Electronic Supporting Information

Total Synthesis of (–)-Spirangien A and Its Methyl Ester

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General Experimental Details

Reagents and solvents were purified by standard means. Dichloromethane (CH_2Cl_2) and hexanes were distilled from calcium hydride and stored under an atmosphere of argon; tetrahydrofuran (THF) was distilled from sodium metal / acetophenone and stored under an atmosphere of argon; dimethyl formamide (DMF) was distilled over 4Å molecular sieves; methanol was distilled from magnesium methoxide and stored under an atmosphere of argon. Triethylamine was distilled from and stored over calcium hydride. All other chemicals were used as received, except where otherwise stated in the experimental text. All extractive procedures were performed using distilled solvents. All solutions of sodium bicarbonate ($NaHCO_3$), ammonium chloride (NH_4Cl), sodium thiosulfate ($Na_2S_2O_3$) and sodium potassium tartrate are aqueous and saturated, unless otherwise stated. The term "brine" describes a saturated aqueous solution of sodium chloride. All experiments were performed under anhydrous conditions and an inert atmosphere of argon and, except where stated, using oven-dried glassware and employing standard techniques for handling air-sensitive materials.

^{1}H nuclear magnetic resonance (NMR) spectra were recorded using an internal deuterium lock for the residual protons in $CDCl_3$ (δ_H 7.26) and CD_3OD (3.35) at ambient temperatures on the following instruments: Bruker AVANCE BB500, TCI500 or TXI500 (500 MHz) and DRX400 or AM400 (400 MHz). Data are presented as follows: chemical shift (in ppm on the δ scale relative to δ_{TMS} = 0), integration, multiplicity (s = singlet, d = doublet, t = triplet, q = quartet, qn = quintet, m = multiplet and br = broad, app = apparent), coupling constant (*J* / Hz) and interpretation. Assignments were determined either on the basis of unambiguous chemical shift or coupling pattern, COSY experiments or by analogy to fully interpreted spectra for related compounds. Resonances, which are either partially or fully obscured, are denoted obscured (obs). ^{13}C spectra were recorded by broadband spin decoupling using an internal deuterium lock for $CDCl_3$ (δ 77.0) and CD_3OD (δ 49.0) at ambient temperatures on the following instruments: Bruker AVANCE BB500, TCI500 or TXI500 (120 MHz) and DRX400 or AM400 (100 MHz). Chemical shift values are reported in ppm on the δ scale (δ_{TMS} = 0).

Infrared spectra were recorded on Perkin-Elmer Spectrum One FT-IR spectrometer fitted with a universal ATR sampling accessory. Wavelengths of maximum absorbance (λ_{max}) are quoted in wavenumbers (cm^{-1}).

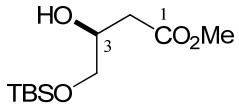
Optical rotations were recorded on a Perkin-Elmer 241 polarimeter at the sodium D-line (589 nm) and are reported as follows: $[\alpha]_D^{20}$, concentration (*c* in g / 100 mL) and solvent.

High and low resolution mass spectrometry (HRMS and LRMS) were recorded by the EPSRC Mass Spectrometry Service (Swansea, UK) using chemical ionisation (CI) or by the Departmental Mass Spectrometry Service (Cambridge University Chemical Laboratory, UK) using Electron Impact (EI), Fast Atom Bombardment (FAB) or Electrospray Ionisation (ESI) techniques. The parent ion (M^+, $[M+H]^+$, $[M+Na]^+$ or $[M+NH_4]^+$) is quoted.

Analytical thin layer chromatography (tlc) was carried out on Merck Kieselgel 60 F254 plates. Flash column chromatography was carried out using Merck Kieselgel 60 (230-400 mesh) or Merck aluminium oxide 90 standardised under a positive pressure generated by regulated compressed air and solvents removed from appropriate fractions *in vacuo.*

Characterisation Data for New Compounds

(*S*)-Methyl 4-[(tert-butyl)dimethylsilyloxy]-3-hydroxybutanoate (15b)



To a solution of (*S*)-malic acid dimethyl ester (1.50 g, 9.25 mmol) in THF (14 mL) at 0 °C was added borane dimethyl sulfide (0.89 mL, 9.39 mmol) slowly. The reaction mixture was allowed to warm to rt and stirred for 45 min before being recooled to 0 °C. $NaBH_4$ (17 mg, 0.46 mmol) was added slowly and the resulting reaction mixture stirred for 45 min at 0 °C, by which time gas evolution had subsided. The ice bath was removed and the reaction was stirred for 1 h at rt. The organic volatiles were then removed *in vacuo* and the product azeotroped with methanol (3 x 10 mL) and then toluene (1 x 10 mL) to afford the diol as an oil that was used directly in the next step.

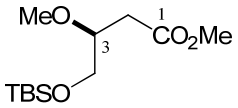
To a solution of the crude diol (1.24 g, 9.25 mmol) in CH_2Cl_2 (30 mL) at rt was added imidazole (0.79 g, 11.6 mmol) followed by TBSCl (1.53 g, 10.2 mmol). The resulting reaction mixture was stirred for 12 h at rt and then quenched by the addition of water (30 mL). The phases were

separated and the aqueous phase was extracted with CH_2Cl_2 (3 x 25 mL). The combined organic phases were dried (Na_2SO_4), concentrated *in vacuo* and purified by flash column chromatography (10% EtOAc / hexanes) to yield TBS ether **15b** (2.21 g, 96%) as a colourless oil.

^{1}H NMR (500 MHz, $CDCl_3$) δ_H 4.10-4.05 (1H, m, H3), 3.70 (3H, s, OMe), 3.64-3.55 (2H, m, H4), 2.56-2.47 (2H, m, H2), 0.89 (9H, s, $SiC(CH_3)_3$), 0.06 (6H, s, $Si(CH_3)_2$).

This data is in agreement with that reported by Carreira co-workers.[1]

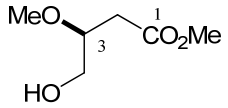
(S)-Methyl 4-[(tert-butyl) dimethylsilyloxy)-3-methoxybutanoate (16)



To a solution of alcohol **15b** (2.00 g, 8.06 mmol) in CH_2Cl_2 (60 mL) at 0 °C was added Proton Sponge™ (10.4 g, 48.4 mmol) followed by trimethyloxonium tetrafluoroborate (3.50 g, 24.2 mmol). The resulting solution was stirred at rt for 1 h and then quenched by the addition of saturated aqueous $NaHCO_3$ (30 mL). The phases were separated and the aqueous phase extracted with CH_2Cl_2 (3 x 20 mL). The combined organic phases were washed with citric acid (10% weight solution, 40 mL), dried (Na_2SO_4), concentrated *in vacuo* and purified by flash column chromatography (10% EtOAc / hexanes) to yield methyl ether **16** (2.0 g, 95%) as a colourless oil.

R_f 0.31 (10% EtOAc / hexanes); $[\alpha]_D^{20}$ = –13.8 (*c* 1.00, $CHCl_3$); **IR** (neat) 2931, 2858, 1743, 1437, 1257, 1116, 1082 cm^{-1}; **^{1}H NMR** (500 MHz, $CDCl_3$) δ_H 3.71-3.68 (2H, m, H4), 3.67 (3H, s, OMe), 3.57-3.52 (1H, m, H3), 3.39 (3H, s, OMe), 2.57 (1H, dd, *J* = 15.7, 4.5 Hz, H2a), 2.45 (1H, dd, *J* = 15.7, 7.4 Hz, H2b) 0.87 (9H, s, $SiC(CH_3)_3$), 0.04 (6H, s, $Si(CH_3)_2$); **^{13}C NMR** (125 MHz, $CDCl_3$) δ_C 172.3, 78.5, 64.2, 58.2, 51.7, 37.0, 26.0, 18.4, -5.3; **HRMS** (ES+) calculated for $C_{12}H_{26}O_4SiNa$ ($[M+Na^+]$) 262.1498, found 262.1502.

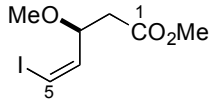
(S)-Methyl 4-hydroxy-3-methoxybutanoate (17)



To a solution of TBS ether **16** (700 mg, 2.67 mmol) in THF (30 mL) at 0 °C was added TBAF (1 M in THF, 5.3 mL, 5.3 mmol). The resulting solution was allowed to warm to rt, stirred for 16 h and then quenched by the addition of saturated aqueous NH_4Cl (10 mL). The phases were separated and the aqueous phase was extracted with CH_2Cl_2 (3 x 20 mL). The combined organics were dried (Na_2SO_4), concentrated *in vacuo* and purified by flash column chromatography (50% EtOAc / hexanes) to yield the alcohol **17** (380 mg, 96%) as a colourless oil.

R_f 0.34 (70% EtOAc / hexanes); $[\alpha]_D^{20}$ = –19.9 (*c* 1.00, $CHCl_3$); **IR** (neat) 3439, 2937, 1733, 1439, 1166, 1100, 1066 cm^{-1}; **^{1}H NMR** (500 MHz, $CDCl_3$) δ_H 3.77-3.72 (2H, m, H4), 3.70 (3H, s, OMe), 3.59-3.52 (1H, m, H3), 3.42 (3H, s, OMe), 2.62 (1H, dd, *J* = 15.7, 6.6 Hz, H2a), 2.53 (1H, dd, *J* = 15.7, 6.0 Hz, H2b); **^{13}C NMR** (125 MHz, $CDCl_3$) δ_C 172.0, 78.1, 63.4, 57.6, 51.9, 36.1.

(*S*,*Z*)-methyl 5-iodo-3-methoxypent-4-enoate (7)



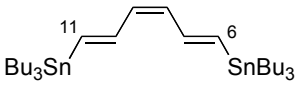
To a solution of oxalyl chloride (0.33 mL, 3.88 mmol) in CH_2Cl_2 (12 mL) at –78 °C was added dimethyl sulfoxide (0.4 mL, 5.67 mmol). After 15 min, a solution of alcohol **17** (280 mg, 1.89 mmol) in CH_2Cl_2 (2 mL) was added dropwise. The resultant solution was stirred for 30 min at –78 °C, then Et_3N (1.6 mL, 11.3 mmol) was added. The reaction mixture was maintained at –78 °C for 30 min, then allowed to warm to rt and quenched by the addition of water (7 mL). The phases were separated and the aqueous phase extracted with CH_2Cl_2 (3 x 20 mL). The combined organics were dried (Na_2SO_4), concentrated *in vacuo* and the corresponding aldehyde was used without further purification.

To a suspension of (iodomethyl)triphenylphosphonium iodide (1.50 g, 2.84 mmol) in THF (4.5 mL) at rt was added NaHMDS (1 M in THF, 2.80 mL, 2.84 mmol). The resulting solution was stirred at rt for 10 min, cooled to –78 °C and HMPA (0.82 mL, 4.73 mmol) added. The resulting solution was then cooled to –100 °C before a solution of aldehyde (276 mg, 1.89 mmol) in THF (0.5 mL)

was added *via* cannula. The solution was stirred at –100 °C for 15 min, –78 °C for 30 min and then allowed to warm to rt. After stirring for 20 min, the reaction was quenched by the addition of saturated aqueous NH_4Cl. The phases were separated and the aqueous phase extracted with Et_2O (3 x 10 mL). The combined organic phases were washed with brine (20 mL), dried ($MgSO_4$) and concentrated *in vacuo*. Purification by flash column chromatography (10% CH_2Cl_2 / hexanes → 100% CH_2Cl_2) allowed separation of (*Z*)- and (*E*)-vinyl iodides to yield (*Z*)-vinyl iodide **7** (268 mg, 53%) as a pale yellow oil.

R_f 0.31 (20% EtOAc / hexanes); $[\alpha]_D^{20}$ = +15.5 (*c* 1.68, $CHCl_3$); **IR** (neat) 2930, 1738, 1609, 1436, 1345, 1280, 1208, 1153, 1102 cm^{-1}; **^{1}H NMR** (500 MHz, $CDCl_3$) δ_H 6.54 (1H, d, *J* = 7.9 Hz, H5), 6.19 (1H, app t, *J* = 7.9 Hz, H4), 4.43-4.38 (1H, m, H3), 3.70 (3H, s, OMe), 3.32 (3H, s, OMe), 2.60 (1H, dd, *J* = 15.2, 8.1 Hz, H2a), 2.51 (1H, dd, *J* = 15.3, 4.9 Hz, H2b); **^{13}C NMR** (125 MHz, $CDCl_3$) δ_C 170.5, 140.1, 85.2, 79.5, 56.9, 51.8, 39.2; **HRMS** (ES+) calculated for $C_{27}H_{11}IO_3Na$ ([M+Na^+]) 292.9645, found 292.9635.

(1*E*,3*Z*,5*E*)-1,6-bis(tributylstannyl)hexa-1,3,5-triene (8)

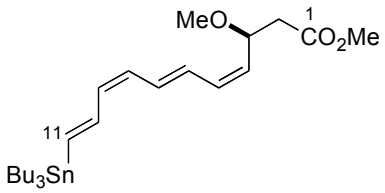


To a solution of (*E*)-$Bu_3SnCH{=}CHCHO$ (440 mg, 1.27 mmol) and sulfone **18** (890 mg, 1.66 mmol) in THF (16 mL) at –78 °C was added KHMDS (0.5 M in toluene, 3.2 mL, 1.59 mmol). The resulting solution was allowed to warm to rt and stirred for 16 h before quenching *via* the addition of H_2O (20 mL). The phases were separated and the aqueous phase extracted with Et_2O (3 x 15 mL). The combined organic phases were dried ($MgSO_4$) and concentrated *in vacuo*. Purification by flash column chromatography (3% Et_3N in 100% hexanes) yielded bis-stannane **8** (571 mg, 68%) as a colourless oil.

^{1}H NMR (500 MHz, $CDCl_3$) δ_H 7.08 (2H, dd, *J* = 18.5, 8.5 Hz, H7 and H10), 6.32 (2H, d, *J* = 18.5 Hz, H6 and H11), 5.90 (2H, d, *J* = 8.5 Hz, H8 and H9), 1.59-1.43 (12H, m, 6 x $SnCH_2C\underline{H}_2CH_2CH_3$), 1.32 (12H, tq, *J* = 7.3 Hz, 6 x $SnCH_2CH_2C\underline{H}_2CH_3$), 0.90 (18H, t, *J* = 7.2 Hz, 6 x $SnCH_2CH_2CH_2C\underline{H}_3$), 0.99-0.86 (12H, m, 6 x $SnC\underline{H}_2CH_2CH_2CH_3$).

This data is in agreement with that reported by Brückner and co-workers.[2]

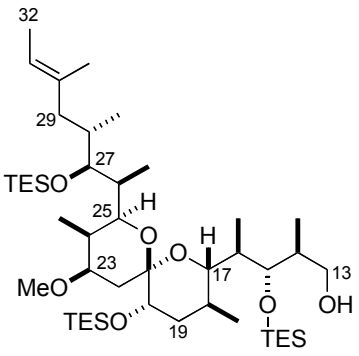
(*S*,4*Z*,6*E*,8*Z*,10*E*)-methyl-3-methoxy-11-(tributylstannyl)undeca-4,6,8,10-tetraenoate (6)



To a solution of (*Z*)-vinyl iodide **7** (12 mg, 44.4 μmol) and triene **8** (70 mg, 0.11 mmol) in DMF (1.2 mL) and THF (0.3 mL) at rt was added $Pd_2(dba)_3$ (2 mg, 2.22 μmol) and Ph_3As (1.8 mg, 5.78 μmol). The resulting solution was purged by evacuating for 1 min and then flushing with Ar (x 3) and then stirred at rt for 16 h. The reaction was then quenched *via* addition of H_2O (2 mL) and diluted with EtOAc (containing 2% Et_3N). The phases were separated and the aqueous phase extracted with EtOAc (containing 2% Et_3N) (3 x 3 mL). The combined organics were washed with brine (5 mL), dried (Na_2SO_4) and concentrated *in vacuo*. Purification by flash column chromatography (2% Et_3N in 5% → 7% EtOAc / hexanes) yielded tetraene **6** (13.5 mg, 59%) as a yellow oil.

R_f 0.40 (20% EtOAc / hexanes); $[\alpha]_D^{20}$ = +12.9 (*c* 0.50, MeOH); **IR** (neat) 1740, 1590, 1103 cm^{-1}; **^{1}H NMR** (500 MHz, CD_3OD) δ_H 7.12 (1H, dd, *J* = 18.5, 9.7 Hz, H10), 6.86 (1H, dd, *J* = 14.6, 10.0 Hz, H7), 6.68 (1H, dd, *J* = 13.9, 11.4 Hz, H6), 6.42-6.36 (2H, m, H5 and H11), 6.10-6.05 (2H, m, H8 and H9), 5.34 (1H, app t, *J* = 10.2 Hz, H4), 4.69-4.64 (1H, m, H3), 3.70 (3H, s, OMe), 3.29 (3H, s, OMe), 2.65 (1H, dd, *J* = 15.1, 8.0 Hz, H2a), 2.49 (1H, dd, *J* = 15.1, 5.4 Hz, H2b), 1.61-1.57 (6H, m, $SnCH_2C\underline{H}_2CH_2CH_3$), 1.42-1.38 (6H, m, $SnCH_2CH_2C\underline{H}_2CH_3$), 1.03-0.97 (6H, m, $SnC\underline{H}_2CH_2CH_2CH_3$), 0.96 (9H, t, *J* = 7.5 Hz, $SnCH_2CH_2CH_2C\underline{H}_3$); **^{13}C NMR** (125 MHz, CD_3OD) δ_C 172.8, 143.2, 137.7, 134.6, 133.8, 131.7, 131.4, 129.3, 129.0, 74.6, 56.6, 52.2, 41.7, 30.3, 28.3, 14.1, 10.4; **HRMS** (ES+) calculated for $C_{25}H_{44}O_3SnNa$ ([M+Na^+]) 535.2204, found 535.2215.

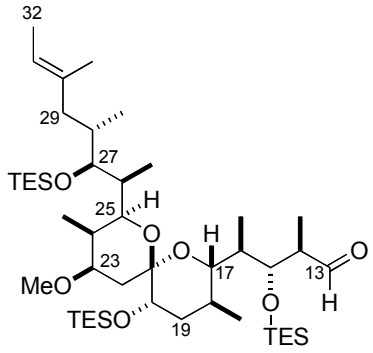
(2*S*,3*S*,4*R*)-4-((2*S*,3*S*,5*S*,6*R*,8*S*,9*R*,10*R*)-8-((2*S*,3*S*,4*S*,*E*)-4,6-dimethyl-3-(triethylsilyl oxy)oct-6-en-2-yl)-10-methoxy-3,9-dimethyl-5-(triethylsilyloxy)-1,7-dioxaspiro[5.5] undecan-2-yl)-2-methyl-3-(triethylsilyloxy)pentan-1-ol (13)



To a solution of the alkene[3] (14 mg, 16.9 μmol) in THF (0.5 mL) at 0 °C was added a freshly prepared solution of 9-BBN (0.5 M in THF, 101 μL, 50.7 μmol). The resulting solution was allowed to warm to rt and stirred at this temperature for 1 h, before recooling to 0 °C. The reaction was quenched by the addition of THF (0.5 mL), MeOH (0.5 mL), NaOH (10% aqueous, 1 mL) and H_2O_2 (30% aqueous, 0.5 mL) and then stirred for 1 h. The phases were separated and the aqueous phase extracted with CH_2Cl_2 (3 x 4 mL). The combined organics were dried (Na_2SO_4), concentrated *in vacuo* and purified by flash column chromatography (10% EtOAc / 40-60 petroleum ether) to yield alcohol **13** (10 mg, 70%) as a colourless oil.

R_f 0.10 (10% EtOAc / 40-60 petroleum ether); $[\alpha]_D^{20}$ = +17.5 (*c* 1.50, MeOH); **IR** (neat) 3499, 1459, 1381, 1233, 1001 cm^{-1}; **^{1}H NMR** (500 MHz, CD_3OD) δ_H 5.24 (1H, q, *J* = 6.5 Hz, H31), 3.93 (1H, dd, *J* = 10.8, 3.2 Hz, H13a), 3.90 (1H, dd, *J* = 5.0, 2.2 Hz, H27), 3.80 (1H, dd, *J* = 3.4, 1.5 Hz, H15), 3.74 (1H, app dt, *J* = 12.0, 4.7 Hz, H23), 3.55-3.50 (2H, m, H13b, H20), 3.44 (1H, dd, *J* = 10.0, 2.1 Hz, H25), 3.36 (3H, s, OMe), 3.38-3.33 (1H, obs, H17), 2.49-2.39 (1H, m, H14), 2.26-2.19 (1H, m, H24), 2.19 (1H, br d, *J* = 14.2 Hz, H29a), 2.16-2.06 (2H, m, H18 and H28), 2.09 (1H, dd, *J* = 12.8, 4.7 Hz, H22a), 2.05-2.00 (1H, m, H16), 2.00-1.96 (1H, m, H26), 1.89-1.82 (1H, m, H19a), 1.72 (1H, dd, *J* = 13.5, 10.3 Hz, H29b), 1.64-1.60 (1H, obs, H19b), 1.62 (3H, d, obs, H32), 1.61 (3H, s, Me31), 1.29 (1H, app t, *J* = 12.5 Hz, H22b), 1.18 (3H, d, *J* = 7.1 Hz, Me14), 1.13 (3H, d, *J* = 7.2 Hz, Me16), 1.10-1.01 (27H, m, 3 x $Si(CH_2C\underline{H}_3)_3$), 0.92 (3H, d, *J* = 7.0 Hz, Me28), 0.91 (3H, d, *J* = 7.3 Hz, Me18), 0.88 (3H, d, *J* = 6.9 Hz, Me26), 0.81 (3H, d, *J* = 7.0 Hz, Me24), 0.68 (18H, m, 3 x $Si(C\underline{H}_2CH_3)_3$); **^{13}C NMR** (125 MHz, MeOD) δ_C 135.7, 120.8, 100.0, 82.7, 78.9, 78.5, 77.8, 77.4, 71.8, 65.8, 55.5, 43.5, 42.6, 39.3, 39.2, 38.1, 36.9, 34.4, 33.6, 25.9, 19.3, 18.6, 17.7, 15.8, 13.6, 13.2, 8.4, 7.7, 7.4, 7.3, 6.9, 6.1, 6.0, 4.4; **HRMS** (ES+) Calculated for $C_{46}H_{95}O_7Si_3$ ($[M+H^+]$) 843.6386, found 843.6418.

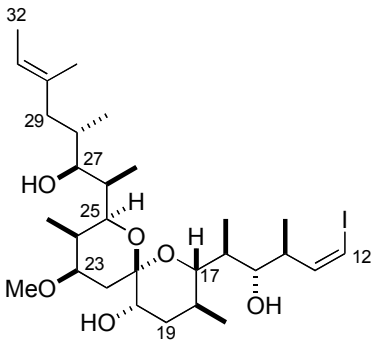
(2*R*,3*R*,4*R*)-4-((2*S*,3*S*,5*S*,6*R*,8*S*,9*R*,10*R*)-8-((2*S*,3*S*,4*S*,*E*)-4,6-dimethyl-3-(triethylsilyl oxy)oct-6-en-2-yl)-10-methoxy-3,9-dimethyl-5-(triethylsilyloxy)-1,7-dioxaspiro[5.5] undecan-2-yl)-2-methyl-3-(triethylsilyloxy)pentanal (13a)



To a solution of alcohol **13** (25 mg, 29.6 μmol) in CH_2Cl_2 (1.5 mL) at rt was added $NaHCO_3$ (20 mg, 0.24 mmol) followed by Dess-Martin periodinane (50 mg, 0.12 mmol). The resulting solution was stirred at rt for 1 h before saturated aqueous $Na_2S_2O_3$ (1.5 mL) and saturated aqueous $NaHCO_3$ (1.5 mL) were added. The resulting biphasic mixture was stirred for *ca*. 20 min before the phases were separated and the aqueous phase was extracted with CH_2Cl_2 (3 x 3 mL). The combined organics were dried (Na_2SO_4), concentrated *in vacuo* and purified by flash column chromatography (10% EtOAc / 40-60 petroleum ether) to yield aldehyde **13a** (22 mg, 87%) as a colourless oil.

R_f 0.45 (10% EtOAc / 40-60 petroleum ether); $[\alpha]_D^{20}$ = +15.4 (*c* 0.43, MeOH); **IR** (neat) 1720, 1458, 1381, 1231, 1110 cm^{-1}; **^{1}H NMR** (500 MHz, CD_3OD) δ_H 9.94 (1H, d, *J* = 2.9 Hz, CHO), 5.24 (1H, q, *J* = 6.6 Hz, H31), 3.92 (1H, dd, *J* = 3.2, 1.0 Hz, H15), 3.89 (1H, dd, *J* = 4.8, 2.2 Hz, H27), 3.70 (1H, app dt, *J* = 12.0, 4.5 Hz, H23), 3.53 (1H, t, *J* = 2.6 Hz, H20), 3.38 (3H, s, OMe), 3.36-3.34 (2H, obs, H17 and H25), 3.21-3.15 (1H, m, H14), 2.23-2.04 (6H, m, H16, H18, H22a, H24, H28 and H29a), 2.02-1.94 (1H, m, H26), 1.89-1.82 (1H, m, H19a), 1.73 (1H, dd, *J* = 13.3, 10.2 Hz, H29b), 1.64-1.60 (1H, obs, H19b), 1.62 (3H, d, *J* = 6.6 Hz, H32), 1.61 (3H, s, Me31), 1.29 (1H, app t, *J* = 1.25 Hz, H22b), 1.22 (3H, d, *J* = 7.3 Hz, Me14), 1.09 (3H, d, *J* = 7.2 Hz, Me16), 1.07 (9H, t, *J* = 8.0 Hz, $Si(CH_2C\underline{H}_3)_3$), 1.05 (9H, t, *J* = 8.0 Hz, $Si(CH_2C\underline{H}_3)_3$), 1.04 (9H, t, *J* = 8.0 Hz, $Si(CH_2C\underline{H}_3)_3$), 0.92 (3H, d, *J* = 7.0 Hz, Me28), 0.91 (3H, d, *J* = 7.1 Hz, Me26), 0.90 (3H, d, *J* = 6.7 Hz, Me18), 0.82 (3H, d, *J* = 6.7 Hz, Me24), 0.72 (6H, q, *J* = 8.0 Hz, $Si(C\underline{H}_2CH_3)_3$), 0.71 (6H, q, *J* = 8.0 Hz, $Si(C\underline{H}_2CH_3)_3$), 0.67 (6H, q, *J* = 8.1 Hz, $Si(C\underline{H}_2CH_3)_3$); **^{13}C NMR** (125 MHz, MeOD) δ_C 207.1, 135.6, 120.8, 100.0, 82.3, 78.8, 78.4, 78.0, 77.7, 71.7, 55.6, 50.0, 43.3, 42.7, 39.3, 38.1, 36.8, 34.1, 33.9, 25.9, 18.5, 17.6, 15.8, 15.8, 13.6, 13.1, 8.2, 7.7, 7.3, 7.3, 6.9, 6.0, 5.9, 4.6; **HRMS** (ES+) Calculated for $C_{46}H_{92}O_7Si_3Na$ ($[M+Na^+]$) 863.6043, found 863.6031.

(2*S*,3*S*,5*S*,6*R*,8*R*,9*R*,10*R*)-8-((2*R*,3*S*,4*S*,*E*)-3-hydroxy-4,6-dimethyloct-6-en-2-yl)-2-((2*S*,3*S*,4*S*,*Z*)-3-hydroxy-6-iodo-4-methylhex-5-en-2-yl)-10-methoxy-3,9-dimethyl-1,7-dioxaspiro[5.5]undecan-5-ol (5)



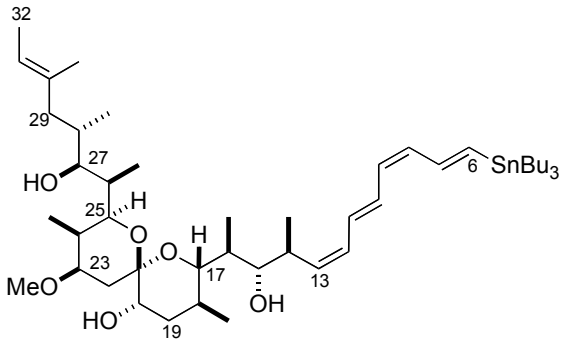
To a suspension of (iodomethyl)triphenylphosphonium iodide (42 mg, 81.0 μmol) in THF (0.3 mL) at rt was added NaHMDS (1 M in THF, 81 μL, 81.0 μmol). The resulting solution was stirred at rt for 10 min, cooled to –78 °C and HMPA (19 μL) added, followed by a solution of aldehyde **13a** (13 mg, 15.4 μmol) in THF (0.7 mL) *via* cannula. After allowing to warm to rt and stirring for 20 min, the reaction was quenched by the addition of hexanes (2 mL) and filtered through a plug Celite™, eluting with hexanes (20 mL). The hexanes fractions were then concentrated *in vacuo*, and purified by flash column chromatography (5% EtOAc / hexanes) to yield vinyl iodide **14** (11 mg, 74%, *ca*. 3:1 (*Z*):(*E*)) as a colourless oil.

To a solution of TES ether **14** (14.2 mg, 14.7 μmol) in MeOH (1.5 mL) at rt was added (+/–)-CSA (catalytic). After stirring at rt for 1 h the reaction was quenched *via* addition saturated aqueous $NaHCO_3$. The phases were separated and the aqueous phase extracted with CH_2Cl_2 (3 x 5 mL). The combined organic phases were dried (Na_2SO_4) and concentrated *in vacuo*. Purification by flash column chromatography (30% EtOAc / hexanes) allowed separation of (*Z*)- and (*E*)-vinyl iodides to yield triol **5** (7.1 mg, 78%) as a colourless oil.

R_f 0.37 (30% EtOAc / hexanes); $[\alpha]_D^{20}$ = +33.7 (*c* 0.43, MeOH); **IR** (neat) 3444, 1457, 1383, 1108, 996 cm^{-1}; **^{1}H NMR** (500 MHz, CD_3OD) δ_H 6.36 (1H, app. t, *J* = 2.5 Hz, H13), 6.36 (1H, d, *J* = 2.6 Hz, H12), 5.25 (1H, q, *J* = 6.7 Hz, H31), 3.73 (1H, dd, *J* = 10.3, 1.8 Hz, H25), 3.71-3.66 (2H, m, H23 and H27), 3.62 (1H, dd, *J* = 10.3, 1.1 Hz, H17), 3.61 (1H, dd, *J* = 9.8, 2.1 Hz, H15) 3.43 (1H, app t, *J* = 2.9 Hz, H20) , 3.39 (3H, s, OMe), 2.78-2.72 (1H, m, H14), 2.70 (1H, br d, *J* = 13.7 Hz, H29a), 2.20-2.13 (1H, m, H24), 2.08 (1H, dd, *J* = 13.0, 4.7 Hz, H22a), 2.04-1.92 (1H, m, H18), 1.91-1.82 (1H, m, H26), 1.81-1.68 (3H, m, H19a, H19b and H28), 1.68-1.54 (2H, obs, H16 and H29b), 1.64 (3H, s, Me31), 1.63 (3H, d, *J* = 6.4 Hz, H32), 1.41 (1H, app. t, *J* = 12.4 Hz, H22b), 1.12 (3H, d, *J* = 7.0 Hz, Me14), 0.87 (3H, d, *J* = 7.0 Hz, Me16), 0.85 (3H, d, *J* = 7.1 Hz, Me26),

0.81 (3H, d, *J* = 6.9 Hz, Me24), 0.80 (3H, d, *J* = 6.7 Hz, Me18), 0.75 (3H, d, *J* = 6.7 Hz, Me28); **^{13}C NMR** (125 MHz, CD_3OD) δ_C 142.7, 135.9, 121.2, 99.5, 82.9, 78.8, 76.2, 75.7, 75.0, 72.4, 71.0, 55.4, 46.0, 43.2, 40.2, 37.8, 37.3, 35.3, 33.9, 32.9, 25.6, 18.0, 17.6, 15.8, 15.6, 13.5, 9.6, 7.9, 4.1; **HRMS** (ES+) Calculated for $C_{29}H_{51}IO_6Na$ ([M+Na^+]) 645.2623, found 645.2619.

Spirangien A tetraene (19)



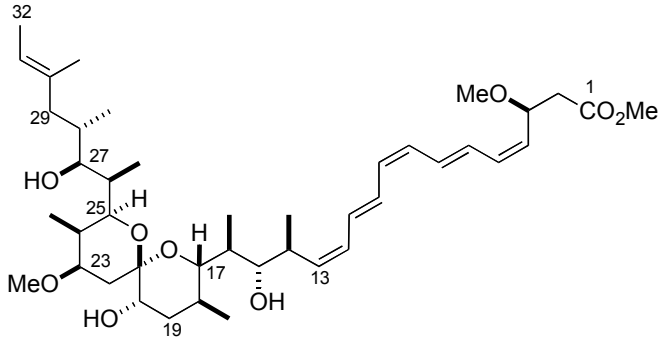
In this case, stock solutions of $Pd_2(dba)_3$ and Ph_3As were used. $Pd_2(dba)_3$ (2 mg) dissolved in DMF (200 μL) and THF (100 μL). Ph_3As (2 mg) in DMF (200 μL) and THF (100 μL).

To a solution of (*Z*)-vinyl iodide **5** (2 mg, 3.2 μmol) and triene **8** (21 mg, 32.1 μmol) in DMF (0.3 mL) and THF (0.1 mL) at rt was added $Pd_2(dba)_3$ (22 μL, 0.16 μmol) and Ph_3As (20 μL, 0.42 μmol). The resulting solution was purged by evacuating for 1 min and then flushing with Ar (x 3) and then stirred at rt for 16 h. The reaction was then quenched *via* addition of H_2O (2 mL) and diluted with EtOAc (containing 2% Et_3N). The phases were separated and the aqueous phase extracted with EtOAc (containing 2% Et_3N) (3 x 3 mL). The combined organics were washed with brine (5 mL), dried (Na_2SO_4) and concentrated *in vacuo*. Purification by flash column chromatography (3% Et_3N in 20% → 30% EtOAc / hexanes) yielded tetraene **19** (1.7 mg, 60%) as a yellow oil.

R_f 0.44 (30% EtOAc / hexanes); **^{1}H NMR** (500 MHz, CD_3OD) δ_H 7.11 (1H, dd, *J* = 18.6, 10.2 Hz, H7), 6.77 (1H, dd, *J* = 14.4, 11.0 Hz, H10), 6.62 (1H, dd, *J* = 14.1, 11.3 Hz, H11), 6.33 (1H, d, *J* = 18.5 Hz, H6), 6.19 (1H, app t, *J* = 11.3 Hz, H12), 6.06 (1H, app t, *J* = 10.8 Hz, H9), 6.00 (1H, app t, *J* = 10.8 Hz, H8), 5.67 (1H, app t, *J* = 10.8 Hz, H13), 5.26 (1H, q, *J* = 6.2 Hz, H31), 3.87 (1H, dd, *J* = 10.3, 1.6 Hz, H25), 3.71-3.65 (2H, m, H23 and H27), 3.62 (1H, d, *J* = 10.8 Hz, H17), 3.60 (1H, dd, *J* = 9.9, 2.0 Hz, H15) 3.43 (1H, app t, *J* = 2.7 Hz, H20), 3.39 (3H, s, OMe), 3.04-2.95 (1H, m, H14), 2.71 (1H, br d, *J* = 12.5 Hz, H29a), 2.19-2.13 (1H, m, H24), 2.07 (1H, dd, *J* = 13.0, 4.5 Hz,

H22a), 1.99-1.93 (1H, m, H18), 1.90-1.84 (1H, m, H26), 1.78-1.76 (1H, m, H19a), 1.76-1.74 (1H, m, H28), 1.73-1.70 (1H, m, H19b), 1.68-1.54 (2H, obs, H16 and H29b), 1.64 (3H, s, Me30), 1.63 (3H, d, obs, H32), 1.62-1.57 (6H, m, $SnCH_2C\underline{H}_2CH_2CH_3$), 1.43-1.37 (7H, m, H22b and $SnCH_2CH_2C\underline{H}_2CH_3$), 1.16 (3H, d, J = 7.0 Hz, Me14), 1.03-0.97 (6H, m, $SnC\underline{H}_2CH_2CH_2CH_3$), 0.96 (9H, t, J = 7.5 Hz, $SnCH_2CH_2CH_2C\underline{H}_3$), 0.85 (3H, d, J = 6.9 Hz, Me26), 0.84 (3H, d, J = 6.9 Hz, Me16), 0.81 (3H, d, J = 7.3 Hz, Me24), 0.80 (3H, d, J = 7.0 Hz, Me18), 0.75 (3H, d, J = 6.6 Hz, Me28); **^{13}C NMR** (125 MHz, CD_3OD) δ_C 142.7, 135.9, 121.2, 99.5, 82.9, 78.8, 76.2, 75.7, 75.0, 72.4, 71.0, 55.4, 46.0, 43.2, 40.2, 37.8, 37.3, 35.3, 33.9, 32.9, 25.6, 18.0, 17.6, 15.8, 15.6, 13.5, 9.6, 7.9, 4.1; **HRMS** (ES+) calculated for $C_{47}H_{84}O_6SnNa$ ([M+Na^+]) 887.5182, found 887.5197.

Spirangien methyl ester (4)



In this case, stock solutions of $Pd_2(dba)_3$ and Ph_3As were used. $Pd_2(dba)_3$ (2 mg) dissolved in DMF (200 μL) and THF (100 μL). Ph_3As (2 mg) in DMF (200 μL) and THF (100 μL).

Strategy 1: To a solution of (*Z*)-vinyl iodide **5** (1.5 mg, 2.4 μmol) and tetraene **6** (12.3 mg, 24.1 μmol) in DMF (0.3 mL) and THF (0.1 mL) at rt was added $Pd_2(dba)_3$ (17 μL, 0.12 μmol) and Ph_3As (15 μL, 0.31 μmol). The resulting solution was purged by evacuating for 1 min and then flushing with Ar (x 3) before stirring at rt for 16 h. The reaction was then quenched *via* addition H_2O (2 mL) and diluted with EtOAc (containing 2% Et_3N). The phases were separated and the aqueous phase extracted with EtOAc (containing 2% Et_3N) (3 x 3 mL). The combined organics were washed with brine (5 mL), dried (Na_2SO_4) and concentrated *in vacuo*. Purification by flash column chromatography (3% Et_3N in 40% EtOAc / hexanes) yielded spirangien methyl ester **4** (1.3 mg, 83%) as a yellow oil. Further purification by analytical HPLC (Microsorb 100 Si, 250 x 4.6 mm, EtOAc/hexanes 25%, R_t = 24.5 min, UV = 320 nm) to remove any traces of minor isomers afforded clean methyl ester **4** (1.05 mg, 65%).

Strategy 2: To a solution of (*Z*)-vinyl iodide **7** (4.0 mg, 17.4 μmol) and tetraene **19** (1.5 mg, 1.7 μmol) in DMF (0.3 mL) and THF (0.1 mL) at rt was added $Pd_2(dba)_3$ (12 μL, 0.08 μmol) and Ph_3As (10 μL, 0.23 μmol). The resulting solution was purged by evacuating for 1 min and then flushing with Ar (x 3) and then stirred at rt for 16 h. The reaction was then quenched *via* addition of H_2O (2 mL) and diluted with EtOAc (containing 2% Et_3N). The phases were separated and the aqueous phase extracted with EtOAc (containing 2% Et_3N) (3 x 3 mL). The combined organics were washed with brine (5 mL), dried (Na_2SO_4) and concentrated *in vacuo*. Purification by flash column chromatography (3% Et_3N in 40% EtOAc / hexanes) yielded spirangien methyl ester **4** (0.7 mg, 58%) as a yellow oil. Further purification by analytical HPLC (Microsorb 100 Si, 250 x 4.6 mm, EtOAc/hexanes 25%, R_t = 24.5 min, UV = 320 nm) to remove any traces of minor isomers afforded clean methyl ester **4** (0.5 mg, 42%).

R_f 0.41 (50% EtOAc / hexanes); $[\alpha]_D^{20}$ = –26.2 (*c* 0.08, MeOH); **IR** (neat) 1740, 1491, 1472, 1381, 1103, 991 cm^{-1}; **HRMS** (ES+) calculated for $C_{42}H_{68}O_9Na$ ($[M+Na^+]$) 739.4756, found 739.4788.

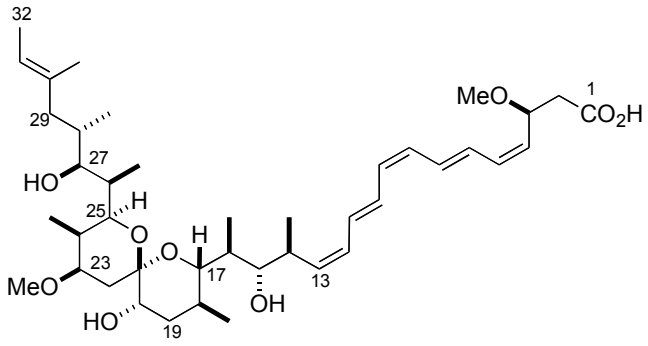
Table 1: Comparison of ^{1}H NMR data for synthetic spirangien methyl ester **4** and natural spirangien A

Position	Spirangien A methyl ester 4 (CD_3OD, 500 MHz)	Natural spirangien A 1 (CD_3OD, 600 MHz)[4]
2a	2.65, dd (8.2, 15.2)	2.60 dd (8.1, 15.1)
2b	2.49, dd (5.4, 15.0)	2.43 dd (5.2, 15.1)
3	4.66, m	4.66 td (5.2, 8.3, 9.2)
4	5.33, app t (10.3)	5.35 dd (10.1, 10.5)
5	6.40, app t (11.3)	6.40 dd (11.0, 11.3)
6	6.69, m	6.69 dd (11.4, 14.5)
7	6.90, dd (11.3, 14.6)	6.90 dd (11.1, 14.5)
8	6.15, app t (11.1)	6.14 dd (11.1, 11.1)
9	6.20, app t (11.1)	6.20 dd (11.1, 11.1)
10	6.83, dd (11.0, 14.4)	6.83, dd (11.1, 14.5)
11	6.64, m	6.64, dd (11.2, 14.5)
12	6.22, app t (11.2)	6.22, dd (11.2, 11.2)
13	5.69, app t (10.9)	5.68, dd (10.8, 10.8)
14	2.99, m	2.99, m
15	3.60, dd (2.1, 9.9)	3.60, dd (2.5, 9.7)
16	1.63, m	1.63, m
17	3.63, dd, (1.0, 10.6)	3.63, dd (1.2, 10.5)
18	1.97, m	1.97, m
19a	1.77, m	1.77, m
19b	1.72, m	1.71, dt (3.2, 3.2, 13.4)
20	3.43, t (2.8)	3.43, t (3.0)
22a	2.07, dd (4.9, 13.2)	2.07, dd (4.8, 13.0)
22b	1.41, app t (12.5)	1.40, dd (12.4, 12.8)
23	3.69, m	3.68, m
24	2.16, m	2.16, m
25	3.73, dd (1.8, 10.2)	3.73, dd (1.9, 10.2)
26	1.87, m	1.87, m
27	3.70, obs	3.70, m
28	1.76, m	1.75, m
29a	2.70, br d (13.1)	2.69, br d (12.3)
29b	1.63, m	1.63, m
31	5.26, q (6.6)	5.25, q (6.6)
32	1.63, m	1.63, m
Me 14	1.14, d (7.0)	1.16, d (7.0)
Me 16	0.84, d (7.2)	0.84, d (7.1)
Me 18	0.79, d (6.6)	0.79, d (6.6)
Me 24	0.81, d (6.9)	0.81, d (6.8)
Me 26	0.85, d (7.2)	0.85, d (6.9)
Me 28	0.75, d (6.6)	0.75, d (6.6)
Me 30	1.65, m	1.64, m
OMe 3	3.29, s	3.29, s
OMe 23	3.38, s	3.38, s
CO_2Me	3.70, s	n/a

Table 2: Comparison of ^{13}C NMR data for synthetic spirangien methyl ester **4** and natural spirangien A

Position	Spirangien A methyl ester 4 (CD_3OD, 125 MHz)	Natural spirangien A 1 (CD_3OD, 150 MHz) [4]
1	172.9	174.8
2	41.7	42.0
3	74.6	74.8
4	132.3	131.4
5	134.0	133.8
6	129.0	129.2
7	132.1	131.9
8	130.2	130.3
9	132.1	132.2
10	129.5	129.5
11	131.0	130.9
12	130.0	130.0
13	134.8	134.8
14	36.1	36.2
15	76.6	76.6
16	40.1	40.0
17	75.2	75.2
18	25.6	25.6
19	37.3	37.3
20	71.0	71.0
21	99.5	99.5
22	34.0	34.0
23	78.8	78.8
24	32.9	33.0
25	72.5	72.5
26	37.8	37.8
27	76.1	76.1
28	35.4	35.4
29	46.0	46.0
30	136.0	136.0
31	121.1	121.1
32	13.5	13.5
Me 14	19.6	19.5
Me 16	7.9	7.9
Me 18	18.1	18.0
Me 24	4.1	4.1
Me 26	9.4	9.4
Me 28	15.6	15.6
Me 30	15.8	15.8
OMe 1	52.2	n/a
OMe 3	56.6	56.6
OMe 23	55.4	54.4

Spirangien A (1)



To a solution of spirangien A methyl ester **4** (1 mg, 1.4 μmol) in MeOH (0.6 mL) and H_2O (0.3 mL) at rt was added aqueous KOH (10%, 25 μL) dropwise. After 16 h at rt, the reaction mixture was partitioned between pH 4 buffer (1 mL) and CH_2Cl_2 (2 mL). The phases were separated and the aqueous phase washed with CH_2Cl_2 (5 x 2 mL). The combined organic phases were then dried (Na_2SO_4) and concentrated *in vacuo*. Purification by analytical HPLC (Hypersil C18, 250 x 4.6 mm, H_2O/MeCN 57%, 50 mM K_2HPO_4/NaH_2PO_4, pH = 7; flow rate: 1 mL/min; R_t = 12 min, UV = 320 nm) to remove any traces of minor isomers afforded clean Spirangien A **1** (0.83 mg, 85%). The compound deteriorated over time, even when stored at –20 °C.

R_f 0.37 (100% EtOAc); $[\alpha]_D^{20}$ = -17.5 (*c* 0.04, MeOH); **IR** (neat) 3520, 1742, 1471, 1389, 1218, 1109 cm^{-1} **HRMS** (ES+) calculated for $C_{41}H_{66}O_9Na$ ([M+Na^+]) 725.4605, found 725.4570.

Table 3: Comparison of ^{1}H NMR data for synthetic and natural spirangien A

Position	Synthetic spirangien A (CD_3OD, 500 MHz)	Natural spirangien A[4] (CD_3OD, 600 MHz)
2a	2.59, dd (8.2, 15.1)	2.60 dd (8.1, 15.1)
2b	2.43, dd (5.2, 15.0)	2.43 dd (5.2, 15.1)
3	4.66, m	4.66 td (5.2, 8.3, 9.2)
4	5.34, app t (10.4)	5.35 dd (10.1, 10.5)
5	6.40, app t (11.2)	6.40 dd (11.0, 11.3)
6	6.69, m	6.69 dd (11.4, 14.5)
7	6.89, dd (10.9, 14.6)	6.90 dd (11.1, 14.5)
8	6.14, app t (11.1)	6.14 dd (11.1, 11.1)
9	6.20, app t (11.1)	6.20 dd (11.1, 11.1)
10	6.82, dd (11.0, 14.5)	6.83, dd (11.1, 14.5)
11	6.64, m	6.64, dd (11.2, 14.5)
12	6.22, app t (11.1)	6.22, dd (11.2, 11.2)
13	5.68, app t (10.6)	5.68, dd (10.8, 10.8)
14	2.99, m	2.99, m
15	3.60, dd (2.3, 9.7)	3.60, dd (2.5, 9.7)
16	1.63, m	1.63, m
17	3.63, dd, (1.0, 10.5)	3.63, dd (1.2, 10.5)
18	1.97, m	1.97, m
19a	1.77, m	1.77, m
19b	1.72, m	1.71, dt (3.2, 3.2, 13.4)
20	3.43, t (2.9)	3.43, t (3.0)
22a	2.07, dd (4.9, 13.1)	2.07, dd (4.8, 13.0)
22b	1.41, app t (12.5)	1.40, dd (12.4, 12.8)
23	3.68, m	3.68, m
24	2.16, m	2.16, m
25	3.73, dd (1.9, 10.2)	3.73, dd (1.9, 10.2)
26	1.87, m	1.87, m
27	3.70, m	3.70, m
28	1.75, m	1.75, m
29a	2.70, br d (13.1)	2.69, br d (12.3)
29b	1.63, m	1.63, m
31	5.25, q (6.6)	5.25, q (6.6)
32	1.63, m	1.63, m
Me 14	1.15, d (7.0)	1.16, d (7.0)
Me 16	0.84, d (7.2)	0.84, d (7.1)
Me 18	0.79, d (6.6)	0.79, d (6.6)
Me 24	0.81, d (6.9)	0.81, d (6.8)
Me 26	0.85, d (7.0)	0.85, d (6.9)
Me 28	0.75, d (6.6)	0.75, d (6.6)
Me 30	1.64, m	1.64, m
OMe 3	3.30, s	3.29, s
OMe 23	3.38, s	3.38, s

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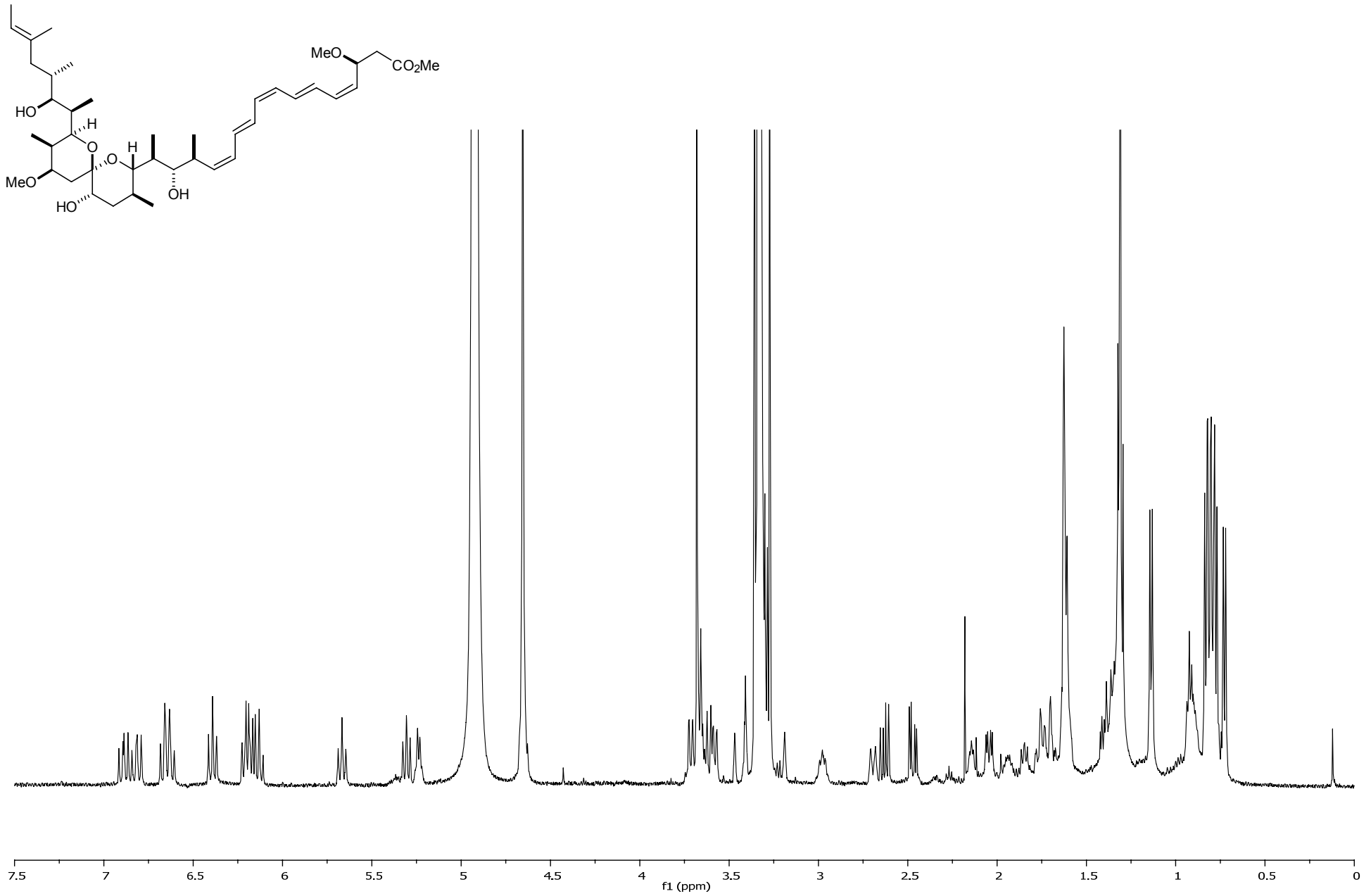
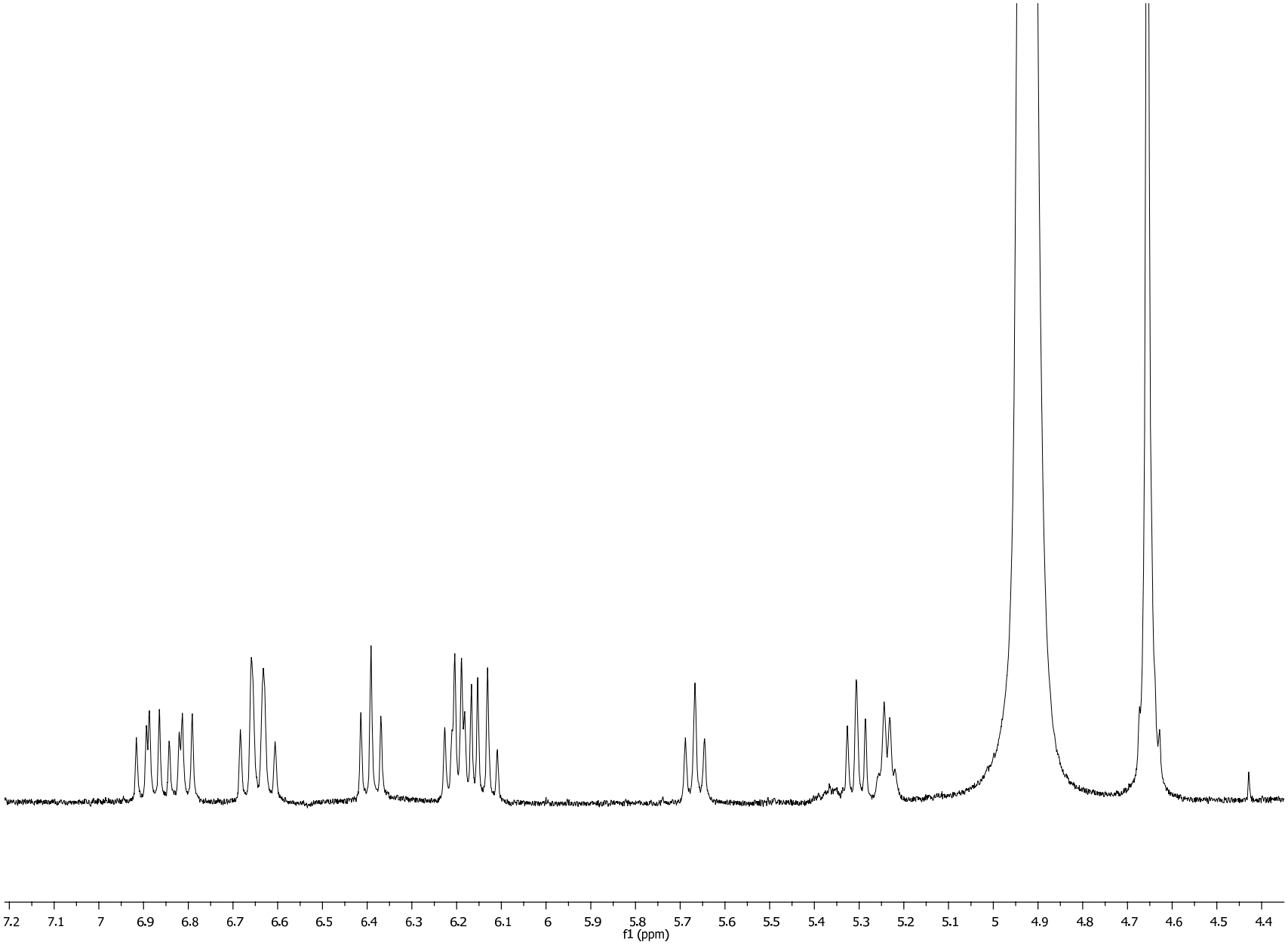
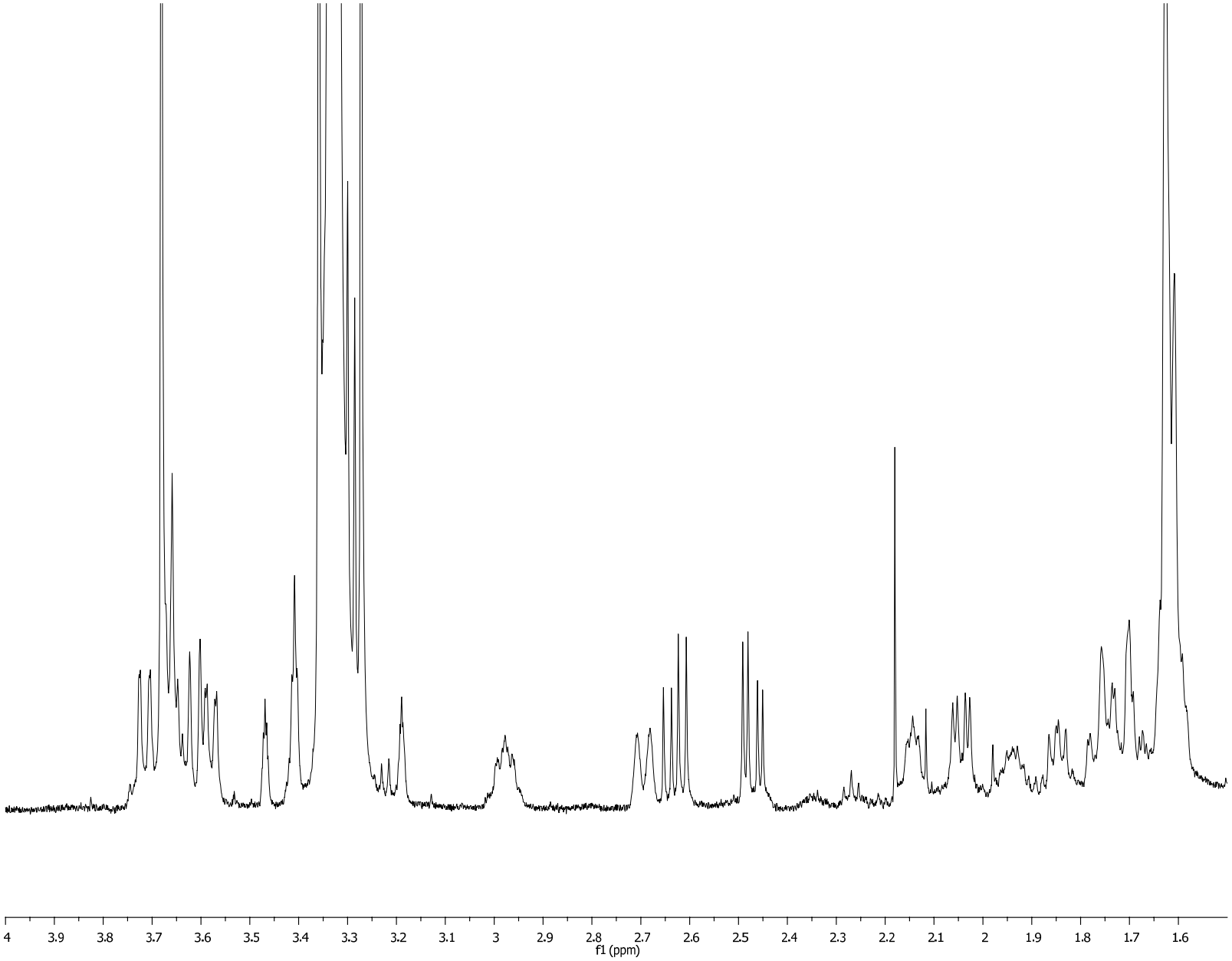
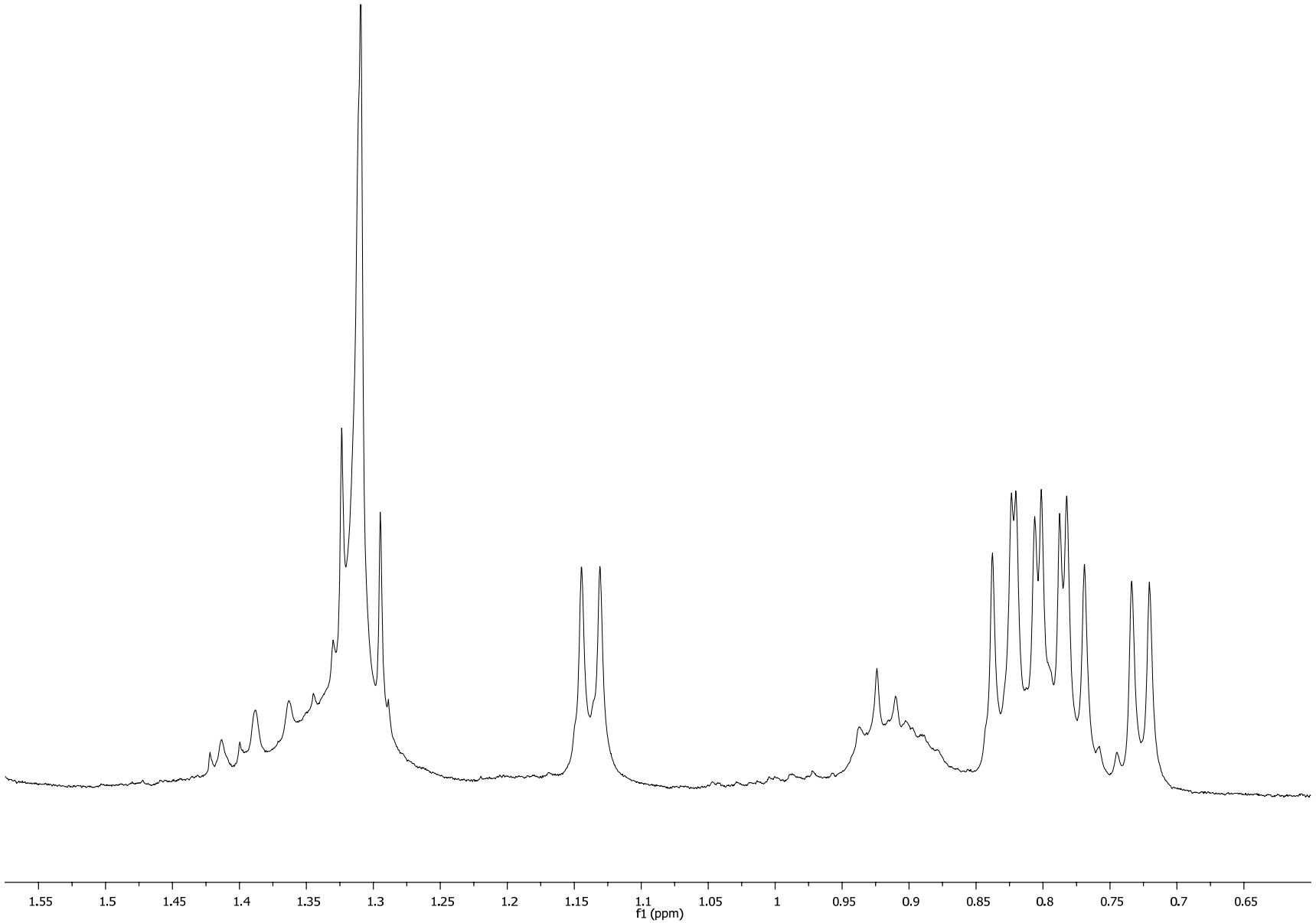
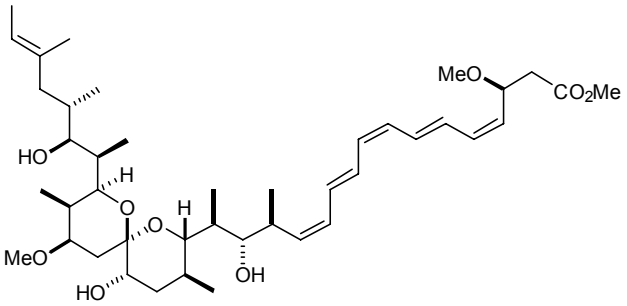
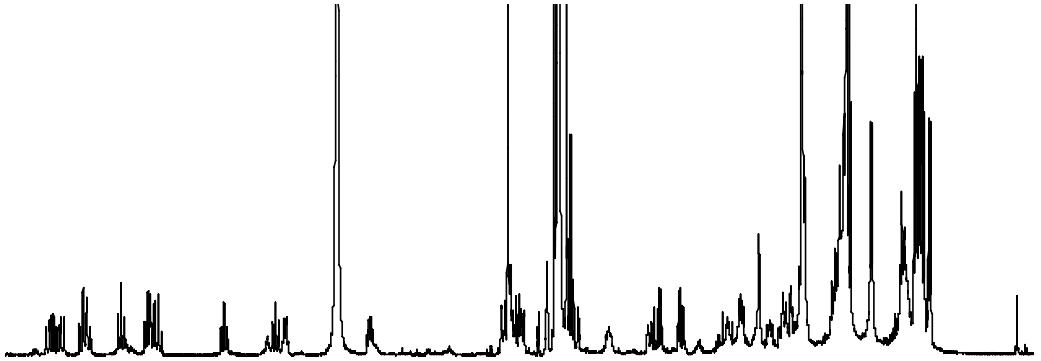

MeO
CO2Me
HO
H
O
H
O
MeO
HO
OH
7.5
7
6.5
6
5.5
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
f1 (ppm)

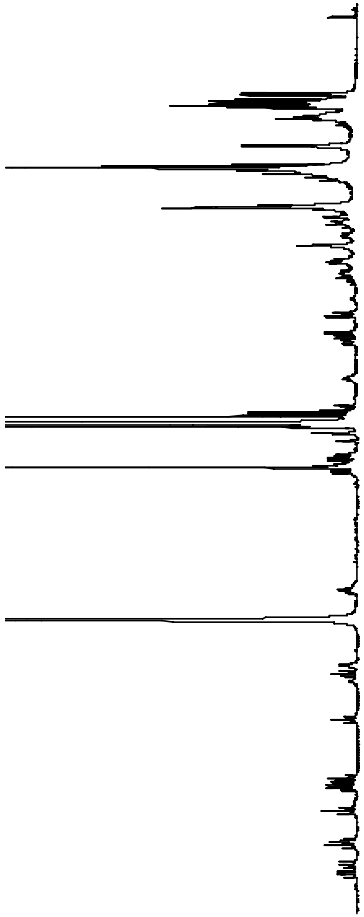

7.2
7.1
7
6.9
6.8
6.7
6.6
6.5
6.4
6.3
6.2
6.1
6
5.9
5.8
5.7
5.6
5.5
5.4
5.3
5.2
5.1
5
4.9
4.8
4.7
4.6
4.5
4.4
f1 (ppm)

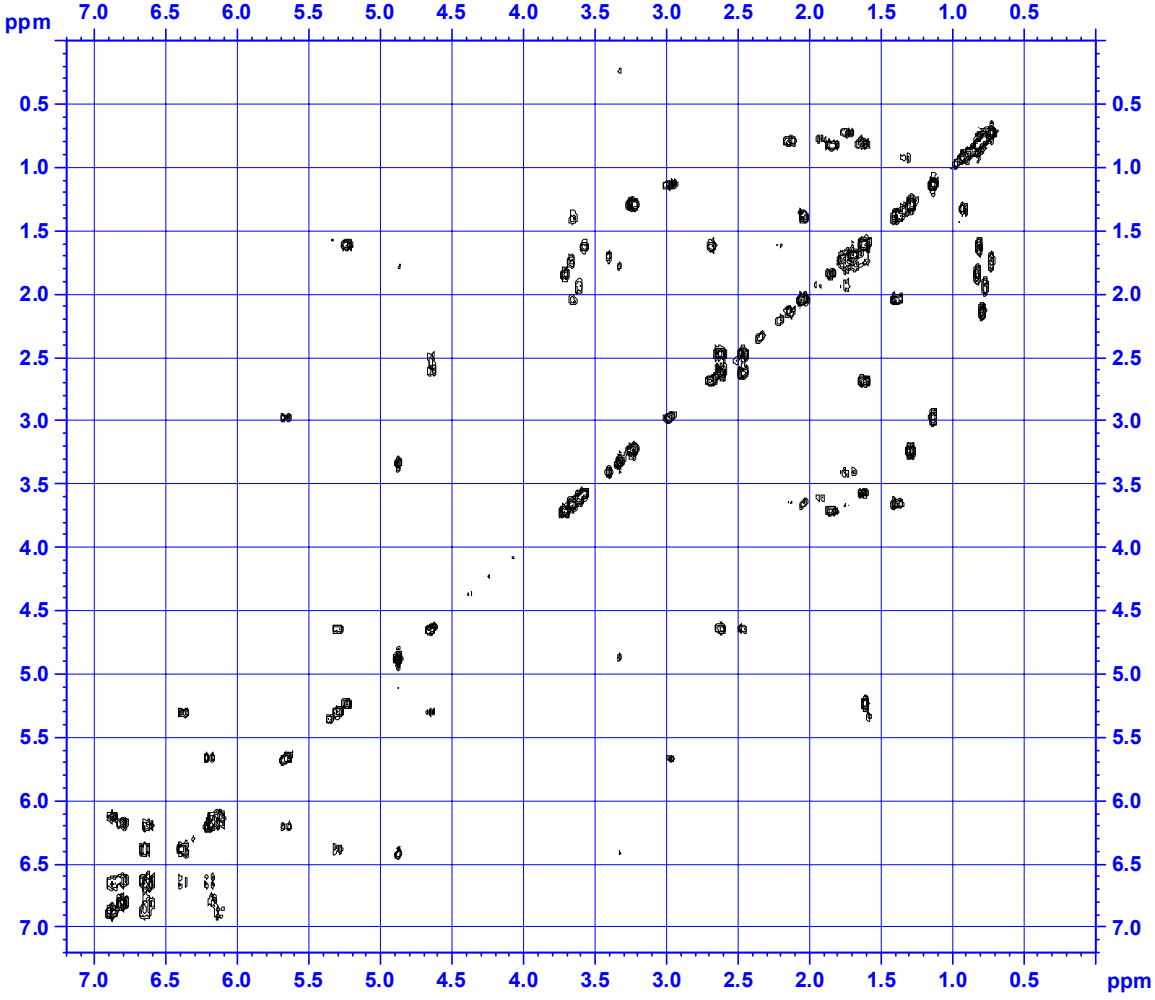

4
3.9
3.8
3.7
3.6
3.5
3.4
3.3
3.2
3.1
3
2.9
2.8
2.7
2.6
2.5
2.4
2.3
2.2
2.1
2
1.9
1.8
1.7
1.6
f1 (ppm)


1.55
1.5
1.45
1.4
1.35
1.3
1.25
1.2
1.15
1.1
1.05
1
0.95
0.9
0.85
0.8
0.75
0.7
0.65
f1 (ppm)

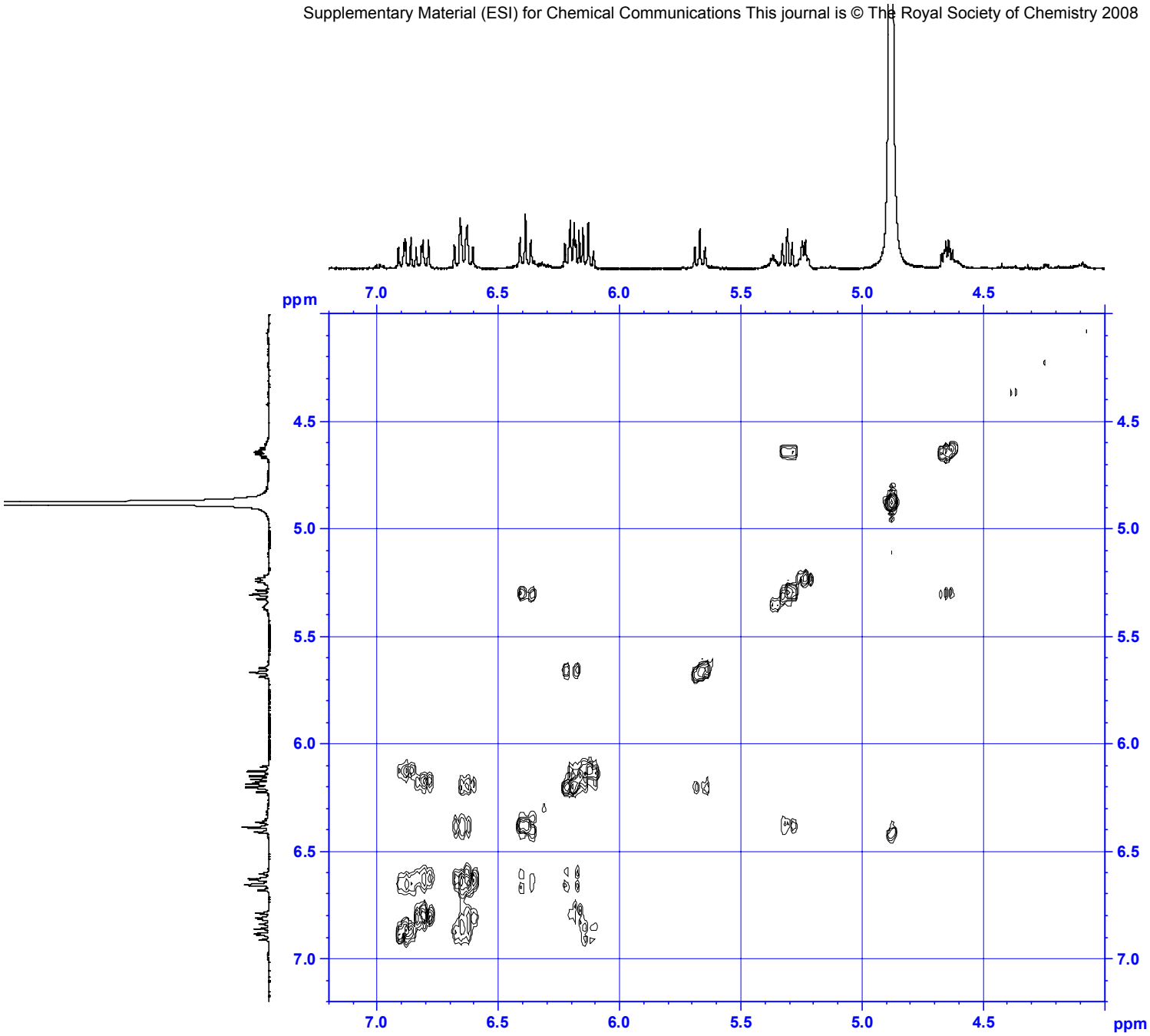









```
Current Data Parameters
NAME      CN266-HPLC-COSY
EXPNO                  2
PROCNO                 1

F2 - Acquisition Parameters
Date_           20080910
Time              12.15
INSTRUM            AV500
PROBHD   5 mm TXI 1H-13
PULPROG       cosygpmfqf
TD                 2048
SOLVENT            MeOD
NS                    4
DS                    8
SWH            5482.456 Hz
FIDRES         2.676980 Hz
AQ             0.1869188 sec
RG                 1024
DW               91.200 usec
DE                6.00 usec
TE                296.2 K
D0            0.00000300 sec
D1            2.00000000 sec
D13           0.00000400 sec
D16           0.00015000 sec
IN0           0.00018240 sec

======= CHANNEL f1 ======
NUC1                1H
P1                8.30 usec
PL1              -2.60 dB
SFO1       500.1325007 MHz

===== GRADIENT CHANNEL ====
GPNAM1          sine.100
GPNAM2          sine.100
GPNAM3          sine.100
GPZ1             16.00 %
GPZ2             12.00 %
GPZ3             40.00 %
P16            1500.00 usec

F1 - Acquisition parameters
NDO                   1
TD                  256
SFO1          500.1325 MHz
FIDRES        21.415777 Hz
SW               10.962 ppm
FnMODE              QF

F2 - Processing parameters
SI                  1024
SF         500.1300000 MHz
WDW                SINE
SSB                   0
LB                 0.00 Hz
GB                    0
PC                 1.40

F1 - Processing parameters
SI                  1024
MC2                 QF
SF         500.1300000 MHz
WDW                SINE
SSB                   0
LB                 0.00 Hz
GB                    0
```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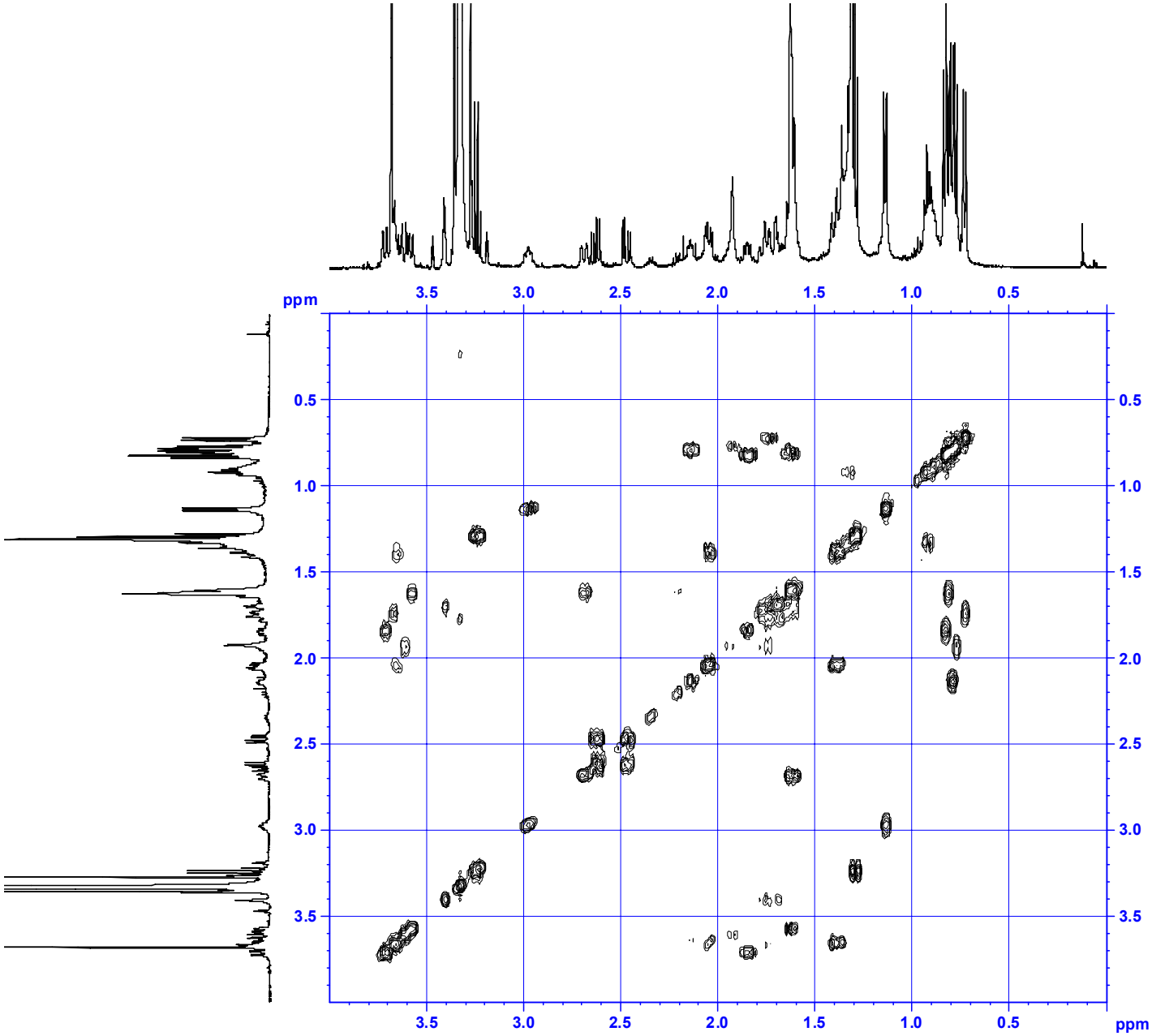
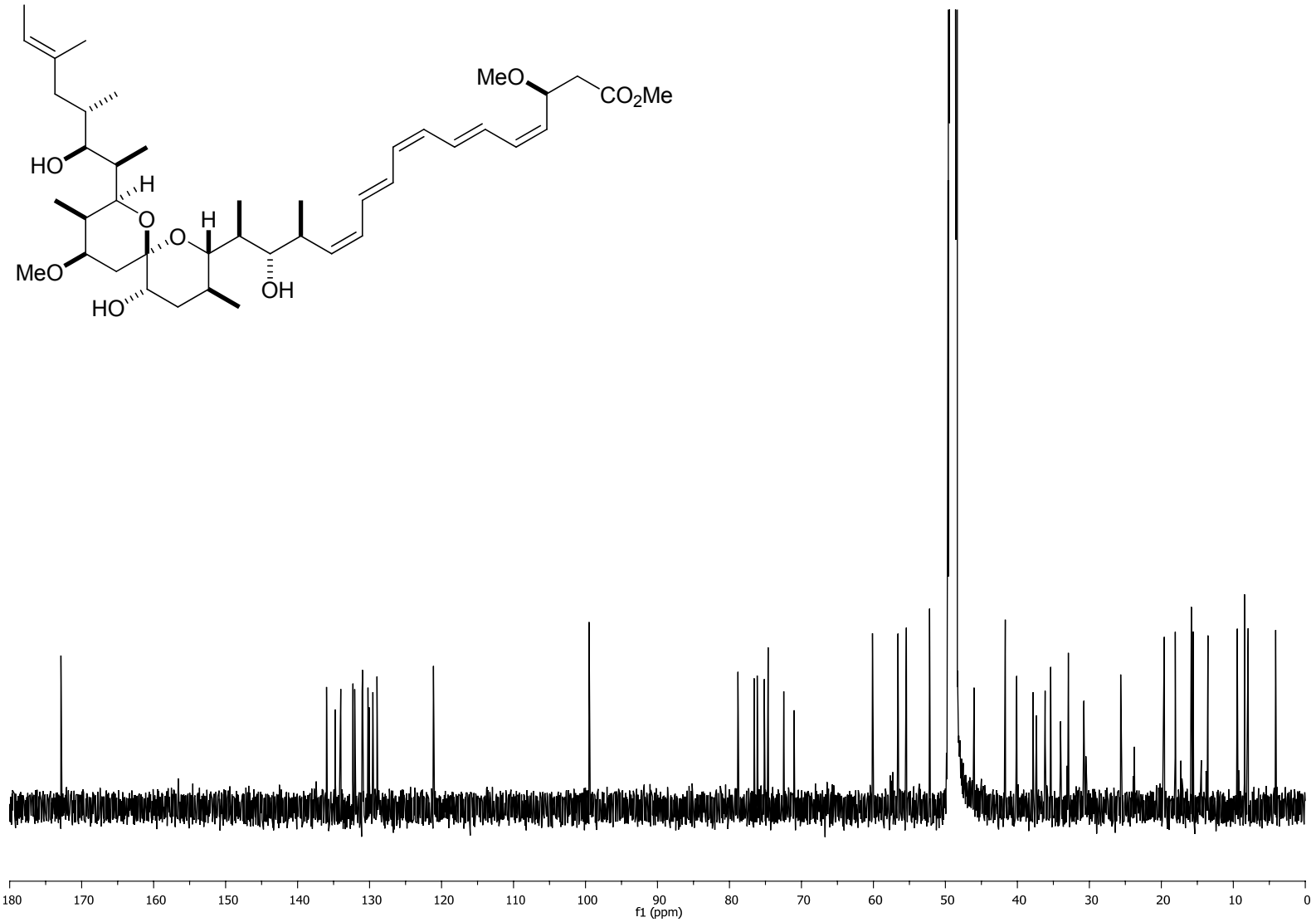
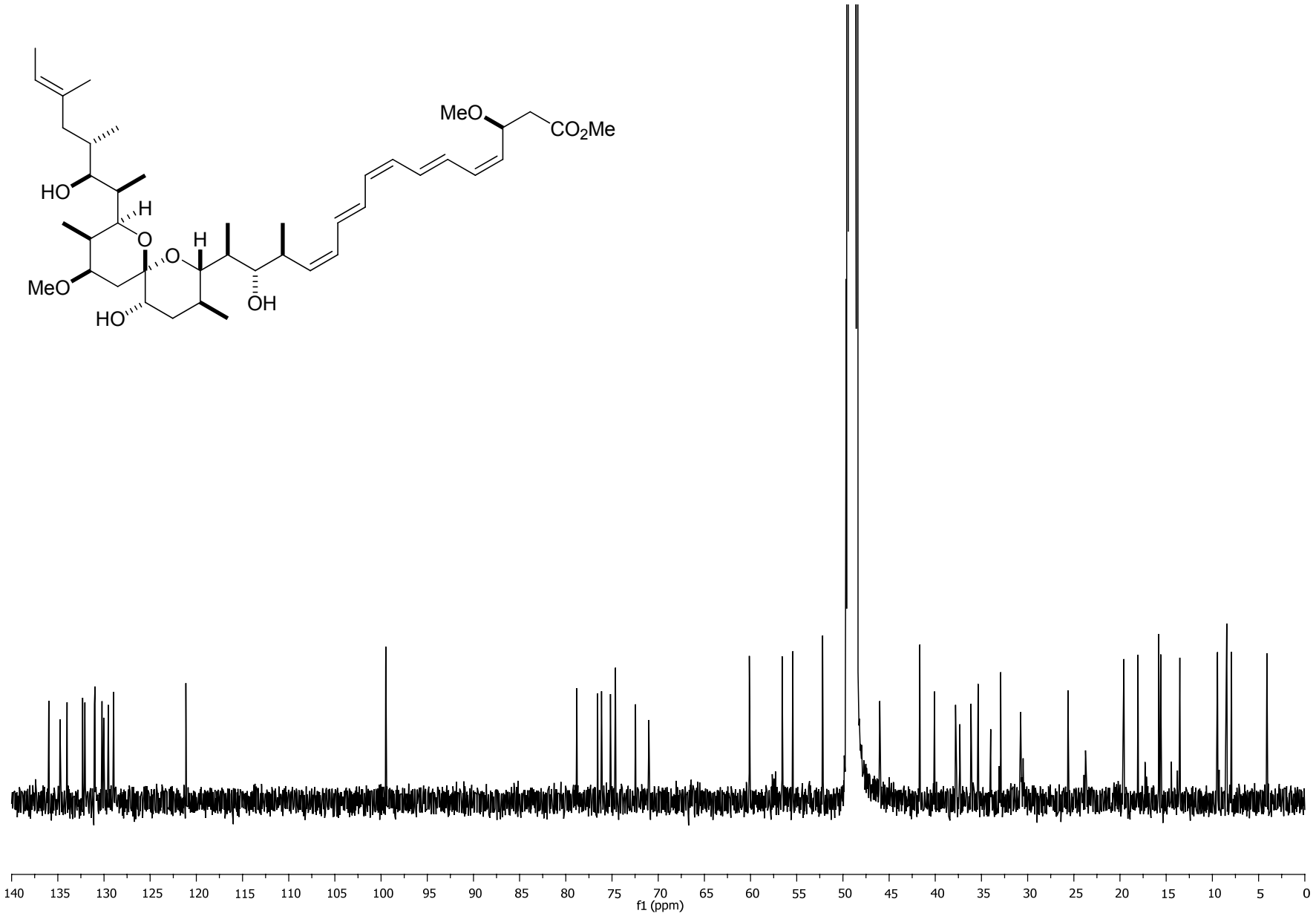
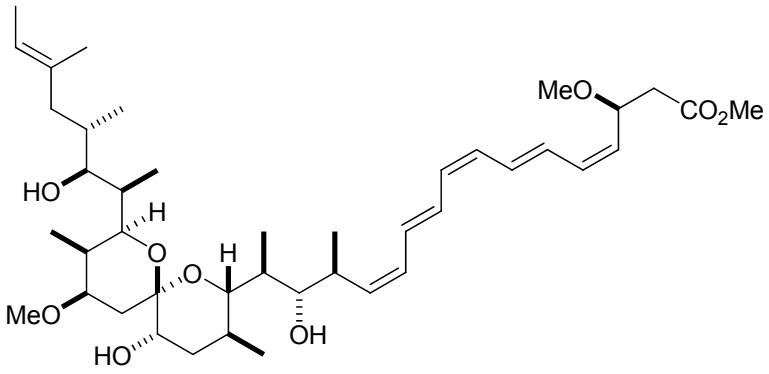
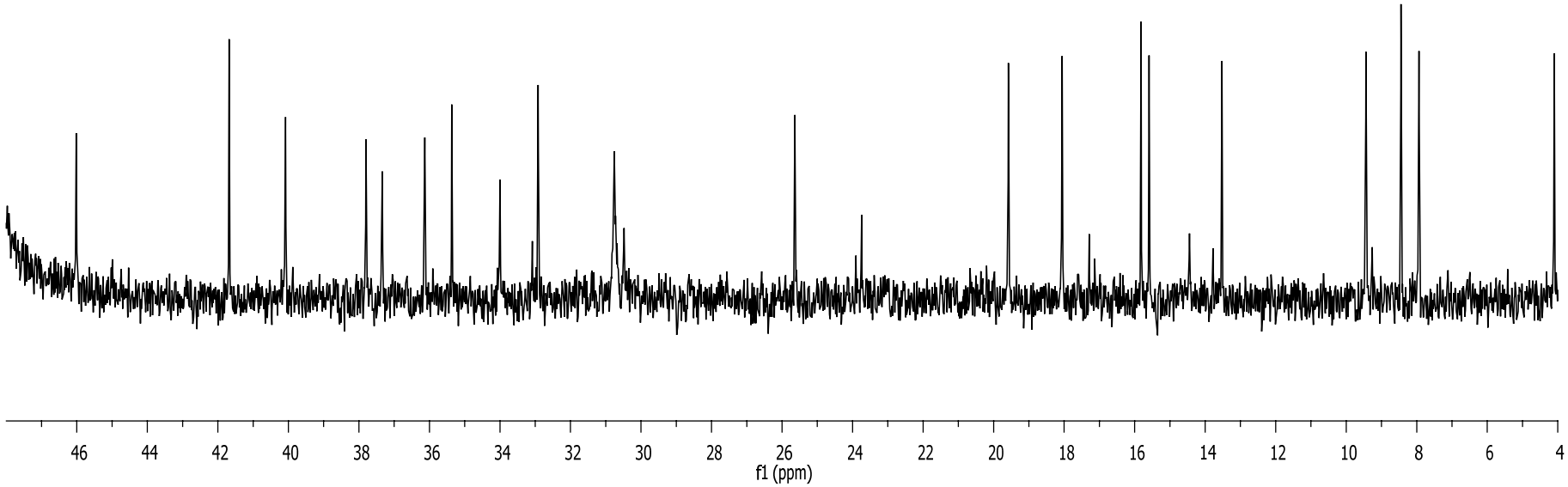
6.5
6.0
5.5
5.0
4.5
ppm

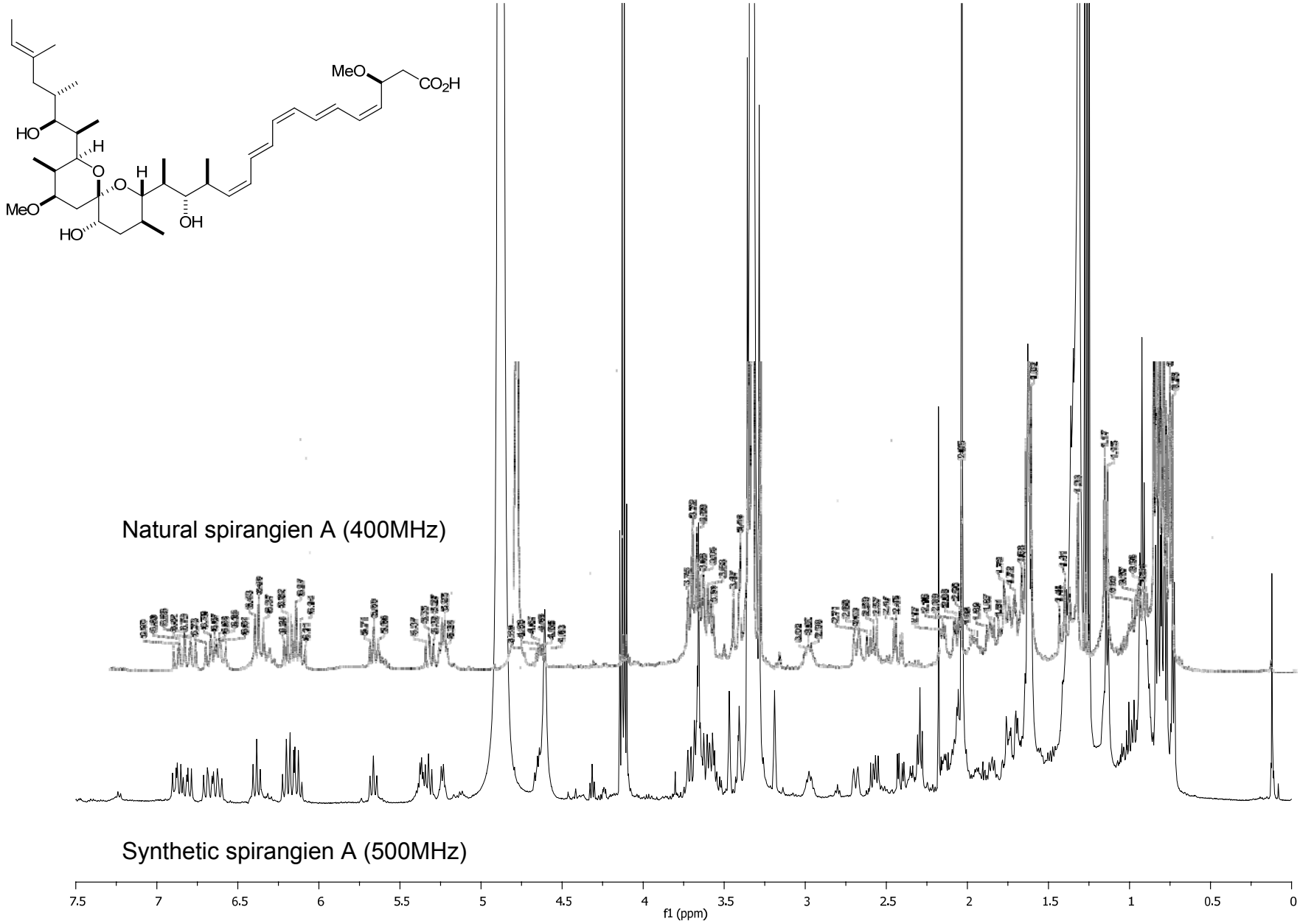

ppm
3.5
3.0
2.5
2.0
1.5
1.0
0.5
ppm

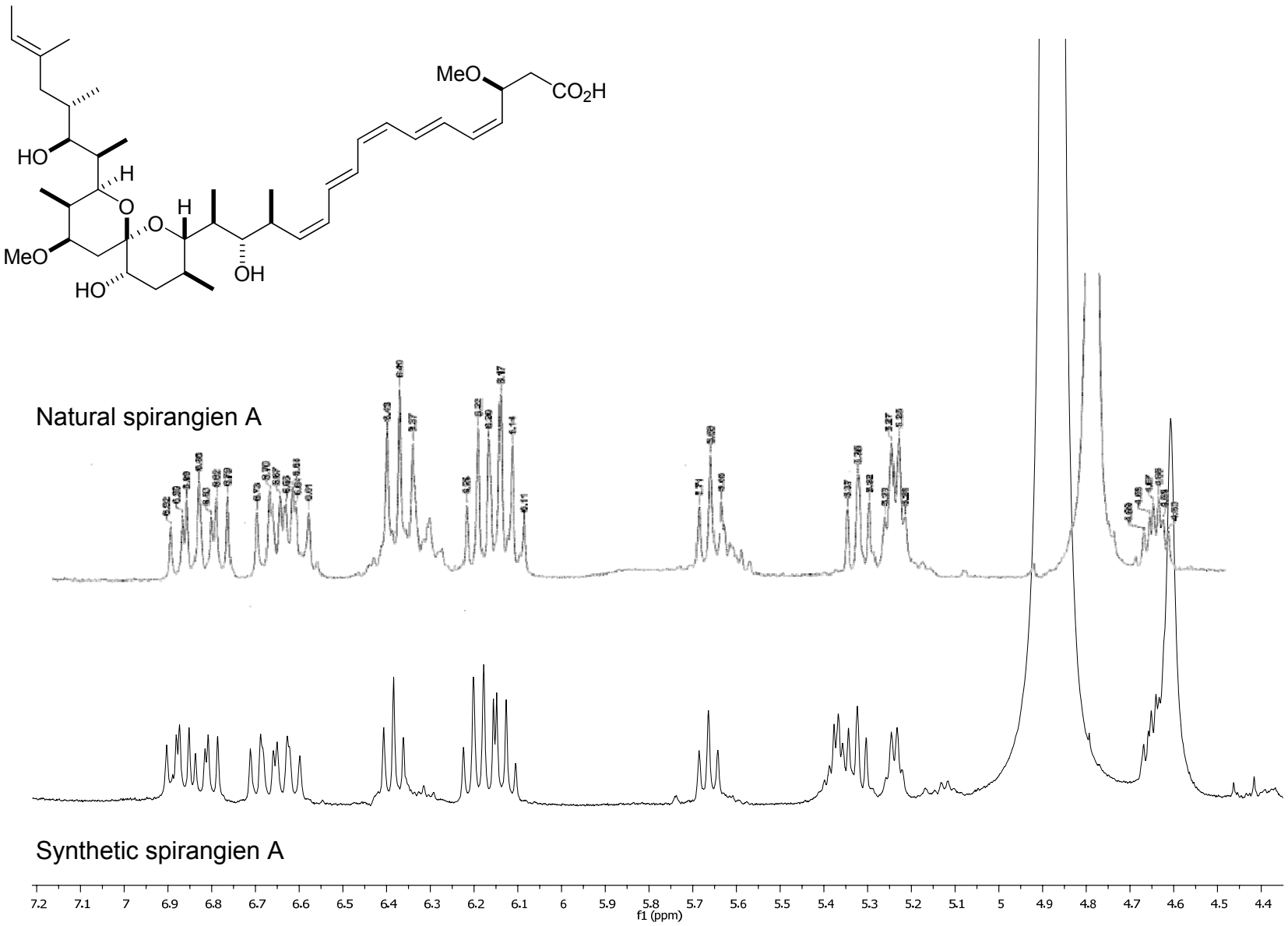

MeO
CO2Me
HO
H
O
O
H
MeO
HO
OH
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

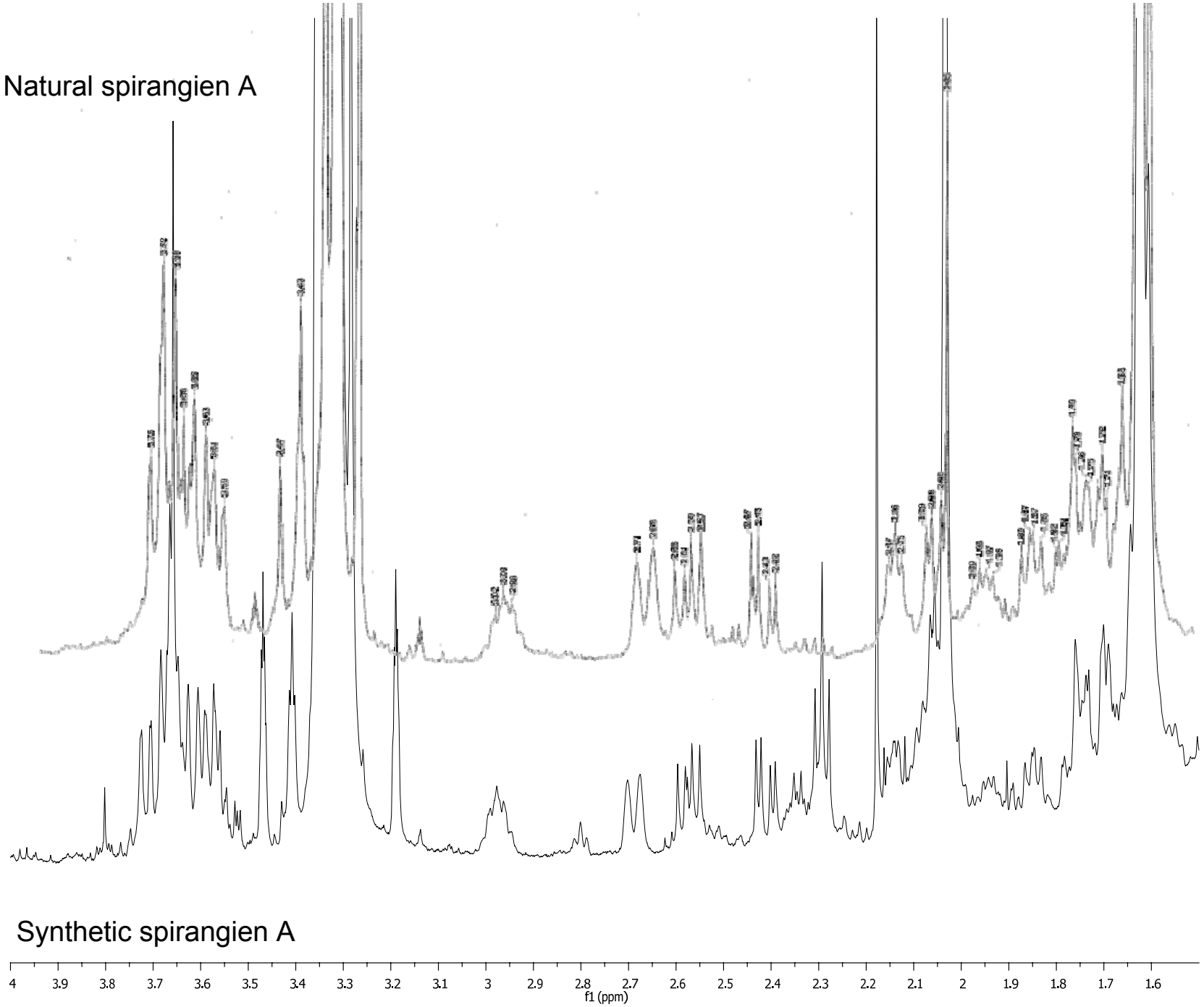

MeO
CO2Me
HO
H
O
O
H
MeO
HO
OH
140
135
130
125
120
115
110
105
100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
25
20
15
10
5
0
f1 (ppm)

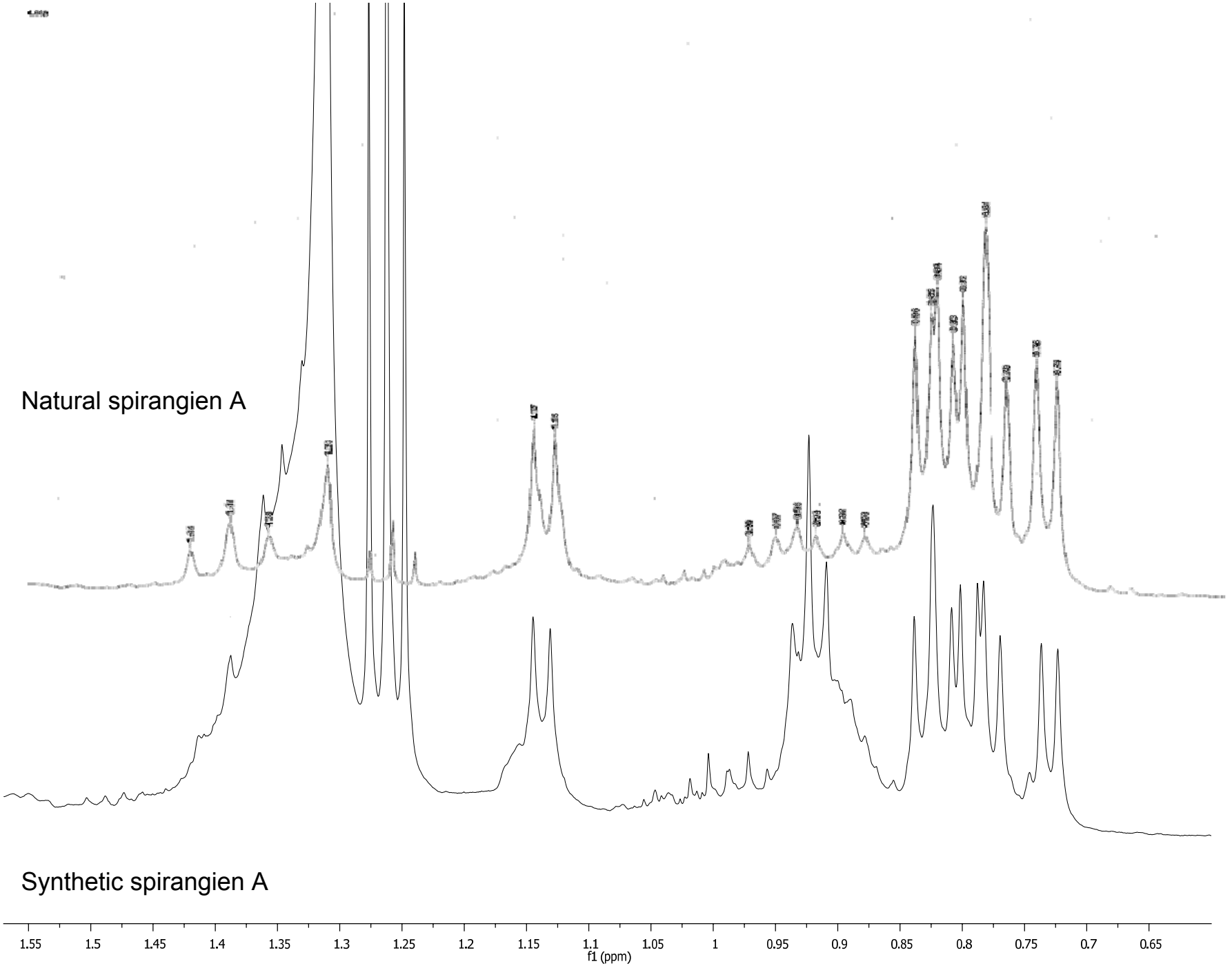

MeO
CO2Me
HO
H
O
O
H
MeO
OH
HO


46
44
42
40
38
36
34
32
30
28
26
24
22
20
18
16
14
12
10
8
6
4
f1 (ppm)


MeO
CO2H
HO
H
O
O
H
MeO
HO
OH
Natural spirangien A (400MHz)
Synthetic spirangien A (500MHz)
7.5
7
6.5
6
5.5
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
f1 (ppm)


MeO
CO2H
HO
H
O
H
O
MeO
OH
HO
Natural spirangien A
Synthetic spirangien A
7.2 7.1 7 6.9 6.8 6.7 6.6 6.5 6.4 6.3 6.2 6.1 6 5.9 5.8 5.7 5.6 5.5 5.4 5.3 5.2 5.1 5 4.9 4.8 4.7 4.6 4.5 4.4
f1 (ppm)


Natural spirangien A
Synthetic spirangien A
4
3.9
3.8
3.7
3.6
3.5
3.4
3.3
3.2
3.1
3
2.9
2.8
2.7
2.6
2.5
2.4
2.3
2.2
2.1
2
1.9
1.8
1.7
1.6
f1 (ppm)


Natural spirangien A
Synthetic spirangien A
1.55
1.5
1.45
1.4
1.35
1.3
1.25
1.2
1.15
1.1
1.05
1
0.95
0.9
0.85
0.8
0.75
0.7
0.65
f1 (ppm)