Supporting Information

Total Synthesis of Laidlomycin

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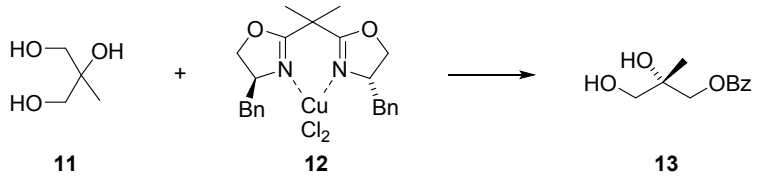
Contents

I. General Information

NMR spectra were obtained on Bruker DPX400 spectrometer and Varian Mercury 400 (400 MHz for ^{1}H NMR, 100 MHz for ^{13}C NMR), and measured in $CDCl_3$. Chemical shifts were recorded in ppm relative to internal standard $CDCl_3$ and coupling constants were reported in Hz. The high resolution mass spectra were recorded on VG Autospec Ultima and JMS-700 spectrometers. The enantioselectivities were determined by HPLC. HPLC measurements were done on a DIONEX model equipped with P580G pump, UV 525 detector (Thermo Science, Waltham, MA) measured at 254 nm, and chiral column DAICEL AD-H. Eluting solvent was a mixture of 2-propanol and hexane. All reactions were carried out in oven-dried glassware under a N_2 atmosphere. All solvents were distilled from the indicated drying reagents right before use: Et_2O and THF (Na, benzophenone), CH_2Cl_2 (P_2O_5), and MeCN, 1,4-dioxane and DMF (CaH_2). The normal work-up included extraction, drying over Na_2SO_4 and evaporation of volatile materials in vacuo. Purification by column chromatography was performed using Merck (Darmstadt, Germany) silica gel 60 (230~400 mesh).

II. Preparation of the Substrates

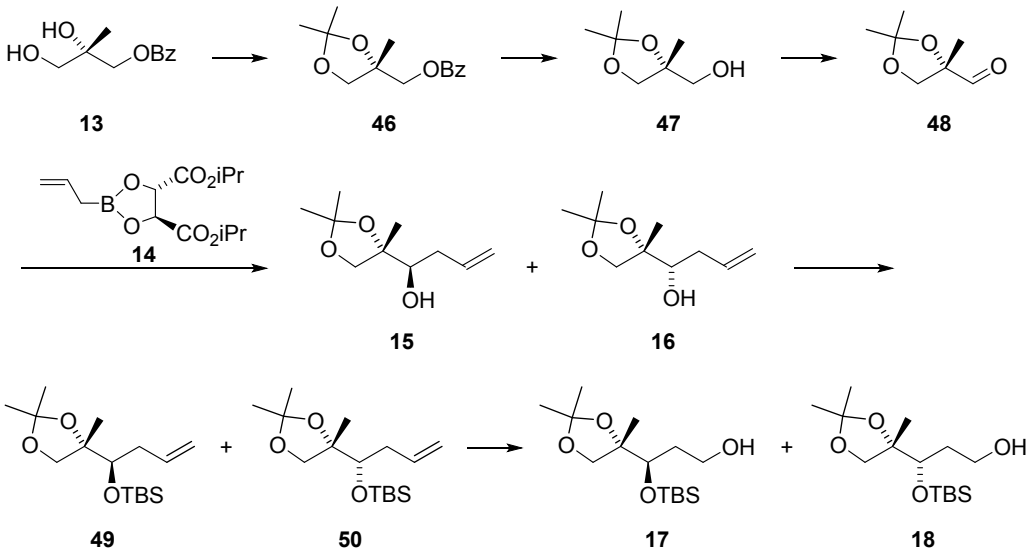
Compound **13**



11 **12** **13**

To **12** (800 mg, 1.6 mmol) dissolved in THF (120 mL) were added **11** (1.71 g, 16.1 mmol) and benzoyl chloride (2.06 mL, 17.71 mmol) dissolved in THF (80 mL), and Et_3N (2.7 mL, 19.32 mmol) dissolved in THF (80 mL) dropwise simultaneously at 25 ^{o}C through two separate cannulas over about 3 hours. The dropping speed was controlled by a few balloons' pressure. After stirring the reaction mixture at RT for an hour, it was quenched with saturated aqueous NH_4Cl (200 mL), worked up with EtOAc (50 mL x 3) and purified chromatographically (Et_2O/hexane = 1/1, then Et_2O) to afford the benzoate **13** (3.28 g, 97% yield). The % ee of **13** was measured by HPLC analysis using a chiral column DAICEL AD-H (hexane/iPrOH = 19/1) to be 96% ee.

Compound **17**



To **13** (3.28 g, 15.6 mmol) dissolved in a mixture of 2,2-dimethoxypropane (2 mL) and acetone (20 mL) was added p-TsOH·H_2O (148 mg, 0.78 mmol) in an ice bath, and the resulting solution was stirred at that temperature for 3 hours. After quenching the reaction with saturated aqueous $NaHCO_3$ (0.2 mL), all the volatile materials were evaporated in vacuo and the residue was separated chromatographically (Et_2O/hexane = 1/9) to deliver the acetonide **46** (3.51 g, 90% yield). To **46** (3.51 g. 14.0 mmol) dissolved in MeOH (10 mL) was added K_2CO_3 (967 mg, 7.0 mmol) at RT and the mixture was stirred at 25 °C until **46** disappeared by TLC. The reaction solution was evaporatd at 5 °C with a rotary evaporator due to the product volatility and the residue was purified by column chromatography ((Et_2O/penane = 1/7, then 1/1) to afford the alcohol **47** (1.89 g, 92% yield).

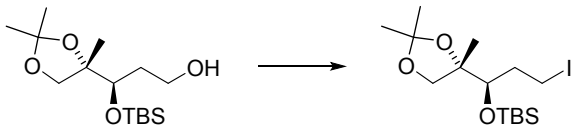
For **47**: ^{1}H NMR (400 MHz, $CDCl_3$) δ 3.97 (d, *J* = 8.5 Hz, 1H), 3.72 (d, *J* = 8.5 Hz, 1H), 3.48 (qd, *J* = 11.3, 6.1 Hz, 2H), 1.97 (t, *J* = 6.3 Hz, 1H), 1.41 (d, *J* = 5.4 Hz, 6H), 1.29 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 109.82, 83.29, 76.20, 74.28, 37.17, 27.47, 27.13, 26.04, 19.21, 18.30, 4.54, -3.30, -4.34; HRMS (ESI) *m*/*z* calcd for $C_7H_{14}NaO_3$ ([M + Na]$^+$) 169.0835, found 169.0847.

To oxalyl chloride (1.47 mL, 16.8 mmol) dissolved in CH_2Cl_2 (25 mL) was injected DMSO (2.51 mL, 35.3 mmol) dropwise at –78 °C over 5 minutes. After stirring the solution at –78 °C for 20 minutes, **47** (1.23 g, 8.4 mmol) was added with a cannula using CH_2Cl_2 (10 mL + 5 mL) at –78 °C over 7-8 minutes. The reaction mixture was stirred at –78 °C for an hour and Et_3N (7 mL, 50.5 mmol) was injected dropwise at –78 °C over 5 minutes. The reaction

temperature of the solution was raised from –78 to 0 °C over 1.5 hours and the reaction was quenched with H_2O (30 mL) at 0 °C. The resulting solution was extracted with a 4 to 1 mixture of Et_2O and pentane (30 mL x 4), and the combined organic layer was washed with brine (10 mL) and saturated aqueous NH_4Cl (10 mL). The organic layer was dried with $MgSO_4$ (3 g), filtered through celite (1 g) and evaporated with a rotary evaporator in an ice bath due to the product volatility to yield the corresponding crude aldehyde **48**. To the freshly prepared allylating reagent **14** (0.5 M in toluene, 34 mL, 17.0 mmol) was added powdered 4Å molecular sieve (dried under a 0.5 mmHg vacuum line at 100°C for 10 hours) at 25 °C, and the mixture was stirred at 25 °C for 30 minutes and cooled down to –78 °C. All the prepared crude aldehyde **48** dissolved in toluene (10 mL + 5 mL) was injected to the resulting solution with a cannula at –78 °C over 15 minutes. The reaction solution was stirred at –78 °C until the starting aldehyde **48** disappeared by TLC (it took about 3 hours). The resulting mixture was filtered through celite (1 g) using CH_2Cl_2 (20 mL), and aqueous NaOH (2 M, 34 mL) was added to the filtrate. H_2O_2 was not used during the work-up. After stirring the solution at 25 °C for 2 hours, the normal work-up with Et_2O (30 mL x 4) and column chromatography (pentane, then Et_2O/pentane = 1/3) furnished a diastereomeric mixture of the allylic alcohols **15** and **16** (1.31 g, 84% combined yield). To the mixture of **15** and **16** (1.31 g, 7.03 mmol) dissolved in CH_2Cl_2 (20 mL) were added 2,6-lutidine (1.63 mL, 14.0 mmol) at once and TBSOTf (2.4 mL, 10.5 mmol) dropwise over 5 minutes in an ice bath. After stirring the reaction mixture at that temperature for 12 hours, it was quenched with saturated aqueous $NaHCO_3$ (15 mL), worked up with Et_2O (20 mL x 3) and separated chromatographically (Et_2O/hexane = 1/9) to give a roughly purified mixture of the TBS ethers **49** and **50**. To all the mixture dissolved in MeOH (50 mL) was bubbled O_3 at –78 °C until the blue color persisted in the solution (it took about 20 minutes). After bubbling O_2 at –78 °C until the blue color disappeared to remove the excess O_3, the dry ice/acetone bath was changed to an ice bath. $NaBH_4$ (500 mg, 13.2 mmol) was added to the reaction mixture at that temperature and it was stirred at the same temperature for an hour. The operation was repeated until all the aldehydes disappeared by TLC. In this case, it was repeated 5 times. The reaction was quenched by adding saturated aqueous NH_4Cl (40 mL) dropwise in an ice bath and stirred at that temperature for 30 minutes. After evaporating MeOH in vacuo, H_2O (20 mL) was added to the residue. The normal work-up with Et_2O (50 mL x 4) and chromatographic isolation (Et_2O/hexane = 1/9, 1/4, then 1/1) provided the desired alcohol **17** (1.93 g, 90% yield) and the isomeric alcohol **18** (148 mg, 7% yield).

For **17**: ^{1}H NMR (400 MHz, $CDCl_3$) δ 3.95 (d, *J* = 8.7 Hz, 1H), 3.74 (d, *J* = 8.7 Hz, 1H), 3.74 – 3.63 (m, 2H), 2.74 (br, 1H), 1.96 (m, 1H), 1.72 (m, 1H), 1.40 (d, *J* = 7.7 Hz, 6H), 1.28 (s, 3H), 0.86 (s, 9H), 0.08 (s, 6H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 110.04, 83.35, 75.75, 74.87, 60.18, 37.24, 27.32, 27.09, 25.94, 18.92, 18.10, -3.63, -4.59; HRMS (ESI) *m*/*z* calcd for $C_{15}H_{32}NaO_4Si$ ([M + Na]$^+$) 327.1962, found 327.1948.

Compound **19**

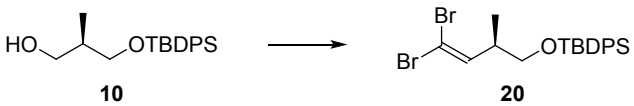


17 **19**

To PPh_3 (1.52 g, 5.78 mmol) and imidazole (394 mg, 5.78 mmol) dissolved in CH_2Cl_2 (40 mL) was added I_2 (1.45 g, 5.71 mmol) at 25 °C, and the mixture was stirred at 25 °C for 15 minutes. **17** (1.1 g, 3.6 mmol) was injected to the mixture in an ice bath through a cannula using CH_2Cl_2 (5 mL + 3 mL + 2 mL) over 5 minutes. After stirring the reaction solution in an ice bath for an hour, it was quenched with saturated aqueous $Na_2S_2O_3$ (5 mL) at that temperature. The normal work-up with CH_2Cl_2 (5 mL x 3) and column chromatography (Et_2O/hexane = 1/20) imparted the iodide **19** (1.44 g, 96% yield) ($[\alpha]_D^{25}$ = +7.14, c = 0.98 in EtOAc).

For **19**: ^{1}H NMR (400 MHz, $CDCl_3$) δ 3.95 (d, *J* = 8.7 Hz, 1H), 3.67 (d, *J* = 8.7 Hz, 1H), 3.67 – 3.64 (m, 1H), 3.36 (ddd, *J* = 9.6, 7.8, 6.1 Hz, 1H), 3.23 (dt, *J* = 9.6, 7.6 Hz, 1H), 2.29 (dd, *J* = 14.7, 5.0 Hz, 1H), 1.92 (ddt, *J* = 14.7, 7.5, 6.3 Hz, 1H), 1.38 (d, *J* = 9.3 Hz, 6H), 1.23 (s, 3H), 0.87 (s, 9H), 0.13 (d, *J* = 2.1 Hz, 6H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 109.82, 83.29, 76.20, 74.28, 37.17, 27.47, 27.13, 26.04, 19.21, 18.30, 4.54, -3.30, -4.34; HRMS (ESI) *m*/*z* calcd for $C_{15}H_{31}INaO_3Si$ ([M + Na]$^+$) 437.0979, found 437.0991.

Compound **20**



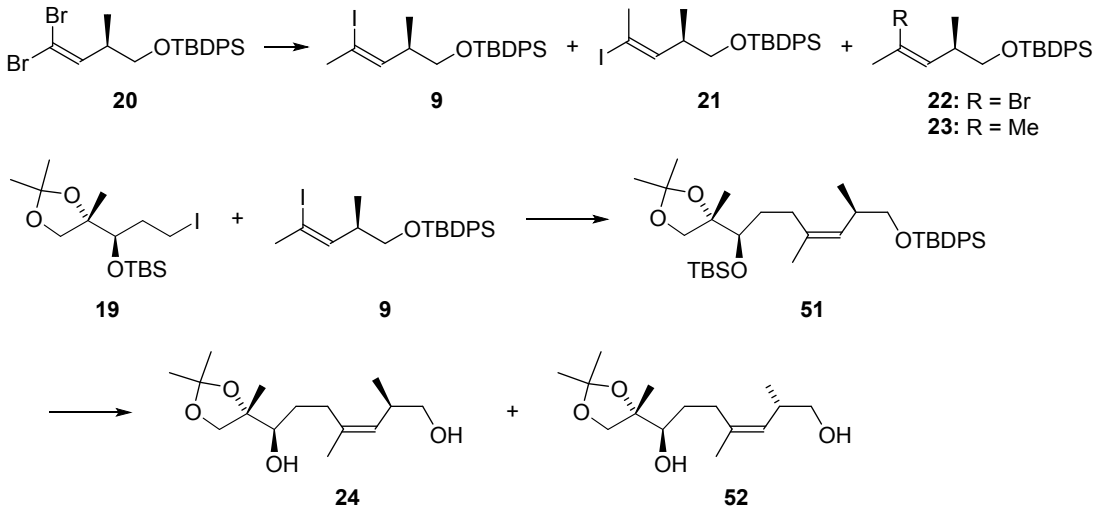
10 **20**

To oxalyl chloride (1.28 mL, 14.8 mmol) dissolved in CH_2Cl_2 (60 mL) was injected DMSO (2.18 mL, 30.7 mmol) dropwise at -78 °C over 5 minutes. After stirring the solution at –78 °C for 20 minutes, **10** (3.26 g, 9.9 mmol) was added with a cannula using CH_2Cl_2 (10 mL + 5

mL + 5 mL) at -78 °C over 7-8 minutes. The reaction mixture was stirred at –78 °C for an hour and iPr_2NEt (6.47 mL, 37.1 mmol) was injected dropwise at –78 °C over 10 minutes. The reaction temperature of the solution was raised from –78 to –20 °C over 2 hours and the reaction was quenched with saturated aqueous NH_4Cl (30 mL) at –20 °C. The resulting mixture was extracted with Et_2O (300 mL + 40 mL + 40 mL), and the combined organic layer was dried with Na_2SO_4 (5 g), filtered through celite (2 g) with Et_2O (50 mL) and evaporated in vacuo to give rise to the crude aldehyde. To PPh_3 (13 g, 49.5 mmol) dissolved in CH_2Cl_2 (100 mL) was added CBr_4 (8.2 g, 24.7 mmol) in an ice bath and the solution was stirred at that temperature for 10 minutes. All of the crude aldehyde was injected to the prepared mixture in an ice bath through a cannula using CH_2Cl_2 (30 mL + 10 mL + 10 mL) over 15 minutes. After stirring the reaction solution in an ice bath for 20 minutes, it was quenched with saturated aqueous $NaHCO_3$ (30 mL). The organic layer was separated from the resulting mixture and the aqueous layer was extracted with CH_2Cl_2 (30 mL x 2). The combined organic layer was evaporated in vacuo and the residue was filtered through silica gel (120 g) using CH_2Cl_2 for loading and Et_2O/hexane (1/9) for elution. After removal of the volatile materials from the collected filtrate in vacuo, the residue was purified by column chromatography (hexane, then Et_2O/hexane = 1/25) to produce the vinyl dibromide **20** (4.26 g, 89% yield).

For **20**: ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.71 – 7.60 (m, 4H), 7.50 – 7.32 (m, 6H), 6.28 (dd, J = 9.2, 0.9 Hz, 1H), 3.62 – 3.48 (m, 2H), 2.79 – 2.63 (m, 1H), 1.06 (d, J = 1.0 Hz, 9H), 1.04 (dd, J = 6.8, 0.9 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 141.65, 135.84, 135.79, 133.74, 133.69, 129.87, 129.85, 127.88, 88.85, 66.92, 41.20, 27.01, 19.47, 15.71; HRMS (ESI) *m*/*z* calcd for $C_{21}H_{26}Br_2NaOSi$ ($[M + Na]^+$) 503.0011, found 503.0039.

Compound **24**

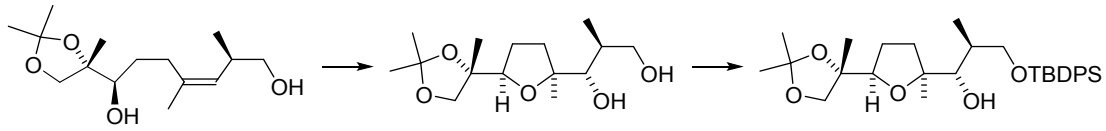


To a slurry of CuI (857 mg, 4.5 mmol) in Et_2O (5.6 mL) was injected MeLi (1.6 M in Et_2O, 5.6 mL, 9.0 mmol) at 0 °C over 5 minutes, and the mixture was stirred at 0 °C for 5 minutes and cooled down to –78 °C. **20** (724 mg, 1.5 mmol) dissolved in Et_2O (5.6 mL) was added to the above solution through a syringe pump at –78 °C over 20 minutes and the reaction mixture was stirred at –78 °C for 1.5 hours. To the resulting solution was added I_2 (2.28 g, 9.0 mmol) dissolved in Et_2O (20 mL) dropwise through a cannula at –78 °C and the mixture was stirred at –78 °C for 10 minutes. After the reaction bath was removed, the reaction was quenched with saturated aqueous NH_4Cl (5 mL) and saturated aqueous $Na_2S_2O_3$ (5 mL). The normal work-up with Et_2O (10 mL x 3) and chromatographic separation (hexane) rendered a 10 : 0.75 : 1 : 1 mixture of **9**, **21**, **22** and **23** (631 mg). Their ratio was roughly determined by the discretely separated vinyl protons in the ^1H NMR spectra. Since **21** could be removed from the mixture chromatographically, the mixture of **9**, **22** and **23** without **21** was used in the next step. To **19** (883 mg, 2.13 mmol) dissolved in Et_2O (12 mL) was added tBuLi (1.5 M in pentane, 3.1 mL, 4.68 mmol) dropwise at –78 °C within a few minutes. After stirring the solution at –78 °C for 3 minutes, B-MeO-9-BBN (1.0 M in hexane, 4.9 mL, 4.9 mmol) was injected dropwise at –78 °C over 5 minutes. THF (12 mL) precooled at –78°C was added quickly to the reaction solution and the resulting solution was stirred at that temperature for 10 minutes. The reaction bath was removed and the reaction mixture was stirred at 25 °C for 1.5 hours. The reaction flask was opened to the air by removing a N_2 balloon and aqueous K_3PO_4 (3.0 M, 3.5 mL, 10.5 mmol) was added at 25 °C. Subsequently, the mixture of **9**, **22** and **23** (1.16 g, the approximate amount of **9** was 990 mg, 2.13 mmol) dissolved in DMF (12

mL), and Pd(dppf)Cl_2·CH_2Cl_2 (87 mg, 0.1 mmol) were added sequentially to the prepared borane reagent at 25 °C. The reaction mixture was stirred at 25 °C for 30 minutes and H_2O (15 mL) was added. The normal work-up with Et_2O (20 mL x 3) and column chromatography (hexane, then Et_2O/hexane = 1/20) yielded the coupled product **51** contaminated with some unknown impurities. To the impure **51** dissolved in THF (6 mL) was added nBu_4NF (1.0 M in THF, 6 mL, 6.0 mmol) at 25 °C and the mixture was stirred at 60 °C for 3 hours. After evaporating all the volatile materials in vacuo, the residue was separated by column chromatography (Et_2O/hexane = 1/1, then EtOAc/hexane = 1/1) to procure the desired diol **23** (523 mg, 90% yield) and the diastereomeric diol **52** (4.6 mg, 0.8% yield).

For **24**: ^{1}H NMR (400 MHz, $CDCl_3$) δ 4.92 (dd, *J* = 9.7, 1.6 Hz, 1H), 4.02 (d, *J* = 8.5 Hz, 1H), 3.65 (d, *J* = 8.4 Hz, 1H), 3.54 – 3.44 (m, 2H), 3.28 (dd, *J* = 10.3, 8.6 Hz, 1H), 2.75 – 2.61 (m, 1H), 2.48 (br, 1H), 2.32 (ddd, *J* = 14.0, 8.9, 5.4 Hz, 1H), 2.26 – 2.14 (m, 1H), 1.73 (d, *J* = 1.4 Hz, 3H), 1.70 – 1.61 (m, 1H), 1.40 (d, *J* = 22.4 Hz, 6H), 1.35 – 1.26 (m, 1H), 1.24 (s, 3H), 0.91 (d, J = 6.7 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 137.55, 128.84, 109.53, 83.77, 74.75, 70.63, 68.13, 35.44, 29.71, 29.39, 27.61, 26.87, 23.61, 21.59, 17.50; HRMS (ESI) *m*/*z* calcd for $C_{15}H_{28}NaO_4$ ([M + Na]$^+$) 295.1879, found 295.1875.

Compound **25**



To **24** (494 mg, 1.81 mmol) dissolved in CH_2Cl_2 (24 mL) were added $VO(acac)_2$ (24 mg, 0.09 mmol) and $tBuO_2H$ (3.5 M in toluene, 1.03 mL, 3.6 mmol) in an ice bath sequentially, and the mixture was stirred at that temperature for 5 hours. After quenching the reaction with saturated aqueous $Na_2S_2O_3$ (1 mL) and saturated aqueous $NaHCO_3$ (1 mL), the normal work-up with EtOAc (5 mL x 5) revealed the crude epoxide. To the crude epoxide dissolved in CH_2Cl_2 (20 mL) was added camphor-10-sulfonic acid (8 mg, 0.036 mmol) in an ice bath and the reaction solution was stirred at that temperature for 2 hours. The reaction mixture was quenched with saturated aqueous $NaHCO_3$ (5 mL), worked up with EtOAc (10 mL x 4) and purified chromatographically (EtOAc/hexane = 1/1) to supply the diol **27** (473 mg, 91% yield) ($[\alpha]_D^{17}$ = –2.06, c = 1.0 in EtOAc).

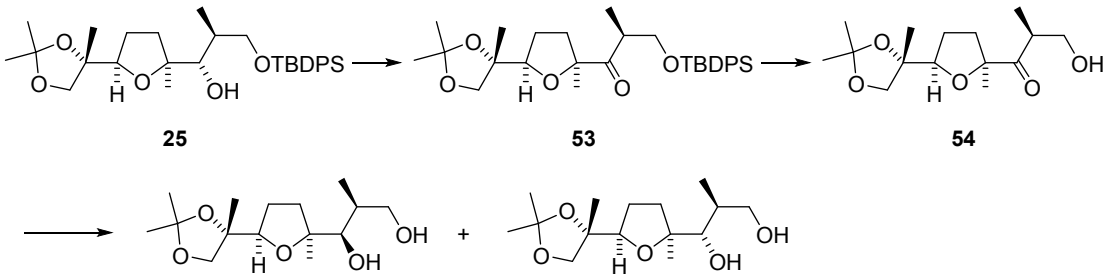
For **27**: ^{1}H NMR (400 MHz, $CDCl_3$) δ 4.02 – 3.96 (m, 2H), 3.87 (d, *J* = 8.9 Hz, 1H), 3.73 (d,

J = 8.8 Hz, 1H), 3.67 (ddd, *J* = 11.4, 8.0, 3.2 Hz, 1H), 3.50 (ddd, *J* = 11.7, 10.2, 3.0 Hz, 1H), 3.39 (m, 2H), 2.32 – 2.23 (m, 1H), 2.02 (m, 3H), 1.75 – 1.67 (m, 1H), 1.46 (s, 3H), 1.40 (s, 3H), 1.37 (s, 3H), 1.27 (s, 3H), 0.97 (d, *J* = 7.1 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 86.57, 83.87, 82.67, 80.54, 72.02, 64.26, 36.95, 36.56, 26.89, 26.52, 26.35, 23.79, 23.38, 16.85; HRMS (ESI) *m*/*z* calcd for $C_{15}H_{28}NaO_5$ ([M + Na]$^+$) 311.1829, found 311.1818.

To **27** (467 mg, 1.62 mmol) dissolved in CH_2Cl_2 (10 mL) were added imidazole (168 mg, 2.46 mmol) and TBDPSCl (463 μL, 1.8 mmol) in an ice bath in sequence, and the mixture was stirred at that temperature for an hour. The reaction solution was quenched with saturated aqueous $NaHCO_3$ (10 mL), worked up with Et_2O (10 mL x 3) and purified chromatographically (Et_2O/hexane = 1/3) to afford the TBDPS ether **25** (834 mg, 98% yield).

For **25**: ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.7 – 7.66 (m, 4H), 7.43 – 7.34 (s, 6H), 3.96 – 3.83 (m, 3H), 3.76 (dd, *J* = 9.9, 7.1 Hz, 1H), 3.64 (d, *J* = 8.6 Hz, 1H), 3.36 (t, *J* = 5.4 Hz, 1H), 3.13 (d, *J* = 5.2 Hz, 1H), 2.07 – 1.80 (m, 4H), 1.68 – 1.60 (m, 1H), 1.41 – 1.33 (m, 6H), 1.17 (s, 3H), 1.11 (d, *J* = 6.9 Hz, 3H), 1.09 (s, 3H), 1.07 (s, 9H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 135.77, 135.76, 134.14, 134.06, 129.58, 129.56, 127.65, 109.68, 86.06, 82.38, 82.03, 79.28, 72.52, 65.89, 37.67, 36.12, 27.05, 26.92, 26.83, 26.63, 21.65, 21.56, 19.46, 15.92; HRMS (ESI) *m*/*z* calcd for $C_{31}H_{46}NaO_5Si$ ([M + Na]$^+$) 549.3006, found 549.3027.

Compound **26**



To **25** (809 mg, 1.54 mmol) dissolved in CH_2Cl_2 (15 mL) was added freshly prepared Dess-Martin periodinane (900 mg, 2.31 mmol) in an ice bath and the mixture was stirred at that temperature until **25** disappeared by TLC. After quenching the reaction with saturated aqueous $Na_2S_2O_3$ (5 mL) and saturated aqueous $NaHCO_3$ (5 mL), the normal work-up with Et_2O (10 mL x 3) followed by column chromatography (Et_2O/hexane = 1/7) furnished the ketone **53** (800 mg, 99% yield).

For **53**: ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.69 – 7.62 (m, 4H), 7.46 – 7.34 (m, 6H), 4.09 – 4.01 (m, 2H), 3.98 – 3.92 (m, 1H), 3.76 (d, *J* = 8.6 Hz, 1H), 3.56 – 3.44 (m, 2H), 2.23 (ddd, *J* = 12.6, 9.7, 6.2 Hz, 1H), 2.03 (dddd, *J* = 12.9, 8.3, 7.0, 6.1 Hz, 1H), 1.83 (dddd, *J* = 12.5, 9.5, 7.6, 6.2 Hz, 1H), 1.73 (ddd, *J* = 12.6, 8.4, 6.2 Hz, 1H), 1.40 (d, *J* = 3.7 Hz, 6H), 1.35 (s, 3H), 1.32 (s, 3H), 1.01 – 0.99 (m, *J* = 5.9 Hz, 12H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 215.08, 135.82, 135.70, 133.86, 133.56, 129.78, 127.81, 109.88, 88.77, 83.13, 81.99, 73.06, 65.61, 42.95, 35.09, 27.17, 26.97, 26.93, 26.52, 23.12, 21.10, 19.32, 14.32; HRMS (ESI) *m*/*z* calcd for $C_{31}H_{44}NaO_5$ ($[M + Na]^+$) 547.2850, found 547.2882. .

To **53** (868 mg, 1.65 mmol) dissolved in THF (16 mL) and pyridine (10 mL) was added HF·pyridine (HF/pyridine ≈ 70/30, 2.48 mL) in an ice bath, and the mixture was stirred at 25 °C for 24 hours. The reaction solution was quenched with saturated aqueous $NaHCO_3$ (20 mL) and H_2O (5 mL), worked up with EtOAc (20 mL x 3), and purified chromatographically (hexane, then EtOAc/hexane = 1/2) to deliver the alcohol **54** (459 mg, 97% yield).

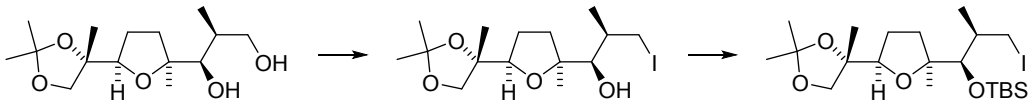
For **54**: ^{1}H NMR (400 MHz, $CDCl_3$) δ 4.00 (dd, J = 8.0, 6.6 Hz, 1H), 3.91 (d, J = 8.7 Hz, 1H), 3.75 (d, J = 8.7 Hz, 1H), 3.79 – 3.67 (m, 1H), 3.61 (ddd, J = 11.0, 6.1, 3.9 Hz, 1H), 3.49 (dddd, J = 11.1, 8.3, 7.1, 4.0 Hz, 1H), 2.63 (ddd, J = 7.0, 6.1, 1.0 Hz, 1H), 2.32 (ddd, J = 12.3, 8.5, 4.8 Hz, 1H), 2.00 – 1.88 (m, 1H), 1.88 – 1.67 (m, 2H), 1.40 (s, 6H), 1.38 (s, 3H), 1.34 (s, 3H), 1.08 (d, J = 7.1 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 217.18, 110.18, 88.96, 83.74, 81.96, 72.55, 65.43, 42.83, 35.30, 26.73, 26.39, 24.23, 22.69, 14.56; HRMS (ESI) *m*/*z* calcd for $C_{15}H_{26}NaO_5$ ($[M + Na]^+$) 309.1672, found 309.1645. .

To **54** (459 mg, 1.6 mmol) dissolved in CH_2Cl_2 (192 mL) was added freshly prepared $Zn(BH_4)_2$ (0.25 M in Et_2O, 6.4 mL, 1.6 mmol) dropwise at –78 °C over 10 minutes and the mixture was stirred at –78 °C for 3 hours. The same operation was repeated twice more with the 3 hours reaction time and the 5 hours, respectively. After quenching the reaction with saturated aqueous NH_4Cl (15 mL), the two layers were separated. The normal work-up with EtOAc (15 mL x 4) and chromatographic purification of the crude products from the combined organic layer (EtOAc/hexane = 1/3, then 2/1) gave the desired alcohol **26** (416 mg, 90% yield) ($[\alpha]_D^{16}$ = +6.60, c = 1.0 in EtOAc) and **27** (14 mg, 3% yield). When the solvent volume (CH_2Cl_2) was decreased to 1/10 in this reduction, the stereoselectivity was reduced to 15-20 : 1 from 30 : 1 with the similar chemical yield.

For **26**: ^{1}H NMR (400 MHz, $CDCl_3$) δ 3.93 – 3.84 (m, 2H), 3.86 (d, *J* = 8.9 Hz, 1H), 3.79 (dt,

J = 10.7, 3.5 Hz, 1H), 3.71 (d, *J* = 8.9 Hz, 1H), 3.63 (ddd, *J* = 10.7, 8.1, 5.4 Hz, 1H), 3.46 (t, *J* = 1.6 Hz, 1H), 2.89 (dd, *J* = 8.1, 3.6 Hz, 1H), 2.25 (dt, *J* = 12.2, 9.5 Hz, 1H), 2.09 (dq, *J* = 13.0, 8.7 Hz, 1H), 1.94 (dddd, *J* = 13.2, 9.6, 5.2, 3.9 Hz, 1H), 1.80 (dqt, *J* = 6.8, 3.4, 1.3 Hz, 1H), 1.55 (ddd, *J* = 12.5, 8.8, 3.9 Hz, 1H), 1.45 (s, 3H), 1.39 (s, 3H), 1.34 (s, 3H) 0.98 (d, *J* = 7.0 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 110.12, 87.46, 83.04, 81.31, 79.02, 71.99, 68.78, 35.90, 31.40, 27.27, 26.52, 26.41, 23.50, 23.07, 10.89; HRMS (ESI) *m*/*z* calcd for $C_{15}H_{28}NaO_5$ ([M + Na]$^+$) 311.1829, found 311.1813.

Compound **28**



To **26** (207 mg, 0.72 mmol) dissolved in benzene (13 mL) and THF (1 mL) were added pyridine (463 μL, 5.74 mmol), PPh_3 (752 mg, 2.9 mmol) and I_2 (691 mg, 2.72 mmol) at 25 °C in sequence, and the mixture was stirred at 25 °C for 4 hours. After an additional loading of pyridine (154 μL, 2.0 mmol), PPh_3 (250 mg, 0.96 mmol) and I_2 (230 mg, 0.91 mmol) to the mixture at 25 °C, it was stirred at RT for another 4 hours. The resulting solution was filtered through celite (2 g) using Et_2O (30 mL), the filtrate was evaporated in vacuo and the residue was separated chromatographically (Et_2O/hexane = 1/7) to offer the hydroxy iodide **55** (264 mg, 92% yield).

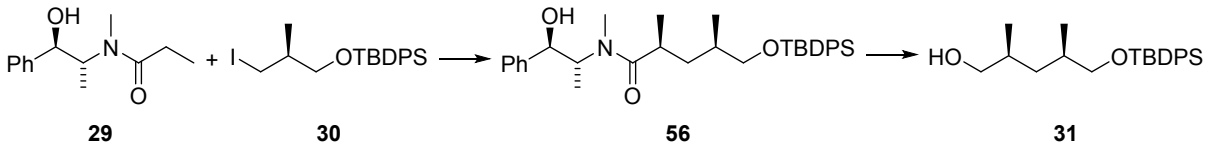
For **55**: ^{1}H NMR (400 MHz, $CDCl_3$) δ 3.91 – 3.85 (m, 3H), 3.71 (d, *J* = 8.9 Hz, 1H), 3.41 (dd, *J* = 9.6, 7.1 Hz, 1H), 3.25 (t, *J* = 1.5 Hz, 1H), 3.22 (dd, *J* = 9.6, 6.8 Hz, 1H), 2.27 – 2.04 (m, 2H), 2.00 – 1.89 (m, 2H), 1.50 (ddd, *J* = 11.7, 8.6, 3.3 Hz, 1H), 1.45 (s, 3H), 1.37 (s, 3H), 1.33 (s, 3H), 1.12 (s, 3H), 1.00 (d, *J* = 6.8 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 110.07, 87.47, 83.07, 81.07, 77.45, 72.11, 37.79, 30.71, 27.24, 26.57, 26.41, 23.33, 23.16, 14.68, 13.93; HRMS (ESI) *m*/*z* calcd for $C_{15}H_{27}INaO_4$ ([M + Na]$^+$) 421.0846, found 421.0838.

2,6-Lutidine (310 μL, 2.64 mmol) and TBSOTf (377 μL, 1.64 mmol) were injected to **55** (260 mg, 0.66 mmol) dissolved in CH_2Cl_2 (5 mL) in an ice bath, and the reaction solution was stirred at that temperature for 2 hours. After quenching the reaction with saturated aqueous $NaHCO_3$ (5 mL), the normal work-up with Et_2O (5 mL x 3) and column chromatography (hexane, then Et_2O/hexane = 1/20) imparted the iodide **28** (324 mg, 96% yield).

For **28**: ^{1}H NMR (400 MHz, $CDCl_3$) δ 3.97 (d, *J* = 8.6 Hz, 1H), 3.95 (dd, *J* = 7.7, 6.1 Hz, 1H),

3.72 (d, *J* = 8.6 Hz, 1H), 3.52 (d, *J* = 3.0 Hz, 1H), 3.30 (dd, *J* = 9.4, 6.4 Hz, 1H), 3.23 (dd, *J* = 9.4, 7.1 Hz, 1H), 2.21 (ddt, *J* = 9.8, 6.8, 3.0 Hz, 1H), 2.05 – 1.90 (m, 1H), 1.88 – 1.77 (m, 1H), 1.76 – 1.68 (m, 2H), 1.39 (s, 6H), 1.26 (s, 3H), 1.13 (s, 3H), 1.03 (d, *J* = 6.8 Hz, 3H), 0.90 (s, 9H), 0.10 (d, J = 7.4 Hz, 6H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 109.63, 86.37, 82.32, 81.81, 80.21, 73.16, 38.61, 37.90, 27.32, 27.14, 26.27, 25.99, 20.79, 20.34, 18.61, 16.89, 16.53, -3.01, -3.85; HRMS (ESI) *m*/*z* calcd for $C_{21}H_{41}INaO_4Si$ ($[M + Na]^+$) 535.1711, found 535.1730.

Compound **31**



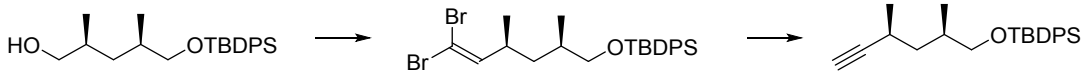
29 **30** **56** **31**

To LiCl (2.04 g, 48 mmol, dried under a 0.5 mmHg vacuum line with an alcohol lamp for a few minutes) were added THF (16 mL) and iPr_2NH (2.28 mL, 16.2 mmol). n-BuLi (2.5 M in hexane, 6.0 mL, 15.0 mmol) was injected to the above solution dropwise at 0 °C and the mixture was stirred at 0 °C for 15 minutes. To the generated LDA solution was added **29** (1.638 g, 3.74 mmol) using THF (13 mL + 3 mL) dropwise through a cannula at –78 °C over 20 minutes and the resulting solution was stirred at –78 °C for 30 minutes. After removal of the reaction bath, **30** (1.65 g, 3.76 mmol) using THF (4 mL + 2 mL) was injected to the enolate solution dropwise through a cannula at 25 °C and the reaction mixture was stirred at 25 °C for 10 hours. The reaction solution was quenched with saturated aqueous NH_4Cl (20 mL), worked up with EtOAc (20 mL x 3) and purified chromatographically (EtOAc/hexane = 1/3, then 1/2) to give rise to the amide **56** (1.85 g, 95% yield). The ^{1}H NMR spectra of **56** were quite complicated due to its rotamers. To iPr_2NH (2.12 mL, 15.0 mmol) in THF (15 mL) was added n-BuLi (2.5 M in hexane, 5.6 mL, 14.0 mmol) dropwise in an ice bath over 10 minutes and the solution was stirred at that temperature for 15 minutes. $H_3B{\cdot}NH_3$ (441 mg, 14.3 mmol) was added to the above LDA solution at once in an ice bath by opening the septum of the reaction flask in the air, and the resulting solution was stirred in an ice bath for 15 minutes and then at RT for 30 minutes. To the prepared $LiBH_3(NH_2)$ solution was added **56** (1.85 g, 3.57 mmol) using THF (10 mL + 2 mL) dropwise through a cannula at 25 °C over 10 minutes and the reaction mixture was stirred at 25 °C for 2 hours. Aqueous HCl (3.0 M, 36 mL) was added to the reaction mixture slowly in an ice bath over 10 minutes and the

resulting solution was stirred in the same bath for 30 minutes. The normal work-up with Et_2O (30 mL x 3), washing the combined organic layer with aqueous NaOH (2 M, 8 mL) and brine (8 mL), and chromatographic purification (EtOAc/hexane = 1/5) produced the alcohol **31** (1.26 g, 95% yield).

For **31**: ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.70 – 7.62 (m, 4H), 7.47 – 7.32 (m, 6H), 3.55 – 3.40 (m, 3H), 3.35 (ddd, *J* = 10.5, 6.5, 5.7 Hz, 1H), 1.74 (dq, *J* = 13.0, 6.6 Hz, 1H), 1.68 – 1.58 (m, 1H), 1.46 (dt, *J* = 13.6, 6.7 Hz, 1H), 1.22 (t, *J* = 5.9 Hz, 1H), 1.06 (s, 9H), 0.95 (d, *J* = 6.7 Hz, 3H), 0.93 – 0.87 (m, 1H), 0.89 (d, *J* = 6.6 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 135.82, 135.80, 134.15, 129.71, 127.77, 68.91, 68.47, 37.34, 33.35, 27.08, 19.48, 18.09, 17.60; HRMS (ESI) *m*/*z* calcd for $C_{23}H_{34}NaO_2Si$ ([M + Na]$^+$) 393.2220, found 393.2253. .

Compound **32**



31 **57** **32**

To oxalyl chloride (397 μL, 4.62 mmol) dissolved in CH_2Cl_2 (18 mL) was injected DMSO (678 μL, 9.55 mmol) dropwise at –78 °C over 3 minutes. After stirring the solution at –78 °C for 20 minutes, **31** (1.143 g, 3.08 mmol) was added with a cannula using CH_2Cl_2 (10 mL + 5 mL + 5 mL) at –78 °C over 7-8 minutes. The reaction mixture was stirred at –78 °C for an hour and iPr_2NEt (2.01 mL, 11.55 mmol) was injected dropwise at –78 °C over 5 minutes. The reaction temperature of the solution was raised from –78 to –20 °C over 2 hours, and the reaction was quenched with saturated aqueous NH_4Cl (15 mL) and Et_2O (100 mL) at –20 °C. Two layers were separated and the aqueous layer was worked up with Et_2O (20 mL x 3). The combined organic layer was dried over Na_2SO_4 (5 g), filtered and evaporated in vacuo to render the corresponding crude aldehyde. To PPh_3 (4g, 15.4 mmol) dissolved in CH_2Cl_2 (33 mL) was added CBr_4 (2.55 g, 7.7 mmol) at once in an ice bath and the mixture was stirred at that temperature for 10 minutes. The prepared crude aldehyde was injected to the above solution using CH_2Cl_2 (10 mL + 5 mL + 5 mL) dropwise through a cannula in an ice bath over 10minutes and the mixture was stirred at that temperature for 20 minutes. After quenching the reaction with saturated aqueous $NaHCO_3$ (15 mL), the aqueous layer was worked up with CH_2Cl_2 (20 mL x 3). The combined organic layer was evaporated in vacuo and the residue was filtered through silica gel (60 g) using CH_2Cl_2 for loading and Et_2O/hexane = 1/9 for elution. The filtrate was evaporated in vacuo and the residue was

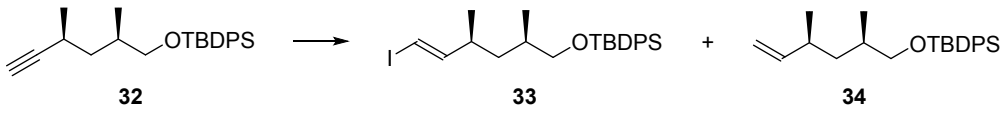
separated by column chromatography (hexane) to provide the vinyl dibromide **57** (1.53 g, 95% yield).

For **57**: ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.73 – 7.61 (m, 4H), 7.48 – 7.34 (m, 6H), 6.11 (d, *J* = 9.5 Hz, 1H), 3.45 (d, *J* = 6.1 Hz, 2H), 2.57 (tdd, *J* = 9.8, 7.0, 4.7 Hz, 1H), 1.69 – 1.57 (m, 1H), 1.57 – 1.46 (m, 1H), 1.12 – 1.06 (m, 1H), 1.06 (s, 9H), 0.99 (d, *J* = 6.7 Hz, 3H), 0.91 (d, *J* = 6.6 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 144.64, 135.82, 134.15, 134.10, 129.74, 127.81, 127.79, 87.45, 69.31, 40.26, 36.28, 34.03, 27.10, 20.22, 19.51, 16.99; HRMS (ESI) *m*/*z* calcd for $C_{24}H_{32}Br_2NaOSi$ ($[M + Na]^+$) 545.0481, found 545.0493. .

To **57** (1.53 g, 2.92 mmol) dissolved in THF (35 mL) was added nBuLi (2.5 M in hexane, 3.5 mL, 8.78 mmol) dropwise at –78 °C over 5 minutes and the mixture was stirred at that temperature until **57** was not detected by TLC. After removal of the reaction bath, the reaction mixture was quenched with H_2O (10 mL), worked up with Et_2O (10 mL x 3) and purified chromatographically (hexane, then Et_2O/hexane = 1/30) to supply the acetylene **32** (1.01 g, 95% yield).

For **32**: ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.68 (dt, *J* = 6.5, 1.7 Hz, 4H), 7.51 – 7.33 (m, 6H), 3.59 – 3.41 (m, 2H), 2.52 (dddd, *J* = 11.8, 9.8, 7.0, 3.4 Hz, 1H), 2.02 (d, *J* = 2.3 Hz, 1H), 2.02 – 1.94 (m, 1H), 1.63 (ddd, *J* = 13.1, 10.4, 4.3 Hz, 1H), 1.20 – 1.13 (m, 1H), 1.19 (d, *J* = 6.8 Hz, 3H), 1.07 (s, 9H), 0.95 (d, *J* = 6.7 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 135.84, 135.82, 134.21, 134.18, 129.69, 127.76, 89.06, 69.38, 68.42, 40.74, 34.04, 27.08, 23.64, 21.85, 19.53, 16.49; HRMS (ESI) *m*/*z* calcd for $C_{24}H_{32}NaOSi$ ($[M + Na]^+$) 387.2115, found 387.2119. .

Compound **33**



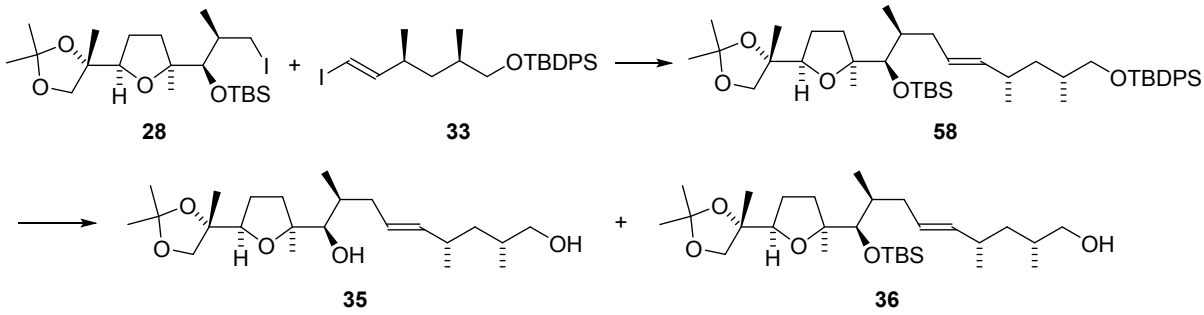
32 **33** **34**

Zirconocene dichloride (1-2 g) in a round-bottomed flask was heated gently with an alcohol lamp under a 0.5 mmHg vacuum line for a few minutes and most of the dichloride sublimed as white solid to the upper part of the flask wall with a little black tar at the bottom. The sublimed white solid was scratched out in the air, poured on the weighing paper and taken as much as required. This operation was essential for the high yielding conversion. To the purified Cp_2ZrCl_2 (1.05 g, 3.6 mmol) dissolved in THF (17 mL) was added DIBAL (1.0 M in

THF, 3.3 mL, 3.3 mmol) dropwise in an ice bath and the solution was stirred at that temperature for 30 minutes. **32** (526 mg, 1.52 mmol) was injected to the generated Cp_2ZrHCl using THF (3 mL + 1 mL + 1 mL) through a cannula in an ice bath and the reaction was stirred at that temperature for an hour (until **32** disappeared by TLC). Subsequently, I_2 (914 mg, 3.6 mmol) dissolved in THF (4 mL + 1 mL) was added to the reaction mixture through a cannula in an ice bath and the resulting solution was stirred at that temperature for 10 minutes. After quenching the reaction with saturated aqueous $Na_2S_2O_3$ (10 mL), the normal work-up with Et_2O (10 mL x 3) and column chromatography (hexane) revealed the vinyl iodide **33** (646 mg, 91% yield) and the pronated alkene **34** (39 mg, 8% yield).

For **33**: ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.72 – 7.63 (m, 4H), 7.48 – 7.35 (m, 6H), 6.34 (dd, *J* = 14.4, 8.5 Hz, 1H), 5.95 (d, *J* = 14.4, 1H), 3.51 – 3.39 (m, 2H), 2.26 (ddq, *J* = 15.2, 8.9, 6.6 Hz, 1H), 1.67 (dddd, *J* = 13.0, 9.1, 6.4, 4.8 Hz, 1H), 1.48 (ddd, *J* = 13.9, 9.4, 4.7 Hz, 1H), 1.07 (s, 9H), 1.05 – 1.00 (m, 1H), 0.98 (d, *J* = 6.7 Hz, 3H), 0.88 (d, *J* = 6.7 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 152.25, 135.82, 135.80, 134.14, 134.10, 129.73, 127.80, 73.47, 69.23, 40.08, 38.58, 33.50, 27.10, 20.87, 19.50, 16.84; HRMS (ESI) *m/z* calcd for $C_{24}H_{33}INaOSi$ ([M + Na]$^+$) 515.1238, found 515.1231.

Compound **35**

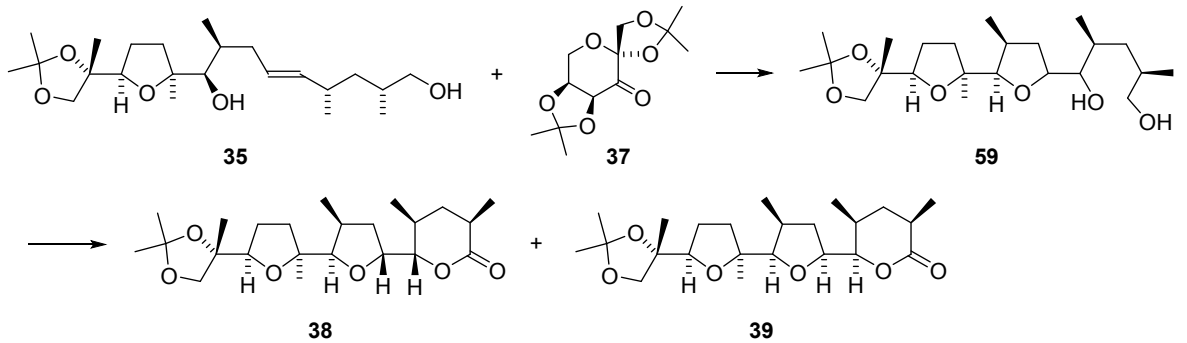


To **28** (198 mg, 0.386 mmol) dissolved in Et_2O (7 mL) was added tBuLi (1.7 M in pentane, 0.9 mL, 1.54 mmol) dropwise at –78 °C in one minute. At the almost same time, to B-MeO-9-BBN (1.0 M in hexane, 1.74 mL, 1.74 mmol) was injected tBuLi (1.7 M in pentane, 0.11 mL, 0.19 mmol) dropwise at –78 °C quickly. After stirring the two flasks for 3 minutes, the latter solution was added to the former lithiated substrate solution through a cannula over 2 minutes at –78 °C without washing. THF (7 mL) precooled at –78 °C was added quickly to the reaction solution and the resulting solution was stirred at that temperature for 10 minutes. The reaction bath was removed and the reaction mixture was stirred at RT for 1.5 hours. The

reaction flask was opened to the air by removing a N_2 balloon and aqueous K_3PO_4 (3.0 M, 650 μL, 1.93 mmol) was added at 25 °C. Subsequently, **33** (190 mg, 0.386 mmol) dissolved in DMF (7 mL), and $Pd(dppf)Cl_2 \cdot CH_2Cl_2$ (32 mg, 0.039 mmol) were added sequentially to the prepared borane reagent at 25 °C. The reaction mixture was stirred at 25 °C for an hour and H_2O (10 mL) was added. The normal work-up with Et_2O (10 mL x 3) and column chromatography (hexane, then Et_2O/hexane = 1/20) yielded the coupled product **58** contaminated with some unknown impurities. To the impure **58** dissolved in THF (4 mL) was added nBu_4NF (1.0 M in THF, 1 mL, 1.0 mmol) at 25 °C and the mixture was stirred at 65 °C for 8 hours. After evaporating all the volatile materials in vacuo, the residue was separated by column chromatography (Et_2O/hexane = 1/3, then EtOAc/hexane = 1/2) to rendered the desired diol **35** (123 mg, 80% yield) ($[\alpha]_D^{27}$ = +21.19, c = 1.0 in THF) and the primary alcohol **36** (7 mg, 4% yield).

For **35**: ^{1}H NMR (400 MHz, $CDCl_3$) δ 5.40 – 5.27 (m, 1H), 5.21 (dd, *J* = 15.3, 8.5 Hz, 1H), 3.87 (d, *J* = 8.6 Hz, 1H), 3.87 – 3.83 (m, 1H), 3.73 (d, *J* = 2.1 Hz, 1H), 3.71 (d, *J* = 8.8 Hz, 1H), 3.47 – 3.38 (m, 1H), 3.34 (dd, *J* = 10.6, 6.9 Hz, 1H), 2.32 – 1.89 (m, 7H), 1.70 – 1.55 (m, 2H), 1.50 – 1.44 (m, 1H), 1.44 (d, *J* = 0.8 Hz, 3H), 1.37 (s, 3H), 1.35 – 1.28 (m, 1H), 1.33 (d, *J* = 0.5 Hz, 3H), 1.10 (s, 3H), 1.04 – 0.98 (m, 1H), 0.98 (d, *J* = 6.7 Hz, 3H), 0.89 (d, *J* = 6.6 Hz, 2H), 0.85 (d, *J* = 6.9, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 138.31, 128.08, 110.05, 88.34, 82.98, 80.83, 76.64, 72.32, 68.89, 40.92, 38.89, 35.26, 34.29, 34.25, 30.51, 27.45, 26.63, 26.42, 23.58, 23.19, 22.35, 16.70, 13.56; HRMS (ESI) *m*/*z* calcd for $C_{23}H_{42}NaO_5$ ($[M + Na]^+$) 421.2924, found 421.2912.

Compound **38**

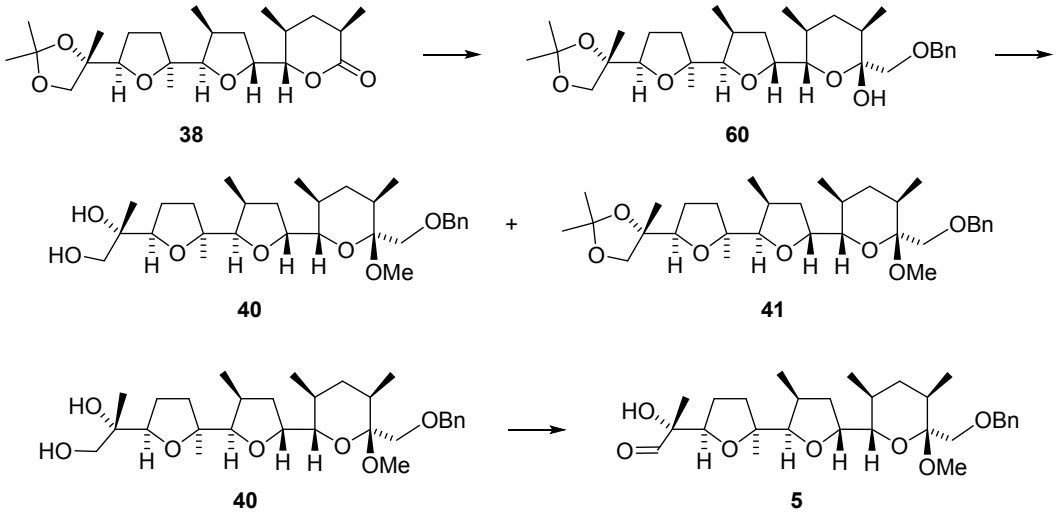


35 (97 mg, 0.243 mmol) was dissolved in a mixture of MeCN (1.2 mL), $(MeO)_2CH_2$ (2.4 mL) and borate buffer (0.5 M $Na_3B_4O_7$, borax, in 10^{-4} M aqueous EDTA, pH 9.3, 2.4 mL). To the prepared solution were added the ketone **37** (63 mg, 0.243 mmol) and nBu_4NHSO_4 (4.1 mg,

0.013 mmol) in a methanolic ice bath (–10 to –5 °C). OXONE® (340 mg, 0.56 mmol) was dissolved in 10^{-4} M aqueous EDTA (2.2 mL) and K_2CO_3 (323 mg, 2.34 mmol) in H_2O (2.2 mL). Each solution was added to the reaction mixture (**35** and **37**), respectively, by 0.1 mL every 15 minutes ensuingly in the methanolic ice bath. After the last addition, the mixture was stirred for 20 minutes and H_2O (5 mL) was added. The normal work-up with EtOAc (15 mL x 3) and chromatographic separation afforded the recovered ketone **37** (30 mg, Et_2O/hexane = 1/1), the recovered starting diol **35** (21.4 mg, 22%, EtOAc/hexane = 1/2) and a mixture of the epoxide and the cyclized product (77 mg, EtOAc/hexane = 2/1). The mixture of the epoxide and the cyclized products (77 mg) dissolved in CH_2Cl_2 (2 mL) was added CSA (2 mg, 9.0 mmol) in an ice bath and the mixture was stirred at that temperature for an hour. The reaction mixture was quenched with saturated aqueous $NaHCO_3$ (0.1 mL) and all the volatile materials were evaporated in vacuo. The residue was purified by column chromatography (EtOAc/hexane = 1/2) to furnish the cyclized products **59** (77 mg, 75% yield). To **59** (70 mg, 0.169 mmol) dissolved in CH_2Cl_2 (1.5 mL) were added Tempo (5.3 mg, 0.034 mmol) and aqueous KBr (1.0 M, 17 μL, 0.0169 mmol) in an ice bath. A mixture of aqueous NaOCl (ca 4%, 0.95 mL) and saturated aqueous $NaHCO_3$ (0.95 mL) were added to the prepared reaction solution in an ice bath over 3 minutes and the resulting mixture was stirred at that temperature for 30 minutes. After quenching the reaction with saturated aqueous $Na_2S_2O_3$ (1 mL), the normal work-up with Et_2O (3 mL x 4) and chromatographic separation (Et_2O/hexane = 1/2, then 1/1) delivered the desired lactone **38** (56.3 mg, 81% yield) ($[\alpha]_D^{17}$ = +15.46, c = 1.0 in EtOAc). and the diastereomeric lactone **39** (3.6 mg, 5% yield).

For **38**: ^{1}H NMR (400 MHz, $CDCl_3$) δ 4.23 (ddd, *J* = 8.5, 6.8, 4.8 Hz, 1H), 4.08 (d, *J* = 8.4 Hz, 1H), 4.03 (dd, *J* = 9.3, 4.8 Hz, 1H), 3.96 (d, *J* = 4.8 Hz, 1H), 3.88 (t, *J* = 7.4 Hz, 1H), 3.67 (d, *J* = 8.4 Hz, 1H), 2.46 (dqd, *J* = 12.8, 7.0, 5.7 Hz, 1H), 2.36 (tdd, *J* = 7.0, 4.6, 2.5 Hz, 1H), 2.14 – 1.65 (m, 7H), 1.54 (ddd, *J* = 12.0, 8.5, 6.5 Hz, 1H), 1.43 – 1.35 (m, 1H), 1.38 (d, *J* = 2.0 Hz, 6H), 1.25 (d, *J* = 7.0 Hz, 3H), 1.22 (s, 3H), 1.16 (s, 3H), 1.09 (d, *J* = 6.5 Hz, 3H), 0.97 (d, *J* = 7.1 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 174.51, 109.45, 88.38, 86.68, 85.08, 82.56, 80.11, 78.62, 72.86, 37.48, 36.13, 36.11, 35.48, 33.86, 32.07, 27.57, 27.33, 27.11, 23.25, 20.43, 18.85, 17.27, 15.75; HRMS (ESI) *m*/*z* calcd for $C_{23}H_{38}NaO_6$ ($[M + Na]^+$) 433.2561, found 433.2677. .

Compound **5**



To tributyl(benzyloxymethyl)tin (234 mg, 0.57 mmol) dissolved in THF (2 mL) was added nBuLi ((2.5 M in hexane, 152 μL, 0.38 mmol) dropwise at –78 °C and the mixture was stirred at that temperature for 30 minutes. **38** (78 mg, 0.189 mmol) was injected dropwise to the generated lithium benzyloxymethylide using THF (1 mL + 0.5 mL + 0.5 mL) through a cannula at –78 °C and the resulting solution was stirred at –78 °C for an hour. After removal of the reaction bath, the reaction was quenched with H_2O (3 mL). The normal work-up with Et_2O (3 mL x 4) and column chromatography (Et_2O/hexane = 1/9, 1/3, then 2/1) imparted the lactol **60** (91 mg, 90% yield) ($[\alpha]_D^{15}$ = +42.39, c = 1.0 in EtOAc).

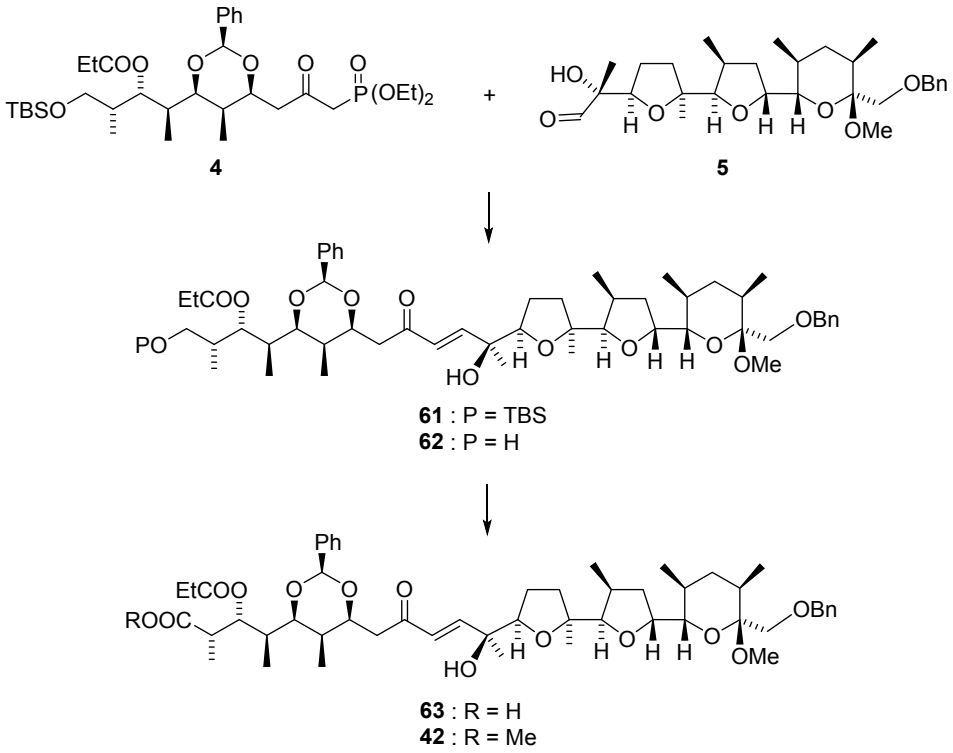
For **60**: ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.37 – 7.26 (m, 5H), 4.64 (d, *J* = 3.7 Hz, 2H), 4.49 (d, *J* = 8.1 Hz, 1H), 4.27 (td, *J* = 7.6, 3.3 Hz, 1H), 3.98 (d, *J* = 4.0 Hz, 1H), 3.87 (dd, *J* = 9.7, 6.1 Hz, 1H), 3.82 – 3.76 (m, 1H), 3.59 (d, *J* = 8.1 Hz, 1H), 3.50 (d, *J* = 10.6 Hz, 1H), 3.42 (d, *J* = 10.6 Hz, 1H), 2.32 – 2.12 (m, 3H), 1.92 – 1.77 (m, 2H), 1.66 (dq, *J* = 12.0, 9.5 Hz, 1H), 1.58 – 1.44 (m, 3H), 1.40 – 1.34 (m, 1H), 1.36 (d, *J* = 3.3 Hz, 6H), 1.22 (s, 3H), 1.19 (s, 3H), 0.96 – 0.85 (m, 9H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 138.88, 128.51, 127.66, 127.59, 109.65, 98.00, 87.48, 85.05, 83.52, 81.07, 77.59, 76.80, 74.05, 73.81, 71.02, 37.30, 35.65, 34.24, 33.89, 33.72, 33.11, 29.86, 27.34, 27.16, 24.78, 22.73, 17.71, 16.62, 15.79; HRMS (ESI) *m*/*z* calcd for $C_{31}H_{48}NaO_7$ ($[M + Na]^+$) 555.3292, found 555.3314.

To **60** (18.5 mg, 0.035 mmol) dissolved in anhydrous MeOH (1 mL) was added p-TsOH·H_2O (0.33 mg, 17.5 μmol) at 25 °C and the mixture was stirred at RT for 12 hours. After quenching the reaction with solid $NaHCO_3$ (5 mg) at 25 °C , the resulting solution was evaporated in vacuo and the residue was purified chromatographically (Et_2O/hexane = 1/2, then 1/1) to give the diol **40** (15.7 mg, 89% yield) ($[\alpha]_D^{15}$ = +54.37, c = 0.83 in EtOAc) and

41 (1.9 mg, 10% yield). To **40** (15.6 mg, 0.038 mmol) dissolved in CH_2Cl_2 (1 mL) were added Tempo (0.49 mg, 0.003 mmol) and aqueous KBr (0.1 M, 3 μL, 0.003 mmol) in an ice bath. A mixture of aqueous NaOCl (ca 4%, 57 μL) and saturated aqueous $NaHCO_3$ (60 μL) were added to the prepared reaction solution in an ice bath over 3 minutes. Since the reaction was not completed after 10 minutes, the above mixture of aqueous NaOCl and saturated aqueous $NaHCO_3$ was added by 5 μL every 5 minutes four times more in an ice bath. After quenching the reaction with saturated aqueous $Na_2S_2O_3$ (1 mL), the normal work-up with Et_2O (2 mL x 4) and chromatographic separation (Et_2O/hexane = 1/3) offered the aldehyde **5** (15.4mg, 99% yield).

For **5**: ^{1}H NMR (400 MHz, $CDCl_3$) δ 9.69 (s, 1H), 7.38 – 7.26 (m, 5H), 5.02 (s, 1H), 4.59 (q, *J* = 12.3 Hz, 2H), 4.42 (ddd, *J* = 9.4, 6.7, 2.4 Hz, 1H), 4.24 (d, *J* = 4.4 Hz, 1H), 4.07 (dd, *J* = 8.8, 2.2 Hz, 1H), 3.62 – 3.57 (m, 1H), 3.52 (d, *J* = 10.4 Hz, 1H), 3.25 (d, *J* = 1.8 Hz, 3H), 2.48 (ddd, *J* = 12.3, 9.7, 6.8 Hz, 1H), 2.40 – 2.25 (m, 2H), 2.13 (tt, *J* = 12.0, 8.8 Hz, 1H), 2.05 – 1.96 (m, 1H), 1.91 (d, *J* = 21.8 Hz, 1H), 1.50 (ddd, *J* = 12.1, 6.9, 4.1 Hz, 2H), 1.43 – 1.29 (m, 3H), 1.19 (s, 3H), 1.17 (s, 3H), 0.91 (dd, J = 6.9, 1.2 Hz, 6H), 0.84 (d, *J* = 5.4 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 206.16, 138.83, 128.54, 127.68, 127.58, 99.99, 87.50, 86.42, 81.10, 80.28, 77.40, 76.71, 73.63, 71.95, 48.44, 37.02, 35.39, 35.18, 32.85, 32.39, 30.77, 28.35, 24.59, 22.35, 17.66, 16.18, 16.02; HRMS (ESI) *m*/*z* calcd for $C_{29}H_{44}NaO_7$ ($[M + Na]^+$) 527.2979, found 527.2971. .

Compound **42**



To **4** (15.0 mg, 22.9 μmol) dissolved in a 40 to 1 mixture of THF and H_2O (0.5 mL) was added freshly flame-dried $Ba(OH)_2$ (4.0 mg, 22.9 μmol) at 25 °C and the mixture was stirred at 25 °C for an hour. **5** (8.8 mg, 17.4 μmol) was added to the resulting solution using the same mixed solvent (0.8 mL) with a pipet at 25 °C. After stirring the reaction mixture at 25 °C for 3 hours, the reaction was quenched with saturated aqueous NH_4Cl (2 mL). The normal work-up with EtOAc (2 mL x 3) and chromatographic purification (EtOAc/hexane = 1/5) afforded the coupled TBS ether **61** (14.4 mg, 82% yield).

For **61**: ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.43 (dd, *J* = 7.8, 1.8 Hz, 2H), 7.33 – 7.25 (m, 8H), 6.64 (d, *J* = 15.7 Hz, 1H), 6.45 (d, *J* = 15.7 Hz, 1H), 5.52 (s, 1H), 5.14 (dd, *J* = 5.4, 2.4 Hz, 1H), 4.64 (d, *J* = 1.5 Hz, 1H), 4.57 (q, *J* = 12.3 Hz, 2H), 4.46 – 4.34 (m, 2H), 4.22 (d, *J* = 4.3 Hz, 1H), 3.85 (dd, *J* = 8.7, 2.3 Hz, 1H), 3.69 (dd, *J* = 8.5, 1.8 Hz, 1H), 3.59 (d, *J* = 10.4 Hz, 1H), 3.57 (brs, 1H), 3.50 (d, *J* = 10.4 Hz, 1H), 3.36 – 3.29 (m, 2H), 3.23 (s, 3H), 3.01 (dd, *J* = 16.1, 8.5 Hz, 1H), 2.46 (t, *J* = 14.2 Hz, 2H), 2.31 (q, *J* = 7.6 Hz, 2H), 2.27 – 2.15 (m, 3H), 2.03 – 1.79 (m, 4H), 1.76 – 1.68 (m, 1H), 1.46 (dd, *J* = 12.1, 6.7 Hz, 1H), 1.39 – 1.28 (m, 4H), 1.19 – 1.04 (m, 15H), 0.96 – 0.79 (m, 21H), 0.00 (d, *J* = 1.5 Hz, 6H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 197.98, 173.80, 149.42, 138.84, 138.68, 128.44, 128.35, 128.01, 127.80, 127.48, 127.39, 126.08, 101.44, 99.78, 87.15, 86.63, 82.61, 81.43, 77.21, 77.15, 76.56, 75.89, 73.43, 72.18, 71.78, 65.92, 48.28, 44.35, 37.53, 36.85, 36.45, 35.19, 34.97, 34.10, 32.67, 32.20,

30.47, 27.85, 27.41, 26.19, 25.92, 24.29, 18.26, 17.47, 15.99, 15.83, 12.54, 11.70, 9.37, 6.67, -5.54, -5.57; HRMS (ESI) *m*/*z* calcd for $C_{58}H_{90}NaO_{12}Si$ ($[M + Na]^+$) 1029.6094, found 1029.6063.

To **61** (14.4 mg, 14.3 μmol) dissolved in a 1 to 1 mixture of THF and pyridine (2 mL) was added HF-pyridine (ca 70/30, 0.4 mL) dissolved in pyridine (0.4 mL) dropwise in an ice bath, and the solution was stirred at that temperature for 12 hours. After quenching the reaction with saturated aqueous $NaHCO_3$ (6 mL), the normal work-up with EtOAc (2 mL x 3) and column chromatography (EtOAc/hexane = 1/2) delivered the alcohol **62** (12.0 mg, 94% yield) ($[\alpha]_D^{23}$ = +68.2, c = 0.79 in $CHCl_3$).

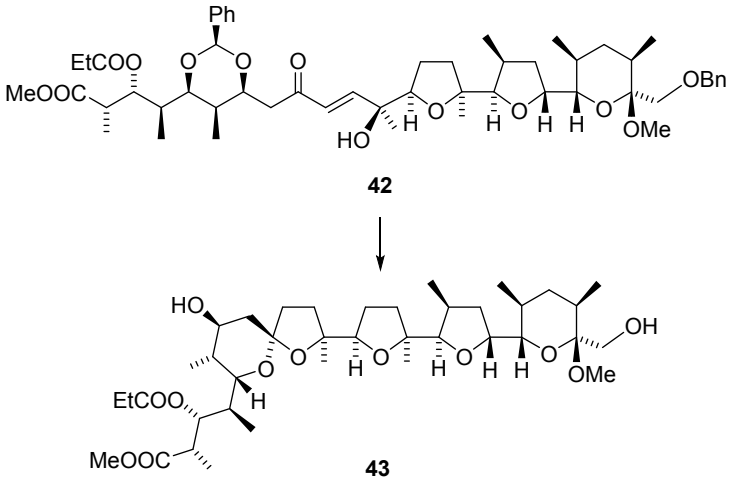
For **62**: ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.43 (dd, *J* = 7.8, 1.8 Hz, 2H), 7.35 – 7.24 (m, 8H), 6.65 (d, *J* = 15.7 Hz, 1H), 6.44 (d, *J* = 15.7 Hz, 1H), 5.51 (s, 1H), 5.07 (dd, *J* = 8.4, 2.0 Hz, 1H), 4.67 (s, 1H), 4.57 (q, *J* = 12.2 Hz, 2H), 4.42 – 3.35 (m, 2H), 4.22 (d, *J* = 4.3 Hz, 1H), 3.86 (dd, *J* = 8.8, 2.1 Hz, 1H), 3.68 (dd, *J* = 6.7, 2.1 Hz, 1H), 3.59 (d, *J* = 10.4 Hz, 1H), 3.56 (brs, 1H), 3.50 (d, *J* = 10.4 Hz, 1H), 4.45 – 3.36 (m, 1H), 3.23 (s, 3H), 3.16 – 3.05 (m, 1H), 2.97 (dd, *J* = 16.3, 7.5 Hz, 1H), 2.85 (s, 1H), 2.57 (dd, *J* = 16.2, 5.6 Hz, 1H), 2.51 – 2.42 (m, 1H), 2.37 (qd, *J* = 7.6, 1.2 Hz, 2H), 2.30 – 2.10 (m, 3H), 2.08 – 1.81 (m, 4H), 1.64 – 1.57 (m, 1H), 1.46 (dd, *J* = 12.1, 6.8 Hz, 1H), 1.41 – 1.27 (m, 4H), 1.25 – 0.96 (m, 15H), 0.93 – 0.74 (m, 12H); ^{13}C NMR (100MHz, $CDCl_3$) δ 197.94, 175.88, 149.67, 138.76, 138.75, 128.72, 128.47, 128.21, 127.68, 127.60, 127.51, 126.21, 101.76, 99.88, 87.26, 86.77, 82.81, 81.50, 77.34, 77.30, 76.67, 76.05, 74.21, 73.55, 71.88, 64.51, 48.39, 44.34, 37.20, 36.96, 36.67, 35.35, 35.32, 35.08, 32.77, 32.30, 30.58, 27.88, 27.55, 26.32, 24.42, 17.61, 16.12, 15.95, 12.42, 9.85, 9.51, 7.17; HRMS (ESI) *m*/*z* calcd for $C_{52}H_{76}NaO_{12}$ ($[M + Na]^+$) 915.5229, found 915.5238.

To **62** (12.0 mg, 13.4 μmol) dissolved in MeCN (0.4 mL) and phosphate buffer solution (pH 6.8, 0.4 mL) were added $PhI(OAc)_2$ (8.8 mg, 26.9 μmol) and AZADO (0.4 mg, 2.7 μmol) at 25 °C. After stirring the mixture at RT for 2 hours, $NaClO_2$ (1.5 mg, 13.4 μmol) was added and the resulting solution was stirred at 25 °C for an hour. The reaction mixture was quenched with 10% aqueous $Na_2S_2O_3$ (3 mL) and worked up with EtOAc (3 mL x 3). To the crude carboxylic acid **63** dissolved in toluene (0.3 mL) and MeOH (0.2 mL) was added $TMSCHN_2$ (2 M in Et_2O, 14 μL, 28 μmol) in an ice bath, and the solution was stirred at that temperature for an hour. The reaction mixture was quenched with a 20 to 1 mixture of MeOH and acetic acid (0.2 mL), and diluted with H_2O (3 mL) and EtOAc (2 mL). The normal work-

up with EtOAc (2 mL x 3) and chromatographic purification (EtOAc/hexane = 1/4) furnished the methyl ester **42** (10.2 mg, 82% yield from **62**).

For **42**: ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.45 (d, *J* = 7.8 Hz, 2H), 7.35 – 7.26 (m, 8H), 6.67 (d, *J* = 15.7 Hz, 1H), 6.46 (d, *J* = 15.7 Hz, 1H), 5.52 (s, 1H), 5.24 (t, *J* = 5.6 Hz, 1H), 4.69 (s, 1H), 4.59 (q, *J* = 12.3 Hz, 2H), 4.46 – 4.34 (m, 2H), 4.24 (d, *J* = 4.2 Hz, 1H), 3.88 (d, *J* = 7.1 Hz, 1H), 3.70 (s, 3H), 3.65 – 3.48 (m, 4H), 3.25 (s, 3H), 3.00 (dd, *J* = 16.3, 7.8 Hz, 1H), 2.87 – 2.73 (m, 1H), 2.59 (dd, *J* = 16.3, 4.9 Hz, 1H), 2.52 – 2.42 (m, 1H), 2.34 (dd, *J* = 14.9, 7.5 Hz, 2H), 2.29 – 2.17 (m, 2H), 2.15 – 1.69 (m, 6H), 1.48 (dd, *J* = 12.1, 6.8 Hz, 1H), 1.42 – 1.24 (m, 6H), 1.20 – 1.05 (m, 15H), 0.95 – 0.83 (m, 9H).; ^{13}C NMR (100 MHz, $CDCl_3$) δ 197.90, 174.65, 173.72, 149.61, 138.78, 128.69, 128.47, 128.19, 127.81, 127.61, 127.52, 126.19, 101.66, 99.89, 87.27, 86.77, 81.82, 81.53, 77.30, 77.25, 76.66, 76.04, 74.11, 73.55, 71.89, 52.24, 48.40, 44.34, 40.50, 38.38, 36.97, 35.32, 35.09, 34.62, 32.78, 32.32, 30.59, 27.80, 27.56, 26.34, 24.43, 17.61, 16.13, 15.96, 12.50, 12.08, 9.35, 6.85; HRMS (ESI) *m*/*z* calcd for $C_{53}H_{76}NaO_{13}$ ([M + Na]$^{+}$) 943.5178, found 943.5184.

Compound **43**

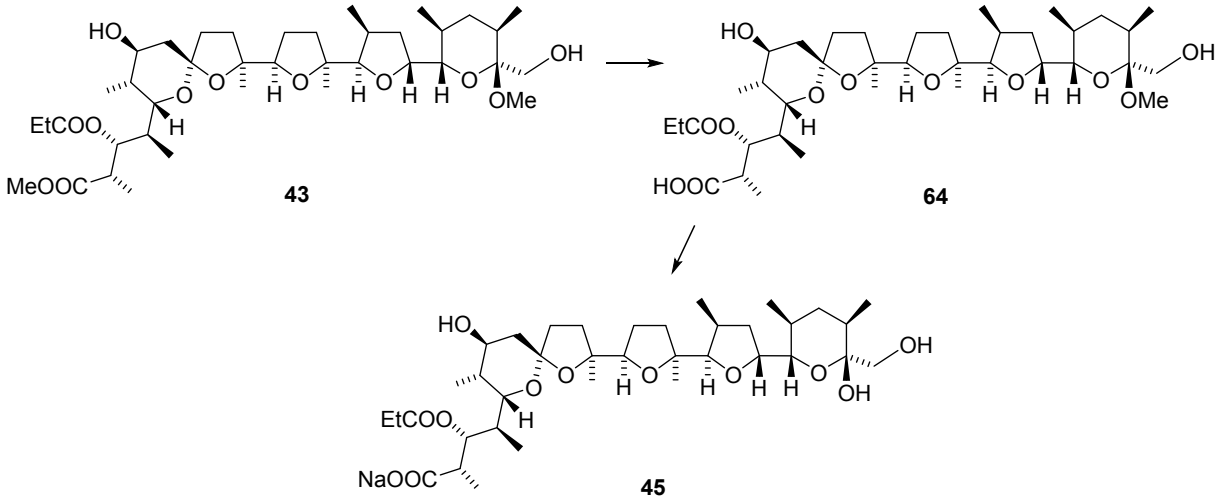


Pd/C (10 wt%, 6 mg) was added to **42** (10.0 mg, 10.9 μmol) dissolved in a 20 to 1 mixture of MeOH and acetic acid (0.6 mL) at 25 °C, and an atmospheric hydrogen balloon was installed. During the installation, the reaction flask was flushed with hydrogen gas three times under reduced pressure by a rotary evaporator. After stirring the reaction solution at 25 °C for 3 hours, it was filtered through celite (50 mg) with MeOH (2 mL) and evaporated in vacuo. To the residue dissolved in a 10 : 10 : 1 mixture of CH_2Cl_2, MeOH and $(MeO)_3CH$ (0.6 mL) was added methanolic p-TsOH·H_2O solution (0.05 mL, 2.5 mg dissolved in 0.5 mL of MeOH) at

25 °C, and the reaction solution was stirred at 25 °C for 2 hours. The reaction was quenched with saturated aqueous $NaHCO_3$ (3 mL), worked up with EtOAc (3 mL x 3) and separated chromatographically (EtOAc/hexane = 1/1) to give the spiroketal ester **43** (6.2 mg, 79% yield from **42**).

For **43**: ^{1}H NMR (400 MHz, $CDCl_3$) δ 5.31 – 5.15 (m, 1H), 4.33 (td, *J* = 7.8, 2.8 Hz, 1H), 4.04 (d, *J* = 9.4 Hz, 1H), 3.91 (dd, *J* = 9.4, 2.0 Hz, 1H), 3.83 (d, *J* = 4.4 Hz, 1H), 3.77 – 3.73 (m, 2H), 3.70 (s, 3H), 3.66 (brs, 1H), 3.58 – 3.46 (m, 2H), 3.27 (s, 3H), 2.85 – 2.73 (m, 1H), 2.62 (brs, 1H), 2.33 (dd, *J* = 15.0, 7.5 Hz, 2H), 2.31 – 2.21 (m, 2H), 2.19 – 1.67 (m, 12H), 1.59 – 1.24 (m, 8H), 1.34 (s, 3H), 1.15 (dd, *J* = 13.3, 7.2 Hz, 6H), 1.06 (d, *J* = 6.9 Hz, 3H), 1.01 (d, *J* = 6.8 Hz, 3H), 0.94 (d, *J* = 7.1 Hz, 3H), 0.86 (t, *J* = 6.2 Hz, 6H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 174.45, 173.43, 107.62, 99.31, 87.67, 86.14, 84.25, 82.46, 77.66, 76.82, 73.77, 71.32, 67.57, 63.48, 52.11, 48.30, 40.28, 38.82, 38.19, 36.83, 36.32, 36.18, 35.97, 34.46, 34.18, 33.02, 32.36, 32.33, 27.67, 26.79, 24.70, 23.17, 17.40, 16.34, 15.71, 12.96, 12.44, 10.90, 9.23; HRMS (ESI) *m*/*z* calcd for $C_{39}H_{66}NaO_{12}$ ([M + Na]$^+$) 749.4446, found 749.4467.

Compound **45**



To **43** (7.2 mg, 9.9 μmol) dissolved in $ClCH_2CH_2Cl$ (1 mL) was added Me_3SnOH (18.3 mg, 99.0 μmol) at 25 °C and the resulting solution was heated at 80 °C for 48 hours. After cooling down the reaction mixture to 25 °C, it was quenched with saturated aqueous NH_4Cl (3 mL) and worked up with CH_2Cl_2 (2 mL x 3). Column chromatography of the crude product (EtOAc/hexane = 2/1, then 3% MeOH in CH_2Cl_2) afforded the laidlomycin methyl ketal **64**

(2.8 mg, 39% yield) and the recovered **43** (3.9 mg, 54%). The second cycle with 3.9 mg of **43** furnished **64** (1.6 mg, 42% yield) and **43** (2.0 mg, 52%), the third cycle with 2.0 mg of **43** gave **64** (0.9 mg, 46% yield) and **43** (1.0 mg, 50%). After three cycles of the demethylation, 5.3 mg of the desired **64** (75% combined yield) was obtained along with 1.0 mg of **43** (14% recovery). To **64** (5.3 mg, 7.4 μmol) dissolved in $CHCl_3$ (0.3 mL) was added aqueous $HClO_4$ (1 M, 0.3 mL) and the reaction mixture was stirred at 25 °C for an hour. The resulting solution was extracted with CH_2Cl_2 (2 mL x 3) and the organic layer was evaporated in vacuo. The residue dissolved in CH_2Cl_2 (2 mL) was basified with aqueous NaOH (0.1 M, 1 mL) in an ice bath and stirred at that temperature for 10 minutes. After the normal work-up with CH_2Cl_2 (2 mL x 3), chromatographic purification (3% MeOH in CH_2Cl_2) produced laidlomycin sodium salt **45** (4.7 mg, 88% yield) ($[\alpha]_D^{25}$ = +64.4, c = 0.32 in $CHCl_3$).

For **45**: ^{1}H NMR (400 MHz, $CDCl_3$) δ 9.60 (s, 1H), 5.08 (dd, *J* = 10.7, 1.9 Hz, 1H), 4.42 (ddd, *J* = 9.6, 7.0, 3.8 Hz, 1H), 4.05 (dd, *J* = 11.1, 2.1 Hz, 1H), 4.00 (d, *J* = 11.9 Hz, 1H), 3.93 (d, *J* = 3.5 Hz, 1H), 3.90 (brd, *J* = 2.4 Hz, 1H), 3.82 (dd, *J* = 9.6, 3.8 Hz, 1H), 3.56 (dd, *J* = 10.5, 4.9 Hz, 1H), 3.38 (s, 1H), 3.32 (d, *J* = 11.8 Hz, 1H), 2.69 (dq, *J* = 13.5, 6.7 Hz, 1H), 2.31 (ddd, *J* = 15.0, 7.6, 1.6 Hz, 2H), 2.26 – 2.13 (m, 4H), 2.03 – 1.85 (m, 4H), 1.79 – 1.52 (m, 9H), 1.49 (s, 3H), 1.44 – 1.29 (m, 4H), 1.23 (d, *J* = 6.9 Hz, 3H), 1.18 (s, 3H), 1.16 – 1.08 (m, 6H), 1.01 (d, *J* = 7.1 Hz, 3H), 0.88 (d, *J* = 6.9 Hz, 3H), 0.85 (d, *J* = 6.2 Hz, 3H), 0.81 (d, *J* = 5.9 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 180.11, 173.72, 106.99, 98.19, 86.42, 85.22, 83.87, 81.51, 76.62, 75.74, 74.56, 70.59, 68.38, 64.89, 43.55, 40.37, 39.27, 36.47, 35.61, 35.27, 34.53, 33.39, 33.16, 33.00, 31.81, 30.35, 27.91, 27.65, 27.40, 23.93, 16.78, 16.63, 16.06, 14.13, 11.12, 10.22, 9.34; HRMS (ESI) *m/z* calcd for $C_{37}H_{62}NaO_{12}$ ($[M + H]^+$) 721.4133, found 721.4115.

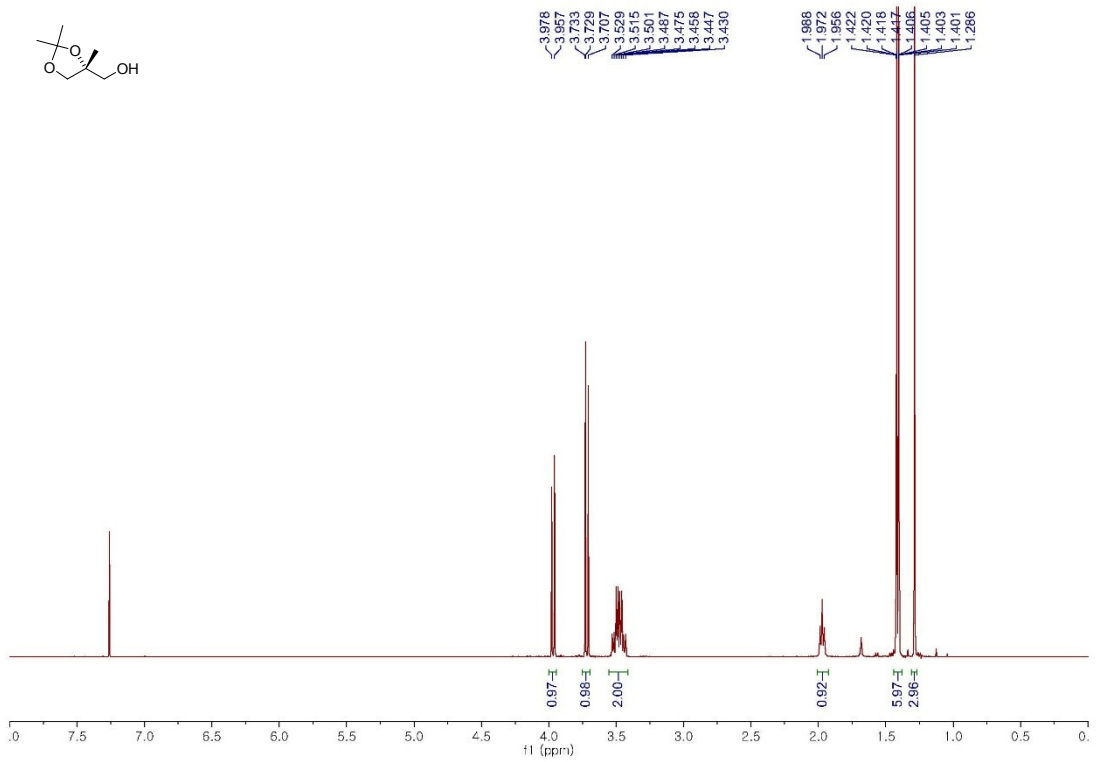
Comparison of the ^{13}C NMR spectral data of **45**

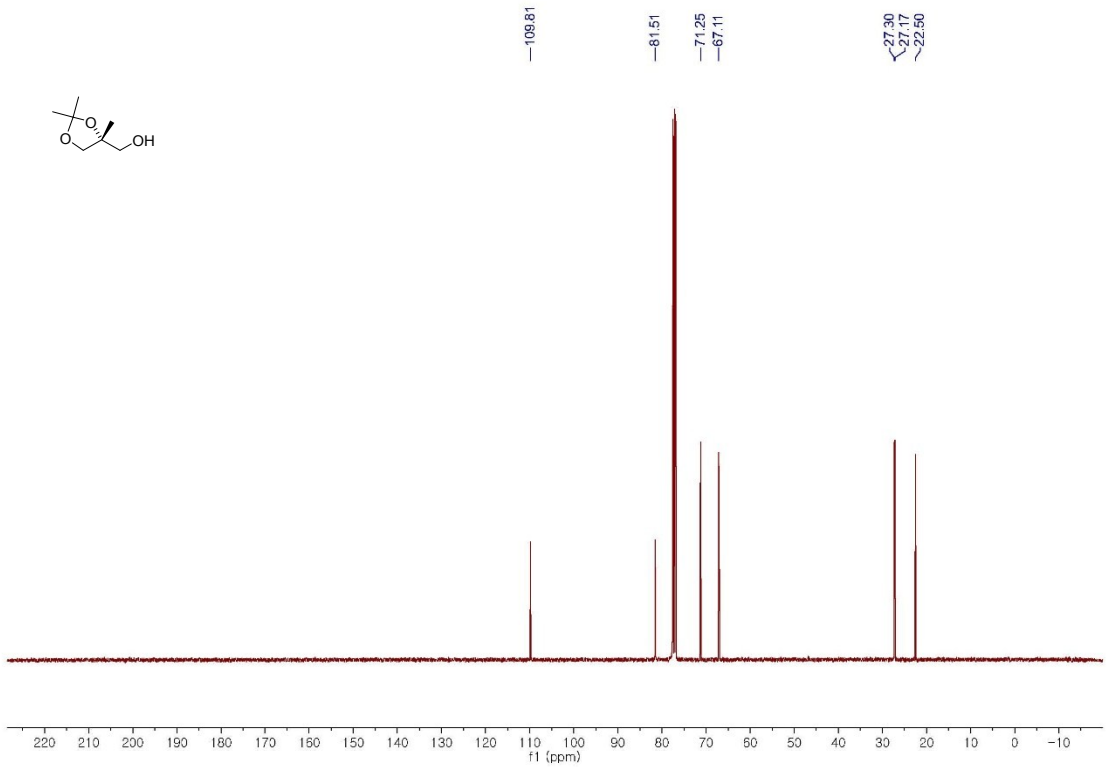
Reference (δ_1)	This work (δ_2)	Difference ($\Delta\delta=\delta_1-\delta_2$)	Reference (δ_1)	This work (δ_2)	Difference ($\Delta\delta=\delta_1-\delta_2$)
179.98	180.11	-0.13	35.25	35.27	-0.02
173.51	173.72	-0.21	34.54	34.53	0.01
106.99	106.99	0	33.34	33.39	-0.05
98.14	98.19	-0.05	33.16	33.16	0
86.46	86.42	0.04	33.02	33.00	0.02
85.23	85.22	0.01	31.76	31.81	-0.05
83.88	83.87	0.01	30.33	30.35	-0.02
81.52	81.51	0.01	27.86	27.91	-0.05
76.60	76.62	-0.02	27.60	27.65	-0.05
75.70	75.74	-0.04	27.39	27.40	-0.01
74.54	74.56	-0.02	23.92	23.93	-0.01
70.58	70.59	-0.01	16.77	16.78	-0.01
68.29	68.38	-0.09	16.61	16.63	-0.02
64.86	64.89	-0.03	16.04	16.06	-0.02
43.54	43.55	-0.01	14.09	14.13	-0.04
40.38	40.37	0.01	11.06	11.12	-0.06
39.25	39.27	-0.02	10.18	10.22	-0.04
36.45	36.47	-0.02	9.33	9.34	-0.01
35.63	35.61	0.02			

Reference: R. D. Clark, G. L. Hedden, A. F. Kluge, M. L. Maddox, H. R. Spires, P. F. Long, *J. Antibiot.* **1982**, *35*, 1527-1537.

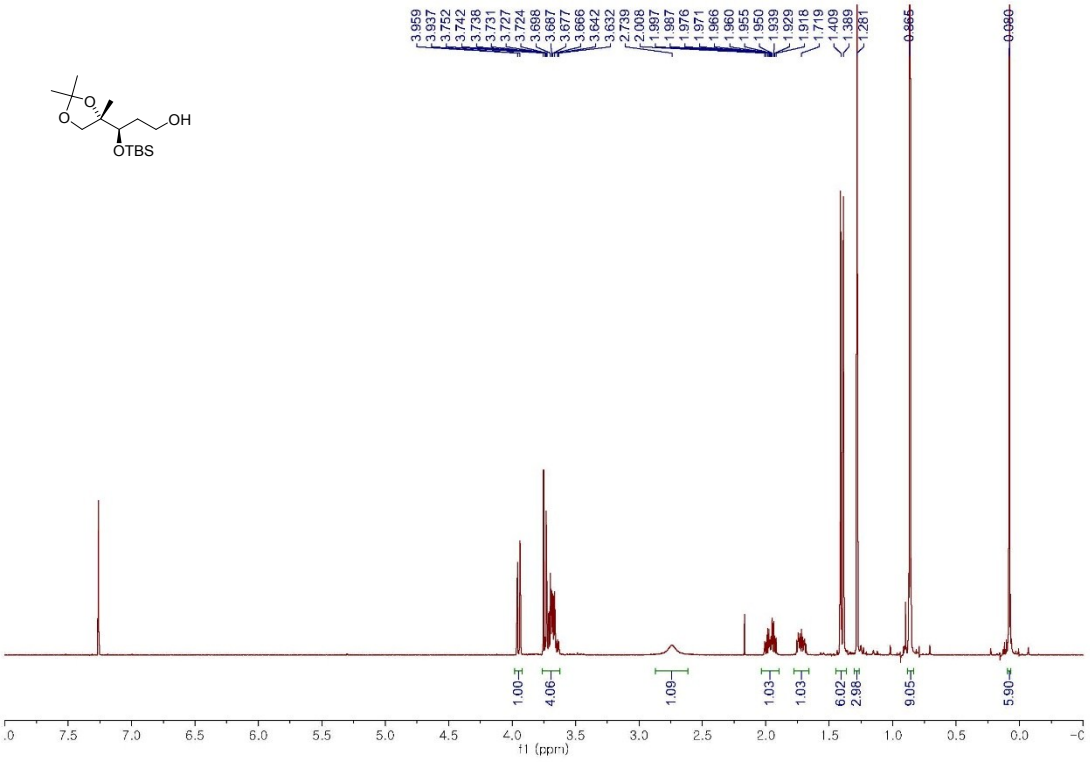
III. Selected NMR Spectral Charts

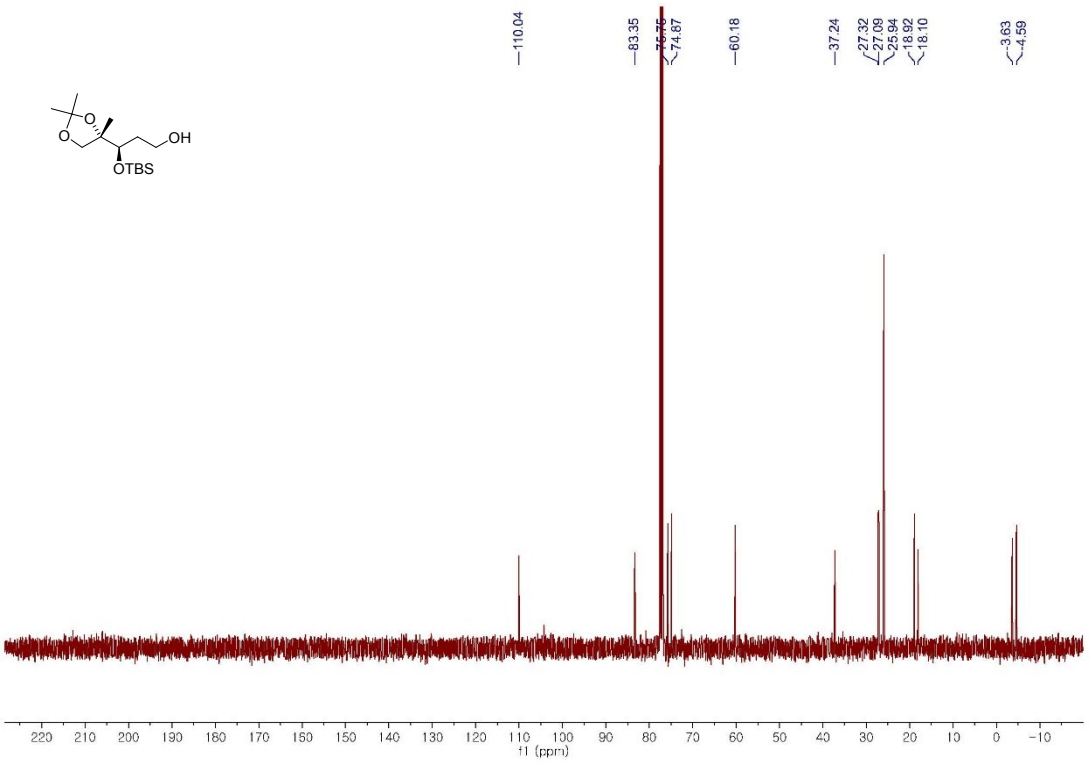
^{1}H NMR (400 MHz, $CDCl_3$) and ^{13}C NMR (100MHz, $CDCl_3$) spectra of **47**



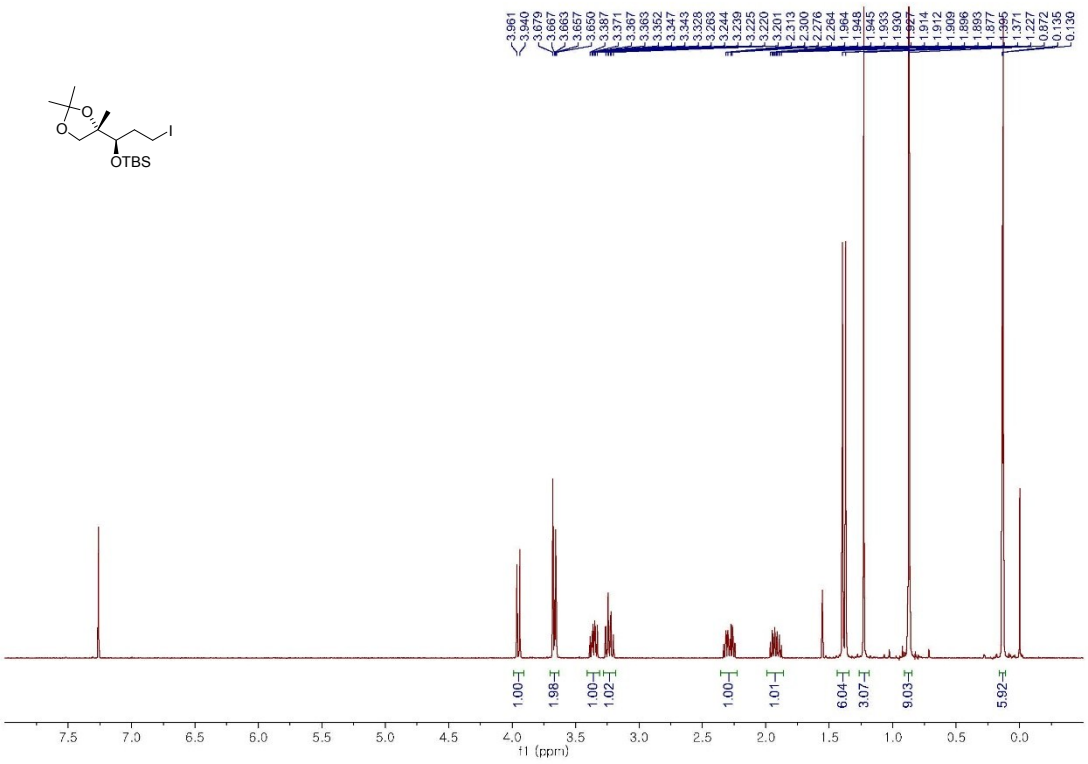


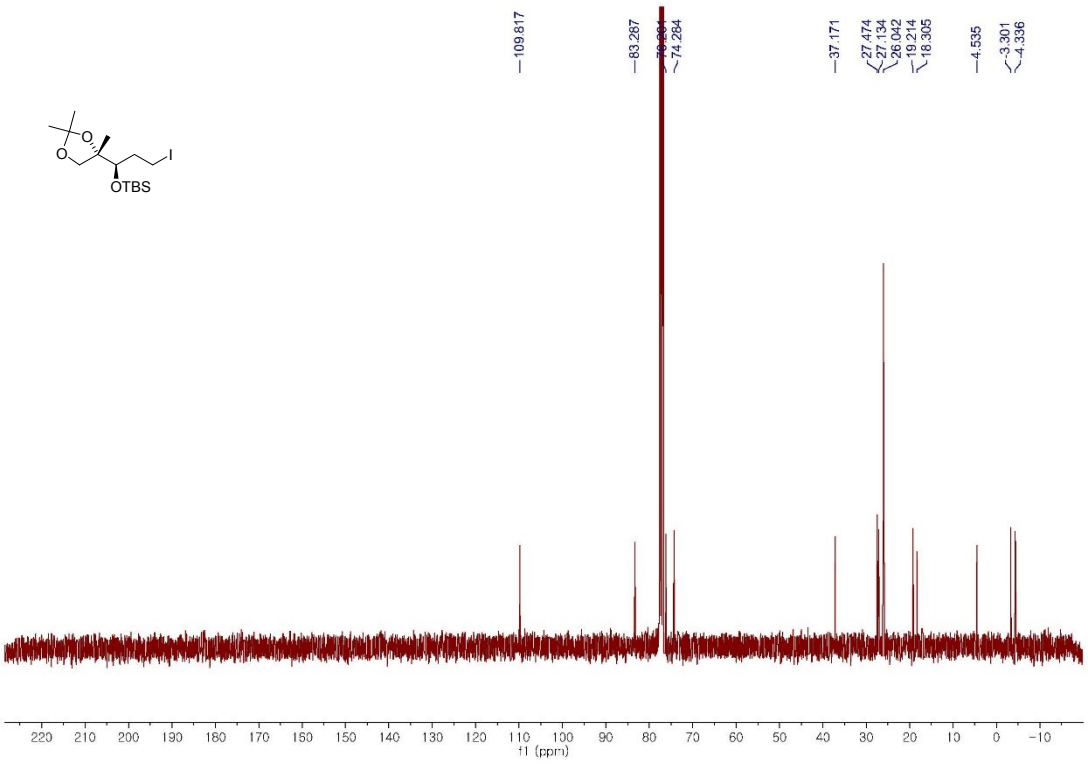
^{1}H NMR (400 MHz, $CDCl_3$) and ^{13}C NMR (100MHz, $CDCl_3$) spectra of **17**



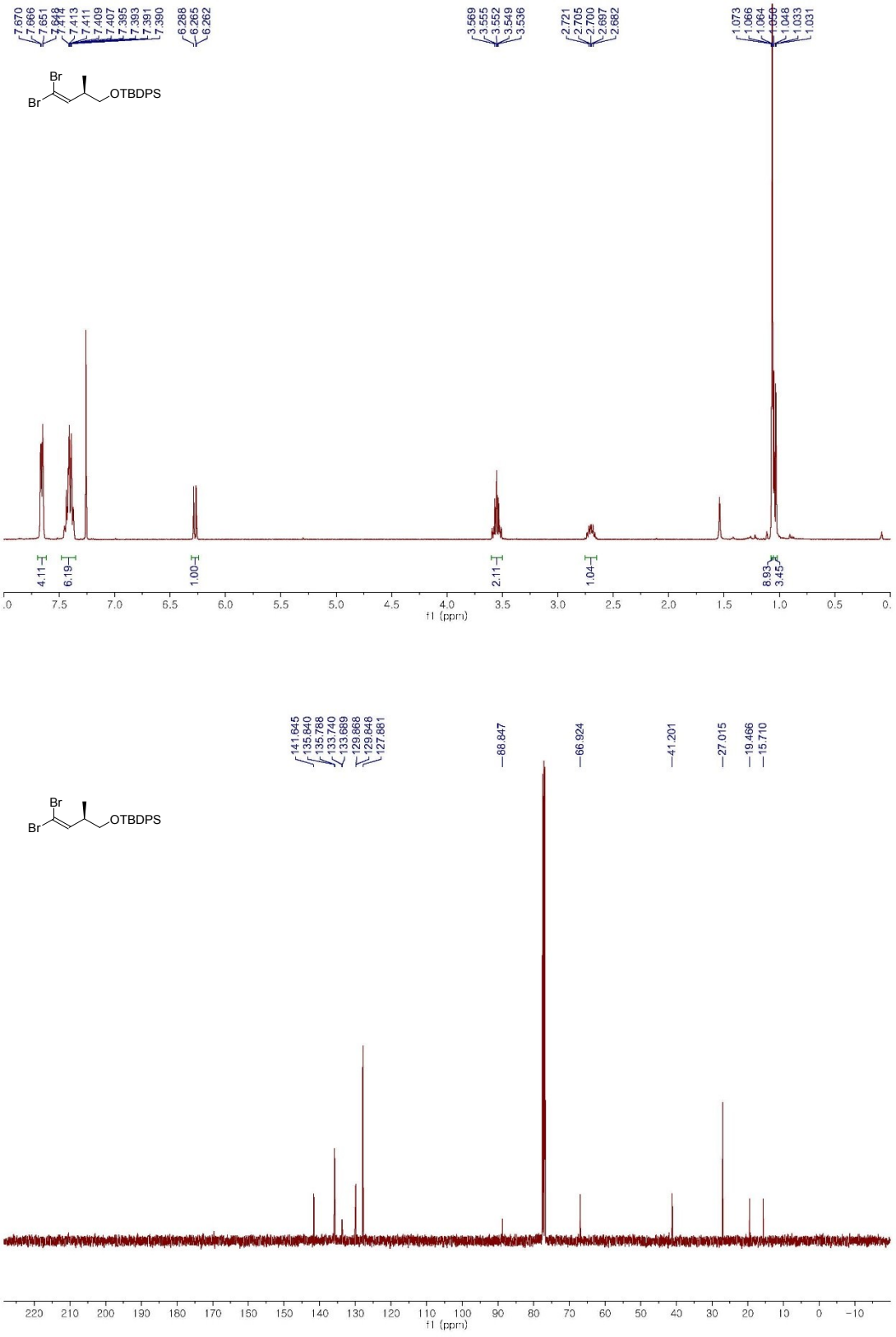


^{1}H NMR (400 MHz, $CDCl_3$) and ^{13}C NMR (100MHz, $CDCl_3$) spectra of **19**

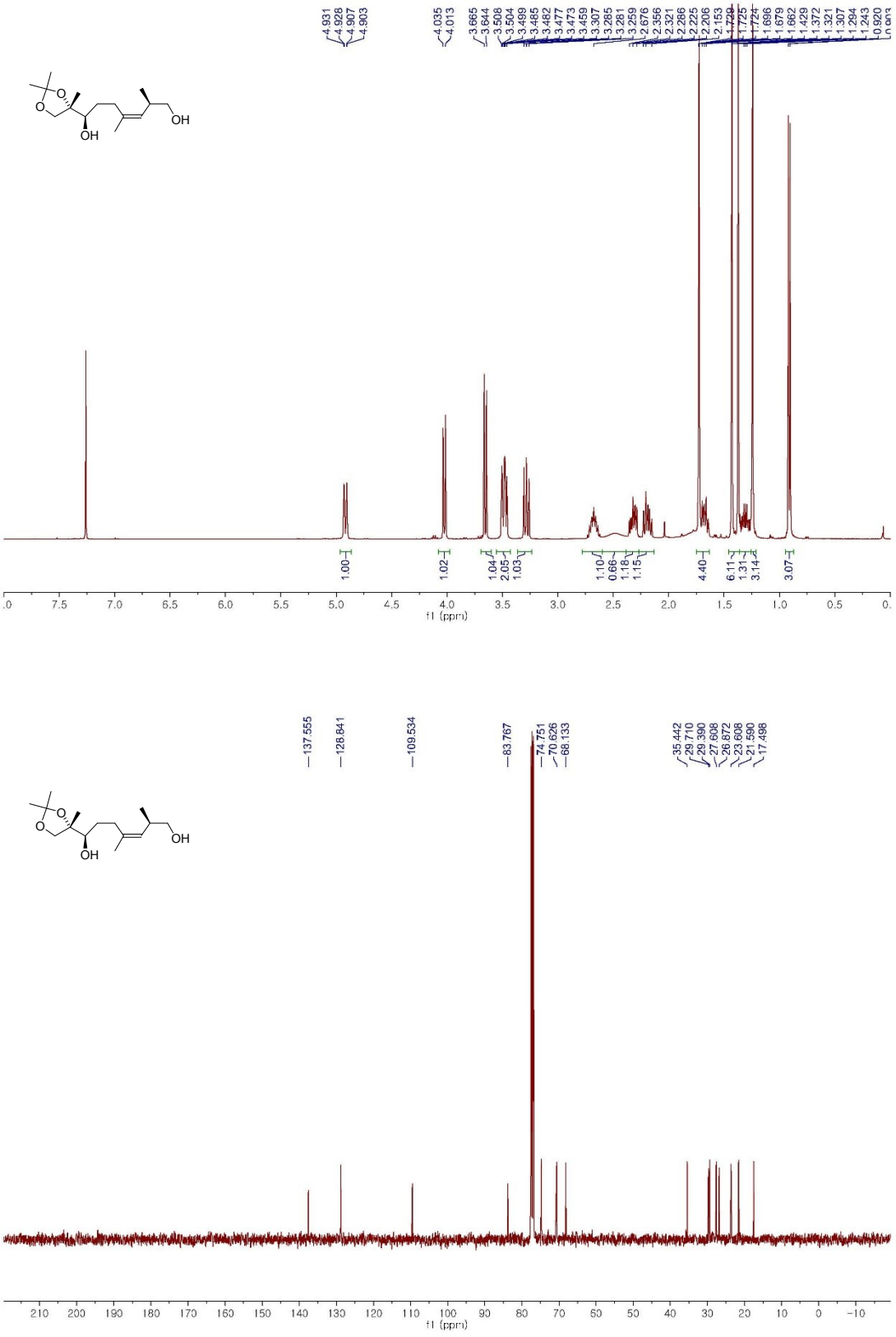




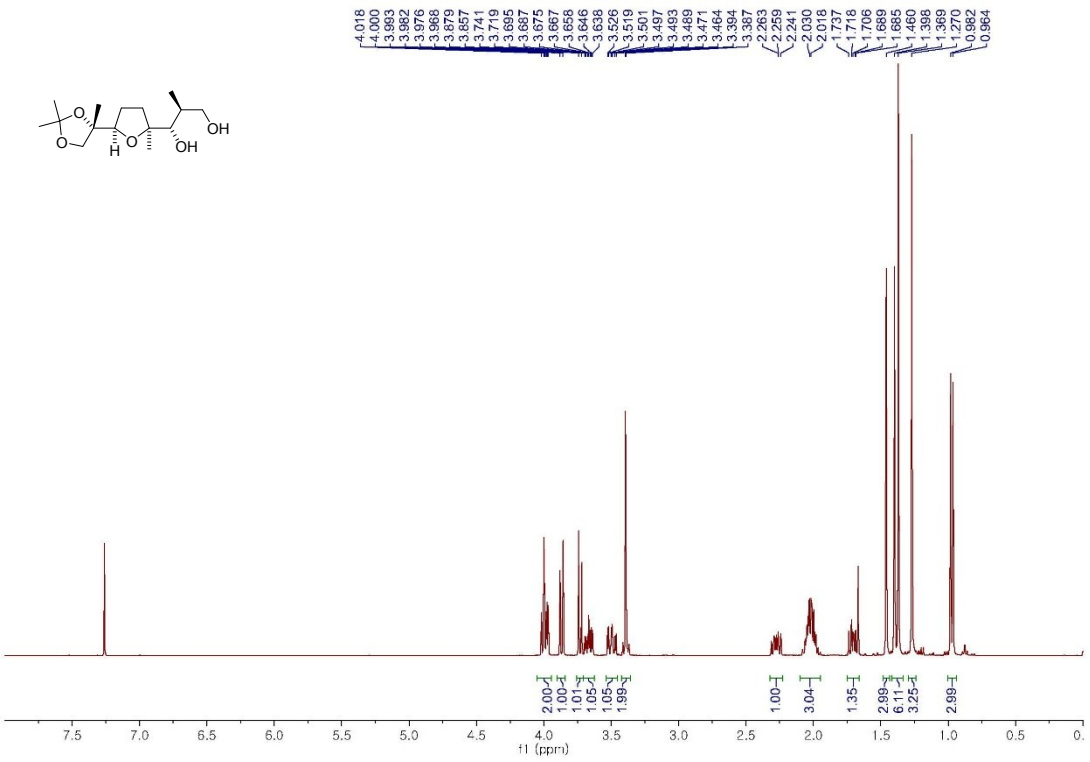
^{1}H NMR (400 MHz, $CDCl_3$) and ^{13}C NMR (100MHz, $CDCl_3$) spectra of **20**

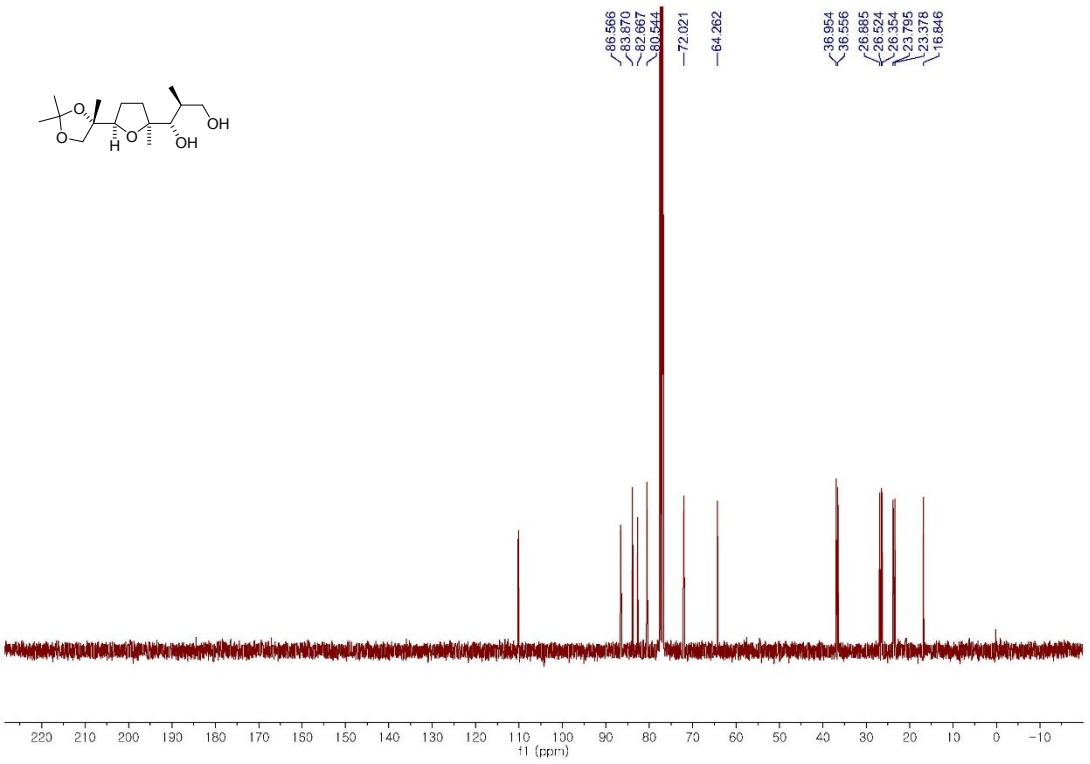


^{1}H NMR (400 MHz, $CDCl_3$) and ^{13}C NMR (100MHz, $CDCl_3$) spectra of **24**

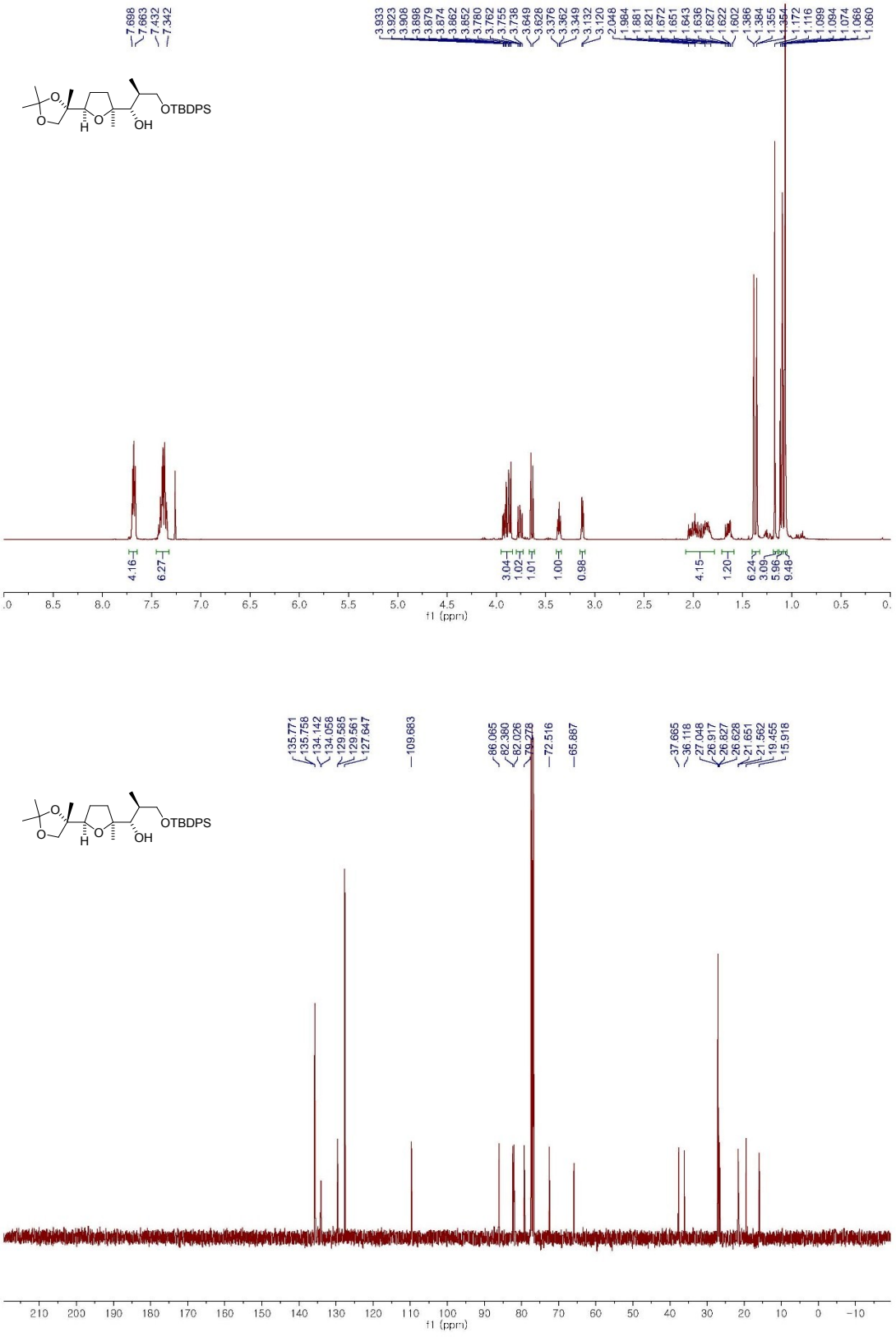


^{1}H NMR (400 MHz, $CDCl_3$) and ^{13}C NMR (100MHz, $CDCl_3$) spectra of **27**

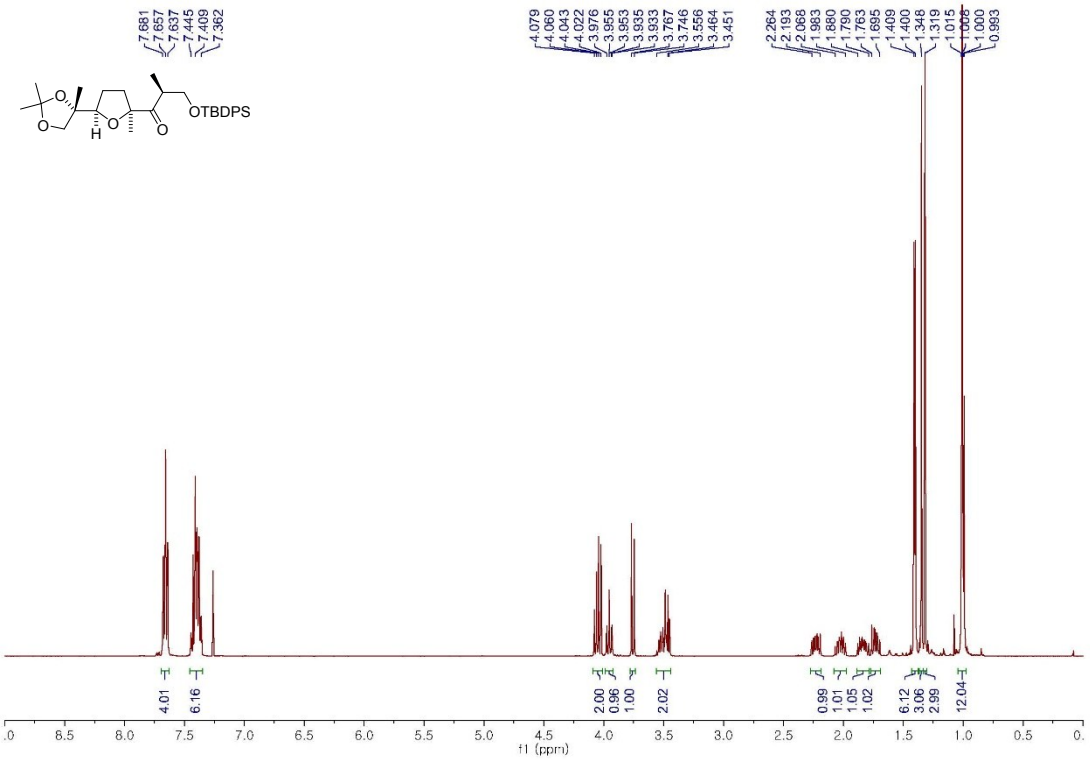


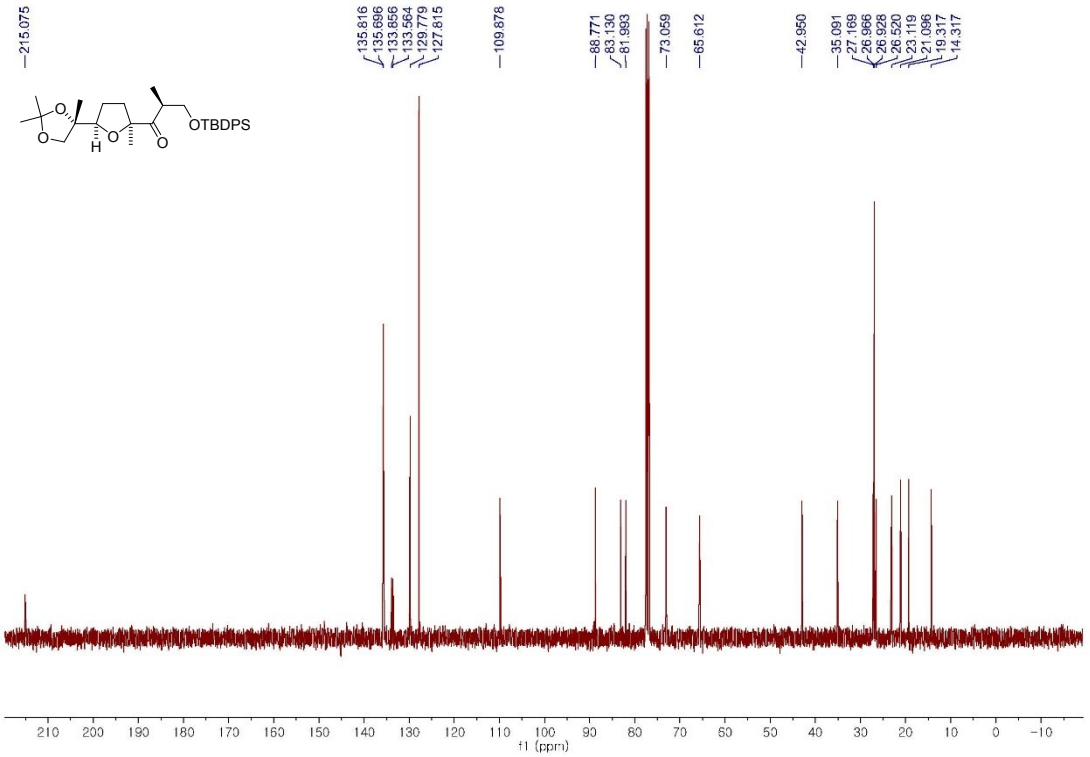


^{1}H NMR (400 MHz, $CDCl_3$) and ^{13}C NMR (100MHz, $CDCl_3$) spectra of **25**

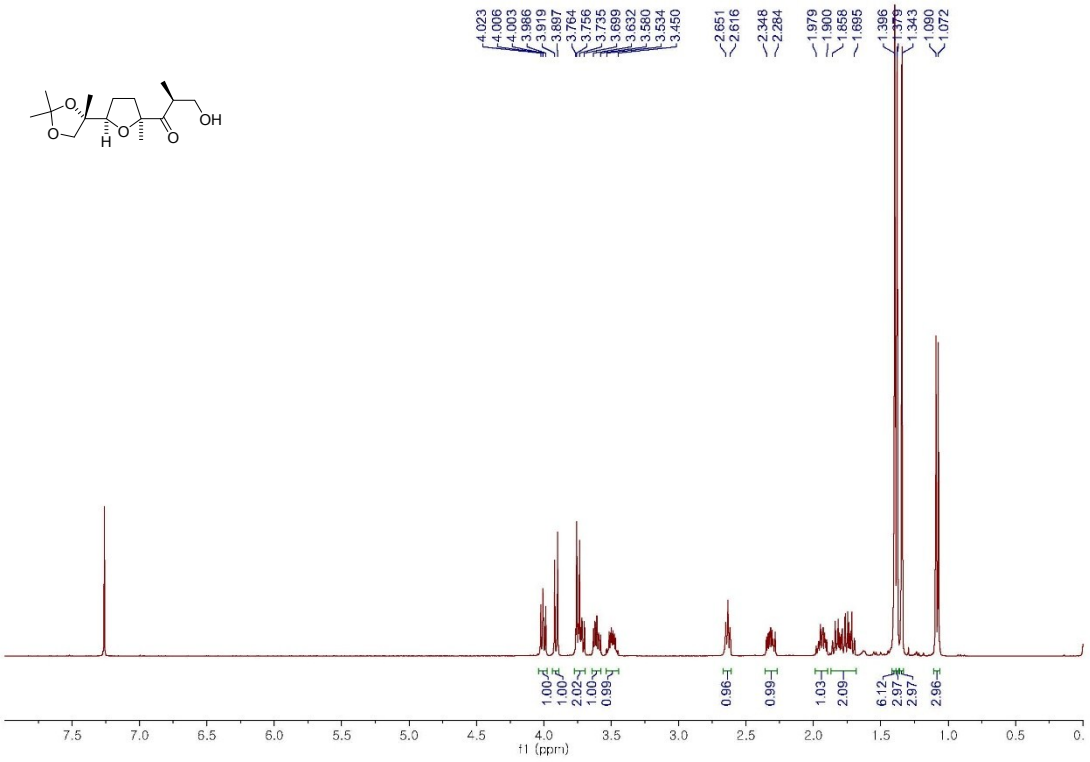


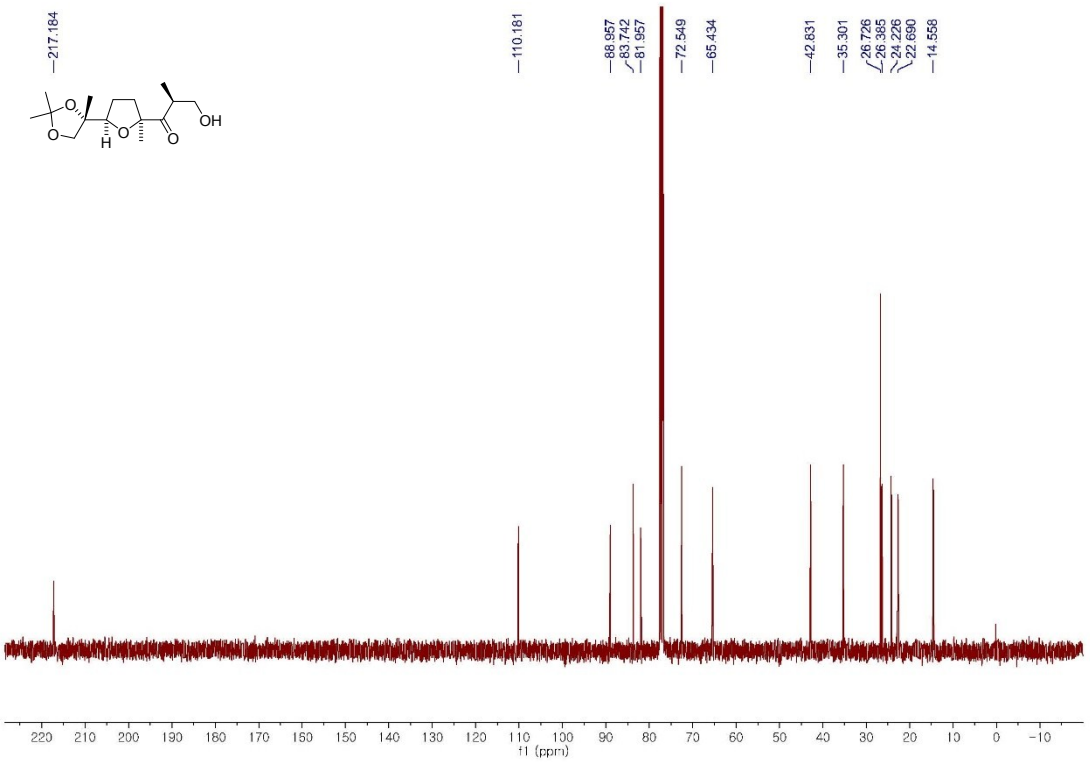
^{1}H NMR (400 MHz, $CDCl_3$) and ^{13}C NMR (100MHz, $CDCl_3$) spectra of **53**



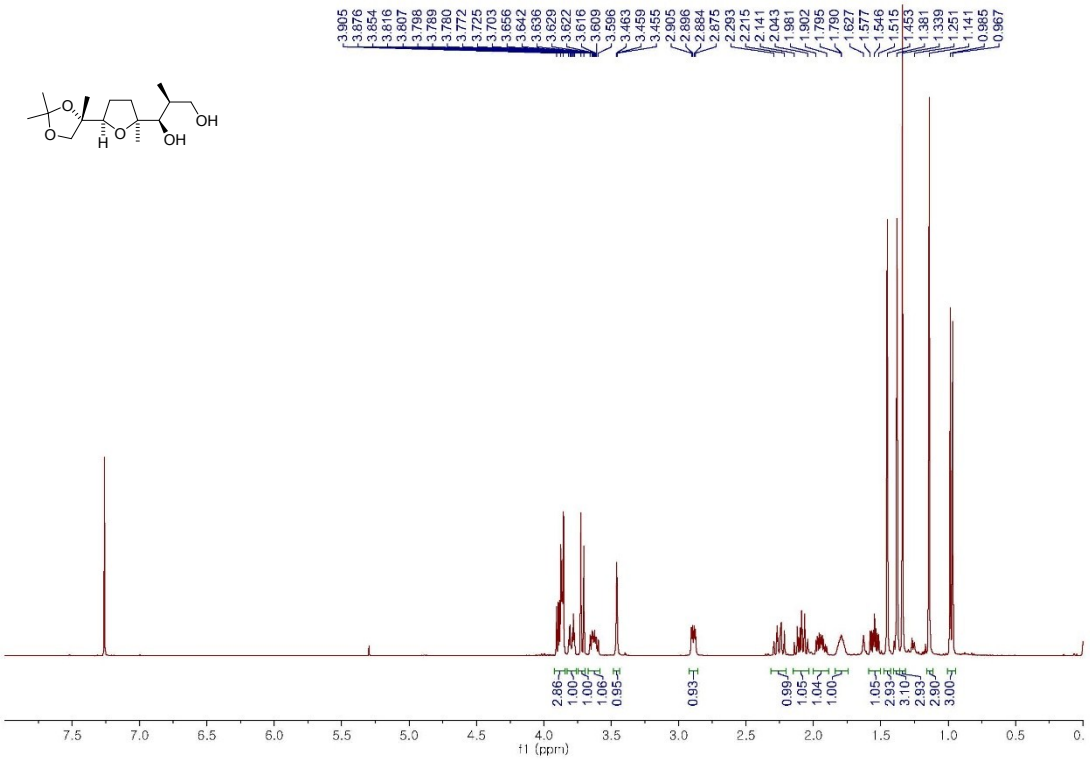


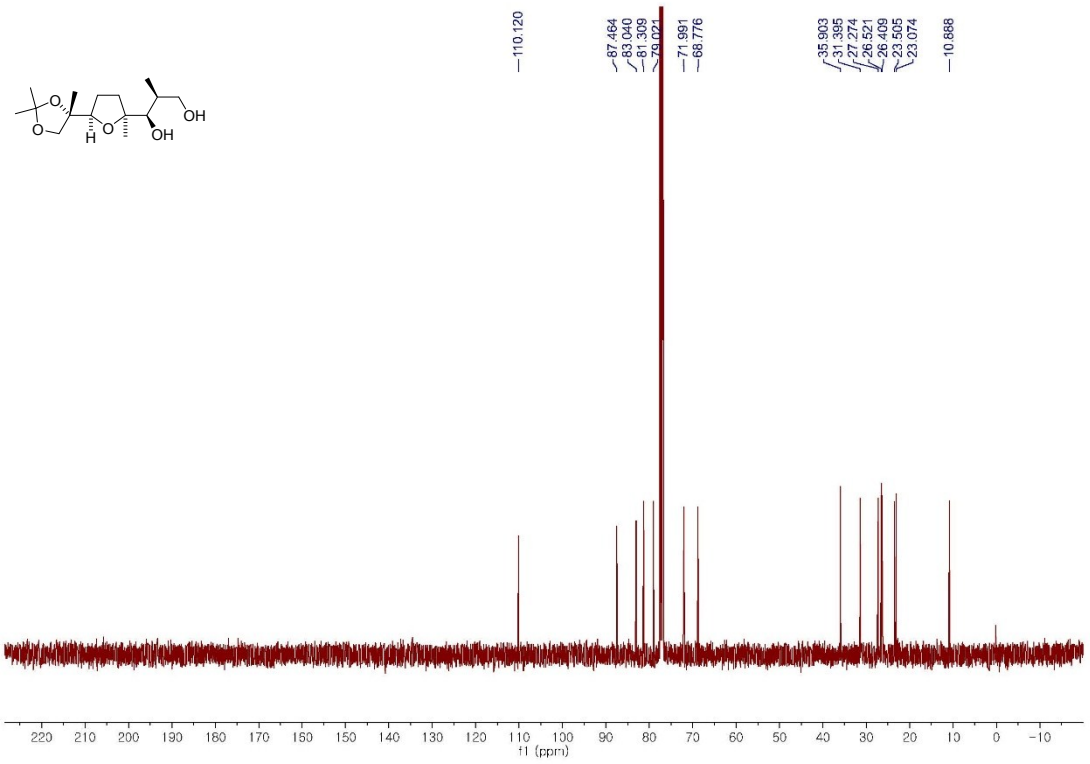
^{1}H NMR (400 MHz, $CDCl_3$) and ^{13}C NMR (100MHz, $CDCl_3$) spectra of **54**



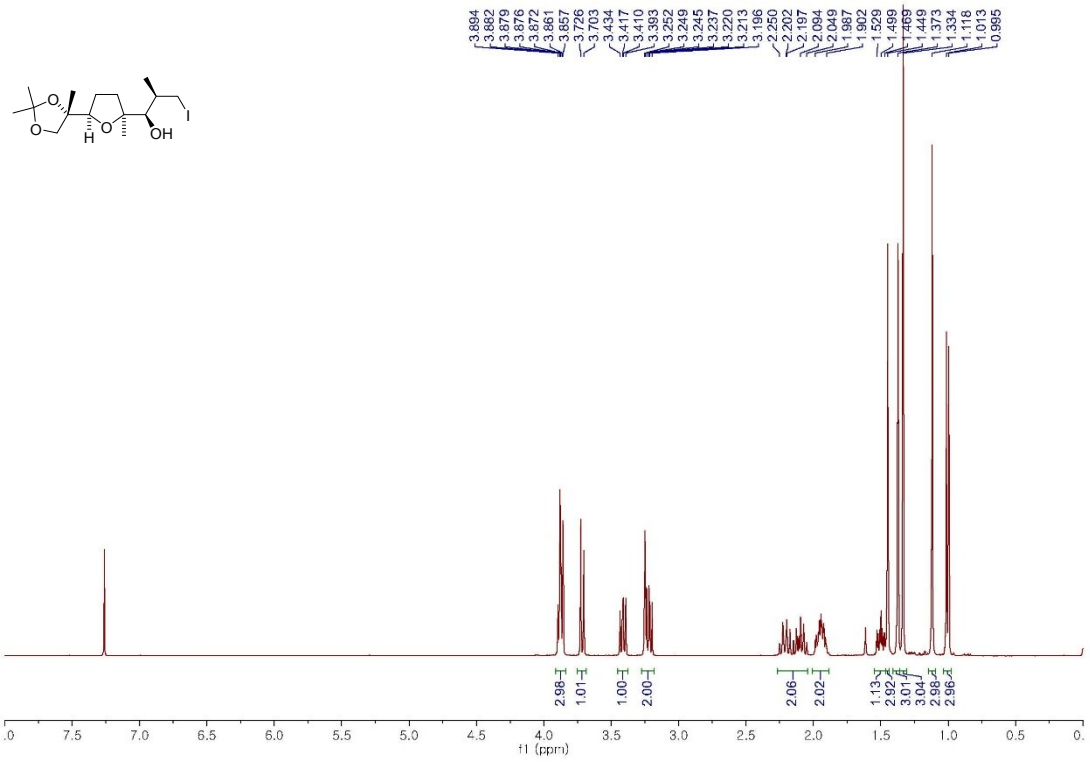


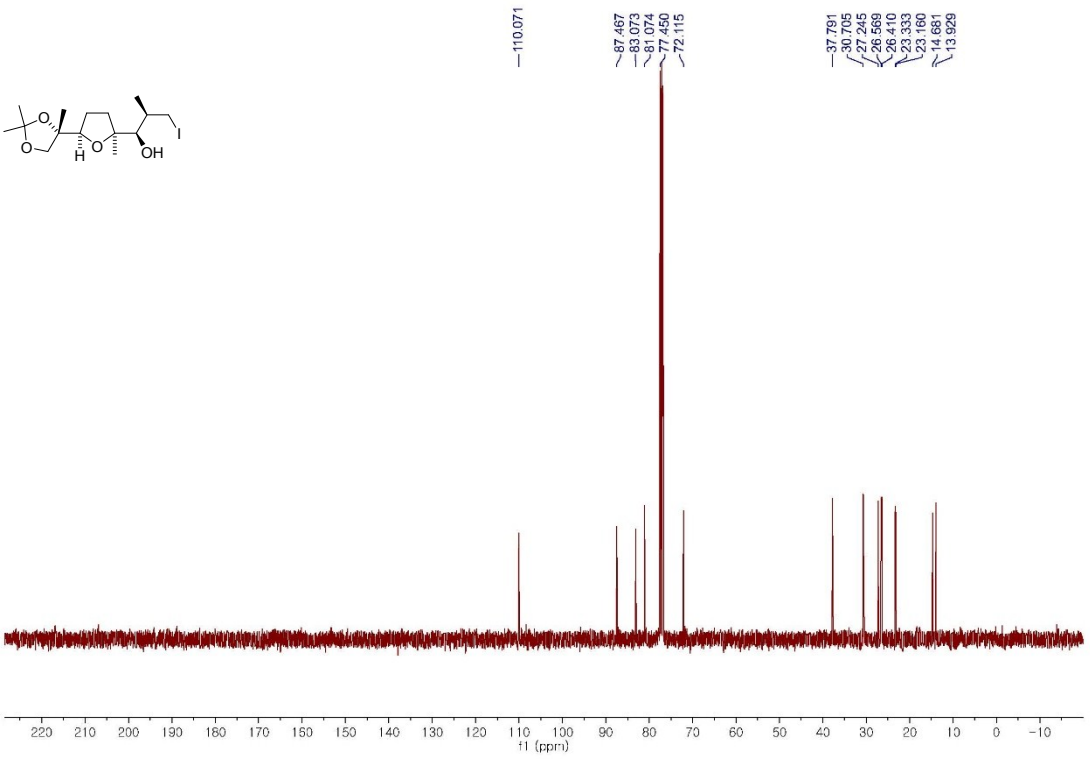
^{1}H NMR (400 MHz, $CDCl_3$) and ^{13}C NMR (100MHz, $CDCl_3$) spectra of **26**



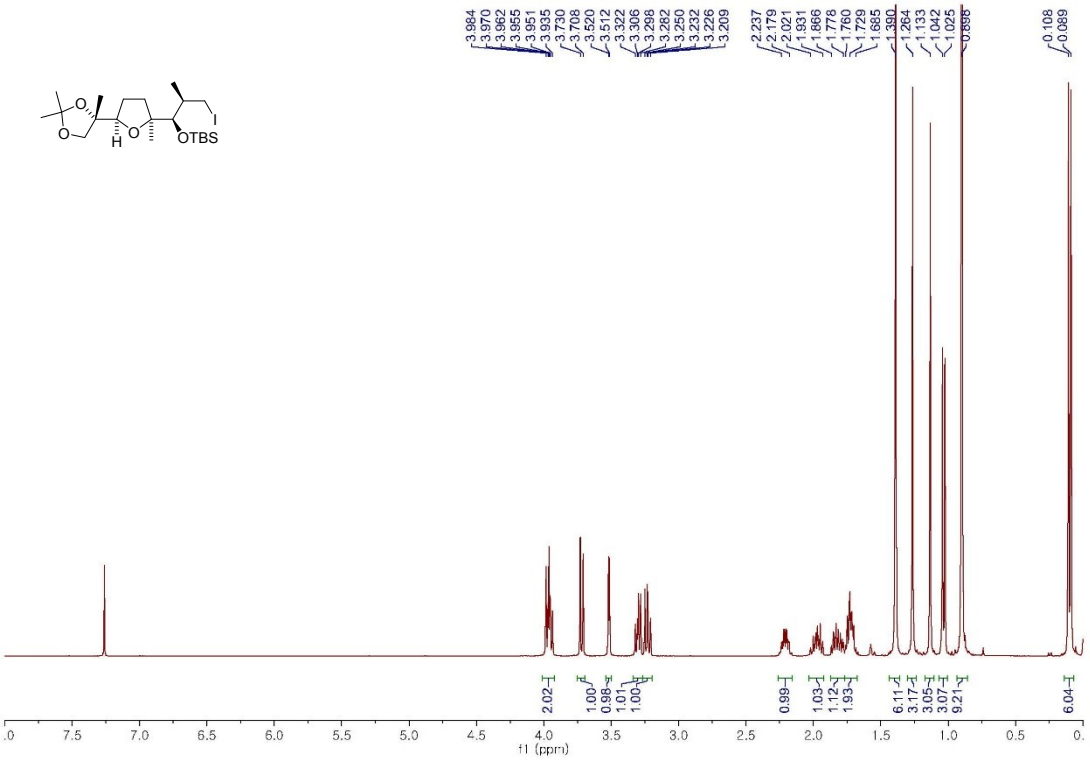


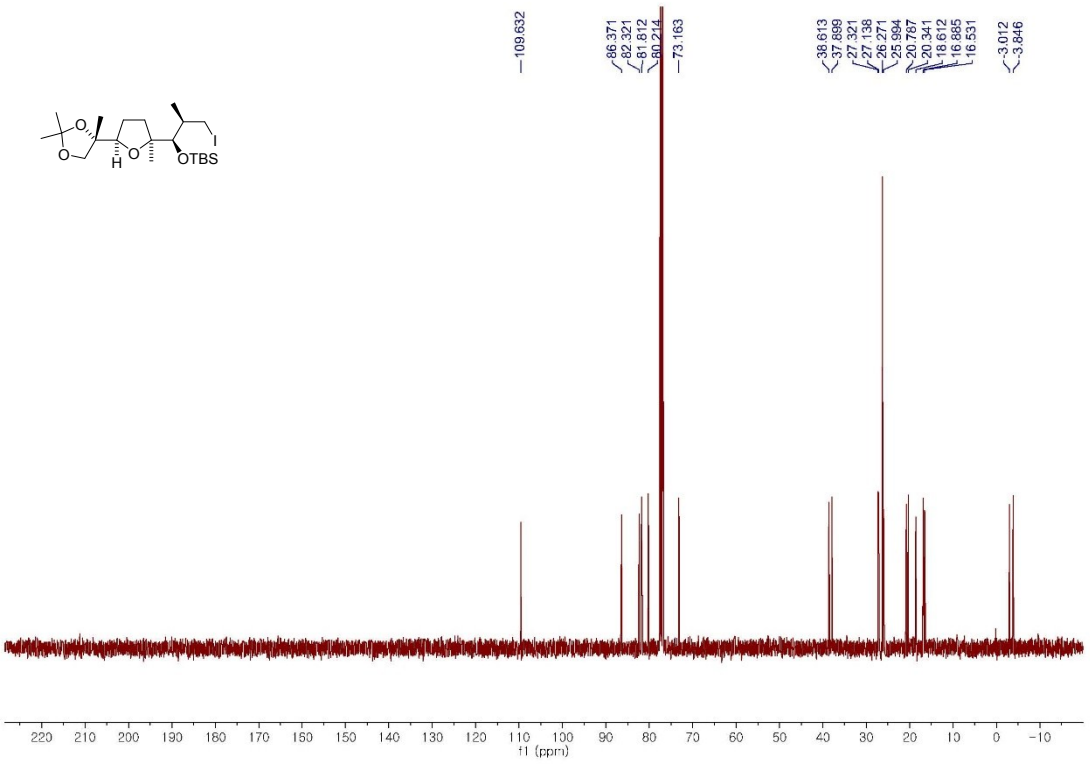
^{1}H NMR (400 MHz, $CDCl_3$) and ^{13}C NMR (100MHz, $CDCl_3$) spectra of **55**



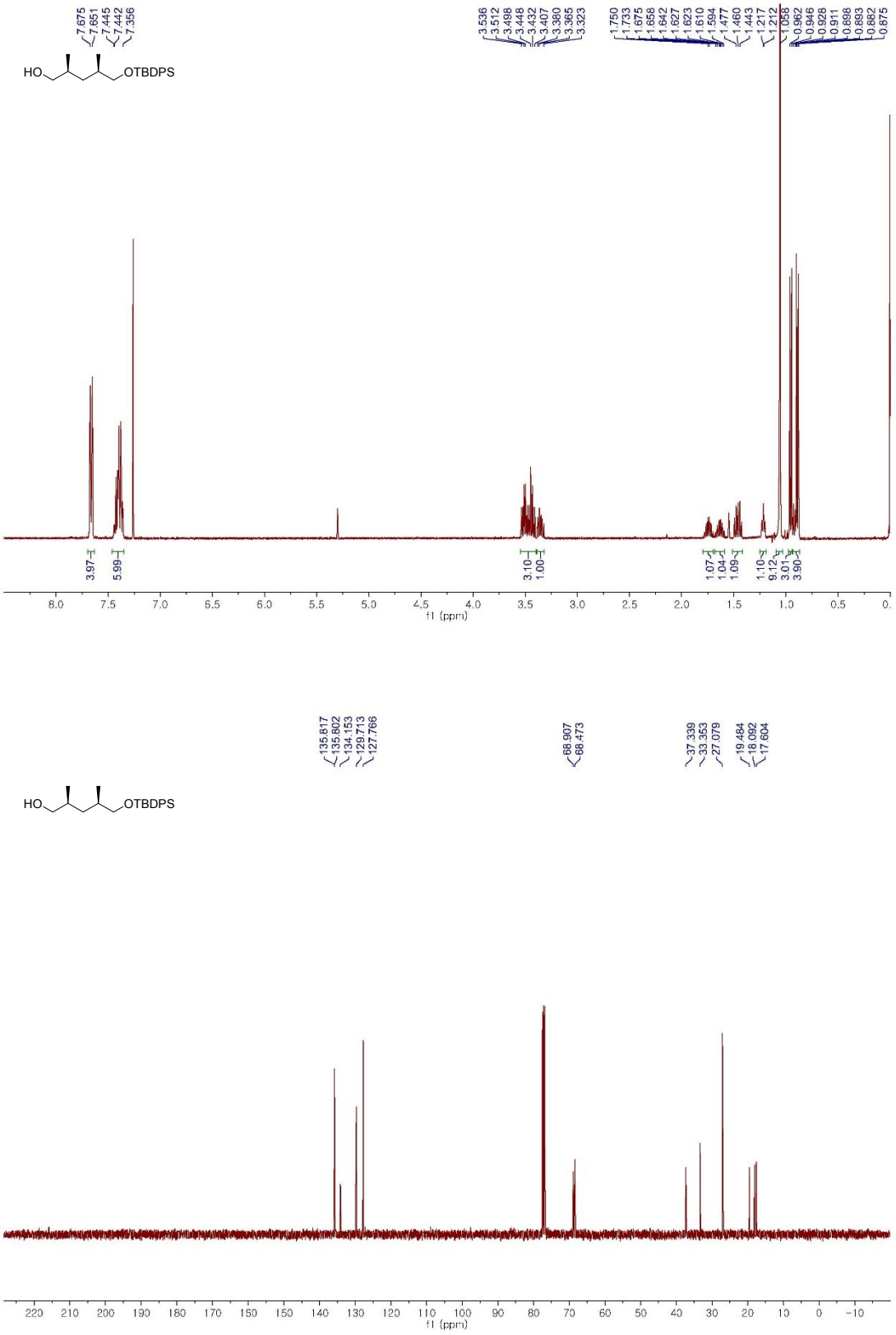


^{1}H NMR (400 MHz, $CDCl_3$) and ^{13}C NMR (100MHz, $CDCl_3$) spectra of **28**

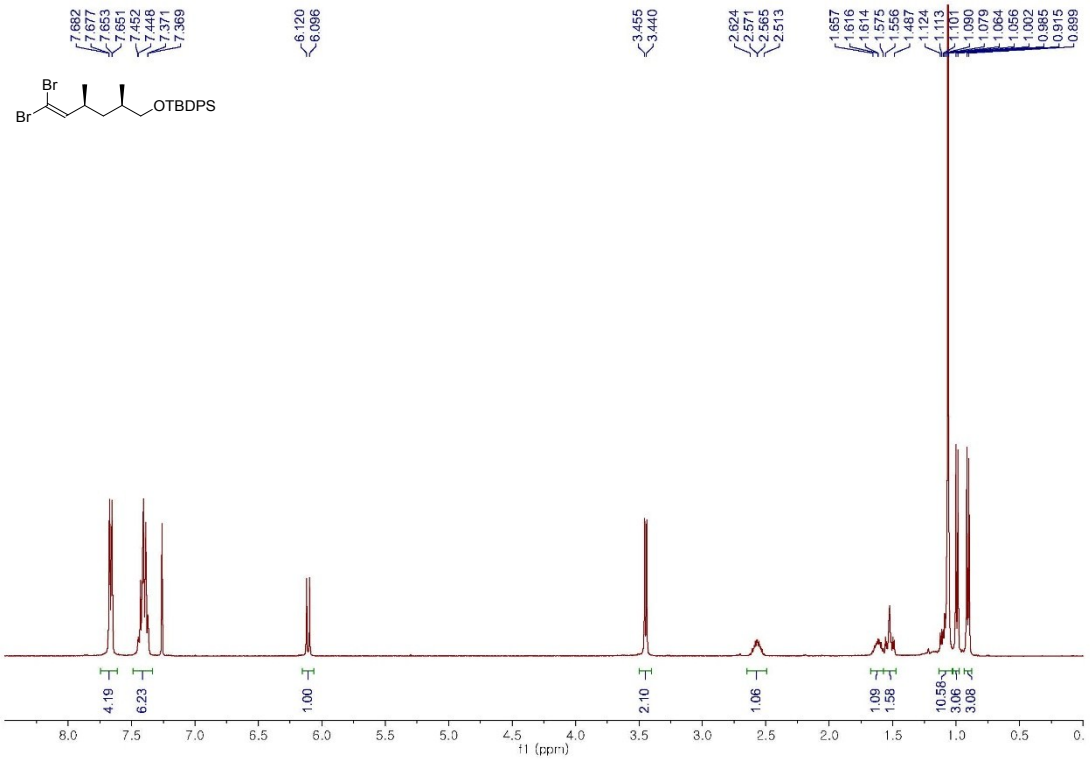


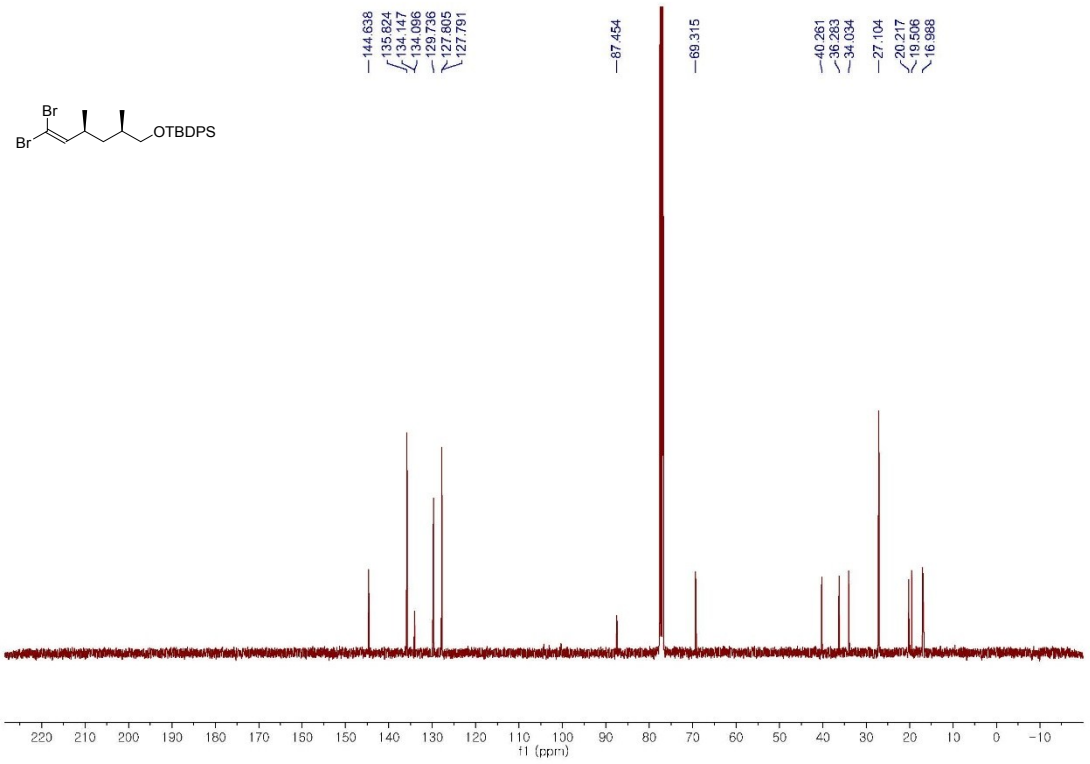


^{1}H NMR (400 MHz, $CDCl_3$) and ^{13}C NMR (100MHz, $CDCl_3$) spectra of **31**

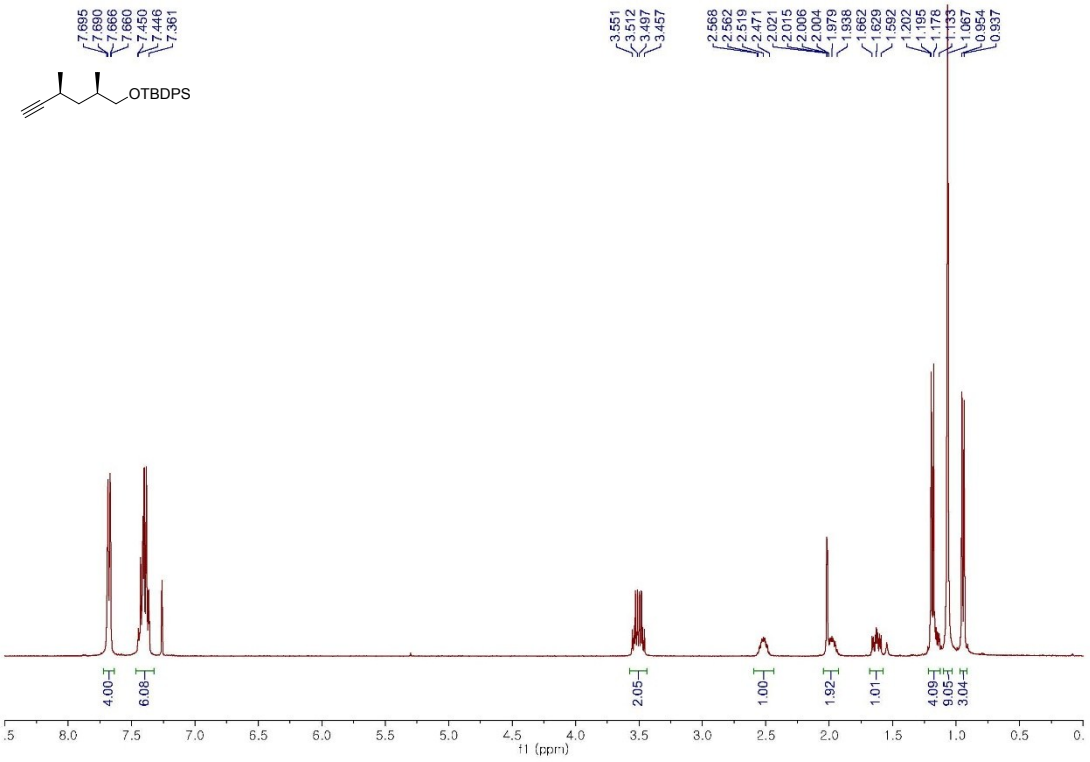


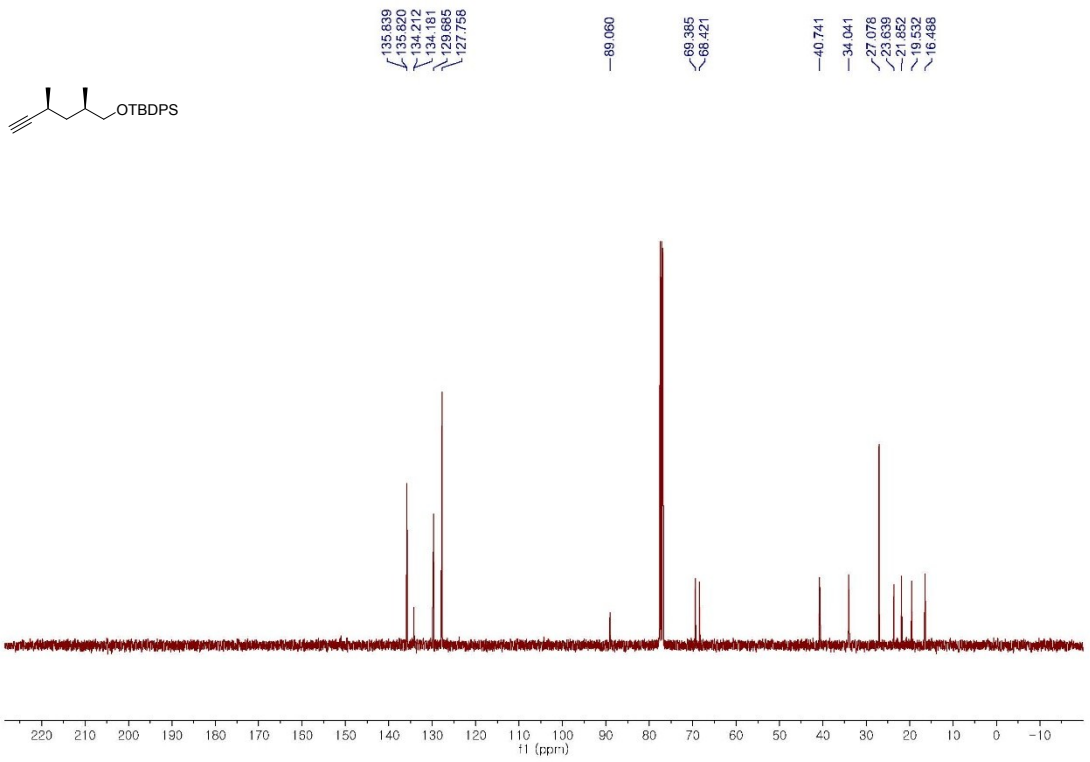
^{1}H NMR (400 MHz, $CDCl_3$) and ^{13}C NMR (100MHz, $CDCl_3$) spectra of **57**



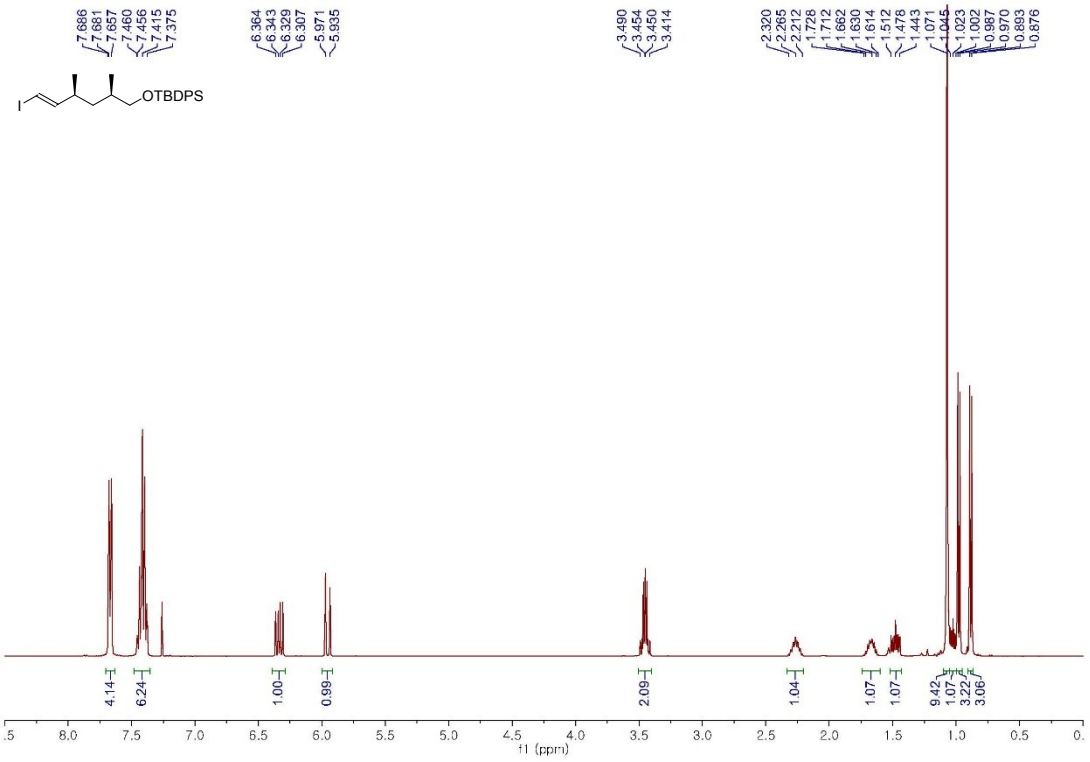


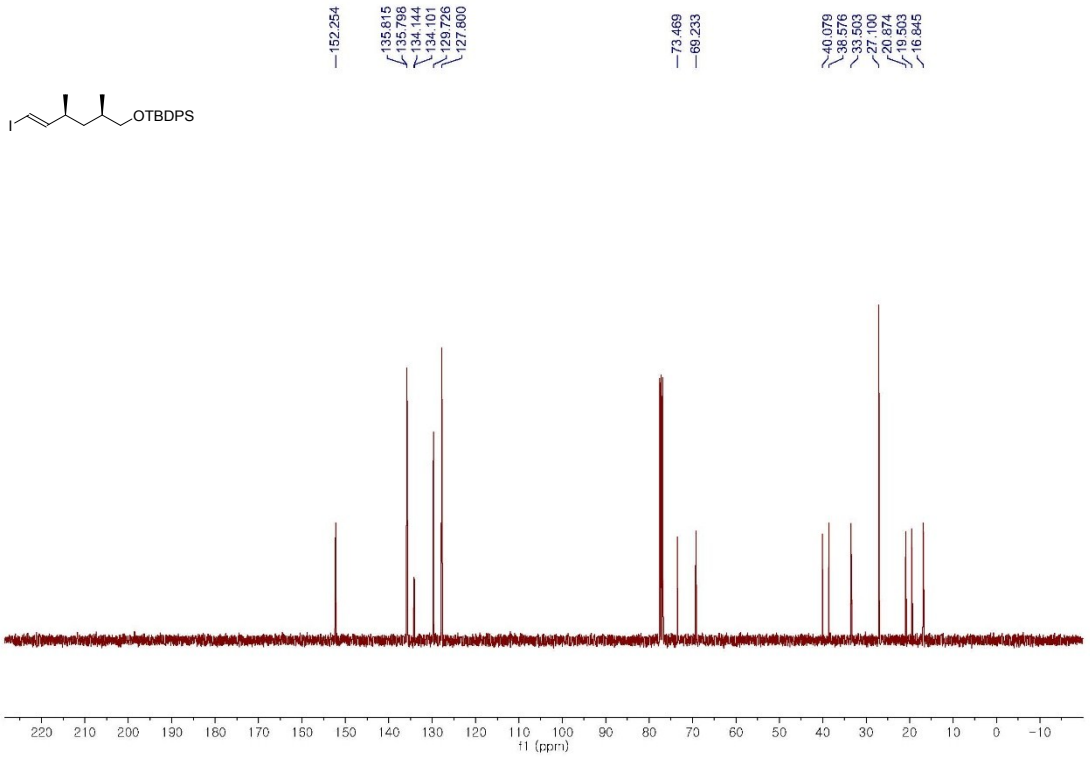
^{1}H NMR (400 MHz, $CDCl_3$) and ^{13}C NMR (100MHz, $CDCl_3$) spectra of **32**



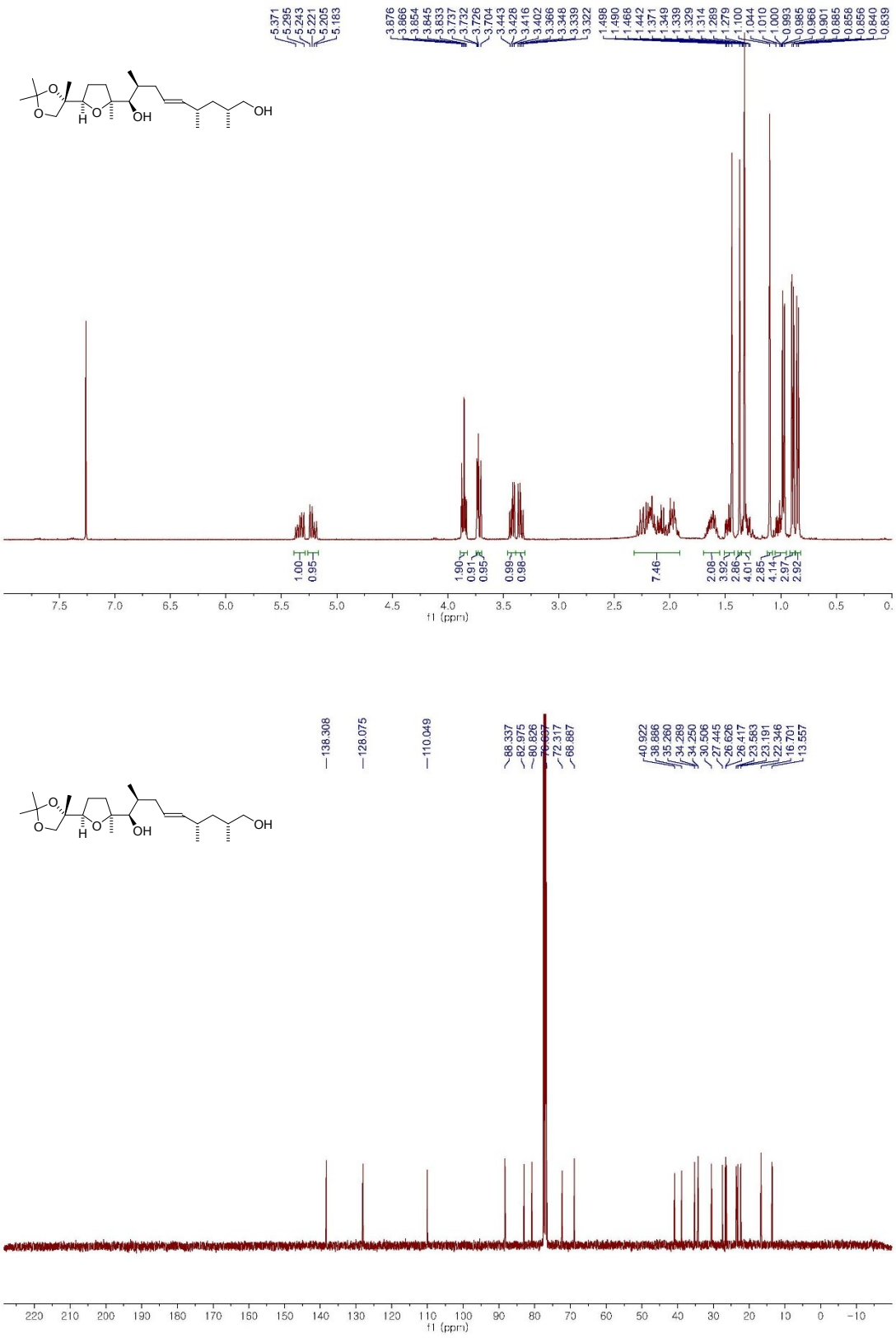


^{1}H NMR (400 MHz, $CDCl_3$) and ^{13}C NMR (100MHz, $CDCl_3$) spectra of **33**

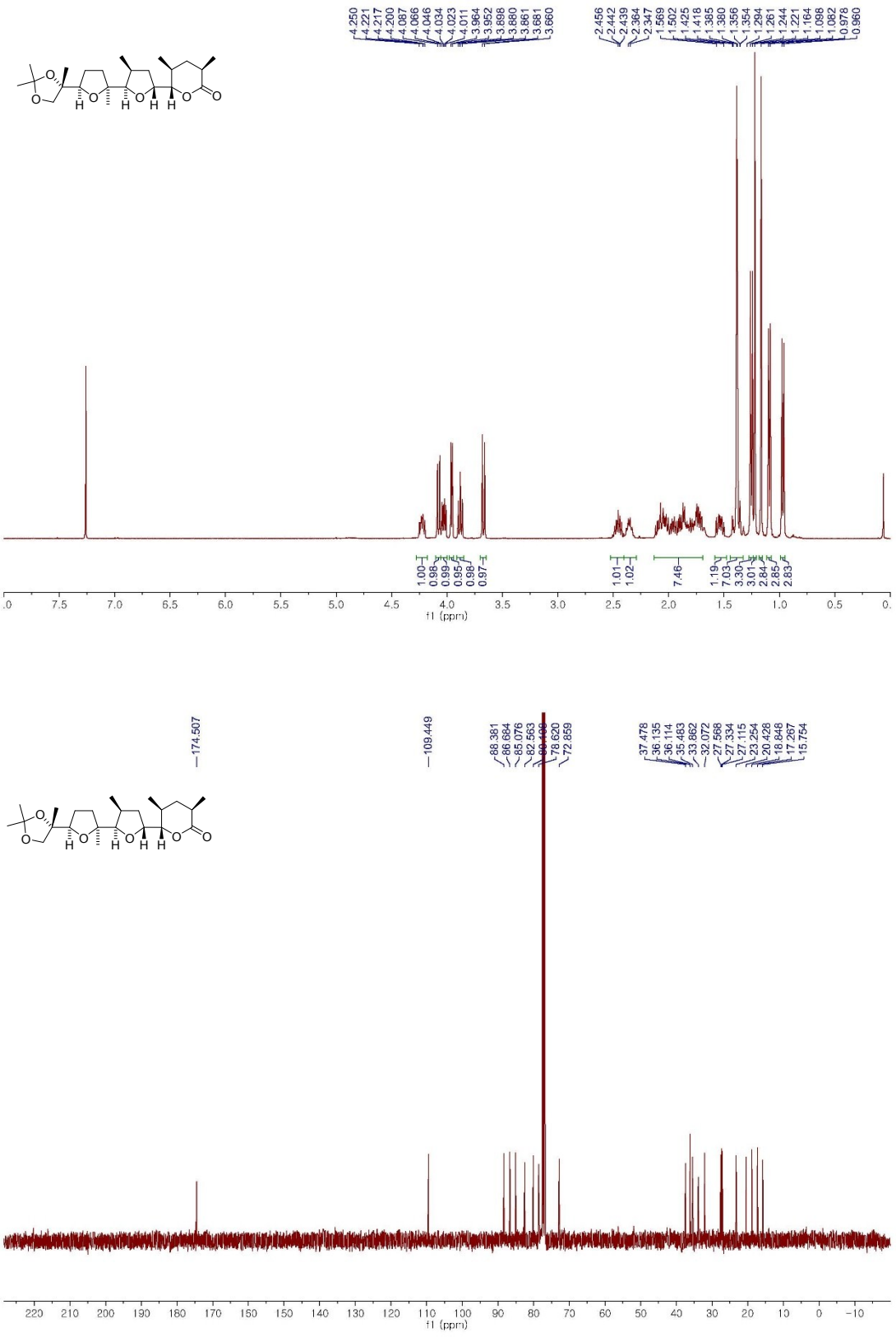




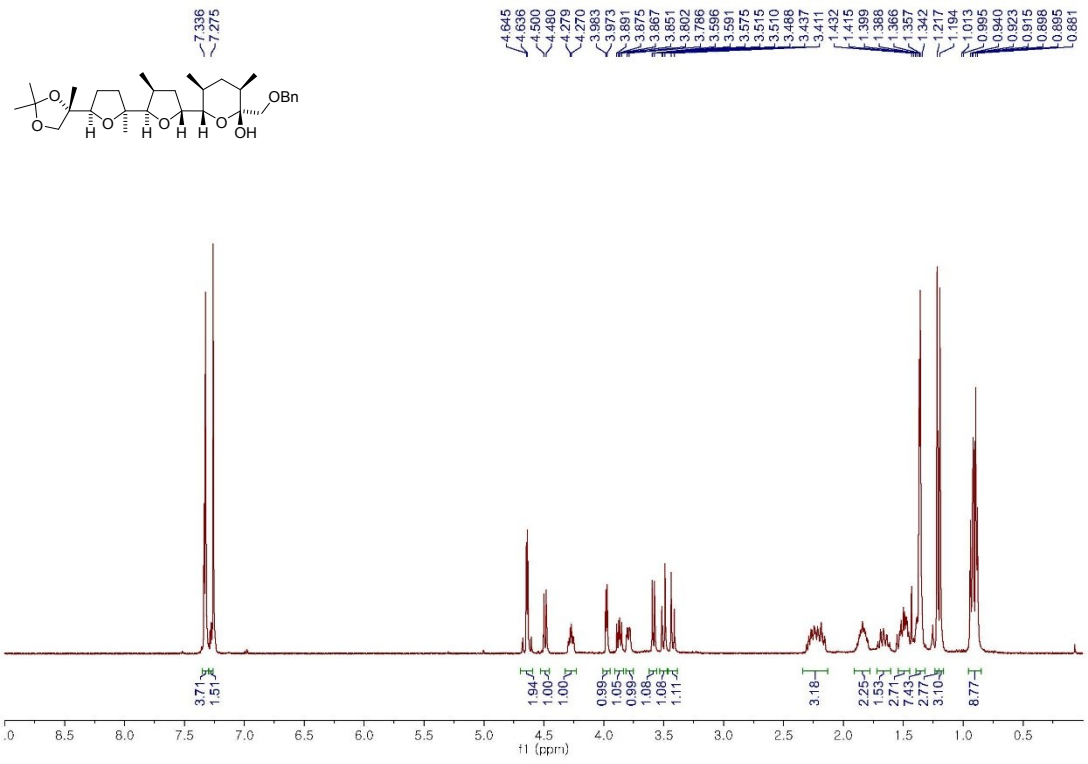
^{1}H NMR (400 MHz, $CDCl_3$) and ^{13}C NMR (100MHz, $CDCl_3$) spectra of **35**

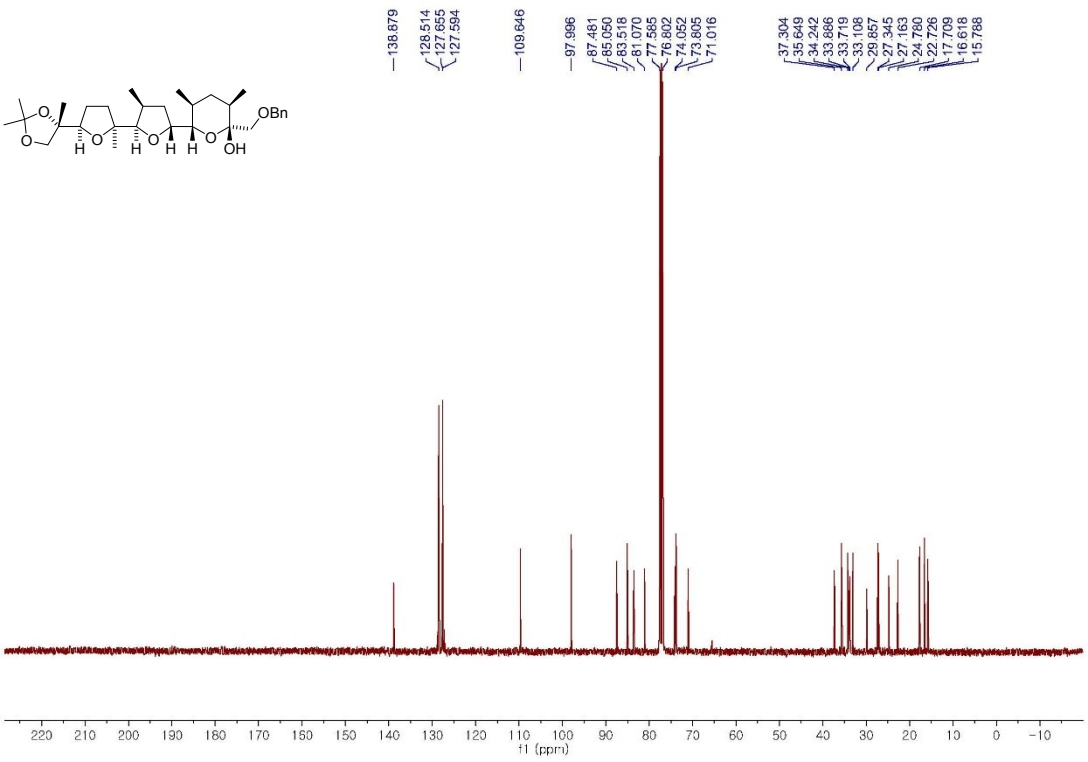


^{1}H NMR (400 MHz, $CDCl_3$) and ^{13}C NMR (100MHz, $CDCl_3$) spectra of **38**

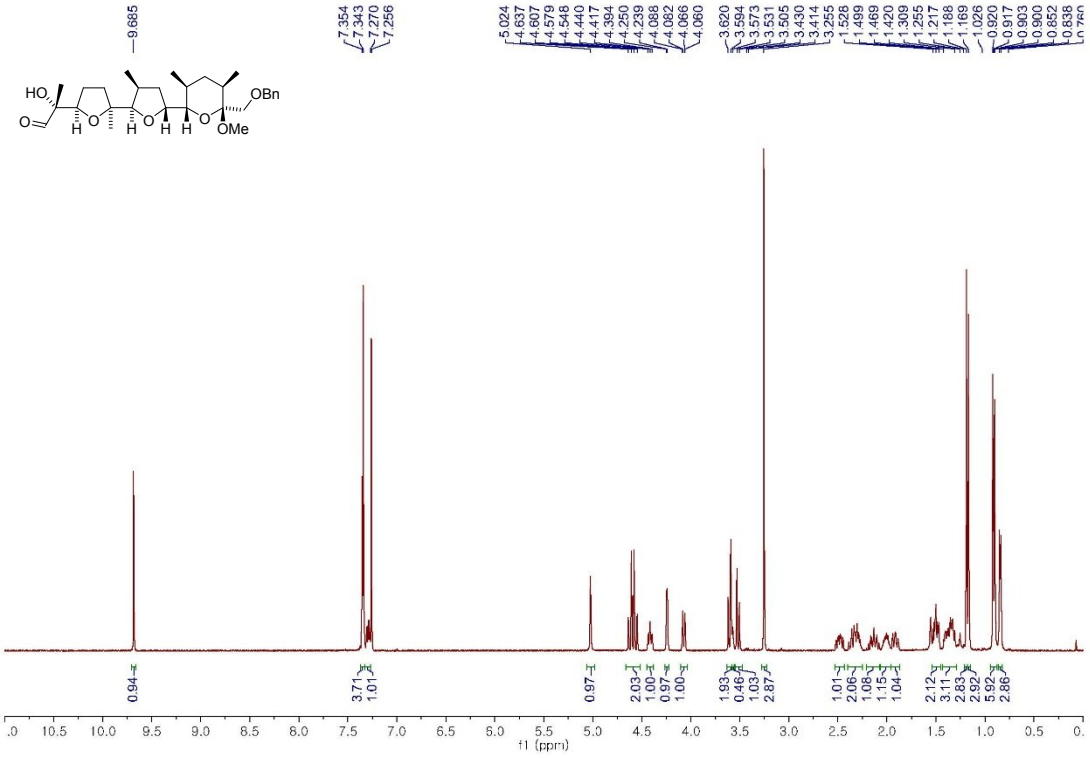


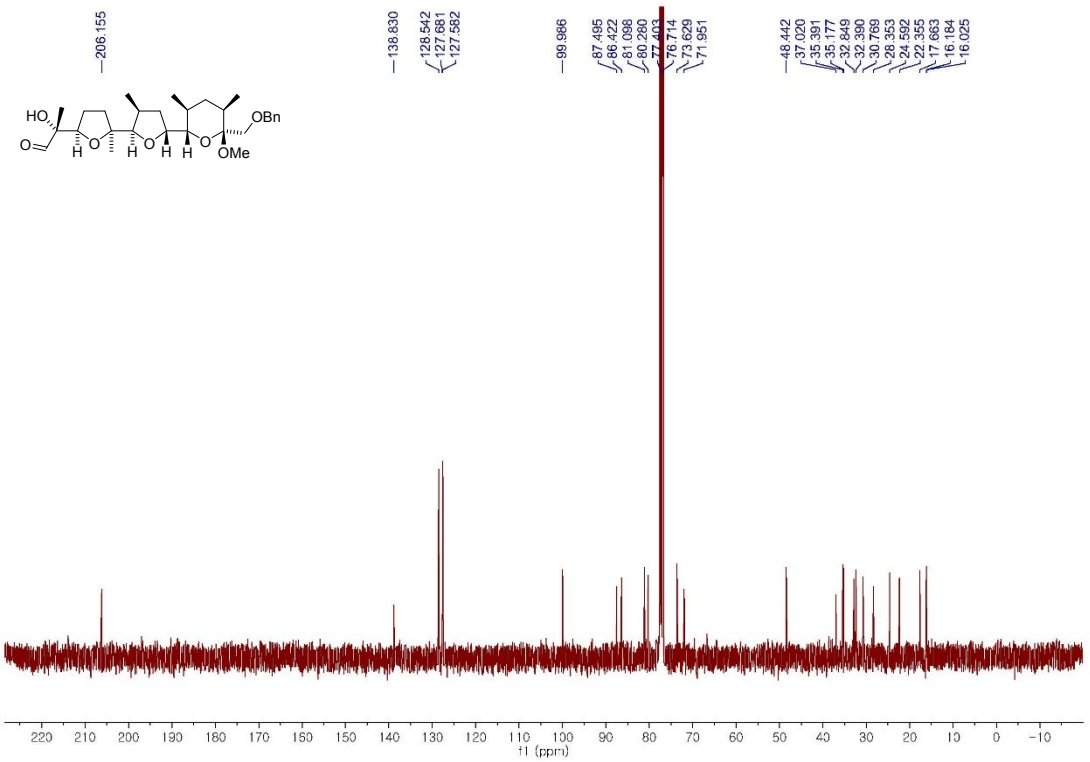
^{1}H NMR (400 MHz, $CDCl_3$) and ^{13}C NMR (100MHz, $CDCl_3$) spectra of **60**



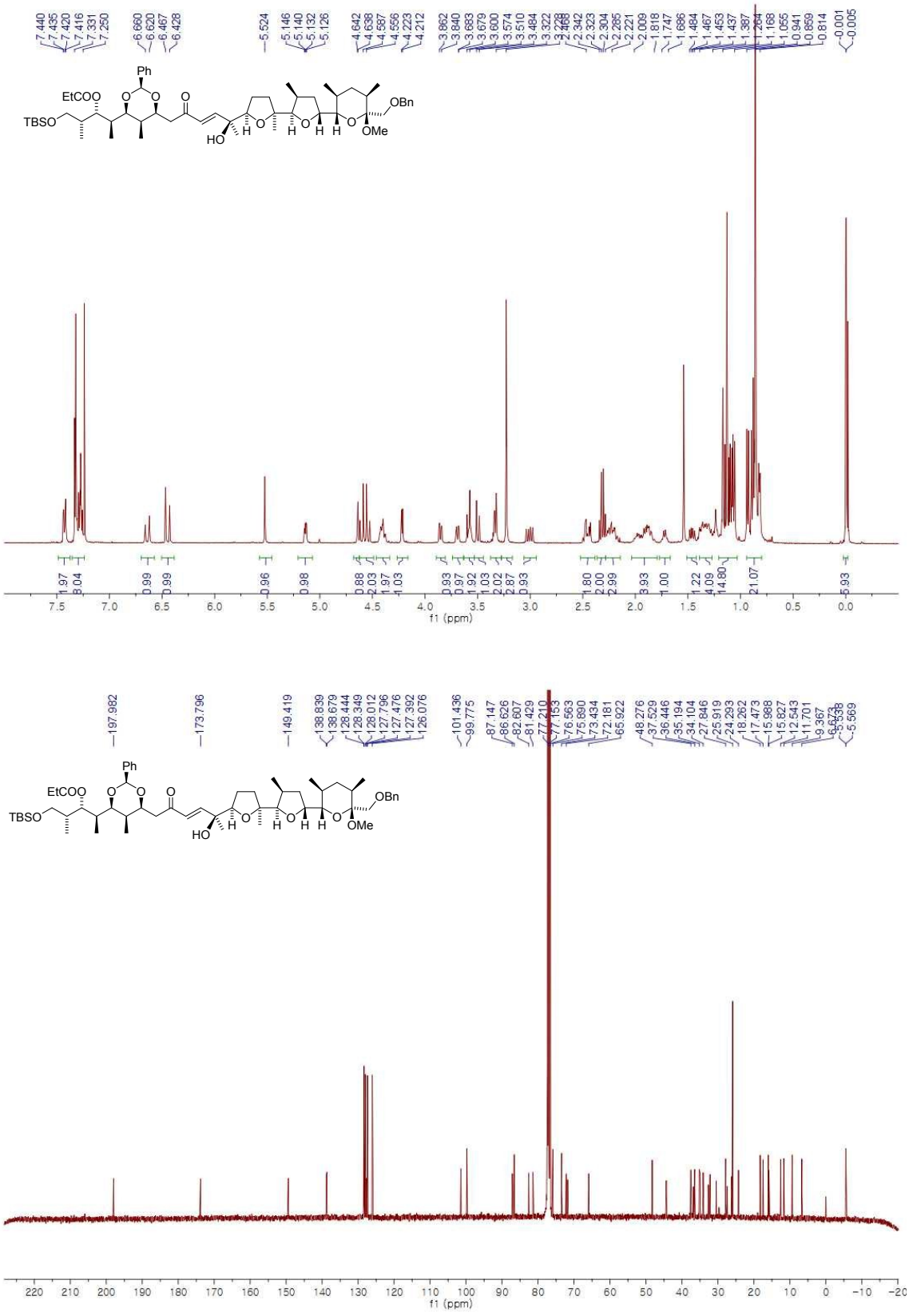


^{1}H NMR (400 MHz, $CDCl_3$) and ^{13}C NMR (100MHz, $CDCl_3$) spectra of **5**

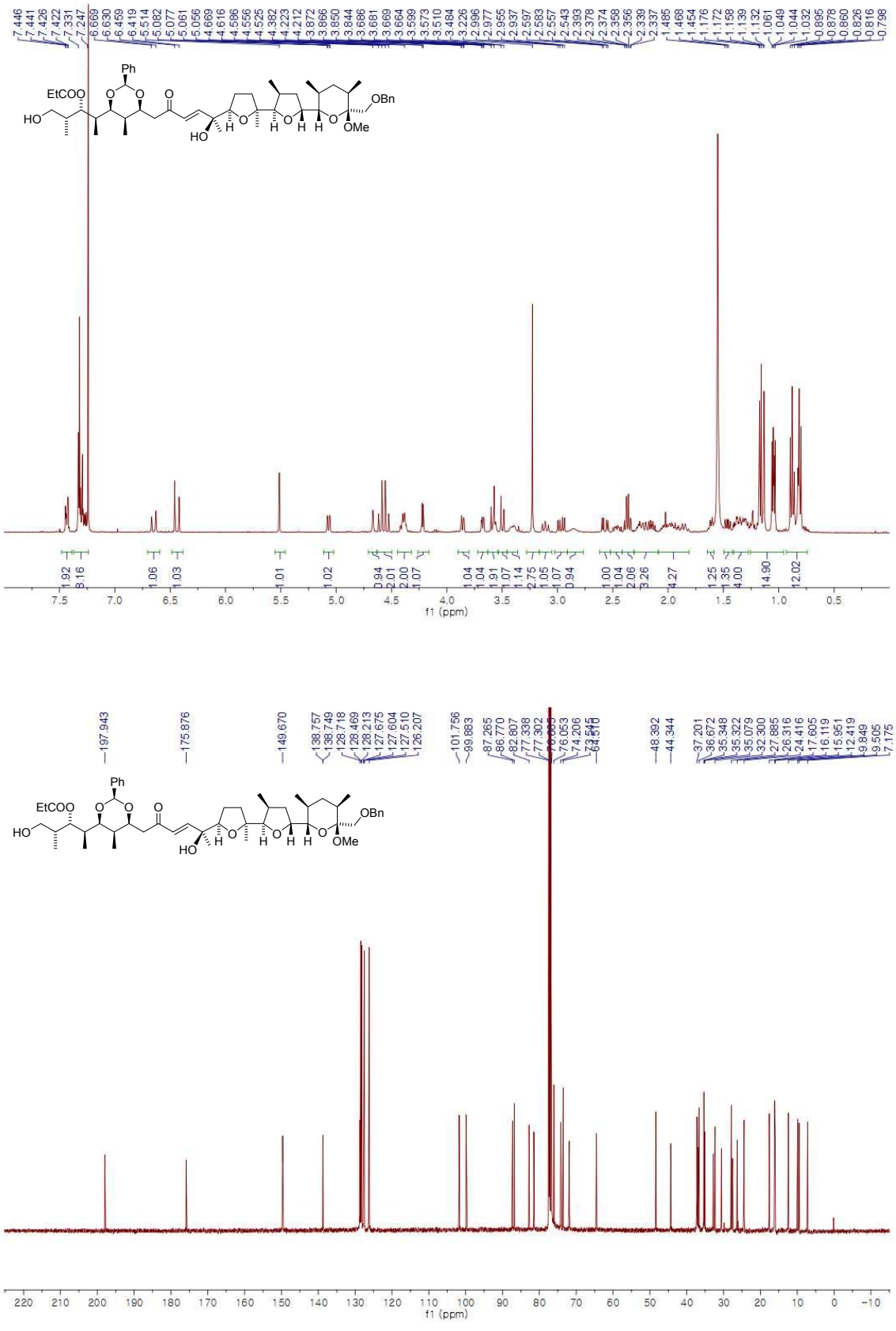




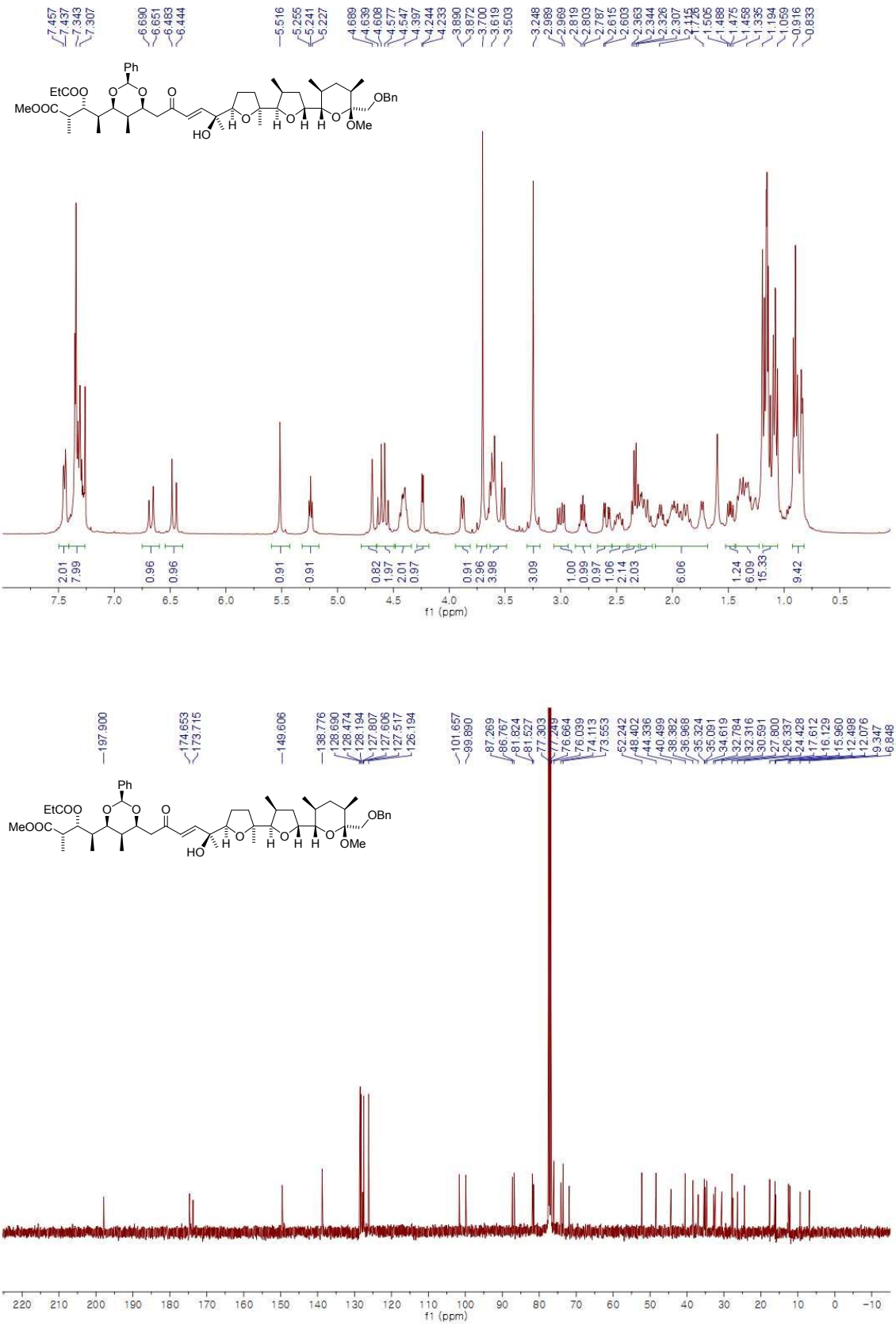
^{1}H NMR (400 MHz, $CDCl_3$) and ^{13}C NMR (100MHz, $CDCl_3$) spectra of **61**



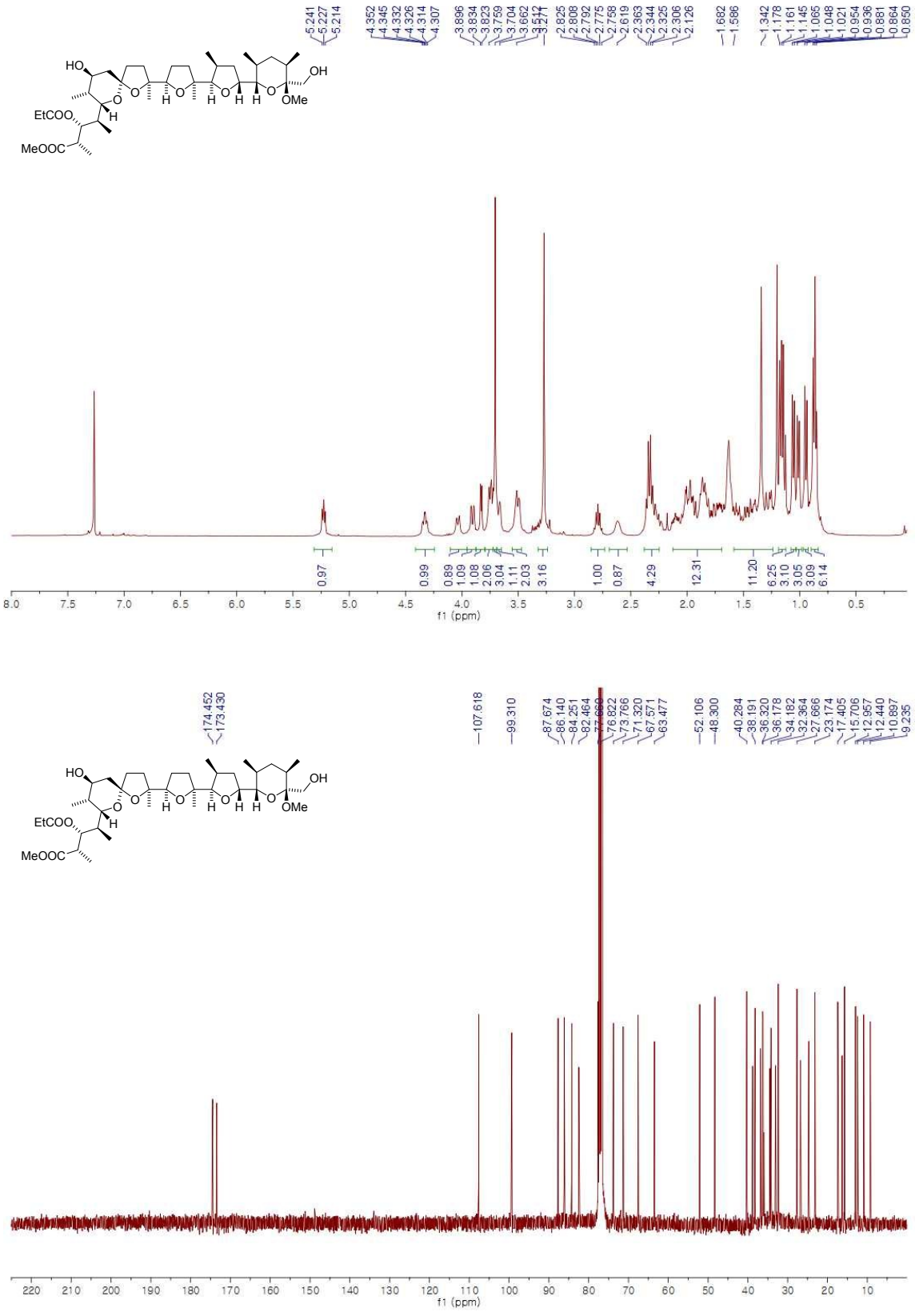
^{1}H NMR (400 MHz, $CDCl_3$) and ^{13}C NMR (100MHz, $CDCl_3$) spectra of **62**



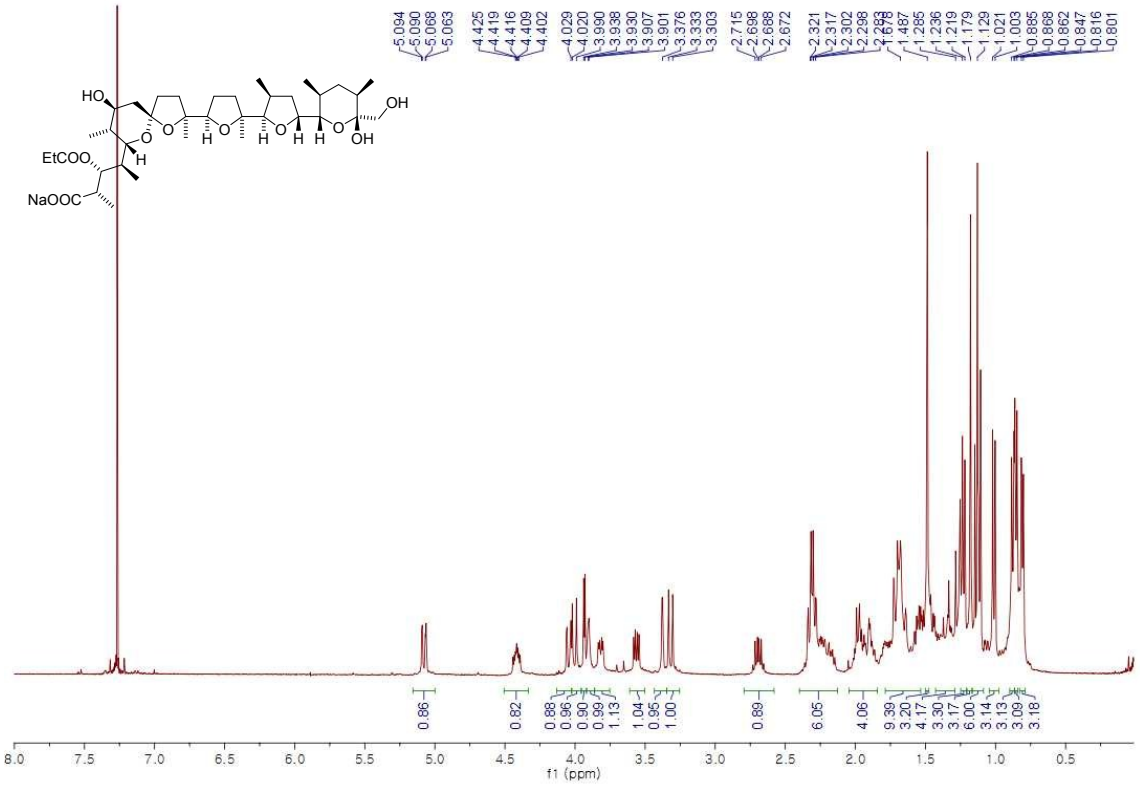
^{1}H NMR (400 MHz, $CDCl_3$) and ^{13}C NMR (100MHz, $CDCl_3$) spectra of **42**

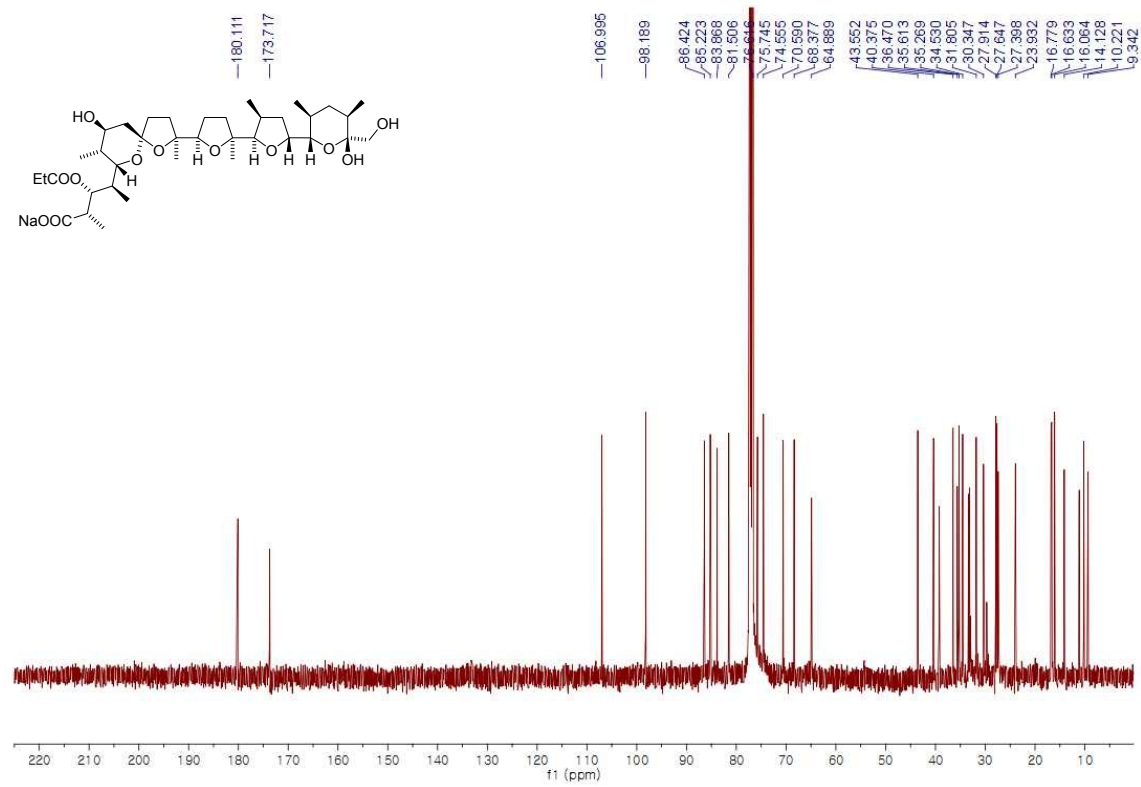


^{1}H NMR (400 MHz, $CDCl_3$) and ^{13}C NMR (100MHz, $CDCl_3$) spectra of **43**



^{1}H NMR (400 MHz, $CDCl_3$) and ^{13}C NMR (100MHz, $CDCl_3$) spectra of **45**


HO
OH
EtCOO
NaOOC
f1 (ppm)


HO
OH
EtCOO
NaOOC
f1 (ppm)