Electronic Supporting Information

The True Structures of the Vannusals, Part 1: Initial Forays into Suspected Structures and Intelligence Gathering.

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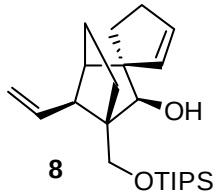
I) Experimentals

General Procedures. All reactions were carried out under an argon atmosphere with dry solvent under anhydrous conditions, unless otherwise noted. Dry tetrahydrofuran (THF), toluene, benzene, diethyl ether (Et_2O), *N*,*N*-dimethylformamide (DMF), CH_3CN, CH_3OH and methylene chloride (CH_2Cl_2) were obtained by passing commercially available pre-dried, oxygen-free formulations through activated alumina columns. Yields refer to chromatographically and spectroscopically (^1H NMR) homogeneous materials. Reagents were purchased at the highest commercial quality and used without further purification, unless otherwise stated.

Reactions were monitored by thin-layer chromatography (TLC) carried out on 0.25 mm E. Merck silica gel plates (60F-254) using UV light as visualizing agent and an ethanolic solution of phosphomolybdic acid and cerium sulfate, and heat as developing agents. E. Merck silica gel (60, particle size 0.040–0.063 mm) was used for flash column chromatography. NMR spectra were recorded on Bruker DRX-600, DRX-500 or Varian Inova-400 instruments and calibrated using residual undeuterated solvent as an internal reference. The following abbreviations were used to explain the multiplicities: s = singlet, d = doublet, t = triplet, br = broad, q = quartet, td = triple doublet, dt = double triplet, dq = double quartet.

Infrared (IR) spectra were recorded on a Perkin-Elmer 1600 series FT-IR spectrometer. High-resolution mass spectra (HRMS) were recorded on a VG ZAB-ZSE mass spectrometer using MALDI (matrix-assisted laser-desorption ionization) or ESI (electrospray ionization).

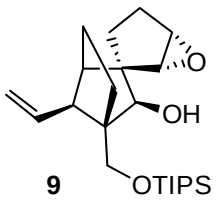
Hydroxy olefin 8: To a stirred solution of diol **7** (5.50 g, 14.6 mmol)[1] in CH_2Cl_2 (150 mL) at 25 °C was added Et_3N (10 equiv, 21.0 mL, 149 mmol) and Martins' Sulfurane (1.1 equiv, 11.0 g, 16.3 mmol). The resulting mixture was stirred at this temperature for 5 h and then quenched with saturated aqueous $NaHCO_3$ solution (100 mL). The mixture was extracted with CH_2Cl_2 (2 × 50 mL), dried ($MgSO_4$), and concentrated under reduced pressure. The crude residue was purified by flash column chromatography (silica, Et_2O/hexanes, 5→10 %) to furnish **8** (4.55 g, 12.6 mmol, 87 %). **8**: R_f



8

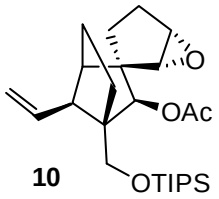
= 0.60 (silica, Et_2O:hexanes, 1:9); IR (film): ν_{max} = 3547brs, 2891s, 2865s, 1637w, 1463m, 1384w, 1245w, 1068s cm^{-1}; ^1H NMR (C_6D_6, 600 MHz): δ = 6.03 (dt, *J* = 6.0, 1.8 Hz, 1 H), 5.80 – 5.74 (m, 2 H), 5.15 (dd, *J* = 16.8, 2.4 Hz, 1 H), 5.05 (dd, *J* = 10.2, 2.4 Hz, 1 H), 3.97 (s, 1 H), 3.81 (d, *J* = 9.6 Hz, 1 H), 3.76 (d, *J* = 9.6 Hz, 1 H), 2.37 (d, *J* = 8.4 Hz, 1 H), 2.27 (ddd, *J* = 7.8, 5.4, 1.2 Hz, 1 H), 2.14 – 2.18 (m, 2 H), 2.02 (s, 1 H), 1.85 (ddd, *J* = 12.6, 6.6, 4.2 Hz, 1 H), 1.81 (d, *J* = 4.2 Hz, 1 H), 1.73 – 1.63 (m, 3 H), 1.20 (ddt, *J* = 12.0, 4.2, 1.8 Hz, 1 H), 1.08 (d, *J* = 6.6 Hz, 18 H), 1.06 – 0.90 (m, 3 H) ppm; ^{13}C NMR (C_6D_6, 150 MHz): δ = 135.80, 133.79, 132.25, 116.90, 84.16, 66.45, 58.74, 56.25, 52.83, 52.46, 41.37, 31.38, 23.48, 21.16, 18.21, 12.18 ppm; HRMS calcd for $C_{23}H_{40}O_2SiH^+$ [*M*+H^+] 377.2870 found 377.3872.

Hydroxy epoxide 9: To a stirred solution of hydroxy olefin **8** (4.55 g, 12.6 mmol) in benzene at 25 °C was added $VO(acac)_2$ (0.2 equiv, 0.77 g, 2.92 mmol) and *t*BuOOH (3.0 equiv, 8.0 mL, 43.8 mmol) . The resulting mixture was stirred at ambient temperature for 6 h and then quenched with saturated aqueous $Na_2S_2O_3$ solution (100 mL). The mixture was extracted with CH_2Cl_2 (2 × 50 mL), dried ($MgSO_4$), and concentrated under reduced pressure. The crude residue was purified by flash column chromatography (silica, Et_2O/hexanes, 10→30 %) to furnish **9** (4.25 g, 11.3 mmol, 90 %). **9**: R_f = 0.40 (silica, Et_2O:hexanes, 3:7); IR (film): ν_{max} = 3491brs, 2891s, 2865s, 1463m, 1380w, 1241w, 1101s cm^{-1}; ^1H NMR: (C_6D_6, 600 MHz) δ = 5.76 (m, 1 H), 5.19 (dd, *J* = 16.8, 1.8 Hz, 1 H), 5.10 (dd, *J* = 10.2, 1.8 Hz, 1 H), 4.06 (s, 1 H), 3.85 (d, *J* = 9.6 Hz, 1 H), 3.65 (d, *J* = 9.6 Hz, 1 H), 3.44 (d, *J* = 2.4 Hz, 1 H), 3.06 (d, *J* = 2.4 Hz, 1 H), 2.45 (s, 1 H), 2.36 (d, *J* = 8.4 Hz, 1 H), 2.26 (ddd, *J* = 7.8, 5.4, 1.2 Hz, 1 H), 1.74 (dd, *J* = 13.8, 7.8, Hz, 1 H), 1.66 (m, 1 H), 1.60 (m, 1 H), 1.52 (d, *J* = 3.6 Hz, 1 H), 1.35 (m, 1 H), 1.25 (dd, *J* = 12.6, 8.4 Hz, 1 H), 1.18 – 1.11 (m, 2 H), 1.10 (s, 18 H), 1.09 – 1.02 (m, 3 H) ppm; ^{13}C NMR (C_6D_6, 150 MHz): δ = 135.29, 117.39, 79.90, 63.84, 58.24, 55.39, 51.68, 56.68, 48.77, 34.26, 30.43, 27.07, 22.15, 20.25, 18.26, 12.27 ppm; HRMS calcd for $C_{23}H_{40}O_3SiH^+$ [*M*+H^+] 393.2819 found 393.2822.



9

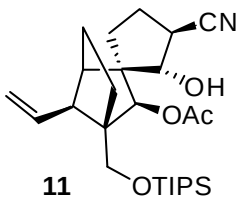
Acetate 10: To a stirred solution of hydroxy epoxide **9** (2.50 g, 6.37 mmol) in CH_2Cl_2 (50 mL) at 25 °C was added Et_3N (30 equiv, 27 mL, 191 mmol), Ac_2O (10 equiv, 6.8 mL, 63 mmol), and 4-DMAP (1 equiv, 0.78 g, 6.37 mmol). The resulting mixture was stirred at ambient temperature for 4 h and then quenched with saturated aqueous $NaHCO_3$ solution (100 mL). The mixture was extracted with CH_2Cl_2 (2 × 50 mL), dried ($MgSO_4$), filtered through a plug of silica (eluting with 100 % Et_2O), and concentrated under reduced pressure to furnish **10** (4.25 g, 11.3 mmol, 90 %) without further purification.



10

10: R_f = 0.40 (silica, Et_2O:hexanes, 3:7); IR (film): ν_{max} = 2942s, 2865s, 1753s, 1456m, 1362m, 1231s, 1100m cm^{-1}; ^1H NMR (C_6D_6, 500 MHz): δ = 5.73 (m, 1 H), 5.50 (d, *J* = 2.0 Hz, 1 H), 5.22 (dd, *J* = 17.0, 1.5 Hz, 1 H), 5.13 (dd, *J* = 10.5, 1.5 Hz, 1 H), 3.68 (d, *J* = 10.0 Hz, 1 H), 3.58 (d, *J* = 10.0 Hz, 1 H), 3.20 (d, *J* = 2.5 Hz, 1 H), 2.97 (d, *J* = 2.5 Hz, 1 H), 2.52 (d, *J* = 8.5 Hz, 1 H), 1.95 (s, 3 H), 1.94 – 1.89 (m, 1 H), 1.81 – 1.74 (m, 1 H), 1.66 (dd, *J* = 14.0, 8.0 Hz, 1 H), 1.63 – 1.57 (m, 2 H), 1.52 (d, *J* = 4.0 Hz, 1 H), 1.26 (dd, *J* = 12.5, 8.5 Hz, 1 H), 1.18 (ddd, *J* = 12.5, 4.0, 2.0 Hz, 1 H), 1.13 – 1.05 (m, 21 H) ppm; ^{13}C NMR (C_6D_6, 125 MHz): δ = 169.36, 134.61, 118.06, 77.96, 62.19, 57.54, 55.99, 54.65, 51.46, 51.10, 48.61, 32.97, 26.78, 22.03, 21.02, 20.84, 18.32, 18.27, 12.38 ppm; HRMS calcd for $C_{25}H_{42}O_4SiH^+$ [*M*+H^+] 435.2925 found 435.2927.

Hydroxy nitrile 11: To a stirred solution of acetate **10** (4.0 g, 9.21 mmol) in PhMe (50 ml) at –78 °C was added Et_2AlCN (10 equiv, 1.0 M in PhMe, 92.1 mL, 9.21 mmol). The resulting mixture was warmed to –20 °C (1 h) and maintained at this temperature for 18 h. The reaction mixture was quenched with saturated aqueous Rochelle's salt solution (100 mL), extracted with Et_2O (2 × 50 mL), dried ($MgSO_4$), and concentrated under reduced pressure. The crude residue was purified by flash column chromatography (silica, EtOAc/hexanes, 10→30 %) to furnish **11** (3.43 g, 7.43 mmol, 81 %).

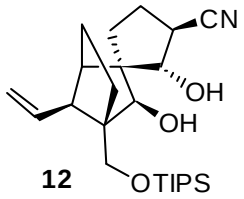


11

11: R_f = 0.35 (silica, EtOAc:hexanes, 1:3); IR (film): ν_{max} = 3468brs, 2891s, 2866s, 2237w, 1727s, 1463m, 1370w, 1260s, 1061s cm^{-1}; ^1H NMR (C_6D_6, 600 MHz): δ = 5.65

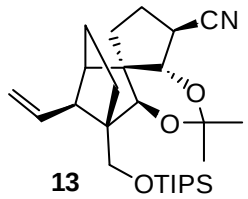
(m, 1 H), 5.21 (s, 1 H), 5.19 (dd, *J* = 16.8, 1.8 Hz, 1 H), 5.10 (dd, *J* = 10.2, 1.8 Hz, 1 H), 4.03 (t, *J* = 7.2 Hz, 1 H), 3.53 (d, *J* = 10.2 Hz, 1 H), 3.47 (d, *J* = 10.2 Hz, 1 H), 2.59 (d, *J* = 7.2 Hz, 1 H), 2.51 (m, 1 H), 2.42 (d, *J* = 8.4 Hz, 1 H), 2.09 (m, 1 H), 1.82 (m, 1 H), 1.75 (m, 1 H), 1.71 (s, 3 H), 1.70 – 1.65 (m, 3 H), 1.33 – 1.29 (m, 2 H), 1.10 – 1.00 (m, 22 H) ppm; ^{13}C NMR (C_6D_6, 150 MHz): δ = 170.38, 134.21, 121.77, 118.39, 80.95, 80.65, 61.83, 56.92, 52.17, 51.84, 50.93, 37.99, 36.80, 24.97, 21.87, 20.81, 20.77, 18.26, 18.21, 12.30 ppm; HRMS calcd for $C_{26}H_{43}NO_4SiH^+$ [*M*+H^+] 462.3034 found 462.3040.

Dihydroxy nitrile 12: To a stirred solution of hydroxy nitrile **11** (3.43 g, 7.43 mmol) in MeOH (100 mL) at 25 °C was added K_2CO_3 (1.0 equiv, 1.02 g, 7.43 mmol,). The resulting reaction mixture was stirred at ambient temperature for 2 h, quenched with saturated aqueous NH_4Cl solution (100 mL), extracted with Et_2O (2 × 50 mL), dried ($MgSO_4$), and concentrated in vacuo. The crude residue was purified by flash column chromatography (silica, Et_2O/hexanes, 10→30 %) to furnish **12** (3.01 g, 7.43 mmol, 100 %). **12**: R_f = 0.50 (silica, Et_2O:hexanes, 4:6); IR (film): ν_{max} = 3454brs, 2936s, 2866s, 2241m, 1635m, 1463m, 1260s, 1061s cm^{-1}; ^{1}H NMR (C_6D_6, 500 MHz): δ = 5.60 (m, 1 H), 5.00 (ddd, *J* = 17.0, 2.0, 0.5 Hz, 1 H), 4.96 (dd, *J* = 10.0, 2.0 Hz, 1 H), 4.67 (d, *J* = 5.5 Hz, 1 H), 4.32 (t, *J* = 5.0 Hz, 1 H), 3.90 (s, 1 H), 3.69 (d, *J* = 10.0 Hz, 1 H), 3.64 (d, *J* = 10.0 Hz, 1 H), 3.59 (d, *J* = 1.5 Hz, 1 H), 2.74 (dt, *J* = 9.5, 5.5 Hz, 1 H), 2.23 (ddd, *J* = 11.5, 9.0, 2.0 Hz, 1 H), 2.15 (ddd, *J* = 13.0, 9.0, 4.0 Hz, 1 H), 2.00 (d, *J* = 8.5 Hz, 1 H), 1.82 – 1.74 (m, 1 H), 1.76 (d, *J* = 4.0 Hz, 1 H), 1.69 (m, 1 H), 1.56 (m, 1 H), 1.46 (m, 1 H), 1.29 (ddd, *J* = 13.0, 9.0, 5.0 Hz, 1 H), 1.15 (ddt, *J* = 12.5, 3.0, 2.0 Hz, 1 H), 1.03 (m, 1 H), 1.00 (m, 18 H), 0.96 – 0.90 (m, 3 H) ppm; ^{13}C NMR (C_6D_6, 125 MHz): δ = 134.72, 122.25, 117.75, 85.85, 80.48, 68.71, 55.82, 53.41, 52.87, 51.63, 37.91, 35.85, 25.58, 22.64, 21.65, 18.31, 12.18 ppm; HRMS calcd for $C_{24}H_{41}NO_3SiH^+$ [*M*+H^+] 420.2928 found 420.2922.



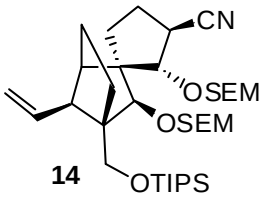
12

Acetonide 13: To a stirred solution of dihydroxy nitrile **12** in a mixture of DMF/2,2-dimethoxypropane (1:1, 100 mL) was added PPTS (1.0 equiv, 1.86 g, 7.43 mmol) and the resulting mixture was maintained at this temperature for 24 h. The reaction mixture was quenched with saturated aqueous $NaHCO_3$ solution (100 mL), extracted with Et_2O (2 × 50 mL), dried ($MgSO_4$), and concentrated in vacuo. The crude residue was purified by flash column chromatography (silica, Et_2O/hexanes, 2→10 %) to furnish **13** (3.03 g, 6.61 mmol, 89 %). Recrystallization from hexanes gave **13** as light yellow crystals, mp 87 – 88 °C. **13**: R_f = 0.50 (silica, Et_2O:hexanes, 1:9); IR (film): ν_{max} = 2931s, 2866s, 2932w, 1641w, 1463m, 1379w, 1224w, 1169s cm^{-1}; ^1H NMR (C_6D_6, 600 MHz): δ = 5.69 (m, 1 H), 5.26 (dd, *J* = 17.4, 1.8 Hz, 1 H), 5.15 (dd, *J* = 10.2, 1.8 Hz, 1 H), 4.26 (s, 1 H), 3.99 (s, 1 H), 3.71 (d, *J* = 10.2 Hz, 1 H), 3.52 (d, *J* = 10.2 Hz, 1 H), 2.50 (dd, *J* = 9.0, 4.2 Hz, 1 H), 2.44 (d, *J* = 8.4 Hz, 1 H), 2.00 (d, *J* = 4.2 Hz, 1 H), 1.91 (ddd, *J* = 9.0, 7.8, 4.8 Hz, 1 H), 1.80 – 1.68 (m, 3 H), 1.65 (dt, *J* = 12.6, 8.4 Hz, 1 H), 1.75 – 1.51 (m, 1 H), 1.41 (ddd, *J* = 8.4, 6.6, 3.0 Hz, 1 H), 1.23 (s, 3 H), 1.22 (s, 3 H), 1.08 (m, 18 H), 1.06 – 1.00 (m, 3 H), 0.96 (dt, *J* = 12.0, 4.2 Hz, 1 H) ppm; ^{13}C NMR (C_6D_6, 150 MHz): δ = 134.69, 120.97, 18.23, 99.96, 76.41, 75.60, 61.74, 56.48, 55.16, 50.98, 48.60, 37.45, 33.60, 28.48, 26.17, 24.21, 22.22, 21.03, 18.28, 12.27 ppm; HRMS calcd for $C_{27}H_{45}NO_3SiH^+$ [M+H^+] 460.3241 found 460.3239.



13

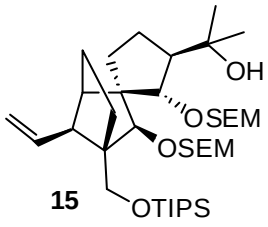
Bis-SEM 14: To a solution of dihydroxy nitrile **12** (2.75 g, 6.78 mmol) in CH_2Cl_2 (70 mL) at 25 °C was added iPr$_2$NEt (30 equiv, 35.0 mL, 203.0 mmol), nBu$_4$NI (1.0 equiv, 2.46 g, 6.78 mmol), and SEMCl (10 equiv, 11.2 mL, 67.8 mmol). The resulting mixture was refluxed for 48 h, cooled to ambient temperature, and quenched with EtOH (5.0 mL) and saturated aqueous $NaHCO_3$ solution (100 mL). The mixture was extracted with Et_2O (2 × 50 mL), dried ($MgSO_4$), and concentrated in vacuo. The crude residue was purified by flash column chromatography (silica, Et_2O/hexanes, 2→10 %) to furnish bis-SEM ether **14** (4.17 g, 6.13 mmol, 90 %) **14**: R_f = 0.50 (silica,



14

Et_2O:hexanes, 1:9); IR (film): ν_{max} = 2953s, 2866s, 2232m, 1638m, 1463w, 1249m, 1104s, 1054s cm^{-1}; ^1H NMR (C_6D_6, 500 MHz): δ = 5.79 (m, 1 H), 5.23 (ddd, *J* = 17.0, 2.0, 1.0 Hz, 1 H), 5.11 (dd, *J* = 10.5, 2.0 Hz, 1 H), 4.72 (d, *J* = 6.0 Hz, 1 H), 4.68 (d, *J* = 6.5 Hz, 1 H), 4.67 (d, *J* = 6.5 Hz, 1 H), 4.63 (d, *J* = 6.0 Hz, 1 H), 4.33 (s, 1 H), 3.92 (s, 1 H), 3.87 (d, *J* = 10.0 Hz, 1 H), 3.78 (m, 1 H), 3.66 – 3.60 (m, 3 H), 3.44 (m, 1 H), 3.08 (dd, *J* = 9.0, 3.5 Hz, 1 H), 2.54 (d, *J* = 8.0 Hz, 1 H), 2.08 (d, *J* = 4.0 Hz, 1 H), 1.97 – 1.91 (m, 2 H), 1.89 – 1.81 (m, 2 H), 1.76 (m, 1 H), 1.64 – 1.58 (m, 2 H), 1.15 (m, 21 H), 1.02 – 0.98 (m, 2 H), 0.93 – 0.89 (m, 2 H), 0.20 (s, 9 H), 0.01 (s, 9 H) ppm; ^{13}C NMR (C_6D_6, 125 MHz): δ = 135.40, 121.48, 117.65, 97.40, 96.67, 85.20, 84.41, 65.97, 65.93, 62.47, 57.62, 56.91, 50.82, 49.39, 37.28, 33.61, 26.19, 22.07, 20.78, 18.46, 18.32, 18.29, 12.56, –1.32, –1.35 ppm; HRMS calcd for $C_{36}H_{69}NO_5Si_3Na^+$ [*M*+Na^+] 702.4375 found 702.4376.

Tertiary alcohol 15: To a solution of **14** (4.17 g, 6.13 mmol) in PhMe (70 mL) at –78 °C was added DIBAL-H (1.10 equiv, 1.0 M in PhMe, 6.75 mL, 6.75 mmol). The reaction mixture was warmed to –30 °C (1 h) and quenched with saturated aqueous Rochelle's salt solution (200 mL).

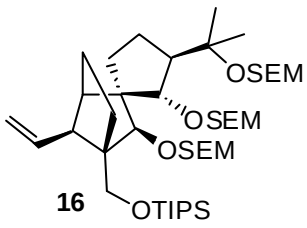


15

The resulting mixture was extracted with Et_2O (2 × 50 mL) and the organic extracts were stirred vigorously with aq. HCl (0.1 M, 100 mL) at 25 °C for 20 min. The layers were separated and the organic phase was dried ($MgSO_4$), and concentrated under reduced pressure to an oil. To a solution of the crude aldehyde in THF (120 mL) at 0 °C was added MeMgBr (10 equiv, 3.0 M in Et_2O, 20.3 mL, 122.0 mmol). After stirring for 30 min at that temperature, the reaction mixture was quenched with saturated aqueous NH_4Cl solution (100 mL), extracted with Et_2O (2 × 50 mL), dried ($MgSO_4$), and concentrated under reduced pressure to afford the crude alcohol as an inconsequential mixture of diastereomers (ca. 2:1). To a stirred solution of this crude alcohol in mixture of CH_2Cl_2/CH_3CN (7:1, 100 mL) was added at ambient temperature freshly dried 4 Å MS (4.0 g), NMO (2.0 equiv, 1.43 g, 12.0 mmol), and TPAP (0.05 equiv, 0.11 g, 0.30 mmol). The resulting mixture was stirred for 3 h, quenched with the addition of celite and hexanes (30

mL), filtered through a plug of silica (eluting with 1:1 Et_2O/hexanes), and concentrated under reduced pressure to furnish the crude ketone. To a solution of this crude ketone in THF (100 mL) at –10 °C was added MeMgBr (10 equiv, 3.0 M in Et_2O, 20.3 mL, 122.0 mmol), and the resulting mixture was stirred for 20 min and then quenched with saturated aqueous NH_4Cl solution (100 mL), extracted with Et_2O (2 × 50 mL), dried ($MgSO_4$), and concentrated under reduced pressure. The crude residue was purified by flash column chromatography (silica, Et_2O/hexanes, 5→20 %) to furnish **15** (3.14 g, 4.40 mmol, 72 % overall yield). **15**: R_f = 0.60 (silica, Et_2O:hexanes, 4:6); IR (film): ν_{max} = 3483brs, 2951s, 2866s, 1464m, 1369m, 1249s, 1098s cm^{-1}; ^1H NMR (C_6D_6, 500 MHz): δ = 5.93 (m, 1 H), 5.26 (ddd, *J* = 17.0, 2.0, 1.0 Hz, 1 H), 5.14 (dd, *J* = 10.0, 2.0 Hz, 1 H), 4.92 (d, *J* = 7.0 Hz, 1 H), 4.88 (d, *J* = 6.0 Hz, 1 H), 4.81 (d, *J* = 6.0 Hz, 1 H), 4.78 (d, *J* = 7.0 Hz, 1 H), 4.32 (d, *J* = 2.5 Hz, 1 H), 4.00 (s, 1 H), 3.96 (d, *J* = 10.0 Hz, 1 H), 3.88 – 3.83 (m, 2 H), 3.74 (m, 1 H), 3.73 (d, *J* = 10.0 Hz, 1 H), 3.54 (m, 1 H), 3.10 (brs, 1 H), 2.70 (d, *J* = 8.0 Hz, 1 H), 2.41 (dt, *J* = 9.5, 2.5 Hz, 1 H), 2.02 (ddd, *J* = 9.5, 5.0, 4.0 Hz, 1 H), 1.91 (m, 1 H), 1.88 (d, *J* = 4.5 Hz, 1 H), 1.82 (dt, *J* = 12.5, 7.0 Hz, 1 H), 1.77 – 1.73 (m, 2 H), 1.58 (m, 1 H), 1.28 (s, 3 H), 1.25 (m, 1 H), 1.23 (m, 1 H), 1.19 (m, 21 H), 1.08 (s, 3 H), 1.04 (m, 4 H), 0.05 (s, 9 H), –0.02 (s, 9 H) ppm; ^{13}C NMR (C_6D_6, 125 MHz): δ = 136.56, 116.99, 97.44, 96.62, 85.73, 83.77, 71.84, 65.98, 65.84, 62.83, 60.58, 57.89, 55.31, 50.18, 48.15, 39.75, 30.83, 26.12, 25.38, 22.23, 21.14, 18.50, 18.43, 18.26, 12.60, –1.29, –1.38 ppm; HRMS calcd for $C_{38}H_{76}O_6Si_3Na^+$ [*M*+Na^+] 735.4842 found 735.4850.

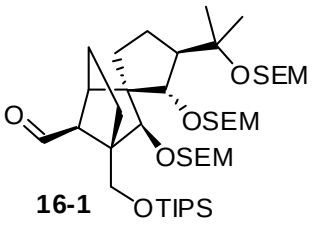
Tri-SEM ether 16: To a stirred solution of tertiary alcohol **15** (3.14 g, 4.40 mmol) in THF (100 mL) at –78 °C was added KHMDS (2.0 equiv, 0.5 M in PhMe, 17.6 mL, 8.80 mmol), SEMCl (5.0 equiv, 3.65 mL, 22.0 mmol), and Et_3N (10 equiv, 6.18 mL, 44.0 mmol) successively. The reaction mixture was warmed to 25 °C (1 h) and then quenched with saturated aqueous NH_4Cl solution (100 mL), extracted with Et_2O (2 × 50 mL), dried ($MgSO_4$), and concentrated under reduced pressure. The crude residue was purified by flash column chromatography (silica,



16

Et_2O/hexanes, 2→10 %) to furnish tri-SEM ether **16** (3.40 g, 4.03 mmol, 92 % yield). **16**: R_f = 0.60 (silica, Et_2O:hexanes, 2:8); IR (film): ν_{max} = 2951s, 2866s, 1464m, 1369m, 1249s, 1098s cm^{-1}; ^1H NMR (C_6D_6, 500 MHz): δ = 6.01 (m, 1 H), 5.28 (dd, *J* = 17.0, 2.0 Hz, 1 H), 5.14 (dd, *J* = 10.0, 2.0 Hz, 1 H), 4.97 (d, *J* = 6.5 Hz, 1 H), 4.92 (d, *J* = 6.5 Hz, 1 H), 4.87 (d, *J* = 6.5 Hz, 1 H), 4.84 (d, *J* = 6.5 Hz, 1 H), 4.70 (d, *J* = 7.5 Hz, 1 H), 4.62 (d, *J* = 7.5 Hz, 1 H), 4.42 (s, 1 H), 4.03 (s, 1 H), 4.00 (d, *J* = 10.0 Hz, 1 H), 3.87 (m, 1 H), 3.81 – 3.63 (m, 6 H), 2.72 (d, *J* = 8.0 Hz, 1 H), 2.22 – 2.16 (m, 2 H), 2.06 (m, 1 H), 1.97 – 1.91 (m, 2 H), 1.87 – 1.80 (m, 2 H), 1.62 (m, 1 H), 1.54 (m, 1 H), 1.46 (s, 3 H), 1.37 – 1.32 (m, 2 H), 1.19 (m, 21 H), 1.16 (s, 3 H), 1.11 – 1.05 (m, 4 H), 0.96 (t, *J* = 8.0 Hz, 2 H), 0.05 (s, 9 H), 0.05 (s, 9 H), 0.03 (s, 9 H) ppm; ^{13}C NMR (C_6D_6, 125 MHz): δ = 137.06, 116.63, 97.64, 95.02, 89.47, 86.04, 81.84, 76.53, 65.86, 65.51, 65.03, 63.07, 60.15, 57.83, 55.69, 49.80, 47.95, 39.50, 30.45, 26.33, 24.84, 22.58, 21.12, 18.53, 18.46, 18.39, 17.95, 12.62, –1.20, –1.28 ppm; HRMS calcd for $C_{44}H_{90}O_7Si_4Na^+$ [*M*+Na^+] 865.5656 found 865.5656.

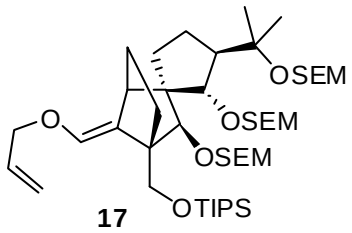
Aldehyde 16-1: To a solution of olefin **16** (3.40 g, 4.03 mmol) in MeOH/CH_2Cl_2 (1:1, 80 mL) at –78 °C was added pyridine (1.0 equiv, 0.31 mL, 4.03 mmol). Ozone was gently bubbled into the reaction mixture until the solution took on a light blue color. The reaction mixture was stirred for 2 min and then purged with oxygen until the solution became colorless once again. Ph_3P (5.0 equiv, 3.6 g, 13.6 mmol) was added and the reaction mixture was warmed to 25 °C, stirred an additional 1 h at this temperature, and concentrated under reduced pressure. The crude residue was directly purified by flash column chromatography (silica, Et_2O/hexanes, 2→10 %) to furnish aldehyde **16-1** (3.0 g, 3.56 mmol, 89 %). **16-1**: R_f = 0.60 (silica, Et_2O:hexanes, 2:8); IR (film): ν_{max} = 2944s, 2866s, 1717s, 1464m, 1374m, 1249m, 1196s, 1062s cm^{-1}; ^1H NMR (C_6D_6, 500 MHz): δ = 10.08 (d, *J* = 3.0 Hz, 1 H), 4.82 (d, *J* = 6.5 Hz, 1 H), 4.81 (d, *J* = 7.0 Hz, 1 H), 4.79 (d, *J* = 7.0 Hz, 1 H), 4.76 (d, *J* = 6.5 Hz, 1 H), 4.66 (d, *J* = 7.5 Hz, 1 H), 4.60 (d, *J* = 7.5 Hz, 1 H), 4.40 (s, 1 H), 4.10 (d, *J* = 10.5 Hz, 1 H), 4.05 (d, *J*



16-1

= 10.5 Hz, 1 H), 3.85 (m, 1 H), 3.79 (m, 1 H), 3.78 (s, 1 H), 3.68 (m, 3 H), 3.58 (m, 1 H), 2.54 (s, 1 H), 2.49 (d, *J* = 3.0 Hz, 1 H), 2.15 (m, 1 H), 2.08 (t, *J* = 9.5 Hz, 1 H), 2.01 (m, 1 H), 1.91 (m, 2 H), 1.79 (dt, *J* = 12.5, 7.0 Hz, 1 H), 1.55 (m, 2 H), 1.48 (m, 1 H), 1.43 (s, 3 H), 1.15 (m, 21 H), 1.10 (s, 3 H), 1.09 – 1.00 (m, 4 H), 0.97 (t, *J* = 8.5 Hz, 2 H), 0.04 (s, 27 H) ppm; ^{13}C NMR (C_6D_6, 125 MHz): δ = 203.11, 97.35, 94.29, 89.50, 87.06, 80.41, 76.36, 65.90, 65.60, 65.17, 64.21, 59.92, 58.74, 58.61, 56.12, 45.83, 39.57, 26.46, 24.60, 24.18, 23.02, 20.88, 18.47, 18.37, 17.96, 12.38, –1.21, –1.25, –1.33 ppm; HRMS calcd for $C_{43}H_{88}O_8Si_4Na^+$ [*M*+Na^+] 867.5448 found 867.5439.

Allyl enol ether 17: To KH (10 equiv, 4.74 g, 35.4 mmol, 30 % in mineral oil, washed with hexanes) in DME (40 mL) at 25 °C was added HMPA (10 equiv, 6.32 mL, 35.4 mmol), aldehyde **16-1** (3.0 g, 3.56 mmol, dissolved into 20 mL DME), and allylchloride (30 equiv, 8.52 mL, 106.0 mmol). The reaction mixture was stirred at this temperature for 12 h and then quenched by cannulation of the reaction mixture into aqueous phosphate buffer solution (pH = 7.0, 100 mL). The resulting mixture was extracted with Et_2O (2 × 100 mL), dried ($MgSO_4$), and concentrated in vacuo. The crude residue was purified by flash column chromatography (silica, Et_2O/hexanes, 2→10 %) to furnish allyl enol ether **17** (2.85 g, 3.21 mmol, 91 %).

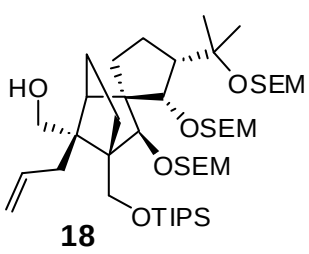


17

17: R_f = 0.40 (silica, Et_2O:hexanes, 1:9); IR (film): ν_{max} = 2951m, 2866m, 1721m, 1464s, 1381s, 1248s, 1108m, 1030s cm^{-1}; ^{1}H NMR (C_6D_6, 600 MHz): δ = 6.27 (s, 1 H), 5.77 (m, 1 H), 5.21 (dd, *J* = 16.8, 1.8 Hz, 1 H), 5.02 (dd, *J* = 10.8, 1.8 Hz, 1 H), 4.84 (d, *J* = 6.6 Hz, 1 H), 4.83 (d, *J* = 6.6 Hz, 1 H), 4.78 (d, *J* = 6.6 Hz, 1 H), 4.77 (d, *J* = 6.6 Hz, 1 H), 4.65 (d, *J* = 7.2 Hz, 1 H), 4.62 (d, *J* = 7.2 Hz, 1 H), 4.39 (s, 1 H), 4.12 (d, *J* = 10.2 Hz, 1 H), 4.07 (m, 2 H), 4.05 (d, *J* = 10.2 Hz, 1 H), 3.85 (m, 1 H), 3.77 (m, 1 H), 3.73 (s, 1 H), 3.71 – 3.66 (m, 3 H), 3.55 (m, 1 H), 3.12 (d, *J* = 4.2 Hz, 1 H), 2.17 (m, 1 H), 2.15 (t, *J* = 9.0 Hz, 1 H), 1.98 (m, 1 H), 1.93 (dd, *J* = 10.8, 6.0 Hz, 1 H), 1.81 (dt, *J* = 12.6, 7.2 Hz, 1 H), 1.77 – 1.70 (m, 2 H), 1.73 (d, *J* = 1.8 Hz, 1 H), 1.65 (m, 1 H), 1.42 (s, 3 H), 1.16 (m, 21 H), 1.13 (s, 3 H), 1.05 – 0.95 (m, 4 H), 0.92 (m, 2

H), 0.02 (s, 18 H), 0.01 (s, 9 H) ppm; ^{13}C NMR (C_6D_6, 150 MHz): δ = 135.11, 134.25, 126.02, 116.62, 97.48, 94.26, 89.50, 87.65, 80.61, 76.49, 72.49, 65.67, 65.46, 64.99, 63.26, 60.57, 57.29, 54.67, 42.46, 40.00, 26.56, 24.65, 24.57, 23.67, 23.40, 18.50, 18.43, 18.32 12.49, –1.12, –1.19, –1.27 ppm; HRMS calcd for $C_{46}H_{92}O_8Si_4Na^+$ [*M*+Na^+] 907.5761 found 907.5751.

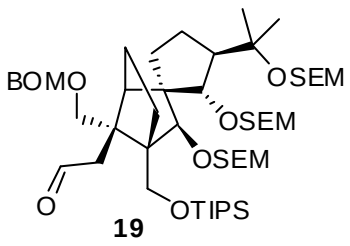
Primary alcohol 18: A solution of allyl enol ether **17** (2.85 g, 3.21 mmol,) and *i*Pr_2NEt (1.0 equiv, 0.55 mL, 3.20 mmol) in 1,2-dichlorobenzene (35 mL) was heated under microwave irradiation at 200 °C for 20 min. The resulting solution was cooled to 25 °C and diluted with MeOH (35 mL). $NaBH_4$ (10 equiv, 1.18 g, 32 mmol) was added and the reaction mixture was stirred for 1 h at that temperature. The reaction mixture was quenched by careful addition of saturated aqueous NH_4Cl solution (100 mL). The resulting mixture was extracted with CH_2Cl_2 (2 × 40 mL), dried ($MgSO_4$), and concentrated in vacuo until only 1,2-dichlorobenzene remained. The resulting crude solution was purified by flash column chromatography (silica, Et_2O/hexanes, 2→30 %) to furnish alcohol **18** (2.61 g, 2.94 mmol, 91 %).



18

18: R_f = 0.40 (silica, Et_2O:hexanes, 2:8); IR (film): ν_{max} = 3483brs, 2951s, 2867s, 1464m, 1380m, 1248m, 1054s, 1029s cm^{-1}; ^{1}H NMR (C_6D_6, 500 MHz): δ = 6.21 (m, 1 H), 5.24 (dd, *J* = 17.0, 2.0 Hz, 1 H), 5.06 (dd, *J* = 10.0, 2.0 Hz, 1 H), 4.27 (d, *J* = 1.0 Hz, 1 H), 4.08 (dd, *J* = 11.5, 3.0 Hz, 1 H), 3.98 (d, *J* = 10.5 Hz, 1 H), 3.88 – 3.73 (m, 7 H), 3.65 (m, 1 H), 2.88 (d, *J* = 14.5, 7.5 Hz, 1 H), 2.47 (dd, *J* = 14.5, 7.5 Hz, 1 H), 2.28 (dd, *J* = 9.0, 3.0 Hz, 1 H), 2.26 (d, *J* = 3.5 Hz, 1 H), 2.20 (m, 1 H), 2.15 – 2.12 (m, 2 H), 2.00 – 1.91 (m, 2 H), 1.80 – 1.65 (m, 3 H), 1.61 (t, *J* = 12.0 Hz, 1 H), 1.49 (s, 3 H), 1.20 (s, 3 H), 1.18 (m, 21 H), 1.10 – 1.01 (m, 4 H), 0.99 (m, 2 H), 0.06 (s, 9 H), 0.05 (s, 9 H), 0.05 (s, 9 H) ppm; ^{13}C NMR (C_6D_6, 125 MHz): δ = 138.04, 116.15, 97.55, 94.99, 89.56, 86.04, 84.14, 76.52, 66.18, 65.63, 65.14, 63.30, 59.22, 56.87, 54.69, 54.41, 47.62, 38.84, 37.24, 26.47, 25.06, 24.52, 23.33, 22.64, 18.64, 18.53, 18.44, 18.40, 12.46, –1.22, –1.28 ppm; HRMS calcd for $C_{46}H_{94}O_8Si_4Na^+$ [*M*+Na^+] 909.5918 found 909.5910.

Aldehyde 19: To a solution of alcohol **18** (2.61 g, 2.94 mmol) in CH_2Cl_2 (50 mL) at 25 °C was added *i*Pr_2NEt (30 equiv, 15.4 mL, 88.2 mmol), *n*Bu_4NI (1.0 equiv, 1.07 g, 2.94 mmol), and BOMCl (10 equiv, 4.60 mL, 29.4 mmol). The resulting mixture was refluxed for 12 h, cooled to ambient temperature, and quenched with EtOH (5 mL) and saturated aqueous $NaHCO_3$ solution (100 mL). The resulting mixture was extracted with Et_2O (2 × 50 mL), dried ($MgSO_4$), and concentrated in vacuo. The crude residue was purified by flash column chromatography (silica, Et_2O/hexanes, 2→10 %) to afford the corresponding BOM ether. To a solution of this intermediate in MeOH/CH_2Cl_2 (1:1, 100 mL) at –78 °C was added pyridine (1.0 equiv, 0.23 mL, 2.94 mmol). Ozone was gently bubbled into the reaction mixture until the solution took on a light blue color. The reaction mixture was stirred for 2 min and then purged with oxygen until the solution became colorless. Ph_3P (5.0 equiv, 3.85 g, 14.7 mmol) was added and the reaction mixture was warmed to 25 °C (1 h) and then concentrated under reduced pressure. The crude residue was purified by flash column chromatography (silica, Et_2O/hexanes, 2→30 %) to furnish **19** (2.73 g, 2.70 mmol, 92 % for the two steps).

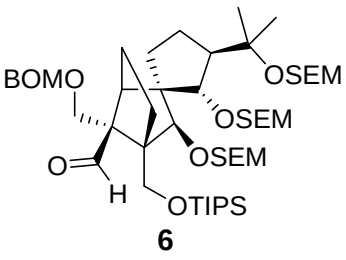


19

19: R_f = 0.50 (silica, Et_2O:hexanes, 2:8); IR (film): ν_{max} = 2949m, 2866m, 1716s, 1463w, 1381m, 1168m, 1096s, 1026s cm^{-1}; ^1H NMR (C_6D_6, 600 MHz): δ = 9.99 (q, *J* = 1.8 Hz, 1 H), 7.38 (d, *J* = 7.2 Hz, 2 H), 7.19 (t, *J* = 7.2 Hz, 2 H), 7.10 (t, *J* = 7.2 Hz, 1 H), 4.87 (d, *J* = 7.2 Hz, 1 H), 4.86 (d, *J* = 7.2 Hz, 1 H), 4.83 (d, *J* = 7.2 Hz, 1 H), 4.81 (d, *J* = 7.2 Hz, 1 H), 4.75 (d, *J* = 7.2 Hz, 1 H), 4.59 (d, *J* = 6.6 Hz, 1 H), 4.58 (d, *J* = 5.4 Hz, 1 H), 4.56 (s, 2 H), 4.55 (d, *J* = 6.6 Hz, 1 H), 4.52 (d, *J* = 12.0 Hz, 1 H), 4.50 (s, 1 H), 4.14 (s, 1 H), 4.01 (d, *J* = 10.2 Hz, 1 H), 3.93 (d, *J* = 10.8 Hz, 1 H), 3.90 (d, *J* = 10.8 Hz, 1 H), 3.87 – 3.78 (m, 4 H), 3.73 (dt, *J* = 10.8, 6.0 Hz, 1 H), 3.65 (m, 2 H), 2.81 (d, *J* = 16.2 Hz, 1 H), 2.76 (d, *J* = 3.0 Hz, 1 H), 2.72 (dd, *J* = 16.2, 4.2 Hz, 1 H), 2.18 (dd, *J* = 13.8, 4.2 Hz, 1 H), 2.10 – 2.06 (m, 2 H), 1.98 – 1.94 (m, 2 H), 1.85 – 1.80 (m, 2 H), 1.80 – 1.60 (m, 2 H), 1.47 (s, 3 H), 1.21 (s, 3 H), 1.14 (m, 21 H), 1.10 – 1.01 (m, 6 H), 0.08 (s, 9 H), 0.05 (s, 9 H), 0.04 (s, 9 H) ppm; ^{13}C NMR (C_6D_6, 150 MHz): δ = 201.91, 138.53, 127.69, 97.38, 95.02, 94.53, 89.51, 85.89, 83.52, 76.32, 73.09, 69.98, 66.18, 65.65, 65.26, 63.29,

59.11, 57.36, 54.94, 5.23, 50.07, 46.85, 38.40, 26.36, 25.22, 24.51, 23.20, 21.21, 18.59, 18.45, 18.42, 12.33, –1.23, –1.32 ppm; HRMS calcd for $C_{53}H_{100}O_{10}Si_4Na^+$ [M+Na^+] 1031.6285 found 1031.6285.

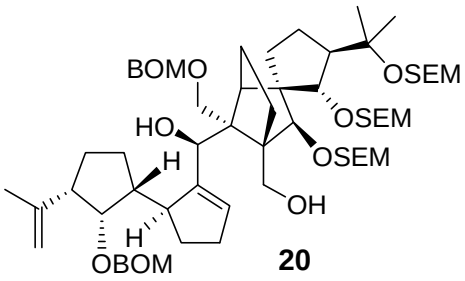
Aldehyde (±)-6: To a solution of aldehyde **19** (1.61 g, 1.59 mmol) in CH_2Cl_2 (40 mL) at 25 °C was added DBU (20 equiv, 4.83 mL, 31.8 mmol) and TBSCl (10 equiv, 2.48 g, 15.9 mmol). The resulting mixture was stirred for 48 h at that temperature and quenched with saturated aqueous $NaHCO_3$ solution (100 mL). The resulting mixture was extracted with Et_2O (2 × 50 mL), dried ($MgSO_4$), and concentrated in vacuo. The crude residue was purified by flash column chromatography (Et_2O/hexanes, 5→10 %) to furnish the corresponding silyl enol ether. To a solution of this enol ether in MeOH/CH_2Cl_2 (1:1, 40 mL) at –78 °C was added pyridine (1.0 equiv, 0.13 mL, 1.59 mmol). Ozone was gently bubbled into the reaction mixture until the solution took on a light blue color. The reaction mixture was stirred for 2 min and then purged with oxygen until it became colorless. Ph_3P (5.0 equiv, 2.08 g, 8.0 mmol) was added and the reaction mixture was warmed to 25 °C, stirred for an additional 1 h, and then concentrated under reduced pressure. The crude residue was purified by flash column chromatography (silica, EtOAc/hexanes, 2→5 %) to furnish **6** (1.45 g, 1.45 mmol, 92 %). **6**: R_f = 0.50 (silica, EtOAc:hexanes, 2:8); IR (film): ν_{max} = 2944s, 2865s, 1723m, 1464m, 1374m, 1249m, 1196m, 1097s, 1036s cm^{-1}; ^1H NMR (C_6D_6, 600 MHz): δ = 10.34 (s, 1 H), 7.36 (d, J = 7.2 Hz, 2 H), 7.19 (t, J = 7.2 Hz, 2 H), 7.09 (t, J = 7.2 Hz, 1 H), 4.90 – 4.87 (m, 3 H), 4.82 (d, J = 7.2 Hz, 1 H), 4.71 (d, J = 7.8 Hz, 1 H), 4.61 – 4.56 (m, 3 H), 4.54 – 4.50 (m, 3 H), 4.23 (d, J = 10.2 Hz, 1 H), 4.21 (d, J = 10.2 Hz, 1 H), 4.17 (s, 1 H), 4.10 (d, J = 10.2 Hz, 1 H), 4.05 (d, J = 10.2 Hz, 1 H), 3.19 – 3.73 (m, 4 H), 3.70 – 3.68 (m, 2 H), 2.87 (d, J = 3.6 Hz, 1 H), 2.22 (m, 1 H), 2.09 (t, J = 9.0 Hz, 1 H), 2.05 – 2.02 (m, 3 H), 1.83 – 1.74 (m, 2 H), 1.47 (s, 3 H), 1.18 (s, 3 H), 1.16 (m, 21 H), 1.10 – 1.05 (m, 3 H), 1.05 – 0.98 (m, 2 H), 0.03 (s, 27 H) ppm; ^{13}C NMR (C_6D_6, 150 MHz): δ = 204.21, 138.49, 97.61, 97.41, 94.88, 94.42, 89.45, 86.26, 82.56, 76.33,



6

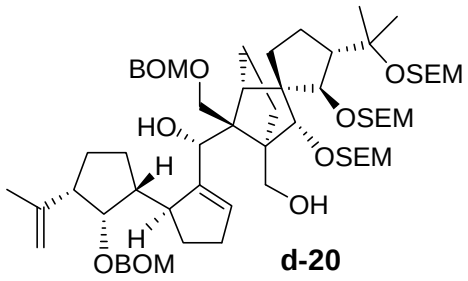
69.81, 67.25, 66.21, 65.66, 65.29, 64.73, 63.40, 59.17, 57.70, 55.05, 46.89, 38.50, 26.55, 24.73, 24.63, 22.96, 21.41, 18.59, 18.48, 18.50, 12.41, –1.21, –1.24, –1.33ppm; HRMS calcd for $C_{52}H_{98}O_{10}Si_4Na^+$ [*M*+Na^+] 1017.6129 found 1017.6121.

Diols 20 and d-20: To a solution of vinyl iodide (–)-**5**[2] (1.3 equiv, 1.43 g, 3.28 mmol) in THF (35 mL) at –78 °C was added *t*BuLi (2.5 equiv, 1.7 M in pentane, 3.70 mL, 6.3 mmol). The reaction mixture was stirred at –78 °C for 20 min and then slowly warmed up to –40 °C over 30 min. A solution of aldehyde (±)-**6** (2.51 g, 2.52 mmol) in THF (15 mL) was added and the resultant reaction mixture was warmed to 0 °C over 20 min. The reaction mixture was quenched with saturated aqueous NH_4Cl solution (30 mL), extracted with Et_2O (2 × 50 mL), dried ($MgSO_4$), and concentrated in vacuo. To the crude residue in THF (30 mL) at 25 °C was added TBAF (2.0 equiv, 1.0 M in THF, 5.04 mL). The resulting mixture was stirred for 6 h at 25 °C and then concentrated under reduced pressure. The resulting crude residue was purified directly by flash column chromatography (silica, EtOAc/hexanes, 15→25 %) to furnish diol **20** (1.18 g, 1.02 mmol, 41 %) and diol **d-20** (1.21 g, 1.05 mmol, 42 %). **20**: R_f = 0.30 (silica, EtOAc:hexanes, 1:4); $[\alpha]^{25}_D$ = –0.40 (*c* = 0.8, $CHCl_3$); IR (film): ν_{max} = 3356brs, 2951m, 1453m, 1379m, 1248m, 1044s cm^{-1}; ^1H NMR (C_6D_6, 600 MHz): δ = 7.42 (d, *J* = 7.8 Hz, 2 H), 7.38 (d, *J* = 7.8 Hz, 1 H), 7.22 (t, *J* = 7.8 Hz, 4 H), 7.11 – 7.08 (m, 2 H), 5.97 (s, 1 H), 4.97 (s, 1 H), 4.96 (d, *J* = 6.6 Hz, 1 H), 4.40 (s, 1 H), 4.91 (s, 1 H), 4.86 (d, *J* = 6.6 Hz, 1 H), 4.82 – 4.78 (m, 5 H), 4.74 (d, *J* = 6.6 Hz, 1 H), 4.71 (d, *J* = 12.0 Hz, 1 H), 4.61 (s, 1 H), 4.59 (s, 1 H), 4.57 (s, 1 H), 4.55 (s, 1 H), 4.52 (brs, 1 H), 4.49 (d, *J* = 12.0 Hz, 1 H), 4.45 (d, *J* = 6.6 Hz, 1 H), 4.42 (brs, 1 H), 4.41 (d, *J* = 6.6 Hz, 1 H), 4.36 (s, 1 H), 4.30 (d, *J* = 12.0 Hz, 1 H), 4.28 (t, *J* = 3.0 Hz, 1 H), 4.22 (d, *J* = 12.0 Hz, 1 H), 4.02 – 3.98 (m, 2 H), 3.90 – 3.84 (m, 2 H), 3.76 – 3.70 (m, 2 H), 3.60 – 3.56 (m, 1 H), 2.85 (t, *J* = 8.4 Hz, 1 H), 2.38 – 2.36 (m, 2 H), 2.26 (t, *J* = 12.0 Hz, 1 H), 2.17 – 1.90 (m, 14 H), 1.79 (s, 3 H), 1.65 – 1.62 (m, 3 H), 1.53 (s, 3 H), 1.48 (m, 1 H), 1.15 (s, 3 H), 1.08 – 1.06 (m, 4 H),



20

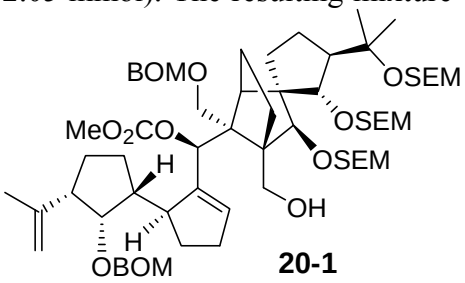
1.04 – 1.01 (m, 2 H), 0.07 (s, 9 H), 0.06 (s, 9 H), 0.03 (s, 9 H) ppm; ^{13}C NMR (C_6D_6, 150 MHz): δ = 151.39, 144.51, 139.02, 138.28, 127.53, 111.71, 97.59, 95.44, 94.90, 94.29, 89.82, 86.77, 83.05, 82.47, 76.49, 71.59, 70.49, 70.06, 69.61, 66.21, 65.74, 64.87, 61.71, 59.50, 58.87, 57.36, 55.06, 51.51, 50.06, 49.29, 48.60, 38.78, 31.45, 30.52, 30.43, 27.24, 27.20, 25.92, 24.63, 24.36, 24.02, 23.78, 21.11, 18.54, 18.52, 18.39, –1.20, –1.32 ppm; HRMS calcd for $C_{64}H_{106}O_{12}Si_3N_a^+$ [*M*+Na^+] 1173.6884 found 1173.6880. **d-20**: R_f = 0.35 (silica, EtOAc:hexanes, 1:4); $[\alpha]^{25}_D$ = +19.65 (*c* = 2.3, $CHCl_3$); IR (film): ν_{max} = 3356brs, 2951m, 1453m, 1379m, 1248m, 1044s cm^{-1};



d-20

^{1}H NMR (C_6D_6, 600 MHz): δ = 7.34 (d, *J* = 7.8 Hz, 2 H), 7.32 (d, *J* = 7.8 Hz, 2 H), 7.18 – 7.15 (m, 4 H), 7.06 (t, *J* = 7.8 Hz, 2 H), 6.11 (s, 1 H), 4.97 (s, 1 H), 4.96 – 4.95 (m, 2 H), 4.90 (s, 1 H), 4.83 (d, *J* = 7.2 Hz, 1 H), 4.82 (d, *J* = 7.2 Hz, 1 H), 4.78 (d, *J* = 6.6 Hz, 1 H), 4.76 (d, *J* = 7.8 Hz, 1 H), 4.75 (d, *J* = 7.8 Hz, 1 H), 4.73 (d, *J* = 7.2 Hz, 1 H), 4.69 (d, *J* = 12.0 Hz, 1 H), 4.61 (d, *J* = 7.8 Hz, 1 H), 4.56 (d, *J* = 12.0 Hz, 1 H), 4.51 (s, 1 H), 4.47 – 4.51 (m, 4 H), 4.40 (d, *J* = 6.6 Hz, 1 H), 4.37 (brs, 1 H), 4.28 – 4.27 (m, 2 H), 4.21 (d, *J* = 10.8 Hz, 1 H), 4.18 (m, 1 H), 4.11 (d, *J* = 10.2 Hz, 1 H), 3.37 (m, 1 H), 3.83 (m, 1 H), 3.77 – 3.73 (m, 2 H), 3.64 (m, 1 H), 3.57 (m, 1 H), 3.51 (t, *J* = 7.8 Hz, 1 H), 2.66 (d, *J* = 3.6 Hz, 1 H), 2.43 (dt, *J* = 15.6, 7.8 Hz, 1 H), 2.38 – 2.33 (m, 2 H), 2.23 (m, 1 H), 2.23 – 2.21 (m, 3 H), 2.15 (m, 1 H), 2.10 (t, *J* = 9.0 Hz, 1 H), 1.97 (m, 4 H), 1.79 (s, 3 H), 1.72 – 1.60 (m, 5 H), 1.52 (s, 3 H), 1.20 (s, 3 H), 1.08 (t, *J* = 7.8 Hz, 2 H), 1.04 – 0.99 (m, 2 H), 0.97 (t, *J* = 7.2 Hz, 2 H), 0.05 (s, 18 H), 0.03 (s, 9 H) ppm; ^{13}C NMR (C_6D_6, 150 MHz): δ = 148.93, 144.35, 139.01, 138.31, 127.52, 126.63, 111.77, 97.41, 95.00, 94.95, 94.71, 89.75, 86.32, 83.49, 83.45, 76.42, 70.63, 69.93, 69.87, 68.91, 66.17, 65.73, 65.03, 61.59, 59.59, 59.18, 56.73, 54.93, 51.84, 50.68, 49.46, 38.75, 31.61, 31.06, 27.04, 26.48, 26.17, 25.42, 24.35, 23.78, 23.71, 21.11, 18.49, 18.39, 18.30, –1.17, –1.25, –1.32 ppm; HRMS calcd for $C_{64}H_{106}O_{12}Si_3N_a^+$ [*M*+Na^+] 1173.6884 found 1173.6880.

Hydroxy carbonate 20-1: To a stirred solution of diol **20** (1.18 g, 1.02 mmol) in CH_2Cl_2 (15 mL) at 25 °C was added imidazole (10 equiv, 0.70 g, 10.2 mmol) and TESCl (2.0 equiv, 0.32 mL, 2.05 mmol). The resulting mixture was stirred at this temperature for 5 h, diluted with Et_2O (15 mL) and quenched with saturated aqueous $NaHCO_3$ solution (5 mL). The organic layer was separated, and the aqueous layer was extracted with Et_2O (30 mL). The combined organics were washed with brine (10 mL), dried ($MgSO_4$), and concentrated under reduced pressure. To a solution of this crude TES ether in THF (40 mL) at –78 °C was added KHMDS (5.0 equiv, 0.5 M in PhMe, 10.2 mL, 5.10 mmol). After 5 min, $ClCO_2Me$ (10 equiv, 97 mL, 10.2 mmol) and Et_3N (10 equiv, 1.43 mL, 10.2 mmol) were added sequentially. The cooling bath was removed and the reaction mixture was stirred at room temperature for 1 h. The reaction was quenched with saturated aqueous NH_4Cl solution (40 mL), and extracted with Et_2O (2 × 30 mL). The combined organics were washed with brine, dried ($MgSO_4$), and concentrated under reduced pressure. To the crude residue in pyridine (12 mL) at 0 °C was added 70 % HF•py (3 mL). The reaction mixture was stirred at room temperature for 36 h, diluted with Et_2O (30 mL) and quenched slowly by adding the reaction mixture to stirred saturated aqueous $NaHCO_3$ solution (100 mL). The organic layer was separated, and the aqueous layer was extracted with Et_2O (30 mL). The combined organics were washed with brine (10 mL), dried ($MgSO_4$), and concentrated under reduced pressure. The residue was subjected to flash column chromatography (silica, EtOAc/hexanes, 5→20 %) to furnish hydroxy carbonate **20-1** (80 mg, 0.81 mmol, 79 % for three steps).

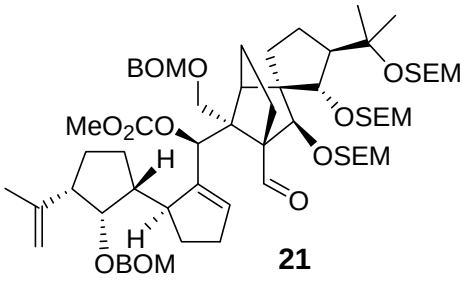


20-1

20-1: R_f = 0.35 (silica, EtOAc:hexanes, 1:4); $[\alpha]^{25}_D$ = –47.4 (*c* = 0.5, $CHCl_3$); IR (film): ν_{max} = 3503brs, 2952s, 2886s, 1746s, 1443w, 1375m, 1270m, 1041s cm^{-1}; ^1H NMR (C_6D_6, 600 MHz): δ = 7.44 (d, *J* = 7.8 Hz, 2 H), 7.37 (d, *J* = 7.8 Hz, 2 H), 7.19 (t, *J* = 7.8 Hz, 4 H), 7.10 – 7.05 (m, 2 H), 6.07 (s, 1 H), 5.78 (s, 1 H), 4.98 (s, 1 H), 4.98 – 4.96 (m, 2 H), 4.93 (d, *J* = 7.8 Hz, 1 H), 4.92 (s, 1 H), 4.89 (d, *J* = 6.6 Hz, 1 H), 4.82 (d, *J* = 6.6 Hz, 1 H), 4.80 (d, *J* = 11.4 Hz, 1 H), 4.77 (t, *J* = 7.2 Hz, 1 H), 4.71 (s, 2 H), 4.70 – 4.69 (m, 2 H), 4.64 (d, *J* = 12.0 Hz, 1 H),

4.55 (d, *J* = 12.0 Hz, 1 H), 4.51 (d, *J* = 6.0 Hz, 1 H), 4.49 (d, *J* = 12.0 Hz, 1 H), 4.38 (d, *J* = 6.6 Hz, 1 H), 4.35 – 4.31 (m, 2 H), 4.27 (t, *J* = 3.0 Hz, 1 H), 4.04 (d, *J* = 12.0 Hz, 1 H), 4.02 – 3.98 (m, 2 H), 3.93 – 3.89 (m, 1 H), 3.83 (m, 1 H), 3.76 – 3.68 (m, 2 H), 3.47 (m, 1 H), 3.31 (s, 3 H), 3.06 (t, *J* = 6.6 Hz, 1 H), 2.92 (t, *J* = 9.0 Hz, 1 H), 2.77 (d, *J* = 3.0 Hz, 1 H), 2.72 (dd, *J* = 11.4, 5.4 Hz, 1 H), 2.66 (m, 1 H), 2.33 – 2.25 (m, 3 H), 2.17 (d, *J* = 3.6 Hz, 1 H), 2.15 – 2.06 (m, 3 H), 2.05 – 1.95 (m, 3 H), 1.92 – 1.90 (m, 3 H), 1.79 – 1.77 (m, 1 H), 1.77 (s, 3 H), 1.74 – 1.70 (m, 2 H), 1.65 (s, 3 H), 1.59 (m, 1 H), 1.16 (s, 3 H), 1.10 – 1.03 (m, 4 H), 1.06 (t, *J* = 7.8 Hz, 2 H), 0.09 (s, 9 H), 0.07 (s, 9 H), –0.05 (s, 9 H) ppm; ^{13}C NMR (C_6D_6, 150 MHz): δ = 155.79, 150.08, 144.59, 139.19, 138.96, 127.57, 127.53, 127.35, 124.84, 111.70, 98.07, 96.08, 95.00, 93.87, 90.07, 85.82, 83.10, 82.74, 79.41, 76.50, 70.93, 69.96, 67.79, 66.40, 65.68, 64.94, 62.13, 60.29, 59.44, 58.16, 54.89, 54.33, 51.31, 49.62, 47.36, 46.87, 38.34, 34.30, 31.52, 30.43, 30.17, 29.36, 28.18, 27.68, 26.13, 25.10, 23.93, 23.73, 23.65, 22.72, 18.60, 18.55, 18.24, –1.12, –1.21, –1.47 ppm; HRMS calcd for $C_{66}H_{108}O_{14}Si_3Na^+$ [*M*+Na^+] 1231.6939. found 1231.6936.

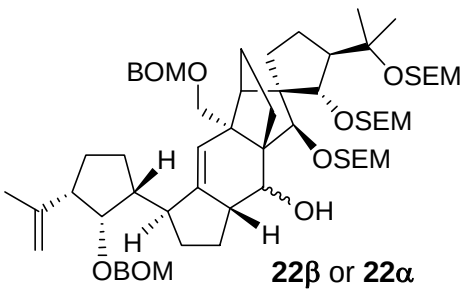
Aldehyde carbonate 21: To a stirred solution of hydroxy carbonate **20-1** (102 mg, 0.103 mmol) in CH_2Cl_2 (1.0 mL) at 25 °C was added $PhI(OAc)_2$ (2.0 equiv, 0.1 g, 0.31 mmol) and AZADO (0.10 equiv, 32 mg, 0.021 mmol). The resulting mixture was stirred for 24 h and then quenched with a mixture of saturated aqueous $NaHCO_3$ solution (5 mL) and saturated aqueous $Na_2S_2O_3$ (5 mL). The resulting mixture was extracted with Et_2O (2 × 15 mL), dried ($MgSO_4$), and concentrated in vacuo. The crude residue was purified by flash column chromatography (silica, EtOAc/hexanes, 2→10 %) to furnish aldehyde carbonate **21** (97 mg, 0.098 mmol, 95 %). **21**: R_f = 0.6 (silica, EtOAc:hexanes, 1:4); $[\alpha]^{25}_D$ = –76.8 (*c* = 1.1, $CHCl_3$); IR (film): ν_{max} = 2951s, 2891s, 1749s, 1721s, 1441w, 1379m, 1267m, 1036s cm^{-1}; ^{1}H NMR (C_6D_6, 600 MHz): δ = 9.91 (s, 1 H), 7.43 (d, *J* = 7.2 Hz, 2 H), 7.36 (d, *J* = 7.2 Hz, 2 H), 7.21 (t, *J* = 7.2 Hz, 2 H), 7.16 (t, *J* = 7.2 Hz, 2 H), 7.11 (t, *J* = 7.2 Hz, 1 H), 7.06 (t, *J* = 7.2 Hz, 1 H), 6.00 (s, 1 H), 5.68 (s, 1 H), 4.98 (s, 1 H),



21

4.94 (s, 2 H), 4.92 (s, 1 H), 4.90 (d, J = 7.2 Hz, 1 H), 4.84 (s, 1 H), 4.80 (d, J = 12.6 Hz, 1 H), 4.79 (d, J = 6.6 Hz, 1 H), 4.74 (d, J = 7.2 Hz, 1 H), 4.68 (s, 1 H), 4.67 (d, J = 7.2 Hz, 1 H), 4.64 (d, J = 7.2 Hz, 1 H), 4.62 (d, J = 12.6 Hz, 1 H), 4.52 (d, J = 12.0 Hz, 1 H), 4.47 (d, J = 12.0 Hz, 1 H), 4.41 (d, J = 12.0 Hz, 1 H), 4.28 (d, J = 12.0 Hz, 1 H), 4.27 (dd, J = 12.0, 2.4 Hz, 1 H), 4.22 (t, J = 3.0 Hz, 1 H), 4.01 (m, 1 H), 3.88 – 3.84 (m, 2 H), 3.75 – 3.66 (m, 3 H), 3.41 (m, 1 H), 3.33 (s, 3 H), 2.85 (d, J = 3.6 Hz, 1 H), 2.84 (m, 1 H), 2.70 – 2.65 (m, 2 H), 2.56 (m, 1 H), 2.36 – 2.16 (m, 4 H), 2.15 – 1.96 (m, 7 H), 1.88 – 1.86 (m, 2 H), 1.76 (s, 3 H), 1.75 – 1.74 (m, 2 H), 1.69 (s, 3 H), 1.13 (s, 3 H), 1.09 – 1.02 (m, 6 H), 0.09 (s, 9 H), 0.08 (s, 9 H), 0.06 (s, 9 H) ppm; ^{13}C NMR (C_6D_6, 150 MHz): δ = 199.33, 155.35, 148.87, 144.45, 139.18, 138.64, 127.53, 124.77, 111.81, 96.88, 96.06, 95.05, 94.16, 90.13, 84.43, 83.25, 83.00, 78.05, 76.45, 71.12, 69.89, 68.63, 66.56, 65.98, 65.70, 65.00, 61.73, 59.13, 57.24, 54.59, 51.20, 49.46, 47.47, 46.55, 37.85, 31.55, 29.34, 28.36, 27.84, 26.13, 25.02, 23.70, 23.43, 19.61, 18.59, 18.52, 18.15, –1.12, –1.23, –1.25 ppm; HRMS calcd for $C_{66}H_{106}O_{14}Si_3Na^+$ [M+Na^+] 1229.6782. found 1229.6764.

Hydroxy olefins 22β and 22α: To a pre-mixed solution of SmI_2 (0.1 M in THF, 8 mL, 0.8 mmol) and HMPA (0.42 mL, 2.4 mmol) at –20 °C was added dropwise a solution of aldehyde carbonate **21** (240 mg, 0.199 mmol) in THF (12 mL). The reaction mixture was stirred at the same temperature for 30 min and then warmed up to 25 °C and stirred for an additional 3 h. The reaction was quenched by bubbling air into the reaction mixture until its color turned from purple to yellow. The reaction mixture was then diluted with Et_2O (30 mL) and saturated aqueous NH_4Cl (10 mL). The organic layer was separated and washed with H_2O (10 mL) and brine (10 mL), and then dried over $MgSO_4$. The filtrate was concentrated in vacuo and the crude residue was subjected to flash column chromatography (silica, Et_2O/hexanes 2→4 %) to furnish a mixture of two diastereomers, which were separated by a second chromatography (silica, CH_2Cl_2/EtOAc, 17→20 %) to provide hydroxy olefins **22β** (74

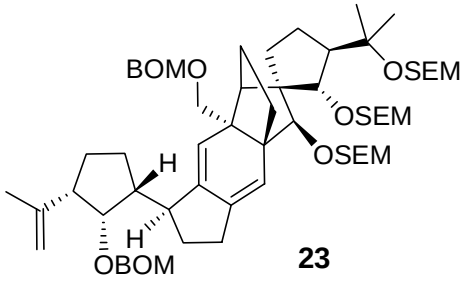


22β or **22α**

mg, 0.065 mmol, 33%) and **22α** (47 mg, 0.041 mmol, 21%). **22β**: R_f = 0.56 (silica, EtOAc:CH_2Cl_2 1:20); $[\alpha]^{25}_D$ = –9.7 (*c* = 1.0, $CHCl_3$); IR (film): ν_{max} = 3518w, 2952s, 2870m, 1454w, 1379w, 1249s, 1097m, 1041s, 1026s cm^{-1}; ^1H NMR (C_6D_6, 600 MHz): δ = 7.33 (d, *J* = 7.2 Hz, 2 H), 7.25 (d, *J* = 7.2 Hz, 2 H), 7.16 – 7.12 (m, 4 H), 7.07 (t, *J* = 7.2 Hz, 1 H), 7.04 (t, *J* = 7.2 Hz, 1 H), 5.94 (d, *J* = 1.8 Hz, 1 H), 4.99 (d, *J* = 6.0 Hz, 1 H), 4.95 (s, 1 H), 4.91 (s, 1 H), 4.90 (d, *J* = 7.2 Hz, 1 H), 4.86 (d, *J* = 6.0 Hz, 1 H), 4.85 (d, *J* = 7.2 Hz, 1 H), 4.71 (d, *J* = 7.2 Hz, 1 H), 4.63 – 4.45 (m, 11 H), 4.30 (d, *J* = 7.2 Hz, 1 H), 4.11 (s, 1 H), 4.08 (d, *J* = 9.0 Hz, 1 H), 3.95 (t, *J* = 2.5 Hz, 1 H), 3.93 (m, 1 H), 3.81 – 3.70 (m, 3 H), 3.64 (m, 1 H), 3.59 (d, *J* = 9.0 Hz, 1 H), 3.52 (m, 1 H), 2.83 (m, 1 H), 2.57 – 2.51 (m, 2 H), 2.51 – 2.40 (m, 2 H), 2.28 (dd, *J* = 11.4, 6.0 Hz, 1 H), 2.16 – 1.82 (m, 8 H), 1.81 (s, 3 H), 1.80 – 1.60 (m, 5 H), 1.51 (s, 3 H), 1.52 – 1.30 (m, 3 H), 1.22 (s, 3 H), 1.18 – 0.95 (m, 4 H), 0.97 (t, *J* = 7.0 Hz, 2 H), 0.08 (s, 9 H), 0.04 (s, 9 H), –0.03 (s, 9 H) ppm; ^{13}C NMR (C_6D_6, 150 MHz): δ = 146.30, 145.20, 139.42, 139.07, 125.61, 111.65, 98.32, 95.37, 95.06, 94.87, 91.72, 89.88, 83.61, 81.26, 76.73, 75.06, 75.01, 70.04, 69.91, 66.28, 66.19, 65.55, 60.43, 56.62, 56.53, 56.22, 52.81, 52.06, 47.74, 47.17, 42.82, 39.28, 30.66, 27.90, 26.95, 26.63, 25.72, 25.42, 24.11, 21.06, 18.92, 18.89, 18.73, –0.82, –0.85, –1.03 ppm; HRMS calcd for $C_{64}H_{104}O_{11}Si_3Na^+$ [*M*+Na^+] 1155.6778 found 1155.6765. **22α**: R_f = 0.44 (silica, EtOAc:CH_2Cl_2 1:20); $[\alpha]^{25}_D$ = –27.0 (*c* = 1.0, $CHCl_3$); IR (film): ν_{max} = 2951s, 2879m, 1249s, 1097m, 1043s cm^{-1}; ^1H NMR (C_6D_6, 600 MHz): δ = 7.37 (d, *J* = 7.2 Hz, 2 H), 7.27 (d, *J* = 7.2 Hz, 2 H), 7.18 – 7.12 (m, 4 H), 7.07 (t, *J* = 7.2 Hz, 1 H), 7.03 (t, *J* = 7.2 Hz, 1 H), 6.07 (d, *J* = 1.0 Hz, 1 H), 4.98 (d, *J* = 6.0 Hz, 1 H), 4.97 (s, 1 H), 4.96 (d, *J* = 7.2 Hz, 1 H), 4.92 (s, 1 H), 4.91 (d, *J* = 7.2 Hz, 1 H), 4.78 (d, *J* = 6.0 Hz, 1 H), 4.73 (d, *J* = 1.5 Hz, 1 H), 4.72 (d, *J* = 7.2 Hz, 1 H), 4.70 – 4.54 (m, 8 H), 4.48 (d, *J* = 12.0 Hz, 1 H), 4.42 (dd, *J* = 6.6, 4.2 Hz, 1 H), 4.31 (d, *J* = 10.2 Hz, 1 H), 4.24 (d, *J* = 10.2 Hz, 1 H), 4.04 (t, *J* = 3.0 Hz, 1 H), 3.92 – 3.89 (m, 2 H), 3.83 (m, 1 H), 3.76 (m, 1 H), 3.64 (m, 1 H), 3.49 (m, 1 H), 2.98 (d, *J* = 4.8 Hz, 1 H), 2.84 (m, 1 H), 2.62 (m, 1 H), 2.58 (d, *J* = 3.0 Hz, 1 H), 2.35 – 2.25 (m, 2 H), 2.24 – 2.04 (m, 7 H), 1.90 – 1.61 (m, 3 H), 1.83 (s, 3 H), 1.61 – 1.49 (m, 2 H), 1.54 (s, 3 H), 1.37 (m, 1 H), 1.23 (s, 3 H), 1.14 – 1.02 (m, 4 H), 0.97 (t, *J* = 8.4 Hz, 2 H), 0.07 (s, 9 H), 0.04 (s, 9 H), 0.01 (s, 9 H) ppm; ^{13}C NMR (C_6D_6, 150

MHz): δ = 145.13, 145.00, 139.39, 139.25, 125.79, 111.77, 97.39, 95.60, 95.55, 95.11, 89.88, 84.88, 84.40, 81.27, 76.84, 75.30, 70.11, 70.00, 66.12, 66.06, 65.52, 60.74, 57.84, 55.79, 52.95, 52.65, 52.44, 48.31, 43.16, 42.86, 39.56, 30.39, 27.97, 27.16, 26.95, 25.88, 25.76, 25.44, 25.06, 24.36, 24.11, 18.89, 18.76, 18.72, –0.85, –1.06 ppm; HRMS calcd for $C_{64}H_{104}O_{11}Si_3Na^+$ [*M*+Na^+] 1155.6778 found 1155.6765.

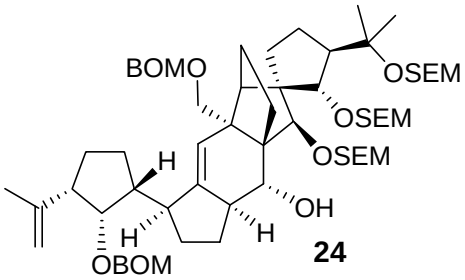
Triene 23: Method a (prepared from **22β**): To a solution of alcohol **22β** (110 mg, 0.097 mmol) in THF (2.0 mL) at 25 °C was added NaH (58 mg, 1.45 mmol, 60 % dispersion in mineral oil) and the reaction mixture was stirred for 20 min. The resulting mixture was cooled to 0 °C, CS_2 (174 μL, 2.91 mmol) was added, and the reaction mixture was stirred for 30 min at that temperature. MeI (273 μL, 4.37 mmol) was added at 0 °C and the mixture was warmed to 25 °C and stirred for 16 h. The reaction was diluted with Et_2O (15 mL) and quenched with saturated aqueous NH_4Cl solution (15 mL). The organic layer was separated, washed with brine (5 mL), dried ($MgSO_4$), and concentrated in vacuo. The crude xanthate was taken up in 1,2-dichlorobenzene (6 mL) and degassed, followed by the addition of several drops of *i*Pr_2NEt. The reaction mixture was heated under microwave irradiation at 185 °C for 15 min. The crude residue was purified directly by flash column chromatography (silica, EtOAc/hexanes, 0→8 %) to furnish triene **23** (94 mg, 0.084 mmol, 86 %). **Method b** (prepared from **22α**): To a solution of alcohol **22α** (65 mg, 0.057 mmol) in pyridine (1 mL) at 25 °C was added $POCl_3$ (160 μL, 1.72 mmol) and DBU (ca. 25 μL). The resulting mixture was heated to 60 °C for 1 h and then quenched by pouring the reaction mixture into saturated aqueous $NaHCO_3$ solution (15 mL). The resulting mixture was extracted with Et_2O (2 × 10 mL), dried ($MgSO_4$), and concentrated in vacuo. The crude residue was purified by flash column chromatography (silica, Et_2O/hexanes, 5→15 %) to furnish **23** (46 mg, 0.041 mmol, 72 %). **23**: R_f = 0.30 (silica, Et_2O:hexanes, 1:4); $[\alpha]^{25}_D$ = +7.8 (*c* = 1.0, $CHCl_3$); IR (film): ν_{max} = 2952s, 1249m, 1110m, 1092m, 1039s, 1027s cm^{-1}; ^1H NMR (C_6D_6, 600 MHz):



23

δ = 7.34 (d, *J* = 7.2 Hz, 2 H), 7.26 (d, *J* = 7.2 Hz, 2 H), 7.16 – 7.12 (m, 4 H), 7.08 (t, *J* = 7.2 Hz, 1 H), 7.03 (t, *J* = 7.2 Hz, 1 H), 6.27 (s, 1 H), 6.26 (s, 1 H), 5.10 (d, *J* = 7.2 Hz, 1 H), 4.94 (s, 1 H), 4.90 (d, *J* = 7.2 Hz, 1 H), 4.89 (d, *J* = 7.2 Hz, 1 H), 4.88 (s, 1 H), 4.87 (d, *J* = 7.2 Hz, 1 H), 4.73 (d, *J* = 7.2 Hz, 1 H), 4.74 – 4.62 (m, 5 H), 4.59 (d, *J* = 7.2 Hz, 1 H), 4.56 – 4.53 (m, 3 H), 4.52 (d, *J* = 1.8 Hz, 1 H), 4.46 (d, *J* = 12.6 Hz, 1 H), 4.21 (d, *J* = 9.6 Hz, 1 H), 4.16 (m, 1 H), 4.06 (t, *J* = 3.0 Hz, 1 H), 3.92 (m, 1 H), 3.86 (d, *J* = 9.6 Hz, 1 H), 3.81 – 3.74 (m, 2 H), 3.68 – 3.60 (m, 2 H), 2.85 – 2.83 (m, 3 H), 2.24 – 2.38 (m, 4 H), 2.14 – 2.00 (m, 4 H), 1.92 – 1.76 (m, 4 H), 1.75 (s, 3 H), 1.75 – 1.54 (m, 4 H), 1.53 (s, 3 H), 1.40 – 1.35 (m, 2 H), 1.22 (s, 3 H), 1.21 – 1.05 (m, 4 H), 0.98 (t, *J* = 8.4 Hz, 2 H), 0.08 (s, 9 H), 0.05 (s, 9 H), 0.04 (s, 9 H) ppm; ^{13}C NMR (C_6D_6, 150 MHz): δ = 144.88, 144.50, 144.42, 139.32, 139.26, 127.51, 122.76, 111.93, 97.08, 95.61, 94.97, 94.92, 89.89, 85.57, 83.87, 80.90, 76.84, 73.09, 70.10, 69.83, 66.05, 65.73, 65.52, 60.28, 57.23, 55.05, 54.61, 52.90, 48.47, 48.35, 44.48, 39.21, 33.24, 32.75, 31.02, 30.57, 28.62, 27.81, 26.97, 25.83, 25.43, 25.05, 24.07, 24.06, 18.89, 18.75, –0.85 ppm; HRMS calcd for $C_{64}H_{102}O_{10}Si_3Na^+$ [*M*+Na^+] 1137.6673 found 1137.6659.

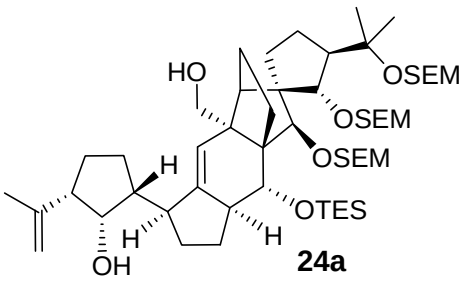
Inverted alcohol 24: To a solution of triene **23** (115 mg, 0.103 mmol) in THF (3.9 mL) at –10 °C was added thexylborane (0.1 mL, 0.5 mmol, 0.5 M in THF). The reaction mixture was slowly warmed to 25 °C (over 30 min), followed by the addition of BH_3•THF (1.55 mL, 1.55 mmol, 1.0 M in THF). The mixture was stirred at 25 °C for 1 h, and then cooled to 0 °C. A pre–mixed solution of 30 % H_2O_2/3 N NaOH (1:1, 3.0 mL) was then added, followed by the addition of THF (3 mL). The reaction mixture was heated at 45 °C for 30 min, cooled to 25 °C, and then quenched with saturated aqueous NH_4Cl solution (5 mL). The resulting mixture was extracted with EtOAc (2 × 20 mL), washed with brine (10 mL), dried ($MgSO_4$), and concentrated under reduced pressure. The crude residue was purified by flash column chromatography (silica, EtOAc/hexanes, 5→20 %) to afford the corresponding diols (83 mg, 0.072 mmol, 70 %) as an



24

inseparable 1.3:1.0 mixture of diastereomers. To a solution of these diols (78 mg, 0.067 mmol) in THF (3.1 mL) at 25 °C was added pyridine (65 μL, 0.81 mmol), *o*$NO_2C_6H_4SeCN$ (46 mg, 0.20 mmol), and *n*Bu_3P (150 μL, 0.61 mmol). The reaction mixture was stirred at 25 °C for 20 min and then quenched with EtOH (23 μL, 0.40 mmol). After 20 min, the reaction mixture was cooled to 0 °C, 35% H_2O_2 (1.0 mL) was added, and the resulting mixture was stirred at 25 °C for 30 min. The reaction mixture was diluted with H_2O (10 mL), and extracted with EtOAc (2 × 15 mL). The combined organics were washed with brine (5 mL), dried over $MgSO_4$, and concentrated in vacuo. The residue was taken up in THF (4 mL) and the reaction mixture was heated at 45 °C for 30 min, cooled to 25 °C, diluted with H_2O (10 mL) and extracted with Et_2O (2 × 15 mL). The combined organics were washed with brine (5 mL), dried over $MgSO_4$, and subjected to flash column chromatography (silica, EtOAc/hexanes, 2→5 %) to furnish alcohol **24** (52 mg, 0.046 mmol, 68 %). **24**: R_f = 0.60 (silica, EtOAc:hexanes, 1:4); $[\alpha]^{25}_D$ = –12.5 (*c* = 0.8, $CHCl_3$); IR (film): ν_{max} = 3473m, 2951s, 1648m, 1451w, 1378w, 1249m, 1097m, 1039s cm^{-1}; ^1H NMR (C_6D_6, 600 MHz): δ = 7.37 (d, *J* = 7.2 Hz, 2 H), 7.29 (d, *J* = 7.2 Hz, 2 H), 7.18 – 7.13 (m, 4 H), 7.09 (t, *J* = 7.2 Hz, 1 H), 7.04 (t, *J* = 7.2 Hz, 1 H), 6.22 (brs, 1 H), 4.98 (d, *J* = 6.6 Hz, 1 H), 4.94 (s, 1 H), 4.89 – 4.82 (m, 3 H), 4.78 (s, 1 H), 4.75 – 4.69 (m, 5 H), 4.67 – 4.64 (m, 3 H), 4.61 – 4.55 (m, 5 H), 4.47 (d, *J* = 12.6 Hz, 1 H), 4.40 (d, *J* = 9.6 Hz, 1 H), 4.27 (d, *J* = 9.6 Hz, 1 H), 4.25 (s, 1 H), 4.15 (brs, 1 H), 4.09 (t, *J* = 3.0 Hz, 1 H), 3.89 – 3.82 (m, 2 H), 3.81 – 3.55 (m, 2 H), 3.66 (m, 1 H), 3.40 (m, 1 H), 2.90 (m, 1 H), 2.79 (m, 1 H), 2.74 (d, *J* = 3.4 Hz, 1 H), 2.46 (dd, *J* = 10.8 Hz, 6.0 Hz, 1 H), 2.32 (m, 1 H), 2.20 – 2.00 (m, 6 H), 2.00 – 1.90 (m, 2 H), 1.86 – 1.75 (m, 4 H), 1.75 (s, 3 H), 1.74 – 1.60 (m, 2 H), 1.52 (m, 1 H), 1.51 (s, 3 H), 1.27 (m, 1 H), 1.23 (s, 3 H), 1.12 – 1.08 (m, 4 H), 0.98 (t, *J* = 8.4 Hz, 2 H), 0.05 (s, 9 H), 0.04 (s, 9 H), –0.02 (s, 9 H) ppm; ^{13}C NMR (C_6D_6, 150 MHz): δ = 145.51, 144.44, 139.01, 138.97, 125.95, 111.56, 97.90, 95.20, 94.69, 94.63, 89.51, 86.44, 83.49, 81.82, 76.40, 72.77, 71.54, 69.77, 69.53, 65.84, 65.76, 65.14, 59.86, 58.32, 55.97, 53.34, 51.94, 49.84, 49.48, 48.58, 42.46, 38.96, 31.73, 31.31, 27.71, 26.63, 25.68, 25.30, 24.90, 24.84, 24.32, 23.75, 18.51, 18.35, 18.20, –1.24, –1.53 ppm; HRMS calcd for $C_{64}H_{104}O_{11}Si_3Na^+$ [*M*+Na^+] 1155.6778 found 1155.6761.

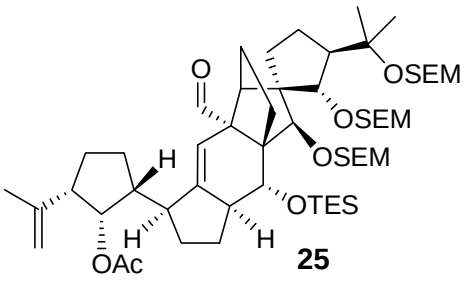
Diol 24a: To a solution of alcohol **24** (50 mg, 0.044 mmol) in THF (2.0 mL) at –50 °C was added KHMDS (0.5 M in PhMe, 0.53 mL, 0.26 mmol). The reaction mixture was stirred at –50 °C for 5 min before TESCl (30 μL, 0.176 mmol) and Et_3N (50 μL, 0.35 mmol) were added. The cooling bath was removed, and the reaction mixture was stirred at 25 °C for 20 min. The resulting mixture was quenched with saturated aqueous NH_4Cl (10 mL) solution and extracted with Et_2O (2 × 10 mL). The organic layer was washed with brine (10 mL), dried ($MgSO_4$), and subjected to flash column chromatography (silica, EtOAc/hexanes, 2→8 %) to furnish TES ether (49 mg, 0.039 mmol, 89 %). To a solution of the above TES silyl ether (45 mg, 0.036 mmol) in THF (2.0 mL) at –78 °C was added LiDBB (~1.0 M in THF, freshly prepared) dropwise until the reaction mixture assumed a persistent dark green color. The reaction mixture was warmed up to –50 °C and stirred at this temperature for 30 min, during which time LiDBB was constantly added to maintain the solution color as dark green. The reaction mixture was quenched at –50 °C with saturated aqueous NH_4Cl (5 mL) solution, extracted with Et_2O (2 × 15 mL), dried ($MgSO_4$), and concentrated in vacuo. The crude residue was dissolved in CH_2Cl_2 (5 mL) and silica (1.0 g) was added. The mixture was stirred at 25 °C for 30 min (to fully hydrolyze the intermediate hemiacetals), and then directly purified by flash column chromatography (silica, CH_2Cl_2 first to remove DBB, then switched to EtOAc/hexanes, 2→14 %) to afford diol **24a** (30 mg, 0.030 mmol, 83 %). **24a**: R_f = 0.57 (silica, EtOAc:hexanes, 1:3); $[\alpha]^{25}_D$ = –12.7 (*c* = 1.0, $CHCl_3$); IR (film): ν_{max} = 3400w, 2954w, 1249w, 1214s, 1056m, 1028m, 908m cm^{-1}; ^1H NMR (C_6D_6, 600 MHz): δ = 5.94 (t, *J* = 2.4 Hz, 1 H), 5.17 (d, *J* = 5.1 Hz, 1 H), 5.10 (d, *J* = 7.2 Hz, 1 H), 5.08 (d, *J* = 7.2 Hz, 1 H), 4.87 (s, 1 H), 4.85 (d, *J* = 5.1 Hz, 1 H), 4.79 (d, *J* = 7.2 Hz, 1 H), 4.78 (s, 1 H), 4.71 (d, *J* = 7.2 Hz, 1 H), 4.62 (d, *J* = 1.8 Hz, 1 H), 4.53 (s, 1 H), 4.21 (s, 1 H), 4.16 (d, *J* = 11.4 Hz, 1 H), 4.09 (d, *J* = 11.4 Hz, 1 H), 4.05 (m, 1 H), 3.96 – 3.84 (m, 4 H), 3.78 (m, 1 H), 3.69 (m, 1 H), 2.79 (m, 1 H), 2.61 (m, 1 H), 2.48 (d, *J* = 3.6 Hz, 1 H), 2.32 – 2.20 (m, 5 H), 2.16 – 2.06 (m,



24a

4 H), 1.92 – 1.69 (m, 6 H), 1.62 (s, 3 H), 1.60 – 1.44 (m, 3 H), 1.55 (s, 3 H), 1.25 (s, 3 H), 1.20 – 0.90 (m, 7 H), 1.09 (t, J = 7.8 Hz, 9 H), 0.80 – 0.70 (m, 6 H), 0.08 (s, 9 H), 0.05 (s, 9 H), 0.04 (s, 9 H) ppm; ^{13}C NMR (C_6D_6, 150 MHz): δ = 145.97, 144.51, 122.98, 112.44, 97.27, 96.75, 89.93, 85.81, 84.19, 77.19, 74.67, 74.16, 67.30, 66.45, 65.98, 65.44, 60.33, 57.44, 56.15, 54.15, 52.89, 49.80, 48.87, 48.79, 45.09, 39.62, 30.68, 29.77, 29.23, 26.85, 26.00, 25.29, 25.06, 25.04, 24.10, 23.88, 19.08, 18.92, 18.74, 7.94, 6.39, –0.84 ppm; HRMS calcd for $C_{54}H_{102}O_9Si_4Na^+$ [M+Na^+] 1029.6493 found 1029.6487.

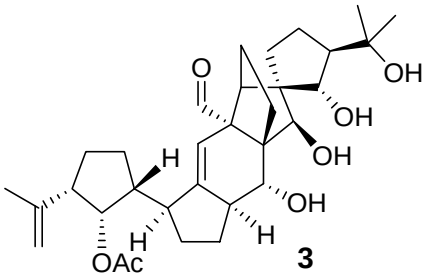
Acetoxy aldehyde 25: To a solution of diol **24a** (30 mg, 0.030 mmol) in CH_2Cl_2 (1.5 mL) at 25 °C was added $PhI(OAc)_2$ (19 mg, 0.060 mmol) and 1-Me-AZADO (1.0 mg, 0.006 mmol). The reaction mixture was stirred at 25 °C for 22 h and then quenched with saturated aqueous solutions of saturated aqueous $Na_2S_2O_3$ (2 mL) and saturated aqueous $NaHCO_3$ solution (2 mL). The resulting mixture was extracted with Et_2O (2 × 10 mL), dried ($MgSO_4$), and concentrated under reduced pressure. The crude residue was taken up in CH_2Cl_2 (1.2 mL), followed by the addition of Et_3N (0.35 mL, 2.5 mmol), 4-DMAP (6.8 mg, 0.055 mmol), and Ac_2O (78 μL, 0.83 mmol). The reaction mixture was stirred at ambient temperature for 36 h and then quenched with saturated aqueous $NaHCO_3$ solution (10 mL). The resulting mixture was extracted with Et_2O (2 × 10 mL), washed with brine (5 mL), dried over $MgSO_4$, and concentrated under reduced pressure. The crude residue was purified by flash column chromatography (silica, EtOAc/hexanes, 2→6 %) to afford acetoxy aldehyde **25** (27 mg, 0.026 mmol, 87 %). **25**: R_f = 0.60 (silica, EtOAc:hexanes, 1:5); $[\alpha]^{25}_D$ = +87.5 (c = 1.0, $CHCl_3$); IR (film): ν_{max} = 2953s, 2877m, 1740m, 1700m, 1371m, 1247s, 1057s, 1032s cm^{-1}; ^{1}H NMR (C_6D_6, 600 MHz): δ = 10.67 (s, 1 H), 5.62 (t, J = 2.1 Hz, 1 H), 5.45 (t, J = 3.6 Hz, 1 H), 5.18 (d, J = 5.4 Hz, 1 H), 5.07 (d, J = 7.2 Hz, 1 H), 5.04 (d, J = 7.2 Hz, 1 H), 4.90 (s, 1 H), 4.88 (d, J = 5.4 Hz, 1 H), 4.81 (s, 1 H), 4.77 (d, J = 7.2 Hz, 1 H), 4.72 (d, J = 7.2 Hz, 1 H), 4.56 (d, J



25

= 1.8 Hz, 1 H), 4.52 (s, 1 H), 4.29 (s, 1 H), 4.04 (m, 1 H), 3.92 – 3.82 (m, 3 H), 3.81 – 3.70 (m, 2 H), 2.87 (d, *J* = 3.6 Hz, 1 H), 2.59 (m, 1 H), 2.42 (m, 1 H), 2.35 (m, 1 H), 2.30 – 2.22 (m, 2 H), 2.11 – 2.02 (m, 3 H), 2.00 – 1.88 (m, 3 H), 1.87 (s, 3 H), 1.81 – 1.72 (m, 4 H), 1.71 (s, 3 H), 1.69 – 1.52 (m, 3 H), 1.50 (s, 3 H), 1.40 – 1.32 (m, 2 H), 1.17 (s, 3 H), 1.16 – 0.98 (m, 7 H), 1.02 (t, *J* = 7.8 Hz, 9 H), 0.76 – 0.64 (m, 6 H), 0.08 (s, 9 H), 0.06 (s, 9 H), 0.05 (s, 9 H) ppm; ^{13}C NMR (C_6D_6, 150 MHz): δ = 201.91, 169.78, 150.32, 144.02, 116.83, 111.56, 97.20, 96.53, 89.98, 84.69, 84.50, 77.57, 77.33, 73.09, 66.66, 66.10, 65.54, 65.36, 60.16, 57.56, 56.50, 51.70, 50.26, 49.84, 47.41, 44.99, 40.80, 30.31, 29.33, 28.98, 26.90, 26.67, 24.62, 24.48, 24.26, 23.51, 21.08, 19.03, 18.91, 18.78, 7.84, 6.34, –0.83, –0.86 ppm; HRMS calcd for $C_{56}H_{102}O_{10}Si_4Na^+$ [*M*+Na^+] 1069.6442 found 1069.6442.

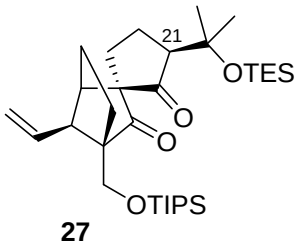
vannusal B structure 3: To a solution of **25** (25 mg, 0.023 mmol) in THF (2.4 mL) at 25 °C was added aqueous HF (48 % in H_2O, 0.8 mL). The reaction mixture was stirred at that temperature for 7 h, diluted with EtOAc (10 mL), and quenched carefully with saturated aqueous $NaHCO_3$ (20 mL). The organic layer was separated and the aqueous layer was extracted with EtOAc (10 mL). The combined organics were dried over $MgSO_4$ and concentrated in vacuo. The crude residue was subjected to flash column chromatography (silica, acetone/hexanes, 20→30 %) to furnish the desired vannusal B structure **3** (10 mg, 0.018 mmol, 77%). **3**: R_f = 0.28 (silica, acetone:hexanes, 1:2); $[\alpha]^{25}_D$ = +52.6 (*c* = 0.5, $CHCl_3$); IR (film): ν_{max} = 3358brs, 2936s, 1731s, 1686m, 1373m, 1249s, 1216s cm^{-1}; ^{1}H NMR (CD_3OD, 500 MHz): δ = 9.53 (s, 1 H), 5.57 (t, *J* = 2.2 Hz, 1 H), 5.47 (t, *J* = 3.3 Hz, 1 H), 4.83 (d, *J* = 1.0 Hz, 1 H), 4.77 (s, 1 H), 4.42 (d, *J* = 2.0 Hz, 1 H), 3.96 (d, *J* = 8.5 Hz, 1 H), 3.63 (d, *J* = 2.0 Hz, 1 H), 2.55 (m, 1 H), 2.47 (m, 1 H), 2.41 – 2.31 (m, 2 H), 2.23 – 2.11 (m, 3 H), 2.09 – 1.98 (m, 4 H), 1.97 (s, 3 H), 1.86 – 1.72 (m, 3 H), 1.78 (s, 3 H), 1.69 – 1.63 (m, 2 H), 1.58 (m, 1 H), 1.52 – 1.33 (m, 4 H), 1.22 (s, 3 H), 1.20 (s, 3 H), 0.95 (tt, *J* = 12.3, 2.0 Hz, 1 H) ppm; ^{13}C NMR (CD_3OD, 125 MHz): δ = 200.50, 172.31,



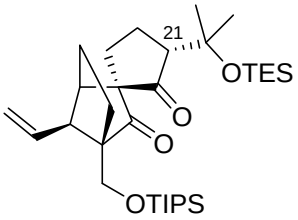
3

158.14, 144.87, 113.92, 111.64, 83.17, 81.62, 78.71, 73.50, 73.48, 70.79, 58.72, 57.33, 55.28, 53.51, 53.20, 52.24, 48.45, 45.44, 40.46, 31.59, 31.20, 29.14, 28.23, 27.63, 26.90, 25.47, 24.17, 23.51, 23.29, 21.07 ppm; HRMS calcd for $C_{32}H_{46}O_7Na^+$ [M+Na^+] 565.3136 found 565.3132.

TES ethers 27 and 27a: To a solution of diketone **26**[2] (4.40 g, 10.9 mmol) in THF (200 mL) at –78 °C was added freshly prepared LDA (5.0 equiv, 54.9 mmol) and the resulting mixture was allowed to warm to –40 °C (30 min). Acetone (20 equiv, 15.0 mL, 218 mmol) was added dropwise and the reaction mixture was maintained at this temperature for 1 h before it was quenched with aqueous phosphate buffer solution (pH = 7.0, 200 mL). The mixture was extracted with Et_2O (2 × 100 mL), dried ($MgSO_4$), and concentrated in vacuo. The crude residue was purified by flash column chromatography (EtOAc/hexanes, 10→30 %) to furnish the corresponding β-hydroxy ketones (3:1 mixture of diastereomers). To this mixture of β-hydroxy ketones in CH_2Cl_2 (250 mL) at –78 °C was added 2,6-lutidine (4.0 equiv, 4.22 mL, 38.8 mmol) and TESOTf (2.0 equiv, 5.12 mL, 19.0 mmol). The reaction mixture was warmed to –40 °C (30 min) and quenched with saturated aqueous $NaHCO_3$ solution (100 mL). The resulting mixture was extracted with CH_2Cl_2 (2 × 50 mL), dried ($MgSO_4$), and concentrated under reduced pressure. The crude residue was purified by flash column chromatography (silica, Et_2O/hexanes, 1→10 %) to furnish the desired (C_{21}) TES ether **27** (4.13 g, 7.2 mmol, 66 %) and undesired (C_{21}) TES ether **27a**[2] (1.37 g, 2.3 mmol, 21 %). **27**: R_f = 0.50 (silica, Et_2O:hexanes, 2:98); IR (film): ν_{max} = 2954s, 2868s, 1754s, 1718s, 1382w, cm^{-1}; ^1H NMR (C_6D_6, 600 MHz): δ = 5.75 (m, 1 H), 5.30 (d, J = 17.4 Hz, 1 H), 5.13 (d, J = 10.2 Hz, 1 H), 4.14 (d, J = 10.2 Hz, 1 H), 3.58 (d, J = 10.2 Hz, 1 H), 2.84 (d, J = 7.8 Hz, 1 H), 2.34 (d, J = 3.6 Hz, 1 H), 2.15 (ddd, J = 9.6, 6.0, 3.6 Hz, 1 H), 1.95 (dt, J = 11.4, 6.0 Hz, 1 H), 1.82 – 1.60 (m, 6 H), 1.45 (dt, J = 12.0, 3.0 Hz, 1 H), 1.17 – 1.11 (m, 21 H), 1.04 (s, 3 H), 0.09 (t, J = 7.8 Hz, 9 H), 0.54 (q, J = 7.8 Hz, 1 H) ppm; ^{13}C NMR (C_6D_6, 150 MHz): δ = 214.14, 212.54, 133.74, 118.50,



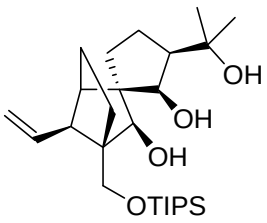
27



27a

74.83, 69.76, 63.83, 60.52, 60.48, 52.18, 46.89, 31.19, 30.22, 27.86, 23.43, 23.32, 21.95, 18.30, 18.27, 12.36, 7.36, 7.01 ppm; HRMS calcd for $C_{32}H_{58}O_4Si_2Na^+$ [*M*+Na^+] 585.3766 found 585.3758.

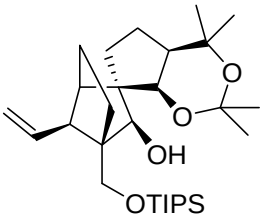
Triol 28: To a stirred solution of **27** (4.13 g, 7.2 mmol) in THF/MeOH (1:1, 100 mL) at –10 °C was added $NaBH_4$ (10 equiv, 5.33 g, 72.1 mmol). The resulting mixture was warmed to 25 °C (4 h) and then quenched with saturated aqueous NH_4Cl solution (100 mL), extracted with Et_2O (2 × 100 mL), dried ($MgSO_4$), filtered, and concentrated under reduced pressure. The crude residue was dissolved in MeOH (100 mL), and PPTS (0.25 equiv, 0.45 g, 1.80 mmol) was added. The mixture stirred at ambient temperature for 2 h and then was quenched with saturated aqueous $NaHCO_3$ solution (50 mL), extracted with Et_2O (2 × 100 mL), dried ($MgSO_4$), filtered, and concentrated under reduced pressure. The crude residue was purified by flash column chromatography (silica, 20→80 % Et_2O/hexanes) to furnish **28** (2.91 g, 6.55 mmol, 91 %).



28

28: R_f = 0.40 (silica, Et_2O:hexanes, 7:10); IR (film): ν_{max} = 3655brs, 3356brs, 2943s, 2866s, 1461m, 1385m, 1056s cm^{-1}; ^1H NMR (C_6D_6, 500 MHz): δ = 5.75 (m, 1 H), 5.06 (dd, *J* = 17.0, 2,5 Hz, 1 H), 4.99 (dd, *J* = 10.5, 2.5 Hz, 1 H), 4.70 (d, *J* = 3.5 Hz, 1 H), 3.88 (s, 1 H), 3.87 (d, *J* = 9.5 Hz, 1 H), 3.76 (d, *J* = 9.5 Hz, 1 H), 3.00 (brs, 1 H), 2.73 (s, 1 H), 2.36 (dt, *J* = 10.0, 4.0 Hz, 2 H), 2.26 (d, *J* = 8.5 Hz, 1 H), 2.17 (d, *J* = 4.0 Hz, 1 H), 2.15 – 2.00 (m, 2 H), 1.59 (ddd, *J* = 9.5, 5.5, 3.5 Hz, 1 H), 1.44 (s, 3 H), 1.23 (ddd, *J* = 7.5, 4.5, 1.5 Hz, 1 H), 1.20 – 1.07 (m, 2 H), 1.04 (s, 3 H), 1.02 (m, 21 H) ppm; ^{13}C NM (C_6D_6, 125 MHz): δ = 135.75, 116.83, 85.72, 75.76, 72.61, 69.43, 57.24, 56.72, 52.00, 51.92, 51.10, 39.73, 30.02, 29.93, 24.36, 22.09, 22.03, 18.14, 12.02 ppm; HRMS calcd for $C_{26}H_{48}O_4SiH^+$ [*M*+H^+] 453.3394 found 453.3401.

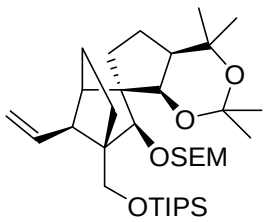
Hydroxy acetonide 28-1: To a stirred solution of triol **28** (3.05 g, 6.86 mmol) in DMF/2,2-dimethoxypropene (1:1, 120 mL) at 25 °C was added PPTS (1.0 equiv, 1.72 g, 6.86 mmol). The resulting reaction mixture was heated to 40 °C for 6 h and quenched with saturated aqueous



28-1

$NaHCO_3$ solution (100 mL). The resulting mixture was extracted with Et_2O (2 × 100 mL), dried ($MgSO_4$), filtered through a short silica plug (eluting with pure Et_2O), and concentrated in vacuo to give the pure titled compound **28-1** (3.25 g, 6.86 mmol, 100 %). **28-1**: R_f = 0.40 (silica, Et_2O:hexanes, 1:9); IR (film): ν_{max} = 3540brs, 2943s, 2866s, 1637w, 1463m, 1372m, 1197s, 1056s cm^{-1}; ^1H NMR (C_6D_6, 500 MHz): δ = 5.76 (m, 1 H), 5.07 (dd, *J* = 17.0, 2.5 Hz, 1 H), 4.99 (dd, *J* = 10.5, 2.5 Hz, 1 H), 4.65 (d, *J* = 2.5 Hz, 1 H), 3.93 (s, 1 H), 3.89 (d, *J* = 9.5 Hz, 1 H), 3.77 (d, *J* = 9.5 Hz, 1 H), 2.72 (s, 1 H), 2.36 (m, 1 H), 2.32 (d, *J* = 4.0 Hz, 1 H), 2.26 (d, *J* = 8.5 Hz, 1 H), 2.12 – 2.00 (m, 4 H), 1.90 (m, 1 H), 1.68 –1.55 (m, 2 H), 1.50 (s, 3 H), 1.49 (s, 3 H), 1.40 (s, 3 H), 1.26 (ddt, *J* = 11.0, 4.0, 2.5 Hz, 1 H), 1.21 (s, 3 H), 1.09 (t, *J* = 7.0 Hz, 1 H), 1.04 (m, 18 H), 1.03 – 0.97 (m, 4 H) ppm; ^{13}C NMR (C_6D_6, 125 MHz): δ = 135.81, 116.78, 97.87, 87.09, 71.71, 69.36, 56.50, 55.80, 52.07, 51.27, 41.18, 41.55, 32.23, 30.83, 29.27, 24.60, 24.26, 24.10, 21.79, 18.15, 12.05 ppm; HRMS calcd for $C_{29}H_{52}O_4SiNa^+$ [*M*+Na^+] 492.3635 found 492.3522.

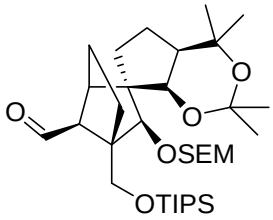
SEM ether 29: To a solution of hydroxy acetonide **28-1** (3.25 g, 6.84 mmol) in CH_2Cl_2 (60 mL) at 25 °C was added *i*Pr_2NEt (15 equiv, 17.7 mL, 102.6 mmol), *n*Bu_4NI (1.0 equiv, 2.50 g, 6.84 mmol), and SEMCl (4.0 equiv, 4.55 mL, 27.3 mmol). The resulting mixture was refluxed (50 °C) for 24 h, cooled to ambient temperature, and quenched with saturated aqueous $NaHCO_3$ solution (100 mL). The mixture was extracted with Et_2O (2 × 50 mL), dried ($MgSO_4$), and concentrated in vacuo. The crude residue was purified by flash column chromatography (silica, Et_2O/hexanes, 2→5 %) to furnish SEM ether **29** (4.16 g, 6.70 mmol, 97 %) **29**: R_f = 0.55 (silica, Et_2O:hexanes, 1:9); IR (film): ν_{max} = 2945s, 2860s, 1466w, 1374m, 1249m, 1196m, 1107m, 1059s, 1031s cm^{-1}; ^1H NMR (C_6D_6, 600 MHz): δ = 5.84 (m, 1 H), 5.25 (d, *J* = 17.4 Hz, 1 H), 5.13 (dd, *J* = 10.2 Hz, 1 H), 4.83 (d, *J* = 6.6 Hz, 1 H), 4.74 (d, *J* = 6.6 Hz, 1 H), 4.61 (d, *J* = 1.8 Hz, 1 H), 3.98 (s, 1 H), 3.87 (d, *J* = 9.6 Hz, 1 H), 3.71 – 3.66 (m, 3 H), 2.64 (d, *J* = 7.8 Hz, 1 H), 2.38 (d, *J* = 3.6 Hz, 1 H), 2.20 – 2.00 (m, 4 H), 2.01 (d, *J* = 7.8 Hz, 1 H), 1.89 (m, 1 H),



29

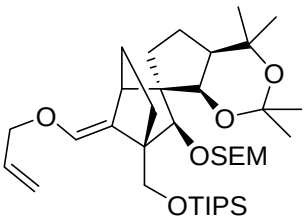
1.75 – 1.68 (m, 2 H), 1.50 (s, 3 H), 1.48 (s, 3 H), 1.45 (s, 3 H), 1.28 (s, 3 H), 1.16 – 1.14 (m, 21 H), 1.12 (m, 1 H), 0.97 – 0.94 (m, 2 H), 0.00 (s, 9 H) ppm; ^{13}C NMR (C_6D_6, 150 MHz): δ = 136.01, 117.47, 98.01, 96.99, 94.74, 89.15, 71.88, 71.80, 66.36, 65.05, 62.70, 58.64, 56.01, 50.50, 47.16, 41.66, 32.07, 31.8, 29.07, 24.61, 24.41, 23.61, 21.04, 18.46, 12.54, –1.28 ppm; HRMS calcd for $C_{35}H_{66}O_5Si_2Na^+$ [*M*+Na^+] 645.4341 found 645.4343.

Aldehyde 29-1: To a solution of olefin **29** (4.16 g, 6.68 mmol) in MeOH/CH_2Cl_2 (1:1, 140 mL) at –78 °C was added pyridine (1.0 equiv, 0.54 mL, 6.68 mmol). Ozone was gently bubbled into the reaction mixture until the solution took on a light blue color. The reaction mixture was stirred for 2 min and then purged with oxygen until the solution became colorless once again. Ph_3P (5.0 equiv, 8.76 g, 33.4 mmol) was added and the reaction mixture was warmed to 25 °C, stirred an additional 1 h at this temperature, and concentrated under reduced pressure. The crude residue was directly purified by flash column chromatography (silica, Et_2O/hexanes, 2→20 %) to furnish aldehyde **29-1** (3.92 g, 6.27 mmol, 94 %). **29-1**: R_f = 0.40 (silica, Et_2O:hexanes, 1:9); IR (film): ν_{max} = 2944s, 2866s, 1717s, 1464m, 1374m, 1249m, 1196s, 1062s cm^{-1}; ^{1}H NMR (C_6D_6, 600 MHz): δ = 9.79 (d, *J* = 1.8 Hz, 1 H), 4.67 (d, *J* = 6.6 Hz, 1 H), 4.56 (d, *J* = 6.6 Hz, 1 H), 4.50 (s, 1 H), 4.10 (d, *J* = 10.2 Hz, 1 H), 3.91 (d, *J* = 10.2 Hz, 1 H), 3.70 (m, 1 H), 3.66 (s, 1 H), 3.56 (m, 1 H), 2.53 (d, *J* = 2.4 Hz, 1 H), 2.52 (s, 1 H), 2.02 (m, 2 H), 1.93 – 1.91 (m, 3 H), 1.85 (m, 1 H), 1.64 – 1.60 (m, 2 H), 1.48 (m, 1 H), 1.48 (s, 3 H), 1.42 (s, 3 H), 1.40 (s, 3 H), 1.25 (s, 3 H), 1.13 (m, 21 H), 0.95 (t, *J* = 8.4 Hz, 2 H), 0.00 (s, 9 H) ppm; ^{13}C NMR (C_6D_6, 150 MHz): δ = 201.41, 98.05, 97.10, 89.94, 71.72, 71.52, 66.39, 63.08, 59.08, 58.17, 56.23, 47.87, 47.19, 41.36, 31.96, 31.00, 28.96, 24.50, 24.34, 20.61, 18.34, 12.34, –1.38 ppm; HRMS calcd for $C_{34}H_{64}O_6Si_2H^+$ [*M*+H^+] 625.4314 found 625.4311.



29-1

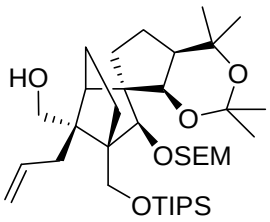
Allyl enol ether 29-2: To KH (10 equiv, 8.38 g, 62.7 mmol, 30 % in mineral oil, washed with hexanes) in DME (120 mL) at –10 °C was added HMPA (10 equiv, 11.2 mL, 62.7 mmol),



29-2

aldehyde **29-1** (3.92 g, 6.27 mmol, dissolved into 20 mL DME), and allylchloride (20 equiv, 9.6 mL, 125 mmol) successively. The reaction mixture was stirred at this temperature for 30 min and then warmed to 25 °C (3 h). The reaction mixture was quenched by cannulation into aqueous phosphate buffer solution (pH = 7.0, 100 mL). The resulting mixture was extracted with Et_2O (2 × 100 mL), dried ($MgSO_4$), and concentrated in vacuo. The crude residue was purified by flash column chromatography (silica, Et_2O/hexanes, 2→5 %) to furnish allyl enol ether **29-2** (3.66 g, 5.51 mmol, 88 %). **29-2**: R_f = 0.50 (silica, Et_2O:hexanes, 1:19); IR (film): ν_{max} = 2943m, 1573m, 1456s, 1434s, 1126m, 1034s cm^{-1}; ^1H NMR (C_6D_6, 600 MHz): δ = 6.22 (s, 1 H), 5.81 (m, 1 H), 5.24 (dd, *J* = 17.4, 1.8 Hz, 1 H), 5.02 (dd, *J* = 10.2, 1.8 Hz, 1 H), 4.78 (d, *J* = 6.6 Hz, 1 H), 4.66 (d, *J* = 6.6 Hz, 1 H), 4.65 (d, *J* = 1.8 Hz, 1 H), 4.13 (dd, *J* = 5.4, 1.8 Hz, 2 H), 4.09 (d, *J* = 10.2 Hz, 1 H), 4.06 (d, *J* = 10.2 Hz, 1 H), 3.75 (m, 1 H), 3.70 (s, 1 H), 3.66 (m, 1 H), 3.42 (d, *J* = 4.8 Hz, 1 H), 2.30 (m, 1 H), 2.17 (ddd, *J* = 10.8, 9.0, 4.2 Hz, 1 H), 2.08 (m, 1 H), 2.04 (dt, *J* = 8.4, 3.6 Hz, 1 H), 1.95 (m, 1 H), 1.87 (m, 1 H), 1.71 – 1.65 (m, 2 H), 1.52 (m, 1 H), 1.51 (s, 3 H), 1.42 (s, 3 H), 1.29 (s, 3 H), 1.22 (m, 1 H), 1.17 (m, 21 H), 1.00 (ddd, *J* = 9.0, 7.2, 1.2 Hz, 2 H), 0.00 (s, 9 H) ppm; ^{13}C NMR (C_6D_6, 150 MHz): δ = 134.97, 133.31, 126.48, 116.66, 98.23, 96.88, 89.66, 72.66, 72.00, 66.32, 63.39, 57.48, 55.15, 47.86, 44.25, 41.07, 31.87, 31.34, 28.57, 24.76, 24.70, 24.43, 23.97, 18.48, 12.51, –1.36 ppm; HRMS calcd for $C_{37}H_{68}O_6Si_2Na^+$ [*M*+Na^+] 687.4446 found 687.4444.

Alcohol 29-3: A solution of allyl enol ether **29-2** (3.66 g, 5.51 mmol) and *i*Pr_2NEt (1.0 equiv, 1.0 mL, 5.51 mmol) in 1,2-dichlorobenzene (60 mL) was heated under microwave irradiation at 200

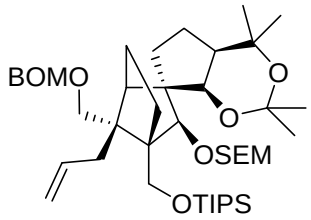


29-3

°C for 20 min. The resulting solution was cooled to 25 °C and diluted with MeOH (60 mL). $NaBH_4$ (10 equiv, 2.0 g, 55.1 mmol) was added and the reaction mixture was stirred for 1 h at that temperature. The reaction mixture was quenched by careful addition of saturated aqueous NH_4Cl solution (100 mL). The resulting mixture was extracted with CH_2Cl_2 (2 ×

50 mL), dried ($MgSO_4$), and concentrated in vacuo until only 1,2-dichlorobenzene remained. The resulting crude solution was purified by flash column chromatography (silica, Et_2O/hexanes, 2→30 %) to furnish alcohol **29-3** (3.00 g, 4.50 mmol, 82 %). **29-3**: R_f = 0.40 (silica, Et_2O:hexanes, 2:8); IR (film): ν_{max} = 3464brs, 2944s, 2867s, 1637w, 1463m, 1370m, 1194s, 1054s, 1030s cm^{-1}; ^1H NMR (C_6D_6, 600 MHz): δ = 6.98 (m, 1 H), 5.24 (d, *J* =17.4 Hz, 1 H), 5.05 (d, *J* = 10.2 Hz, 1 H), 4.77 (d, *J* = 6.0 Hz, 1 H), 4.74 (d, *J* = 6.0 Hz, 1 H), 4.55 (s, 1 H), 4.12 (s, 1 H), 3.97 (d, *J* = 12.0 Hz, 1 H), 3.78 (d, *J* = 10.8 Hz, 1 H), 3.72 (m, 3 H), 3.66 (d, *J* = 10.8 Hz, 1 H), 3.00 (d, *J* = 9.0 Hz, 1 H), 2.88 (dd, *J* = 13.8, 3.0 Hz, 1 H), 2.16 – 2.05 (m, 5 H), 2.00 (m, 1 H), 1.82 (m, 1 H), 1.67 (m, 1 H), 1.58 (m, 1 H), 1.51 (s, 3 H), 1.50 (s, 3 H), 1.48 (s, 3 H), 1.26 (s, 3 H), 1.13 (m, 21 H), 0.95 (q, *J* = 7.2 Hz, 2 H), 0.01 (s, 9 H) ppm; ^{13}C NMR (C_6D_6, 150 MHz): δ = 135.87, 117.17, 97.84, 97.35, 90.39, 73.94, 71.36, 66.81, 62.79, 62.26, 58.33, 55.38, 53.83, 50.41, 46.04, 44.61, 32.92, 32.44, 30.46, 30.09, 25.15, 24.20, 24.00, 23.15, 18.38, 18.35, 12.50, –1.29 ppm; HRMS calcd for $C_{37}H_{70}O_6Si_2H^+$ [*M*+H^+] 667.4783 found 667.4785.

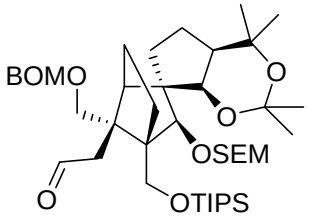
BOM ether 29-4: To a solution of alcohol **29-3** (3.00 g, 4.50 mmol) in 1,2-dichloroethane (50 mL) at 25 °C was added *i*Pr_2NEt (10 equiv, 8.0 mL, 45.0 mmol), *n*Bu_4NI (1.0 equiv, 1.60 g, 4.50 mmol), and BOMCl (3.0 equiv, 2.11 mL, 13.5 mmol). The resulting mixture was refluxed for 12 h, cooled to ambient temperature, and quenched with saturated aqueous $NaHCO_3$ solution (100 mL). The resulting mixture was extracted with Et_2O (2 × 50 mL), dried ($MgSO_4$), and concentrated in vacuo. The crude residue was purified by flash column chromatography (silica, Et_2O/hexanes, 2→10 %) to afford BOM ether **29-4**. **29-4**: R_f = 0.45 (silica, Et_2O:hexanes, 1:9); IR (film): ν_{max} = 2943s, 2860s, 1464m, 1374m, 1246m, 1196s, 1097s, 1046s cm^{-1}; ^1H NMR (C_6D_6, 600 MHz): δ = 7.37 (d, *J* = 7.2 Hz, 2 H), 7.20 (t, *J* = 7.2 Hz, 2 H), 7.10 (t, *J* = 7.2 Hz, 1 H), 6.29 (m, 1 H), 5.14 (d, *J* = 16.8 Hz, 1 H), 5.06 (d, *J* = 10.2 Hz, 1 H), 4.80 (d, *J* = 7.2 Hz, 1 H), 4.73 (d, *J* = 7.2 Hz, 1 H), 4.70 (d, *J* = 6.6 Hz, 1 H), 4.64 (d, *J* = 6.6 Hz, 1 H), 4.63 (s, 1 H), 4.62 (d, *J* = 12.0 Hz, 1 H), 4.56 (d, *J* = 12.0 Hz, 1 H), 4.06 (s, 1 H), 4.03 (d, *J*



29-4

= 10.8 Hz, 1 H), 3.94 (d, *J* = 10.8 Hz, 1 H), 3.85 (d, *J* = 10.8 Hz, 1 H), 3.82 (d, *J* = 10.8 Hz, 1 H), 3.72 (t, *J* = 8.4 Hz, 1 H), 2.65 (dd, *J* = 12.6, 6.0 Hz, 1 H), 2.54 – 2.48 (m, 3 H), 2.23 – 2.18 (m, 2 H), 2.13 (m, 1 H), 1.99 – 1.92 (m, 2 H), 1.76 (dt, *J* = 13.2, 8.4 Hz, 1 H), 1.63 (m, 1 H), 1.54 (m, 1 H), 1.53 (s, 3 H), 1.51 (s, 3 H), 1.50 (s, 3 H), 1.35 (m, 1 H), 1.28 (s, 3 H), 1.16 (m, 21 H), 1.00 (t, *J* = 8.4 Hz, 1 H), 0.01 (s, 9 H) ppm; ^{13}C NMR (C_6D_6, 150 MHz): δ = 138.85, 137.50, 115.78, 97.91, 97.32, 95.38, 91.96, 74.00, 72.89, 71.38, 69.57, 66.67, 63.18, 58.61, 54.38, 53.40, 50.43, 46.25, 43.86, 37.70, 32.42, 30.53, 30.03, 25.20, 24.22, 22.10, 18.48, 12.48, –1.32 ppm; HRMS calcd for $C_{45}H_{78}O_7Si_2Na^+$ [*M*+Na^+] 809.5178 found 809.5175.

Aldehyde 29-5: To a solution of intermediate olefin **29-4** (3.54 g, 4.50 mmol) in MeOH/CH_2Cl_2 (1:1, 40 mL) at –78 °C was added pyridine (1.0 equiv, 0.35 mL, 4.50 mmol). Ozone was gently bubbled into the reaction mixture until the solution took on a light blue color. The reaction mixture was stirred for 2 min and then purged with oxygen until the solution became colorless. Ph_3P (5.0 equiv, 5.90 g, 22.5 mmol) was added and the reaction mixture was warmed to 25 °C, stirred an additional 50 min at that temperature, and concentrated under reduced pressure. The crude residue was purified by flash column chromatography (silica, Et_2O/hexanes, 2→10 %) to furnish **29-5** (3.32 g, 4.21 mmol, 94 % for two steps).

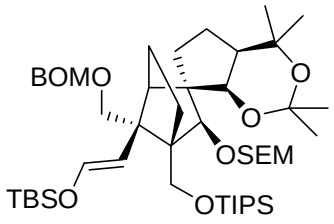


29-5

29-5: R_f = 0.40 (silica, Et_2O:hexanes, 2:8); IR (film): ν_{max} = 2945m, 2860m, 1717s, 1464w, 1367m, 1249m, 1100s, 1036s cm^{-1}; ^{1}H NMR (C_6D_6, 600 MHz): δ = 9.89 (d, *J* = 4.2 Hz, 1 H), 7.38 (d, *J* = 7.2 Hz, 2 H), 7.18 (t, *J* = 7.2 Hz, 2 H), 7.09 (t, *J* = 7.2 Hz, 1 H), 4.71 (d, *J* = 6.0 Hz, 1 H), 4.65 (d, *J* = 6.0 Hz, 1 H), 4.58 (d, *J* = 1.2 Hz, 1 H), 4.57 (d, *J* = 6.6 Hz, 1 H), 4.54 (d, *J* = 12.0 Hz, 1 H), 4.47 (d, *J* = 12.0 Hz, 1 H), 3.98 (s, 1 H), 3.93 (d, *J* = 10.8 Hz, 1 H), 3.79 (d, *J* = 10.8 Hz, 1 H), 3.71 (d, *J* = 10.8 Hz, 1 H), 3.69 – 3.66 (m, 2 H), 3.60 (d, *J* = 10.8 Hz, 1 H), 2.85 (d, *J* = 4.2 Hz, 1 H), 2.53 (t, *J* = 10.8 Hz, 1 H), 2.44 (dd, *J* = 15.6, 4.2 Hz, 1 H), 2.40 (d, *J* = 15.6 Hz, 1 H), 2.22 (m, 1 H), 2.10 – 2.07 (m, 2 H), 1.92 (t, *J* = 9.6 Hz, 1 H), 1.73 – 1.70 (m, 2 H), 1.60 (dt, *J* = 19.2, 10.8 Hz, 1 H), 1.52 (s, 3 H), 1.50 (s, 9 H), 1.27 (s, 3 H), 1.15 (m, 1 H), 1.09 (m,

21 H), 0.96 (t, J = 8.4 Hz, 2 H), –0.01 (s, 9 H) ppm; ^{13}C NMR (C_6D_6, 150 MHz): δ = 200.84, 138.61, 128.57, 128.53, 127.62, 97.94, 90.27, 73.89, 73.06, 71.35, 69.60, 66.70, 62.15, 58.77, 54.36, 53.00, 49.87, 47.81, 46.22, 43.62, 32.43, 30.46, 30.06, 25.20, 24.18, 21.55, 18.44, 12.37, –1.33 ppm; HRMS calcd for $C_{44}H_{76}O_8Si_2Na^+$ [M+Na^+] 811.4971 found 811.4964.

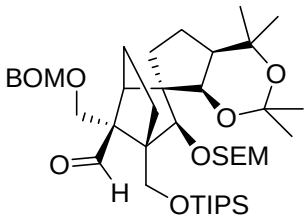
Silyl enol ether 29-6: To a solution of aldehyde **29-5** (3.32 g, 4.21 mmol) in CH_2Cl_2 (50 mL) at 25 °C was added DBU (20 equiv, 12.7 mL, 84 mmol) and TBSCl (10 equiv, 6.54 g, 41.9 mmol). The resulting mixture was stirred for 24 h at that temperature and then quenched with saturated aqueous $NaHCO_3$ solution (100 mL). The resulting mixture was extracted with Et_2O (2 × 50 mL), dried ($MgSO_4$), and concentrated in vacuo. The crude residue was purified by flash column chromatography (silica, Et_2O/hexanes, 5→10 %) to furnish **29-6** (3.79 g, 4.21 mmol, 100 %).



29-6

29-6: R_f = 0.50 (silica, Et_2O:hexanes, 1:9); IR (film): ν_{max} = 2946s, 2866s, 1652m, 1463m, 1373m, 1250m, 1195m, 1173m, 1094s, 1046s cm^{-1}; ^{1}H NMR (C_6D_6, 600 MHz): δ = 7.41 (d, J = 7.2 Hz, 2 H), 7.22 (t, J = 7.2 Hz, 2 H), 7.11 (t, J = 7.2 Hz, 1 H), 6.75 (d, J = 6.0 Hz, 1 H), 5.49 (d, J = 6.0 Hz, 1 H), 4.85 (d, J = 6.0 Hz, 1 H), 4.79 (d, J = 6.0 Hz, 1 H), 4.77 (s, 2 H), 4.72 (s, 1 H), 4.65 (d, J = 6.0 Hz, 1 H), 4.60 (d, J = 6.0 Hz, 1 H), 4.27 (s, 1 H), 4.93 (d, J = 10.8 Hz, 1 H), 3.90 (d, J = 10.8 Hz, 1 H), 3.86 (d, J = 11.4 Hz, 1 H), 3.82 (d, J = 11.4 Hz, 1 H), 3.76 – 3.72 (m, 2 H), 2.86 (d, J = 3.6 Hz, 1 H), 2.80 (t, J = 10.8 Hz, 1 H), 2.28 (m, 1 H), 2.20 (m, 1 H), 2.13 – 2.07 (m, 2 H), 2.04 (t, J = 9.0 Hz, 1 H), 1.88 (dt, J = 13.8, 8.4 Hz, 1 H), 1.69 (q, J = 8.4 Hz, 1 H), 1.54 (s, 6 H), 1.51 (s, 3 H), 1.30 (s, 3 H), 1.27 (m, 1 H), 1.13 (m, 21 H), 1.00 – 0.96 (m, 2 H), 0.95 (s, 9 H), 0.09 (s, 3 H), 0.08 (s, 3 H), 0.01 (s, 9 H) ppm; ^{13}C NMR (C_6D_6, 150 MHz): δ = 143.45, 138.71, 128.45, 128.29, 127.56, 112.54, 97.98, 97.42, 95.47, 90.45, 74.08, 71.89, 71.46, 69.53, 66.66, 62.14, 59.14, 54.47, 53.85, 51.31, 46.24, 43.34, 32.47, 30.59, 30.04, 25.87, 25.31, 24.82, 24.26, 22.46, 18.56, 18.52, 18.40, 12.45, –1.30, –4.92, –5.05 ppm; HRMS calcd for $C_{50}H_{90}O_8Si_3Na^+$ [M+Na^+] 925.5835 found 925.5826.

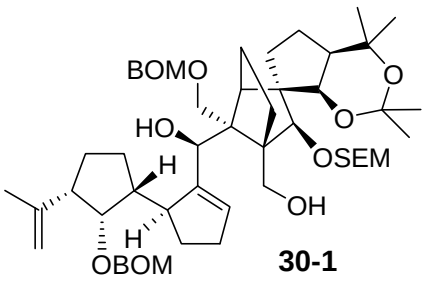
Aldehyde 30: To a solution of enol ether **29-6** (3.79 g, 4.21 mmol) in MeOH/CH_2Cl_2 (1:1, 100 mL) at –78 °C was added pyridine (1.0 equiv, 0.33 mL, 4.21 mmol). Ozone was gently bubbled into the reaction mixture until the solution took on a light blue color. The reaction mixture was stirred for 2 min and then purged with oxygen until it became colorless. Ph_3P (5.0 equiv, 5.53 g, 21.1 mmol) was added and the reaction mixture was warmed to 25 °C, stirred an additional 50 min at this temperature, and then concentrated under reduced pressure. The crude residue was purified by flash column chromatography (silica, Et_2O/hexanes, 5→20 %) to furnish **30** (3.11 g, 4.01 mmol, 95 %).



30

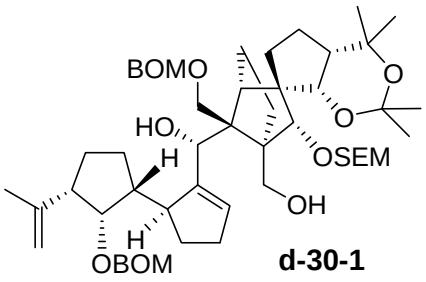
30: R_f = 0.30 (silica, Et_2O:hexanes, 1:9); IR (film): ν_{max} = 2944s, 2867s, 1720m, 1463m, 1372m, 1250m, 1195m, 1097s, 1041s cm^{-1}; ^1H NMR (C_6D_6, 600 MHz): δ = 10.11 (s, 1 H), 7.32 (d, *J* = 7.2 Hz, 2 H), 7.18 (t, *J* = 7.2 Hz, 2 H), 7.10 (t, *J* = 7.2 Hz, 1 H), 4.76 (d, *J* = 6.0 Hz, 1 H), 4.68 (d, *J* = 6.0 Hz, 1 H), 4.60 (d, *J* = 6.6 Hz, 1 H), 4.59 (s, 1 H), 4.55 (d, *J* = 6.6 Hz, 1 H), 4.50 (d, *J* = 12.0 Hz, 1 H), 4.44 (d, *J* = 12.0 Hz, 1 H), 4.36 (d, *J* = 10.8 Hz, 1 H), 4.31 (d, *J* = 10.8 Hz, 1 H), 4.03 (s ,1 H), 3.90 (d, *J* = 10.8 Hz, 1 H), 3.87 (d, *J* = 10.8 Hz, 1 H), 3.68 (t, *J* = 7.8 Hz, 2 H), 2.97 (d, *J* = 4.2 Hz, 1 H), 2.54 (m, 1 H), 2.20 (m, 1 H), 2.10 (m, 2 H), 1.93 (m, 1 H), 1.84 (m, 1 H), 1.73 (dt, *J* = 13.2, 7.2 Hz, 1 H), 1.52 (s, 3 H), 1.49 (s, 3 H), 1.47 (s, 3 H), 1.42 (m, 1 H), 1.27 (s, 3 H), 1.15 (m, 21 H), 0.96 (dt, *J* = 7.2, 1.8 Hz, 2 H), 0.00 (s, 9 H) ppm; ^{13}C NMR (C_6D_6, 150 MHz): δ = 204.83, 138.51, 97.92, 97.30, 95.06, 91.14, 90.57, 97.92, 97.30, 95.06, 91.14, 90.57, 73.40, 71.36, 69.75, 69.57, 68.99, 66.70, 64.31, 62.58, 58.41, 54.42, 49.31, 46.09, 43.29, 32.35, 30.53, 29.96, 25.16, 24.23, 24.19, 21.15, 18.45, 18.38, 12.48, –1.33 ppm; HRMS calcd for $C_{43}H_{74}O_8Si_2H^+$ [*M*+H^+] 775.4995 found 775.5000.

Diols 30-1 and d-36-1: To a solution of vinyl iodide (–)-**5**[2] (0.594 g, 1.36 mmol) in THF (9.0 mL) at –78 °C was added *t*BuLi (1.7 M in pentane, 1.60 mL, 2.71 mmol). The reaction mixture was stirred at –78 °C for 20 min and then slowly warmed up to –40 °C over 30 min. A solution of aldehyde **30** (0.808 g, 1.04 mmol) in THF (6.0 mL) was added and the resultant reaction mixture was warmed to 0 °C over 20 min. The reaction mixture was quenched with saturated



30-1

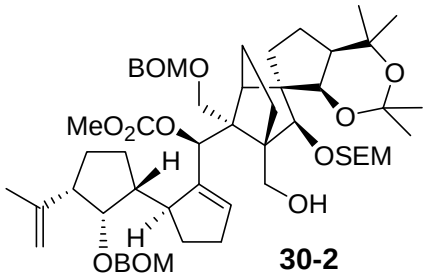
aqueous NH_4Cl solution (25 mL), extracted with Et_2O (2 × 60 mL), dried ($MgSO_4$), and concentrated in vacuo. The crude residue was purified by flash column chromatography (silica, EtOAc/hexanes, 7→11 %) to furnish an inseparable 1:1 mixture of two diasteromers. To this mixture of diastereomers in THF (7.0 mL) at 25 °C was added TBAF (1.0 M in THF, 4.0 mL, 4.0 mmol). The resulting mixture was stirred for 30 min at 25 °C and then concentrated under reduced pressure. The resulting crude residue was purified directly by flash column chromatography (silica, EtOAc/hexanes, 15→25 %) to furnish diol **30-1** (350 mg, 0.38 mmol, 36%) and diol **d-30-1** (350 mg, 0.38 mmol, 36 %). **30-1**: R_f = 0.16 (silica, EtOAc:hexanes, 1:4); $[\alpha]^{25}_D$ = –22.45 (*c* = 1.1, $CHCl_3$); IR (film): ν_{max} = 3377brs, 2950m, 2886m, 1455m, 1373m, 1250m, 1194m, 1036s cm^{-1}; ^1H NMR (C_6D_6, 600 MHz): δ = 7.44 (d, *J* = 7.2 Hz, 2 H), 7.36 (d, *J* = 7.2 Hz, 1 H), 7.22 (t, *J* = 7.2 Hz, 2 H), 7.18 (t, *J* = 7.2 Hz, 2 H), 7.11 (t, *J* = 7.2 Hz, 1 H), 7.07 (t, *J* = 7.2 Hz, 1 H), 5.80 (s, 1 H), 5.04 (s, 1 H), 4.94 (s, 1 H), 4.90 (s, 1 H), 4.78 – 4.76 (m, 4 H), 4.71 – 4.70 (m, 2 H), 4.62 – 4.60 (m, 2 H), 4.58 (d, *J* = 12.0 Hz, 1 H), 4.57 (s, 1 H), 4.41 (d, *J* = 12.0 Hz, 1 H), 4.34 (d, *J* = 12.0 Hz, 1 H), 4.33 (d, *J* = 6.6 Hz, 1 H), 4.30 (d, *J* = 6.6 Hz, 1 H), 4.22 (d, *J* = 10.8 Hz, 1 H), 4.19 (s, 1 H), 4.16 (d, *J* = 10.8 Hz, 1 H), 3.98 (d, *J* = 10.2 Hz, 1 H), 3.97 (s, 1 H), 3.76 (dt, *J* = 8.4, 7.8 Hz, 1 H), 3.58 (dt, *J* = 8.4, 7.8 Hz, 1 H), 2.88 (t, *J* = 9.0 Hz, 1 H), 2.36 (m, 1 H), 2.30 – 2.24 (m, 3 H), 2.22 – 2.20 (m, 2 H), 2.16 – 2.03 (m, 5 H), 2.00 (s, 1 H), 1.92 (dd, *J* = 12.6, 6.6 Hz, 1 H), 1.86 (t, *J* = 9.0 Hz, 1 H), 1.80 – 1.79 (m, 2 H), 1.75 (s, 3 H), 1.64 – 1.59 (m, 2 H), 1.51 (t, *J* = 9.6 Hz, 1 H), 1.43 (s, 3 H), 1.36 (s, 3 H), 1.31 (s, 3 H), 1.18 (s, 3 H), 0.98 (t, *J* = 8.4 Hz, 2 H), 0.01 (s, 9 H) ppm; ^{13}C NMR (C_6D_6, 150 MHz): δ = 151.39, 144.40, 138.85, 138.03, 128.72, 127.45, 111.75, 97.82, 95.01, 94.80, 92.08, 83.19, 73.90, 72.47, 71.21, 70.36, 69.79, 69.42, 66.65, 61.70, 61.28, 57.04, 54.33, 52.60, 51.11, 50.17, 46.99, 44.85, 32.42, 31.54, 30.29, 30.20, 29.97, 26.79, 25.77, 25.11, 24.73, 23.95, 23.66, 21.03, 18.31, –1.32 ppm; HRMS calcd for $C_{55}H_{82}O_{10}SiNa^+$ [*M*+Na^+]



d-30-1

953.5569 found 953.5555. **d-30-1**: R_f = 0.19 (silica, EtOAc:hexanes, 1:4); $[\alpha]^{25}_D$ = –27.43 (*c* = 1.2, $CHCl_3$); IR (film): ν_{max} = 3380brs, 2948m, 2886m, 1455m, 1373m, 1250m, 1194m, 1036s cm^{-1}; ^1H NMR (C_6D_6, 600 MHz): δ = 7.31 (d, *J* = 7.2 Hz, 4 H), 7.19 – 7.13 (m, 4 H), 7.08 (t, *J* = 7.2 Hz, 1 H), 7.07 (t, *J* = 7.2 Hz, 1 H), 5.80 (s, 1 H), 4.97 (s, 1 H), 4.92 (brs, 1 H), 4.91 (s, 1 H), 4.75 (d, *J* = 7.2 Hz, 2 H), 4.73 (d, *J* = 7.2 Hz, 2 H), 4.69 (d, *J* = 12.6 Hz, 1 H), 4.68 (d, *J* = 6.6 Hz, 1 H), 4.62 (s, 1 H), 4.60 (d, *J* = 6.6 Hz, 1 H), 4.55 (d, *J* = 6.6 Hz, 1 H), 4.50 (brs, 1 H), 4.42 (d, *J* = 12.0 Hz, 1 H), 4.38 (d, *J* = 12.0 Hz, 1 H), 4.32 (s, 2 H), 4.30 (d, *J* = 10.8 Hz, 1 H), 4.25 (d, *J* = 12.0 Hz, 1 H), 4.19 (t, *J* = 3.0 Hz, 1 H), 4.13 (d, *J* = 10.8 Hz, 1 H), 4.10 (d, *J* = 10.8 Hz, 1 H), 3.86 (s, 1 H), 3.77 (dt, *J* = 8.4, 7.8 Hz, 1 H), 3.58 (dt, *J* = 8.4, 7.8 Hz, 1 H), 3.47 (t, *J* = 8.4 Hz, 1 H), 2.53 (d, *J* = 3.6 Hz, 1 H), 2.33 – 2.30 (m, 2 H), 2.24 – 2.14 (m, 7 H), 2.04 – 1.90 (m, 3 H), 1.88 – 1.84 (m, 3 H), 1.78 (s, 3 H), 1.75 (dd, *J* = 9.6, 1.8 Hz, 1 H), 1.66 – 1.60 (m, 3 H), 1.47 (s, 6 H), 1.45 (s, 3 H), 1.25 (s, 3 H), 1.00 (t, *J* = 7.8 Hz, 1 H), 0.01 (s, 9 H) ppm; ^{13}C NMR (C_6D_6, 150 MHz): δ = 148.63, 144.46, 139.07, 138.11, 128.67, 128.53, 128.46, 127.72, 127.67, 127.49, 126.23, 111.70, 97.97, 97.84, 95.90, 94.83, 91.85, 83.28, 73.98, 71.25, 69.84, 69.55, 66.61, 66.60, 61.42, 56.79, 54.48, 52.96, 51.73, 50.00, 46.53, 45.82, 44.13, 32.41, 31.34, 30.79, 30.39, 29.95, 26.99, 26.09, 25.12, 24.74, 24.15, 23.76, 20.91, 18.30, –1.32 ppm; HRMS calcd for $C_{55}H_{82}O_{10}SiNa^+$ [*M*+Na^+] 953.5569. found 953.5570.

Hydroxy carbonate 30-2: To a stirred solution of diol **30-1** (196 mg, 0.21 mmol) in CH_2Cl_2 (2.4 mL) at 25 °C was added imidazole (4.0 equiv, 57 mg, 0.84 mmol) and TESCl (2.0 equiv, 71 μL, 0.42 mmol). The resulting mixture was stirred at this temperature for 30 min, diluted with Et_2O (10 mL) and quenched with saturated aqueous $NaHCO_3$ solution (5 mL). The organic layer was separated, and the aqueous layer was extracted with Et_2O (10 mL). The combined organics were washed with brine (5 mL), dried ($MgSO_4$), and concentrated under reduced pressure. The residue was subjected to flash column chromatography (silica, Et_2O/hexanes, 5→12 %) to afford the corresponding

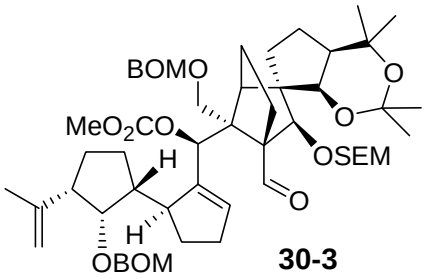


30-2

TES ether. To a solution of this TES ether (215 mg, 0.205 mmol) in THF (3.2 mL) at –50 °C was added KHMDS (2.5 equiv, 0.5 M in PhMe, 1.03 mL, 0.52 mmol). After 5 min, $ClCO_2Me$ (3.0 equiv, 48 μL, 0.61 mmol) and Et_3N (3.0 equiv, 86 μL, 0.61 mmol) were added, respectively. The cooling bath was removed and the reaction mixture was stirred at room temperature for 20 min. The reaction mixture was quenched with saturated aqueous NH_4Cl solution (10 mL) and extracted with Et_2O (2 × 15 mL). The combined organics were washed with brine (5 mL), dried with $MgSO_4$, and concentrated under reduced pressure. To the crude residue in pyridine (1.0 mL) at 0 °C was added 70 % HF•py (0.2 mL). The reaction mixture was stirred at room temperature for 12 h, diluted with Et_2O (15 mL) and quenched slowly with saturated aqueous $NaHCO_3$ (10 mL). The organic layer was separated, and the aqueous layer was extracted with Et_2O (10 mL). The combined organics were washed with brine (5 mL), dried ($MgSO_4$), and concentrated under reduced pressure. The residue was subjected to flash column chromatography (silica, EtOAc/hexanes, 5→17 %) to furnish hydroxy carbonate **30-2** (80 mg, 0.81 mmol, 84 % for three steps). **30-2**: R_f = 0.25 (silica, EtOAc:hexanes, 1:4); $[\alpha]^{25}_D$ = –27.0 (*c* = 1.0, $CHCl_3$); IR (film): ν_{max} = 3443brs, 2950s, 2886s, 1746s, 1441w, 1374m, 1269m, 1195m, 1027s cm^{-1}; ^1H NMR (C_6D_6, 600 MHz): δ = 7.49 (d, *J* = 7.2 Hz, 2 H), 7.40 (d, *J* = 7.2 Hz, 2 H), 7.21 (t, *J* = 7.2 Hz, 2 H), 7.20 (d, *J* = 7.2 Hz, 2 H), 7.11 – 7.05 (m, 2 H), 6.10 (s, 1 H), 5.91 (s, 1 H), 4.89 (d, *J* = 7.2 Hz, 1 H), 4.81 (d, *J* = 12.6 Hz, 1 H), 4.80 – 4.72 (m, 2 H), 4.73 (d, *J* = 6.6 Hz, 1 H), 4.66 – 4.63 (m, 3 H), 4.60 (d, *J* = 13.8 Hz, 1 H), 4.52 (s, 2 H), 4.31 (s, 1 H), 4.21 (s, 1 H), 4.18 (d, *J* = 11.4 Hz, 1 H), 4.06 (d, *J* = 12.0 Hz, 1 H), 4.00 (d, *J* = 11.4 Hz, 1 H), 3.75 (dd, *J* = 12.0, 9.0 Hz, 1 H), 3.67 (dt, *J* = 8.4, 7.8 Hz, 1 H), 3.56 (*J* = 8.4, 7.8 Hz, 1 H), 3.41 (brs, 1 H), 3.35 (s, 3 H), 2.97 (t, *J* = 7.8 Hz, 1 H), 2.69 (m, 1 H), 2.60 (d, *J* = 3.6 Hz, 1 H), 2.56 (dt, *J* = 13.2, 1.8 Hz, 1 H), 2.46 (m, 1 H), 2.30 – 2.10 (m, 7 H), 1.99 (dd, *J* = 10.8, 6.0 Hz, 1 H), 1.95 – 1.80 (m, 5 H), 1.74 (s, 3 H), 1.64 – 1.62 (m, 2 H), 1.44 (s, 3 H), 1.38 (s, 3 H), 1.35 (s, 3 H), 1.24 (s, 3 H), 0.94 (t, *J* = 8.4 Hz, 2 H), –0.04 (s, 9 H) ppm; ^{13}C NMR (C_6D_6, 150 MHz): δ = 155.82, 148.53, 144.45, 139.08, 138.77, 128.63, 128.53, 127.56, 127.46, 111.73, 97.94, 97.79, 95.54, 95.31, 89.67, 83.50, 78.91, 74.14, 71.40, 70.26, 69.99, 67.43, 66.80, 61.66, 61.48, 58.24, 54.39, 54.17, 51.95, 51.28, 49.65,

45.84, 45.74, 43.83, 32.34, 32.18, 30.52, 29.79, 29.49, 26.64, 25.86, 25.12, 24.43, 24.02, 23.65, 22.71, 18.30, –1.37 ppm; HRMS calcd for $C_{57}H_{84}O_{12}SiNa^+$ [M+Na^+] 1011.5624. found 1011.5613.

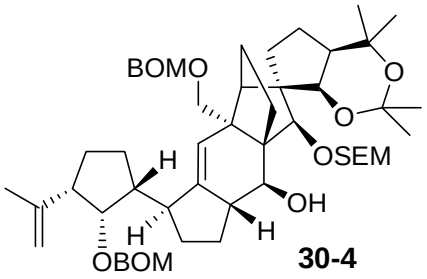
Aldehyde carbonate 30-3: To a stirred solution of hydroxy carbonate **30-3** (102 mg, 0.103 mmol) in CH_2Cl_2 (1.0 mL) at 25 °C was added $PhI(OAc)_2$ (3.0 equiv, 0.1 g, 0.31 mmol) and TEMPO (2.0 equiv, 32 mg, 0.21 mmol). The resulting mixture was stirred for 16 h and then quenched with a mixture of saturated aqueous solution of $NaHCO_3$ (5 mL) and $Na_2S_2O_3$ (5 mL). The resulting mixture was extracted with Et_2O (2 × 15 mL), dried ($MgSO_4$), and concentrated in vacuo. The crude residue was purified by flash column chromatography (silica, EtOAc/hexanes, 9→11 %) to furnish aldehyde carbonate **30-3** (97 mg, 0.098 mmol, 95 %). **30-3**: R_f = 0.32 (silica, EtOAc:hexanes, 1:5); $[\alpha]^{25}_D$ = –50.6 (*c* = 1.0, $CHCl_3$); IR (film): ν_{max} = 2951s, 1751s, 1441w, 1373m, 1266m, 1195m, 1039s cm^{-1}; ^1H NMR (C_6D_6, 600 MHz): δ = 9.87 (s, 1 H), 7.48 (d, *J* = 7.2 Hz, 2 H), 7.38 (d, *J* = 7.2 Hz, 2 H), 7.21 (t, *J* = 7.2 Hz, 4 H), 7.12 (t, *J* = 7.2 Hz, 1 H), 7.06 (t, *J* = 7.2 Hz, 1 H), 6.05 (s, 1 H), 5.75 (s, 1 H), 4.85 (s, 2 H), 4.81 (d, *J* = 12.0 Hz, 1 H), 4.74 (d, *J* = 7.2 Hz, 1 H), 4.68 (d, *J* = 7.2 Hz, 1 H), 4.65 (d, *J* = 12.6 Hz, 1 H), 4.61 (d, *J* = 12.6 Hz, 1 H), 4.55 (s, 1 H), 4.49 (d, *J* = 6.6 Hz, 1 H), 4.44 (d, *J* = 12.6 Hz, 1 H), 4.41 – 4.38 (m, 3 H), 4.32 (s, 1 H), 4.19 (s, 1 H), 4.09 (d, *J* = 11.4 Hz, 1 H), 3.90 (d, *J* = 11.4 Hz, 1 H), 3.64 (m, 1 H), 3.38 (s, 3 H), 3.34 (m, 1 H), 2.95 (t, *J* = 7.8 Hz, 1 H), 2.86 (d, *J* = 3.0 Hz, 1 H), 2.79 (dt, *J* = 13.8, 3.6 Hz, 1 H), 2.60 – 2.48 (m, 3 H), 2.44 (t, *J* = 13.8 Hz, 1 H), 2.29 – 2.24 (m, 2 H), 2.20 – 2.08 (m, 4 H), 1.98 (m, 1 H), 1.92 – 1.85 (m, 3 H), 1.80 (m, 1 H), 1.72 (s, 3 H), 1.72 – 1.68 (m, 2 H), 1.59 (m, 1 H), 1.38 (s, 3 H), 1.37 (s, 3 H), 1.30 (s, 3 H), 1.21 (s, 3 H), 0.98 – 0.94 (m, 2 H), 0.01 (s, 9 H) ppm; ^{13}C NMR (C_6D_6, 150 MHz): δ = 199.97, 155.21, 155.21, 148.20, 144.36, 139.21, 138.83, 128.69, 128.53, 127.53, 125.52, 111.77, 98.10, 96.73, 96.00, 95.44, 89.68, 83.49, 77.58, 73.93, 77.57, 73.93, 71.37, 70.64, 70.00, 69.38, 66.82, 66.39, 63.62, 56.96, 54.63, 51.30, 50.89,



30-3

49.60, 46.15, 45.71, 42.49, 32.16, 31.91, 30.53, 29.52, 27.00, 25.81, 24.96, 24.21, 23.97, 23.62, 19.30, 17.94, –1.34 ppm; HRMS calcd for $C_{57}H_{82}O_{12}SiNa^+$ [M+Na^+] 1009.5567. found 1009.5462.

Hydroxy olefin 30-4: To a pre-mixed solution of SmI_2 (4.0 equiv, 0.1 M in THF, 4.9 mL, .049 mmol) and HMPA (12.0 equiv, 0.25 mL, 1.47 mmol) at –10 °C was added dropwise a solution of **30-3** (120 mg, 0.122 mmol) in THF (8 mL). The reaction mixture was stirred at that temperature for 40 min before being quenched with saturated aqueous NH_4Cl (10 mL). The organic layer was separated and washed with H_2O (10 mL) and dried over $MgSO_4$. The filtrate was concentrated under reduced pressure and the crude residue was subjected to flash column chromatography (silica, EtOAc/hexanes, 5→11 %) to furnish hydroxy olefin **30-4** (82 mg, 0.090 mmol, 74 %).

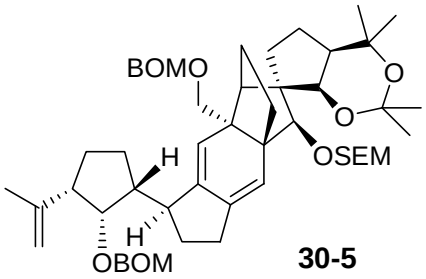


30-4

30-4: R_f = 0.27 (silica, EtOAc:CH_2Cl_2, 1:5); $[\alpha]^{25}_D$ = –7.35 (c = 1.4, $CHCl_3$); IR (film): ν_{max} = 3480brs, 2948s, 2875m, 1454w, 1372m, 1251m, 1195m, 1026s cm^{-1}; ^1H NMR (C_6D_6, 600 MHz): δ = 7.34 (d, J = 7.2 Hz, 2 H), 7.28 (d, J = 7.2 Hz, 2 H), 7.15 (m, 4 H), 7.07 (t, J = 7.2 Hz, 1 H), 7.05 (t, J = 7.2 Hz, 1 H), 5.77 (d, J = 1.8 Hz, 1 H), 4.96 (s, 1 H), 4.92 (s, 1 H), 4.67 (d, J = 5.4 Hz, 1 H), 4.63 (d, J = 7.2 Hz, 1 H), 4.63 (d, J = 6.6 Hz, 1 H), 4.61 (d, J = 7.2 Hz, 1 H), 4.59 (d, J = 6.6 Hz, 1 H), 4.57 – 4.56 (m, 2 H), 4.54 (s, 1 H), 4.53 (s, 1 H), 4.52 (d, J = 6.0 Hz, 1 H), 4.46 (d, J = 11.4 Hz, 1 H), 4.21 (d, J = 7.2 Hz, 1 H), 4.12 (s, 1 H), 3.96 (t, J = 3.0 Hz, 1 H), 3.80 (s, 1 H), 3.65 (d, J = 9.6 Hz, 1 H), 3.60 (m, 1 H), 3.55 (d, J = 9.6 Hz, 1 H), 3.35 (m, 1 H), 2.75 (dt, J = 9.6, 7.2 Hz, 1 H), 2.61 (m, 1 H), 2.56 (d, J = 3.6 Hz, 1 H), 2.53 (m, 1 H), 2.47 – 2.43 (m, 2 H), 2.30 – 2.10 (m, 4 H), 2.01 (dt, J = 12.6, 8.4 Hz, 1 H), 1.94 (t, J = 12.6 Hz, 1 H), 1.78 (s, 3 H), 1.78 – 1.77 (m, 2 H), 1.67 – 1.63 (m, 3 H), 1.57 – 1.56 (m, 2 H), 1.56 (s, 3 H), 1.52 (s, 3 H), 1.48 (s, 3 H), 1.47 (m, 1 H), 1.39 – 1.35 (m, 2 H), 1.28 (s, 3 H), 1.03 – 1.00 (m, 2 H), –0.09 (s, 9 H) ppm; ^{13}C NMR (C_6D_6, 150 MHz): δ = 146.35, 144.79, 139.02, 138.75, 128.53, 127.51, 123.54, 111.33, 98.62, 98.52, 97.95 94.94, 94.70, 80.92, 74.48, 74.14, 73.92, 71.20, 69.66, 69.32, 66.28, 58.40, 57.15,

56.49, 52.51, 51.75, 50.21, 47.60, 46.86, 43.95, 42.24, 32.43, 30.43, 30.36, 30.32, 30.03, 27.46, 26.62, 25.27, 25.13, 24.11, 23.74, 20.16, 18.24, –1.57 ppm; HRMS calcd for $C_{55}H_{80}O_9SiNa^+$ [M+Na^+] 935.5464 found 935.5442.

Triene 30-5: To a solution of alcohol **30-4** (70 mg, 0.077 mmol) in THF (1.5 mL) at 25 °C was added NaH (8.0 equiv, 25 mg, 0.61 mmol, 60 % dispersion in mineral oil) and the reaction mixture was stirred for 20 min. The resulting mixture was cooled to 0 °C, CS_2 (8.0 equiv, 37 μL, 0.61 mmol) was added, and the reaction mixture was stirred for 20 min at that temperature. MeI (12 equiv, 57 μL, 0.92 mmol) was added at 0 °C and the mixture was warmed to 25 °C and stirred for 5 h. The reaction mixture was quenched with saturated aqueous NH_4Cl solution (10 mL), extracted with Et_2O (2 × 20 mL), dried ($MgSO_4$), and concentrated under reduced pressure. To this crude xanthate in 1,2-dichlorobenzene (3 mL) was added several drops of iPr$_2$NEt, followed by microwave irradiation at 185 °C for 15 min. The crude residue was purified directly by flash column chromatography (silica, EtOAc/hexanes, 0→8 %) to furnish triene **30-5** (61 mg, 0.069 mmol, 89 %).

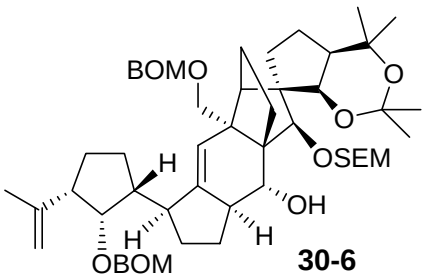


30-5

30-5: R_f = 0.27 (silica, EtOAc:hexanes, 1:5); $[\alpha]^{25}_D$ = +20.2 (c = 1.0, $CHCl_3$); IR (film): ν_{max} = 2948m, 2881m, 1454w, 1372m, 1250m, 1194m, 1046s cm^{-1}; ^{1}H NMR (C_6D_6, 600 MHz: δ = 7.35 (d, J = 7.8 Hz, 2 H), 7.29 (d, J = 7.8 Hz, 2 H), 7.15 (m, 4 H), 7.09 (t, J = 7.8 Hz, 1 H), 7.05 (t, J = 7.8 Hz, 1 H), 6.22 (s, 1 H), 6.20 (s, 1 H), 4.94 (s, 1 H), 4.89 (s, 1 H), 4.72 (d, J = 6.6 Hz, 1 H), 4.70 (d, J = 6.6 Hz, 1 H), 4.68 (d, J = 6.6 Hz, 1 H), 4.67 (d, J = 6.6 Hz, 1 H), 4.62 (d, J = 7.2 Hz, 1 H), 4.59 (s, 2 H), 4.58 (d, J = 7.2 Hz, 1 H), 4.51 (d, J = 14.4 Hz, 1 H), 4.49 (d, J = 12.6 Hz, 1 H), 4.07 (s, 1 H), 3.88 (m, 1 H), 3.81 (d, J = 7.2 Hz, 1 H), 3.80 (d, J = 7.2 Hz, 1 H), 3.52 (m, 1 H), 2.87 (d, J = 2.4 Hz, 1 H), 2.85 (t, J = 8.4 Hz, 1 H), 2.66 (m, 1 H), 2.56 (t, J = 10.8 Hz, 1 H), 2.35 (m, 3 H), 2.20 (m, 1 H), 2.10 (m, 1 H), 2.04 (m, 1 H), 1.86 – 1.80 (m, 2 H), 1.80 – 1.75 (m, 2 H), 1.74 (s, 3 H), 1.72 – 1.58 (m, 6 H), 1.56 (s, 3 H), 1.52 (s, 3 H), 1.48 (s, 3 H), 1.26 (s, 3 H), 1.08 – 1.01 (m, 2 H), 0.01 (s, 9 H) ppm; ^{13}C NMR (C_6D_6, 150 MHz): δ = 144.45, 144.21,

141.34, 138.91, 138.88, 128.50, 126.30, 122.05, 111.60, 97.89, 96.69, 95.21, 94.55, 91.97, 80.59, 74.05, 72.13, 71.34, 69.72, 69.19, 65.87, 57.00, 55.77, 55.30, 52.58, 51.30 ,48.05, 46.70, 43.91, 43.65, 32.50, 32.46, 31.30, 31.68, 30.48, 29.97, 28.30, 27.29, 25.39, 25.11, 24.20, 23.68, 18.28, –1.32 ppm; HRMS calcd for $C_{55}H_{78}O_8SiNa^+$ [M+Na^+] 917.5358 found 917.5353.

Hydroxy diene 30-6: To a solution of triene **30-5** (60 mg, 0.067 mmol) in THF (2 mL) at –10 °C was added thexylborane (5.0 equiv, 0.5 M in THF, 0.67 mL, 0.20 mmol). The reaction mixture was warmed to 25 °C (over 30 min), cooled to 0 °C, and BH_3•THF (15 equiv, 1.0 mL, 1.0 mmol, 1.0 M in THF) was added. The reaction mixture was stirred at 25 °C for 1.5 h, and then cooled to 0 °C. A pre-mixed solution of 30 % H_2O_2/3 N NaOH (1:1, 3.0 mL) was then added, followed by the addition of THF (3 mL). The reaction mixture was heated at 45 °C (30 min), cooled to 25 °C, and then quenched with saturated aqueous NH_4Cl solution (5 mL). The resulting mixture was extracted with EtOAc (2 × 20 mL), washed with brine (10 mL), dried ($MgSO_4$), and concentrated under reduced pressure. The crude residue was purified by flash column chromatography (silica, EtOAc/hexanes, 5→20 %) to afford the corresponding diols (44 mg, 0.047 mmol, 71 %) as a 1.3:1.0 mixture of diastereomers. To a solution of these diols (20 mg, 0.021 mmol) in THF (1.5 mL) at 25 °C was added pyridine (12 equiv, 21 μL, 0.258 mmol), $o$$NO_2C_6H_4SeCN$ (3.0 equiv, 15 mg, 0.064 mmol), and $n$$Bu_3P$ (9.0 equiv, 48 μl, 0.193 mmol). The reaction mixture was stirred at 25 °C for 20 min and then quenched with EtOH (7.5 μL, 0.129 mmol, dissolved in 0.1 mL THF). After 20 min, the reaction mixture was cooled to 0 °C, 35 % H_2O_2 (0.5 mL) was added, and the resulting mixture was stirred at room temperature for 30 min. The reaction mixture was diluted with H_2O (10 mL) and extracted with EtOAc (2 × 10 mL). The combined organics were washed with brine (5 mL), dried ($MgSO_4$), and concentrated under reduced pressure. The residue was taken up in THF (2 mL) and pyridine (3 drops) was added. The reaction mixture was heated to 45 °C for 1 h, cooled to 25 °C, diluted with H_2O (10 mL), and extracted with Et_2O (2 × 15 mL).

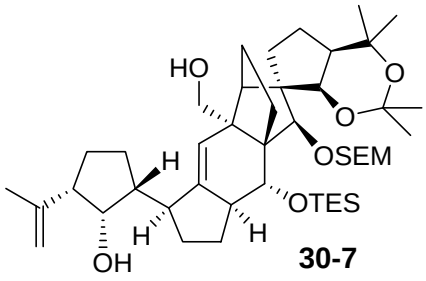


30-6

The combined organics were washed with brine (5 mL), dried ($MgSO_4$), and subjected to flash column chromatography (silica, EtOAc/hexanes, 5→11 %) to furnish hydroxy diene **30-6** (14 mg, 0.015 mmol, 70 %). **30-6:** R_f = 0.33 (silica, EtOAc:hexanes, 1:5); $[\alpha]^{25}_D$ = –8.30 (*c* = 1.0, $CHCl_3$); IR (film): ν_{max} = 3476brs, 2948m, 2870m, 1454w, 1373w, 1251w, 1195m, 1100m, 1039s cm^{-1}; ^1H NMR (C_6D_6, 600 MHz): δ = 7.37 (d, *J* = 7.2 Hz, 2 H), 7.31 (d, *J* = 7.2 Hz, 1 H), 7.17 – 7.15 (m, 4 H), 7.09 (t, *J* = 7.2 Hz, 1 H), 7.05 (t, *J* = 7.2 Hz, 1 H), 6.12 (s, 1 H), 4.95 (s, 1 H), 4.89 (s, 1 H), 4.75 (d, *J* = 6.6 Hz, 1 H), 4.73 (d, *J* = 6.6 Hz, 1 H), 4.67 (d, *J* = 6.6 Hz, 1 H), 4.62 (d, *J* = 7.8 Hz, 1 H), 4.60 (d, *J* = 7.8 Hz, 1 H), 4.58 – 4.55 (m, 3 H), 4.51 (d, *J* = 9.0 Hz, 1 H), 4.49 (d, *J* = 12.6 Hz, 1 H), 4.25 (d, *J* = 10.2 Hz, 1 H), 4.23 (s, 1 H), 4.17 (s, 1 H), 4.10 (s, 1 H), 4.05 (d, *J* = 10.2 Hz, 1 H), 3.94 (s, 1 H), 3.88 (m, 1 H), 3.30 (m, 1 H), 2.88 – 2.83 (m, 2 H), 2.82 (d, *J* = 3.0 Hz, 1 H), 2.64 (t, *J* = 12.0 Hz, 1 H), 2.28 (m, 1 H), 2.23 – 2.19 (m, 2 H), 2.16 – 2.10 (m, 2 H), 2.05 (t, *J* = 8.4 Hz, 1 H), 1.93 – 1.88 (m, 2 H), 1.82 – 1.72 (m, 4 H), 1.74 (s, 3 H), 1.63 – 1.58 (m, 2 H), 1.57 (s, 3 H), 1.54 (m, 1 H), 1.51 (s, 3 H), 1.47 (m, 1 H), 1.44 (s, 3 H), 1.27 (s, 3 H), 1.24 (t, *J* = 11.4 Hz, 1 H), 1.03 (t, *J* = 6.0 Hz, 1 H), 1.02 (t, *J* = 6.0 Hz, 1 H), –0.04 (s, 9 H) ppm; ^{13}C NMR (C_6D_6, 150 MHz): δ = 145.68, 144.41, 138.97, 128.49, 127.56, 127.52, 125.11, 111.62, 97.96, 97.40, 95.23, 94.62, 92.00, 81.76, 74.01, 72.73, 71.34, 70.98, 69.75, 69.40, 66.37, 59.73, 56.03, 54.61, 51.97, 51.84, 50.04, 49.88, 46.82, 43.51, 42.21, 32.36, 31.88, 31.42, 30.58, 29.82, 27.63, 25.61, 25.28, 25.13, 24.21, 23.74, 17.94, –1.52 ppm; HRMS calcd for $C_{55}H_{82}O_{10}SiNa^+$ [*M*+Na^+] 935.5464 found 935.5465.

Diol 30-7: To a solution of hydroxy diene **30-6** (20 mg, 0.022 mmol) in THF (1.0 mL) at –50 °C was added KHMDS (6.0 equiv, 0.5 M in PhMe, 0.26 mL, 0.131 mmol). The reaction mixture was stirred at –50 °C for 5 min before TESCl (4.0 equiv, 15 μL, 0.088 mmol) and Et_3N (8.0 equiv, 25 μL, 0.175 mmol) were added. The cooling bath was removed, and the reaction mixture was stirred at 25 °C for 20 min. The resulting mixture was quenched with saturated aqueous NH_4Cl solution (4 mL) and extracted with Et_2O (2 × 10 mL). The organic layer was washed with brine (10 mL), dried ($MgSO_4$), and subjected to flash column chromatography (silica,

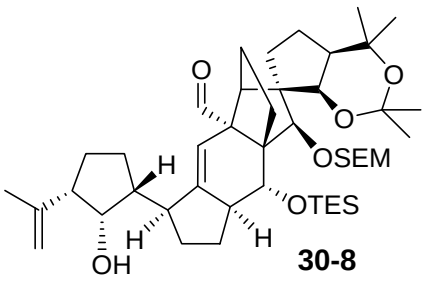
EtOAc/hexanes, 2→8 %) to furnish the corresponding TES ether (21 mg, 94 %). To a solution of this TES ether in THF (1.0 mL) at –78 °C was added LiDBB (~1.0 M in THF, freshly prepared) dropwise until the reaction mixture assumed a persistent dark green color. The reaction mixture was allowed to warm up to –50 °C (30 min), during which time LiDBB was constantly added to maintain the solution color as dark green. The reaction mixture was quenched at –50 °C with saturated aqueous NH_4Cl solution (1 mL), extracted with Et_2O (2 × 10 mL), dried ($MgSO_4$), and concentrated under reduced pressure. The crude residue was dissolved in CH_2Cl_2 (5 mL) and silica (1.0 g) was added. The mixture was stirred at 25 °C for 30 min (to fully hydrolyze the intermediate hemiacetals), and then directly purified by flash column chromatography (silica, CH_2Cl_2 first to remove DBB, then switch to EtOAc/hexanes, 2→14 %) to afford diol **30-7** (14 mg, 82 % for two steps).



30-7

30-7: R_f = 0.30 (silica, EtOAc:hexanes, 1:4); $[\alpha]^{25}_D$ = +1.1 (*c* = 1.0, $CHCl_3$); IR (film): ν_{max} = 3466brs, 2953m, 2876m, 1643w, 1458w, 1372m, 1249m, 1195m, 1062s cm^{-1}; ^1H NMR (C_6D_6, 500 MHz): δ = 5.81 (t, *J* = 2.0 Hz, 1 H), 4.88 (s, 1 H), 4.86 (d, *J* = 6.0 Hz, 1 H), 4.81 (d, *J* = 6.0 Hz, 1 H), 4.80 (s, 1 H), 4.66 (d, *J* = 2.5 Hz, 1 H), 4.35 (d, *J* = 1.5 Hz, 1 H), 4.14 (s, 1 H), 4.10 (d, *J* = 11.5 Hz, 1 H), 3.91 – 3.87 (m, 2 H), 3.81 – 3.73 (m, 2 H), 2.80 (q, *J* = 8.0 Hz, 1 H), 2.62 (dt, *J* = 9.0, 2.0 Hz, 1 H), 2.50 – 2.45 (m, 1 H), 2.47 (d, *J* = 4.0 Hz, 1 H), 2.25 – 2.00 (m, 8 H), 1.94 – 1.87 (m, 2 H), 1.80 – 1.63 (m, 4 H), 1.61 (s, 3 H), 1.58 (m, 1 H), 1.57 (s, 3 H), 1.56 (s, 3 H), 1.55 (s, 3 H), 1.46 (m, 1 H), 1.30 (s, 3 H), 1.19 (t, *J* = 12.0 Hz, 1 H), 1.04 (t, *J* = 8.0 Hz, 9 H), 1.03 (m, 2 H), 0.71 (q, *J* = 8.0 Hz, 6 H), 0.02 (s, 9 H) ppm; ^{13}C NMR (C_6D_6, 150 MHz): δ = 146.39, 144.16, 121.60, 112.10, 97.82, 96.01, 88.71, 74.31, 74.22, 74.11, 71.48, 66.61, 65.89, 58.25, 56.17, 55.13, 52.56, 51.22, 49.72, 48.65, 46.44, 44.42, 44.22, 32.50, 30.70, 30.59, 30.06, 29.46, 28.71, 25.62, 25.38, 25.25, 24.27, 23.70, 23.31, 18.49, 7.47, 5.92, –1.30 ppm; HRMS calcd for $C_{45}H_{78}O_7Si_2Na^+$ [*M*+Na^+] 809.5178 found 809.5176.

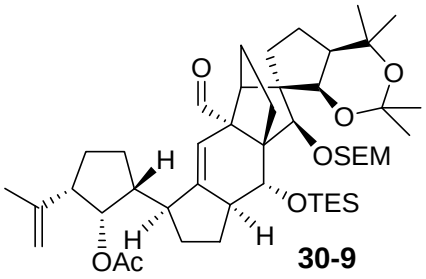
Hydroxy aldehyde 30-8: To a solution of diol **30-7** (13 mg, 0.0165 mmol) in CH_2Cl_2 (0.8 mL) at 25 °C was added $PhI(OAc)_2$ (3.0 equiv, 16 mg, 0.05 mmol) and TEMPO (1.0 equiv, 2.6 mg, 0.0165 mmol). The reaction mixture was stirred at 25 °C for 12 h and then quenched with saturated aqueous solutions of $Na_2S_2O_3$ (1 mL) and $NaHCO_3$ (1 mL). The resulting mixture was extracted with Et_2O (2 × 5 mL), dried ($MgSO_4$), and concentrated under reduced pressure. The crude residue was purified by flash column chromatography (silica, EtOAc/hexanes, 3→5 %) to afford the corresponding hydroxy aldehyde **30-8** (12 mg, 0.0153 mmol, 92 %). **30-8**: R_f = 0.30 (silica, EtOAc:hexanes, 1:9); $[\alpha]^{25}_D$ = +118.5 (*c* = 0.8, $CHCl_3$); IR (film): ν_{max} = 3534brs, 2953m, 2881s, 1703s, 1456w, 1373m, 1249m, 1059s cm^{-1}; ^1H NMR (C_6D_6, 600 MHz): δ = 10.47 (s, 1 H), 5.55 (s, 1 H), 4.89 (d, *J* = 6.0 Hz, 1 H), 4.86 (s, 1 H), 4.83 (d, *J* = 6.0 Hz, 1 H), 4.76 (s, 1 H), 4.67 (d, *J* = 3.0 Hz, 1 H), 4.37 (s, 1 H), 4.26 (s, 1 H), 3.83 (s, 1 H), 3.77 (d, *J* = 7.8 Hz, 1 H), 3.75 (d, *J* = 7.8 Hz, 1 H), 2.93 (d, *J* = 3.6 Hz, 1 H), 2.74 (dd, *J* = 16.2, 8.4 Hz, 1 H), 2.63 (t, *J* = 8.4 Hz, 1 H), 2.49 (m, 1 H), 2.24 (m, 1 H), 2.19 – 2.09 (m, 5 H), 2.04 (m, 1 H), 1.88 (m, 1 H), 1.80 (m, 1 H), 1.75 – 1.68 (m, 4 H), 1.58 (s, 3 H), 1.55 (s, 3 H), 1.53 (s, 3 H), 1.49 (s, 3 H), 1.47 – 1.43 (m, 2 H), 1.29 (s, 3 H), 1.21 (t, *J* = 11.4 Hz, 1 H), 1.01 (t, *J* = 7.8 Hz, 9 H), 1.00 (m, 2 H), 0.69 – 0.64 (m, 6 H), 0.01 (s, 9 H) ppm; ^{13}C NMR (C_6D_6, 150 MHz): δ = 199.86, 151.13, 143.97, 115.18, 112.21, 98.06, 96.01, 87.47, 74.01, 73.86, 73.39, 71.81, 66.70, 66.11, 58.55, 56.95, 52.52, 49.73, 49.69, 48.05, 46.59, 44.76, 43.79, 32.09, 31.13, 30.08, 29.09, 28.98, 28.49, 25.54, 24.51, 24.41, 23.67, 22.66, 18.48, 7.43, 5.94, –1.34 ppm; HRMS calcd for $C_{45}H_{76}O_7Si_2Na^+$ [*M*+Na^+] 807.5021 found 807.5020.



30-8

Acetoxy aldehyde 30-9: To a solution of hydroxy aldehyde **30-8** (11 mg, 0.014 mmol) in CH_2Cl_2 (0.8 mL) at 25 °C was added Et_3N (90 equiv, 177 μL, 1.26 mmol), 4–DMAP (1 crystal), and Ac_2O (30 equiv, 39 μL, 0.042 mmol). The reaction mixture was stirred for 12 h and then quenched with saturated aqueous $NaHCO_3$ solution (10 mL). The resulting mixture was

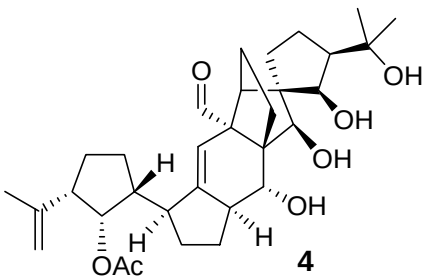
extracted with Et_2O (2 × 10 mL), washed with brine (5 mL), dried ($MgSO_4$), and concentrated under reduced pressure. The crude residue was purified by flash column chromatography (silica, EtOAc/hexanes, 2→5 %) to afford acetoxy aldehyde **30-9** (11 mg, 100 %).



30-9

30-9: R_f = 0.47 (silica, EtOAc:hexanes, 1:9); $[\alpha]^{25}_D$ = +139.4 (*c* = 0.7, $CHCl_3$); IR (film): ν_{max} = 2953s, 2875s, 1739s, 1704s, 1458w, 1371s, 1247s, 1064s cm^{-1}; ^1H NMR (C_6D_6, 600 MHz): δ = 10.55 (s, 1 H), 5.66 (s, 1 H), 5.55 (t, *J* = 3.6 Hz, 1 H), 5.01 (s, 1 H), 4.97 (d, *J* = 6.6 Hz, 1 H), 4.93 (s, 1 H), 4.91 (d, *J* = 6.6 Hz, 1 H), 4.77 (d, *J* = 2.4 Hz, 1 H), 4.47 (s, 1 H), 4.31 (s, 1 H), 3.86 (t, *J* = 8.4 Hz, 2 H), 2.99 (d, *J* = 3.6 Hz, 1 H), 2.64 (t, *J* = 10.2 Hz, 1 H), 2.54 (m, 2 H), 2.33 (m, 1 H), 2.26 – 2.18 (m, 3 H), 2.14 – 2.10 (m, 2 H), 2.02 (m, 1 H), 1.96 (s, 3 H), 1.95 (m, 1 H), 1.82 (s, 3 H), 1.85 – 1.75 (m, 4 H), 1.69 (m, 2 H), 1.65 (s, 3 H), 1.62 (s, 3 H), 1.59 (s, 3 H), 1.48 (m, 1 H), 1.40 (m, 1 H), 1.37 (s, 3 H), 1.20 (t, *J* = 12.6 Hz, 1 H), 1.09 (t, *J* = 8.4 Hz, 9 H), 1.08 (m, 2 H), 0.77 – 0.72 (m, 6 H), 0.10 (s, 9 H) ppm; ^{13}C NMR (C_6D_6, 150 MHz): δ = 199.86, 169.40, 150.10, 143.63, 116.47, 111.23, 98.07, 97.63, 87.32, 77.11, 73.79, 71.77, 66.73, 58.69, 56.99, 51.31, 50.32, 50.01, 47.23, 46.58, 44.04, 43.83, 30.10, 30.29, 29.17, 28.42, 26.26, 25.22, 24.48, 24.06, 22.86, 7.42, 5.94, –1.35 ppm; HRMS calcd for $C_{457}H_{78}O_8Si_2Na^+$ [*M*+Na^+] 849.5127 found 849.5125.

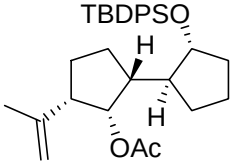
Vannusal B structure 4: To a solution of acetoxy aldehyde **30-9** (10 mg, 0.0095 mmol) in a mixture of THF (1 mL) and CH_3CN (1 mL) at 25 °C was added aqueous HF (48 % in H_2O, 60 µL). The reaction mixture was stirred at that temperature for 1 h before a second aliquot of aqueous HF (48 % in H_2O, 250 µL) was added, and the reaction mixture was stirred for another 6 h. The reaction mixture was diluted with EtOAc (20 mL), and quenched carefully with saturated aqueous $NaHCO_3$ (20 mL). The organic layer was separated and the aqueous layer was extracted with EtOAc (15 mL). The combined organics were dried over $MgSO_4$, and concentrated in vacuo. The residue



4

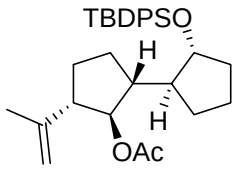
was subjected to flash column chromatography (silica, acetone/hexanes, 20→30 %) to furnish the desired vannusal B structure **4** (4 mg, 60 %) and mono–SEM protected intermediate (2.5 mg, 30 %). This intermediate was subjected to deprotection again under the above conditions to afford an additional amount of **4** (1.0 mg, 75% overall yield). **4**: R_f = 0.20 (silica, acetone:hexanes, 1:2); $[\alpha]^{25}_D$ = +34.5 (*c* = 0.2, MeOH); IR (film): ν_{max} = 3418brs, 2956s, 2870w, 1737s, 1683m, 1373m, 1231s, 1067m cm^{-1}; ^1H NMR: (CD_3OD, 500 MHz) δ = 9.54 (s, 1 H), 5.58 (t, *J* = 1.5 Hz, 1 H), 5.46 (t, *J* = 3.5 Hz, 1 H), 4.83 (s, 1 H), 4.77 (s, 1 H), 4.41 (d, *J* = 3.5 Hz, 1 H), 4.05 (d, *J* = 1.5 Hz, 1 H), 3.59 (d, *J* = 2.5 Hz, 1 H), 2.51 (t, *J* = 9.0 Hz, 1 H), 2.50 (d, *J* = 4.0 Hz, 1 H), 2.46 – 2.42 (m, 2 H), 2.22 – 2.10 (m, 4 H), 2.10 – 1.98 (m, 4 H), 1.97 (s, 3 H), 1.87 – 1.79 (m, 2 H), 1.79 (m, 1 H), 1.77 (s, 3 H), 1.75 – 1.68 (m, 2 H), 1.68 – 1.58 (m, 4 H), 1.48 (m, 1 H), 1.38 (s, 3 H), 1.37 – 1.32 (m, 2 H), 1.15 (s, 3 H), 0.92 (dt, *J* = 12.0, 3.0 Hz, 1 H) ppm; ^{13}C NMR (CD_3OD, 150 MHz): δ = 201.13, 172.32, 157.85, 144.87, 114.43, 111.64, 78.71, 78.30, 77.79, 73.75, 73.41, 69.40, 59.11, 58.73, 53.26, 52.73, 52.25, 51.96, 48.42, 45.37, 40.37, 31.58, 31.19, 30.08, 29.78, 29.11, 26.89, 25.14, 24.48, 24.17, 23.37, 21.07 ppm; HRMS calcd for $C_{32}H_{46}O_7H^+$ [*M*+H^+] 543.3316 found 543.3314.

Model compound 31a: R_f = 0.65 (silica, Et_2O:hexanes, 2:8); $[\alpha]^{25}_D$ = +10.90 (*c* = 2.2, $CHCl_3$); IR (film): ν_{max} = 2958s, 2857s, 1737s, 1472w, 1427m, 1239s, 1196s, 1110s cm^{-1}; ^1H NMR (C_6D_6, 500 MHz): δ = 7.80 (m, 4 H), 7.22 (m, 6 H), 5.43 (t, *J* = 3.5 Hz, 1 H), 4.88 (s, 1 H), 4.80 (s, 1 H), 4.08 (m, 1 H), 2.12 – 2.05 (m, 3 H), 1.91 – 1.82 (m, 2 H), 1.81 (s, 3 H), 1.72 (m, 1 H), 1.71 (s, 3 H), 1.50 – 1.40 (m, 4 H), 1.40 – 1.30 (m, 2 H), 1.25 (dq, *J* = 10.0, 3.5 Hz, 1 H) 1.18 (s, 9 H) ppm; ^{13}C NMR (C_6D_6, 125 MHz): δ = 169.39, 143.91, 136.33, 136.28, 135.08, 134.84, 129.87, 111.00, 79.86, 76.20, 51.31, 49.80, 48.06, 34.76, 29.31, 27.27, 27.21, 26.02, 23.85, 22.89, 20.59, 19.41 ppm; HRMS calcd for $C_{31}H_{42}O_3SiNa^+$ [*M*+Na^+] 513.2795 found 513.2800.



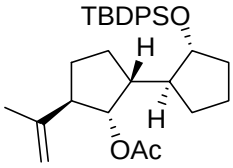
31a

Model compound 31b: R_f = 0.55 (silica, Et_2O:hexanes, 2:8); $[\alpha]^{25}_D$ = +6.50 (*c* = 1.0, $CHCl_3$); IR (film): ν_{max} = 2957s, 2860s, 1737s, 1427w, 1244s, 1110s cm^{-1}; ^1H NMR (C_6D_6, 600 MHz): δ = 7.79 (m, 4 H), 7.21 (m, 6 H), 5.22 (t, *J* = 7.8 Hz, 1 H), 4.87 (s, 1 H), 4.78 (s, 1 H), 4.08 (m, 1 H), 2.47 (dt, *J* = 9.0, 7.8 Hz, 1 H), 2.02 (m, 1 H), 1.96 (m, 1 H), 1.75 (s, 3 H), 1.72 – 1.68 (m, 3 H), 1.65 (s, 3 H), 1.58 (m, 1 H), 1.53 (m, 1 H), 1.50 – 1.36 (m, 4 H), 1.25 (m, 1 H) 1.17 (s, 9 H) ppm; ^{13}C NMR (C_6D_6, 150 MHz): δ = 170.17, 146.04, 136.99, 136.92, 135.80, 135.48, 130.56, 130.50, 112.35, 80.80, 80.38, 54.90, 53.48, 47.28, 35.75, 28.65, 28.53, 27.93, 27.89, 23.65, 21.58, 20.19, 20.07 ppm; HRMS calcd for $C_{31}H_{42}O_3SiH^+$ [*M*+H^+] 491.2976 found 491.2972.



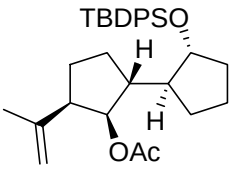
31b

Model compound 31c: R_f = 0.40 (silica, CH_2Cl_2:hexanes, 4:6); $[\alpha]^{25}_D$ = +5.52 (*c* = 1.9, $CHCl_3$); IR (film): ν_{max} = 2957s, 2860s, 1737s, 1427w, 1244s, 1110s cm^{-1}; ^1H NMR (C_6D_6, 500 MHz): δ = 7.80 (m, 4 H), 7.22 (m, 6 H), 5.29 (dd, *J* = 4.5, 2.0 Hz, 1 H), 4.76 (s, 1 H), 4.72 (s, 1 H), 4.08 (dt, *J* = 5.0, 2.5 Hz, 1 H), 2.49 (t, *J* = 6.0 Hz, 1 H), 2.18 (m, 1 H), 2.02 (m, 1 H), 1.79 (m, 2 H), 1.75 (s, 3 H), 1.69 (m, 1 H), 1.68 (s, 3 H), 1.57 (m, 1 H), 1.42 (dd, *J* = 11.0, 5.0 Hz, 1 H), 1.42 – 1.35 (m, 4 H), 1.23 (m, 1 H), 1.18 (s, 9 H) ppm; ^{13}C NMR (C_6D_6, 150 MHz): δ = 169.46, 146.70, 136.32, 136.28, 135.12, 134.85, 129.89, 110.00, 80.22, 79.43, 53.37, 48.75, 47.07, 34.91, 29.42, 28.82, 27.28, 22.86, 22.28, 20.81, 19.42 ppm; HRMS calcd for $C_{31}H_{42}O_3SiNa^+$ [*M*+Na^+] 513.2795 found 513.2799.



31c

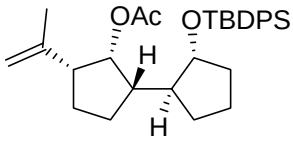
Model compound 31d: R_f = 0.65 (silica, Et_2O:hexanes, 2:8); $[\alpha]^{25}_D$ = +8.31 (*c* = 1.5, $CHCl_3$); IR (film): ν_{max} = 2957s, 2860s, 1737s, 1427w, 1244s, 1110s cm^{-1}; ^1H NMR (C_6D_6, 600 MHz): δ = 7.79 (m, 4 H), 7.21 (m, 6 H), 5.30 (dd, *J* = 5.4, 1.8 Hz, 1 H), 4.89 (s, 1 H), 4.81 (s, 1 H), 4.08 (dt, *J* = 5.4, 3.0 Hz, 1 H), 2.18 (dt, *J* = 12.0, 6.0 Hz, 1 H), 1.99 (m, 1 H), 1.87 (m, 1 H), 1.77 (m, 1 H), 1.76 (s, 3 H), 1.75 – 1.67 (m, 3 H), 1.66 (s, 3 H), 1.61 (m, 1 H), 1.53 – 1.43 (m, 4 H), 1.17 (s, 9 H), 0.93 (m,



31d

1 H) ppm; ^{13}C NMR (C_6D_6, 150 MHz): δ = 169.21, 143.82, 136.34, 136.26, 135.00, 134.87, 129.91, 129.86, 111.69, 79.25, 78.74, 53.05, 50.68, 49.14, 34.77, 28.84, 28.47, 28.34, 27.26, 23.28, 22.84, 20.88, 19.42 ppm; HRMS calcd for $C_{31}H_{42}O_3SiNa^+$ [*M*+Na^+] 513.2795 found 513.2783.

Model compound 31e: R_f = 0.50 (silica, Et_2O:hexanes, 2:8); $[\alpha]^{25}_D$ = +8.31 (*c* = 2.0, $CHCl_3$); IR (film): ν_{max} = 2966s, 2864s, 1736s, 1427w, 1241s, 1111s cm^{-1}; ^{1}H NMR (C_6D_6, 600 MHz): δ = 7.82 (m, 4 H), 7.26 (m, 6 H), 5.41 (t, *J* = 3.6 Hz, 1 H), 4.88 (s, 1 H), 4.79 (s, 1 H), 4.08 (dt, *J* = 4.8, 4.2 Hz, 1 H), 2.28 (ddd, *J* = 12.0, 8.4, 4.2 Hz, 1 H), 2.10 (dt, *J* = 8.4, 2.4 Hz, 1 H), 1.94 (m, 1 H), 1.84 (m, 1 H), 1.79 (s, 3 H), 1.75 (m, 1 H), 1.69 (s, 3 H), 1.66 – 1.58 (m, 2 H), 1.49 (m, 1 H), 1.44 (m, 2 H), 1.40 – 1.31 (m, 3 H), 1.18 (s, 9 H) ppm; ^{13}C NMR (C_6D_6, 150 MHz): δ = 169.44, 143.99, 136.30, 136.27, 135.02, 134.81, 129.91, 129.87, 110.97, 79.28, 76.70, 51.88, 48.69, 45.27, 34.03, 27.26, 26.48, 25.68, 25.21, 23.93, 21.94, 20.89, 19.46 ppm; HRMS calcd for $C_{31}H_{42}O_3SiH^+$ [*M*+H^+] 491.2976 found 491.2964.



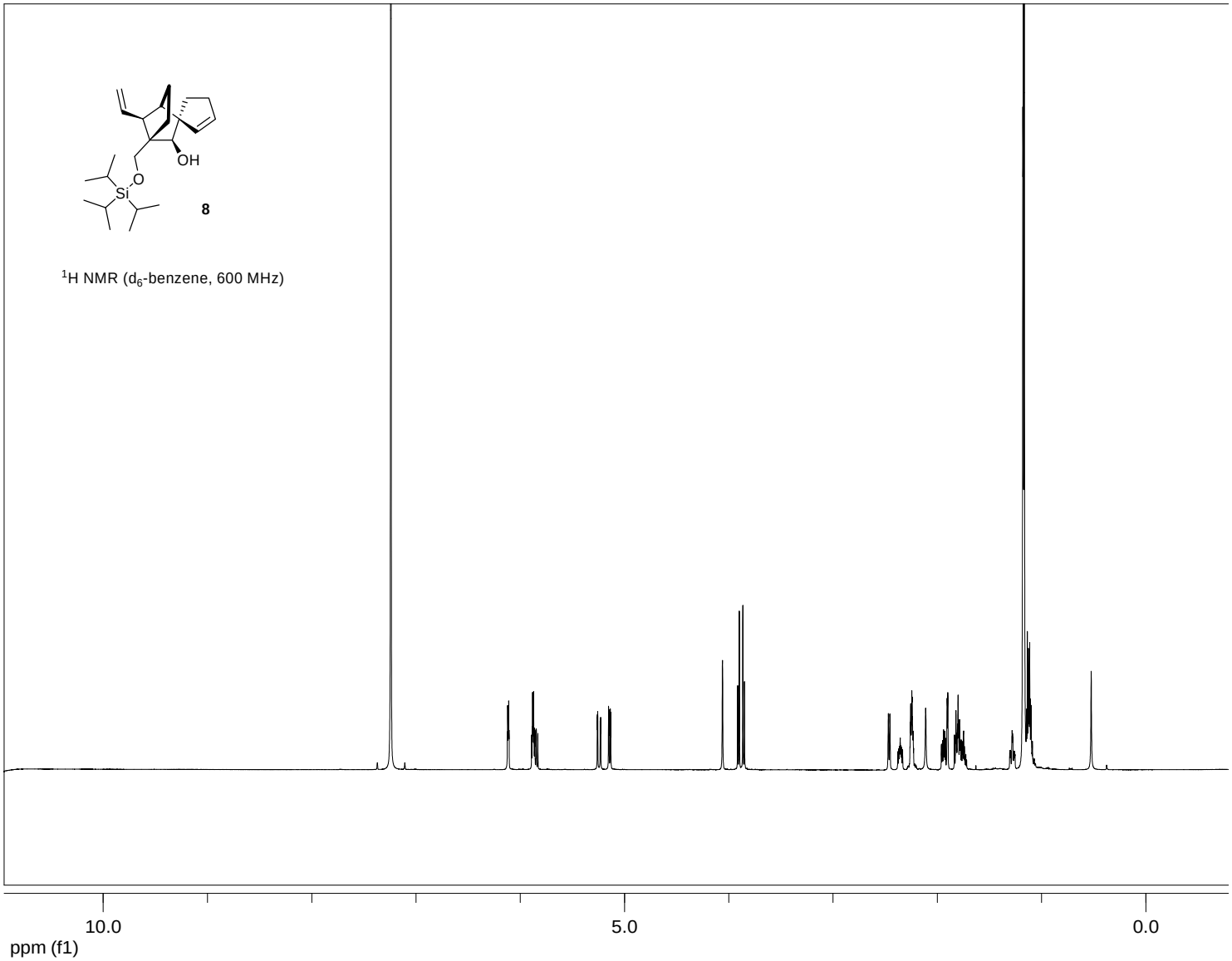
31e

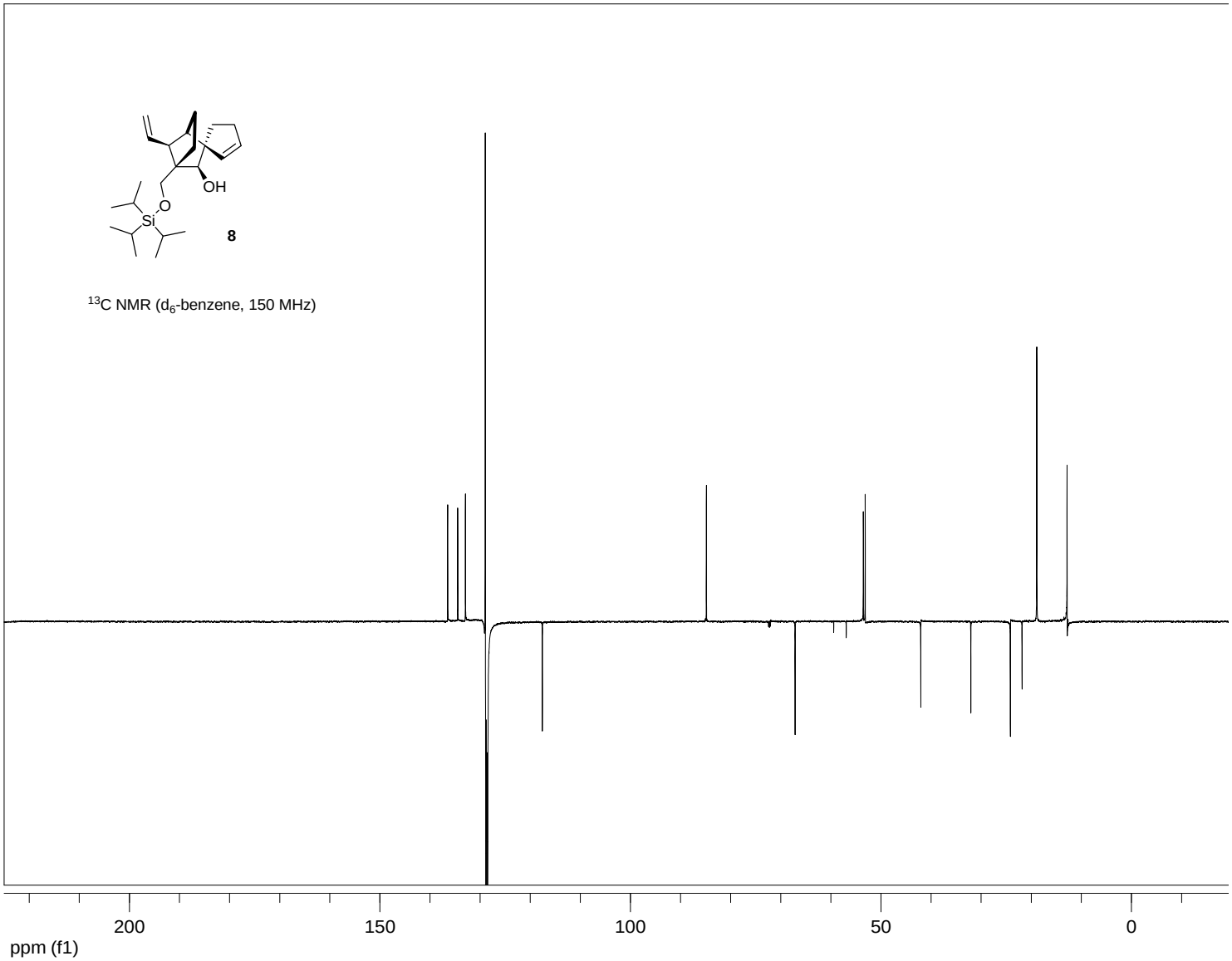
II) References

[1] K. C. Nicolaou, M. P. Jennings, P. Dagneau, *Chem. Commun*. **2002**, 2480–2481.

[2] K. C. Nicolaou, H. Zhang, A. Ortiz, P. Dagneau, *Angew. Chem.* **2008**, *120*, 8733–8738; K. C. Nicolaou, H. Zhang, A. Ortiz, P. Dagneau, *Angew. Chem. Int. Ed.* **2008**, *47*, 8605–8610.

III) ^{1}H and ^{13}C NMR Spectra

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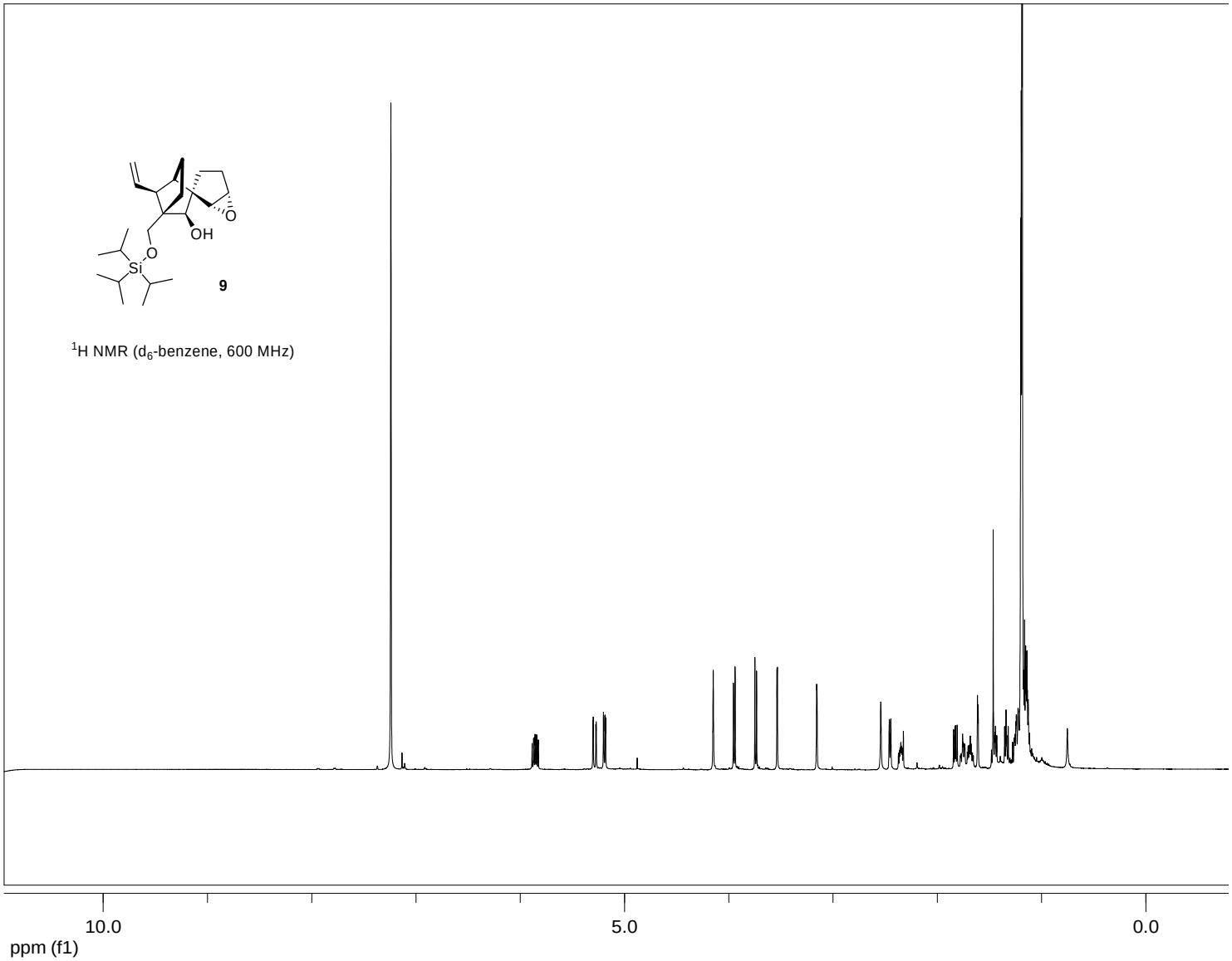
O
Si
8
^{13}C NMR (d_6-benzene, 150 MHz)
200
150
100
50
0
ppm (f1)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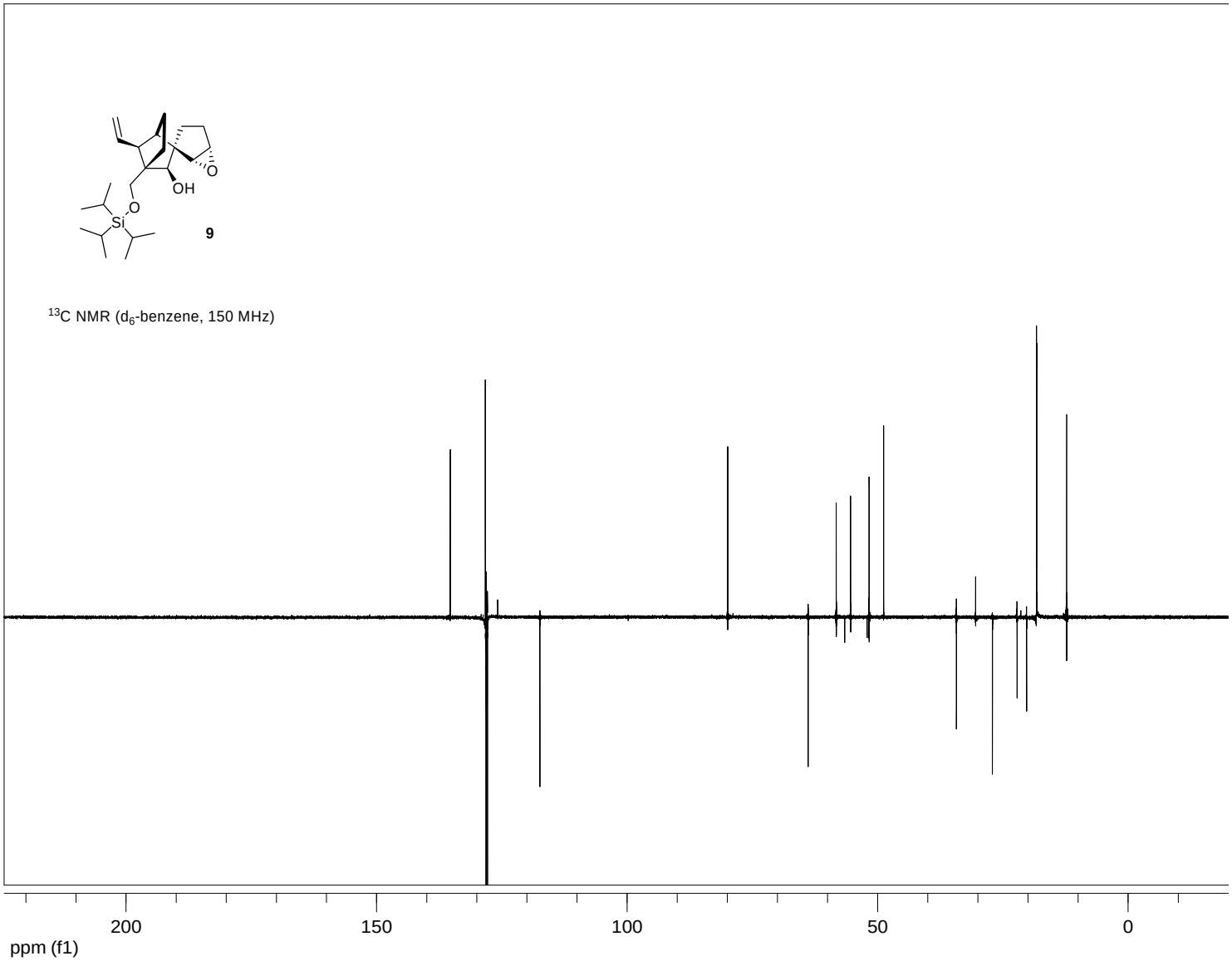
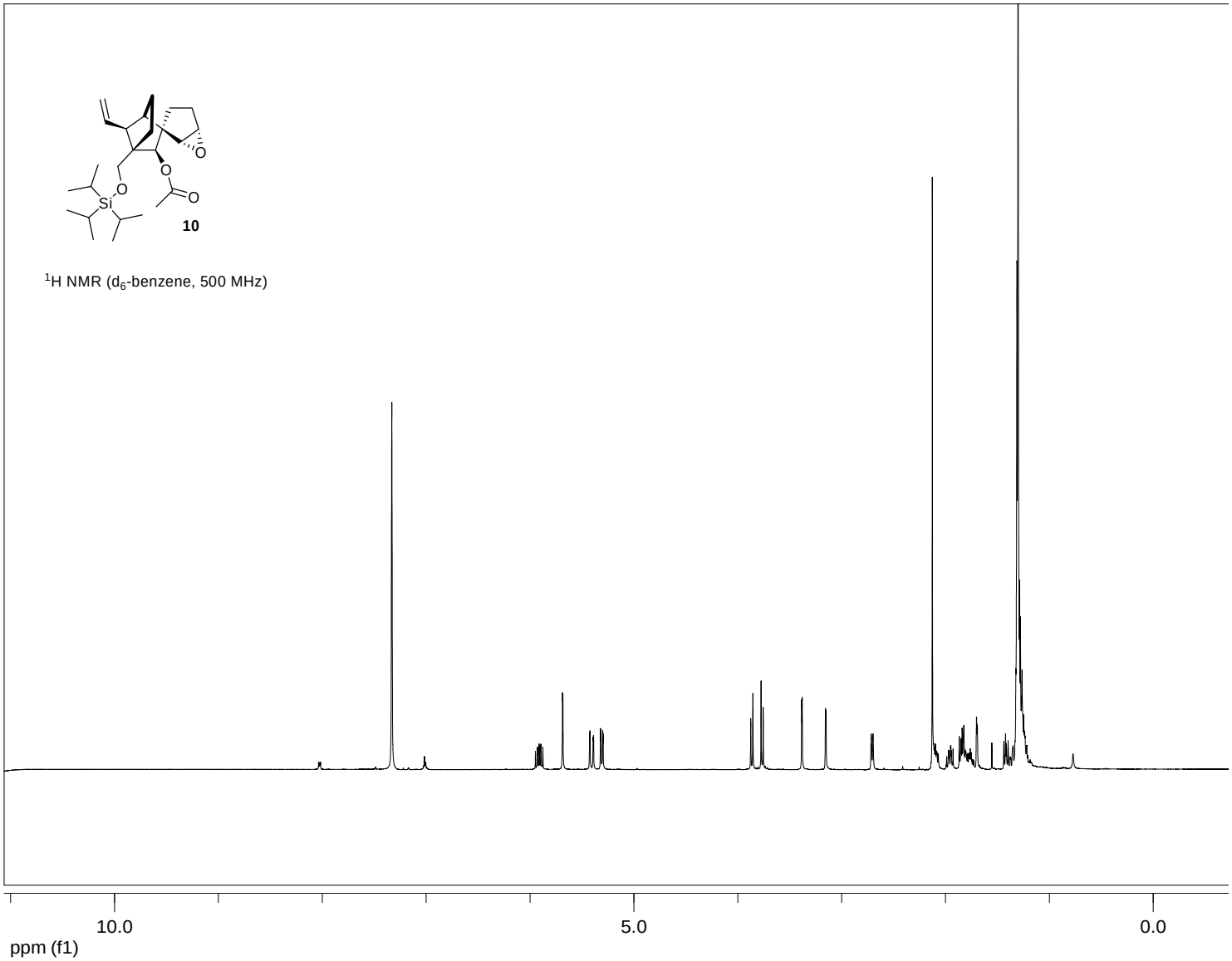
O
O
Si
9
^{1}H NMR (d_6-benzene, 600 MHz)
10.0
5.0
0.0
ppm (f1)


O
OH
O
Si
9
^{13}C NMR (d_6-benzene, 150 MHz)
200
150
100
50
0
ppm (f1)


O
O
O
O
Si
10
^{1}H NMR (d_6-benzene, 500 MHz)
10.0
5.0
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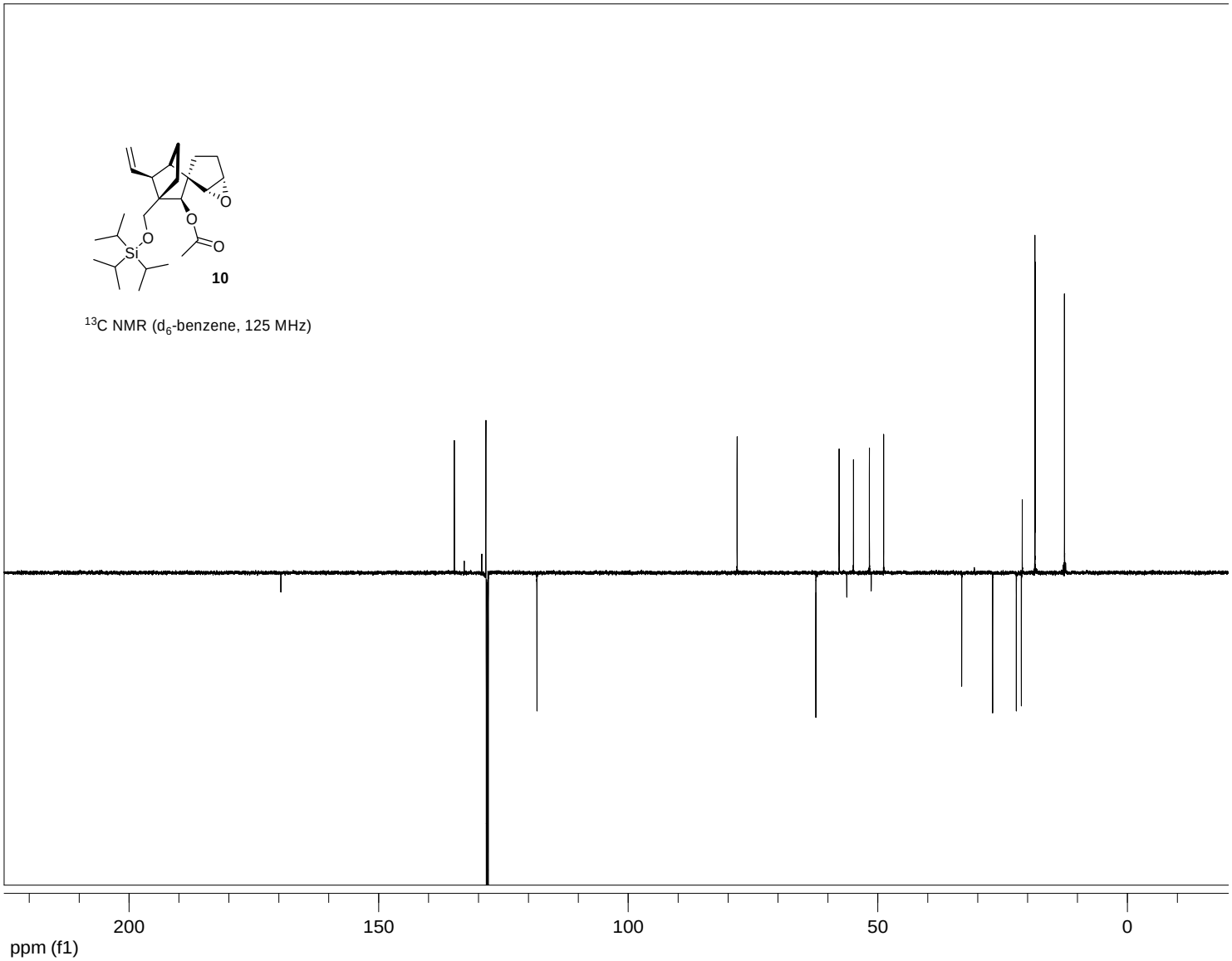
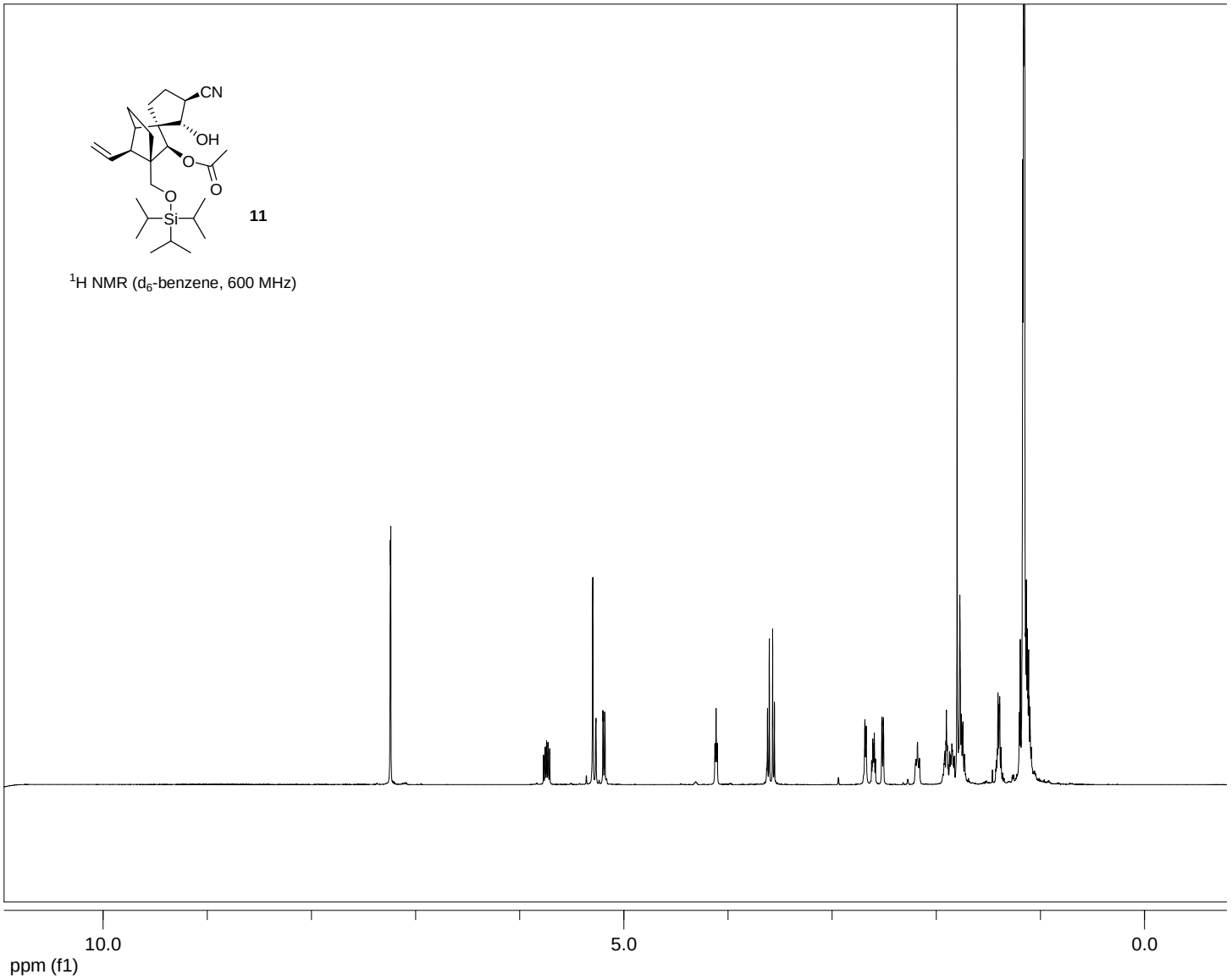
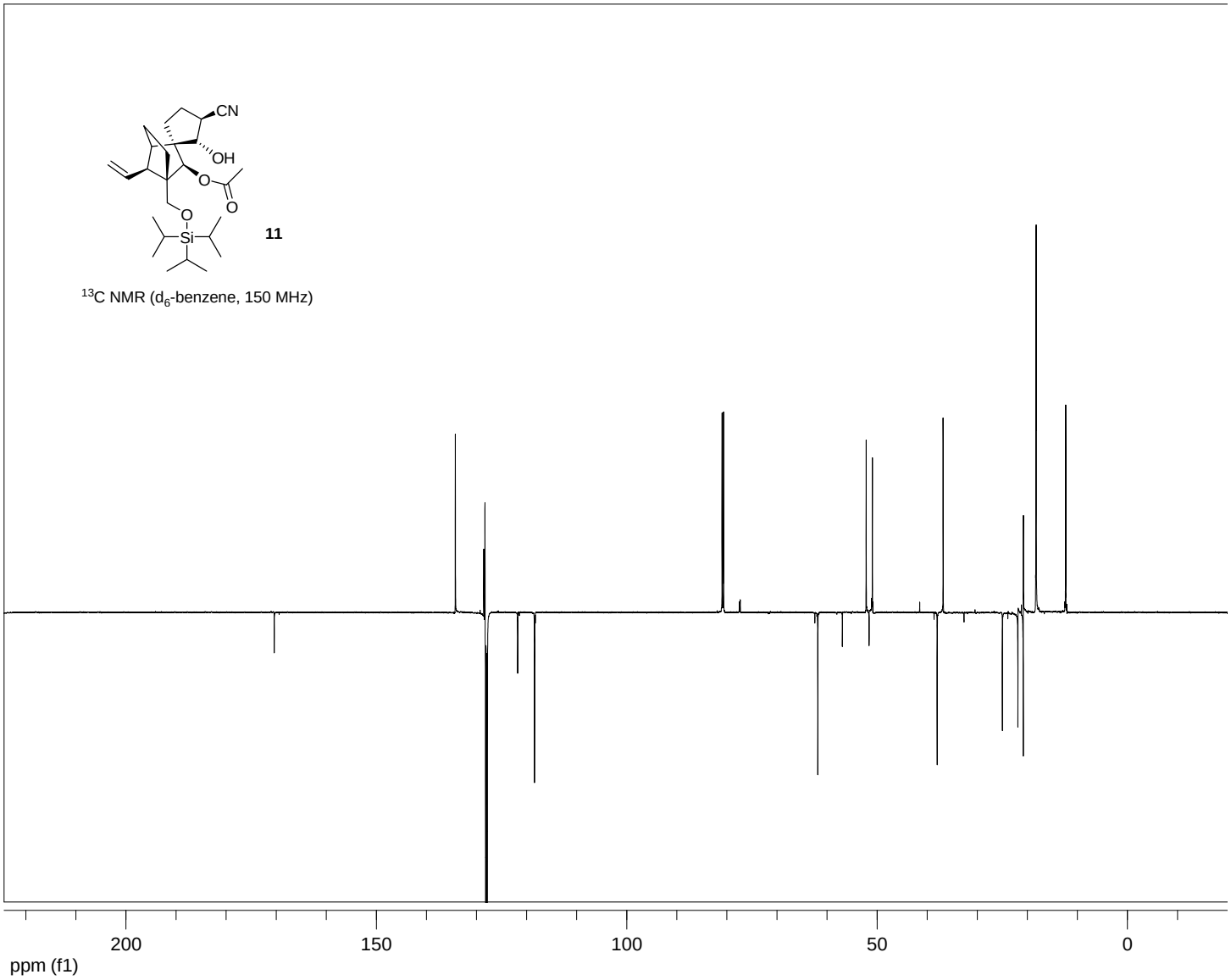
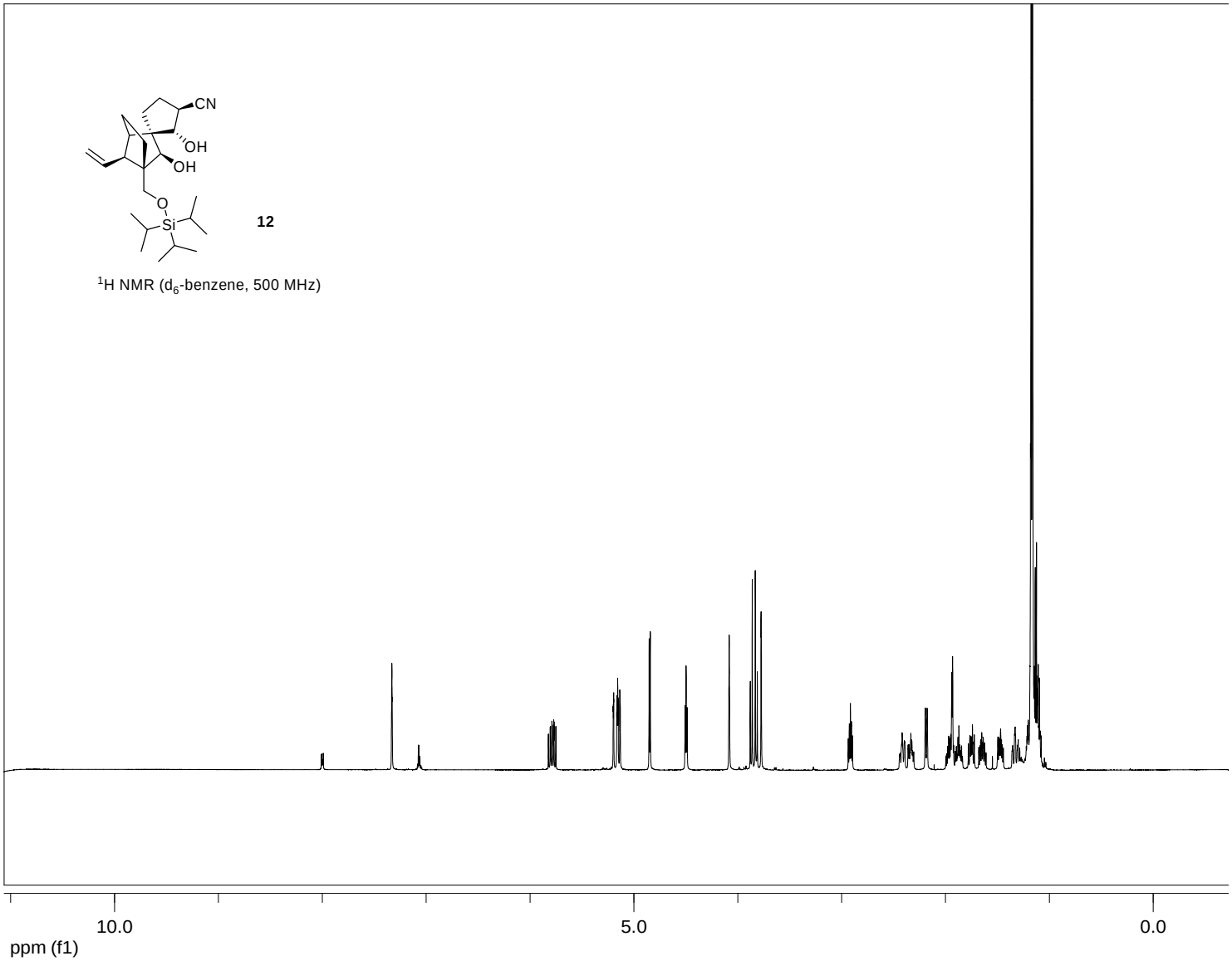
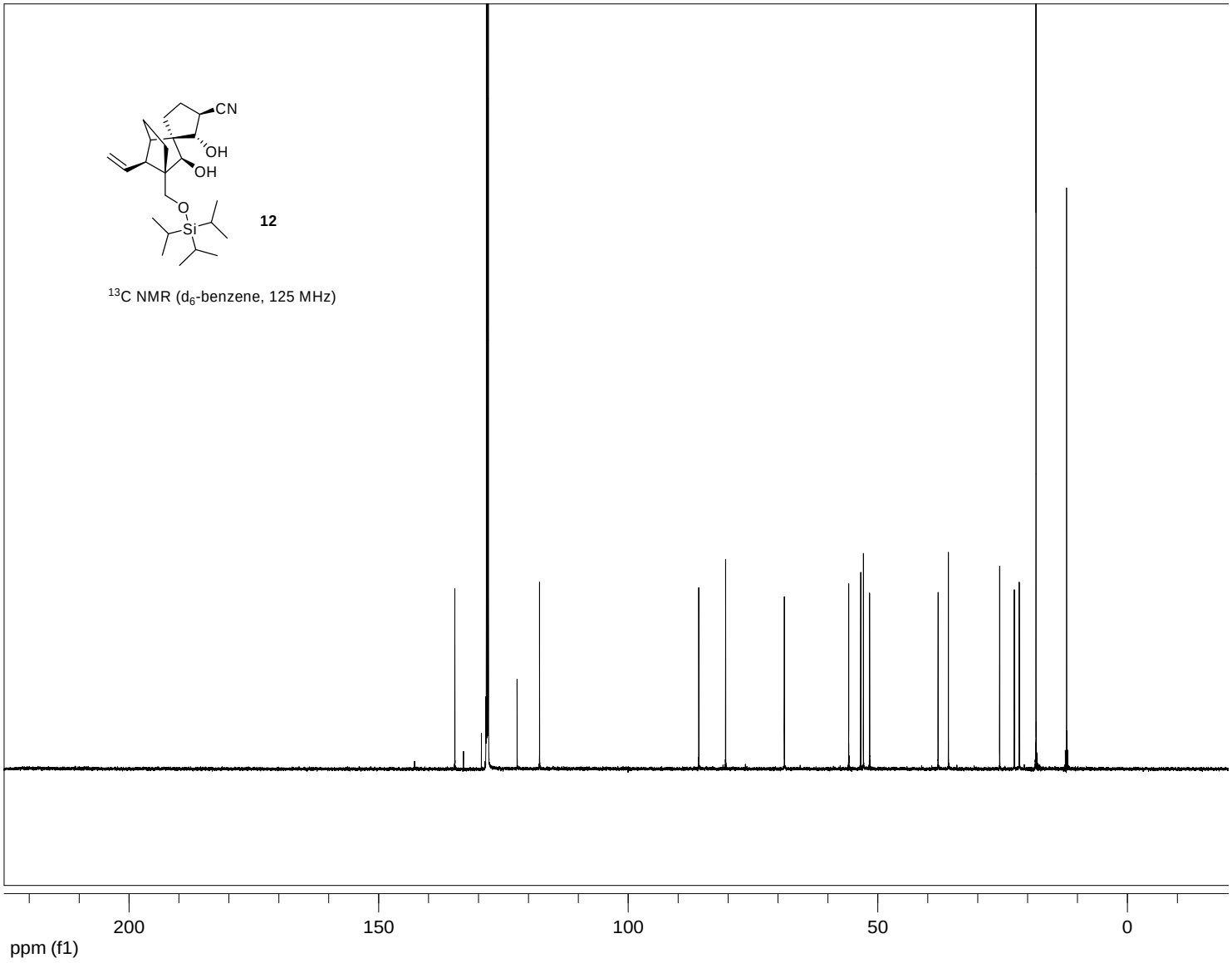
ppm (f1)

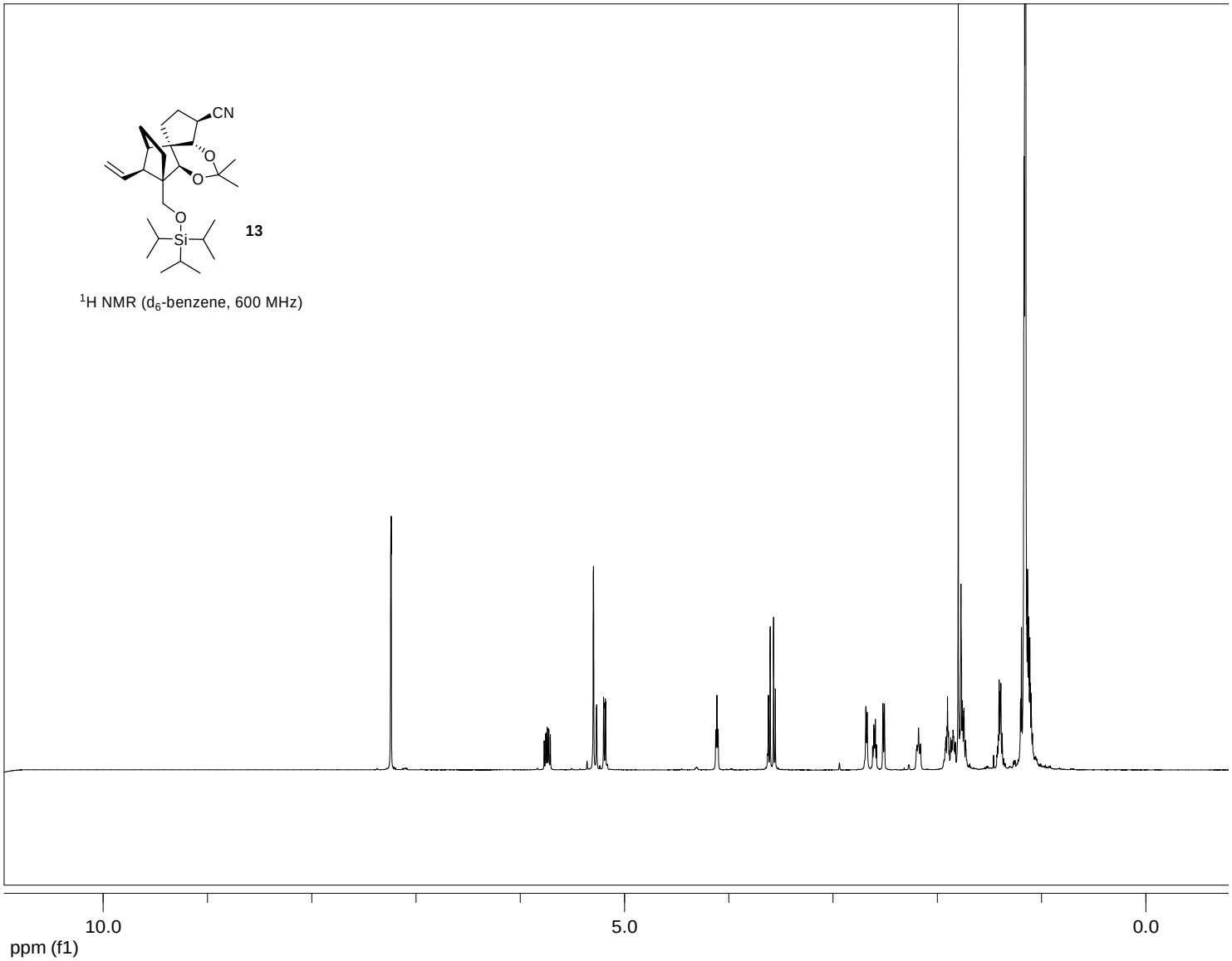

O
O
O
O
Si
10
^{13}C NMR (d_6-benzene, 125 MHz)
200
150
100
50
0
ppm (f1)

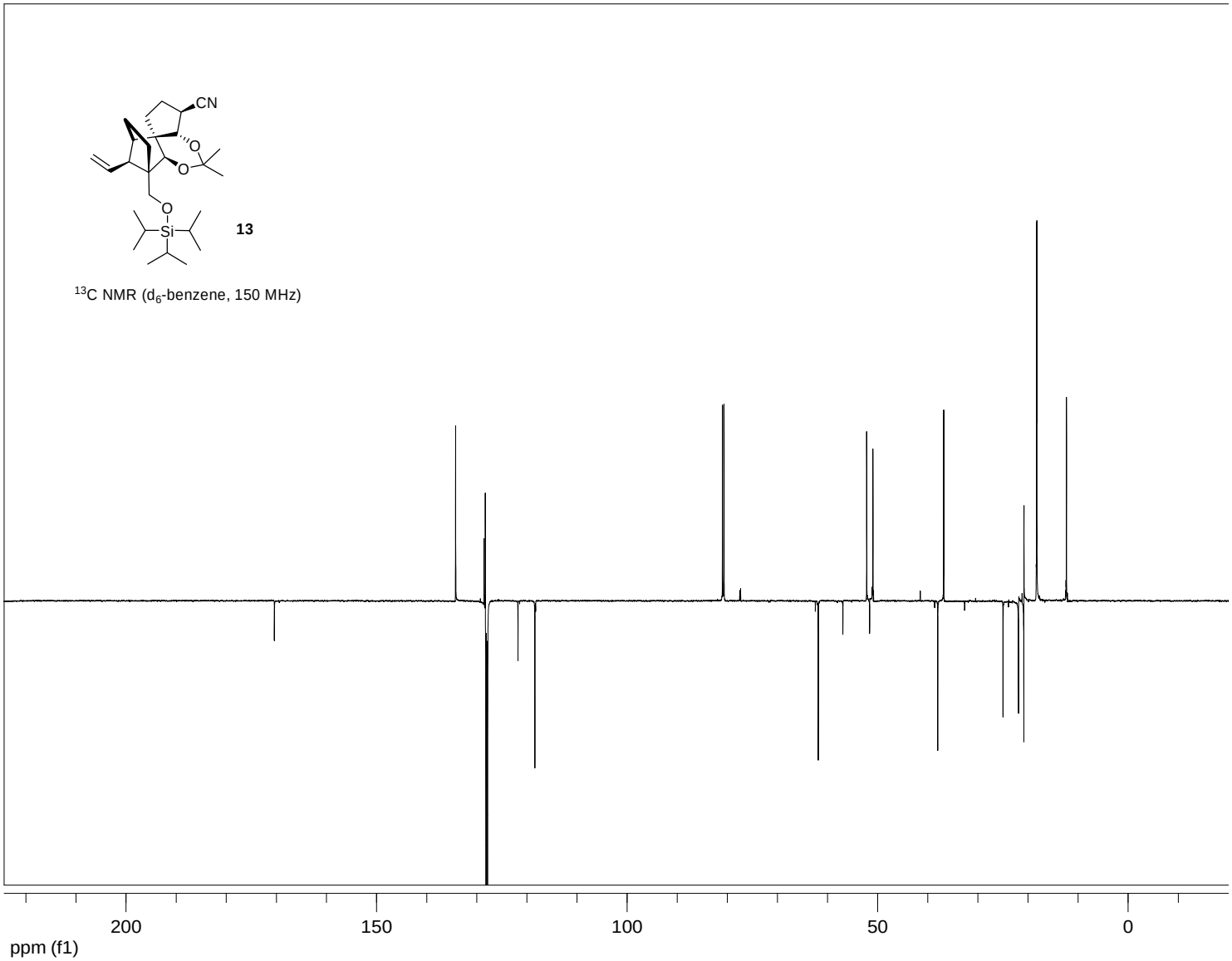

CN
OH
O
O
O
Si
11
^{1}H NMR (d_6-benzene, 600 MHz)
10.0
5.0
0.0
ppm (f1)

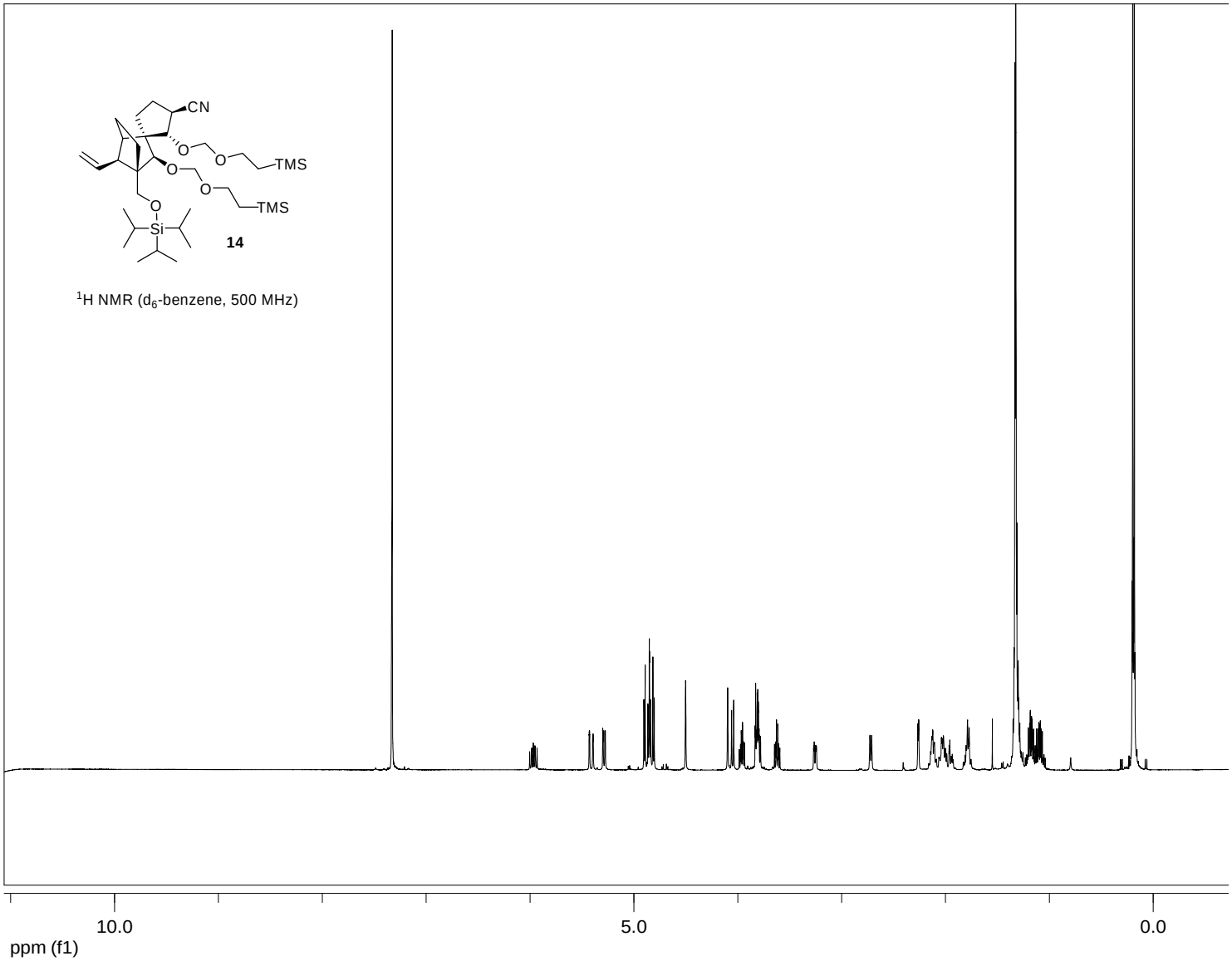

CN
OH
O
O
O
Si
11
^{13}C NMR (d_6-benzene, 150 MHz)
200
150
100
50
0
ppm (f1)

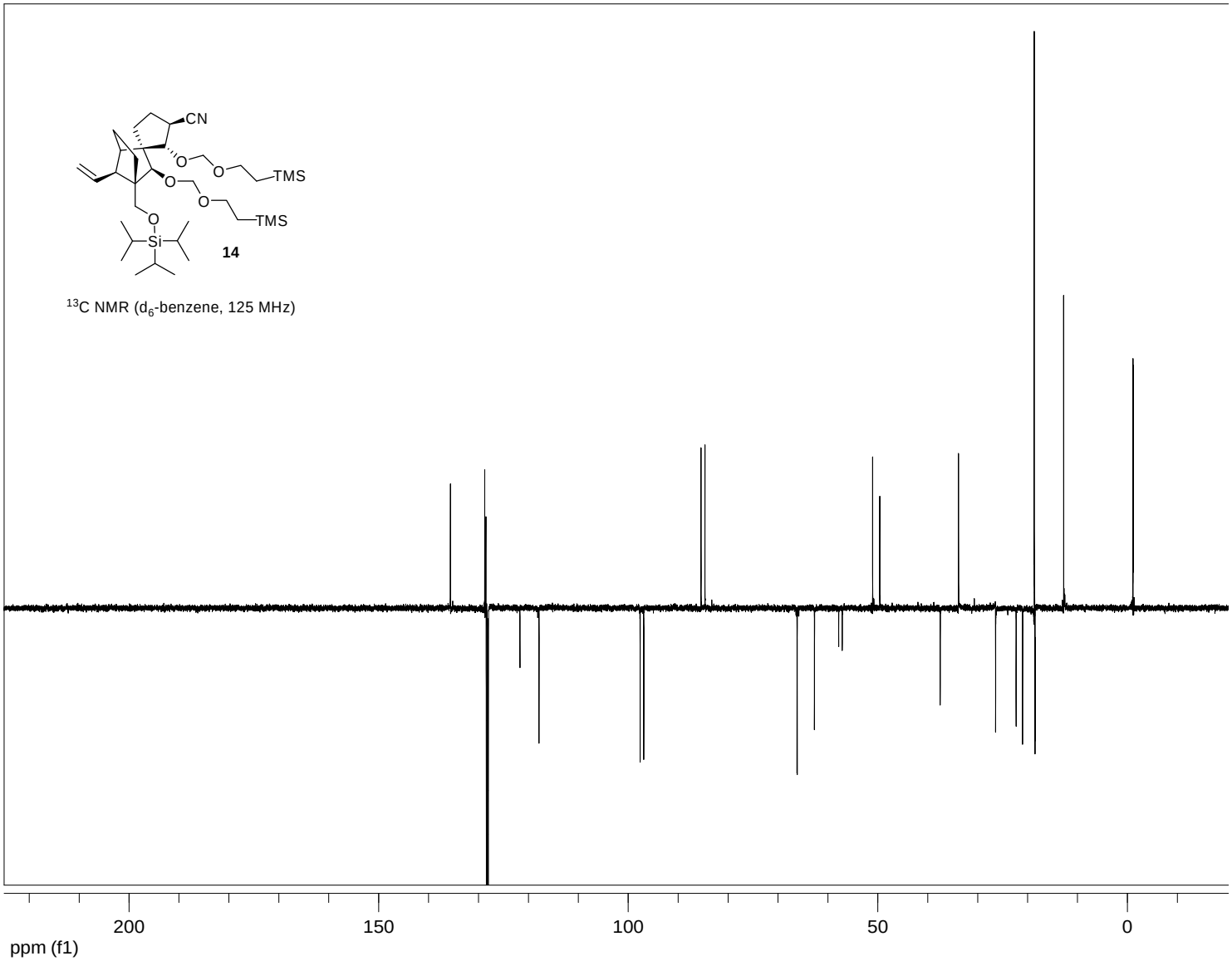

CN
OH
OH
O
Si
12
^{1}H NMR (d_6-benzene, 500 MHz)
10.0
5.0
0.0
ppm (f1)

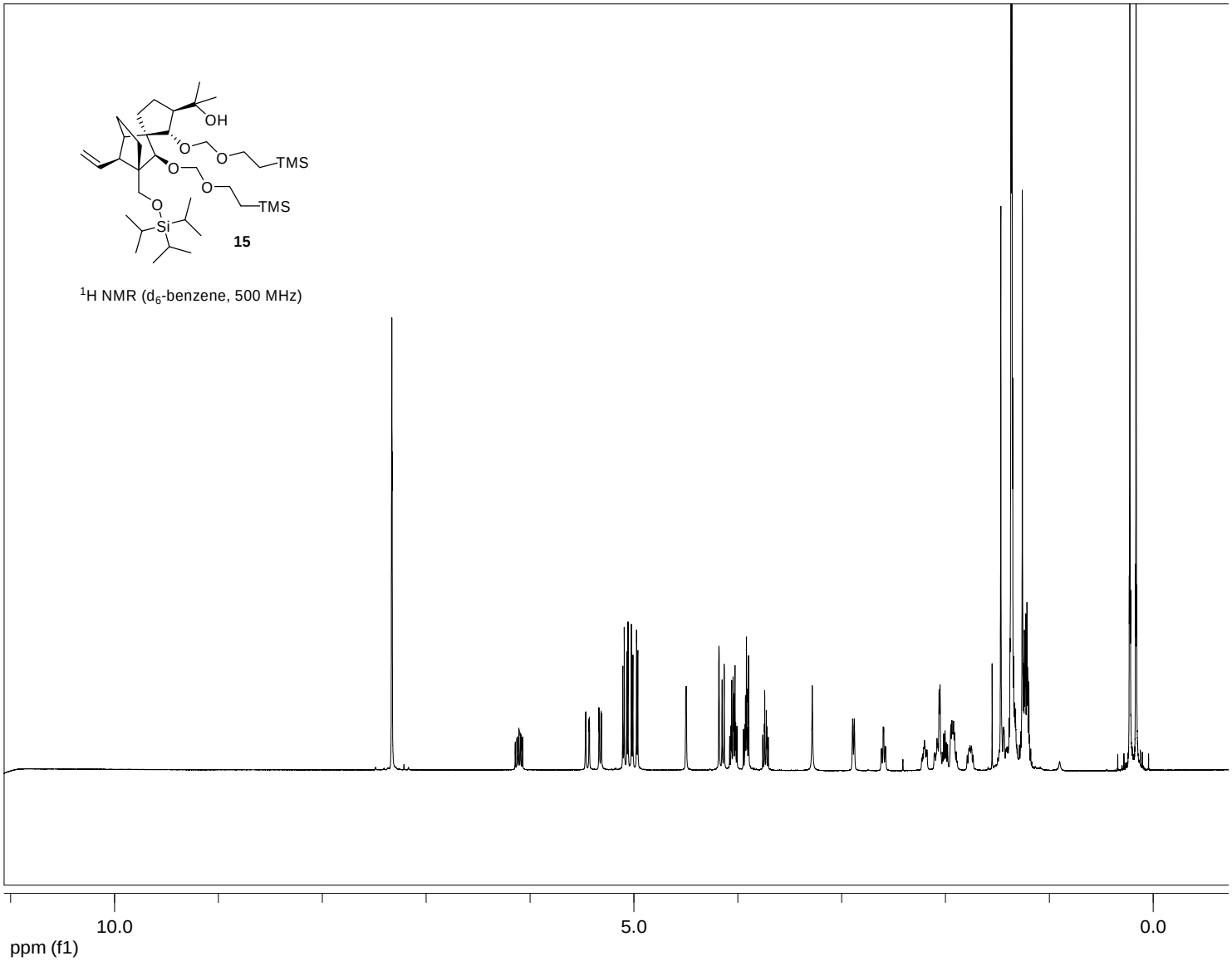

CN
OH
OH
O
Si
12
^{13}C NMR (d_6-benzene, 125 MHz)
200
150
100
50
0
ppm (f1)

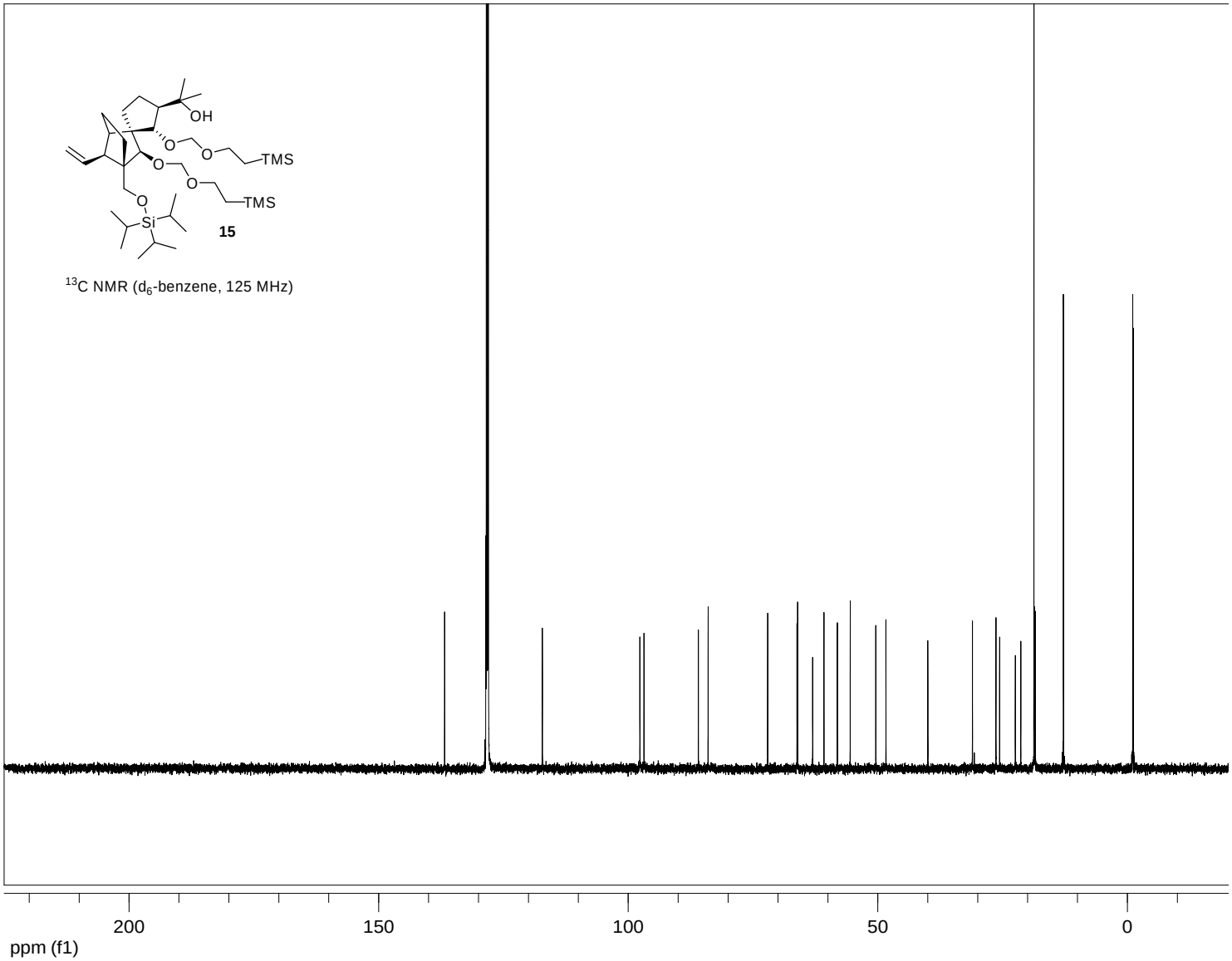

CN
O
O
O
Si
13
^{1}H NMR (d_6-benzene, 600 MHz)
10.0
5.0
0.0
ppm (f1)

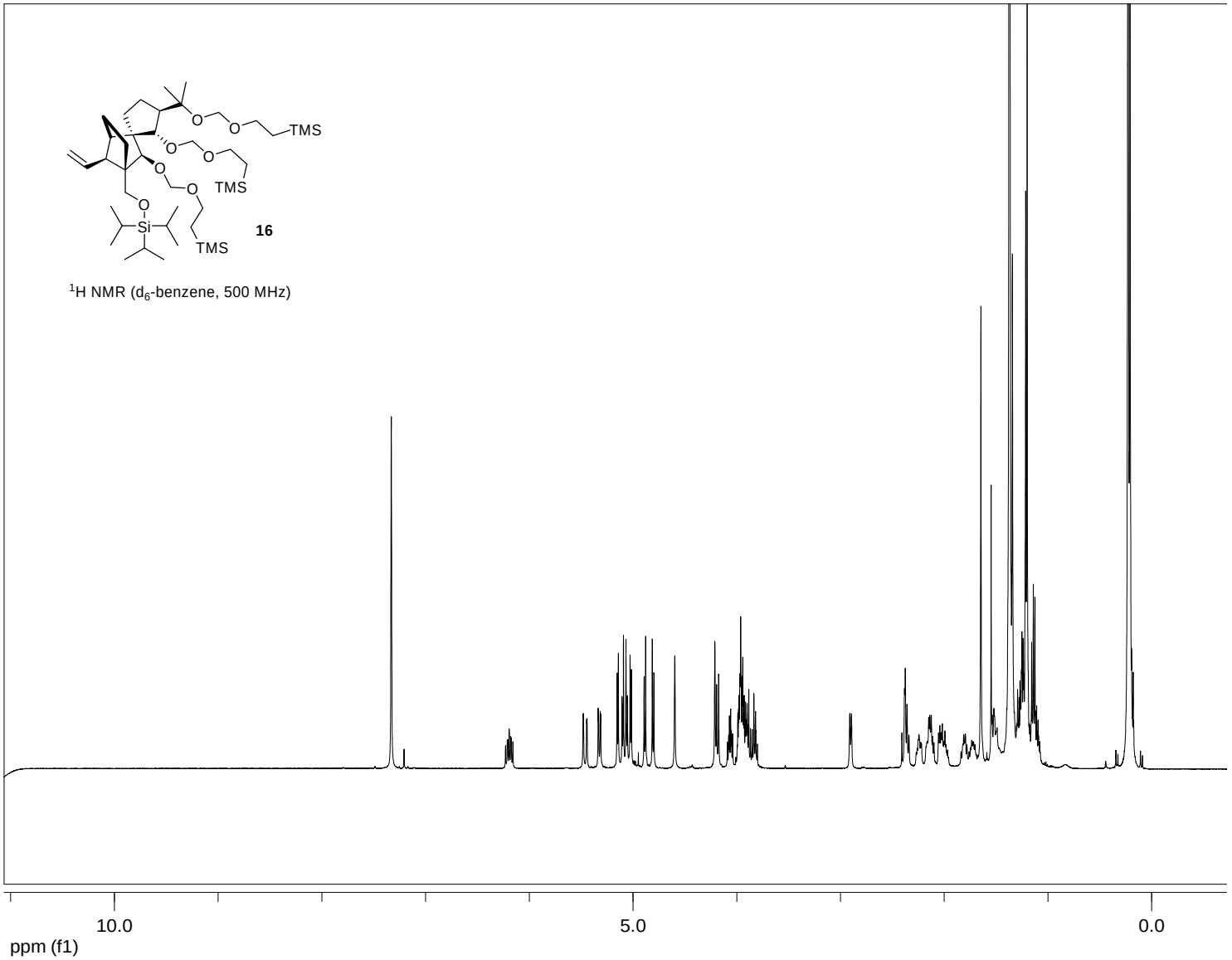

CN
O
O
O
Si
13
^{13}C NMR (d_6-benzene, 150 MHz)
200
150
100
50
0
ppm (f1)

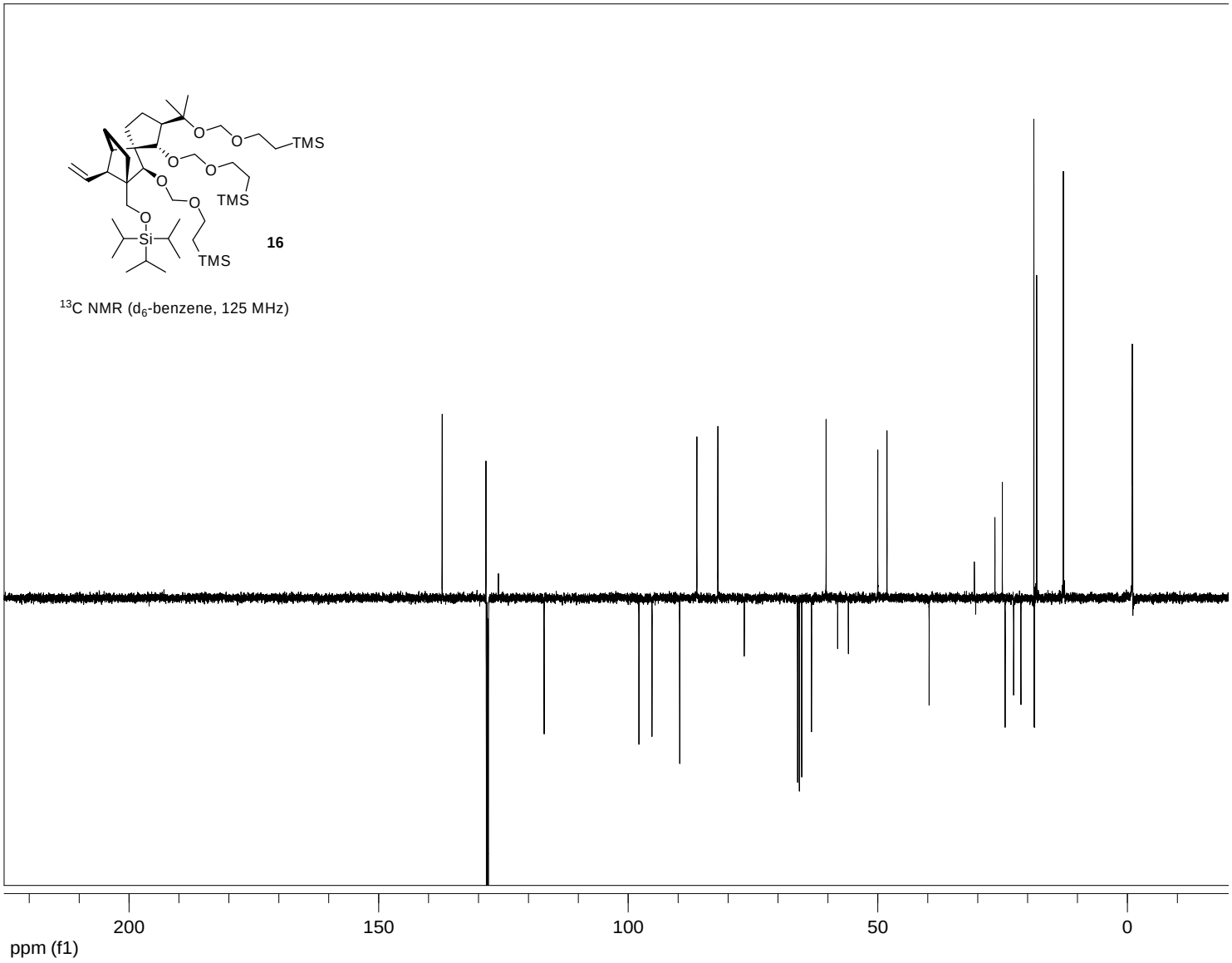

CN
O
O
TMS
O
O
TMS
O
Si
14
^{1}H NMR (d_6-benzene, 500 MHz)
10.0
5.0
0.0
ppm (f1)

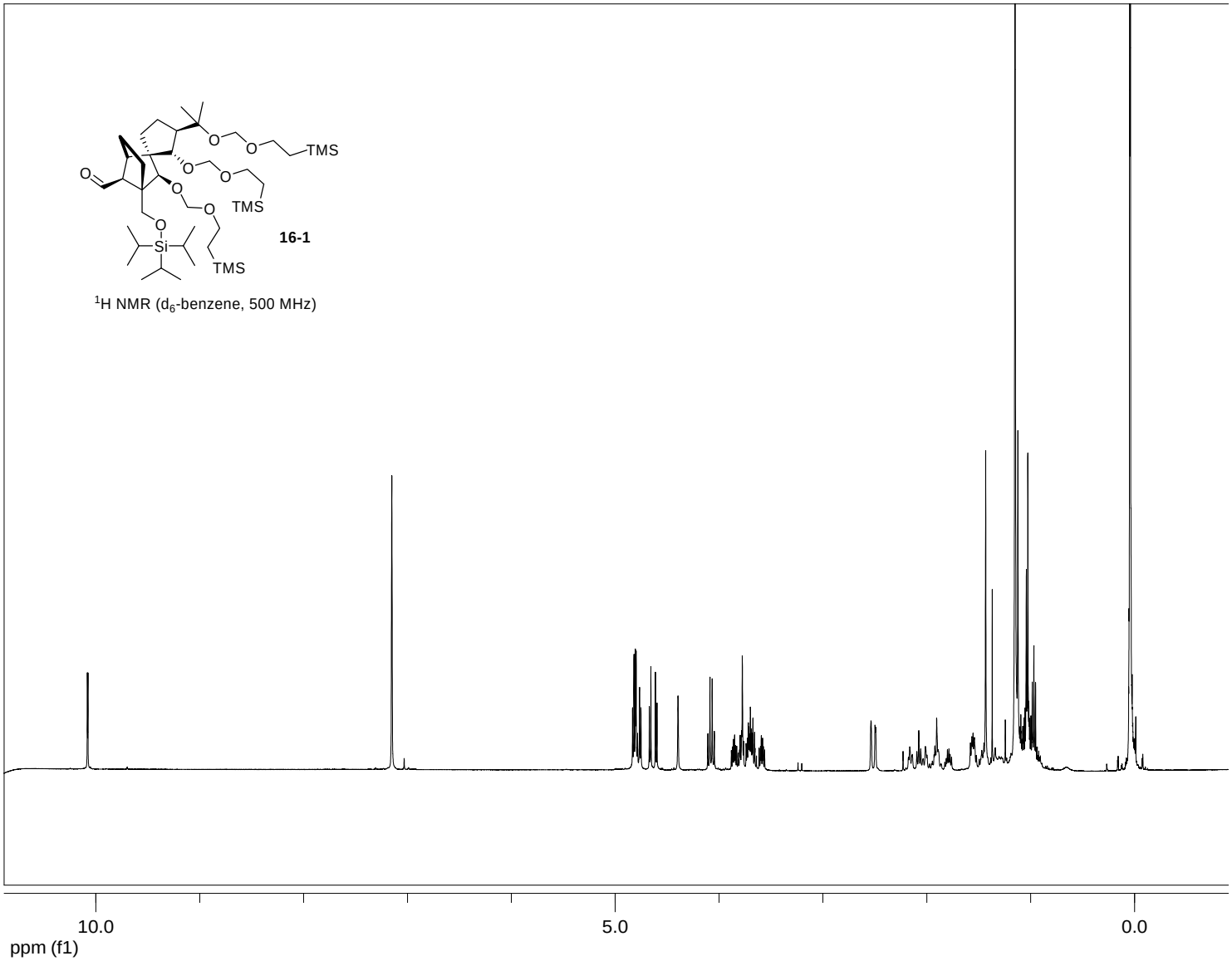

CN
O
O
TMS
O
O
TMS
O
Si
14
^{13}C NMR (d_6-benzene, 125 MHz)
200
150
100
50
0
ppm (f1)


OH
O
O
TMS
O
O
TMS
O
Si
15
1H NMR (d6-benzene, 500 MHz)
10.0
5.0
0.0
ppm (f1)


OH
O
O
TMS
O
O
TMS
O
Si
15
^{13}C NMR (d_6-benzene, 125 MHz)
200
150
100
50
0
ppm (f1)

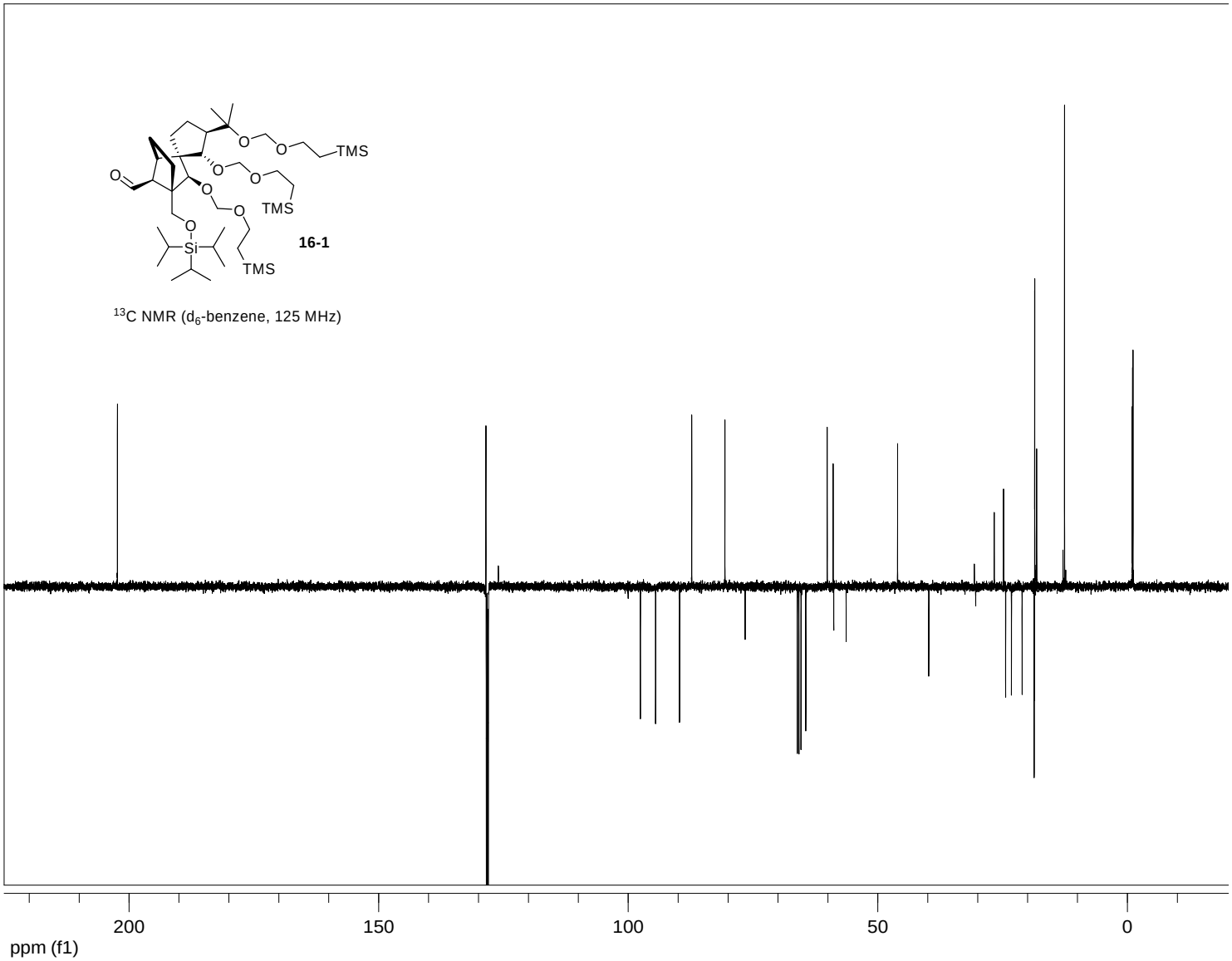

TMS
TMS
TMS
O
Si
16
^{1}H NMR (d_6-benzene, 500 MHz)
10.0
5.0
0.0
ppm (f1)

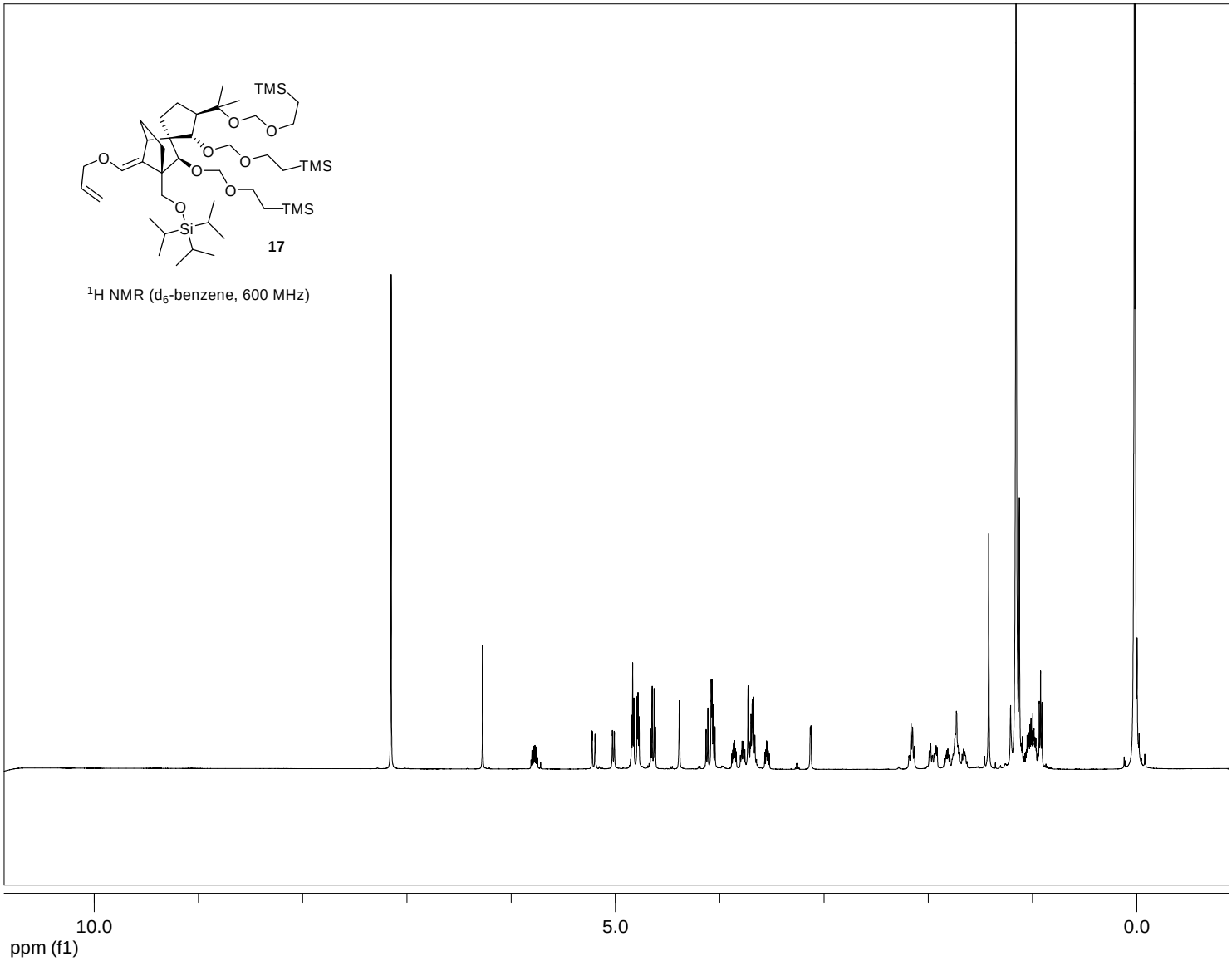

TMS
TMS
TMS
16
^{13}C NMR (d_6-benzene, 125 MHz)
200
150
100
50
0
ppm (f1)



16-1

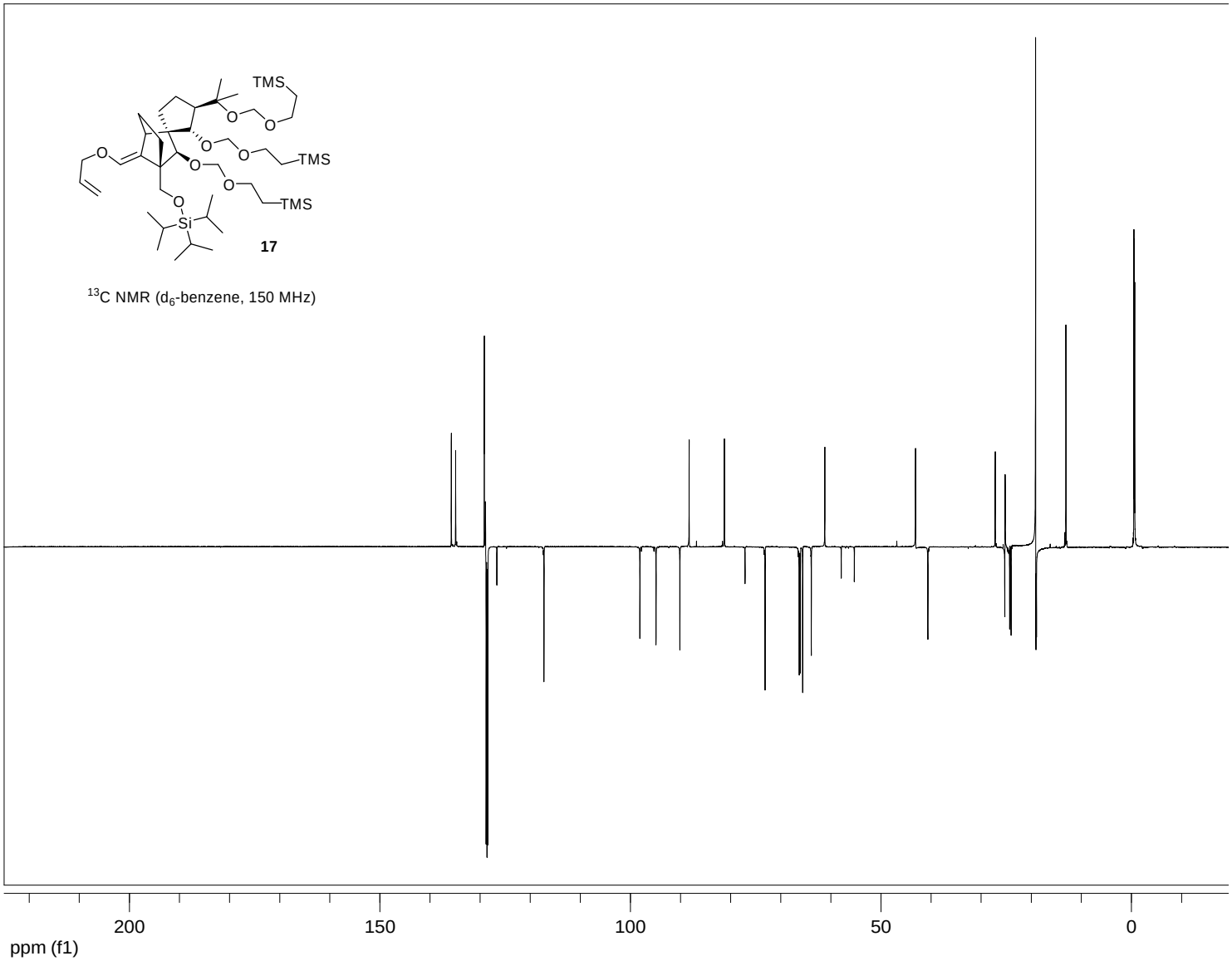
^{1}H NMR (d_6-benzene, 500 MHz)

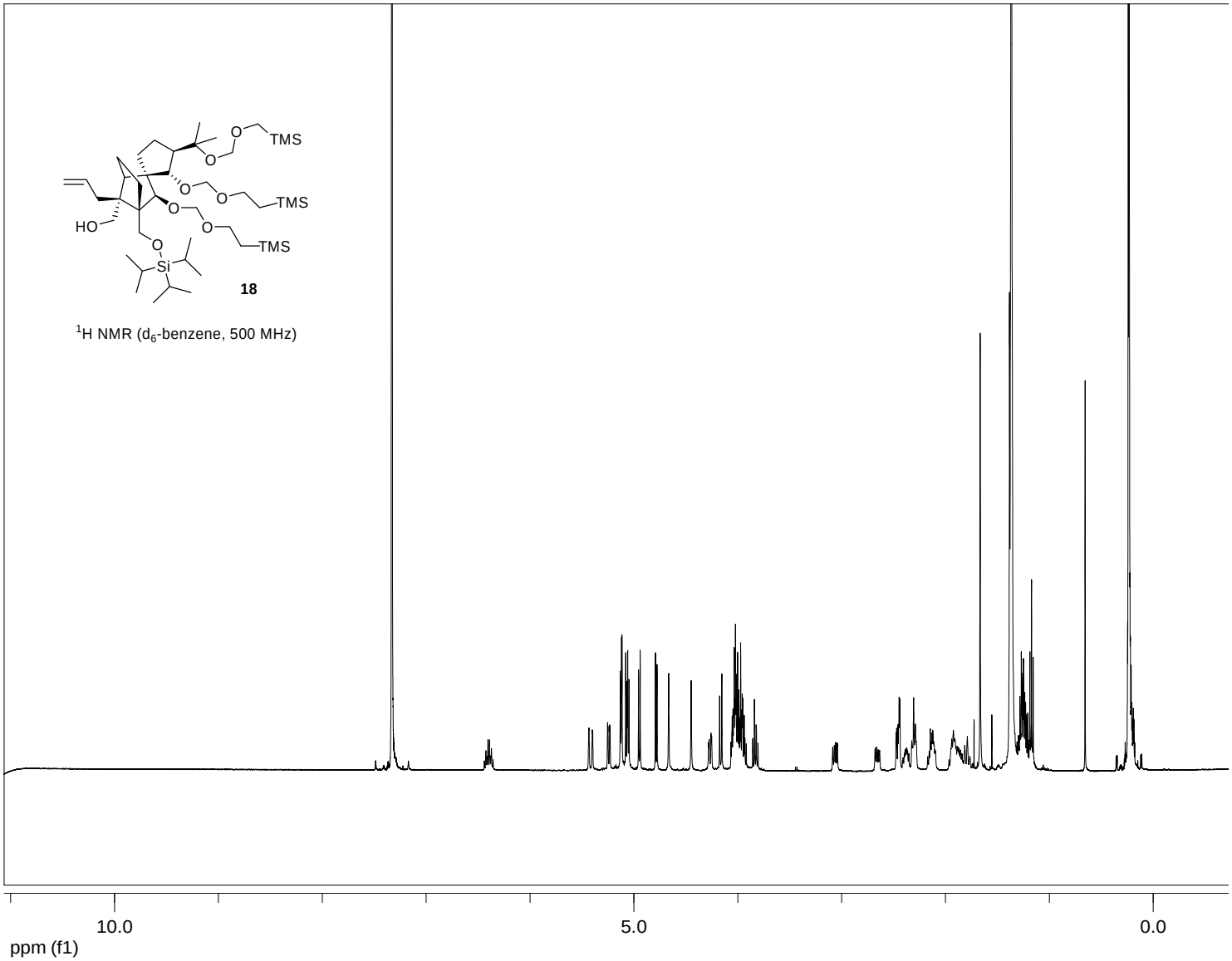

O
O
O
TMS
O
O
O
TMS
O
Si
TMS
16-1
^{13}C NMR (d_6-benzene, 125 MHz)
200
150
100
50
0
ppm (f1)

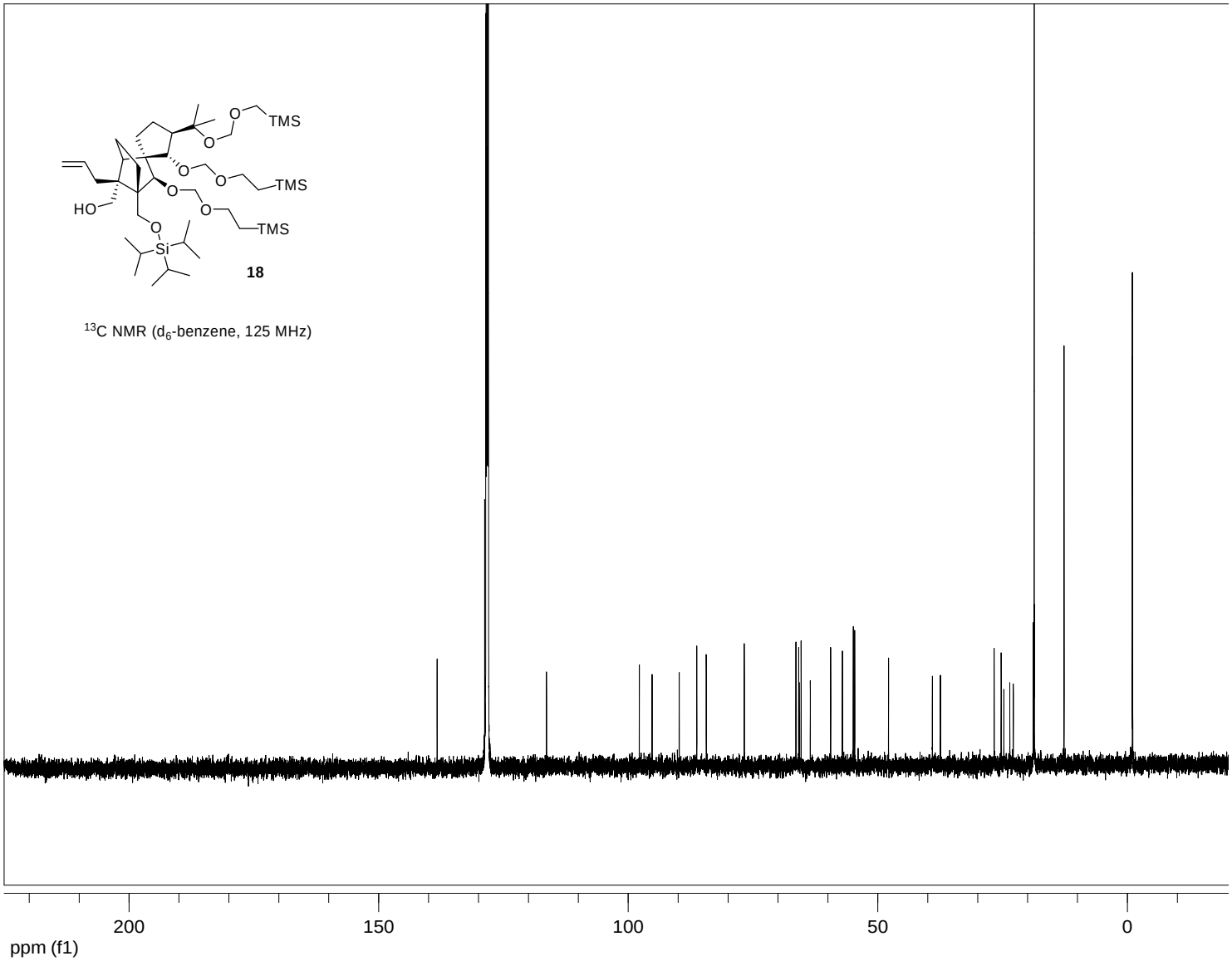


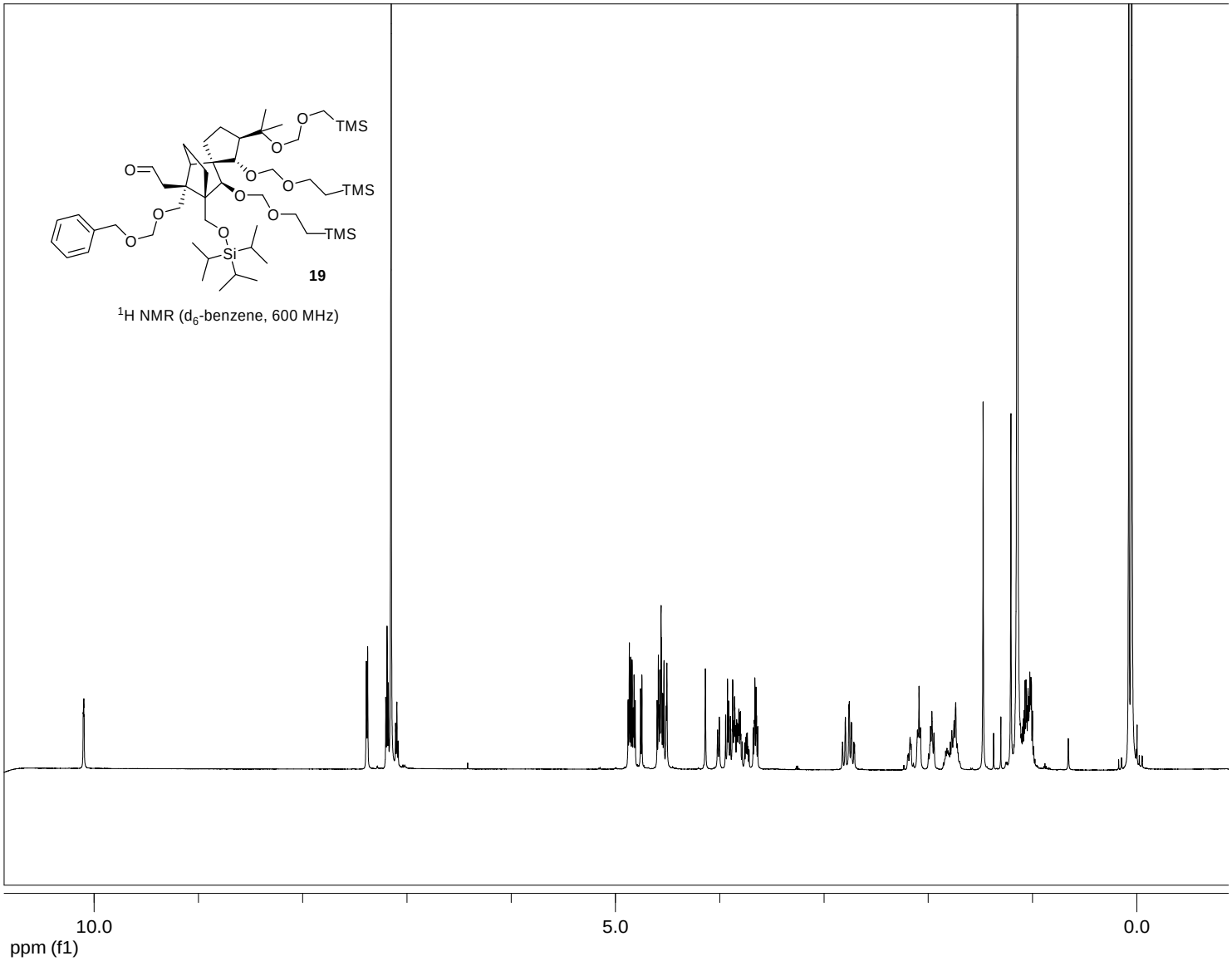
17

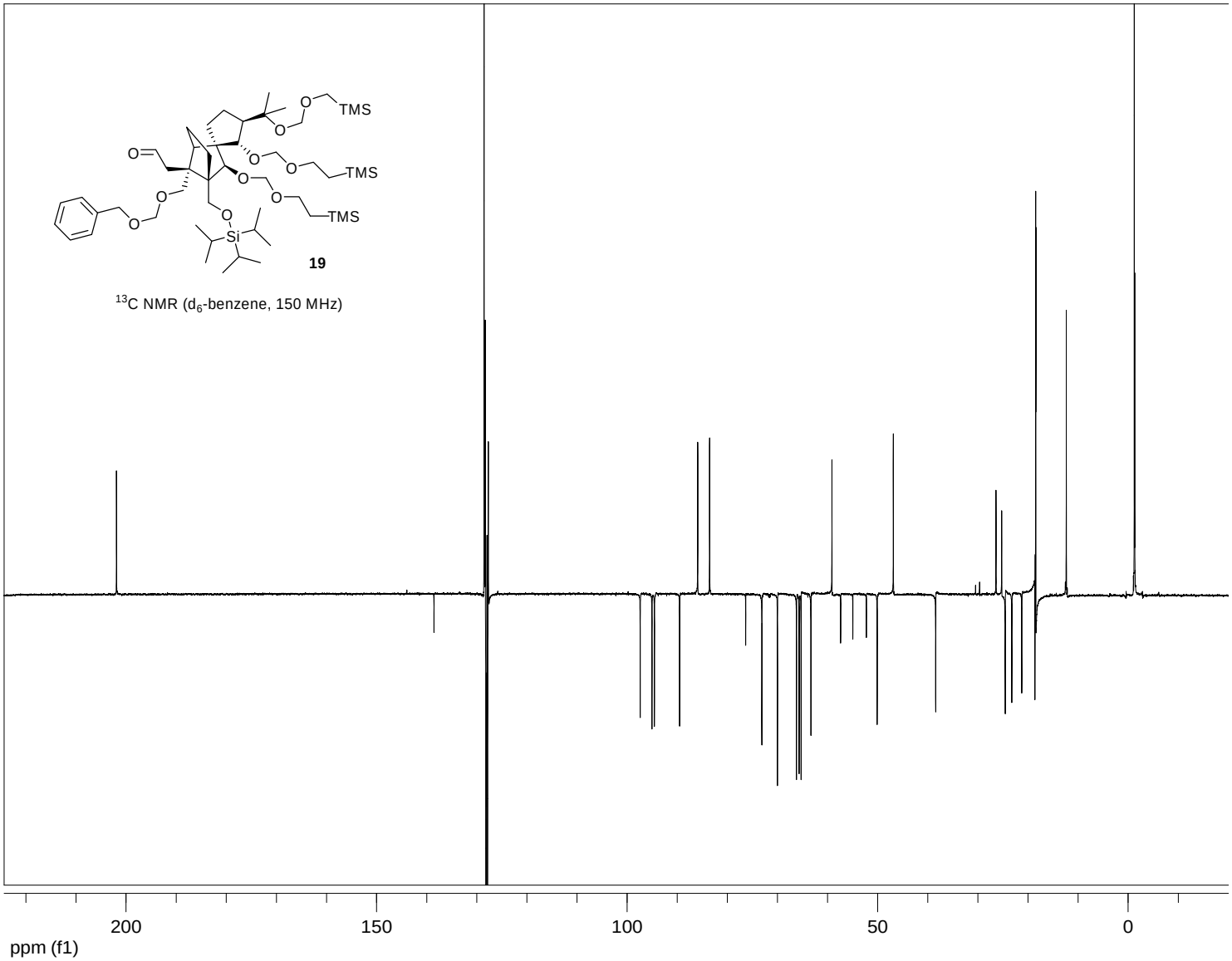
^{1}H NMR (d_6-benzene, 600 MHz)

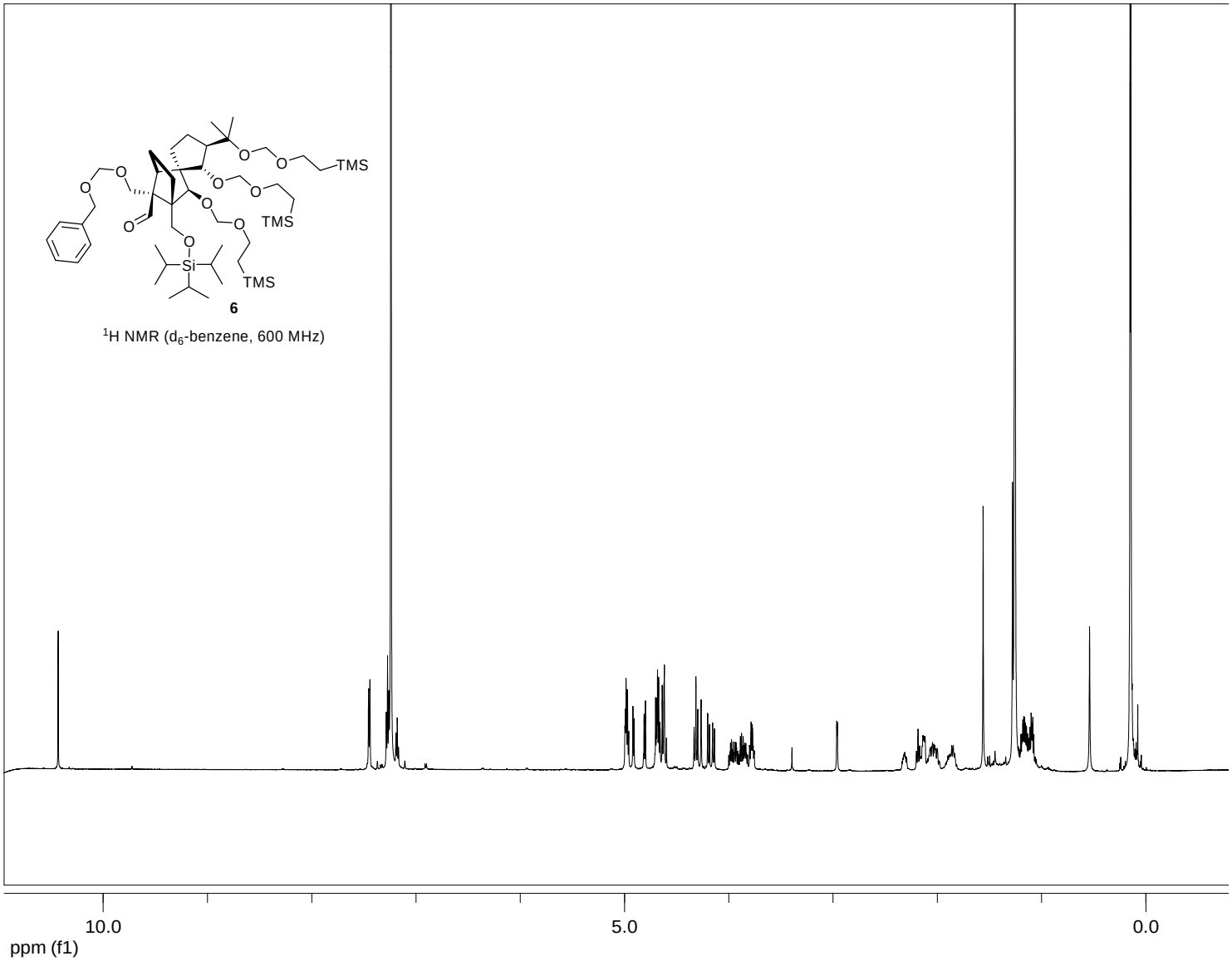

TMS
TMS
TMS
O
Si
17
13C NMR (d6-benzene, 150 MHz)
200
150
100
50
0
ppm (f1)


TMS
TMS
TMS
HO
O
Si
18
^{1}H NMR (d_6-benzene, 500 MHz)
10.0
5.0
0.0
ppm (f1)


TMS
TMS
TMS
HO
O
Si
18
^{13}C NMR (d_6-benzene, 125 MHz)
200
150
100
50
0
ppm (f1)

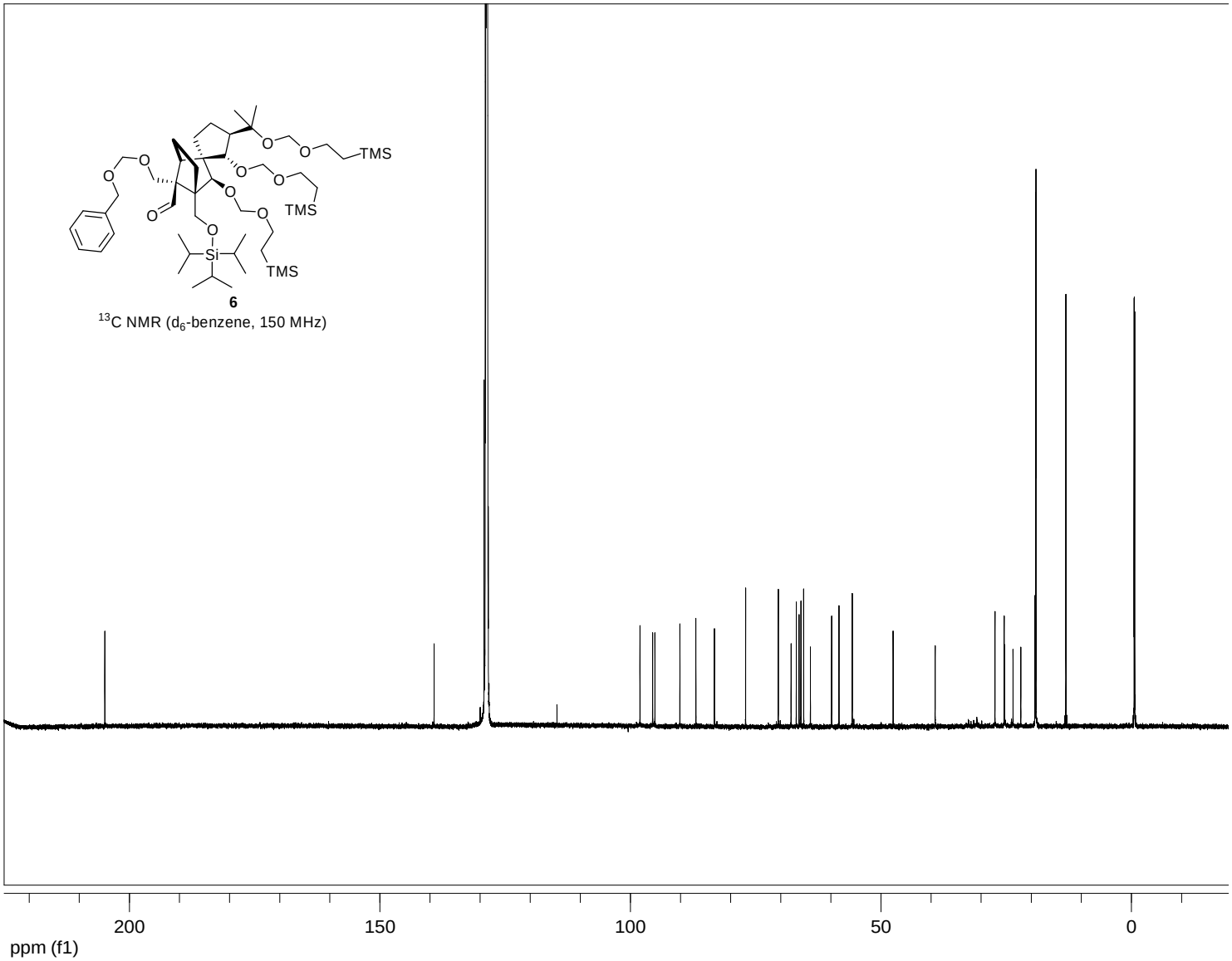

O
TMS
O
TMS
O
TMS
O
O
O
O
O
Si
19
1H NMR (d6-benzene, 600 MHz)
10.0
5.0
0.0
ppm (f1)


O
O
TMS
O
O
O
TMS
O
O
O
TMS
O
Si
19
13C NMR (d6-benzene, 150 MHz)
200
150
100
50
0
ppm (f1)



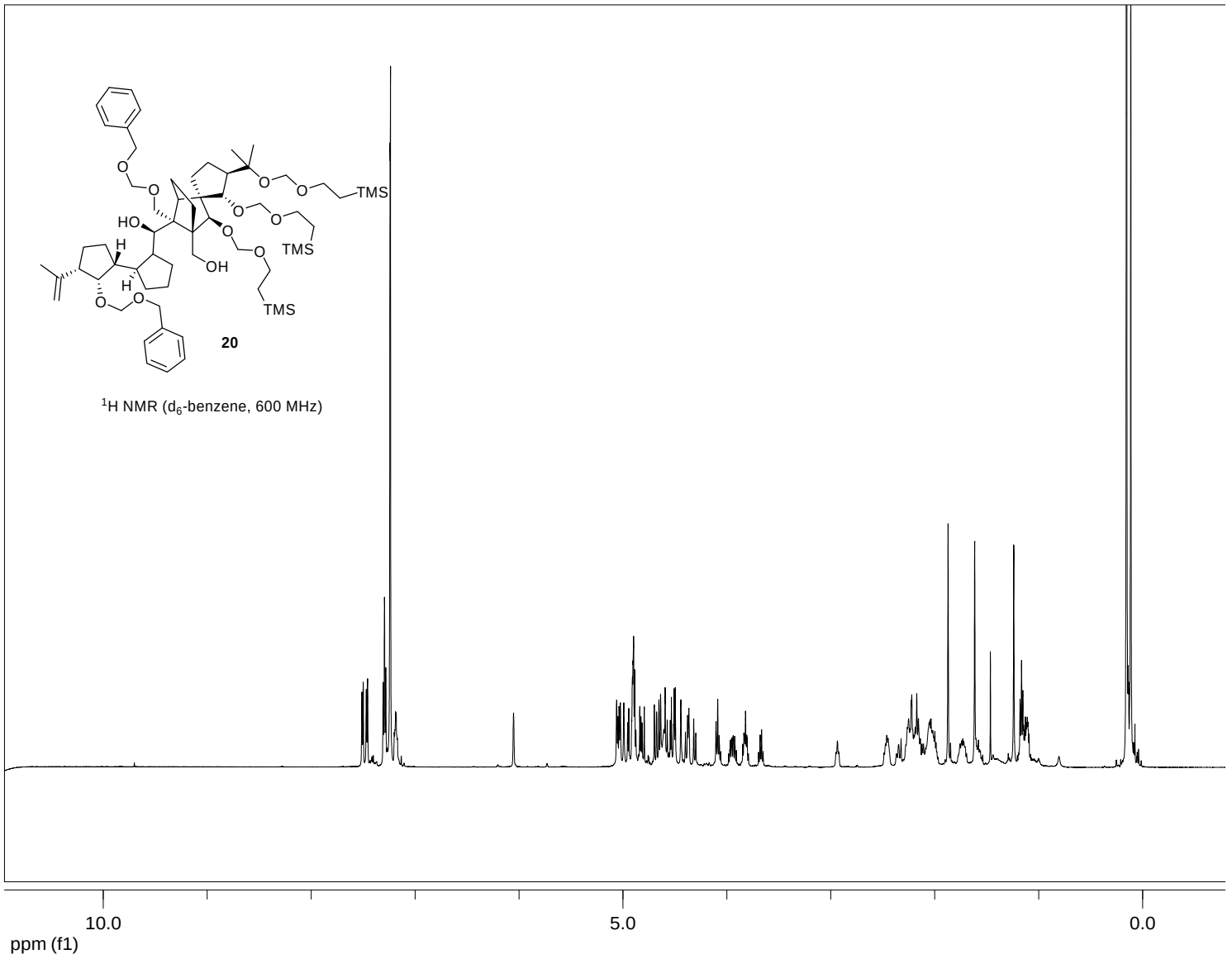
6

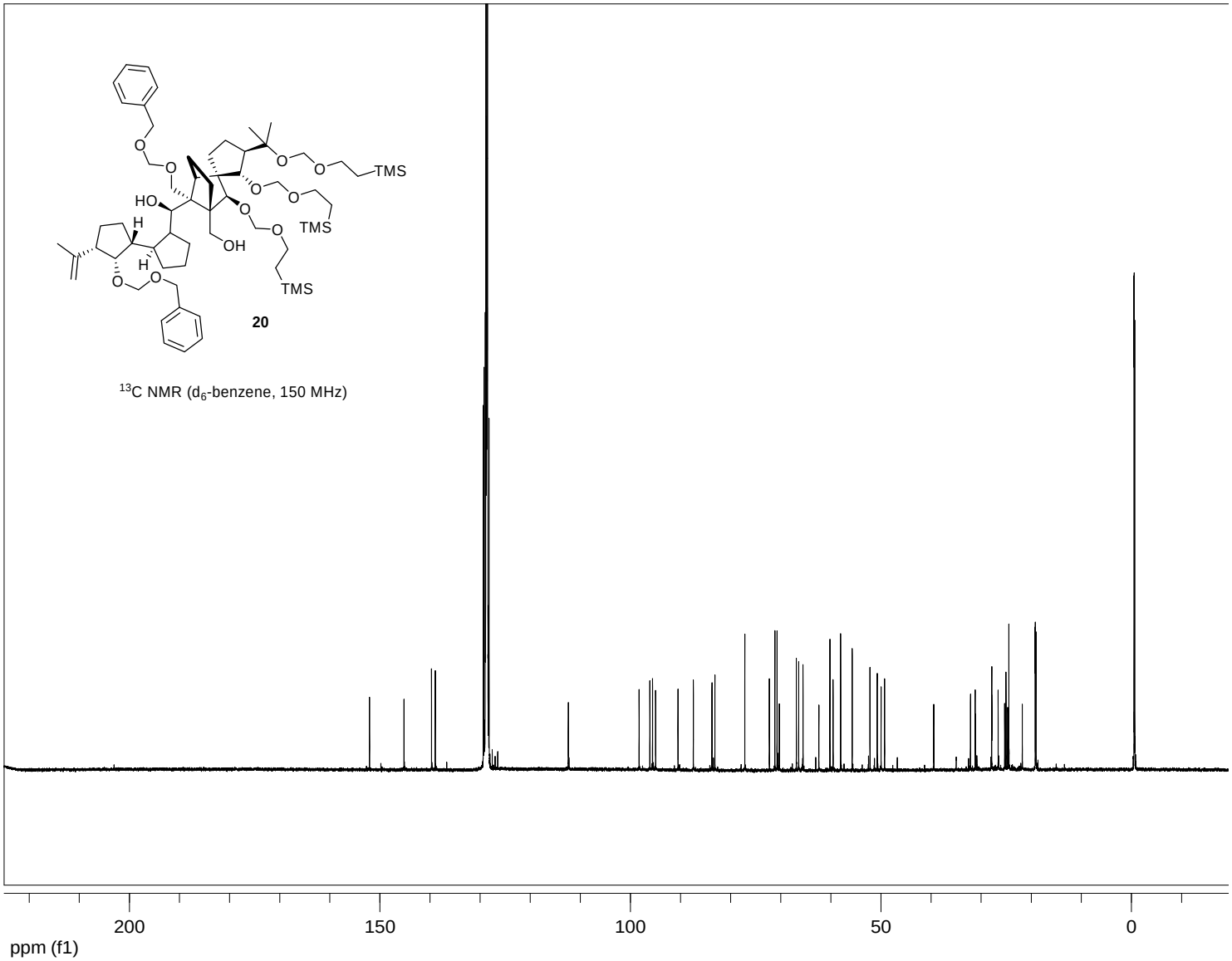
^{1}H NMR (d_6-benzene, 600 MHz)

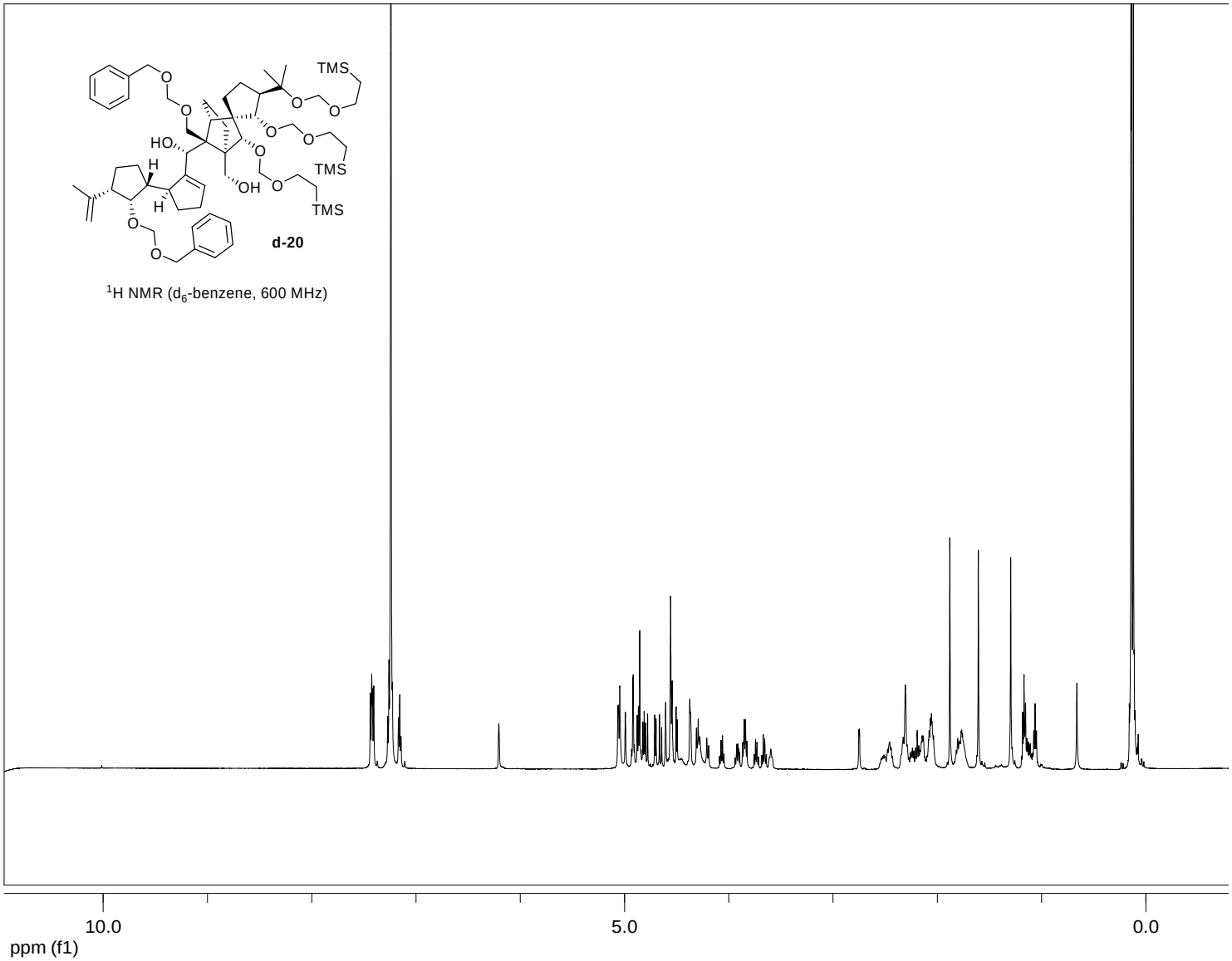


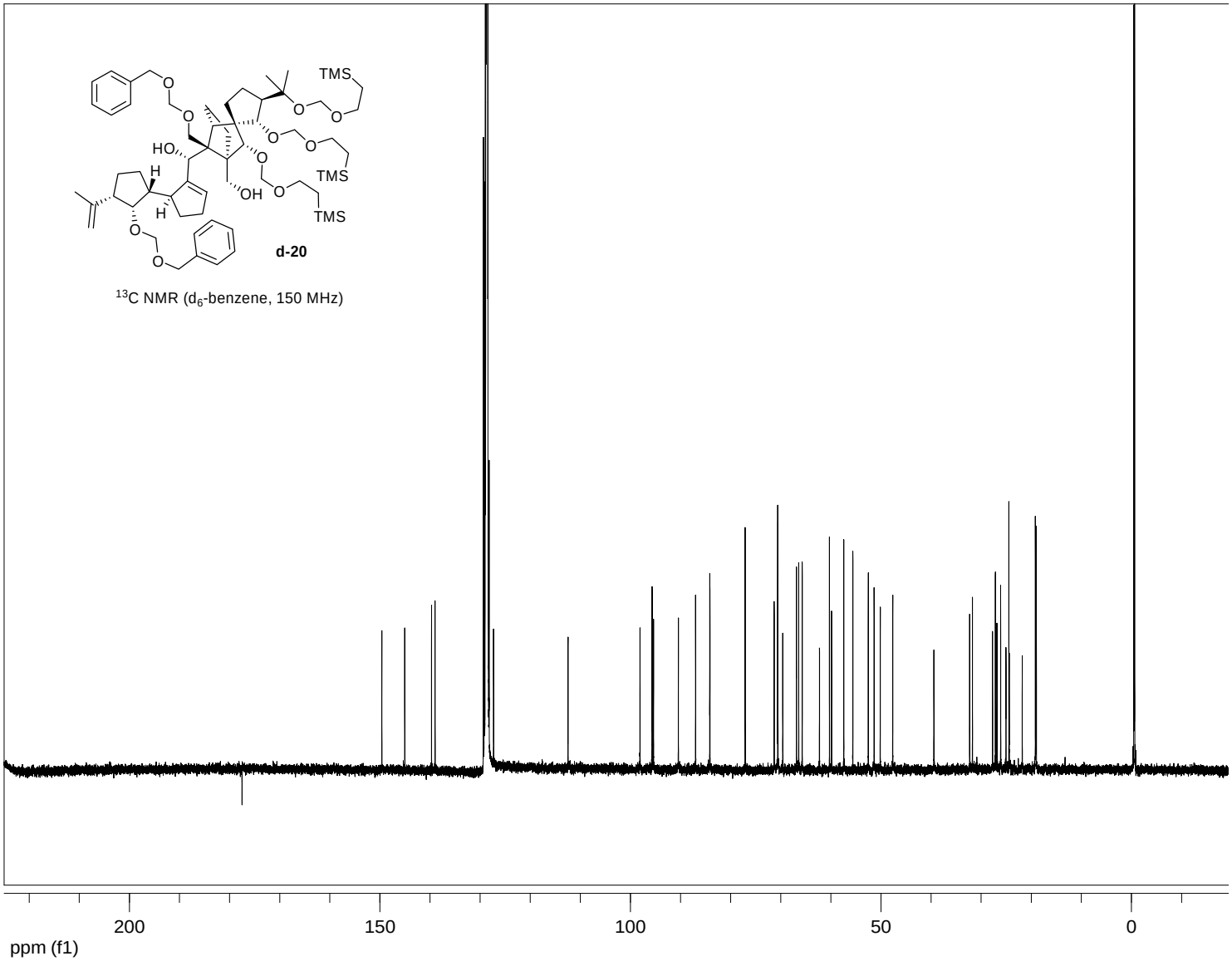
6

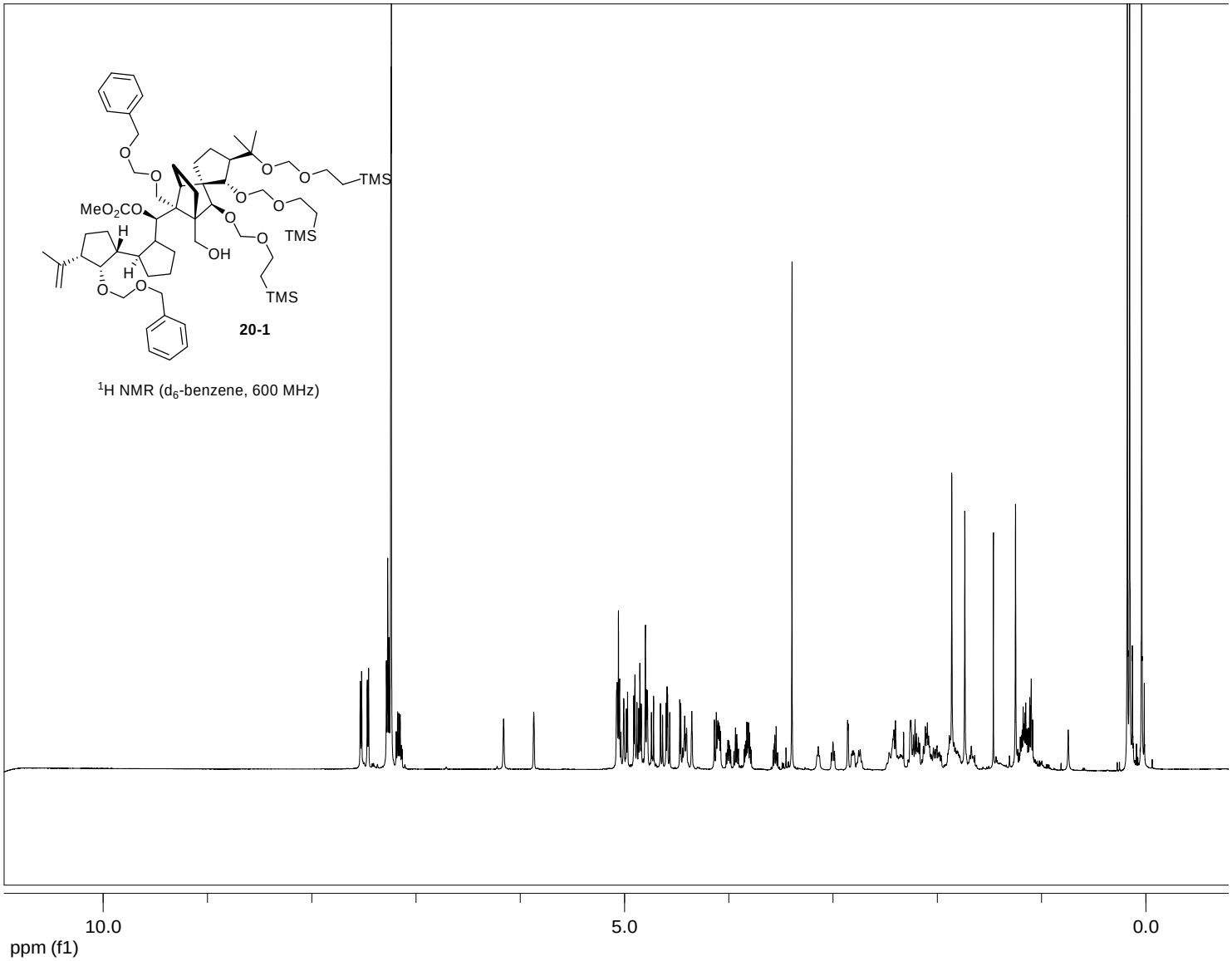
^{13}C NMR (d_6-benzene, 150 MHz)

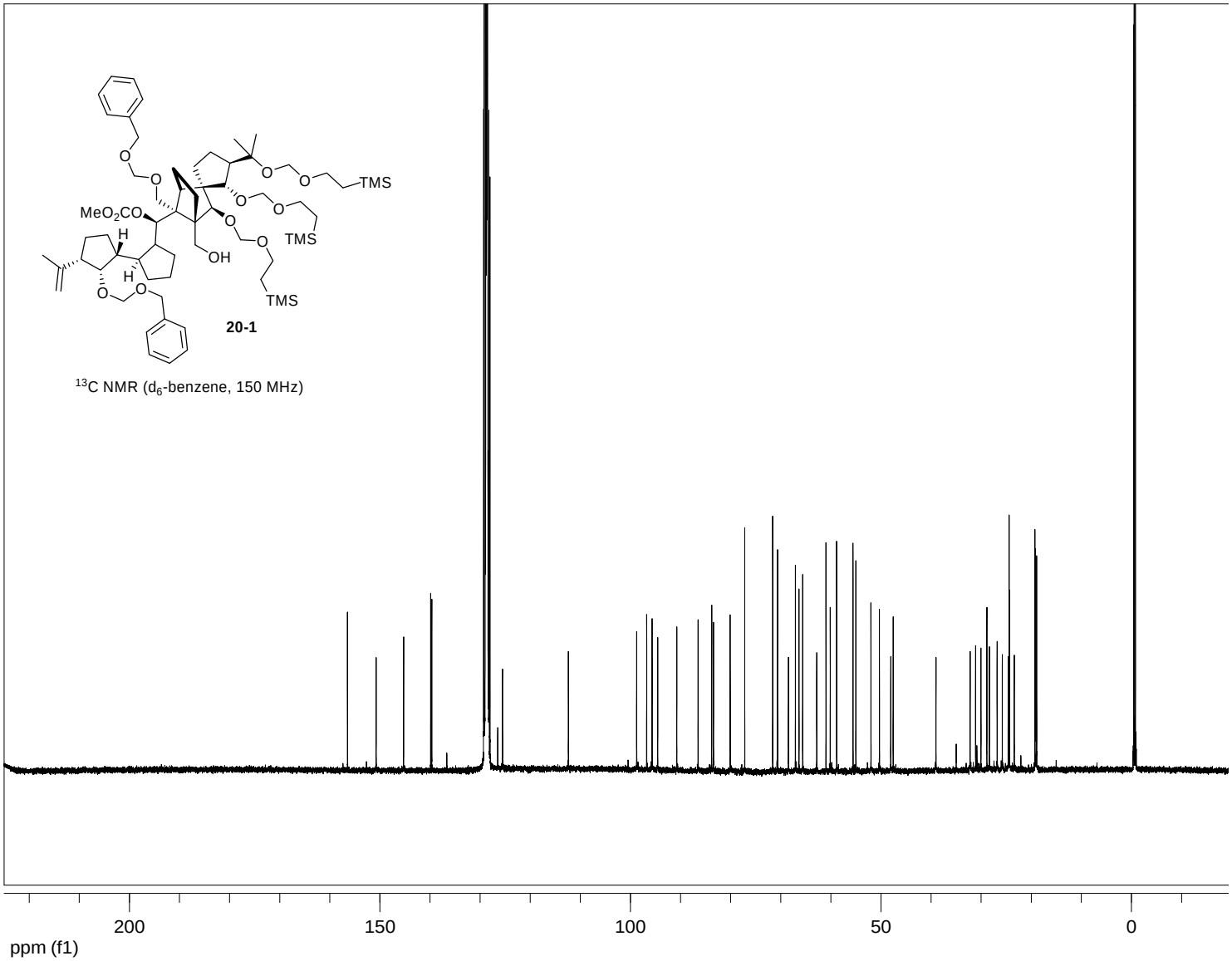

HO
H
H
OH
TMS
TMS
TMS
20
^{1}H NMR (d_6-benzene, 600 MHz)
10.0
5.0
0.0
ppm (f1)

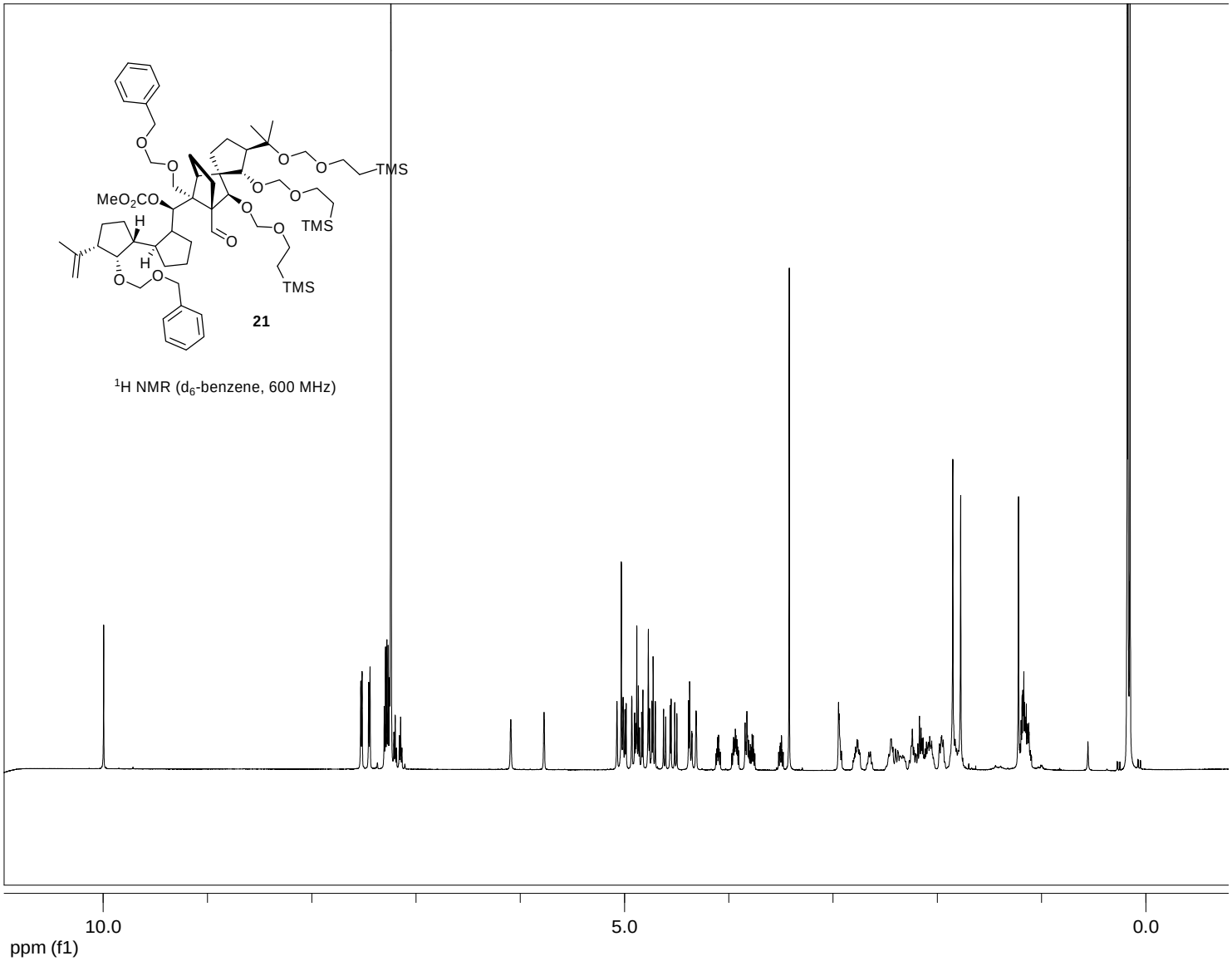

HO
H
H
OH
TMS
TMS
TMS
20
^{13}C NMR (d_6-benzene, 150 MHz)
200
150
100
50
0
ppm (f1)

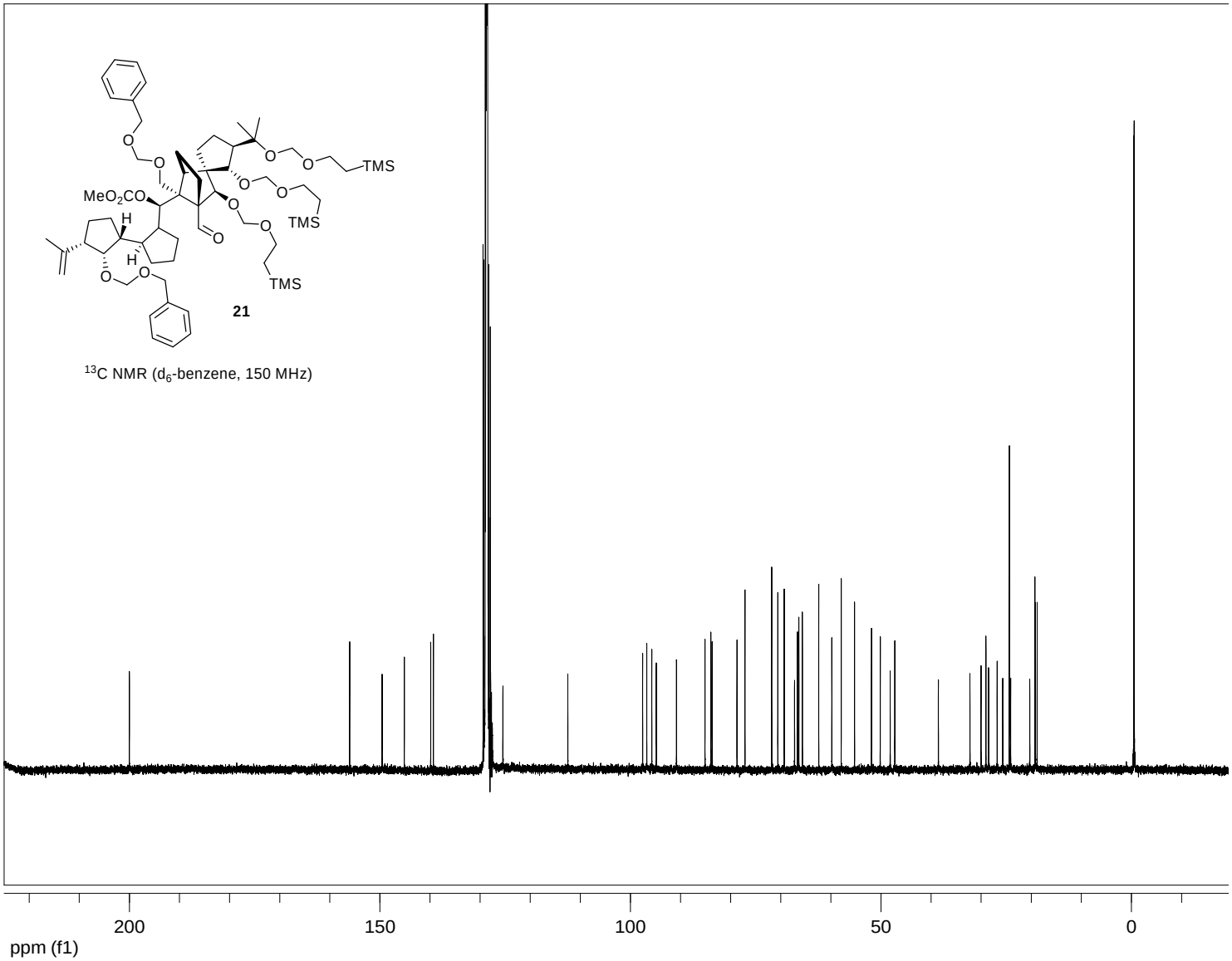

TMS
HO
H
OH
TMS
TMS
H
d-20
^{1}H NMR (d_6-benzene, 600 MHz)
10.0
5.0
0.0
ppm (f1)

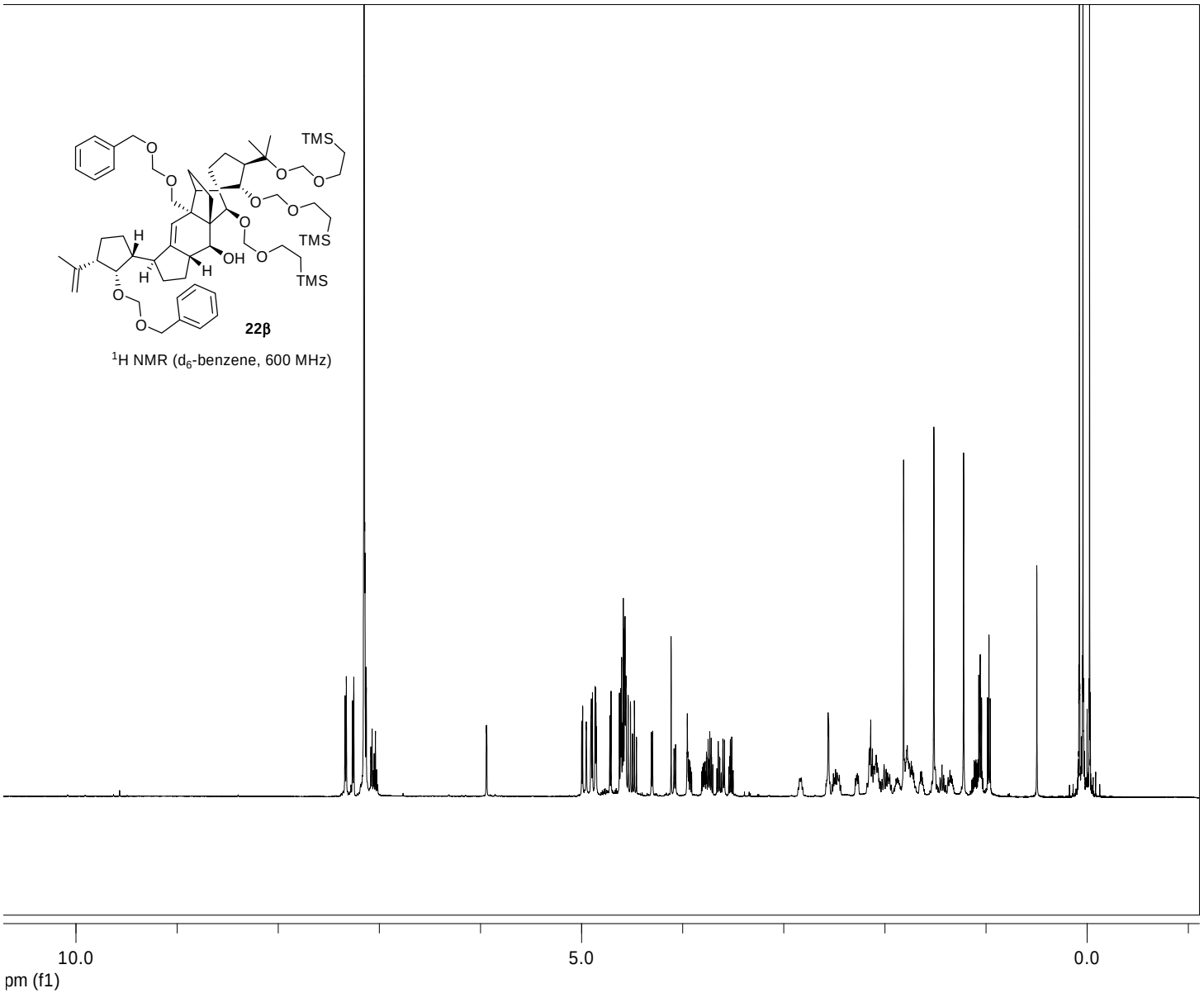

TMS
HO
H
OH
TMS
TMS
H
O
O
d-20
^{13}C NMR (d_6-benzene, 150 MHz)
200
150
100
50
0
ppm (f1)

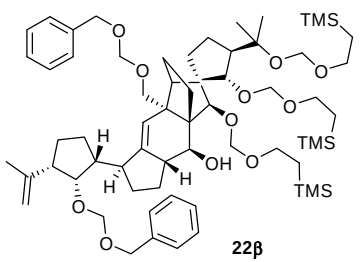

MeO2CO
H
H
OH
TMS
TMS
TMS
20-1
1H NMR (d6-benzene, 600 MHz)
10.0
5.0
0.0
ppm (f1)


MeO2CO
H
H
OH
O
TMS
TMS
TMS
20-1
13C NMR (d6-benzene, 150 MHz)
200
150
100
50
0
ppm (f1)


MeO2CO
H
H
O
TMS
TMS
TMS
21
1H NMR (d6-benzene, 600 MHz)
10.0
5.0
0.0
ppm (f1)

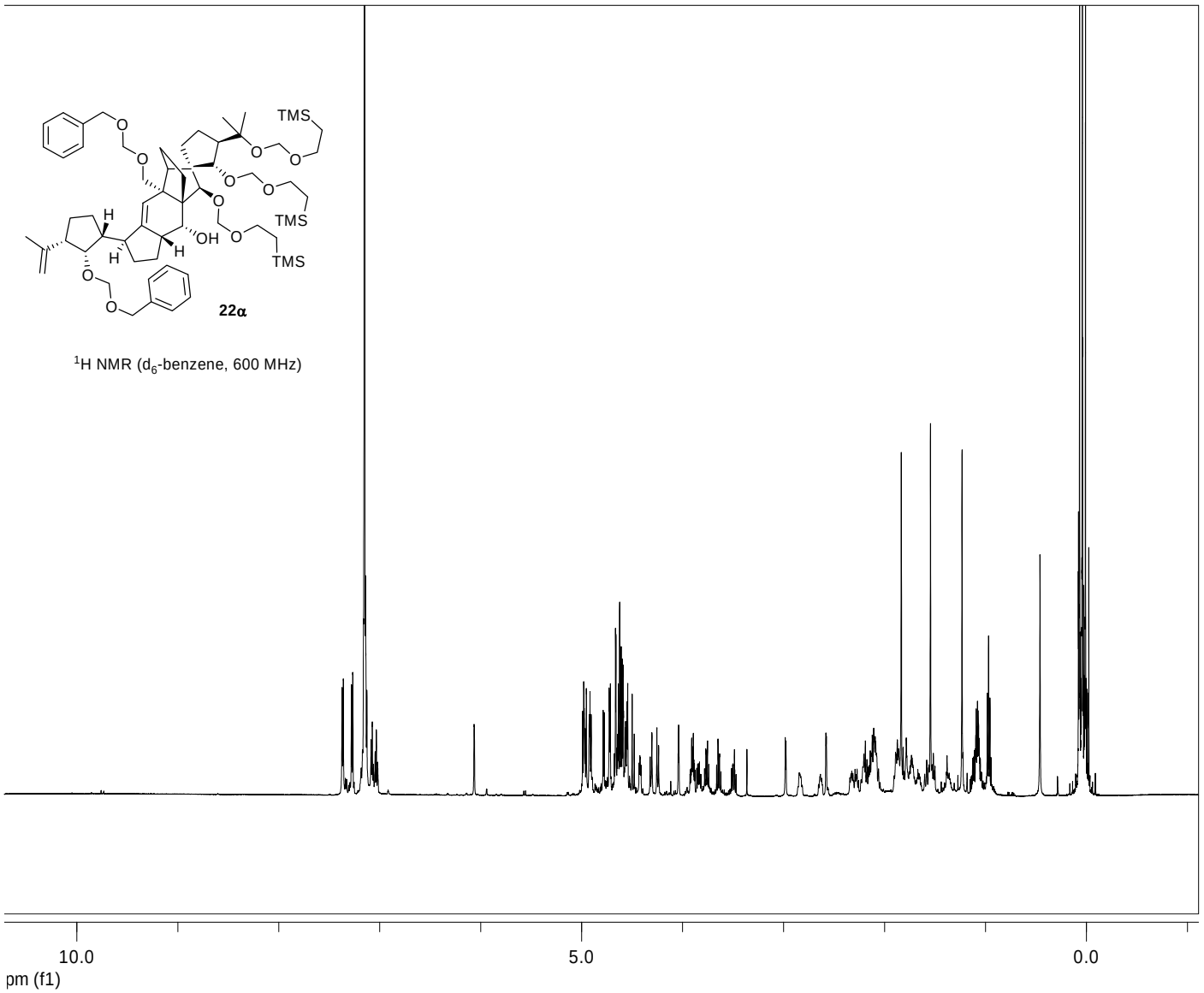

MeO2CO
H
H
O
O
O
O
O
O
O
O
O
TMS
TMS
TMS
21
13C NMR (d6-benzene, 150 MHz)
200
150
100
50
0
ppm (f1)

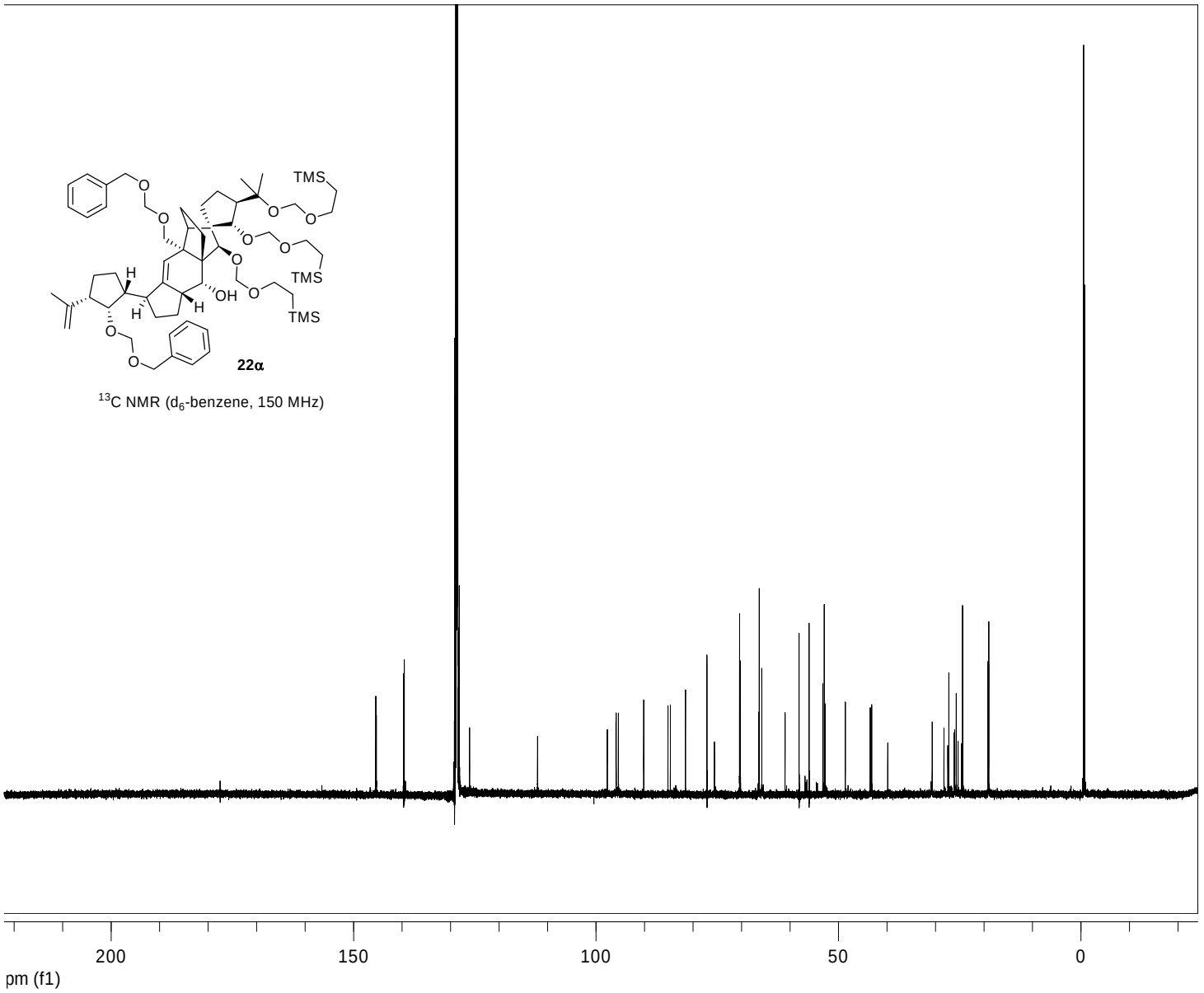

TMS
TMS
TMS
OH
H
H
H
O
O
O
O
O
O
O
O
O
O
O
O
22β
^{1}H NMR (d_6-benzene, 600 MHz)
10.0
5.0
0.0
pm (f1)

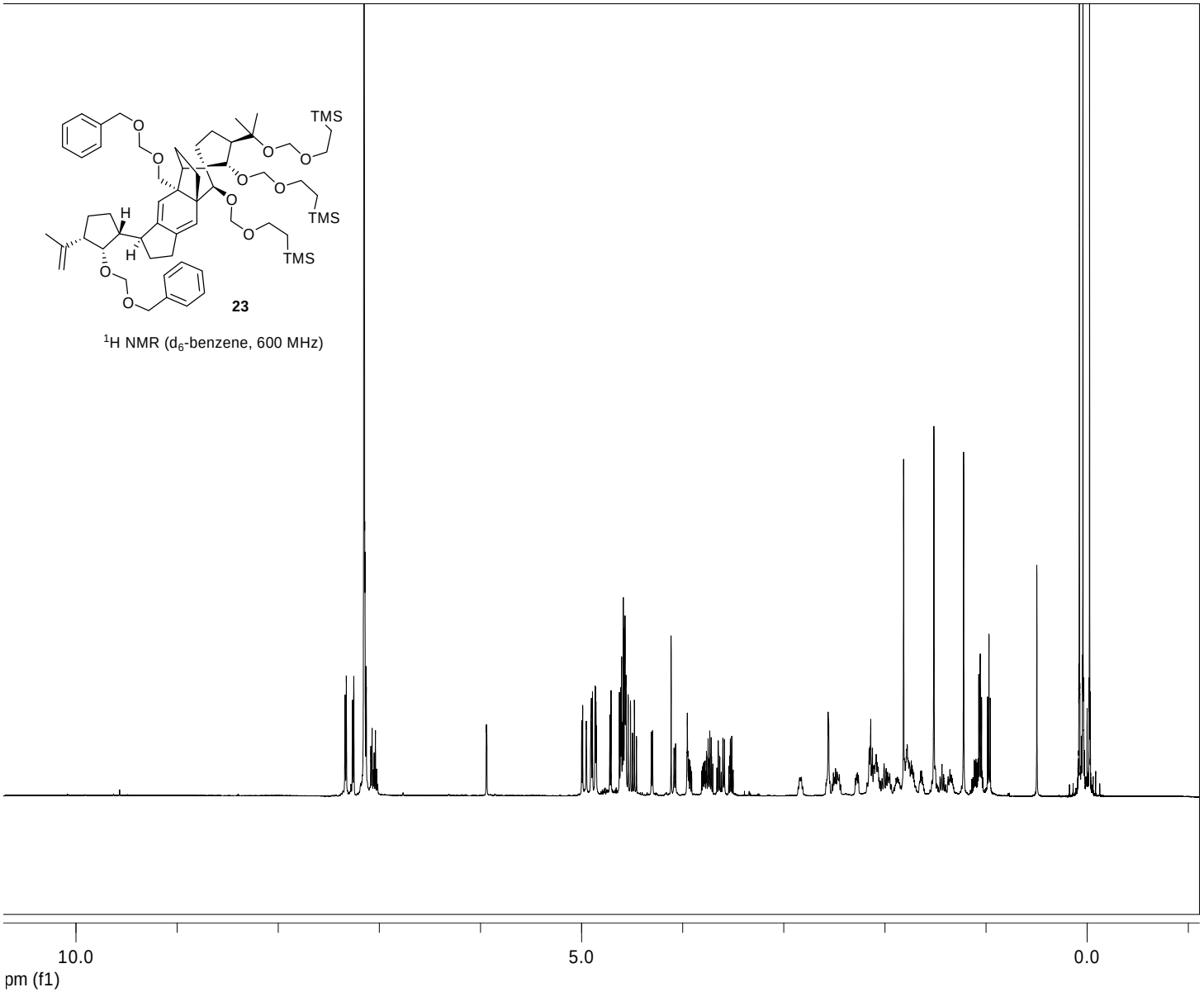


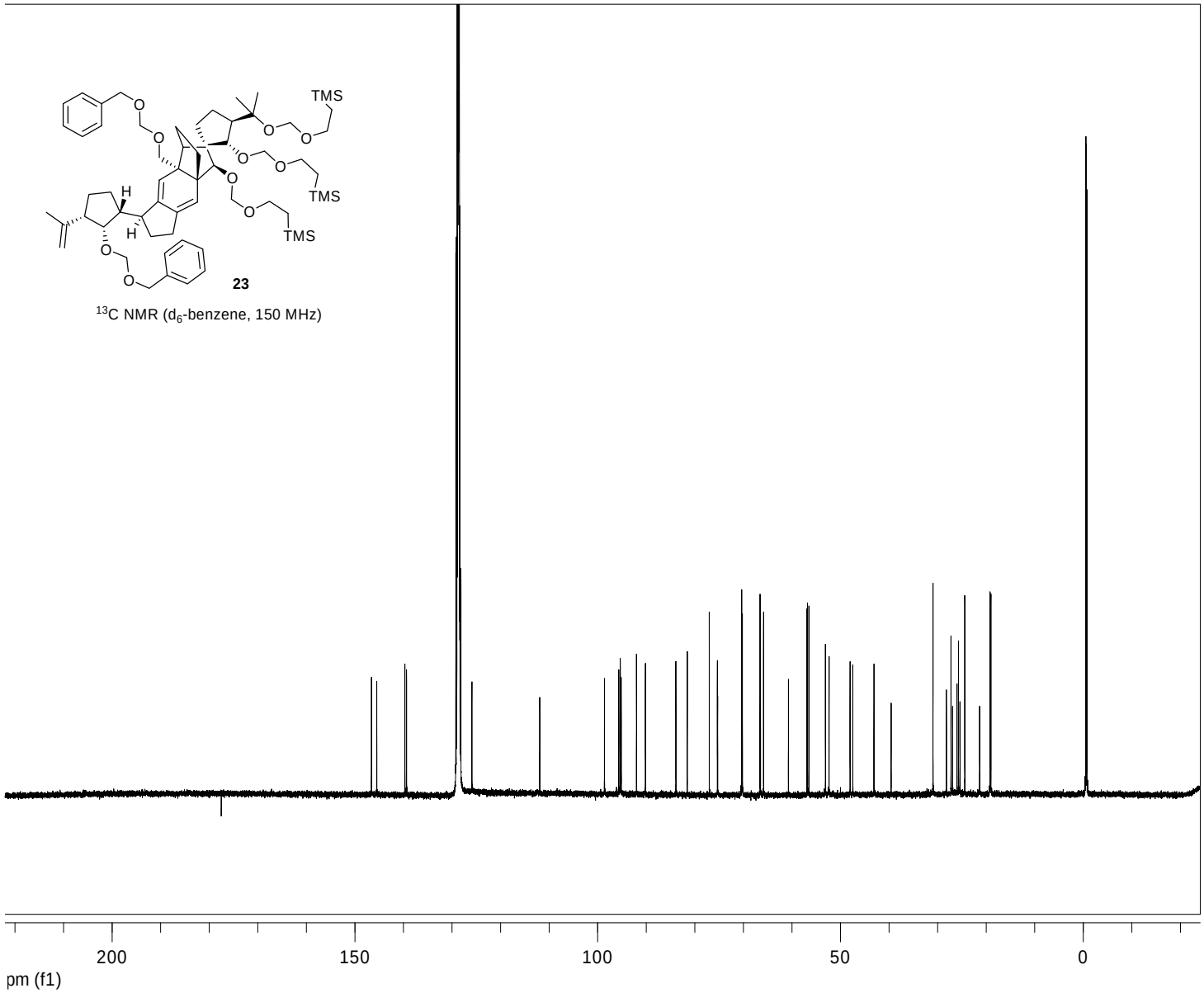
22β

^{13}C NMR (d_6-benzene, 150 MHz)


TMS
TMS
TMS
OH
H
H
H
O
O
O
O
O
O
O
O
O
O
O
22α
^{1}H NMR (d_6-benzene, 600 MHz)
10.0
5.0
0.0
pm (f1)

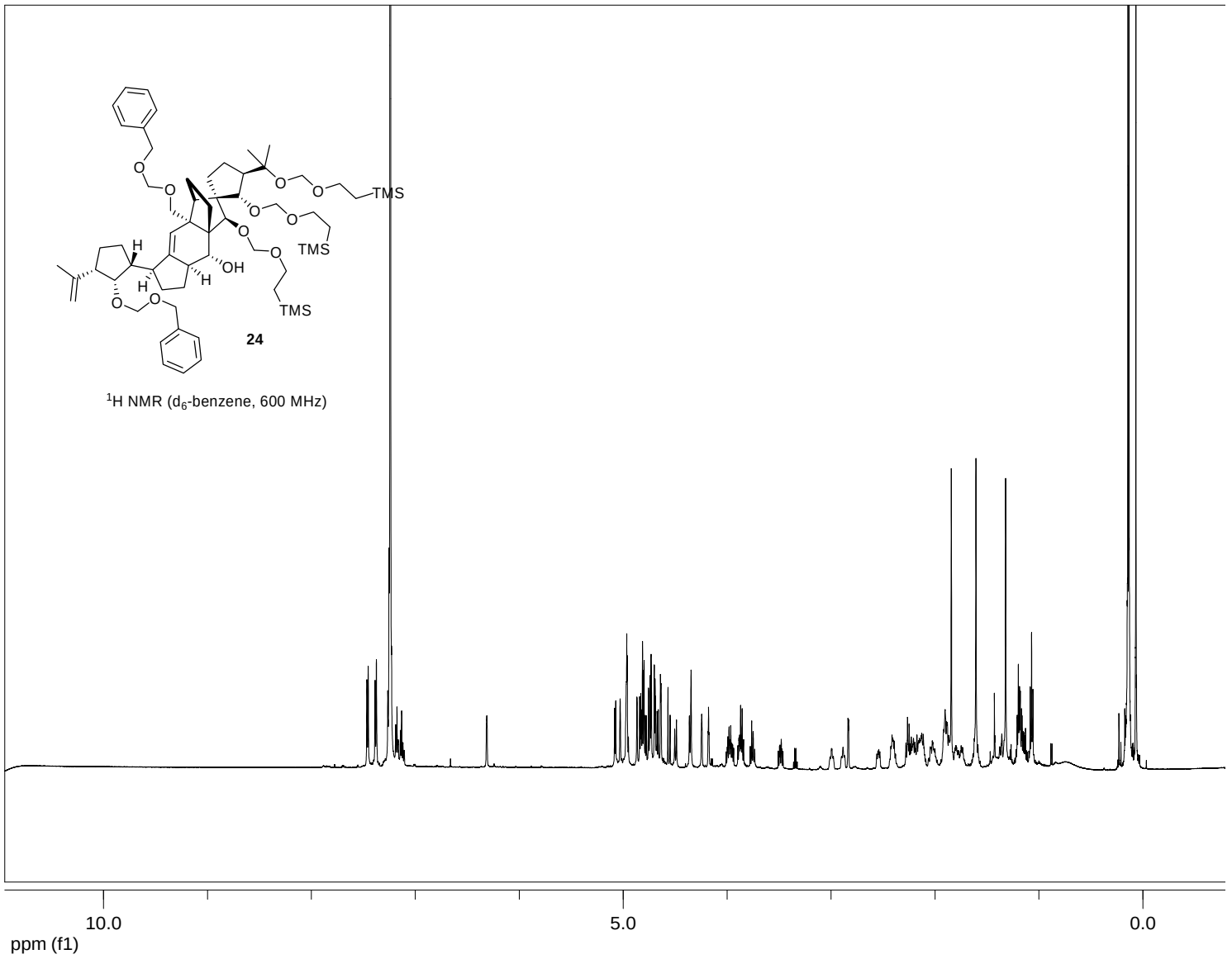

TMS
TMS
TMS
OH
H
H
H
O
O
O
O
O
O
O
O
O
O
O
O
22α
^{13}C NMR (d_6-benzene, 150 MHz)
200
150
100
50
0
pm (f1)


TMS
TMS
TMS
H
H
O
O
O
O
O
O
O
O
O
O
O
O
23
^{1}H NMR (d_6-benzene, 600 MHz)
10.0
5.0
0.0
pm (f1)



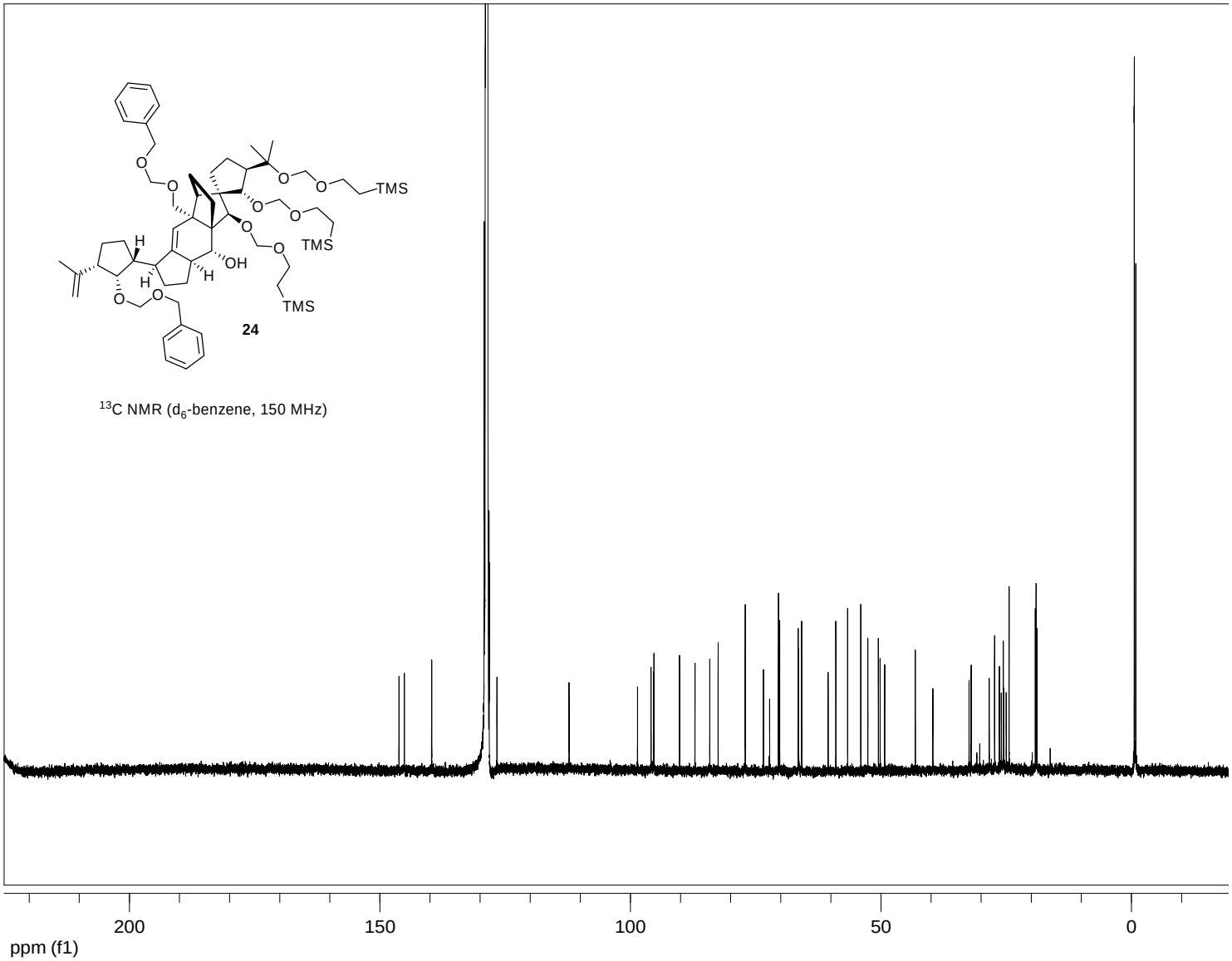
23

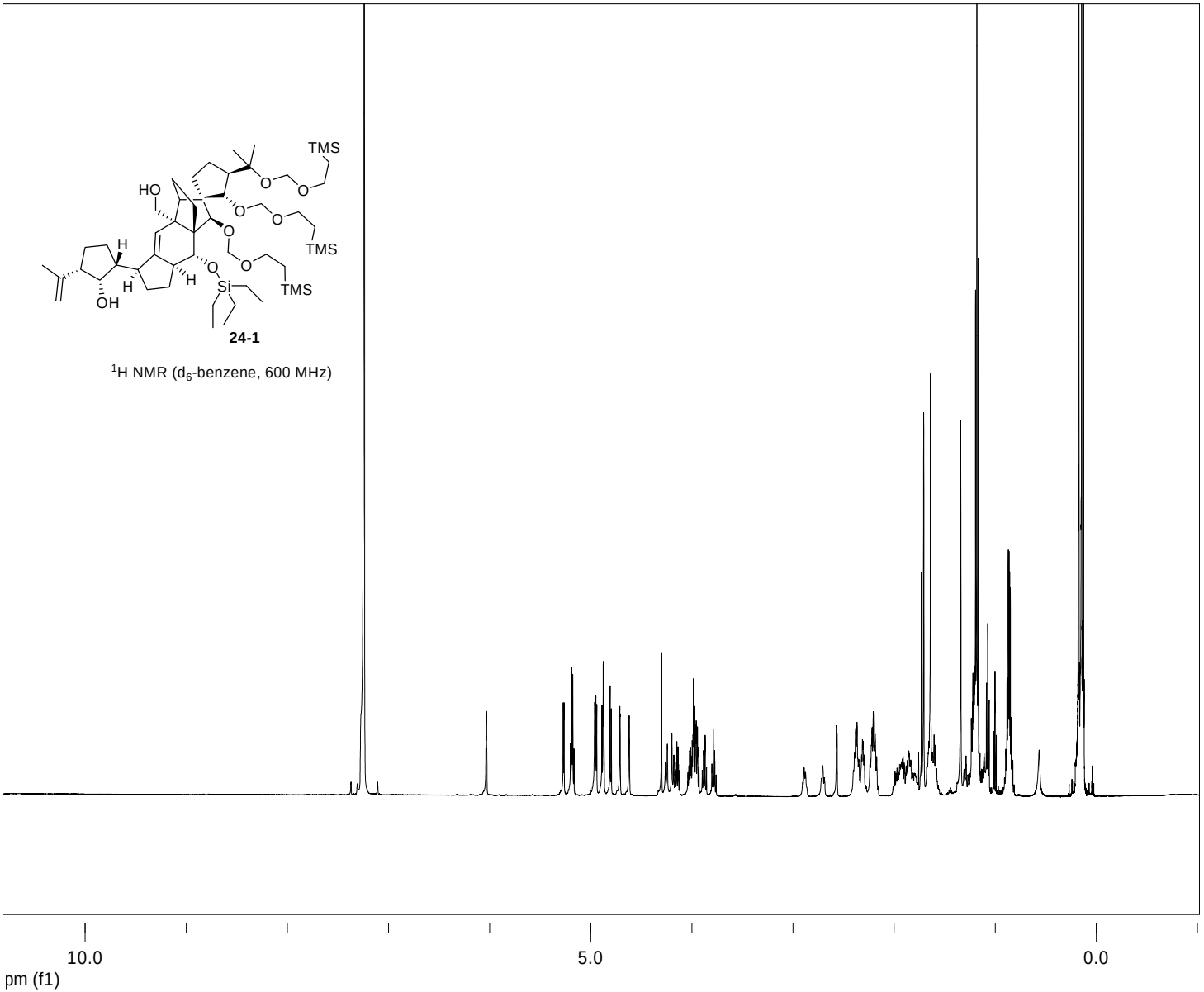
^{13}C NMR (d_6-benzene, 150 MHz)

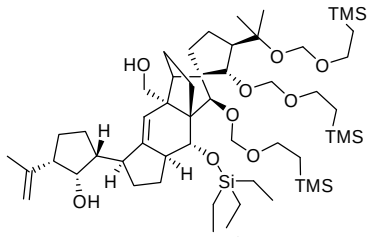


24

^{1}H NMR (d_6-benzene, 600 MHz)

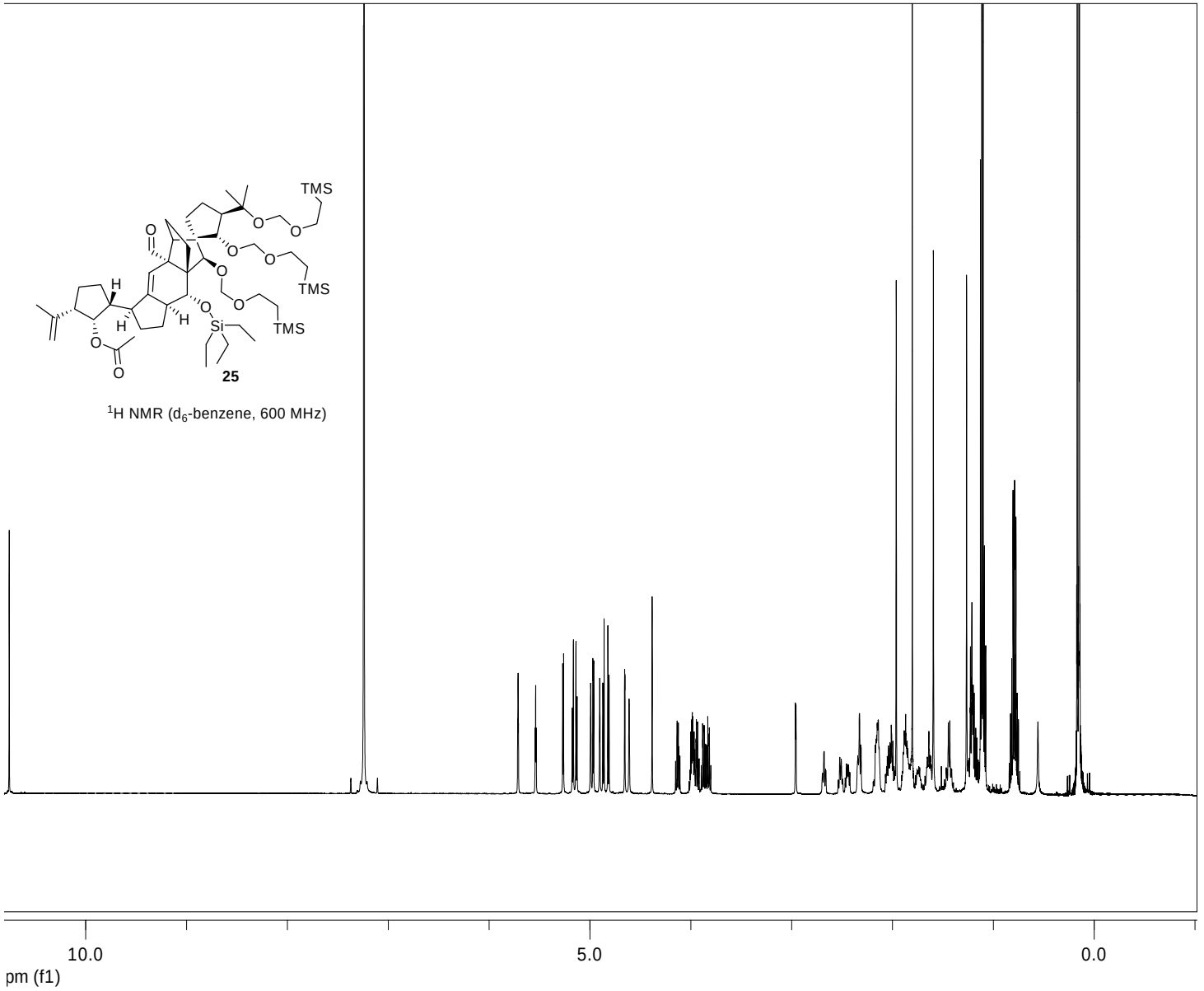

TMS
TMS
TMS
OH
H
H
H
O
24
^{13}C NMR (d_6-benzene, 150 MHz)
200
150
100
50
0
ppm (f1)


TMS
HO
O
O
O
O
O
TMS
H
O
O
TMS
H
H
OH
O
Si
24-1
^{1}H NMR (d_6-benzene, 600 MHz)
10.0
5.0
0.0
pm (f1)

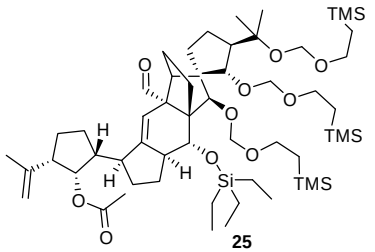


24-1

^{13}C NMR (d_6-benzene, 150 MHz)

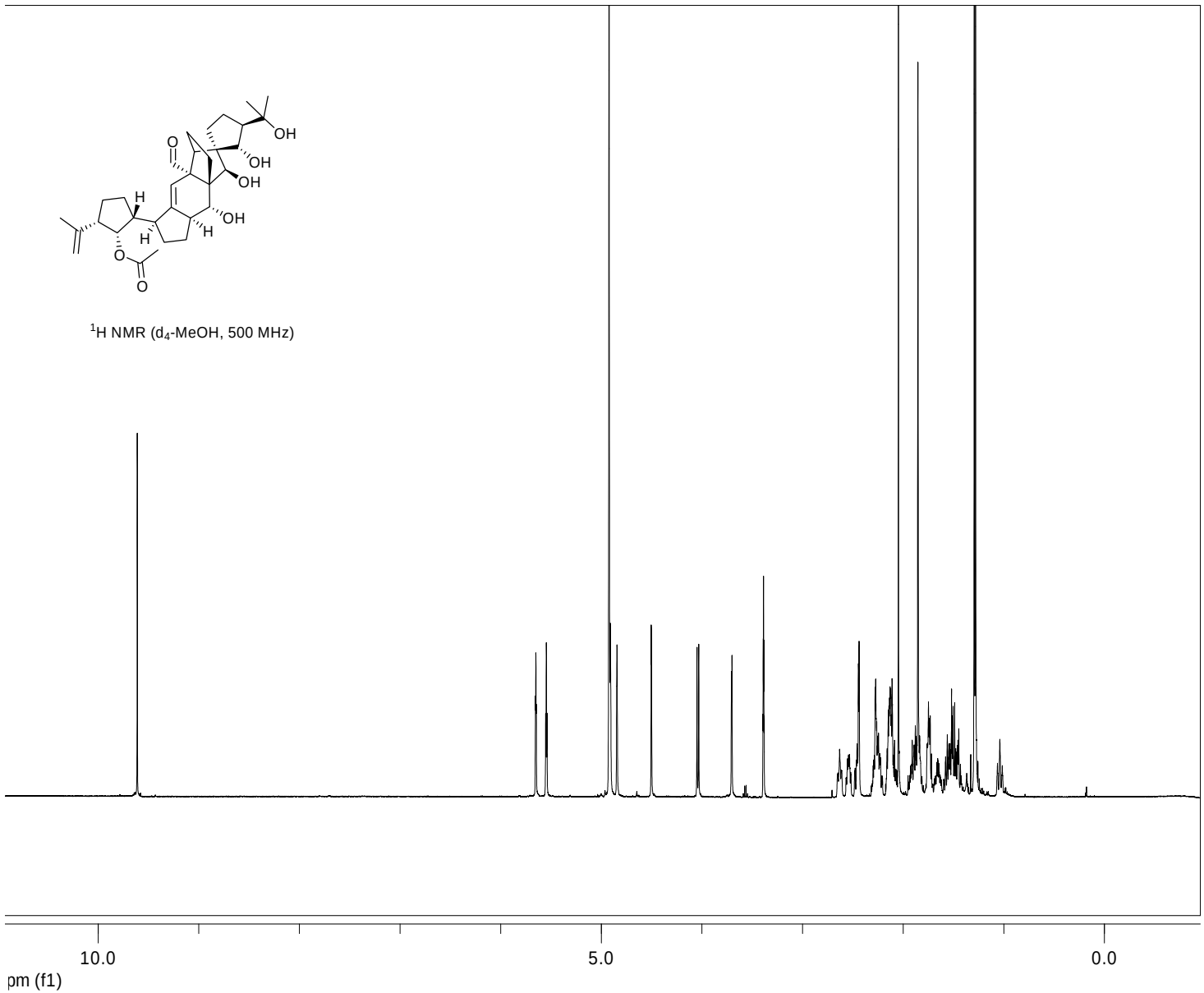


^{1}H NMR (d_6-benzene, 600 MHz)

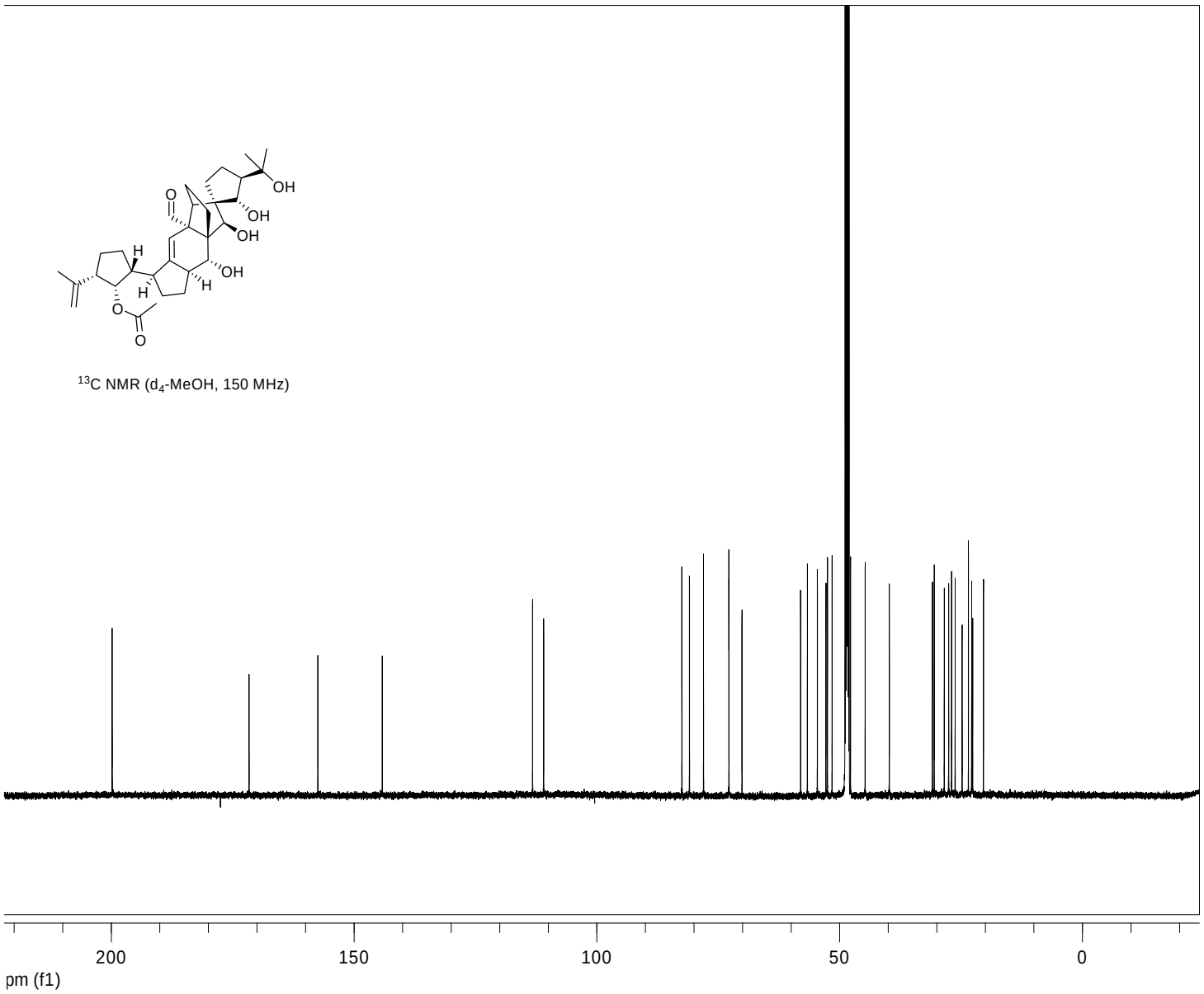


25

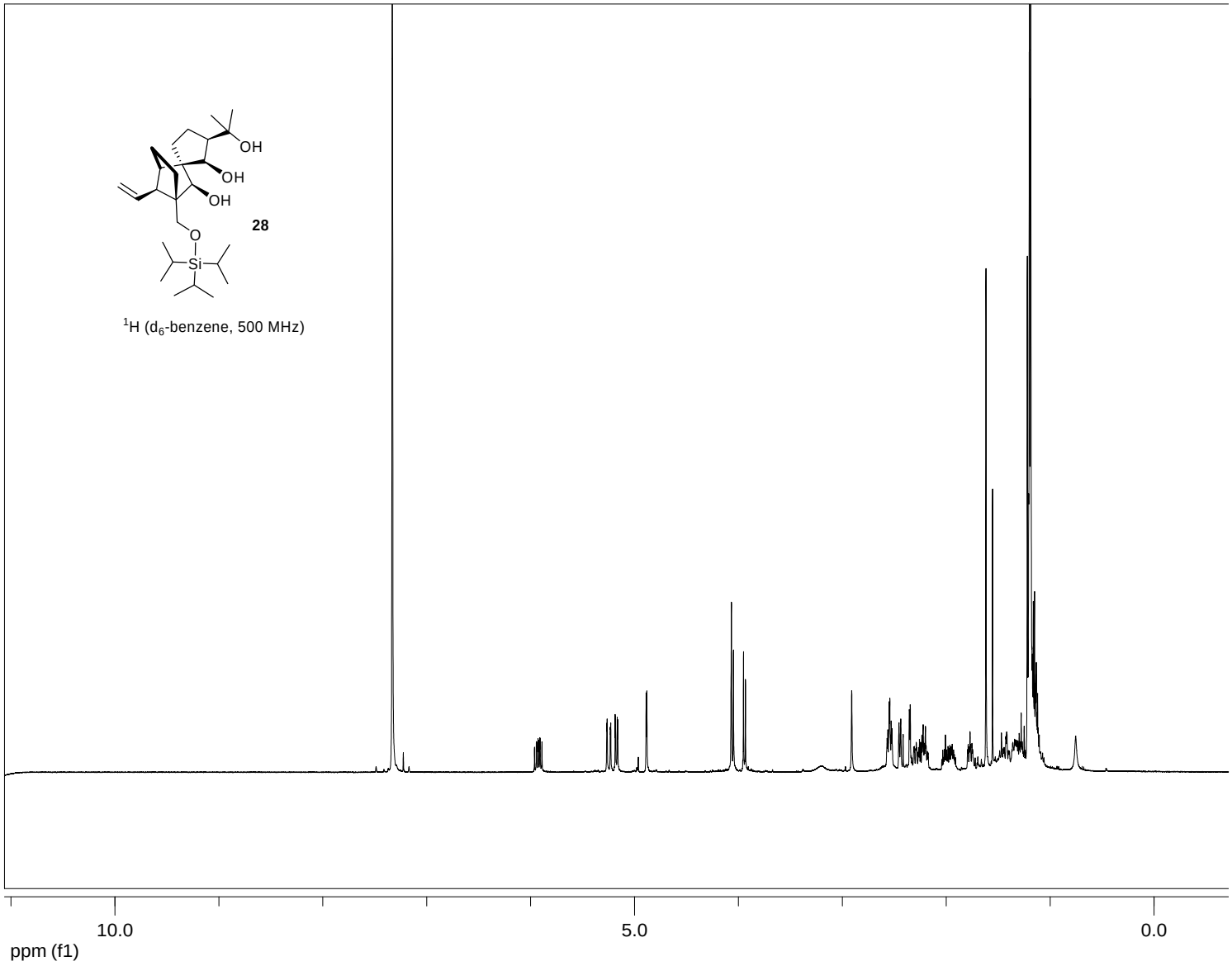
^{13}C NMR (d_6-benzene, 150 MHz)

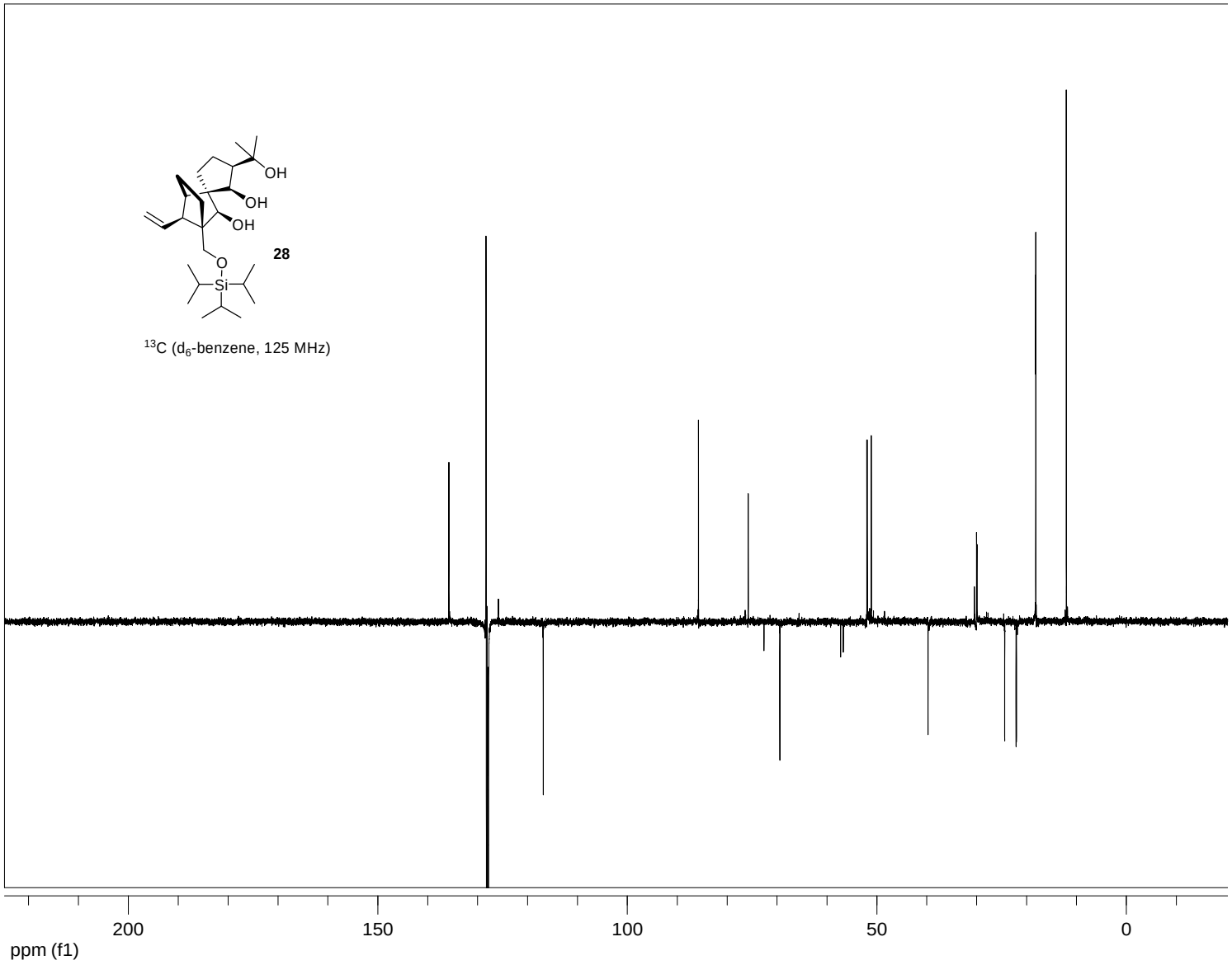


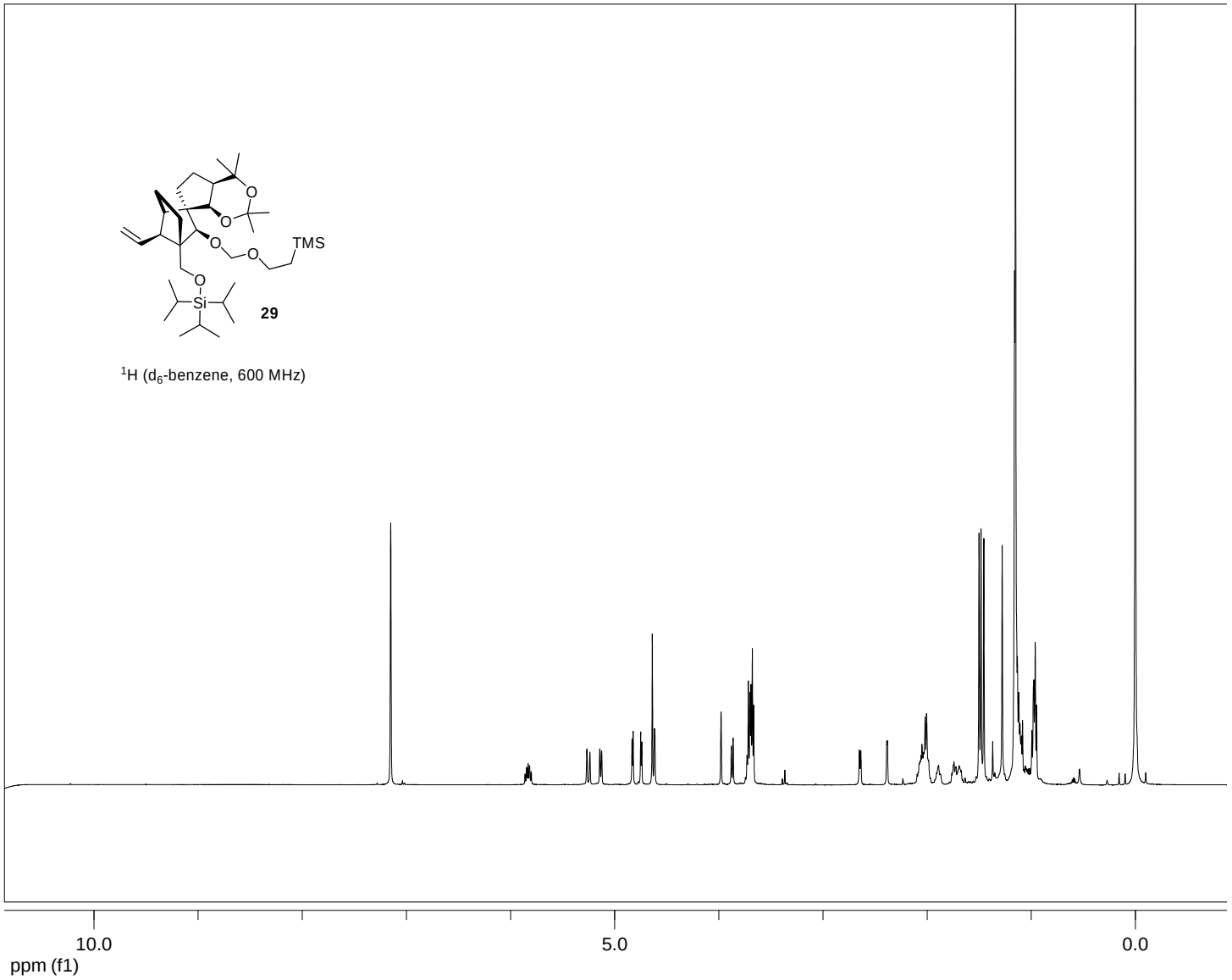
^{1}H NMR (d_4-MeOH, 500 MHz)

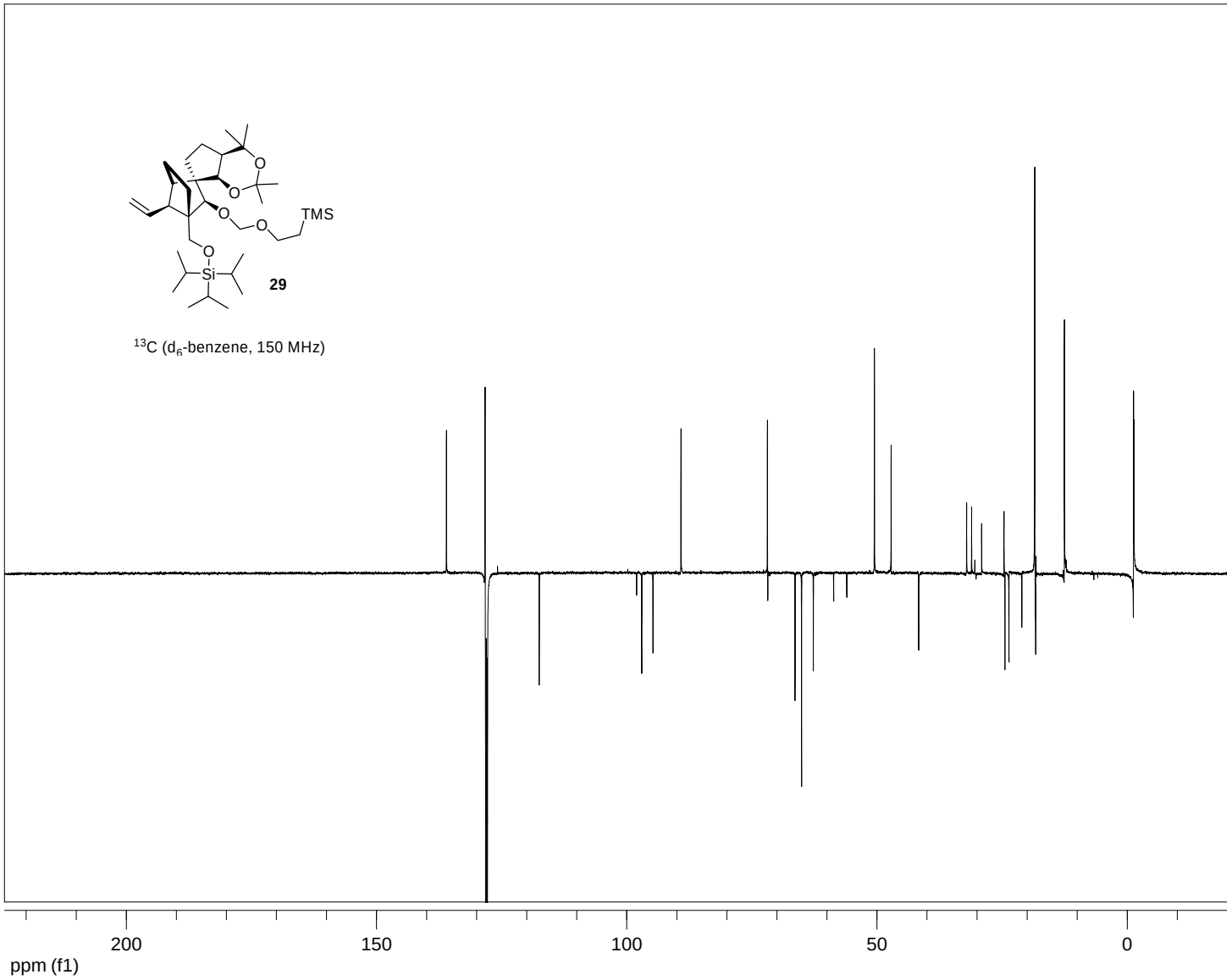


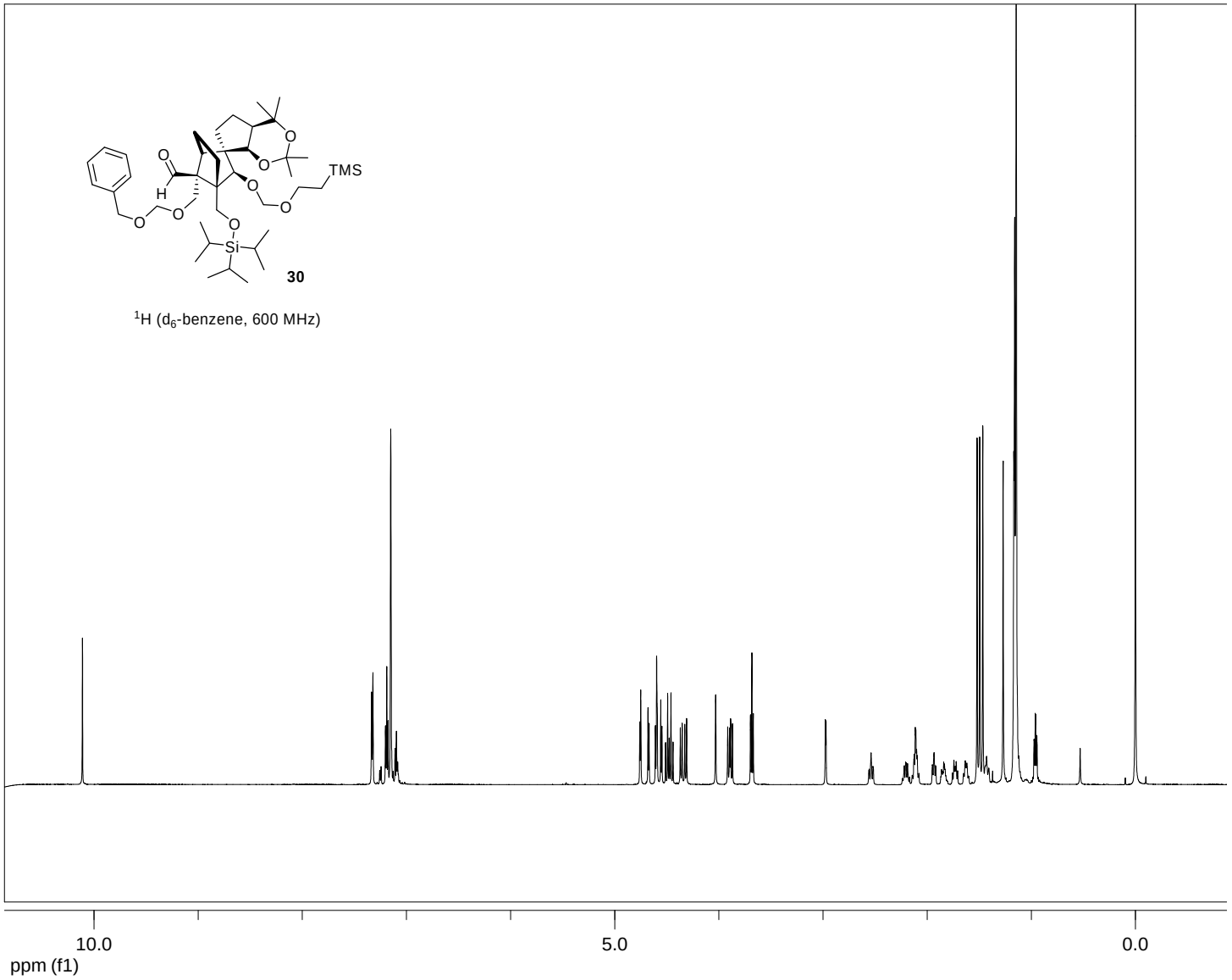
^{13}C NMR (d_4-MeOH, 150 MHz)

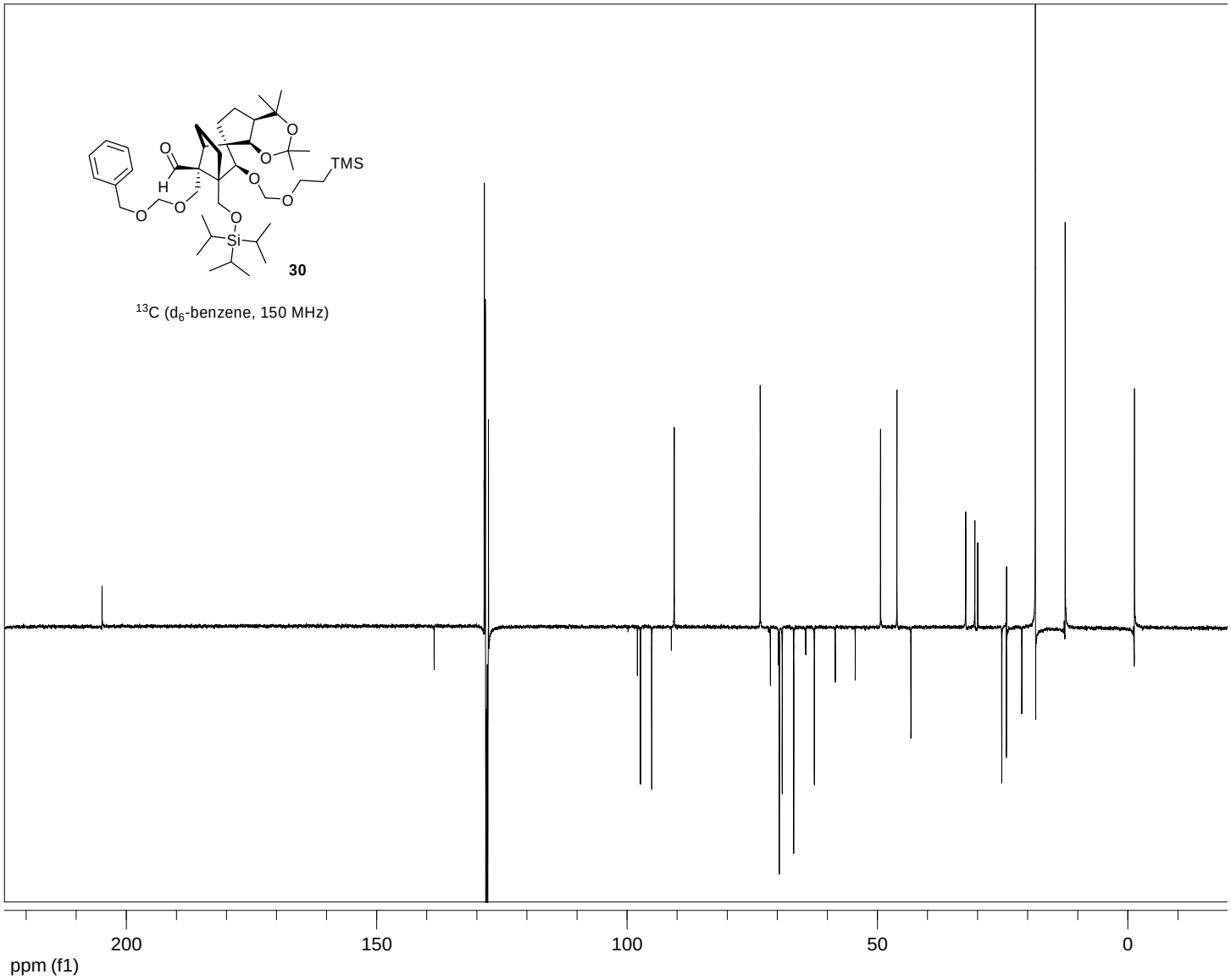

OH
OH
OH
O
Si
28
^{1}H (d_6-benzene, 500 MHz)
10.0
5.0
0.0
ppm (f1)

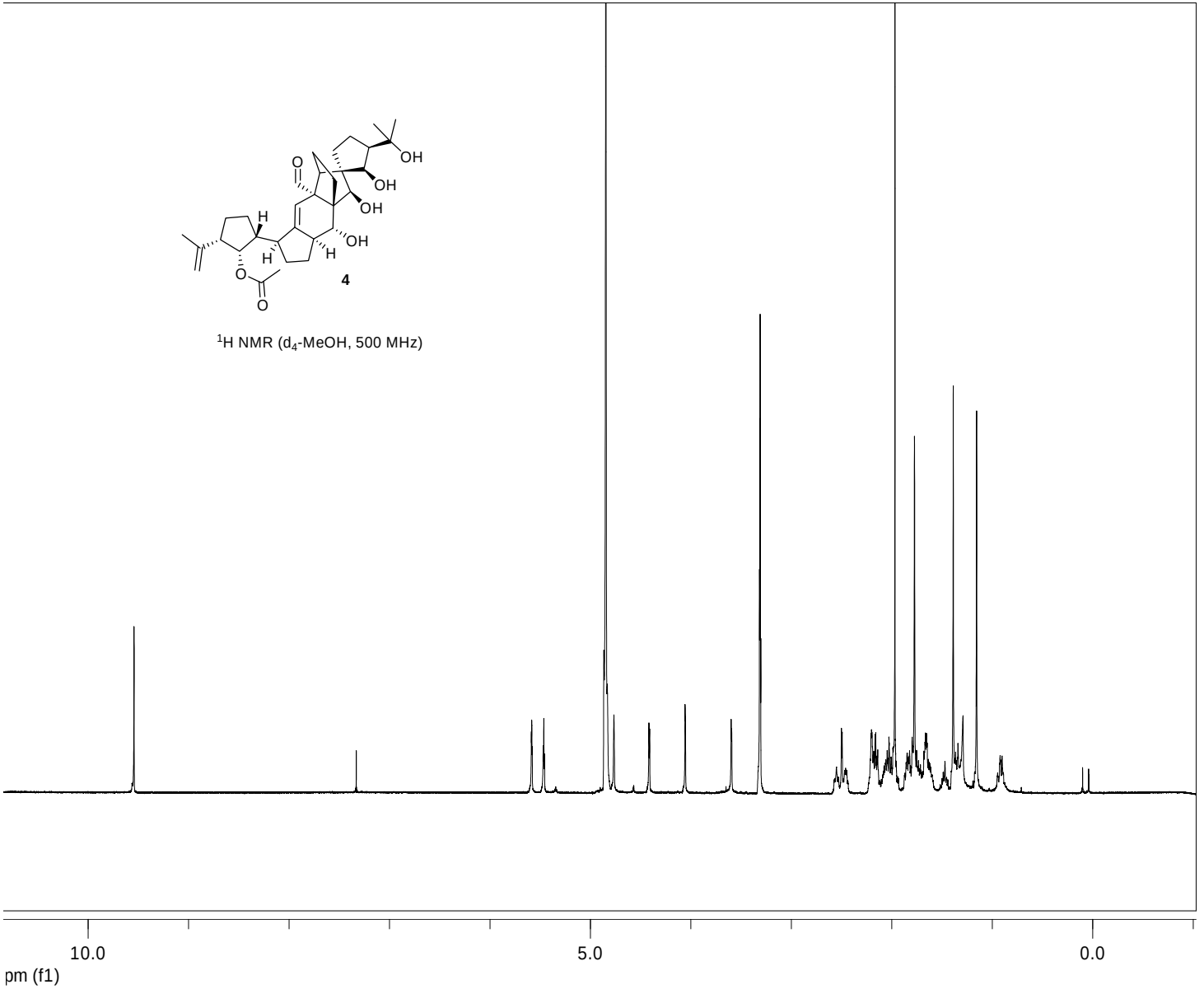

OH
OH
OH
O
Si
28
^{13}C (d_6-benzene, 125 MHz)
200
150
100
50
0
ppm (f1)


TMS
29
^{1}H (d_6-benzene, 600 MHz)
10.0
5.0
0.0
ppm (f1)

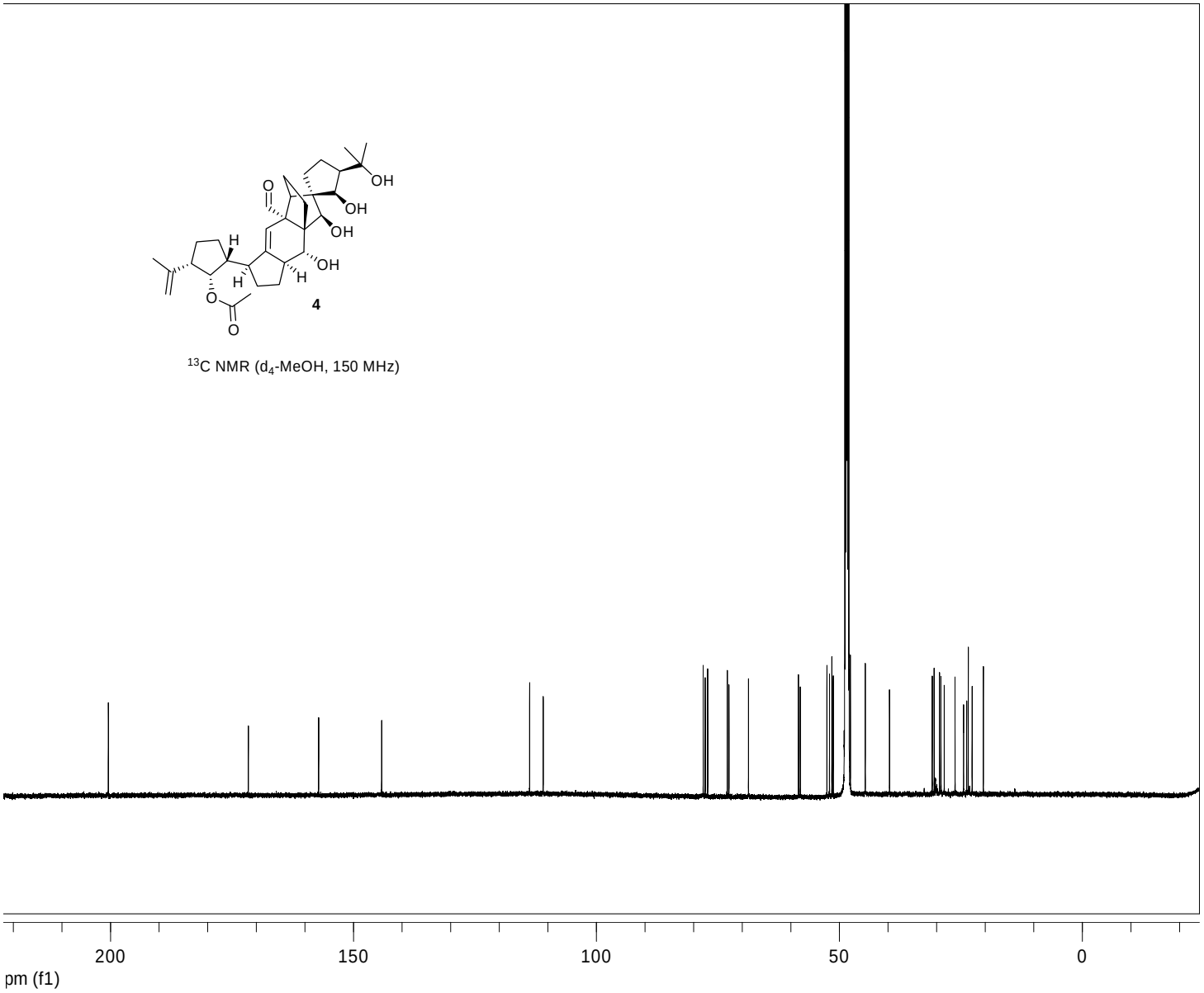

TMS
O
Si
29
^{13}C (d_6-benzene, 150 MHz)
200
150
100
50
0
ppm (f1)


TMS
O
H
Si
30
^{1}H (d_6-benzene, 600 MHz)
10.0
5.0
0.0
ppm (f1)

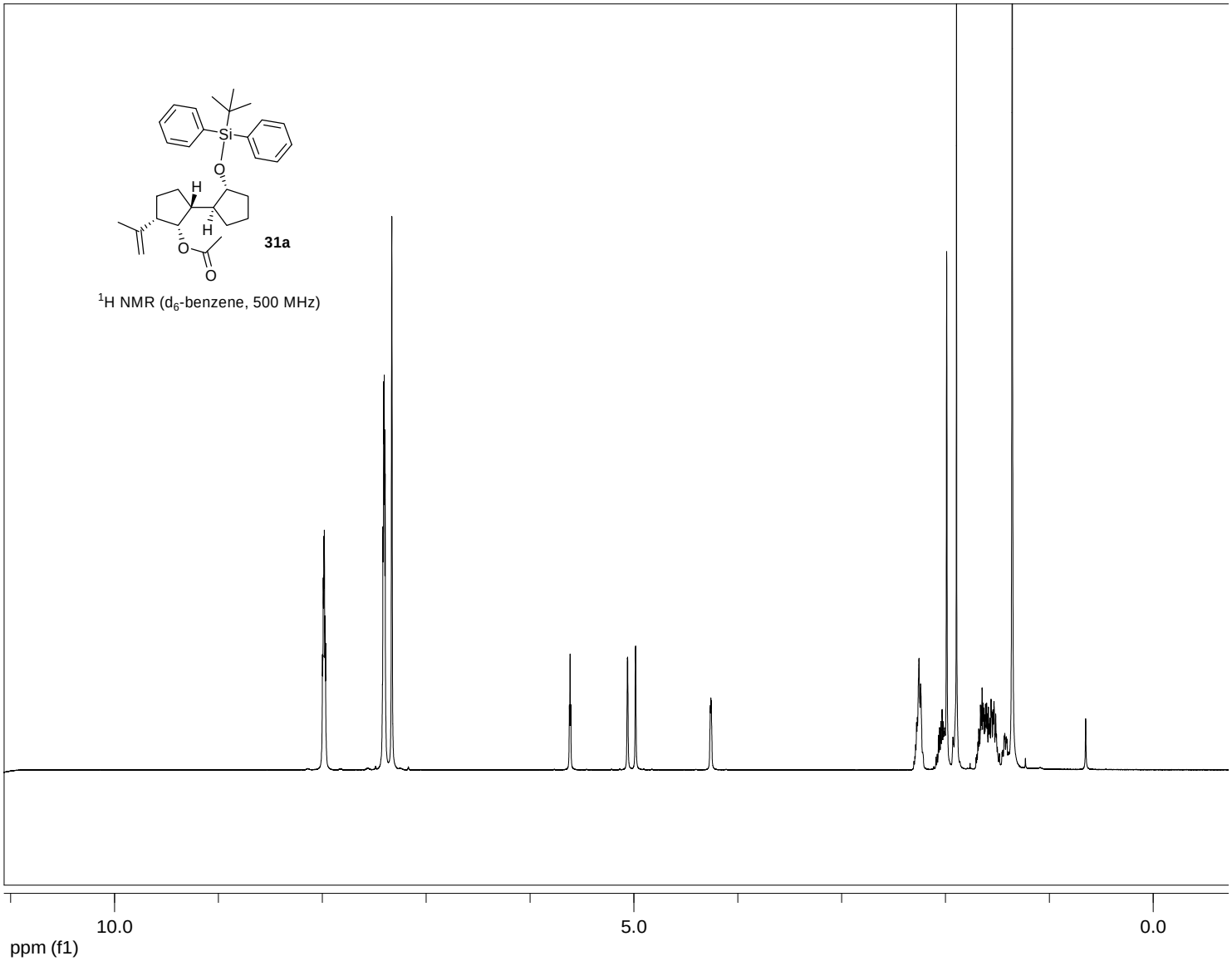

TMS
30
^{13}C (d_6-benzene, 150 MHz)
200
150
100
50
0
ppm (f1)

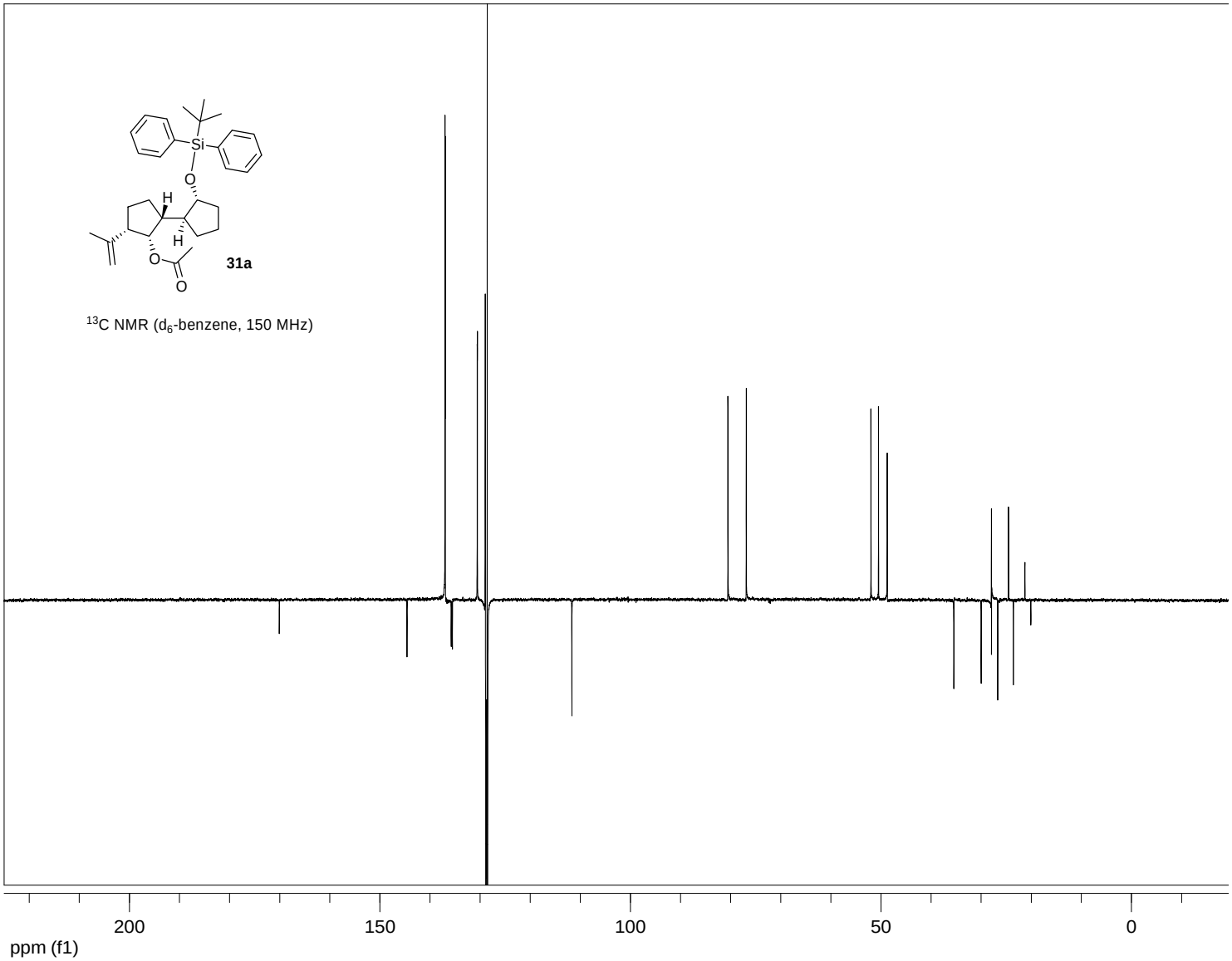


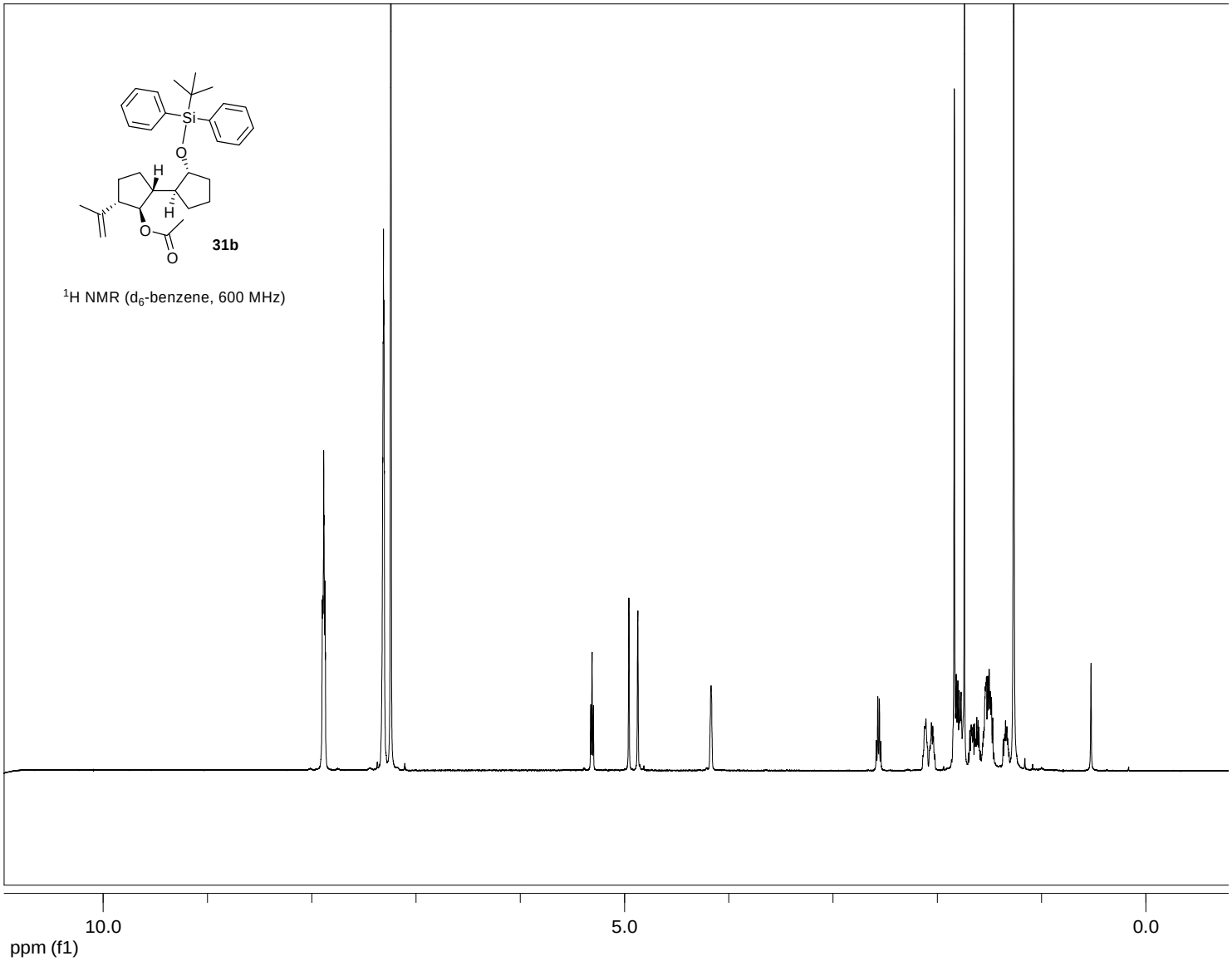
^{1}H NMR (d_4-MeOH, 500 MHz)

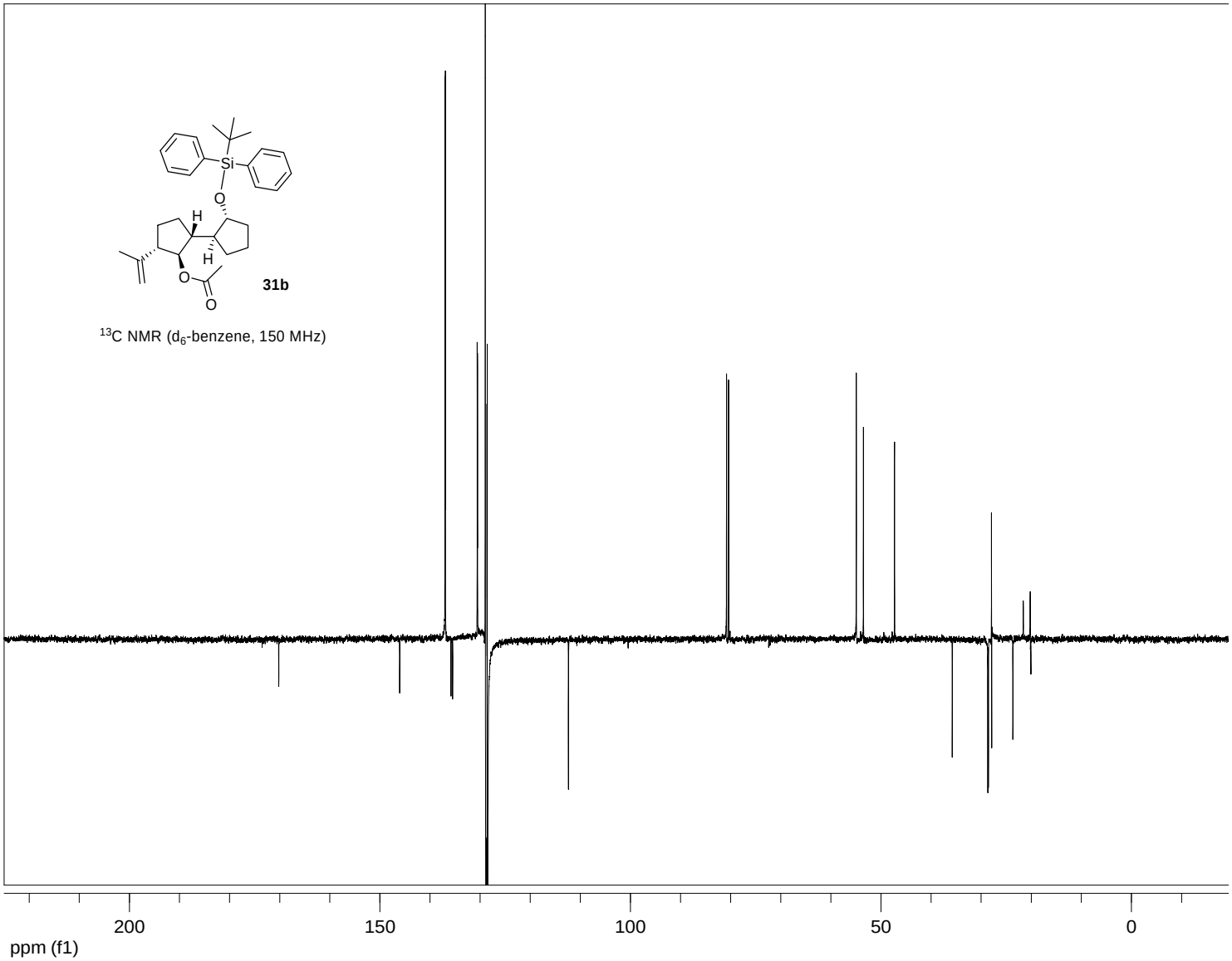


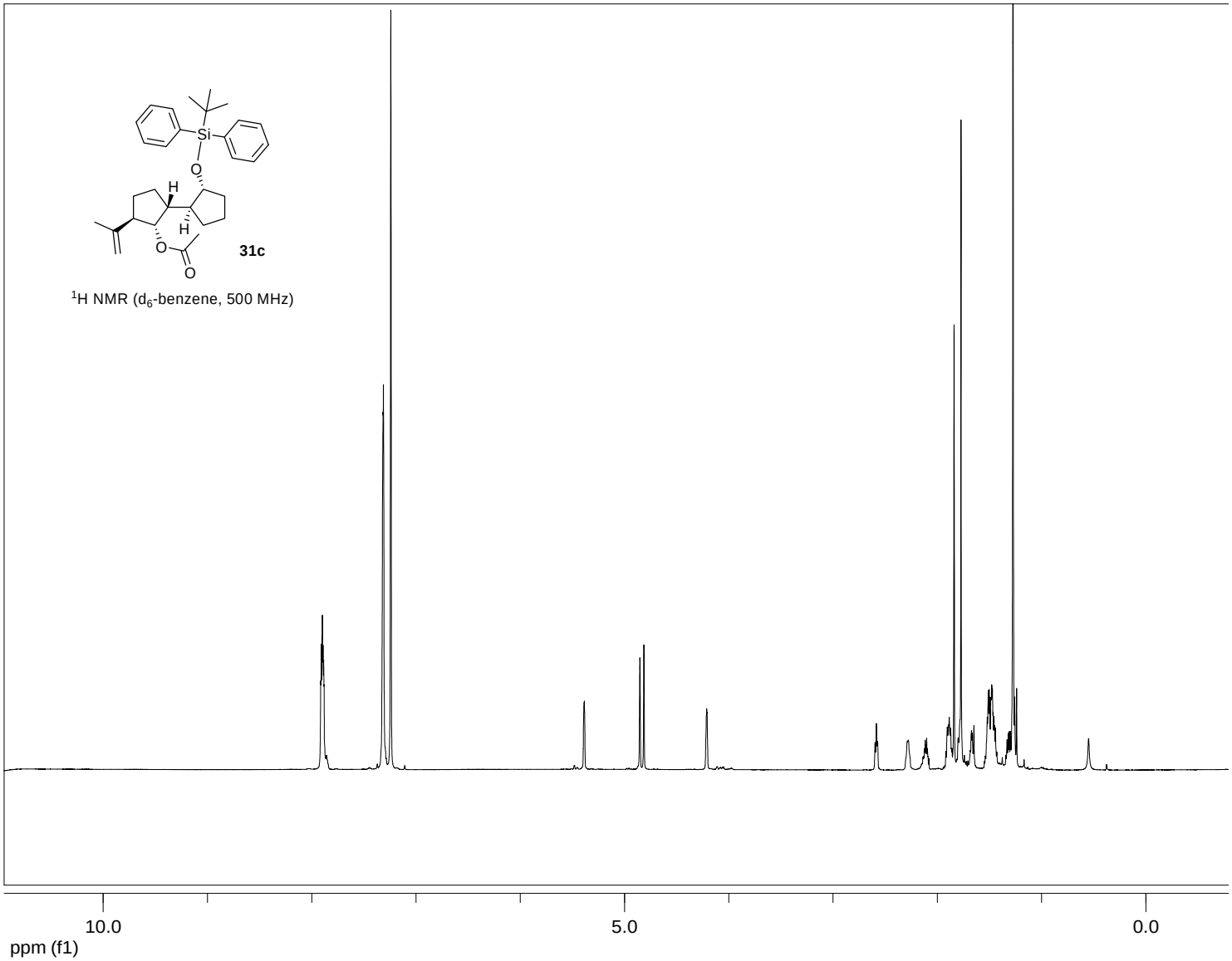
^{13}C NMR (d_4-MeOH, 150 MHz)

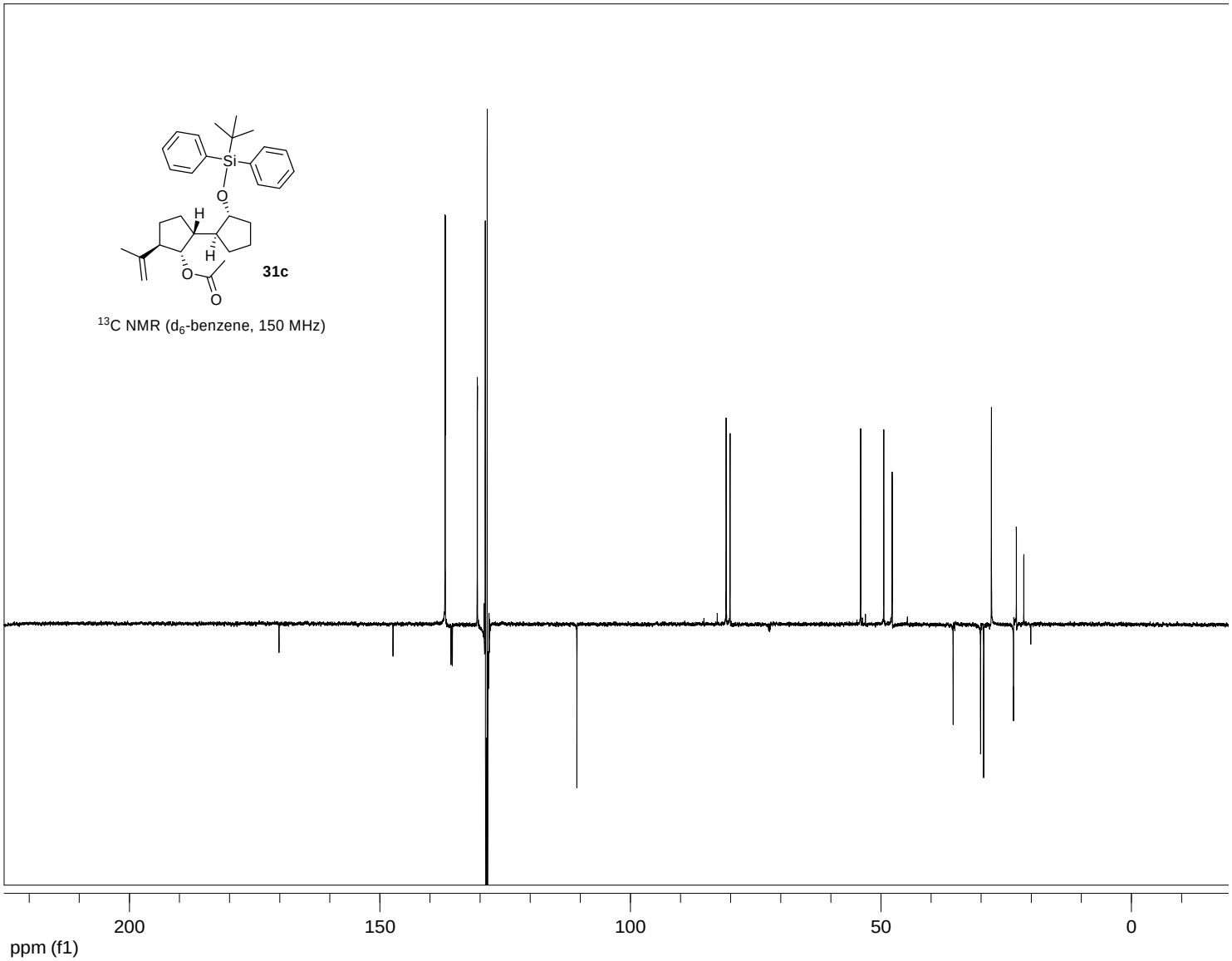

Si
O
H
H
O
O
31a
^{1}H NMR (d_6-benzene, 500 MHz)
10.0
5.0
0.0
ppm (f1)

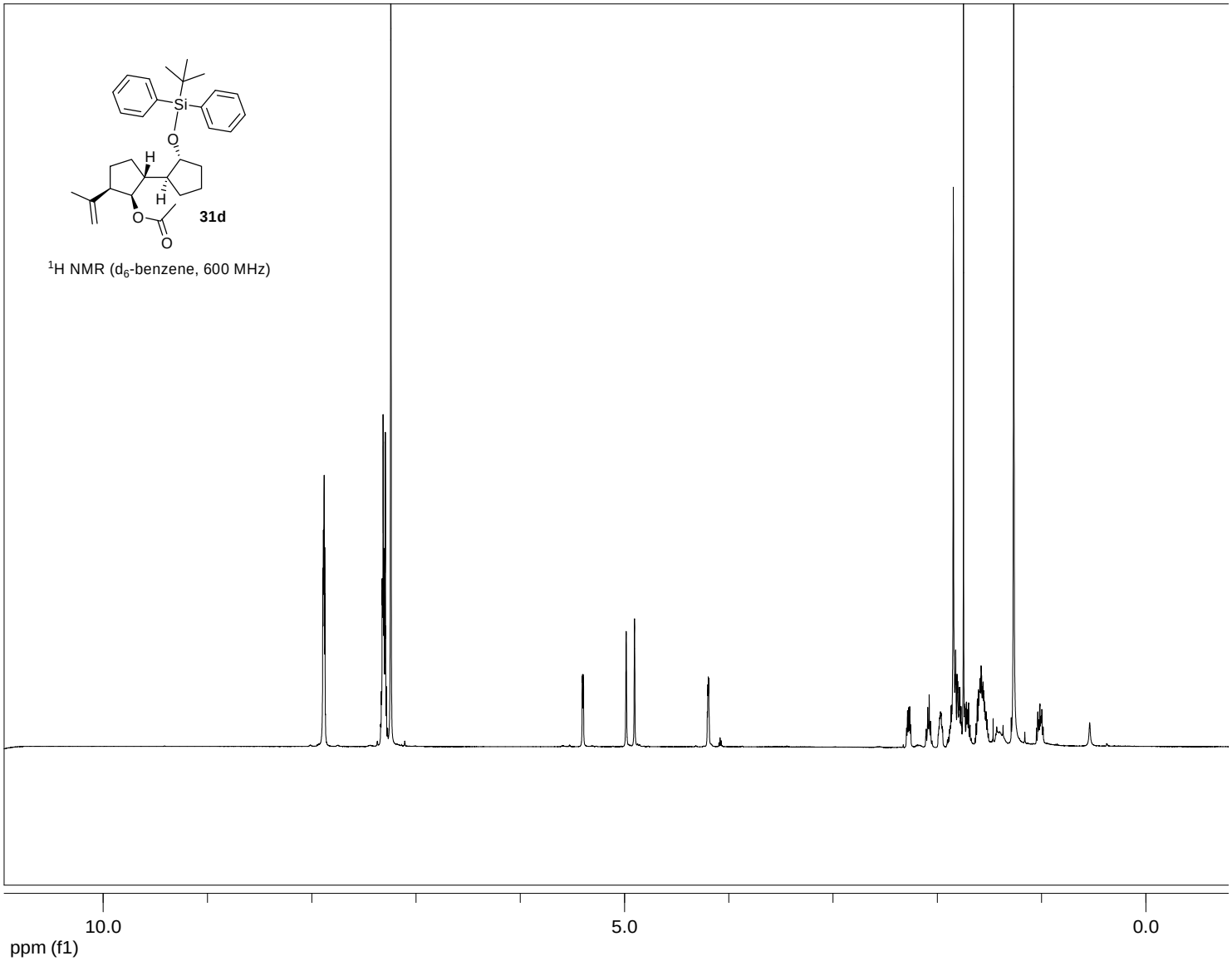

Si
O
H
H
O
O
31a
^{13}C NMR (d_6-benzene, 150 MHz)
200
150
100
50
0
ppm (f1)

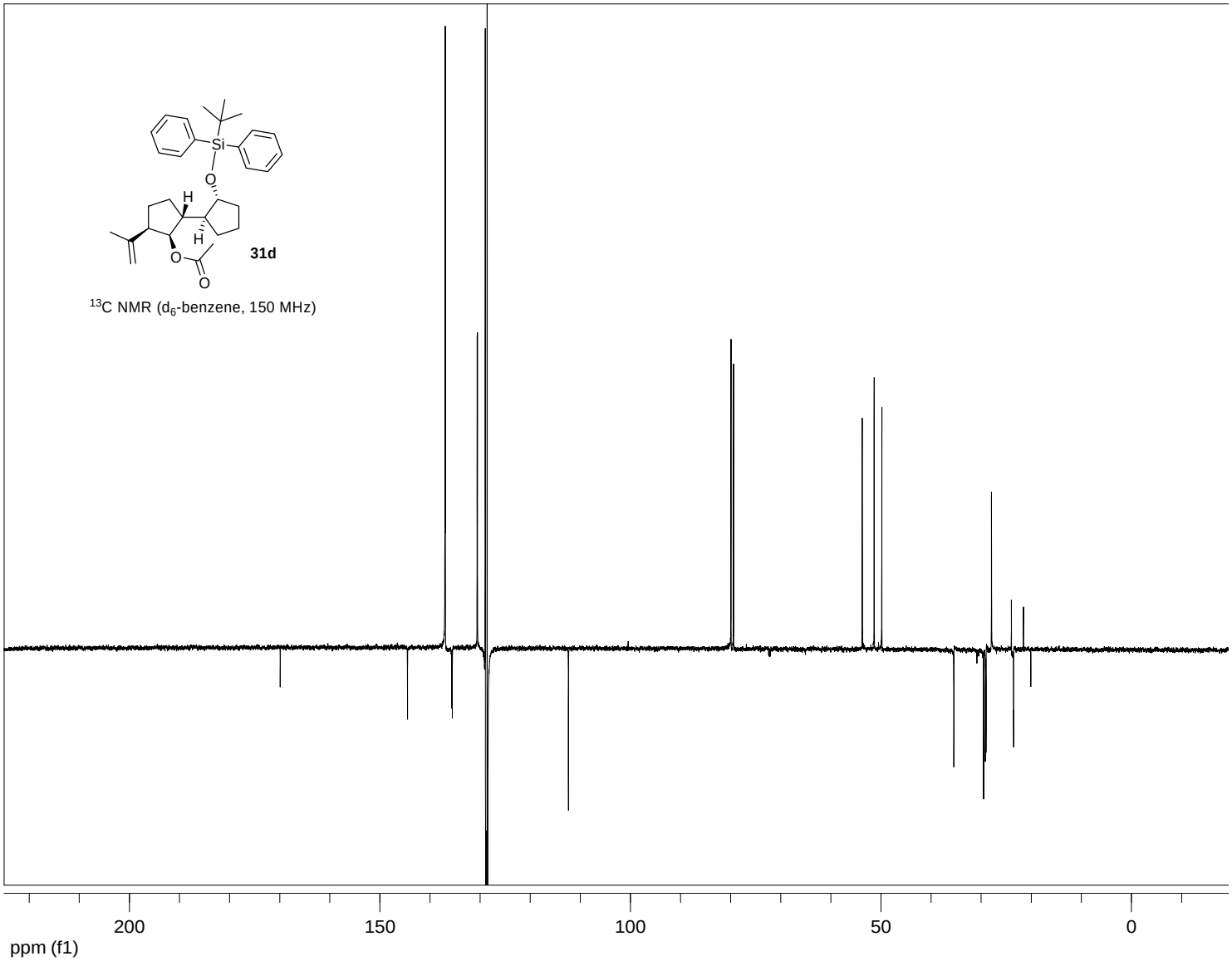

Si
O
H
H
O
O
31b
^{1}H NMR (d_6-benzene, 600 MHz)
10.0
5.0
0.0
ppm (f1)

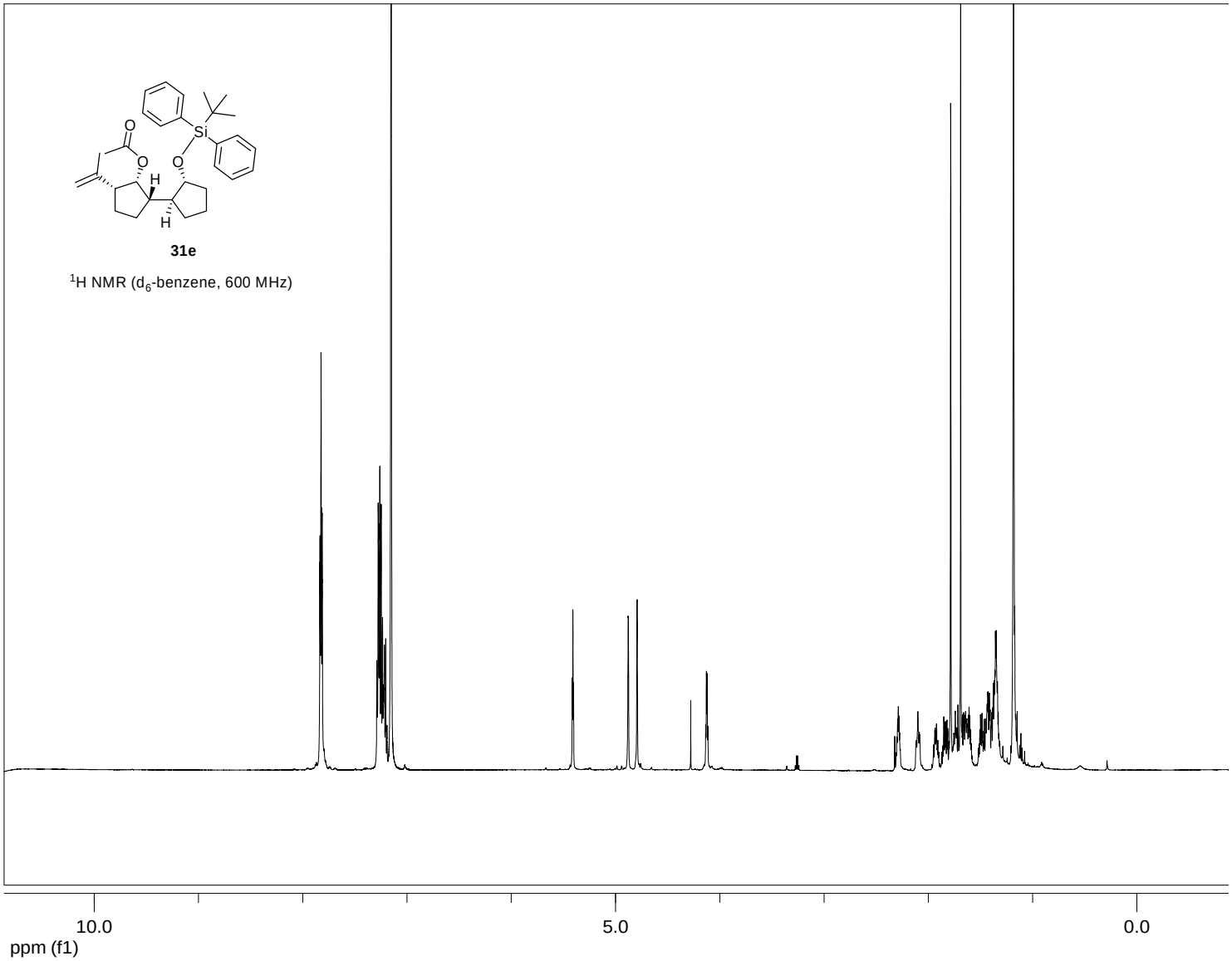

Si
O
H
H
O
O
31b
^{13}C NMR (d_6-benzene, 150 MHz)
200
150
100
50
0
ppm (f1)


Si
O
H
H
O
O
31c
^{1}H NMR (d_6-benzene, 500 MHz)
10.0
5.0
0.0
ppm (f1)


Si
O
H
H
O
O
31c
^{13}C NMR (d_6-benzene, 150 MHz)
200
150
100
50
0
ppm (f1)

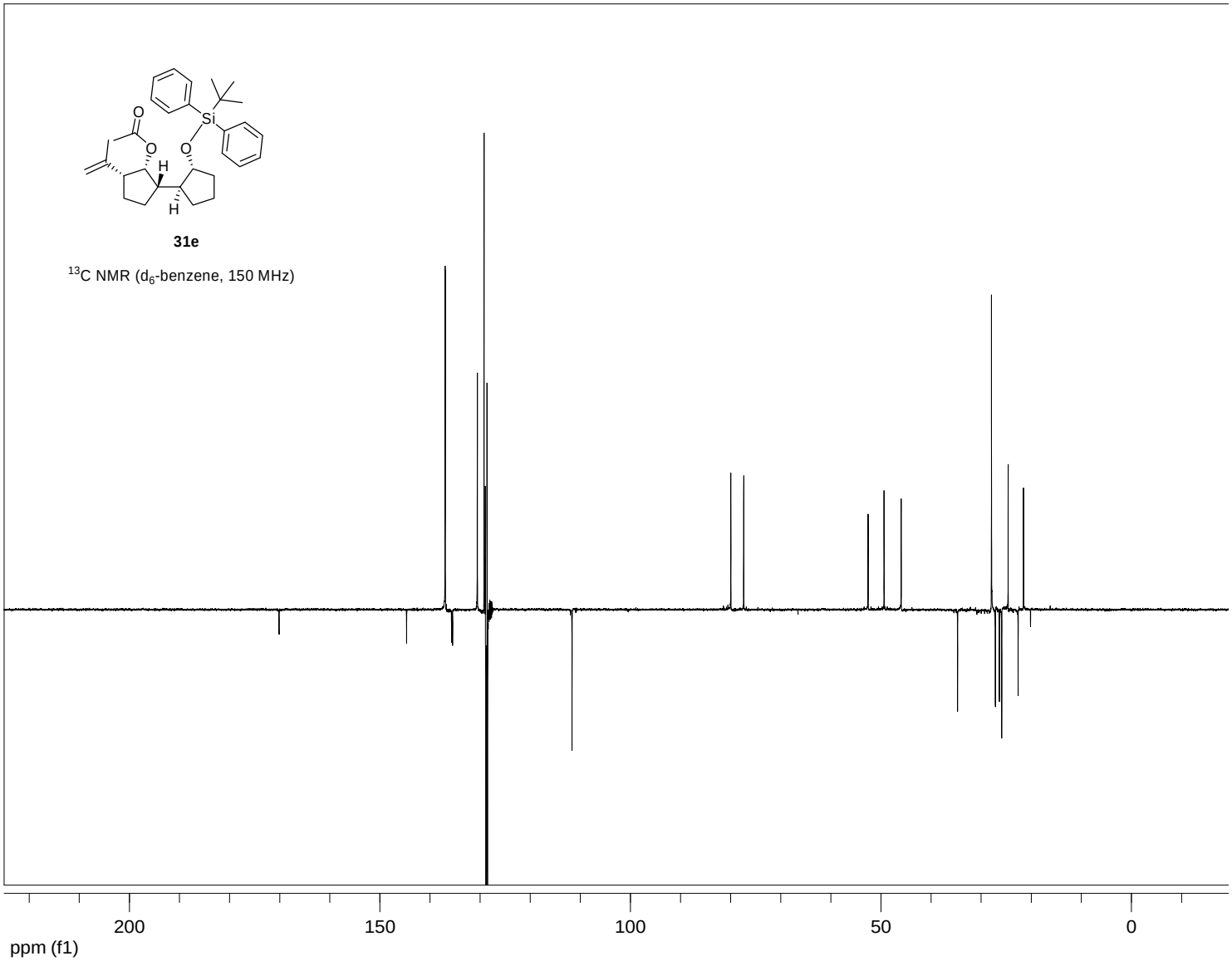

31d
^{1}H NMR (d_6-benzene, 600 MHz)
10.0
5.0
0.0
ppm (f1)


Si
O
H
H
O
O
31d
^{13}C NMR (d_6-benzene, 150 MHz)
200
150
100
50
0
ppm (f1)



31e

^{1}H NMR (d_6-benzene, 600 MHz)


O
Si
O
O
H
H
31e
13C NMR (d6-benzene, 150 MHz)
200
150
100
50
0
ppm (f1)