Synthesis of the Core Structure of Salicylihalamide A by Intramolecular Suzuki Reaction

*Matthias Bauer and Martin E. Maier**

Institut für Organische Chemie, Universität Tübingen, Auf der Morgenstelle 18, D-72076 Tübingen, Germany

martin.e.maier@uni-tuebingen.de

Supporting Information

Experimental Section

General. ^{1}H and ^{13}C NMR: Bruker Avance 400, spectra were recorded in $CDCl_3$ except otherwise noted; chemical shifts are calibrated to the residual proton and carbon resonance in $CDCl_3$ (7.25 ppm, 77.00 ppm). EI-MS; Finnigan Triple-Stage-Quadrupol (TSQ-70). HR-MS (EI): modified AMD Intectra MAT 711 A. HRMS (FT-ICR): BRUKER Daltonic APEX 2 with electronspray-ionization (ESI). HPLC-MS: Agilent 1100 Series LC/MSD VL; Optical rotation: JASCO Polarimeter P-1020. IR: Jasco FT/IR-430 spectrometer. Flash chromatography: J. T. Baker silica gel 43-60 μm. Thin-layer chromatography Machery-Nagel Polygram Sil G/UV_{254}. Solvents were distilled prior to use; petroleum ether with a boiling range of 40-60 °C was used.

2-Allyl-6-methoxybenzoic acid (3). This compound was prepared according to Smith, III et al.[1] ^{1}H NMR (400 MHz, $CDCl_3$): δ = 3.47 (d, *J* = 6.6 Hz, 2H, C*H*$_2$CHCH$_2$), 3.83 (s, 3H, OCH_3), 5.01-5.12 (m, 2H, CH_2CHCH_2), 5.86-5.99 (m, 1H, CH_2CHCH_2), 6.80 (d, *J* = 8.3 Hz, 1H, H-5), 6.84 (d, *J* = 7.6 Hz, 1H, H-3), 7.28 (dd, *J* = 7.6, 8.34 Hz, 1H, H-4); ^{13}C NMR (100 MHz, $CDCl_3$): δ = 37.66, 55.91, 109.08, 116.21, 121.89, 122.35, 130.83, 136.27, 139.05, 156.56, 172.65.

***tert*-Butyl 2-methoxy-6-(2-oxoethyl)benzoate (4): (a) *tert*-Butyl 2-allyl-6-methoxybenzoate.** To a solution of the acid **3** (1.0 g, 5.2 mmol) in dry toluene (10 mL) was added *N*,*N*-dimethylformamide di-*tert*-butyl acetal (4.3 g, 20.8 mmol) dropwise at 110 °C within 20 min. The mixture was refluxed for further 30 min, cooled, washed with water (10 mL), saturated $NaHCO_3$ solution (2 × 10 mL), and brine (10 mL). The organic layer was dried with Na_2SO_4, filtered, and concentrated in vacuo. Purification of the residue by flash chromatography (petroleum ether/Et_2O, 3:1) gave 0.96 g (74%) of the *tert*-butyl ester as a colorless oil. TLC (petroleum ether/Et_2O, 3:1): R_f = 0.61; ^{1}H NMR (400 MHz, $CDCl_3$): δ = 1.58 (s, 9H, ^{t}Bu), 3.38 (d, *J* = 6. 6 Hz, 2H, CH_2), 3.81 (s, 3H, OCH_3), 5.01-5.11 (m, 2H, CH=C*H*$_2$), 5.90-6.00 (m, 1H, C*H*=CH_2), 6.76 (d, *J* = 8.3 Hz, 1H, H-5), 6.80 (d, *J* = 7.8 Hz, 1H, H-3), 7.26 (dd, *J* = 7.8, 8.3 Hz, 1H, H-4); ^{13}C NMR (100 MHz, $CDCl_3$): δ = 28.15, 37.21, 55.86, 81.75, 108.98, 116.10, 121.44, 125.24, 129.76, 136.47, 137.73, 156.20, 167.28.

(b) *tert*-Butyl 2-methoxy-6-(2-oxoethyl)benzoate (4). Ozone was passed through a solution of *tert*-butyl 2-allyl-6-methoxybenzoate (6.25 g, 25.0 mmol) in a 2:1 mixture of CH_2Cl_2/MeOH (250 mL) at –78 °C until a slight blue color persisted. The excess of ozone was removed by passing a stream of nitrogen gas through the solution. Subsequently, Me_2S (50 mL) was added at 0 °C and stirring was continued for 1 h at this temperature. The reaction mixture was washed with saturated NaCl (2 × 100

[1] Smith, A. B., III; Zheng, J. *Synlett* **2001**, 1019-1023.

mL) and the aqueous layer re-extracted with CH_2Cl_2 (100 mL). The combined organic layers were dried over Na_2SO_4, filtered, and the solvent was removed in vacuo. The crude aldehyde was used for the Takai olefination without further purification. ^{1}H NMR (400 MHz, $CDCl_3$): δ = 1.54 (s, 9H, ^{t}Bu), 3.62 (d, *J* = 2.0 Hz, 2H, C*H*$_2$CHO), 3.82 (s, 3H, OCH_3), 6.78 (d, *J* = 7.6 Hz, 1H, H-3), 6.86 (d, *J* = 8.3 Hz, 1H, H-5), 7.30 (dd, *J* = 7.3, 8.3 Hz, 1H, H-4), 9.67 (t, *J* = 2.0 Hz, 1H, CH_2CHO); ^{13}C NMR (100 MHz, $CDCl_3$): δ = 28.09, 47.99, 55.94, 82.51, 110.55, 122.58, 130.49, 156.86, 166.70, 198.95.

***tert*-Butyl 2-[(2*E*)-3-iodoprop-2-enyl]-6-methoxybenzoate (5)**. To a vigorously stirred suspension of $CrCl_2$ (14.8 g, 120 mmol, 6 eq) in THF (300 mL) was added dropwise a solution of the aldehyde **4** (5.0 g, 20.0 mmol) and CHI_3 (15.75 g, 40.0 mmol, 2 eq) in THF (100 mL) at 0 °C under nitrogen atmosphere. The red-brown mixture was stirred for further 12 h at 0 °C, before it was diluted with diethyl ether (200 mL) and washed with half-saturated aqueous $Na_2S_2O_3$ solution (100 mL). After separation of the layers, the aqueous phase was extracted with diethyl ether (3 × 100 mL). The combined organic layers were washed with water (100 mL), dried (Mg_2SO_4), filtered, and concentrated in vacuo. The residue was purified by flash chromatography to yield 4.64 g (62%) of the vinyl iodide **5** as a white solid, m.p. 33 °C. TLC (petroleum ether/Et_2O, 3:1): R_f = 0.62; IR (neat): 1074, 1116, 1264, 1288, 1470, 1721, 2977 cm^{-1}; ^{1}H NMR (400 MHz, $CDCl_3$): δ = 1.57 (s, 9H, ^{t}Bu), 3.34 (d, *J* = 6.8 Hz, 2H, C*H*$_2$CHCHI), 3.80 (s, 3H, OCH_3), 6.04 (d, *J* = 14.4 Hz, 1H, CH_2CHCHI), 6.04 (d, *J* = 14.4 Hz, 1H, CH_2CHCHI), 6.62 (dt, *J* = 6.8, 14.4 Hz, 1H, CH_2CHCHI), 6.75 (d, *J* = 7.8 Hz, 1H, H-5), 6.78 (d, *J* = 8.3 Hz, 1H, H-3), 7.24 (t, *J* = 8.1 Hz, 1H, H-4); ^{13}C NMR (100 MHz, $CDCl_3$): δ = 28.16, 39.20, 55.89, 76.90, 82.03, 109.50, 121.52, 125.16, 130.03, 135,73, 143.62, 156.38, 167.04.

2-[(2*E*)-3-Iodoprop-2-enyl]-6-methoxybenzoic acid (6). Trifluoroacetic acid (10 mL) was added to an ice-cooled solution of **4** (2.0 g, 5.34 mmol) in CH_2Cl_2 (50 mL). After the solution was stirred for 2 h at 0 °C, the solvent was removed by rotary evaporation and the residue purified by flash chromatography (petroleum ether/EtOAc, 1:3) to yield 1.68 g (99%) of the acid **6** as a white solid, m.p. 102-103 °C. TLC (petroleum ether/EtOAc, 1:3): R_f = 0.79; IR (neat): 1268, 1471, 1701 cm^{-1}; ^{1}H NMR (400 MHz, $CDCl_3$): δ = 3.52 (d, *J* = 7.1 Hz, 2H, C*H*$_2$CHCHI), 3.89 (s, 3H, OCH_3), 6.12 (d, *J* = 14.4 Hz, 1H, CH_2CHCHI), 6.65 (dt, *J* = 7.1, 14.4 Hz, 1H, CH_2CHCHI), 6.85 (2 d, *J* = 7.6, 8.3 Hz, 2H, H-3, H-5), 7.34 (t, *J* = 8.1 Hz, 1H, H-4); ^{13}C NMR (100 MHz, $CDCl_3$): δ = 40.02, 56.21, 76.98, 109.71, 121,32, 122.43, 131,59, 138.32, 143.57, 157.11, 171.32; MS (API-ES), *m/z* (%): 319 (77) $[M + H]^+$, 301 (56), 279 (78), 261 (38), 196 (36), 180 (62), 165 (33), 149 (100), 113 (57).

***tert*-Butyl 3-hydroxypent-4-enoate (8).** To a solution of LDA [prepared from diisopropylamine (19.2 g, 0.19 mol) in THF (200 mL) and *n*-BuLi in hexane (2.7 M, 70 mL, 0.19 mol) at –10 °C] was added a solution of *tert*-butyl acetate (**7**) (20.0 g, 0.17 mol) in THF (100 mL) at –78 °C. After being stirred at this temperature for 1 h, acrolein (9.5 g, 0.17 mol) was added, and the mixture stirred for 1 h, before the

cooling bath was removed. The reaction was quenched by addition of saturated NH_4Cl solution (50 mL) and the mixture extracted with Et_2O (3 × 50 mL). The organic layers were dried ($MgSO_4$), filtered, and concentrated under reduced pressure to yield nearly pure hydroxy ester **8** (28.9 g, 98%) as a colorless oil. TLC (petroleum ether/Et_2O, 1:1): R_f = 0.43; IR (neat): 1157, 1256, 1284, 1368, 1729, 2979 cm^{-1}; ^1H NMR (400 MHz, $CDCl_3$): δ = 1.42 (s, 9H, ^{t}Bu), 2.35-2.49 (m, 2H, H-2), 3.22 (s, br, 1H, OH), 4.40-4.48 (m, 1H, C*H*OH), 5.09 (d, *J* = 10.4 Hz, 1H, H-5a), 5.26 (d, *J* = 17.2 Hz, 1H, H-5b), 5.77-5.88 (m, 1H, H-4); ^{13}C NMR (100 MHz, $CDCl_3$): δ = 28.01, 42.11, 68.96, 81.28, 115.00, 138.94, 171.56; MS (API-ES), *m/z* (%): 195 (12) [M + Na^+], 188 (7), 158 (23), 116 (5), 103 (7), 102 (100), 99 (63), 83 (5).

3-(Methoxymethoxy)pent-4-en-1-ol (9): (a) *tert*-Butyl 3-(methoxymethoxy)pent-4-enoate. The MOM-protection was performed as described for the MOM ether **25**; yield 78%. TLC (petroleum ether/Et_2O, 3:1): R_f = 0.64; ^1H NMR (400 MHz, $CDCl_3$): δ = 1.42 (s, 9H, ^{t}Bu), 2.37 (dd, ^3J = 5.6, ^2J = 14.9 Hz, 1H, H-2a), 2.52 (dd, ^3J = 8.1, ^2J = 14.9 Hz, 1H, H-2b), 3.33 (s, 3H, MOM-CH_3), 4.37-4.44 (m, 1H, H-3), 4.53 (d, *J* = 6.6 Hz, 1H, MOM-CH_2), 4.66 (d, *J* = 6.6 Hz, 1H, MOM-CH_2), 5.18 (d, *J* = 10.4 Hz, 1H, H-5a), 5.18 (d, *J* = 17.2 Hz, 1H, H-5b), 5.64-5.76 (m, 1H, H-4); ^{13}C NMR (100 MHz, $CDCl_3$): δ = 28.03, 42.09, 55.50, 74.12, 80.59, 94.06, 117.75, 136.95, 169.89.

(b) 3-(Methoxymethoxy)pent-4-en-1-ol (9). To a stirred suspension of $LiAlH_4$ (1.17 g, 30.8 mmol) in dry Et_2O (50 mL) was added a solution of *tert*-butyl 3-(methoxymethoxy)pent-4-enoate (5.0 g, 23.1 mmol) in Et_2O (10 mL) at room temperature. After being stirred for 3 h, water (5 mL) was carefully added, and the mixture treated with 2 N H_2SO_4 until the solution became clear. The mixture was extracted with Et_2O (3 × 50 mL) and the combined organic layers were washed with brine, dried ($MgSO_4$), filtered, and concentrated under reduced pressure. Purification of the residue by flash chromatography (petroleum ether/EtOAc, 3:1) gave 2.33 g (69%) of alcohol **9** as a colorless oil. TLC (petroleum ether/EtOAc, 3:1): R_f = 0.39; ^1H NMR (400 MHz, $CDCl_3$): δ = 1.68-1.84 (m, 2H, H-2), 2.67 (s, br, 1H, OH), 3.33 (s, 3H, MOM-CH_3), 3.62-3.76 (m, 2H, H-1), 4.18 (dt, *J* = 6.1, 7.1 Hz, 1H, H-3), 4.49 (d, *J* = 6. 6 Hz, 1H, MOM-CH_2), 4.64 (d, *J* = 6.6 Hz, 1H, MOM-CH_2), 5.16 (dd, ^3J = 11.1, ^2J = 18.5 Hz, 2H, H-5), 5.59-5.73 (m, 1H, H-4); ^{13}C NMR (100 MHz, $CDCl_3$): δ = 37.64, 55.44, 59.54, 75.79, 93.77, 117.29, 137.54; MS (API-ES), *m/z* (%): 147 (100) [M + H^+], 132 (67), 115 (93), 104 (42), 91 (100), 78 (13).

3-(Methoxymethoxy)pent-4-enyl 2-[(2*E*)-3-iodoprop-2-enyl]-6-methoxybenzoate (10). The Mitsunobu esterification was performed as described for **30**. Starting with 400 mg (1.25 mmol) of acid **6** and 230 mg (1.56 mmol) of alcohol **9** resulted in 480 mg (86%) of ester **10** as a slightly yellow oil. ^1H NMR (400 MHz, $CDCl_3$): δ = 1.89-2.07 (m, 2H, H-2'), 3.33 (d, *J* = 6.8 Hz, 2H, CH_2CHCHI), 3.36 (s, 3H, MOM-CH_3), 3.81 (s, 3H, OCH_3), 4.19 (dt, *J* = 5.6, 7.6 Hz, 1H, H-3'), 4.33-4.48 (m, 2H, H-1'), 4.55 (d, *J* = 6.8 Hz, 1H, MOM-CH_2), 4.71 (d, *J* = 6.8 Hz, 1H, MOM-CH_2), 5.24 (dd, *J* = 9.6, 16.9 Hz, 2H, H-

5'), 5.65-5.76 (m, 1H, H-4'), 6.06 (d, *J* = 14.4 Hz, 1H, CH_2CHCHI), 6.58 (dt, *J* = 6.8, 14.4 Hz, 1H, CH_2CHCHI), 6.78 (d, *J* = 7.8 Hz, 1H, H-5), 6.80 (d, *J* = 8.3 Hz, 1H, H-3), 7.28 (dd, *J* = 7.8, 8.3 Hz, 1H, H-4); ^{13}C NMR (100 MHz, $CDCl_3$): δ = 34.41, 39.53, 55.53, 55.73, 61.83, 73.95, 76.89, 93.84, 109.40, 117.88, 121.60, 123.51, 130.65, 136.50, 137.55, 143.42, 156.63, 167.84; MS (API-ES), *m/z* (%): 469 (94) [M + Na^+], 413 (58), 391 (62), 338 (69), 301 (100), 174 (28), 146 (19), 64 (41).

14-Methoxy-5-(methoxymethoxy)-3,4,5,6,7,10-hexahydro-1*H*-2-benzoxacyclododecin-1-one (11). Intramolecular Suzuki reaction: The cyclization was performed as described for macrolactone **31**. Thus, 350 mg (0.79 mmol) of **10** in THF (5 mL) were subjected to the hydroboration (6.2 ml of 9-BBN, 0.5 M in THF) at room temperature for 12 h. Subsequently, NaOH (3N, 2.6 mL) and THF (25 mL) were added. This mixture was then added by syringe pump to the solution of the catalyst (dppf)$PdCl_2$ (150 mg) in benzene (150 mL). Purification of the residue by flash chromatography (EtOAc/petroleum ether, 1:2) gave 155 mg (62%) of the lactone **11** as a colorless solid, m.p. 103 ^{o}C. TLC (petroleum ether/EtOAc, 2:1): R_f = 0.62; IR (neat): 1041, 1068, 1272, 1470, 1725, 2841, 2930 cm^{-1}; ^{1}H NMR (400 MHz, $CDCl_3$): δ = 1.48-1.60 (m, 1H, H-6a), 1.73-1.80 (m, 1H, H-6b), 1.87-2.05 (m, 3H, H-7a, H-4), 2.19-2.30 (m, 1H, H-4b), 3.22 (d, *J* = 14.4 Hz, 1H, H-10a), 3.34 (s, 3H, MOM-CH_3), 3.53-3.64 (m, 2H, H-5, H-10b), 3.80 (s, 3H, OCH_3), 4.06-4.14 (m, 1H, H-3a), 4.58-4.65 (m, 3H, H-3b, MOM-CH_2), 5.29-5.42 (m, 2H, H-8, H-9), 6.78 (d, *J* = 7.6 Hz, 1H, H-13), 6.80 (d, *J* = 8.6 Hz, 1H, H-11), 7.25 (dd, *J* = 7.6, 8.6 Hz, 1H, H-12); ^{13}C NMR (100 MHz, $CDCl_3$): δ = 30.83, 32.63, 34.47, 37.46, 55.35, 55.94, 62.14, 75.23, 95.67, 109.51, 122.44, 124.28, 129.09, 130.29, 131.59, 139.09, 156.57, 168.46; MS (EI), *m/z* (%): 320 (5) [M^+], 288 (10), 258 (17), 187 (29), 162 (21), 121 (100), 115 (16), 71 (16), 69 (37), 57 821), 45 (94); HRMS (EI): [M^+] calcd for $C_{18}H_{24}O_5$ 320.16235, found 320.16373.

(4*S*)-4-Benzyl-3-{(2*S*,3*R*)-3-hydroxy-2-methyl-5-[(triisopropylsilyl)oxy]pentanoyl}-1,3-oxazolidin-2-one (14). This compound was prepared as described for **24**. Starting with 2.25 g (9.77 mmol) of **13**[2] and 1.80 g (7.82 mmol) of **12** there were obtained 3.19 g (88%) of the aldol product **14** as a colorless oil. TLC (petroleum ether/Et_2O, 1:1): R_f = 0.43; $[\alpha]_D$ = +48.9 (*c* 2.14, CH_2Cl_2); IR (neat): 1107, 1208, 1384, 1698, 1783, 2865, 2942 cm^{-1}; ^{1}H NMR (400 MHz, $CDCl_3$): δ = 0.81-0.89 (m, 3H, TIPS-CH), 1.05 (s, 18H, TIPS-CH_3), 1.28 (d, *J* = 6.8 Hz, 3H, CH_3), 1.58-1.70 (m, 1H, H-4), 1.72-1.87 (m, 1H, H-4), 2.76 (dd, *J* = 9.6, 13.4 Hz, 1H, Bn-CH_2), 3.27 (d, *J* = 12.6 Hz, 1H, Bn-CH_2) 3.68 (s, 1H, OH), 3.79-3.99 (m, 3H, C*H*OH, CH_2OTIPS), 4.13-4.24 (m, 3H, C*H*CH_3, oxazolidinone-CH_2), 4.63-4.75 (m, 1H, oxazolidinone-CH), 7.17-7.36 (m, 5H, H-Bn); ^{13}C NMR (100 MHz, $CDCl_3$): δ = 11.36, 11.75, 17.94, 36.00, 37.78, 42.97, 55.35, 62.57, 66.08, 71.64, 127.35, 128.93, 129.43, 135.22, 153.12, 176.24;

[2] Hamdouchi, C.; Sanchez-Martinez, C. *Synthesis* **2001**, 833-840.

MS (EI), *m/z* (%): 420 (14) [M^+], 308 (14), 243 (34), 187 (49), 157 (18), 145 (100), 117 (54), 91 (34), 57 (48); HRMS (EI): [M^+] calcd for $C_{22}H_{34}NO_5Si$ 420.22063, found 420.22063.

(4*S*)-4-Benzyl-3-{(2*S*,3*R*)-3-(methoxymethoxy)-2-methyl-5-[(triisopropylsilyl)oxy]pentanoyl}-1,3-oxazolidin-2-one (15). This compound was prepared in a similar manner as described for **25**. Starting with 2.25 g of **14** resulted in 2.15 g (87%) of **15** as a slightly yellow oil. TLC (petroleum ether/Et_2O, 1:1): R_f = 0.56; $[\alpha]_D$ = +66.4 (*c* 1.24, CH_2Cl_2); IR (neat): 1782, 2865, 2891, 2942 cm^{-1}; ^1H NMR (400 MHz, $CDCl_3$): δ = 1.04 (s, 21H, TIPS-CH, -CH_3), 1.28 (d, *J* = 6.8 Hz, 3H, CH_3), 1.70-1.92 (m, 2H, H-4), 2.76 (dd, *J* = 9.6, 13.4 Hz, 1H, Bn-CH_2), 3.25-3.33 (m, 4H, Bn-CH_2, MOM-CH_3), 3.71-3.84 (m, 2H, CH_2OTIPS), 3.96-4.06 (m, 2H, C*H*CH_3, CHOMOM), 4.12-4.18 (m, 2H, oxazolidinone-CH_2), 4.57-4.64 (m, 3H, oxazolidinone-CH, CH_2-MOM), 7.17-7.35 (m, 5H, Bn-H); ^{13}C NMR (100 MHz, $CDCl_3$): δ = 11.86, 11.91, 17.97, 35.99, 37.73, 41.54, 55.93, 56.02, 59.77, 66.05, 76.43, 96.73, 127.27, 128.90, 129.42, 135.46, 153.18, 174.87; MS (EI), *m/z* (%): 464 (17) [M - C_3H_7]$^+$, 402 (8), 290 (35), 257 (22), 241 (18), 190 (40), 157 (50), 145 (100), 117 (62), 115 (51), 91 (30), 45 (75); HRMS (EI): [M - C_3H_7]$^+$ calcd for $C_{24}H_{38}NO_6Si$: 464.24684, found 464.24897.

2,4-Dideoxy-3-*O*-(methoxymethyl)-2-methyl-5-*O*-(triisopropylsilyl)-D-*glycero*-pentitol (16) The reduction was performed as described for **26**. Starting with 2.10 g (4.14 mmol) of **15** gave 2.15 g (87%) of **16** as a colorless oil. TLC (petroleum ether/Et_2O, 1:3): R_f = 0.60; $[\alpha]_D$ = -10.14 (*c* 0.48, CH_2Cl_2); IR (neat): 1035, 1098, 1702, 1782, 2865, 2943 cm^{-1}; ^1H NMR (400 MHz, $CDCl_3$): δ = 0.82 (d, *J* = 6.8 Hz, 3H, CH_3), 1.01-1.07 (m, 21H, TIPS-CH, -CH_3), 1.63-1.81 (m, 2H, H-4), 1.89-2.01 (m, 1H, C*H*CH_3), 2.60-3.05 (s, br, 1H, OH), 3.39 (s, 3H, MOM-CH_3), 3.51 (dd, *J* = 5.3, 11.1 Hz, 1H, CH_2OH), 3.60 (dd, *J* = 8.9, 11.1 Hz, 1H, CH_2OH), 3.68-3.81 (m, 2H, CH_2OTIPS), 3.90-3.97 (m, 1H, H-3), 4.64 (d, *J* = 6.6 Hz, 1H, MOM-CH_2), 4.71 (d, *J* = 6.6 Hz, 1H, MOM-CH_2); ^{13}C NMR (100 MHz, $CDCl_3$): δ = 11.23, 11.90, 17.98, 34.69, 38.51, 55.87, 59.90, 65.26, 76.83, 97.07; MS (API-ES), *m/z* (%): 357 (31) [M + Na^+], 311 (19), 303 (34), 271 (24), 157 (26), 145 (100), 129 (26), 99 (94), 81 (13).

(3*R*)-3-(Methoxymethoxy)-2-methyl-5-[(triisopropylsilyl)oxy]-1-pentene (17). (a) Tosylation of alcohol 16. The alcohol **16** (400 mg, 1.2 mmol) in pyridine (1 mL) was converted to the corresponding tosylate using tosyl chloride (0.7 g) according to the procedure described en route to **27**. TLC (petroleum ether/EtOAc, 3:1): R_f = 0.64; ^1H NMR (400 MHz, $CDCl_3$): δ = 0.89 (d, *J* = 6.8 Hz, 3H, CH_3), 1.00 (s, 3H, TIPS-CH), 1.01 (s, 18H, TIPS-CH_3), 1.59-1.66 (m, 2H, H-4), 2.02-2.12 (m, 1H, H-2), 2.42 (s, 3H, Tos-CH_3), 3.25 (s, 3H, MOM-CH_3), 3.63-3.74 (m, 3H, H-3, H-5), 3.89 (dd, *J* = 7.3, 9.3 Hz, 1H, H-1a), 4.08 (dd, *J* = 6.1, 9.3 Hz, 1H, H-1b), 4.51 (d, *J* = 6.8 Hz. 1H, MOM-CH_2), 4.55 (d, *J* = 6.8 Hz. 1H, MOM-CH_2), 7.32 (d, *J* = 8.1 Hz, 2H, Tos-H-3,5), 7.77 (d, *J* = 8.1 Hz, 2H, Tos-H-2,6); ^{13}C NMR (100 MHz, $CDCl_3$): δ = 11.37, 11.84, 17.94, 21.56, 34.60, 36.58, 55.57, 59.74, 72.38, 75.63, 96.72, 127.86, 129.73, 133.09, 144.58.

(b) Elimination to the alkene 17. This alkene was prepared as described for compound **27**. Starting with 1.25 g (2.56 mmol) of the forgoing tosylate resulted in 805 mg (99%) of **17**, slightly yellow oil. TLC (petroleum ether/Et_2O, 10:1): R_f = 0.61; $[\alpha]_D$ =+71.6 (*c* 0.36, CH_2Cl_2); IR (neat): 1034, 1095, 1154, 1462, 2866, 2943 cm^{-1}; ^1H NMR (400 MHz, $CDCl_3$): δ = 1.01-1.09 (m, 21H, TIPS), 1.66 (s, 3H, CH_3), 1.68-1.77 (m, 1H, H-4), 1.81-1.90 (m, 1H, H-4), 3.36 (s, 3H, MOM-CH_3), 3.68-3.81 (m, 2H, CH_2OTIPS), 4.20 (dd, *J* = 7.8, 8.1 Hz, 1H, H-3), 4.49 (d, *J* = 6.6 Hz, 1H, MOM-CH_2), 4.61 (d, *J* = 6.6 Hz, 1H, MOM-CH_2), 4.90 (s, 1H, C(CH_3)CH_2), 4.94 (s, 1H, C(CH_3)CH_2); ^{13}C NMR (100 MHz, $CDCl_3$): δ = 11.96, 16.86, 17.98, 37.20, 55.46, 59.96, 76.59, 93.68, 113.68, 144.03; MS (API-ES), *m/z* (%): 339 (52) [M + Na^+], 311 (28), 287 (28), 255 (100), 198 (25), 186 (37), 172 (96), 145 (98), 131 (40).

(3*R*)-3-(Methoxymethoxy)-4-methylpent-4-en-1-ol (18). The deprotection was performed as described for **28**. Starting with 500 mg (1.58 mmol) of **17** resulted in 245 mg (97%) of **18**, colorless oil**.** TLC (petroleum ether/Et_2O, 1:10): R_f = 0.54; $[\alpha]_D$ = +118.9 (*c* 0.55, CH_2Cl_2); IR (neat): 1031, 1096, 1152, 2887, 2948, 3431 cm^{-1}; ^1H NMR (400 MHz, $CDCl_3$): δ = 1.65 (s, 3H, CH_3), 1.69-1.79 (m, 1H, H-2), 1.81-1.93 (m, 1H, H-2), 2.45 (s, br, 1H, OH), 3.37 (s, 3H, MOM-CH_3), 3.66-3.79 (m, 2H, H-1), 4.19 (dd, *J* = 8.9, 9.1 Hz, 1H, H-3), 4.48 (d, *J* = 6.6 Hz, 1H, MOM-CH_2), 4.60 (d, *J* = 6.6 Hz, 1H, MOM-CH_2), 4.91 (s, 1H, H-5a), 4.94 (s, 1H, H-5b); ^{13}C NMR (100 MHz, $CDCl_3$): δ = 17.06, 36.04, 55.46, 60.28, 78.50, 93.75, 113.70, 143.64; MS (API-ES), *m/z* (%): 183 (29) [M + Na^+], 144 (66), 129 (100), 111 (28), 99 (28), 81 (23).

(3*R*)-3-(Methoxymethoxy)-4-methylpent-4-enyl 2-[(2*E*)-3-iodoprop-2-enyl]-6-methoxybenzoate (19). This ester was prepared as described for **30**. Starting with 360 mg (1.13 mmol) of the acid **6** and 200 mg (1.25 mmol) of alcohol **18** provided 445 mg (86%) of **19**, slightly yellow oil. TLC (petroleum ether/EtOAc, 3:1): R_f = 0.60; $[\alpha]_D$ = +41.8 (*c* 0.38, CH_2Cl_2); IR (neat): 1034, 1070, 1268, 1470, 1726, cm^{-1}; ^1H NMR (400 MHz, $CDCl_3$): δ = 1.68 (s, 3H, CH_3), 1.88-2.10 (m, 2H, CH_2CHOMOM), 3.33 (d, *J* = 6.8 Hz, 2H, CH_2CHCHI), 3.36 (s, 3H, MOM-CH_3), 3.81 (s, 3H, OCH_3), 4.16-4.22 (m, 1H, CH_2C*H*OMOM), 4.29-4.47 (m, 2H, C(O)OCH_2), 4.50 (d, *J* = 6.5 Hz, 1H, MOM-CH_2), 4.63 (d, *J* = 6.5 Hz, 1H, MOM-CH_2), 4.96 (s, 1H, C(CH_3)CH_2), 4.97 (s, 1H, C(CH_3)CH_2), 6.07 (d, *J* = 14.4 Hz, 1H, CH_2CHC*H*I), 6.58 (dt, *J* = 6.8, 14.4 Hz, 1H, CH_2C*H*CHI), 6.78 (d, *J* = 7.8 Hz, 1H, H-5), 6.80 (d, *J* = 8.3 Hz, 1H, H-3), 7.28 (dd, *J* = 7.8, 8.3 Hz, 1H, H-4); ^{13}C NMR (100 MHz, $CDCl_3$): δ = 16.70, 32.71, 39.51, 55.61, 55.72, 62.14, 76.24, 76.86, 93.58, 109.37, 114.49, 121.56, 123.50, 130.62, 136.48, 143.21, 143.41, 156.62, 167.84; MS (API-ES), *m/z* (%): 483 (83) [M + Na^+], 399 (54), 319 (6), 301 (100), 174 (39), 146 (69), 146 (26), 81 (16).

(5*R*,6*S*)-14-Methoxy-5-(methoxymethoxy)-6-methyl-3,4,5,6,7,10-hexahydro-1*H*-2-benzoxacyclo-dodecin-1-one (20). The intramolecular Suzuki coupling was performed as described for macrolactone

31. Starting with 130 mg (0.28 mmol) of ester **19** resulted in 49 mg (53%) of **20**, colorless oil. TLC (CH_2Cl_2/acetone, 15:1): R_f = 0.70; $[\alpha]_D$ = +34.1 (*c* 0.75, CH_2Cl_2); IR (neat): 1039, 1069, 1109, 1274, 1470, 1725, 2931, 2956 cm^{-1}; ^1H NMR (400 MHz, $CDCl_3$, salicylihalamide numbering!): δ = 0.89 (d, *J* = 7.1 Hz, 3H, CH_3), 1.40-1.53 (m, 1H, H-14), 1.88-1.99 (m, 1H, H-11), 2.00-2.13 (m, 2H, H-12, H-14), 2.13-2.24 (m, 1H, H-11), 3.30 (d, *J* = 8.3 Hz, 1H, H-8), 3.35 (s, 3H, MOM-CH_3), 3.52 (dd, *J* = 6.5, 15.9 Hz, 1H, H-8), 3.75 (s, 4H, OCH_3, H-13), 4.31 (t, *J* = 11.2 Hz, 1H, H-15), 4.46-4.58 (m, 1H, H-15), 4.67 (s, 2H, MOM-CH_2), 5.26-5.39 (m, 1H, H-9), 5.40-5.52 (m, 1H, H-10), 6.72 (d, *J* = 7.4 Hz, 1H, H-4), 6.75 (d, *J* = 8.3 Hz, 1H, H-6), 7.19 (dd, *J* = 7.4, 8.3 Hz, 1H, H-5); ^{13}C NMR (100 MHz, $CDCl_3$): δ = 13.76, 30.14, 34.14, 37.38, 38.00, 55.57, 55.96, 63.23, 79.06, 96.49, 109.31, 122.55, 124.20, 129.05, 129.65, 130.18, 139.34, 156.62, 168.65; MS (EI), *m/z* (%): 334 (5) [M^+], 302 (34), 272 (59), 259 (30), 228 (23), 213 (32), 187 (100), 162 (47), 148 (28), 115 (62), 85 (26), 45 (94); HRMS (EI): [M^+] calcd for $C_{19}H_{26}O_5$ 334.17800, found 334.17652.

***tert*-Butyl (3*S*)-3-hydroxy-6-[(4-methoxybenzyl)oxy]hexanoate (22).** To a solution of dicyclohexylamin (6.96 g, 38.4 mmol) in dry diethyl ether (75 mL) was added *n*-BuLi (2.7 M in hexane, 12.4 mL, 33.5 mmol) at –25 °C. After 30 minutes at –25°C the solution was cooled to –78 °C followed by the dropwise addition of *tert*-butyl acetate (3.34 g, 28.8 mmol), dissolved in diethyl ether (25 mL), within 30 minutes. After being stirred for 30 minutes at –78 °C, a precooled (-78 °C) solution of $CpTiCl(OR^*)_2$ (R* = diacetone-D-glucose) (0.08 M in Et_2O, 450 ml, 36 mmol) was added within 1 h via canula.[3] After 1 h at –78 °C, the solution was warmed to –30°C, stirred 30 minutes at this temperature and recooled to –78 °C before 4-[(4-methoxybenzyl)oxy]butanal (**21**)[4] (6.0 g, 28.8 mmol) in diethyl ether (20 mL) was added. The solution was stirred at –78 °C for 2 h, then the reaction was quenched with H_2O (5 M in THF, 70 mL), warmed to room temperature and stirred for 1 h. Thereafter, the solution was filtered through a short pad of celite and saturated NaCl (50 mL) was added to the filtrate. The mixture was extracted with diethyl ether (2 × 200 mL) and the combined organic layers were briefly dried ($MgSO_4$), filtered, and concentrated. In order to hydrolyse the diacetone-D-glucose, the residue was dissolved in 1N HCl (500 mL) and stirred for 1 h. After extraction with diethyl ether (3 × 150 mL), the organic layer was dried ($MgSO_4$), filtered, evaporated and purified by flash chromatography (diethyl ether/petroleum ether, 2:1) to yield 6.9 g (74%, 83% ee), of the aldol product

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22, colorless oil. TLC (petroleum ether/Et_2O, 1:1): R_f = 0.45; $[\alpha]_D$ = +9.5 (*c* 0.94, CH_2Cl_2); IR (neat): 1035, 1094, 1153, 1248, 1367, 1456, 1513, 1612, 1726, 2858, 2933 cm^{-1}; ^1H NMR (400 MHz, $CDCl_3$): δ = 1.42 (s, 9H, ^tBu), 1.44-1.58 (m, 2H, H-5), 1.59-1.77 (m, 2H, H-4), 2.25-2.39 (m, 2H, H-2), 3.43 (s, br, 3H, H-6, OH), 3.74 (s, 3H, OCH_3), 3.89-3.97 (m, 1H, H-3), 4.39 (s, 2H, PMB-CH_2), 6.83 (d, *J* = 8.6 Hz, 2H, H-3-PMB, H-5-PMB), 7.21 (d, *J* = 8.6 Hz, 2H, H-2-PMB, H-6-PMB); ^{13}C NMR (100 MHz, $CDCl_3$): δ = 25.66, 27.88, 33.31, 42.36, 54.98, 67.70, 69.68, 72.31, 80.75, 113.53, 129.03, 130.23, 158.93, 172.04; MS (EI), *m/z* (%): 324 (0.5) [M^+], 267 (4), 245 (2), 137 (100), 121 (90), 109 (21), 94 (9), 77 (13), 57 (21).

The ee-determination was performed by HPLC using a CHIRA-GROM 4 column, 8 μm, 60 × 2 mm, Part-No. GS CH40891K0602 (corresponds to CHIRACEL AS), eluent: heptane/isopropanol, 95:5, flow: 0.15 mL min^{-1}, retention times: major: 8.95 min, minor 6.82 min.

(3*S*)-6-[(4-Methoxybenzyl)oxy]-3-[(triisopropylsilyl)oxy]hexanal (23): (a) *tert*-Butyl (3*S*)-6-[(4-methoxybenzyl)oxy]-3-[(triisopropylsilyl)oxy]hexanoate. Triisopropylsilyl chloride (1.61 g, 1.9 mmol) was added to a stirred solution of *tert*-butyl (3*S*)-3-hydroxy-6-[(4-methoxybenzyl)oxy]hexanoate (**22**) (3.0 g 9.25 mmol) and imidazole (1.57 g, 23.1 mmol) in dry dimethylformamide (50 mL). The resulting solution was stirred at ambient temperature for 72 h, then diluted with water and extracted with ether (3 × 100 mL). The combined extracts were dried with Na_2SO_4 and the resulting residue was purified by flash chromatography to give 3.69 g (83%) of the protected ester as a colorless oil. TLC (petroleum ether/Et_2O, 3:1): R_f = 0.50; $[\alpha]_D$ = +4.2 (*c* 0.90, CH_2Cl_2); IR (neat): 1097, 1247, 1730 cm^{-1}; ^1H NMR (400 MHz, $CDCl_3$): δ = 1.07 (s, 21H, TIPS-CH, -CH_3), 1.45 (s, 9H, ^tBu), 1.58-1.74 (m, 4H, H-4, H-5), 2.36-2.51 (m, 2H, H-2), 3.43-3.49 (m, 2H, H-6), 3.82 (s, 3H, OCH_3), 4.25-4.34 (m, 1H, H-3), 4.44 (s, 2H, PMB-CH_2), 6.88 (d, *J* = 8.6 Hz, 2H, H-3-PMB, H-5-PMB), 7.27 (d, *J* = 8.6 Hz, 2H, H-2-PMB, H-6-PMB); ^{13}C NMR (100 MHz, $CDCl_3$): δ = 12.53, 17.68, 24.75, 28.04, 33.72, 43.53, 55.23, 69.24, 70.18, 72.35, 80.28, 113.68, 129.12, 130.74, 159.03, 170.87.

(b) (3*S*)-6-[(4-Methoxybenzyl)oxy]-3-[(triisopropylsilyl)oxy]hexanal (23). To a solution of the forgoing ester (2.75 g, 5.72 mmol) in dry CH_2Cl_2 (50 mL) was added DIBAH (1.0 M in hexane, 7 mL) dropwise over 30 min at –78 °C. After being stirred for 3.5 h at –78 °C, methanol (1.5 mL) was added, the cooling bath removed, and the mixture warmed to room temperature. Then water (10 mL) was added and the mixture extracted with Et_2O (3 × 50 ml). The combined organic layers were washed with water (15 mL), dried (Na_2SO_4), filtered and concentrated. The residue was purified by flash chromatography (petroleum ether/Et_2O, 3:1) to yield 2.1 g (90%) of aldehyde **23** as a colorless oil. TLC (petroleum ether/Et_2O, 3:1): R_f = 0.61; $[\alpha]_D$ = +1.9 (*c* 0.74, CH_2Cl_2); IR (neat): 1037, 1098, 1248, 1513, 1612, 1724, 2866, 2943 cm^{-1}; ^1H NMR (400 MHz, $CDCl_3$): δ = 1.04 (s, 21H, TIPS-CH, -CH_3), 1.58-1.70 (m, 4H, H-4, H-5), 2.49-2.64 (m, 2H, H-2), 3.38-3.47 (m, 2H, H-6), 3.79 (s, 3H, OCH_3), 4.32-4.38 (m, 1H,

H-3), 4.41 (s, 2H, PMB-CH_2), 6.86 (d, J = 8.6 Hz, 2H, H-3-PMB, H-5-PMB), 7.23 (d, J = 8.6 Hz, 2H, H-2-PMB, H-4-PMB), 9.83 (t, J = 2.4 Hz, 1H, H-1); ^{13}C NMR (100 MHz, $CDCl_3$): δ = 12.47, 18.07, 25.16, 34.48, 50.42, 55.22, 68.31, 69.84, 72.50, 113.71, 129.16, 130.53, 159.09, 202.28; MS (API-ES), *m/z* (%): 431(47) [M + Na^+], 338 (9), 271 (25), 241 (17), 227 (23), 198 (21), 157 (12), 121 (100).

((4*S*)-4-Benzyl-3-{(2*S*,3*R*,5*S*)-3-hydroxy-8-[(4-methoxybenzyl)oxy]-2-methyl-5-[(triisopropylsilyl)oxy]octanoyl}-1,3-oxazolidin-2-one (24). To a cooled (0 ^{o}C) solution of the oxazolidinone[5] **12** (910 mg, 3.90 mmol) in CH_2Cl_2 (50 mL) was added dropwise titanium(IV) chloride (0.45 mL, 4.10 mmol) and the mixture allowed to stir for 5 min. Subsequently, (-)-sparteine (2.28 g, 9.75 mmol) was added to the yellow slurry.[6] The dark red enolate solution was stirred for 20 min at 0 °C before aldehyde **23** (4.29 mmol) was added dropwise and the mixture stirred for 1 h at 0 °C. The reaction was quenched with half-saturated ammonium chloride (6 mL). After separation of the layers, the organic layer was dried (Na_2SO_4), filtered, and concentrated in vacuo. Purification of the residue by flash chromatography afforded 2.25 g (90%) of **24**, colorless oil. TLC (petroleum ether/Et_2O, 2:3): R_f = 0.51; $[\alpha]_D$ = +47.0 (*c* 0.82, CH_2Cl_2); IR (neat): 1209, 1247, 1782, 2866, 2943 cm^{-1}; ^{1}H NMR (400 MHz, $CDCl_3$): δ = 0.77-0.82 (m, 3H, TIPS-CH), 0.99 (s, 18 H, TIPS-CH_3), 1.21 (d, J = 6.8 Hz, 3H, CH_3), 1.39-1.80 (m, 6H, H-4, H-6, H-7), 2.70 (dd, J = 9.6, 13.1 Hz, 1H, Bn-CH_2), 3.20 (dd, J = 3.0, 13.4 Hz, 1H, Bn-CH_2), 3.32-3.44 (m, 2H, CH_2OPMB), 3.68-3.76 (m, 2H, H-3, H-5), 3.72 (s, 3H, OCH_3), 4.05-4.14 (m, 3H, oxazolidinone-CH_2, C*H*CH_3), 4.20-4.27 (m, 1H, OH), 4.36 (s, 2H, PMB-CH_2), 4.56-4.65 (m, 1H, oxazolidinone-CH), 6.80 (d, J = 8.6 Hz, 2H, H-3,5-PMB), 7.10-7.28 (m, 7H, H-2,6-PMB, H-Bn); ^{13}C NMR (100 MHz, $CDCl_3$): δ = 11.39, 12.40, 18.06, 25.49, 32.73, 37.75, 37.77, 43.42, 55.22, 55.29, 65.99, 68.54, 69.94, 71.46, 72.37, 113.68, 127.30, 128.90, 129.11, 129.41, 130.66, 135.23, 153.13, 159.04, 175.96; MS (API-ES), *m/z* (%): 664 (100) [M + Na^+], 535 (10), 504 (6), 391(11), 346 (25), 282 (9), 169 (14), 151 (15), 121 (71), 85 (11), 61 (10).

(4*S*)-4-Benzyl-3-{(2*S*,3*R*,5*S*)-3-hydroxy-8-[(4-methoxybenzyl)oxy]-2-methyl-5-[(triisopropylsilyl)oxy]octanoyl}-1,3-oxazolidin-2-one (25). To a cooled (0 °C) solution of alcohol **24** (2.1 g, 3.27 mmol) in CH_2Cl_2 (80 mL) were added *N,N*-diisopropylethylamine (11.4 mL, 65 mmol, 20 eq), chloromethylmethyl ether (2.5 mL, 33 mmol, 10 eq) and tetrabutylammonium iodide (120 mg, 0.33 mmol). The reaction mixture was immediately allowed to warm to room temperature and protected from

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[6] (a) Crimmins, M. T.; King, B. W.; Tabet, E. A. *J. Am. Chem. Soc.* **1997**, *119*, 7883-7884. (b) Crimmins, M. T.; King, B. W.; Tabet, E. A.; Chaudhary, K. *J. Org. Chem.* **2001**, *66*, 894-902.

light. After 18 h saturated aqueous $NaHCO_3$ solution was added followed by Et_2O. The organic layer was washed with brine and the aqueous layer extracted with CH_2Cl_2 (2 × 50 mL). The combined extracts were dried (Na_2SO_4), filtered, and concentrated in vacuo. Flash chromatography of the residue provided the MOM ether product; yield 1.95 g (87%), slightly yellow oil. TLC (petroleum ether/Et_2O, 1:1): R_f = 0.37; $[\alpha]_D$ = +58.5 (*c* 0.82, CH_2Cl_2); IR (neat): 1034, 1097, 1246, 1781, 2864, 2942 cm^{-1}; ^1H NMR (400 MHz, $CDCl_3$): δ = 1.05 (s, 21H, TIPS), 1.21 (d, 3H, *J* = 7.1 Hz, CH_3), 1.52-1.87 (m, 6H, H-4, H-6, H-7), 2.74 (dd, *J* = 9.9, 13.4 Hz, 1H, Bn-CH_2), 3.28 (s, 3H, MOM-CH_3), 3.28-3.33 (m, 1H, Bn-CH_2), 3.40-3.49 (m, 2H, CH_2OPMB), 3.78 (s, 3H, PMB-OCH_3), 3.89-3.99 (m, 2H, CHOMOM, CHOTIPS), 4.03-4.21 (m, 3H, C*H*CH_3, oxazolidinone-CH_2), 4.41 (s, 2H, PMB-CH_2), 4.55-4.63 (m, 3H, oxazolidinone-CH, MOM-CH_2), 6.85 (d, 2H, *J* = 8.6 Hz, H-3-PMB, H-5-PMB), 7.16-7.34 (m, 7H, H-2-PMB, H-6-PMB, Bn-H); ^{13}C NMR (100 MHz, $CDCl_3$): δ = 12.05, 12.84, 18.23, 25.02, 34.20, 37.69, 39.76, 41.09, 55.20, 55.86, 55.91, 65.97, 69.61, 70.24, 72.34, 77.45, 96.57, 113.64, 127.24, 128.87, 129.09, 129.41, 130.73, 135.44, 153.19, 159.00, 174.64; MS (API-ES), *m/z* (%): 708 (60) [M + Na^+], 360 (33), 330 (100), 151 (15), 121 (17).

(2*R*,3*R*,5*S*)-8-[(4-Methoxybenzyl)oxy]-3-(methoxymethoxy)-2-methyl-5-[(triisopropyl-silyl)oxy]octan-1-ol (26). To a stirred solution of **25** (1.90 g, 2.80 mmol) in THF (25 mL) was added a solution of $NaBH_4$ (0.53 g, 14.0 mmol) in H_2O (10 mL) at 0 °C. The reaction mixture was stirred at 0 °C for 5 min, allowed to warm to room temperature and stirred overnight at room temperature. The reaction was quenched by addition of saturated aqueous NH_4Cl and the mixture stirred for 1 h and then extracted with EtOAc (2 × 30 mL). The combined organic layers were washed with saturated $NaHCO_3$ solution (20 mL), H_2O (20 mL), brine (20 mL), dried ($MgSO_4$), filtered, and concentrated in vacuo. The crude alcohol **26** was purified by flash chromatography to give 1.28 g (90%) of **26** as a colorless oil. TLC (petroleum ether/Et_2O, 1:3): R_f = 0.50; $[\alpha]_D$ = -9.3 (*c* 0.72, CH_2Cl_2); IR (neat): 1037, 1096, 1247, 1464, 1513, 2865, 2942 cm^{-1}; ^1H NMR (400 MHz, $CDCl_3$): δ = 0.84 (d, *J* = 7.1 Hz, 3H CH_3), 1.06 (s, 21H, TIPS), 1.51-1.84 (m, 6H, H-4, H-6, H-7), 1.89-2.02 (m, 1H, C*H*CH_3), 2.70 (s, 1H, OH), 3.39 (s, 3H, MOM-CH_3), 3.42-3.55 (m, 1H, C*H*$_2$OH, 2H, CH_2OPMB), 3.62 (t, *J* = 9.9 Hz, 1H, C*H*$_2$OH), 3.81 (s, 3H, PMB-OCH_3), 3.85-3.91 (m, 1H, C*H*OMOM), 3.91-3.98 (m, 1H, CHOTIPS), 4.43 (s, 2H, PMB-CH_2), 4.64 (d, *J* = 6.8 Hz, 1H, MOM-CH_2), 4.71 (d, *J* = 6.8 Hz, 1H, MOM-CH_2), 6.88 (d, 2H, *J* = 8.6 Hz, H-3-PMB, H-5-PMB), 7.26 (d, 2H, *J* = 8.6 Hz, H-2-PMB, H-6-PMB); ^{13}C NMR (100 MHz, $CDCl_3$): δ = 11.15, 12.84, 18.23, 24.83, 33.98, 38.51, 38.52, 55.22, 55.83, 65.26, 69.67, 70.15, 72.41, 77.72, 96.86, 113.67, 129.13, 130.66, 159.05; MS (API-ES), *m/z* (%): 535 (43) [M + Na^+], 413 (5), 391 (18), 279 (79, 259 (37), 171 (17), 121 (100), 85 (15), 61 (14).

[(4*R*,6*S*)-6-(methoxymethoxy)-7-methyl-4-[triisopropylsilyl)oxy]-7-octenyl p-methoxybenzyl ether (27): (a) Tosylation of alcohol 26. To a stirred solution of alcohol **26** 1.24 g (2.42 mmol) in

pyridine (5 mL) was added *p*-toluenesulfonyl chloride (1.53 g, 8.0 mmol) at 0 °C. After being stirred for 2 h, the reaction was quenched by addition of ice (0.5 g) and water (10 mL). The mixture was diluted with Et_2O (50 mL) and washed with saturated $NaHCO_3$ solution, 1N HCl and saturated NaCl solution. The organic layer was dried (Na_2SO_4), filtered and concentrated. Filtration of the residue over a short pad of silica gel and evaporation of the solvent gave the pure tosylate in nearly quantitative yield as a slightly yellow oil. TLC (petroleum ether/Et_2O, 1:1): R_f = 0.31; $[\alpha]_D$ = +11.5 (*c* 0.90, CH_2Cl_2); ^{1}H NMR (400 MHz, $CDCl_3$): δ = 0.86 (d, *J* = 7.1 Hz, 3H, CH_3), 1.01 (s, 21H, TIPS), 1.42-1.67 (m, 6H, H-4, H-6, H-7), 2.01-2.10 (m, 1H, H-2), 2.41 (s, 3H, Tos-CH_3), 3.22 (s, 3H, MOM-CH_3), 3.40 (dd, *J* = 5.6, 6.6 Hz, 2H, H-8), 3.63-3.68 (m, 1H, H-3), 3.78 (s, 3H, PMB-OCH_3), 3.84 (dd, *J* = 7.6, 9.3 Hz, 1H, H-1), 4.08 (dd, *J* = 6.1, 9.3 Hz, 1H, H-1), 4.40 (s, 2H, PMB-CH_2), 4.51 (d, *J* = 6.8 Hz, 1H, MOM-CH_2), 4.54 (d, *J* = 6.8 Hz, 1H, MOM-CH_2), 6.85 (d, *J* = 8.6 Hz, 2H, H-3-PMB, H-5-PMB), 7.23 (d, *J* = 8.6 Hz, 2H, H-2-PMB, H-6-PMB), 7.30 (d, *J* = 8.1 Hz, 2H, Tos-H-3,5), 7.76 (d, *J* = 8.1 Hz, 2H, Tos-H-2,6); ^{13}C NMR (100 MHz, $CDCl_3$): δ = 11.25, 12.80, 18.19, 21.56, 24.71, 34.05, 36.85, 38.65, 55.20, 55.52, 69.57, 70.13, 72.14, 76.61, 96.79, 113.67, 127.86, 129.12, 129.75, 130.63. 133.08, 144.59, 159.04.

(b) [(4*R*,6*S*)-6-(methoxymethoxy)-7-methyl-4-[triisopropylsilyl)oxy]-7-octenyl p-methoxybenzyl ether (27). A mixture of the forgoing tosylate (2.29 mmol), NaI (0.86 g, 5.75 mmol, 2.5 eq) and DBU (1.75 g, 11.5 mmol, 5 eq) in glyme (50 mL) was refluxed with stirring for 3 h. After that, the solution was cooled to room temperature, diluted with Et_2O (100 mL), and washed with saturated $NaHCO_3$ solution, 1N HCl and brine. The organic layer was dried (Na_2SO_4), filtered, and concentrated in vacuo. Filtration of the residue over a short pad of silica gel gave the pure alkene **27** in nearly quantitative yield as a slightly yellow oil. TLC (petroleum ether/Et_2O, 10:1): R_f = 0.27; $[\alpha]_D$ = +34.0 (*c* 0.50, CH_2Cl_2); IR (neat): 1036, 1095, 1247, 2865, 2943 cm^{-1}; ^{1}H NMR (400 MHz, $CDCl_3$): δ = 1.07 (s, 21H, TIPS), 1.56-1.74 (m, 5H, H-2, H-3, H-5), 1.68 (s, 3H, CH_3), 1.77-1.89 (m, 1H, H-5), 3.36 (s, 3H, MOM-CH_3), 3.42-3.50 (m, 2H, CH_2OPMB), 3.80 (s, 3H, PMB-OCH_3), 3.90-3.99 (m, 1H, CHOTIPS), 4.07-4.15 (m, 1H, CHOMOM), 4.43 (s, 2H, PMB-CH_2), 4.49 (d, *J* = 6.6 Hz, 1H, MOM-CH_2), 4.60 (d, *J* = 6.6 Hz, 1H, MOM-CH_2), 4.91 (s, 2H, CH_2=), 6.88 (d, 2H, *J* = 8.6 Hz, H-3-PMB, H-5-PMB), 7.26 (d, 2H, *J* = 8.6 Hz, H-2-PMB, H-6-PMB); ^{13}C NMR (100 MHz, $CDCl_3$): δ = 12.72, 16.61, 18.19, 24.51, 33.65, 41.13, 55.17, 55.73, 69.53, 70.29, 72.31, 77.74, 93.85, 113.64, 113.84, 129.06, 130.72, 144.31, 159.01; MS (API-ES), *m/z* (%): 517 (100) [M + Na$^+$], 463 (16), 433 (25), 338 (9), 289 (32), 271 (6), 259 (47), 205 (22), 121 (57), 71.2 (19).

(4*S*,6*R*)-1-[(4-Methoxybenzyl)oxy]-6-(methoxymethoxy)-7-methyloct-7-en-4-ol (28). To a solution of **27** (0.95 g, 1.92 mmol) in THF (15 mL) was added a 1 M THF solution of TBAF (9.6 mL, 9.6 mmol, 5 eq) at 0 °C. After being stirred for 3 h at room temperature, saturated aqueous $NaHCO_3$ solution (20 mL) was added and the mixture extracted with Et_2O (3 × 50 mL). The combined extracts were dried

(Na_2SO_4), filtered, and concentrated. Flash chromatography of the residue gave 585 mg (90%) of the desired alcohol **28** as a colorless oil. TLC (petroleum ether/Et_2O, 1:3): R_f = 0.45; $[\alpha]_D$ = +66.6 (*c* 1.24, CH_2Cl_2); IR (neat): 1035, 1096, 1247, 1513, 2944 cm^{-1}; ^1H NMR (400 MHz, $CDCl_3$): δ = 1.43-1.63 (m, 3H, H-5, H-3), 1.65 (s, 3H, CH_3), 1.67-1.82 (m, 3H, H-5, H-2), 3.05 (d, *J* = 3.5 Hz, 1H, OH), 3.35 (s, 3H, MOM-CH_3), 3.46 (t, *J* = 6.1 Hz, 2H, CH_2OPMB), 3.77 (s, 3H, PMB-OCH_3), 3.78-3.88 (m, 1H, H-4), 4.26 (dd, *J* = 3.4, 9.2 Hz 1H, CHOMOM), 4.41 (s, 2H, PMB-CH_2), 4.50 (d, *J* = 6.6 Hz, 1H, MOM-CH_2), 4.59 (d, *J* = 6.6 Hz, 1H, MOM-CH_2), 4.88 (s, 1H, C*H*$_2$=C), 4.95 (s, 1H, C*H*$_2$=C), 6.85 (d, *J* = 8.6 Hz, 2H, H-3-PMB, H-5-PMB), 7.23 (d, *J* = 8.6 Hz, 2H, H-2-PMB, H-6-PMB); ^{13}C NMR (100 MHz, $CDCl_3$): δ = 17.31, 25.95, 34.39, 40.80, 54.97, 55.53, 67.65, 69.95, 72.34, 76.52, 93.98, 112.70, 113.50, 129.01, 130.11, 143.98, 158.89; MS (API-ES), *m/z* (%): 361 (100) [M + Na^+], 338 (45), 307 (12), 277 (27), 259 (7), 242 (8), 121 (49).

(4*R*,6*R*)-1-[(4-Methoxybenzyl)oxy]-6-(methoxymethoxy)-7-methyloct-7-en-4-ol (29): (a) (1*S*,3*R*)-1-{3-[(4-Methoxybenzyl)oxy]propyl}-3-(methoxymethoxy)-4-methylpent-4-enyl 4-nitrobenzoate. This compound was prepared according to a procedure of O'Doherty et al.[7] TLC (petroleum ether/Et_2O, 1:1): R_f = 0.51; $[\alpha]_D$ = +51.8 (*c* 0.54, CH_2Cl_2); ^1H NMR (400 MHz, $CDCl_3$): δ = 1.61-1.74 (m, 5H, H-2", CH_3), 1.76-1.94 (m, 3H, H-2a', H-1"), 2.07-2.17 (m, 1H, H-2b'), 3.33 (s, 3H, MOM-CH_3), 3.44 (t, *J* = 6.3 Hz, 2H, H-3"), 3.77 (s, 3H, PMB-OCH_3), 4.12 (t, *J* = 6.8 Hz, 1H, H-1'), 4.39 (s, 2H, PMB-CH_2), 4.46 (d, *J* = 6.8 Hz, 1H, MOM-CH_2), 4.56 (d, *J* = 6.8 Hz, 1H, MOM-CH_2), 4.86, 4.91 (2 s, 1H each, H-5'), 5.19-5.27 (m, 1H, H-1'), 6.84 (d, *J* = 8.6 Hz, 2H, H-3-PMB, H-5-PMB), 7.21 (d, *J* = 8.6 Hz, 2H, H-2-PMB, H-6-PMB), 8.16 (d, *J* = 9.1 Hz, 2H, nitrobenzoate-H-3,5), 8.25 (d, *J* = 9.1 Hz, 2H, nitrobenzoate-H-2,6); ^{13}C NMR (100 MHz, $CDCl_3$): δ = 16.48, 25.42, 30.76, 37.59, 55.14, 55.61, 69.44, 72.53, 73.32, 76.83, 93.53, 113.65, 114.93, 123.42, 129.14, 130.33, 130.53, 135.84, 142.80, 150.37, 159.06, 164.04.

(b) (4*R*,6*R*)-1-[(4-Methoxybenzyl)oxy]-6-(methoxymethoxy)-7-methyloct-7-en-4-ol (29). To a stirred solution of the forgoing nitrobenzoate (450 mg, 0.92 mmol) in MeOH (5 mL) was added NaOH (184 mg, 4.6 mmol, 5 eq) at room temperature. The mixture was stirred for 18 h, treated with saturated NH_4Cl solution (10 mL) and extracted with diethyl ether (3 × 50 mL). The combined organic layers were dried ($MgSO_4$), filtered, and concentrated in vacuo. Flash chromatography of the residue afforded 275 mg (88%) of the alcohol **29** as a colorless oil. TLC (petroleum ether/diethyl ether, 1:3): R_f = 0.45; $[\alpha]_D$ = +73.1 (*c* 0.56, CH_2Cl_2); IR (neat): 1035, 1095, 1247, 1513, 2856, 2945, 3469 cm^{-1}; ^1H NMR (400 MHz, $CDCl_3$): δ = 1.48-1.65 (m, 3H, H-5, H-3), 1.67 (s, 3H, CH_3), 1.69-1.85 (m, 3H, H-5, H-2), 3.40 (s,

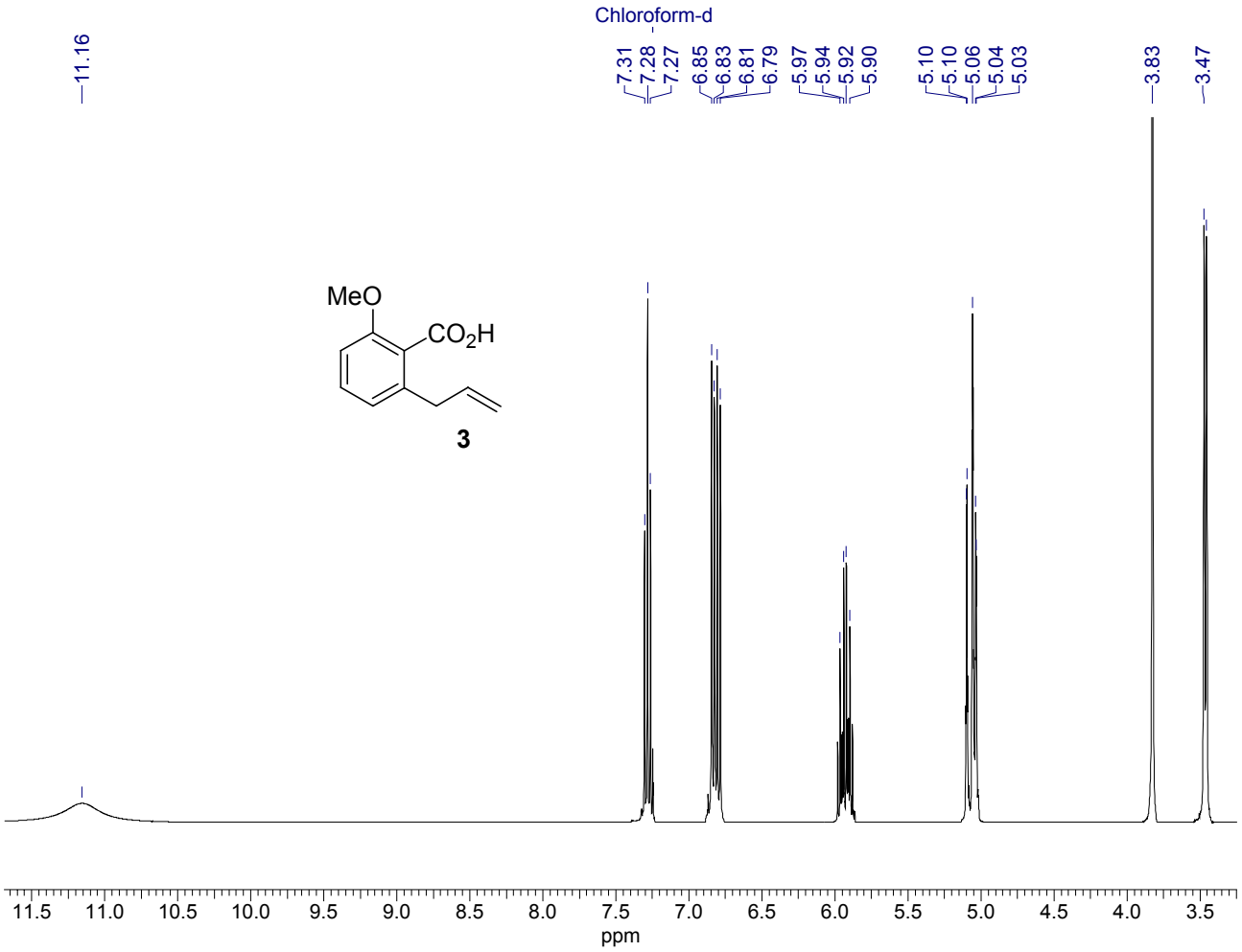
[7] Haukaas, M. H.; O'Doherty, G. A. *Org. Lett.* **2001**, *3*, 3899-3902.

3H, MOM-CH_3), 3.41 (s, 1H, OH), 3.45-3.53 (m, 2H, H-1), 3.75-3.79 (m, 1H, C*H*OH), 3.81 (s, 3H, PMB-OCH_3), 4.26 (dd, *J* = 4.6, 9.4 Hz, 1H, CHOMOM), 4.44 (s, 2H, PMB-CH_2), 4.50 (d, *J* = 6.8, Hz, 1H, MOM-CH_2), 4.64 (d, *J* = 6.6 Hz, 1H, MOM-CH_2), 4.97 (d, *J* = 9.1 Hz, 2H, CH_2=), 6.88 (d, 2H, *J* = 8.6 Hz, H-3-PMB, H-5-PMB), 7.26 (d, 2H, *J* = 8.6 Hz, H-2-PMB, H-6-PMB); ^{13}C NMR (100 MHz, $CDCl_3$): δ = 16.69, 25.79, 34.41, 40.67, 55.22, 55.86, 70.06, 70.56, 72.50, 79.85, 93.33, 113.71, 114.45, 129.22, 130.49, 143.38, 159.09; MS (EI), *m/z* (%): 338 (1) [M^+], 306 (2), 292 (2), 276 (3), 258 (2), 241 (2), 137 (99), 121 (100), 109 (24), 91 (17), 77 (25), 71 (73), 45 (62); HRMS (EI): [M - CH_3OH]$^+$ calcd for $C_{18}H_{26}O_4$ 306.18309, found 306.18566.

1-{3-[(4-Methoxybenzyl)oxy]propyl}-3-(methoxymethoxy)-4-methylpent-4-enyl 2-[(2*E*)-but-2-enyl]-6-methoxybenzoate (30). A solution of the alcohol **29** (0.23 g, 0.68 mmol) and PPh_3 (180 mg, 0.68 mmol) in Et_2O (10 mL) was added dropwise at ambient temperature to a suspension of the carboxylic acid **6** (200 mg, 0.62 mmol) and DIAD (138 mg, 0.68 mmol) in Et_2O (10 mL). After being stirred for 3 h at room temperature, the mixture was concentrated in vacuo and the residue subjected to flash chromatography to yield 320 mg (81%) of the ester **30**, slightly yellow oil. TLC (petroleum ether/EtOAc, 2:1): R_f = 0.61; $[\alpha]_D$ = +24.5 (*c* 0.40, CH_2Cl_2); IR (neat): 1034, 1070, 1095, 1246, 1267, 1470, 1512, 1584, 1722, 2854, 2945 cm^{-1}; ^{1}H NMR (400 MHz, $CDCl_3$): δ = 1.71 (s, 3H, CH_3), 1.72-1.95 (m, 6H, H-2', H-1", H-2"), 3.30-3.39 (m, 2H, C*H*$_2$CHCHI), 3.40 (s, 3H, MOM-CH_3), 3.46-3.53 (m, 2H, CH_2OPMB), 3.80 (s, 3H, PMB-OCH_3), 3.82 (s, 3H, benzoate-OCH_3), 4.20 (dd, *J* = 3.5, 9.4 Hz, 1H, CHOMOM), 4.45 (s, 2H, PMB-CH2), 4.54 (d, *J* = 6.6 Hz, 1H, MOM-CH_2), 4.66 (d, *J* = 6.6 Hz, 1H, MOM-CH_2), 4.95 (d, *J* = 7.3 Hz, 2H, C*H*$_2$=), 5.34-5.43 (m, 1H, CH(OOCR**)**, 6.07 (d, *J* = 14.4 Hz, 1H, CH_2CHC*H*I), 6.64 (dt, *J* = 6.6, 14.4 Hz, 1H, CH_2C*H*CHI), 6.78 (m, 2H, H-3, H-5), 6.88 (d, *J* = 8.6 Hz, 2H, H-3-PMB, H-5-PMB), 7.23-7.33 (m, 3H, H-4, H-2-PMB, H-6-PMB); ^{13}C NMR (100 MHz, $CDCl_3$): δ =16.82, 25.22, 31.38, 38.79, 39.15, 55.17, 55.46, 55.89, 69.64, 72.32, 72.42, 76.03, 77.04, 93.84, 109.16, 113.65, 113.86, 121.49, 123.94, 129.10, 130.42, 130.57, 136.24, 143.59, 144.00, 156.41, 158.99, 167.58; MS (API-ES), *m/z* (%): 661 (100) [M + Na^+], 577 (42), 301 (29), 289 (31), 259 (43), 205 (20), 169 (20), 121 (67), 71 (12).

(3*S*,5*R*,6*S*)-14-Methoxy-3-{3-[(4-methoxybenzyl)oxy]propyl}-5-(methoxymethoxy)-6-methyl-3,4,5,6,7,10-hexahydro-1*H*-2-benzoxacyclododecin-1-one (31). To a solution of **30** (100 mg, 0.16 mmol) in THF (3 mL) was added 9-BBN (0.5 M in THF, 0.78 mmol, 5 eq) at 0°C. The mixture was stirred overnight at room temperature, then aqueous NaOH (3 M, 0.7 mL) and THF (15 mL) were added. This solution was added by syringe pump over 20 h to a refluxing solution of $PdCl_2$(dppf) (30 mg, 20 mol %) in benzene (150 mL). After being refluxed for further 4 h, the solution was cooled to room temperature, treated with saturated NH_4Cl solution and extracted with Et_2O. The organic layer was dried (Na_2SO_4), filtered, and concentrated in vacuo. The residue was purified by flash

chromatography (CH_2Cl_2/acetone, 15:1); yield 39 mg (48%) of **31** (as a 4:1 *trans*:*cis* mixture), as a colorless oil. The isomers were separated by preparative HPLC (Varian-ProStar, Chrom-Sil 120, Si NP-2, 10 μm, 250 × 20 mm, heptane/EtOAc, 75:25, flow 15 ml min^{-1}, 254 nm, injection ~ 30 mg, major isomer: 20.2 min). TLC (CH_2Cl_2/acetone, 15:1); R_f = 0.61; $[\alpha]_D$ = -39.5 (*c* 0.68, CH_2Cl_2); IR (neat): 1040, 1072, 1098, 1116, 1248, 1275, 1722, 2929, 2929 cm^{-1}; ^{1}H NMR (400 MHz, $CDCl_3$): δ = 0.85 (d, *J* = 6.8 Hz, 3H, CH_3), 1.41 (dd, *J* = 9.4, 15.4 Hz, 1H, H-14a), 1.61-1.80 (m, 5H, H-11a, H-14b, H-16, H-17a), 1.81-1.91 (m, 1H, H-17b), 2.05-2.17 (m, 1H, H-12), 2.28 (d, *J* = 13.6 Hz, 1H, H-11b), 3.31 (d, *J* = 16.9 Hz, 1H, H-8a), 3.43 (s, 3H, MOM-CH_3), 3.47 (dd, *J* = 5.8, 6.6 Hz, 2H, H-18), 3.70 (dd, *J* = 9.6, 16.9 Hz, 1H, H-8b), 3.74 (s, 3H, PMB-OCH_3), 3.79 (s, 3H, OCH_3-benzoate), 4.13 (dd, *J* = 3.5, 9.4 Hz, 1H, H-13), 4.42 (s, 2H, PMB-CH_2), 4.78 (d, *J* = 6.6 Hz, 1H, MOM-CH_2), 4.89 (d, *J* = 6.6 Hz, 1H, MOM-CH_2), 5.25-5.38 (m, 2H, H-9, H-15), 5.42-5.53 (m, 1H, H-10), 6.74 (d, *J* = 7.6 Hz, 1H, H-4), 6.77 (d, *J* = 8.3 Hz, 1H, H-6), 6.86 (d, *J* = 8.6 Hz, 2H, H-3-PMB, H-5-PMB), 7.17-7.28 (m, 3H, H-5, H-2-PMB, H-6-PMB); ^{13}C NMR (100 MHz, $CDCl_3$): δ = 13.31, 25.55, 32.79, 34.08, 35.68, 37.69, 37.75, 55.25, 55.27, 55.52, 69.72, 72.45, 74.47, 79.37, 96.98, 109.10, 113.70, 122.73, 124.71 (C-2), 128.53, 129.08, 129.86, 130.74, 131.30, 138.90, 156.46, 159.04, 168.48; MS (EI), *m/z* (%): 480 (6) $[M - CH_3OH]^+$, 467 (5), 331 (6), 315 (7), 227 (9), 190 (22), 187 (19), 121 (100), 71 (9), 45 (25); HRMS (EI): $[M - CH_3OH]^+$ calcd for $C_{29}H_{36}O_6$ 480.25116, found 480.25403.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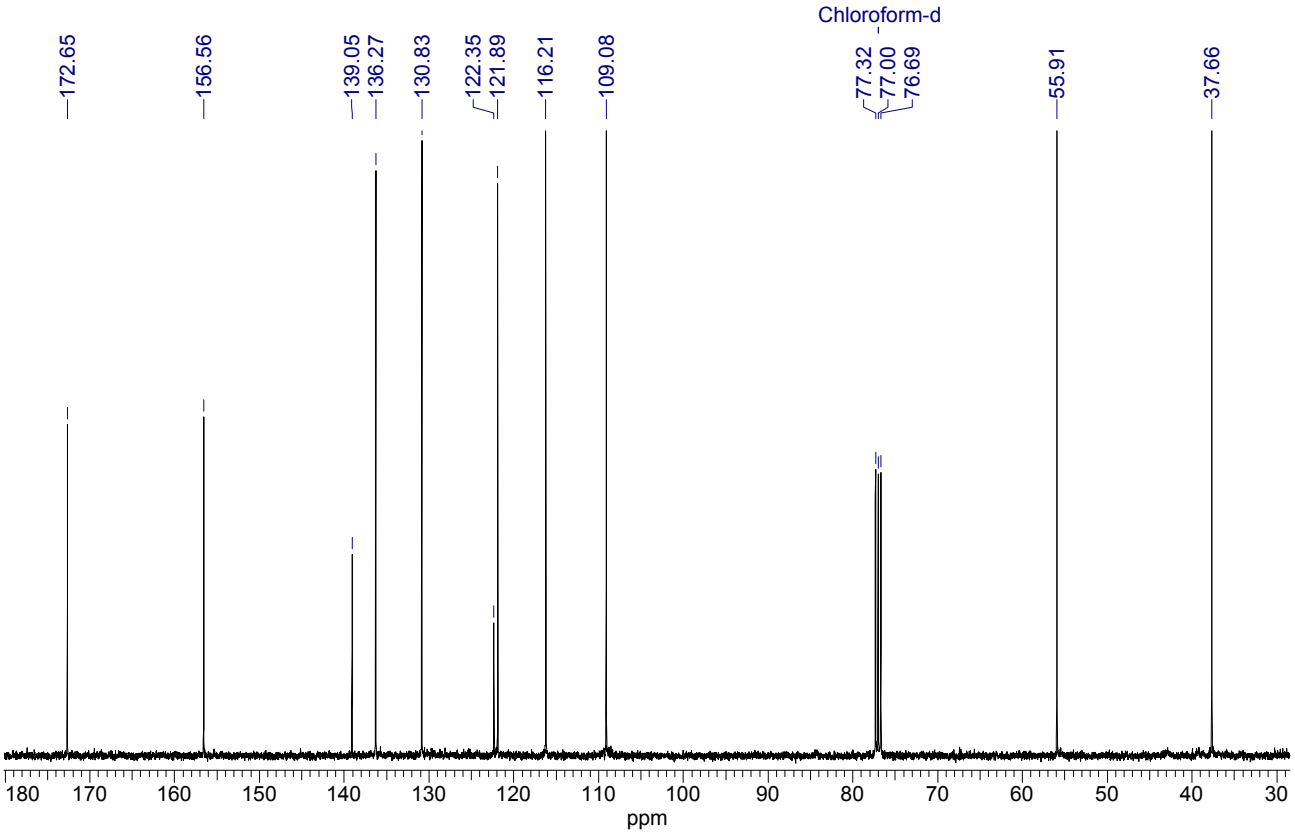
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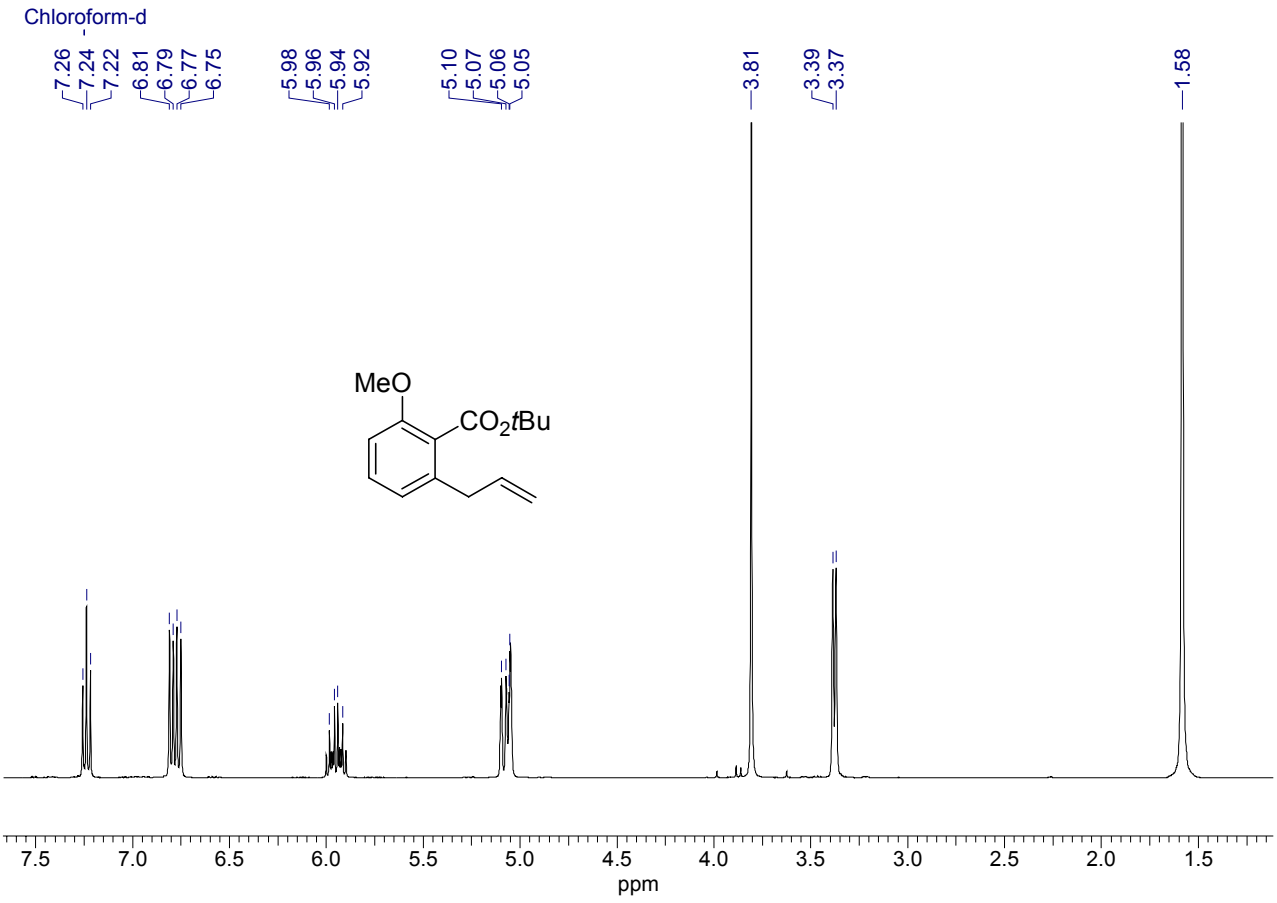
Chloroform-d
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7.24
7.22
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5.94
5.92
5.10
5.07
5.06
5.05
3.81
3.39
3.37
1.58
MeO
CO2tBu
7.5
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5.0
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3.0
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2.0
1.5
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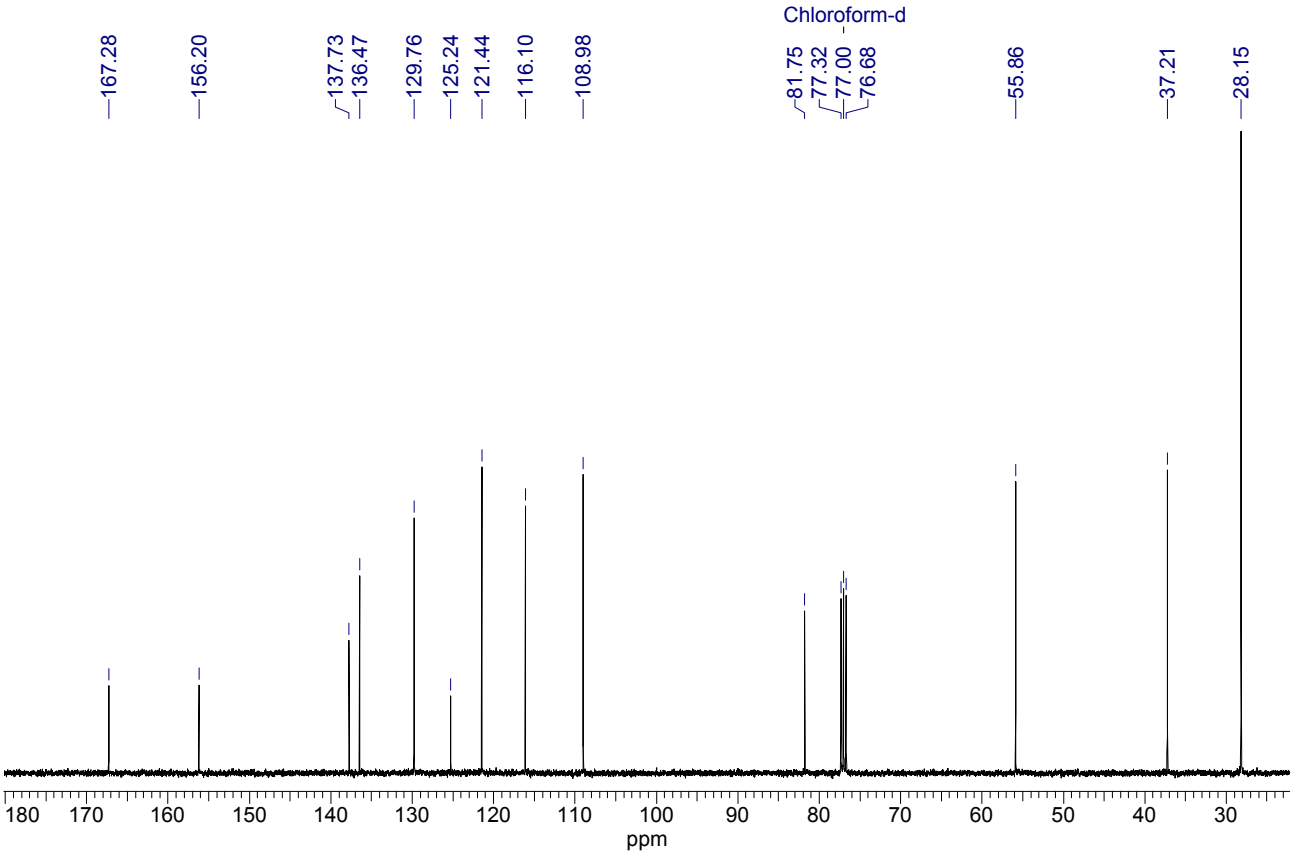
Chloroform-d
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121.44
116.10
108.98
81.75
77.32
77.00
76.68
55.86
37.21
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30
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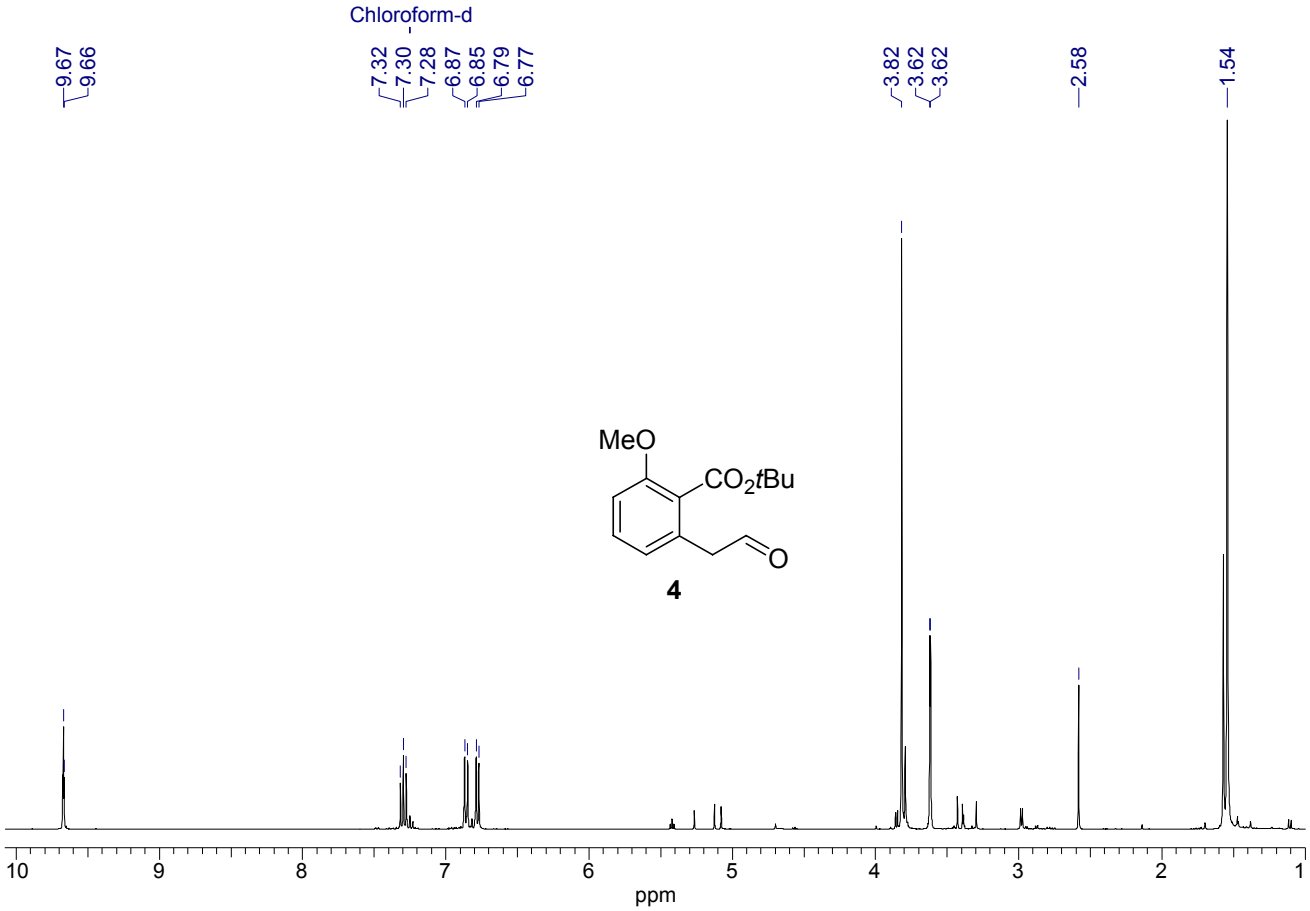
Chloroform-d
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7.32
7.30
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6.77
3.82
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3.62
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CO2tBu
O
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4
3
2
1
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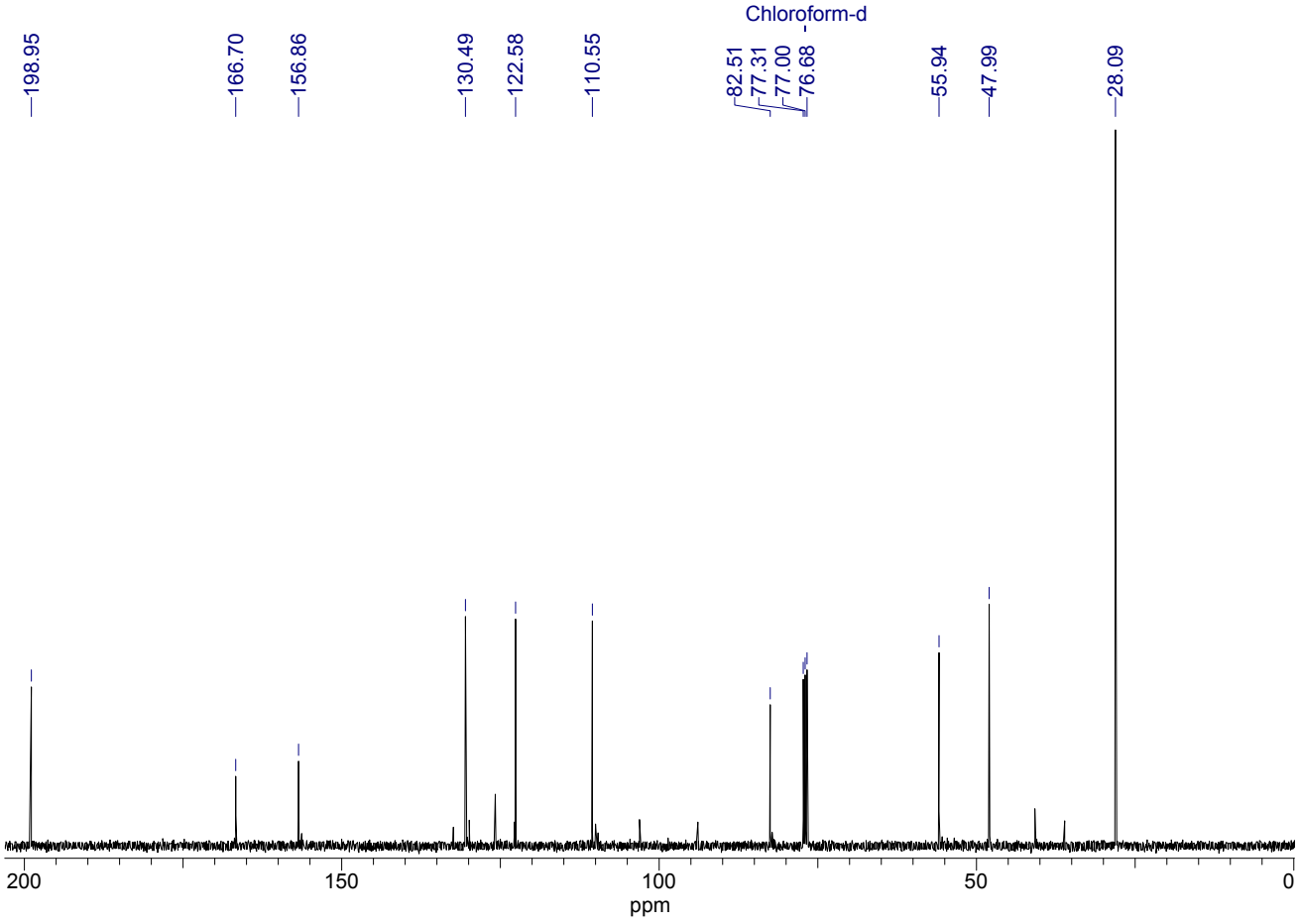
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76.68
55.94
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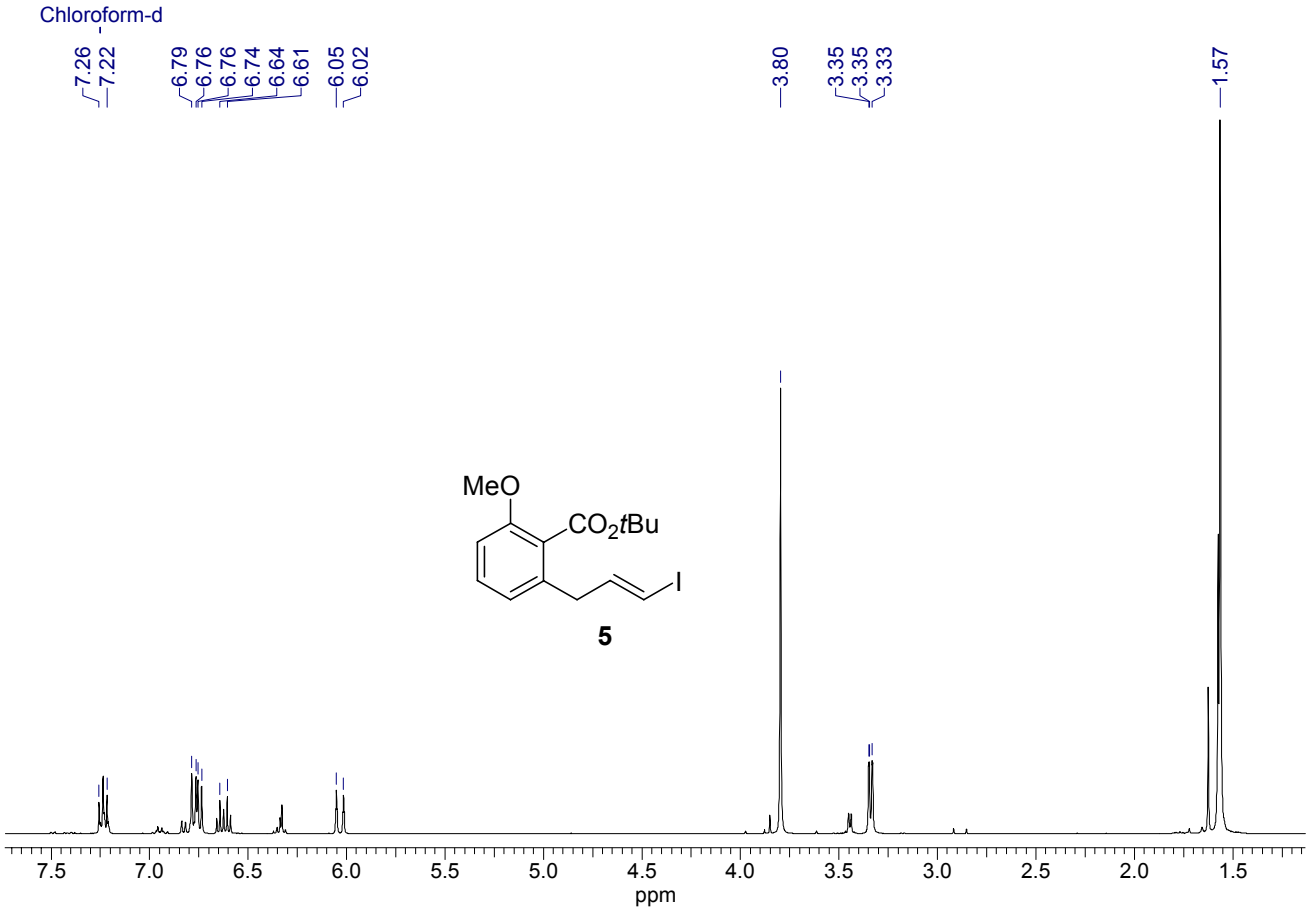
Chloroform-d
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6.76
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6.05
6.02
3.80
3.35
3.35
3.33
1.57
MeO
CO2tBu
I
5
7.5
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4.5
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2.0
1.5
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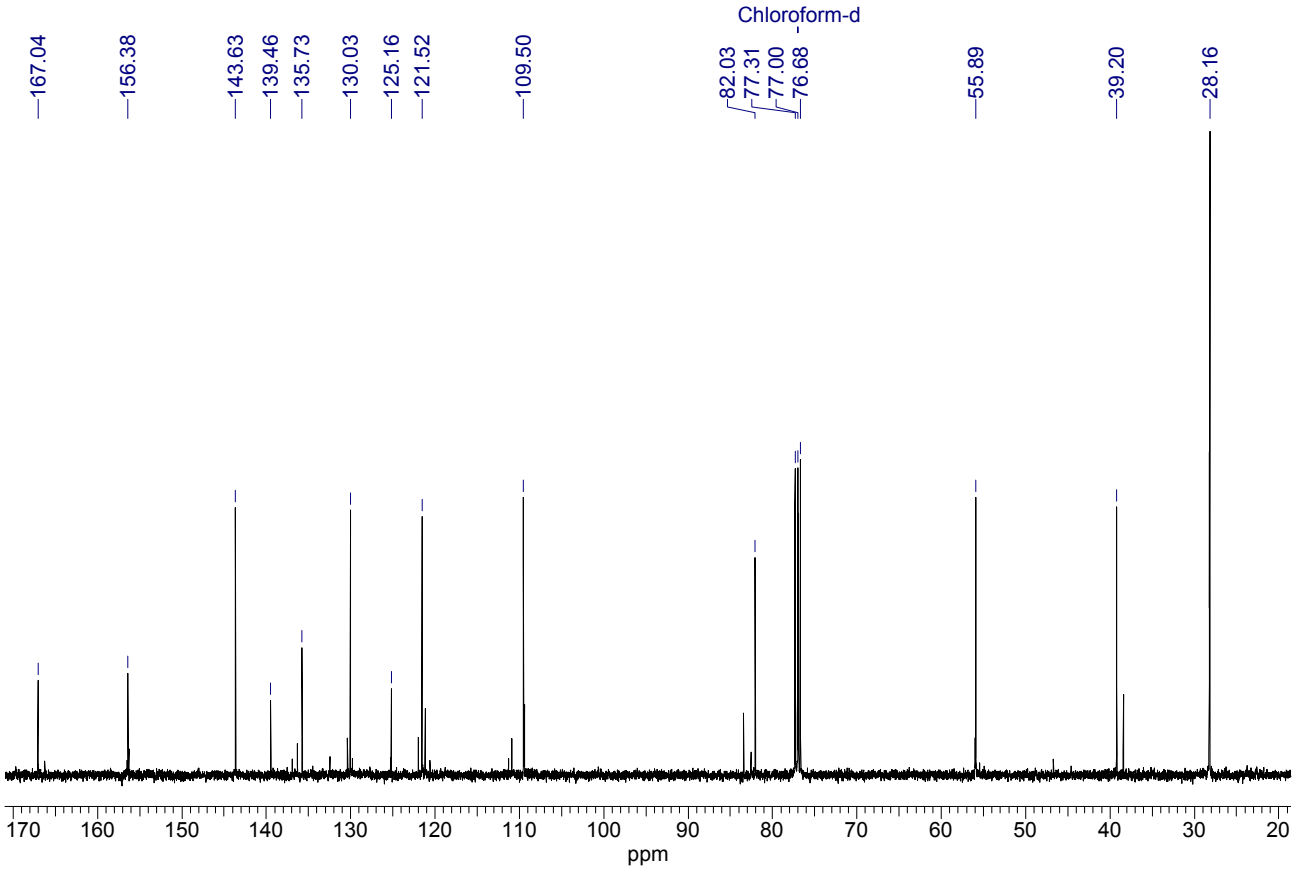
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130.03
125.16
121.52
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77.00
76.68
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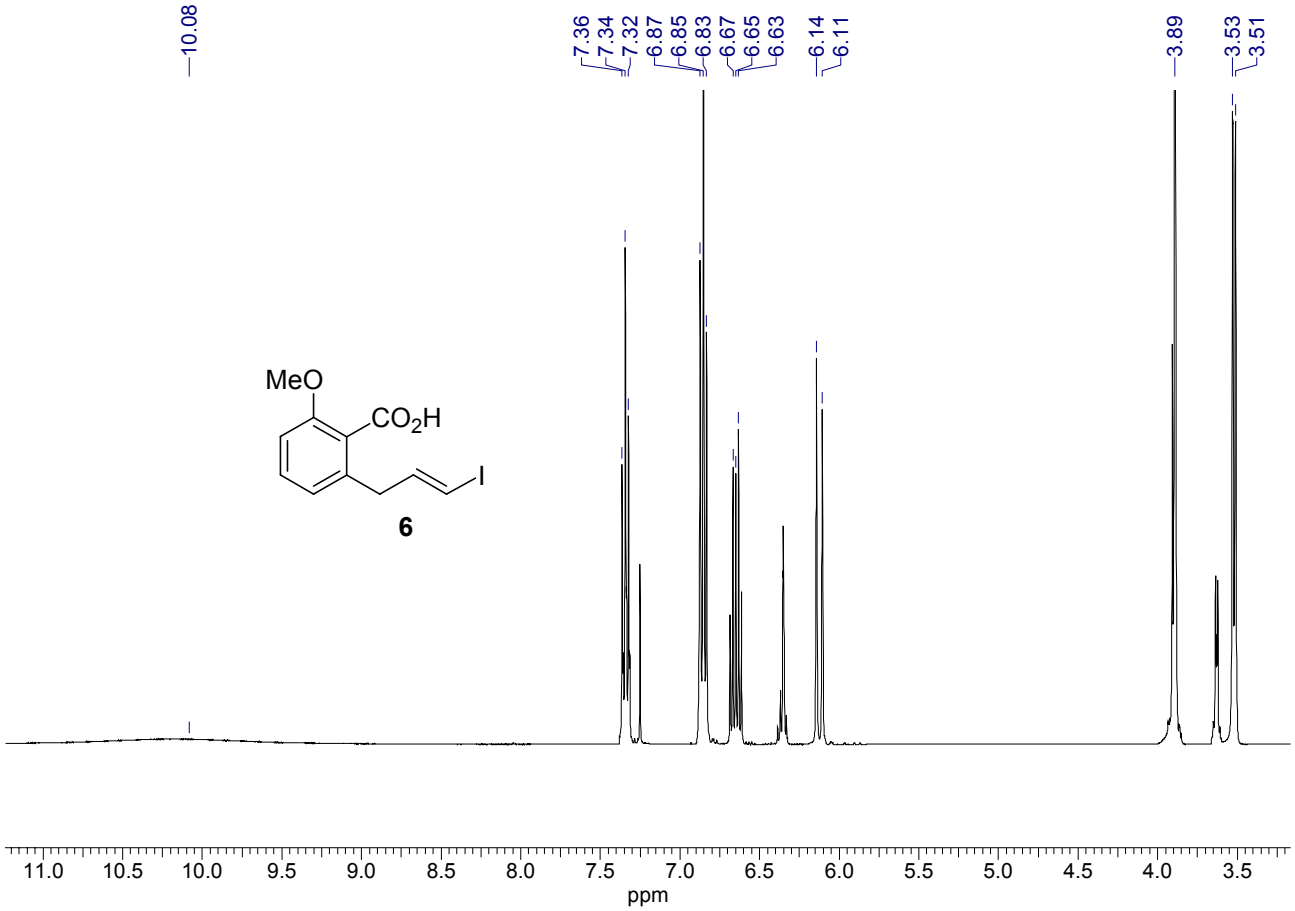
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6.65
6.63
6.14
6.11
3.89
3.53
3.51
MeO
CO2H
I
6
11.0
10.5
10.0
9.5
9.0
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7.0
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5.0
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4.0
3.5
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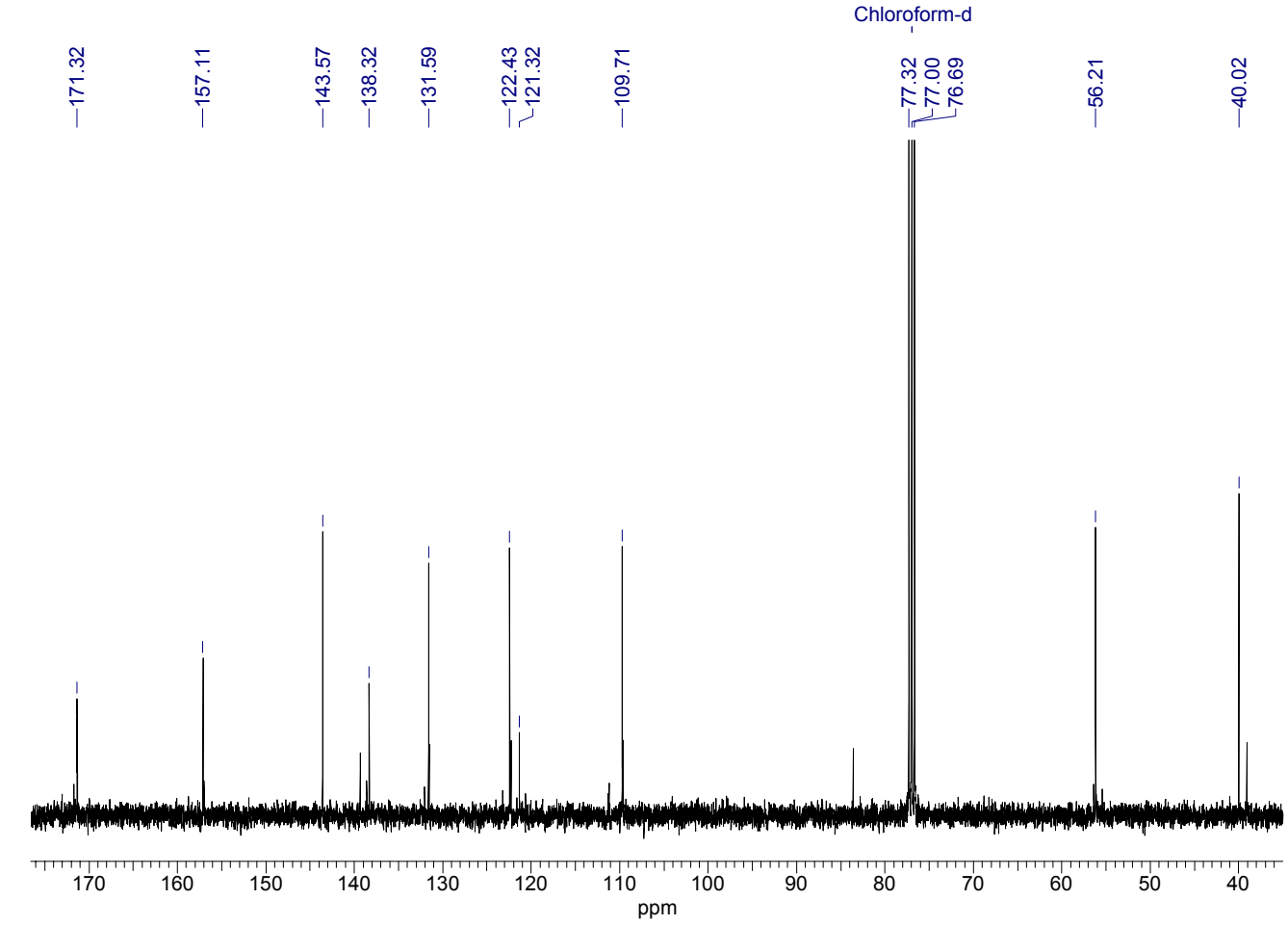
Chloroform-d
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122.43
121.32
109.71
77.32
77.00
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40.02
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40
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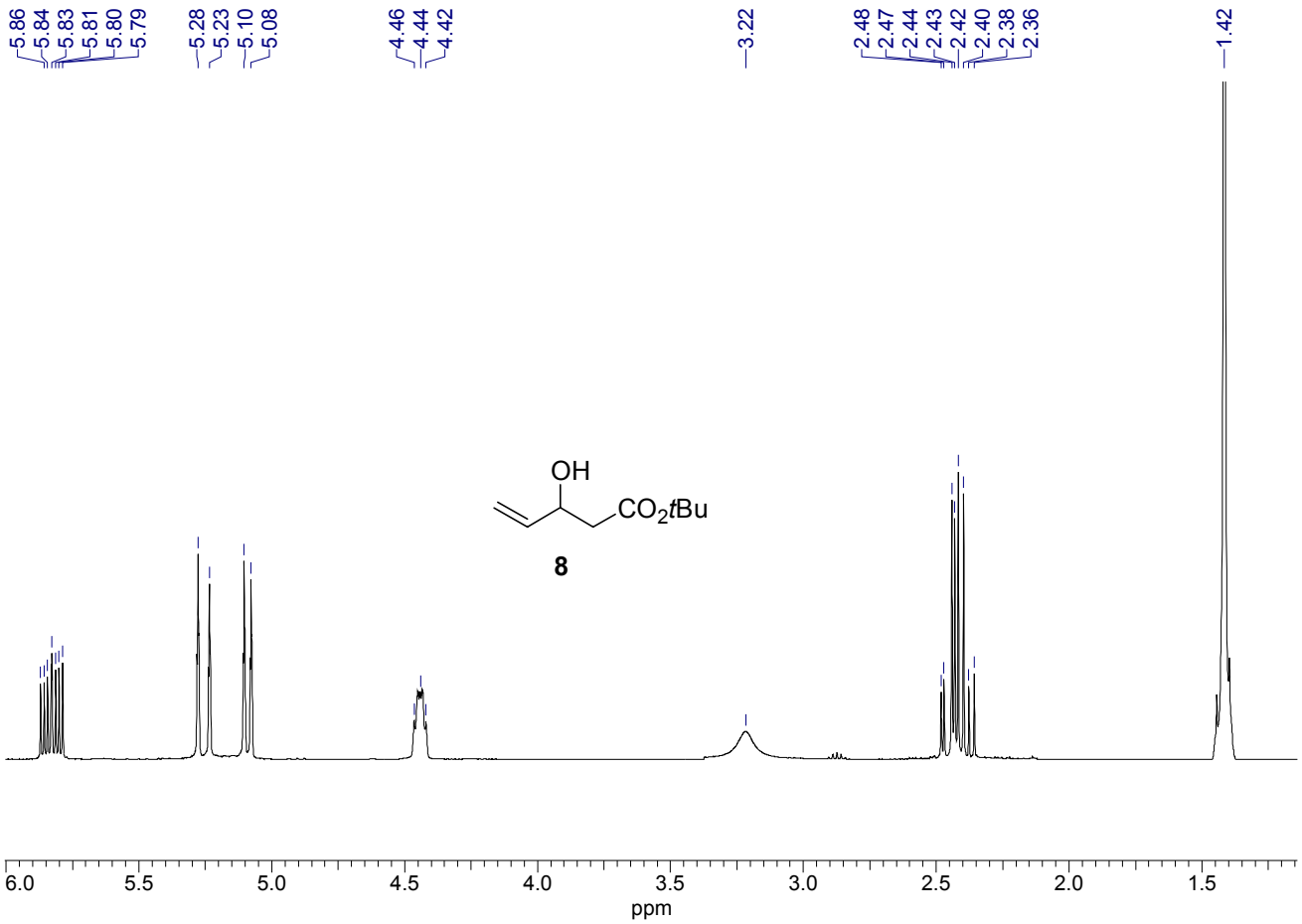
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5.83
5.81
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5.79
5.28
5.23
5.10
5.08
4.46
4.44
4.42
3.22
2.48
2.47
2.44
2.43
2.42
2.40
2.38
2.36
1.42
OH
CO2tBu
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3.0
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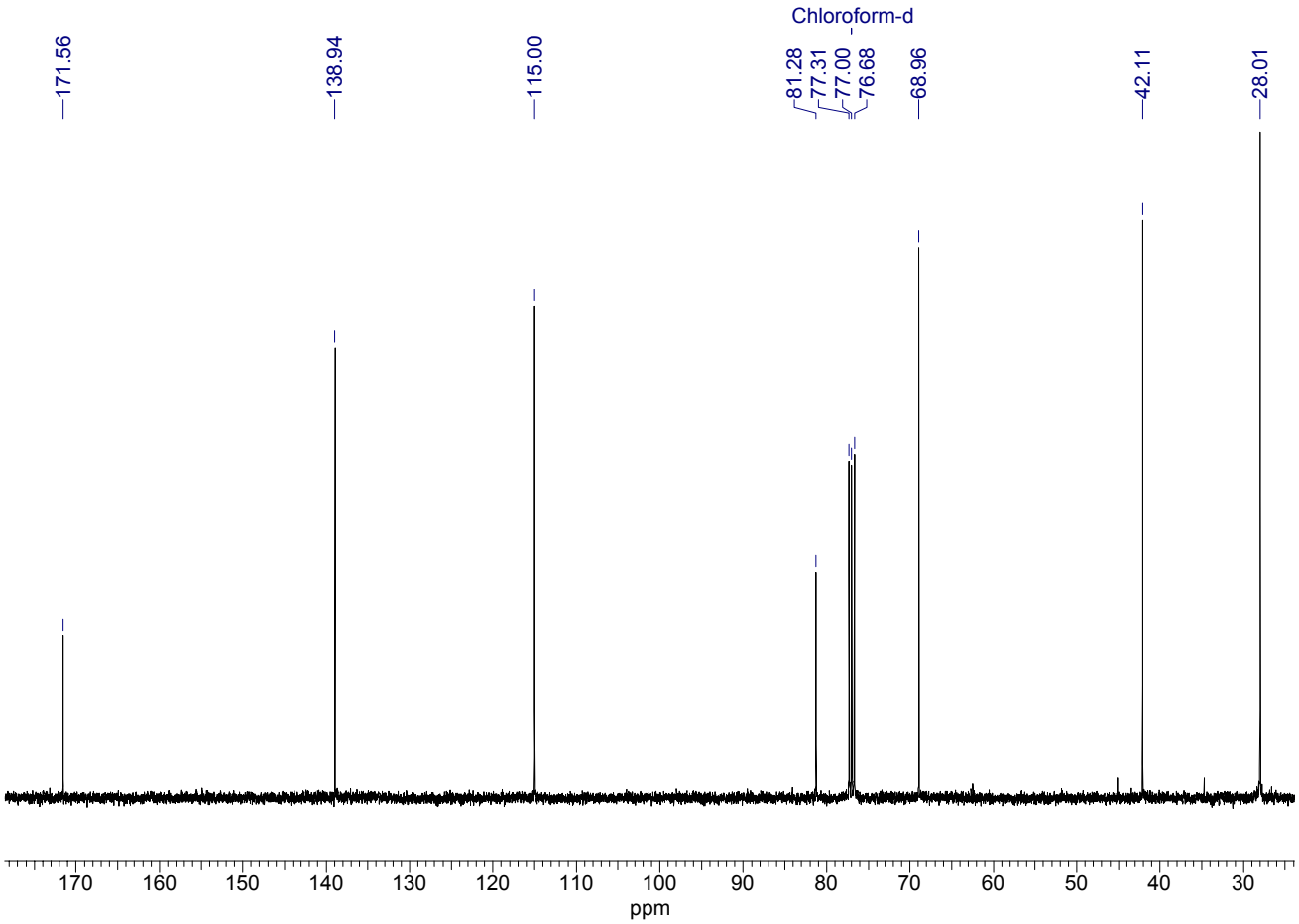
2.0
1.5
ppm


Chloroform-d
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138.94
115.00
81.28
77.31
77.00
76.68
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160
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140
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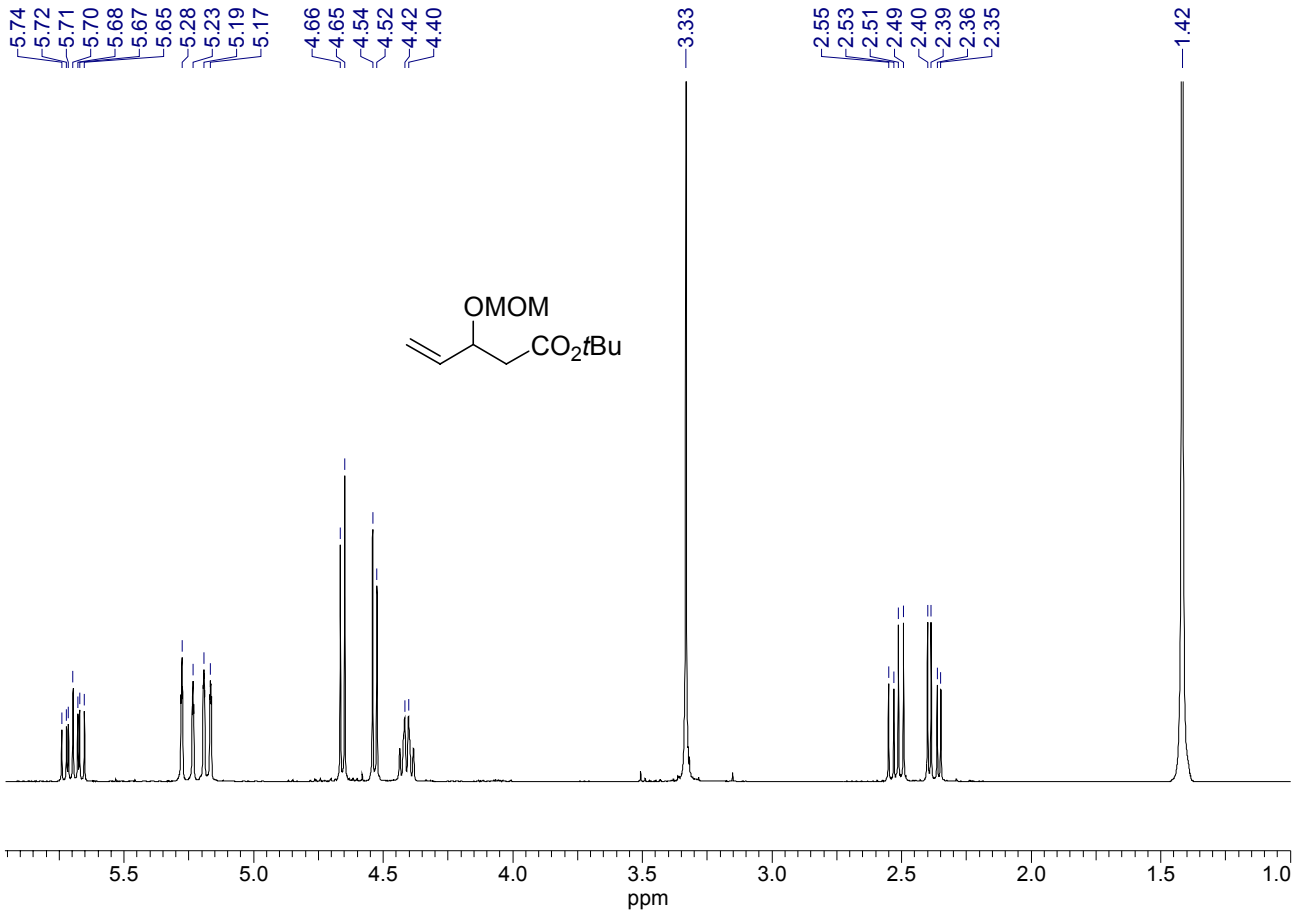
ppm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5.17
4.66
4.65
4.54
4.52
4.42
4.40
3.33
2.55
2.53
2.51
2.49
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2.35
1.42
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CO2tBu
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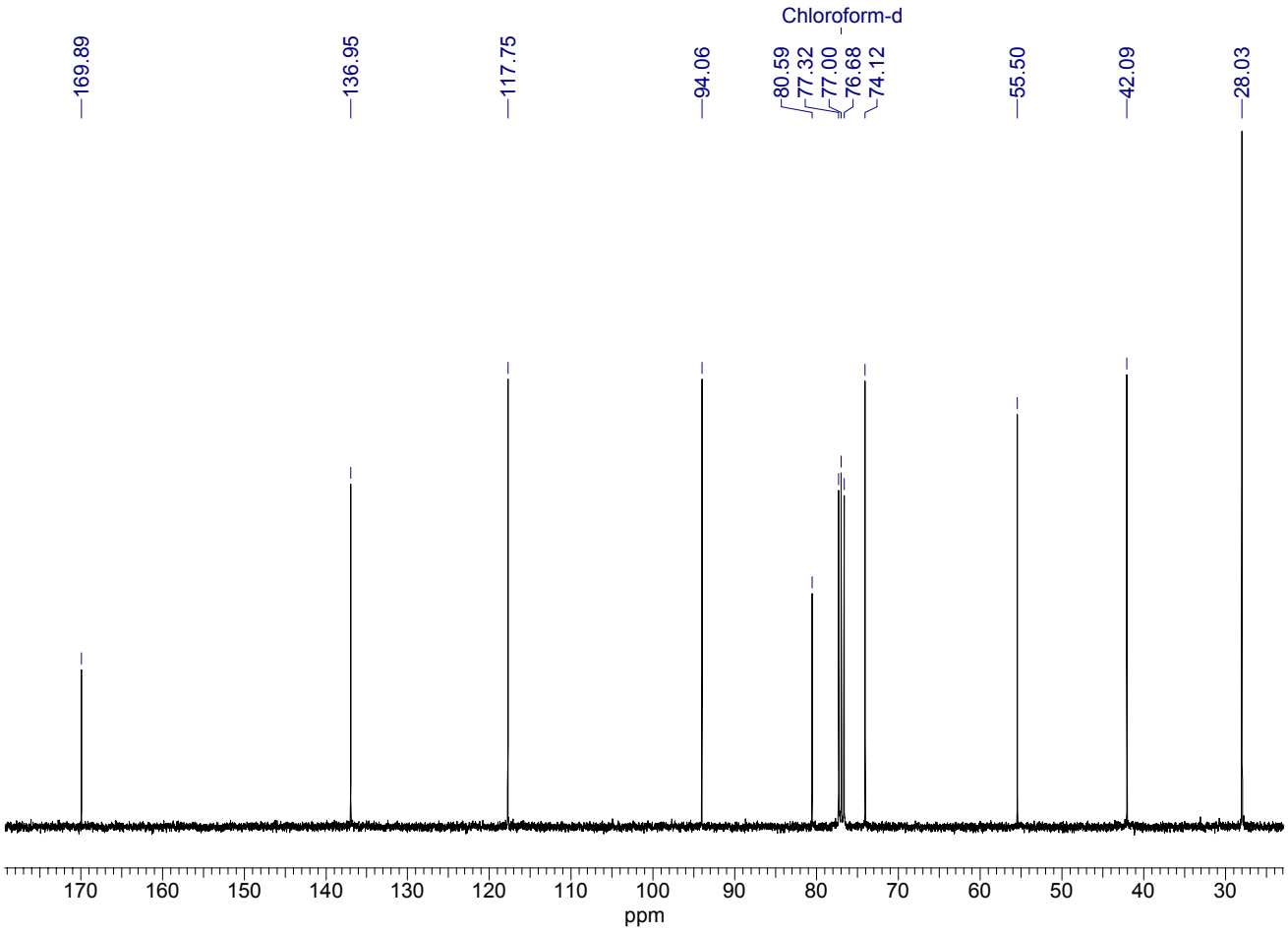
3.5
3.0
2.5
2.0
1.5
1.0
ppm


Chloroform-d
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136.95
117.75
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80.59
77.32
77.00
76.68
74.12
55.50
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130
120
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80
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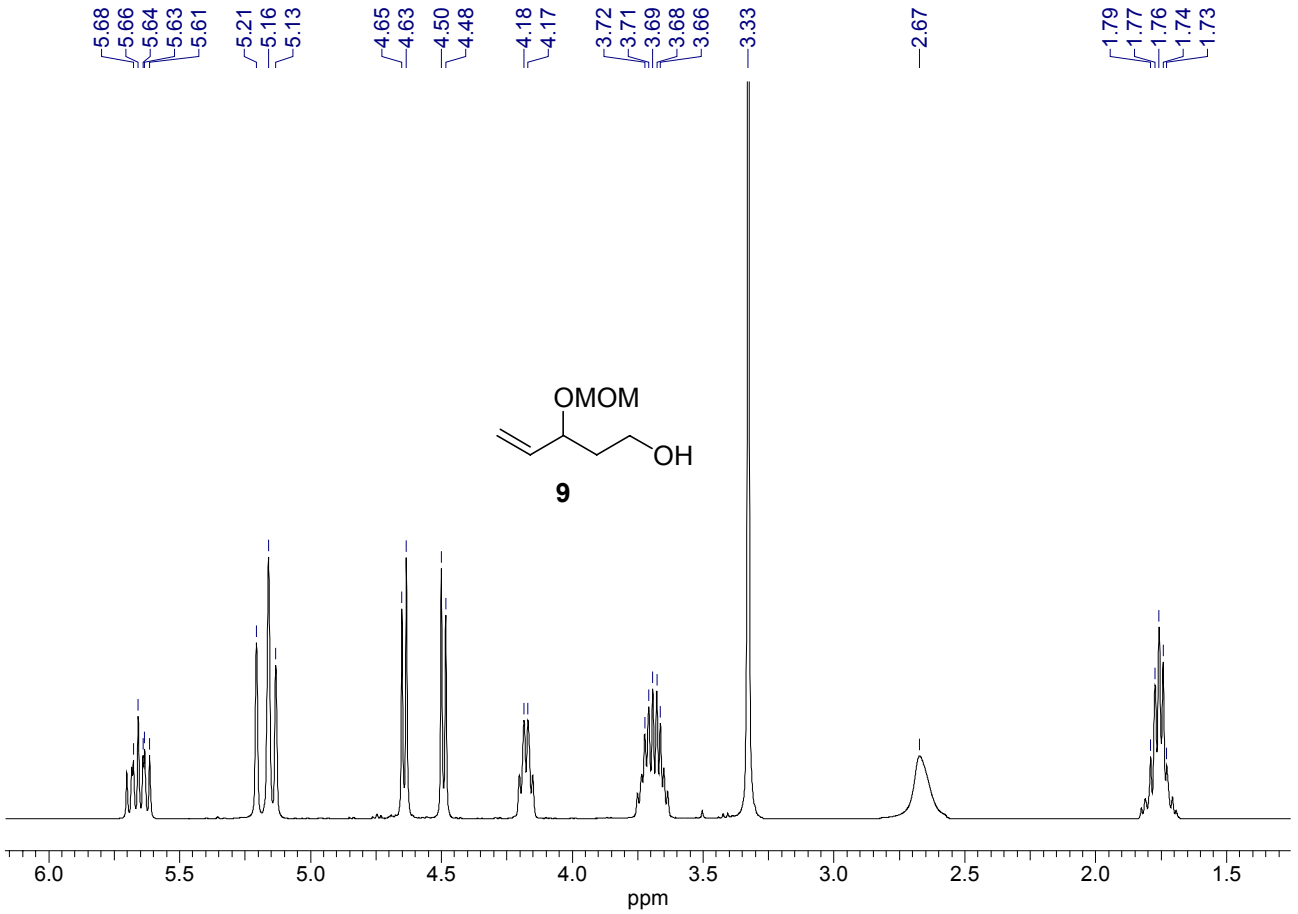
30
ppm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5.21
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4.50
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4.18
4.17
3.72
3.71
3.69
3.68
3.66
3.33
2.67
1.79
1.77
1.76
1.74
1.73
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5.5
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3.0
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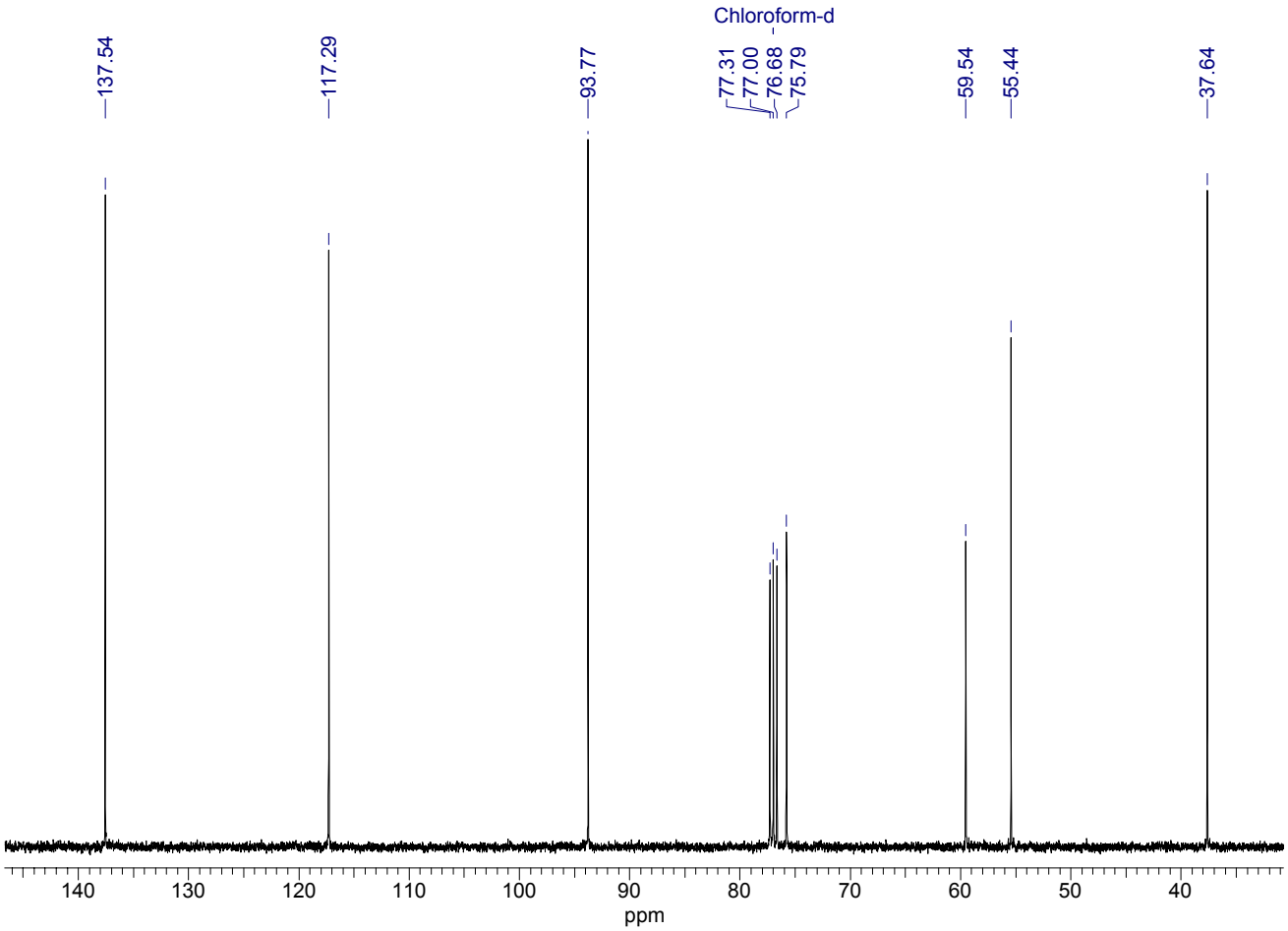
2.0
1.5
ppm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140
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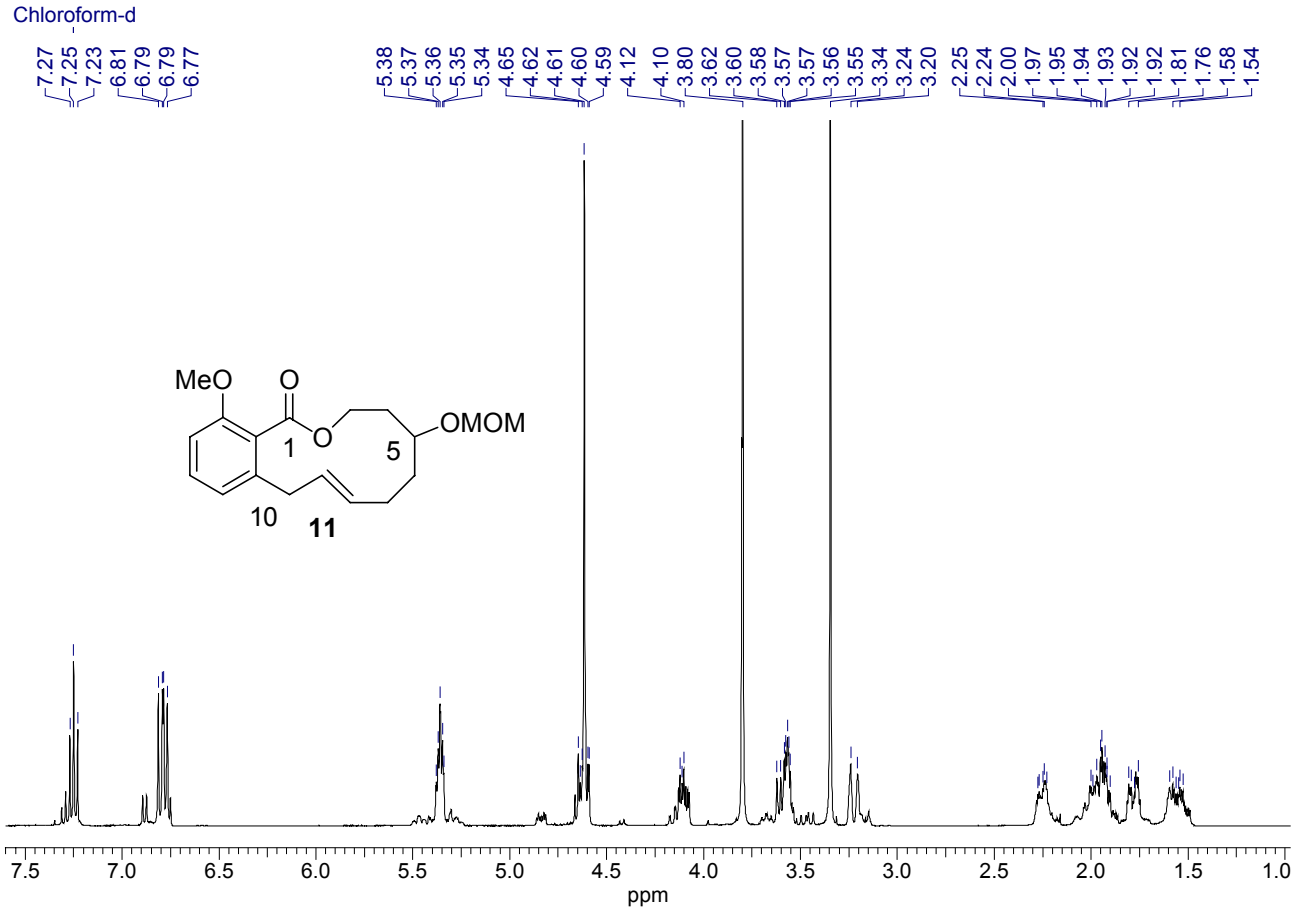
40
ppm


Chloroform-d
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6.79
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5.37
5.36
5.35
5.34
4.65
4.62
4.61
4.60
4.59
4.12
4.10
3.80
3.62
3.60
3.58
3.57
3.57
3.56
3.55
3.34
3.24
3.20
2.25
2.24
2.00
1.97
1.95
1.94
1.93
1.92
1.92
1.81
1.76
1.58
1.54
MeO
O
OMOM
1
O
5
10
11
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
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2.5
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1.5
1.0
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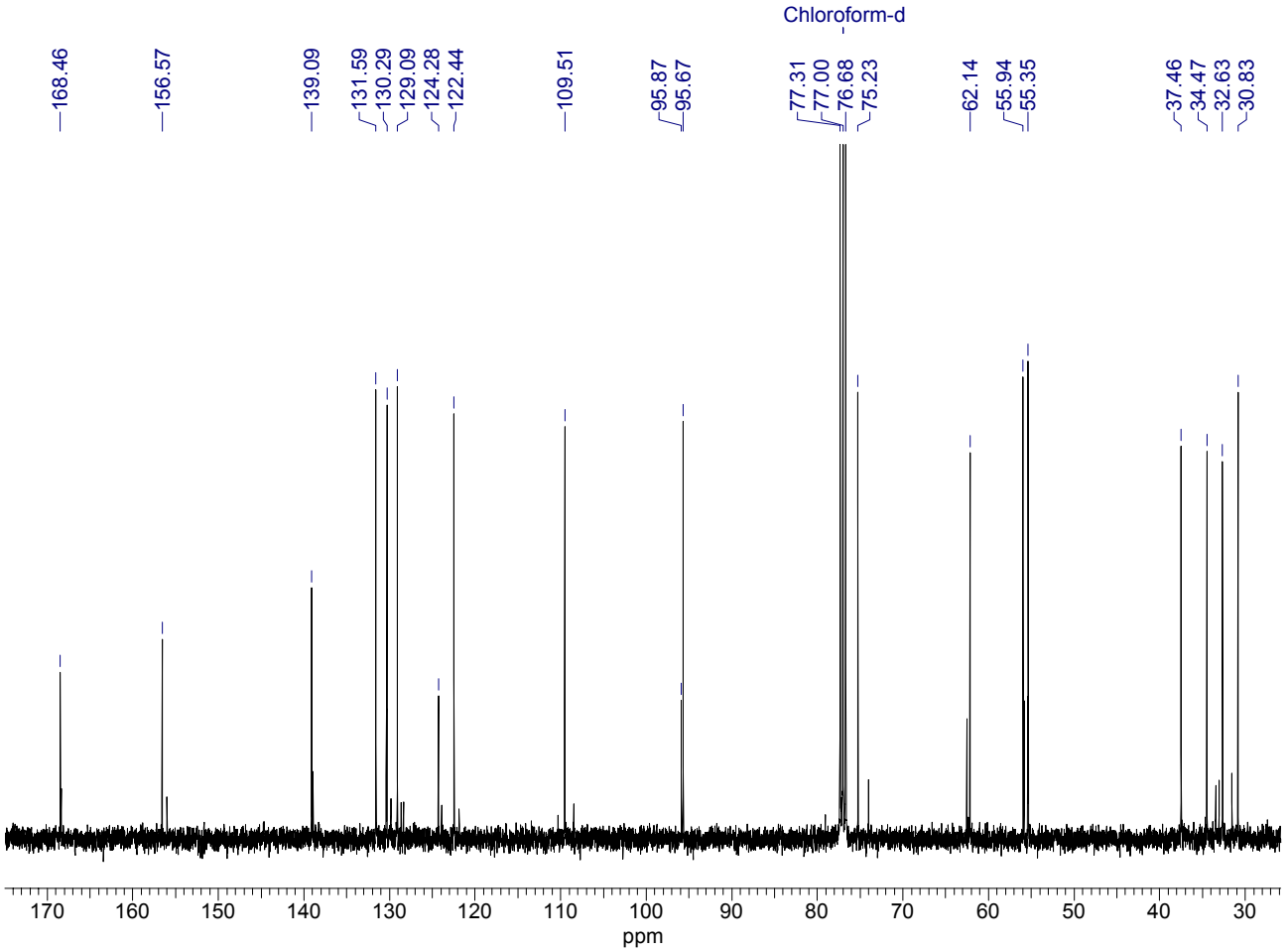
Chloroform-d
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129.09
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122.44
109.51
95.87
95.67
77.31
77.00
76.68
75.23
62.14
55.94
55.35
37.46
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120
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90
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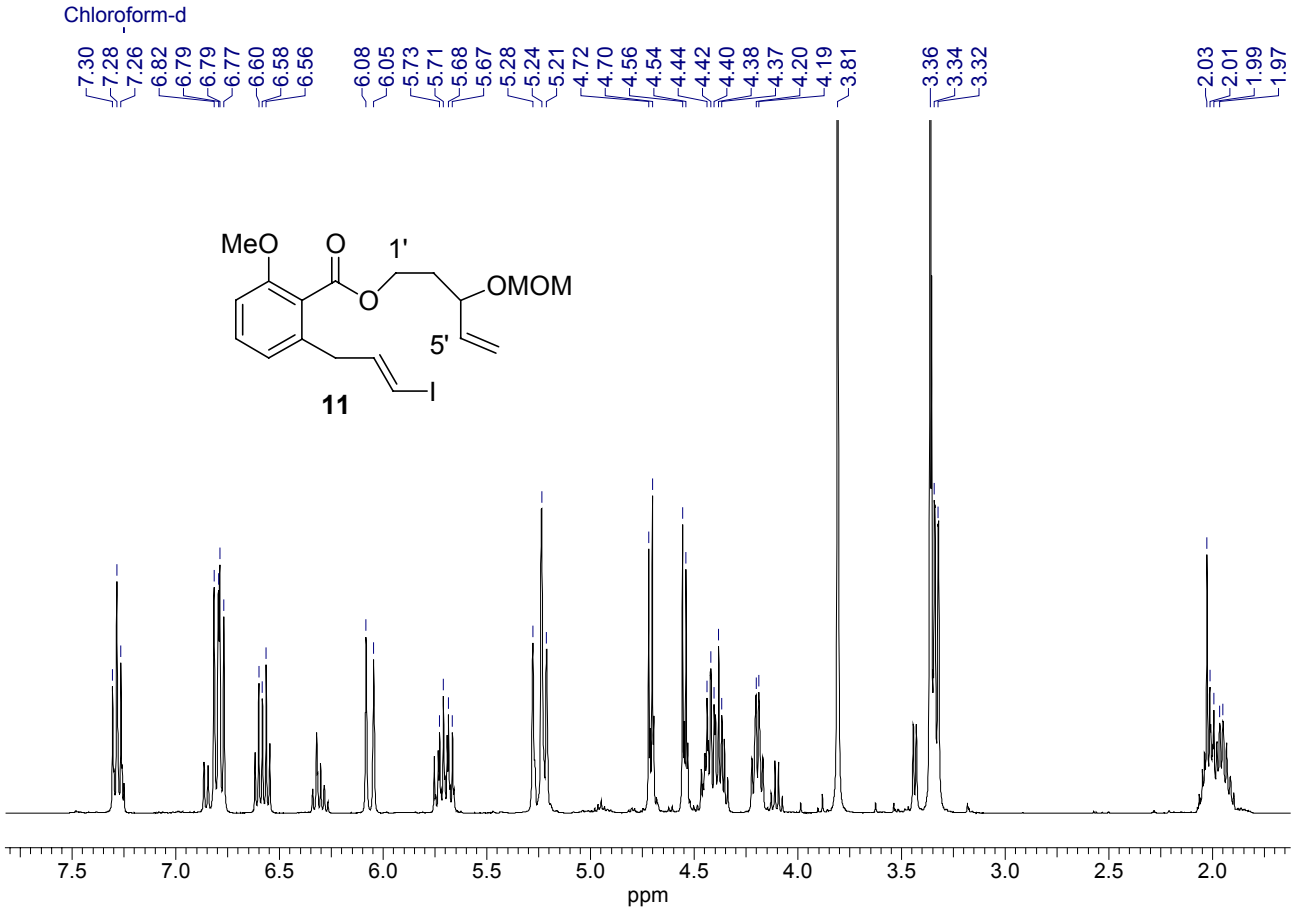
30
ppm


Chloroform-d
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6.77
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6.58
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6.08
6.05
5.73
5.71
5.68
5.67
5.28
5.24
5.21
4.72
4.70
4.56
4.54
4.44
4.42
4.40
4.38
4.37
4.20
4.19
3.81
3.36
3.34
3.32
2.03
2.01
1.99
1.97
MeO
O
1'
OMOM
O
5'
I
11
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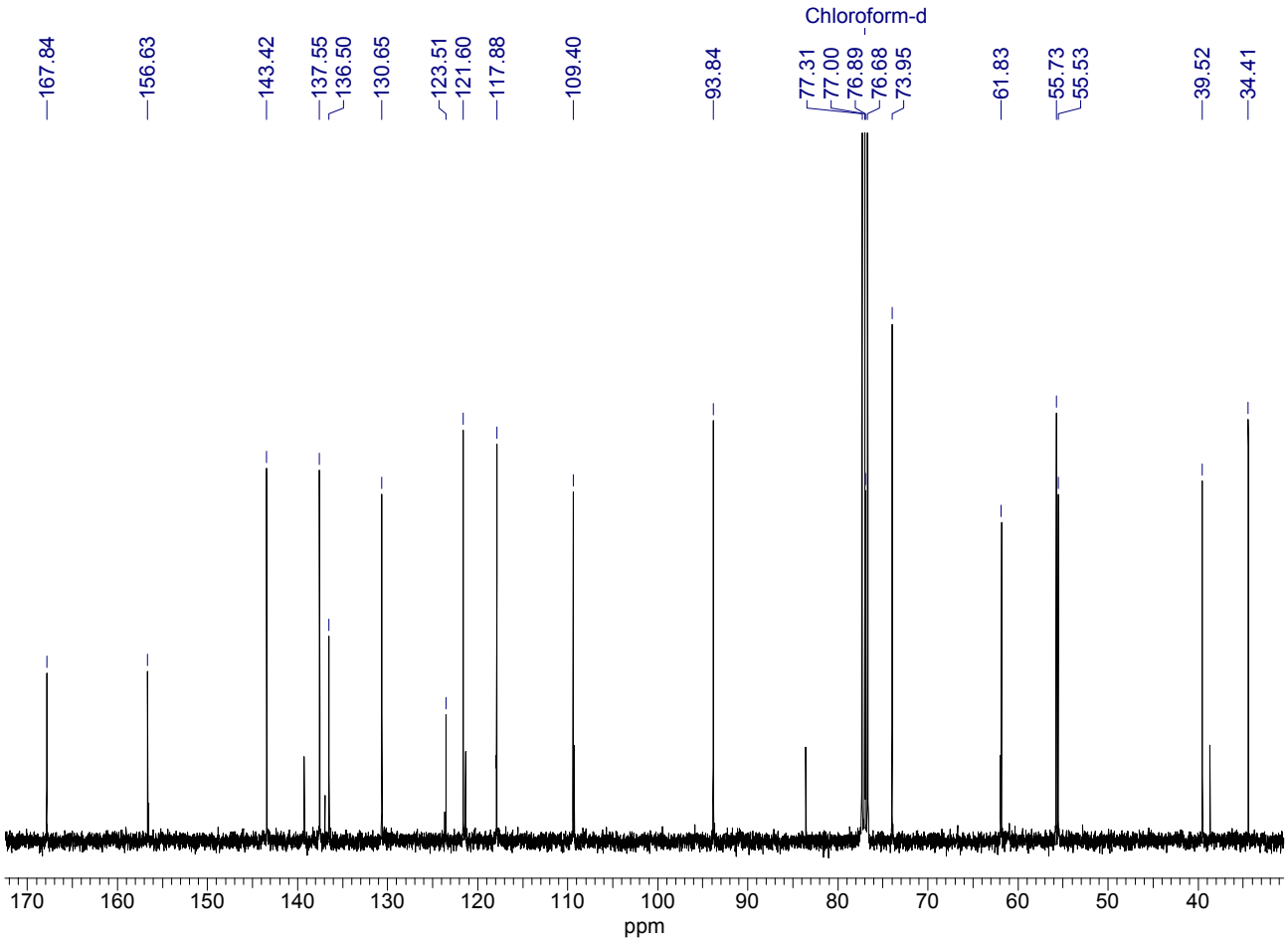
Chloroform-d
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77.31
77.00
76.89
76.68
73.95
61.83
55.73
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100
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60
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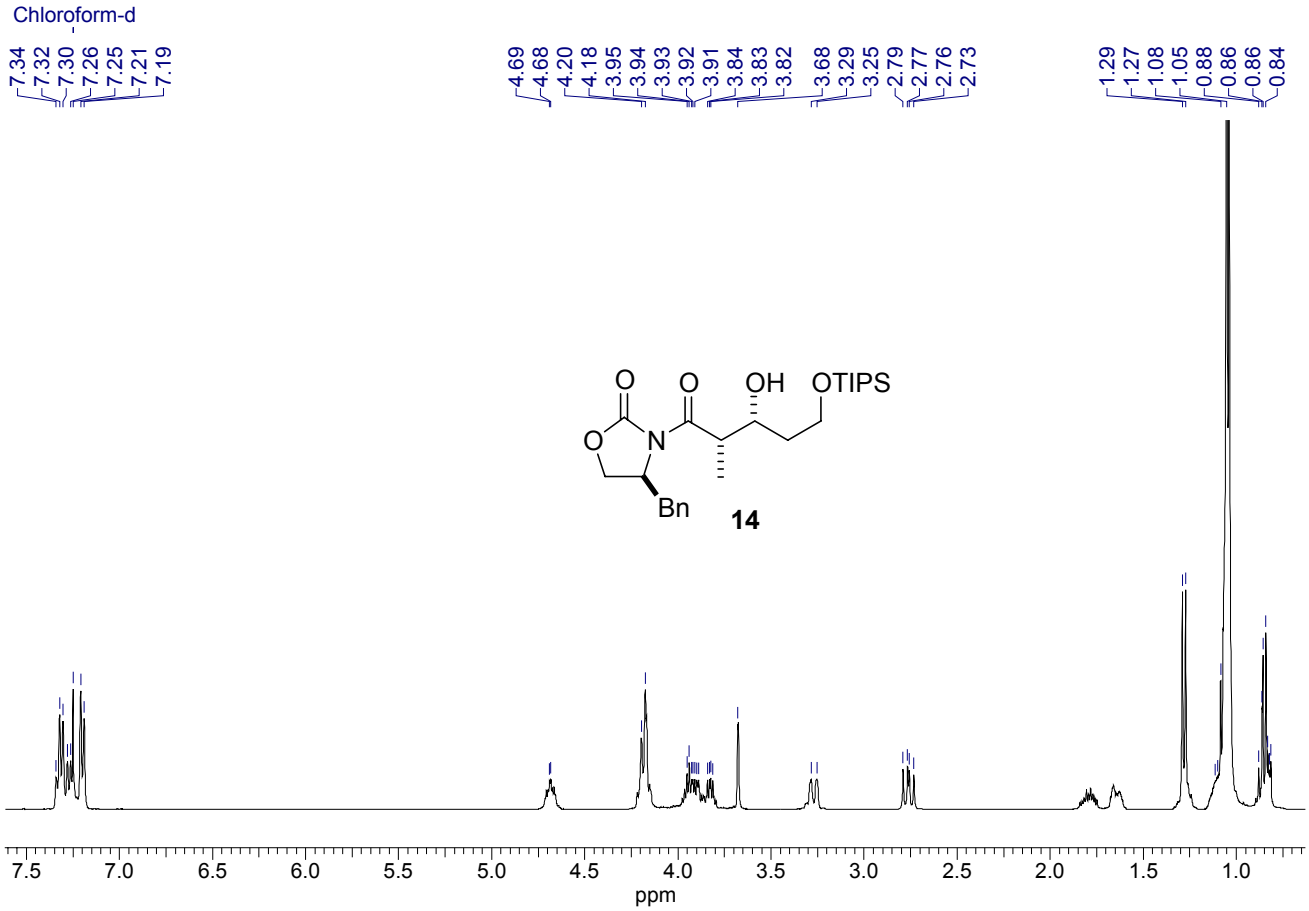
Chloroform-d
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7.25
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7.19
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4.68
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3.95
3.94
3.93
3.92
3.91
3.84
3.83
3.82
3.68
3.29
3.25
2.79
2.77
2.76
2.73
1.29
1.27
1.08
1.05
0.88
0.86
0.86
0.84
O
O
OH
OTIPS
O
N
Bn
14
7.5
7.0
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4.0
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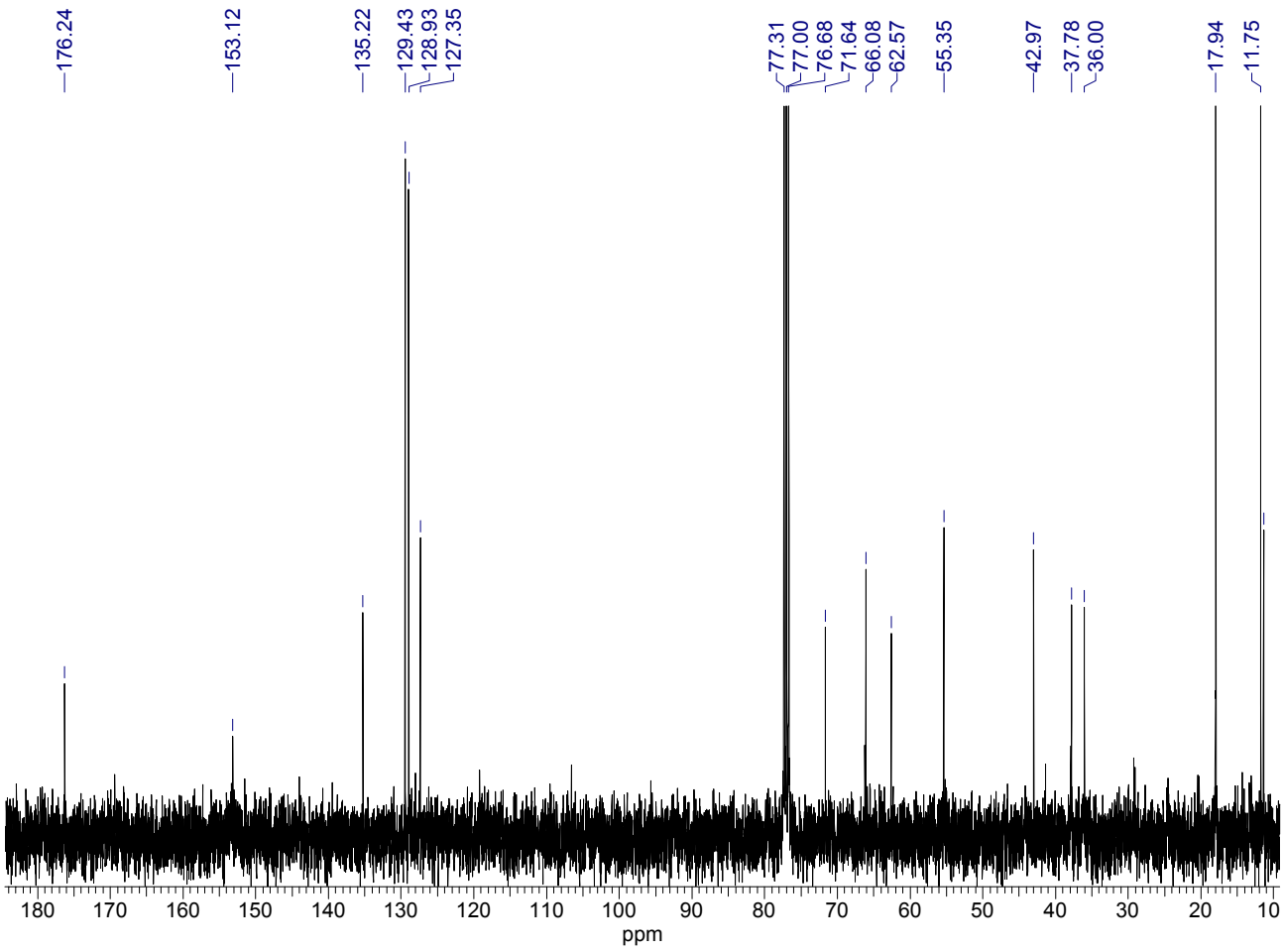
1.5
1.0
ppm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127.35
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77.00
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71.64
66.08
62.57
55.35
42.97
37.78
36.00
17.94
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140
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120
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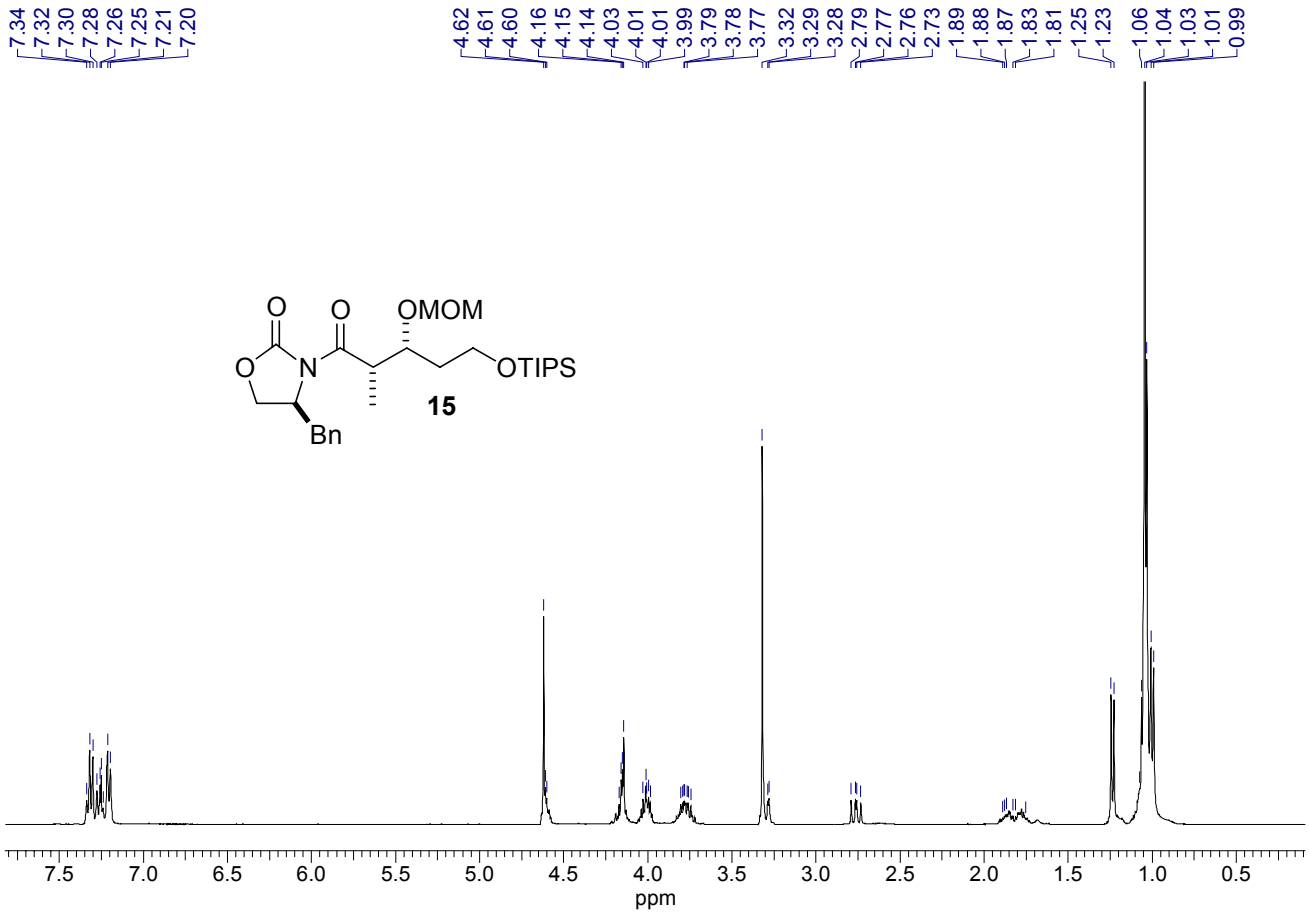
30
20
10
ppm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7.20
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4.61
4.60
4.16
4.15
4.14
4.03
4.01
4.01
3.99
3.79
3.78
3.77
3.32
3.29
3.28
2.79
2.77
2.76
2.73
1.89
1.88
1.87
1.83
1.81
1.25
1.23
1.06
1.04
1.03
1.01
0.99
O
O
OMOM
O
N
OTIPS
15
Bn
7.5
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6.5
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1.0
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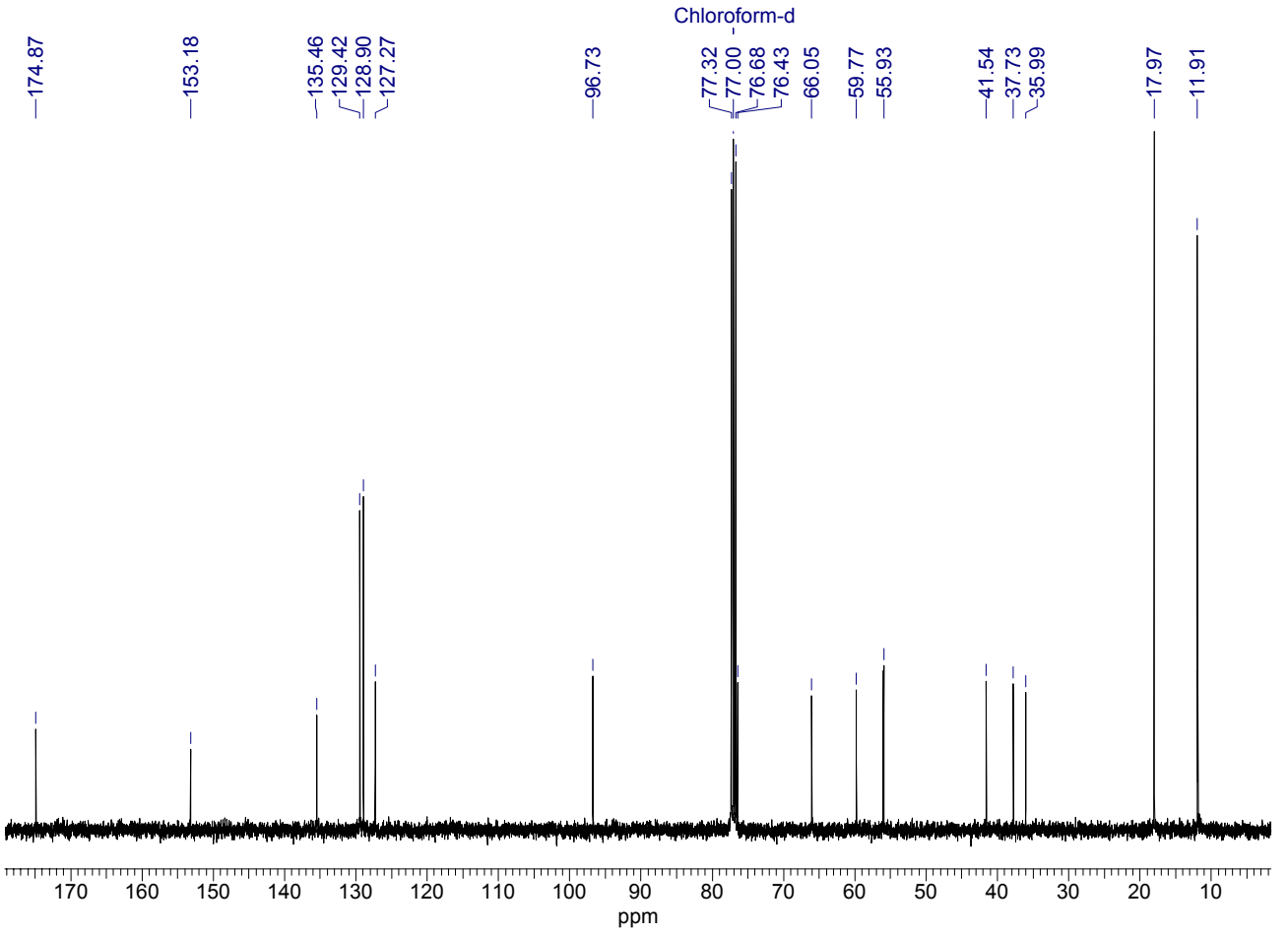
ppm


Chloroform-d
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77.00
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76.43
66.05
59.77
55.93
41.54
37.73
35.99
17.97
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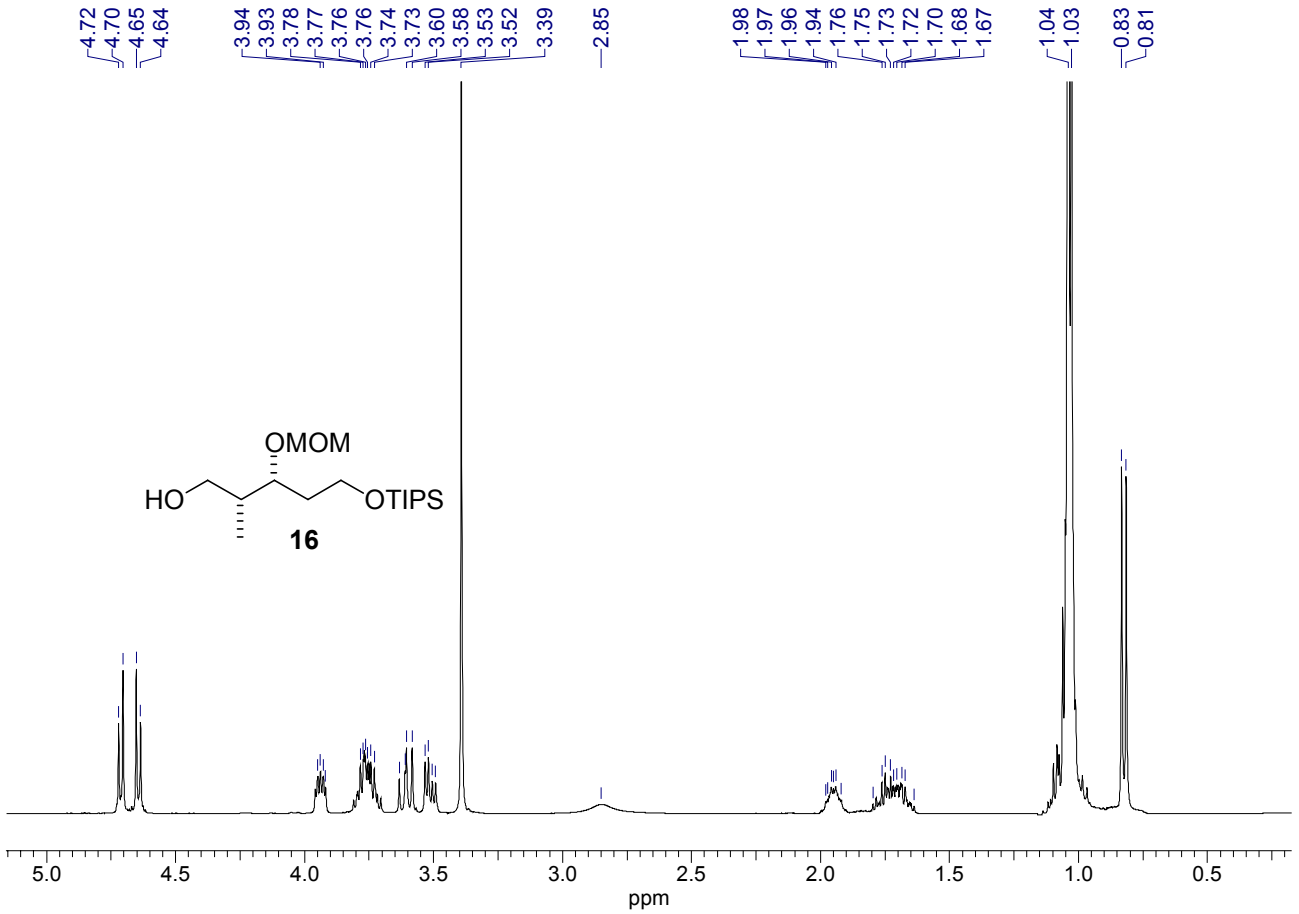
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3.93
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3.77
3.76
3.76
3.74
3.73
3.60
3.58
3.53
3.52
3.39
2.85
1.98
1.97
1.96
1.94
1.76
1.75
1.73
1.72
1.70
1.68
1.67
1.04
1.03
0.83
0.81
OMOM
HO
OTIPS
16
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4.0
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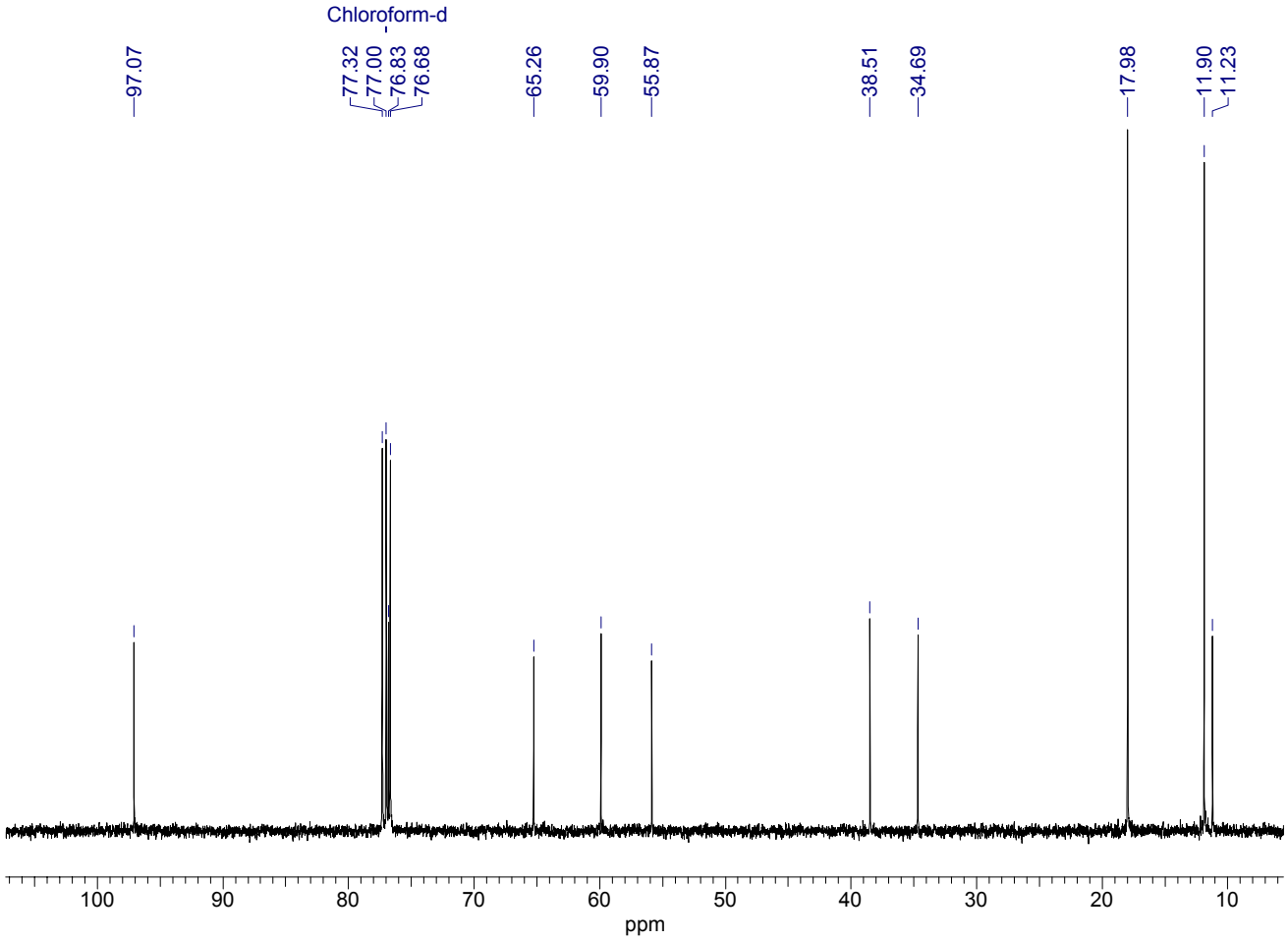
2.0
1.5
1.0
0.5
ppm


Chloroform-d
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11.23
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70
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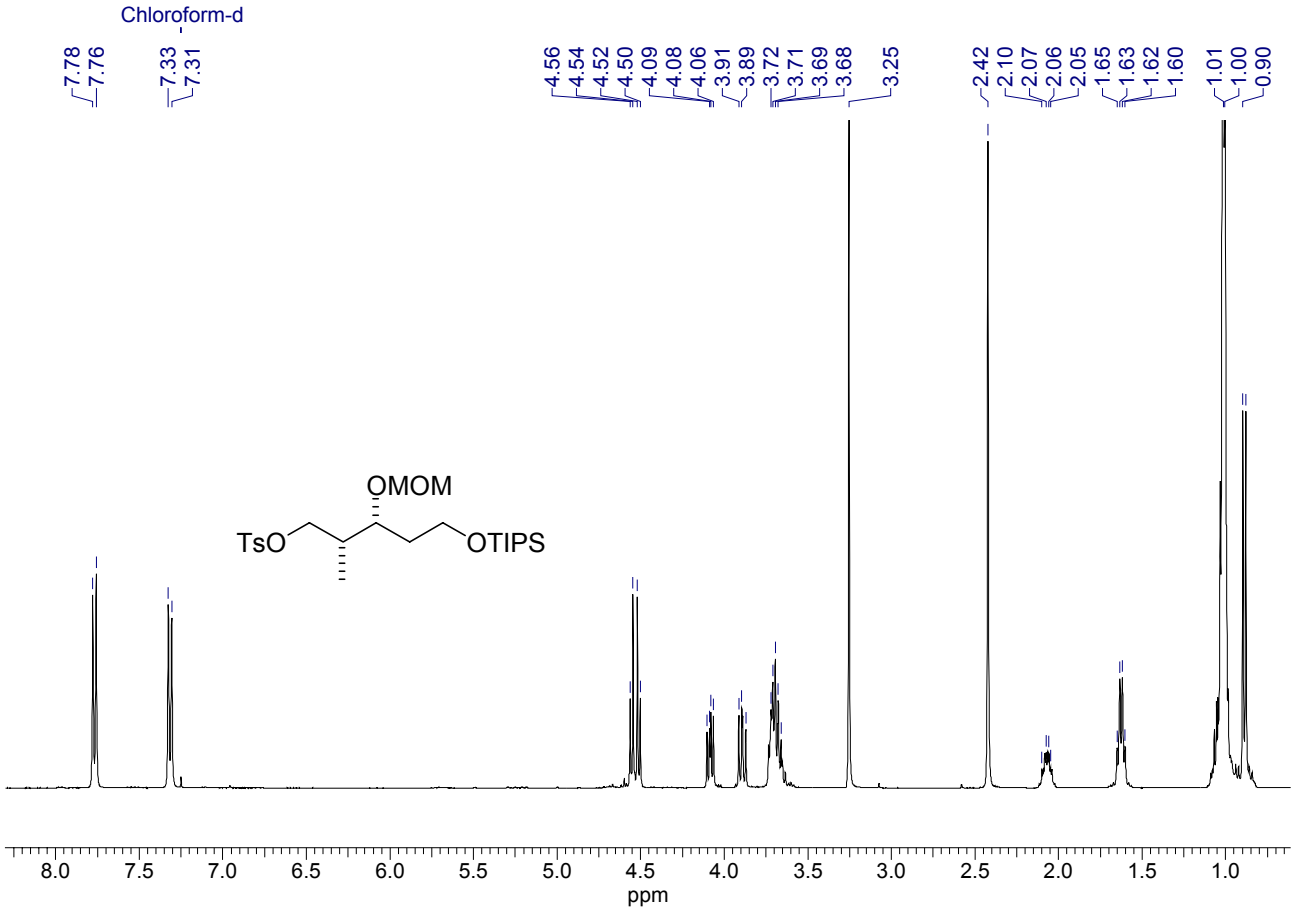
30
20
10
ppm


Chloroform-d
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7.76
7.33
7.31
4.56
4.54
4.52
4.50
4.09
4.08
4.06
3.91
3.89
3.72
3.71
3.69
3.68
3.25
2.42
2.10
2.07
2.06
2.05
1.65
1.63
1.62
1.60
1.01
1.00
0.90
OMOM
TsO
OTIPS
8.0
7.5
7.0
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5.0
4.5
4.0
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2.5
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1.5
1.0
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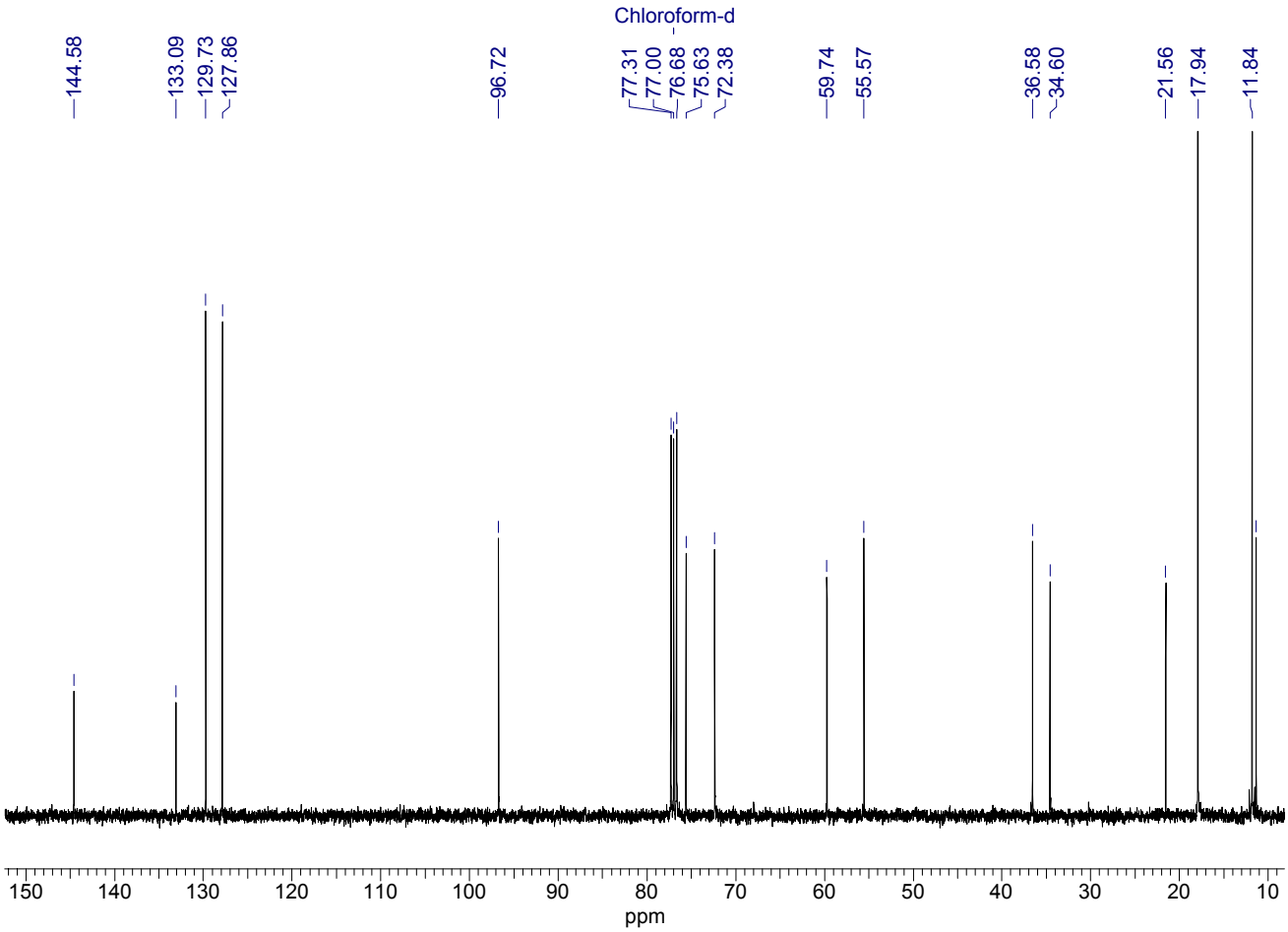
Chloroform-d
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77.00
76.68
75.63
72.38
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55.57
36.58
34.60
21.56
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150
140
130
120
110
100
90
80
70
60
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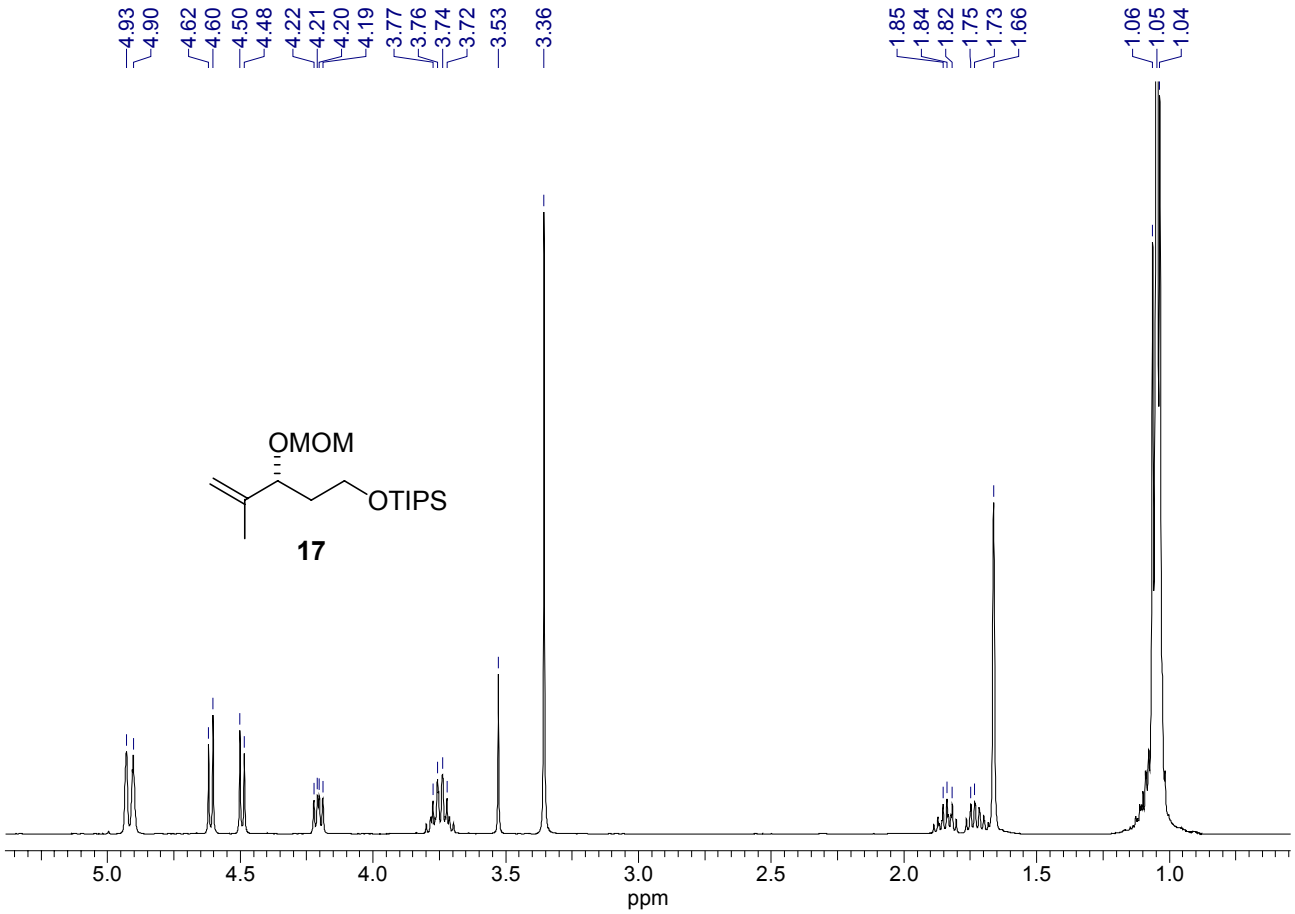
30
20
10
ppm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4.60
4.50
4.48
4.22
4.21
4.20
4.19
3.77
3.76
3.74
3.72
3.53
3.36
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1.84
1.82
1.75
1.73
1.66
1.06
1.05
1.04
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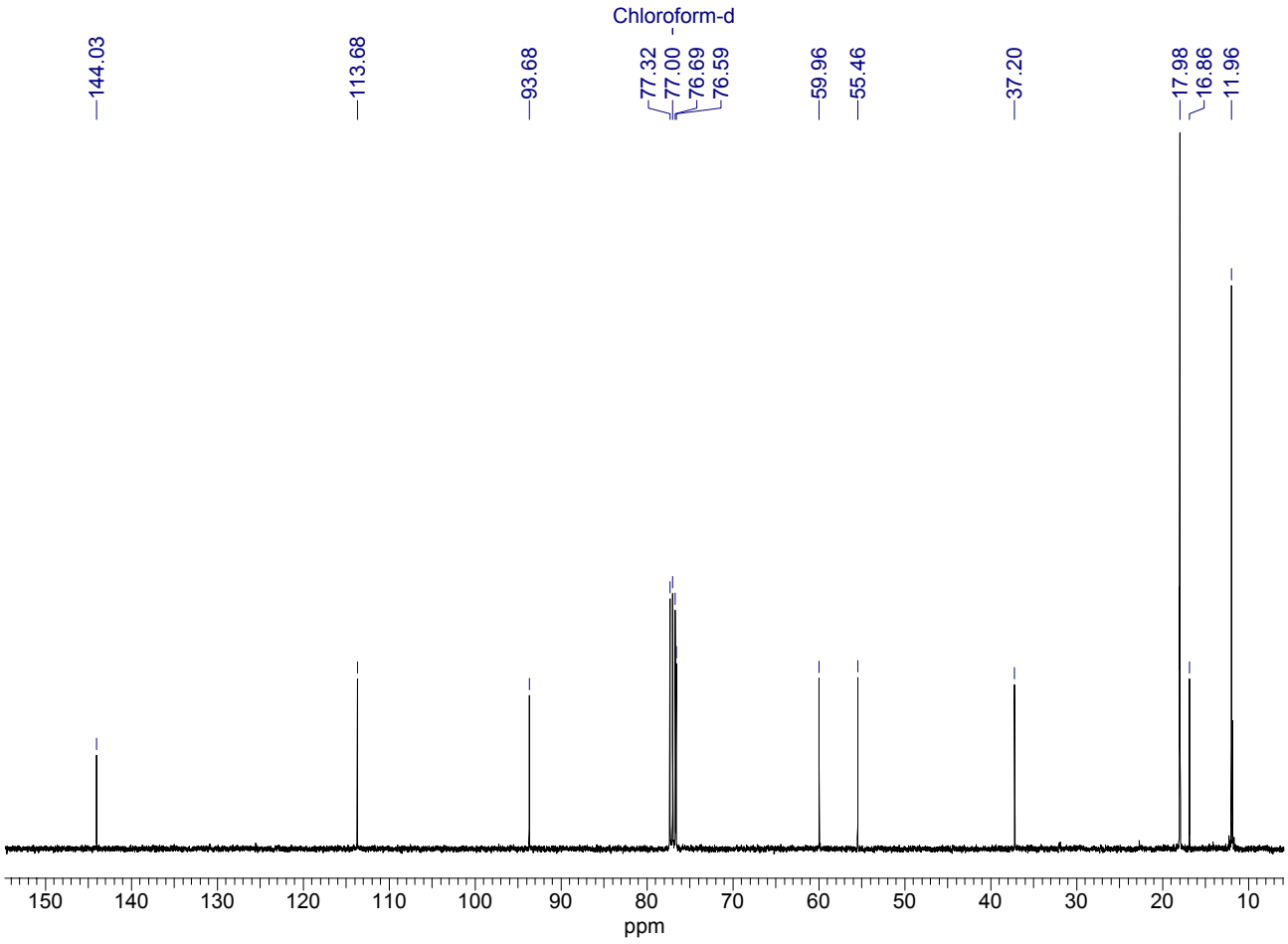
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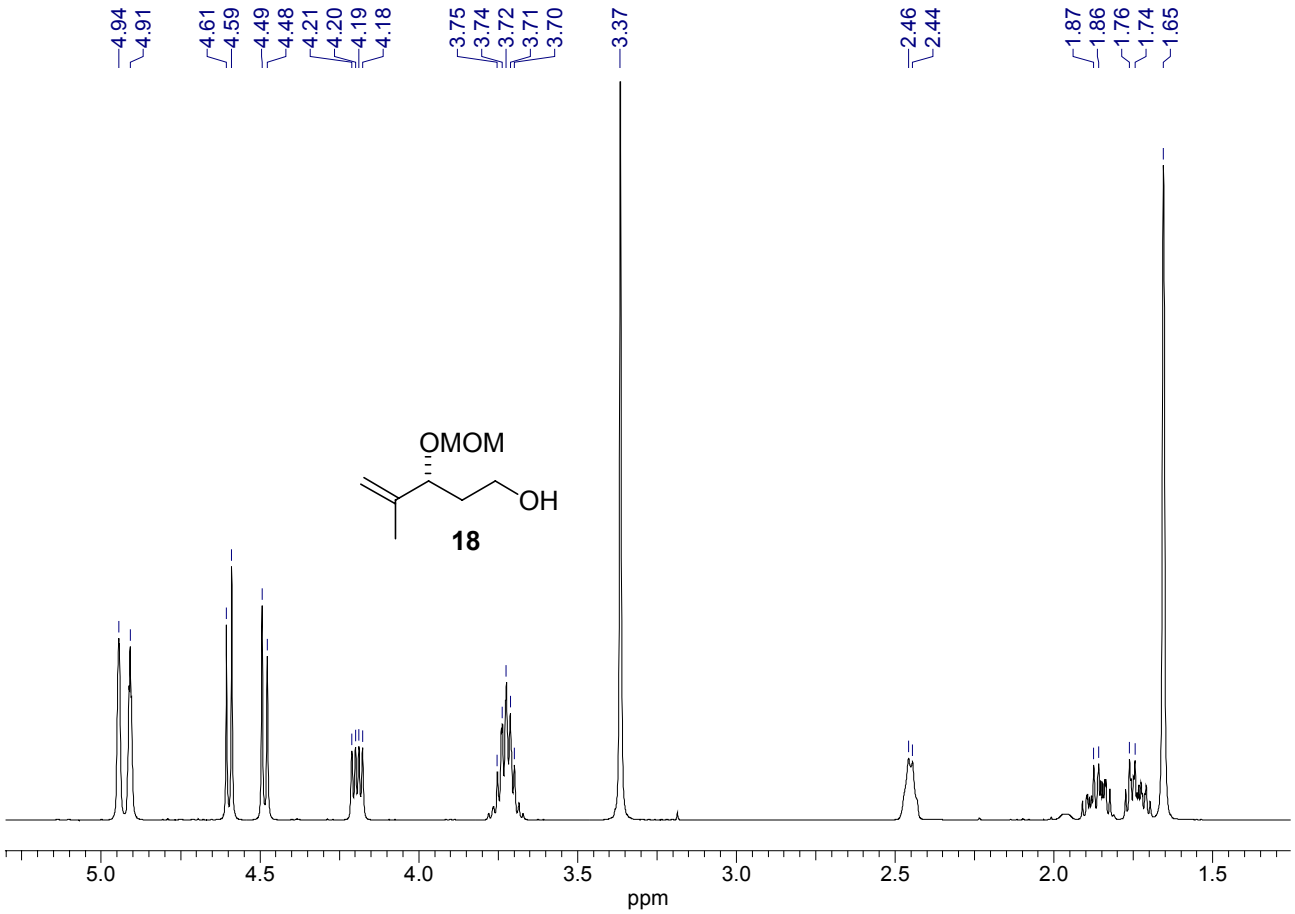
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3.70
3.37
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2.44
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1.86
1.76
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OH
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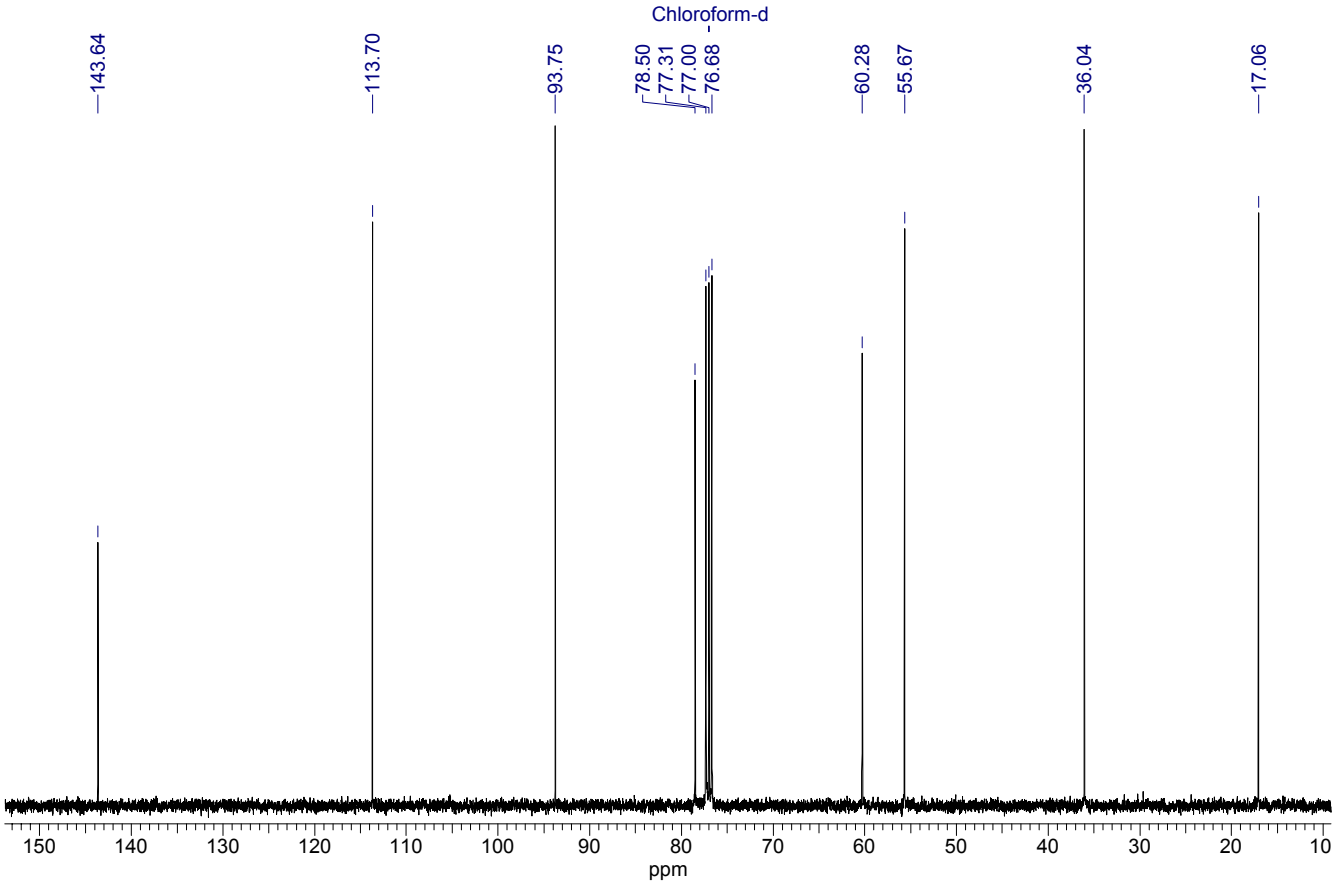
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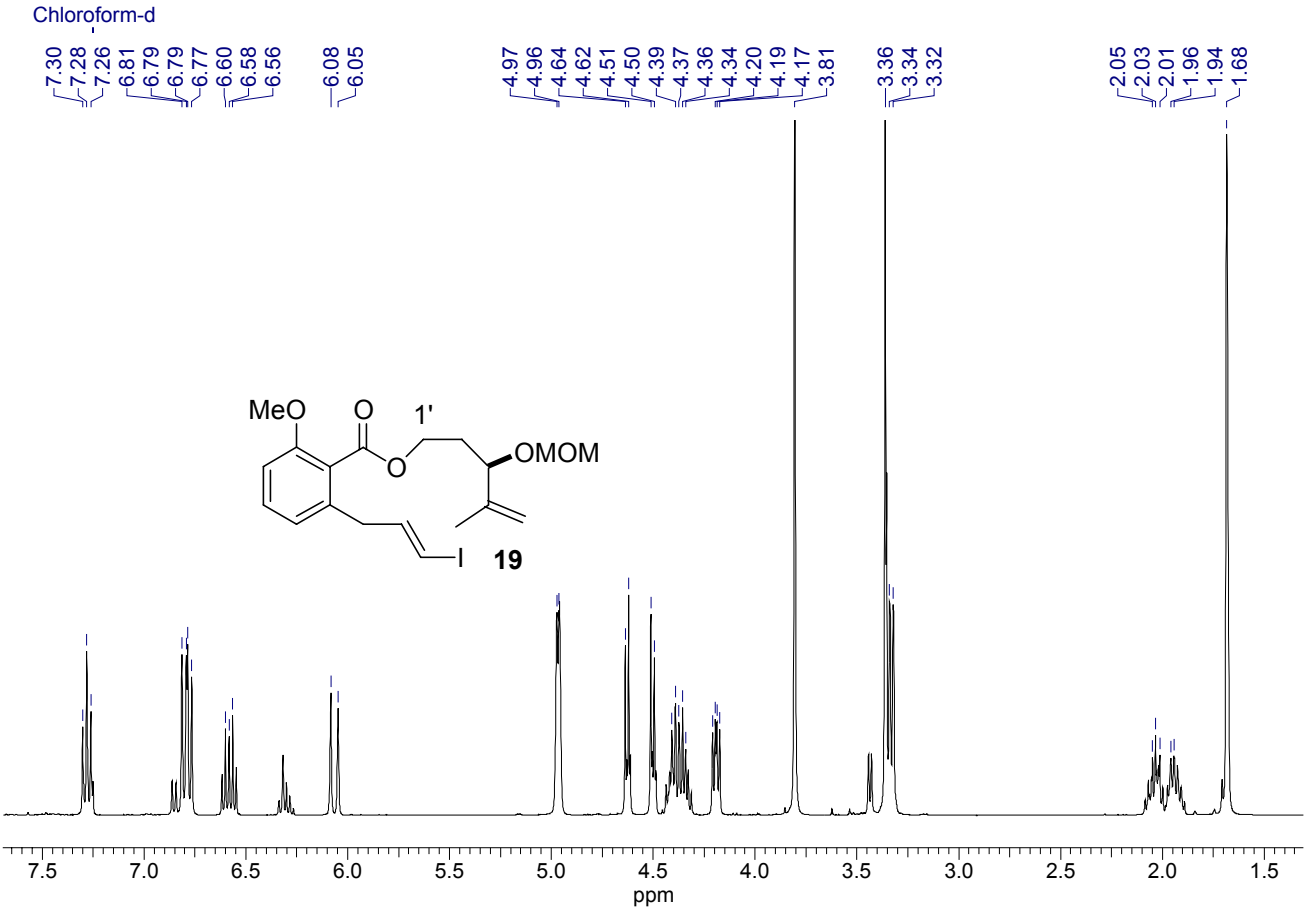
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6.77
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6.08
6.05
4.97
4.96
4.64
4.62
4.51
4.50
4.39
4.37
4.36
4.34
4.20
4.19
4.17
3.81
3.36
3.34
3.32
2.05
2.03
2.01
1.96
1.94
1.68
MeO
O
1'
O
OMOM
I
19
7.5
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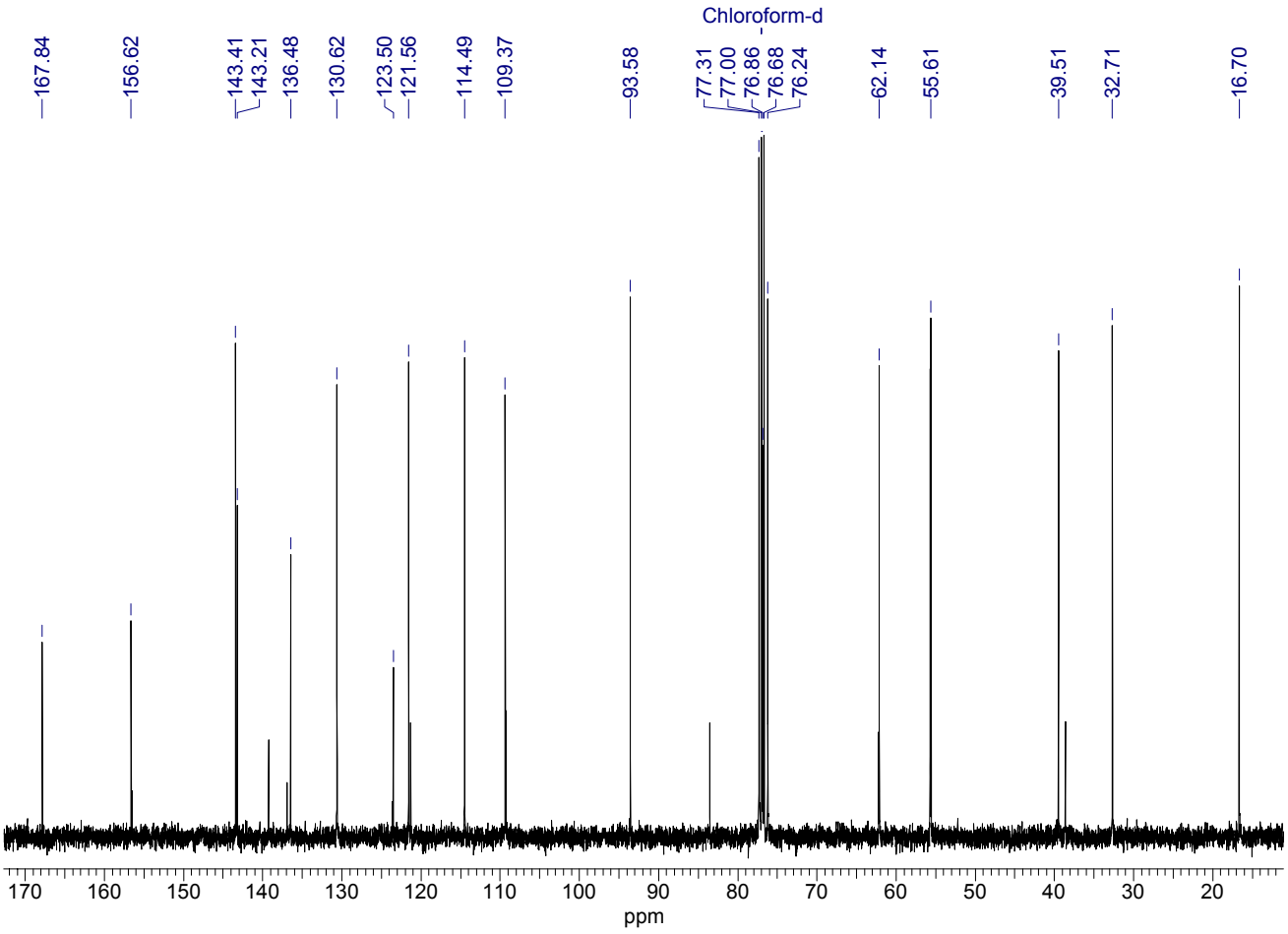
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77.31
77.00
76.86
76.68
76.24
62.14
55.61
39.51
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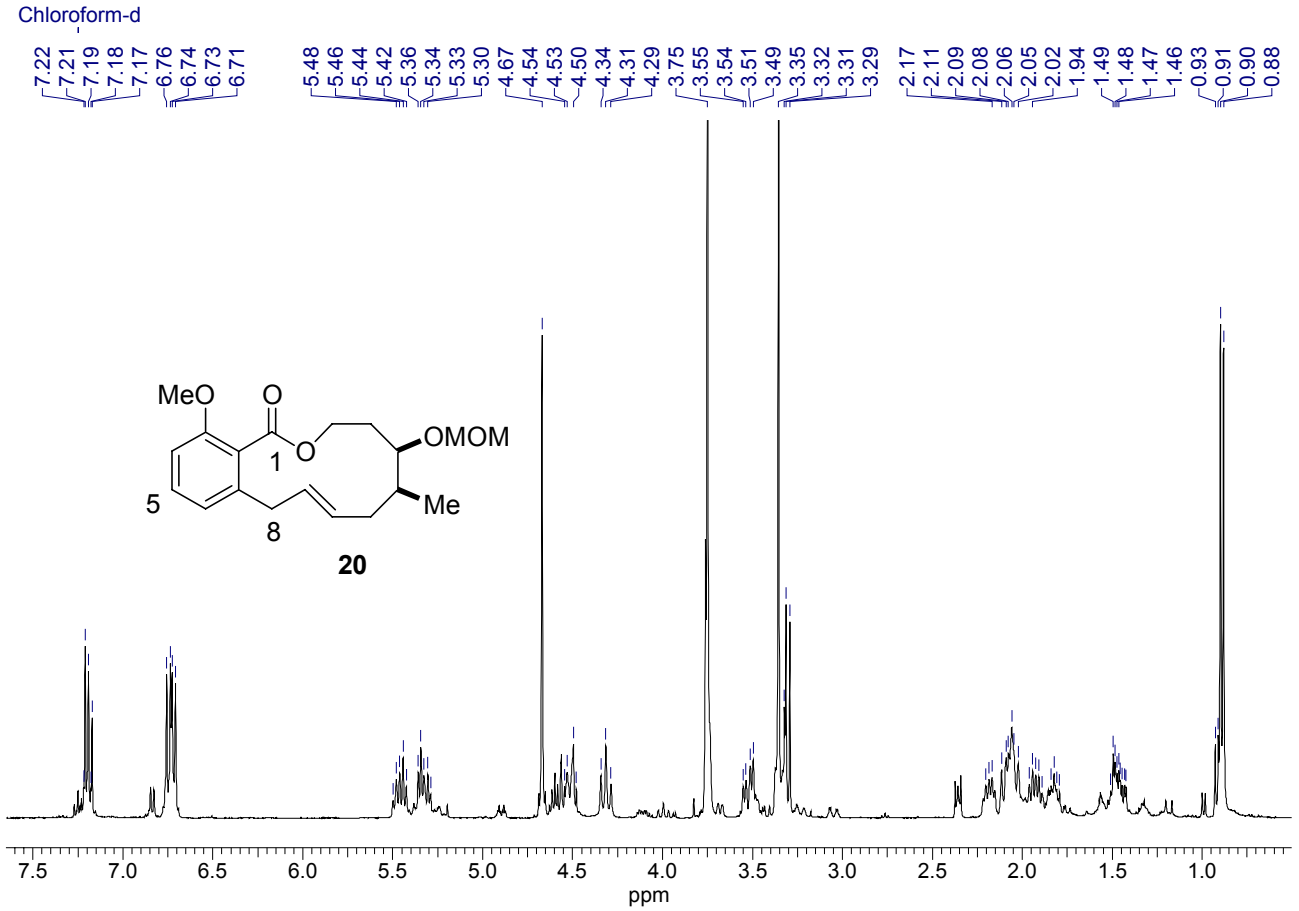
Chloroform-d
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5.42
5.36
5.34
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4.54
4.53
4.50
4.34
4.31
4.29
3.75
3.55
3.54
3.51
3.49
3.35
3.32
3.31
3.29
2.17
2.11
2.09
2.08
2.06
2.05
2.02
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1.49
1.48
1.47
1.46
0.93
0.91
0.90
0.88
MeO
O
1
O
OMOM
5
Me
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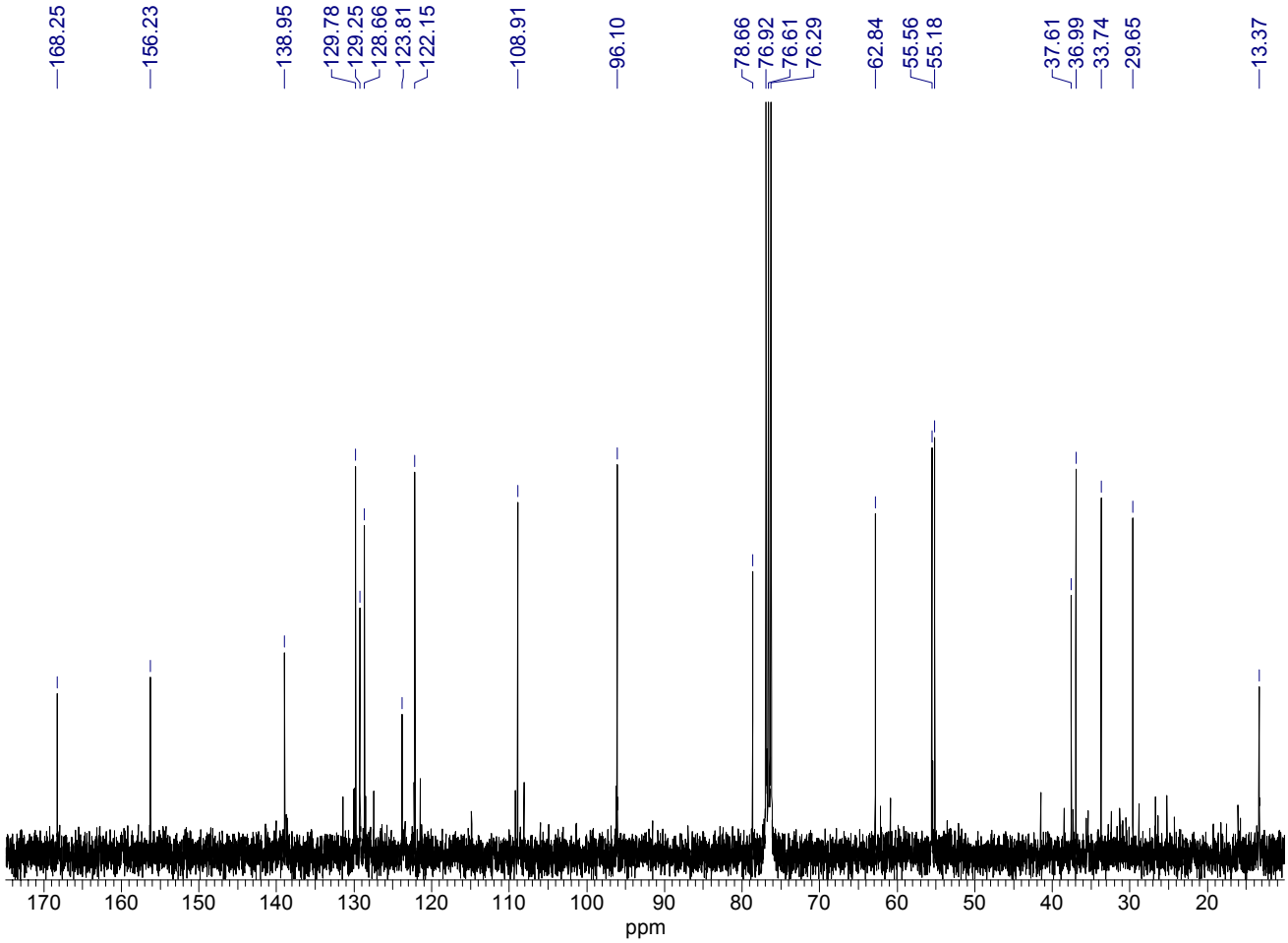
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128.66
123.81
122.15
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76.61
76.29
62.84
55.56
55.18
37.61
36.99
33.74
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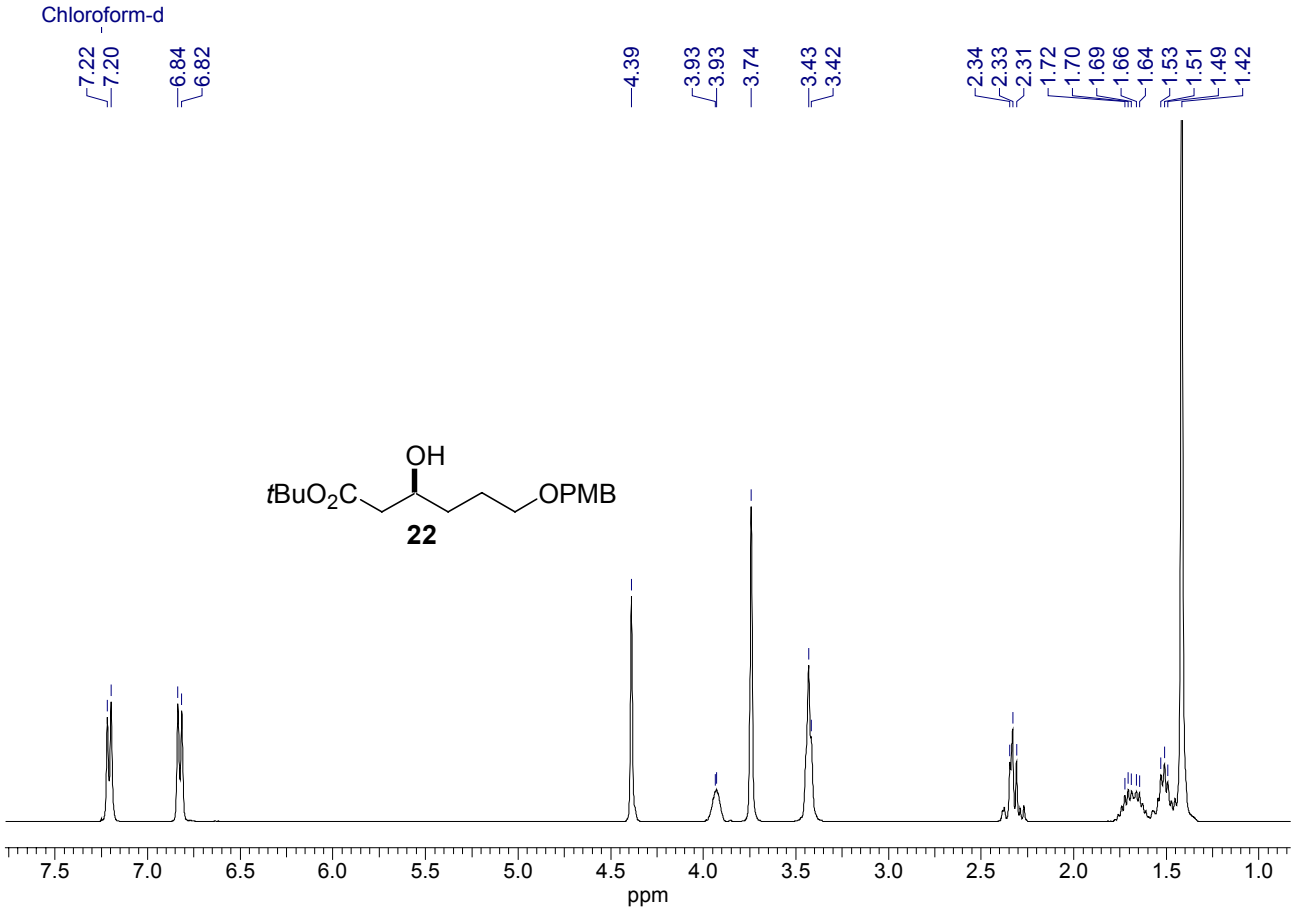
Chloroform-d
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3.43
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2.33
2.31
1.72
1.70
1.69
1.66
1.64
1.53
1.51
1.49
1.42
OH
tBuO2C
OPMB
22
7.5
7.0
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1.5
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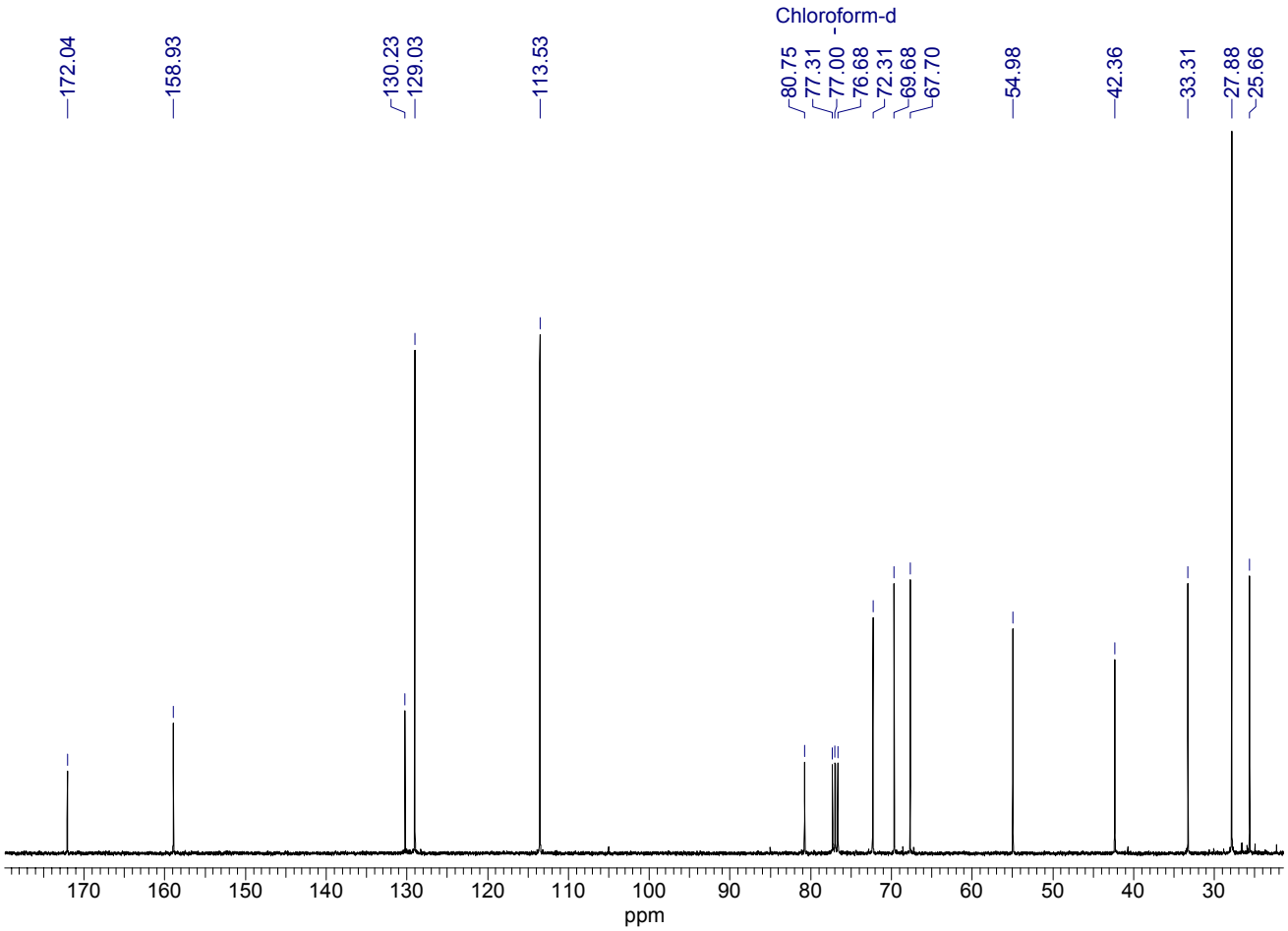
Chloroform-d
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72.31
69.68
67.70
54.98
42.36
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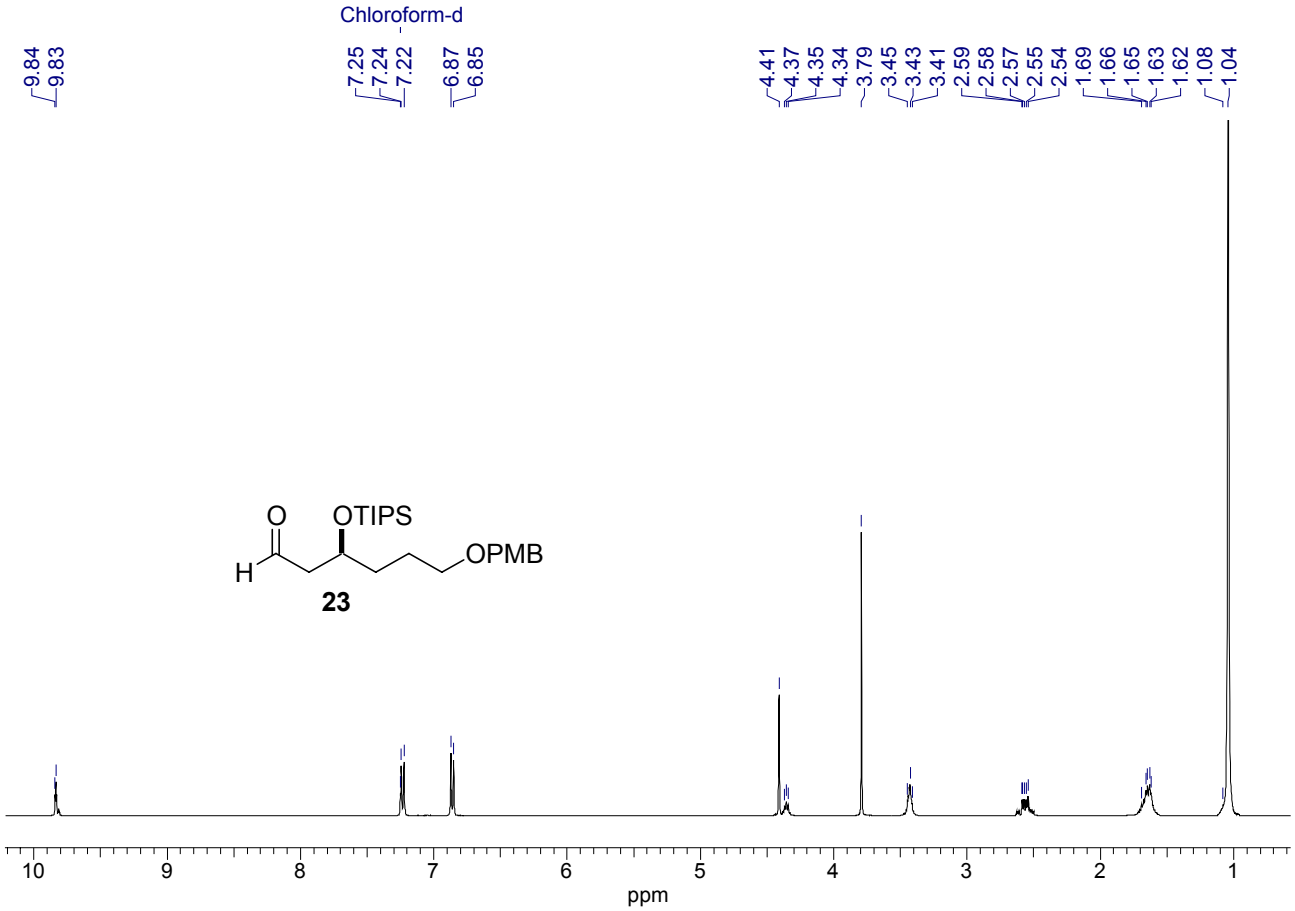
30
ppm


Chloroform-d
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6.85
4.41
4.37
4.35
4.34
3.79
3.45
3.43
3.41
2.59
2.58
2.57
2.55
2.54
1.69
1.66
1.65
1.63
1.62
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OTIPS
H
OPMB
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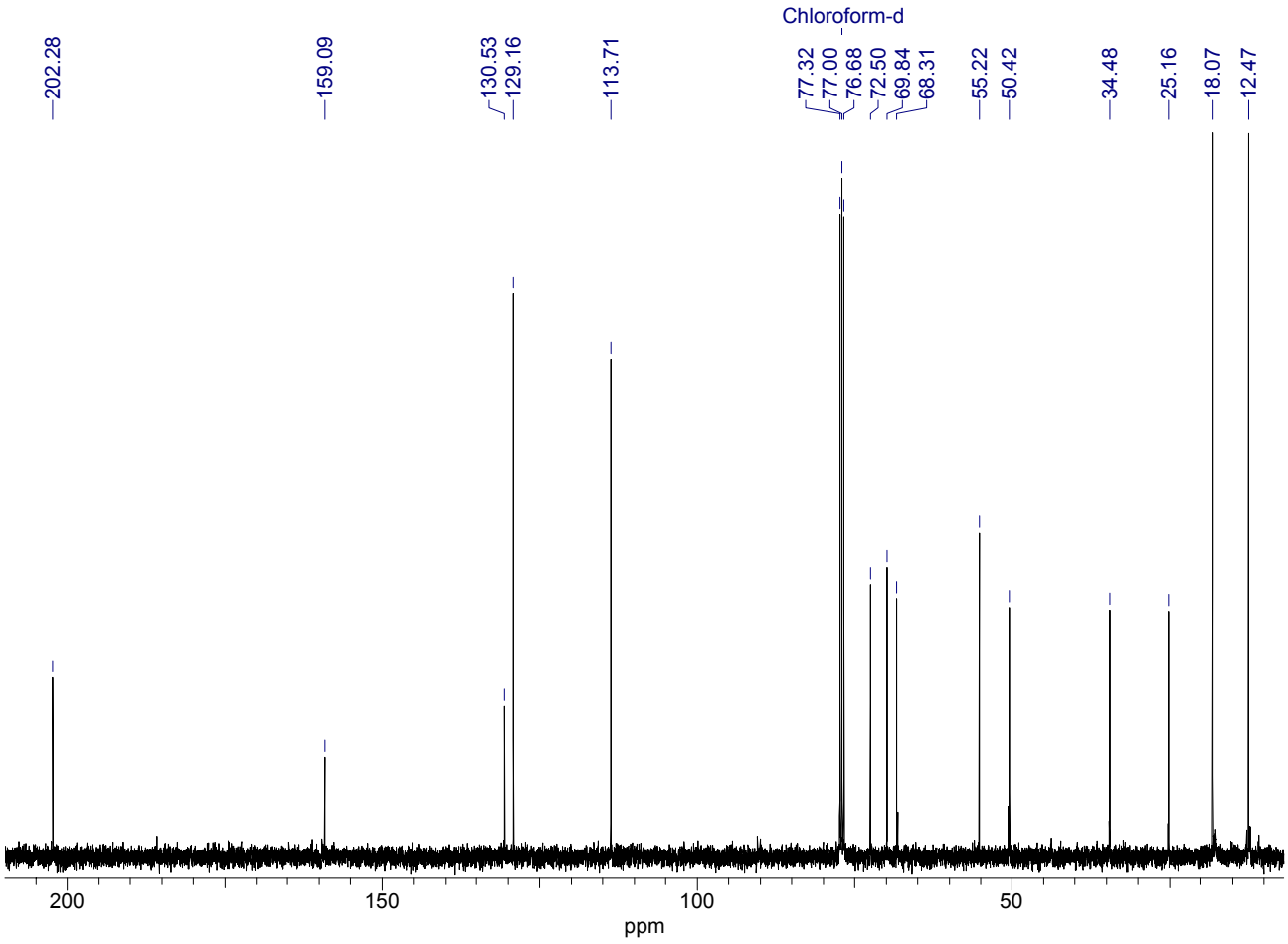
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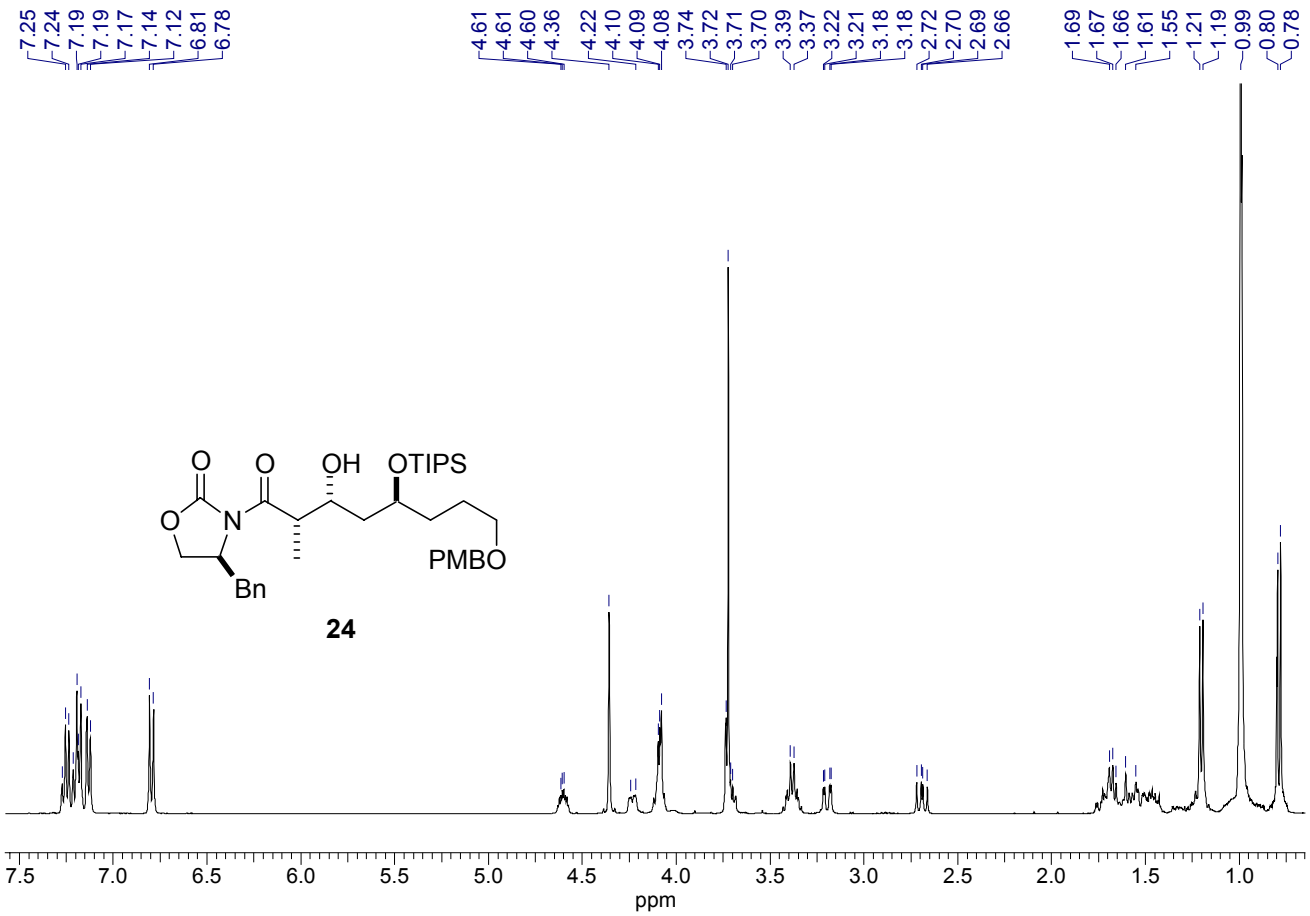
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4.61
4.60
4.36
4.22
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4.09
4.08
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3.72
3.71
3.70
3.39
3.37
3.22
3.21
3.18
3.18
2.72
2.70
2.69
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1.66
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1.55
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1.19
0.99
0.80
0.78
O
O
OH
OTIPS
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N
PMBO
Bn
24
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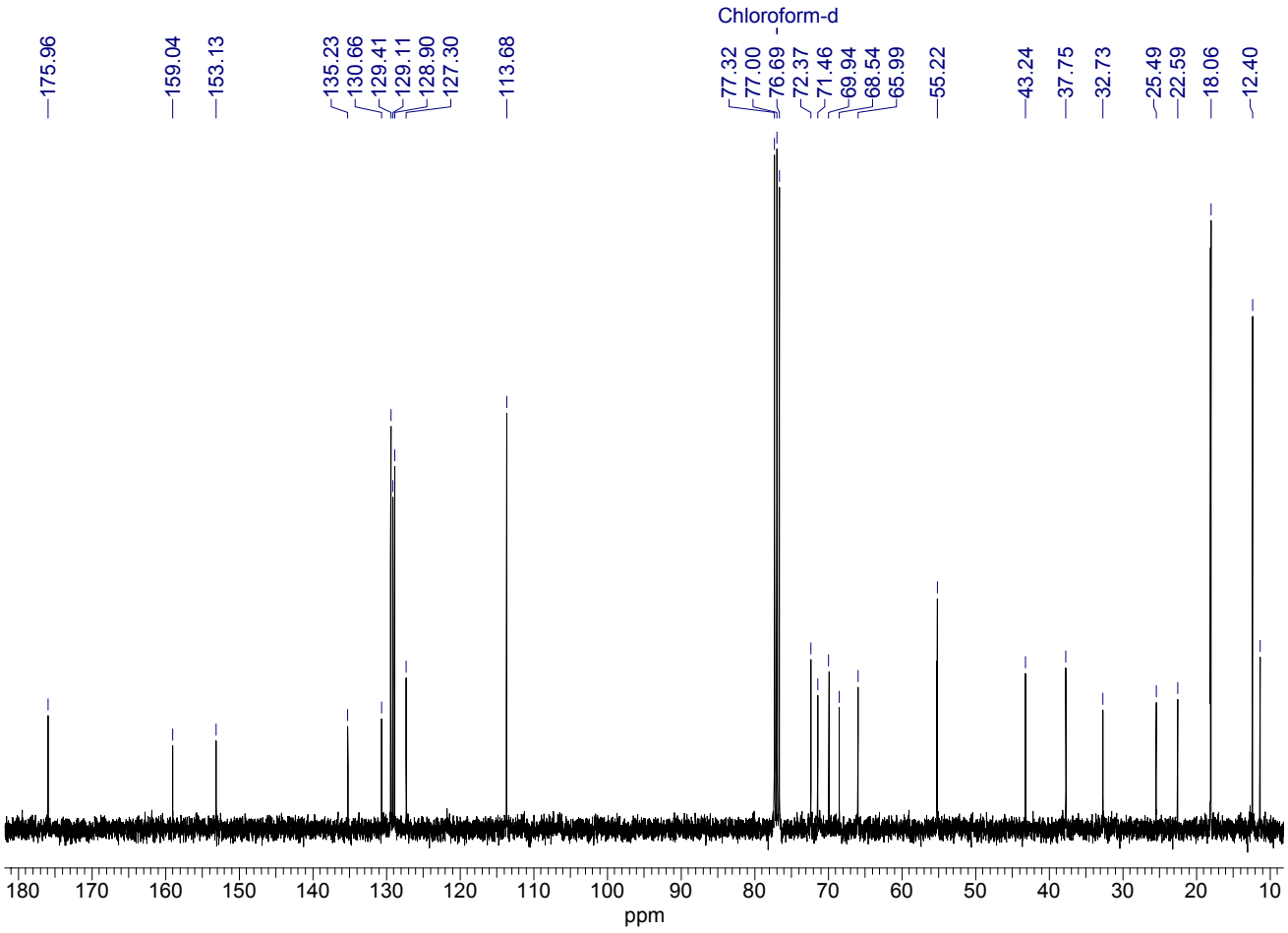
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77.00
76.69
72.37
71.46
69.94
68.54
65.99
55.22
43.24
37.75
32.73
25.49
22.59
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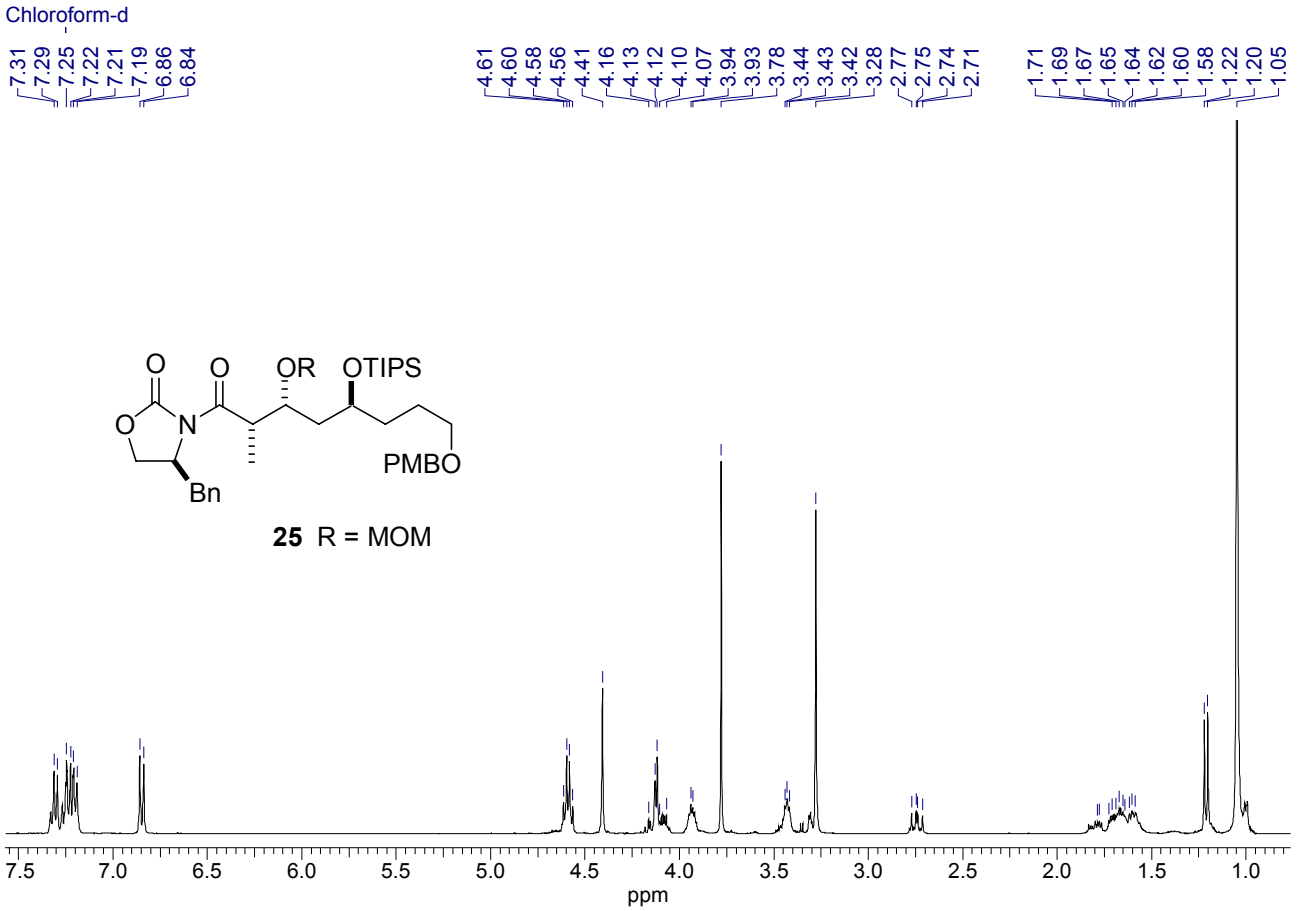
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7.21
7.19
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4.61
4.60
4.58
4.56
4.41
4.16
4.13
4.12
4.10
4.07
3.94
3.93
3.78
3.44
3.43
3.42
3.28
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2.75
2.74
2.71
1.71
1.69
1.67
1.65
1.64
1.62
1.60
1.58
1.22
1.20
1.05
O
O
OR
OTIPS
O
N
PMBO
Bn
25 R = MOM
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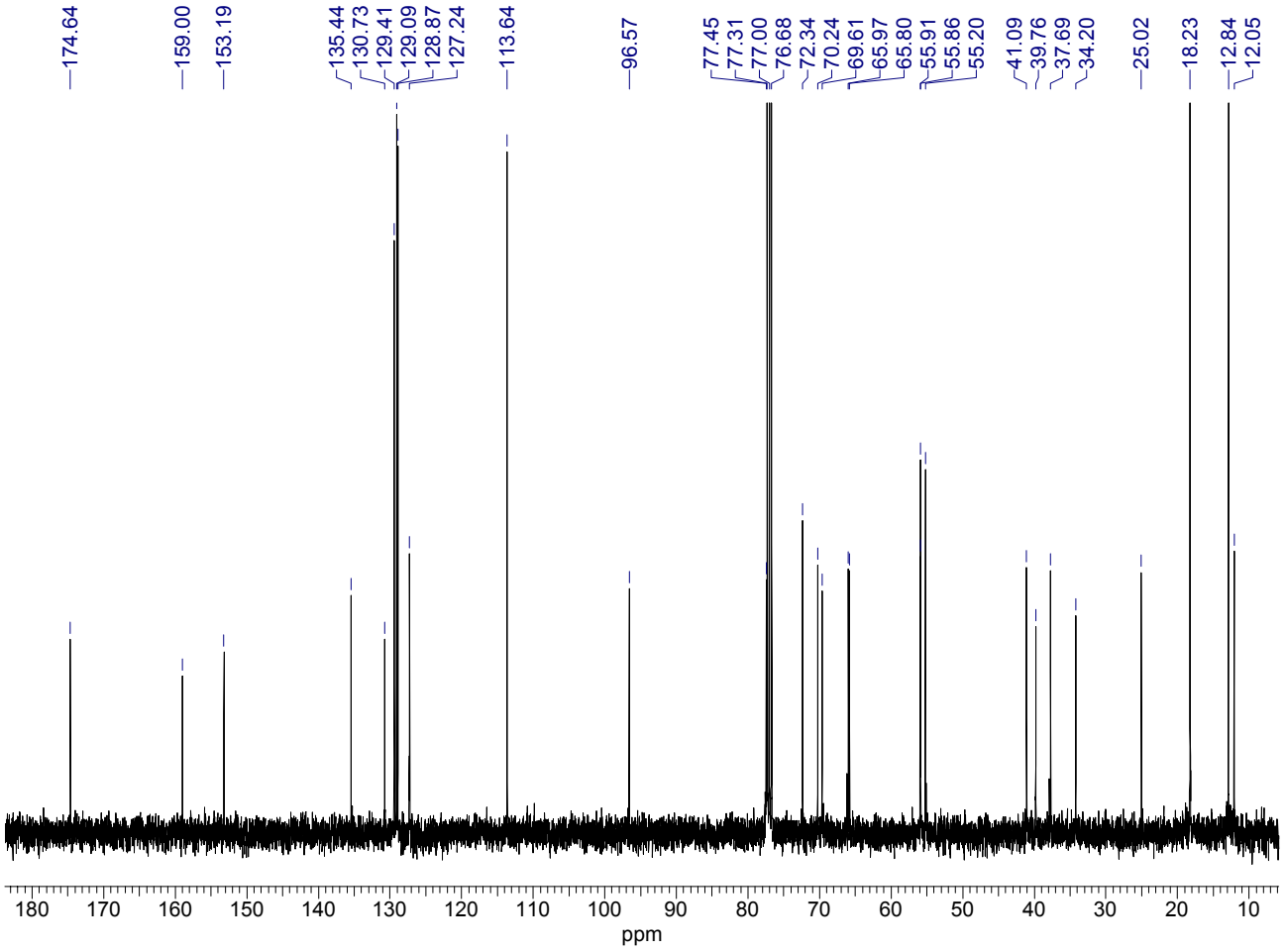
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77.31
77.00
76.68
72.34
70.24
69.61
65.97
65.80
55.91
55.86
55.20
41.09
39.76
37.69
34.20
25.02
18.23
12.84
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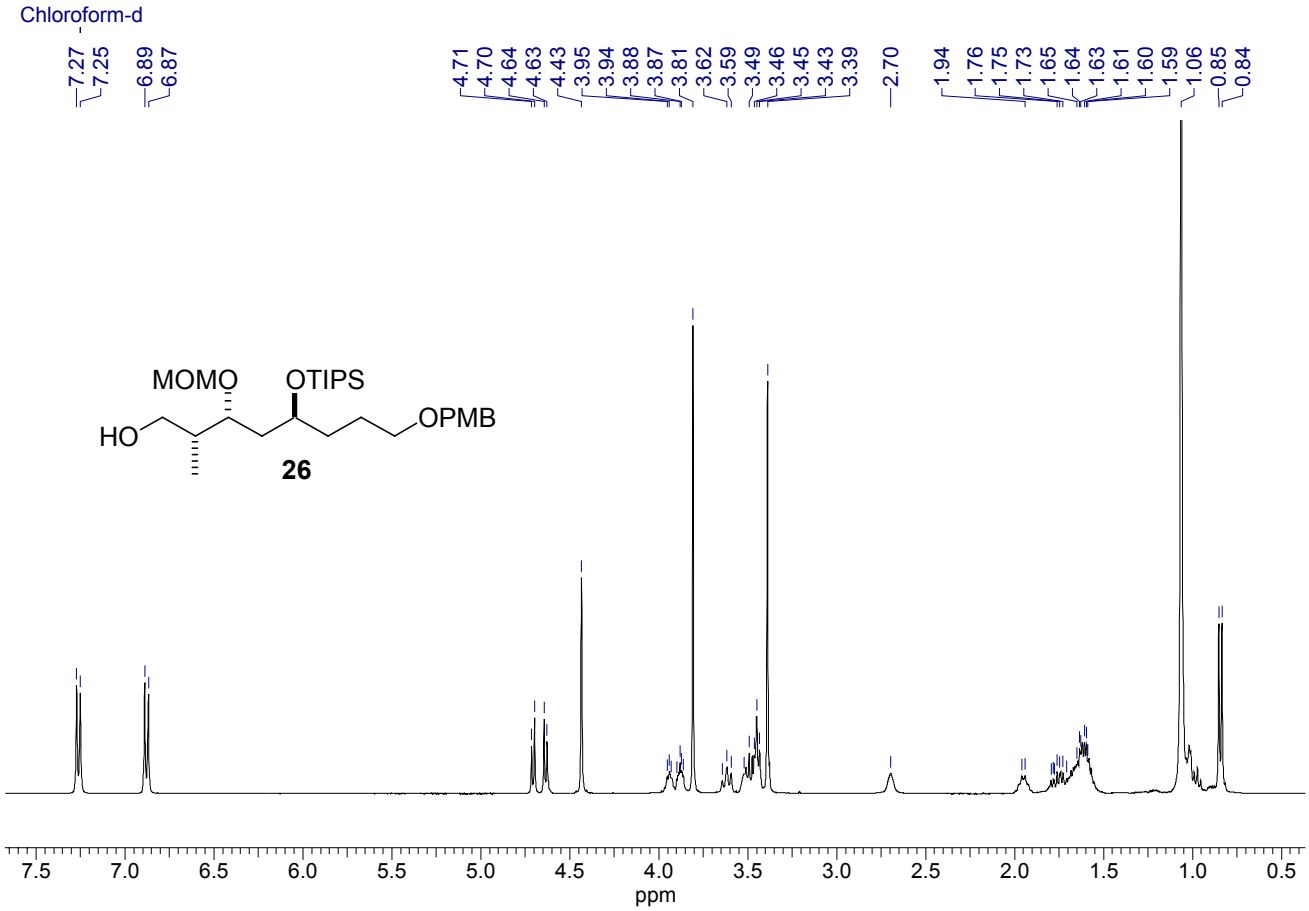
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3.88
3.87
3.81
3.62
3.59
3.49
3.46
3.45
3.43
3.39
2.70
1.94
1.76
1.75
1.73
1.65
1.64
1.63
1.61
1.60
1.59
1.06
0.85
0.84
MOMO
OTIPS
HO
OPMB
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6.5
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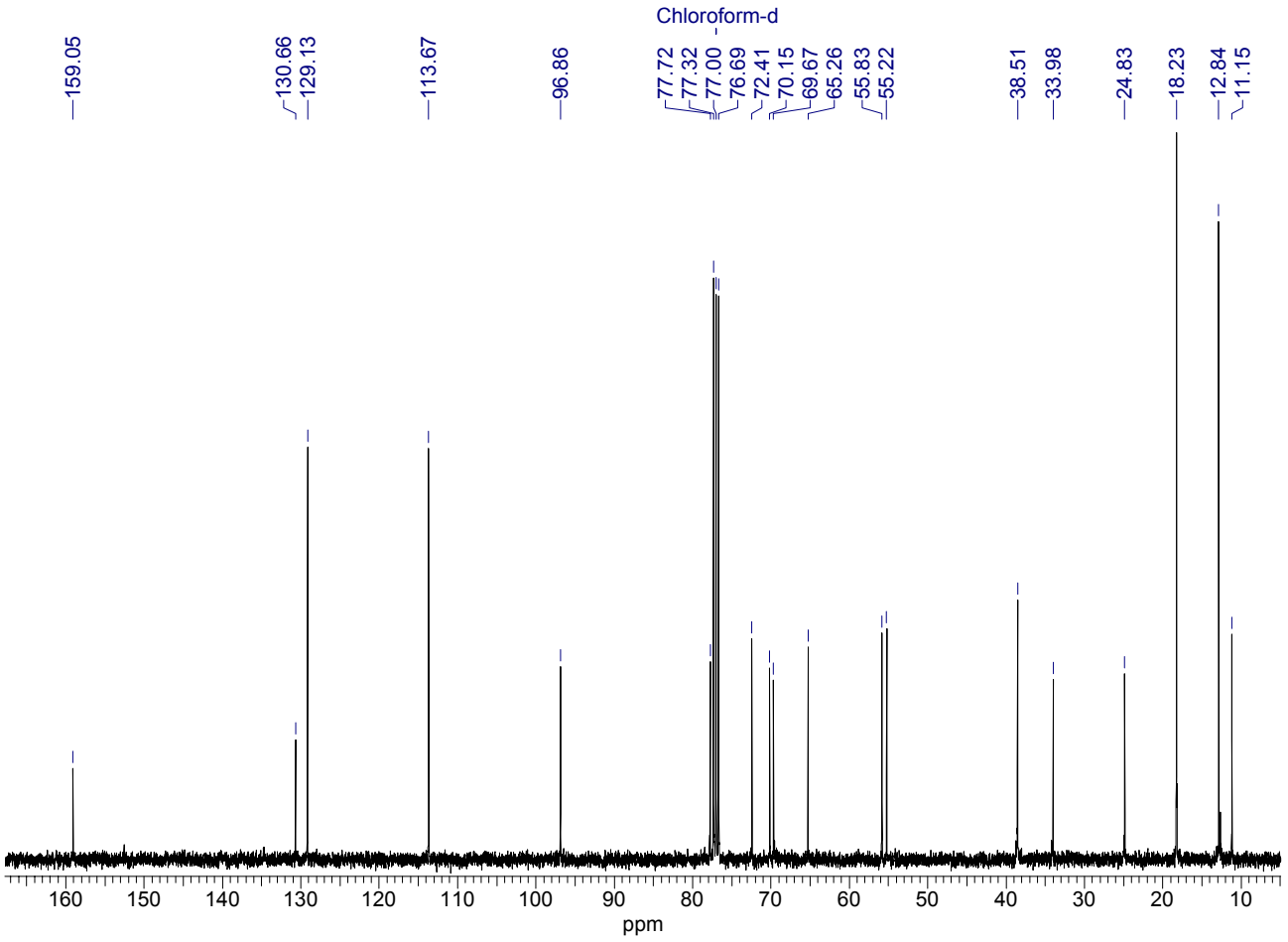
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72.41
70.15
69.67
65.26
55.83
55.22
38.51
33.98
24.83
18.23
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11.15
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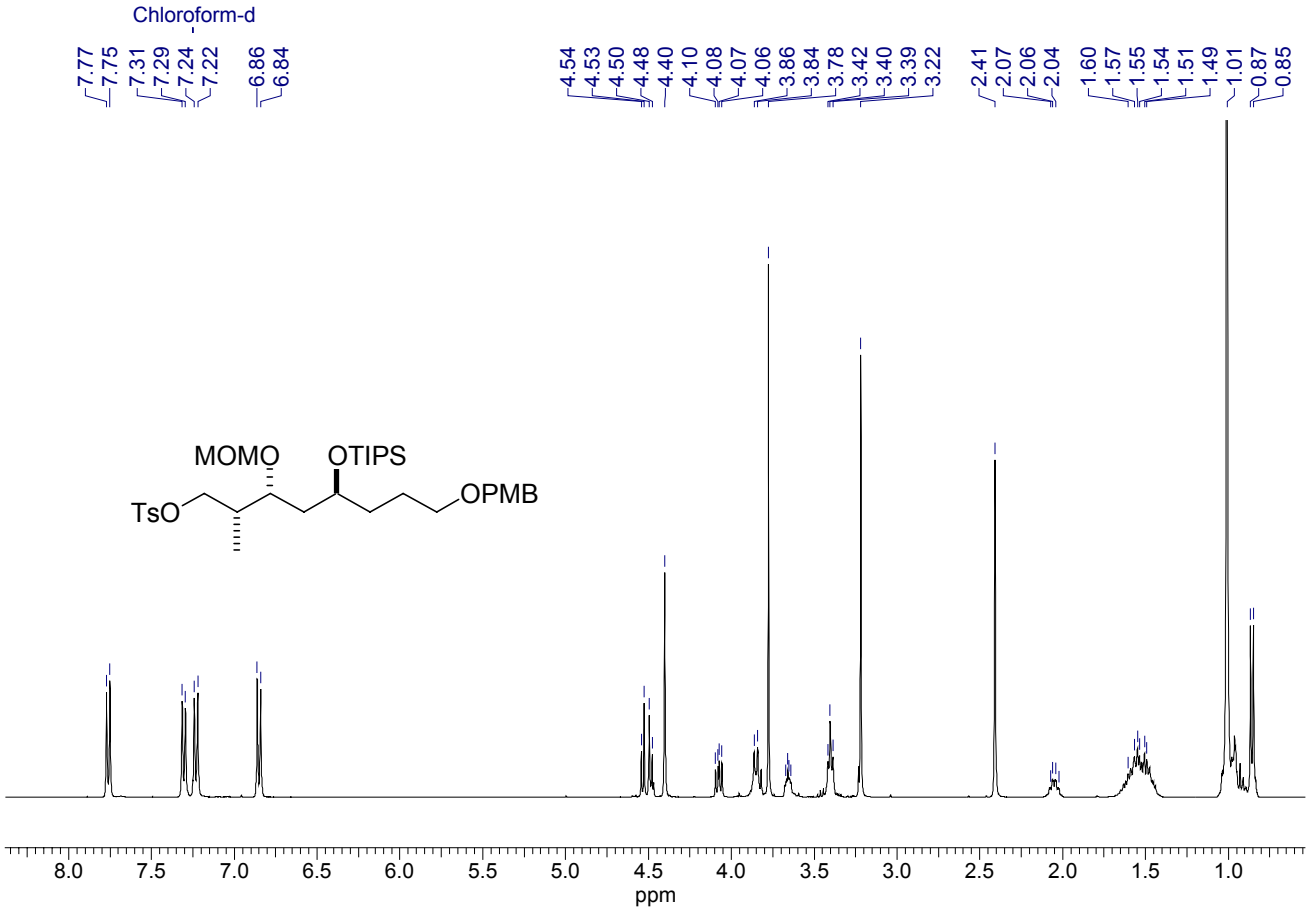
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4.54
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4.48
4.40
4.10
4.08
4.07
4.06
3.86
3.84
3.78
3.42
3.40
3.39
3.22
2.41
2.07
2.06
2.04
1.60
1.57
1.55
1.54
1.51
1.49
1.01
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0.85
MOMO
OTIPS
TsO
OPMB
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7.0
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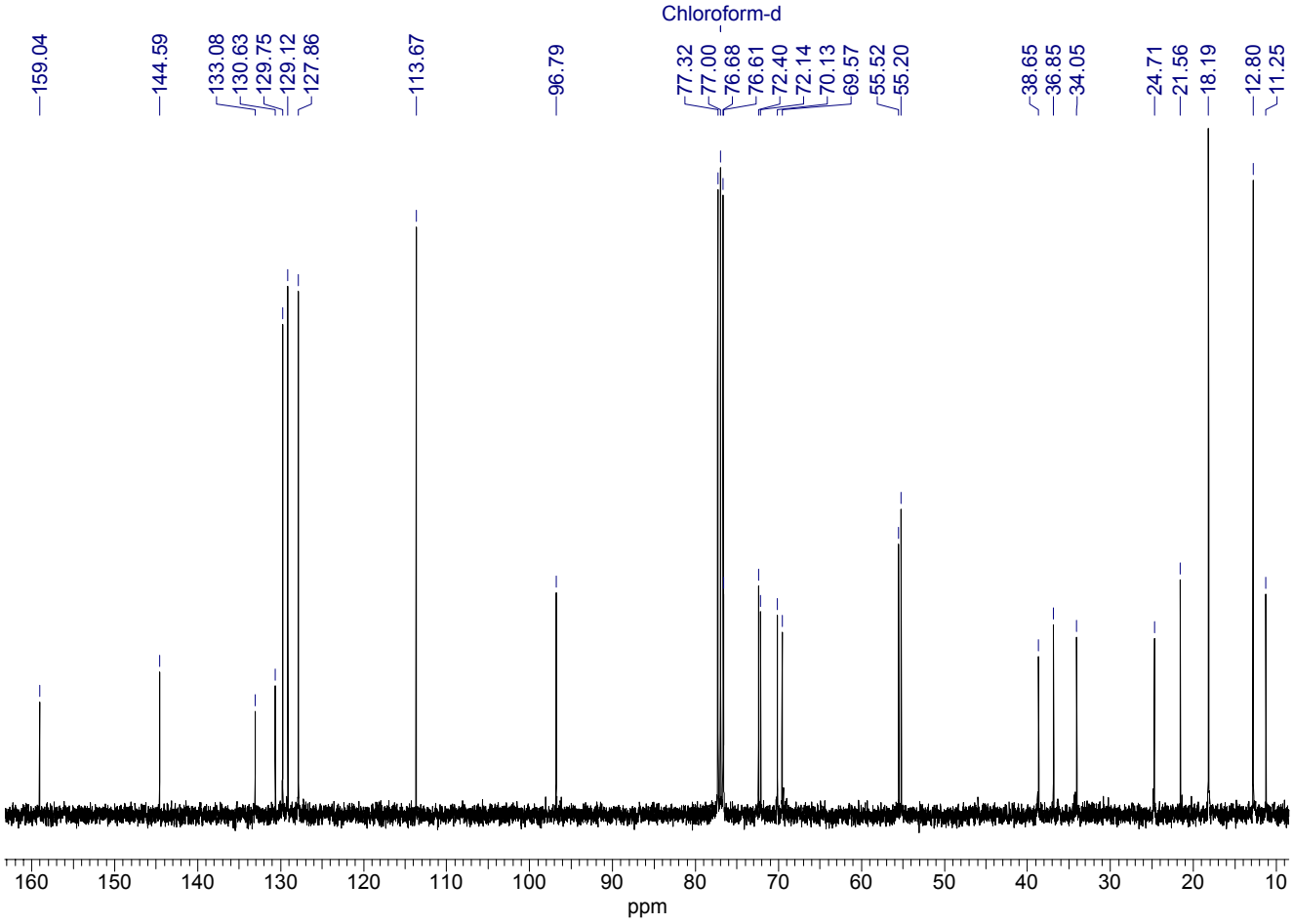
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72.40
72.14
70.13
69.57
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38.65
36.85
34.05
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21.56
18.19
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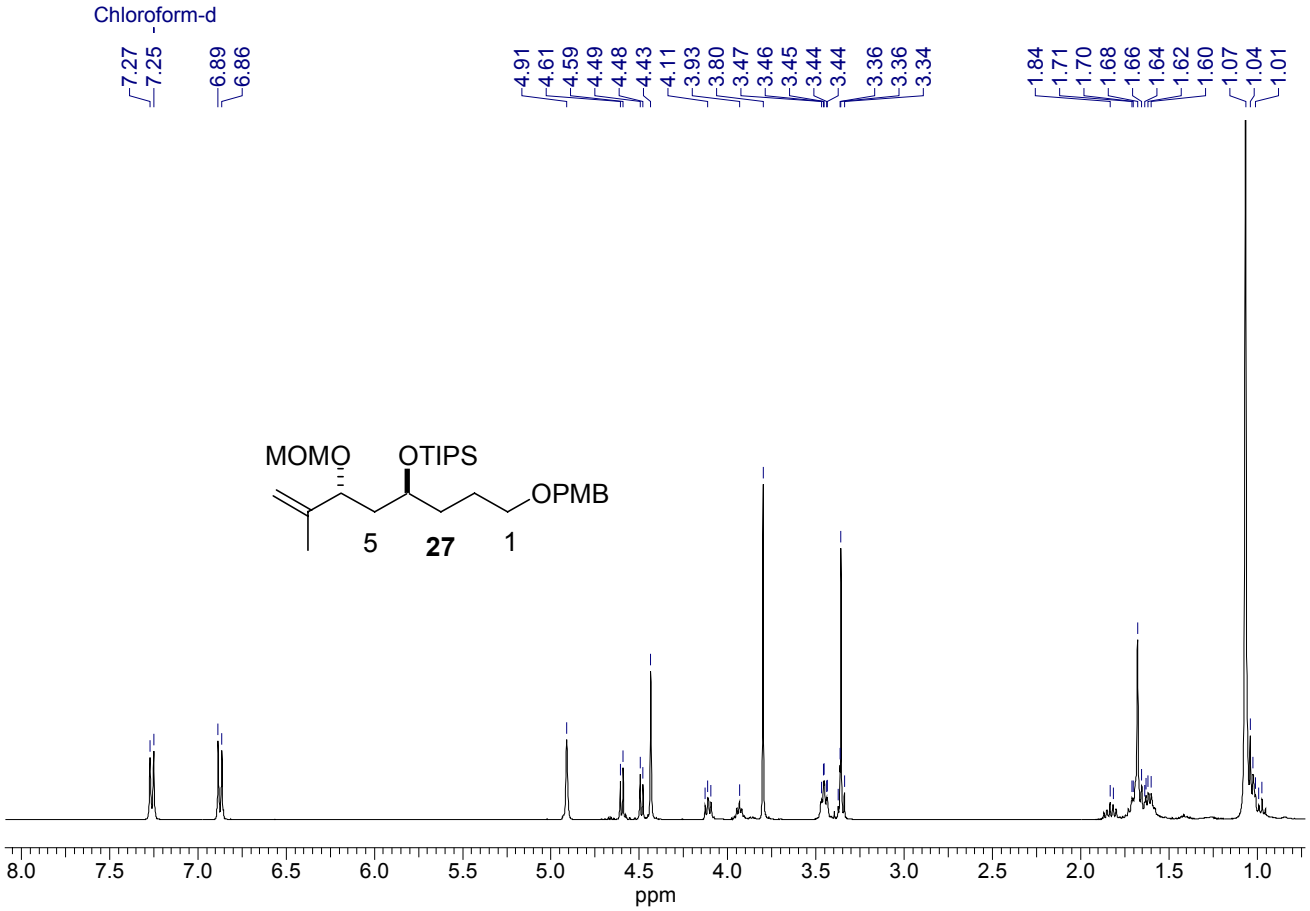
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1.71
1.70
1.68
1.66
1.64
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1.60
1.07
1.04
1.01
MOMO
OTIPS
OPMB
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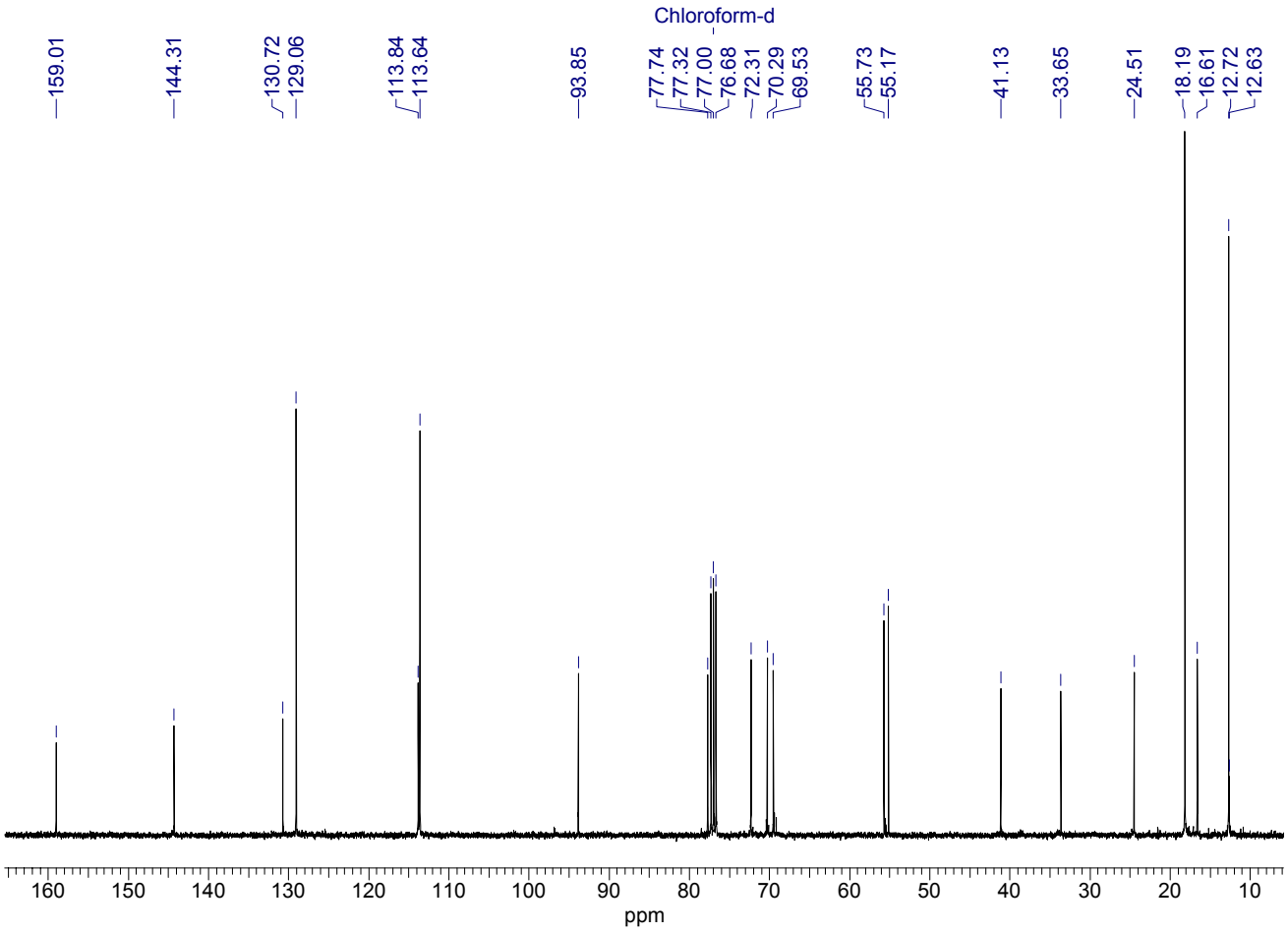
Chloroform-d
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76.68
72.31
70.29
69.53
55.73
55.17
41.13
33.65
24.51
18.19
16.61
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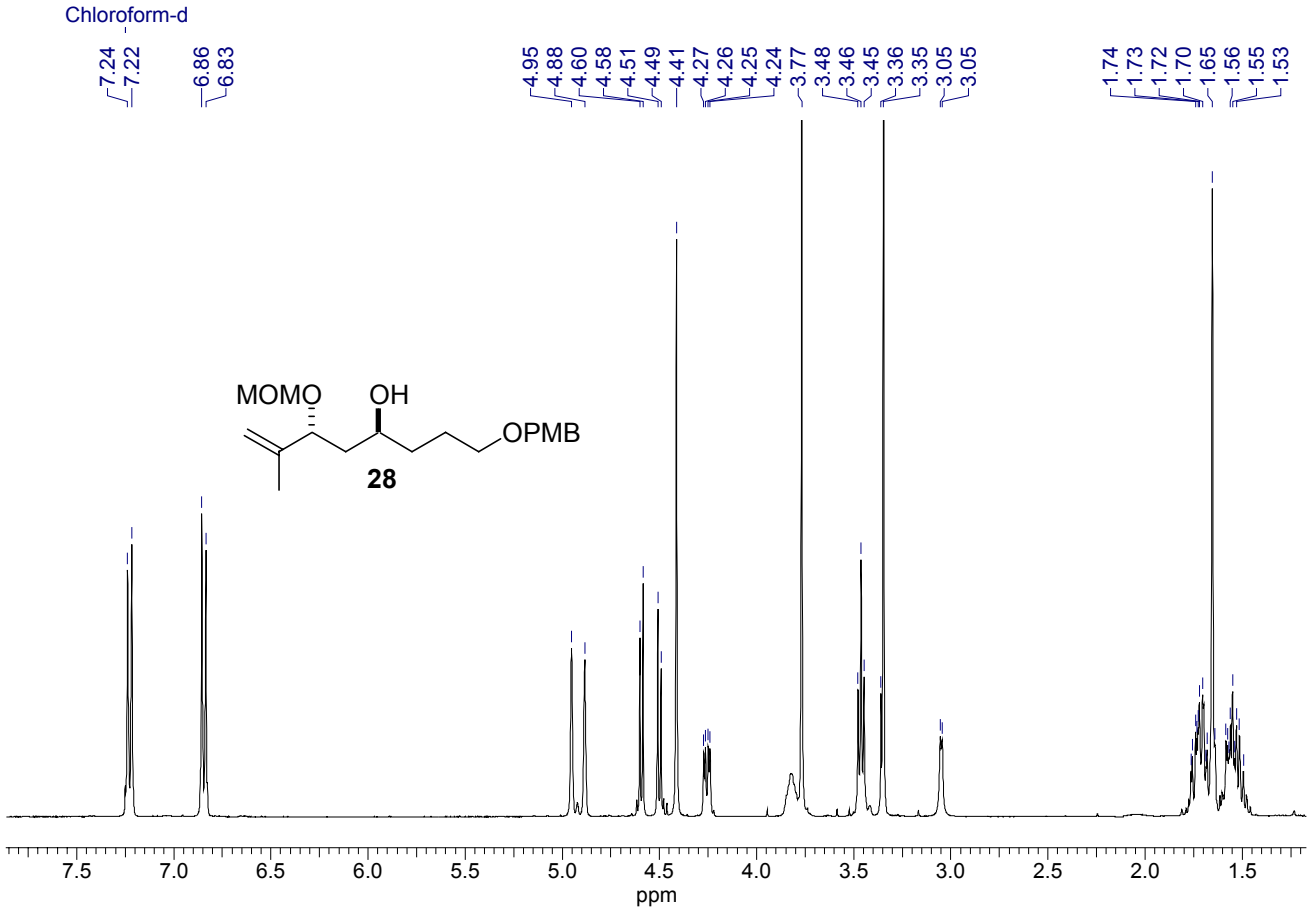
Chloroform-d
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4.51
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4.41
4.27
4.26
4.25
4.24
3.77
3.48
3.46
3.45
3.36
3.35
3.05
3.05
1.74
1.73
1.72
1.70
1.65
1.56
1.55
1.53
MOMO
OH
OPMB
28
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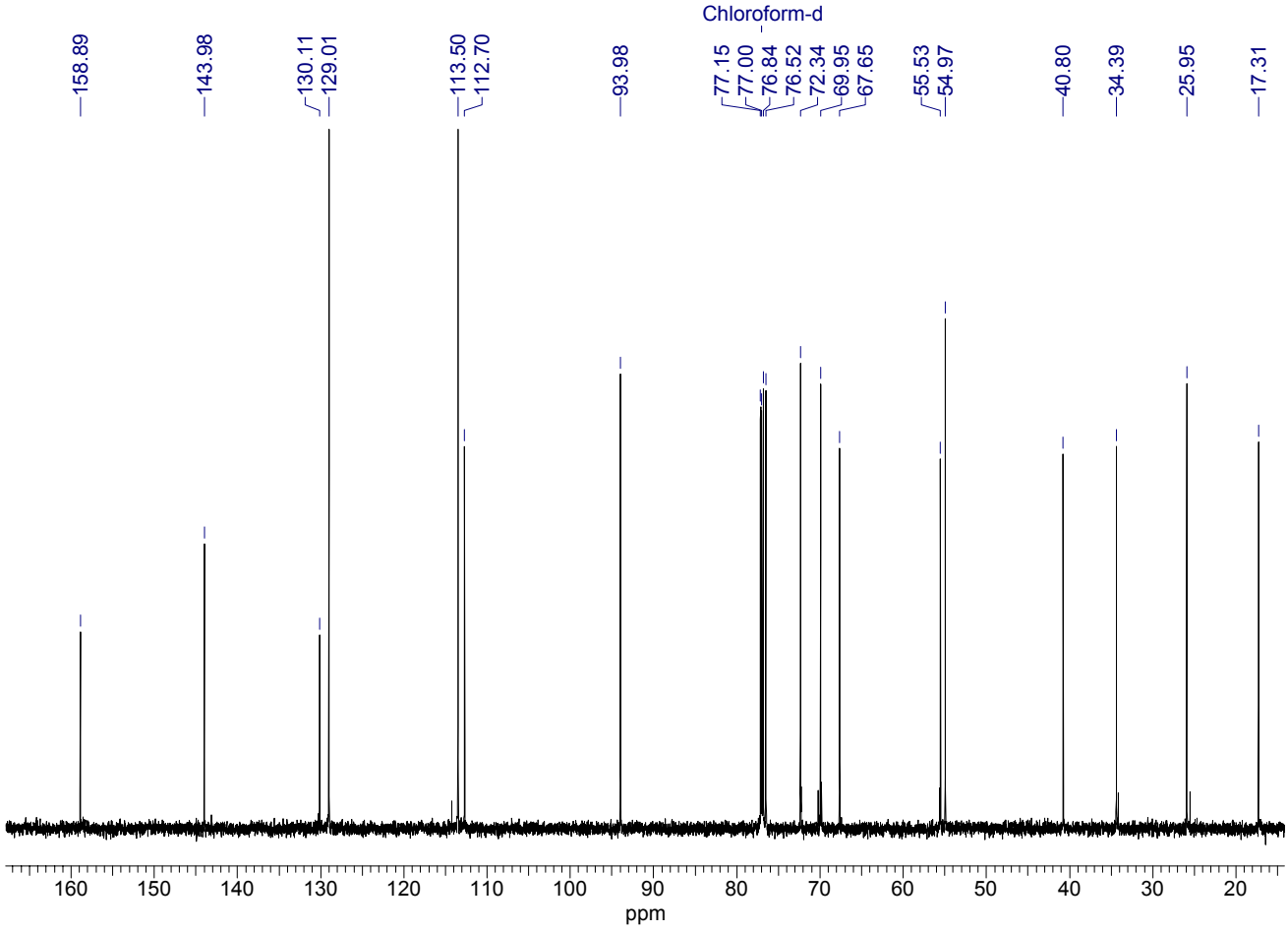
Chloroform-d
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40.80
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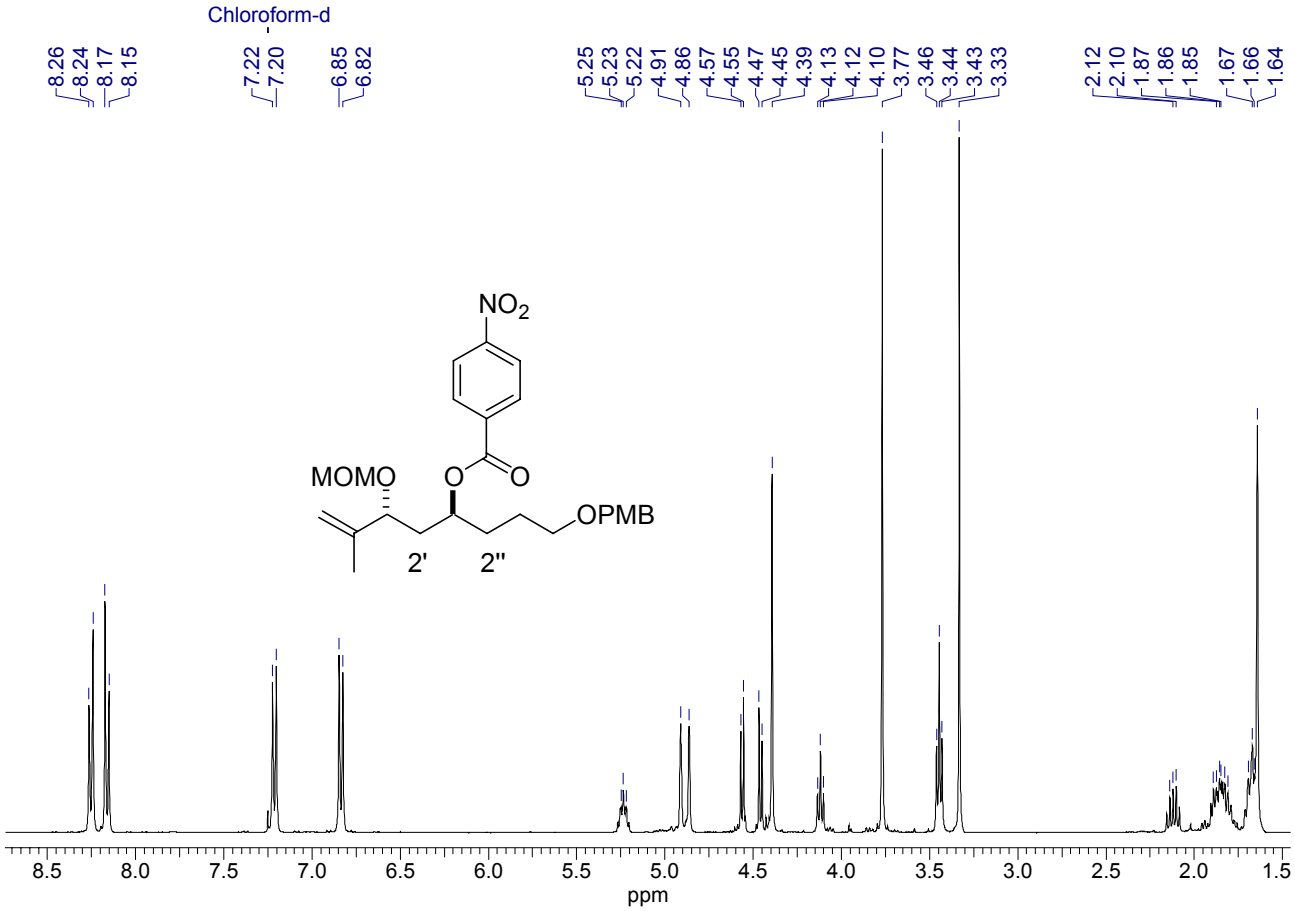
30
20
ppm


Chloroform-d
8.26
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2.10
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OPMB
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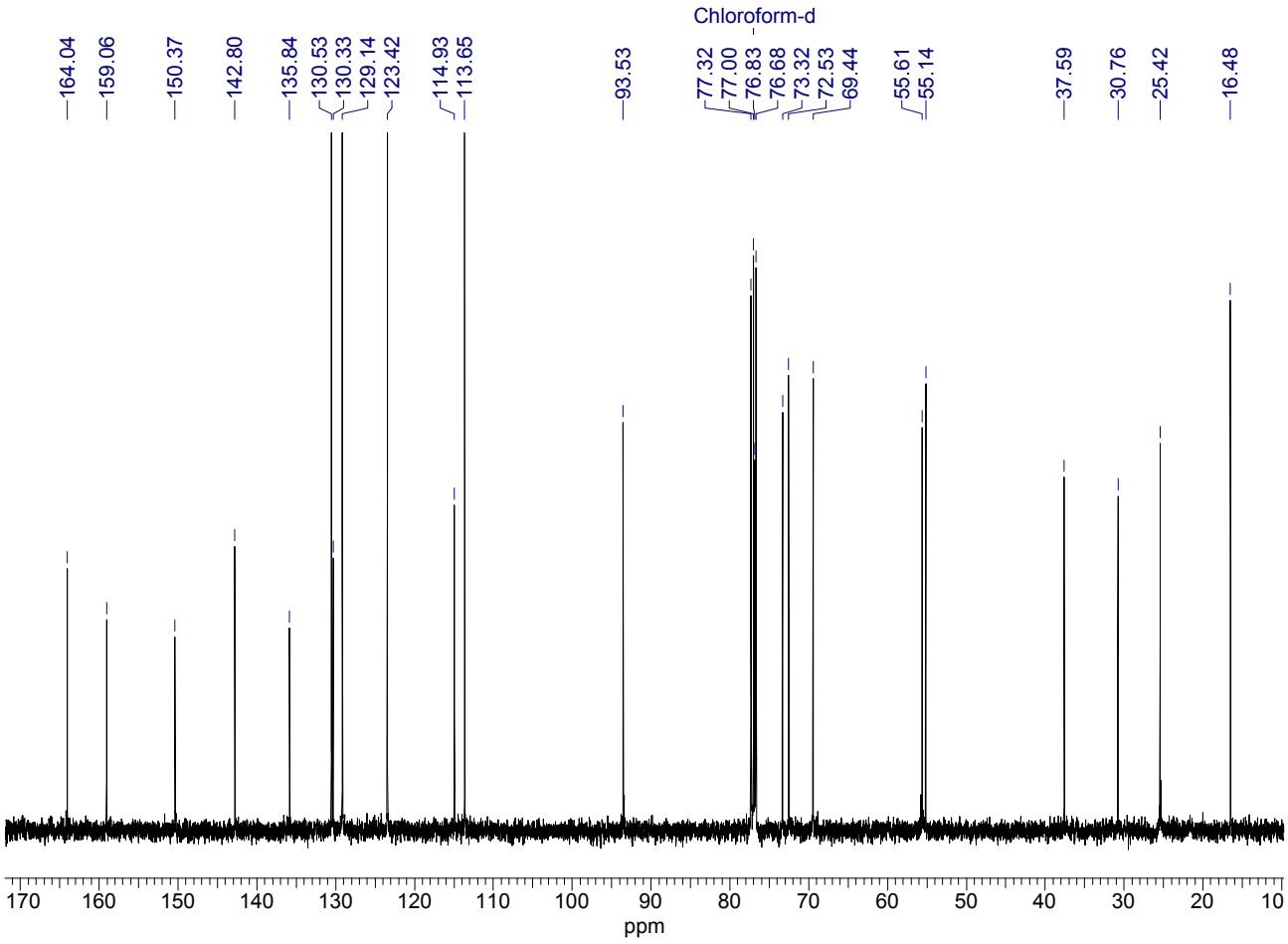
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93.53
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72.53
69.44
55.61
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30.76
25.42
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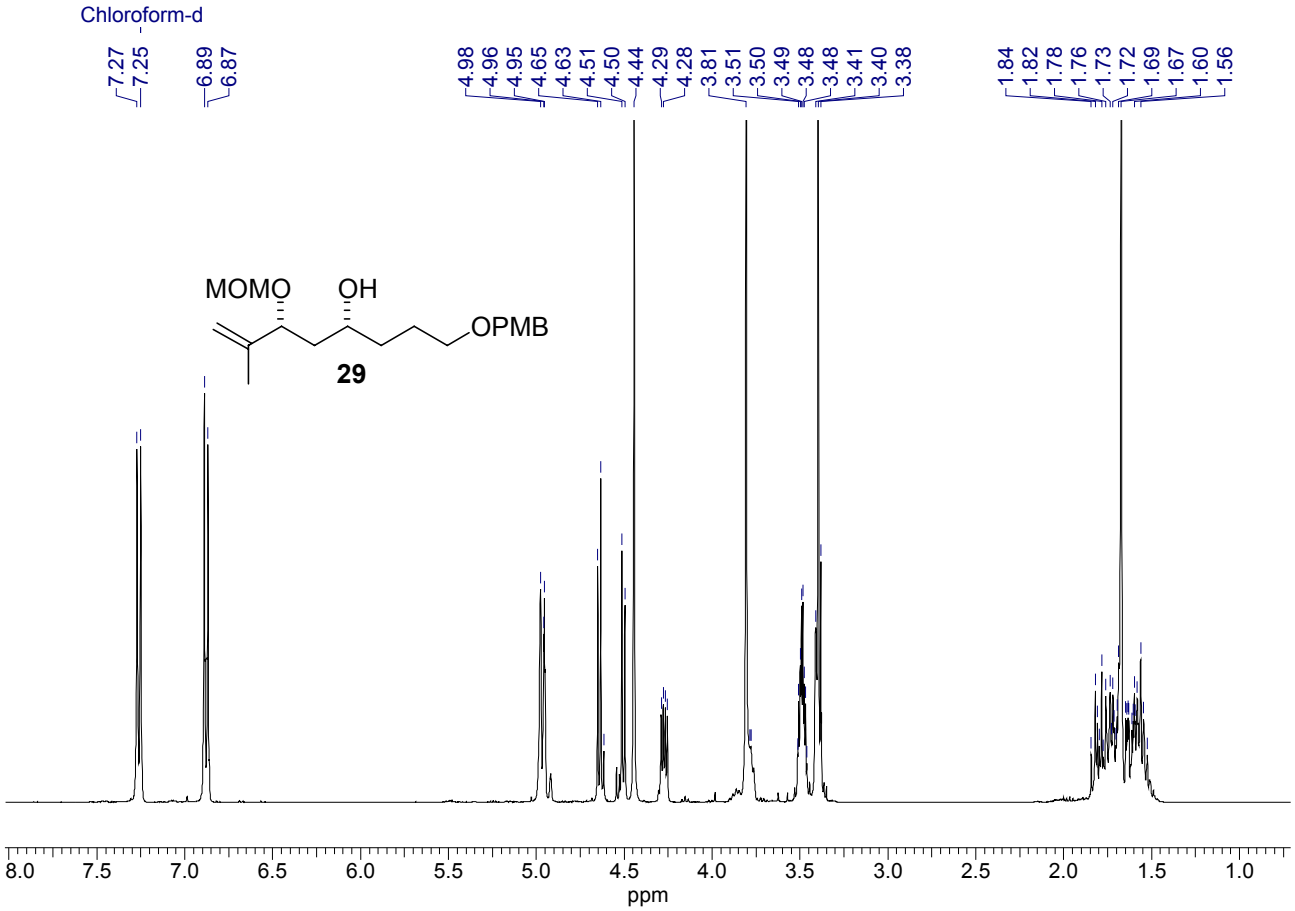
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4.29
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3.81
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3.50
3.49
3.48
3.48
3.41
3.40
3.38
1.84
1.82
1.78
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1.73
1.72
1.69
1.67
1.60
1.56
MOMO
OH
OPMB
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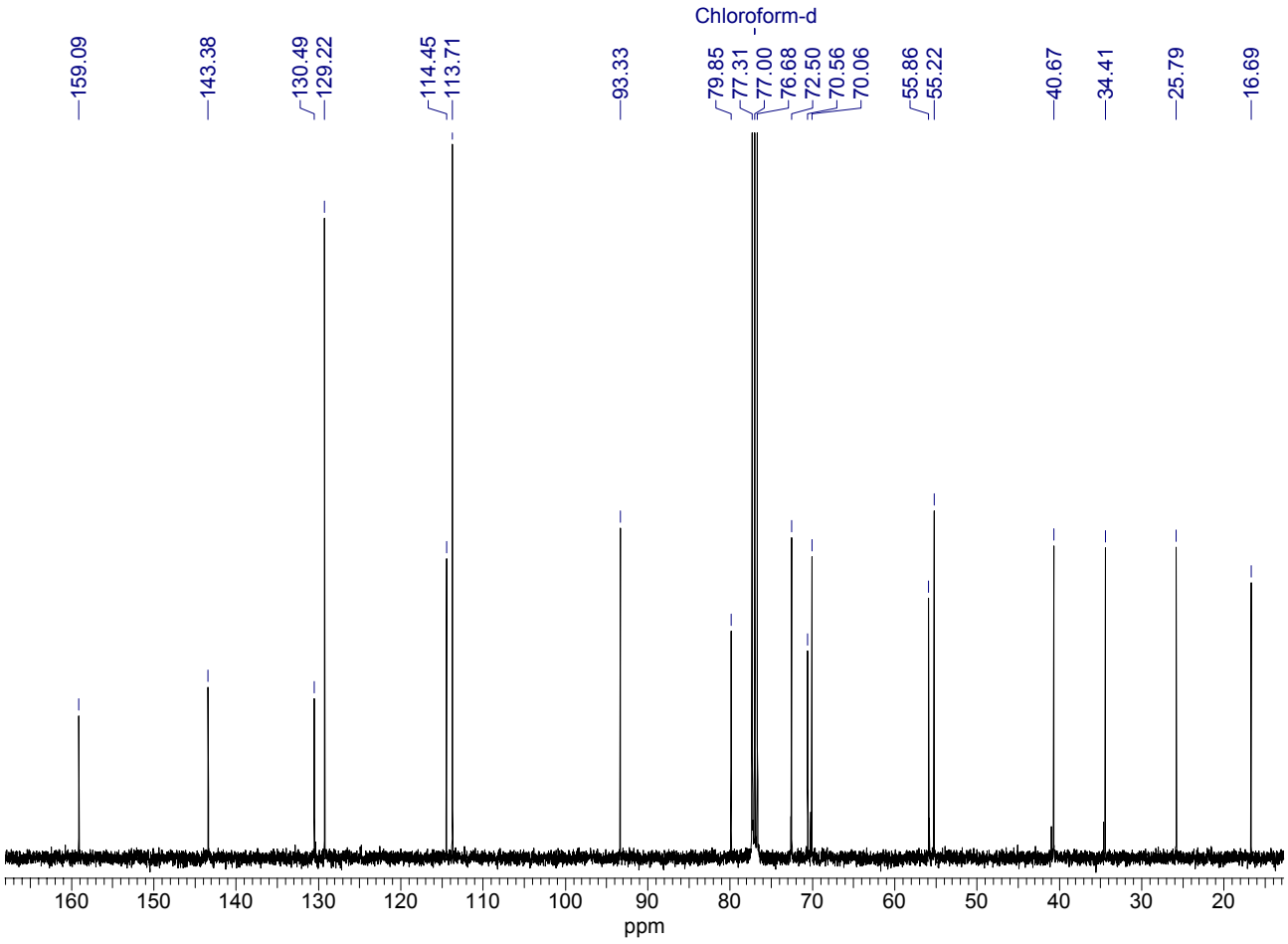
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40.67
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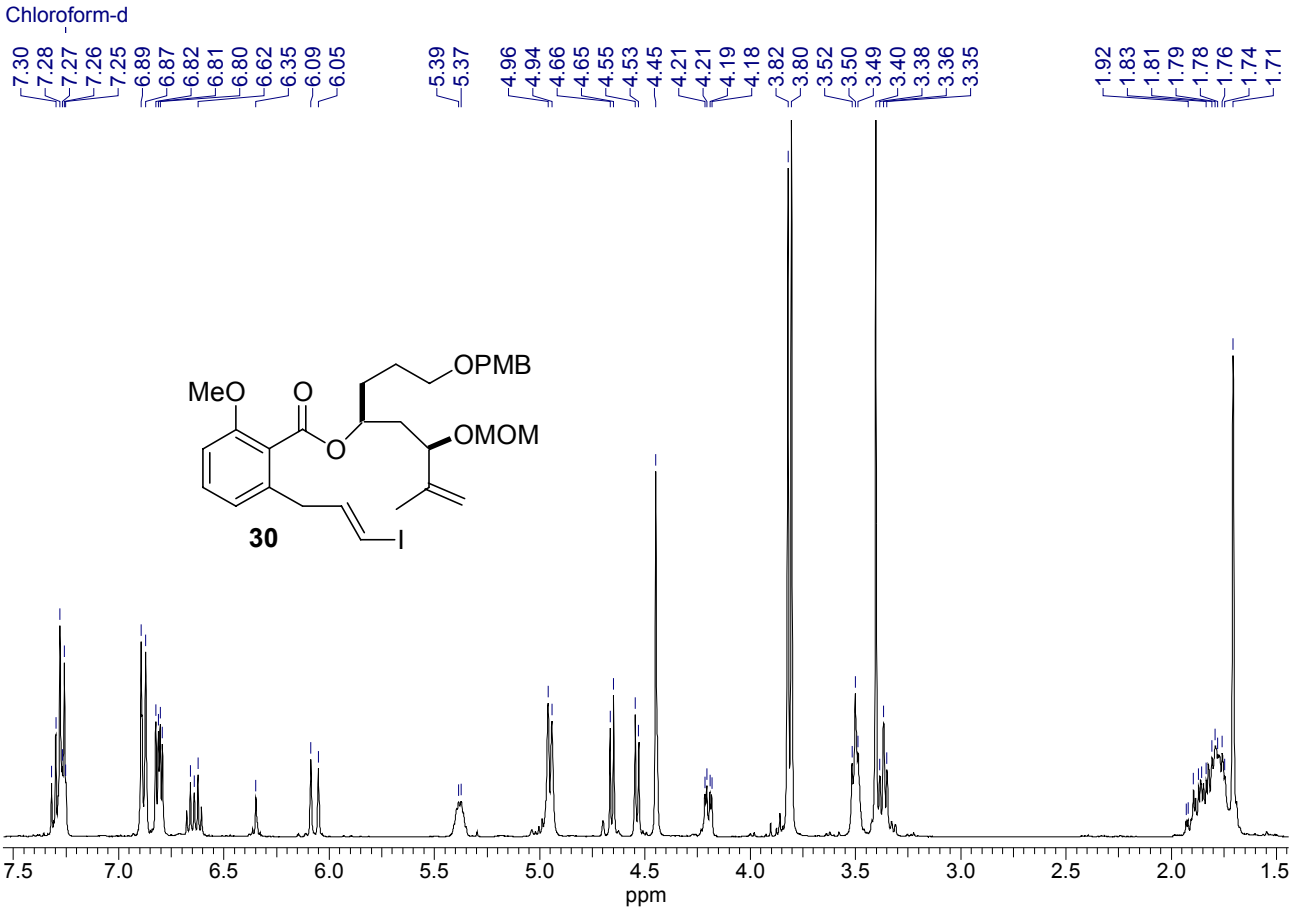
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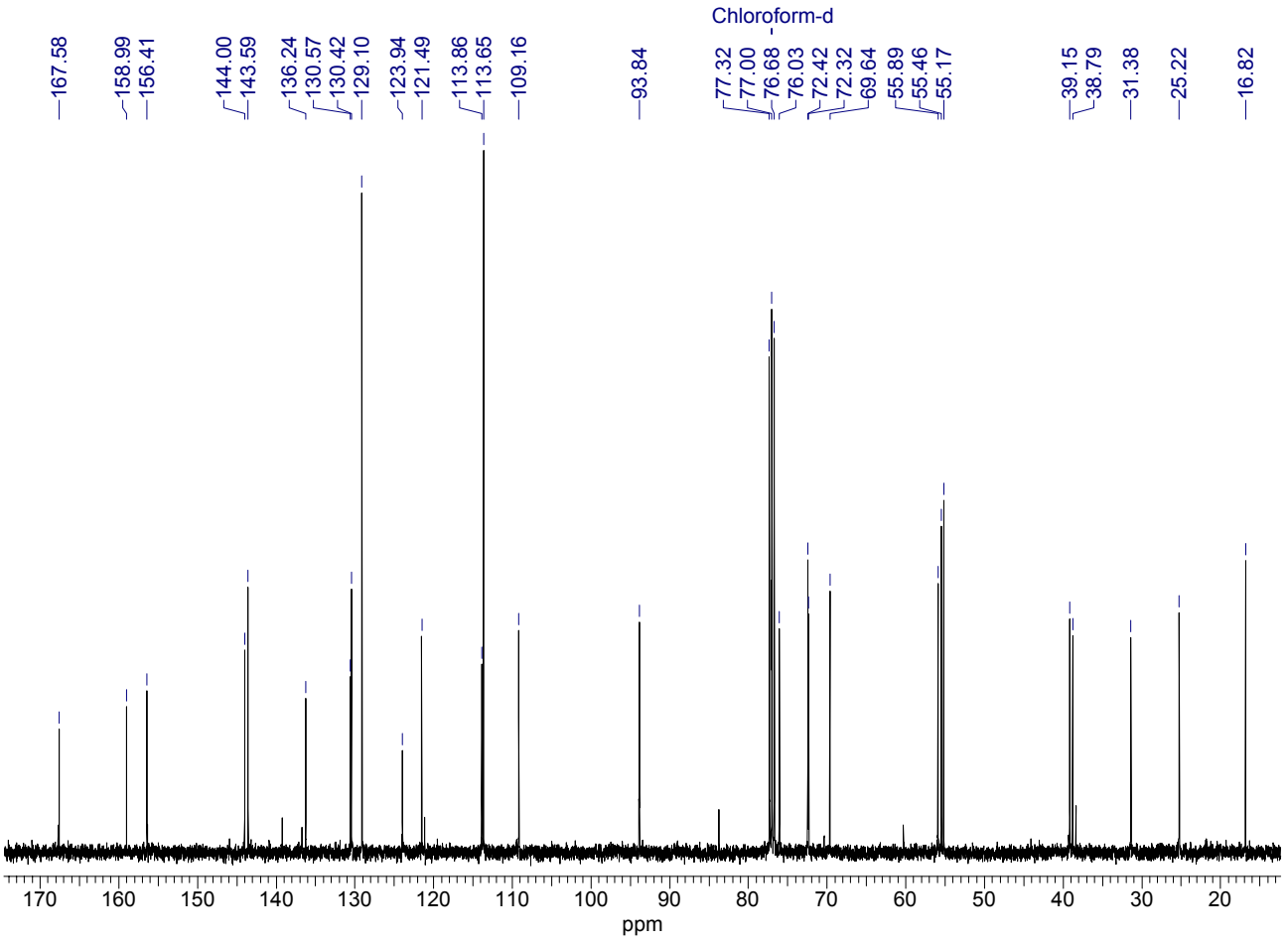
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76.03
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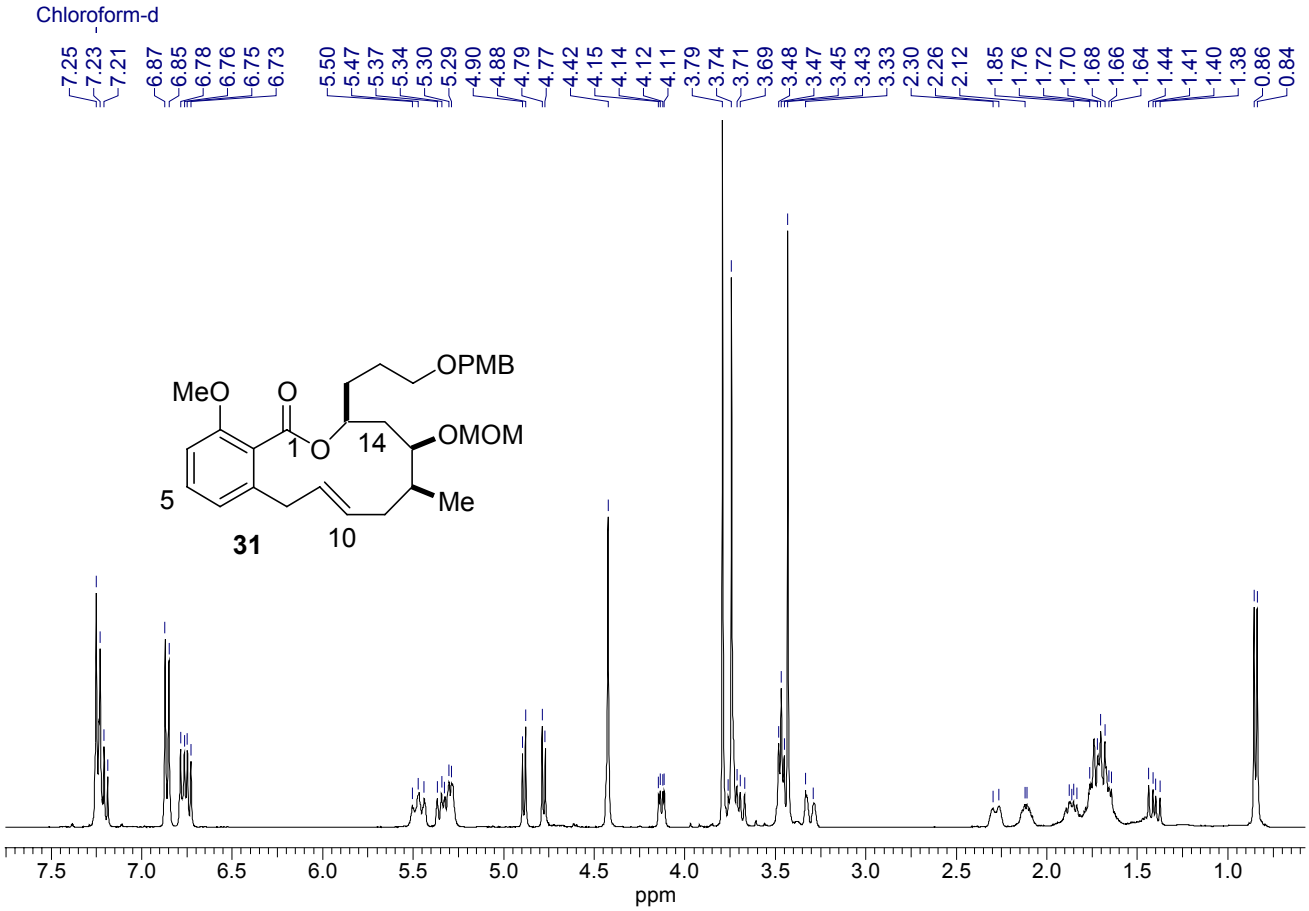
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5.29
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3.74
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3.69
3.48
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3.45
3.43
3.33
2.30
2.26
2.12
1.85
1.76
1.72
1.70
1.68
1.66
1.64
1.44
1.41
1.40
1.38
0.86
0.84
MeO
O
OPMB
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O
14
OMOM
5
Me
10
31
7.5
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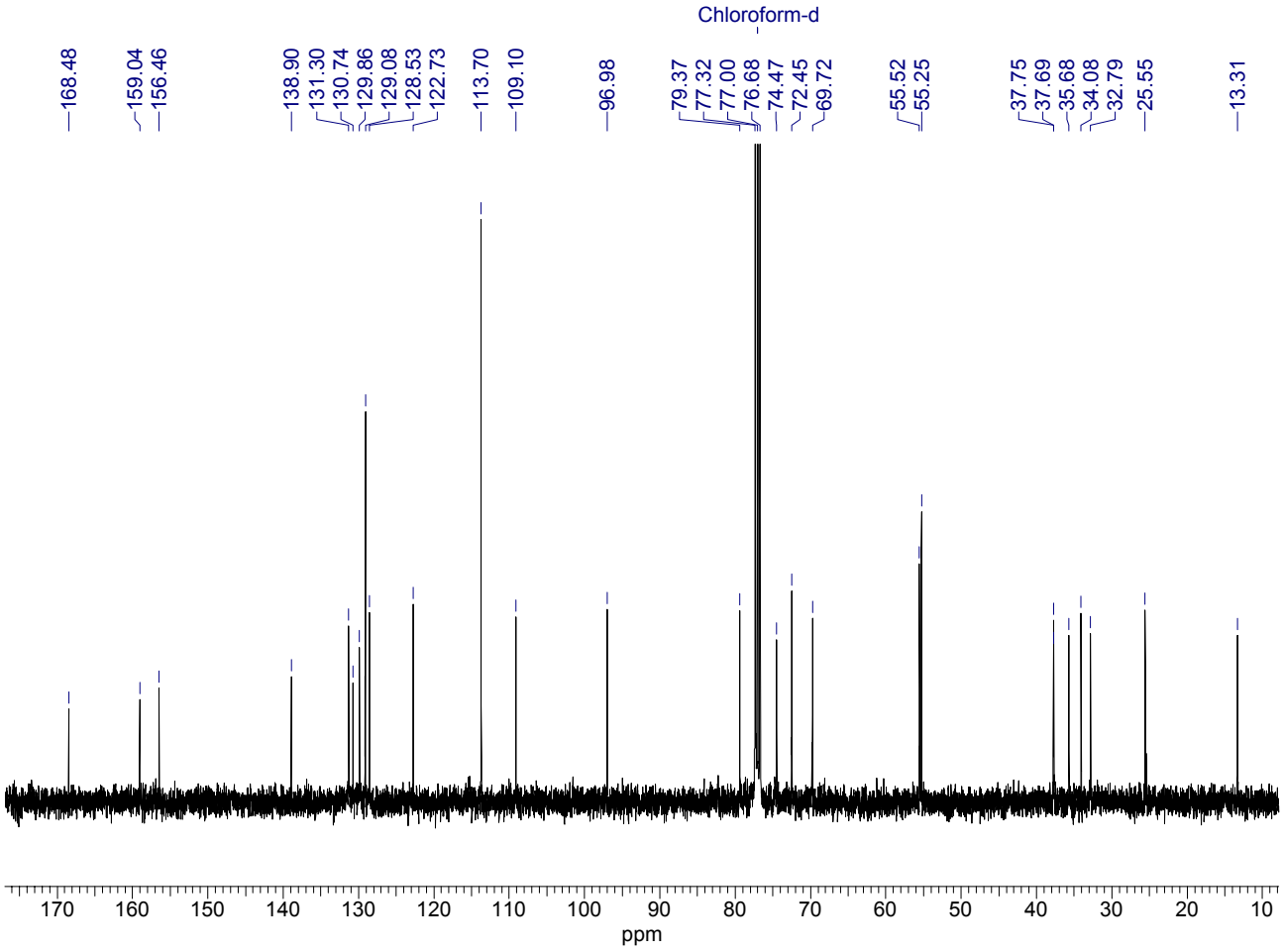
Chloroform-d
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ppm