Fully synthetic group A streptogramin antibiotics that overcome resistance

Qi Li[*,1], Jenna Pellegrino[*,2], D. John Lee[2], Arthur A. Tran[1], Hector A. Chaires[2], Ruoxi Wang[1], Jesslyn E. Park[2], Kaijie Ji[1], David Chow[1], Na Zhang[1,3], Axel F. Brilot[4], Justin T. Biel[2], Gydo van Zundert[5], Kenneth Borrelli[4], Dean Shinabarger[6], Cindy Wolfe[6], Beverly Murray[6], Matthew P. Jacobson[1], Estelle Mühle[7], Olivier Chesneau[7], James S. Fraser[2], Ian B. Seiple[1#]

1 - Department of Pharmaceutical Chemistry and Cardiovascular Research Institute, University of California, San Francisco, San Francisco, United States
2 - Department of Bioengineering and Therapeutic Sciences, University of California, San Francisco, San Francisco, United States
3 - College of Life Science and Bioengineering, Beijing University of Technology, Beijing 100124, China
4 - Department of Biochemistry and Biophysics and Howard Hughes Medical Institute, University of California, San Francisco, San Francisco, United States
5 - Schrödinger, New York, New York, United States
6 - Micromyx, Kalamazoo, Michigan, United States
7 - Collection de l'Institut Pasteur (CIP), Microbiology Department, Institut Pasteur, Paris, France
* - these authors contributed equally
# - correspondence to ian.seiple@ucsf.edu

* - these authors contributed equally
# - correspondence to ian.seiple@ucsf.edu

Supporting Information

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General Experimental Procedures: All reactions were performed in oven-dried glassware fitted with rubber septa under a positive pressure of nitrogen or argon, unless otherwise noted. Procedures were conducted at 23 ºC unless otherwise noted. All reaction mixtures were stirred throughout the duration of each procedure using Teflon-coated magnetic stir bars. Air- and moisture-sensitive liquids were transferred by means of syringe or stainless steel cannula. Solutions were concentrated by rotary evaporation at or below 35 °C. Analytical thin-layer chromatography (TLC) was performed using glass plates pre-coated with silica gel (0.25-mm, 60-Å pore size, 230−400 mesh, SILICYCLE INC) impregnated with a fluorescent indicator (254 nm). TLC plates were visualized by exposure to ultraviolet light (UV), and then were stained by submersion in a basic aqueous solution of potassium permanganate or with an acidic ethanolic solution of anisaldehyde, followed by brief heating.

Materials: Dichlorometane (DCM), tetrahydrofuran (THF), and acetonitrile to be used in anhydrous reaction mixtures were dried by passage through activated alumina columns immediately prior to use. Other commercial solvents and reagents were used as received, unless otherwise noted. Anhydrous toluene, 2-propanol, and acetone were purchased from Fisher Chemical in Acroseal™ bottles. Anhydrous $^{i}Pr_2EtN$ and Et_3N were purchased from Sigma Aldrich in Sure/Seal™ bottles. Hexanes used were ≥85% *n*-hexane.

Instrumentation: Proton nuclear magnetic resonance (^{1}H NMR) spectra and carbon nuclear magnetic resonance (^{13}C NMR) spectra were recorded on 300 or 400 MHz Bruker Avance III HD 2-channel instrument NMR spectrometers at 23 °C or 50 ºC. Proton chemical shifts are expressed in parts per million (ppm, δ scale) and are referenced to residual protium in the NMR solvent ($CHCl_3$: δ 7.26, $CHDCl_2$: δ 5.32, CHD_2SOCD_3: δ 2.50 and CHD_2OD: δ 3.31). Carbon chemical shifts are expressed in parts per million (ppm, δ scale) and are referenced to the carbon resonance of the NMR solvent ($CDCl_3$: δ 77.0, CD_2Cl_2: δ 53.8 and CD_3OD: δ 49.0). Data are represented as follows: chemical shift, multiplicity (s = singlet, d = doublet, t = triplet, q = quartet, dd = doublet of doublets, dt = doublet of triplets, m = multiplet, br = broad, app = apparent), integration, and coupling constant (*J*) in hertz (Hz). Optical rotations were measured using a JASCO P-2000 polarimeter. High-resolution mass spectra (HRMS) were obtained at the QB3/Chemistry Mass Spectrometry Facility at University of California, Berkeley using a Thermo LTQ-FT mass spectrometer or a Waters Acquity UPLC/Xevo G2-XS QTOF mass spectrometer (special thanks to Dr. Ziyang Zhang in the Shokat Laboratory for assistance). Melting points were recorded on an Electrothermal IA6304 Melting Point Apparatus. HPLC purification was conducted on a Waters Delta Prep 4000 preparative HPLC using a Gemini®-NX (5µm, C18, 110Å, 30.00 mm i.d. x 100 mm) column at a flow rate of 45 mL/min.

Methods for measuring minimum inhibitory concentrations (MICs)

Compounds were evaluated by Micromyx LLC for Minimum Inhibitory Concentration (MIC) activity using the broth microdilution method as recommended by the Clinical and Laboratory Standards Institute (CLSI)[1,2]. Pre-weighed vials of the test agents were stored at -20 °C until testing. On the day of the assay, the compounds were dissolved in 100% DMSO (Sigma 472301, Lot No. SHBH5551V) to a stock concentration of 6,464 µg/mL. The concentration range tested for each of the compounds was 64–0.06 µg/mL. Levofloxacin was used as the quality control agent. For more details on test organisms, media, and methods, see the Supporting Information.

Test Organisms

The organisms in the study were a combination of in vivo strains, clinical isolates and strains with different permeability or resistance phenotypes. Test organisms consisted of reference strains from the American Type Culture Collection (ATCC; Manassas, VA) and clinical isolates from the Micromyx repository (MMX; Kalamazoo, MI). Organisms were initially received at Micromyx and were streaked for isolation. Colonies were picked by sterile swab and suspended in the appropriate broth containing cryoprotectant. The suspensions were aliquoted into cryogenic vials and maintained at -80ºC.

Prior to testing, all isolates except for *H. influenzae* and the *S. aureus vatA* strain were streaked from frozen vials onto Trypticase Soy agar plates with 5% sheep blood (BBL Ref. No. 221261, Lot 7292618) and incubated overnight at 35ºC. The *S. pneumoniae* strain was incubated in the presence of 3% CO_2.

H. influenzae was streaked onto chocolate agar (BBL Ref. No. 221267, Lot 7299878) and incubated overnight at 35ºC in the presence of 3% CO_2.

The *S. aureus vatA* strain was streaked onto Mueller-Hinton agar containing 2, 10, 20, and 40 µg/mL of virginiamycin M1. Colonies growing on 10 µg/mL of virginiamycin M1 were selected for use in the assay.

Test Media

The medium employed for testing in the broth microdilution MIC assay for all organisms except *S. pneumoniae* and *H. influenzae* was cation-adjusted Mueller Hinton broth (MHBII; Becton Dickenson 212322; Lot 7143896) prepared according to CLSI guidelines (1). *S. pneumoniae* was tested in MHBII supplemented with 3% lysed horse blood (LHB; Hemostat, Lot 399694) and *H. influenzae* was tested in Haemophilus Test Medium (Remel Ref. No. R112380, Lot 106403).

Broth Microdilution Susceptibility Testing

The MIC assay method followed the procedure described by the Clinical and Laboratory Standards Institute[1,2] and employed automated liquid handlers (Multidrop 384, Labsystems, Helsinki, Finland; Biomek 2000 and Biomek FX, Beckman Coulter, Fullerton CA) to conduct serial dilutions and liquid transfers. The wells in columns 2-12 in a standard 96-well microdilution plate (Costar) were filled with 150 µL of the appropriate solvent (DMSO for the test agents and water for levofloxacin). These would become the 'mother plates' from which 'daughter' or test plates

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[1] Clinical and Laboratory Standards Institute. Methods for Dilution Antimicrobial Susceptibility Tests for Bacteria That Grow Aerobically; Approved Standard—Eleventh Edition. CLSI document M07-A11. Clinical and Laboratory Standards Institute, 950 West Valley Road, Suite 2500, Wayne, Pennsylvania 19087 USA, 2018.

[2] Clinical and Laboratory Standards Institute. Performance Standards for Antimicrobial Susceptibility Testing—27th Edition: CLSI supplement M100-S27. CLSI, Wayne, PA, USA, 2017.

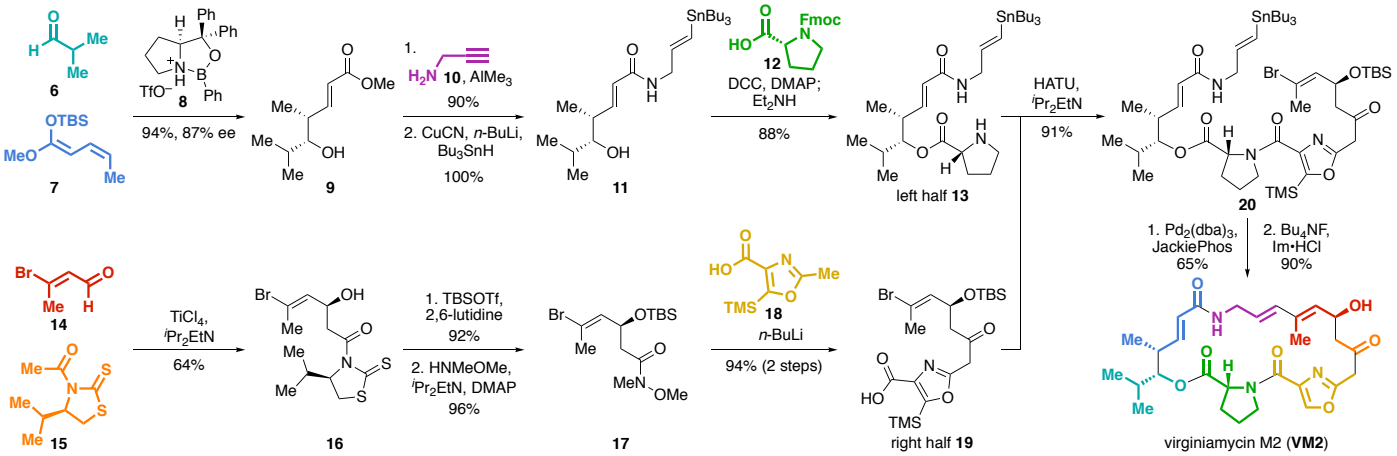
would be prepared. The drugs (300 µL at 101X the desired top concentration in the test plates) were dispensed into the appropriate well in Column 1 of the mother plates. The Biomek 2000 was used to make serial 2-fold dilutions through Column 11 in the "mother plate". The wells of Column 12 contained no drug and were the organism growth control wells.

The daughter plates were loaded with 190 µL per well of MHBII using the Multidrop 384. Plates for testing of *S. pneumoniae* were loaded with MHBII + LHB and those for testing of *H. influenzae* with HTM using a multi-channel pipet. The daughter plates were prepared on the Biomek FX instrument which transferred 2 µL of 101X drug solution from each well of a mother plate to the corresponding well of each daughter plate in a single step. The wells of the daughter plates ultimately contained 190 µL of medium, 2 µL of drug solution, and 10 µL of bacterial inoculum prepared in broth.

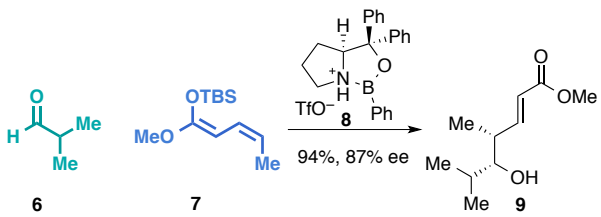
A standardized inoculum of each organism was prepared per CLSI methods[1,2]. Suspensions were prepared in MHBII to equal a turbidity of a 0.5 McFarland standard. The 0.5 McFarland suspensions were diluted 1:20 in the appropriate media. The inoculum for each organism was dispensed into sterile reservoirs divided by length (Beckman Coulter), and the Biomek 2000 was used to inoculate the plates. Daughter plates were placed on the Biomek 2000 work surface in reverse orientation so that inoculation took place from low to high drug concentration. The Biomek 2000 delivered 10 µL of standardized inoculum into each well. This yielded a final cell density in the daughter plates of approximately 5×10^5 CFU/mL.

Plates were stacked 3-4 high, covered with a lid on the top plate, placed in plastic bags and incubated for approximately 20 h at 35ºC. The microplates were viewed from the bottom using a plate viewer. The MIC was read and recorded as the lowest concentration of drug that inhibited visible growth of the organism. Some of the test agents showed precipitation at 32-64 µg/mL; however, the precipitation did not interfere with reading of the MIC values. The MIC values for levofloxacin were within CLSI established QC ranges[2], thus validating the study.

Scheme I Convergent route to virginiamycin M2 (VM2) from seven simple building blocks



Mukaiyama aldol product 9[3]



A 250-mL round-bottom flask was charged with phenylboronic acid (1.22 g, 10.0 mmol, 0.5 equiv) and (*S*)-diphenyl(pyrrolidin-2-yl)methanol (2.53 g, 10.0 mmol, 0.5 equiv). The vessel was equipped with a reflux condenser and the system was evacuated and flushed with nitrogen (this process was repeated a total of 3 times). Toluene (50 mL) was added, and the resulting clear solution was brought to reflux by means of a 145 ºC oil bath. After 12 h, the mixture was allowed to cool to 23 ºC and was concentrated. The resulting white solid was dried at ≤1 Torr for 1 h. The vessel was flushed with nitrogen, and DCM (80 mL) was added. The resulting colorless solution was cooled to -78 °C, and TfOH (0.80 mL, 8.99 mmol, 0.45 equiv) was added dropwise over 5 min by means of glass syringe (CAUTION: TfOH rapidly corrodes most plastic syringes!). Some of the TfOH froze upon contact with the solution. After 1 h, the solids had dissolved, and a mixture of isobutyraldehyde (**6**, 1.82 mL, 20.0 mmol, 1 equiv), silyl dienolether **7** (5.70 g, 25.0 mmol, 1.25 equiv), and 2-propanol (1.68 mL, 22.0 mmol, 1.1 equiv) in DCM (20 mL) was added dropwise over 2 h by means of syringe pump. The mixture was stirred at -78 °C for another 1.5 h, and saturated aqueous $NaHCO_3$ solution (50 mL) was added in one portion. The vessel was removed from the cooling bath and was allowed to warm to 23 ºC while it was rapidly stirred. The biphasic mixture was transferred to a separatory funnel, and the layers were separated. The aqueous layer was extracted with DCM (2 × 30 mL). The combined organic layers were washed with water (100 mL) and brine (100 mL), and the washed solution was dried (Na_2SO_4). The dried solution was filtered, and the filtrate was concentrated. The resulting crude residue was purified by flash chromatography (silica gel, eluent: EtOAc:hexanes = 1:10 to 1:6) to afford Mukaiyama aldol product **9** (3.48 g, 94% yield) as a colorless oil.

TLC (EtOAc:hexanes = 1:6): R_f = 0.25 (UV, $KMnO_4$).

$[\alpha]^{23}_D$ = +23.5 (*c* = 1.0, $CHCl_3$).

[3] Simsek, S.; Kalesse, M. *Tetrahedron Lett.* **2009**, *50*, 3485–3488.

^{1}H NMR (400 MHz, $CDCl_3$) δ 6.92 (dd, *J* = 15.7, 8.1 Hz, 1H), 5.86 (dd, *J* = 15.7, 1.2 Hz, 1H), 3.72 (s, 3H), 3.26 (t, *J* = 5.8 Hz, 1H), 2.59 – 2.39 (m, 1H), 1.78 – 1.64 (m, 1H), 1.59 (br s, 1H), 1.09 (d, *J* = 6.7 Hz, 3H), 0.92 (d, *J* = 6.8 Hz, 3H), 0.90 (d, *J* = 6.8 Hz, 3H).

^{13}C NMR (100 MHz, $CDCl_3$) δ 167.1, 152.2, 120.4, 80.0, 51.4, 39.9, 30.9, 19.6, 16.5, 13.9.

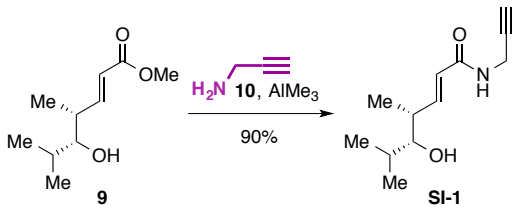
HRMS-EI m/z calcd for $C_{10}H_{19}O_3^+$ $[M + H]^+$ 187.1329, found 187.1331.

Determination of enantiomeric excess: To a solution of **9** (20 mg, 0.11 mmol, 1 equiv) in DCM (2 mL) was added successively Et_3N (0.12 mL, 0.86 mmol, 8.0 equiv), DMAP (18 mg, 0.15 mmol, 1.4 equiv) and (S) or (R)-Mosher acid chloride (80 µL, 0.43 mmol, 4.0 equiv). After 2 h, the mixture was diluted with EtOAc (15 mL). The mixture was transferred to a separatory funnel and was washed successively with 1 M aqueous $KHSO_4$ solution (3 x 5 mL), 1 M aqueous NaOH solution (5 mL) and saturated aqueous $NaHCO_3$ solution (3 x 5 mL). The washed solution was dried (Na_2SO_4). The dried solution was filtered, and the filtrate concentrated. The resulting residue was analyzed by ^{1}H-NMR withour further purification.

For (*S*)-3,3,3-trifluoro-2-methoxy-2-phenylpropanoyl chloride: the enantiomeric excess (ee) was calculated from integration of the double dublet at 5.82 ppm (major), 5.84 ppm (minor). The ee was 87%.

For (*R*)-3,3,3-trifluoro-2-methoxy-2-phenylpropanoyl chloride: the enantiomeric excess (ee) was calculated from integration of the double dublet at 5.84 ppm (major), 5.82 ppm (minor). The ee was 87%.

Amide SI-1



A 500-mL round-bottom flask was charged with propargylamine (**10**, 4.40 mL, 68.7 mmol, 4.0 equiv) and dry DCM (115 mL) under nitrogen. The resulting colorless solution was cooled to 0 ºC by means of an ice/water bath. A solution of $AlMe_3$ in heptane (1 M, 68.7 mL, 68.7 mmol, 4.0 equiv) was added dropwise over 30 min (CAUTION: Gas evolution!). The mixture was allowed to warm to 23 ºC. After 30 min, a solution of **9** (3.20 g, 17.2 mmol, 1 equiv) in DCM (20 mL) was added over 10 min (CAUTION: Gas evolution!). The vessel was equipped with a reflux condenser, and the solution was brought to reflux by means of a 50 ºC oil bath. After 3 h, the mixture was cooled to 0 °C by means of an ice/water bath, and MeOH (10 mL) was added dropwise (CAUTION: Gas evolution!). Once gas evolution ceased, saturated aqueous potassium sodium tartrate solution (100 mL) was added. After 1 h, the biphasic mixture was transferred to a separatory funnel, and the layers were separated. The aqueous layer was extracted with DCM (2 × 30 mL). The combined organic layers were washed with water (100 mL) and brine (100 mL), and the washed solution was dried (Na_2SO_4). The dried solution was filtered, and the filtrate was concentrated. The resulting crude residue was purified by flash chromatography (silica gel, eluent: EtOAc:hexanes = 1:1) to afford amide **SI-1** (3.22 g, 90% yield) as a white solid.

m. p. 88 – 90 ºC (Hexanes).

TLC (EtOAc:hexanes = 1:1): R_f = 0.15 (UV).

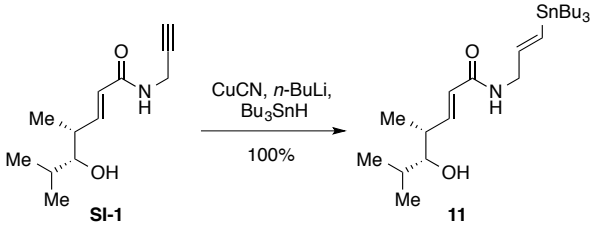
$[\alpha]^{24}_D$ = +29.7 (*c* = 1.0, DCM).

^{1}H NMR (400 MHz, $CDCl_3$) δ 6.84 (dd, *J* = 15.4, 7.9 Hz, 1H), 5.82 (dd, *J* = 15.4, 1.2 Hz, 1H), 5.78 (s, 1H), 4.12 (dd, J = 5.3, 2.6 Hz, 2H), 3.30 – 3.22 (m, 1H), 2.56 – 2.43 (m, 1H), 2.24 (t, *J* = 2.6 Hz, 1H), 1.80 – 1.65 (m, 1H), 1.59 (d, *J* = 5.1 Hz, 1H), 1.08 (d, *J* = 6.7 Hz, 3H), 0.92 (d, *J* = 6.7 Hz, 6H).

^{13}C NMR (100 MHz, $CDCl_3$) δ 165.4, 148.4, 122.6, 79.4, 79.2, 71.7, 39.6, 30.8, 29.2, 19.7, 16.7, 13.9.

HRMS-ESI m/z calcd for $C_{12}H_{20}NO_2^+$ $[M + H]^+$ 210.1489, found 210.1487.

Vinyl stannane 11[4]



A 500-mL round-bottom flask containing CuCN (2.65 g, 29.6 mmol, 2.0 equiv) was evacuated and flushed with nitrogen (this process was repeated a total of 3 times). THF (200 mL) was added, resulting in a white suspension, and the vessel and its contents were cooled to -78 ºC by means of a dry ice/acetone bath. A solution of *n*-BuLi in hexanes (2.5 M, 24.9 mL, 62.2 mmol, 4.2 equiv) was added dropwise over 10 min, and the resulting light-yellow solution was stirred for 30 min. Bu_3SnH (16.8 mL, 62.2 mmol, 4.2 equiv) was added dropwise over 5 min. After 30 min, a solution of **SI-1** (3.10 g, 14.8 mmol, 1 equiv) in THF (15 mL) was added dropwise over 15 min. After 1 h, saturated aqueous ammonium chloride solution (100 mL) was added in one portion. The vessel was removed from the cooling bath, and the system was allowed to warm to 23 ºC while the mixture was rapidly stirred. The biphasic mixture was transferred to a separatory funnel, and the layers were separated. The aqueous layer was extracted with EtOAc (2 × 100 mL). The combined organic layers were washed with water (2 × 100 mL) and brine (100 mL). The washed solution was dried (Na_2SO_4). The dried solution was filtered, and the filtrate was concentrated. The resulting crude residue was purified by flash chromatography (silica gel, eluent: EtOAc:hexanes = 0:1 to 1:3) to afford vinyl stannane **11** (7.4 g, 100% yield, ≥20:1 E:Z) as a colorless oil.

TLC (EtOAc:hexanes = 1:3): R_f = 0.25 (UV).

$[\alpha]^{24}_D$ = +10.6 (*c* = 1.0, $CHCl_3$).

Note regarding NMR spectra: Satellite peaks caused by geminal coupling between the vinyl proton and ^{117}Sn/^{119}Sn isotopes appear in the spectra[5]. Only the major peaks and ^{1}H-^{1}H coupling constants are reported below. In the spectra section (vide infra), we provide inset spectra highlighting the peaks in question in two solvents as well as a reference that supports the minor peaks arising due to geminal ^{1}H/Sn coupling. Additionally, we provide variable temperature ^{1}H-NMR data that supports the hypothesis that these are not amide rotamers (the ratio does not change even at 140 ºC in DMSO-d*6*). These peaks are present only for the intermediates in the synthesis that contain vinyl tin functionality.

^{1}H NMR (400 MHz, $CDCl_3$) δ 6.82 (dd, *J* = 15.4, 7.9 Hz, 1H), 6.12 (dt, *J* = 19.0, 1.5 Hz, 1H), 5.97 (dt, *J* = 19.0, 5.1 Hz, 1H), 5.83 (dd, *J* = 15.4, 1.2 Hz, 1H), 5.58 (br s, 1H), 4.04 – 3.94 (m, 2H), 3.26 (q, *J* = 5.6 Hz, 1H), 2.56 – 2.42 (m, 1H), 1.80 – 1.67 (m, 1H), 1.53 – 1.40 (m, 6H), 1.29 (m, 6H), 1.09 (d, *J* = 6.6 Hz, 3H), 0.94 – 0.83 (m, 21H).

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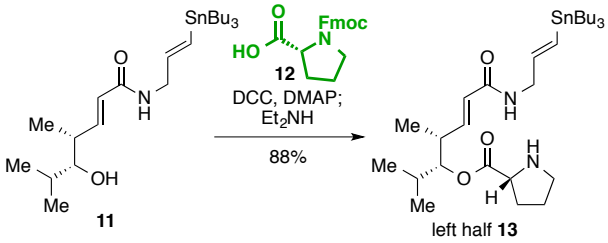
[4] Entwistle, D. A.; Jordan, S. I.; Montgomery, J.; Pattenden, G. *Synthesis* **1998**, 603–612.

[5] Cochran, J. C.; Bayef, S. C.; Bolbo, J. T.; Brown, M. S.; Colen, L. B.; Gaspirini, F. J.; Goldsmith, D. W.; Jamin, M. D.; Nealy, K. A.; Resnick, C. T.; Schwartz, G. J. ; Short, W. M.; Skarda, K. R.; Spring, J. P.; Strause, W. L. *Organometallics* **1982**, *1,* 586–590.

^{13}C NMR (100 MHz, $CDCl_3$) δ 165.5, 147.4, 143.4, 130.4, 123.3, 79.2, 44.9, 39.6, 30.8, 29.0, 27.2, 19.7, 16.7, 14.0, 13.7, 9.4.

HRMS-ESI m/z calcd for $C_{24}H_{47}NNaO_2Sn^+$ $[M + Na]^+$ 524.2521, found 524.2515.

Left half 13



A 100-mL round-bottom flask was charged with Fmoc-D-Pro-OH (**12**, 2.00 g, 5.94 mmol, 1.35 equiv), DMAP (0.11 g, 0.88 mmol, 0.2 equiv) and **11** (2.20 g, 4.40 mmol, 1 equiv). DCM (44 mL) was added, resulting in a colorless solution. DCC (1.36 g, 6.60 mmol, 1.5 equiv) was added in one portion. resulting in a white suspension. After 5 h, alcohol **11** was entirely consumed as indicated by TLC analysis (eluent: EtOAc:hexanes = 1:2), and diethylamine (22 mL) was added. After, 3 h, the mixture was filtered through a pad of celite, and the filter cake was washed with DCM (2 × 20 mL). The combined filtrates were concentrated, and the resulting crude residue was purified by flash chromatography (silica gel, eluent: NH_4OH:MeOH:DCM = 0.2:1:100 to 0.2:1:50) to afford left half **13** (2.32 g, 88% yield) as light-yellow oil.

TLC (MeOH:DCM = 1:20): R_f = 0.20 (UV).

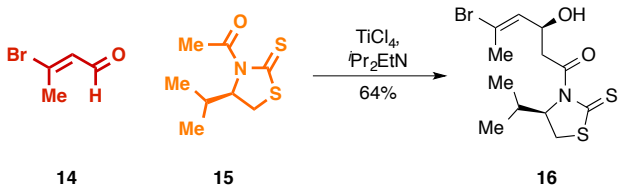
$[\alpha]^{24}_D$ = +13.9 (*c* = 0.1, $CHCl_3$).

^{1}H NMR (400 MHz, $CDCl_3$) δ 6.70 (dd, *J* = 15.4, 7.8 Hz, 1H), 6.11 (dt, *J* = 19.0, 1.5 Hz, 1H), 5.96 (dt, *J* = 19.0, 5.1 Hz, 1H), 5.82 (dd, *J* = 15.4, 1.2 Hz, 1H), 5.59 (t, *J* = 5.9 Hz, 1H), 4.81 (dd, *J* = 6.9, 5.4 Hz, 1H), 4.03 – 3.89 (m, 2H), 3.76 (dd, *J* = 8.5, 5.6 Hz, 1H), 3.07 (ddd, *J* = 10.2, 7.4, 6.1 Hz, 1H), 2.89 (ddd, *J* = 10.2, 7.1, 6.2 Hz, 1H), 2.65 (dtd, *J* = 8.0, 6.8, 1.2 Hz, 1H), 2.13 (dtd, *J* = 12.3, 8.1, 6.6 Hz, 1H), 2.07 (s, 1H), 1.94 – 1.79 (m, 2H), 1.80 – 1.65 (m, 2H), 1.56 – 1.39 (m, 6H), 1.35 – 1.21 (m, 6H), 1.04 (d, *J* = 6.8 Hz, 3H), 0.95 – 0.80 (m, 21H).

^{13}C NMR (100 MHz, $CDCl_3$) δ 175.3, 165.2, 145.2, 143.4, 130.4, 123.8, 80.3, 59.9, 46.9, 44.9, 38.2, 30.5, 29.8, 29.0, 27.2, 25.4, 19.6, 16.8, 14.7, 13.7, 9.4.

HRMS-ESI m/z calcd for $C_{29}H_{55}N_2O_3Sn^+$ $[M + H]^+$ 599.3229, found 599.3219.

***β*-hydroxyl amide 16**[6]



A 250-mL round-bottom flask containing **15** (7.96 g, 39.1 mmol, 1.1 equiv) was evacuated and flushed with nitrogen (this process was repeated a total of 3 times). DCM (80 mL) was added, resulting in a yellow solution, and the vessel and its contents were cooled to -78 ºC by means of a dry ice/acetone bath. A solution of $TiCl_4$ in DCM (1 M, 42.7 mL, 42.7

[6] Romo, D.; Choi, N. S.; Li, S.; Buchler, I.; Shi, Z.; Liu, J. O. *J. Am. Chem. Soc.* **2004**, *34*, 10582–10588.

mmol, 1.2 equiv) was added dropwise, resulting in a deep yellow solution. After 5 min, $^{i}Pr_2EtN$ (7.46 mL, 42.7 mmol, 1.2 equiv) was added over 30 min by means of syringe pump, and the resulting deep red solution was stirred for 2 h at -78 ºC. A solution of aldehyde **14**[7,8] (5.30 g, 35.6 mmol, 1 equiv) in DCM (10 mL) was added by means of syringe pump over 30 min. After 30 min, water (100 mL) was added. The vessel was removed from the cooling bath, and the system was allowed to warm to 23 ºC while the mixture was rapidly stirred. The biphasic mixture was transferred to a separatory funnel and the layers were separated. The aqueous layer was extracted with DCM (2 × 30 mL). The combined organic layers were washed with water (2 × 100 mL) and brine (100 mL), and the washed solution was dried (Na_2SO_4). The dried solution was filtered, and the filtrate was concentrated. The resulting crude residue was purified by flash chromatography (silica gel, eluent: EtOAc: hexanes = 1:10 to 1:2.5) to afford *β*-hydroxyl amide **16** (8.3 g, 64% yield) as a yellow oil.

TLC (EtOAc:hexanes = 1:5): R_f = 0.25 (UV and $KMnO_4$).

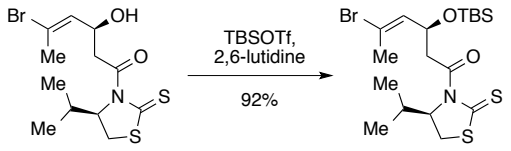
[α]$^{24}_{D}$ = –320 (*c* = 1.0, $CHCl_3$).

^{1}H NMR (400 MHz, $CDCl_3$) δ 5.95 (dq, *J* = 8.9, 1.3 Hz, 1H), 5.14 (ddd, *J* = 7.7, 6.3, 1.1 Hz, 1H), 4.80 (tdd, *J* = 8.4, 4.4, 3.3 Hz, 1H), 3.59 (dd, *J* = 17.6, 3.3 Hz, 1H), 3.53 (dd, *J* = 11.5, 8.0 Hz, 1H), 3.32 (dd, *J* = 17.7, 8.4 Hz, 1H), 3.03 (dd, *J* = 11.5, 1.1 Hz, 1H), 2.98 (d, *J* = 4.6 Hz, 1H), 2.45 – 2.25 (m, 1H), 2.32 (d, *J* = 1.4 Hz, 3H), 1.05 (d, *J* = 6.8 Hz, 3H), 0.97 (d, *J* = 6.9 Hz, 3H).

^{13}C NMR (100 MHz, $CDCl_3$) δ 202.9, 171.8, 132.4, 124.2, 71.3, 65.7, 44.8, 30.7, 30.6, 24.1, 19.0, 17.7.

HRMS-ESI m/z calcd for $C_{12}H_{17}BrNO_2S_2^-$ $[M - H]^-$ 349.9890, found 349.9886.

TBS ether SI-2



16 **SI-2**

A 250-mL round-bottom flask containing *β*-hydroxyl amide **16** (4.71 g, 13.4 mmol, 1 equiv) was evacuated and flushed with nitrogen (this process was repeated a total of 3 times). DCM (134 mL) was added, followed by 2,6-lutidine (3.1 mL, 26.8 mmol, 2.0 equiv), resulting in a yellow solution. The vessel and its contents were cooled to 0 ºC by means of an ice/water bath, and TBSOTf (3.69 mL, 16.0 mmol, 1.2 equiv) was added dropwise over 10 min. After 30 min, the mixture was transferred to a separatory funnel and washed with water (2 × 100 mL) and brine (100 mL). The washed solution was dried (Na_2SO_4). The dried solution was filtrated, and the filtrate was concentrated. The resulting crude residue was purified by flash chromatography (silica gel, eluent: EtOAc:hexanes = 1:20) to afford TBS ether **SI-2** (5.76 g, 92% yield) as a light-yellow oil.

TLC (EtOAc:hexanes = 1:50): R_f = 0.20 (UV).

[α]$^{24}_{D}$ = –479 (*c* = 1.0, $CHCl_3$).

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[7] Ghosh, A. K.; Li, J. *Org. Lett.* **2009**, *11*, 4164–4167.

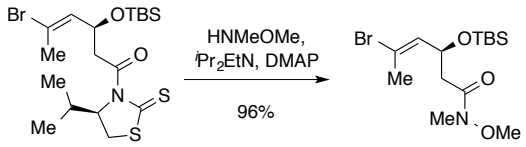
[8] Entwistle, D. A.; Jordan, S. I.; Montgomery, J.; Pattenden, G. *J. Chem. Soc., Perkin Trans. 1* **1996**, 1315–1317.

^{1}H NMR (400 MHz, $CDCl_3$) δ5.87 (dq, *J* = 8.9, 1.3 Hz, 1H), 5.03 (ddd, *J* = 7.6, 6.2, 1.1 Hz, 1H), 4.96 – 4.86 (m, 1H), 3.63 (dd, *J* = 16.5, 8.3 Hz, 1H), 3.47 (dd, *J* = 11.5, 7.9 Hz, 1H), 3.18 (dd, *J* = 16.5, 4.3 Hz, 1H), 3.03 (dd, *J* = 11.4, 1.1 Hz, 1H), 2.36 (dq, *J* = 13.5, 6.8 Hz, 1H), 2.31 (d, *J* = 1.3 Hz, 3H), 1.06 (d, *J* = 6.8 Hz, 3H), 0.97 (d, *J* = 7.0 Hz, 3H), 0.84 (s, 9H), 0.05 (s, 3H), 0.05 (s, 3H).

^{13}C NMR (100 MHz, CDCl3) δ 202.8, 170.7, 134.5, 121.7, 71.7, 67.2, 45.6, 30.9, 30.8, 25.7, 24.1, 19.1, 18.0, 17.8, –4.5, –5.0.

HRMS-EI m/z calcd for $C_{18}H_{32}BrNO_2S_2Si^+$ $[M]^+$ 465.0827, found 465.0819.

Weinreb amide 17



SI-2 **17**

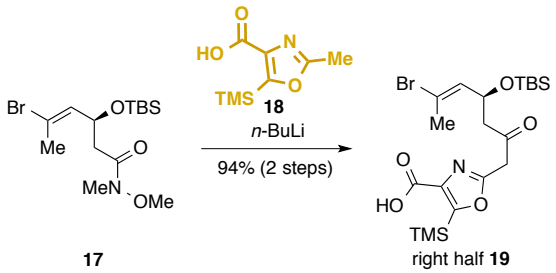
A 500-mL round-bottom flask containing HN(OMe)Me•HCl (2.26 g, 23.1 mmol, 2.0 equiv) was evacuated and flushed with nitrogen (this process was repeated a total of 3 times). DCM (115 mL) was added, resulting in a white suspension, and the vessel and its contents were cooled to 0 ºC by means of an ice/water bath. ^{i}Pr$_2$EtN (4.01 mL, 28.9 mmol, 2.5 equiv) was added. After 30 min, a solution of **SI-2** (5.40 g, 11.6 mmol, 1 equiv) and DMAP (0.141 g, 1.16 mmol, 0.1 equiv) in DCM (15 mL) was added. The mixture was allowed to warm to 23 ºC. After 12 h, water (150 mL) was added. The resulting biphasic mixture was transferred to a separatory funnel, and the layers were separated. The organic layers were washed with water (100 mL) and brine (100 mL), and the washed solution was dried (Na_2SO_4). The dried solution was filtered, and the filtrate was concentrated. The resulting crude residue was purified by flash chromatography (silica gel, eluent: EtOAc:hexanes = 1:15) to afford Weinreb amide **17** (4.06 g, 96% yield) as a colorless oil.

TLC (EtOAc:hexanes = 1:5): R_f = 0.20 (UV).

^{1}H NMR (400 MHz, $CDCl_3$) δ 5.86 (dq, *J* = 9.0, 1.3 Hz, 1H), 4.84 (ddd, *J* = 9.0, 7.9, 5.3 Hz, 1H), 3.69 (s, 3H), 3.17 (s, 3H), 2.83 (dd, *J* = 14.8, 8.0 Hz, 1H), 2.41 (dd, *J* = 14.7, 5.3 Hz, 1H), 2.30 (d, *J* = 1.3 Hz, 3H), 0.85 (s, 9H), 0.05 (s, 3H), 0.05 (s, 3H).

^{13}C NMR (100 MHz, $CDCl_3$) δ 171.0, 135.0, 121.4, 67.5, 61.4, 40.0, 32.0, 25.7, 24.1, 18.0, –4.6, –5.1.

Right half 19



17 right half **19**

A 250-mL round-bottom flask containing acid **18**[9] (1.76 g, 8.19 mmol, 2.0 equiv) was evacuated and flushed with nitrogen (this process was repeated a total of 3 times). THF (82 mL) was added, resulting in a light-yellow solution, and

[9] Wood, R. D.; Ganem, B. *Tetrahedron Lett.* **1983**, *24*, 4391–4392.

the vessel and its contents were cooled to -78 ºC by means of a dry ice/acetone bath. A solution of *n*-BuLi in hexanes (2.5 M, 6.55 mL, 16.4 mmol, 4.0 equiv) was added dropwise over 15 min, resulting in a deep red solution. After 30 min, a solution of Weinreb amide **17** (1.50 g, 4.09 mmol, 1 equiv) in THF (10 mL) was added over 30 min by means of syringe pump. After an additional 30 min, water (50 mL) was added, followed by 1 M aqueous $KHSO_4$ solution (20 mL). The system was allowed to warm to 23 ºC while the mixture was rapidly stirred. The biphasic mixture was transferred to a separatory funnel, and the layers were separated. The aqueous layer was extracted with EtOAc (2 × 50 mL). The combined organic layers were washed with water (2 × 100 mL) and brine (100 mL), and the washed solution was dried (Na_2SO_4). The dried solution was filtered, and the filtrate was concentrated. The resulting crude residue was purified by flash chromatography (silica gel, eluent: MeOH:DCM = 1:70) to afford right half **19** (2.00 g, 94% yield) as a yellow solid.

m. p. 143 – 146 ºC (DCM).

TLC (MeOH:DCM = 1:20): R_f = 0.30 (UV).

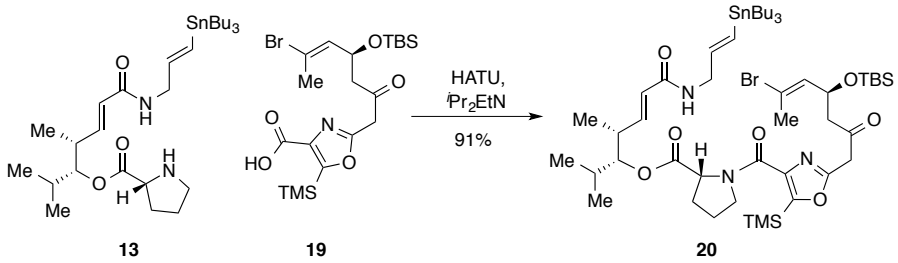
$[\alpha]^{24}_D$ = –24.5 (*c* = 1.0, $CHCl_3$).

^{1}H NMR (400 MHz, $CDCl_3$) δ 5.81 (dq, *J* = 9.0, 1.3 Hz, 1H), 4.79 (ddd, *J* = 9.1, 8.2, 4.6 Hz, 1H), 4.13 (d, *J* = 17.1 Hz, 1H), 4.05 (d, *J* = 17.1 Hz, 1H), 2.86 (dd, *J* = 15.6, 8.1 Hz, 1H), 2.55 (dd, *J* = 15.6, 4.6 Hz, 1H), 2.27 (d, *J* = 1.3 Hz, 3H), 0.84 (s, 9H), 0.37 (s, 9H), 0.04 (s, 6H).

^{13}C NMR (100 MHz, $CDCl_3$) δ 200.5, 165.4, 165.3, 161.1, 140.7, 134.2, 121.8, 66.9, 49.7, 43.7, 25.7, 24.0, 18.9, 18.0, –2.1, –4.6, –5.1.

HRMS-ESI m/z calcd for $C_{20}H_{35}BrNO_5Si_2$ $[M + H]^+$ 504.1232, found 504.1227.

Stille coupling precursor 20



A 50-mL round-bottom flask was charged with ^{i}Pr$_2$EtN (0.39 mL, 2.24 mmol, 2.0 equiv), amine **13** (0.67 g, 1.12 mmol, 1 equiv), and acid **19** (0.62 g, 1.23 mmol, 1.1 equiv). DCM (12 mL) was added, resulting in a colorless solution. HATU (0.53 g, 1.40 mmol, 1.25 equiv) was added in one portion. After 5 h, the mixture was diluted with DCM (30 mL). The resulting solution was transferred to a separatory funnel and was washed with water (2 × 25 mL) and brine (25 mL). The washed solution was dried (Na_2SO_4). The dried solution was filtered, and the filtrate was concentrated. The resulting crude residue was purified by flash chromatography (silica gel, eluent: EtOAc:hexanes = 1:6 to 1:4) to afford Stille coupling precursor **20** (1.10 g, 91% yield) as a light-yellow oil.

TLC (EtOAc:hexanes = 1:4): R_f = 0.30 (UV).

$[\alpha]^{24}_D$ = –10.7 (*c* = 1.0, $CHCl_3$).

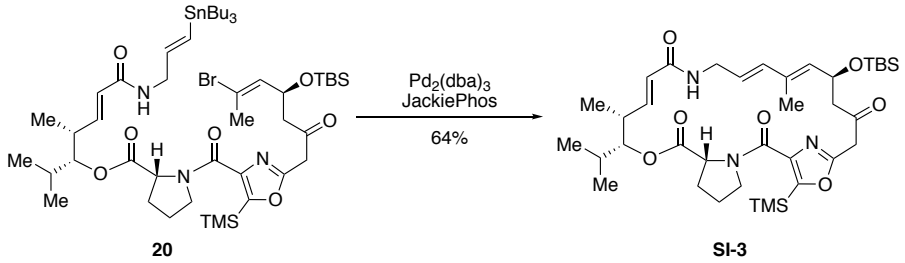
^{1}H NMR (400 MHz, $CDCl_3$, mixtures of rotamers) δ 6.76 – 6.53 (m, 1H), 6.11 (dd, *J* = 18.9, 1.6 Hz, 1H), 6.03 – 5.90 (m, 1H), 5.89 – 5.71 (m, 2H), 5.70 – 5.54 (m, 1H), 4.86 – 4.55 (m, 3H), 4.14 – 3.82 (m, 5H), 3.81 – 3.61 (m, 1H), 2.90 – 2.75

(m, 1H), 2.68 – 2.45 (m, 2H), 2.35 – 2.22 (m, 4H), 2.09 – 1.75 (m, 4H), 1.52 – 1.42 (m, J = 8.3, 6.0 Hz, 6H), 1.35 – 1.22 (dq, J = 13.3, 6.6, 6.0 Hz, 6H), 1.08 – 0.99 (m, 3H), 0.99 – 0.78 (m, 30H), 0.37 – 0.26 (m, 9H), 0.11 – 0.01 (m, 6H).

^{13}C NMR (100 MHz, $CDCl_3$, mixtures of rotamers) δ 201.1, 200.7, 172.34 165.4, 165.1, 163.2, 162.5, 161.5, 159.1, 145.4, 145.2, 145.1, 143.4, 143.3, 134.2, 130.4, 130.2, 123.9, 123.8, 121.8, 80.8, 80.4, 67.0, 66.9, 60.5, 59.9, 49.6, 48.8, 47.1, 44.91, 44.86, 44.2, 44.0, 38.4, 38.1, 31.6, 29.9, 29.8, 29.7, 29.1, 29.0, 28.9, 27.5, 27.2, 27.0, 25.69, 25.67, 25.6, 25.2, 24.00, 23.99, 21.5, 19.7, 19.5, 18.0, 17.0, 16.8, 14.9, 14.6, 13.7, 11.14, 11.06, 9.4, 7.8, 7.7, –1.77, –1.79, –4.57, –5.13, –5.15.

HRMS-ESI m/z calcd for $C_{49}H_{87}BrN_3O_7Si_2Sn^+$ $[M + H]^+$ 1084.4282, found 1084.4275.

Stille coupling product SI-3



20 **SI-3**

A 500-mL round-bottom flask was charged with JackiePhos (0.16 g, 0.20 mmol, 0.2 equiv), Stille coupling precursor **20** (1.10 g, 1.02 mmol, 1 equiv), and $Pd_2(dba)_3$ (93 mg, 0.10 mmol, 0.1 equiv). The system was evacuated and flushed with nitrogen (this process was repeated a total of 3 times). Toluene (200 mL) was added, resulting in a red suspension. A stream of argon was passed through the solution by a stainless steel needle for 30 min. The vessel and its contents were then heated by means of a 50 ºC oil bath. After 3 h, **SI-3** was entirely consumed by TLC analysis, and the mixture was allowed to cool to 23 ºC. The mixture was concentrated, and the resulting crude residue was purified by flash chromatography (silica gel, eluent: EtOAc:hexanes = 1:2.5 to 1:2) to afford Stille coupling product **SI-3** (0.46 g, 64% yield) as a white solid.

m. p. 105 – 110 ºC (Hexanes).

TLC (EtOAc:hexanes = 1:2): R_f = 0.20 (UV).

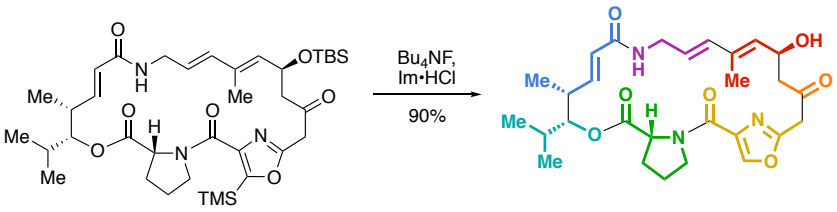
$[\alpha]^{24}_D$ = –57.1 (c = 1.0, $CHCl_3$).

^{1}H NMR (400 MHz, $CDCl_3$) δ 6.49 (dd, J = 16.3, 4.2 Hz, 1H), 6.19 – 6.10 (m, 1H), 6.07 (dd, J = 9.2, 3.2 Hz, 1H), 5.77 (dd, J = 16.4, 2.0 Hz, 1H), 5.57 (ddd, J = 15.5, 9.4, 4.2 Hz, 1H), 5.42 (d, J = 8.9 Hz, 1H), 5.00 (ddd, J = 8.9, 7.0, 5.9 Hz, 1H), 4.85 – 4.72 (m, 2H), 4.57 – 4.43 (m, 1H), 3.89 (d, J = 17.2 Hz, 1H), 3.78 – 3.69 (m, 3H), 3.39 (ddd, J = 14.8, 9.5, 3.3 Hz, 1H), 2.92 (dd, J = 15.9, 7.0 Hz, 1H), 2.79 – 2.68 (m, 2H), 2.18 – 2.04 (m, 1H), 1.90 (dddd, J = 24.9, 15.9, 11.3, 6.8 Hz, 3H), 1.77 – 1.68 (m, 1H), 1.66 (d, J = 1.2 Hz, 3H), 1.08 (d, J = 6.9 Hz, 3H), 0.99 (d, J = 6.5 Hz, 3H), 0.94 (d, J = 6.8 Hz, 3H), 0.85 (s, 9H), 0.30 (s, 9H), 0.05 (s, 3H), 0.02 (s, 3H).

^{13}C NMR (100 MHz, $CDCl_3$) δ 201.0, 172.1, 166.4, 161.8, 161.3, 159.6, 145.1, 144.8, 136.7, 134.7, 132.4, 124.9, 123.7, 81.1, 65.4, 58.7, 50.6, 48.4, 43.7, 41.3, 36.7, 29.3, 28.2, 25.7, 24.8, 19.9, 18.6, 18.1, 12.67, 9.9, –1.8, –4.5, –5.0.

HRMS-ESI m/z calcd for $C_{37}H_{60}N_3O_7Si_2^+$ $[M + H]^+$ 714.3964, found 714.3968.

Virginiamycin M2



SI-3 virginiamycin M2 (**VM2**)

A 100-mL round-bottom flask containing Stille coupling product **SI-3** (0.46 g, 0.64 mmol, 1 equiv) was evacuated and flushed with nitrogen (this process was repeated a total of 3 times). THF (1.6 mL) was added, resulting in a light-yellow solution. In a separate flask, Im•HCl (0.67 g, 6.44 mmol, 10.0 equiv) that had been previously dried at >100 ºC under vacuum for 10 minutes was added to a solution of tetrabutylammonium fluoride in THF (1 M, 6.44 mL, 6.44 mmol, 10.0 equiv)[10]. The resulting colorless solution was added dropwise to the solution of **SI-3**. After 12 h, the mixture was concentrated, and the residue was dissolved in DCM (50 mL). The resulting solution was transferred to a separatory funnel and was washed with water (3 × 50 mL) and brine (50 mL). The washed solution was dried (Na_2SO_4), and the dried solution was filtered. The filtrate was concentrated, and the resulting crude residue was purified by flash chromatography (silica gel, eluent: MeOH:DCM = 1:40) to afford virginiamycin M2 (**VM2**, 0.31 g, 90% yield) as a light-yellow solid.

m. p. 120 – 125 ºC (DCM).

TLC (MeOH:DCM = 1:20): R_f = 0.30 (UV).

[α]$^{25}_D$ = –67.4 (*c* = 0.3, DCM).

^{1}H NMR (400 MHz, $CDCl_3$) δ 8.08 (s, 1H), 6.47 (dd, *J* = 16.4, 5.0 Hz, 1H), 6.39 (dd, *J* = 9.0, 3.7 Hz, 1H), 6.11 (m, *J* = 15.6 Hz, 1H), 5.78 (dd, *J* = 16.4, 1.9 Hz, 1H), 5.69 (ddd, *J* = 15.6, 9.2, 4.6 Hz, 1H), 5.41 (d, *J* = 8.8 Hz, 1H), 4.90 (dt, *J* = 8.9, 5.6 Hz, 1H), 4.73 (dd, *J* = 10.1, 2.0 Hz, 1H), 4.70 (dd, *J* = 8.9, 3.2 Hz, 1H), 4.45 (ddd, *J* = 13.9, 8.9, 4.6 Hz, 1H), 4.00 – 3.92 (m, 1H), 3.82 (s, 2H), 3.79 – 3.70 (m, 1H), 3.39 (ddd, *J* = 14.0, 9.2, 3.6 Hz, 1H), 3.05 (dd, *J* = 17.0, 6.0 Hz, 1H), 2.89 (dd, *J* = 17.0, 5.2 Hz, 1H), 2.74 (ddt, *J* = 6.9, 4.9, 2.0 Hz, 1H), 2.60 (br s, 1H), 2.24 – 2.08 (m, 1H), 2.01 – 1.88 (m, 3H), 1.88 – 1.75 (m, 1H), 1.71 (d, *J* = 1.2 Hz, 3H), 1.03 (d, *J* = 6.9 Hz, 3H), 0.98 (d, *J* = 6.5 Hz, 3H), 0.95 (d, *J* = 6.8 Hz, 3H).

^{13}C NMR (100 MHz, $CDCl_3$) δ 202.1, 171.6, 166.5, 160.2, 156.9, 144.5, 143.9, 136.92, 136.86, 134.3, 132.7, 125.2, 124.0, 81.4, 65.0, 59.6, 48.9, 48.4, 43.3, 40.9, 36.6, 29.4, 28.3, 25.0, 19.7, 18.7, 12.6, 10.4.

HRMS-ESI m/z calcd for $C_{28}H_{38}N_3O_7^+$ $[M + H]^+$ 528.2704, found 528.2703.

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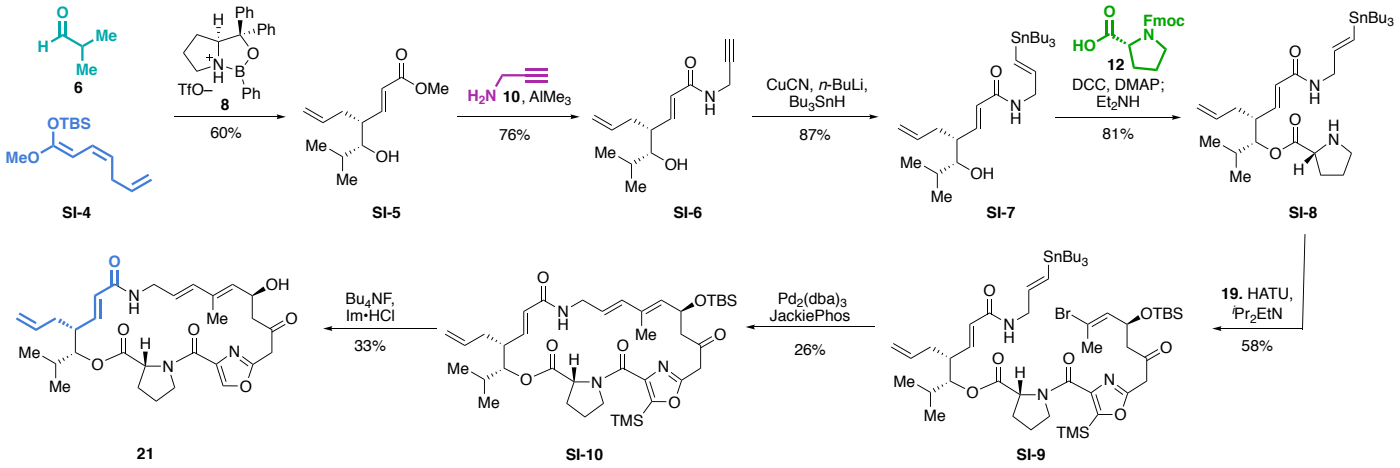
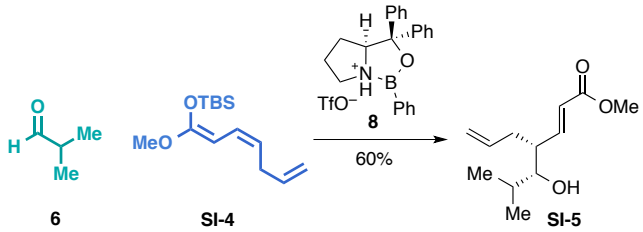
[10] Austad, B. A.; Calkins, T. L.; Chase, C. E.; Fang, F. G.; Horstmann, T. E.; Hu, Y.; Lewis, B. M.; Niu, X.; Noland, T. A.; Orr, J. D.; Schnaderbeck, M. J.; Zhang, H.; Asakawa, N.; Asai, N.; Chiba, H.; Hasebe, T.; Hoshino, Y.; Ishizuka, H.; Kajima, T.; Kayano, A.; Komatsu, Y.; Kubota, M.; Kuroda, H.; Miyazawa, M. Tagami K.; Watanabe, T. *Synlett*, **2013**, *24*, 333–337.

Scheme II Synthesis of 21



Mukaiyama aldol product SI-5



Preparation of SI-4: A 250-mL round-bottome flask was charged with anhydrous $^{i}Pr_2NH$ (3.30 mL, 23.0 mmol, 1.28 equiv) and THF ((46 mL), and the vessel and its contents were cooled to 0 ºC by means of an ice/water bath. A solution of n-butyllithium in hexanes (1.60 M, 14.4 mL, 23.0 mmol, 1.28 equiv) was added. After 30 min, the mixture was cooled to -78°C by means of a dry ice/acetone bath, and DMPU (3.20 mL, 27.0 mmol, 1.50 equiv) was added dropwise. After 15 min, a solution of methyl (*E*)-hepta-2,6-dienoate[11] (2.50 g, 18.0 mmol, 1 equiv) in THF (5 mL) was added dropwise. After a further 15 min, a solution of TBSCl (3.30 g, 22.0 mmol, 1.23 equiv) in THF (8 mL) was added dropwise. After stirring for 30 min, the vessel was removed from the bath and was allowed to warm to 23 °C. After 1.5 h at this temperature, saturated aqueous $NaHCO_3$ solution (50 mL) was added, and the mixture was extracted with hexanes (2 x 70 mL), and the organic extracts were washed with saturated aqueous $NaHCO_3$ (3 x 50 mL) and brine (35 mL). The washed solution was dried ($MgSO_4$), and the dried solution was filtered. The filtrate was concentrated, and the crude mixture was purified by distillation at reduced pressure (b.p. = 71.0-74.0 °C, ~0.5 torr) to afford the product **SI-4** (2.15 g, 47% yield) as light yellow oil.

^{1}H NMR (300 MHz, $CDCl_3$) δ 6.23 (tt, *J* = 10.9, 1.6 Hz, 1H), 5.93 – 5.76 (m, 1H), 5.13 – 4.92 (m, 3H), 4.56 – 4.39 (m, 1H), 3.59 (s, 3H), 2.89 – 2.76 (m, 2H), 0.95 (s, 9H), 0.17 (s, 6H).

Preparation of SI-5: A 100-mL round-bottom flask was charged with phenylboronic acid (0.41 g, 3.36 mmol, 0.50 equiv) and (*S*)-diphenyl(pyrrolidin-2-yl)methanol (0.85 g, 3.36 mmol, 0.50 equiv). The vessel was equipped with a reflux condenser, and the system was evacuated and flushed with nitrogen (this was repeated a total of 3 times). Toluene (25 mL) was added, and the resulting solution was brought to reflux by means of a 145 °C oil bath. After 12 h, the mixture was allowed to cool to 23 °C and was concentrated in vacuum. The resulting white solid was dried at ≤ 1 Torr for 1 h. The vessel was flushed with nitrogen, and DCM (26 mL) was added. The vessel and its contents (a colorless solution) were cooled to -78 °C by means of a dry ice/acetone bath and TfOH (0.27 mL, 3.03 mmol, 0.45 equiv) was

[11] Davies, S. G.; Fletcher, A. M.; Roberts, P. M.; Smith, A. D. *Tetahedron* **2009**, *65*, 10192–10213.

added dropwise over 5 min by glass syringe (CAUTION: TfOH rapidly corrodes most plastic syringes!). NOTE: Some of TfOH froze upon contact with the solution. After 1.5 h the solids had completely dissolved, and a mixture of isobutyraldehyde (**6**, 0.62 mL, 6.72 mmol, 1 equiv), silyl trienolether **SI-4** (2.14 g, 8.40 mmol, 1.25 equiv) and 2-propanol (0.57 mL, 7.39 mmol, 1.1 equiv) in DCM (7 mL) was added dropwise into the solution over 2 h by syringe pump. The mixture was stirred at -78 °C for another 2.5 h, and saturated aqueous $NaHCO_3$ solution (17 mL) was added in one portion. The vessel was removed from the cooling bath and the system was allowed to warm to 23 °C. The biphasic mixture was transferred to a separatory funnel and the layers were separated. The aqueous layer was extracted with DCM (2 × 15 mL). The organic layers were combined, and the resulting solution was dried (Na_2SO_4). The dried solution was filtered, and the filtrate was concentrated. The resulting crude residue was purified by flash chromatography (silica gel, eluent: EtOAc:hexanes = 1:10 to 1:6) to afford Mukaiyama aldol product **SI-5** (0.85 g, 60% yield) as colorless oil.

TLC (EtOAc: hexanes = 1:6): R_f = 0.2 (UV, $KMnO_4$).

^{1}H NMR (400 MHz, $CDCl_3$) δ 6.78 (dd, *J* = 15.7, 9.6 Hz, 1H), 5.84 (dd, *J* = 15.7, 0.8 Hz, 1H), 5.80 – 5.61 (m, 1H), 5.09 – 4.99 (m, 2H), 3.73 (s, 3H), 3.41 – 3.33 (m, 1H), 2.58 – 2.31 (m, 2H), 2.25 – 2.12 (m, 1H), 1.79 – 1.66 (m, 1H), 1.47 (d, *J* = 5.7 Hz, 1H), 0.95 (d, *J* = 6.9 Hz, 3H), 0.86 (d, *J* = 6.8 Hz, 3H).

^{13}C NMR (100 MHz, $CDCl_3$) δ 166.8, 149.5, 136.9, 122.11, 116.9, 77.9, 51.5, 46.5, 34.5, 30.8, 20.1, 15.1.

Amide SI-6

SI-5 **SI-6**

A 250-mL round-bottom flask was charged with propargylamine (**10**, 1.00 mL, 16.0 mmol, 4.0 equiv) and DCM (27 mL). The vessel and its contents (a colorless solution) were cooled to 0 °C by means of an ice/water bath. A solution of $AlMe_3$ in heptane (1.00 M, 16.0 mL, 16.0 mmol, 4.0 equiv) was added dropwise over 30 min (Caution: Gas evolution!). The mixture was allowed to cool to 23 °C. After 30 min, a solution of Mukaiyama aldol product **SI-5** (0.85 g, 4.00 mmol, 1 equiv) in DCM (4.8 mL) was added over 10 min (Caution: Gas evolution!). The vessel was equipped with a reflux condenser, and the solution was brought to reflux by means of a 50 °C oil bath. After 3 h, the system was cooled to 0 °C by means of an ice/water bath, and MeOH (3.0 mL) was added dropwise (Caution: Gas evolution!). Once gas evolution ceased, saturated aqueous potassium sodium tartrate solution (30 mL) was added. After 1 h, the biphasic mixture was transferred to a separatory funnel. The layers were separated, and the aqueous layer was extracted with DCM (2 × 10 mL). The combined organic layers were washed with water (30 mL) and brine (30 mL), and the organic extracts were dried (Na_2SO_4). The dried solution was filtered, and the filtrate was concentrated. The resulting crude residue was purified by flash chromatography (silica gel, eluent: EtOAc:hexanes = 1:1) to afford amide **SI-6** (0.71 g, 76% yield) as a white solid.

TLC (EtOAc: hexanes = 1:1): R_f = 0.40 (UV).

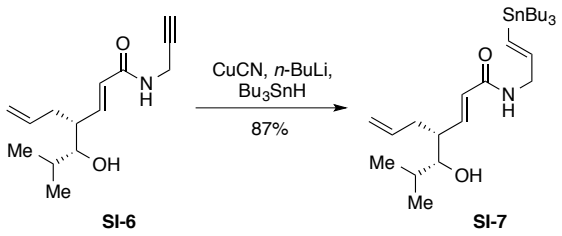
^{1}H NMR (300 MHz, $CDCl_3$) δ 6.70 (ddd, *J* = 15.3, 9.6, 1.6 Hz, 1H), 5.81 (d, *J* = 1.5 Hz, 1H), 5.79 – 5.65 (m, 1H), 5.62 (br s, 1H), 5.10 – 4.98 (m, 2H), 4.13 (m, 2H), 3.40 – 3.34 (m, 1H), 2.49 (d, *J* = 6.0 Hz, 1H), 2.39 (q, *J* = 9.5 Hz, 1H), 2.26

(q, J = 2.3 Hz, 1H), 2.18 (dt, J = 15.2, 8.3 Hz, 1H), 1.73 (m, 1H), 1.57 (s, 1H), 0.95 (dd, J = 6.9, 1.5 Hz, 3H), 0.86 (dd, J = 6.8, 1.6 Hz, 3H).

^{13}C NMR (75 MHz, $CDCl_3$) δ 165.4, 146.2, 136.5, 124.2, 117.1, 79.7, 78.4, 72.1, 46.7, 34.8, 31.0, 29.6, 20.4, 15.6.

HRMS-ESI m/z calcd for $C_{14}H_{21}NNaO_2^+$ $[M + Na]^+$ 258.1465, found 258.1458.

Vinyl stannane SI-7



A 250-mL round-bottom flask charged with CuCN (0.54 g, 6.07 mmol, 2.0 equiv) was evacuated and flushed with nitrogen (this process was repeated a total of 3 times). THF (40.0 mL) was added, resulting in a white suspension, and the vessel and its contents were cooled to -78 °C by means of a dry ice/acetone bath. A solution of *n*-BuLi in hexanes (2.50 M, 5.1 mL, 12.7 mmol, 4.2 equiv) was added dropwise over 10 min, and the resulting solution was stirred for 30 min. Bu_3SnH (3.43 mL, 12.7 mmol, 4.2 equiv) was added dropwise over 5 min. After 30 minutes, a solution of amide **SI-6** (0.71 g, 3.03 mmol, 1 equiv) in THF (3.2 mL) was added dropwise over 15 min. After 1 h, saturated aqueous ammonium chloride solution (25 mL) was added in one portion. The vessel was removed from the cooling bath, and the system was allowed to warm 23 °C while the mixture was rapidly stirring. The biphasic mixture was transferred to a separatory funnel, and the layers were separated. The aqueous layers were extracted with EtOAc (2 × 25 mL). The combined organic layers were washed with water (2 × 25 mL) and brine (25 mL). The washed solution was dried (Na_2SO_4). The dried solution was filtered, and the filtrate was concentrated. The resulting crude residue was purified by flash chromatography (silica gel, eluent: EtOAc:hexanes = 0:1 to 1:3) to afford vinyl stannane **SI-7** (1.38 g, 87% yield) as a colorless oil.

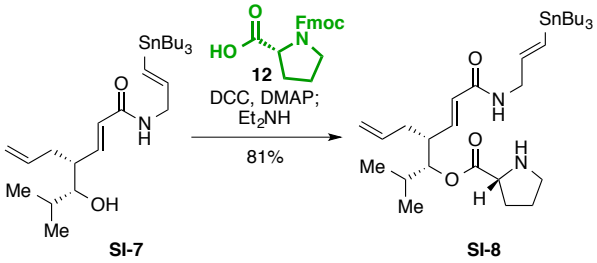
TLC (EtOAc:hexanes = 1:3): R_f = 0.20 (UV).

^{1}H NMR (400 MHz, $CDCl_3$) δ 6.67 (dd, J = 15.3, 9.6 Hz, 1H), 6.12 (dt, J = 18.9, 1.5 Hz, 1H), 5.98 (dt, J = 19.0, 5.1 Hz, 1H), 5.83 – 5.69 (m, 2H), 5.52 (t, J = 5.9 Hz, 1H), 5.10 – 4.96 (m, 2H), 4.04 – 3.95 (m, 2H), 3.41 – 3.34 (m, 1H), 2.55 – 2.47 (m, 1H), 2.44 – 2.32 (m, 1H), 2.24 – 2.12 (m, 1H), 1.80 – 1.70 (m, 1H), 1.59 – 1.36 (m, 6H), 1.34 – 1.26 (m, 6H), 0.99 – 0.77 (m, 21H).

^{13}C NMR (100 MHz, $CDCl_3$) δ 165.2, 144.8, 143.4, 136.3, 130.5, 124.7, 116.6, 78.1, 46.3, 45.0, 34.6, 30.7, 29.1, 27.3, 20.1, 15.2, 13.7, 9.5.

HRMS-ESI m/z calcd for $C_{26}H_{50}NO_2Sn^+$ $[M + H]^+$ 528.2858 found 528.2866.

Amine SI-8



A 100-mL round-bottom flask was charged with Fmoc-D-Pro-OH (**12**, 1.16 g, 3.42 mmol, 1.35 equiv), DMAP (62.0 mg, 0.51 mmol, 0.2 equiv) and vinyl stannane **SI-7** (1.34 g, 2.54 mmol, 1 equiv). DCM (25 mL) was added, resulting in a colorless solution. DCC (0.79 g, 3.81 mmol, 1.50 equiv) was added in one portion at 23 °C, resulting in a white suspension. After 5 h, **SI-7** was entirely consumed as indicated by TLC analysis (eluent: EtOAc:hexanes = 1:2), and diethyl amine (13.0 mL) was added. After 3 h, the mixture was filtered through a pad of celite, and the filter cake was washed with DCM (2 × 20 mL). The combined filtrates were concentrated, and the resulting crude residue was purified by flash chromatography (silica gel, eluent: NH_4OH:MeOH:DCM = 0.2:1:100 to 0.2:1:50) to afford amine **SI-8** (1.28 g, 81% yield) as a light-yellow oil.

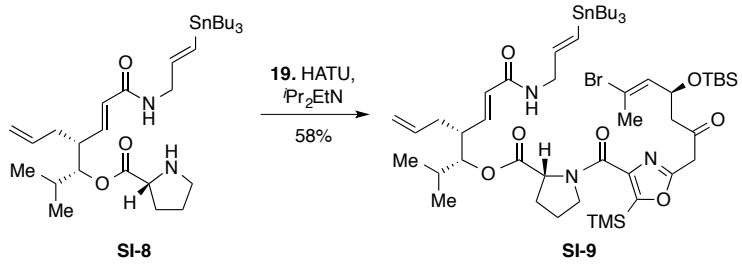
TLC (MeOH:DCM = 1:20) : R_f = 0.20 (UV).

^{1}H NMR (400 MHz, $CDCl_3$) δ 6.58 (dd, *J* = 15.3, 9.5 Hz, 1H), 6.11 (dt, *J* = 19.0, 1.5 Hz, 1H), 5.96 (dt, *J* = 19.0, 5.1 Hz, 1H), 5.81 (d, *J* = 15.3 Hz, 1H), 5.72 – 5.60 (m, 1H), 5.57 (br, 1H), 5.03 – 4.95 (m, 2H), 4.89 (dd, *J* = 8.1, 4.2 Hz, 1H), 4.01 – 3.95 (m, 2H), 3.80 (dd, *J* = 8.4, 5.7 Hz, 1H), 3.09 (dt, *J* = 10.2, 6.8 Hz, 1H), 2.92 (dt, *J* = 10.2, 6.6 Hz, 1H), 2.55 (m, 1H), 2.38 (s, 1H), 2.28 – 2.02 (m, 3H), 1.94 – 1.72 (m, 4H), 1.54 – 1.40 (m, 6H), 1.33 – 1.24 (m, 6H), 0.91 – 0.83 (m, 21H).

^{13}C NMR (100 MHz, $CDCl_3$) δ 175.1, 164.8, 143.3, 142.9, 135.3, 130.5, 125.5, 117.1, 79.2, 59.9, 46.9, 45.0, 44.5, 34.4, 30.5, 29.9, 29.0, 27.3, 25.5, 19.8, 15.9, 13.7, 9.5.

HRMS-ESI m/z calcd for $C_{31}H_{57}N_2O_3Sn^+$ $[M + H]^+$ 625.3386 found 625.3390.

Stille coupling precursor SI-9



A 50-mL round-bottom flask was charged with ^{i}Pr$_2$EtN (0.18 mL, 1.06 mmol, 2.0 equiv), amine **SI-8** (0.33 g, 0.53 mmol, 1 equiv) and acid **19** (0.29 g, 0.58 mmol, 1.1 equiv). DCM (6 mL) was added, resulting in colorless solution. HATU (0.25 g, 0.66 mmol, 1.25 equiv) was added in one portion. After 5 h, the mixture was diluted with DCM (22 mL). The resulting solution was transferred to a separatory funnel and was washed with water (2 × 28 mL) and brine (18 mL). The washed solution was dried (Na_2SO_4). The dried solution was filtered, and the filtrate was concentrated. The resulting crude residue was purified by flash chromatography (silica gel, eluent: EtOAc:hexanes = 1:6 to 1:4) to afford Stille coupling precursor **SI-9** (0.34 g, 58% yield) as a light-yellow foam.

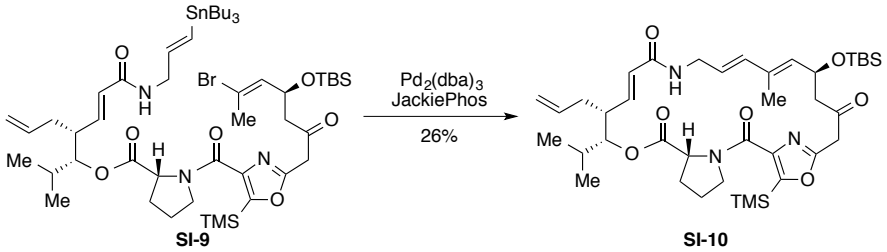
TLC (EtOAc:hexanes = 1:4) : R_f = 0.25 (UV).

^{1}H NMR (400 MHz, $CDCl_3$, mixtures of rotamers) δ 6.56 (ddd, *J* = 20.2, 15.3, 9.5 Hz, 1H), 6.20 – 6.07 (m, 1H), 6.05 – 5.90 (m, 1H), 5.87 – 5.79 (m, 1H), 5.77 – 5.59 (m, 2H), 5.00 – 4.87 (m, 3H), 4.87 – 4.76 (m, 1H), 4.14 – 3.90 (m, 4H), 3.89 – 3.69 (m, 2H), 2.85 (dt, *J* = 16.3, 8.3 Hz, 1H), 2.55 (pd, *J* = 9.2, 4.5 Hz, 1H), 2.34 – 2.24 (m, 4H), 2.17 – 1.79 (m, 2H), 1.56 – 1.42 (m, 6H), 1.38 – 1.26 (m, 9H), 0.96 – 0.82 (m, 30H), 0.38 – 0.30 (m, 9H), 0.08 – 0.03 (m, 6H).

^{13}C NMR (100 MHz, $CDCl_3$, mixtures of rotamers) δ 201.1, 200.7, 172.4, 172.2, 165.1, 164.8, 163.3, 162.5, 161.5, 159.2, 159.1, 145.2, 145.1, 143.4, 143.3, 143.1, 142.8, 135.6, 135.4, 134.3, 130.4, 130.2, 125.6, 121.8, 117.0, 116.9, 79.5, 79.4, 67.1, 66.9, 60.7, 59.9, 49.7, 49.6, 48.8, 47.1, 44.96, 45.0, 44.7, 44.3, 44.2, 44.0, 34.3, 33.9, 31.7, 30.1, 29.9, 29.0, 27.8, 27.3, 26.8, 25.7, 25.7, 25.3, 24.0, 23.9, 21.6, 20.0, 19.6, 18.0, 17.5, 16.4, 16.2, 13.7, 13.6, 9.5, –1.73, –1.75, –4.5, –5.10, –5.12.

HRMS-ESI m/z calcd for $C_{51}H_{89}BrN_3O_7Si_2Sn^+$ $[M + H]^+$ 1110.4439 found 1110.4449.

Stille coupling product SI-10



SI-9 **SI-10**

A 100-mL round-bottom flask containing JackiePhos (23.0 mg, 29.0 μmol, 0.2 equiv), Stille coupling precursor **SI-9** (0.16 g, 0.15 mmol, 1 equiv) and $Pd_2(dba)_3$ (13.4 mg, 14.6 μmol, 0.1 equiv) was evacuated and flushed with nitrogen (this process was repeated a total of 3 times). Toluene (30 mL) was added, resulting in a red suspension. A stream of argon was passed through the solution by a stainless steel needle for 30 min. The vessel and its contents were then heated by means of an 80 ºC oil bath. After 16 h, **SI-9** was entirely consumed as indicated by TLC analysis (eluent: EtOAc:hexanes = 1:2), and the mixture was allowed to cool to 23 ºC. The mixture was concentrated, and the resulting crude residue was purified by flash chromatography (silica gel, eluent: EtOAc:hexanes = 1:2.5 to 1:2) to afford Stille coupling product **SI-10** (28.6 mg, 26% yield) as a white foam.

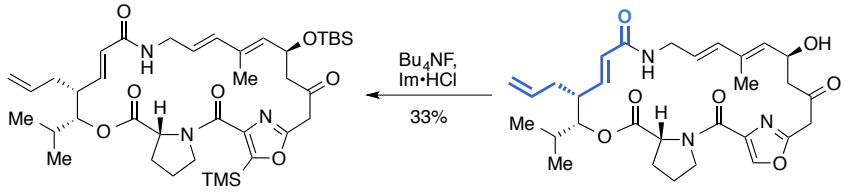
TLC (EtOAc:hexanes = 1:2) : R_f = 0.30 (UV).

^{1}H NMR (400 MHz, $CDCl_3$) δ 6.50 (dd, *J* = 16.2, 5.1 Hz, 1H), 6.14 (d, *J* = 15.6 Hz, 1H), 6.10 – 6.00 (m, 1H), 5.93 – 5.76 (m, 2H), 5.62 (ddd, *J* = 15.6, 9.1, 4.3 Hz, 1H), 5.42 (d, *J* = 8.8 Hz, 1H), 5.19 – 4.98 (m, 3H), 4.87 (ddd, *J* = 15.3, 9.3, 2.7 Hz, 2H), 4.50 (ddd, *J* = 14.1, 8.8, 4.4 Hz, 1H), 3.97 – 3.86 (m, 1H), 3.86 – 3.72 (m, 2H), 3.67 (dd, *J* = 4.1, 2.1 Hz, 1H), 3.42 (ddd, *J* = 14.9, 9.1, 3.1 Hz, 1H), 3.00 – 2.89 (m, 1H), 2.78 (dd, *J* = 15.9, 6.0 Hz, 1H), 2.44 (d, *J* = 14.5 Hz, 1H), 2.30 – 2.11 (m, 2H), 2.08 – 1.83 (m, 2H), 1.84 – 1.71 (m, 1H), 1.02 – 0.85 (m, 18H), 0.33 (s, 9H), 0.06 (d, *J* = 12.7 Hz, 6H).

^{13}C NMR (100 MHz, $CDCl_3$) δ 201.1, 171.9, 166.0, 161.9, 161.3, 160.9, 159.7, 145.1, 142.9, 136.6, 135.8, 134.7, 132.5, 124.8, 117.1, 81.5, 65.5, 58.9, 50.5, 48.5, 43.8, 41.7, 41.2, 30.4, 29.4, 28.3, 25.8, 24.9, 19.9, 18.7, 12.8, –1.8, –4.5, –4.9.

HRMS-ESI m/z calcd for $C_{39}H_{62}N_3O_7Si_2^+$ $[M + H]^+$ 740.4121 found 740.4116.

Analogue 21



A 50 mL round-bottom flask containing Stille coupling product **SI-10** (30 mg, 41 μmol, 1 equiv) was evacuated and flushed with nitrogen (this process was repeated a total of 3 times). THF (0.8 mL) was added, resulting in a light-yellow solution. In a separate flask, Im•HCl (43 mg, 0.41 mmol, 10.0 equiv) that had previously been dried at >100 ºC for 10 minutes under vacuum was added to a solution of tetrabutylammonium fluoride in THF (1 M, 0.41 mL, 0.41 mmol, 10.0 equiv). The resulting colorless solution was added dropwise to the solution of **SI-10**. After 12 h, the mixture was concentrated, and the residue was dissolved in DCM (30 mL). The resulting solution was transferred to a separatory funnel and was washed with water (5 × 15 mL) and brine (15 mL). The washed solution was dried (Na_2SO_4). The dried solution was filtered, and the filtrate was concentrated. The resulting crude residue was purified by flash chromatography (silica gel, eluent: MeOH:DCM = 1:40) to afford analogue **21** (7.3 mg, 33% yield) as a white solid.

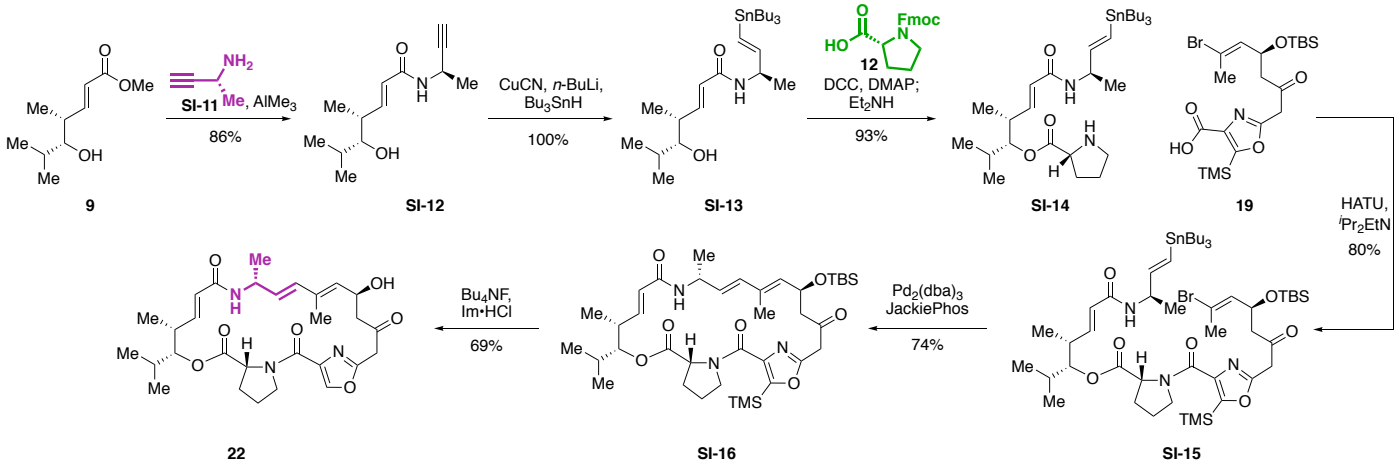
TLC (MeOH:DCM = 1:20) : R_f = 0.15 (UV).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.98 (s, 1H), 6.69 (dd, *J* = 10.1 Hz, 1H), 6.38 (dd, *J* = 16.3, 6.7 Hz, 1H), 6.06 (d, *J* = 15.7 Hz, 1H), 5.86 (dd, *J* = 16.2, 1.4 Hz, 1H), 5.71 (ddt, *J* = 14.3, 9.8, 5.9 Hz, 2H), 5.25 (d, *J* = 8.8 Hz, 1H), 5.04 – 4.96 (m, 2H), 4.90 (td, *J* = 7.2, 5.0 Hz, 1H), 4.80 (dd, *J* = 9.8, 2.2 Hz, 1H), 4.69 (dd, *J* = 8.8, 3.3 Hz, 1H), 4.46 (ddd, *J* = 14.2, 8.8, 4.9 Hz, 1H), 3.93 – 3.86 (m, 1H), 3.82 (d, *J* = 15.4 Hz, 1H), 3.78 – 3.70 (m, 1H), 3.65 (dd, *J* = 4.0, 1.9 Hz, 1H), 3.44 – 3.34 (m, 1H), 3.04 (dd, *J* = 16.3, 6.8 Hz, 1H), 2.91 – 2.81 (m, 1H), 2.69 – 2.61 (m, 1H), 2.44 – 2.31 (m, 2H), 2.28 – 2.17 (m, 1H), 2.16 – 2.06 (m, 1H), 2.06 – 1.85 (m, 3H), 0.95 (d, *J* = 6.6 Hz, 6H).

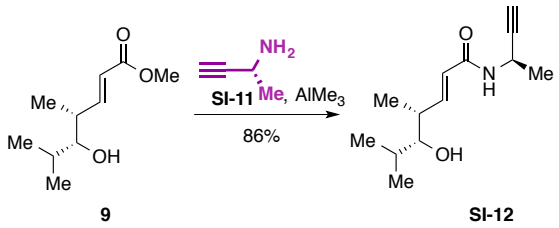
^{13}C NMR (100 MHz, $CDCl_3$) δ 201.89, 171.44, 166.31, 160.51, 156.61, 143.95, 141.77, 137.03, 136.86, 135.77, 134.75, 132.21, 126.07, 125.44, 116.91, 81.83, 65.45, 60.05, 48.52, 43.94, 41.97, 41.27, 40.67, 30.99, 29.61, 28.54, 25.15, 19.69, 18.97, 12.80.

HRMS-ESI m/z calcd for $C_{30}H_{39}N_3NaO_7^+$ $[M + H]^+$ 576.2680, found 576.2678.

Scheme III Synthesis of 22



Amide SI-12



A 200-mL round-bottom flask was charged with (*R*)-but-3-yn-2-amine[12] (**SI-11**, 1.04 g, 15.0 mmol, 4.0 equiv) and dry DCM (25 mL). The resulting colorless solution was cooled to 0 ºC by means of an ice/water bath. A solution of $AlMe_3$ in heptane (2 M, 7.5 mL, 15.0 mmol, 4.0 equiv) was added dropwise over 30 min (CAUTION: Gas evolution!). The mixture was allowed to warm to 23 ºC. After 30 min, a solution of **9** (3.20 g, 17.2 mmol, 1 equiv) in DCM (20 mL) was added over 10 min (CAUTION: Gas evolution!). The vessel was equipped with a reflux condenser, and the solution was brought to reflux by means of a 50 ºC oil bath. After 12 h, the mixture was cooled to 0 °C by means of an ice/water bath, and MeOH (5 mL) was added (CAUTION: Gas evolution!). Once gas evolution ceased, saturated aqueous potassium sodium tartrate solution (50 mL) was added. After 1 h, the biphasic mixture was transferred to a separatory funnel, and the layers were separated. The aqueous layer was extracted with DCM (2 × 30 mL). The combined organic layers were washed with water (60 mL) and brine (60 mL), and the washed solution was dried (Na_2SO_4). The dried solution was filtered, and the filtrate was concentrated. The resulting crude residue was purified by flash chromatography (silica gel, eluent: EtOAc:hexanes = 1:1) to afford amide **SI-12** (0.72 g, 86% yield) as a white solid.

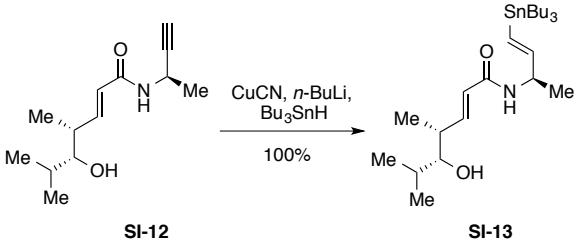
TLC (EtOAc:hexanes = 1:1) : R_f = 0.25 (UV).

^{1}H NMR (400 MHz, $CDCl_3$) δ 6.79 (dd, *J* = 15.4, 7.8 Hz, 1H), 6.30 (d, *J* = 8.0 Hz, 1H), 5.81 (dd, *J* = 15.5, 1.2 Hz, 1H), 4.91 – 4.76 (m, 1H), 3.22 (t, *J* = 5.8 Hz, 1H), 2.46 (dddd, *J* = 8.0, 6.9, 5.6, 1.3 Hz, 1H), 2.24 (d, *J* = 2.4 Hz, 2H), 1.69 (dq, *J* = 13.2, 6.6 Hz, 1H), 1.40 (d, *J* = 6.9 Hz, 3H), 1.04 (d, *J* = 6.8 Hz, 3H), 0.89 (d, *J* = 6.6 Hz, 3H), 0.87 (d, *J* = 6.9 Hz, 3H).

^{13}C NMR (100 MHz, $CDCl_3$) δ 164.9, 148.2, 122.8, 84.1, 79.0, 70.3, 39.5, 36.7, 30.8, 22.1, 19.6, 17.0, 13.6.

HRMS-ESI m/z calcd for $C_{13}H_{22}NO_2^+$ $[M + H]^+$ 224.1645, found 224.1648.

Vinyl stannane SI-13



A 200-mL round-bottom flask containing CuCN (0.56 g, 6.27 mmol, 2.0 equiv) was evacuated and flushed with nitrogen (this process was repeated a total of 3 times). THF (63 mL) was added, resulting in a white suspension, and the vessel and its contents were cooled to -78 ºC by means of a dry ice/acetone bath. To this suspension was added a solution of *n*-BuLi in hexanes (2.5 M, 5.27 mL, 13.2 mmol, 4.2 equiv) dropwise over 10 min, and the resulting light-yellow

[12] Rajagopal, B.; Chen, Y.-Y.; Chen, C.-C.; Liu, X.-Y.; Wang, H.-R.; Lin, P.-C. *J. Org. Chem.* **2014**, *79*, 1254–1264.

solution was stirred for 30 min. Bu_3SnH (3.55 mL, 13.2 mmol, 4.2 equiv) was added dropwise over 5 min. After 30 min, a solution of **SI-12** (0.70 g, 3.13 mmol, 1 equiv) in THF (5 mL) was added dropwise over 15 min. After 1 h, saturated aqueous ammonium chloride solution (50 mL) was added in one portion. The vessel was removed from the cooling bath, and the system was allowed to warm to 23 ºC while the mixture was rapidly stirred. The biphasic mixture was transferred to a separatory funnel, and the layers were separated. The aqueous layer was extracted with EtOAc (2 × 100 mL). The combined organic layers were washed with water (2 × 100 mL) and brine (100 mL). The washed solution was dried (Na_2SO_4). The dried solution was filtered, and the filtrate was concentrated. The resulting crude residue was purified by flash chromatography (silica gel, eluent: EtOAc:hexanes = 0:1 to 1:3) to afford vinyl stannane **SI-13** (1.61 g, 100% yield, ≥20:1 E:Z) as a colorless oil.

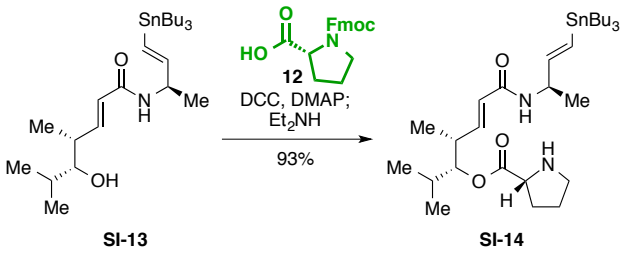
TLC (EtOAc:hexanes = 1:3): R_f = 0.25 (UV).

^{1}H NMR (400 MHz, $CDCl_3$) δ 6.79 (dd, *J* = 15.3, 7.8 Hz, 1H), 6.06 (dd, *J* = 19.1, 1.5 Hz, 1H), 5.95 (dd, *J* = 19.2, 4.1 Hz, 1H), 5.81 (dd, *J* = 15.3, 1.2 Hz, 1H), 5.48 (d, *J* = 8.6 Hz, 1H), 4.70 – 4.57 (m, 1H), 3.25 (q, *J* = 5.6 Hz, 1H), 2.48 (dddd, *J* = 8.0, 7.0, 5.9, 1.2 Hz, 1H), 1.80 (d, *J* = 5.1 Hz, 1H), 1.78 – 1.68 (m, 1H), 1.55 – 1.41 (m, 6H), 1.34 – 1.25 (m, 6H), 1.24 (d, *J* = 6.8 Hz, 3H), 1.07 (d, *J* = 6.7 Hz, 3H), 0.97 – 0.77 (m, 21H).

^{13}C NMR (100 MHz, $CDCl_3$) δ 164.9, 148.6, 147.3, 127.1, 123.5, 79.1, 48.8, 39.6, 30.7, 29.0, 27.2, 20.4, 19.7, 16.8, 13.9, 13.6, 9.4.

HRMS-ESI m/z calcd for $C_{25}H_{50}NO_2Sn^+$ $[M + H]^+$ 516.2858, found 516.2863.

Amine SI-14



A 100-mL round-bottom flask was charged with Fmoc-D-Pro-OH (**12**, 0.89 g, 2.62 mmol, 1.35 equiv), DMAP (48 mg, 0.39 mmol, 0.2 equiv) and **SI-13** (1.00 g, 1.94 mmol, 1 equiv). DCM (20 mL) was added, resulting in a colorless solution. DCC (0.60 g, 2.92 mmol, 1.5 equiv) was added in one portion. resulting in a white suspension. After 5 h, the alcohol **SI-13** was entirely consumed as indicated by TLC analysis (eluent: EtOAc:hexanes = 1:2), and diethyl amine (11 mL) was added. After 3 h, the mixture was filtered through a pad of celite, and the filter cake was washed with DCM (2 × 10 mL). The filtrate was concentrated, and the resulting crude residue was purified by flash chromatography (silica gel, eluent: NH_4OH:MeOH:DCM = 0.2:1:100 to 0.2:1:50) to afford amine **SI-14** (1.10 g, 93% yield) as light-yellow oil.

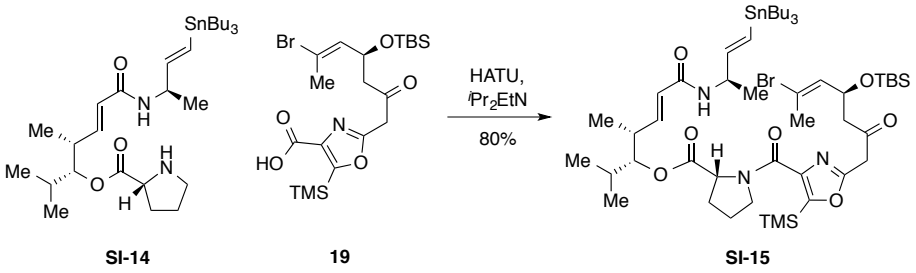
TLC (MeOH:DCM= 1:20): R_f = 0.20 (UV).

^{1}H NMR (400 MHz, $CDCl_3$) δ 6.68 (dd, *J* = 15.4, 7.7 Hz, 1H), 6.06 (dd, *J* = 19.2, 1.5 Hz, 1H), 5.94 (dd, *J* = 19.1, 4.1 Hz, 1H), 5.81 (dd, *J* = 15.4, 1.2 Hz, 1H), 5.48 (d, *J* = 8.6 Hz, 1H), 4.82 (dd, *J* = 6.7, 5.6 Hz, 1H), 4.68 – 4.56 (m, 1H), 4.02 (br s, 1H), 3.89 (dd, *J* = 8.5, 5.6 Hz, 1H), 3.14 (ddd, *J* = 10.4, 7.5, 6.1 Hz, 1H), 3.05 – 2.95 (m, 1H), 2.70 – 2.60 (m, 1H), 2.25 – 2.15 (m, 1H), 1.97 – 1.87 (m, 2H), 1.85 – 1.71 (m, 2H), 1.53 – 1.40 (m, 6H), 1.34 – 1.24 (m, 6H), 1.23 (d, *J* = 6.8 Hz, 3H), 1.03 (d, *J* = 6.8 Hz, 3H), 0.92 – 0.79 (m, 21H).

^{13}C NMR (100 MHz, $CDCl_3$) δ 174.1, 164.5, 148.5, 144.9, 127.1, 124.2, 80.9, 59.7, 48.8, 46.7, 38.0, 30.2, 29.7, 29.0, 27.2, 25.1, 20.4, 19.5, 16.9, 14.6, 13.7, 9.4.

HRMS-ESI m/z calcd for $C_{30}H_{57}N_2O_3Sn^+$ $[M + H]^+$ 613.3386, found 613.3380.

Stille coupling precursor SI-15



A 100-mL round-bottom flask was charged with $^iPr_2EtN$ (0.63 mL, 3.60 mmol, 2.0 equiv), amine **SI-14** (1.10 g, 1.80 mmol, 1 equiv) and acid **19** (1.00 g, 1.98 mmol, 1.1 equiv). DCM (18 mL) was added, resulting in a colorless solution. HATU (0.86 g, 2.25 mmol, 1.25 equiv) was added in one portion. After 5 h, the mixture was diluted with DCM (30 mL), and the diluted solution was transferred to a separatory funnel and was washed with water (2 × 25 mL) and brine (25 mL). The washed solution was dried (Na_2SO_4). The dried solution was filtered, and the filtrate was concentrated. The resulting crude residue was purified by flash chromatography (silica gel, eluent: EtOAc:hexanes = 1:6 to 1:4) to afford Stille coupling precursor **SI-15** (1.58 g, 80% yield) as a light-yellow oil.

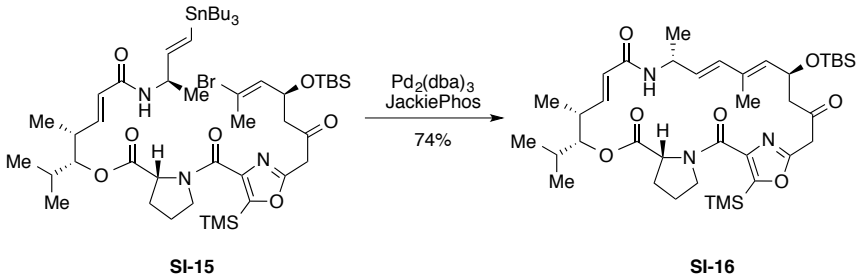
TLC (EtOAc:hexanes = 1:4): R_f = 0.30 (UV).

^{1}H NMR (400 MHz, $CDCl_3$, mixtures of rotamers) δ 6.70 – 6.56 (m, 1H), 6.09 – 5.99 (m, 1H), 5.97 – 5.87 (m, 1H), 5.86 – 5.68 (m, 2H), 5.61 – 5.46 (m, 1H), 4.84 – 4.68 (m, 2H), 4.67 – 4.51 (m, 2H), 4.13 – 3.90 (m, 1H), 3.92 – 3.80 (m, 2H), 3.80 – 3.58 (m, 1H), 2.90 – 2.70 (m, 1H), 2.68 – 2.41 (m, 2H), 2.31 – 2.10 (m, 4H), 1.95 – 1.72 (m, 4H), 1.54 – 1.35 (m, 6H), 1.35 – 1.15 (m, 9H), 0.97 – 0.72 (m, 33H), 0.38 – 0.21 (m, 9H), 0.06 – –0.03 (m, 6H).

^{13}C NMR (100 MHz, $CDCl_3$, mixtures of rotamers) δ 201.0, 200.6, 172.30, 172.29, 164.71, 164.69, 164.4, 163.1, 162.4, 161.5, 161.4, 159.0, 148.57, 148.53, 145.24, 145.12, 145.10, 144.8, 134.2, 126.97, 126.86, 124.16, 124.11, 121.73, 121.71, 80.8, 80.4, 67.0, 66.8, 60.4, 59.8, 49.58, 49.55, 48.74, 48.70, 48.66, 47.0, 44.2, 44.0, 38.3, 37.9, 29.85, 29.73, 28.96, 28.85, 27.2, 25.64, 25.59, 23.95, 23.93, 20.38, 20.35, 19.58, 19.38, 17.9, 17.0, 16.9, 14.7, 14.4, 13.6, 9.4, –1.81, –1.82, –4.6, –4.7, –5.18, –5.20.

HRMS-ESI m/z calcd for $C_{50}H_{89}BrN_3O_7Si_2Sn^+$ $[M + H]^+$ 1098.4439, found 1098.4455.

Stille coupling product SI-16



A 500-mL round-bottom flask containing JackiePhos (0.22 g, 0.27 mmol, 0.2 equiv), Stille coupling precursor **SI-15** (1.50 g, 1.02 mmol, 1 equiv) and $Pd_2(dba)_3$ (0.13 g, 0.14 mmol, 0.1 equiv) was evacuated and flushed with nitrogen (this process was repeated a total of 3 times). Toluene (270 mL) was added, resulting in a red suspension. A stream of argon was passed through the solution by a stainless steel needle for 30 min. The vessel and its contents were then heated by

means of a 50 ºC oil bath. After 3 h, **SI-15** was entirely consumed as indicated by TLC analysis (eluent: EtOAc:hexanes = 1:2), and the mixture was allowed to cool to 23 ºC. The mixture was concentrated, and the resulting crude residue was purified by flash chromatography (silica gel, eluent: EtOAc:hexanes = 1:2.5 to 1:2) to afford Stille coupling product **SI-16** (0.71 g, 74% yield) as a white solid.

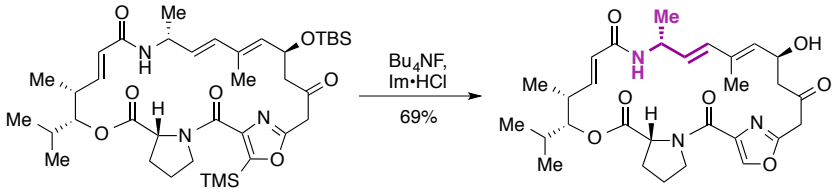
TLC (EtOAc:hexanes = 1:2): R_f = 0.20 (UV).

^{1}H NMR (400 MHz, $CDCl_3$) δ 6.82 (dd, *J* = 15.5, 4.3 Hz, 1H), 6.22 (d, *J* = 15.4 Hz, 1H), 5.67 – 5.55 (m, 2H), 5.45 (d, *J* = 8.6 Hz, 1H), 5.32 (dd, *J* = 15.4, 8.6 Hz, 1H), 5.05 (td, *J* = 8.4, 3.2 Hz, 1H), 4.85 – 4.70 (m, 2H), 4.62 – 4.50 (m, 1H), 3.82 (d, *J* = 17.3 Hz, 1H), 3.78 – 3.71 (m, 1H), 3.68 (d, *J* = 17.3 Hz, 1H), 3.56 (ddd, *J* = 11.4, 8.8, 3.1 Hz, 1H), 2.97 (dd, *J* = 18.4, 3.2 Hz, 1H), 2.75 – 2.63 (m, 1H), 2.64 (dd, *J* = 18.4, 8.2 Hz, 1H), 2.02 – 1.81 (m, 5H), 1.66 (d, *J* = 1.2 Hz, 3H), 1.23 (d, *J* = 6.7 Hz, 3H), 1.04 (d, *J* = 6.7 Hz, 3H), 0.95 (d, *J* = 6.5 Hz, 3H), 0.93 (d, *J* = 6.8 Hz, 3H), 0.82 (s, 9H), 0.29 (s, 9H), 0.04 (s, 3H), 0.01 (s, 3H).

^{13}C NMR (100 MHz, $CDCl_3$) δ 201.0, 169.8, 164.1, 161.54, 161.48, 159.8, 147.5, 145.1, 136.2, 135.3, 130.9, 129.3, 122.6, 80.4, 64.5, 58.9, 50.5, 48.2, 47.4, 43.1, 36.9, 29.3, 28.5, 25.7, 24.4, 21.1, 19.7, 18.5, 18.0, 12.5, 9.2, –1.9, –4.6, –5.0.

HRMS-ESI m/z calcd for $C_{38}H_{62}N_3O_7Si_2^+$ $[M + H]^+$ 728.4121, found 728.4127.

Analogue 22



SI-16 **22**

A 100-mL round-bottom flask containing Stille coupling product **SI-16** (0.70 g, 0.96 mmol, 1 equiv) was evacuated and flushed with nitrogen (this process was repeated a total of 3 times). THF (9.6 mL) was added, resulting in a light-yellow solution. In a separate flask, Im•HCl (1.01 g, 9.60 mmol, 10.0 equiv) that had previously been dried at >100 ºC for 10 minutes under vacuum was added to a solution of tetrabutylammonium fluoride in THF (1 M, 9.60 mL, 9.60 mmol, 10.0 equiv). The resulting colorless solution was added dropwise to the solution of **SI-16**. After 12 h, the mixture was concentrated, and the residue was dissolved in DCM (100 mL). The resulting solution was transferred to a separatory funnel and was washed with water (5 × 100 mL) and brine (100 mL). The washed solution was dried (Na_2SO_4). The dried solution was filtered, and the filtrate was concentrated. The resulting crude residue was purified by flash chromatography (silica gel, eluent: MeOH:DCM = 1:40) to afford analogue **22** (0.36 g, 69% yield) as a light-yellow solid.

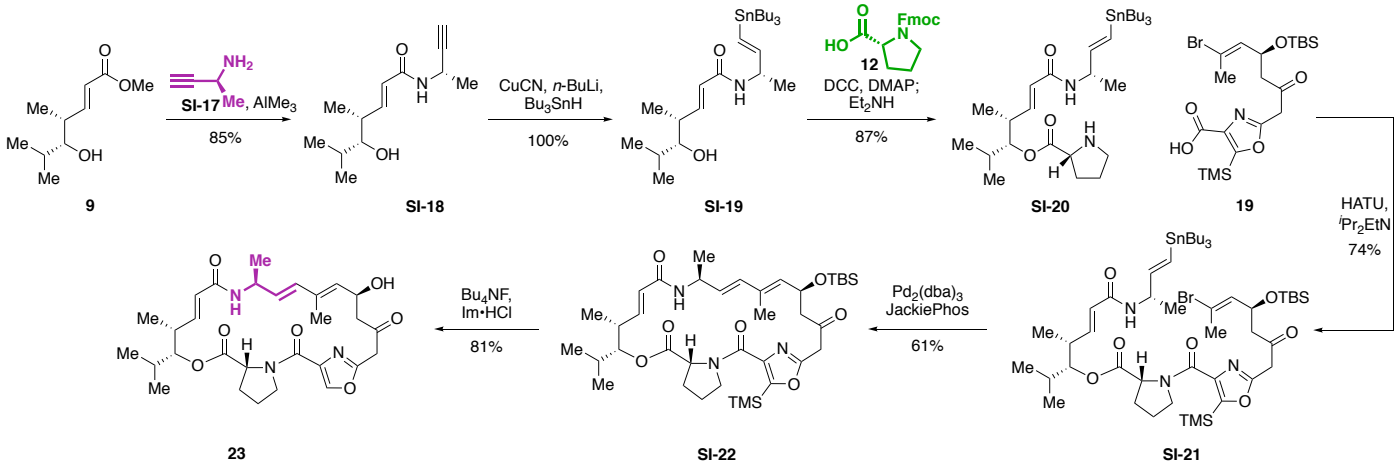
TLC (MeOH:DCM = 1:20): R_f = 0.30 (UV).

^{1}H NMR (400 MHz, $CDCl_3$) δ 8.13 (s, 1H), 6.87 (dd, *J* = 15.5, 4.2 Hz, 1H), 6.29 (d, *J* = 15.4 Hz, 1H), 5.66 – 5.53 (m, 3H), 5.40 (dd, *J* = 15.4, 8.9 Hz, 1H), 4.99 (td, *J* = 8.3, 3.5 Hz, 1H), 4.82 (dd, *J* = 10.3, 1.9 Hz, 1H), 4.77 (dd, *J* = 8.3, 2.5 Hz, 1H), 4.62 – 4.52 (m, 1H), 3.84 (d, *J* = 17.4 Hz, 1H), 3.80 – 3.70 (m, 2H), 3.77 (d, *J* = 17.4 Hz, 1H), 3.29 (dd, *J* = 18.4, 3.4 Hz, 1H), 2.79 – 2.67 (m, 2H), 2.08 – 1.99 (m, 1H), 1.99 – 1.86 (m, 3H), 1.72 (d, *J* = 1.2 Hz, 3H), 1.60 – 1.45 (m, 1H), 1.26 (d, *J* = 6.8 Hz, 3H), 1.05 (d, *J* = 6.7 Hz, 3H), 0.95 (d, *J* = 6.5 Hz, 3H), 0.94 (d, *J* = 6.8 Hz, 3H).

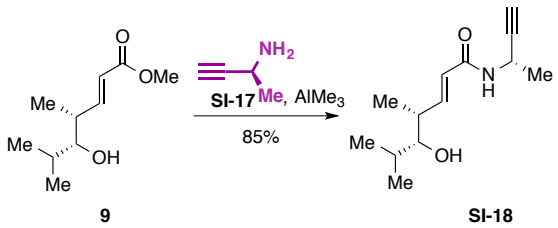
^{13}C NMR (100 MHz, $CDCl_3$) δ 203.4, 169.6, 164.1, 159.9, 157.4, 147.9, 143.8, 137.2, 135.5, 133.7, 133.3, 130.0, 122.3, 80.6, 64.4, 59.1, 49.1, 48.4, 47.7, 42.6, 36.9, 29.3, 28.3, 24.6, 21.0, 19.7, 18.5, 12.6, 9.2.

HRMS-ESI m/z calcd for $C_{29}H_{39}N_3NaO_7^+$ $[M + Na]^+$ 564.2680, found 564.2678.

Scheme IV Synthesis of 23



Amide SI-18



A 100-mL round-bottom flask was charged with (*S*)-but-3-yn-2-amine[12] (**SI-17**, 1.04 g, 15.0 mmol, 4.0 equiv) and dry DCM (25 mL) under nitrogen. The resulting colorless solution was cooled to 0 ºC by means of an ice/water bath. A solution of $AlMe_3$ in heptane (2 M, 7.5 mL, 15.0 mmol, 4.0 equiv) was added dropwise over 30 min (CAUTION: Gas evolution!). The mixture was allowed to warm to 23 ºC. After 30 min, a solution of **9** (3.20 g, 17.2 mmol, 1 equiv) in DCM (10 mL) was added over 10 min (CAUTION: Gas evolution!). The vessel was equipped with a reflux condenser, and the solution was brought to reflux by means of a 50 ºC oil bath. After 12 h, the mixture was cooled to 0 °C by means of an ice/water bath, and MeOH (10 mL) was added (CAUTION: Gas evolution!). Once gas evolution ceased, saturated aqueous potassium sodium tartrate solution (50 mL) was added. After 1 h, the biphasic mixture was transferred to a separatory funnel, and the layers were separated. The aqueous layer was extracted with DCM (2 × 30 mL). The combined organic layers were washed with water (60 mL) and brine (60 mL), and the washed solution was dried (Na_2SO_4). The dried solution was filtered, and the filtrate was concentrated. The resulting crude residue was purified by flash chromatography (silica gel, eluent: EtOAc:hexanes = 1:1) to afford amide **SI-18** (0.71 g, 85% yield) as a white solid.

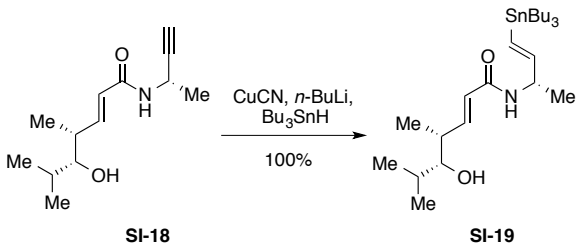
TLC (EtOAc:hexanes = 1:1) : R_f = 0.25 (UV).

^{1}H NMR (400 MHz, $CDCl_3$) δ 6.81 (dd, *J* = 15.4, 7.8 Hz, 1H), 6.06 (d, *J* = 8.1 Hz, 1H), 5.80 (dd, *J* = 15.4, 0.8 Hz, 1H), 4.94 – 4.80 (m, 1H), 3.23 (t, *J* = 5.8 Hz, 1H), 2.52 – 2.42 (m, 1H), 2.26 (d, *J* = 2.3 Hz, 1H), 1.97 (s, 1H), 1.71 (dq, *J* = 13.2, 6.6 Hz, 1H), 1.42 (d, *J* = 6.9 Hz, 3H), 1.06 (d, *J* = 6.8 Hz, 3H), 0.90 (d, *J* = 6.6 Hz, 3H), 0.89 (d, *J* = 6.8 Hz, 3H).

^{13}C NMR (100 MHz, $CDCl_3$) δ 164.8, 148.3, 122.8, 84.1, 79.1, 70.4, 39.5, 36.8, 30.8, 22.2, 19.7, 16.9, 13.7.

HRMS-ESI m/z calcd for $C_{13}H_{22}NO_2^+$ $[M + H]^+$ 224.1645, found 224.1648.

Vinyl stannane SI-19



SI-18 **SI-19**

A 200-mL round-bottom flask containing CuCN (0.56 g, 6.27 mmol, 2.0 equiv) was evacuated and flushed with nitrogen (this process was repeated a total of 3 times). Dry THF (63 mL) was added, resulting in a white suspension and the vessel and its contents were cooled to -78 ºC by means of a dry ice/acetone bath. A solution of *n*-BuLi in hexanes (2.5 M, 5.27 mL, 13.2 mmol, 4.2 equiv) was added dropwise over 10 min, and the resulting light-yellow solution was stirred for 30 min. Bu_3SnH (3.55 mL, 13.2 mmol, 4.2 equiv) was added dropwise over 5 min. After 30 min, a solution of **SI-18** (0.70 g, 3.13 mmol, 1 equiv) in THF (5 mL) was added dropwise over 15 min. After 1 h, saturated aqueous ammonium chloride solution (50 mL) was added in one portion. The vessel was removed from the cooling bath and the system was allowed to warm to 23 ºC while the mixture was rapidly stirred. The biphasic mixture was transferred to a separatory funnel and the layers were separated. The aqueous layer was extracted with EtOAc (2 × 100 mL). The combined organic layers were washed with water (2 × 100 mL) and brine (100 mL). The washed solution was dried (Na_2SO_4). The dried solution was filtered, and the filtrate was concentrated. The resulting crude residue was purified by flash chromatography (silica gel, eluent: EtOAc:hexanes = 0:1 to 1:3) to afford vinyl stannane **SI-19** (1.61 g, 100% yield, ≥20:1 E:Z) as a colorless oil.

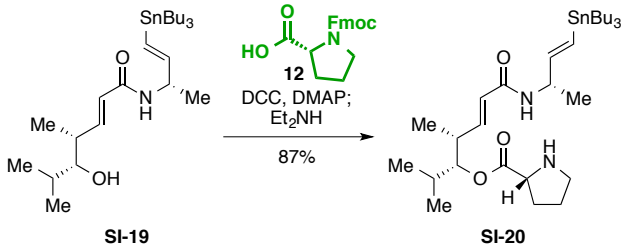
TLC (EtOAc:hexanes = 1:3): R_f = 0.25 (UV).

^{1}H NMR (400 MHz, $CDCl_3$) δ 6.81 (dd, *J* = 15.3, 7.8 Hz, 1H), 6.07 (dd, *J* = 19.1, 1.5 Hz, 1H), 5.96 (dd, *J* = 19.1, 4.1 Hz, 1H), 5.81 (dd, *J* = 15.3, 1.2 Hz, 1H), 5.43 (d, *J* = 8.6 Hz, 1H), 4.70 – 4.55 (m, 1H), 3.26 (q, *J* = 5.6 Hz, 1H), 2.49 (dddd, *J* = 8.0, 7.0, 5.8, 1.3 Hz, 1H), 1.74 (dq, *J* = 13.3, 6.6 Hz, 1H), 1.64 (d, *J* = 5.1 Hz, 1H), 1.52 – 1.42 (m, 6H), 1.34 – 1.26 (m, 6H), 1.24 (d, *J* = 6.8 Hz, 3H), 1.08 (d, *J* = 6.6 Hz, 3H), 0.92 (d, *J* = 2.0 Hz, 3H), 0.91 (d, *J* = 2.1 Hz, 3H), 0.88 (t, *J* = 7.4 Hz, 15H).

^{13}C NMR (100 MHz, $CDCl_3$) δ 164.8, 148.6, 147.2, 127.1, 123.5, 79.2, 48.8, 39.5, 30.8, 29.0, 27.2, 20.4, 19.7, 16.8, 13.8, 13.7, 9.4.

HRMS-ESI m/z calcd for $C_{25}H_{50}NO_2Sn^+$ $[M + H]^+$ 516.2858, found 516.2863.

Amine SI-20



SI-19 **SI-20**

A 100-mL round-bottom flask was charged with **12** (0.73 g, 2.15 mmol, 1.35 equiv), DMAP (39 mg, 0.32 mmol, 0.2 equiv) and **SI-19** (0.82 g, 1.59 mmol, 1 equiv). DCM (16 mL) was added, resulting in a colorless solution. DCC (0.49 g,

2.39 mmol, 1.5 equiv) was added in one portion. resulting in a white suspension. After 5 h, the alcohol **SI-19** was entirely consumed as indicated by TLC analysis (eluent: EtOAc:hexanes = 1:2), and diethyl amine (8 mL) was added. After 3 h, the mixture was filtered through a pad of celite, and the filter cake was washed with DCM (2 × 20 mL). The combined filtrates were concentrated, and the resulting crude residue was purified by flash chromatography (silica gel, eluent: NH_4OH:MeOH:DCM = 0.2:1:100 to 0.2:1:50) to afford amine **SI-20** (0.85 g, 87% yield) as light-yellow oil.

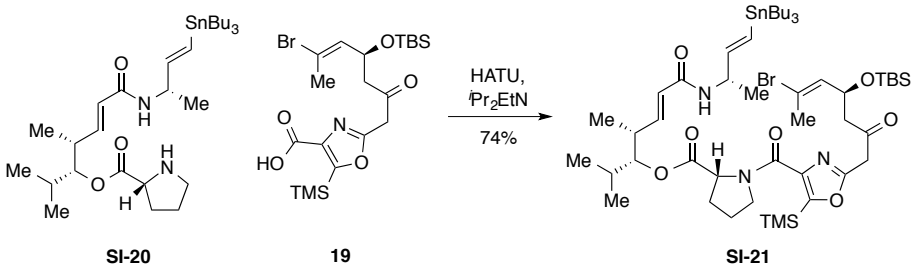
TLC (MeOH:DCM= 1:20): R_f = 0.20 (UV).

^{1}H NMR (400 MHz, $CDCl_3$) δ 6.69 (dd, *J* = 15.4, 7.6 Hz, 1H), 6.06 (dd, *J* = 19.2, 1.5 Hz, 1H), 5.95 (dd, *J* = 19.2, 4.2 Hz, 1H), 5.81 (dd, *J* = 15.5, 1.2 Hz, 1H), 5.53 (d, *J* = 8.6 Hz, 1H), 4.82 (t, *J* = 6.1 Hz, 1H), 4.67 – 4.56 (m, 1H), 4.52 (br s, 1H), 3.93 (dd, *J* = 8.5, 5.6 Hz, 1H), 3.16 (ddd, *J* = 10.6, 7.5, 6.1 Hz, 1H), 3.03 (dt, *J* = 10.5, 6.8 Hz, 1H), 2.66 (q, *J* = 6.4 Hz, 1H), 2.31 – 2.07 (m, 1H), 2.01 – 1.69 (m, 4H), 1.54 – 1.37 (m, 6H), 1.35 – 1.20 (m, 6H), 1.23 (d, *J* = 6.7 Hz, 4H), 1.03 (d, *J* = 6.8 Hz, 3H), 0.95 – 0.75 (m, 22H).

^{13}C NMR (100 MHz, $CDCl_3$) δ 173.6, 164.5, 148.5, 144.9, 127.2, 124.1, 81.1, 59.7, 48.8, 46.6, 38.0, 30.1, 29.7, 29.0, 27.2, 24.9, 20.4, 19.5, 16.9, 14.5, 13.6, 9.4.

HRMS-ESI m/z calcd for $C_{30}H_{57}N_2O_3Sn^+$ $[M + H]^+$ 613.3386, found 613.3380.

Stille coupling precursor SI-21



A 100-mL round-bottom flask was charged with ^{i}Pr$_2$EtN (0.34 mL, 1.96 mmol, 2.0 equiv), amine **SI-20** (0.60 g, 0.98 mmol, 1 equiv) and acid **19** (0.55 g, 1.08 mmol, 1.1 equiv). DCM (10 mL) was added, resulting in a colorless solution. HATU (0.47 g, 1.23 mmol, 1.25 equiv) was added in one portion. After 5 h, the mixture was diluted with DCM (30 mL). The resulting solution was transferred to a separatory funnel and was washed with water (2 × 50 mL) and brine (50 mL). The washed solution was dried (Na_2SO_4). The dried solution was filtered, and the filtrate was concentrated. The resulting crude residue was purified by flash chromatography (silica gel, eluent: EtOAc:hexanes = 1:6 to 1:4) to afford Stille coupling precursor **SI-21** (0.80 g, 74% yield) as a light-yellow oil.

TLC (EtOAc:hexanes = 1:4): R_f = 0.30 (UV).

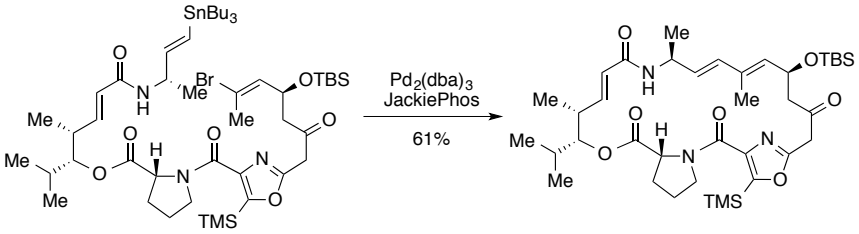
^{1}H NMR (400 MHz, $CDCl_3$, mixtures of rotamers) δ 6.75 – 6.57 (m, 1H), 6.13 – 6.04 (m, 1H), 6.01 – 5.93 (m, 1H), 5.84 – 5.70 (m, 2H), 5.51 – 5.38 (m, 1H), 4.86 – 4.69 (m, 2H), 4.63 (ddd, *J* = 11.6, 8.3, 3.2 Hz, 2H), 4.17 – 3.93 (m, 1H), 3.93 – 3.82 (m, 2H), 3.82 – 3.61 (m, 1H), 2.90 – 2.75 (m, 1H), 2.68 – 2.43 (m, 2H), 2.33 – 2.19 (m, 3H), 2.24 – 2.14 (m, 1H), 2.15 – 1.75 (m, 4H), 1.70 – 1.57 (m, 1H), 1.54 – 1.40 (m, 6H), 1.38 – 1.18 (m, 9H), 1.07 – 0.66 (m, 33H), 0.41 – 0.21 (m, 9H), 0.10 – –0.05 (m, 6H).

^{13}C NMR (100 MHz, $CDCl_3$, mixtures of rotamers) δ 201.1, 200.6, 172.33, 172.31, 164.65, 164.63, 164.41, 163.2, 162.5, 161.52, 161.42, 159.07, 159.03, 148.59, 148.52, 145.37, 145.30, 145.2, 145.0, 134.2, 127.19, 127.11, 124.09, 124.03, 121.79, 121.78, 80.8, 80.3, 67.0, 66.9, 60.5, 59.8, 49.64, 49.62, 48.85, 48.80, 48.74, 47.1, 44.2, 44.0, 38.5, 38.1,

30.0, 29.8, 29.0, 28.9, 27.2, 25.7, 25.6, 20.41, 20.38, 19.7, 19.5, 18.0, 17.5, 16.82, 16.78, 15.1, 14.7, 13.7, 13.6, 9.4, –1.76, –1.77, –4.6, –5.13, –5.14.

HRMS-ESI m/z calcd for $C_{50}H_{89}BrN_3O_7Si_2Sn^+$ $[M + H]^+$ 1098.4439, found 1098.4455.

Stille coupling product SI-22



SI-21 **SI-22**

A 250-mL round-bottom flask containing JackiePhos (0.12 g, 0.15 mmol, 0.2 equiv), Stille coupling precursor **SI-21** (0.80 g, 0.73 mmol, 1 equiv) and $Pd_2(dba)_3$ (67 mg, 0.073 mmol, 0.1 equiv) was evacuated and flushed with nitrogen (this process was repeated a total of 3 times). Toluene (146 mL) was added, resulting in a red suspension. A stream of argon was passed through the solution by a stainless steel needle for 30 min. The vessel and its contents were then heated by means of a 50 ºC oil bath. After 3 h, **SI-21** was entirely consumed as indicated by TLC analysis (eluent: EtOAc:hexanes = 1:2), and the mixture was allowed to cool to 23 ºC. The mixture was concentrated, and the resulting crude residue was purified by flash chromatography (silica gel, eluent: EtOAc:hexanes = 1:2.5 to 1:2) to afford Stille coupling product **SI-22** (0.35 g, 61% yield) as a white solid.

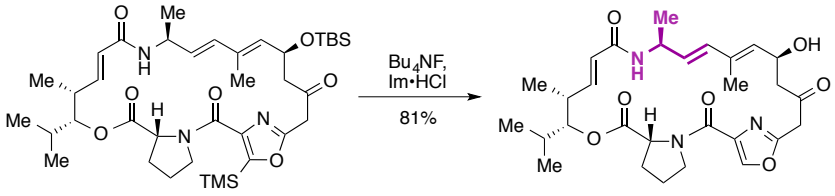
TLC (EtOAc:hexanes = 1:2): R_f = 0.20 (UV).

^{1}H NMR (400 MHz, $CDCl_3$) δ 6.46 (dd, *J* = 16.3, 4.3 Hz, 1H), 6.07 (dd, *J* = 16.1, 1.6 Hz, 1H), 5.83 – 5.73 (m, 2H), 5.68 (dd, *J* = 16.0, 4.4 Hz, 1H), 5.41 (d, *J* = 8.7 Hz, 1H), 5.00 (dt, *J* = 8.7, 6.4 Hz, 1H), 4.82 – 4.69 (m, 3H), 3.86 (d, *J* = 17.0 Hz, 1H), 3.79 – 3.73 (m, 2H), 3.70 (d, *J* = 17.0 Hz, 1H), 2.89 (dd, *J* = 16.2, 6.6 Hz, 1H), 2.78 (dd, *J* = 16.2, 6.2 Hz, 1H), 2.76 – 2.66 (m, 1H), 2.14 – 2.02 (m, 1H), 2.00 – 1.80 (m, 3H), 1.78 – 1.69 (m, 1H), 1.67 (s, 3H), 1.28 (d, *J* = 6.8 Hz, 3H), 1.08 (d, *J* = 6.9 Hz, 3H), 0.97 (d, *J* = 6.5 Hz, 3H), 0.92 (d, *J* = 6.7 Hz, 3H), 0.84 (s, 9H), 0.29 (s, 9H), 0.04 (s, 3H), 0.00 (s, 3H).

^{13}C NMR (100 MHz, $CDCl_3$) δ 201.1, 172.0, 165.6, 161.6, 161.4, 159.7, 145.1, 144.6, 134.5, 132.5, 132.4, 129.6, 123.9, 80.9, 65.4, 58.9, 50.2, 48.4, 44.3, 43.5, 36.5, 29.3, 28.2, 25.7, 24.8, 19.8, 18.8, 18.6, 18.04, 12.8, 10.2, –1.9, –4.5, –5.0.

HRMS-ESI m/z calcd for $C_{38}H_{62}N_3O_7Si_2^+$ $[M + H]^+$ 728.4121, found 728.4127.

Analogue 23



SI-22 **23**

A 100-mL round-bottom flask containing Stille coupling product **SI-22** (0.30 g, 0.41 mmol, 1 equiv) was evacuated and flushed with nitrogen (this process was repeated a total of 3 times). THF (4.1 mL) was added, resulting in a light-yellow

solution. In a separate flask, Im•HCl (0.43 g, 4.1 mmol, 10.0 equiv) that had previously been dried at >100 ºC for 10 minutes under vacuum was added to a solution of tetrabutylammonium fluoride in THF (1 M, 4.1 mL, 4.1 mmol, 10.0 equiv). The resulting colorless solution was added dropwise to the solution of **SI-22**. After 12 h, the mixture was concentrated, and the residue was dissolved in DCM (100 mL). The resulting solution was transferred to a separatory funnel and was washed with water (5 × 100 mL) and brine (100 mL). The washed solution was dried (Na_2SO_4). The dried solution was filtered, and the filtrate was concentrated. The resulting crude residue was purified by flash chromatography (silica gel, eluent: MeOH:DCM = 1:40) to afford analogue **23** (0.18 g, 81% yield) as a light-yellow solid.

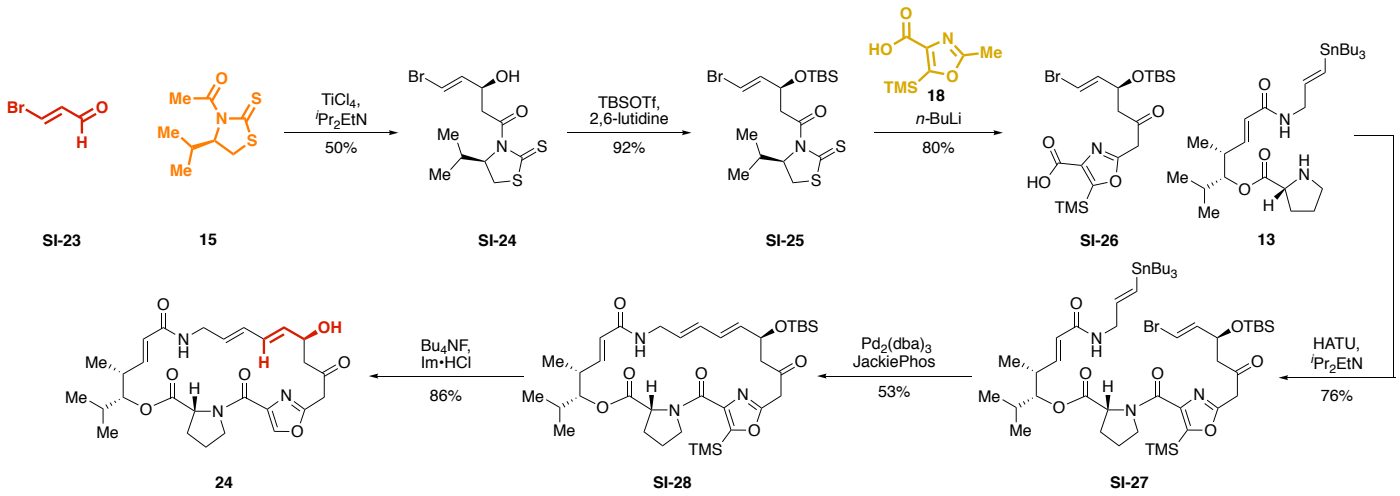
TLC (MeOH:DCM = 1:20): R_f = 0.30 (UV).

^{1}H NMR (400 MHz, $CDCl_3$) δ 8.05 (s, 1H), 6.46 (dd, *J* = 16.3, 5.1 Hz, 1H), 6.20 (d, *J* = 9.0 Hz, 1H), 6.06 (dd, *J* = 16.1, 1.5 Hz, 1H), 5.85 – 5.75 (m, 2H), 5.32 (d, *J* = 8.6 Hz, 1H), 4.89 (dt, *J* = 8.7, 5.8 Hz, 1H), 4.81 – 4.66 (m, 3H), 3.97 (dt, *J* = 10.9, 7.2 Hz, 1H), 3.84 (d, *J* = 15.6 Hz, 1H), 3.84 – 3.74 (m, 1H), 3.78 (d, *J* = 15.5 Hz, 1H), 3.00 (dd, *J* = 16.6, 6.4 Hz, 1H), 2.87 (dd, *J* = 16.6, 5.3 Hz, 1H), 2.77 – 2.67 (m, 1H), 2.21 – 2.11 (m, 1H), 2.02 – 1.78 (m, 4H), 1.71 (s, 3H), 1.27 (d, *J* = 6.8 Hz, 3H), 1.04 (d, *J* = 6.9 Hz, 3H), 0.96 (d, *J* = 6.5 Hz, 3H), 0.93 (d, *J* = 6.7 Hz, 3H).

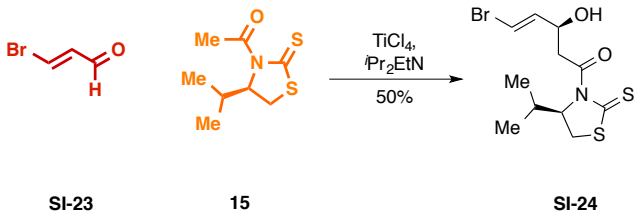
^{13}C NMR (100 MHz, $CDCl_3$) δ 202.1, 171.7, 165.9, 160.2, 156.9, 144.1, 143.9, 137.0, 135.0, 132.4, 131.8, 130.5, 124.4, 81.3, 65.2, 59.7, 48.48, 48.46, 44.3, 43.5, 36.5, 29.5, 28.4, 25.0, 19.7, 19.2, 18.8, 12.9, 10.9.

HRMS-ESI m/z calcd for $C_{29}H_{39}N_3NaO_7^+$ $[M + Na]^+$ 564.2680, found 564.2678.

Scheme V Synthesis of 24



***β*-hydroxyl amide SI-24**



A 250-mL round-bottom flask containing **15** (1.94 g, 9.54 mmol, 1.1 equiv) was evacuated and flushed with nitrogen (this process was repeated a total of 3 times). DCM (50 mL) was added, resulting in a yellow solution, and the vessel and its contents were cooled to -78 ºC by means of a dry ice/acetone bath. A solution of $TiCl_4$ in DCM (1 M, 10.4 mL, 10.4

mmol, 1.2 equiv) was added dropwise, resulting in a deep yellow solution. After 5 min, $^{i}Pr_2EtN$ (1.80 mL, 10.4 mmol, 1.2 equiv) was added over 30 min by means of syringe pump, and the resulting deep red solution was stirred for 2 h at -78 ºC. A solution of aldehyde **SI-23** (1.17 g, 8.67 mmol, 1 equiv) in DCM (10 mL) was added over 30 min by means of syringe pump. After 30 min, water (100 mL) was added. The vessel was removed from the cooling bath, and the system was allowed to warm to 23 ºC while the mixture was rapidly stirred. The biphasic mixture was transferred to a separatory funnel, and the layers were separated. The aqueous layer was extracted with DCM (2 × 30 mL). The combined organic layers were washed with water (2 × 100 mL) and brine (100 mL), and the washed solution was dried (Na_2SO_4). The dried solution was filtered, and the filtrate was concentrated. The resulting crude residue was purified by flash chromatography (silica gel, eluent: EtOAc:hexanes = 1:5 to 1:2) to afford *β*-hydroxyl amide **SI-24** (1.46 g, 50% yield) as a yellow oil.

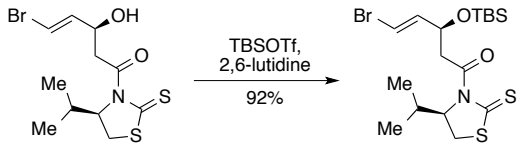
TLC (EtOAc:hexanes = 1:4): R_f = 0.25 (UV, $KMnO_4$).

^{1}H NMR (400 MHz, $CDCl_3$) δ 6.44 (dd, *J* = 13.5, 1.4 Hz, 1H), 6.28 (dd, *J* = 13.6, 5.6 Hz, 1H), 5.15 (ddd, *J* = 7.7, 6.2, 1.1 Hz, 1H), 4.72 – 4.62 (m, 1H), 3.69 (dd, *J* = 17.7, 3.1 Hz, 1H), 3.54 (dd, *J* = 11.5, 7.9 Hz, 1H), 3.29 (dd, *J* = 17.7, 8.6 Hz, 1H), 3.06 (br s, 1H), 3.04 (dd, *J* = 11.4, 1.1 Hz, 1H), 2.45 – 2.25 (m, 1H), 1.06 (d, *J* = 6.8 Hz, 3H), 0.98 (d, *J* = 6.9 Hz, 3H).

^{13}C NMR (100 MHz, $CDCl_3$) δ 203.0, 171.8, 137.7, 108.1, 71.3, 68.5, 44.6, 30.8, 30.7, 19.1, 17.8.

HRMS-ESI m/z calcd for $C_{11}H_{15}BrNOS_2^+$ $[M - OH]^+$ 319.9773, found 319.9777.

TBS ether SI-25



SI-24 **SI-25**

A 250-mL round-bottom flask containing *β*-hydroxyl amide **SI-24** (1.45 g, 4.29 mmol, 1 equiv) was evacuated and flushed with nitrogen (this process was repeated a total of 3 times). DCM (43 mL) was added, followed by 2,6-lutidine (1.0 mL, 8.57 mmol, 2.0 equiv), resulting in a yellow solution. The vessel and its contents were cooled to 0 ºC by means of an ice/water bath. TBSOTf (1.48 mL, 6.43 mmol, 1.2 equiv) was added dropwise over 10 min. After 30 min, the mixture was transferred to a separatory funnel and was washed with water (2 × 100 mL) and brine (100 mL). The washed solution was dried (Na_2SO_4). The dried solution was filtrated, and the filtrate was concentrated. The resulting crude residue was purified by flash chromatography (silica gel, eluent: EtOAc:hexanes = 1:20) to afford TBS ether **SI-25** (1.79 g, 92% yield) as a light-yellow oil.

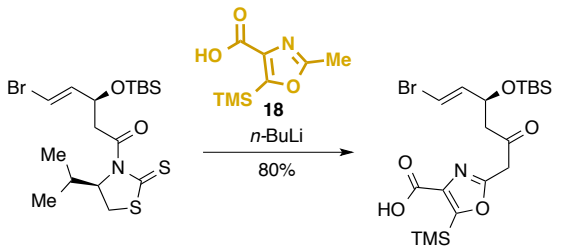
TLC (EtOAc:hexanes = 1:50): R_f = 0.20 (UV, $KMnO_4$).

^{1}H NMR (400 MHz, $CDCl_3$) δ 6.38 – 6.23 (m, 2H), 5.04 (ddd, *J* = 7.7, 6.3, 1.1 Hz, 1H), 4.73 (ddd, *J* = 7.7, 5.9, 4.6 Hz, 1H), 3.61 (dd, *J* = 16.8, 7.8 Hz, 1H), 3.48 (dd, *J* = 11.5, 7.8 Hz, 1H), 3.26 (dd, *J* = 16.8, 4.6 Hz, 1H), 3.03 (dd, *J* = 11.5, 1.1 Hz, 1H), 2.42 – 2.28 (m, 1H), 1.06 (d, *J* = 6.8 Hz, 3H), 0.97 (d, *J* = 6.9 Hz, 3H), 0.86 (s, 9H), 0.05 (s, 6H).

^{13}C NMR (100 MHz, $CDCl_3$) δ 202.8, 170.5, 139.5, 107.1, 71.6, 70.0, 45.8, 30.8, 30.7, 25.7, 19.1, 18.0, 17.8, –4.5, –5.0.

HRMS-ESI m/z calcd for $C_{17}H_{30}BrNNaO_2S_2Si^+$ $[M + Na]^+$ 474.0563, found 474.0569.

Acid SI-26



SI-25 **SI-26**

A 100-mL round-bottom flask containing **18** (0.34 g, 1.68 mmol, 2.0 equiv) was evacuated and flushed with nitrogen (this process was repeated a total of 3 times). THF (17 mL) was added, resulting in a light-yellow solution, and the vessel and its contents were cooled to -78 ºC by means of a dry ice/acetone bath. A solution of *n*-BuLi in hexanes (2.5 M, 1.34 mL, 3.36 mmol, 4.0 equiv) was added dropwise over 15 min, resulting in a deep red solution. After 30 min, a solution of **SI-25** (0.38 g, 0.84 mmol, 1 equiv) in THF (5.0 mL) was added over 30 min by means of syringe pump. After an additional 30 min, water (100 mL) was added, followed by 1 M aqueous $KHSO_4$ solution (5 mL). The system was allowed to warm to 23 ºC while the mixture was rapidly stirred. The biphasic mixture was transferred to a separatory funnel, and the layers were separated. The aqueous layer was extracted with EtOAc (2 × 40 mL). The combined organic layers were washed with water (2 × 70 mL) and brine (70 mL), and the washed solution was dried (Na_2SO_4). The dried solution was filtered, and the filtrate was concentrated. The resulting crude residue was purified by flash chromatography (silica gel, eluent: AcOH:EtOAc:hexanes = 0.5:50:50) to afford carboxylic acid **SI-26** (0.33 g, 80% yield) as a yellow solid.

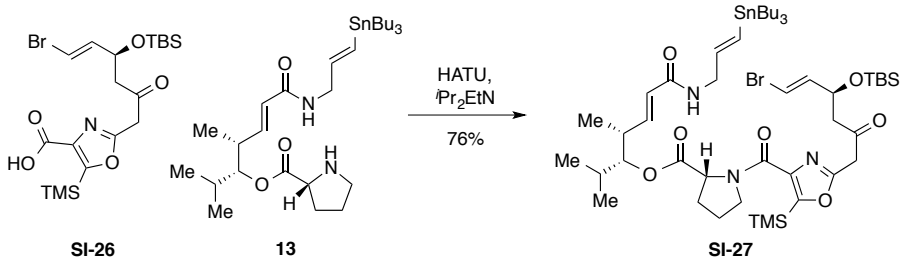
TLC (MeOH:DCM = 1:20): R_f = 0.20 (UV, $KMnO_4$).

^{1}H NMR (400 MHz, $CDCl_3$) δ 9.38 (s, 1H), 6.31 (dd, *J* = 13.5, 1.0 Hz, 1H), 6.19 (dd, *J* = 13.6, 6.3 Hz, 1H), 4.64 (dddd, *J* = 7.5, 6.1, 4.9, 1.1 Hz, 1H), 4.15 (d, *J* = 17.0 Hz, 1H), 4.06 (d, *J* = 17.0 Hz, 1H), 2.84 (dd, *J* = 15.9, 7.6 Hz, 1H), 2.64 (dd, *J* = 15.9, 4.9 Hz, 1H), 0.86 (s, 9H), 0.37 (s, 9H), 0.04 (s, 6H).

^{13}C NMR (100 MHz, $CDCl_3$) δ 200.4, 165.3, 165.2, 161.0, 140.8, 139.1, 107.3, 69.5, 49.9, 43.5, 25.7, 18.0, –2.2, –4.6, –5.1.

HRMS-ESI m/z calcd for $C_{19}H_{32}BrNNaO_5Si_2^+$ $[M + Na]^+$ 512.0895, found 512.0920

Stille coupling precursor SI-27



SI-26 **13** **SI-27**

A 50-mL round-bottom flask was charged with ^{i}Pr$_2$EtN (0.11 mL, 0.64 mmol, 2.0 equiv), amine **13** (0.19 g, 0.32 mmol, 1 equiv) and acid **SI-26** (0.17 g, 0.33 mmol, 1.1 equiv). DCM (6.5 mL) was added, resulting in a colorless solution. HATU (0.15 g, 0.40 mmol, 1.25 equiv) was added in one portion. After 5 h, the mixture was diluted with DCM (30 mL), and the diluted solution was transferred to a separatory funnel and was washed with water (2 × 25 mL) and brine (25 mL). The washed solution was dried (Na_2SO_4). The dried solution was filtered, and the filtrate was concentrated. The

resulting crude residue was purified by flash chromatography (silica gel, eluent: EtOAc:hexanes = 1:3) to afford Stille coupling precursor **SI-27** (0.26 g, 76% yield) as a light-yellow oil.

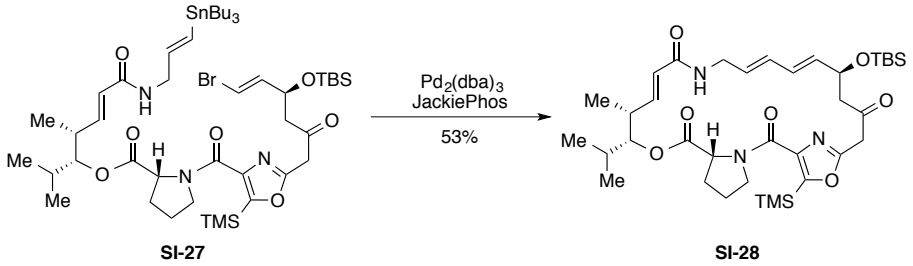
TLC (EtOAc:hexanes = 1:2): R_f = 0.30 (UV, $KMnO_4$).

^{1}H NMR (400 MHz, $CDCl_3$, mixtures of rotamers) δ 6.76 – 6.56 (m, 1H), 6.35 – 6.25 (m, 1H), 6.25 – 6.16 (m, 1H), 6.11 (dq, *J* = 19.0, 1.5 Hz, 1H), 5.96 (dt, *J* = 19.1, 5.1 Hz, 1H), 5.87 – 5.72 (m, 1H), 5.72 – 5.55 (m, 1H), 4.80 (t, *J* = 6.2 Hz, 0.6H), 4.73 (t, *J* = 6.2 Hz, 0.4H), 4.66 – 4.46 (m, 2H), 4.15 – 3.64 (m, 6H), 2.88 – 2.74 (m, 1H), 2.71 – 2.40 (m, 2H), 2.33 – 2.15 (m, 1H), 2.10 – 1.82 (m, 4H), 1.57 – 1.37 (m, 6H), 1.35 – 1.32 (m, 6H), 1.07 – 0.92 (m, 6H), 0.92 – 0.77 (m, 27H), 0.37 – 0.27 (m, 9H), 0.07 – 0.01 (m, 6H).

^{13}C NMR (100 MHz, $CDCl_3$, mixtures of rotamers) δ 201.0, 200.5, 172.34, 172.32, 165.4, 165.1, 163.2, 162.5, 161.5, 161.4, 159.01, 158.97, 145.37, 145.26, 145.22, 145.13, 143.4, 143.3, 139.23, 139.20, 130.4, 130.2, 123.9, 123.8, 107.3, 80.8, 80.4, 69.6, 69.5, 60.5, 59.9, 49.8, 48.8, 47.1, 44.9, 44.9, 44.1, 43.8, 38.4, 38.1, 31.6, 29.9, 29.8, 29.1, 29.0, 28.9, 27.2, 25.73, 25.68, 25.2, 21.5, 19.7, 19.5, 18.0, 17.0, 16.9, 14.9, 14.6, 13.7, 9.4, –1.74, –1.77, –1.79, –4.6, –5.10, –5.13.

HRMS-ESI m/z calcd for $C_{48}H_{85}BrN_3O_7Si_2Sn^+$ $[M + H]^+$ 1070.4126, found 1070.4136.

Stille coupling product SI-28



A 100-mL round-bottom flask containing JackiePhos (15 mg, 19 μmol, 0.2 equiv), Stille coupling precursor **SI-27** (100 mg, 94 μmol, 1 equiv) and $Pd_2(dba)_3$ (9 mg, 9 μmol, 0.1 equiv) was evacuated and flushed with nitrogen (this process was repeated a total of 3 times). Toluene (19 mL) was added, resulting in a red suspension. A stream of argon was passed through the solution by a stainless steel needle for 30 min. The vessel and its contents were then heated by means of a 50 ºC oil bath. After 3 h, **SI-27** was entirely consumed as indicated by TLC analysis (eluent: EtOAc:hexanes = 1:2), and the mixture was allowed to cool to 23 ºC. The mixture was concentrated, and the resulting crude residue was purified by flash cheomatography (silica gel, eluent: EtOAc:hexanes = 1:3 to 1:1.5) to afford Stille coupling product **SI-28** (35 mg, 53% yield) as a white solid.

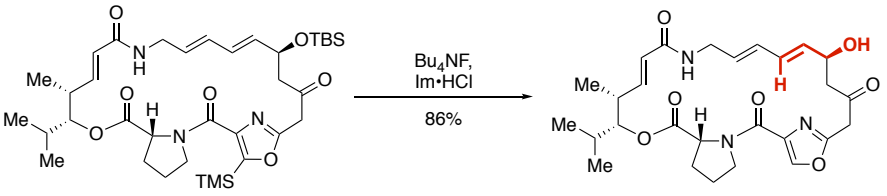
TLC (EtOAc:hexanes = 1:2.5): R_f = 0.30 (UV, *p*-anisaldehyde).

^{1}H NMR (400 MHz, $CDCl_3$) δ 6.45 (dd, *J* = 16.3, 4.6 Hz, 1H), 6.19 – 6.03 (m, 2H), 5.99 (dd, *J* = 7.5, 3.6 Hz, 1H), 5.78 (dd, *J* = 16.3, 1.9 Hz, 1H), 5.72 – 5.56 (m, 2H), 4.84 – 4.70 (m, 3H), 4.26 (dt, *J* = 14.3, 6.5 Hz, 1H), 3.90 (d, *J* = 16.4 Hz, 1H), 3.85 – 3.80 (m, 2H), 3.73 (d, *J* = 16.4 Hz, 1H), 3.56 (ddd, *J* = 15.2, 7.5, 3.5 Hz, 1H), 2.86 (dd, *J* = 16.3, 7.0 Hz, 1H), 2.78 – 2.68 (m, 1H), 2.70 (dd, *J* = 16.3, 5.7 Hz, 1H), 2.20 – 2.06 (m, 1H), 2.03 – 1.77 (m, 4H), 1.08 (d, *J* = 6.8 Hz, 3H), 1.00 (d, *J* = 6.4 Hz, 3H), 0.95 (d, *J* = 6.8 Hz, 3H), 0.87 (s, 9H), 0.30 (s, 9H), 0.07 (s, 3H), 0.04 (s, 3H).

^{13}C NMR (100 MHz, $CDCl_3$) δ 201.0, 172.4, 166.7, 161.7, 161.6, 159.6, 145.2, 144.7, 135.5, 131.9, 129.0, 128.9, 123.8, 81.3, 69.0, 59.1, 50.8, 48.5, 43.3 41.1, 36.7, 29.4, 28.29, 25.8, 25.1, 19.8, 18.6, 18.1, 9.9, –1.8, –4.5, –5.0.

HRMS-ESI m/z calcd for $C_{36}H_{58}N_3O_7Si_2^+$ $[M + H]^+$ 700.3808, found 700.3816.

Analogue 24



SI-28 **24**

A 100-mL round-bottom flask containing **SI-28** (35 mg, 50 µmol, 1 equiv) was evacuated and flushed with nitrogen (this process was repeated a total of 3 times). THF (1.0 mL) was added, resulting in a light-yellow solution. In a separate flask, Im•HCl (52 mg, 0.50 mmol, 10.0 equiv) that had previously been dried at >100 ºC for 10 minutes under vacuum was added to a solution of tetrabutylammonium fluoride in THF (1 M, 0.50 mL, 0.50 mmol, 10.0 equiv). The resulting colorless solution was added dropwise to the solution of **SI-28**. After 12 h, the mixture was concentrated, and the residue was dissolved in DCM (25 mL). The resulting solution was transferred to a separatory funnel and was washed with water (5 × 40 mL) and brine (40 mL). The washed solution was dried (Na_2SO_4). The dried solution was filtered, and the filtrate was concentrated. The resulting crude residue was purified by flash chromatography (silica gel, eluent: MeOH:DCM = 1:40) to afford analogue **24** (22 mg, 86% yield) as a light-yellow solid.

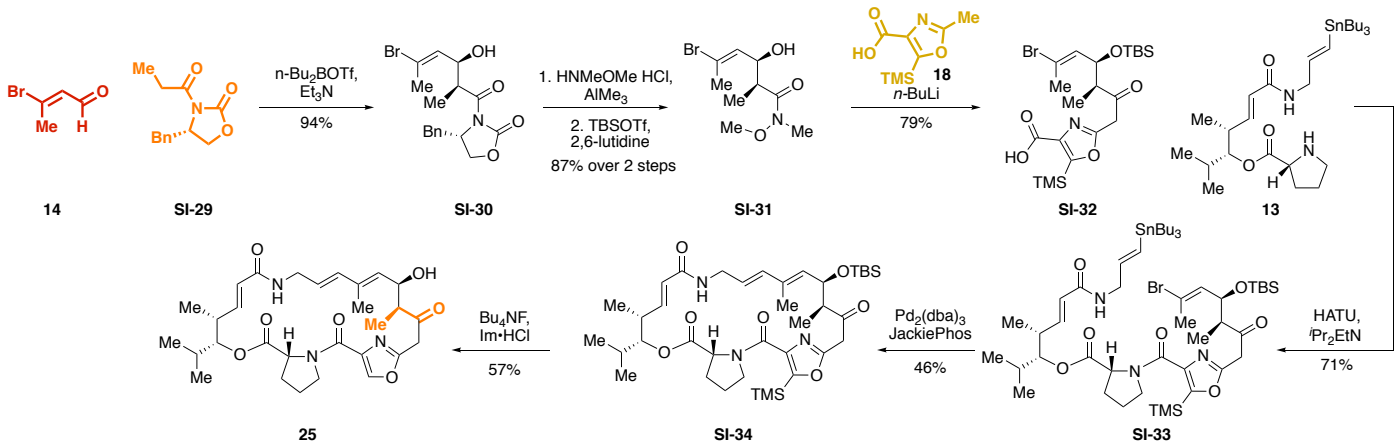
TLC (EtOAc:hexanes = 1:2.5): R_f = 0.30 (UV, *p*-anisaldehyde).

^{1}H NMR (400 MHz, $CDCl_3$) δ 8.14 (s, 1H), 6.48 (dd, *J* = 16.4, 4.8 Hz, 1H), 6.27 – 6.15 (m, 1H), 6.15 – 6.04 (m, 2H), 5.78 (dd, *J* = 16.4, 2.1 Hz, 1H), 5.73 – 5.58 (m, 2H), 4.71 (ddd, *J* = 12.7, 9.3, 2.8 Hz, 2H), 4.60 (q, *J* = 6.3 Hz, 1H), 4.33 (ddd, *J* = 14.4, 8.1, 5.0 Hz, 1H), 4.10 – 3.96 (m, 1H), 3.95 – 3.85 (m, 1H), 3.84 (s, 2H), 3.48 (ddd, *J* = 15.0, 7.9, 3.5 Hz, 1H), 3.01 (dd, *J* = 16.8, 5.4 Hz, 1H), 2.91 (dd, *J* = 16.9, 5.7 Hz, 1H), 2.80 – 2.71 (m, 1H), 2.68 (br s, 1H), 2.23 – 2.10 (m, 1H), 2.01 – 1.79 (m, 4H), 1.05 (d, *J* = 6.7 Hz, 3H), 0.99 (d, *J* = 6.3 Hz, 3H), 0.95 (d, *J* = 6.6 Hz, 3H).

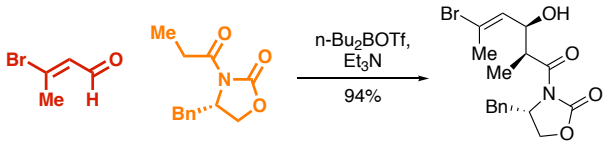
^{13}C NMR (100 MHz, $CDCl_3$) δ 202.4, 171.7, 166.7, 160.1, 157.0, 144.6, 144.1, 137.2, 133.9, 131.6, 130.4, 130.1, 124.1, 81.6, 69.0, 59.6, 48.9, 48.6, 43.1, 40.9, 36.7, 29.4, 28.4, 25.1, 19.7, 18.7, 10.2

HRMS-ESI m/z calcd for $C_{27}H_{34}N_3O_6^+$ $[M - OH]^+$ 496.2442, found 496.2454.

Scheme VI Synthesis of 25



β-hydroxyl Amide SI-30



14 **SI-29** **SI-30**

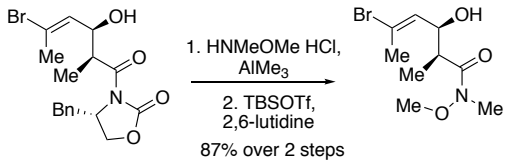
A 250-mL round-bottom flask containing **SI-29** (0.38 g, 1.61 mmol, 1.2 equiv) was evacuated and flushed with nitrogen (this process was repeated a total of 3 times). DCM (8 mL) was added, resulting in a colorless solution, and the vessel and its contents were cooled to 0 ºC by means of an ice/water bath. A solution of *n*-Bu_2BOTf in DCM (1 M, 1.88 mL, 1.88 mmol, 1.2 equiv) was added dropwise, resulting in a pink solution. After 5 min, Et_3N (0.28 mL, 2.01 mmol, 1.5 equiv) was added dropwise over 15 min, and the resulting colorless solution was stirred at 0 ºC for 1 h. Then the flask was cooled to -78 ºC by means of a dry ice/acetone bath, and a solution of aldehyde **14** (0.20 g, 1.34 mmol, 1 equiv) in DCM (2 mL) was added over 30 min by means of syringe pump. After 3 h, the mixture was warmed to 0 ºC by means of an ice/water bath, and pH = 7 phosphate buffer (10 mL), MeOH (20 mL) and 30% H_2O_2 (10 mL) were cautiously added with maintaining the internal temperature between 0-5 ºC. The resulting cloudy mixture was stirred for 1 h and was transferred to a separatory funnel, and the layers were separated. The aqueous layer was extracted with DCM (2 × 30 mL). The combined organic layers were washed with water (2 × 100 mL) and brine (100 mL), and the washed solution was dried (Na_2SO_4). The dried solution was filtered, and the filtrate was concentrated. The resulting crude residue was purified by flash chromatography (silica gel, eluent: EtOAc:hexanes = 1:5 to 1:2) to afford *β*-hydroxyl amide **SI-30** (0.48 g, 94% yield, dr > 20:1) as a yellow oil.

TLC (EtOAc:hexanes = 1:4): R_f = 0.25 (UV, $KMnO_4$).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.30 – 7.17 (m, 3H), 7.15 – 7.08 (m, 2H), 5.90 (dq, *J* = 8.9, 1.3 Hz, 1H), 4.61 (ddt, *J* = 9.4, 7.6, 3.2 Hz, 1H), 4.51 (dd, *J* = 8.9, 5.1 Hz, 1H), 4.17 (dd, *J* = 9.1, 7.6 Hz, 1H), 4.11 (dd, *J* = 9.1, 2.9 Hz, 1H), 3.84 (qd, *J* = 7.0, 5.0 Hz, 1H), 3.16 (dd, *J* = 13.4, 3.4 Hz, 1H), 2.72 (dd, *J* = 13.4, 9.4 Hz, 1H), 2.58 (br s, 1H), 2.24 (d, *J* = 1.4 Hz, 3H), 1.23 (d, *J* = 7.0 Hz, 3H).

^{13}C NMR (100 MHz, $CDCl_3$) δ 175.4, 153.1, 134.9, 131.4, 129.3, 128.9, 127.4, 124.6, 69.9, 66.2, 55.1, 42.8, 37.7, 24.2, 12.1.

Weinreb amide SI-31



SI-30 **SI-31**

A 250-mL round-bottom flask containing HN(OMe)Me•HCl (0.84 g, 8.58 mmol, 4.0 equiv) was evacuated and flushed with nitrogen (this process was repeated a total of 3 times). THF (43 mL) was added, resulting in a white suspension, and the vessel and its contents were cooled to 0 ºC by means of an ice/water bath. A solution of $AlMe_3$ in heptane (2.0 M, 4.18 mL, 8.37 mmol, 3.9 equiv) was added dropwise. The mixture was maintained at 0 °C for 30 min and then at 23 ºC for 90 min. The mixture was cooled to -10 °C by means of an ice/acetone bath, and a solution of *β*-hydroxyl amide **SI-30** (0.82 g, 2.15 mmol, 1 equiv) in THF (10 mL) was added by cannula. The mixture was warmed to 0 °C by means of an ice/water bath. After 90 min, 1.0 M aqueous HCl solution (30 mL) was carefully added, followed by DCM (50 mL) at 0

ºC. After 1 h, the biphasic mixture was transferred to a separatory funnel, and the layers were separated. The aqueous layer was extracted with DCM (2 × 30 mL). The combined organic layers were washed with water (2 × 100 mL) and brine (100 mL), and the washed solution was dried (Na_2SO_4). The dried solution was filtered, and the filtrate was concentrated. The resulting crude residue was used for next step without further purification.

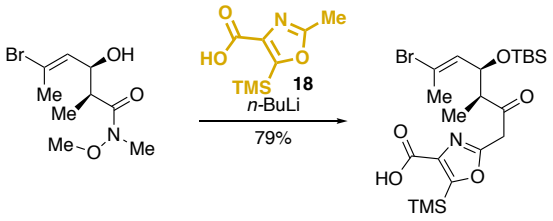
DCM (22 mL) was added to the above residue, and the resulting solution was cooled to 0 ºC by means of an ice/water bath. Then 2,6-lutidine (1.00 mL, 8.58 mmol, 4.0 equiv) was added, followed by TBSOTf (0.99 mL, 4.29 mmol, 2.0 equiv). After 15 min, DCM (50 mL) was added, and the resulting solution was transferred to a separatory funnel and was washed with cold $KHSO_4$ (0.5 M, 20 mL), water (2 × 70 mL) and brine (70 mL). The washed solution was dried (Na_2SO_4), and the dried solution was filtered. The filtrate was concentrated, and the resulting crude residue was purified by flash chromatography (silica gel, eluent: EtOAc:hexanes = 1:40) to afford Weinreb amide **SI-31** (0.71 g, 87% yield) as a yellow oil.

TLC (EtOAc:hexanes = 1:10): R_f = 0.25 (UV, $KMnO_4$).

^{1}H NMR (400 MHz, $CDCl_3$) δ 5.78 (dt, *J* = 9.3, 1.4 Hz, 1H), 4.34 (t, *J* = 9.1 Hz, 1H), 3.66 (s, 3H), 3.13 (s, 3H), 3.01 (br s, 1H), 2.23 (d, *J* = 1.3 Hz, 3H), 1.18 (d, *J* = 6.8 Hz, 3H), 0.87 (s, 9H), 0.05 (s, 3H), 0.03 (s, 3H).

^{13}C NMR (100 MHz, $CDCl_3$) δ 175.0, 134.3, 122.0, 72.1, 61.6, 42.1, 32.0, 25.7, 24.2, 18.1, 14.3, –4.4, –5.0.

Acid SI-32



SI-31 **SI-32**

A 100-mL round-bottom flask containing **18** (0.52 g, 2.63 mmol, 2.0 equiv) was evacuated and flushed with nitrogen (this process was repeated a total of 3 times). THF (26 mL) was added, resulting in a light-yellow solution, and the vessel and its contents were cooled to -78 ºC by means of a dry ice/acetone bath. A solution of *n*-BuLi in hexanes (2.5 M, 2.10 mL, 5.26 mmol, 4.0 equiv) was added dropwise over 15 min, resulting in a deep red solution. After 30 min, a solution of **SI-31** (0.50 g, 1.31 mmol, 1 equiv) in THF (5.0 mL) was added over 30 min by means of syringe pump. After an additional 30 min, water (100 mL) was added, followed by 1 M aqueous $KHSO_4$ solution (7 mL). The system was allowed to warm to 23 ºC while the mixture was rapidly stirred. The biphasic mixture was transferred to a separatory funnel, and the layers were separated. The aqueous layer was extracted with EtOAc (2 × 40 mL). The combined organic layers were washed with water (2 × 70 mL) and brine (70 mL), and the washed solution was dried (Na_2SO_4). The dried solution was filtered, and the filtrate was concentrated. The resulting crude residue was purified by flash chromatography (silica gel, eluent: MeOH:DCM = 1:75) to afford carboxylic acid **SI-32** (0.54 g, 79% yield) as a yellow solid.

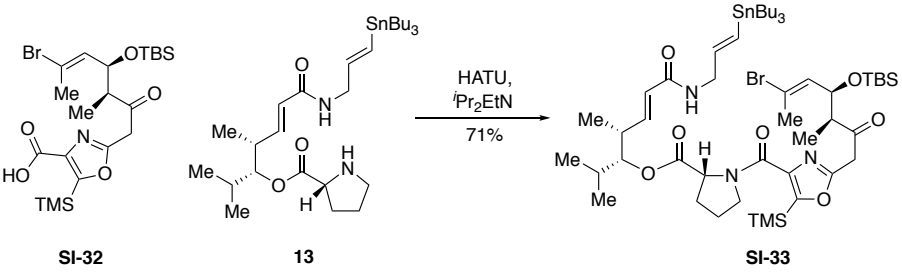
TLC (MeOH:DCM = 1:20): R_f = 0.20 (UV, $KMnO_4$).

^{1}H NMR (400 MHz, $CDCl_3$) δ 5.79 (dd, *J* = 9.4, 1.4 Hz, 1H), 4.44 (dd, *J* = 9.4, 6.8 Hz, 1H), 4.19 (d, *J* = 17.1 Hz, 1H), 4.14 (d, *J* = 17.1 Hz, 1H), 2.88 (p, *J* = 6.9 Hz, 1H), 2.23 (d, *J* = 1.4 Hz, 3H), 1.15 (d, *J* = 6.9 Hz, 3H), 0.88 (s, 10H), 0.38 (s, 9H), 0.06 (s, 3H), 0.04 (s, 3H).

^{13}C NMR (100 MHz, $CDCl_3$) δ 204.8, 165.3, 165.0, 161.3, 140.7, 133.0, 122.5, 71.5, 52.2, 43.0, 25.7, 24.1, 18.1, 12.5, –2.1, –4.4, –5.1.

HRMS-ESI m/z calcd for $C_{21}H_{37}BrNO_5Si_2^+$ $[M + H]^+$ 518.1388, found 518.1392.

Stille coupling precursor SI-33



SI-32 **13** **SI-33**

A 50-mL round-bottom flask was charged with $^{i}Pr_2EtN$ (0.32 mL, 1.84 mmol, 2.0 equiv), amine **13** (0.55 g, 0.92 mmol, 1 equiv) and acid **SI-32** (0.53 g, 1.01 mmol, 1.1 equiv). DCM (9.2 mL) was added, resulting in a colorless solution. HATU (0.44 g, 1.15 mmol, 1.25 equiv) was added in one portion. After 5 h, the mixture was diluted with DCM (50 mL). The resulting solution was transferred to a separatory funnel and was washed with water (2 × 50 mL) and brine (50 mL). The washed solution was dried (Na_2SO_4). The dried solution was filtered, and the filtrate was concentrated. The resulting crude residue was purified by flash chromatography (silica gel, eluent: EtOAc:hexanes = 1:3) to afford Stille coupling precursor **SI-33** (0.72 g, 71% yield) as a light-yellow oil.

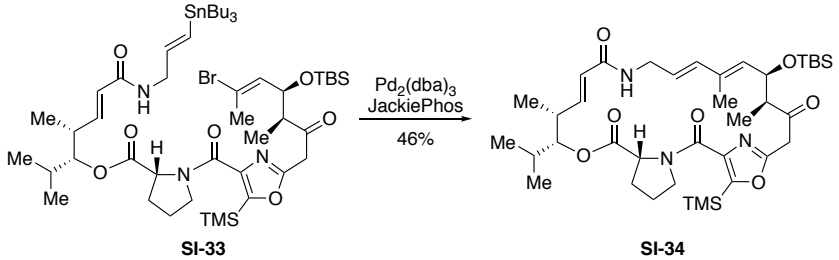
TLC (EtOAc:hexanes = 1:2): R_f = 0.30 (UV, $KMnO_4$).

^{1}H NMR (400 MHz, $CDCl_3$, mixtures of rotamers) δ 6.75 – 6.55 (m, 1H), 6.16 – 6.05 (m, 1H), 5.95 (dt, *J* = 19.1, 5.1 Hz, 1H), 5.87 – 5.73 (m, 2H), 5.73 – 5.58 (m, 1H), 4.84 – 4.59 (m, 2H), 4.54 – 4.34 (m, 1H), 4.13 – 3.83 (m, 5H), 3.83 – 3.61 (m, 1H), 2.84 (dp, *J* = 27.1, 6.9 Hz, 1H), 2.71 – 2.44 (m, 1H), 2.43 – 2.11 (m, 4H), 2.13 – 1.82 (m, 3H), 1.60 – 1.35 (m, 6H), 1.35 – 1.23 (m, 6H), 1.23 – 0.98 (m, 6H), 0.99 – 0.75 (m, 30H), 0.39 – 0.23 (m, 9H), 0.09 – –0.04 (m, 6H).

^{13}C NMR (100 MHz, $CDCl_3$, mixtures of rotamers) δ 205.3, 205.0, 172.37, 172.33, 165.43, 165.39, 165.1, 163.1, 162.4, 161.6, 161.5, 159.31, 159.29, 145.35, 145.30, 145.25, 145.15, 143.44, 143.42, 143.32, 132.92, 132.91, 130.4, 130.1, 123.9, 123.9, 122.56, 122.50, 80.7, 80.4, 71.61, 71.57, 60.4, 59.93, 59.89, 51.94, 51.89, 48.8, 47.0, 46.2, 44.89, 44.86, 43.52, 43.49, 38.4, 38.09, 38.05, 31.6, 29.93, 29.81, 29.0, 27.2, 25.70, 25.68, 24.05, 19.7, 19.5, 18.10, 18.04, 16.95, 16.92, 15.0, 14.6, 13.7, 12.6, 9.4, –1.76, –1.78, –4.4, –4.5, –5.11, –5.16.

HRMS-ESI m/z calcd for $C_{50}H_{89}BrN_3O_7Si_2Sn^+$ $[M + H]^+$ 1098.4439, found 1098.4455.

Stille coupling product SI-34



SI-33 **SI-34**

A 250-mL round-bottom flask containing JackiePhos (97 mg, 0.12 mmol, 0.2 equiv), Stille coupling precursor **SI-33** (0.67 g, 0.61 mmol, 1 equiv) and $Pd_2(dba)_3$ (56 mg, 61 μmol, 0.1 equiv) was evacuated and flushed with nitrogen (this

process was repeated a total of 3 times). Toluene (122 mL) was added, resulting in a red suspension. A stream of argon was passed through the solution by a stainless steel needle for 30 min. The mixture was heated by means of a 50 ºC oil bath. After 12 h, **SI-33** was entirely consumed as indicated by TLC analysis (eluent: EtOAc:hexanes = 1:2), and the mixture was allowed to cool to 23 ºC. The mixture was concentrated, and the resulting crude residue was purified by flash chromatography (silica gel, eluent: EtOAc:hexanes = 1:3 to 1:1.5) to afford Stille coupling product **SI-34** (0.21 g, 46% yield) as a white solid.

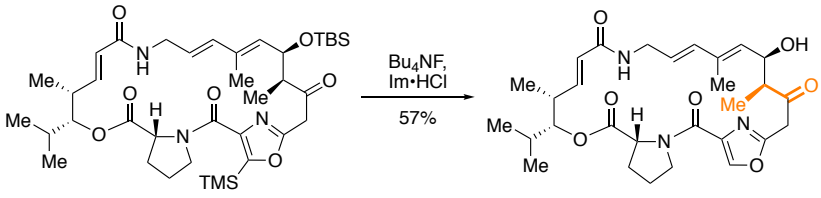
TLC (EtOAc:hexanes = 1:2.5): R_f = 0.30 (UV, *p*-anisaldehyde).

^{1}H NMR (400 MHz, $CDCl_3$) δ 6.54 (dd, *J* = 9.5, 2.9 Hz, 1H), 6.49 (dd, *J* = 16.4, 3.8 Hz, 1H), 6.16 (d, *J* = 16.0 Hz, 1H), 5.78 (dd, *J* = 16.4, 2.1 Hz, 1H), 5.52 (ddd, *J* = 15.5, 10.0, 3.8 Hz, 1H), 5.35 (d, *J* = 8.9 Hz, 1H), 4.90 (dd, *J* = 8.9, 4.1 Hz, 1H), 4.82 (dd, *J* = 10.2, 1.8 Hz, 1H), 4.69 – 4.56 (m, 1H), 4.41 (t, *J* = 9.2 Hz, 1H), 3.95 (d, *J* = 18.0 Hz, 1H), 3.87 – 3.77 (m, 1H), 3.82 (d, *J* = 18.0 Hz, 1H), 3.48 (dt, *J* = 11.2, 7.0 Hz, 1H), 3.34 (ddd, *J* = 14.7, 10.0, 2.8 Hz, 1H), 2.83 (dd, *J* = 9.1, 6.8 Hz, 1H), 2.80 – 2.70 (m, 1H), 2.14 (dq, *J* = 12.9, 8.3 Hz, 1H), 1.99 – 1.86 (m, 2H), 1.86 – 1.77 (m, 1H), 1.77 – 1.66 (m, 1H), 1.57 (d, *J* = 1.2 Hz, 3H), 1.22 (d, *J* = 6.7 Hz, 3H), 1.08 (d, *J* = 6.9 Hz, 3H), 0.96 (d, *J* = 6.5 Hz, 3H), 0.93 (d, *J* = 6.7 Hz, 3H), 0.86 (s, 9H), 0.29 (s, 9H), 0.03 (s, 3H), –0.04 (s, 3H).

^{13}C NMR (100 MHz, $CDCl_3$) δ 206.0, 172.1, 166.6, 162.4, 160.0, 159.4, 145.0, 144.6, 136.2, 133.9, 133.1, 126.0, 123.4, 80.9, 70.7, 58.0, 52.8, 48.5, 43.9, 41.6, 36.7, 29.3, 28.2, 25.8, 25.7, 24.7, 19.9, 18.6, 18.1, 14.2, 12.7, 10.3, –1.8, –4.3, –5.0.

HRMS-ESI m/z calcd for $C_{38}H_{62}N_3O_7Si_2^+$ $[M + H]^+$ 728.4121, found 728.4127.

Analogue 25



SI-34 **25**

A 100-mL round-bottom flask containing Stille coupling product **SI-34** (0.19 g, 0.26 mmol, 1 equiv) was evacuated and flushed with nitrogen (this process was repeated a total of 3 times). THF (5.2 mL) was added, resulting in a light-yellow solution. In a separate flask, Im•HCl (0.55 g, 5.22 mmol, 20.0 equiv) that had previously been dried at >100 ºC for 10 minutes under vacuum was added to a solution of tetrabutylammonium fluoride in THF (1 M, 5.2 mL, 5.22 mmol, 20.0 equiv). The resulting colorless solution was added dropwise to the solution of **SI-34**. After 24 h, the mixture was concentrated, and the residue was dissolved in DCM (50 mL). The resulting solution was transferred to a separatory funnel and was washed with water (5 × 40 mL) and brine (40 mL). The washed solution was dried (Na_2SO_4). The dried solution was filtered, and the filtrate was concentrated. The resulting crude residue was purified by flash chromatography (silica gel, eluent: MeOH:DCM = 1:40) to afford analogue **25** (80 mg, 57% yield) as a light-yellow solid.

TLC (MeOH:DCM = 1:20): R_f = 0.25 (UV, *p*-anisaldehyde).

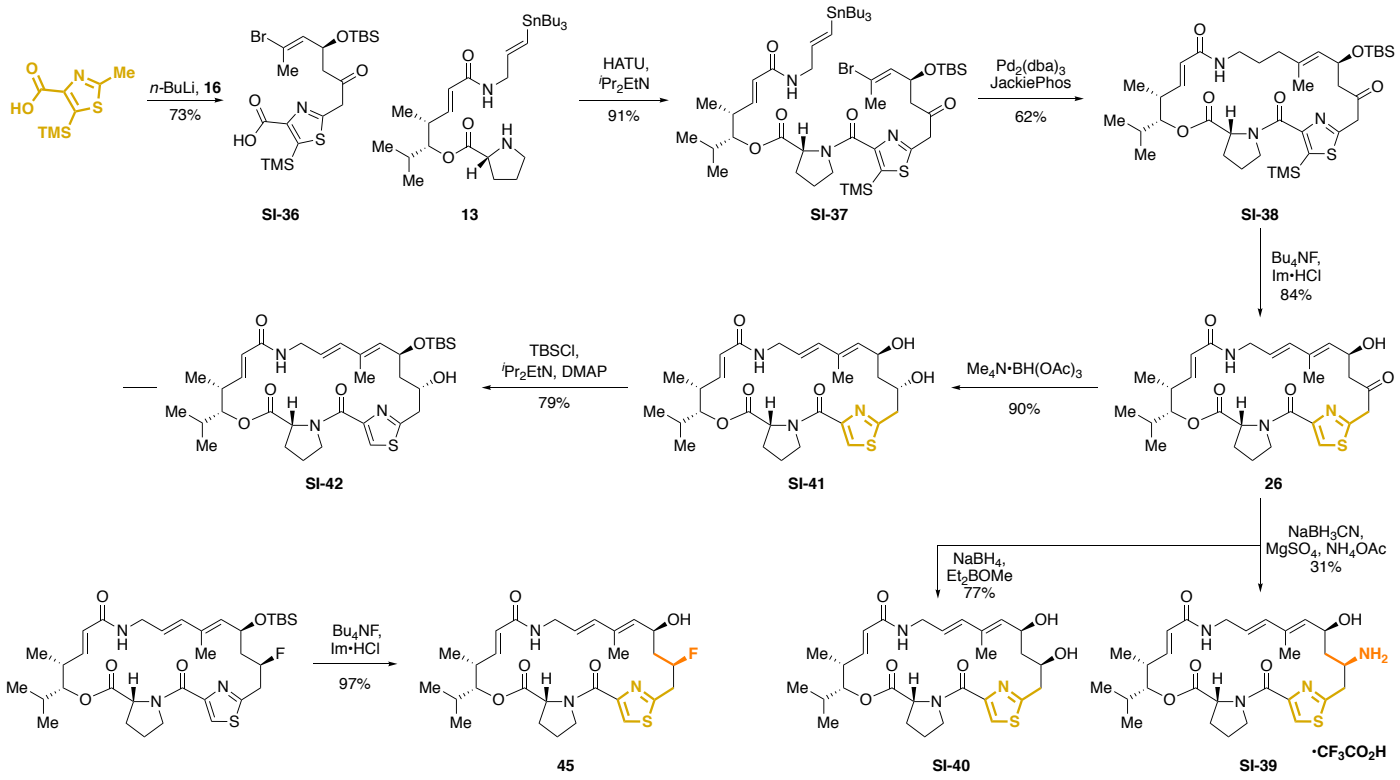
^{1}H NMR (400 MHz, $CDCl_3$) δ 7.94 (s, 1H), 6.85 (d, *J* = 8.6 Hz, 1H), 6.47 (dd, *J* = 16.4, 5.4 Hz, 1H), 6.09 (d, *J* = 15.7 Hz, 1H), 5.82 (dd, *J* = 16.4, 1.7 Hz, 1H), 5.69 (ddd, *J* = 15.6, 8.5, 4.7 Hz, 1H), 5.16 (d, *J* = 9.2 Hz, 1H), 4.74 (ddd, *J* = 11.3, 9.5, 2.9 Hz, 2H), 4.56 (t, *J* = 8.7 Hz, 1H), 4.48 (td, *J* = 9.0, 8.4, 4.0 Hz, 1H), 3.99 (d, *J* = 15.7 Hz, 1H), 3.92 (dt, *J* = 11.0, 7.0 Hz, 1H), 3.83 – 3.73 (m, 1H), 3.75 (d, *J* = 15.7 Hz, 1H), 3.41 (ddd, *J* = 15.1, 8.6, 3.3 Hz, 1H), 2.97 – 2.80 (m, 1H),

2.73 (dtd, J = 8.9, 7.0, 5.1 Hz, 1H), 2.30 – 2.06 (m, 2H), 2.04 – 1.81 (m, 4H), 1.70 (d, J = 1.2 Hz, 3H), 1.24 (d, J = 6.9 Hz, 3H), 1.01 (d, J = 6.9 Hz, 3H), 0.94 (d, J = 6.7 Hz, 6H).

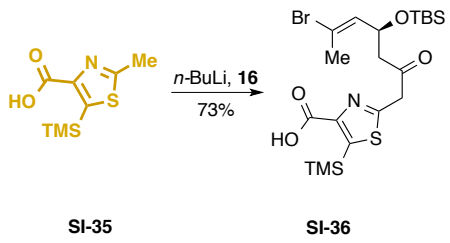
^{13}C NMR (100 MHz, $CDCl_3$) δ 205.0, 171.6, 166.9, 160.8, 156.7, 144.1, 143.4, 136.8, 136.8, 136.2, 131.1, 125.9, 124.4, 81.4, 69.2, 59.7, 51.7, 48.5, 42.8, 40.8, 36.6, 29.5, 28.4, 25.0, 19.6, 18.9, 13.4, 12.8, 11.1.

HRMS-ESI m/z calcd for $C_{29}H_{39}N_3NaO_7^+$ $[M + Na]^+$ 564.2680, found 564.2678.

Scheme VII Synthesis of 26 and derivatives thereof



Acid SI-36



Synthesis of SI-35: A 250-mL round-bottom flask containing 5-methylthiazole-3-carboxylic acid (3.80 g, 26.5 mmol, 1 equiv) was evacuated and flushed with nitrogen (this process was repeated a total of 3 times). THF (135 mL) was added, resulting in a light-yellow solution, and the vessel and its contents were cooled to -78 ºC by means of a dry ice/acetone bath. A solution of *n*-butyllithium in hexanes (2.5 M, 31.9 mL, 79.6 mmol, 3.0 equiv) was added dropwise over 15 min, resulting in a deep red solution. After 30 min, chlorotrimethylsilane (17.0 mL, 133.0 mmol, 5.0 equiv) was added over 30 min by syringe pump. After 1 h, water (100 mL) was added, and the system was allowed to warm to 23 ºC while the mixture was rapidly stirred. The biphasic mixture was transferred to a separatory funnel, and the layers were separated. The aqueous layer was extracted with EtOAc (2 × 50 mL). The combined organic layers were washed with water (2 × 100 mL) and brine (100 mL), and the washed solution was dried (Na_2SO_4). The dried solution was filtered, and the

filtrate was concentrated. The resulting crude residue was purified by flash chromatography (silica gel, eluent: MeOH:DCM = 1:100 to 1:50) to afford acid **SI-35** (5.02 g, 88% yield) as a yellow solid.

TLC (MeOH:DCM = 1:20): R_f = 0.30 (UV, $KMnO_4$).

^{1}H NMR (400 MHz, $CDCl_3$) δ 9.32 (s, 1H), 2.74 (s, 3H), 0.38 (s, 9H).

^{13}C NMR (100 MHz, $CDCl_3$) δ 169.5, 164.5, 149.7, 145.6, 18.6, -0.5.

Synthesis of SI-36: A 100-mL round-bottom flask containing **SI-35** (0.46 g, 2.15 mmol, 2.0 equiv) was evacuated and flushed with nitrogen (this process was repeated a total of 3 times). THF (20 mL) was added, resulting in a light-yellow solution, and the vessel and its contents were cooled to -78 ºC by means of a dry ice/acetone bath. A solution of *n*-BuLi in hexanes (1.6 M, 2.70 mL, 4.30 mmol, 4.0 equiv) was added dropwise over 15 min, resulting in a deep red solution. After 30 min, a solution of **16** (0.50 g, 1.10 mmol, 1 equiv) in THF (5 mL) was added over 30 min by means of syringe pump. After an additional 30 min, water (30 mL) was added, followed by 1 M aqueous $KHSO_4$ solution (6 mL). The system was allowed to warm to 23 ºC while the mixture was rapidly stirred. The biphasic mixture was transferred to a separatory funnel, and the layers were separated. The aqueous layer was extracted with EtOAc (2 × 30 mL). The combined organic layers were washed with water (2 × 50 mL) and brine (50 mL), and the washed solution was dried (Na_2SO_4). The dried solution was filtered, and the filtrate was concentrated. The resulting crude residue was purified by flash chromatography (silica gel, eluent: AcOH:EtOAc:hexanes = 0.5:50:50) to afford carboxylic acid **SI-36** (0.41 g, 73% yield) as a yellow solid.

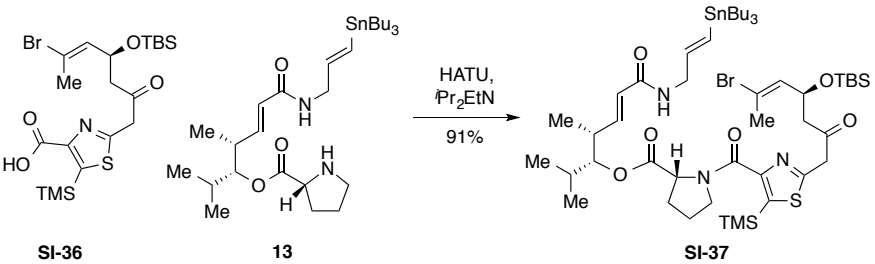
TLC (MeOH:DCM = 1:25): R_f = 0.30 (UV, $KMnO_4$).

^{1}H NMR (400 MHz, $CDCl_3$) δ 9.56 (br s, 1H), 5.82 (dd, *J* = 9.1, 1.4 Hz, 1H), 4.82 (ddd, *J* = 9.1, 8.0, 4.8 Hz, 1H), 4.36 (d, *J* = 18.2 Hz, 1H), 4.27 (d, *J* = 18.2 Hz, 1H), 2.89 (dd, *J* = 15.6, 8.0 Hz, 1H), 2.60 (dd, *J* = 15.6, 4.8 Hz, 1H), 2.28 (d, *J* = 1.3 Hz, 3H), 0.83 (s, 9H), 0.40 (s, 9H), 0.04 (s, 3H), 0.03 (s, 3H).

^{13}C NMR (100 MHz, $CDCl_3$) δ 202.2, 165.0, 164.3, 149.6, 146.8, 134.2, 121.8, 66.9, 50.1, 47.4, 25.7, 24.0, 18.0, –0.5, –4.5, –5.1.

HRMS-ESI m/z calcd for $C_{20}H_{33}BrNO_4SSi_2^-$ $[M - H]^-$ 518.0858, found 518.0868.

Stille coupling precursor SI-37



SI-36 **13** **SI-37**

A 50-mL round-bottom flask was charged with ^{i}Pr$_2$EtN (0.51 mL, 2.85 mmol, 2.0 equiv), amine **13** (0.85 g, 1.42 mmol, 1 equiv) and acid **SI-36** (0.82 g, 1.56 mmol, 1.1 equiv). DCM (14 mL) was added, resulting in a colorless solution. HATU (0.68 g, 1.78 mmol, 1.25 equiv) was added in one portion. After 5 h, the mixture was diluted with DCM (50 mL). The resulting solution was transferred to a separatory funnel and was washed with water (2 × 50 mL) and brine (50 mL). The washed solution was dried (Na_2SO_4). The dried solution was filtered, and the filtrate was concentrated. The resulting crude residue was purified by flash chromatography (silica gel, eluent: EtOAc:hexanes = 1:5) to afford Stille coupling precursor **SI-37** (1.42 g, 91% yield) as a light-yellow oil.

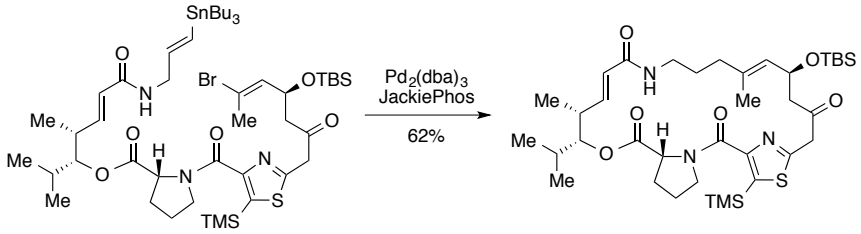
TLC (EtOAc:hexanes = 1:5): R_f = 0.20 (UV, $KMnO_4$).

^{1}H NMR (400 MHz, $CDCl_3$, mixtures of rotamers) δ 6.74 – 6.55 (m, 1H), 6.10 (dt, *J* = 19.0, 1.5 Hz, 1H), 5.95 (dtd, *J* = 19.0, 5.0, 2.1 Hz, 1H), 5.89 – 5.77 (m, 2H), 5.77 – 5.59 (m, 1H), 4.87 – 4.75 (m, 2H), 4.75 – 4.58 (m, 1H), 4.21 – 3.62 (m, 6H), 2.87 (ddd, *J* = 15.5, 8.0, 2.3 Hz, 1H), 2.73 – 2.40 (m, 2H), 2.41 – 2.14 (m, 5H), 2.12 – 1.87 (m, 3H), 1.60 – 1.35 (m, 6H), 1.35 – 1.22 (m, 6H), 1.09 – 0.92 (m, 6H), 0.92 – 0.70 (m, 27H), 0.40 – 0.28 (m, 9H), 0.08 – –0.02 (m, 6H).

^{13}C NMR (100 MHz, $CDCl_3$, mixtures of rotamers) δ 202.4, 202.2, 172.5, 172.1, 172.0, 165.42, 165.37, 165.0, 163.1, 163.0, 162.9, 162.8, 161.7, 155.0, 154.3, 145.4, 145.2, 145.0, 143.4, 143.3, 142.7, 141.0, 135.2, 134.3, 134.3, 130.3, 130.2, 130.1, 124.0, 123.9, 121.7, 80.7, 80.4, 67.9, 66.94, 66.86, 61.3, 59.8, 49.9, 49.8, 49.2, 48.03, 47.7, 47.4, 44.8, 38.4, 38.1, 31.7, 29.9, 29.8, 29.7, 29.0, 27.2, 25.7, 25.1, 24.00, 23.98, 23.89, 21.9, 19.7, 19.4, 18.0, 17.0, 16.8, 15.1, 14.5, 13.7, 9.4, 0.2, 0.1, –4.6, –5.1.

HRMS-ESI m/z calcd for $C_{49}H_{87}BrN_3O_6SSi_2Sn^+$ $[M + H]^+$ 1100.4054, found 1100.4078.

Stille coupling product SI-38



SI-37 **SI-38**

A 500-mL round-bottom flask containing JackiePhos (0.21 g, 0.26 mmol, 0.2 equiv), Stille coupling precursor **SI-37** (1.42 g, 1.29 mmol, 1 equiv) and $Pd_2(dba)_3$ (0.12 g, 1.13 mmol, 0.1 equiv) was evacuated and flushed with nitrogen (this process was repeated a total of 3 times). Toluene (258 mL) was added, resulting in a red suspension. A stream of argon was passed through the solution by a stainless steel needle for 30 min. The vessel and its contents were then heated by means of a 50 ºC oil bath. After 3 h, **SI-37** was entirely consumed as indicated by TLC analysis (EtOAc:hexanes = 1:2), and the mixture was allowed to cool to 23 ºC. The mixture was concentrated, and the resulting crude residue was purified by flash chromatography (silica gel, eluent: EtOAc:hexanes = 1:3 to 1:1.5) to afford Stille couping product **SI-38** (0.58 g, 62% yield) as a white solid.

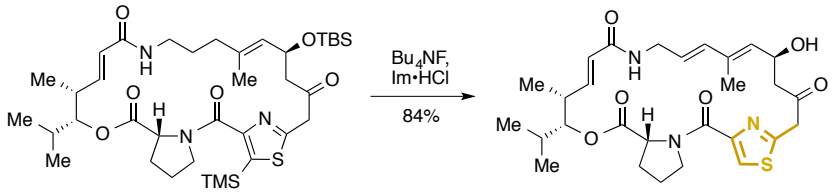
TLC (EtOAc:hexanes = 1:2.5): R_f = 0.30 (UV, *p*-anisaldehyde).

^{1}H NMR (400 MHz, $CDCl_3$) δ 6.49 (dd, *J* = 16.3, 4.1 Hz, 1H), 6.13 (d, *J* = 15.6 Hz, 1H), 6.00 (dd, *J* = 8.8, 2.9 Hz, 1H), 5.77 (dd, *J* = 16.3, 2.0 Hz, 1H), 5.55 (ddd, *J* = 15.5, 9.5, 4.3 Hz, 1H), 5.39 (d, *J* = 9.0 Hz, 1H), 4.97 (ddd, *J* = 9.0, 7.8, 5.3 Hz, 1H), 4.77 (ddd, *J* = 8.7, 6.6, 2.9 Hz, 2H), 4.48 (ddd, *J* = 13.4, 8.9, 4.1 Hz, 1H), 4.10 (d, *J* = 17.2 Hz, 1H), 3.90 (d, *J* = 17.2 Hz, 1H), 3.68 – 3.50 (m, 2H), 3.39 (ddd, *J* = 14.7, 9.5, 3.3 Hz, 1H), 2.89 (dd, *J* = 16.1, 7.8 Hz, 1H), 2.75 (dd, *J* = 16.0, 5.3 Hz, 1H), 2.79 – 2.69 (m, 1H), 2.19 – 2.05 (m, 2H), 1.99 – 1.89 (m, 1H), 1.89 – 1.68 (m, 2H), 1.64 (d, *J* = 1.2 Hz, 3H), 1.08 (d, *J* = 6.9 Hz, 3H), 1.00 (d, *J* = 6.4 Hz, 3H), 0.94 (d, *J* = 6.8 Hz, 3H), 0.84 (s, 9H), 0.31 (s, 9H), 0.03 (s, 3H), 0.00 (s, 3H).

^{13}C NMR (100 MHz, $CDCl_3$) δ 202.2, 172.2, 166.4, 163.3, 163.2, 155.4, 144.8, 140.1, 137.0, 134.7, 132.5, 124.7, 123.7, 80.9, 65.3, 58.8, 50.8, 48.8, 47.4, 41.3, 36.6, 29.3, 28.6, 25.7, 25.0, 19.9, 18.6, 18.0, 12.7, 9.7, 0.0, –4.5, –5.0.

HRMS-ESI m/z calcd for $C_{37}H_{60}N_3O_6SSi_2^+$ $[M + H]^+$ 730.3736, found 730.3758.

Analogue 26



SI-38 **26**

A 100-mL round-bottom flask containing **SI-38** (0.30 g, 0.41 mmol, 1 equiv) was evacuated and flushed with nitrogen (this process was repeated a total of 3 times). THF (4.1 mL) was added, resulting in a light-yellow solution. In a separate flask, Im•HCl (0.43 g, 4.11 mmol, 10.0 equiv) that had previously been dried at >100 ºC for 10 minutes under vacuum was added to a solution of tetrabutylammonium fluoride in THF (1 M, 4.11 mL, 4.11 mmol, 10.0 equiv). The resulting colorless solution was added dropwise to the solution of **SI-38**. After 12 h, the mixture was concentrated, and the residue was dissolved in DCM (50 mL). The resulting solution was transferred to a separatory funnel and was washed with water (5 × 50 mL) and brine (50 mL). The washed solution was dried (Na_2SO_4). The dried solution was filtered, and the filtrate was concentrated. The resulting crude residue was purified by flash chromatography (silica gel, eluent: MeOH:DCM = 1:40) to afford analogue **26** (0.19 g, 84% yield) as a light-yellow solid.

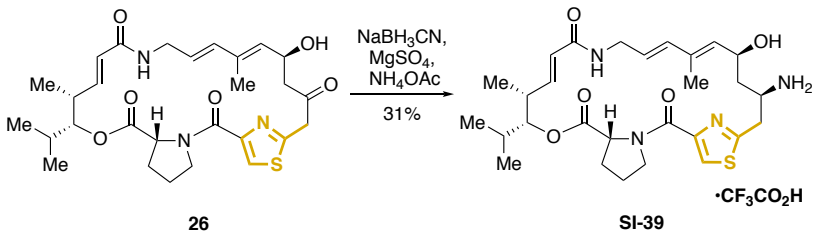
TLC (MeOH:DCM = 1:20): R_f = 0.30 (UV, *p*-anisaldehyde).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.91 (s, 1H), 6.53 (dd, *J* = 16.3, 4.7 Hz, 1H), 6.40 (dd, *J* = 8.4, 4.1 Hz, 1H), 6.12 (d, *J* = 15.6 Hz, 1H), 5.76 (dd, *J* = 16.2, 1.9 Hz, 1H), 5.61 (ddd, *J* = 15.6, 8.9, 4.4 Hz, 1H), 5.40 (d, *J* = 8.9 Hz, 1H), 4.91 (dt, *J* = 8.7, 6.1 Hz, 1H), 4.82 – 4.64 (m, 2H), 4.32 (ddd, *J* = 13.7, 8.5, 4.6 Hz, 1H), 3.98 (d, *J* = 2.3 Hz, 2H), 3.85 (dt, *J* = 10.9, 7.3 Hz, 1H), 3.71 (ddd, *J* = 11.1, 7.8, 4.9 Hz, 1H), 3.45 (ddd, *J* = 14.8, 9.0, 4.0 Hz, 1H), 3.05 (dd, *J* = 16.8, 6.6 Hz, 2H), 2.82 (dd, *J* = 16.8, 5.7 Hz, 1H), 2.73 (ddq, *J* = 6.9, 4.4, 2.3 Hz, 1H), 2.14 (dtd, *J* = 13.2, 9.4, 7.4 Hz, 1H), 1.99 – 1.71 (m, 4H), 1.68 (d, *J* = 1.2 Hz, 3H), 1.05 (d, *J* = 6.8 Hz, 3H), 0.98 (d, *J* = 6.5 Hz, 3H), 0.94 (d, *J* = 6.7 Hz, 3H).

^{13}C NMR (100 MHz, $CDCl_3$) δ 203.5, 171.7, 166.4, 161.4, 160.6, 150.6, 144.9, 136.5, 134.4, 132.7, 126.1, 125.2, 123.9, 81.2, 64.7, 59.6, 49.4, 49.1, 47.5, 40.9, 36.57, 29.4, 28.5, 25.1, 19.7, 18.6, 12.7, 10.2.

HRMS-ESI m/z calcd for $C_{28}H_{38}N_3O_6S^+$ $[M + H]^+$ 544.2476, found 544.2480.

Analogue SI-39



26 **SI-39**

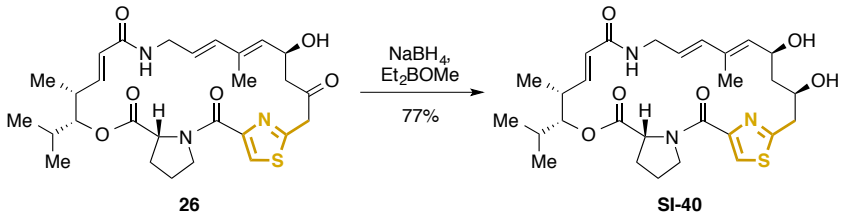
A 50-mL round-bottom flask containing anhydrous $MgSO_4$ (60 mg, 0.50 mmol, 10.0 equiv), NH_4OAc (19 mg, 0.25 mmol, 5.0 equiv) and $NaBH_3CN$ (7.5 mg, 0.12 mmol, 2.4 equiv) was evacuated and flushed with nitrogen (this process was repeated a total of 3 times). MeOH (5 mL) was added, resulting in a white suspension. After 30 min, a solution of compound **26** (27 mg, 50 µmol, 1 equiv) in MeOH (1 mL) was added. After 20 h, the mixture was filtered through a pad of celite, and the filter cake was washed with MeOH (2 × 10 mL). The combined filtrates were concentrated. The resulting crude residue was purified by preparative HPLC (eluent: H_2O:acetonitrile = 95:5 to 5:95 over 15 min) to afford analogue **SI-39** TFA salt (10 mg, 31 % yield) as a white solid.

^{1}H NMR (400 MHz, MeOD) δ 8.12 (s, 1H), 6.83 (dd, *J* = 15.7, 4.4 Hz, 1H), 6.31 (dd, *J* = 15.5, 1.0 Hz, 1H), 5.88 (dd, *J* = 15.7, 2.0 Hz, 1H), 5.77 – 5.66 (m, 1H), 5.50 (d, *J* = 8.6 Hz, 1H), 4.90 – 4.80 (m, 1H), 4.82 – 4.71 (m, 2H), 4.11 (dd, *J* = 14.3, 9.1 Hz, 1H), 3.92 – 3.82 (m, 2H), 3.77 (dt, *J* = 11.2, 7.6 Hz, 1H), 3.61 – 3.48 (m, 2H), 3.37 (dd, *J* = 15.6, 6.9 Hz, 1H), 2.89 – 2.77 (m, 1H), 2.45 (ddd, *J* = 14.7, 5.1, 3.1 Hz, 1H), 2.22 – 2.07 (m, 1H), 2.03 – 1.90 (m, 3H), 1.83 (d, *J* = 1.2 Hz, 3H), 1.81 – 1.72 (m, 2H), 1.63 – 1.50 (m, 1H), 1.14 (d, *J* = 6.8 Hz, 3H), 1.00 (d, *J* = 6.9 Hz, 3H), 0.97 (d, *J* = 6.5 Hz, 3H).

^{13}C NMR (100 MHz, MeOD) δ 172.1, 167.5, 164.0, 163.0, 151.9, 148.34 138.7, 136.3, 134.9, 128.0, 126.3, 124.2, 82.4, 67.0, 61.1, 50.98, 50.95, 41.3, 39.8, 38.0, 35.5, 30.7, 29.8, 26.4, 20.2, 18.8, 13.2, 9.6.

HRMS-ESI m/z calcd for $C_{28}H_{39}N_4O_4S^+$ $[M - OH]^+$ 527.2687, found 527.2708.

Analogue SI-40



A 50-mL round-bottom flask containing analogue **26** (27 mg, 50 µmol, 1 equiv) was evacuated and flushed with nitrogen (this process was repeated a total of 3 times). THF (1 mL) and MeOH (4 mL) were added, and the resulting colorless solution was cooled to -78 ºC by means of a dry ice/acetone bath. A solution of Et_2BOMe in THF (1.0 M, 60 µL, 60 µmol, 1.2 equiv) was added dropwise over 5 min at -78 ºC. After 30 min, $NaBH_4$ (2.8 mg, 74 µmol, 1.5 equiv) was added in one portion at -78 ºC. After additional 3 h, acetic acid (1 mL) and EtOAc (25 mL) were added, and the system was allowed to warm to 23 ºC while the mixture was rapidly stirred. The solution was transferred to a separatory funnel and was washed with saturated aqueous $NaHCO_3$ solution (20 mL), water (3 × 40 mL) and brine (40 mL). The washed solution was dried (Na_2SO_4). The dried solution was filtered, and the filtrate was concentrated. The resulting crude residue was purified by flash chromatography (silica gel, eluent: MeOH:DCM = 1:40 to 1:20) to afford analogue **SI-40** (21 mg, 77% yield) as a white solid.

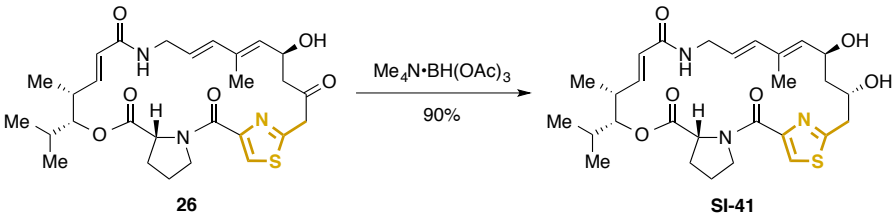
TLC (MeOH:DCM = 1:20): R_f = 0.30 (UV, KMnO4).

^{1}H NMR (400 MHz, $CDCl_3$) δ 8.06 (s, 1H), 6.52 (dd, *J* = 16.3, 4.3 Hz, 1H), 6.19 (d, *J* = 15.5 Hz, 1H), 5.93 (dd, *J* = 8.7, 3.9 Hz, 1H), 5.80 (dd, *J* = 16.3, 2.0 Hz, 1H), 5.65 (ddd, *J* = 15.5, 9.4, 4.1 Hz, 1H), 5.38 (d, *J* = 9.2 Hz, 1H), 4.95 – 4.71 (m, 3H), 4.46 (ddd, *J* = 13.5, 8.6, 4.1 Hz, 1H), 4.33 (td, *J* = 8.1, 4.0 Hz, 1H), 4.07 (ddd, *J* = 12.5, 8.0, 4.5 Hz, 1H), 3.86 (dt, *J* = 11.1, 7.2 Hz, 1H), 3.44 (ddd, *J* = 14.2, 9.4, 3.8 Hz, 1H), 3.17 (dd, *J* = 16.3, 7.5 Hz, 1H), 3.04 (dd, *J* = 16.3, 3.7 Hz, 1H), 2.97 (br s, 1H), 2.83 – 2.68 (m, 1H), 2.20 – 2.05 (m, 2H), 2.05 – 1.83 (m, 3H), 1.78 (s, 3H), 1.76 – 1.60 (m, 2H), 1.10 (d, *J* = 6.9 Hz, 3H), 1.01 (d, *J* = 6.5 Hz, 3H), 0.95 (d, *J* = 6.7 Hz, 3H).

^{13}C NMR (100 MHz, $CDCl_3$) δ 171.8, 166.4, 166.3, 161.0, 149.7, 145.0, 136.6, 134.8, 134.0, 126.6, 125.2, 123.7, 81.0, 68.4, 66.9, 59.7, 49.3, 42.6, 41.4, 40.8, 36.6, 29.4, 28.4, 25.3, 19.9, 18.6, 13.0,10.0.

HRMS-ESI m/z calcd for $C_{28}H_{39}N_3NaO_6S^+$ $[M + Na]^+$ 568.2452, found 568.2473.

Analogue SI-41



A 50-mL round-bottom flask containing $Me_4N•BH(OAc)_3$ (0.12 g, 0.46 mmol, 5.0 equiv) was evacuated and flushed with nitrogen (this process was repeated a total of 3 times). Acetonitrile (5 mL) and acetic acid (5 mL) were added, and the resulting colorless solution was cooled to -10 ºC by means of an ice/acetone bath. A solution of **26** (50 mg, 0.093 mmol, 1 equiv) in acetonitrile (2.5 mL) was added dropwise (the syringe was rinsed with acetonitrile (1 mL)). The mixture was allowed to warm to 23 ºC slowly. After 5 h, saturated aqueous $NaHCO_3$ solution (50 mL) was added (CAUTION: Gas evolution!), followed by EtOAc (50 mL). The resulting biphasic mixture was transferred to a separatory funnel, and the layers were separated. The aqueous layer was extracted with EtOAc (2 × 10 mL). The combined organic layers were washed with water (2 × 50 mL) and brine (50 mL), and the washed solution was dried (Na_2SO_4). The dried solution was filtered, and the filtrate was concentrated. The resulting crude residue was purified by flash chromatography (silica gel, eluent: MeOH: DCM = 1:30) to afford analogue **SI-41** (45 mg, 90% yield) as a white solid.

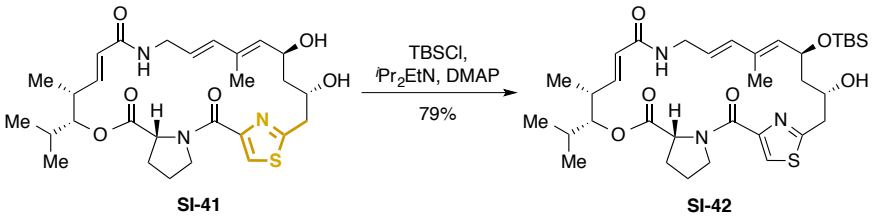
TLC (MeOH:DCM = 1:20): R_f = 0.20 (UV, *p*-anisaldehyde).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.96 (s, 1H), 6.51 (dd, *J* = 16.2, 4.5 Hz, 1H), 6.20 (dd, *J* = 15.6, 1.1 Hz, 1H), 6.14 (dd, *J* = 8.6, 4.0 Hz, 1H), 5.76 (dd, *J* = 16.2, 2.0 Hz, 1H), 5.72 – 5.66 (m, 1H), 5.66 – 5.59 (m, 1H), 4.86 (dt, *J* = 9.6, 4.9 Hz, 1H), 4.77 – 4.66 (m, 2H), 4.42 – 4.28 (m, 2H), 4.04 (br s, 1H), 3.92 – 3.72 (m, 2H), 3.44 (ddd, *J* = 14.0, 9.4, 4.1 Hz, 1H), 3.23 – 3.02 (m, 3H), 2.74 (dqd, *J* = 7.4, 4.8, 2.6 Hz, 1H), 2.12 (dq, *J* = 13.2, 8.1, 7.3 Hz, 1H), 2.05 – 1.86 (m, 4H), 1.85 – 1.78 (m, 2H), 1.77 (d, *J* = 1.2 Hz, 3H), 1.07 (d, *J* = 6.8 Hz, 3H), 1.01 (d, *J* = 6.5 Hz, 3H), 0.94 (d, *J* = 6.8 Hz, 3H).

^{13}C NMR (100 MHz, $CDCl_3$) δ 172.0, 166.5, 166.1, 161.3, 150.3, 145.1, 137.3, 133.9, 133.4, 125.8, 125.0, 123.7, 81.3, 68.6, 66.7, 59.6, 49.2, 41.9, 41.1, 40.47, 36.7, 29.4, 28.5, 25.5, 19.8, 18.6, 12.8, 9.7.

HRMS-ESI m/z calcd for $C_{28}H_{39}N_3NaO_6S^+$ $[M + Na]^+$ 568.2452, found 568.2473.

Mono-TBS ether SI-42



To a solution of anti-diol **SI-41** (45 mg, 82 µmol, 1 equiv) and DMAP (1 mg, 8 µmol, 0.1 equiv) in DCM (8 mL) was added $^iPr_2NEt$ (0.22 mL, 1.20 mmol, 15.0 equiv), followed by TBS-Cl (0.19 g, 1.2 mmol, 15.0 equiv). After 24 h, the mixture was concentrated, and the resulting residue was purified by flash chromatography (silica gel, eluent: acetone:hexanes = 1:4) to afford mono-TBS ether **SI-42** (43 mg, 79% yield) as a white solid.

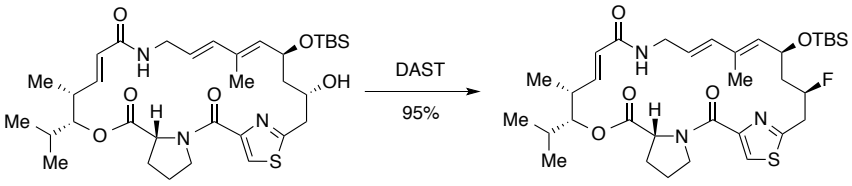
TLC (acetone:hexanes = 1:2): R_f = 0.30 (UV, *p*-anisaldehyde).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.98 (s, 1H), 6.44 (dd, *J* = 16.4, 4.5 Hz, 1H), 6.18 (d, *J* = 15.6 Hz, 1H), 6.05 (dd, *J* = 9.3, 3.5 Hz, 1H), 5.76 (dd, *J* = 16.4, 2.0 Hz, 1H), 5.73 – 5.62 (m, 2H), 4.93 (ddd, *J* = 9.4, 4.9, 2.8 Hz, 1H), 4.73 – 4.64 (m, 2H), 4.55 – 4.42 (m, 2H), 4.37 (br s, 1H), 3.84 (dt, *J* = 11.1, 6.6 Hz, 1H), 3.72 (dt, *J* = 11.5, 6.8 Hz, 1H), 3.32 (ddd, *J* = 13.9, 10.2, 3.5 Hz, 1H), 3.23 (dd, *J* = 16.0, 3.1 Hz, 1H), 3.06 (dd, *J* = 16.1, 8.8 Hz, 1H), 2.75 (ddt, *J* = 6.7, 4.3, 2.0 Hz, 1H), 2.13 (dtd, *J* = 16.4, 5.7, 4.7, 2.1 Hz, 1H), 1.96 (tt, *J* = 11.0, 4.7 Hz, 2H), 1.85 – 1.75 (m, 4H), 1.72 (d, *J* = 1.2 Hz, 3H), 1.06 (d, *J* = 5.8 Hz, 3H), 1.04 (d, *J* = 5.4 Hz, 3H), 0.95 (d, *J* = 6.7 Hz, 3H), 0.89 (s, 9H), 0.08 (s, 3H), 0.03 (s, 3H).

^{13}C NMR (100 MHz, $CDCl_3$) δ 172.4, 167.1, 166.3, 161.3, 150.5, 144.4, 137.2, 133.6, 132.0, 125.7, 125.2, 123.9, 81.5, 69.2, 68.1, 59.8, 49.0, 43.3, 41.4, 40.7, 36.8, 29.4, 28.4, 25.8, 25.71, 19.9, 18.6, 17.92, 12.7, 9.37, –4.4, –5.3.

HRMS-ESI m/z calcd for $C_{34}H_{54}N_3O_6SSi^+$ $[M + H]^+$ 660.3497, found 660.3521.

Fluorinated compound SI-43



SI-42 **SI-43**

A 50-mL round-bottom flask containing mono-TBS ether **SI-42** (42 mg, 64 μmol, 1 equiv) was evacuated and flushed with nitrogen (this process was repeated a total of 3 times). DCM (5 mL) was added, and the resulting colorless solution was cooled to 0 ºC by means of an ice/water bath. DAST (21 μL, 0.16 mmol, 2.50 equiv) was added dropwise, and the vessel and its contents were allowed to warm to 23 ºC. After 3 h, aqueous saturate solution of $NaHCO_3$ (10 mL) was added, followed by DCM (20 mL), and the resulting biphasic solution was transferred to a separatory funnel. The layers were separated, and the organic layer was washed with water (2 × 25 mL) and brine (25 mL). The washed solution was dried (Na_2SO_4), and the dried solution was concentrated. The resulting crude residue was purified by flash chromatography (silica gel, eluent: acetone:hexanes = 1:5) to afford fluorinated compound **SI-43** (40 mg, 95 % yield) as a white solid.

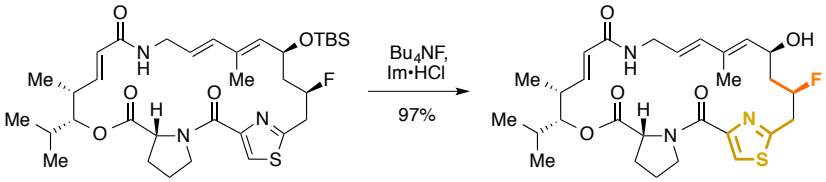
TLC (acetone:hexanes = 1:2.5): R_f = 0.30 (UV, *p*-anisaldehyde).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.92 (s, 1H), 6.49 (dd, *J* = 16.4, 4.1 Hz, 1H), 6.21 (dd, *J* = 15.5, 1.4 Hz, 1H), 5.91 (dd, *J* = 9.4, 3.2 Hz, 1H), 5.80 (dd, *J* = 16.4, 2.0 Hz, 1H), 5.61 (ddd, *J* = 15.5, 9.6, 4.0 Hz, 1H), 5.34 (d, *J* = 9.2 Hz, 1H), 5.20 (dtt, *J* = 49.7, 11.6, 3.0 Hz, 1H), 4.85 – 4.70 (m, 3H), 4.59 (ddd, *J* = 13.4, 8.4, 3.3 Hz, 1H), 4.06 (dt, *J* = 11.7, 6.9 Hz, 1H), 3.76 (dt, *J* = 11.7, 6.4 Hz, 1H), 3.45 – 3.24 (m, 2H), 3.04 (ddd, *J* = 30.6, 16.5, 3.5 Hz, 1H), 2.75 (ddt, *J* = 7.2, 5.0, 2.4 Hz, 1H), 2.15 (dtd, *J* = 13.6, 6.7, 3.8 Hz, 2H), 2.03 – 1.77 (m, 5H), 1.73 (s, 3H), 1.09 (d, *J* = 6.9 Hz, 3H), 1.01 (d, *J* = 6.4 Hz, 3H), 0.94 (d, *J* = 6.7 Hz, 3H), 0.87 (s, 9H), 0.05 (s, 3H), 0.02 (s, 3H).

^{13}C NMR (100 MHz, $CDCl_3$) δ 172.2, 166.5, 164.1 (d, $^3J_{CF}$ = 3.5 Hz), 161.5, 150.1, 144.6, 137.0, 134.9, 133.4, 124.9, 124.7, 123.9, 89.9 (d, $^1J_{CF}$ = 169.5 Hz), 80.8, 66.4, 59.1, 49.3, 43.6 (d, $^2J_{CF}$ = 20.0 Hz), 41.5, 38.7 (d, $^2J_{CF}$ = 22.8 Hz), 36.6, 29.3, 28.5, 25.78, 25.75, 25.4, 19.9, 18.5, 18.1, 12.62, 12.60, 9.8, –4.4, –4.9.

HRMS-ESI m/z calcd for $C_{34}H_{53}FN_3O_5SSi^+$ $[M + H]^+$ 662.3454, found 662.3482.

Analogue 45



SI-43 **45**

A 100-mL round-bottom flask containing **SI-43** (20 mg, 30 µmol, 1 equiv) was evacuated and flushed with nitrogen (this process was repeated a total of 3 times). THF (3 mL) was added, resulting in a light-yellow solution. In a separate flask, Im•HCl (32 mg, 0.30 mmol, 10.0 equiv) that had previously been dried at >100 ºC for 10 minutes under vacuum was added to a solution of tetrabutylammonium fluoride in THF (1 M, 0.30 mL, 0.30 mmol, 10.0 equiv). The resulting colorless solution was added dropwise to the above solution of **SI-43**. After 12 h, the mixture was concentrated, and the residue was dissolved in DCM (50 mL). The resulting solution was transferred to a separatory funnel and was washed with water (5 × 50 mL) and brine (50 mL). The washed solution was dried Na_2SO_4). The dried solution was filtered, and the filtrate was concentrated. The resulting crude residue was purified by flash chromatography (silica gel, eluent: MeOH:DCM = 1:100 to 1:50) to afford analogue **45** (16 mg, 97 % yield) as a light-yellow solid.

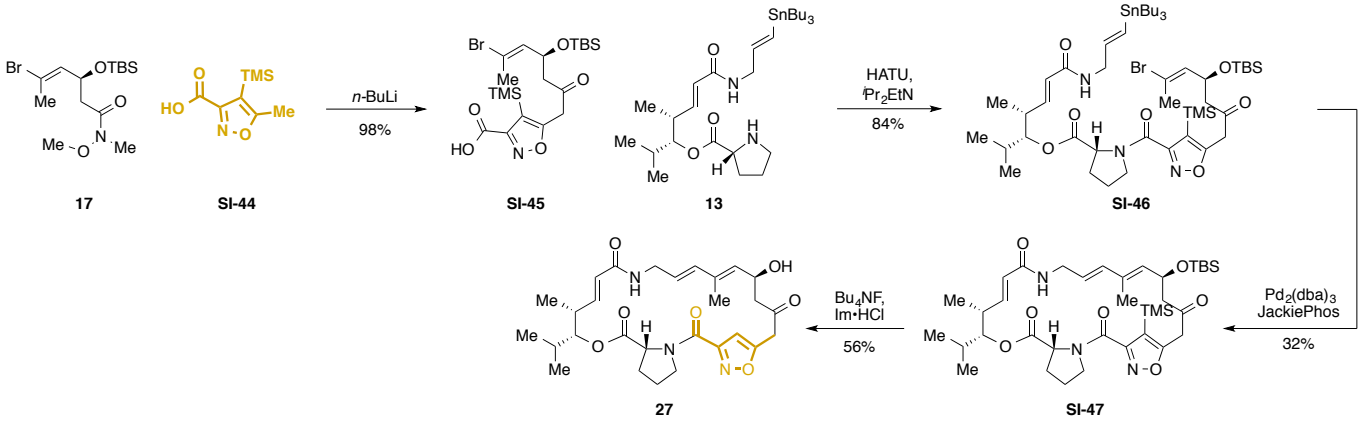
TLC (MeOH:DCM = 1:30): R_f = 0.20 (UV, *p*-anisaldehyde).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.95 (s, 1H), 6.51 (dd, *J* = 16.4, 4.2 Hz, 1H), 6.23 (d, *J* = 15.7 Hz, 1H), 5.96 (dd, *J* = 8.9, 3.5 Hz, 1H), 5.81 (dd, *J* = 16.3, 2.0 Hz, 1H), 5.68 (ddd, *J* = 15.9, 9.3, 4.1 Hz, 1H), 5.39 (d, *J* = 9.2 Hz, 1H), 5.34 – 5.10 (dm, $^2J_{HF}$ = 47.9, 1H), 4.88 – 4.71 (m, 3H), 4.55 (ddd, *J* = 14.2, 9.0, 4.0 Hz, 1H), 4.06 (dt, *J* = 11.6, 6.4 Hz, 1H), 3.78 (dt, *J* = 11.6, 6.3 Hz, 1H), 3.52 – 3.31 (m, 2H), 3.10 (ddd, *J* = 27.6, 16.4, 4.1 Hz, 1H), 2.82 – 2.68 (m, 1H), 2.29 – 2.09 (m, 2H), 2.00 – 1.80 (m, 5H), 1.78 (s, 3H), 1.10 (d, *J* = 6.7 Hz, 3H), 1.02 (d, *J* = 6.3 Hz, 3H), 0.95 (d, *J* = 6.5 Hz, 3H).

^{13}C NMR (100 MHz, $CDCl_3$) δ 172.2, 166.5, 163.9 (d, $^3J_{CF}$ = 4.3 Hz), 161.5, 150.1, 144.8, 136.2, 135.8, 133.4, 125.48, 125.2, 123.8, 90.0 (d, $^1J_{CF}$ = 169.9 Hz), 80.9, 65.6, 59.2, 49.3, 42.1 (d, $^2J_{CF}$ = 20.6 Hz), 41.3, 38.5 (d, $^2J_{CF}$ = 22.8 Hz), 36.6, 29.4, 28.5, 25.4, 19.9, 18.5, 12.8, 9.8.

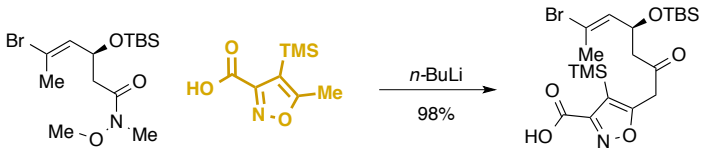
HRMS-ESI m/z calcd for $C_{28}H_{39}FN_3O_5S^+$ $[M + H]^+$ 548.2589, found 548.2593.

Scheme VIII Synthesis of 27



17 **SI-44** **SI-45** **13** **SI-46** **SI-47** **27**

Acid SI-45



17 SI-44 SI-45

Preparation of SI-44: A 250-mL round-bottom flask containing 5-methylisoxazole-3-carboxylic acid (0.64 g, 5.04 mmol, 1 equiv) was evacuated and flushed with nitrogen (this process was repeated a total of 3 times). THF (56 mL) was added, resulting in a light-yellow solution, and the vessel and its contents were cooled to -78 ºC by means of a dry ice/acetone bath. A solution of *n*-butyllithium in hexanes (2.5 M, 5.04 mL, 12.6 mmol, 2.5 equiv) was added dropwise over 15 min, resulting in a deep red solution. After 30 min, chlorotrimethylsilane (3.2 mL, 25.2 mmol, 5.0 equiv) was added over 30 min by syringe pump. After 1 h, water (50 mL) was added, and the system was allowed to warm to 23 ºC while the mixture was rapidly stirred. The biphasic mixture was transferred to a separatory funnel, and the layers were separated. The aqueous layer was extracted with EtOAc (2 × 50 mL). The combined organic layers were washed with water (2 × 100 mL) and brine (100 mL), and the washed solution was dried (Na_2SO_4). The dried solution was filtered, and the filtrate was concentrated. The resulting crude residue was purified by flash chromatography (silica gel, eluent: MeOH:DCM = 1:150 to 1:120) to afford acid **SI-44** (0.49 g, 49.2 %) as a yellow solid.

TLC (MeOH:DCM = 1:20): R_f = 0.30 (UV, $KMnO_4$).

^{1}H NMR (400 MHz, $CDCl_3$) δ 9.63 (s, 1H), 2.53 (s, 3H), 0.33 (s, 9H).

^{13}C NMR (100 MHz, $CDCl_3$) δ 175.9, 164.8, 159.1, 109.1, 13.6, -0.1.

Preparation of SI-45: A 100-mL round-bottom flask containing acid **SI-44** (0.21 g, 1.06 mmol, 2.0 equiv) was evacuated and flushed with nitrogen (this process was repeated a total of 3 times). THF (12 ml) was added, resulting in a light-yellow solution, and the vessel and its contents were cooled to -78 ºC by means of a dry ice/acetone bath. A solution of *n*-BuLi in hexanes (2.5 M, 0.85 mL, 2.13 mmol, 4.0 equiv) was added dropwise over 15 min, resulting in a deep red solution. After 30 min, a solution of **17** (0.20 g, 0.53 mmol, 1 equiv) in THF (2 mL) was added over 30 min by means of syringe pump. After an additional 30 min, water (40 mL) was added, followed by 1 M aqueous $KHSO_4$ solution (3 mL). The system was allowed to warm to 23 ºC while the mixture was rapidly stirred. The biphasic mixture was transferred to a separatory funnel, and the layers were separated. The aqueous layer was extracted with EtOAc (2 × 30 mL). The combined organic layers were washed with water (2 × 50 mL) and brine (50 mL), and the washed solution was dried (Na_2SO_4). The dried solution was filtered, and the filtrate was concentrated. The resulting crude residue was purified by flash chromatography (silica gel, eluent: DCM:MeOH=150:1 to 100:1) afford acid **SI-45** (0.26 g, 98% yield).

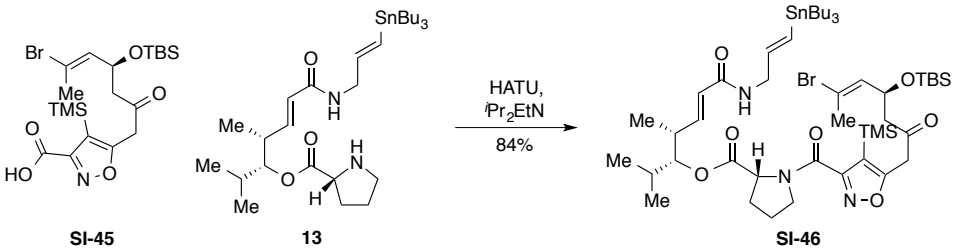
TLC (MeOH:DCM = 1:5): R_f = 0.45 (UV).

^{1}H NMR (400 MHz, $CDCl_3$) δ 6.84 (s, 1H), 5.83 (dd, J = 9.1, 1.2 Hz, 1H), 4.83 (ddd, J = 9.0, 7.9, 4.9 Hz, 1H), 4.00 (d, J = 7.6 Hz, 2H), 2.90 – 2.80 (m, 1H), 2.56 (dd, J = 16.0, 4.9 Hz, 1H), 2.30 (d, J = 1.1 Hz, 3H), 0.86 (d, J = 8.6 Hz, 9H), 0.31 (s, 9H), 0.07 (t, J = 3.5 Hz, 6H).

^{13}C NMR (100 MHz, $CDCl_3$) δ 200.7, 171.3, 163.6, 159.6, 134.2, 122.0, 112.1, 66.7, 50.0, 42.8, 25.7, 24.0, 18.0, –0.4, –4.6, –5.1.

HRMS-ESI m/z calcd for $C_{20}H_{33}BrNO_5Si_2^-$ $[M - H]^-$ 502.1086, found 502.1091.

Stille coupling precursor SI-46



A 25-mL round-bottom flask was charged with amine **13** (0.31 g, 0.52 mmol 2.6 equiv), $^{i}Pr_2EtN$ (0.18 mL, 1.03 mmol, 5.2 equiv) and acid **SI-45** (0.10 g, 0.20 mmol, 1 equiv). DCM (5 mL) was added, resulting in a clear, colorless solution, and HATU (0.24 g, 0.64 mmol, 3.2 equiv) was added to this solution in one portion. After 5 h, the mixture was diluted with DCM (30 mL). The solution was transferred to a separatory funnel and was washed with water (2 × 30 mL) and brine (30 mL). The washed solution was dried (Na_2SO_4). The dried solution was filtered, and the filtrate was concentrated. The resulting crude residue was purified by flash chromatography (silica gel, eluent: EtOAc:hexanes = 1:6 to 1:4) to afford Stille coupling precursor **SI-46** (0.18 g, 84% yield) as a light-yellow foam.

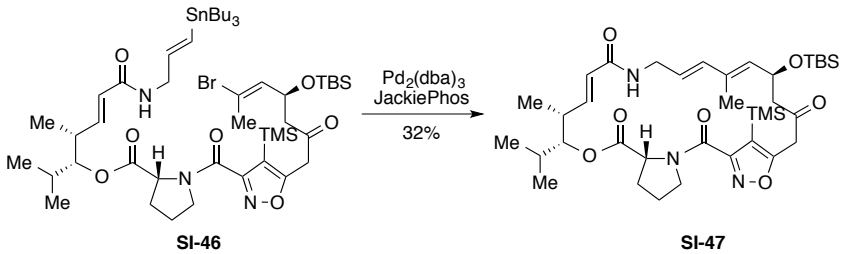
TLC (EtOAc:hexanes = 1:4): R_f = 0.3 (UV)

^{1}H NMR (400 MHz, $CDCl_3$, mixtures of rotamers) δ 6.70 (dt, *J* = 16.6, 8.4 Hz, 1H), 6.25 – 6.04 (m, 1H), 5.98 (dt, *J* = 19.0, 5.0 Hz, 1H), 5.82 (ddd, *J* = 10.6, 9.2, 6.6 Hz, 2H), 5.68 (dt, *J* = 41.8, 5.6 Hz, 1H), 5.19 (dd, *J* = 8.5, 2.5 Hz, 1H), 4.90 – 4.70 (m, 2H), 4.64 (dd, *J* = 8.6, 3.2 Hz, 1H), 4.09 – 3.78 (m, 6H), 3.78 – 3.67 (m, 1H), 2.80 (ddd, *J* = 15.8, 11.5, 7.8 Hz, 1H), 2.72 – 2.58 (m, 1H), 2.51 (ddd, *J* = 15.8, 11.8, 4.9 Hz, 1H), 2.38 – 2.25 (m, 4H), 2.25 – 2.02 (m, 2H), 1.97 (ddd, *J* = 22.8, 12.9, 6.3 Hz, 2H), 1.80 – 1.73 (m, 1H), 1.61 – 1.40 (m, 7H), 1.31 (dq, *J* = 14.3, 7.1 Hz, 7H), 1.10 – 0.75 (m, 35H), 0.28 (dd, *J* = 18.5, 6.7 Hz, 9H), 0.14 – 0.02 (m, 6H).

^{13}C NMR (100 MHz, $CDCl_3$, mixtures of rotamers) δ 200.9, 171.7, 169.3, 169.2, 165.4, 165.2, 162.6, 162.5, 160.5, 145.2, 143.5, 143.4, 134.2, 130.4, 130.2, 124.1, 123.9, 121.9, 112.0, 111.4, 81.1, 80.8, 66.7, 66.6, 60.8, 59.5, 49.9, 49.7, 49.1, 47.2, 44.9, 42.8, 38.2, 38.1, 31.6, 29.9, 29.7, 29.4, 29.1, 29.0, 28.9, 27.3, 27.0, 25.7, 24.8, 24.0, 22.1, 19.5, 19.4, 18.0, 17.0, 16.6, 14.8, 14.6, 13.7, 11.1, 9.5, 7.7, –0.2, –0.3, –4.5, –5.06, –5.08.

HRMS-ESI m/z calcd for $C_{49}H_{87}BrN_3O_7Si_2Sn^+$ $[M + H]^+$ 1084.4282 found 1084.4292.

Stille coupling product SI-47



A 100-mL round-bottom flask containing JackiePhos (13.2 mg, 16.6 μmol, 0.2 equiv), $Pd_2(dba)_3$ (7.6 mg, 8.3 μmol, 0.1 equiv) and Stille coupling precursor **SI-46** (90.0 mg, 83.0 μmol, 1 equiv) was evacuated and flushed with nitrogen (this process was repeated a total of 3 times). Toluene (17 ml) was added, resulting in a red suspension. A stream of argon was passed through the solution by a stainless steel needle for 30 min. The mixture was heated by means of a 50 ºC oil bath. After 15 h, **SI-46** was entirely consumed as indicated by TLC analysis (EtOAc:hexanes = 1:2), and the mixture was cooled to 23 ºC. The mixture was concentrated, and the resulting crude residue was purified by flash

chromatography (silica gel, eluent: EtOAc:hexanes =1:3 to 1:1.5) to afford Stille coupling product **SI-47** (19.2 mg, 32% yield) as a light-yellow solid.

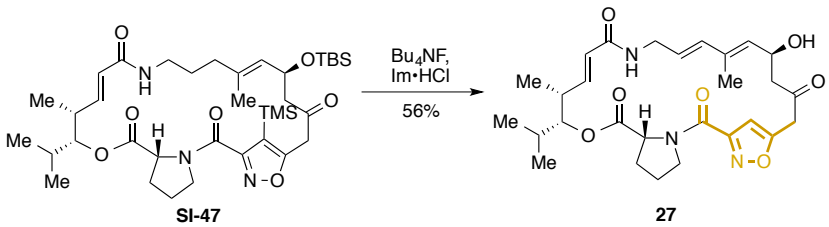
TLC (EtOAc:hexanes = 1:2): R_f = 0.15 (UV)

^{1}H NMR (400 MHz, $CDCl_3$) δ 6.81 (d, *J* = 7.1 Hz, 1H), 6.67 (dd, *J* = 15.6, 8.2 Hz, 1H), 6.28 (d, *J* = 15.5 Hz, 1H), 5.92 (dd, *J* = 15.7, 0.9 Hz, 1H), 5.77 – 5.65 (m, 1H), 5.52 (d, *J* = 9.3 Hz, 1H), 4.97 – 4.83 (m, 2H), 4.61 (dd, *J* = 8.3, 5.5 Hz, 1H), 4.48 – 4.38 (m, 1H), 4.05 (d, *J* = 17.4 Hz, 1H), 3.75 – 3.61 (m, 2H), 3.60 – 3.49 (m, 1H), 3.39 (dd, *J* = 13.3, 8.9 Hz, 1H), 2.98 – 2.89 (m, 1H), 2.80 (dd, *J* = 11.9, 5.8 Hz, 1H), 2.63 – 2.53 (m, 1H), 2.36 (dd, *J* = 15.0, 7.3 Hz, 1H), 2.14 (ddd, *J* = 16.1, 9.5, 4.6 Hz, 2H), 2.03 – 1.91 (m, 2H), 1.73 (s, 1H), 1.56 (d, *J* = 15.1 Hz, 3H), 1.29 – 1.24 (m, 1H), 1.15 (d, *J* = 7.3 Hz, 3H), 1.02 – 0.82 (m, 21H), 0.33 – 0.15 (m, 12H), 0.12 – –0.04 (m, 9H).

^{13}C NMR (100 MHz, $CDCl_3$) δ 200.9, 170.4, 169.7, 166.0, 161.9, 161.6, 142.5, 138.1, 134.6, 132.4, 125.9, 125.2, 110.4, 82.3, 66.8, 60.4, 51.2, 49.0, 43.6, 41.9, 40.6, 29.5, 28.9, 25.7, 25.1, 20.8, 19.6, 18.1, 16.5, 13.2, –0.7, –0.9, –4.5, –4.9.

HRMS-ESI m/z calcd for $C_{37}H_{59}N_3NaO_7Si_2^+$ $[M + Na]^+$ 736.3784, found 736.3791.

Analogue 27



A 25-mL round-bottom flask containing **SI-47** (60 mg, 84.0 µmol, 1 equiv) was evacuated and flushed with nitrogen (this process was repeated a total of 3 times). THF (2.5 ml) was added, resulting in a light-yellow solution. In a separate flask, Im•HCl (0.13 g, 1.30 mmol, 15.0 equiv) that had previously been dried at >100 ºC for 10 minutes under vacuum was added to a solution of tetrabutylammonium fluoride in THF (1 M, 1.30 mL, 1.30 mmol, 15.0 equiv). The resulting colorless solution was added dropwise to the solution of **SI-47**. After 7 d, the mixture was concentrated, and the residue was dissolved in DCM (50 mL). The resulting solution was transferred to a separatory funnel and was washed with water (5 × 50 mL) and brine (50 mL). The washed solution was dried (Na_2SO_4). The dried solution was filtered, and the filtrate was concentrated. The resulting crude residue was purified by preparative TLC (eluent: MeOH:DCM = 1:25) to afford analogue **27** (25 mg, 56%, yield).

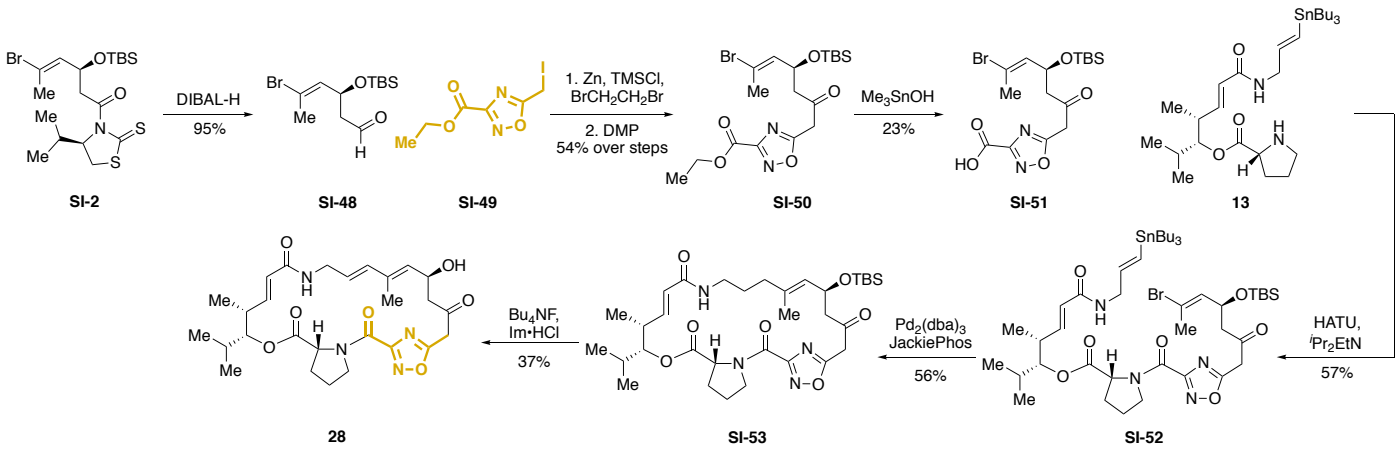
TLC (MeOH:DCM = 1:20): R_f = 0.40 (UV).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.34 (dd, *J* = 8.8, 3.6 Hz, 1H), 6.18 (dd, *J* = 16.4, 8.1 Hz, 1H), 6.13 (d, *J* = 15.2 Hz, 1H), 5.90 – 5.72 (m, 2H), 5.19 (d, *J* = 8.9 Hz, 1H), 4.97 (td, *J* = 8.7, 4.6 Hz, 1H), 4.75 (dd, *J* = 9.9, 2.4 Hz, 1H), 4.69 (dd, *J* = 8.8, 3.0 Hz, 1H), 4.48 (ddd, *J* = 13.9, 8.8, 5.0 Hz, 1H), 4.15 – 3.95 (m, 2H), 3.92 (d, *J* = 16.0 Hz, 1H), 3.69 (d, *J* = 16.0 Hz, 1H), 3.33 (ddd, *J* = 13.4, 9.1, 3.6 Hz, 1H), 2.91 (dd, *J* = 15.3, 4.6 Hz, 1H), 2.81 (dd, *J* = 15.2, 8.6 Hz, 1H), 2.61 – 2.51 (m, 1H), 2.48 (br s, 1H), 2.40 – 2.20 (m, 1H), 2.17 – 2.02 (m, 3H), 1.94 – 1.83 (m, 1H), 1.78 (s, 3H), 0.92 (d, *J* = 6.8 Hz, 3H), 0.86 (d, *J* = 6.7 Hz, 3H), 0.86 (d, *J* = 6.7 Hz, 3H).

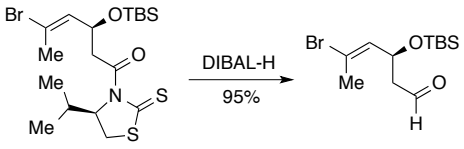
^{13}C NMR (100 MHz, $CDCl_3$) δ 201.6, 171.0, 166.8, 166.0, 159.3, 158.9, 142.8, 136.7, 136.1, 131.7, 127.1, 125.8, 104.1, 82.2, 65.1, 61.1, 49.5, 49.3, 41.9, 40.6, 36.9, 29.7, 29.1, 25.1, 19.4, 18.8, 13.3, 12.4.

HRMS-ESI m/z calcd for $C_{28}H_{37}N_3NaO_7^+$ $[M + Na]^+$ 550.2524, found 550.2515.

Scheme IX synthesis of 28



Aldehyde SI-48



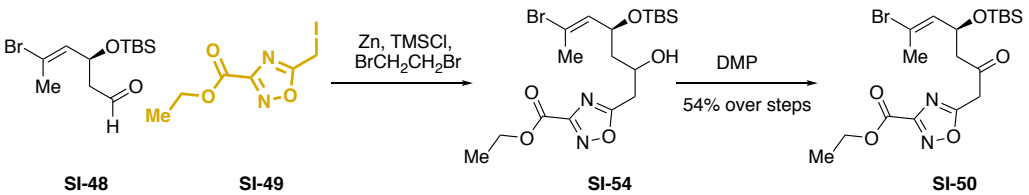
A 250-mL round-bottom flask containing TBS ether **SI-2** (3.00 g, 6.43mmol, 1 equiv) was evacuated and flushed with nitrogen (this process was repeated a total of 3 times). DCM (65 ml) was added, resulting in a light-yellow solution. The vessel and its contents were cooled to -78 ºC by means of a dry ice/acetone bath, and a solution of DIBAL-H in hexanes (1.0 M, 12.86 mL, 12.86 mmol, 2.0 equiv) was added dropwise over 10 min. After 1 h, MeOH (5 mL) was carefully added, followed saturated aqueous solution of potassium sodium tartrate (50 mL). The vessel was removed from the cooling bath, and the system was allowed to warm to 23 ºC while the mixture was rapidly stirred. After 1 h, the biphasic mixture was transferred to a separatory funnel, and the layers were separated. The aqueous layer was extracted with DCM (2 × 30 mL). The combined organic layers were washed with water (2 × 100 mL) and brine (100 mL), and the washed solution was dried (Na_2SO_4). The dried solution was filtered, and the filtrate was concentrated. The resulting crude residue was purified by flash chromatography (silica gel, eluent: EtOAc:hexanes = 1:15) to afford aldehyde **SI-48** (1.87 g, 95% yield) as a colorless oil.

TLC (EtOAc:hexanes = 1:5): R_f = 0.4 ($KMnO_4$).

^{1}H NMR (400 MHz, $CDCl_3$) δ 9.76 (t, *J* = 2.1 Hz, 1H), 5.88 (dq, *J* = 9.0, 1.3 Hz, 1H), 4.82 (ddd, *J* = 9.0, 7.7, 4.8 Hz, 1H), 2.69 (ddd, *J* = 16.1, 7.7, 2.3 Hz, 1H), 2.57 – 2.47 (m, 1H), 2.30 (d, *J* = 1.3 Hz, 3H), 0.86 (s, 9H), 0.06 (s, 6H).

^{13}C NMR (100 MHz, $CDCl_3$) δ 200.4, 134.3, 121.6, 65.9, 51.2, 25.6, 24.0, 18.0, –4.4, –5.1.

Keto ester SI-50



Preparation of SI-49: A 100-mL round-bottom flask was charged with ethyl 5-(chloromethyl)-1,2,4-oxadizaole-3-carboxylate (3.20 g, 16.8 mmol, 1 equiv) and sodium iodide (12.60 g, 84.0 mmol, 5.0 equiv). Acetone (50 mL) was added, resulting a white suspension. After 3 h, the solvent was removed under vacuum, and EtOAc (100 mL) and water (100 mL) were added. The resulting biphasic mixture was transferred to separatory funnel, and the layers were separated. The organic layer was washed with water (100 mL) and brine (100 mL), and the washed solution was dried (Na_2SO_4). The dried solution was concentrated, the resulting crude residue was purified by flash chromatography (EtOAc:hexanes = 1:3) to afford **SI-49** (3.56 g, 75% yield) as a white solid.

TLC (EtOAc:hexanes = 1:3): R_f = 0.2 (UV).

^{1}H NMR (400 MHz, $CDCl_3$) δ 4.49 (d, *J* = 7.1 Hz, 2H), 4.48 (s, 2H), 1.43 (t, *J* = 7.1 Hz, 3H).

^{13}C NMR (100 MHz, $CDCl_3$) δ 177.9, 162.3, 157.1, 63.2, 14.0, -17.8.

Preparation of SI-50: A 250-mL round-bottom flask containing activated zinc powder (2.80 g, 42.0 mmol, 20.0 equiv) was heated to ≥ 100 ºC at ≤ 1 Torr by means of a heat gun for 1 min and was then flushed with nitrogen (this process was repeated a total of 3 times). After cooling to 23 ºC. THF (42 mL) was added, resulting in a grey suspension. 1,2-dibromoethane (0.36 mL, 4.20 mmol, 2.0 equiv) was added, and the mixture was then heated to reflux by means of an 80 ºC oil bath for 30 min. After cooling to 23 ºC. TMSCl (0.27 mL, 2.10 mmol, 1 equiv) was added. After 15 min, the vessel and its contents were cooled to 0 ºC by means of an ice/water bath, and BF_3•Et_2O (0.52 mL, 4.20 mmol, 2.0 equiv) was added, followed by a solution of **SI-48** (0.65 g, 2.10 mmol, 1 equiv) in THF (8 mL). Then a solution of iodide compound **SI-49** in THF (8 mL) was added dropwise in 10 min, resulting in a deep green solution. After 1.5 h, the aldehyde is entirely consumed as indicated by TLC analysis (EtOAc:hexanes = 1:2, R_f = 0.85), and saturated aqueous ammonium chloride solution (30 mL) was added. The resulting biphasic solution was transferred to a separated funnel, and the layers were separated. The aqueous phase was extracted with EtOAc (2 × 50 ml), and the combined organic layers were washed with water (100 mL) and brine (100 ml). The washed solution was dried (Na_2SO_4), and the dried solution was filtered. The filtrate was concentrated, and the resulting crude residue was purified by flash chromatography (silica gel, eluent: EtOAc:hexanes = 1:7 to 1:9) to afford Reformatsky product **SI-54** (1:1 mixture, 0.81 g, 83% yield) as a colorless oil.

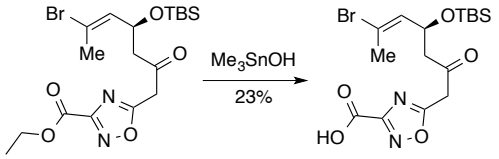
A 1000-mL round-bottom flask containing **SI-54** (0.81 g, 1.75 mmol, 1 equiv) was evacuated and flushed with nitrogen (this process was repeated a total of 3 times). DCM (480 mL) was added, resulting in a colorless solution, and a solution of Dess–Martin periodinane (3.71 g, 8.74 mmol, 5.0 equiv) in CH_2Cl_2 (120 mL) was added. After 1 h, saturated aqueous $Na_2S_2O_3$ solution (50 mL) and saturated aqueous $NaHCO_3$ solution (50 mL) were added, and the mixture was stirred for 1 h. The resulting biphasic mixture was transferred to separatory funnel, and the layers were separated. The organic layer was washed with water (200 mL) and brine (200 ml), and the washed solution was dried (Na_2SO_4). The dried solution was filtered, and the filtrate was concentrated. The resulting crude residue was purified by flash chromatography (silica gel, eluent: eluent: EtOAc:hexanes = 1:7 to 1:9) afford keto ester **SI-50** (0.52 g, 65% yield) as a colorless oil.

TLC (EtOAc:hexanes = 1:3): R_f = 0.7 (UV).

^{1}H NMR (400 MHz, MeOD) δ 5.87 (dd, *J* = 9.1, 1.3 Hz, 1H), 4.93 – 4.88 (m, 1H), 4.48 (q, *J* = 7.1 Hz, 2H), 3.33 (dt, *J* = 3.2, 1.6 Hz, 1H), 2.97 (dd, *J* = 15.9, 7.9 Hz, 1H), 2.77 (dd, *J* = 15.9, 4.7 Hz, 1H), 2.32 (d, *J* = 1.3 Hz, 3H), 1.43 (t, *J* = 7.1 Hz, 3H), 0.88 (d, *J* = 11.9 Hz, 9H), 0.11 – 0.04 (m, 6H).

^{13}C NMR (100 MHz, MeOD) δ 199.8, 175.4, 161.9, 157.5, 134.2, 121.6, 67.7, 66.7, 62.5, 49.4, 24.9, 22.9, 17.5, 12.9, –5.8, –6.2.

Acid SI-51



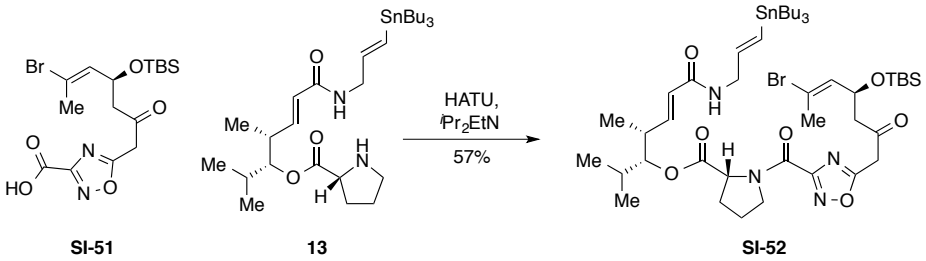
A 100-mL round-bottom flask equipped condenser was charged with ethyl ester **SI-50** (0.13 g, 0.27 mmol, 1 equiv). The vessel was evacuated and flushed with nitrogen (this process was repeated a total of 3 times). DCE (5.4 mL) was added, resulting in a colorless solution. Me_3SnOH (0.25 g, 1.36 mmol, 5.0 equiv) was added, and the vessel and its contents were heated by means of an 80 ºC oil bath for 1 h. After cooling to 23 ºC. the mixture was concentrated and the resulting residue was dissolved with EtOAc (50 mL). Then the solution was washed with 0.1 N $KHSO_4$ (30 mL), water (2 × 50 mL) and brine (50 mL), and the washed solution was dried (Na_2SO_4). The dried solution was filtered, and the filtrate was concentrated. The resulting crude residue was purified by flash chromatography (silica gel, eluent: EtOAC:hexanes =1:2.5) to afford acid **SI-51** (27.0 mg, 23% yield) as a colorless oil which showed a mixture of keto-enol tautomers (2:1) in NMR spectra.

TLC (EtOAc:hexanes = 1:1): R_f = 0.3 (UV).

Keto-form. ^{1}H NMR (300 MHz, $CDCl_3$) δ 5.81 (d, *J* = 8.9 Hz, 1H), 4.84 – 4.72 (m, 1H), 3.53 (s, 2H), 2.83 (dd, *J* = 15.7, 8.0 Hz, 1H), 2.56 (dd, *J* = 15.5, 4.7 Hz, 1H), 2.30 (s, 3H), 0.84 (s, 9H), 0.04 (s, 6H).

Enol-form. ^{1}H NMR (300 MHz, $CDCl_3$) δ 12.77 (s, 1H), 5.82 (d, *J* = 8.9 Hz, 1H), 4.98 (s, 1H), 4.71 – 4.61 (m, 1H), 2.27 (s, 3H), 0.84 (s, 9H), 0.04 (s, 6H).

Stille coupling precursor SI-52



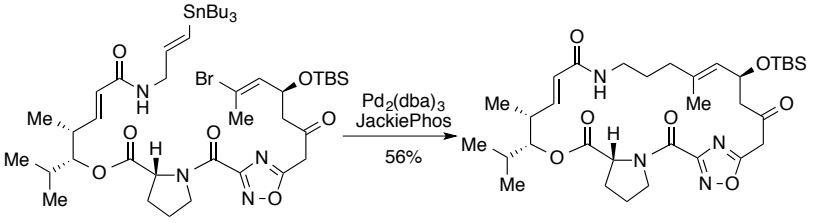
A 25-mL round-bottom flask was charged with amine **13** (32.6 mg, 54.6 µmol, 1 equiv), acid **SI-51** (26.0 mg, 60.0 µmol, 1.1 equiv) and ^{i}Pr$_2$EtN (19.7 µL, 0.11 mmol, 2.0 equiv). DCM (5 mL) was added, resulting in a colorless solution. HATU (25.9 mg, 68.2 µmol, 1.25 equiv) was added to this solution in one portion. After 5 h, the mixture was diluted with DCM (20 mL), and the diluted solution was transferred to a separatory funnel and was washed with water (2 × 20 mL) and brine (20 mL). The washed solution was dried (Na_2SO_4). The dried solution was filtered, and the filtrate was concentrated. The resulting crude residue was purified by flash chromatography (silica gel, eluent: EtOAc:hexanes = 1:6 to 1:4) to Stille coupling precursor **SI-52** (27 mg, 57% yield) as a light-yellow foam.

TLC (EtOAc:hexanes = 1:3): R_f = 0.3 (UV).

^{1}H NMR (300 MHz, $CDCl_3$, mixtures of rotamers) δ 6.67 (dd, *J* = 15.5, 8.0 Hz, 1H), 6.16 – 6.07 (m, 1H), 5.96 (dt, *J* = 19.0, 5.0 Hz, 1H), 5.90 – 5.57 (m, 3H), 4.88 – 4.73 (m, 2H), 4.53 (ddd, *J* = 10.1, 8.3, 3.2 Hz, 1H), 4.08 – 3.87 (m, 2H), 3.62 – 3.54 (m, 1H), 3.47 (dq, *J* = 13.0, 3.9, 3.3 Hz, 2H), 2.87 (dd, *J* = 16.2, 7.8 Hz, 1H), 2.70 – 2.50 (m, 2H), 2.34 – 2.15

(m, 4H), 2.12 – 1.83 (m, 4H), 1.58 – 1.42 (m, 6H), 1.37 – 1.17 (m, 9H), 1.10 – 1.00 (m, 3H), 1.00 – 0.77 (m, 27H), 0.10 – 0.00 (m, 6H).

Stille coupling product SI-53



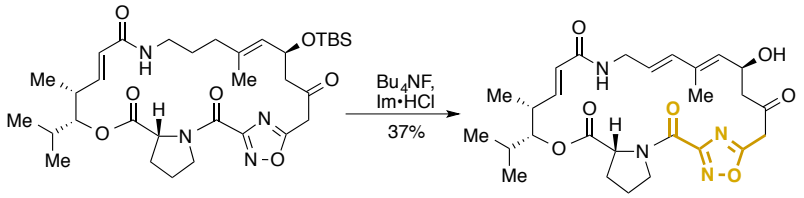
SI-52 **SI-53**

A 25-mL round-bottom flask containing JackiePhos (4.1 mg, 5.1 µmol, 0.2 equiv), $Pd_2(dba)_3$ (2.4 mg, 2.6 µmol, 0.1 equiv) and Stille coupling precursor **SI-52** (26 mg, 26 µmol, 1 equiv) was evacuated and flushed with nitrogen (this process was repeated a total of 3 times). Toluene (5.2 mL) was added, resulting in a red suspension. A stream of argon was passed through the solution by a stainless steel needle for 30 min. The mixture was heated by means of a 50 ºC oil bath. After 15 h, **SI-52** was entirely consumed as indicated by TLC analysis (EtOAc:hexanes = 1:1), and the mixture was allowed to cool to 23 ºC. The mixture was concentrated, and the resulting crude residue was purified by flash chromatography (silica gel, eluent: EtOAc:hexanes = 1:2 to to 1:1) to afford Stille coupling product **SI-53** (9.3 mg, 56% yield).

TLC (EtOAc:hexanes = 1:1): R_f = 0.15 (UV).

^{1}H NMR (300 MHz, $CDCl_3$) δ 6.56 (dd, *J* = 16.2, 5.6 Hz, 1H), 6.13 (d, *J* = 16.2 Hz, 1H), 5.97 – 5.78 (m, 2H), 5.78 – 5.58 (m, 2H), 4.99 (td, *J* = 10.2, 3.4 Hz, 1H), 4.83 (dd, *J* = 10.4, 2.3 Hz, 1H), 4.60 -4.40 (m, 2H), 3.55 (d, *J* = 18.9 Hz, 1H), 3.44 – 3.18 (m, 4H), 3.12 – 2.95 (m, 1H), 2.84 – 2.68 (m, 1H), 2.58 (dd, *J* = 17.5, 3.4 Hz, 1H), 2.20 – 1.70 (m, 5H), 1.82 (s, 3H), 1.08 (d, *J* = 6.7 Hz, 3H), 1.03 (d, *J* = 6.5 Hz, 3H), 0.98 (d, *J* = 6.7 Hz, 3H), 0.85 (s, 9H), 0.05 (s, 3H), 0.01 (s, 3H).

Analogue 28



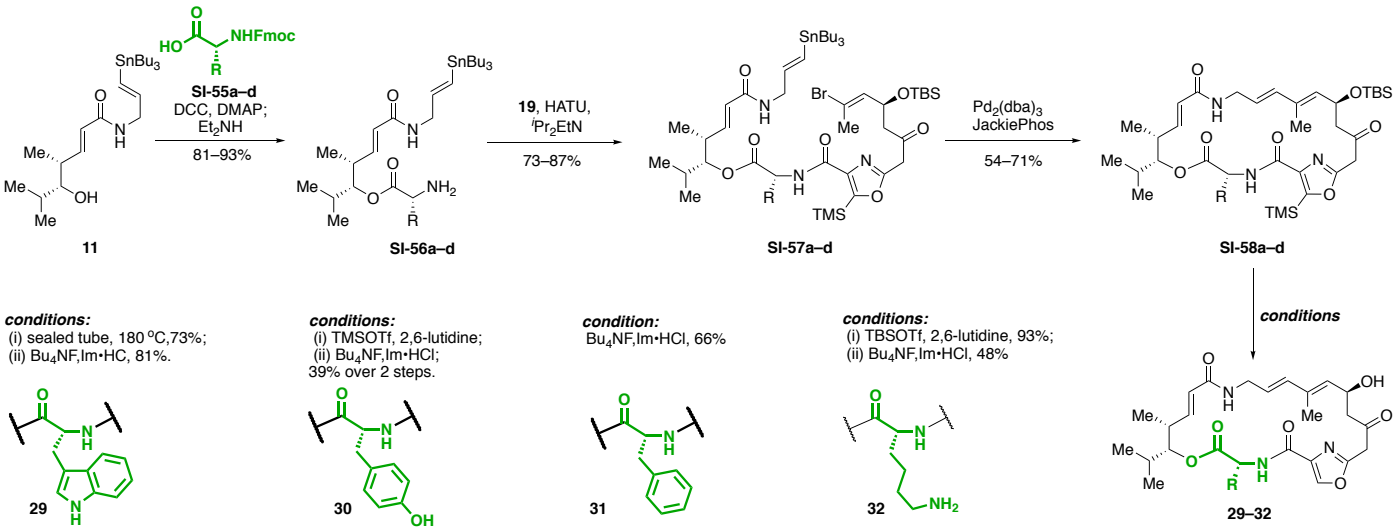
SI-53 **28**

A 25-mL round-bottom flask containing Stille coupling product **SI-53** (9.3 mg, 14.5 µmol, 1 equiv) was evacuated and flushed with nitrogen (this process was repeated a total of 3 times). THF (2 ml) was added, resulting in a light-yellow solution. In a separate flask, Im•HCl (30 mg, 0.29 mmol, 20.0 equiv) that had previously been dried at >100 ºC for 10 minutes under vacuum was added to a solution of tetrabutylammonium fluoride in THF (1 M, 0.29 mL, 0.29 mmol, 20.0 equiv). The resulting colorless solution was added to the solution of **SI-53**. After 72 h, the mixture was concentrated, and the residue was dissolved in DCM (50 mL). The resulting solution was transferred to a separatory funnel and was washed with water (5 × 50 mL) and brine (50 mL). The washed solution was dried (Na_2SO_4), and the dried solution was filtered. The filtrate was concentrated, the resulting crude residue was purified by preparative TLC (eluent: MeOH:DCM = 1:25) to afford analogue **28** (2.8 mg, 37% yield) as a white solid.

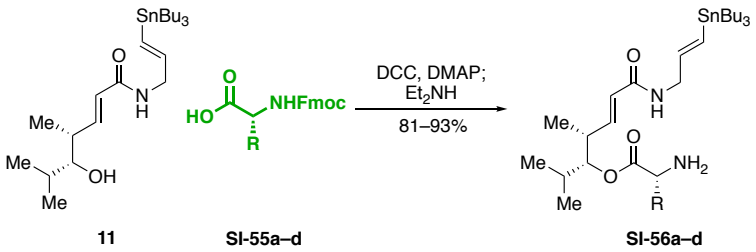
TLC (MeOH:DCM = 1:20): R_f = 0.40 (UV).

^{1}H NMR (300 MHz, $CDCl_3$) δ 6.57 (dd, *J* = 16.3, 5.6 Hz, 1H), 6.12 (dt, *J* = 15.7, 2.0 Hz, 1H), 5.98 – 5.82 (m, 3H), 5.71 (dt, *J* = 16.2, 3.3 Hz, 1H), 4.98 (dd, *J* = 10.2, 6.9 Hz, 1H), 4.81 (dd, *J* = 10.4, 2.2 Hz, 1H), 4.61 – 4.44 (m, 2H), 3.56 (d, *J* = 18.8 Hz, 1H), 3.43 (d, *J* = 12.6 Hz, 1H), 3.35 (d, *J* = 12.7 Hz, 1H), 3.28 (ddd, *J* = 10.7, 7.1, 4.1 Hz, 1H), 3.09 (td, *J* = 9.9, 8.7, 4.9 Hz, 1H), 3.01 – 2.89 (m, 2H), 2.82 – 2.67 (m, 1H), 2.73 (dd, *J* = 17.0, 3.4 Hz, 1H), 2.20 – 2.03 (m, 1H), 2.03 – 1.90 (m, 2H), 1.87 (d, *J* = 1.2 Hz, 3H), 1.84 – 1.72 (m, 2H), 1.09 (d, *J* = 6.8 Hz, 3H), 1.02 (d, *J* = 6.5 Hz, 3H), 0.98 (d, *J* = 6.8 Hz, 3H).

Scheme X General route to 29–32

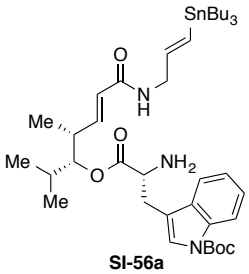


Scheme X-1 General procedure A for preparation of amines SI-56a–d



A 50-mL round-bottom flask was charged with vinyl stannane **11** (0.20 g, 0.40 mmol, 1 equiv), Fmoc-D-amino acid **SI-55a**–**d** (0.60 mmol, 1.5 equiv) and DMAP (10 mg, 80 μmol, 0.2 equiv). DCM (4 mL) was added, resulting in a colorless solution. DCC (0.13 g, 0.64 mmol, 1.6 equiv) was added in one portion, resulting in a white suspension. After 5 h, the alcohol **11** was entirely consumed as indicated by TLC analysis (eluent: EtOAc:hexanes = 1:3), and diethyl amine (2 mL) was added. After an additional 3 h, the mixture was filtered through a pad of celite, and the filter cake was washed with DCM (2 × 20 mL). The filtrate was concentrated, and the resulting crude residue was purified by flash chromatography (silica gel, eluent: NH_4OH:MeOH:DCM = 0.2:1:100 to 0.2:1:50) to afford amine **SI-56a**–**d** as a light-yellow oil.

Amine SI-56a



SI-56a

Prepared according to general procedure A from alcohol **11** (0.20 g, 0.40 mmol, 1 equiv), Fmoc-D-Trp(Boc)-OH (**SI-55a**, 0.32 g, 0.60 mmol, 1.5 equiv), DMAP (10 mg, 80 μmol, 0.2 equiv) and DCC (0.13 g, 0.64 mmol, 1.6 equiv). Amine **SI-56a** (0.28 g, 89% yield) was obtained as a light-yellow oil.

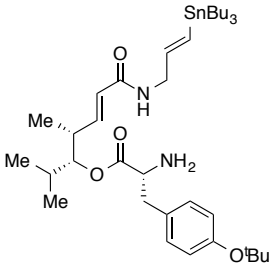
TLC (MeOH:DCM = 1:20): R_f = 0.30 (UV).

^{1}H NMR (400 MHz, $CDCl_3$) δ 8.14 (d, *J* = 8.2 Hz, 1H), 7.60 – 7.53 (m, 1H), 7.49 (s, 1H), 7.32 (ddd, *J* = 8.4, 7.2, 1.3 Hz, 1H), 7.29 – 7.21 (m, 2H), 6.72 (dd, *J* = 15.4, 8.2 Hz, 1H), 6.12 (dt, *J* = 19.0, 1.5 Hz, 1H), 5.96 (dt, *J* = 19.0, 5.1 Hz, 1H), 5.79 (dd, *J* = 15.4, 1.1 Hz, 1H), 5.54 (t, *J* = 5.9 Hz, 1H), 4.86 (dd, *J* = 7.4, 4.7 Hz, 1H), 4.03 – 3.95 (m, 2H), 3.87 (dd, *J* = 8.9, 4.8 Hz, 1H), 3.26 (dd, *J* = 14.5, 4.7 Hz, 1H), 2.86 (dd, *J* = 14.4, 8.9 Hz, 1H), 2.68 – 2.58 (m, 1H), 1.99 – 1.85 (m, 1H), 1.66 (s, 9H), 1.53 – 1.43 (m, 6H), 1.35 – 1.23 (m, 6H), 0.99 (d, *J* = 6.8 Hz, 3H), 0.95 – 0.75 (m, 21H).

^{13}C NMR (100 MHz, $CDCl_3$) δ 174.7, 165.1, 149.6, 145.1, 143.3, 135.6, 130.6, 130.3, 124.5, 124.1, 124.0, 122.5, 118.9, 116.3, 115.4, 83.6, 80.7, 54.6, 44.9, 38.4, 30.9, 29.9, 29.0, 28.2, 27.2, 19.8, 16.5, 15.4, 13.7, 9.4.

HRMS-ESI m/z calcd for $C_{40}H_{66}N_3O_5Sn^+$ $[M + H]^+$ 788.4019, found 788.4017.

Amine SI-56b



SI-56b

Prepared according to general procedure A from alcohol **11** (0.20 g, 0.40 mmol, 1 equiv), Fmoc-D-Tyr(tBu)-OH (**SI-55b**, 0.28 g, 0.60 mmol, 1.5 equiv), DMAP (0.010 g, 0.080 mmol, 0.2 equiv) and DCC (0.13 g, 0.64 mmol, 1.6 equiv). Amine **SI-56b** (0.23 g, 79% yield) was obtained as a light-yellow oil.

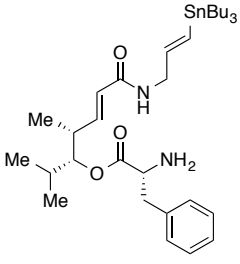
TLC (MeOH:DCM = 1:20): R_f = 0.30 (UV).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.12 (d, *J* = 8.4 Hz, 2H), 6.92 (d, *J* = 8.4 Hz, 2H), 6.69 (dd, *J* = 15.4, 8.2 Hz, 1H), 6.12 (d, *J* = 19.0 Hz, 1H), 5.96 (dt, *J* = 19.0, 5.1 Hz, 1H), 5.77 (dd, *J* = 15.3, 1.1 Hz, 1H), 5.62 (t, *J* = 5.3 Hz, 1H), 4.81 (dd, *J* = 7.2, 4.9 Hz, 1H), 3.98 (t, *J* = 4.8 Hz, 2H), 3.72 (dd, *J* = 8.2, 5.5 Hz, 1H), 3.10 (dd, *J* = 13.7, 5.5 Hz, 1H), 2.74 (dd, *J* = 13.7, 8.4 Hz, 1H), 2.66 – 2.49 (m, 1H), 1.96 – 1.82 (m, 1H), 1.56 – 1.41 (m, 6H), 1.32 (s, 9H), 1.36 – 1.22 (m, 6H), 0.96 (d, *J* = 6.7 Hz, 3H), 0.93 – 0.78 (m, 21H).

^{13}C NMR (100 MHz, $CDCl_3$) δ 174.8, 165.2, 154.1, 145.0, 143.4, 132.2, 130.4, 129.7, 124.3, 123.9, 80.6, 78.4, 56.1, 44.9, 40.5, 38.4, 29.8, 29.0, 28.8, 27.2, 19.8, 16.5, 15.4, 13.7, 9.4.

HRMS-ESI m/z calcd for $C_{37}H_{64}N_2NaO_4Sn^+$ $[M + Na]^+$ 743.3780, found 743.3776.

Amine SI-56c



SI-56c

Prepared according to general procedure A from alcohol **11** (0.20 g, 0.40 mmol, 1 equiv), Fmoc-D-Phe-OH (**SI-55c**, 0.23 g, 0.60 mmol, 1.5 equiv), DMAP (0.010 g, 0.080 mmol, 0.2 equiv) and DCC (0.13 g, 0.64 mmol, 1.6 equiv). Amine **SI-56c** (0.21 g, 81% yield) was obtained as a light-yellow oil.

TLC (MeOH:DCM = 1:20): R_f = 0.30 (UV).

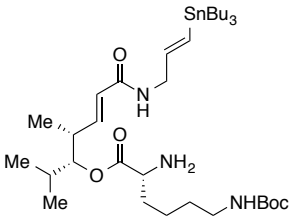
^{1}H NMR (400 MHz, $CDCl_3$) δ 7.34 – 7.27 (m, 2H), 7.25 – 7.19 (m, 3H), 6.70 (dd, *J* = 15.4, 8.0

Hz, 1H), 6.12 (dt, *J* = 19.0, 1.5 Hz, 1H), 5.97 (dt, *J* = 19.0, 5.1 Hz, 1H), 5.81 (dd, *J* = 15.4, 1.2 Hz, 1H), 5.56 (t, *J* = 5.9 Hz, 1H), 4.83 (dd, *J* = 7.2, 4.9 Hz, 1H), 4.02 – 3.95 (m, 2H), 3.75 (dd, *J* = 8.9, 5.0 Hz, 1H), 3.16 (dd, *J* = 13.6, 5.0 Hz, 1H), 2.76 (dd, *J* = 13.6, 8.9 Hz, 1H), 2.68 – 2.56 (m, 1H), 1.98 – 1.82 (m, 1H), 1.57 (br s, 2H), 1.55 – 1.41 (m, 6H), 1.36 – 1.22 (m, 7.3 Hz, 6H), 0.98 (d, *J* = 6.8 Hz, 3H), 0.95 – 0.77 (m, 21H).

^{13}C NMR (100 MHz, $CDCl_3$) δ 174.7, 165.2, 145.1, 143.3, 137.5, 130.5, 129.3, 128.6, 126.8, 123.9, 80.6, 56.1, 44.9, 41.2, 38.3, 29.9, 29.0, 27.2, 19.7, 16.6, 15.2, 13.7, 9.4.

HRMS-ESI m/z calcd for $C_{33}H_{57}N_2O_3Sn^+$ $[M + H]^+$ 649.3386, found 649.3378.

Amine SI-56d



SI-56d

Prepared according to general procedure A from alcohol **11** (0.20 g, 0.40 mmol, 1 equiv), Fmoc-D-Lys(Boc)-OH (**SI-55d**, 0.28 g, 0.60 mmol, 1.5 equiv), DMAP (0.010 g, 0.080 mmol, 0.2 equiv) and DCC (0.13 g, 0.64 mmol, 1.6 equiv). Amine **SI-56d** (0.27 g, 93% yield) was obtained as a light-yellow oil.

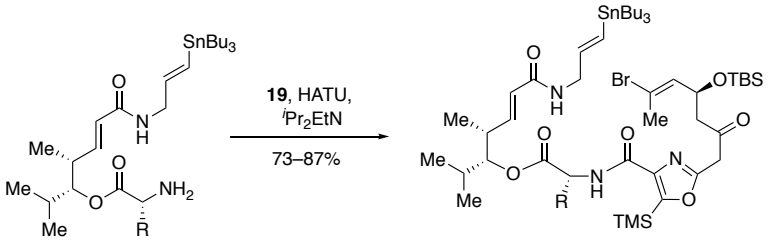
TLC (MeOH:DCM = 1:20): R_f = 0.30 (UV).

^{1}H NMR (400 MHz, $CDCl_3$) δ 6.73 (dd, *J* = 15.2, 7.5 Hz, 1H), 6.09 (d, *J* = 19.0 Hz, 1H), 6.02 – 5.88 (m, 2H), 5.84 (d, *J* = 15.4 Hz, 1H), 4.79 (q, *J* = 6.2 Hz, 2H), 3.97 (t, *J* = 5.4 Hz, 2H), 3.47 (s, 1H), 3.09 (q, *J* = 7.3, 6.7 Hz, 2H), 2.71 – 2.55 (m, 1H), 1.97 – 1.84 (m, 1H), 1.67 – 1.34 (m, 21H), 1.35 – 1.22 (m, 6H), 1.03 (d, *J* = 6.7 Hz, 3H), 0.97 – 0.77 (m, 21H).

^{13}C NMR (100 MHz, $CDCl_3$) δ 175.7, 165.2, 156.1, 145.4, 143.5, 130.1, 123.8, 80.5, 79.0, 54.4, 44.9, 40.3, 38.0, 34.6, 29.8, 29.1, 29.0, 28.4, 27.2, 22.9, 19.6, 17.2, 14.3, 13.6, 9.4.

HRMS-ESI m/z calcd for $C_{35}H_{68}N_3O_5Sn^+$ $[M + H]^+$ 730.4175, found 730.4164.

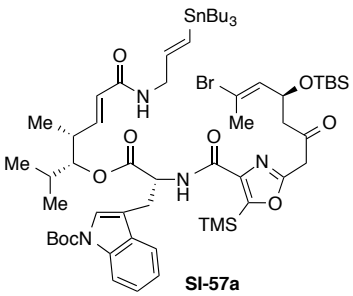
Scheme X-2 General procedure B for preparation of Stille coupling precursors SI-57a–d



SI-56a–d **SI-57a–d**

A 50-mL round-bottom flask was charged with amine **SI-56a–d** (1 equiv), ^{i}Pr$_2$EtN (2.0 equiv) and acid **19 (**1.1 equiv). DCM (about 0.1 M) was added, resulting in a clear, colorless solution, and HATU (1.25 equiv) was added to this solution in one portion. After 5 h, the mixture was diluted with DCM (50 mL). The solution was transferred to a separatory funnel and was washed with water (2 × 50 mL) and brine (50 mL). The washed solution was dried (Na_2SO_4), and the dried solution was filtered. The filtrate was concentrated, and the resulting crude residue was purified by flash chromatography (silica gel, eluent: EtOAc:hexanes = 1:6 to 1:4) to afford Stille coupling precursor **SI-57a–d** as a light-yellow foam.

Stille coupling precursor SI-57a



SI-57a

Prepared according to general procedure B from amine **SI-56a** (0.28 g, 0.36 mmol, 1 equiv), acid **19** (0.20 g, 0.39 mmol, 1.1 equiv), $^{i}Pr_2EtN$ (0.12 mL, 0.71 mmol, 2.0 equiv) and HATU (0.17 g, 0.45 mmol, 1.25 equiv). Stille coupling precursor **SI-57a** (0.35 g, 77% yield) was obtained as a light-yellow oil.

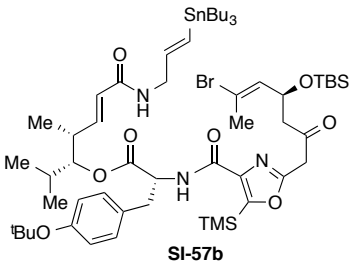
TLC (EtOAc:hexanes = 1:3): R_f = 0.2 (UV).

^{1}H NMR (400 MHz, $CDCl_3$) δ 8.10 (d, *J* = 8.2 Hz, 1H), 7.57 (d, *J* = 7.8 Hz, 1H), 7.47 (s, 1H), 7.41 (d, *J* = 8.7 Hz, 1H), 7.29 (t, *J* = 7.7 Hz, 1H), 7.20 (t, *J* = 7.4 Hz, 1H), 6.66 (dd, *J* = 15.3, 8.1 Hz, 1H), 6.11 (dt, *J* = 19.0, 1.4 Hz, 1H), 5.96 (dt, *J* = 19.1, 5.0 Hz, 1H), 5.85 – 5.78 (m, 1H), 5.78 – 5.65 (m, 2H), 5.11 (dt, *J* = 8.9, 6.4 Hz, 1H), 4.86 – 4.71 (m, 2H), 3.97 (t, *J* = 5.3 Hz, 2H), 3.88 (s, 2H), 3.32 (dd, *J* = 15.0, 6.1 Hz, 1H), 3.24 (dd, *J* = 14.8, 6.7 Hz, 1H), 2.80 (dd, *J* = 15.3, 8.2 Hz, 1H), 2.55 – 2.43 (m, 2H), 2.27 (d, *J* = 1.3 Hz, 3H), 1.89 – 1.76 (m, 1H), 1.64 (s, 9H), 1.56 – 1.40 (m, 6H), 1.35 – 1.20 (m, 6H), 0.99 – 0.82 (m, 27H), 0.81 (d, *J* = 6.7 Hz, 3H), 0.77 (d, *J* = 6.7 Hz, 3H), 0.34 (s, 9H), 0.04 (s, 3H), 0.03 (s, 3H).

^{13}C NMR (100 MHz, $CDCl_3$) δ 200.7, 171.3, 165.3, 161.2, 161.1, 159.6, 149.5, 144.7, 143.5, 135.4, 134.2, 130.4, 130.3, 130.2, 124.5, 124.2, 124.1, 122.6, 121.8, 119.1, 115.2, 115.1, 83.5, 81.6, 67.0, 52.1, 49.6, 44.9, 44.1, 38.1, 29.7, 29.0, 28.2, 27.9, 27.3, 25.7, 24.0, 19.5, 18.0, 16.6, 14.9, 13.7, 9.4, –2.0, –4.6, –5.1.

HRMS-ESI m/z calcd for $C_{48}H_{72}BrN_4O_9Si_2^+$ $[M - SnBu_3 + H]^+$ 983.4016, found 983.4026.

Stille coupling precursor SI-57b



SI-57b

Prepared according to general procedure B from amine **SI-56b** (0.23 g, 0.32 mmol, 1 equiv), acid **19** (0.18 g, 0.35 mmol, 1.1 equiv), $^{i}Pr_2EtN$ (0.11 mL, 0.64 mmol, 2.0 equiv) and HATU (0.15 g, 0.40 mmol, 1.25 equiv). Stille coupling precursor **SI-57b** (0.28 g, 73% yield) was obtained as a light-yellow oil.

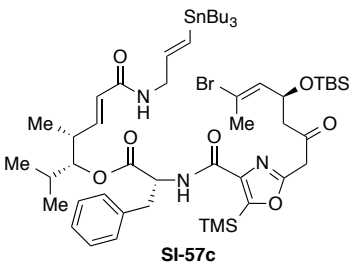
TLC (EtOAc:hexanes = 1:3): R_f = 0.2 (UV).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.30 (d, *J* = 8.9 Hz, 1H), 7.13 (d, *J* = 8.5 Hz, 2H), 6.89 (d, *J* = 8.4 Hz, 2H), 6.66 (dd, *J* = 15.4, 8.2 Hz, 1H), 6.12 (d, *J* = 19.0 Hz, 1H), 5.97 (dt, *J* = 19.0, 5.0 Hz, 1H), 5.90 – 5.70 (m, 3H), 5.05 – 4.95 (m, 1H), 4.83 – 4.72 (m, 2H), 3.98 (t, *J* = 4.7 Hz, 2H), 3.91 (s, 2H), 3.17 (dd, *J* = 14.3, 6.5 Hz, 1H), 3.08 (dd, *J* = 14.0, 6.9 Hz, 1H), 2.83 (dd, *J* = 15.2, 8.2 Hz, 1H), 2.58 – 2.48 (m, 2H), 2.28 (d, *J* = 1.3 Hz, 3H), 1.90 -1.75 (m, 1H), 1.56 – 1.41 (m, 6H), 1.30 (s, 9H), 1.30 – 1.22 (m, 6H), 0.92 – 0.83 (m, 27H), 0.80 (d, *J* = 6.8 Hz, 3H), 0.78 (d, *J* = 6.7 Hz, 3H), 0.33 (s, 9H), 0.05 (s, 3H), 0.05 (s, 3H).

^{13}C NMR (100 MHz, $CDCl_3$) δ 200.8, 171.3, 165.3, 161.1, 160.9, 159.6, 154.2, 144.8, 143.5, 143.5, 134.2, 131.0, 130.2, 129.8, 124.3, 124.2, 121.8, 81.4, 78.4, 67.1, 52.9, 49.7, 44.9, 44.1, 38.1, 37.5, 29.8, 29.0, 28.8, 27.2, 25.7, 24.0, 19.6, 18.0, 16.6, 15.1, 13.7, 9.4, -2.0, -4.6, -5.1.

HRMS-ESI m/z calcd for $C_{57}H_{97}BrN_3O_8Si_2Sn^+$ $[M + H]^+$ 1206.5014, found 1206.5034.

Stille coupling precursor SI-57c



SI-57c

Prepared according to general procedure B from amine **SI-56c** (0.18 g, 0.28 mmol, 1 equiv), acid **19** (0.16 g, 0.31 mmol, 1.1 equiv), $^{i}Pr_2EtN$ (0.10 mL, 0.56 mmol, 2.0 equiv) and HATU (0.13 g, 0.35 mmol, 1.25 equiv). Stille coupling precursor **SI-57c** (0.28 g, 80% yield) was obtained as a light-yellow oil.

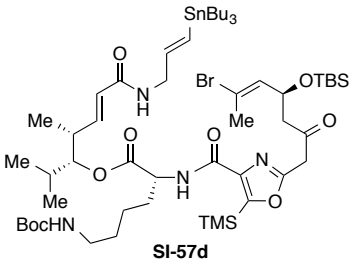
TLC (EtOAc:hexanes = 1:3): R_f = 0.2 (UV).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.37 – 7.16 (m, 6H), 6.67 (dd, *J* = 15.4, 8.0 Hz, 1H), 6.13 (dt, *J* = 19.0, 1.5 Hz, 1H), 5.97 (dt, *J* = 18.9, 5.0 Hz, 1H), 5.86 – 5.74 (m, 3H), 5.08 – 4.98 (m, 1H), 4.82 – 4.74 (m, 2H), 3.99 (t, *J* = 5.2 Hz, 2H), 3.91 (s, 2H), 3.24 (dd, *J* = 14.1, 6.1 Hz, 1H), 3.11 (dd, *J* = 14.0, 7.4 Hz, 1H), 2.83 (dd, *J* = 15.2, 8.2 Hz, 1H), 2.62 – 2.48 (m, 2H), 2.28 (d, *J* = 1.3 Hz, 3H), 1.91 – 1.79 (m, 1H), 1.60 – 1.36 (m, 6H), 1.36 – 1.24 (m, 6H), 1.07 – 0.73 (m, 33H), 0.33 (s, 9H), 0.053 (s, 6H), 0.050 (s, 6H).

^{13}C NMR (100 MHz, $CDCl_3$) δ 200.8, 171.2, 165.3, 161.1, 160.9, 159.6, 144.8, 143.5, 143.4, 136.0, 134.2, 130.2, 129.3, 128.5, 126.9, 124.2, 121.8, 81.4, 67.1, 52.8, 49.6, 44.9, 44.1, 38.1, 37.9, 29.8, 29.0, 27.2, 25.7, 24.0, 19.5, 18.0, 16.6, 14.8, 13.7, 9.4, –2.0, –4.6, –5.2.

HRMS-ESI m/z calcd for $C_{53}H_{89}BrN_3O_7Si_2Sn^+$ $[M + H]^+$ 1134.4439, found 1134.4455.

Stille coupling precursor SI-57d



SI-57d

Prepared according to general procedure B from amine **SI-56d** (0.27 g, 0.37 mmol, 1 equiv), acid **19** (0.21 g, 0.41 mmol, 1.1 equiv), $^{i}Pr_2EtN$ (0.13 mL, 0.74 mmol, 2.0 equiv) and HATU (0.18 g, 0.46 mmol, 1.25 equiv). Stille coupling precursor **SI-57d** (0.39 g, 87% yield) yield was obtained as a light-yellow oil.

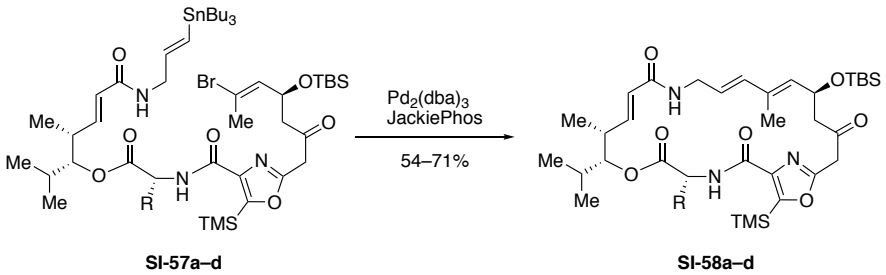
TLC (EtOAc:hexanes = 1:3): R_f = 0.2 (UV).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.35 (d, *J* = 8.6 Hz, 1H), 6.75 (dd, *J* = 15.3, 7.4 Hz, 1H), 6.10 (dt, *J* = 18.9, 1.5 Hz, 1H), 6.05 (s, 1H), 5.96 (dt, *J* = 19.1, 5.1 Hz, 1H), 5.91 – 5.76 (m, 2H), 4.91 – 4.62 (m, 4H), 3.98 (t, *J* = 5.1 Hz, 2H), 3.93 (s, 2H), 3.18 – 3.02 (m, 2H), 2.84 (dd, *J* = 15.3, 8.2 Hz, 1H), 2.71 – 2.60 (m, 1H), 2.53 (dd, *J* = 15.3, 4.6 Hz, 1H), 2.28 (d, *J* = 1.3 Hz, 3H), 2.01 – 1.84 (m, 2H), 1.84 – 1.66 (m, 1H), 1.60 – 1.36 (m, 19H), 1.34 – 1.21 (m, 6H), 1.03 (d, *J* = 6.8 Hz, 3H), 0.99 – 0.70 (m, 30H), 0.34 (s, 9H), 0.05 (s, 6H).

^{13}C NMR (100 MHz, $CDCl_3$) δ 200.8, 171.8, 165.2, 161.1, 161.0, 159.6, 156.1, 145.3, 143.6, 143.5, 134.2, 130.2, 124.0, 121.8, 81.3, 79.1, 67.0, 51.8, 49.7, 44.9, 44.1, 40.3, 37.8, 32.4, 29.8, 29.6, 29.0, 28.4, 27.2, 25.7, 24.0, 22.7, 19.5, 18.0, 17.3, 14.0, 13.7, 9.4, –2.0, –4.6, –5.1.

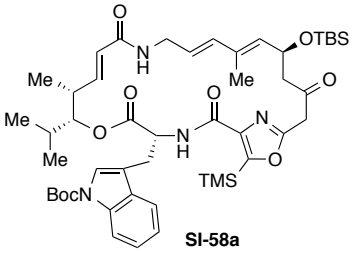
HRMS-ESI m/z calcd for $C_{55}H_{100}BrN_4O_9Si_2Sn^+$ $[M + H]^+$ 1215.5229, found 1215.5249.

Scheme X-3 General procedure C for preparation of Stille coupling products SI-58a–d



A round-bottom flask containing JackiePhos (0.2 equiv), $Pd_2(dba)_3$ (0.1 equiv) and Stille coupling precursor **SI-57a–d** (1 equiv) was evacuated and flushed with nitrogen (this process was repeated a total of 3 times). Toluene (about 0.005 M) was added, resulting in a red suspension. A stream of argon was passed through the solution by a stainless steel needle for 30 min. The mixture was heated by means of a 50 ºC oil bath. After 3 – 12 h, **SI-57a–d** was entirely consumed as indicated by TLC analysis (eluent: EtOAc:hexanes = 1:2), and the mixture was allowed to cool to 23 ºC. The mixture was concentrated, and the resulting crude residue was purified by flash chromatography (silica gel, eluent: EtOAc:hexanes = 1:3 to 1:1.5) to afford Stille coupling product **SI-58a–d** as a light-yellow foam.

Stille coupling product SI-58a



SI-58a

Prepared according to general procedure C from JackiePhos (44 mg, 55 μmol, 0.2 equiv), $Pd_2(dba)_3$ (25 mg, 28 μmol, 0.1 equiv) and Stille couping precursor **SI-57a** (0.35 g, 0.28 mmol, 1 equiv). Stille coupling product **SI-58a** (0.18 g, 71% yield) was obtained as a light-yellow foam.

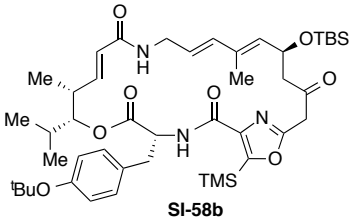
TLC (EtOAc:hexanes = 1:2): R_f = 0.2 (UV).

^{1}H NMR (400 MHz, $CDCl_3$) δ 8.09 (d, *J* = 8.2 Hz, 1H), 7.55 – 7.37 (m, 3H), 7.27 (t, *J* = 7.4 Hz, 1H), 7.17 (d, *J* = 7.4 Hz, 1H), 6.45 (dd, *J* = 16.2, 5.5 Hz, 1H), 6.19 (d, *J* = 15.7 Hz, 1H), 5.87 (dd, *J* = 7.9, 4.0 Hz, 1H), 5.79 (dd, *J* = 16.2, 1.7 Hz, 1H), 5.60 (ddd, *J* = 15.7, 7.9, 3.7 Hz, 1H), 5.45 (d, *J* = 8.9 Hz, 1H), 5.13 (td, *J* = 8.7, 4.7 Hz, 1H), 4.93 (td, *J* = 8.7, 5.3 Hz, 1H), 4.76 (dd, *J* = 10.1, 1.9 Hz, 1H), 4.44 – 4.30 (m, 1H), 3.88 (d, *J* = 17.4 Hz, 1H), 3.71 (d, *J* = 17.4 Hz, 1H), 3.64 (ddd, *J* = 11.6, 7.8, 3.9 Hz, 1H), 3.32 (dd, *J* = 15.2, 4.8 Hz, 1H), 2.93 (dt, *J* = 14.4, 8.8 Hz, 2H), 2.82 (dd, *J* = 14.4, 5.3 Hz, 1H), 2.78 – 2.68 (m, 1H), 2.04 – 1.92 (m, 1H), 1.63 (s, 9H), 1.63 (s, 3H), 1.03 (d, *J* = 6.8 Hz, 3H), 0.96 (d, *J* = 7.0 Hz, 2H), 0.94 (d, *J* = 6.7 Hz, 4H), 0.85 (s, 9H), 0.27 (s, 9H), 0.04 (s, 3H), 0.01 (s, 3H).

^{13}C NMR (100 MHz, $CDCl_3$) δ 201.1, 172.6, 166.7, 161.0, 160.5, 159.9, 149.5, 144.2, 143.4, 135.2, 133.6, 133.4, 130.3, 125.1, 124.5, 124.4, 123.7, 122.6, 118.9, 115.4, 115.2, 83.6, 83.3, 66.3, 51.4, 50.2, 43.9, 41.1, 37.0, 29.5, 29.0, 28.2, 25.8, 19.9, 18.7, 18.1, 13.0, 10.1, –2.1,– 4.5, –5.0.

HRMS-ESI m/z calcd for $C_{48}H_{71}N_4O_9Si_2^+$ $[M + H]^+$ 903.4754, found 903.4737.

Stille coupling product SI-58b



SI-58b

Prepared according to general procedure C from JackiePhos (37 mg, 47 μmol, 0.2 equiv), $Pd_2(dba)_3$ (22 mg, 24 μmol, 0.1 equiv) and Stille coupling precursor **SI-57b** (0.28 g, 0.24 mmol, 1 equiv). Stille coupling product **SI-58b** (0.11 g, 54% yield) was obtained as a light-yellow foam.

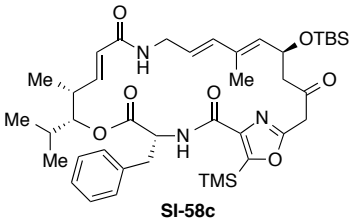
TLC (EtOAc:hexanes = 1:2): R_f = 0.2 (UV).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.33 (d, *J* = 8.9 Hz, 1H), 7.05 (d, *J* = 8.4 Hz, 2H), 6.84 (d, *J* = 8.4 Hz, 2H), 6.40 (dd, *J* = 16.2, 5.2 Hz, 1H), 6.20 (d, *J* = 15.8 Hz, 1H), 5.83 (dd, *J* = 8.1, 3.9 Hz, 1H), 5.78 (dd, *J* = 16.2, 1.8 Hz, 1H), 5.64 (ddd, *J* = 15.7, 8.2, 3.8 Hz, 1H), 5.45 (d, *J* = 8.9 Hz, 1H), 5.04 (td, *J* = 8.3, 5.1 Hz, 1H), 4.95 (td, *J* = 8.6, 5.6 Hz, 1H), 4.75 (dd, *J* = 10.2, 1.8 Hz, 1H), 4.47 – 4.33 (m, 1H), 3.90 (d, *J* = 17.4 Hz, 1H), 3.73 (d, *J* = 17.4 Hz, 1H), 3.64 (ddd, *J* = 15.7, 8.2, 3.8 Hz, 1H), 3.23 (dd, *J* = 14.4, 5.2 Hz, 1H), 2.94 – 2.67 (m, 4H), 2.03 – 1.90 (m, 1H), 1.73 (d, *J* = 1.2 Hz, 3H), 1.28 (s, 9H), 1.04 (d, *J* = 6.8 Hz, 3H), 0.95 (d, *J* = 6.8 Hz, 3H), 0.92 (d, *J* = 6.5 Hz, 3H), 0.86 (s, 9H), 0.29 (s, 9H), 0.05 (s, 3H), 0.02 (s, 3H).

^{13}C NMR (100 MHz, $CDCl_3$) δ 201.3, 172.5, 166.6, 160.7, 160.4, 159.8, 154.2, 144.2, 143.4, 135.4, 133.6, 133.5, 130.7, 129.6, 125.3, 124.4, 124.1, 83.1, 78.3, 66.3, 52.1, 50.2, 44.0, 41.1, 38.0, 36.9, 29.5, 28.8, 25.8, 19.9, 18.7, 18.1, 13.0, 10.2, –2.1, –4.4, –5.0.

HRMS-ESI m/z calcd for $C_{45}H_{70}N_3O_8Si_2^+$ $[M + H]^+$ 836.4696, found 836.4712.

Stille coupling product SI-58c



SI-58c

Prepared according to general procedure C from JackiePhos (28 mg, 35 μmol, 0.2 equiv), $Pd_2(dba)_3$ (16 mg, 18 μmol, 0.1 equiv) and Stille coupling precursor **SI-57c** (0.20 g, 0.18 mmol, 1 equiv). Stille coupling product **SI-58c** (77 mg, 57% yield) was obtained as a light-yellow foam.

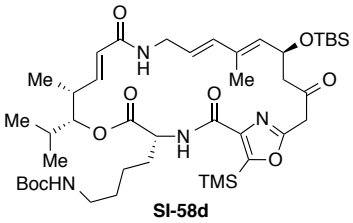
TLC (EtOAc:hexanes = 1:2): R_f = 0.2 (UV).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.30 (d, *J* = 8.9 Hz, 1H), 7.25 – 7.15 (m, 3H), 7.12 (dd, *J* = 7.8, 1.7 Hz, 2H), 6.42 (dd, *J* = 16.3, 5.0 Hz, 1H), 6.18 (d, *J* = 15.6 Hz, 1H), 5.86 – 5.74 (m, 2H), 5.52 (ddd, *J* = 15.2, 8.2, 3.5 Hz, 1H), 5.43 (d, *J* = 8.9 Hz, 1H), 5.06 (ddd, *J* = 9.0, 7.5, 5.2 Hz, 1H), 4.93 (td, *J* = 8.8, 5.3 Hz, 1H), 4.75 (dd, *J* = 10.2, 1.8 Hz, 1H), 4.52 – 4.35 (m, 1H), 3.89 (d, *J* = 17.5 Hz, 1H), 3.73 (d, *J* = 17.6 Hz, 1H), 3.56 (ddd, *J* = 15.8, 8.4, 3.4 Hz, 1H), 3.29 (dd, *J* = 14.2, 5.3 Hz, 1H), 2.94 – 2.68 (m, 4H), 2.06 – 1.94 (m, 6.6 Hz, 1H), 1.67 (s, 3H), 1.08 (d, *J* = 6.9 Hz, 3H), 0.95 (d, *J* = 6.8 Hz, 3H), 0.93 (d, *J* = 6.4 Hz, 3H), 0.85 (s, 9H), 0.29 (s, 9H), 0.04 (s, 3H), 0.02 (s, 3H).

^{13}C NMR (100 MHz, $CDCl_3$) δ 201.4, 172.5, 166.7, 160.7, 160.5, 159.8, 144.1, 143.3, 135.7, 135.4, 133.6, 133.4, 129.3, 128.4, 126.9, 125.4, 124.5, 83.5, 66.4, 52.1, 50.2, 44.1, 41.1, 38.5, 36.8, 29.5, 25.7, 19.9, 18.7, 18.1, 13.1, 10.1, –2.1, –4.5, –5.0.

HRMS-ESI m/z calcd for $C_{41}H_{61}N_3NaO_7Si_2^+$ $[M + Na]^+$ 786.3940, found 786.3914.

Stille coupling product SI-58d



SI-58d

Prepared according to general procedure C from JackiePhos (0.052 g, 0.065 mmol, 0.2 equiv), $Pd_2(dba)_3$ (0.030 g, 0.033 mmol, 0.1 equiv) and Stille coupling precursor **SI-57d** (0.39 g, 0.33 mmol, 1 equiv). Stille coupling product **SI-58d** (0.17 g, 62% yield) was obtained as a light-yellow foam.

TLC (EtOAc:hexanes = 1:2): R_f = 0.2 (UV).

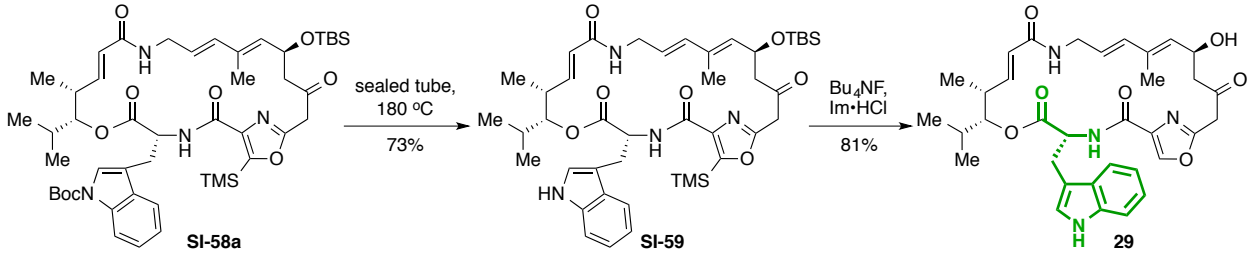
^{1}H NMR (400 MHz, $CDCl_3$) δ 7.37 (d, *J* = 9.0 Hz, 1H), 6.65 (dd, *J* = 15.8, 4.5 Hz, 1H), 6.47 (s, 1H), 6.22 (d, *J* = 15.6 Hz, 1H), 5.86 (dd, *J* = 16.0, 1.9 Hz, 1H), 5.64 – 5.51 (m, 1H), 5.47 (d, *J* = 9.0 Hz, 1H), 5.07 – 4.90 (m, 2H), 4.82 (d, *J* = 10.2 Hz, 1H), 4.80 – 4.70 (m, 1H), 4.25 – 4.11 (m, 1H), 3.91 (d, *J* = 17.2 Hz, 1H), 3.86 – 3.78 (m, 1H), 3.74 (d, *J* = 17.1 Hz, 1H), 3.10 (dt, *J* = 13.2, 6.6 Hz, 1H), 3.05 – 2.91 (m, 2H), 2.85 (dd, *J* = 15.0, 5.6 Hz, 1H), 2.80 – 2.67 (m, 1H), 2.25 – 2.05

(m, 1H), 2.02 – 1.84 (m, 2H), 1.68 (s, 3H), 1.65 – 1.47 (m, 3H), 1.42 (s, 9H), 1.09 (d, J = 6.8 Hz, 3H), 0.95 (d, J = 6.8 Hz, 3H), 0.89 (d, J = 6.3 Hz, 3H), 0.85 (s, 9H), 0.34 (s, 9H), 0.03 (s, 3H), 0.01 (s, 3H).

^{13}C NMR (100 MHz, $CDCl_3$) δ 201.3, 172.2, 166.1, 160.9, 160.2, 159.9, 156.2, 145.4, 143.6, 135.4, 133.9, 133.0, 125.2, 124.0, 82.2, 79.1, 66.1, 50.9, 50.3, 43.9, 40.9, 40.3, 36.6, 32.6, 29.8, 29.5, 28.4, 25.8, 22.2, 19.8, 18.7, 18.1, 13.0, 10.0, –2.0, –4.5, –5.0.

HRMS-ESI m/z calcd for $C_{43}H_{72}N_4NaO_9Si_2^+$ $[M + Na]^+$ 867.4730, found 867.4721.

Analogue 29



A 25-mL sealed tube containing Stille coupling product **SI-58a** (40 mg, 45 µmol, 1 equiv) was evacuated and flushed with nitrogen (this process was repeated a total of 3 times). *O*-dichlorobenzene (4.5 mL) was added, resulting in a colorless solution, and the sealed tube was quickly sealed with a TFP cap. The sealed tube and its contents were heated by means of a 180 ºC oil bath, After 2 h, **SI-58a** was entirely consumed as indicated by TLC analysis (eluent: EtOAc:hexanes = 1:2), and the mixture was allowed to cool to 23 ºC. The mixture was directly purified by flash chromatography (silica gel, eluent: EtOAc:hexanes = 1:2) to afford compound **SI-59** (26 mg, 73% yield) as a white solid.

TLC (EtOAc:hexanes = 1:2): R_f = 0.1 (UV).

^{1}H NMR (400 MHz, $CDCl_3$) δ 8.20 (s, 1H), 7.53 (d, J = 8.5 Hz, 1H), 7.47 (d, J = 7.9 Hz, 1H), 7.25 (d, J = 7.9 Hz, 1H), 7.10 (t, J = 7.5 Hz, 1H), 7.03 – 6.93 (m, 2H), 6.42 (dd, J = 16.1, 5.2 Hz, 1H), 6.11 (d, J = 15.7 Hz, 1H), 5.77 (dd, J = 8.0, 4.1 Hz, 1H), 5.68 (dd, J = 16.2, 1.8 Hz, 1H), 5.58 (ddd, J = 15.8, 7.2, 3.8 Hz, 1H), 5.35 (d, J = 9.0 Hz, 1H), 5.13 (dt, J = 8.5, 5.3 Hz, 1H), 4.88 (ddd, J = 8.8, 7.5, 6.2 Hz, 1H), 4.81 (dd, J = 10.1, 1.8 Hz, 1H), 4.40 (dd, J = 14.8, 7.9 Hz, 1H), 3.84 (d, J = 17.2 Hz, 1H), 3.69 (d, J = 17.2 Hz, 1H), 3.66 – 3.58 (m, 1H), 3.50 (dd, J = 15.3, 4.8 Hz, 1H), 3.19 (dd, J = 15.3, 5.8 Hz, 1H), 2.86 (dd, J = 14.4, 6.3 Hz, 1H), 2.78 – 2.66 (m, 1H), 2.56 (dd, J = 14.4, 7.6 Hz, 1H), 2.07 – 1.89 (m, 1H), 1.61 (s, 3H), 1.00 (d, J = 6.9 Hz, 3H), 0.95 (d, J = 6.9 Hz, 3H), 0.93 (d, J = 6.7 Hz, 3H), 0.83 (s, 9H), 0.33 (s, 9H), 0.02 (s, 3H), -0.01 (s, 3H).

^{13}C NMR (100 MHz, $CDCl_3$) δ 201.5, 172.4, 166.7, 161.0, 160.2, 159.7, 145.3, 143.6, 135.9, 134.9, 134.0, 132.8, 127.7, 125.0, 124.3, 123.0, 122.0, 119.3, 118.7, 111.0, 109.7, 83.4, 66.3, 52.3, 49.6, 44.1, 40.9, 36.6, 29.7, 27.8, 25.7, 19.9, 18.8, 18.1, 13.0, 10.4, –2.0, –4.5, –5.0.

HRMS-ESI m/z calcd for $C_{43}H_{63}N_4O_7Si_2^+$ $[M + H]^+$ 803.4230, found 803.4214.

A 50-mL round-bottom flask containing **SI-59** (13 mg, 16 µmol, 1 equiv) was evacuated and flushed with nitrogen (this process was repeated a total of 3 times). THF (1.6 mL) was added, resulting in a light-yellow solution. In a separate flask, Im•HCl (17 mg, 0.16 mmol, 10.0 equiv) that had previously been dried at >100 ºC for 10 minutes under vacuum was added to a solution of tetrabutylammonium fluoride in THF (1 M, 0.16 mL, 0.16 mmol, 10.0 equiv). The resulting colorless solution was added dropwise to the solution of **SI-59**. After 12 h, the mixture was concentrated, and the residue was dissolved in DCM (50 mL). The resulting solution was transferred to a separatory funnel and was washed with

water (5 × 50 mL) and brine (50 mL). The washed solution was dried (Na_2SO_4). The dried solution was filtered, and the filtrate was concentrated. The resulting crude residue was purified by preparative TLC (silica gel, eluent: MeOH:DCM = 1:20) to afford analogue **29** (8 mg, 81% yield) as a white solid.

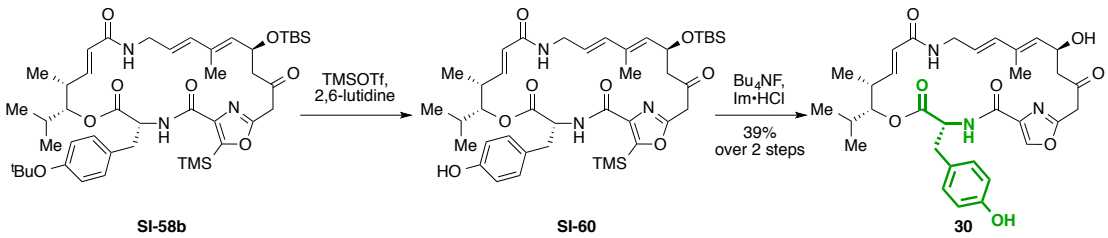
TLC (MeOH:DCM = 1:20): R_f = 0.1 (UV).

^{1}H NMR (400 MHz, CD_2Cl_2) δ 8.35 (s, 1H), 8.05 (s, 1H), 7.52 (d, *J* = 7.9 Hz, 1H), 7.35 (d, *J* = 8.4 Hz, 1H), 7.26 (d, *J* = 8.1 Hz, 1H), 7.10 (t, *J* = 7.3 Hz, 1H), 7.05 (d, *J* = 2.2 Hz, 1H), 6.99 (t, *J* = 7.2 Hz, 1H), 6.58 (dd, *J* = 16.0, 5.6 Hz, 1H), 6.01 (d, *J* = 15.9 Hz, 1H), 5.98 – 5.93 (m, 1H), 5.84 (dd, *J* = 16.0, 1.8 Hz, 1H), 5.70 (ddd, *J* = 15.8, 6.2, 3.6 Hz, 1H), 5.17 (d, *J* = 8.5 Hz, 1H), 5.02 (ddd, *J* = 8.5, 6.5, 4.7 Hz, 1H), 4.86 (dd, *J* = 10.1, 1.9 Hz, 1H), 4.82 – 4.72 (m, 1H), 4.40 – 4.27 (m, 1H), 3.80 (d, *J* = 16.9 Hz, 1H), 3.72 (d, *J* = 16.9 Hz, 1H), 3.76 – 3.69 (m, 1H), 3.49 (dd, *J* = 15.1, 4.7 Hz, 1H), 3.20 (dd, *J* = 15.2, 6.5 Hz, 1H), 2.80 – 2.71 (m, 1H), 2.76 (dd, *J* = 16.0, 6.8 Hz, 1H), 2.62 (dd, *J* = 16.1, 6.1 Hz, 1H), 2.36 (br s, 1H), 2.09 – 1.95 (m, 1H), 1.70 (s, 3H), 1.12 (d, *J* = 6.9 Hz, 3H), 0.98 (d, *J* = 6.8 Hz, 3H), 0.94 (d, *J* = 6.5 Hz, 3H).

^{13}C NMR (100 MHz, CD_2Cl_2) δ 202.4, 172.1, 166.6, 163.2, 160.1, 158.3, 146.2, 141.6, 136.5, 135.4, 134.3, 132.7, 128.0, 126.2, 124.8, 124.0, 122.2, 119.6, 118.9, 111.6, 109.9, 83.8, 65.3, 53.0, 48.8, 43.8, 40.8, 37.0, 30.2, 27.9, 19.9, 18.9, 13.1, 11.0.

HRMS-ESI m/z calcd for $C_{34}H_{40}N_4NaO_7^+$ $[M + Na]^+$ 639.2789, found 639.2790.

Analogue 30



A 25-mL round-bottom flask containing Stille coupling product **SI-58b** (10 mg, 12 µmol, 1 equiv) was evacuated and flushed with nitrogen (this process was repeated a total of 3 times). DCM (1 mL) was added, resulting in a colorless solution. After cooling to 0 ºC. 2,6-lutidine (33 µL, 287 µmol, 24.0 equiv) was added, followed by TMSOTf (43 µL, 239 µmol, 20.0 equiv). Then the mixture was allowed to warm to 23 ºC. After 36 h, DCM (30 mL) was added, and the resulting solution was transferred to a separatory funnel and was washed with water (3 × 50 mL) and brine (50 mL). The washed solution was dried (Na_2SO_4). The dried solution was filtered, and the filtrate was concentrated. The resulting crude residue **SI-60** was used for next step without further purification.

A 50-mL round-bottom flask containing **SI-60** was evacuated and flushed with nitrogen (this process was repeated a total of 3 times). THF (1.6 mL) was added, resulting in a light-yellow solution. In a separate flask, Im•HCl (13 mg, 0.12 mmol, 10.0 equiv) that had previously been dried at >100 ºC for 10 minutes under vacuum was added to a solution of tetrabutylammonium fluoride in THF (1 M, 0.12 mL, 0.12 mmol, 10.0 equiv). The resulting colorless solution was added dropwise to the solution of **SI-60**. After 12 h, the mixture was concentrated, and the residue was dissolved in DCM (50 mL). The resulting solution was transferred to a separatory funnel and was washed with water (5 × 50 mL) and brine (50 mL). The washed solution was dried (Na_2SO_4). The dried solution was filtered, and the filtrate was concentrated. The resulting crude residue was purified by preparative TLC (silica gel, eluent: MeOH:DCM = 1:20) to afford **30** (2.8 mg, 39% yield over 2 steps) as a white solid.

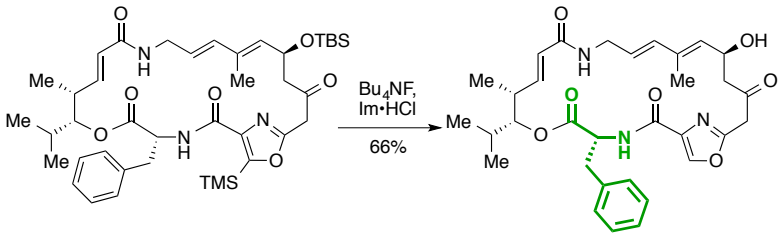
TLC (MeOH:DCM = 1:20): R_f = 0.1 (UV).

^{1}H NMR (400 MHz, CD_2Cl_2)) δ 8.07 (s, 1H), 7.22 (d, *J* = 8.5 Hz, 1H), 6.94 (d, *J* = 8.4 Hz, 2H), 6.68 (d, *J* = 8.5 Hz, 2H), 6.55 (dd, *J* = 16.2, 5.0 Hz, 1H), 6.11 (d, *J* = 15.5 Hz, 1H), 6.10 (br s, 1H), 5.84 (m, 1H), 5.54 (ddd, *J* = 15.7, 8.0, 3.6 Hz, 1H), 5.40 (d, *J* = 8.9 Hz, 1H), 4.95 – 4.84 (m, 2H), 4.78 (dd, *J* = 10.1, 1.9 Hz, 1H), 4.35 – 4.20 (m, 1H), 3.89 (d, *J* = 17.3 Hz, 1H), 3.80 (d, *J* = 17.2 Hz, 1H), 3.61 (ddd, *J* = 16.0, 8.2, 4.2 Hz, 1H), 3.24 (dd, *J* = 14.3, 4.9 Hz, 1H), 2.97 – 2.77 (m, 4H), 2.10 – 1.90 (m, 1H), 1.67 (s, 3H), 1.13 (d, *J* = 6.9 Hz, 3H), 0.97 (d, *J* = 6.7 Hz, 3H), 0.93 (d, *J* = 6.4 Hz, 3H).

^{13}C NMR (100 MHz, CD_2Cl_2) δ 202.1, 172.4, 167.3, 160.3, 158.4, 156.01 145.6, 142.1, 136.2, 135.7, 135.6, 132.6, 130.8, 127.3, 126.3, 124.6, 115.9, 84.0, 65.7, 49.4, 44.1, 41.4, 37.3, 37.2, 30.0, 29.0, 20.0, 18.9, 13.2, 10.5.

HRMS-ESI m/z calcd for $C_{32}H_{39}N_3NaO_8^+$ $[M + Na]^+$ 616.2969, found 616.2969.

Analogue 31



SI-58c **31**

A 50-mL round-bottom flask containing **SI-58c** (40 mg, 52 μmol, 1 equiv) was evacuated and flushed with nitrogen (this process was repeated a total of 3 times). THF (5.2 mL) was added, resulting in a light-yellow solution. In a separate flask, Im•HCl (55 mg, 0.52 mmol, 10.0 equiv) that had previously been dried at >100 ºC for 10 minutes under vacuum was added to a solution of tetrabutylammonium fluoride in THF (1 M, 0.52 mL, 0.52 mmol, 10.0 equiv). The resulting colorless solution was added dropwise to the solution of **SI-58c**. After 12 h, the mixture was concentrated, and the residue was dissolved in DCM (50 mL). The resulting solution was transferred to a separatory funnel and was washed with water (5 × 50 mL) and brine (50 mL). The washed solution was dried (Na_2SO_4), and the dried solution was filtered. The filtrate was concentrated, and the resulting crude residue was purified by flash chromatography (silica gel, eluent: MeOH:DCM = 1:100 to 1:50) to afford analogue **31** (20 mg, 66% yield) as a light-yellow solid.

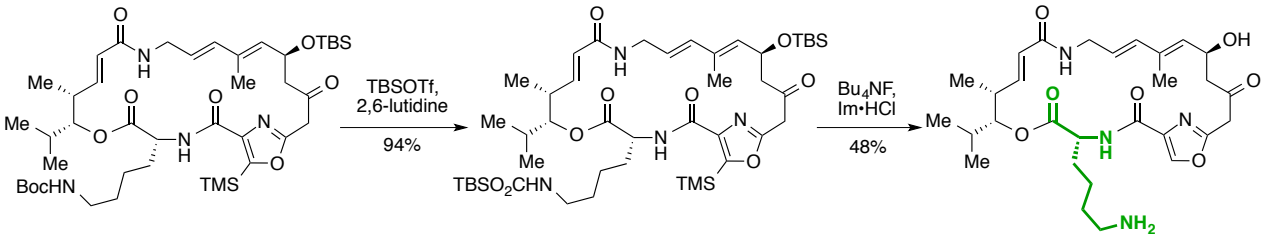
TLC (MeOH:DCM = 1:20): R_f = 0.2 (UV).

^{1}H NMR (400 MHz, $CDCl_3$) δ 8.04 (s, 1H), 7.26 – 7.11 (m, 5H), 6.50 (dd, *J* = 16.2, 5.6 Hz, 1H), 6.11 (d, *J* = 15.7 Hz, 1H), 6.01 (dd, *J* = 7.8, 4.4 Hz, 1H), 5.84 (dd, *J* = 16.1, 1.7 Hz, 1H), 5.69 – 5.59 (m, 1H), 5.43 (d, *J* = 8.8 Hz, 1H), 5.01 – 4.86 (m, 2H), 4.78 (dd, *J* = 10.2, 1.9 Hz, 1H), 4.42 – 4.23 (m, 1H), 3.86 (d, *J* = 16.8 Hz, 1H), 3.77 (d, *J* = 16.8 Hz, 1H), 3.69 (ddd, *J* = 16.5, 7.5, 4.4 Hz, 1H), 3.32 (dd, *J* = 14.3, 5.1 Hz, 1H), 3.05 – 2.85 (m, 3H), 2.83 – 2.72 (m, 1H), 2.55 (br s, 1H), 2.08 – 1.92 (m, 1H), 1.73 (d, *J* = 1.2 Hz, 3H), 1.09 (d, *J* = 6.9 Hz, 3H), 0.97 (d, *J* = 6.8 Hz, 3H), 0.94 (d, *J* = 6.5 Hz, 3H).

^{13}C NMR (100 MHz, $CDCl_3$) δ 201.6, 171.8, 166.5, 159.9, 157.6, 144.5, 141.7, 135.8, 135.8, 135.2, 134.9, 132.0, 129.1, 128.6, 127.0, 125.7, 124.5, 83.5, 65.3, 52.7, 48.7, 43.6, 40.7, 37.9, 36.9, 29.5, 19.8, 18.7, 13.0, 10.4.

HRMS-ESI m/z calcd for $C_{32}H_{39}N_3NaO_7^+$ $[M + Na]^+$ 600.2680, found 600.2654.

Analogue 32



A 25-mL round-bottom flask containing **SI-58d** (16 mg, 19 µmol, 1 equiv) was evacuated and flushed with nitrogen (this process was repeated a total of 3 times). DCM (2 mL) was added, resulting in a colorless solution. After cooling to 0 ºC. 2,6-lutidine (11 µL, 96 µmol, 4.0 equiv) was added, followed by TBSOTf (18 µL, 96 µmol, 5.0 equiv). Then the mixture was allowed to warm to 23 ºC. After 12 h, the mixture was diluted with DCM (30 mL), and the resulting solution was transferred to a separatory funnel and was washed with water (3 × 50 mL) and brine (50 mL). The washed solution was dried (Na_2SO_4). The dried solution was filtered, and the filtrate was concentrated. The resulting crude residue was purified by flash chromatography (silica gel, eluent: EtOAc:hexanes = 1:2) to afford TBS carbamate **SI-61** (16 mg, 94% yield) as a white solid.

TLC (EtOAc:hexanes = 1:2): R_f = 0.25 (UV).

^{1}H NMR (300 MHz, $CDCl_3$) δ 7.39 (d, *J* = 8.9 Hz, 1H), 6.66 (dd, *J* = 16.1, 4.4 Hz, 1H), 6.52 – 6.40 (m, 1H), 6.22 (d, *J* = 15.8 Hz, 1H), 5.86 (d, *J* = 16.0 Hz, 1H), 5.70 – 5.50 (m, 1H), 5.47 (d, *J* = 9.0 Hz, 1H), 5.37 – 5.27 (m, 1H), 4.94 (q, *J* = 7.9 Hz, 1H), 4.89 – 4.68 (m, 2H), 4.27 – 4.10 (m, 1H), 3.92 (d, *J* = 17.2 Hz, 1H), 3.86 – 3.70 (m, 1H), 3.75 (d, *J* = 17.0 Hz, 1H), 3.24 – 3.08 (m, 1H), 3.07 – 2.90 (m, 2H), 2.86 (dd, *J* = 15.1, 5.4 Hz, 1H), 2.76 (s, 1H), 2.05 – 1.80 (m, 2H), 1.78 – 1.58 (m, 1H), 1.68 (s, 3H), 1.59 – 1.44 (m, 3H), 1.09 (d, *J* = 6.8 Hz, 3H), 0.96 (d, *J* = 6.9 Hz, 3H), 0.92 – 0.87 (m, 3H), 0.91 (s, 9H), 0.85 (s, 9H), 0.34 (s, 9H), 0.25 (s, 6H), 0.04 (s, 3H), 0.02 (s, 3H).

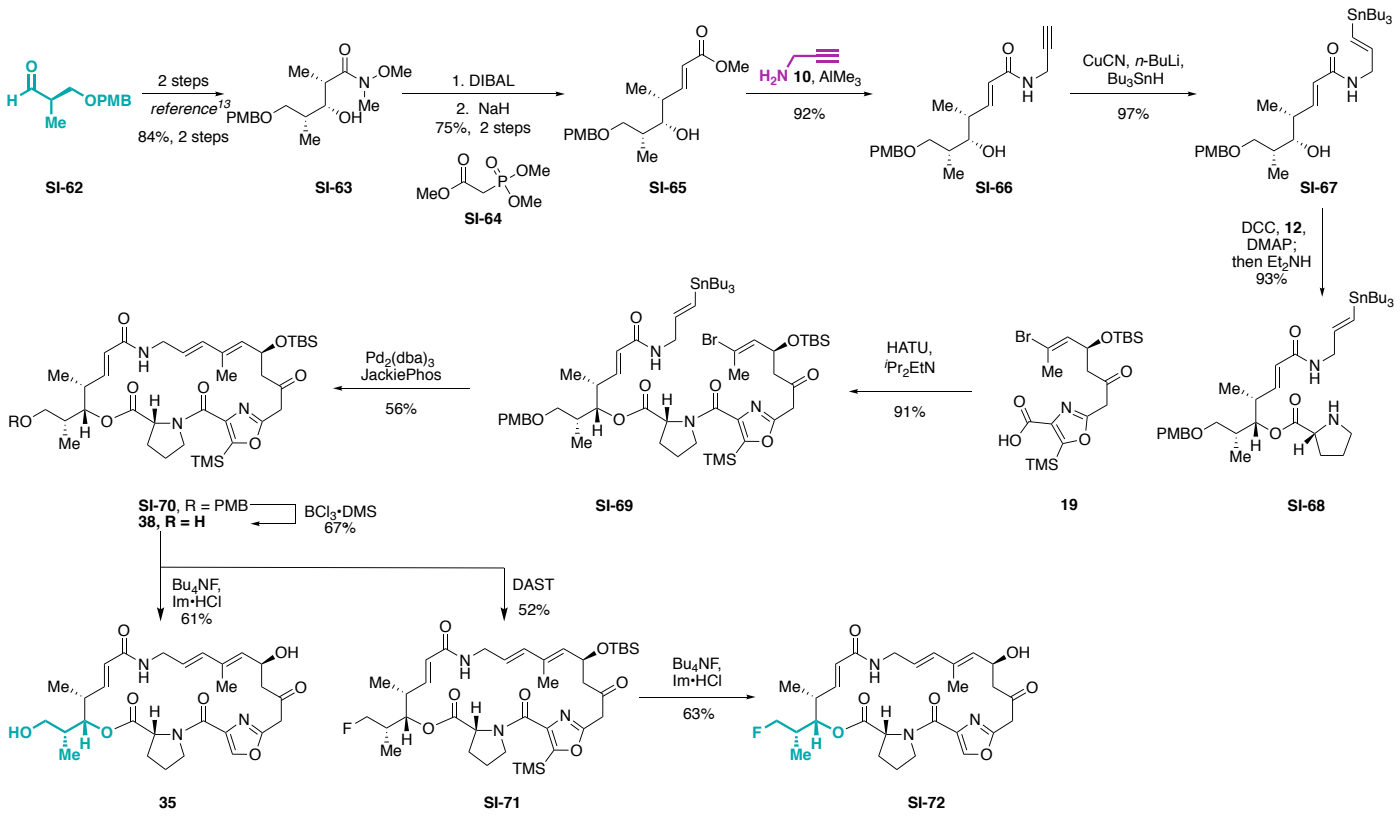
A 50-mL round-bottom flask containing TBS carbamate **SI-61** (42 mg, 46 µmol, 1 equiv) was evacuated and flushed with nitrogen (this process was repeated a total of 3 times). THF (2.3 mL) was added, resulting in a light-yellow solution. In a separate flask, Im•HCl (98 mg, 920 µmol, 20.0 equiv) that had previously been dried at >100 ºC for 10 minutes under vacuum was added to a solution of tetrabutylammonium fluoride in THF (1 M, 0.92 mL, 920 µmol, 20.0 equiv). The resulting colorless solution was added dropwise to the solution of **SI-61**. After 12 h, the mixture was concentrated, and the resulting residue was purified with preparative HPLC (eluent: H_2O:acetonitrile = 95:5 to 5:95 over 15 min) to afford analogue **32** (15 mg, 48% yield) as a white solid.

^{1}H NMR (400 MHz, MeOD) δ 8.34 (s, 1H), 6.64 (dd, *J* = 15.9, 6.1 Hz, 1H), 6.14 (d, *J* = 15.7 Hz, 1H), 5.98 (dd, *J* = 15.9, 1.6 Hz, 1H), 5.73 (ddd, *J* = 15.8, 6.5, 3.7 Hz, 1H), 5.42 (d, *J* = 9.1 Hz, 1H), 5.25 – 4.75 (m, 2H), 4.74 – 4.65 (m, 1H), 4.20 (d, *J* = 17.1 Hz, 1H), 4.07 (d, *J* = 17.2 Hz, 1H), 3.87 (d, *J* = 17.3 Hz, 1H), 3.73 – 3.60 (m, 1H), 3.01 (dd, *J* = 16.3, 8.2 Hz, 1H), 2.97 – 2.88 (m, 3H), 2.88 – 2.79 (m, 1H), 2.13 – 1.95 (m, 3H), 1.80 (s, 3H), 1.70 (q, *J* = 7.8 Hz, 2H), 1.43 (q, *J* = 7.9 Hz, 2H), 1.15 (d, *J* = 6.9 Hz, 3H), 1.00 (d, *J* = 6.8 Hz, 3H), 0.91 (d, *J* = 6.5 Hz, 3H).

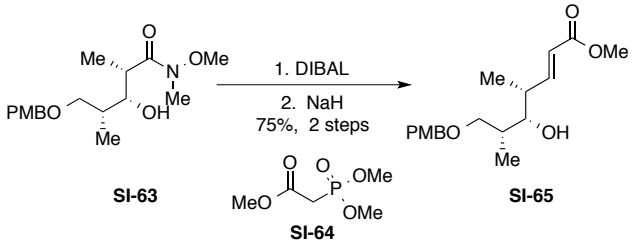
^{13}C NMR (100 MHz, MeOD) δ 203.1, 172.5, 168.4, 162.5, 160.5, 147.8, 143.3, 136.9, 136.0, 135.5, 133.8, 126.4, 125.0, 84.4, 65.2, 52.6, 50.3, 41.4, 40.5, 40.4, 37.8, 32.5, 30.7, 28.1, 23.4, 20.0, 18.9, 13.3, 11.5.

HRMS-ESI m/z calcd for $C_{29}H_{43}N_4O_7^+$ $[M + H]^+$ 559.3126, found 559.3096.

Scheme XI Synthesis of 35 and derivatives thereof



Methyl acrylate SI-65



A 100-mL round-bottom flask containing Weinreb amide **SI-63**[13] (0.35 g, 1.10 mmol, 1 equiv) was evacuated and flushed with nitrogen (the process of nitrogen exchange was repeated a total of 3 times). Dry DCM (11 mL) was added, and the resulting clear solution was cooled to -78 ºC by means of a dry ice/acetone bath. A solution of DIBAL-H in toluene (1.2 M, 2.70 mL, 3.20 mmol, 3.0 equiv) was added dropwise to this solution. After 1 h, **SI-63** was consumed as indicated by TLC analysis, and MeOH (1 mL) was carefylly added (CAUTION: Gas evolution!), followed by saturated aqueous potassium sodium tartrate solution (50 ml). The mixture was allowed to warm to 23 ºC. After 1.5 h, the biphasic mixture was transferred to a separatory funnel, and the layers were separated. The aqueous layer was extracted with DCM (2 × 30 mL). The combined organic layers were washed with water (2 × 50 mL) and brine (50 mL), and the washed solution was dried (Na_2SO_4). The dried solution was filtered, and the filtrate was concentrated. The crude aldehyde was used for next step immediately without further purification.

A separate oven-dried 50-mL round-bottom flask containing 60% NaH (0.13 g, 3.20 mmol, 3.0 equiv) was evacuated and flushed with nitrogen (the process of nitrogen exchange was repeated a total of 3 times). THF (11 mL) was added, and the resulting suspension was cooled to 0 ºC by means of an ice/water bath. A solution of **SI-64** (0.52 mL, 3.20 mmol,

13 Dias, L. C.; Perez, C. C. *Eur. J. Org. Chem.* **2013**, *2013*, 2930–2939.

3.0 equiv) in THF (2 mL) was added dropwise at 0 ºC. After 1 h, a solution of the above aldehyde in THF (2 mL) was added. After 2 h, the saturated aqueous ammonium chloride solution (25 mL) was carefully added, and the resulting biphasic mixture was transferred to a separatory funnel. The layers were separated, and the aqueous layer was extracted with ether (2 × 30 mL). The combined organic layers were washed with water (2 × 50 mL) and brine (50 mL), and the washed solution was dried (Na_2SO_4). The dried solution was filtered, and the filtrate was concentrated. The resulting residue was purified by flash chromatography (silica gel, eluent: EtOAc:hexanes = 1:5) to afford methyl ester **SI-65** (0.26 g, 75% yield over 2 steps) as a colorless oil.

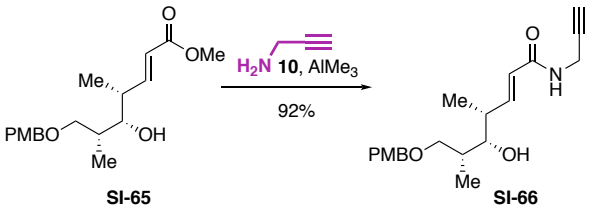
TLC (EtOAc:hexanes = 1:4): R_f = 0.20 (UV, $KMnO_4$).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.23 (d, *J* = 8.6 Hz, 2H), 7.00 (dd, *J* = 15.8, 7.7 Hz, 1H), 6.88 (d, *J* = 8.6 Hz, 2H), 5.82 (dd, *J* = 15.8, 1.3 Hz, 1H), 4.43 (s, 2H), 3.81 (s, 3H), 3.72 (s, 3H), 3.63 (dd, *J* = 10.2, 3.8 Hz, 1H), 3.53 (d, *J* = 4.3 Hz, 1H), 3.47 (dt, *J* = 7.0, 4.5 Hz, 1H), 3.42 (dd, *J* = 9.2, 6.8 Hz, 1H), 2.50 – 2.34 (m, 1H), 1.95 – 1.85 (m, 1H), 1.09 (d, *J* = 6.7 Hz, 3H), 0.93 (d, *J* = 7.0 Hz, 3H).

^{13}C NMR (100 MHz, $CDCl_3$) δ 167.1, 159.4, 152.6, 129.5, 129.4, 120.4, 113.9, 78.9, 74.6, 73.3, 55.3, 51.4, 40.1, 35.7, 14.3, 13.0.

HRMS-ESI m/z calcd for $C_{36}H_{52}NaO_{10}^+$ $[2M + Na]^+$ 667.3453, found 667.3456.

Amide SI-66



A 200-mL round-bottom flask was charged with propargylamine (**10**, 2.30 mL, 36.0 mmol, 4.0 equiv) and DCM (60 mL) under nitrogen. The solution was cooled to 0 ºC by means of an ice/water bath, and a solution of $AlMe_3$ in heptane (1 M, 36.0 mL, 36.0 mmol, 4.0 equiv) was added dropwise over 30 min (CAUTION: Gas evolution!). The mixture was allowed to warm to 23 ºC. After 30 min, a solution of **SI-65** (2.90 g, 9.0 mmol, 1 equiv) in DCM (9 mL) was added over 10 min (CAUTION: Gas evolution!). The vessel was equipped with a reflux condenser, and the solution was brought to reflux by means of a 50 ºC oil bath. After 3 h, **SI-65** was entirely consumed as indicated by TLC analysis (EtOAc:hexanes = 1:1.5), and the mixture was cooled to 0 °C by means of an ice/water bath. Then MeOH (10 mL) was carefully added (CAUTION: Gas evolution!), followed by saturated aqueous potassium sodium tartrate solution (100 mL). After 1 h, the biphasic mixture was transferred to a separatory funnel, and the layers were separated. The aqueous layer was extracted with DCM (2 × 50 mL). The combined organic layers were washed with water (100 mL) and brine (100 mL), and the washed solution was dried (Na_2SO_4). The dried solution was filtered, and the filtrate was concentrated. The resulting crude residue was purified by flash chromatography (silica gel, eluent: EtOAc:hexanes = 1:1) to afford amide **SI-66** (2.86 g, 92% yield) as a white, waxy solid.

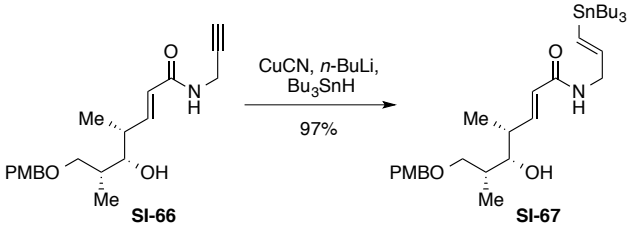
TLC (EtOAc:hexanes = 1:1): R_f = 0.30 (UV, $KMnO_4$).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.23 (d, *J* = 8.6 Hz, 2H), 6.87 (d, *J* = 8.6 Hz, 2H), 6.84 (dd, *J* = 15.5, 1.3 Hz, 1H), 5.86 (s, 1H), 5.76 (dd, *J* = 15.5, 1.3 Hz, 1H), 4.42 (s, 2H), 4.09 (dd, *J* = 5.3, 2.6 Hz, 2H), 3.80 (s, 3H), 3.61 (dd, *J* = 9.2, 3.9 Hz, 1H), 3.54 – 3.39 (m, 3H), 2.49 – 2.36 (m, 1H), 2.22 (t, *J* = 2.6 Hz, 1H), 1.89 (m, 2H), 1.07 (d, *J* = 6.7 Hz, 3H), 0.92 (d, *J* = 7.0 Hz, 3H).

^{13}C NMR (100 MHz, $CDCl_3$) δ 165.6, 159.3, 148.4, 129.6, 129.39, 129.36, 122.5, 113.8, 99.9, 79.6, 78.6, 77.3, 77.0, 76.7, 74.4, 73.2, 71.5, 55.3, 39.7, 35.6, 29.1, 14.4, 12.9.

HRMS-ESI m/z calcd for $C_{20}H_{28}NO_4^+$ $[M + H]^+$ 346.2013, found 346.2012.

Vinyl stannane SI-67



A 500-mL round-bottom flask containing CuCN (1.56 g, 17.4 mmol, 2.0 equiv) was evacuated and flushed with nitrogen (this process was repeated a total of 3 times). THF (120 mL) was added, resulting in a white suspension, and the vessel and its contents were cooled to -78 ºC by means of a dry ice/acetone bath. A solution of *n*-BuLi in hexanes (2.5 M, 14.6 mL, 36.5 mmol, 4.2 equiv) was added dropwise over 10 min, resulting in a light-yellow solution, and the mixture was stirred for 30 min. Bu_3SnH (9.83 mL, 36.5 mmol, 4.2 equiv) was added dropwise over 5 min. After 30 min, a solution of **SI-66** (3.00 g, 8.68 mmol, 1 equiv) in THF (17 m) was added dropwise over 15 min. After 1 h, saturated aqueous ammonium chloride solution (100 mL) was added in one portion. The vessel was removed from the cooling bath, and the system was allowed to warm to 23 ºC while the mixture was rapidly stirred. The biphasic mixture was transferred to a separatory funnel, and the layers were separated. The aqueous layer was extracted with EtOAc (2 × 75 mL), and the combined organic layers were washed with water (2 × 100 mL) and brine (100 mL). The washed solution was dried (Na_2SO_4), and the dried solution was filtered. The filtrate was concentrated, and the resulting crude residue was purified by flash chromatography (silica gel, eluent: EtOAc:hexanes = 0:1 to 1:3) to afford vinyl stannane **SI-67** (5.38 g, 97% yield) as a colorless oil.

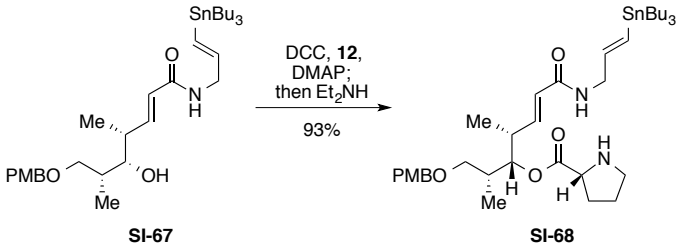
TLC (EtOAc:hexanes = 1:2.5): R_f = 0.30 (UV, $KMnO_4$).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.23 (d, *J* = 8.7 Hz, 2H), 6.87 (d, *J* = 8.7 Hz, 2H), 6.83 (dd, *J* = 15.5, 7.5 Hz, 1H), 6.11 (dt, *J* = 19.0, 1.4 Hz, 1H), 5.97 (dt, *J* = 19.0, 5.1 Hz, 1H), 5.79 (dd, *J* = 15.5, 1.3 Hz, 1H), 5.54 (br t, *J* = 5.9 Hz, 1H), 4.43 (s, 2H), 4.00 – 3.93 (m, 2H), 3.80 (s, 3H), 3.62 (dd, *J* = 9.2, 3.9 Hz, 1H), 3.50 – 3.40 (m, 3H), 2.49 – 2.37 (m, 1H), 1.95 – 1.85 (m, 1H), 1.54 – 1.41 (m, 6H), 1.37 – 1.24 (m, 6H), 1.08 (d, *J* = 6.7 Hz, 3H), 0.93 (d, *J* = 7.0 Hz, 3H), 0.91 – 0.77 (m, 15H)..

^{13}C NMR (100 MHz, $CDCl_3$) δ 165.6, 159.3, 147.5, 143.5, 130.3, 129.6, 129.4, 123.2, 113.8, 78.7, 74.4, 73.2, 55.3, 44.9, 39.7, 35.6, 29.0, 27.3, 14.4, 13.7, 13.1, 9.4.

HRMS-ESI m/z calcd for $C_{32}H_{56}NO_4Sn^+$ $[M + H]^+$ 638.3226, found 638.3219.

Amine SI-68



A 250-mL round-bottom flask was charged with Fmoc-D-Pro-OH (**12**, 1.34 g, 3.96 mmol, 1.5 equiv), alcohol **SI-67** (1.68 g, 2.64 mmol, 1 equiv) and DMAP (0.065 g, 0.53 mmol, 0.2 equiv). DCM (26 mL) was added, resulting in a colorless solution. DCC (0.87 g, 4.22 mmol, 1.6 equiv) was added in one portion, resulting in a white suspension. After 5 h, the alcohol **SI-67** was entirely consumed as indicated by TLC analysis (eluent: EtOAc:hexanes = 1:3), and diethyl amine (13 mL) was added. After 3 h, the mixture was filtered through a pad of celite, and the filter cake was washed with DCM (2 × 30 mL). The combined filtrates were concentrated, and the resulting crude residue was purified by flash chromatography (silica gel, eluent: NH_4OH:MeOH:DCM = 0.2:1:100 to 0.2:1:50) to afford amine **SI-68** (1.80 g, 93% yield) as a light-yellow oil.

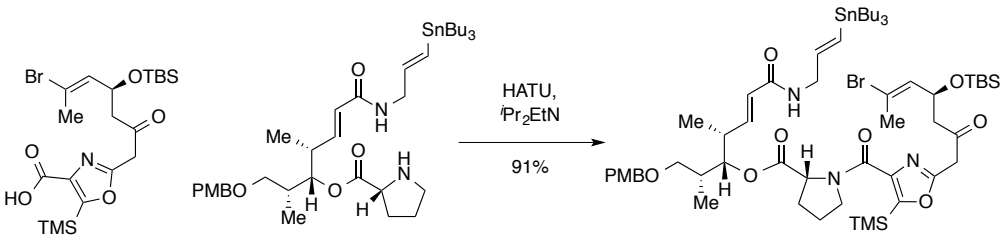
TLC (MeOH: DCM = 1:20): R_f = 0.20 (UV, $KMnO_4$).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.24 (d, *J* = 8.7 Hz, 2H), 6.87 (d, *J* = 8.7 Hz, 2H), 6.67 (dd, *J* = 15.5, 7.4 Hz, 1H), 6.11 (dt, *J* = 19.0, 1.5 Hz, 1H), 5.95 (dt, *J* = 19.0, 5.1 Hz, 1H), 5.74 (dd, *J* = 15.5, 1.3 Hz, 1H), 5.54 (br t, *J* = 5.9 Hz, 1H), 4.97 (t, *J* = 6.2 Hz, 1H), 4.37 (s, 2H), 4.03 – 3.90 (m, 2H), 3.79 (s, 3H), 3.70 (dd, *J* = 8.5, 5.6 Hz, 1H), 3.45 (dd, *J* = 9.2, 5.0 Hz, 1H), 3.21 (dd, *J* = 9.2, 6.4 Hz, 1H), 3.03 (ddd, *J* = 10.2, 7.5, 6.2 Hz, 1H), 2.87 (ddd, *J* = 10.2, 7.0, 6.2 Hz, 1H), 2.80 – 2.67 (m, 1H), 2.19 – 2.05 (m, 2H), 1.90 – 1.64 (m, 3H), 1.57 – 1.36 (m, 6H), 1.36 – 1.22 (m, 6H), 1.03 (d, *J* = 6.9 Hz, 3H), 0.95 (d, *J* = 6.9 Hz, 3H), 0.91 – 0.77 (m, 15H).

^{13}C NMR (100 MHz, $CDCl_3$) δ 175.0, 165.3, 159.1, 145.1, 143.4, 130.4, 130.3, 129.3, 124.2, 113.7, 77.7, 72.8, 71.3, 59.9, 55.2, 46.9, 44.9, 37.8, 35.4, 30.4, 29.0, 27.2, 25.4, 14.8, 13.9, 13.7, 9.4.

HRMS-ESI m/z calcd for $C_{37}H_{63}N_2O_5Sn^+$ $[M + H]^+$ 735.3753, found 735.3740.

Stille precursor SI-69



A 250-mL round-bottom flask was charged with amine **SI-68** (1.80 g, 2.45 mmol, 1 equiv), ^{i}Pr$_2$EtN (0.86 mL, 4.91mmol, 2.0 equiv) and acid **19** (1.36 g, 2.70 mmol, 1.1 equiv). DCM (45 mL) was added, resulting in a colorless solution, and HATU (1.17 g, 3.07 mmol, 1.25 equiv) was added in one portion. After 5 h, the mixture was diluted with DCM (100 mL). The solution was transferred to a separatory funnel and was washed with water (2 × 100 mL) and brine (100 mL). The washed solution was dried (Na_2SO_4). The dried solution was filtered, and the filtrate was concentrated. The resulting crude residue was purified by flash chromatography (silica gel, eluent: EtOAc:hexanes = 1:6 to 1:4) to afford Stille coupling precursor **SI-69** (2.72 g, 91% yield) as a light-yellow foam.

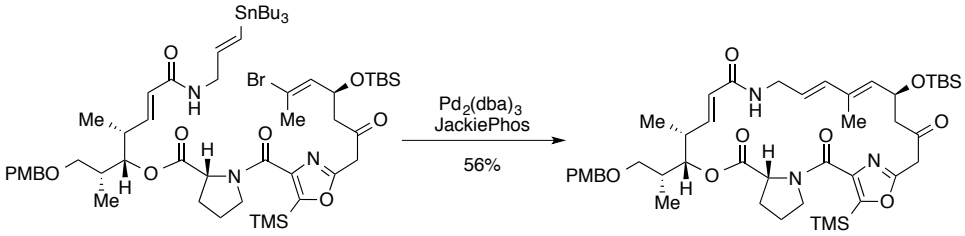
TLC (EtOAc:Hexanes = 1:3): R_f = 0.20 (UV, *p*-Anisaldehyde).

^{1}H NMR (400 MHz, $CDCl_3$, mixtures of rotamers) δ 7.26 – 7.16 (m, 2H), 6.85 (dt, *J* = 8.9, 2.0 Hz, 2H), 6.70 – 6.52 (m, 1H), 6.18 – 6.00 (m, 1H), 6.03 – 5.90 (m, 1H), 5.84 – 5.70 (m, 2H), 5.68 – 5.50 (m, 2H), 4.97 – 4.83 (m, 1H), 4.82 – 4.65 (m, 1H), 4.59 (td, *J* = 8.6, 3.5 Hz, 1H), 4.40 (s, 1H), 4.31 (s, 1H), 4.15 – 3.85 (m, 5H), 3.85 – 3.59 (m, 5H), 3.31 – 3.10 (m, 1H), 2.89 – 2.32 (m, 3H), 2.32 – 2.25 (m, 3H), 2.24 – 1.70 (m, 2H), 1.60 – 1.37 (m, 6H), 1.29 (h, *J* = 6.7, 6.1 Hz, 6H), 1.01 (ddd, *J* = 6.9, 5.5, 2.3 Hz, 4H), 0.97 – 0.71 (m, 26H), 0.42 – 0.23 (m, 9H), 0.10 – 0.01 (m, 6H).

^{13}C NMR (100 MHz, $CDCl_3$, mixtures of rotamers) δ 201.0, 200.7, 172.3, 172.0, 171.8, 165.4, 165.0, 164.6, 163.8, 163.3, 162.3, 161.5, 161.4, 159.20, 159.08, 159.05, 158.96, 145.2, 145.1, 145.03, 143.5, 143.3, 142.8, 135.0, 134.2, 134.2, 130.9, 130.8, 130.4, 130.3, 130.0, 129.3, 129.3, 129.2, 124.4, 124.3, 121.8, 121.7, 121.0, 113.7, 113.7, 113.6, 78.4, 77.7, 72.7, 72.6, 71.5, 70.9, 67.8, 67.0, 66.1, 60.5, 59.8, 55.2, 55.2, 49.6, 49.5, 48.8, 48.70 47.1, 44.9, 44.8, 44.18, 43.9, 38.1, 37.8, 35.7, 35.6, 31.6, 29.0, 27.2, 25.7, 25.6, 25.2, 24.0, 21.5, 17.9, 14.9, 14.8, 14.76, 14.0, 13.6, 9.4, –1.75, –1.78, –4.6, –5.15, –5.17.

HRMS-ESI m/z calcd for $C_{57}H_{95}BrN_3O_9Si_2Sn^+$ $[M + H]^+$ 1220.4807, found 1220.4827.

Stille coupling product SI-70



SI-69 **SI-70**

A 1000-mL round-bottom flask containing JackiePhos (0.36 g, 0.45 mmol, 0.2 equiv), $Pd_2(dba)_3$ (0.20 g, 0.22 mmol, 0.1 equiv) and Stille coupling precursor **SI-69** (2.72 g, 2.23 mmol, 1 equiv) was evacuated and flushed with nitrogen (this process was repeated a total of 3 times). Toluene (446 mL) was added, resulting in a red suspension. A stream of argon was passed through the solution by a stainless steel needle for 30 min. The mixture was heated by means of a 50 ºC oil bath. After 12 h, the mixture was allowed to cool to 23 ºC and was concentrated. The resulting crude residue was purified by flash chromatography (silica gel, eluent: EtOAc:hexanes = 1:3 to 1:1.5) to afford Stille coupling product **SI-70** (1.0 g, 56% yield) as a light-yellow foam.

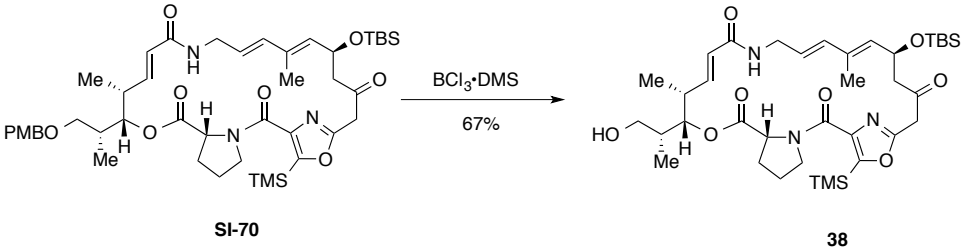
TLC (EtOAc:Hexanes = 1:3): R_f = 0.20 (UV, *p*-Anisaldehyde).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.27 (d, *J* = 8.4 Hz, 2H), 6.85 (d, *J* = 8.6 Hz, 2H), 6.49 (dd, *J* = 16.4, 4.1 Hz, 1H), 6.14 (dd, *J* = 15.5, 1.3 Hz, 1H), 6.09 (dd, *J* = 9.0, 3.4 Hz, 1H), 5.77 (dd, *J* = 16.4, 2.1 Hz, 1H), 5.57 (ddd, *J* = 15.5, 9.5, 4.2 Hz, 1H), 5.43 (d, *J* = 8.8 Hz, 1H), 5.11 (dd, *J* = 10.5, 1.8 Hz, 1H), 5.02 (ddd, *J* = 9.0, 6.9, 5.8 Hz, 1H), 4.78 (dd, *J* = 8.8, 3.3 Hz, 1H), 4.56 – 4.36 (m, 3H), 3.89 (d, *J* = 17.1 Hz, 1H), 3.83 – 3.68 (m, 7H), 3.51 (dd, *J* = 9.1, 3.1 Hz, 1H), 3.39 (ddd, *J* = 14.9, 9.7, 3.5 Hz, 1H), 3.31 (dd, *J* = 9.1, 5.6 Hz, 1H), 2.94 (dd, *J* = 16.1, 7.0 Hz, 1H), 2.76 (dd, *J* = 16.1, 5.8 Hz, 1H), 2.75 – 2.65 (m, 1H), 2.16 – 2.10 (m, 2H), 1.91 – 1.80 (m, 2H), 1.76 – 1.69 (m, 1H), 1.68 (d, *J* = 1.2 Hz, 3H), 1.08 (d, *J* = 6.9 Hz, 3H), 1.02 (d, *J* = 6.9 Hz, 3H), 0.85 (s, 9H), 0.30 (s, 9H), 0.05 (s, 3H), 0.02 (s, 3H).

^{13}C NMR (100 MHz, $CDCl_3$) δ 200.9, 171.9, 166.5, 161.5, 161.5, 159.5, 158.9, 145.1, 144.5, 136.7, 134.8, 132.4, 130.9, 129.4, 124.9 123.8, 113.6, 76.2, 73.0, 71.6, 65.3, 58.8, 55.2, 50.8, 48.5, 43.5, 41.3, 36.4, 35.4, 28.3, 25.7, 24.9, 18.0, 13.9, 12.7, 9.6, –1.8, –4.5, –5.0.

HRMS-ESI m/z calcd for $C_{45}H_{67}N_3NaO_9Si_2^+$ $[M + Na]^+$ 872.4308, found 872.4348.

Primary alcohol 38[14]



A 200-mL round-bottom charged with compound **SI-70** (0.57 g, 0.67 mmol, 1 equiv) was evacuated and reflushed with nitrogen (this process was repeated 3 times). DCM (67 mL) was added, resulting in a yellow solution. The mixture was cooled to 0 ºC by means of an ice/water bath, and a solution of BCl_3•DMS in DCM (2 M, 0.54 mL, 1.07 mmol, 1.6 equiv) was added dropwise. After 20 min, saturated aqueous $NaHCO_3$ solution (20 mL) was added. The resulting biphasic mixture was stirred for 1 h at 0 ºC and was transferred to a separatory funnel. The organic layer was washed with water (2 × 100 mL) and brine (100 mL). The washed solution was dried (Na_2SO_4). The dried solution was filtered, and the filtrate was concentrated. The resulting crude residue was purified by flash chromatography (silica gel, eluent: acetone:hexanes = 1:3.5 to 1:2.5) to afford primary alcohol **38** (0.33 g, 67% yield) as a light-yellow solid.

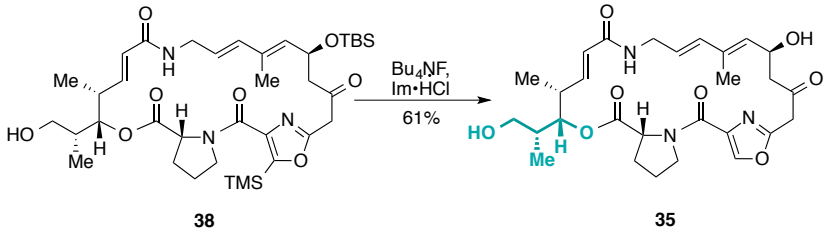
TLC (acetone:hexanes = 1:2.5): R_f = 0.20 (UV, *p*-anisaldehyde).

^{1}H NMR (400 MHz, $CDCl_3$) δ 6.48 (dd, *J* = 16.4, 4.4 Hz, 1H), 6.16 (d, *J* = 15.7 Hz, 1H), 6.05 (dd, *J* = 9.0, 2.8 Hz, 1H), 5.75 (dd, *J* = 16.3, 2.0 Hz, 1H), 5.58 (ddd, *J* = 15.6, 9.0, 4.4 Hz, 1H), 5.43 (d, *J* = 8.8 Hz, 1H), 5.09 – 4.94 (m, 2H), 4.58 (dd, *J* = 8.4, 5.2 Hz, 1H), 4.50 (ddd, *J* = 14.1, 8.7, 4.2 Hz, 1H), 3.91 – 3.78 (m, 4H), 3.69 (d, *J* = 16.9 Hz, 1H), 3.52 (dd, *J* = 11.6, 3.2 Hz, 1H), 3.40 (ddd, *J* = 15.3, 9.0, 2.8 Hz, 1H), 2.93 (dd, *J* = 16.8, 6.2 Hz, 1H), 2.79 (dd, *J* = 16.9, 5.8 Hz, 1H), 2.79 – 2.69 (m, 1H), 2.21 – 2.07 (m, 1H), 2.05 – 1.95 (m, 1H), 1.90 – 1.80 (m, 2H), 1.81 – 1.71 (m, 1H), 1.71 (d, *J* = 1.2 Hz, 3H), 1.07 (d, *J* = 6.9 Hz, 3H), 1.03 (d, *J* = 7.0 Hz, 3H), 0.84 (s, 9H), 0.30 (s, 9H), 0.04 (s, 3H), 0.00 (s, 3H).

^{13}C NMR (100 MHz, $CDCl_3$) δ 200.7, 172.8, 166.9, 162.3, 161.8, 159.8, 144.6, 144.5, 136.8, 135.1, 132.0, 124.2, 123.6, 77.5, 65.0, 64.6, 59.5, 50.8, 49.1, 43.1, 41.1, 36.4, 36.2, 28.1, 25.7, 25.5, 18.0, 14.0, 12.7, 9.4, –1.9, –4.5, –5.0.

HRMS-ESI m/z calcd for $C_{37}H_{59}N_3NaO_8Si_2^+$ $[M + Na]^+$ 752.3733, found 752.3731.

Analogue 35



A 25-mL round-bottom flask containing compound **38** (36 mg, 49 µmol, 1 equiv) was evacuated and flushed with nitrogen (this process was repeated a total of 3 times). THF (2.0 mL) was added, resulting in a light-yellow solution. In a separate flask, Im•HCl (0.010 g, 0.10 mmol, 2.0 equiv)that had previously been dried at >100 ºC for 10 minutes under vacuum was added to a solution of tetrabutylammonium fluoride in THF (1 M, 0.15 mL, 0.15 mmol, 3.0 equiv). The resulting colorless solution was added dropwise to the above solution of **38** at 0 ºC by means of an ice/water bath. After

[14] Congreve, M. S.; Davision, E. C.; Fuhry, M. A.; Holmes, A. B.; Payne, A. N.; Robinson, R. A.; Ward, S. E. *Synlett*, **1993**, 663–664.

1 h, the mixture was concentrated, and the residue was purified by preparative TLC (eluent: MeOH:DCM = 1:25) to afford analogue **35** (0.016 g, 61% yield) as a light-yellow solid.

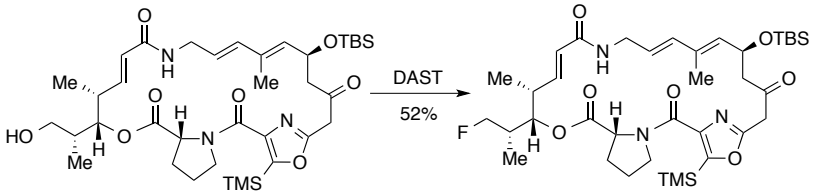
TLC (acetone:hexanes = 1:2.5): R_f = 0.20 (UV, *p*-anisaldehyde).

^{1}H NMR (400 MHz, $CDCl_3$) δ 8.09 (s, 1H), 6.48 (dd, *J* = 16.4, 5.0 Hz, 1H), 6.40 – 6.30 (m, 1H), 6.12 (d, *J* = 15.6 Hz, 1H), 5.78 (dd, *J* = 16.4, 1.8 Hz, 1H), 5.69 (ddd, *J* = 14.7, 9.1, 4.8 Hz, 1H), 5.42 (d, *J* = 8.7 Hz, 1H), 5.03 (dd, *J* = 10.7, 1.8 Hz, 1H), 4.90 (dt, *J* = 9.1, 5.7 Hz, 1H), 4.60 (dd, *J* = 8.6, 4.3 Hz, 1H), 4.48 (ddd, *J* = 14.1, 8.9, 4.7 Hz, 1H), 4.02 (dt, *J* = 11.2, 6.8 Hz, 1H), 3.84 – 3.73 (m, 4H), 3.53 (dd, *J* = 11.4, 2.9 Hz, 1H), 3.37 (ddd, *J* = 14.8, 9.0, 3.1 Hz, 1H), 3.01 (dd, *J* = 17.3, 5.6 Hz, 1H), 2.89 (dd, *J* = 17.2, 5.4 Hz, 1H), 2.77 – 2.66 (m, 1H), 2.27 – 2.15 (m, 1H), 1.99 – 1.78 (m, 4H), 1.72 (d, *J* = 1.2 Hz, 3H), 1.05 (d, *J* = 6.9 Hz, 6H).

^{13}C NMR (100 MHz, $CDCl_3$) δ 202.4, 172.6, 166.9, 160.4, 157.1, 145.6, 144.3, 137.0, 136.8, 134.2, 132.7, 125.1, 124.1, 77.6, 65.1, 64.2, 60.0, 48.9, 48.7, 43.1, 40.8, 36.5, 36.2, 28.2, 25.5, 14.0, 12.7, 9.9.

HRMS-ESI m/z calcd for $C_{28}H_{38}N_3O_8^+$ $[M + H]^+$ 544.2653, found 544.2651.

Fluorinated product SI-71



A 25-mL round-bottom flask containing of alcohol **38** (25 mg, 34 μmol, 1 equiv) was evacuated and flushed with nitrogen (this process was repeated a total of 3 times). DCM (3.4 mL) was added, resulting in a light-yellow solution. The vessel and its contents were cooled to 0 ºC by means of an ice/water bath, and DAST (12 μL, 89 μmol, 2.6 equiv) was added dropwise. The mixture was allowed to warm to 23 ºC. After 3 h, saturated aqueous $NaHCO_3$ solution (20 mL) and DCM (20 mL) were added. After stirring for 30 min, the biphasic solution was transferred to a separatory funnel, and the layers were separated. The organic layer was washed with water (2 × 25 mL) and brine (25 mL). The washed solution was dried (Na_2SO_4), and the dried solution was concentrated. The resulting crude residue was purified by flash chromatography (silica gel, eluent: acetone:hexanes = 1:5) to afford fluorinated product **SI-71** (13 mg, 52% yield) as a white solid.

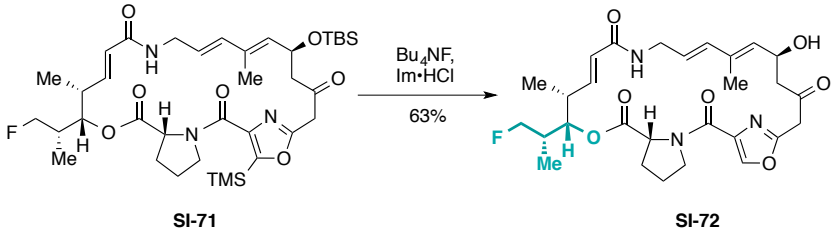
TLC (acetone:hexanes = 1:2.5): R_f = 0.30 (UV, *p*-anisaldehyde).

^{1}H NMR (400 MHz, $CDCl_3$) δ 6.48 (dd, *J* = 16.4, 4.1 Hz, 1H), 6.14 (d, *J* = 15.7 Hz, 1H), 6.09 (dd, *J* = 8.8, 2.6 Hz, 1H), 5.79 (dd, *J* = 16.3, 2.0 Hz, 1H), 5.57 (ddd, *J* = 15.5, 9.3, 4.3 Hz, 1H), 5.42 (d, *J* = 8.9 Hz, 1H), 5.07 (dd, *J* = 10.5, 1.8 Hz, 1H), 5.01 (dt, *J* = 8.9, 6.4 Hz, 1H), 4.75 (dd, *J* = 8.9, 3.5 Hz, 1H), 4.57 – 4.41 (m, 2H), 4.38 (ddd, *J* = 47.5, 9.2, 5.2 Hz 1H), 3.88 (d, *J* = 17.1 Hz, 1H), 3.81 – 3.70 (m, 2H), 3.73 (d, *J* = 17.1 Hz, 1H), 3.39 (ddd, *J* = 14.9, 9.4, 3.2 Hz, 1H), 2.91 (dd, *J* = 16.1, 6.8 Hz, 1H), 2.80 – 2.69 (m, 1H), 2.91 (dd, *J* = 16.0, 5.9 Hz, 1H), 2.20 – 2.05 (m, 2H), 1.90 – 1.80 (m, 3H), 1.67 (d, *J* = 1.2 Hz, 3H), 1.11 (d, *J* = 6.9 Hz, 3H), 1.08 (d, *J* = 6.9 Hz, 3H), 0.85 (s, 9H), 0.31 (s, 9H), 0.05 (s, 3H), 0.02 (s, 3H).

^{13}C NMR (100 MHz, $CDCl_3$) δ 201.0, 172.1, 166.3, 161.8, 161.7, 159.7, 144.9, 144.0, 136.7, 134.9, 132.3, 124.7, 124.1, 85.05 (d, $^1J_{CF}$ = 169.7 Hz), 75.1 (d, $^3J_{CF}$ = 5.2 Hz), 65.3, 58.8, 50.6, 48.5, 43.6, 41.3, 36.3, 35.8 (d, $^2J_{CF}$ = 19.2 Hz), 28.2, 25.7, 25.0, 18.1, 12.9 (d, $^3J_{CF}$ = 4.7 Hz), 12.7, 9.7, –1.9, –4.50, –4.96.

HRMS-ESI m/z calcd for $C_{37}H_{59}FN_3O_7Si_2^+$ [M + H]$^+$ 732.3870, found 732.3905.

Analogue SI-72



A 25-mL round-bottom flask containing fluorinated compound **SI-71** (13 mg, 18 µmol, 1 equiv) was evacuated and flushed with nitrogen (this process was repeated a total of 3 times). THF (1.6 mL) was added, resulting in a light-yellow solution. In a separate flask, Im•HCl (19 mg, 0.18 mmoL, 10.0 equiv) that had previously been dried at >100 ºC for 10 minutes under vacuum was added to a solution of tetrabutylammonium fluoride in THF (1 M, 0.18 mL, 0.18 mmol, 10.0 equiv). The resulting colorless solution was added dropwise to the above solution of **SI-71**. After 12 h, the mixture was concentrated, and the residue was dissolved in DCM (50 mL). The resulting solution was transferred to a separatory funnel and was washed with water (5 × 50 mL) and brine (30 mL). The washed solution was dried (Na_2SO_4). The dried solution was filtered, and the filtrate was concentrated. The resulting crude residue was purified by preparative TLC (eluent: MeOH:DCM = 1:25) to afford analogue **SI-72** (6.1 mg, 63% yield) as a light-yellow solid.

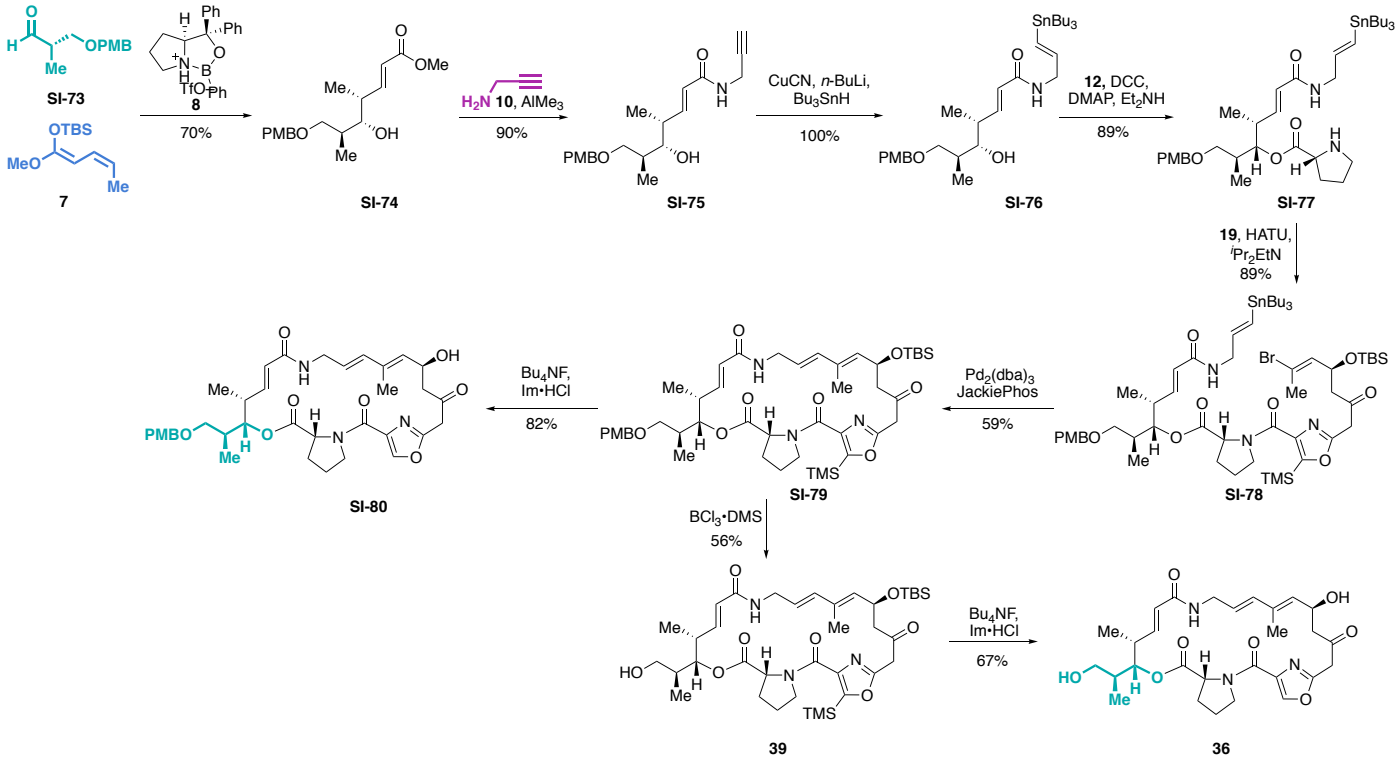
TLC (acetone:hexanes = 1:2): R_f = 0.20 (UV, *p*-anisaldehyde).

^{1}H NMR (400 MHz, $CDCl_3$) δ 8.11 (s, 1H), 6.49 (dd, *J* = 16.4, 5.0 Hz, 1H), 6.48 – 6.40 (m, 1H), 6.13 (d, *J* = 15.7 Hz, 1H), 5.83 (d, *J* = 16.4 Hz, 1H), 5.72 (ddd, *J* = 14.8, 9.1, 4.6 Hz, 1H), 5.42 (d, *J* = 8.8 Hz, 1H), 5.03 (d, *J* = 10.4 Hz, 1H), 4.93 (dt, *J* = 9.6, 5.6 Hz, 1H), 4.69 (dd, *J* = 8.9, 3.2 Hz, 1H), 4.55 – 4.30 (m, 3H), 4.01 (dt, *J* = 11.5, 7.2 Hz, 1H), 3.84 (s, 2H), 3.81 – 3.71 (m, 1H), 3.41 (ddd, *J* = 13.8, 9.2, 3.7 Hz, 1H), 3.07 (dd, *J* = 17.0, 5.9 Hz, 1H), 3.03 – 2.95 (m, 1H), 2.90 (dd, *J* = 17.0, 5.1 Hz, 1H), 2.75 (br t, *J* = 6.6 Hz, 1H), 2.25 – 2.11 (m, 2H), 2.00 – 1.84 (m, 3H), 1.74 (s, 3H), 1.09 (d, *J* = 6.9 Hz, 6H).

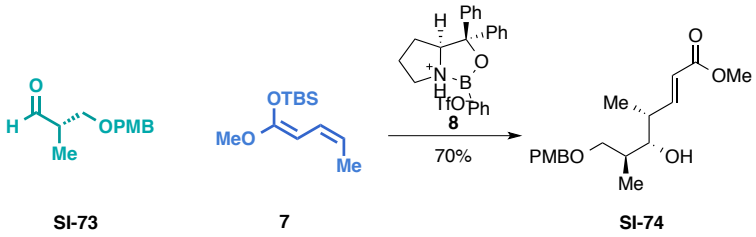
^{13}C NMR (100 MHz, $CDCl_3$) δ 202.3, 171.6, 166.5, 160.2, 156.8, 144.0, 143.6, 137.0, 134.4, 132.6, 125.3, 125.3, 124.6, 85.3 (d, $^1J_{CF}$ = 170.4 Hz), 76.1 (d, $^3J_{CF}$ = 4.8 Hz), 65.2, 59.6, 52.1, 48.8, 48.5, 43.3, 40.9, 36.4, 35.8 (d, $^2J_{CF}$ = 19.1 Hz), 29.7, 28.3, 25.13, 25.11, 20.2, 13.5, 13.0 (d, $^3J_{CF}$ = 5.2 Hz), 12.7, 10.1.

HRMS-ESI m/z calcd for $C_{28}H_{37}FN_3O_7^+$ [M + H]$^+$ 546.2610, found 546.2630.

Scheme XII Synthesis of 36 and SI-80



Mukaiyama aldol product SI-74



A 250-mL round-bottom flask was charged with phenylboronic acid (1.22 g, 9.99 mmol, 0.5 equiv) and (S)-diphenyl(pyrrolidin-2-yl)methanol (2.53 g, 9.99 mmol, 0.5 equiv). The vessel was equipped with a Dean-Stark apparatus and a reflux condenser, evacuated and flushed with nitrogen (the process of nitrogen exchange was repeated a total of 3 times). Toluene (50 mL) was added, and the resulting colorless solution was brought to reflux by means of a 145 ºC oil bath. After 12 h, the mixture was allowed to cool to 23 ºC and was concentrated. The resulting white solid was dried at ≤1 Torr for 1 h. The vessel was flushed with nitrogen, and DCM (80 mL) was added. The resulting colorless solution was cooled to -78 °C by means of a dry ice/acetone bath, and TfOH (0.79 mL, 8.99 mmol, 0.45 equiv) was added dropwise over 5 min by means of glass syringe (CAUTION: TfOH rapidly corrodes most plastic syringes!). Some of the TfOH froze upon contact with the solution. After 1 h, the solids had dissolved, and a solution of aldehyde **SI-73** (4.16 g, 20.0 mmol, 1 equiv), TBS ether **7** (5.70 g, 25.0 mmol 1.25 equiv) and 2-propanol (1.91 mL, 25.0 mmol, 1.25 equiv) in DCM (20 mL) was added dropwise over 2 h by means of syringe pump. The mixture was stirred at -78 °C for another 1.5 h, and saturated aqueous $NaHCO_3$ solution (50 mL) was added in one portion. The vessel was removed from the cooling bath, and the system was allowed to warm to 23 ºC while it was rapidly stirred. The biphasic mixture was transferred to a separatory funnel, and the layers were separated. The aqueous layer was extracted with DCM (2 × 30 mL). The combined organic layers were dried (Na_2SO_4). The dried solution was filtered, and the filtrate was concentrated. The resulting crude residue was purified by flash chromatography (silica gel, eluent: EtOAc:hexanes = 1:6 to 1:4) to afford aldol product **SI-74** (4.52 g, 70% yield, dr > 20:1) as a colorless oil.

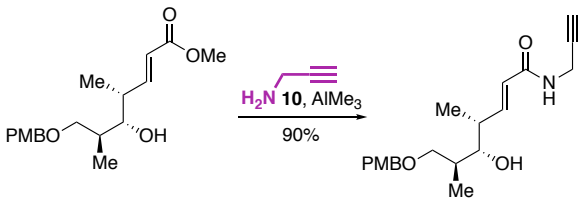
TLC (EtOAc:hexanes = 1:4): R_f = 0.20 (UV, $KMnO_4$).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.23 (d, *J* = 8.7 Hz, 2H), 6.87 (d, *J* = 8.7 Hz, 2H), 6.79 (dd, *J* = 15.7, 9.3 Hz, 1H), 5.85 (dd, *J* = 15.7, 0.7 Hz, 1H), 4.45 (d, *J* = 11.6 Hz, 1H), 4.41 (d, *J* = 11.6 Hz, 1H), 3.80 (s, 3H), 3.72 (s, 3H), 3.63 (dt, *J* = 9.0, 2.3 Hz, 1H), 3.52 (dd, *J* = 9.0, 3.9 Hz, 1H), 3.46 (dd, *J* = 9.0, 4.9 Hz, 1H), 2.85 (d, *J* = 2.9 Hz, 1H), 2.51 – 2.38 (m, 1H), 1.78 (dddd, *J* = 7.9, 7.0, 6.1, 2.6 Hz, 1H), 1.14 (d, *J* = 6.6 Hz, 3H), 0.94 (d, *J* = 7.0 Hz, 3H).

^{13}C NMR (100 MHz, $CDCl_3$) δ 167.0, 159.2, 151.1, 129.9, 129.2, 120.8, 113.8, 76.9, 75.2, 73.2, 55.3, 51.5, 40.8, 35.8, 16.7, 9.7.

HRMS-ESI m/z calcd for $C_{36}H_{52}NaO_{10}^+$ $[2M + Na]^+$ 667.3453, found 667.3456.

Amide SI-75



SI-74 **SI-75**

A 250-mL round-bottom flask was charged with propargylamine (**10**, 3.10 mL, 48.0 mmol, 4.0 equiv) and DCM (80 mL) under nitrogen. The resulting colorless solution was cooled to 0 ºC by means of an ice/water bath. A solution of $AlMe_3$ in heptane (1 M, 48.0 mL, 48.0 mmol, 4.0 equiv) was added dropwise over 30 min (CAUTION: Gas evolution!). The mixture was allowed to warm to 23 ºC. After 30 min, a solution of **SI-74** (3.50 g, 12.0 mmol, 1 equiv) in DCM (20 mL) was added over 10 min (CAUTION: Gas evolution!). The vessel was equipped with a reflux condenser, and the solution was brought to reflux by means of a 50 ºC oil bath. After 3 h, **SI-74** was entirely consumed as indicated by TLC analysis, and the mixture was cooled to 0 °C by means of an ice/water bath. MeOH (10 mL) was added (CAUTION: Gas evolution!), followed by saturated aqueous potassium sodium tartrate solution (100 mL). After 1 h, the biphasic mixture was transferred to a separatory funnel, and the layers were separated. The aqueous layer was extracted with DCM (2 × 50 mL). The combined organic layers were washed with water (100 mL) and brine (100 mL), and the washed solution was dried (Na_2SO_4). The dried solution was filtered, and the filtrate was concentrated. The resulting crude residue was purified by flash chromatography (silica gel, eluent: EtOAc:hexanes = 1:1) to afford amide **SI-75** (3.22 g, 90% yield) as a white, waxy solid.

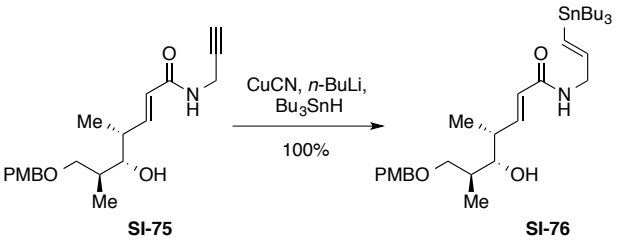
TLC (EtOAc:hexanes = 1:1): R_f = 0.30 (UV, $KMnO_4$).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.21 (d, *J* = 8.7 Hz, 2H), 6.86 (d, *J* = 8.7 Hz, 2H), 6.70 (dd, *J* = 15.3, 9.2 Hz, 1H), 5.92 (t, *J* = 5.2 Hz, 1H), 5.79 (dd, *J* = 15.3, 0.9 Hz, 1H), 4.43 (d, *J* = 11.5 Hz, 1H), 4.39 (d, *J* = 11.5 Hz, 1H), 4.09 (dd, *J* = 5.3, 2.6 Hz, 2H), 3.79 (s, 3H), 3.61 (dt, *J* = 9.0, 2.2 Hz, 1H), 3.51 (dd, *J* = 9.0, 3.9 Hz, 1H), 3.45 (dd, *J* = 9.0, 4.8 Hz, 1H), 2.95 (d, *J* = 2.8 Hz, 1H), 2.47 – 2.34 (m, 1H), 2.23 (t, *J* = 2.6 Hz, 1H), 1.84 – 1.71 (m, 1H), 1.12 (d, *J* = 6.6 Hz, 3H), 0.92 (d, *J* = 7.0 Hz, 3H).

^{13}C NMR (100 MHz, $CDCl_3$) δ 165.3, 159.2, 147.4, 129.9, 129.2, 122.6, 113.8, 79.4, 76.94, 76.7, 75.2, 73.1, 71.6, 55.2, 40.5, 35.7, 29.1, 16.8, 9.8.

HRMS-ESI m/z calcd for $C_{20}H_{28}NO_4^+$ $[M + H]^+$ 346.2013, found 346.2012.

Vinyl stannane SI-76



A 500-mL round-bottom flask containing CuCN (1.92 g, 21.4 mmol, 2.0 equiv) was evacuated and flushed with nitrogen (this process was repeated a total of 3 times). THF (140 mL) was added, resulting in a white suspension. The vessel and its contents were allowed cool to -78 ºC by means of a dry ice/acetone bath, and a solution of *n*-BuLi in hexanes (2.5 M, 18 mL, 45.0 mmol, 4.2 equiv) was added dropwise over 10 min, resulting in a light-yellow solution. After 30 min, Bu_3SnH (12.1 mL, 45.0 mmol, 4.2 equiv) was added dropwise over 5 min. After 30 min, a solution of amide **SI-75** (3.70 g, 10.7 mmol, 1 equiv) in THF (10 mL) was added dropwise over 15 min. After 1 h, saturated aqueous ammonium chloride solution (100 mL) was added in one portion. The vessel was removed from the cooling bath, and the system was allowed to warm to 23 ºC while the mixture was rapidly stirred. The biphasic mixture was transferred to a separatory funnel, and the layers were separated. The aqueous layer was extracted with EtOAc (2 × 100 mL). The combined organic layers were washed with water (2 × 100 mL) and brine (100 mL). The washed solution was dried (Na_2SO_4). The dried solution was filtered, and the filtrate was concentrated. The resulting crude residue was purified by flash chromatography (silica gel, eluent: EtOAc:hexanes = 0:1 to 1:3) to afford vinyl stannane **SI-76** (6.80 g, 100% yield, ≥20:1 E:Z) as a colorless oil.

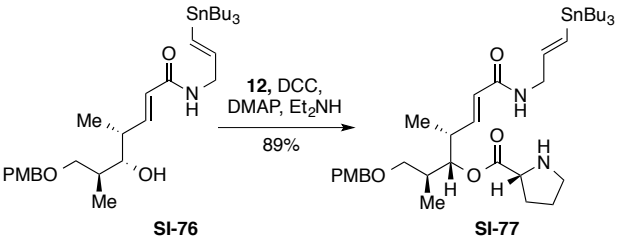
TLC (EtOAc:hexanes = 1:2.5): R_f = 0.30 (UV, $KMnO_4$).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.22 (d, *J* = 8.6 Hz, 2H), 6.87 (d, *J* = 8.6 Hz, 2H), 6.69 (dd, *J* = 15.2, 9.2 Hz, 1H), 6.12 (dt, *J* = 19.0, 1.5 Hz, 1H), 5.97 (dt, *J* = 19.0, 5.1 Hz, 1H), 5.81 (dd, *J* = 15.3, 0.8 Hz, 1H), 5.50 (t, *J* = 5.9 Hz, 1H), 4.45 (d, *J* = 11.6 Hz, 1H), 4.40 (d, *J* = 11.6 Hz, 1H), 4.04 – 3.92 (m, 2H), 3.80 (s, 3H), 3.63 (dt, *J* = 9.0, 2.4 Hz, 1H), 3.53 (dd, *J* = 9.0, 3.8 Hz, 1H), 3.46 (dd, *J* = 9.0, 4.6 Hz, 1H), 2.91 (d, *J* = 2.6 Hz, 1H), 2.50 – 2.35 (m, 1H), 1.88 – 1.76 (m, 1H), 1.54 – 1.41 (m, 6H), 1.30 (h, *J* = 7.3 Hz, 6H), 1.14 (d, *J* = 6.6 Hz, 3H), 0.95 (d, *J* = 7.1 Hz, 3H), 0.88 (t, *J* = 7.3 Hz, 15H).

^{13}C NMR (100 MHz, $CDCl_3$) δ 165.3, 159.2, 146.5, 143.4, 130.5, 130.0, 129.2, 123.4, 113.8, 77.2, 75.4, 73.2, 55.3, 44.9, 40.6, 35.66, 29.0, 27.2, 16.9, 13.7, 9.8, 9.4.

HRMS-ESI m/z calcd for $C_{32}H_{56}NO_4Sn^+$ $[M + H]^+$ 638.3226, found 638.3219.

Amine SI-77



A 500-mL round-bottom flask was charged with **12** (5.40 g, 16.0 mmol, 1.5 equiv), **SI-76** (6.80 g, 10.7 mmol, 1 equiv) and DMAP (0.26 g, 2.14 mmol, 0.2 equiv). DCM (160 mL) was added, resulting in a colorless solution. DCC (3.53 g, 17.1 mmol, 1.6 equiv) was added in one portion, resulting in a white suspension. After 5 h, the alcohol **SI-76** was entirely consumed as indicated by TLC analysis (eluent: EtOAc:hexanes = 1:3), and diethyl amine (80 mL) was

added. After an additional 3 h, the mixture was filtered through a pad of celite, and the filter cake was washed with DCM (2 × 30 mL). The filtrate was concentrated, and the resulting crude residue was purified by flash chromatography (silica gel, eluent: NH_4OH:MeOH:DCM = 0.2:1:100 to 0.2:1:50) to afford amine **SI-77** (6.96 g, 89% yield) as a light-yellow oil.

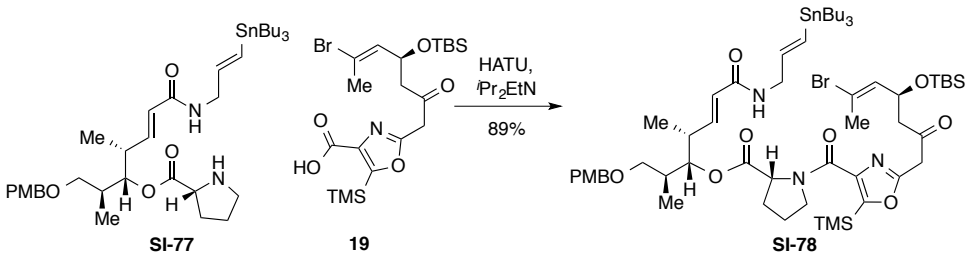
TLC (MeOH: DCM = 1:20): R_f = 0.20 (UV, $KMnO_4$).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.23 (d, *J* = 8.6 Hz, 2H), 6.86 (d, *J* = 8.7 Hz, 2H), 6.68 (dd, *J* = 15.4, 8.2 Hz, 1H), 6.11 (dt, *J* = 19.0, 1.5 Hz, 1H), 5.95 (dt, *J* = 18.9, 5.1 Hz, 1H), 5.81 (dd, *J* = 15.5, 1.1 Hz, 1H), 5.55 (br s, 1H), 5.11 (dd, *J* = 8.1, 3.6 Hz, 1H), 4.38 (d, *J* = 11.5 Hz, 1H), 4.34 (d, *J* = 11.5 Hz, 1H), 4.00 – 3.90 (m, 2H), 3.79 (s, 3H), 3.72 (dd, *J* = 8.5, 5.6 Hz, 1H), 3.34 – 3.17 (m, 2H), 3.12 – 2.99 (m, 1H), 2.88 (ddd, *J* = 10.2, 7.1, 6.2 Hz, 1H), 2.73 – 2.59 (m, 1H), 2.18 – 1.95 (m, 4H), 1.93 – 1.75 (m, 1H), 1.75 – 1.61 (m, 1H), 1.57 – 1.38 (m, 6H), 1.38 – 1.24 (m, 6H), 1.03 (d, *J* = 6.7 Hz, 3H), 0.96 – 0.81 (m, 18H).

^{13}C NMR (100 MHz, $CDCl_3$) δ 175.0, 165.1, 159.1, 144.7, 143.4, 130.4, 130.3, 129.3, 124.1, 113.7, 76.5, 72.9, 72.5, 59.9, 55.2, 46.9, 44.9, 38.5, 35.5, 30.4, 29.0, 27.2, 25.4, 15.8, 13.7, 11.2, 9.4.

HRMS-ESI m/z calcd for $C_{37}H_{63}N_2O_5Sn^+$ $[M + H]^+$ 735.3753, found 735.3740.

Stille coupling precursor SI-78



A 250-mL round-bottom flask was charged with amine **SI-77** (6.76 g, 9.21 mmol, 1 equiv), ^{i}Pr$_2$EtN (3.22 mL, 18.4 mmol, 2.0 equiv) and acid **19** (5.11 g, 10.1 mmol, 1.1 equiv). DCM (92 mL) was added, resulting in a colorless solution, and HATU (4.38 g, 11.5 mmol, 1.25 equiv) was added to this solution in one portion. After 5 h, the mixture was diluted with DCM (100 mL). The solution was transferred to a separatory funnel and was washed with water (2 × 100 mL) and brine (100 mL). The washed solution was dried (Na_2SO_4). The dried solution was filtered, and the filtrate was concentrated. The resulting crude residue was purified by flash chromatography (silica gel, eluent: EtOAc:hexanes = 1:6 to 1:4) to afford Stille coupling precursor **SI-78** (10.0 g, 89% yield) as a light-yellow foam.

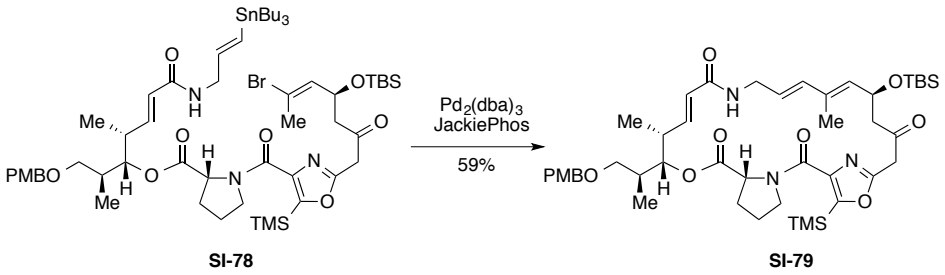
TLC (EtOAc:hexanes = 1:3): R_f = 0.20 (UV, *p*-Anisaldehyde).

^{1}H NMR (400 MHz, $CDCl_3$, mixtures of rotamers) δ 7.26 – 7.15 (m, 2H), 6.91 – 6.78 (m, 2H), 6.63 (m, 1H), 6.10 (m, 1H), 6.01 – 5.91 (m, 1H), 5.85 – 5.68 (m, 2H), 5.68 – 5.53 (m, 1H), 5.05 (m, 1H), 4.82 – 4.71 (m, 1H), 4.64 (m, 1H), 4.45 – 4.22 (m, 2H), 4.11 – 3.64 (m, 9H), 3.33 (m, 1H), 3.17 (d, *J* = 6.6 Hz, 1H), 2.81 (m, 1H), 2.69 – 2.42 (m, 2H), 2.26 (m, 3H), 2.22 – 1.84 (m, 5H), 1.47 (m, 6H), 1.29 (m, 6H), 1.08 – 0.73 (m, 30H), 0.39 – 0.25 (m, 9H), 0.08 – 0 (m, 6H).

^{13}C NMR (100 MHz, $CDCl_3$, mixtures of rotamers) δ 201.1, 200.6, 172.1, 171.9, 165.3, 165.1, 163.4, 162.3, 161.5, 161.4, 159.2, 159.1, 159.04, 159.00, 145.2, 145.1, 144.8, 144.6, 143.43, 143.35, 134.2, 130.7, 130.31, 130.3, 130.2, 129.3, 129.2, 124.19, 124.15, 121.8, 113.70, 113.65, 72.8, 72.7, 72.6, 72.3, 67.0, 66.8, 60.6, 59.8, 55.2, 49.6, 48.8, 47.1, 44.9, 44.2, 43.9, 38.7, 38.5, 35.8, 35.4, 31.6, 29.0, 27.2, 25.7, 25.7, 25.6, 25.2, 24.0, 21.5, 18.0, 15.7, 13.7, 11.4, 11.3, 9.4, –1.73, –1.77, –4.6, –5.14, –5.16.

HRMS-ESI m/z calcd for $C_{57}H_{95}BrN_3O_9Si_2Sn^+$ $[M + H]^+$ 1220.4807, found 1220.4827.

Stille coupling product SI-79



A round-bottom flask containing JackiePhos (0.54 g, 0.67 mmol, 0.2 equiv), $Pd_2(dba)_3$ (0.31 g, 0.34 mmol, 0.1 equiv) and Stille coupling precursor **SI-78** (4.10 g, 3.36 mmol, 1 equiv) was evacuated and flushed with nitrogen (this process was repeated a total of 3 times). Toluene (672 mL) was added, resulting in a red suspension. A stream of argon was passed through the solution by a stainless steel needle for 30 min. The mixture was heated by means of a 50 ºC oil bath. After 12 h, **SI-78** was entirely consumed as indicated by TLC analysis (eluent: EtOAc:hexanes = 1:2), and the mixture was allowed to cool to 23 ºC. The mixture was concentrated, and the resulting crude residue was purified by flash chromatography (silica gel, eluent: EtOAc:hexanes = 1:3 to 1:1.5) to afford Stille coupling product **SI-79** (1.68 g, 59%) as a light-yellow foam.

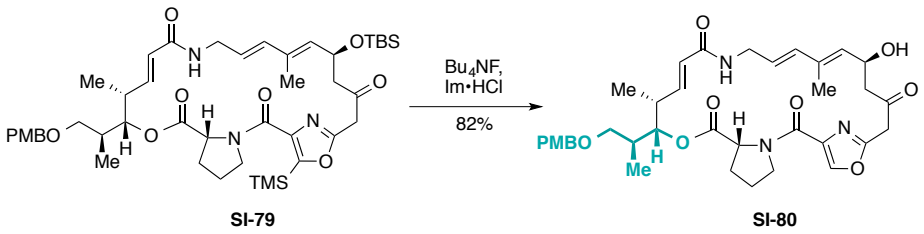
TLC (EtOAc:hexanes = 1:3): R_f = 0.20 (UV, *p*-Anisaldehyde).

^{1}H NMR (400 MHz, CDCl3) δ 7.21 (d, *J* = 8.7 Hz, 2H), 6.87 (d, *J* = 8.7 Hz, 2H), 6.47 (dd, *J* = 16.3, 4.1 Hz, 1H), 6.20 – 6.10 (m, 2H), 5.75 (dd, *J* = 16.3, 2.1 Hz, 1H), 5.56 (ddd, *J* = 15.5, 9.5, 4.2 Hz, 1H), 5.41 (d, *J* = 8.9 Hz, 1H), 5.08 (dd, *J* = 9.6, 1.8 Hz, 1H), 5.00 (ddd, *J* = 8.9, 7.1, 5.8 Hz, 1H), 4.80 (dd, *J* = 8.6, 3.3 Hz, 1H), 4.51 (ddd, *J* = 13.9, 9.0, 4.1 Hz, 1H), 4.43 (d, *J* = 11.7 Hz, 1H), 4.38 (d, *J* = 11.7 Hz, 1H), 3.89 (d, *J* = 17.2 Hz, 1H), 3.80 (s, 3H), 3.74 (d, *J* = 17.2 Hz, 1H), 3.74 – 3.68 (m, 2H), 3.37 (qt, *J* = 9.4, 4.1 Hz, 3H), 2.91 (dd, *J* = 15.7, 7.2 Hz, 1H), 2.73 (dd, *J* = 15.7, 7.2 Hz, 1H), 2.80 – 2.69 (m, 1H), 2.17 – 2.03 (m, 2H), 1.91 – 1.78 (m, 2H), 1.78 – 1.67 (m, 1H), 1.65 (d, *J* = 1.2 Hz, 3H), 1.08 (d, *J* = 6.9 Hz, 3H), 1.04 (s, 3H), 0.85 (s, 9H), 0.30 (s, 9H), 0.05 (s, 3H), 0.02 (s, 3H).

^{13}C NMR (100 MHz, $CDCl_3$) δ 201.1, 172.0, 166.5, 161.8, 161.3, 159.6, 159.2, 145.0, 144.8, 136.6, 134.6, 132.5, 130.2, 129.1, 125.0, 123.5, 113.8, 78.1, 72.9, 71.9, 65.4, 58.7, 55.3, 50.6, 48.4, 43.8, 41.3, 37.2, 35.1, 28.3, 25.7, 24.8, 18.1, 14.9, 12.7, 10.6, –1.8, –4.5, –5.0.

HRMS-ESI m/z calcd for $C_{45}H_{67}N_3NaO_9Si_2^+$ $[M + Na]^+$ 872.4308, found 872.4348.

Analogue SI-80



A 25-mL round-bottom flask containing compound **SI-79** (30 mg, 38 μmol, 1 equiv) was evacuated and flushed with nitrogen (this process was repeated a total of 3 times). THF (4 mL) was added, resulting in a light-yellow solution. In a separate flask, Im•HCl (40 mg, 0.38 mmol, 10.0 equiv) was added to a tetrabutylammonium fluoride solution in THF (1 M, 0.38 mL, 0.38 mmol, 10.0 equiv). The resulting colorless solution was added dropwise to the solution of **SI-79**. After 12 h, the mixture was concentrated, and the residue was dissolved in DCM (30 mL). The resulting solution was

transferred to a separatory funnel and was washed with water (5 × 30 mL) and brine (30 mL). The washed solution was dried (Na_2SO_4). The dried solution was filtered, and the filtrate was concentrated. The resulting crude residue was purified by preparative TLC (eluent: MeOH:DCM = 1:25) to afford analogue **SI-80** (21 mg, 82% yield) as a light-yellow solid.

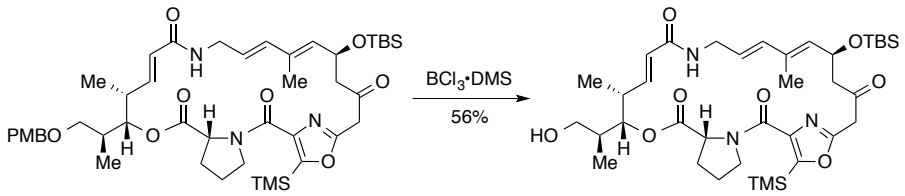
TLC (MeOH:DCM = 1:25): R_f = 0.20 (UV, *p*-anisaldehyde).

^{1}H NMR (400 MHz, $CDCl_3$) δ 8.06 (s, 1H), 7.21 (d, *J* = 8.6 Hz, 2H), 6.86 (d, *J* = 8.6 Hz, 2H), 6.48 (dd, *J* = 16.3, 5.0 Hz, 1H), 6.41 (dd, *J* = 8.9, 3.6 Hz, 1H), 6.09 (d, *J* = 15.6 Hz, 1H), 5.76 (dd, *J* = 16.4, 1.8 Hz, 1H), 5.72 – 5.63 (m, 1H), 5.36 (d, *J* = 8.7 Hz, 1H), 5.01 (dd, *J* = 9.1, 2.0 Hz, 1H), 4.90 (dt, *J* = 8.9, 5.8 Hz, 1H), 4.69 (dd, *J* = 9.0, 3.0 Hz, 1H), 4.52 – 4.32 (m, 3H), 3.97 (dt, *J* = 11.2, 7.6 Hz, 1H), 3.86 – 3.68 (m, 7H), 3.44 – 3.30 (m, 3H), 3.04 (dd, *J* = 16.8, 6.2 Hz, 1H), 2.87 (dd, *J* = 16.8, 5.1 Hz, 1H), 2.76 (ddd, *J* = 9.1, 4.6, 2.0 Hz, 1H), 2.22 – 2.04 (m, 2H), 1.91 (m, 2H), 1.81 (m, 1H), 1.71 (d, *J* = 1.2 Hz, 3H), 1.03 (d, *J* = 6.8 Hz, 3H), 1.01 (d, *J* = 6.7 Hz, 3H).

^{13}C NMR (100 MHz, $CDCl_3$) δ 202.2, 171.6, 166.7, 160.3, 159.2, 156.8, 144.4, 143.9, 137.0, 136.7, 134.4, 132.4, 130.1, 129.1, 125.4, 124.1, 113.8, 78.5, 72.9, 71.9, 65.2, 59.6, 55.3, 48.7, 48.41, 43.4, 40.9, 37.2, 34.9, 28.4, 25.0, 14.7, 12.7, 11.1.

HRMS-EI m/z calcd for $C_{36}H_{46}N_3O_9^+$ $[M + H]^+$ 664.3229, found 664.3251.

Primary alcohol 39



SI-79 **39**

A round-bottom flak containing compound **SI-79** (0.83 g, 0.98 mmol, 1 equiv) was evacuated and reflushed with nitrogen (this process was repeated 3 times). DCM (98 mL) was added, resulting in a yellow solution. The mixture was cooled down to 0 ºC. and a solution of BCl_3•DMS in DCM (2 M, 0.78 mL, 1.56 mmol, 1.6 equiv) was added dropwise. After 20 min, saturated aqueous $NaHCO_3$ (20 mL) was added. The resulting biphasic mixture was stirred at 0 ºC for 1 h and was transferred to a separatory funnel. The organic layer was washed with water (2 × 100 mL) and brine (100 mL). The washed solution was dried (Na_2SO_4), and the dried solution was filtered. The filtrate was concentrated, and the resulting crude residue was purified by flash chromatography (silica gel, eluent: acetone:hexanes = 1:3.5 to 1:2.5) to afford primary alcohol **39** (0.40 g, 56 % yield) as a light-yellow solid.

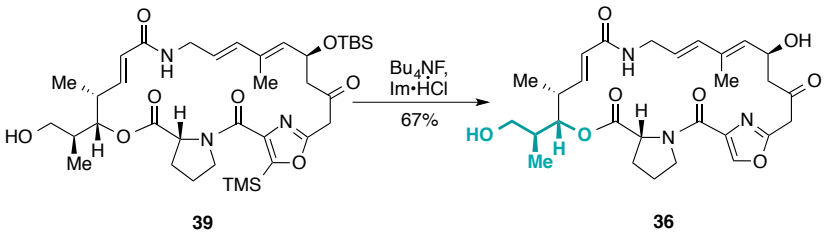
TLC (acetone:hexanes = 1:2.5): R_f = 0.20 (UV, *p*-anisaldehyde).

^{1}H NMR (400 MHz, $CDCl_3$) δ 6.51 (dd, *J* = 16.3, 4.3 Hz, 1H), 6.19 (dd, *J* = 8.9, 3.2 Hz, 1H), 6.14 (d, *J* = 15.7 Hz, 1H), 5.77 (dd, *J* = 16.3, 2.0 Hz, 1H), 5.56 (ddd, *J* = 15.5, 9.3, 4.2 Hz, 1H), 5.41 (d, *J* = 8.9 Hz, 1H), 5.16 (dd, *J* = 8.6, 1.9 Hz, 1H), 4.99 (ddd, *J* = 8.9, 7.2, 5.8 Hz, 1H), 4.79 (dd, *J* = 8.6, 3.5 Hz, 1H), 4.49 (ddd, *J* = 13.6, 8.8, 4.2 Hz, 1H), 3.89 (d, *J* = 17.2 Hz, 1H), 3.74 (d, *J* = 17.2 Hz, 1H), 3.82 – 3.67 (m, 3H), 3.59 (d, *J* = 5.0 Hz, 2H), 3.39 (ddd, *J* = 14.8, 9.4, 3.2 Hz, 1H), 2.91 (dd, *J* = 15.7, 7.2 Hz, 1H), 2.83 (ddq, *J* = 6.6, 4.3, 2.3 Hz, 1H), 2.74 (dd, *J* = 15.7, 5.8 Hz, 1H), 2.20 – 2.06 (m, 2H), 2.06 – 1.96 (m, 1H), 1.94 – 1.80 (m, 2H), 1.65 (d, *J* = 1.2 Hz, 3H), 1.13 (d, *J* = 6.9 Hz, 3H), 1.03 (d, *J* = 6.7 Hz, 3H), 0.85 (s, 9H), 0.30 (s, 9H), 0.05 (s, 3H), 0.01 (s, 3H).

^{13}C NMR (100 MHz, $CDCl_3$) δ 201.1, 172.1, 166.4, 161.9, 161.3, 159.7, 144.94, 144.85, 136.6, 134.6, 132.5, 124.9, 123.6, 77.0, 65.4, 64.6, 58.8, 50.6, 48.5, 43.7, 41.3, 37.4, 37.0, 28.3, 25.7, 24.9, 18.1, 13.9, 12.7, 11.0, –1.8, –4.5, –5.0.

HRMS-ESI m/z calcd for $C_{37}H_{59}N_3NaO_8Si_2^+$ $[M + Na]^+$ 752.3733, found 752.3731.

Analogue 36



A 25-mL round-bottom flask containing compound **39** (36 mg, 49 μmol, 1 equiv) was evacuated and flushed with nitrogen (this process was repeated a total of 3 times). THF (2.0 mL) was added, resulting in a light-yellow solution. In a separate flask, Im•HCl (10 mg, 0.10 mmol, 2.0 equiv) that had previously been dried at >100 ºC for 10 minutes under vacuum was added to a solution of tetrabutylammonium fluoride in THF (1 M, 0.15 mL, 0.15 mmol, 3.0 equiv). The resulting colorless solution was added dropwise to the above solution of **39** at 0 ºC. After 1 h, the mixture was concentrated, and the resulting crude residue was purified by preparative TLC (eluent: MeOH:DCM = 1:25) to afford analogue **36** (18 mg, 67% yield) as a light-yellow solid.

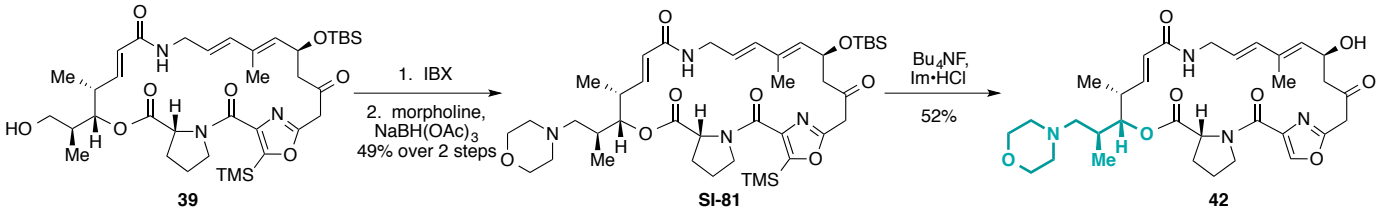
TLC (acetone:hexanes = 1:2.5): R_f = 0.20 (UV, *p*-anisaldehyde).

^{1}H NMR (400 MHz, $CDCl_3$) δ 8.06 (s, 1H), 6.82 – 6.63 (m, 1H), 6.52 (dd, J = 16.3, 5.1 Hz, 1H), 6.08 (d, J = 15.7 Hz, 1H), 5.80 (dd, J = 16.3, 1.8 Hz, 1H), 5.75 – 5.62 (m, 1H), 5.34 (d, J = 8.6 Hz, 1H), 5.09 (d, J = 9.1 Hz, 1H), 4.90 (dt, J = 8.8, 5.8 Hz, 1H), 4.70 (dd, J = 8.8, 3.3 Hz, 1H), 4.48 – 4.32 (m, 1H), 4.01 – 3.88 (m, 1H), 3.88 – 3.72 (m, 3H), 3.64 – 3.50 (m, 2H), 3.41 (ddd, J = 15.0, 8.4, 3.7 Hz, 1H), 3.30 (br s, 2H), 3.00 (dd, J = 16.5, 6.2 Hz, 1H), 2.94 – 2.78 (m, 2H), 2.24 – 2.11 (m, 1H), 2.05 – 1.74 (m, 4H), 1.70 (s, 3H), 1.07 (d, J = 6.8 Hz, 3H), 0.99 (d, J = 7.1 Hz, 3H).

^{13}C NMR (100 MHz, $CDCl_3$) δ 202.2, 171.7, 166.6, 160.4, 157.0, 144.6, 143.9, 136.9, 136.3, 134.4, 132.6, 125.3, 124.1, 77.8, 65.1, 64.4, 59.0, 48.7, 48.6, 43.4, 40.8, 37.3, 36.8, 28.5, 25.0, 13.8, 12.7, 11.4.

HRMS-ESI m/z calcd for $C_{28}H_{38}N_3O_8^+$ $[M + H]^+$ 544.2653, found 544.2651.

Scheme XIII Synthesis of 42



To a solution of alcohol **39** (30 mg, 41 μmol, 1 equiv) in EtOAc (2 mL) was added IBX (35 mg, 0.12 mmol, 3.0 equiv), and the resulting suspension was heated by means of an 80 ºC oil bath for 3 h. The mixture was allowed to cool to 23 ºC and was filtered through a pad of celite. The filter cake was washed with ethyl acetate (3 × 2 mL), and the combined filtrates were concentrated to yield a crude aldehyde which was used without further purification.

A 25-mL round-bottom flask containing $NaBH(OAc)_3$ (17 mg, 82 μmol, 2.0 equiv) was evacuated and flushed with nitrogen (this process was repeated a total of 3 times). DCE (2 mL) and morpholine (7 μL, 82 μmol, 2.0 equiv) was

added, resulting in a light-yellow solution, and a solution of the above crude aldehyde in DCE (2 mL) was added. After 3 h, saturated aqueous $NaHCO_3$ solution (10 mL) was added, followed by EtOAc (50 mL). The resulting biphasic mixture was transferred to separatory funnel, and the layers were separated. The organic layer was washed with water (2 × 20 mL) and brine (20 mL). The washed solution was dried (Na_2SO_4). The dried solution was filtered, and the filtrate was concentrated. The resulting residue was purified by flash chromatography (silica gel, eluent: acetone:hexanes = 1:3) to afford **SI-81** (16 mg, 49%, 2 steps) as a light-yellow solid.

TLC (acetone:hexanes = 1:4): R_f = 0.30 (UV, *p*-anisaldehyde).

^{1}H NMR (400 MHz, $CDCl_3$) δ 6.50 (dd, *J* = 16.3, 4.1 Hz, 1H), 6.20 – 6.05 (m, 2H), 5.77 (dd, *J* = 16.3, 2.0 Hz, 1H), 5.56 (ddd, *J* = 14.8, 9.5, 4.1 Hz, 1H), 5.41 (d, *J* = 8.9 Hz, 1H), 5.05 – 4.95 (m, 2H), 4.80 (dd, *J* = 8.7, 3.3 Hz, 1H), 4.49 (ddd, *J* = 14.1, 9.0, 4.1 Hz, 1H), 3.88 (d, *J* = 17.2 Hz, 1H), 3.81 – 3.56 (m, 7H), 3.40 (ddd, *J* = 13.5, 9.7, 3.1 Hz, 1H), 2.91 (dd, *J* = 15.8, 5.8 Hz, 1H), 2.95 – 2.80 (m, 1H), 2.73 (dd, *J* = 15.7, 5.8 Hz, 1H), 2.52 – 2.29 (m, 6H), 2.29 – 1.75 (m, 5H), 1.65 (s, 3H), 1.11 (d, *J* = 6.9 Hz, 3H), 0.98 (d, *J* = 6.5 Hz, 3H), 0.85 (s, 9H), 0.30 (s, 9H), 0.05 (s, 3H), 0.02 (s, 3H).

^{13}C NMR (100 MHz, $CDCl_3$) δ 201.0, 171.9, 166.4, 161.8, 161.3, 159.6, 145.0, 144.8, 136.7, 134.7, 132.5, 124.9, 123.6, 79.1, 67.0, 65.4, 62.6, 58.7, 54.1, 50.6, 48.4, 43.7, 41.3, 37.6, 31.7, 28.3, 25.7, 24.8, 18.1, 15.8, 12.7, 10.9, –1.9, –4.5, –5.0.

HRMS-ESI m/z calcd for $C_{41}H_{67}N_4O_8Si_2^+$ $[M + H]^+$ 799.4492, found 799.4499.

A 25-mL round-bottom flask containing **SI-81** (16 mg, 20 μmol, 1 equiv) was evacuated and flushed with nitrogen (this process was repeated a total of 3 times). THF (2.0 mL) was added, resulting in a light-yellow solution. In a separate flask, Im•HCl (21 mg, 0.20 mmol, 10.0 equiv) that had previously been dried at >100 ºC for 10 minutes under vacuum was added to a solution of tetrabutylammonium fluoride in THF (1 M, 0.20 mL, 0.20 mmol, 10.0 equiv). The resulting colorless solution was added dropwise to the above solution of **SI-81**. After 12 h, the mixture was concentrated, and the residue was dissolved in DCM (30 mL). The resulting solution was transferred to a separatory funnel and was washed with water (5 × 30 mL) and brine (30 mL). The washed solution was dried (Na_2SO_4), ans the dried solution was filtered. The filtrate was concentrated, the resulting crude residue was purified by preparative TLC (eluent: MeOH:DCM = 1:25) to afford analogue **42** (6.4 mg, 52% yield) as a light-yellow solid.

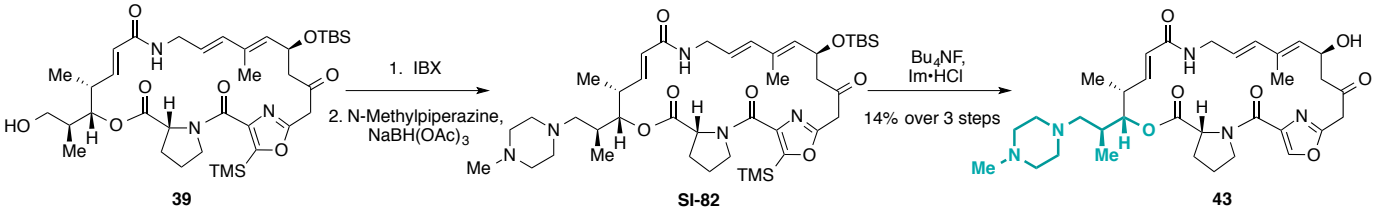
TLC (MeOH:DCM = 1:25): R_f = 0.30 (UV, *p*-anisaldehyde).

^{1}H NMR (400 MHz, $CDCl_3$) δ 8.04 (s, 1H), 6.51 (dd, *J* = 16.3, 5.1 Hz, 1H), 6.45 (dd, *J* = 8.9, 3.7 Hz, 1H), 6.09 (d, *J* = 15.6 Hz, 1H), 5.79 (dd, *J* = 16.3, 1.8 Hz, 1H), 5.69 (ddd, *J* = 15.6, 8.8, 4.6 Hz, 1H), 5.34 (d, *J* = 8.8 Hz, 1H), 5.00 – 4.84 (m, 2H), 4.70 (dd, *J* = 8.9, 3.1 Hz, 1H), 4.45 (ddd, *J* = 14.0, 8.7, 4.6 Hz, 1H), 3.98 (dt, *J* = 11.3, 7.5 Hz, 1H), 3.84 (d, *J* = 15.5 Hz, 1H), 3.79 (d, *J* = 15.7 Hz, 1H), 3.77 – 3.60 (m, 5H), 3.40 (ddd, *J* = 14.9, 8.9, 3.6 Hz, 1H), 3.05 (dd, *J* = 16.7, 6.4 Hz, 1H), 3.01 – 2.90 (m, 1H), 2.87 (dd, *J* = 16.8, 5.0 Hz, 1H), 2.52 – 2.29 (m, 4H), 2.29 – 1.75 (m, 7H), 1.71 (d, *J* = 1.2 Hz, 3H), 1.06 (d, *J* = 6.8 Hz, 3H), 0.96 (d, *J* = 6.5 Hz, 3H).

^{13}C NMR (100 MHz, $CDCl_3$) δ 202.1, 171.6, 166.6, 160.3, 156.7, 144.3, 143.9, 137.0, 136.7, 134.5, 132.4, 125.4, 124.2, 79.6, 66.9, 65.3, 62.7, 59.7, 54.1, 48.7, 48.43, 43.5, 40.9, 37.5, 31.5, 28.5, 25.0, 15.7, 12.7, 11.4.

HRMS-ESI m/z calcd for $C_{32}H_{44}N_4NaO_8^+$ $[M + Na]^+$ 635.3051, found 635.3054.

Scheme XIV Synthesis of 43



To a solution of alcohol **39** (30 mg, 41 μmol, 1 equiv) in EtOAc (2 mL) was added IBX (35 mg, 0.12 mmol, 3.0 equiv), and the resulting suspension was heated by means of an 80 ºC oil bath for 3 h. The mixture was allowed to cool to 23 ºC and was filtered through a pad of celite. The filter cake was washed with ethyl acetate (3 × 2 mL), and the combined filtrates were concentrated to yield a crude aldehyde which was used for next step without further purification.

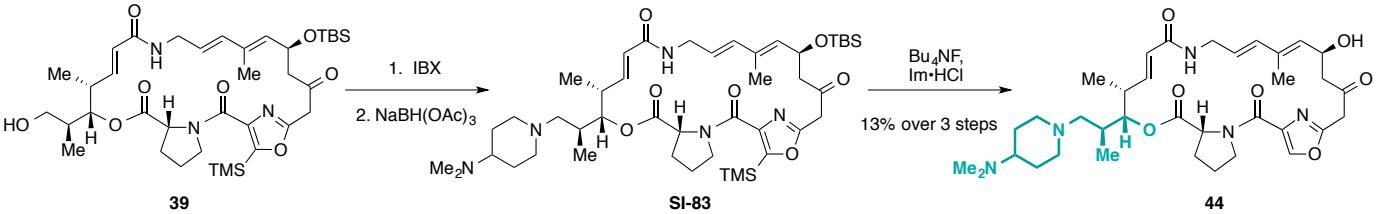
A 25-mL round-bottom flask containing $NaBH(OAc)_3$ (17 mg, 82 μmol, 2.0 equiv) was evacuated and flushed with nitrogen (this process was repeated a total of 3 times). DCE (2 mL) and N-methylpiperazine (9 μL, 82 μmol, 2.0 equiv) was added, resulting in a light-yellow solution, and the above crude aldehyde solution in DCE (2 mL) was added. After 3 h, saturated aqueous $NaHCO_3$ solution (10 mL) was added, followed by EtOAc (50 mL). The resulting biphasic mixture was transferred to separatory funnel, and the layers were separated. The organic layer was washed with water (2 × 20 mL) and brine (20 mL). The washed solution was dried (Na_2SO_4), and the dried solution was filtered. The filtrate was concentrated, and the resulting residue was purified by flash chromatography (silica gel, eluent: acetone:hexanes = 1:1) to afford **SI-82** (14 mg, 41% yield over 2 steps) as a white solid.

A 25-mL round-bottom flask containing **SI-82** (14 mg, 17 μmol, 1 equiv) was evacuated and flushed with nitrogen (this process was repeated a total of 3 times). THF (1.7 mL) was added, resulting in a light-yellow solution. In a separate flask, Im•HCl (17 mg, 0.17 mmol, 10.0 equiv) that had previously been dried at >100 ºC for 10 minutes under vacuum was added to a solution of tetrabutylammonium fluoride in THF (1 M, 0.17 mL, 0.17 mmol, 10.0 equiv). The mixture was concentrated and the resulting crude residue was purified by preparative HPLC (eluent: H_2O:acetonitrile = 95:5 to 5:95 over 15 min) to afford analogue **43** (5 mg, 31% yield) as a white solid.

^{1}H NMR (300 MHz, MeOD) δ 8.29 (s, 1H), 6.76 (dd, *J* = 15.9, 4.7 Hz, 1H), 6.22 (d, *J* = 15.9 Hz, 1H), 5.89 (d, *J* = 15.7 Hz, 1H), 5.68 (dd, *J* = 14.8, 7.5 Hz, 1H), 5.43 (d, *J* = 9.3 Hz, 1H), 5.15 – 5.05 (m, 1H), 5.05 – 4.95 (m, 1H), 4.85- 4.75 (m, 2H), 4.05 – 3.80 (m, 5H), 3.78 – 3.65 (m, 1H), 3.60 – 3.40 (m, 1H), 3.24 – 2.68 (m, 14H), 2.50 – 2.25 (m, 4H), 2.25 – 2.00 (m, 4H), 1.95 – 1.85 (m, 1H), 1.78 (d, *J* = 1.7 Hz, 3H), 1.19 (d, *J* = 6.7 Hz, 3H), 1.12 (d, *J* = 6.3 Hz, 3H).

HRMS-ESI m/z calcd for $C_{35}H_{52}N_5O_7^+$ $[M + H]^+$ 654.3861, found 654.3867.

Scheme XV Synthesis of 44



To a solution of alcohol **39** (30 mg, 41 μmol, 1 equiv) in EtOAc (2 mL) was added IBX (35 mg, 0.12 mmol, 3.0 equiv), and the resulting suspension was heated by means of an 80 ºC oil bath for 3 h. The mixture was allowed to cool to 23 ºC and was filtered through a pad of celite. The filter cake was washed with ethyl acetate (3 × 2 mL), and

the combined filtrates were concentrated to yield a crude aldehyde which was used for next step without further purification.

A 25-mL round-bottom flask containing sodium $NaBH(OAc)_3$ (17 mg, 82 μmol, 2.0 equiv) was evacuated and flushed with nitrogen (this process was repeated a total of 3 times). DCE (2 mL), $^{i}Pr_2EtN$ (29 μL, 0.16 mmol, 4.0 equiv) and 4-(dimethylammonio)piperidinium dichloride (33 μg, 0.16 mmol, 4.0 equiv) were added, resulting in a light-yellow solution. After 30 min, to this solution was added a solution of the above crude aldehyde in DCE (2 mL). After 3 h, saturated aqueous $NaHCO_3$ solution (10 mL) was added, followed by EtOAc (50 mL). The resulting biphasic mixture was transferred to separatory funnel, and the layers were separated. The organic layer was washed with water (2 × 20 mL) and brine (20 mL). The organic layer was washed with water (2 × 20 mL) and brine (20 mL). The washed solution was dried (Na_2SO_4), and the dried solution was filtered. The filtrate was concentrated, and the resulting residue was purified by flash chromatography (silica gel, eluent: acetone:hexanes = 1:1) to afford **SI-83** (15 mg, 45% yield over 2 steps) as a white solid.

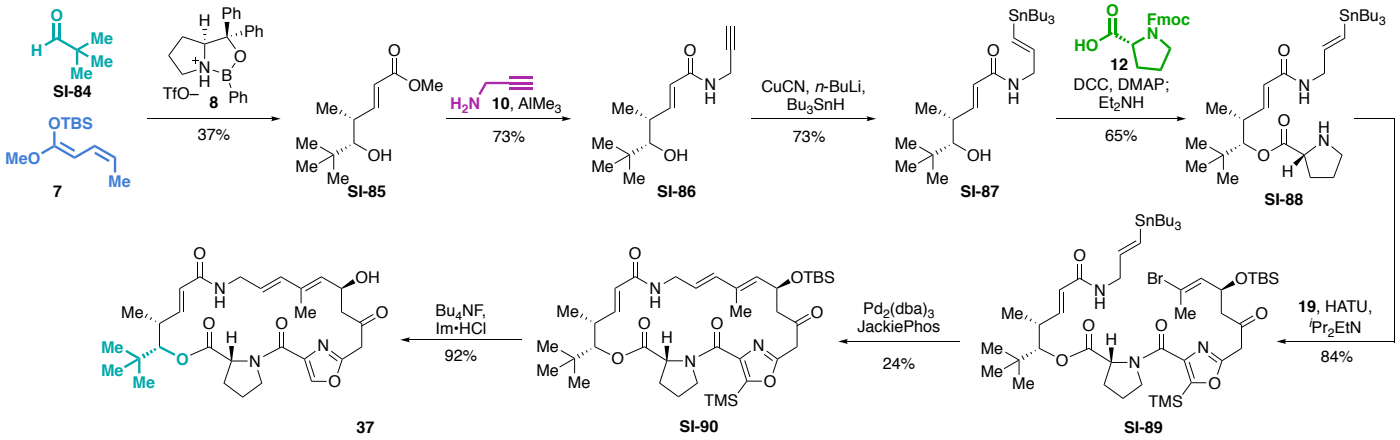
A 25-mL round-bottom flask containing **SI-83** (15 mg, 18 μmol, 1 equiv) was evacuated and flushed with nitrogen (this process was repeated a total of 3 times). THF (2.0 mL) was added, resulting in a light-yellow solution. In a separate flask, Im•HCl (19 mg, 0.18 mmol, 10.0 equiv) that had previously been dried at >100 ºC for 10 minutes under vacuum was added to a solution of tetrabutylammonium fluoride in THF (1 M, 0.18 mL, 0.18 mmol, 10.0 equiv). The mixture was concentrated and the resulting crude residue was purified by preparative HPLC (eluent: H_2O:acetonitrile = 95:5 to 5:95 over 15 min) to afford analogue **44** (5 mg, 32% yield) as a light-yellow solid.

TLC (MeOH:DCM = 1:25): R_f = 0.30 (UV, *p*-anisaldehyde).

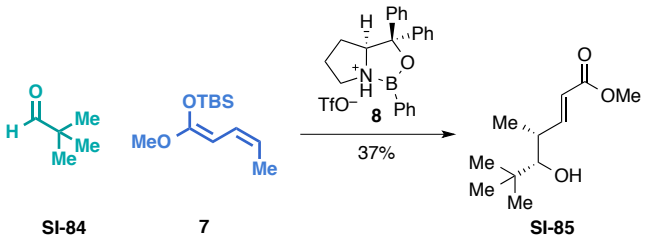
^{1}H NMR (300 MHz, MeOD) δ 8.28 (s, 1H), 6.79 (dd, *J* = 15.8, 4.7 Hz, 1H), 6.21 (d, *J* = 15.9 Hz, 1H), 5.86 (d, *J* = 16.2 Hz, 1H), 5.67 (d, *J* = 14.3 Hz, 1H), 5.41 (d, *J* = 9.1 Hz, 1H), 5.20 – 5.10 (m, 1H), 5.00 (d, *J* = 8.3 Hz, 1H), 4.85 – 4.75 m, 1H), 4.75 (d, *J* = 9.9 Hz, 1H), 4.00 (d, *J* = 16.8 Hz, 1H), 3.95 – 3.80 (m, 3H), 3.27 – 2.68 (m, 14H), 2.50 – 2.35 (m, 1H), 2.35 – 2.25 (m, 2H), 2.15 – 2.00 (s, 2H), 1.78 (s, 3H), 1.16 (d, *J* = 6.7 Hz, 3H), 0.98 (d, *J* = 6.6 Hz, 3H).

HRMS-ESI m/z calcd for $C_{33}H_{48}N_5O_7^+$ $[M + H]^+$ 626.3548, found 626.3552.

Scheme XVI Synthesis of 37

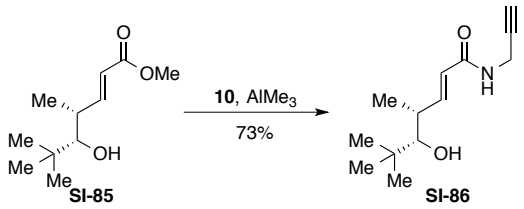


Mukaiyama aldol product SI-85



A 100-mL round-bottom flask was charged with phenylboronic acid (0.30 g, 2.50 mmol, 0.5 equiv) and (S)-diphenyl(pyrrolidin-2-yl)methanol (0.63 g, 2.50 mmol, 0.5 equiv). The vessel was equipped with a Dean-Stark apparatus and a reflux condenser, evacuated and flushed with nitrogen (the process of nitrogen exchange was repeated a total of 3 times). Toluene (25 mL) was added, and the resulting clear solution was brought to reflux by means of a 145 ºC oil bath. After 12 h, the mixture was allowed to cool to 23 ºC and was concentrated. The resulting white solid was dried at ≤1 Torr for 1 h. The vessel was flushed with nitrogen, and DCM (25 mL) was added. The resulting colorless solution was cooled to -78 °C by means of a dry ice-acetone, and TfOH (0.20 mL, 2.25 mmol, 0.45 equiv) was added dropwise over 5 min by means of glass syringe (CAUTION: TfOH rapidly corrodes most plastic syringes!). Some of the TfOH froze upon contact with the solution. After 1 h, the solids had dissolved, and a solution of aldehyde **SI-84** (0.43 g, 5.00 mmol, 1 equiv), TBS dienol ether **8** (1.43 g, 6.24 mmol 1.25 equiv) and isopropanol (0.48 mL, 6.24 mmol, 1.25 equiv) in DCM (10 mL) was added dropwise over 2 h by means of syringe pump. The mixture was stirred at -78 °C for another 1.5 h, and saturated aqueous $NaHCO_3$ solution (50 mL) was added in one portion. The vessel was removed from the cooling bath, and the system was allowed to warm to 23 ºC while it was rapidly stirred. The biphasic mixture was transferred to a separatory funnel, and the layers were separated. The aqueous layer was extracted with DCM (2 × 30 mL). The combined organic layers were dried (Na_2SO_4). The dried solution was filtered, and the filtrate was concentrated. The resulting crude residue was purified by flash chromatography (silica gel, eluent: EtOAc:hexanes = 1:6 to 1:4) to afford Mukaiyama aldol product **SI-85** (0.37 g, 37% yield) as a colorless oil.

Amide SI-86

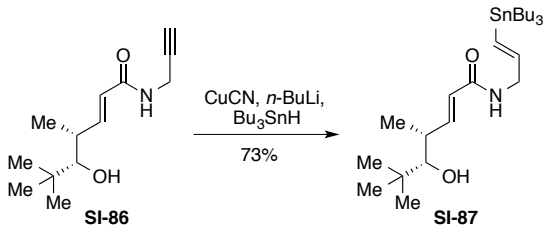


A 100-mL round-bottom flask was charged with propargylamine (**10**, 0.47 mL, 7.40 mmol, 4.0 equiv) and DCM (15 mL) under nitrogen. The resulting colorless solution was cooled to 0 ºC by means of an ice/water bath. A solution of $AlMe_3$ in heptane (1 M, 7.40 mL, 7.40 mmol, 4.0 equiv) was added dropwise over 30 min (CAUTION: Gas evolution!), and then the mixture was allowed to warm to 23 ºC. After 30 min, a solution of **SI-85** (0.37 g, 1.85 mmol, 1 equiv) in DCM (5 mL) was added over 10 min (CAUTION: Gas evolution!). The vessel was equipped with a reflux condenser, and the solution was brought to reflux by means of a 50 ºC oil bath. After 3 h, the mixture was cooled to 0 °C by means of an ice/water bath, and MeOH (3 mL) was added (CAUTION: Gas evolution!), followed by saturated aqueous potassium sodium tartrate solution (50 mL). After 1 h, the biphasic mixture was transferred to a separatory funnel, and the layers were separated. The aqueous layer was extracted with DCM (2 × 50 mL). The combined organic layers were washed with water (100 mL) and brine (100 mL), and the washed solution was dried (Na_2SO_4). The dried solution was filtered, and the filtrate was concentrated. The resulting crude residue was purified by flash chromatography (silica gel, eluent: EtOAc:hexanes = 1:1) to afford amide **SI-86** (0.30 g, 73% yield) as a white, waxy solid.

TLC (EtOAc:hexanes = 1:1): R_f = 0.30 (UV, $KMnO_4$).

^{1}H NMR (300 MHz, $CDCl_3$) δ 6.91 (dd, *J* = 15.4, 8.1 Hz, 1H), 5.75 (dd, *J* = 15.4, 1.1 Hz, 1H), 5.61 (s, 1H), 4.13 (dd, *J* = 5.4, 2.5 Hz, 2H), 3.29 (d, *J* = 4.2 Hz, 1H), 2.71 – 2.53 (m, 1H), 2.25 (t, *J* = 2.5 Hz, 1H), 1.11 (d, *J* = 6.8 Hz, 3H), 0.95 (s, 9H).

Vinyl stannane SI-87

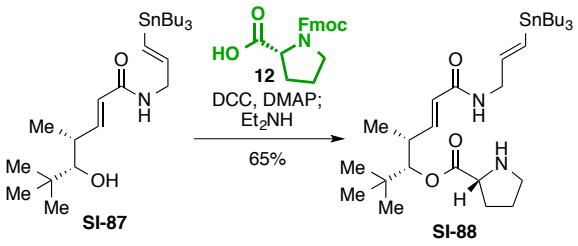


A 100-mL round-bottom flask containing CuCN (0.30 g, 1.35 mmol, 2.0 equiv) was evacuated and flushed with nitrogen (this process was repeated a total of 3 times). Dry THF (14 mL) was added, resulting in a white suspension, and the vessel and its contents were cooled to -78 ºC by means of a dry ice/acetone bath. A solution of *n*-BuLi in hexanes (2.5 M, 2.30 mL, 5.66 mmol, 4.2 equiv) was added dropwise over 10 min, resulting in a light-yellow solution. After 30 min, Bu_3SnH (1.53 mL, 5.66 mmol, 4.2 equiv) was added dropwise over 5 min. The resulting yellow solution was stirred at -78 ºC for 30 min, and a solution of amide **SI-86** (0.30 g, 1.35 mmol, 1 equiv) in THF (5 mL) was added dropwise over 15 min. After 1 h, saturated aqueous ammonium chloride solution (100 mL) was added in one portion. The vessel was removed from the cooling bath, and the system was allowed to warm to 23 ºC while the mixture was rapidly stirred. The biphasic mixture was transferred to a separatory funnel, and the layers were separated. The aqueous layer was extracted with EtOAc (2 × 50 mL). The combined organic layers were washed with water (2 × 100 mL) and brine (100 mL). The washed solution was dried (Na_2SO_4), and the dried solution was filtered. The filtrate was concentrated, and the resulting crude residue was purified by flash chromatography (silica gel, eluent: EtOAc:hexanes = 0:1 to 1:3) to afford vinyl stannane **SI-87** (0.50 g, 73% yield, ≥20:1 E:Z) **a**s a colorless oil.

TLC (EtOAc:hexanes = 1:2.5): R_f = 0.30 (UV, $KMnO_4$).

^{1}H NMR (300 MHz, $CDCl_3$) δ 6.89 (dd, *J* = 15.7, 8.0 Hz, 1H), 6.12 (d, *J* = 19.1 Hz, 1H), 5.97 (dt, *J* = 18.6, 5.5 Hz, 1H),), 5.84 – 5.70 (m, 1H), 5.54 – 5.40 (m, 1H), 4.04 – 3.94 (m, 2H), 3.36 – 3.26 (m, 1H), 2.67 – 2.54 (m, 1H), 1.54 – 1.40 (m, 6H), 1.38 – 1.20 (m, 6H), 1.11 (d, *J* = 6.7 Hz, 3H), 0.95 (s, 9H), 1.00 – 0.80 (m, 15H).

Amine SI-88



A 100-mL round-bottom flask was charged with Fmoc-D-Pro-OH (**12,** 0.11 g, 0.32 mmol, 1.5 equiv), DMAP (5.2 mg, 0.042 mmol, 0.2 equiv) and **SI-87** (0.11 g, 0.21 mmol, 1 equiv). DCM (3 mL) was added, resulting in a colorless solution. DCC (0.071 g, 0.34 mmol, 1.6 equiv) was added in one portion. resulting in a white suspension. After 5 h, the alcohol **SI-87** was entirely consumed as indicated by TLC analysis (eluent: EtOAc:hexanes = 1:2), and then diethyl amine (1.5 mL) was added. After 3 h, the mixture was filtered through a pad of celite, and the filter cake was washed

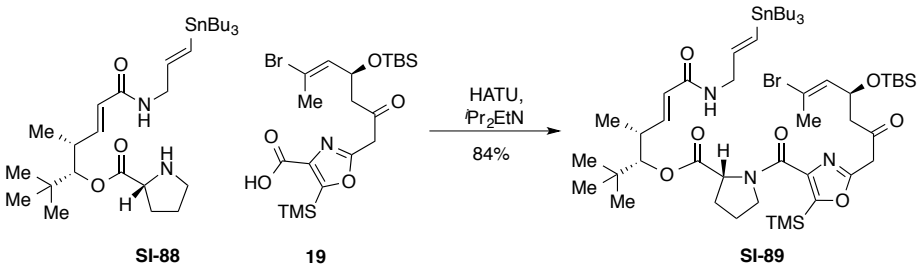
with DCM (2 × 5 mL). The combined filtrates were concentrated, and the resulting crude residue was purified by flash chromatography (silica gel, eluent: NH_4OH:MeOH:DCM = 0.2:1:100 to 0.2:1:50) to afford amine **SI-88** (85 mg, 65% yield) as a light-yellow oil.

TLC (MeOH:DCM= 1:20): R_f= 0.20 (UV).

^{1}H NMR (300 MHz, $CDCl_3$) δ 6.77 (dd, *J* = 15.4, 8.3 Hz, 1H), 6.10 (dt, *J* = 18.9, 1.4 Hz, 1H), 5.95 (dt, *J* = 19.0, 4.9 Hz, 1H), 5.78 (dd, *J* = 15.4, 1.0 Hz, 1H), 5.62 (t, *J* = 5.8 Hz, 1H), 4.75 (d, *J* = 5.7 Hz, 1H), 3.97 (t, *J* = 5.3 Hz, 2H), 3.77 (dd, *J* = 8.4, 5.7 Hz, 1H), 3.07 (dt, *J* = 10.2, 6.8 Hz, 1H), 2.89 (dt, *J* = 10.3, 6.6 Hz, 1H), 2.78 – 2.62 (m, 1H), 2.22 (br s, 1H), 2.19 – 2.05 (m, 1H), 1.97 – 1.79 (m, 1H), 1.80 – 1.66 (m, 2H), 1.57 – 1.39 (m, 6H), 1.38 – 1.19 (m, 6H), 1.02 (d, *J* = 6.9 Hz, 3H), 0.92 (s, 9H), 0.92 – 0.82 (m, 15H).

^{13}C NMR (75 MHz, $CDCl_3$) δ 175.0, 165.4, 147.3, 143.4, 130.3, 122.7, 82.0, 59.9, 46.9, 44.9, 37.5, 35.7, 30.4, 29.0, 27.2, 26.6, 25.5, 16.5, 13.7, 9.4.

Stille coupling precursor SI-89



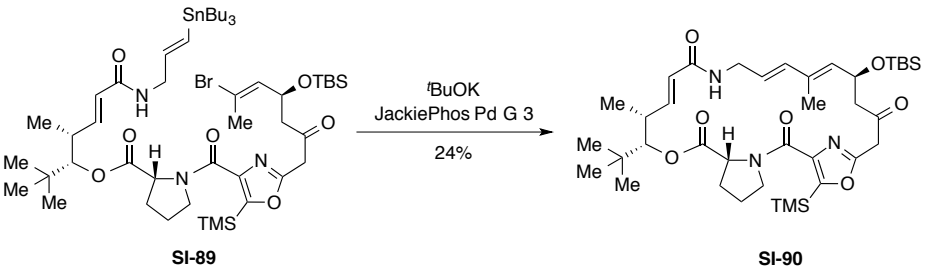
A 50-mL round-bottom flask was charged with amine **SI-88** (80 mg, 0.13 mmol, 1 equiv), ^{i}Pr$_2$EtN (46 μL, 0.26 mmol, 2.0 equiv) and acid **19** (73 mg, 0.14 mmol, 1.1 equiv). DCM (1.3 mL) was added, resulting in a clear, colorless solution, and HATU (62 mg, 0.16 mmol, 1.25 equiv) was added to this solution in one portion. After 5 h, the mixture was diluted with DCM (10 mL). The solution was transferred to a separatory funnel and was washed with water (2 × 10 mL) and brine (10 mL). The washed solution was dried (Na_2SO_4), and the dried solution was filtered. The filtrate was concentrated, and the resulting crude residue was purified by flash chromatography (silica gel, eluent: EtOAc:hexanes = 1:6 to 1:4) to afford Stille coupling precursor **SI-89**(0.12 g, 84% yield) as a light-yellow foam.

TLC (EtOAc:Hexanes = 1:3): R_f = 0.20 (UV, *p*-Anisaldehyde).

^{1}H NMR (300 MHz, $CDCl_3$, mixtures of rotamers) δ 6.80 – 6.58 (m, 1H), 6.09 (d, *J* = 19.0 Hz, 1H), 5.93 (dt, *J* = 19.0, 5.0 Hz, 1H), 5.86 – 5.60 (m, 3H), 4.85 – 4.58 (m, 3H), 4.15 – 3.63 (m, 6H), 2.91 – 2.71 (m, 1H), 2.75 – 2.57 (m, 1H), 2.56 – 2.43 (m, 1H), 2.31 – 2.20 (m, 1H), 2.26 (s, 3H), 2.09 – 1.85 (m, 3H), 1.55 – 1.35 (m, 6H), 1.35 – 1.15 (m, 9H), 1.05 – 0.73 (m, 33H), 0.36 – 0.23 (m, 9H), 0.09 – -0.05 (m, 6H).

^{13}C NMR (75 MHz, $CDCl_3$, mixtures of rotamers) δ 201.1, 200.8, 172.15, 172.06, 165.7, 165.3, 163.2, 162.5, 161.4, 159.11, 159.05, 147.3, 147.2, 145.2, 145.0, 143.45, 143.35, 134.2, 130.2, 123.0, 122.9, 122.6, 121.7, 82.3, 81.8, 67.0, 66.8, 60.4, 59.8, 49.6, 49.5, 48.7, 47.0, 44.8, 44.2, 43.9, 37.5, 37.4, 36.6, 35.73, 35.68, 29.0, 27.2, 26.77, 26.70, 25.6, 23.95, 23.93, 17.9, 16.2, 16.0, 13.6, 9.4, –1.3, –4.6, –5.18, –5.21.

Stille coupling product SI-90



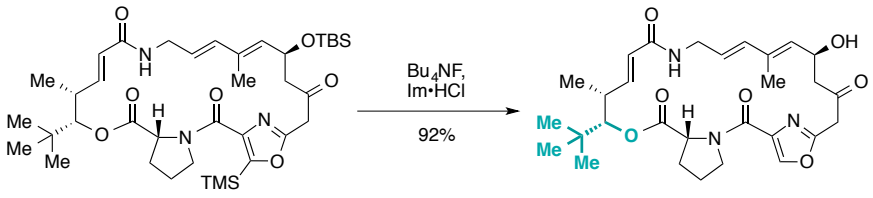
SI-89 **SI-90**

A 25-mL round-bottom flask containing JackiePhos Pd G3 (16 mg, 14 µmol, 0.3 equiv) was evacuated and flushed with nitrogen (this process was repeated a total of 3 times). Toluene (8 mL) was added, and a stream of argon was passed through the solution by means of a stainless steel needle for 30 min. A solution of KOtBu in THF (1.6 M, 8.5 µL, 14 µmol, 0.3 equiv) was added, and the resulting orange mixture was heated by means of an 80 ºC oil bath for 5 minutes, during which time the mixture turned deep brown-red. In a scintillation vial, a stream of argon was passed through a solution of Stille coupling precursor **SI-89** (50 mg, 46 µmol, 1 equiv) in Toluene (2 mL) for 5 minutes. The resulting degassed solution was added dropwise over 1 min to the solution of catalyst, which was already stirring at 80 ºC. The mixture was stirred under a positive pressure of nitrogen for 40 h, after which time **SI-89** was completely consumed by TLC analysis (eluent: EtOAc:hexanes = 1:2, stain: anisaldehyde). The mixture was allowed to cool to 23 ºC and was concentrated. The resulting residue was purified by column chromatography (silica gel, eluent: EtOAc:hexanes = 1:2) to afford **SI-90** (8.0 mg, 24% yield) as a light-yellow oil.

TLC (EtOAc:Hexanes = 1:3): R_f = 0.20 (UV, *p*-Anisaldehyde).

^{1}H NMR (300 MHz, $CDCl_3$) δ 6.45 (dd, *J* = 16.3, 4.4 Hz, 1H), 6.14 (d, *J* = 15.7 Hz, 1H), 6.08 (s, 1H), 5.75 (dd, *J* = 16.3, 2.0 Hz, 1H), 5.56 (ddd, *J* = 15.0, 9.6, 4.2 Hz, 1H), 5.41 (d, *J* = 8.8 Hz, 1H), 5.08 – 4.95 (m, 1H), 4.88 (d, *J* = 1.5 Hz, 1H), 4.84 (dd, *J* = 8.8, 3.1 Hz, 1H), 4.50 (ddd, *J* = 13.8, 9.0, 4.2 Hz, 1H), 3.89 (d, *J* = 17.2 Hz, 1H), 3.82 – 3.69 (m, 3H), 3.38 (ddd, *J* = 13.9, 9.6, 3.0 Hz, 1H), 2.89 (dd, *J* = 16.1, 6.7 Hz, 1H), 2.88 – 2.78 (m, 1H), 2.73 (dd, *J* = 16.0, 6.0 Hz, 1H), 2.20 – 2.10 (m, 1H), 2.17 (s, 3H), 1.95 – 1.85 (m, 3H), 1.15 (d, *J* = 6.8 Hz, 3H), 1.03 (s, 9H), 0.85 (s, 9H), 0.30 (s, 9H), 0.05 (s, 3H), 0.02 (s, 3H).

Analogue 37



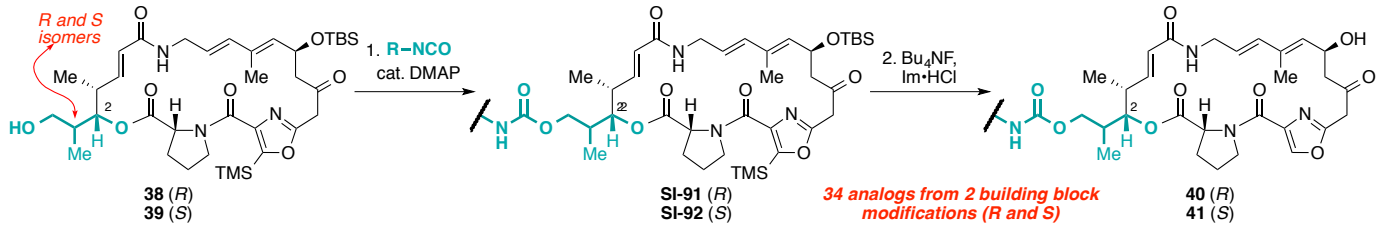
SI-90 **37**

A 10-mL round-bottom flask containing compound **SI-90** (8 mg, 11 µmol, 1 equiv) was evacuated and flushed with nitrogen (this process was repeated a total of 3 times). THF (0.5 mL) was added, resulting in a light-yellow solution. In a separate flask, Im•HCl (23 mg, 0.22 mmol, 20.0 equiv) was added to a tetrabutylammonium fluoride solution in THF (1 M, 0.22 mL, 0.22 mmol, 20.0 equiv). The resulting colorless solution was added dropwise to the solution of **SI-90**. After 12 h, the mixture was concentrated, and the residue was dissolved in DCM (30 mL). The resulting solution was transferred to a separatory funnel and was washed with water (5 × 30 mL) and brine (30 mL). The washed solution was dried (Na_2SO_4), and the dried solution was filtered. The filtrate was concentrated, and the resulting crude residue was purified by preparative TLC (eluent: MeOH:DCM = 1:25) to afford analogue **37** (5.5 mg, 92% yield) as a light-yellow solid.

TLC (MeOH:DCM = 1:25): R_f = 0.20 (UV, *p*-anisaldehyde).

^{1}H NMR (300 MHz, $CDCl_3$) δ 8.13 (s, 1H), 6.44 (dd, *J* = 16.3, 5.2 Hz, 1H), 6.19 (d, *J* = 7.0 Hz, 1H), 6.11 (d, *J* = 15.5 Hz, 1H), 5.85 – 5.71 (m, 1H), 5.71 – 5.60 (m, 1H), 5.44 (d, *J* = 8.7 Hz, 1H), 4.91 (dt, *J* = 9.1, 5.4 Hz, 1H), 4.81 (d, *J* = 1.5 Hz, 1H), 4.72 (dd, *J* = 8.6, 3.1 Hz, 1H), 4.45 (ddd, *J* = 13.9, 9.0, 4.6 Hz, 1H), 3.98 (dt, *J* = 11.3, 7.1 Hz, 1H), 3.82 (s, 3H), 3.48 (s, 1H), 3.37 (ddd, *J* = 13.8, 9.2, 3.4 Hz, 1H), 3.00 (dd, *J* = 17.4, 5.3 Hz, 1H), 2.92 – 2.75 (m, 2H), 2.63 (s, 1H), 2.28 – 2.12 (m, 1H), 1.91 (dtt, *J* = 12.2, 7.6, 4.3 Hz, 3H), 1.72 (d, *J* = 1.3 Hz, 3H), 1.11 (d, *J* = 6.8 Hz, 3H), 1.03 (s, 9H).

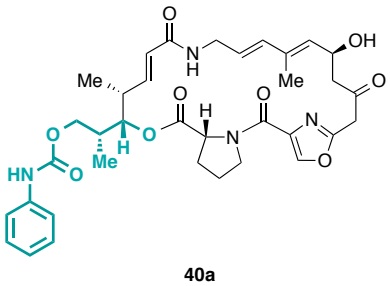
Scheme XVII General procedure D for preparation of carbamate analogues 40a–q and 41a–q



(1) A 50-mL round-bottom containing primary alcohol **38 or 39** (1 equiv) and DMAP (0.1 equiv) was evacuated and reflushed with nitrogen (this process was repeated 3 times). Toluene or DCM (0.01 M) was added, followed by aryl isocyanate or a solution of heteroaryl isocyanate in toluene (0.1 M, 2.0–10.0 equiv), resulting in a yellow solution. The mixture was stirred at 23 ºC or 80 ºC for 12 h. After cooling to 23 ºC (if necessary), the mixture was concentrated, and the resulting crude residue was purified by flash chromatography (silica gel, eluent: acetone:hexanes = 1:5) to afford cabamate **SI-91** or **SI-92** as a white solid.

(2) A 50-mL round-bottom flask containing carbamate **SI-92** or **SI-92** (1 equiv) was evacuated and flushed with nitrogen (this process was repeated a total of 3 times). THF (0.01 M) was added, resulting in a light-yellow solution. In a separate flask, Im•HCl (15.0 equiv) was added to a solution of 1 M tetrabutylammonium fluoride in THF (15.0 equiv). The resulting colorless solution was added dropwise to the solution of **SI-91** or **SI-92**. After 12 h, the mixture was concentrated, and the residue was dissolved in DCM (50 mL). The resulting solution was transferred to a separatory funnel and was washed with water (5 × 50 mL) and brine (50 mL). The washed solution was dried (Na_2SO_4), and the dried solution was filtered. The filtrate was concentrated, and the resulting crude residue was purified by preparative TLC (eluent: MeOH:DCM = 1:20) to afford carbamate analogues **40** or **41** as a white solid.

Analogue 40a



40a

Prepared according to general procedure D from primary alcohol **38** (20 mg, 27 µmol, 1 equiv), DMAP (0.3 mg, 3 µmol, 0.1 equiv) and phenyl isocyanate (9 µL, 82 µmol, 3.0 equiv). DCM was employed as solvent, and the procedure was performed at 23 ºC. Analogue **40a** (10 mg, 54% yield over 2 steps) was obtained as a white solid.

TLC (MeOH;DCM = 1:20): R_f = 0.30 (UV, *p*-anisaldehyde).

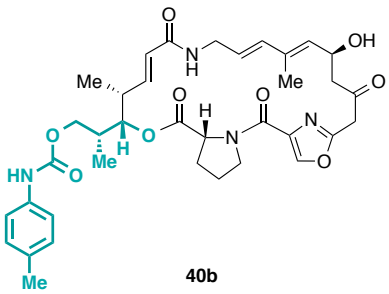
^{1}H NMR (400 MHz, $CDCl_3$) δ 9.04 (br s, 1H), 8.20 (s, 1H), 7.49 (d, *J* = 8.0 Hz, 2H), 7.32 – 7.20 (m, 2H), 7.00 (t, *J* = 7.4 Hz, 1H), 6.54 (dd, *J* = 16.2, 4.2 Hz, 1H), 6.18 (d, *J* = 15.6 Hz, 1H), 6.00 (dd, *J* = 8.4, 4.3 Hz, 1H), 5.80 (dd, *J* = 16.2, 2.0 Hz, 1H), 5.69 (ddd, *J* = 15.6, 9.3, 4.4 Hz, 1H), 5.57 (d, *J* = 8.7 Hz, 1H), 5.17 (dd, *J* = 9.7, 1.9 Hz, 1H), 4.96 (dt, *J* = 9.0, 5.6 Hz, 1H), 4.77 (dd, *J* = 8.7, 2.7 Hz, 1H), 4.58 (dd, *J* = 11.6, 3.7 Hz, 1H), 4.37 (ddd, *J* = 13.6, 8.3, 4.4 Hz, 1H), 4.00 – 3.80 (m, 2H), 3.84 (s, 2H), 3.75 (dd, *J* = 11.6, 9.5 Hz, 1H), 3.48 (ddd, *J* = 14.0, 9.3, 4.2 Hz, 1H), 3.13 (dd, *J* = 17.7, 4.9 Hz, 1H), 2.92 (dd, *J* = 17.7, 6.1 Hz, 1H), 2.78 (br s, 1H), 2.76 – 2.66 (m, 1H), 2.40 – 2.25

(m, 1H), 2.17 – 2.03 (m, 1H), 2.00 – 1.80 (m, 2H), 1.74 (d, J = 1.1 Hz, 3H), 1.11 (d, J = 6.9 Hz, 3H), 0.97 (d, J = 7.0 Hz, 3H).

^{13}C NMR (100 MHz, $CDCl_3$) δ 202.6, 170.8, 165.9, 160.2, 157.3, 153.7, 144.5, 139.1, 137.1, 136.7, 134.1, 132.9, 128.8, 125.1, 124.2, 122.7, 118.4, 79.2, 68.4, 64.9, 59.9, 49.2, 48.7, 42.6, 41.1, 37.1, 33.8, 28.5, 24.7, 13.5, 12.7, 10.2.

HRMS-ESI m/z calcd for $C_{35}H_{43}N_4O_9^+$ $[M + H]^+$ 663.3025, found 663.3021.

Analog 40b



40b

Prepared according to general procedure D from primary alcohol **38** (20 mg, 27 µmol, 1 equiv), DMAP (0.3 mg, 3 µmol, 0.1 equiv) and 4-fluorodephenyl isocyanate (10 µL, 82 µmol, 3.0 equiv). DCM was employed as solvent, and the procedure was performed at 23 ºC. Analog **40b** (6.8 mg, 36% yield over 2 steps) was obtained as a white solid.

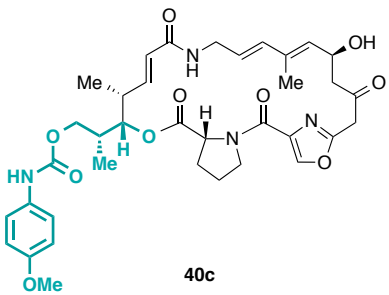
TLC (MeOH;DCM = 1:20): R_f = 0.30 (UV, *p*-anisaldehyde).

^{1}H NMR (400 MHz, $CDCl_3$) δ 8.91 (br s, 1H), 8.18 (s, 1H), 7.36 (d, J = 8.5 Hz, 2H), 7.05 (d, J = 8.2 Hz, 2H), 6.53 (dd, J = 16.2, 4.2 Hz, 1H), 6.17 (d, J = 15.6 Hz, 1H), 6.04 (d, J = 7.8 Hz, 1H), 5.79 (dd, J = 16.2, 2.0 Hz, 1H), 5.67 (ddd, J = 14.9, 9.3, 4.4 Hz, 1H), 5.55 (d, J = 8.7 Hz, 1H), 5.15 (dd, J = 9.7, 1.9 Hz, 1H), 4.95 (dt, J = 9.0, 5.6 Hz, 1H), 4.75 (dd, J = 8.7, 2.7 Hz, 1H), 4.54 (dd, J = 11.5, 3.8 Hz, 1H), 4.36 (ddd, J = 13.5, 8.2, 4.5 Hz, 1H), 4.01 – 3.84 (m, 2H), 3.83 (s, 2H), 3.74 (dd, J = 11.5, 9.3 Hz, 1H), 3.48 (ddd, J = 14.2, 9.3, 4.2 Hz, 1H), 3.12 (dd, J = 17.6, 5.0 Hz, 1H), 2.91 (dd, J = 17.6, 6.1 Hz, 1H), 2.83 (br s, 1H), 2.77 – 2.67 (m, 1H), 2.40 – 2.31 (m, 1H), 2.27 (s, 3H), 2.15 – 2.00 (m, 1H), 1.99 – 1.80 (m, 3H), 1.73 (d, J = 1.2 Hz, 3H), 1.10 (d, J = 6.8 Hz, 3H), 0.95 (d, J = 7.0 Hz, 3H).

^{13}C NMR (100 MHz, $CDCl_3$) δ 202.6, 170.8, 165.9, 160.2, 157.3, 153.8, 144.5, 144.5, 137.5, 136.7, 136.5, 134.10 132.9, 132.1, 129.3, 125.1, 124.2, 118.4, 79.1, 68.7, 64.9, 59.8, 49.3, 48.6, 42.67 41.1, 37.0, 33.8, 28.5, 24.7, 20.7, 13.3, 12.7, 10.2.

HRMS-ESI m/z calcd for $C_{36}H_{45}N_4O_9^+$ $[M + H]^+$ 677.3181, found 677.3190.

Analog 40c



40c

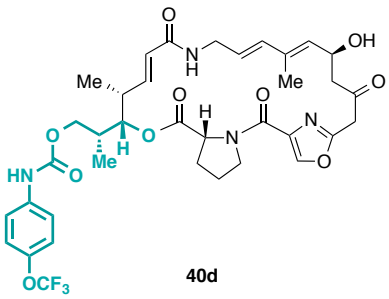
Prepared according to general procedure D from primary alcohol **38** (20 mg, 27 µmol, 1 equiv), DMAP (0.3 mg, 3 µmol, 0.1 equiv) and 4-methoxyphenyl isocyanate (11 µL, 82 µmol, 3.0 equiv). DCM was employed as solvent, and the procedure was performed at 23 ºC. Analogue **40c** (3.2 mg, 17% yield over 2 steps) was obtained as a white solid.

TLC (MeOH;DCM = 1:20): R_f = 0.30 (UV, *p*-anisaldehyde).

^{1}H NMR (400 MHz, $CDCl_3$) δ 8.88 (s, 1H), 8.17 (s, 1H), 7.39 (d, J = 9.0 Hz, 2H), 6.80 (d, J = 9.0 Hz, 2H), 6.54 (dd, J = 16.2, 4.2 Hz, 1H), 6.17 (d, J = 15.6 Hz, 1H), 6.12 – 5.98 (m, 1H), 5.79 (dd, J = 16.2, 2.0 Hz, 1H), 5.67 (ddd, J = 15.5, 9.3, 4.4 Hz, 1H), 5.55 (d, J = 8.7 Hz, 1H), 5.15 (dd, J = 9.6, 1.9 Hz, 1H), 4.95 (dt, J = 8.6, 5.6 Hz, 1H), 4.76 (dd, J = 8.8, 2.7 Hz, 1H), 4.54 (dd, J = 11.6, 3.7 Hz, 1H), 4.35 (ddd, J = 13.6, 8.3, 4.5 Hz, 1H), 3.98 – 3.84 (m, 2H), 3.82 (s, 2H), 3.76 (s, 3H), 3.80 – 3.68 (m, 1H), 3.49 (ddd, J = 14.2, 9.4, 4.2 Hz, 1H), 3.12 (dd, J = 17.6, 5.0 Hz, 1H), 2.91 (dd, J = 17.6, 6.1 Hz, 1H), 2.86 (br s, 1H), 2.72 (ddt, J = 6.7, 4.3, 2.2 Hz, 1H), 2.40 – 2.24 (m, 1H), 2.16 – 2.02 (m, 1H), 2.00 – 1.81 (m, 3H), 1.73 (s, 3H), 1.10 (d, J = 6.9 Hz, 3H), 0.95 (d, J = 7.0 Hz, 3H).

^{13}C NMR (100 MHz, $CDCl_3$) δ 202.6, 170.8, 165.9, 160.2, 157.4, 155.3, 154.0, 144.5, 144.4, 137.0, 136.7, 134.1, 132.9, 132.3, 125.1, 124.2, 112.0, 114.0, 79.1, 68.7, 64.9, 59.8, 55.5, 49.2, 48.6, 42.7, 41.1, 37.0, 33.8, 28.5, 24.7, 13.3, 12.7, 10.2.

Analogue 40d



40d

Prepared according to general procedure D from primary alcohol **38** (20 mg, 27 µmol, 1 equiv), DMAP (0.3 mg, 3 µmol, 0.1 equiv) and 4-trifluoromethoxyphenyl isocyanate (12 µL, 82 µmol, 3.0 equiv). DCM was employed as solvent, and the procedure was performed at 23 ºC. Analogue **40d** (11 mg, 52% yield over 2 steps) was obtained as a white solid.

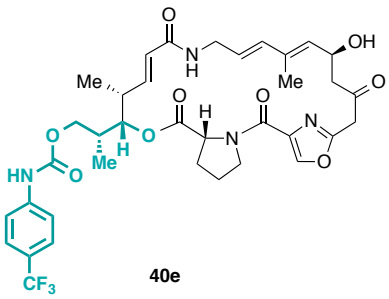
TLC (MeOH;DCM = 1:20): R_f = 0.30 (UV, *p*-anisaldehyde).

^{1}H NMR (400 MHz, $CDCl_3$) δ 9.25 (br s, 1H), 8.19 (s, 1H), 7.52 (d, *J* = 9.1 Hz, 2H), 7.10 (d, *J* = 8.6 Hz, 2H), 6.54 (dd, *J* = 16.2, 4.2 Hz, 1H), 6.18 (d, *J* = 15.6 Hz, 1H), 5.96 (dd, *J* = 8.2, 4.3 Hz, 1H), 5.80 (dd, *J* = 16.2, 2.0 Hz, 1H), 5.68 (ddd, *J* = 15.6, 9.3, 4.4 Hz, 1H), 5.57 (d, *J* = 8.6 Hz, 1H), 5.17 (dd, *J* = 9.6, 1.9 Hz, 1H), 4.96 (q, *J* = 7.0, 6.5 Hz, 1H), 4.74 (dd, *J* = 8.8, 2.6 Hz, 1H), 4.61 (dd, *J* = 11.5, 3.5 Hz, 1H), 4.36 (ddd, *J* = 13.7, 8.3, 4.5 Hz, 1H), 4.02 – 3.85 (m, 2H), 3.84 (s, 2H), 3.72 (dd, *J* = 11.6, 9.8 Hz, 1H), 3.50 (ddd, *J* = 14.2, 9.2, 4.3 Hz, 1H), 3.13 (dd, *J* = 17.7, 4.9 Hz, 1H), 2.91 (dd, *J* = 17.7, 6.2 Hz, 1H), 2.82 – 2.62 (m, 2H), 2.40 – 2.25 (m, 1H), 2.16 – 2.04 (m, 1H), 2.02 – 1.81 (m, 3H), 1.74 (d, *J* = 1.2 Hz, 3H), 1.11 (d, *J* = 6.8 Hz, 3H), 0.96 (d, *J* = 7.0 Hz, 3H).

^{13}C NMR (100 MHz, $CDCl_3$) δ 202.6, 170.6, 165.8, 160.3, 157.5, 153.7, 151.2, 144.5, 144.5, 137.9, 137.0, 136.7, 134.1, 132.9, 125.1, 124.2, 121.6, 119.3, 79.3, 69.1, 64.9, 59.9, 49.2, 48.7, 42.6, 41.1, 37.1, 33.8, 28.5, 24.7, 13.2, 12.7, 10.2.

HRMS-ESI m/z calcd for $C_{36}H_{42}F_3N_4O_{10}^+$ $[M + H]^+$ 747.2848, found 747.2838.

Analogue 40e



40e

Prepared according to general procedure D from primary alcohol **38** (20 mg, 27 µmol, 1 equiv), DMAP (0.3 mg, 3 µmol, 0.1 equiv) and 4-trifluoromethylphenyl isocyanate (12 µL, 82 µmol, 3.0 equiv). DCM was employed as solvent, and the procedure was performed at 23 ºC. Analogue **40e** (12 mg, 59% yield over 2 steps) was obtained as a white solid.

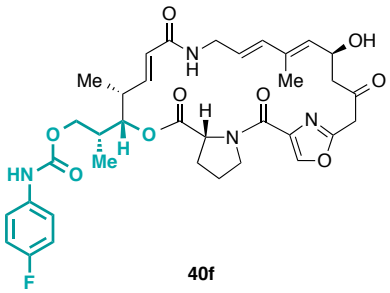
TLC (MeOH;DCM = 1:20): R_f = 0.30 (UV, *p*-anisaldehyde).

^{1}H NMR (400 MHz, CDCl3) δ 9.40 (s, 1H), 8.20 (s, 1H), 7.62 (d, *J* = 8.5 Hz, 2H), 7.49 (d, *J* = 8.6 Hz, 2H), 6.54 (dd, *J* = 16.2, 4.2 Hz, 1H), 6.18 (d, *J* = 15.6 Hz, 1H), 5.98 (dd, *J* = 8.3, 4.4 Hz, 1H), 5.80 (dd, *J* = 16.2, 2.0 Hz, 1H), 5.68 (ddd, *J* = 15.6, 9.3, 4.4 Hz, 1H), 5.57 (d, *J* = 8.6 Hz, 1H), 5.18 (dd, *J* = 9.6, 2.0 Hz, 1H), 4.96 (dt, *J* = 9.3, 5.6 Hz, 1H), 4.73 (dd, *J* = 8.7, 2.6 Hz, 1H), 4.62 (dd, *J* = 11.6, 3.6 Hz, 1H), 4.35 (ddd, *J* = 13.7, 8.2, 4.5 Hz, 1H), 3.98 – 3.86 (m, 2H), 3.84 (s, 2H), 3.73 (dd, *J* = 11.6, 9.8 Hz, 1H), 3.50 (ddd, *J* = 14.2, 9.3, 4.3 Hz, 1H), 3.13 (dd, *J* = 17.7, 4.9 Hz, 1H), 2.92 (dd, *J* = 17.7, 6.1 Hz, 1H), 2.80 (br s, 1H), 2.80 – 2.65 (m, 1H), 2.40 – 2.25 (m, 1H), 2.18 – 2.05 (m, 1H), 2.00 – 1.80 (m, 3H), 1.74 (d, *J* = 1.2 Hz, 3H), 1.11 (d, *J* = 6.9 Hz, 3H), 0.97 (d, *J* = 7.0 Hz, 3H).

^{13}C NMR (100 MHz, $CDCl_3$) δ 202.6, 170.6, 165.7, 160.3, 157.5, 153.5, 144.6, 144.4, 142.3, 137.0, 136.7, 134.1, 133.0, 126.0 (q, ^3J = 4.2 Hz), 125.1, 124.2, 117.9, 79.3, 69.2, 64.9, 59.9, 49.2, 48.7, 42.6, 41.1, 37.1, 33.7, 28.5, 24.7, 13.2, 12.7, 10.2.

HRMS-ESI m/z calcd for $C_{36}H_{41}F_3N_4NaO^+$ $[M + Na]^+$ 753.2718, found 753.2717.

Analogue 40f



40f

Prepared according to general procedure D from primary alcohol **38** (20 mg, 27 µmol, 1 equiv), DMAP (0.3 mg, 3 µmol, 0.1 equiv) and 4-fluorodephenyl isocyanate (9 µL, 82 µmol, 3.0 equiv). DCM was employed as solvent, and the procedure was performed at 23 ºC. Analogue **40f** (7.3 mg, 39% yield over 2 steps) was obtained as a white solid.

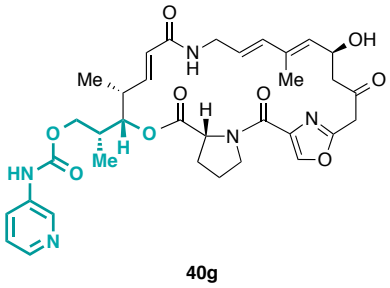
TLC (MeOH;DCM = 1:20): R_f = 0.30 (UV, *p*-anisaldehyde).

^{1}H NMR (400 MHz, $CDCl_3$) δ 9.07 (br s, 1H), 8.19 (s, 1H), 7.50 – 7.41 (m, 2H), 6.94 (t, *J* = 8.7 Hz, 2H), 6.53 (dd, *J* = 16.2, 4.2 Hz, 1H), 6.17 (d, *J* = 15.6 Hz, 1H), 5.99 – 5.91 (m, 1H), 5.80 (dd, *J* = 16.2, 2.0 Hz, 1H), 5.69 (ddd, *J* = 15.7, 9.3, 4.5 Hz, 1H), 5.56 (d, *J* = 8.8 Hz, 1H), 5.16 (dd, *J* = 9.6, 1.9 Hz, 1H), 5.03 – 4.90 (m, 1H), 4.75 (dd, *J* = 8.7, 2.6 Hz, 1H), 4.58 (dd, *J* = 11.6, 3.7 Hz, 1H), 4.36 (td, *J* = 8.6, 8.2, 4.0 Hz, 1H), 3.98 – 3.85 (m, 2H), 3.84 (s, 2H), 3.76 – 3.68 (m, 1H), 3.48 (ddd, *J* = 14.1, 9.3, 4.2 Hz, 1H), 3.12 (dd, *J* = 17.7, 4.9 Hz, 1H), 2.91 (dd, *J* = 17.7, 6.1 Hz, 1H), 2.80 -2.60 (m, 2H), 2.40 – 2.25 (m, 1H), 2.20 – 2.03 (m, 2H), 2.00 -1.80 (m, 2H), 1.74 (d, *J* = 1.2 Hz, 3H), 1.11 (d, *J* = 6.8 Hz, 3H), 0.96 (d, *J* = 7.1 Hz, 3H).

^{13}C NMR (100 MHz, $CDCl_3$) δ 202.5, 170.7, 165.8, 160.3, 157.5, 153.8, 144.6, 144.4, 137.0, 136.7, 135.1, 134.1, 133.0, 125.1, 124.2, 119.9 (d, $^3J_{CF}$ = 7.7 Hz), 115.3 (d, $^2J_{CF}$ = 22.3 Hz), 79.2, 68.9, 64.8, 59.8, 49.2, 48.7, 42.6, 41.1, 37.0, 33.8, 28.5, 24.7, 13.2, 12.7, 10.3.

HRMS-ESI m/z calcd for $C_{35}H_{42}FN_4O_9^+$ $[M + H]^+$ 681.2930, found 681.2935.

Analogue 40g



40g

Prepared according to general procedure D from primary alcohol **38** (25 mg, 34 µmol, 1 equiv), DMAP (0.4 mg, 3 µmol, 0.1 equiv) and a solution of 3-isocyanatopyridine in toluene (0.1 M, 1.0 mL, 0.10 mmol, 3.0 equiv). Toluene was employed as solvent, and the procedure was performed at 80 ºC. Analogue **40g** (12 mg, 53% yield over 2 steps) was obtained as a white solid.

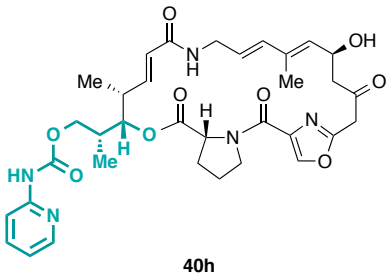
TLC (MeOH;DCM = 1:20): R_f = 0.30 (UV, *p*-anisaldehyde).

^{1}H NMR (400 MHz, $CDCl_3$) δ 9.38 (br s, 1H), 8.54 (d, *J* = 2.6 Hz, 1H), 8.22 (dd, *J* = 4.7, 1.5 Hz, 1H), 8.20 (s, 1H), 8.11 (ddd, *J* = 8.4, 2.6, 1.5 Hz, 1H), 7.21 (dd, *J* = 8.4, 4.7 Hz, 1H), 6.54 (dd, *J* = 16.2, 4.1 Hz, 1H), 6.18 (d, *J* = 15.6 Hz, 1H), 6.06 (dd, *J* = 8.3, 4.4 Hz, 1H), 5.80 (dd, *J* = 16.2, 2.0 Hz, 1H), 5.67 (ddd, *J* = 15.6, 9.2, 4.4 Hz, 1H), 5.57 (d, *J* = 8.7 Hz, 1H), 5.17 (dd, *J* = 9.5, 1.9 Hz, 1H), 4.95 (dt, *J* = 8.7, 5.6 Hz, 1H), 4.74 (dd, *J* = 8.7, 2.7 Hz, 1H), 4.61 (dd, *J* = 11.6, 3.7 Hz, 1H), 4.34 (ddd, *J* = 13.6, 8.2, 4.4 Hz, 1H), 3.90 (dd, *J* = 8.5, 5.6 Hz, 2H), 3.83 (d, *J* = 1.5 Hz, 2H), 3.74 (dd, *J* = 11.6, 9.7 Hz, 1H), 3.50 (td, *J* = 9.6, 4.6 Hz, 1H), 3.12 (dd, *J* = 17.5, 5.1 Hz, 1H), 2.93 (dd, *J* = 17.5, 6.0 Hz, 1H), 2.80 – 2.65 (m, 1H), 2.40 – 2.25 (m, 1H), 2.20 – 2.00 (m, 1H), 2.00 – 1.80 m, 3H), 1.73 (d, *J* = 1.2 Hz, 3H), 1.11 (d, *J* = 6.9 Hz, 3H), 0.97 (d, *J* = 7.0 Hz, 3H).

^{13}C NMR (100 MHz, $CDCl_3$) δ 202.5, 170.6, 165.8, 160.4, 157.5, 153.8, 144.5, 144.5, 143.6, 140.3, 136.9, 136.6, 136.1, 134.0, 133.1 125.3, 125.0, 124.2, 123.5, 79.2, 69.2, 64.8, 59.8, 49.2, 48.8, 42.6, 41.1, 37.0, 33.7, 28.5, 24.7, 13.3, 12.7, 10.2.

HRMS-ESI m/z calcd for $C_{34}H_{42}N_5O_9^+$ $[M + H]^+$ 664.2977, found 664.2988.

Analogue 40h



40h

Prepared according to general procedure D from primary alcohol **38** (21 mg, 29 µmol, 1 equiv), DMAP (0.4 mg, 3 µmol, 0.1 equiv) and a solution of 2-isocyanatopyridine in toluene (0.1 M, 0.86 mL, 0.086 mmol, 3.0 equiv). Toluene was employed as solvent, and the procedure was performed at 80 ºC. Analogue **40h** (10 mg, 57% yield over 2 steps) was obtained as a white solid.

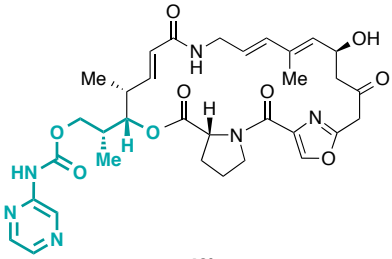
TLC (MeOH;DCM = 1:20): R_f = 0.30 (UV, *p*-anisaldehyde).

^{1}H NMR (400 MHz, $CDCl_3$) δ 8.93 (s, 1H), 8.34 (s, 1H), 8.23 (dd, *J* = 5.1, 1.8 Hz, 1H), 7.95 (d, *J* = 8.4 Hz, 1H), 7.64 (td, *J* = 8.0, 2.0 Hz, 1H), 6.94 (dd, *J* = 7.3, 5.0 Hz, 1H), 6.49 (dd, *J* = 16.3, 4.6 Hz, 1H), 6.18 (dd, *J* = 8.7, 3.7 Hz, 1H), 6.13 (d, *J* = 15.6 Hz, 1H), 5.79 (dd, *J* = 16.3, 1.9 Hz, 1H), 5.67 (ddd, *J* = 15.0, 9.3, 4.4 Hz, 1H), 5.49 (d, *J* = 8.7 Hz, 1H), 5.07 (dd, *J* = 10.0, 1.8 Hz, 1H), 4.91 (dt, *J* = 9.3, 5.5 Hz, 1H), 4.74 (dd, *J* = 8.8, 3.1 Hz, 1H), 4.42 (ddd, *J* = 13.9, 8.7, 4.5 Hz, 1H), 4.27 (dd, *J* = 11.2, 4.6 Hz, 1H), 4.15 (dd, *J* = 11.2, 5.7 Hz, 1H), 3.97 (dt, *J* = 11.4, 7.3 Hz, 1H), 3.85 – 3.75 (m, 1H), 3.83 (d, *J* = 16.1 Hz, 1H), 3.78 (d, *J* = 16.2 Hz, 1H), 3.40 (ddd, *J* = 13.8, 9.3, 3.7 Hz, 1H), 3.05 (dd, *J* = 17.6, 5.2 Hz, 1H), 2.91 (dd, *J* = 17.5, 5.8 Hz, 1H), 2.73 (ddd, *J* = 9.1, 4.6, 2.2 Hz, 1H), 2.37 – 2.21 (m, 1H), 2.21 – 2.04 (m, 1H), 1.90 (qq, *J* = 7.4, 3.2 Hz, 2H), 1.84 – 1.70 (m, 1H), 1.72 (s, 3H), 1.08 (d, *J* = 6.8 Hz, 3H), 1.04 (d, *J* = 7.0 Hz, 3H).

^{13}C NMR (100 MHz, $CDCl_3$) δ 202.8, 171.5, 166.4, 160.2, 157.0, 153.7, 152.1, 147.8, 145.1, 144.1, 138.0, 137.0, 136.3, 134.0, 132.9, 125.1, 124.2, 118.5, 112.6, 77.8, 67.8, 65.0, 59.8, 48.9, 48.5, 42.8, 41.0, 36.7, 34.1, 28.2, 25.0, 14.1, 12.7, 10.0.

HRMS-ESI m/z calcd for $C_{34}H_{42}N_5O_9^+$ $[M + H]^+$ 664.2977, found 664.2988.

Analogue 40i



40i

Prepared according to general procedure D from primary alcohol **38** (21 mg, 29 µmol, 1 equiv), DMAP (0.4 mg, 3 µmol, 0.1 equiv) and a solution of 2-isocyanatopyrazine in toluene (0.1 M 0.86 mL, 0.086 mmol, 3.0 equiv). Toluene was employed as solvent, and the procedure was performed at 80 ºC. Analogue **40i** (10 mg, 43% yield over 2 steps) was obtained as a white solid.

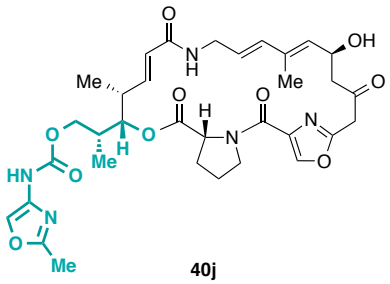
TLC (MeOH;DCM = 1:20): R_f = 0.30 (UV, *p*-anisaldehyde).

^{1}H NMR (400 MHz, $CDCl_3$) δ 9.41 (br s, 1H), 9.28 (d, *J* = 1.5 Hz, 1H), 8.36 (s, 1H), 8.23 (d, *J* = 2.7 Hz, 1H), 8.19 (dd, *J* = 2.6, 1.5 Hz, 1H), 6.50 (dd, *J* = 16.3, 4.5 Hz, 1H), 6.14 (d, *J* = 15.6 Hz, 1H), 6.05 (dd, *J* = 9.0, 3.8 Hz, 1H), 5.80 (dd, *J* = 16.3, 2.0 Hz, 1H), 5.68 (ddd, *J* = 15.6, 9.2, 4.5 Hz, 1H), 5.53 (d, *J* = 8.6 Hz, 1H), 5.11 (dd, *J* = 9.9, 1.9 Hz, 1H), 4.93 (q, *J* = 6.2 Hz, 1H), 4.74 (dd, *J* = 8.9, 3.0 Hz, 1H), 4.50 – 4.35 (m, 2H), 4.09 (dd, *J* = 11.3, 6.9 Hz, 1H), 3.98 (dd, *J* = 11.5, 7.3 Hz, 1H), 3.90 – 3.75 (m, 3H), 3.42 (ddd, *J* = 14.0, 9.3, 3.8 Hz, 1H), 3.07 (dd, *J* = 17.6, 5.0 Hz, 1H), 2.92 (dd, *J* = 17.7, 5.8 Hz, 1H), 2.86 (br s, 1H), 2.78 – 2.68 (m, 1H), 2.40 – 2.25 (m 1H), 2.20 – 2.07 (m, 1H), 1.97 – 1.85 (m, 2H), 1.84 – 1.74 (m, 1H), 1.73 (s, 3H), 1.10 (d, *J* = 6.8 Hz, 3H), 1.04 (d, *J* = 7.0 Hz, 3H).

^{13}C NMR (100 MHz, $CDCl_3$) δ 202.7, 171.3, 166.2, 160.3, 157.2, 153.4, 149.0, 145.1, 144.1, 141.9, 138.8, 137.0, 136.7, 136.2, 134.0, 132.9, 125.1, 124.2, 78.2, 68.6, 65.0, 59.8, 49.0 48.6, 42.7, 41.1, 36.8, 33.9, 28.3, 25.0, 14.0, 12.7, 10.0.

HRMS-ESI m/z calcd for $C_{33}H_{41}N_6O_9^+$ $[M + Na]^+$ 687.2749, found 687.2744.

Analogue 40j



40j

Prepared according to general procedure D from primary alcohol **38** (25 mg, 34 µmol, 1 equiv), DMAP (0.4 mg, 3 µmol, 0.1 equiv) and a solution of 4-isocyanato-2-methyloxazole in toluene (0.1 M, 1.0 mL, 0.10 mmol, 3.0 equiv). Toluene was employed as solvent, and the procedure was performed at 80 ºC. Analogue **40j** (12 mg, 52% yield over 2 steps) was obtained as a white solid.

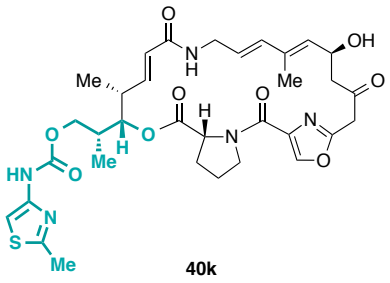
TLC (MeOH;DCM = 1:20): R_f = 0.30 (UV, *p*-anisaldehyde).

^{1}H NMR (400 MHz, $CDCl_3$) δ 9.15 (br s, 1H), 8.53 (s, 1H), 7.67 (s, 1H), 6.49 (dd, *J* = 16.3, 4.3 Hz, 1H), 6.15 (d, *J* = 15.6 Hz, 1H), 6.04 (d, *J* = 9.4 Hz, 1H), 5.79 (dd, *J* = 16.3, 2.0 Hz, 1H), 5.68 (ddd, *J* = 14.9, 9.2, 4.4 Hz, 1H), 5.54 (d, *J* = 8.7 Hz, 1H), 5.10 (d, *J* = 9.4 Hz, 1H), 4.93 (q, *J* = 6.4 Hz, 1H), 4.76 (dd, *J* = 9.1, 2.8 Hz, 1H), 4.49 – 4.29 (m, 2H), 4.06 – 3.70 (m, 5H), 3.42 (ddd, *J* = 14.1, 9.3, 3.8 Hz, 1H), 3.09 (dd, *J* = 17.7, 4.9 Hz, 1H), 2.91 (dd, *J* = 17.8, 6.0 Hz, 1H), 2.87 (br s, 1H), 2.77 – 2.66 (m, 1H), 2.37 (s, 3H), 2.34 – 2.24 (m, 1H), 2.20 – 2.06 (m, 1H), 1.95 – 1.85 (m, 3H), 1.73 (s, 3H), 1.10 (d, *J* = 6.8 Hz, 3H), 0.99 (d, *J* = 7.0 Hz, 3H).

^{13}C NMR (100 MHz, $CDCl_3$) δ 202.8, 171.2, 166.1, 160.3, 159.2, 157.12 153.5, 145.53 144.3, 137.5, 137.0, 136.7, 134.0, 133.0, 125.1, 124.2, 123.9, 78.5, 69.0, 64.9, 59.8, 49.0, 48.5, 42.7, 41.1, 36.9, 33.9, 28.3, 24.9, 14.0, 13.7, 12.7, 10.2.

HRMS-ESI m/z calcd for $C_{33}H_{42}N_5O_{10}^+$ $[M + H]^+$ 668.2926, found 668.2932.

Analogue 40k



40k

Prepared according to general procedure D from primary alcohol **38** (25 mg, 34 µmol, 1 equiv), DMAP (0.4 mg, 3 µmol, 0.1 equiv) and a solution of 4-isocyanato-2-methylthiazole in toluene (0.1 M 1.0 mL, 0.10 mmol, 3.0 equiv). Toluene was employed as solvent, and the procedure was performed at 80 ºC. Analogue **40k** (11 mg, 47% yield over 2 steps) was obtained as a white solid.

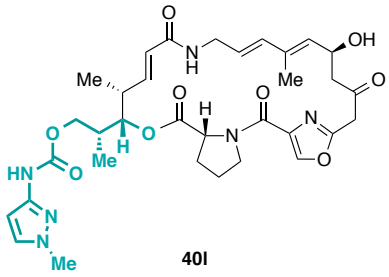
TLC (MeOH;DCM = 1:20): R_f = 0.30 (UV, *p*-anisaldehyde).

^{1}H NMR (400 MHz, $CDCl_3$) δ 9.32 (br s, 1H), 8.55 (s, 1H), 7.07 (s, 1H), 6.48 (dd, *J* = 16.3, 4.4 Hz, 1H), 6.14 (d, *J* = 15.6 Hz, 1H), 6.07 (d, *J* = 8.3 Hz, 1H), 5.79 (dd, *J* = 16.3, 2.0 Hz, 1H), 5.68 (ddd, *J* = 15.5, 9.3, 4.4 Hz, 1H), 5.52 (d, *J* = 8.7 Hz, 1H), 5.07 (dd, *J* = 9.8, 1.8 Hz, 1H), 4.92 (dt, *J* = 9.1, 5.4 Hz, 1H), 4.74 (dd, *J* = 8.7, 3.1 Hz, 1H), 4.44 (ddd, *J* = 13.8, 8.8, 4.5 Hz, 1H), 4.32 (dd, *J* = 11.2, 4.5 Hz, 1H), 4.08 (dd, *J* = 11.3, 6.8 Hz, 1H), 4.05 – 3.93 (m, 1H), 3.91 – 3.74 (m, 3H), 3.39 (ddd, *J* = 13.9, 9.4, 3.7 Hz, 1H), 3.06 (dd, *J* = 17.7, 5.0 Hz, 1H), 2.92 (dd, *J* = 17.7, 5.8 Hz, 1H), 2.79 (s, 1H), 2.76 – 2.6 (m, 1H), 2.61 (s, 3H), 2.37 – 2.23 (m, 1H), 2.22 – 2.08 (m, 1H), 1.98 – 1.80 (m, 2H), 1.84 – 1.76 (m, 1H), 1.73 (s, 3H), 1.10 (d, *J* = 6.8 Hz, 3H), 1.03 (d, *J* = 7.0 Hz, 3H).

^{13}C NMR (100 MHz, $CDCl_3$) δ 202.9, 171.4, 166.4, 163.5, 160.2, 157.0, 153.9, 147.3, 145.6, 144.2, 137.0, 136.8, 134.0, 132.9, 125.1, 124.2, 98.0, 78.01 68.3, 65.0, 59.8, 48.9, 48.45 42.7, 41.1, 36.9, 34.0, 28.2, 25.0, 19.0, 14.1, 12.7, 10.0.

HRMS-ESI m/z calcd for $C_{33}H_{42}N_5O_9S^+$ $[M + H]^+$ 684.2698, found 684.2726.

Analogue 40l



40l

Prepared according to general procedure D from primary alcohol **38** (25 mg, 34 µmol, 1 equiv), DMAP (0.4 mg, 3 µmol, 0.1 equiv) and a solution of 4-isocyanato-2-methyloxazole in toluene (0.1 M, 1.0 mL, 0.10 mmol, 3.0 equiv). Toluene was employed as solvent, and the procedure was performed at 80 ºC. Analogue **40l** (12 mg, 52% yield over 2 steps) was obtained as a white solid.

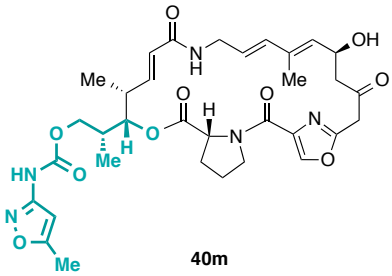
TLC (MeOH;DCM = 1:20): R_f = 0.30 (UV, *p*-anisaldehyde).

^{1}H NMR (400 MHz, $CDCl_3$) δ 9.01 (br s, 1H), 8.43 (s, 1H), 7.19 (d, *J* = 2.3 Hz, 1H), 6.50 (dd, *J* = 16.3, 4.4 Hz, 1H), 6.42 (s, 1H), 6.14 (d, *J* = 15.4 Hz, 2H), 5.79 (dd, *J* = 16.3, 1.9 Hz, 1H), 5.67 (ddd, *J* = 15.6, 9.3, 4.5 Hz, 1H), 5.51 (d, *J* = 8.6 Hz, 1H), 5.09 (dd, *J* = 9.7, 1.8 Hz, 1H), 4.93 (dd, *J* = 8.8, 5.2 Hz, 1H), 4.77 (dd, *J* = 8.9, 2.8 Hz, 1H), 4.46 – 4.26 (m, 2H), 4.05 – 3.87 (m, 2H), 3.88 – 3.77 (m, 3H), 3.75 (s, 3H), 3.42 (ddd, *J* = 14.0, 9.2, 3.9 Hz, 1H), 3.07 (dd, *J* = 17.6, 5.1 Hz, 1H), 2.92 (br s, 1H), 2.91 (dd, *J* = 17.5, 5.9 Hz, 1H), 2.76 – 2.66 (m, 1H), 2.40 – 2.20 (m, 1H), 2.20 – 2.01 (m, 1H), 2.00 – 1.80 (m, 3H), 1.72 (s, 3H), 1.09 (d, *J* = 6.8 Hz, 3H), 0.99 (d, *J* = 7.0 Hz, 3H).

^{13}C NMR (100 MHz, $CDCl_3$) δ 202.8, 171.3, 166.2, 160.2, 157.0, 153.9, 147.6, 145.3 144.3, 137.0, 136.7, 134.0, 133.0, 130.6, 125.1, 124.2, 96.1, 78.3, 68.4, 65.0, 59.8, 49.0, 48.5, 42.8, 41.0, 38.7, 36.9, 33.9, 28.3, 24.9, 13.8, 12.7, 10.2.

HRMS-ESI m/z calcd for $C_{33}H_{42}N_6NaO_9^+$ $[M + Na]^+$ 689.2905, found 689.2935.

Analogue 40m



40m

Prepared according to general procedure D from primary alcohol **38** (25 mg, 34 µmol, 1 equiv), DMAP (0.4 mg, 3 µmol, 0.1 equiv) and a solution of 3-isocyanato-5-methylisoxazole in toluene (0.1 M, 1.0 mL, 0.10 mmol, 3.0 equiv). Toluene was employed as solvent, and the procedure was performed at 80 ºC. Analogue **40m** (2.6 mg, 13% yield over 2 steps) was obtained as a white solid.

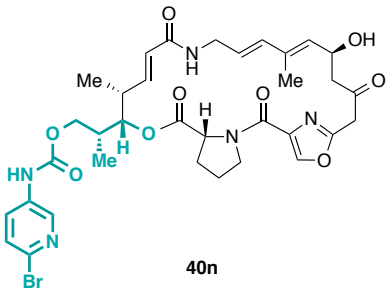
TLC (MeOH;DCM = 1:20): R_f = 0.30 (UV, *p*-anisaldehyde).

^{1}H NMR (400 MHz, $CDCl_3$) δ 9.79 (s, 1H), 8.46 (s, 1H), 6.54 – 6.44 (m, 2H), 6.16 (d, *J* = 15.6 Hz, 1H), 6.03 (dd, *J* = 8.6, 4.0 Hz, 1H), 5.79 (dd, *J* = 16.3, 2.0 Hz, 1H), 5.67 (ddd, *J* = 15.6, 9.3, 4.4 Hz, 1H), 5.56 (d, *J* = 8.6 Hz, 1H), 5.11 (dd, *J* = 9.6, 1.8 Hz, 1H), 4.93 (dt, *J* = 8.7, 5.4 Hz, 1H), 4.72 (dd, *J* = 9.0, 3.0 Hz, 1H), 4.44 (dd, *J* = 11.3, 3.9 Hz, 1H), 4.39 (td, *J* = 8.7, 4.1 Hz, 1H), 4.02 – 3.89 (m, 2H), 3.90 – 3.80 (m, 1H), 3.84 (d, *J* = 16.6 Hz, 1H), 3.78 (d, *J* = 16.6 Hz, 1H), 3.43 (ddd, *J* = 14.1, 9.4, 3.9 Hz, 1H), 3.10 (dd, *J* = 17.8, 4.9 Hz, 1H), 2.93 (dd, *J* = 17.8, 5.9 Hz, 2H), 2.90 (br s,1H), 2.77 – 2.66 (m, 1H), 2.36 (d, *J* = 0.9 Hz, 3H), 2.35 – 2.25 (m, 1H), 2.20 – 2.05 (m, 1H), 1.97 – 1.80 (m, 3H), 1.73 (d, *J* = 1.2 Hz, 3H), 1.10 (d, *J* = 6.8 Hz, 3H), 0.99 (d, *J* = 7.0 Hz, 3H).

^{13}C NMR (100 MHz, $CDCl_3$) δ 202.9, 171.2, 169.3, 166.1, 160.3, 158.9, 157.2, 153.5, 145.6, 144.2, 136.8, 136.8, 133.9, 133.1, 125.0, 124.2, 95.7, 78.6, 69.2, 64.9, 59.8, 49.1, 48.6, 42.6, 41.1, 37.0, 33.7, 28.3, 24.9, 13.6, 12.7, 12.6, 10.0.

HRMS-ESI m/z calcd for $C_{33}H_{40}N_5O_9^+$ $[M - OH]^+$ 650.2821, found 650.2822.

Analogue 40n



40n

Prepared according to general procedure D from primary alcohol **38** (25 mg, 34 µmol, 1 equiv), DMAP (0.4 mg, 3 µmol, 0.1 equiv) and a solution of 3-isocyanato-6-bromopyridine in toluene (0.1 M, 1.0 mL, 0.10 mmol, 3.0 equiv). Toluene was employed as solvent, and the procedure was performed at 80 ºC. Analogue **40n** (11 mg, 43% yield over 2 steps) was obtained as a white solid.

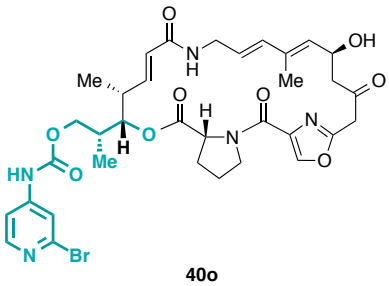
TLC (MeOH;DCM = 1:20): R_f = 0.30 (UV, *p*-anisaldehyde).

^{1}H NMR (400 MHz, CDCl3) δ 9.50 (br s, 1H), 8.37 (d, *J* = 2.8 Hz, 1H), 8.19 (s, 1H), 8.02 (dd, *J* = 8.7, 2.9 Hz, 1H), 7.36 (d, *J* = 8.7 Hz, 1H), 6.54 (dd, *J* = 16.2, 4.1 Hz, 1H), 6.18 (d, *J* = 15.6 Hz, 1H), 5.93 (dd, *J* = 8.2, 4.4 Hz, 1H), 5.80 (dd, *J* = 16.2, 2.0 Hz, 1H), 5.68 (ddd, *J* = 15.6, 9.2, 4.4 Hz, 1H), 5.57 (d, *J* = 8.7 Hz, 1H), 5.17 (dd, *J* = 9.5, 1.9 Hz, 1H), 4.95 (dt, *J* = 8.7, 5.5 Hz, 1H), 4.71 (dd, *J* = 8.8, 2.6 Hz, 1H), 4.63 (dd, *J* = 11.6, 3.7 Hz, 1H), 4.35 (ddd, *J* = 13.5, 8.1, 4.6 Hz, 1H), 3.95 – 3.85 (m, 2H), 3.84 (d, *J* = 2.6 Hz, 2H), 3.71 (dd, *J* = 11.6, 10.0 Hz, 1H), 3.51 (ddd, *J* = 14.2, 9.2, 4.4 Hz, 1H), 3.13 (dd, *J* = 17.7, 5.0 Hz, 1H), 2.93 (dd, *J* = 17.7, 6.0 Hz, 1H), 2.83 – 2.68 (m, 2H), 2.40 – 2.22 (m, 1H), 2.16 – 2.04 (m, 1H), 1.98 – 1.83 (m, 2H), 1.74 (d, *J* = 1.3 Hz, 3H), 1.72 – 1.62 (m, 1H), 1.12 (d, *J* = 6.9 Hz, 3H), 0.97 (d, *J* = 7.0 Hz, 3H).

^{13}C NMR (100 MHz, $CDCl_3$) δ 202.6, 170.5, 165.8, 160.4, 157.5, 153.6, 144.6, 144.5, 140.4, 136.9, 136.6, 135.8, 134.1, 134.0, 133.0, 128.1, 127.7, 125.1, 124.2, 79.3, 69.4, 64.9, 59.9, 49.2, 48.8, 42.6, 41.1, 37.1, 33.7, 28.5, 24.7, 13.3, 12.8, 10.2.

HRMS-ESI m/z calcd for $C_{34}H_{39}BrN_5O_8^+$ $[M - OH]^+$ 724.1977, found 724.1988.

Analogue 40o



40o

Prepared according to general procedure D from primary alcohol **38** (25 mg, 34 µmol, 1 equiv), DMAP (0.4 mg, 3 µmol, 0.1 equiv) and a solution of 4-isocyanato-2-bromopyridine in toluene (0.1 M, 1.0 mL, 0.10 mmol, 3.0 equiv). Toluene was employed as solvent, and the procedure was performed at 80 ºC. Analogue **40o** (17 mg, 67% yield over 2 steps) was obtained as a white solid.

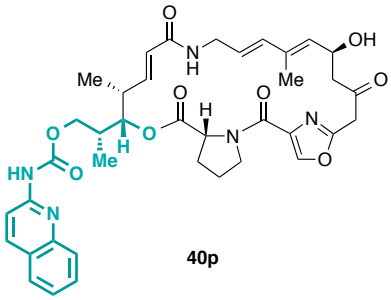
TLC (MeOH;DCM = 1:20): R_f = 0.30 (UV, *p*-anisaldehyde).

^{1}H NMR (400 MHz, CDCl3) δ 9.65 (br s, 1H), 8.22 (s, 1H), 8.12 (d, *J* = 5.6 Hz, 1H), 7.73 (d, *J* = 1.9 Hz, 1H), 7.43 (dd, *J* = 5.7, 1.9 Hz, 1H), 6.54 (dd, *J* = 16.2, 4.1 Hz, 1H), 6.18 (d, *J* = 15.6 Hz, 1H), 6.01 (dd, *J* = 8.1, 4.5 Hz, 1H), 5.80 (dd, *J* = 16.2, 2.0 Hz, 1H), 5.67 (ddd, *J* = 15.6, 9.1, 4.4 Hz, 1H), 5.58 (d, *J* = 8.7 Hz, 1H), 5.17 (dd, *J* = 9.4, 1.9 Hz, 1H), 4.96 (dt, *J* = 8.8, 5.6 Hz, 1H), 4.70 (dd, *J* = 8.8, 2.6 Hz, 1H), 4.61 (dd, *J* = 11.6, 3.6 Hz, 1H), 4.33 (ddd, *J* = 13.6, 8.0, 4.4 Hz, 1H), 3.91 (dd, *J* = 8.6, 5.5 Hz, 2H), 3.84 (s, 2H), 3.73 (dd, *J* = 11.6, 9.9 Hz, 1H), 3.52 (ddd, *J* = 14.2, 9.2, 4.4 Hz, 1H), 3.14 (dd, *J* = 17.6, 5.0 Hz, 1H), 3.00 – 2.80, (m, 1H), 2.93 (dd, *J* = 17.6, 6.1 Hz, 1H), 2.78 – 2.66 (m, 1H), 2.40 – 2.20 (m, 1H), 2.20 – 2.00 (m, 1H), 1.99 – 1.81 (m, 3H), 1.74 (d, *J* = 1.1 Hz, 3H), 1.12 (d, *J* = 6.8 Hz, 3H), 0.97 (d, *J* = 7.0 Hz, 3H).

^{13}C NMR (100 MHz, $CDCl_3$) δ 202.4, 170.4, 165.6, 160.3, 157.7, 153.0, 150.2, 148.2, 144.6, 144.4, 142.5, 136.9, 136.6, 134.13 133.0, 125.01 124.2, 116.2, 112.0, 79.2, 69.5, 64.8, 59.8, 49.3, 48.8, 42.6, 41.1, 37.0, 33.7, 28.4, 24.6, 13.3, 12.7, 10.3.

HRMS-ESI m/z calcd for $C_{34}H_{39}BrN_5O_8^+$ $[M - OH]^+$ 724.1977, found 724.1988.

Analogue 40p



40p

Prepared according to general procedure D from primary alcohol **38** (25 mg, 34 µmol, 1 equiv), DMAP (0.4 mg, 3 µmol, 0.1 equiv) and a solution of 2-isocyanatoquinoline in toluene (0.1 M, 3.0 mL, 0.34 mmol, 10.0 equiv). Toluene was employed as solvent, and the procedure was performed at 80 ºC. Analogue **40p** (12 mg, 49% yield over 2 steps) was obtained as a white solid.

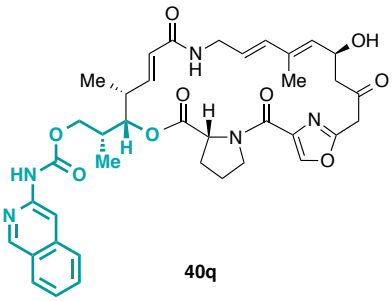
TLC (MeOH;DCM = 1:20): R_f = 0.30 (UV, *p*-anisaldehyde).

^{1}H NMR (400 MHz, CDCl3) δ 9.08 (br s, 1H), 8.20 (d, *J* = 9.0 Hz, 1H), 8.11 (d, *J* = 9.0 Hz, 1H), 7.77 (d, *J* = 8.5 Hz, 1H), 7.74 (dd, *J* = 8.1, 1.3 Hz, 1H), 7.63 (ddd, *J* = 8.5, 6.8, 1.5 Hz, 1H), 7.40 (ddd, *J* = 8.1, 6.9, 1.2 Hz, 1H), 6.48 (dd, *J* = 16.3, 4.6 Hz, 1H), 6.24 – 6.16 (m, 1H), 6.13 (d, *J* = 15.7 Hz, 1H), 5.79 (dd, *J* = 16.3, 1.9 Hz, 1H), 5.67 (ddd, *J* = 15.6, 9.3, 4.5 Hz, 1H), 5.50 (d, *J* = 8.7 Hz, 1H), 5.06 (dd, *J* = 10.1, 1.8 Hz, 1H), 4.91 (dt, *J* = 9.3, 5.4 Hz, 1H), 4.74 (dd, *J* = 8.7, 3.2 Hz, 1H), 4.45 (ddd, *J* = 13.9, 8.8, 4.5 Hz, 1H), 4.27 (d, *J* = 4.8 Hz, 2H), 4.01 (dt, *J* = 11.3, 7.3 Hz, 1H), 3.92 – 3.73 (m, 3H), 3.38 (ddd, *J* = 14.6, 9.4, 3.6 Hz, 1H), 3.04 (dd, *J* = 17.6, 5.1 Hz, 1H), 2.94 (dd, *J* = 17.6, 5.6 Hz, 1H), 2.89 (s, 1H), 2.79 – 2.63 (m, 1H), 2.38 – 2.23 (m, 1H), 2.20 – 2.10 (m, 1H), 2.01 – 1.82 (m, 3H), 1.72 (d, *J* = 1.2 Hz, 3H), 1.13 – 1.07 (m, 3H), 1.06 (s, 3H).

^{13}C NMR (100 MHz, $CDCl_3$) δ 202.8, 171.6, 166.6, 160.2, 157.0, 154.0, 151.5, 146.8, 145.5, 144.0, 138.2, 137.0, 136.9, 133.9, 132.9, 129.7, 127.5, 127.14 125.7, 125.1, 124.6, 124.2, 113.3, 77.6, 67.6, 65.1, 59.8, 48.9, 48.5, 42.8, 41.1, 36.7, 34.1, 28.2, 25.2, 14.4, 12.7, 9.9.

HRMS-ESI m/z calcd for $C_{38}H_{43}N_5NaO_9^+$ $[M + Na]^+$ 736.2953, found 736.2957.

Analogue 40q



40q

Prepared according to general procedure D from primary alcohol **38** (25 mg, 34 µmol, 1 equiv), DMAP (0.4 mg, 3 µmol, 0.1 equiv) and a solution of 3-isocyanatoisoquinoline in toluene (0.1 M, 3.0 mL, 0.34 mmol, 10.0 equiv).. Toluene was employed as solvent, and the procedure was performed at 80 ºC. Analogue **40q** (16 mg, 65% yield over 2 steps) was obtained as a white solid.

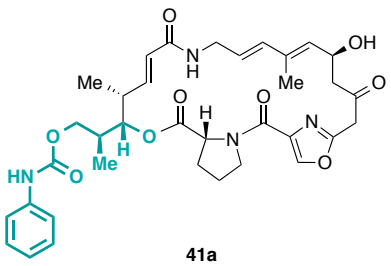
TLC (MeOH;DCM = 1:20): R_f = 0.30 (UV, p-anisaldehyde).

^{1}H NMR (400 MHz, CDCl3) δ 8.98 (s, 1H), 8.95 (s, 1H), 8.39 (s, 1H), 8.28 (s, 1H), 7.89 – 7.83 (m, 1H), 7.76 (d, *J* = 8.3 Hz, 1H), 7.60 (ddd, *J* = 8.2, 6.8, 1.2 Hz, 1H), 7.42 (ddd, *J* = 8.1, 6.8, 1.1 Hz, 1H), 6.50 (dd, *J* = 16.3, 4.6 Hz, 1H), 6.15 (broad t, *J* = 4.7 Hz, 1H), 6.12 (d, *J* = 8.2 Hz, 1H), 5.80 (dd, *J* = 16.3, 1.9 Hz, 1H), 5.68 (ddd, *J* = 15.5, 9.3, 4.5 Hz, 1H), 5.50 (d, *J* = 8.7 Hz, 1H), 5.10 (dd, *J* = 10.0, 1.8 Hz, 1H), 4.92 (dt, *J* = 8.6, 5.4 Hz, 1H), 4.78 (dd, *J* = 8.8, 3.1 Hz, 1H), 4.44 (ddd, *J* = 14.0, 8.9, 4.5 Hz, 1H), 4.32 (dd, *J* = 11.2, 4.7 Hz, 1H), 4.22 (dd, *J* = 11.2, 5.6 Hz, 1H), 3.99 (dt, *J* = 11.4, 7.4 Hz, 1H), 3.89 – 3.73 (m, 3H), 3.39 (ddd, *J* = 14.1, 9.3, 3.6 Hz, 1H), 3.06 (dd, *J* = 17.6, 5.1 Hz, 1H), 2.92 (dd, *J* = 17.6, 5.7 Hz, 1H), 2.74 (ddt, *J* = 6.9, 4.5, 2.1 Hz, 1H), 2.41 – 2.26 (m, 1H), 2.23 – 2.10 (m, 1H), 2.01 – 1.75 (m, 4H), 1.72 (d, *J* = 1.2 Hz, 3H), 1.10 (d, *J* = 6.8 Hz, 3H), 1.07 (d, *J* = 7.0 Hz, 3H).

^{13}C NMR (100 MHz, $CDCl_3$) δ 202.8, 171.6, 166.4, 160.2, 157.0, 153.8, 151.0, 147.2, 145.19, 144.1, 138.0, 137.1, 136.8, 134.0, 132.9, 130.5, 127.4, 126.5, 125.90, 125.2, 125.1, 124.2, 106.2, 77.9, 67.8, 65.1, 59.8, 48.9, 48.5, 42.8, 41.1, 36.7, 34.2, 28.3, 25.1, 14.2, 12.7, 10.03.

HRMS-ESI m/z calcd for $C_{38}H_{43}N_5NaO_9^+$ $[M + Na]^+$ 736.2953, found 736.2957.

Analog 41a



41a

Prepared according to general procedure D from primary alcohol **39** (40 mg, 55 µmol, 1 equiv), DMAP (0.7 mg, 6 µmol, 0.1 equiv) and phenyl isocyanate (18 µL, 0.16 mmol, 3.0 equiv). DCM was employed as solvent, and the procedure was performed at 23 ºC. Analogue **41a** (18 mg, 50% yield over 2 steps) was obtained as a white solid.

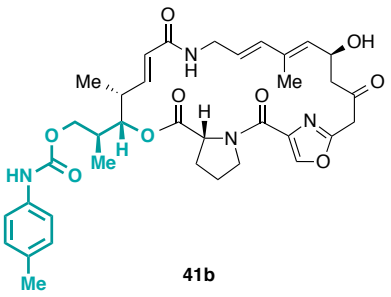
TLC (MeOH;DCM = 1:20): R_f = 0.30 (UV, *p*-anisaldehyde).

^{1}H NMR (400 MHz, CDCl3) δ 8.06 (s, 1H), 7.54 (br s, 1H), 7.45 (d, *J* = 8.0 Hz, 2H), 7.36 – 7.26 (m, 2H), 7.05 (tt, *J* = 7.4, 1.2 Hz, 1H), 6.50 (dd, *J* = 16.3, 4.9 Hz, 1H), 6.24 (dd, *J* = 8.2, 2.9 Hz, 1H), 6.11 (d, *J* = 15.7 Hz, 1H), 5.79 (dd, *J* = 16.3, 1.8 Hz, 1H), 5.69 (ddd, *J* = 15.6, 9.0, 4.5 Hz, 1H), 5.42 (d, *J* = 8.6 Hz, 1H), 5.17 (d, *J* = 4.3 Hz, 1H), 4.91 (d, *J* = 7.6 Hz, 1H), 4.74 (dd, *J* = 9.0, 3.1 Hz, 1H), 4.44 (ddd, *J* = 13.9, 8.7, 4.6 Hz, 1H), 4.24 (dd, *J* = 11.0, 3.7 Hz, 1H), 4.08 (dd, *J* = 10.9, 4.3 Hz, 1H), 3.99 (dt, *J* = 11.2, 7.4 Hz, 1H), 3.82 (s, 2H), 3.81 – 3.73 (m, 1H), 3.40 (ddd, *J* = 14.5, 9.1, 3.8 Hz, 1H), 3.04 (dd, *J* = 17.2, 5.7 Hz, 1H), 2.89 (dd, *J* = 17.2, 5.4 Hz, 1H), 2.81 – 2.71 (m, 1H), 2.58 (br s, 1H), 2.20 (td, *J* = 8.9, 3.7 Hz, 2H), 1.94 (ddt, *J* = 11.9, 7.3, 3.7 Hz, 2H), 1.88 – 1.76 (m, 1H), 1.72 (d, *J* = 1.2 Hz, 3H), 1.14 (d, *J* = 6.8 Hz, 6H).

^{13}C NMR (100 MHz, $CDCl_3$) δ 202.4, 171.3, 166.4, 160.2, 157.0, 153.7, 144.1, 143.8, 138.2, 137.0, 136.5, 134.3, 132.6, 128.9, 125.3, 124.3, 123.3, 118.9, 76.8, 67.8, 65.1, 59.7, 48.8, 48.5, 43.1, 41.0, 36.5, 35.0, 28.4, 25.0, 13.8, 12.7, 11.0.

HRMS-ESI m/z calcd for $C_{35}H_{42}N_4NaO_9^+$ $[M + Na]^+$ 685.2844, found 685.2850.

Analog 41b



41b

Prepared according to general procedure D from primary alcohol **39** (50 mg, 68 µmol, 1 equiv), DMAP (0.9 mg, 7 µmol, 0.1 equiv) and 4-methylphenyl isocyanate (17 µL, 0.14 mmol, 2.0 equiv). DCM was employed as solvent, and the procedure was performed at 23 ºC. Analogue **41b** (22 mg, 47% yield over 2 steps) was obtained as a white solid.

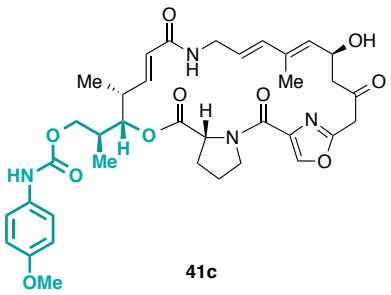
TLC (MeOH:DCM = 1:20): R_f = 0.30 (UV, *p*-anisaldehyde).

^{1}H NMR (400 MHz, CDCl3) δ 8.05 (s, 1H), 7.48 (br s, 1H), 7.31 (d, J = 8.0 Hz, 2H), 7.08 (d, J = 8.1 Hz, 2H), 6.50 (dd, J = 16.3, 5.0 Hz, 1H), 6.33 (br s, 1H), 6.10 (d, J = 15.6 Hz, 1H), 5.79 (dd, J = 16.3, 1.8 Hz, 1H), 5.68 (ddd, J = 15.6, 8.9, 4.5 Hz, 1H), 5.41 (d, J = 8.7 Hz, 1H), 5.14 (d, J = 6.5 Hz, 1H), 4.91 (dt, J = 8.8, 5.7 Hz, 1H), 4.73 (dd, J = 9.0, 3.1 Hz, 1H), 4.42 (ddd, J = 14.1, 8.6, 4.7 Hz, 1H), 4.21 (dd, J = 11.0, 3.8 Hz, 1H), 4.07 (dd, J = 11.0, 4.3 Hz, 1H), 3.97 (dt, J = 11.4, 7.5 Hz, 1H), 3.87 – 3.72 (m, 1H), 3.81 (s, 2H), 3.46 – 3.36 (m, 1H), 3.03 (dd, J = 17.0, 5.8 Hz, 1H), 2.89 (dd, J = 17.0, 5.5 Hz, 1H), 2.76 (td, J = 6.2, 5.3, 2.7 Hz, 1H), 2.29 (s, 3H), 2.24 – 2.10 (m, 2H), 1.99 – 1.89 (m, 2H), 1.85 – 1.75 (m, 1H), 1.71 (d, J = 1.2 Hz, 3H), 1.12 (d, J = 7.0 Hz, 3H), 1.11 (d, J = 6.9 Hz, 3H).

^{13}C NMR (100 MHz, CDCl3) δ 202.38, 171.3, 166.4, 160.2, 157.0, 153.8, 144.0, 143.9, 137.0, 136.5, 135.5, 134.3, 132.9, 132.6, 129.4, 125.3, 124.3, 119.0, 76.7, 67.6, 65.1, 59.7, 48.8, 48.53, 43.1, 41.0, 38.6, 34.9, 28.4, 25.0, 20.7, 13.8, 12.7, 11.0.

HRMS-ESI m/z calcd for $C_{36}H_{45}N_4O_9^+$ $[M + H]^+$ 677.3181, found 677.3190.

Analog 41c



41c

Prepared according to general procedure D from primary alcohol **39** (50 mg, 68 µmol, 1 equiv), DMAP (0.9 mg, 7 µmol, 0.1 equiv) and 4-methoxyphenyl isocyanate (28 µL, 0.21 mmol, 3.0 equiv). DCM was employed as solvent, and the procedure was performed at 23 ºC. Analogue **41c** (25 mg, 53% yield over 2 steps) was obtained as a white solid.

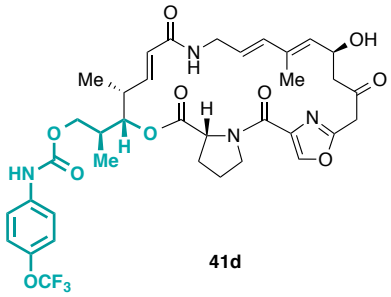
TLC (MeOH;DCM = 1:20): R_f = 0.30 (UV, *p*-anisaldehyde).

^{1}H NMR (400 MHz, CDCl3) δ 8.04 (br s, 1H), 7.43 (s, 1H), 7.34 (d, *J* = 8.0 Hz, 2H), 6.83 (d, *J* = 9.0 Hz, 2H), 6.50 (d, *J* = 16.4 Hz, 1H), 6.28 (s, 1H), 6.10 (d, *J* = 15.6 Hz, 1H), 5.79 (d, *J* = 16.3 Hz, 1H), 5.69 (ddd, *J* = 15.5, 8.9, 4.5 Hz, 1H), 5.41 (d, *J* = 8.7 Hz, 1H), 5.16 (s, 1H), 4.91 (dt, *J* = 8.6, 5.6 Hz, 1H), 4.80 – 4.67 (m, 1H), 4.43 (ddd, *J* = 14.0, 8.7, 4.6 Hz, 1H), 4.21 (dd, *J* = 11.0, 3.7 Hz, 1H), 4.07 (dd, *J* = 11.0, 4.3 Hz, 1H), 3.98 (dt, *J* = 11.3, 7.5 Hz, 1H), 3.81 (s, 2H), 3.78 (s, 3H), 3.41 (ddd, *J* = 14.6, 8.9, 3.7 Hz, 1H), 3.03 (dd, *J* = 17.1, 5.8 Hz, 1H), 2.89 (dd, *J* = 17.1, 5.4 Hz, 1H), 2.76 (s, 1H), 2.64 (s, 1H), 2.25 – 2.10 (m, 2H), 2.00 – 1.83 (m, 2H), 1.87 – 1.79 (m, 1H), 1.72 (d, *J* = 1.2 Hz, 3H), 1.12 (d, *J* = 6.8 Hz, 6H).

^{13}C NMR (100 MHz, $CDCl_3$) δ 202.40, 171.34, 166.46, 160.22, 157.02, 144.08, 143.86, 137.05, 136.56, 134.35, 132.56, 131.19, 125.34, 124.33, 120.87, 114.13, 76.86, 67.73, 65.14, 59.67, 55.49, 48.80, 48.53, 43.13, 41.00, 38.76, 34.97, 28.42, 25.03, 13.82, 12.73, 10.99.

HRMS-ESI m/z calcd for $C_{36}H_{45}N_4O_{10}^+$ $[M + H]^+$ 693.3130, found 693.3138.

Analog 41d



41d

Prepared according to general procedure D from primary alcohol **39** (50 mg, 68 µmol, 1 equiv), DMAP (0.9 mg, 7 µmol, 0.1 equiv) and 4-trifluoromethoxyphenyl isocyanate (31 µL, 0.21 mmol, 3.0 equiv). DCM was employed as solvent, and the procedure was performed at 23 ºC. Analogue **41d** (15 mg, 30% yield over 2 steps) was obtained as a white solid.

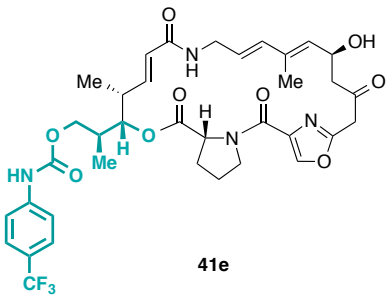
TLC (MeOH;DCM = 1:20): R_f = 0.30 (UV, *p*-anisaldehyde).

^{1}H NMR (400 MHz, CDCl3) δ 8.05 (s, 1H), 7.92 (br s, 1H), 7.51 (d, *J* = 8.7 Hz, 2H), 7.13 (d, *J* = 8.6 Hz, 2H), 6.50 (dd, *J* = 16.3, 4.8 Hz, 1H), 6.16 (s, 1H), 6.12 (d, *J* = 15.6 Hz, 1H), 5.79 (dd, *J* = 16.3, 1.8 Hz, 1H), 5.75 – 5.63 (m, 1H), 5.45 (d, *J* = 8.7 Hz, 1H), 5.22 (d, *J* = 4.8 Hz, 1H), 4.91 (q, *J* = 7.6, 6.6 Hz, 1H), 4.75 (dd, *J* = 9.0, 3.0 Hz, 1H), 4.43 (ddd, *J* = 14.0, 8.7, 4.6 Hz, 1H), 4.30 (dd, *J* = 10.9, 3.3 Hz, 1H), 4.07 (dd, *J* = 10.9, 3.9 Hz, 1H), 3.98 (dt, *J* = 11.4, 7.5 Hz, 2H), 3.83 (s, 2H), 3.83 – 3.74 (m, 1H), 3.41 (ddd, *J* = 13.7, 9.0, 3.7 Hz, 1H), 3.04 (dd, *J* = 17.3, 5.6 Hz, 1H), 2.90 (dd, *J* = 17.2, 5.5 Hz, 1H), 2.79 – 2.69 (m, 1H), 2.56 (br s, 1H), 2.30 – 2.13 (m, 2H), 2.00 – 1.88 (m, 2H), 1.87 – 1.75 (m, 1H), 1.73 (d, *J* = 1.2 Hz, 3H), 1.16 (d, *J* = 2.8 Hz, 3H), 1.14 (d, *J* = 2.9 Hz, 3H).

^{13}C NMR (100 MHz, $CDCl_3$) δ 202.39, 171.20, 166.41, 160.24, 157.18, 153.76, 144.56, 144.01, 143.84, 137.16, 137.09, 136.59, 134.31, 132.64, 125.29, 124.30, 121.65, 119.93, 76.58, 68.59, 65.10, 59.67, 48.87, 48.59, 43.02, 41.08, 39.49, 35.27, 28.43, 25.01, 13.51, 12.73, 11.01.

HRMS-ESI m/z calcd for $C_{36}H_{40}F_3N_4O_9^+$ $[M - H_2O]^+$ 729.2742, found 729.2754.

Analog 41e



41e

Prepared according to general procedure D from primary alcohol **39** (40 mg, 55 µmol, 1 equiv), DMAP (0.7 mg, 6 µmol, 0.1 equiv) and 4-trifluoromethylphenyl isocyanate (18 µL, 0.16 mmol, 3.0 equiv). DCM was employed as solvent, and the procedure was performed at 23 ºC. Analogue **41e** (19 mg, 47% yield over 2 steps) was obtained as a white solid.

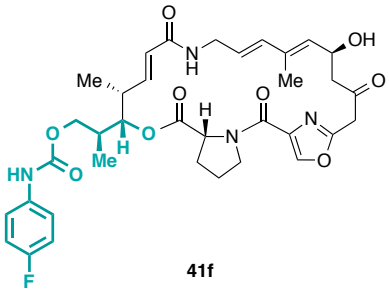
TLC (MeOH;DCM = 1:20): R_f = 0.30 (UV, *p*-anisaldehyde).

^{1}H NMR (400 MHz, CDCl3) δ 8.18 (br s, 1H), 8.06 (s, 1H), 7.62 (d, *J* = 8.5 Hz, 2H), 7.52 (d, *J* = 8.7 Hz, 2H), 6.50 (dd, *J* = 16.3, 4.9 Hz, 1H), 6.18 – 6.10 (m, 1H), 6.12 (d, *J* = 15.4 Hz, 1H), 5.80 (dd, *J* = 16.3, 1.8 Hz, 1H), 5.69 (ddd, *J* = 15.5, 9.1, 4.4 Hz, 1H), 5.46 (d, *J* = 8.7 Hz, 1H), 5.25 (dd, *J* = 4.7, 2.2 Hz, 1H), 4.92 (d, *J* = 7.7 Hz, 1H), 4.75 (dd, *J* = 9.0, 3.1 Hz, 1H), 4.42 (ddd, *J* = 13.7, 8.5, 4.4 Hz, 1H), 4.33 (dd, *J* = 10.9, 3.2 Hz, 1H), 4.08 (dd, *J* = 11.0, 3.7 Hz, 1H), 4.04 – 3.91 (m, 1H), 3.83 (s, 2H), 3.82 – 3.76 (m, 1H), 3.42 (ddd, *J* = 15.0, 9.1, 3.8 Hz, 1H), 3.04 (dd, *J* = 17.3, 5.6 Hz, 1H), 2.91 (dd, *J* = 17.3, 5.5 Hz, 1H), 2.79 – 2.69 (m, 1H), 2.60 (br s, 1H), 2.24 – 2.14 (m, 2H), 2.00 – 1.90 (m, 2H), 1.85 – 1.76 (m, 1H), 1.73 (d, *J* = 1.2 Hz, 3H), 1.17 (d, *J* = 4.2 Hz, 3H), 1.15 (d, *J* = 4.2 Hz, 3H).

^{13}C NMR (100 MHz, $CDCl_3$) δ 202.4, 171.2, 166.4, 160.3, 157.3, 153.6, 144.0, 141.7, 137.1, 136.6, 134.3, 132.69, 126.1 (q, $^3J_{CF}$ = 3.6 Hz), 125.3, 124.3, 118.4, 76.5, 68.8, 65.0, 59.7, 48.9, 48.6, 43.0, 41.1, 35.3, 31.6, 25.0, 22.6, 14.1, 12.72, 11.0.

HRMS-ESI m/z calcd for $C_{36}H_{41}F_3N_4NaO_9^+$ $[M + Na]^+$ 753,2718, found 753.2717.

Analogue 41f



41f

Prepared according to general procedure D from primary alcohol **39** (50 mg, 68 µmol, 1 equiv), DMAP (0.9 mg, 7 µmol, 0.1 equiv) and 4-fluorodephenyl isocyanate (16 µL, 0.14 mmol, 2.0 equiv). DCM was employed as solvent, and the procedure was performed at 23 ºC. Analogue **41f** (18 mg, 39% yield over 2 steps) was obtained as a white solid.

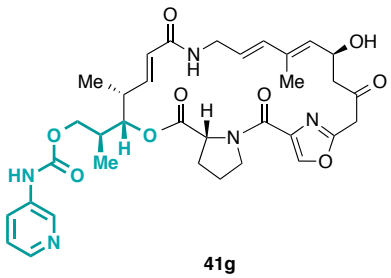
TLC (MeOH;DCM = 1:20): R_f = 0.30 (UV, *p*-anisaldehyde).

^{1}H NMR (400 MHz, CDCl3) δ 8.04 (s, 1H), 7.73 (br s, 1H), 7.42 (br s, 2H), 6.98 (t, *J* = 8.7 Hz, 2H), 6.50 (dd, *J* = 16.3, 4.9 Hz, 1H), 6.19 (d, *J* = 8.6 Hz, 1H), 6.11 (d, *J* = 15.6 Hz, 1H), 5.79 (dd, *J* = 16.3, 1.8 Hz, 1H), 5.69 (ddd, *J* = 15.5, 9.0, 4.5 Hz, 1H), 5.43 (d, *J* = 8.7 Hz, 1H), 5.19 (d, *J* = 3.0 Hz, 1H), 4.95 – 4.85 (m, 1H), 4.74 (dd, *J* = 8.9, 3.0 Hz, 1H), 4.43 (ddd, *J* = 14.1, 8.9, 4.7 Hz, 1H), 4.25 (dd, *J* = 10.9, 3.4 Hz, 1H), 4.07 (dd, *J* = 10.9, 4.0 Hz, 1H), 3.98 (dt, *J* = 11.4, 7.5 Hz, 1H), 3.82 (s, 2H), 3.80 – 3.72 (m, 1H), 3.41 (ddd, *J* = 15.0, 9.1, 3.8 Hz, 1H), 3.04 (dd, *J* = 17.2, 5.6 Hz, 1H), 2.90 (dd, *J* = 17.2, 5.5 Hz, 1H), 2.79 – 2.72 (m, 1H), 2.60 (br s, 1H), 2.26 – 2.12 (m, 2H), 1.94 (dp, *J* = 11.2, 3.8 Hz, 2H), 1.87 – 1.77 (m, 1H), 1.73 (d, *J* = 1.2 Hz, 3H), 1.14 (d, *J* = 6.6 Hz, 6H).

^{13}C NMR (100 MHz, $CDCl_3$) δ 202.4, 171.3, 166.4, 160.2, 157.1, 153.9, 144.1, 143.8, 137.1, 136.6, 134.3, 132.6, 125.3, 124.3, 120.7 (d, $^3J_{CF}$ = 7.7 Hz), 115.5 (d, $^2J_{CF}$ = 22.6 Hz), 76.7, 68.3, 65.1, 59.7, 48.8, 48.6, 43.0, 41.06, 39.3, 35.2, 28.42, 25.0, 13.6, 12.7, 11.0.

HRMS-ESI m/z calcd for $C_{35}H_{42}FN_4O_9^+$ $[M + H]^+$ 681.2930, found 681.2935.

Analogue 41g



41g

Prepared according to general procedure D from primary alcohol **39** (25 mg, 34 µmol, 1 equiv), DMAP (0.4 mg, 3 µmol, 0.1 equiv) and a solution of 3-isocyanatopyridine in toluene (0.1 M, 1.0 mL, 0.10 mmol, 3.0 equiv). Toluene was employed as solvent, and the procedure was performed at 80 ºC. Analogue **41g** (10 mg, 44% yield over 2 steps) was obtained as a white solid.

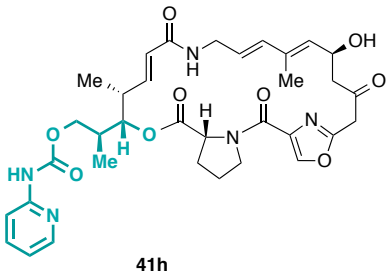
TLC (MeOH;DCM = 1:20): R_f = 0.30 (UV, *p*-anisaldehyde).

^{1}H NMR (400 MHz, CDCl3) δ 8.52 (d, *J* = 2.6 Hz, 1H), 8.37 (br s, 1H), 8.24 (dd, *J* = 4.7, 1.5 Hz, 1H), 8.09 (br s, 1H), 8.08 (s, 1H), 7.23 (dd, *J* = 8.4, 4.8 Hz, 1H), 6.49 (dd, *J* = 16.3, 4.8 Hz, 1H), 6.15 (d, *J* = 9.5 Hz, 1H), 6.11 (d, *J* = 15.8 Hz, 1H), 5.80 (dd, *J* = 16.3, 1.8 Hz, 1H), 5.68 (ddd, *J* = 15.7, 8.7, 4.3 Hz, 1H), 5.46 (d, *J* = 8.7 Hz, 1H), 5.25 (dd, *J* = 4.2, 2.2 Hz, 1H), 4.91 (dt, *J* = 8.7, 5.7 Hz, 1H), 4.76 (dd, *J* = 9.0, 3.2 Hz, 1H), 4.41 (ddd, *J* = 13.7, 8.1, 4.0 Hz, 1H), 4.26 (dd, *J* = 10.9, 2.9 Hz, 1H), 4.15 (dd, *J* = 10.9, 3.7 Hz, 1H), 3.98 (dt, *J* = 11.5, 7.4 Hz, 1H), 3.88 (td, *J* = 7.5, 7.0, 3.8 Hz, 1H), 3.82 (s, 2H), 3.44 (ddd, *J* = 15.2, 8.7, 3.8 Hz, 1H), 3.07 – 2.91 (m, 2H), 2.76 – 2.66 (m, 1H), 2.28 – 2.08 (m, 2H), 2.00 – 1.90 (m, 2H), 1.89 – 1.75 (m, 1H), 1.72 (d, *J* = 1.2 Hz, 3H), 1.18 (d, *J* = 7.9 Hz, 3H), 1.16 (d, *J* = 7.4 Hz, 3H).

^{13}C NMR (100 MHz, $CDCl_3$) δ 202.4, 171.1, 166.4, 160.4, 157.4, 154.1, 144.2, 144.0, 143.8, 140.8, 137.0, 136.1, 135.6, 134.2, 132.8, 126.3, 125.2, 124.4, 123.6, 76.2, 69.3, 65.1, 59.7, 48.8, 48.7, 43.1, 41.0, 40.1, 35.5, 28.5, 25.0, 13.5, 12.7, 11.0.

HRMS-ESI m/z calcd for $C_{34}H_{42}N_5O_9^+$ $[M + H]^+$ 664.2977, found 664.2988.

Analogue 41h



41h

Prepared according to general procedure D from primary alcohol **39** (35 mg, 40 µmol, 1 equiv), DMAP (0.5 mg, 4 µmol, 0.1 equiv) and a solution of 2-isocyanatopyridine in toluene (0.1 M, 4.0 mL, 0.40 mmol, 10.0 equiv). Toluene was employed as solvent, and the procedure was performed at 80 ºC. Analogue **41h** (11 mg, 31% yield over 2 steps) was obtained as a white solid.

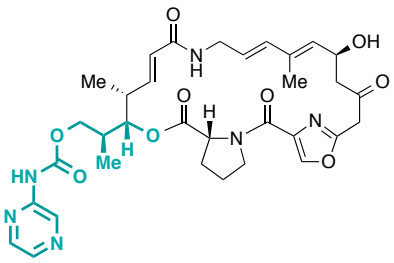
TLC (MeOH;DCM = 1:20): R_f = 0.30 (UV, *p*-anisaldehyde).

^{1}H NMR (400 MHz, CDCl3) δ 8.52 (s, 1H), 8.32 (s, 1H), 8.29 – 8.21 (m, 1H), 7.95 (d, *J* = 8.4 Hz, 1H), 7.68 (ddd, *J* = 8.7, 7.4, 1.9 Hz, 1H), 6.99 (ddd, *J* = 7.3, 4.9, 1.0 Hz, 1H), 6.55 – 6.44 (m, 1H), 6.37 (dd, *J* = 8.9, 3.6 Hz, 1H), 6.11 (d, *J* = 15.6 Hz, 1H), 5.79 (dd, *J* = 16.3, 1.8 Hz, 1H), 5.69 (ddd, *J* = 15.6, 8.9, 4.6 Hz, 1H), 5.41 (d, *J* = 8.7 Hz, 1H), 5.11 (dd, *J* = 7.3, 2.2 Hz, 1H), 4.92 (dt, *J* = 8.7, 5.6 Hz, 1H), 4.71 (dd, *J* = 8.7, 3.3 Hz, 1H), 4.45 (ddd, *J* = 14.1, 8.9, 4.6 Hz, 1H), 4.21 (dd, *J* = 11.1, 4.1 Hz, 1H), 4.12 (dd, *J* = 11.1, 4.7 Hz, 1H), 4.05 – 3.97 (m, 1H), 3.84 – 3.74 (m, 1H), 3.81 (s, 2H), 3.39 (ddd, *J* = 14.9, 8.9, 3.6 Hz, 1H), 3.05 (dd, *J* = 17.2, 5.7 Hz, 1H), 2.89 (dd, *J* = 17.3, 5.3 Hz, 1H), 2.82 – 2.70 (m, 1H), 2.27 – 2.11 (m, 2H), 1.98 – 1.78 (m, 3H), 1.72 (d, *J* = 1.2 Hz, 3H), 1.12 (d, *J* = 6.8 Hz, 6H).

^{13}C NMR (100 MHz, $CDCl_3$) δ 202.5, 171.6, 166.5, 160.3, 157.0, 153.4, 151.6, 147.6, 144.7, 143.7, 138.4, 136.9, 136.6, 134.2, 132.7, 125.3, 124.4, 119.0, 112.6, 76.9, 67.7, 65.1, 59.7, 48.7, 48.5, 43.2, 40.9, 38.2, 34.7, 28.3, 25.1, 14.03, 12.7, 10.9.

HRMS-ESI m/z calcd for $C_{34}H_{42}N_5O_9^+$ $[M + H]^+$ 664.2977, found 681.2988.

Analogue 41i



41i

Prepared according to general procedure D from primary alcohol **39** (21 mg, 29 µmol, 1 equiv), DMAP (0.4 mg, 3 µmol, 0.1 equiv) and a solution of 2-isocyanatopyrazine in toluene (0.1 M, 0.86 mL, 0.086 mmol, 3.0 equiv). Toluene was employed as solvent, and the procedure was performed at 80 ºC. Analogue **41i** (7.3 mg, 43% yield over 2 steps) was obtained as a white solid.

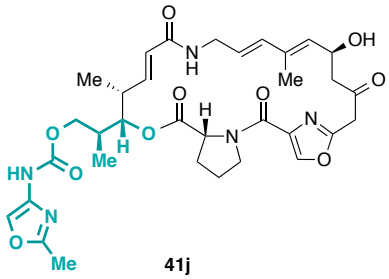
TLC (MeOH;DCM = 1:20): R_f = 0.30 (UV, *p*-anisaldehyde).

^{1}H NMR (400 MHz, CDCl3) δ 9.31 (br s, 1H), 8.84 (s, 1H), 8.38 (d, *J* = 3.5 Hz, 1H), 8.28 (d, *J* = 2.6 Hz, 1H), 8.22 (t, *J* = 2.0 Hz, 1H), 6.49 (dd, *J* = 16.3, 4.9 Hz, 1H), 6.29 (d, *J* = 8.7 Hz, 1H), 6.10 (d, *J* = 15.7 Hz, 1H), 5.79 (dd, *J* = 16.2, 1.8 Hz, 1H), 5.68 (ddd, *J* = 15.6, 8.8, 4.5 Hz, 1H), 5.43 (d, *J* = 8.7 Hz, 1H), 5.17 (dd, *J* = 6.1, 2.1 Hz, 1H), 4.91 (dt, *J* = 8.7, 5.5 Hz, 1H), 4.71 (dd, *J* = 8.6, 3.3 Hz, 1H), 4.43 (dd, *J* = 11.7, 6.4 Hz, 1H), 4.27 (dd, *J* = 11.0, 3.6 Hz, 1H), 4.15 (dd, *J* = 11.0, 4.2 Hz, 1H), 4.07 – 3.96 (m, 1H), 3.89 – 3.83 (m, 1H), 3.81 (s, 2H), 3.39 (ddd, *J* = 14.9, 8.9, 3.6 Hz, 1H), 3.03 (dd, *J* = 17.1, 5.5 Hz, 1H), 2.91 (dd, *J* = 17.1, 5.5 Hz, 1H), 2.80 – 2.70 (m, 1H), 2.27 – 2.14 (m, 2H), 1.90 (ddd, *J* = 18.9, 10.3, 4.4 Hz, 3H), 1.72 (s, 3H), 1.15 (d, *J* = 6.5 Hz, 3H), 1.13 (s, 3H).

^{13}C NMR (100 MHz, $CDCl_3$) δ 202.5, 171.6, 166.5, 160.3, 157.1, 153.2, 148.5, 145.0, 143.6, 141.7, 139.3, 136.9, 136.51 136.1, 134.2, 132.8, 125.2, 124.4, 76.4, 68.9, 65.1, 59.7, 48.8, 48.6, 43.1, 40.9, 39.0, 34.9, 28.3, 25.2, 13.7, 12.7, 10.8.

HRMS-ESI m/z calcd for $C_{33}H_{41}N_6O_9^+$ $[M + H]^+$ 665.2930, found 665.2963.

Analogue 41j



41j

Prepared according to general procedure D from primary alcohol **39** (25 mg, 34 µmol, 1 equiv), DMAP (0.4 mg, 3 µmol, 0.1 equiv) and a solution of 4-isocyanato-2-methyloxazole in toluene (0.1 M, 1.0 mL, 0.10 mmol, 3.0 equiv). Toluene was employed as solvent, and the procedure was performed at 80 ºC. Analogue **41j** (11 mg, 33% yield over 2 steps) was obtained as a white solid.

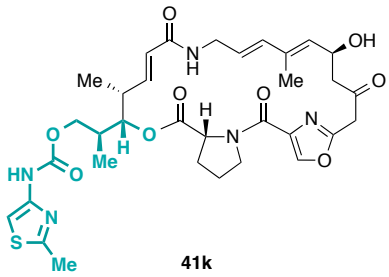
TLC (MeOH;DCM = 1:20): R_f = 0.30 (UV, *p*-anisaldehyde).

^{1}H NMR (400 MHz, CDCl3) δ 8.89 (s, 1H), 8.65 (s, 1H), 7.67 (s, 1H), 6.46 (dd, *J* = 16.4, 4.8 Hz, 1H), 6.21 – 6.07 (m, 2H), 5.78 (dd, *J* = 16.4, 1.9 Hz, 1H), 5.68 (ddd, *J* = 15.6, 9.2, 4.5 Hz, 1H), 5.47 (d, *J* = 8.6 Hz, 1H), 5.24 – 5.13 (m, 1H), 4.91 (dt, *J* = 8.9, 5.3 Hz, 1H), 4.71 (dd, *J* = 8.7, 3.2 Hz, 1H), 4.47 (ddd, *J* = 13.9, 9.0, 4.6 Hz, 1H), 4.18 (dd, *J* = 10.7, 2.9 Hz, 1H), 4.15 – 3.99 (m, 2H), 3.90 – 3.75 (m, 3H), 3.35 (ddd, *J* = 13.8, 9.1, 3.5 Hz, 1H), 3.04 (dd, *J* = 17.7, 5.0 Hz, 1H), 2.91 (dd, *J* = 17.6, 5.7 Hz, 1H), 2.2.80 – 2.60 (m, 2H), 2.40 (s, 3H), 2.27 – 2.14 (m, 2H), 1.98 – 1.78 (m, 3H), 1.73 (d, *J* = 1.2 Hz, 3H), 1.16 (d, *J* = 7.0 Hz, 3H), 1.14 (d, *J* = 6.9 Hz, 3H).

^{13}C NMR (100 MHz, $CDCl_3$) δ 202.8, 171.5, 166.5, 160.2, 159.3, 157.0, 153.5, 146.1, 143.7, 137.2, 136.9, 136.7, 134.0, 132.9, 125.1, 124.3, 123.9, 76.2, 69.4, 65.0, 59.7, 48.8, 48.5, 42.9, 41.0, 40.0 35.2, 28.3, 25.2, 13.9, 13.6, 12.7, 10.6.

HRMS-ESI m/z calcd for $C_{33}H_{41}N_5NaO_{10}^+$ $[M + Na]^+$ 690.2746, found 690.2773.

Analogue 41k



Prepared according to general procedure D from primary alcohol **39** (38 mg, 52 µmol, 1 equiv), DMAP (0.6 mg, 5 µmol, 0.1 equiv) and a solution of 4-isocyanato-2-methylthiazole in toluene (0.1 M, 1.60 mL, 0.16 mmol, 3.0 equiv). Toluene was employed as solvent, and the procedure was performed at 80 ºC. Analogue **41k** (17 mg, 52% yield over 2 steps) was obtained as a white solid.

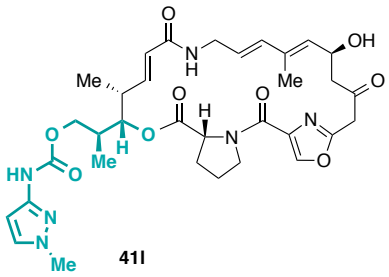
TLC (MeOH;DCM = 1:20): R_f = 0.30 (UV, *p*-anisaldehyde).

^{1}H NMR (400 MHz, CDCl3) δ 8.81 (s, 1H), 8.66 (s, 1H), 7.08 (s, 1H), 6.47 (dd, *J* = 16.3, 4.9 Hz, 1H), 6.37 – 6.18 (m, 1H), 6.10 (d, *J* = 15.7 Hz, 1H), 5.78 (dd, *J* = 16.4, 1.8 Hz, 1H), 5.68 (ddd, *J* = 15.5, 9.0, 4.5 Hz, 1H), 5.44 (d, *J* = 8.7 Hz, 1H), 5.14 (dd, *J* = 5.8, 2.1 Hz, 1H), 4.91 (dt, *J* = 9.6, 5.6 Hz, 1H), 4.70 (dd, *J* = 8.8, 3.2 Hz, 1H), 4.45 (ddd, *J* = 14.2, 9.0, 4.7 Hz, 1H), 4.19 (dd, *J* = 10.9, 3.5 Hz, 1H), 4.10 (dd, *J* = 10.9, 4.2 Hz, 1H), 4.01 (dt, *J* = 11.1, 7.1 Hz, 1H), 3.87 – 3.71 (m, 1H), 3.81 (s, 2H), 3.36 (ddd, *J* = 14.8, 9.1, 3.5 Hz, 1H), 3.04 (dd, *J* = 17.4, 5.3 Hz, 1H), 2.91 (dd, *J* = 17.4, 5.3 Hz, 1H), 2.85 (br s, 1H), 2.76- 2.67 (m, 1H), 2.63 (s, 3H), 2.26 – 2.10 (m, 2H), 2.01 – 1.82 (m, 3H), 1.72 (s, 3H), 1.14 (d, *J* = 3.7 Hz, 3H), 1.12 (d, *J* = 3.7 Hz, 3H).

^{13}C NMR (100 MHz, $CDCl_3$) δ 202.7, 171.5, 166.6, 163.7, 160.2, 157.0, 153.7, 146.8, 145.6, 143.7, 136.9, 136.7, 134.1, 132.8, 125.2, 124.3, 98.2, 76.5, 68.67 65.1, 59.7, 48.8, 48.5, 43.0, 41.0, 39.4, 35.0, 28.3, 25.2, 18.9, 13.8, 12.7, 10.7.

HRMS-ESI m/z calcd for $C_{33}H_{42}N_5O_9S^+$ $[M + H]^+$ 684.2698, found 684.2726.

Analogue 41l



Prepared according to general procedure D from primary alcohol **39** (25 mg, 34 µmol, 1 equiv), DMAP (0.4 mg, 3 µmol, 0.1 equiv) and a solution of 4-isocyanato-2-methyloxazole in toluene (0.1 M, 1.0 mL, 0.10 mmol, 3.0 equiv). Toluene was employed as solvent, and the procedure was performed at 80 ºC. Analogue **41l** (11 mg, 48% yield over 2 steps) was obtained as a white solid.

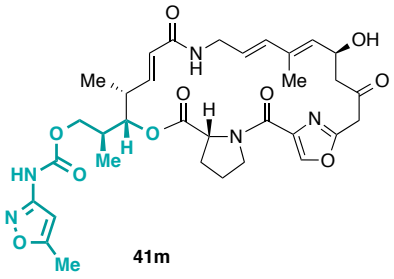
TLC (MeOH;DCM = 1:20): R_f = 0.30 (UV, *p*-anisaldehyde).

^{1}H NMR (400 MHz, CDCl3) δ 8.57 (s, 1H), 8.44 (s, 1H), 7.21 (d, *J* = 2.3 Hz, 1H), 6.47 (dd, *J* = 16.4, 5.0 Hz, 1H), 6.44 (br s, 1H), 6.31 (brs, 1H), 6.10 (d, *J* = 15.6 Hz, 1H), 5.77 (dd, *J* = 16.3, 1.8 Hz, 1H), 5.69 (ddd, *J* = 15.6, 9.0, 4.5 Hz, 1H), 5.42 (d, *J* = 8.6 Hz, 1H), 5.18 – 5.01 (m, 1H), 4.91 (q, *J* = 6.4 Hz, 1H), 4.71 (dd, *J* = 8.7, 3.2 Hz, 1H), 4.45 (ddd, *J* = 14.1, 8.8, 4.6 Hz, 1H), 4.13 (qd, *J* = 11.0, 4.0 Hz, 2H), 4.00 (dt, *J* = 11.3, 7.1 Hz, 1H), 3.85 -3.75 (m, 1H), 3.81 (s, 2H), 3.78 (s, 3H), 3.37 (ddd, *J* = 14.3, 9.1, 3.5 Hz, 1H), 3.03 (dd, *J* = 17.3, 5.4 Hz, 1H), 2.90 (dd, *J* = 17.3, 5.6 Hz, 1H), 2.83 (br s, 1H), 2.72 (br t, *J* = 6.5 Hz, 1H), 2.25 – 2.10 (m, 2H), 1.99 – 1.82 (m, 3H), 1.72 (d, *J* = 1.2 Hz, 3H), 1.12 (d, *J* = 6.6 Hz, 3H).

^{13}C NMR (100 MHz, $CDCl_3$) δ 202.7, 171.5, 166.5, 160.2, 157.0, 153.8, 147.3, 145.4, 143.8, 136.9, 136.6, 134.1, 132.7, 130.8, 125.3, 124.3, 96.1, 76.7, 68.2, 65.1, 59.7, 48.7, 48.5, 43.1, 41.0, 39.1, 38.7, 35.0, 28.3, 25.1, 13.9, 12.7, 10.8.

HRMS-ESI m/z calcd for $C_{33}H_{43}N_6O_9^+$ $[M + H]^+$ 667.3086, found 667.3093.

Analogue 41m



41m

Prepared according to general procedure D from primary alcohol **39** (25 mg, 34 µmol, 1 equiv), DMAP (0.4 mg, 3 µmol, 0.1 equiv) and a solution of 3-isocyanato-5-methylisoxazole in toluene (0.1 M, 1.0 mL, 0.10 mmol, 3.0 equiv). Toluene was employed as solvent, and the procedure was performed at 80 ºC. Analogue **41m** (11 mg, 48% yield over 2 steps) was obtained as a white solid.

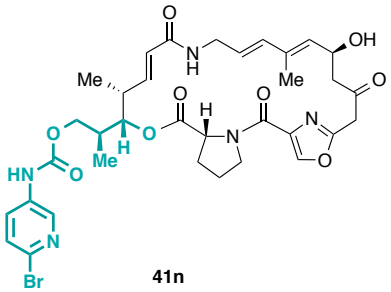
TLC (MeOH;DCM = 1:20): R_f = 0.30 (UV, *p*-anisaldehyde).

^{1}H NMR (400 MHz, CDCl3) δ 9.35 (s, 1H), 8.85 (s, 1H), 6.52 (s, 1H), 6.45 (dd, *J* = 16.3, 4.7 Hz, 1H), 6.11 (d, *J* = 15.7 Hz, 2H), 5.78 (dd, *J* = 16.4, 1.8 Hz, 1H), 5.68 (ddd, *J* = 14.9, 9.3, 4.5 Hz, 1H), 5.49 (d, *J* = 8.7 Hz, 1H), 5.23 (s, 1H), 4.95 – 4.85 (m, 1H), 4.70 (dd, *J* = 8.7, 3.3 Hz, 1H), 4.52 – 4.42 (m, 1H), 4.21 (dd, *J* = 10.8, 2.6 Hz, 1H), 4.10 (dd, *J* = 10.8, 3.6 Hz, 1H), 4.10 – 4.00 (m, 1H), 3.88 – 3.75 (m, 3H), 3.34 (ddd, *J* = 13.8, 9.3, 3.4 Hz, 1H), 3.05 (dd, *J* = 17.2, 4.9 Hz, 1H), 2.91 (dd, *J* = 17.8, 5.7 Hz, 1H), 2.78 (br s, 1H), 2.72 – 2.63 (m, 1H), 2.37 (d, *J* = 0.9 Hz, 2H), 2.23 – 2.12 (m, 2H), 1.98 – 1.89 (m, 1H), 1.91 – 1.79 (m, 2H), 1.73 (d, *J* = 1.1 Hz, 3H), 1.18 (s, 3H), 1.15 (d, *J* = 6.9 Hz, 3H).

^{13}C NMR (100 MHz, $CDCl_3$) δ 203.0, 171.5, 169.4, 166.6, 160.3, 158.79, 157.0, 153.7, 146.6, 143.5, 136.8, 136.7, 133.9, 133.0, 125.1, 124.3, 95.6, 75.9, 70.3, 65.0, 59.8, 48.8, 48.6, 42.7, 41.1, 40.8, 35.41, 28.2, 25.3, 13.4, 12.7, 12.6, 10.5.

HRMS-ESI m/z calcd for $C_{33}H_{40}N_5O_9^+$ $[M - H_2O]^+$ 650.2821, found 650.2822.

Analogue 41n



41n

Prepared according to general procedure D from primary alcohol **39** (25 mg, 34 µmol, 1 equiv), DMAP (0.4 mg, 3 µmol, 0.1 equiv) and a solution of 3-isocyanato-6-brolmopyridine in toluene (0.1 M, 1.0 mL, 0.10 mmol, 3.0 equiv). Toluene was employed as solvent, and the procedure was performed at 80 ºC. Analogue **41n** (11 mg, 40% yield over 2 steps) was obtained as a white solid.

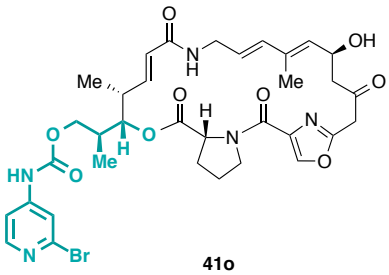
TLC (MeOH;DCM = 1:20): R_f = 0.30 (UV, *p*-anisaldehyde).

^{1}H NMR (400 MHz, CDCl3) δ 8.66 (br s, 1H), 8.41 (d, *J* = 2.8 Hz, 1H), 8.15 – 7.95 (m, 1H), 8.07 (s, 1H), 7.23 (d, *J* = 8.7 Hz, 1H), 6.51 (dd, *J* = 16.2, 4.8 Hz, 1H), 6.19 (br s, 1H), 6.11 (d, *J* = 15.6 Hz, 1H), 5.79 (dd, *J* = 16.3, 1.8 Hz, 1H), 5.67 (ddd, *J* = 15.6, 8.9, 4.4 Hz, 1H), 5.46 (d, *J* = 8.7 Hz, 1H), 5.27 (dd, *J* = 3.9, 2.2 Hz, 1H), 4.91 (dt, *J* = 9.1, 5.7 Hz, 1H), 4.76 (dd, *J* = 8.9, 3.1 Hz, 1H), 4.37 (ddd, *J* = 14.0, 8.1, 4.3 Hz, 1H), 4.30 (dd, *J* = 11.0, 2.7 Hz, 1H), 4.09 (dd, *J* = 10.9, 3.4 Hz, 1H), 3.93 (dt, *J* = 11.7, 7.6 Hz, 1H), 3.89 – 3.78 (m, 1H), 3.82 (s, 2H), 3.46 (ddd, *J* = 15.0, 9.0, 4.0 Hz, 1H), 3.02 (dd, *J* = 17.1, 5.6 Hz, 1H), 2.97 – 2.83 (m, 2H), 2.75 – 2.58 (m, 1H), 2.30 – 2.10 (m, 1H), 2.00 – 1.86 (m, 2H), 1.84 – 1.74 (m, 2H), 1.72 (d, *J* = 1.2 Hz, 3H), 1.16 (dd, *J* = 6.9, 3.5 Hz, 6H).

^{13}C NMR (100 MHz, $CDCl_3$) δ 202.4, 170.9, 166.3, 160.4, 157.4, 153.9, 144.0, 144.0, 140.2, 136.9, 136.4, 134.9, 134.3, 132.8, 128.9, 127.7, 125.2, 124.2, 124.0, 76.2, 69.6, 65.0, 59.6, 48.9, 48.7, 42.9, 41.1, 40.2, 35.5, 28.4, 24.9, 13.3, 12.7, 11.0.

HRMS-ESI m/z calcd for $C_{34}H_{40}BrN_5NaO_9^+$ $[M + Na]^+$ 764.1902, found 764.1928

Analogue 41o



41o

Prepared according to general procedure D from primary alcohol **39** (25 mg, 34 µmol, 1 equiv), DMAP (0.4 mg, 3 µmol, 0.1 equiv) and a solution of 4-isocyanato-2-bromopyridine in toluene (0.1 M, 1.0 mL, 0.10 mmol, 3.0 equiv). Toluene was employed as solvent, and the procedure was performed at 80 ºC. Analogue **41o** (13 mg, 53% yield over 2 steps) was obtained as a white solid.

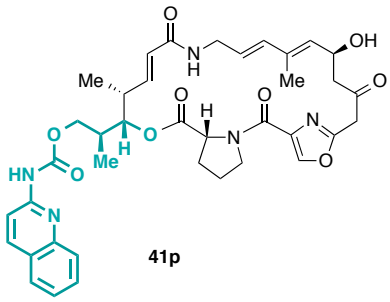
TLC (MeOH;DCM = 1:20): R_f = 0.30 (UV, *p*-anisaldehyde).

^{1}H NMR (400 MHz, CDCl3) δ 8.91 (s, 1H), 8.20 – 8.10 (m, 2H), 7.71 (d, *J* = 1.9 Hz, 1H), 7.63 – 7.52 (m, 1H), 6.50 (dd, *J* = 16.2, 4.7 Hz, 1H), 6.13 (d, *J* = 15.8 Hz, 2H), 6.09 (d, *J* = 3.8 Hz, 1H), 5.78 (dd, *J* = 16.2, 1.9 Hz, 1H), 5.73 – 5.65 (m, 1H), 5.50 (d, *J* = 8.7 Hz, 1H), 5.30 (t, *J* = 2.7 Hz, 1H), 4.92 (dt, *J* = 8.7, 5.5 Hz, 1H), 4.75 (dd, *J* = 8.9, 3.1 Hz, 1H), 4.47 – 4.36 (m, 1H), 4.34 (dd, *J* = 10.8, 2.6 Hz, 1H), 4.09 (dd, *J* = 10.9, 3.1 Hz, 1H), 3.99 – 3.85 (m, 2H), 3.84 (s, 2H), 3.45 (ddd, *J* = 14.2, 9.1, 4.0 Hz, 1H), 3.04 (dd, *J* = 17.3, 5.6 Hz, 1H), 2.93 (dd, *J* = 17.2, 5.5 Hz, 1H), 2.75 – 2.65 (m, 1H), 2.27 – 2.08 (m, 2H), 1.99 – 1.89 (m, 2H), 1.87 – 1.76 (m, 1H), 1.73 (d, *J* = 1.2 Hz, 6H), 1.17 (d, *J* = 6.9 Hz, 6H).

^{13}C NMR (100 MHz, $CDCl_3$) δ 202.4, 170.8, 166.3, 160.4, 157.5, 153.2, 150.3, 148.1, 144.0, 143.9 142.4, 137.0, 136.5, 134.3, 132.8, 125.2, 124.2, 116.4, 112.1, 76.0, 70.3, 65.0, 59.6, 49.0, 48.8, 42.8, 41.2, 40.7, 35.5, 28.5, 24.94 13.1, 12.7, 11.0.

HRMS-ESI m/z calcd for $C_{34}H_{40}BrN_5NaO_9^+$ $[M + Na]^+$ 764.1902, found 764.1928.

Analogue 41p



41p

Prepared according to general procedure D from primary alcohol **39** (25 mg, 34 µmol, 1 equiv), DMAP (0.4 mg, 3 µmol, 0.1 equiv) and a solution of 2-isocyanatoquinoline in toluene (0.1 M, 1.0 mL, 0.10 mmol, 3.0 equiv). Toluene was employed as solvent, and the procedure was performed at 80 ºC. Analogue **41p** (10 mg, 46% yield over 2 steps) was obtained as a white solid.

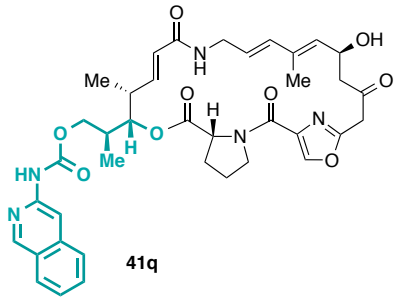
TLC (MeOH;DCM = 1:20): R_f = 0.30 (UV, *p*-anisaldehyde).

^{1}H NMR (400 MHz, CDCl3) δ 8.61 (br s, 1H), 8.43 (s, 1H), 8.18 (q, *J* = 9.0 Hz, 2H), 7.84 – 7.72 (m, 2H), 7.65 (ddd, *J* = 8.5, 6.9, 1.5 Hz, 1H), 7.44 (ddd, *J* = 8.1, 6.9, 1.2 Hz, 1H), 6.49 (dd, *J* = 16.3, 4.9 Hz, 1H), 6.35 (d, *J* = 6.0 Hz, 1H), 6.12 (d, *J* = 15.7 Hz, 1H), 5.81 (dd, *J* = 16.3, 1.8 Hz, 1H), 5.70 (ddd, *J* = 15.6, 8.9, 4.5 Hz, 1H), 5.43 (d, *J* = 8.7 Hz, 1H), 5.13 (dd, *J* = 7.1, 2.1 Hz, 1H), 4.93 (dt, *J* = 8.7, 5.5 Hz, 1H), 4.72 (dd, *J* = 8.6, 3.3 Hz, 1H), 4.47 (ddd, *J* = 14.3, 9.1, 4.7 Hz, 1H), 4.25 (dd, *J* = 11.0, 4.1 Hz, 1H), 4.15 (dd, *J* = 11.0, 4.6 Hz, 1H), 4.00 (dt, *J* = 11.3, 7.2 Hz, 1H), 3.87 – 3.75 (m, 1H), 3.82 (s, 2H), 3.38 (ddd, *J* = 14.8, 9.0, 3.6 Hz, 1H), 3.06 (dd, *J* = 17.3, 5.5 Hz, 1H), 2.90 (dd, *J* = 17.2, 5.5 Hz, 1H), 2.80 – 2.70 (m, 1H), 2.30 – 2.11 (m, 2H), 2.02 – 1.78 (m, 3H), 1.73 (d, *J* = 1.2 Hz, 3H), 1.14 (d, *J* = 3.2 Hz, 3H), 1.13 (d, *J* = 3.2 Hz, 3H).

^{13}C NMR (100 MHz, $CDCl_3$) δ 202.6, 171.6, 166.5, 160.2, 157.0, 153.6, 151.0, 146.5, 144.9, 143.7, 138.7, 137.0, 136.6, 134.2, 132.7, 130.1, 127.6, 126.9, 125.9, 125.3, 125.0 124.45 113.1, 76.7, 68.0, 65.1, 59.7, 48.7, 48.5, 43.1, 41.0, 38.4, 34.8, 28.3, 25.2, 14.0, 12.8, 10.8.

HRMS-ESI m/z calcd for $C_{38}H_{43}N_5NaO_9^+$ $[M + Na]^+$ 736.2953, found 736.2957.

Analogue 41q



Prepared according to general procedure D from primary alcohol **39** (35 mg, 34 µmol, 1 equiv), DMAP (0.6 mg, 5 µmol, 0.1 equiv) and a solution of 2-isocyanatoisoquinoline in toluene (0.1 M, 3.40 mL, 0.34 mmol, 10.0 equiv). Toluene was employed as solvent, and the procedure was performed at 80 ºC. Analogue **41q** (11 mg, 31% yield over 2 steps) was obtained as a white solid.

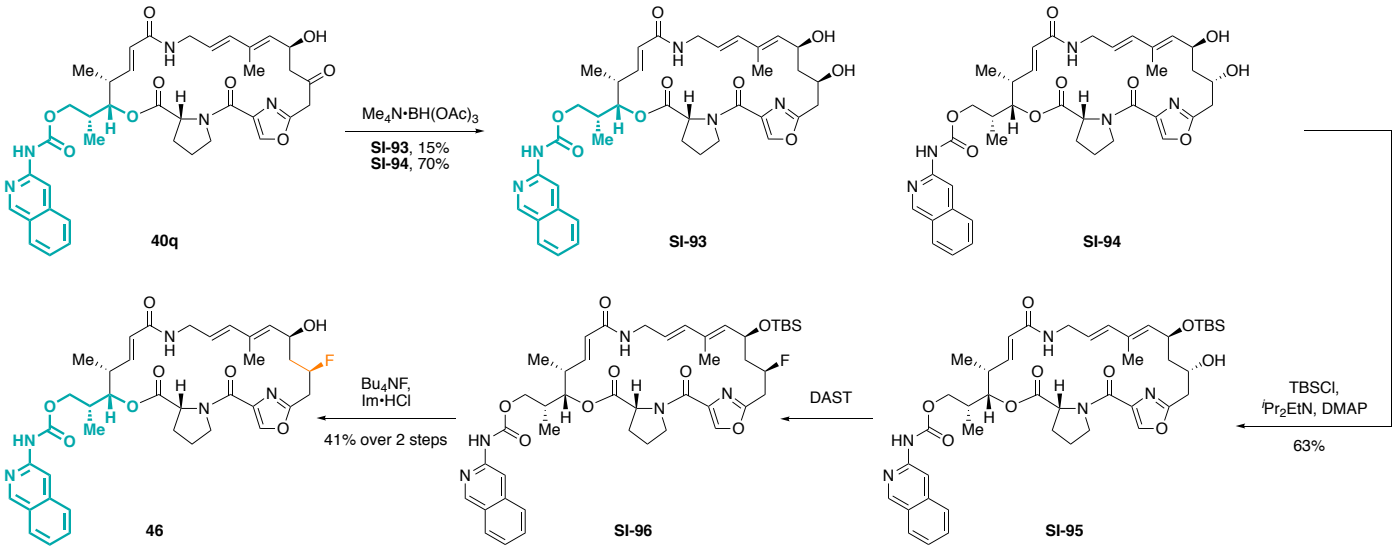
TLC (MeOH;DCM = 1:20): R_f = 0.30 (UV, *p*-anisaldehyde).

^{1}H NMR (400 MHz, $CDCl_3$) δ 8.97 (s, 1H), 8.46 (s, 1H), 8.32 (s, 1H), 8.25 (s, 1H), 7.88 (d, *J* = 8.2 Hz, 1H), 7.79 (d, *J* = 8.3 Hz, 1H), 7.62 (ddd, *J* = 8.2, 6.8, 1.2 Hz, 1H), 7.45 (ddd, *J* = 8.1, 6.8, 1.1 Hz, 1H), 6.50 (dd, *J* = 16.3, 4.9 Hz, 1H), 6.36 (dd, *J* = 8.8, 3.7 Hz, 1H), 6.10 (d, *J* = 15.6 Hz, 1H), 5.80 (dd, *J* = 16.3, 1.8 Hz, 1H), 5.69 (ddd, *J* = 15.6, 8.9, 4.5 Hz, 1H), 5.41 (d, *J* = 8.7 Hz, 1H), 5.14 (dd, *J* = 7.4, 2.2 Hz, 1H), 4.92 (dt, *J* = 8.8, 5.5 Hz, 1H), 4.72 (dd, *J* = 8.7, 3.3 Hz, 1H), 4.26 (dd, *J* = 11.0, 4.1 Hz, 1H), 4.17 (dd, *J* = 11.0, 4.8 Hz, 1H), 3.99 (dt, *J* = 11.3, 7.1 Hz, 1H), 3.81 (s, 3H), 3.37 (ddd, *J* = 14.9, 8.9, 3.6 Hz, 1H), 3.05 (dd, *J* = 17.1, 5.7 Hz, 1H), 2.89 (dd, *J* = 17.1, 5.5 Hz, 1H), 2.80 (ddt, *J* = 7.3, 4.9, 2.2 Hz, 1H), 2.37 – 2.08 (m, 2H), 2.00 – 1.74 (m, 4H), 1.72 (d, *J* = 1.2 Hz, 3H), 1.19 – 1.14 (m, 3H), 1.13 (s, 3H).

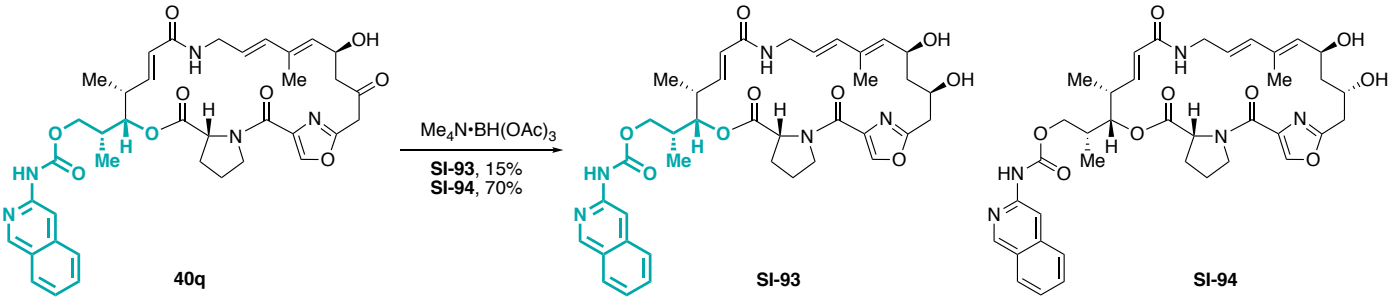
^{13}C NMR (100 MHz, $CDCl_3$) δ 202.5, 171.6, 166.5, 160.3, 157.0, 153.4, 151.0, 146.5, 144.67, 143.7, 138.0, 137.0, 136.6, 134.2, 132.7, 130.8, 127.5, 126.6, 126.1, 125.5, 125.3, 124.5, 106.3, 77.0, 67.6, 65.1, 59.7, 48.7, 48.5, 43.2, 40.9, 38.2, 34.7, 28.4, 25.1, 14.1, 12.7, 10.9.

HRMS-ESI m/z calcd for $C_{38}H_{43}N_5NaO_9^+$ $[M + Na]^+$ 736.2953, found 736.2957.

Scheme XVIII Synthesis of SI-93, SI-94 and 46



Analogues SI-93 and SI-94



A 50-mL round-bottom flask containing $Me_4N{\cdot}BH(OAc)_3$ (87 mg, 0.33 mmol, 5.0 equiv) was evacuated and flushed with nitrogen (this process was repeated a total of 3 times). Acetonitrile (6.6 mL) and acetic acid (1.3 mL) was added, and the resulting colorless solution was cooled to -10 ºC by means of an ice-acetone bath. A solution of **40q** (47 mg, 66 µmol, 1 equiv) in acetonitrile (1.2 mL) was added dropwise (the syringe was rinsed with acetonitrile (2 × 0.6 mL) twice), and the mixture was allowed to warm to 23 ºC. After 5 h, saturated aqueous $NaHCO_3$ solution (30 mL) was carefully added (CAUTION: Gas evolution!), followed by EtOAc (50 mL), and the resulting biphasic mixture was transferred to a separatory funnel. Then layers were separated, and the aqueous layer was extracted with EtOAc (2 × 10 mL). The combined organic layers were washed with water (2 × 50 mL) and brine (50 mL), and the washed solution was dried (Na_2SO_4). The dried solution was filtered, and the filtrate was concentrated. The resulting crude residue was purified by flash chromatography (silica gel, eluent: MeOH: DCM = 1:30) to afford **SI-93** (7 mg, 15% yield) and **SI-94** (33 mg, 70 % yield) as a white solid.

SI-93: TLC (MeOH:DCM = 1:20): R_f = 0.30 (UV, *p*-anisaldehyde).

^{1}H NMR (400 MHz, $CDCl_3$) δ 9.18 (s, 1H), 8.94 (s, 1H), 8.32 (s, 1H), 8.28 (s, 1H), 7.85 (d, *J* = 8.2 Hz, 1H), 7.76 (d, *J* = 8.3 Hz, 1H), 7.60 (ddd, *J* = 8.2, 6.8, 1.3 Hz, 1H), 7.42 (ddd, *J* = 8.1, 6.8, 1.1 Hz, 1H), 6.53 (dd, *J* = 16.2, 4.2 Hz, 1H), 6.18 (d, *J* = 15.7 Hz, 1H), 5.98 (dd, *J* = 8.9, 3.8 Hz, 1H), 5.82 (dd, *J* = 16.2, 2.0 Hz, 1H), 5.65 (ddd, *J* = 15.6, 9.3, 4.2 Hz, 1H), 5.45 (d, *J* = 9.0 Hz, 1H), 5.17 (dd, *J* = 10.0, 1.9 Hz, 1H), 4.95 – 4.80 (m, 2H), 4.46 (ddd, *J* = 14.0, 8.1, 4.3 Hz, 1H), 4.38 (dd, *J* = 11.3, 4.2 Hz, 1H), 4.32 – 4.24 (m, 1H), 4.14 (dd, *J* = 11.3, 6.5 Hz, 2H), 4.05 (ddd, *J* = 12.2, 8.2, 4.1 Hz, 2H), 3.91 (dt, *J* = 11.6, 7.5 Hz, 1H), 3.43 (ddd, *J* = 14.7, 9.3, 3.7 Hz, 1H), 3.00 (dd, *J* = 16.6, 6.1 Hz, 1H), 2.81 (dd, *J* = 16.6, 5.7 Hz, 1H), 2.77 – 2.65 (m, 1H), 2.40 – 2.25 (m, 2H), 2.20 – 2.04 (m, 2H), 1.97 – 1.80 (m 4H), 1.79 (s, 3H), 1.13 (d, *J* = 6.9 Hz, 3H), 1.04 (d, *J* = 7.0 Hz, 3H).

^{13}C NMR (100 MHz, $CDCl_3$) δ 171.4, 165.9, 161.8, 160.5, 153.9, 151.0, 147.3, 144.8, 144.6, 138.0, 136.7, 136.3, 134.4, 134.3, 130.5, 127.4, 126.5, 125.9, 125.2, 125.0, 124.1, 106.3, 77.9, 68.3, 68.1, 67.6, 59.7, 48.7, 42.9, 41.2, 36.6, 35.6, 34.2, 28.2, 24.9, 13.89, 13.1, 10.6.

HRMS-ESI m/z calcd for $C_{38}H_{44}N_5O_8^+$ $[M - OH]^+$ 698.3184, found 698.3190.

SI-94: TLC (MeOH:DCM = 1:20): R_f = 0.30 (UV, *p*-anisaldehyde).

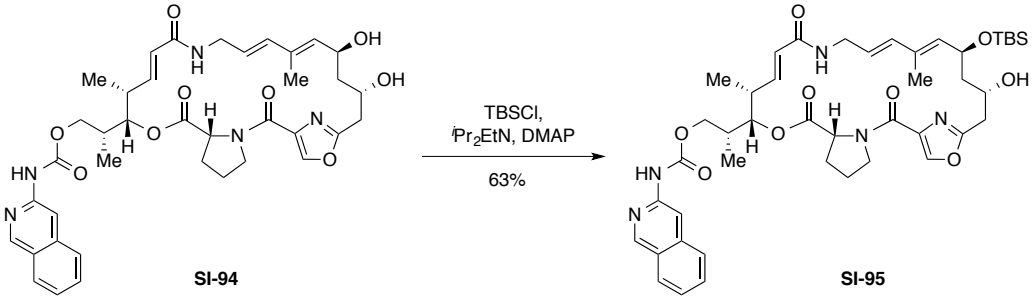
^{1}H NMR (400 MHz, CDCl3) δ 9.16 (s, 1H), 8.93 (s, 1H), 8.28 (s, 1H), 8.26 (s, 1H), 7.84 (d, *J* = 8.2 Hz, 1H), 7.75 (d, *J* = 8.3 Hz, 1H), 7.59 (ddd, *J* = 8.2, 6.8, 1.2 Hz, 1H), 7.41 (ddd, *J* = 8.1, 6.8, 1.1 Hz, 1H), 6.46 (dd, *J* = 16.4, 4.1 Hz, 1H), 6.21 – 6.09 (m, 2H), 5.82 – 5.76 (m, 1H), 5.75 (t, *J* = 2.2 Hz, 1H), 5.67 (ddd, *J* = 15.0, 9.8, 4.5 Hz, 1H), 5.09 (dd, *J* = 10.2, 1.8 Hz, 1H), 4.97 (dt, *J* = 8.6, 4.0 Hz, 1H), 4.77 (dd, *J* = 8.7, 3.5 Hz, 1H), 4.43 (td, *J* = 14.1, 11.7, 5.9 Hz, 2H), 4.34 (dd, *J* = 11.2, 4.5 Hz, 1H), 4.18 (dd, *J* = 11.2, 5.9 Hz, 1H), 3.88 – 3.73 (m, 2H), 3.35 (ddd, *J* = 14.0, 9.8, 3.8 Hz, 1H), 3.04 (dd, *J* = 16.4, 3.0 Hz, 1H), 2.88 (dd, *J* = 16.5, 9.8 Hz, 1H), 2.95 – 2.80 (m, 2H), 2.77- 2.67 (m, 1H), 2.31 (ddd, *J* = 10.7, 6.8,

4.5 Hz, 1H), 2.20 (ddd, *J* = 14.4, 3.8, 2.0 Hz, 1H), 2.14 – 2.04 (m, 2H), 1.93 (ddd, *J* = 14.0, 9.3, 4.4 Hz, 1H), 1.88 – 1.76 (m, 2H), 1.72 (s, 3H), 1.09 (d, *J* = 6.8 Hz, 3H), 1.03 (d, *J* = 7.0 Hz, 3H).

^{13}C NMR (100 MHz, $CDCl_3$) δ 171.9, 166.5, 161.1, 160.5, 153.9, 151.0, 147.12, 144.3, 144.2, 138.0, 137.2, 136.4, 133.7, 133.3, 130.6, 127.3, 126.5, 125.9, 125.2, 124.9, 124.1, 106.3, 77.8, 67.9, 67.5, 66.8, 59.5, 48.3, 41.6, 41.3, 36.7, 35.2, 34.1, 28.1, 25.4, 13.9, 12.5, 9.7.

HRMS-ESI m/z calcd for $C_{38}H_{44}N_5O_8^+$ $[M - OH]^+$ 698.3184, found 698.3190.

Mono-TBS ether SI-95



To a solution of anit-diol **SI-94** (45 mg, 82 µmol, 1 equiv) and DMAP (1 mg, 8 µmol, 0.10 equiv) in DCM (8 mL) was added $^{i}Pr_2NEt$ (0.22 mL, 1.20 mmol, 15.0 equiv), followed by TBS-Cl (0.19 g, 1.2 mmol, 15.0 equiv). After 24 h, the mixture was concentrated, and the resulting crude residue was purified by flash chromatography (silica gel, eluent: acetone:hexanes = 1:4) to afford mono-TBS ether **SI-95** (43 mg, 79% yield) as a white solid.

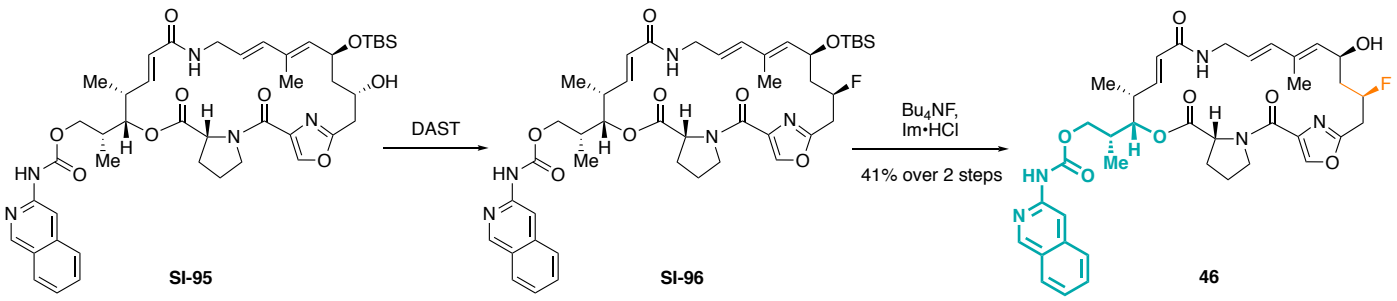
TLC (MeOH:DCM = 1:20): R_f = 0.30 (UV, *p*-anisaldehyde).

^{1}H NMR (400 MHz, CDCl3) δ 9.13 (s, 1H), 8.93 (s, 1H), 8.37 (s, 1H), 8.27 (s, 1H), 7.84 (d, *J* = 8.2 Hz, 1H), 7.75 (d, *J* = 8.4 Hz, 1H), 7.59 (ddd, *J* = 8.2, 6.8, 1.2 Hz, 1H), 7.41 (ddd, *J* = 8.0, 6.7, 1.1 Hz, 1H), 6.44 (dd, *J* = 16.4, 4.1 Hz, 1H), 6.17 (s, 1H), 6.07 – 5.93 (m, 1H), 5.82 – 5.72 (m, 2H), 5.67 (ddd, *J* = 15.1, 10.3, 4.2 Hz, 1H), 5.07 (dd, *J* = 10.1, 1.8 Hz, 1H), 4.99 (ddd, *J* = 9.6, 4.9, 2.2 Hz, 1H), 4.76 (dd, *J* = 8.7, 3.7 Hz, 1H), 4.60 – 4.44 (m, 2H), 4.46 – 4.29 (m, 2H), 4.20 (dd, *J* = 11.3, 6.0 Hz, 1H), 3.92 – 3.72 (m, 2H), 3.29 (ddd, *J* = 13.9, 10.4, 3.4 Hz, 1H), 3.03 (d, *J* = 2.4 Hz, 1H), 2.86 – 2.67 (m, 2H), 2.35 (d, *J* = 13.4 Hz, 2H), 2.14 – 2.06 (m, 1H), 2.00 – 1.85 (m, 2H), 1.90 – 1.73 (m, 2H), 1.70 (s, 3H), 1.09 (d, *J* = 6.8 Hz, 3H), 1.06 (d, *J* = 7.0 Hz, 3H), 0.90 (s, 9H), 0.09 (s, 3H), 0.04 (s, 3H).

^{13}C NMR (100 MHz, $CDCl_3$) δ 172.1, 166.9, 161.1, 160.5, 153.9, 151.0, 147.3, 144.5, 143.7, 138.0, 137.2, 136.5, 134.1, 131.62, 130.4, 127.3, 126.5, 125.9, 125.1, 125.0, 124.2, 106.1, 77.9, 69.8, 67.9, 66.7, 59.6, 48.1, 42.9, 41.6, 36.9, 35.0, 34.0, 28.1, 25.7, 25.6, 17.9, 14.1, 12.4, 9.4, -4.5, -5.3.

HRMS-ESI m/z calcd for $C_{44}H_{60}N_5O_9Si^+$ $[M + H]^+$ 830.4155, found 830.4159.

Analogue 46



A 50-mL round-bottom flask containing mono-TBS ether **SI-95** (42 mg, 64 μmol, 1 equiv) was evacuated and flushed with nitrogen (this process was repeated a total of 3 times). DCM (6.4 mL) was added, and the resulting colorless solution was cooled to 0 ºC by means of an ice/water bath. A solution of DAST in DCM (2 M, 0.13 mL, 0.27mmol, 10.0 equiv) was added dropwise, and the resulting yellow solution was allowed to warm to 23 ºC. After 3 h, saturated aqueous $NaHCO_3$ solution (10 mL) was added, followed by DCM (20 mL). After stirring for 30 min, the resulting biphasic mixture was transferred to a separatory funnel, and the layers were separated. The organic layer was washed with water (2 × 50 mL) and brine (50 mL). The washed solution was dried (Na_2SO_4), and the dried solution was concentrated. The resulting crude residue **SI-96** (22 mg, 100%) was used without further purification.

A 100-mL round-bottom flask containing crude **SI-96** (22 mg, 26 μmol, 1 equiv) was evacuated and flushed with nitrogen (this process was repeated a total of 3 times). THF (3 mL) was added, resulting in a light-yellow solution. In a separate flask, Im•HCl (28 mg, 0.26 mmol, 10.0 equiv) that had previously been dried at >100 ºC for 10 minutes under vacuum was added to a solution of tetrabutylammonium fluoride in THF (1 M, 0.26 mL, 0.26 mmol, 10.0 equiv). The resulting colorless solution was added dropwise to the above solution of **SI-96**. After 12 h, the mixture was concentrated, and the residue was dissolved in DCM (50 mL). The resulting solution was transferred to a separatory funnel and was washed with water (5 × 50 mL) and brine (50 mL). The washed solution was dried (Na_2SO_4). The dried solution was filtered, and the filtrate was concentrated. The resulting crude residue was purified by preparative TLC (silica gel, eluent: MeOH:DCM = 1:20) to afford analogue **46** (6.5 mg, 34% yield) as a white solid.

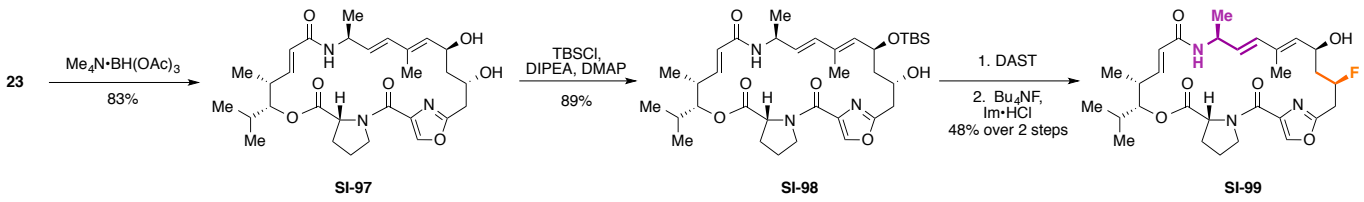
TLC (MeOH:DCM = 1:20): R_f = 0.30 (UV, *p*-anisaldehyde).

^{1}H NMR (400 MHz, CDCl3) δ 9.16 (s, 1H), 8.94 (s, 1H), 8.35 – 8.21 (m, 2H), 7.85 (dd, *J* = 8.2, 1.1 Hz, 1H), 7.76 (d, *J* = 8.3 Hz, 1H), 7.59 (ddd, *J* = 8.3, 6.9, 1.2 Hz, 1H), 7.41 (ddd, *J* = 8.1, 6.9, 1.1 Hz, 1H), 6.52 (dd, *J* = 16.3, 4.3 Hz, 1H), 6.19 (d, *J* = 15.7 Hz, 1H), 6.06 – 5.96 (m, 1H), 5.84 (dd, *J* = 16.3, 2.0 Hz, 1H), 5.69 (ddd, *J* = 15.3, 8.5, 4.1 Hz, 1H), 5.40 (d, *J* = 9.0 Hz, 1H), 5.16 (dd, *J* = 10.1, 1.9 Hz, 1H), 5.11 (dm, $^2J_{HF}$ = 41.8 Hz, 1H), 4.88 (dd, *J* = 8.7, 3.4 Hz, 1H), 4.79 (td, *J* = 9.0, 4.4 Hz, 1H), 4.61 – 4.46 (m, 1H), 4.39 (ddd, *J* = 11.3, 4.4, 1.8 Hz, 1H), 4.19 – 4.05 (m, 2H), 3.87 (dt, *J* = 11.4, 6.9 Hz, 1H), 3.45 (ddd, *J* = 15.5, 8.6, 3.1 Hz, 1H), 3.19 (ddd, *J* = 18.9, 16.6, 5.8 Hz, 1H), 3.03 – 2.87 (m, 1H), 2.82 – 2.66 (m, 1H), 2.46 – 2.26 (m, 2H), 2.27 – 2.07 (m, 3H), 1.95 – 1.80 (m, 2H), 1.81 (d, *J* = 1.3 Hz, 3H), 1.13 (d, *J* = 6.9 Hz, 3H), 1.03 (d, *J* = 6.9 Hz, 3H).

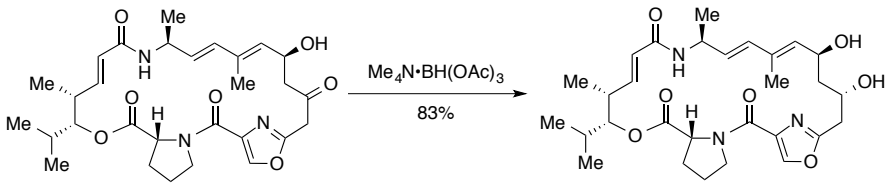
^{13}C NMR (100 MHz, $CDCl_3$) δ 171.6, 166.1, 160.5, 159.8 (d, $^3J_{CF}$ = 8.2 Hz), 153.8, 151.0, 147.2, 144.4, 144.3, 138.0, 136.6, 135.9, 135.6, 133.5, 130.5, 127.4, 126.5, 125.9, 125.2, 125.2, 124.1, 106.3, 89.3 (d, $^1J_{CF}$ = 169.9 Hz), 77.9, 68.2, 65.7, 59.4, 48.7, 42.3 (d, $^2J_{CF}$ = 20.1 Hz), 41.0, 36.6, 34.1, 33.6 (d, $^2J_{CF}$ = 25.2 Hz), 28.2, 24.9, 13.8, 12.9, 10.3.

HRMS-ESI m/z calcd for $C_{38}H_{44}FN_5NaO_8^+$ $[M + Na]^+$ 740.3066, found 740.3058.

Scheme XIX Synthesis of SI-99



Anti-diol SI-97



23 SI-97

A 50-mL round-bottom flask containing $Me_4N•BH(OAc)_3$ (0.13 g, 0.50 mmol, 5.0 equiv) was evacuated and flushed with nitrogen (this process was repeated a total of 3 times). Acetonitrile (5 mL) and acetic acid (5 mL) was added, and the resulting colorless solution was cooled to -10 ºC by means of an ice-acetone bath. A solution of **23** (54 mg, 0.10 mmol, 1 equiv) in acetonitrile (2.5 mL) was added dropwise (the syringe was rinsed with acetonitrile (2 × 1 mL) twice). The mixture was allowed to warm to 23 ºC slowly. After 5 h, saturated aqueous $NaHCO_3$ solution was added (CAUTION: Gas evolution!), followed by EtOAc (50 mL), and the biphasic mixture was transferred to a separatory funnel. The layers were separated, and aqueous layer was extracted with EtOAc (2 × 10 mL). The combined organic layers were washed with water (50 mL) and brine (50 mL), and the washed solution was dried (Na_2SO_4). The dried solution was filtered, and the filtrate was concentrated. The resulting crude residue was purified by flash chromatography (silica gel, eluent: MeOH: DCM = 1:30) to afford anti-diol **SI-97** (45 mg, 83% yield) as a white solid.

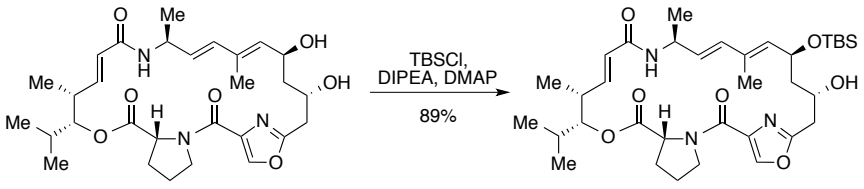
TLC (MeOH:DCM = 1:20): R_f = 0.20 (UV, *p*-anisaldehyde).

^{1}H NMR (400 MHz, $CDCl_3$) δ 8.11 (s, 1H), 6.42 (dd, *J* = 16.4, 4.3 Hz, 1H), 6.14 (d, *J* = 16.1 Hz, 1H), 5.82 (dd, *J* = 16.1, 4.8 Hz, 1H), 5.79 – 5.71 (m, 3H), 4.98 (dt, *J* = 8.6, 4.0 Hz, 1H), 4.82 – 4.73 (m, 1H), 4.73 – 4.66 (m, 2H), 4.46 (tt, *J* = 9.6, 2.6 Hz, 1H), 3.81 (ddd, *J* = 13.7, 7.2, 4.7 Hz, 2H), 3.05 (dd, *J* = 16.5, 3.1 Hz, 1H), 2.89 (dd, *J* = 16.4, 9.8 Hz, 1H), 2.80 – 2.68 (m, 1H), 2.25 – 2.19 (m, 1H), 2.09 (dtd, *J* = 11.3, 6.4, 5.8, 2.9 Hz, 1H), 2.00 – 1.76 (m, 5H), 1.74 (d, *J* = 1.2 Hz, 3H), 1.31 (d, *J* = 6.9 Hz, 3H), 1.06 (d, *J* = 6.9 Hz, 3H), 0.99 (d, *J* = 6.5 Hz, 3H), 0.93 (d, *J* = 6.7 Hz, 3H).

^{13}C NMR (100 MHz, $CDCl_3$) δ 172.1, 166.2, 161.2, 160.3, 144.5, 143.3, 136.6, 133.7, 133.1, 132.5, 129.8, 123.8, 81.4, 67.6, 66.8, 59.3, 48.3, 44.0, 41.5, 36.6, 35.1, 29.3, 28.2, 25.3, 19.8, 18.6, 17.9, 12.8, 9.7.

HRMS-ESI m/z calcd for $C_{29}H_{42}N_3O_7^+$ $[M + H]^+$ 544.3017, found 544.3020.

Mono-TBS ether SI-98



SI-97 SI-98

To a solution of anti-diol **SI-97** (40 mg, 74 μmol, 1 equiv) and DMAP (0.9 mg, 7.4 μmol, 0.1 equiv) in DCM (7.4 mL) was added ^{i}Pr$_2$NEt (0.19 mL, 1.10 mmol, 15.0 equiv), followed by TBS-Cl (0.17 g, 1.10 mmol, 15.0 equiv). After 24 h, the mixture was concentrated, and the resulting crude residue was purified by flash chromatography (silica gel, eluent: ethyl acetate:hexanes = 1:3 to 1:1) to afford mono-TBS ether **SI-98** (43 mg, 89% yield) as a white solid.

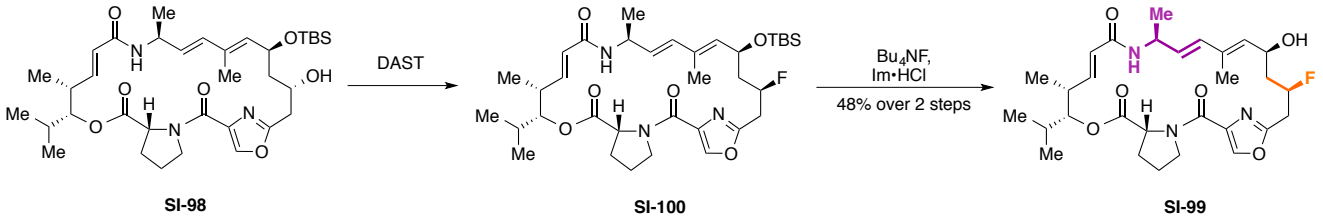
TLC (EtOAc:hexanes = 1:1): R_f = 0.10 (UV, *p*-anisaldehyde).

^{1}H NMR (400 MHz, $CDCl_3$) δ 8.11 (s, 1H), 6.39 (dd, *J* = 16.4, 4.3 Hz, 1H), 6.15 (d, *J* = 16.2 Hz, 1H), 5.81 (dd, *J* = 16.1, 4.6 Hz, 1H), 5.79 – 5.63 (m, 3H), 5.02 – 4.94 (m, 1H), 4.86 – 4.72 (m, 1H), 4.72 – 4.64 (m, 2H), 4.51 (s, 1H), 4.45 (t, *J* = 10.0 Hz, 1H), 3.85 – 3.71 (m, 2H), 3.05 (dd, *J* = 16.8, 2.5 Hz, 1H), 2.80 (dd, *J* = 16.8, 10.3 Hz, 1H), 2.76 – 2.67 (m, 1H), 2.31 (d, *J* = 14.3 Hz, 1H), 2.16 – 2.02 (m, 1H), 1.99 – 1.72 (m, 5H), 1.70 (d, *J* = 1.2 Hz, 3H), 1.34 (d, *J* = 6.9 Hz, 3H), 1.05 (d, *J* = 6.9 Hz, 3H), 1.00 (d, *J* = 6.5 Hz, 3H), 0.93 (d, *J* = 6.7 Hz, 3H), 0.89 (s, 9H), 0.08 (s, 3H), 0.04 (s, 3H).

^{13}C NMR (100 MHz, $CDCl_3$) δ 172.2, 166.4, 161.1, 160.3, 144.2, 143.3, 136.6, 133.6, 132.4, 131.9, 129.5, 123.8, 81.4, 69.9, 66.6, 59.2, 48.1, 43.8, 42.4, 36.7, 35.1, 29.3, 28.1, 25.7, 25.5, 19.9, 18.6, 17.9, 17.2, 12.5, 9.4, –4.5, –5.3.

HRMS-ESI m/z calcd for $C_{35}H_{56}N_3O_7Si^+$ $[M + H]^+$ 658.3882, found 658.3890.

Analogue SI-99



SI-98 **SI-100** **SI-99**

A 50-mL round-bottom flask containing mono-TBS ether **SI-98** (42 mg, 64 µmol, 1 equiv) was evacuated and flushed with nitrogen (this process was repeated a total of 3 times). DCM (5 mL) was added, and the resulting colorless solution was cooled to 0 ºC by means of an ice/water bath. DAST (21 µL, 0.16 mmol, 2.50 equiv) was added, and then the mixture was allowed to warm to 23 ºC. After 3 h, saturated aqueous $NaHCO_3$ solution (10 mL) was added, followd by DCM (20 mL), and the resulting biphasic mixture was transferred to a separatory funnel. The layers were separated, and the organic layer was washed with water (50 mL) and brine (50 mL). The washed solution was dried (Na_2SO_4), and the dried solution was concentrated. The resulting crude residue was purified by flash chromatography (silica gel, eluent: acetone:hexanes = 1:5) to afford fluorinated compound **SI-100** (40 mg, 95% yield) as a white solid.

TLC (acetone:hexanes = 1:2.5): R_f = 0.30 (UV, *p*-anisaldehyde).

^{1}H NMR (400 MHz, $CDCl_3$) δ 8.09 (s, 1H), 6.50 (dd, *J* = 16.3, 4.3 Hz, 1H), 6.14 (d, *J* = 16.1 Hz, 1H), 5.93 – 5.68 (m, 3H), 5.34 (d, *J* = 9.0 Hz, 1H), 5.06 (dm, $^1J_{HF}$ = 48.8 Hz, 1H), 4.91 – 4.78 (m, 3H), 4.73 (td, *J* = 9.6, 3.8 Hz, 1H), 4.10 (ddd, *J* = 12.3, 8.1, 4.9 Hz, 1H), 3.83 (dt, *J* = 11.2, 6.9 Hz, 1H), 3.16 (td, *J* = 16.8, 6.5 Hz, 1H), 2.91 (ddd, *J* = 21.5, 16.4, 5.6 Hz, 1H), 2.81 – 2.66 (m, 1H), 2.20 – 2.03 (m, 2H), 1.92 (ddq, *J* = 12.0, 7.7, 4.9, 3.4 Hz, 4H), 1.78 (s, 4H), 1.71 – 1.51 (m, 1H), 1.31 (d, *J* = 6.8 Hz, 3H), 1.10 (d, *J* = 6.9 Hz, 3H), 0.98 (d, *J* = 6.5 Hz, 3H), 0.94 (d, *J* = 6.7 Hz, 3H), 0.88 (s, 9H), 0.06 (s, 3H), 0.02 (s, 3H).

^{13}C NMR (100 MHz, $CDCl_3$) δ 171.6, 165.6, 160.0 (d, $^3J_{CF}$ = 7.8 Hz), 144.7, 143.2, 136.8, 134.3, 133.7, 132.6, 129.6, 124.0, 89.1 (d, $^1J_{CF}$ = 169.0 Hz), 66.5, 59.0, 48.6, 44.6, 43.5 (d, $^2J_{CF}$ = 20.5 Hz), 36.4, 33.8 (d, $^2J_{CF}$ = 25.3 Hz), 29.4, 28.2, 25.8, 24.8, 19.8, 19.2, 18.6, 18.1, 13.1, 10.7, –4.4, –4.9.

A 100-mL round-bottom flask containing **SI-100** (20 mg, 30 µmol, 1 equiv) was evacuated and flushed with nitrogen (this process was repeated a total of 3 times). THF (3 mL) was added, resulting in a light-yellow solution. In a separate flask, Im•HCl (32 mg, 0.30 mmol, 10.0 equiv,) that had previously been dried at >100 ºC for 10 minutes under vacuum was added to a solution of tetrabutylammonium fluoride in THF (1 M, 0.30 mL, 0.30 mmol, 10.0 equiv). The resulting colorless solution was added dropwise to the above solution. After 12 h, the mixture was concentrated, and the residue was dissolved in DCM (50 mL). The resulting solution was transferred to a separatory funnel and was washed with

water (5 × 50 mL) and brine (50 mL). The washed solution was dried (Na_2SO_4). The dried solution was filtered, and the filtrate was concentrated. The resulting crude residue was purified by preparative TLC (eluent: MeOH:DCM = 1:25) to afford analogue **SI-99** (16 mg, 97% yield) as a light-yellow solid.

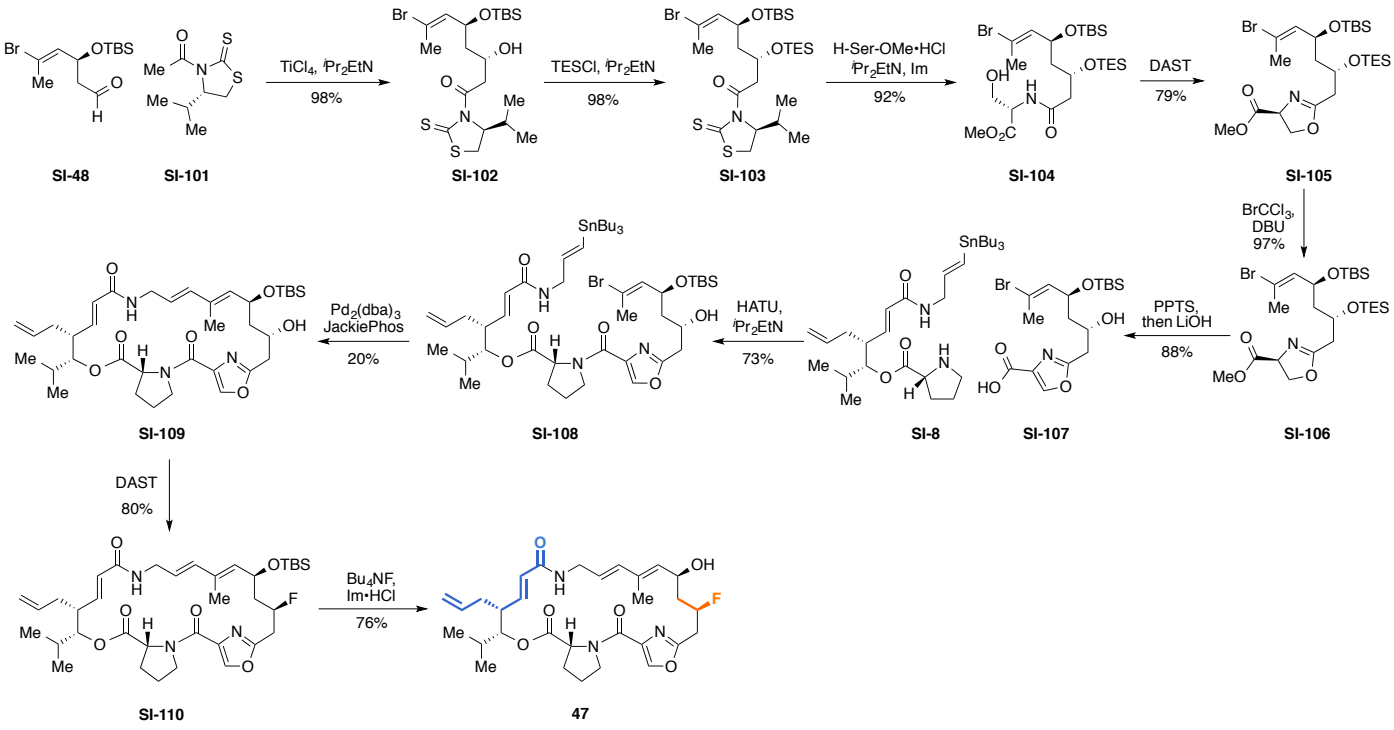
TLC (MeOH:DCM = 1:30): R_f = 0.20 (UV, *p*-anisaldehyde).

^{1}H NMR (400 MHz, $CDCl_3$) δ 8.10 (s, 1H), 6.51 (dd, *J* = 16.3, 4.5 Hz, 1H), 6.15 (d, *J* = 16.1 Hz, 1H), 5.92 – 5.72 (m, 3H), 5.38 (d, *J* = 8.9 Hz, 1H), 5.06 (dm, $^2J_{HF}$ = 48.0 Hz, 1H), 4.89 – 4.69 (m, 4H), 4.08 (ddd, *J* = 12.5, 8.4, 4.7 Hz, 1H), 3.81 (dt, *J* = 11.4, 7.1 Hz, 1H), 3.21 (td, *J* = 16.7, 5.4 Hz, 1H), 2.99 (td, *J* = 15.9, 7.0 Hz, 1H), 2.81 – 2.67 (m, 1H), 2.25 – 2.05 (m, 2H), 2.05 – 1.75 (m, 4H), 1.83 (s, 3H), 1.75 – 1.53 (m, 1H), 1.29 (d, *J* = 6.8 Hz, 3H), 1.10 (d, *J* = 6.9 Hz, 3H), 0.98 (d, *J* = 6.5 Hz, 3H), 0.94 (d, *J* = 6.8 Hz, 3H).

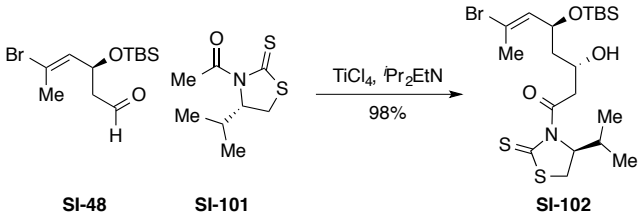
^{13}C NMR (100 MHz, $CDCl_3$) δ 171.7, 165.6, 160.4, 159.7 (d, $^3J_{CF}$ = 10.7 Hz), 144.7, 143.2, 136.8, 136.4, 132.7, 132.0, 130.8, 124.1, 89.1 (d, $^1J_{CF}$ = 169.8 Hz), 81.0, 65.7, 59.1, 48.6, 44.6, 42.3 (d, $^2J_{CF}$ = 20.3 Hz), 36.4, 33.7 (d, $^2J_{CF}$ = 25.7 Hz), 29.4, 28.3, 24.8, 19.9, 19.8, 18.6, 13.2, 10.7.

HRMS-ESI m/z calcd for $C_{29}H_{41}FN_3O_6^+$ $[M + H]^+$ 546.2974, found 546.2964.

Scheme XX Synthesis of 47



***β*-hydroxyl amide SI-102**



A 500-mL round-bottom flask containing **SI-101** (4.37 g, 21.5 mmol, 1.2 equiv) was evacuated and flushed with nitrogen (this process was repeated a total of 3 times). DCM (110 mL) was added, resulting in a yellow solution, and the vessel and its contents were cooled to -78 ºC by means of a dry ice/acetone bath. A solution of $TiCl_4$ in DCM (1 M, 23.3

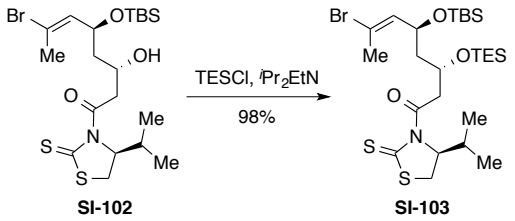
mL, 23.3 mmol, 1.3 equiv) was added dropwise over 5 min, resulting in a deep yellow solution. After 5 min, $^{i}Pr_2EtN$ (4.06 mL, 23.3 mmol, 1.3 equiv) was added over 30 min by means of syringe pump, and the resulting deep red solution was stirred for 2 h at -78 ºC. A solution of aldehyde **SI-48** (5.50 g, 17.9 mmol, 1 equiv) in DCM (18 mL) was added over 30 min by means of syringe pump. After 30 min, **SI-48** was entirely comsumed as indicated by TLC analysis (eluent: EtOAc:hexanes = 1:4), and then water (150 mL) was added. The vessel was removed from the cooling bath, and the system was allowed to warm to 23 ºC while the mixture was rapidly stirred. The biphasic mixture was transferred to a separatory funnel, and the layers were separated. The aqueous layer was extracted with DCM (2 × 50 mL). The combined organic layers were washed with water (2 × 100 mL) and brine (100 mL), and the washed solution was dried (Na_2SO_4). The dried solution was filtered, and the filtrate was concentrated. The resulting crude residue was purified by flash chromatography (silica gel, eluent: EtOAc: hexanes = 1:10 to 1:2.5) to afford *β*-hydroxyl amide **SI-102** (9.0 g, 98% yield) as a yellow oil.

TLC (EtOAc:hexanes = 1:3): R_f = 0.25 (UV).

^{1}H NMR (400 MHz, $CDCl_3$) δ 5.92 (dq, *J* = 8.8, 1.3 Hz, 1H), 5.21 – 5.10 (m, 1H), 4.67 – 4.57 (m, 1H), 4.38 (dddd, *J* = 10.7, 5.4, 4.2, 2.8 Hz, 1H), 3.56 – 3.47 (m, 2H), 3.23 (dd, *J* = 17.7, 9.1 Hz, 1H), 3.03 (dd, *J* = 11.5, 1.1 Hz, 1H), 2.37 (dq, *J* = 13.5, 6.8 Hz, 1H), 2.26 (d, *J* = 1.3 Hz, 3H), 1.70 – 1.56 (m, 2H), 1.06 (d, *J* = 6.8 Hz, 3H), 0.98 (d, *J* = 6.9 Hz, 3H), 0.88 (s, 9H), 0.09 (s, 3H), 0.06 (s, 3H).

^{13}C NMR (100 MHz, $CDCl_3$) δ 202.9, 172.6, 135.6, 120.2, 71.4, 67.6, 64.5, 45.9, 43.5, 30.9, 30.6, 25.8, 23.9, 19.1, 18.07, 17.8, –4.5, –5.1.

TES ether SI-103



SI-102 **SI-103**

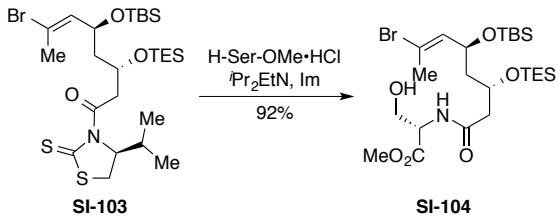
A 250-mL round-bottom flask containing *β*-hydroxyl amide **SI-102** (7.00 g, 13.7 mmol, 1 equiv) was evacuated and flushed with nitrogen (this process was repeated a total of 3 times). DCM (140 mL) was added, followed by $^{i}Pr_2EtN$ (7.20 mL, 41.1 mmol, 3.0 equiv), resulting in a colorless solution. The vessel and its contents were cooled to 0 ºC by means of an ice/water bath. TESCl (3.50 mL, 20.6 mmol, 1.5 equiv) was added dropwise over 10 min, and the mixture was allowed to warm to 23 ºC. After 3 h, the mixture was transferred to a separatory funnel and was washed with water (2 × 100 mL) and brine (100 mL). The washed solution was dried (Na_2SO_4), and the dried solution was filtrated. The filtrate was concentrated, and the resulting crude residue was purified by flash chromatography (silica gel, eluent: EtOAc:hexanes = 1:50) to afford TES ether **SI-103** (8.45 g, 98% yield) as a light-yellow oil.

TLC (EtOAc:hexanes = 1:10): R_f = 0.20 (UV).

^{1}H NMR (400 MHz, $CDCl_3$) δ 5.83 (d, *J* = 9.2 Hz, 1H), 5.07 (t, *J* = 7.0 Hz, 1H), 4.52 – 4.32 (m, 2H), 3.59 (dd, *J* = 17.2, 7.3 Hz, 1H), 3.46 (dd, *J* = 11.4, 7.8 Hz, 1H), 3.29 (dd, *J* = 17.2, 4.6 Hz, 1H), 3.02 (d, *J* = 11.5 Hz, 1H), 2.37 (dq, *J* = 13.5, 6.8 Hz, 1H), 2.25 (s, 3H), 1.81 (ddd, *J* = 13.7, 7.9, 5.8 Hz, 1H), 1.62 (dt, *J* = 13.9, 5.4 Hz, 1H), 1.06 (d, *J* = 6.8 Hz, 3H), 0.94 (t, *J* = 8.1 Hz, 9H), 0.87 (s, 9H), 0.60 (q, *J* = 7.8 Hz, 6H), 0.05 (s, 3H), 0.05 (s, 3H).

^{13}C NMR (100 MHz, $CDCl_3$) δ 202.6, 171.3, 136.1, 120.7, 71.5, 67.5, 66.2, 46.5, 46.2, 30.8, 30.8, 25.9, 23.86, 19.1, 18.1, 17.9, 7.0, 5.2, –4.0, –4.7.

Amide SI-104



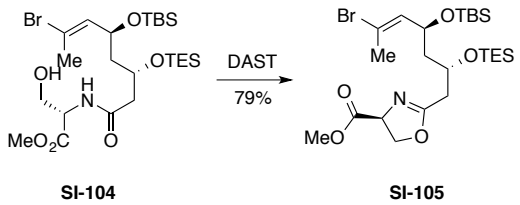
A 500-mL round-bottom flask containing H-Ser-OMe•HCl (3.36 g, 21.6 mmol, 1.5 equiv) was evacuated and flushed with nitrogen (this process was repeated a total of 3 times). THF (110 mL) was added, followed by $^{i}Pr_2EtN$ (5.01 mL, 28.8 mmol, 2.0 equiv). After 30 min, the resulting colorless solution was cooled to 0 ºC by means of an ice/water bath. A solution of **SI-103** (9.00 g, 14.4 mmol, 1 equiv) in THF (15 mL) was added, followed by Imidazole (2.94 g, 43.2 mmol, 3.0 equiv), and the vessel and its contents were allowed to warm to 23 ºC. After 12 h, the mixture was concentrated, and the residue was dissolved with DCM (150 mL) and water (150 mL). The resulting biphasic mixture was transferred to a separatory funnel, and the layers were separated. The aqueous layer was extract with DCM (50 mL), and the combined layers were washed with water (100 mL) and brine (100 mL). The washed solution was dried (Na_2SO_4), and the dried solution was filtered. The filtrate was concentrated, and the resulting crude residue was purified by flash chromatography (silica gel, eluent: EtOAc:hexanes = 1:10 to 1:1) to afford amide **SI-104** (7.75 g, 92% yield) as a colorless oil.

TLC (EtOAc:hexanes = 1:5): R_f = 0.20 (UV).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.11 (d, *J* = 7.4 Hz, 1H), 5.79 (dt, *J* = 9.0, 1.4 Hz, 1H), 4.62 (dt, *J* = 7.5, 3.8 Hz, 1H), 4.36 (ddd, *J* = 9.4, 7.5, 5.4 Hz, 1H), 4.17 – 4.07 (m, 1H), 3.96 – 3.82 (m, 2H), 3.74 (s, 3H), 3.01 (br s, 1H), 2.51 (dd, *J* = 14.7, 4.8 Hz, 1H), 2.32 (dd, *J* = 14.7, 5.0 Hz, 1H), 2.24 (s, 3H), 1.79 (ddd, *J* = 13.7, 7.5, 6.0 Hz, 1H), 1.64 (dt, *J* = 13.9, 5.7 Hz, 1H), 0.93 (t, *J* = 7.9 Hz, 9H), 0.84 (s, 9H), 0.61 (q, *J* = 8.1 Hz, 6H), 0.02 (s, 3H), 0.01 (s, 3H).

^{13}C NMR (100 MHz, $CDCl_3$) δ 170.9, 170.7, 135.6, 121.1, 67.3, 66.3, 63.3, 54.7, 52.5, 45.2, 44.3, 25.7, 23.8, 18.0, 6.7, 4.8, –4.0, –4.7.

Oxazoline 105



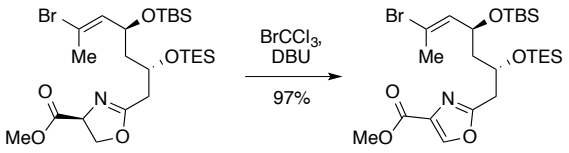
A 250-mL round-bottom flask containing amide **SI-104** (7.60 g, 13.0 mmol, 1 equiv) was evacuated and flushed with nitrogen (this process was repeated a total of 3 times). DCM (130 mL) was added, and the resulting colorless solution was cooled to -78 ºC by means of a dry ice/acetone bath. DAST (2.15 mL, 16.3mmol, 1.25 equiv) was added dropwise at -78 ºC under nitrogen. After 3 h, saturated aqueous $NaHCO_3$ solution (50 mL) was added, and the system was allowed to warm to 23 ºC while the mixture was rapidly stirred. The resulting biphasic solution was transferred to a separatory funnel. The organic layer was washed with water (100 mL) and brine (100 mL), and the washed solution was dried (Na_2SO_4). The dried solution was concentrated, and the resulting crude residue was purified by flash chromatography (silica gel, eluent: EtOAc:hexanes = 1:8) to afford oxazoline **SI-105** (5.78 g, 79% yield) as a colorless oil.

TLC (EtOAc:hexanes = 1:5): R_f = 0.20 (UV).

^{1}H NMR (400 MHz, $CDCl_3$) δ 5.82 (dq, *J* = 9.3, 1.4 Hz, 1H), 4.71 (dd, *J* = 10.6, 8.0 Hz, 1H), 4.48 – 4.34 (m, 3H), 4.18 (tdd, *J* = 7.0, 5.9, 4.1 Hz, 1H), 3.78 (s, 3H), 2.52 (ddd, *J* = 8.1, 6.5, 1.0 Hz, 1H), 2.25 (d, *J* = 1.4 Hz, 3H), 1.76 (ddd, *J* = 14.0, 8.5, 4.0 Hz, 1H), 1.60 – 1.53 (m, 1H), 0.95 (t, *J* = 7.9 Hz, 9H), 0.86 (s, 9H), 0.59 (q, *J* = 8.0 Hz, 6H), 0.03 (s, 3H), 0.03 (s, 3H).

^{13}C NMR (100 MHz, $CDCl_3$) δ 171.5, 167.9, 136.0, 120.8, 69.2, 68.1, 67.1, 66.5, 52.6, 46.1, 37.2, 25.8, 23.8, 18.0, 6.8, 5.1, –3.8, –4.7.

Oxazole SI-106



SI-105 **SI-106**

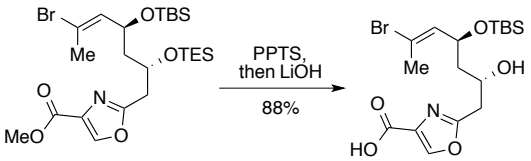
A 250-mL round-bottom flask containing oxazoline **SI-105** (5.78 g, 10.2 mmol, 1 equiv) was evacuated and flushed with nitrogen (this process was repeated a total of 3 times). DCM (130 mL) and $BrCCl_3$ (5.04 mL, 51.2 mmol, 5.0 equiv) were added, and the resulting colorless solution was cooled to 0 ºC by means of an ice/water bath. DBU (7.71 mL, 51.2 mmol, 5.0 equiv) was added dropwise at 0 ºC. After 24 h, saturated aqueous ammonium chloride solution (100 mL) was added, and the biphasic mixture was transferred to a separatory funnel. The layers were separated, and the aqueous layer was extracted with DCM (50 mL). The combined organic layers were washed with water (2 × 100 mL) and brine (100 mL). The washed solution was dried (Na_2SO_4), and the dried solution was concentrated. The residue was purified by flash chromatography (silica gel, eluent: EtOAc:hexanes = 1:10) to afford oxazole **SI-106** (5.57 g, 97% yield) as a colorless oil.

TLC (EtOAc:hexanes = 1:5): R_f = 0.20 (UV).

^{1}H NMR (400 MHz, Chloroform-*d*) δ 8.16 (s, 1H), 5.81 (dt, *J* = 9.3, 1.5 Hz, 1H), 4.44 (td, *J* = 8.9, 4.0 Hz, 1H), 4.29 (qd, *J* = 6.5, 4.1 Hz, 1H), 3.91 (d, *J* = 0.7 Hz, 3H), 2.99 (d, *J* = 6.3 Hz, 2H), 2.26 (d, *J* = 1.3 Hz, 3H), 1.78 – 1.66 (m, 1H), 1.63 – 1.53 (m, 1H), 0.93 (t, *J* = 8.0 Hz, 9H), 0.85 (s, 9H), 0.57 (q, *J* = 8.0 Hz, 6H), 0.04 (s, 3H), 0.02 (s, 3H).

^{13}C NMR (100 MHz, $CDCl_3$) δ 163.1, 161.7, 143.9, 135.9, 133.3, 120.9, 67.3, 67.1, 52.1, 46.0, 37.2, 25.8, 23.8, 18.0, 6.8, 5.0, –3.7, –4.7.

Acid SI-107

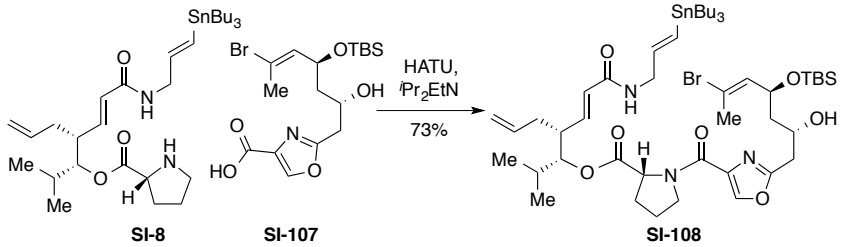


SI-106 **SI-107**

To a solution of oxazole **SI-106** (5.57 g, 9.90 mmol, 1 equiv) in MeOH (100 mL) was added PPTS (0.25 g, 0.99 mmol, 0.1 equiv). After 1 h, **SI-106** was entirely consumed as indicated by TLC analysis (EtOAc:hexanes = 1:3), and then a solution of LiOH in water (1 M, 29.7 mL, 29.7 mmol, 3.0 equiv) was added. After 12 h, the mixture was concentrated, and then water (200 mL) and EtOAc (200 mL) were added, followed by aqueous 1.0 N HCl solution (40 mL) to adjust the pH to 3. The resulting biphasic mixture was transferred to a separatory funnel, and the layers were separated. The

organic layer was washed with water (100 mL) and brine (100 mL), and the washed solution was dried (Na_2SO_4). The dried solution was filtered, and the filtrate was concentrated. The resulting crude residue (3.80 g, 88% yield) was used for next step without further purification.

Stille coupling precursor SI-108



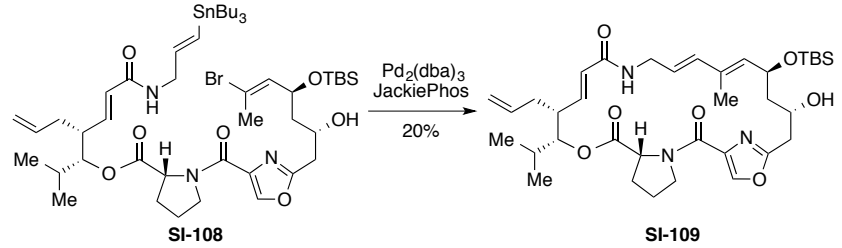
A 50-mL round-bottom flask was charged with acid **SI-107** (0.40 g, 0.92 mmol 1 equiv), $^{i}Pr_2EtN$ (0.32 mL, 1.84 mmol, 2.0 equiv) and amine **SI-8** (0.57 g, 0.92 mmol, 1 equiv). DCM (10 mL) was added, resulting in a clear, colorless solution, and HATU (0.44 g, 1.15 mmol, 1.25 equiv) was added in one portion. After 5 h, the mixture was diluted with DCM (30 mL), and the solution was transferred to a separatory funnel and was washed with water (2 × 50 mL) and brine (50 mL). The washed solution was dried (Na_2SO_4), and the dried solution was filtered. The filtrate was concentrated, and the resulting crude residue was purified by flash chromatography (silica gel, eluent: EtOAc:hexanes = 1:6 to 1:4) to afford Stille coupling precursor **SI-108** (0.70 g, 73% yield) as a light-yellow foam.

TLC (EtOAc:hexanes = 1:4): R_f = 0.3 (UV)

^{1}H NMR (400 MHz, $CDCl_3$) δ 8.14 (s, 1H), 6.49 (dt, *J* = 15.3, 9.6 Hz, 1H), 6.18 – 6.05 (m, 1H), 6.07 – 5.95 (m, 1H), 5.91 (dq, *J* = 8.7, 1.3 Hz, 1H), 5.84 – 5.41 (m, 3H), 4.97 – 4.82 (m, 3H), 4.66 (dp, *J* = 8.4, 4.3 Hz, 2H), 4.43 – 4.19 (m, 1H), 4.09 (tt, *J* = 6.8, 3.1 Hz, 1H), 3.96 (dtt, *J* = 7.1, 5.5, 2.7 Hz, 2H), 3.83 – 3.61 (m, 2H), 2.97 – 2.79 (m, 2H), 2.52 (tdd, *J* = 9.8, 6.7, 3.7 Hz, 1H), 2.33 – 2.19 (m, 4H), 2.15 – 1.84 (m, 6H), 1.66 (dq, *J* = 8.5, 4.6, 3.7 Hz, 2H), 1.53 – 1.38 (m, 6H), 1.33 – 1.15 (m, 6H), 0.99 – 0.77 (m, 30H), 0.15 – –0.04 (m, 6H).

^{13}C NMR (100 MHz, $CDCl_3$) δ 172.7, 171.7, 165.3, 164.7, 162.12, 162.11, 160.3, 160.1, 143.58, 143.55, 143.50, 143.3, 142.7, 142.4, 136.73, 136.67, 135.54, 135.29, 135.25, 130.4, 130.2, 125.9, 125.6, 120.4, 120.3, 116.9, 116.8, 80.0, 79.9, 67.7, 65.6, 65.2, 60.9, 60.3, 48.8, 47.3, 50.0, 44.9, 44.7, 43.95, 43.90, 43.5, 36.1, 35.8, 33.98, 33.93, 33.7, 30.0, 29.0, 28.8, 27.2, 25.8, 25.7, 23.87, 23.84, 19.9, 19.6, 18.0, 16.8, 16.6, 13.7, 9.42, 9.40, –4.46, –4.50, –5.0, –5.2.

Stille coupling product SI-109



A 500-mL round-bottom flask containing JackiePhos (92 mg, 0.12 mmol, 0.2 equiv), $Pd_2(dba)_3$ (53 mg, 53 μmol, 0.1 equiv) and Stille coupling precursor **SI-108** (0.60 g, 0.58 mmol, 1 equiv) was evacuated and flushed with nitrogen (this process was repeated a total of 3 times). Toluene (115 ml) was added, resulting in a red suspension. A stream of argon was passed through the solution by a stainless steel needle for 30 min. The mixture was heated by means of a 50° C oil bath. After 60 h, **SI-108** was entirely consumed as indicated by TLC analysis (eluent: EtOAc:hexanes = 1:1), and the mixture was allowed to cool to 23 °C. The mixture was concentrated, and the resulting crude residue was

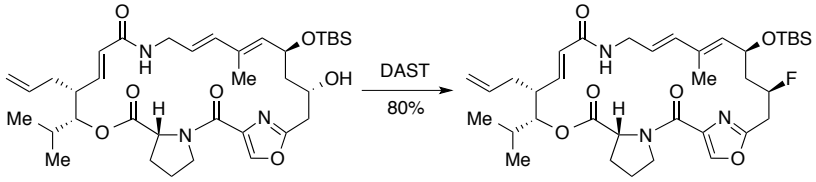
purified by flash chromatography (silica gel, eluent: EtOAc:hexanes =1:3 to 1:1) to afford Stille coupling product **SI-109** (76 mg, 20% yield) as a light-yellow solid.

TLC (EtOAc:hexanes = 1:1): R_f = 0.15 (UV)

^{1}H NMR (400 MHz, $CDCl_3$) δ 8.10 (s, 1H), 6.28 (dd, *J* = 16.3, 5.3 Hz, 1H), 6.18 (d, *J* = 15.5 Hz, 1H), 5.96 (d, *J* = 8.6 Hz, 1H), 5.84 (d, *J* = 16.3 Hz, 1H), 5.81 – 5.63 (m, 3H), 5.14 – 5.01 (m, 2H), 4.96 (ddt, *J* = 9.2, 4.5, 2.0 Hz, 1H), 4.72 (tt, *J* = 7.4, 2.2 Hz, 2H), 4.57 – 4.36 (m, 3H), 3.79 (t, *J* = 6.0 Hz, 2H), 3.29 (ddd, *J* = 13.9, 10.3, 3.3 Hz, 1H), 3.04 (d, *J* = 16.8 Hz, 1H), 2.79 (dd, *J* = 16.7, 10.4 Hz, 1H), 2.69 – 2.58 (m, 1H), 2.45 – 2.33 (m, 1H), 2.29 (d, *J* = 13.8 Hz, 1H), 2.21 – 2.08 (m, 2H), 2.08 – 1.73 (m, 4H), 1.70 (s, 3H), 0.99 (d, *J* = 6.3 Hz, 3H), 0.94 (d, *J* = 6.6 Hz, 3H), 0.88 (s, 9H), 0.08 (s, 3H), 0.03 (s, 3H).

^{13}C NMR (100 MHz, $CDCl_3$) δ 172.0, 166.8, 161.1, 160.3, 143.2, 142.0, 137.4, 136.6, 135.7, 134.0, 131.6, 125.2, 124.8, 116.9, 81.9, 69.8, 66.6, 59.2, 48.1, 42.8, 41.9, 41.6, 35.1, 29.6, 29.3, 28.1, 25.7, 25.6, 19.9, 18.6, 17.9, 12.4, –4.5, –5.3.

Fluorinated product SI-110



SI-109 **SI-110**

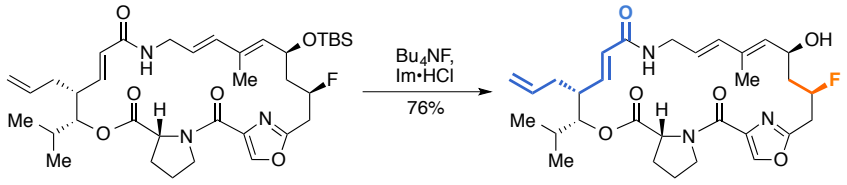
A 50-mL round-bottom flask containing Stille product **SI-109** (70 mg, 0.10 mmol, 1 equiv) was evacuated and flushed with nitrogen (this process was repeated a total of 3 times). DCM (5 mL) was added, and the resulting colorless solution was cooled to -78 ºC by means of a dry ice/acetone bath. DAST (34 μL, 0.26 mmol, 2.50 equiv) was added dropwise, and the vessel and its contents were warmed to 0 ºC by means of an ice/water bath. After 3 h, saturated aqueous $NaHCO_3$ solution (30 mL) and DCM (30 mL) were added. After stirring for 30 min, the biphasic mixture was transferred to a separatory funnel, the layers were separated. The organic layer was washed with water (50 mL) and brine (50 mL), and the washed solution was dried (Na_2SO_4). The dried solution was concentrated, and the residue was purified by flash chromatography (silica gel, eluent: EtOAc:hexanes = 1:2) to afford fluorinated product **SI-110** (56 mg, 80% yield) as a white solid.

TLC (EtOAc:hexanes = 1:1): R_f = 0.30 (UV, *p*-anisaldehyde).

^{1}H NMR (400 MHz, $CDCl_3$) δ 8.07 (s, 1H), 6.50 (dd, *J* = 16.3, 5.2 Hz, 1H), 6.17 (d, *J* = 15.5 Hz, 1H), 6.02 (d, *J* = 8.5 Hz, 1H), 5.89 (d, *J* = 16.2 Hz, 1H), 5.80 – 5.70 (m, 1H), 5.72 – 5.58 (m, 1H), 5.36 – 5.19 (m, 1H), 5.18 – 5.02 (m, 2H), 5.02 – 4.76 (m, 2H), 4.72 (td, *J* = 10.1, 3.8 Hz, 1H), 4.63 – 4.41 (m, 1H), 4.15 – 4.00 (m, 1H), 3.94 – 3.78 (m, 1H), 3.65 (s, 2H), 3.54 – 3.34 (m, 1H), 3.15 (td, *J* = 16.9, 7.0 Hz, 1H), 3.02 – 2.82 (m, 1H), 2.73 – 2.59 (m, 1H), 2.50 – 2.35 (m, 1H), 2.28 – 2.11 (m, 3H), 2.09 – 1.93 (m, 3H), 1.77 (s, 3H), 1.71 – 1.53 (m, 1H), 0.97 (d, *J* = 7.1 Hz, 3H), 0.95 (d, *J* = 7.4 Hz, 3H), 0.87 (s, 9H), 0.05 (s, 3H), 0.01 (s, 3H).

^{13}C NMR (100 MHz, $CDCl_3$) δ 171.4, 166.0, 160.6, 160.1 (d, $^3J_{CF}$ = 7.2 Hz), 143.2, 142.8, 136.7, 136.5, 135.8, 134.7, 133.4, 125.0, 124.5, 117.1, 89.1 (d, $^1J_{CF}$ = 169.5 Hz), 81.4, 66.5, 59.0, 48.6, 43.6 (d, $^2J_{CF}$ = 20.5 Hz), 41.5, 41.2, 33.9 (d, $^2J_{CF}$ = 205.2 Hz), 30.6, 29.4, 28.2, 25.8, 24.9, 19.8, 18.7, 18.1, 12.9, –4.4, –4.9.

Analogue 47



SI-110 **47**

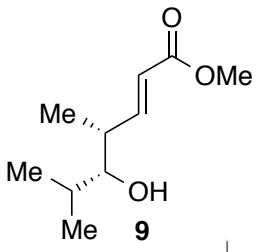
A 50-mL round-bottom flask containing **SI-110** (35 mg, 52 µmol, 1 equiv) was evacuated and flushed with nitrogen (this process was repeated a total of 3 times). THF (5.2 mL) was added, resulting in a light-yellow solution. In a separate flask, Im•HCl (82 mg, 0.78 mmol, 15.0 equiv,) that had previously been dried at >100 ºC for 10 minutes under vacuum was added to a solution of tetrabutylammonium fluoride in THF (1 M, 0.78 mL, 0.78 mmol, 15.0 equiv). The resulting colorless solution was added dropwise to the above solution of **SI-110**. After 12 h, the mixture was concentrated, and the residue was dissolved in DCM (50 mL). The resulting solution was transferred to a separatory funnel and was washed with water (5 × 50 mL) and brine (50 mL). The washed solution was dried (Na_2SO_4), and the dried solution was filtered. The filtrate was concentrated, and the resulting crude residue was purified by preparative TLC (eluent: MeOH:DCM = 1:25) to afford analogue **47** (22 mg, 76 % yield) as a white solid.

TLC (MeOH:DCM = 1:25): R_f = 0.10 (UV, *p*-anisaldehyde).

^{1}H NMR (400 MHz, $CDCl_3$) δ 8.07 (s, 1H), 6.50 (dd, *J* = 16.2, 5.4 Hz, 1H), 6.16 (d, *J* = 15.7 Hz, 1H), 6.10 (d, *J* = 6.0 Hz, 1H), 5.88 (dd, *J* = 16.2, 1.7 Hz, 1H), 5.85 – 5.65 (m, 2H), 5.32 (d, *J* = 9.0 Hz, 1H), 5.16 – 4.93 (m, 3H), 4.91 – 4.71 (m, 3H), 4.50 (ddd, *J* = 14.5, 8.7, 4.3 Hz, 1H), 4.04 (ddd, *J* = 11.9, 8.0, 4.8 Hz, 1H), 3.84 (dt, *J* = 11.4, 7.2 Hz, 1H), 3.46 (ddd, *J* = 15.9, 8.1, 3.2 Hz, 1H), 3.19 (td, *J* = 16.9, 5.8 Hz, 1H), 2.96 (td, *J* = 17.1, 6.4 Hz, 1H), 2.72 – 2.60 (m, 1H), 2.47 – 2.35 (m, 1H), 2.25 – 2.10 (m, 3H), 2.10 – 1.87 (m, 5H), 1.80 (s, 3H), 1.73 – 1.52 (m, 1H), 0.96 (d, *J* = 6.5 Hz, 3H), 0.94 (d, *J* = 6.8 Hz, 3H).

^{13}C NMR (100 MHz, $CDCl_3$) δ 171.4, 165.9, 160.5, 159.8 (d, $^3J_{CF}$ = 9.4 Hz), 143.3, 143.0, 136.7, 135.8, 135.73, 135.69, 133.1, 125.4, 125.0, 117.1, 89.1 (d, $^1J_{CF}$ = 169.9 Hz), 81.6, 65.7 (d, $^3J_{CF}$ = 2.4 Hz), 59.1, 48.6, 42.3 (d, $^2J_{CF}$ = 20.5 Hz), 41.5, 40.8, 33.7 (d, $^2J_{CF}$ = 25.5 Hz), 30.6, 29.4, 28.2, 24.9, 19.8, 18.7, 13.0.

HRMS-ESI m/z calcd for $C_{30}H_{40}FN_3NaO_6^+$ $[M + Na]^+$ 580.2793, found 580.2794.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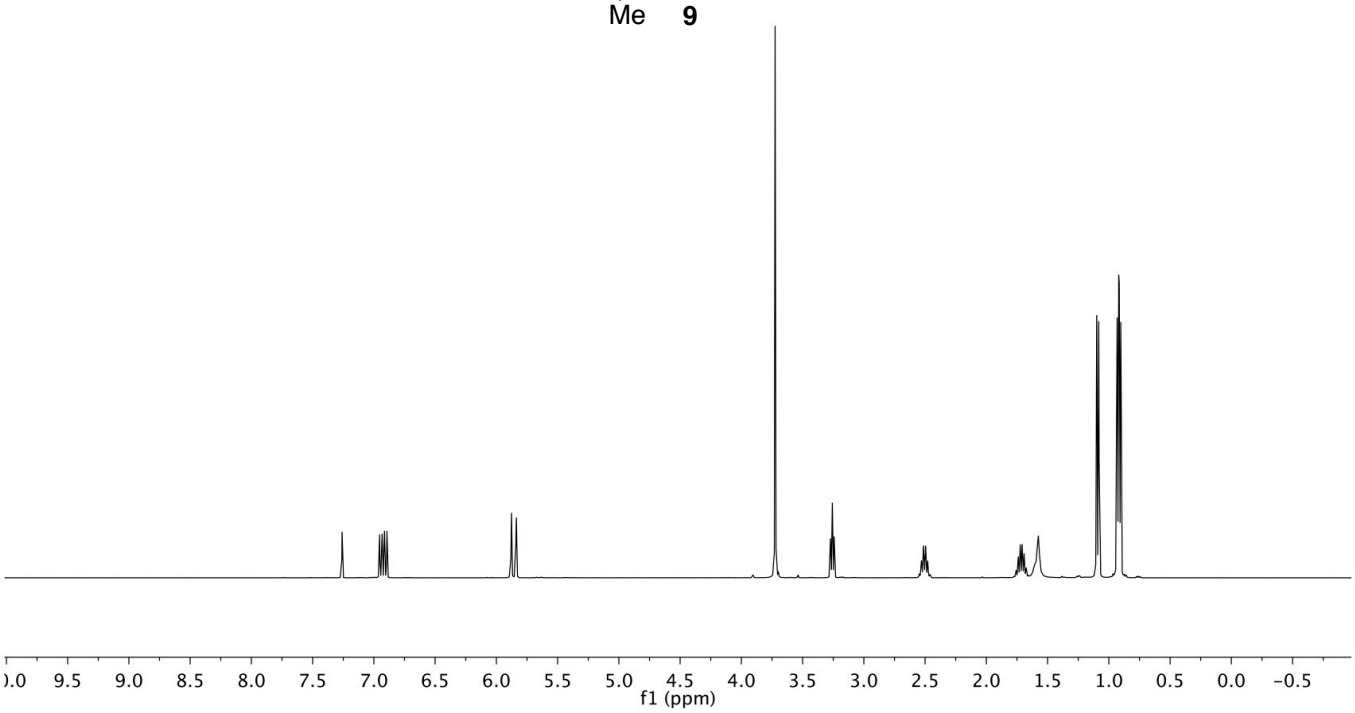
Me
Me
OH
Me

9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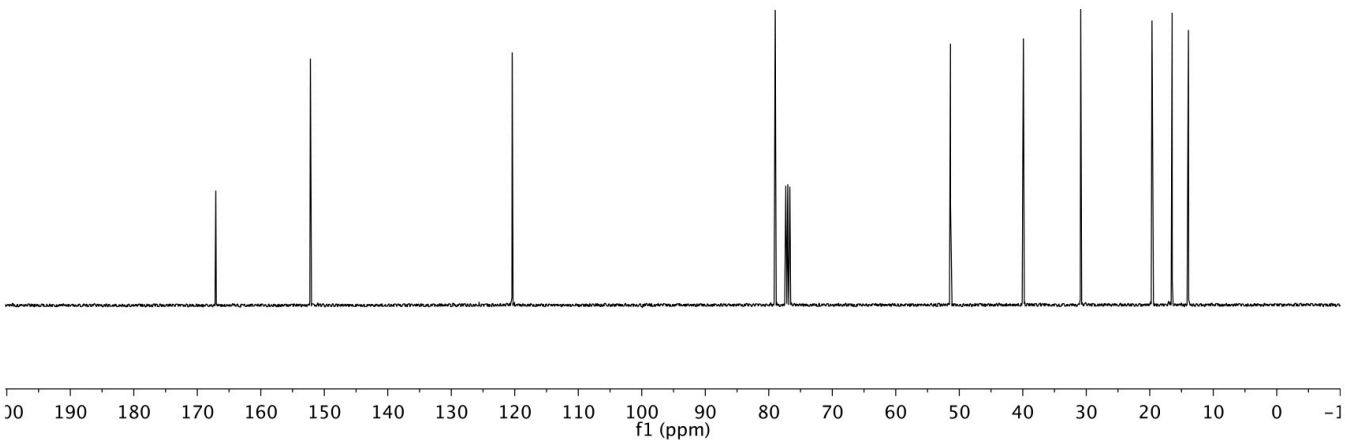
f1 (ppm)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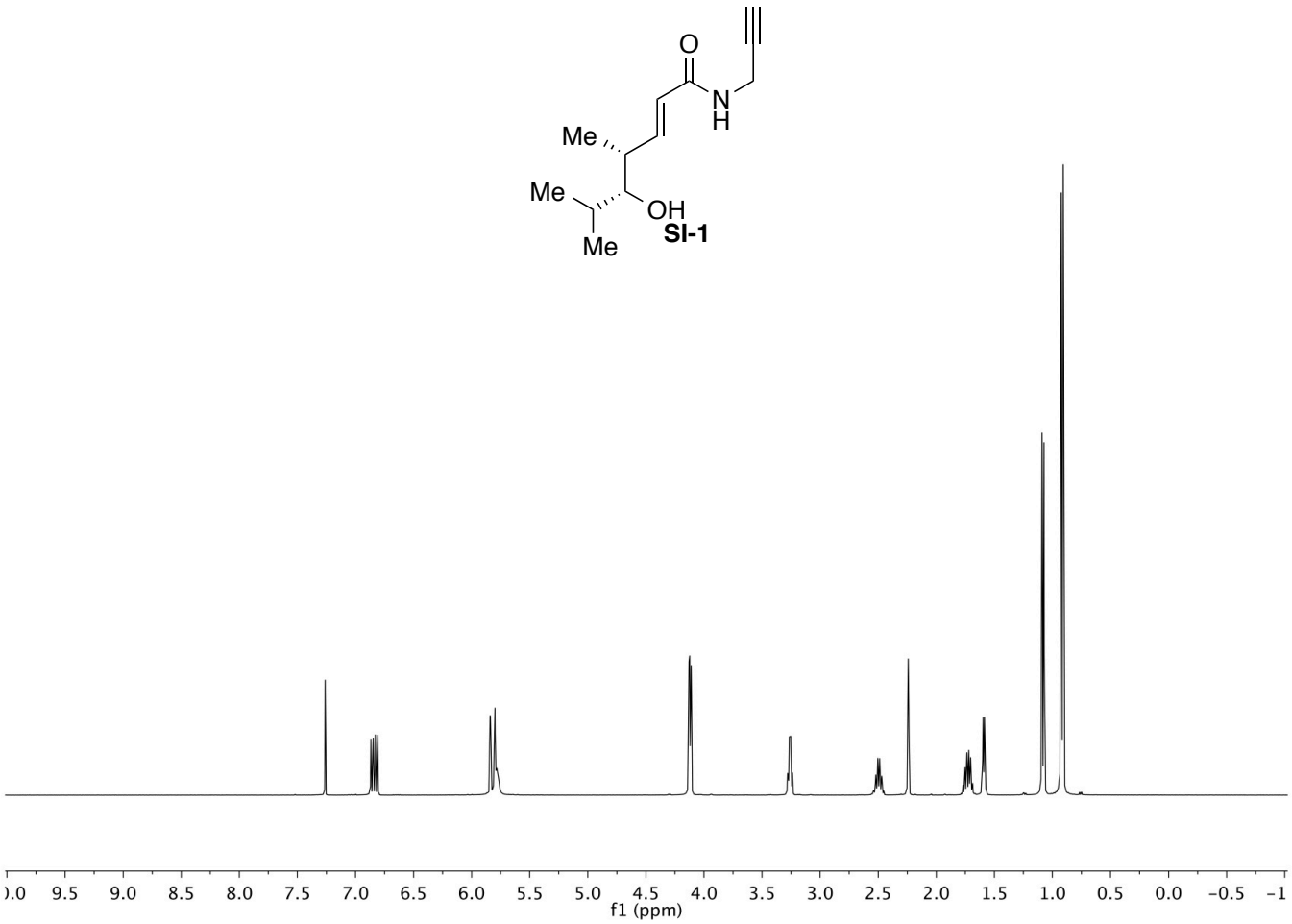
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N
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Me
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SI-1
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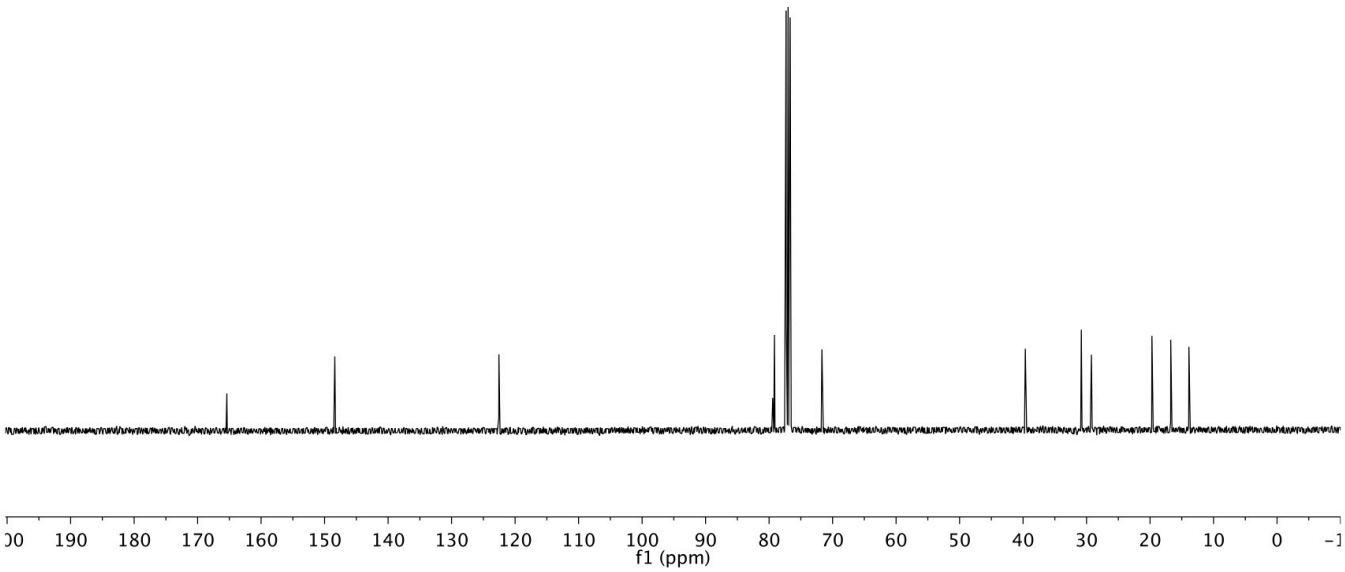
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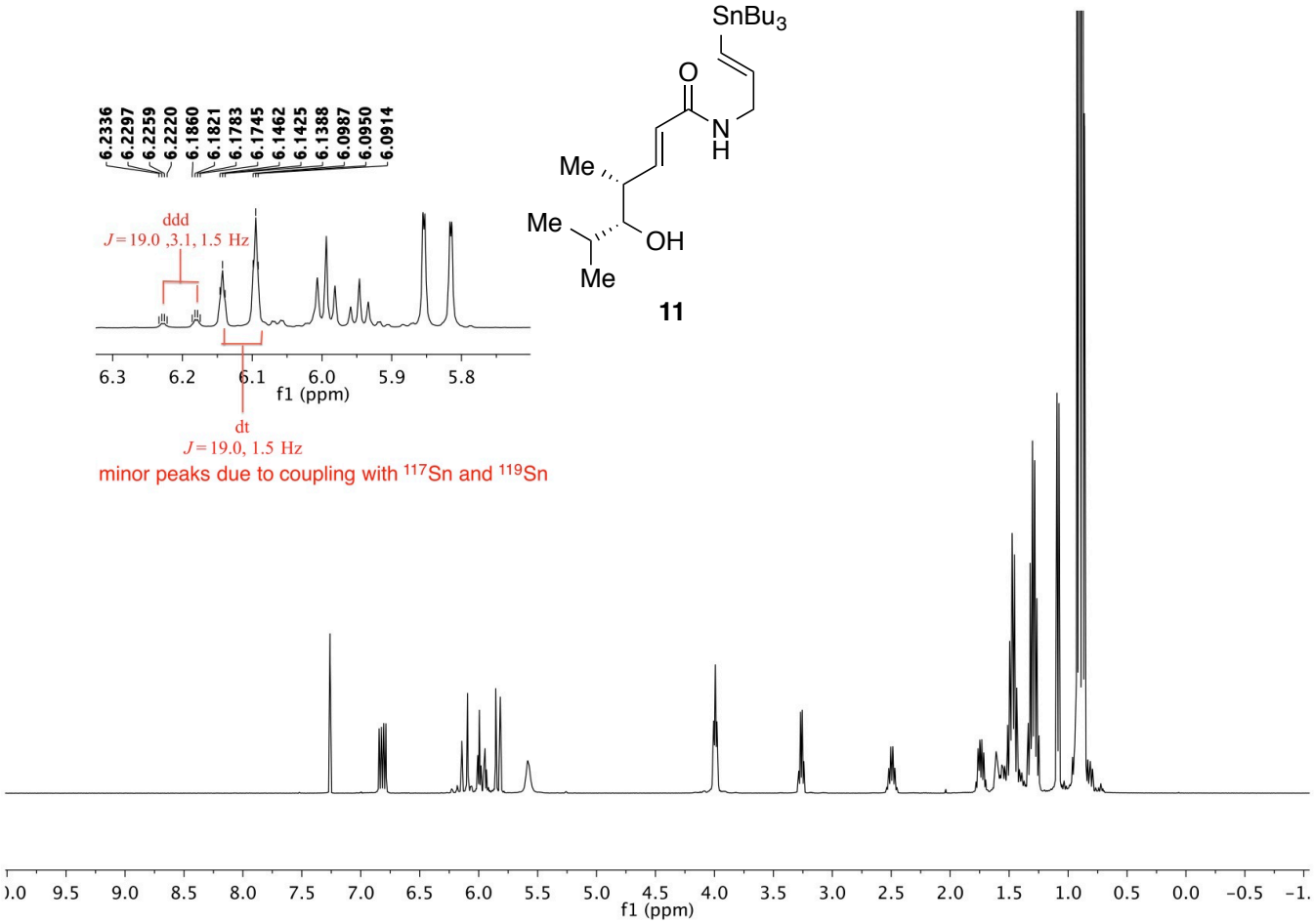
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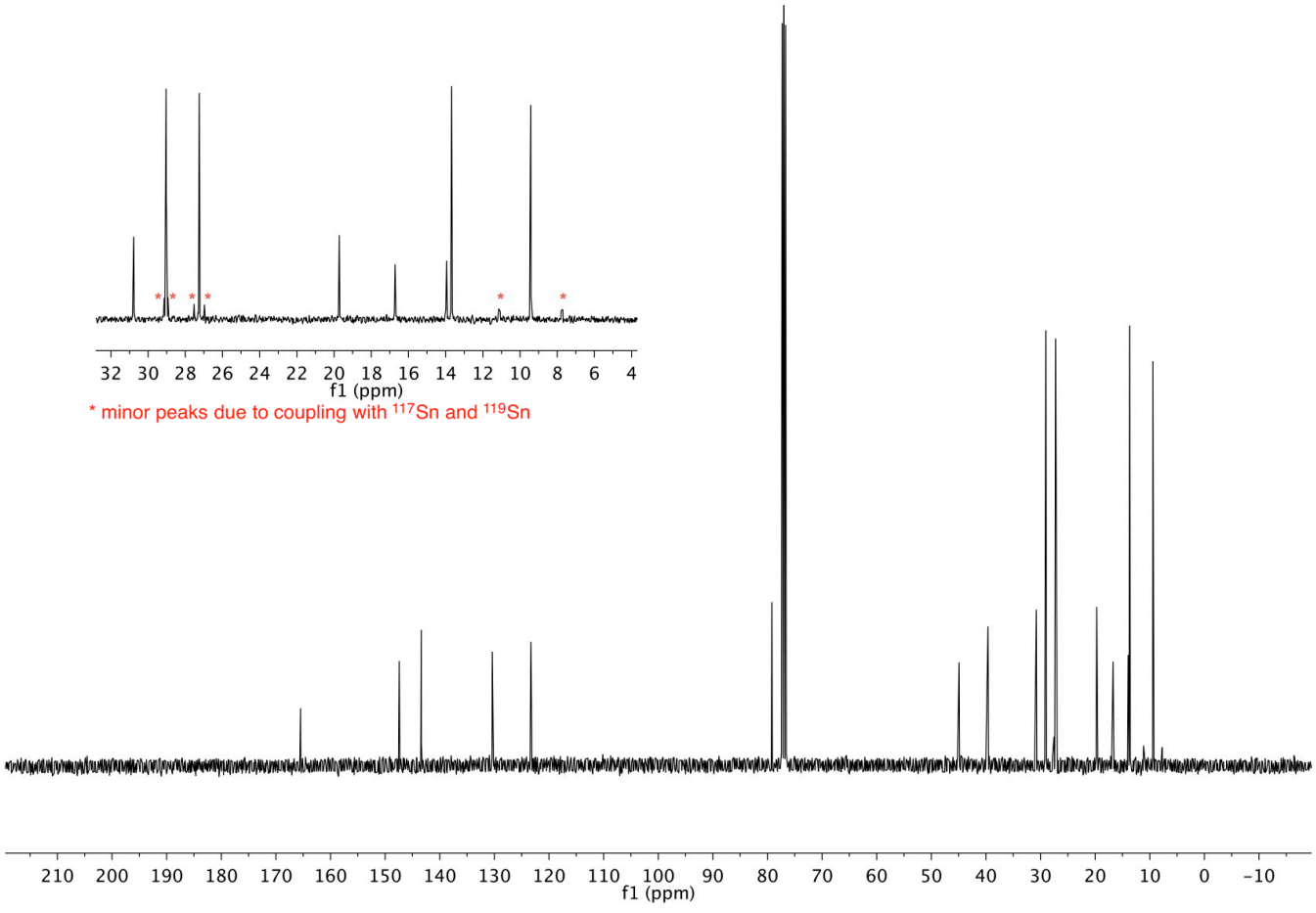
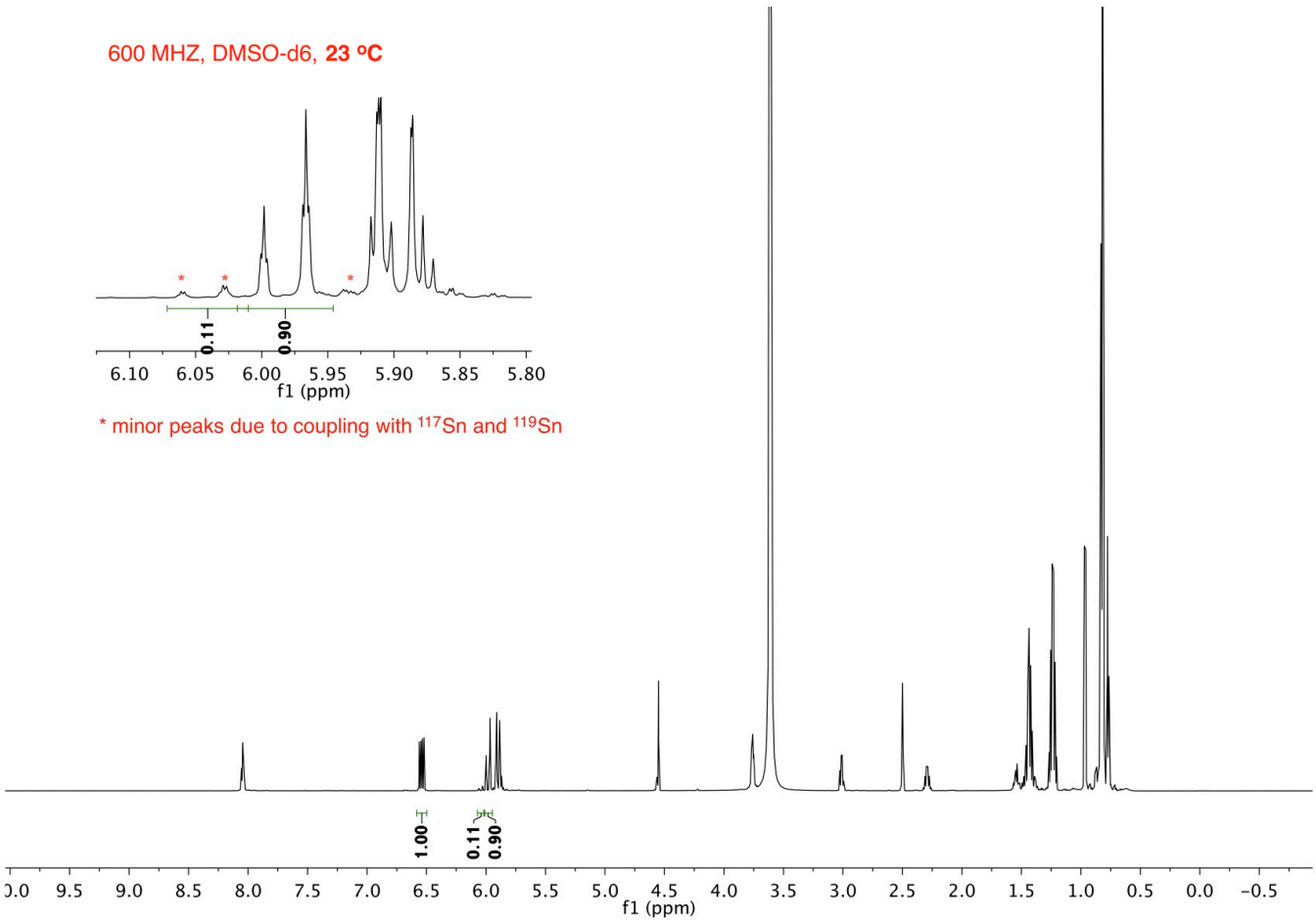
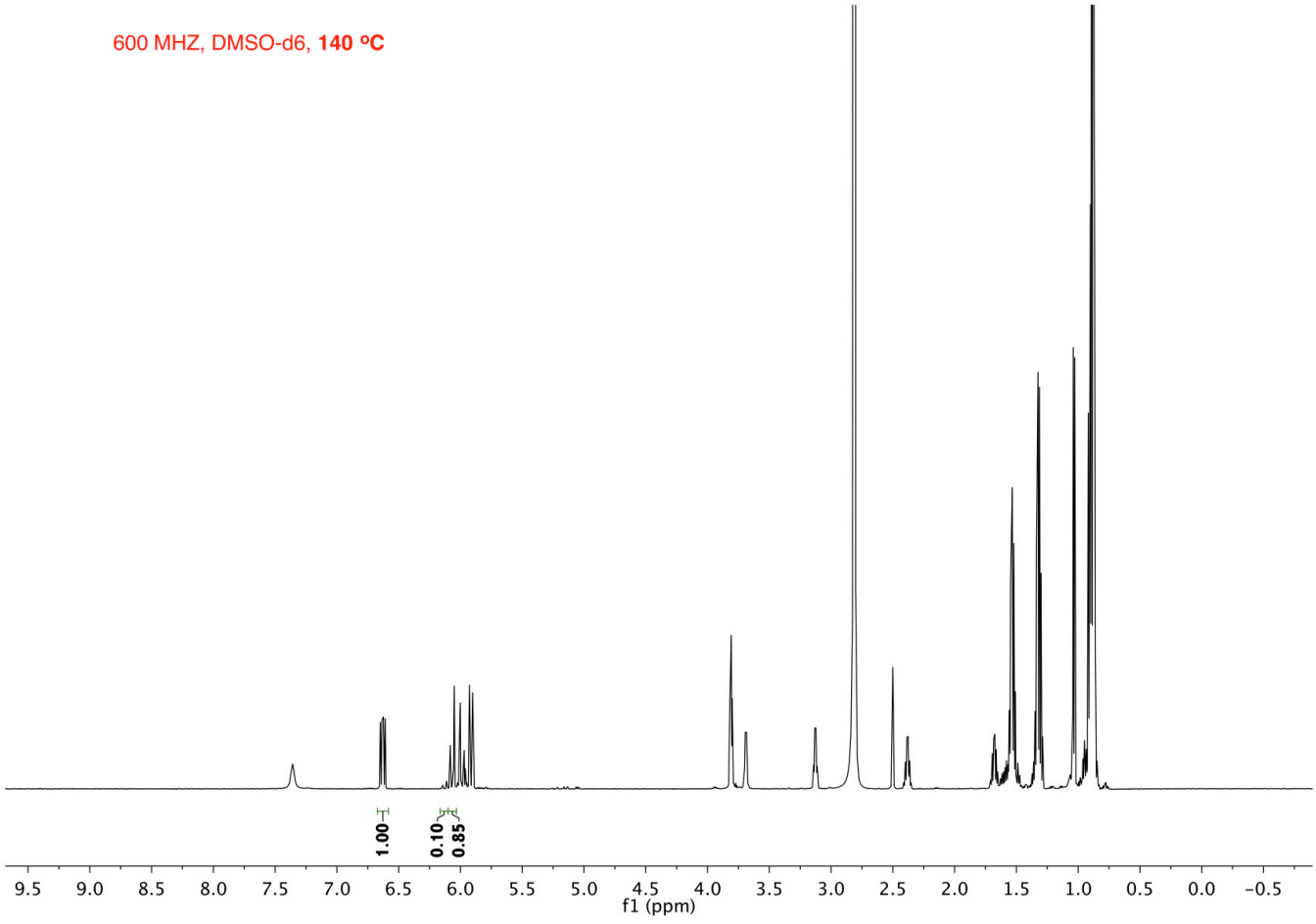
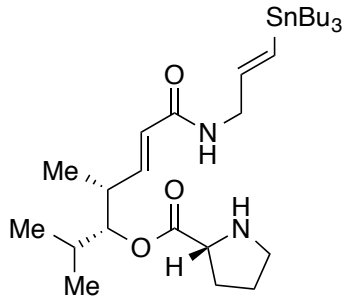
6.0987
6.0950
6.0914
ddd
J = 19.0 ,3.1, 1.5 Hz
dt
J = 19.0, 1.5 Hz
f1 (ppm)
minor peaks due to coupling with 117Sn and 119Sn
SnBu3
O
N
H
Me
Me
Me
OH
11
f1 (ppm)


* minor peaks due to coupling with 117Sn and 119Sn
f1 (ppm)
f1 (ppm)

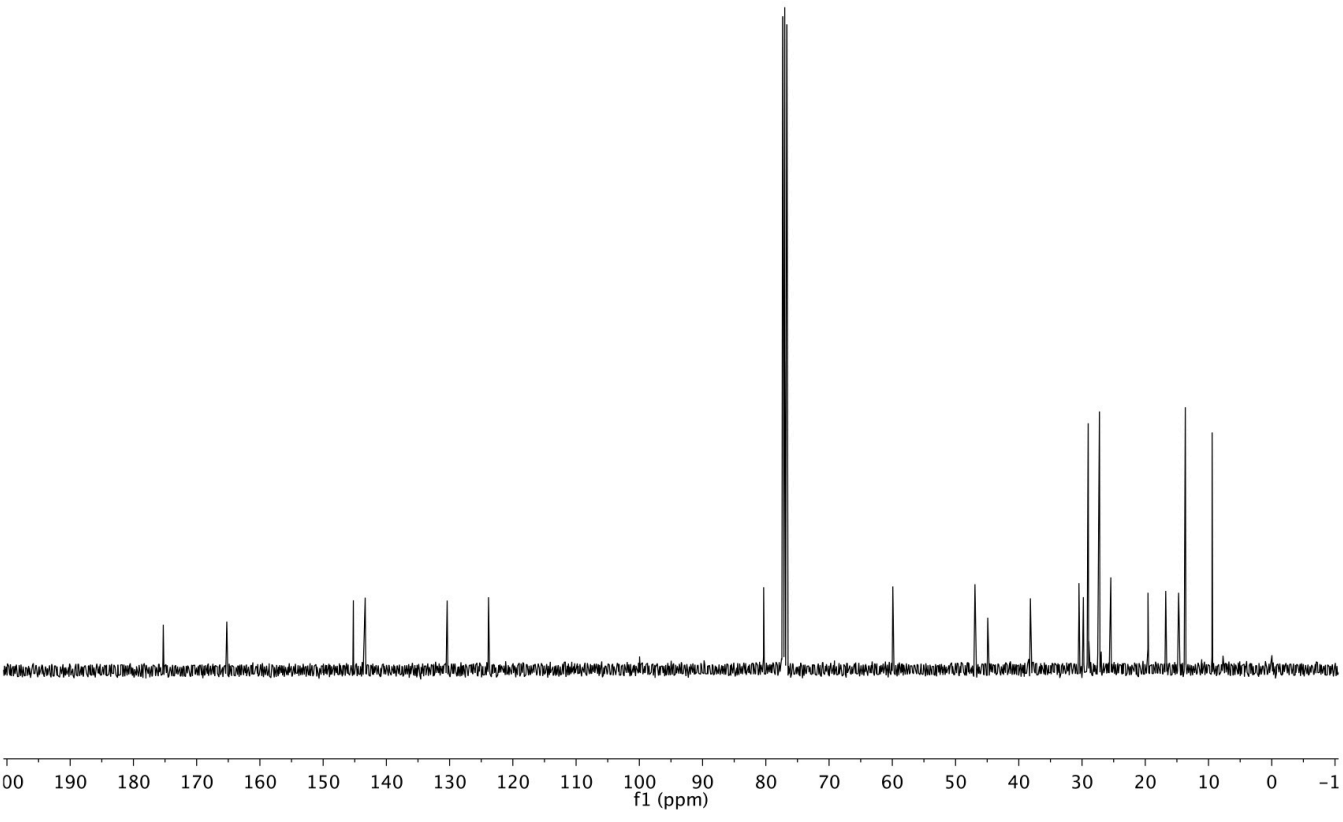

600 MHZ, DMSO-d6, 23 ºC
0.11
0.90
6.10 6.05 6.00 5.95 5.90 5.85 5.80
f1 (ppm)
* minor peaks due to coupling with 117Sn and 119Sn
1.00
0.11
0.90
f1 (ppm)

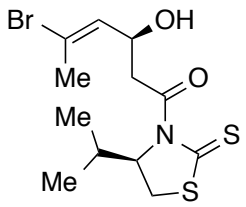

600 MHZ, DMSO-d6, 140 ºC
1.00
0.10
0.85
f1 (ppm)


SnBu3
O
N
H
Me
O
H
N
Me
O
H
Me

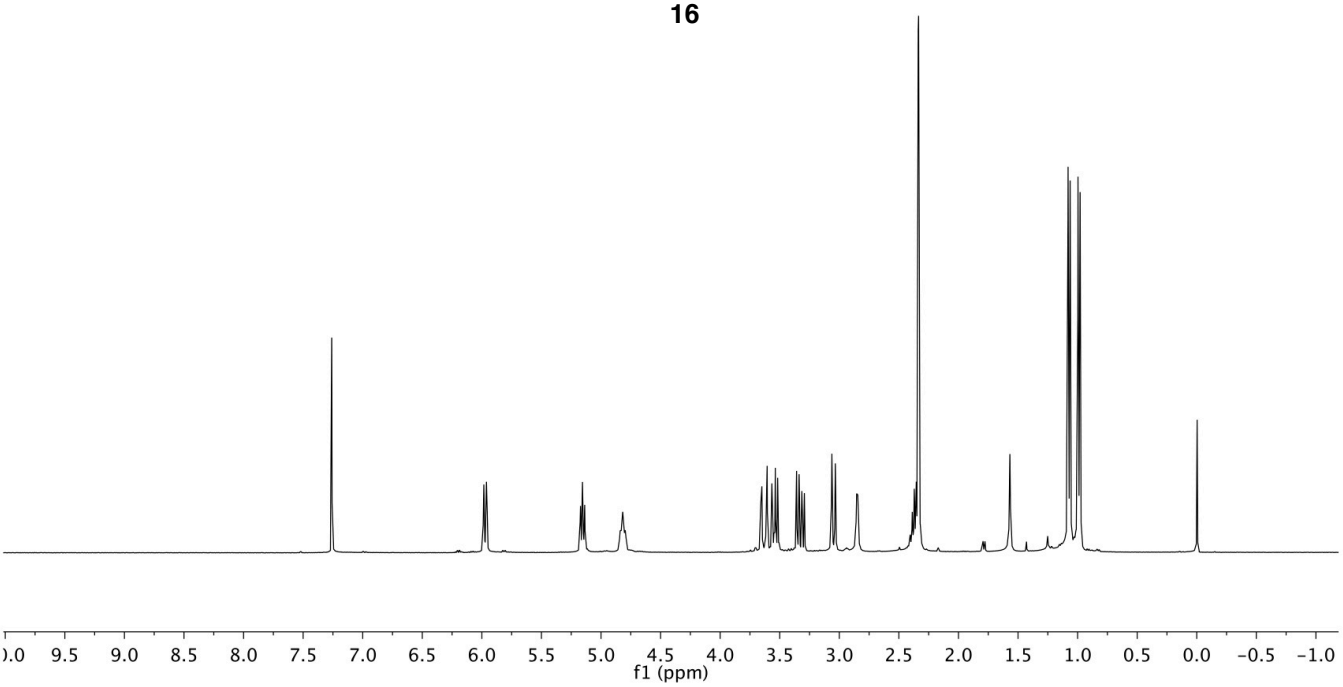
13

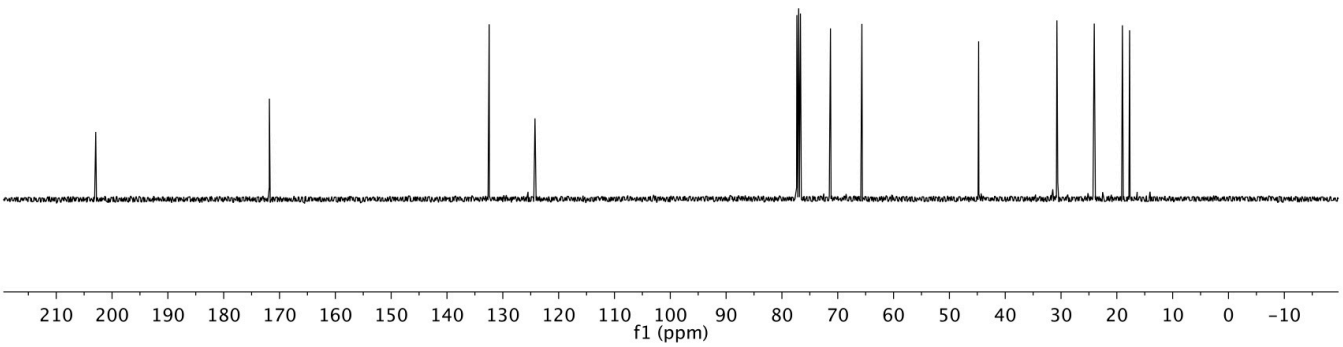
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 −0.5 −1
f1 (ppm)

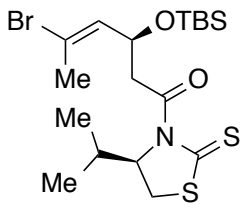

190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 −1
f1 (ppm)


Br
OH
Me
O
Me
N
S
Me
S

16

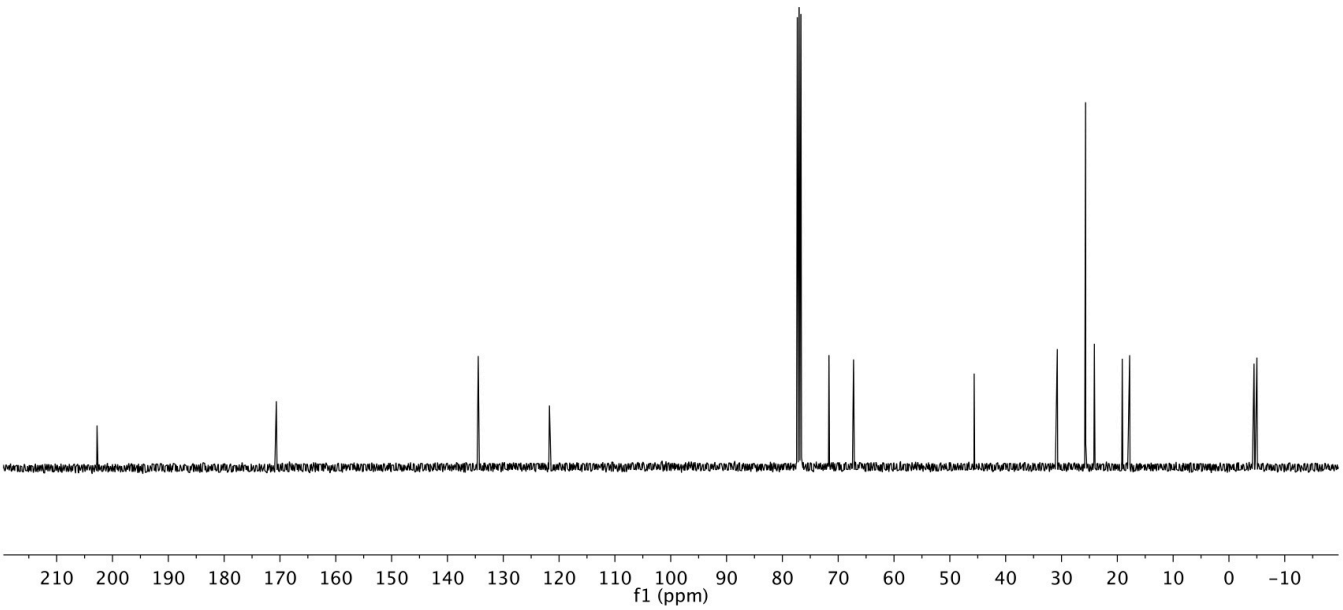

9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1.0
f1 (ppm)

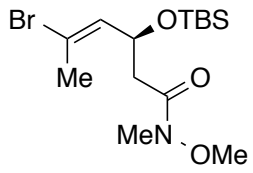

210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


Br
OTBS
Me
O
Me
N
S
Me
S

SI-2

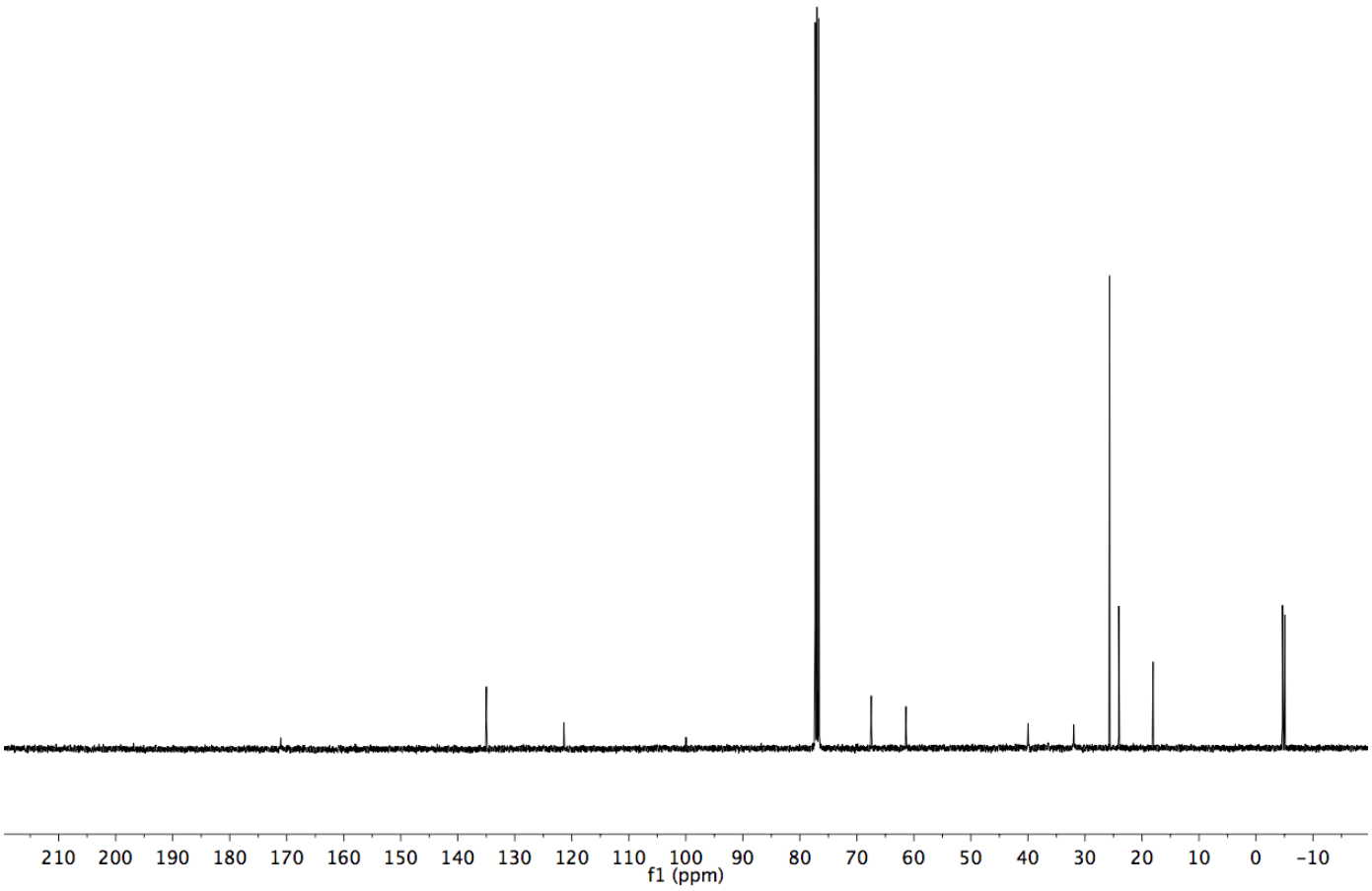
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1
f1 (ppm)

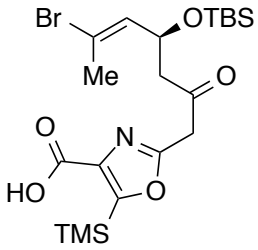

210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


Br
OTBS
Me
O
MeN
OMe

17

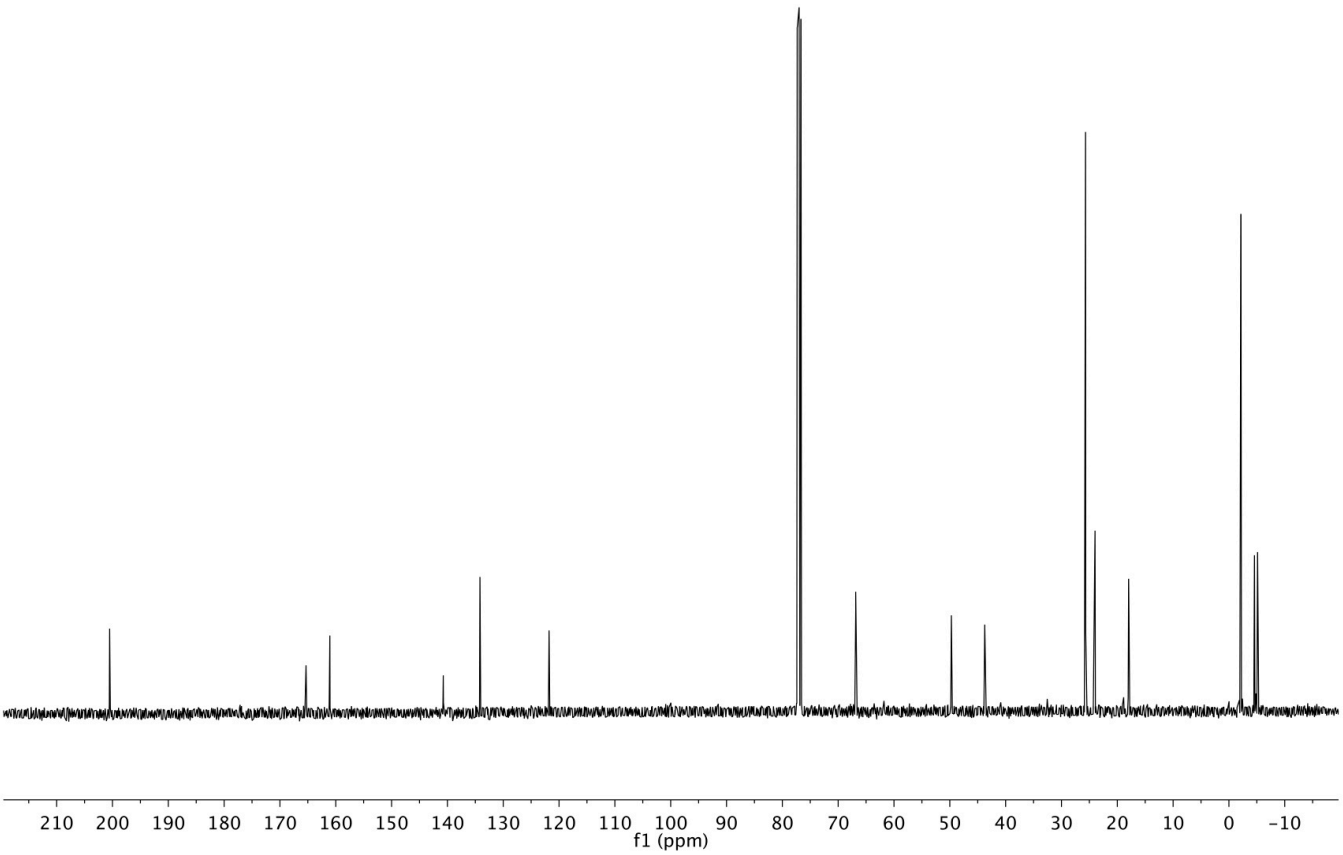
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5
f1 (ppm)

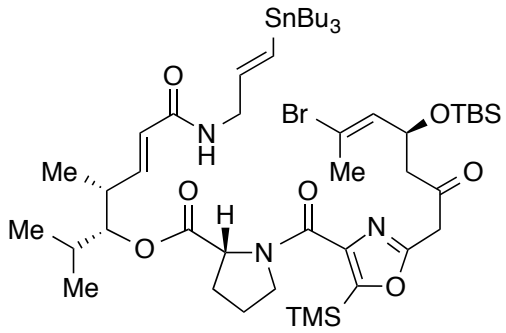

210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


Br
OTBS
Me
O
O
N
HO
O
TMS

19

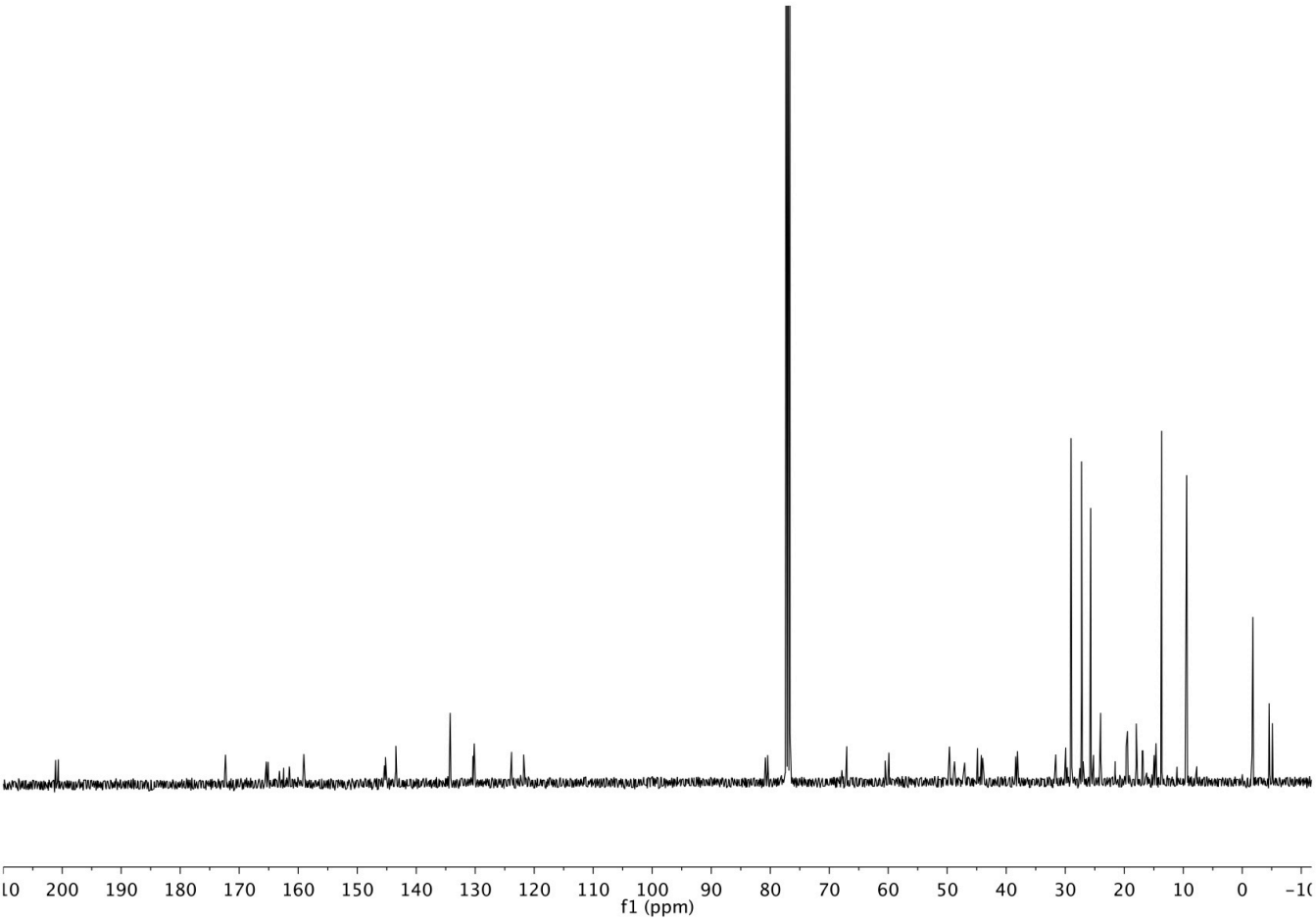
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1
f1 (ppm)

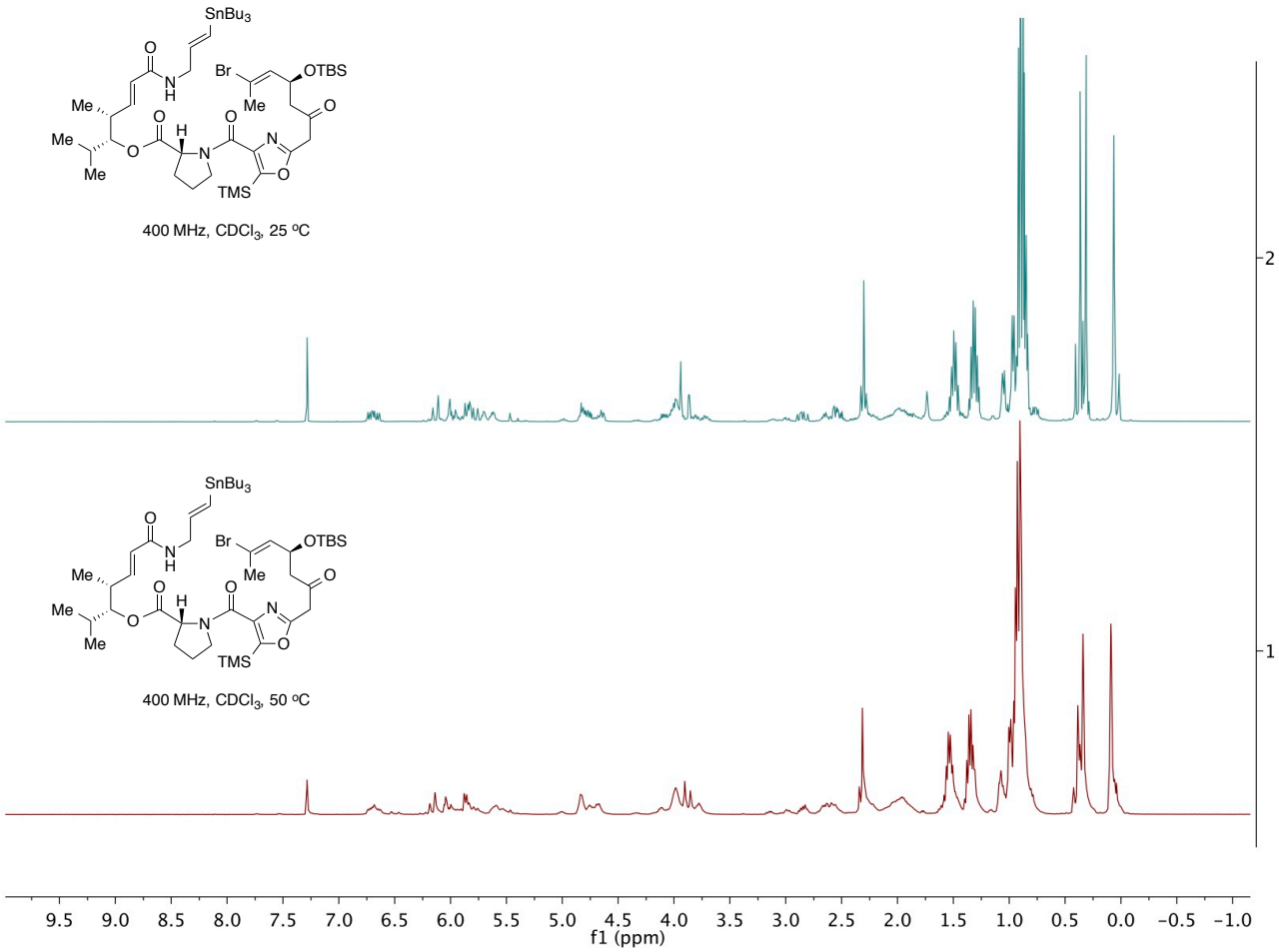

210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

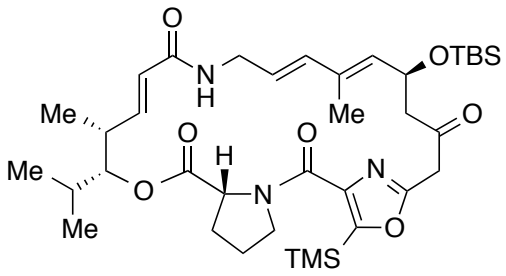

SnBu3
O
N
H
Br
OTBS
Me
Me
O
O
H
Me
O
N
N
O
Me
O
TMS

20

9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5
f1 (ppm)

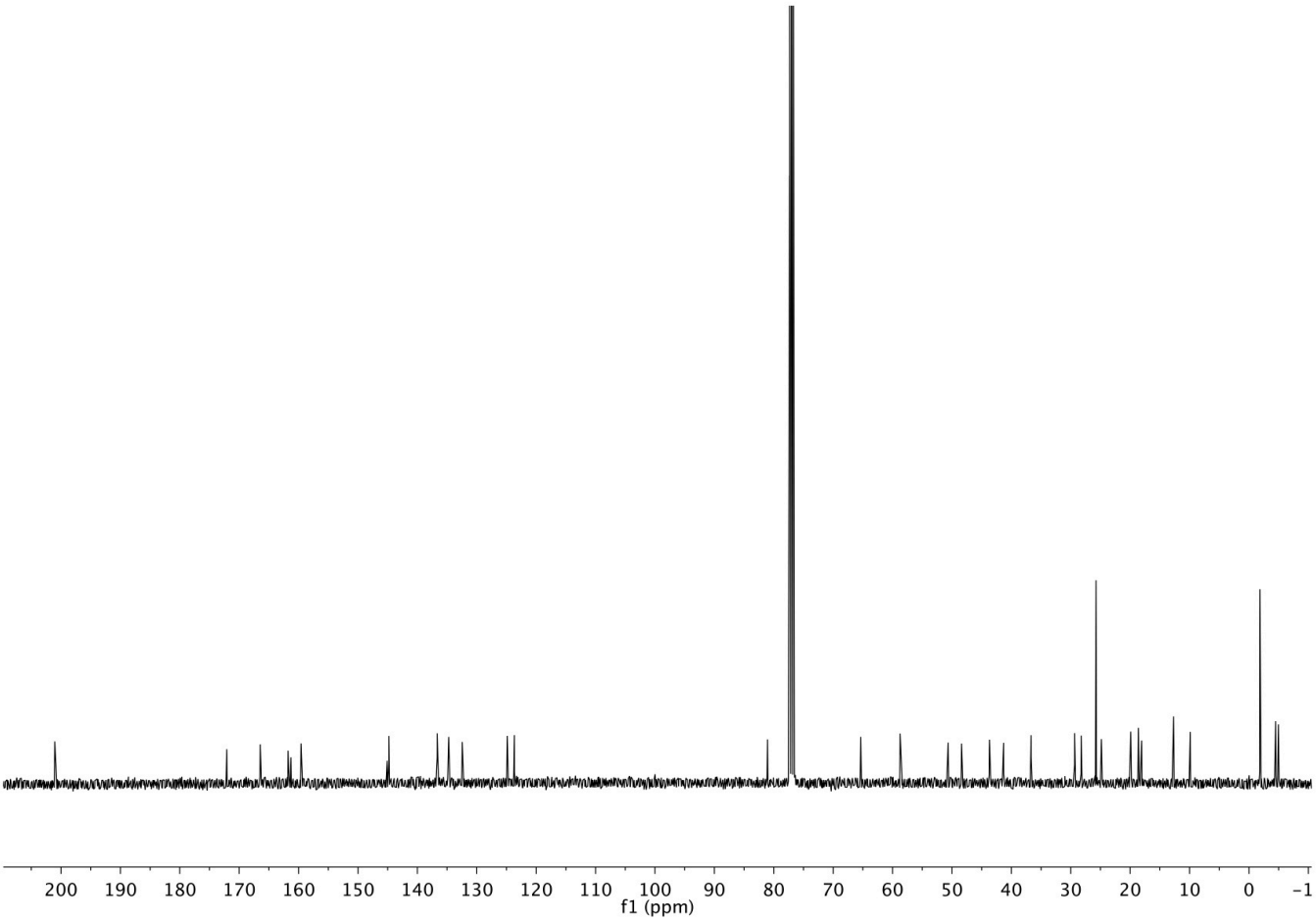

200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)

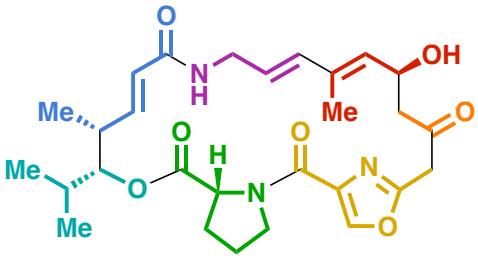

SnBu3
Br
OTBS
Me
Me
Me
Me
O
N
H
TMS
400 MHz, CDCl3, 25 ºC
2
SnBu3
Br
OTBS
Me
Me
Me
Me
O
N
H
TMS
400 MHz, CDCl3, 50 ºC
1
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1.0
f1 (ppm)


O
N
H
OTBS
Me
Me
O
O
H
O
Me
O
N
N
O
Me
TMS

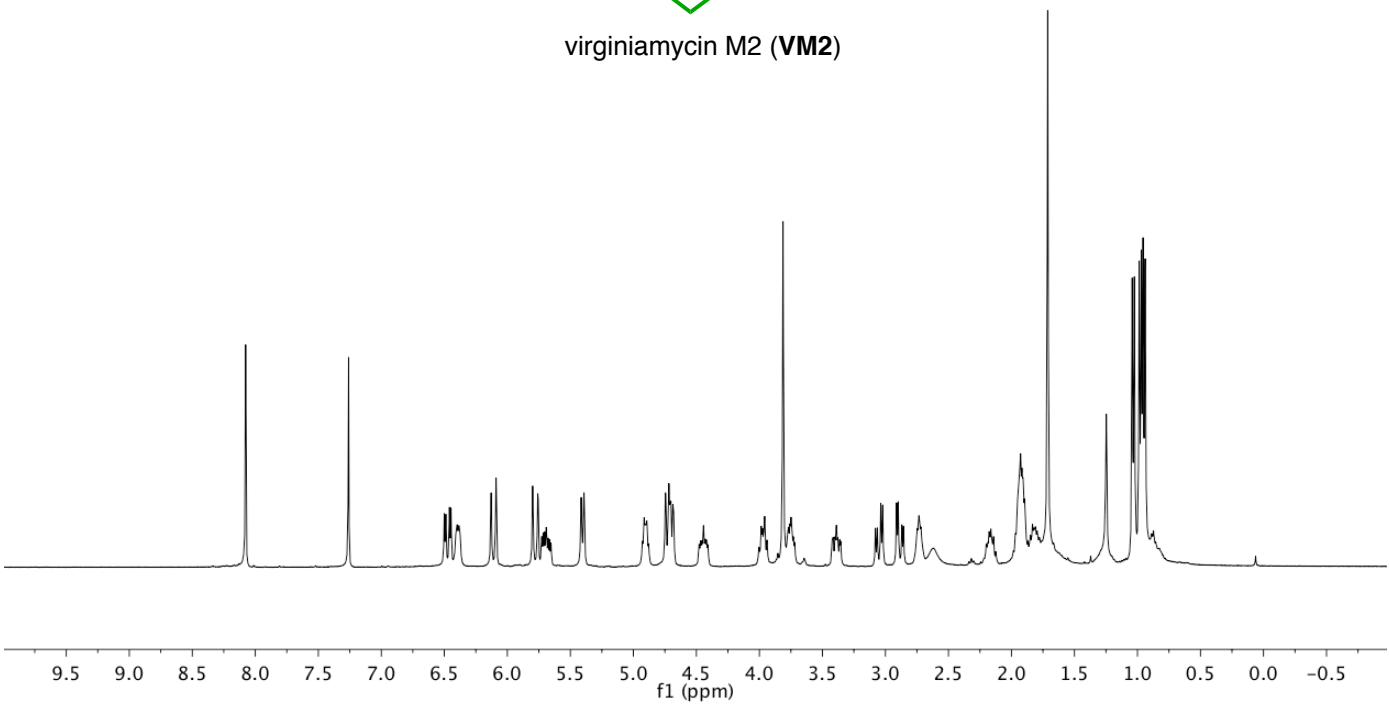
SI-3

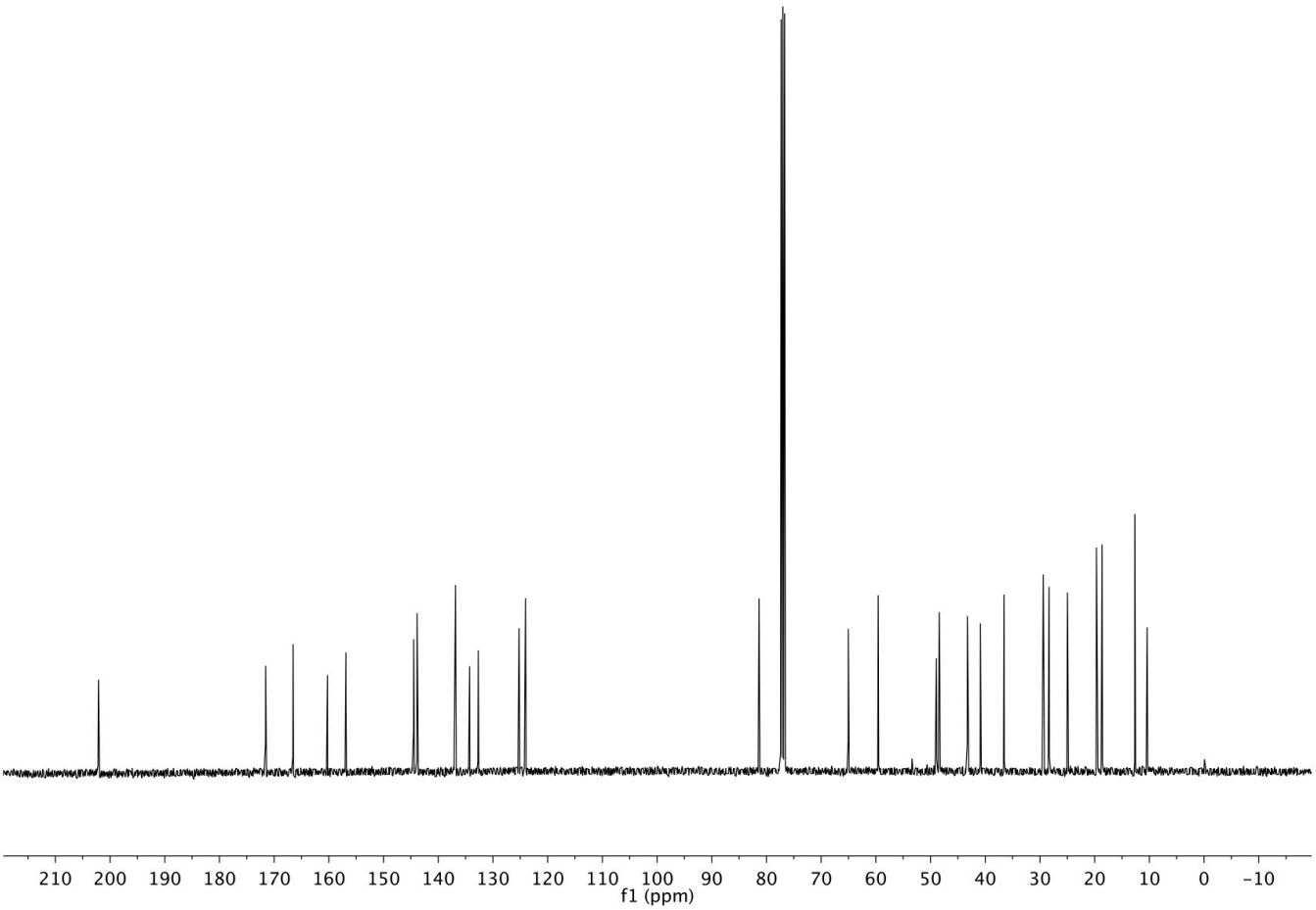
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
f1 (ppm)

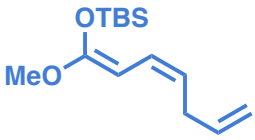

200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)



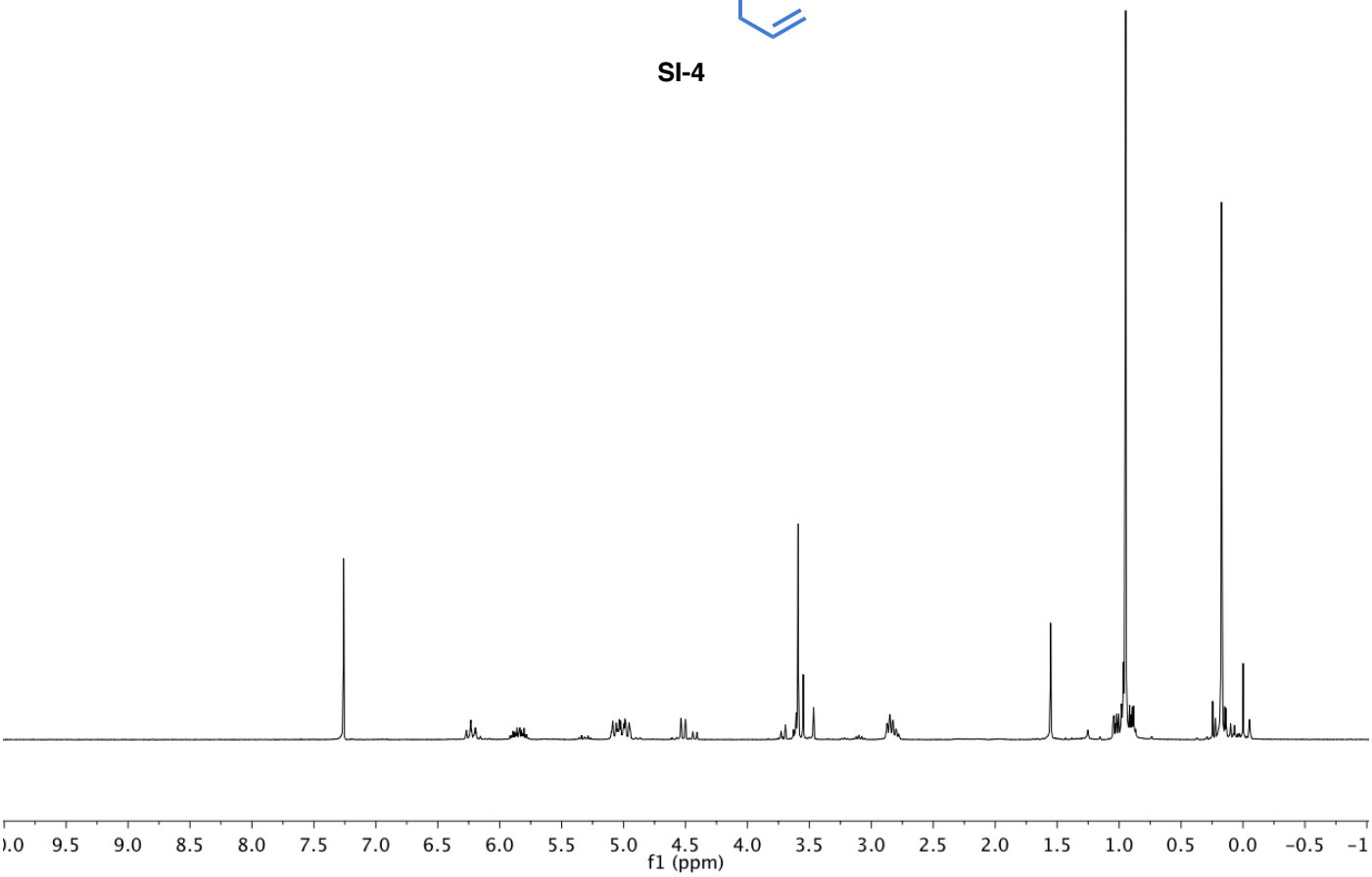
virginiamycin M2 (**VM2**)

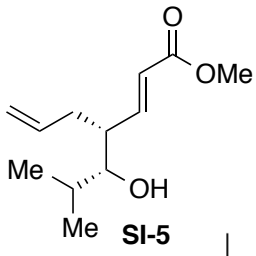




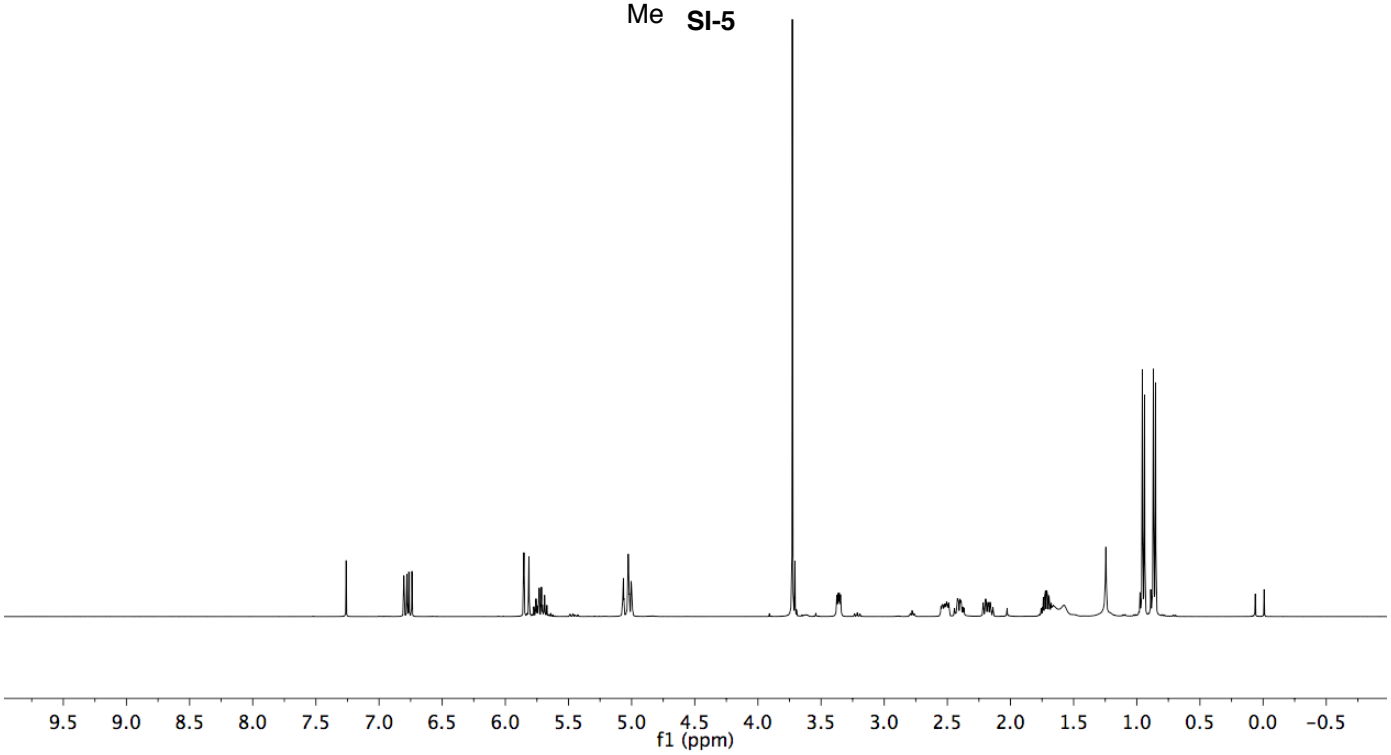

OTBS
MeO

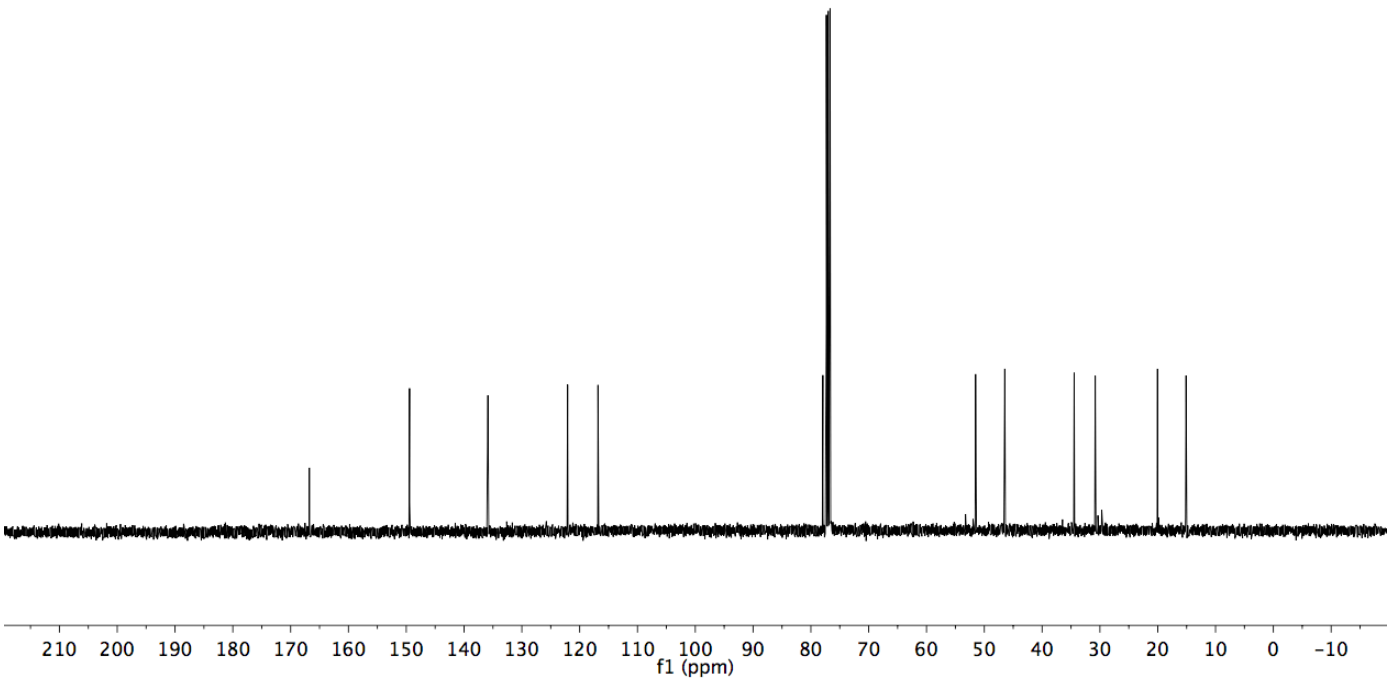
SI-4

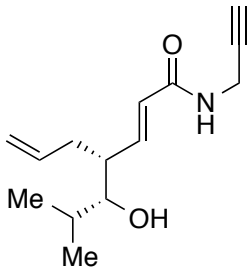

9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
f1 (ppm)


O
OMe
Me
OH
Me

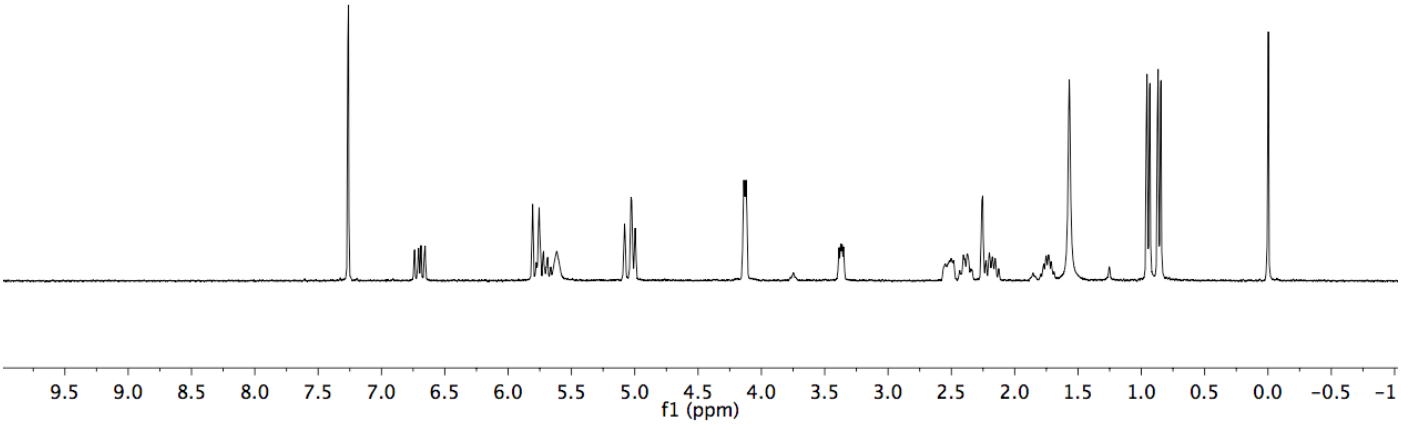
SI-5

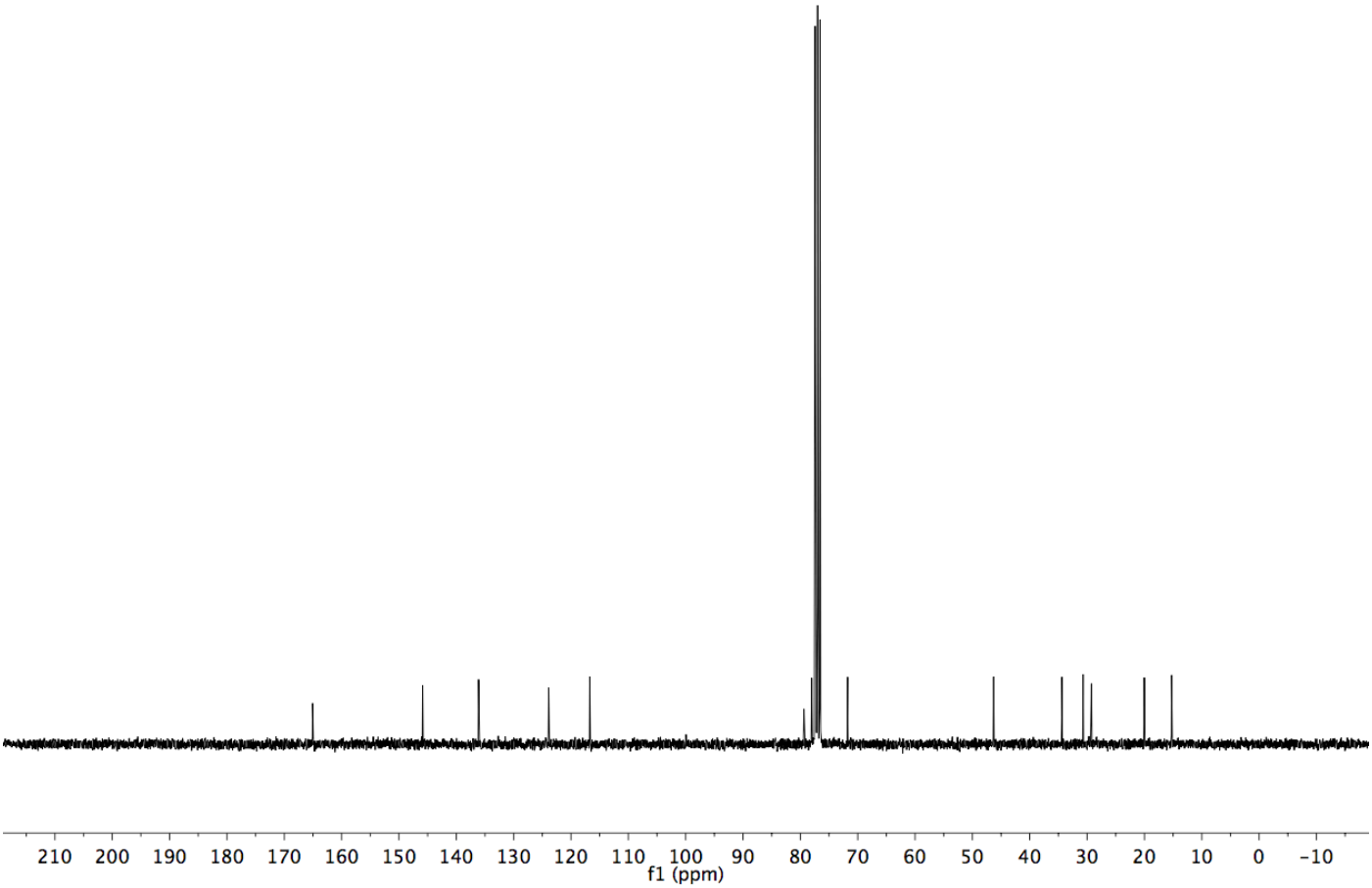

9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5
f1 (ppm)

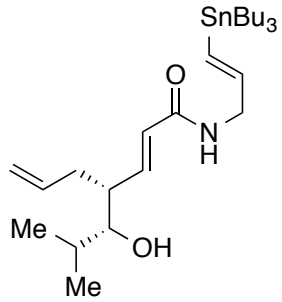

210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


O
N
H
Me
OH
Me

SI-6

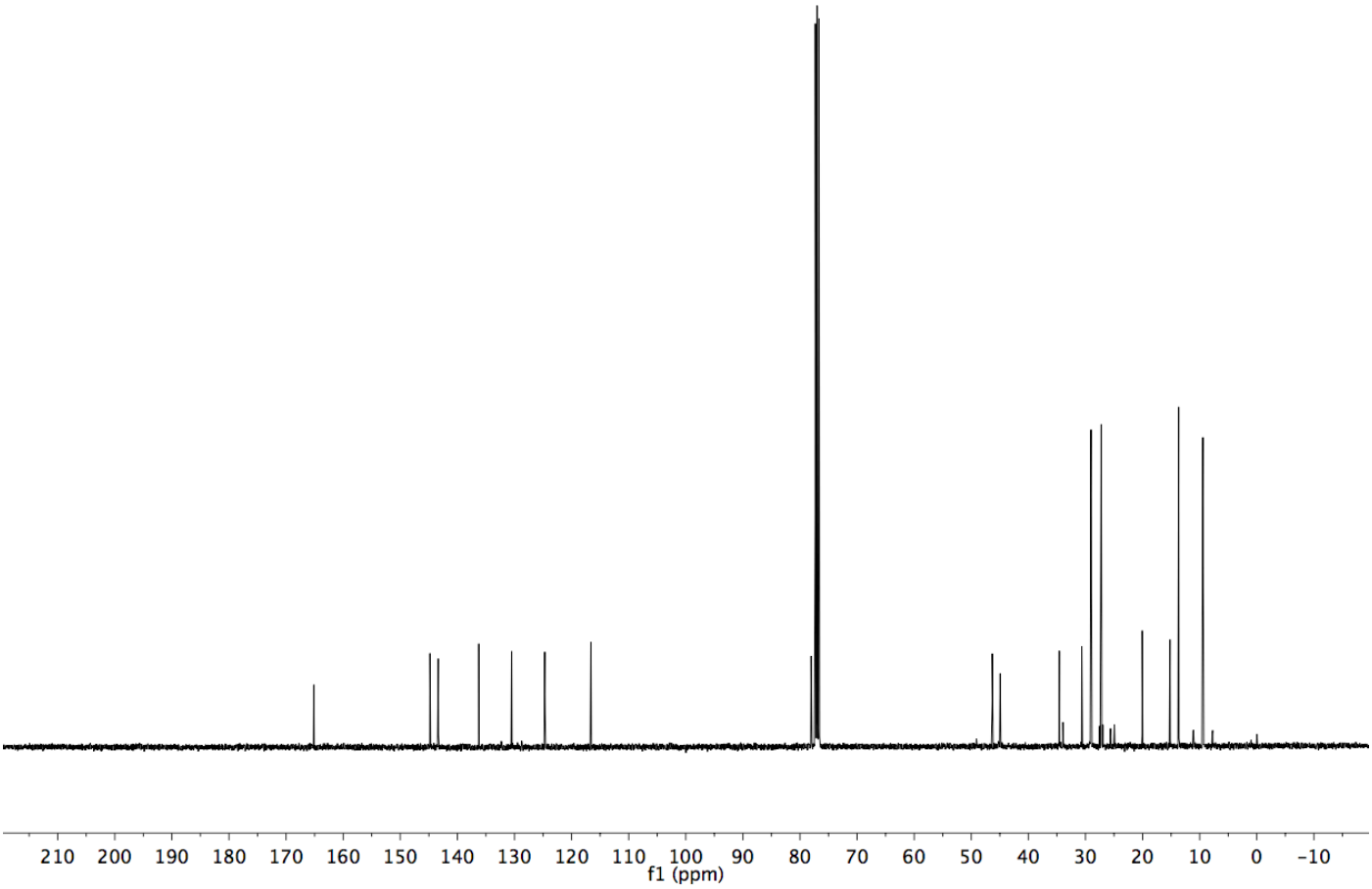

9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1
f1 (ppm)

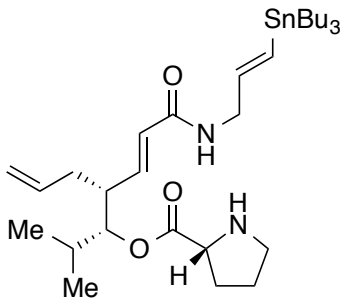

210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


SnBu3
O
N
H
Me
OH
Me

SI-7

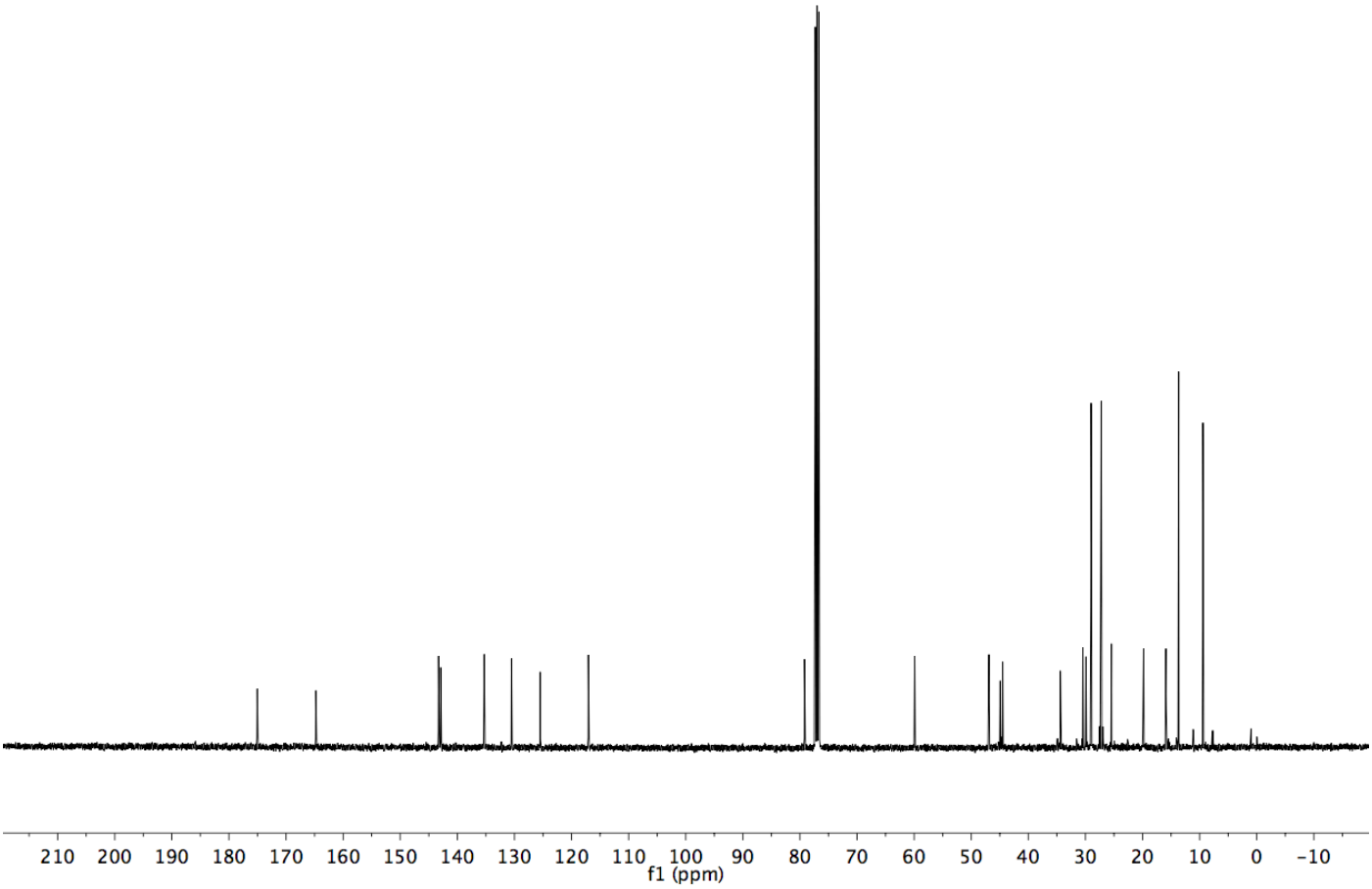
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1
f1 (ppm)

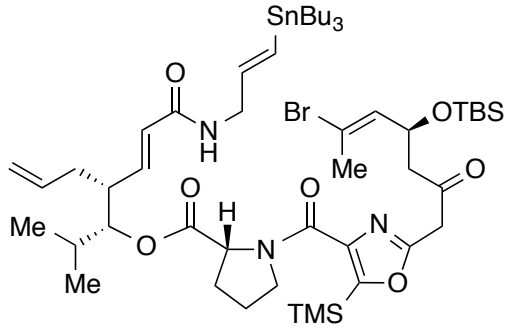

210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


SnBu3
O
N
H
O
H
N
Me
O
H
Me

SI-8

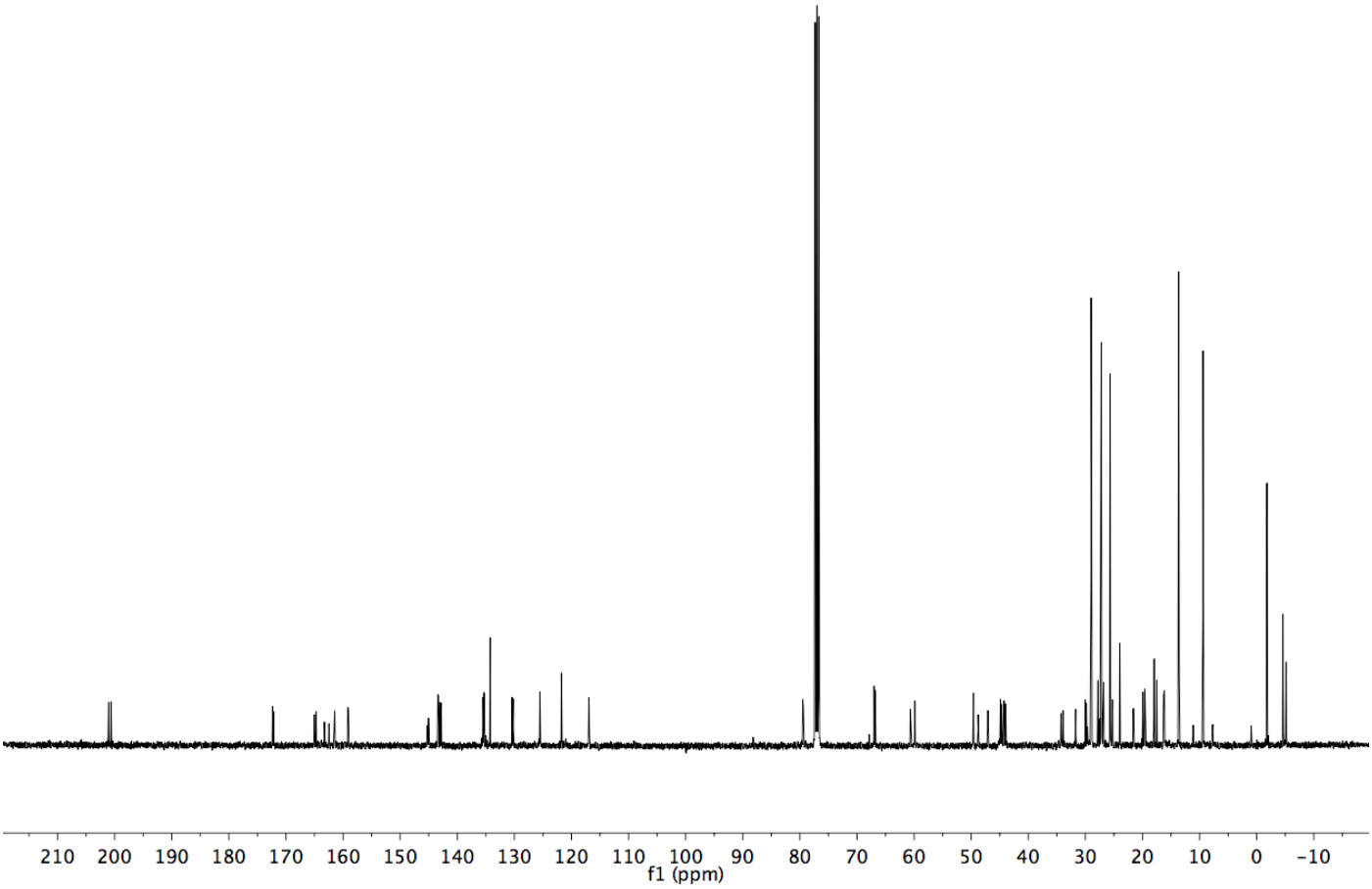
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1
f1 (ppm)

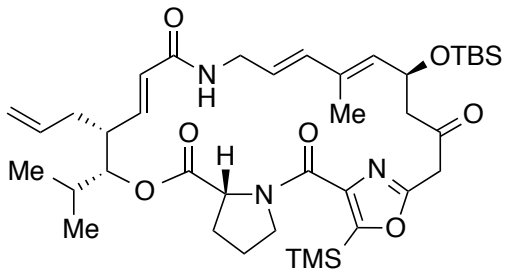

210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


SnBu3
O
N
H
Br
OTBS
Me
O
O
O
H
Me
O
N
N
O
Me
TMS

SI-9

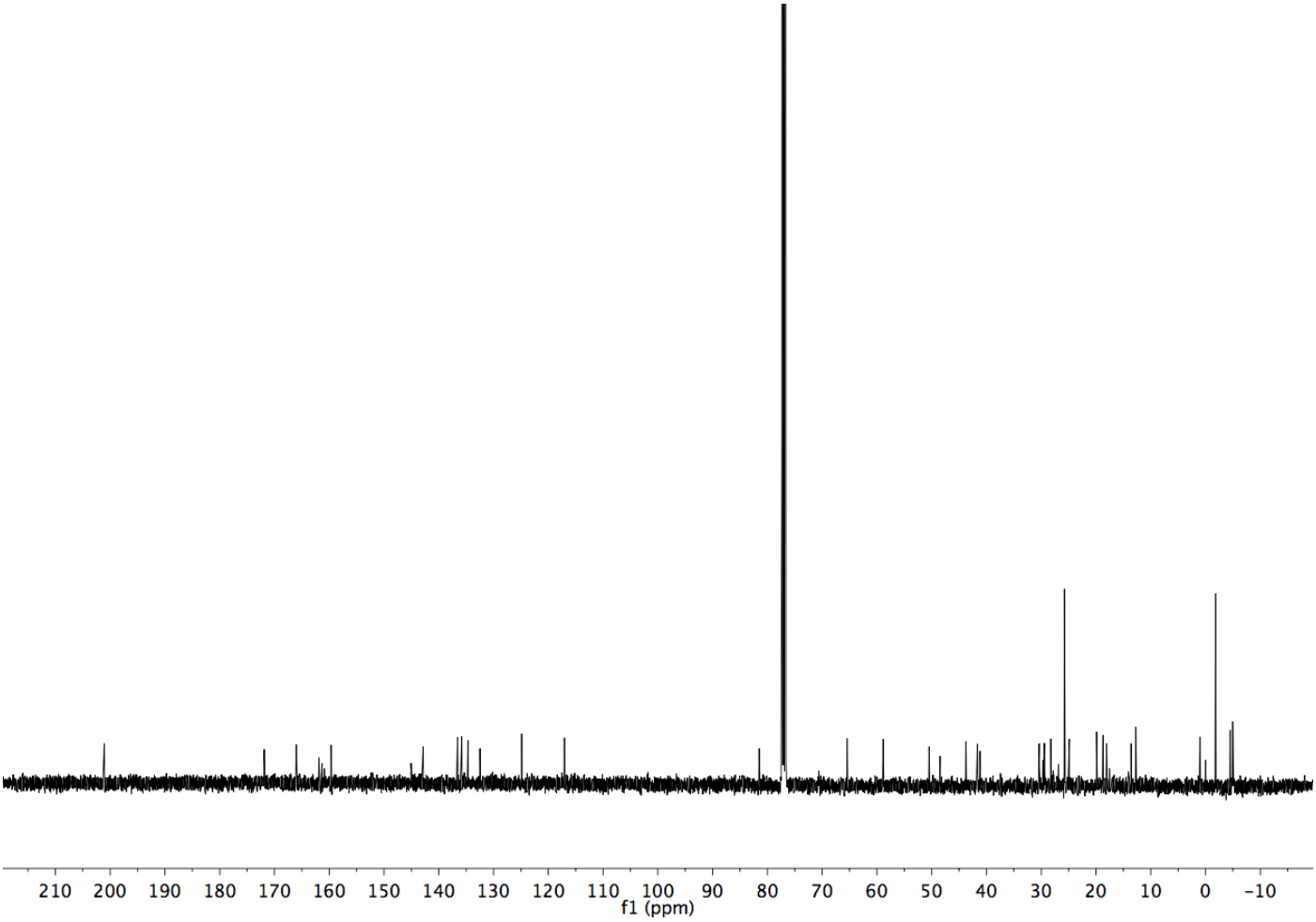
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1
f1 (ppm)

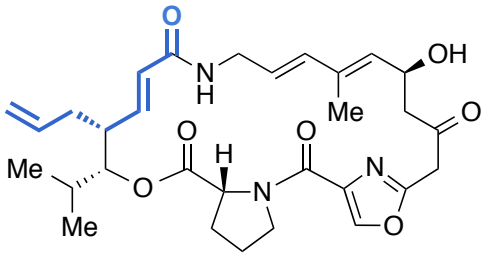

210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


O
N
H
OTBS
Me
O
Me
O
O
H
N
N
O
O
Me
TMS

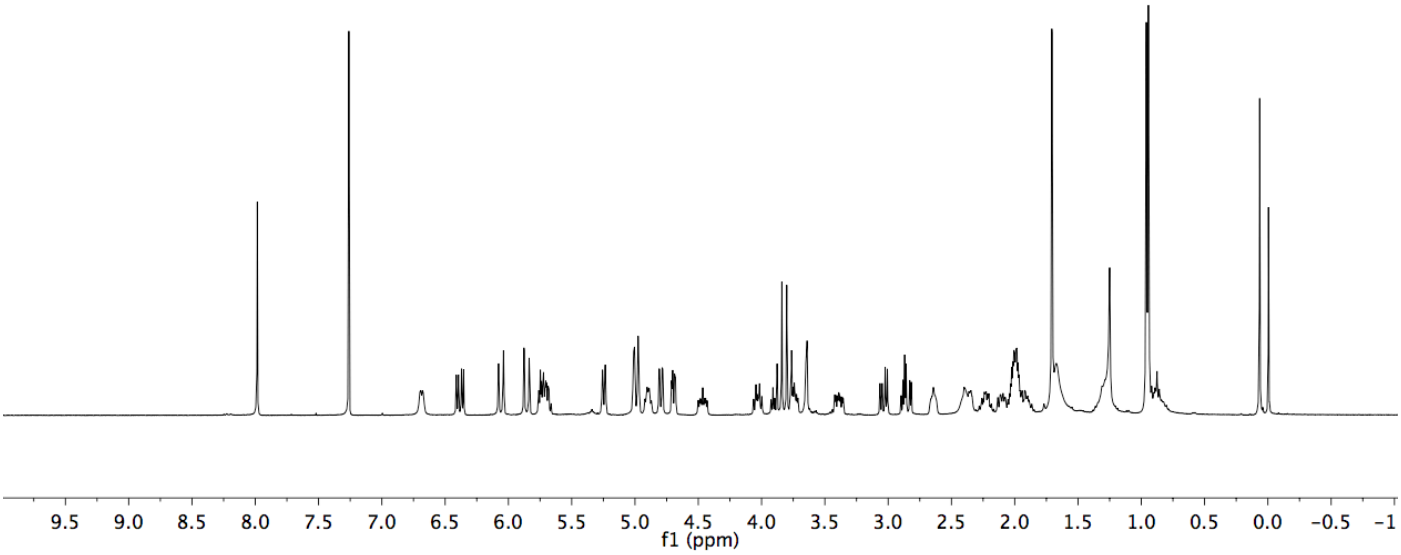
SI-10

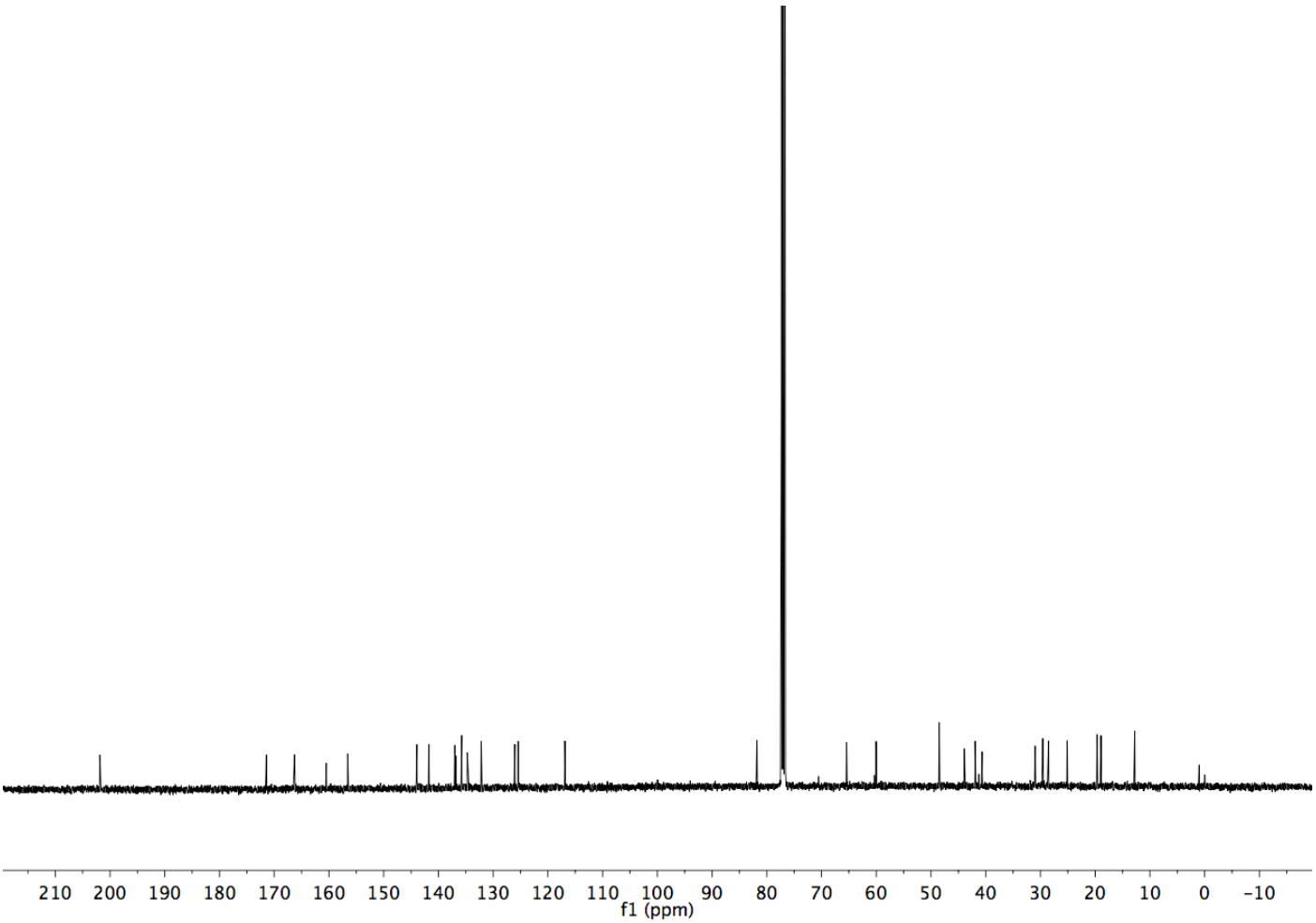
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1.
f1 (ppm)

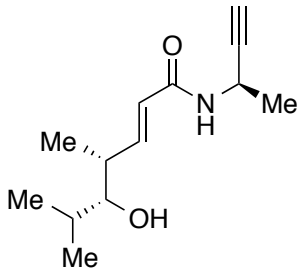

210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


O
N
H
OH
Me
O
O
O
H
Me
O
N
N
Me
O

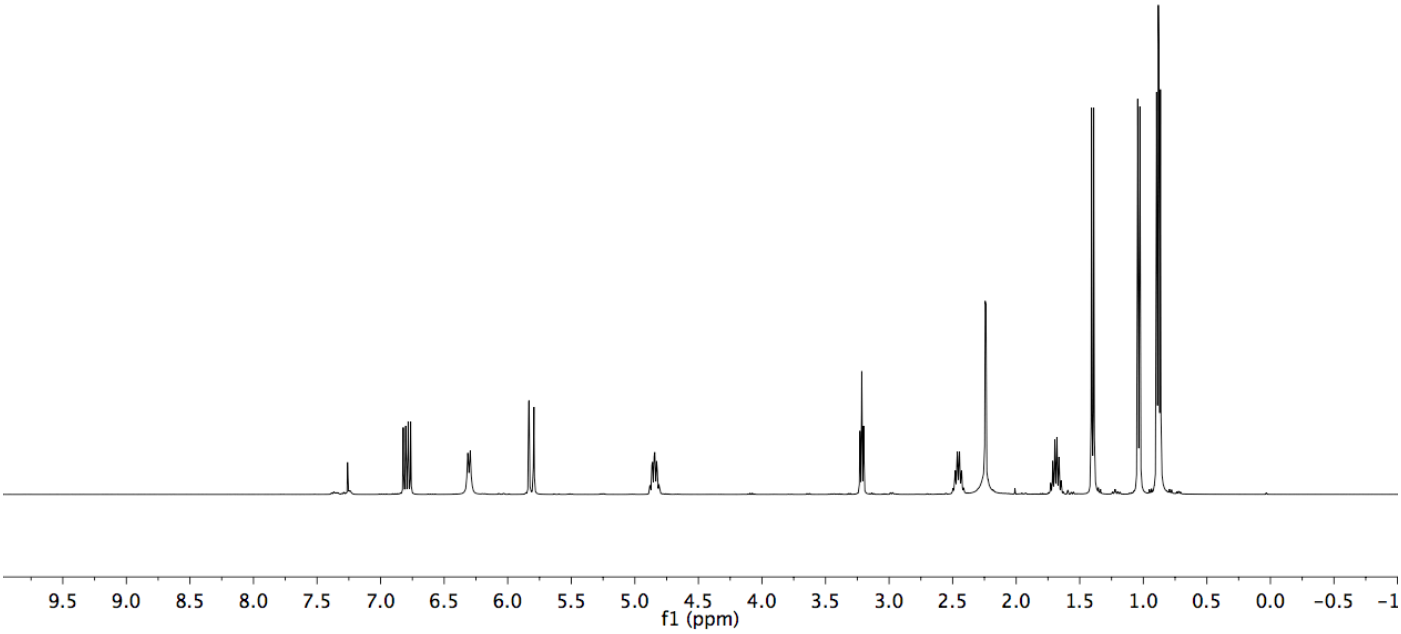
21

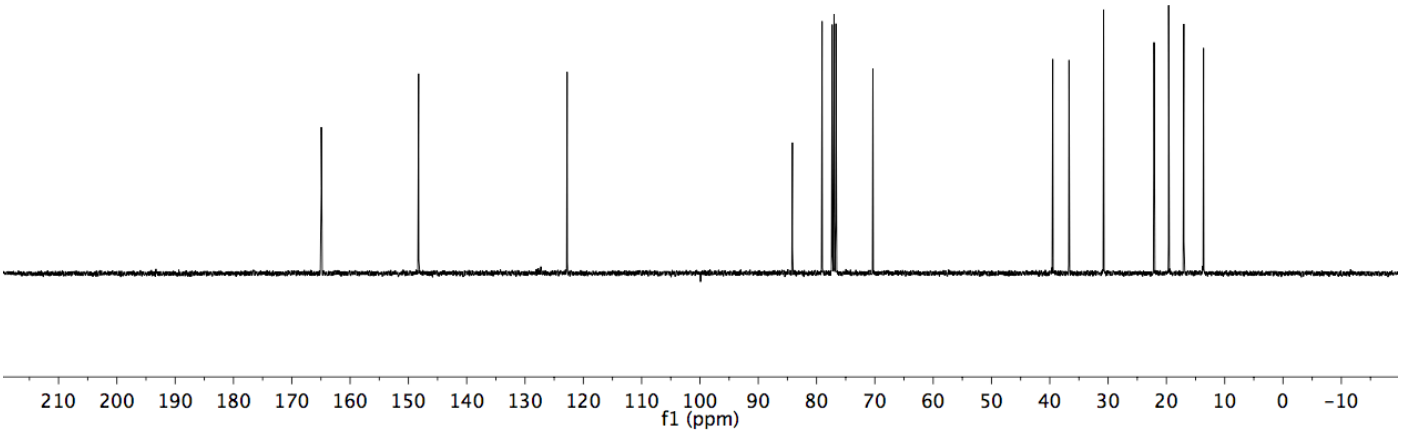

9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1
f1 (ppm)

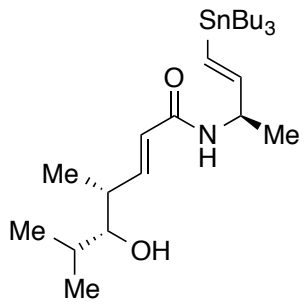

210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


O
N
H
Me
Me
Me
OH
Me

SI-12

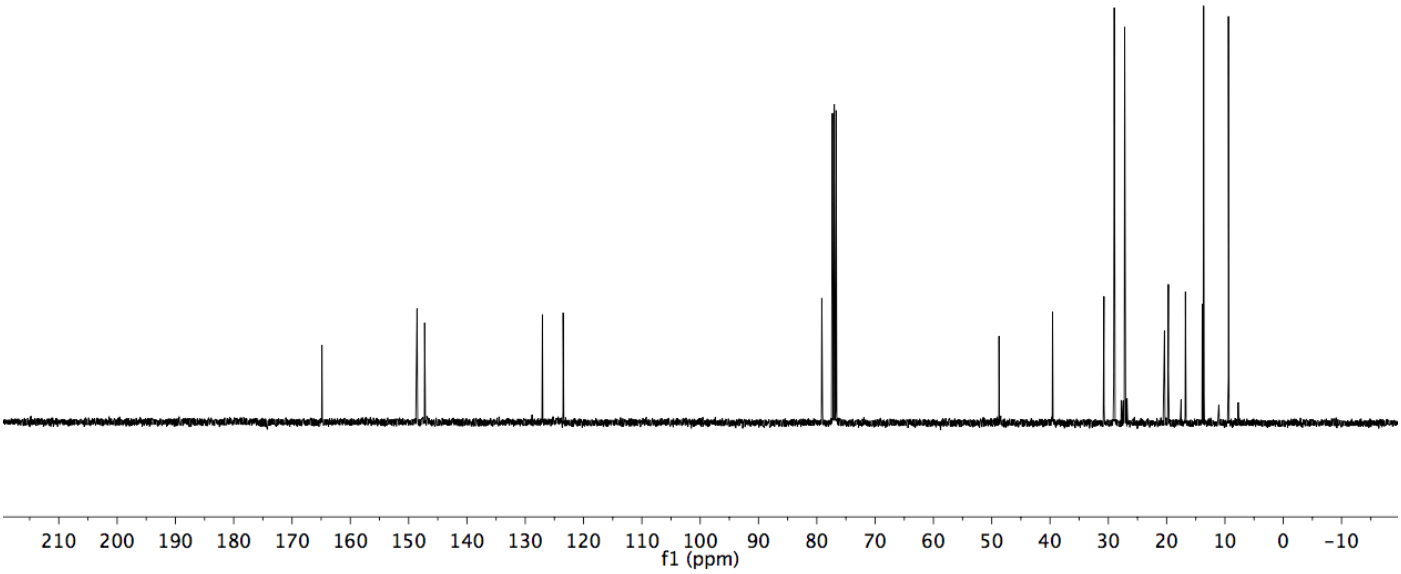

9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1
f1 (ppm)

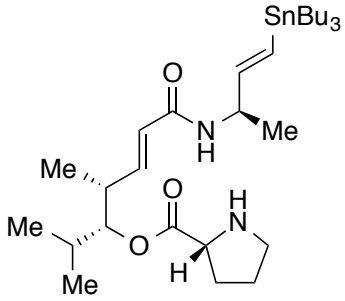

210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


SnBu3
O
N
H
Me
Me
Me
OH
Me

SI-13

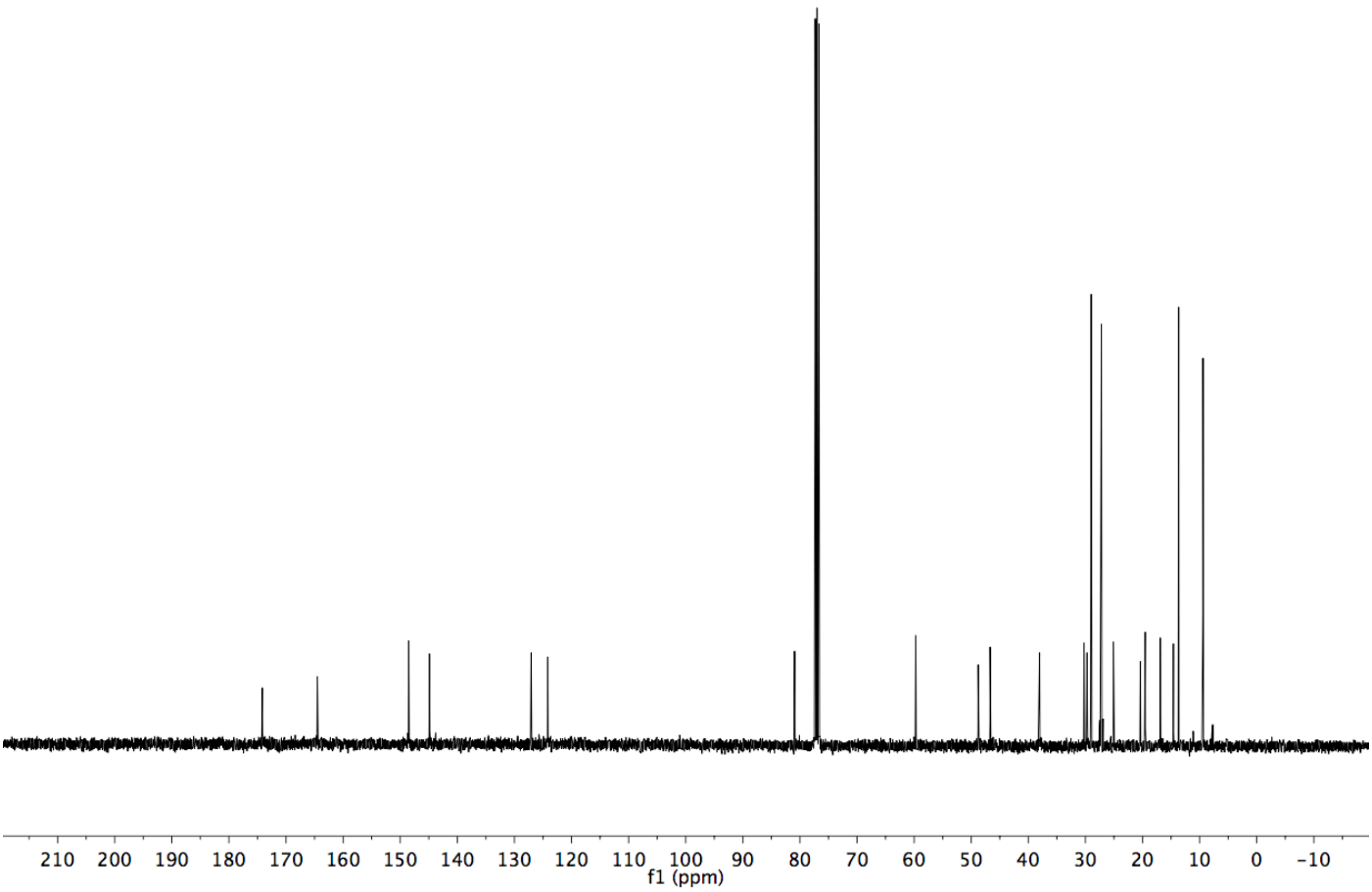
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1
f1 (ppm)

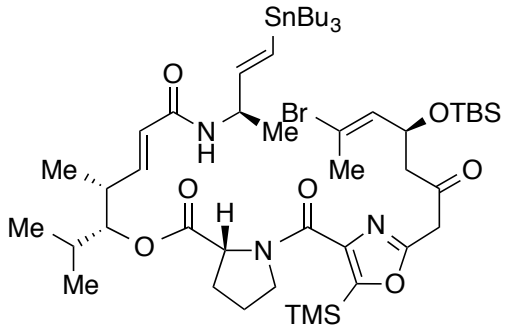

210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


SnBu3
O
N
H
Me
Me
O
H
N
O
H
Me
Me

SI-14

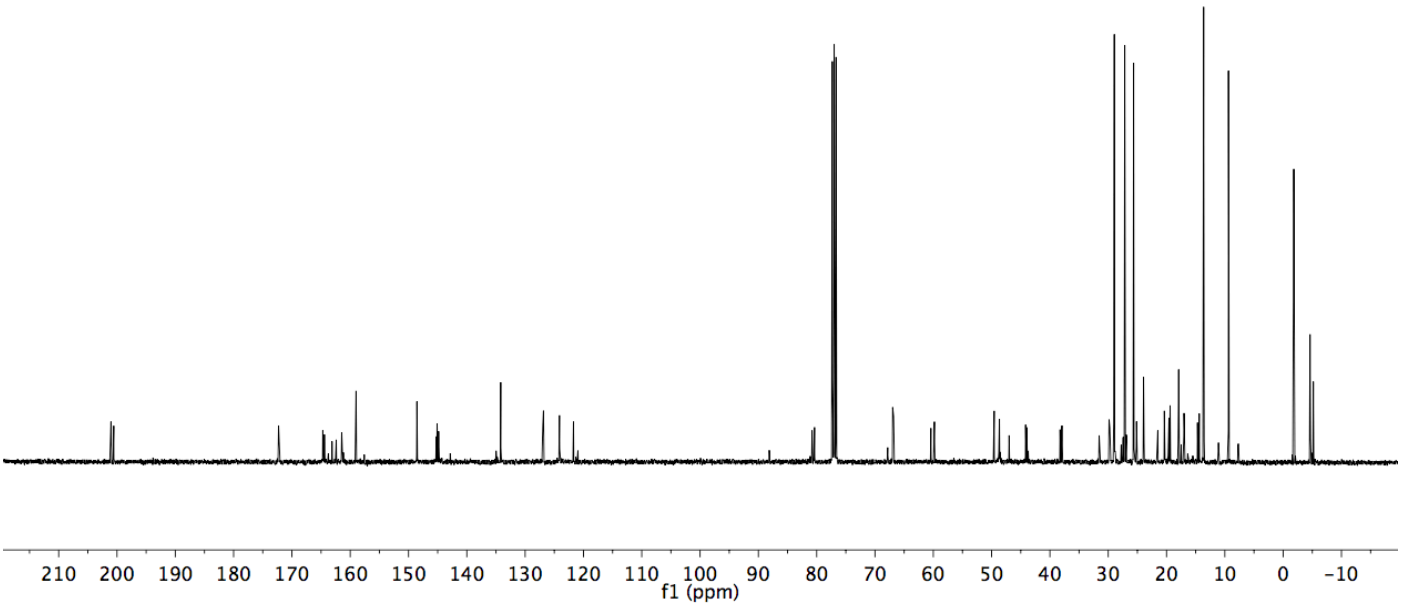
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1
f1 (ppm)

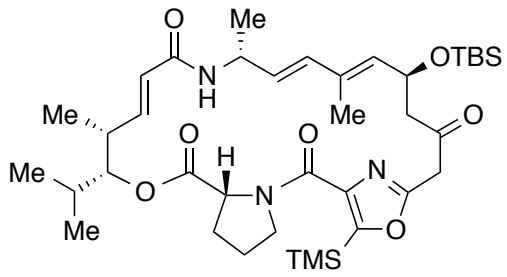

210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


SnBu3
O
N
H
Me
Br
OTBS
Me
Me
O
O
O
H
Me
O
N
N
Me
O
TMS

SI-15

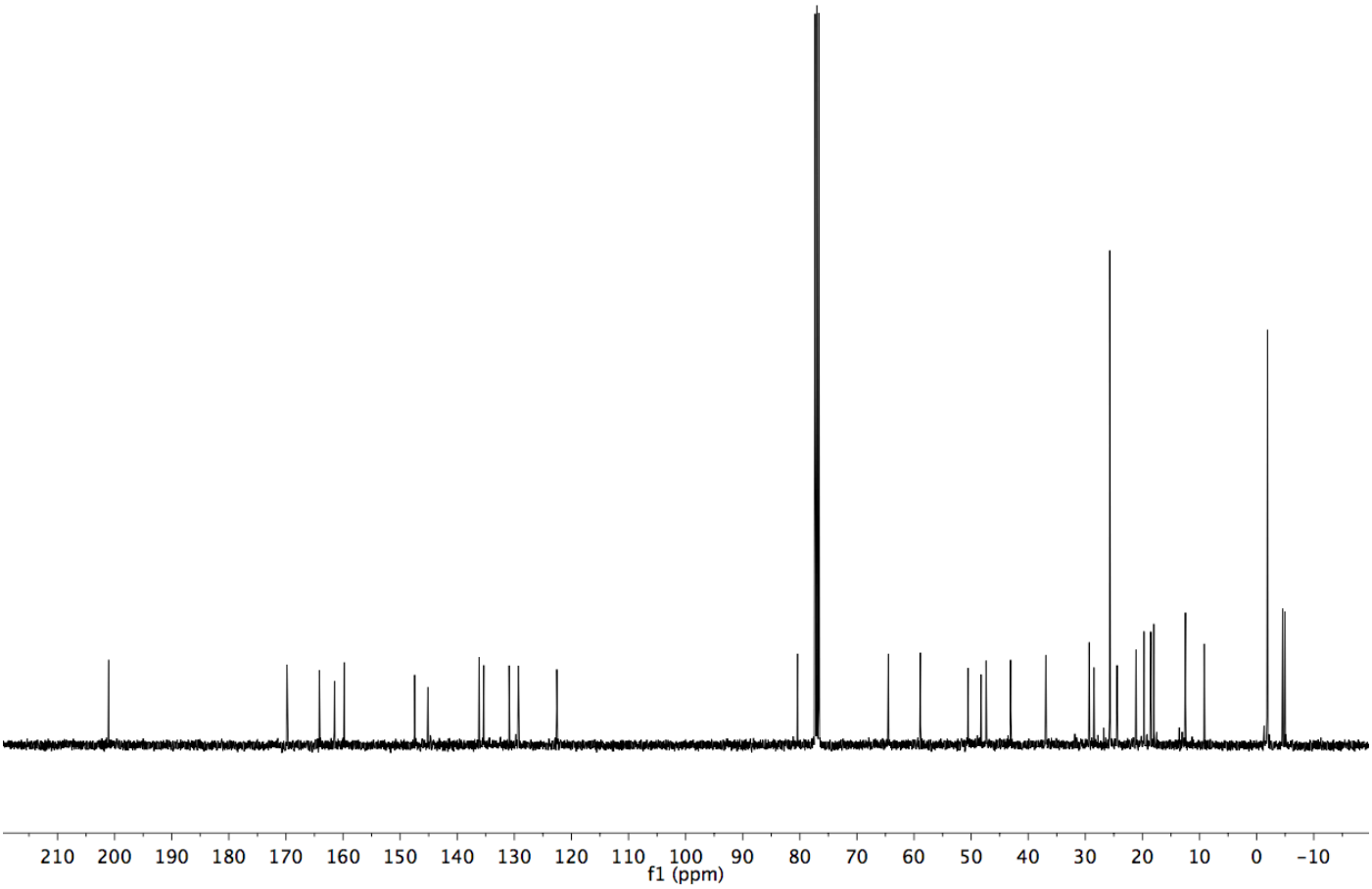
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1
f1 (ppm)

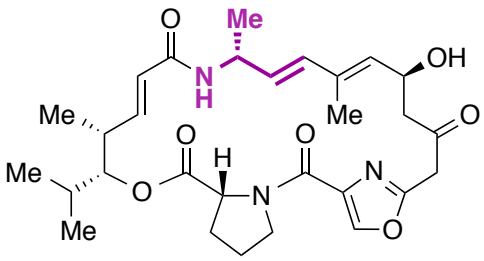

210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


O
Me
N
H
OTBS
Me
Me
O
O
H
O
Me
O
N
N
Me
O
TMS

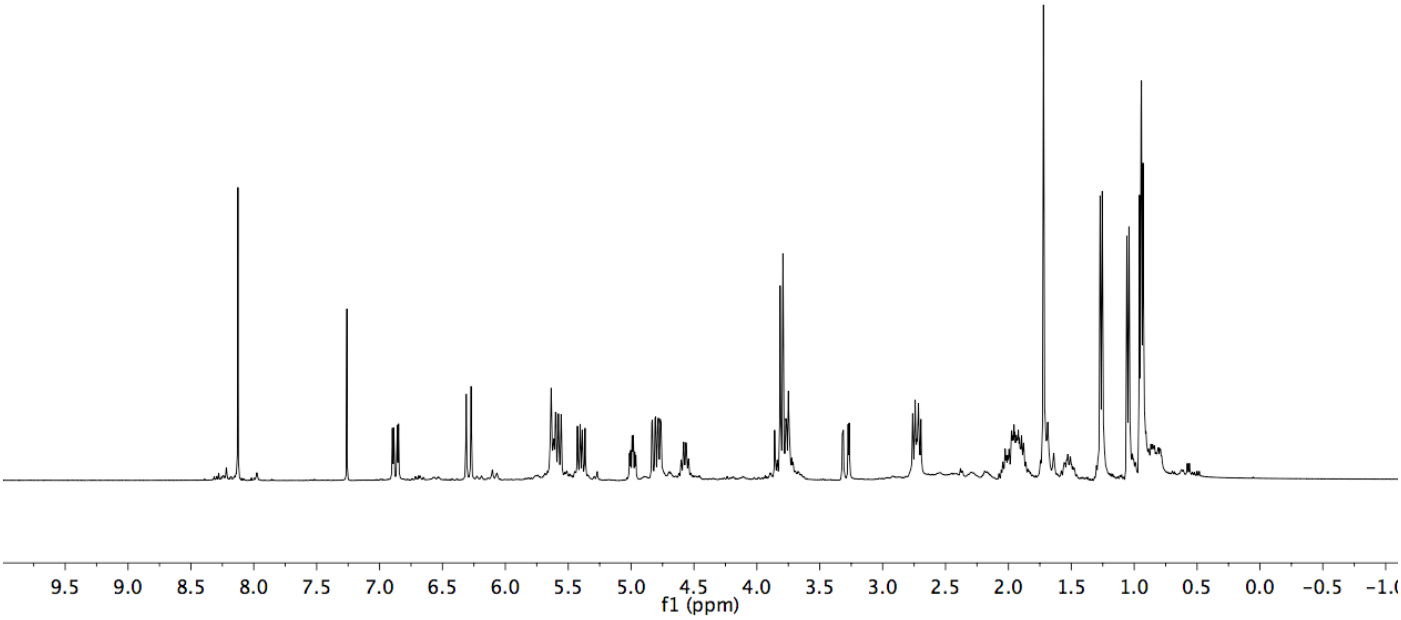
SI-16

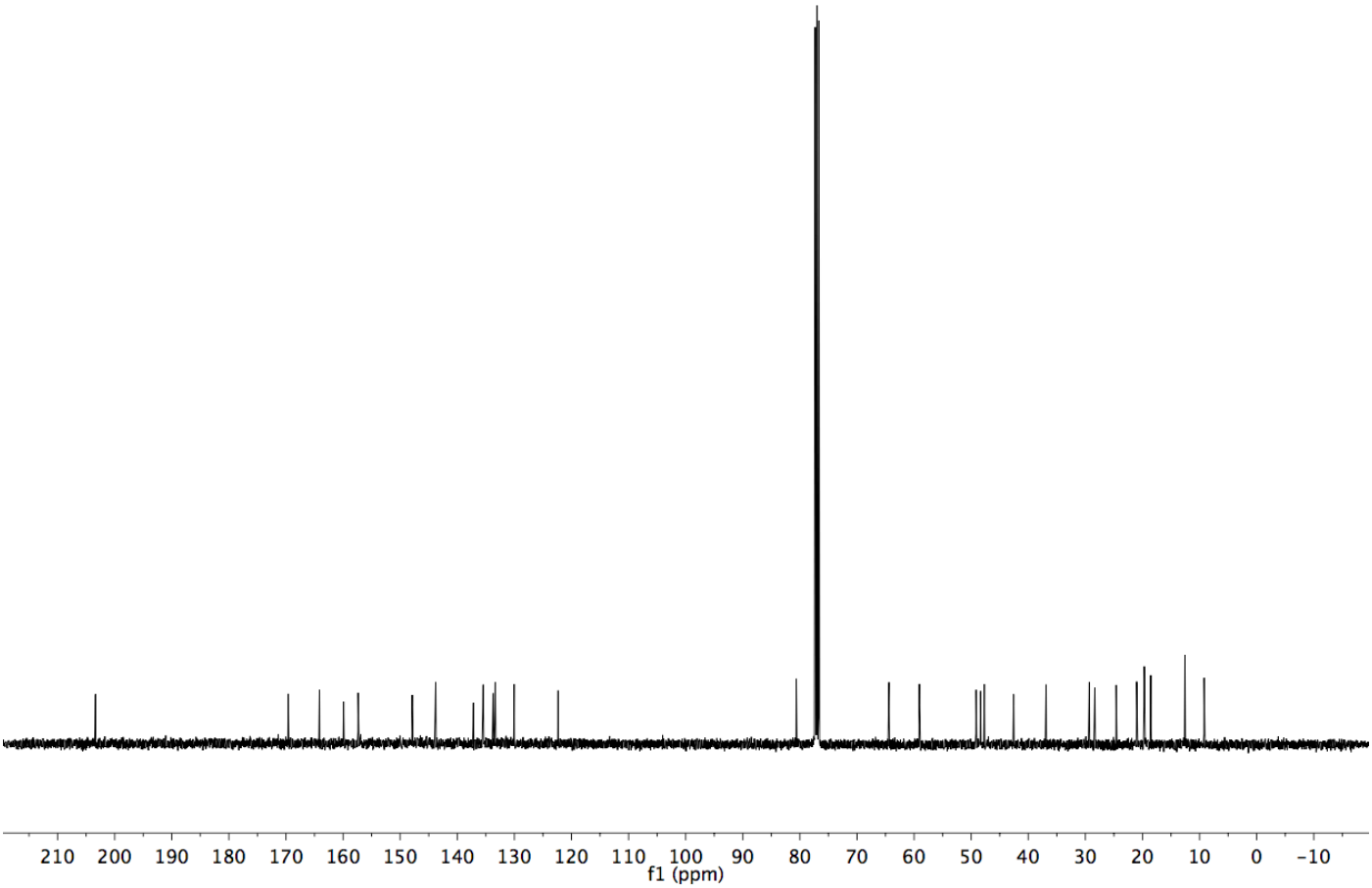
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1.
f1 (ppm)

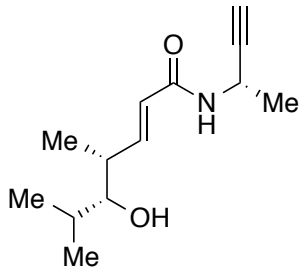

210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


O
Me
N
H
OH
Me
Me
O
O
O
H
Me
O
N
N
Me
O

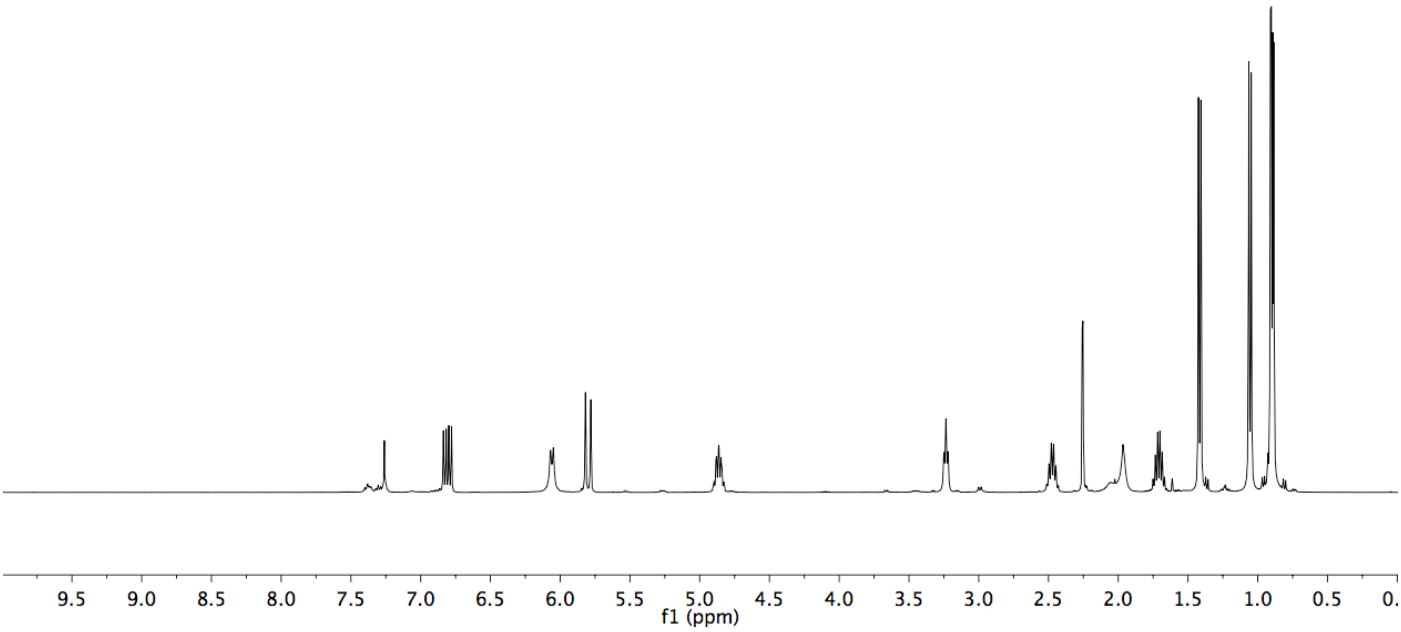
22

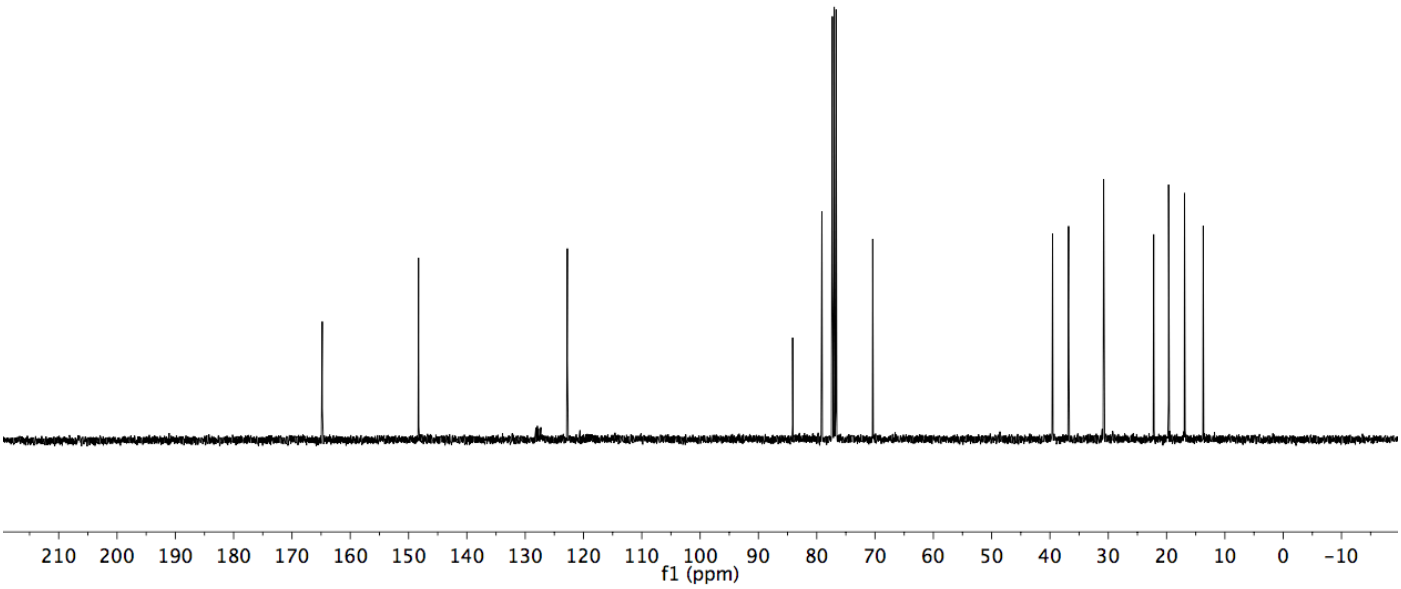

9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5
f1 (ppm)

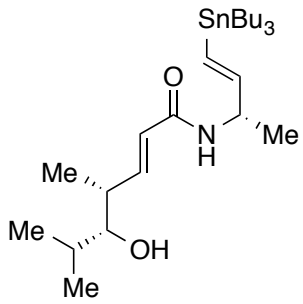

210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


O
N
H
Me
Me
Me
OH
Me

SI-18

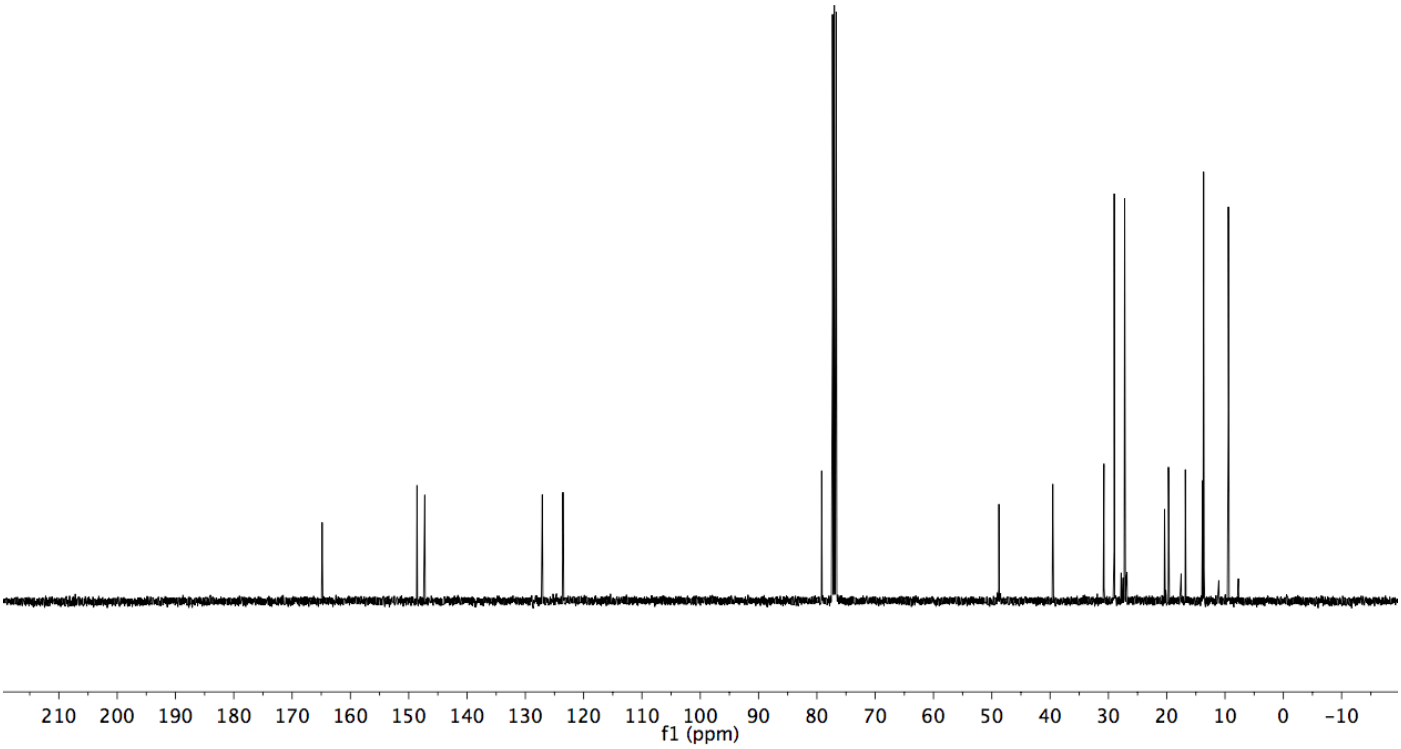

9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.
f1 (ppm)

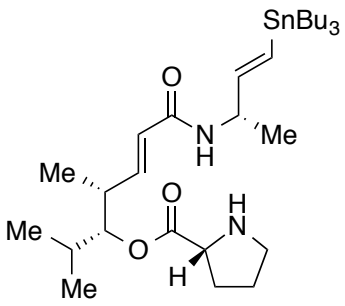

210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


SnBu3
O
N
H
Me
Me
Me
OH
Me

SI-19

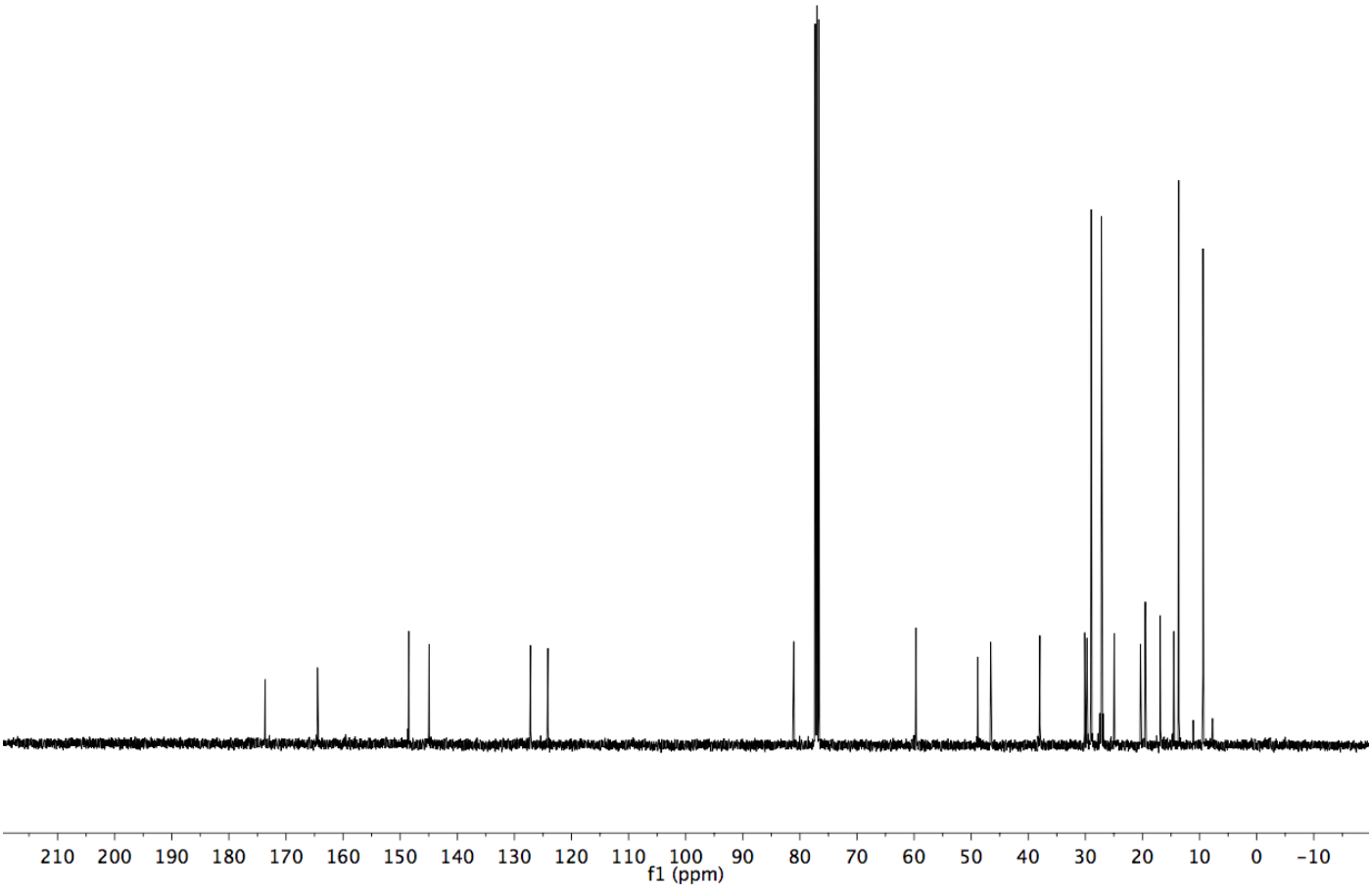
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1.
f1 (ppm)

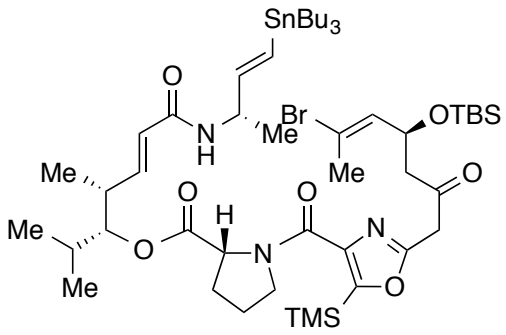

210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


SnBu3
O
N
H
Me
Me
O
H
N
Me
O
H
Me

SI-20

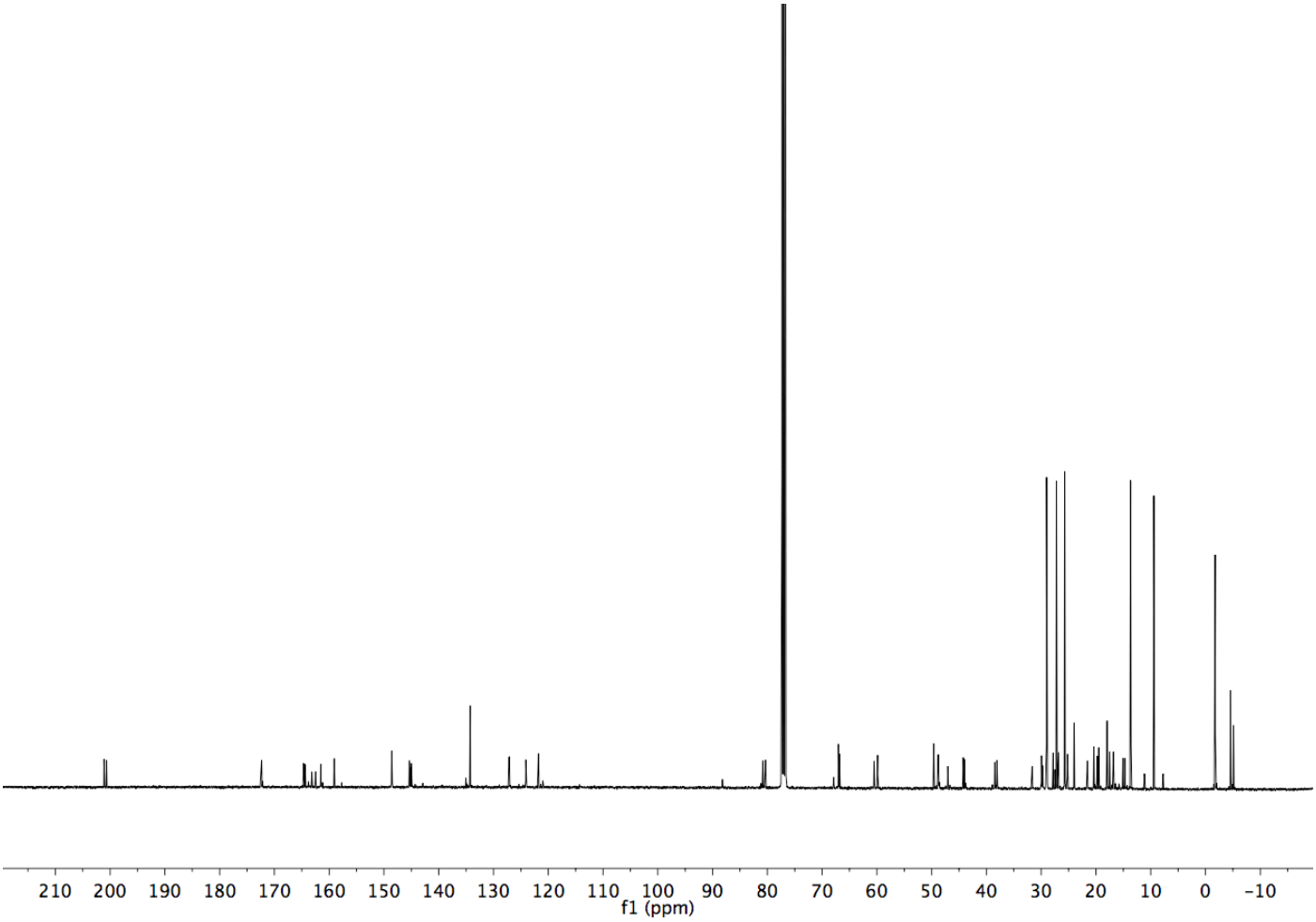
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5
f1 (ppm)

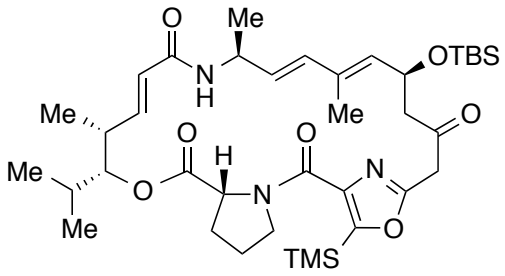

210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


SnBu3
O
N
H
Br
Me
OTBS
Me
Me
O
O
O
H
Me
O
N
N
O
Me
TMS

SI-21

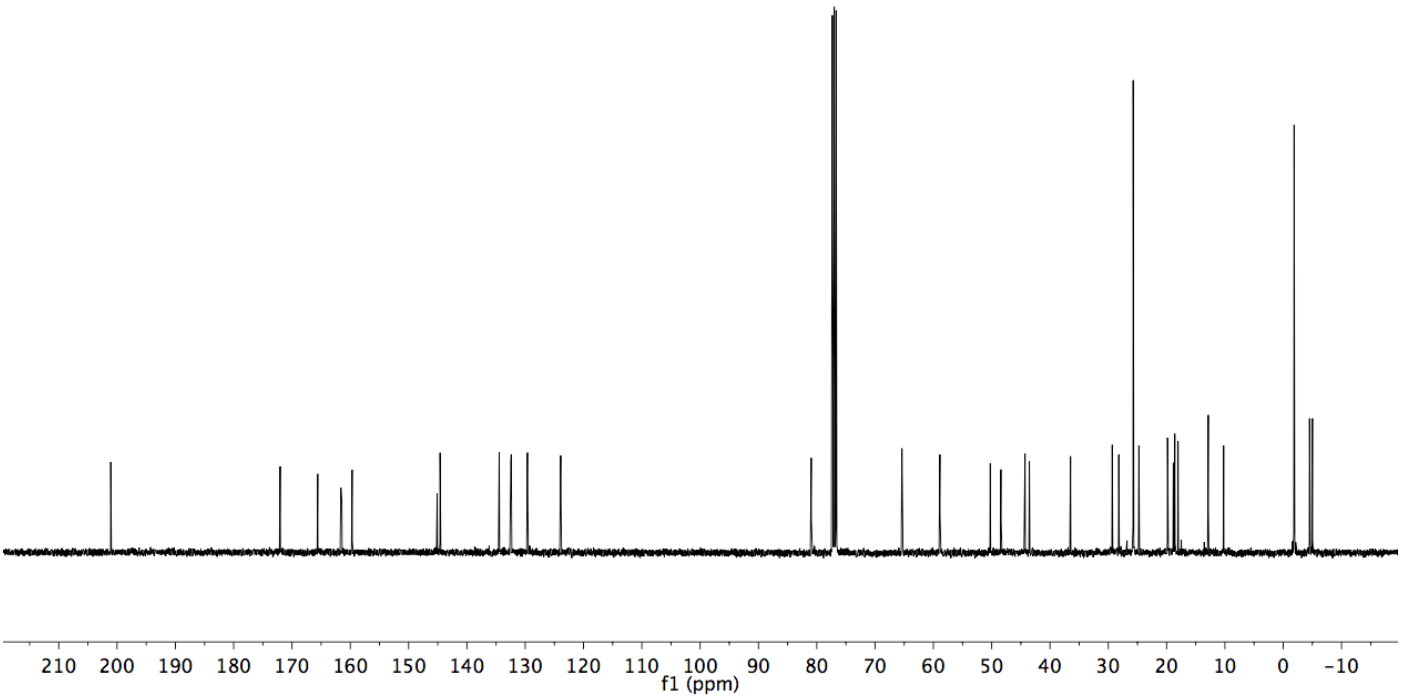
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1.
f1 (ppm)

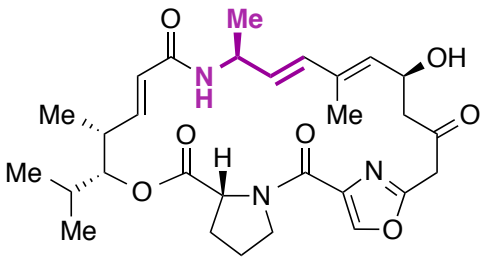

210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


O
Me
N
H
OTBS
Me
Me
O
O
H
O
Me
O
N
N
O
Me
TMS

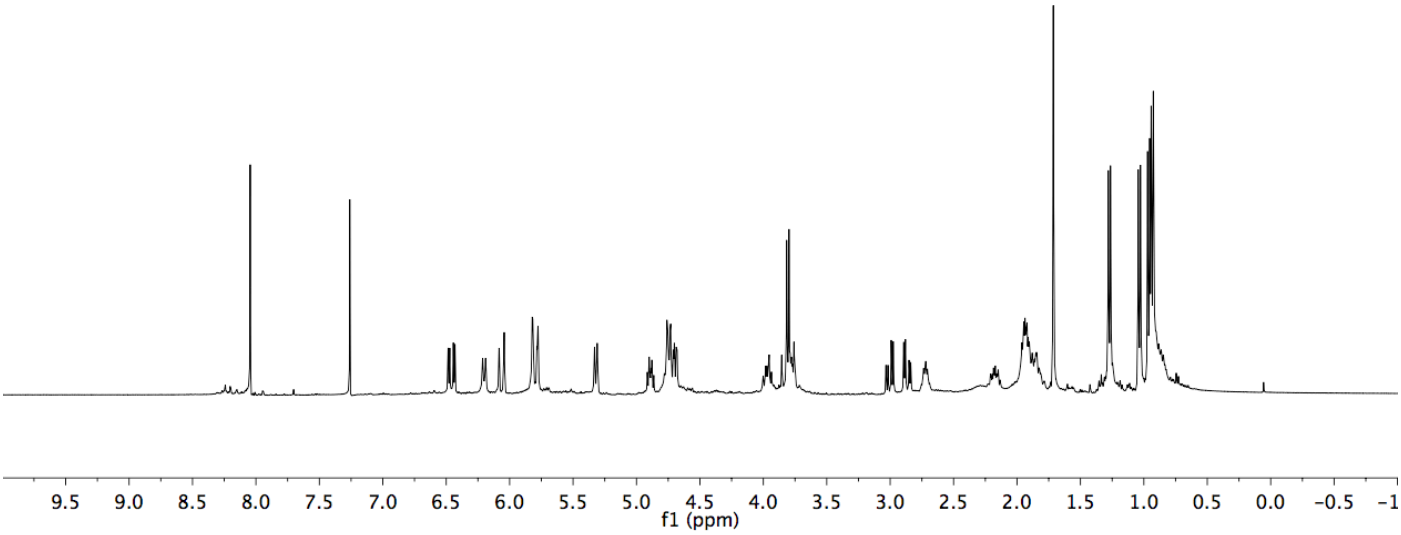
SI-22

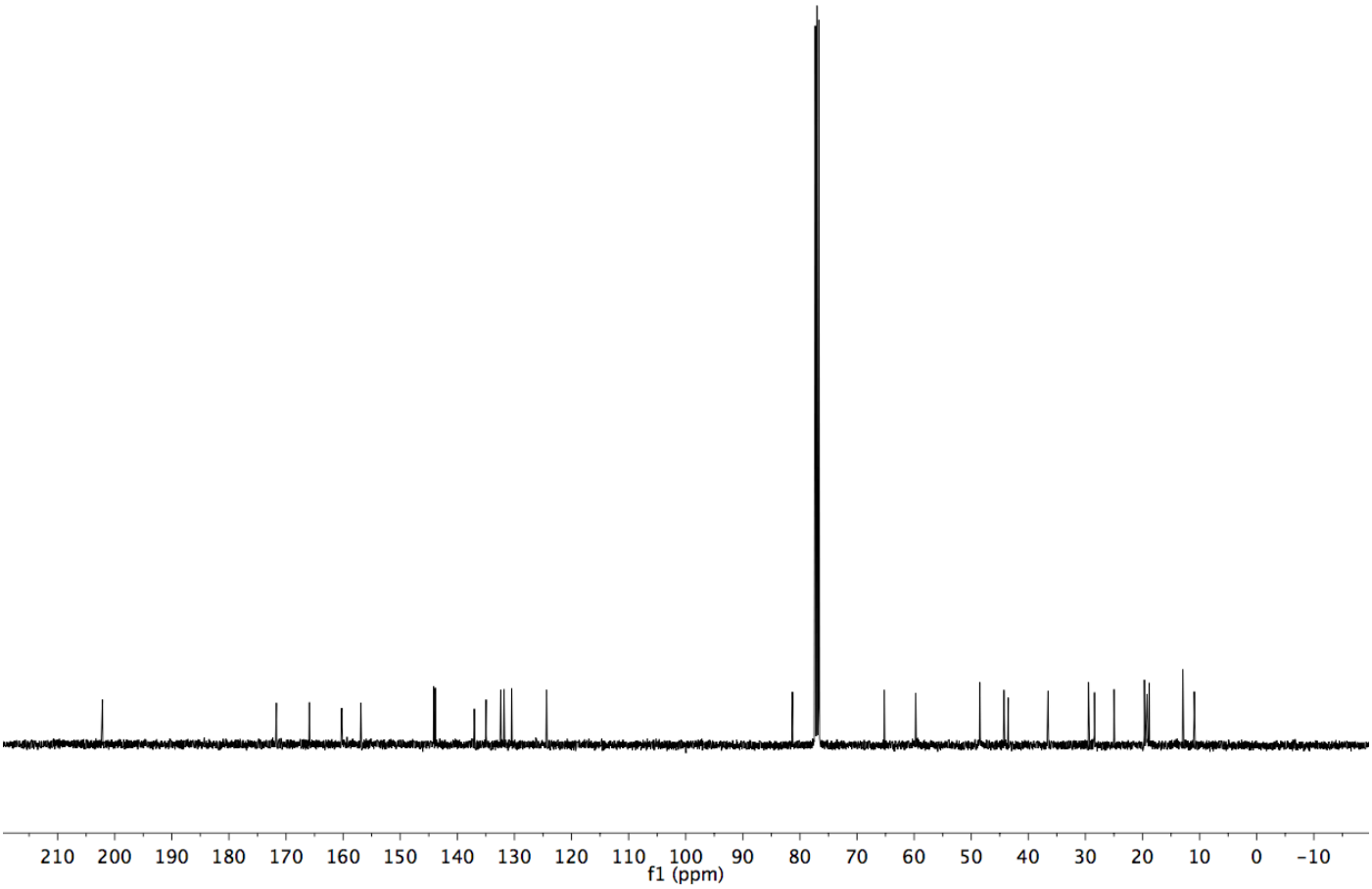
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1
f1 (ppm)

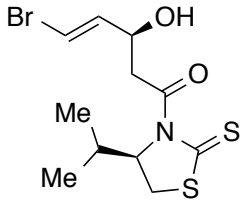

210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


O
Me
N
H
OH
Me
Me
O
O
H
O
Me
O
N
N
Me
O

23

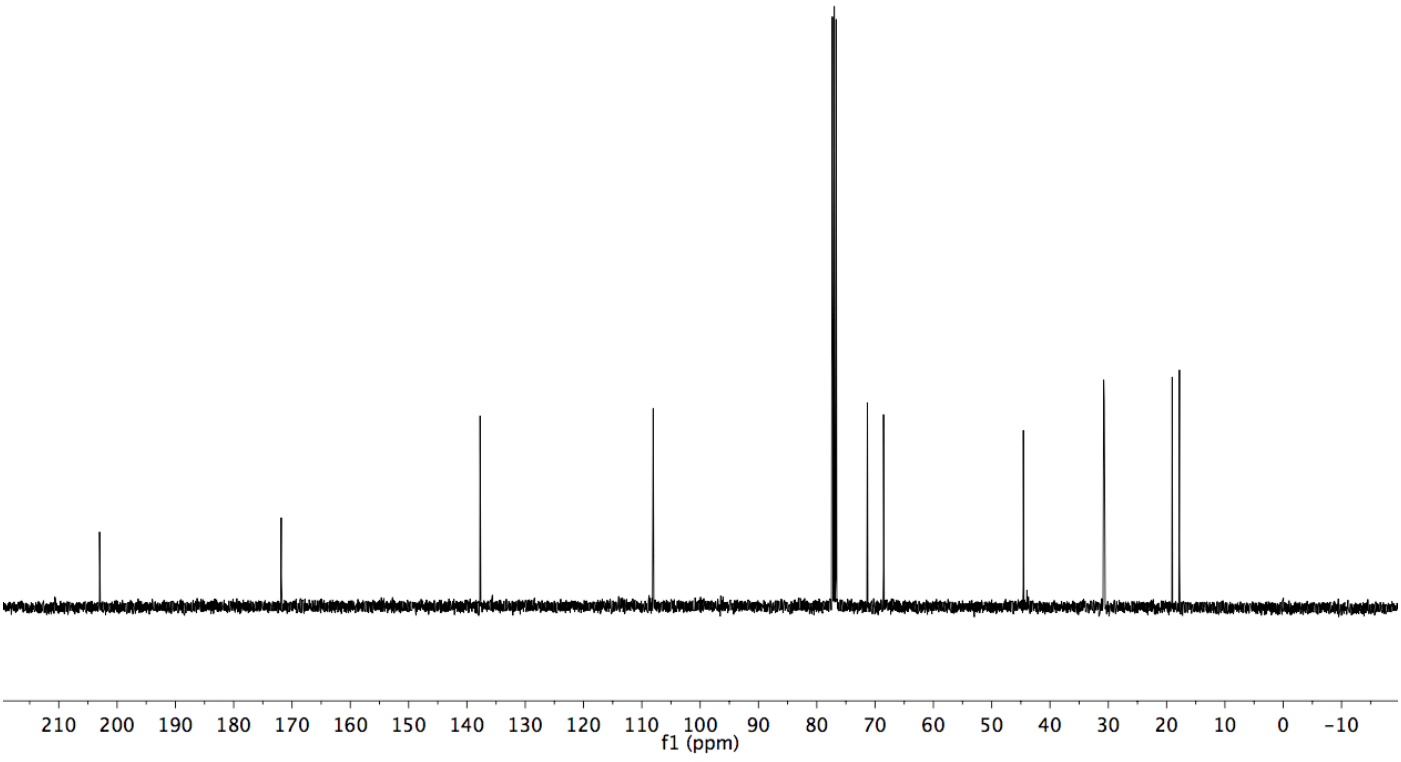

9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1
f1 (ppm)

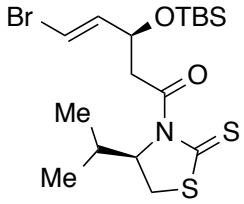

210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


Br
OH
O
Me
N
S
Me
S

SI-24

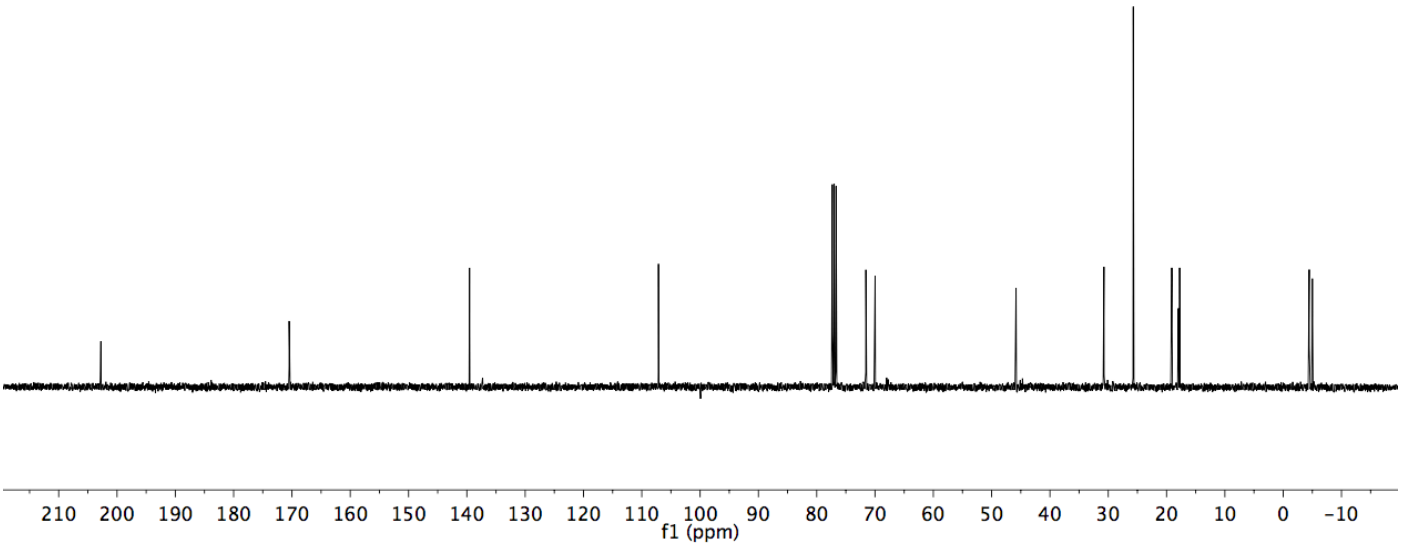
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1
f1 (ppm)

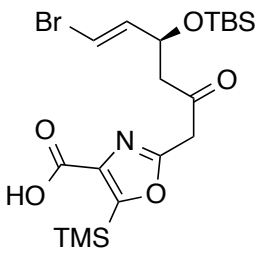

210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


Br
OTBS
O
Me
N
S
Me
S

SI-25

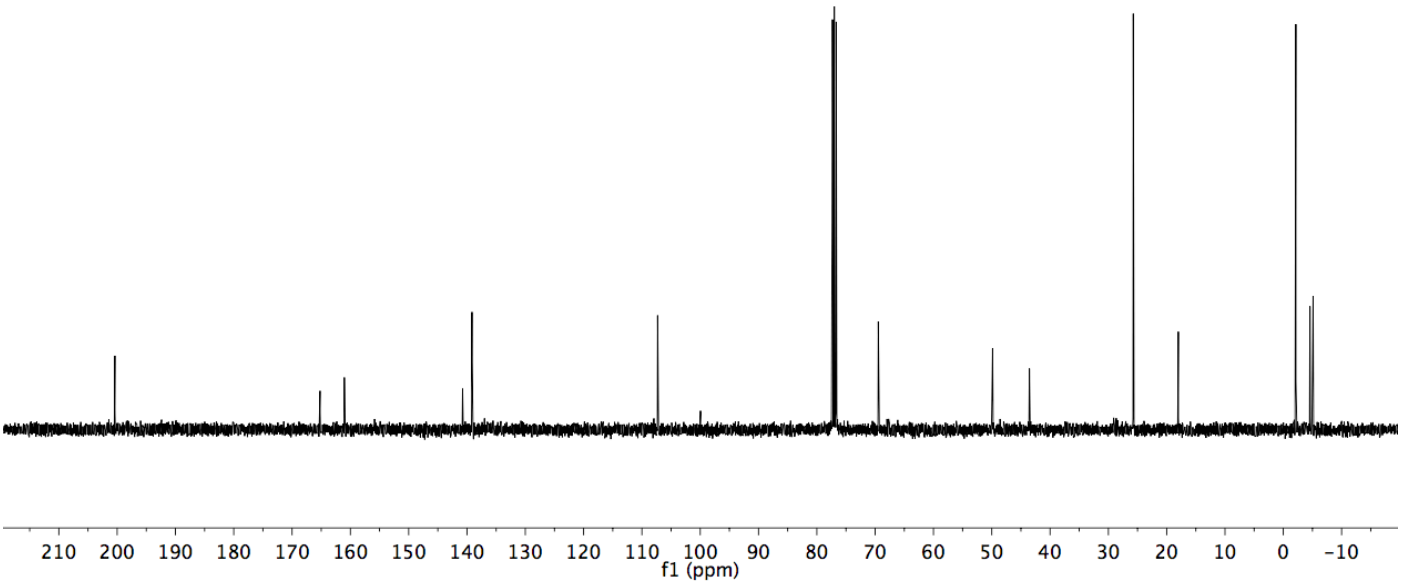
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5
f1 (ppm)

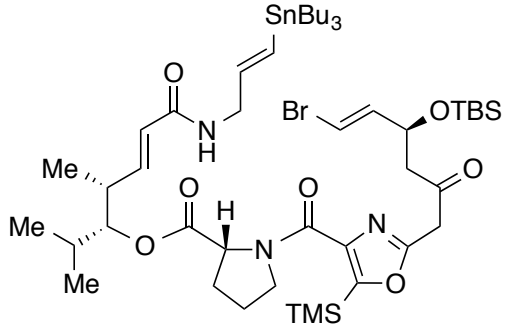

210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


Br
OTBS
O
O
N
HO
O
TMS

SI-26

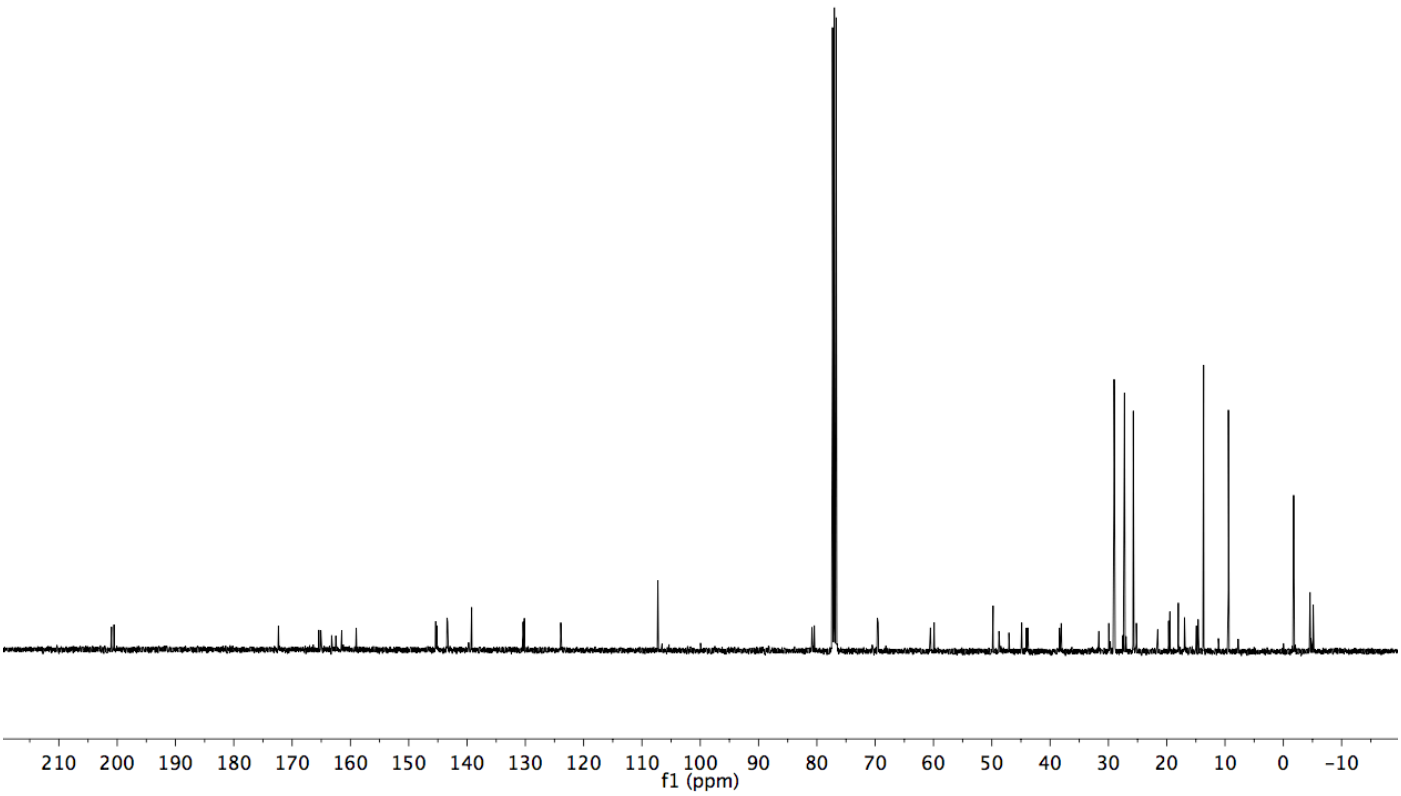
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1.
f1 (ppm)

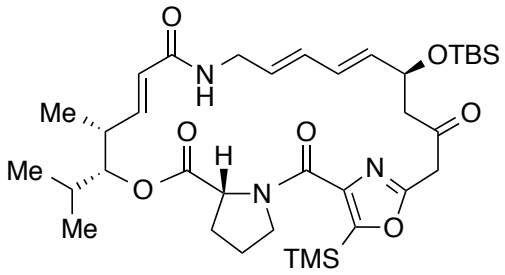

210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


SnBu3
O
N
H
Br
OTBS
Me
O
O
H
O
N
N
Me
O
O
Me
TMS

SI-27

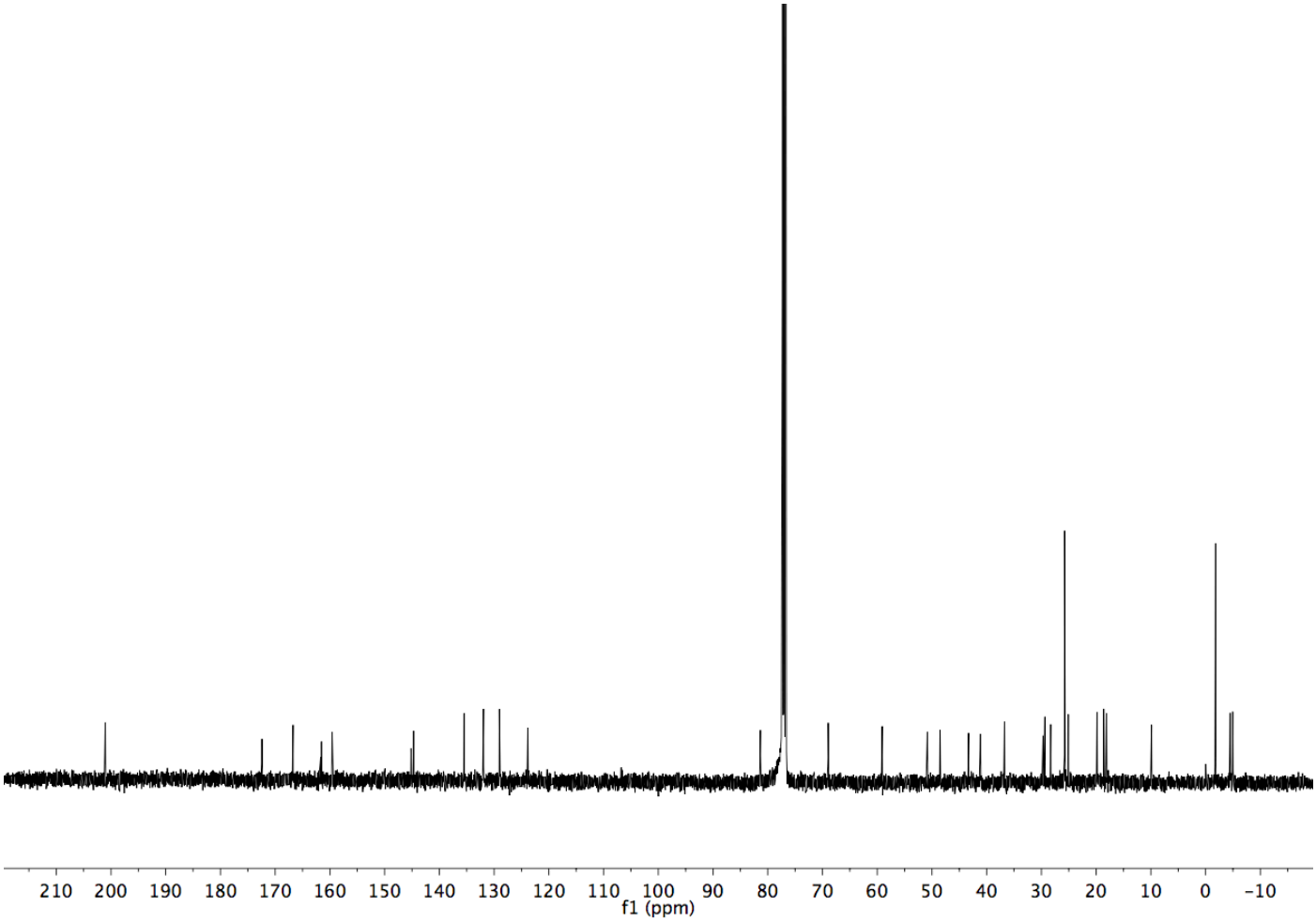
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5
f1 (ppm)

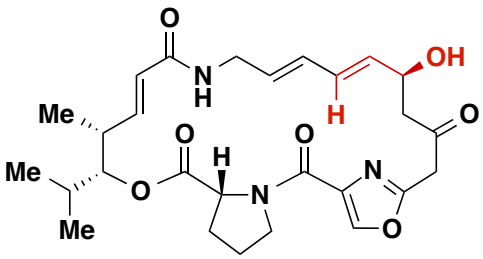

210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


O
N
H
OTBS
Me
O
O
Me
O
H
N
N
O
O
Me
TMS

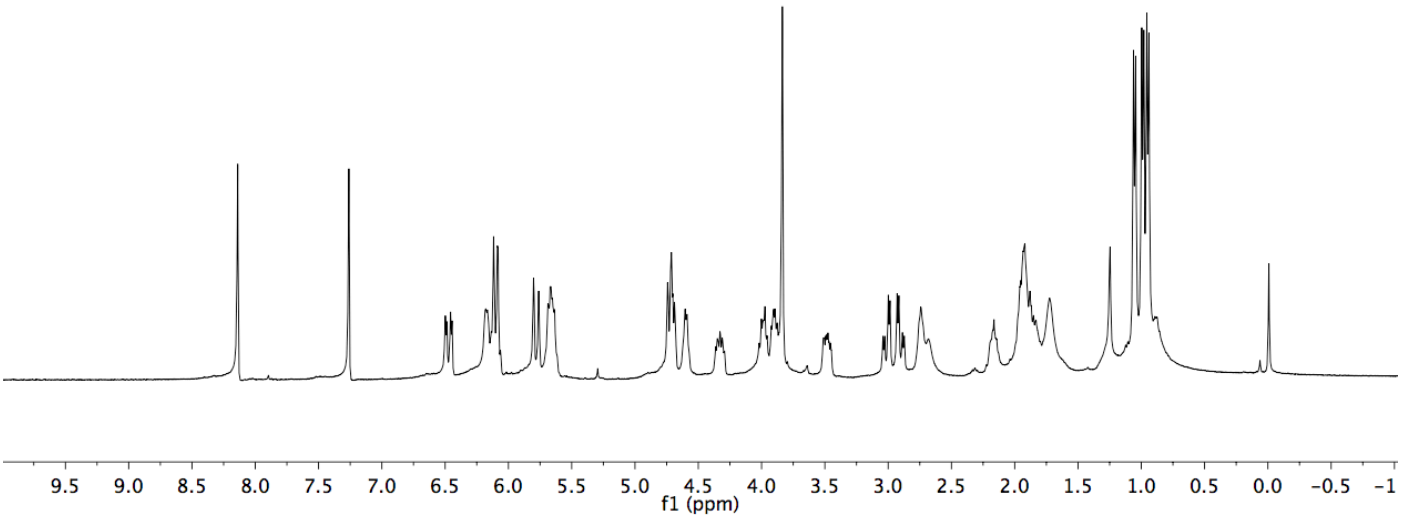
SI-28

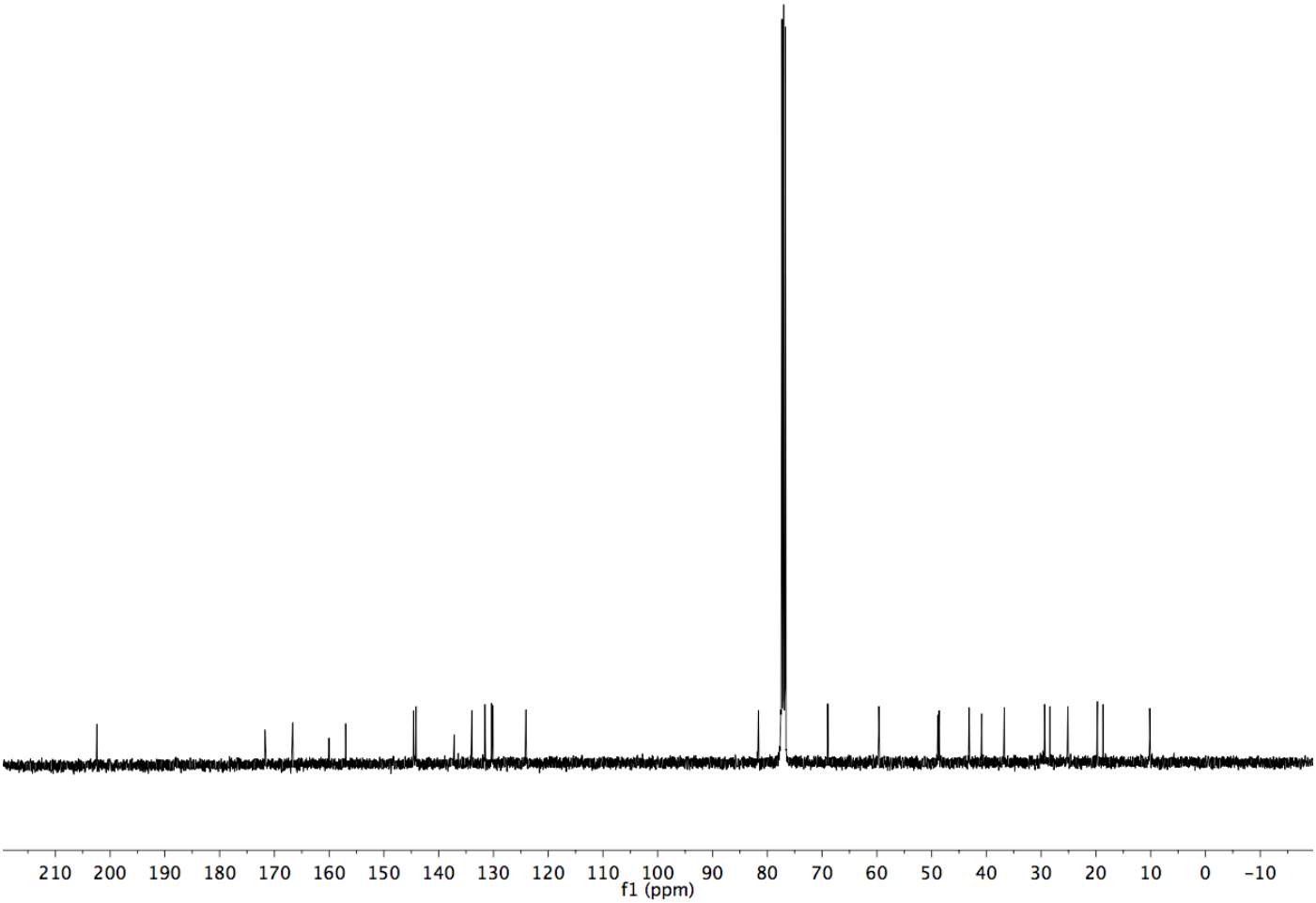
0.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5
f1 (ppm)

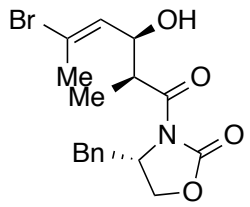

210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


O
N
H
OH
H
O
Me
O
H
O
Me
O
N
N
Me
O

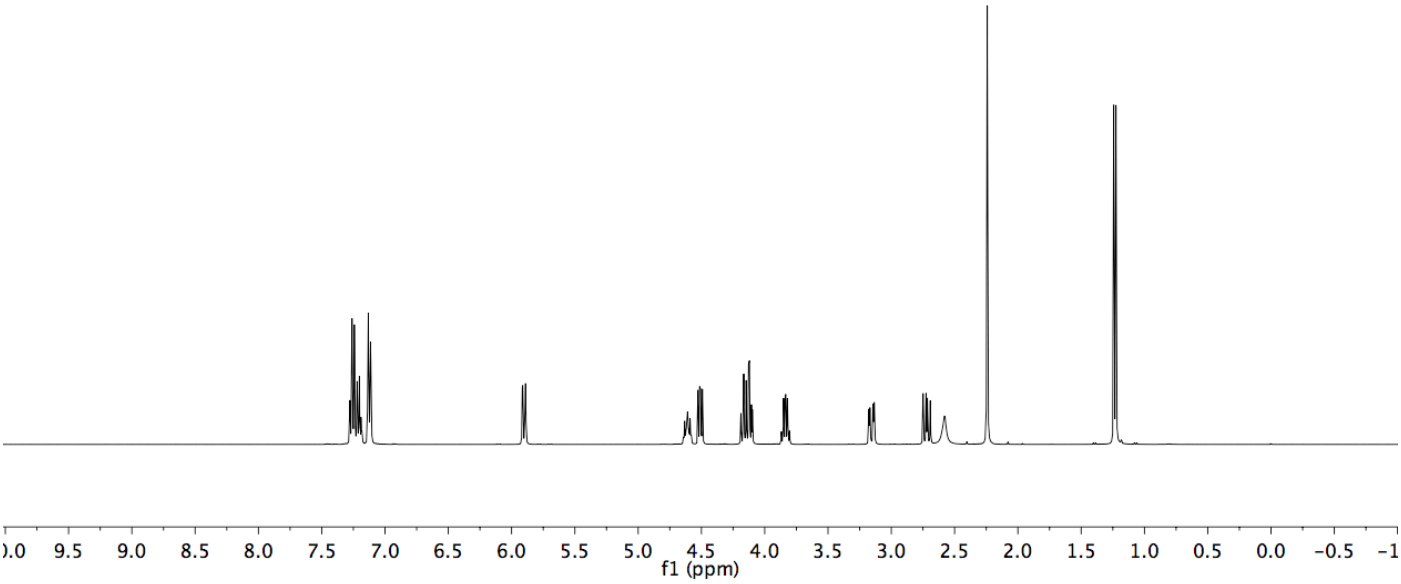
24

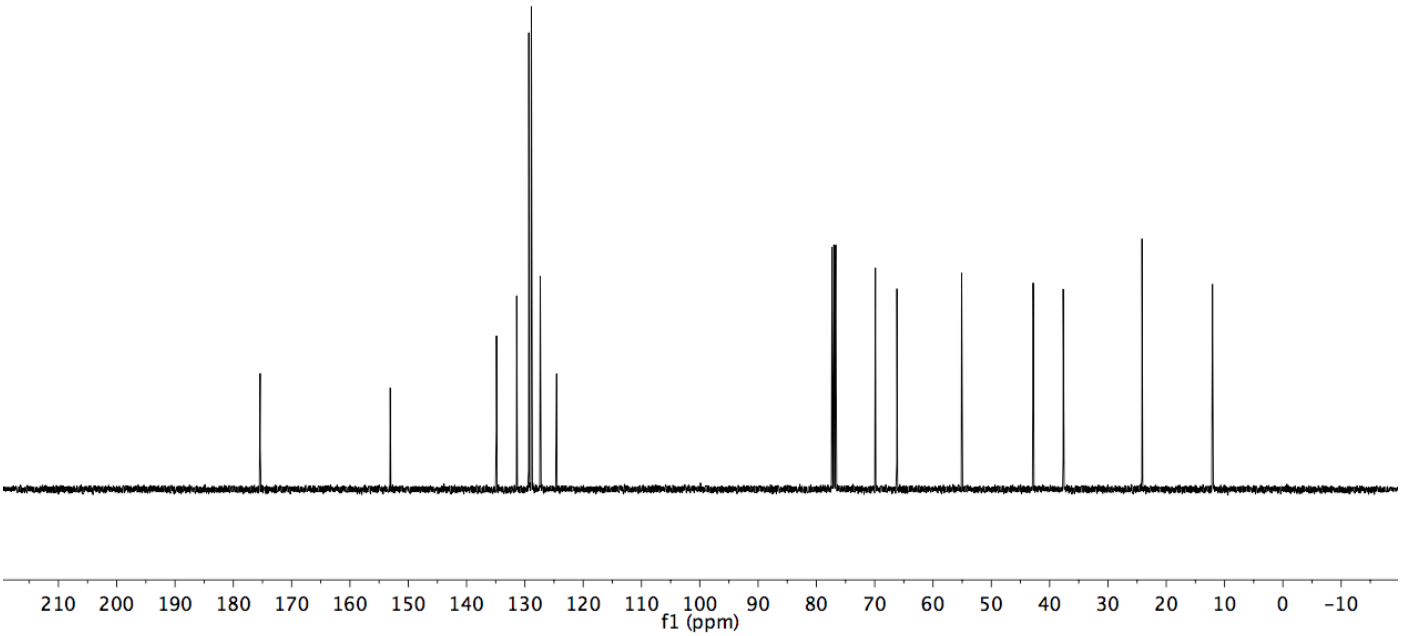

9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1
f1 (ppm)

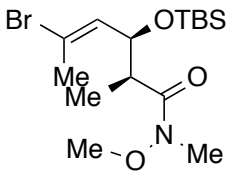

210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


Br
OH
Me
Me
O
N
O
Bn
O

SI-30

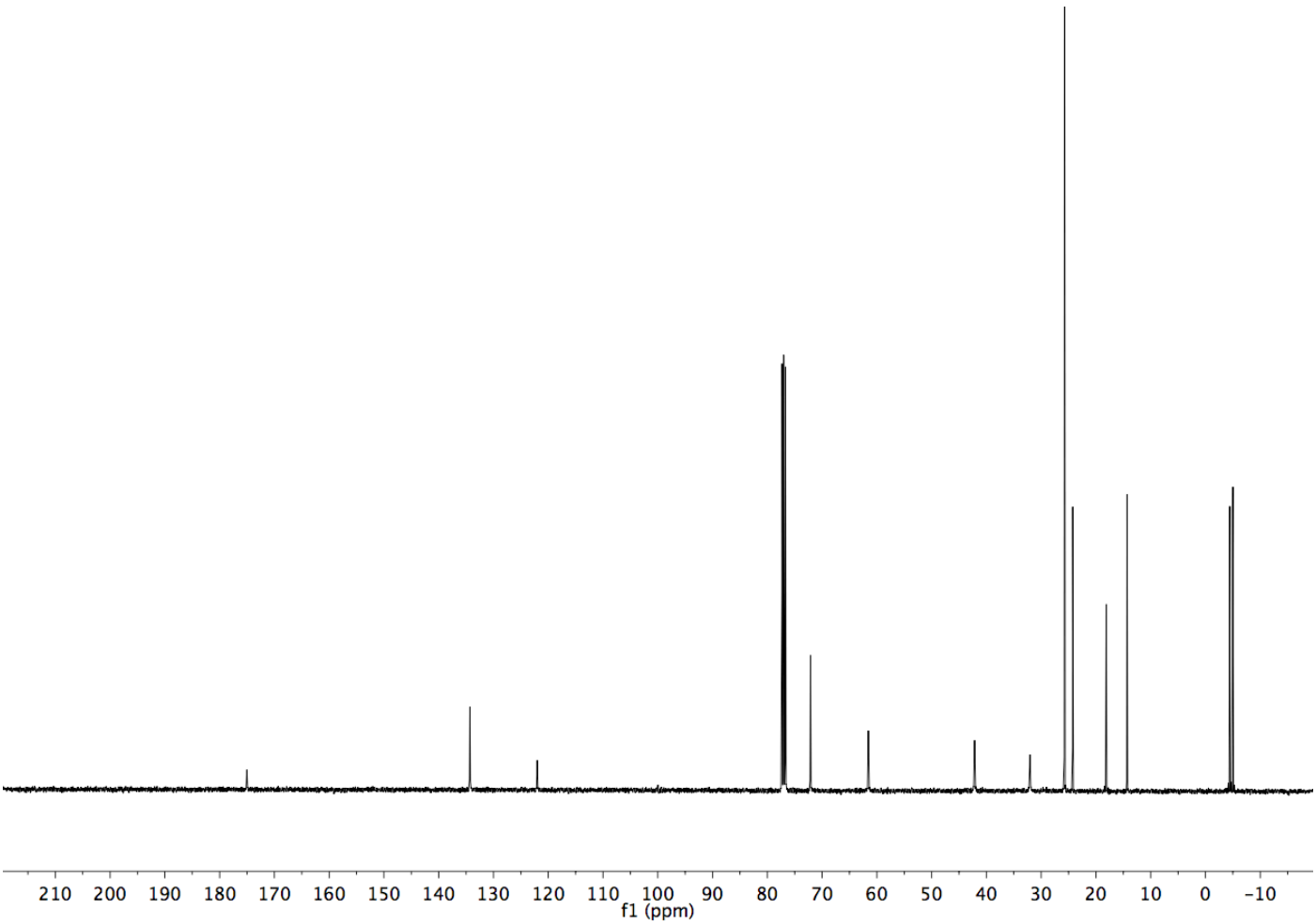

9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5
f1 (ppm)

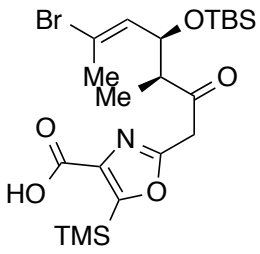

210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


Br
OTBS
Me
Me
O
N
Me
O
Me

SI-31

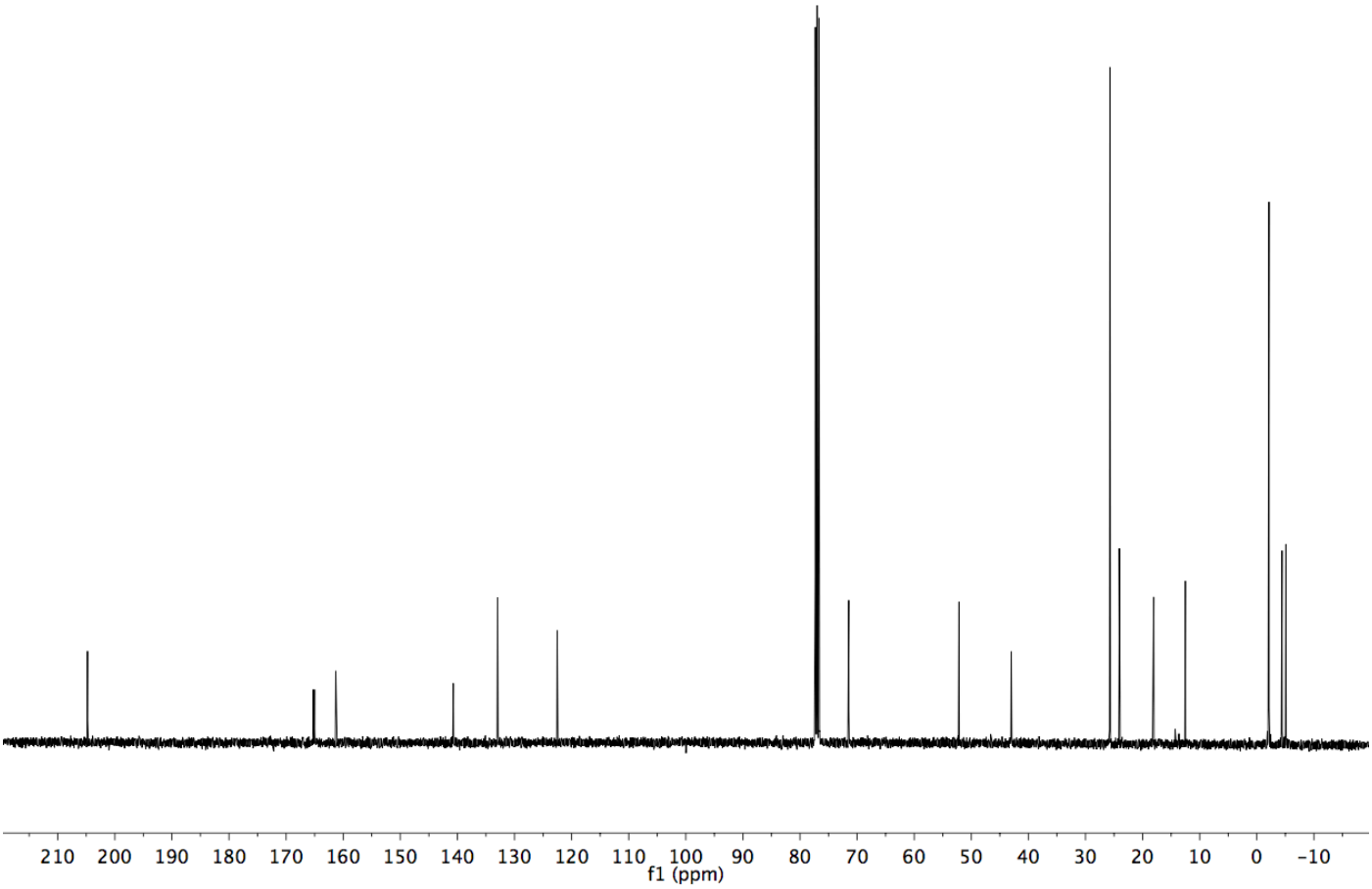
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1
f1 (ppm)

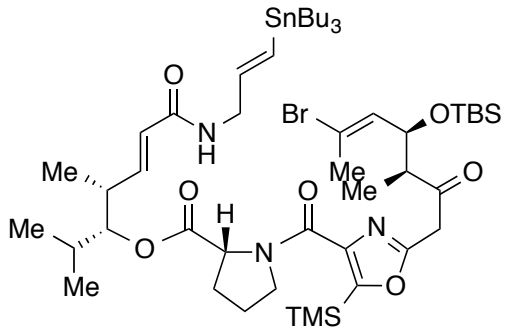

210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


Br
OTBS
Me
Me
O
O
N
HO
O
TMS

SI-32

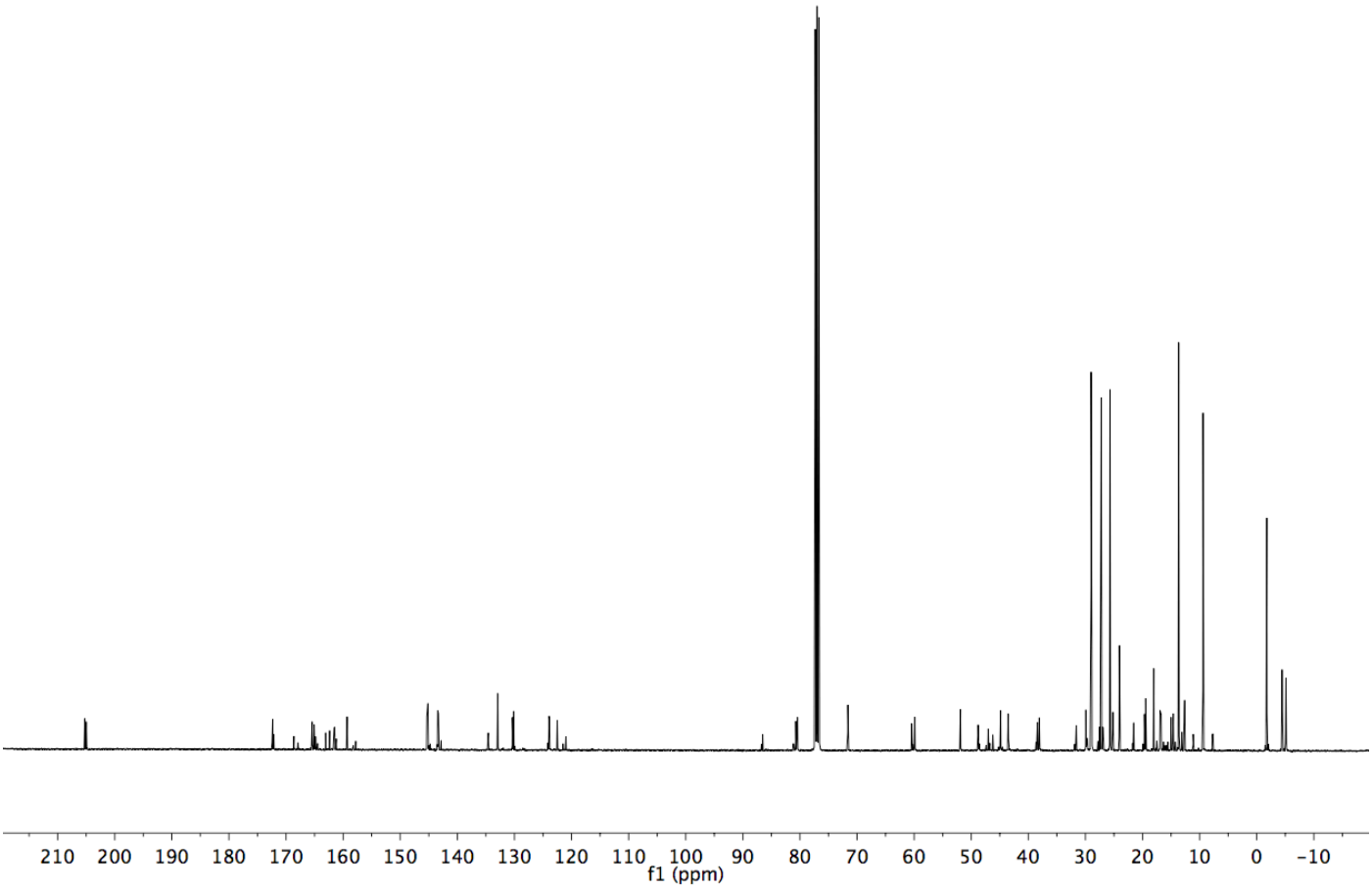
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1
f1 (ppm)

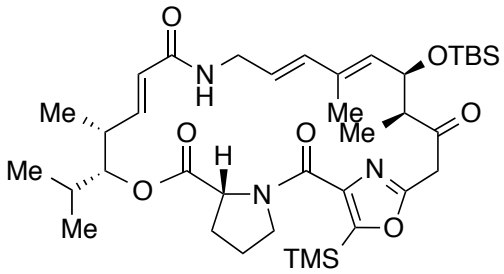

210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


SnBu3
O
N
H
Br
OTBS
Me
Me
Me
O
O
O
H
Me
O
N
N
O
Me
TMS

SI-33

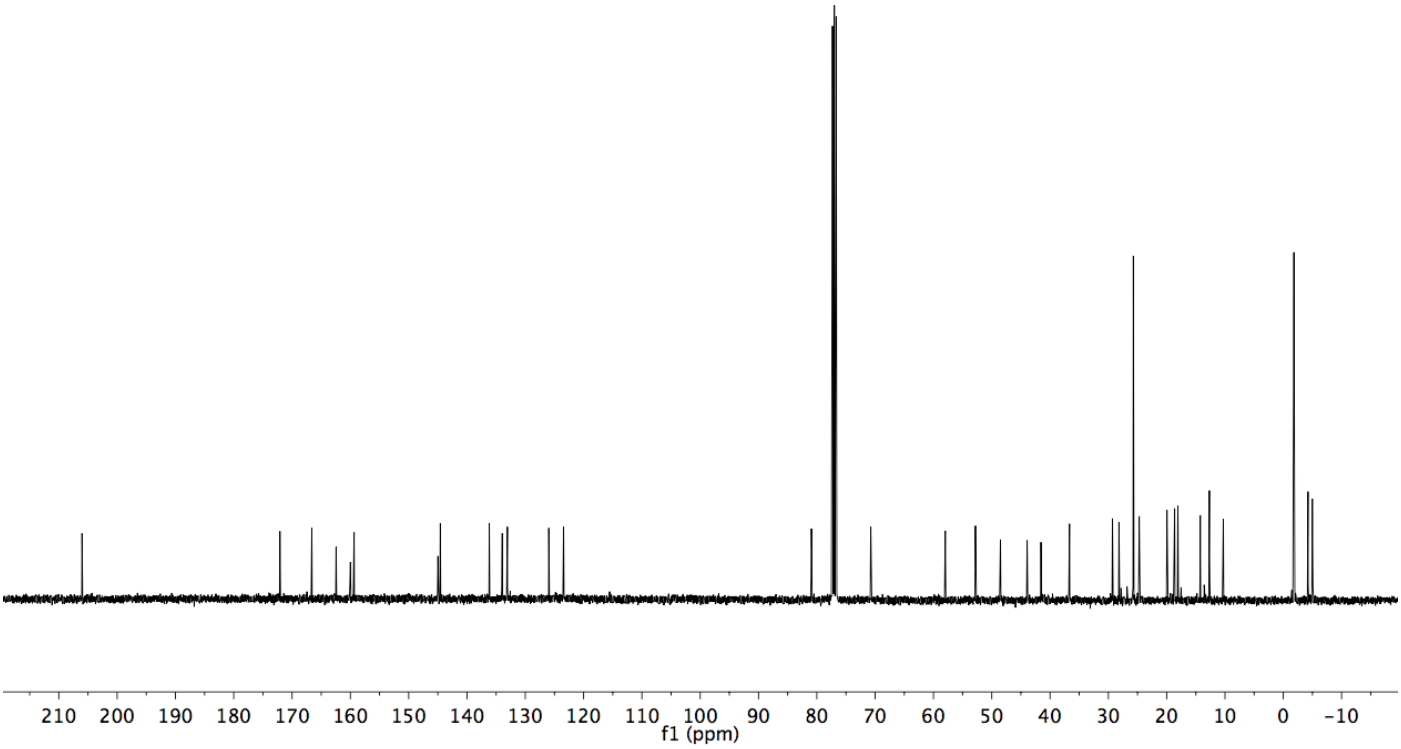
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1
f1 (ppm)

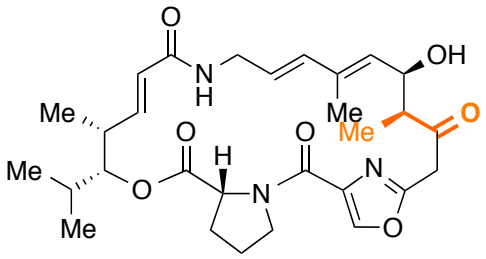

210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


O
N
H
OTBS
Me
Me
Me
O
O
O
H
Me
O
N
N
O
Me
TMS

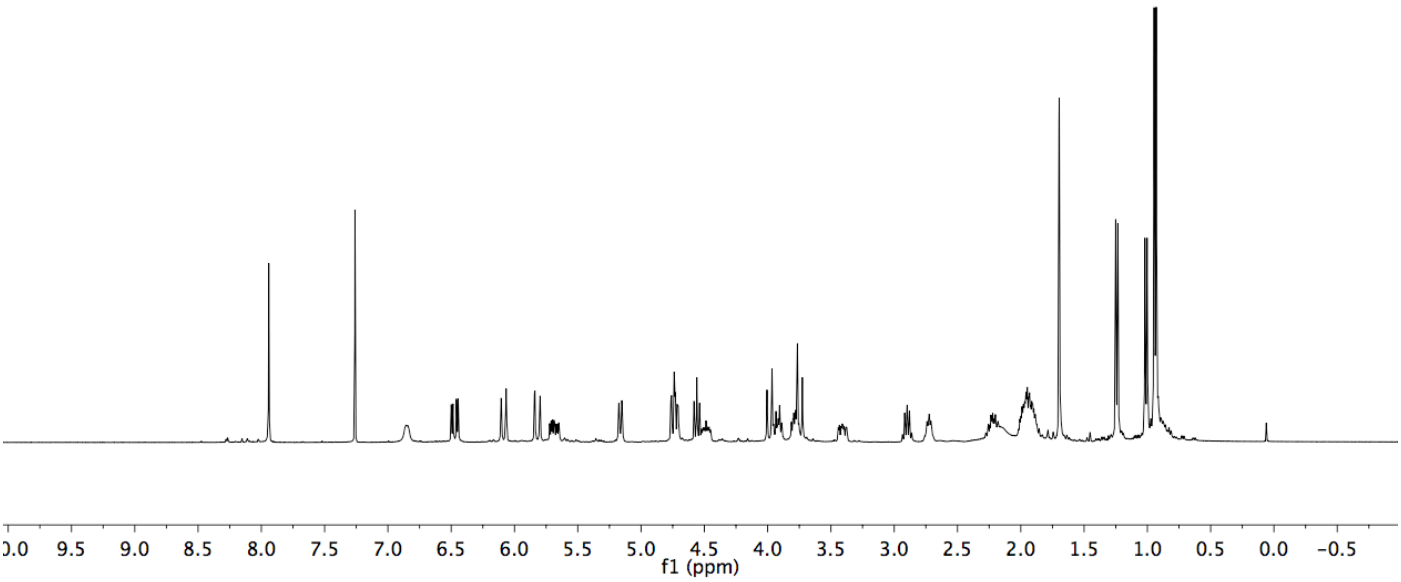
SI-34

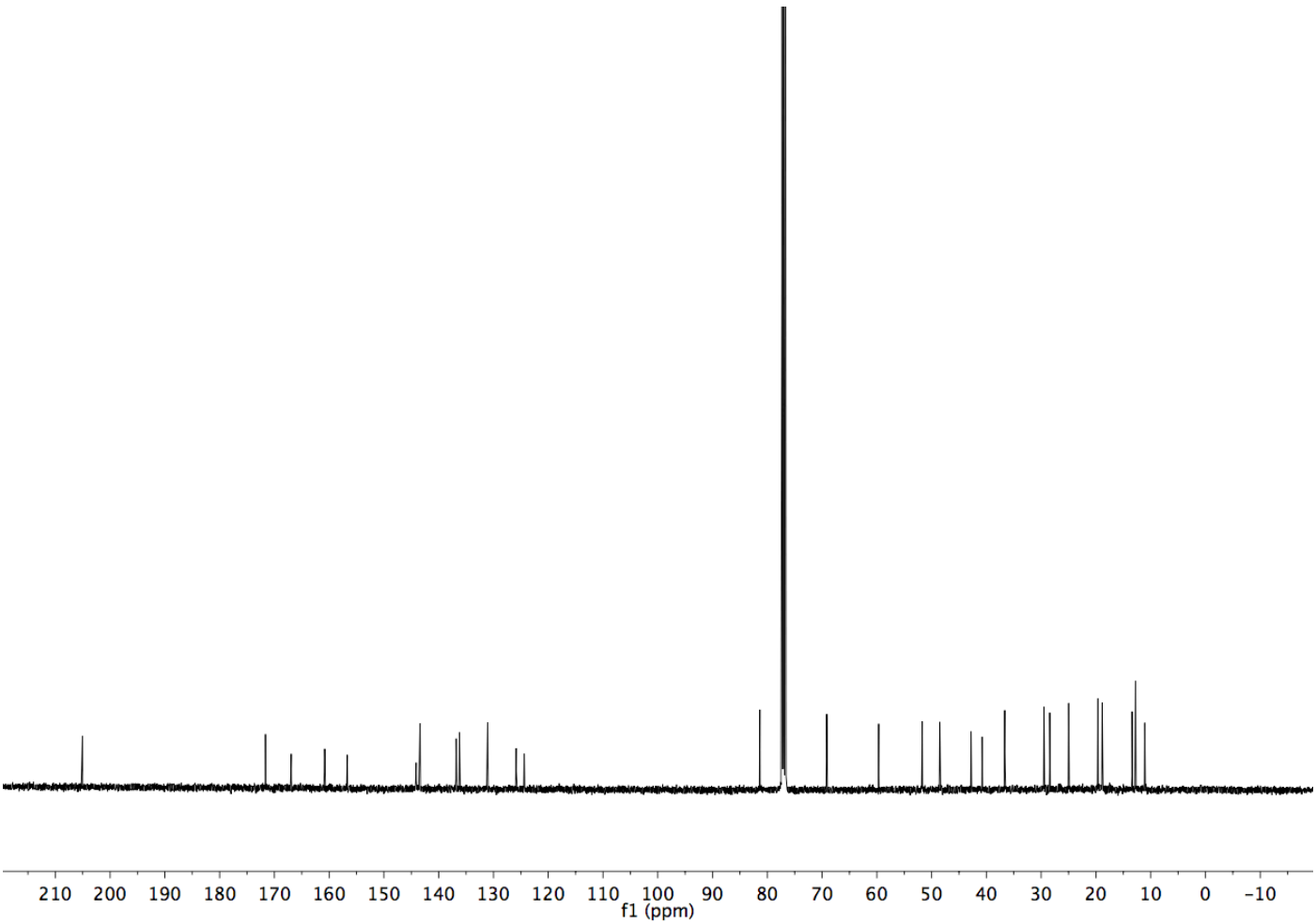
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1
f1 (ppm)

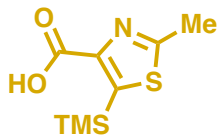

210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


O
N
H
OH
Me
Me
Me
O
O
O
H
Me
O
N
N
Me
O

25

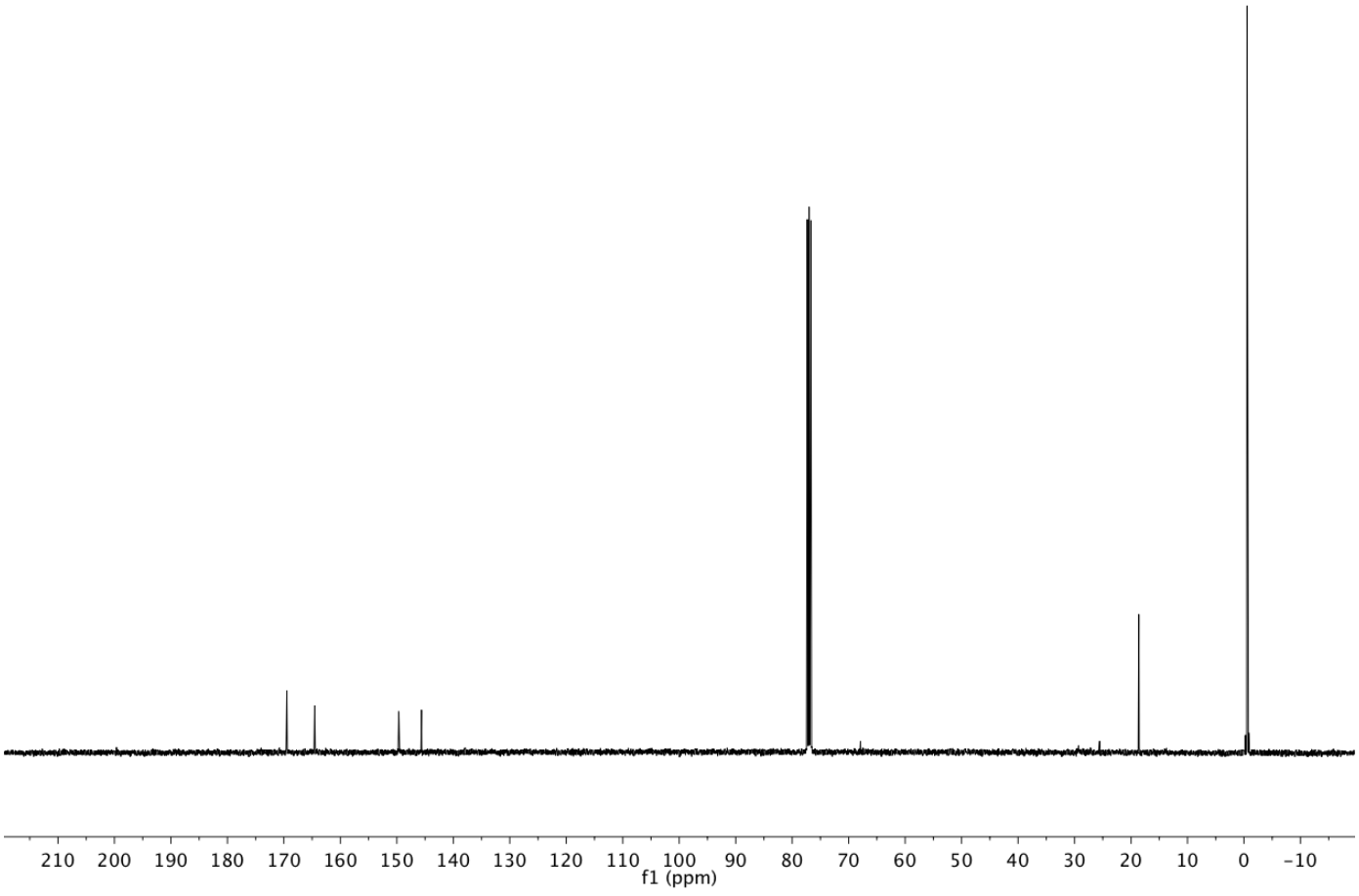

0.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5
f1 (ppm)

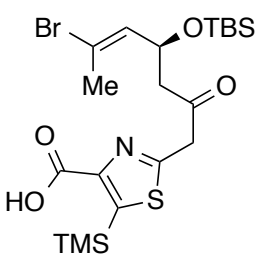

210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


O
HO
N
Me
S
TMS

SI-35

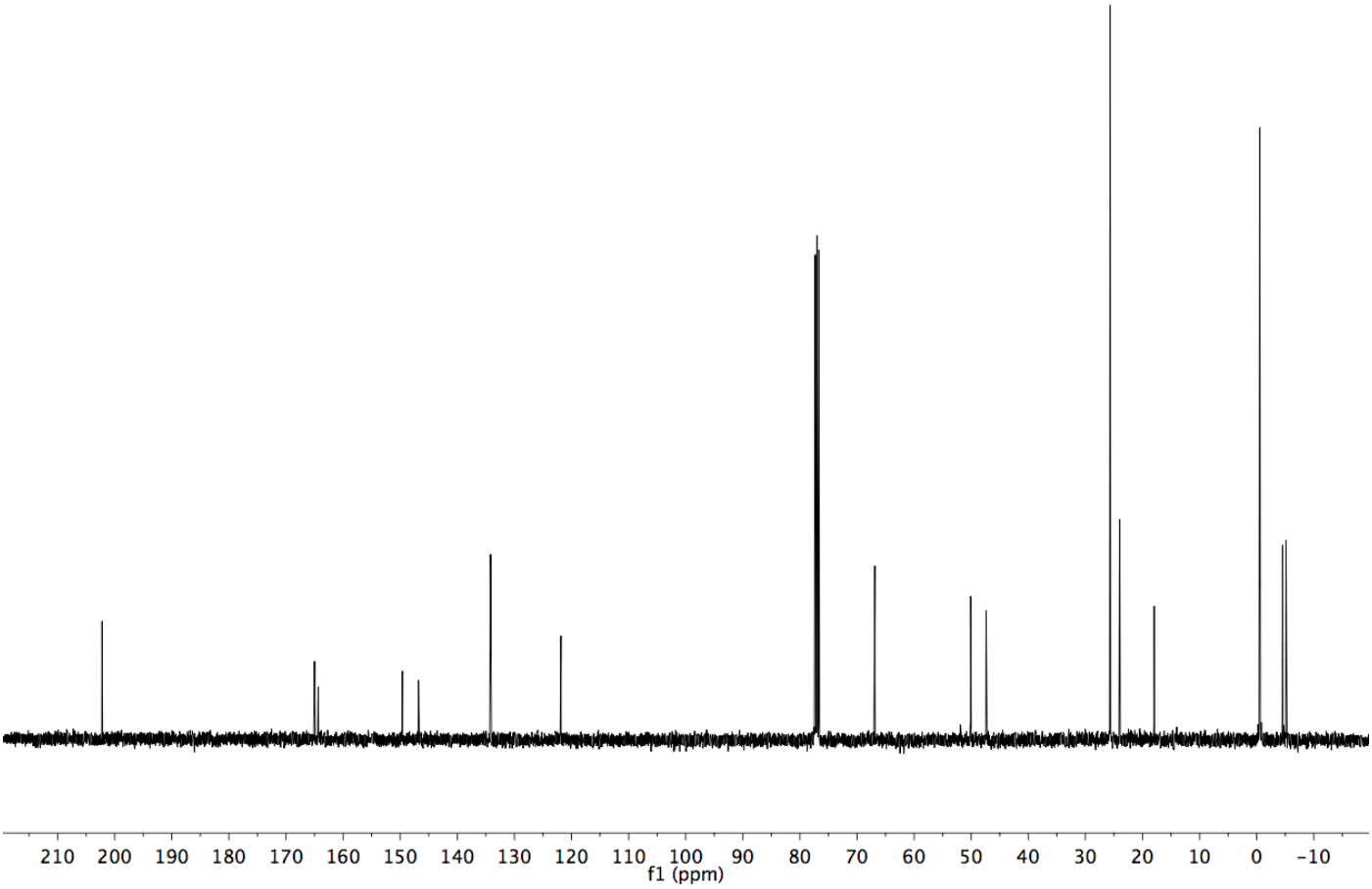
10.5 10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5
f1 (ppm)

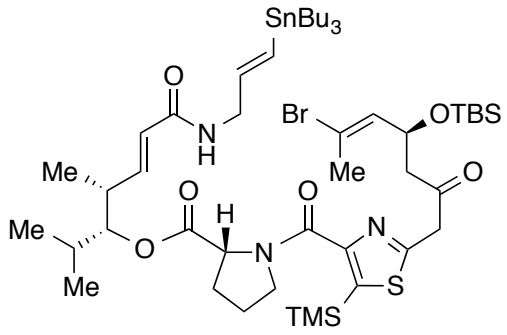

210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


Br
OTBS
Me
O
O
N
HO
S
TMS

SI-36

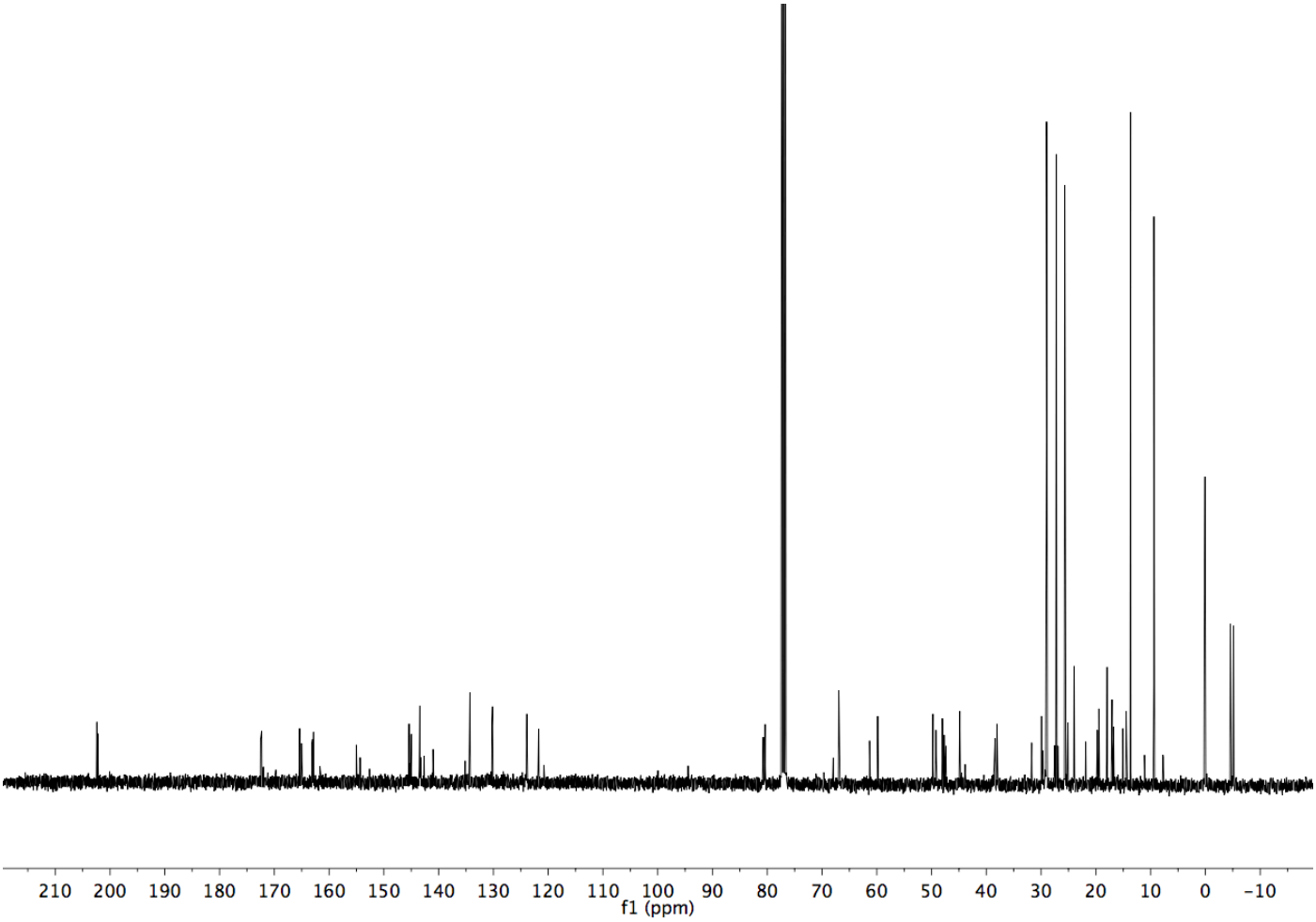
10.5 10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1
f1 (ppm)

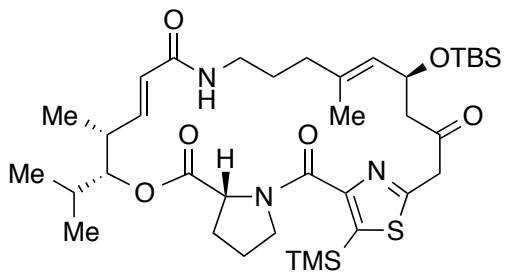

210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


SnBu3
O
N
H
Br
OTBS
Me
Me
O
O
O
H
Me
O
N
N
S
Me
TMS

SI-37

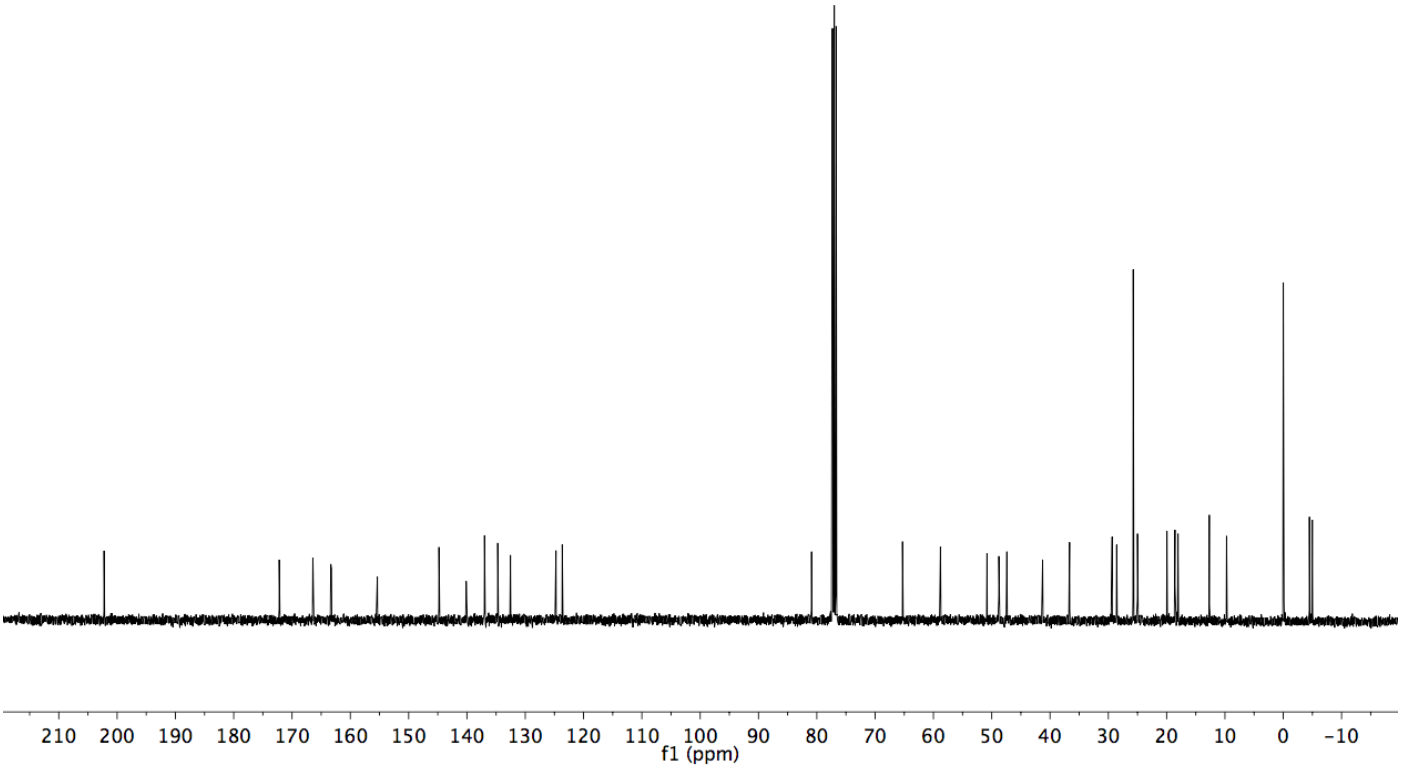
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5
f1 (ppm)

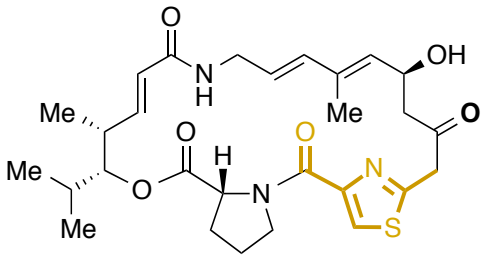

210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


O
N
H
OTBS
Me
Me
O
O
O
H
Me
O
N
N
Me
S
TMS

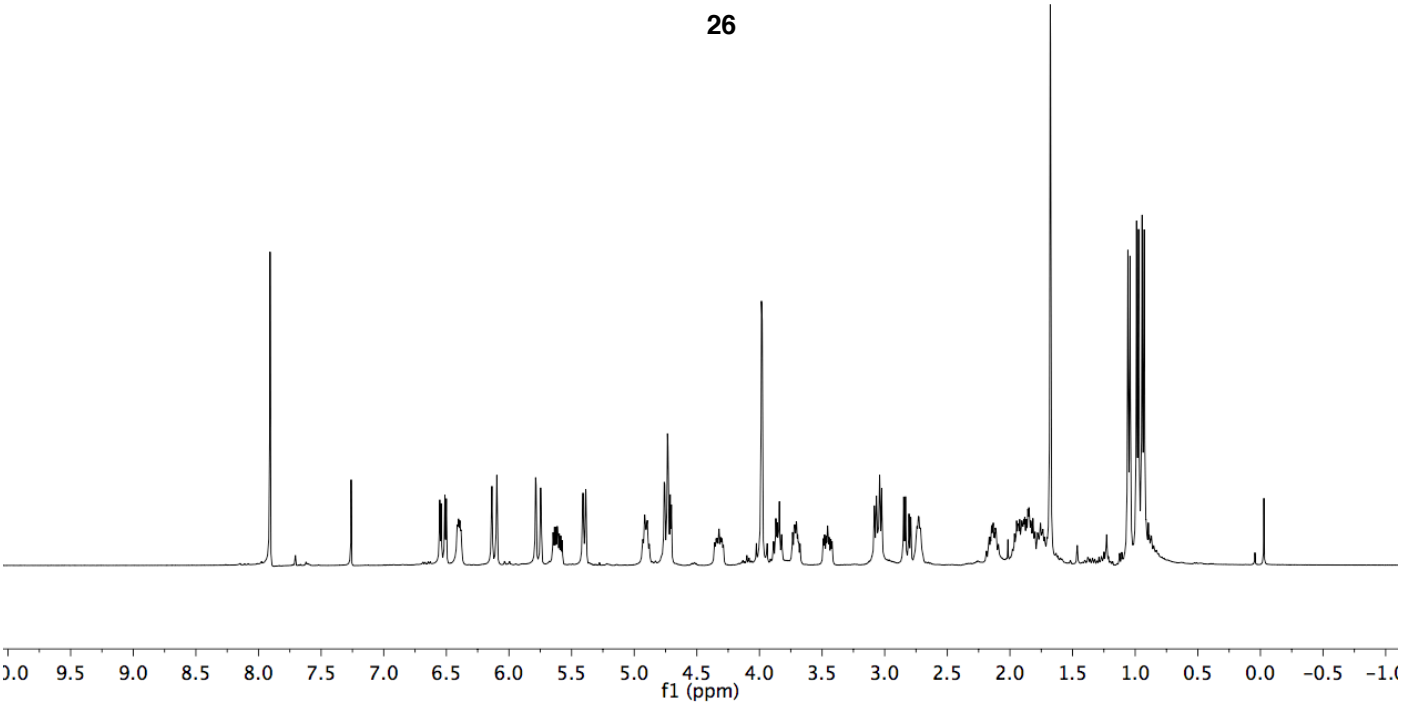
SI-38

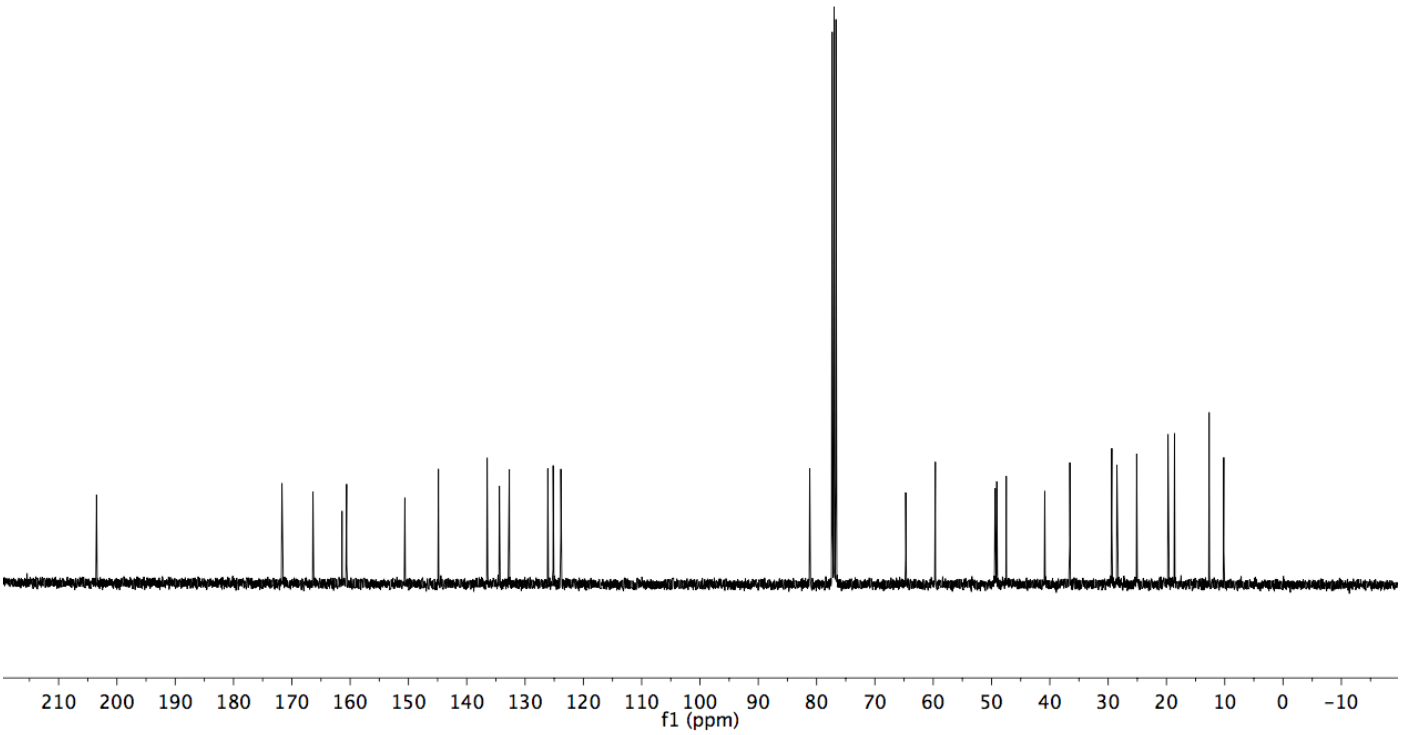
0.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1.
f1 (ppm)

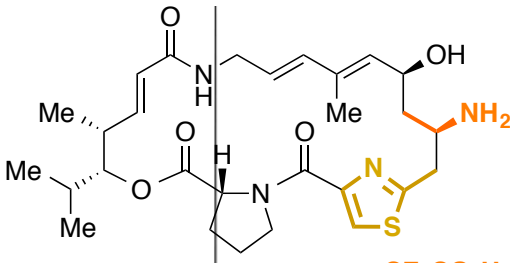

210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


O
N
H
OH
Me
Me
O
Me
O
H
O
N
N
S
Me

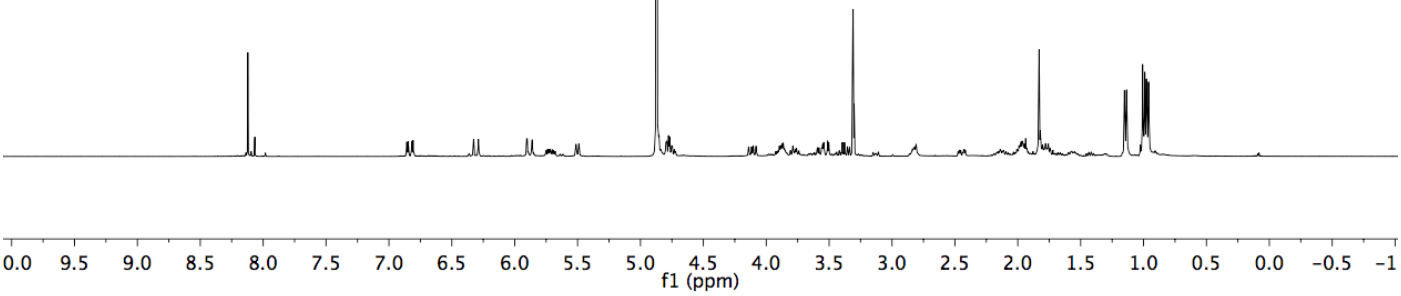
26


9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
f1 (ppm)

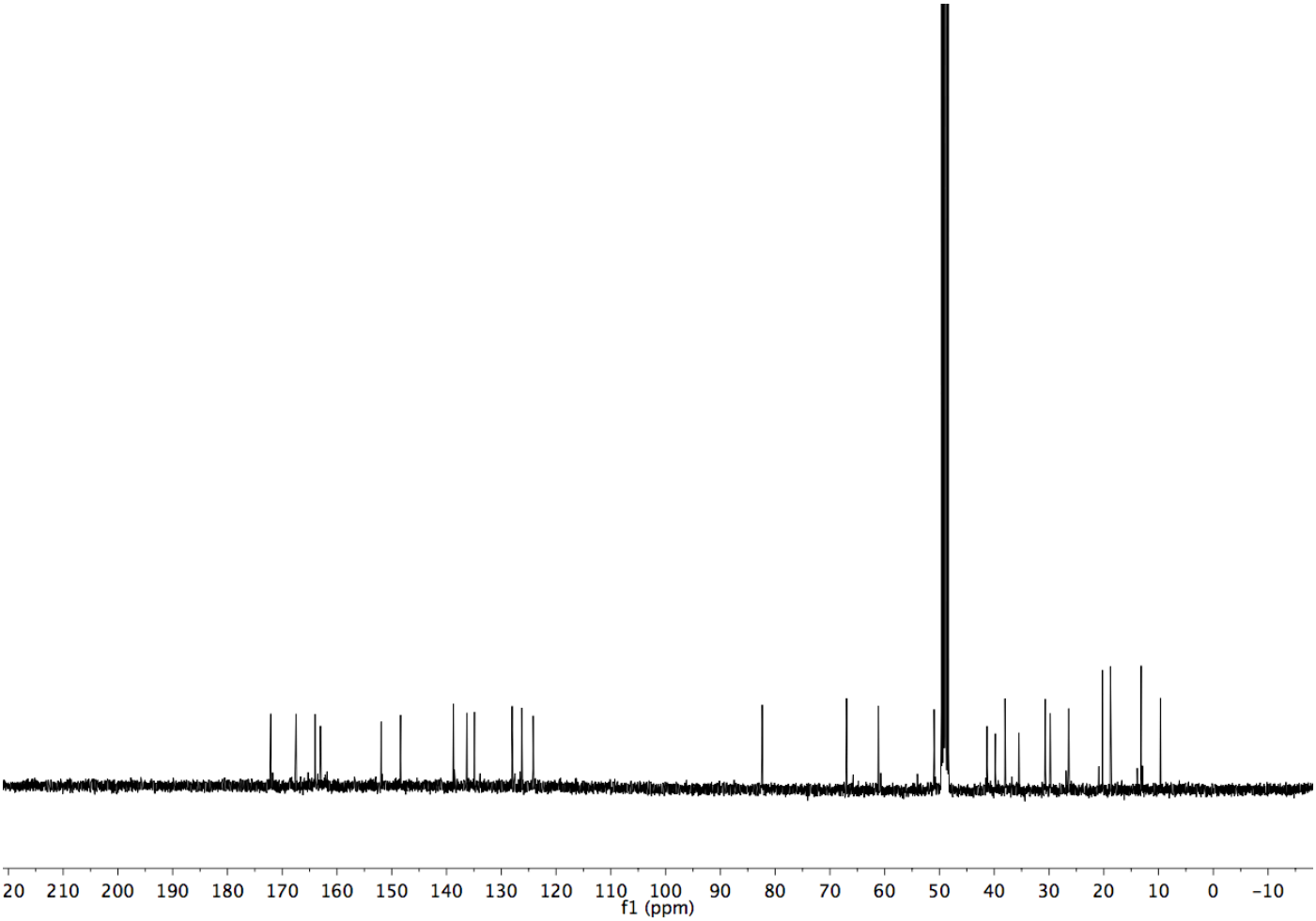

210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
-10
f1 (ppm)


O
N
H
OH
Me
Me
NH2
O
O
H
Me
O
N
N
S
Me
CF3CO2H

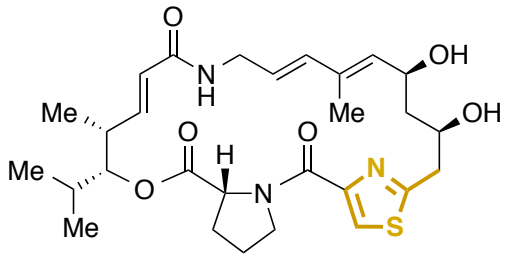
SI-39



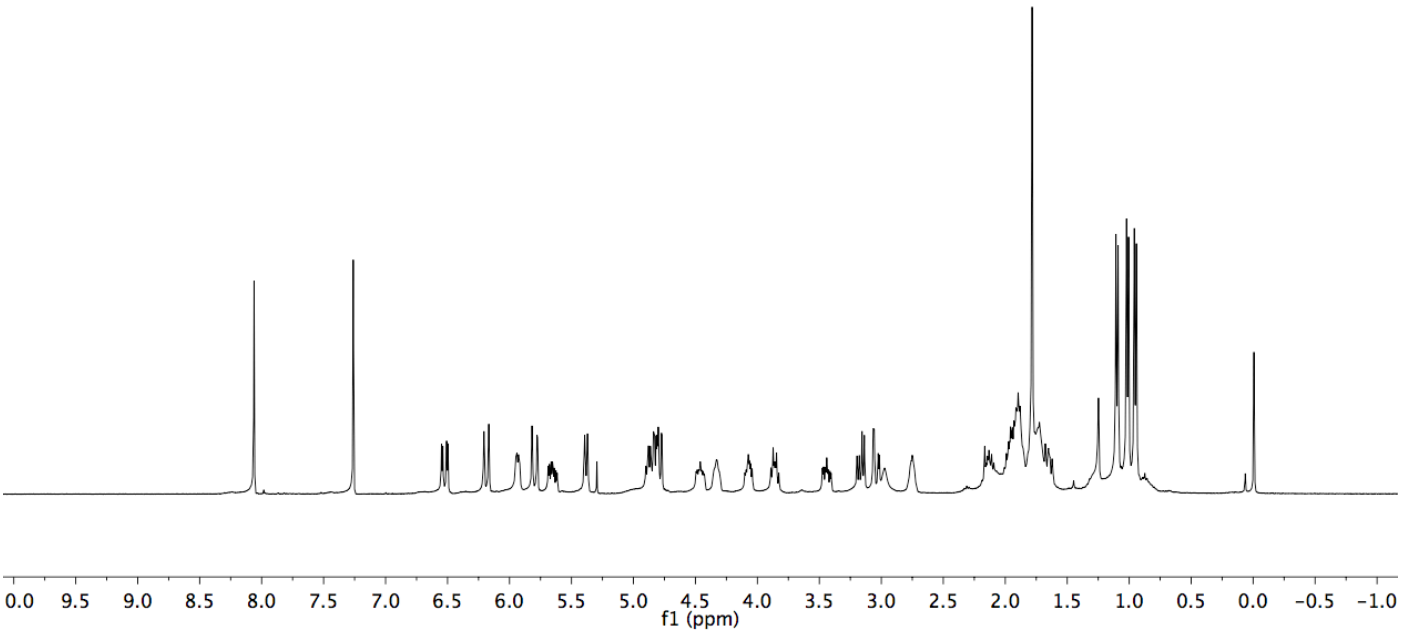
0.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1
f1 (ppm)

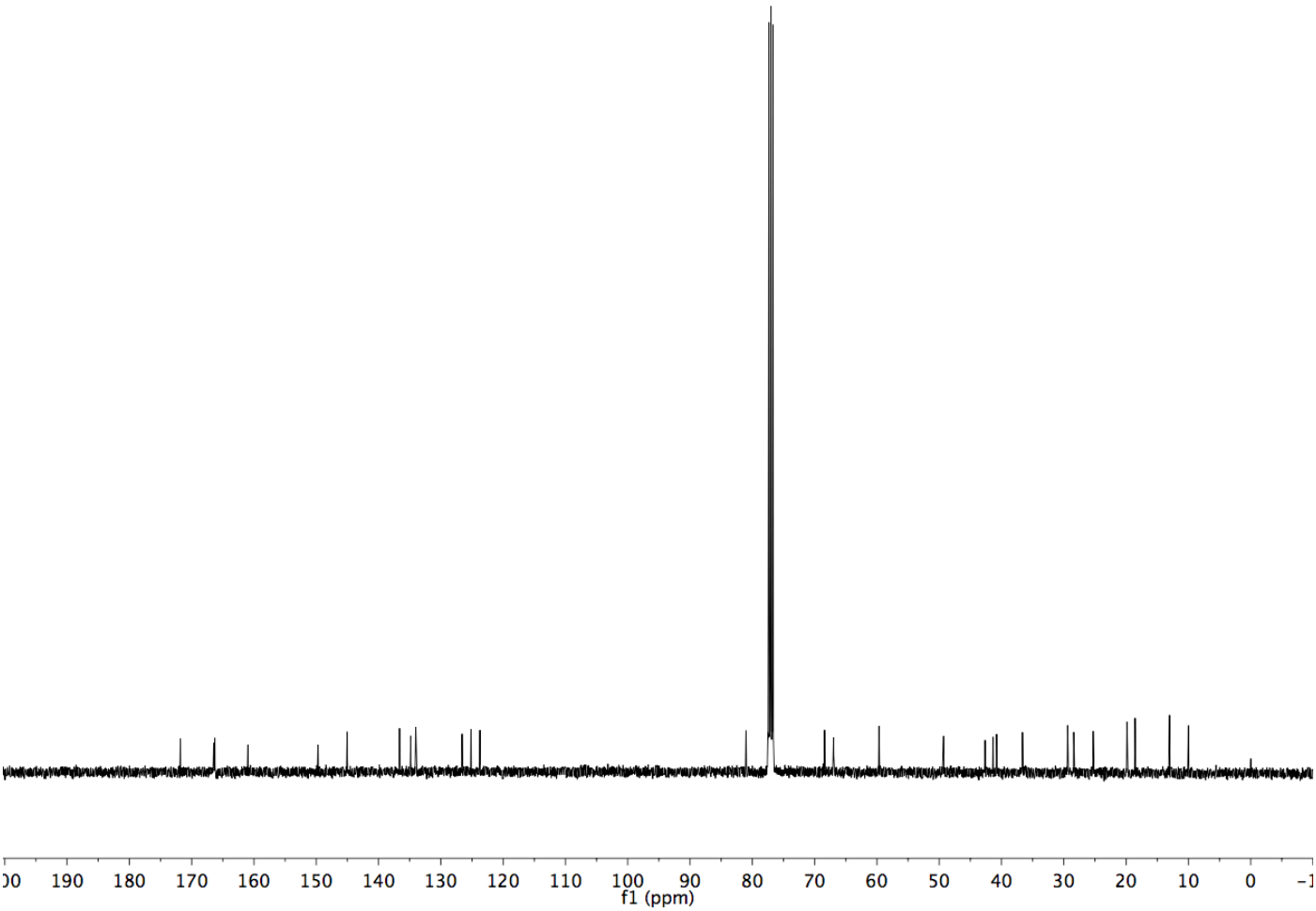


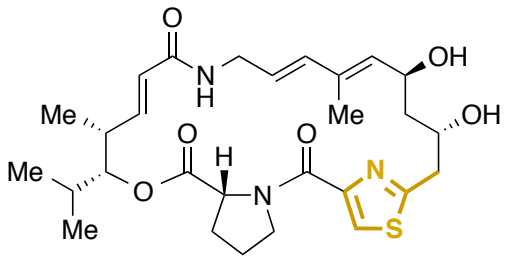
20 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


O
N
H
OH
Me
Me
OH
O
H
O
Me
O
N
N
S
Me

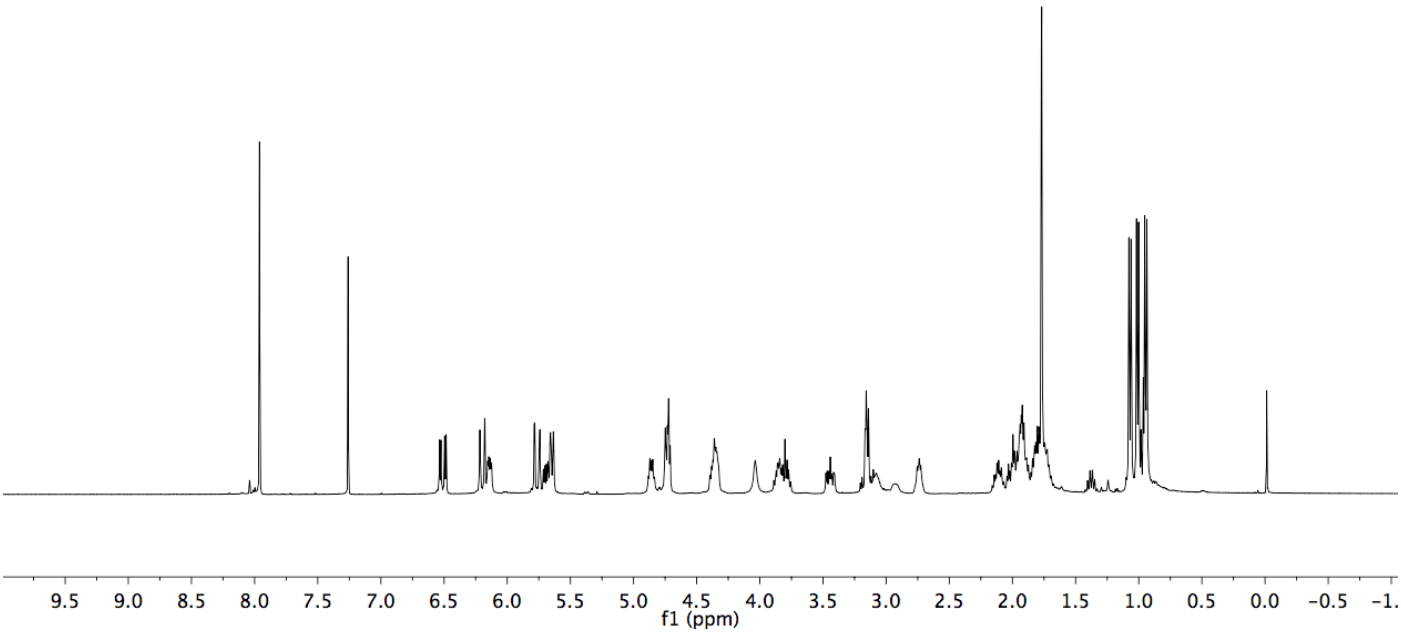
SI-40

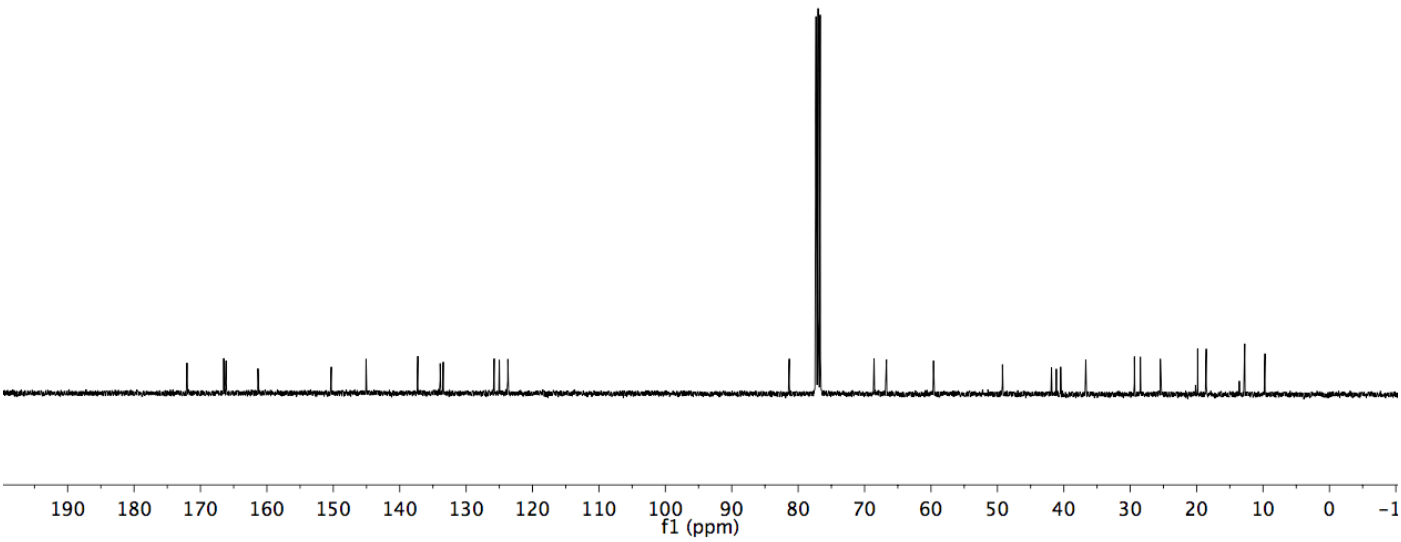

0.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1.0
f1 (ppm)

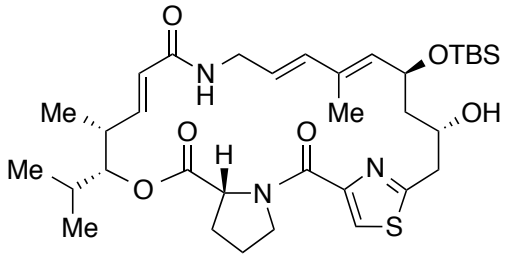

190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)



SI-41

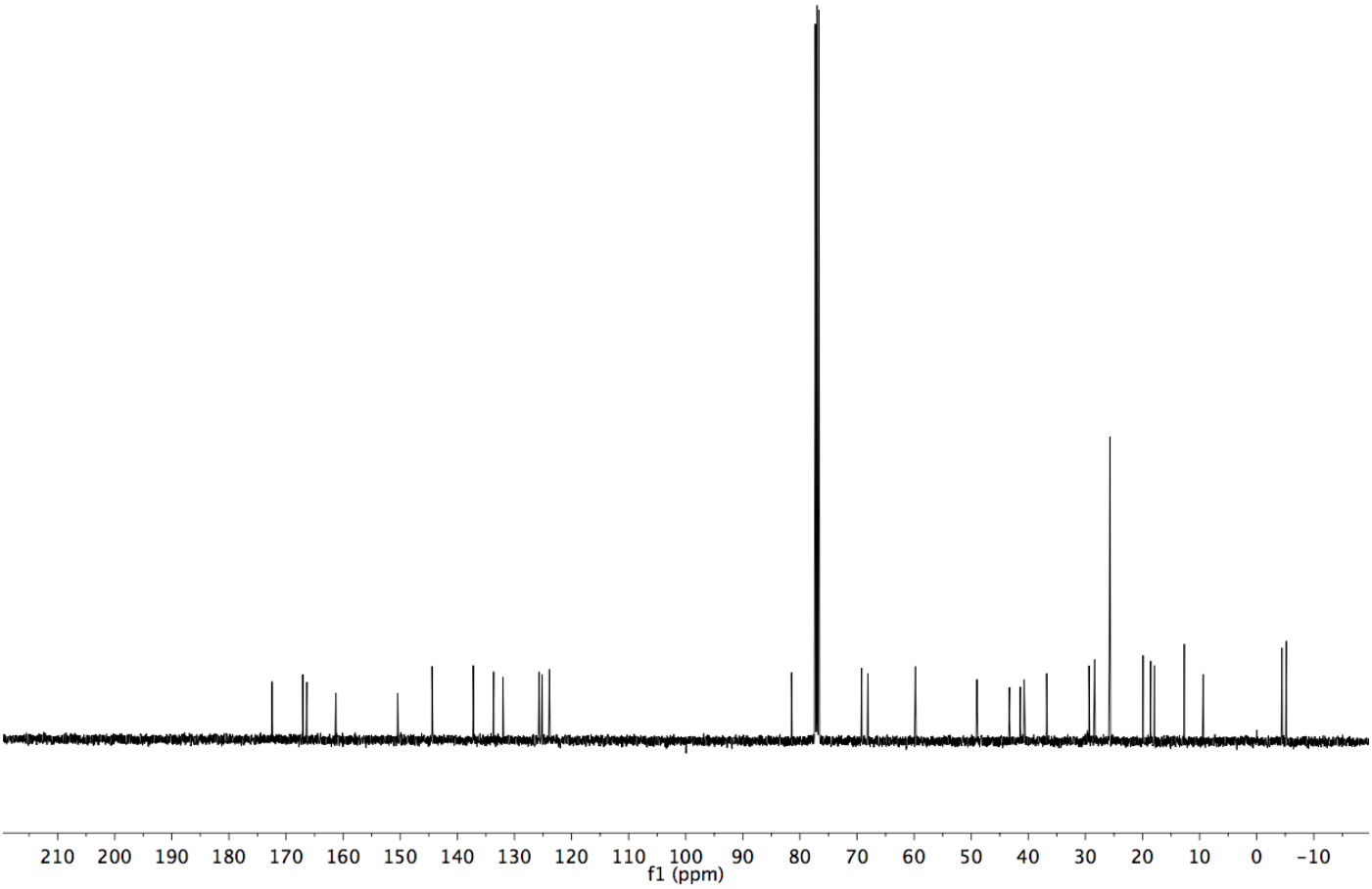

9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1.
f1 (ppm)

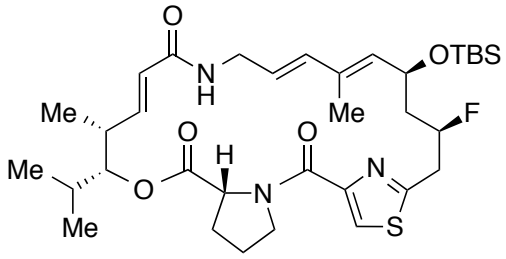

190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -1
f1 (ppm)


O
N
H
OTBS
Me
Me
OH
O
O
H
Me
O
N
N
Me
S

SI-42

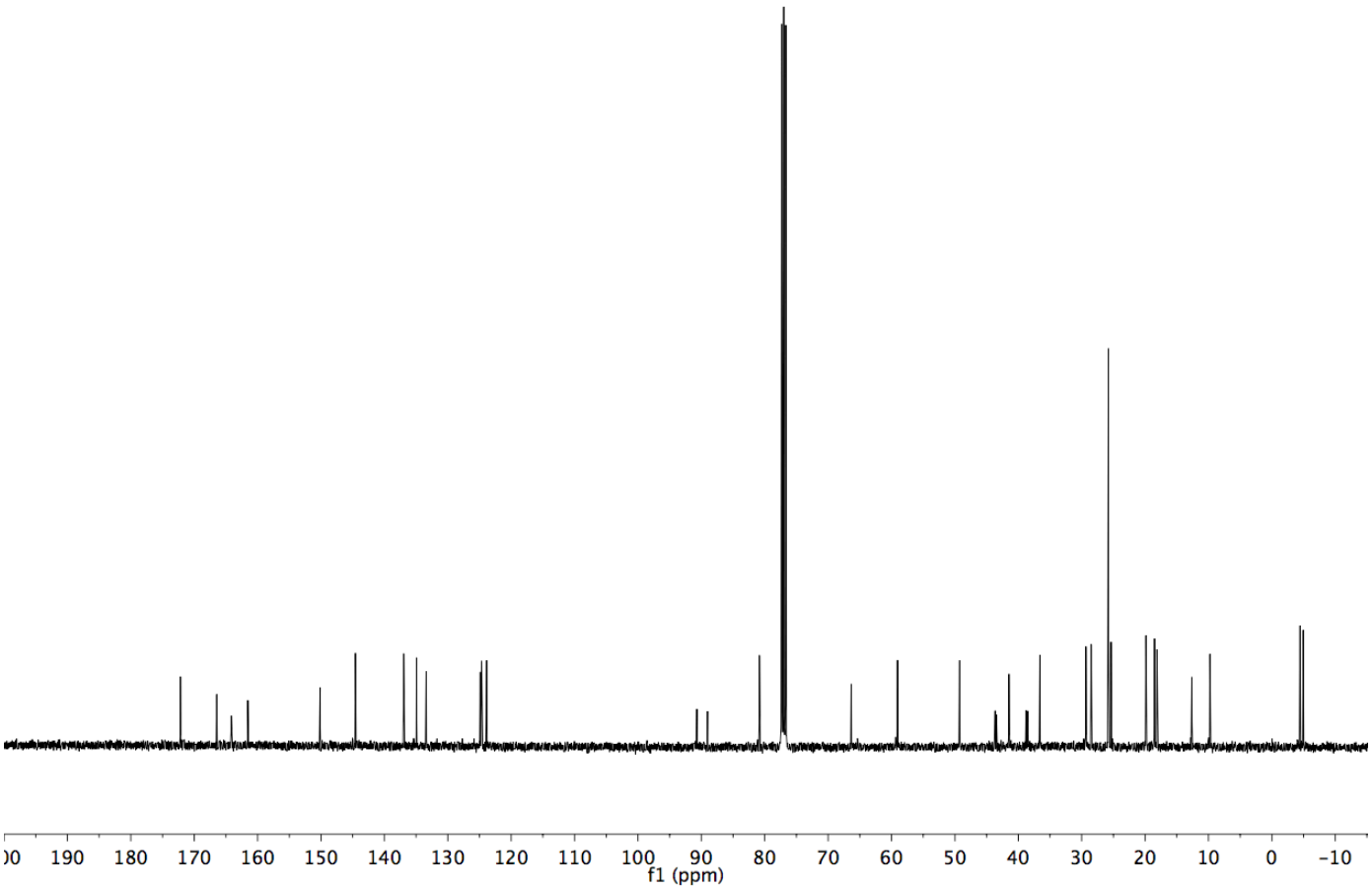
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1.
f1 (ppm)

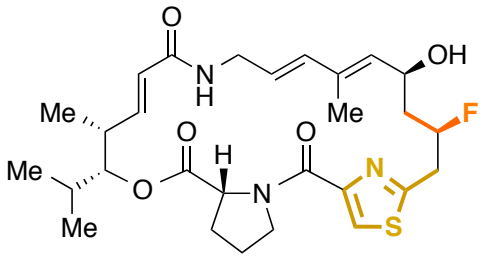

210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


O
N
H
OTBS
Me
Me
F
O
O
H
Me
O
N
N
Me
S

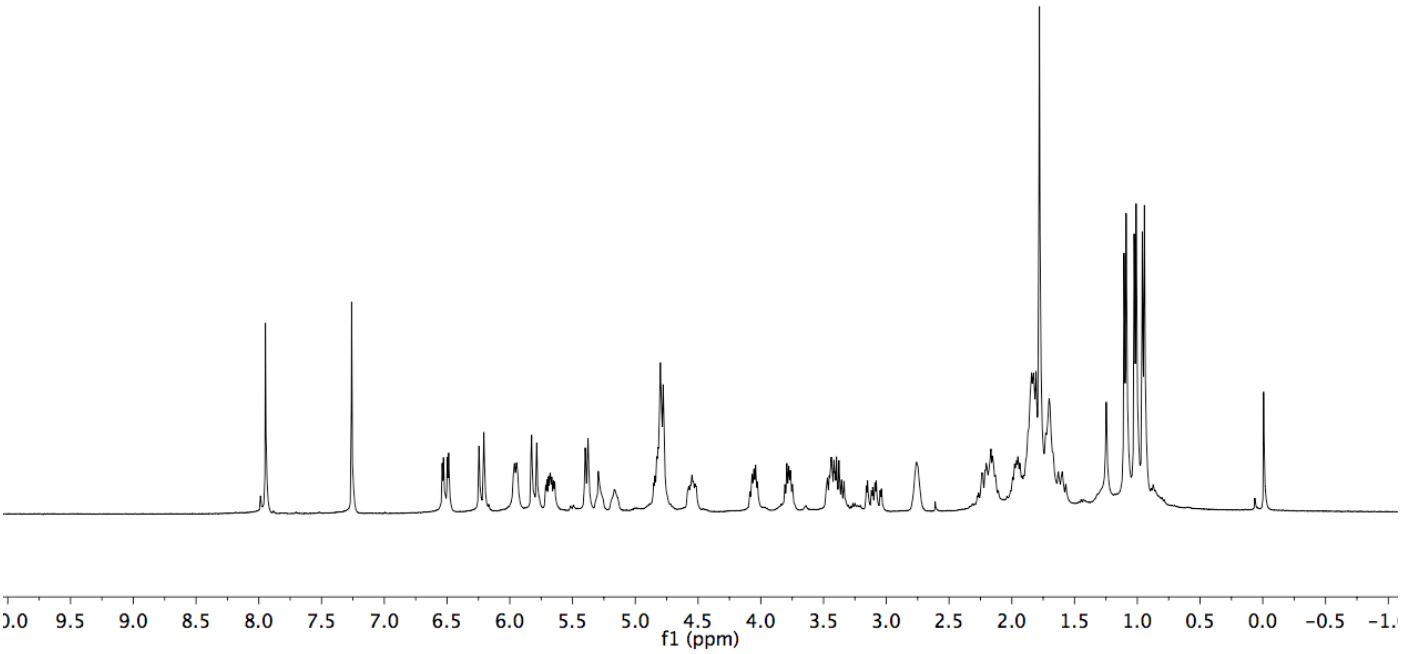
SI-43

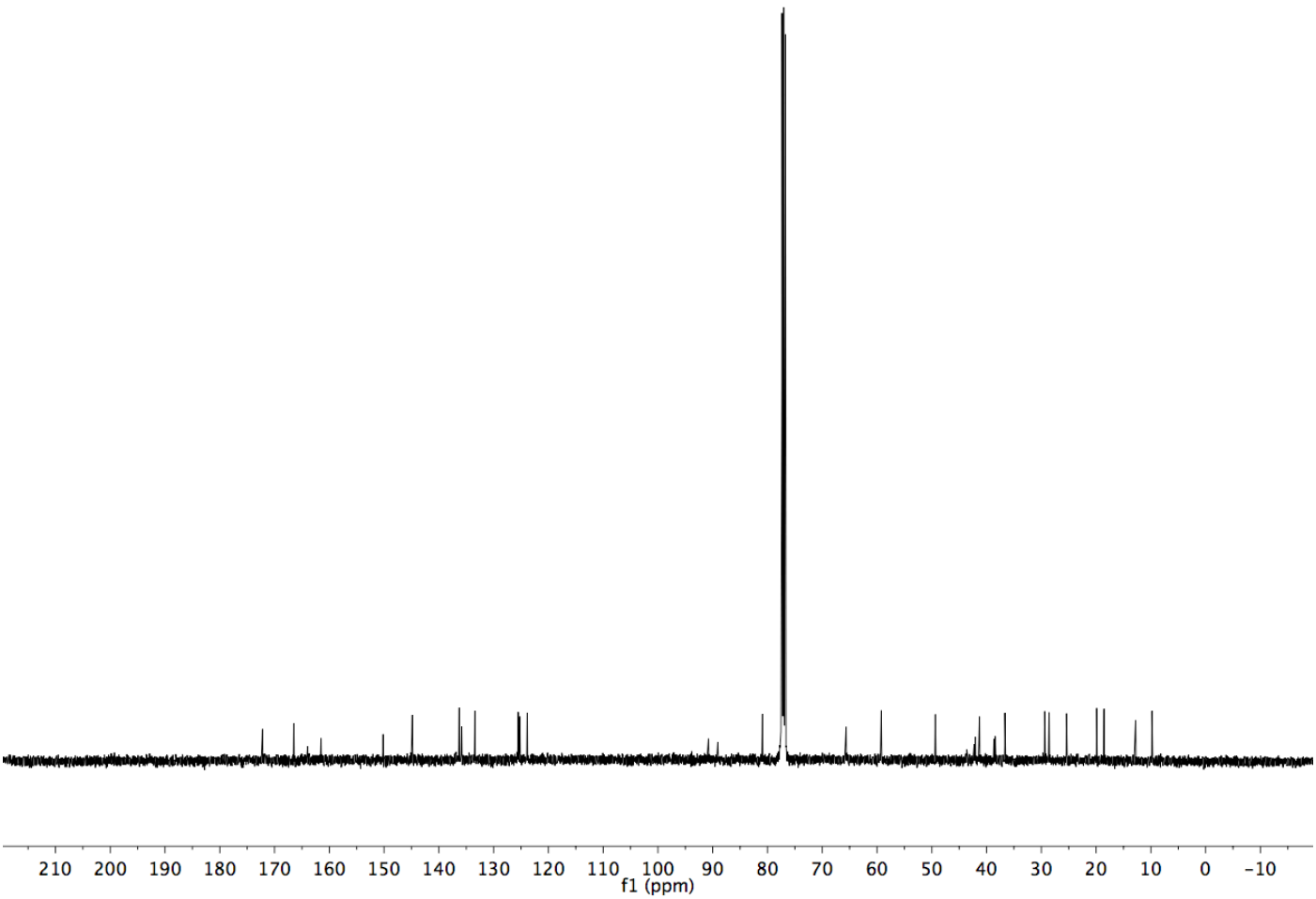
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1
f1 (ppm)

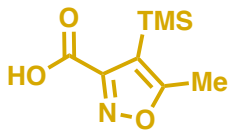

190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


O
N
H
OH
Me
Me
F
O
O
H
Me
O
N
N
S
Me

45

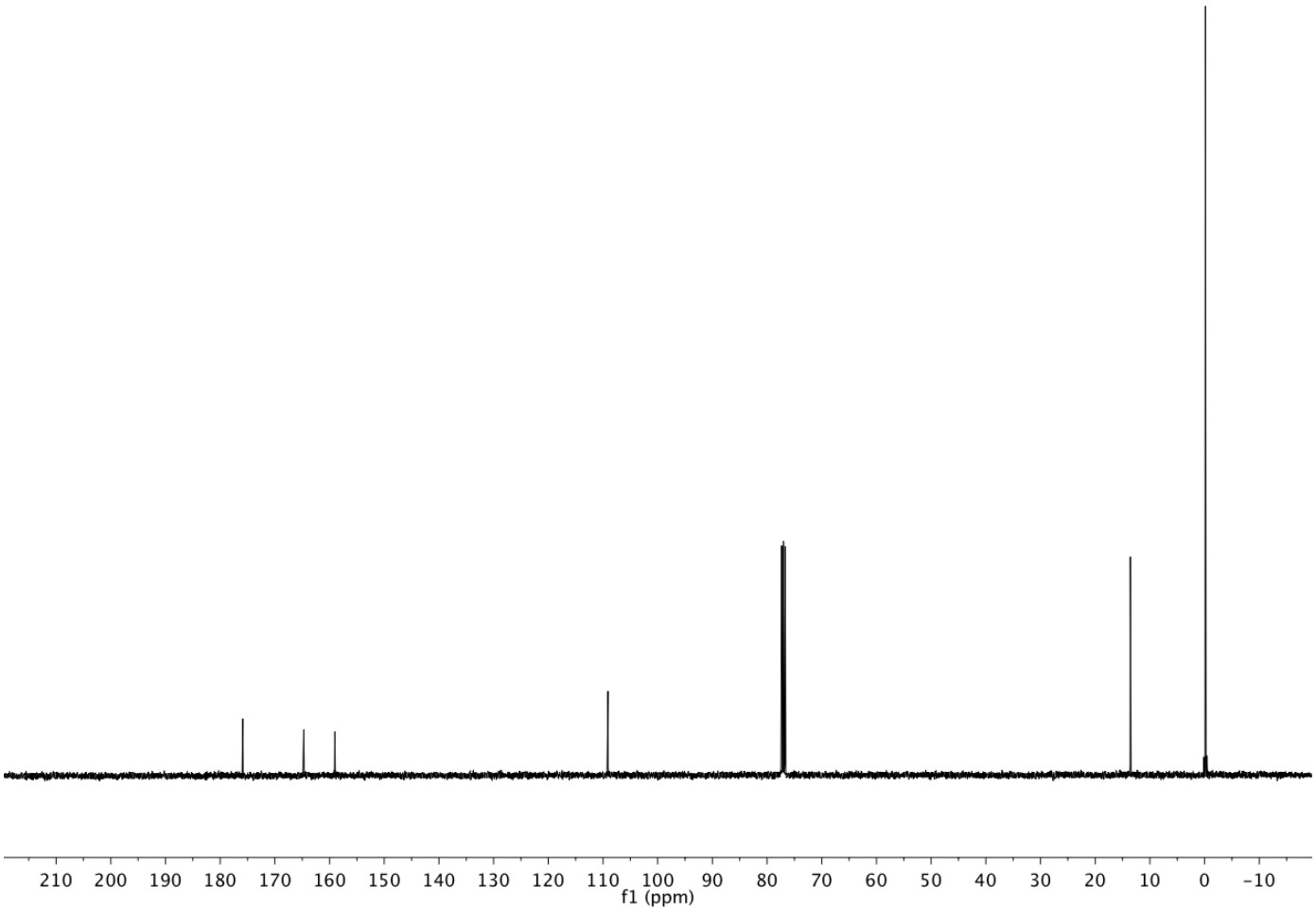

9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5
f1 (ppm)

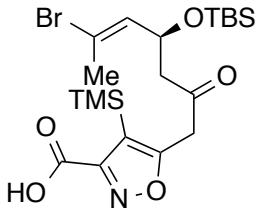

210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


O
TMS
HO
Me
N
O

SI-44

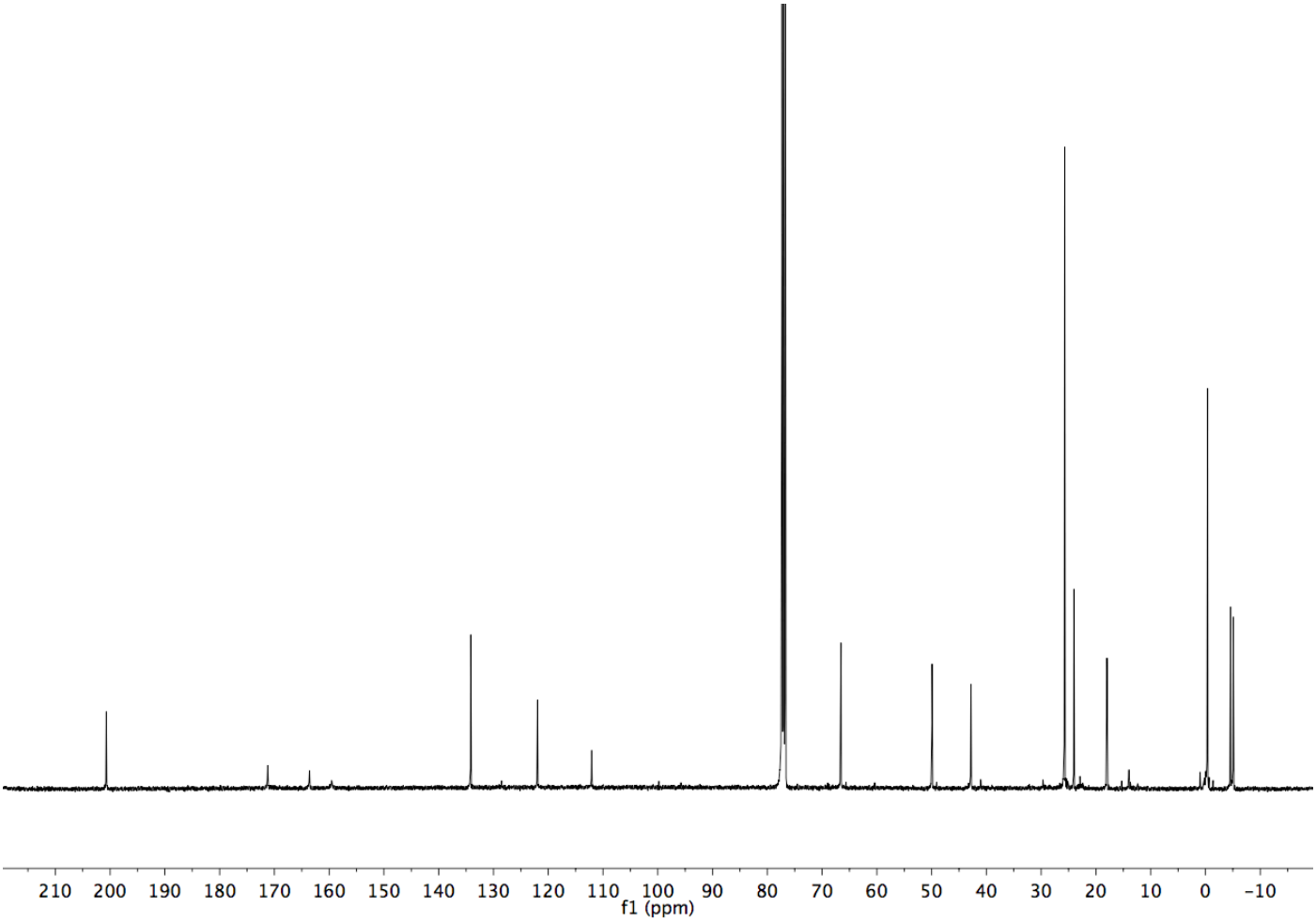
10.5 10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1
f1 (ppm)

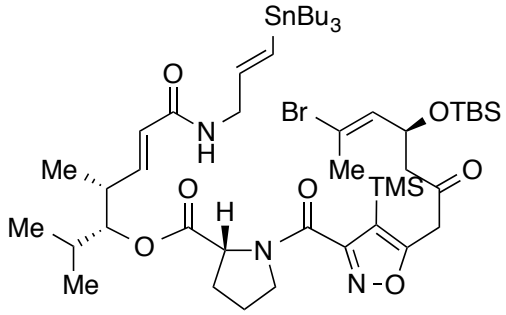

210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


Br
OTBS
Me
TMS
O
O
HO
N
O

SI-45

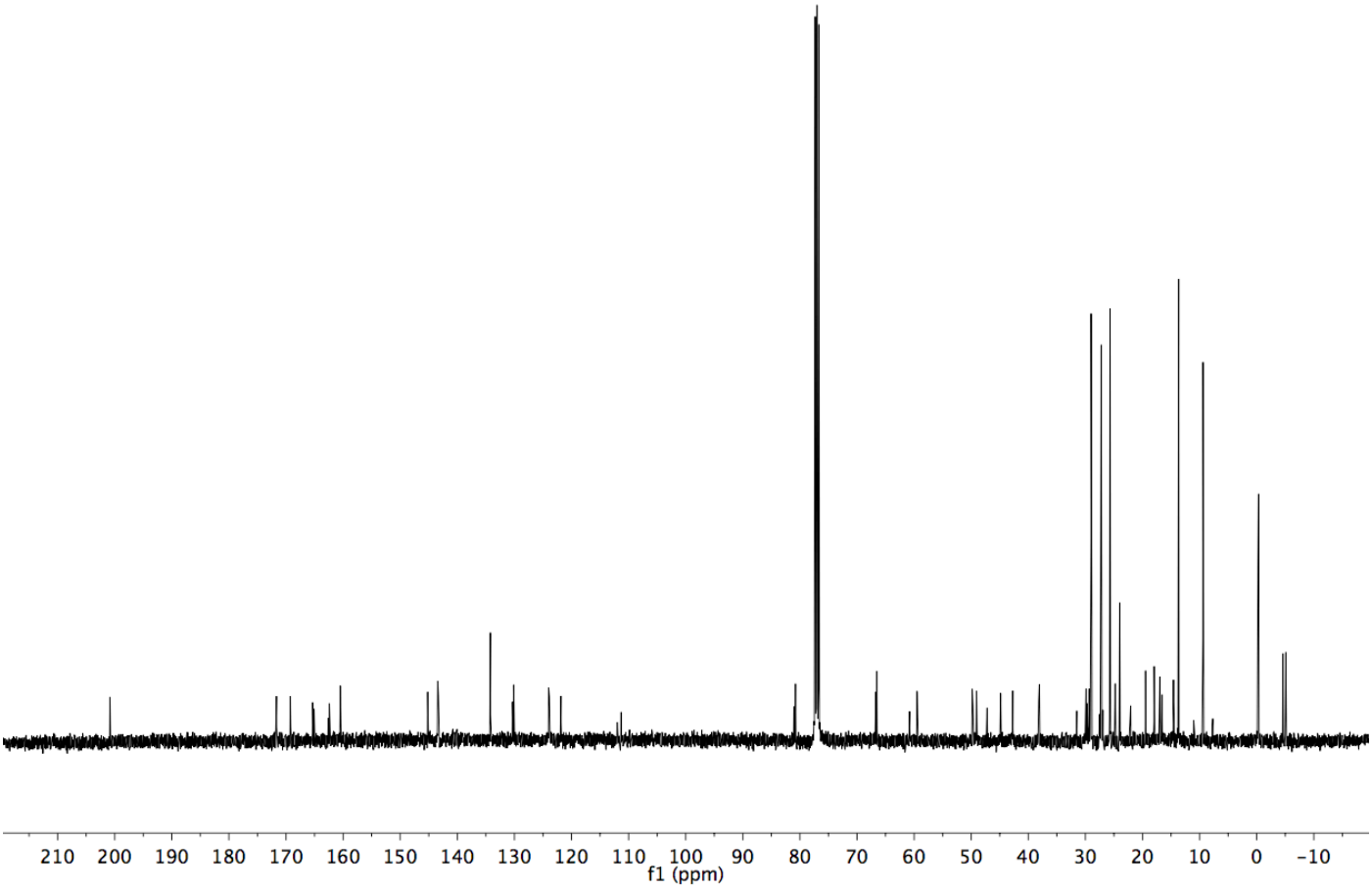
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1
f1 (ppm)

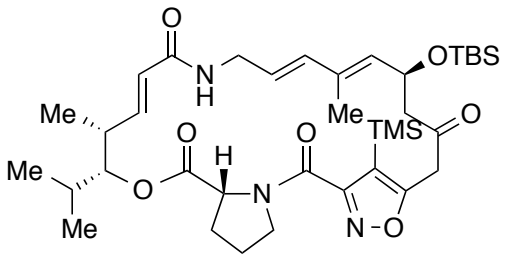

210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


SnBu3
O
N
H
Br
OTBS
Me
Me
TMS
O
O
O
H
Me
O
N
N
O
Me

SI-46

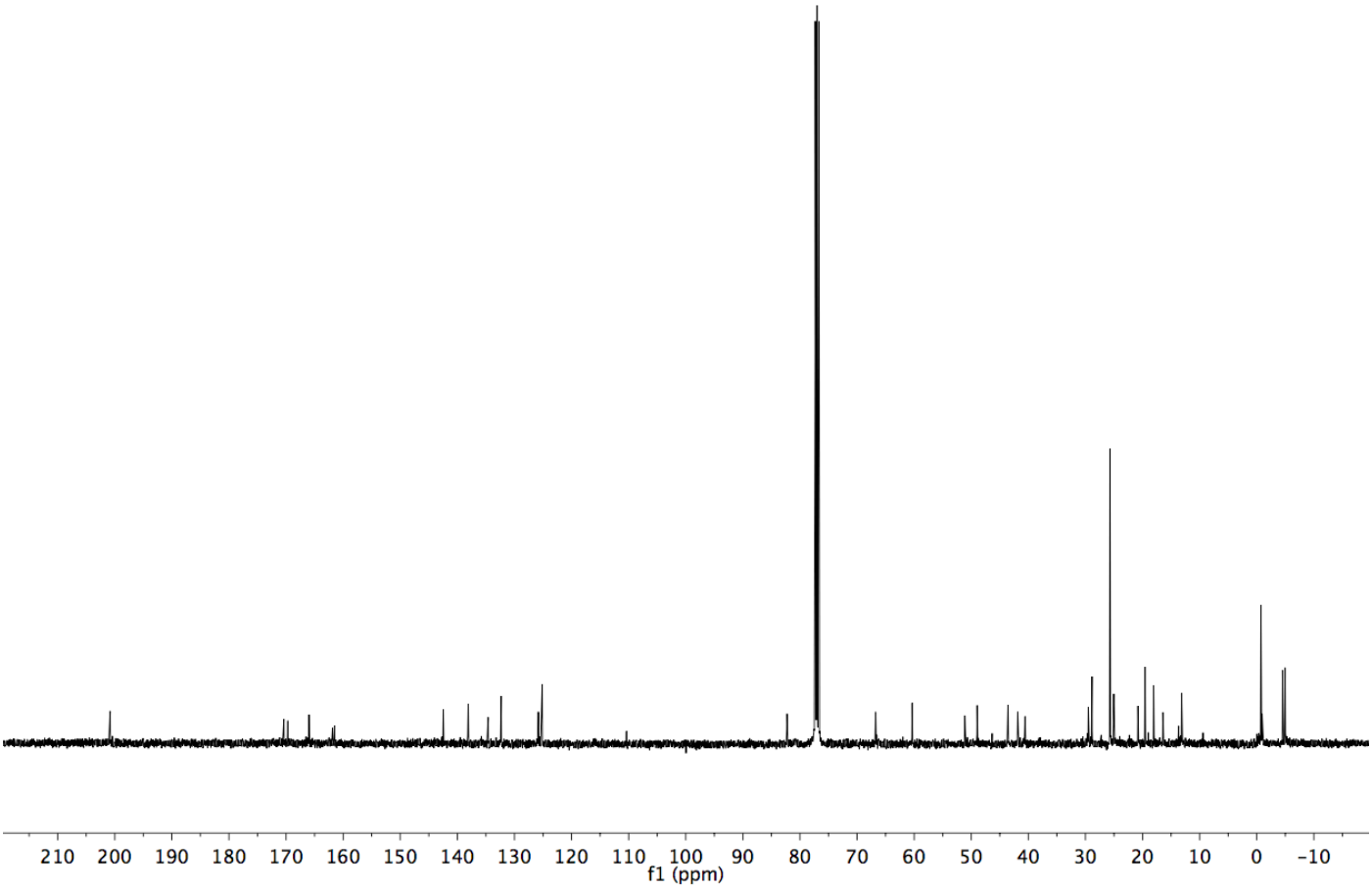
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1
f1 (ppm)

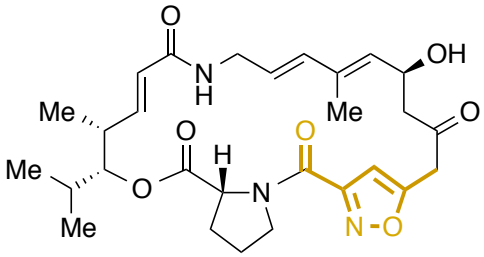

210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


O
N
H
OTBS
Me
Me
TMS
O
O
O
H
Me
O
N
Me
N
O

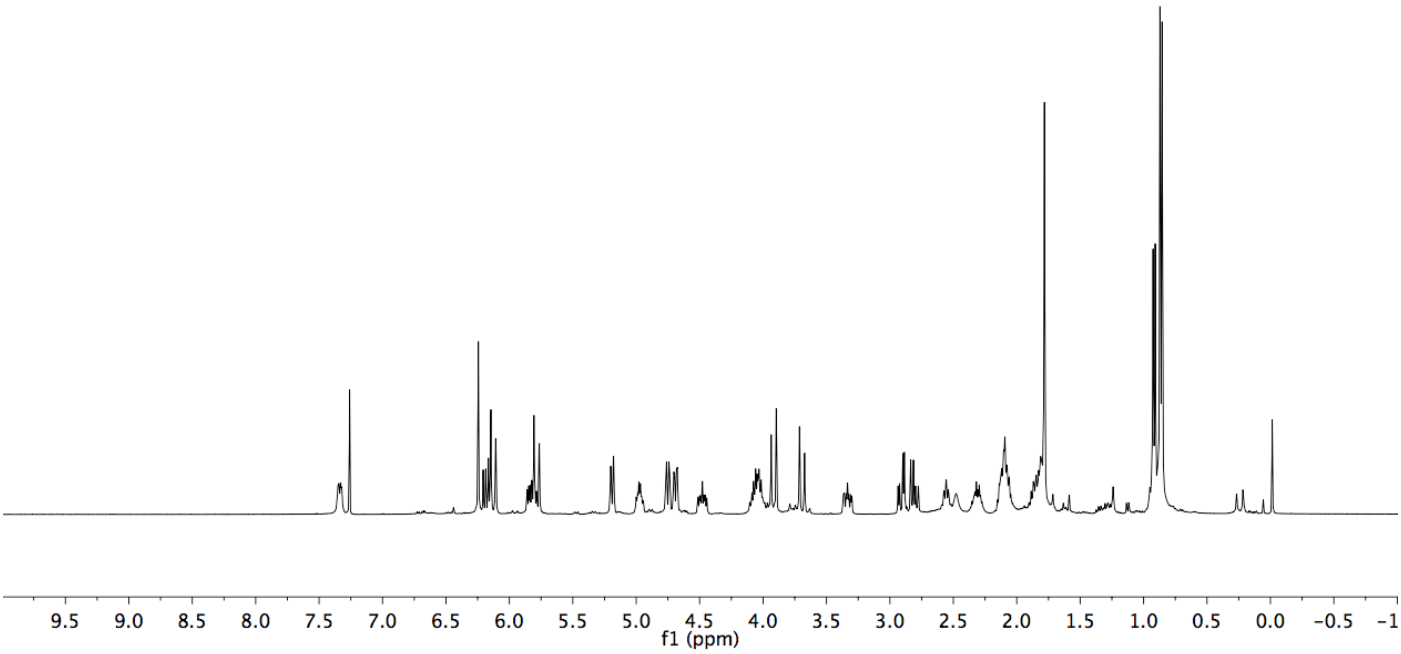
SI-47

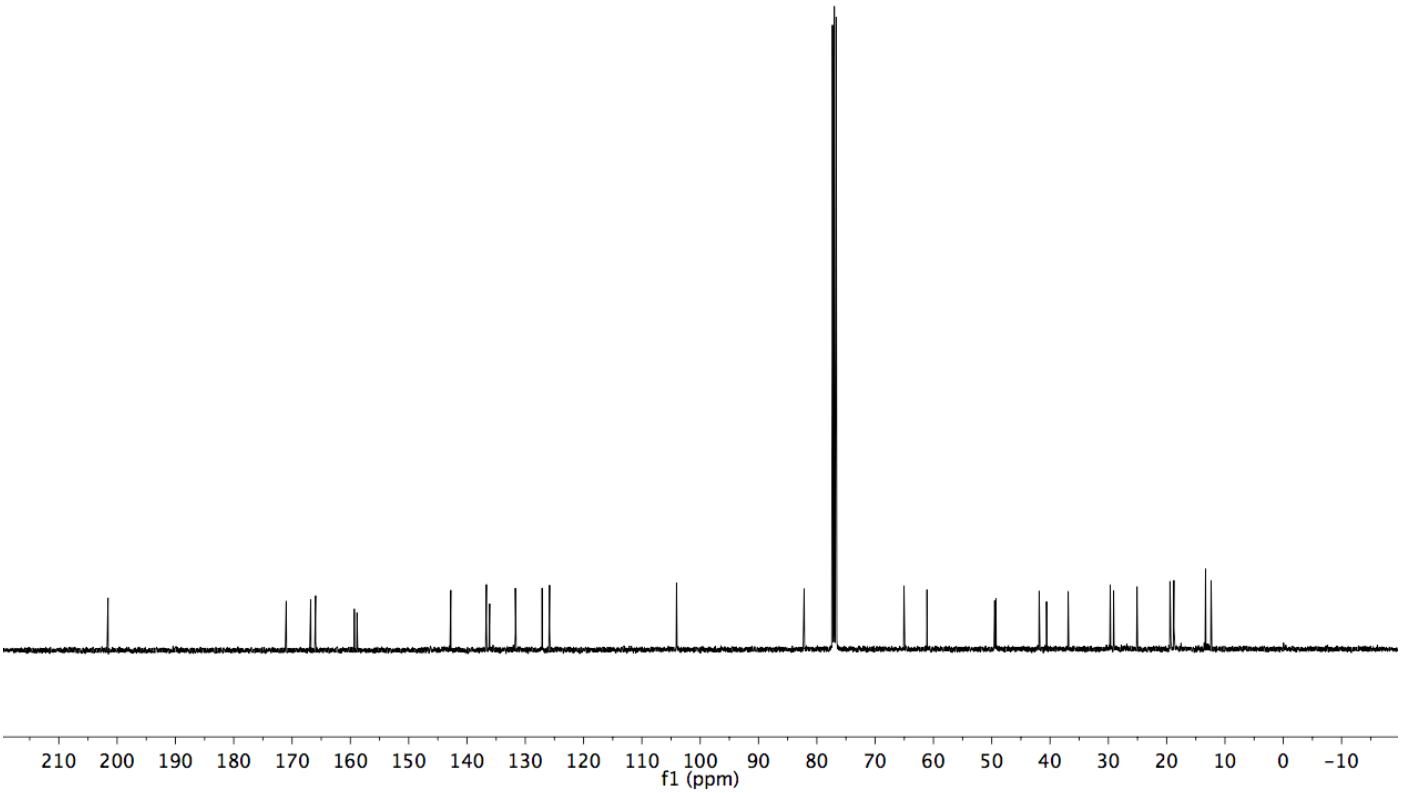
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1
f1 (ppm)

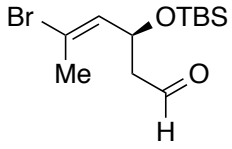

210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


O
N
H
OH
Me
Me
O
O
H
Me
O
N
O
N-O
Me

27

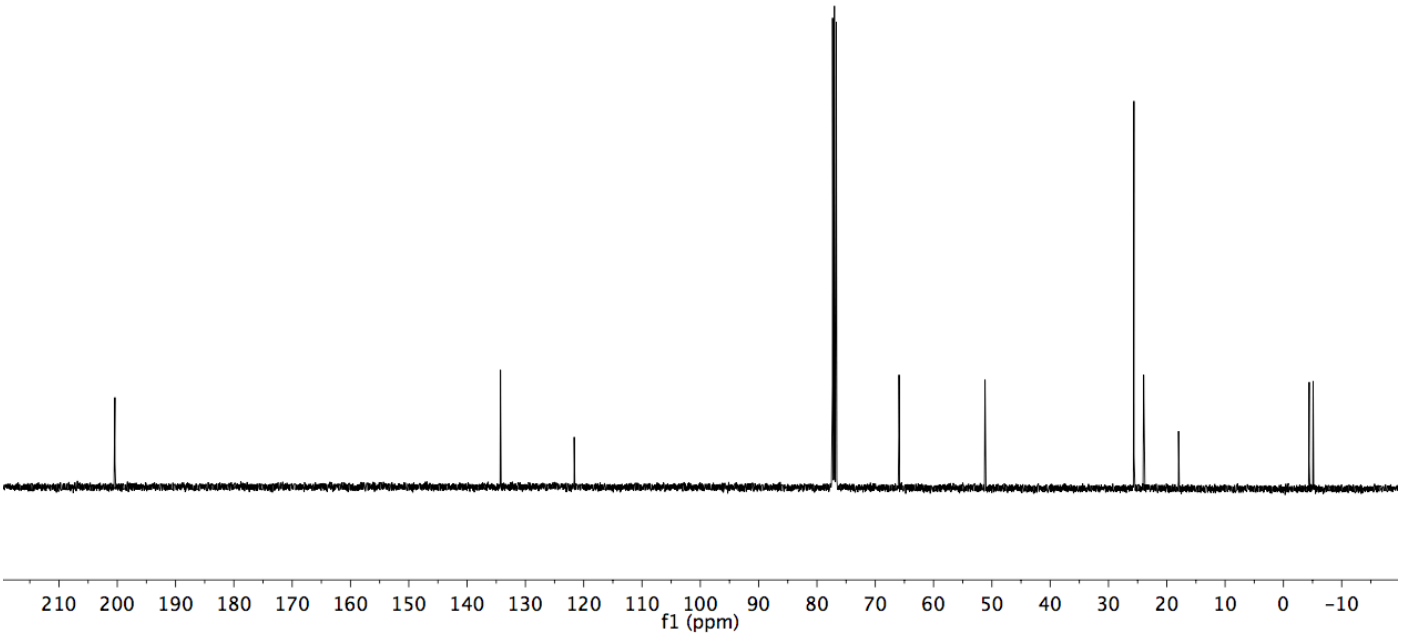

9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1
f1 (ppm)

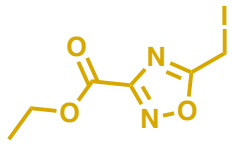

210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


Br
OTBS
Me
O
H

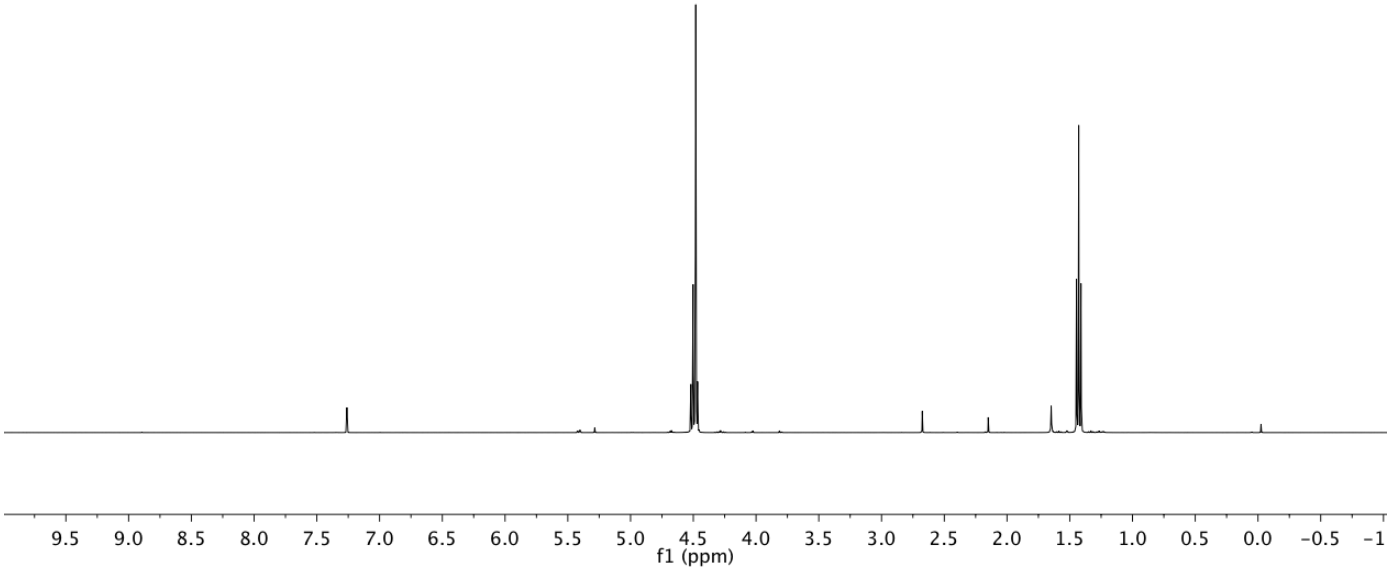
SI-48

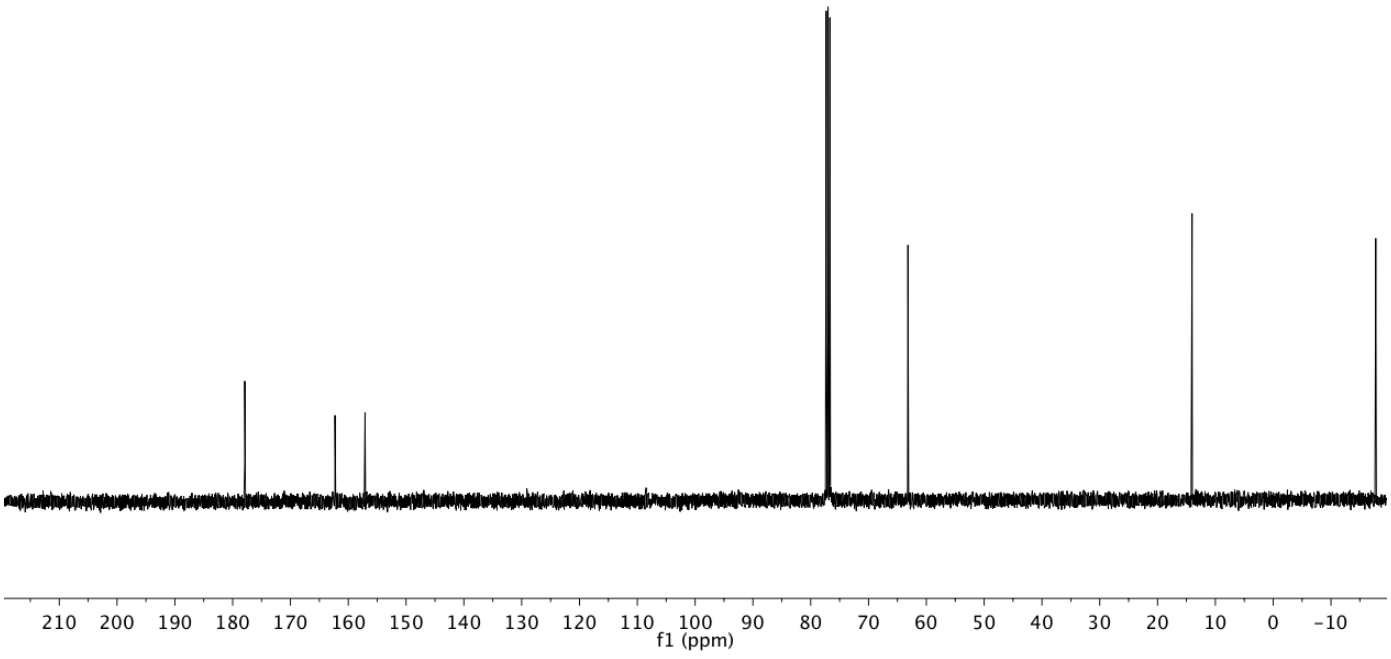
1.0 10.5 10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1
f1 (ppm)

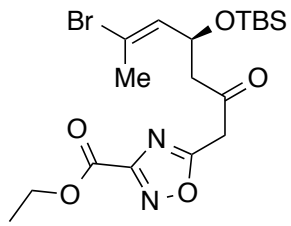

210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


O
O
N
N
O
I

SI-49

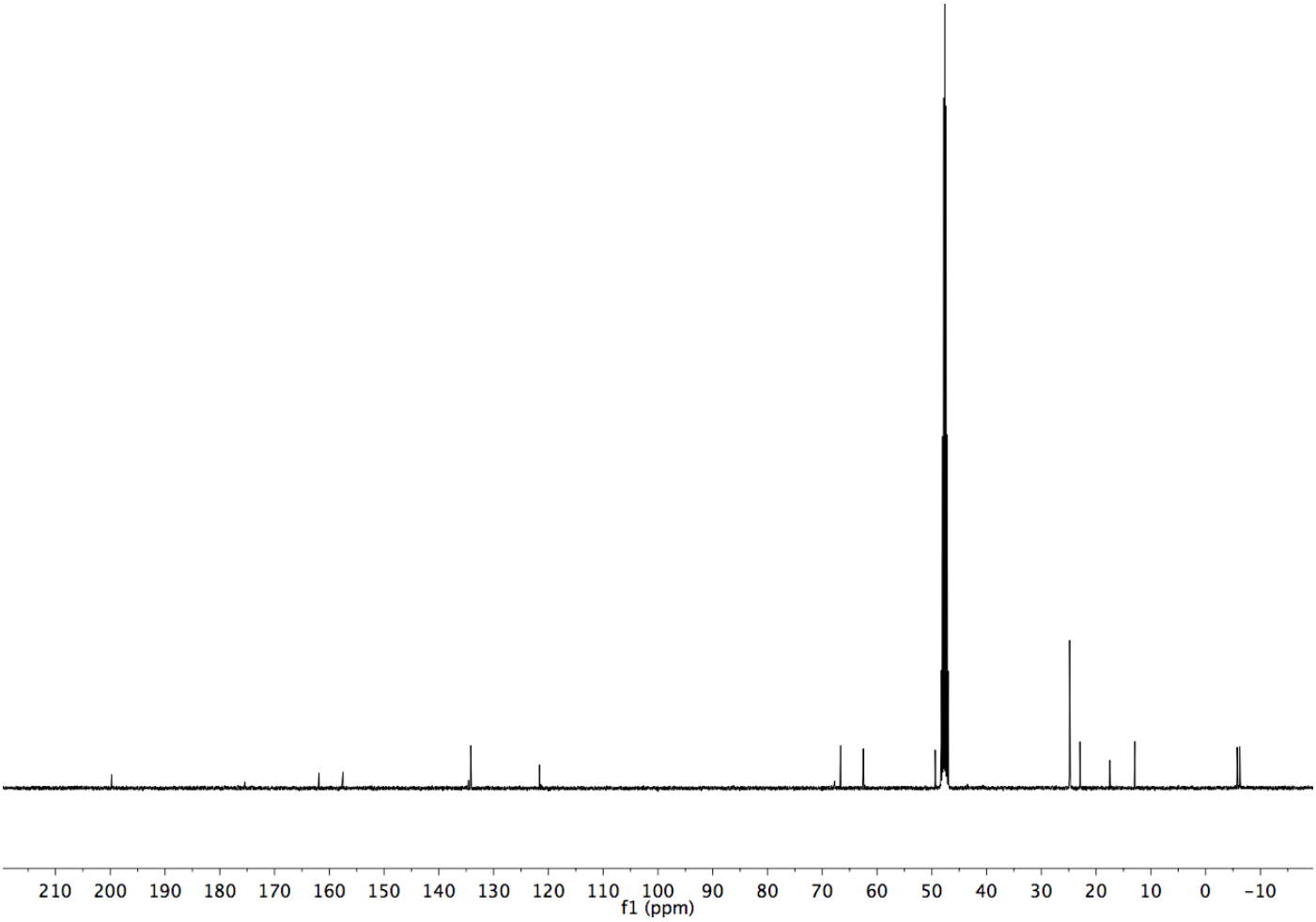

9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1
f1 (ppm)

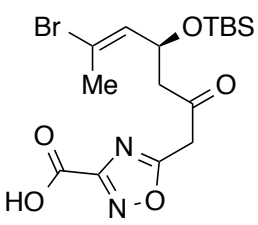

210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


Br
OTBS
Me
O
O
N
O
N
O

SI-50

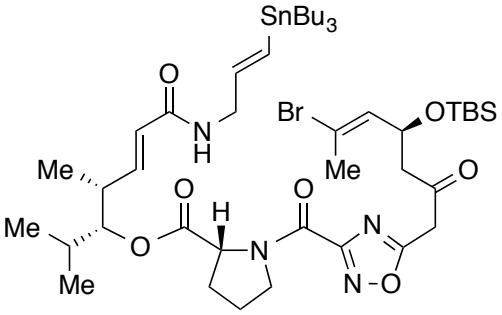
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1
f1 (ppm)


210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

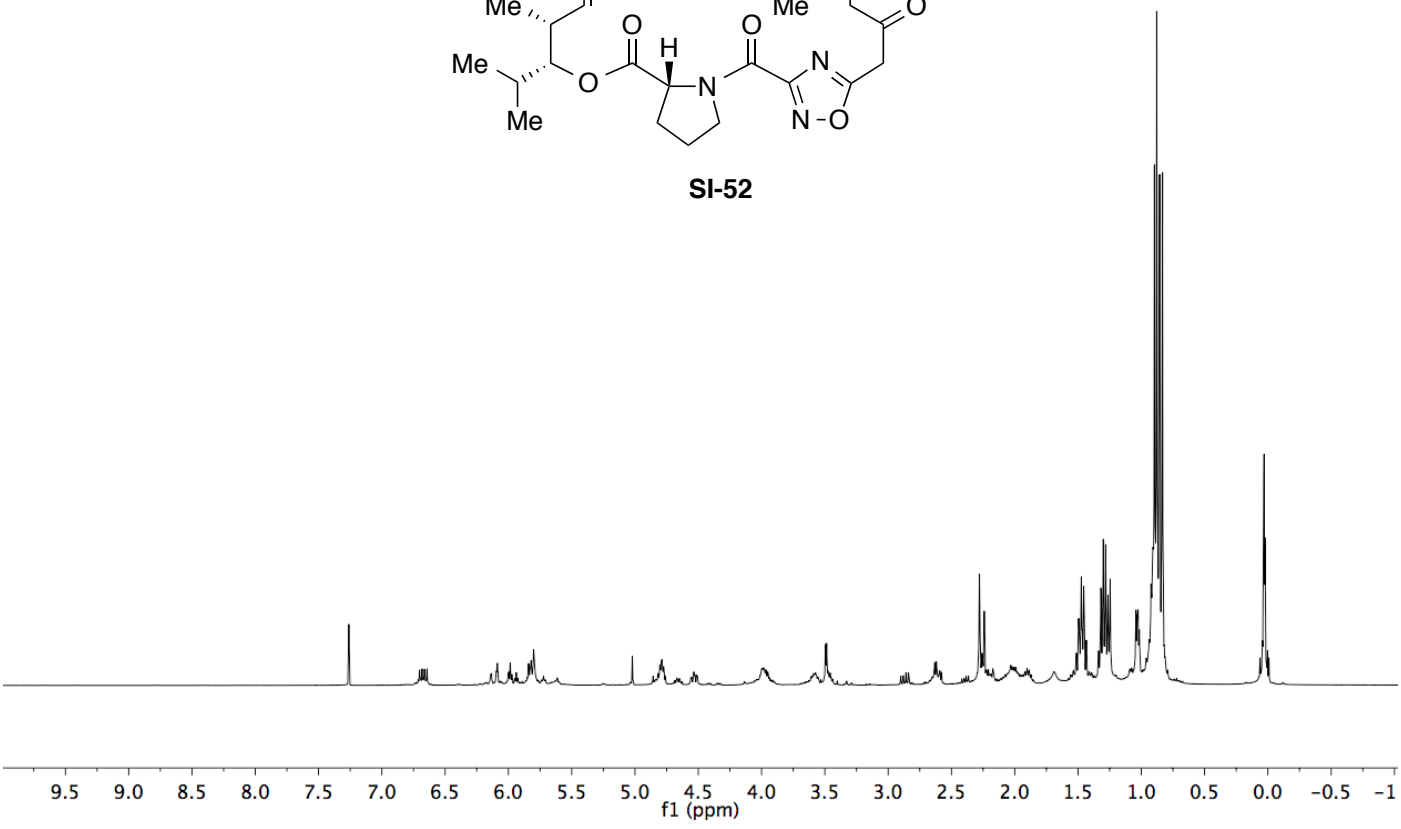

Br
OTBS
Me
O
O
N
HO
N
O

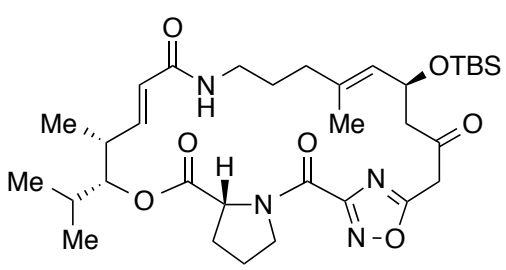
SI-51

16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0 -1 -2 -3 -4
f1 (ppm)


SnBu3
O
N
H
Br
OTBS
Me
Me
O
O
H
O
Me
O
N
N
Me
N
O

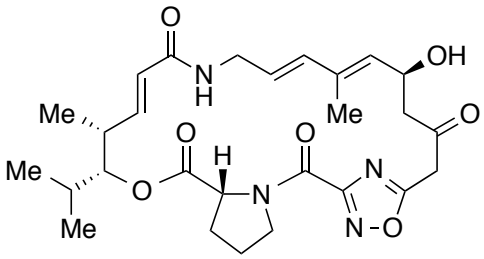
SI-52


9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1
f1 (ppm)

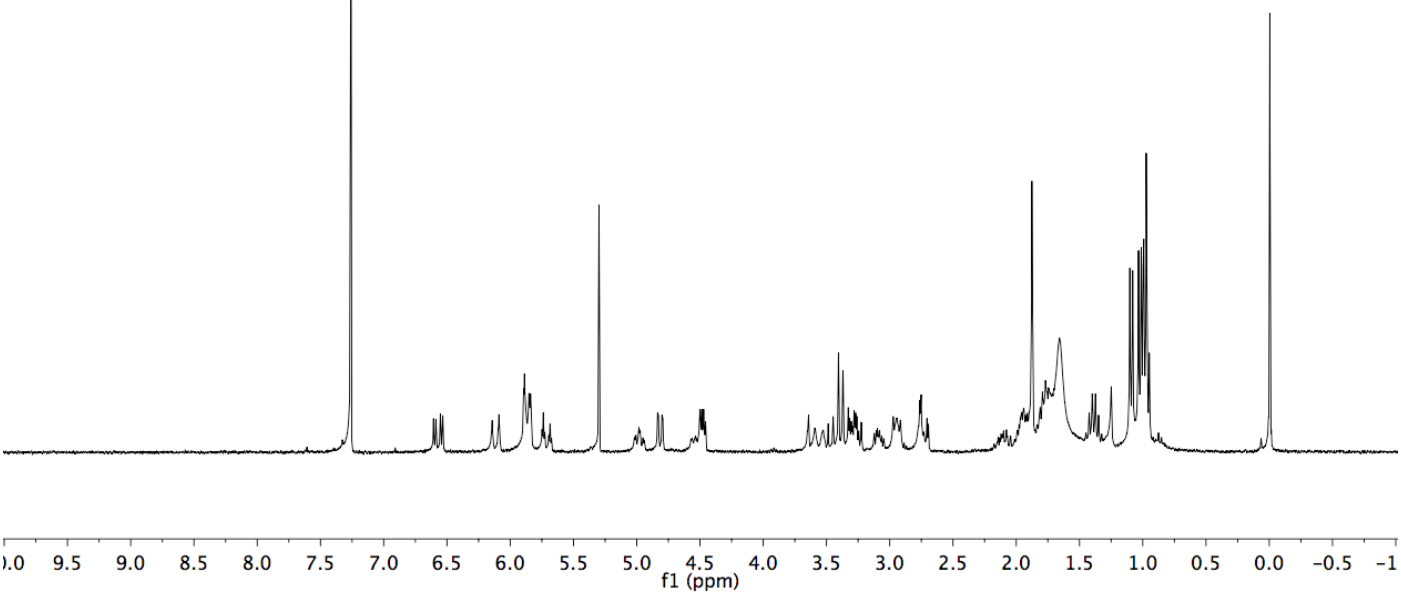

O
N
H
OTBS
Me
Me
O
O
O
H
Me
O
N
N
Me
N
O

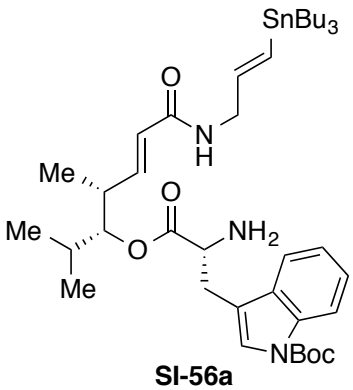
SI-53

9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1
f1 (ppm)


O
N
H
OH
Me
Me
O
O
O
H
Me
O
N
N
Me
N
O

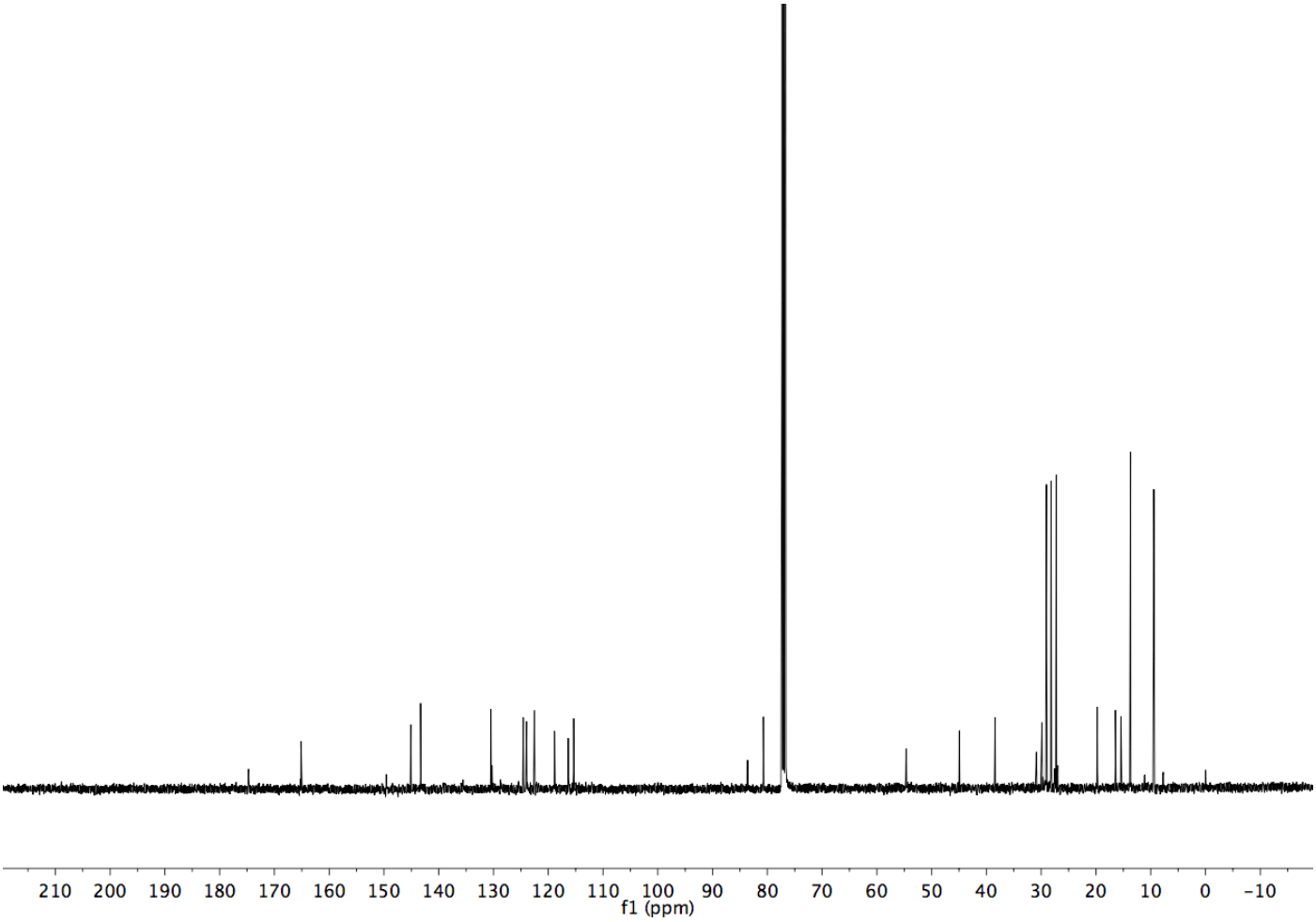
28

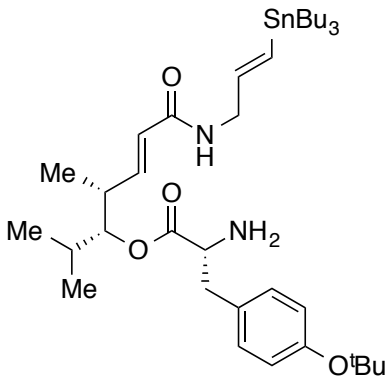

9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1
f1 (ppm)


SnBu3
O
N
H
Me
O
Me
O
NH2
Me
NBoc

SI-56a

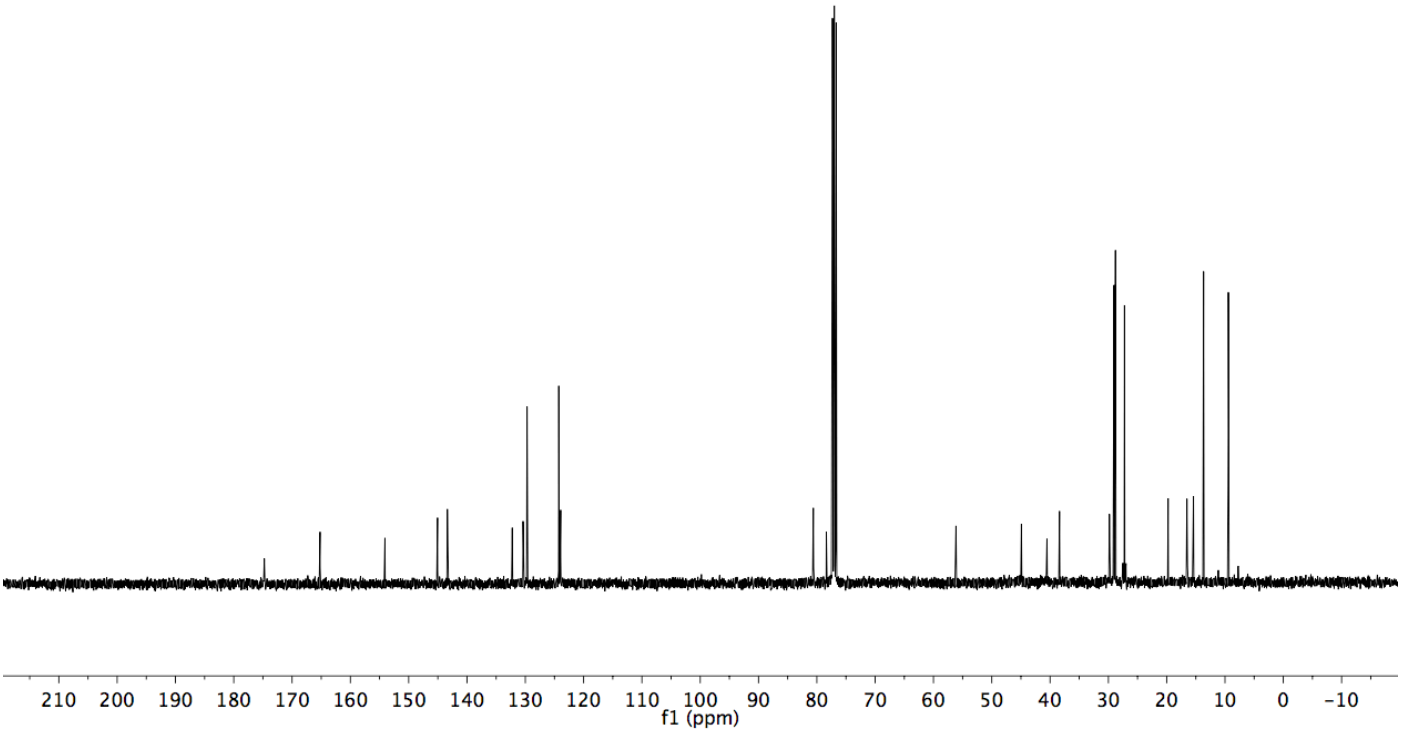
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1.
f1 (ppm)

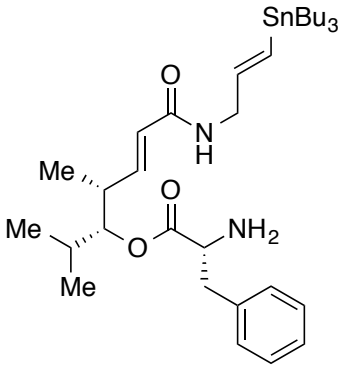

210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


SnBu3
O
N
H
Me
O
Me
O
NH2
Me
OtBu

SI-56b

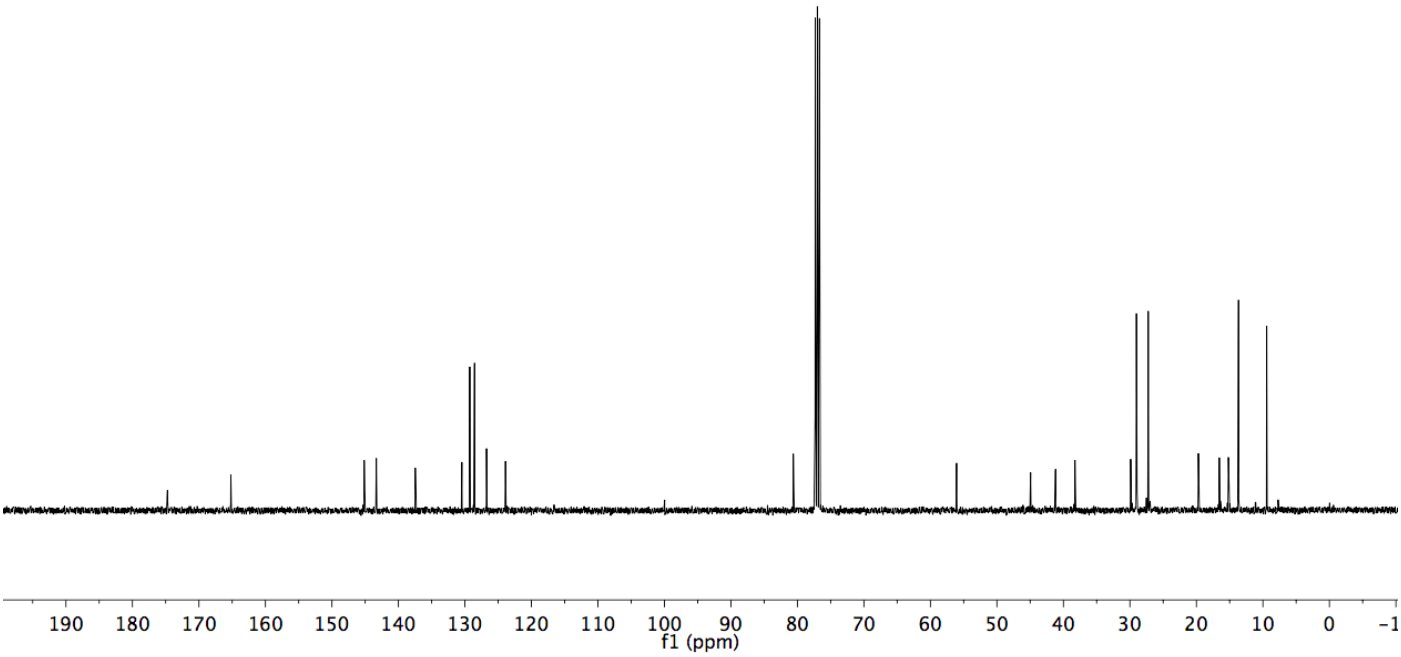
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5
f1 (ppm)

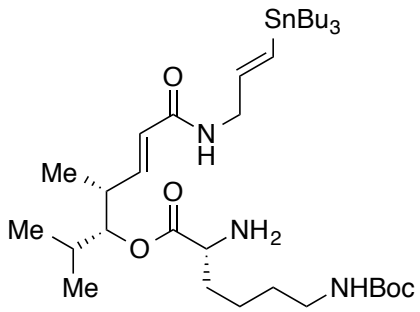

210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


SnBu3
O
N
H
Me
Me
Me
O
O
NH2

SI-56c

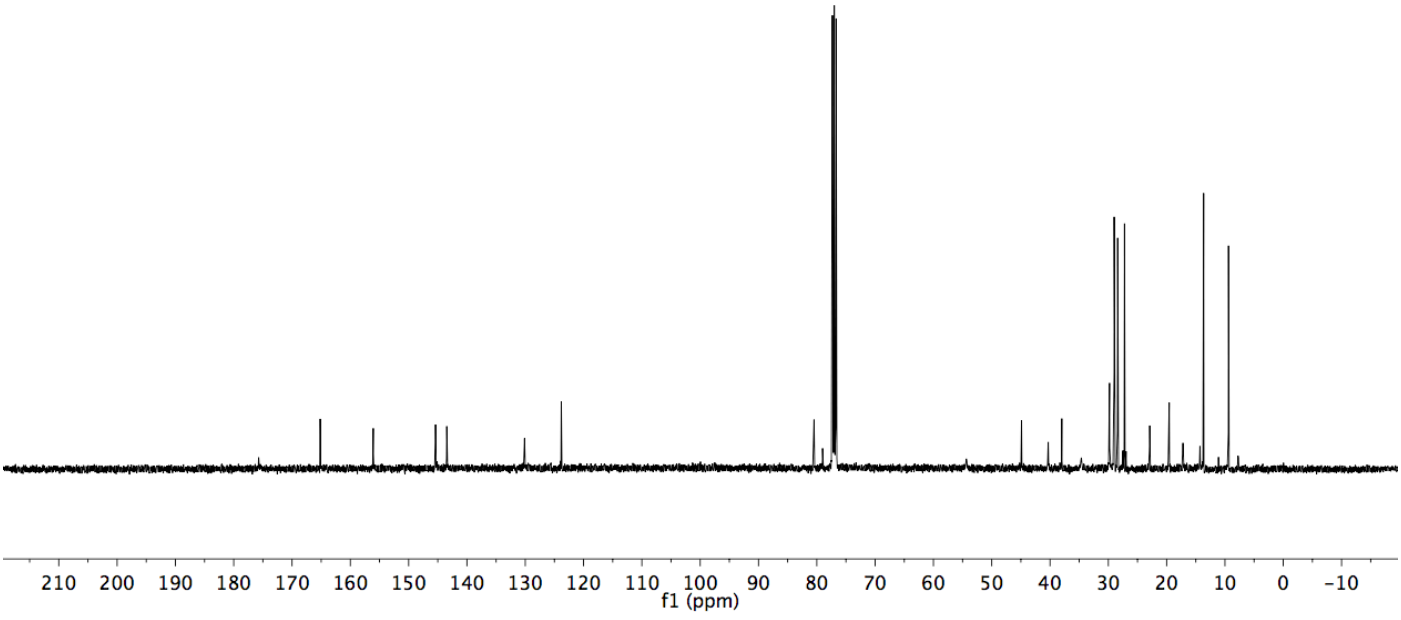
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1
f1 (ppm)

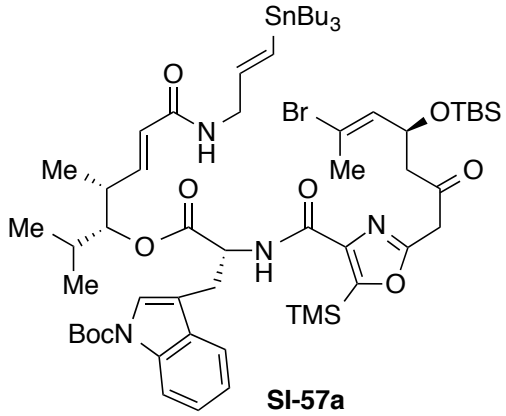

190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -1
f1 (ppm)


SnBu3
O
N
H
Me
O
Me
O
NH2
Me
NHBoc

SI-56d

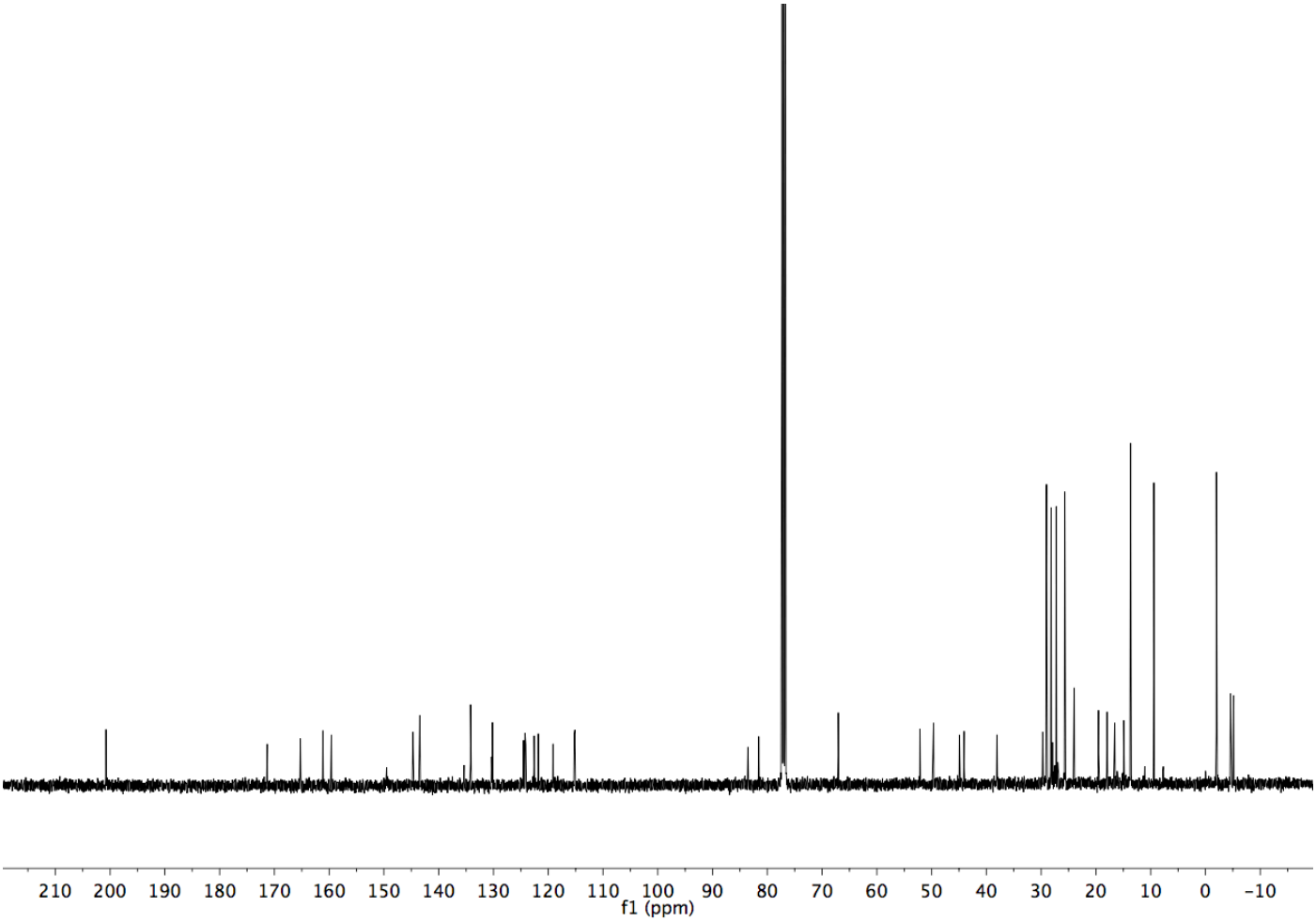
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5
f1 (ppm)

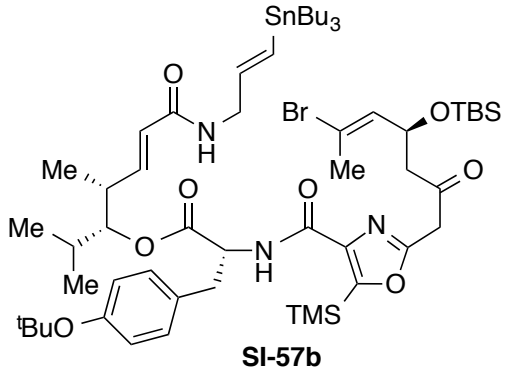

210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


SnBu3
O
N
H
Br
OTBS
Me
Me
O
O
O
Me
O
N
H
N
Me
O
TMS
BocN

SI-57a

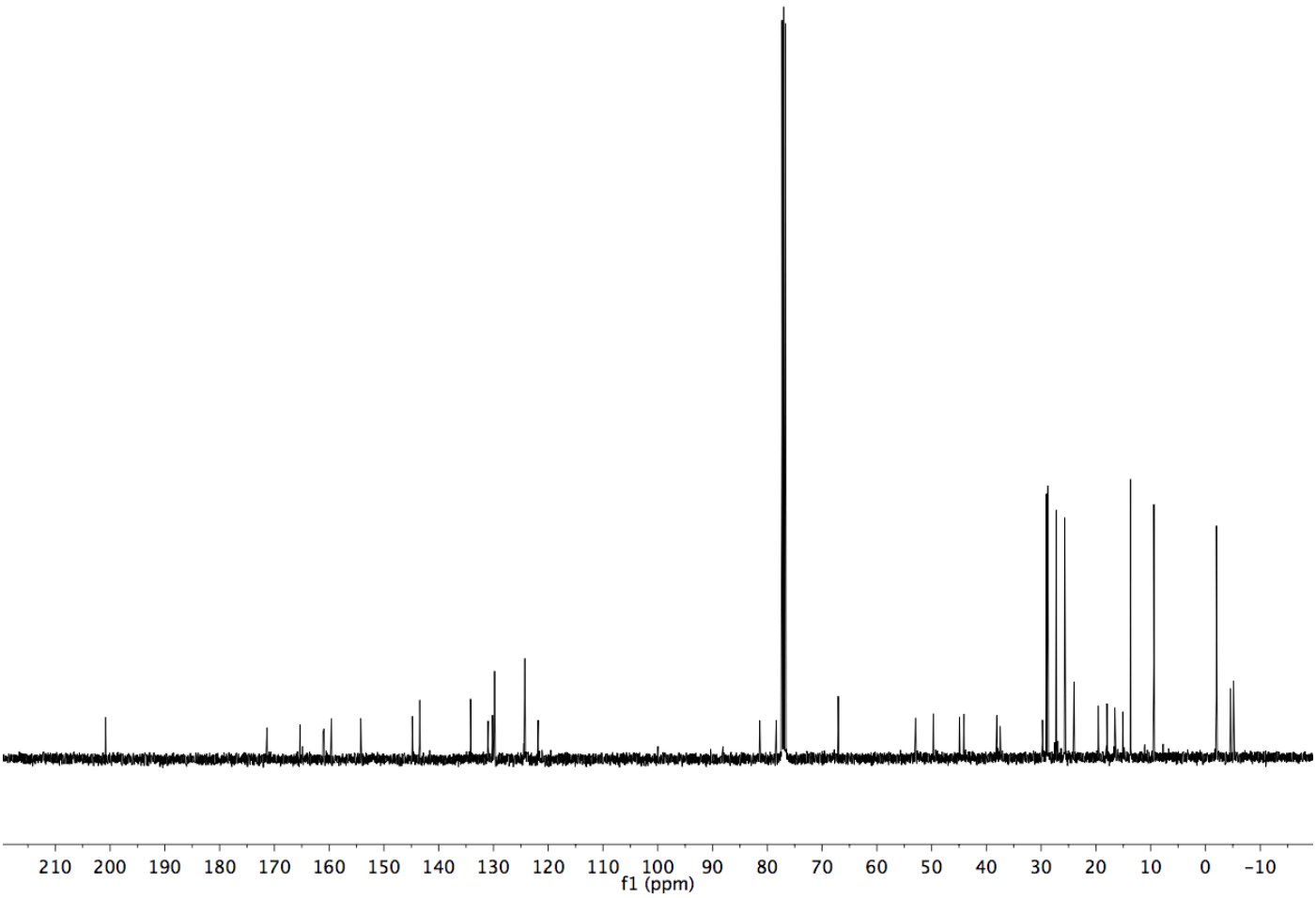
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1
f1 (ppm)

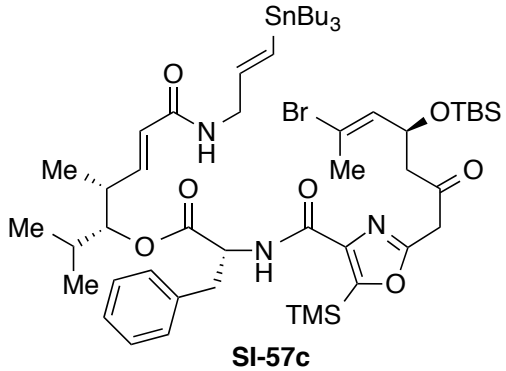

210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


SnBu3
O
N
H
Br
OTBS
Me
Me
O
O
O
Me
O
N
H
N
Me
O
tBuO
TMS

SI-57b

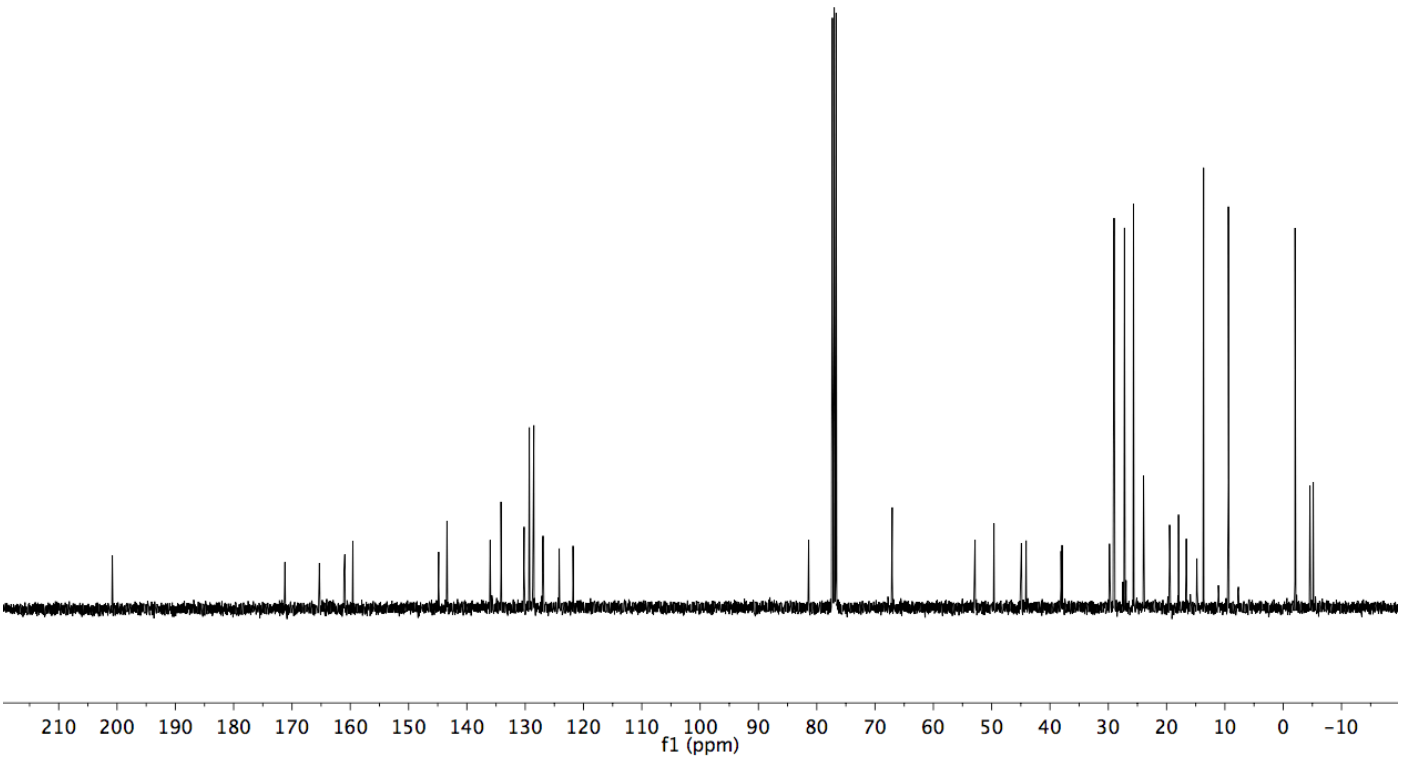
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1.
f1 (ppm)

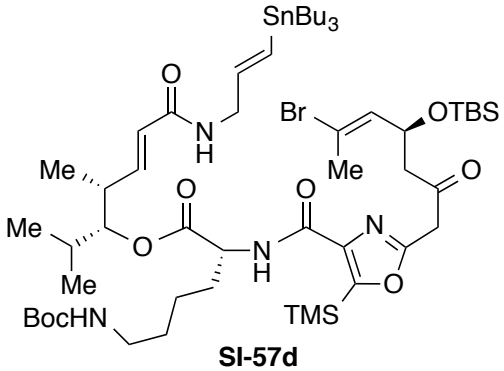

210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


SnBu3
O
N
H
Br
OTBS
Me
Me
O
O
O
Me
O
N
H
N
Me
O
TMS

SI-57c

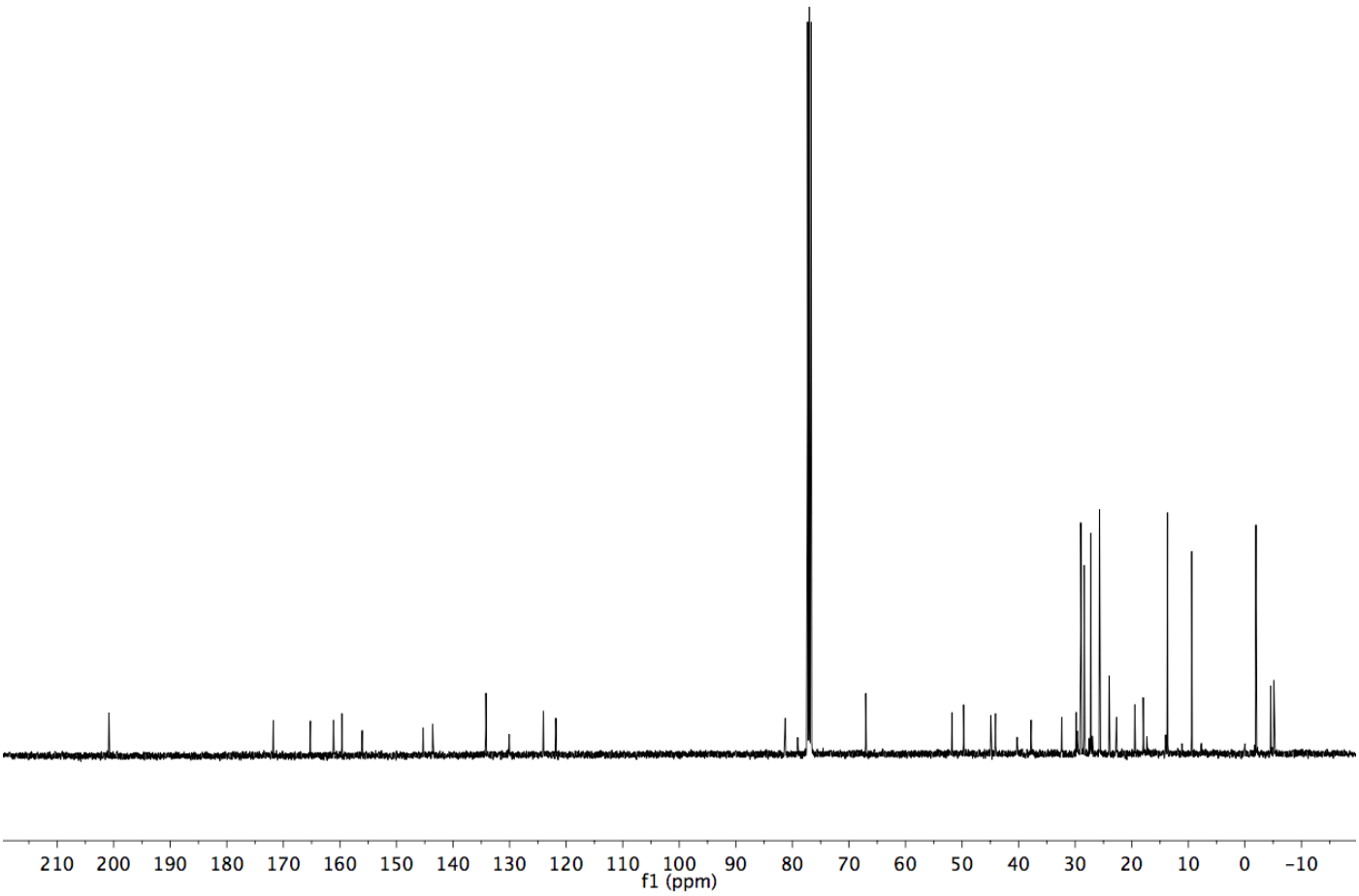
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5
f1 (ppm)

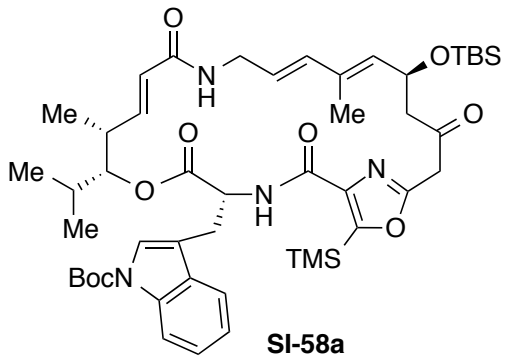

210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


SnBu3
O
N
H
Br
OTBS
Me
Me
O
O
O
Me
O
N
H
N
Me
O
BocHN
TMS

SI-57d

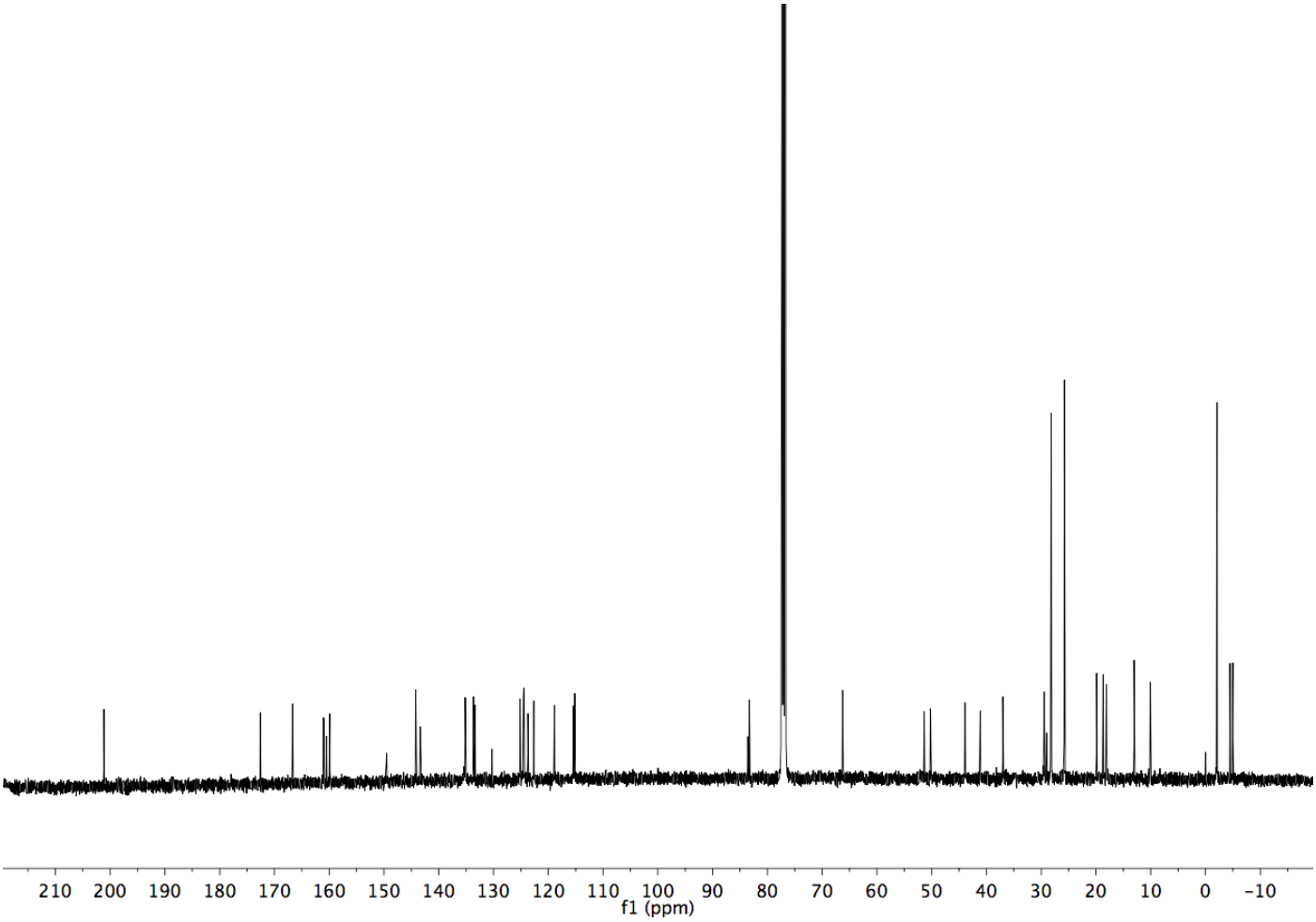
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5
f1 (ppm)

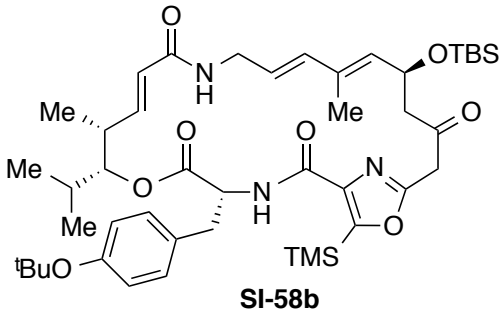

210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


O
N
H
OTBS
Me
Me
O
O
O
Me
O
N
H
N
Me
O
TMS
BocN

SI-58a

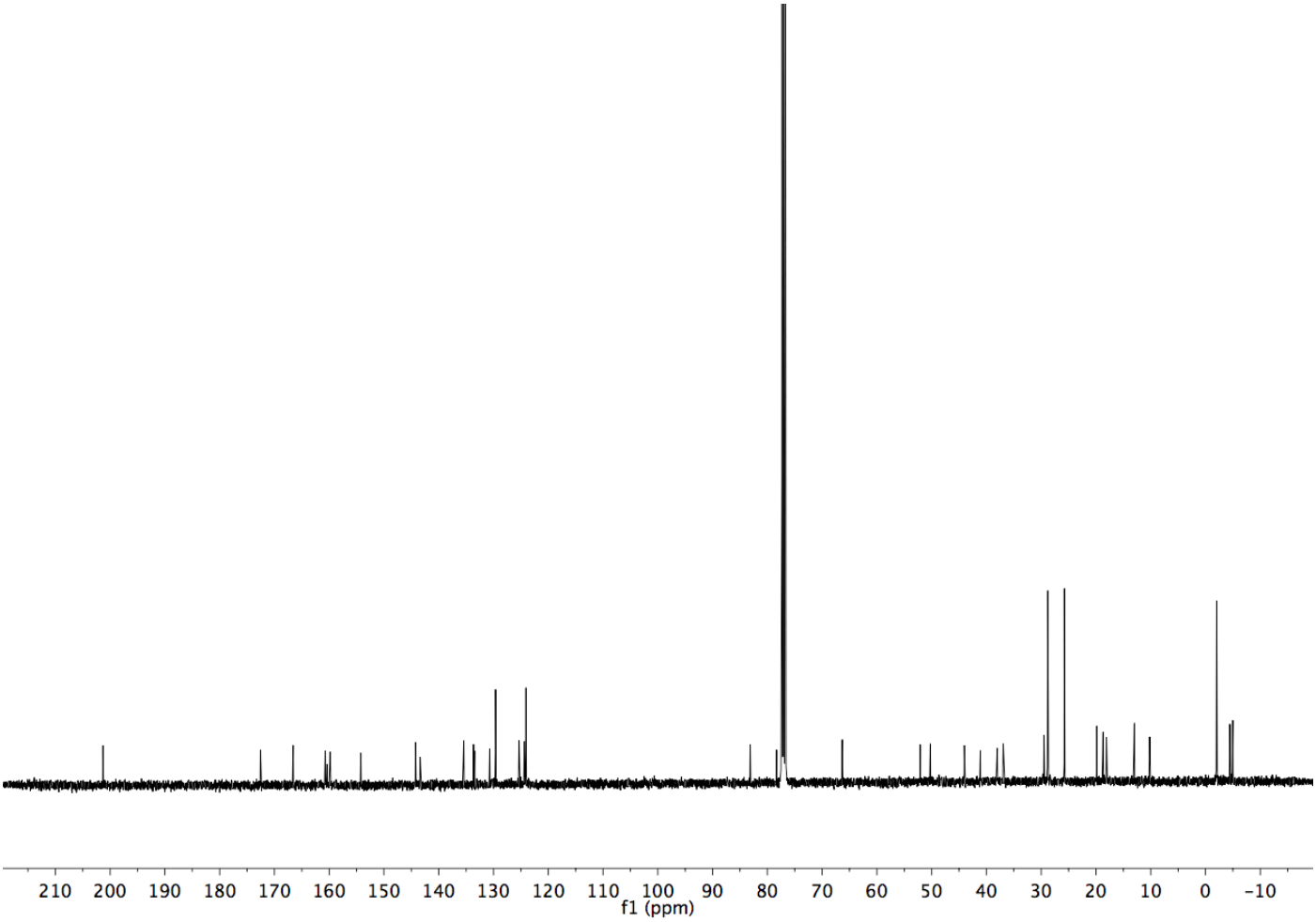
0.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1.
f1 (ppm)

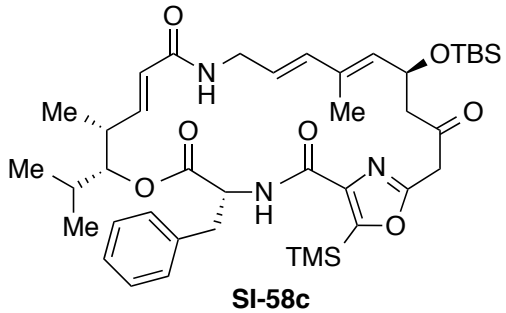

210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


O
N
H
OTBS
Me
Me
O
O
O
Me
O
N
H
O
Me
TMS
tBuO

SI-58b

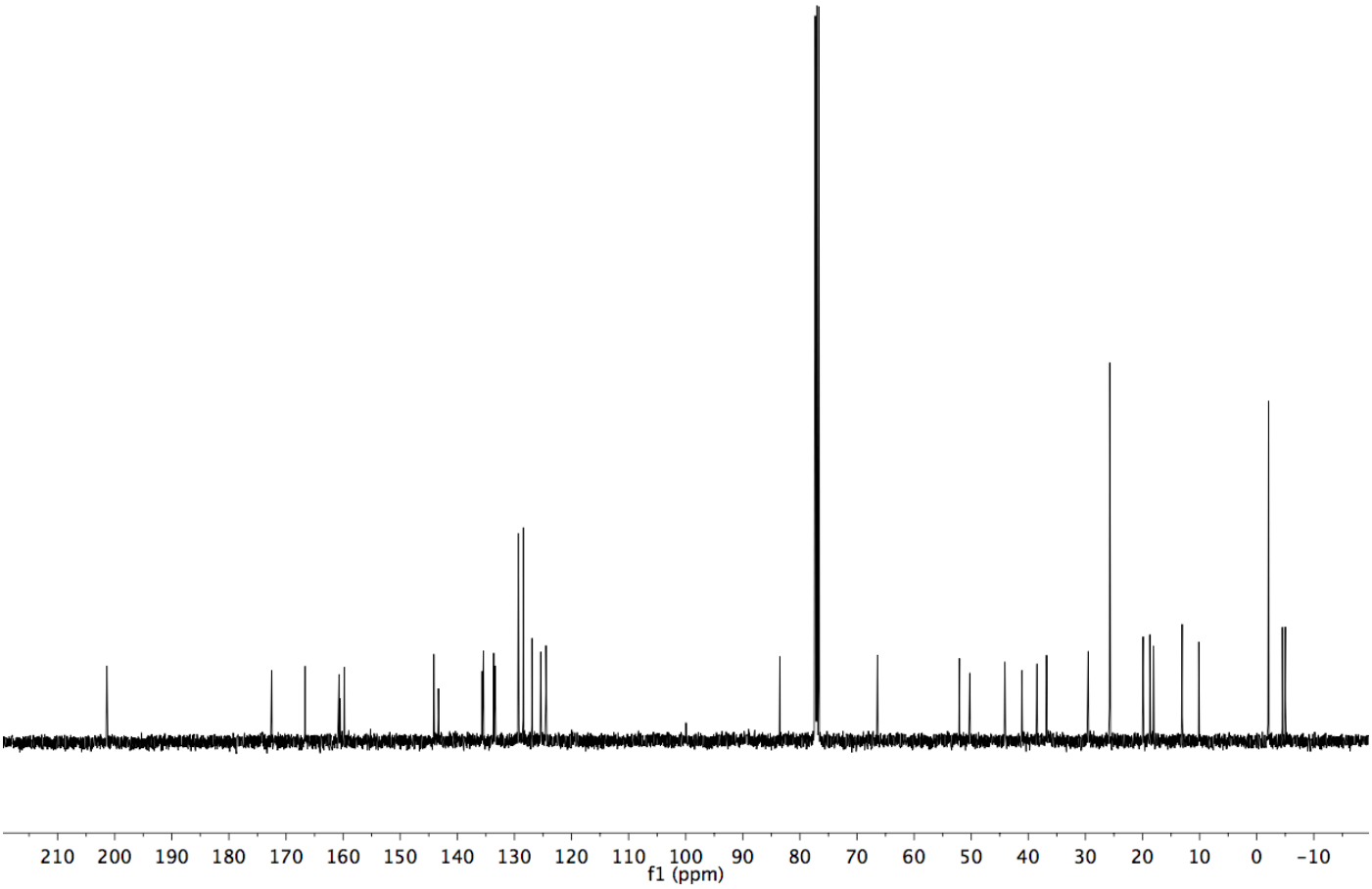
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5
f1 (ppm)

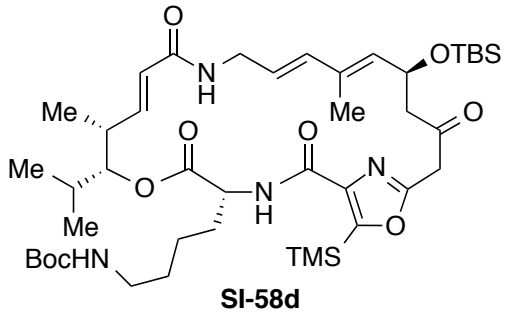

210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


O
N
H
OTBS
Me
Me
O
O
O
Me
O
N
H
O
Me
TMS

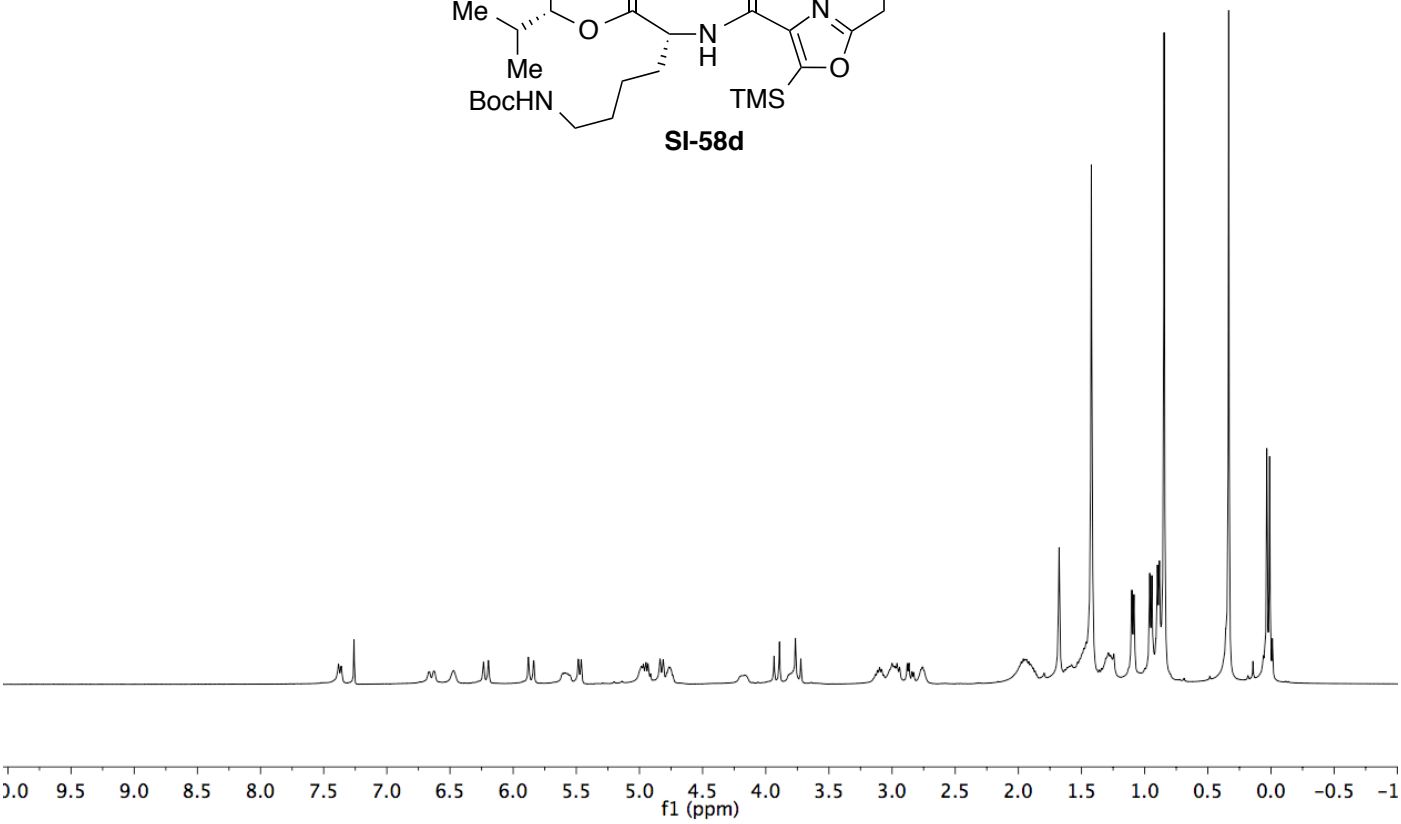
SI-58c

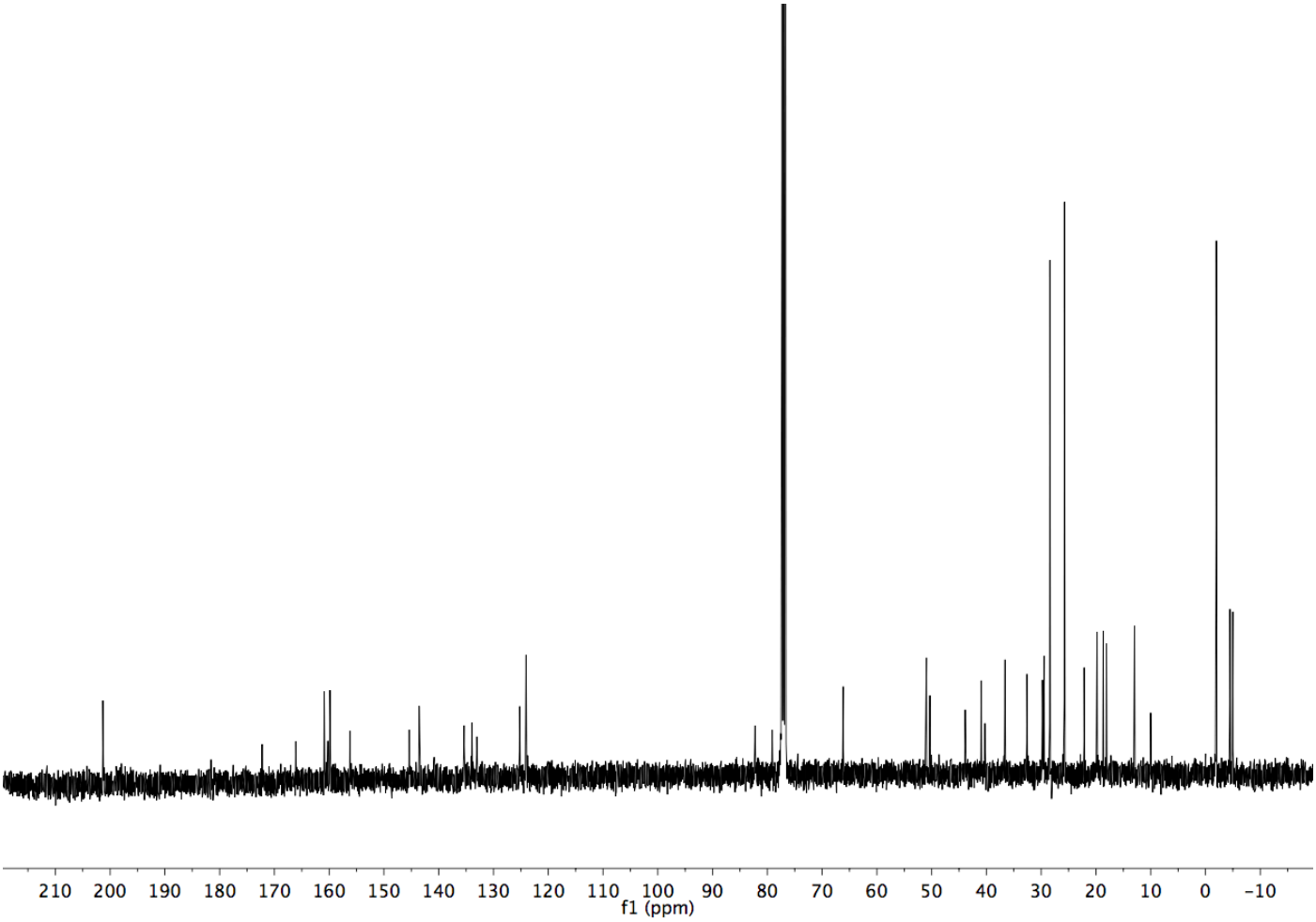
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1
f1 (ppm)

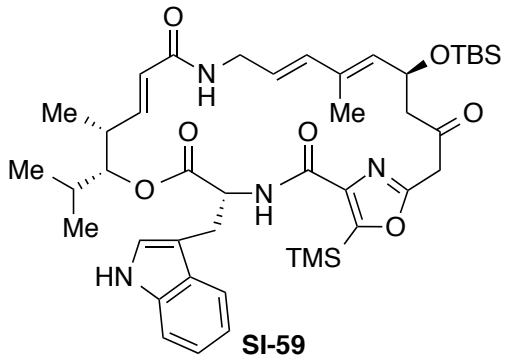

210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


O
N
H
OTBS
Me
Me
O
O
O
Me
O
N
H
O
Me
BocHN
TMS

SI-58d

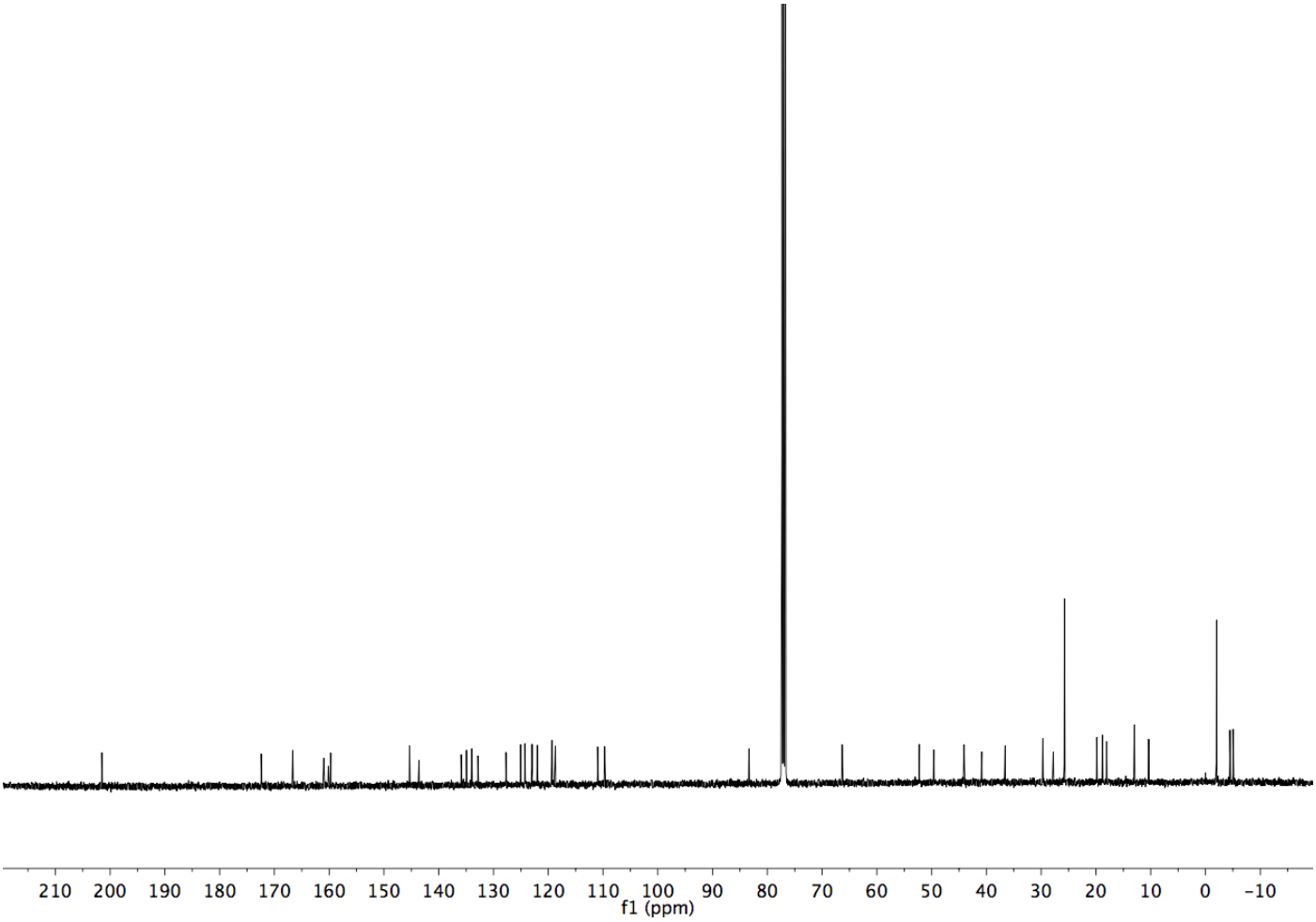

9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1
f1 (ppm)

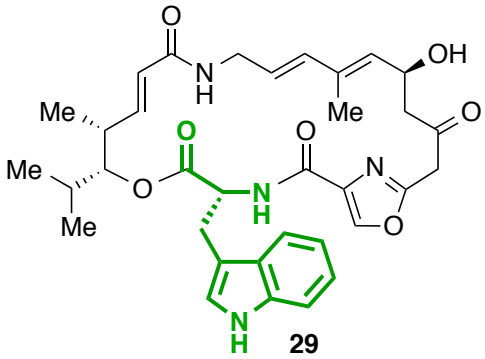

210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


O
N
H
OTBS
Me
Me
O
O
O
Me
O
N
H
N
O
Me
TMS
HN

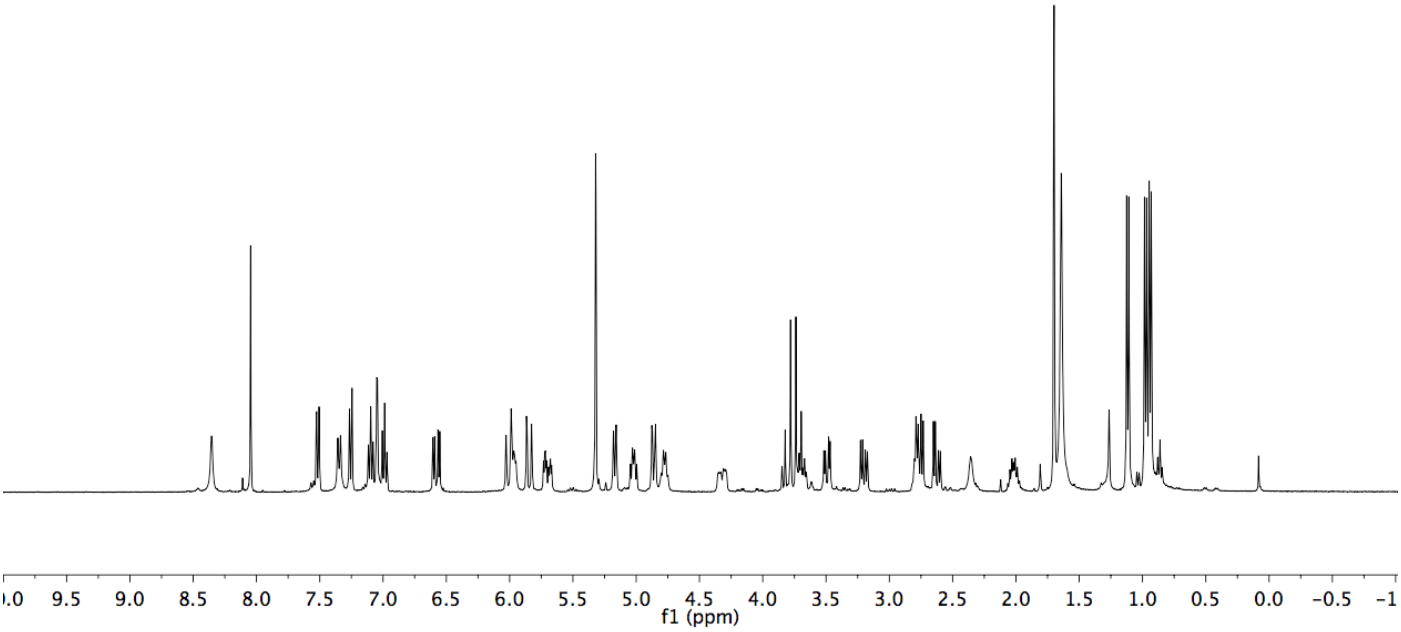
SI-59

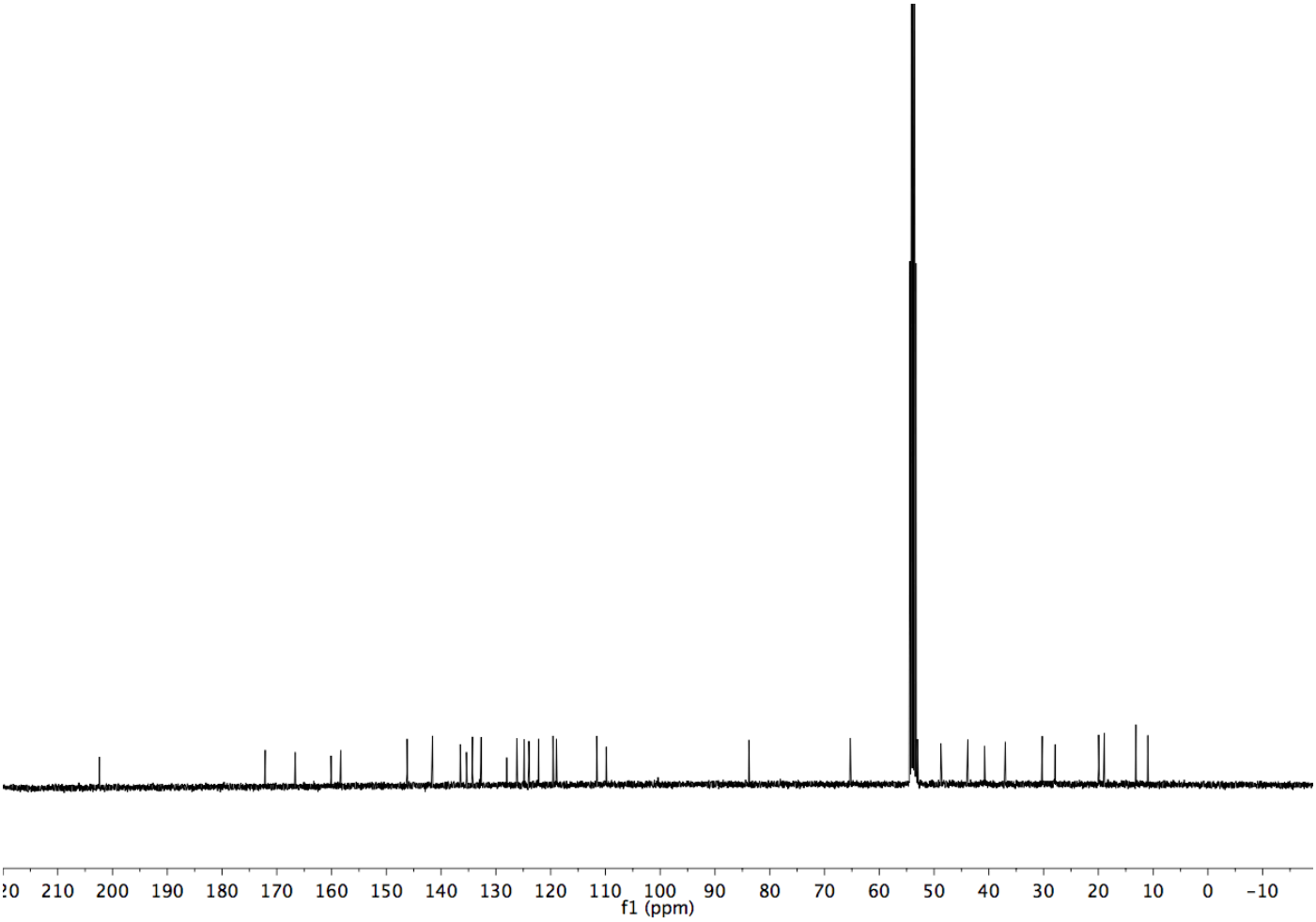
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5
f1 (ppm)

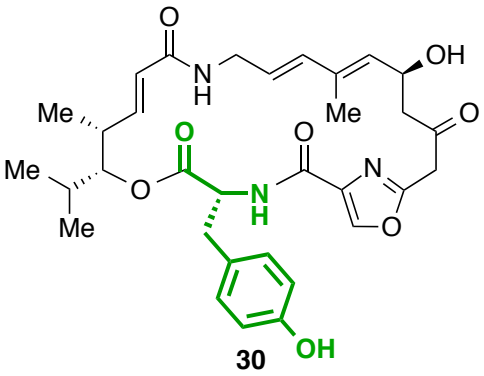

210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


O
N
H
OH
Me
Me
O
O
O
Me
O
N
H
N
O
Me
N
H

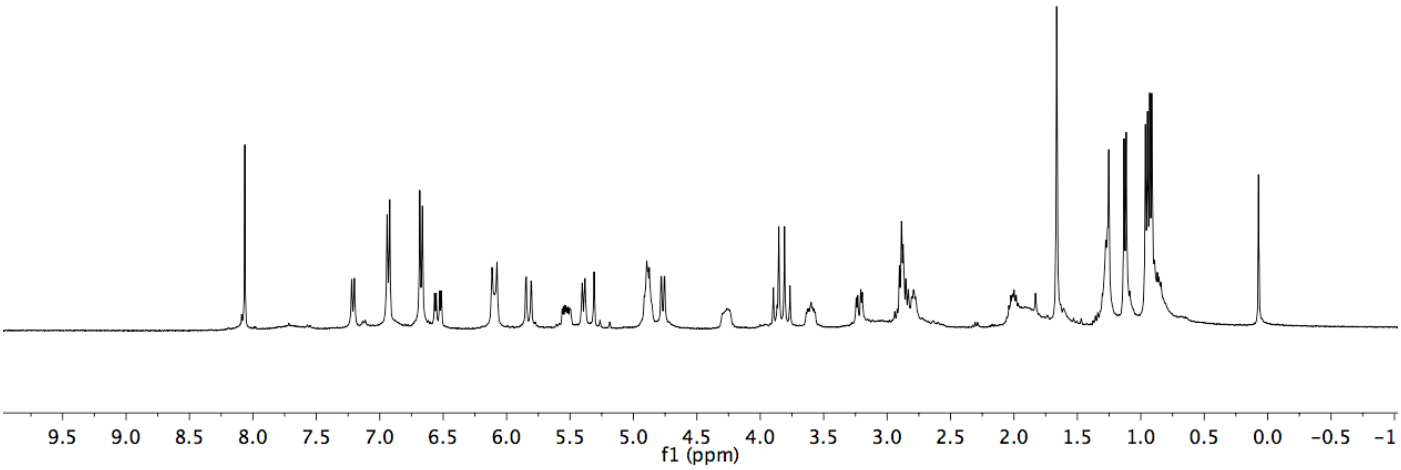
29

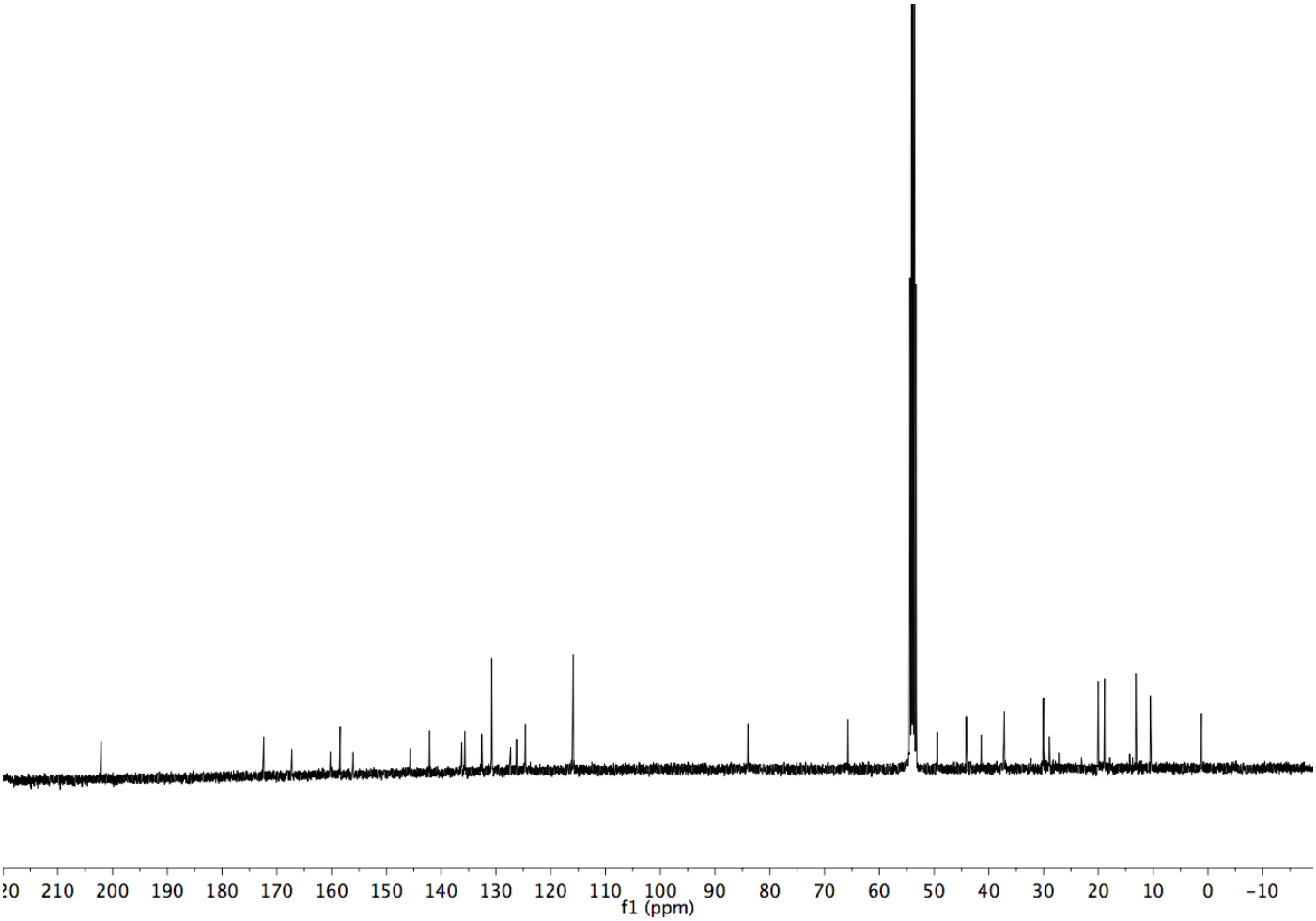

9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5
f1 (ppm)

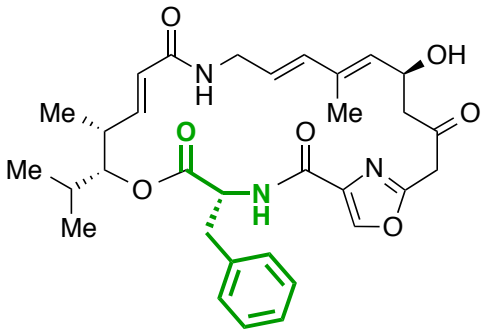

210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


O
N
H
OH
Me
Me
O
Me
O
O
N
O
O
N
H
Me
O
OH

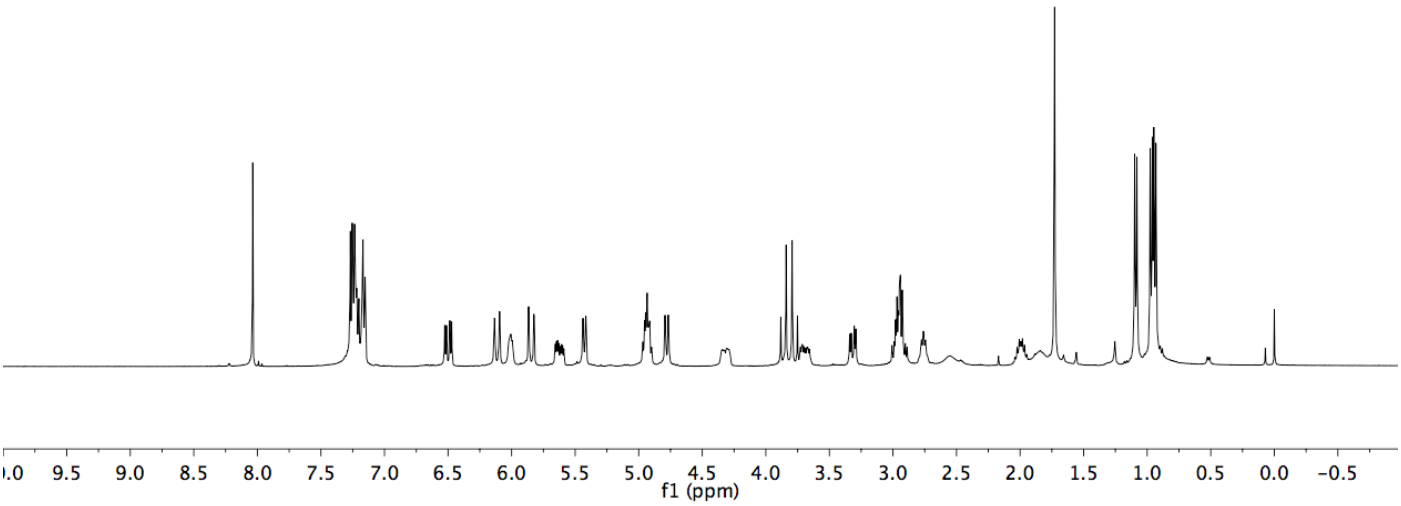
30

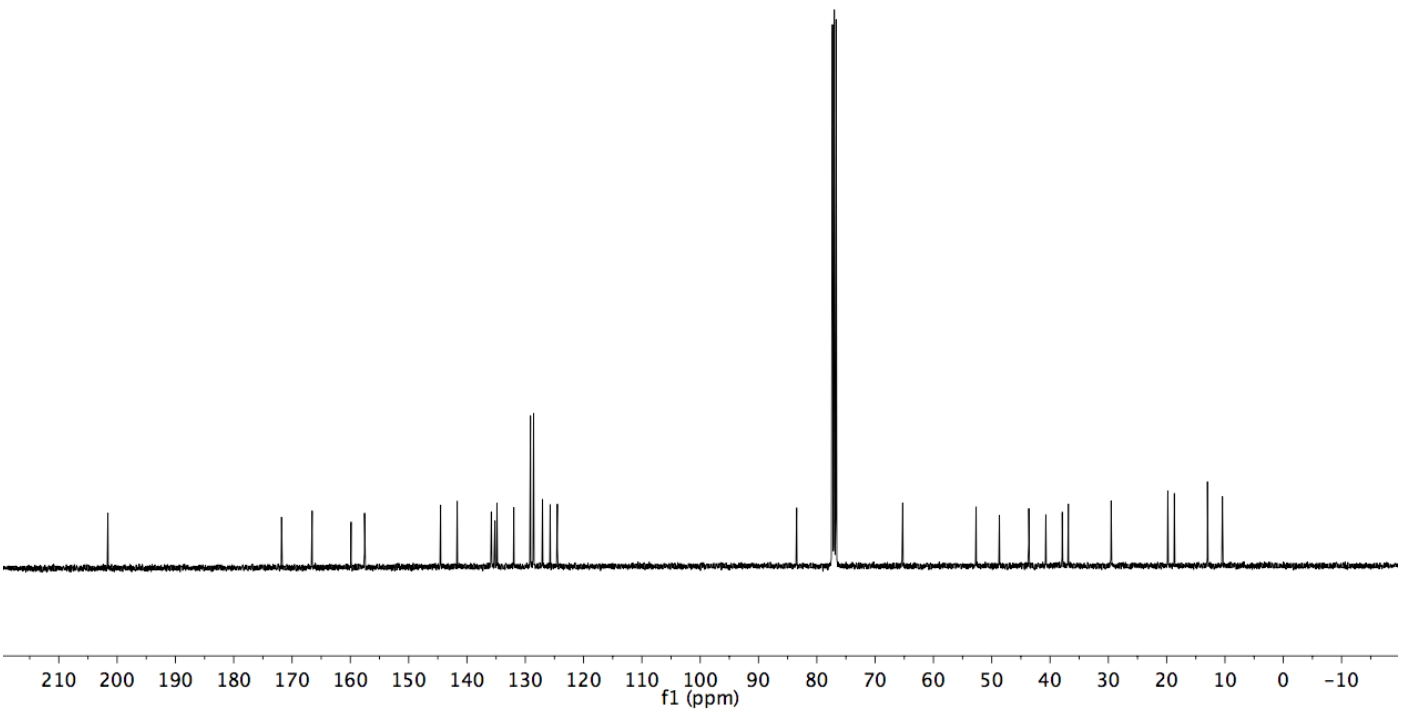

9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1
f1 (ppm)

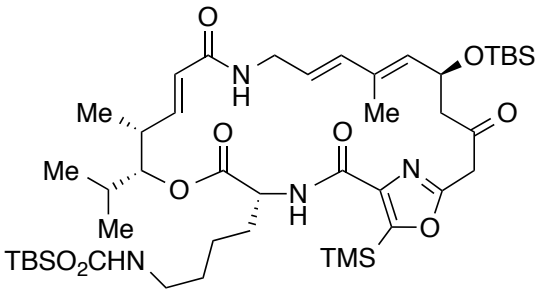

210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


O
N
H
OH
Me
Me
O
O
O
Me
O
N
N
H
O
Me

31

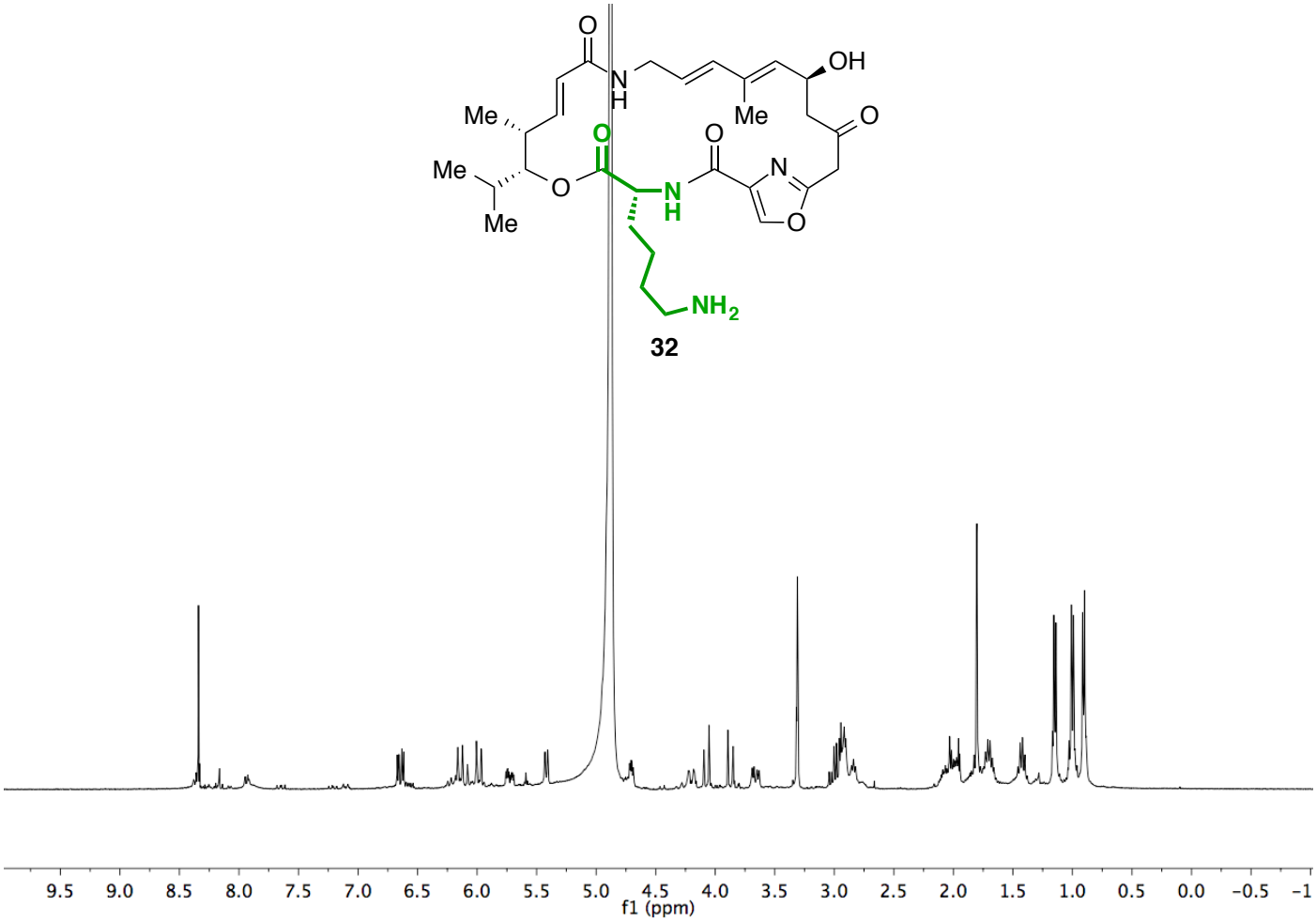

9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
f1 (ppm)


210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
-10
f1 (ppm)

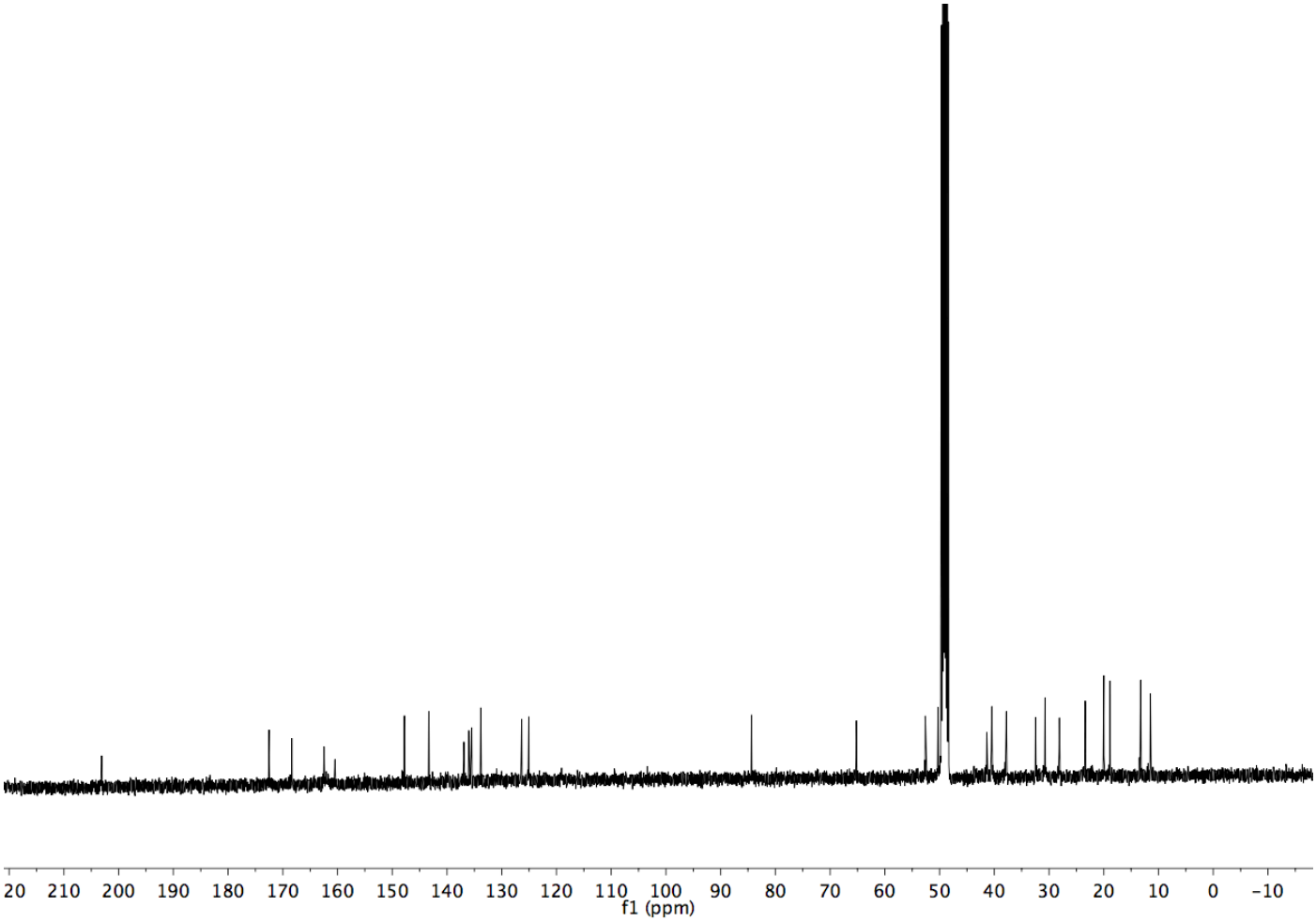

O
N
H
OTBS
Me
Me
O
O
Me
O
N
H
O
Me
TBSO2CHN
TMS

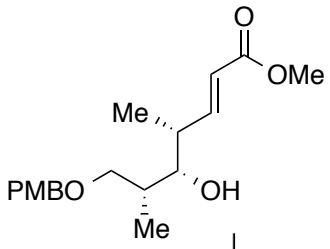
SI-61

9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
f1 (ppm)

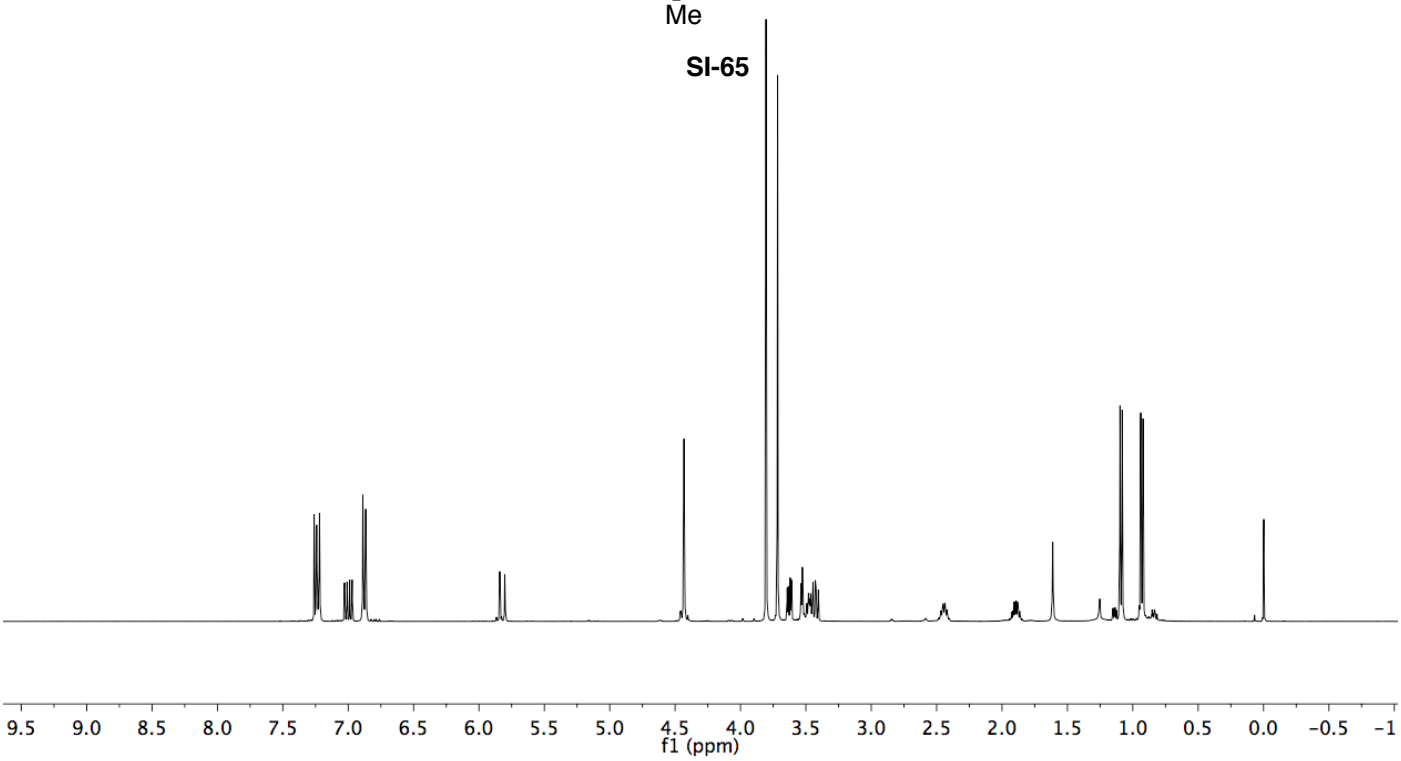

O
N
H
OH
Me
Me
O
Me
O
O
O
N
O
N
H
Me
O
NH2
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1
f1 (ppm)

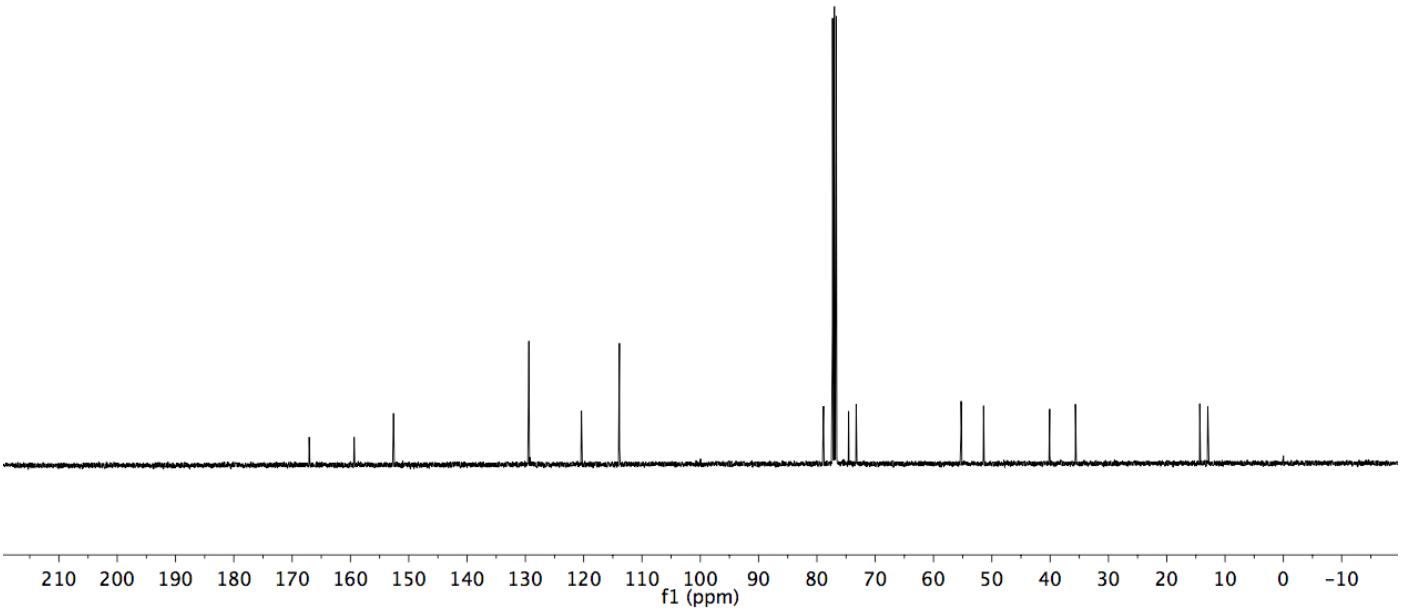
32

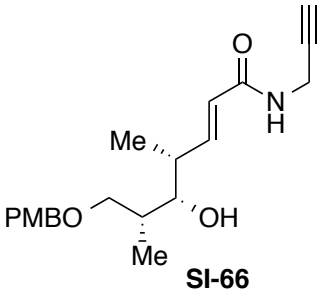

20 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


O
OMe
Me
PMBO
OH
Me

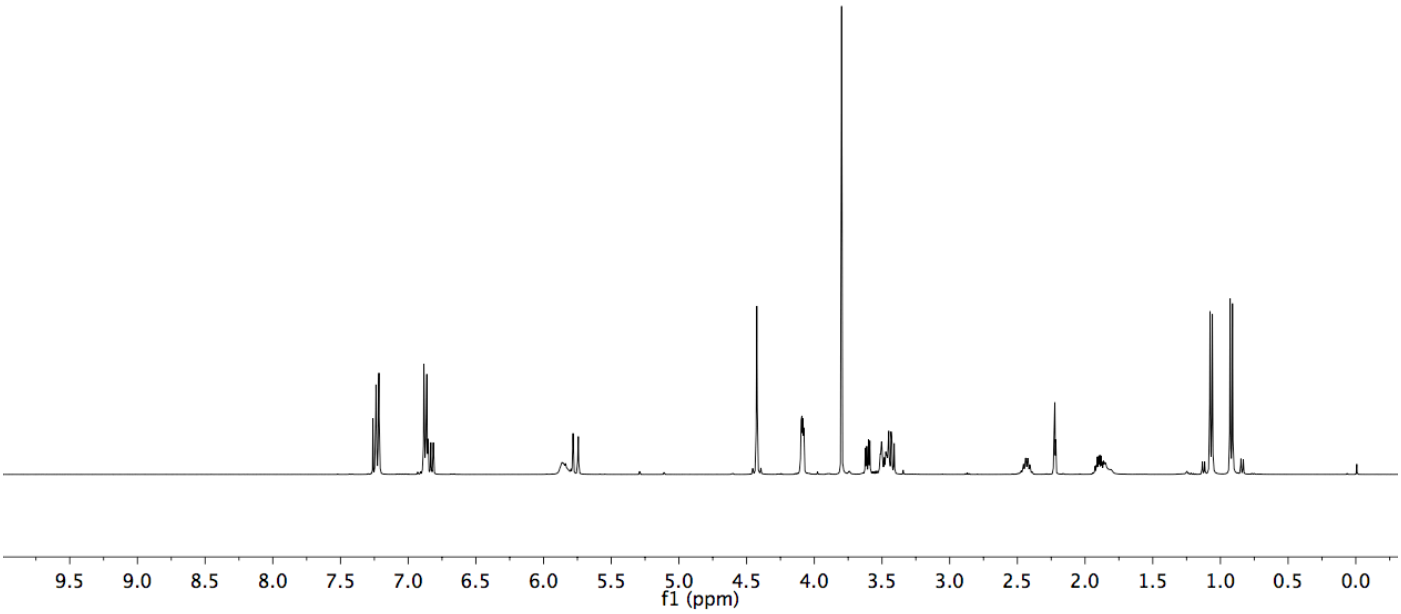
SI-65

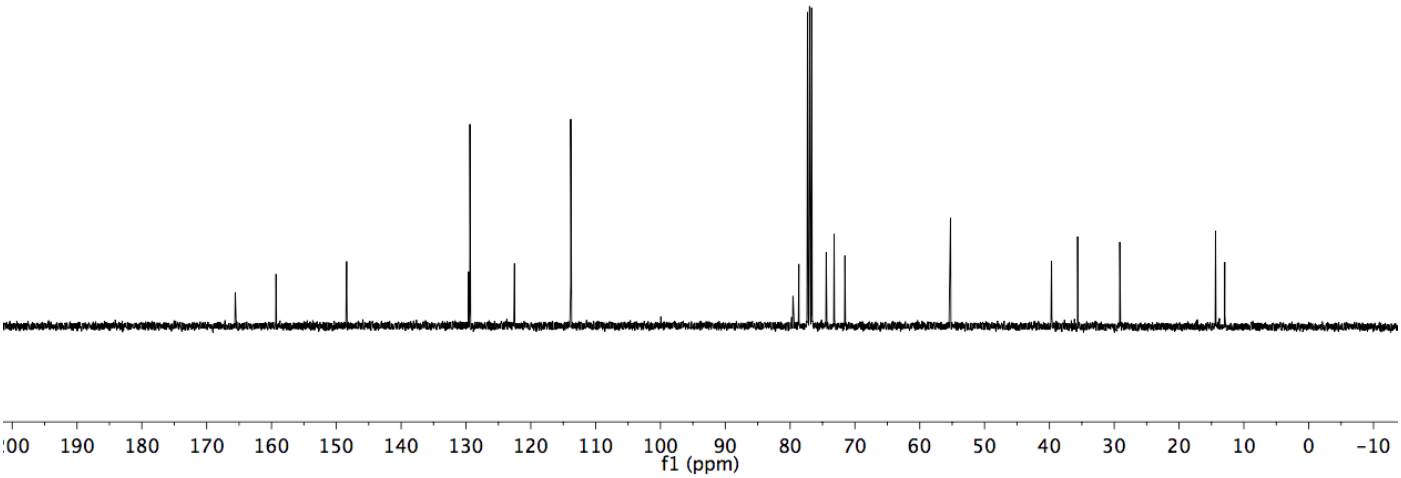

9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1
f1 (ppm)

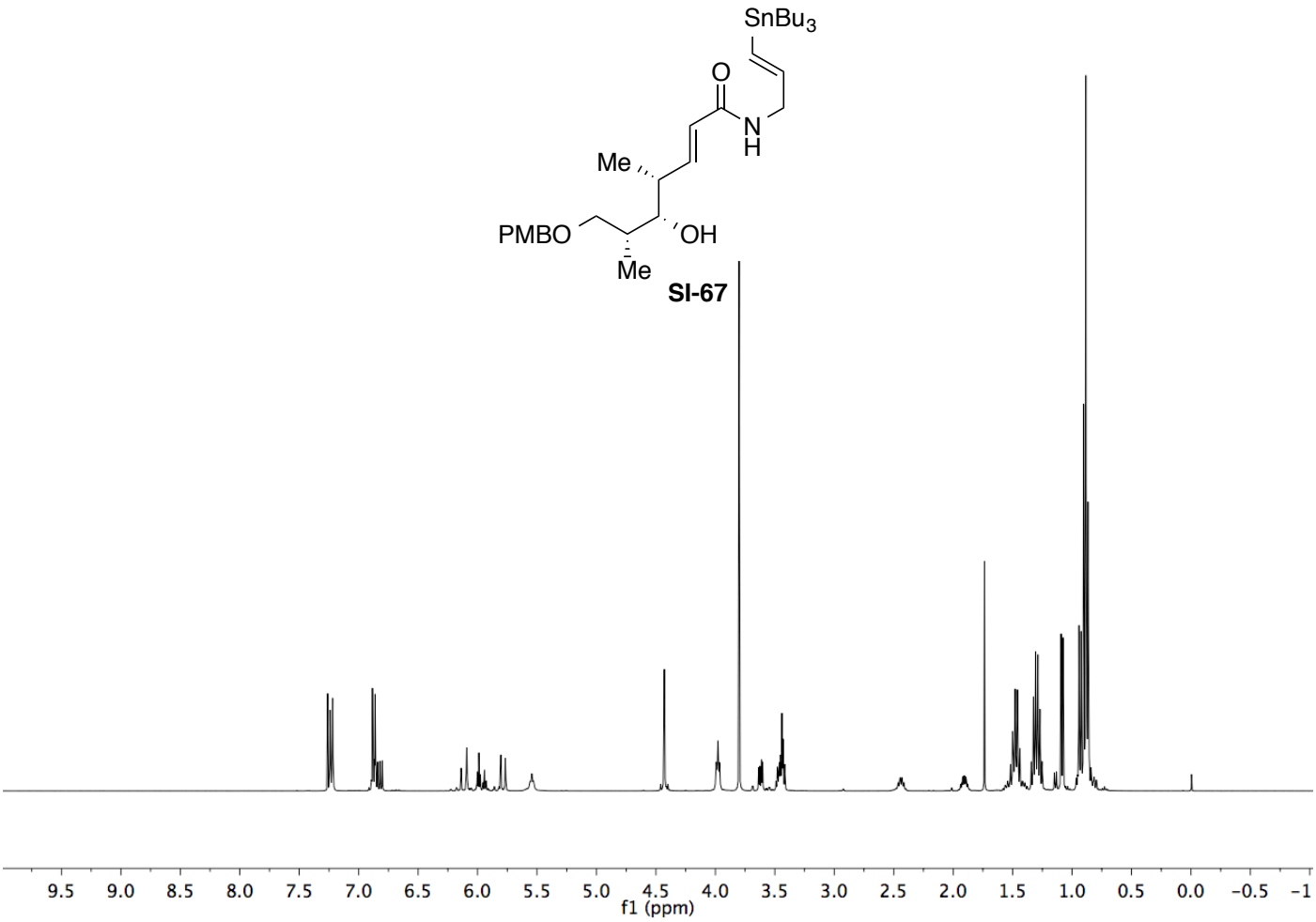

210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

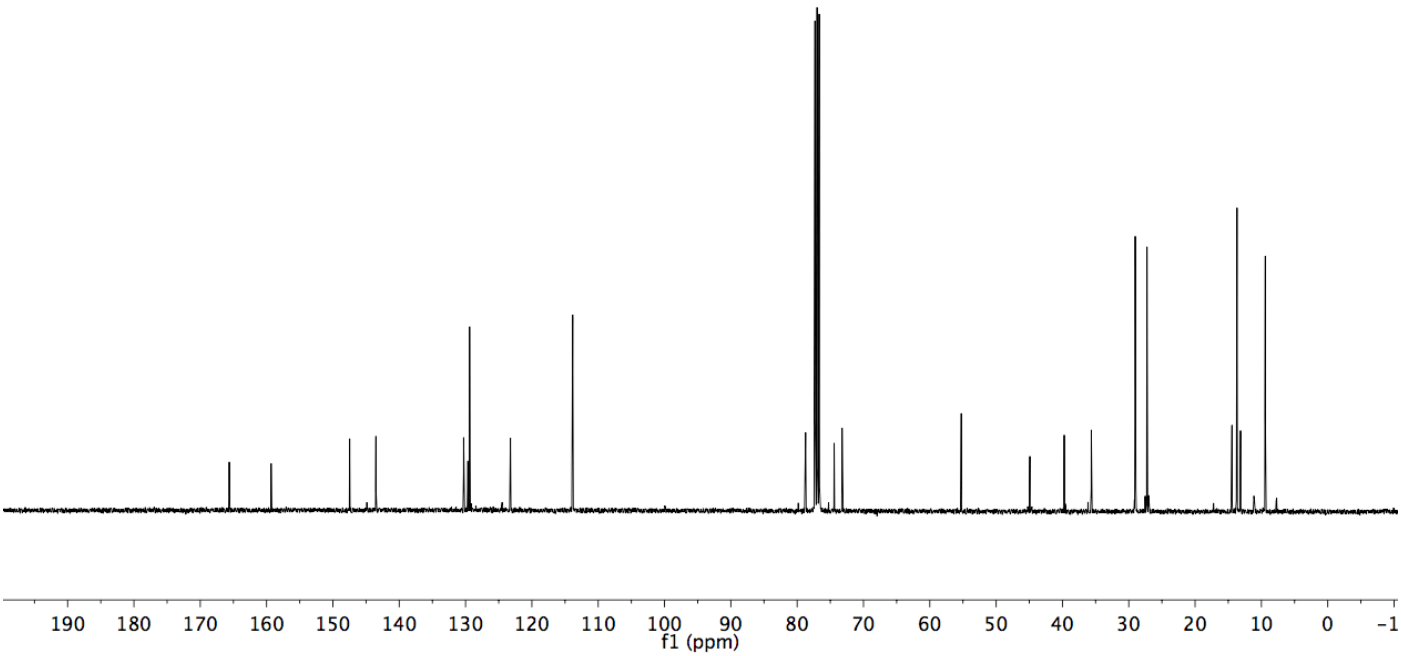

O
N
H
Me
PMBO
OH
Me

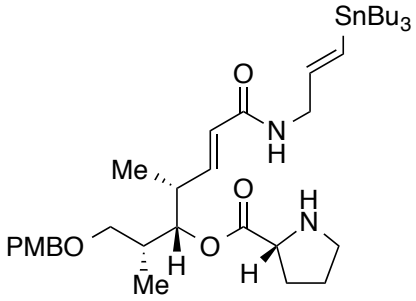
SI-66


9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)


:00 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

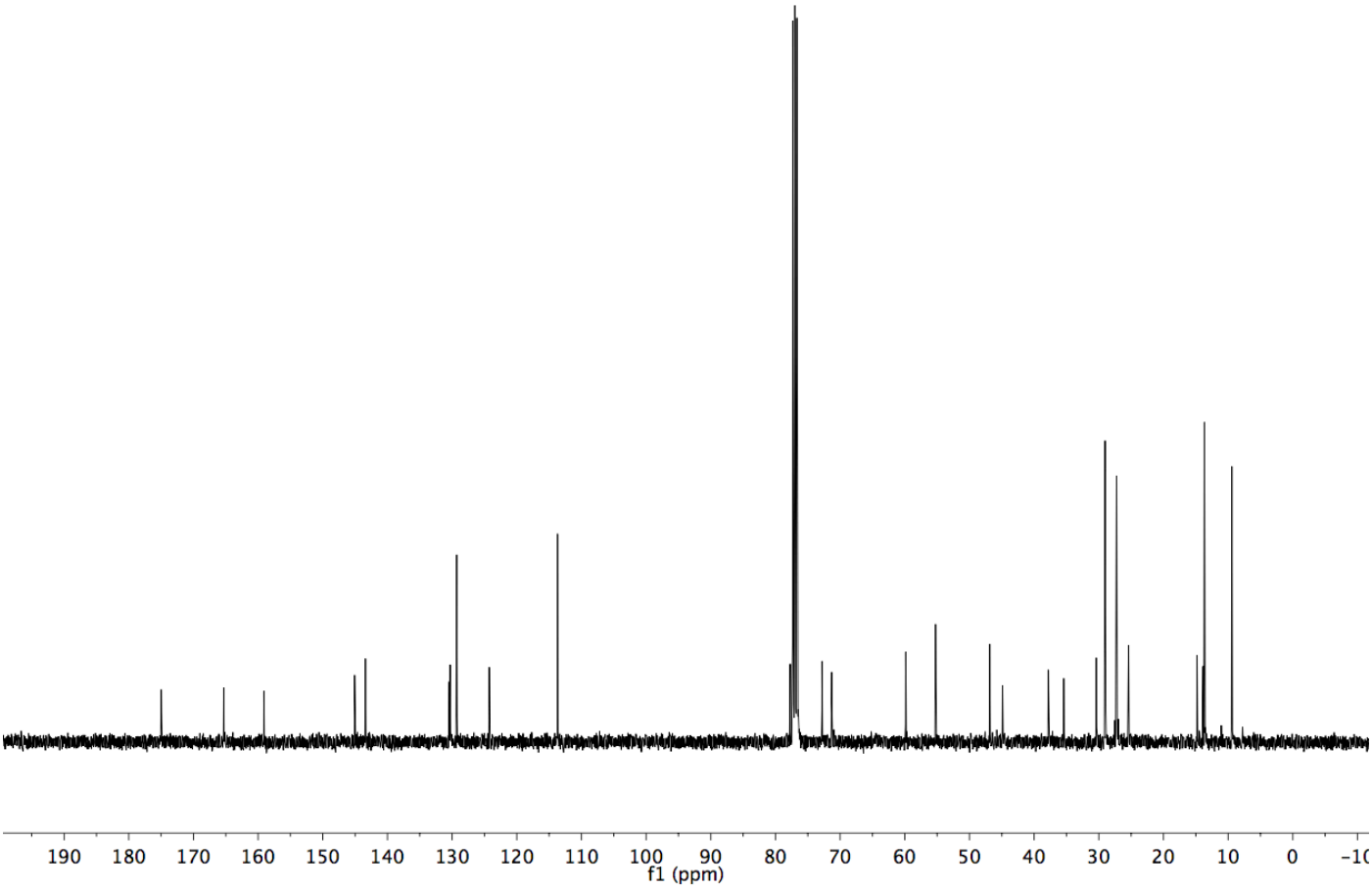

SnBu3
O
N
H
Me
PMBO
OH
Me
SI-67
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1
f1 (ppm)

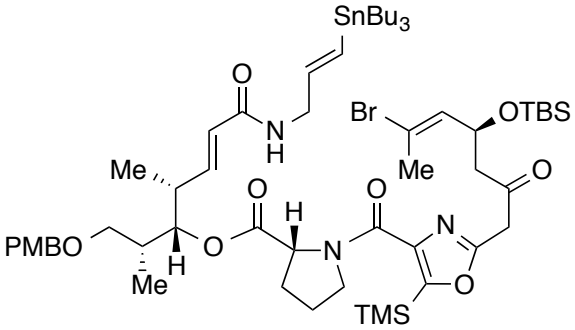

190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -1
f1 (ppm)


SnBu3
O
N
H
Me
O
H
N
PMBO
O
H
H
Me

SI-68

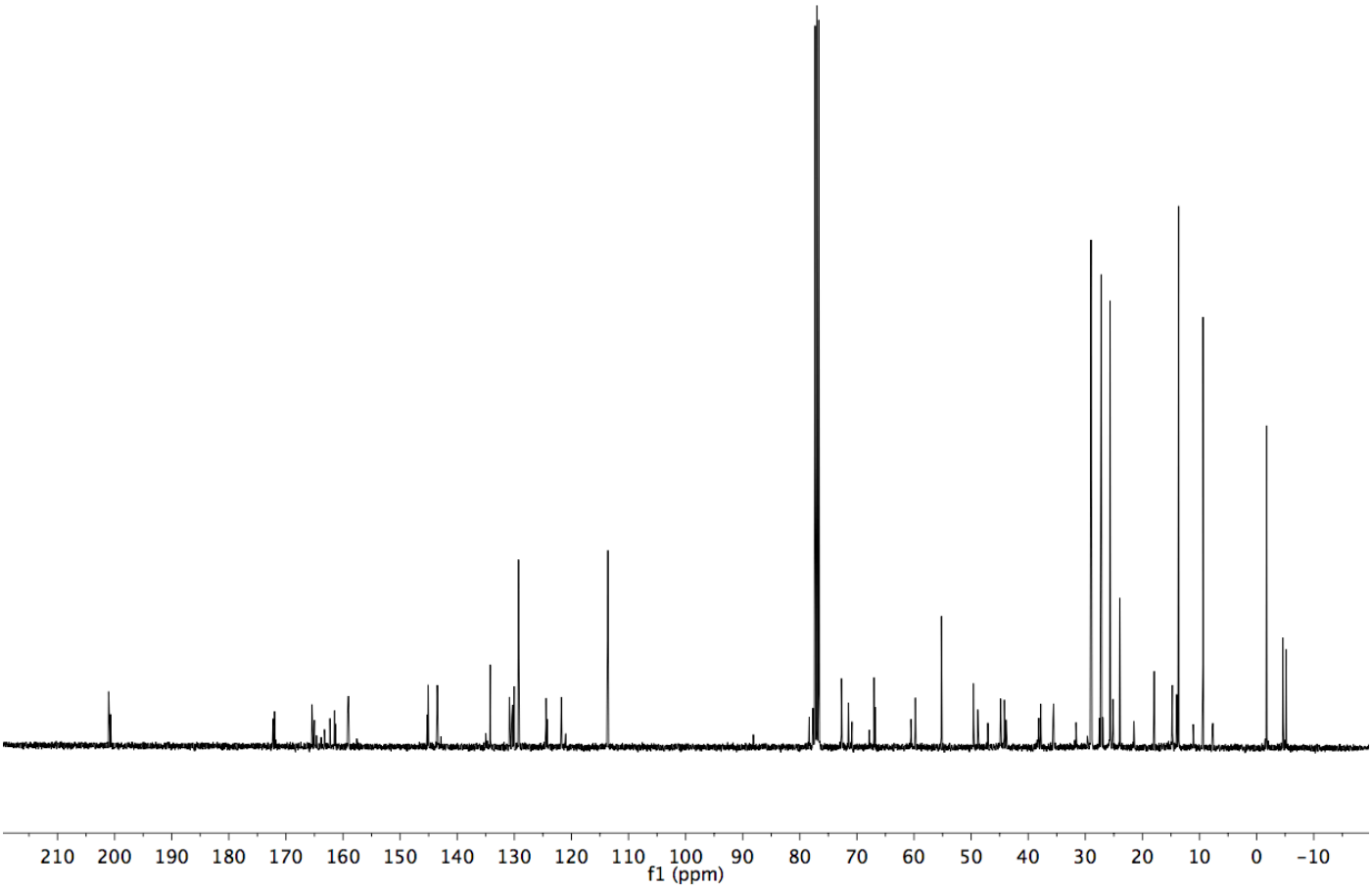
0.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1
f1 (ppm)

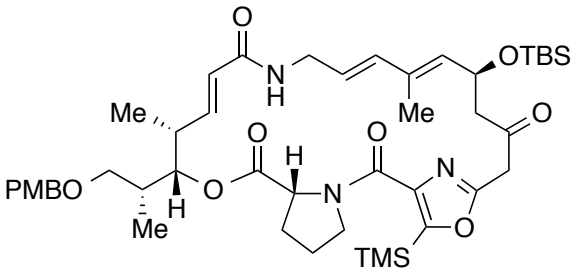

190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


SnBu3
O
N
H
Br
OTBS
Me
Me
O
O
H
O
PMBO
O
N
N
H
Me
O
TMS

SI-69

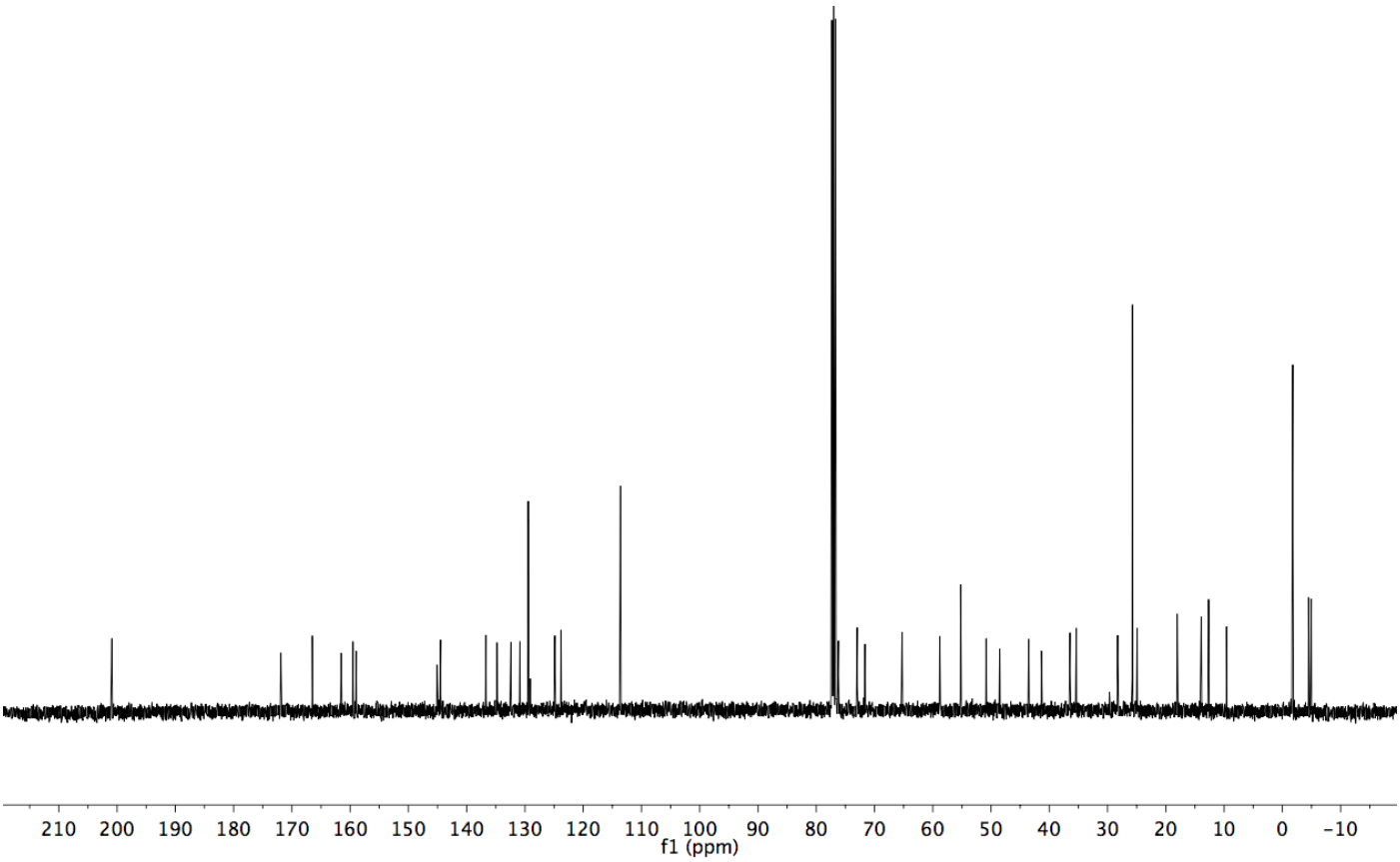
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5
f1 (ppm)

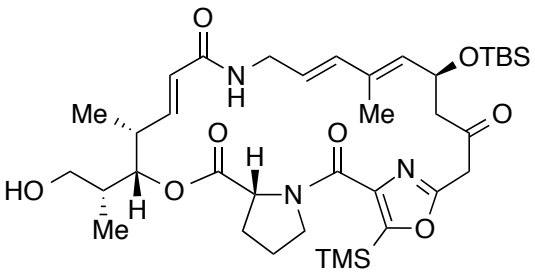

210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


O
N
H
OTBS
Me
Me
O
O
O
H
PMBO
O
N
N
H
Me
O
TMS

SI-70

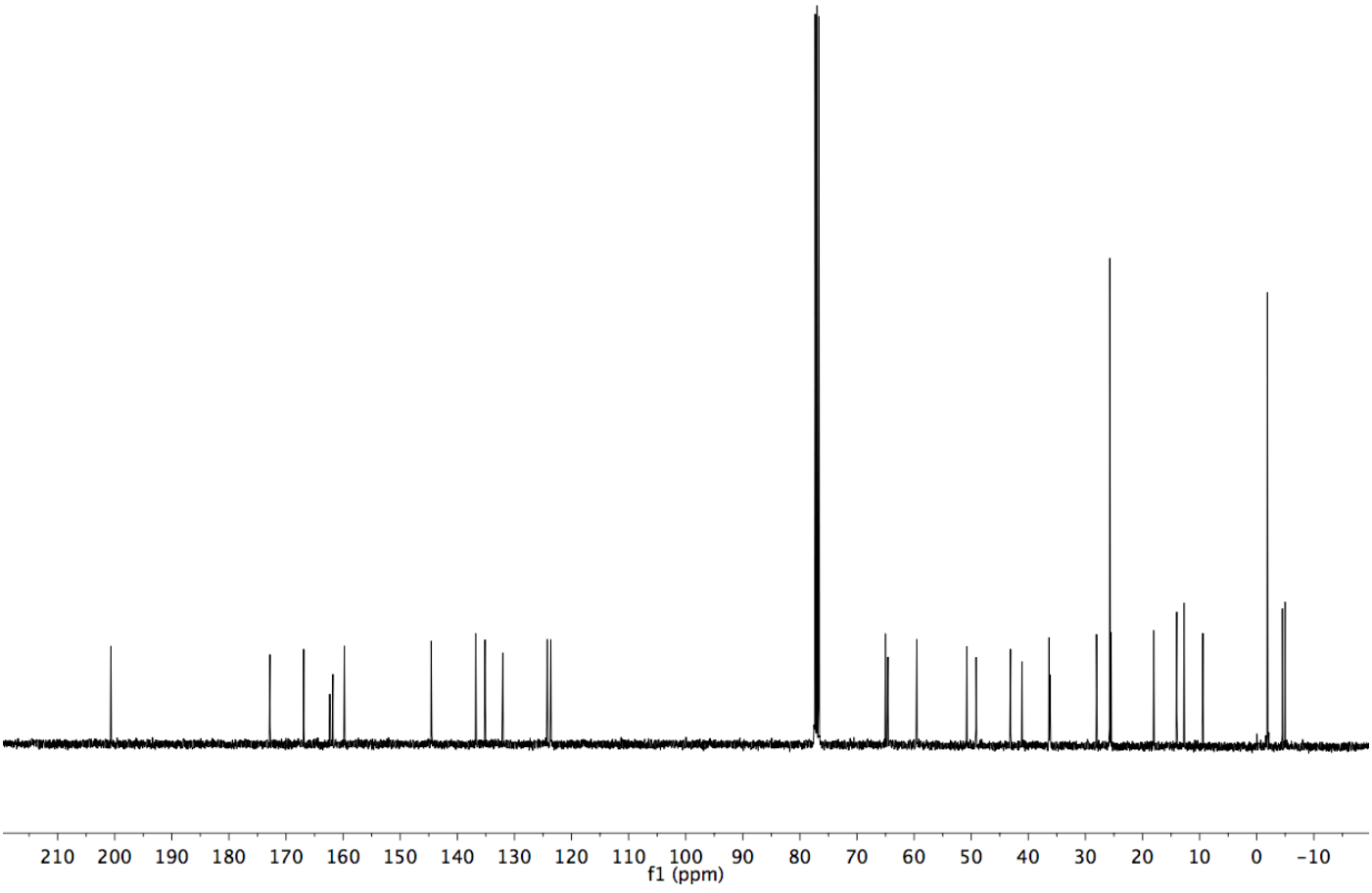
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1
f1 (ppm)

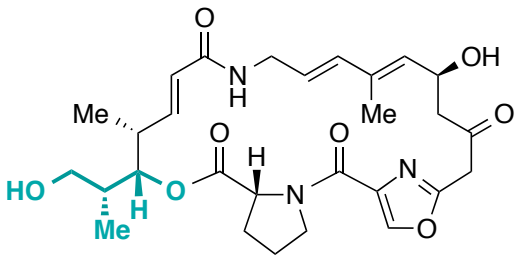

210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


O
N
H
OTBS
Me
Me
O
O
O
H
HO
O
N
N
H
Me
O
TMS

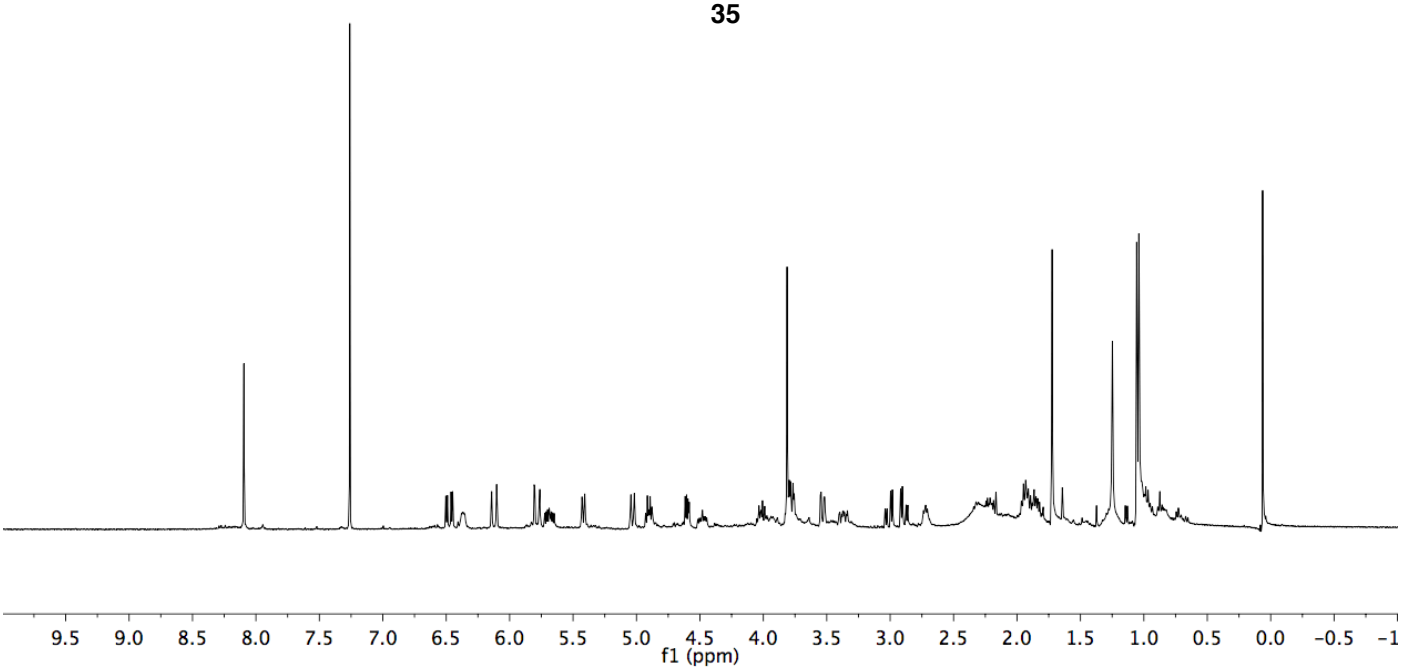
38

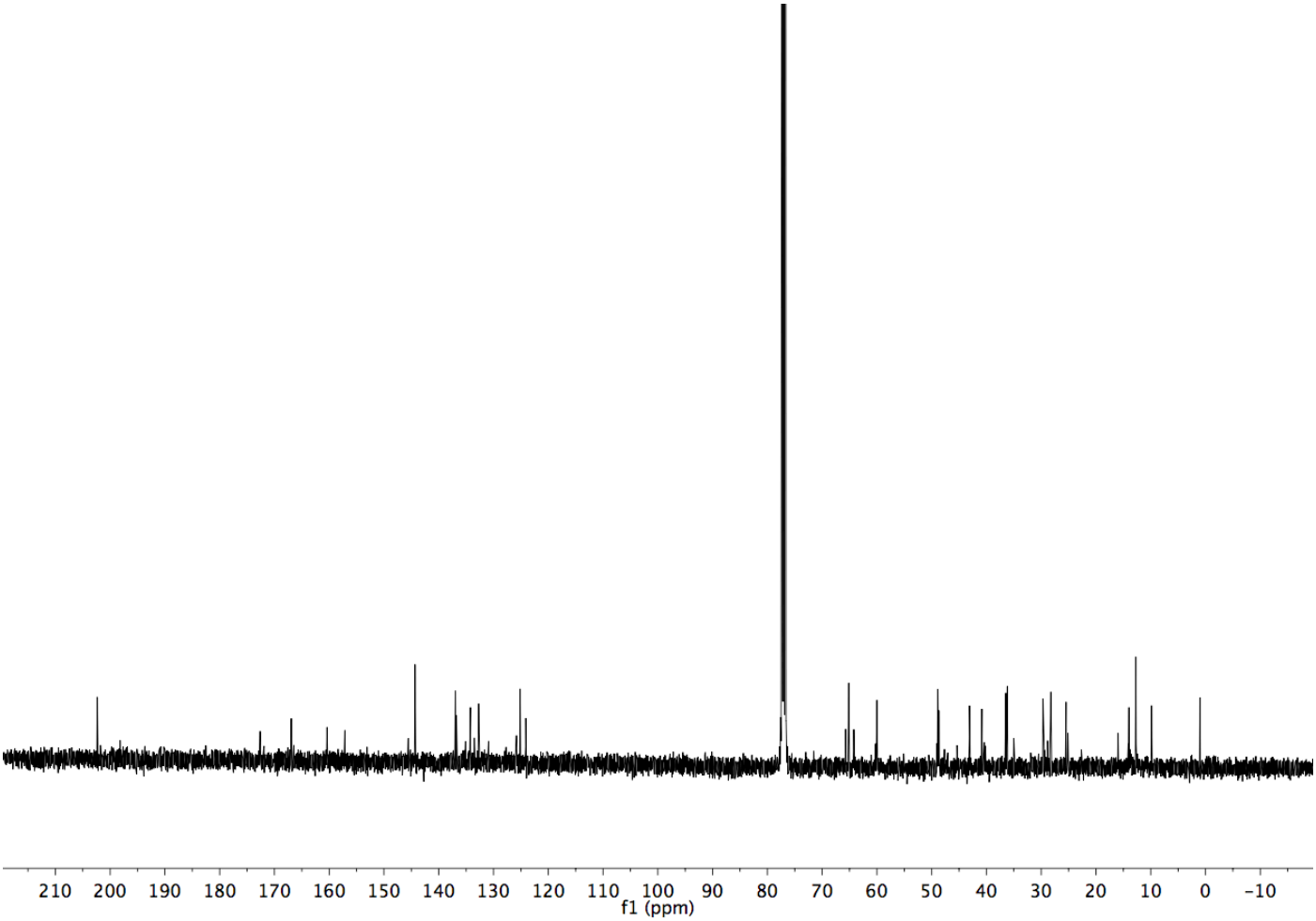
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5
f1 (ppm)

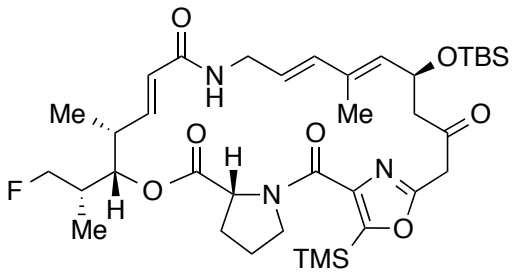

210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


O
N
H
OH
Me
Me
O
O
O
H
HO
O
N
N
Me
H
O

35

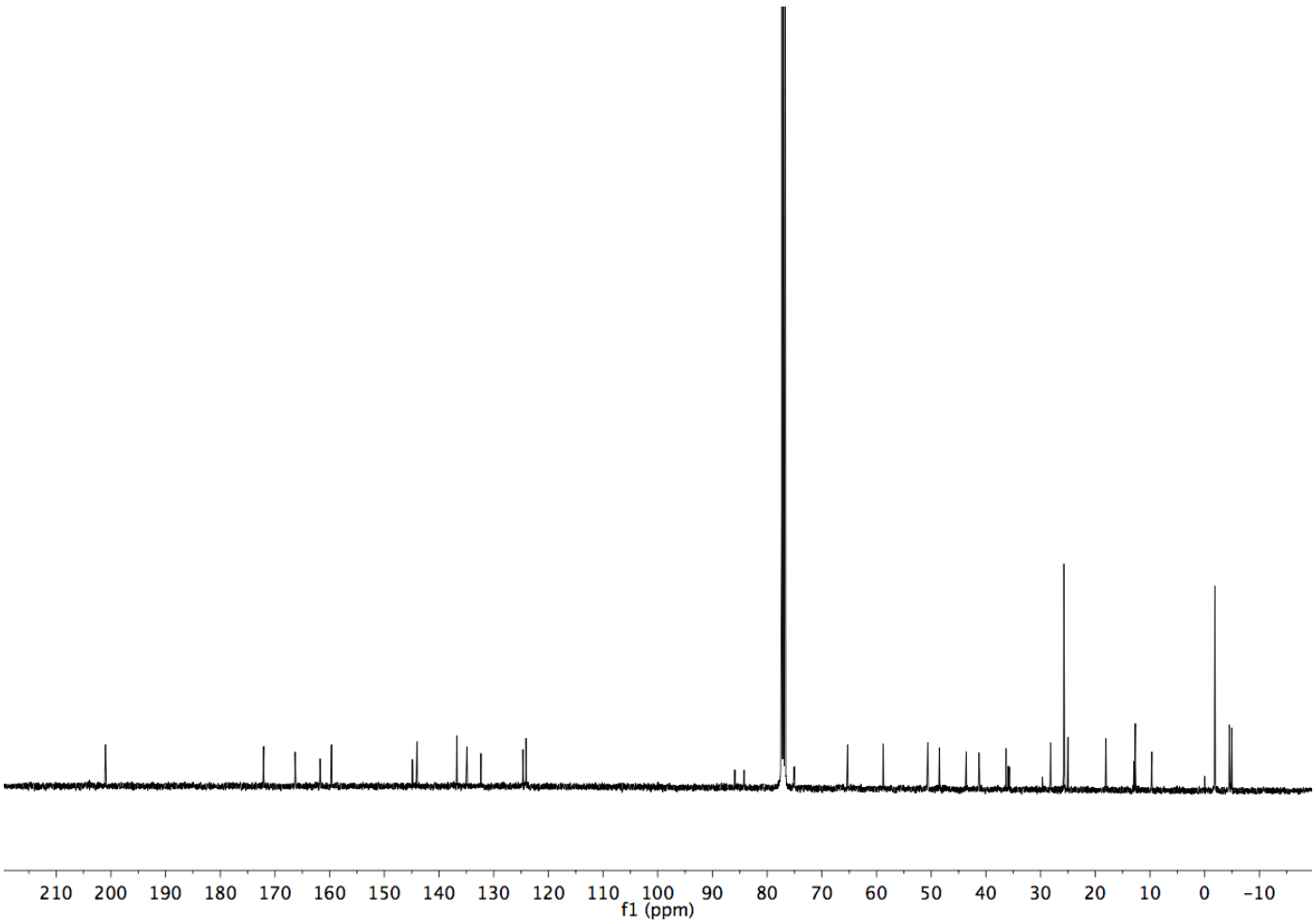

9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1
f1 (ppm)

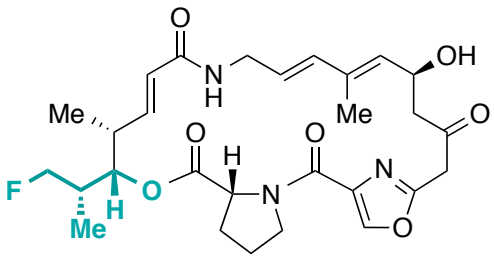

210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


O
N
H
OTBS
Me
Me
O
O
O
H
F
O
N
N
O
H
Me
TMS

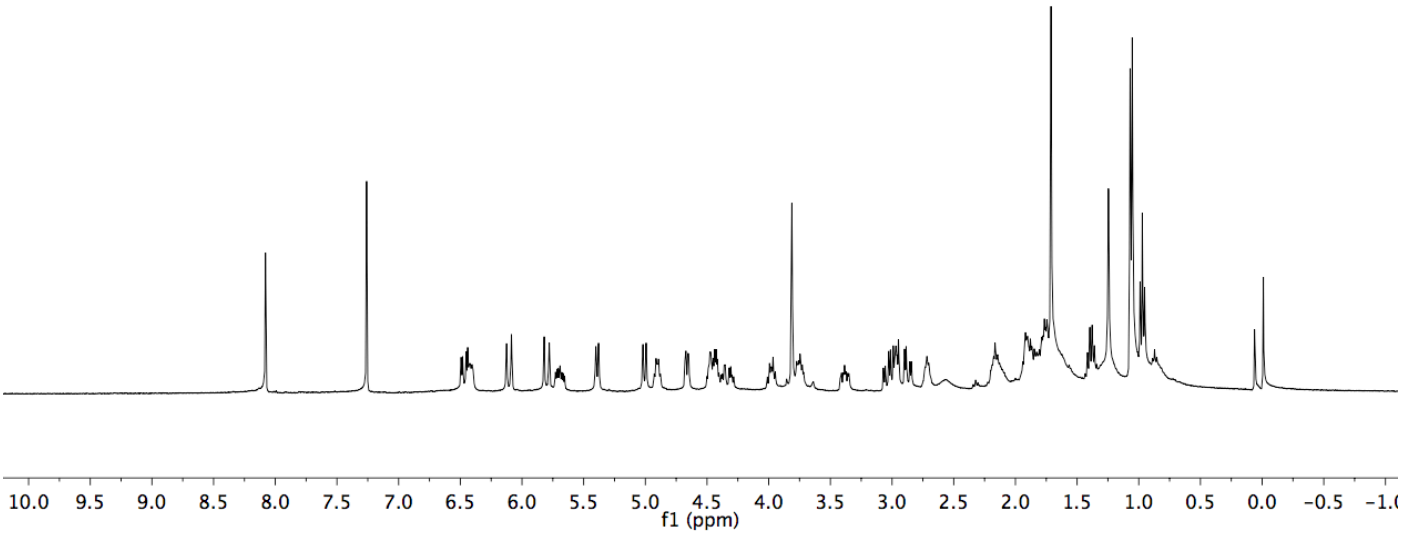
SI-71

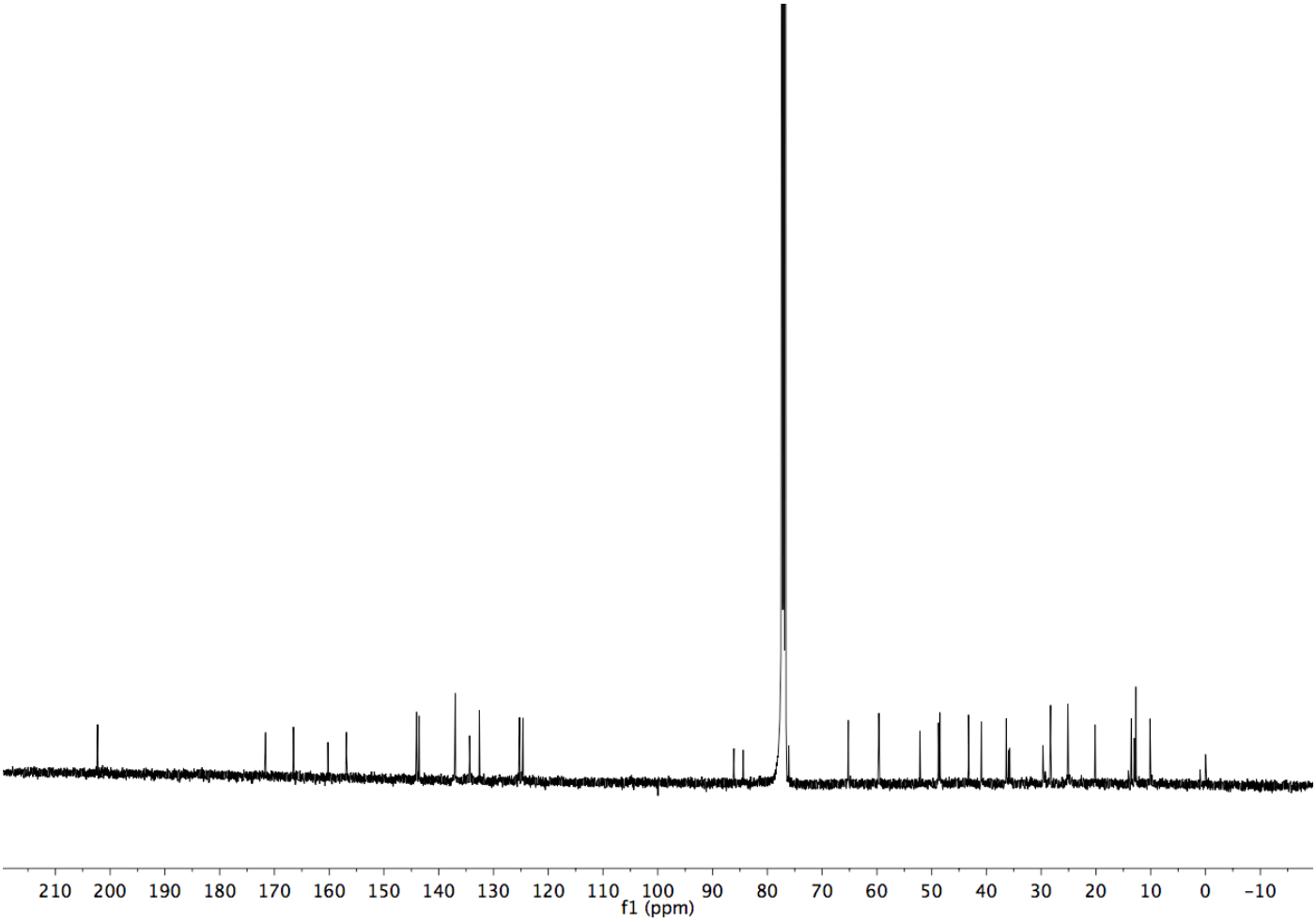
0.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1
f1 (ppm)

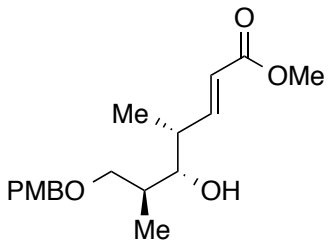

210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


O
N
H
OH
Me
Me
O
O
O
H
N
N
O
F
O
H
Me

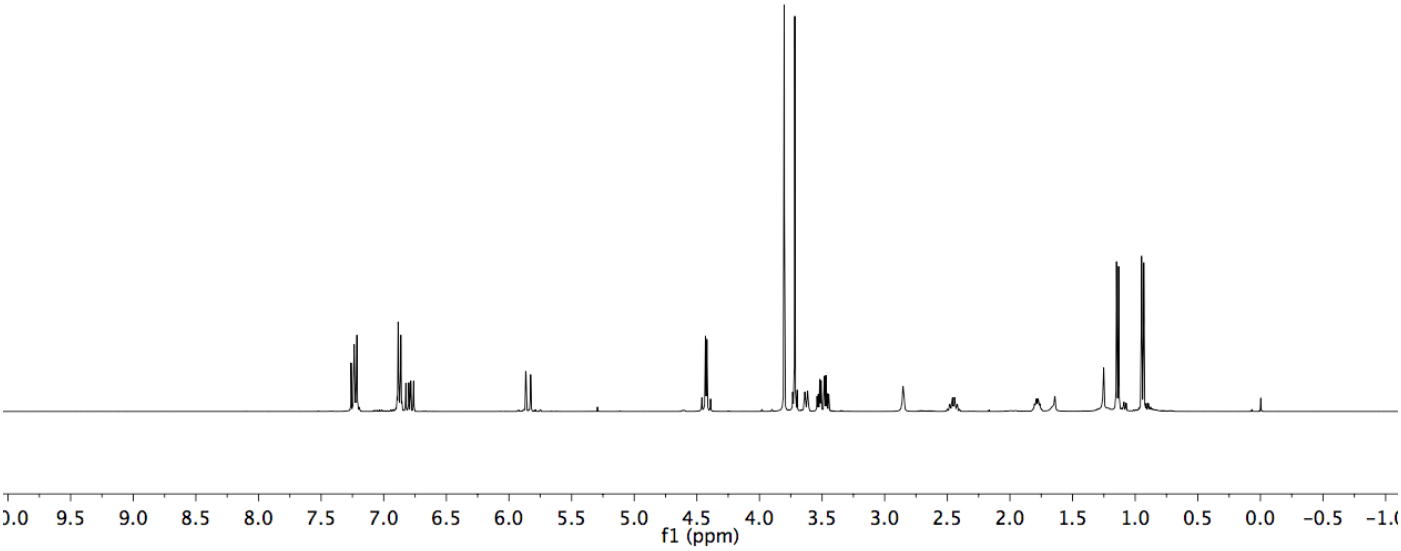
SI-72

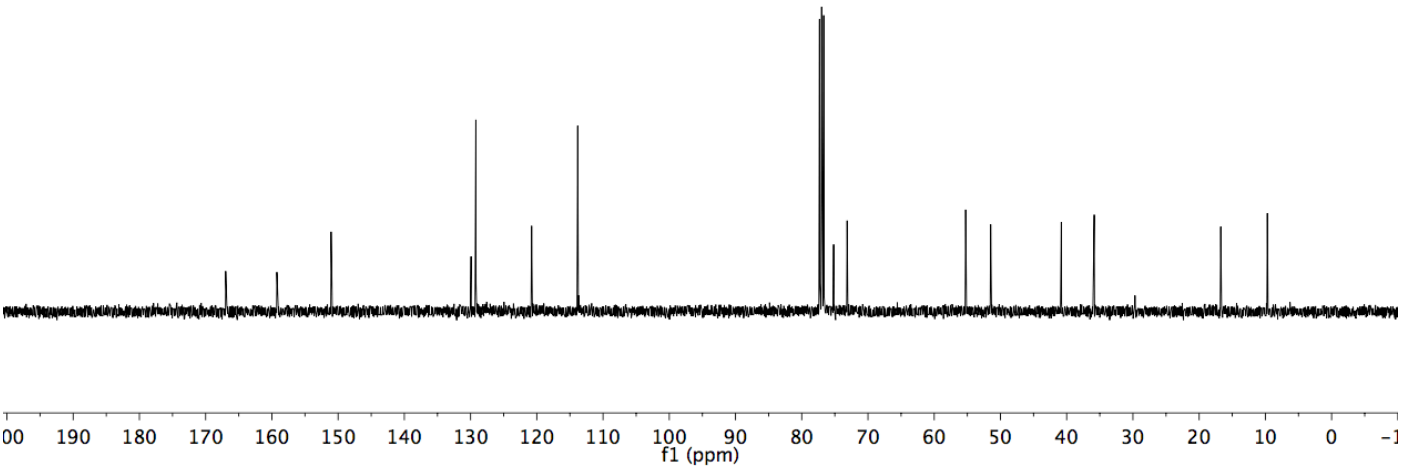

10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5
f1 (ppm)

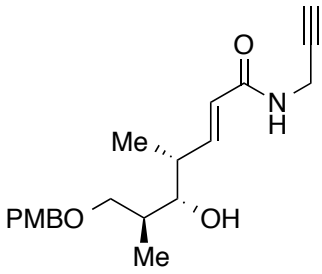

210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


O
OMe
Me
PMBO
OH
Me

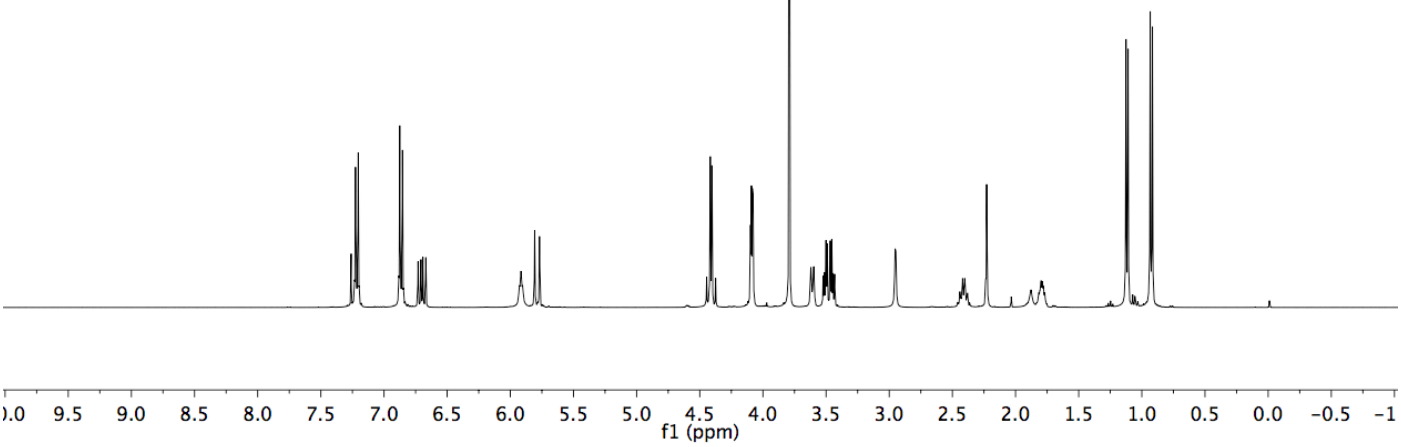
SI-74

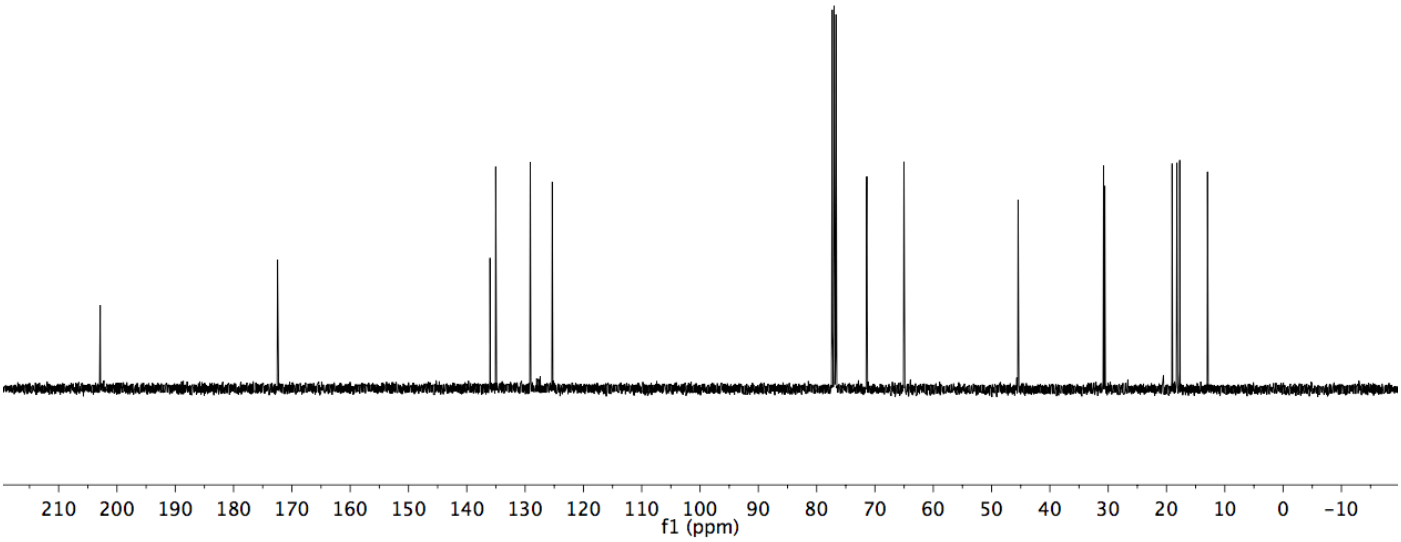

9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5
f1 (ppm)

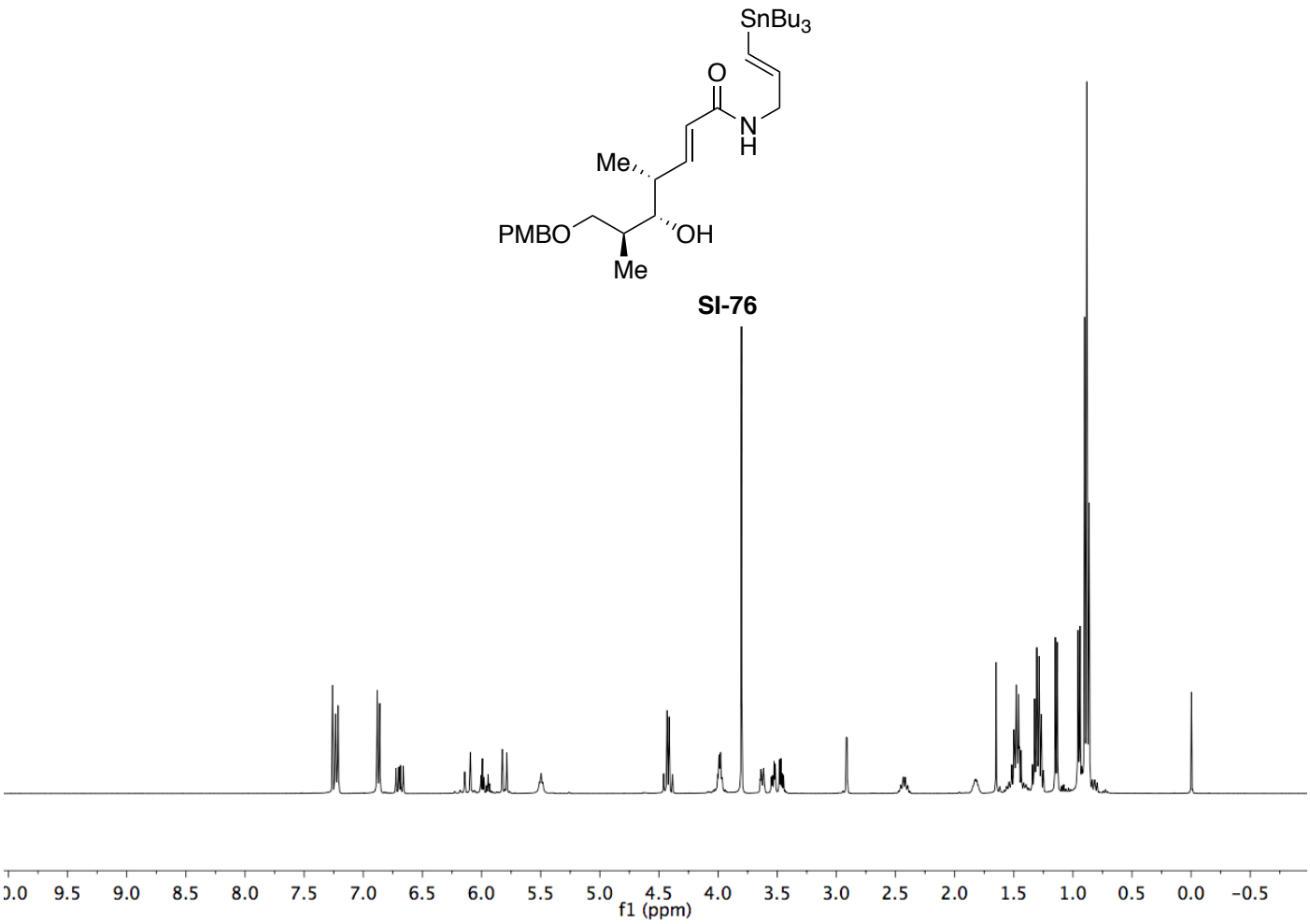

190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)

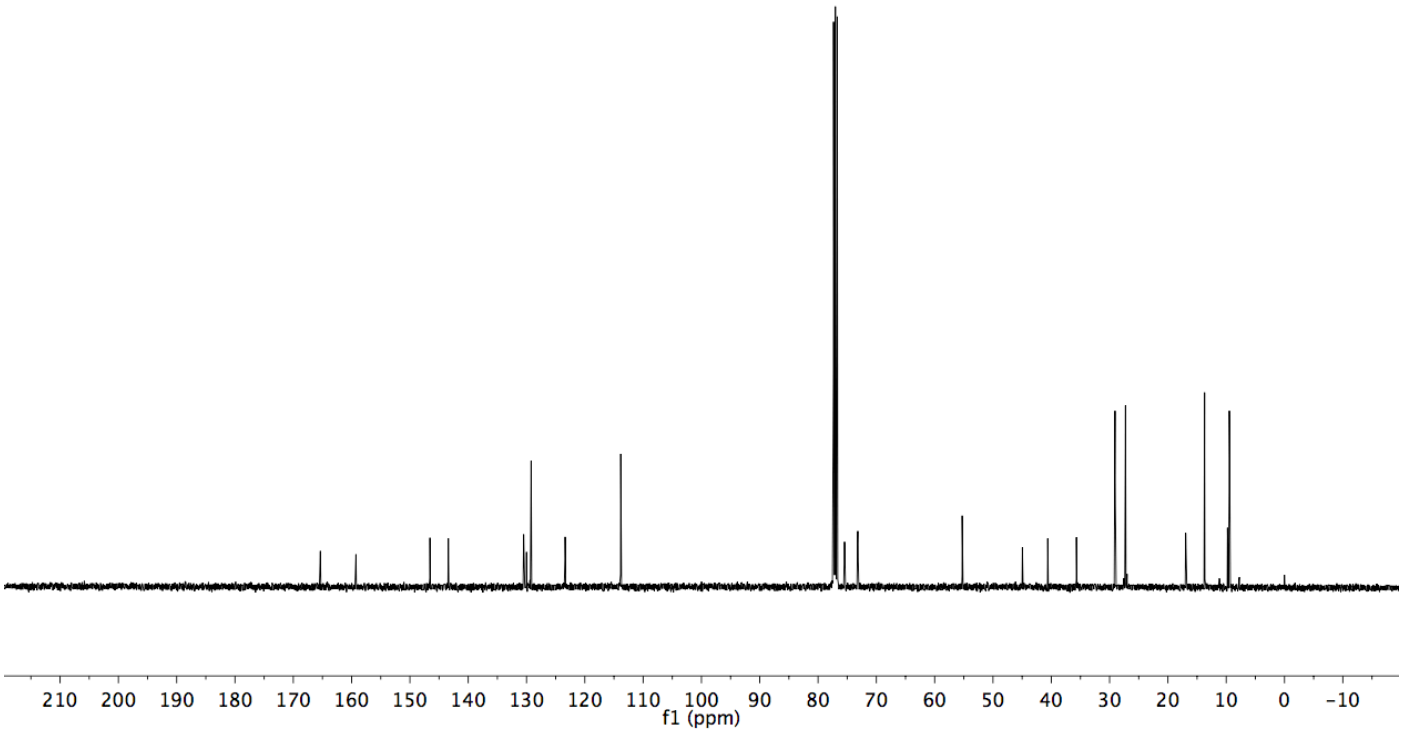

O
N
H
Me
PMBO
OH
Me

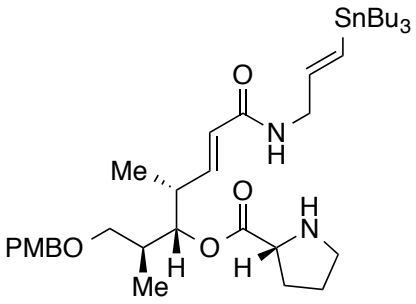
SI-75


9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1
f1 (ppm)


210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

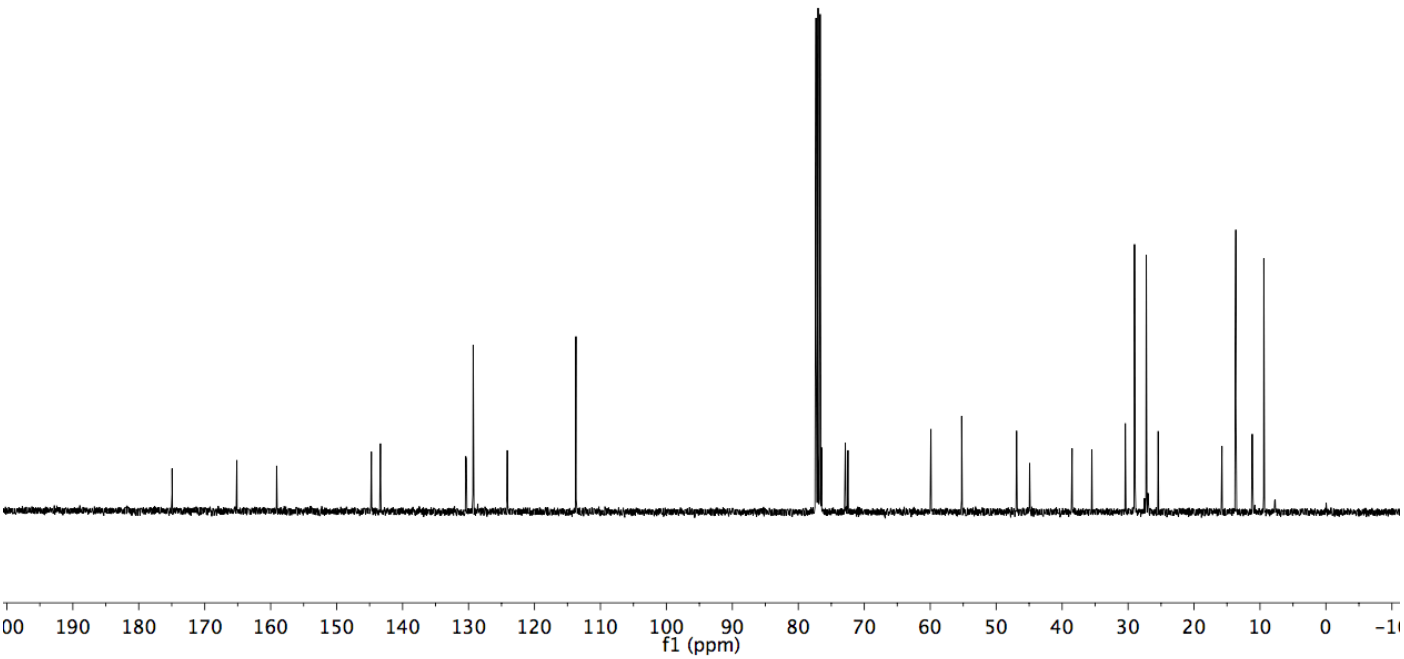

SnBu3
O
N
H
Me
PMBO
OH
Me
SI-76
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5
f1 (ppm)

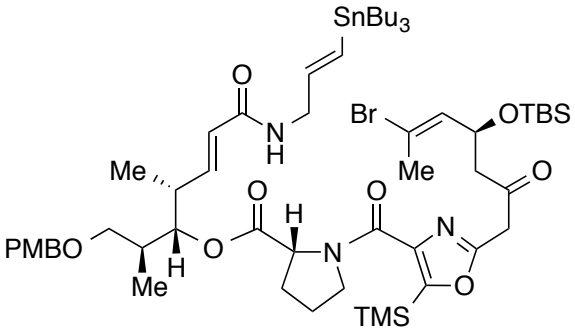

210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


SnBu3
O
N
H
Me
O
H
N
PMBO
O
H
H
Me

SI-77

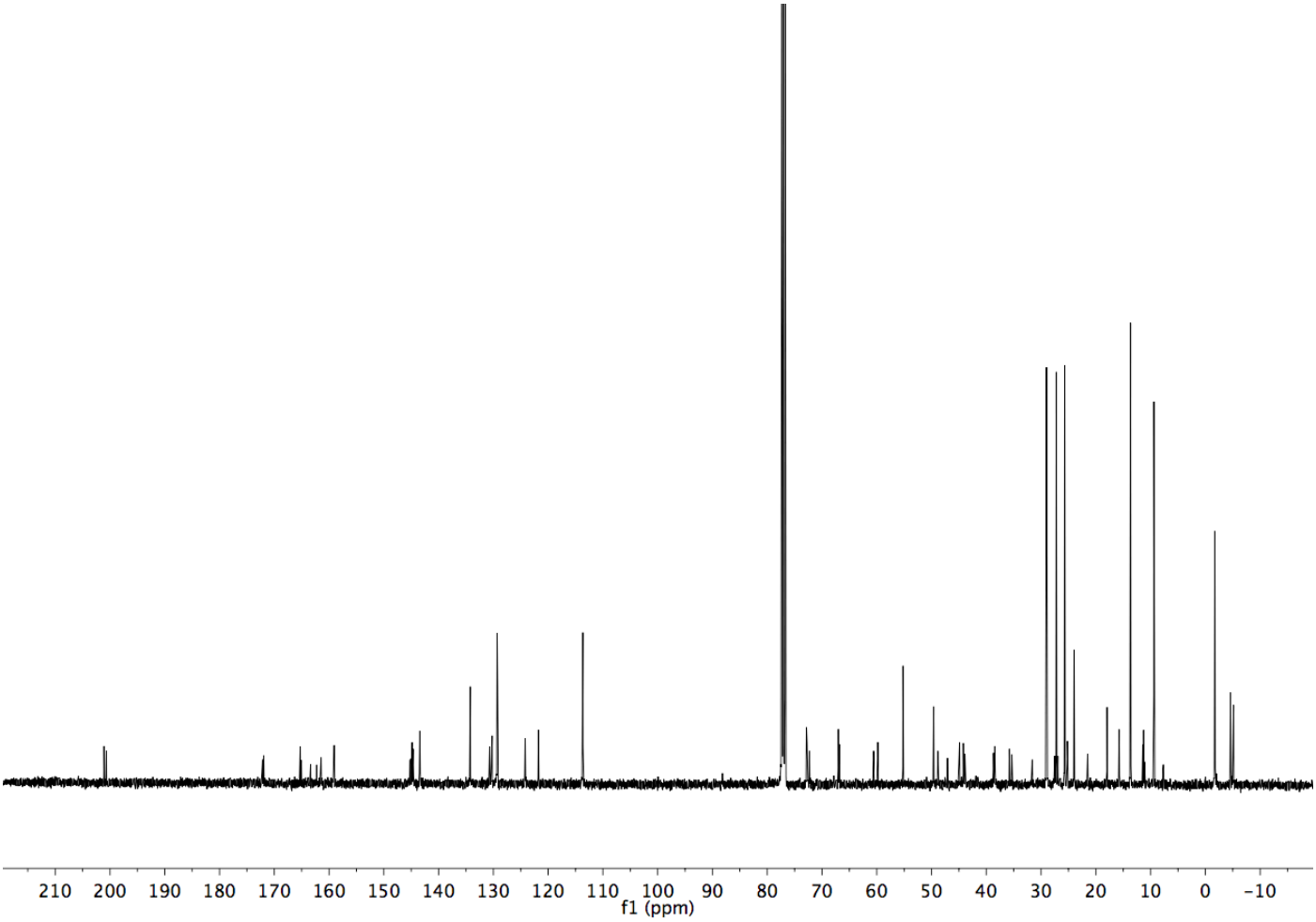
0.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1.0
f1 (ppm)

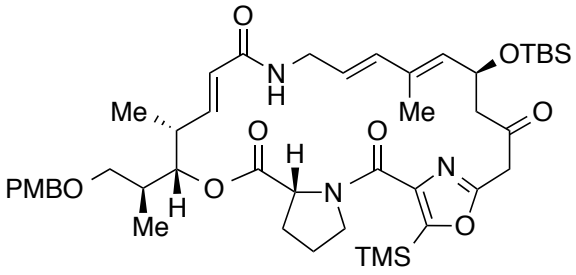

00 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -1
f1 (ppm)


SnBu3
O
N
H
Br
OTBS
Me
Me
O
O
H
O
PMBO
O
N
N
H
Me
O
TMS

SI-78

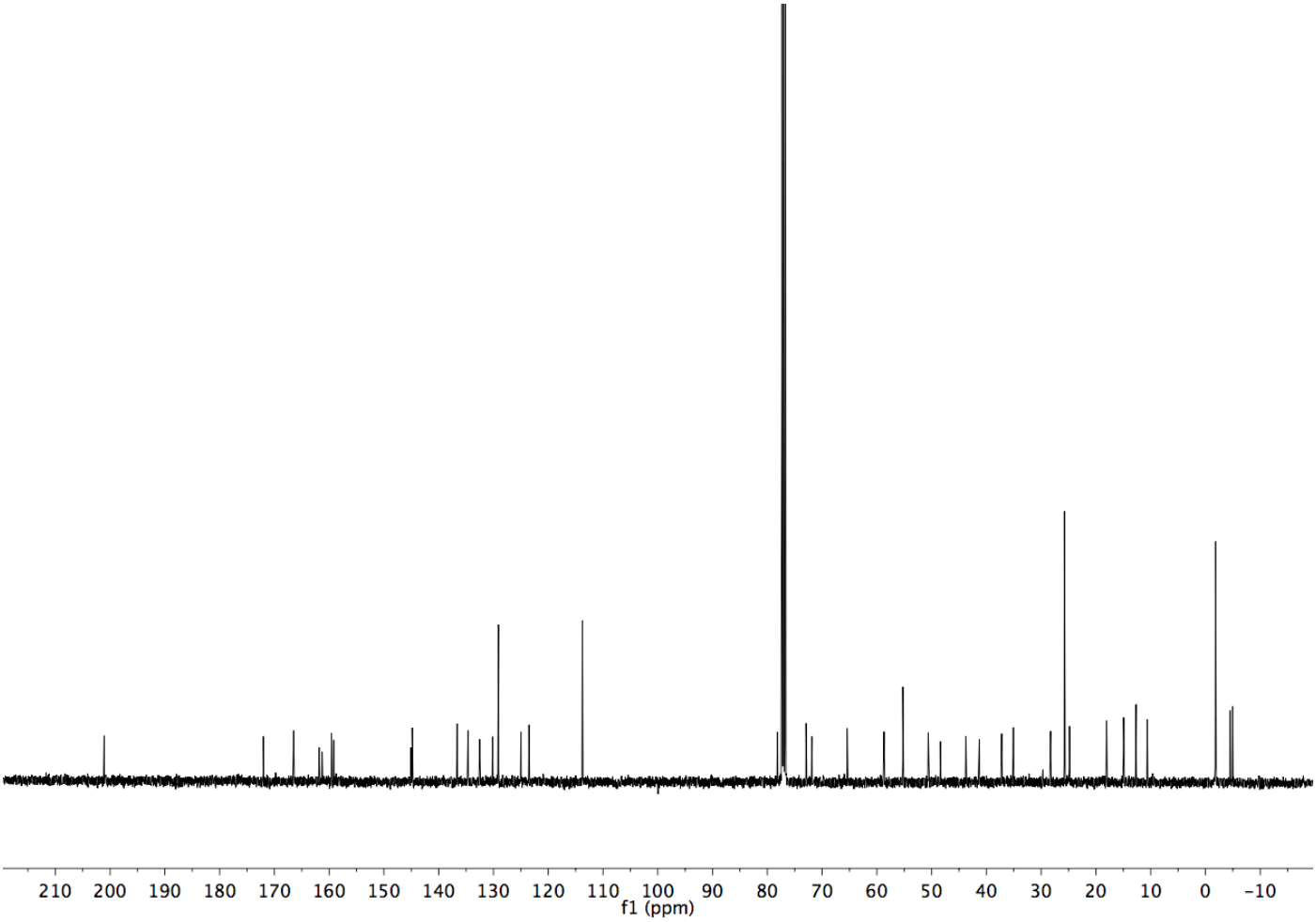
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1
f1 (ppm)

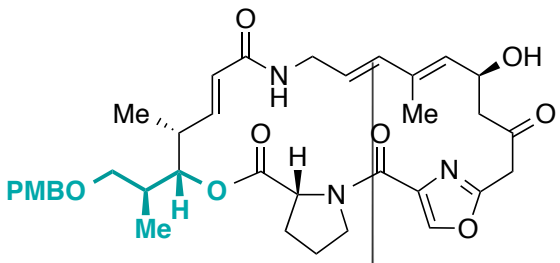

210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


O
N
H
OTBS
Me
Me
O
O
H
O
PMBO
O
N
N
H
Me
O
TMS

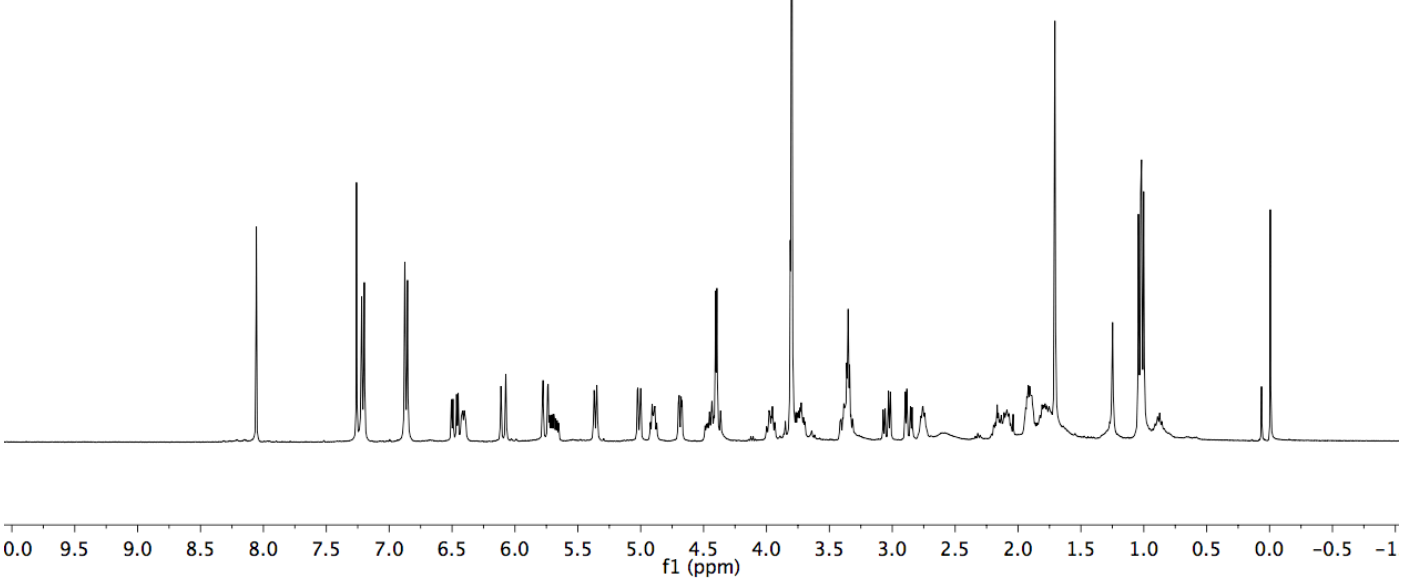
SI-79

9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5
f1 (ppm)

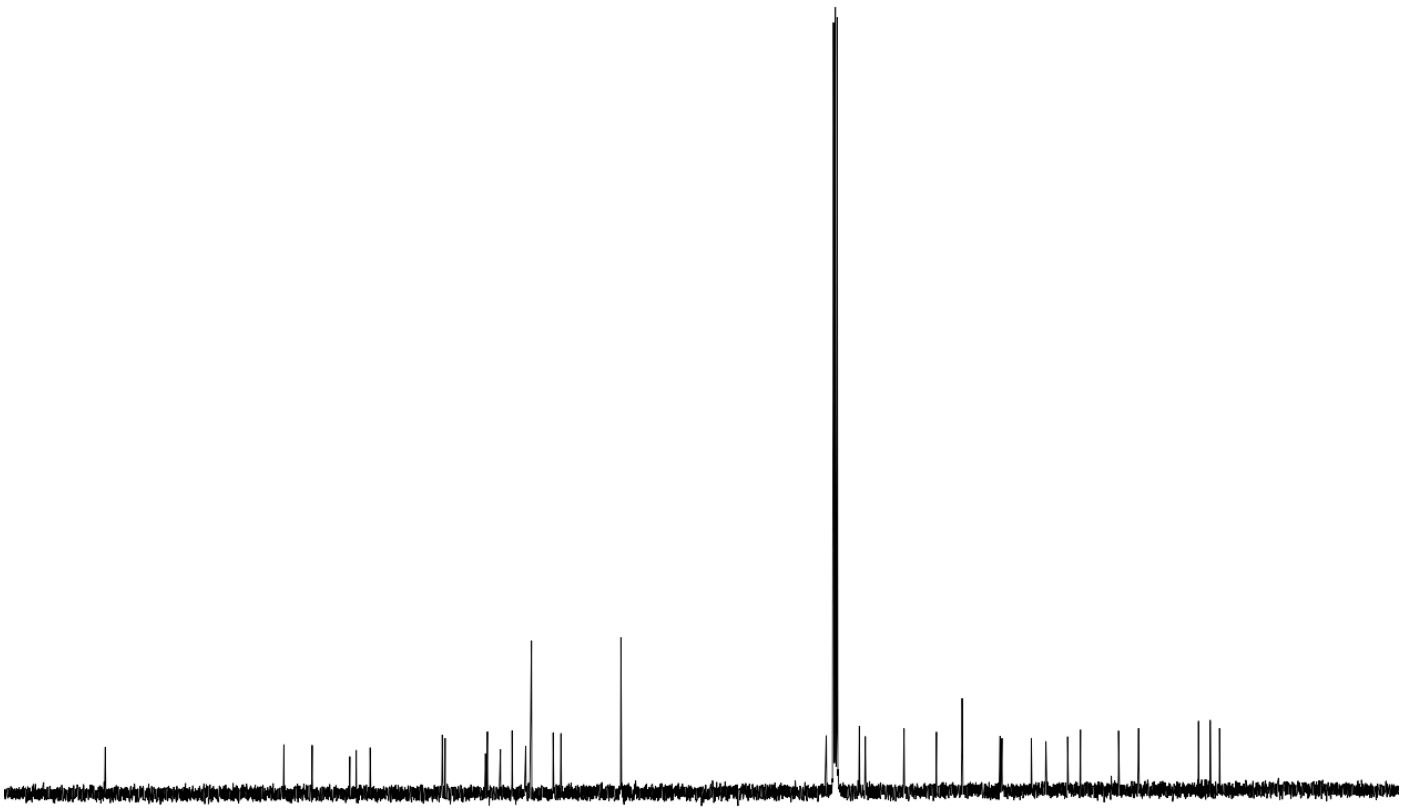

210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

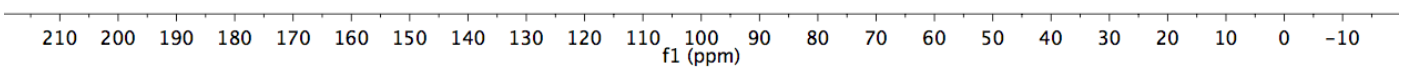

O
N
H
OH
Me
Me
O
O
O
H
O
PMBO
O
N
N
Me
H
O

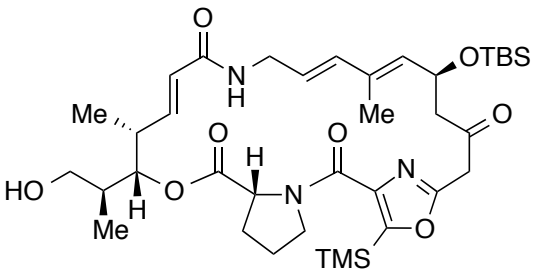
SI-80



0.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1
f1 (ppm)

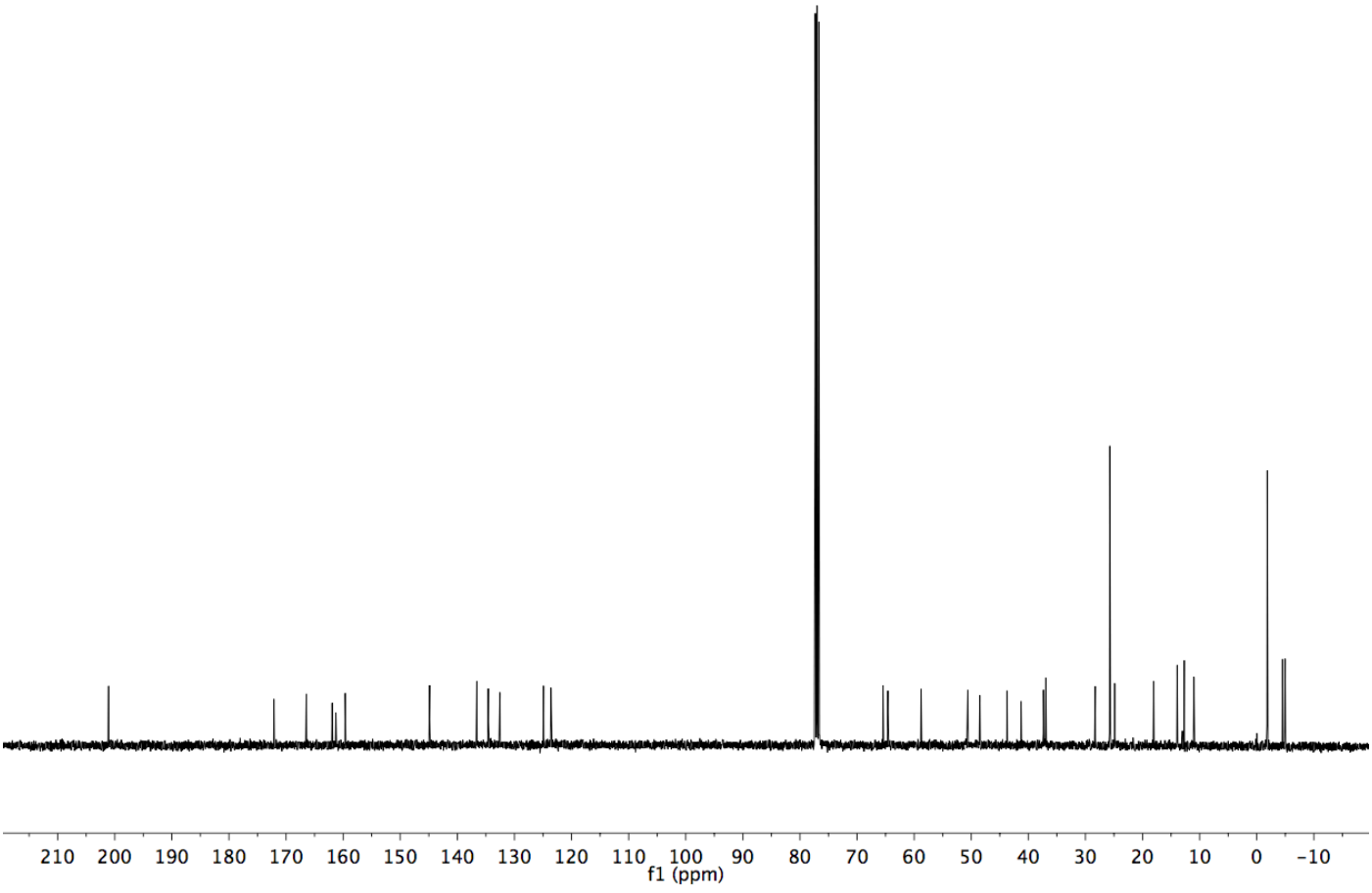


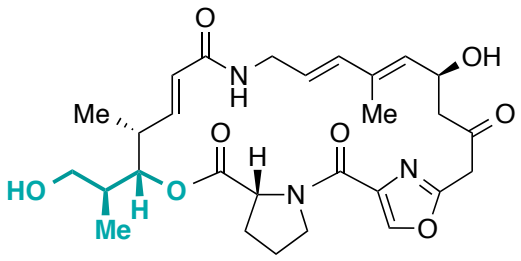

210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


O
N
H
OTBS
Me
Me
O
O
O
H
HO
O
N
N
H
Me
O
TMS

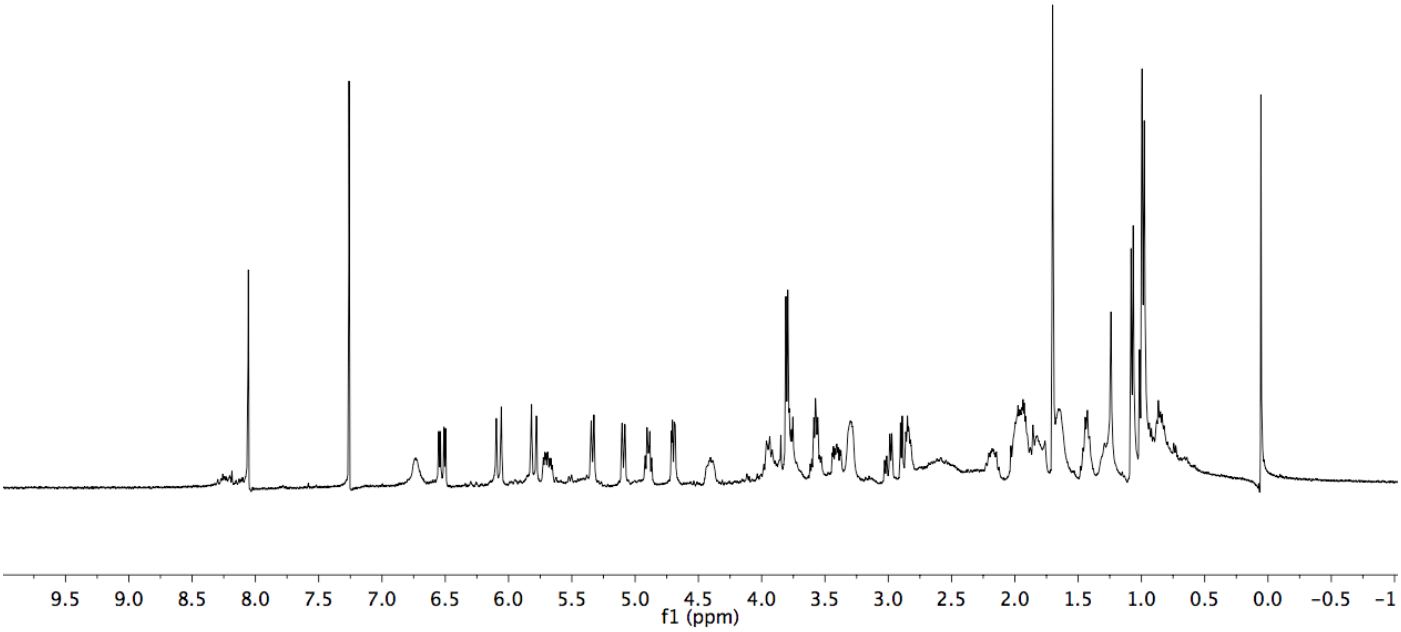
39

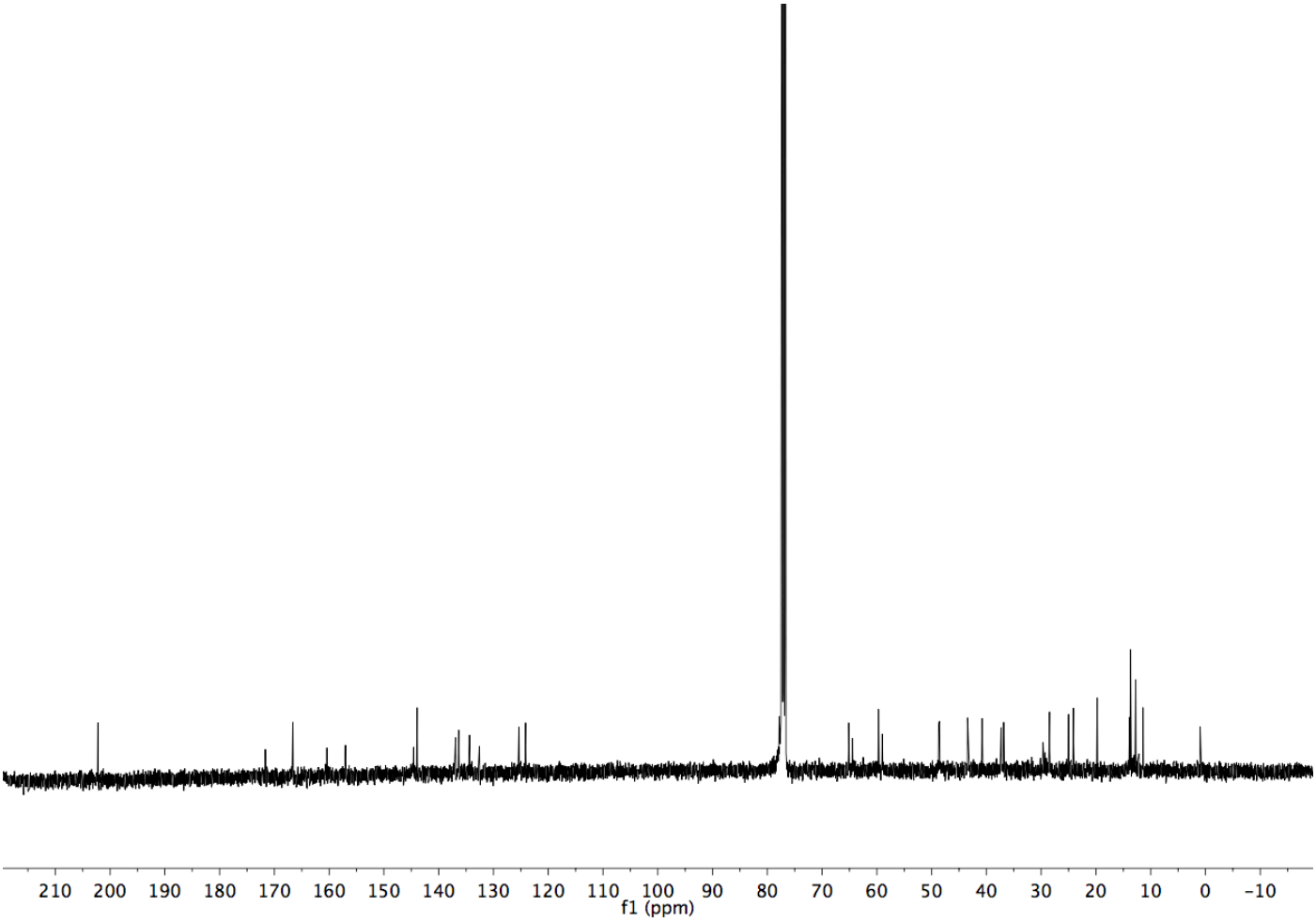
0.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1.
f1 (ppm)

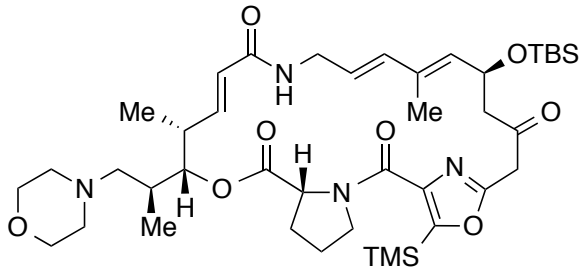

210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


O
N
H
OH
Me
Me
O
O
O
H
HO
O
N
N
Me
H
O

36

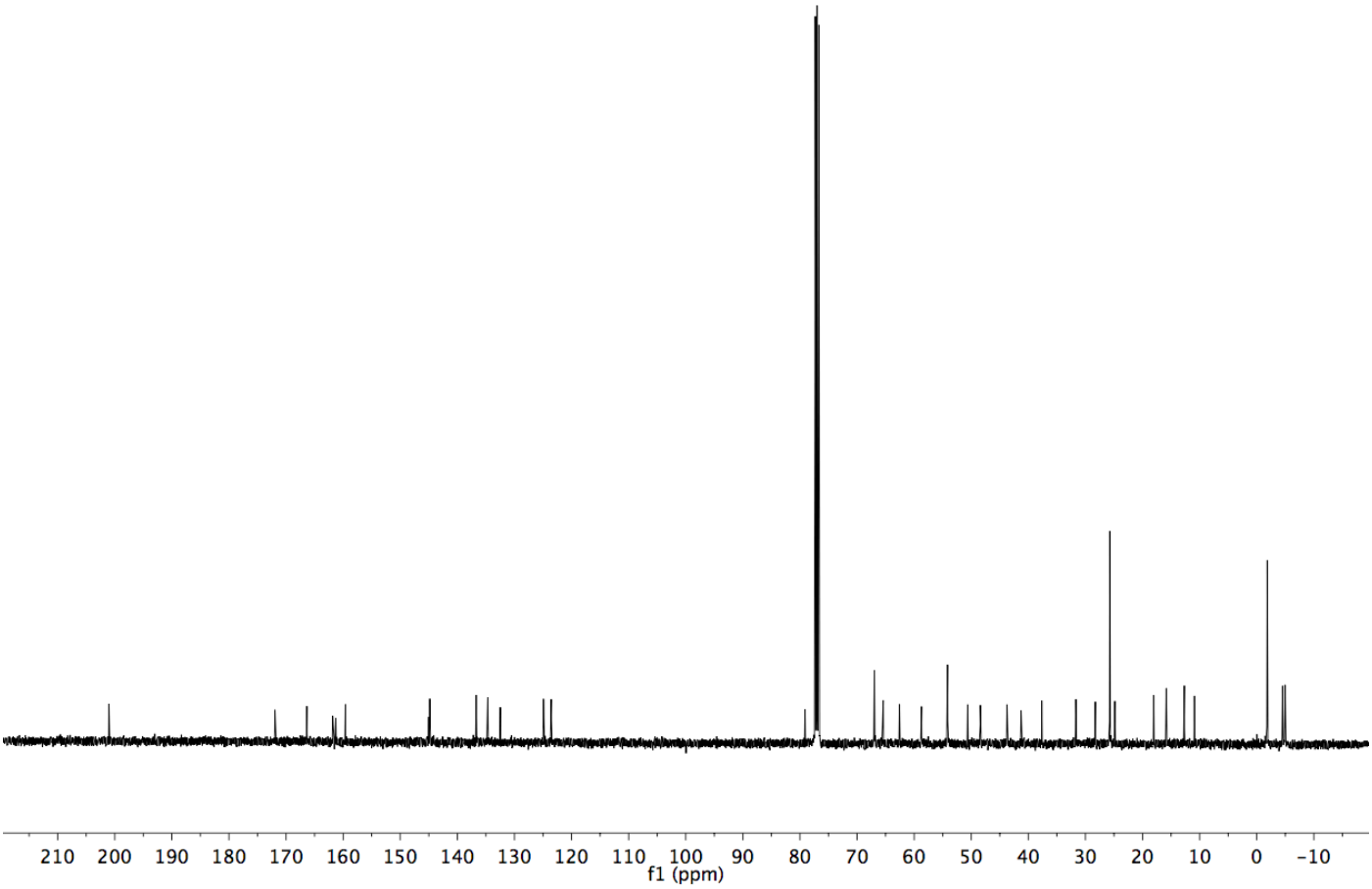

9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1
f1 (ppm)

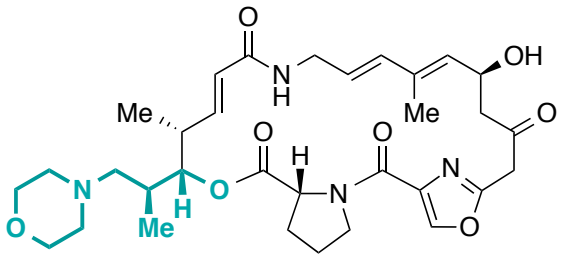

210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


O
N
H
OTBS
Me
Me
O
O
O
H
N
N
O
O
N
O
Me
H
O
TMS

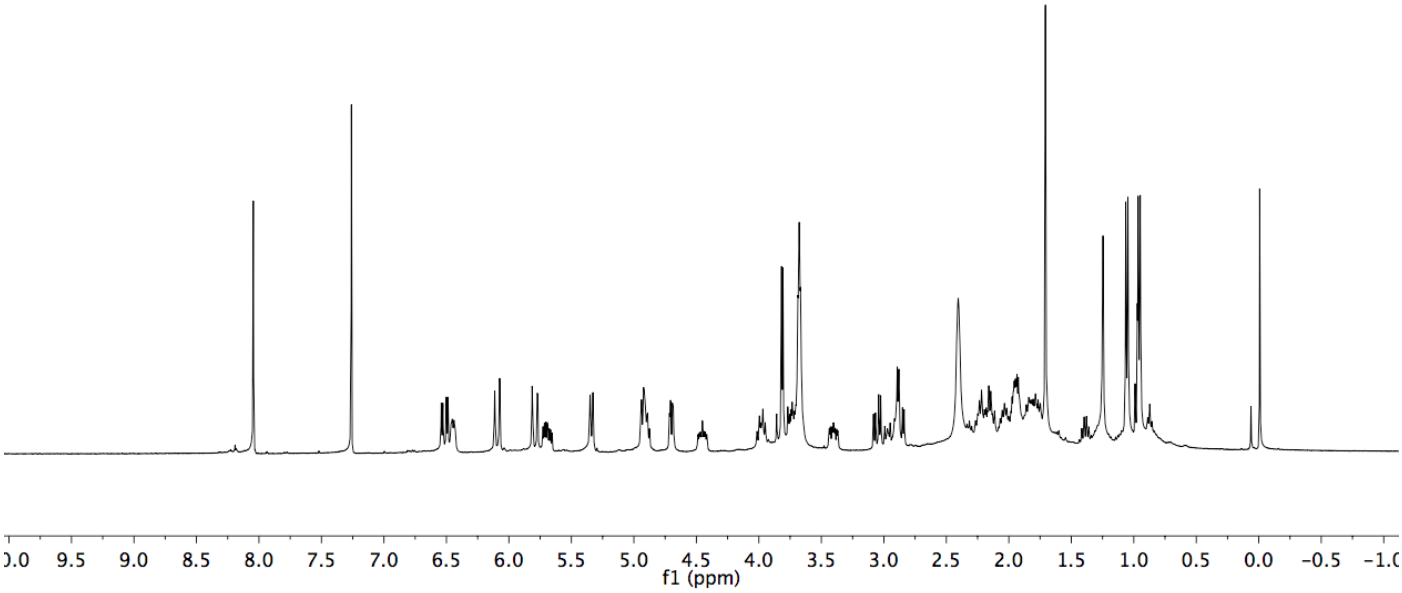
SI-81

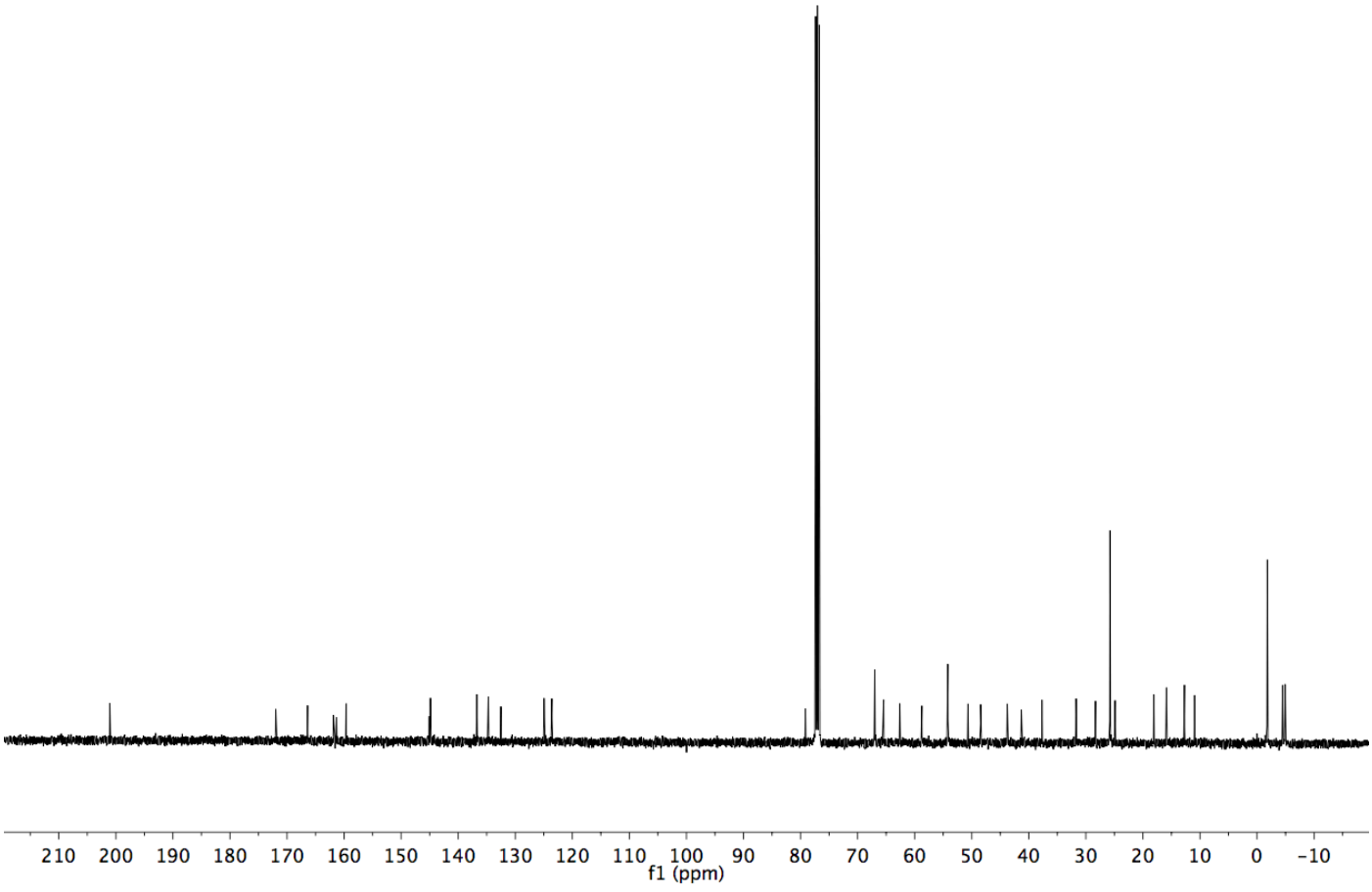
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1
f1 (ppm)

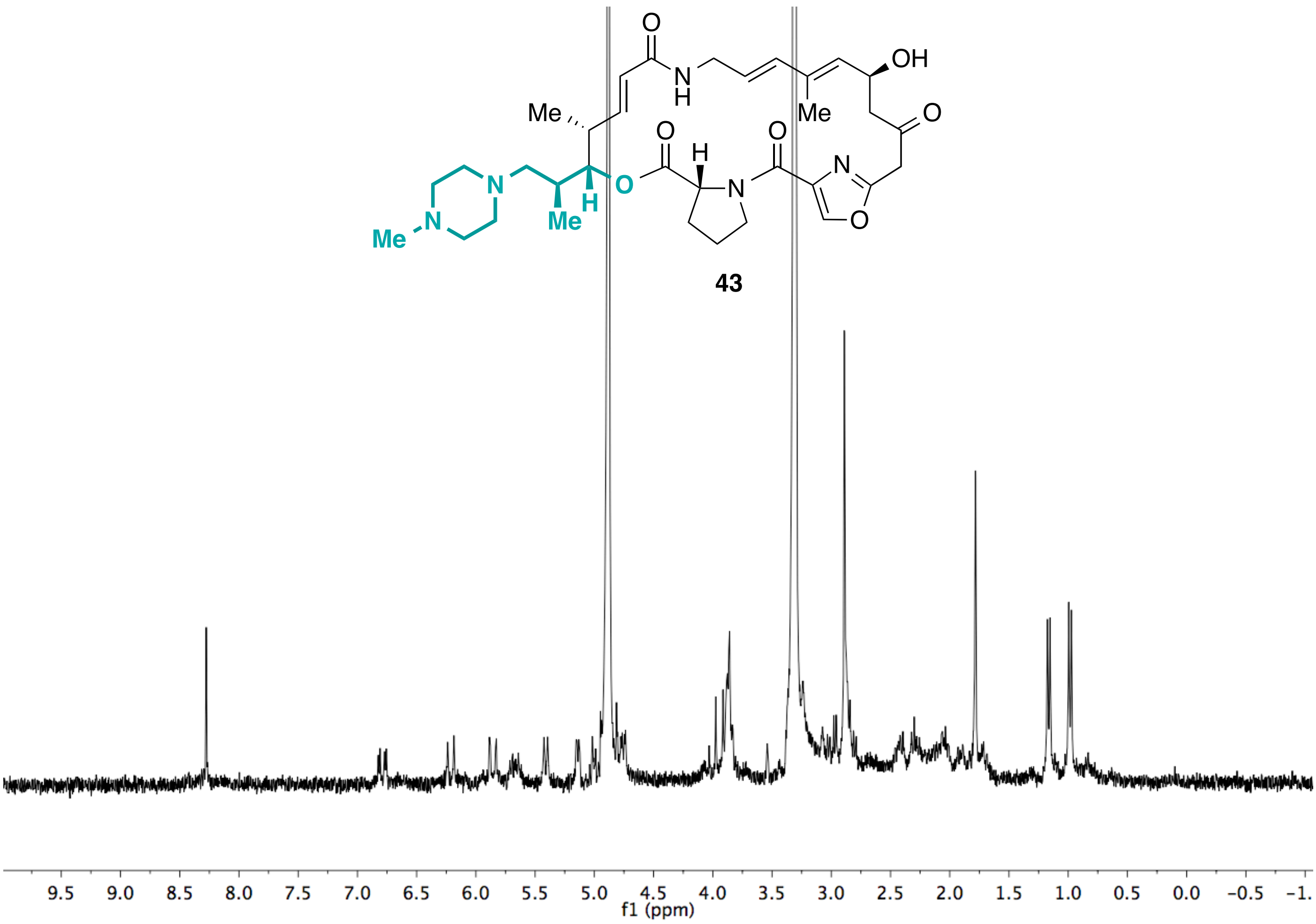

210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

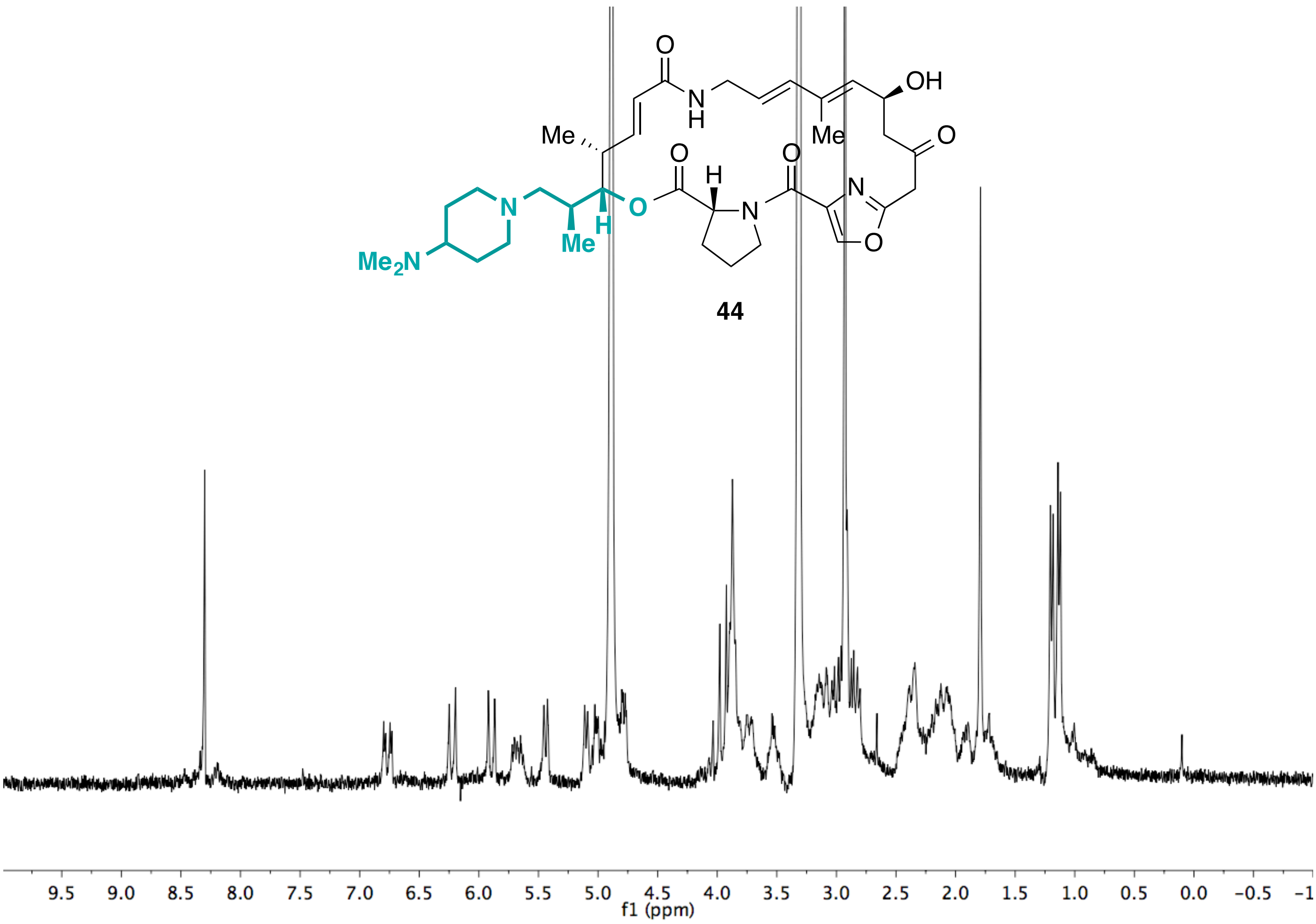


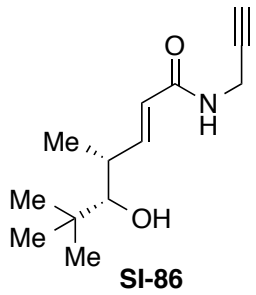
42


9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
f1 (ppm)

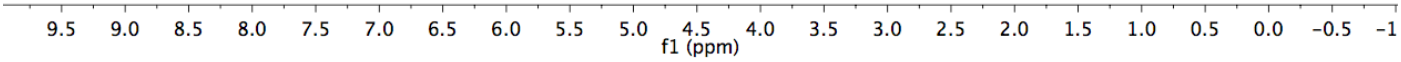

210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
-10
f1 (ppm)

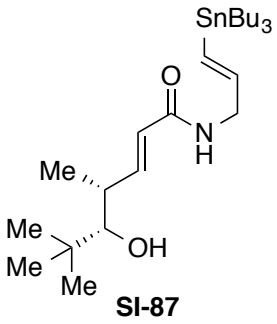

O
N
H
OH
Me
O
O
O
H
N
N
O
Me
N
N
Me
H
O
43
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 −0.5 −1.
f1 (ppm)


O
N
H
OH
Me
O
O
O
H
N
N
O
Me
N
Me_2N
Me
H
O
44
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 −0.5 −1
f1 (ppm)

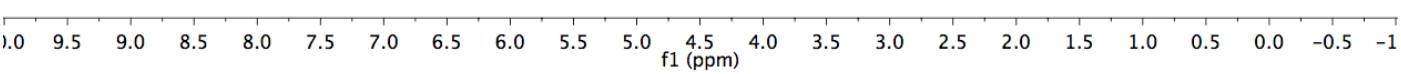

O
N
H
Me
Me
Me
OH

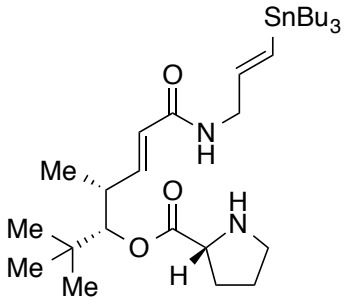
SI-86


9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1
f1 (ppm)


SnBu3
O
N
H
Me
Me
Me
OH

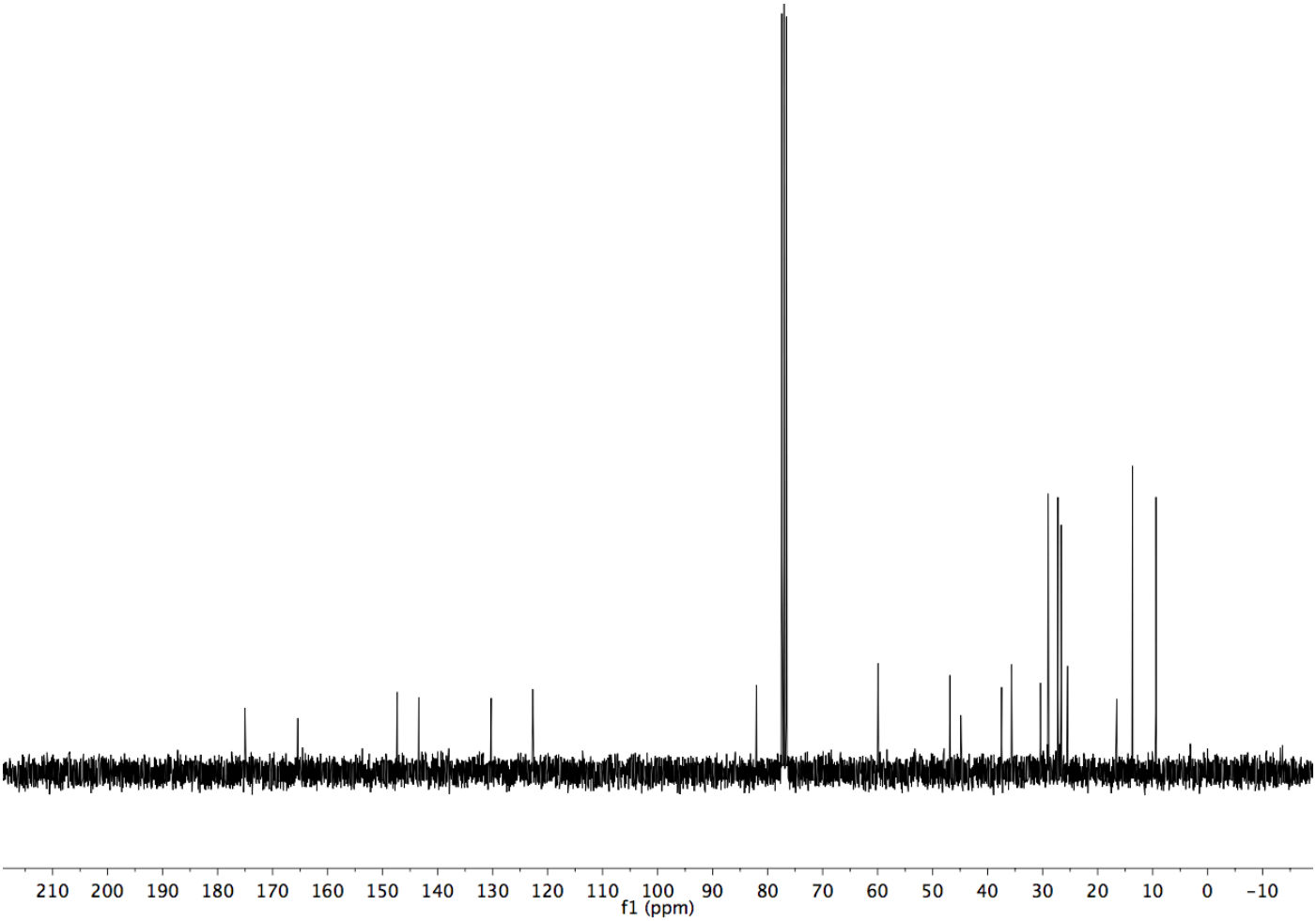
SI-87

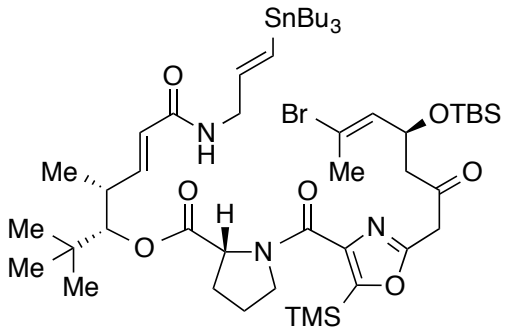

9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1
f1 (ppm)


SnBu3
O
N
H
Me
O
H
N
Me
O
Me
H
Me

SI-88

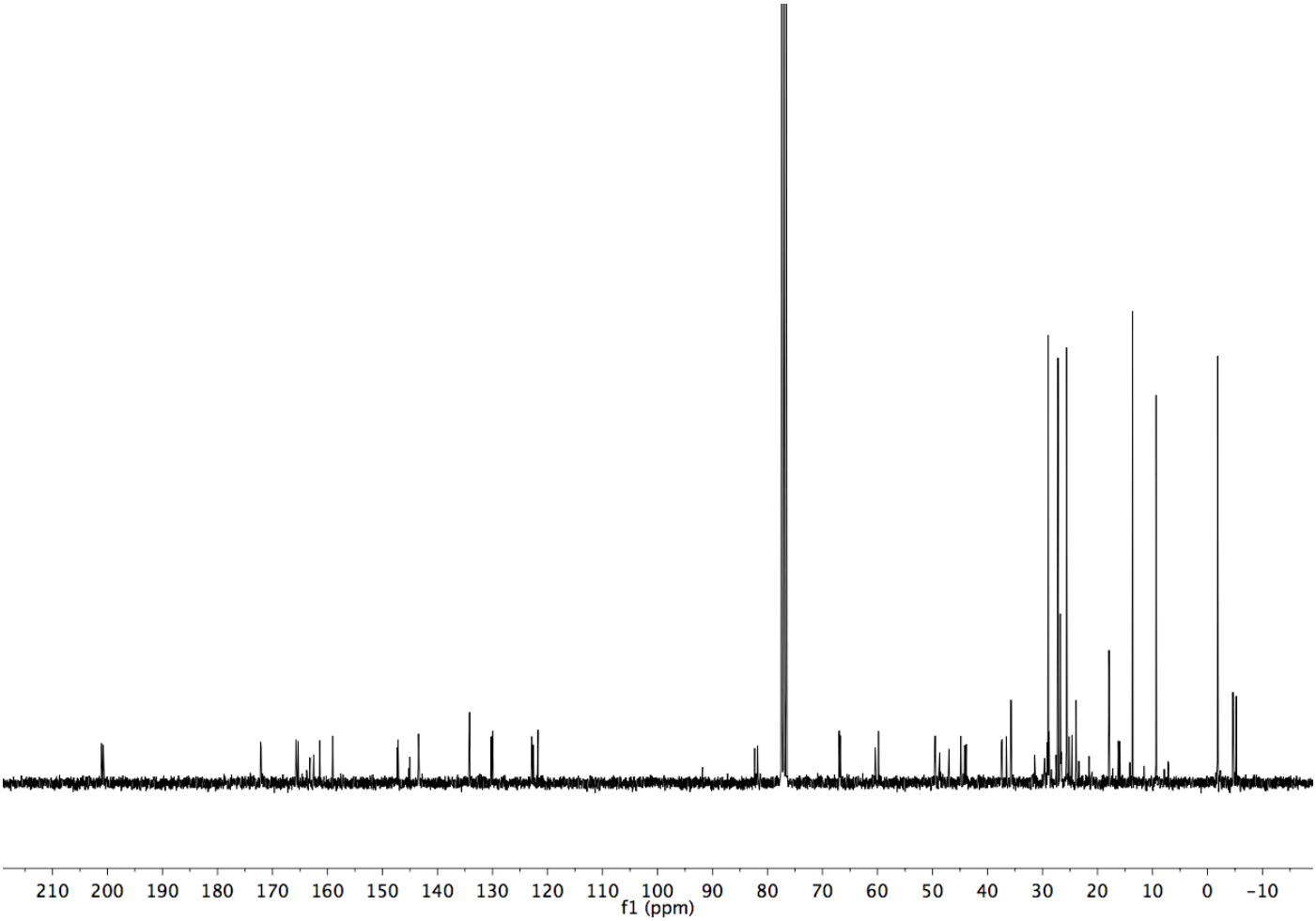
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1.
f1 (ppm)

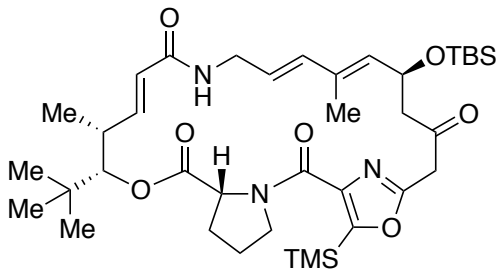

210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


SnBu3
O
N
H
Br
OTBS
Me
Me
O
O
H
O
N
N
Me
Me
Me
O
O
TMS

SI-89

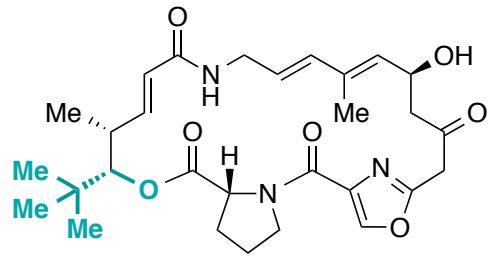
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1
f1 (ppm)


210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

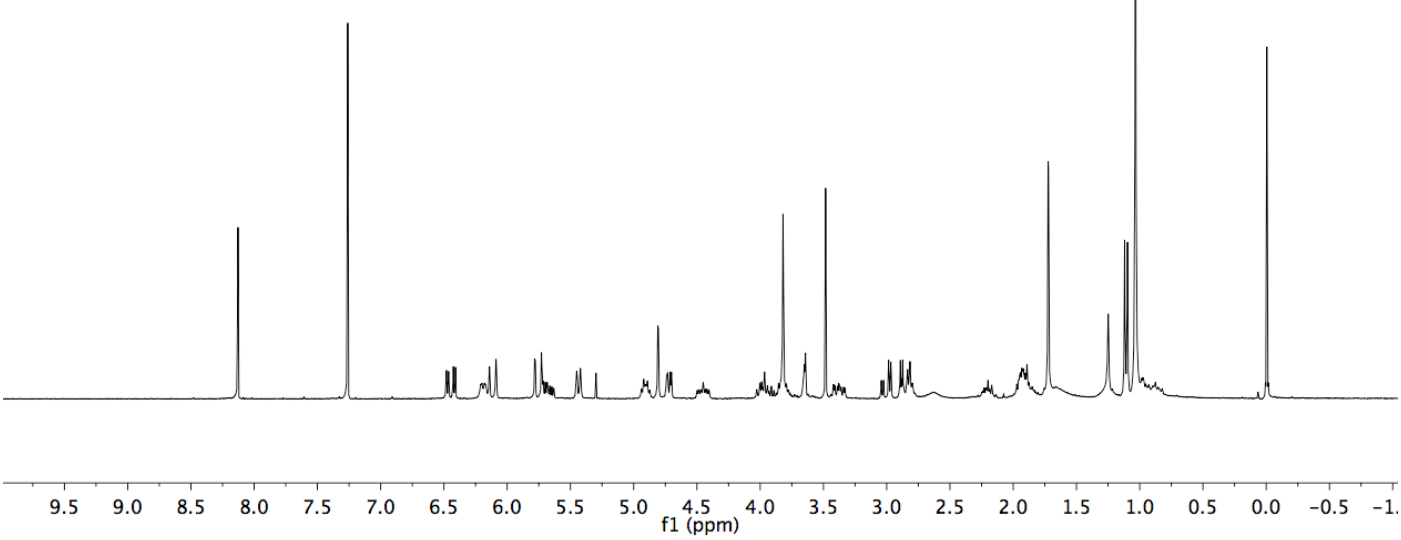

O
N
H
OTBS
Me
Me
O
O
H
O
Me
Me
Me
O
N
N
O
TMS

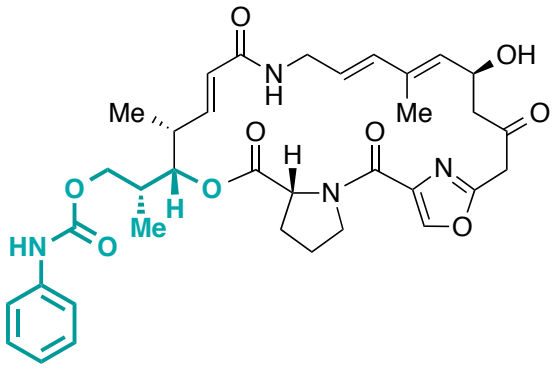
SI-90

9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5
f1 (ppm)

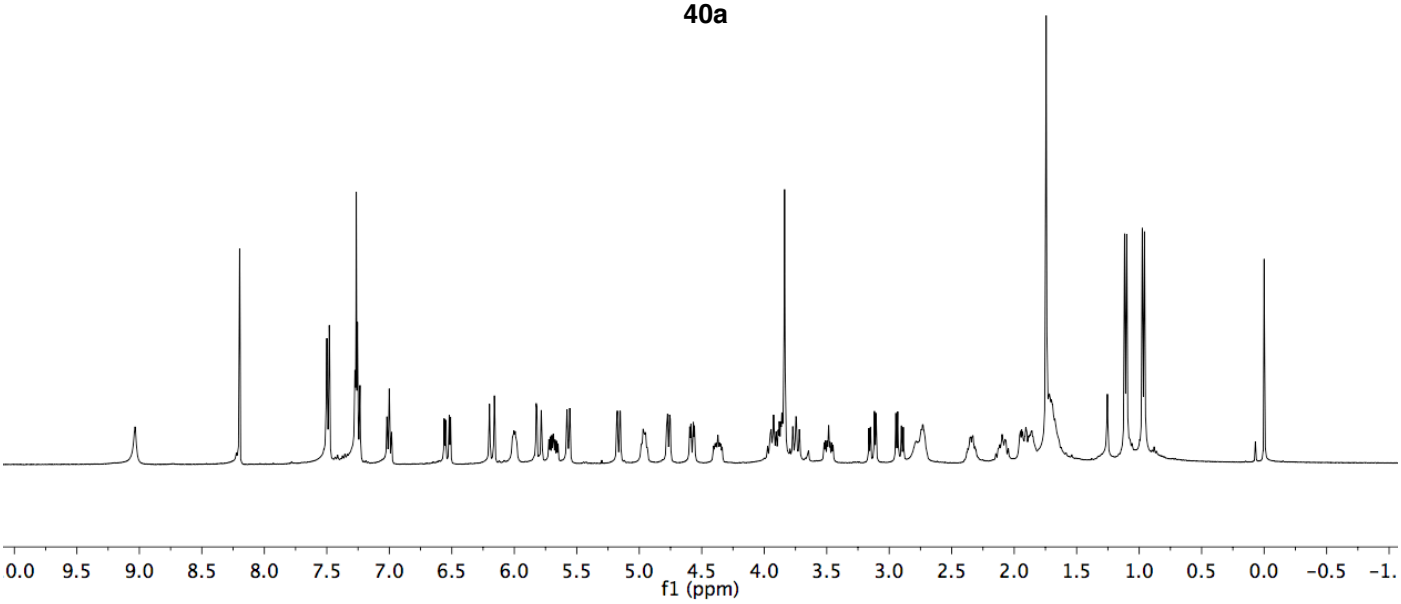

O
N
H
OH
Me
Me
O
O
H
O
Me
Me
Me
O
N
N
O

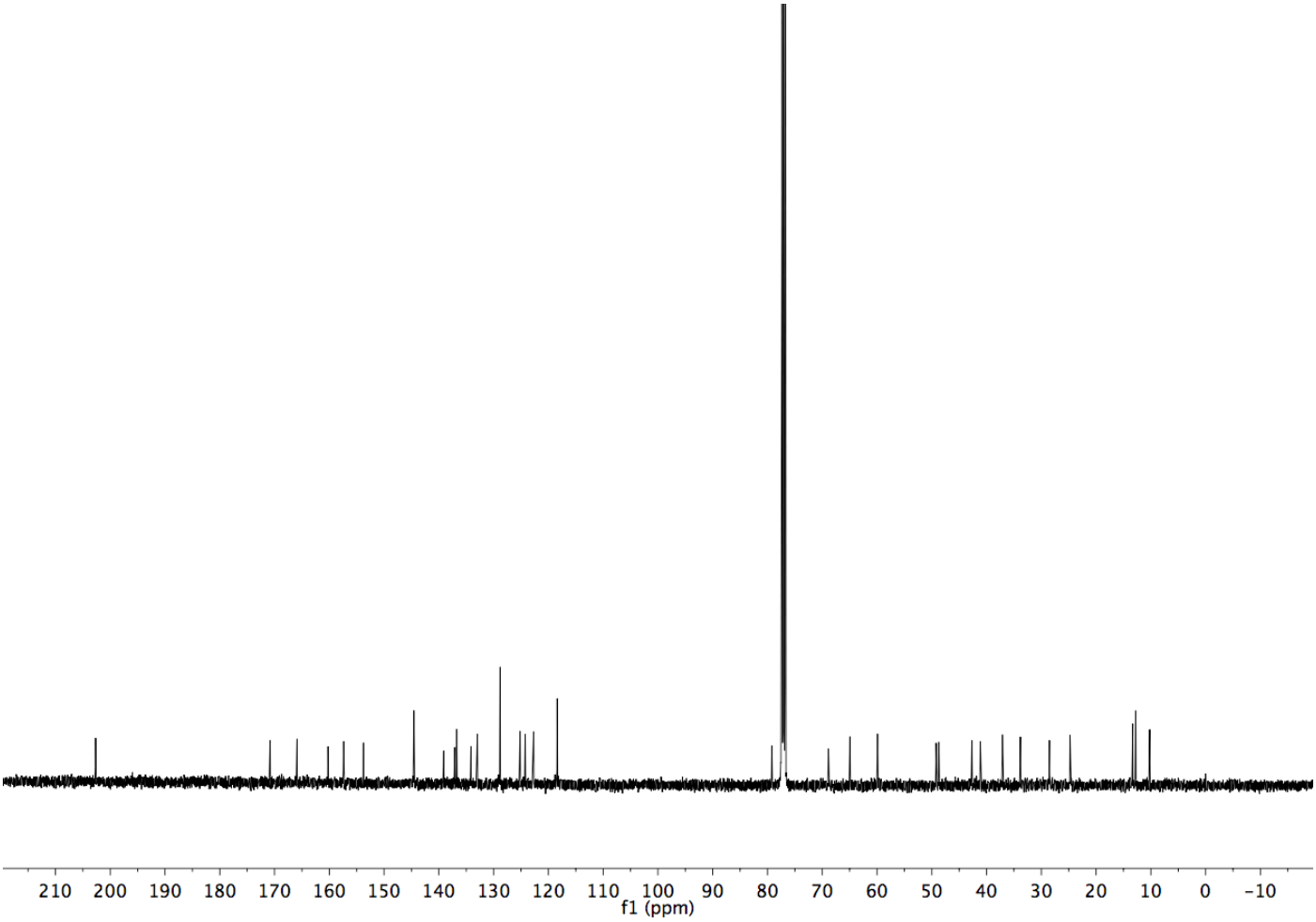
37

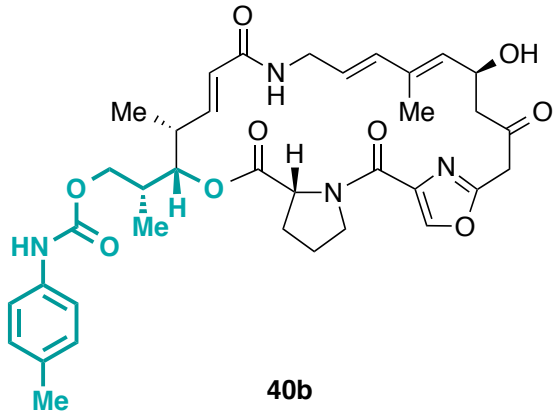

9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5
f1 (ppm)


O
N
H
OH
Me
Me
O
O
O
H
O
N
N
O
O
H
Me
HN
O

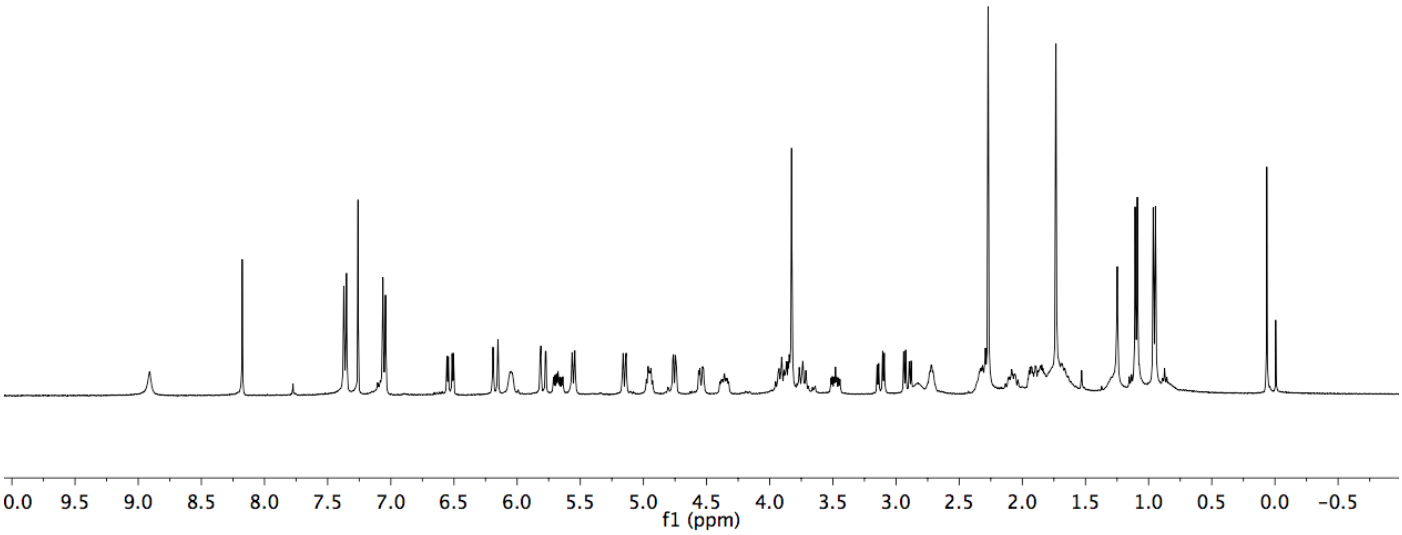
40a

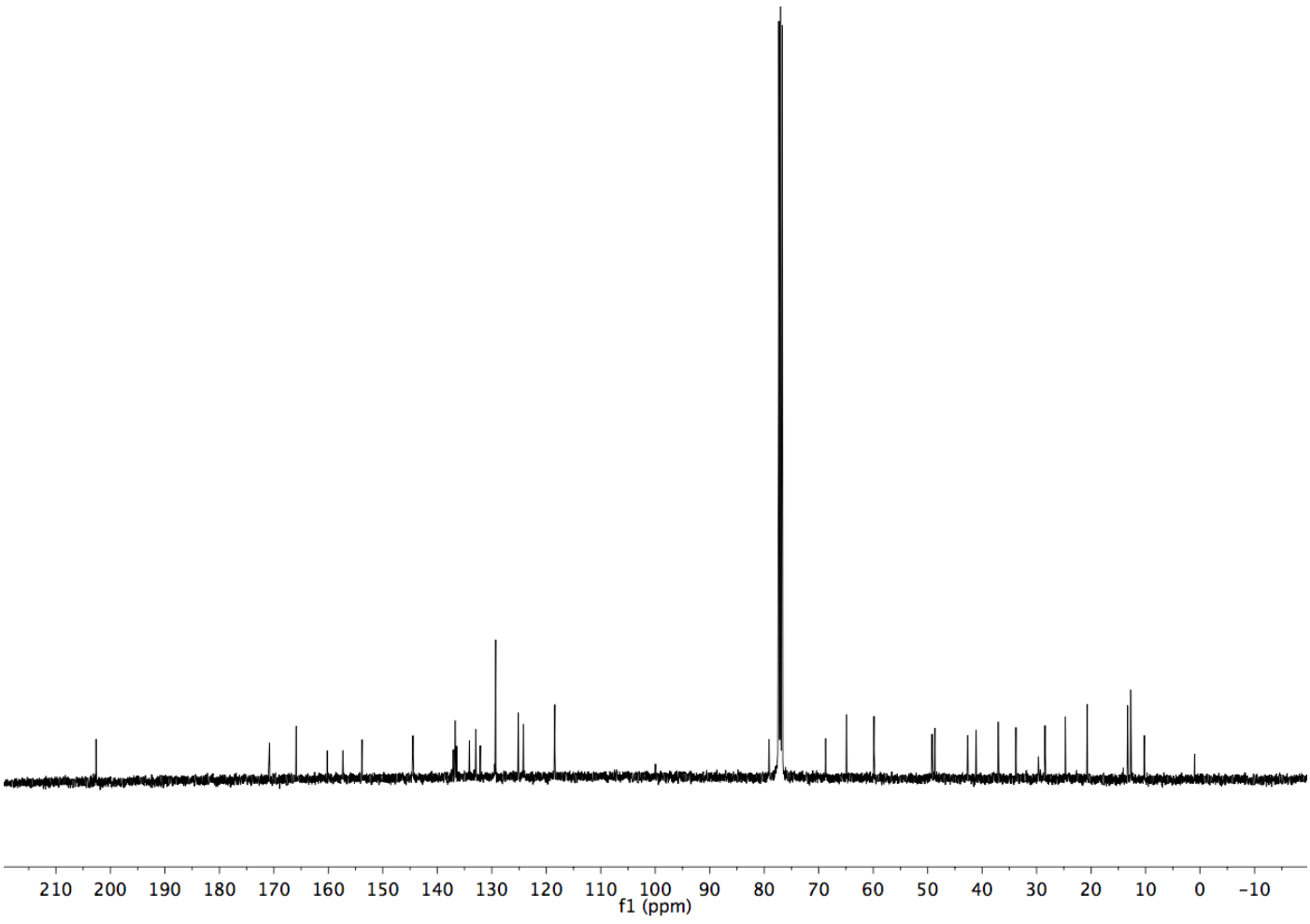

0.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1.
f1 (ppm)

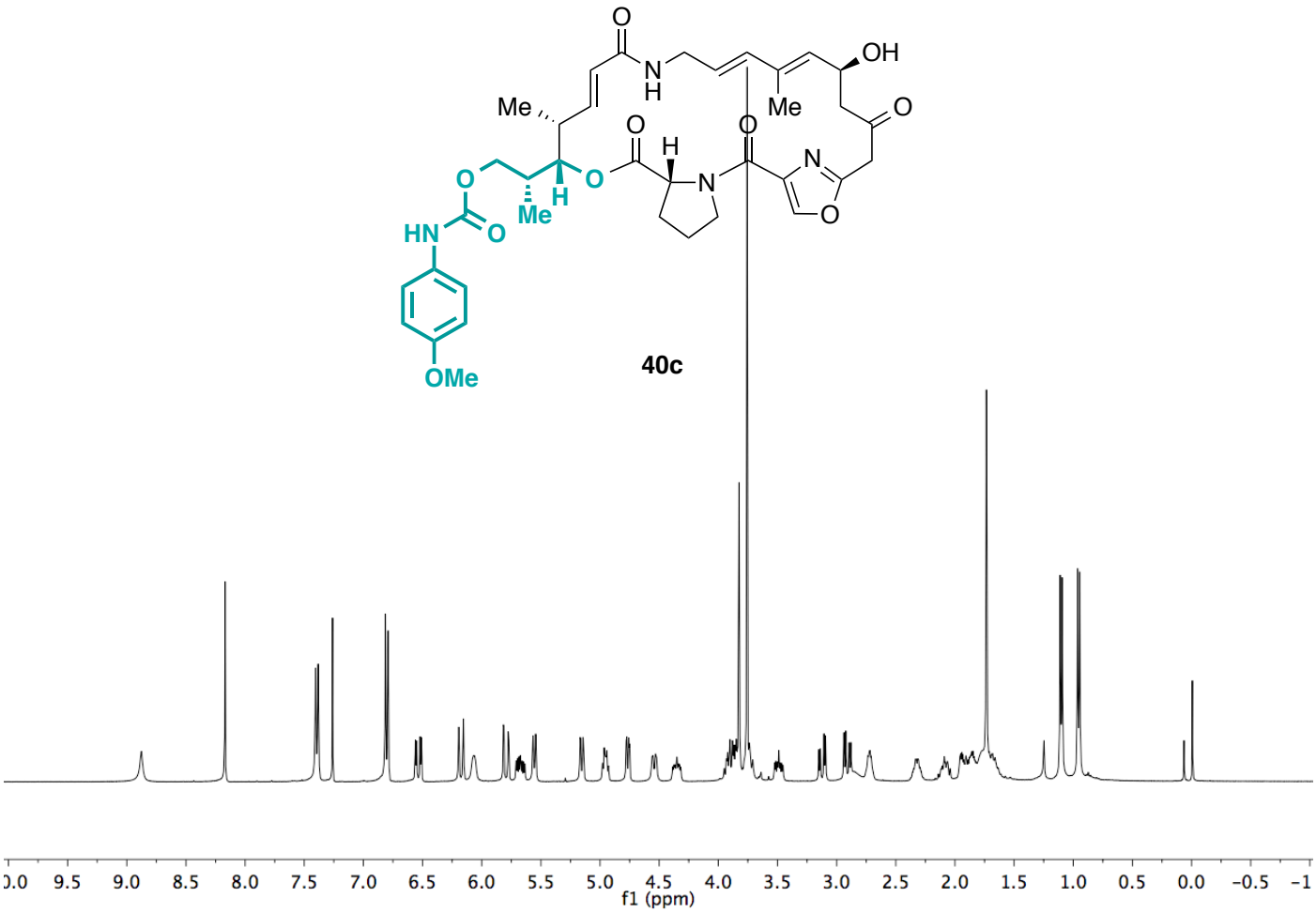

210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


O
N
H
OH
Me
Me
O
O
H
O
N
N
O
O
H
Me
O
HN
O
Me

40b

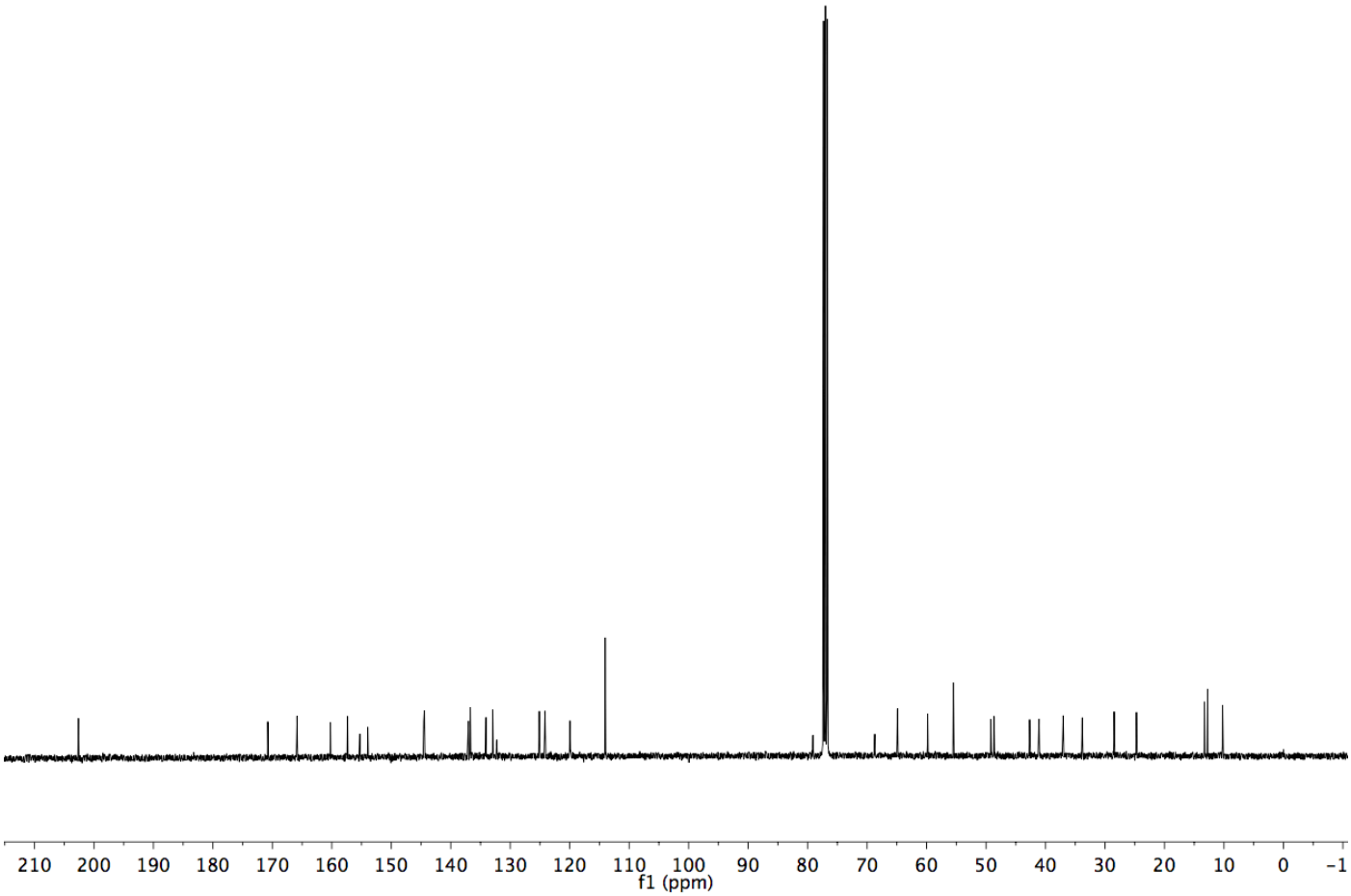

0.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5
f1 (ppm)


210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

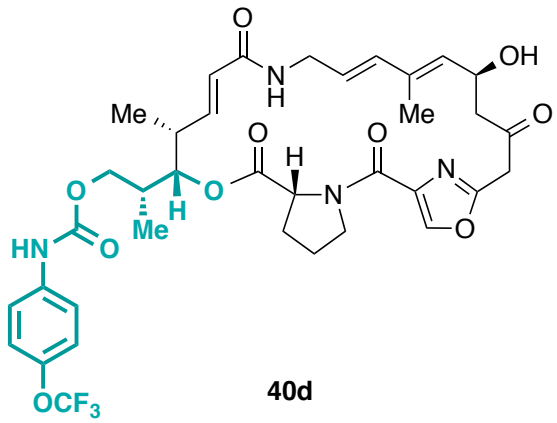

O
N
H
OH
Me
Me
O
O
O
H
N
N
O
O
O
Me
H
HN
O
OMe

40c

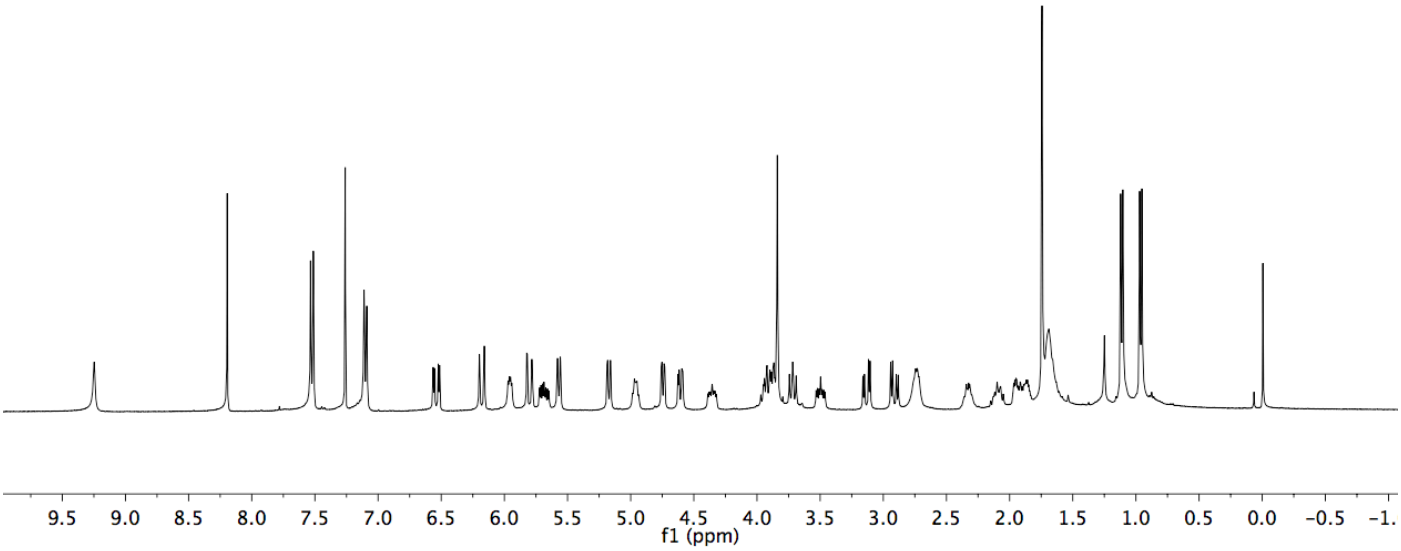
0.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1
f1 (ppm)

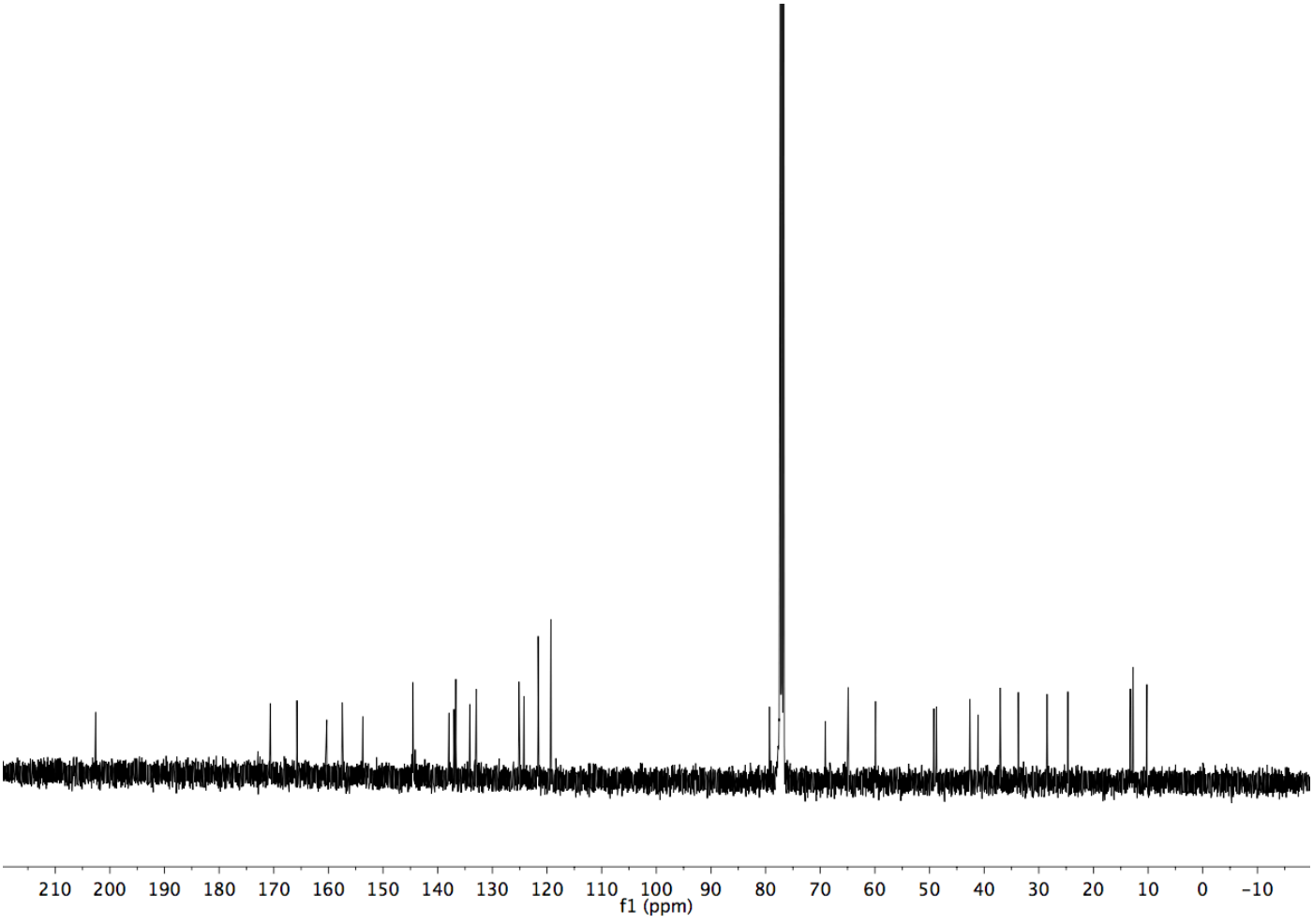


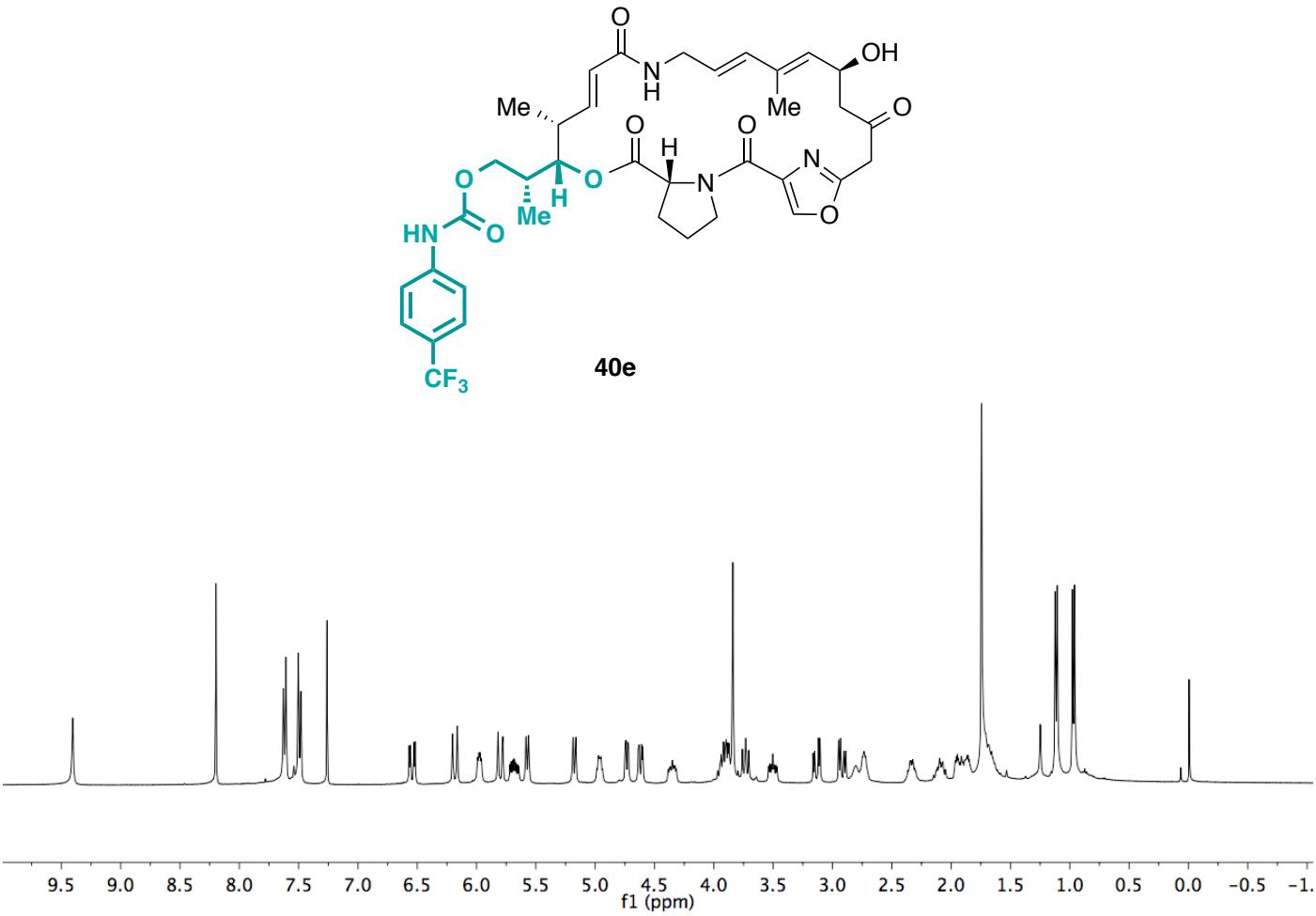
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -1
f1 (ppm)


O
N
H
OH
Me
Me
O
O
O
H
O
N
N
O
O
H
Me
HN
O
OCF3

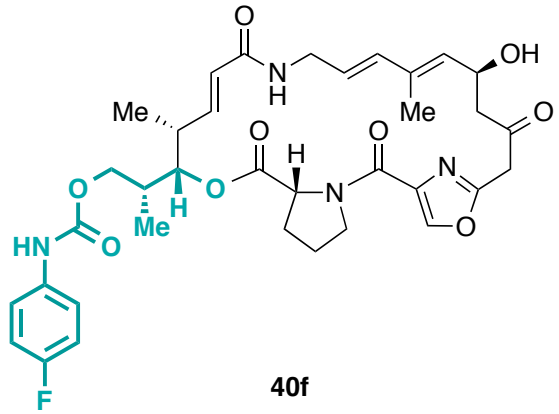
40d


9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1.
f1 (ppm)

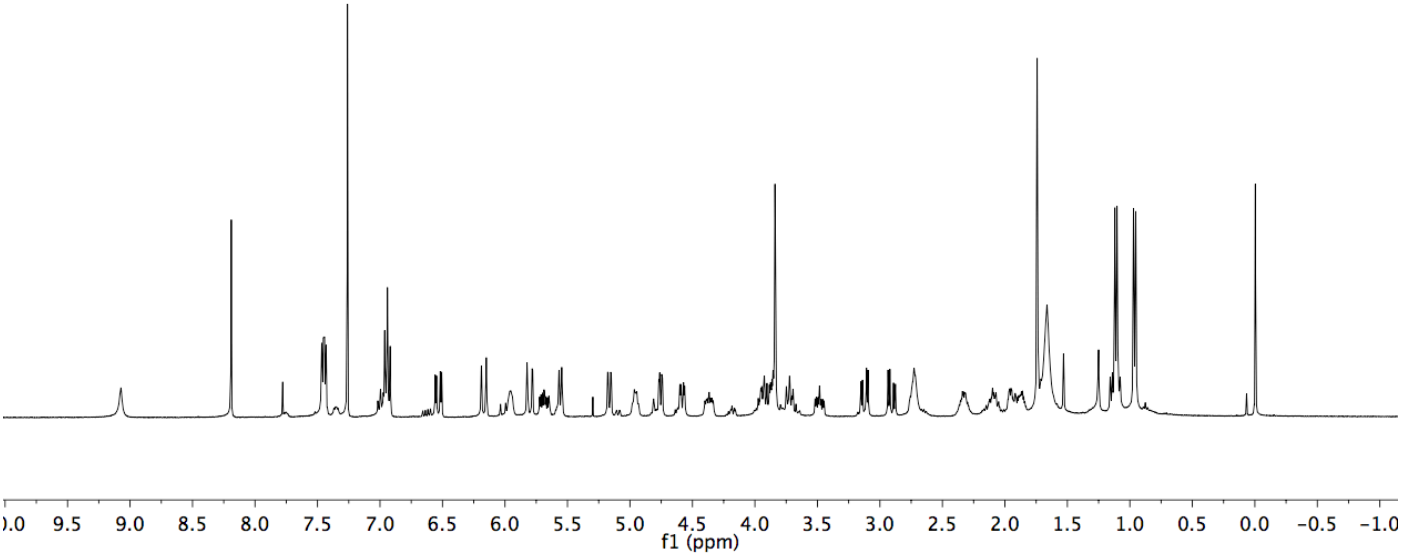

210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

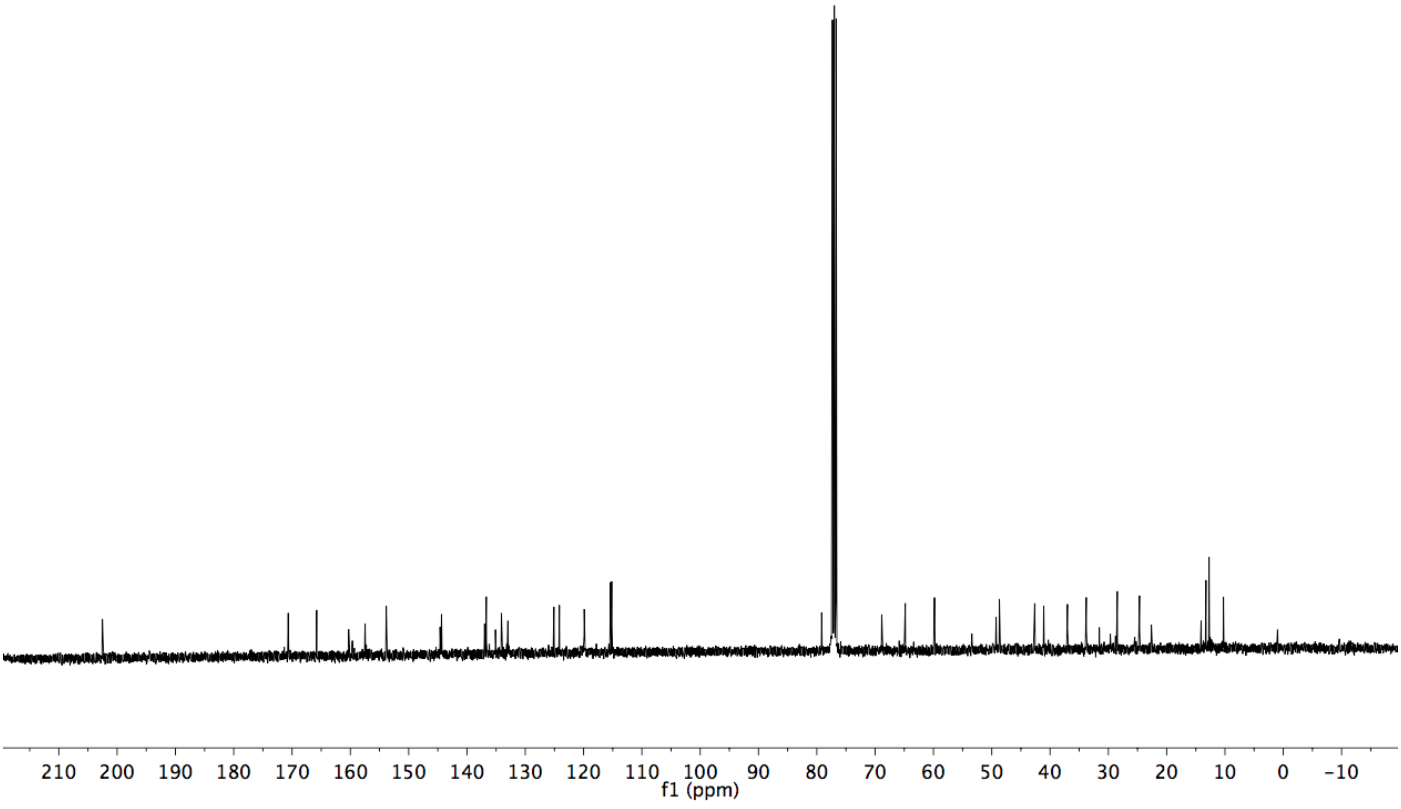

O
N
H
OH
Me
Me
O
O
O
H
O
N
N
O
O
H
Me
HN
O
CF3
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1.
f1 (ppm)
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

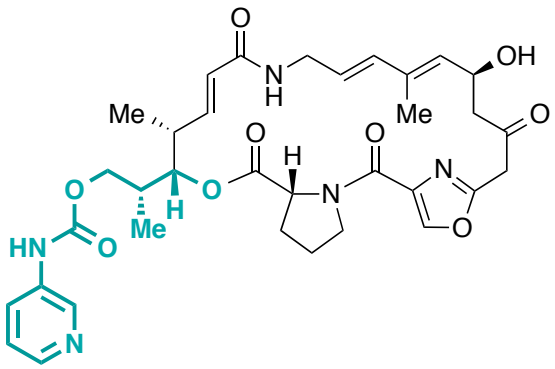
40e



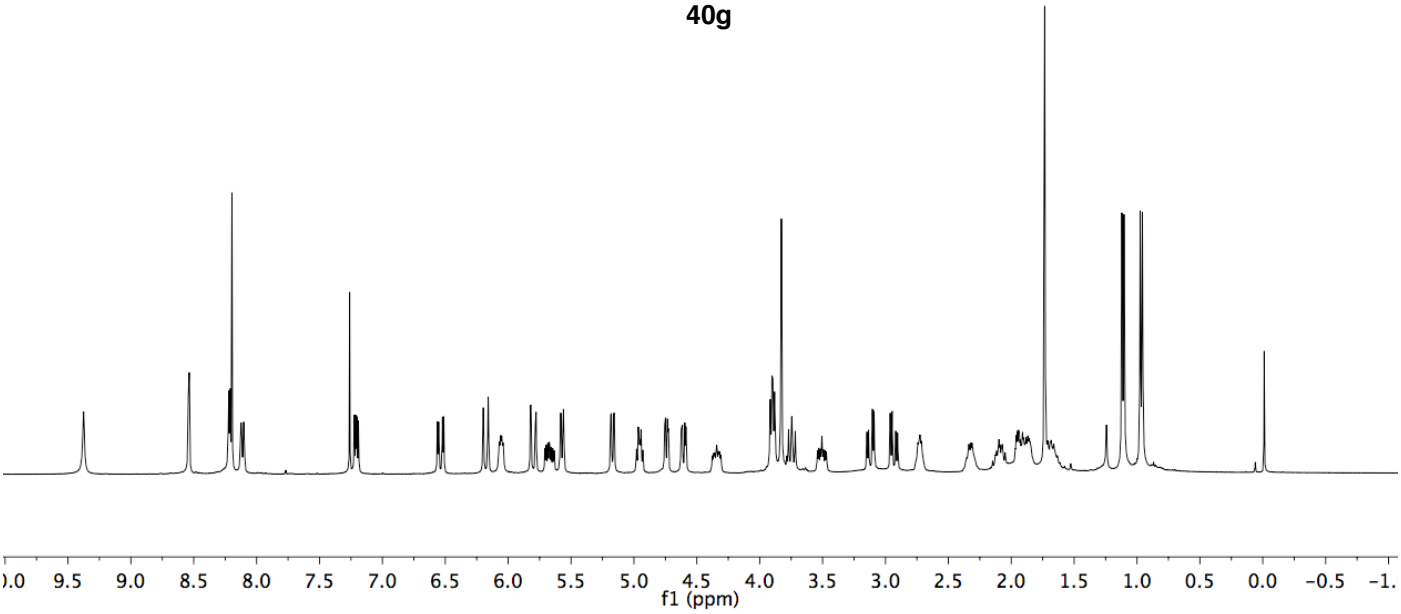
40f

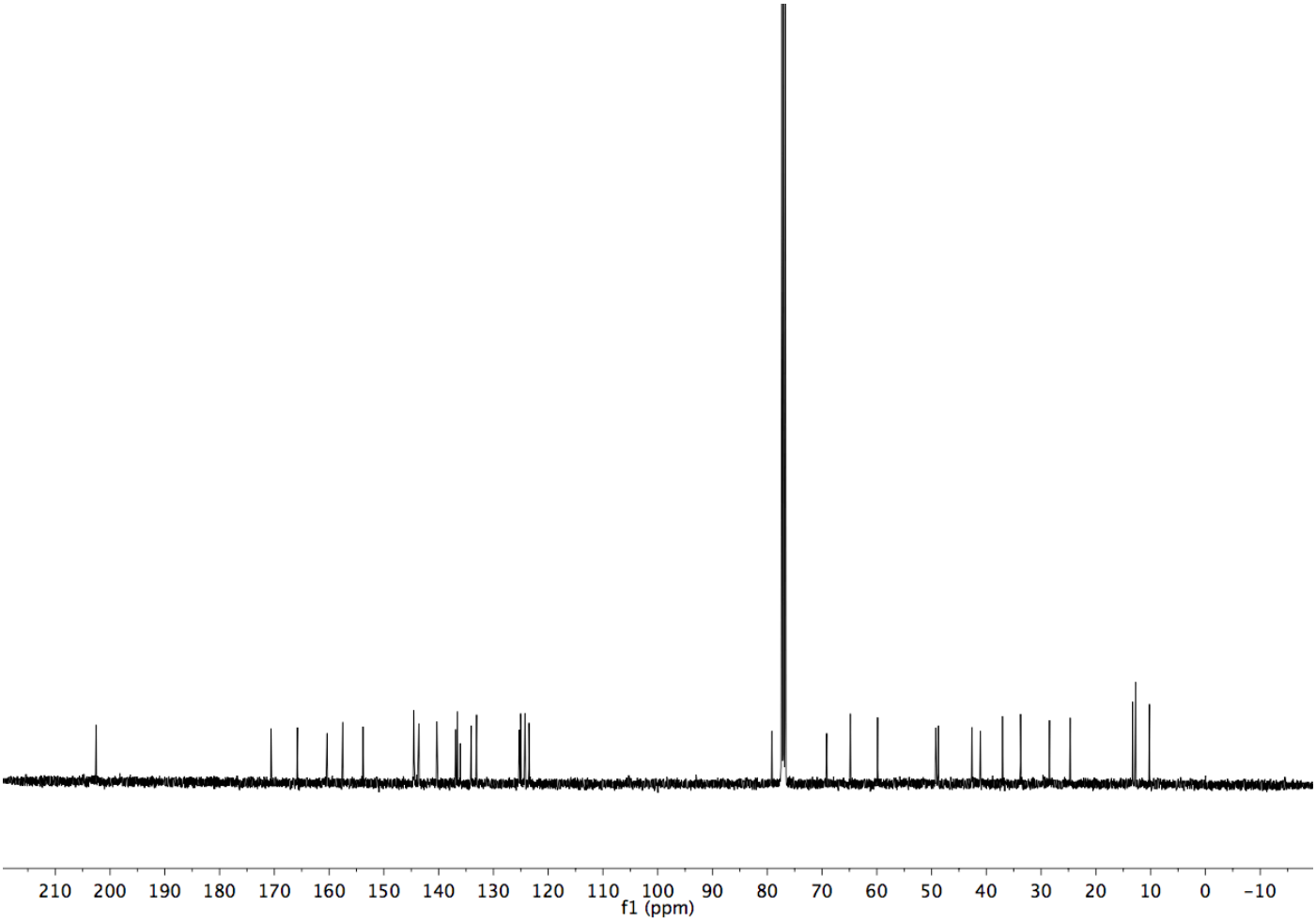

9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
f1 (ppm)

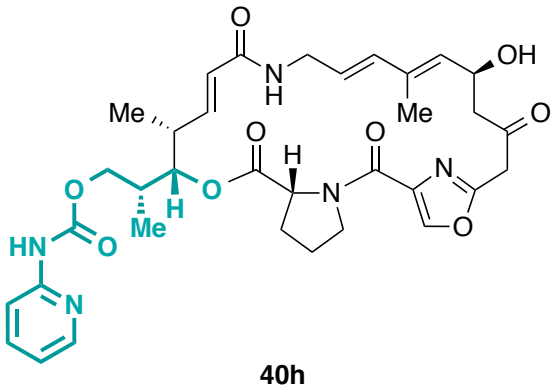

210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
-10
f1 (ppm)


O
N
H
OH
Me
Me
O
O
O
H
O
N
N
O
O
H
Me
HN
O
N

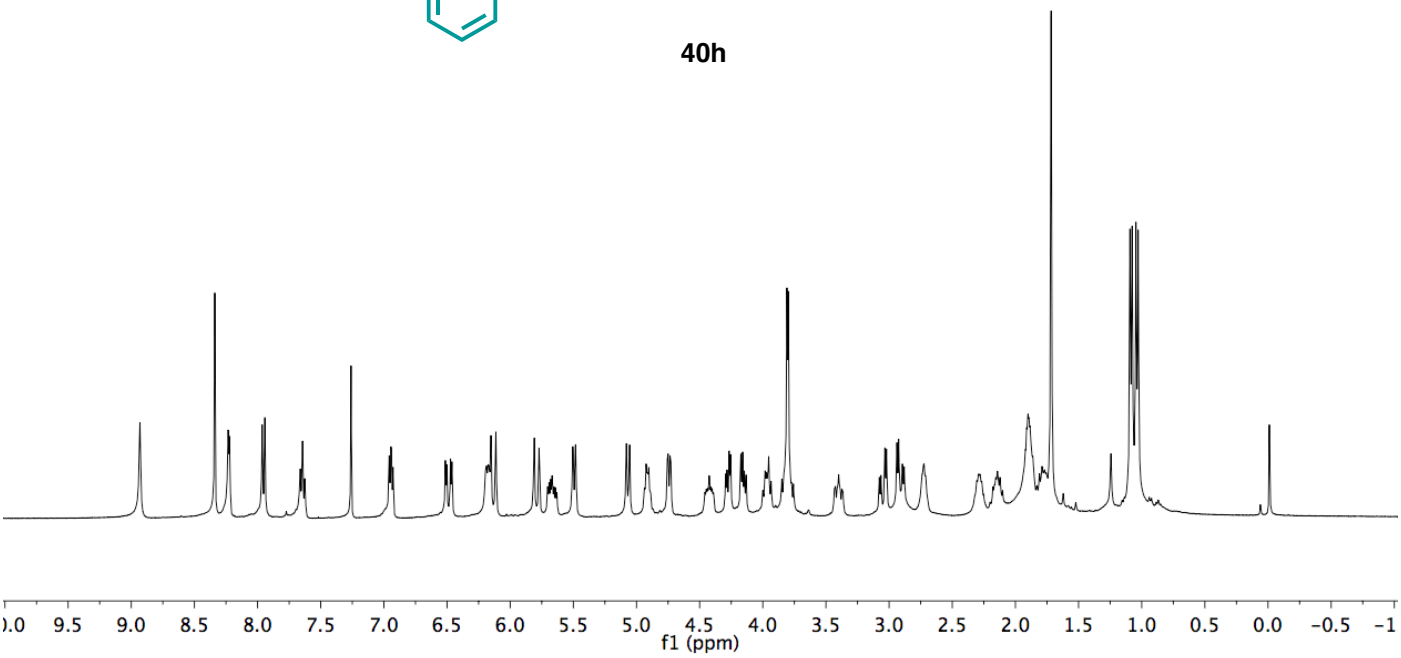
40g

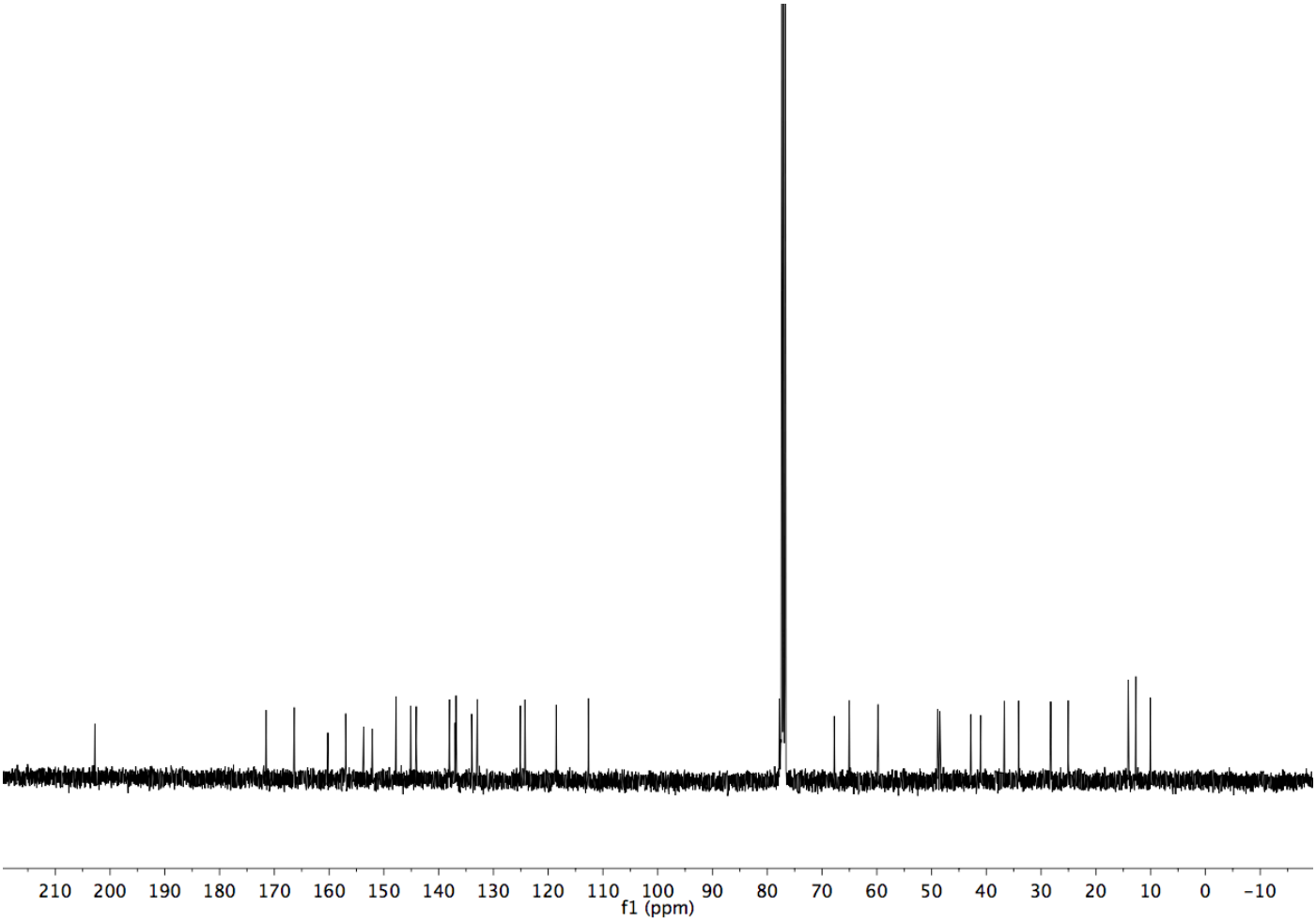

9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
f1 (ppm)

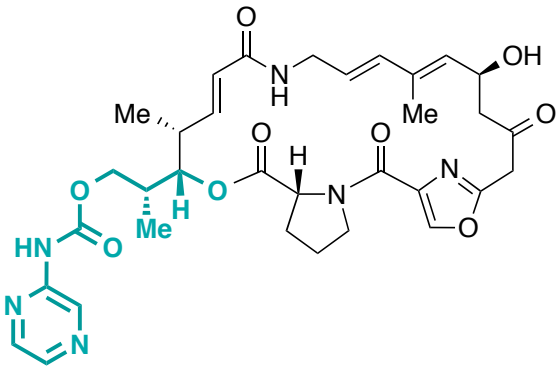

210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
-10
f1 (ppm)



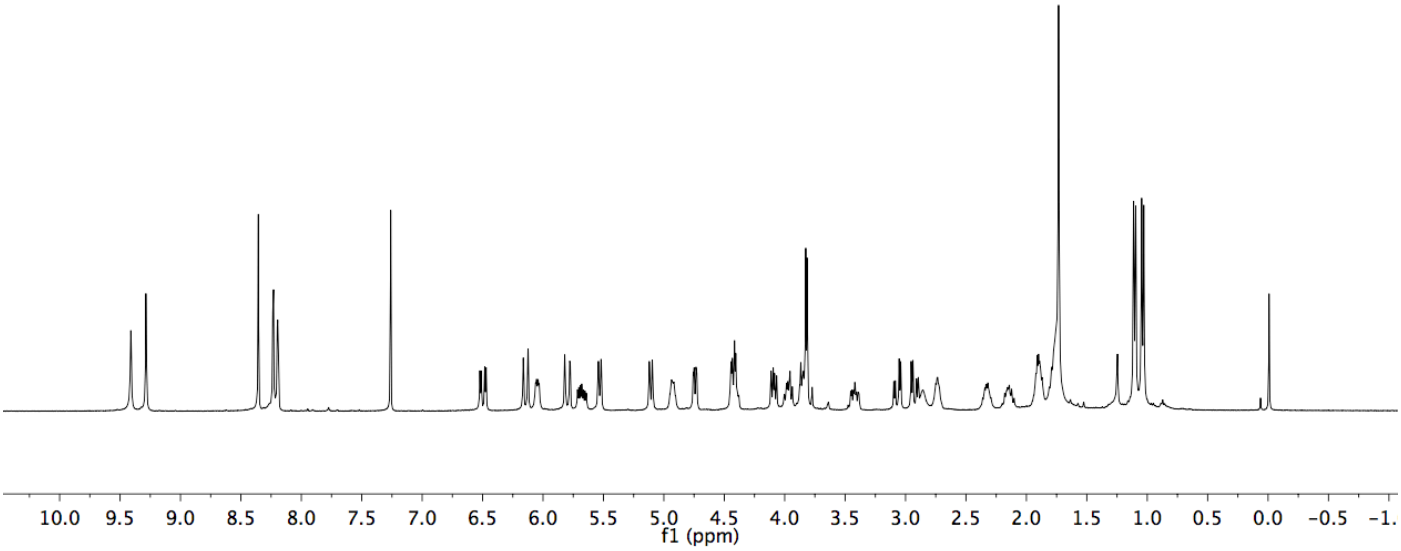
40h

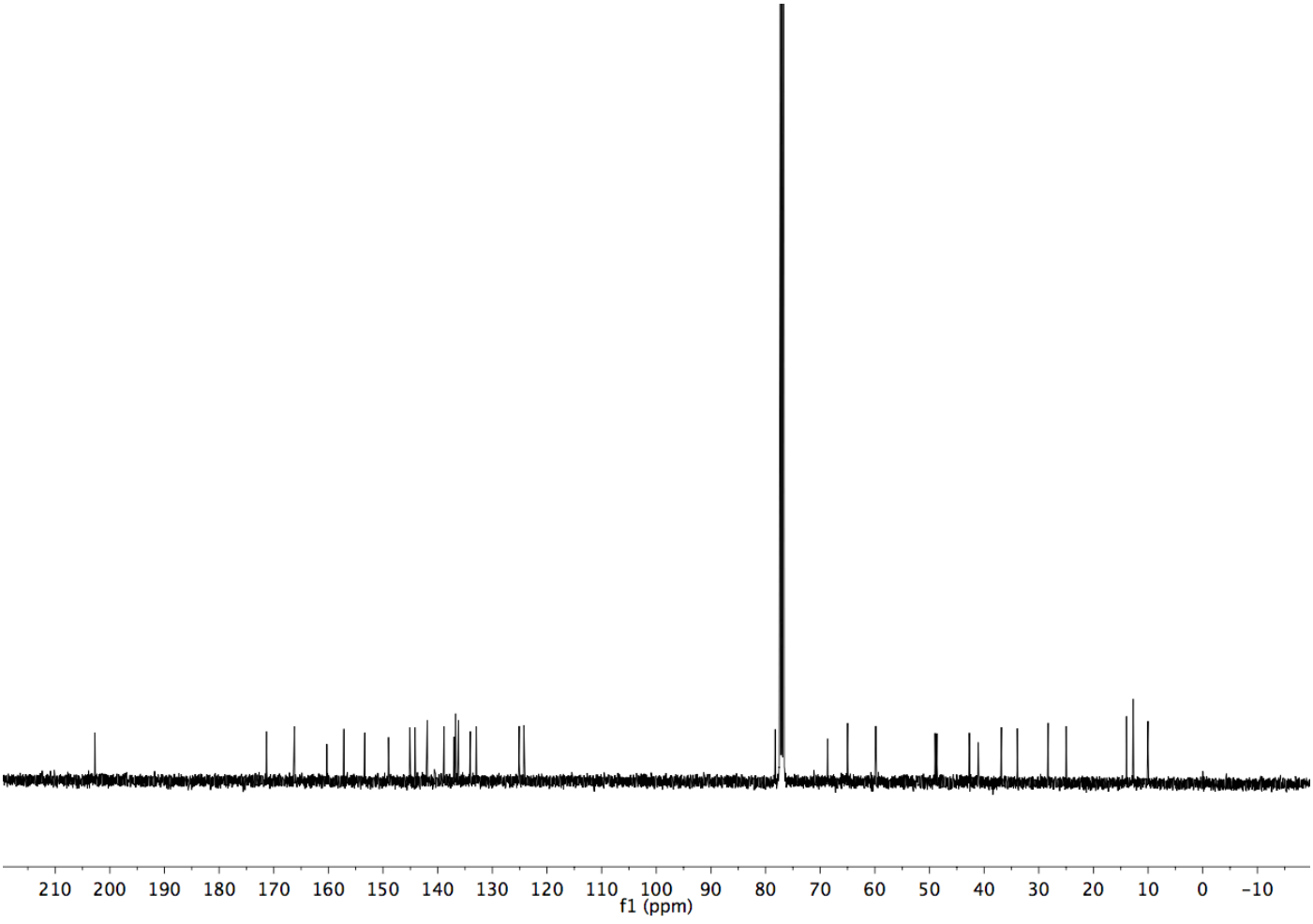

9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
f1 (ppm)

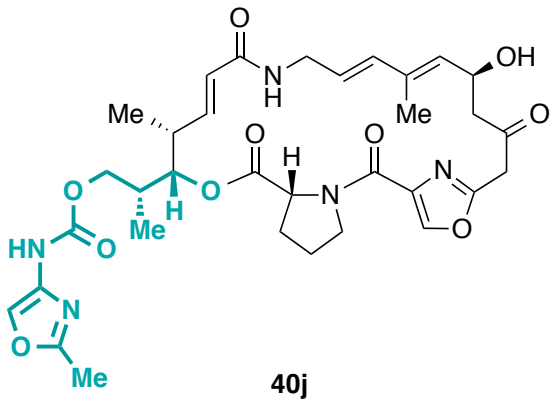

210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
-10
f1 (ppm)


O
N
H
OH
Me
Me
O
O
O
H
O
N
N
O
O
O
Me
H
HN
O
N
N

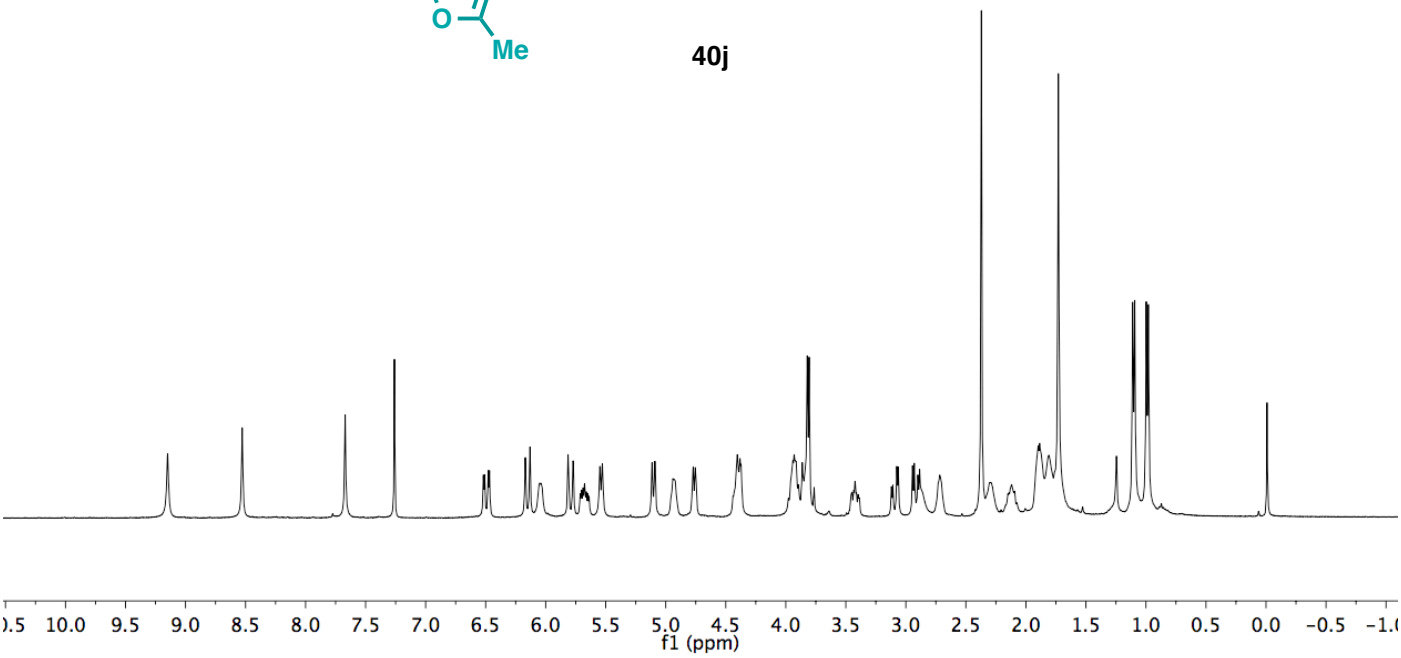
40i

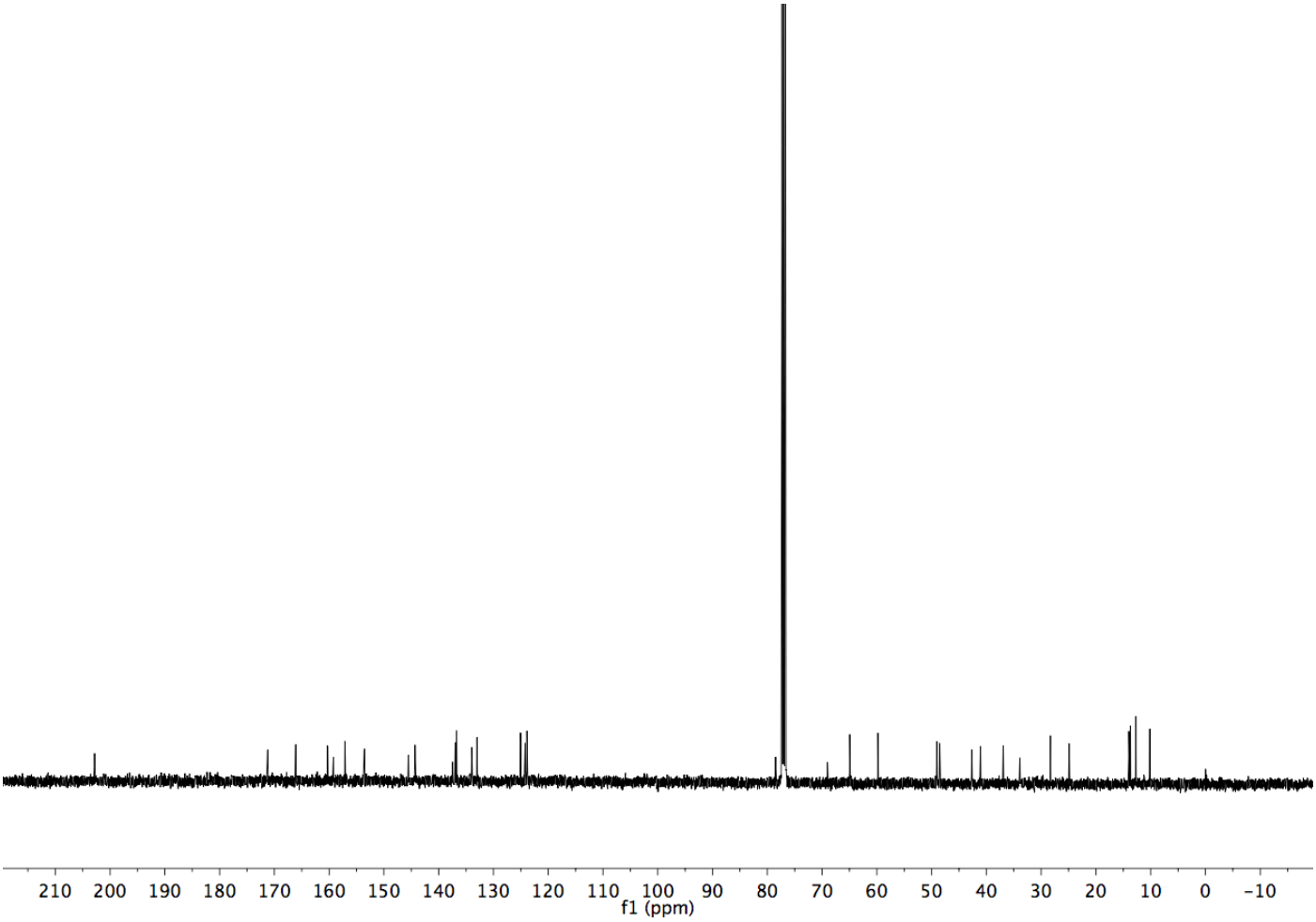

10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1.
f1 (ppm)

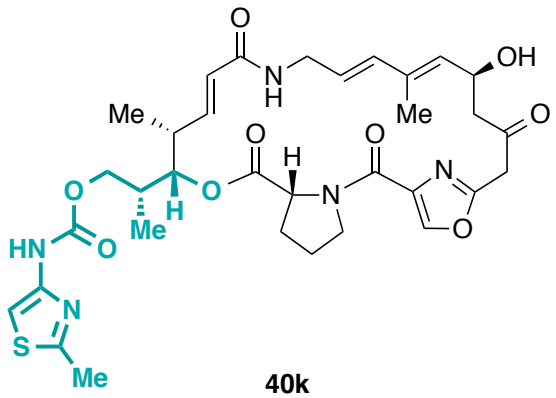

210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


O
N
H
OH
Me
Me
O
O
H
O
N
N
O
O
H
Me
O
HN
O
N
O
Me

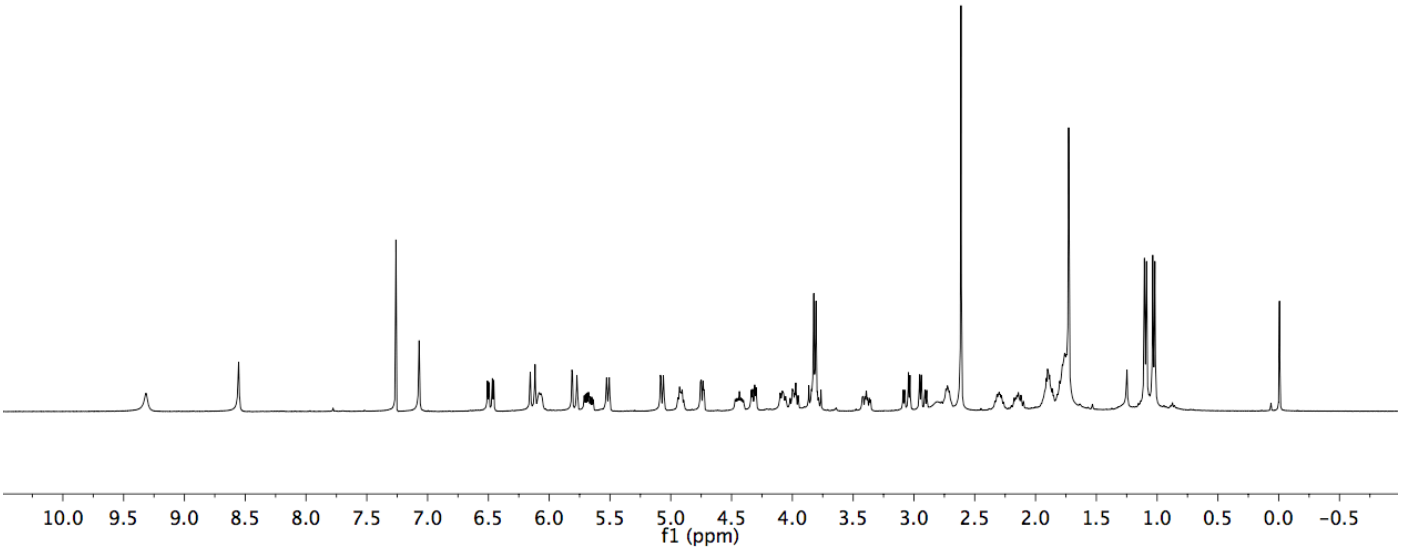
40j

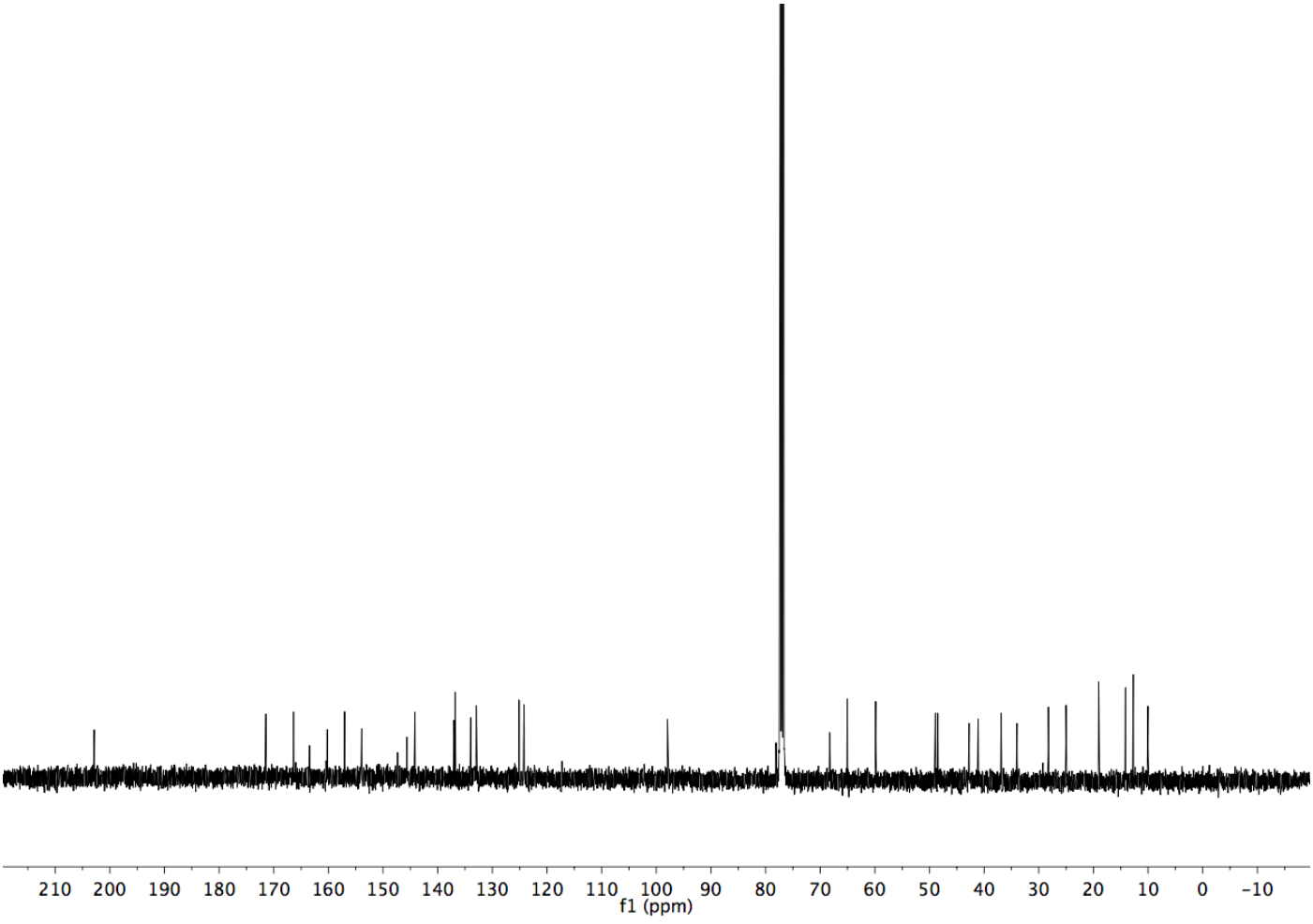

10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5
f1 (ppm)

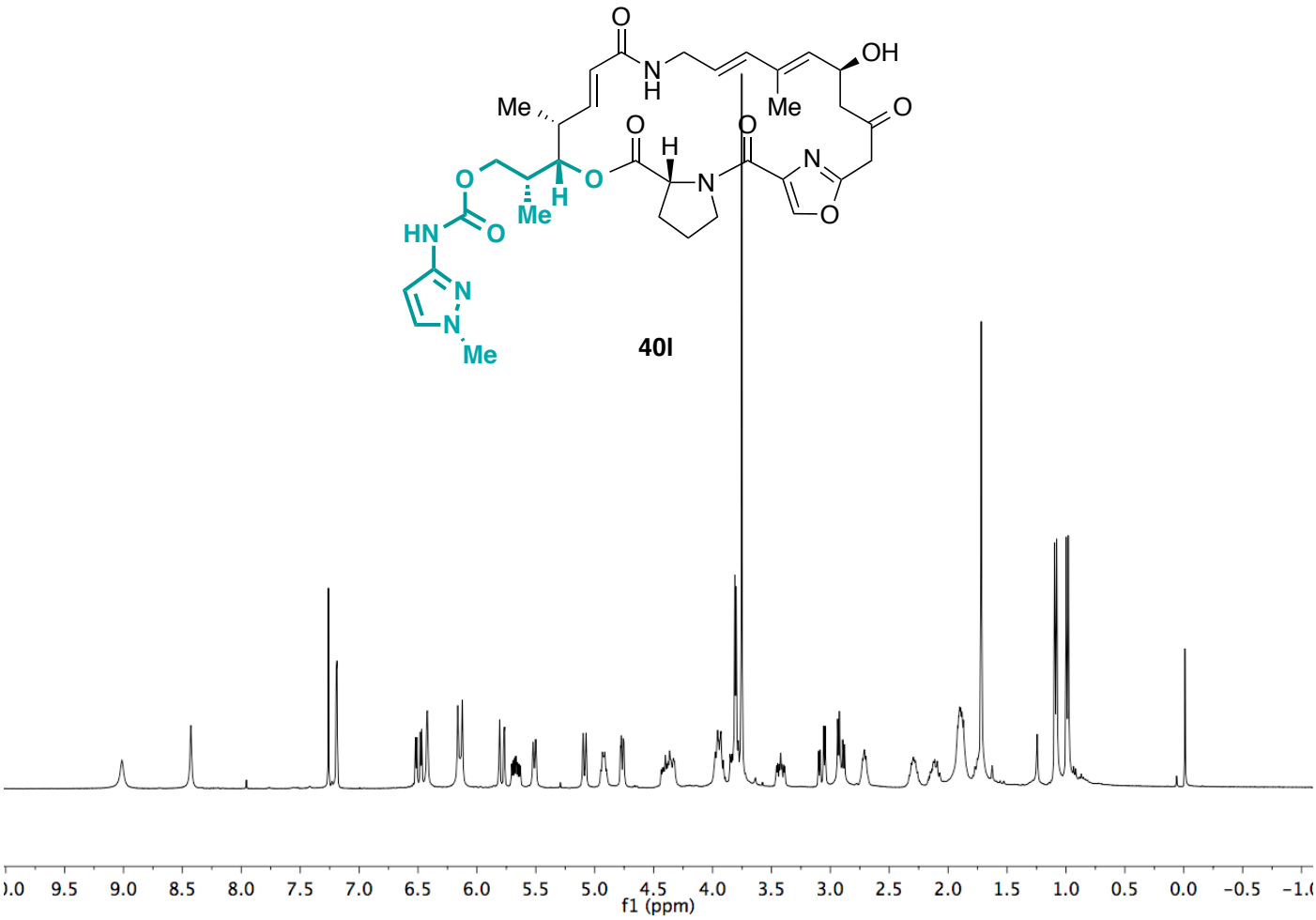

210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


O
N
H
OH
Me
Me
O
O
O
H
O
N
N
O
O
H
Me
HN
O
N
S
Me

40k

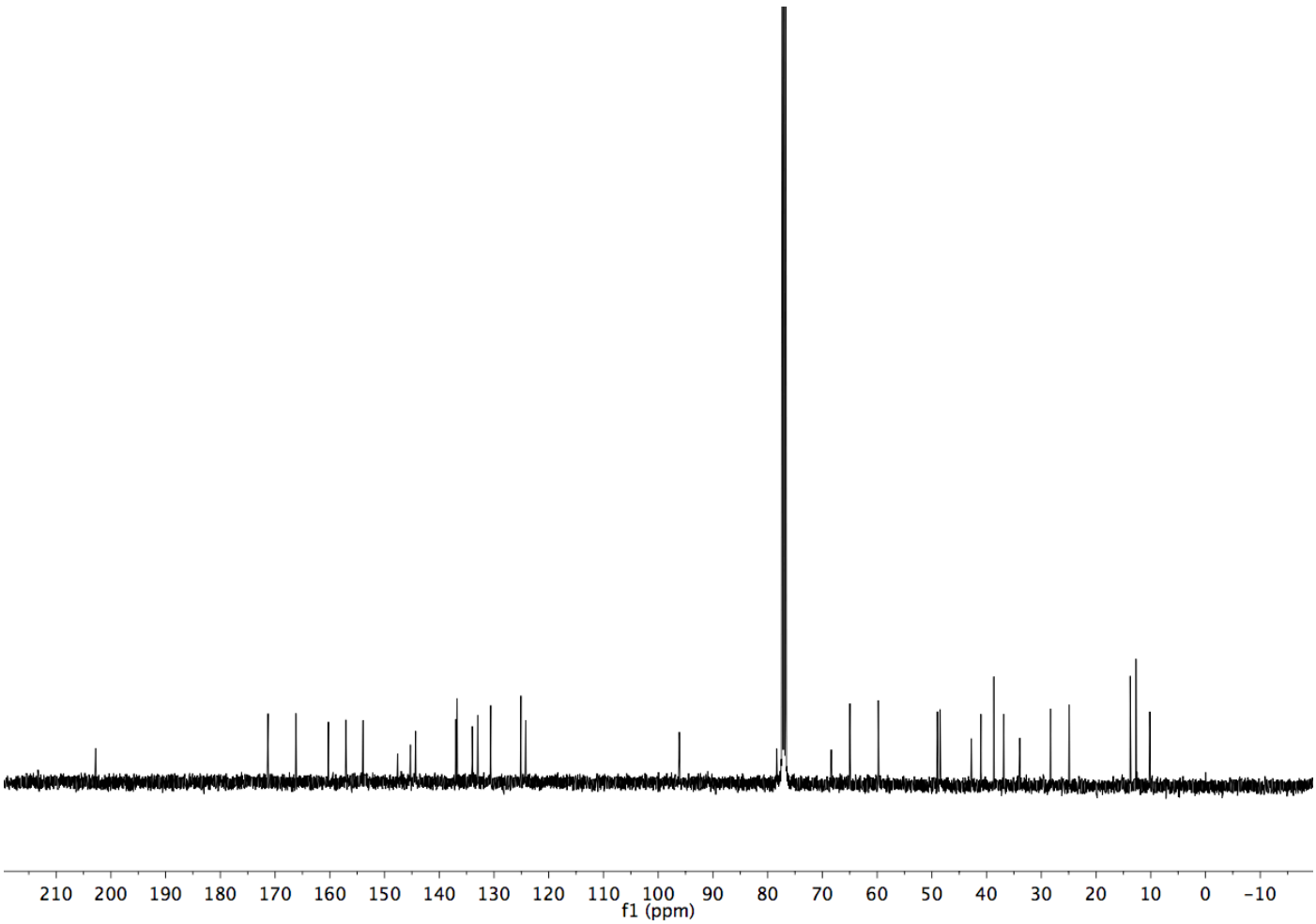

10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5
f1 (ppm)


210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

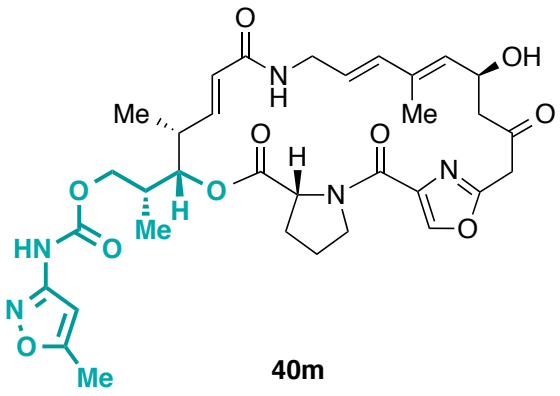

O
N
H
OH
Me
Me
O
O
H
O
N
N
O
O
O
H
Me
HN
O
N
N
Me

40l

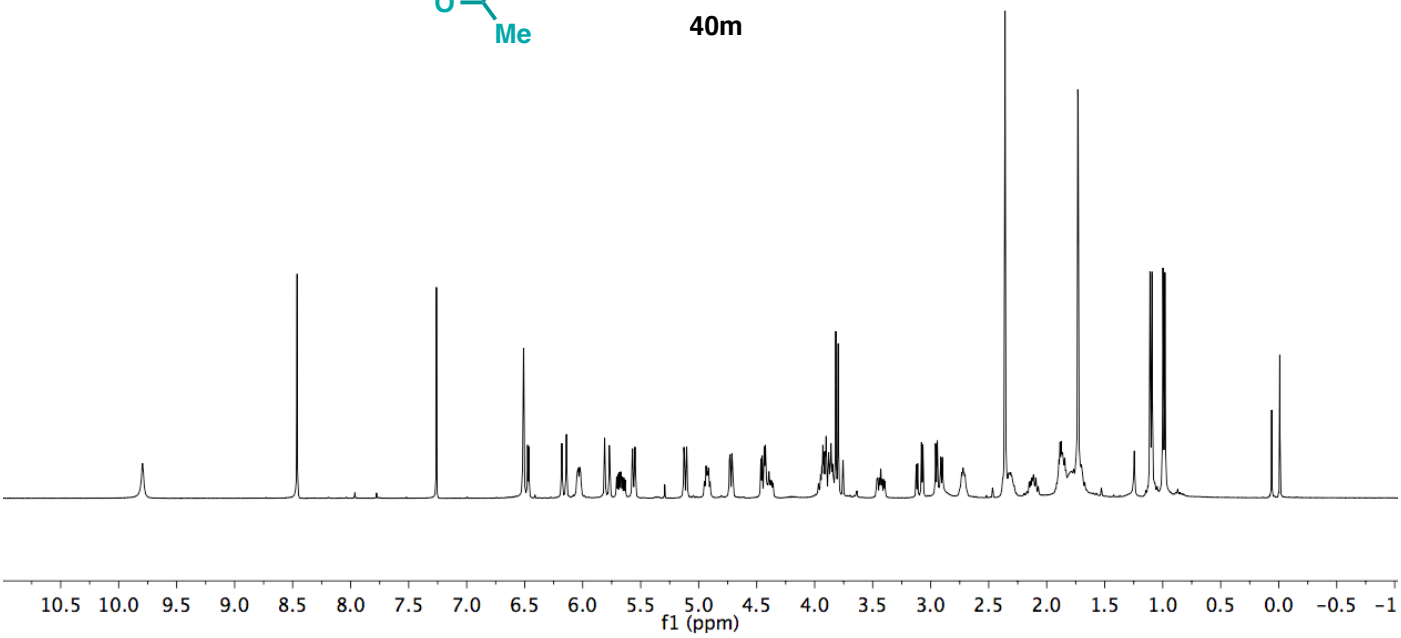
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5
f1 (ppm)

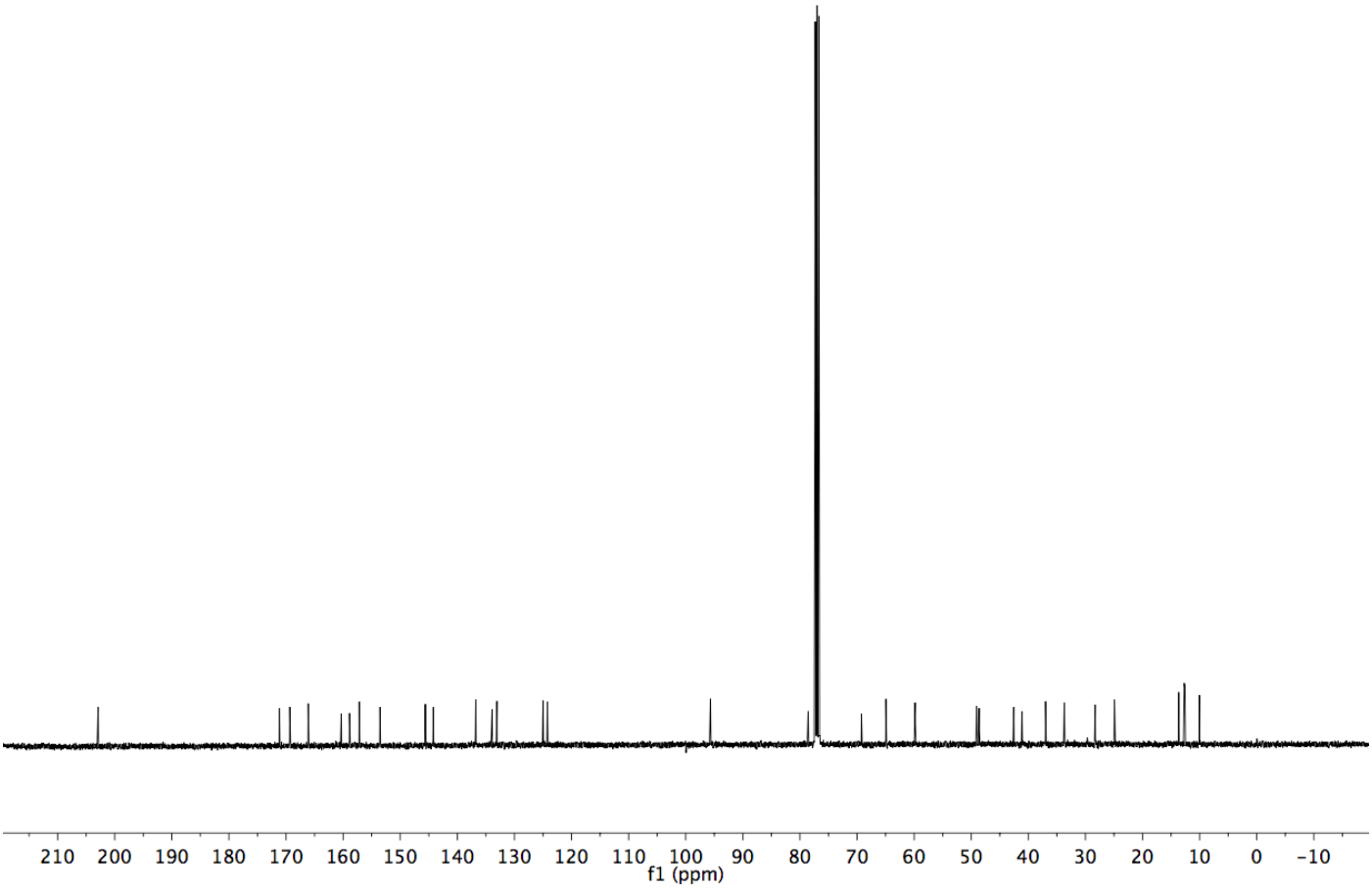


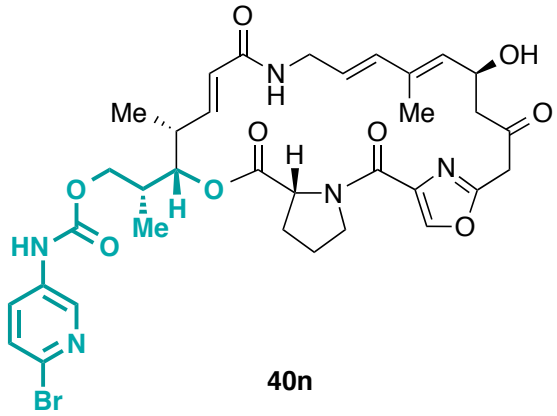
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


O
N
H
OH
Me
Me
O
O
O
H
O
N
N
O
O
H
Me
HN
O
N
O
Me

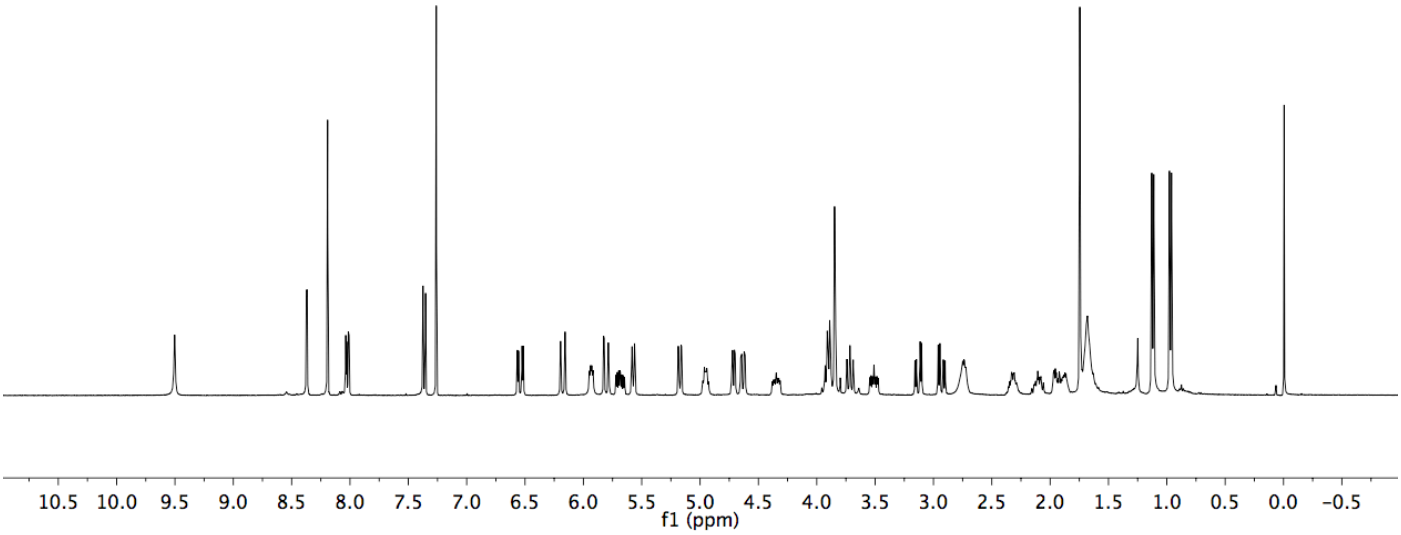
40m

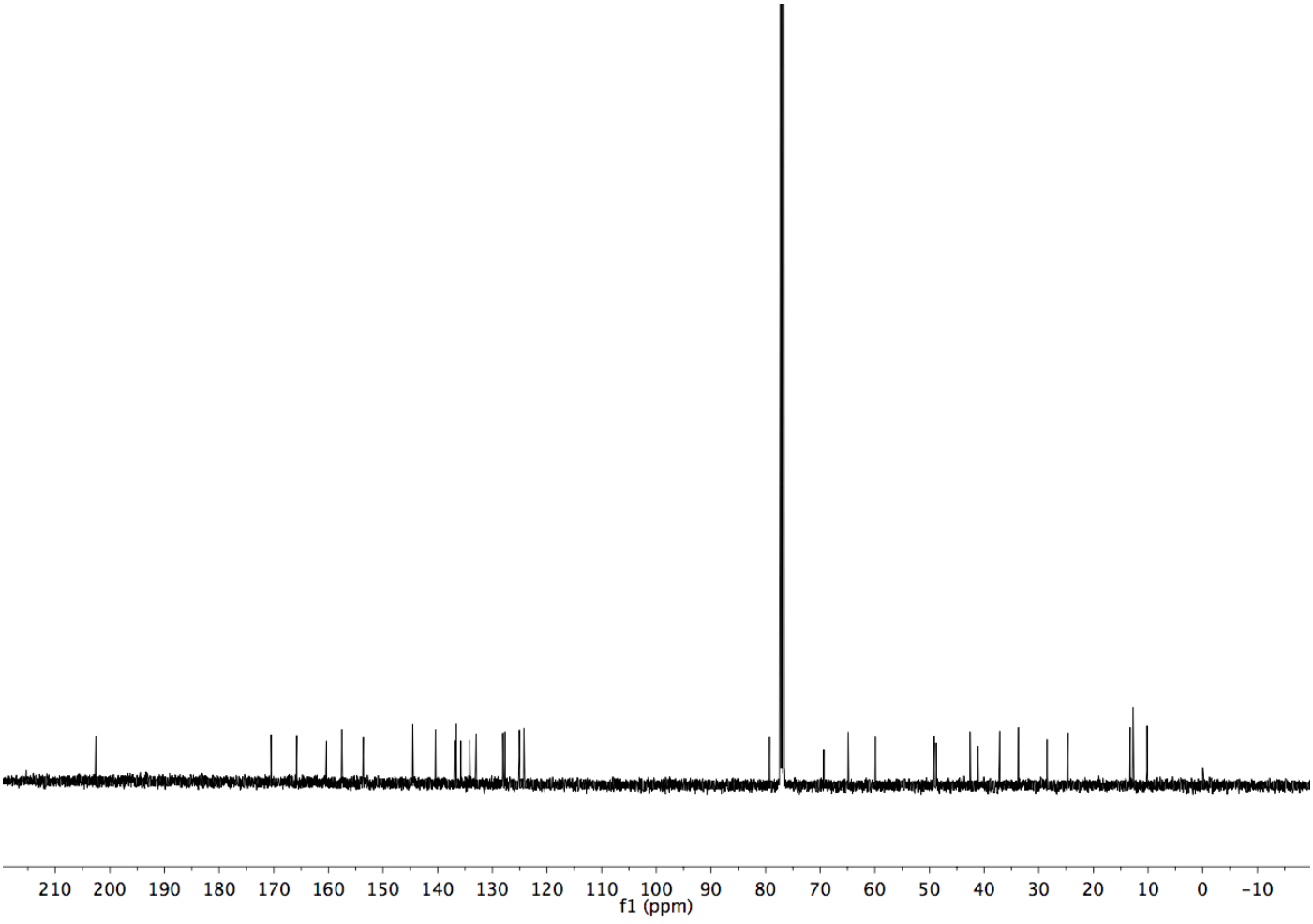

10.5 10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1
f1 (ppm)

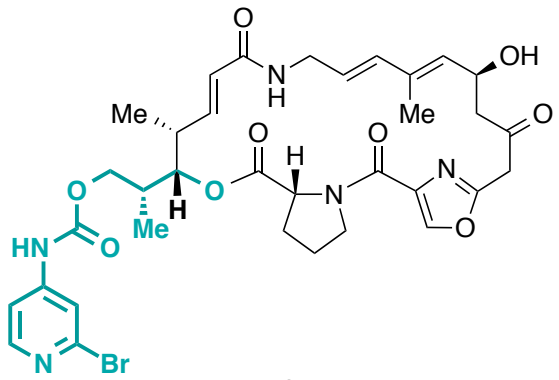

210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


O
N
H
OH
Me
Me
O
O
H
O
N
N
O
O
H
Me
O
HN
O
N
Br

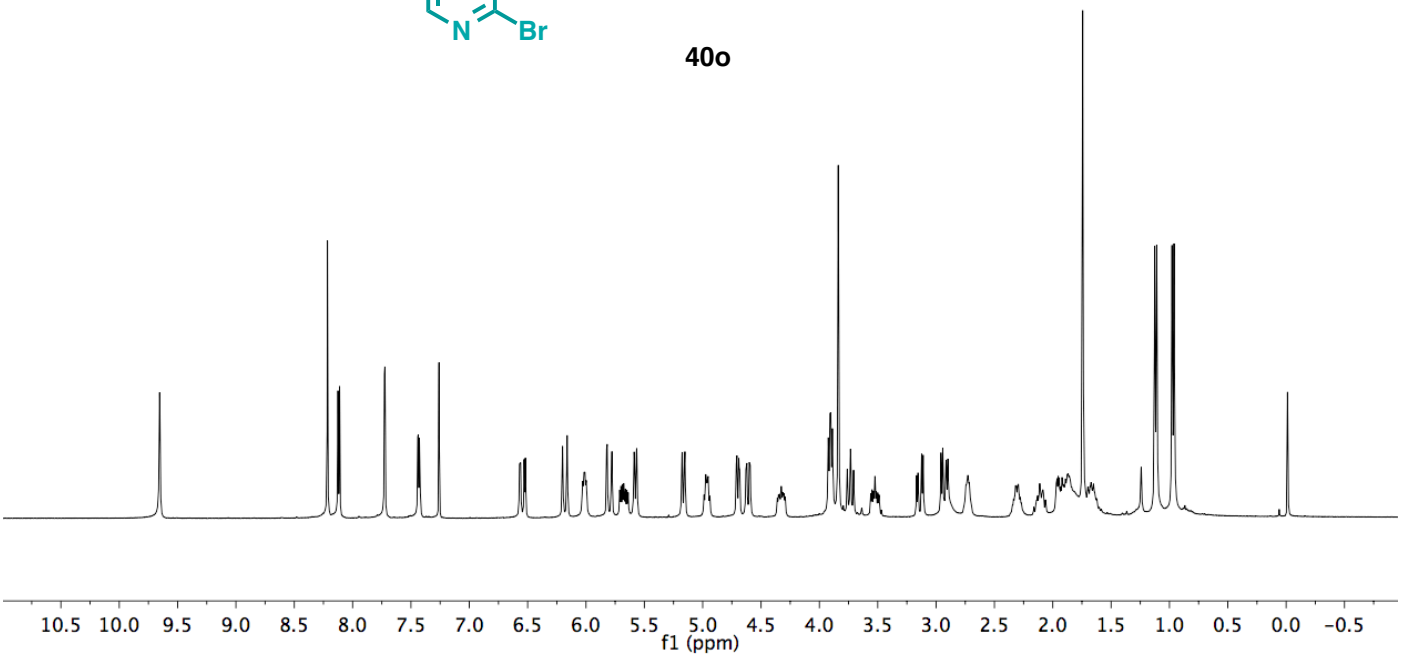
40n

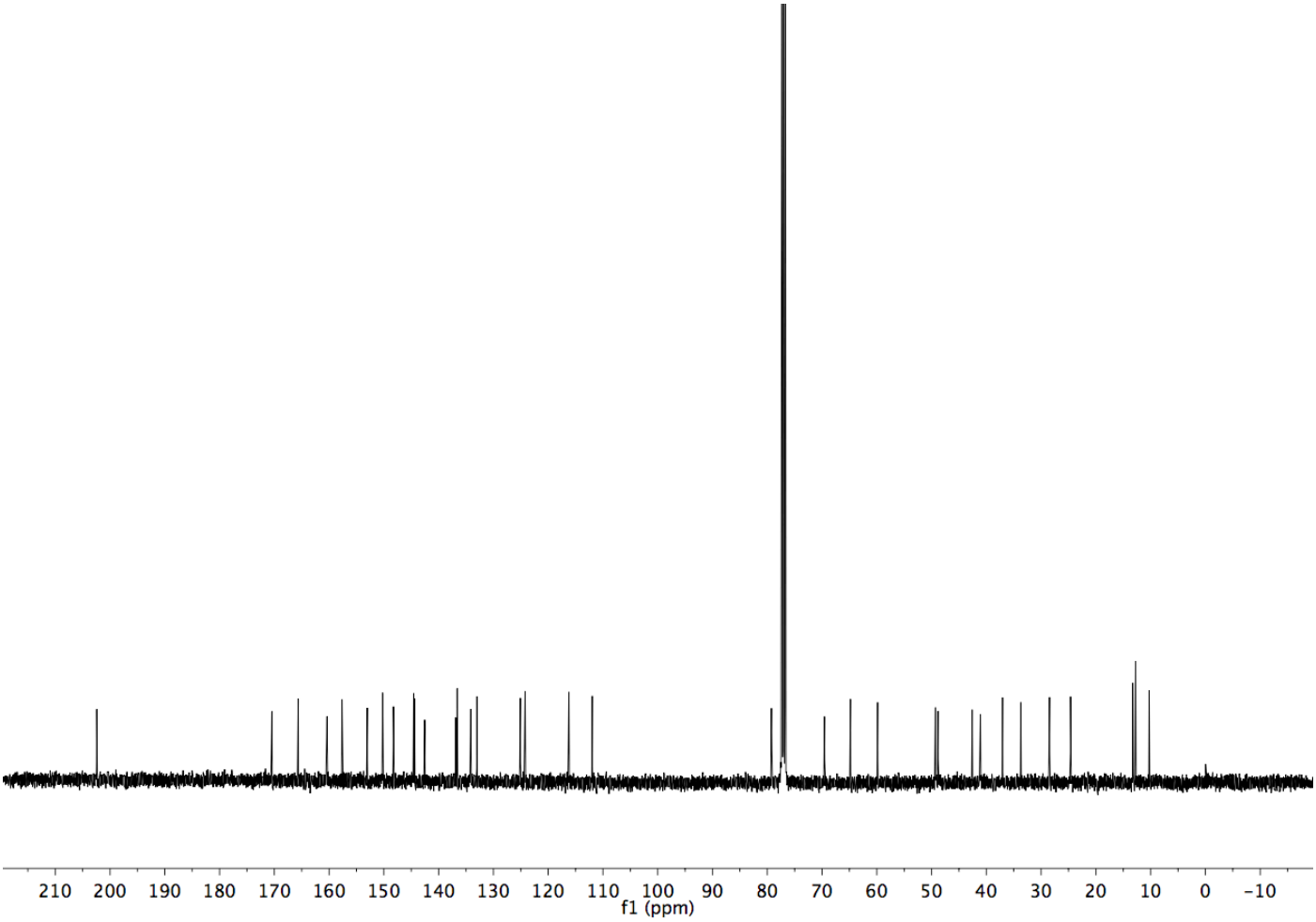

10.5 10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5
f1 (ppm)

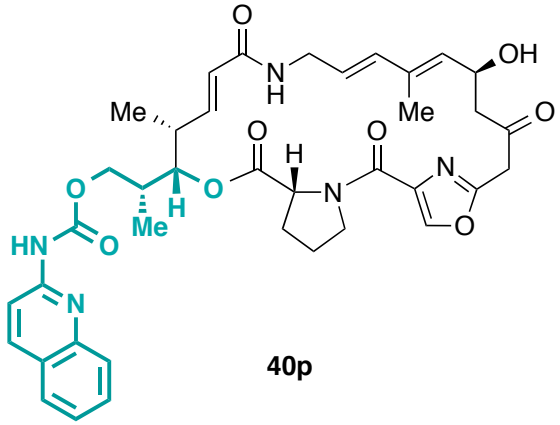

210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


O
N
H
OH
Me
Me
O
O
O
H
O
N
N
O
O
H
Me
HN
O
N
Br

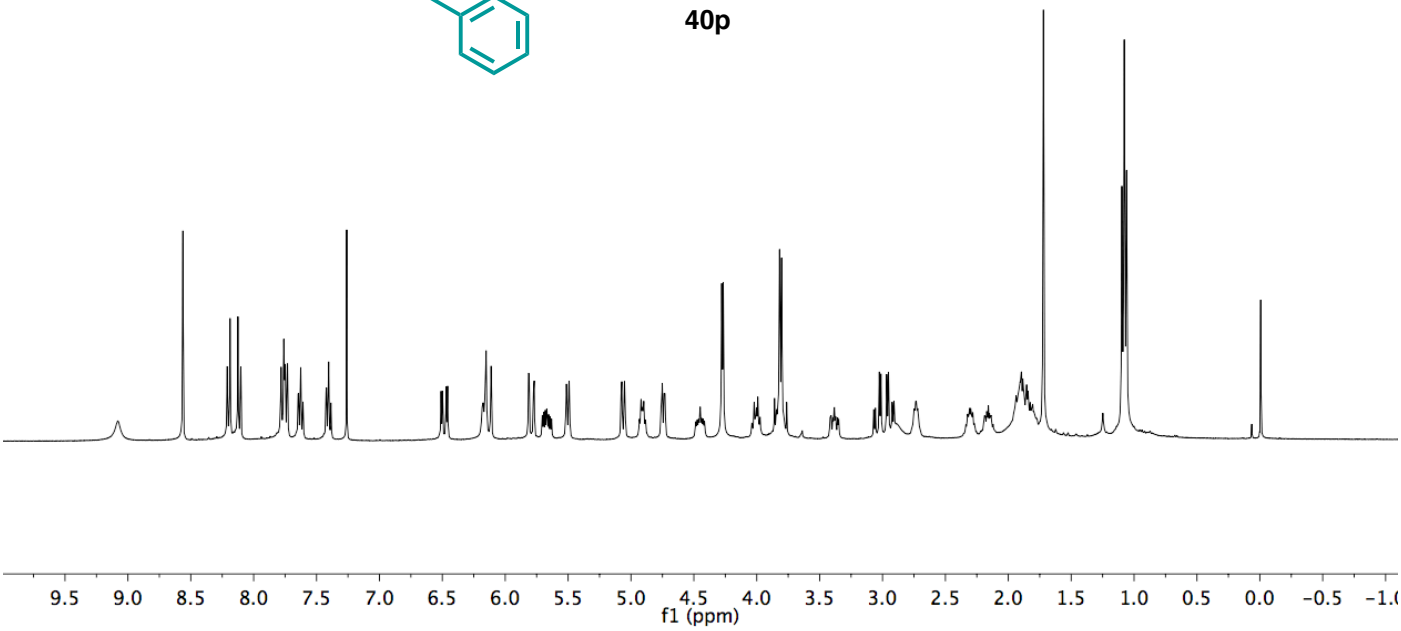
40o

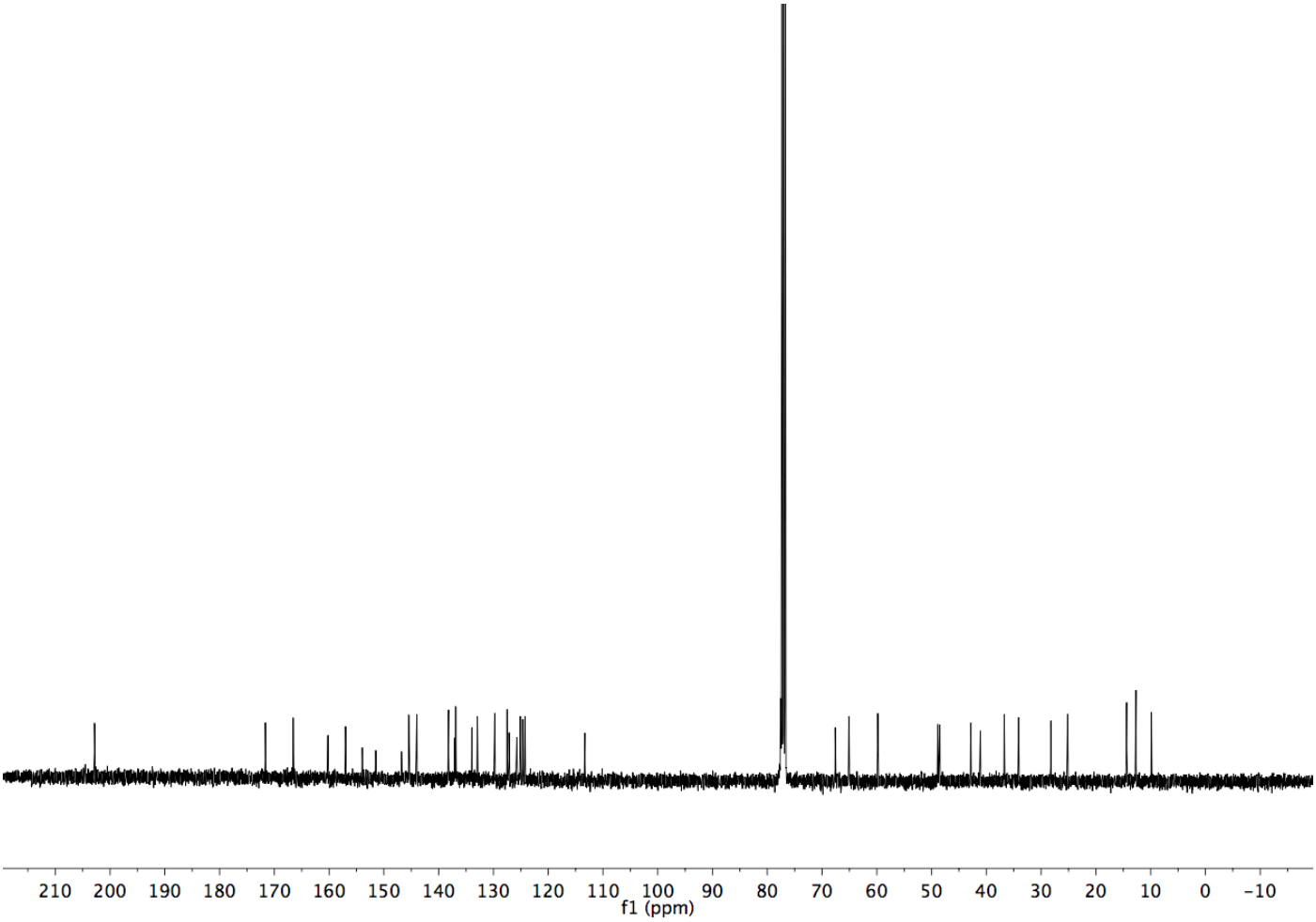

10.5 10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5
f1 (ppm)

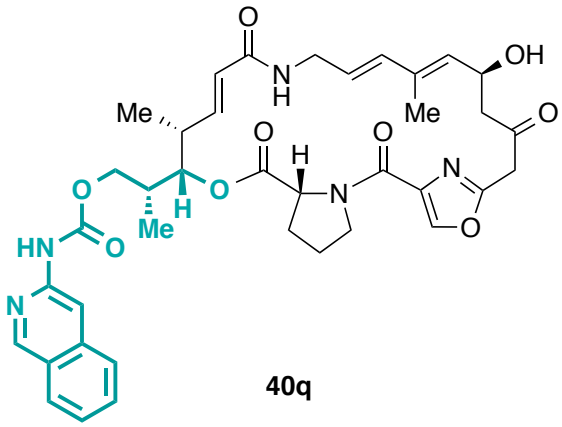

210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)



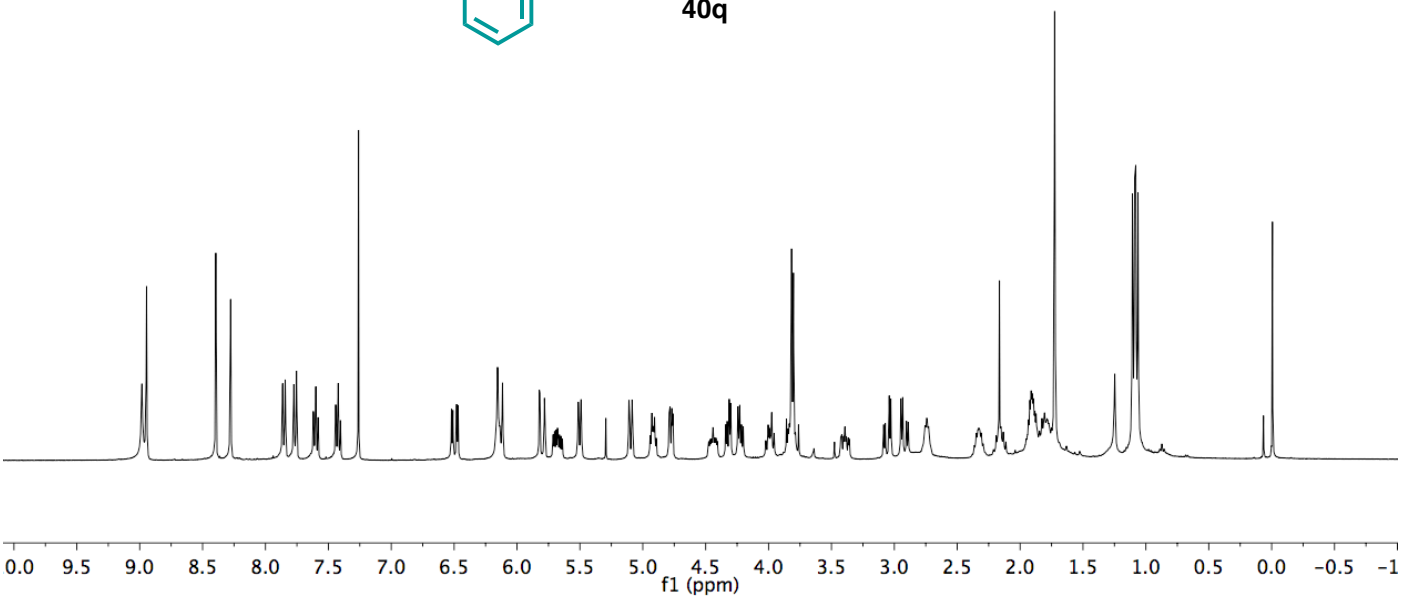
40p

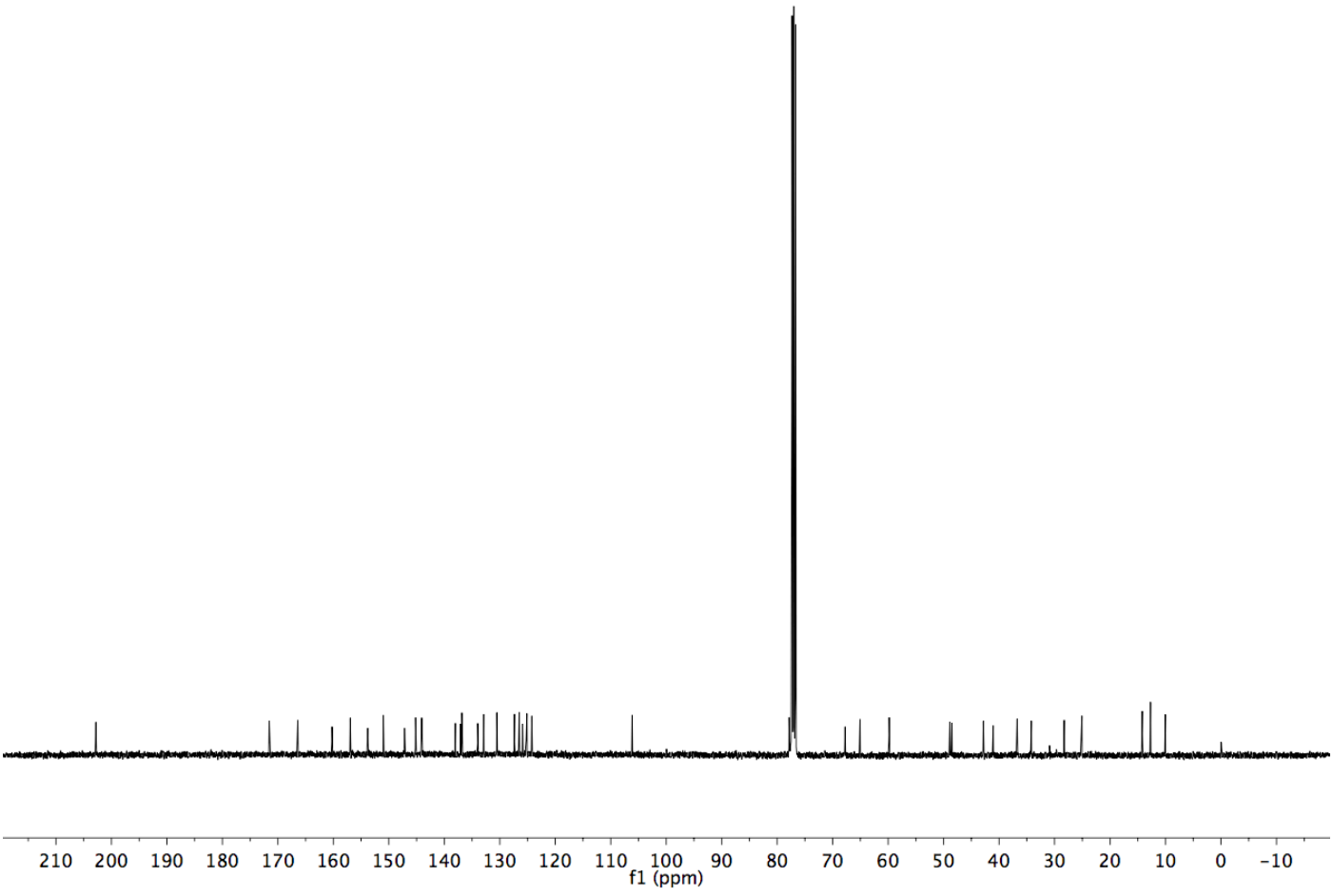

9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5
f1 (ppm)

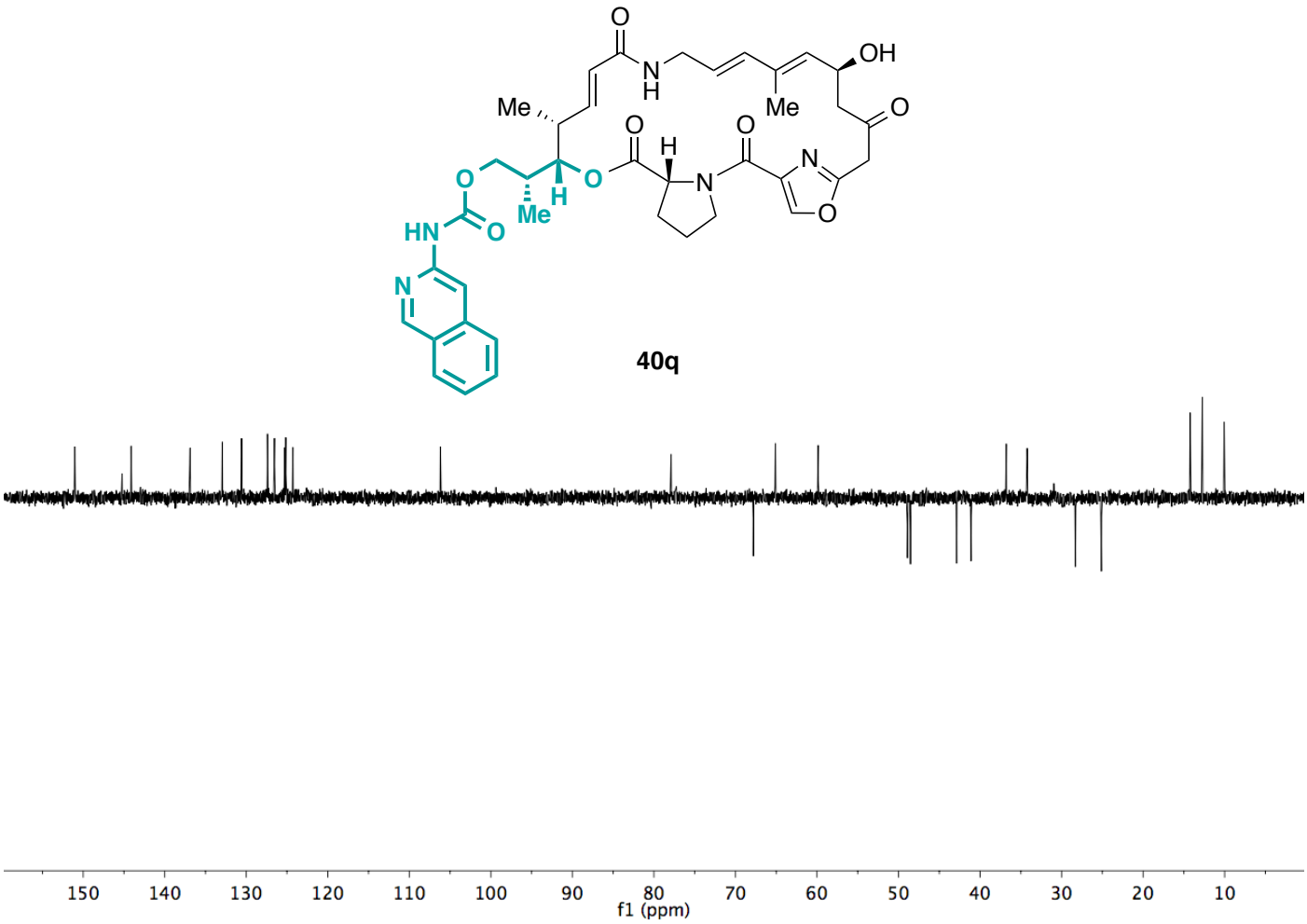

210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


O
N
H
OH
Me
Me
O
O
H
O
O
N
N
O
O
H
Me
HN
O
N

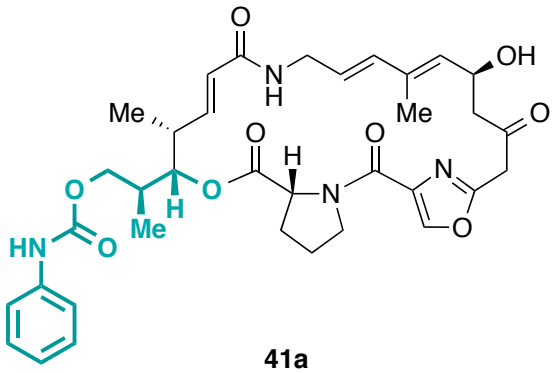
40q


0.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1
f1 (ppm)

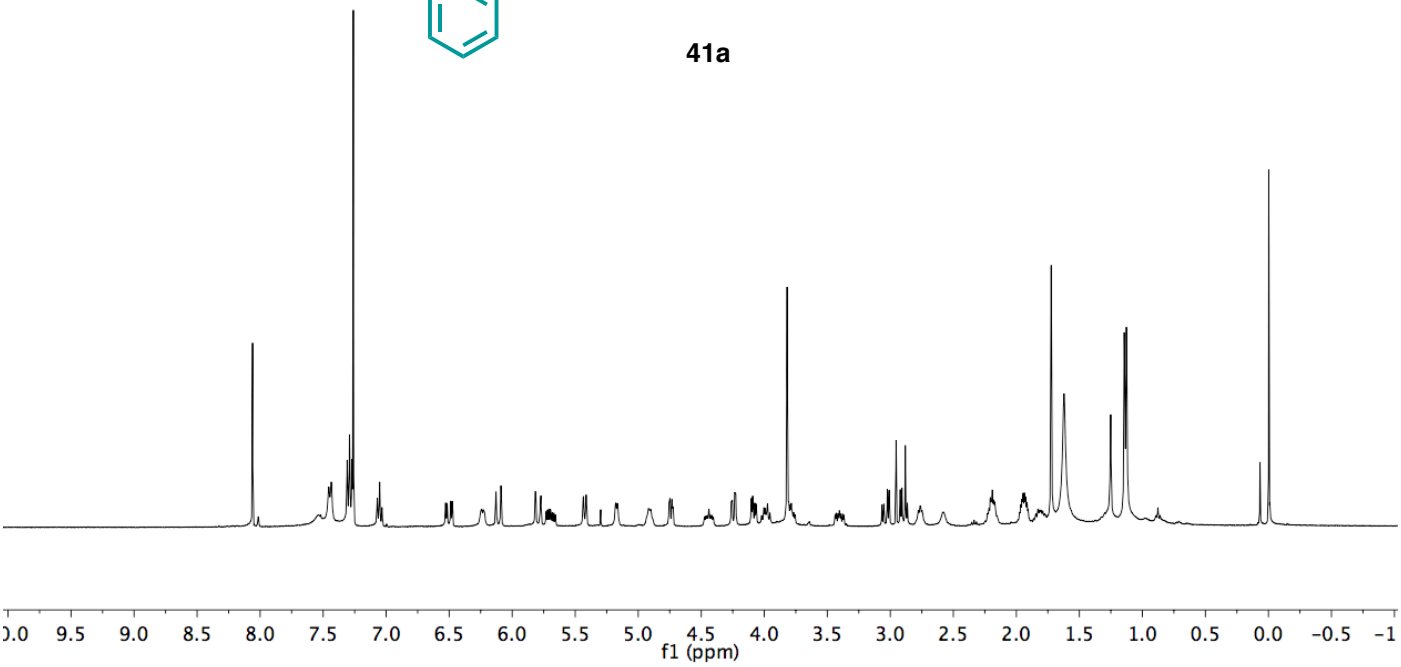

210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

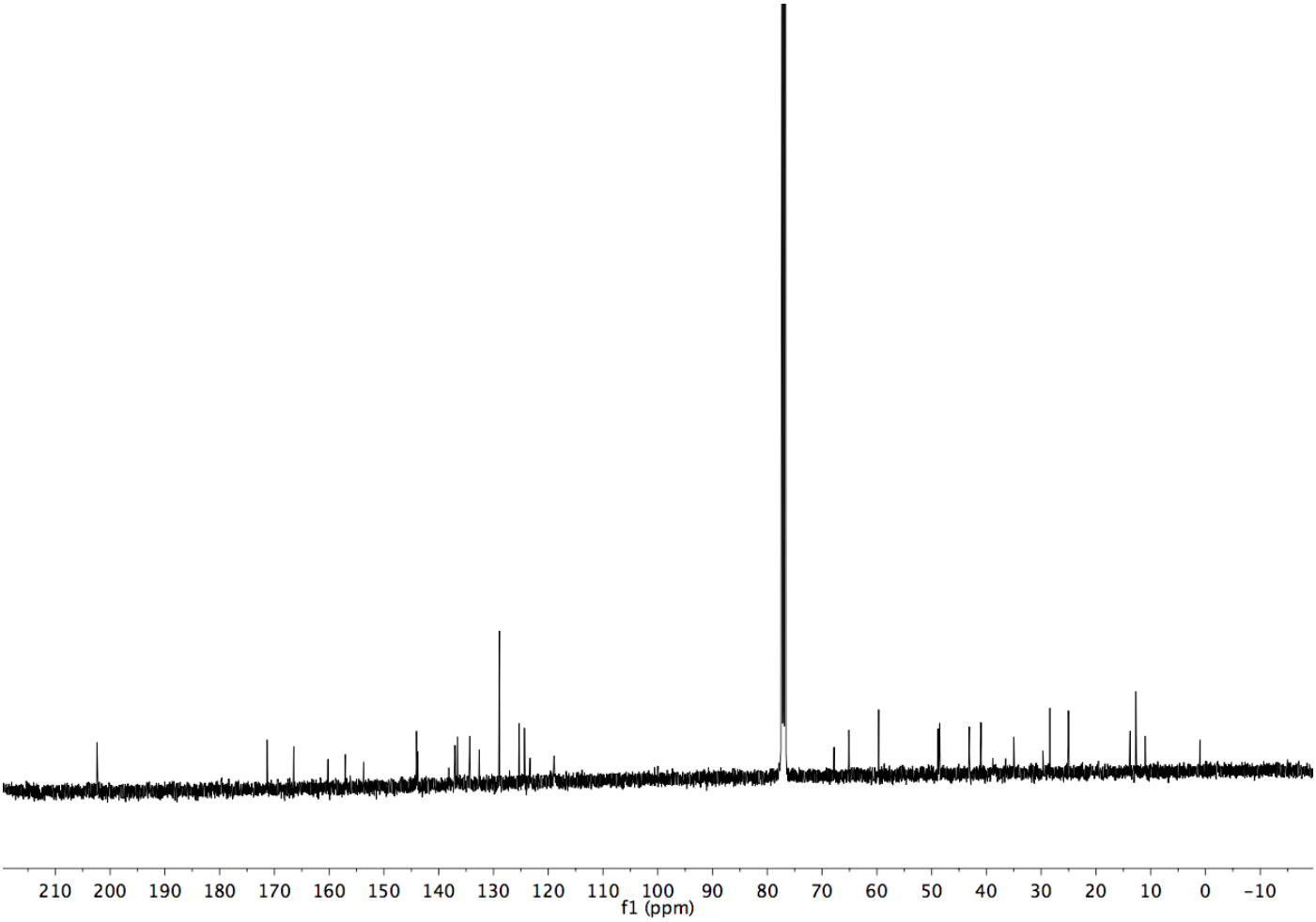

O
N
H
OH
Me
Me
O
O
O
H
O
N
O
Me
H
O
HN
O
N
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
f1 (ppm)

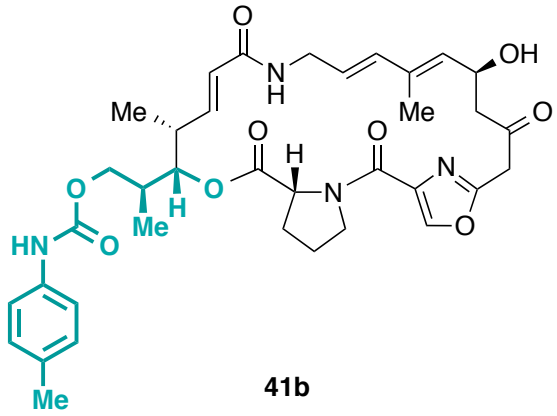
40q



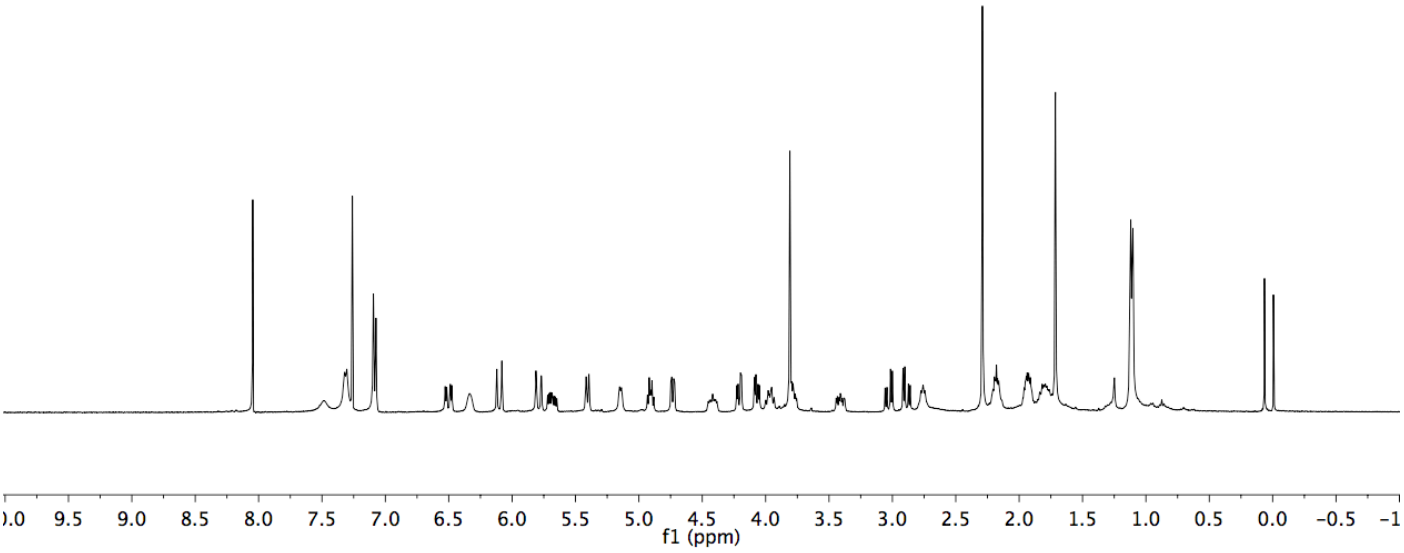
41a

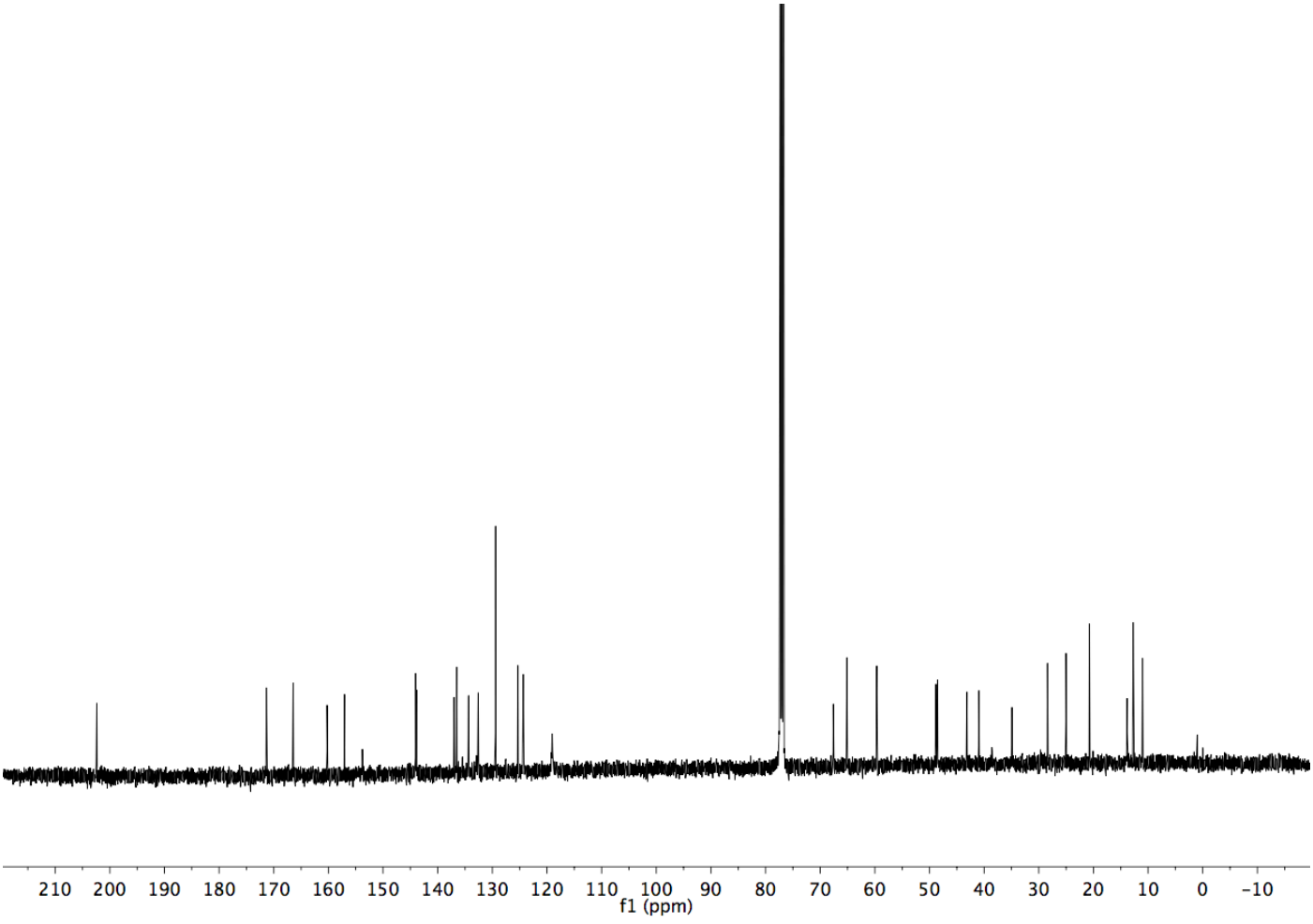

9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
f1 (ppm)

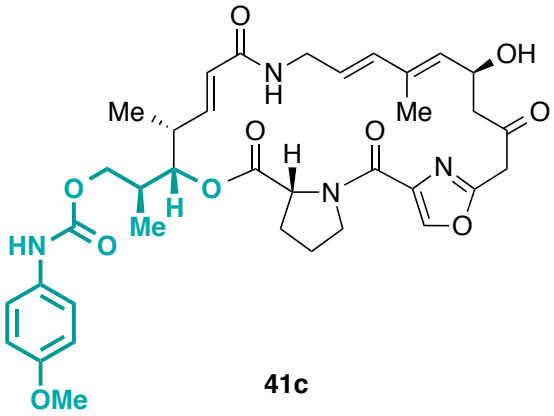

210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
-10
f1 (ppm)


O
N
H
OH
Me
Me
O
O
O
H
O
N
N
O
O
H
Me
HN
O
Me

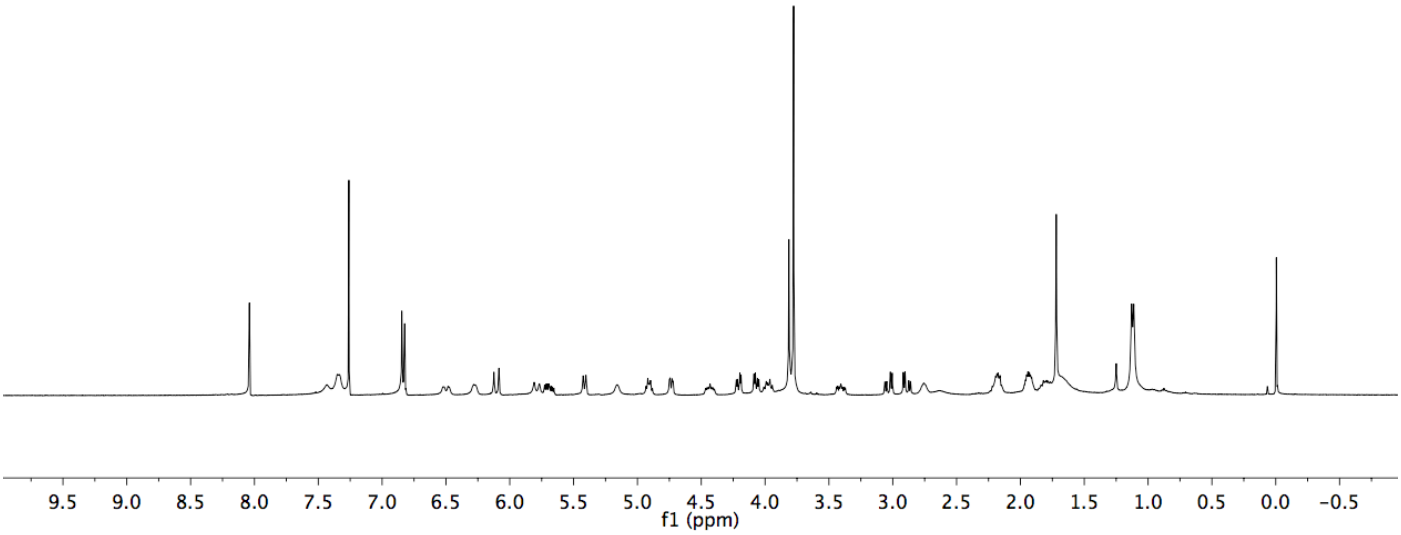
41b

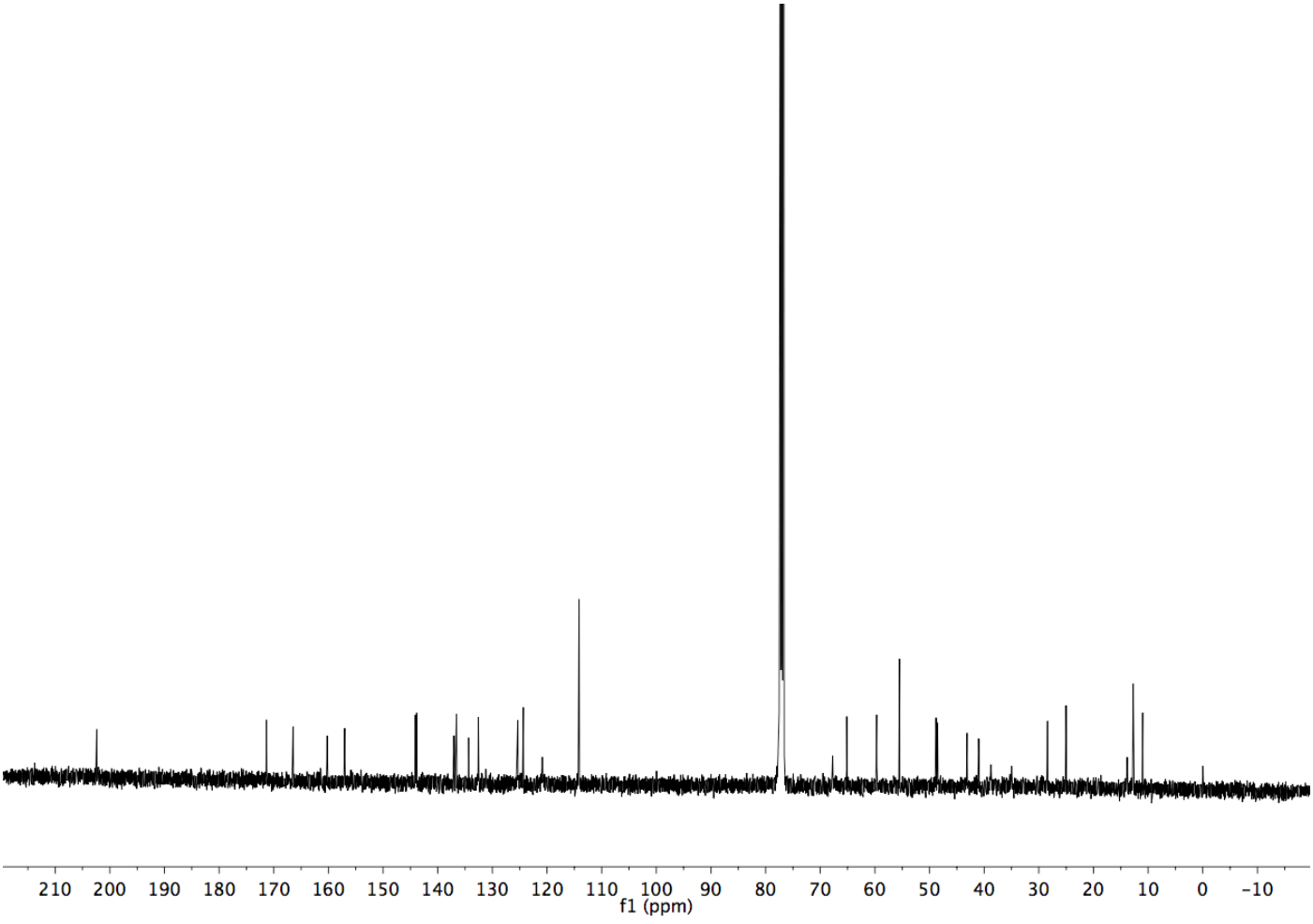

9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1
f1 (ppm)

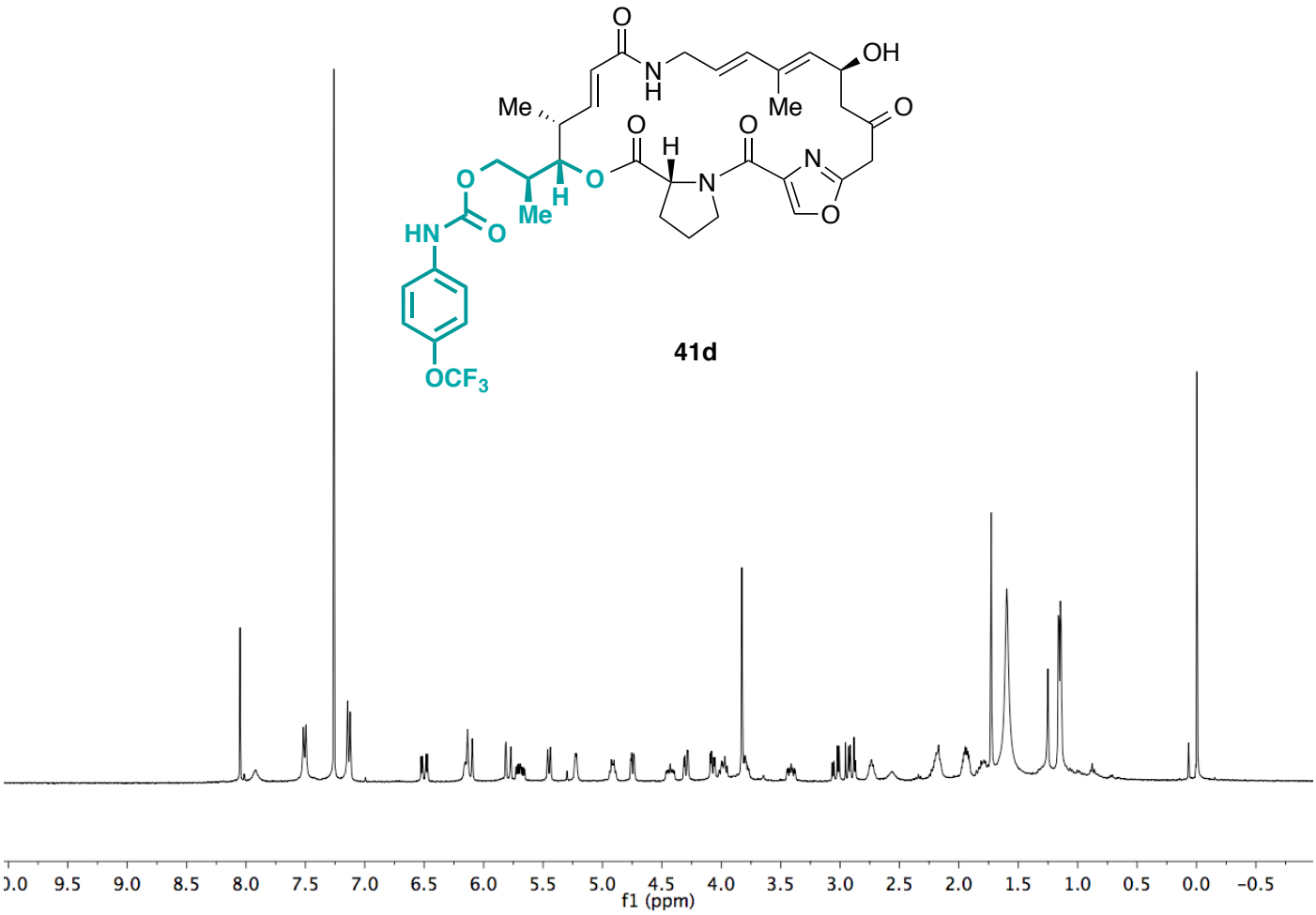

210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


O
N
H
OH
Me
Me
O
O
O
H
O
N
N
O
O
H
Me
HN
O
OMe

41c

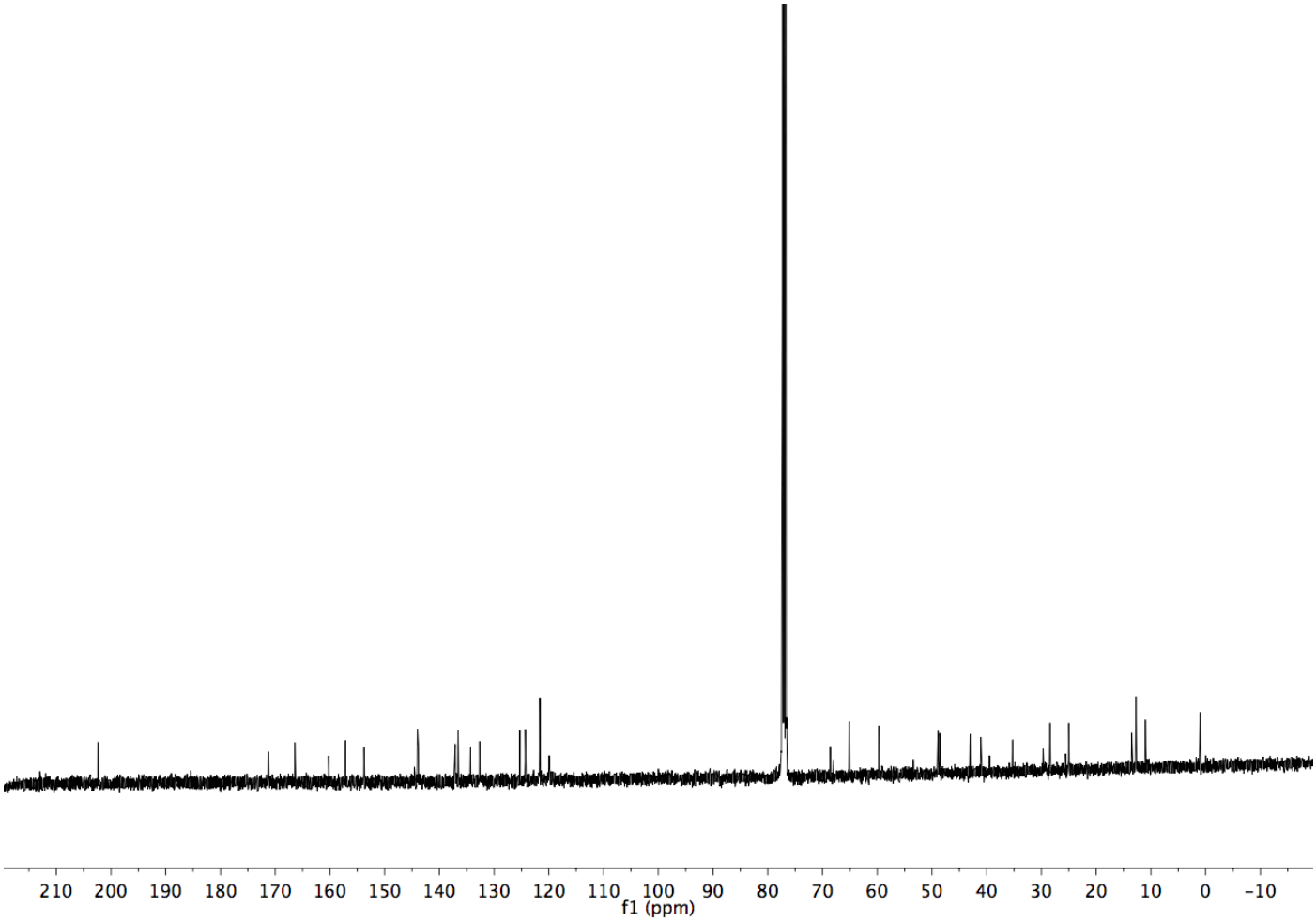

9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5
f1 (ppm)

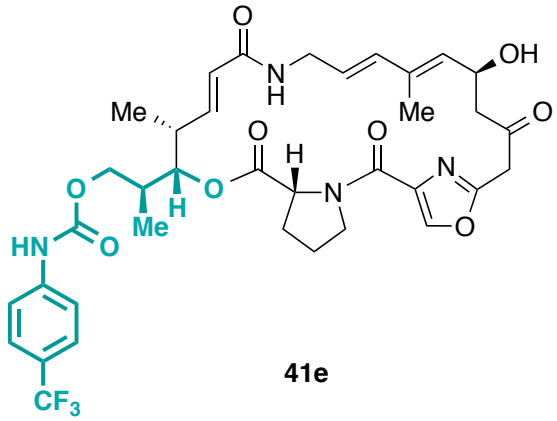

210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


O
N
H
OH
Me
Me
O
O
H
O
O
N
O
H
Me
HN
O
OCF3

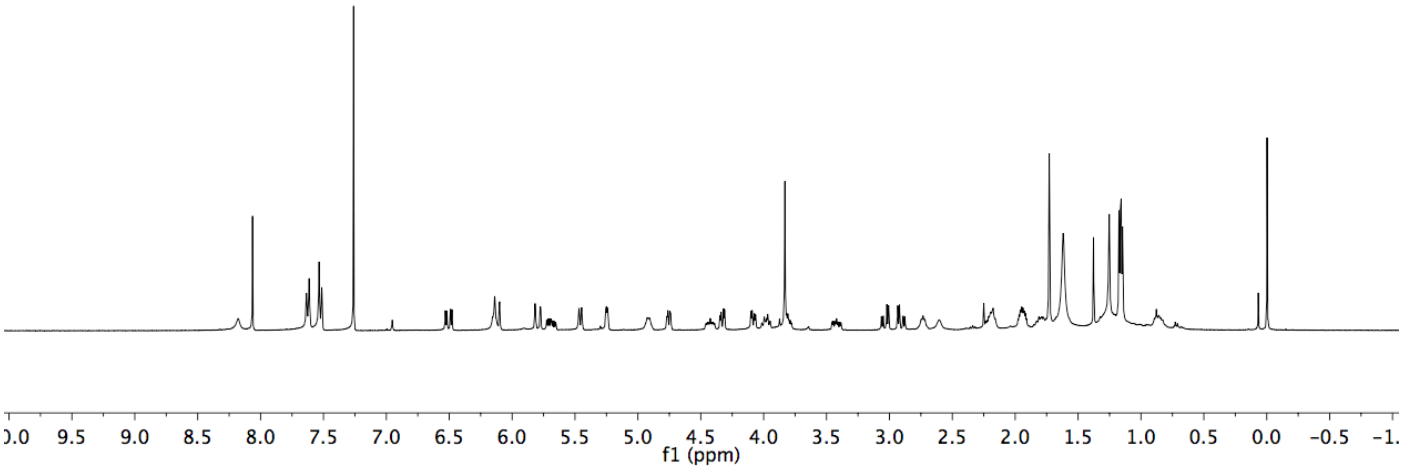
41d

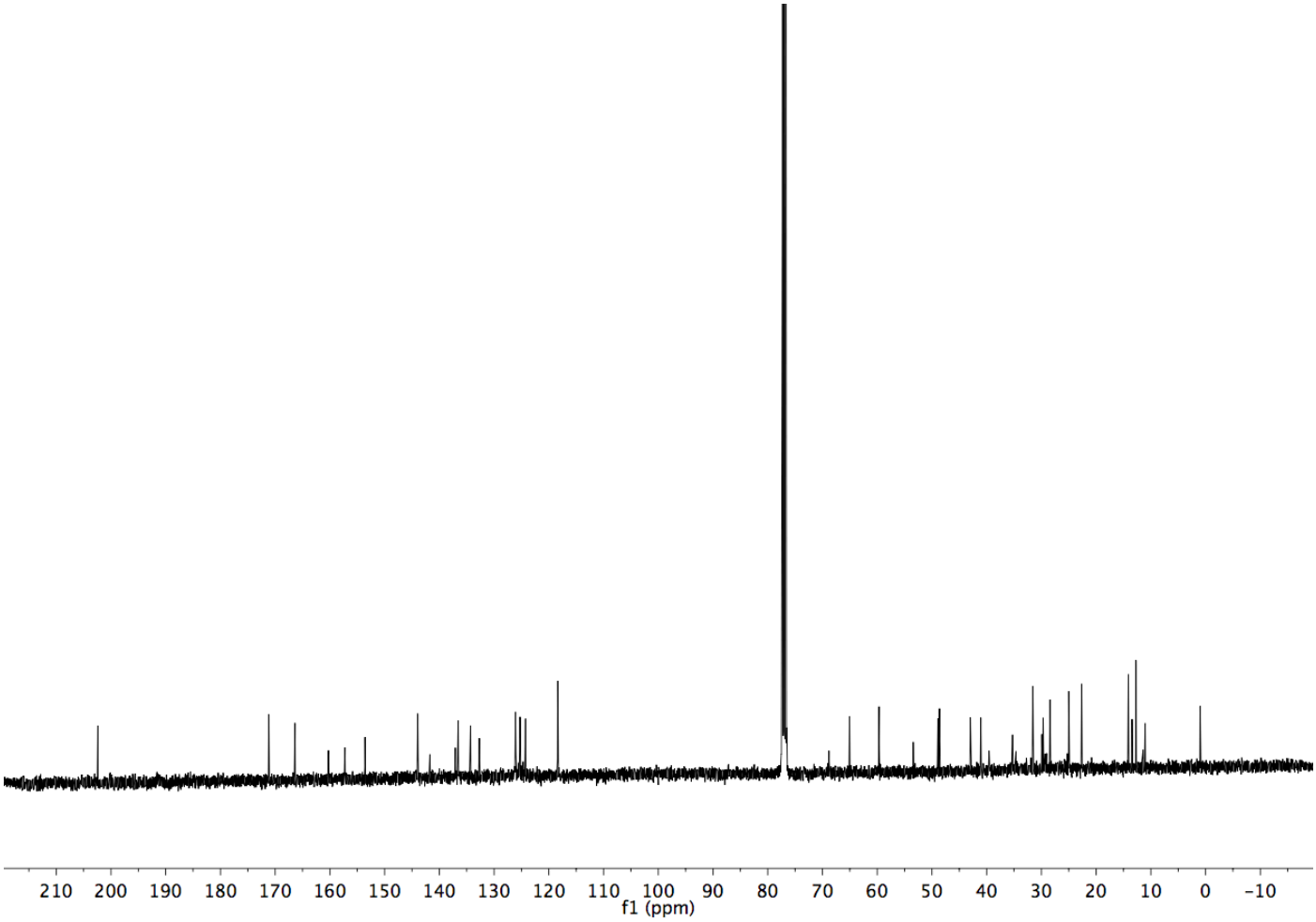
0.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5
f1 (ppm)

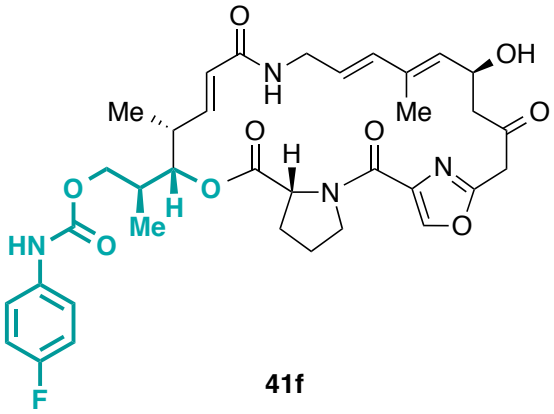

210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)



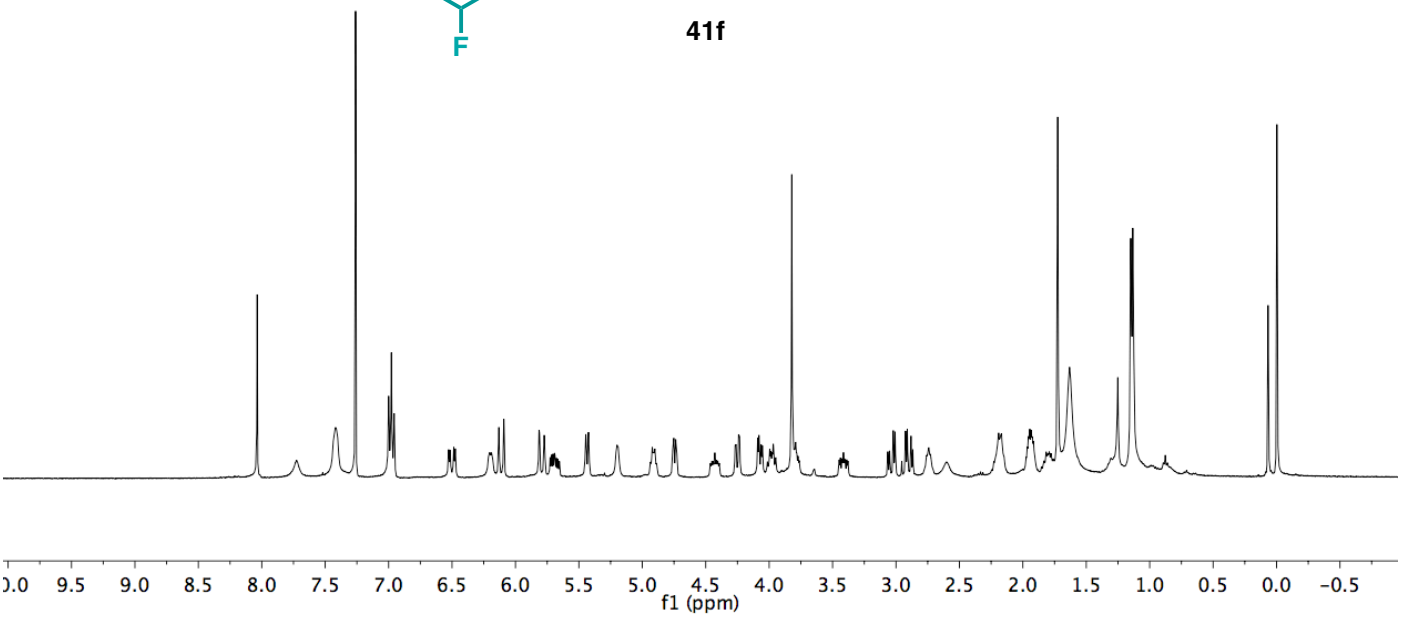
41e

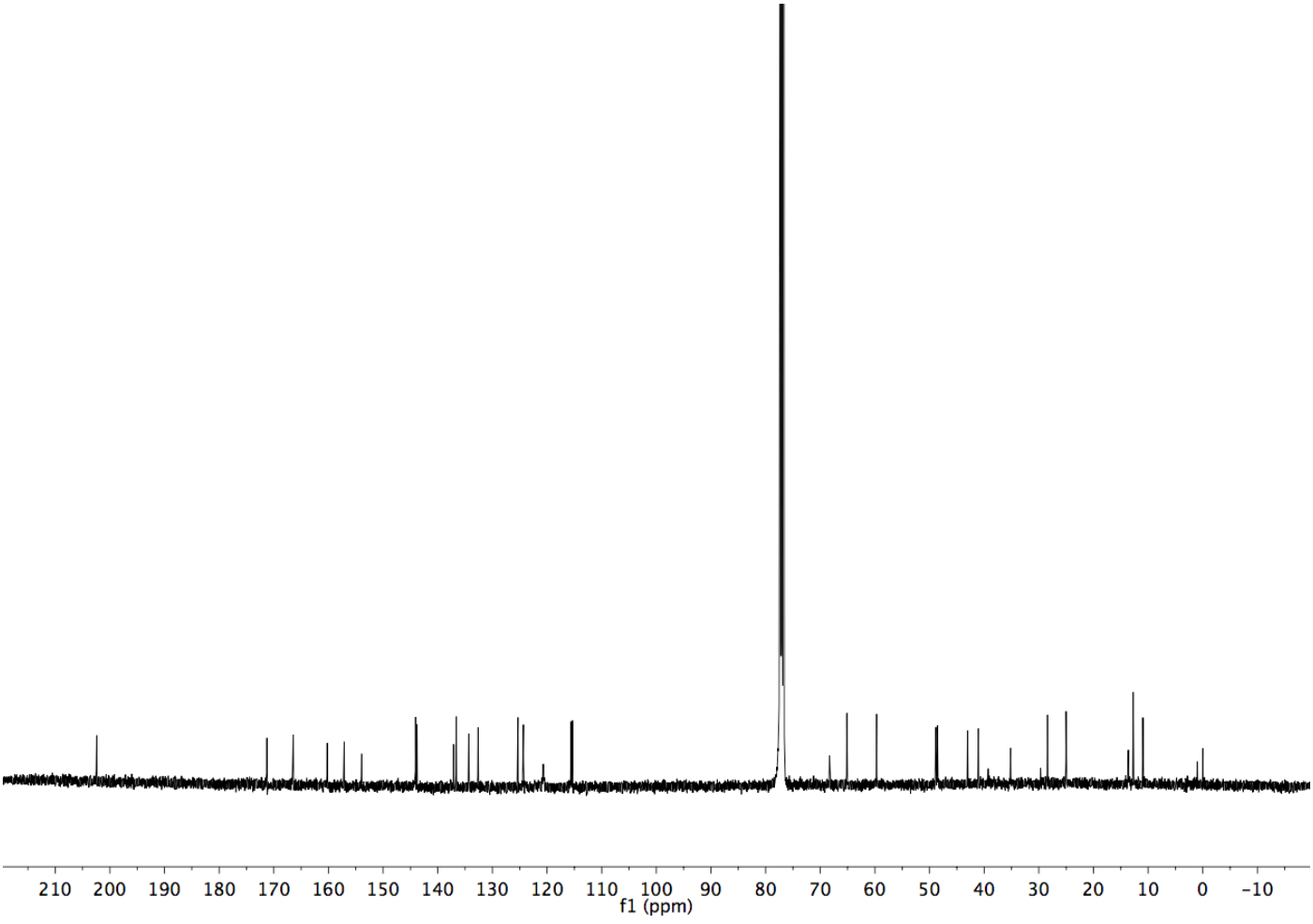

9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5
f1 (ppm)

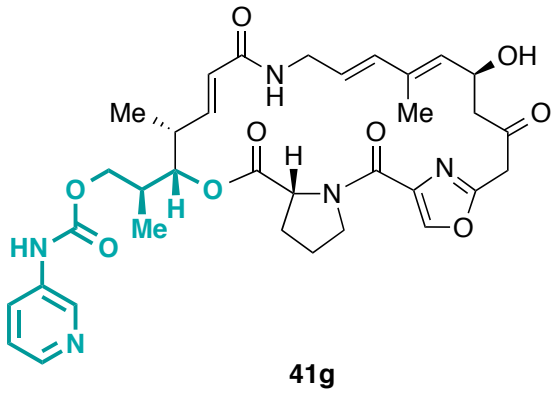

210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)



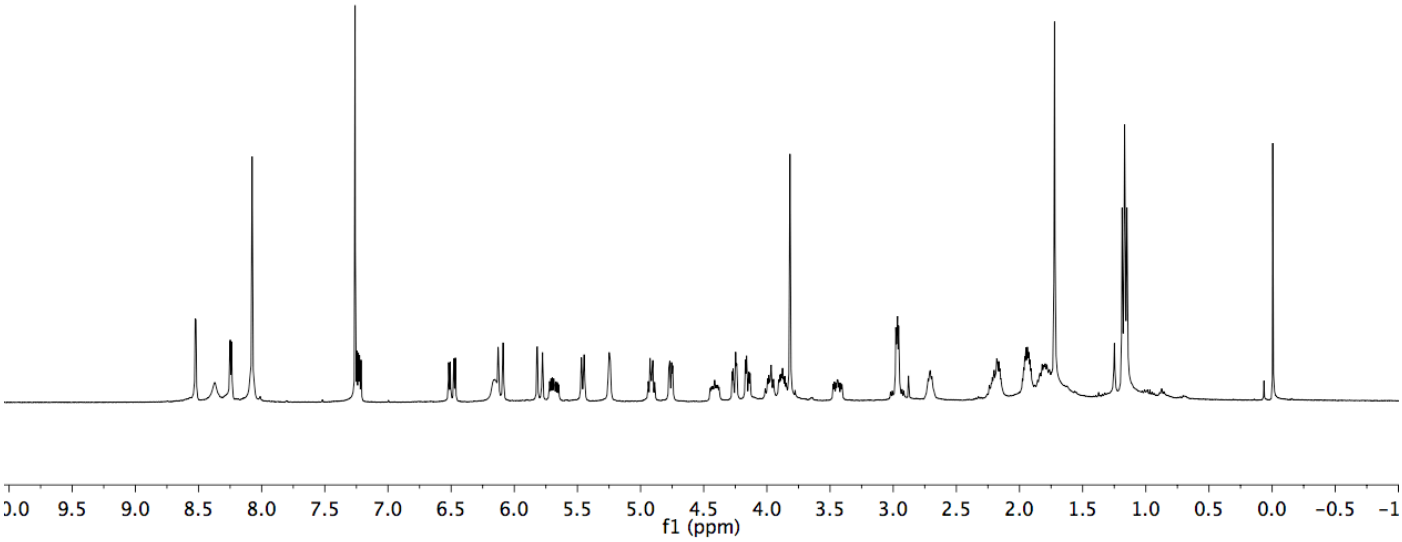
41f

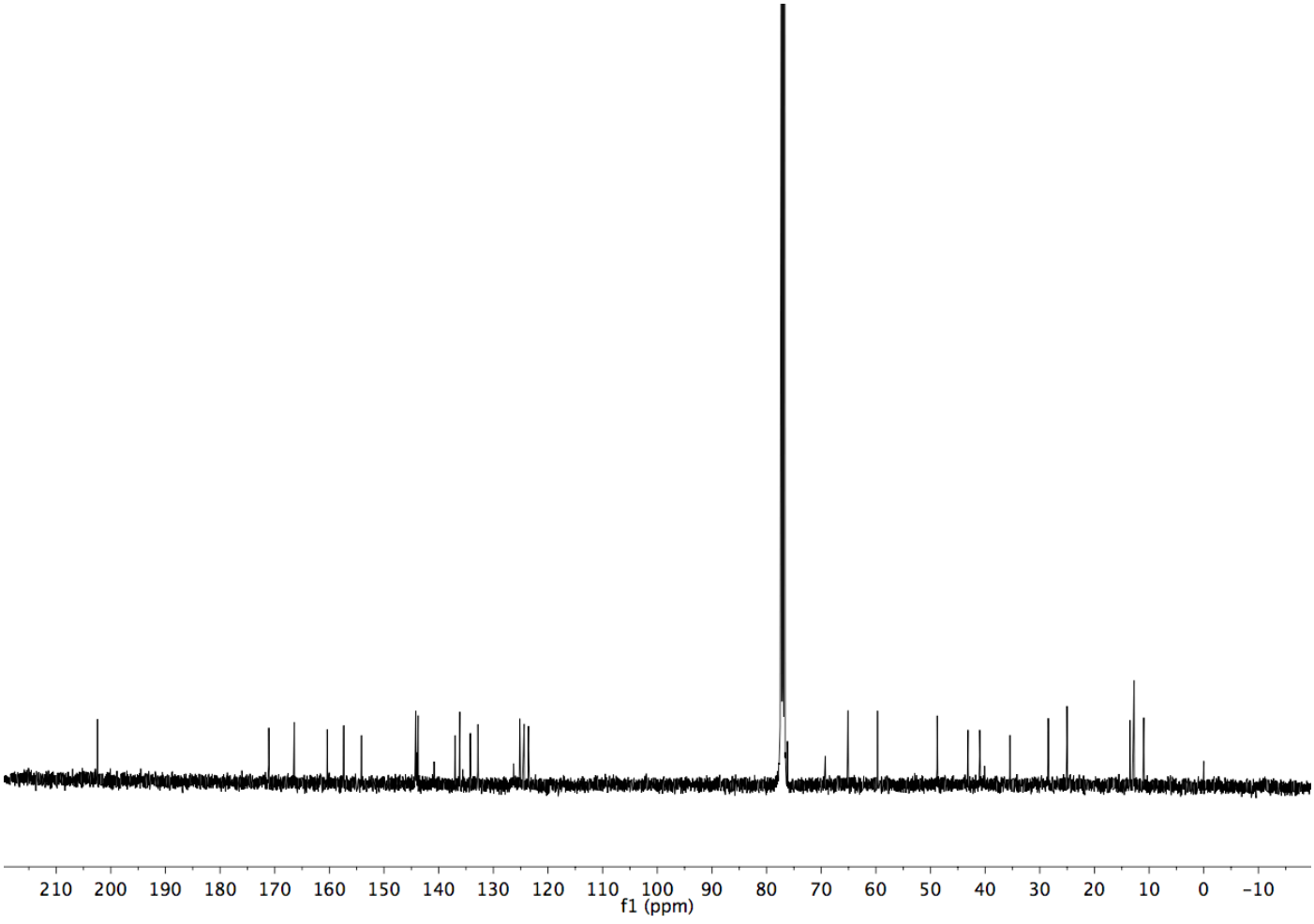


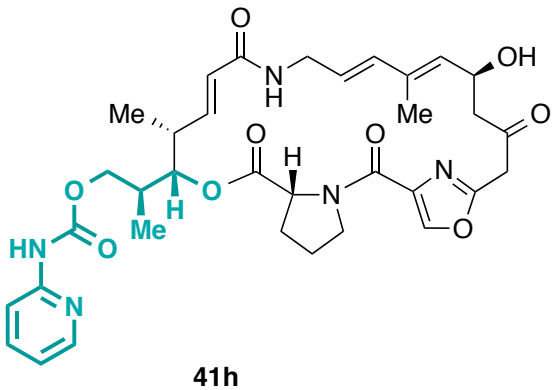



O
N
H
OH
Me
Me
O
O
O
H
O
N
N
O
O
H
Me
HN
O
N

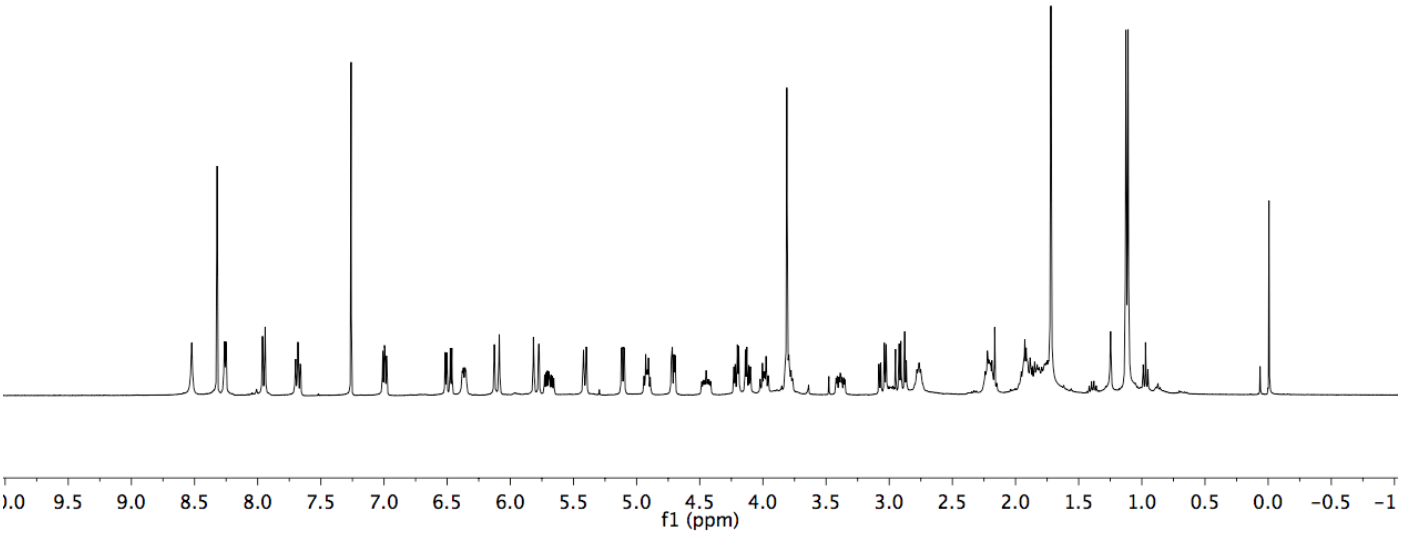
41g

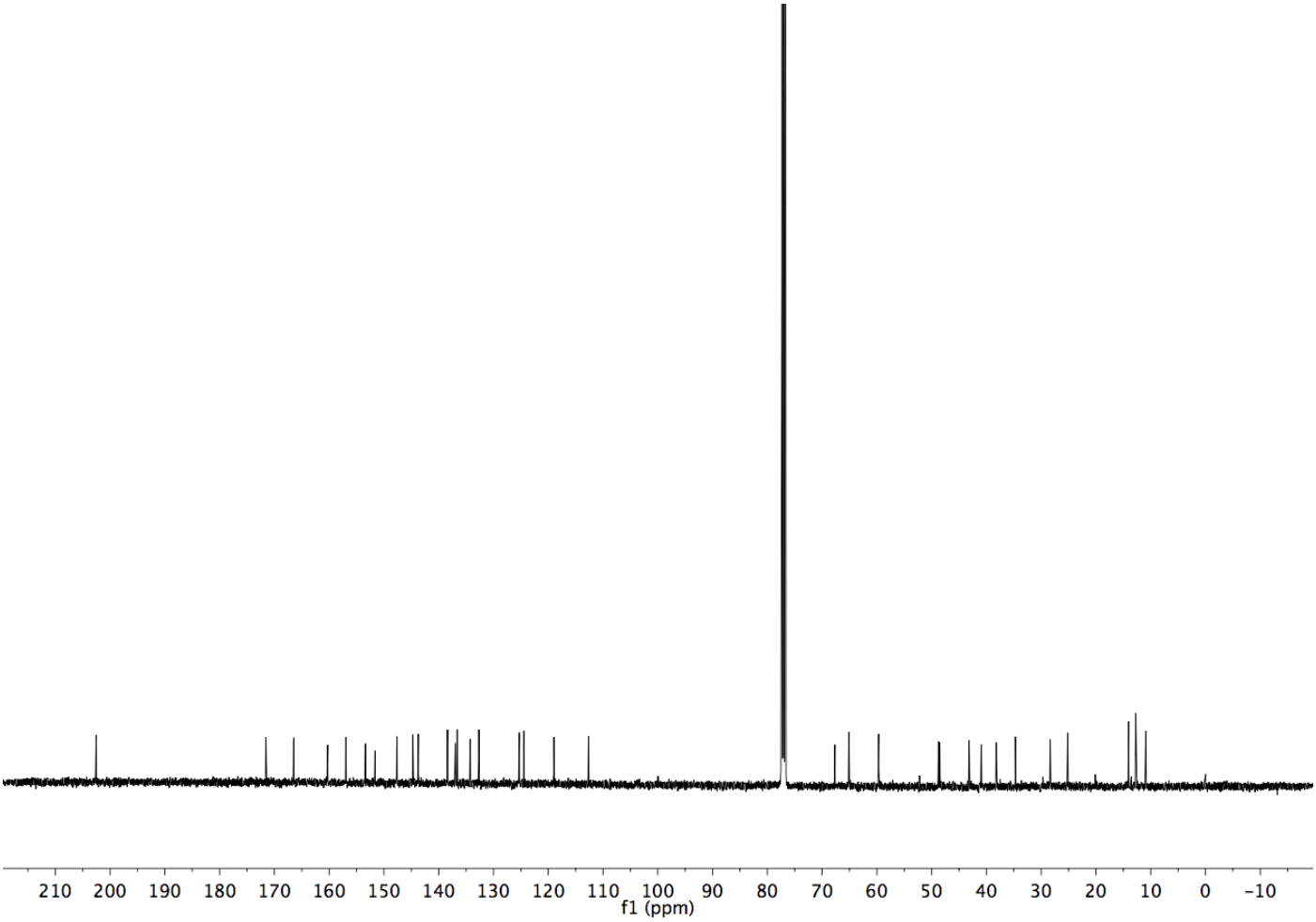

0.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1
f1 (ppm)

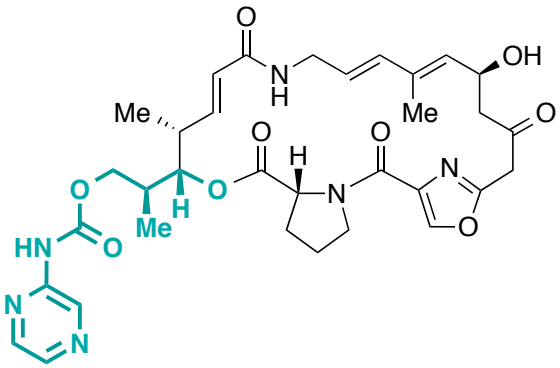

210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


O
N
H
OH
Me
Me
O
O
O
H
O
N
N
O
O
H
Me
HN
O
N

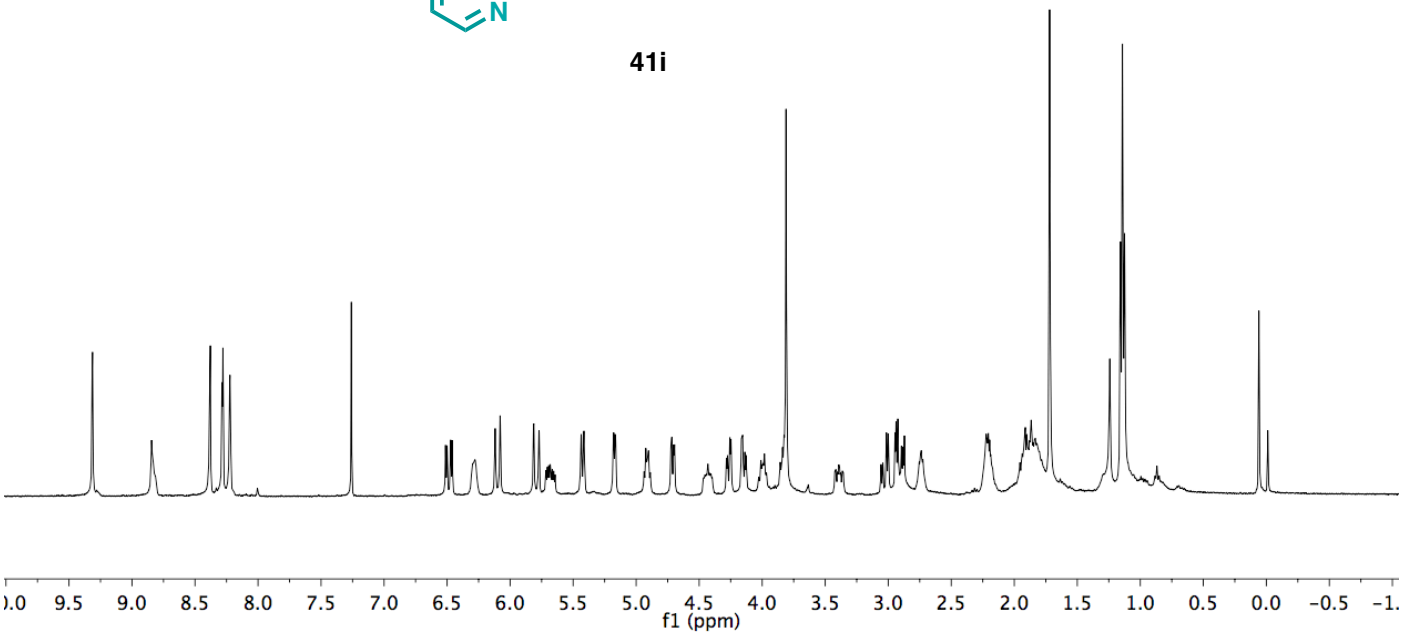
41h

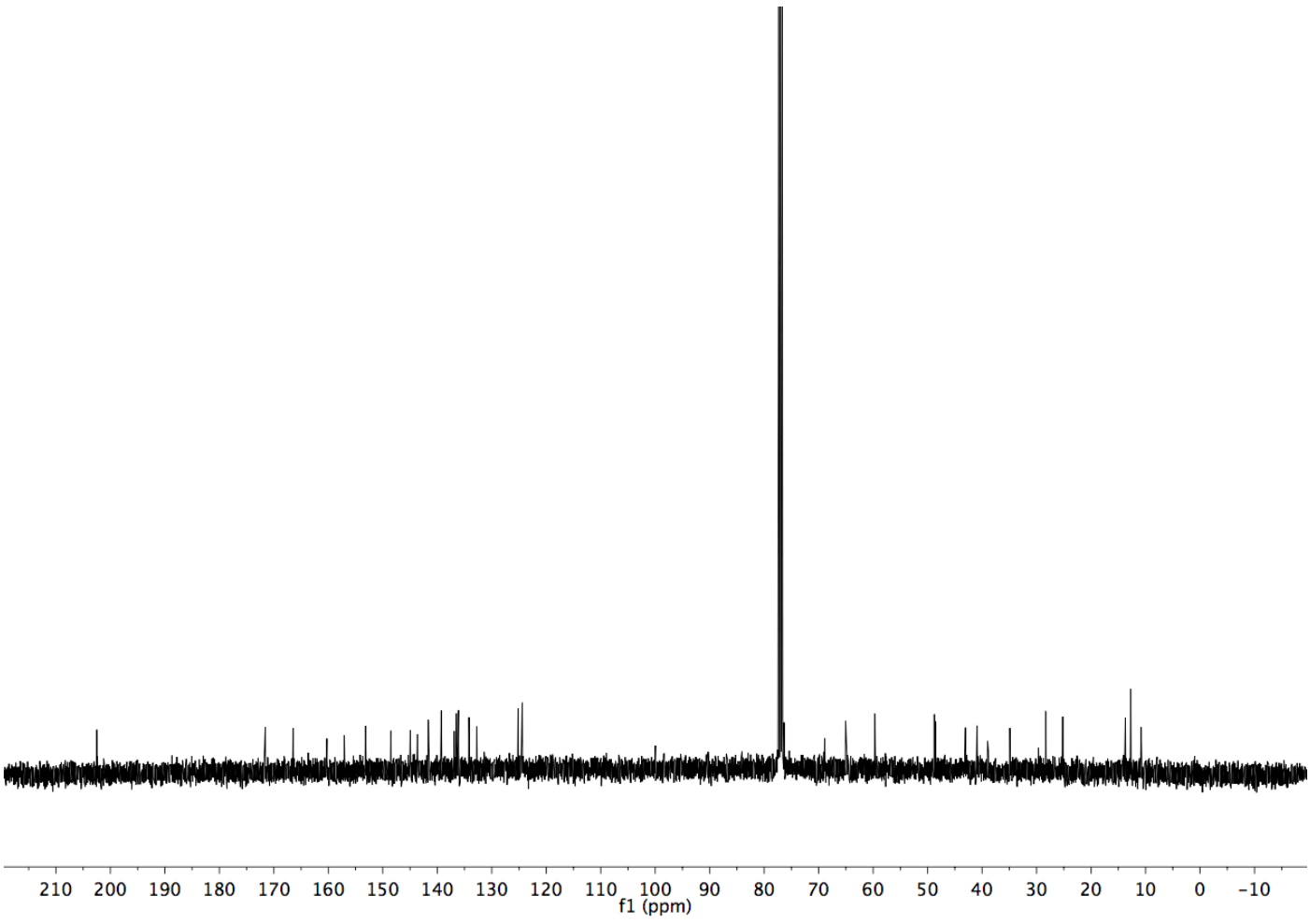

9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1
f1 (ppm)

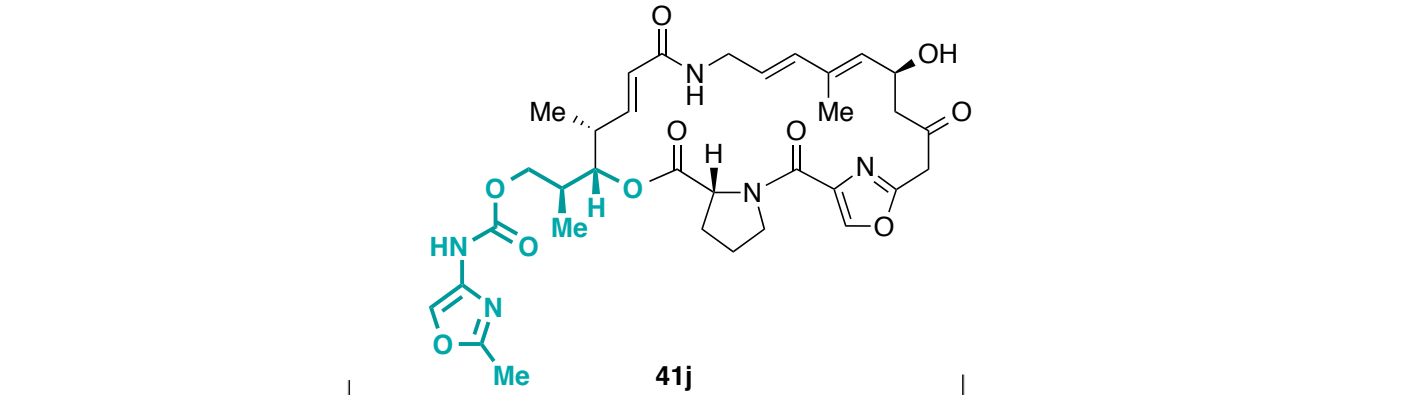

210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


O
N
H
OH
Me
Me
O
O
O
H
O
N
N
O
O
H
Me
HN
O
N
N

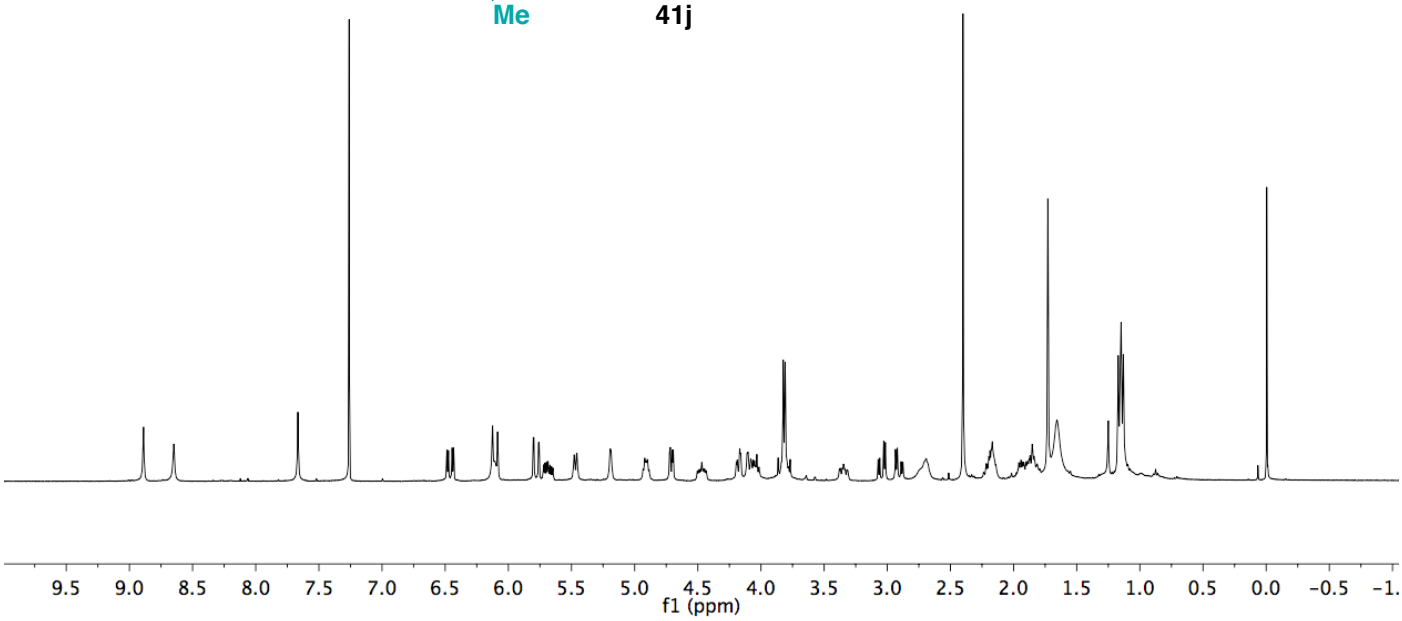
41i

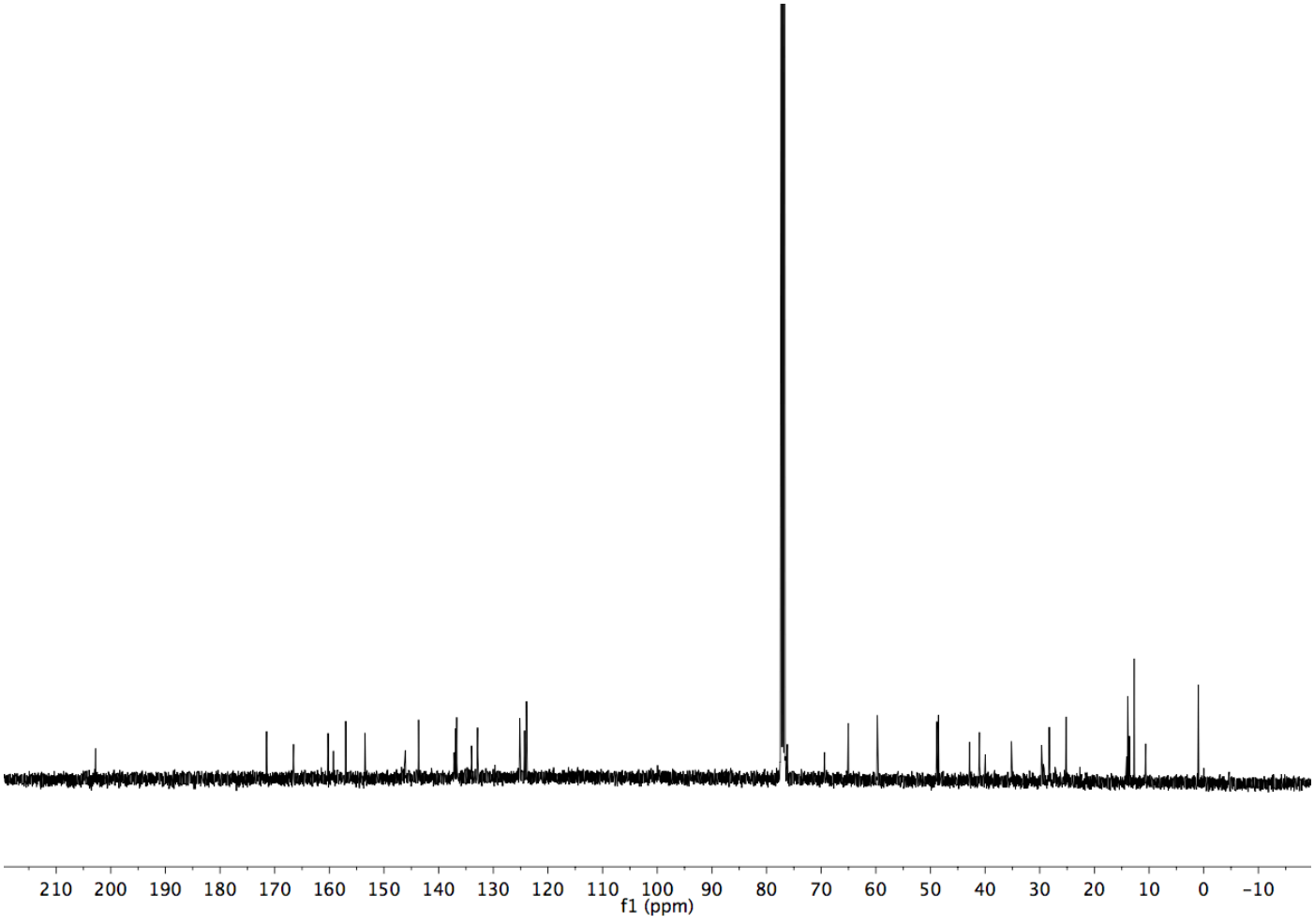

9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
f1 (ppm)

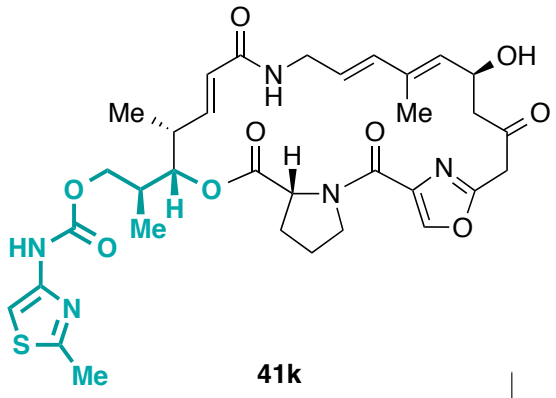

210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
-10
f1 (ppm)


O
N
H
OH
Me
Me
O
O
O
H
O
N
N
O
O
H
Me
HN
O
N
O
Me

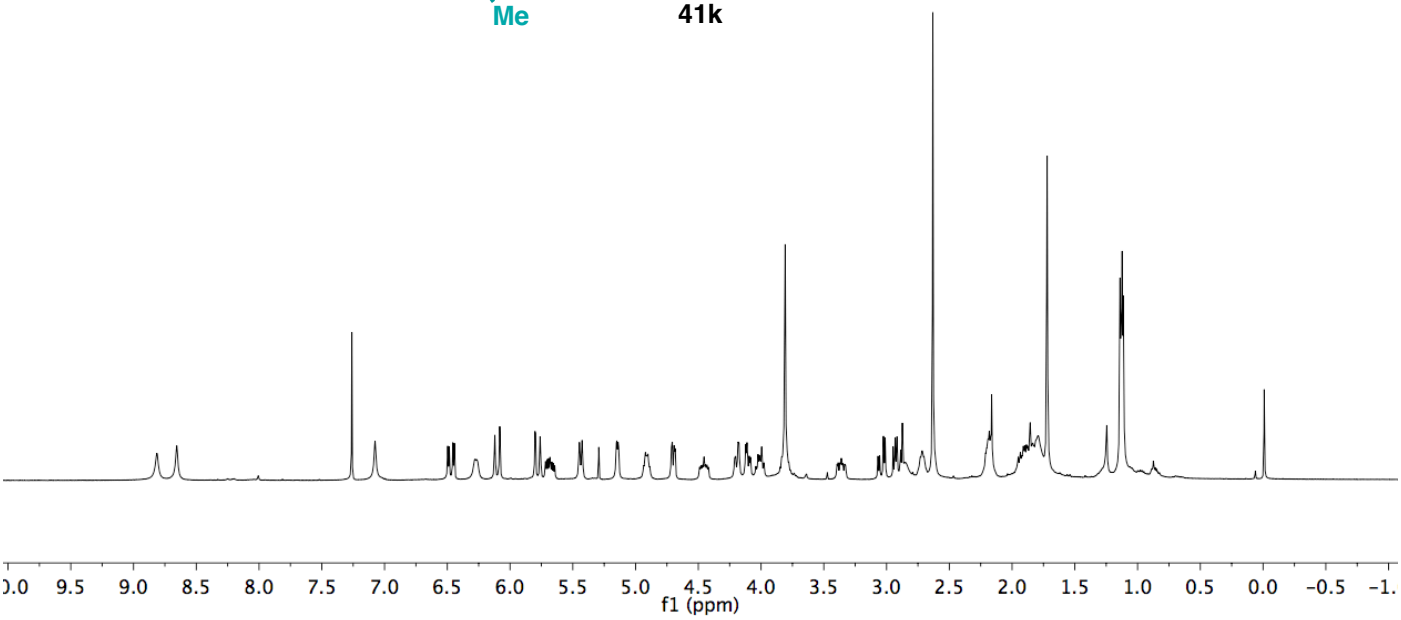
41j

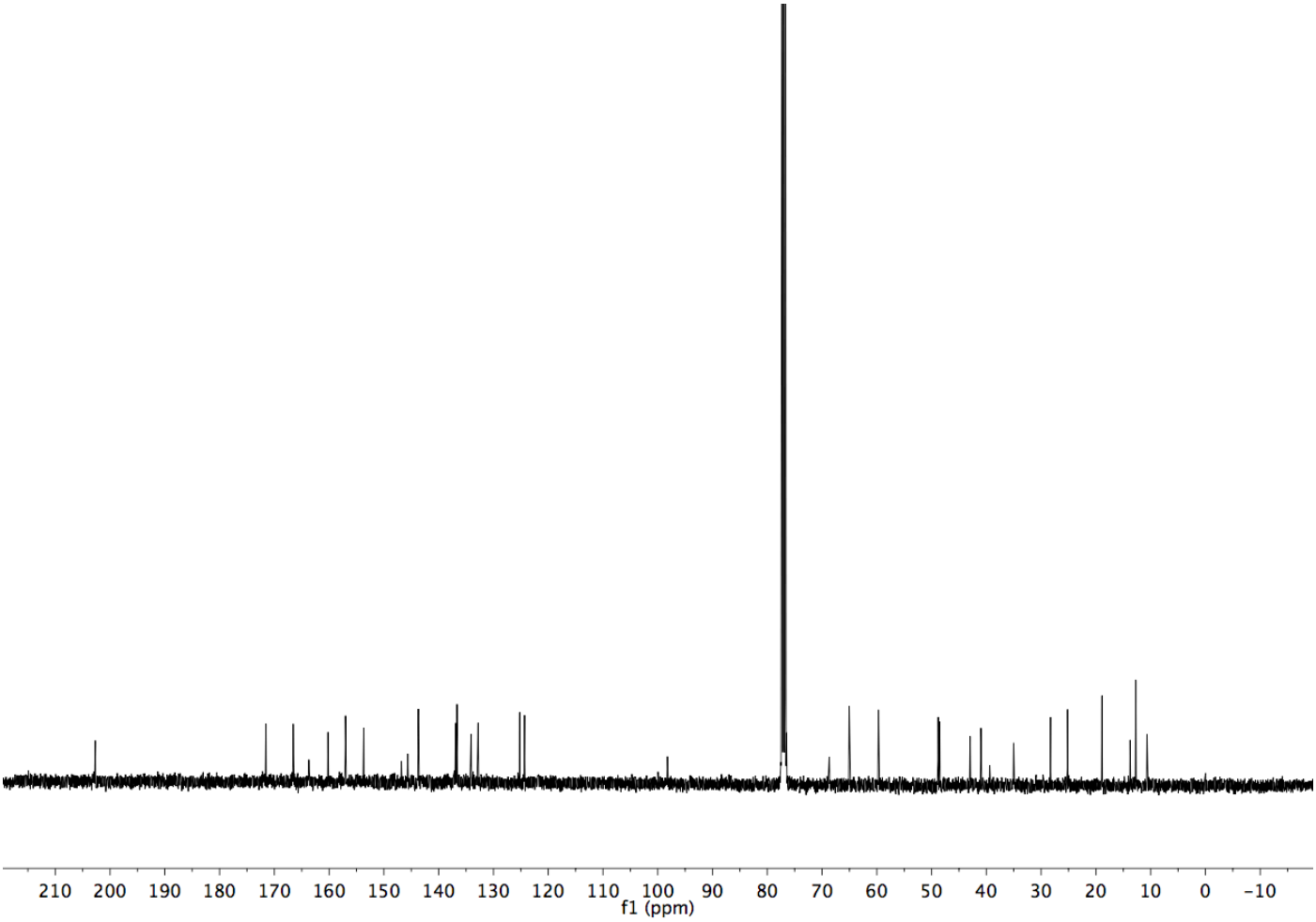

9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1.
f1 (ppm)

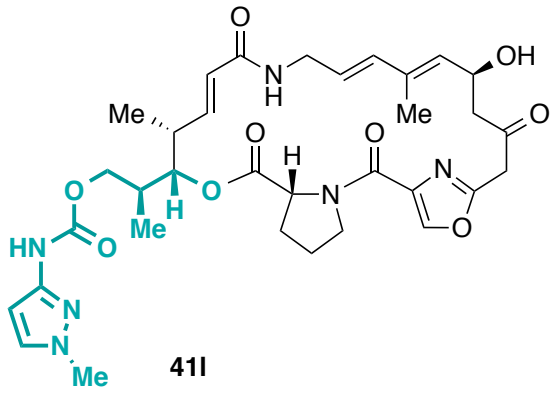

210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


O
N
H
OH
Me
Me
O
O
O
H
O
N
N
O
O
H
Me
HN
O
N
S
Me

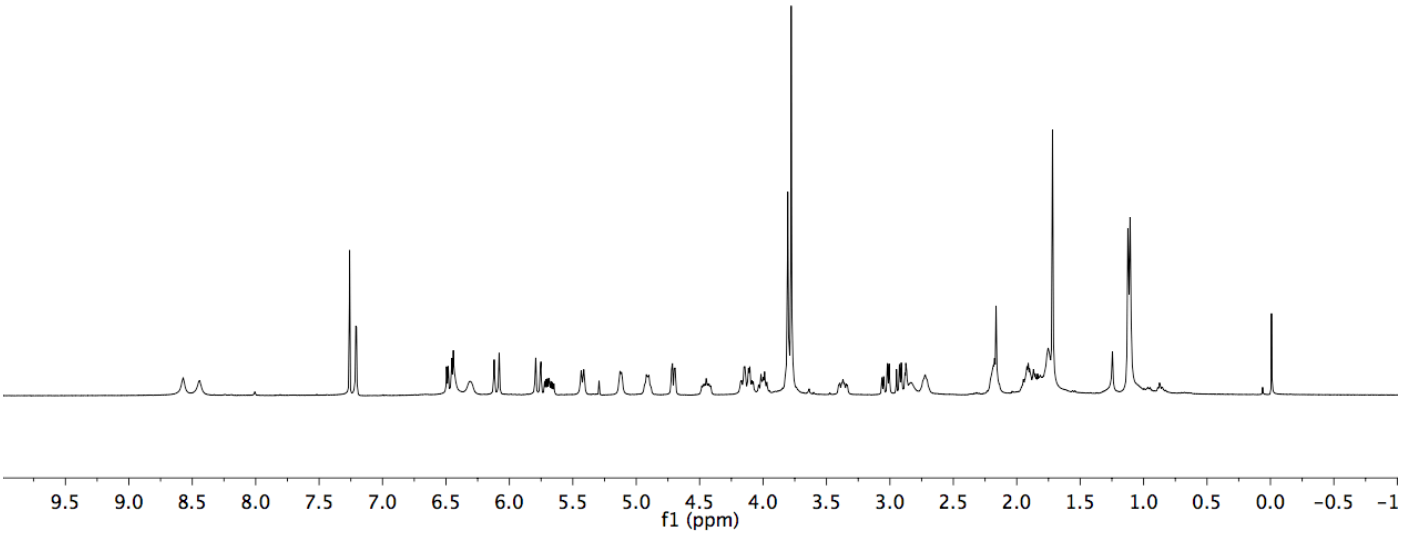
41k

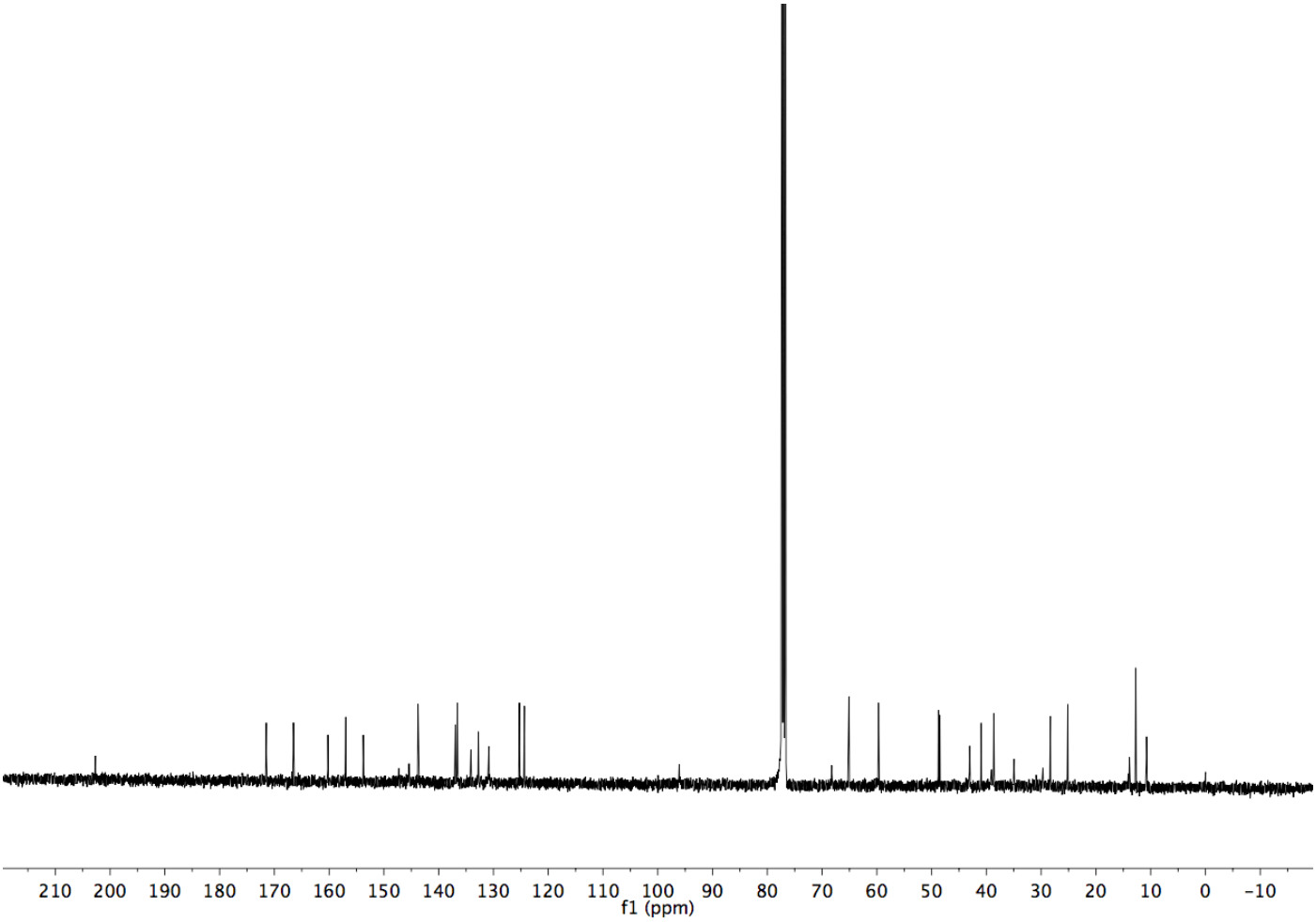

9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5
f1 (ppm)

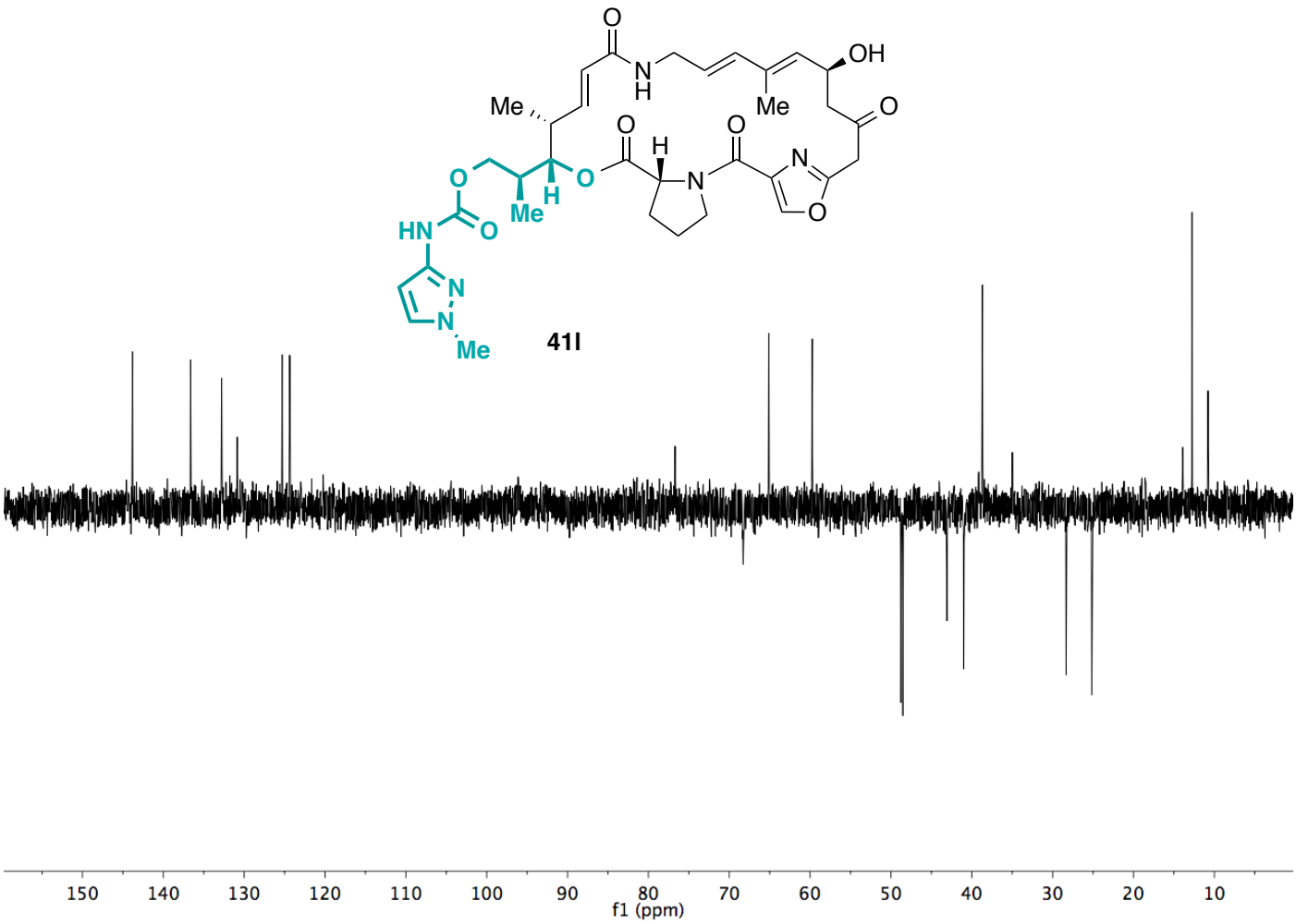

210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


O
N
H
OH
Me
Me
O
O
O
H
O
N
N
O
O
H
Me
HN
O
N
N
Me

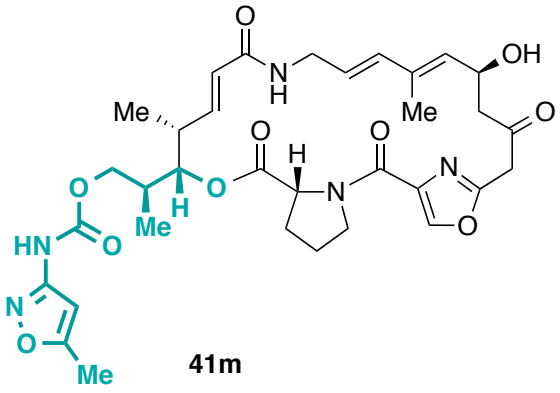
41l


9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1
f1 (ppm)

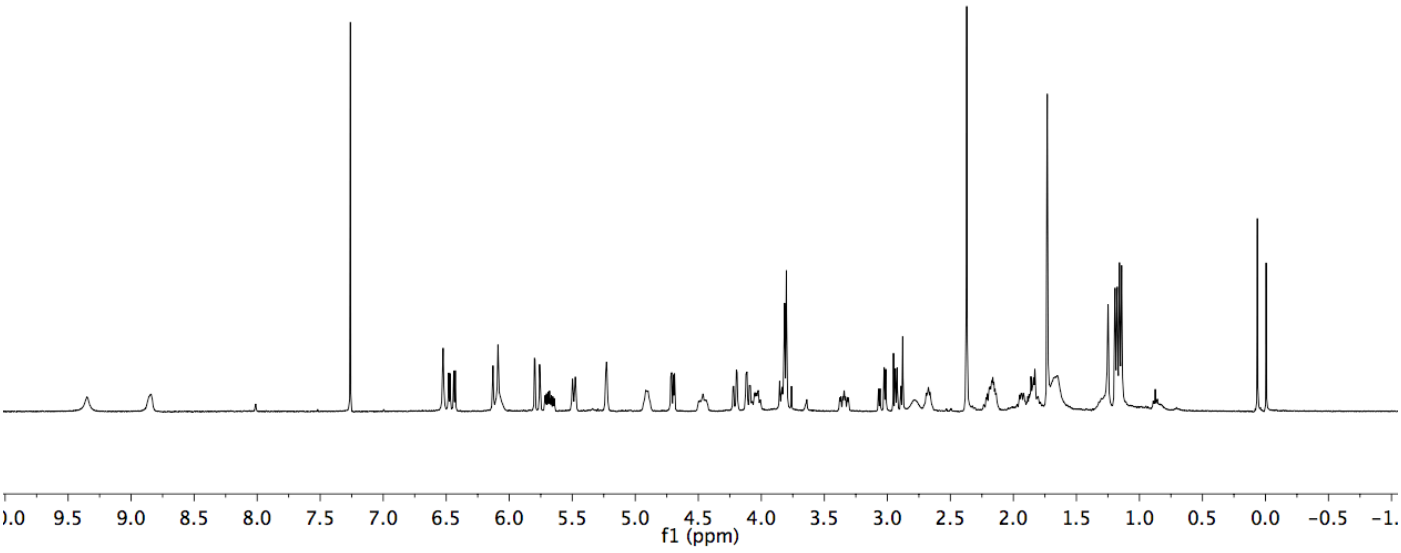

210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

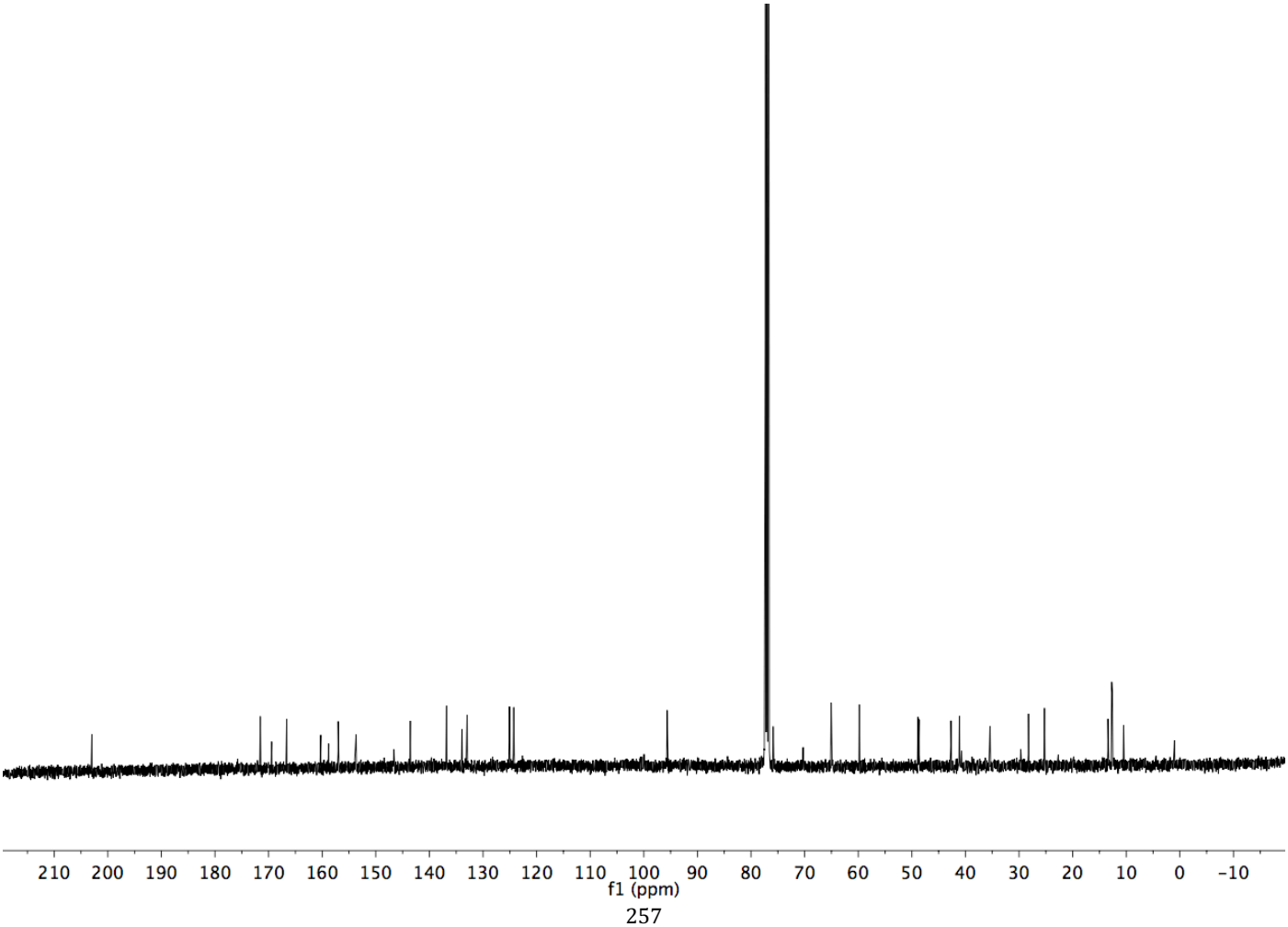

O
N
H
OH
Me
Me
O
O
H
O
N
N
O
O
O
H
Me
HN
O
N
N
Me
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
f1 (ppm)

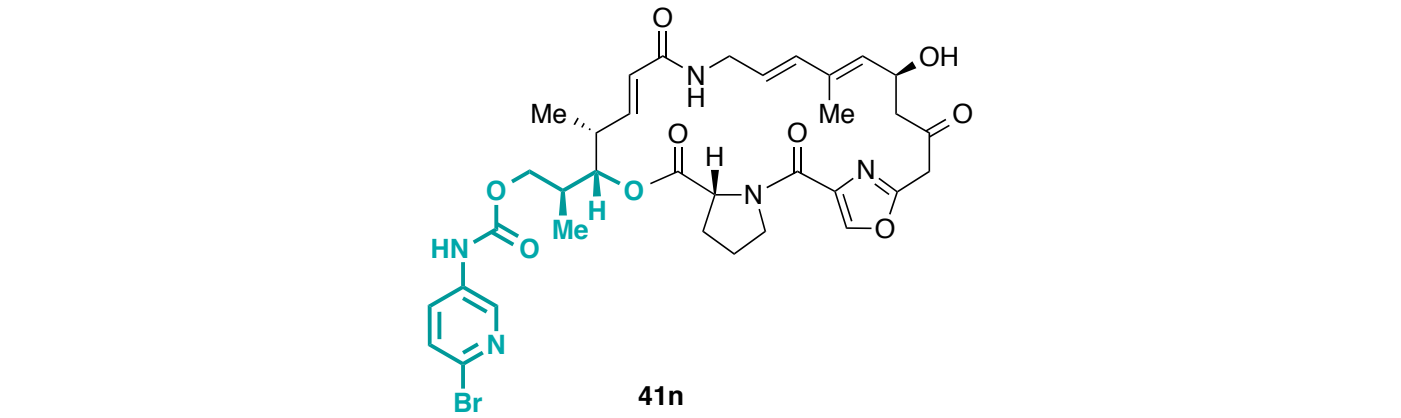
41l


O
N
H
OH
Me
Me
O
O
H
O
N
N
O
O
Me
H
HN
O
N
O
Me

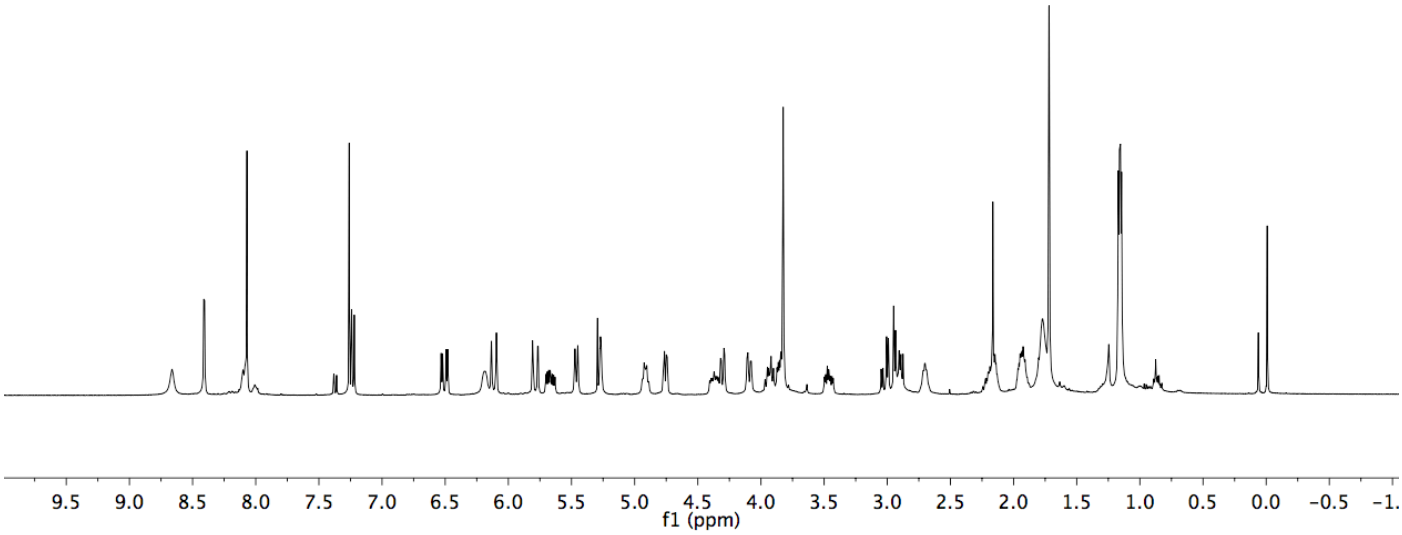
41m

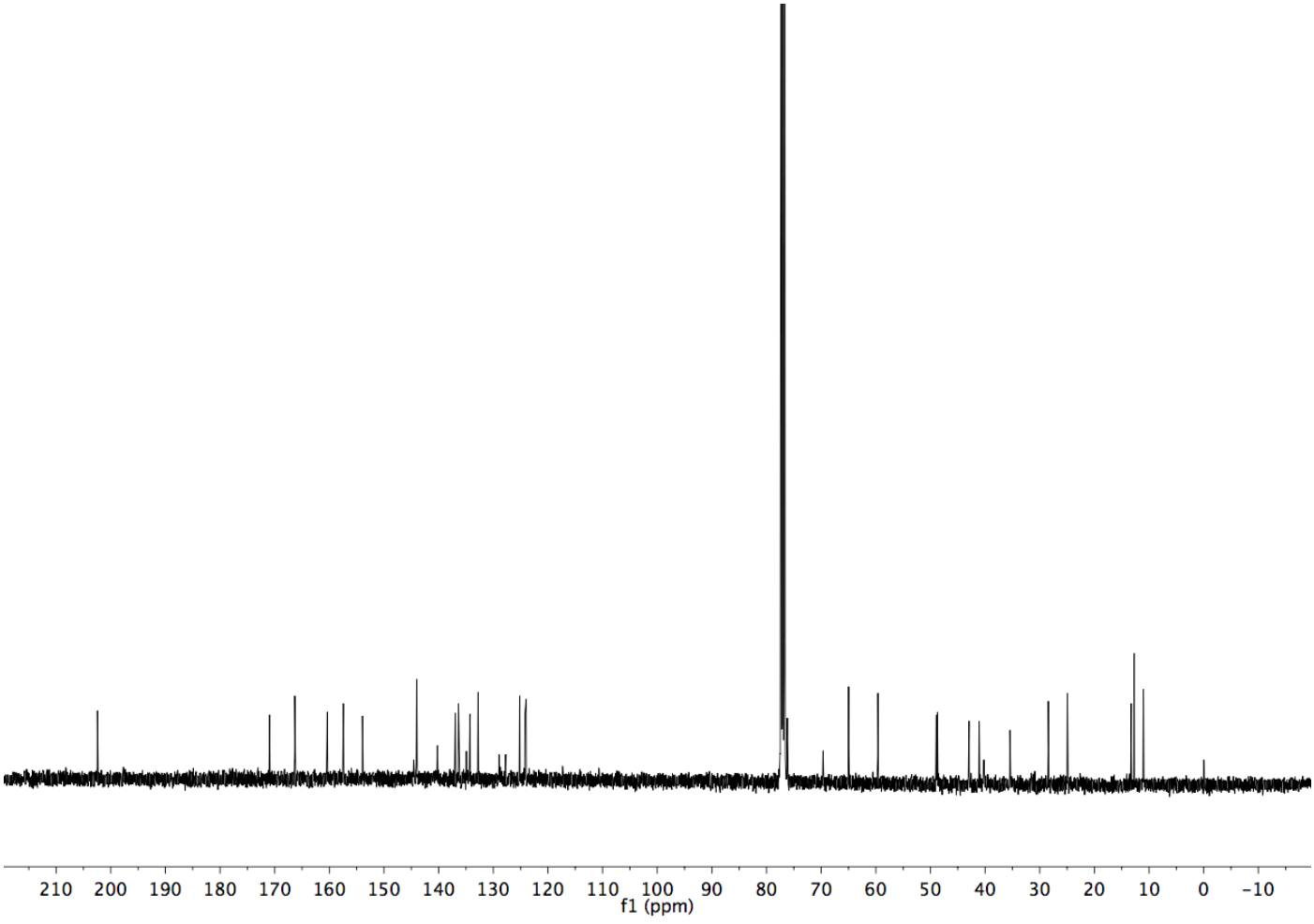

9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
f1 (ppm)

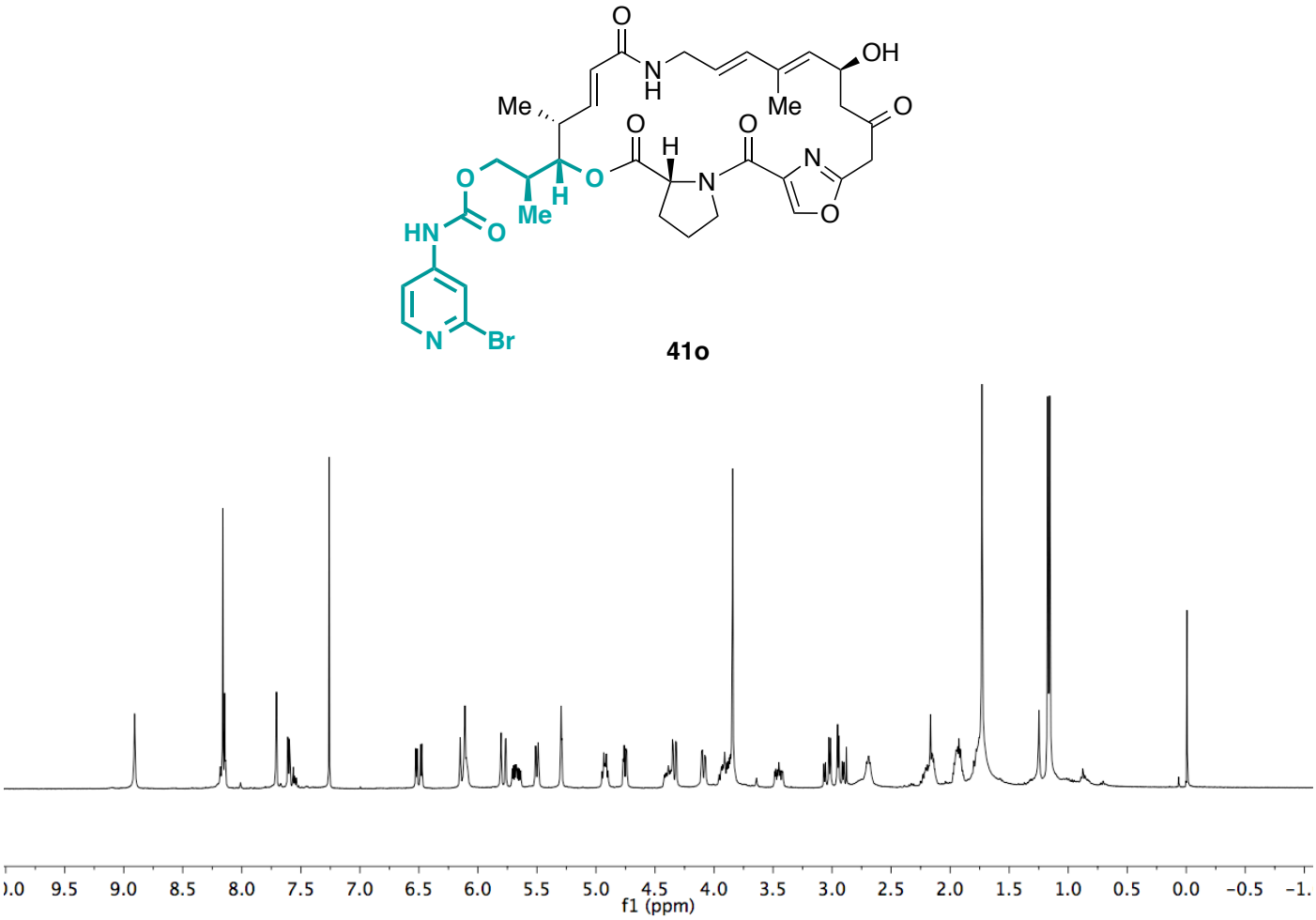

210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
-10
f1 (ppm)


O
N
H
OH
Me
Me
O
O
O
H
O
N
N
O
O
H
Me
HN
O
N
Br

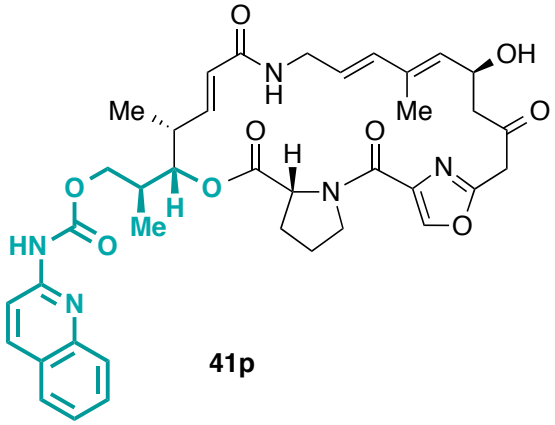
41n


9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1.
f1 (ppm)

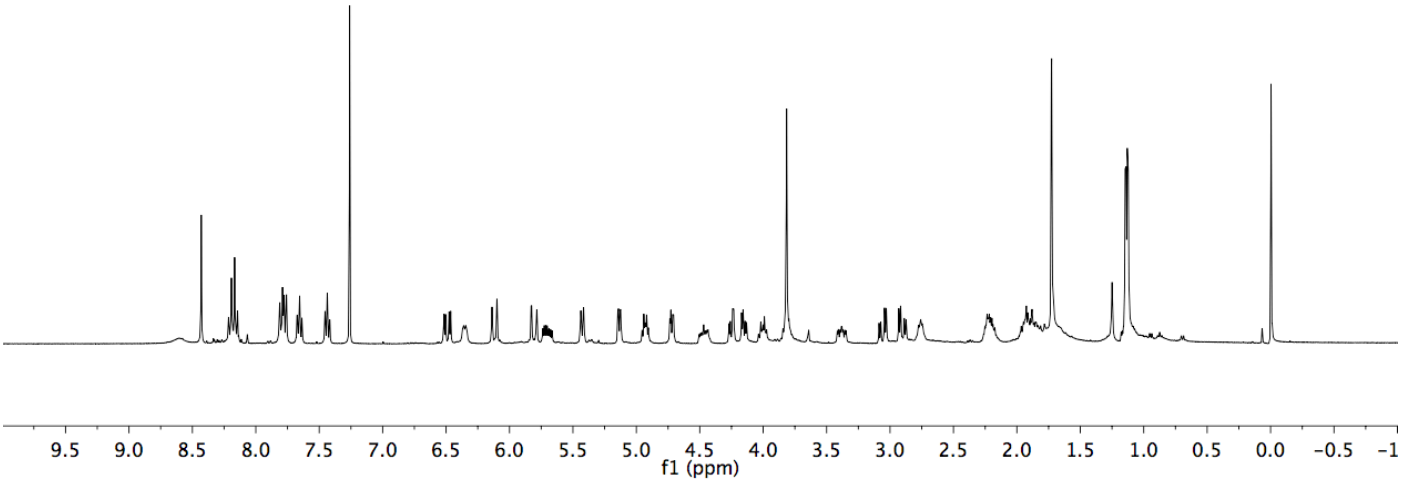

210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

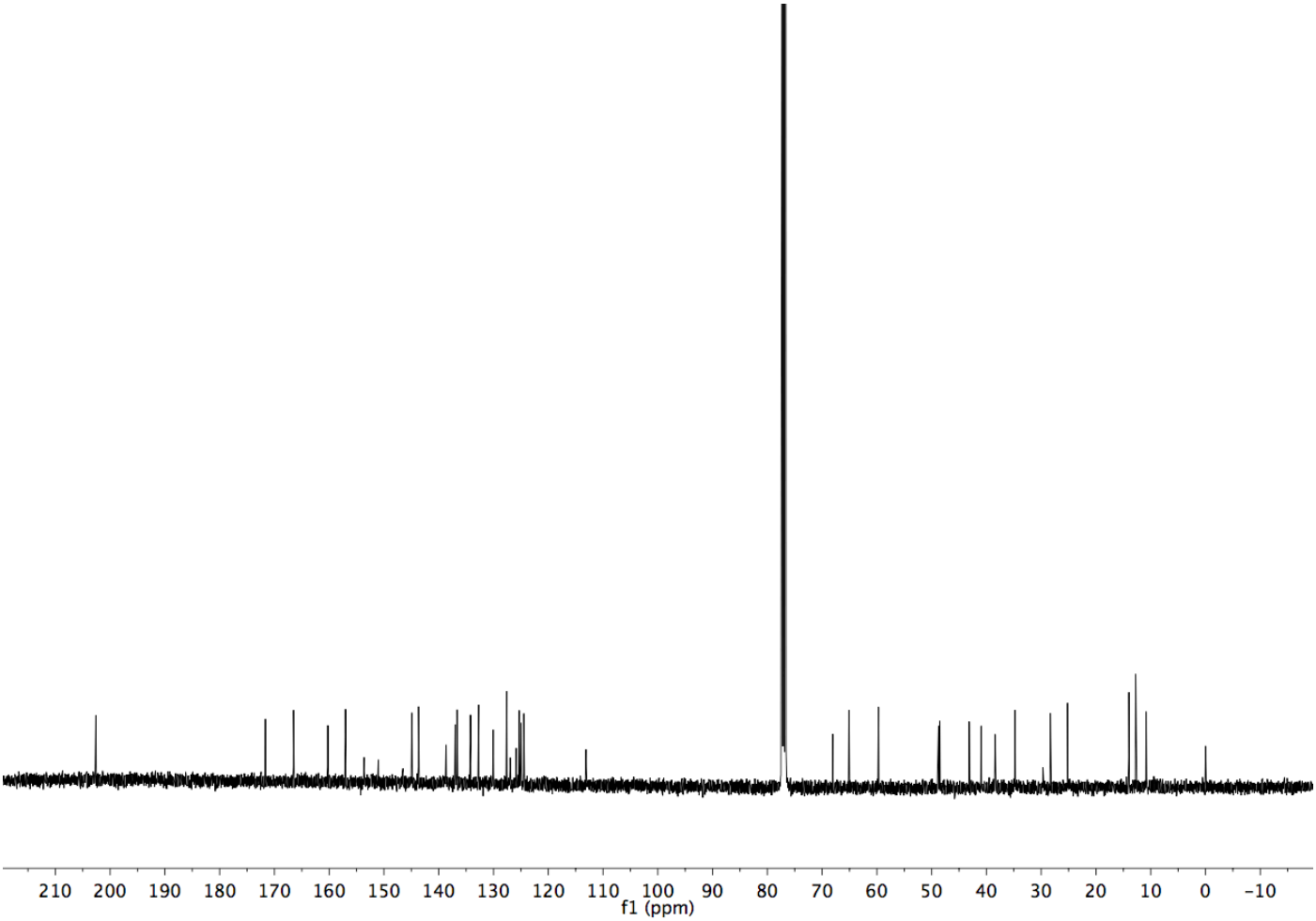


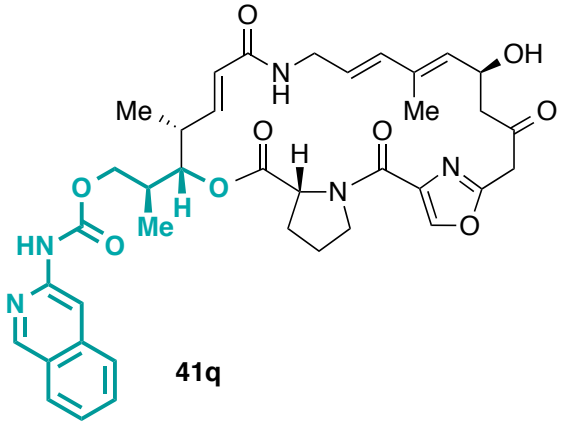
41o



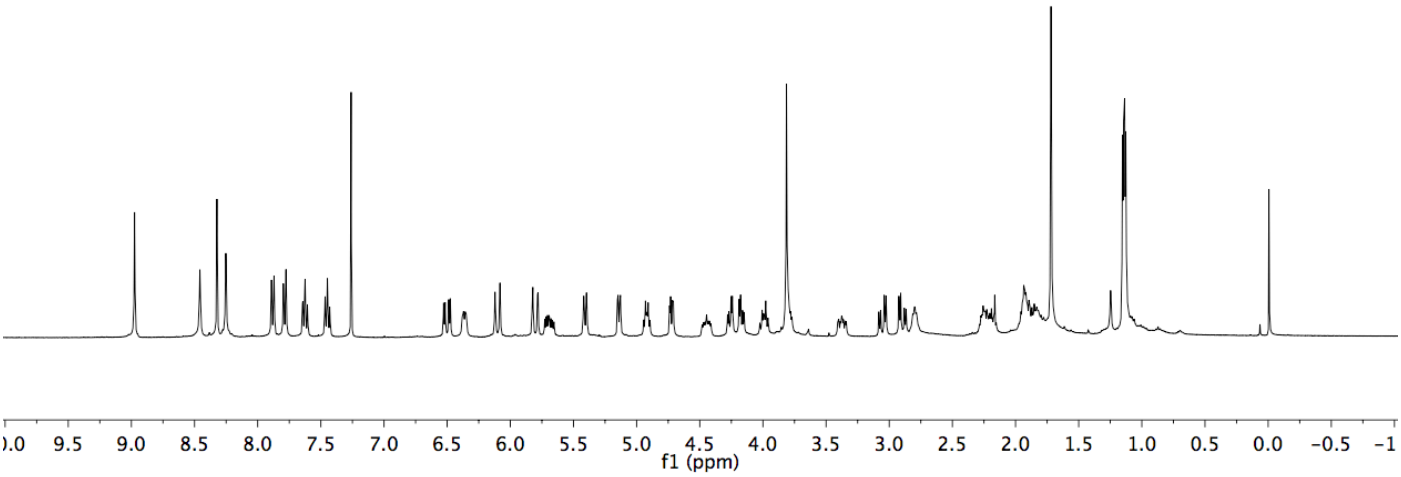
41p

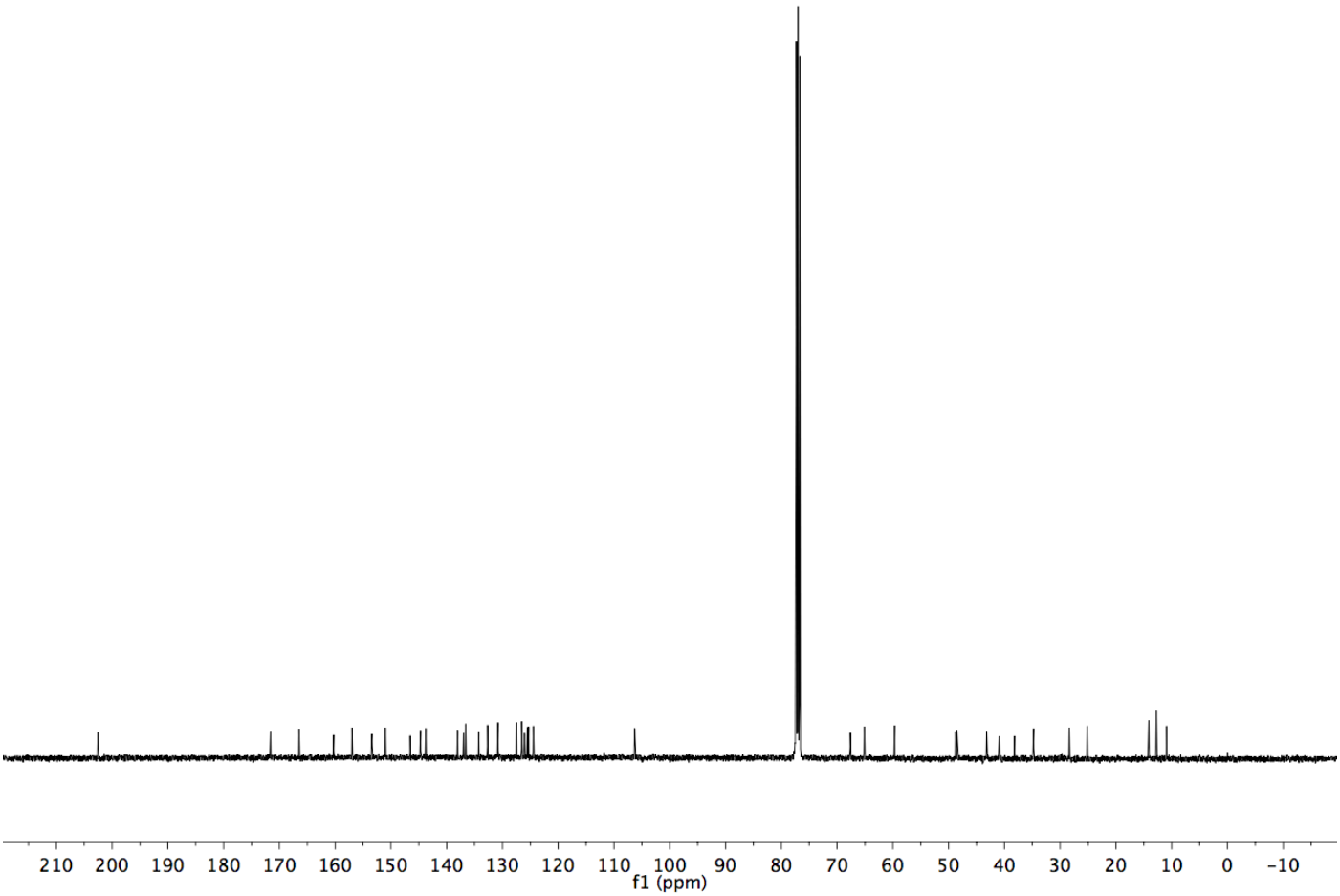

9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1
f1 (ppm)

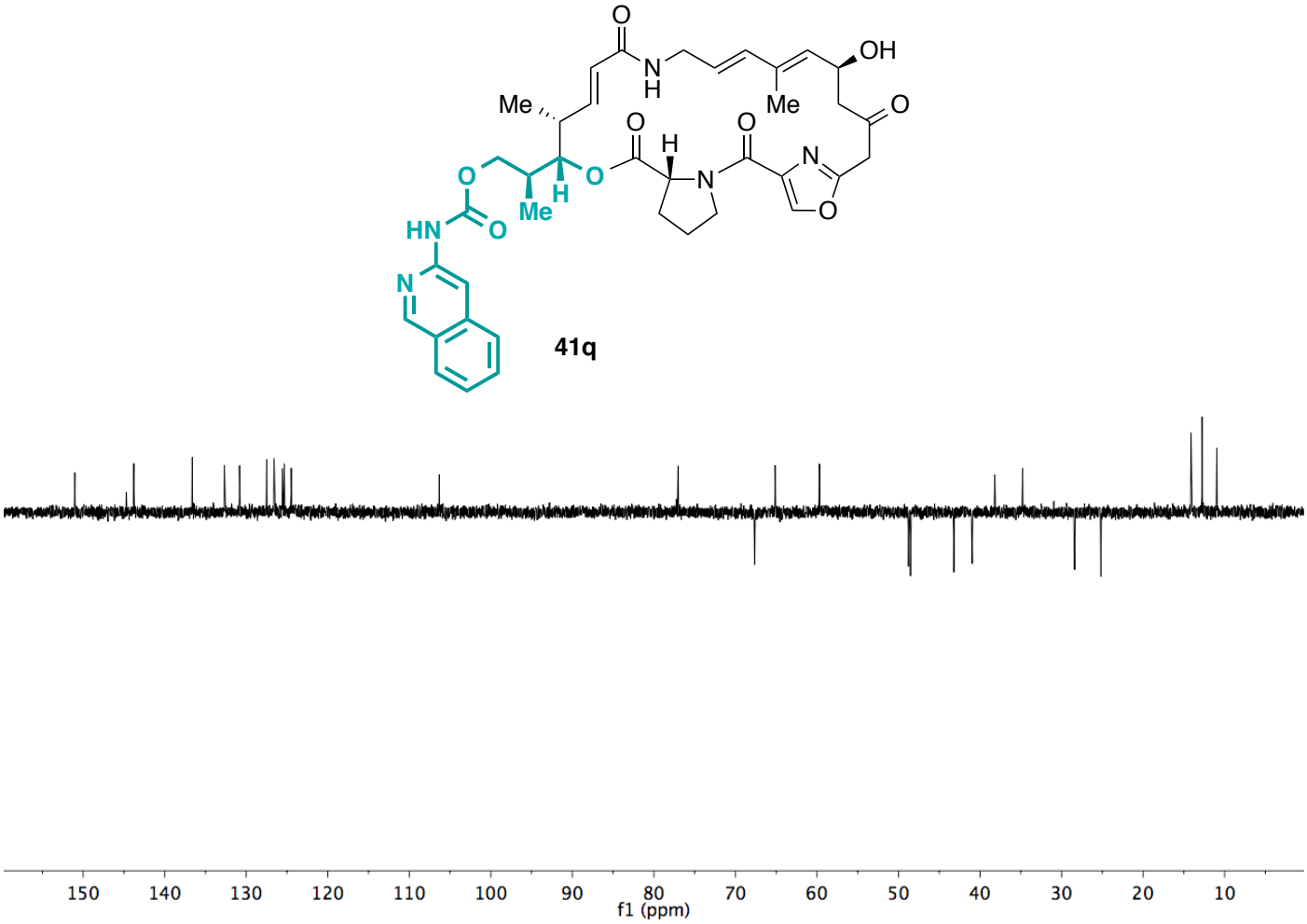

210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)



41q

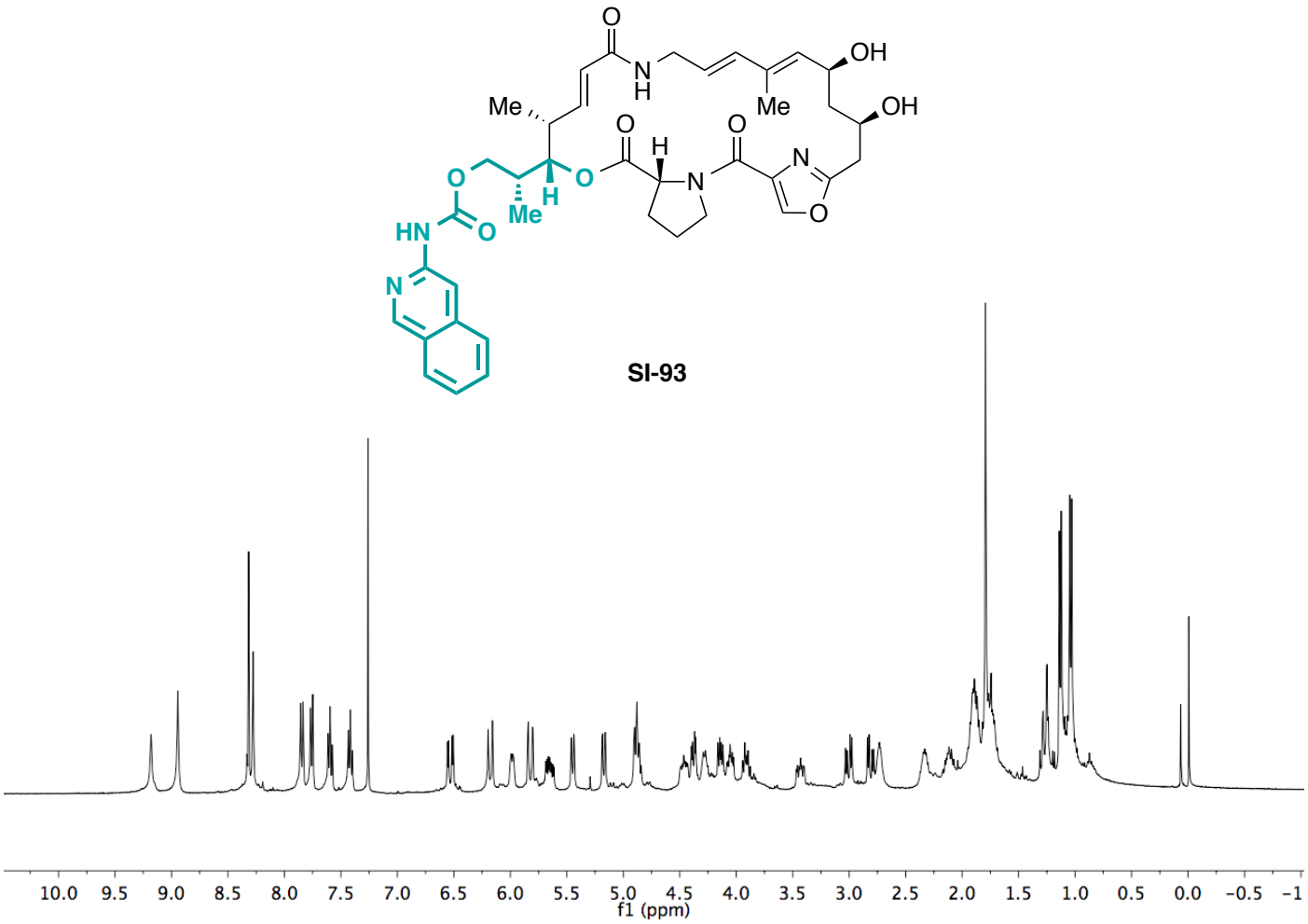

9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1
f1 (ppm)


210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


O
N
H
OH
Me
Me
O
O
O
H
O
N
N
O
O
Me
H
HN
O
N

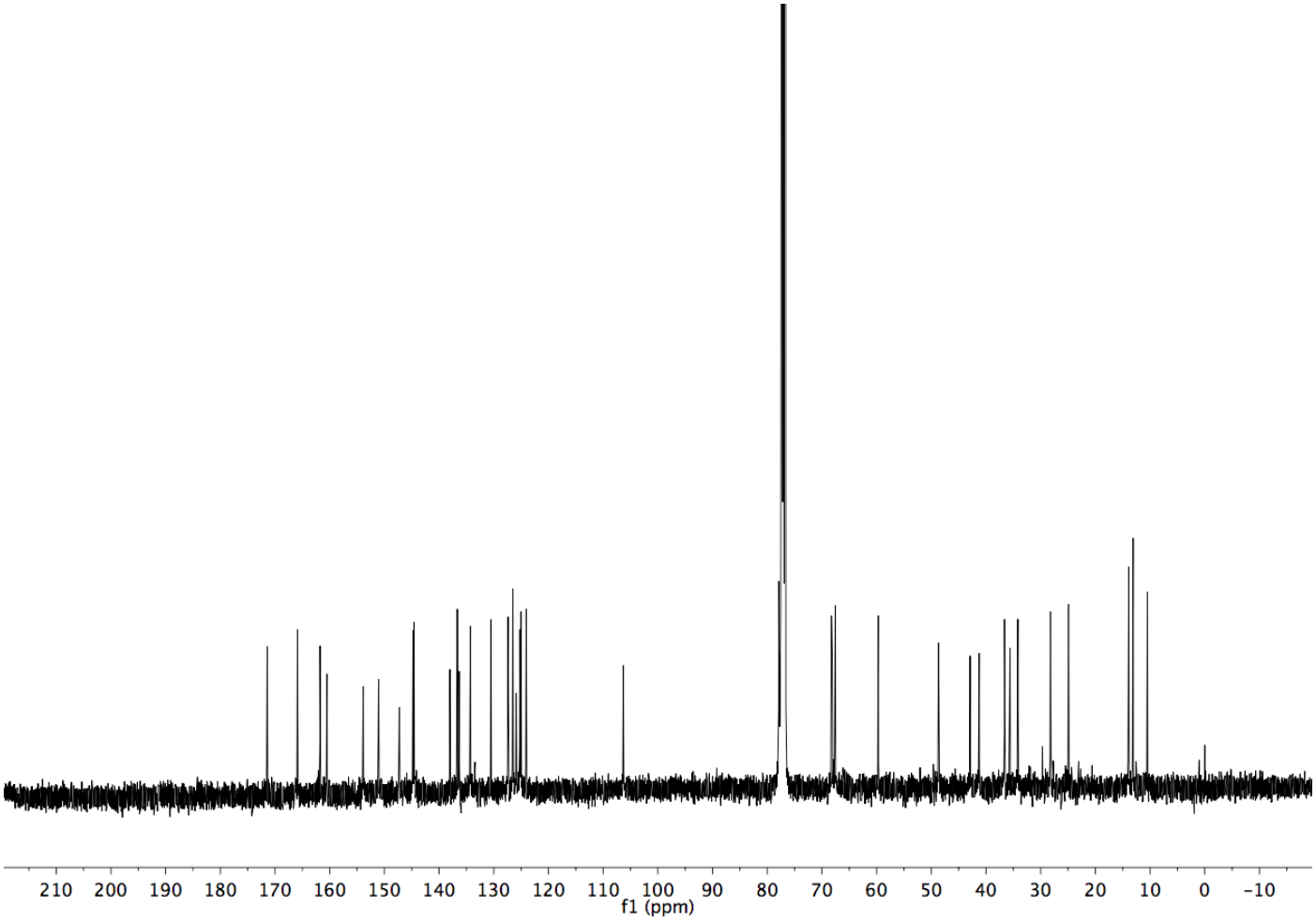
41q

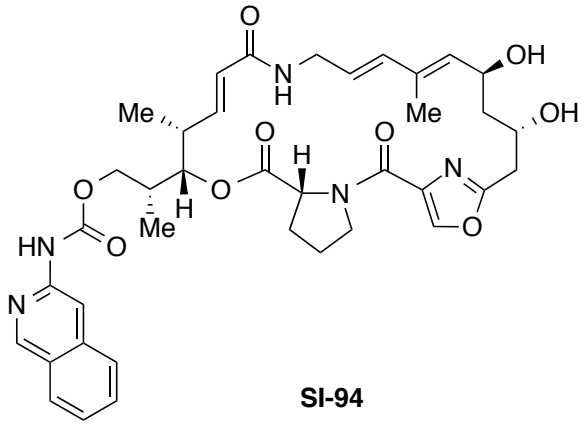
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
f1 (ppm)


O
N
H
OH
Me
Me
OH
O
H
O
N
O
O
O
Me
H
HN
O
N

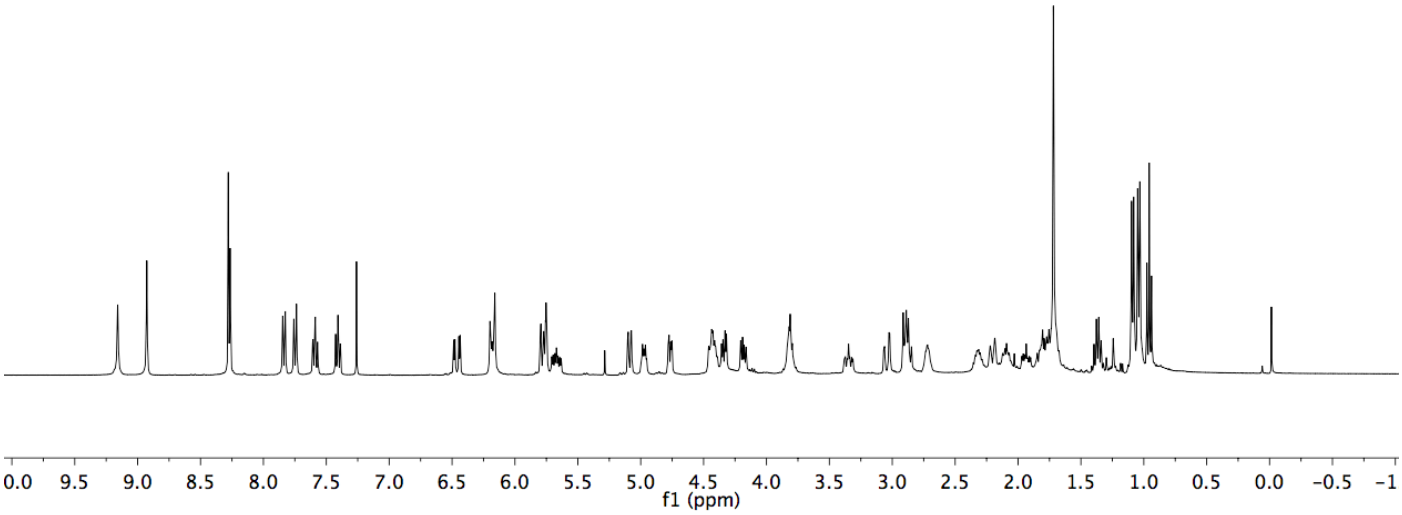
SI-93

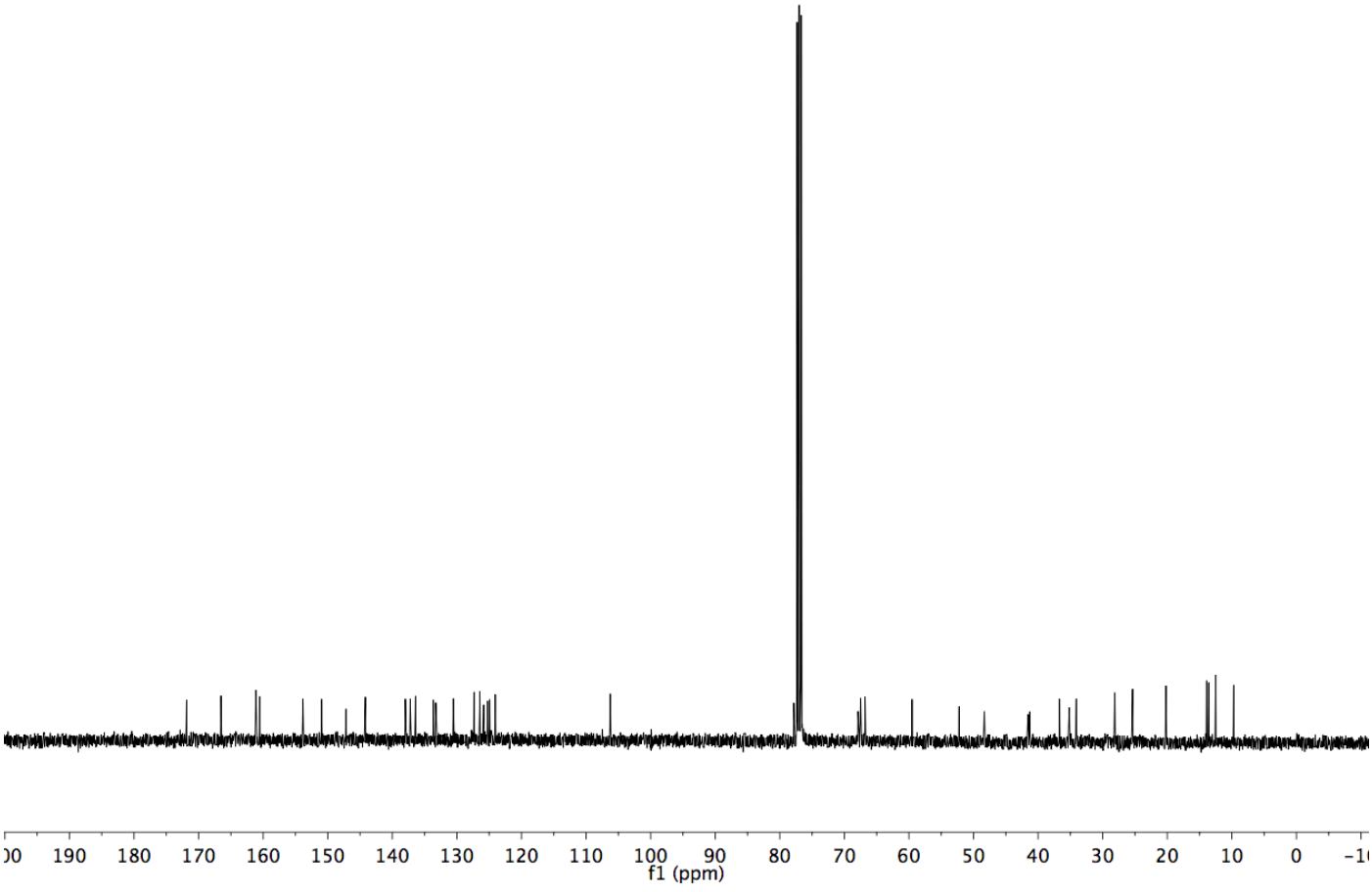
10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1
f1 (ppm)

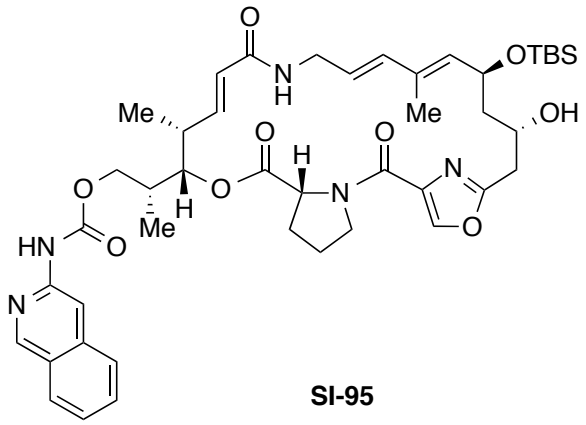

210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)



SI-94

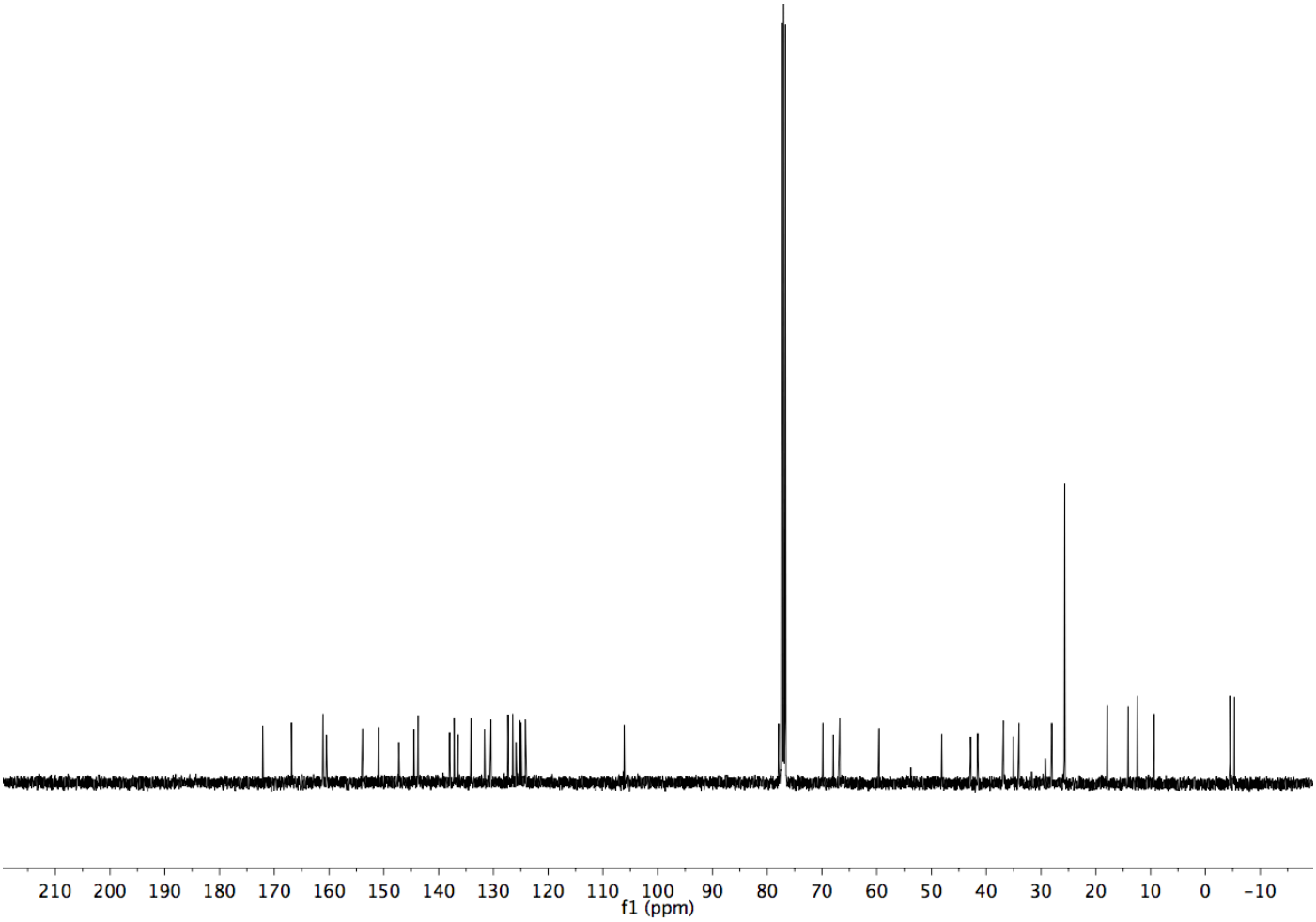

0.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1
f1 (ppm)

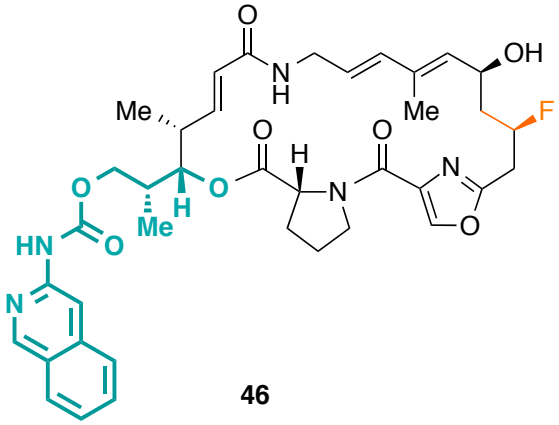

)0 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -1
f1 (ppm)


O
N
H
OTBS
Me
Me
OH
O
O
H
O
N
O
H
Me
HN
O
N

SI-95

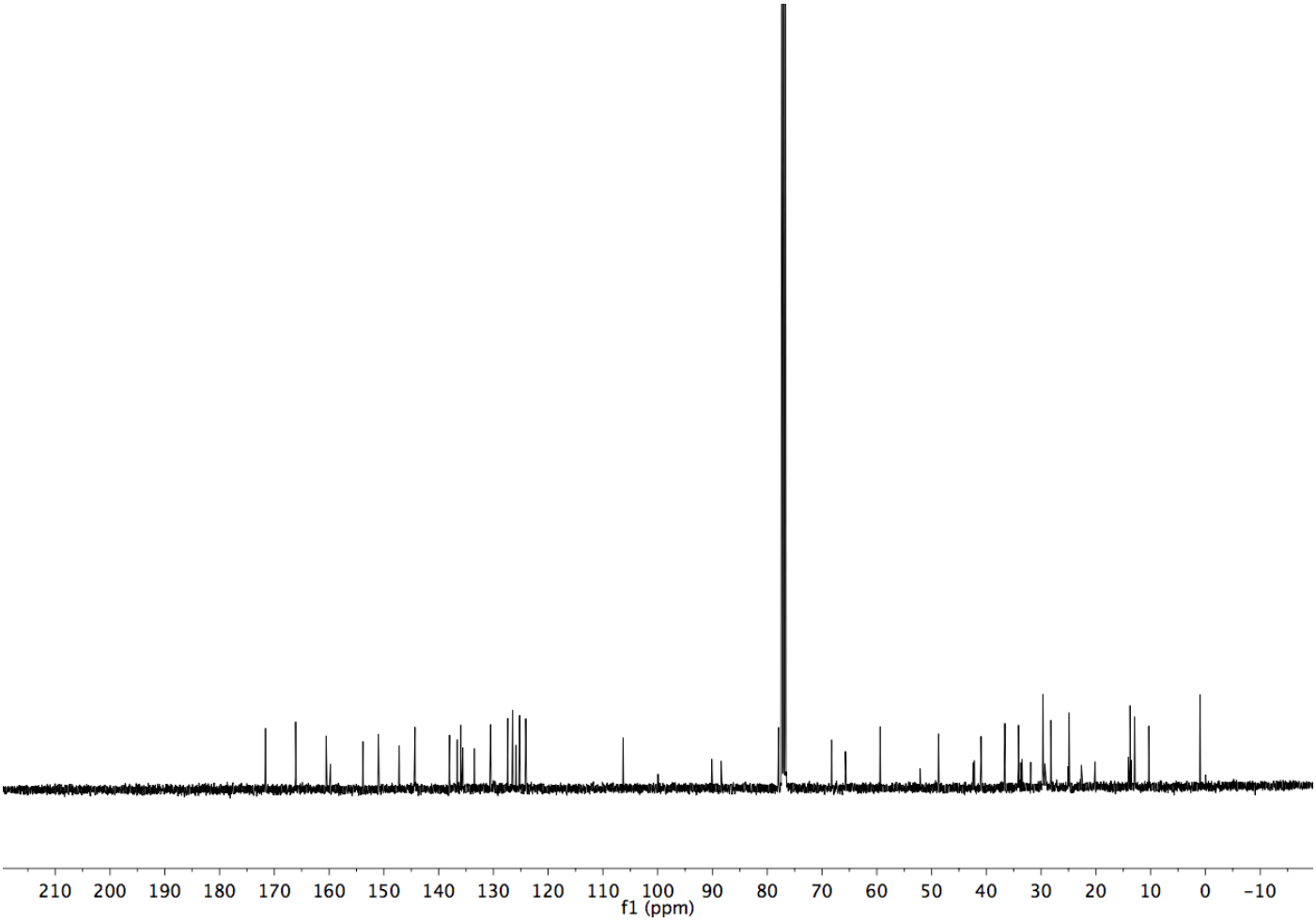
0.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5
f1 (ppm)

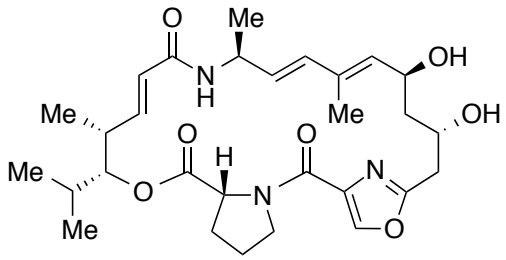

210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


O
N
H
OH
Me
Me
F
O
H
O
N
O
N
O
O
Me
H
HN
O
N

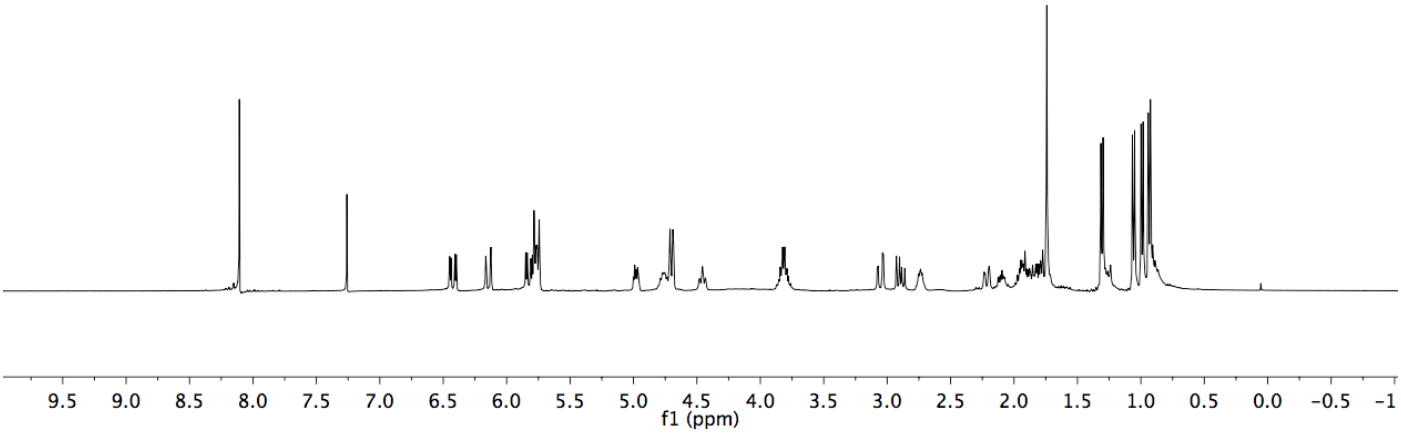
46

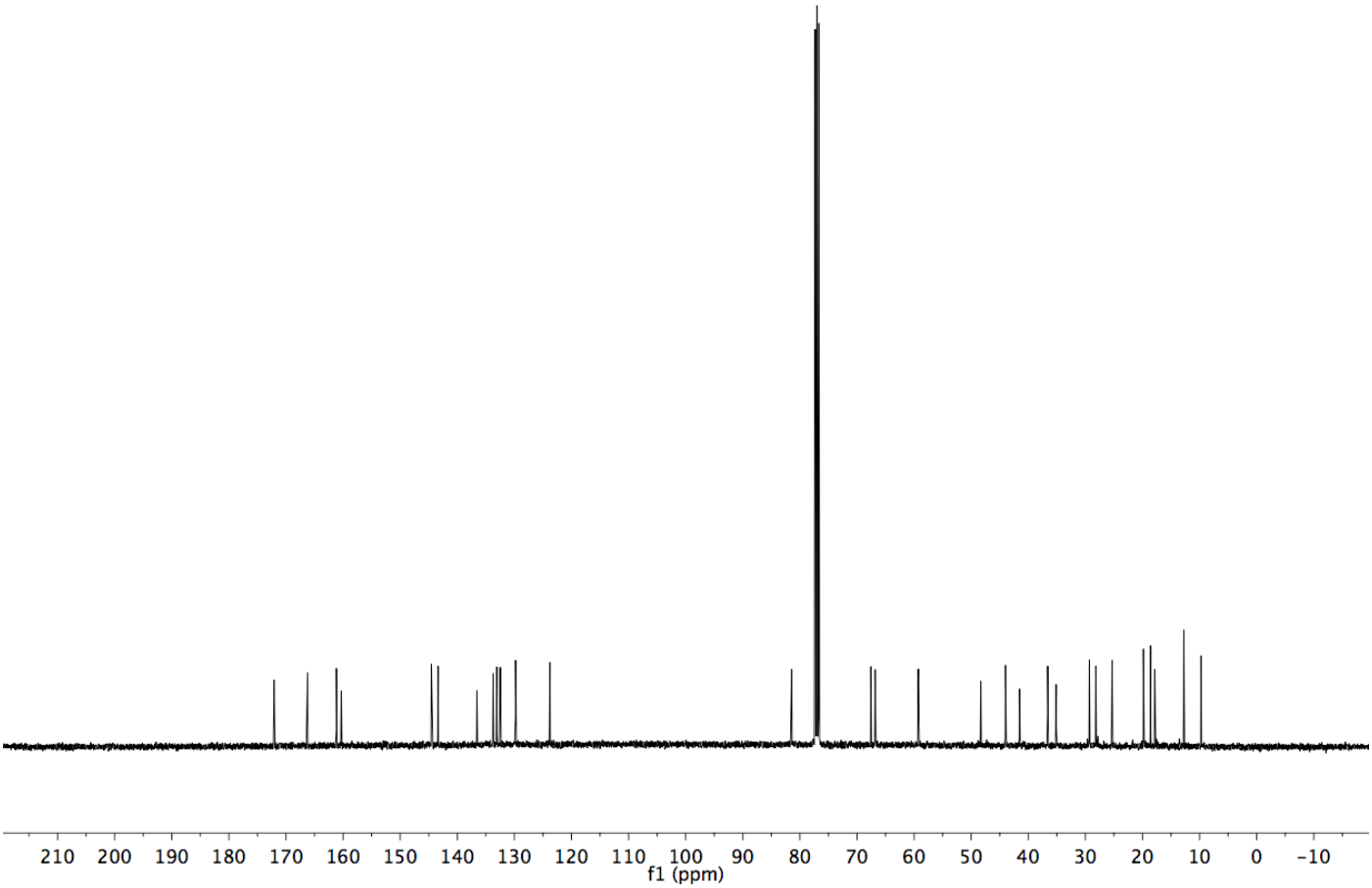
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1
f1 (ppm)

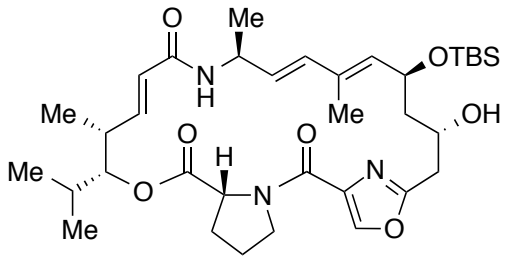

210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


O
Me
N
H
OH
Me
Me
OH
O
H
O
Me
O
N
N
Me
O

SI-97

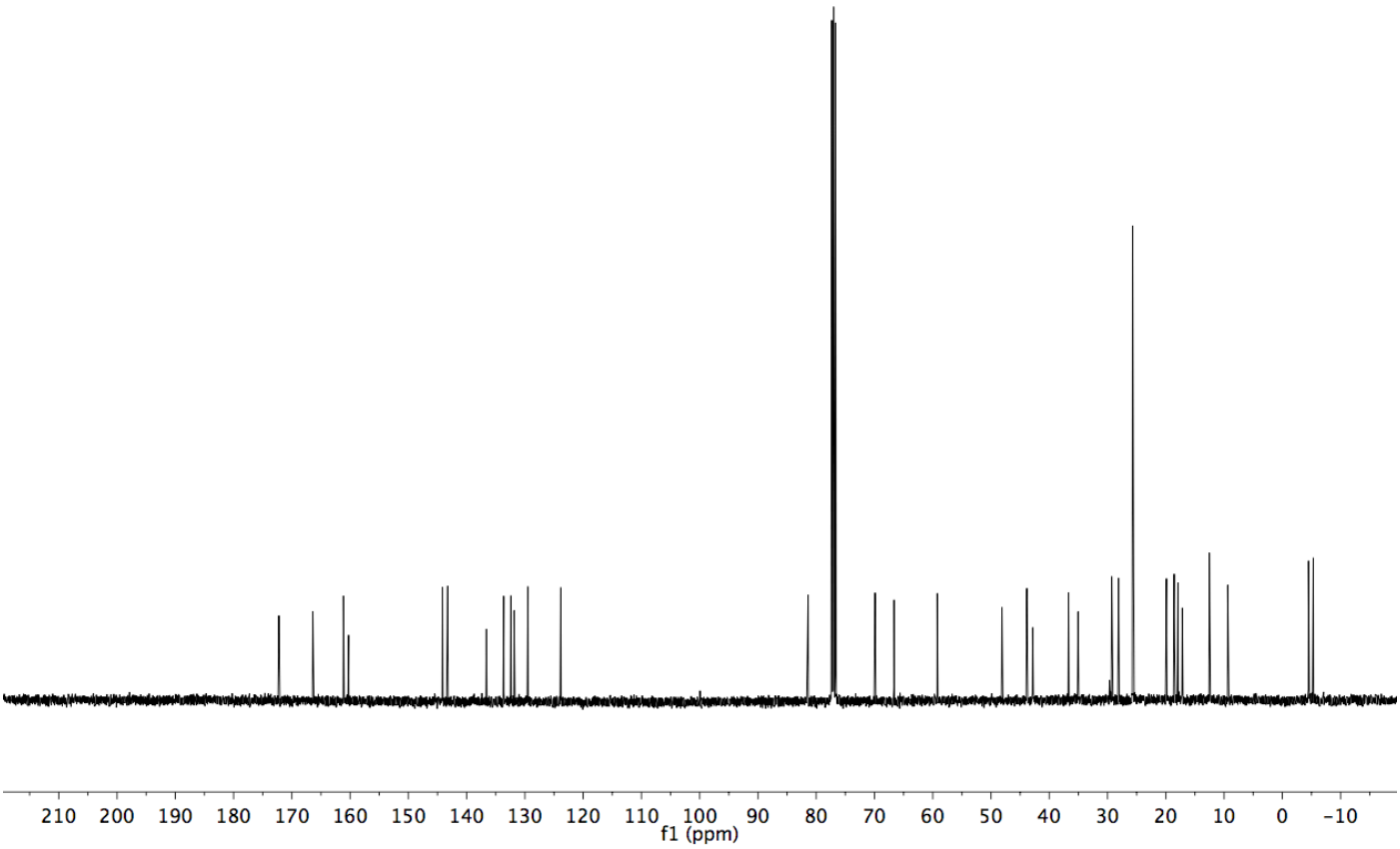

9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1
f1 (ppm)

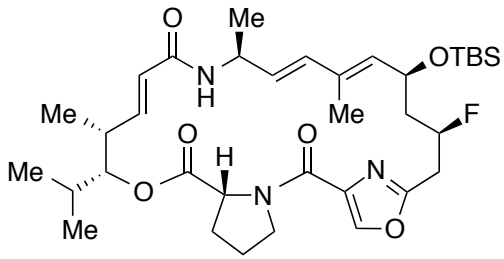

210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


O
Me
N
H
OTBS
Me
Me
OH
O
H
O
Me
O
N
N
Me
O

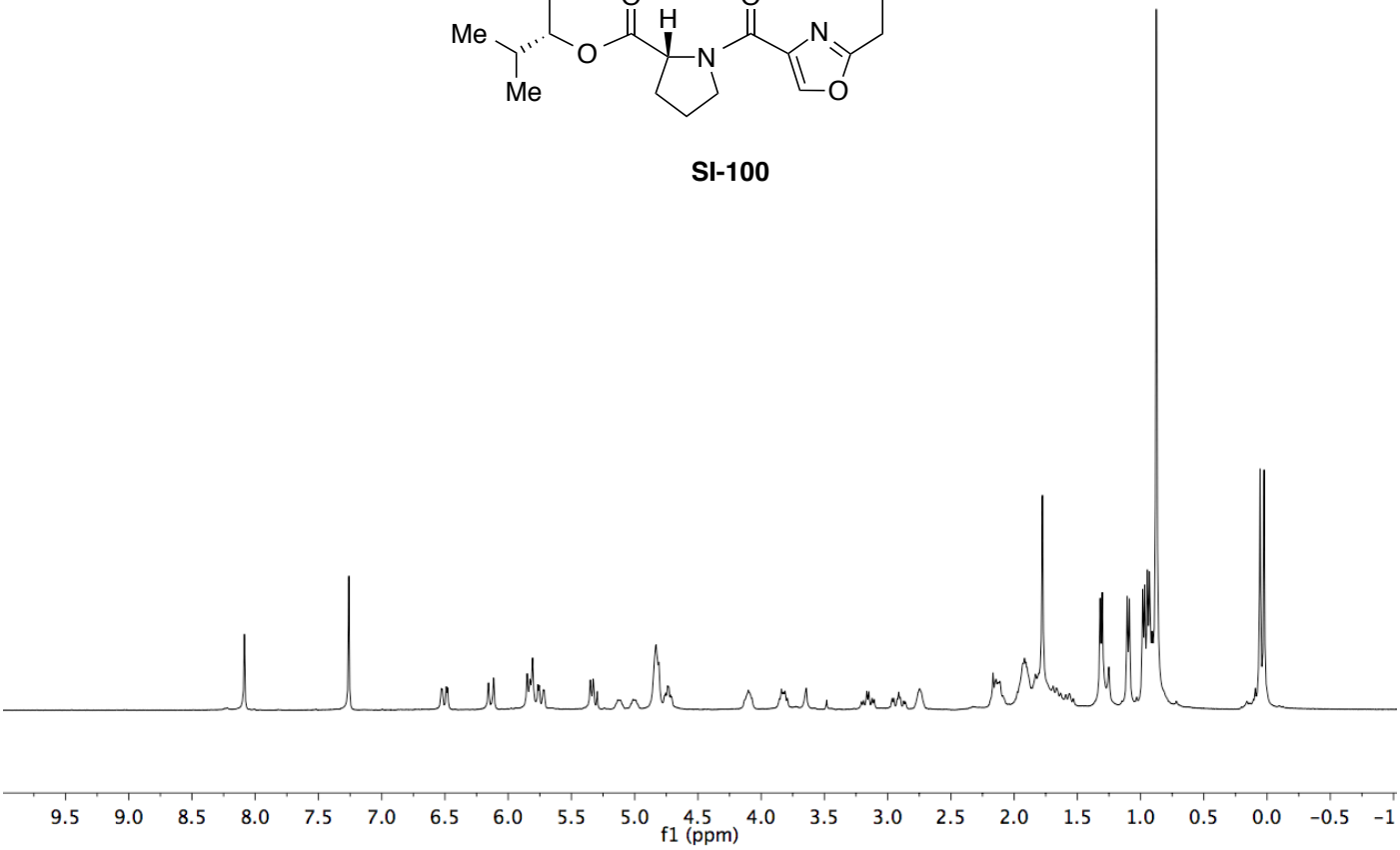
SI-98

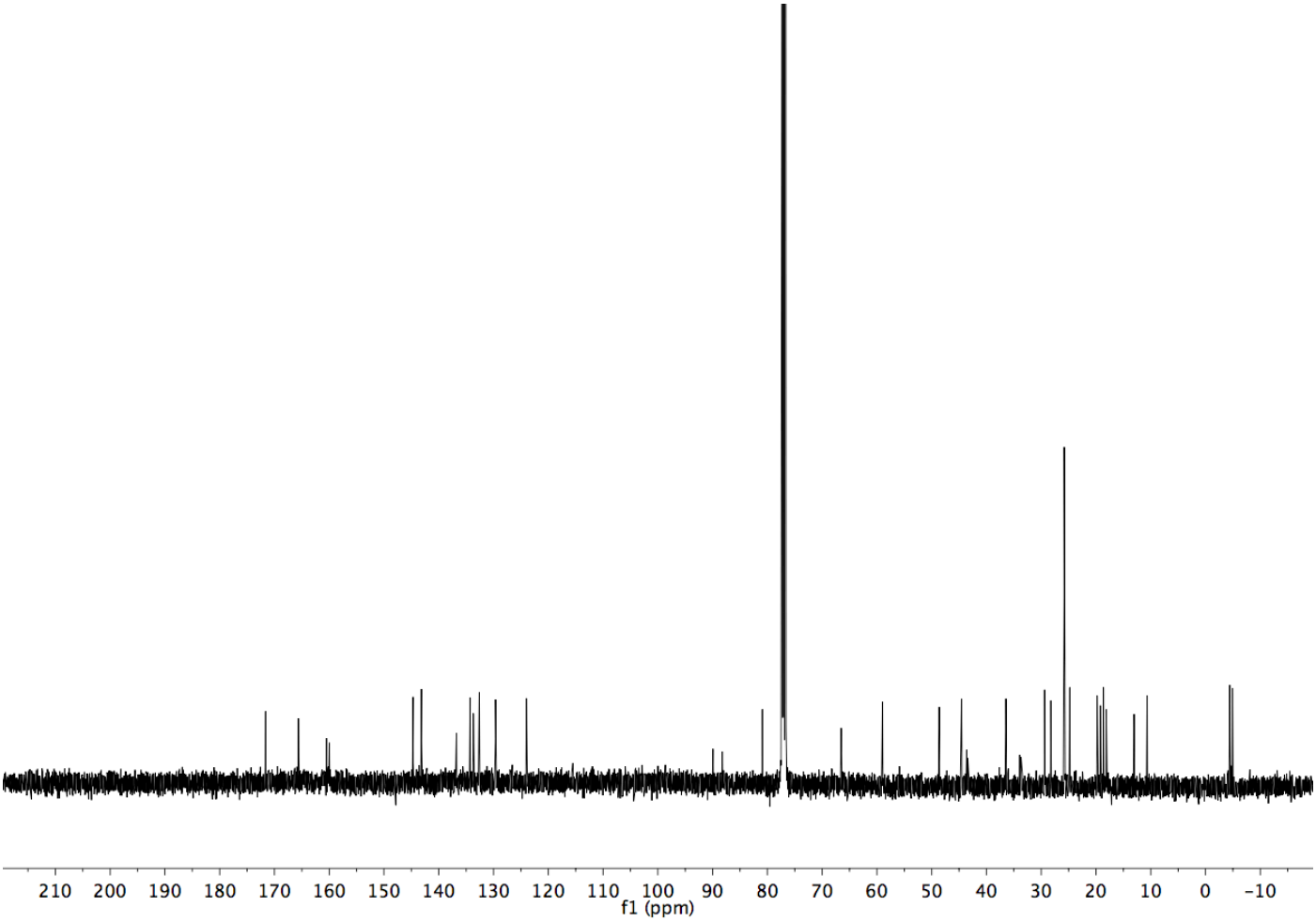
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5
f1 (ppm)

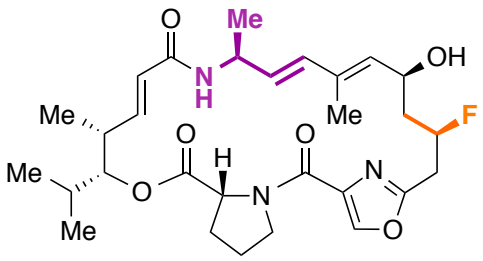

210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


O
Me
N
H
OTBS
Me
Me
F
O
H
O
Me
O
N
N
Me
O

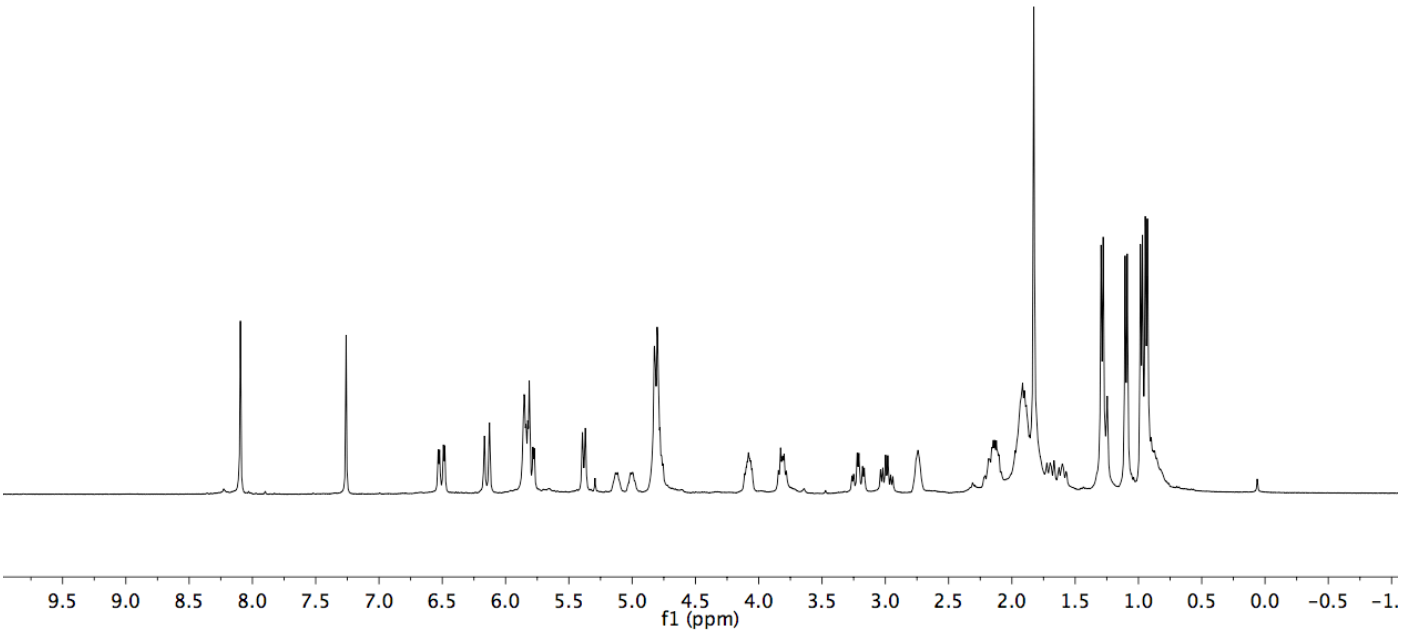
SI-100

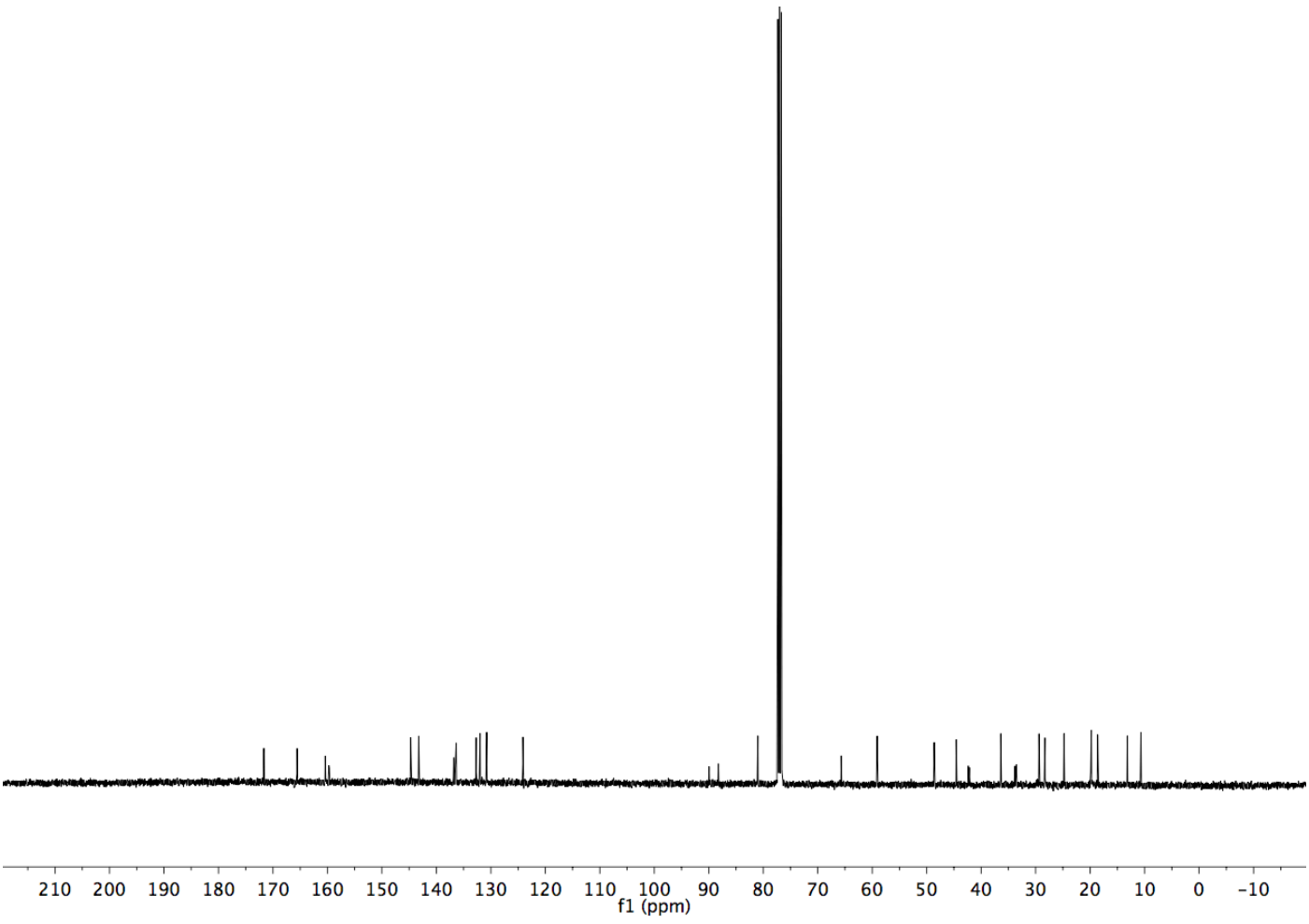

9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1
f1 (ppm)

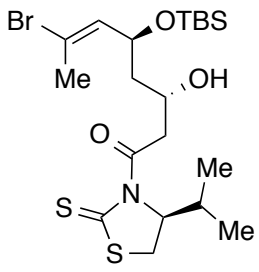

210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


O
Me
N
H
OH
Me
Me
F
O
H
O
Me
O
N
N
Me
O

SI-99

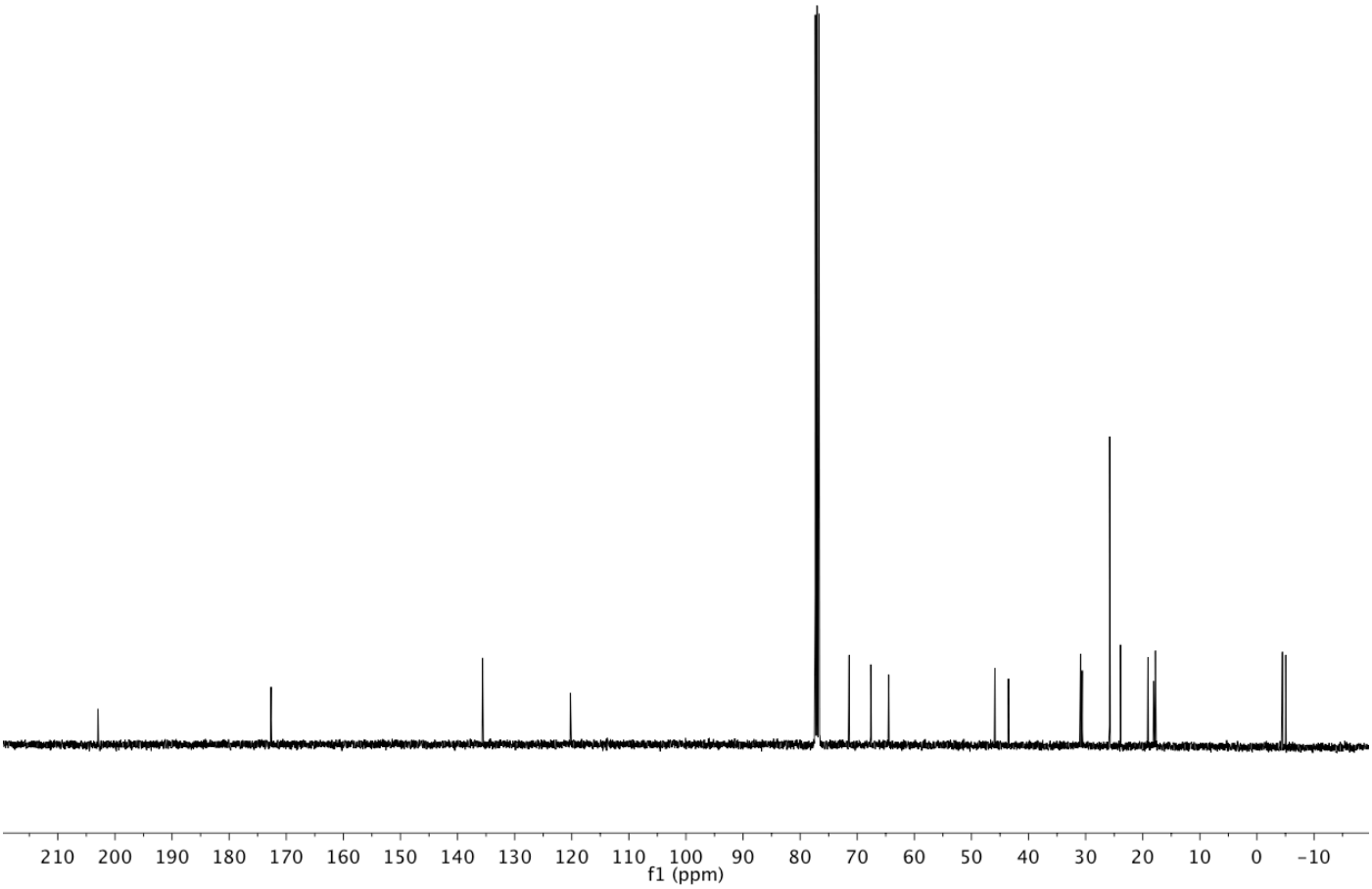

9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1.
f1 (ppm)

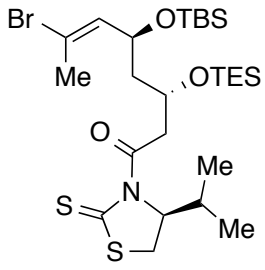

210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


Br
OTBS
Me
OH
O
Me
N
S
Me
S

SI-102

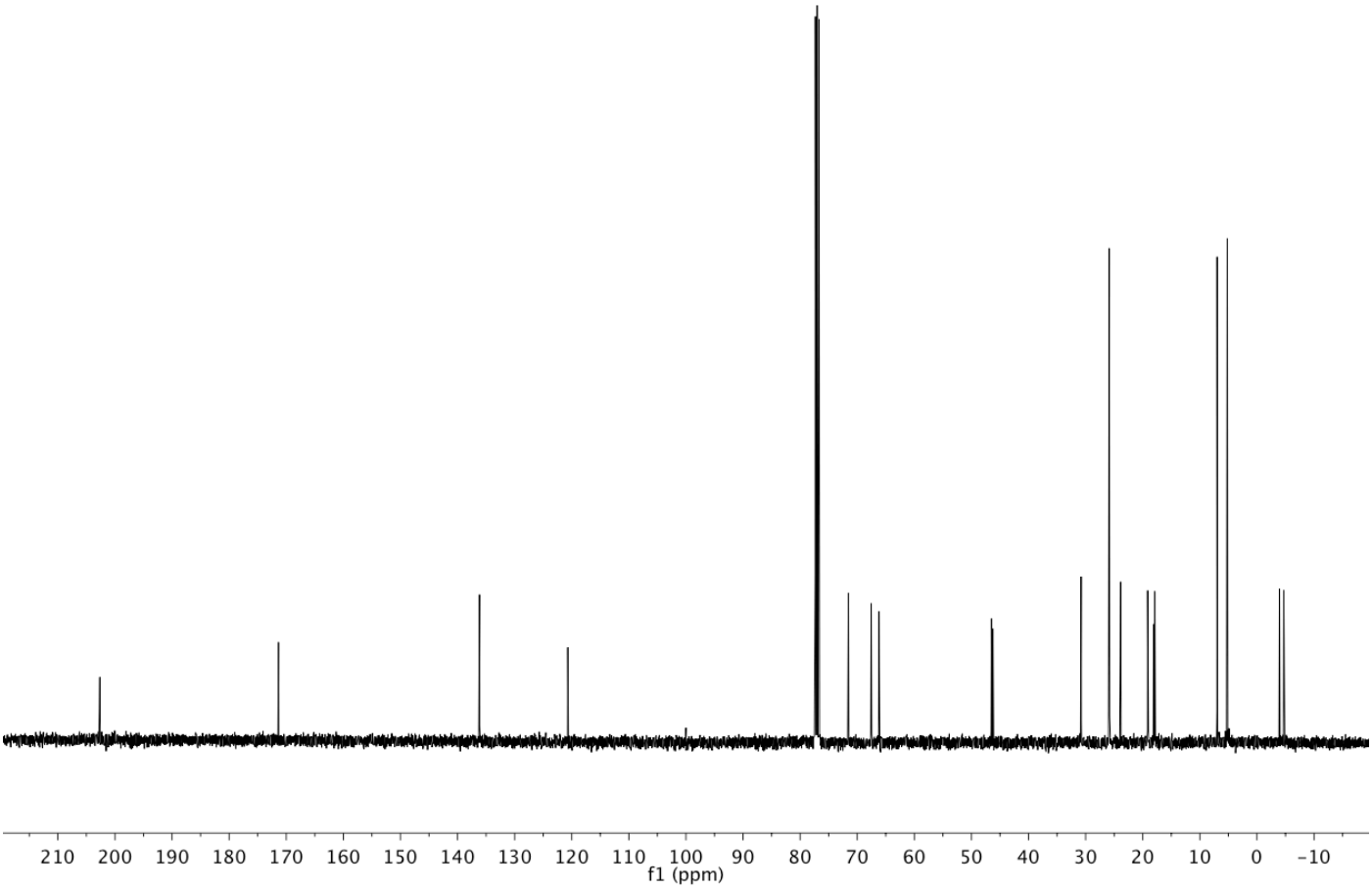
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1
f1 (ppm)

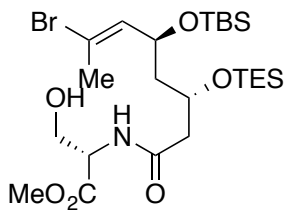

210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


Br
OTBS
Me
OTES
O
Me
N
S
Me
S

SI-103

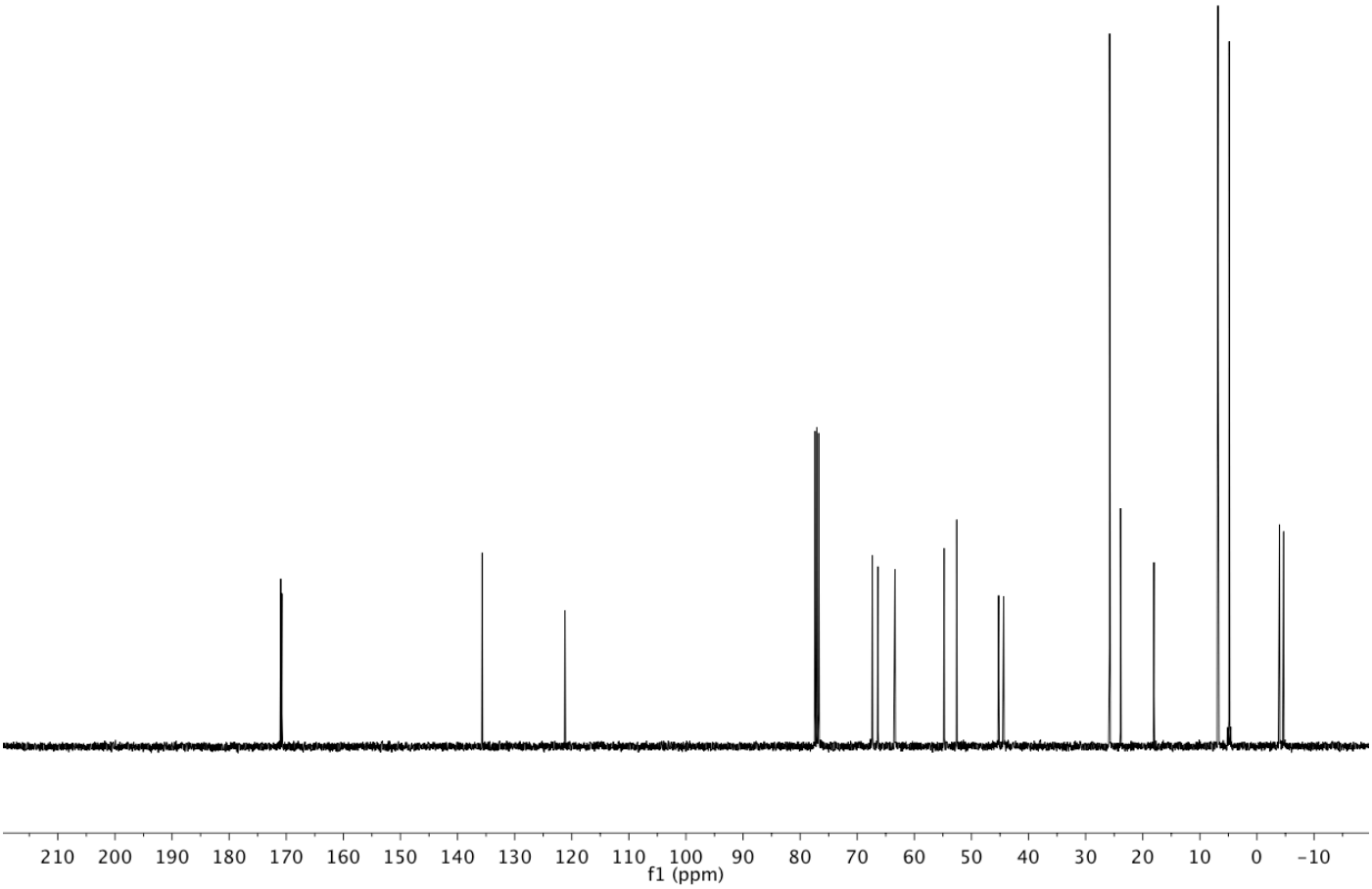
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1.
f1 (ppm)

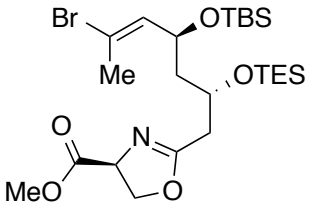

210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


Br
OTBS
Me
OTES
OH
H
N
MeO2C
O

SI-104

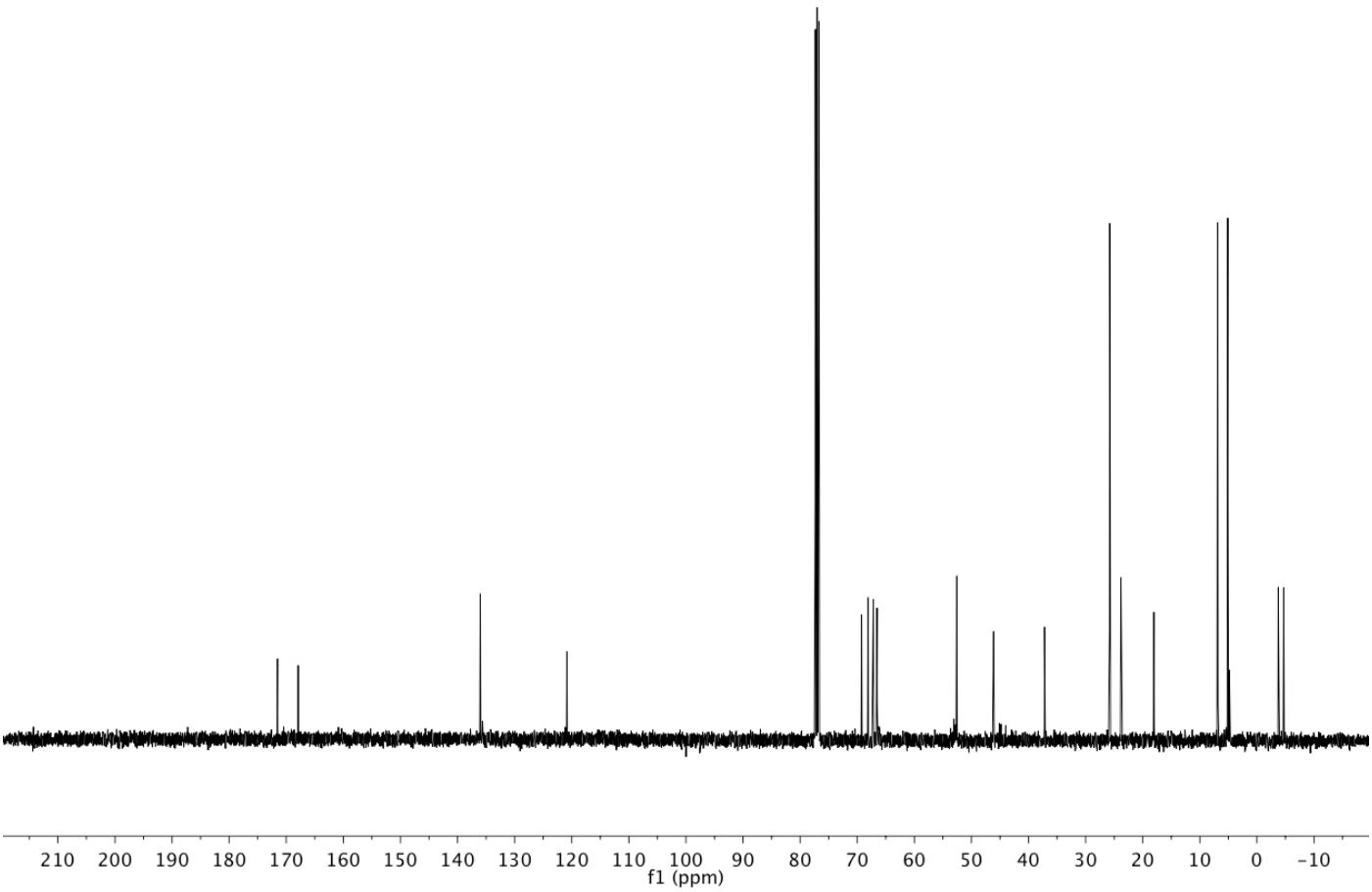
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1
f1 (ppm)

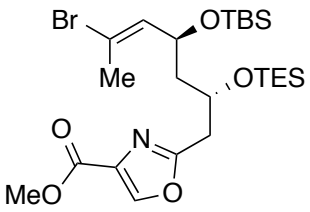

210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


Br
OTBS
Me
OTES
O
N
MeO
O

SI-105

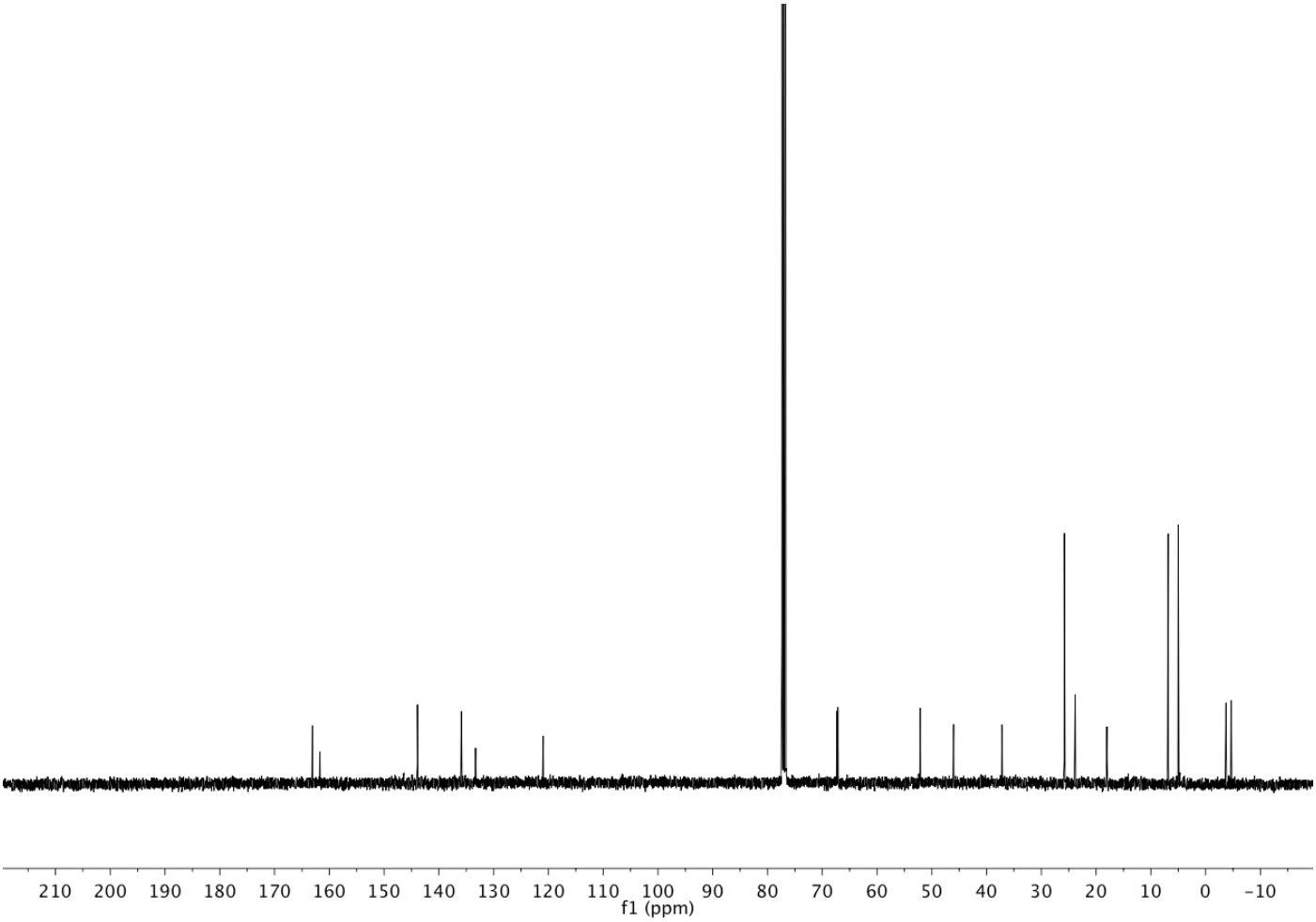
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1
f1 (ppm)

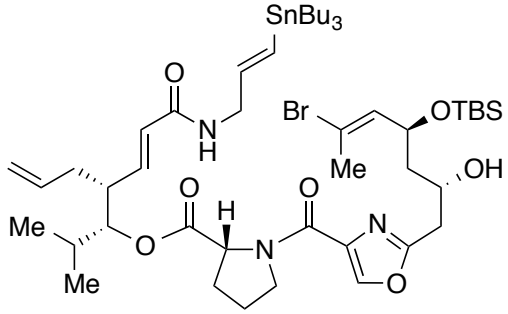

210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


Br
OTBS
Me
OTES
O
N
MeO
O

SI-106

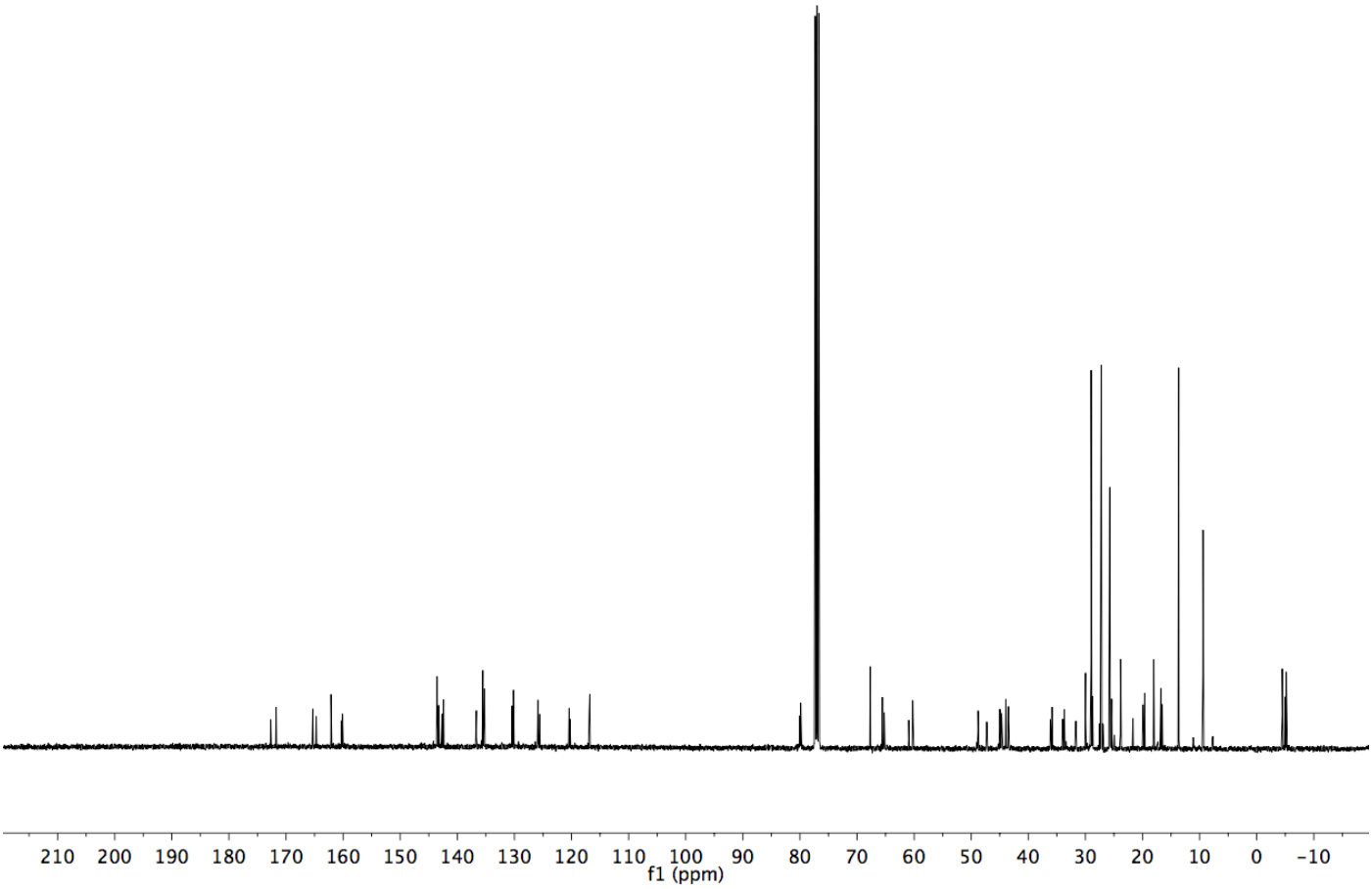
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1
f1 (ppm)

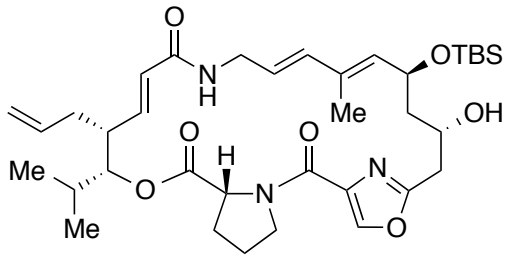

210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


SnBu3
O
N
H
Br
OTBS
Me
OH
O
H
O
Me
O
N
N
O
Me

SI-108

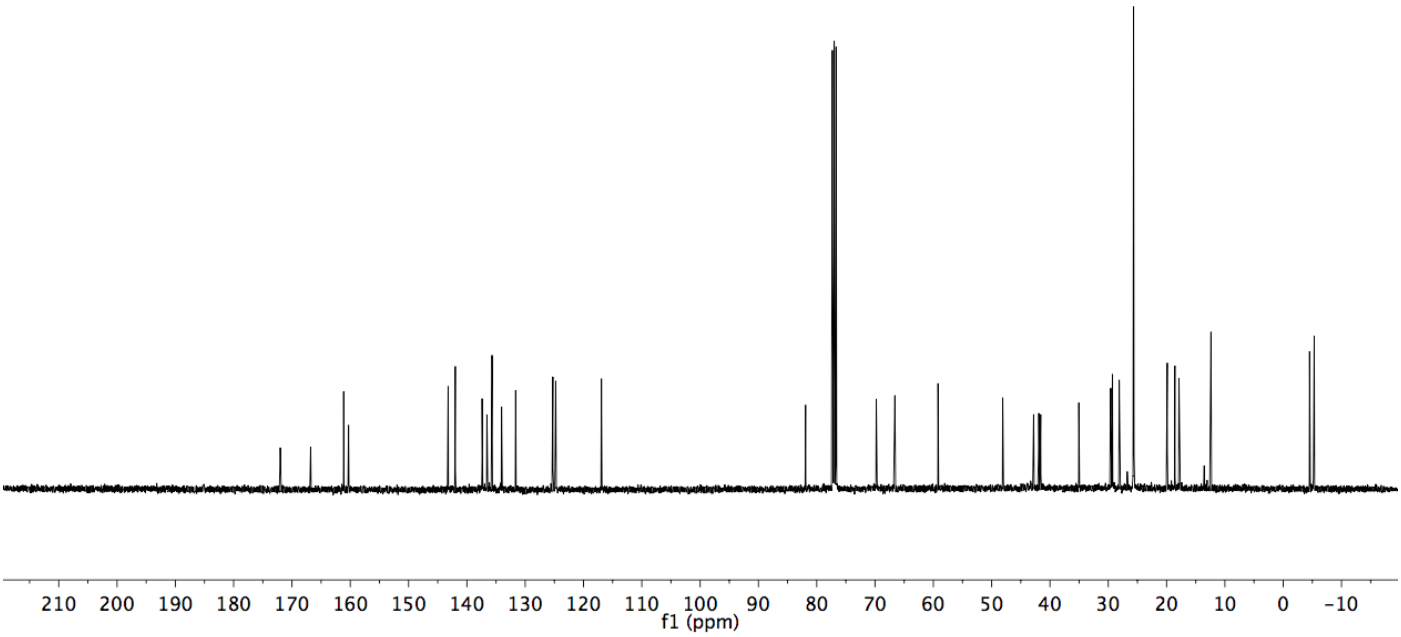
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1
f1 (ppm)

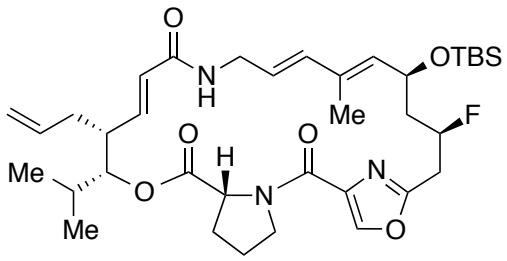

210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


O
N
H
OTBS
Me
OH
O
H
O
Me
O
N
N
Me
O

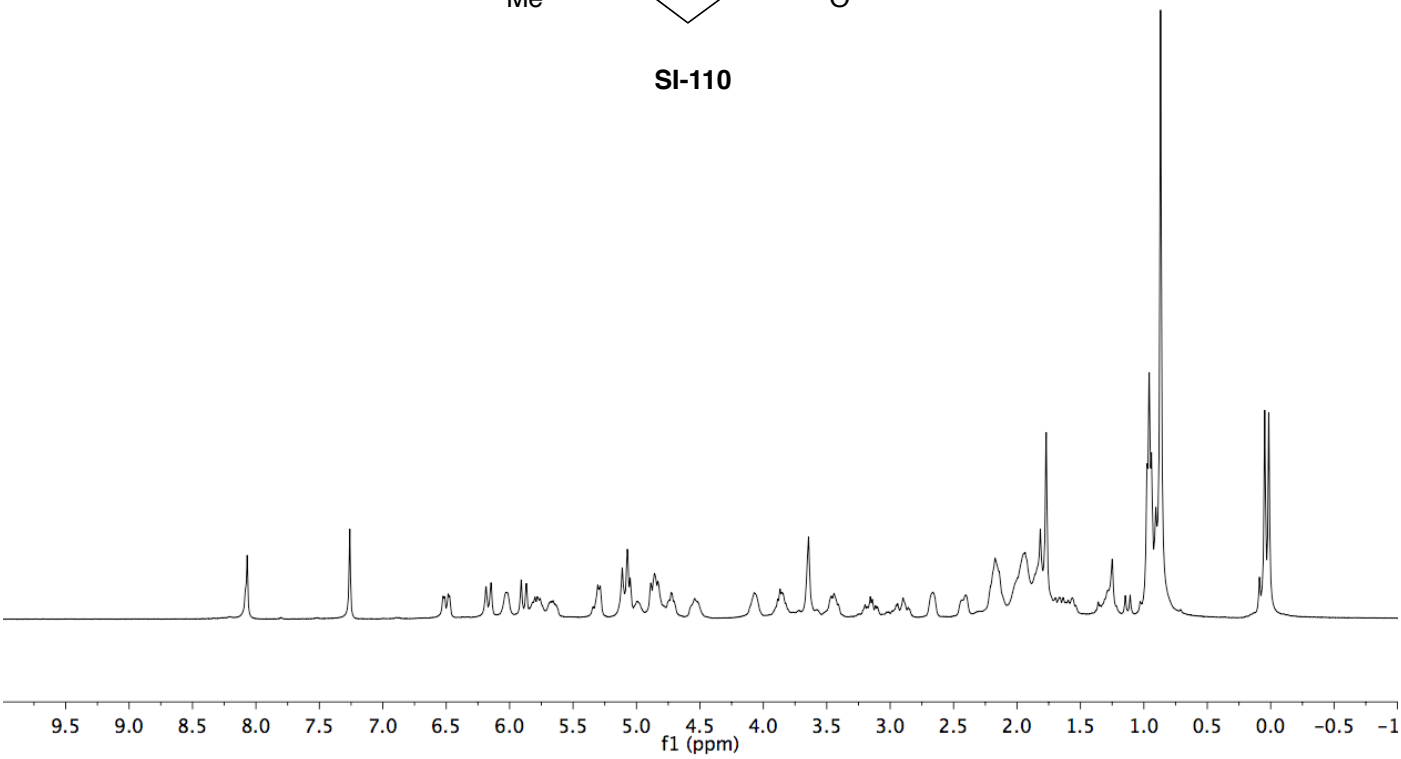
SI-109

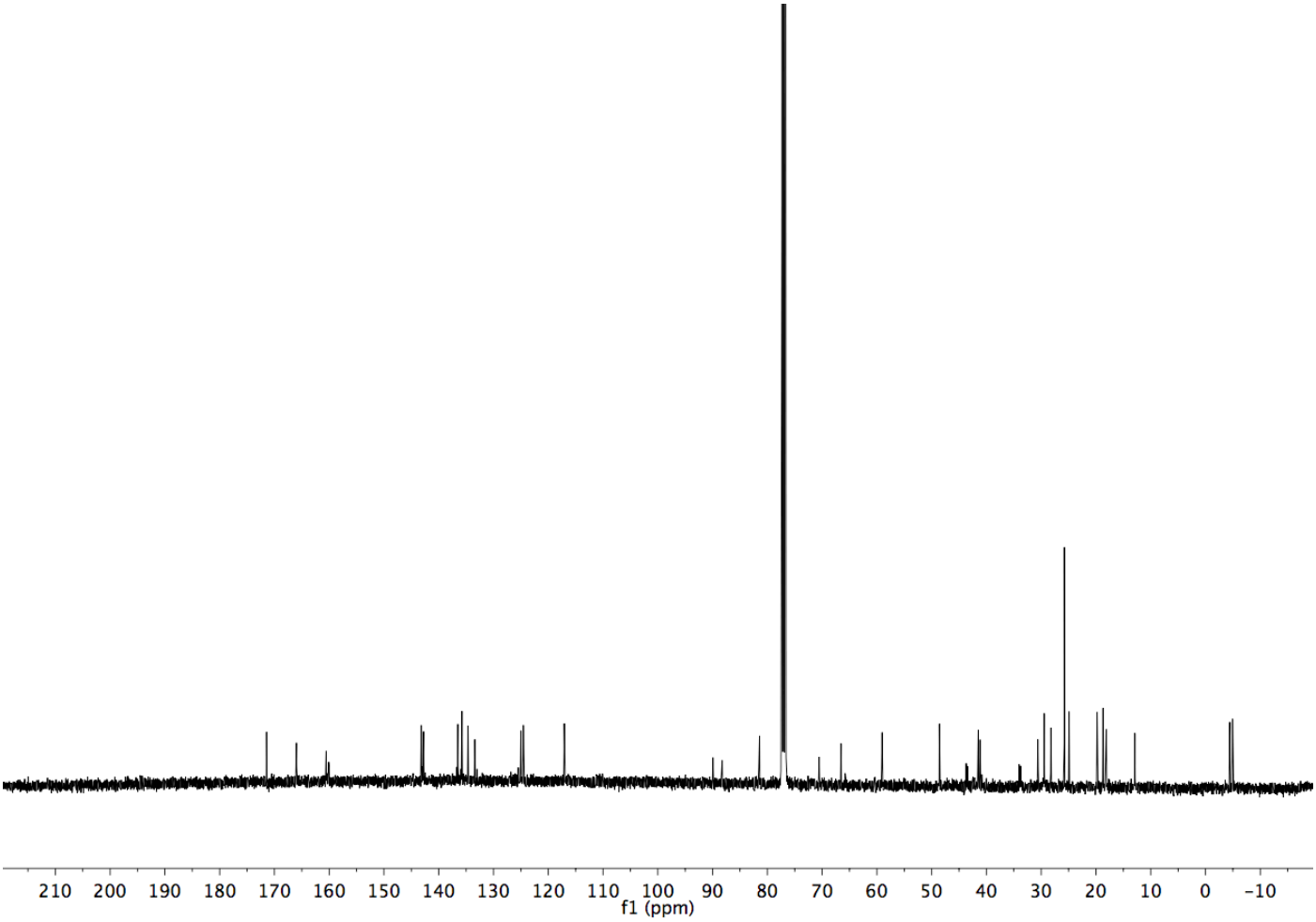
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1.
f1 (ppm)

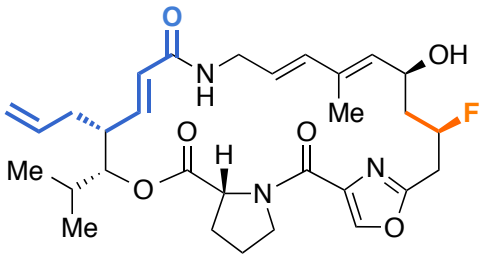

210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


O
N
H
OTBS
Me
F
O
H
O
Me
O
N
N
Me
O

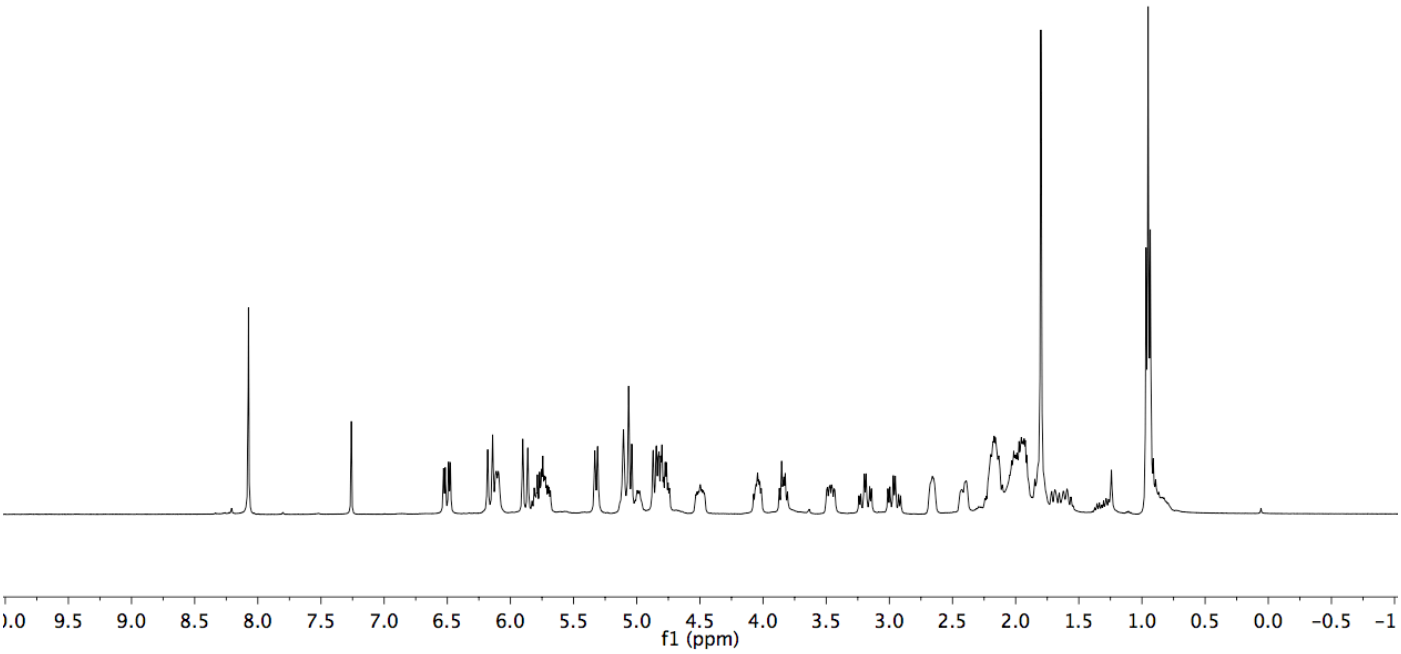
SI-110

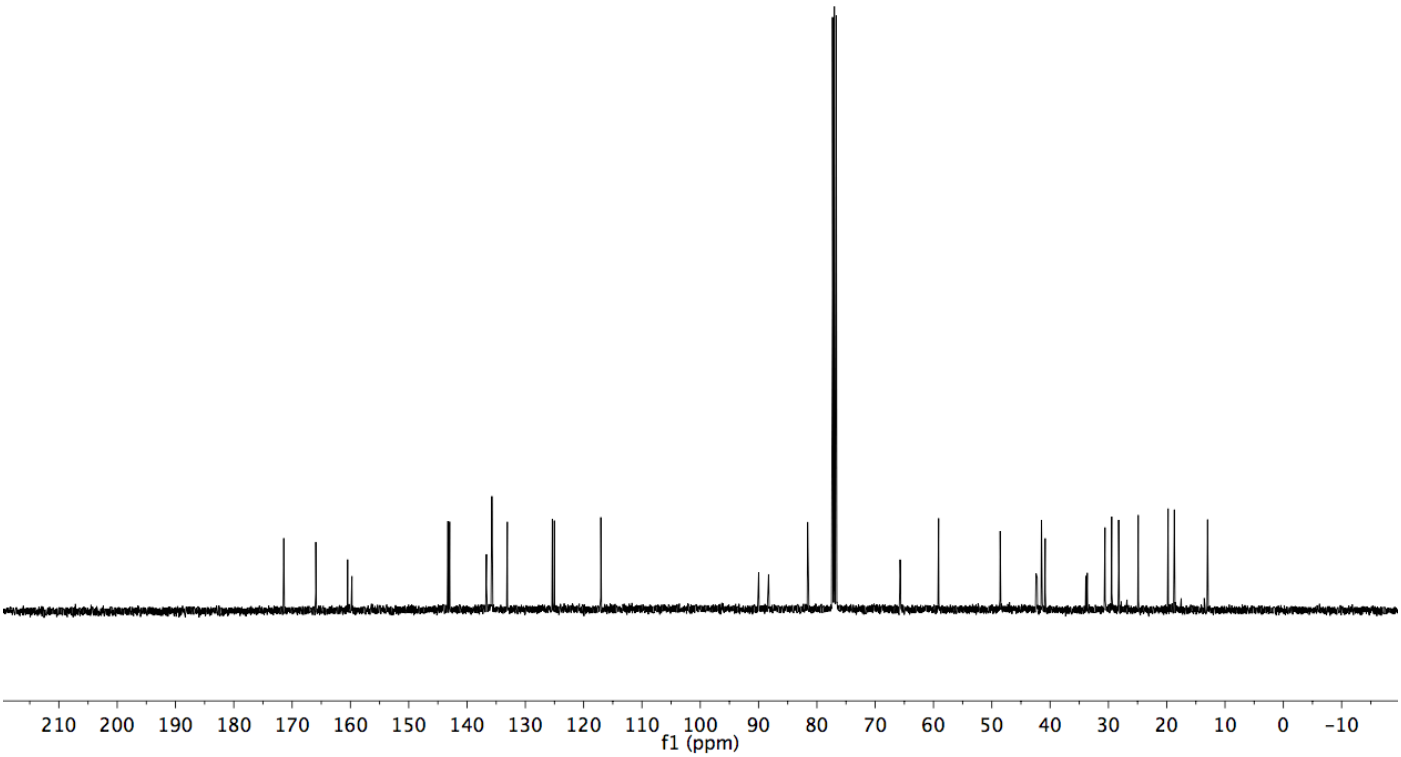

9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 -1
f1 (ppm)


210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


O
N
H
OH
Me
F
O
H
O
Me
O
N
N
Me
O

47


9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
f1 (ppm)


210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
-10
f1 (ppm)