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Supporting Information

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A Total Synthesis of (+)-Oocydin A: An Application of the Suzuki-Miyaura Cross-Coupling of 1,1-Dichloro-1-alkenes with 9-Alkyl-9-BBN

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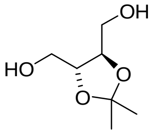
Supporting Informations

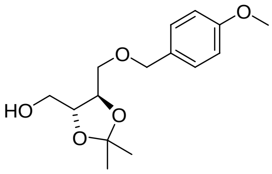
Experimental Section

General Experimental Procedures. NMR spectra were recorded (Bruker 300 or 500MHz ^{1}H and 75 or 100 MHz ^{13}C) in $CDCl_3$ (which also provided the lock signal at δ= 7.26 ppm ^{1}H and δ= 77.16 ppm ^{13}C). IR spectra were recorded on a Perkin Elmer FT-IR system using diamond window Dura SamplIR II. Mass spectra were determined with Micromass LCT. Optical rotations were measured on a JASCO P-1010 polarimeter. Silica gel 60 (35-70 μm) was used for flash chromatography. Silica gel (5 μm) was used for HPLC. TLC plates (Merck 60 F_{254} aluminum sheets) were rendered visible by ultraviolet and/or spraying with phosphomolybdic acid (5%) in MeOH or vanillin (1%) + sulfuric acid (5%) in EtOH followed by heating. THF and ether were distilled under argon from sodium-benzophenone prior to use. Dichloromethane was distilled over CaH_2 under argon prior to use.



((4R,5R)-2,2-dimethyl-1,3-dioxolane-4,5-diyl)dimethanol (i):

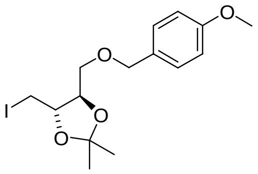
To a solution of dimethyl 2,3-*O*-isopropylidene-D-tartrate (9.943g, 45.57 mmol) in anhydrous ether (300 mL) at 0 °C under argon was added $LiAlH_4$ (4.32 g, 113.91 mmol). After 1 h 15 min of stirring at 0 °C, water was added drop-wise (4.50 mL) followed by a 3N NaOH water solution (4.50 mL) and then water (13.50 mL). A white precipitate formed and was removed but filtation. After removal of the solvent, the oily product was distilled (190 °C, 3.10^{-2} mbar) affording diol **i** as a colorless oil (7.304 g, 99%)



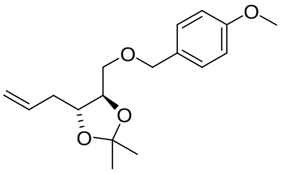
((4R,5R)-5-((4-methoxybenzyloxy)methyl)-2,2-dimethyl-1,3-dioxolan-4-yl)methanol (ii):

To as solution of diol **i** (3.150 g, 19.423 mmol) in anhydrous benzene (32 mL) under argon was added 4-methoxybenzylchloride (2.502 mL, 18.45 mmol) and KOH (1.035 g, 18.45 mmol). The reaction mixture was refluxed during 4 h and then filtered. After evaporation of the solvent, the crude was purified by flash chromatography (heptane/EtOAc, 1:1) affording alcohol **ii** as a colourless oil (3.980 g, 73 %).

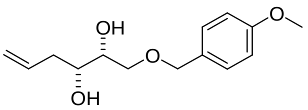
$[\alpha]_D^{23}$ -8.44 (*c* 1.08, $CHCl_3$); R*f* 0.30 (heptanes/EtOAc, 1:1); IR (film) 3462, 2985, 2933, 2868, 1611, 1512, 1243 cm^{-1}; ^{1}H NMR (500 MHz, $CDCl_3$) δ_H 1.41 (s, 3H), 1.41 (s, 3H), 2.26 (dd, 1H, *J* = 5.3, 8.2 Hz), 3.52 (dd, 1H, *J* = 6.1, 9.8 Hz), 3.66 (dd, 1H, J = 4.9, 9.8 Hz), 3.67 (dd, 1H, J = 4.3, 7.8 Hz), 3.74 (dt, 1H, J = 4.3, 11.6 Hz), 3.81 (s, 3H), 3.92 (m, 1H), 4.03 (m, 1H), 4.51 (s, 2H), 6.88 (dt, 2H, J = 2.7, 8.9 Hz), 7.25 (dt, 2H, J = 1.8, 8.9 Hz); ^{13}C (75 MHz, $CDCl_3$) δ_C 27.1, 55.4, 62.6, 70.1, 73.5, 76.9, 80.0, 109.4, 114.0, 129.6, 129.7; MS (TOF) m/z 305.1 ([M+Na]$^+$); HRMS (TOF) m/z calcd for $C_{15}H_{22}O_5Na$ [M+Na]$^+$ 305.1365, found 305.1346; Anal. calcd for $C_{15}H_{22}O_5$: C 63.81; H 7.85, found C 63.78; H 7.97.



(4S,5R)-4-(iodomethyl)-5-((4-methoxybenzyloxy)methyl)-2,2-dimethyl-1,3-dioxolane (10):
A solution of alcohol **ii** (4.316 g, 15.28 mmol), triphenylphosphine (4.812 g, 18.35 mmol) and imidazole (3.122 g, 45.86 mmol) in toluene (100 mL) was refluxed under argon. The reflux was stopped and iodide (5.01 g, 19.87 mmol) was carefully added. After 30 min of reflux, the reaction medium was cooled down, and poured in a separatory funnel containing water (200 mL) and a 10% $Na_2S_2O_4$ aqueous solution (50 mL). After extraction with CH_2Cl_2 and drying over anhydrous Na_2SO_4, the solvent was removed under vacuum. Flash column chromatography purification (heptanes/EtOAc, 6:1) afforded iodide derivative **10** (5.162 g, 86%) as a colorless oil.
$[\alpha]_D^{23}$ + 10.96 (*c* 1.8, $CHCl_3$); R*f* 0.54 (heptanes/EtOAc, 1:1); IR (film) 2985, 2932, 2862, 1611, 1511, 1369, 1243 cm^{-1}; ^1H NMR (500 MHz, $CDCl_3$) δ_H 1.41 (s, 3H), 1.46 (s, 3H), 3.25 (dd, 1H, *J* = 10.4, 5.2 Hz), 3.33 (dd, 1H, *J* = 10.7, 5.2 Hz), 3.59 (dd, 1H, J = 10.4, 5.2 Hz), 3.62 (dd, 1H, *J* = 10.4, 5.2 Hz), 3.80 (s, 3H), 3.83 (dt, 1H, *J* = 7.3, 5.2 Hz), 3.94 (dt, *J* = 7.3, 5.1 Hz), 4.51 (s, 2H), 6.87 (d, 2H, *J* = 8.5 Hz), 7.25 (d, 2H, *J* = 8.5 H) ; ^{13}C (75 MHz, $CDCl_3$) δ_C 6.5, 27.4, 27.4, 55.3, 70.2, 73.3, 77.8, 80.1, 109.8, 113.9, 129.4, 129.9, 159.4; MS (TOF) m/z 415.0 ($[M+Na]^+$); HRMS (TOF) m/z calcd for $C_{15}H_{21}O_4NaI$ $[M+Na]^+$ 415.0382, found 415.0394.



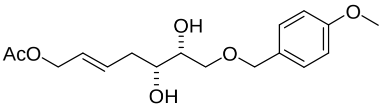
(4R,5R)-4-allyl-5-((4-methoxybenzyloxy)methyl)-2,2-dimethyl-1,3-dioxolane (iii):
A solution of the alcohol **10** (4.815 g, 12.275 mmol), CuI (234 mg, 1.227 mmol) and HMPA (8.54 mL, 49.10 mmol) in THF (25 mL) was cooled at – 50 °C under an argon atmosphere. Then a solution of vinylmagnesium chloride in THF (14.44 mL, c= 1.7 M, 24.55 mmol) was slowly introduced over 10 min. After 15 min of stirring, the reaction medium was poured in a separatory funnel containing a mixture of a NH_4Cl saturated solution (100 mL) and concentrated ammoniac (100 mL). After a strong agitation, and extraction by CH_2Cl_2, the organic phase was dried over anhydrous Na_2SO_4, filtered and the solvent was removed under vacuum. Flash column chromatography purification (heptanes/EtOAc, 10:1) afforded derivative **iii** (2.723 g, 76%) as a colorless oil.
$[\alpha]_D^{23}$ + 13.51 (*c* 1.22, $CHCl_3$); R*f* 0.20 (heptanes/EtOAc, 3:1); IR (film) 2984, 2933, 2904, 2863, 1612, 1512, 1244, 1079 cm^{-1}; ^1H NMR (500 MHz, $CDCl_3$) δ_H 1.40 (s, 3H), 1.41 (s, 3H), 2.37 (m, 2H, *J*= 1.5 Hz), 3.54 (d, 2H, J= 4.3 Hz), 3.81 (s, 3H), 3.87 (m, 2H, *J*= 4.9 Hz), 4.50 (d, 1H, *J*= 11.9 Hz), 4.53 (d, 1H, *J*= 11.9 Hz), 5.07 (dd, 1H, *J*= 10.1, 1.2 Hz), 5.11 (dd, 1H, *J*= 17.1, 1.5 Hz), 5.81 (ddt, 1H, *J*= 17.2, 10.4, 6.9 Hz), 6.88 (dt, 2H, *J*= 8.7, 2.0 Hz), 7.25 (dt, 2H, *J*= 8.5, 2.0 Hz); ^{13}C (75 MHz, $CDCl_3$) δ_C 27.1, 27.4, 37.5, 55.4, 70.2, 73.3, 79.7, 109.0, 113.9, 117.7, 129.4, 130.2, 133.9; MS (TOF) m/z 315.1 ($[M+Na]^+$); HRMS (TOF) m/z calcd for $C_{17}H_{24}O_4Na$ $[M+Na]^+$ 315.1572, found 315.1561.



(2R,3R)-1-(4-methoxybenzyloxy)hex-5-ene-2,3-diol (11) :

The allylic derivative **iii** (2.228 g, 7.621 mmol), was dissolved in a mixture of ethanol (18 mL) and ethylene glycol (15 mL) and the solution was cooled at 0 °C under argon. Then, a 2M hydrochloric acid solution was added and the reaction medium was stirred during 6 h at 20 °C. The reaction was quenched by addition of an aqueous NaOH solution (2N, 18 mL) and was poured in a separating funnel containing a $NaHCO_3$ saturated solution (100 mL). After extraction by CH_2Cl_2, the organic phase was dried over anhydrous Na_2SO_4, filtered and the solvent was removed under vacuum. Flash column chromatography purification (heptanes/EtOAc, 1:2) afforded the diol **11** (1.773 g, 92%) as a white solid.

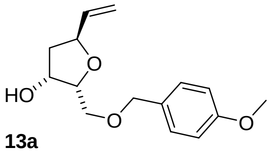
$[\alpha]_D^{23}$ +16.63 (*c* 1.05, $CHCl_3$); R*f* 0.32 (heptanes/EtOAc, 1:2); MP 58-59 °C; IR (film) 3422, 3307, 3077, 3002, 2937, 2913, 2863, 1611, 1512, 1252 cm^{-1}; ^1H NMR (500 MHz, $CDCl_3$) δ_H 2.31 (m, 2H), 2.56 (d, 1H, *J*= 4.3 Hz), 2.59 (d, 1H, *J*= 5.8 Hz), 3.55 (dd, 1H, *J*= 9.4, 5.8, Hz), 3.61 (dd, 1H, *J*= 9.5, 3.6 Hz), 3.66 (m, 1H), 3.71 (m, 1H), 3.81 (s, 3H), 4.46 (d, 1H, *J*= 11.5 Hz), 4.51 (d, 1H, *J*= 11.5 Hz), 5.10 (d, 1H, *J*= 8.9 Hz), 5.13 (dd, 1H, *J*= 17.1, 1.5 Hz), 5.84 (ddt, 1H, *J*= 17.1, 10.0, 7.1 Hz), 6.88 (dt, 2H, *J*= 8.5, 2.1 Hz), 7.24 (dt, 2H, *J*= 8.5, 2.1 Hz); ^{13}C (75 MHz, $CDCl_3$) δ_C 38.1, 55.3, 71.5, 71.7, 72.3, 73.3, 113.9, 117.7, 129.5, 129.8, 134.6, 159.4; MS (TOF) m/z 275.1 ($[M+Na]^+$); HRMS (TOF) m/z calcd for $C_{14}H_{20}O_4Na$ $[M+Na]^+$ 275.1259, found 275.1260.



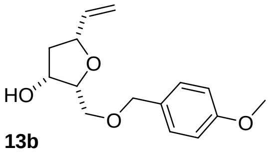
(E)-4-((4R,5R)-5-((4-methoxybenzyloxy)methyl)-2,2-dimethyl-1,3-dioxolan-4-yl)but-2-enyl acetate (10) and (5R,6R,E)-5,6-dihydroxy-7-(4-methoxybenzyloxy)hept-2-enyl acetate (12) :

To a solution of the allylic derivative **11** (1.416 g, 5.61 mmol) and allyl acetate (3.63 mL, 33.66 mmol) in CH_2Cl_2 (120 mL) under argon was added Grubbs II catalyst (238 mg, 0.280 mmol). The reaction medium was reflux under argon during 4 h then the solvent was removed under vacuum over 5 g of silica. Flash column chromatography purification (heptanes/EtOAc, 2:3) afforded the diol **12** (1.388 g, 76%) as a brownish oil and some starting material **11** was recovered (189 mg, 13%).

$[\alpha]_D^{23}$ +18.63 (*c* 1.31, $CHCl_3$); R*f* 0.11 (heptanes/EtOAc, 1:1); IR (film) 3440, 3311, 3002, 2938, 2910, 2861, 2836, 1730, 1608, 1512 cm^{-1}; ^1H NMR (500 MHz, $CDCl_3$) δ_H 2.06 (s, 3H), 2.31 (t, 2H, *J*= 6.8 Hz), 2.61 (bs, 2H), 3.55 (dd, 1H, *J*= 5.5, 9.5 Hz), 3.61 (dd, 1H, J= 3.7, 9.5 Hz), 3.63 (bs, 1H), 3.71 (ddd, 1H, *J*=2.8, 6.0, 6.8 Hz), 3.81 (s, 3H), 4.46 (d, 1H, *J*= 11.6 Hz), 4.50 (d, 1H, *J*= 11.6 Hz), 4.52 (d, 2H, *J*= 6.7 Hz), 5.67 (dtt, 1H, *J*= 1.4, 6.3, 15.4 Hz), 5.80 (dtt, 1H, *J*= 1.2, 7.0, 15.4 Hz), 6.88 (dt, 2H, *J*= 2.9, 8.7 Hz), 7.25 (dt, 2H, *J*= 2.8, 8.7 Hz); ^{13}C (75 MHz, $CDCl_3$) δ_C 21.2, 36.7, 55.4, 65.1, 71.7, 71.8, 72.5, 73.5, 114.1, 127.2, 129.6, 129.7, 131.7, 159.6, 171.0; MS (TOF) m/z 347.1 ($[M+Na]^+$); HRMS (TOF) m/z calcd for $C_{17}H_{24}O_6Na$ $[M+Na]^+$ 347.1471, found 347.1476. Anal. calcd for $C_{17}H_{24}O_6$: C 62.95; H 7.46, found C 62.94; H 7.42.



13a

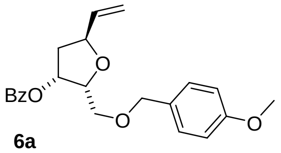


13b

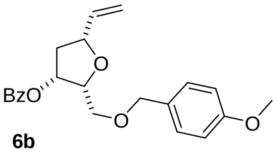
(2R,3R,5S)-2-((4-methoxybenzyloxy)methyl)-5-vinyltetrahydrofuran-3-ol (13a) and (2R,3R,5R)-2-((4-methoxybenzyloxy)methyl)-5-vinyltetrahydrofuran-3-ol (13b):

A solution of $Pd_2(dba)_3$ (105.4 mg, 0.115 mmol) and tris(*p*-methoxyphenyl)phosphine (162.2 mg, 0.460 mmol) in THF (40 mL) was refluxed under argon during 1 min. Once cooled to r.t., that solution was then transferred into a solution of allylacetate **12** (3.733 g, 11.509 mmol) in THF (100 mL) heated at 40 °C under argon. After 2 h of stirring, 10 g of silica (60 Å, 70-200 μm) were added and the solvent was removed under vacuum. The resulting powder was charged on the top of a chromatography column. The purification (Heptane/EtOAc : 2/1) afforded the inseparable mixture of diastereoisomers **13a** and **13b** (93:7 ratio by ^{1}H NMR) (3.010 g, 99 %) as a colorless oil.

$[\alpha]_D^{23}$ -14.24 (*c* 0.88, $CHCl_3$); R*f* 0.28 (heptanes/EtOAc, 2:1); IR (film) 3420, 2931, 1712, 1610, 1512, 1245, 1029 cm^{-1}; ^{1}H NMR (500 MHz, $CDCl_3$) δ_H 1.83 (ddd, 1H, *J*= 9.5, 13.4, 4.6 Hz), 2.15 (ddd, 1H, *J*= 13.2, 5.7, 1.3 Hz), 3.03 (d, 1H, *J*= 4.0 Hz), 3.77 (d, 2H, *J*= 5.2 Hz), 3.81 (s, 3H), 4.11 (q, 1H, *J*= 4.7 Hz), 4.50 (m, 2H), 4.52 (dd, 2H, *J*= 18.1, 11.6 Hz), 4.68 (dt, 1H, *J*= 9.5, 6.3 Hz), 5.11 (dt, 1H, *J*= 10.4, 1.2 Hz), 5.27 (dt, 1H, *J*= 17.1, 1.2 Hz), 5.83 (ddd, 1H, *J*= 16.9, 6.8, 10.6 Hz), 6.88 (dt, 2H, *J*= 8.6, 2.1 Hz), 7.26 (dt, 2H, *J*= 8.6, 2.4 Hz); ^{13}C (75 MHz, $CDCl_3$) δ_C 42.1, 55.4, 68.9, 73.7, 73.9, 79.3, 80.2, 114.1, 116.1, 129.7, 138.6, 159.6; MS (TOF) m/z 287.1 ([M+Na]$^+$); HRMS (TOF) m/z calcd for $C_{15}H_{20}O_4Na$ [M+Na]$^+$ 287.1259, found 287.1258.



6a



6b

The alcohols **13a**/**b** (1.067 g, 4.035 mmol) and DMAP (15 mg, 0.12 mmol) were dissolved in pyridine (15 mL) under an argon atmosphere. Then benzoyl chloride (940 µL, 8.07 mmol) was introduced and the reaction medium was stirred during 1 h 30 min. Then, the solvent was removed under vacuum. The purification (Heptane/EtOAc : 8/1) afforded **6a** (1.422 g, 96%) and **6b** (63.5 mg, 4%) as a colorless oils.

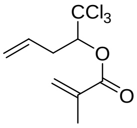
((2R,3R,5S)-2-((4-methoxybenzyloxy)methyl)-5-vinyltetrahydrofuran-3-yl benzoate (6a):

$[\alpha]_D^{23}$-70.99 (*c* 1.08, $CHCl_3$); R*f* 0.44 (heptanes/EtOAc, 2:1); IR (film) 3064, 2998, 2907, 2865, 2836, 1715, 1611, 1511, 1267, 1244 cm^{-1}; ^{1}H NMR (500 MHz, $CDCl_3$) δ_H 2.07 (ddd, 1H, *J*= 14.0, 9.5, 4.8 Hz), 2.32 (ddd, 1H, *J*= 13.7, 6.0, 1.0 Hz), 3.70 (d, 2H, *J*= 6.1 Hz), 3.74 (s, 3H), 4.36 (d, 1H, *J*= 11.7 Hz), 4.38 (td, 1H, *J*= 6.0, 3.9 Hz), 4.51 (d, 1H, *J*= 11.7 Hz), 4.71 (dt, 1H, *J*=9.5, 6.4 Hz), 5.15 (d, 1H, *J*= 10.4 Hz), 2.29 (d, 1H, *J*= 17.1 Hz), 5.69 (t, 1H, *J*= 3.9 Hz), 5.89 (ddd, 1H, *J*= 17.2, 10.2, 6.8 H), 6.76 (dt, 2H, *J*= 8.5, 1.8 Hz), 7.16 (d, 2H, *J*= 8.5 Hz), 7.44 (t, 2H, *J*= 7.9 Hz), 7.82 (tt, 1H, *J*= 7.3, 1.2 Hz), 7.99 (d, 2H, *J*= 8.2 Hz); ^{13}C (75 MHz, $CDCl_3$) δ_C 39.8, 55.3, 68.2, 73.3, 75.4, 79.2, 80.0, 113.8, 116.3, 128.6, 129.5, 129.7, 130.1, 133.3, 138.2, 159.2, 165.7; MS (TOF) m/z 391.1 ([M+Na]$^+$); HRMS (TOF) m/z calcd for $C_{22}H_{24}O_5Na$ [M+Na]$^+$ 391.1521, found 391.1524.

(2R,3R,5R)-2-((4-methoxybenzyloxy)methyl)-5-vinyltetrahydrofuran-3-yl benzoate (6b):

^{1}H NMR (500 MHz, $CDCl_3$) δ_H 1.92 (ddd, 1H, *J*= 14.3, 5.8, 2.3 Hz), 2.64 (ddd, 1H, *J*= 14.3, 8.1, 6.3 Hz), 3.75 (s, 3H), 3.75 (d, 2H, *J*= 5.8 Hz), 4.17 (td, 1H, *J*= 5.8, 4.0 Hz), 4.38 (d, 1H, *J*= 11.7 Hz), 4.47 (q, 1H, *J*= 7.2 Hz), 4.52 (d, 1H, *J*= 11.7 Hz), 5.13 (d, 1H, *J*= 10.1 Hz), 5.28 (d, 1H, *J*= 17.2 Hz), 5.60 (ddd, 1H, *J*= 4.1, 2.5, 6.3 Hz), 5.94 (ddd, 1H, *J*= 17.2, 10.1, 6.9 Hz), 6.77 (dt, 2H, *J*= 8.5, 2.1 Hz), 7.18

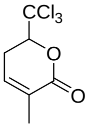
(d, 2H, *J*= 8.5 Hz), 7.44 (t, 2H, *J*= 7.7 Hz), 7.58 (t, 1H, *J*= 7.4 Hz), 7.98 (d, 2H, *J*= 7.3 Hz); ^{13}C (75 MHz, $CDCl_3$) δ_C 39.5, 55.3, 68.2, 73.3, 75.0, 79.3, 80.7, 113.8, 116.4, 128.6, 129.5, 129.7, 130.1, 133.3, 138.7, 159.2, 165.8.



1,1,1-trichloropent-4-en-2-yl methacrylate (iv) :

Alcohol **14** (14.23 g, 75.91 mmol) and DMAP (927 mg, 7.59 mmol) were dissolved in CH_2Cl_2 under argon and then cooled to -78 °C. Then, *i*Pr_2NEt (41 mL, 235.3 mmol) and methacryloyl chloride (9.18 mL, 94.9 mmol) were added. The temperature was then allowed to go back to r.t. over night and then the reaction was quenched by addition of a 2N aqueous HCl solution (80 mL). After extraction by CH_2Cl_2, the organic phase was dried over anhydrous Na_2SO_4, filtered and the solvent was removed under vacuum. Flash column chromatography purification (heptanes/CH_2Cl_2, 70:30) a distillation afforded the mathacrylic ester **iv** (17.46 g, 89 %) as a colorless oil.

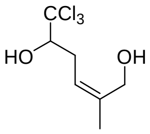
R*f* 0.40 (heptanes/CH_2Cl_2, 70:30); IR (film) 3083, 2960, 2929, 1731, 1638, 1287, 1131, 777 cm^{-1}; ^{1}H NMR (500 MHz, $CDCl_3$) δ_H 1.99 (s, 3H), 2.62 (dt, 1H, *J*= 16.0, 8.8 Hz), 2.98 (ddm, 1H, *J*= 14.4, 6.0, 1.5 Hz), 5.13 (d, 1H, *J*= 10.1 Hz), 5.19 (dd, 1H, *J*= 17.0, 1.4 Hz), 5.61 (dd, 1H, J= 10.2, 2.2 Hz), 5.67 (t, 1H, J= 1.1 Hz), 5.75 (dddd, 1H, J= 16.7, 10.6, 8.2, 6.2 Hz), 6.23 (s, 1H);^{13}C (75 MHz, $CDCl_3$) δ_C 18.4, 35.5, 80.4, 99.8, 119.5, 127.4, 131.9, 135.4, 165.9; Anal. calcd for $C_9H_{11}O_2Cl_3$: C 41.97; H 4.31, found C 41.83; H, 4.25.



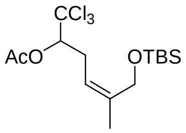
(3-methyl-6-(trichloromethyl)-5,6-dihydro-2H-pyran-2-one (15) :

The ester **iv** (6.632 g, 25.75 mmol) was dissolved in freshly distilled CH_2Cl_2 (2.5 L, over CaH_2, under argon) and heated to reflux under argon. Then, the Grubbs' catalyst (424 mg, 0.515 mmol, 2 mol%) was added. After 17 h of reflux, silica (20 g, 60 Å, 70-200 μm) was added and the solvent was removed under vacuum. The resulting powder was charged on the top of a flash chromatography column and then purified (Heptane/EtOAc : 6/1) affording lactone **15** (4.963 g, 84%) as a brown solid that was purified again by distillation (200 °C, 3.10^{-2} Torr) affording then a white crystalline solid (4.797 g, 81%)

Melting point: 64 °C; R*f* 0.47 (heptanes/EtOAc, 1:1); IR (film) 2962, 1731, 1351, 1231, 1093, 788 cm^{-1}; ^{1}H NMR (500 MHz, $CDCl_3$) δ_H 1.98 (m, 3H, *J*= 1.3 Hz), 2.77 (ddm, 1H, *J*= 17.6, 12.4, 2.6 Hz), 2.88 (dtq, 1H, *J*= 18.1, 5.2, 1.0 Hz), 4.84 (dd, 1H, *J*= 11.9, 4.2 Hz), 6.64 (dm, 1H, *J*= 6.5, 1.8 Hz);^{13}C (75 MHz, $CDCl_3$) δ_C 17.0, 26.1, 85.0, 97.8, 128.6, 137.2, 163.2; MS (TOF) m/z 250.9 ([M^{35}Cl$_3$+Na]$^+$); HRMS (TOF) m/z calcd for $C_7H_7O_2{}^{35}Cl_3Na$ [M+Na]$^+$ 250.9409, found 250.9407; Anal. calcd for $C_7H_7O_2Cl_3$: C 36.64; H 3.07, found C 37.05; H, 3.06.



v



vi

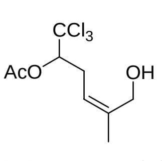
Lactone **15** (8.891g, 38.74 mmol) and $CeCl_3.7H_2O$ (43.31 g, 116.2 mmol) were dissolved in MeOH (154 mL) and cooled down to 0 °C. Then, $NaBH_4$ (4.40 g, 116.2 mmol) was added portion wise over 30 min. Then, the reaction medium was poured in a Becker containing 1 L of brine and a 2N aqueous HCl solution was added until the precipitate disappeared. After extraction by CH_2Cl_2, drying over anhydrous Na_2SO_4, and filtration, the solvent was removed under vacuum yielding crude **v** as a colorless oil. The crude was taken in DMF (100 mL) then, imidazole (10.55 g, 155.0 mmol) and TBSCl (6.424 g, 42.62 mmol) were introduced. After 1 h of stirring at 20 °C under argon, the reaction medium was poured in a separatory funnel containing water (500 mL) and a 2N aqueous HCl solution (50 mL). After extraction by ether, drying over anhydrous Na_2SO_4, and filtration, the solvent was removed under vacuum yielding a colorless oil. The latter was taken in pyridine (150 mL) then, Ac_2O (7.32 mL, 77.49 mmol) and DMAP (470 mg, 3.87 mmol) were added. After 30 min of strirring at 20 °C the solvent was removed under vaccum. The crude was purified by flash chromatography (Heptane/EtOAc : 4/1) affording acetate **vi** (14.152 g, 94 % over 3 steps) as a colorless oil.

(Z)-6,6,6-trichloro-2-methylhex-2-ene-1,5-diol (v) :

R*f* 0.37 (heptanes/EtOAc, 1:1); IR (film) 3300, 2915, 1434, 1091, 998, 794 cm^{-1}; ^1H NMR (500 MHz, $CDCl_3$) δ_H 1.87 (s, 3H), 2.59 (dt, 1H, *J*= 14.3, 9.8 Hz), 2.76 (dd, 1H, *J*= 14.1, 6.4 Hz), 3.97 (d, 1H, *J*= 11.8 Hz), 4.01 (dd, 1H, *J*= 9.9, 2.4 Hz), 4.34 (d, 1H, *J*= 11.8 H), 5.47 (tddd, 1H, *J*= 7.9, 2.6, 1.7, 1.2 Hz);^{13}C (75 MHz, $CDCl_3$) δ_C 22.8, 30.6, 61.7, 81.8, 103.8, 123.1, 139.3; MS (TOF) m/z 255.0 ($[M^{35}Cl_3+Na]^+$), 257.0 ($[M^{35}Cl_2{}^{37}Cl+Na]^+$), 259.0 ($[M^{35}Cl^{37}Cl_2+Na]^+$); HRMS (TOF) m/z calcd for $C_7H_{11}{}^{35}Cl_3O_2Na$ $[M+Na]^+$ 254.9722, found 254.9724 and calcd for $C_7H_{11}{}^{35}Cl_2{}^{37}ClO_2Na$ $[M+Na]^+$ 256.9693, found 256.9690.

(Z)-6-(tert-butyldimethylsilyloxy)-1,1,1-trichloro-5-methylhex-4-en-2-yl acetate (vi):

R*f* 0.75 (heptanes/EtOAc, 2:1); IR (film) 2952, 2929, 2856, 1762, 1370, 1208 cm^{-1}; ^1H NMR (500 MHz, $CDCl_3$) δ_H 0.08 (s, 6H), 0.91 (s, 9H), 1.75 (d, 3H, J= 1.0 Hz), 2.14 (s, 3H), 2.65 (dt, 1H, J= 14.8, 9.1 Hz), 2.85 (dd, 1H, J= 14.4, 6.2 Hz), 4.16 (s, 2H), 5.15 (m, 1H, J= 7.4, 1.4 Hz), 5.49 (dd, J= 10.1, 2.6 Hz); ^{13}C (75 MHz, $CDCl_3$) δ_C -5.2, 0.2, 18.5, 20.8, 21.4, 26.1, 29.2, 61.9, 80.6, 99.8, 118.7, 139.9; MS (TOF) m/z 411.0 ($[M^{35}Cl_3+Na]^+$), 412 ($[M^{35}Cl_2{}^{37}Cl+Na]^+$); HRMS (TOF) m/z calcd for $C_{15}H_{27}O_3{}^{35}Cl_3Na$ $[M+Na]^+$ 411.0693, found 411.0684.

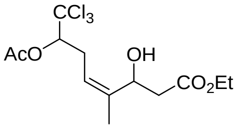


(Z)-1,1,1-trichloro-6-hydroxy-5-methylhex-4-en-2-yl acetate (16):

The silylether **vi** (6.22 g, 15.96 mmol), and PPTS (200 mg, 0.80 mmol) were dissolved in MeOH (130 mL) and then refluxed under argon during 3 h 30 min. The solvent was removed under vacuum and the residue was purified by flash chromatography (heptanes/EtOAc, 4:1) afforded the alcohol **16** (4.22 g, 96 %) as a colorless oil.

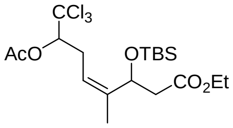
R*f* 0.32 (heptanes/EtOAc, 2:1); IR (film) 3379, 2948, 1758, 1371, 1207, 791 cm^{-1}; ^1H NMR (500 MHz, $CDCl_3$) δ_H 1.82 (s, 3H), 2.16 (s, 3H), 2.65 (ddd, 1H, *J*= 14.7, 9.0, 9.5 Hz), 2.89 (dd, 1H, *J*= 14.6, 6.8 Hz), 4.13 (d, 1H, *J*= 12.0 Hz), 4.19 (d, 1H, *J*= 12.0 Hz), 5.26 (t, 1H, *J*= 7.6 Hz), 5.50 (dd, 1H, *J*= 10.0, 2.9 Hz);^{13}C (75 MHz, $CDCl_3$) δ_C 20.8, 21.5, 29.1, 61.5, 80.6, 99.6, 120.6, 139.6, 169.7; MS

(TOF) m/z 297.0 ([$M^{35}Cl_3$+Na]$^+$), 299.0 ([$M^{35}Cl_2{}^{37}Cl$+Na]$^+$), 301.0 ([$M^{35}Cl^{37}Cl_2$+Na]$^+$); HRMS (TOF) m/z calcd for $C_9H_{13}O_3{}^{35}Cl_3Na$ [M+Na]$^+$ 296.9828, found 296.9817, calcd for $C_9H_{13}O_3{}^{35}Cl_2{}^{37}ClNa$ [M+Na]$^+$ 298.9798, found 298.9812 calcd for $C_9H_{13}O_3{}^{35}Cl^{37}Cl_2Na$ [M+Na]$^+$ 300.9769, found 300.9812.



(Z)-ethyl 7-acetoxy-8,8,8-trichloro-3-hydroxy-4-methyloct-4-enoate (vii a,b):
Flask A: Oxalyl chloride (1.74 mL, 19.92 mmol) was added drop wise to a solution of DMSO (2.83 mL, 39.83 mmol) in CH_2Cl_2 (90 mL) at -78 °C under argon. After 30 min of stirring, a solution of alcohol **16** (4.222 g, 15.32 mmol) in CH_2Cl_2 (15 mL) was added followed 30 min later by NEt_3 (10.65 mL, 76.61 mmol). The flask was removed from de dry ice/acetone bath and once temperature around 0 °C, the reaction medium was poured into a separatory funnel containing an aqueous NH_4Cl saturated solution (200 mL) and 2 M hydrochloric acid solution (25 ml). After extraction by CH_2Cl_2, the organic phase was dried over anhydrous Na_2SO_4, filtered and the solvent was removed under vacuum.
Flask B: *i*Pr_2NH (2.598 mL, 18.38 mmol) was added to an *n*BuLi solution in hexane (c= 1.6M, 11.01 mL, 17.62 mml) at -78 °C under argon. The flask was removed from de dry ice/acetone bath and stirred at rt during 20 min. The thick LDA hexane solution was taken in THF (90 mL) and cooled at -78 °C. The crude aldehyde coming from flask A was taken in THF (15 mL) and introduced in flask A. After 15 min of stirring at -78 °C, the reaction medium was poured into a Becker containing an aqueous NH_4Cl saturated solution (200 mL) and 2 M hydrochloric acid solution (40 ml). After extraction by CH_2Cl_2, the organic phase was dried over anhydrous Na_2SO_4, filtered and the solvent was removed under vacuum. Flash column chromatography purification (heptanes/EtOAc, 5:1) afforded the aldol **vii a,b** (5.165 g, 93 %) as a mixture of diastereoisomers and as a colorless oil.

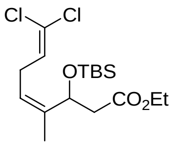
R*f* 0.38 (heptanes/EtOAc, 1:1); IR (film) 3508, 2980, 1759, 1732, 1370, 1209, 1025, 781 cm^{-1}; ^{1}H NMR (500 MHz, $CDCl_3$) δ_H 1.28 and 1.29 (two t, 3H, *J*= 7.2 Hz), 1.74 (s, 3H), 2.16 and 2.17 (two s, 3H), 2.39 and 2.42 (two t, 1H, *J*= 3.5 Hz), 2.59 to 2.74 (m, 2 H), 2.84 (m, 1.5H), 2.97 and 3.00 (two ddd, 0.5H, *J*= 6.7, 2.6, 1.4 Hz), 4.19 (q, 2H, *J*= 7.2 Hz), 7.96 and 4.98 (two t, 1H, *J*= 3.1 Hz), 5.22 (m, 1H), 5.49 and 5.55 (two dd, 1H, J= 10.0, 2.7 Hz);^{13}C (75 MHz, $CDCl_3$) δ_C 14.3, 18.1, 20.8, 28.9, 29.0, 39.7, 39.8, 61.8, 61.4, 66.2, 66.3, 80.4, 80.6, 99.6, 120.6, 120.7, 140.0, 140.1; MS (TOF) m/z 383.0 ([$M^{35}Cl_3$+Na]$^+$), 385.0 ([$M^{35}Cl_2{}^{37}Cl$+Na]$^+$); HRMS (TOF) m/z calcd for $C_{13}H_{19}O_5{}^{35}Cl_3Na$ [M+Na]$^+$ 383.0196, found 383.0211 and calcd for $C_{13}H_{19}O_5{}^{35}Cl_2{}^{37}ClNa$ [M+Na]$^+$ 385.0166, found 385.0183.



(Z)-ethyl 7-acetoxy-3-(tert-butyldimethylsilyloxy)-8,8,8-trichloro-4-methyloct-4-enoate (17a,b):
TBSCl (2.800g, 18.57 mmol) and imidazole (3.210 g, 47.13 mmol) were added to a solution of alcohol **vii** (5.165 g, 14.28 mmol) in DMF (40 mL). The reaction medium was stirred under argon at 20 °C during 20 h and was then poured into a separatory funnel containing water (200 mL) and 2 M hydrochloric acid solution (14.3 ml). After extraction by ether, the organic phase was dried over

anhydrous Na_2SO_4, filtered and the solvent was removed under vacuum. Flash column chromatography purification (heptanes/EtOAc, 10:1) afforded the silyl ether **17a,b** (6.80 g, 100 %) as a mixture of diastereoisomers and as a colorless oil.

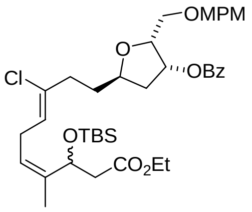
R*f* 0.60 (heptanes/EtOAc, 2:1); IR (film) 2954, 2929, 2856, 1761, 1735, 1209, 1066 cm^{-1}; ^{1}H NMR (500 MHz, $CDCl_3$) δ_H 0.02 and 0.03 (two s, 3H), 0.96 (s, 9H), 1.26 (two t, 3H, *J*= 7.2 Hz), 1.70 (s, 3H), 2.15 and 2.16 (two s, 3H), 2.30 and 2.36 (two dd, 1H, *J*= 14.5, 4.5 Hz), 2.63 (m, 1H), 2.73 and 2.76 (two t, 1H, *J*=9.1 Hz), 2.87 and 2.90 (two m, 0.5H), 2.98 and 3.02 (two ddd, 0.5H, *J*= 7.4, 2.2, 1.2 Hz), 4.12 (q, 2H, *J*= 7.2 Hz), 5.00 (dd, 1H, *J*= 8.9, 4.6 Hz), 5.09 (m, 1H), 5.50 and 5.54 (two dd, 1H, *J*= 9.9, 2.4 Hz); ^{13}C (75 MHz, $CDCl_3$) δ_C -5.1, -4.8, 14.3, 18.0, 18.1, 20.8, 25.8, 29.0, 42.0, 42.1, 60.6, 67.6, 80.5, 80.7, 99.7, 119.0, 119.1, 141.1, 141.4, 169.6, 169.7, 171.1; MS (TOF) m/z 497.1 ([$M^{35}Cl_3$+Na]$^+$), 499.1 ([$M^{35}Cl_2{}^{37}Cl$+Na]$^+$); HRMS (TOF) m/z calcd for $C_{19}H_{33}O_5{}^{35}Cl_3SiNa$ [M+Na]$^+$ 497.1061, found 497.1089 and calcd for $C_{19}H_{33}O_5{}^{35}Cl_2{}^{37}Cl$ SiNa [M+Na]$^+$ 499.1031, found 499.1059.



((Z)-ethyl 3-(tert-butyldimethylsilyloxy)-8,8-dichloro-4-methylocta-4,7-dienoate (7):

Diiodomethane (2.847 mL, 35.34 mmol) was added to a suspension of samarium (powder, 5.314 g, 35.34 mmol) in THF (150 mL) at 0 °C under argon. After 2 h 30 min of stirring at 20 °C, the deep blue SmI_2 solution was cooled at 0 °C and a solution of **17** (5.113 g, 10.74 mmol) in THF (25 mL) was added. Then, the ice bath was removed and after 1 h 20 min of stirring, the reaction was quenched by pouring into a separatory funnel containing a 0.5 M hydrochloric acid solution (300 ml). After extraction by CH_2Cl_2, the organic phase was dried over anhydrous Na_2SO_4, filtered and the solvent was removed under vacuum. Flash column chromatography purification (heptanes/EtOAc, 50:1) afforded the 1,1-dichloroakene **7** (3.970 g, 97 %) as a pale yellow oil.

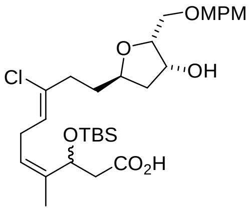
R*f* 0.7 (heptanes/EtOAc, 8:1); IR (film) 2953, 2928, 2856, 1736, 1250, 1077, 830, 775 cm^{-1}; ^{1}H NMR (500 MHz, $CDCl_3$) δ_H 0.01 (s, 3H), 0.05 (s, 3H), 0.86 (s, 9H), 1.26 (t, 3H, *J*= 7.2 Hz), 1.70 (s, 3H), 2.32 (dd, 1H, *J*= 14.5, 4.5 Hz), 2.63 (dd, 1H, *J*= 14.4, 8.7 Hz), 2.91 (ddd, 1H, *J*= 15.5, 6.9, 7.0 Hz), 3.01 (ddd, 1H, *J*= 15.3, 7.8, 7.5 Hz), 4.12 (ddd, 2H, *J*= 1.7, 6.9, 0.8 Hz), 5.00 (dd, 1H, *J*= 8.4, 4.5 Hz), 5.11 (t, 1H, *J*= 6.9 Hz), 5.79 (t, 1H, *J*= 7.3 Hz); ^{13}C (75 MHz, $CDCl_3$) δ_C -5.1, -4.8, 14.4, 17.8, 18, 2, 25.8, 28.2, 42.1, 60.6, 67.5, 121.0, 128.0, 139.4, 171.2; MS (TOF) m/z 403.1 ([$M^{35}Cl_2$+Na]$^+$), 405.1 ([$M^{37}Cl_2$+Na]$^+$); HRMS (TOF) m/z calcd for $C_{17}H_{30}O_3{}^{35}Cl_2Na$ [M+Na]$^+$ 403.1239, found 403.1287.



(2R,3R,5R)-5-((3Z,6Z)-8-(tert-butyldimethylsilyloxy)-3-chloro-10-ethoxy-7-methyl-10-oxodeca-3,6-dienyl)-2-((4-methoxybenzyloxy)methyl)tetrahydrofuran-3-yl benzoate (18a,b):

The alkene **6a** (1.811 g, 4.916 mmol) was dissolved in THF (14 mL) and 9-H-9-BBN (660 mg, 5.41 mmol) was added. After 5 h of stirring at 20 °C under argon, K_3PO_4 (3.13 g, 14.75 mmol), DpePhos (344 mg, 0.639 mmol), $Pd_2(dba)_3$ (270 mg, 0.295 mmol) and the 1,1-dichloro-1-alkene **7** (2.250 g, 5.899 mmol) dissolved in THF (7 mL) were added. The reaction medium was refluxed under argon during 72 h and then the solvent was removed under vaccum. Flash column chromatography purification (heptanes/EtOAc, 8:1) afforded compound **18a,b** (3.048 g, 87 %) as a yellow oil and as un inseparable mixture.

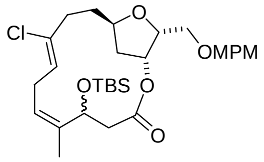
R*f* 0.13 (heptanes/EtOAc, 6:1); IR (film) 2950, 2927, 2855, 1720, 1512, 1270, 1246, 1081, 1069, 830, 710 cm^{-1}; ^{1}H NMR (500 MHz, $CDCl_3$) δ_H 0.01 (s, 3H), 0.05 (s, 3H), 0.85 and 0.86 (two s, 9H), 1.26 (t, 3H, *J*= 7.1 Hz), 1.67 (s, 3H), 1.83 (m, 2H), 1.95 (ddd, 1H, *J*= 14.1, 9.1, 4.7 Hz), 2.26 (dd, 1H, *J*= 13.8, 5.7 Hz), 2.31 (dd, 1H, *J*= 14.2, 4.4 Hz), 2.38 (m, 1H), 2.50 (m, 1H), 2.62 (dd, 1H, *J*= 14.3, 9.1 Hz), 2.89 (m, 1H, *J*= 7.5 Hz), 3.01 (m, 1H, *J*= 7.5 Hz), 6.68 (d, 2H, *J*= 5.9 hz), 3.75 (s, 3H), 4.12 (two q, 2h, *J*= 7.0 Hz), 4.62 (m, 1H), 4.32 (m, 1H), 4.37 (d, 1H, *J*= 11.5 Hz), 4.52 (d, 1H, *J*= 11.5 Hz), 5.05 (dd, 1H, *J*= 8.9,4.6 Hz), 5.11 (t, 1H, *J*= 7.6 Hz), 5.45 (t, 1H, *J*= 6.9 Hz), 5.66 (t, 1H, *J*= 3.8 Hz), 6.77 (d, 2H, *J*= 8.6 Hz), 7.18 (d, 2H, *J*= 8.6 Hz), 7.44 (t, 2H, *J*= 7.9 Hz), 7.58 (t, 1H, *J*= 7.4 Hz), 7.98 (d, 2H, *J*= 7.3 Hz); ^{13}C (75 MHz, $CDCl_3$) δ_C -5.2, -4.8, 14.3, 17.6, 18.1, 25.7, 27.2, 33.9, 36.2, 39.4, 42.1, 55.3, 60.5, 67.5, 68.2, 73.3, 75.5, 77.3, 79.6, 113.8, 122.8, 123.9, 128.6, 129.5, 129.7, 130.1, 133.3, 134.5, 138.0, 159.2, 165.7, 171.3; MS (TOF) m/z 737.3 ([M^{35}Cl+Na]$^+$), 738.3 ([M^{37}Cl+Na]$^+$); HRMS (TOF) m/z calcd for $C_{39}H_{55}O_8{}^{35}ClSiNa$ [M+Na]$^+$ 737.3252, found 737.3149.



(4Z,7Z)-3-(tert-butyldimethylsilyloxy)-8-chloro-10-((2R,4R,5R)-4-hydroxy-5-((4-methoxybenzyloxy)methyl)tetrahydrofuran-2-yl)-4-methyldeca-4,7-dienoic acid (19a,b):

The ester **18** (2.813 g, 3.932 mmol) was dissolved in MeOH/H_2O/THF (1:1:1) and cooled at 0 °C. Then KOH (6.632 g, 118 mmol) was added and the flask was removed from the ice bath. After 6 h 30 min of stirring, the flask was recooled at 0 °C and the reaction medium was neutralized by addition of a 2 M hydrochloric acid solution until a white precipitate appeared. After extraction by CH_2Cl_2, the organic phase was dried over anhydrous Na_2SO_4, filtered and the solvent was removed under vacuum. Flash column chromatography purification (heptanes/EtOAc/AcOH, 50:50:0.2) afforded the seco-acid **19a,b** (1.916 g, 84 %) as a yellow oil and as un inseparable mixture.

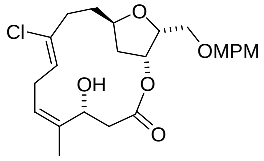
R*f* 0.35 (heptanes/EtOAc/AcOH, 50:50:1); IR (film) 3420, 2951, 2927, 2855, 1712, 1513, 1247, 1071, 831 cm^{-1}; ^{1}H NMR (500 MHz, $CDCl_3$) δ_H 0.03 and 0.04 (two s, 3H), 0.08 and 0.09 (two s, 3H), 0.87 and 0.88 (two s, 9H), 1.69–1.16 (m, 2H), 1.71 (s, 3H), 2.13 and 2.16 (two t, 1H, *J*= 4.9 and 5.7 Hz), 2.34–2.50 (m, 3H), 2.59 and 2.64 (two dd, 1H, *J*= 14.1, 7.1 and 13.5, 7.3 Hz), 2.86–2.99 (m, 2H), 3.67–3.77 (m, 2H), 3.81 (s, 3H), 4.03 (m, 1H), 4.24 (m, 1H), 4.36 and 4.44 (two t, 1H, *J*= 3.8 Hz), 4.49 (m, 2H), 5.01 (m, 1H), 5.23 and 5.35 (two t, 1H, J= 7.4 Hz), 5.30 (s, 1H), 5.40 and 5.53 (two t, 1H, J= 5.9 and 7.0 Hz), 6.88 (d, 2H, J= 8.5 Hz), 7.25 (m, 2H); ^{13}C (75 MHz, $CDCl_3$) δ_C -5.1, -5.0, -4.8, 17.4, 17.5, 18.2, 25.8, 27.0, 27.2, 33.4, 33.5, 36.1, 41.5, 41.8, 41.9, 55.4, 67.2, 67.3, 68.6, 68.7, 73.6, 73.8, 76.4, 77.0, 79.9, 80.3, 114.0, 123.2, 123.3, 124.2, 124.4, 129.7, 134.0, 134.3, 137.5, 159.5, 175.2, 175.7; MS (TOF) m/z 605.2 ([M+Na]$^+$); HRMS (TOF) m/z calcd for $C_{30}H_{47}O_7ClSiNa$ [M+Na]$^+$ 605.2677, found 605.2650.

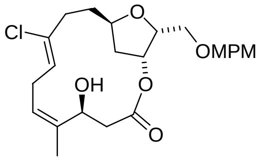


(1R,6Z,9Z,13R,15R)-5-(tert-butyldimethylsilyloxy)-10-chloro-15-((4-methoxybenzyloxy)methyl)-6-methyl-2,14-dioxabicyclo[11.2.1]hexadeca-6,9-dien-3-one (viii a,b) :

To a solution of seco-acid **19** (162.1 mg, 0.278 mmol) in THF (10 mL) was successively added NEt_3 (466 μL, 3.33 mmol) and 2,4,6-trichlorobenzoyle chloride (677 μL, 2.78 mmol). After 2 h 30 min of stirring, the reaction medium was diluted in dry toluene (50 mL) and was slowly injected into a DMAP (850 mg, 6.95 mmol) toluene solution (800 mL, azeotropically dried) over a 15 h period of time. After 6 h of stirring, the reaction was quenched by addition of a NH_4Cl saturated solution (200 mL). After extraction, the organic phase was dried over anhydrous Na_2SO_4, filtered and the solvent was removed under vacuum. Flash column chromatography purification (heptanes/EtOAc, 3:1) afforded the lactones **viii a,b** (86.4 mg, 55 %) as a colorless oil and as un inseparable mixture.

R*f* 0.28 (heptanes/EtOAc, 2:1); IR (film) 2952, 2927, 2855, 1727, 1512, 1247, 1065, 833 cm^{-1}; ^{1}H NMR (500 MHz, $CDCl_3$) δ_H 0.01 and 0.07 (two s, 1H), 0.09 and 0.11 (two s, 1H), 0.86 and 0.87 (s, 1H), 1.37–1.46 (m, 2H), 1.82 and 1.83 (two s, 3H), 2.04–2.83 (m, 6.7H), 3.24 (m, 0.3 H), 3.51–3.65 (m, 2H), 3.75 and 3.86 (two tt, 1H, *J*=11.5, 3.4 Hz), 3.796 and 3.801 (two s, 3H), 4.28 (m, 1H), 4.40 (d, 1H, *J*= 11.9 Hz), 4.58 (d, 1H, *J*= 11.9 Hz), 4.61 and 4.71 (two dd, 1H, J= 10.9, 4.2 and 10.5, 3.4 Hz), 5.03 and 5.18 (two t, 1H, *J*= 4.1 and 3.0 Hz), 5.21 and 5.40 (two t, 1 H, *J*= 7.7 Hz), 5.48 and 5.65 (two t, 1H, *J*= 10, 7.3 and 9.6 and 7.9 Hz), 6.86 and 6.87 (two d, 2h, *J*= 8.5 Hz), 7.24 (m, 2H); ^{13}C (75 MHz, $CDCl_3$) δ_C -4.63, -4.59, -4.5, 17.5, 17.7, 18.1, 25.7, 26.9, 28.0, 28.9, 34.9, 36.1, 37.77, 37.83, 41.8, 42.6, 55.4, 66.3, 67.1, 68.1, 73.1, 75.5, 75.6, 76.2, 77.0, 79.1, 79.4, 113.9, 122.7, 123.9, 125.1, 126.0, 129.5, 129.6, 130.2, 130.3, 131.3, 132.0, 133.9, 136.3, 138.2, 159.36, 159.40, 169.0, 170.6; MS (TOF) m/z 587.3 ([M+Na]$^+$); HRMS (TOF) m/z calcd for $C_{30}H_{45}O_6ClSiNa$ [M+Na]$^+$ 587.2572, found 587.2568.





(1R,5R,6Z,9Z,13R,15R)-10-chloro-5-hydroxy-15-((4-methoxybenzyloxy)methyl)-6-methyl-2,14-dioxabicyclo[11.2.1]hexadeca-6,9-dien-3-one (20a); (1R,5S,6Z,9Z,13R,15R)-10-chloro-5-hydroxy-15-((4-methoxybenzyloxy)methyl)-6-methyl-2,14-dioxabicyclo[11.2.1]hexadeca-6,9-dien-3-one (20b)

<u>By deprotecting the alcohol function of **viii a,b**:</u>

To a solution of lactone **viii a,b** (199 mg, 0.352 mmol) in THF (3.5 mL) was added acetic acid (20 μL, 0.352 mmol) and a THF solution of TBAF (775 μL, 0.774 mmol) at 20 °C under argon. After 4 h of stirring, 2g of silica was added and the solvent was removed under reduced pressure. Flash column chromatography purification (heptanes/EtOAc, 3:2) afforded the two alcohols **20a** (53.5 mg, 34 %) and **20b** (85.1 mg, 54 %) as a colorless oils.

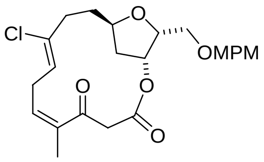
<u>By reduction of ketone **21**:</u>

Ketone **21** (85.0 mg, 0.188 mmol) was dissolved in EtOH (2.5 mL) along with $CeCl_3.7H_2O$ (71 mg, 0.188 mmol) and the solution was cooled down to -30 °C before the addition of $NaBH_4$ (18 mg, 0.453

mmol) in two portions. After 30 min of stirring, the reaction mixture was stirred at 0 °C and 15 min later the reaction was quenched by addition of a saturated aqueous solution of NH_4Cl (10 mL). After extraction by AcOEt drying over anhydrous Na_2SO_4, the solvent was removed under vacuum. Flash column chromatography purification (heptanes/EtOAc, 2:1) afforded the alcohol **20a** (84.6 mg, 99 %) as a colorless oil.

Alcohol **20a :**
$[\alpha]_D^{23}$ – 37.6 (*c* 1.0, $CHCl_3$); R*f* 0.26 (heptanes/EtOAc, 1:1); IR (film) 3422, 2926, 2863, 1736, 1731, 1611, 1512, 1241, 1076, 1013 cm^{-1}; ^1H NMR (500 MHz, $CDCl_3$) δ_H 1.41 (m, 1H), 1.46 (dd, 1H, *J*= 3.4, 11.9 Hz), 1.60 (bs, 1H), 1.88 (s, 3H), 2.03 (dd, 1H, *J*= 13.1, 3.1 Hz), 2.16 (dt, 1H, J= 13.0, 5.4 Hz), 2.41 (tt, 1H, *J*= 12.8, 4.8 Hz), 2.17 to 2.66 (m, 4H), 3.23 (ddd, 1H, *J*= 16.8, 10.1, 8.5 Hz), 3.57 (dd, 1H, J= 9.5, 6.1 Hz), 3.62 (dd, 1H, *J*= 9.7, 6.8 Hz), 3.80 (s, 3H), 3.87 (tt, 1H, *J*= 11.6, 3.5 Hz), 4.27 (ddd, 1H, *J*= 6.6, 5.9, 3.9 Hz), 4.40 (d, 1H, *J*= 11.9 Hz), 4.58 (d, 1H, *J*= 11.8 Hz), 4.66 (dd, 1H, *J*= 10.2, 4.8 Hz), 5.18 (d, 1H, *J*= 7.5 Hz), 5.24 (t, 1H, *J*= 3.4 Hz), 5.62 (dd, 1H, *J*= 9.8, 7.9 Hz), 6.87 (d, 2H, *J*= 8.5 Hz), 7.24 (d, 2H, *J*= 8.5 Hz) ; ^{13}C (75 MHz, $CDCl_3$) δ_C 17.5, 26.3, 27.9, 29.6, 34.8, 37.7, 39.9, 55.3, 65.9, 68.0, 73.0, 75.3, 76.1, 79.0, 113.8, 125.6, 127.5, 129.4, 130.1, 131.9, 137.5, 159.2, 168.9; MS (TOF) m/z 473.2 ($[M+Na]^+$); HRMS (TOF) m/z calcd for $C_{24}H_{31}ClO_6Na$ $[M+Na]^+$ 473.1707, found 473.1719.

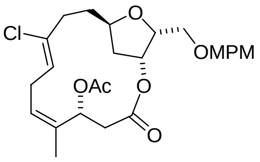
Alcohol **20b :**
$[\alpha]_D^{23}$ + 74.7 (*c* 0.9, $CHCl_3$); R*f* 0.17 (heptanes/EtOAc, 1:1); IR (film) 3418, 2923, 2864, 1724, 1511, 1244, 1073 cm^{-1}; ^1H NMR (500 MHz, $CDCl_3$) δ_H 1.44 (dt, 1H, *J*= 10.7, 3.5 Hz), 1.50 (dd, 1H, *J*= 12.7, 3.5 Hz), 1.71 (s, 3H), 2.18-2.31 (m, 3H), 2.41 (dt, 1H, *J*= 12.9, 3.9 Hz), 2.54 (dd, 1H, *J*= 12.1, 4.0 Hz), 2.67 (dd, 1H, *J*= 12.3, 9.3 Hz), 2.78 (dt, 1H, *J*= 13.6, 9.3 Hz), 2.78 (dt, 1H, *J*= 13.6, 9.3 Hz), 2.89 (dt, 1H, *J*= 14.6, 7.1 Hz), 3.51 (dd, 1H, *J*= 9.7, 5.5 Hz), 3.55 (dd, 1H, *J*= 9.7, 7.3 Hz), 3.80 (s, 3H), 4.31 (dt, 1H, *J*= 6.9, 5.0 Hz), 4.41 (d, 1H, *J*= 11.9 Hz), 4.58 (d, 1H, *J*= 11.9 Hz), 4.71 (dd, 1H, *J*= 9.2, 4.6 Hz), 5.19 (t, 1H, *J*= 3.6 Hz), 5.45 (t, 1H, *J*= 7.3 Hz), 5.73 (t, 1H, *J*= 8.4 Hz), 6.87 (d, 2H, *J*= 8.6. Hz), 7.25 (d, 2H, *J*= 8.4 Hz); ^{13}C (75 MHz, $CDCl_3$) δ_C 17.8, 26.0, 28.9, 36.1, 38.5, 40.9, 55.4, 66.9, 68.2, 73.1, 75.8, 76.8, 79.2, 113.9, 124.2, 125.5, 129.6, 130.2, 133.8, 135.9, 159.4, 170.8; MS (TOF) m/z 473.2 ($[M+Na]^+$); HRMS (TOF) m/z calcd for $C_{24}H_{31}ClO_6Na$ $[M+Na]^+$ 473.1707, found 473.1719.



(1R,6Z,9Z,13R,15R)-10-chloro-15-((4-methoxybenzyloxy)methyl)-6-methyl-2,14-dioxabicyclo[11.2.1]hexadeca-6,9-diene-3,5-dione (21) :

To a solution of alcohol **20b** (85.1 mg, 0.189 mmol) in CH_2Cl_2 (2 mL) at 0 °C was added 4-DMP (144 mg, 0.340 mmol). After 2 h of stirring at 20 °C, aqueous saturated solutions of $NaHCO_3$ (10 mL) and $Na_2S_2O_3$ (0.5 mL) were added and the mixture that stirred during 30 min. After extraction by CH_2Cl_2, the organic phase was dried over anhydrous Na_2SO_4, filtered and the solvent was removed under vacuum. Flash column chromatography purification (heptanes/EtOAc, 5:1) afforded ketone **21** (85.0 mg, 100 %) as a colorless oil.
$[\alpha]_D^{23}$ + 151.2 (*c* 1.0, $CHCl_3$); R*f* 0.45 (heptanes/EtOAc, 1:1); IR (film) 2927, 2866, 1741, 1686, 1610, 1511, 1240, 1075, 1033 cm^{-1}; ^1H NMR (500 MHz, $CDCl_3$) δ_H 1.42 (m, 1H), 1.47 (dd, 1H, *J*= 12.6, 3.4 Hz), 1.93 (dd, 1H, *J*= 13.1, 3.4 Hz), 2.03 (s, 3H), 2.15 (ddd, 1h, *J*= 13.4, 12.6, 4.3 Hz), 2.29 (tt, 1H, *J*= 12.5, 4.3 Hz), 2.43 (dt, 1H, *J*= 13.8, 3.6 Hz), 3.14 (dt, 1H, *J*= 13.5, 6.7 Hz), 3.29 (dd, 1H, *J*= 13.4, 6.7

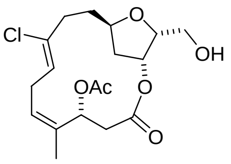
Hz), 3.31 (d, 1H, *J*= 11.7 Hz), 3.52 (dd, 1H, *J*= 9.5, 6.2 Hz), 3.57 (m, 2H), 3.75 (tt, 1H, *J*= 11.1, 3.7 Hz), 3.80 (s, 3H), 4.28 (ddd, 1H, *J*= 6.3, 6.3, 3.9 Hz), 4.37 (d, 1H, *J*= 12.1 Hz), 4.58 (d, 1H, *J*= 12.1 Hz), 5.39 (t, 1H, *J*= 3.5 Hz), 5.49 (t, 1H, *J*= 6.6 Hz), 6.28 (ddd, 1H, *J*= 9.3, 7.6, 1.2 Hz), 6.87 (d, 2H, *J*= 8.4 Hz), 7.24 (d, 2H, *J*= 8.5 Hz) ; ^{13}C (75 MHz, CDCl$_3$) δ_C 22.3, 27.4, 28.9, 35.6, 38.4, 48.5, 55.4, 67.8, 73.0, 76.1, 76.2, 78.8, 113.8, 123.6, 129.6, 130.2, 133.5, 133.6, 141.0, 159.3, 165.5, 194.2; MS (TOF) m/z 471.2 ([M+Na]$^+$); HRMS (TOF) m/z calcd for $C_{24}H_{29}ClO_6Na$ [M+Na]$^+$ 471.1550, found 471.1560.



(1R,5R,6Z,9Z,13R,15R)-10-chloro-15-((4-methoxybenzyloxy)methyl)-6-methyl-3-oxo-2,14-dioxabicyclo[11.2.1]hexadeca-6,9-dien-5-yl acetate (ix):

To a solution of alcohol **20a** (138.1 mg, 0.306 mmol) in pyridine (3 mL) was added DMAP (2 mg, 0.015 mmol) and Ac$_2$O (87 μL, 0.919 mmol). After 1 h 30 min of stirring, the solvent was removed under vacuum. Flash column chromatography purification (heptanes/EtOAc, 2:1) afforded acetate i**x** (143.1 mg, 95 %) as a colorless oil.

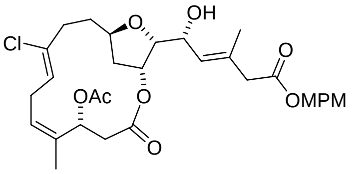
$[\alpha]_D^{23}$ –41.49 (*c* 1.55, CHCl$_3$); R*f* 0.40 (heptanes/EtOAc, 1:1); IR (film) 2954, 2927, 2864,1731, 1512, 1224, 1067 cm^{-1}; ^{1}H NMR (500 MHz, CDCl$_3$) δ_H 1.42 (m, 1H), 1.46 (dd, 1H, *J*= 3.6, 13.1 Hz), 1.87 (s, 3H), 2.04 (s, 3H), 2.08 (dd, , 1H *J* = 3.5, 12.8 Hz), 2.16 (ddd, 1H, *J* = 5.6, 12.5, 13.7 Hz), 2.41 (tdd, 1H, *J* = 4.9, 12.6, 12.9 Hz), 2.50 (m, 2H), 2.55 (dd, 1H, *J*= 11.5, 4.5 Hz), 2.71 (t, 1H, *J* = 11.5 Hz), 3.53 (ddd, 1H, *J*= 17.3, 10.4, 8.8 Hz), 3.58 (dd, 1H, *J*= 9.4, 6.5 Hz), 3.63 (dd, 1H, *J*= 9.7, 6.8 Hz), 3.80 (s, 3H), 3.91 (tt, 1H, *J* = 3.7, 11.7 Hz), 4.27 (dt, 1H, *J* = 3.9, 6.4 Hz), 4.38 (d, 1H, *J* = 11.8 Hz), 4.58 (d, 1H, *J* = 11.8 Hz), 5.19 (d, 1H, *J* = 7.9 Hz), 5.24 (t, 1H, *J* = 3.5 Hz), 5.66 (dd, 1H, *J* = 6.7, 10.9 Hz), 6.87 (d, 1H, *J* = 8.5 Hz), 7.24 (d, 1H, *J* = 8.7 Hz); ^{13}C (75 MHz, CDCl$_3$) δ_C 18.4, 21.2, 26.8, 28.0, 35.0, 37.8, 37.9, 55.4, 67.5, 68.0, 73.1, 75.8, 76.3, 79.1, 113.9, 125.5, 129.6, 130.0, 130.3, 132.2, 133.1, 159.3, 168.1, 196.5; MS (TOF) m/z 515.2 and 517.2 ([M+Na]$^+$); HRMS (TOF) m/z calcd for $C_{26}H_{33}O_7ClNa$ [M+Na]$^+$ 515.1813, found 515.1835.



(1R,5R,6Z,9Z,13R,15R)-10-chloro-15-(hydroxymethyl)-6-methyl-3-oxo-2,14-dioxabicyclo[11.2.1]hexadeca-6,9-dien-5-yl acetate (22):

To a solution of lactone **ix** (143.1 mg, 0.290 mmol) in CH$_2$Cl$_2$ (3.1 mL) was added H$_2$O (152 μL) and after cooling down to 0 °C, DDQ (99 mg, 0.435 mmol) was introduced. After 4 h of stirring, the reaction was quenched by addition of a saturated NaHCO$_3$ solution (10 mL). After extraction by EtOAc, the organic phase was dried over anhydrous Na$_2$SO$_4$, filtered and the solvent was removed under vacuum. Flash column chromatography purification (heptanes/EtOAc, 1:1) afforded alcohol **22** (102.5 mg, 95 %) as a colorless oil.

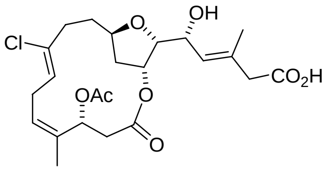
$[\alpha]_D^{23}$ –17.30 (*c* 1.27, CHCl$_3$); R*f* 0.13 (heptanes/EtOAc, 1:1); IR (film) 3444, 2926, 1736, 1731, 1225 cm^{-1}; ^{1}H NMR (500 MHz, CDCl$_3$) δ_H 1.45 (ddd, 1H, *J*= 11.0, 5.5, 1.5 Hz), 1.48 (ddd, 1H, *J*= 24.5, 12.6, 3.3 Hz), 1.88 (s, 3H), 2.05 (s, 3H), 2.12 (dd, 1H, *J* = 2.9, 13.0 Hz), 2.18 (ddd, 1H, *J* = 5.1, 12.4, 13.7 Hz), 2.41 (ddt, 1H, *J* = 4.7, 5.3, 12.7 Hz), 2.53 (m, 2H), 2.7 (dd,1H, *J* = 4.5, 11.5 Hz), 2.77 (t, 1H, *J* = 11.5 Hz), 3.52 (ddd, 1H, *J* = 8.0, 11.0, 17.0 Hz), 3.67 (dd, 1H, *J* = 4.5, 11.5 Hz), 3.88 (dd, 1H, *J*= 11.4, 7.5 Hz), 3.93 (tt, 1H, *J*= 11.7, 3.6 Hz), 4.23 (td, 1H, *J* = 4.4, 7.7 Hz), 5.21 (dd, 1H, *J* = 2.3, 8.1 Hz), 5.27 (t, 1H, *J* = 3.8 Hz), 5.67 (dd, 1H, *J* = 9.9, 7.4 Hz), 5.75 (dd, 1H, *J* = 4.5, 11.4 Hz); ^{13}C (75 MHz, CDCl$_3$) δ_C 18.4, 21.3, 26.8, 27.9, 35.0, 38.0, 38.1, 61.7, 67.4, 75.98, 76.0, 80.7, 125.7, 130.1, 132.2, 133.1, 168.2, 169.6; MS (TOF) m/z 395.1 and 397.1 ([M+Na]$^+$); HRMS (TOF) m/z calcd for $C_{18}H_{25}O_6ClNa$ [M+Na]$^+$ 395.1237, found 395.1251.



(R,E)-4-methoxybenzyl 5-((1R,5R,6Z,9Z,13R,15R)-5-acetoxy-10-chloro-6-methyl-3-oxo-2,14-dioxabicyclo[11.2.1]hexadeca-6,9-dien-15-yl)-5-hydroxy-3-methylpent-3-enoate (24a) :

To a solution of alcohol **22** (20.8 mg, 0.056 mmol) in CH_2Cl_2 (2 mL) at 0 °C, was added Dess-Martin periodinane (42.6 mg, 0.100 moml). After 3 h of stirring at 20 °C, aqueous saturated solutions of $NaHCO_3$ (10 mL) and $Na_2S_2O_3$ (0.5 mL) were added and the mixture that stirred during 30 min. After extraction by Et_2O, the organic phase was dried over anhydrous Na_2SO_4, filtered and the solvent was removed under vacuum. The crude oil was quickly purified by passing through a short silica pad (1 cm, heptanes/EtOAc, 1:2) afforded aldehyde **23** as a colorless oil. This crude aldehyde was taken in THF (1 mL), vinylic iodide **8** (135.2 mg, 0.391 mmol) was added and this mixture was then introduced into a solution of $CrCl_2$ (100 mg, 0.815 mmol) and $NiCl_2$ (2 mg, 0.015 mmol) in DMSO (1 mL) at 10 °C under argon. After 1h 30min of stirring at 20 °C, a 1.1 M aqueous solution of serine (9 mL) and a saturated aqueous solution of $NaHCO_3$ (1 mL) were added. After 30 min of stirring, the mixture was extracted by EtOAc, the organic phase was dried over anhydrous Na_2SO_4, filtered and the solvent was removed under vacuum. After HPLC purification (heptanes/EtOAc, 2:3), we obtained alcohol **24a** (14.1 mg, 43 %) and alcohol **24b** (1.4 mg 4%) as a colorless oils.

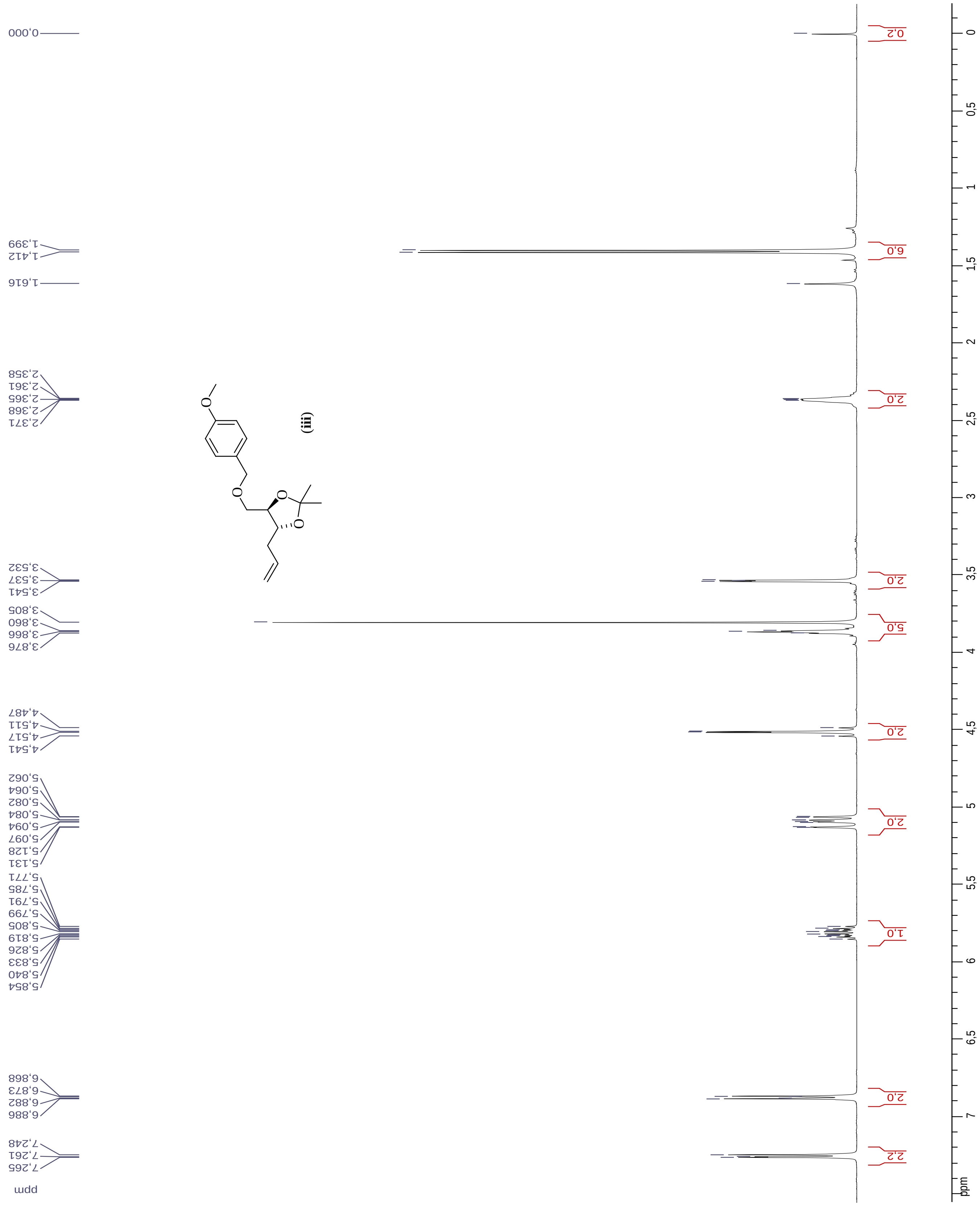
$[\alpha]_D^{23}$ +4.5 (*c* 1.41, $CHCl_3$); R*f* 0.29 (heptanes/EtOAc, 1:2); IR (film) 3452, 2927, 1735, 1516, 1231, 1149 cm^{-1}; ^{1}H NMR (500 MHz, CDCl$_3$) δ_H 1.40 (ddd, 1H, *J*= 12.2, 12.2, 4.4 Hz), 1.46 (dt, 1H, *J*= 12.2, 12.2, 3.4 Hz), 1.69 (br s, 1H), 1.83 (s, 3H), 1.89 (s, 3H), 2.04 (s, 3H), 2.12 (dd, 1H, *J* = 3.8, 13.3 Hz), 2.18 (dd, 1H, *J*= 13.0, 5.5 Hz), 2.38 (tt, 1H, *J* = 5.2, 12.8 Hz), 2.51 (m, 2H), 2.75 (dd, 1H, *J*= 11.6, 5.2 Hz), 3.08 (s, 2H), 3.55 (ddd, 1H, *J* = 8.0, 10.9, 17.0 Hz), 3.81 (s, 3H), 3.94 (dd, 1H, *J*= 7.9, 3.7 Hz), 3.96 (m, 1H), 4.6 (dd, 1H, *J* = 7.8, 8.2 Hz), 5.06 (s, 2H), 5.21 (d, 1H, *J* = 7.8 Hz), 5.32 (t, 1H, *J* = 3.5 Hz), 5.42 (d, 1H, *J* = 8.2 Hz), 5.68 (dd, 1H, *J* = 8.4, 8.7 Hz), 5.77 (dd, 1H, *J* = 4.9, 10.9 Hz), 6.89 (d, 2H, *J* = 8.2 Hz), 7.29 (d, 2H, *J* = 8.2 Hz); ^{13}C (125 MHz, CDCl$_3$) δ_C 17.5, 18.5, 21.3, 26.8, 28.1, 29.8, 35.0, 38.0, 38.2, 45.2, 55.4, 66.4, 66.6, 67.6, 75.9, 76.9, 82.8, 114.1, 125.7, 128.2, 129.4, 130.0, 130.2, 132.2, 133.3, 134.7, 168.2, 169.6, 171.4; MS (TOF) m/z 613.1, 615.2 ([M+Na]$^+$); HRMS (TOF) m/z calcd for $C_{31}H_{39}{}^{35}ClO_9Na$ [M+Na]$^+$ 613.2180, found 613.2197, for $C_{31}H_{39}{}^{37}ClO_9Na$ [M+Na]$^+$ 613.2180, found 613.2184.



(+)-Oocydin A (1) :

To a solution of ester **24a** (14.0 mg, 0.0237 mmol) and Et_3SiH (40 μL, 0.237 mmol) in CH_2Cl_2 (0.3 mL) at 0 °C under argon was slowly added TFA (0.3 mL). After 25 min of stirring, the solvent was removed under vacuum. After HPLC purification (heptanes/EtOAc, 1:3), we obtained (+)-Oocydin A **1** (7.9 mg, 71 %) as a colorless oil.

$[\alpha]_D^{23}$ + 11.8 (*c* 0.8, MeOH); R*f* 0.11 (heptanes/EtOAc, 1:2); IR (film) 3405, 2924, 2853, 1736, 1435, 1371, 1295, 1230, 1179, 1148, 1064, 1016, 971 cm^{-1}; ^1H NMR (500 MHz, CD_3OD) δ_H 1.40 (t, 1H, *J*= 9.3 Hz), 1.53 (td, 1H, *J*= 12.5, 2.5 Hz), 1.84 (s, 3H), 1.89 (s, 3H), 2.03 (s, 3H), 2.11 (dd, 1H, *J*= 12.8, 3.1 Hz), 2.27 (d, 1H, *J*= 13.1 Hz), 2.32 (d, 1H, *J*= 13.7 Hz), 2.46 (m, 1H, *J*= 7.8 Jz), 2.51 (m, 1H, *J*= 6.6 Hz), 2.78 (t, 1H, *J*= 11.5 Hz), 2.84 (dd, 1H, *J*= 11.5, 4.5 Hz), 3.04 (d, 1H, *J*= 16.2 Hz), 3.07 (d, 1H, *J*= 16.2 Hz), 3.49 (ddd, 1H, *J*= 17.9, 7.4, 10.0 Hz), 3.91 (dd, 1H, *J*= 8.9, 3.7 Hz), 3.96 (dt, 1H, *J*= 11.7, 3.1 Hz), 4.55 (t, 1H, *J*= 8.6 Hz), 5.31 (m, 1H), 5.32 (m, 1H) 5.39 (d, 1H, *J*= 8.1 Hz), 5.71 (dd, 1H, *J*= 9.3, 7.9 Hz), 5.80 (dd, 1H, *J*= 11.4, 4.6 Hz); ^{13}C (125 MHz, CD_3OD) δ_C 17.4, 18.6, 21.0, 27.7, 29.0, 35.5, 38.8, 38.9, 45.8, 66.5, 68.8, 76.6, 78.1, 84.5, 127.0, 130.7, 130.9, 133.2, 134.7, 135.1, 169.5, 171.3, 175.6; MS (TOF) m/z 493.1, 495.1 ($[M+Na]^+$); HRMS (TOF) m/z calcd for $C_{23}H_{31}{}^{35}ClO_8Na$ $[M+Na]^+$ 493.1605, found 493.1614, calcd for $C_{23}H_{31}{}^{37}ClO_8Na$ $[M+Na]^+$ 495.1576, found 495.1609.



(iii)

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3,805
3,860
3,866
3,876
4,487
4,511
4,517
4,541
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5,064
5,082
5,084
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5,097
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5,791
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6,886
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7,261
7,265
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5,5
6
6,5
7
ppm
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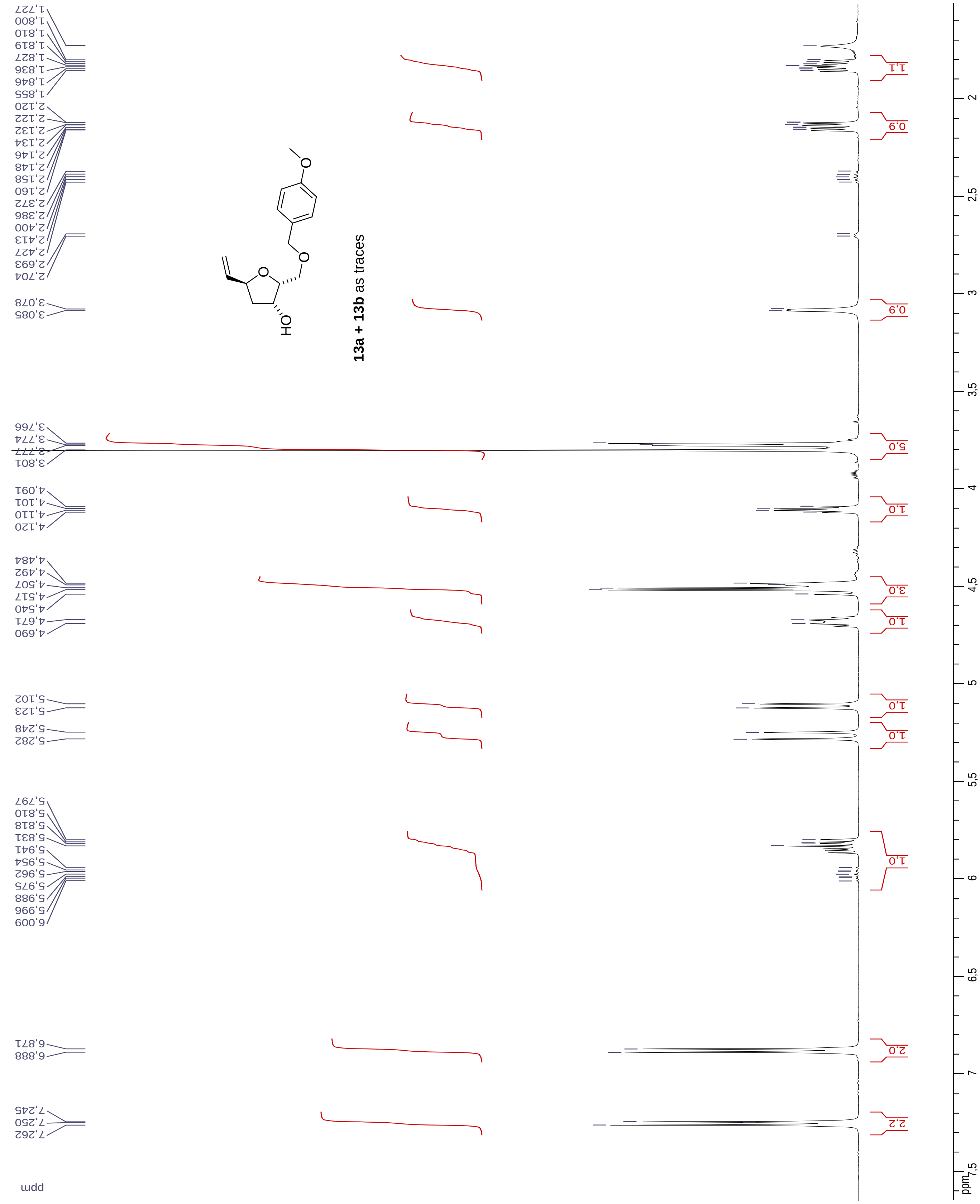
O
O
O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2,160
2,372
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2,413
2,427
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2,704
3,078
3,085
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4,484
4,492
4,507
4,517
4,540
4,671
4,690
5,102
5,123
5,248
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5,941
5,954
5,962
5,975
5,988
5,996
6,009
ppm
O
O
O
HO
13a + 13b as traces
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0,9
0,9
5,0
1,0
3,0
1,0
1,0
1,0
1,0
2,0
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2
2,5
3
3,5
4
4,5
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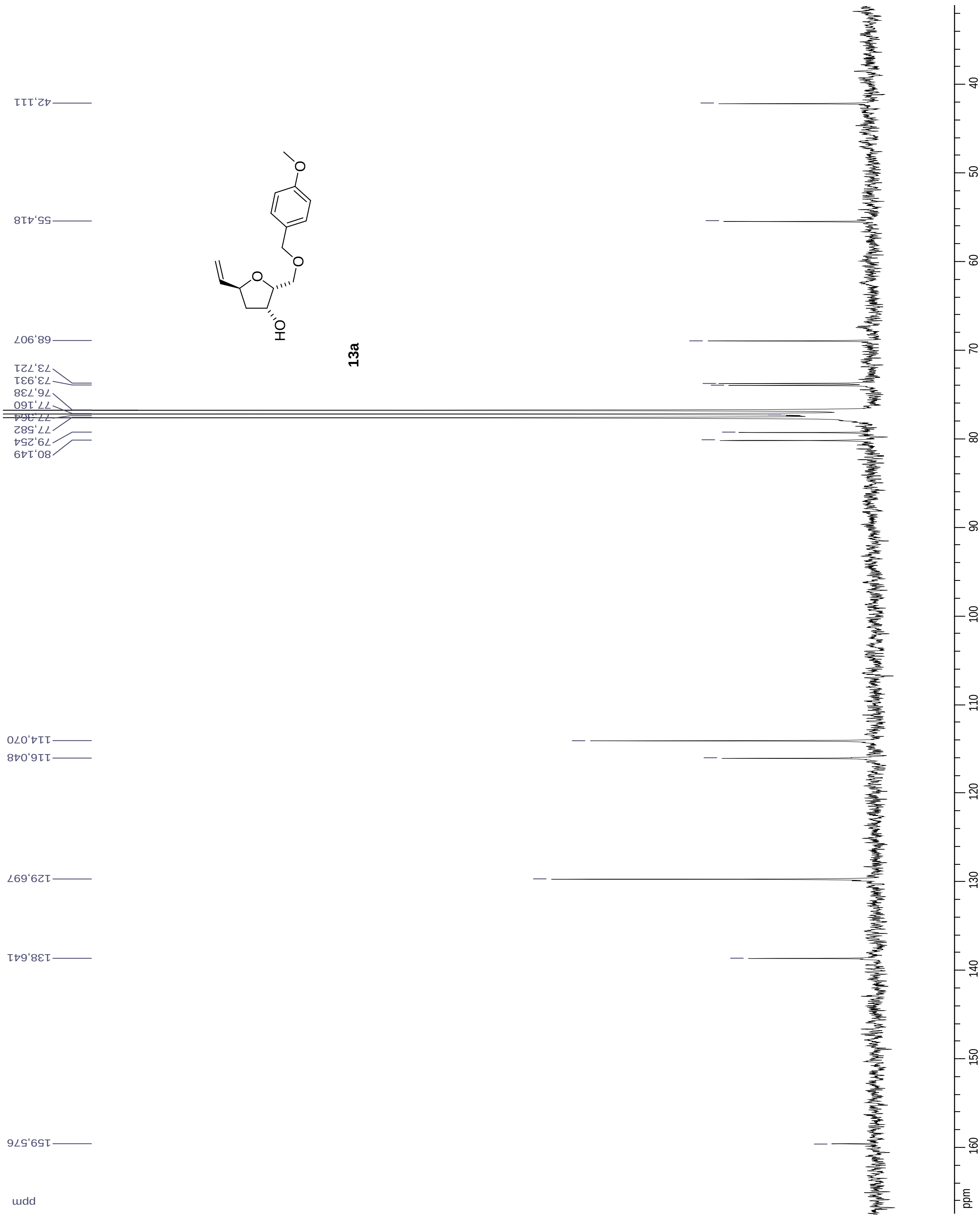
5,5
6
6,5
7
ppm 7,5


13a

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77,160
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77,582
79,254
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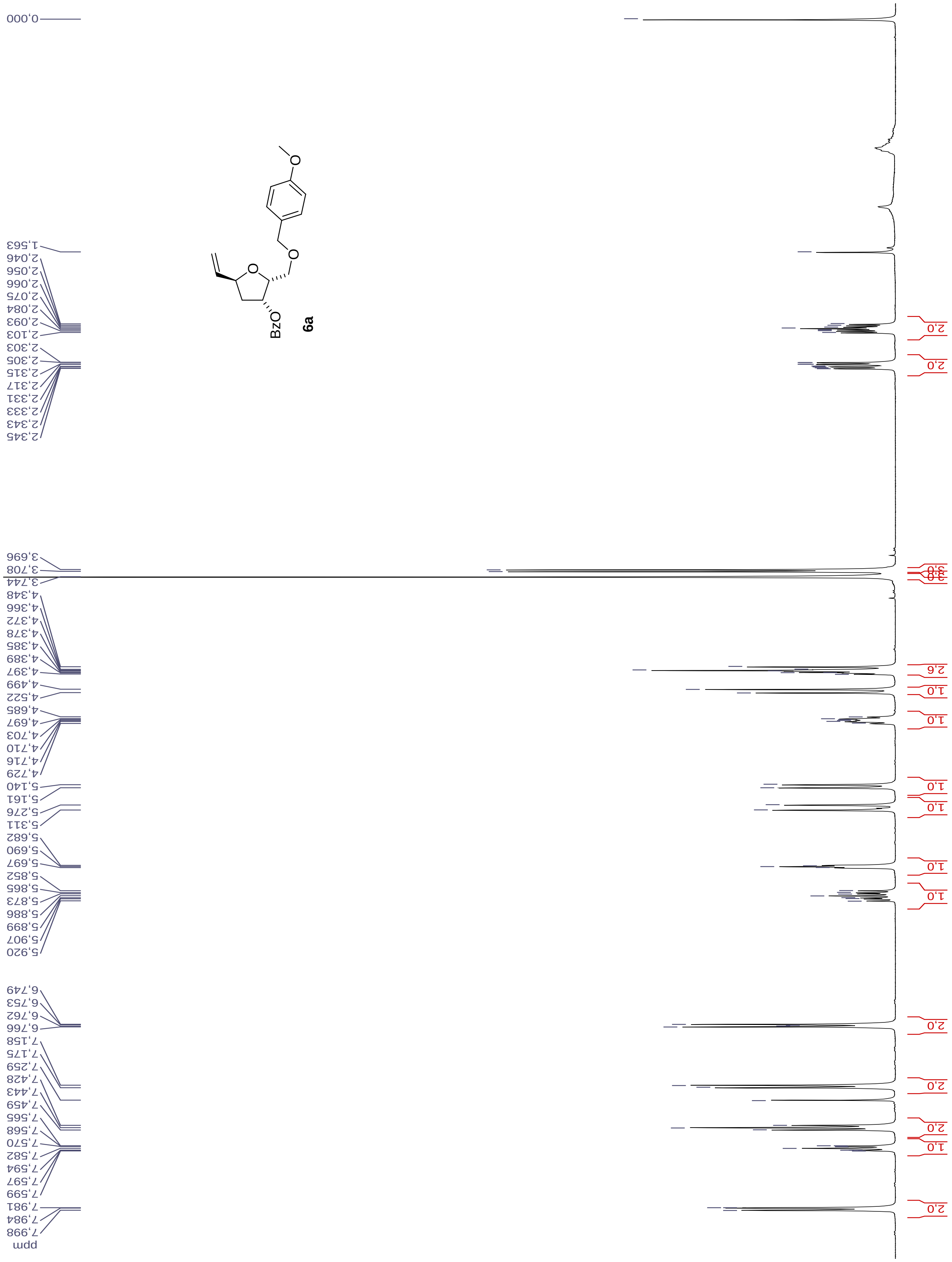
114,070
116,048
129,697
138,641
159,576
ppm
40
50
60
70
80
90
100
110
120
130
140
150
160
ppm



6a

BzO
O
O
O
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2,066
2,075
2,084
2,093
2,103
2,303
2,305
2,315
2,317
2,331
2,333
2,343
2,345
3,696
3,708
3,744
4,348
4,366
4,372
4,378
4,385
4,389
4,397
4,499
4,522
4,685
4,697
4,703
4,710
4,716
4,729
5,140
5,161
5,276
5,311
5,682
5,690
5,697
5,852
5,865
5,873
5,886
5,899
5,907
5,920
6,749
6,753
6,762
6,766
7,158
7,175
7,259
7,428
7,443
7,459
7,565
7,568
7,570
7,582
7,594
7,597
7,599
7,981
7,984
7,998
ppm
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2,0
3,0
3,0
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1,0
2,0
2,0
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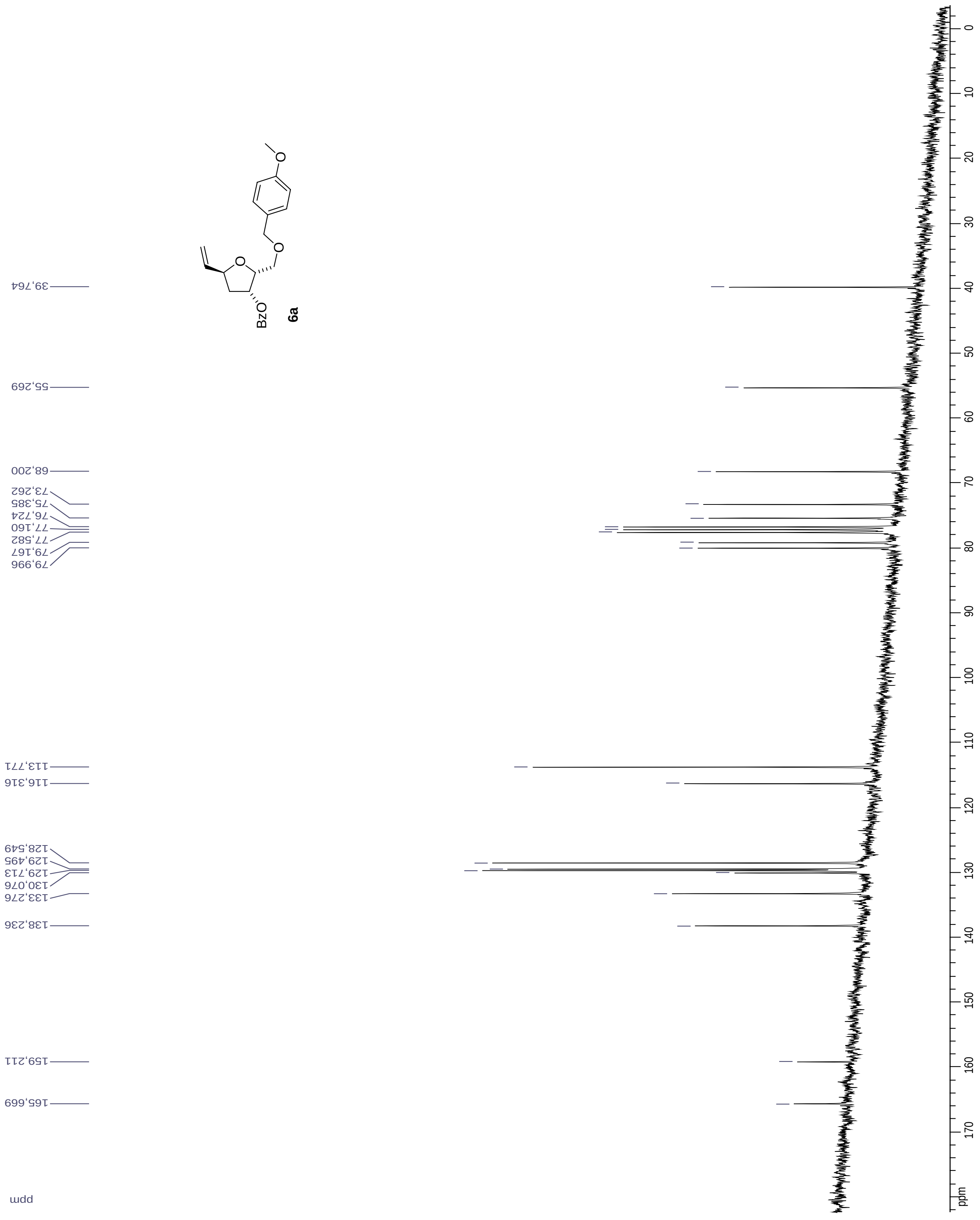
1,0
2,0



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O
O
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73,262
75,385
76,724
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77,582
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79,996
113,771
116,316
128,549
129,495
129,713
130,076
133,276
138,236
159,211
165,669
ppm
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20
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40
50
60
70
80
90
100
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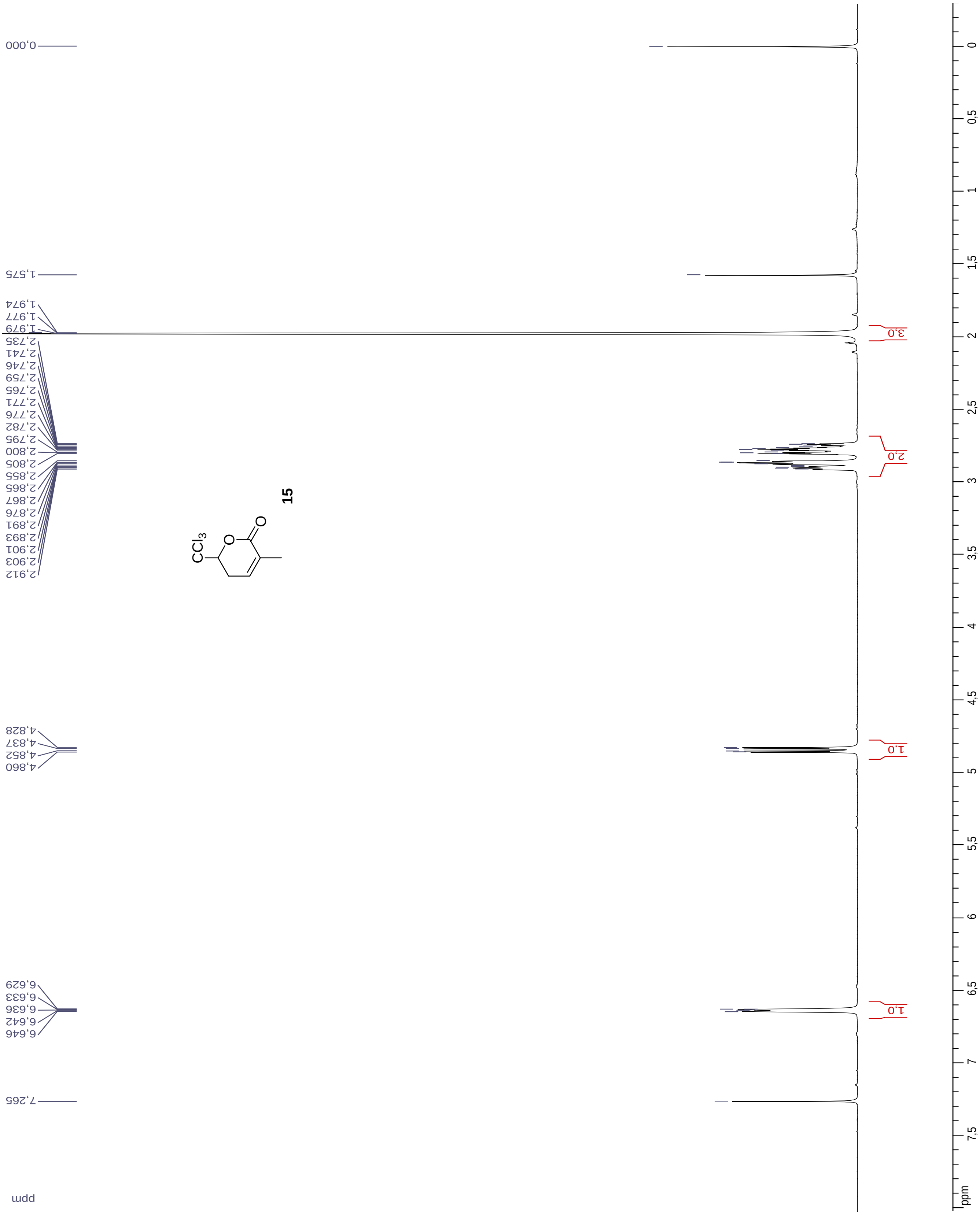
120
130
140
150
160
170
ppm

6a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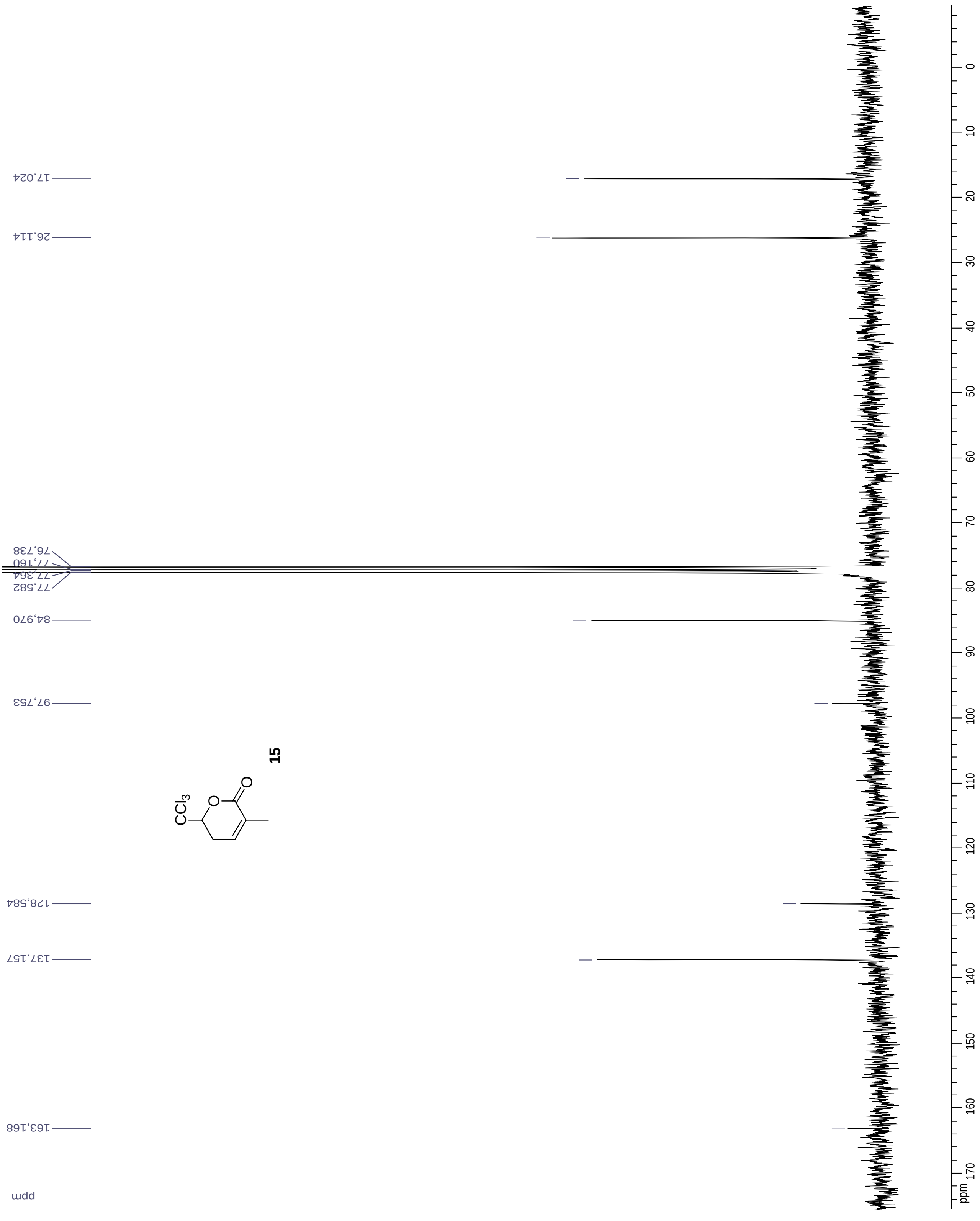
2,776
2,782
2,795
2,800
2,805
2,855
2,865
2,867
2,876
2,891
2,893
2,901
2,903
2,912
4,828
4,837
4,852
4,860
6,629
6,633
6,636
6,642
6,646
7,265
ppm
CCl3
O
O
3,0
2,0
1,0
1,0
0
0,5
1
1,5
2
2,5
3
3,5
4
4,5
5
5,5
6
6,5
7
7,5
ppm

15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77,364
77,582
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97,753
128,584
137,157
163,168
ppm
CCl3
O
O
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0
10
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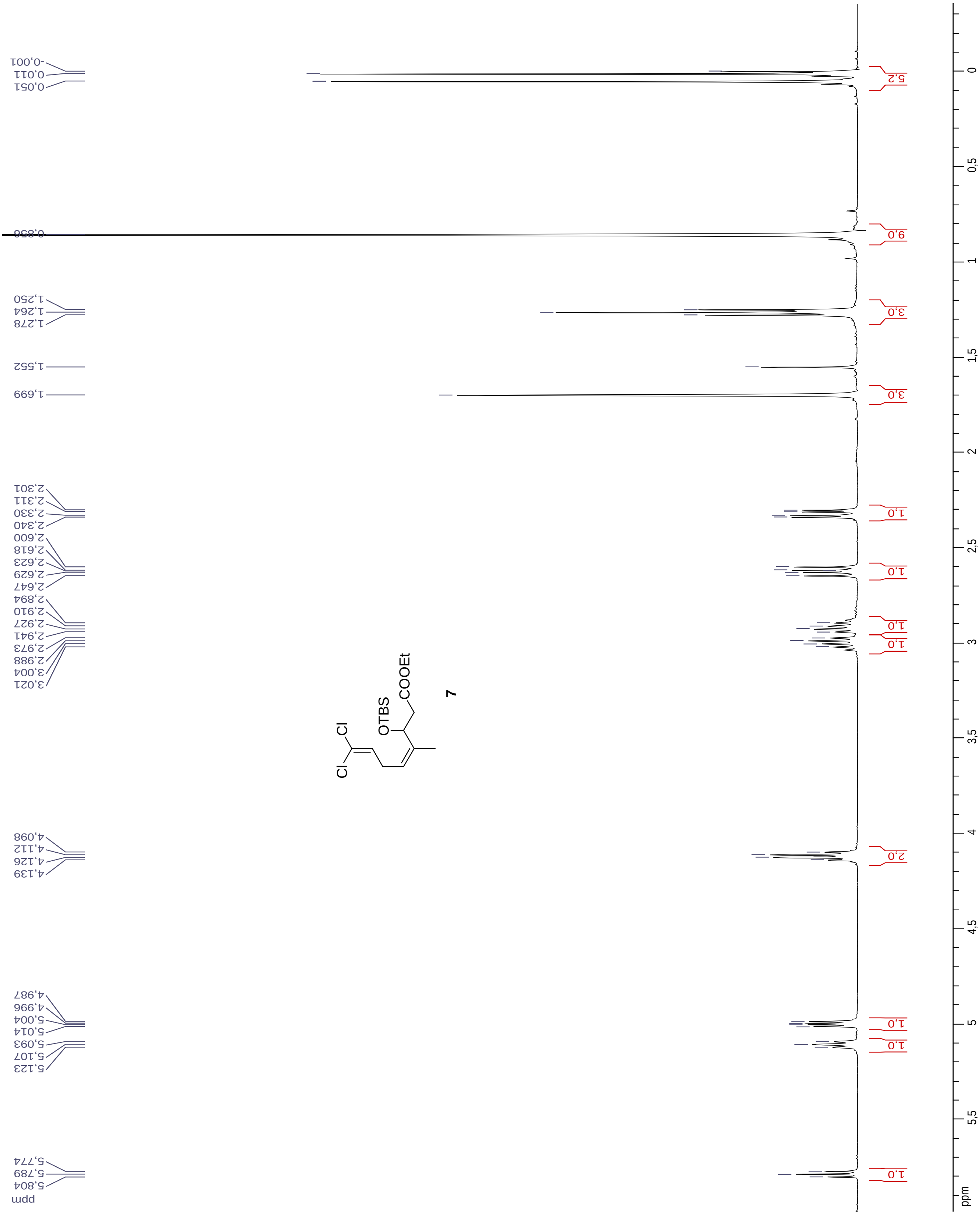
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170
ppm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2,618
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2,629
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2,894
2,910
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2,941
2,973
2,988
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4,112
4,126
4,139
4,987
4,996
5,004
5,014
5,093
5,107
5,123
5,774
5,789
5,804
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3,0
3,0
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1,0
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2,0
1,0
1,0
1,0
0
0,5
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2
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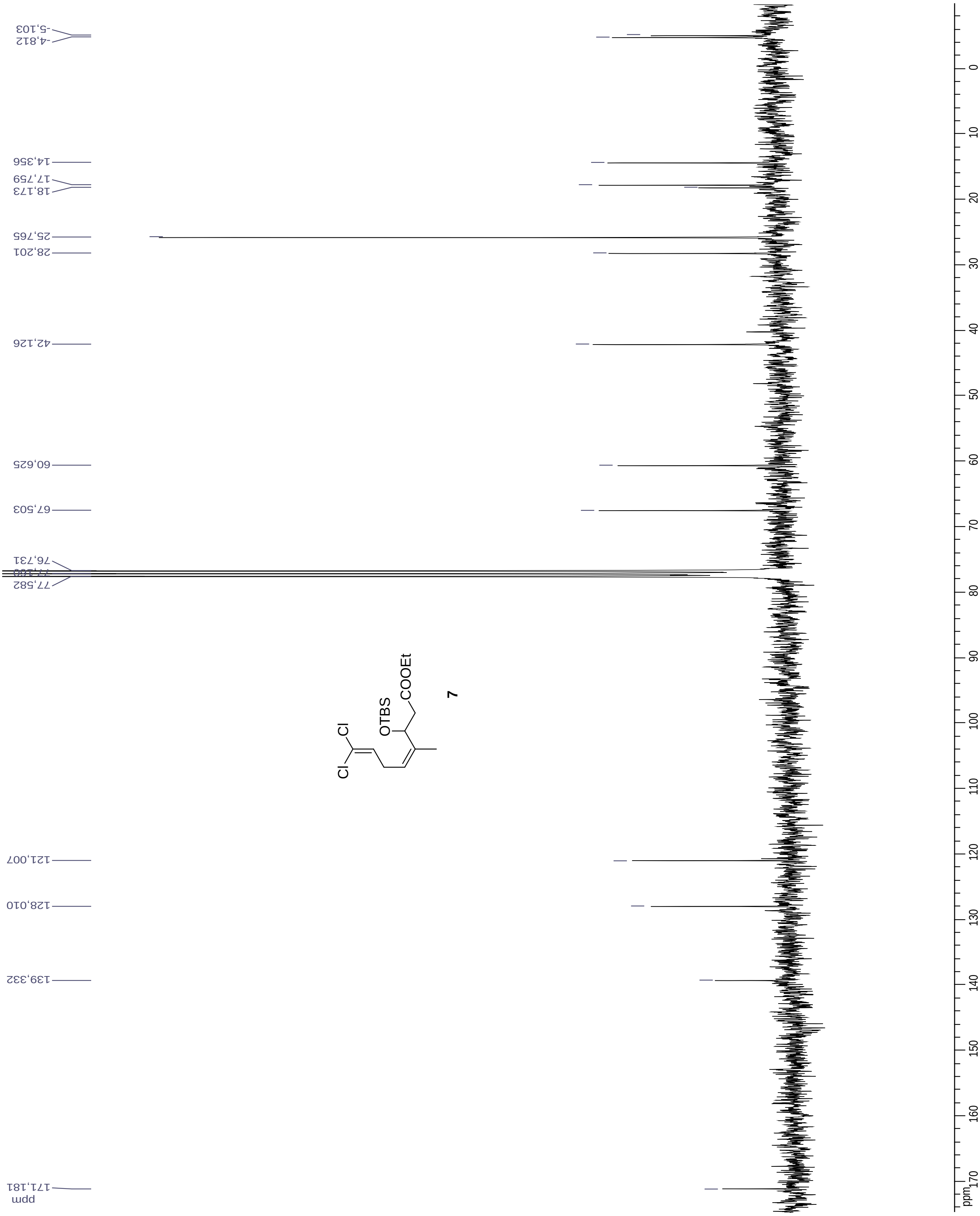
3
3,5
4
4,5
5
5,5
ppm
Cl
Cl
OTBS
COOEt
7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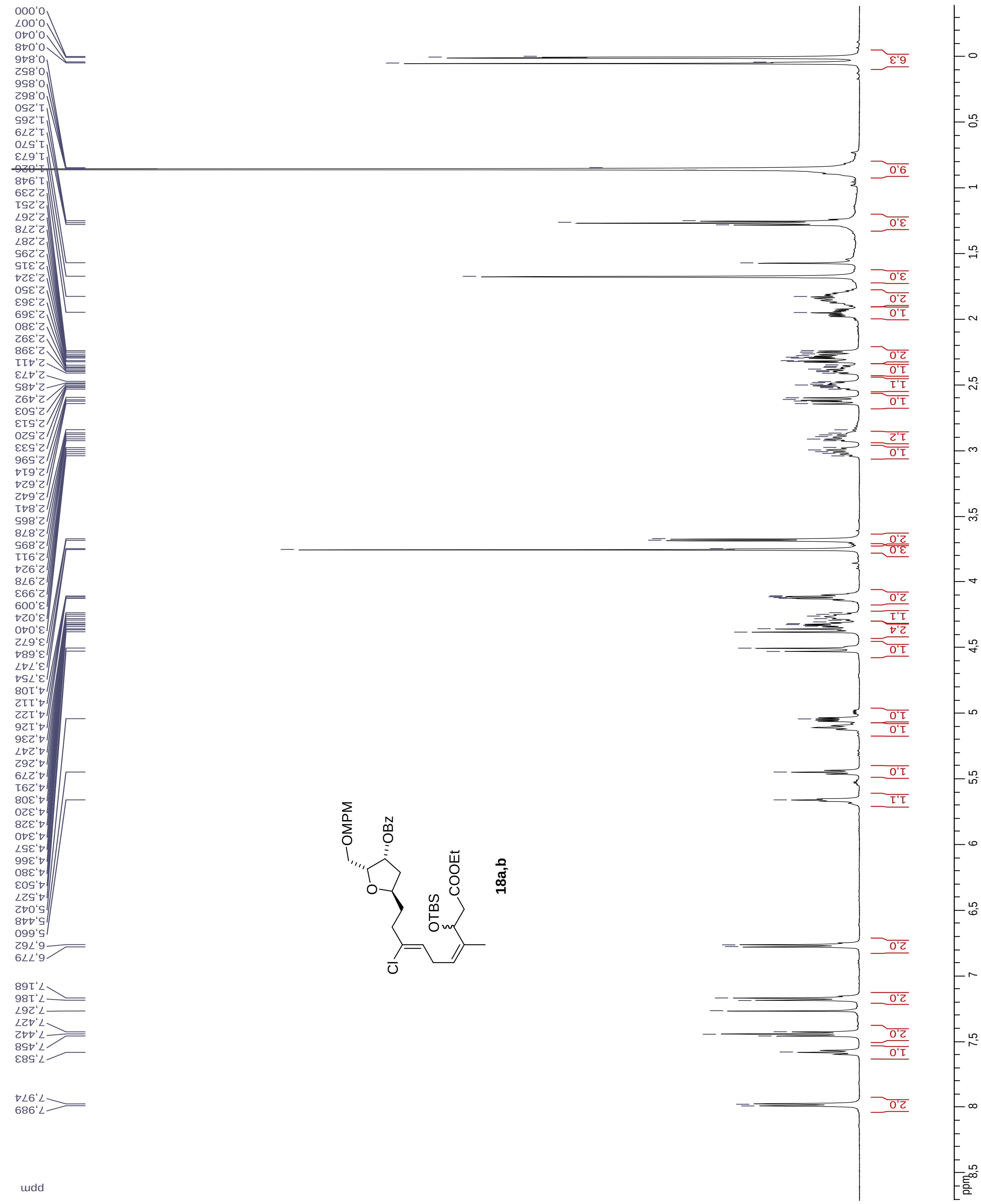
42,126
60,625
67,503
76,731
77,160
77,582
121,007
128,010
139,332
171,181
ppm
Cl
Cl
OTBS
COOEt
7
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170
ppm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1,948
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2,251
2,267
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2,287
2,295
2,315
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2,363
2,369
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2,978
2,993
3,009
3,024
3,040
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3,684
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3,754
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4,126
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4,262
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4,366
4,380
4,503
4,527
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6,762
6,779
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7,267
7,427
7,442
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7,974
7,989
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1,0
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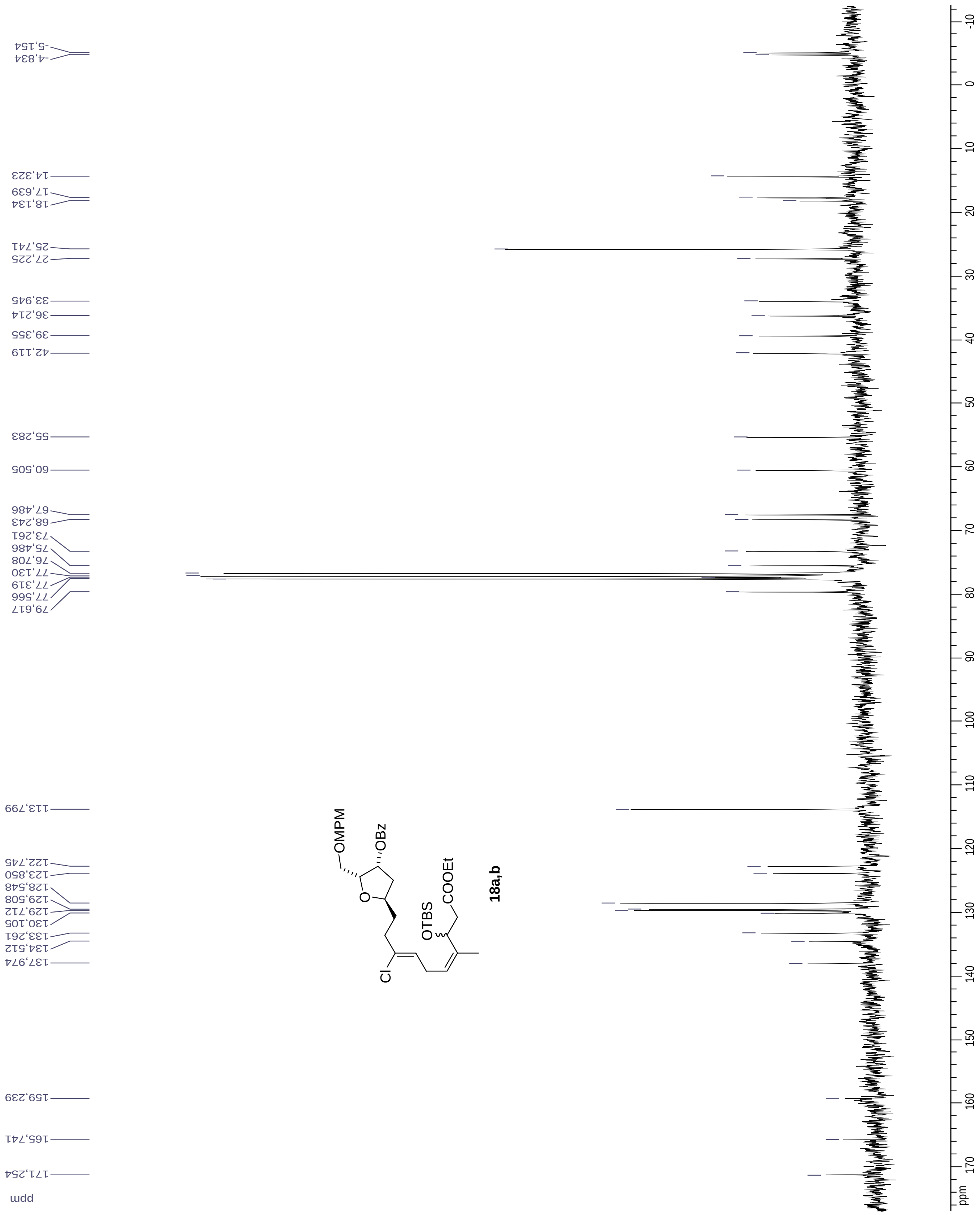
1,0
1,2
1,0
2,0
3,0
2,0
1,1
2,4
1,0
1,0
1,0
1,0
1,1
2,0
2,0
2,0
1,0
2,0
0
0,5
1
1,5
2
2,5
3
3,5
4
4,5
5
5,5
6
6,5
7
7,5
8
8,5
ppm
OMPM
OBz
O
Cl
OTBS
COOEt
18a,b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55.283
60.505
67.486
68.243
73.261
75.486
76.708
77.130
77.319
77.566
79.617
113.799
122.745
123.850
128.548
129.508
129.712
130.105
133.261
134.512
137.974
159.239
165.741
171.254
ppm
OMPM
OBz
O
Cl
OTBS
COOEt
18a,b
-10
0
10
20
30
40
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60
70
80
90
100
110
120
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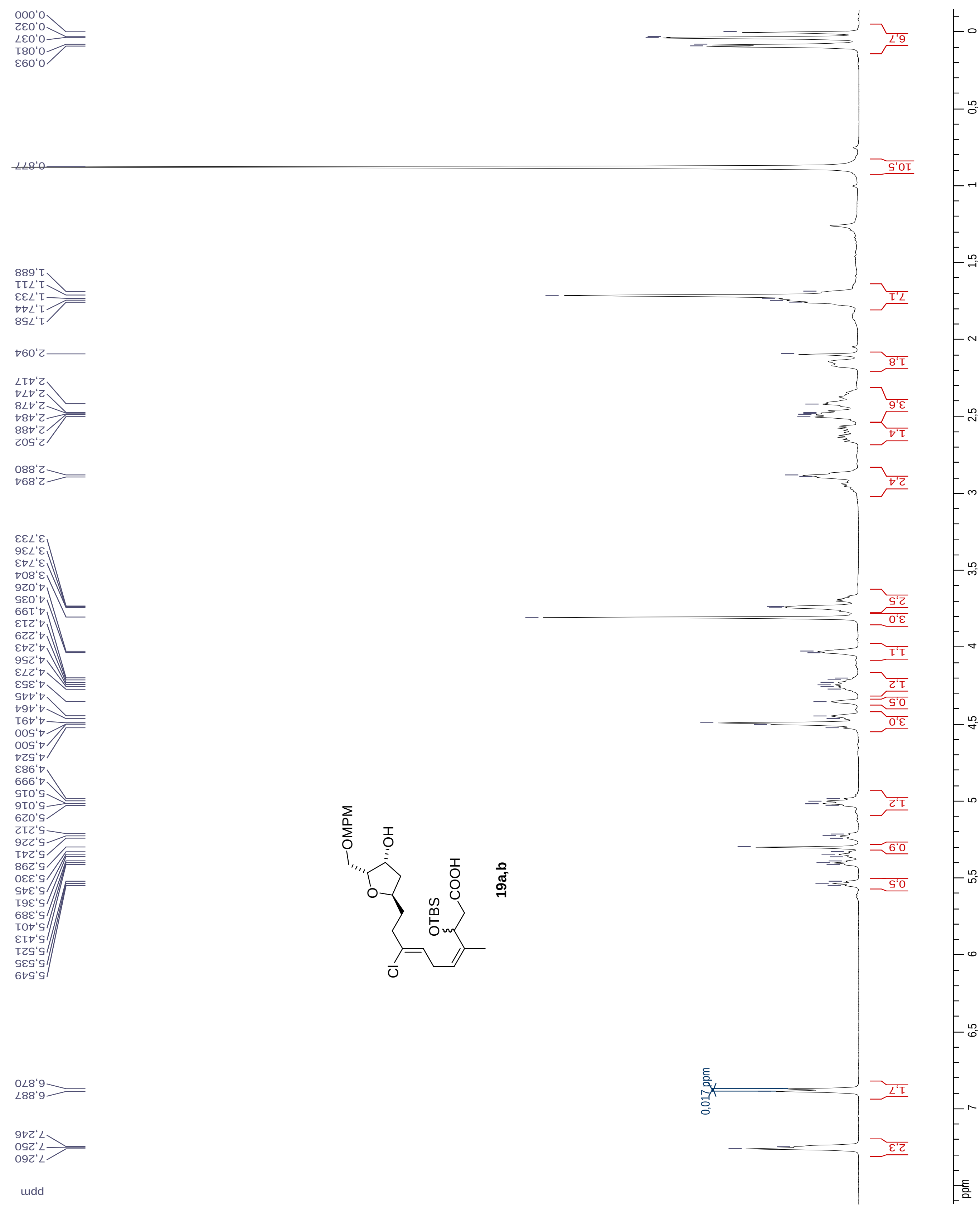
140
150
160
170
ppm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2,474
2,478
2,484
2,488
2,502
2,880
2,894
3,733
3,736
3,743
3,804
4,026
4,035
4,199
4,213
4,229
4,243
4,256
4,273
4,353
4,445
4,464
4,491
4,500
4,500
4,524
4,983
4,999
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5,016
5,029
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5,298
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5,535
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7,260
ppm
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1,2
0,5
3,0
1,2
0,9
0,5
1,7
2,3
0,017 ppm
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0,5
1
1,5
2
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3
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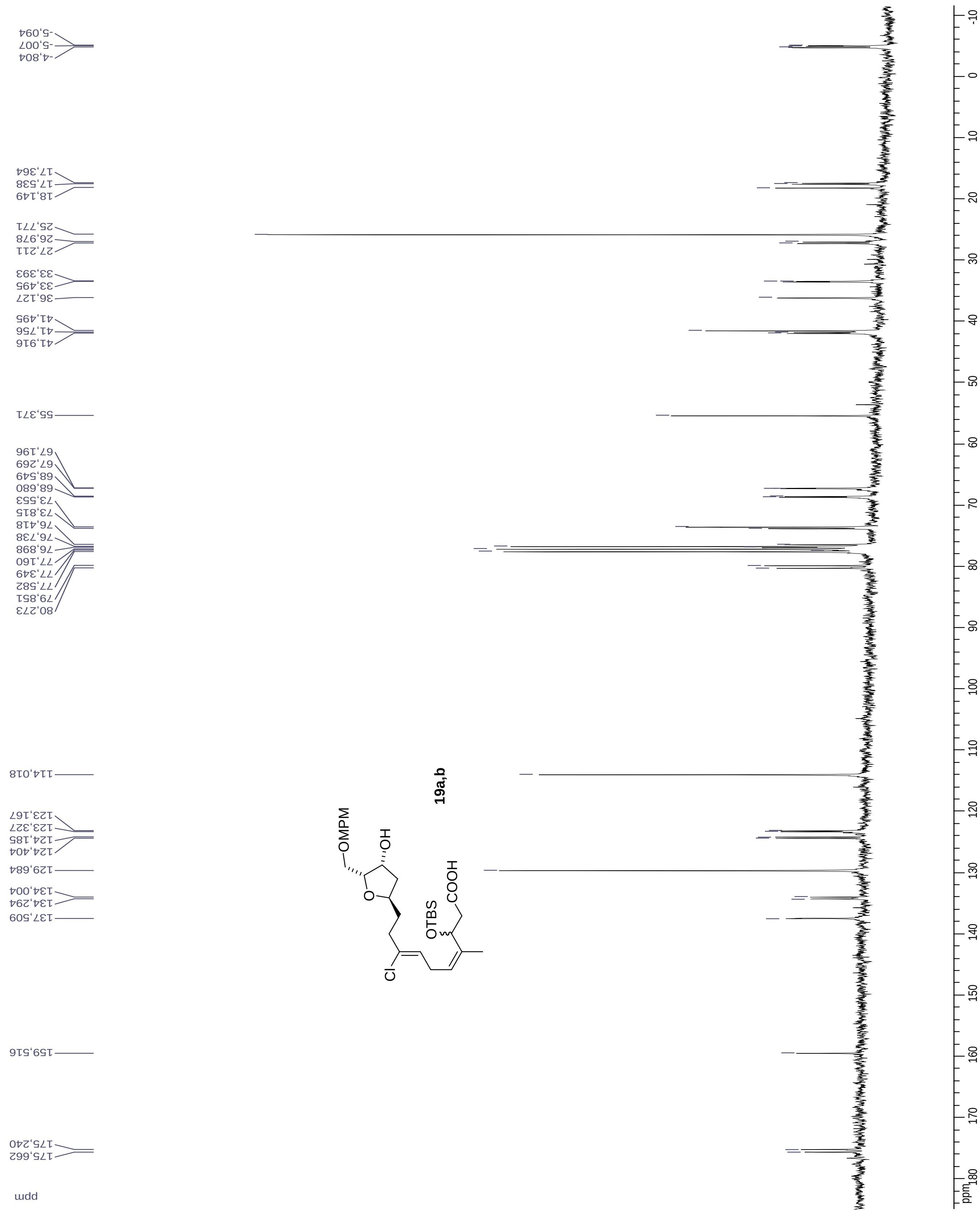
OH
O
COOH
OTBS
Cl

19a,b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67,269
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73,815
76,418
76,738
76,898
77,160
77,349
77,582
79,851
80,273
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123,327
124,185
124,404
129,684
134,004
134,294
137,509
159,516
175,240
175,662
ppm
OMPM
OH
O
COOH
OTBS
Cl
-10
0
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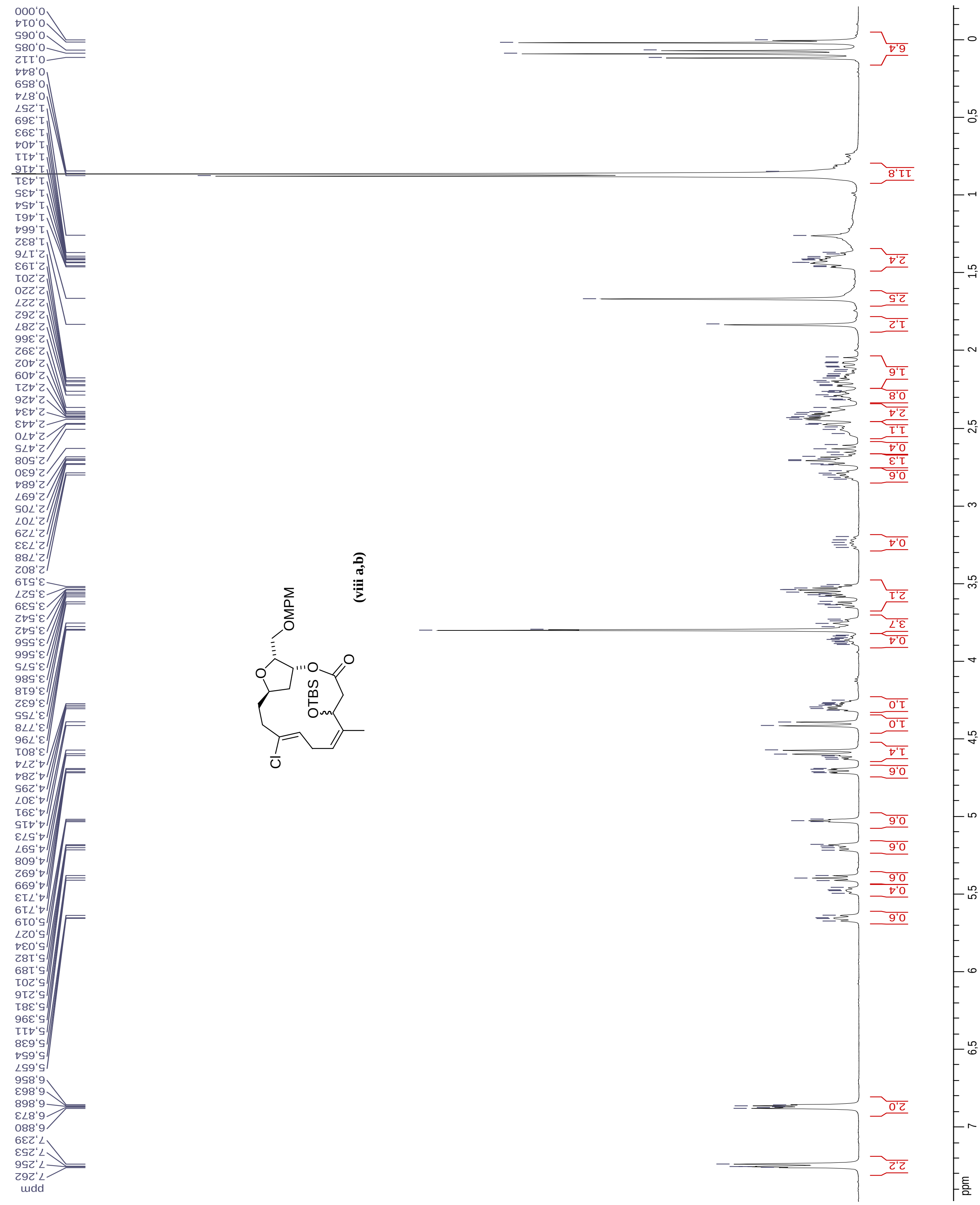
170
ppm 180

19a,b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1,461
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2,220
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2,262
2,287
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2,392
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2,684
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3,539
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4,719
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5,027
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5,189
5,201
5,216
5,381
5,396
5,411
5,638
5,654
5,657
6,856
6,863
6,868
6,873
6,880
7,239
7,253
7,256
7,262
ppm
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O
O
OTBS
Cl
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11.8
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2.5
1.2
1.6
0.8
2.4
1.1
0.4
1.3
0.6
0.4
2.1
3.7
0.4
1.0
1.0
1.4
0.6
0.6
0.6
0.6
0.4
0.6
2.0
2.2
0
0,5
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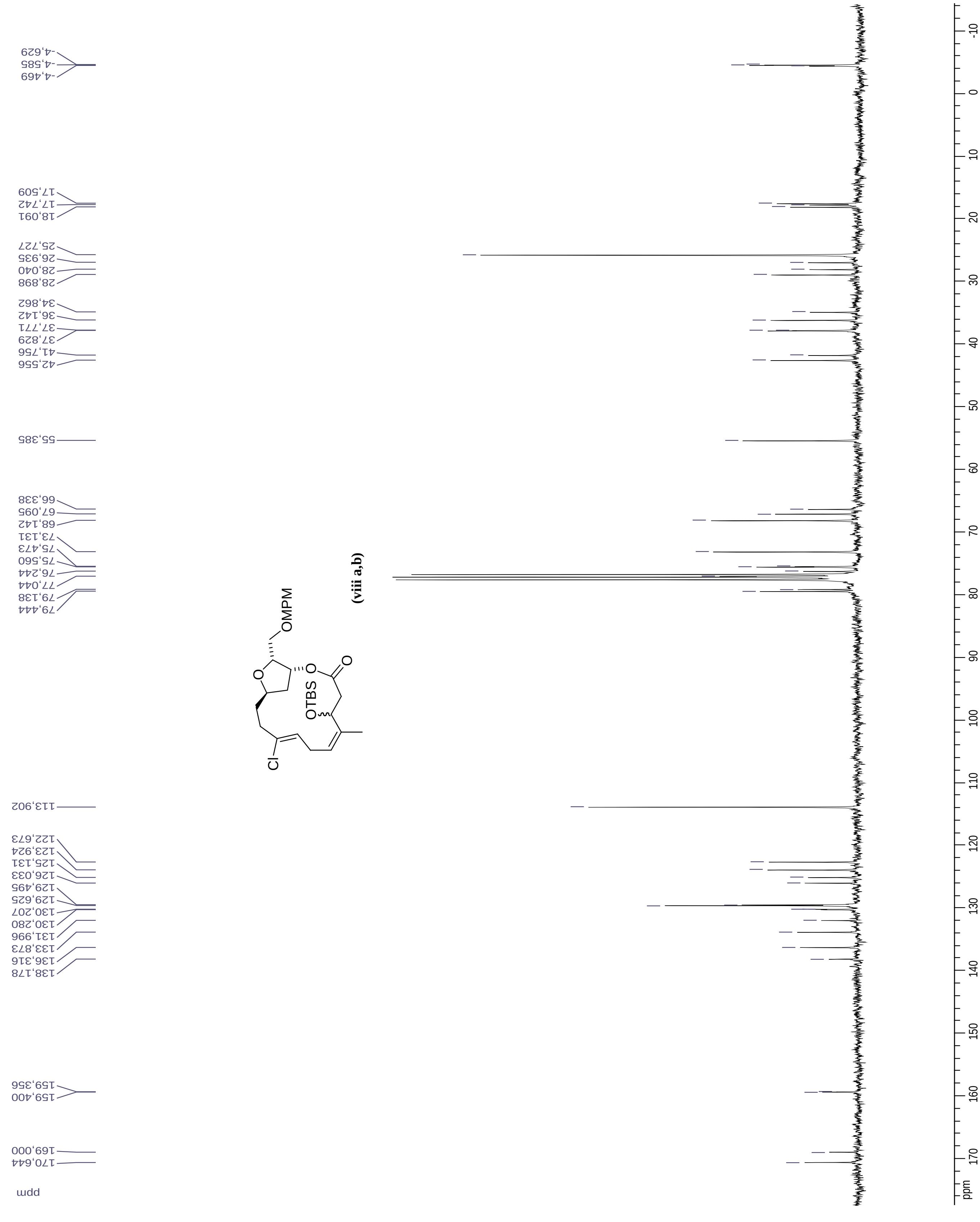
3
3,5
4
4,5
5
5,5
6
6,5
7
ppm

(viii a,b)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26.935
28.040
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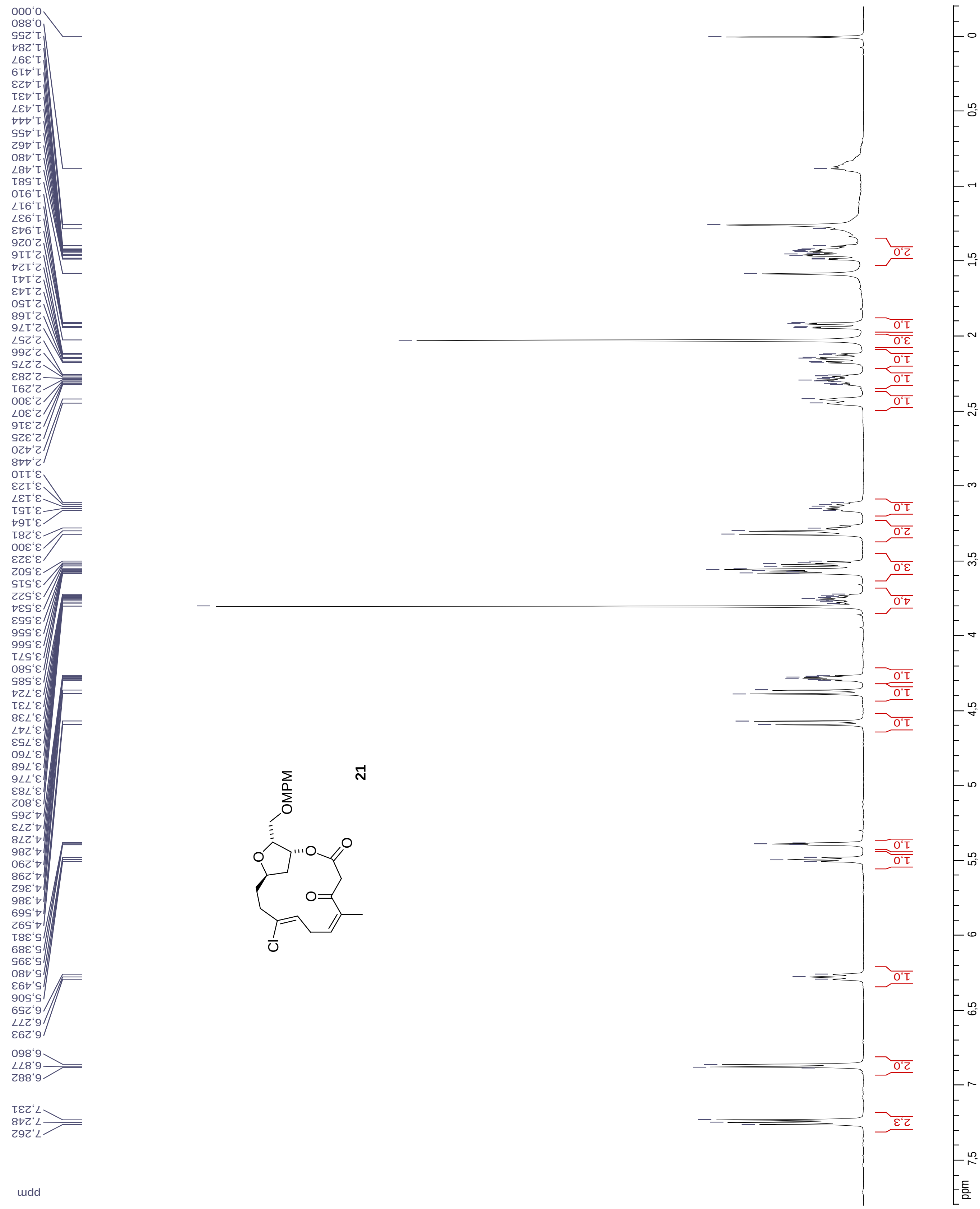
36.142
37.771
37.829
41.756
42.556
55.385
66.338
67.095
68.142
73.131
75.473
75.560
76.244
77.044
79.138
79.444
113.902
122.673
123.924
125.131
126.033
129.495
129.625
130.207
130.280
131.996
133.873
136.316
138.178
159.356
159.400
169.000
170.644
ppm
OMPM
O
O
O
OTBS
Cl
-10
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170
ppm

(viii a,b)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1,487
1,581
1,910
1,917
1,937
1,943
2,026
2,116
2,124
2,141
2,143
2,150
2,168
2,176
2,257
2,266
2,275
2,283
2,291
2,300
2,307
2,316
2,325
2,420
2,448
3,110
3,123
3,137
3,151
3,164
3,281
3,300
3,323
3,502
3,515
3,522
3,534
3,553
3,556
3,566
3,571
3,580
3,585
3,724
3,731
3,738
3,747
3,753
3,760
3,768
3,776
3,783
3,802
4,265
4,273
4,278
4,286
4,290
4,298
4,362
4,386
4,569
4,592
5,381
5,389
5,395
5,480
5,493
5,506
6,259
6,277
6,293
6,860
6,877
6,882
7,231
7,248
7,262
ppm
OMPM
O
O
O
O
Cl
2,0
1,0
3,0
1,0
1,0
1,0
1,0
2,0
3,0
4,0
1,0
1,0
1,0
1,0
1,0
1,0
2,0
2,3
0
0,5
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2
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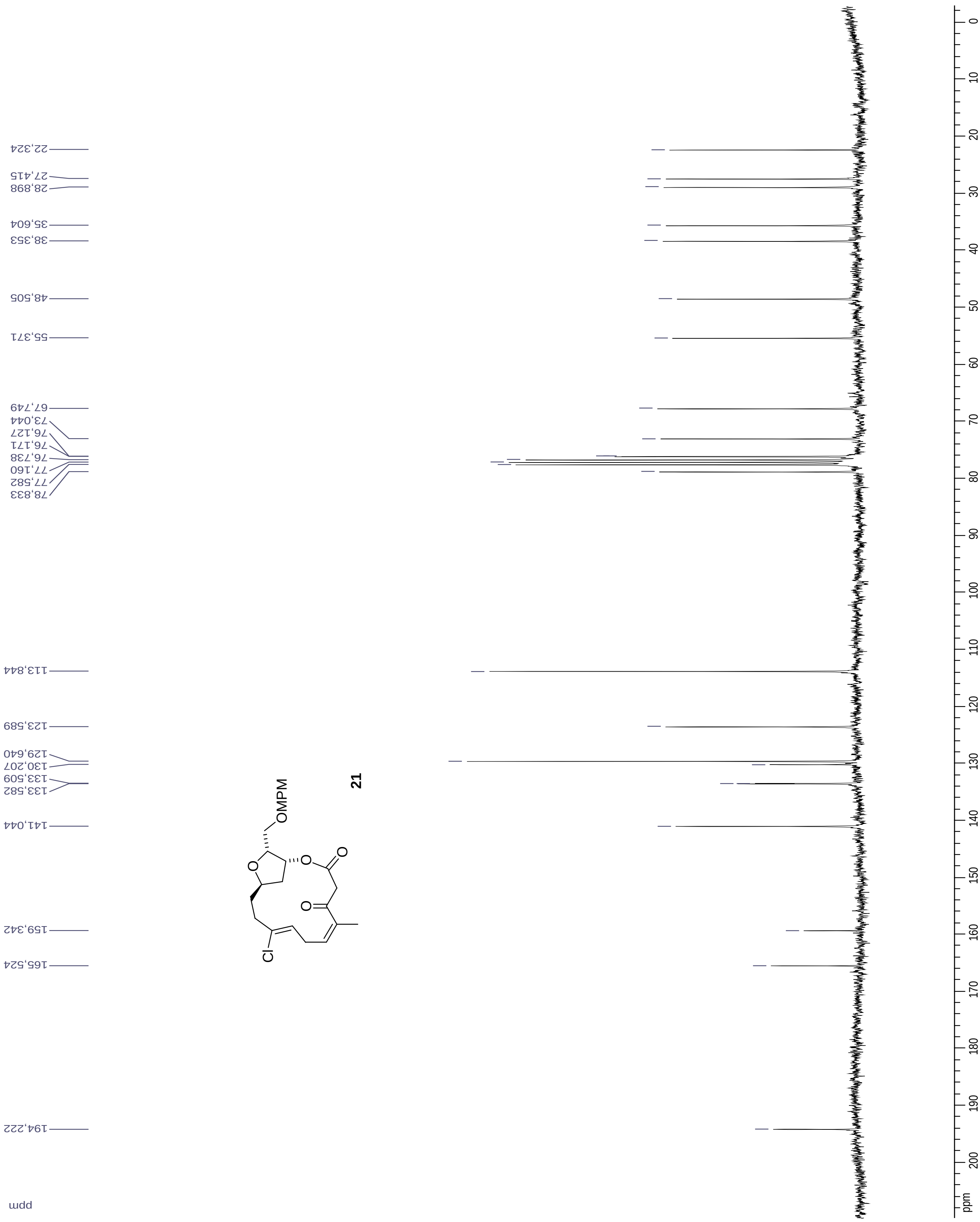
3
3,5
4
4,5
5
5,5
6
6,5
7
7,5
ppm

21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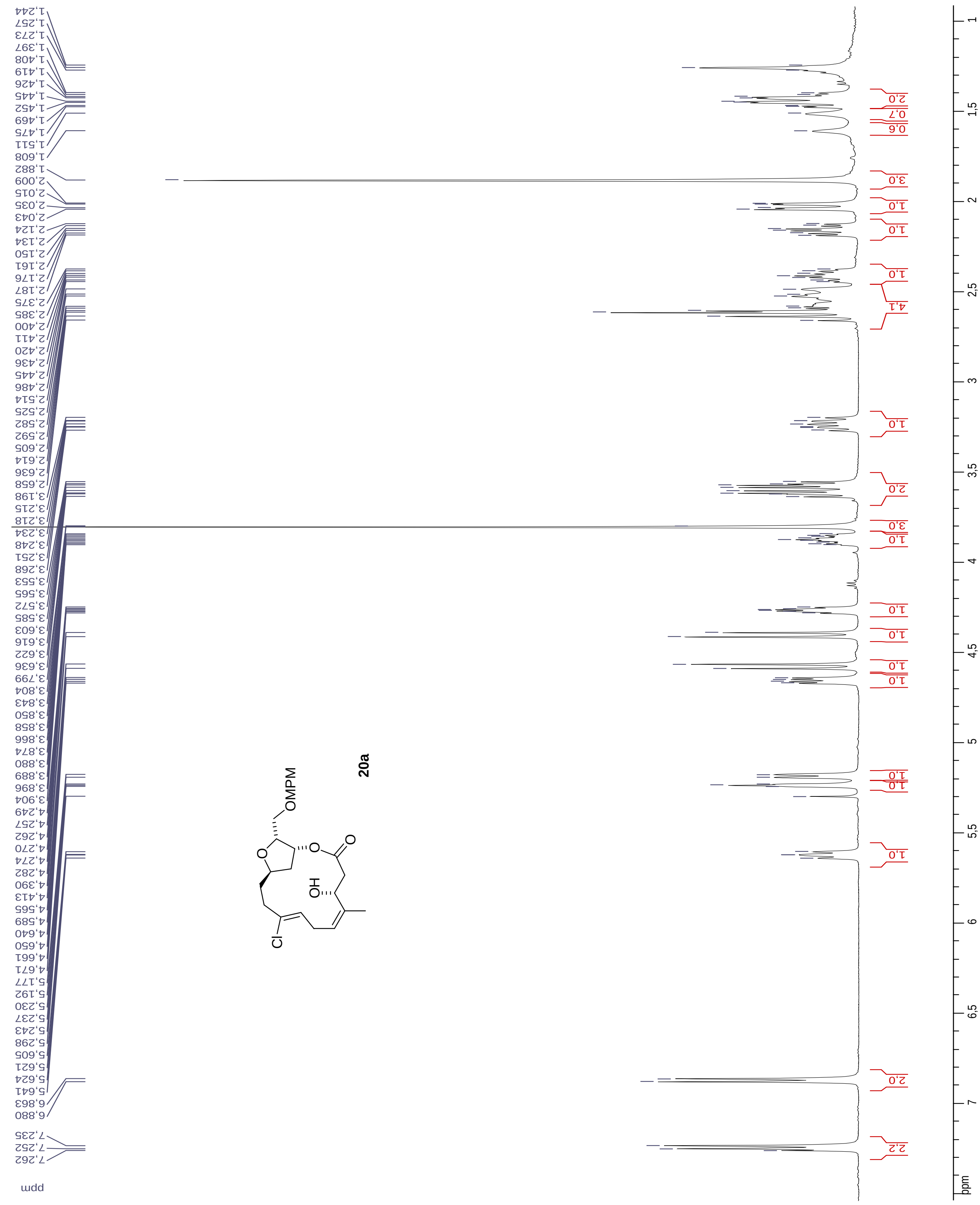
55,371
67,749
73,044
76,127
76,171
76,738
77,160
77,582
78,833
113,844
123,589
129,640
130,207
133,509
133,582
141,044
159,342
165,524
194,222
ppm
OMPM
O
O
O
O
Cl
21
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170
180
190
200
ppm


20a
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O
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OH
Cl
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1,257
1,273
1,397
1,408
1,419
1,426
1,445
1,452
1,469
1,475
1,511
1,608
1,882
2,009
2,015
2,035
2,043
2,124
2,134
2,150
2,161
2,176
2,187
2,375
2,385
2,400
2,411
2,420
2,436
2,445
2,486
2,514
2,525
2,582
2,592
2,605
2,614
2,636
2,658
3,198
3,215
3,218
3,234
3,248
3,251
3,268
3,553
3,565
3,572
3,585
3,603
3,616
3,622
3,636
3,799
3,804
3,843
3,850
3,858
3,866
3,874
3,880
3,889
3,896
3,904
4,249
4,257
4,262
4,270
4,274
4,282
4,390
4,413
4,565
4,589
4,640
4,650
4,661
4,671
5,177
5,192
5,230
5,237
5,243
5,298
5,605
5,621
5,624
5,641
6,863
6,880
7,235
7,252
7,262
ppm
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0,7
0,6
3,0
1,0
1,0
1,0
4,1
1,0
2,0
3,0
1,0
1,0
1,0
1,0
1,0
1,0
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1,0
2,0
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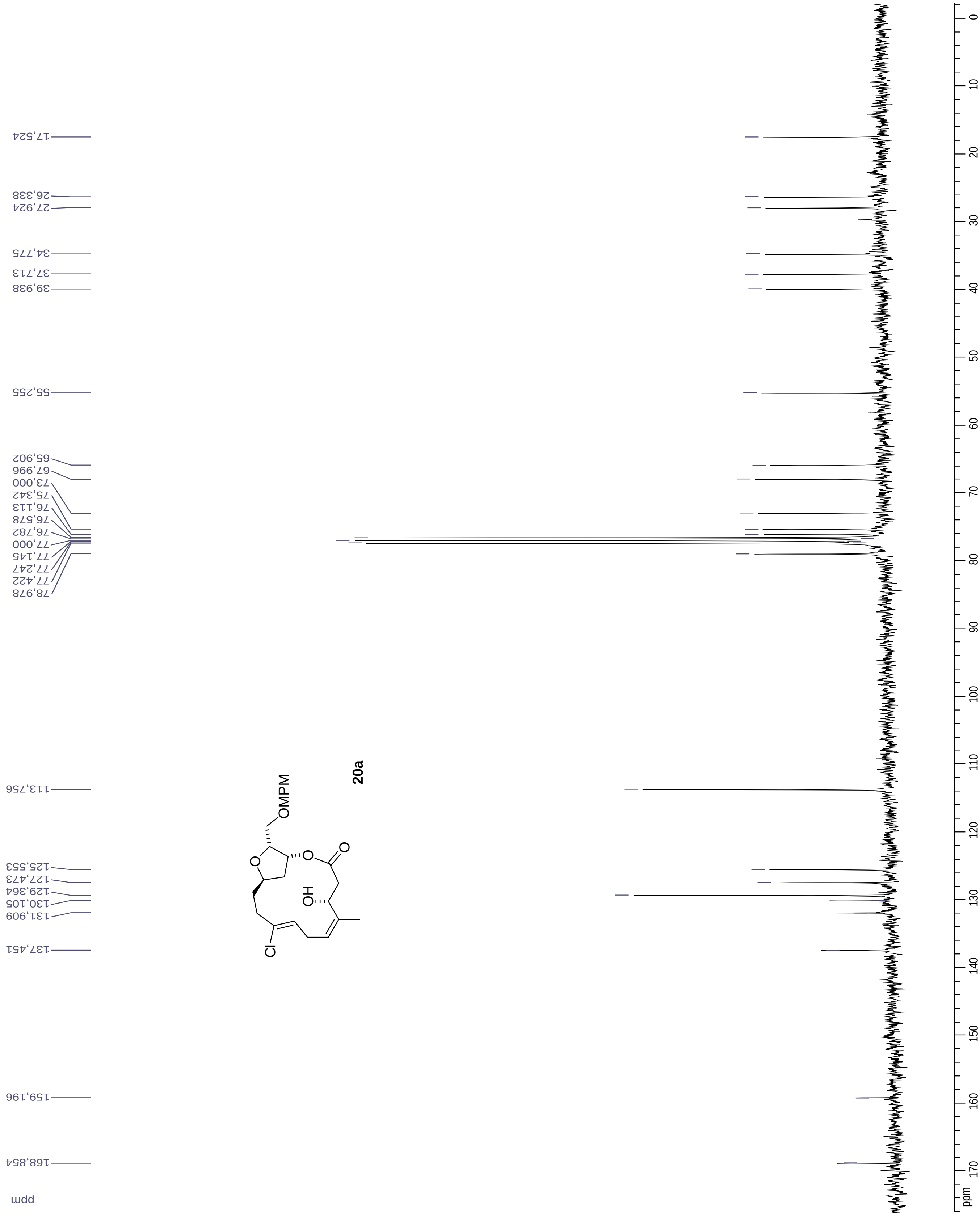
2
2,5
3
3,5
4
4,5
5
5,5
6
6,5
7
ppm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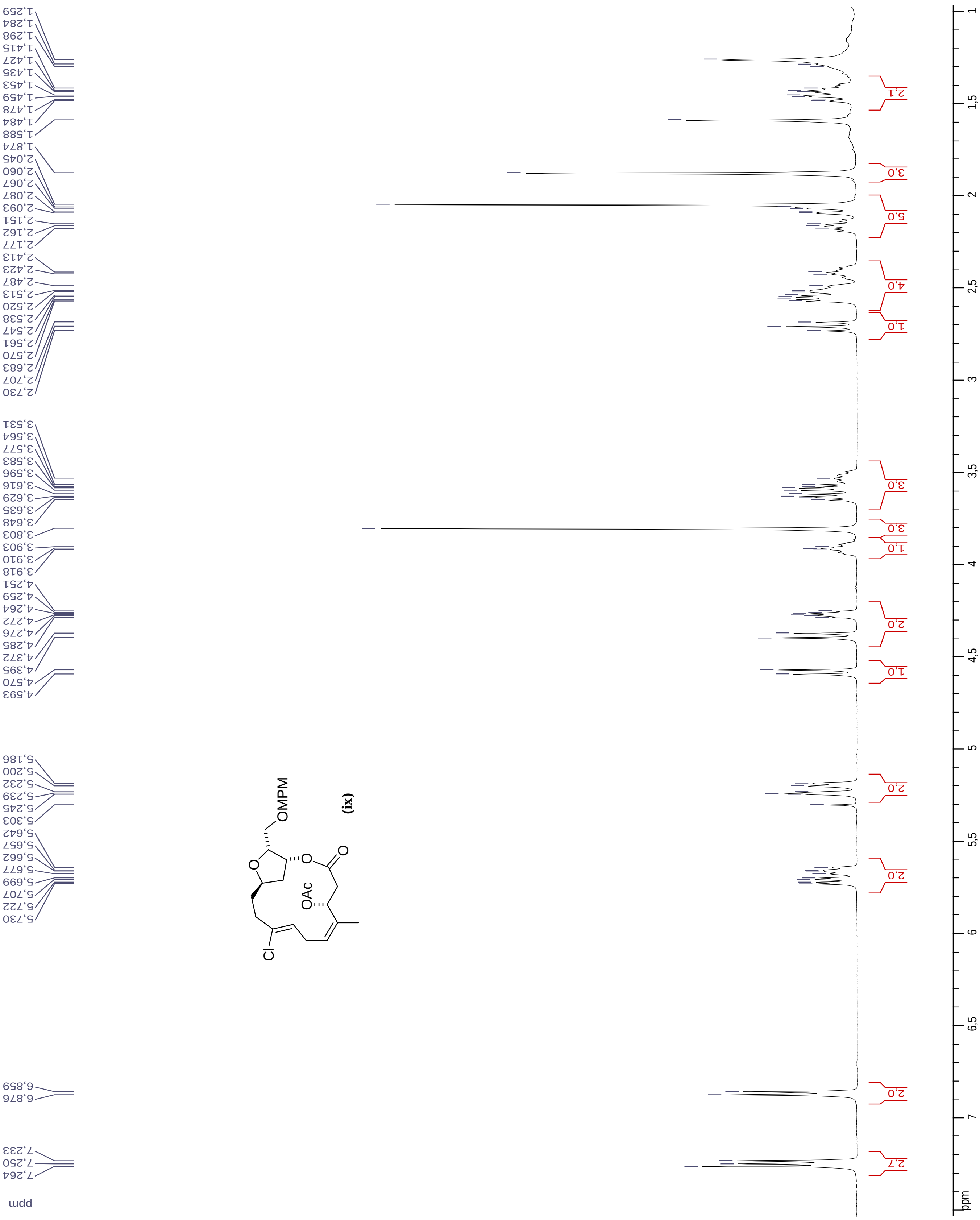
27,924
34,775
37,713
39,938
55,255
65,902
67,996
73,000
75,342
76,113
76,578
76,782
77,000
77,145
77,247
77,422
78,978
113,756
125,553
127,473
129,364
130,105
131,909
137,451
159,196
168,854
ppm
OMPM
O
O
O
OH
Cl
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170
ppm

20a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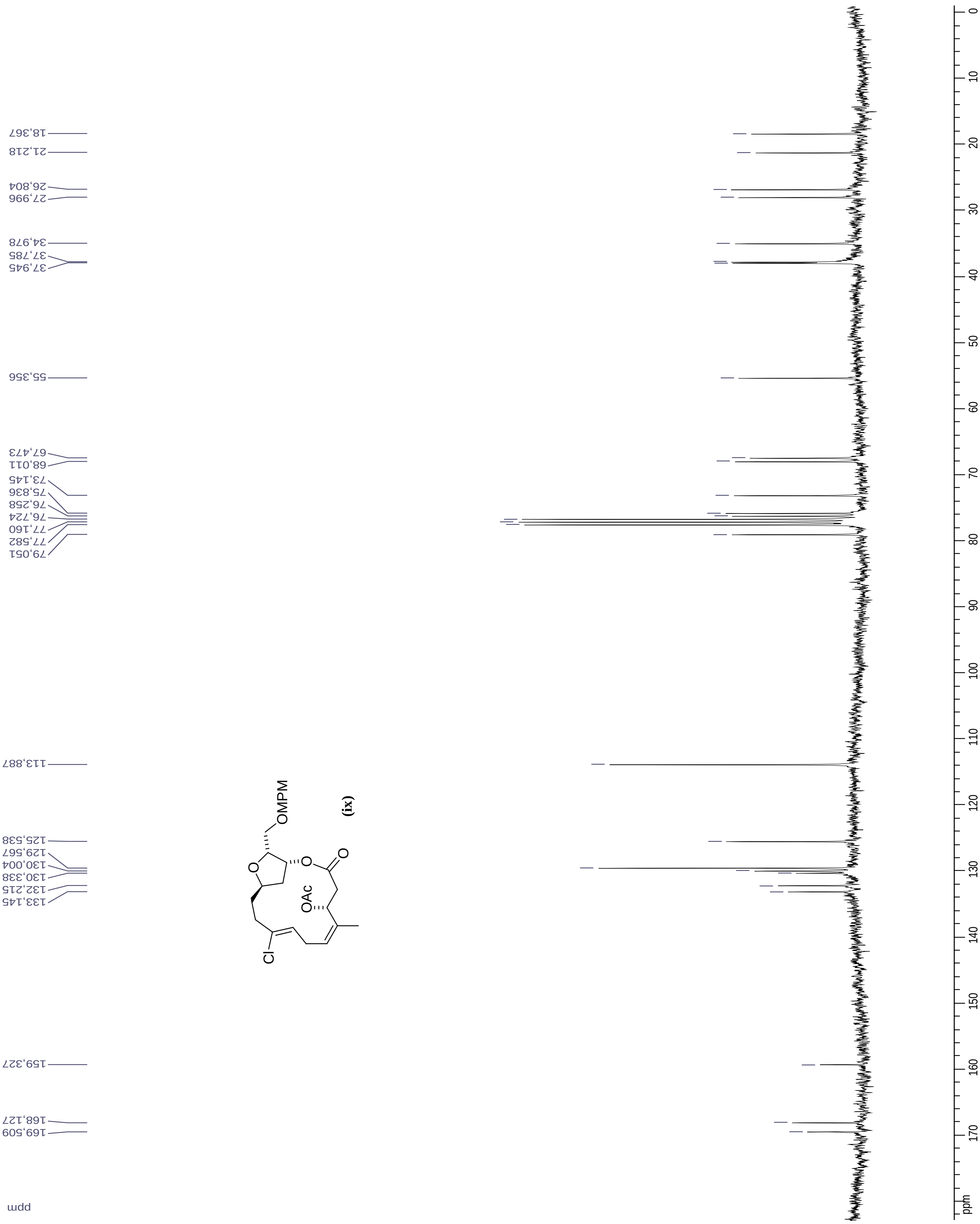
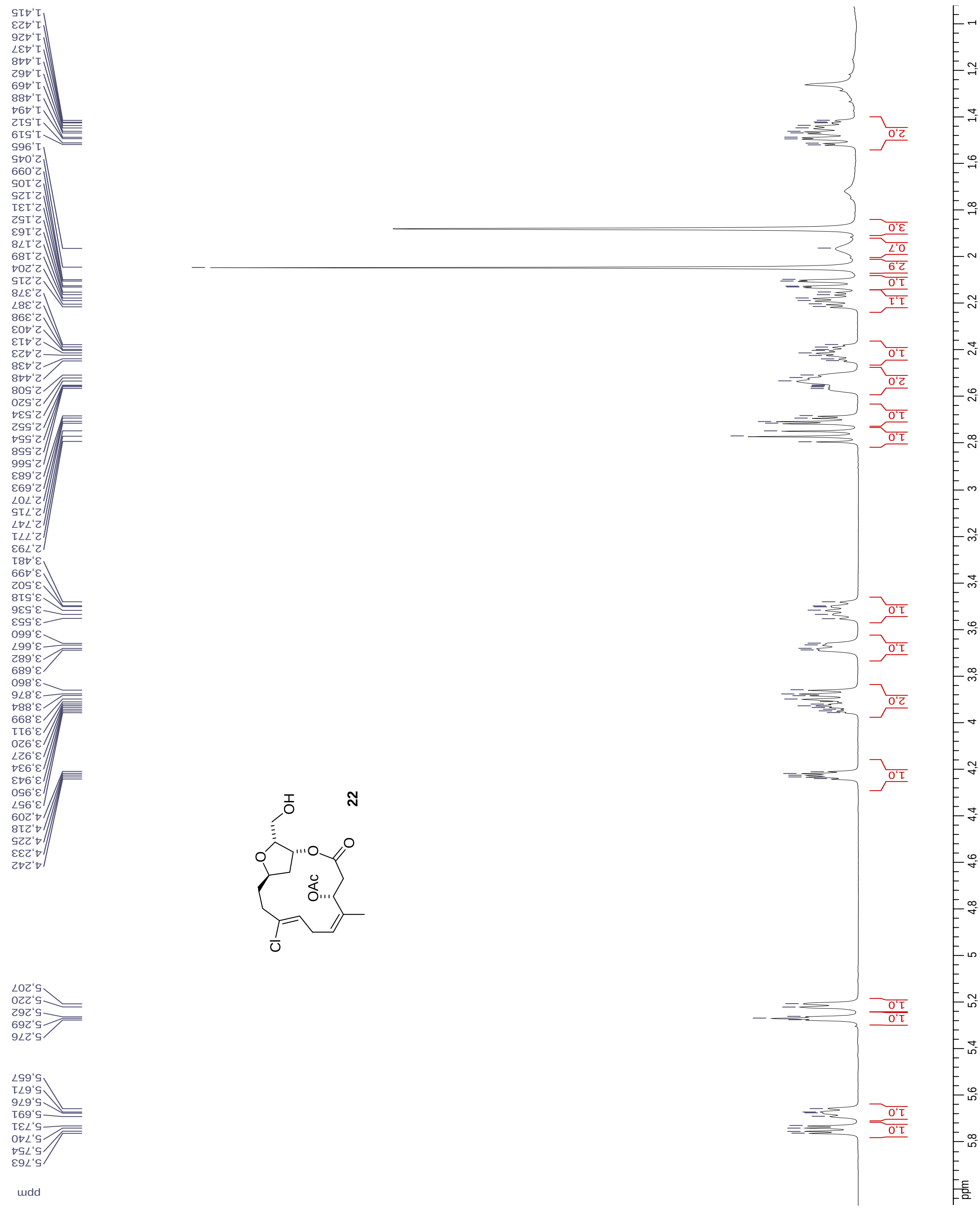
1,298
1,415
1,427
1,435
1,453
1,459
1,478
1,484
1,588
1,874
2,045
2,060
2,067
2,087
2,093
2,151
2,162
2,177
2,413
2,423
2,487
2,513
2,520
2,538
2,547
2,561
2,570
2,683
2,707
2,730
3,531
3,564
3,577
3,583
3,596
3,616
3,629
3,635
3,648
3,803
3,903
3,910
3,918
4,251
4,259
4,264
4,272
4,276
4,285
4,372
4,395
4,570
4,593
5,186
5,200
5,232
5,239
5,245
5,303
5,642
5,657
5,662
5,677
5,699
5,707
5,722
5,730
6,859
6,876
7,233
7,250
7,264
ppm
OMPM
O
O
O
OAc
Cl
2,1
3,0
5,0
4,0
1,0
3,0
3,0
1,0
2,0
1,0
2,0
2,0
2,0
2,7
1
1,5
2
2,5
3
3,5
4
4,5
5
5,5
6
6,5
7
ppm

(ix)


18,367
21,218
26,804
27,996
34,978
37,785
37,945
55,356
67,473
68,011
73,145
75,836
76,258
76,724
77,160
77,582
79,051
113,887
125,538
129,567
130,004
130,338
132,215
133,145
159,327
168,127
169,509
ppm
OMPM
O
O
O
OAc
Cl
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170
ppm

(ix)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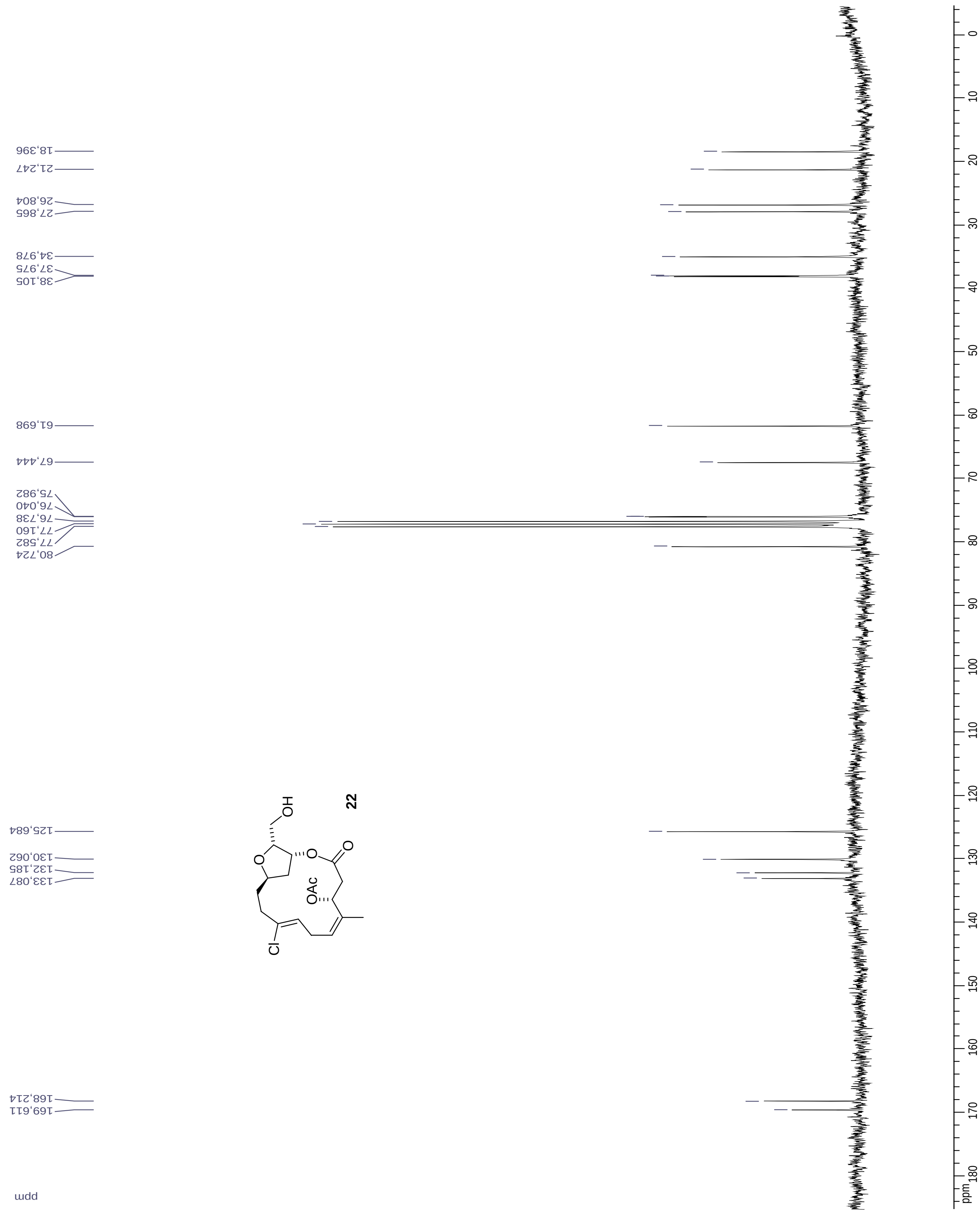
1,423
1,426
1,437
1,448
1,462
1,469
1,488
1,494
1,512
1,519
1,965
2,045
2,099
2,105
2,125
2,131
2,152
2,163
2,178
2,189
2,204
2,215
2,378
2,387
2,398
2,403
2,413
2,423
2,438
2,448
2,508
2,520
2,534
2,552
2,554
2,558
2,566
2,683
2,693
2,707
2,715
2,747
2,771
2,793
3,481
3,499
3,502
3,518
3,536
3,553
3,660
3,667
3,682
3,689
3,860
3,876
3,884
3,899
3,911
3,920
3,927
3,934
3,943
3,950
3,957
4,209
4,218
4,225
4,233
4,242
5,207
5,220
5,262
5,269
5,276
5,657
5,671
5,676
5,691
5,731
5,740
5,754
5,763
ppm
OH
O
O
O
OAc
Cl
2,0
3,0
0,7
2,9
1,0
1,1
1,0
2,0
1,0
1,0
1,0
1,0
2,0
1,0
1,0
1,0
1,0
1,0
1
1,2
1,4
1,6
1,8
2
2,2
2,4
2,6
2,8
3
3,2
3,4
3,6
3,8
4
4,2
4,4
4,6
4,8
5
5,2
5,4
5,6
5,8
ppm

22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26,804
27,865
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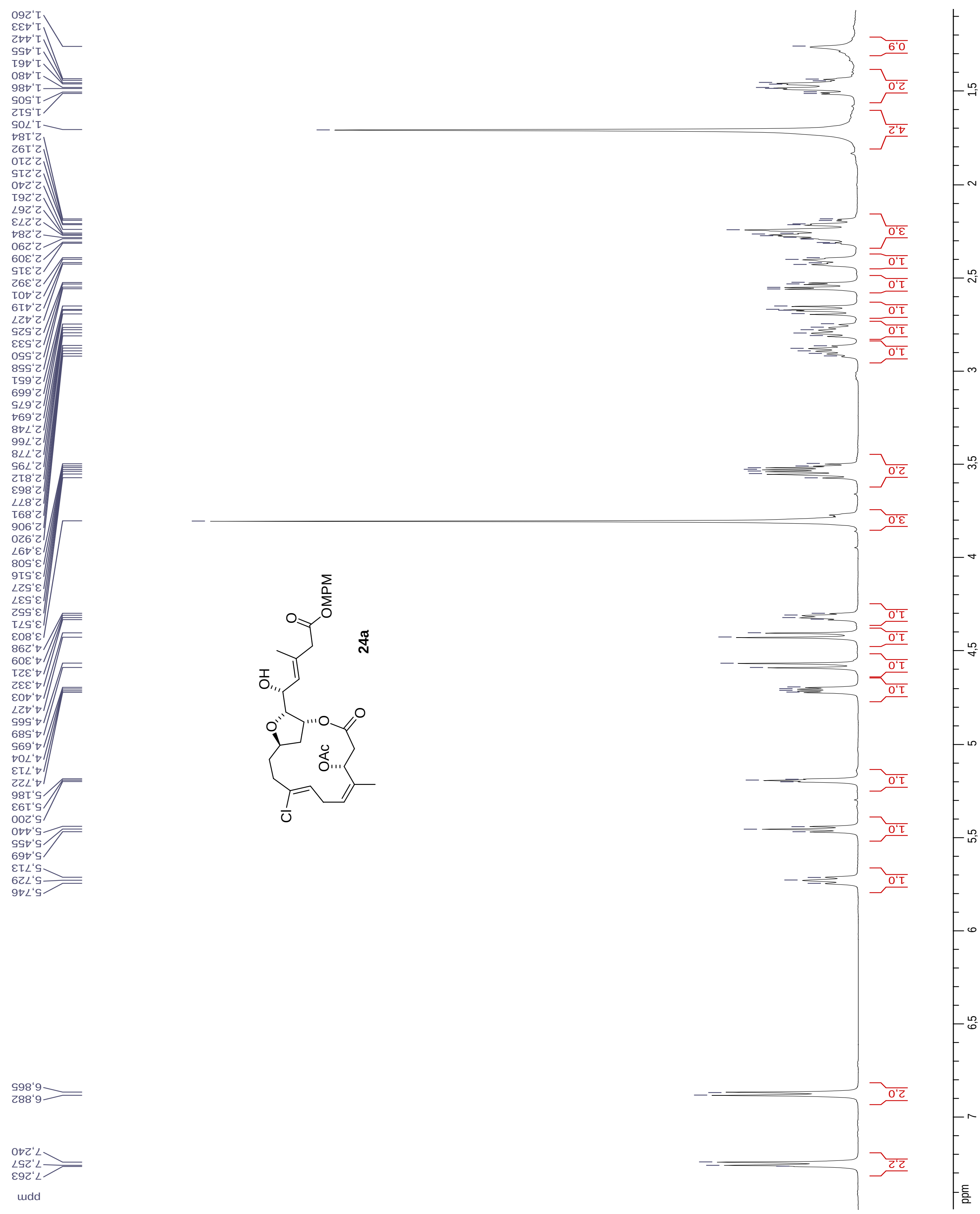
37,975
38,105
61,698
67,444
75,982
76,040
76,738
77,160
77,582
80,724
125,684
130,062
132,185
133,087
168,214
169,611
ppm
OH
O
O
O
OAc
Cl
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170
180
ppm

22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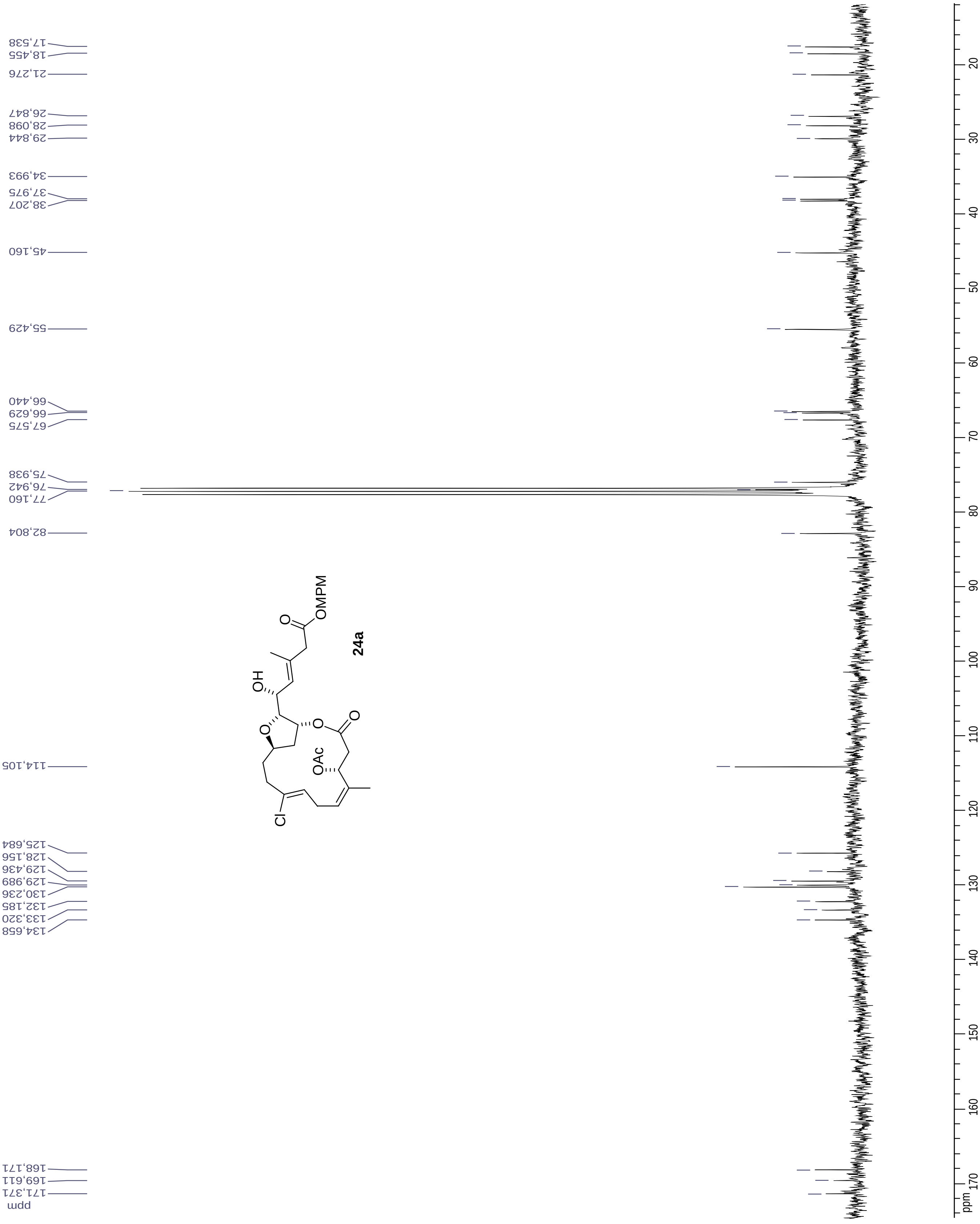
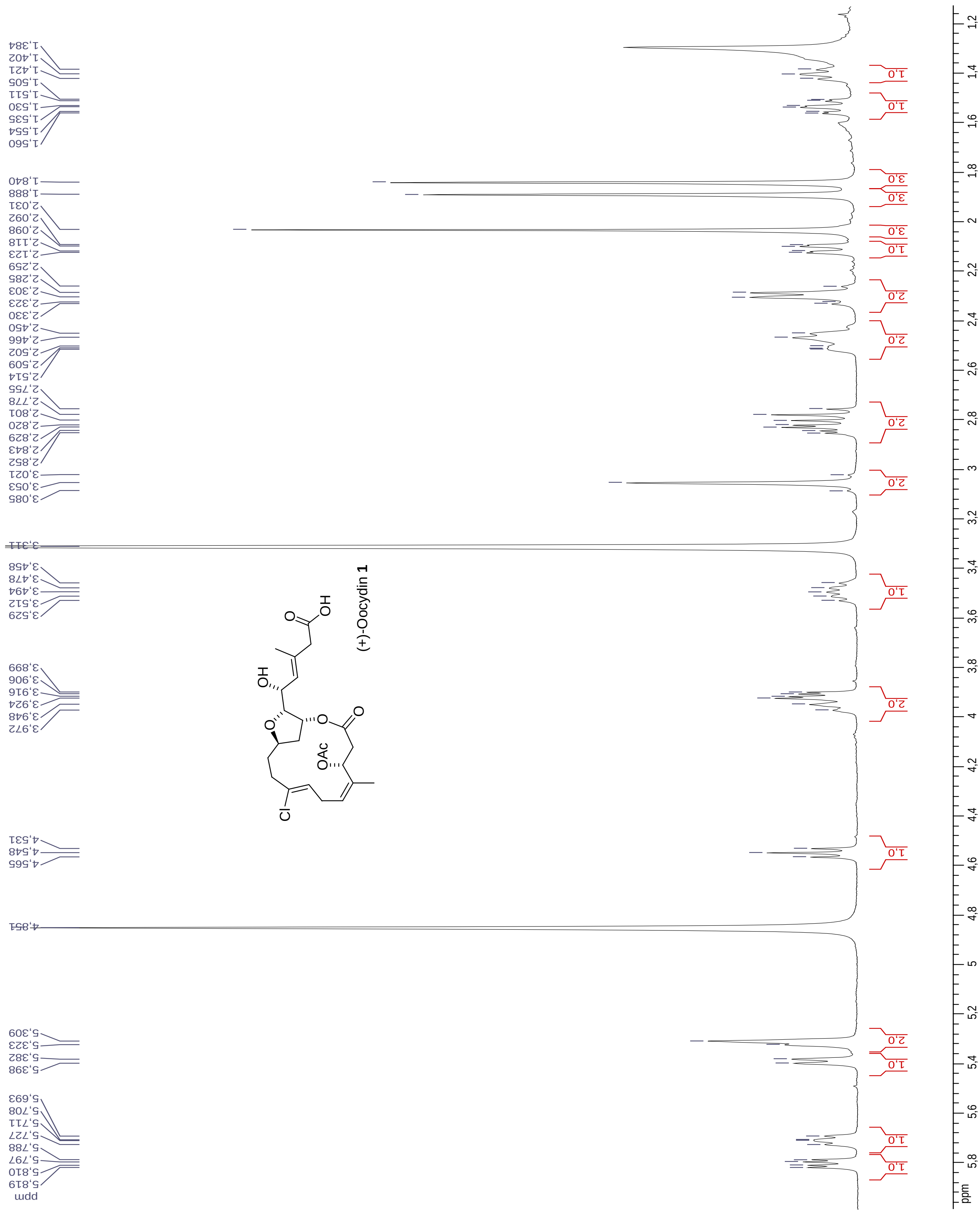
1,433
1,442
1,455
1,461
1,480
1,486
1,505
1,512
1,705
2,184
2,192
2,210
2,215
2,240
2,261
2,267
2,273
2,284
2,290
2,309
2,315
2,392
2,401
2,419
2,427
2,525
2,533
2,550
2,558
2,651
2,669
2,675
2,694
2,748
2,766
2,778
2,795
2,812
2,863
2,877
2,891
2,906
2,920
3,497
3,508
3,516
3,527
3,537
3,552
3,571
3,803
4,298
4,309
4,321
4,332
4,403
4,427
4,565
4,589
4,695
4,704
4,713
4,722
5,186
5,193
5,200
5,440
5,455
5,469
5,713
5,729
5,746
6,865
6,882
7,240
7,257
7,263
ppm
0,9
2,0
4,2
3,0
1,0
1,0
1,0
1,0
1,0
2,0
3,0
1,0
1,0
1,0
1,0
1,0
1,0
1,0
2,0
2,2
1,5
2
2,5
3
3,5
4
4,5
5
5,5
6
6,5
7
ppm
OMPM
O
OH
O
O
O
OAc
Cl

24a


17.538
18.455
21.276
26.847
28.098
29.844
34.993
37.975
38.207
45.160
55.429
66.440
66.629
67.575
75.938
76.942
77.160
82.804
114.105
125.684
128.156
129.436
129.989
130.236
132.185
133.320
134.658
168.171
169.611
171.371
ppm
OMPM
O
OH
O
O
O
OAc
Cl
24a
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170
ppm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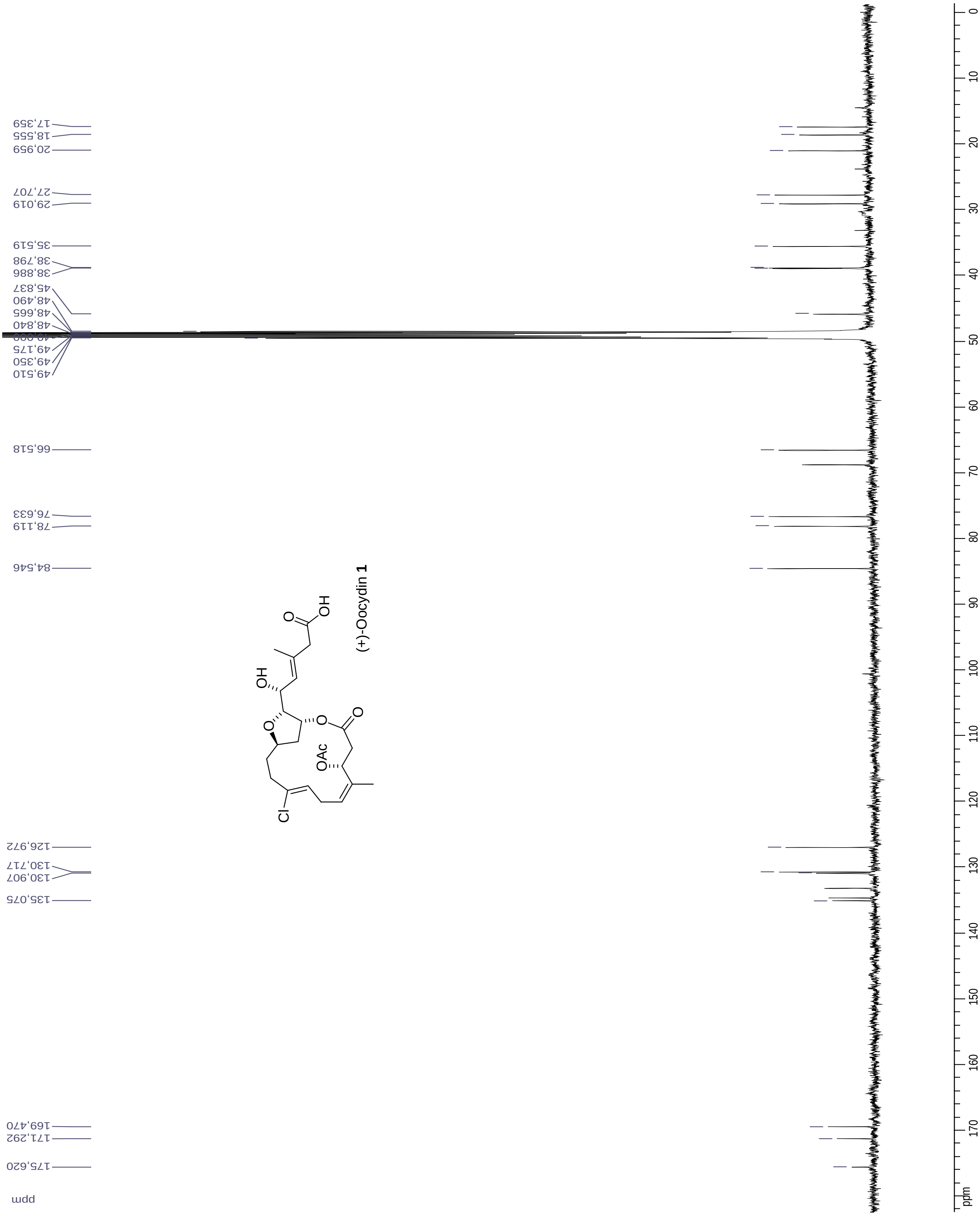
1,505
1,511
1,530
1,535
1,554
1,560
1,840
1,888
2,031
2,092
2,098
2,118
2,123
2,259
2,285
2,303
2,323
2,330
2,450
2,466
2,502
2,509
2,514
2,755
2,778
2,801
2,820
2,829
2,843
2,852
3,021
3,053
3,085
3,311
3,458
3,478
3,494
3,512
3,529
3,899
3,906
3,916
3,924
3,948
3,972
4,531
4,548
4,565
4,851
5,309
5,323
5,382
5,398
5,693
5,708
5,711
5,727
5,788
5,797
5,810
5,819
ppm
1,0
1,0
3,0
3,0
3,0
1,0
2,0
2,0
2,0
2,0
1,0
2,0
1,0
2,0
1,0
1,0
1,0
OH
O
OH
O
O
O
OAc
Cl
(+)-Oocydin **1**
1,2
1,4
1,6
1,8
2
2,2
2,4
2,6
2,8
3
3,2
3,4
3,6
3,8
4
4,2
4,4
4,6
4,8
5
5,2
5,4
5,6
5,8
ppm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18,555
20,959
27,707
29,019
35,519
38,798
38,886
45,837
48,490
48,665
48,840
49,000
49,175
49,350
49,510
66,518
76,633
78,119
84,546
126,972
130,717
130,907
135,075
169,470
171,292
175,620
ppm
OH
O
OH
O
O
O
OAc
Cl
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170
ppm

(+)-Oocydin **1**