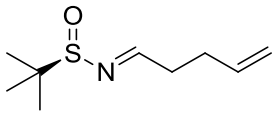
Supporting Information

Experimental Section

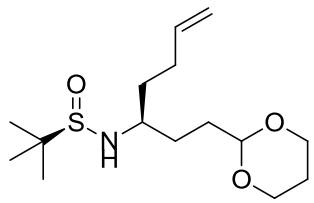
Flame-dried (under vacuum) glassware was used for all reactions. All reagents and solvents were commercial grade and purified prior to use when necessary. All polymer-supported reagents were purchased from Biotage, Inc. Thin layer chromatography (TLC) was performed on glass-backed silica gel. Visualization was accomplished with UV light, and/or the use of anisaldehyde and ceric ammonium molybdate solutions followed by charring on a hot-plate. Chromatography on silica gel was performed using Silica Gel 60 (230-400 mesh) from Sorbent Technologies. IR spectra were recorded as thin films and are reported in wavenumbers (cm^{-1}). ^{1}H & ^{13}C NMR spectra were recorded on Bruker DRX-400 (400 MHz) or Bruker AV-NMR (600 MHz) instrument. Chemical shifts are reported in ppm relative to residual solvent peaks as an internal standard set to δ 7.26, δ 77.0 ($CDCl_3$) and DMSO-d_6 2.50 ppm, 39.51 ppm for ^{1}H, ^{13}C respectively). Data are reported as follows: chemical shift, multiplicity (s = singlet, d = doublet, t = triplet, q = quartet, dd = doublet of doublets, br = broad, m = multiplet), coupling constant (Hz), integration. Optical rotations were measured on a JASCO P-2000 digital polarimeter. Concentration (c) in g/100 ml and solvent are given in parentheses. Low resolution mass spectra (LCMS) were obtained on an Agilent 1200 LCMS with electrospray

ionization. A Micromass Q-Tof API-US mass spectrometer was used to acquire high-resolution mass spectrometry (HRMS) data. The value Δ is the error in the measurement (in ppm) given by the equation $\Delta = [(M_E - M_T)/ M_T] \times 10^6$, where M_E is the experimental mass and M_T is the theoretical mass. The HRMS results were obtained with ES as the ion source and leucine enkephalin as the reference.



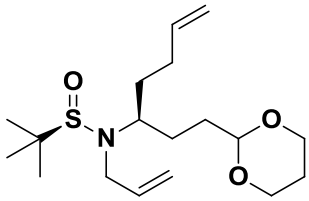
(*R*)-2-methyl-*N*-(pent-4-en-1-ylidene)propane-2-sulfinamide (**24**).

4-pentenal (**23**) (11.89 mmol, 0.5 g) was dissolved in THF (40 mL) and $Ti(OEt)_4$ (23.79 mmol, 2 eq.) was added followed by (*R*)-(+)-2-methyl-2-propanesulfinamide (2.0 mmol, 1.0 eq.). The mixture was stirred at rt for 5 h. The reaction is then quenched by addition of an equal volume of sat. $NaHCO_3$. The resulting mixture is filtered through a pad of Celite® and the filter cake rinsed washed with EtOAc. The filtrate was extracted with EtOAc (3 x 40 mL), the combined organic layer was washed with water, brine and dried over magnesium sulfate. Concentration *in vacuo* gave the crude aldimine which was purified by flash chromatography (4:1 to 1:1 Hex/EtOAc) to yield the desired product 2.11 g (95%) as a colorless oil: $[\alpha]_D^{20}$ = +276.3 (*c* = 1.00, $CHCl_3$); ^{1}H NMR (400.1 MHz, $CDCl_3$) δ (ppm): 8.08 (t, *J* = 4.4 Hz, 1H), 5.83 (m, 1H), 5.05 (m, 2H), 2.62 (m, 2H), 2.40 (q, *J* = 6.8, 2H); ^{13}C NMR (100.6 MHz, $CDCl_3$) δ (ppm): 168.7, 136.6, 115.7, 56.4, 35.2, 29.2, 22.2; HRMS (TOF, ES+) $C_9H_{18}NOS$ $[M+H]^+$ calc'd 188.1131, found 188.1130.



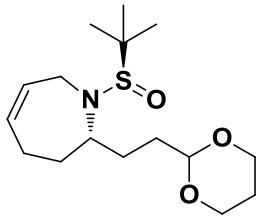
(*R*)-*N*-((*S*)-1-(1,3-dioxan-2-yl)hept-6-en-3-yl)-2-methylpropane-2-sulfinamide (**25**).

Magnesium turnings (4.99 g, 205.2 mmol) were flame dried with catalytic amount of Iodine in 500 mL reaction flask. 70 mL of THF was added, followed by dropwise addition of 2-(2-Bromoethyl)-1,3-dioxane (6.94 mL, 51.3 mmol). The reaction mixture was periodically cooled in a rt water bath to prevent refluxing. After addition of the 2-(2-bromoethyl)-1,3-dioxane solution was complete, the reaction mixture was stirred for 1 h. The solution was then transferred to a different flask and was cooled to −78 ◦C. Upon cooling, precipitate was observed and to the solid *N-tert*-Butanesulfinyl imine **24** (1.63 g, 10.26 mmol) in 20 mL THF was added dropwise to the Grignard solution, the solution was stirred for overnight at −48 ◦C and then warmed to rt. The reaction mixture was quenched with sat NH_4Cl and extracted with EtOAc (3 x 40 mL). The organic layer was dried over sodium sulfate. Concentration *in vacuo* gave crude product as >9:1 dr, which was then purified by flash chromatography (4:1 to 1:1 Hex/EtOAc) to yield the product 2.74 g (88%) as a pale yellow oil: $[\alpha]_D^{20}$ = +55.1 (*c* = 1.00, $CHCl_3$); ^{1}H NMR (400.1 MHz, $CDCl_3$) δ (ppm): 5.80 (m, 1H), 5.05 (dd, *J* = 8.7, 17.2 Hz, 1H), 4.97 (dd, *J* = 8.4 Hz, 1H), 4.51 (t, *J* = 4.4 Hz, 1H), 4.07 (dd, *J* = 10.8, 5.2 Hz, 2H), 3.75 (dt, *J* = 12.4, 2.0 Hz, 2H), 3.23 (m, 1H), 3.05 (d, *J* = 6.8 Hz, 1H), 2.15 (q, *J* = 7.6, 2H), 2.07 (m, 1H), 1.56-1.75 (m, 6H), 1.54 (m, 1H), 1.33 (d, *J* = 13.6 Hz, 1H), 1.20 (s, 9H); ^{13}C NMR (100.6 MHz, $CDCl_3$) δ (ppm): 137.9, 115.1, 101.9, 101.8, 66.8, 58.7, 56.2, 55.7, 36.9, 35.4, 31.2, 29.8, 29.7, 25.7, 25.6, 22.6; HRMS (TOF, ES+) $C_{15}H_{30}NO_3S$ $[M+H]^+$ calc'd 304.1946, found 304.1945.

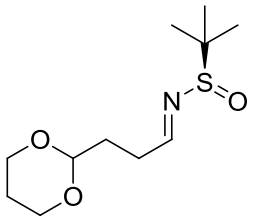


(*R*)-*N*-((*S*)-1-(1,3-dioxan-2-yl)hept-6-en-3-yl)-N-allyl-2-methylpropane-2-sulfinamide (**26**).

To a solution of **25** (303 mg, 1 mmol) in DMF (2.8 mL) at -20 ^{o}C was added 1 M LiHMDS in THF (1.76 mL, 1.76 mmol) dropwise. The mixture was stirred for 20 mins and allyl bromide (0.43 mL, 5 mmol) was added. After stirring for 2 h, the reaction was quenched with sat. NH_4Cl, extracted with EtOAc (3 x 10 mL). The organic layer was washed with water, brine and dried over Na_2SO_4. Concentration *in vacuo* gave the residue which was then purified by automated flash chromatography (4:1 Hex/EtOAc) to yield the product 274.4 mg (80%) as a pale yellow oil: $[\alpha]_D^{20}$ = -40.5 (*c* = 1.00, $CHCl_3$); ^{1}H NMR (400.1 MHz, $CDCl_3$) δ (ppm): 5.71-5.89 (m, 2H), 5.15 (m, 2H), 4.98 (m, 2H), 4.49 (t, *J* = 5.2 Hz, 1H), 4.08 (dd, *J* = 11.6, 4.4 Hz, 2H), 3.95 (dd, *J* = 16.4, 5.2 Hz, 1H), 3.73 (t, *J* = 12.4 Hz, 2H), 3.11 (dd, *J* = 16.4, 7.2 Hz, 2H), 2.93 (m, 1H), 2.17 (m, 1H), 2.05 (m, 2H), 1.87 (m, 1H), 1.70 (m, 1H), 1.62 (m, 4H), 1.32 (d, *J* = 13.6 Hz, 1H), 1.19 (s, 9H); ^{13}C NMR (100.6 MHz, $CDCl_3$) δ (ppm): 137.9, 136.1, 117.4, 114.8, 101.9, 66.8, 57.8, 45.1, 33.0, 32.8, 30.7, 27.6, 25.7, 23.6; HRMS (TOF, ES+) $C_{18}H_{34}NO_3S$ $[M+H]^+$ calc'd 344.2259, found 344.2260.



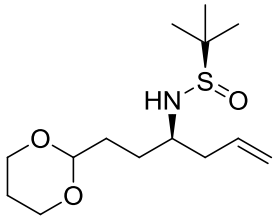
(*S*)-2-(2-(1,3-dioxan-2-yl)ethyl)-1-((*R*)-*tert*-butylsulfinyl)-2,3,4,7-tetrahydro-1H-azepine (**27**). To a solution of **26** (195.7 mg, 0.57 mmol) in CH_2Cl_2 (60 mL) was added 2nd Gen. Grubbs (24.2 mg, 0.028 mmol). The mixture was refluxed for 1 h and concentrated. The resulting crude product was purified by automated flash chromatography (4:1 to 1:1 Hex/EtOAc) to yield the desired product 140.2 mg (78%) as yellow oil: $[\alpha]_D^{20}$ = +27.5 (*c* = 0.55, $CHCl_3$); ^{1}H NMR (400.1 MHz, $CDCl_3$) δ (ppm): 5.71 (m, 1H), 5.62 (m, 1H), 4.54 (t, *J* = 4.8 Hz, 1H), 4.11 (dd, *J* = 7.4, 4.8 Hz, 2H), 3.64-3.88 (m, 4H), 3.52 (m, 1H), 2.28 (m, 2H), 2.05 (m, 2H), 1.86 (m, 1H), 1.58-1.73 (m, 4H), 1.33 (q, *J* = 13.6 Hz, 1H), 1.2 (s, 9H); ^{13}C NMR (100.6 MHz, $CDCl_3$) δ (ppm): 131.1, 128.8, 102.1, 66.8, 60.8, 58.4, 42.3, 32.3, 32.2, 27.6, 25.7, 25.0, 23.5; HRMS (TOF, ES+) $C_{16}H_{30}NO_3S$ $[M+H]^+$ calc'd 316.1946, found 316.1946.



(*R*)-*N*-(3-(1,3-dioxan-2-yl)propylidene)-2-methylpropane-2-sulfinamide (**19)**.

To a solution of 3-(1,3-dioxan-2-yl)propanal (**18**) (2.1 g, 14.6 mmol) in CH_2Cl_2 (100 mL) was added (*R*)-2-methylpropane-2-sulfinamide (2.12 g, 17.5 mmol) and $CuSO_4$ (7.0 g, 43.8 mmol). The reaction mixture was stirred at rt overnight. The mixture was filtered through a through celite pad and washed with CH_2Cl_2. Concentration *in vacuo* gave the crude product which was

purified by automated flash chromatography (4:1 to 1:1 Hex/EtOAc) to yield the desired product 1.91 g (91%) as yellow oil: $[\alpha]_D^{20}$ = -208.8 (*c* = 0.86, $CHCl_3$); ^{1}H NMR (400.1 MHz, $CDCl_3$) δ (ppm): 8.11 (t, *J* = 4.0 Hz, 1H), 4.62 (t, *J* = 4.8 Hz, 1H), 4.10 (dd, *J* = 6.0, 4.8 Hz, 2H), 3.76 (m, 2H), 2.64 (sextet, *J* = 4.0 Hz, 2H), 2.07 (m, 1H), 1.93 (m, 2H), 1.32 (dm, *J* = 13.8 Hz, 1H), 1.18 (s, 9H); ^{13}C NMR (100.6 MHz, $CDCl_3$) δ (ppm): 169.1, 101.0, 67.0, 56.7, 30.8, 30.7, 25.8, 22.5; HRMS (TOF, ES+) $C_{11}H_{22}NO_3S$ $[M+H]^+$ calc'd 248.1320, found 248.1319.



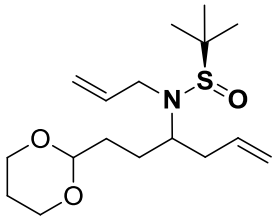
(*R*)-*N*-((*R*)-1-(1,3-dioxan-2-yl)hex-5-en-3-yl)-2-methylpropane-2-sulfinamide (**20)**.

In-Mediated allylation were done according to procedures published by Lin and co-workers. To a reaction flask containing **19** (1.1 g, 4.45 mmol) and indium powder (2.05 g, 17.8 mmol) was added saturated aqueous NaBr solution (90 mL) followed by the allyl bromide (1.54 mL, 17.8 mmol). The resulting suspension stirred at rt overnight. The reaction was quenched by the addition of saturated aqueous $NaHCO_3$ and filtered through a pad of celite. The aqueous layer was extracted with EtOAc (3x), dried over Na_2SO_4, filtered, concentrated *in vacuo* to give the crude product as >19:1 *dr*, which was then purified by flash chromatography (1:1 Hex/EtOAc) to yield the allylation product 1.12 g (87%) as a pale yellow oil: $[\alpha]_D^{20}$ = -46.4 (*c* = 1.79, $CHCl_3$); ^{1}H NMR (400.1 MHz, $CDCl_3$) δ (ppm): 5.77 (m, 1H), 5.16 (d, *J* = 4 Hz, 1H), 5.13 (s, 1H), 4.51 (t, *J* = 4.5 Hz, 1H), 4.08 (dd, *J* = 5.0, 6.3 Hz, 2H), 3.74 (dt, *J* = 10, 2.2 Hz, 2H), 3.30 (m, 1H), 3.23 (d, *J* = 6.5 Hz, 1H), 2.37 (m, 2H), 2.05 (m, 1H), 1.63 (m, 3H), 1.33 (br, *J* = 14

Hz, 1H), 1.19 (s, 9H); ^{13}C NMR (100.6 MHz, $CDCl_3$) δ (ppm): 133.9, 119.0, 101.9, 66.8, 55.8, 55.0, 40.5, 31.3, 29.2, 25.7, 22.6; HRMS (TOF, ES+) $C_{14}H_{28}NO_3S$ $[M+H]^+$ calc'd 290.1790, found 290.1790.

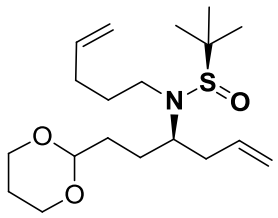
General Procedure for *N*-alkylation:

To a solution of sulfinamide **20** (1 equiv), in DMF at -20 ^oC was added LiHMDS (1 M, 1.0 equiv) and the mixture was stirred for 20 mins. Bromide (1.5 equiv.) was then added slowly to the mixture and the reaction was stirred for 3 hrs at rt. The reaction was quenched with saturated NH_4Cl solution and extracted with EtOAc (3x). The combined organic extracts were washed with water and the dried over Na_2SO_4. Filtration and concentration afforded the crude product, which was purified by flash chromatography (4:1 Hex/EtOAc).

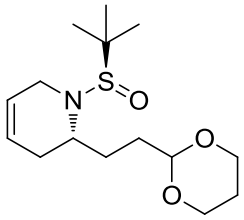


(*R*)-*N*-((*R*)-1-(1,3-dioxan-2-yl)hex-5-en-3-yl)-N-allyl-2-methylpropane-2-sulfinamide (**21**). The product was prepared according to the general procedure using allyl bromide. The reaction was run on a 1 mmol scale, to afford the product **21** as a off white gum (263.2 mg, 80%): $[\alpha]_D^{20}$ = +40.1 (*c* = 1.11, $CHCl_3$); ^{1}H NMR (400.1 MHz, $CDCl_3$) δ (ppm): 5.82 (m, 2H), 5.03-5.21 (m, 4H), 4.49 (t, *J* = 4.8 Hz, 1H), 4.07 (dd, *J* = 6.8, 4.8 Hz, 2H), 3.94 (dd, *J* = 11.6, 5.2 Hz, 1H), 3.74 (t, *J* = 12.0 Hz, 2H), 3.20 (dd, *J* = 9.6, 6.8 Hz, 1H), 3.09 (q, *J* = 6.8 Hz, 1H), 2.24-2.41 (m, 2H), 2.34 (t, *J* = 6.2 Hz, 1H), 1.83 (m, 1H), 1.65-1.73 (m, 2H), 1.62 (m, 1H), 1.33 (d, *J* = 13.6 Hz, 1H), 1.19 (s, 9H); ^{13}C NMR (100.6 MHz, $CDCl_3$) δ (ppm): 136.5, 135.9, 117.4,

117.1, 102.2, 67.0, 58.2, 45.2, 39.1, 33.0, 27.6, 25.9, 23.9; HRMS (TOF, ES+) $C_{17}H_{32}NO_3S$ $[M+H]^+$ calc'd 330.2103, found 330.2104.



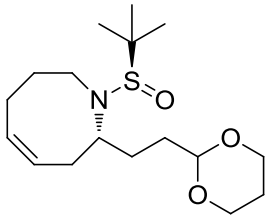
(*R*)-*N*-((*R*)-1-(1,3-dioxan-2-yl)hex-5-en-3-yl)-2-methyl-N-(pent-4-en-1-yl)propane-2-sulfinamide (**28**). The product was prepared according to the general procedure using 5-bromopent-1-ene. The reaction was run on a 1 mmol scale, to afford the product **30** as yellow oil (303.4 mg, 85 $\alpha]_D^{20}$ = +39.7 (*c* = 0.91, $CHCl_3$); ^{1}H NMR (400.1 MHz, $CDCl_3$) δ (ppm): 5.79 (m, 2H), 5.03 (m, 4H), 4.51 (t, *J* = 4.8 Hz, 1H), 4.07 (dd, *J* = 6.8, 4.8 Hz, 2H), 3.94 (dt, *J* = 12.0, 2.4 Hz, 2H), 3.23 (m, 1H), 3.06 (q, *J* = 6.4 Hz, 1H), 2.56 (m, 1H), 2.33 (m, 2H), 2.07 (m, 3H), 1.59-1.86 (m, 6H), 1.32 (d, *J* = 13.6 Hz, 1H), 1.19 (s, 9H); ^{13}C NMR (100.6 MHz, $CDCl_3$) δ (ppm): 137.8, 136.0, 117.1, 115.14, 102.3, 67.0, 66.9, 57.9, 42.8, 39.2, 33.1, 31.6, 29.6, 28.0, 24.0; HRMS (TOF, ES+) $C_{19}H_{36}NO_3S$ $[M+H]^+$ calc'd 358.2416, found 358.2416.



(*R*)-2-(2-(1,3-dioxan-2-yl)ethyl)-1-((*R*)-*tert*-butylsulfinyl)-1,2,3,6-tetrahydropyridine (**22**).

To a solution of **21** (200 mg, 0.61 mmol) in CH_2Cl_2 (65 mL) was added 2nd Gen. Grubbs (25.9 mg, 0.030 mmol). The mixture was refluxed for 1 h and concentrated. The resulting crude product was purified by automated flash chromatography (4:1 to 1:1 Hex/EtOAc) to yield the

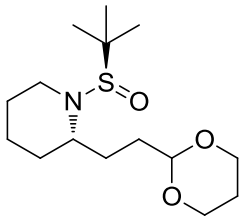
desired product 154.2 mg (84%) as off white solid: $[\alpha]_D^{20}$ = +20.7 (*c* = 1.05, $CHCl_3$); ^{1}H NMR (400.1 MHz, $CDCl_3$) δ (ppm): 5.69 (m, 2H), 4.53 (t, *J* = 5.2 Hz, 1H), 4.10 (dd, *J* = 7.6, 4.0 Hz, 2H), 3.85 (m, 1H), 3.76 (tt, *J* = 12.0, 2.8 Hz, 2H), 3.29-3.40 (m, 2H), 2.55 (m, 1H), 2.01-2.13 (m, 1H), 1.85-1.91 (m, 2H), 1.70-1.79 (m, 1H), 1.57-1.66 (m, 2H), 1.34 (d, *J* = 13.6 Hz, 1H), 1.16 (s, 9H); ^{13}C NMR (100.6 MHz, $CDCl_3$) δ (ppm): 125.26, 123.57, 102.17, 67.00, 58.62, 56.90, 36.46, 32.86, 28.16, 26.88, 25.85, 23.49; HRMS (TOF, ES+) $C_{15}H_{28}NO_3S$ $[M+H]^+$ calc'd 302.1790, found 302.1788.



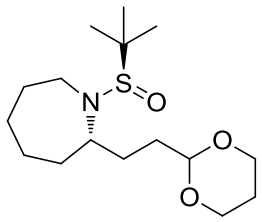
(*R*)-8-(2-(1,3-dioxan-2-yl)ethyl)-1-((*R*)-*tert*-butylsulfinyl)-1,2,3,4,7,8-hexahydroazocine (**29**). To a solution of **28** (217.8 mg, 0.61 mmol) in CH_2Cl_2 (65 mL) was added 2nd Gen. Grubbs (25.9 mg, 0.030 mmol). The mixture was refluxed for 1 h and concentrated. The resulting crude product was purified by automated flash chromatography (4:1 to 1:1 Hex/EtOAc) to yield the desired product 178.6 mg (82%) as off white solid: $[\alpha]_D^{20}$ = +24.6 (*c* = 1.16, $CHCl_3$); ^{1}H NMR (400.1 MHz, $CDCl_3$) δ (ppm): 5.75 (m, 2H), 4.52 (t, *J* = 4.4 Hz, 1H), 4.09 (m, 2H), 3.75 (m, 3H), 3.19 (m, 2H), 2.3-2.4 (m, 2H), 2.15-2.2 (m, 1H), 1.98-2.1 (m, 2H), 1.53-1.8 (m, 5H), 1.45 (m, 1H), 1.30 (d, *J* = 13.6 Hz, 1H), 1.18 (s, 9H); ^{13}C NMR (100.6 MHz, $CDCl_3$) δ (ppm): 132.3, 127.6, 102.5, 67.0, 66.9, 58.2, 45.8, 32.7, 31.2, 30.9, 27.4, 25.9, 24.0, 23.9; HRMS (TOF, ES+) $C_{17}H_{32}NO_3S$ $[M+H]^+$ calc'd 330.2103, found 330.2104.

General Procedure for Alkene-Reduction.

To a solution of sulfinamide (0.43 mmol) in EtOH (7 mL) was added Pd/C (45.6 mg, 0.43 mmol). The reaction mixture was purged and back filled with H_2 gas. The mixture was stirred at rt overnight. The mixture was filtered through celite pad and washed with CH_2Cl_2. Concentration *in vacuo* gave the crude product which was used without purification.

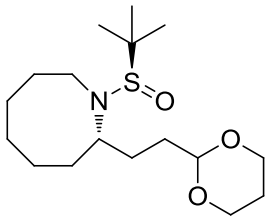


(*R*)-2-(2-(1,3-dioxan-2-yl)ethyl)-1-((*R*)-tert-butylsulfinyl)piperidine: $[\alpha]_D^{20}$ = -3.06 (*c* = 1.00, $CHCl_3$); ^{1}HNMR (400.1 MHz, $CDCl_3$) δ (ppm): 4.52 (t, *J* = 5.2 Hz, 1H), 4.09 (dd, *J* = 6.4, 4.4 Hz, 2H), 3.75 (t, *J* = 11.6 Hz, 2H), 3.19-3.26 (m, 2H), 3.04 (m, 1H), 2.02-2.12 (m, 1H), 1.77-1.92 (m, 3H), 1.46-1.72 (m, 7H), 1.34 (d, *J* = 13.6 Hz, 1H), 1.16 (s, 9H); ^{13}C NMR (100.6 MHz, $CDCl_3$) δ (ppm): 102.3, 67.1, 59.2, 58.5, 40.7, 32.7, 29.0, 26.3, 25.9, 25.7, 23.7, 19.6; HRMS (TOF, ES+) $C_{15}H_{30}NO_3S$ $[M+H]^+$ calc'd 304.1946, found 304.1946.



(*S*)-2-(2-(1,3-dioxan-2-yl)ethyl)-1-((*R*)-*tert*-butylsulfinyl)azepane: $[\alpha]_D^{20}$ = -1.7 (*c* = 0.33, $CHCl_3$); ^{1}HNMR (400.1 MHz, $CDCl_3$) δ (ppm): 4.52 (t, *J* = 5.2 Hz, 1H), 4.10 (dd, J = 6.8, 4.8 Hz, 2H), 3.75 (t, *J* = 12.0 Hz, 2H), 3.48 (q, *J* = 6.0 Hz, 1H), 3.37 (m, 1H), 3.08 (m, 1H), 2.05

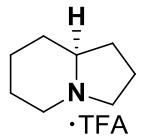
(m, 1H), 1.82-1.89 (m, 2H), 1.77 (m, 1H), 1.45-1.65 (m, 9H), 1.33 (d, *J* = 13.6 Hz, 1H), 1.21 (s, 9H); ^{13}C NMR (100.6 MHz, $CDCl_3$) δ (ppm): 101.5, 66.3, 60.8, 57.7, 42.3, 33.3, 32.1, 29.7, 27.6, 27.1, 25.3, 23.9, 23.5; HRMS (TOF, ES+) $C_{16}H_{32}NO_3S$ $[M+H]^+$ calc'd 318.2103, found 318.2101.



(*R*)-2-(2-(1,3-dioxan-2-yl)ethyl)-1-((*R*)-tert-butylsulfinyl)azocane: $[\alpha]_D^{20}$ = -16.9 (*c* = 0.34, $CHCl_3$); ^{1}HNMR (400.1 MHz, $CDCl_3$) δ (ppm): 4.51 (t, *J* = 5.2 Hz, 1H), 4.08 (m, 2H), 3.75 (tt, *J* = 12.0, 2.4 Hz, 2H), 3.31-3.38 (m, 2H), 3.14-3.25 (m, 2H), 2.01-2.12 (m, 1H), 1.81-1.89 (m, 2H), 1.57-1.74 (m, 8H), 1.52 (m, 1H), 1.30-1.44 (m, 3H), 1.2 (s, 9H); ^{13}C NMR (100.6 MHz, $CDCl_3$) δ (ppm): 102.3, 67.0, 59.7, 58.6, 43.5, 33.1, 32.8, 29.2, 28.9, 28.6, 25.9, 25.0, 24.1, 22.9; HRMS (TOF, ES+) $C_{17}H_{34}NO_3S$ $[M+H]^+$ calc'd 332.2259, found 332.2257.

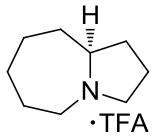
General Procedure for Ring Closure.

To the crude product cooled to 0 ^{o}C was added 5 ml of 95:5 TFA/H_2O, after stirring at rt for 45 mins the mixture was concentrated in vacuo to remove the TFA/H_2O solvent. The residue was dissolved in DCE and PS-$BH(OAc)_3$ (0.5 g, 1.08 mmol) was added and placed on a shaker overnight. The beads were filtered off and the solvent was concentrated *in vacuo* to give the crude azabicyclic product. Purification by flash chromatography gave the desired azabicylic ring product.



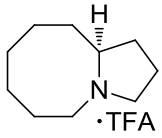
(*S*)-octahydroindolizine

(*S*)-octahydroindolizine (**1**). Flash chromatography (9:1:0.5 CH_2Cl_2/MeOH/NH_3) yield the product 10.1 mg (81% over 2-steps) as a yellow oil: $[\alpha]_D^{20}$ = + 1.9 (*c* = 1.14, EtOH); ^{1}H NMR (400.1 MHz, MeOD) δ (ppm): 4.44 (dt, *J*= 2, 4 Hz, 1H), 3.61, m, 1H), 3.37 (m, 1H), 3.12 (m, 1H), 2.98 (t, *J*= 12.6 Hz, 1H), 2.04 (m, 1H), 1.89-1.39 (m, 9H); ^{13}C NMR (100.6 MHz, MeOD) δ (ppm): 62.2, 58.2, 45.9, 31.8, 29.8, 28.9, 23.5, 23.1; HRMS (TOF, ES+) $C_8H_{16}N$ $[M+H]^+$ calc'd 126.1277, found 126.1276.



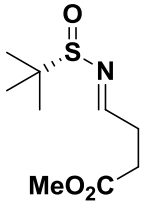
(*S*)-octahydro-1H-pyrrolo[1,2-a]azepine (**2**).

Flash chromatography (9:1:0.5 CH_2Cl_2/MeOH/NH_3) yield the product 11.9 mg (86% over 2-steps) as off white solid: $[\alpha]_D^{23}$ = +0.6 (*c* = 1.55, EtOH); ^{1}H NMR (400.1 MHz, MeOD) δ (ppm): 4.57 (s, 1H), 3.60 (m, 2H), 3.23 (m, 1H), 3.17 (m, 1H), 2.05-1.59 (m, 12H)**;** ^{13}C NMR (100.6 MHz, MeOD) δ (ppm): 62.21, 60.41, 46.51, 32.29, 31.83, 29.46, 27.57, 26.13, 25.74; HRMS (TOF, ES+) $C_{14}H_{18}O_4$ $[M+H]^+$ calc'd 140.1439, found 140.1439.

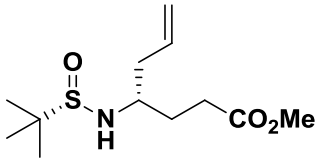


(*S*)-decahydropyrrolo[1,2-a]azocine (**3**).

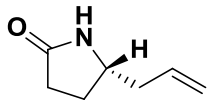
Flash chromatography (9:1:0.5 CH_2Cl_2/MeOH/NH_3) yield the product 13.3 mg (87% over 2-steps) as off white solid: $[\alpha]_D^{20}$ = + 1.1 (*c* = 1.85, EtOH); ^{1}H NMR (400.1 MHz, MeOD) δ (ppm): 3.62 (m, 2H), 3.34 (m, 1H), 3.18 (m, 2H), 1.6-2.0 (m, 14H); ^{13}C NMR (100.6 MHz, MeOD) δ (ppm): 60.7, 57.4, 44.2, 30.8, 28.1, 27.9, 24.6, 24.1, 24.0, 23.2; HRMS (TOF, ES+) $C_{10}H_{20}N$ $[M+H]^+$ calc'd 154.1596, found 154.1594.



(*S*)-methyl 4-((*tert*-butylsulfinyl)imino)butanoate (**31**). To a solution of methyl 4-oxobutanoate (**30**) (10 g, 86.2 mmol) in CH_2Cl_2 (500 mL) was added (*S*)-2-methylpropane-2-sulfinamide (12.9 g, 106.2 mmol) and $CuSO_4$ (54.7 g, 344.0 mmol). The reaction mixture was stirred at rt overnight. The mixture was filtered through a pad of celite and washed with CH_2Cl_2. Concentration *in vacuo* gave the crude product which was purified by automated flash chromatography (4:1 to 1:1 Hex/EtOAc) to yield the desired product 17.9 g (95%) as yellow oil: $[\alpha]_D^{20}$ = +178.1 (*c* = 1.67, $CHCl_3$); ^{1}H NMR (400.1 MHz, $CDCl_3$) δ (ppm): 8.13 (t, *J* = 2.8 Hz, 1H), 3.68 (s, 3H), 2.82-2.94 (m, 2H), 2.70-2.82 (m, 1H), 2.59-2.67 (m, 1H), 1.17 (s, 9H); ^{13}C NMR (100.6 MHz, $CDCl_3$) δ (ppm): 172.4, 167.3, 56.9, 51.9, 31.2, 29.2, 22.4; HRMS (TOF, ES+) $C_9H_{18}NO_3S$ $[M+H]^+$ calc'd 220.1007, found 220.1007.



(*S*)-methyl-4-((*S*)-1,1-dimethylethylsulfinamido)hept-6-enoate (**32**). In-Mediated allylation were done according to procedures previously shown above for **20**. The reaction was run on a 50 mmol scale, to afford the crude product as >19:1 *dr*, which was then purified by flash chromatography (1:1 Hex/EtOAc) to yield the allylation product 11.5 g (88%) as yellow oil: $[\alpha]_D^{20}$ = +45.7 (*c* = 0.95, $CHCl_3$); ^{1}H NMR (400.1 MHz, $CDCl_3$) δ (ppm): 5.78 (m, 1H), 5.15 (m, 2H), 3.67 (s, 3H), 3.40 (m, 1H), 3.22 (d, *J*= 7.2 Hz, 1H), 2.40 (m, 3H), 1.90 (m, 1H), 1.75 (m, 1H), 1.20 (s, 9H); ^{13}C NMR (100.6 MHz, $CDCl_3$) δ (ppm): 173.9, 133.6, 119.6, 56.1, 55.1, 51.9, 40.1, 30.5, 30.1, 22.8; HRMS (TOF, ES+) $C_{12}H_{24}NO_3S$ $[M+H]^+$ calc'd 262.1477, found 262.1476.

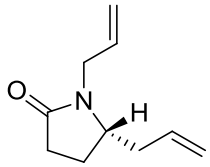


(*S*)-5-allylpyrrolidin-2-one (**33**). To a solution of compound **32** (2.61 g, 10 mmol) in methanol (100 mL) was added 10 mL of 12 N HCl aqueous solution at room temperature. The resultant mixture was then stirred at rt for 2 h. After concentrated, the residue was dissolved in 150 mL CH_2Cl_2 and 200 mL of saturated aqueous Na_2CO_3 was added. After overnight, the mixture is extracted with CH_2Cl_2; combined organic extracts were washed with water and brine and dried over Na_2SO_4. Filtration and concentration afforded the crude product, which was purified by flash chromatography (1:1 Hex/EtOAc) to yield the desired product 1.21 g (97%) as brown oil: $[\alpha]_D^{20}$ = +2.5 (*c* = 1.16, $CHCl_3$); ^{1}H NMR (400.1 MHz, $CDCl_3$) δ (ppm); 6.43 (br s, 1H), 5.74 (m, 1H), 5.11 (d, *J* = 12.7 Hz, 2H), 3.70 (q, *J* = 6.5 Hz, 1H), 2.32 (m, 2H), 2.22 (m, 3H), 1.76

(m, 1H); ^{13}C NMR (100.6 MHz, $CDCl_3$) δ (ppm): 173.4, 153.5, 146.9, 130.5, 125.5, 125.2, 116.6, 113.9, 111.9, 60.6, 55.7, 34.1, 28.6, 14.2; HRMS (TOF, ES+) $C_7H_{12}NO$ $[M+H]^+$ calc'd 126.0919, found 126.0921.

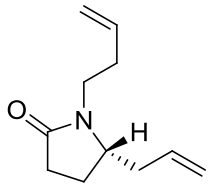
General Procedure for lactam *N*-alkylation:

To a solution of lactam **33** (1 equiv), in DMF at 0 ^oC was added NaH (1.02 equiv) and the mixture was stirred for 10 mins and additional 10 mins at rt. At 0 ^oC bromide (1.5 equiv.) was then added slowly to the mixture and the reaction was warmed to rt and stirred for 2 hrs. The reaction was quenched with water and extracted with EtOAc (3x). The combined organic extract was the dried over Na_2SO_4. Filtration and concentration afforded the crude product, which was purified by flash chromatography (1:1 Hex/EtOAc).



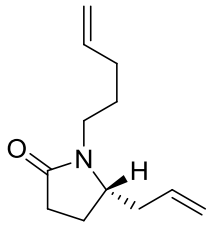
(*S*)-1,5-diallylpyrrolidin-2-one.

The product was prepared according to the general procedure using allyl bromide. The reaction was run on a 5 mmol scale, to afford the product as a light brown oil (800.3 mg, 97%): $[\alpha]_D^{20}$ = -21.4 (*c* = 0.44, $CHCl_3$); ^{1}H NMR (400.1 MHz, $CDCl_3$) δ (ppm): 5.70 (m, 2H), 5.17 (m, 4H), 4.33 (dd, *J* = 10.4, 5.2 Hz, 1H), 3.67 (septet, *J* = 4.0 Hz, 1H), 3.55 (dd, *J* = 7.2 Hz, 1H), 2.8-2.47 (m, 3H), 2.05-2.23 (m, 2H), 1.77 (m, 1H); ^{13}C NMR (100.6 MHz, $CDCl_3$) δ (ppm): 175.03, 132.93, 132.89, 56.79, 43.25, 37.48, 30.18, 23.43; HRMS (TOF, ES+) $C_{10}H_{15}NO$ $[M+H]^+$ calc'd 166.1228, found 166.1223.



(*S*)-5-allyl-1-(but-3-en-1-yl)pyrrolidin-2-one.

The product was prepared according to the general procedure using 4-bromobut-1-ene. The reaction was run on a 5 mmol scale, to afford the product as colorless oil (868.2 mg, 97%): $[\alpha]_D^{20}$ = -26.3 (*c* = 0.73, $CHCl_3$); ^1H NMR (400.1 MHz, $CDCl_3$) δ (ppm): 5.66-5.82 (m, 2H), 5.03-5.18 (m, 4H), 3.66-3.80 (m, 2H), 2.97 (m, 1H), 2.18-2.57 (m, 7H), 1.69-1.78 (m, 1H)**;** ^{13}C NMR (100.6 MHz, $CDCl_3$) δ (ppm): 175.3, 135.3, 132.9, 118.9, 117.0, 57.0, 39.7, 37.6, 31.9, 30.3, 23.6; HRMS (TOF, ES+) $C_{11}H_{18}NO$ $[M+H]^+$ calc'd 180.1388, found 180.1387.

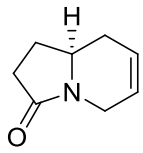


(*S*)-5-allyl-1-(pent-4-en-1-yl)pyrrolidin-2-one.

The product was prepared according to the general procedure using 5-bromopent-1-ene. The reaction was run on a 5 mmol scale, to afford the product as colorless oil (916.8 mg, 95%): $[\alpha]_D^{20}$ = -25.3 (*c* = 0.84, $CHCl_3$); ^1H NMR (400.1 MHz, $CDCl_3$) δ (ppm): 5.65-5.86 (m, 2H), 4.97-5.17 (m, 4H), 3.61-3.69 (m, 2H), 2.93 (m, 1H), 2.22-2.44 (m, 3H), 2.10-2.20 (m, 1H), 2.07 (m, 3H), 1.55-1.79 (m, 3H)**;** ^{13}C NMR (100.6 MHz, $CDCl_3$) δ (ppm): 175.2, 137.8, 132.9, 118.9, 115.3, 57.0, 40.0, 37.7, 31.3, 30.3, 26.7, 23.6; HRMS (TOF, ES+) $C_{12}H_{19}NO$ $[M+H]^+$ calc'd 194.2931, found 194.2929.

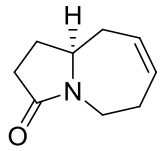
General Procedure for ring closing metathesis of *N*-alkyl lactam:

To a solution of N-alkyl-lactam (1 equiv), in CH_2Cl_2 was added 2nd Gen. Grubbs (0.05 equiv). The mixture was refluxed for 1 – 2 h and concentrated. The resulting crude product was purified by automated flash chromatography (1:1 Hex/EtOAc) to yield the desired product.



(*S*)-1,2,8,8a-tetrahydroindolizin-3(5H)-one (**34**).

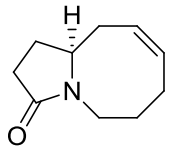
The product was prepared according to the general procedure. The reaction was run on a 3 mmol scale, to afford the product as a brown oil (316.5 mg, 77%): $[\alpha]_D^{20}$ = -27.3 (*c* = 0.62, $CHCl_3$); ^{1}H NMR (400.1 MHz, $CDCl_3$) δ (ppm): 5.78 (m, 1H), 5.69 (m, 1H), 4.24 (dd, *J* = 16.0, 2.5 Hz, 1H), 3.55 (m, 2H), 2.25-2.42 (m, 4H), 1.99 (m, 2H), 1.68 (m, 1H); ^{13}C NMR (100.6 MHz, $CDCl_3$) δ (ppm): 174.4, 124.3, 123.6, 53.1, 40.5, 32.6, 30.1, 25.7; HRMS (TOF, ES+) $C_8H_{12}NO$ $[M+H]^+$ calc'd 138.0919, found 138.0916.



(*S*)-5,6,9,9a-tetrahydro-1H-pyrrolo[1,2-a]azepin-3(2H)-one (**35**).

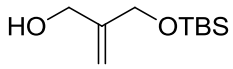
The product was prepared according to the general procedure. The reaction was run on a 3 mmol scale, to afford the product as colorless oil (339.8 mg, 75%): $[\alpha]_D^{20}$ = -22.3 (*c* = 0.52, $CHCl_3$); ^{1}H NMR (400.1 MHz, MeOD) δ (ppm): 5.89 (m,1H), 5.80 (m, 1H), 3.81 (m, 2H), 3.08 (dt, *J* = 1.6, 8 Hz, 1H), 2.4-2.2 (m, 7H), 1.66 (m, 1H); ^{13}C NMR (100.6 MHz, MeOD) δ

(ppm):176.89, 132.37, 129.76, 60.49, 42.61, 36.90, 31.34, 28.61, 26.48; HRMS (TOF, ES+) $C_9H_{14}NO$ $[M+H]^+$ calc'd 152.1119, found 152.1116.



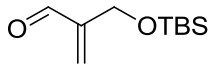
(*S*)-1,2,6,7,10,10a-hexahydropyrrolo[1,2-a]azocin-3(5H)-one (**36**).

The product was prepared according to the general procedure. The reaction was run on a 3 mmol scale, to afford the product as colorless oil (252.5 mg, 51%): $[\alpha]_D^{20}$ = -20.8 (*c* = 0.42, $CHCl_3$); ^{1}H NMR (400.1 MHz, $CDCl_3$) δ (ppm): 5.81 (m, 1H), 5.71 (m, 1H), 3.81 (dt, *J* = 13.6, 4.0 Hz, 1H), 3.58 (septet, *J* = 4.8 Hz, 1H), 2.74 (m, 1H), 2.34-2.45 (m, 2H), 2.21-2.32 (m, 2H), 2.11-2.20 (m, 2H), 1.97-2.10 (m, 2H), 1.64-1.76 (m, 1H), 1.48-1.52 (m, 1H); ^{13}C NMR (100.6 MHz, $CDCl_3$) δ (ppm): 175.9, 133.4, 125.8, 61.6, 42.9, 33.1, 30.5, 26.9, 24.6, 24.5; HRMS (TOF, ES+) $C_{10}H_{16}NO$ $[M+H]^+$ calc'd 166.1232, found 166.1233.

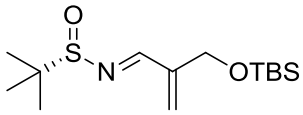


2-(((*tert*-butyldimethylsilyl)oxy)methyl)prop-2-en-1-ol. To a flame-dried flask was added 350 mL dry THF, followed by addition of NaH (2.74 g, 113.5 mmol). To this solution at 0°C was added 2-methylenepropane-1,3-diol (10 g, 113.5 mmol) drop wise. Mixture was then brought to room temperature and stirred for 45 min. *Tert*-butyldimethylsilyl chloride (17.11 g, 113.5 mmol) was added in one batch and stirring was continued for an additional 50 min. until complete by TLC. Reaction quenched with H_2O, and extracted 3 times with ethyl acetate, washed with brine, dried with anhydrous $MgSO_4$, and concentrated *in vacuo*. Purification by flash chromatography (4:1 to 1:1 Hex/EtOAc) yielded the product in 20.66 g (89%) as a clear

oil: ^{1}H NMR (400.1 MHz, $CDCl_3$) δ (ppm): 5.08 (d, J = 7.4 Hz, 2H), 4.25 (s, 2H), 4.17 (d, J = 6.0 Hz, 2H), 1.92 (t, J = 6.0 Hz, 1H), 0.92 (s, 9H), 0.09 (s, 6H); ^{13}C NMR (100.6 MHz, $CDCl_3$) δ (ppm): 147.35, 111.08, 65.07, 64.67, 25.78, 18.21, -5.52; HRMS (TOF, ES+) $C_{10}H_{23}O_2Si$ [M+H]+ calc'd 203.1467, found 203.1466.

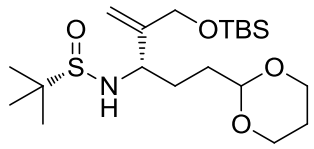


2-(((tert-butyldimethylsilyl)oxy)methyl)acrylaldehyde. In a flame dried flask, alcohol (13.687 g, 67.63 mmol) was dissolved in 200 mL DCM. While stirring, MnO_2 (29.4 g, 338 mmol) was added in two batches. Mixture was then stirred for 6 h, until reaction was determined complete by TLC. Solution was filtered through celite, concentrated *in vacuo*, and purified by flash chromatography (4:1 Hex/EtOAc) to yield product in 12.71g (89%) as clear oil. : ^{1}H NMR (400.1 MHz, $CDCl_3$) δ (ppm): 9.62 (s, 1H), 6.52 (s, 1H) 6.11 (s, 1H), 4.40 (s, 2H), 0.92 (s, 9H), 0.09 (s, 6H); ^{13}C NMR (100.6 MHz, $CDCl_3$) δ (ppm): 193.86, 149.74, 133.05, 59.79, 26.06, 18.52, -5.28; HRMS (TOF, ES+) $C_{10}H_{21}O_2Si$ [M+H]+ calc'd 201.1311, found 201.1312.

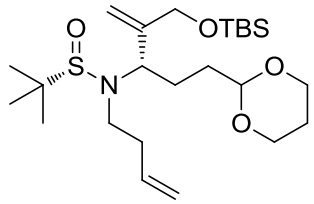


(*S*)-*N*-(2-(((*tert*-butyldimethylsilyl)oxy)methyl)allylidene)-2-methylpropane-2-sulfinamide (**46**). To a solution of aldehyde (9.00 g, 45 mmol) in 400 mL DCM was added (*S*)-2-methylpropane-2-sulfinamide (6.54 g, 54 mmol) and $CuSO_4$ (14.00 g, 90 mmol). Solution stirred at room temperature for 16 h. Mixture filtered through a pad of celite, with DCM as an eluent. Solution was then concentrated *in vacuo* and purified by column chromatography (4:1 Hex/EtOAc) to yield product in 10.75 g (79%). $[\alpha]_D^{20}$ = + 27.276 (*c*= 0.01, MeOH); ^{1}H NMR

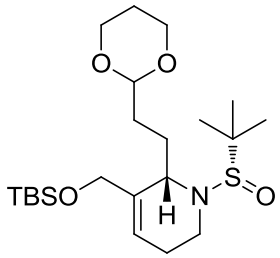
(400.1 MHz, $CDCl_3$) δ (ppm): 8.26 (s, 1H), 6.13 (s, 1H), 5.82 (s, 1H), 4.48 (dt, J=16, 7 Hz, 2H), 1.20 (s, 9H), 0.93 (s, 9H), 0.09 (s, 6H); ^{13}C NMR (100.6 MHz, $CDCl_3$) δ (ppm): 163.32, 145.25, 127.42, 61.08, 57.62, 26.09, 22.70, 18.57, -5.23; HRMS (TOF, ES+) $C_{14}H_{30}O_2SiS$ [M+H]+ calc'd 304.1767, found 304.1765.



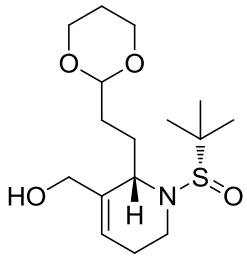
(*S*)-*N*-((*S*)-2-(((*tert*-butyldimethylsilyl)oxy)methyl)-5-(1,3-dioxan-2-yl)pent-1-en-3-yl)-2-methylpropane-2-sulfinamide (**48**). In a flame dried flask under Argon gas was added (2-(1,3-dioxan-2-yl)ethyl)magnesium bromide (19.8 mL, 0.5 M in THF) to 30 mL THF. Mixture was then cooled to -78^o C, and aldimine **46** (1.00 g, 3.3 mmol) was added drop wise as a solution in 20 mL THF. Reaction was then warmed to -48^o C and stirred 16 h. Reaction was quenched with NH_4Cl and brought to room temperature. Extracted 3 times with ethyl acetate, organic layers combined and dried with Na_2SO_4, concentrated *in vacuo*, and purified by column chromatography (1:1 Hex/EtOAc) to afford product in 1.13 g (80%) as a clear oil: $[\alpha]_D^{20}$ = +1.596 (*c*= 0.01, MeOH); ^1H NMR (400.1 MHz, $CDCl_3$) δ (ppm): 5.30 (s, 1H), 5.20 (s, 1H), 5.07 (s, 1H), 4.50 (t, J= 5 Hz, 1H), 4.22 (q, J = 13.5, 18.7 Hz, 2H), 4.07 (dd, J = 5.0, 7.0 Hz, 2H), 3.76 (m, 3H), 3.70 (d, J = 7 Hz, 1H), 2.04 (m, 1H), 1.70 (m, 3H), 1.31 (br d, J = 13.6 Hz, 1H), 1.20 (s, 9H), 0.91 (s, 9H), 0.08 (s, 6H); ^{13}C NMR (100.6 MHz, $CDCl_3$) δ (ppm): 148.66, 112.74, 102.12, 67.08, 64.75, 59.33, 56.00, 31.81, 29.48, 26.14, 26.01, 22.92, 18.55, -5.20; HRMS (TOF, ES+) $C_{20}H_{42}O_4SiS$ [M+H]+ calc'd 420.2604, found 420.2603.



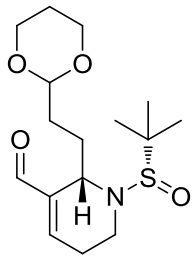
(*S*)-*N*-(but-3-en-1-yl)-*N*-((*S*)-2-(((tert-butyldimethylsilyl)oxy)methyl)-5-(1,3-dioxan-2-yl)pent-1-en-3-yl)-2-methylpropane-2-sulfinamide **(49).** To a solution of sulfinamide **48** (100 mg, 0.24 mmol) in 3 mL THF at -78 ^{o}C was added HMPA (83 µL, 0.48 mmol) and ^{n}BuLi (94 µL, 2.5 M, 0.48 mmol). The mixture was stirred for 30 mins and a pre-cooled solution of but-3-enyl-trifluoromethanesulfonate (60 mg, 0.29 mmol) in 1 mL THF was then added slowly to the mixture. The mixture was stirred at -78 ^{o}C for 30 mins. The reaction was quenched with water and extracted with EtOAc (3x). The combined organic extracts were washed with brine and dried over Na_2SO_4. Filtration and concentration afforded the crude product, which was purified by flash chromatography (1:1 Hex/EtOAc) to afford the product as a pale yellow oil (56 mg, 87% yield brsm): $[\alpha]_D^{20}$ = -2.53 (*c* = 1.00, $CHCl_3$); ^{1}H NMR (400.1 MHz, $CDCl_3$) δ (ppm): 5.67-5.77 (m, 1H), 5.32 (brd, *J* = 1.2 Hz,1H), 5.13 (s, 1H), 5.03 (dd, *J* = 17.2, 1.6 Hz, 1H), 5.02 (d, *J* = 10.0 Hz, 1H), 4.52 (t, *J* = 4.8 Hz, 1H), 4.05-4.08 (m, 4H), 3.72 (dt, *J* = 12.0, 2.4 Hz, 2H), 3.56 (dd, *J* = 10.8, 4.4 Hz, 1H), 3.29 (m, 1H), 2.58 (m, 1H), 2.38 (m, 1H), 2.25 (m, 1H), 1.95-2.23 (m, 3H), 1.67 (m, 1H), 1.50 (m, 1H), 1.32 (dm, *J* = 13.8 Hz, 1H), 1.14 (s, 9H), 0.89 (s, 9H), 0.05 (d, *J* = 8.0 Hz, 6H); ^{13}C NMR (100.6 MHz, $CDCl_3$) δ (ppm): 145.6, 135.3, 116.6, 112.9, 102.2, 67.0, 65.0, 61.7, 57.6, 42.2, 34.3, 32.8, 26.0, 25.9, 24.9, 23.7, 18.4, -5.1, -5.2; HRMS (TOF, ES+) $C_{24}H_{48}NO_4SiS$ $[M+H]^+$ calc'd 474.3073, found 474.3074.



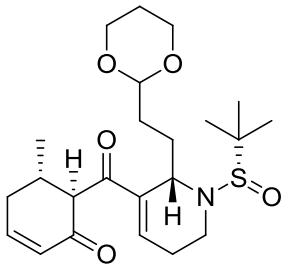
(*S*)-6-(2-(1,3-dioxan-2-yl)ethyl)-5-(((tert-butyldimethylsilyl)oxy)methyl)-1-((*S*)-tert-butylsulfinyl)-1,2,3,6-tetrahydropyridine. To a solution of **49** (1.2 g, 2.54 mmol) in CH_2Cl_2 (271 mL) was added 2nd Gen. Grubbs (107.7 mg, 0.127 mmol). The mixture was refluxed for 1 h and concentrated. The resulting crude product was purified by automated flash chromatography (4:1 to 1:1 Hex/EtOAc) to yield the desired product 1.005 g (89%) as yellow oil: $[\alpha]_D^{20}$ = +2.6 (*c* = 1.81, $CHCl_3$); ^{1}H NMR (400.1 MHz, $CDCl_3$) δ (ppm): 5.75 (s, 1H), 4.49 (t, *J*= 4.8 Hz, 1 H), 4.09 (m, 4H), 3.73 (dt, *J* = 12.0, 2.4 Hz, 3H), 3.53 (dd, *J* = 14.0, 6.4 Hz, 3H), 3.12 (m, 1H), 2.45 (m, 1H), 2.05 (m, 1H), 1.87-1.79 (m, 1H), 1.78-1.69 (m, 2H), 1.66-1.58 (m, 2H), 1.32 (br d, *J*= 13.2 Hz, 1H), 1.20 (s, 9H), 0.90 (s, 9H), 0.06 (s, 6H); ^{13}C NMR (100.6 MHz, $CDCl_3$) δ (ppm): 139.0, 122.3, 102.3, 67.0, 65.6, 58.9, 58.8, 37.8, 32.3, 27.9, 26.1, 26.0, 25.9, 25.2, 23.8, 18.5, -5.1, -5.3; HRMS (TOF, ES+) $C_{22}H_{44}NO_4SiS$ $[M+H]^+$ calc'd 446.2760, found 446.2762.



((*S*)-2-(2-(1,3-dioxan-2-yl)ethyl)-1-((*S*)-tert-butylsulfinyl)-1,2,5,6-tetrahydropyridin-3-yl)methanol. To a solution of silyl ether (375 mg, 0.84 mmol) in THF (35 mL) under argon was added 1.0 M TBAF (1.3 mL, 1.26 mmol) dropwise at 0 ^{o}C. The mixture was warmed to rt and stirred for 2 h. The reaction was quenched with saturated NH_4Cl solution and extracted with EtOAc (3x). The combined organic extracts were washed with water and the dried over Na_2SO_4. Filtration and concentration afforded the crude product, which was purified by flash chromatography (9:1 CH_2Cl_2/MeOH) to afford the product as yellow oil (267 mg, 96%): $[\alpha]_D^{20}$ = +5.45 (*c* = 4.7, $CHCl_3$); ^{1}H NMR (400.1 MHz, $CDCl_3$) δ (ppm): 5.82 (br s, 1H), 4.52 (t, *J* = 4.8 Hz, 1H), 4.04 (m, 4H), 3.81 (br d, *J* = 7.2 Hz, 1H), 3.74 (dt, *J* = 2.4, 10 Hz, 2H), 3.57 (q, *J*= 7.2 Hz, 1H), 3.13 (m, 1H), 2.49 (m, 1H), 2.17 (m, 2H), 1.88 (m, 2H), 1.77 (m, 2H), 1.62 (m, 1H), 1.33 (d, *J*= 11 Hz, 1H), 1.21 (s, 9H); ^{13}C NMR (100.6 MHz, $CDCl_3$) δ (ppm): 139.81, 124.20, 102.17, 67.05, 65.46, 59.43, 58.97, 37.43, 32.33, 27.80, 25.88, 25.23, 23.87; HRMS (TOF, ES+) $C_{16}H_{30}NO_4S$ $[M+H]^+$ calc'd 332.1896, found 332.1898.



(*S*)-2-(2-(1,3-dioxan-2-yl)ethyl)-1-((*S*)-tert-butylsulfinyl)-1,2,5,6-tetrahydropyridine-3-carbaldehyde (**45**). To a solution of alcohol (1.69 g, 5.11 mmol) in THF (300 mL) under argon was added MnO_2 (8.87 g, 102.1 mmol). The mixture was stirred at rt overnight. Filtration over celite and concentration afforded the pure product in 99% yield: $[\alpha]_D^{20}$ = +40.0 (*c* = 0.3, $CHCl_3$); ^{1}H NMR (400.1 MHz, $CDCl_3$) δ (ppm): 9.34 (s, 1H), 6.91 (t, *J* = 4 Hz, 1H), 4.51 (t, *J* = 4.4 Hz, 1H), 4.05 (m, 3H), 3.70 (m, 3H), 3.23 (m, 1H), 2.84 (m, 1H), 2.17 (dt, *J* = 5.2, 20 Hz, 1H), 2.04 (m, 1H), 1.7 (m, 4H), 1.32 (br d, *J* = 12.4 Hz, 1H), 1.20 (s, 9H) ; ^{13}C NMR (100.6 MHz, $CDCl_3$) δ (ppm): 192.05, 150.64, 143.48, 102.11, 67.02, 59.36, 57.12, 36.48, 32.67, 28.57, 26.76, 25.88, 23.50; HRMS (TOF, ES+) $C_{16}H_{28}NO_4S$ $[M+H]^+$ calc'd 330.1739, found 330.1741.

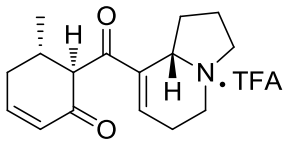


(5*S*,6*R*)-6-((*S*)-2-(2-(1,3-dioxan-2-yl)ethyl)-1-((*S*)-*tert*-butylsulfinyl)-1,2,5,6-tetrahydropyridine-3-carbonyl)-5-methylcyclohex-2-enone (**50**). To a solution of (*S*)-5-methylcyclohex-2-enone (**44**) (43.5 mg, 0.395 mmol) in CH_2Cl_2 (2 mL) at -78 ^{o}C was added *N*-ethyl-*N*-isopropylamine (*i*Pr_2NEt) (0.103 mL, 0.592 mmol) and ^{n}Bu_2BOTf (0.592 mL, 0.592

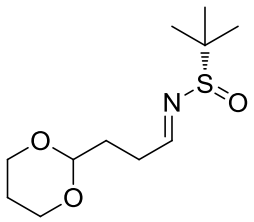
mmol). The mixture was stirred at 78 ^{o}C for 1 h. Aldehyde **45** (86.6 mg, 0.263 mmol) dissolved in CH_2Cl_2 (2 mL) was added dropwise. The mixture was warm to rt and stir for 1.5 h. The reaction mixture was cool -78 ^{o}C and quenched with 0.1 mL each of MeOH and H_2O_2, diluted with $NaHCO_3$ and extracted with CH_2Cl_2 (3x). The combined organic extracts were washed with water and the dried over Na_2SO_4. Filtration and concentration afforded the crude product, which was used in the next step without purification.

To a stirred solution of DMSO (38 μL, 0.53 mmol) in CH_2Cl_2 (7 mL) at -78 ºC was added drop-wise trifluoroacetic anhydride (50 μL, 0.35 mmol). After stirring at -78 ºC for 30 mins, a pre-cooled solution of the crude alcohol dissolved in CH_2Cl_2 (4 mL). The reaction mixture was stirred at -78 ºC for 1 h, then Et_3N (0.18 mL, 1.32 mmol) was added drop-wise. The solution was further stirred at −78 ºC for a further 20 min, then warmed to rt and held for 1 h.

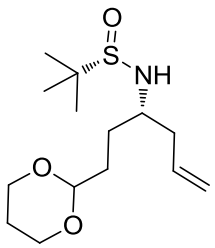
The reaction was quenched by the addition of saturated aqueous $NaHCO_3$ and the aqueous layer was extracted with CH_2Cl_2 (5x), dried over Na_2SO_4, filtered, concentrated *in vacuo* to give the crude product, which was then purified by flash chromatography (1:20 MeOH/EtOAc) to yield **50** in 5:1 d.r., 88.4 mg (77% over 2-steps) as a pale yellow oil: $[\alpha]_D^{20}$ = +3.4 (*c* = 1.55, $CHCl_3$); ^{1}H NMR (400.1 MHz, $CDCl_3$) δ (ppm): 6.84 (m, 1H), 6.02 (d, *J*= 9.7 Hz, 1H), 5.91 (t, *J* = 3.8 Hz, 1H), 4.52 (m, 1H), 4.21 (m, 1H), 4.07 (m, 2H), 3.73 (m, 2H), 3.61 (m, 2H), 3.20 (m, 1H), 2.66 (m, 1H), 2.53 (m, 1H), 2.40 (m, 1H), 2.34 (m, 1H), 2.10-2.09 (m, 2H), 1.87-1.73 (m, 3H), 1.61 (m, 1H), 1.33 (d, *J* = 13.4 Hz, 1H), 1.20 (s, 9H), 1.08 (d, *J* = 6.88, 3H); ^{13}C NMR (100.6 MHz, $CDCl_3$) δ (ppm): 200.98, 200.90, 147.6, 141.5, 128.9, 125.0, 102.2, 72.4, 67.3, 60.2, 59.2, 57.7, 36.34, 32.29, 30.95, 30.09, 27.97, 25.65, 23.53, 19.72 ; HRMS (TOF, ES+) $C_{23}H_{36}NO_5S$ $[M+H]^+$ calc'd 438.2371, found 438.2373.



Grandisine D (**41**). Ketone **50** (43.7 mg, 0.1 mmol) was dissolved in 95:5 TFA: H_2O to a final concentration of 0.1 M. After stirring for 1.5 h, the mixture was concentrated in vacuo and the residue was dissolved in DCE and PS-$BH(OAc)_3$ (0.5 g, 0.5 mmol) was added and placed on a shaker for 2 h. The beads were filtered off and the solvent was concentrated *in vacuo* to give the crude product. Purification by flash chromatography (28% NH_3-MeOH-AcOEt, 1:10:50) gave grandisine D as pale yellow oil (12.2 mg, 47%). To a solution of the grandisine D (**41**) (9 mg, 0.034 mmol) in DCM (1 mL) at 0 ºC was added dropwise TFA (3.6 μL, 0.051 mmol). The solution was held at 0 ºC for 30 min, then warmed to rt and held for 1 h. The pale yellow solution was concentrated *in vacuo* to afford TFA salt of grandisine D (12.1 mg, Quant.) as pale yellow oil; $[\alpha]_D^{20}$ +68.8 (*c* 0.09, MeOH); ^{1}H NMR (400.1 MHz, DMSO) δ (ppm): 10.47 (br s, 1H), 7.32 (bdd, *J* = 4.0, 4.0 Hz, 1H), 7.16 (ddd, *J* = 10.0, 6.0, 2.4 Hz, 1H), 5.94 (dd, *J* = 10.0, 2.4 Hz, 1H), 4.42 (dd, *J* = 8.8, 8.8 Hz, 1H), 4.36 (d, *J* = 12.0 Hz, 1H), 3.58-3.51 (m, 1H), 3.41-3.29 (m, 2H), 3.20-3.06 (m, 1H), 2.67-2.59 (m, 2H), 2.53-2.33 (m, 3H), 2.27-2.18 (m, 1H), 2.08-1.98 (m, 2H), 1.77-1.67 (m, 1H) 0.86 (d, *J* = 6.0 Hz, 3H); ^{13}C NMR (100.6 MHz, DMSO) 198.4, 196.9, 151.9, 140.0, 137.3, 128.3, 59.1, 58.0, 52.7, 43.0, 32.7, 32.3, 28.0, 22.4, 20.4, 19.1; HRMS (TOF, ES+) $C_{16}H_{22}NO_2$ $[M+H]^+$ calc'd 260.1651, found 260.1650.



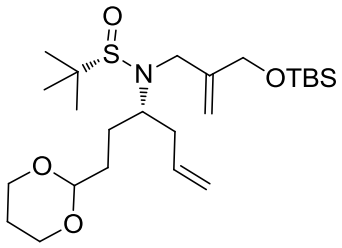
(*S*)-*N*-(3-(1,3-dioxan-2-yl)propylidene)-2-methylpropane-2-sulfinamide (**51)**. To a solution of 3-(1,3-dioxan-2-yl)propanal (**18**) (10.1 g, 70.1 mmol) in CH_2Cl_2 (500 mL) was added (*S*)-2-methylpropane-2-sulfinamide (10.17 g, 84.1 mmol) and $CuSO_4$ (44.6 g, 280.4 mmol). The reaction mixture was stirred at rt overnight. The mixture was filtered through a through celite pad and washed with CH_2Cl_2. Concentration *in vacuo* gave the crude product which was purified by automated flash chromatography (4:1 to 1:1 Hex/EtOAc) to yield the desired product 15.6 g (90%) as yellow oil: $[\alpha]_D^{20}$ = +209.3 (*c* = 0.86, $CHCl_3$); ^{1}H NMR (400.1 MHz, $CDCl_3$) δ (ppm): 8.11 (t, *J* = 4.0 Hz, 1H), 4.62 (t, *J* = 4.8 Hz, 1H), 4.10 (dd, *J* = 6.0, 4.8 Hz, 2H), 3.76 (m, 2H), 2.64 (sextet, *J* = 4.0 Hz, 2H), 2.07 (m, 1H), 1.93 (m, 2H), 1.32 (dm, *J* = 13.8 Hz, 1H), 1.18 (s, 9H); ^{13}C NMR (100.6 MHz, $CDCl_3$) δ (ppm): 169.1, 101.0, 67.0, 56.7, 30.8, 30.7, 25.8, 22.5; HRMS (TOF, ES+) $C_{11}H_{22}NO_3S$ $[M+H]^+$ calc'd 248.1320, found 248.1319.



(*S*)-*N*-((*S*)-1-(1,3-dioxan-2-yl)hex-5-en-3-yl)-2-methylpropane-2-sulfinamide (**52**).

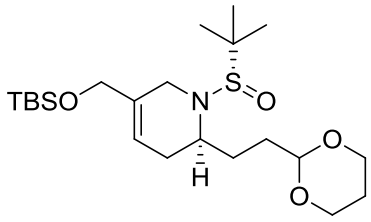
In-Mediated allylation were done according to procedures published by Lin and co-workers. To a reaction flask containing sulfinimine **51** (14.5 g, 58.7 mmol) and indium powder (27.0 g,

234.8 mmol) was added saturated aqueous NaBr solution (1174 mL, (1062.4 g of NaBr)) followed by the allyl bromide (36.8 mL, 234.8 mmol). The resulting suspension stirred at rt for 24 h. The reaction was quenched by the addition of saturated aqueous $NaHCO_3$ and filtered through a pad of celite. The aqueous layer was extracted with EtOAc (3x), dried over Na_2SO_4, filtered, concentrated *in vacuo* to give the crude product as >19:1 *dr*, which was then purified by flash chromatography (1:1 Hex/EtOAc) to yield the allylation product in 14.7 g (87%) as a pale yellow oil: $[\alpha]_D^{20}$ = +38.9 (*c* = 1.43, $CHCl_3$); ^{1}H NMR (400.1 MHz, $CDCl_3$) δ (ppm): 5.77 (m, 1H), 5.16 (d, *J* = 4 Hz, 1H), 5.13 (s, 1H), 4.51 (t, *J* = 4.5 Hz, 1H), 4.08 (dd, *J* = 5, 6.3 Hz, 2H), 3.74 (dt, *J* = 10, 2.2 Hz, 2H), 3.30 (m, 1H), 3.23 (d, *J* = 6.5 Hz, 1H), 2.37 (m, 2H), 2.05 (m, 1H), 1.63 (m, 3H), 1.33 (br, *J* = 14 Hz, 1H), 1.19 (s, 9H); ^{13}C NMR (100.6 MHz, $CDCl_3$) δ (ppm): 133.9, 119.0, 101.9, 66.8, 55.8, 55.0, 40.5, 31.3, 29.2, 25.7, 22.6; HRMS (TOF, ES+) $C_{14}H_{28}NO_3S$ $[M+H]^+$ calc'd 290.1790, found 290.1790.



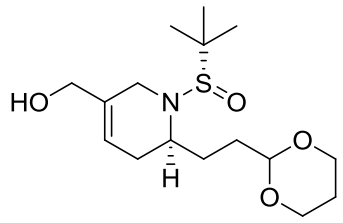
(*S*)-N-((*S*)-1-(1,3-dioxan-2-yl)hex-5-en-3-yl)-*N*-(2-(((*tert*-butyldimethylsilyl)oxy)methyl)allyl)-2-methylpropane-2-sulfinamide (**54**). To a solution of sulfinamide **52** (1.4 g, 4.84 mmol) in 25 mL DMF at -20 ^{o}C was added LiHMDS (9.7 mL, 1 M in THF,) and the mixture was stirred for 20 mins at -20 ^{o}C and 20 mins at rt. The mixture was cooled back to -20 ^{o}C and **53** (3.83 g, 14.83 mmol) was then added slowly to the mixture and the reaction was slowly. The mixture was stirred at -20 ^{o}C for 30 mins and rt overnight. The reaction was quenched with saturated NH_4Cl solution and extracted with EtOAc (3x). The combined organic extracts were washed

with water and the dried over Na_2SO_4. Filtration and concentration afforded the crude product, which was purified by flash chromatography (4:1 to 1:1 Hex/EtOAc) to afford the product as a pale yellow oil (2.06 g, 90%): $[\alpha]_D^{20}$ = -2.3 (*c* = 0.85, $CHCl_3$); ^{1}H NMR (400.1 MHz, $CDCl_3$) δ (ppm): 5.74-5.84 (m, 1H), 5.23 (s, 1H), 5.14 (s, 1H), 5.03 (m, 1H), 4.48 (t, *J* = 5.2 Hz, 1H), 4.05 (m, 4H), 3.94 (brd, *J* = 17.2 Hz, 1H), 3.72 (dt, *J* = 12.0, 2.4 Hz, 2H), 3.14 (d, *J* = 17.2 Hz, 1H), 2.96 (q, *J* = 7.2 Hz, 1H), 2.40 (dq, *J* = 28.2, 6.8 Hz, 2H), 1.89-2.09 (m, 2H), 1.61-1.80 (m, 3H), 1.32 (dm, *J* = 13.8 Hz, 1H), 1.29 (s, 9H), 1.19 (s, 9H), 0.06 (s, 6H); ^{13}C NMR (100.6 MHz, $CDCl_3$) δ (ppm): 145.2, 136.3, 117.2, 111.7, 102.2, 67.0, 66.9, 64.8, 62.6, 58.0, 53.6, 45.5, 39.5, 33.3, 27.3, 26.0, 25.9, 23.8, 18.5, -5.2, -5.3; HRMS (TOF, ES+) $C_{24}H_{48}NO_4SiS$ $[M+H]^+$ calc'd 474.3073, found 474.3076.

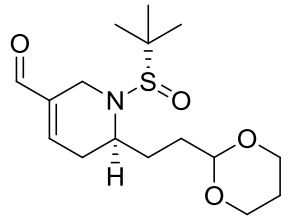


(*S*)-2-(2-(1,3-dioxan-2-yl)ethyl)-5-(((tert-butyldimethylsilyl)oxy)methyl)-1-((*S*)-*tert*-butylsulfinyl)-1,2,3,6-tetrahydropyridine (**55**)**.** To a solution of **54** (1.0 g, 2.11 mmol) in CH_2Cl_2 (260 mL) was added 2nd Gen. Grubbs (89.5 mg, 0.106 mmol). The mixture was refluxed for 1 h and concentrated. The resulting crude product was purified by automated flash chromatography (4:1 to 1:1 Hex/EtOAc) to yield the desired product 0.845 g (90%) as yellow oil: **[**$\alpha]_D^{20}$ = -1.7 (*c* = 0.0181, $CHCl_3$); ^{1}H NMR (400.1 MHz, $CDCl_3$) δ (ppm): 5.62 (d, *J* = 4.8 Hz, 1H), 4.51 (t, *J* = 4.8 Hz, 1 H), 4.09 (dd, *J* = 4.0, 7.6 Hz, 2H), 4.03 (d, *J* = 4.0 Hz, 1H), 3.73 (m, 3H), 3.34 (m, 2H), 2.52 (m, 1H), 2.06 (m, 1H), 1.89 (dd, *J* = 6, 12.4 Hz, 1H), 1.80 (m, 1H), 1.68 (m, 2H), 1.57 (m, 2H), 1.33 (br, d, *J*= 12.4 Hz, 1H), 1.16 (s, 9H), 0.89 (s, 9H), 0.05 (s,

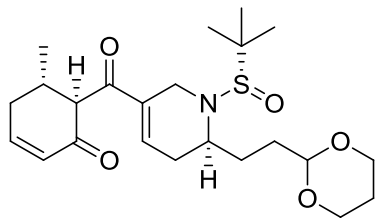
6H); ^{13}C NMR (100.6 MHz, $CDCl_3$) δ (ppm): 135.3, 118.3, 102.3, 67.0, 65.5, 58.7, 56.8, 37.2, 32.9, 28.0, 27.0, 26.1, 25.9, 23.5, 18.5, -5.2; HRMS (TOF, ES+) $C_{22}H_{44}NO_4SiS$ $[M+H]^+$ calc'd 446.2760, found 446.2764.



((*S*)-6-(2-(1,3-dioxan-2-yl)ethyl)-1-((*S*)-*tert*-butylsulfinyl)-1,2,5,6-tetrahydropyridin-3-yl)methanol . To a solution of **55** (300 mg, 0.67 mmol) in THF (27 mL) under argon was added 1.0 M TBAF (1.01 mL, 1.01 mmol) dropwise at 0 ^{o}C. The mixture was warmed to rt and stirred for 2 h. The reaction was quenched with saturated NH_4Cl solution and extracted with EtOAc (3x). The combined organic extracts were washed with water and the dried over Na_2SO_4. Filtration and concentration afforded the crude product, which was purified by flash chromatography (9:1 CH_2Cl_2/MeOH) to afford the product as yellow oil (210 mg, 95%): $[\alpha]_D^{20}$ = -116.1 (*c* = 4.7, $CHCl_3$); ^{1}H NMR (400.1 MHz, $CDCl_3$) δ (ppm): 5.64 (br d, *J* = 4.8 Hz, 1H), 4.49 (t, *J* = 4.8 Hz, 1H), 4.05 (dd, *J*= 11.6, 4.0 Hz, 2H), 3.91 (m, 3H), 3.71 (tt, *J* = 12.0, 3.6, Hz, 2H), 3.33 (m, 2H), 2.96 (br s, 1H), 2.52 (br d, *J* = 17.6 Hz, 1H), 2.04 (m, 1H), 1.87 (br dd, *J* = 17.6, 5.2, Hz, 1H), 1.79-1.68 (m, 2H), 1.59-1.49 (m, 2H), 1.31 (d, *J* = 12.4 Hz, 1H), 1.14 (s, 9H); ^{13}C NMR (100.6 MHz, $CDCl_3$) δ (ppm): 135.7, 119.8, 101.9, 66.8, 65.2, 58.6, 56.9, 36.6, 32.6, 27.7, 26.8, 25.7, 23.3; HRMS (TOF, ES+) $C_{16}H_{30}NO_4S$ $[M+H]^+$ calc'd 332.1896, found 332.1897.



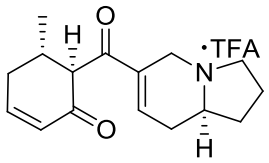
(*S*)-6-(2-(1,3-dioxan-2-yl)ethyl)-1-((*S*)-*tert*-butylsulfinyl)-1,2,5,6-tetrahydropyridine-3-carbaldehyde (**56**). To a solution of alcohol (150 mg, 0.45 mmol) in THF (30 mL) under argon was added MnO_2 (796 mg, 9.16 mmol). The mixture was stirred at rt overnight. Filtration over celite and concentration afforded the pure product in Quant. yield: $[\alpha]_D^{20}$ = -8.1 (*c* = 1, MeOH); ^{1}H NMR (400.1 MHz, $CDCl_3$) δ (ppm): 9.34 (s, 1H), 6.91 (d, *J* = 5.2 Hz, 1H), 4.51 (t, *J*= 4.4 Hz, 1H), 4.12 (m, 3H), 3.72 (tt, *J* = 12.0, 2.8 Hz, 2H), 3.49 (m, 2H), 2.79 (dm, *J* = 3.2 Hz, 1H), 2.22 (ddd, *J* = 19.2, 6.0, 2.0 Hz, 1H), 2.06 (m, 1H), 1.75-1.51 (m, 4H), 1.32 (br d, *J* = 12.4 Hz, 1H), 1.18 (s, 9H) ; ^{13}C NMR (100.6 MHz, $CDCl_3$) δ (ppm): 191.9, 146.5, 138.7, 101.5, 66.7, 58.7, 56.6, 33.6, 32.3, 29.3, 26.8, 25.6, 23.2; HRMS (TOF, ES+) $C_{16}H_{28}NO_4S$ $[M+H]^+$ calc'd 330.1739, found 330.1739.



(5*S*,6*R*)-6-((*S*)-6-(2-(1,3-dioxan-2-yl)ethyl)-1-((*S*)-*tert*-butylsulfinyl)-1,2,5,6-tetrahydropyridine-3-carbonyl)-5-methylcyclohex-2-enone (**57**). To a solution of (*S*)-5-methylcyclohex-2-enone (**44**) (43.5 mg, 0.395 mmol) in CH_2Cl_2 (2 mL) at -78 ^{o}C was added *N*-ethyl-*N*-isopropylpropylamine (*i*Pr_2NEt) (0.103 mL, 0.592 mmol) and ^{n}Bu_2BOTf (0.592 mL, 0.592 mmol). The mixture was stirred at 78 ^{o}C for 1 h. Aldehyde **56** (86.6 mg, 0.263 mmol)

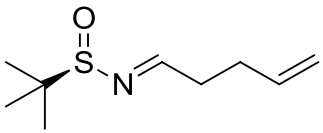
dissolved in CH_2Cl_2 (2 mL) was added dropwise. The mixture was warm to rt and stir for 1.5 h. The reaction mixture was cool -78 ^oC and quenched with 0.1 mL each of MeOH and H_2O_2, diluted with $NaHCO_3$ and extracted with CH_2Cl_2 (3x). The combined organic extracts were washed with water and the dried over Na_2SO_4. Filtration and concentration afforded the crude product, which was used in the next step without purification.

To a stirred solution of DMSO (38 μL, 0.53 mmol) in CH_2Cl_2 (7 mL) at -78 ºC was added drop-wise trifluoroacetic anhydride (50 μL, 0.35 mmol). After stirring at -78 ºC for 30 mins, a pre-cooled solution of the crude alcohol dissolved in CH_2Cl_2 (4 mL). The reaction mixture was stirred at -78 ºC for 1 h, then Et_3N (0.18 mL, 1.32 mmol) was added dropwise. The solution was further stirred at −78 ºC for a further 20 min, then warmed to rt and held for 1 h. The reaction was quenched by the addition of saturated aqueous $NaHCO_3$ and the aqueous layer was extracted with CH_2Cl_2 (5x), dried over Na_2SO_4, filtered, concentrated *in vacuo* to give the crude product, which was then purified by flash chromatography (1:20 MeOH/EtOAc) to yield the desired product **57**, 77.0 mg (67% over 2-steps) as a pale yellow oil: $[\alpha]_D^{20}$ = +3.6 (*c* = 0.27, $CHCl_3$); ^{1}H NMR (400.1 MHz, $CDCl_3$) δ (ppm): 6.96 (m, 1H), 6.86 (br d, *J*= 5.2 Hz, 1H), 6.02 (d, *J*= 10 Hz, 1H), 4.51 (m, 1H), 4.08 (m, 3H), 3.82 (m, 1H), 3.72 (m, 3H), 3.53 (br d, *J*= 18.8 Hz, 1H), 3.39 (m, 1H), 2.77 (m, 1H), 2.67 (m, 1H), 2.56 (m, 1H), 2.09 (m, 3H), 1.75 (m, 1H), 1.59 (m, 2H), 1.32 (br d, *J*= 12.4 Hz, 1H), 1.16 (s, 9H), 0.99 (d, *J*= 6.4 Hz, 3H); ^{13}C NMR (100.6 MHz, $CDCl_3$) δ (ppm): 197.73, 196.79, 149.98, 138.64, 129.34, 101.97, 67.00, 59.85, 58.91, 56.27, 34.79, 33.08, 32.90, 32.62, 29.04, 27.28, 25.88, 23.39, 22.86, 20.20; HRMS (TOF, ES+) $C_{23}H_{36}NO_5S$ $[M+H]^+$ calc'd 438.2371, found 438.2371.



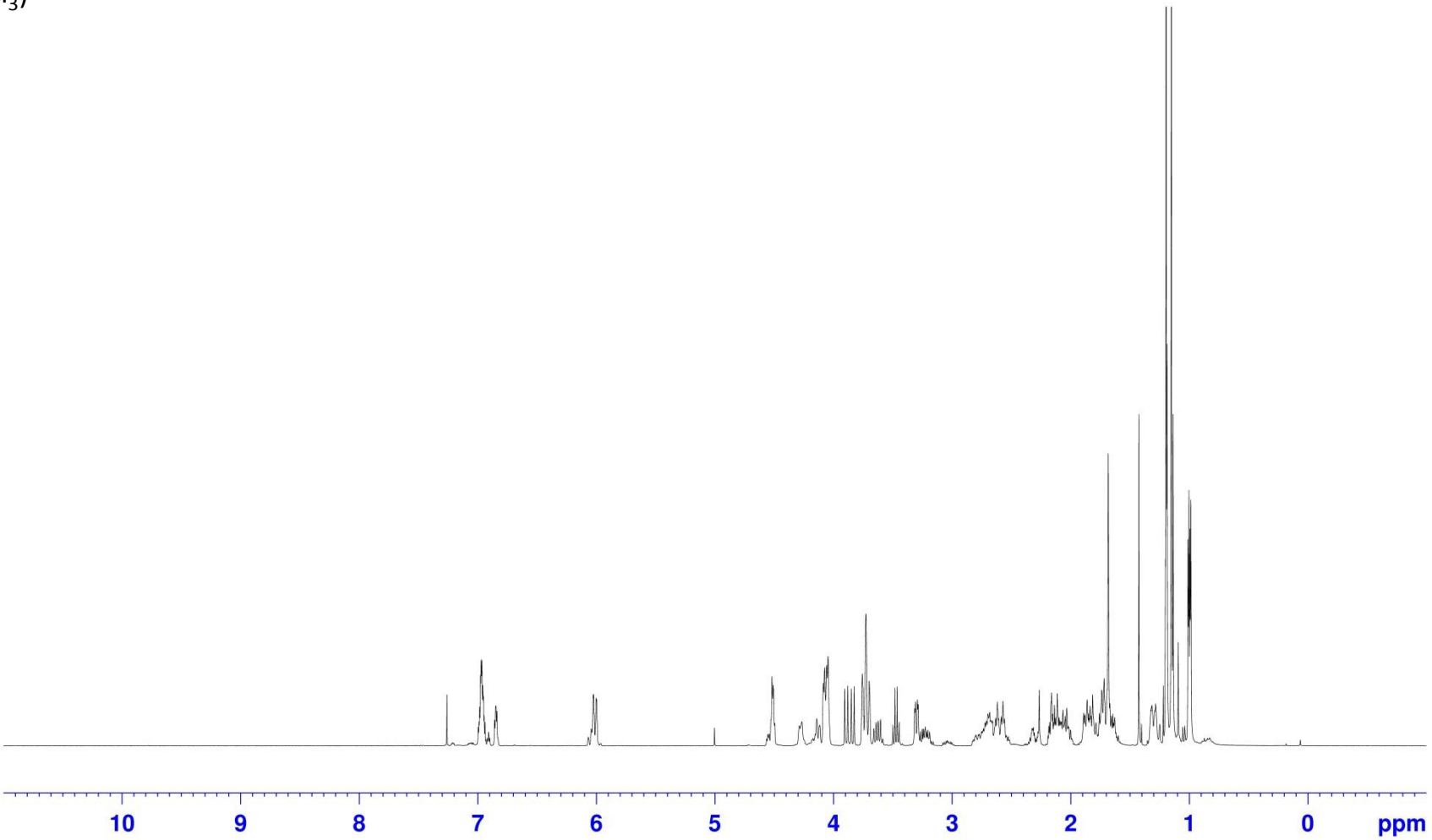
(5*S*,6*R*)-6-((*S*)-1,2,3,5,8,8a-hexahydroindolizine-6-carbonyl)-5-methylcyclohex-2-enone (**58**). Ketone **57** (40.7 mg, 0.093 mmol) was dissolved in 95: 5 (TFA: H_2O) to a final concentration of 0.1 M. After stirring for 1.5 h, the mixture was concentrated in vacuo and the residue was dissolved in DCE and PS-$BH(OAc)_3$ (0.5 g, 0.465 mmol) was added and placed on a shaker for 2 h. The beads were filtered off and the solvent was concentrated *in vacuo* to give the crude product. Purification by flash chromatography (28% NH_3-MeOH-AcOEt, 1:10:50) gave **58** as pale yellow oil (11.8 mg, 49%). To a solution of **58** (10 mg, 0.0386 mmol) in DCM (1 mL) at 0 ºC was added dropwise TFA (4.1 μL, 0.058 mmol). The solution was held at 0 ºC for 30 min, then warmed to rt and held for 1 h. The pale yellow solution was concentrated *in vacuo* to afford TFA salt of **58** (13.7 mg, Quant.) as pale yellow oil; $[\alpha]_D^{20}$ +2.1 (*c* 0.05, MeOH);

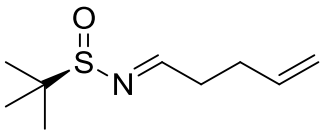
^{1}H NMR (600.1 MHz, DMSO) δ (ppm): 10.27 (br s, 1H), 7.33 (m, 1H), 7.15 (ddd, *J* = 10.2, 6.6, 2.4 Hz, 1H), 5.96 (dd, *J* = 10.2, 2.4 Hz, 1H), 4.35 (d, *J* = 12.0 Hz, 1H), 4.30 (d, *J* = 16.2 Hz, 1H), 3.80 (m, 1H), 3.74-3.68 (m, 1H), 3.30 (br s, 1H), 3.12-3.09 (m, 1H), 2.89 (dt, *J* = 19.8, 4.2, Hz, 1H), 2.55-2.44 (m, 3H), 2.32-2.27 (m, 1H), 2.32-2.27 (m, 1H), 2.24-2.19 (m, 1H), 2.06-1.99 (m, 1H), 1.97-1.91 (m, 1H), 1.64 (q, *J* = 10.2 Hz, 1H) 0.87 (d, *J* = 6.0 Hz, 3H); $^{\delta}$C (150.9 MHz, DMSO) 198.0, 196.8, 151.9, 140.9, 134.6, 128.4, 60.4, 59.5, 52.2, 47.8, 32.7, 32.6, 28.7, 27.6, 19.9, 19.2; HRMS (TOF, ES+) $C_{16}H_{22}NO_2$ $[M+H]^+$ calc'd 260.1651, found 260.1651.



24

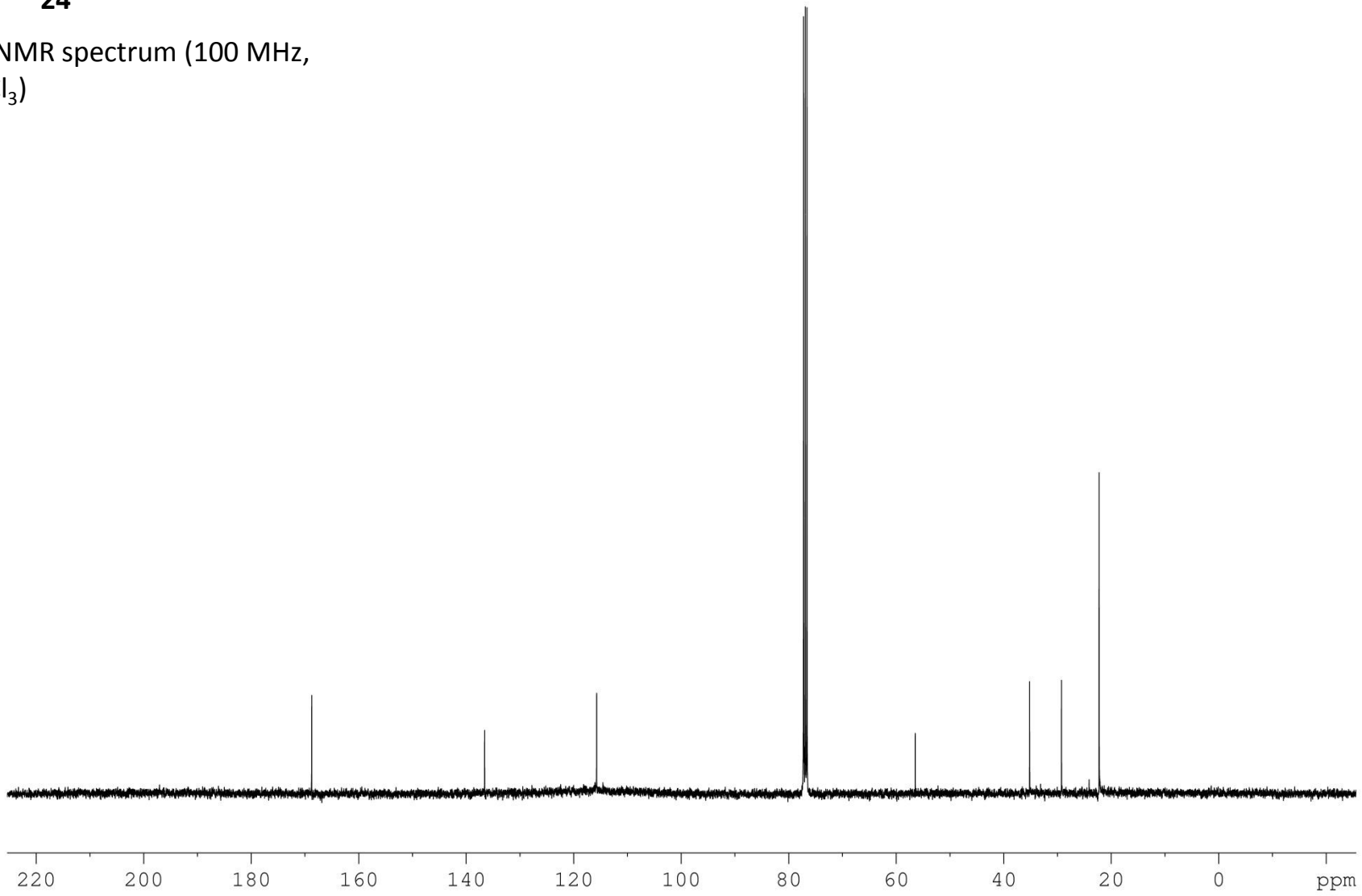
^{1}H NMR spectrum (400 MHz, $CDCl_3$)

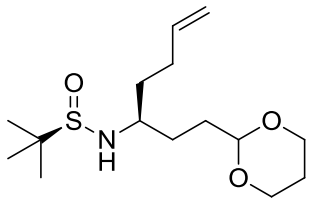




24

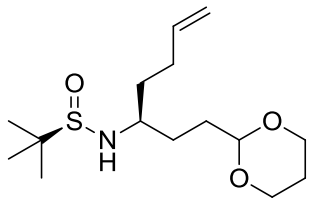
^{13}C NMR spectrum (100 MHz, $CDCl_3$)





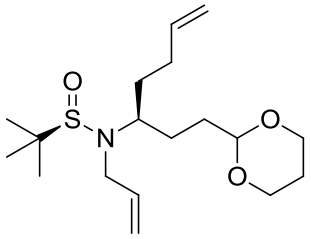
25

^{1}H NMR spectrum (400 MHz, $CDCl_3$)



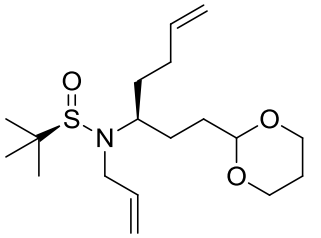
25

^{13}C NMR spectrum (100 MHz, $CDCl_3$)



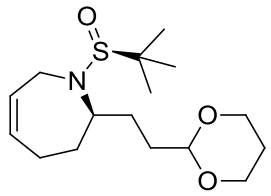
26

^{1}H NMR spectrum (400 MHz, $CDCl_3$)



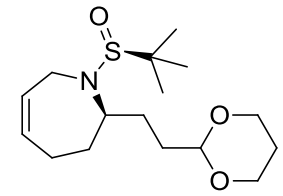
26

^{13}C NMR spectrum (100 MHz, $CDCl_3$)



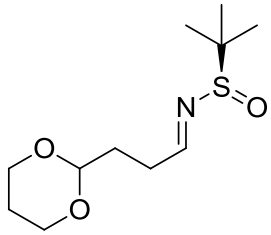
27

^{1}H NMR spectrum (400 MHz, $CDCl_3$)



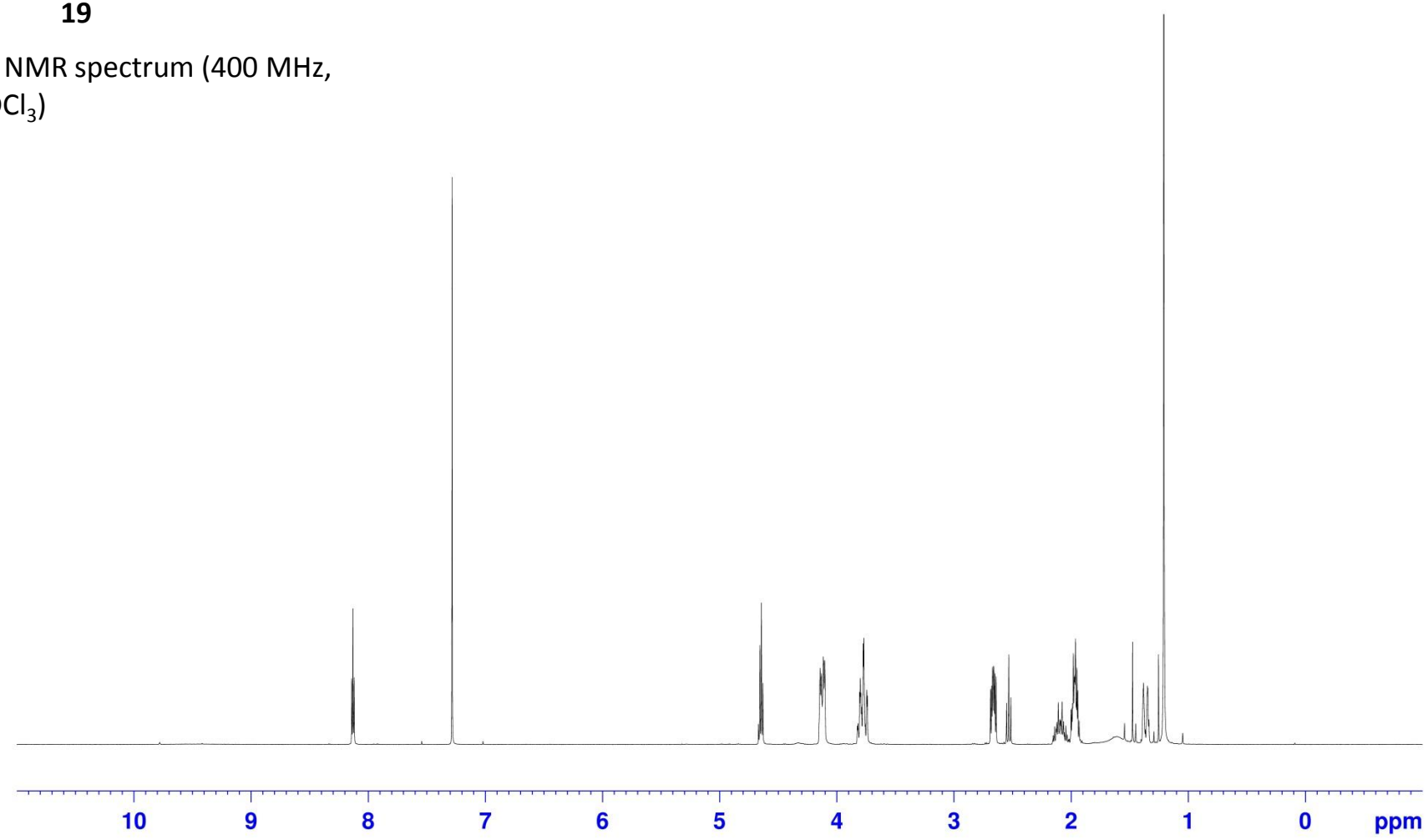
27

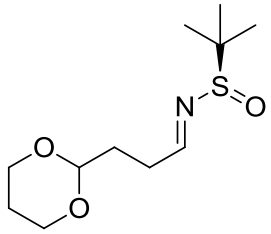
^{13}C NMR spectrum (100 MHz, $CDCl_3$)



19

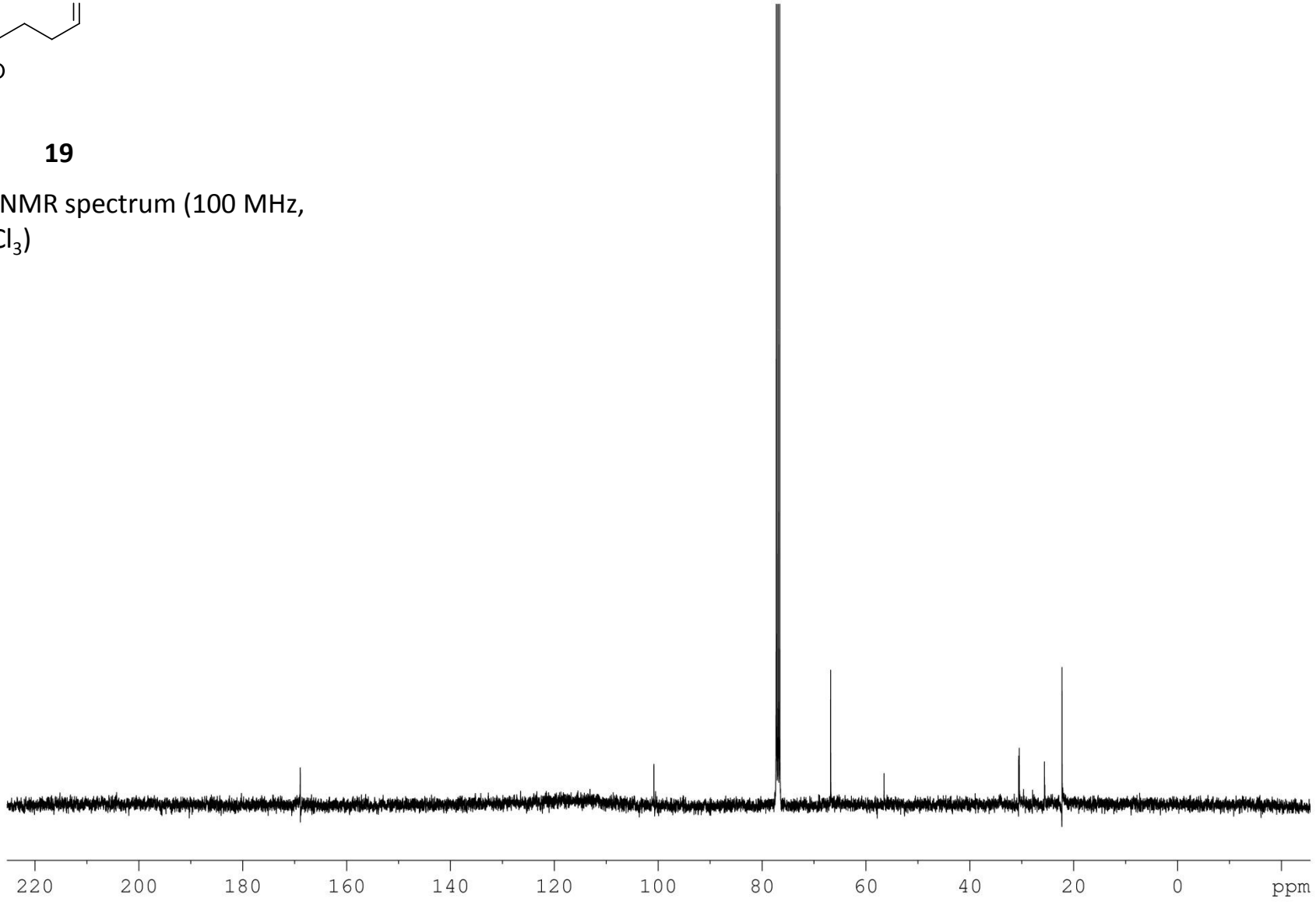
^{1}H NMR spectrum (400 MHz, $CDCl_3$)

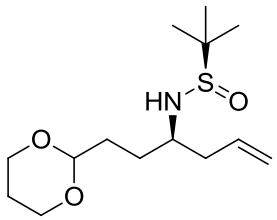




19

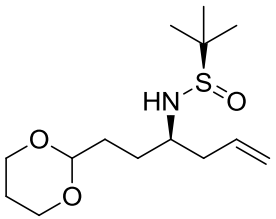
^{13}C NMR spectrum (100 MHz, $CDCl_3$)





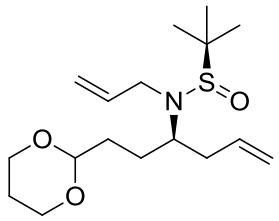
20

^{1}H NMR spectrum (400 MHz, $CDCl_3$)



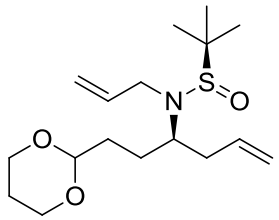
20

^{13}C NMR spectrum (100 MHz, $CDCl_3$)



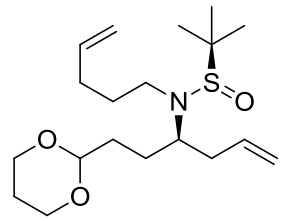
21

^{1}H NMR spectrum (400 MHz, $CDCl_3$)



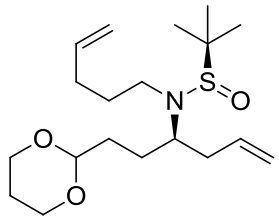
21

^{13}C NMR spectrum (100 MHz, $CDCl_3$)



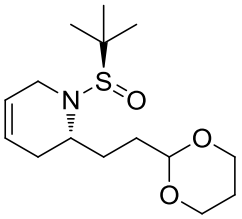
28

^{1}H NMR spectrum (400 MHz, $CDCl_3$)



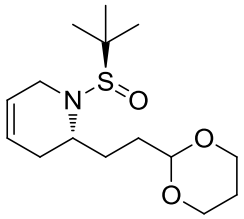
28

^{13}C NMR spectrum (100 MHz, $CDCl_3$)



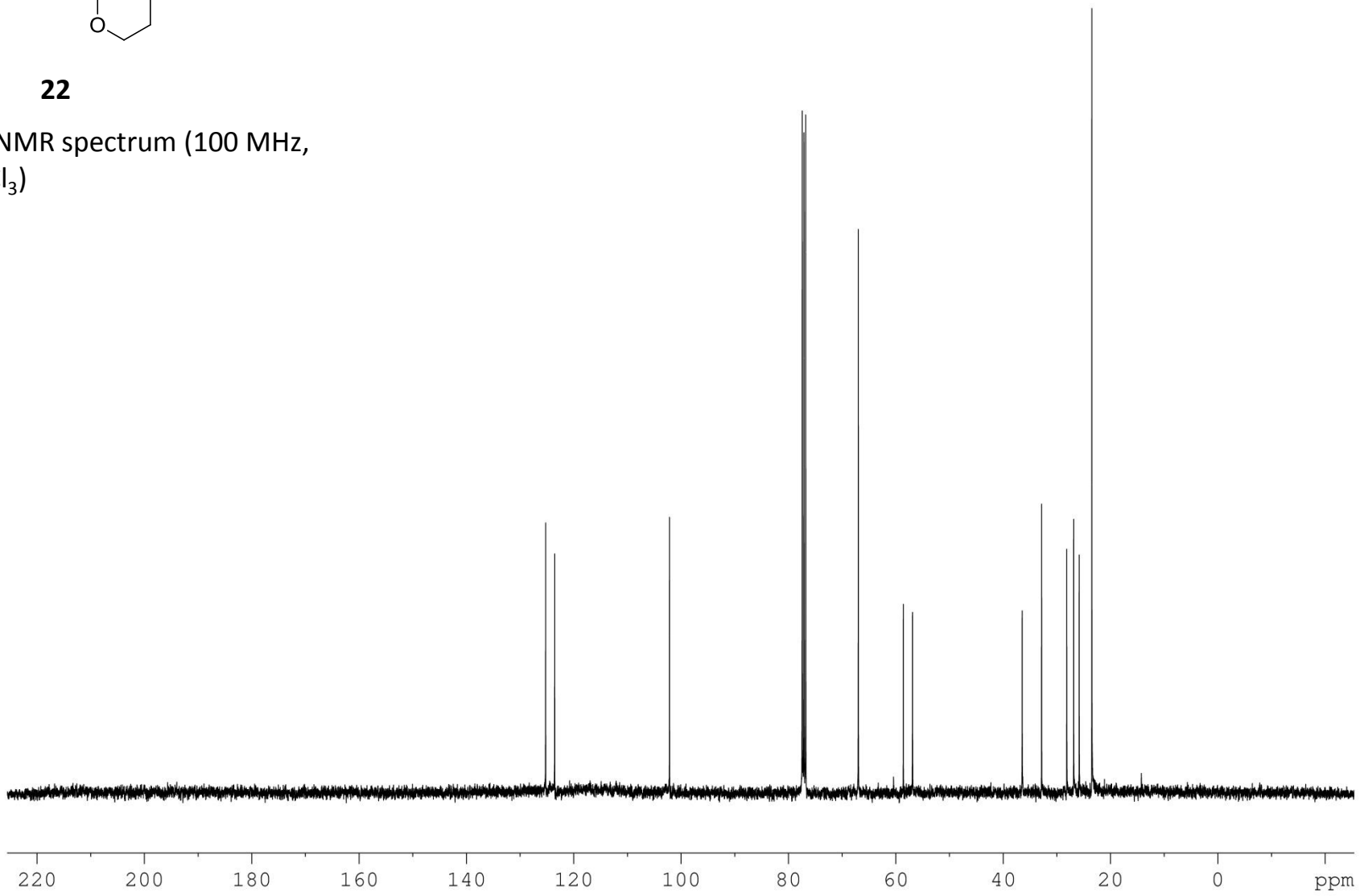
22

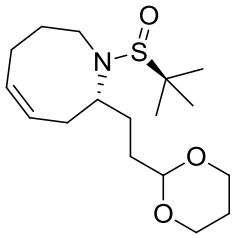
^{1}H NMR spectrum (400 MHz, $CDCl_3$)



22

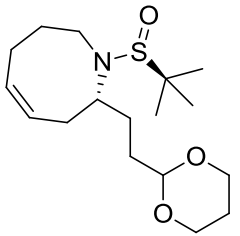
^{13}C NMR spectrum (100 MHz, $CDCl_3$)





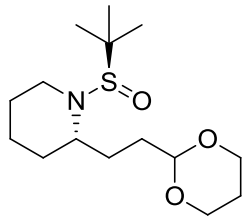
29

^{1}H NMR spectrum (400 MHz, $CDCl_3$)

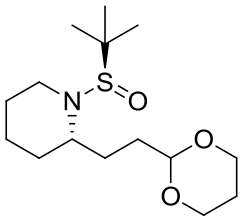


29

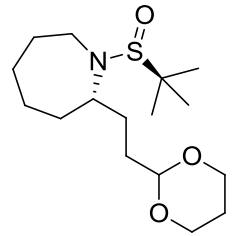
^{13}C NMR spectrum (100 MHz, $CDCl_3$)



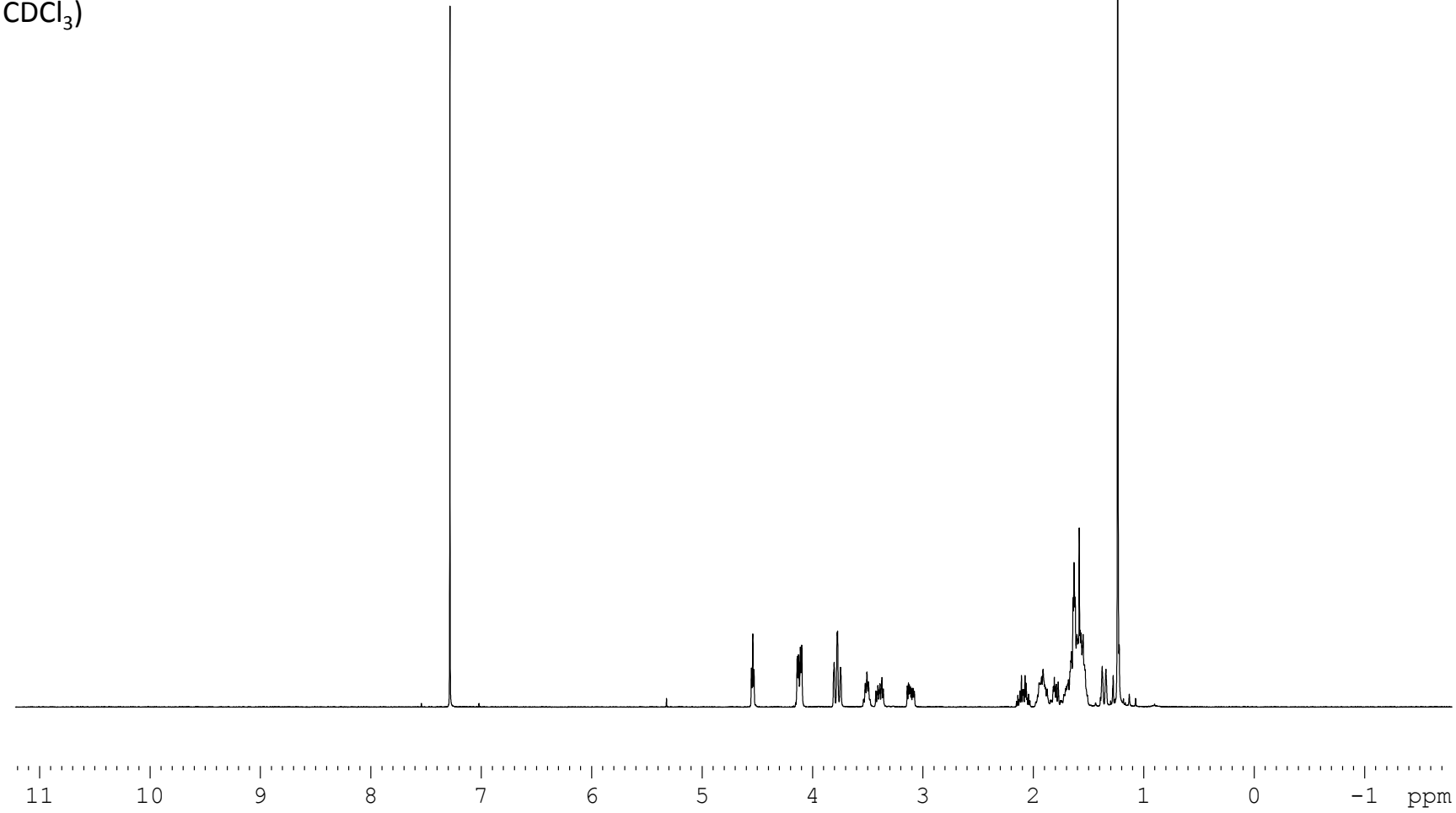
^{1}H NMR spectrum (400 MHz, $CDCl_3$)

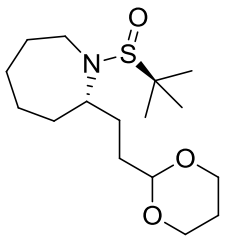


^{13}C NMR spectrum (100 MHz, $CDCl_3$)

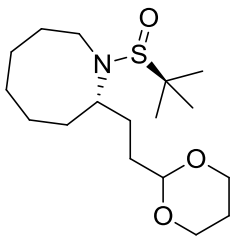


^{1}H NMR spectrum (400 MHz, $CDCl_3$)

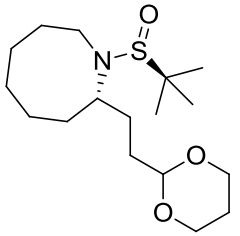




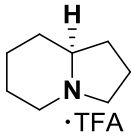
^{13}C NMR spectrum (100 MHz, $CDCl_3$)



^{1}H NMR spectrum (400 MHz, $CDCl_3$)

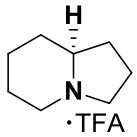


^{13}C NMR spectrum (100 MHz, $CDCl_3$)



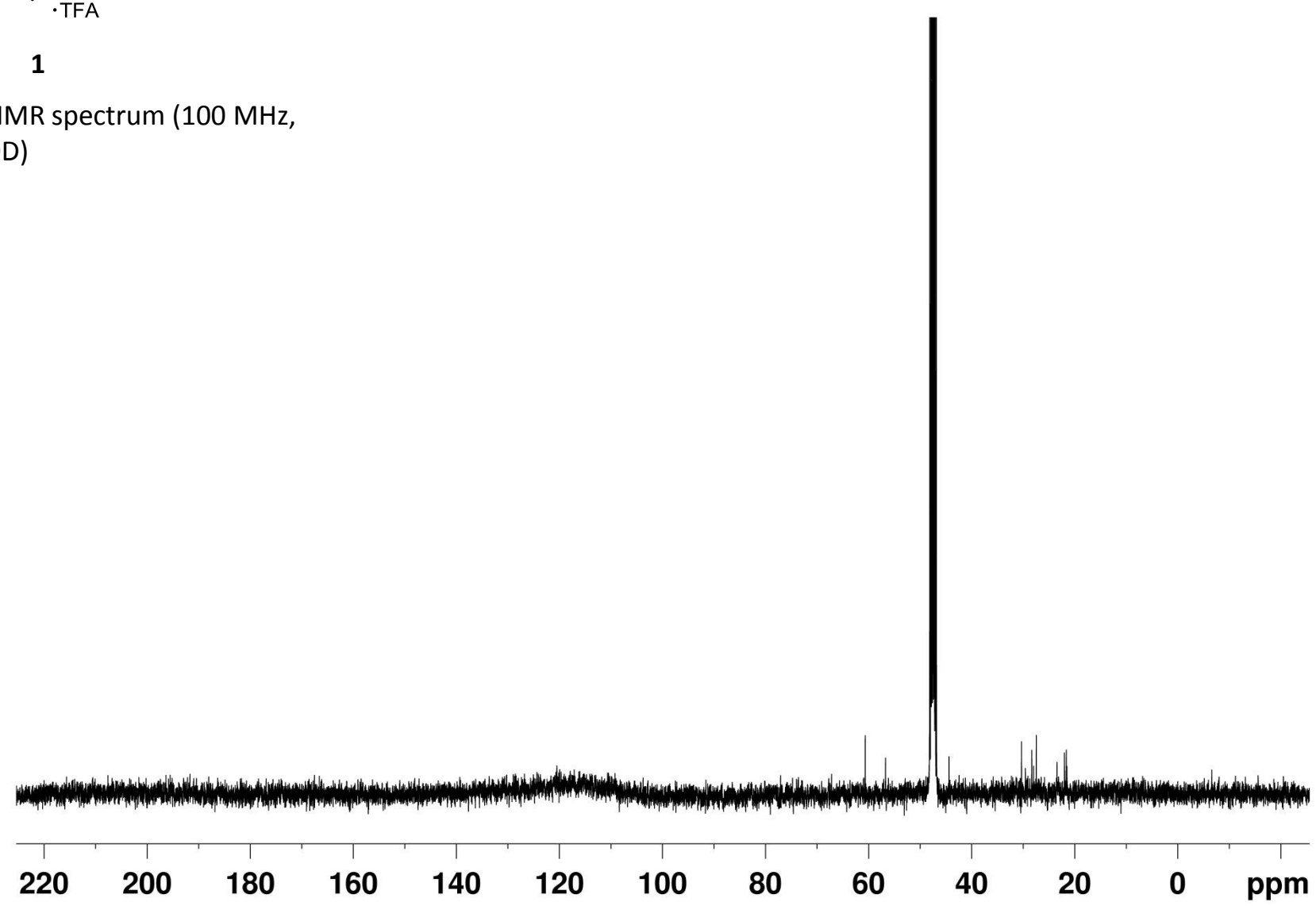
1

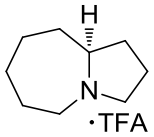
^{1}H NMR spectrum (400 MHz, MeOD)



1

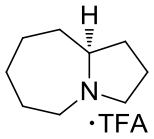
^{13}C NMR spectrum (100 MHz, MeOD)





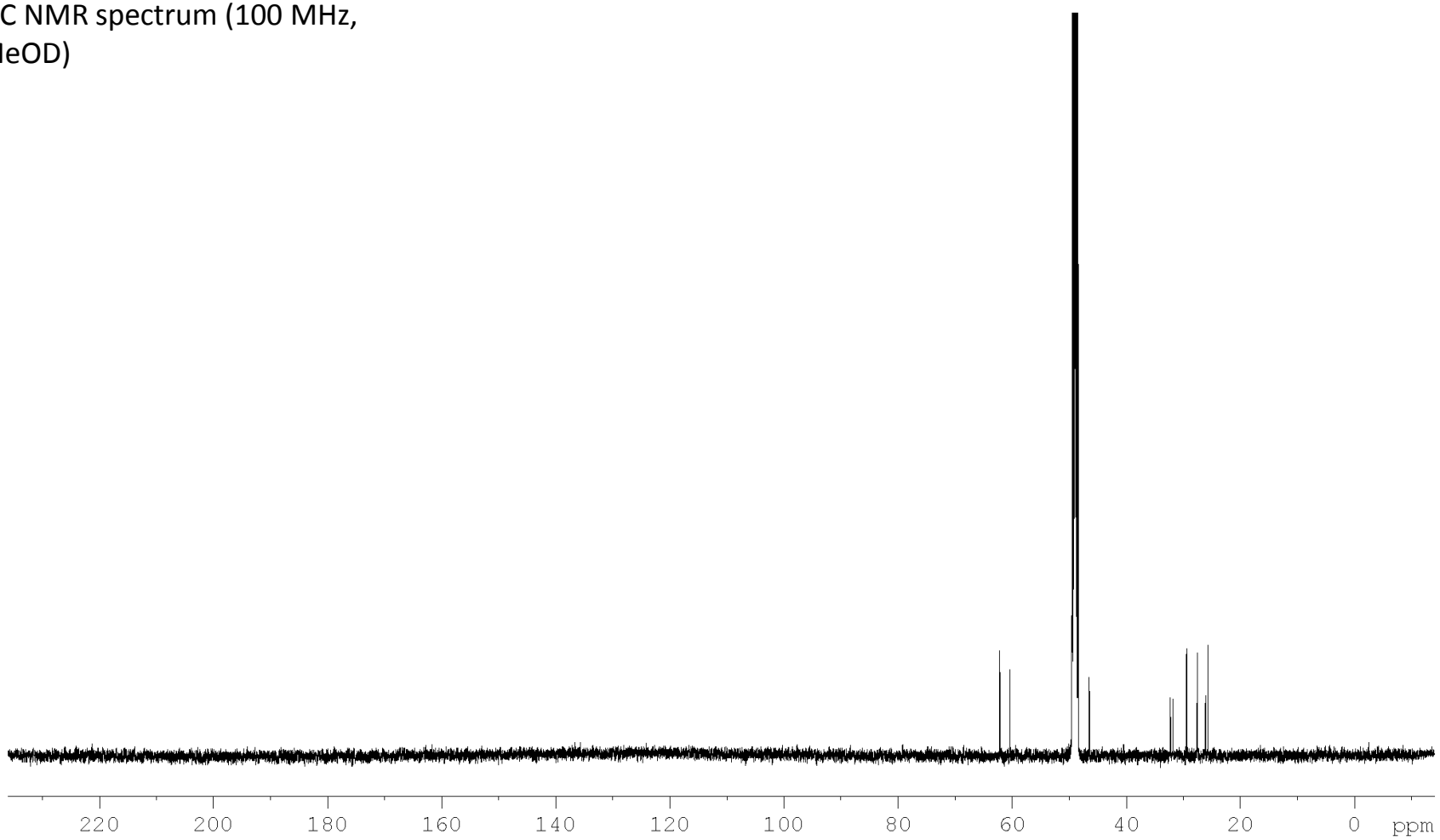
2

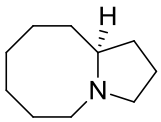
^{1}H NMR spectrum (400 MHz, MeOD)



2

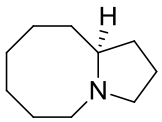
^{13}C NMR spectrum (100 MHz, MeOD)





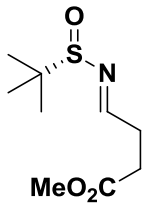
3

^{1}H NMR spectrum (400 MHz, MeOD)



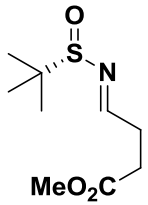
3

^{13}C NMR spectrum (100 MHz, MeOD)



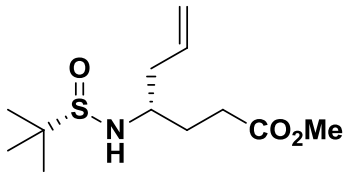
31

^{1}H NMR spectrum (400 MHz, $CDCl_3$)



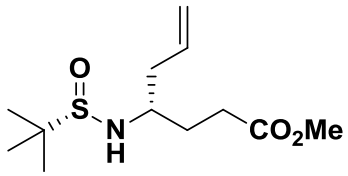
31

^{13}C NMR spectrum (100 MHz, $CDCl_3$)



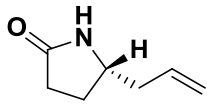
32

^{1}H NMR spectrum (400 MHz, $CDCl_3$)



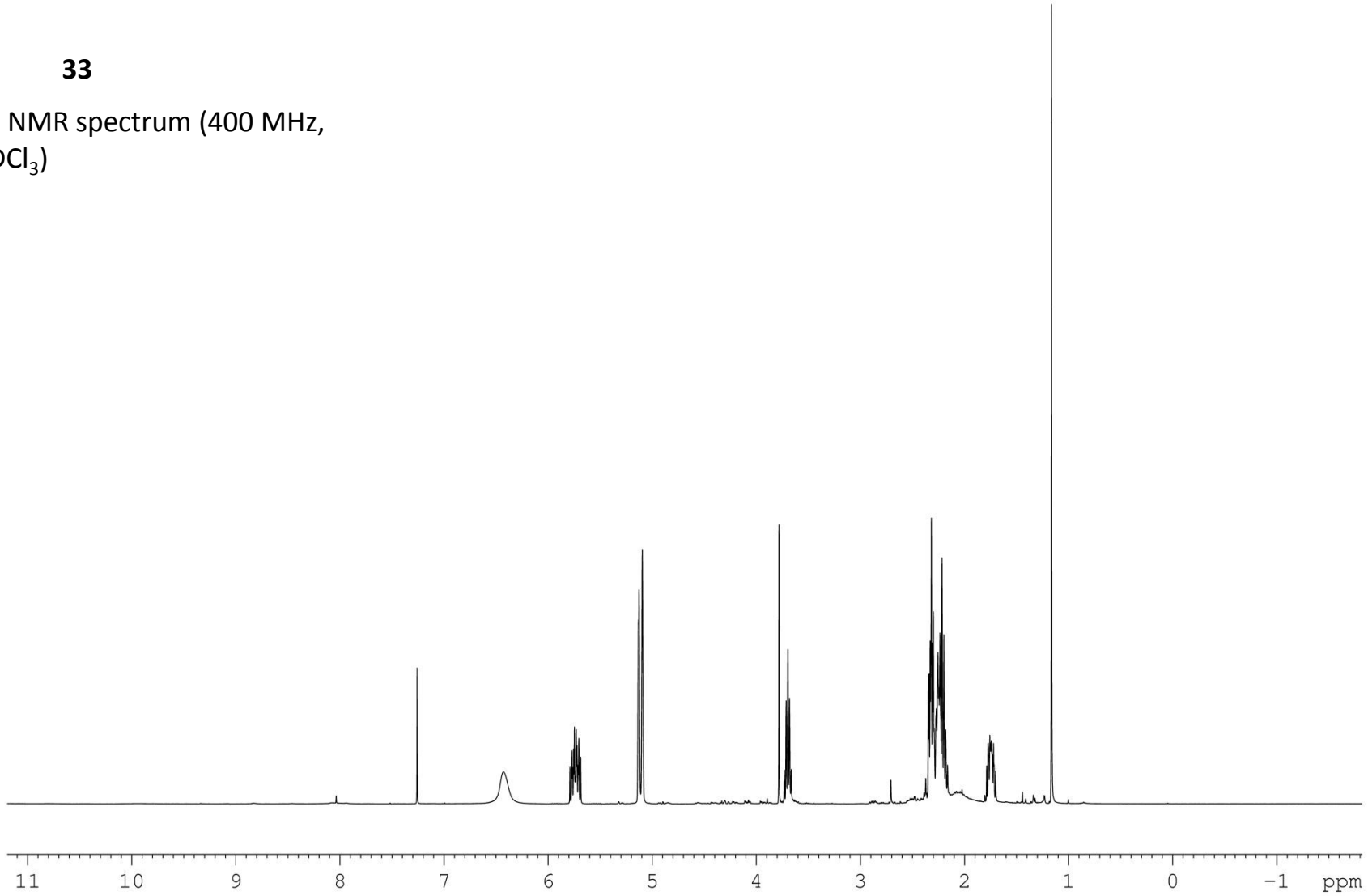
32

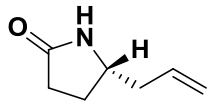
^{13}C NMR spectrum (100 MHz, $CDCl_3$)



33

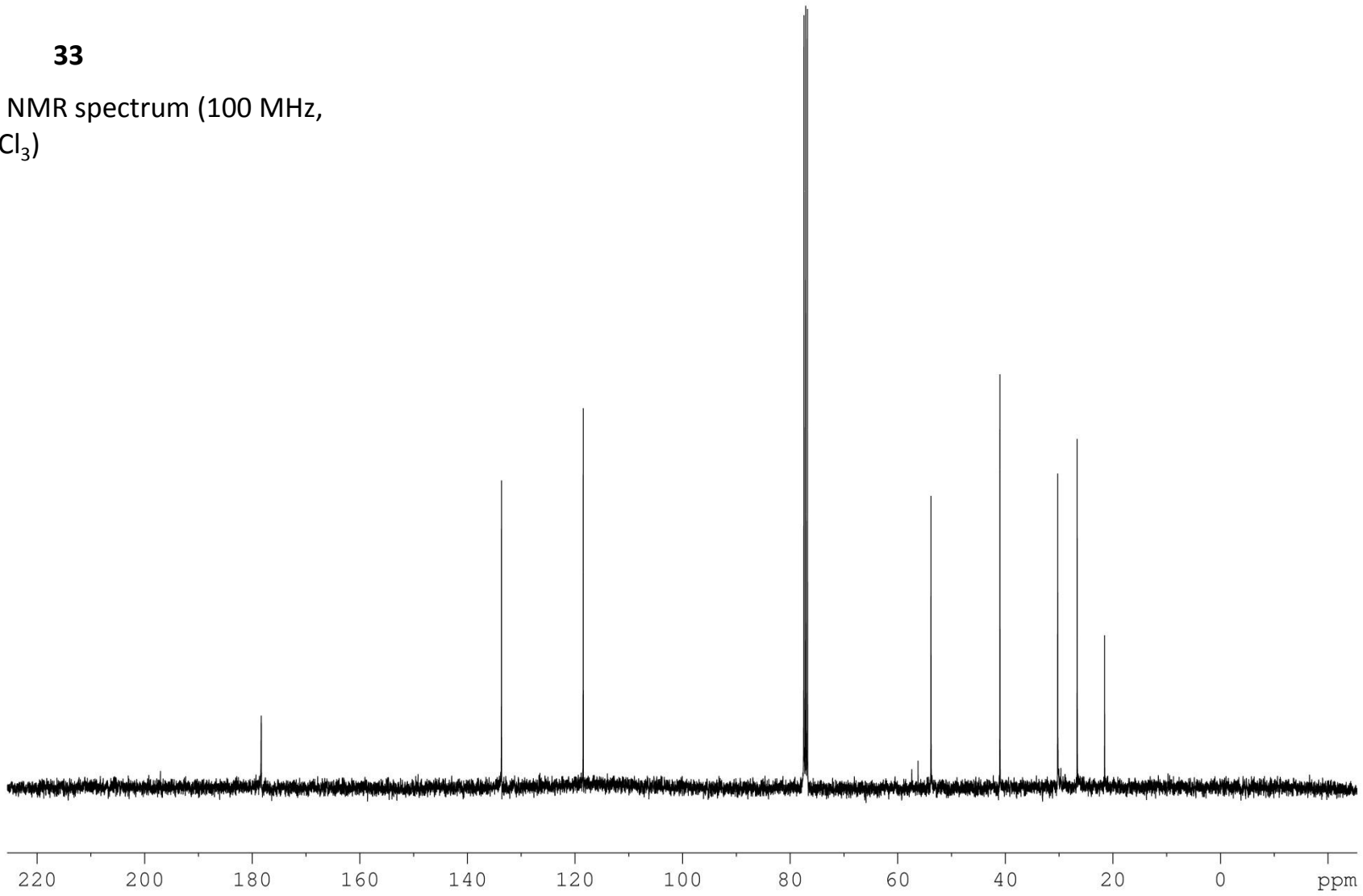
^{1}H NMR spectrum (400 MHz, $CDCl_3$)

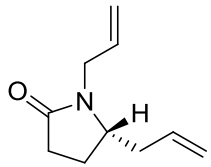




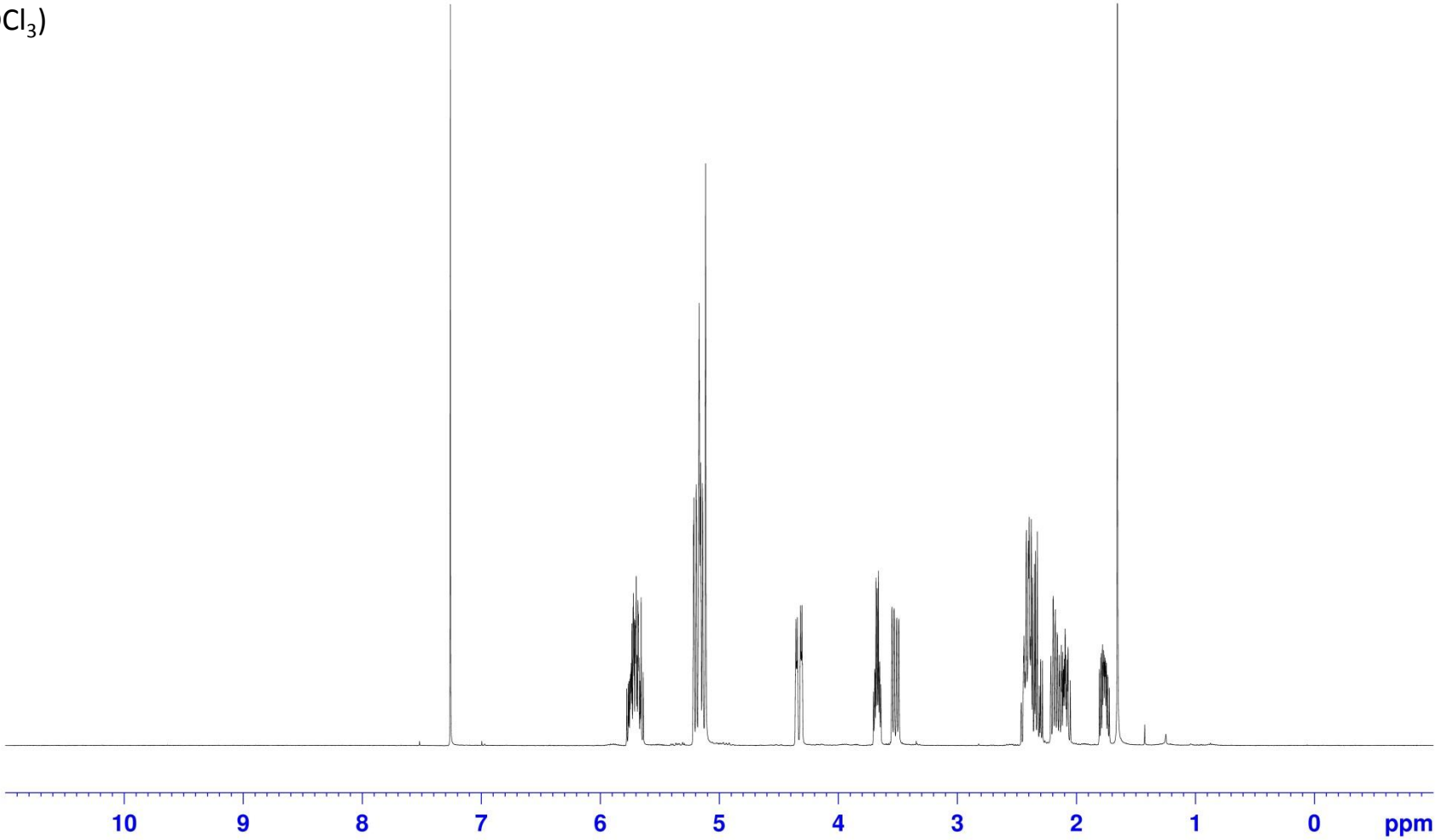
33

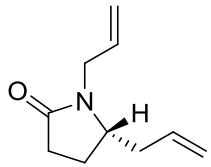
^{13}C NMR spectrum (100 MHz, $CDCl_3$)



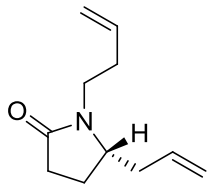


^{1}H NMR spectrum (400 MHz, $CDCl_3$)

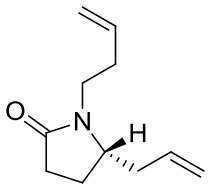




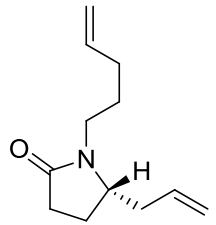
^{13}C NMR spectrum (100 MHz, $CDCl_3$)



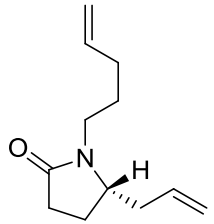
^{1}H NMR spectrum (400 MHz, $CDCl_3$)



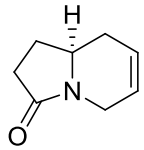
^{13}C NMR spectrum (100 MHz, $CDCl_3$)



^{1}H NMR spectrum (400 MHz, $CDCl_3$)

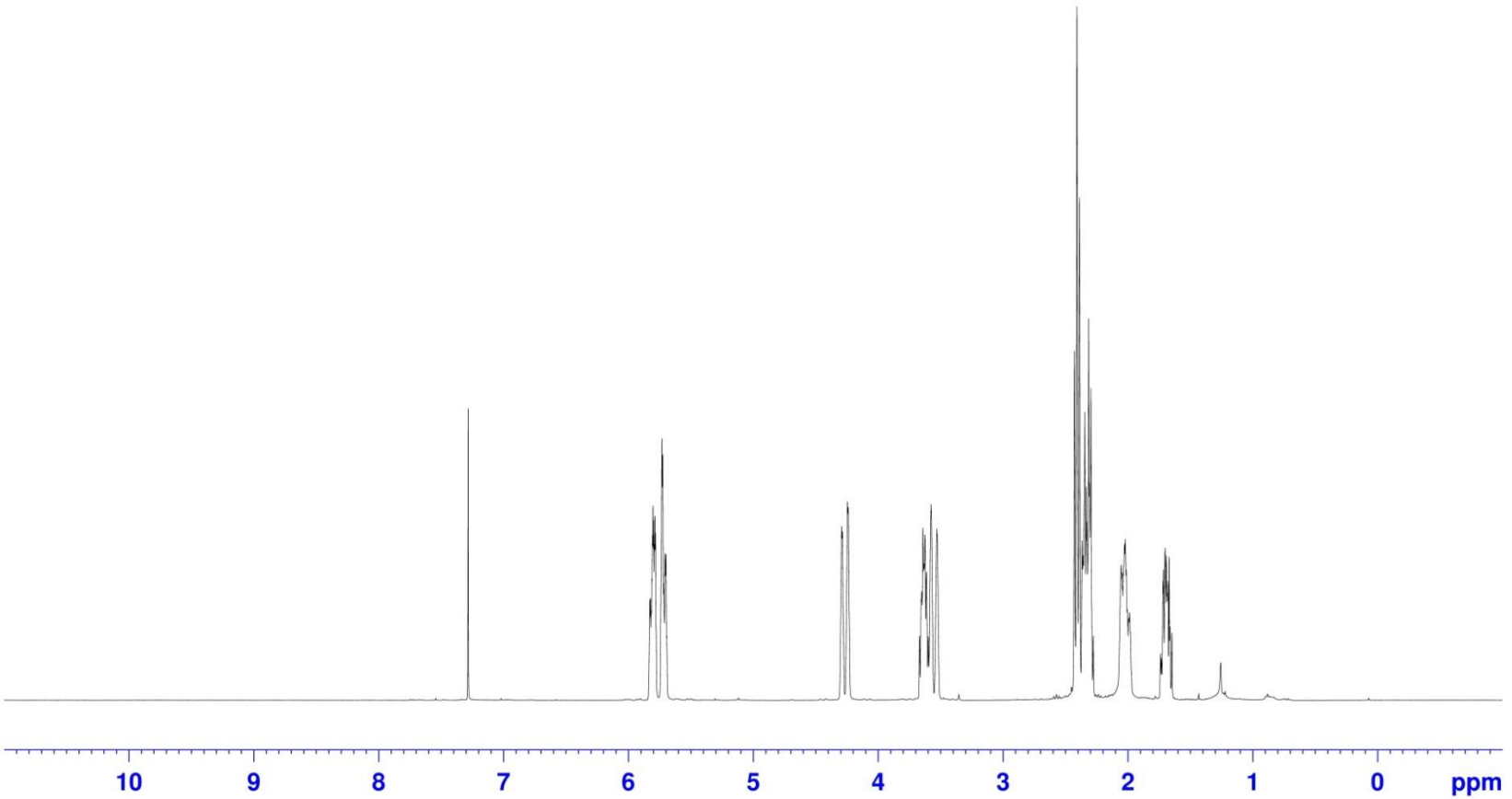


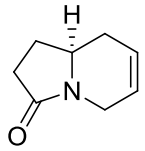
^{13}C NMR spectrum (100 MHz, $CDCl_3$)



34

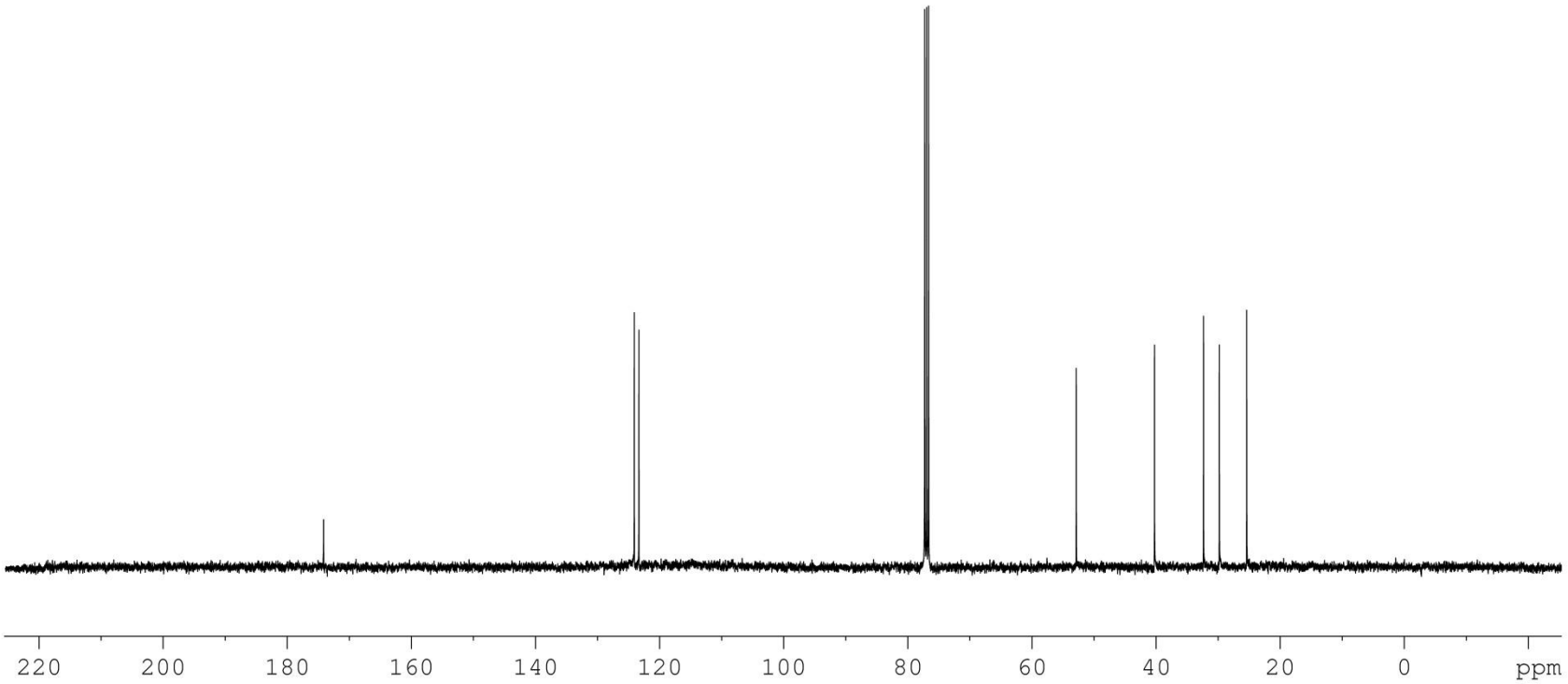
^{1}H NMR spectrum (400 MHz, $CDCl_3$)

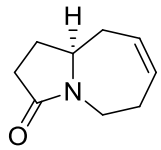




34

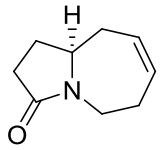
^{13}C NMR spectrum (100 MHz, $CDCl_3$)





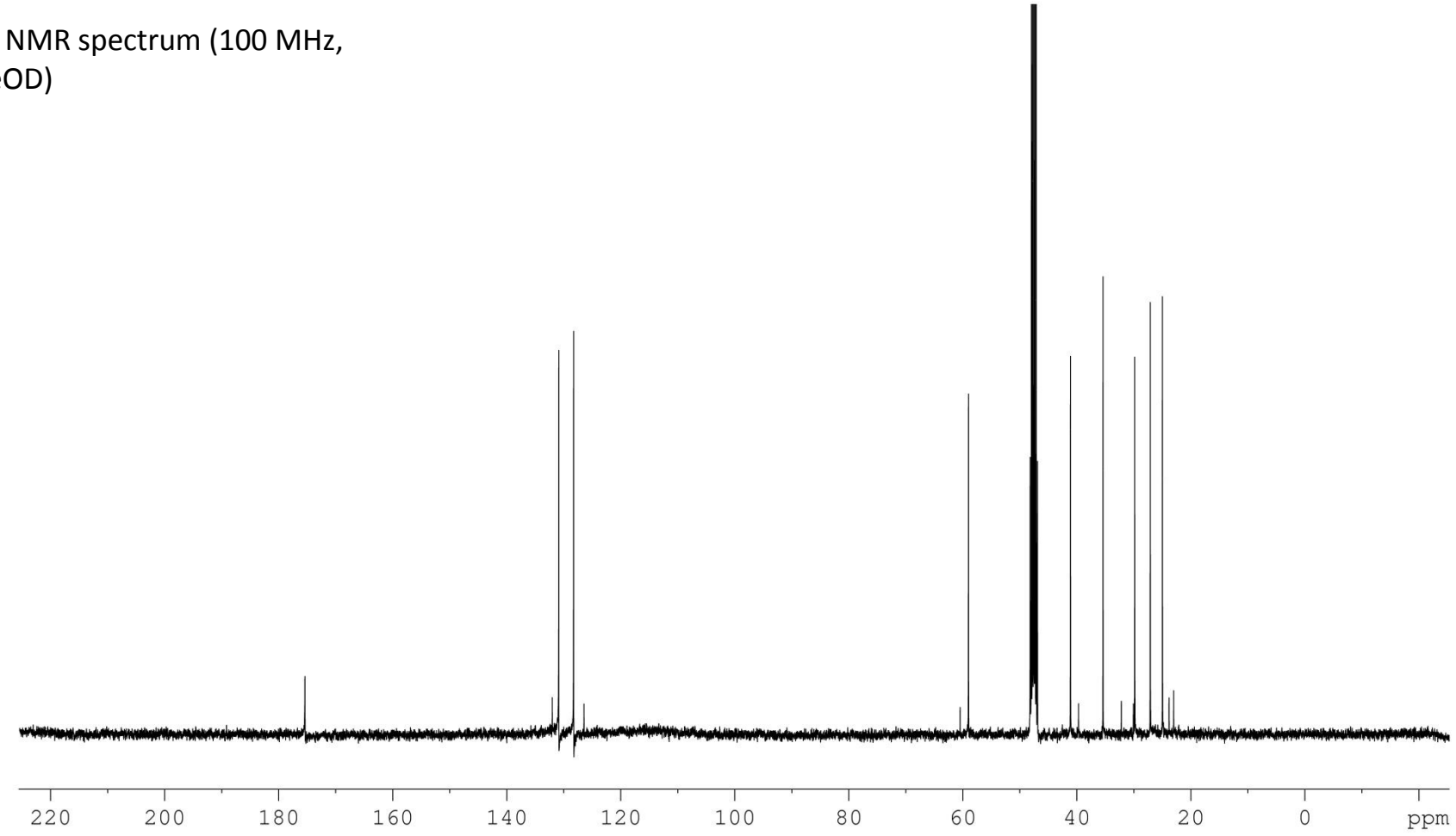
35

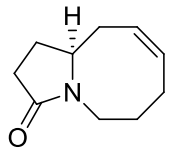
^{1}H NMR spectrum (400 MHz, MeOD)



35

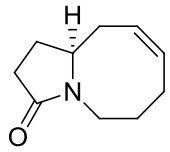
^{13}C NMR spectrum (100 MHz, MeOD)





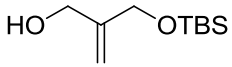
36

^{1}H NMR spectrum (400 MHz, $CDCl_3$)

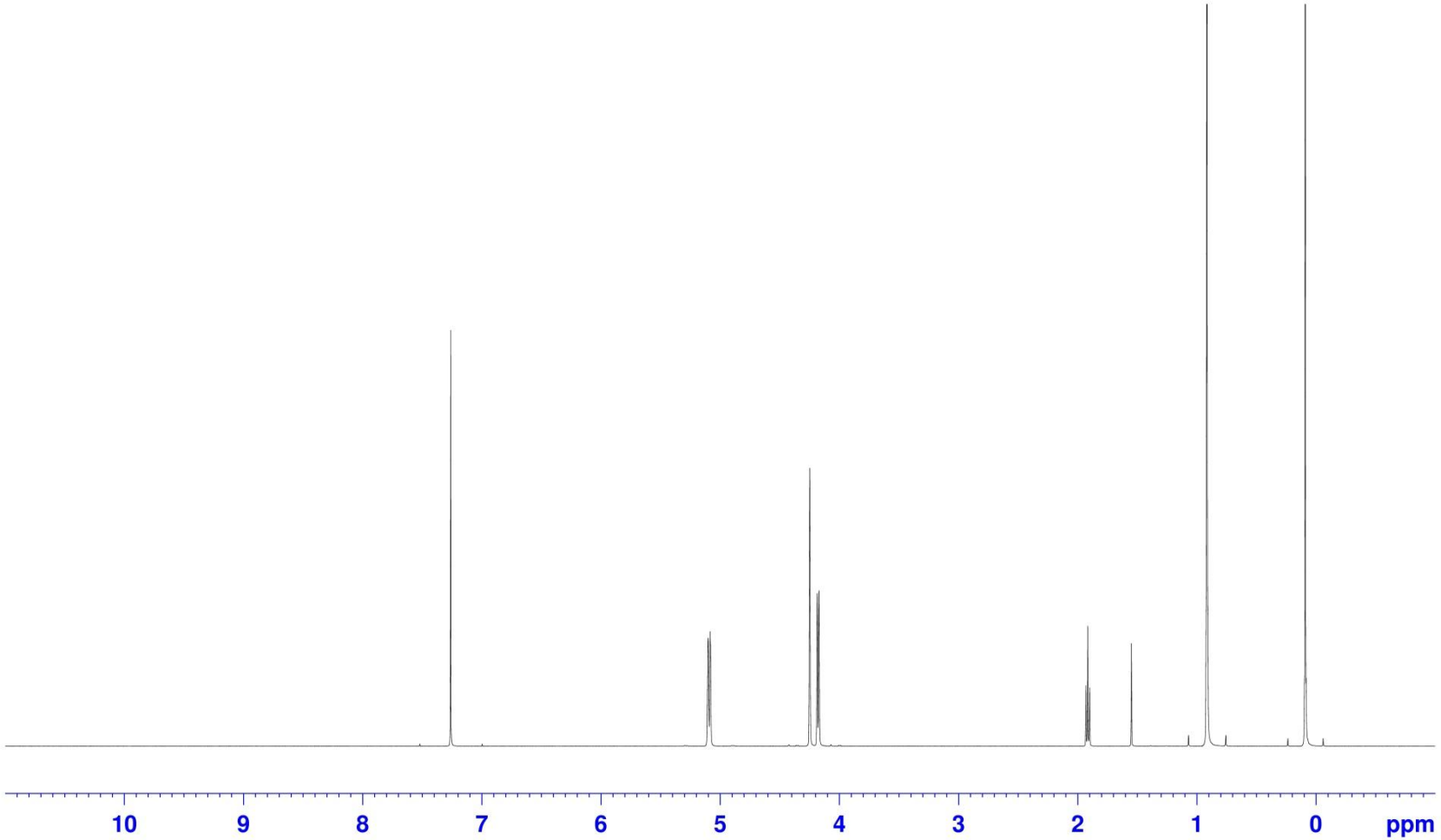


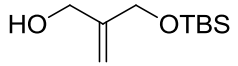
36

^{13}C NMR spectrum (100 MHz, $CDCl_3$)

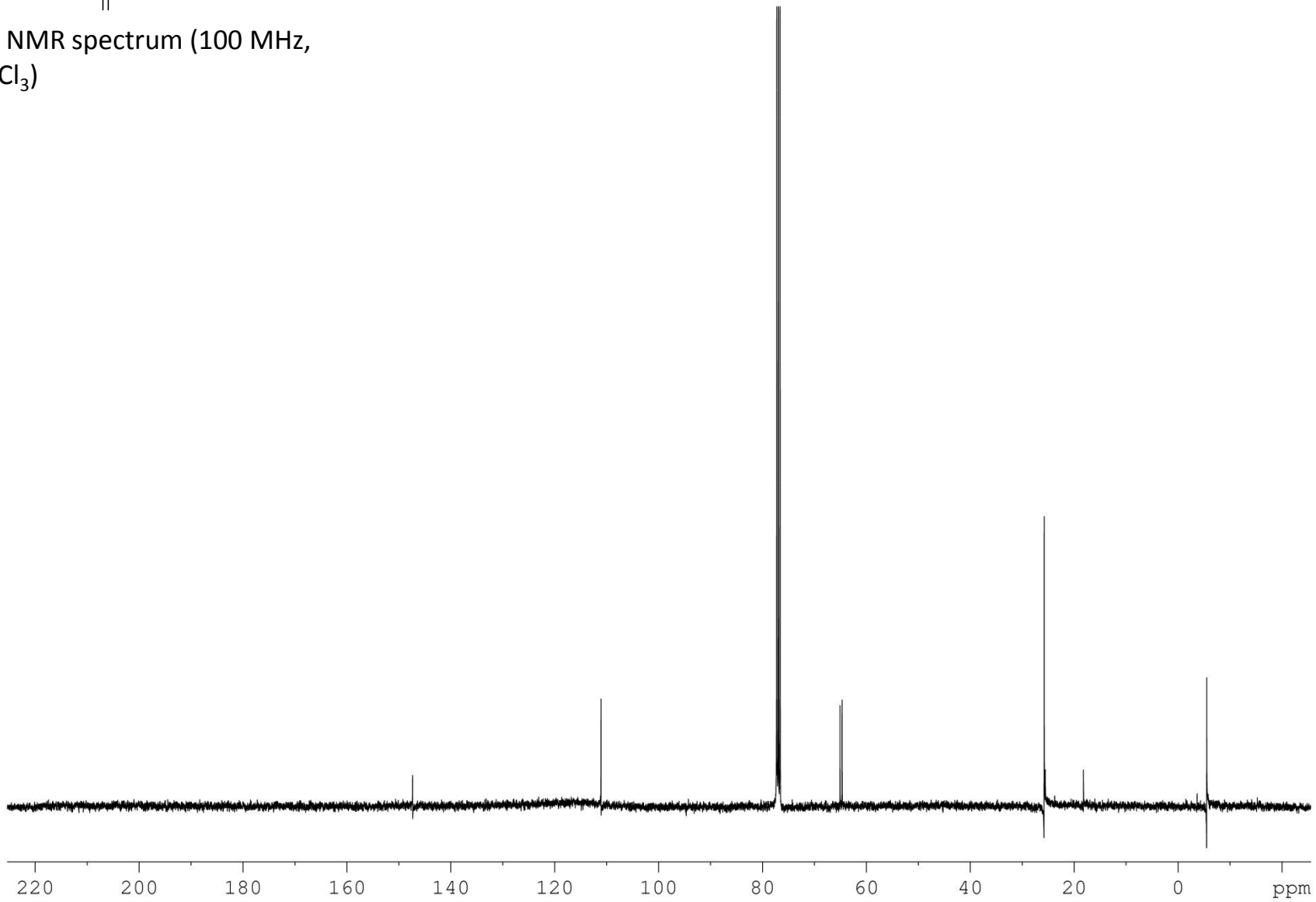


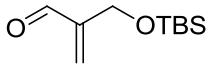
^{1}H NMR spectrum (400 MHz, $CDCl_3$)



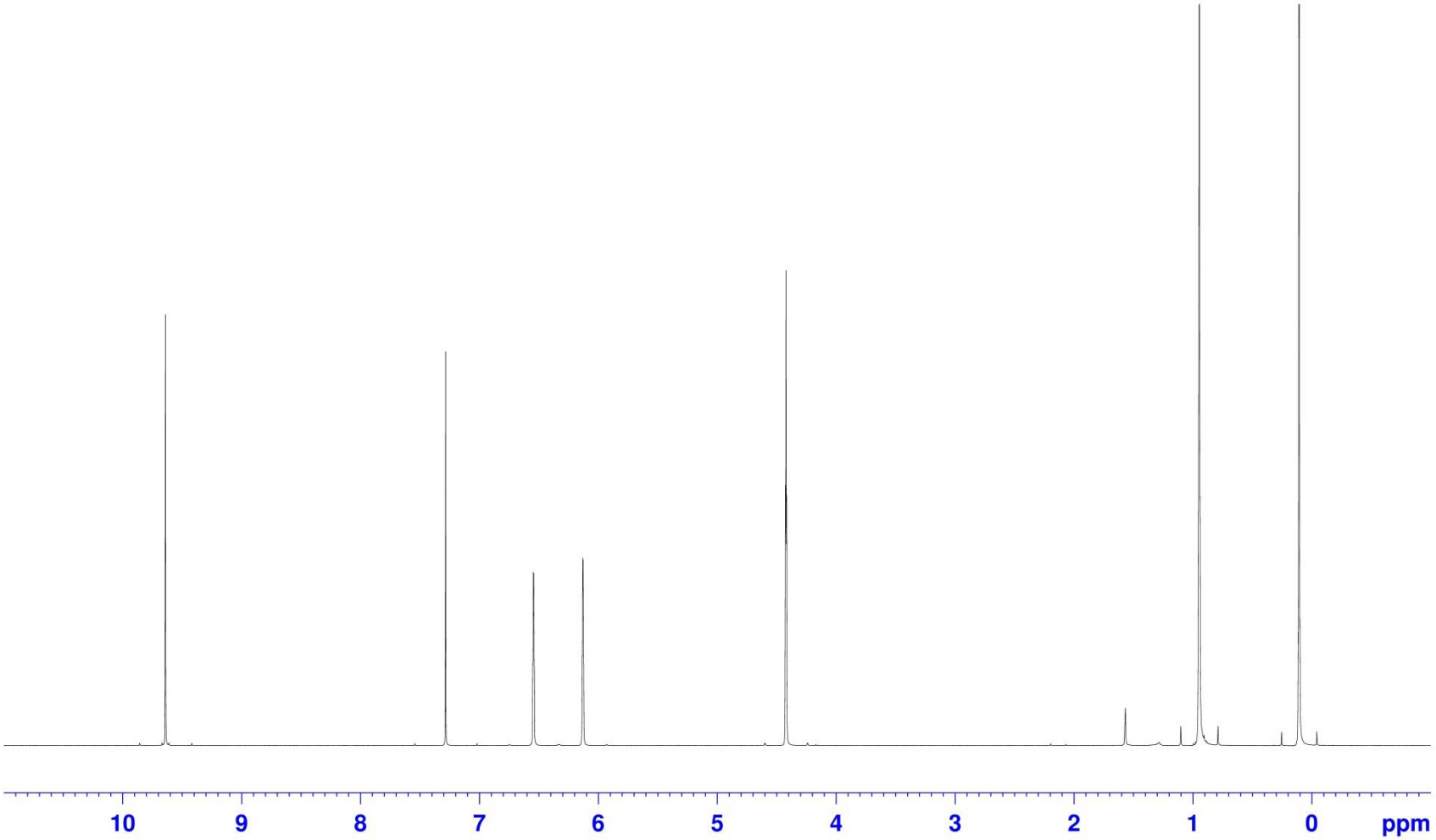


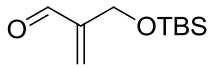
^{13}C NMR spectrum (100 MHz, $CDCl_3$)



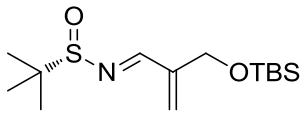


^{1}H NMR spectrum (400 MHz, $CDCl_3$)



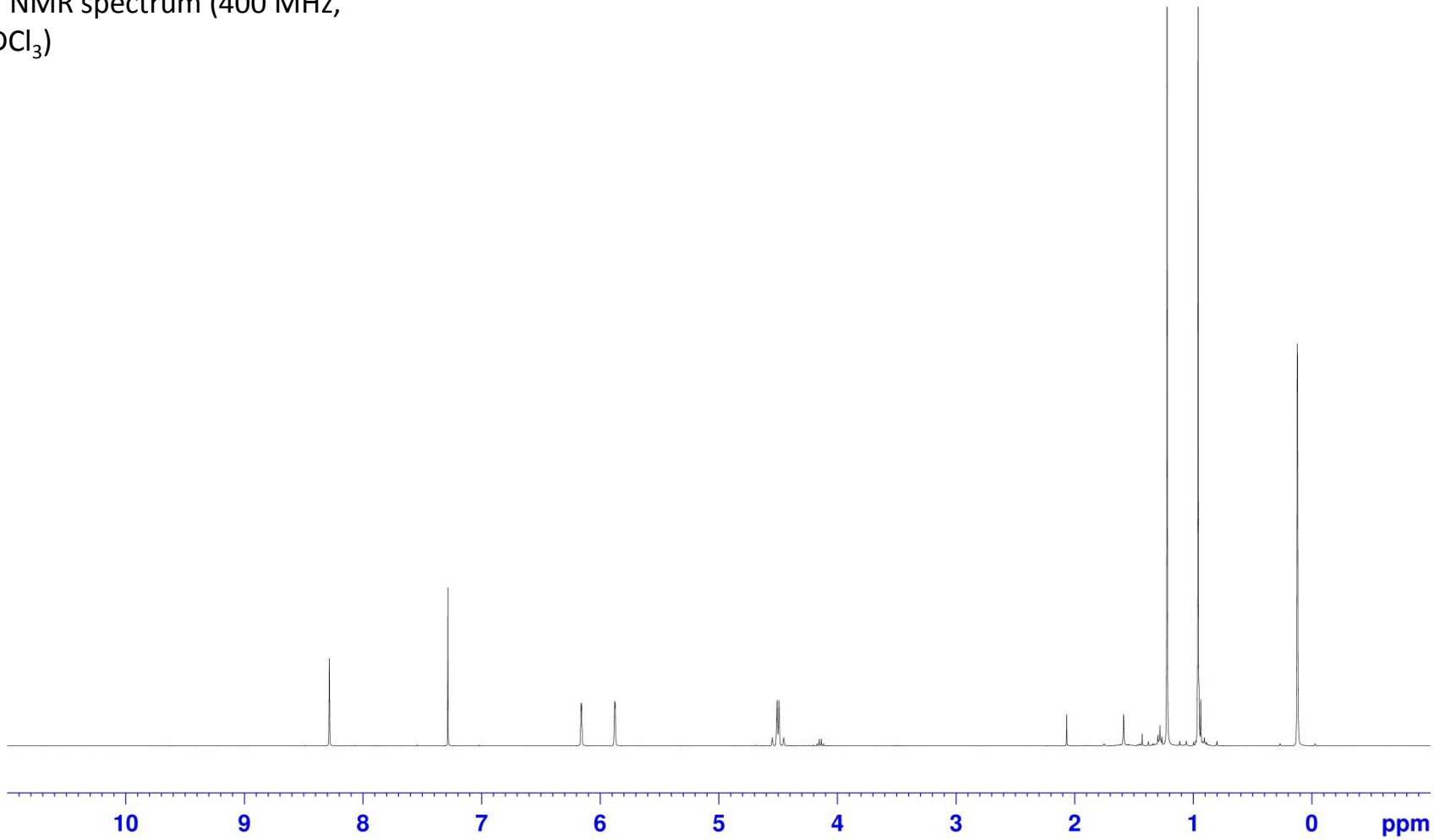


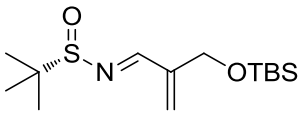
^{13}C NMR spectrum (100 MHz, $CDCl_3$)



46

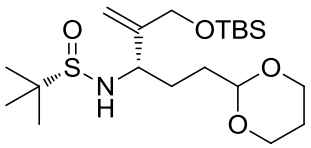
^{1}H NMR spectrum (400 MHz, $CDCl_3$)





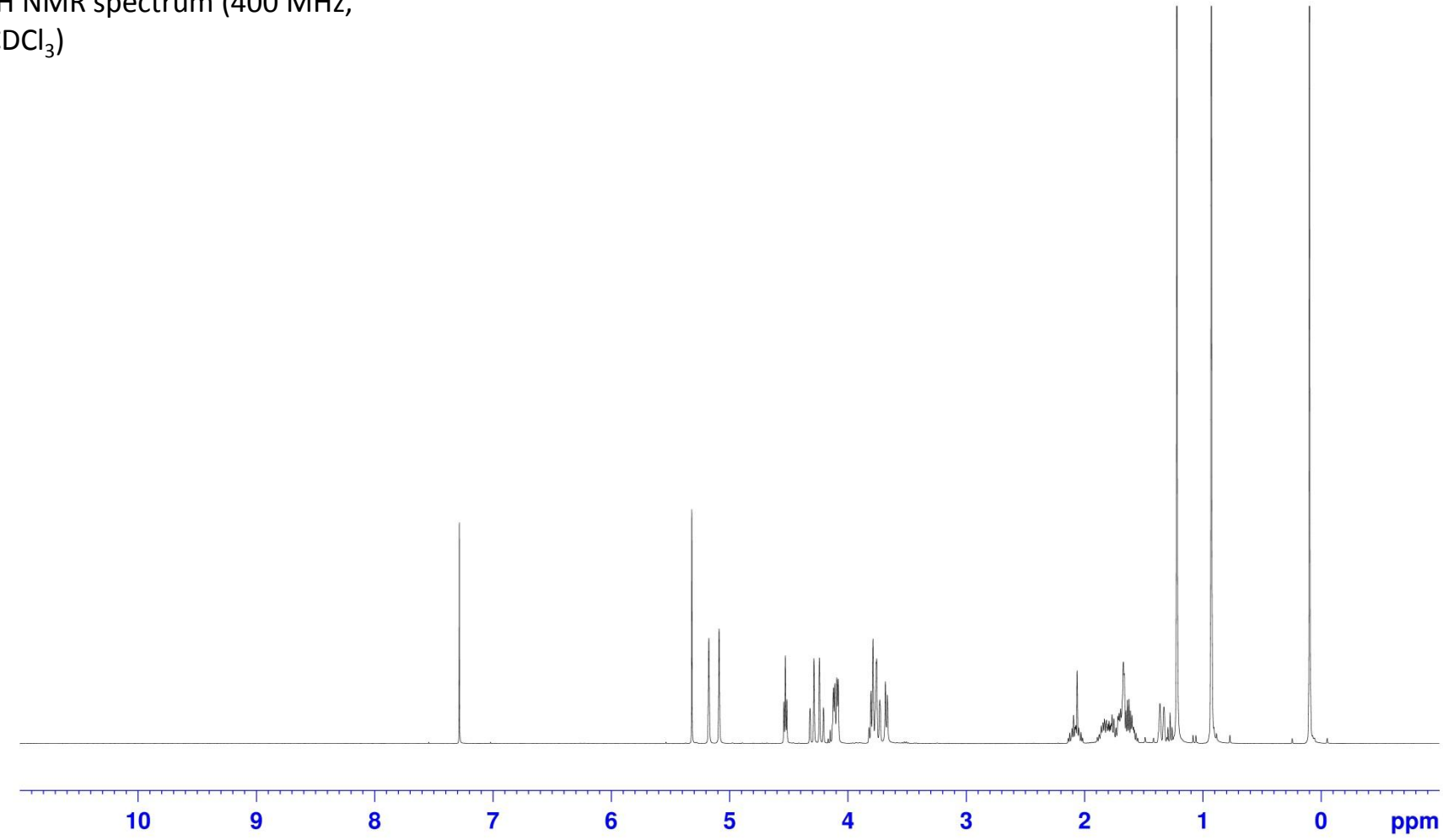
46

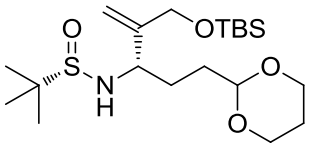
^{13}C NMR spectrum (100 MHz, $CDCl_3$)



48

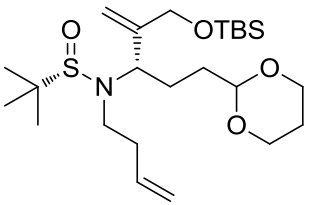
^{1}H NMR spectrum (400 MHz, $CDCl_3$)





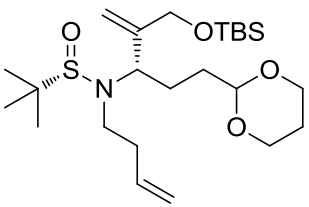
48

^{13}C NMR spectrum (100 MHz, $CDCl_3$)



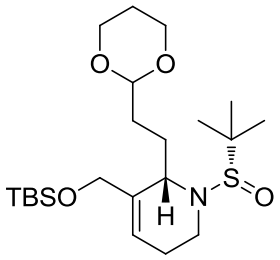
49

^{1}H NMR spectrum (400 MHz, $CDCl_3$)

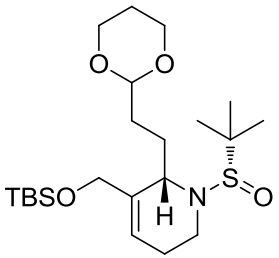


49

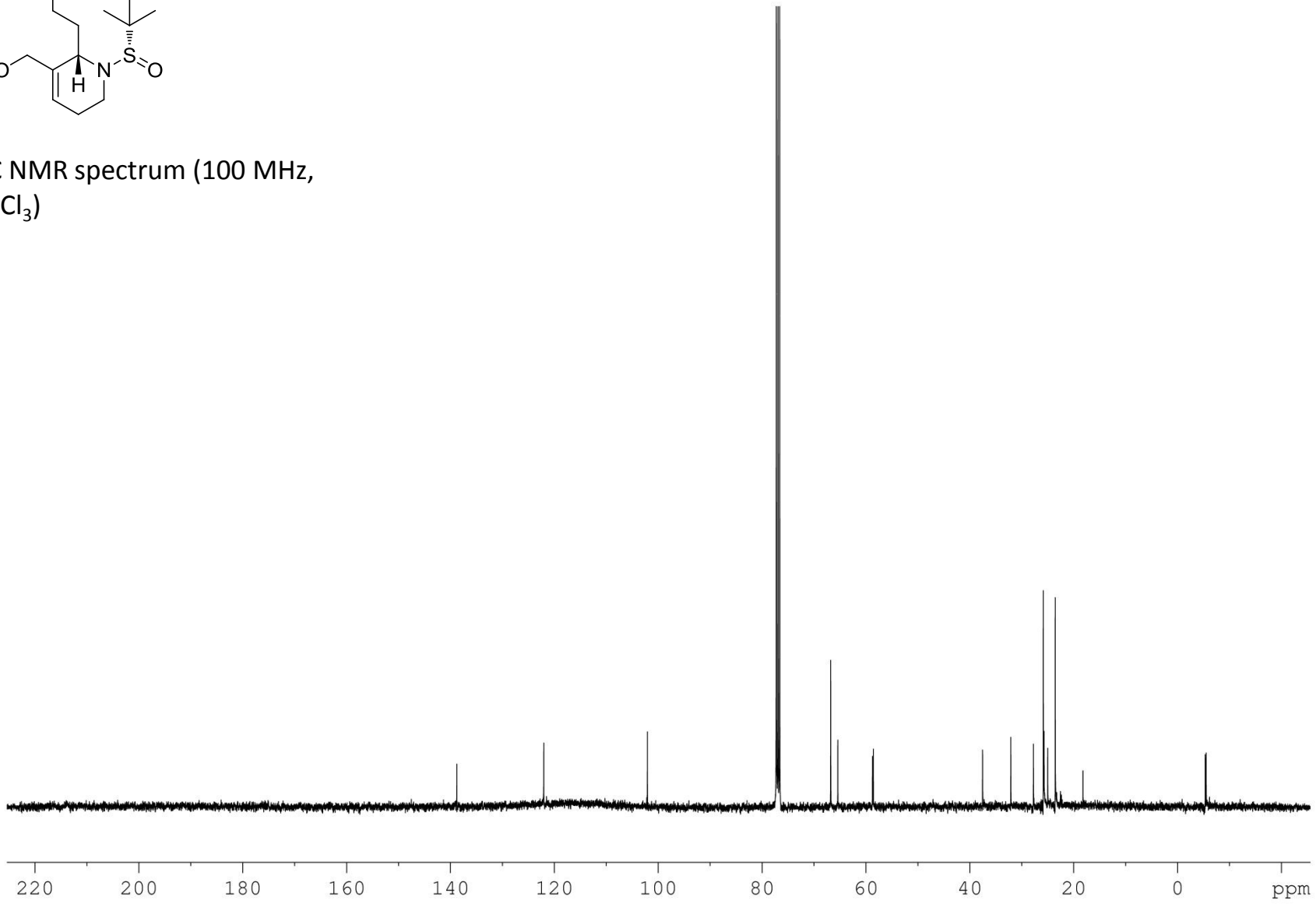
^{13}C NMR spectrum (100 MHz, $CDCl_3$)

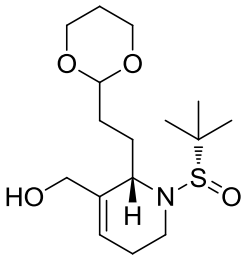


^{1}H NMR spectrum (400 MHz, $CDCl_3$)

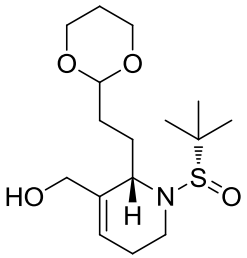


^{13}C NMR spectrum (100 MHz, $CDCl_3$)

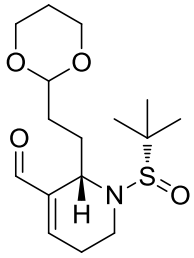




^{1}H NMR spectrum (400 MHz, $CDCl_3$)

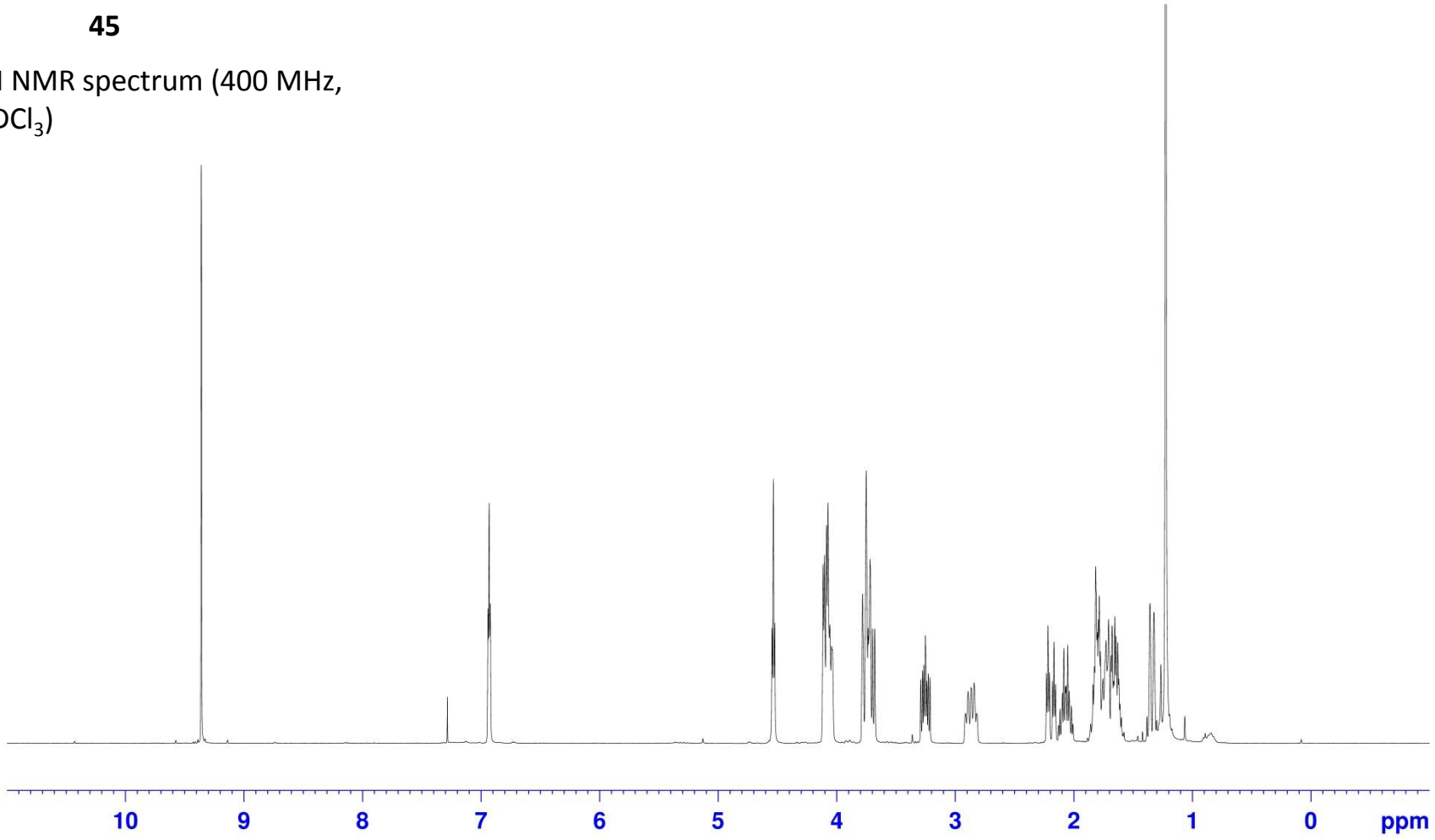


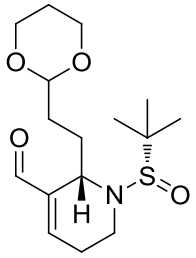
^{13}C NMR spectrum (100 MHz, $CDCl_3$)



45

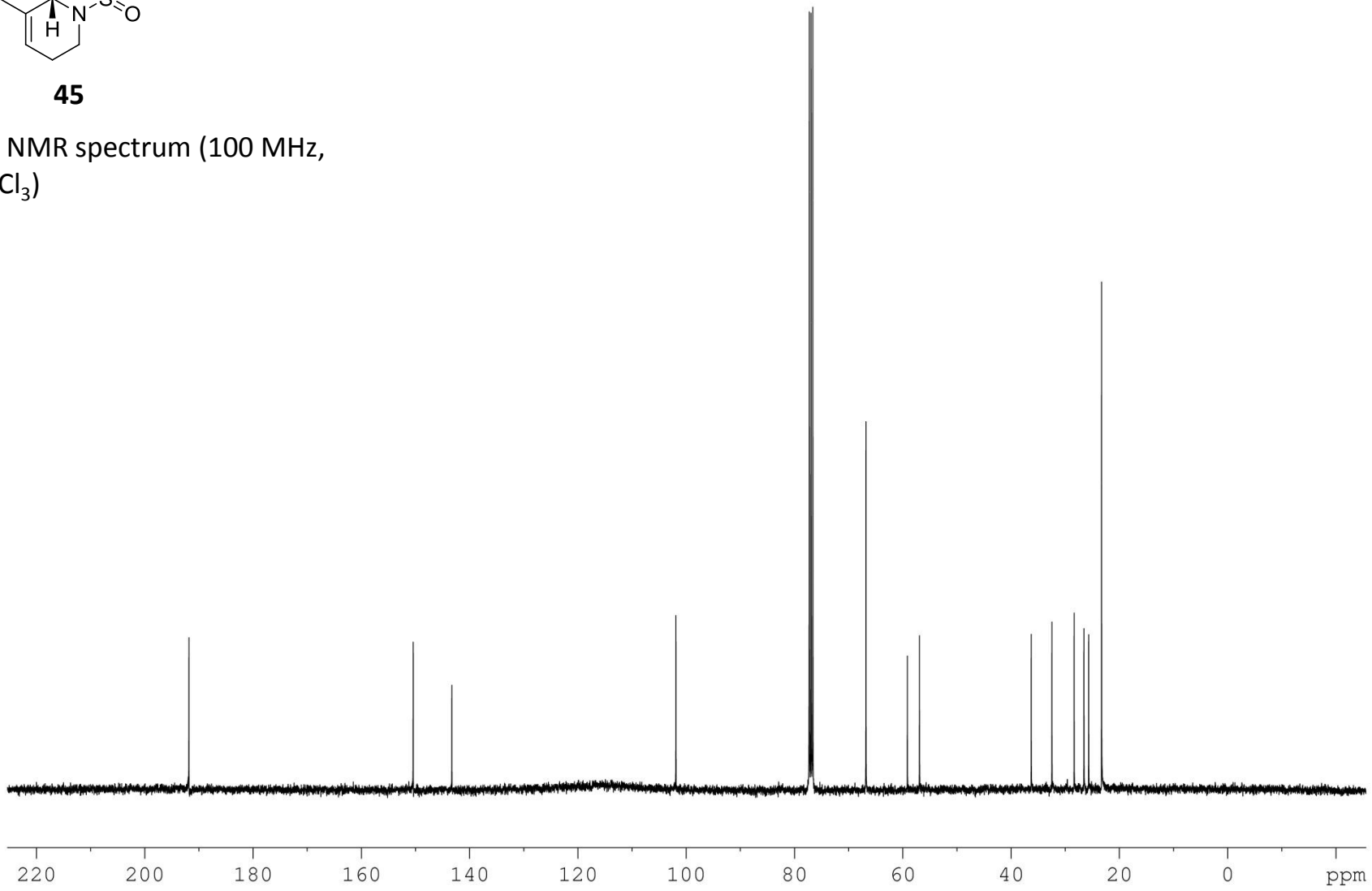
^{1}H NMR spectrum (400 MHz, $CDCl_3$)

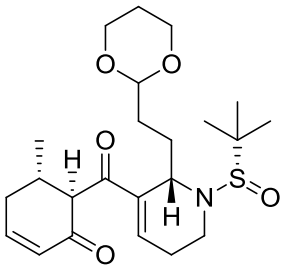




45

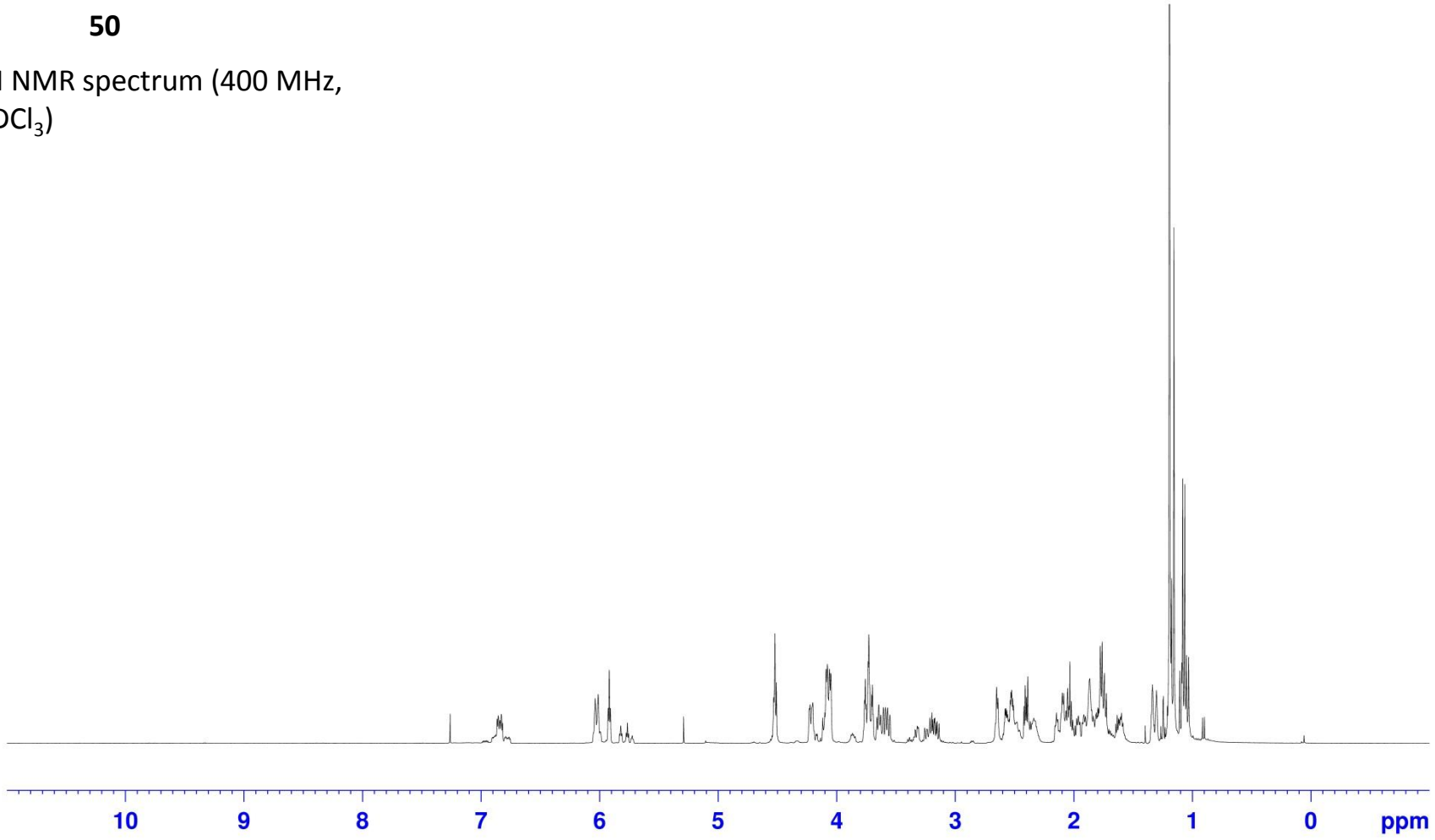
^{13}C NMR spectrum (100 MHz, $CDCl_3$)

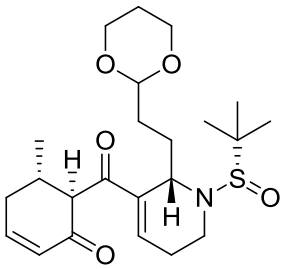




50

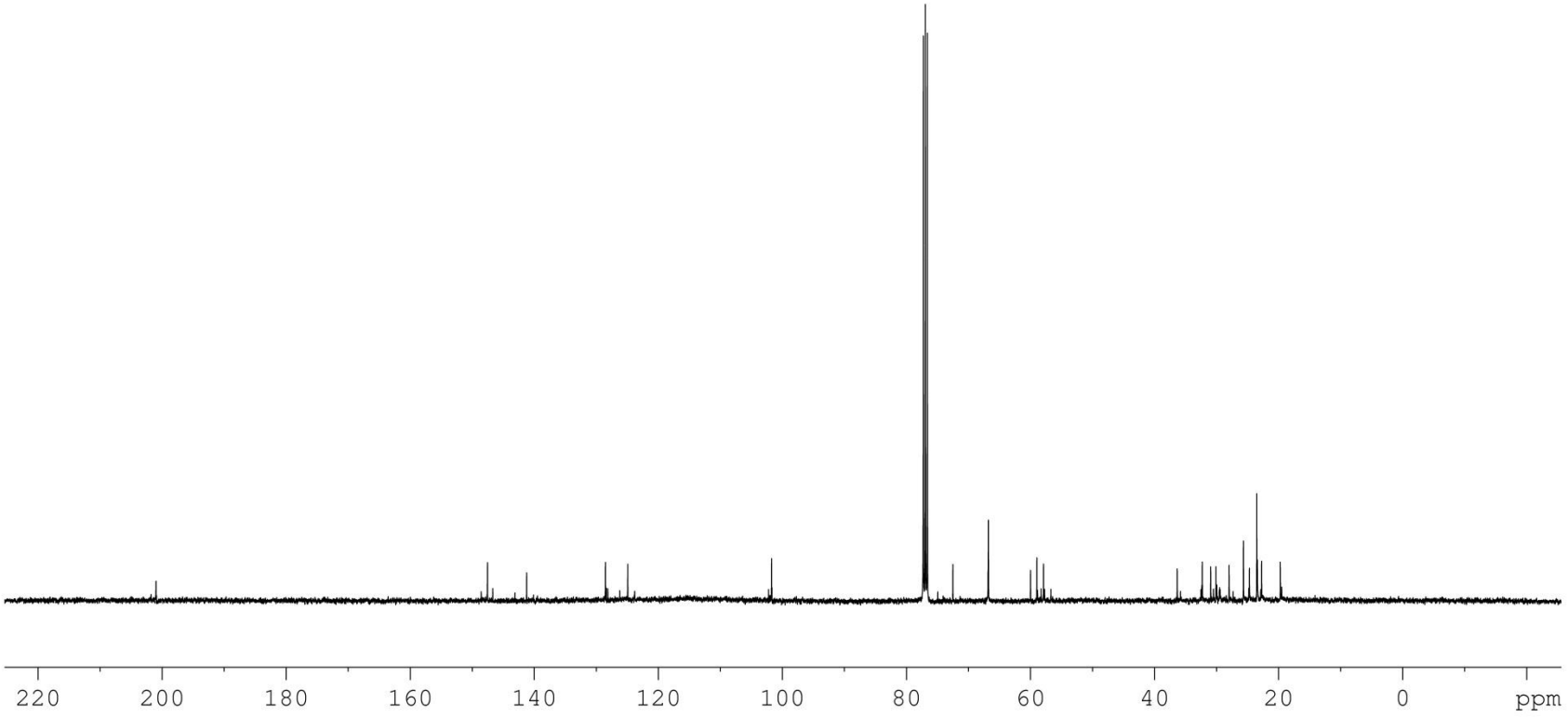
^{1}H NMR spectrum (400 MHz, $CDCl_3$)

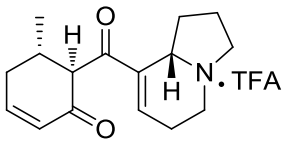




50

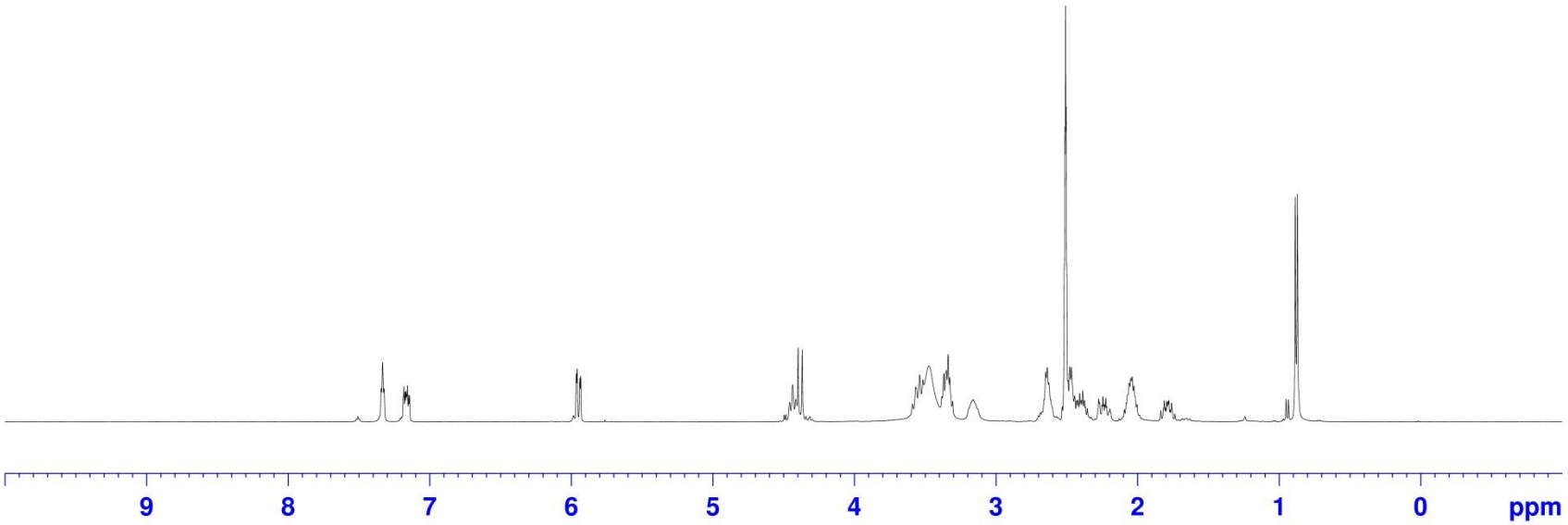
^{13}C NMR spectrum (100 MHz, $CDCl_3$)

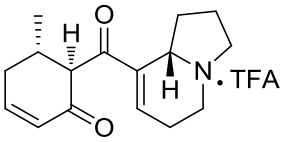




41

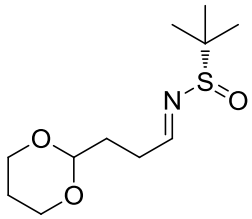
^{1}H NMR spectrum (400 MHz, DMSO)





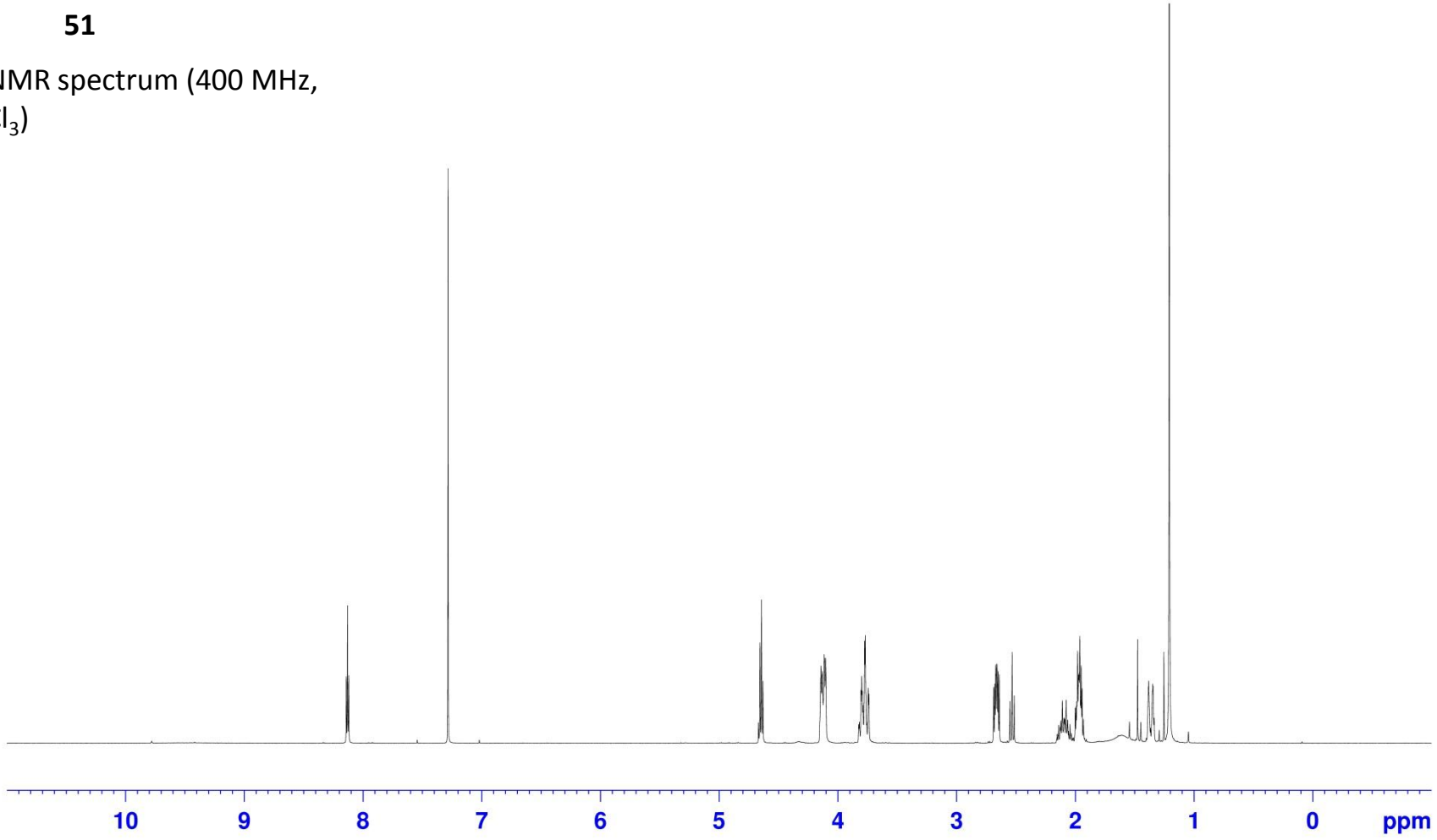
41

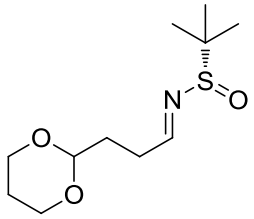
^{13}C NMR spectrum (100 MHz, DMSO)



51

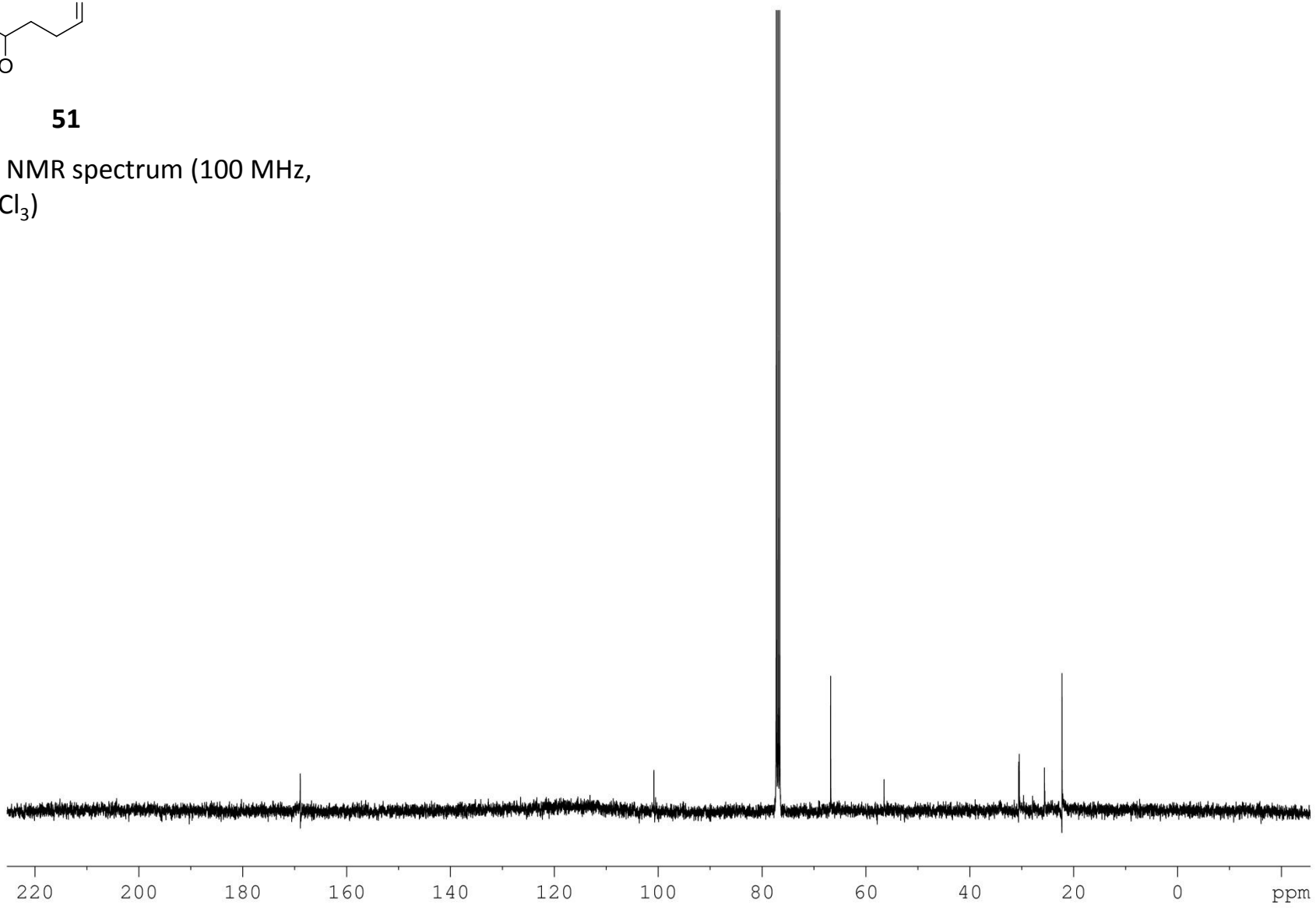
^{1}H NMR spectrum (400 MHz, $CDCl_3$)

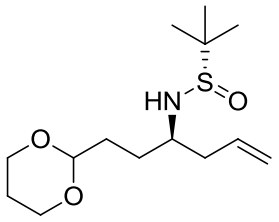




51

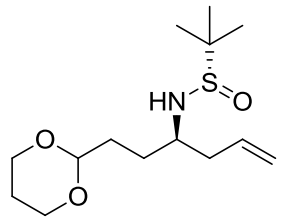
^{13}C NMR spectrum (100 MHz, $CDCl_3$)





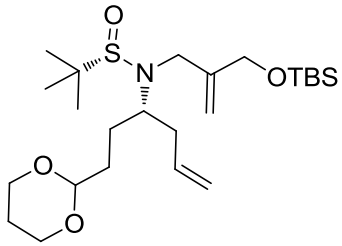
52

^{1}H NMR spectrum (400 MHz, $CDCl_3$)



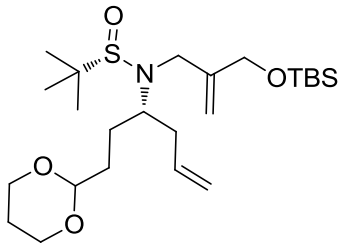
52

^{13}C NMR spectrum (100 MHz, $CDCl_3$)



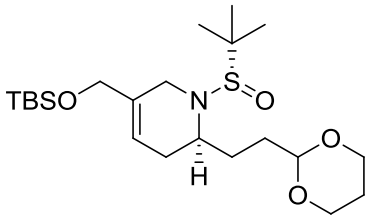
54

^{1}H NMR spectrum (400 MHz, $CDCl_3$)



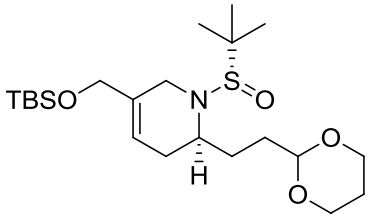
54

^{13}C NMR spectrum (100 MHz, $CDCl_3$)



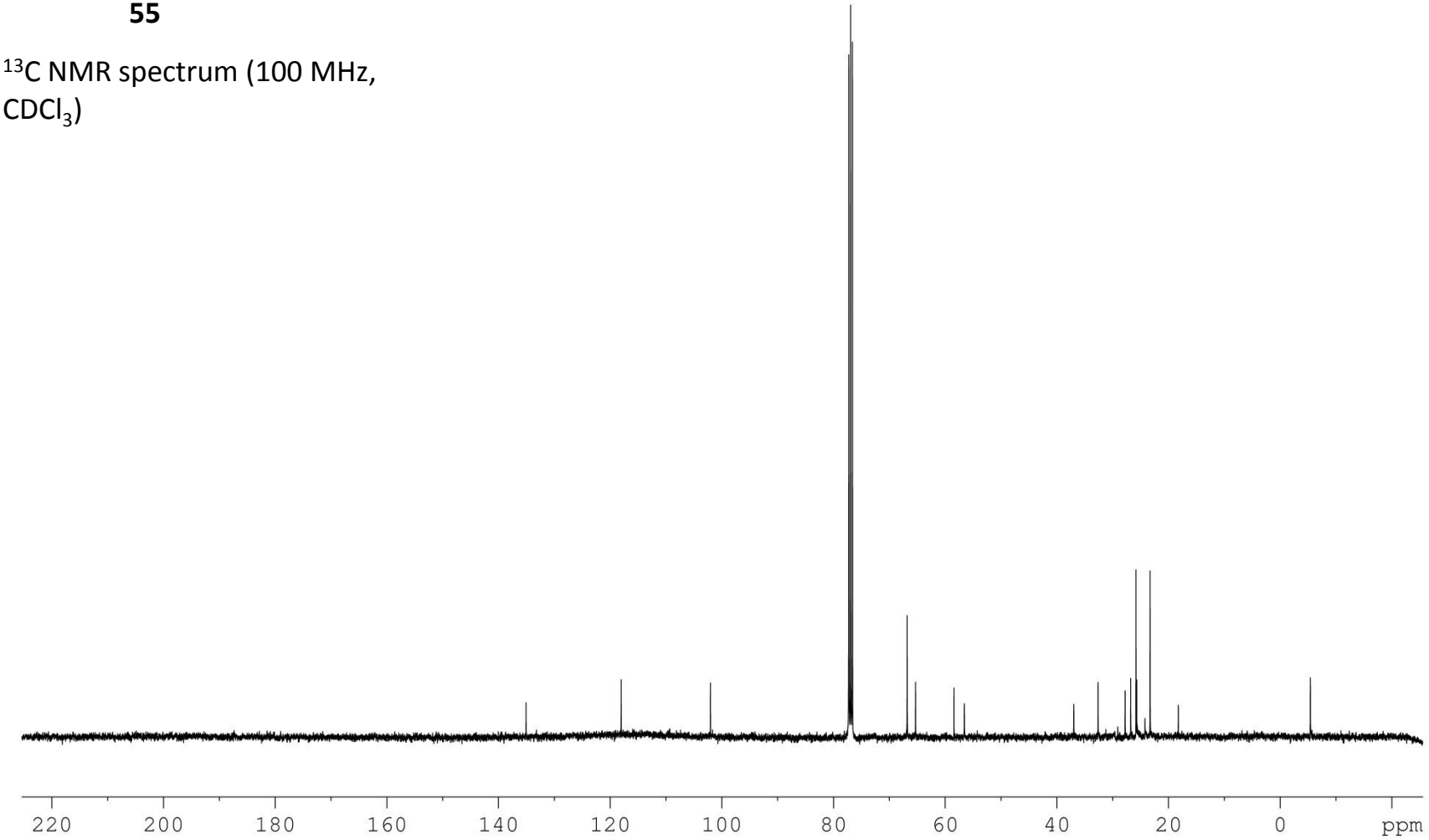
55

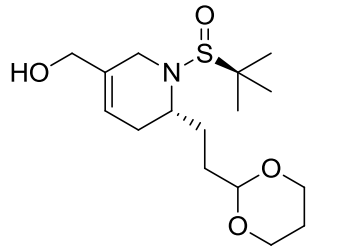
^{1}H NMR spectrum (400 MHz, $CDCl_3$)



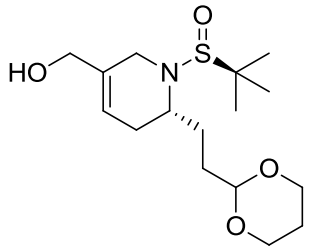
55

^{13}C NMR spectrum (100 MHz, $CDCl_3$)

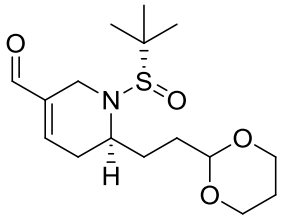




^{1}H NMR spectrum (400 MHz, $CDCl_3$)

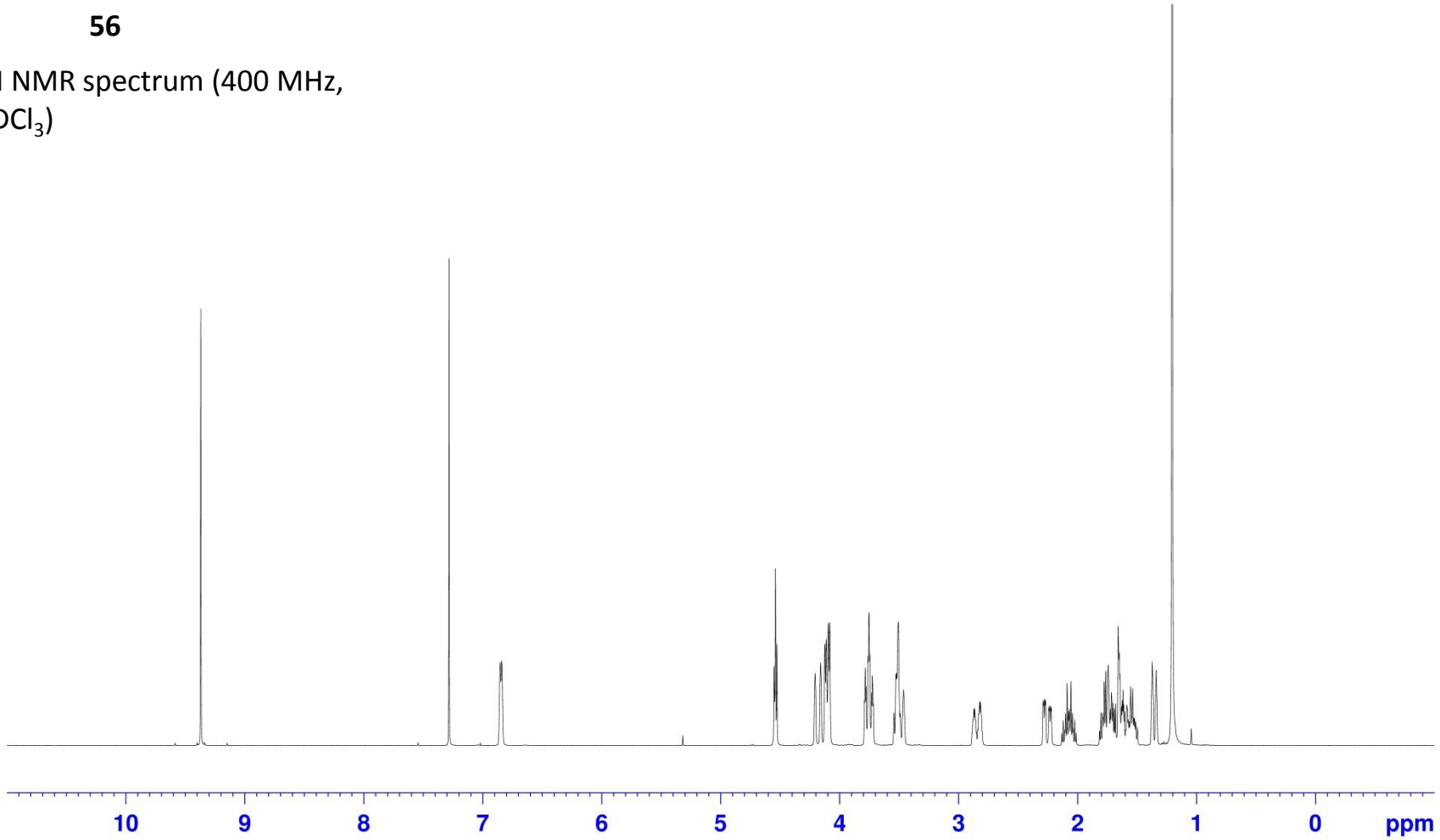


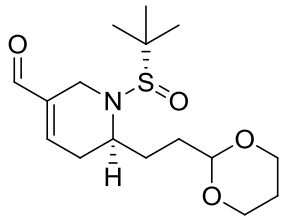
^{13}C NMR spectrum (100 MHz, $CDCl_3$)



56

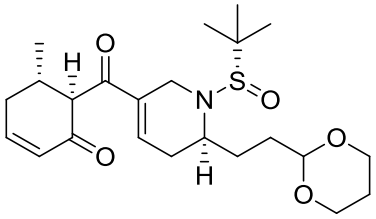
^{1}H NMR spectrum (400 MHz, $CDCl_3$)





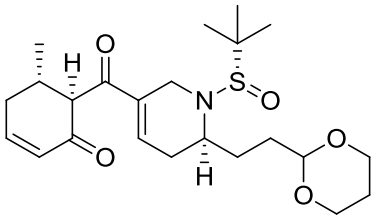
56

^{13}C NMR spectrum (100 MHz, $CDCl_3$)



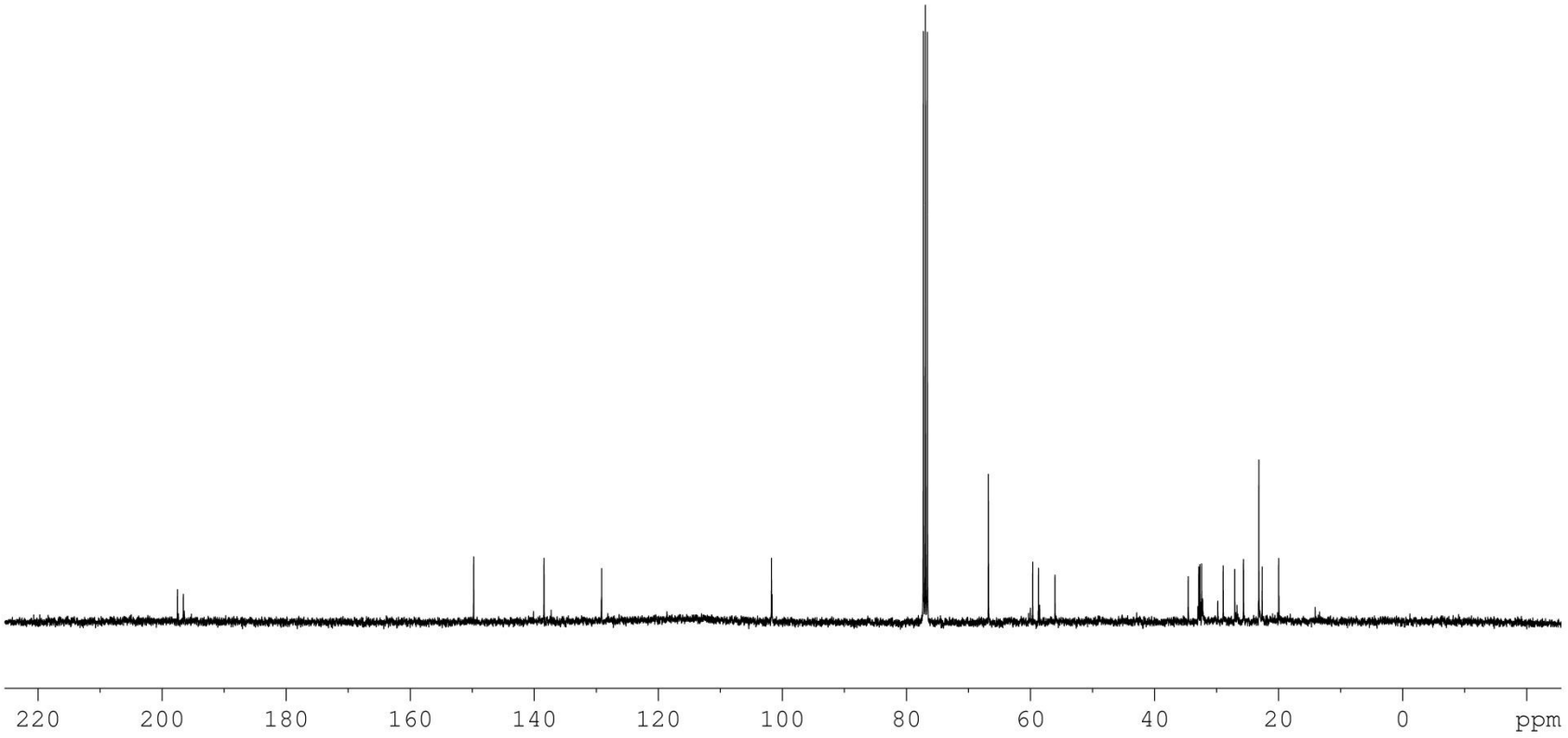
57

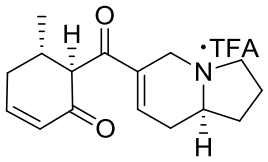
^{1}H NMR spectrum (400 MHz, $CDCl_3$)



57

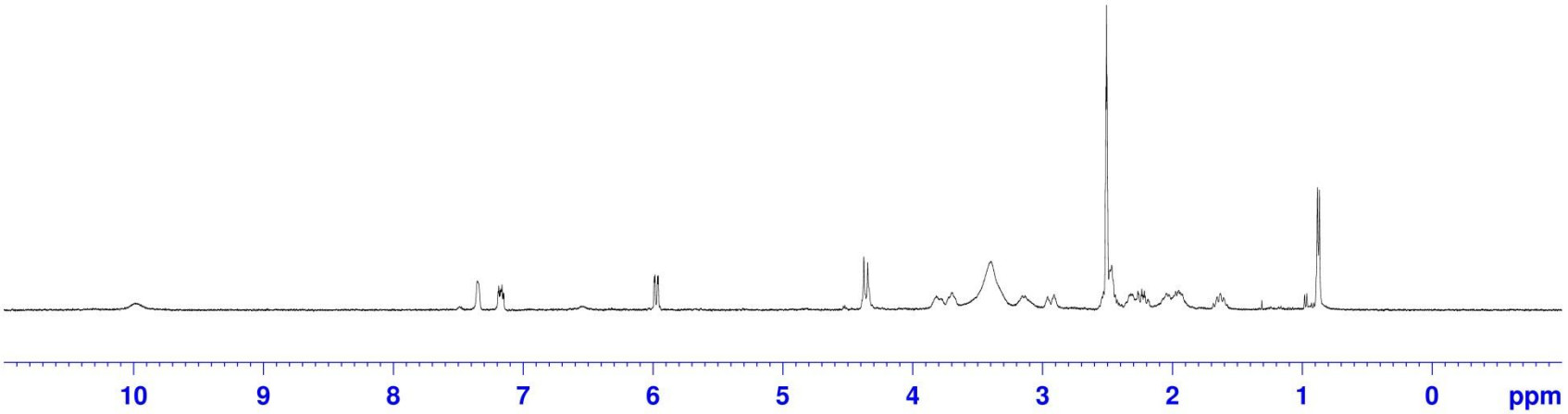
^{13}C NMR spectrum (100 MHz, $CDCl_3$)

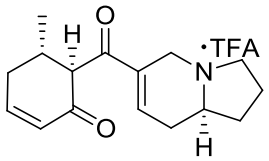




58

^{1}H NMR spectrum (600 MHz, DMSO)





58

^{13}C NMR spectrum (150.9 MHz, DMSO)