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Supporting Information

Enantioselective Total Synthesis of Parnafungin A1 and 10a-*epi*-Hirtusneanine

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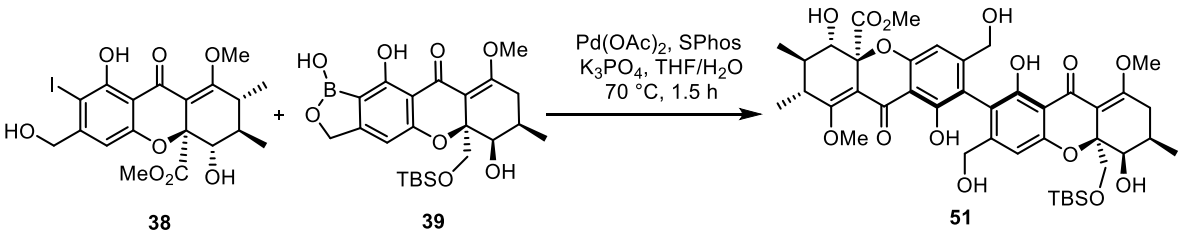
Table S1. Optimization of the Suzuki-Miyaura cross-coupling reaction.



38 **39** **51**

Entry[a]	Derivations	Results
1	none	15%
2	DIPEA	< 5%
3	no water	0%
4	Pd_2dba_3	< 5%
5	PPh_3	0%
6	**L2**	0%
7	45 min	25%
8[b]	60 °C	43%
9[b]	50 °C	27%
10[b]	30 °C	no reaction

Reaction conditions: [a] Benzoxaborole **39** (1.0 equiv), aryl bromide **38** (0.02 mmol, 1.0 equiv), $Pd(OAc)_2$ (20 mol %), Sphos (30 mol %) and K_3PO_4 (3.0 equiv) in THF (0.8 mL) and H_2O (0.2 mL) at 70 ^oC for 1.5 h. [b] 45min.

1. Synthetic route to known compound 19

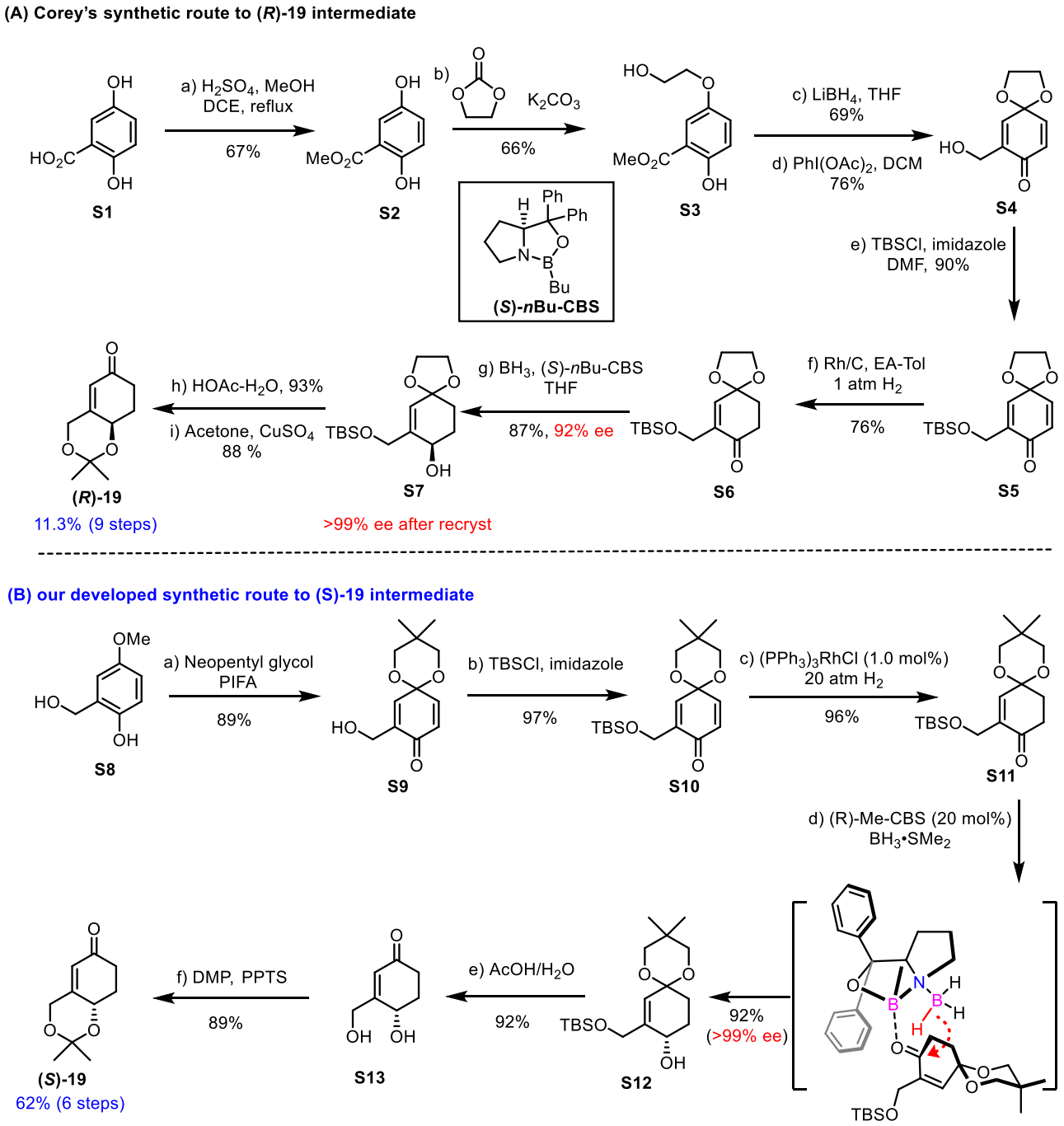


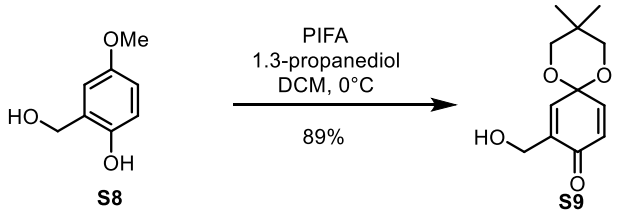
Figure S1.（**A**）Corey's synthetic approach to **(*R*)-16** intermediate[1] [*Tetrahedron Lett.* **32**, 5025-5028 (1991).]. (**B**) Our developed synthetic route to **(S)-19** intermediate

2. General Procedures:

Most of reactions were carried out under nitrogen atmosphere using Schlenk techniques. Reagents were purchased at the highest commercial quality and used without further purification, unless otherwise stated. Anhydrous tetrahydrofuran, diethyl ether and toluene were distilled immediately before us from sodium-benzophenone ketyl. Methylene chloride (CH_2Cl_2), *N*,*N*-dimethylformamide (DMF), *N*,*N*,*N'*,*N'*-Tetramethylethylenediamine (TMEDA), tert-butanol (t-BuOH), diisopropylamine (i-Pr_2NH), trimethylamine (Et_3N), were distilled from calcium hydride and stored under an argon atmosphere. Methanol (MeOH) and ethanol (EtOH) was distilled from magnesium and stored under a nitrogen atmosphere. All other solvents and reagents were used as received from commercial sources, unless otherwise specified Solvents for chromatography were used as supplied by Adamas-beta®. Flash column chromatography was performed employing Qingdao Haiyang silica gel 60 (200–300 mesh). TLC analyses were performed on EMD 250 μm Silica Gel $HSGF_{254}$ plates (and visualized by quenching of UV fluorescence (λ_{max} = 254 nm), or by staining ceric ammonium molybdate, ammonium molybdate, or potassium permanganate. ^{1}H and ^{13}C NMR spectra were recorded on a Bruker Avance III 400 MHz, an Agilent DD2 500 MHz, or a Bruker Avance III HD 600 MHz NMR spectrometer. Chemical shifts for ^{1}H and ^{13}C NMR spectra are reported in ppm (δ) relative to residue protium and carbon resonance in the solvent (chloroform-d: δ 7.26, 77.0 ppm; methanol-d4: δ = 3.31, 48.8 ppm; acetone-d6: δ = 2.05, 29.7, 206.2 ppm) and the multiplicities are presented as follows: s = singlet, d = doublet, t = triplet, q = quartet, m= multiplet, br = broad. High-resolution mass spectra (HRMS) were recorded on a Bruker maXis 4G mass spectrometer. Chiral HPLC analyses were performed on an Agilent 1100 Series using a Daicel Chiralpak column with hexane/*i*PrOH or MeCN/H_2O as the eluent. Optical rotations were measured on an Anton Paar Modular Circular Polarimeter. X-ray structures were measured on BRUKER APEX II and SC-XRD.

3. Synthetic Procedures

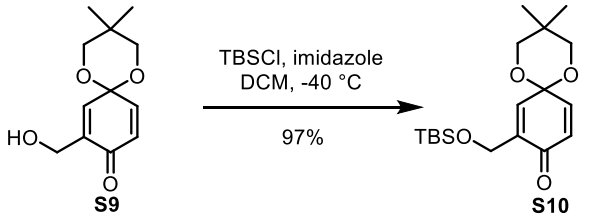
Preparation of alcohol S9



An oven-dried, 5 L three-necked, round-bottomed flask was treated with Bis(trifluoroacetoxy)iodo]benzene (306 g, 711 mmol, 1.1 equiv) and CH_2Cl_2 (2.0 L). The reaction mixture was cooled to 0 ℃ via ice/water bath. After 30 min of continued stirring at 0 ℃, the solution of benzyl alcohol **S8** (100 g, 647 mmol, 1.0 equiv) and neopentyl glycol (101 g, 970 mmol, 1.5 equiv) in CH_2Cl_2 (800 mL) was added dropwise via addition funnel over a period of 80 min. Upon complete addition, the resulting yellow reaction mixture was stirred at 0 ℃ for an additional 60 min at which point TLC analysis indicated the complete consumption of starting material. The reaction was carefully quenched with *sat.* aq. $NaHCO_3$ (300 mL) and then warmed to ambient temperature. The layers were separated and aqueous layer was extracted with CH_2Cl_2 (3 × 300 mL) and the combined layers were washed with brine (300 mL), dried over Na_2SO_4, filtered and concentration *in vacu*o. The crude residue was purified via SiO_2 flash chromatography (eluent: EtOAc/hexanes = 5/1) to give alcohol **S9** (129 g, 89% yield) as a yellow solid.

$\boldsymbol{R_f}$ = 0.33 (silica gel, 2:1 hexanes:EtOAc); ^{1}H NMR (400 MHz, Chloroform-*d*) δ 7.15 (dt, *J* = 3.1, 1.5 Hz, 1H), 7.11 (dd, *J* = 10.2, 3.2 Hz, 1H), 6.20 (d, *J* = 10.2 Hz, 1H), 4.41 (s, 2H), 3.73 (d, *J*=11.6 Hz, 1H), 3.67 (d, *J*=11.5 Hz, 1H), 1.10 (s, 3H), 1.06 (s, 3H); ^{13}C NMR (126 MHz, Chloroform-*d*) δ = 185.7, 142.5, 137.2, 135.9, 128.5, 89.2, 71.4, 60.5, 30.1, 22.7, 22.6; HRMS (ESI) calcd.for $C_{12}H_{16}O_4Na$ [M+Na]+: 247.0941; found: 247.0945.

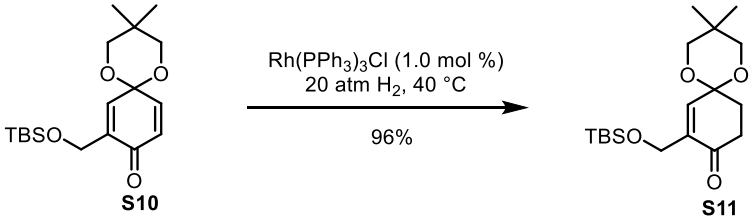
Preparation of cyclic ketal S10



An oven-dried, 2.0 L round-bottomed flask was treated with alcohol **S9** (130 g, 579 mmol, 1.0 equiv), imidazole (59.1 g, 869 mol, 1.5 equiv) and CH_2Cl_2 (800 mL). The reaction mixture was cooled to 0 ℃ via ice/water bath. After 30 min of continued stirring at -40 ℃, TBSCl (91.7 g, 608 mmol, 1.05 equiv.) was added in portions during a period of 30 min. Upon complete addition, the resulting dark-brown reaction mixture was stirred at -40 ℃ for an additional 6 h at which point TLC analysis indicated the complete consumption of starting material. The reaction was quenched with *sat.* aq. $NaHCO_3$ (100 mL) and then warmed to ambient temperature. The layers were separated and aqueous layer was extracted with CH_2Cl_2 (3 × 200 mL) and the combined layers were washed with brine (400 mL), dried over Na_2SO_4, filtered and concentration *in vacu*o. The crude residue was purified via SiO_2 flash chromatography (eluent: EtOAc/hexanes = 1:15) to give cyclic ketal **S10** (190 g, 97% yield) as a yellow solid.

***R*$_f$** = 0.45 (silica gel, 5:1 hexanes:EtOAc); ^{1}H NMR (500 MHz, Chloroform-d) δ 7.31 (dt, *J* = 3.2, 2.2 Hz, 1H), 7.00 (dd, *J* = 10.2, 3.3 Hz, 1H), 6.15 (d, *J* = 10.2 Hz, 1H), 4.44 (d, *J* = 2.2 Hz, 2H), 3.76 (d, *J* = 11.8 Hz, 2H), 3.63 (d, *J* = 11.8 Hz, 2H), 1.14 (s, 3H), 1.00 (s, 3H), 0.95 (s, 9H), 0.10 (s, 6H);^{13}C NMR (126 MHz, Chloroform-*d*) δ 185.2, 143.1, 138.0, 133.7, 128.9, 89.6, 71.6, 59.4, 30.2, 23.0, 22.8, 18.4, -5.3; HRMS (ESI) calcd.for $C_{18}H_{30}O_4SiNa$ $[M+Na]^+$: 361.1806; found: 361.1810.

Preparation of enone S11

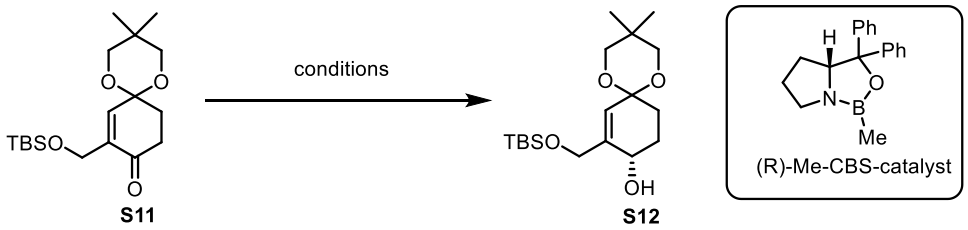


In a nitrogen-filled glovebox, a clean autoclave was treated with ketoketal **S10** (190 g, 562 mmol, 1.0 equiv), Wilkinson's catalyst (5.20 g, 5.62 mmol, 0.01 equiv) and anhydrous PhMe (250 mL). The autoclave was sealed, removed from the glovebox, and was then evauated/refilled three times with

hydrogen gas under 20 atm pressure. The suspension was placed in preheated 40 ℃ water bath and vigorously stirred for 8 h (Note: if hydrogen gas was consumed too quickly, autoclave need to be refilled with hydrogen gas under 20 atm pressure) at which point ^{1}H-NMR analysis indicated the complete consumption of the starting material. The suspension was diluted with CH_2Cl_2, filtered through a short pad of celite, and concentrated *in vacuo*. Purification of crude residue by SiO_2 flash chromatography (eluent: EtOAc/hexanes = 1/10) yielded enone **S11** as a white solid (184 g, 96%).

***R*$_f$** = 0.42 (silica gel, 5:1 hexanes:EtOAc); ^{1}H NMR (500 MHz, Chloroform-*d*) δ 7.26 (tt, *J* = 2.1, 1.0 Hz, 1H), 4.29 (d, *J* = 2.2 Hz, 2H), 3.63 (d, *J* = 11.5 Hz, 2H), 3.44 (d, *J* = 11.9 Hz, 2H), 2.51 (dd, *J* = 7.1, 6.0 Hz, 2H), 2.17 (ddd, *J* = 7.3, 6.0, 1.0 Hz, 2H). 1.07 (s, 3H), 0.83 (s, 9H), 0.83 (s, 3H), 0.02 (s, 6H); ^{13}C NMR (126 MHz, Chloroform-d): δ 198.5, 139.3, 136.9, 94.3, 71.1, 59.5, 34.6, 33.5, 30.2, 25.9, 22.8, 22.4, 18.3, -5.4; HRMS (ESI) calcd.for $C_{18}H_{32}O_4SiNa$ $[M+Na]^+$: 363.1962; found: 363.1965.

Preparation of enantioenriched alcohol S12

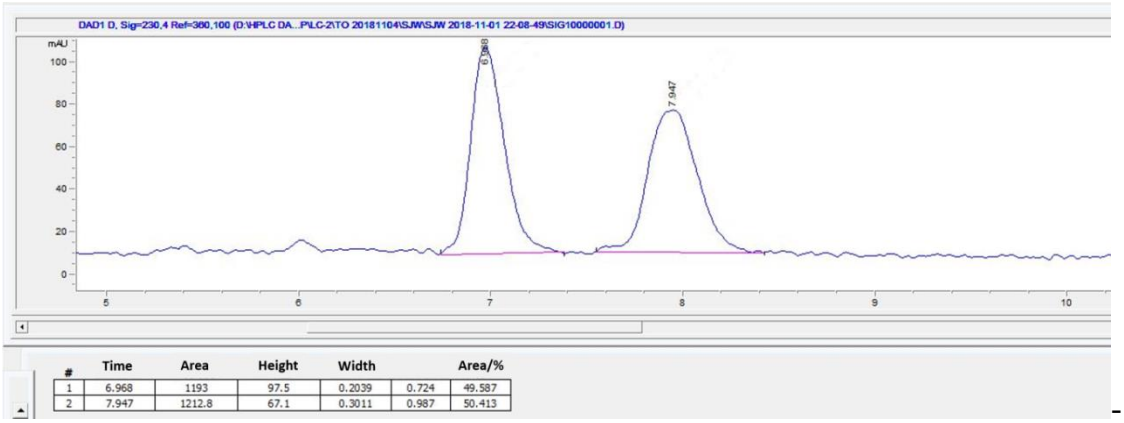


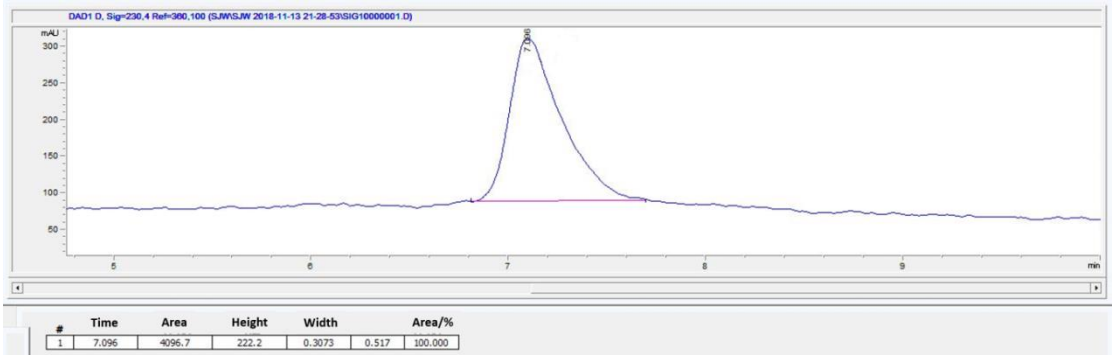
Entry	***Conditions***	***Results***	***Ee***
1	CBS catalyst, BH_3 (1.0 M in THF), THF, 0 ℃, 30 min	< 5%	-
2	CBS catalyst, BH_3 (1.0 M in THF), THF, -78 ℃, 30 min	SM	-
3	CBS catalyst, catecholborane, PhMe, -78℃ to rt, 30 min	66%	91%
4	CBS catalyst, catecholborane, PhMe, rt, 20 min	50%	71%
5	CBS catalyst, BH_3(10 M in Me_2S), THF, 0 ℃, 20 min	92%	>99%

An oven-dried, 250 mL round-bottomed flask was treated with enone **S11** (5.78 g, 17.0 mmol, 1.0 equiv), (R)-Me-CBS-oxazaborolidine (3.39 mL, 1.0 M in Toluene, 3.4 mmol, 0.2 equiv) and anhydrous THF (50 mL). The reaction was cooled to 0 ℃ via ice/water bath. After 15 min of continued stirring at 0 ℃, $BH_3 \cdot SMe_2$ (1.86 mL, 10.0 M in Me_2S, 18.7 mmol, 1.1 equiv) in anhydrous THF (10 mL) was added dropwise via syringe. Upon complete addition, the reaction was continued

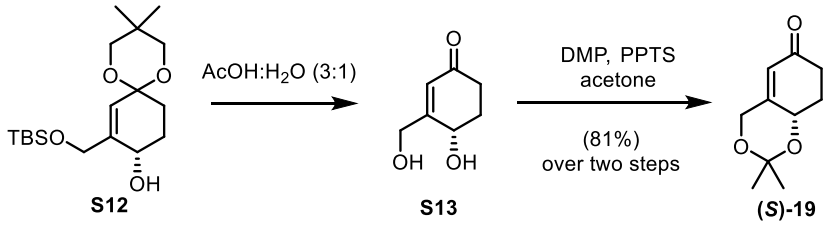
at 0 ℃ for 20 min at which point TLC analysis indicated the complete consumption of starting material and quenched with carefully addition of MeOH (5 mL) followed by H_2O (10 mL). The layers were separated and aqueous layer was extracted with EtOAc (3 × 20 mL) and the combined layers were washed with brine (30 mL), dried over Na_2SO_4, filtered and concentration *in vacu*o. The crude residue was purified via SiO_2 flash chromatography (eluent: EtOAc/hexanes = 1/5) to give enantioenriched alcohol **S12** (5.3 g, 92% yield, >99% ee) as a white solid.

Enantiomeric excess was determined by HPLC, OD-H, n-hexane/isopropanol 95/5 isocratic, 23 ^{o}C, 1.0 mL/min, 6.97 min (*S*), 7.95 min (*R*); $\boldsymbol{R_f}$ = 0.47 (silica gel, 3:1 hexanes:EtOAc); Optical rotation: $[\alpha]_D^{25}$ = -18.2 (c = 1.01, $CHCl_3$]; ^{1}H NMR (500 MHz, Chloroform-*d*): δ 6.08 (s, 1H), 4.34 (dd, *J*=12.9, 1.4 Hz, 1H), 4.23 (dd, *J*=13.0, 1.3 Hz, 1H), 4.23 (d, *J*=5.1 Hz, 1H), 3.65-3.46 (m, 4H), 2.77 (d, *J* = 3.8 Hz, -OH), 2.07 (ddd, *J* = 12.8, 9.8, 2.9 Hz, 1H), 1.99 (dddd, *J* = 12.6, 9.5, 6.0, 3.5 Hz, 1H), 1.96-1.89 (m, 1H). 1.82 (dddd, *J* = 13.1, 7.9, 5.2, 2.8 Hz, 1H), 1.01 (s, 3H), 0.96 (s, 3H), 0.91 (s, 9H), 0.10 (d, *J* = 2.9 Hz, 6H); ^{13}C NMR (126 MHz, Chloroform-d): δ 142.4, 122.4, 95.4, 70.8, 70.7, 66.9, 66.2, 30.3, 28.5, 28.4, 26.0, 22.9, 22.7, 18.3, -5.3, -5.3; HRMS (ESI) calcd.for $C_{18}H_{34}O_4SiNa$ $[M+Na]^+$: 365.2119; found: 365.2122.





Preparation of acetonide (*S*)-19

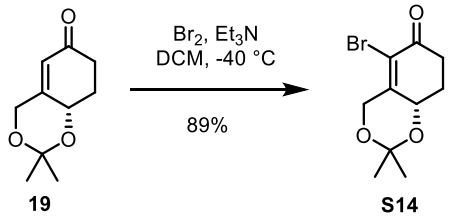


An oven-dried, 500 mL round-bottomed flask was treated with enantioenriched alcohol **S12** (55.0 g, 0.160 mmol, 1.0 equiv) and 200 mL AcOH/water (3:1). The reaction mixture was placed in a preheated oil bath at 50 ℃ and stirred for 10 hours at which point TLC analysis indicated the complete consumption of starting material. The reaction was cooled to ambient temperature and concentrated *in vacuo*. The crude residue was purified via SiO_2 flash chromatography (eluent: CH_2Cl_2/MeOH = 20/1) to give diol **S13** (21.0 g, 92% yield) as a colorless oil.

An oven-dried, 1.0 L round-bottomed flask was treated with diol **S13** (22.7 g, 160 mmol, 1.0 equiv), 2,2-dimethoxy-propane (400 mL) and 400 mL acetone. After 10 min of continued stirring, pyridinium 4-toluenesulfonate (PPTS) (3.25 g, 12.8 mmol, 0.08 equiv) was added in one portion. The reaction mixture was vigorously stirred for 4 h at ambient temperature at which point TLC analysis indicated the complete consumption of starting material. The reaction was quenched with the addition of *sat.* aq. $NaHCO_3$ (100 ml) and concentrated *in vacuo*. The residue was diluted with EtOAc (400 mL) and the layers were separated. Aqueous layer was extracted with EtOAc (3 × 200 mL) and the combined layers were washed with brine (100 mL), dried over Na_2SO_4, filtered and concentration *in vacu*o. The crude residue was purified via SiO_2 flash chromatography (eluent: EtOAc/hexanes = 30/1) to give acetonide (*S*)-**19** (25.9 g, 89% yield) as a white solid.

$\boldsymbol{R_f}$ = 0.37 (silica gel, 2:1 hexanes:EtOAc); Optical rotation: $[\alpha]_D^{25}$ = -69.5 (c = 1.04, $CHCl_3$); ^{1}H NMR (500 MHz, Chloroform-*d*) δ 5.76 (q, *J* = 1.6 Hz, 1H), 4.65 (ddt, *J* = 10.8, 5.2, 1.7 Hz, 1H), 4.50 (dt, *J*=16.3, 1.5 Hz, 1H), 4.41 (dt, *J*=16.3, 1.8 Hz, 1H), 2.57 (dddd, *J* = 16.9, 4.1, 2.7, 1.2 Hz, 1H), 2.37 (ddd, *J* = 16.9, 14.9, 4.8 Hz, 1H), 2.28 (dtd, *J* = 12.7, 5.0, 2.6 Hz, 1H), 1.98 (dddd, *J* = 15.1, 12.5, 10.8, 4.4 Hz, 1H), 1.52 (s, 3H), 1.43 (s, 3H); ^{13}C NMR (126 MHz, Chloroform-*d*) δ 197.5, 160.6, 121.9, 100.1, 66.6, 61.7, 35.9, 29.4, 26.2, 21.9; HRMS (ESI) calcd.for $C_{10}H_{14}O_3Na$ $[M+Na]^+$: 205.0835; found: 205.0838.

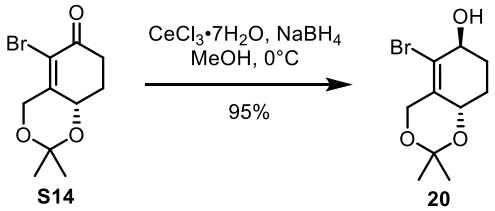
Preparation of α,β-Unsaturated enone S14



An oven-dried, 250 mL round-bottomed flask was treated with acetonide (*S*)-**19** (10.0 g, 54.9 mmol, 1.0 equiv) and 109 mL CH_2Cl_2. The reaction was cooled to -40 ℃ via an ice/MeCN bath and stirring was continued at this temperature for 15 min prior to the addition dropwise of Br_2 (2.8 mL, 54.9 mmol, 1.0 equiv) via syringe. The reaction was continued for 30 min at -40 ℃ at which point TLC indicated the complete consumption of starting material. Et_3N (7.6 mL, 54.9 mmol, 1.0 equiv) was added dropwise via syringe. The reaction was warmed to ambient temperature over 10 min and quenched with addition of *sat.* aq. $NaHCO_3$ (20 mL). The layers were separated and the aqueous layer was extracted with CH_2Cl_2 (3 × 30 mL). The combined layers were washed with brine (30 mL), dried over Na_2SO_4, filtered and concentrated *in vacuo* to give crude residue. The crude residue was purified via SiO_2 flash chromatography (eluent: EtOAc/hexanes = 1/5) to give α,β-Unsaturated enone **S14** (12.7 g, 89 % yield) as a colorless oil. [Note: α,β-Unsaturated enone **S14** is not stable to storage and was used immediately upon isolation].

$\boldsymbol{R_f}$ = 0.61 (silica gel, 2:1 hexanes:EtOAc); Optical rotation: $[\alpha]_D^{25}$ = -103.2 (c = 1.00, $CHCl_3$); ^{1}H NMR (500 MHz, Chloroform-*d*) δ = 4.61 (dd, *J* =10.8, 5.2, 1H), 4.54 (dd, *J* =18.0, 1.2, 1H), 4.47 (dd, *J* =18.0, 2.3, 1H), 2.81 (ddd, *J* =16.9, 4.3, 2.8, 1H), 2.50 (ddd, *J* =16.9, 15.1, 4.7, 1H), 2.32 (dtd, *J* =12.7, 5.1, 2.8, 1H), 1.98 (dddd, *J* =15.1, 12.8, 10.8, 4.3, 1H), 1.47 (s, 3H), 1.42 (s, 3H); ^{13}C NMR (126 MHz, Chloroform-*d*) δ = 189.2, 161.9, 117.8, 100.9, 68.0, 62.9, 35.3, 29.1, 24.3, 24.1; HRMS (ESI) calcd.for $C_{10}H_{13}O_3BrNa$ $[M+Na]^+$: 282.9940; found: 282.9939.

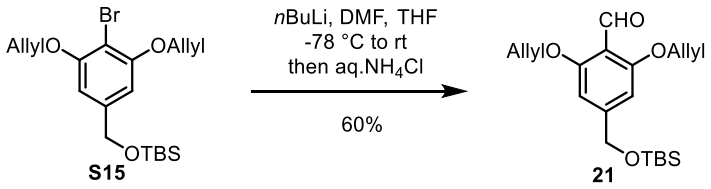
Preparation of vinyl bromide 20



An oven-dried, 250 mL round-bottomed flask was treated with α,β-Unsaturated enone **S14** (13.2 g, 50.8 mmol, 1.0 equiv), $CeCl_3 \cdot 7H_2O$ (18.9 g, 50.8 mmol, 1.0 equiv) and 109 mL MeOH. The reaction was cooled to 0 ℃ via an ice/water bath and stirring was continued at this temperature for 15 min prior to the addition of $NaBH_4$ (1.92 g, 50.8 mmol, 1.0 equiv) in portions. The reaction was continued for 10 min at 0 ℃ at which point TLC indicated the complete consumption of starting material. The reaction was concentrated *in vacuo*. EtOAc (3 × 50 mL) was added and organic layer was washed by water (3 × 30 mL) and brine (30 mL), dried over Na_2SO_4, filtered and concentrated *in vacu*o. The crude residue was purified via SiO_2 flash chromatography (eluent: EtOAc/hexanes = 1/3) to give vinyl bromide **20** (12.6 g, 95 % yield) as a colorless oil.

***R*$_f$** = 0.40 (silica gel, 2:1 hexanes:EtOAc); Optical rotation: $[\alpha]_D^{25}$ = -73.1 (c = 1.03, $CHCl_3$); ^{1}H NMR (500 MHz, Chloroform-*d*) δ = 4.42-4.37 (m, 1H), 4.37 (d, *J* =15.6, 1H), 4.31 (d, *J* =15.6, 1H), 4.31-4.26 (m, 1H), 2.39-2.28 (m, 1H), 2.11-2.03 (m, 1H), 1.66-1.54 (m, 1H) (m, 2H), 1.44 (s, 3H), 1.38 (s, 3H); ^{13}C NMR (126 MHz, Chloroform-*d*) δ = 138.2, 122.1, 100.0, 70.2, 67.9, 62.4, 29.9, 27.4, 25.2, 23.2; HRMS (EI) calcd.for $C_{10}H_{15}O_3Br$ $[M]^+$: 262.0205; found: 262.0204.

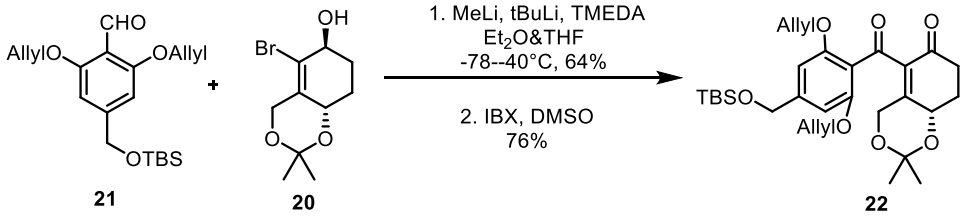
Preparation of aldehyde 21



An oven-dried, 500 mL round-bottomed flask was treated with aryl bromide **S15** (22.0 g, 53.3 mmol, 1.0 equiv) THF (200 mL). The reaction was cooled to -78 ℃ via dry ice/acetone bath, then treated with *n*BuLi (23.5 mL, 2.5 M in Toluene, 58.6 mmol, 1.1 equiv) dropwise via syringe. Upon complete addition, the reaction was stirred for 15 min at -78 ℃ at which point TLC analysis indicated the complete consumption of starting material. A solution of *N,N*-Dimethylformamide (5.8 g, 80.0 mmol, 1.5 equiv) in THF (20 mL) was added dropwise via syringe. The resulting solution was stirred at -78 ℃ for 15 min and allowed to warm up to ambient temperature. The reaction was quenched with *sat.* aq. NH_4Cl (25 mL) and the layers were separated. The aqueous layer was extracted with EtOAc (3×50 mL). The combined layers were washed with brine (50 mL), dried over Na_2SO_4, filtered and concentration *in vacu*o. The crude residue was purified via via SiO_2 flash chromatography (eluent: EtOAc/hexanes = 1/5) to give aldehyde **21** (11.0 g, 60% yield) as a pale yellow oil.

***R*$_f$** = 0.68 (silica gel, 3:1 hexanes:EtOAc); ^{1}H NMR (500 MHz, Chloroform-*d*) δ = 10.54 (s, 1H), 6.54 (s, 2H), 6.05 (ddt, *J* =17.3, 10.3, 4.9, 2H), 5.49 (dd, *J* =17.3, 1.6, 2H), 5.30 (dd, *J* =10.6, 1.5, 2H), 4.70 (s, 2H), 4.64-4.60 (m, 4H), 0.96 (s, 9H), 0.11 (s, 6H); ^{13}C NMR (126 MHz, Chloroform-*d*) δ = 188.9, 161.4, 150.5, 132.6, 117.9, 113.8, 102.4, 69.5, 64.8, 26.0, 18.5, -5.1; HRMS (ESI) calcd.for $C_{20}H_{31}O_4Si$ $[M+H]^+$: 363.1986; found: 363.1994.

Preparation of diketone 22



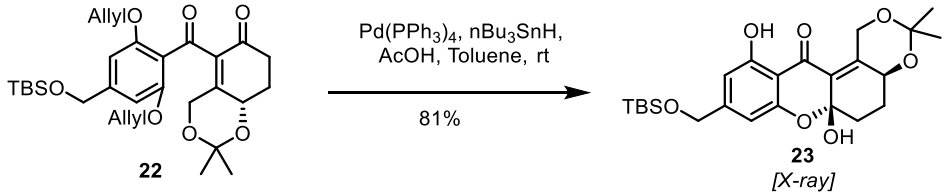
An oven-dried, 250 mL round-bottomed flask was treated with vinyl bromide **20** (4.0 g, 15.2 mmol, 1.0 equiv), *N*,*N*,*N'*,*N'*-Tetramethylethane-1,2-diamine (TMEDA) (9.2 mL, 61.0 mmol, 4.0 equiv) and Et_2O (100 mL). The reaction was cooled to -78 ℃ via dry ice/acetone bath, then treated with MeLi (12.9 mL, 1.3 M in Et_2O mmol, 1.1 equiv) dropwise via syringe. Upon complete addition, the reaction was stirred for 15 min at -78 ℃ and then transferred via cannula to a solution of *t*BuLi (21.0 mL, 1.6 M in Et_2O mmol, 33.4 mmol 1.5 equiv) in Et_2O (50 mL). After 5 min of continued stirred at -78 ℃ at which point TLC analysis indicated the complete consumption of starting material. A solution of aldehyde **21** (6.60 g, 18.2 mmol, 1.2 equiv) in THF (20 mL) was added dropwise via syringe. The resulting solution was stirred at -78 ℃ for 10 min. The reaction was quenched with *sat.* aq. NH_4Cl (50 mL) and the warmed to ambient temperature and diluted with Et_2O (50 mL). The layers were separated and the aqueous layer was extracted with EtOAc (3×50 mL). The combined layers were washed with brine (50 mL), dried over Na_2SO_4, filtered and concentration *in vacu*o. The crude residue was purified via via SiO_2 flash chromatography (eluent: EtOAc/hexanes = 5/1) to give diol (5.30 g, 64% yield) as a pale yellow oil.

An oven-dried, 100 mL round-bottomed flask was treated with diol (5.20 g, 9.50 mmol, 1.0 equiv) and DMSO (30 mL). A solution of IBX (5.80 g, 20.9 mmol, 2.2 equiv) was added. The resulting solution was stirred at ambient temperature for 1 h at which point TLC analysis indicated the complete consumption of starting material. The reaction was quenched with *sat.* aq. $NaHCO_3$ (20 mL). The mixture was extracted with EtOAc (3×40 mL) and the combined layers were washed with brine (50 mL), dried over Na_2SO_4, filtered and concentration *in vacu*o. The crude residue was purified via via SiO_2 flash chromatography (eluent: EtOAc/hexanes = 1/10) to give diketone **22** (3.9

g, 76% yield) as a yellow oil.

***R**_f* = 0.55 (silica gel, 5:1 hexanes:EtOAc); Optical rotation: $[\alpha]_D^{25}$ = -64.8 (c = 1.0, $CHCl_3$); ^{1}H NMR (500 MHz, Chloroform-*d*) δ = 6.49 (s, 2H), 5.97 (ddt, *J* =17.2, 10.4, 5.1, 2H), 5.35 (dd, *J* =17.3, 1.6, 2H), 5.24 (dd, *J* =10.6, 1.5, 2H), 4.73 (dd, *J* =2.9, 1.7, 2H), 4.67 (s, 2H), 4.62 (ddt, *J* =11.1, 5.3, 1.6, 1H), 4.50 (dd, *J* =7.2, 5.3, 4H), 2.51 (ddd, *J* =16.3, 4.3, 2.9, 1H), 2.39 (ddd, *J* =16.3, 14.9, 4.7, 1H), 2.25 (dtd, *J* =12.7, 4.9, 2.9, 1H), 1.96 (dddd, *J*=15.2, 12.5, 11.1, 4.3, 1H), 1.47 (s, 3H), 1.42 (s, 3H), 0.94 (s, 9H), 0.09 (s, 6H); ^{13}C NMR (126 MHz, Chloroform-*d*) δ = 194.2, 192.3, 166.1, 157.2, 146.0, 133.8, 132.9, 117.4, 102.8, 100.5, 69.4, 66.6, 64.6, 61.2, 36.5, 28.6, 25.9, 24.0, 24.0, 18.3, 14.2, -5.3; HRMS (ESI) calcd.for $C_{30}H_{42}O_7SiNa$ $[M+Na]^+$: 565.2592; found: 565.2594.

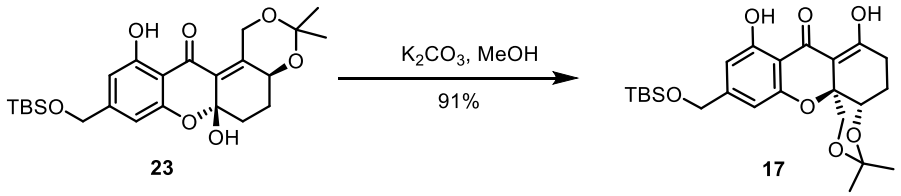
Preparation of hemiketal 23



An oven-dried, 150 mL round-bottomed flask was treated with diketone **22** (3.89 g, 7.2 mmol, 1.0 equiv) and PhMe (30 mL) at ambient temperature. AcOH (950 mg, 15.8 mmol, 2.2 equiv), *n*Bu_3SnH (4.59 g, 15.8 mmol, 2.2 equiv) and $Pd(PPh_3)_4$ (0.41 g, 0.36 mmol, 0.05 equiv) was sequentially added. The resulting solution was stirred at ambient temperature for 20 min. The reaction mixture was quenched with brine (30 mL). The mixture was extracted with EtOAc (3 × 50 mL), filtered and concentration *in vacu*o. The crude residue was purified via SiO_2 flash chromatography (eluent: EtOAc/hexanes = 1/15) to give hemiketal **23** (2.69 g, 81% yield) as a yellow solid.

***R**_f* = 0.30 (silica gel, 5:1 hexanes:EtOAc); Optical rotation: $[\alpha]_D^{25}$ = -200.3 (c = 0.56, $CHCl_3$); ^{1}H NMR (500 MHz, DMSO-d6): δ 11.23 (s, 1H), 6.45 (s, 1H), 5.62 (d, *J* = 1.3 Hz, 1H), 5.56 (d, *J* = 1.3 Hz, 1H), 3.90 (d, *J* = 1.7 Hz, 2H), 3.83 (s, 2H), 3.74 (dd, *J* = 10.9, 5.9 Hz, 1H), 1.41 (dt, *J* = 13.2, 3.5 Hz, 1H), 1.30 (td, *J* = 13.8, 13.3, 2.8 Hz, 1H), 1.21-1.14 (m, 1H), 0.93-0.82 (m, 1H), 0.54 (s, 3H), 0.51 (s, 3H), 0.09 (s, 9H), -0.74 (d, *J* = 1.2 Hz, 6H); ^{13}C NMR (126 MHz, DMSO-d6): δ 186.9, 161.9, 157.8, 157.5, 153.1, 124.0, 107.3, 105.9, 104.9, 100.4, 98.4, 66.3, 63.7, 61.7, 33.5, 25.9, 25.0, 24.6, 23.4, 18.1, -5.3. HRMS (ESI) calcd.for $C_{24}H_{34}O_7SiNa$ $[M+Na]^+$: 485.1966; found: 485.1970.

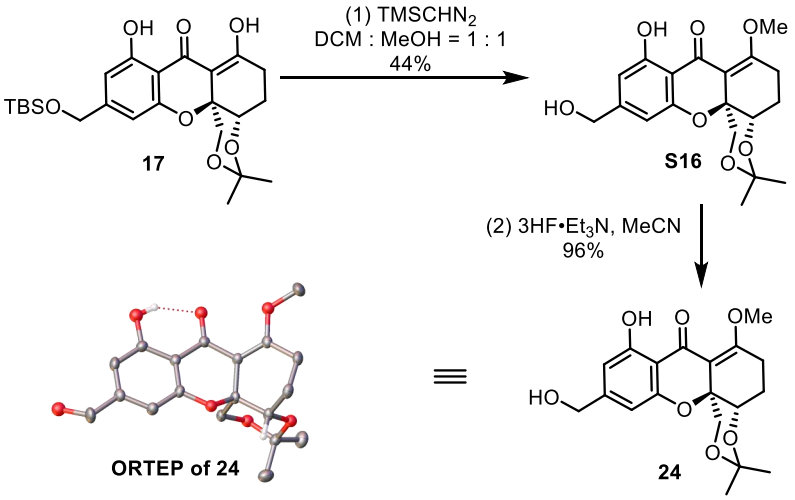
Preparation of tricyclic enol 17



An oven-dried, 250 mL round-bottomed flask was treated with hemiketal **23** (2.67 g, 5.58 mmol, 1.0 equiv), K_2CO_3 (5.0 g, 36.0 mmol, 5.0 equiv) and 50 mL MeOH. The reaction mixture was vigorously stirred for 2 hours at which point TLC indicated the complete consumption of starting material then immediately diluted with EtOAc (60 mL) and water (15 mL). The reaction was neutralized with 10 w% AcOH until no CO_2 was evolved and the layers were separated. The aqueous layer was extracted with EtOAc (3×40 mL) and the combined layers were washed with brine (40 mL), dried over Na_2SO_4, filtered and concentration *in vacu*o. The crude residue was purified via SiO_2 flash chromatography (eluent: EtOAc/hexanes = 1/25) to give tricycli enol **17** (2.4 g, 91% yield) as a brown oil.

$\boldsymbol{R_f}$ = 0.53 (silica gel, 5:1 hexanes:EtOAc); Optical rotation: $[\alpha]_D^{25}$ = -23.9 (c = 1.03, $CHCl_3$); ^{1}H NMR (500 MHz, Chloroform-*d*) δ 13.42 (s, 1H), 11.41 (s, 1H), 6.51 (dd, *J* = 1.5, 0.7 Hz, 1H), 6.46 (dt, *J* = 1.6, 0.8 Hz, 1H), 4.65-4.61 (m, 2H), 4.32 (t, *J* = 3.1 Hz, 1H), 3.90 (d, *J* = 12.7 Hz, 1H), 3.40 (d, *J* = 12.7 Hz, 1H), 2.68 (ddd, *J* = 17.5, 12.9, 4.5 Hz, 1H), 2.26 (dddd, *J* = 17.6, 3.4, 2.3, 1.2 Hz, 1H), 2.04 (ddt, *J* = 13.8, 4.7, 2.4 Hz, 1H), 1.91 (tt, *J* = 13.5, 3.9 Hz, 1H), 1.50 (s, 3H), 1.31 (s, 3H), 0.94 (s, 9H), 0.10 (s, 6H); ^{13}C NMR (126 MHz, Chloroform-*d*): δ 187.5, 178.0, 162.3, 157.8, 153.4, 106.9, 106.1, 106.1, 102.6, 100.7, 80.6, 69.8, 65.6, 64.6, 26.1, 25.4, 25.2, 24.9, 23.5, 18.6, -5.2; HRMS (ESI) calcd.for $C_{24}H_{34}O_7SiNa$ $[M+Na]^+$: 485.1966; found: 485.1965.

Preparation of derivative 24



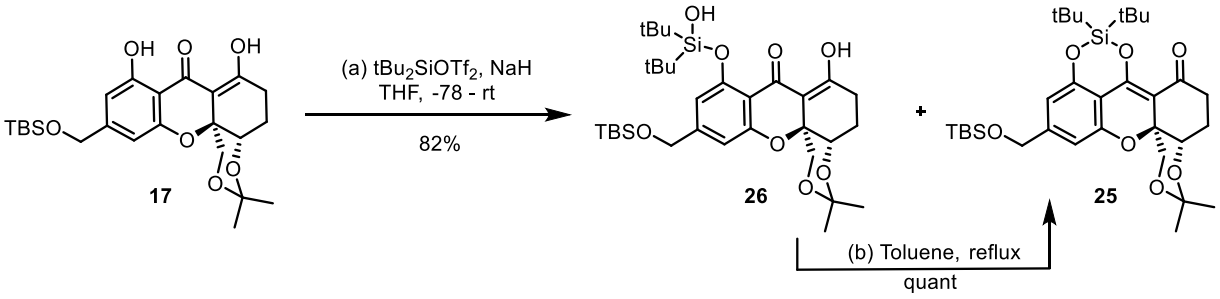
An oven-dried, 100 mL round-bottomed flask was treated with enol **17** (1.00 g, 2.16 mmol, 1.0 equiv), and anhydrous 20 mL CH_2Cl_2/MeOH (1:1) under a N_2 atmosphere. The resulting solution was cooled to 0 ℃ via an ice/water bath and stirring was continued at this temperature for 15 min prior to the addition of $TMSCHN_2$ (5.41 mL, 2 mol/L in hexane, 10.8 mmol, 5.0 equiv) via syringe. The reaction was warmed to ambient temperature and stirred for 15 min and quenched with 10 w% aqueous AcOH solution. The reaction was extracted twice with 30 mL of EtOAc. The combined layers were washed with brine (50 mL), dried over Na_2SO_4, filtered and concentrated *in vacuo*. The crude residue was purified via SiO_2 flash chromatography (eluent: EtOAc/hexanes = 1/10) to give enol methyl ether **S16** (450 mg, 44% yield) as a yellow foamy solid.

An oven-dried, 100 mL round-bottomed flask was treated with enol methyl ether **S16** (344 mg, 0.722 mmol, 1.0 equiv) and MeCN (20 ml). The resulting solution was treated with 3HF Et$_3$N(0.20 mL, 1.08 mmol 1.5 equiv) via syringe and submerged in preheated oil bath at 50 ^{o}C. The reaction was left to stir at this temperature for 10 h and TLC analysis indicated the complete consumption of starting material. The reaction was cooled to ambient temperature the quenched with the carefully addition of sat. aq. $NaHCO_3$ (5 ml). EtOAc (10 mL) and the layers were separated. The aqueous layer was extracted with EtOAc (3×10 mL) and the combined layers were washed with brine (50 mL), dried over Na_2SO_4, filtered and concentration *in vacuo*. The crude residue was purified via preparative TLC (eluent: EtOAc/hexanes = 1/5) to give derivative **24** (250 mg, 96% yield) as a yellow solid. Derivative **25** was crystallized from $CHCl_2$/MeOH for single crystal X-ray analysis.

$\boldsymbol{R_f}$ = 0.24 (silica gel, 1:1 hexanes:EtOAc); Optical rotation:$[\alpha]_D^{25}$ = 0.37 (c = 0.63, $CHCl_3$); ^{1}H

NMR (500 MHz, Chloroform-*d*): δ 12.65 (s, 1H), 6.45 (s, 1H), 6.44 (s, 1H), 4.58 (s, 2H), 4.25 (t, *J* = 3.0 Hz, 1H), 3.93 (s, 3H). 3.93 (d, *J*=12.8, 1H), 3.56 (d, *J* = 12.8 Hz, 1H), 2.67-2.49 (m, 2H), 2.10 (ddt, *J* = 13.9, 5.0, 2.6 Hz, 1H), 2.00-1.89 (m, 1H), 1.47 (s, 3H), 1.28 (s, 3H); ^{13}C NMR (126 MHz, Chloroform-d): δ 186.3, 168.1, 163.1, 157.7, 151.4, 108.1, 107.1, 106.2, 105.6, 100.8, 81.0, 68.7, 66.0, 64.7, 56.1, 24.6, 24.3, 23.3, 21.1; HRMS (ESI) calcd.for $C_{19}H_{23}O_7$ $[M+H]^+$: 363.1438; found: 363.1445.

Preparation of silanol 26 and di-tert-butylsiylene (DTBS) ether 25



(**a**) An oven-dried, 150 mL round-bottomed flask was treated with enol **17** (2.7 g, 5.85 mmol, 1.0 equiv) and anhydrous THF (30 mL). The resulting solution was cooled to 0 ℃ via ice/water bath and stirring was continued at this temperature for 10 min prior to the addition of NaH (699 mg, 29.2 mmol, 5.0 equiv) in several portions. After 15 min of continued stirring at 0 ℃, The solution was cooled to -78 ℃ via a dry ice/acetone bath and stirring continued for 15 min prior to the dropwise addition of tBu_2SiOTf_2 (2.57 g, 5.85 mmol, 1.0 equiv) in THF (6.0 mL) via syringe. Upon complete addition, the reaction mixture was stirred an additional 1 hours at -78 ℃. The reaction was slowly warmed to ambient temperature over 50 min and the reaction was continued at ambient temperature until TLC analysis indicated the complete consumption of starting material. The reaction was carefully quenched with the addition of *sat.* aq. $NHCl_4$ (10 mL) and diluted with CH_2Cl_2 (20 mL). The layers were separated and the aqueous layer was extracted with CH_2Cl_2 (3 × 15 mL). The combined layers were washed with brine (20 mL), dried over Na_2SO_4, filtered and concentrated *in vacuo*. The crude residue was purified via SiO_2 flash chromatography (eluent: EtOAc/hexanes = 1/25) to give silanol **26** (2.97 g, 82% yield. **26**:**25**=4:1) as a yellow foamy solid. Silanol **26** exists as a mixture of two inseparable compounds (**26**:**25**=4:1).

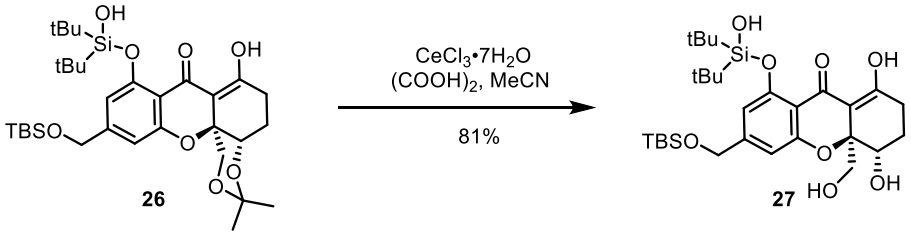
(**b**) An oven-dried, 150 mL round-bottomed flask was treated with compound **26** (3.0 g, 4.84 mmol, 1.0 equiv) and anhydrous PhMe (50 mL). The resulting solution was heated to reflux and remove water by Dean-Stark trap for 3 h. The reaction was cooled to ambient temperature and

immediately concentrated *in vacuo* to give di-tert-butylsiylene (DTBS) ether **25** as a yellow foamy solid.

(**silanol 26**): $\boldsymbol{R_f}$ = 0.58 (silica gel, 5:1 hexanes:EtOAc); Optical rotation: $[\alpha]_D^{25}$ = 13.2 (c = 1.04, $CHCl_3$); ^{1}H NMR (500 MHz, Chloroform-*d*) δ 15.45 (s, 1H), 6.71 (s, 1H), 6.56 (s, 1H), 4.62 (dd, *J* = 3.8, 1.0 Hz, 2H), 4.33-4.27 (m, 1H), 3.86 (d, *J* = 12.9 Hz, 1H), 3.72 (s, 1H), 3.40 (d, *J* = 12.9 Hz, 1H), 2.66 (ddd, *J* = 17.6, 13.2, 4.6 Hz, 1H), 2.30-2.19 (m, 1H), 2.05-1.99 (m, 1H), 1.94 (tt, *J* = 13.7, 3.7 Hz, 1H), 1.49 (s, 3H), 1.30 (s, 3H), 1.06 (s, 9H), 1.06 (s, 9H), 0.93 (s, 9H), 0.09 (s, 6H). ^{13}C NMR (126 MHz, Chloroform-*d*) δ 185.4, 180.5, 158.4, 156.7, 150.9, 112.4, 110.9, 108.6, 103.1, 100.6, 80.0, 69.9, 64.5, 64.2, 27.5, 27.4, 26.0, 25.3, 24.9, 23.6, 21.0, 21.0, 18.5, -5.2; HRMS (ESI) calcd.for $C_{32}H_{52}O_8Si_2Na$ $[M+Na]^+$: 643.3093; found: 643.3092.

(**DTBS ether 25**): $\boldsymbol{R_f}$ = 0.58 (silica gel, 5:1 hexanes:EtOAc); Optical rotation: $[\alpha]_D^{25}$ = 67.8 (c = 1.00, $CHCl_3$); ^{1}H NMR (500 MHz, Chloroform-*d*): δ 6.57 (s, 1H), 6.51 (s, 1H), 4.62 (d, *J* = 2.7 Hz, 2H), 4.32 (s, 1H), 3.77 (d, *J* = 13.0 Hz, 1H), 3.37 (d, *J* = 13.0 Hz, 1H), 2.59 (ddd, *J* = 18.2, 14.1, 4.6 Hz, 1H), 2.31–2.15 (m, 2H), 2.03 (d, *J* = 13.9 Hz, 1H), 1.50 (s, 3H), 1.30 (s, 3H), 1.15 (s, 9H), 1.05 (s, 9H), 0.95 (s, 9H), 0.11 (s, 6H); ^{13}C NMR (126 MHz, Chloroform-*d*): δ 196.3, 154.1, 154.0, 151.9, 148.7, 129.1, 128.3, 125.4, 109.3, 107.7, 106.5, 104.8, 100.7, 82.4, 70.4, 64.6, 63.6, 33.6, 27.5, 26.3, 26.1, 26.1, 25.0, 24.8, 23.7, 21.8, 20.9, 18.6, -5.2, -5.2. HRMS (ESI) calcd.for $C_{32}H_{51}O_7Si_2$ $[M+H]^+$: 603.3168; found: 603.3173.

Preparation of tricyclic alcohol 27

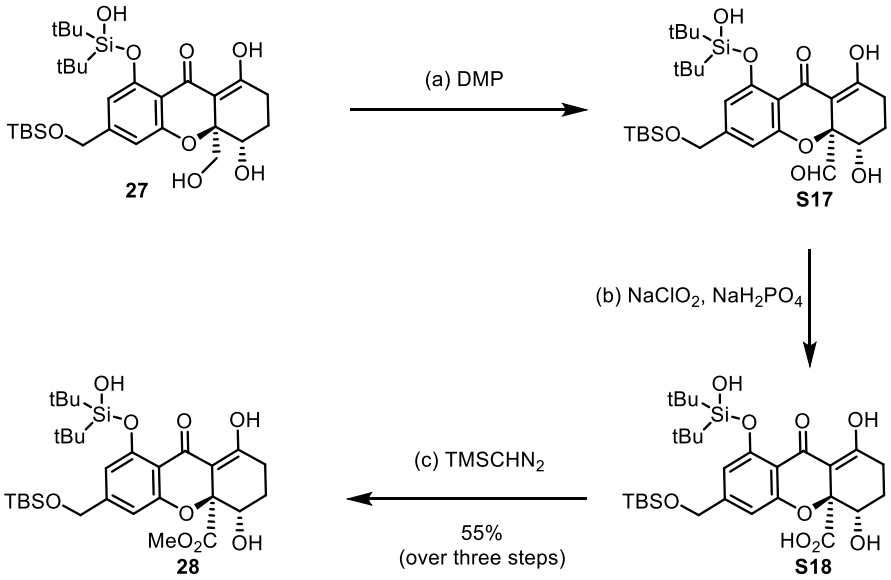


An oven-dried, 150 mL round-bottomed flask was treated with silanol **26** (3.6 g, 6.12 mmol, 1.0 equiv), $CeCl_3 \cdot 7H_2O$ (6.84 g, 18.4 mmol, 3.0 equiv), $(COOH)_2$ (27.6 mg, 0.306 mmol, 0.05 equiv) and MeCN (50 mL). The reaction mixture was vigorously stirred for 5 hours and quenched with the addition of *sat.* aq. $NaHCO_3$ (10 mL). EtOAc (20 mL) was added and the layers were separated. The aqueous layer was extracted with EtOAc (3 × 20 mL). The combined layers were washed with brine (20 mL), dried over Na_2SO_4, filtered and concentrated *in vacuo*. The crude residue was purified via SiO_2 flash chromatography (eluent: CH_2Cl_2/MeOH = 30/1) to give tricyclic **27** (2.86 g, 81% yield) as

a yellow foamy solid.

$\boldsymbol{R_f}$ = 0.28 (silica gel, 2:1 hexanes:EtOAc); Optical rotation: $[\alpha]_D^{25}$ = 6.7 (c = 1.00, $CHCl_3$); ^{1}H NMR (500 MHz, Chloroform-*d*) δ = 16.03 (s, 1H), 6.74 (s, 1H), 6.55 (s, 1H), 4.60 (s, 2H), 4.39 (s, 1H), 4.26 (d, *J* =12.1, 1H), 3.93 (dd, *J* =12.9, 7.0, 1H), 3.85 (d, *J* =13.2, 1H), 3.80 (s, 1H), 2.57-2.47 (m, 2H), 2.13-1.95 (m, 2H), 1.05 (s, 9H), 1.02 (s, 9H), 0.91 (s, 9H), 0.07 (s, 6H).; ^{13}C NMR (126 MHz, Chloroform-*d*) δ = 182.5, 181.9, 158.8, 156.7, 150.9, 112.6, 110.7, 107.8, 103.1, 79.7, 74.2, 64.2, 63.1, 27.4, 25.9, 21.0, 20.8, 18.4, -5.3; HRMS (ESI) calcd.for $C_{29}H_{48}O_8Si_2Na$ $[M+Na]^+$: 603.2780; found: 603.2772.

Preparation of tricyclic methyl ester 28



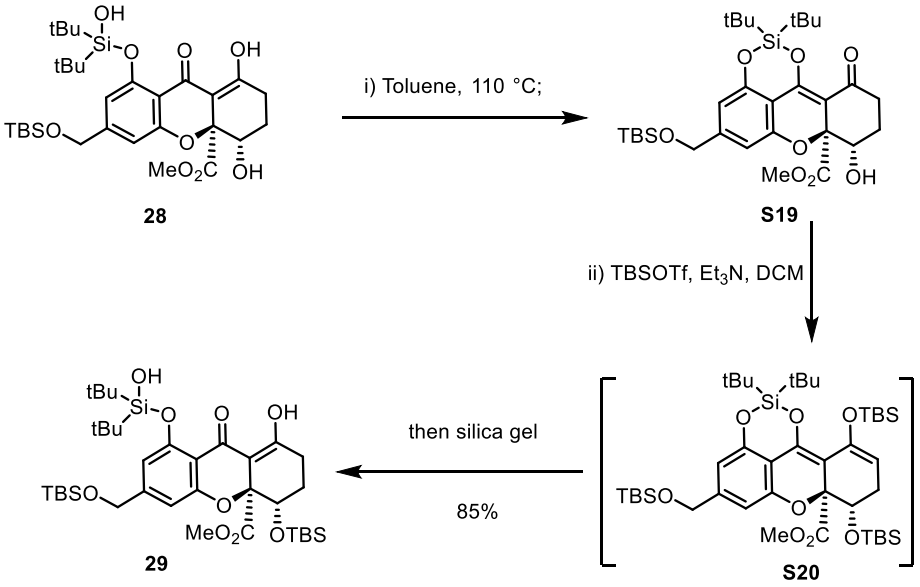
An oven-dried, 100 mL round-bottomed flask was treated with alcohol **27** (1.54 g, 2.66 mmol, 1.0 equiv) and CH_2Cl_2 (26 mL). The resulting solution was cooled to 0 ℃ via ice/water bath and stirring was continued at this temperature for 10 min prior to the addition of Dess-Martin periodinane (1.12g, 2.66 mmol, 1.0 equiv) in several portions. The reaction was continued at 0 ℃ for 3 hours. The reaction was quenched was the addition of *sat.* aq. $NaHCO_3$ (10 mL). The layers was separated and the aqueous layer was extracted with CH_2Cl_2 (3 × 15 mL) The combined layers were washed with brine (20 mL), dried over Na_2SO_4, filtered and concentrated *in vacuo*. The crude residue was purified via SiO_2 flash chromatography (eluent: EtOAc/hexanes = 1/5) to give aldehyde **S17** (1.12 g, 66% yield) as a yellow foamy solid.

An oven-dried, 100 mL round-bottomed flask was treated with aldehyde **S17** (1.46 g, 2.52 mmol, 1.0 equiv), 2-methyl-2-butene (14 mL) and *t*BuOH (26 mL). $NaClO_2$ (296 mg, 3.28 mmol, 5.0 equiv) and NaH_2PO_4 (6.06 g, 13.2 mmol, 10.0 equiv) was dissolved in 34 mL water and added to the above solution. The reaction mixture was vigorously stirred for 5 hours at which point TLC indicated the complete consumption of starting material. EtOAc (20 mL) was added and the layers were separated. The aqueous layer was extracted with EtOAc (3 × 20 mL). The combined layers were washed with brine (30 mL), dried over Na_2SO_4, filtered and concentrated *in vacuo*. The crude residue acid **S18** was used without further purification.

An oven-dried, 100 mL round-bottomed flask was treated with crude acid **S18** and anhydrous 10 mL CH_2Cl_2/MeOH(1:1) under a N_2 atmosphere. The resulting solution was cooled to 0 ℃ via an ice/water bath and stirring was continued at this temperature for 15 min prior to the addition of $TMSCHN_2$ (1.26 mL, 2.0 mol/L in hexane, 2.52 mmol, 1.0 equiv) via syringe. The reaction was warmed to ambient temperature and stirred for 15 min and quenched with 10 w% aqueous AcOH solution. The reaction was extracted twice with 30 mL of EtOAc. The combined layers were washed with brine (30 mL), dried over Na_2SO_4, filtered and concentrated *in vacu*o. The crude residue was purified via SiO_2 flash chromatography (eluent: EtOAc/hexanes = 1/5) to give methyl ester **28** (1.4 g, 83% yield, 2 steps) as a yellow foamy solid.

$\boldsymbol{R_f}$ = 0.32 (silica gel, 2:1 hexanes:EtOAc); Optical rotation: $[\alpha]_D^{25}$ = 0.2 (c = 1.00, $CHCl_3$); ^{1}H NMR (500 MHz, Chloroform-*d*) δ = 15.81 (s, 1H), 6.73 (s, 1H), 6.62 (s, 1H), 4.62 (s, 2H), 4.27 (dd, *J*=12.7, 4.5, 1H), 3.91 (s, 1H, -OH), 3.60 (s, 3H), 2.64-2.52 (m, 2H), 2.22-2.09 (m, 1H), 2.04-1.96 (m, 1H), 1.02 (s, 9H), 1.00 (s, 9H), 0.90 (s, 9H), 0.06 (s, 6H); ^{13}C NMR (126 MHz, Chloroform-*d*) δ = 183.0, 181.3, 170.4, 160.0, 156.7, 151.0, 112.8, 110.9, 107.6, 102.7, 84.5, 72.0, 64.2, 52.9, 29.2, 27.3, 27.3, 25.9, 24.2, 20.9, 20.9, 18.4, -5.3; HRMS (ESI) calcd.for $C_{30}H_{48}O_9Si_2Na$ $[M+Na]^+$: 631.2729; found: 631.2734.

Preparation of tricyclic silyl ether 29



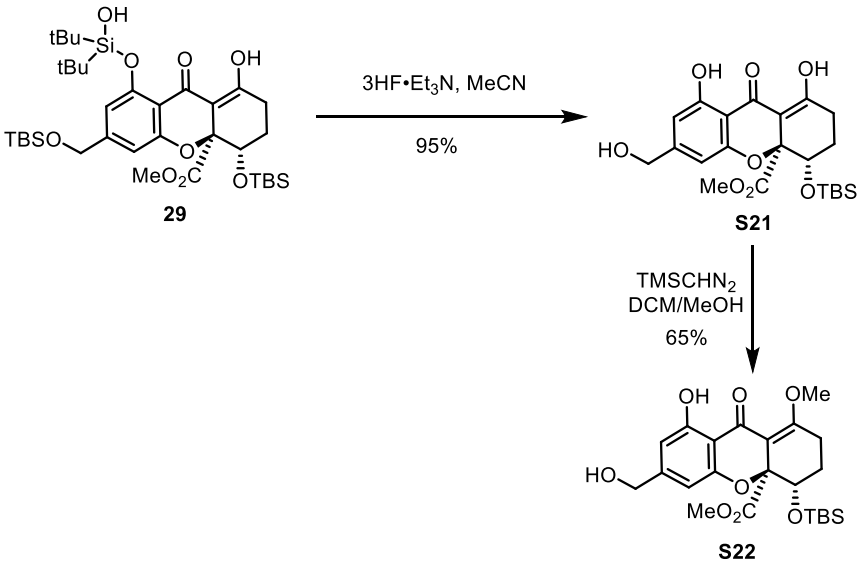
An oven-dried, 100 mL round-bottomed flask was treated with **28** (1.30 g, 2.2 mmol, 1.0 equiv) anhydrous PhMe (22 mL). The resulting solution was heated to reflux and remove water by Dean-Stark trap for 3 h. The reaction was cooled to ambient temperature and immediately concentrated *in vacuo* to give di-tert-butylsilylene (DTBS) product **S19** as a yellow solid.

An oven-dried, 100 mL round-bottomed flask was treated with di-tert-butylsilylene (DTBS) product **S19**, Et_3N (0.467 mL, 6.6 mmol, 3.0 equiv) and anhydrous CH_2Cl_2 (40 mL) under N_2 atmosphere. The resulting solution was cooled to 0 ℃ via ice/water bath and stirring was continued at this temperature for 10 min. TBSOTf (1.52 mL, 6.6 mmol, 3.0 equiv) was added dropwise via syringe. The reaction was continued at 0 ℃ for 15 min at which point TLC indicated the complete consumption of starting material. The reaction was quenched was the addition of *sat.* aq. $NaHCO_3$ (10 mL). The layers was separated and the aqueous layer was extracted with CH_2Cl_2 (3 × 15 mL) The combined layers were washed with brine (50 mL), dried over Na_2SO_4, filtered and concentrated *in vacu*o. The crude residue **S20** was hydrolysed and purified via SiO_2 flash chromatography (eluent: EtOAc/hexanes = 1/20) to give tricyclic silyl ether **29** (1.36 g, 85 yield) as a yellow foamy solid.

$\boldsymbol{R_f}$ = 0.57 (silica gel, 5:1 hexanes:EtOAc); Optical rotation: $[\alpha]_D^{25}$ = 19.4 (c = 0.99, $CHCl_3$); ^{1}H NMR (500 MHz, Chloroform-d): δ 15.77 (s, 1H), 6.64 (s, 1H), 6.62 (s, 1H), 4.67 (s, 2H), 4.23 (dd, *J* = 12.1, 4.9 Hz, 1H), 3.56 (s, 3H), 2.63-2.57 (m, 2H), 2.33 (dddd, *J* = 13.6, 12.2, 10.5, 7.9 Hz, 1H), 1.86 (dtd, *J* = 13.5, 5.2, 3.1 Hz, 1H), 1.04 (s, 9H), 1.02 (s, 9H), 0.95 (s, 9H), 0.90 (s, 9H), 0.22 (s,

3H), 0.12 (s, 3H), 0.09 (s, 6H); ^{13}C NMR (126 MHz, Chloroform-*d*): δ 182.5, 181.9, 170.7, 161.1, 156.5, 151.2, 112.4, 111.3, 107.7, 103.3, 84.6, 73.0, 64.2, 52.4, 29.2, 27.5, 27.4, 26.5, 26.0, 25.8, 25.8, 21.1, 18.4, 18.2, -3.4, -4.4, -4.7, -5.2, -5.2; HRMS (ESI) calcd.for $C_{36}H_{62}O_9Si_3Na$ $[M+Na]^+$: 745.3594; found: 745.3595.

Preparation of benzyl alcohol S22



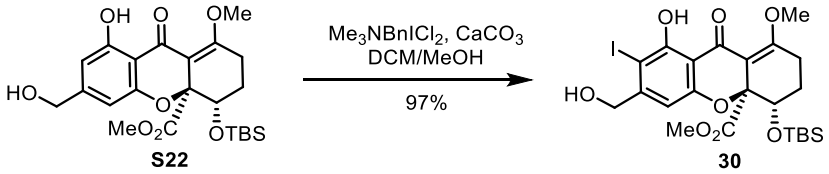
An oven-dried, 100 mL round-bottomed flask was treated with tricyclic silyl ether **29** (1.30 g, 1.80 mmol, 1.0 equiv) anhydrous MeCN (15 mL). The resulting solution was added 3HF Ɛt$_3$N (0.86 mL, 5.4 mmol, 3.0 equiv) dropwise via syringe at ambient temperature. The reaction mixture was continued at ambient temperature until TLC analysis indicated the complete consumption of the starting material. The reaction was quenched with *sat.* aq. $NaHCO_3$ (5 mL) and diluted with EtOAc (10 mL). The layers were separated and the aqueous layer was extracted with EtOAc (3 × 10 mL). The combined layers were washed with brine (20 mL), dried over Na_2SO_4, filtered and concentrated *in vacu*o. The crude residue was purified via SiO_2 flash chromatography (eluent: EtOAc/hexanes = 1/5) to give enol **S21** (794 mg, 95% yield) as a yellow foamy solid.

An oven-dried, 100 mL round-bottomed flask was treated with enol **S21** (794 mg, 1.71 mmol, 1.0 equiv) and anhydrous 16 mL CH_2Cl_2/MeOH (1:1) under a N_2 atmosphere. The resulting solution was cooled to 0 ℃ via an ice/water bath and stirring was continued at this temperature for 15 min prior to the addition of $TMSCHN_2$ (1.7 mL, 2.0 mol/L in hexane, 3.42 mmol, 2.0 equiv) via syringe. The reaction was warmed to ambient temperature and stirred for 15 min and quenched with 10 w% aqueous AcOH solution. The reaction was extracted twice with 30 mL of CH_2Cl_2. The combined

layers were washed with brine (20 mL), dried over Na_2SO_4, filtered and concentrated *in vacu*o. The crude residue was purified via SiO_2 flash chromatography (eluent: EtOAc/hexanes = 1/5) to give benzyl alcohol **S22** (500 mg, 65% yield) as a yellow foamy solid.

$\boldsymbol{R_f}$ = 0.39 (silica gel, 1:1 hexanes:EtOAc); Optical rotation: $[\alpha]_D^{25}$ = -76.3 (c = 0.75, $CHCl_3$); ^{1}H NMR (500 MHz, Chloroform-d): δ 12.52 (s, 1H), 6.42 (s, 1H), 6.42 (s, 1H), 4.57 (s, 2H), 4.18 (dd, *J* = 11.8, 4.4 Hz, 1H), 3.87 (s, 3H), 3.58 (s, 3H), 2.72 (ddd, *J* = 18.6, 6.1, 2.6 Hz, 1H), 2.57 (ddd, *J* = 18.2, 10.7, 6.2 Hz, 1H), 2.30 (ddq, *J* = 17.7, 11.0, 6.0 Hz, 1H), 1.88 (dd, *J* = 11.8, 5.0 Hz, 1H), 0.87 (s, 9H), 0.19 (s, 3H), 0.11 (s, 3H); ^{13}C NMR (126 MHz, Chloroform-d): δ 185.5, 170.2, 168.4, 163.0, 159.6, 151.7, 107.5, 107.2, 106.1, 104.4, 86.4, 72.4, 64.6, 56.2, 52.7, 26.4, 25.7, 24.6, 18.1, -4.4, -4.8. HRMS (ESI) calcd.for $C_{23}H_{32}O_8SiNa$ $[M+Na]^+$: 487.1759; found: 487.1758.

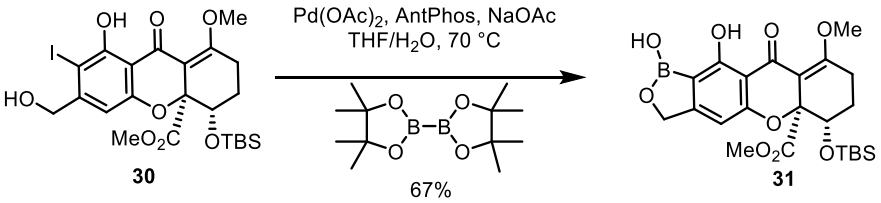
Preparation of tricyclic iodide 30



An oven-dried, 25 mL round-bottomed flask was treated with benzyl alcohol **S22** (200 mg, 0.43 mmol, 1.0 equiv) and $CaCO_3$ (302 mg, 3.02 mmol, 7.0 equiv), $Me_3NBnICl_2$ (150 mg, 0.43 mmol, 1.0 equiv), and anhydrous 5 mL CH_2Cl_2/MeOH (5:1). The suspension was vigorously stirred for 12 h at which time TLC analysis indicated the complete consumption of starting material then diluted with CH_2Cl_2, filtered through a short pad of Celite and concentrated *in vacuo*. Purification of the crude residue by SiO_2 flash chromatography (eluent: EtOAc/hexanes = 1/4) to give tricyclic iodide **30** (246 mg, 97% yield) as a yellow foamy solid.

$\boldsymbol{R_f}$ = 0.55 (silica gel, 1:1 hexanes:EtOAc); Optical rotation: $[\alpha]_D^{25}$ = -19.2 (c = 1.00, $CHCl_3$); ^{1}H NMR (500 MHz, Chloroform-*d*): δ 13.57 (d, *J* = 1.0 Hz, 1H), 6.72 (s, 1H), 4.60 (d, *J* = 2.8 Hz, 2H), 4.22 (dd, *J* = 11.8, 4.5 Hz, 1H), 3.91 (s, 3H), 3.59 (d, *J* = 1.4 Hz, 3H), 2.75 (ddd, *J* = 18.6, 6.1, 2.5 Hz, 1H), 2.61 (ddd, *J* = 18.5, 10.7, 6.2 Hz, 1H), 2.39-2.26 (m, 1H), 1.95-1.86 (m, 1H), 0.88 (s, 9H), 0.20 (s, 3H), 0.12 (s, 3H); ^{13}C NMR (126 MHz, Chloroform-*d*): δ 184.8, 170.0, 169.4, 161.0, 160.0, 152.2, 107.5, 106.8, 105.2, 86.6, 76.4, 72.3, 69.5, 56.4, 52.8, 26.4, 25.7, 24.7, 18.1, -4.7; HRMS (ESI) calcd.for $C_{23}H_{31}IO_8SiNa$ $[M+Na]^+$: 613.0725; found: 613.0723.

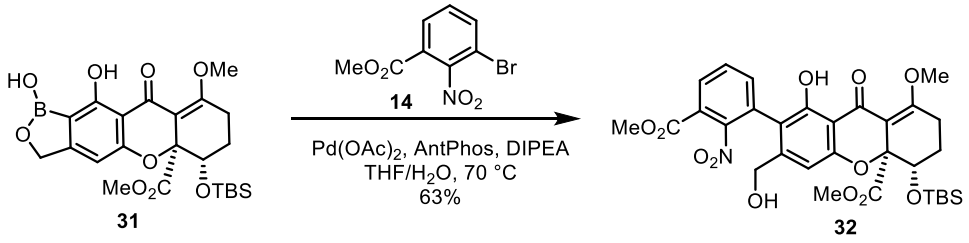
Preparation of benzoxaborole 31



To a mixture of ary iodide **30** (70.0 mg, 0.12 mmol, 1.0 equiv), bis(pinacolato)diboron (60.2 mg, 0.24 mmol, 2 equiv), sodium acetate (29.2 mg, 0.35 mmol, 3.0 equiv), $Pd(OAc)_2$ (5.3 mg, 0.024 mmol, 0.2 equiv) and AntPhos (13.2 mg, 0.035 mmol, Pd/ligand mol ratio: 1/1.5) under N_2 was charged freshly degassed 5.0 mL THF/water (4:1) . The biphasic mixture was immediately placed in preheated oil bath at 70 ^oC and the reaction was continued at 70 ^oC for 3.5 h. The reaction mixture was cooled to ambient temperature, diluted with EtOAc (10 mL), and treated with sat. aq. NH_4Cl (5 mL). The layers were separated and the aqueous layer was extracted with EtOAc (3 × 10 mL). The combined layers were washed with brine (10 mL), dried over Na_2SO_4, filtered and concentrated *in vacu*o. The crude residue was purified via SiO_2 flash chromatography (eluent: CH_2Cl_2/MeOH = 30/1) to give benzoxaborole **31** (39 mg, 67% yield) as a yellow foamy solid.

$\boldsymbol{R_f}$ = 0.10 (silica gel, 1:1 hexanes:EtOAc); Optical rotation: $[\alpha]_D^{25}$ = -32.2 (c = 1.00, $CHCl_3$); ^{1}H NMR (500 MHz, Acetone-d_6) δ = 13.53 (s, 1H), 7.61 (s, 1H), 6.49 (s, 1H), 4.92 (dd, *J* =3.7, 0.9, 2H), 4.36-4.32 (m, 1H), 3.91 (s, 3H), 3.58 (s, 3H), 2.89-2.85 (m, 1H). 2.36-2.25 (m, 1H), 1.97 (m, 2H). 0.92 (s, 9H), 0.25 (s, 3H), 0.18 (s, 3H); ^{13}C NMR (126 MHz, Chloroform-*d*) δ = 185.7, 169.8, 168.6, 165.9, 164.2, 162.6, 107.1, 105.7, 103.4, 100.4, 86.6, 75.1, 72.3, 71.2, 56.2, 55.5, 52.7, 26.3, 25.6, 24.8, 24.6, 18.0, -4.5, -4.8; HRMS (ESI) calcd.for $C_{23}H_{31}BO_9SiNa$ $[M+Na]^+$: 512.1759; found: 512.1765.

Preparation of coupling product 32



To a mixture of benzoxaborole **31** (45 mg, 91.8 μmol, 1.0 equiv), aryl bromide **14** (23.8 mg,

91.8 μmol, 1.0 equiv), DIPEA (35 mg, 0.275 mmol, 3.0 equiv), $Pd(OAc)_2$ (4.12 mg, 18.4 μmol, 0.2 equiv) and AntPhos (10.2 mg, 27.5 μmol, 0.3 equiv, Pd/ligand mol ratio: 1/1.5) under N_2 was charged freshly degassed 5.0 mL THF/water (4:1) . The biphasic mixture was immediately placed in preheated oil bath at 70 ^oC and the reaction was continued at 70 ^oC for 3 h. The reaction mixture was cooled to ambient temperature, diluted with EtOAc (10 mL), and treated with *sat.* aq. NH_4Cl (5 mL). The layers were separated and the aqueous layer was extracted with EtOAc (3 × 10 mL). The combined layers were washed with brine (10 mL), dried over Na_2SO_4, filtered and concentrated *in vacu*o. The crude residue was purified via SiO_2 flash chromatography (eluent: EtOAc/hexanes = 1/1) to give coupling products **32** (37.2 mg, 63% yield, atropisomeric mixture, dr 1.5:1) as a yellow foamy solid.

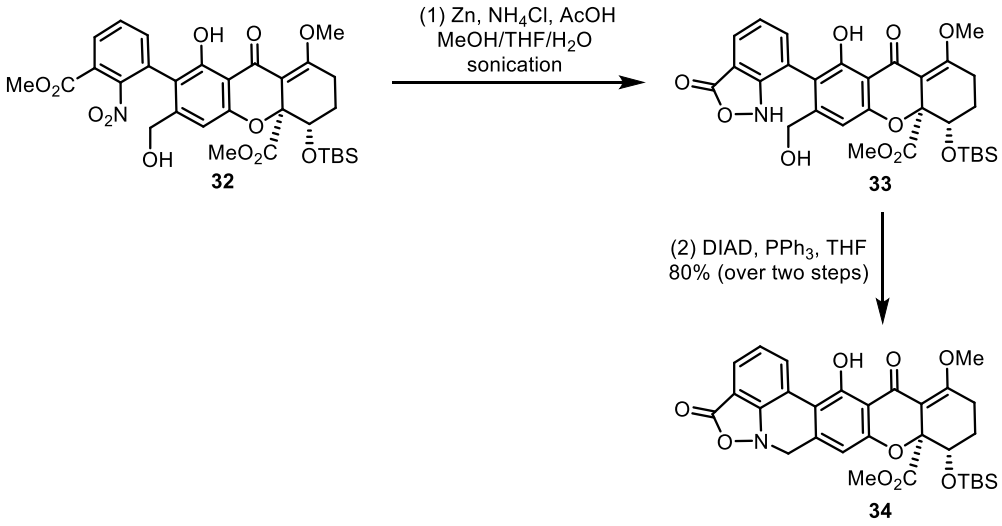
Coupling product (major):

$\boldsymbol{R_f}$ = 0.23 (silica gel, 1:1 hexanes:EtOAc); Optical rotation: $[\alpha]_D^{25}$ = 40.1 (c = 1.00, $CHCl_3$); ^1H NMR (500 MHz, Chloroform-*d*) δ = 12.75 (s, 1H), 8.03 (dd, *J* =7.8, 1.4, 1H), 7.60 (t, *J*=7.7, 1H), 7.46 (dd, *J* =7.7, 1.4, 1H), 6.70 (s, 1H), 4.41 (dd, *J* =14.3, 3.2, 1H), 4.27 (dd, *J* =14.4, 5.8, 1H), 4.22 (dd, *J* =11.9, 4.5, 1H), 3.90 (s, 3H), 3.89 (s, 3H), 3.65 (s, 3H), 2.77 (ddd, *J* =18.6, 6.1, 2.4, 1H), 2.60 (ddd, *J* =18.3, 10.8, 6.2, 1H), 2.37 (dtd, *J* =13.2, 11.5, 6.0, 1H), 1.90 (dddd, *J* =13.3, 6.5, 4.4, 2.3, 1H), 0.91 (s, 9H), 0.23 (s, 3H), 0.14 (s, 3H); ^{13}C NMR (126 MHz, Chloroform-*d*) δ = 185.2, 170.3, 169.0, 164.0, 160.4, 160.3, 150.7, 149.6, 136.9, 130.9, 130.5, 129.3, 123.9, 113.5, 107.2, 106.1, 105.5, 86.7, 72.5, 62.8, 56.4, 53.2, 52.9, 26.4, 25.7, 24.9, 18.2, -4.3, -4.7; HRMS (ESI) calcd.for $C_{31}H_{37}O_{12}NSiNa$ $[M+Na]^+$: 666.1977; found: 666.1982.

Coupling product (minor):

$\boldsymbol{R_f}$ = 0.32 (silica gel, 1:1 hexanes:EtOAc); Optical rotation: $[\alpha]_D^{25}$ = -62.6 (c = 0.50, $CHCl_3$); ^1H NMR (500 MHz, Chloroform-*d*) δ = 12.82 (s, 1H), 8.04 (dd, *J* =7.8, 1.4, 1H), 7.62 (t, *J* =7.8, 1H), 7.50 (dd, *J* =7.6, 1.5, 1H), 6.74 (s, 1H), 4.38 (d, *J* =14.2, 1H), 4.30 (d, *J* =14.3, 1H), 4.23 (dd, *J* =11.8, 4.5, 1H), 3.92 (s, 3H), 3.89 (s, 3H), 3.66 (s, 3H), 2.75 (ddd, *J*=18.4, 6.0, 2.5, 1H), 2.69-2.58 (m, 1H), 2.36 (ddd, *J*=24.3, 11.1, 6.2, 1H), 1.99-1.86 (m, 1H), 0.91 (s, 9H), 0.23 (s, 3H), 0.15 (s, 3H); ^{13}C NMR (126 MHz, Chloroform-*d*) δ = 185.32, 169.95, 168.72, 164.04, 160.33, 160.25, 150.80, 149.73, 136.73, 130.91, 130.47, 129.37, 123.92, 113.58, 107.28, 105.87, 105.72, 86.63, 72.41, 62.96, 56.38, 53.24, 52.87, 26.59, 25.95, 25.77, 24.65, 18.16, 1.17, 0.15, -4.34, -4.67; HRMS (ESI) calcd.for $C_{31}H_{37}O_{12}NSiNa$ $[M+Na]^+$: 666.1977; found: 666.1984.

Preparation of isoxazolidinone 34



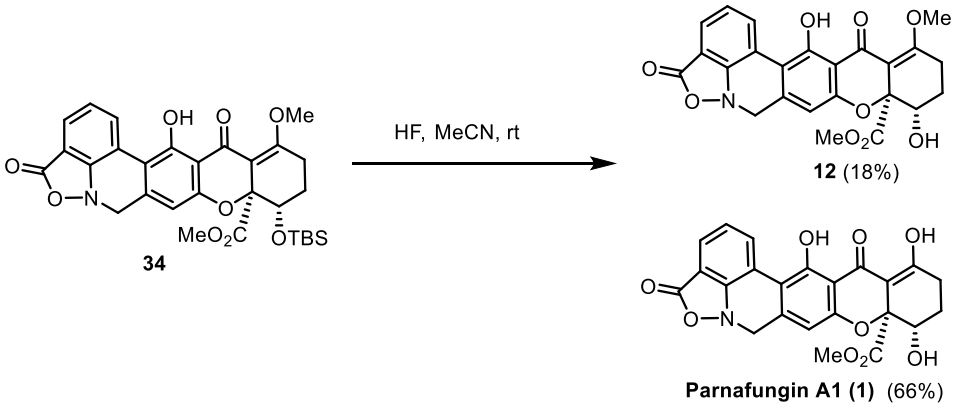
An oven-dried, 25 mL round-bottomed flask was treated with coupling product **32** (25 mg, 38.8 μmol, 1.0 equiv), NH_4Cl (10.4 mg, 0.194 mmol, 5.0 equiv), AcOH (18.6 mg, 0.310 mmol, 8.0 equiv) freshly activated zinc power (10.1 mg, 0.155 mmol, 4.0 equiv) and 1.0 mL THF/MeOH/Water(3:3:1). The resulting solution was sonicated for 15 min at ambient temperature. EtOAc (5 mL) was added and the layers were separated. The aqueous layer was extracted with EtOAc (3×5 mL) and the combined layers were washed with brine (50 mL), dried over Na_2SO_4, filtered. Concentration *in vacu*o to give crude residue **33** as a pale yellow oil.

An oven-dried, 25 ml round-bottomed flask was treated with crude residue **33** and anhydrous THF (1.0 mL). The resulting solution was cooled to 0 ^oC via an ice/water bath and PPh_3 (20.4 mg, 77.8 μmol, 2.0 equiv) was charged *as a single portion* prior to the addition dropwise of DIAD (15.7 mg, 77.8 μmol, 2.0 equiv) in THF (0.5 mL) via syringe. The reaction was allowed 5 min at 0 ^oC and concentrated *in vacuo.* The crude residue was purified via SiO_2 flash chromatography (eluent: EtOAc/hexanes = 1/1) to give isoxazolidinone **34** (18.0 mg, 80% yield) as a yellow solid.

$\boldsymbol{R_f}$ = 0.32 (silica gel, 1:1 hexanes:EtOAc); Optical rotation: $[\alpha]_D^{25}$ = 28.0 (c = 0.2, CH_2Cl_2); ^1H NMR (500 MHz, Chloroform-*d*) δ = 13.72 (s, 1H), 8.46 (d, *J* =7.6, 1H), 7.62 (d, *J* =7.8, 1H), 7.29 (t, *J* =7.7, 1H), 6.43 (s, 1H), 4.52 (s, 2H), 4.24 (dd, *J* =12.0, 4.6, 1H), 3.96 (s, 3H), 3.64 (s, 3H), 2.85-2.74 (m, 1H), 2.65 (ddd, *J* =18.2, 10.9, 6.2, 1H), 2.38 (dtd, *J* =18.3, 11.3, 6.0, 1H), 1.98-1.88 (m, 1H), 0.91 (d, *J* =3.1, 9H), 0.22 (d, *J* =5.2, 3H), 0.15 (s, 3H); ^{13}C NMR (126 MHz, Chloroform-*d*) δ = 185.6, 169.9, 169.7, 168.4, 161.3, 159.6, 155.9, 140.9, 131.4, 125.9, 122.9, 119.7, 110.9, 110.5, 110.2, 108.4, 107.1, 105.5, 86.9, 72.3, 56.5, 56.1, 53.0, 26.4, 25.7, 25.7, 24.8, 18.2, -4.3, -4.6; HRMS

(ESI) calcd.for $C_{30}H_{33}O_9NSiNa$ [M+Na]$^+$: 602.1817; found: 666.1823.

Preparation of 12-O-methyl-parnafungin A1 (12) and parnafungin A1 (1)



10 mL plastic tube was treated with **34** (15 mg, 25.9 μmol, 1.0 equiv) and MeCN (1.0 ml). The resulting solution was treated with HF (0.3 mL, 48-51% solution in water) via syringe. The reaction was left to stir at ambient temperature for 10 h. The reaction was cooled to ambient temperature the quenched with the carefully addition of *sat.* aq. $NaHCO_3$ (3 mL). EtOAc (5 mL) was added and the layers were separated. The aqueous layer was extracted with EtOAc (3×50 mL) and the combined layers were washed with brine (5 mL), dried over Na_2SO_4, filtered and concentration *in vacu*o. The crude residue was purified via preparative TLC (eluent: CH_2Cl_2/MeOH = 30/1) to give 12-O-methyl-parnafungin A1 (**12**) (2.2 mg, 18% yield) and parnafungin A1 (**1**) (7.7 mg, 66% yield) as a yellow solid.

12-O-methyl-parnafungin A1（12）:

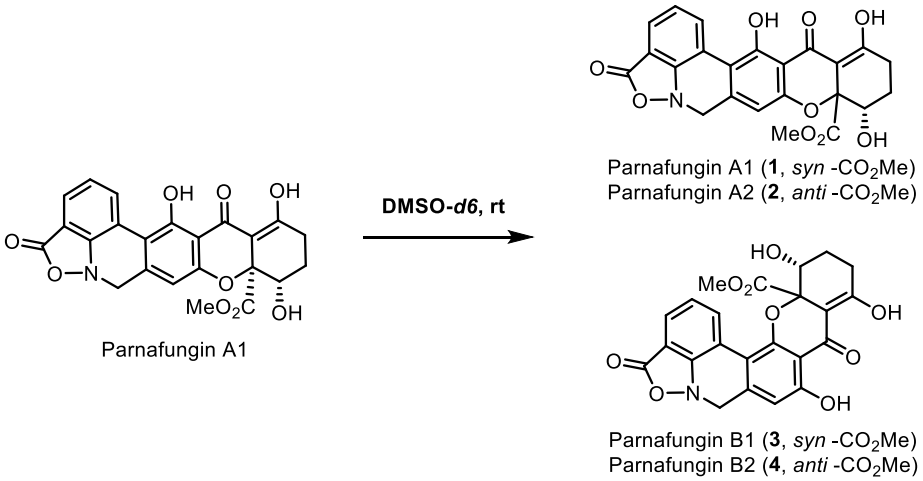
$\boldsymbol{R_f}$ = 0.40 (silica gel, 10:1 CH_2Cl_2:MeOH); Optical rotation: $[\alpha]_D^{25}$ = 25.2 (c = 0.2, CH_2Cl_2); ^{1}H NMR (600 MHz, DMSO-d_6) δ = 14.14 (s, 1H), 8.36 (dd, *J* =7.5, 0.8, 1H), 7.68 (dd, *J* =7.9, 0.8, 1H), 7.38 (t, *J* =7.7, 1H), 6.71 (s, 1H), 5.94 (d, *J* =4.9, 1H, -OH), 4.71 (s, 2H), 4.15 (dt, *J* =12.0, 4.7, 1H), 3.91 (s, 3H), 3.58 (s, 3H), 2.94-2.78 (m, 2H), 2.15-2.05 (m, 1H), 1.94-1.85 (m, 1H); ^{13}C NMR (151 MHz, DMSO-d_6) δ = 184.8, 173.2, 169.8, 167.4, 160.2, 159.3, 155.6, 141.1, 130.6, 125.9, 122.6, 119.1, 109.8, 109.4, 107.5, 107.4, 103.4, 87.1, 69.8, 56.3, 54.8, 52.8, 25.4, 24.0; HRMS (ESI) calcd.for $C_{24}H_{19}O_9NNa$ [M+Na]$^+$: 488.0952; found: 488.0958.

Parnafungin A1 (1):

$\boldsymbol{R_f}$ = 0.40 (silica gel, 10:1 CH_2Cl_2:MeOH); Optical rotation: $[\alpha]_D^{25}$ = 30.5 (c = 0.20, CH_2Cl_2); ^{1}H NMR (600 MHz, Chloroform-*d*) δ = 13.78 (s, 1H), 12.30 (s, 1H), 8.43 (dd, *J*=7.6, 0.8, 1H), 7.66 (dd,

J=7.8, 0.8, 1H), 7.30 (t, *J*=7.7, 1H), 6.58 (s, 1H), 4.53 (m, 2H), 4.36 (dd, *J*=12.4, 4.7, 1H), 3.74 (s, 3H), 2.82 (s, 1H, -OH), 2.72 (m, 2H), 2.26 (m, 1H), 2.13 (m, 1H); ^{13}C NMR (151 MHz, Chloroform-*d*) δ = 186.8, 179.5, 169.9, 168.1, 160.1, 159.0, 155.9, 142.0, 131.6, 125.9, 123.5, 119.1, 112.0 110.7, 108.3, 107.2, 101.3, 85.1, 71.9, 56.0, 53.6, 27.9, 24.0, 1.2; HRMS (ESI) calcd.for $C_{23}H_{18}O_9N$ $[M+H]^+$: 452.0976; found: 452.0968.

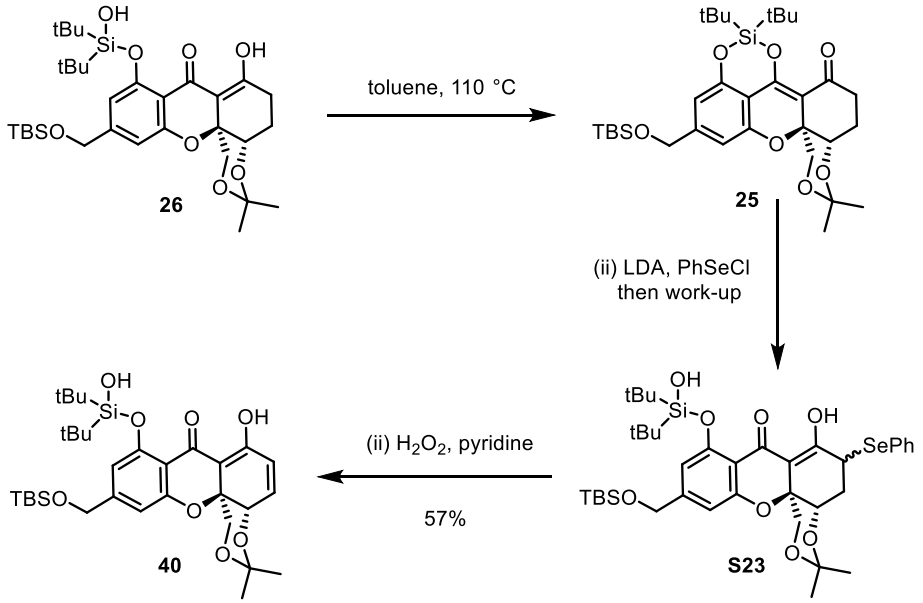
Equilibrating mixture of four interconverting isomers in DMSO-*d6*



Mixture of parnafungins:

Optical rotation: synthetic: $[\alpha]_D^{25}$ = 30.5 (c = 0.20, CH_2Cl_2); natural: $[\alpha]_D$ = 38.0 (c = 0.20, CH_2Cl_2);

Preparation of diene 40



An oven-dried, 100 mL round-bottomed flask was treated with **26** (1.60 g, 2.6 mmol, 1.0 equiv) and anhydrous PhMe (30 mL). The resulting solution was heated to reflux and remove water by Dean-Stark trap for 3 h. The reaction was cooled to ambient temperature and immediately concentrated *in vacuo* to give di-tert-butylsilylene (DTBS) product **25** as a yellow solid.

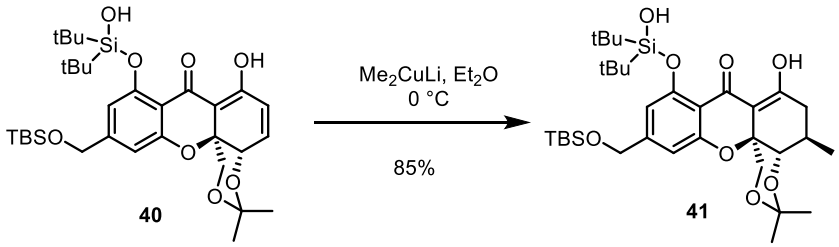
An oven-dried, 150 mL round-bottomed flask was treated with **25** and anhydrous THF (26 mL), The solution was cooled to -78 ℃ via a dry ice/acetone bath and stirring continued for 10 min prior to the dropwise addition of LDA (2.0 M in THF, 1.9 mL, 3.9 mmol, 1.5 equiv) via syringe. Upon complete addition, the reaction mixture was warmed up to 0 ℃ via an ice/water bath and stirring was continued at this temperature for 25 min. [Note: the mixture turned dark brown gradually]. Then the mixture was placed back to -78 ℃ and stirring continued for 10 min prior to the dropwise addition of PhSeCl (787 mg, 4.1 mmol, 1.6 equiv) in anhydrous THF (4 mL) via syringe. The reaction was continued at -78 ℃ until TLC analysis indicated the complete consumption of starting material (*ca*. 1.0 h). The reaction was quenched with the addition of *sat.* aq. NH_4Cl (10.0 ml) and then warmed to ambient temperature and diluted with EtOAc (20 mL). The layers were separated and the aqueous layer was extracted with EtOAc (3×20 mL) and the combined layers were washed with brine (10 mL), dried over Na_2SO_4, filtered and concentration *in vacuo* to yield the crude residue **S23**.

An oven-dried, 150 mL round-bottomed flask was treated with crude residue **S23**, pyridine (0.66 mL, 8.3 mmol, 3.2 equiv) and THF (30 mL). After 5 min of continued stirring, H_2O_2 (35% in water, 0.92 mL, 8.3 mmol, 3.2 equiv) was added dropwise. The reaction was stirred an additional 20 min at ambient temperature at which point TLC analysis indicated the complete consumption of starting material. The reaction was quenched with the addition of *sat.* aq. $Na_2S_2O_3$ (2 mL). EtOAc (20 mL) was added and the layers were separated. The aqueous layer was extracted with EtOAc (3×20 mL) and the combined layers were washed with brine (10 mL), dried over Na_2SO_4, filtered and concentration *in vacuo*. The crude residue was purified via SiO_2 flash chromatography (eluent: EtOAc/hexanes = 1/10) to give diene **40** (910 mg, 57% yield) as a yellow foamy solid.

$\boldsymbol{R_f}$ = 0.40 (silica gel, 5:1 hexanes:EtOAc); Optical rotation: $[\alpha]_D^{25}$ = 103.7 (c = 1.00, $CHCl_3$); ^{1}H NMR (500 MHz, Chloroform-d) δ = 15.77 (s, 1H), 6.81 (d, *J*=1.4, 1H), 6.71 (dd, *J*=10.3, 2.3, 1H), 6.68 (d, *J*=1.4, 1H), 6.08 (dd, *J*=10.3, 2.8, 1H), 5.10 (d, *J*=2.1, 1H), 4.65 (s, 2H), 3.86 (d, *J*=13.3, 1H), 3.80 (dd, *J*=13.3, 1.6, 1H), 3.27 (s, 1H, -OH), 1.53 (s, 3H), 1.50 (s, 3H), 1.07 (s, 9H), 1.05 (s, 9H), 0.94 (s, 9H), 0.10 (d, *J*=1.5, 6H); ^{13}C NMR (126 MHz, Chloroform-d) δ = 178.8, 176.1, 157.7, 150.8, 146.7, 125.8, 112.6, 108.7, 98.9, 75.0, 73.0, 64.3, 60.1, 29.7, 27.5, 27.4, 26.3, 26.1, 26.1, 26.0, 23.5, 21.0, 21.0, 18.5, -5.2, -5.2; HRMS (ESI) calcd.for $C_{32}H_{50}O_8Si_2Na$ $[M+Na]^+$: 641.2936; found:

641.2933.

Preparation of methyl tetracyclic compound 41



Preparation of dimethylcopperlithium reagent:

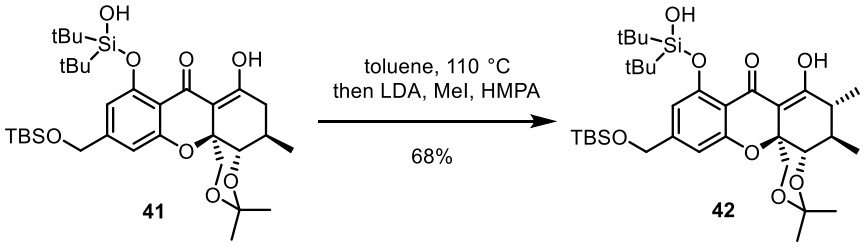
An oven-dried, 150 mL round-bottomed flask was treated with CuI (2.08 g, 10.9 mmol, 1.0 equiv) and anhrydrous Et_2O (20 mL). The resulted solution was cooled to 0 ℃ via an ice/water bath and stirring was continued at this temperature for 10 min prior to the addition of MeLi (1.3 M in Et_2O, 16.8 mL, 21.8 mmol, 2.0 equiv) via syringe. The reaction was allowed 25 min at 0 ℃, during which time the CuI power was dissolved completely. And the dimethylcopperlithium reagent (0.3 M in Et_2O) was used immediately.

An oven-dried, 150 mL round-bottomed flask was treated with diene **40** (1.50 g, 2.4 mmol, 1.0 equiv) and anhrydrous Et_2O (20 mL). The resulted solution was cooled to 0 ℃ via an ice/water bath and stirring was continued at this temperature for 10 min prior to the addition of dimethylcopperlithium reagent (0.3 M in Et_2O, 24.3 mL, 7.3 mmol, 3.0 equiv) via syringe. Upon the complete addition, the reaction was continued at 0 ℃ for 20 min at which point TLC analysis indicated the complete consumption of starting material. The reaction was quenched with the addition of *sat.* aq. NH_4Cl (5 mL). EtOAc (20 mL) was added and the layers were separated. The aqueous layer was extracted with EtOAc (3×20 mL) and the combined layers were washed with diluted ammonia (3×10 mL) and brine (10 mL), dried over Na_2SO_4, filtered and concentration *in vacuo*. The crude residue was purified via SiO_2 flash chromatography (eluent: EtOAc/hexanes = 1/15) to give methyl tetracyclic compound **41** (1.30 g, 85% yield) as a yellow foamy solid.

$\boldsymbol{R_f}$ = 0.67 (silica gel, 5:1 hexanes:EtOAc); Optical rotation: $[\alpha]_D^{25}$ = 7.4 (c = 1.00, $CHCl_3$); ^{1}H NMR (500 MHz, Chloroform-d) δ = 15.54 (s, 1H), 6.71 (s, 1H), 6.56 (s, 1H), 4.62 (s, 2H), 4.04 (dd, *J*=2.8, 1.2, 1H), 3.86 (d, *J*=12.9, 1H), 3.41 (d, *J*=12.9, 1H), 2.83 (dd, *J*=17.1, 5.1, 1H), 2.31 (ddq, *J*=7.5, 5.0, 2.5, 1H), 2.12 (ddd, *J*=17.1, 2.8, 1.3, 1H), 1.50 (s, 3H), 1.31 (s, 3H), 1.10 (d, *J*=7.5, 3H), 1.07 (s, 9H), 1.06 (s, 9H), 0.94 (s, 9H), 0.10 (s, 6H); ^{13}C NMR (126 MHz, Chloroform-d) δ = 183.6, 112.4, 108.6, 100.6, 79.6, 74.6, 64.2, 64.2, 34.7, 31.7, 31.2, 30.3, 29.8, 27.5, 27.5, 26.1, 26.0, 25.0,

24.0, 21.1, 21.0, 16.6, 1.2, -5.2; HRMS (ESI) calcd.for $C_{33}H_{54}O_8Si_2Na$ $[M+Na]^+$: 657.3249; found: 657.3250.

Preparation of dimethyl tetracyclic compound 42



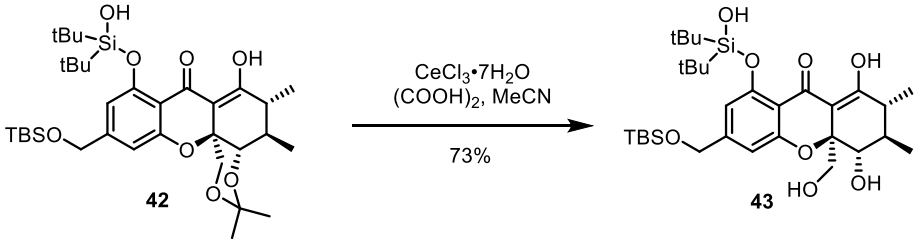
An oven-dried, 150 mL round-bottomed flask was treated with methyl tetracyclic compound **41** (1.30 g, 2.1 mmol, 1.0 equiv) and anhydrous PhMe (30 mL). The resulting solution was heated to reflux and remove water by Dean-Stark trap for 3 h. The reaction was cooled to ambient temperature and immediately concentrated *in vacuo* to give di-tert-butylsilylene (DTBS) product as a yellow solid.

An oven-dried, 150 mL round-bottomed flask was treated with (DTBS) product and anhydrous THF (20 mL), The solution was cooled to -78 ℃ via a dry ice/acetone bath and stirring continued for 10 min prior to the dropwise addition of LDA (2.0 M in THF, 1.5 mL, 3.1 mmol, 1.5 equiv) via syringe. Upon complete addition, the reaction mixture was warmed up to 0 ℃ via an ice/water bath and stirring was continued at this temperature for 25 min. [Note: the mixture turned dark brown gradually]. Then the mixture was placed back to -78 ℃ and stirring continued for 10 min prior to the dropwise addition of MeI (0.25 ml, 4.1 mmol, 2 equiv) via syringe. The reaction was continued at -78 ℃ for 20min prior to the dropwise addition of HMPA (1.5 ml, 8.2 mmol, 4 equiv) via syringe. Upon the complete addition of HMPA, the reaction was slowly warmed to -40 ℃ over 6 h. The reaction was quenched with the addition of *sat.* aq. NH_4Cl (10.0 ml) and then warmed to ambient temperature and diluted with EtOAc (20 mL). The layers were separated and the aqueous layer was extracted with EtOAc (3×20 mL) and the combined layers were washed with brine (10 mL), dried over Na_2SO_4, filtered and concentration *in vacuo*. The crude residue was purified via SiO_2 flash chromatography (eluent: EtOAc/hexanes = 1/20) to give dimethyl tetracyclic compound **42** (1.11 g, 68% yield) as a yellow foamy solid.

$\boldsymbol{R_f}$ = 0.72 (silica gel, 5:1 hexanes:EtOAc); Optical rotation: $[\alpha]_D^{25}$ = 8.2 (c = 1.00, $CHCl_3$); ^{1}H NMR (500 MHz, Chloroform-d) δ = 15.63 (s, 1H), 6.69 (s, 1H), 6.57 (s, 1H), 4.63 (s, 2H), 4.03 (d, *J*=3.8, 1H), 3.92 (d, *J*=12.8, 1H), 3.49 (d, *J*=12.8, 1H), 2.34 (tdd, *J*=7.9, 6.8, 3.2, 1H), 2.13 (d, *J*=7.3, 1H), 1.49 (s, 3H), 1.37 (d, *J*=7.5, 3H), 1.34 (s, 3H), 1.12 (d, *J*=7.3, 3H), 1.08 (s, 9H), 1.05 (s, 9H),

0.94 (s, 9H), 0.09 (s, 6H); ^{13}C NMR (126 MHz, Chloroform-d) δ = 184.4, 182.8, 158.7, 156.6, 151.1, 112.4, 111.5, 108.5, 101.5, 100.2, 78.9, 76.3, 64.1, 63.8, 41.9, 37.1, 27.5, 27.5, 27.4, 27.4, 26.0, 26.0, 25.9, 25.2, 24.6, 21.1, 21.0, 18.7, 18.5, 18.4, -5.3; HRMS (ESI) calcd.for $C_{34}H_{56}O_8Si_2Na$ [M+Na]$^+$: 671.3406; found: 671.3407.

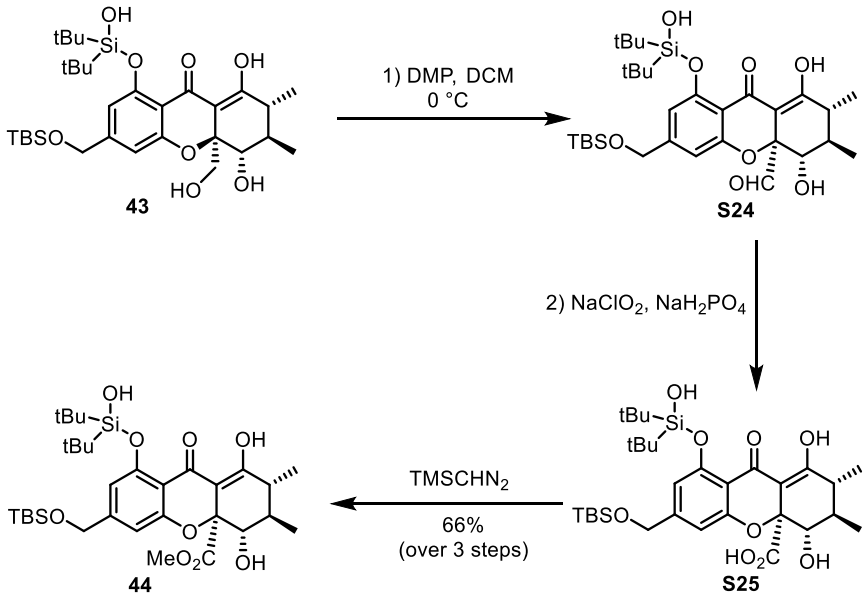
Preparation of dimethyl tricyclic alcohol 43



An oven-dried, 150 mL round-bottomed flask was treated with dimethyl tetracyclic compound **42** (600 mg, 0.93 mmol, 1.0 equiv), $CeCl_3 \cdot 7H_2O$ (1.03 g, 2.78 mmol, 3.0 equiv), $(COOH)_2$ (4.2 mg, 0.05 mmol, 0.05 equiv) and MeCN (10 mL). The reaction mixture was vigorously stirred for 5 hours at which point TLC indicated the complete consumption of starting material and quenched with the addition of *sat.* aq. $NaHCO_3$ (5 mL). EtOAc (20 mL) was added and the layers were separated. The aqueous layer was extracted with EtOAc (3 × 10 mL). The combined layers were washed with brine (20 mL), dried over Na_2SO_4, filtered and concentrated *in vacuo*. The crude residue was purified via SiO_2 flash chromatography (eluent: EtOAc/hexanes = 1/3) to give dimethyl tricyclic alcohol **43** (401 mg, 73% yield) as a yellow foamy solid.

$\boldsymbol{R_f}$ = 0.57 (silica gel, 2:1 hexanes:EtOAc); Optical rotation: $[\alpha]_D^{25}$ = 17.8 (c = 1.00, $CHCl_3$); ^{1}H NMR (500 MHz, Chloroform-d) δ = 16.22 (s, 1H), 6.72 (s, 1H), 6.56 (s, 1H), 4.62 (s, 2H), 3.96 (d, *J*=12.8, 1H), 3.84 (d, *J*=11.4, 1H), 3.78 (d, *J*=12.8, 1H), 2.20 (p, *J*=7.3, 1H), 1.78 (ddt, *J*=16.1, 10.1, 5.1, 1H), 1.28 (d, *J*=6.4, 3H), 1.19 (d, *J*=6.2, 3H), 1.06 (s, 9H), 1.05 (s, 9H), 0.93 (s, 9H), 0.09 (s, 6H); ^{13}C NMR (126 MHz, Chloroform-d) δ = 183.8, 182.7, 158.9, 156.7, 151.0, 112.8, 110.9, 108.0, 102.6, 79.7, 78.7, 64.3, 64.2, 42.4, 38.2, 27.5, 27.4, 26.0, 21.1, 20.9, 18.5, 16.6, 16.4, -5.2; HRMS (ESI) calcd.for $C_{31}H_{52}O_8Si_2Na$ [M+Na]$^+$: 631.3093; found: 631.3090.

Preparation of dimethyl tricyclic ester 44



An oven-dried, 150 mL round-bottomed flask was treated with dimethyl tricyclic alcohol **43** (480 mg, 0.79 mmol, 1.0 equiv) and CH_2Cl_2 (15 mL). The resulting solution was cooled to 0 °C via ice/water bath and stirring was continued at this temperature for 10 min prior to the addition of Dess-Martin periodinane (334 mg, 0.79 mmol, 1.0 equiv) in several portions. The reaction was continued at 0 °C for 3 hours. The reaction was quenched was the addition of *sat.* aq. $NaHCO_3$ (10 mL). The layers were separated and the aqueous layer was extracted with CH_2Cl_2 (3 × 15 mL). The combined layers were washed with brine (20 mL), dried over Na_2SO_4, filtered and concentrated *in vacuo*. The crude residue was purified via SiO_2 flash chromatography (eluent: EtOAc/hexanes = 1/5) to give aldehyde **S24** (350 mg, 73% yield) as a yellow foamy solid.

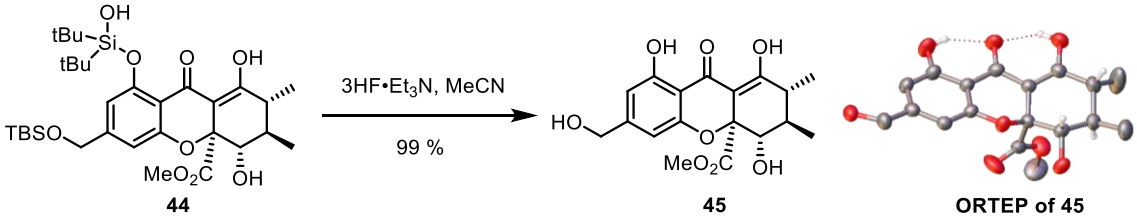
An oven-dried, 150 mL round-bottomed flask was treated with aldehyde **S24** (400 g, 0.66 mmol, 1.0 equiv), 2-methyl-2-butene (3.5 mL) and *t*BuOH (7.2 mL). $NaClO_2$ (298 mg, 3.3 mmol, 5.0 equiv) and NaH_2PO_4 (1.58 g, 6.6 mmol, 10.0 equiv) was dissolved in 9.6 mL water and added to the above solution. The reaction mixture was vigorously stirred for 5 hours at which point TLC indicated the complete consumption of starting material. EtOAc (20 mL) was added and the layers were separated. The aqueous layer was extracted with EtOAc (3 × 20 mL). The combined layers were washed with brine (30 mL), dried over Na_2SO_4, filtered and concentrated *in vacuo*. The crude residue acid **S25** was used without further purification.

An oven-dried, 150 mL round-bottomed flask was treated with crude acid **S25** and anhydrous 10

mL CH_2Cl_2/MeOH(1:1) under a N_2 atmosphere. The resulting solution was cooled to 0 ℃ via an ice/water bath and stirring was continued at this temperature for 15 min prior to the addition of $TMSCHN_2$ (0.66 mL, 2.0 mol/L in hexane, 0.66 mmol, 2.0 equiv) via syringe. The reaction was warmed to ambient temperature and stirred for 15 min and quenched with 10 w% aqueous AcOH solution. The reaction was extracted twice with 30 mL of EtOAc. The combined layers were washed with brine (30 mL), dried over Na_2SO_4, filtered and concentrated *in vacu*o. The crude residue was purified via SiO_2 flash chromatography (eluent: EtOAc/hexanes = 1/5) to give dimethyl tricyclic ester **44** (380 mg, 90% yield) as a yellow foamy solid.

***R*$_f$** = 0.45 (silica gel, 2:1 hexanes:EtOAc); Optical rotation: $[\alpha]_D^{25}$ = 0.9 (c = 1.00, $CHCl_3$); ^{1}H NMR (500 MHz, Chloroform-d) δ = 16.07 (s, 1H), 6.72 (d, *J*=1.6, 1H), 6.63 (d, *J*=1.5, 1H), 4.65 (s, 2H), 3.90 (dd, *J*=11.3, 2.3, 1H), 3.63 (s, 3H), 2.87 (s, 1H, -OH), 2.26 (dq, *J*=9.4, 7.0, 1H), 1.93 (ddq, *J*=12.8, 10.3, 6.4, 1H), 1.36 (d, *J*=7.0, 3H), 1.18 (d, *J*=6.5, 3H), 1.04 (s, 18H), 0.94 (s, 9H), 0.10 (d, J=2.3, 6H). ^{13}C NMR (126 MHz, Chloroform-d) δ = 184.7, 182.0, 170.5, 160.0, 156.6, 151.1, 113.1, 111.1, 107.7, 102.2, 84.3, 76.4, 64.2, 53.0, 41.9, 36.6, 27.5, 27.4, 26.0, 21.1, 21.0, 18.5, 16.5, 15.7, -5.2; HRMS (ESI) calcd.for $C_{32}H_{52}O_9Si_2Na$ $[M+Na]^+$: 659.3042; found: 659.3048.

Preparation of dimethyl benzyl alcohol 45

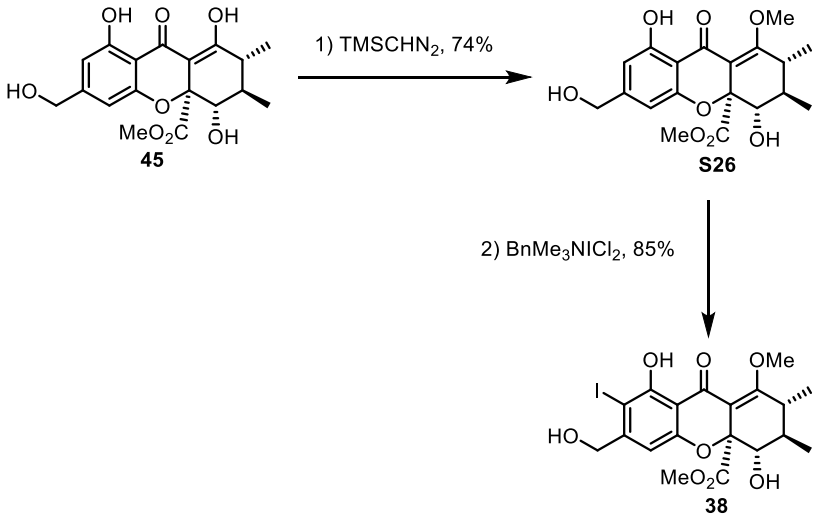


An oven-dried, 100 mL round-bottomed flask was treated with dimethyl tricyclic ester **44** (269 mg, 0.42 mmol, 1.0 equiv) anhydrous MeCN (5 mL). The resulting solution was added 3HF·Et_3N (0.23 mL, 1.27 mmol, 3.0 equiv) dropwise via syringe at ambient temperature. The reaction mixture was continued at ambient temperature until TLC analysis indicated the complete consumption of the starting material (*ca.* 8 h). The reaction was quenched with *sat.* aq. $NaHCO_3$ (2 mL) and diluted with EtOAc (10 mL). The layers were separated and the aqueous layer was extracted with EtOAc (3 × 10 mL). The combined layers were washed with brine (10 mL), dried over Na_2SO_4, filtered and concentrated *in vacu*o. The crude residue was purified via SiO_2 flash chromatography (eluent: CH_2Cl_2/MeOH = 30/1) to give dimethyl benzyl alcohol **45** (183 mg, 99% yield) as a faint yellow solid.

***R*$_f$** = 0.25 (silica gel, 10:1 CH_2Cl_2:MeOH); Optical rotation: $[\alpha]_D^{25}$ = 4.1 (c = 1.00, MeOH); ^{1}H

NMR (600 MHz, DMSO) δ = 14.56 (s, 1H), 10.94 (s, 1H), 6.54 (s, 1H), 6.45 (s, 1H), 4.46 (d, *J*=5.8, 2H), 3.78 (dd, *J*=11.1, 5.7, 1H), 3.57 (s, 3H), 2.4 (dq, J=9.4, 7.0, 1H), 1.8 (ddd, J=11.2, 9.4, 6.5, 1H), 1.25 (d, *J*=7.0, 3H), 1.08 (d, *J*=6.5, 3H); ^{13}C NMR (151 MHz, DMSO) δ = 185.5, 181.6, 170.1, 160.6, 159.4, 154.9, 106.7, 105.1, 105.1, 101.0, 84.4, 74.5, 62.3, 52.8, 37.3, 16.3, 15.4; HRMS (ESI) calcd.for $C_{18}H_{20}O_8Na$ $[M+Na]^+$: 387.1050; found: 387.1058.

Preparation of dimethyl tricyclic iodide 38

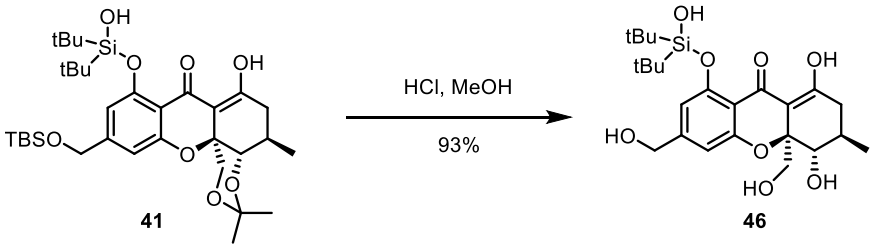


An oven-dried, 100 mL round-bottomed flask was treated with dimethyl benzyl alcohol **45** (183 mg, 0.50 mmol, 1.0 equiv) and anhydrous 4.0 mL CH_2Cl_2/MeOH (1:1) under a N_2 atmosphere. The resulting solution was cooled to 0 ℃ via an ice/water bath and stirring was continued at this temperature for 15 min prior to the addition of $TMSCHN_2$ (1.25 mL, 2.0 mol/L in hexane, 2.5 mmol, 5.0 equiv) via syringe. The reaction was warmed to ambient temperature and stirred for 15 min and quenched with 10 w% aqueous AcOH solution. The reaction was extracted twice with 20 mL of CH_2Cl_2. The combined layers were washed with brine (10 mL), dried over Na_2SO_4, filtered and concentrated *in vacu*o. The crude residue was purified via SiO_2 flash chromatography (eluent: CH_2Cl_2/MeOH = 30/1) to give product **S26** (140 mg, 74% yield) as a yellow foamy solid.

An oven-dried, 25 mL round-bottomed flask was treated with product **S26** (98 mg, 0.25 mmol, 1.0 equiv) and $CaCO_3$ (181 mg, 1.81 mmol, 7.0 equiv), $Me_3NBnICl_2$ (90.2 mg, 0.25 mmol, 1.0 equiv), and anhydrous 5 mL CH_2Cl_2/MeOH (5:1). The suspension was vigorously stirred for 6 h at which time TLC analysis indicated the complete consumption of starting material then diluted with CH_2Cl_2, filtered through a short pad of Celite and concentrated *in vacuo*. Purification of the crude residue by SiO_2 flash chromatography (eluent: CH_2Cl_2/MeOH = 30/1) to give dimethyl tricyclic iodide **38** (115 mg, 85% yield) as a yellow foamy solid.

***R*$_f$** = 0.31 (silica gel, 10:1 CH_2Cl_2:MeOH); Optical rotation: $[\alpha]_D^{25}$ = 11.5 (c = 1.00, $CHCl_3$); ^{1}H NMR (600 MHz, Chloroform-d) δ = 13.43 (s, 1H), 6.90 (s, 1H), 4.63 (d, *J*=2.1, 2H), 3.86 (d, *J*=11.7, 1H), 3.84 (s, 3H), 3.68 (s, 3H), 2.27 (dq, *J*=8.9, 6.9, 1H), 1.85 (ddq, *J*=12.8, 8.9, 6.4, 1H), 1.35 (d, *J*=6.9, 3H), 1.17 (d, *J*=6.5, 3H); ^{13}C NMR (151 MHz, Chloroform-d) δ = 184.6, 175.1, 170.0, 160.7, 159.3, 153.1, 107.3, 106.9, 105.5, 87.6, 76.7, 76.0, 69.5, 61.9, 53.6, 42.2, 35.9, 17.2, 16.3; HRMS (ESI) calcd.for $C_{19}H_{21}O_8INa$ $[M+Na]^+$: 527.0173; found: 527.0165.

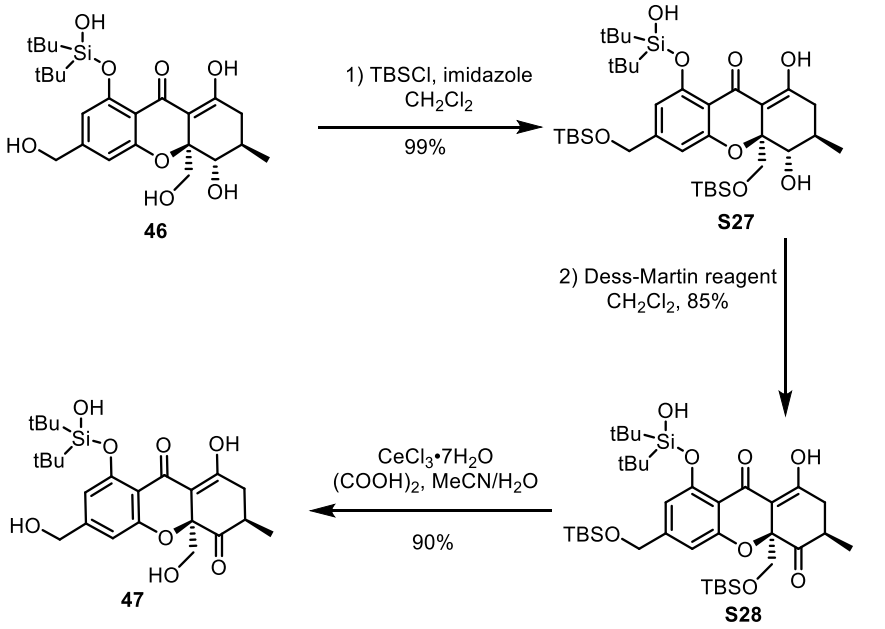
Preparation of methyl tricyclic alcohol 46



An oven-dried, 100 mL round-bottomed flask was treated with methyl tetracyclic compound **41** (660 mg, 1.04 mmol, 1.0 equiv) and MeOH (30 mL). The resulting solution was addition HCl (*conc.*) (0.45 mL, 5.20 mmol, 5.0 equiv) *as a single portion* via syringe. The reaction was allowed 15 min at ambient temperature at which point TLC analysis indicated the complete consumption of the starting material. The reaction was quenched with *sat.* aq. $NaHCO_3$ (30 mL) and MeOH was removed by vacuum distillation. Crude residue was diluted with EtOAc (20 mL) and the layers were separated. The aqueous layer was extracted with EtOAc (3 × 20 mL). The combined layers were washed with brine (20 mL), dried over Na_2SO_4, filtered and concentrated in vacuo. The crude residue was purified via SiO2 flash chromatography (eluent: CH_2Cl_2/MeOH = 20/1) to give methyl tricyclic alcohol **46** (465 mg, 93% yield) as a yellow foamy solid.

***R*$_f$** = 0.16 (silica gel, 10:1 CH_2Cl_2:MeOH); Optical rotation: $[\alpha]_D^{25}$ = 24.1 (c = 1.00, $CHCl_3$); ^{1}H NMR (500 MHz, Chloroform-d) δ = 15.99 (s, 1H), 6.69 (s, 1H), 6.63 (s, 1H), 4.67 (s, 2H), 4.47 (s, 2H), 3.87 (t, J=9.4, 1H), 3.80 (d, *J*=12.9, 1H), 3.70 (dd, *J*=11.4, 4.3, 1H), 2.63-2.50 (m, 1H), 2.25-2.07 (m, 2H), 1.10 (d, *J*=6.1, 3H), 1.05 (s, 9H), 0.98 (s, 9H); ^{13}C NMR (126 MHz, Chloroform-d) δ = 182.4, 181.2, 171.4, 158.9, 157.0, 149.8, 112.8, 110.9, 108.7, 103.2, 79.5, 64.0, 60.6, 38.5, 27.4, 27.4, 20.9, 20.8, 18.0, 14.3; HRMS (ESI) calcd.for $C_{24}H_{36}O_8SiNa$ $[M+Na]^+$: 503.2072; found: 503.2073.

Preparation of methyl tricyclic ketone 47



(a) Preparation of methyl tricyclic silyl ketone S28

An oven-dried, 150 mL round-bottomed flask was treated with methyl tricyclic alcohol **46** (465 mg, 0.97 mmol, 1.0 equiv), imidazole (329 mg, 4.84 mol, 5.0 equiv) and CH_2Cl_2 (10 mL). After 10 min of continued stirring at ambient temperature, TBSCl (581 mg, 3.9 mmol, 4.0 equiv.) was added in portions during a period of 30 min. Upon complete addition, the resulting reaction mixture was stirred for an additional 2 hour at which point TLC analysis indicated the complete consumption of starting material. The reaction was quenched with *sat.* aq. $NaHCO_3$ (5 mL) and then warmed to ambient temperature. The layers were separated and aqueous layer was extracted with CH_2Cl_2 (3 × 20 mL) and the combined layers were washed with brine (10 mL), dried over Na_2SO_4, filtered and concentration *in vacu*o. The crude residue was purified via SiO_2 flash chromatography (eluent: EtOAc/hexanes = 1:20) to give TBS silyl product **S27** (684 mg, 99% yield) as a yellow oil.

An oven-dried, 150 mL round-bottomed flask was treated with TBS silyl product **S27** (684 mg, 0.96 mmol, 1.0 equiv) and CH_2Cl_2 (10 mL). The resulting solution was stirred at ambient temperature for 10 min prior to the addition of Dess-Martin periodinane (609 mg, 1.44 mmol, 1.5 equiv) in several portions. The reaction was continued at ambient temperature for 3 hours. The reaction was quenched was the addition of *sat.* aq. $NaHCO_3$ (5 mL). The layers were separated and the aqueous layer was extracted with CH_2Cl_2 (3 × 15 mL). The combined layers were washed with brine (10 mL), dried over Na_2SO_4, filtered and concentrated *in vacuo*. The crude residue was purified

via SiO_2 flash chromatography (eluent: EtOAc/hexanes = 1/20) to give methyl tricyclic silyl ketone **S28** (544 mg, 85% yield) as a yellow foamy solid.

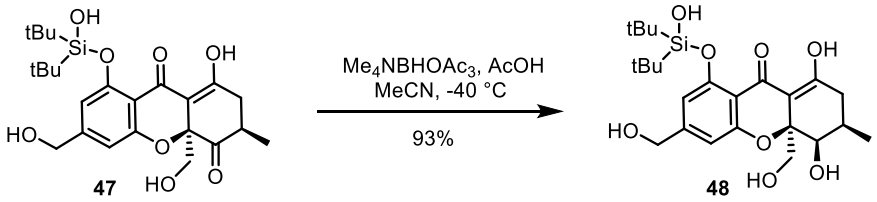
***R*$_f$** = 0.34 (silica gel, 10:1 hexanes:EtOAc); Optical rotation: $[\alpha]_D^{25}$ = -28.5 (c = 1.00, $CHCl_3$); ^{1}H NMR (500 MHz, Chloroform-d) δ = 15.98 (s, 1H), 6.74 (d, *J*=1.4, 1H), 6.63 (d, *J*=1.4, 1H), 4.60 (s, 2H), 3.87 (d, *J*=10.4, 1H), 3.83 (d, *J*=10.4, 1H), 3.67 (t, *J*=5.8, 1H), 3.14 (dddd, *J*=13.2, 11.8, 10.1, 5.9, 1H), 3.02 (dd, *J*=18.2, 8.0, 1H), 2.45 (dd, *J*=18.2, 9.4, 1H), 1.20 (d, *J*=6.6, 3H), 1.06 (s, 9H), 1.04 (s, 9H), 0.91 (s, 9H), 0.80 (s, 9H), 0.07 (s, 6H), -0.09 (d, *J*=7.4, 6H); ^{13}C NMR (126 MHz, Chloroform-d) δ = 203.5, 181.4, 181.3, 158.5, 156.8, 151.3, 112.4, 110.0, 108.2, 103.0, 81.8, 66.6, 64.3, 39.4, 38.6, 27.4, 27.4, 26.2, 26.1, 26.1, 26.0, 25.8, 21.0, 20.9, 18.4, 18.2, 15.1, -5.3, -5.3, -5.5; HRMS (ESI) calcd.for $C_{36}H_{62}O_8Si_3Na$ $[M+Na]^+$: 729.3645; found: 729.3646.

(b) Preparation of methyl tricyclic ketone 47

An oven-dried, 150 mL round-bottomed flask was treated with methyl tricyclic silyl ketone **S28** (550 mg, 0.78 mmol, 1.0 equiv), $CeCl_3 \cdot 7H_2O$ (1.45 g, 3.90 mmol, 5.0 equiv), $(COOH)_2$ (144 mg, 1.56 mmol, 2.0 equiv) and 30 mL MeCN/H_2O (20:1). The reaction mixture was vigorously stirred for 8 hours at which point TLC indicated the complete consumption of starting material and quenched with the addition of *sat.* aq. $NaHCO_3$ (5 mL). EtOAc (20 mL) was added and the layers were separated. The aqueous layer was extracted with EtOAc (3 × 20 mL). The combined layers were washed with brine (20 mL), dried over Na_2SO_4, filtered and concentrated *in vacuo*. The crude residue was purified via SiO_2 flash chromatography (eluent: CH_2Cl_2/MeOH = 20/1) to give dimethyl tricyclic ketone **47** (335 mg, 90% yield) as a yellow foamy solid.

***R*$_f$** = 0.29 (silica gel, 10:1 CH_2Cl_2:MeOH); Optical rotation: $[\alpha]_D^{25}$ = -56.6 (c = 1.00, $CHCl_3$); ^{1}H NMR (500 MHz, Chloroform-d) δ = 16.12 (s, 1H), 6.78 (s, 1H), 6.70 (s, 1H), 4.47 (d, *J*=7.5, 2H), 4.07 (d, *J*=12.7, 1H), 3.81 (d, *J*=12.7, 1H), 3.17 (dt, *J*=14.3, 7.3, 1H), 3.02 (dd, *J*=18.7, 8.2, 1H), 2.46 (dd, *J*=18.9, 10.8, 1H), 1.12 (d, *J*=6.4, 3H), 1.03 (s, 9H), 0.97 (s, 9H); ^{13}C NMR (126 MHz, Chloroform-d) δ = 204.0, 182.2, 180.0, 157.3, 157.3, 150.5, 112.9, 109.8, 108.9, 102.6, 83.4, 66.1, 63.8, 60.6, 40.5, 37.3, 27.3, 27.3, 26.1, 25.9, 21.2, 20.8, 20.7, 14.3, 14.3. HRMS (ESI) calcd.for $C_{24}H_{34}O_8SiNa$ $[M+Na]^+$: 501.1915; found: 501.1910.

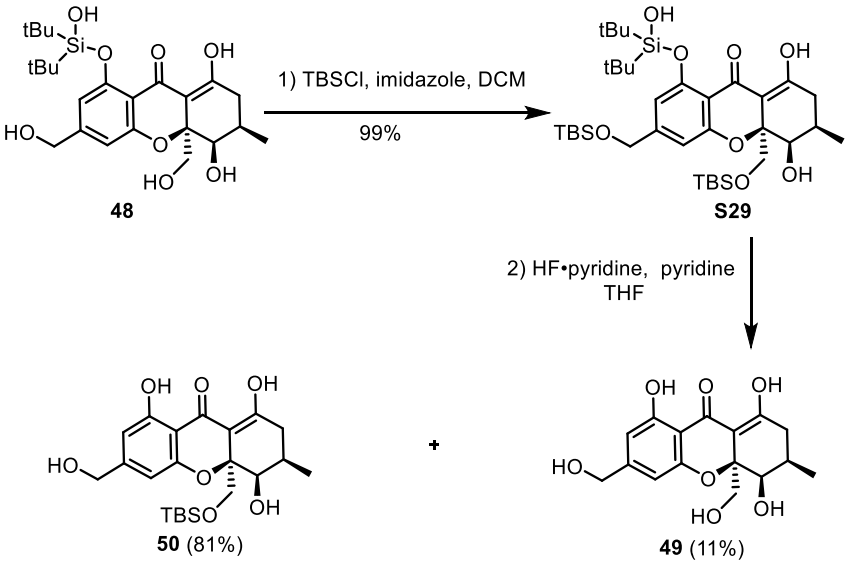
Preparation of methyl tricyclic alcohol 48



An oven-dried, 150 mL round-bottomed flask was treated with tetramethylammonium triacetoxyborohydride (1.75 g, 6.58 mmol, 5.0 equiv) and MeCN (10 mL). After 10 min of continued stirring at ambient temperature, AcOH (2.5 mL) was added *as a single portion* via syringe. Upon complete addition, the resulting reaction was cooled to -40 ℃ and after 15 min of continued stirring, methyl tricyclic ketone **47** (630 mg, 1.32 mmol, 1.0 equiv) was added dropwise via syringe. Upon complete addition, the reaction was continued at -40 ℃ for 12 h at which point TLC analysis indicated the complete consumption of starting material. The reaction was quenched with aqueous sodium potassium tartrate (0.5 M, 30 mL) at 0 ℃ and then warm to ambient temperature. The mixture was vigorously stirred for 1 h. Then the mixture diluted with EtOAc (30 mL) and washed with aqueous saturated sodium bicarbonate. The layers were separated and the aqueous layer was extracted with EtOAc (3 × 30 mL). The combined layers were washed with brine (15 mL), dried over Na_2SO_4, filtered and concentrated in vacuo. The crude residue was purified via SiO_2 flash chromatography (eluent: CH_2Cl_2/MeOH = 20/1) to give dimethyl tricyclic alcohol **48** (588 mg, 93% yield) as a yellow foamy solid.

***R*$_f$** = 0.19 (silica gel, 10:1 CH_2Cl_2:MeOH); Optical rotation: $[\alpha]_D^{25}$ = -38.0 (c = 1.00, $CHCl_3$); ^{1}H NMR (500 MHz, Chloroform-d) δ = 16.21 (s, 1H), 6.70 (s, 1H), 6.52 (s, 1H), 4.41 (s, 2H), 4.18 (s, 1H), 3.86 (d, *J*=13.1, 1H), 3.43 (d, *J*=13.2, 1H), 3.18 (s, 1H), 2.39 (dd, *J*=19.1, 11.3, 1H), 2.28 (dd, *J*=19.3, 6.0, 1H), 2.11 (td, *J*=13.1, 6.8, 1H), 1.09 (d, *J*=6.1, 3H), 1.04 (s, 9H), 0.99 (s, 9H); ^{13}C NMR (126 MHz, Chloroform-d) δ = 187.5, 179.7, 158.1, 157.1, 149.3, 112.9, 110.5, 108.3, 101.0, 83.6, 69.3, 63.9, 63.6, 35.0, 28.3, 27.4, 26.2, 26.0, 20.9, 20.8, 18.0; HRMS (ESI) calcd.for $C_{24}H_{36}O_8SiNa$ $[M+Na]^+$: 503.2072; found: 503.2067.

Preparation of methyl tricyclic silyl 50 and alcohol 49



An oven-dried, 150 mL round-bottomed flask was treated with methyl tricyclic alcohol **48** (550 mg, 1.15 mmol, 1.0 equiv), imidazole (389 mL, 5.73 mol, 5.0 equiv) and CH_2Cl_2 (11 mL). After 10 min of continued stirring at ambient temperature, TBSCl (687 mg, 4.58 mmol, 4.0 equiv.) was added in portions during a period of 30 min. Upon complete addition, the resulting reaction mixture was stirred for an additional 2 hour at which point TLC analysis indicated the complete consumption of starting material. The reaction was quenched with *sat.* aq. $NaHCO_3$ (5 mL) and then warmed to ambient temperature. The layers were separated and aqueous layer was extracted with CH_2Cl_2 (3 × 15 mL) and the combined layers were washed with brine (10 mL), dried over Na_2SO_4, filtered and concentration *in vacu*o. The crude residue was purified via SiO_2 flash chromatography (eluent: EtOAc/hexanes = 1:20) to give TBS silyl product **S29** (803 mg, 99% yield) as a yellow oil.

Preparation of hydrogen fluoride pyridine solution: 100 mL plastic tube was treated with 65-70 wt% HF Þy (6.6 mL, 45.3 mmol, 40.0 equiv) and THF (11.2 mL), The resulting solution was cooled to 0 ℃ via an ice/water bath and stirring was continued at this temperature for 10 min prior to the addition of pyridine (11.0 mL). Upon complete addition, the resulting reaction mixture was stirred for an additional 20 min at 0 ℃.

150 mL plastic tube was treated with TBS silyl product **S29** (803 mg, 1.13 mmol, 1.0 equiv) and THF (12 mL). The resulting solution was cooled to 0 ℃ via an ice/water bath and stirring was continued at this temperature for 10 min prior to the addition of above HF Þy solution dropwise via syringe. The reaction mixture was continued at 0 ℃ until TLC analysis indicated the complete consumption of the starting material (*ca.* 50 min). The reaction was carefully quenched with *sat.* aq.

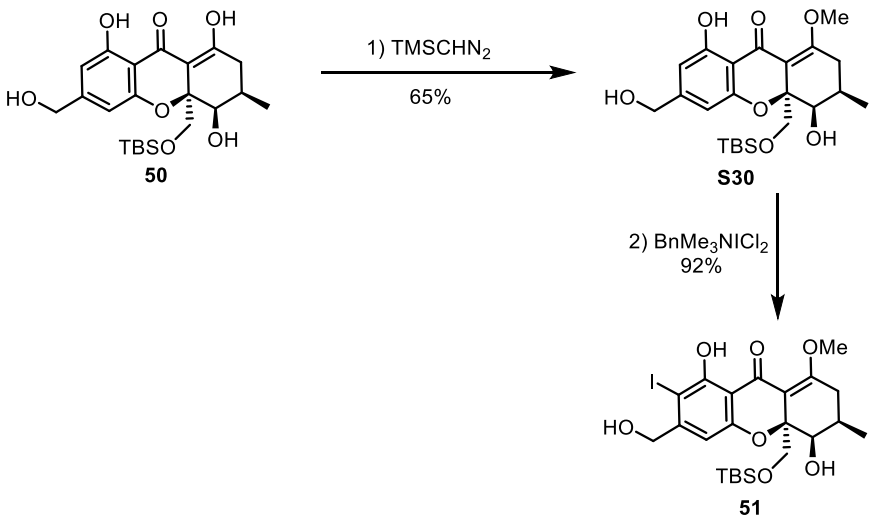
$NaHCO_3$ (30 mL) and diluted with EtOAc (50 mL). The layers were separated and the aqueous layer was extracted with EtOAc (3 × 50 mL). The combined layers were washed with brine (30 mL), dried over Na_2SO_4, filtered and concentrated *in vacu*o. The crude residue was purified via SiO_2 flash chromatography (eluent: EtOAc/hexanes = 1:2) to give methyl tricyclic silyl **50** (400 mg, 81% yield) as a faint yellow solid;

***R*$_f$** = 0.58 (silica gel, 1:1 hexanes:EtOAc); Optical rotation: $[\alpha]_D^{25}$ = -71.3 (c = 1.00, $CHCl_3$); ^{1}H NMR (500 MHz, Chloroform-*d*) δ = 13.93 (s, 1H), 11.46 (s, 1H), 6.41 (s, 1H), 6.38 (s, 1H), 4.54 (s, 2H), 4.07 (s, 1H), 3.77 (d, *J*=11.6, 1H), 3.56 (d, *J*=11.6, 1H), 2.44 (dd, *J*=18.9, 11.1, 1H), 2.31 (dd, *J*=19.0, 6.2, 1H), 2.24 (dd, *J*=12.2, 6.6, 1H), 1.16 (d, *J*=6.7, 3H), 0.80 (s, 9H), -0.11 (d, *J*=12.2, 6H); ^{13}C NMR (126 MHz, Chloroform-*d*) δ = 187.5, 178.8, 162.0, 158.3, 152.1, 107.4, 105.7, 84.3, 71.0, 66.1, 64.5, 33.0, 28.3, 25.7, 18.1, 17.9, -5.5, -5.6; HRMS (ESI) calcd.for $C_{22}H_{33}O_7Si$ $[M+Na]^+$: 437.1990; found: 437.1983.

The crude residue was purified via SiO_2 flash chromatography (eluent: CH_2Cl_2/MeOH = 20/1) to give alcohol **49** (40.2 mg, 11% yield) as a yellow oil.

***R*$_f$** = 0.08 (silica gel, 1:1 hexanes:EtOAc); Optical rotation: $[\alpha]_D^{25}$ = -69.3 (c = 1.00, $CHCl_3$); ^{1}H NMR (500 MHz, DMSO-d_6) δ = 14.02 (s, 1H), 11.36 (s, 1H), 6.41 (s, 1H), 6.38 (s, 1H), 4.42 (d, *J*=5.5, 2H), 3.93 (d, *J*=4.1, 1H), 3.64 (dd, *J*=12.6, 5.6, 1H), 3.44 (dd, *J*=12.6, 5.7, 1H), 3.37 (s, 3H), 2.32 (q, *J*=11.8, 11.2, 1H), 2.21 (d, *J*=12.6, 2H), 1.01 (d, *J*=5.7, 3H); ^{13}C NMR (126 MHz, DMSO-d_6) δ = 186.8, 178.9, 160.9, 158.8, 154.1, 105.8, 105.7, 104.8, 101.4, 84.5, 68.8, 64.5, 62.4, 33.0, 27.8, 17.9; HRMS (ESI) calcd.for $C_{16}H_{19}O_7$ $[M+H]^+$: 323.1125; found: 323.1132.

Preparation of methyl tricyclic iodide 51



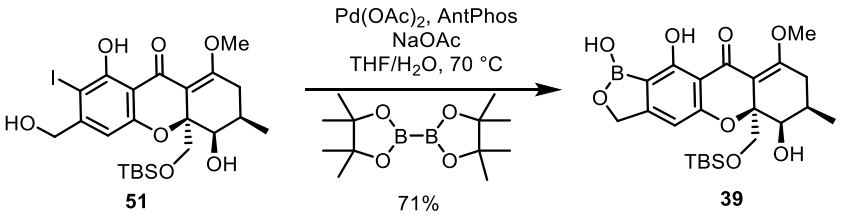
An oven-dried, 100 mL round-bottomed flask was treated with methyl tricyclic silyl **50** (220 mg, 0.50 mmol, 1.0 equiv) and anhydrous 4.0 mL CH_2Cl_2/MeOH (1:1) under a N_2 atmosphere. The resulting solution was cooled to 0 ℃ via an ice/water bath and stirring was continued at this temperature for 15 min prior to the addition of $TMSCHN_2$ (1.25 mL, 2.0 mol/L in hexane, 2.5 mmol, 5.0 equiv) via syringe. The reaction was warmed to ambient temperature and stirred for 15 min and quenched with 10 w% aqueous AcOH solution. The reaction was extracted twice with 20 mL of CH_2Cl_2. The combined layers were washed with brine (10 mL), dried over Na_2SO_4, filtered and concentrated *in vacu*o. The crude residue was purified via SiO_2 flash chromatography (eluent: EtOAc/hexanes = 1:2) to give product **S30** (134 mg, 65% yield) as a yellow foamy solid.

An oven-dried, 25 mL round-bottomed flask was treated with product **S30** (105 mg, 0.23 mmol, 1.0 equiv) and $CaCO_3$ (163 mg, 1.63 mmol, 7.0 equiv), $Me_3NBnICl_2$ (81.2 mg, 0.23 mmol, 1.0 equiv), and anhydrous 5 mL CH_2Cl_2/MeOH (5:1). The suspension was vigorously stirred for 6 h at which time TLC analysis indicated the complete consumption of starting material then diluted with CH_2Cl_2, filtered through a short pad of Celite and concentrated *in vacuo*. Purification of the crude residue by SiO_2 flash chromatography (eluent: EtOAc/hexanes = 1:2) to give dimethyl tricyclic iodide **51** (123 mg, 92% yield) as a yellow foamy solid.

$\boldsymbol{R_f}$ = 0.39 (silica gel, 1:1 hexanes:EtOAc); Optical rotation: $[\alpha]_D^{25}$ = -70.0 (c = 1.00, $CHCl_3$); ^{1}H NMR (500 MHz, Chloroform-*d*) δ = 13.80 (s, 1H), 6.60 (s, 1H), 4.77-4.40 (m, 2H), 4.09 (s, 1H), 3.93 (s, 3H), 3.80 (d, *J*=11.7, 1H), 3.58 (d, *J*=11.5, 1H), 2.53-2.39 (m, 2H), 2.19 (p, *J*=10.8, 9.0, 1H), 1.20 (d, *J*=7.1, 3H), 0.78 (s, 9H), -0.14 (d, *J*=6.5, 3H); ^{13}C NMR (126 MHz, Chloroform-*d*) δ = 185.3,

171.0, 160.9, 157.9, 152.1, 107.3, 106.9, 103.5, 85.8, 70.2, 69.4, 65.7, 56.1, 30.3, 28.2, 25.9, 25.7, 18.1, 17.9, -5.5, -5.6; HRMS (ESI) calcd.for $C_{22}H_{33}IO_7SiNa$ $[M+Na]^+$: 599.0932; found: 599.0924.

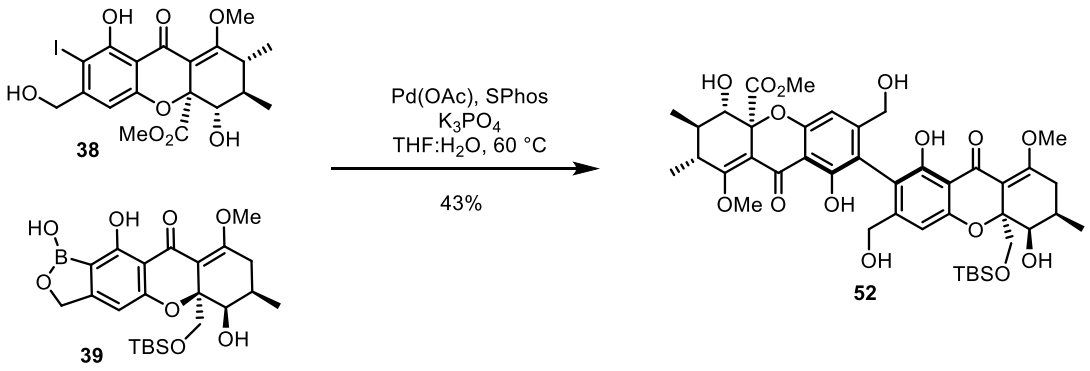
Preparation of benzoxaborole 39



To a mixture of aryl iodide **51** (30.0 mg, 0.052 mmol, 1.0 equiv), bis(pinacolato)diboron (26.4 mg, 0.104 mmol, 2.0 equiv), sodium acetate (15.3 mg, 0.156 mmol, 3.0 equiv), $Pd(OAc)_2$ (2.34 mg, 0.01 mmol, 0.2 equiv) and AntPhos (5.57 mg, 0.015 mmol, Pd/ligand mol ratio: 1/1.5, 0.3 equiv) under N_2 was charged freshly degassed 2.5 mL THF/water (4:1). The biphasic mixture was immediately placed in preheated oil bath at 70 ^oC and the reaction was continued at 70 ^oC for 3.5 h. The reaction mixture was cooled to ambient temperature, diluted with EtOAc (10 mL), and treated with sat. aq. NH_4Cl (5 mL). The layers were separated and the aqueous layer was extracted with EtOAc (3 × 10 mL). The combined layers were washed with brine (50 mL), dried over Na_2SO_4, filtered and concentrated *in vacu*o. The crude residue was purified via SiO_2 flash chromatography (eluent: CH_2Cl_2/MeOH = 30/1) to give benzoxaborole **39** (17.6 mg, 71% yield) as a yellow oil.

$\boldsymbol{R_f}$ = 0.07 (silica gel, 1:1 hexanes:EtOAc); Optical rotation: $[\alpha]_D^{25}$ = -115.5 (c = 1.00, $CHCl_3$); ^{1}H NMR (500 MHz, Chloroform-*d*) δ = 13.50 (s, 1H), 6.34 (s, 1H), 5.28 (s, 1H), 4.96 (s, 2H), 4.14 (d, *J*=1.5, 1H), 3.93 (s, 3H), 3.89 (d, *J*=11.9, 1H), 3.61 (d, *J*=11.8, 1H), 2.51 (s, 1H), 2.47 (d, *J*=2.7, 1H), 2.23-2.14 (m, 1H), 1.22 (d, *J*=6.7, 3H), 0.81 (s, 9H), -0.12 (d, *J*=1.2, 6H); ^{13}C NMR (126 MHz, Chloroform-*d*) δ = 186.5, 170.1, 166.0, 163.9, 161.1, 107.1, 104.0, 101.0, 86.0, 71.3, 69.8, 65.7, 56.1, 30.2, 28.4, 25.8, 18.2, 18.0, -5.5, -5.6; HRMS (ESI) calcd.for $C_{22}H_{33}BO_8SiNa$ $[M+Na]^+$: 498.1968; found: 498.1965.

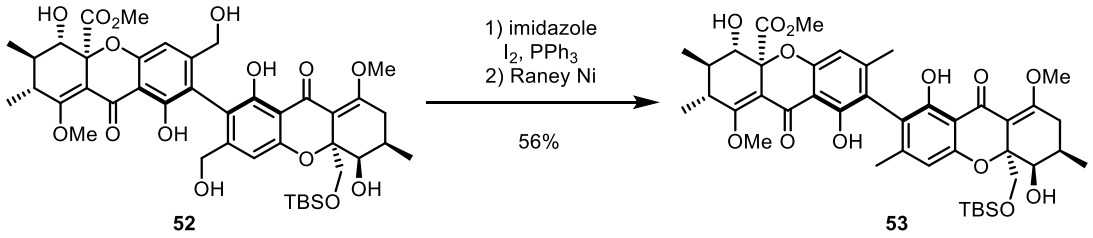
Preparation of coupling product 52



To a mixture of iodide **38** (15.0 mg, 0.032 mmol, 1.0 equiv), benzoxaborole **39** (17.0 mg, 0.036 mmol, 1.2 equiv), K_3PO_4 (19.0 mg, 0.089 mmol, 3.0 equiv), $Pd(OAc)_2$ (1.37 mg, 6.0 μmol, 0.2 equiv) and SPhos (3.88 mg, 8.9 μmol, 0.3 equiv, Pd/ligand mol ratio: 1/1.5) under N_2 was charged freshly degassed 1.6 mL THF/water (4:1). The biphasic mixture was immediately placed in preheated oil bath at 60 ^oC and the reaction was continued at 60 ^oC for 45 min. The reaction mixture was cooled to ambient temperature, diluted with EtOAc (10 mL), and treated with *sat.* aq. NH_4Cl (5 mL). The layers were separated and the aqueous layer was extracted with EtOAc (3 × 10 mL). The combined layers were washed with brine (10 mL), dried over Na_2SO_4, filtered and concentrated *in vacu*o. The crude residue was purified via SiO_2 flash chromatography (eluent: EtOAc/hexanes = 1/1) to give coupling products **52** (10.6 mg, 43% yield) as a yellow oil.

$\boldsymbol{R_f}$ = 0.25 (silica gel, 10:1 CH_2Cl_2:MeOH); Optical rotation: $[\alpha]_D^{25}$ = -31.6 (c = 0.4, $CHCl_3$); ^{1}H NMR (500 MHz, Chloroform-*d*) δ = 13.39 (s, 1H), 12.83 (s, 1H), 6.83 (s, 1H), 6.69 (s, 1H), 4.37 (d, *J*=13.0, 1H), 4.32 (d, *J*=12.9, 1H), 4.27 (d, *J*=13.0, 1H), 4.22 (d, *J*=12.9, 1H), 4.12 (d, *J*=1.8, 1H), 3.93 (d, *J*=11.7, 1H), 3.89 (s, 3H), 3.87 (d, *J*=9.5, 1H), 3.82 (s, 3H), 3.73 (s, 3H), 3.68 (d, *J*=10.2, 1H), 2.49-2.42 (m, 2H), 2.26 (dd, *J*=8.9, 6.9, 1H), 2.20 (dt, *J*=12.0, 6.9, 1H), 1.88 (ddt, *J*=15.3, 12.7, 6.6, 1H), 1.36 (d, *J*=6.9, 3H), 1.23 (d, *J*=7.0, 3H), 1.18 (d, *J*=6.5, 3H), 0.83 (s, 9H), -0.08 (d, *J*=3.3, 6H); ^{13}C NMR (151 MHz, Chloroform-*d*) δ = 186.2, 185.2, 174.5, 169.9, 160.0, 159.8, 158.6, 157.6, 151.1, 149.7, 114.3, 113.2, 109.1, 107.5, 107.4, 107.0, 106.2, 105.9, 104.1, 87.2, 85.5, 69.8, 65.8, 63.4, 63.2, 61.9, 55.9, 53.3, 42.2, 35.7, 30.1, 29.7, 28.4, 25.7, 18.2, 17.9, 17.1, 16.2, -5.7, -5.7; HRMS (ESI) calcd.for $C_{42}H_{54}O_{15}SiNa$ $[M+Na]^+$: 849.3124; found: 849.3134.

Preparation of dimer 53

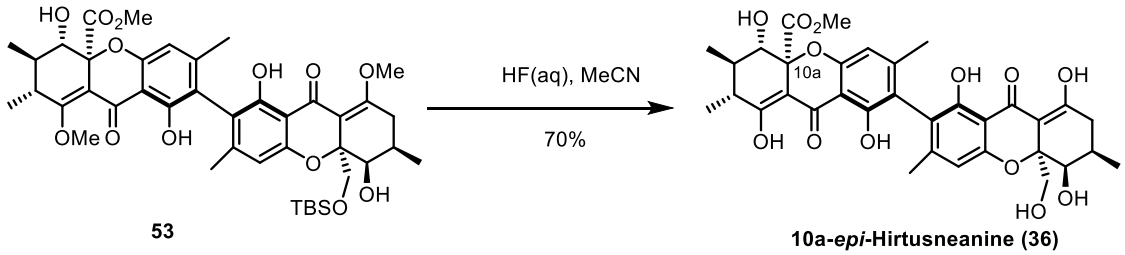


An oven-dried, 25 mL round-bottomed flask was treated with iodine (25.7 mg, 0.102 mmol, 6.0 equiv) and anhydrous 1.0 mL CH_2Cl_2 under a N_2 atmosphere. After 10 min of continued stirring, triphenylphosphine (26.7 mg, 0.102 mmol, 6.0 equiv) was added. The reaction was continued at ambient temperature for another additional 15 min prior to the addition of coupling products **52** (14.0 mg, 0.017 mmol, 1.0 equiv). Upon complete addition, the reaction was closely monitored by TLC analysis. The reaction was allowed to continue for an additional 20 min before it was diluted with CH_2Cl_2 and quenched with *sat.* aq. $Na_2S_2O_3$. The layers were separated and the aueous layer was extracted with (3 × 10 mL). The combined layers were washed with brine (10 mL), dried over Na_2SO_4, filtered and concentrated *in vacu*o. The crude residue diiodide **53** was used without further purification.

An oven-dried, 25 mL round-bottomed flask was treated with crude residue diiodide **53** and THF (5 mL). After 5 min of continued stirring, Raney nickel (50 mg, 0.847 mmol, 50.0 equiv) was added. The reaction was continued at ambient temperature for another additional 30 min. The suspension was vigorously stirred until the TLC analysis indicated complete consumption of starting material then diluted with EtOAc, filtered through a short pad of Celite and concentrated in vacuo. Purification of the crude residue by preparative TLC (eluent: EtOAc/hexanes = 1/1) to give dimer **53** (7.53 mg, 56%) as a yellow solid.

***R*$_f$** = 0.53 (silica gel, 1:2 hexanes:EtOAc); Optical rotation: $[\alpha]_D^{25}$ = -100.7 (c = 0.4, $CHCl_3$); ^{1}H NMR (600 MHz, Chloroform-*d*) δ = 13.02 (s, 1H), 12.56 (s, 1H), 6.51 (s, 1H), 6.37 (s, 1H), 4.10 (s, 1H), 3.94 (d, *J*=11.7, 1H), 3.86 (s, 3H), 3.86 (d, *J*=11.8, 1H), 3.81 (s, 3H), 3.69 (s, 3H), 3.64 (d, *J*=11.8, 1H), 2.49-2.37 (m, 2H), 2.23 (dd, *J*=8.8, 6.8, 1H), 2.16 (dt, *J*=16.3, 8.7, 1H), 2.04 (s, 3H), 1.99 (s, 3H), 1.90-1.81 (m, 1H), 1.34 (d, *J*=6.8, 3H), 1.22 (d, *J*=6.6, 3H), 1.16 (d, *J*=6.4, 3H), 0.83 (s, 9H), -0.10 (d, *J*=3.7, 6H); ^{13}C NMR (151 MHz, Chloroform-*d*) δ = 186.3, 185.2, 173.6, 170.1, 168.9, 160.3, 160.2, 157.8, 156.7, 149.6, 148.2, 117.2, 116.1, 108.7, 108.2, 106.7, 106.5, 106.4, 104.5, 87.1, 85.3, 76.4, 69.7, 65.6, 62.1, 56.0, 53.2, 42.5, 35.8, 30.2, 29.8, 28.5, 25.9, 20.9, 20.7, 18.3, 18.0, 17.1, 16.2, -5.6, -5.7; CD (c, 0.3 dioxan) λ (Δε) 400 (0.27), 329 (-10.1), 392 (-1.8), 282 (2.8), 258 (-2.4), 245 (-7.4), 233(13.5), 224 (37.9), 210 (14.8) nm; HRMS (ESI) calcd.for $C_{42}H_{54}O_{13}SiNa$ $[M+Na]^+$: 817.3226; found: 817.3224.

Preparation of 10a-*epi*-hirtusneanine (36)



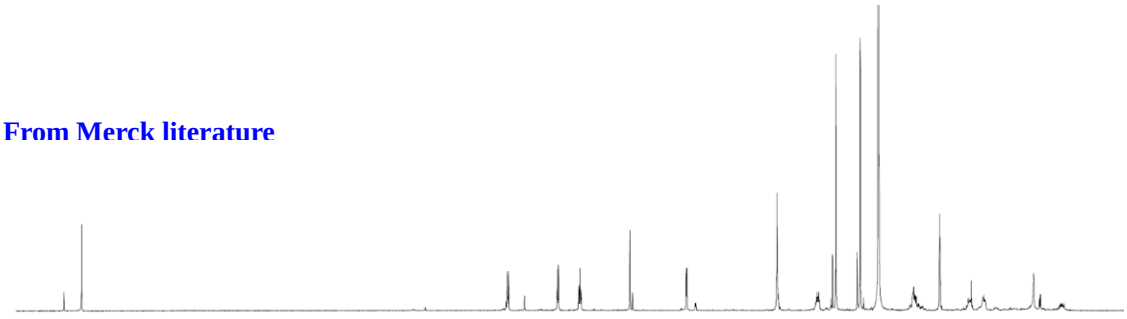
53 **10a-*epi*-Hirtusneanine (36)**

10 mL plastic tube was treated with **53** (4.0 mg, 5.0 μmol, 1.0 equiv) and MeCN (0.5 ml). The resulting solution was treated with HF (0.16 mL, 48-51% solution in water) via syringe. The reaction was left to stir at ambient temperature for 2 days and TLC analysis indicated the complete consumption of starting material. The reaction was cooled to ambient temperature the quenched with the carefully addition of *sat.* aq. $NaHCO_3$ (3 mL). EtOAc (5 mL) was added and the layers were separated. The aqueous layer was extracted with EtOAc (3×10 mL) and the combined layers were washed with brine (5 mL), dried over Na_2SO_4, filtered and concentration *in vacu*o. The crude residue was purified via preparative TLC (eluent: CH_2Cl_2/MeOH = 30/1) to give 10a-*epi*-hirtusneanine (**36**) (2.3 mg, 66% yield) as a yellow solid.

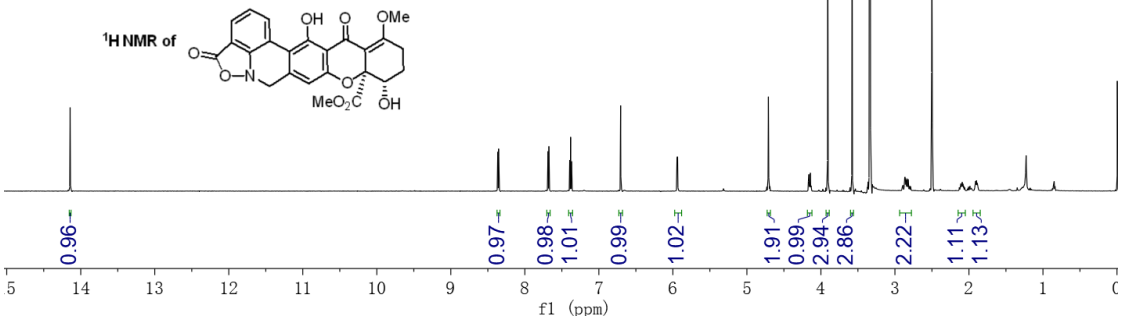
$\boldsymbol{R_f}$ = 0.38 (silica gel, 10:1 CH_2Cl_2:MeOH); Optical rotation: synthetic: $[\alpha]_D^{25}$ = -62.4 (c = 0.05, MeOH); natural: $[\alpha]_D^{23}$ = -232 (c = 0.01, MeOH); (**Chloroform-*d***); ^{1}H NMR (500 MHz, Chloroform-*d*) δ = 14.22 (s, 1H), 13.92 (s, 1H), 11.73 (s, 1H), 11.47 (s, 1H), 6.57 (s, 1H), 6.47 (s, 1H), 4.25 (s, 1H), 4.05 (d, *J*=12.9, 1H), 3.92 (d, *J*=11.4, 1H), 3.74 (s, 3H), 3.56 (d, *J*=12.9, 1H), 2.50 (dd, *J*=19.0, 11.3, 1H), 2.38-2.31 (m, 2H), 2.28-2.19 (m, 1H), 2.09 (s, 3H), 2.04 (s, 3H), 1.94 (ddd, *J*=11.2, 8.9, 6.2, 1H), 1.37 (d, *J*=7.0, 3H), 1.29 (d, *J*=8.4, 3H), 1.21 (d, *J*=6.5, 3H); ^{13}C NMR (126 MHz, Chloroform-*d*) δ = 187.4, 186.6, 180.4, 178.9, 170.4, 159.7, 159.3, 157.8, 156.2, 150.0, 149.8, 117.1, 116.8, 109.4, 109.2, 104.9, 104.7, 100.4, 99.9, 84.3, 84.2, 76.4, 69.3, 64.9, 53.2, 36.8, 32.8,32.0, 29.7, 21.0, 20.8, 17.8, 16.6, 15.8. (**DMSO-d_6**); ^{1}H NMR (500 MHz, DMSO-d_6) δ = 14.25 (s, 1H), 13.89 (s, 1H), 11.61 (s, 1H), 11.18 (s, 1H), 6.58 (s, 1H), 6.43 (s, 1H), 3.95 (s, 1H), 3.81 (dd, *J*=11.1, 5.5, 1H), 3.69 (dd, *J*=12.3, 4.5, 1H), 3.60 (s, 3H), 3.46 (dd, *J*=12.2, 5.0, 1H), 2.47 (m, 1 H), 2.34 (dd, *J*=23.5, 10.6, 1H), 2.23 (m, 1H), 2.20 (m, 1H), 2.02 (s, 3H), 1.93 (s, 3H), 1.85 (ddq, J=11.3, 9.0, 6.2 Hz, 1 H), 1.26 (d, *J*=7.2, 3H), 1.09 (d, *J*=6.5, 3H), 1.02 (d, *J*=5.5, 3H); ^{13}C NMR (126 MHz, DMSO-d_6) δ = 187.1, 186.2, 180.9, 178.5, 170.2, 158.5, 158.5, 158.3, 157.9, 149.8, 148.8, 116.4, 115.0, 109.5, 108.9, 104.4, 104.0, 101.2, 101.0, 84.5, 84.4, 74.5, 68.8, 64.6, 52.8, 37.4, 33.7, 31.3, 29.1, 20.6, 20.3, 17.9, 16.3, 15.5; HRMS (ESI) calcd.for $C_{34}H_{37}O_{13}$ $[M+H]^+$: 653.2229; found: 653.2226.

4. Comparison of NMR Data of derivative 12 from Merck lab[2] and our lab.

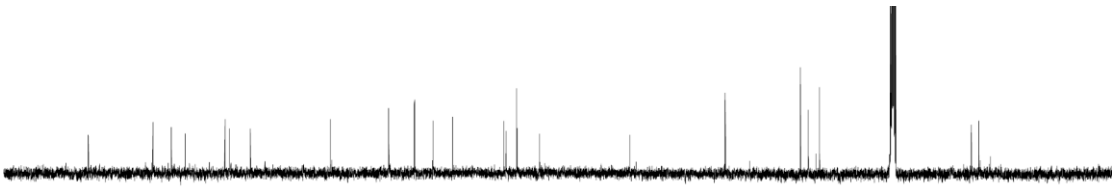
From Merck literature



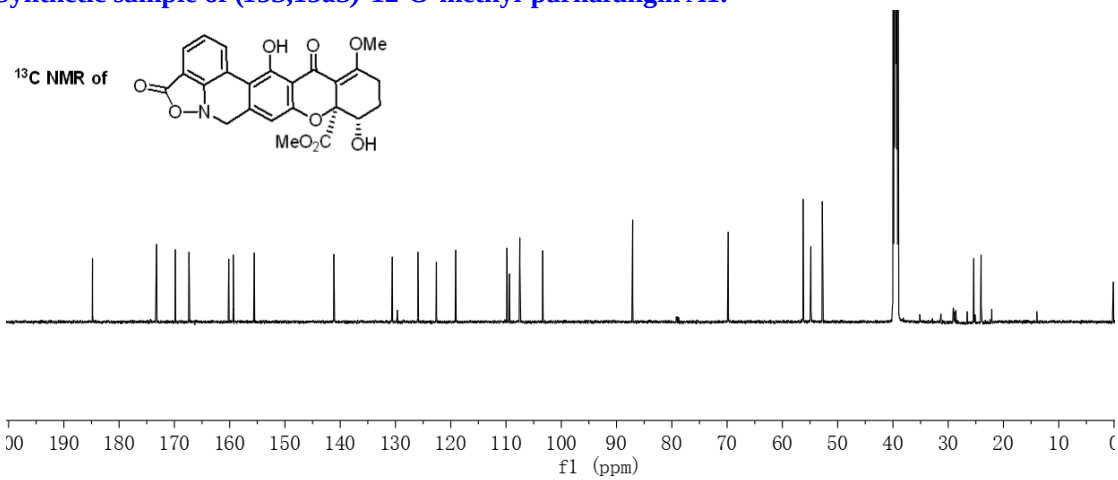
Synthetic sample of (*15S,15aS*)-12-O-methyl-parnafungin A1.

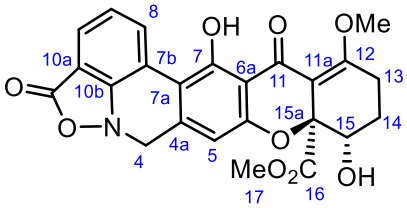


From Merck literature



Synthetic sample of (*15S,15aS)*-12-O-methyl-parnafungin A1.





12-O-methyl-parnafungin A1

Table S2. Comparison of ^{1}H NMR data for (15S,15aS)-12-O-methyl-parnafungin A1 (12).

Proton No.	Natural ^{1}H NMR, 499 MHz, DMSO-*d6* ^{1}H [δ, multi., *J* (Hz)]	Synthetic ^{1}H NMR, 600 MHz, DMSO-*d6* ^{1}H [δ, multi., *J* (Hz)]	Chemical shift, Δδ (ppm)
O(7)-H	14.13 (s, 1 H)	14.13 (s), 1 H	0.00
8	8.34 (d, *J* = 7.5 Hz, 1 H)	8.36 (dd, *J* = 7.5, 0.8 Hz), 1 H	0.02
10	7.68 (d, *J* = 7.8 Hz, 1 H)	7.68 (dd, *J* = 7.9, 0.8 Hz), 1 H	0.00
9	7.36 (dd, *J* =7.8, 7.5 Hz, 1 H)	7.38 (t, *J* =7.7 Hz, 1 H)	0.02
5	6.68 (s, 1 H)	6.71 (s, 1 H)	0.03
O(15)-H	5.92 (d, *J* = 3.4 Hz, 1 H)	5.94 (d, *J* = 4.8 Hz, 1 H)	0.02
4	4.70 (s, 2 H)	4.71 (s, 2 H)	0.01
15	4.15 (m, 1 H)	4.15 (dt, *J* = 12.0, 4.7 Hz)	0.00
12-*O*-CH_3	3.88 (s, 3 H)	3.91 (s, 3 H)	0.03
17	3.55 (s, 3 H)	3.58 (s, 3 H)	0.03
13	2.83 (m, 2 H)	2.86 (m, 2 H)	0.03
14	2.06 (m, 1 H)	2.10 (m, 2 H)	0.04
14’	1.87 (m, 1 H)	1.90 (m, 2 H)	0.03
1			
4a			
6			
6a			
7			
7a			
10a			
10b			
11			
11a			

Table S3. Comparison of ^{13}C NMR data for (15S,15aS)-12-O-methyl-parnafungin A1 (12).

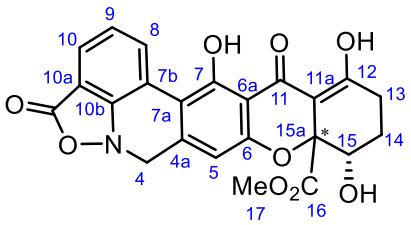
carbon No.	Natural ^{13}C NMR, 125 MHz, DMSO-*d6* ^{1}H [δ, multi., *J* (Hz)]	Syntehtic ^{13}C NMR, 151 MHz, DMSO-*d6* ^{1}H [δ, multi., *J* (Hz)]	Chemical shift, Δδ (ppm)
11	184.8	184.8	0.0
12	173.2	173.2	0.0
16	169.8	169.8	0.0
1	167.3	167.4	0.1
7	160.1	160.2	0.1
6	159.3	159.3	0.0
10b	155.5	155.6	0.1
4a	141.1	141.1	0.0
8	130.5	130.5	0.0
9	125.9	125.9	0.0
10	122.6	122.6	0.0
7b	119.1	119.1	0.0
10a	109.8	109.8	0.0
7a	109.4	109.4	0.0
5	107.5	107.5	0.0
6a	107.4	107.4	0.0
11a	103.3	103.4	0.1
15a	87.0	87.1	0.1
15	69.8	69.8	0.0
12-*O*-CH_3	56.2	56.3	0.1
4	54.8	54.8	0.0
17	52.7	52.8	0.1
14	25.3	25.4	0.1
13	24.0	24.0	0

5. NMR Data (in $CDCl_3$) of Parnafungin A1 (1)

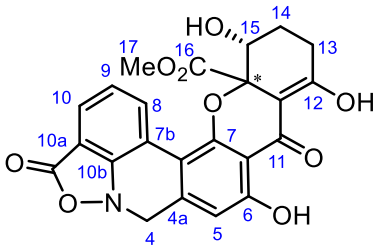
Table S4. ^{1}H NMR and ^{13}C NMR data for parnafungin A1 (1).

Proton No.	Synthetic ^{1}H NMR, 600 MHz, $CDCl_3$ ^{1}H [δ, multi., *J* (Hz)]	carbon No.	Synthetic ^{13}C NMR, 151 MHz, $CDCl_3$ ^{1}H [δ, multi., *J* (Hz)]
O(7)-H	13.78 (s, 1 H)	11	188.8
O(12)-H	12.30 (s, 1 H)	12	179.5
8	8.43 (dd, *J* = 7.6, 0.8 Hz, 1 H)	16	169.9
10	7.66 (dd, *J* = 7.8, 0.8 Hz, 1 H)	1	168.1
9	7.30 (t, *J* =7.7 Hz, 1 H)	7	160.1
5	6.58 (s, 1 H)	6	159.0
4	4.53 (m, 1 H)	10b	155.9
	4.53 (m, 1 H)	4a	142.0
15	4.15 (dd, *J* = 12.0, 4.7 Hz)	8	131.6
17	3.74 (s, 3 H)	9	125.9
13	2.72 (m, 2 H)	10	123.5
14	2.26 (m, 1 H)	7b	119.1
	2.13 (m, 1 H)	10a	112.0
1		7a	110.7
4a		5	108.3
6		6a	107.2
6a		11a	101.3
7		15a	85.1
7a		15	71.9
10a		4	56.0
10b		17	53.6
11		14	27.9
11a		13	24.0
12			
15a			
16			

6. Comparison of NMR Data of Natural[2] and Synthetic Parnafungins



Parnafungin A1 (**1**, syn-CO_2Me)
Parnafungin A2 (**2**, anti-CO_2Me)

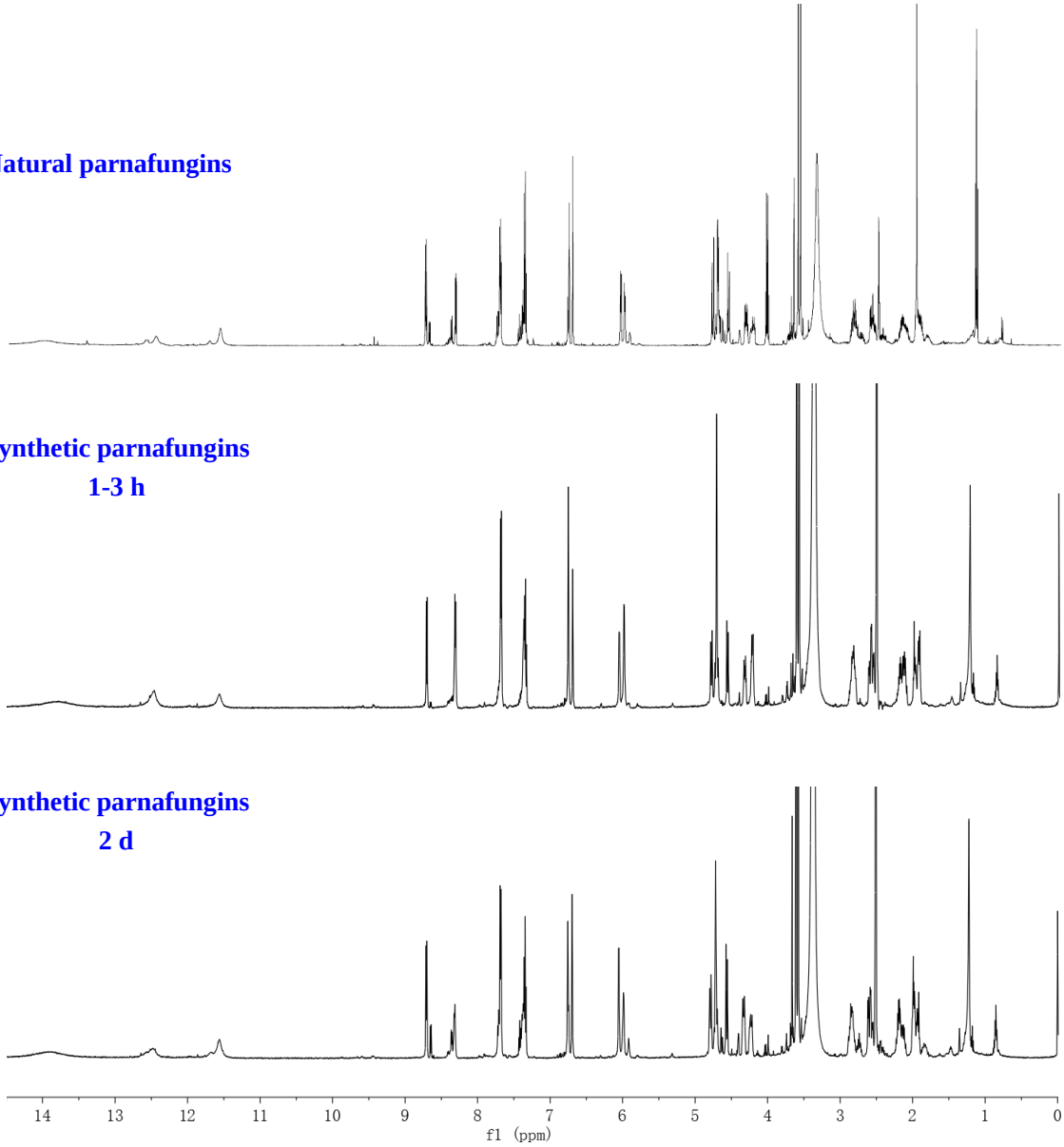


Parnafungin B1 (**3**, syn-CO_2Me)
Parnafungin B2 (**4**, anti-CO_2Me)

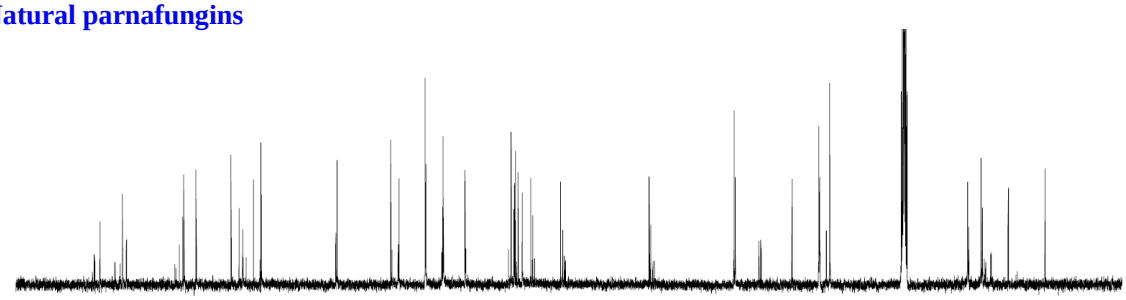
Natural parnafungins

Synthetic parnafungins
1-3 h

Synthetic parnafungins
2 d

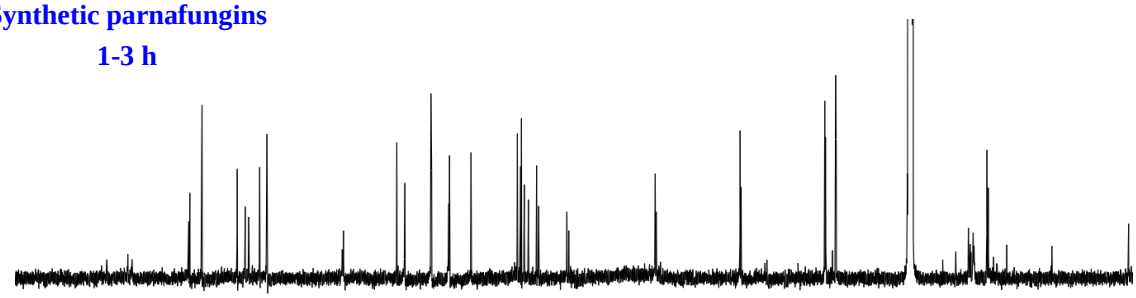


Natural parnafungins



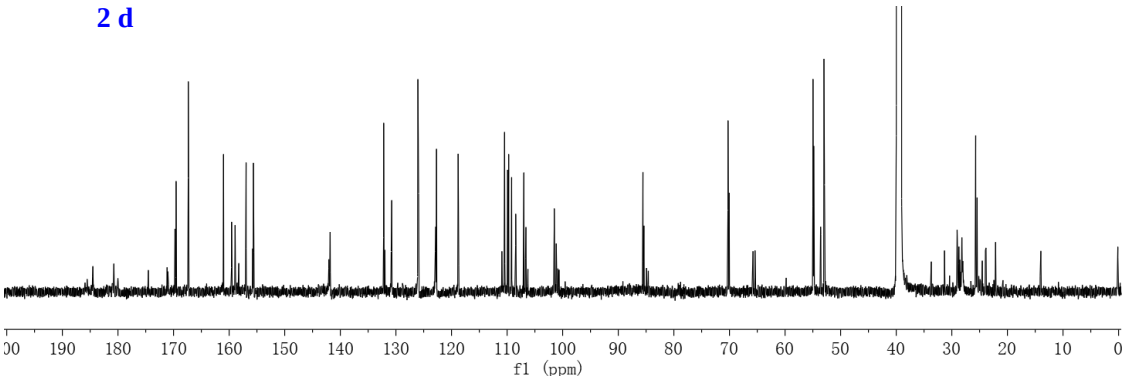
Synthetic parnafungins

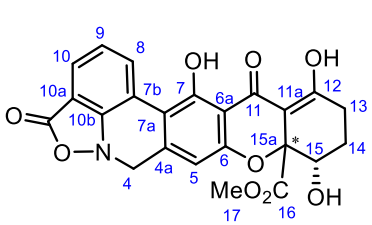
1-3 h



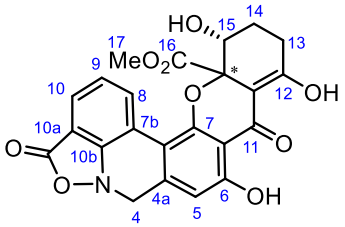
Synthetic parnafungins

2 d





Parnafungin A1 (**1**, syn-CO_2Me)
Parnafungin A2 (**2**, anti-CO_2Me)



Parnafungin B1 (**3**, syn-CO_2Me)
Parnafungin B2 (**4**, anti-CO_2Me)

Table S5. Comparison of ^{1}H NMR data for parnafungin A1.

Proton No.	Natural ^{1}H NMR, 499 MHz, DMSO-*d6* ^{1}H [δ, multi., *J* (Hz)]	Synthetic ^{1}H NMR, 600 MHz, DMSO-*d6* ^{1}H [δ, multi., *J* (Hz)]	Chemical shift, Δδ (ppm)
O(12)-H	13.85 (br, 1 H)	13.78 (br, 1 H)	-0.07
O(7)-H	12.35 (br, 1 H)	12.44 (br, 1 H)	0.10
8	8.27 (d, *J* = 7.3 Hz, 1 H)	8.29 (d, *J* = 7.4, 1 H)	0.02
10	7.65 (d, *J* = 7.8 Hz, 1 H)	7.65 (dd, *J* = 7.8, 1 H)	0.00
9	7.34 (dd, *J* =7.8, 7.3 Hz, 1 H)	7.34 (dd, *J* =7.8, 7.3 Hz, 1 H)	0.00
5	6.72 (s, 1 H)	6.73 (s, 1 H)	0.01
O(15)-H	5.92 (d, *J* = 4.6 Hz, 1 H)	5.97 (d, *J* = 4.8 Hz, 1 H)	0.05
4	4.70 (d, *J* = 11.9 Hz, 1 H)	4.70 (d, *J* = 10.4 Hz, 1 H)	0.00
	4.67 (d, *J* = 11.9 Hz, 1 H)	4.68 (d, *J* = 10.4 Hz, 1 H)	0.01
15	4.20 (dt, *J* = 12.0, 4.6 Hz, 1 H)	4.20 (dt, *J* = 12.3, 4.8 Hz)	0.00
17	3.56 (s, 3 H)	3.56 (s, 3 H)	0.00
13	2.82 (m, 1 H)	2.82 (m, 2 H)	0.00
	2.60 (m, 1 H)	2.58 (m, 1 H)	-0.02
14	2.13 (m, 1 H)	2.12 (m, 2 H)	-0.01
	1.94 (m, 1 H)	1.95 (m, 2 H)	0.01
1			
4a			
6			
6a			
7			
7a			
10a			
10b			
11			
11a			
12			
15a			
16			

Table S6. Comparison of ^{13}C NMR data for parnafungin A1.

carbon No.	Natural ^{13}C NMR, 125 MHz, DMSO-*d6* ^{1}H [δ, multi., *J* (Hz)]	Synthetic ^{13}C NMR, 151 MHz, DMSO-*d6* ^{1}H [δ, multi., *J* (Hz)]	Chemical shift, Δδ (ppm)
11	185.6	185.5 (br)	0.0
12	179.8	180.0(br)	0.0
16	169.7	169.7	0.0
1	167.2	167.3	0.1
7	160.9	161.0	0.1
6	159.5	159.6	0.0
10b	155.5	155.6	0.1
4a	142.0	142.0	0.0
8	130.7	130.7	0.0
9	125.9	125.9	0.0
10	122.8	122.8	0.0
7b	118.7	118.8	0.0
10a	109.9	109.9	0.0
7a	109.8	109.9	0.0
5	108.5	108.5	0.0
6a	106.5	106.6	0.0
11a	101.1	101.2	0.1
15a	85.3	85.4	0.1
15	70.0	70.1	0.0
4	54.8	54.8	0.0
17	53.0	53.0	0.1
13	27.7	28.0 (br)	0.1
14	25.3	25.5	0

Table S7. Comparison of ^{1}H NMR data for parnafungin B1.

Proton No.	Natural ^{1}H NMR, 499 MHz, DMSO-*d6* ^{1}H [δ, multi., *J* (Hz)]	Synthetic ^{1}H NMR, 600 MHz, DMSO-*d6* ^{1}H [δ, multi., *J* (Hz)]	Chemical shift, Δδ (ppm)
O(12)-H	13.85 (br, 1 H)	13.78 (br, 1 H)	-0.07
O(6)-H	11.62 (br, 1 H)	11.67 (br, 1 H)	0.06
8	8.32 (d, *J* = 7.3 Hz, 1 H)	8.34 (d, *J* = 7.6, 1 H)	0.01
10	7.67 (d, *J* = 7.6 Hz, 1 H)	7.70 (d, *J* = 8.0, 1 H)	0.00
9	7.40 (dd, *J* = 7.3, 7.6 Hz, 1 H)	7.40 (t, *J* =7.8, 1 H)	0.00
5	6.74 (s, 1 H)	6.74 (s, 1 H)	0.00
O(15)-H	5.97 (obscured)	5.97 (obscured)	0.02
4	4.70-4.68 (obscured)	4.70-4.67 (obscured)	0.00
			0.00
15	4.39 (t, *J* = 4.6 Hz, 1 H)	4.39 (d, *J* = 4.2 Hz)	0.01
17	3.59 (s, 3 H)	3.59 (s, 3 H)	0.00
13	2.70 (m, 1 H)	2.72 (m, 1 H)	0.00
	2.40 (m, 1 H)k	2.42 (m, 1 H)	-0.02
14	2.13 (m, 1 H)	2.14 (m, 1 H)	0.00
	1.94 (m, 1 H)	1.94 (m, 1 H)	0.00
1			
4a			
6			
6a			
7			
7a			
10a			
10b			
11			
11a			
12			
15a			
16			

Table S8. Comparison of ^{13}C NMR data for parnafungin B1.

carbon No.	Natural ^{13}C NMR, 125 MHz, DMSO-*d6* ^{1}H [δ, multi., *J* (Hz)]	Synthetic ^{13}C NMR, 151 MHz, DMSO-*d6* ^{1}H [δ, multi., *J* (Hz)]	Chemical shift, Δδ (ppm)
11	185.5	185.5(br)	0.0
12	180.9	180.7(br)	-0.2
16	171.1	171.2	0.1
1	167.2	167.3	0.1
7	158.8	158.9	0.1
6	158.2	158.3	0.1
10b	155.7	155.8	0.1
4a	142.0	142.0	0.0
8	130.8	130.8	0.0
9	125.9	125.9	0.0
10	122.9	122.9	0.0
7b	118.7	118.8	0.1
10a	110.4	110.4	0.0
7a	109.9	109.9	0.0
5	108.5	108.5	0.0
6a	106.6	106.7	0.1
11a	100.6	100.6	0.0
15a	84.5	84.6	0.1
15	65.7	65.8	0.1
4	54.7	54.8	0.1
17	53.6	53.6	0.0
13	24.7	24.5 (br)	-0.2
14	23.8	23.8	0

Table S9.Comparison of ^{1}H NMR data for parnafungin A2.

Proton No.	Natural ^{1}H NMR, 499 MHz, DMSO-*d6* ^{1}H [δ, multi., *J* (Hz)]	Synthetic ^{1}H NMR, 600 MHz, DMSO-*d6* ^{1}H [δ, multi., *J* (Hz)]	Chemical shift, Δδ (ppm)
O(12)-H	13.85 (br, 1 H)	13.78 (br, 1 H)	-0.07
O(6)-H	11.47 (br, 1 H)	12.53 (br, 1 H)	0.06
8	8.67 (d, *J* = 7.3 Hz, 1 H)	8.68 (d, *J* = 7.6, 1 H)	0.01
10	7.66 (d, *J* = 7.3 Hz, 1 H)	7.66 (d, *J* = 7.8, 1 H)	0.00
9	7.32 (t, *J* = 7.3 Hz, 1 H)	7.32 (t, *J* =7.8, 1 H)	0.00
5	6.67 (s, 1 H)	6.67 (s, 1 H)	0.00
O(15)-H	6.01 (d, *J* = 5.3 Hz, 1 H)	6.03 (d, *J* = 5.5 Hz, 1 H)	0.02
4	4.76 (d, *J* = 11.7 Hz, 1 H)	4.76 (d, *J* = 11.8 Hz, 1 H)	0.00
	4.54 (d, *J* = 11.7 Hz, 1 H)	4.54 (d, *J* = 11.8 Hz, 1 H)	0.00
15	4.30 (dt, *J* = 12.0, 5.3 Hz, 1 H)	4.31 (dt, *J* = 11.0, 5.1 Hz)	0.01
17	3.59 (s, 3 H)	3.59 (s, 3 H)	0.00
13	2.82 (dd, *J* = 19.0, 8.0 Hz, 1 H)	2.82 (dd, *J* = 19.0, 7.7 Hz, 1 H)	0.00
	2.60 (m, 1 H)	2.58 (m, 1 H)	-0.02
14	2.17 (m, 1 H)	2.17 (m, 2 H)	0.00
	1.97 (m, 1 H)	1.97 (m, 2 H)	0.00
1			
4a			
6			
6a			
7			
7a			
10a			
10b			
11			
11a			
12			
15a			
16			

Table S10. Comparison of ^{13}C NMR data for parnafungin A2.

carbon No.	Natural ^{13}C NMR, 125 MHz, DMSO-*d6* ^{1}H [δ, multi., *J* (Hz)]	Synthetic ^{13}C NMR, 151 MHz, DMSO-d6 1H [δ, multi., J (Hz)]	Chemical shift, Δδ (ppm)
11	184.6	184.5(br)	-0.1
12	180.5	180.7(br)	0.2
16	169.5	169.5	0.0
1	167.3	167.4	0.1
7	161.0	161.0	0.0
6	156.9	156.9	0.0
10b	155.6	155.6	0.0
4a	141.8	141.8	0.0
8	133.2	132.2	0.0
9	126.0	126.0	0.0
10	122.7	122.7	0.0
7b	118.7	118.8	0.0
10a	109.7	109.7	0.0
7a	109.2	109.2	0.0
5	110.4	110.4	0.0
6a	106.9	107.0	0.0
11a	101.5	101.5	0.0
15a	85.5	85.6	0.1
15	70.2	70.3	0.1
4	55.0	55.0	0.0
17	52.9	52.9	0.0
13	28.0	28.0 (br)	0.0
14	25.4	25.5	0.1

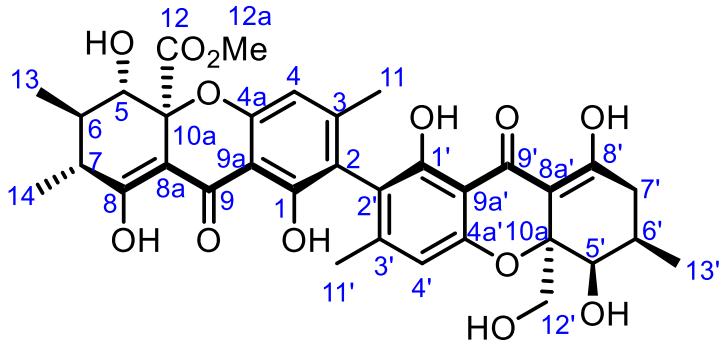
Table S11. Comparison of ^{1}H NMR data for parnafungin B2.

Proton No.	Natural ^{1}H NMR, 499 MHz, DMSO-*d6* ^{1}H [δ, multi., *J* (Hz)]	Synthetic ^{1}H NMR, 600 MHz, DMSO-*d6* ^{1}H [δ, multi., *J* (Hz)]	Chemical shift, Δδ (ppm)
O(12)-H	13.85 (br, 1 H)	13.78 (br, 1 H)	-0.07
O(6)-H	12.48 (br, 1 H)	12.67 (br, 1 H)	0.19
8	8.63 (d, *J* = 7.3 Hz, 1 H)	8.63 (d, *J* = 7.6, 1 H)	0.01
10	7.70 (d, *J* = 7.8 Hz, 1 H)	7.70 (d, *J* = 7.8, 1 H)	0.00
9	7.36 (dd, *J* = 7.8, 7.3 Hz, 1 H)	7.36 (dd, *J* =7.8, 7.6, 1 H)	0.00
5	6.72 (s, 1 H)	6.72 (s, 1 H)	0.00
O(15)-H	5.89 (d, *J* = 3.6 Hz, 1 H)	5.89 (d, *J* = 4.4 Hz, 1 H)	0.00
4	4.73 (d, *J* = 11.9 Hz, 1 H)	4.73 (d, *J* = 11.6 Hz, 1 H)	0.00
	4.61 (d, *J* = 11.9 Hz, 1 H)	4.61 (d, *J* = 11.6 Hz, 1 H)	0.00
15	4.24 (br s)	4.24 (br s)	0.00
17	3.65 (s, 3 H)	3.64 (s, 3 H)	-0.01
13	2.73 (m, 1 H)	2.73 (m, 1 H)	0.00
	2.42 (ddd, *J* = 19.0, 13.0, 6.0 Hz, 1 H)	2.42 (m, 1 H)	0.00
14	2.17 (m, 1 H)	2.17 (m, 2 H)	0.00
	1.97 (m, 1 H)	1.97 (m, 2 H)	0.00
1			
4a			
6			
6a			
7			
7a			
10a			
10b			
11			
11a			
12			
15a			
16			

Table S12.Comparison of ^{13}C NMR data for parnafungin B2.

carbon No.	Natural ^{13}C NMR, 125 MHz, DMSO-*d6* ^{1}H [δ, multi., *J* (Hz)]	Synthetic ^{13}C NMR, 151 MHz, DMSO-d6 1H [δ, multi., J (Hz)]	Chemical shift, Δδ (ppm)
11	185.9	185.9(br)	0.0
12	181.9	182.0(br)	0.1
16	170.9	171.0	0.1
1	167.2	167.3	0.1
7	158.9	158.9	0.0
6	158.9	158.9	0.0
10b	155.5	155.6	0.1
4a	142.0	142.0	0.0
8	132.0	132.0	0.0
9	126.0	126.0	0.0
10	123.0	123.0	0.0
7b	118.6	118.7	0.1
10a	109.2	109.2	0.0
7a	109.8	109.7	-0.1
5	110.9	110.9	0.0
6a	106.5	106.3	-0.2
11a	100.8	100.9	0.1
15a	84.9	84.9	0.1
15	65.3	65.4	0.1
4	54.9	55.0	0.1
17	53.6	53.6	0.0
13	24.9	24.9 (br)	0.1
14	24.0	24.0	0

7. Comparison of NMR Data of reported hirtusneanine (6) [3] and Synthetic 10a-*epi*-hirtusneanine (36)



10a-*epi*-hirtusneanine (36)

Table S13. Comparison of ^{1}H NMR data

Proton No.	Reported ^{1}H NMR, DMSO-*d6* ^{1}H [δ, multi., *J* (Hz)]	Synthetic ^{1}H NMR, 500 MHz, DMSO-*d6* ^{1}H [δ, multi., *J* (Hz)]	Chemical shift, Δδ (ppm)
O(8)-H	13.7 (br, 1 H)	14.25 (br, 1 H)	0.55
O(8')-H	13.7 (br, 1 H)	13.89 (br, 1 H)	0.19
O(1')-H	11.5 (br, 1 H)	11.61 (s, 1 H)	0.11
O(1)-H	11.5 (br, 1 H)	11.18 (s, 1 H)	-0.32
4,4'	6.66 (s, 1 H), 6.69 (s, 1 H)	6.58 (s, 1 H), 6.43 (s, 1 H)	
5'	4.07 (d, *J* = 1.3 Hz, 1 H)	3.95 (s, 1 H)	-0.12
5	4.02 (d, *J* = 9.5 Hz, 1 H)	3.81 (dd, *J* = 11.1, 5.5 Hz, 1 H)	-0.21
12'	4.14 (dd, *J* = 7.0, 13.0 Hz, 1 H)	3.69 (dd, J=4.5,12.3 Hz, 1H)	-0.45
	3.75 (dd, *J* = 4.7, 13.0 Hz, 1 H)	3.46 (dd, *J* = 5.0, 12.2 Hz, 1 H)	-0.29
12a	3.73 (s, 3 H)	3.60 (s, 3 H)	-0.13
7'	2.48 (dd, *J* = 19.2, 11.3 Hz, 1 H)	2.34 (dd, *J* = 23.5, 10.6 Hz, 1 H)	-0.14
	2.35 (dd, *J* = 19.2, 6.5 Hz, 1 H)	2.20 (m, 1 H)	-0.15
7	2.36 (dq, *J* = 10.3, 6.4 Hz, 1 H)	2.47 (m, 1 H)	0.11
6'	2.28 (dddq, *J* = 1.3, 6.5, 11.3,6.7 Hz, 1 H)	2.23 (m, 1 H)	-0.05
6	2.05 (ddq, *J* = 9.5, 10.3, 6.7 Hz, 1 H)	1.85 (ddq, *J*=11.3, 9.0, 6.2 Hz, 1 H)	-0.20
11,11'	1.96 (s, 3 H), 1.94 (s, 3 H)	2.02 (s, 3 H), 1.93 (s, 3 H)	
13	1.09 (d, *J* = 6.7 Hz, 3 H)	1.02 (d, *J* = 6.7 Hz, 3 H)	-0.07
13'	1.04 (d, *J* = 6.7 Hz, 3 H)	1.09 (d, *J* = 6.5 Hz, 3 H)	0.05

14	1.01 (d, *J* = 6.4 Hz, 3 H)	1.26 (d, *J* = 7.2 Hz, 3 H)	0.25
O(12')-H	3.28 (m, 1 H)		

Table S14.Comparison of ^{13}C NMR data

carbon No.	Reported ^{13}C NMR, DMSO-*d6* ^{1}H [δ, multi., *J* (Hz)]	Synthetic ^{13}C NMR, 126 MHz, DMSO-d6 1H [δ, multi., *J* (Hz)]	Chemical shift, Δδ (ppm)
9	186.8	187.1	0.3
9'	186.6	186.2	-0.4
8	177.8	180.9	3.1
8'	177.6	178.5	-0.1
12	171.3	170.2	-1.1
1'	159.6	158.6	-1.5
1	159.2	158.5	-0.7
4a	156.8	158.3	1.5
4a'	156.7	157.9	1.2
3'	150.2	149.8	-0.4
3	149.6	148.8	-0.8
2'	118.1	116.4	-1.7
2	116.7	115.0	-1.7
4'	109.3	109.5	0.2
4	109.2	108.9	-0.3
9a'	106.3	104.4	-1.9
9a	105.7	104.0	-1.7
8a'	102.1	101.2	-0.9
8a	101.3	101.0	-0.3
10a	85.1	84.5	-0.6
10a'	84.1	84.4	0.3
5	68.8	68.8	0.0
5'	68.7	74.5	5.8
12'	68.7	64.6	-4.1
12a	54.3	52.8	-1.5

7	36.7	37.4	0.7
7’	33.6	33.7	0.1
6	31.3	31.3	0.0
6’	28.5	29.1	0.6
11	20.7	20.6	-0.1
11’	20.6	20.3	-0.3
13’	17.7	17.9	0.2
14	17.3	16.3	-1.0
13	15.6	15.5	-0.1

8. Experimental CD spectra of 53

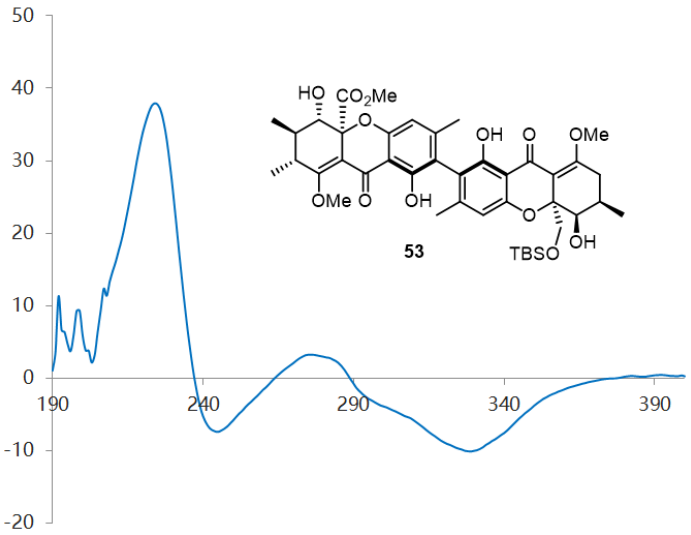


Figure S2. Experimental CD (Dioxane) spectra of 53

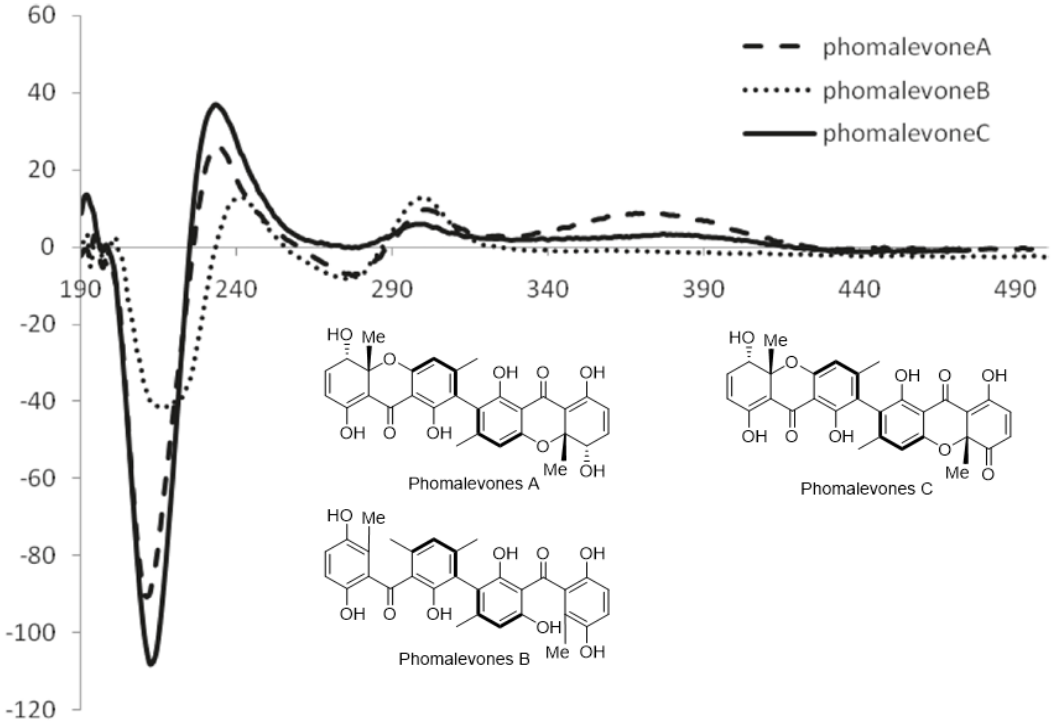
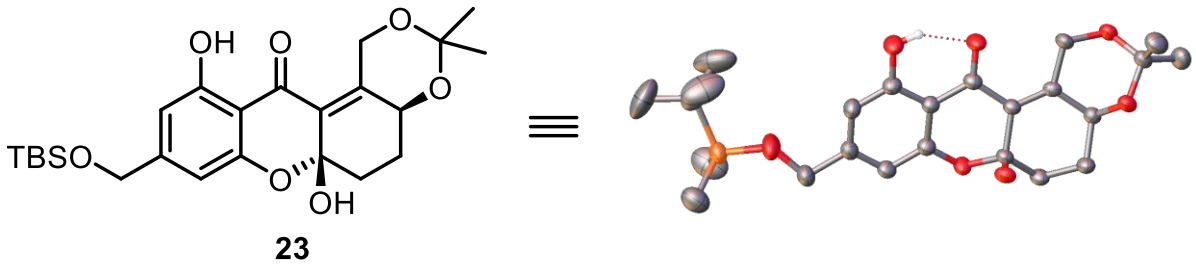


Figure S3. Experimental ECD (MeOH) spectra of phomalevones A-C[4]

9. Single Crystal X-Ray Diffraction Data



23

Figure S4. ORTEP drawing of compound 23 at 50% probability

Method for crystal growth

Compound **23** (5 mg) was dissolved in CH_2Cl_2/MeOH (0.2 ml/0.05 ml). With slow evaporation of the solvent, crystal suitable for X-ray diffraction was obtained.

Crystal data and structure refinement for compound **23**

Identification code	CCDC 2026687	
Empirical formula	C24 H34 O7 Si	
Formula weight	462.60	
Temperature	293(2) K	
Wavelength	0.71073 Å	
Crystal system	Monoclinic	
Space group	P 21	
Unit cell dimensions	a = 6.3380(3) Å	= 90°.
	b = 27.3588(13) Å	= 110.458(2)°.
	c = 7.5392(4) Å	= 90°.
Volume	1224.84(11) $Å^3$	
Z	2	
Density (calculated)	1.254 Mg/m^3	
Absorption coefficient	0.136 mm^{-1}	
F(000)	496	
Crystal size	0.170 x 0.120 x 0.080 mm^3	
Theta range for data collection	2.978 to 27.474 °.	
Index ranges	-8<=h<=8, -35<=k<=35, -9<=l<=9	
Reflections collected	22029	
Independent reflections	5595 [R(int) = 0.0486]	
Completeness to theta = 25.242 °	99.6 %	

Absorption correction	Semi-empirical from equivalents
Max. and min. transmission	0.7456 and 0.6012
Refinement method	Full-matrix least-squares on F^2
Data / restraints / parameters	5595 / 7 / 315
Goodness-of-fit on F^2	1.020
Final R indices [I>2sigma(I)]	R1 = 0.0374, wR2 = 0.0862
R indices (all data)	R1 = 0.0453, wR2 = 0.0915
Absolute structure parameter	-0.13(6)
Extinction coefficient	n/a
Largest diff. peak and hole	0.163 and -0.171 e.$Å^{-3}$

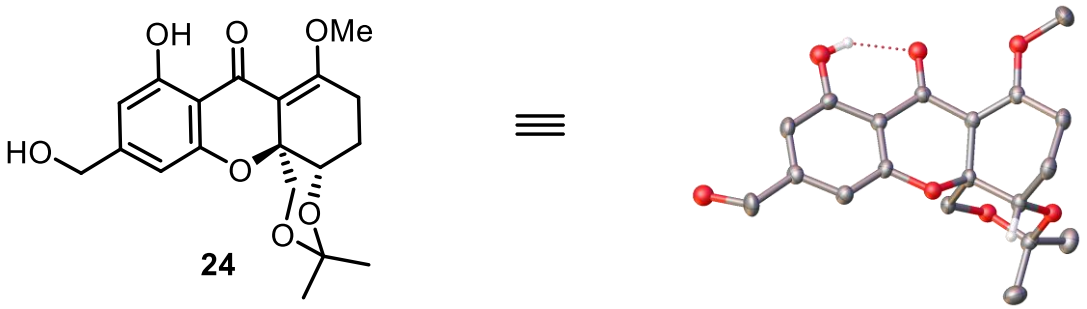


Figure S5. ORTEP drawing of compound 24 at 50% probability

Method for crystal growth

Compound **24** (5 mg) was dissolved in CH_2Cl_2/MeOH (0.2 ml/0.05 ml). With slow evaporation of the solvent, crystal suitable for X-ray diffraction was obtained.

Crystal data and structure refinement for compound **24**

Identification code	CCDC 2026689
Empirical formula	C19 H22 O7
Formula weight	362.36
Temperature	173(2) K
Wavelength	1.54178 A
Crystal system, space group	Orthorhombic, P2(1)2(1)2(1)
Unit cell dimensions	a = 5.33940(10) A alpha = 90 deg.
	b = 10.5708(2) A beta = 90 deg.
	c = 29.8220(6) A gamma = 90 deg.

Volume	1683.21(6) A^3
Z, Calculated density	4, 1.430 Mg/m^3
Absorption coefficient	0.915 mm^-1
F(000)	768
Crystal size	0.200 x 0.180 x 0.150 mm
Theta range for data collection	2.963 to 68.347 deg.
Limiting indices	-6<=h<=6, -12<=k<=11, -35<=l<=35
Reflections collected / unique	20234 / 3092 [R(int) = 0.0576]
Completeness to theta = 67.679	100.0 %
Refinement method	Full-matrix least-squares on F^2
Data / restraints / parameters	3092 / 0 / 209
Goodness-of-fit on F^2	1.017
Final R indices [I>2sigma(I)]	R1 = 0.0467, wR2 = 0.1109
R indices (all data)	R1 = 0.0528, wR2 = 0.1166
Absolute structure parameter	0.09(12)
Extinction coefficient	n/a
Largest diff. peak and hole	0.389 and -0.411 e.A^-3

45

Figure S6. ORTEP drawing of compound 45 at 50% probability

Method for crystal growth

Compound **45** (5 mg) was dissolved in CH_2Cl_2/MeOH (0.2 ml : 0.05 ml). With slow evaporation of the solvent, crystal suitable for X-ray diffraction was obtained.

Crystal data and structure refinement for **45**.

Identification code	CCDC 2068312
Empirical formula	C18 H20 O8
Formula weight	364.34
Temperature	293(2) K

Wavelength	1.54178 Å	
Crystal system	Monoclinic	
Space group	P 21/c	
Unit cell dimensions	a = 8.2810(4) Å	= 90°.
	b = 26.6332(13) Å	= 104.3000(10)°.
	c = 8.0706(4) Å	= 90°.
Volume	1724.82(15) $Å^3$	
Z	4	
Density (calculated)	1.403 Mg/m^3	
Absorption coefficient	0.942 mm^{-1}	
F(000)	768	
Crystal size	0.200 x 0.150 x 0.110 mm^3	
Theta range for data collection	3.319 to 65.500 °.	
Index ranges	-9<=h<=9, -31<=k<=31, -9<=l<=9	
Reflections collected	22297	
Independent reflections	2904 [R(int) = 0.0530]	
Completeness to theta = 67.679 °	97.9 %	
Absorption correction	Semi-empirical from equivalents	
Max. and min. transmission	0.7456 and 0.5945	
Refinement method	Full-matrix least-squares on F^2	
Data / restraints / parameters	2904 / 0 / 247	
Goodness-of-fit on F^2	1.127	
Final R indices [I>2sigma(I)]	R1 = 0.0839, wR2 = 0.2582	
R indices (all data)	R1 = 0.0864, wR2 = 0.2601	
Extinction coefficient	0.020(4)	
Largest diff. peak and hole	0.351 and -0.237 $e.Å^{-3}$	

10. References

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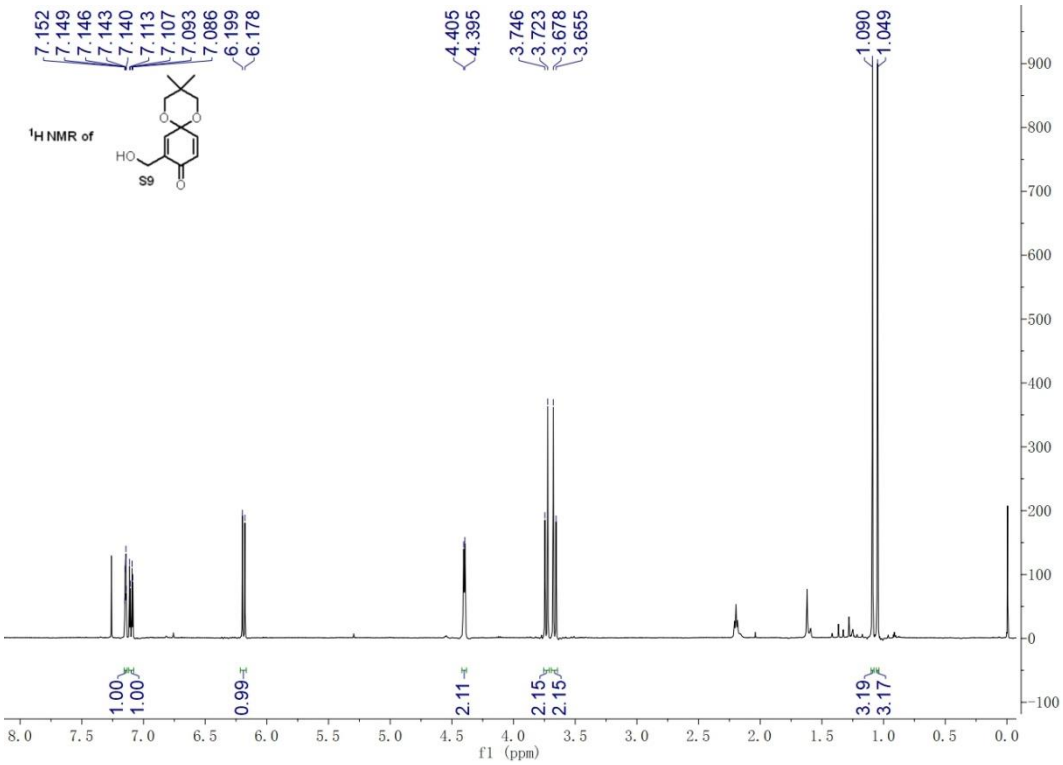
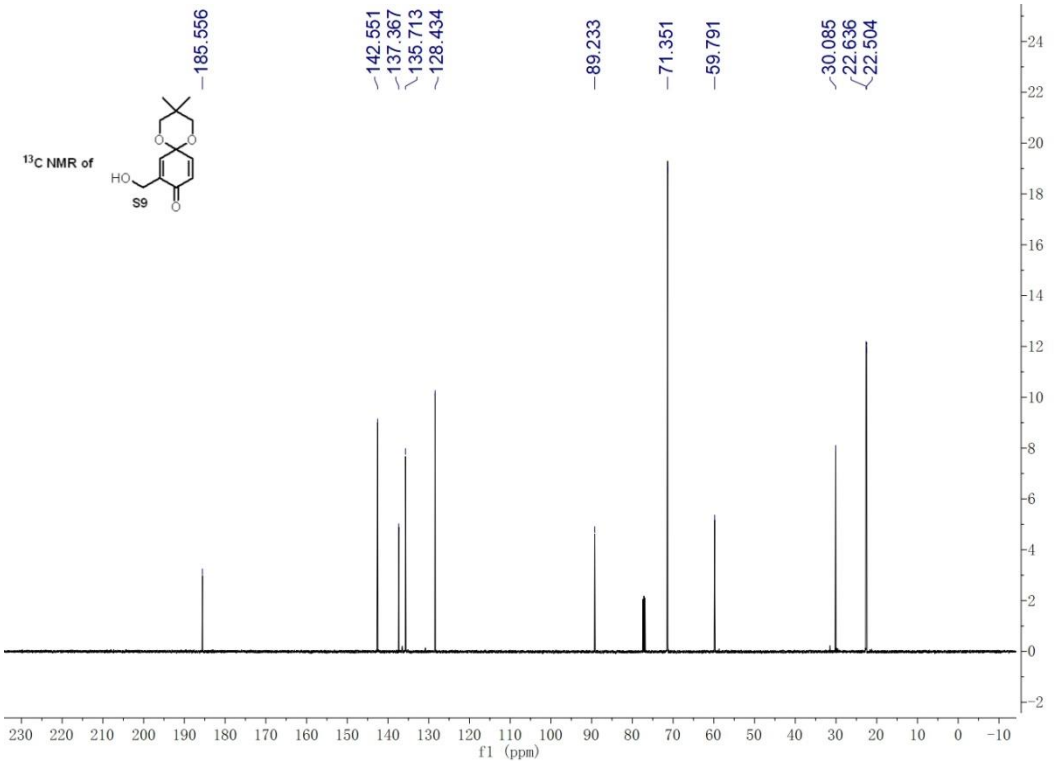
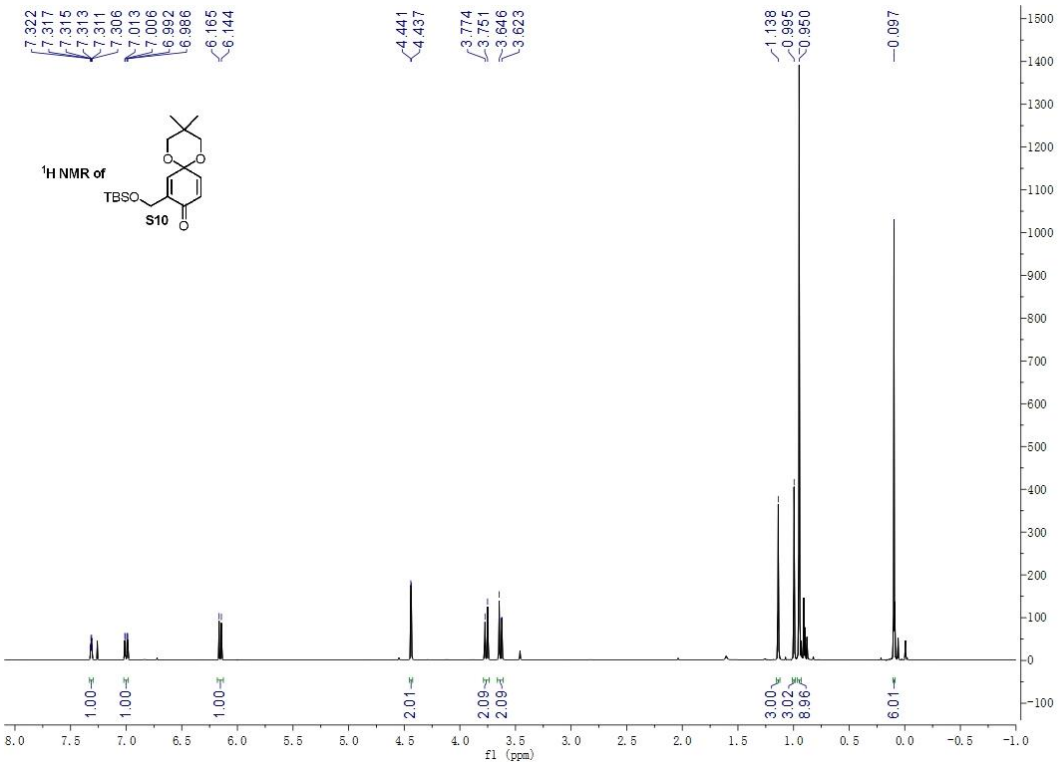
11. ^{1}H and ^{13}C NMR Spectral Data



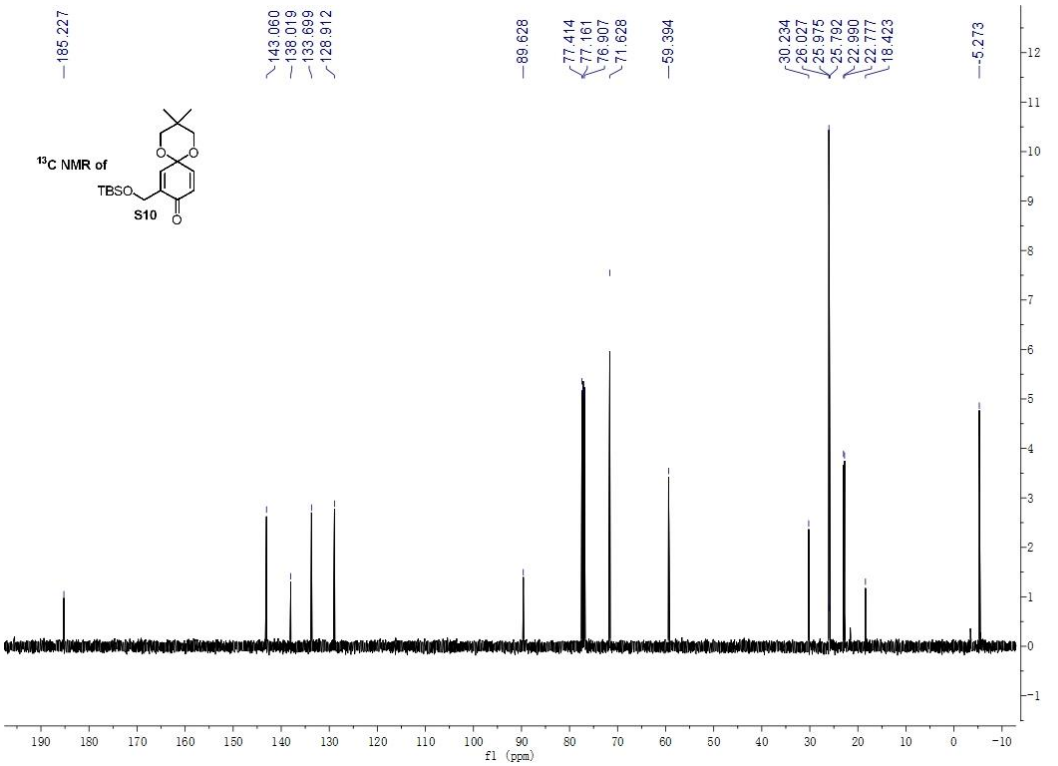
^{1}H NMR spectrum of compound S9



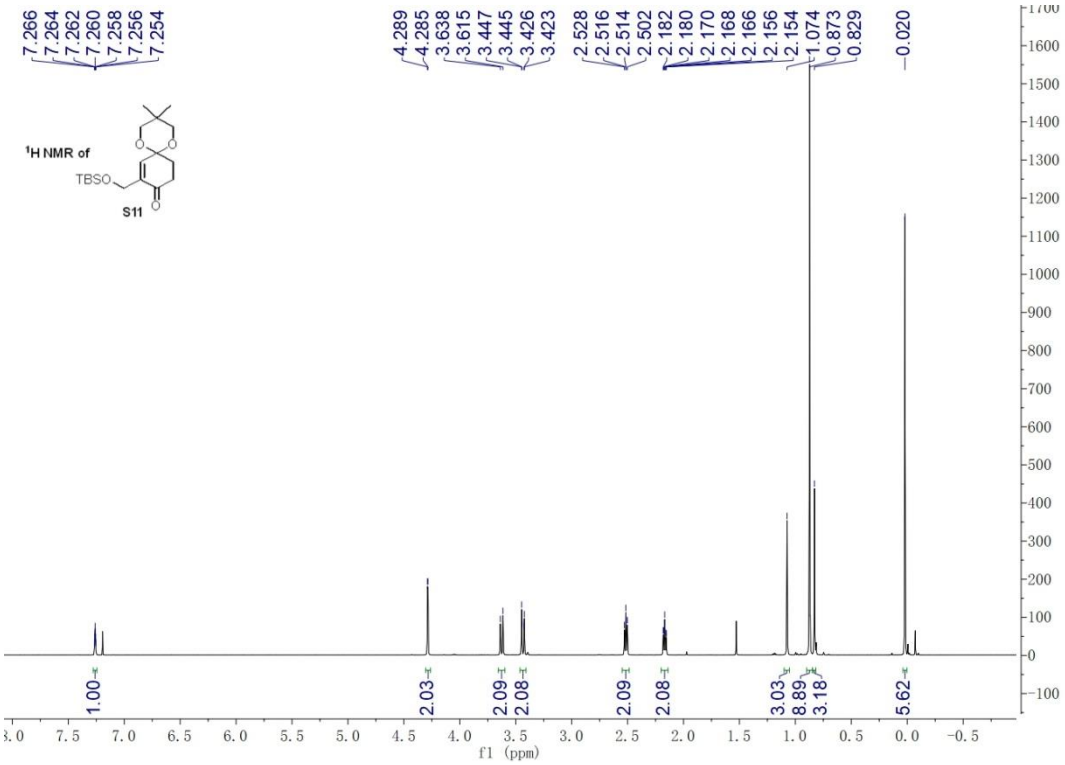
^{13}C NMR spectrum of compound S9



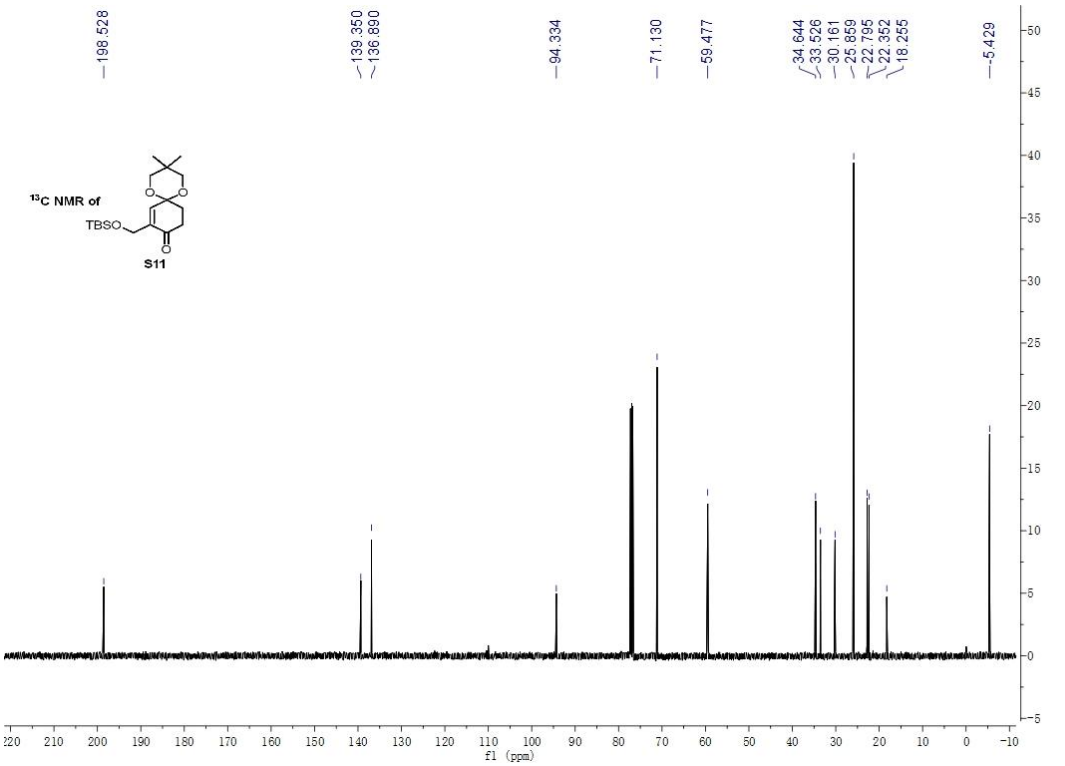
^{1}H NMR spectrum of compound S10



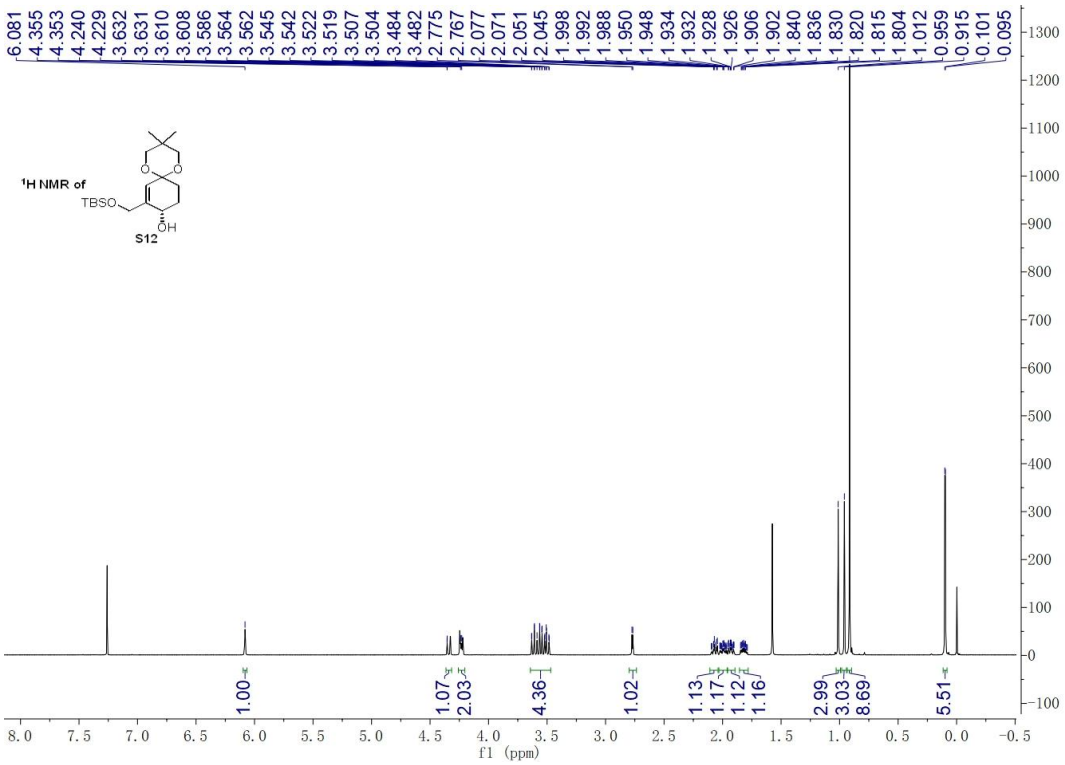
^{13}C NMR spectrum of compound S10



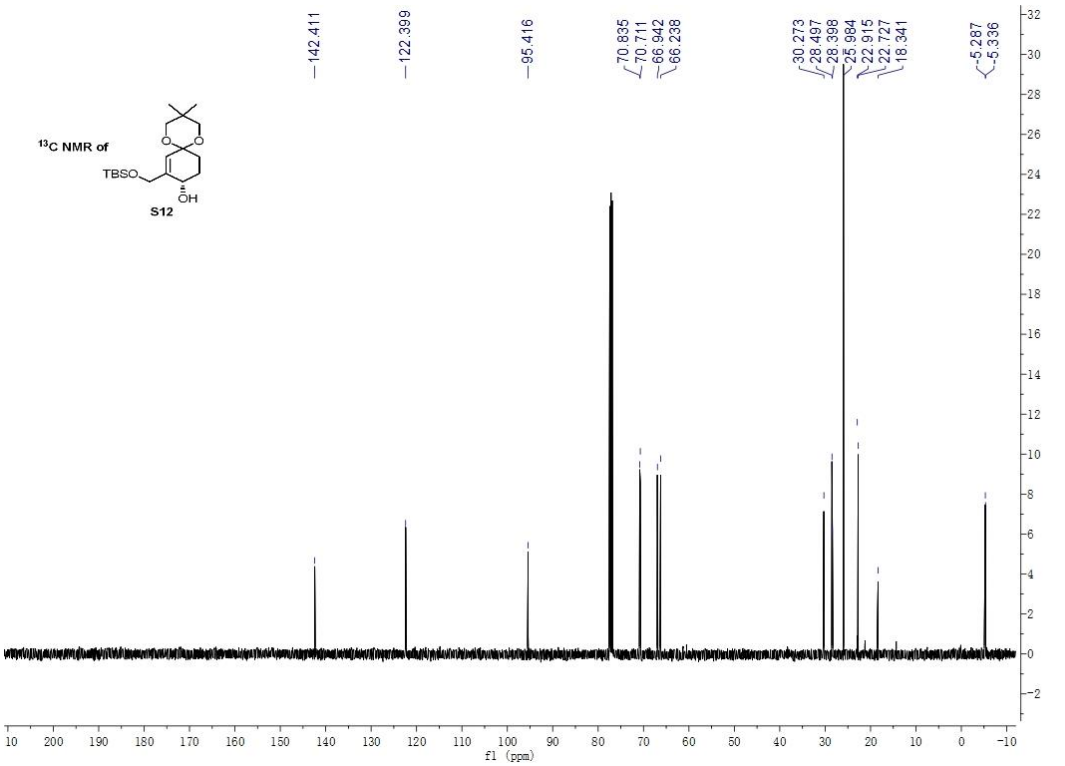
^{1}H NMR spectrum of compound S11



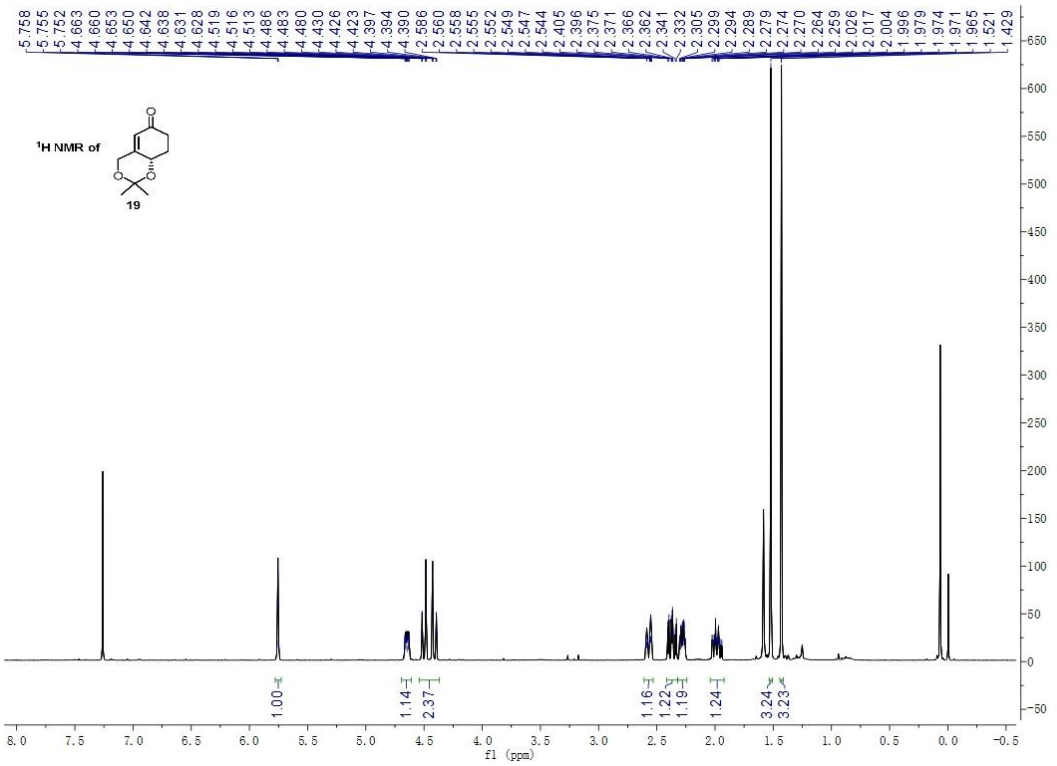
^{13}C NMR spectrum of compound S11



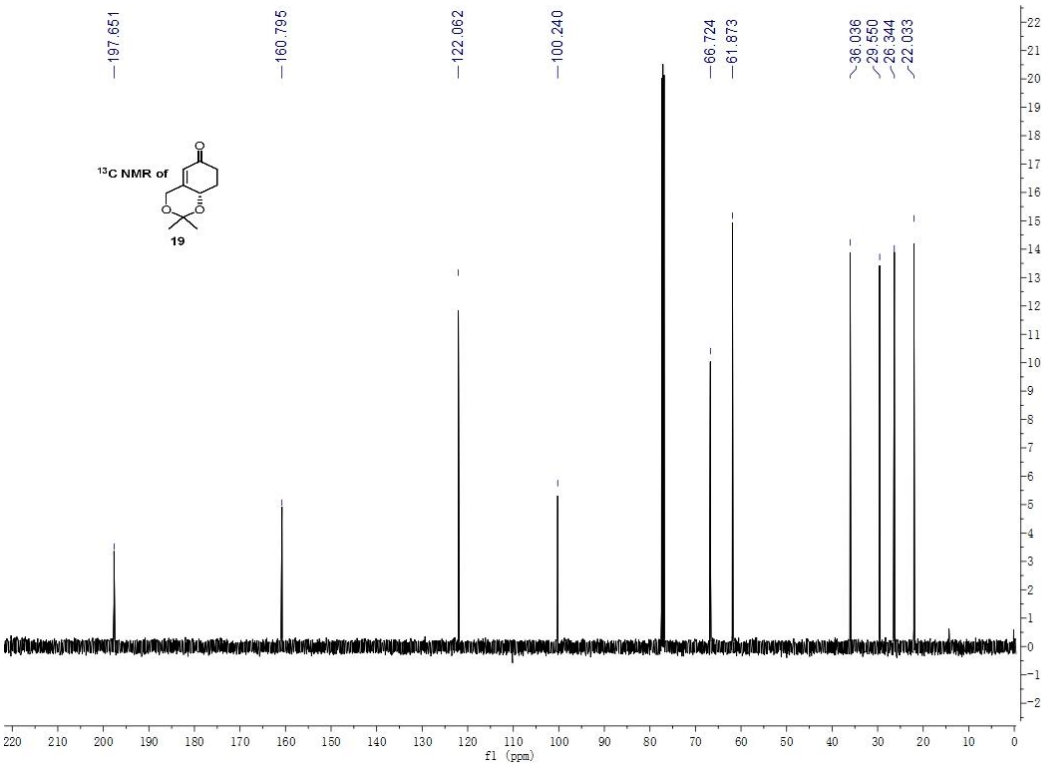
^{1}H NMR spectrum of compound S12



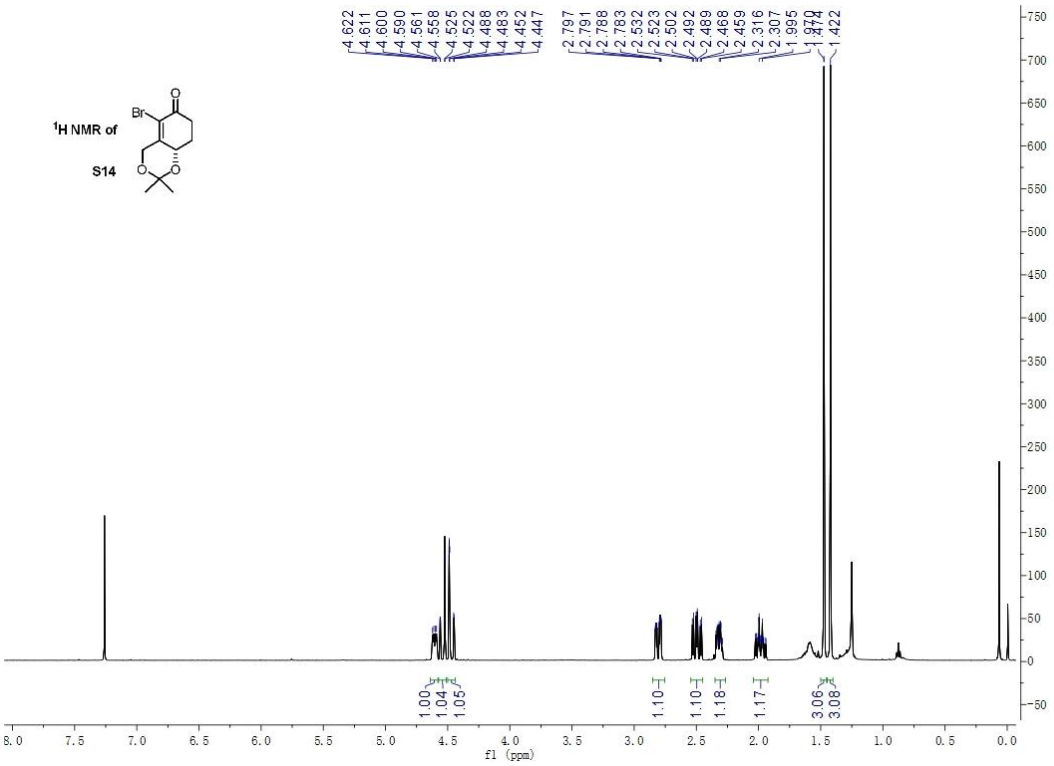
^{13}C NMR spectrum of compound S12



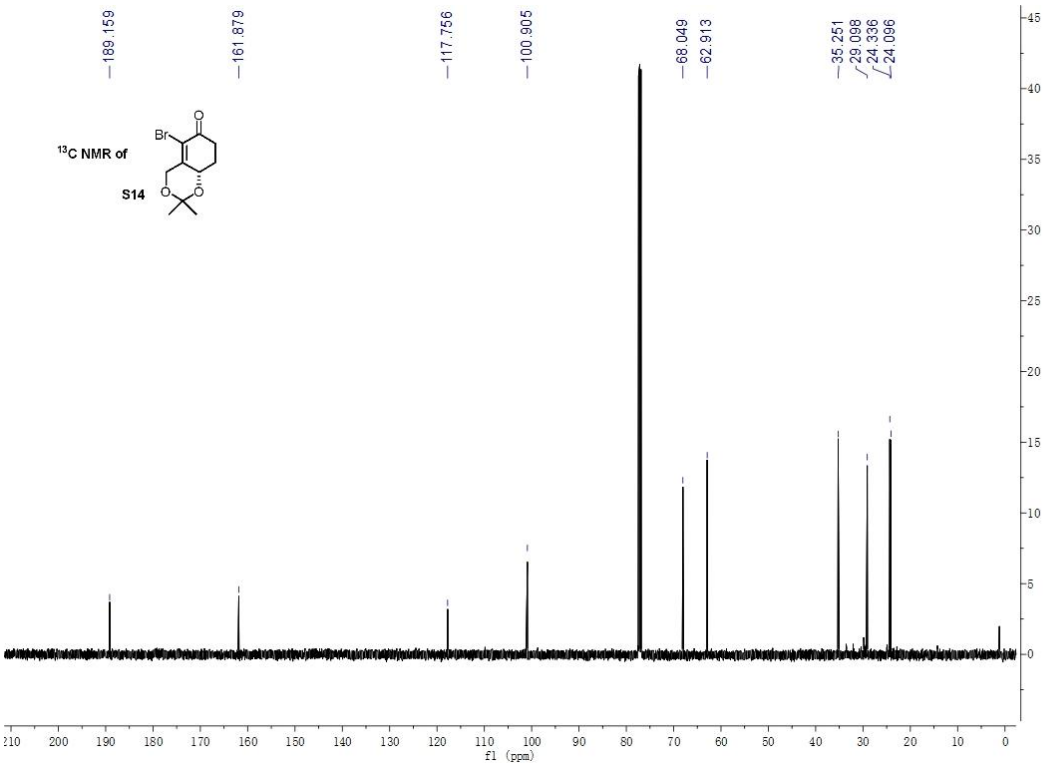
^{1}H NMR spectrum of compound 19



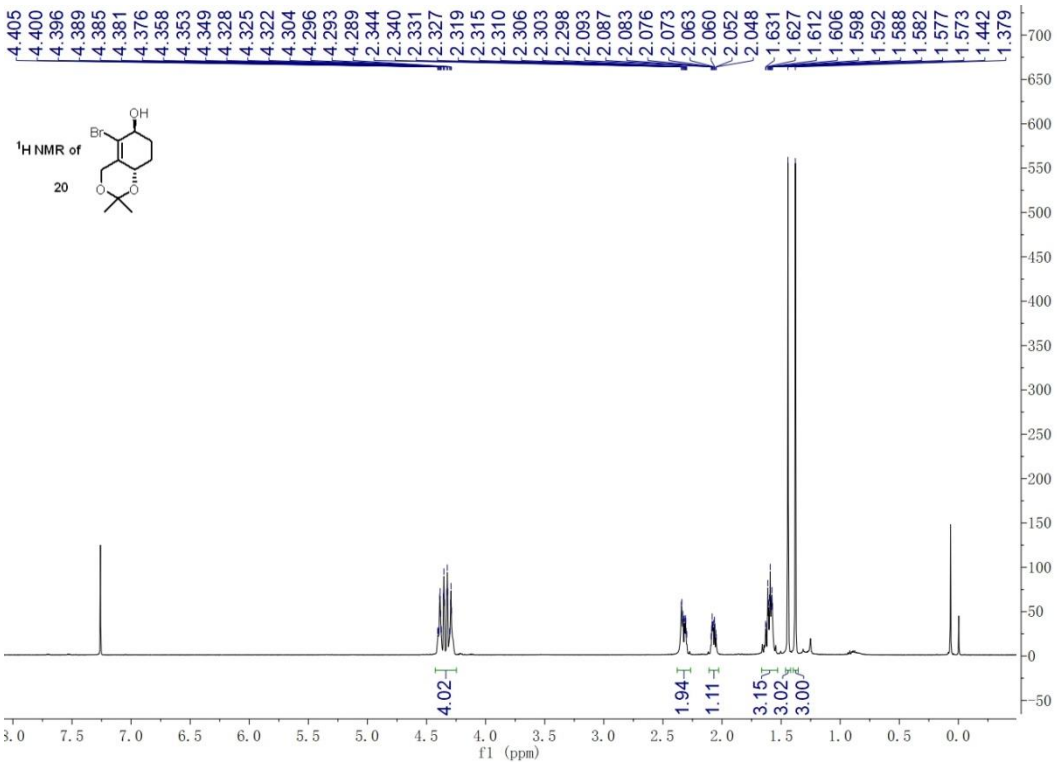
^{13}C NMR spectrum of compound 19



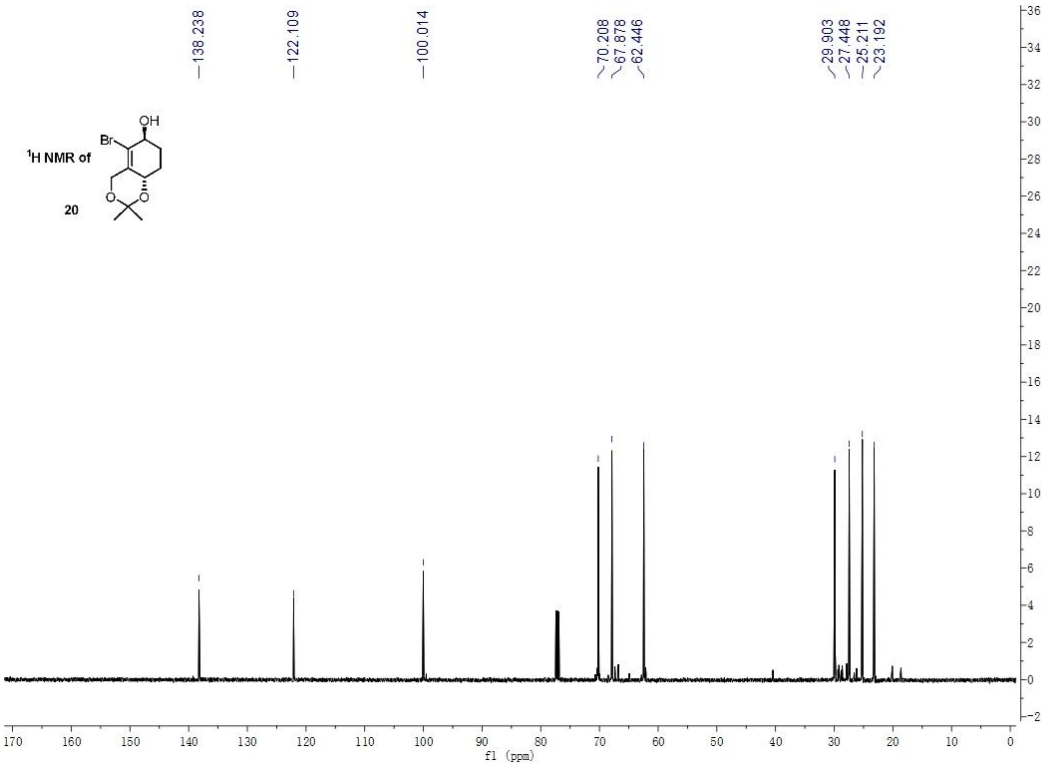
^{1}H NMR spectrum of compound S14



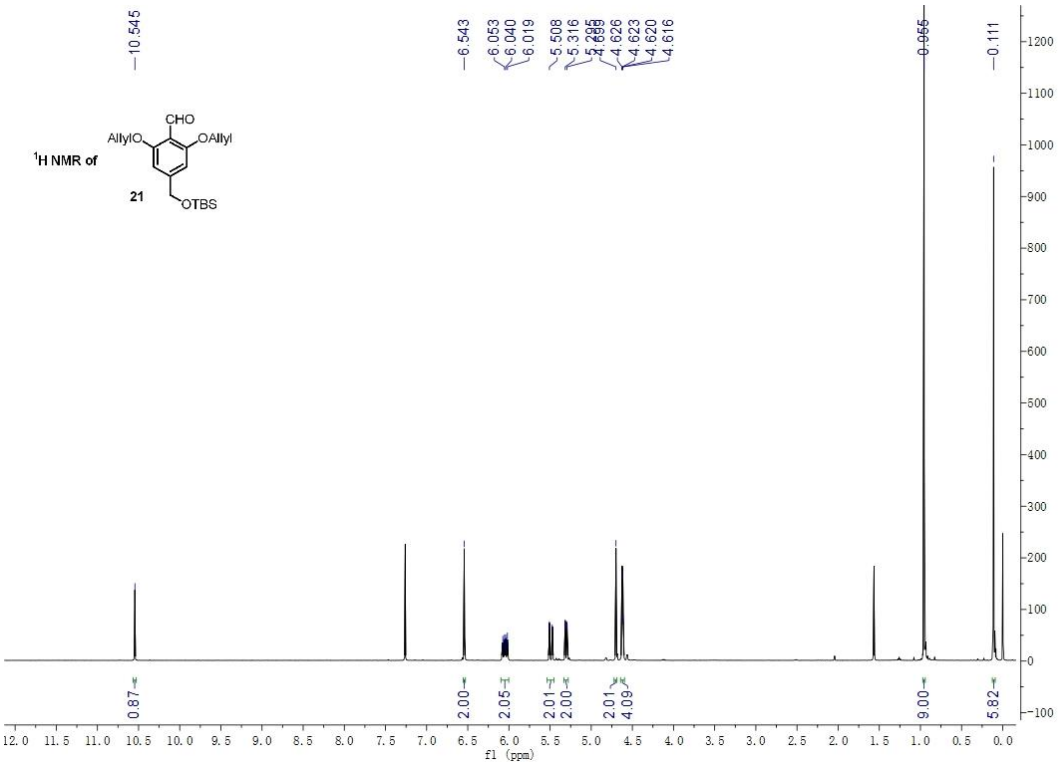
^{13}C NMR spectrum of compound S14



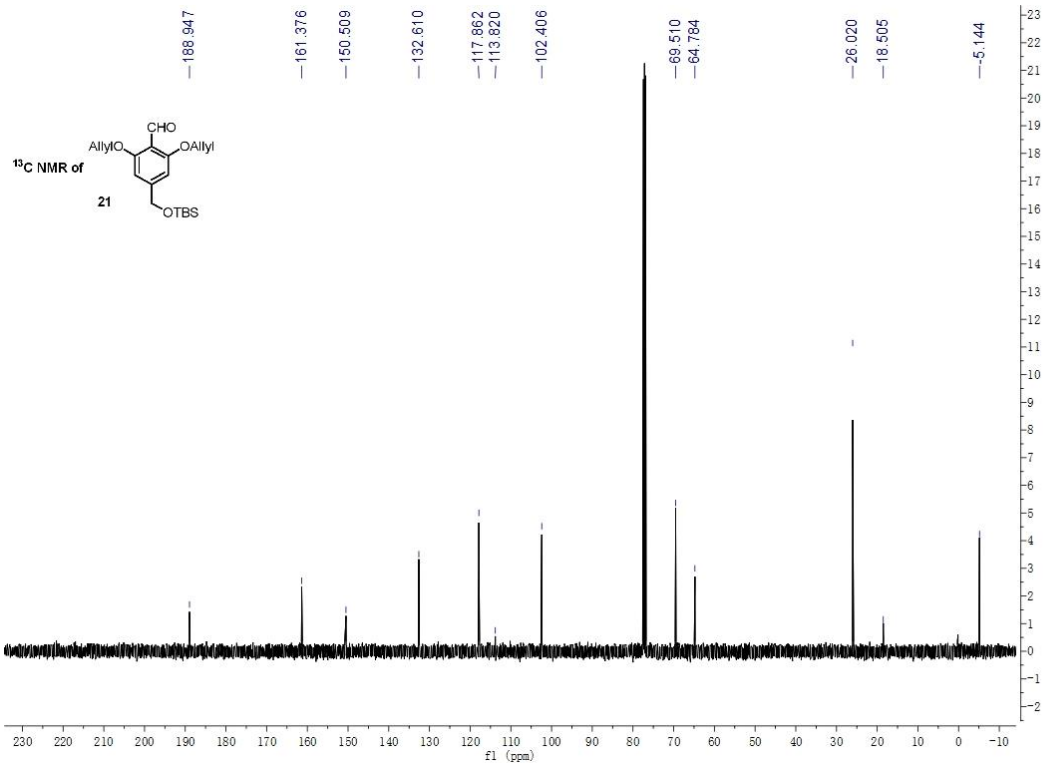
^{1}H NMR spectrum of compound 20



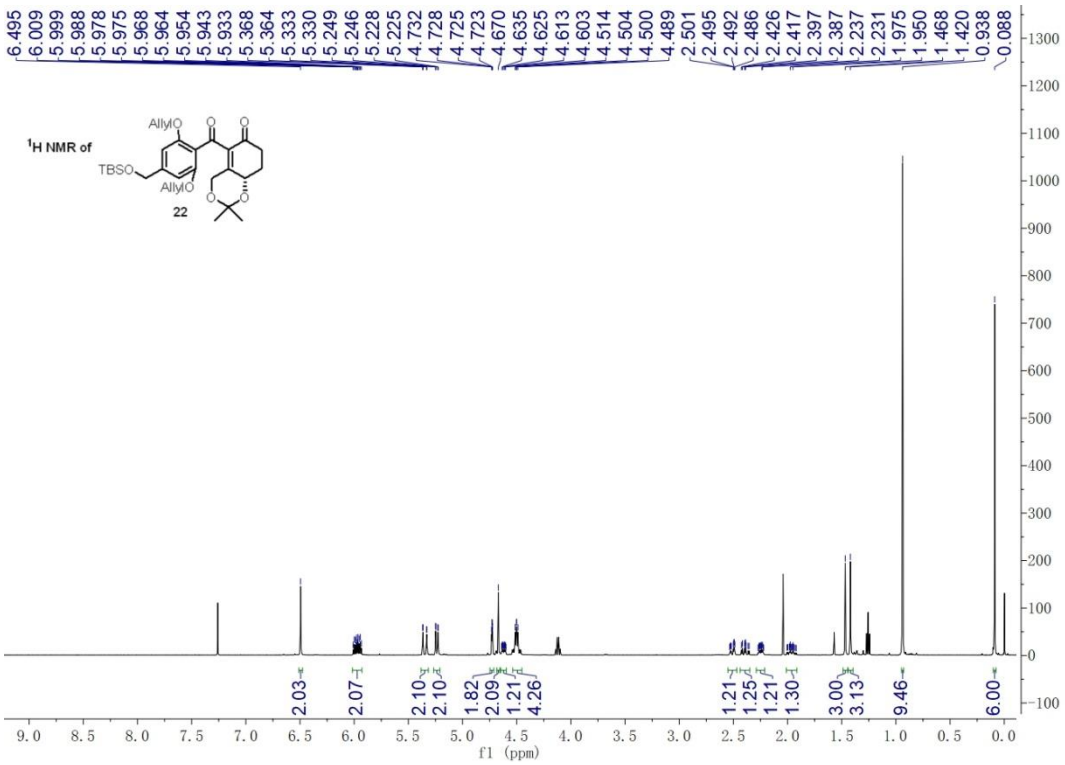
^{13}C NMR spectrum of compound 20



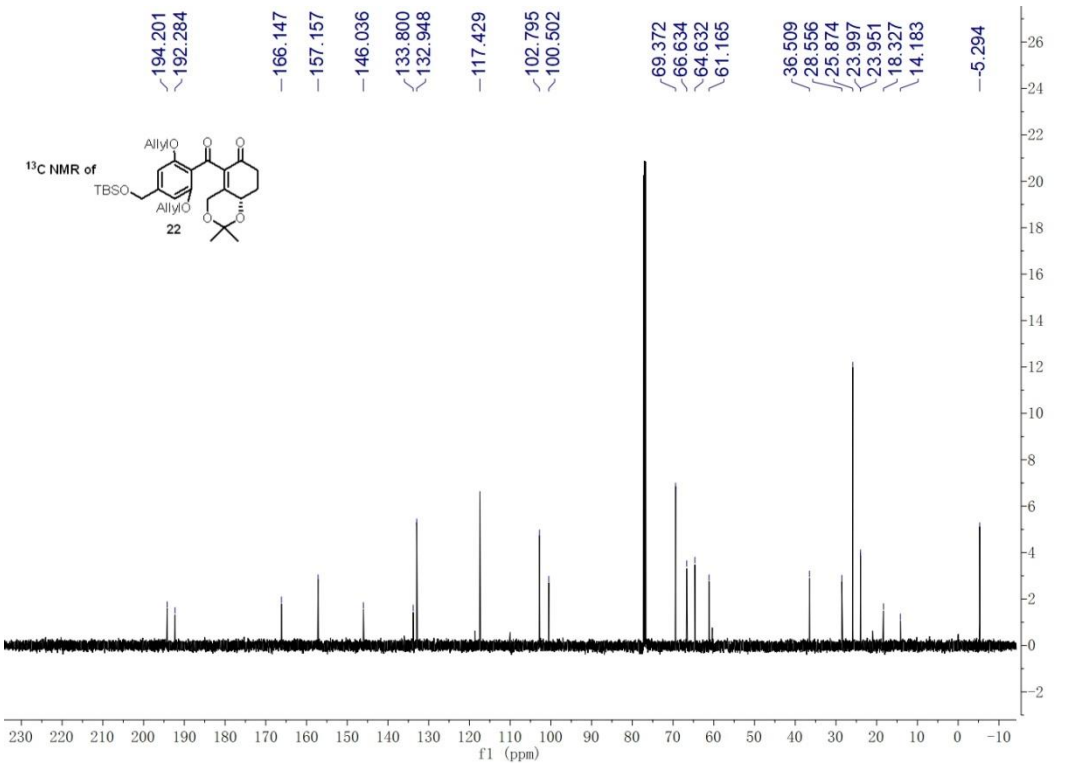
^{1}H NMR spectrum of compound 21



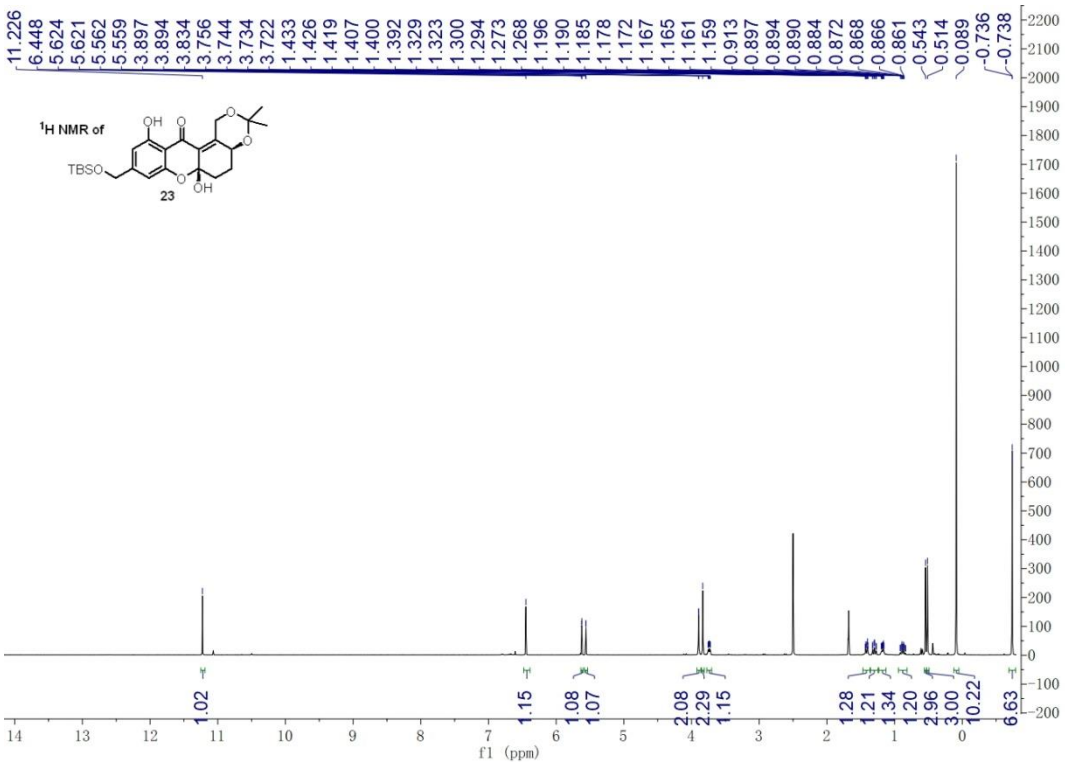
^{13}C NMR spectrum of compound 21



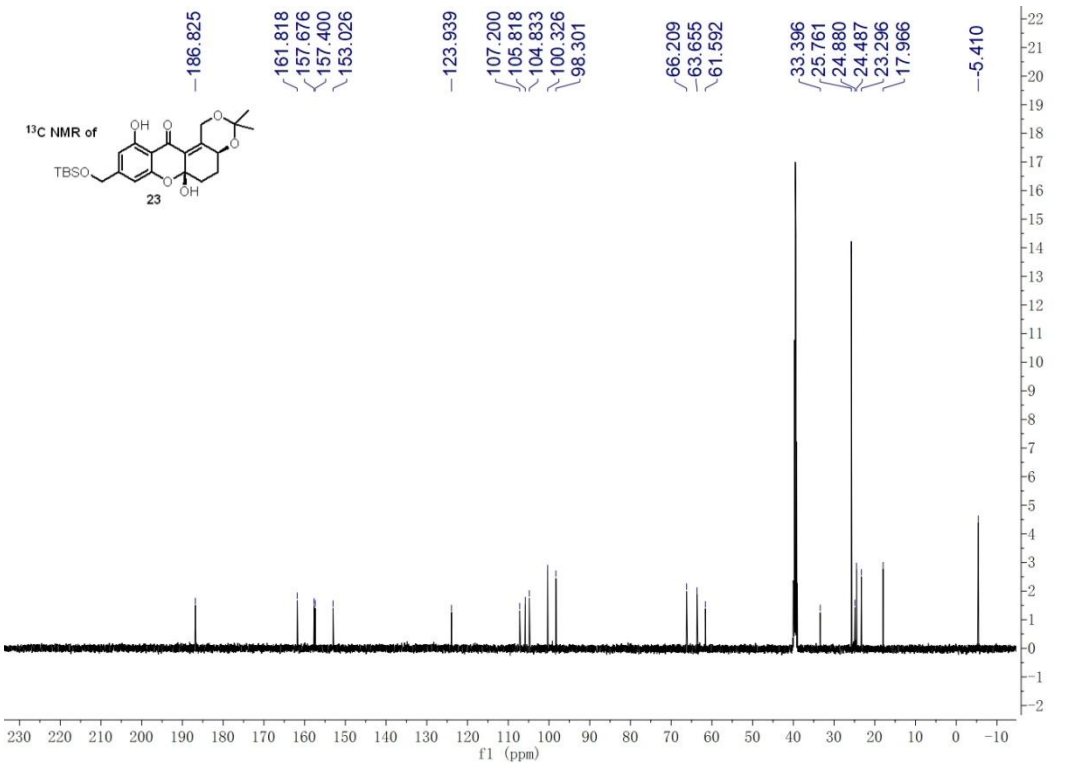
^{1}H NMR spectrum of compound 22



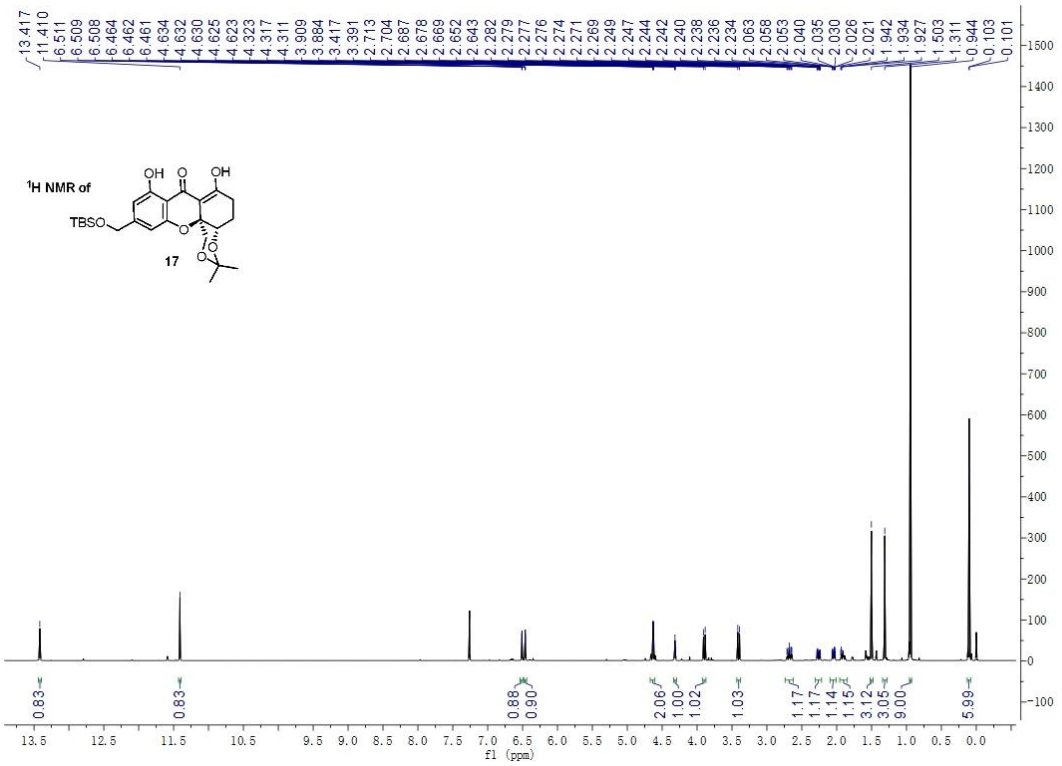
^{13}C NMR spectrum of compound 22



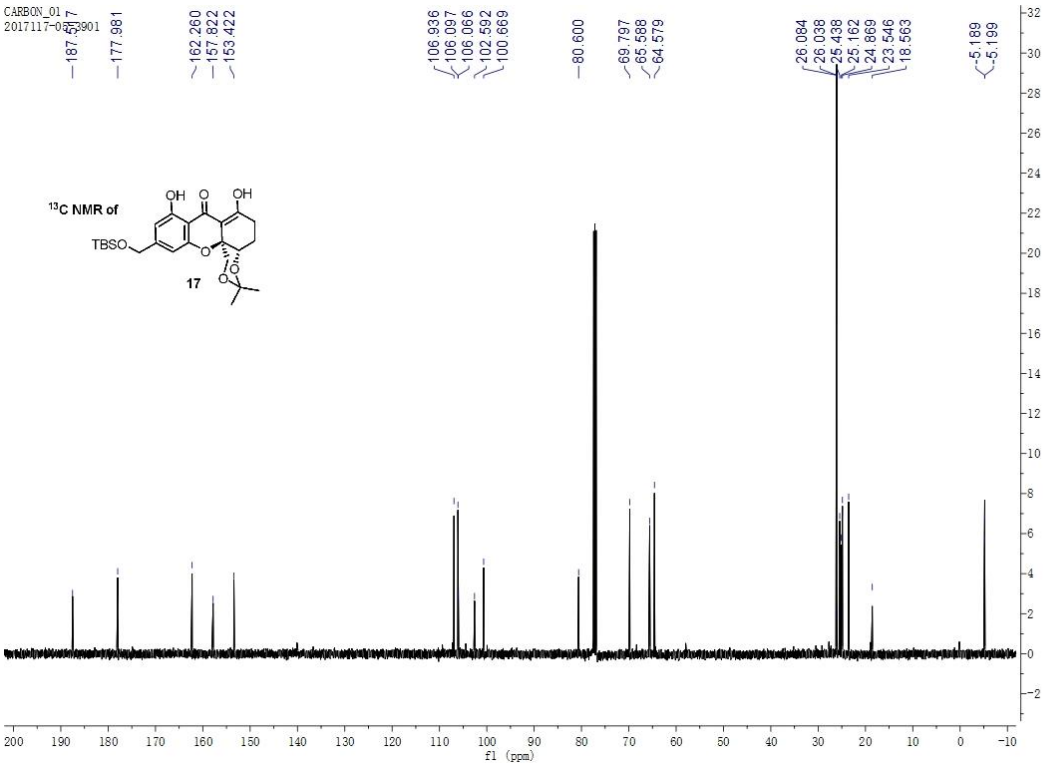
^{1}H NMR spectrum of compound 23



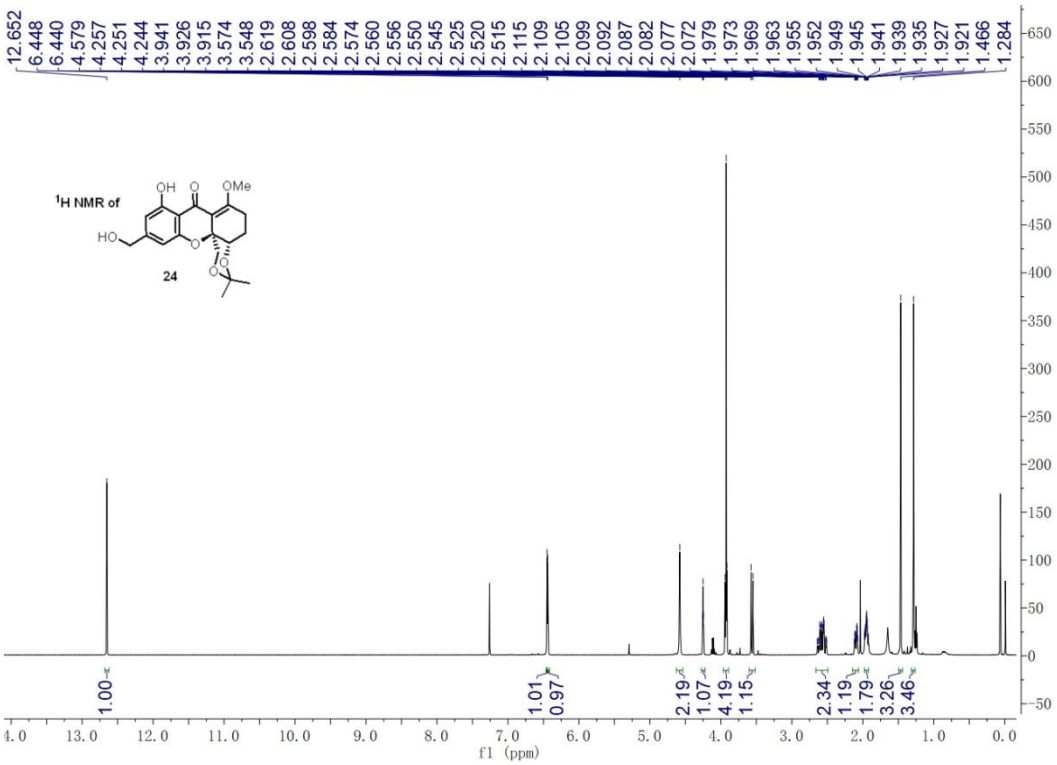
^{13}C NMR spectrum of compound 23



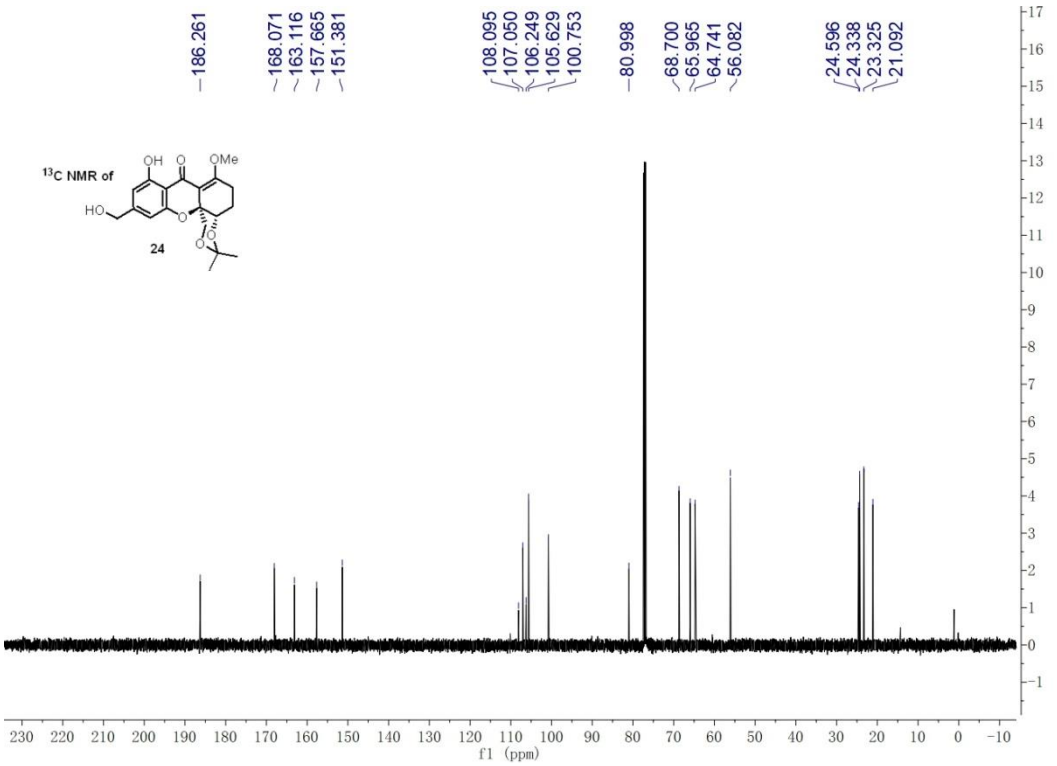
^{1}H NMR spectrum of compound 17



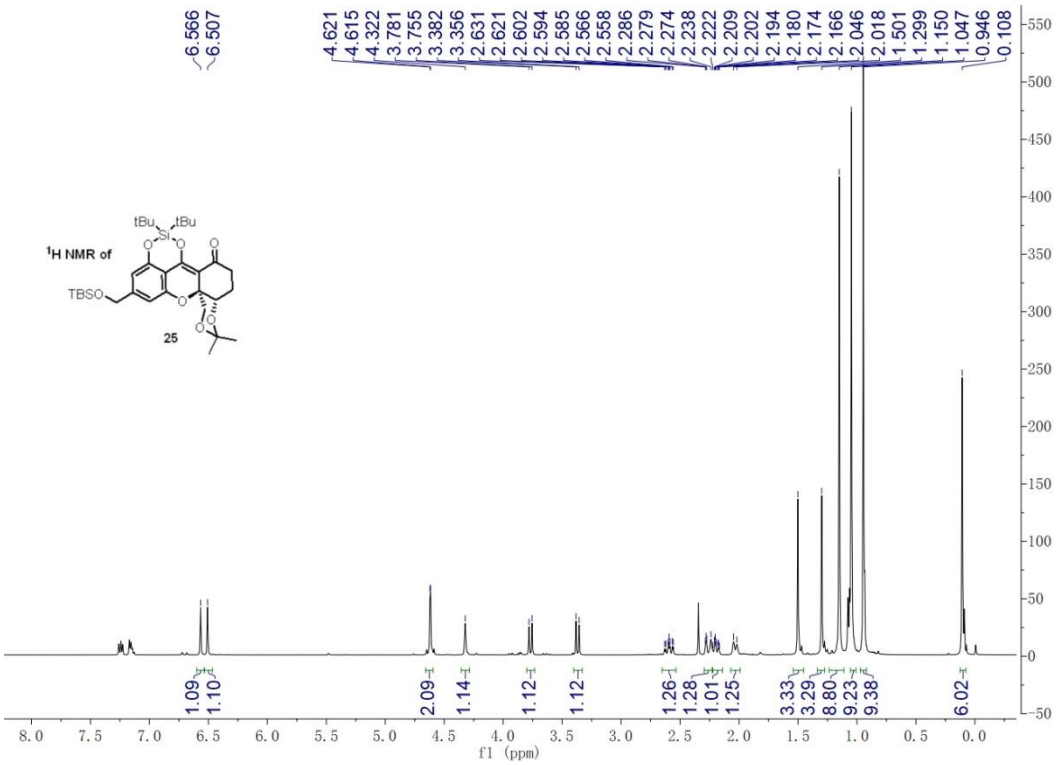
^{13}C NMR spectrum of compound 17



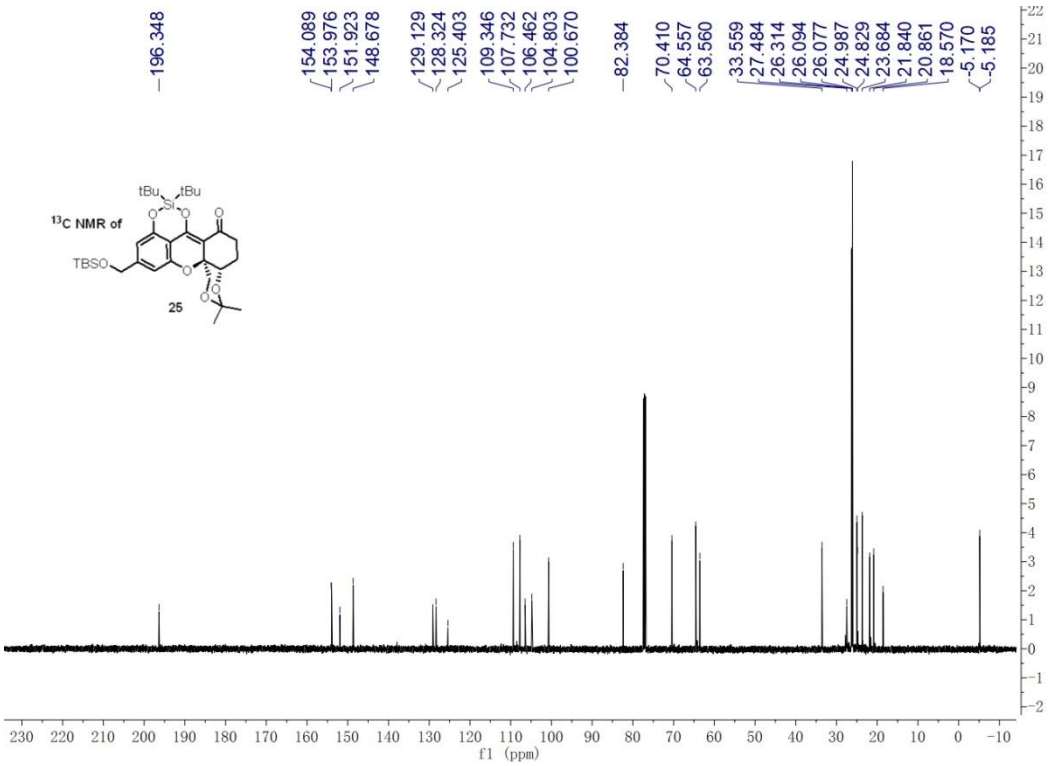
^{1}H NMR spectrum of compound 24



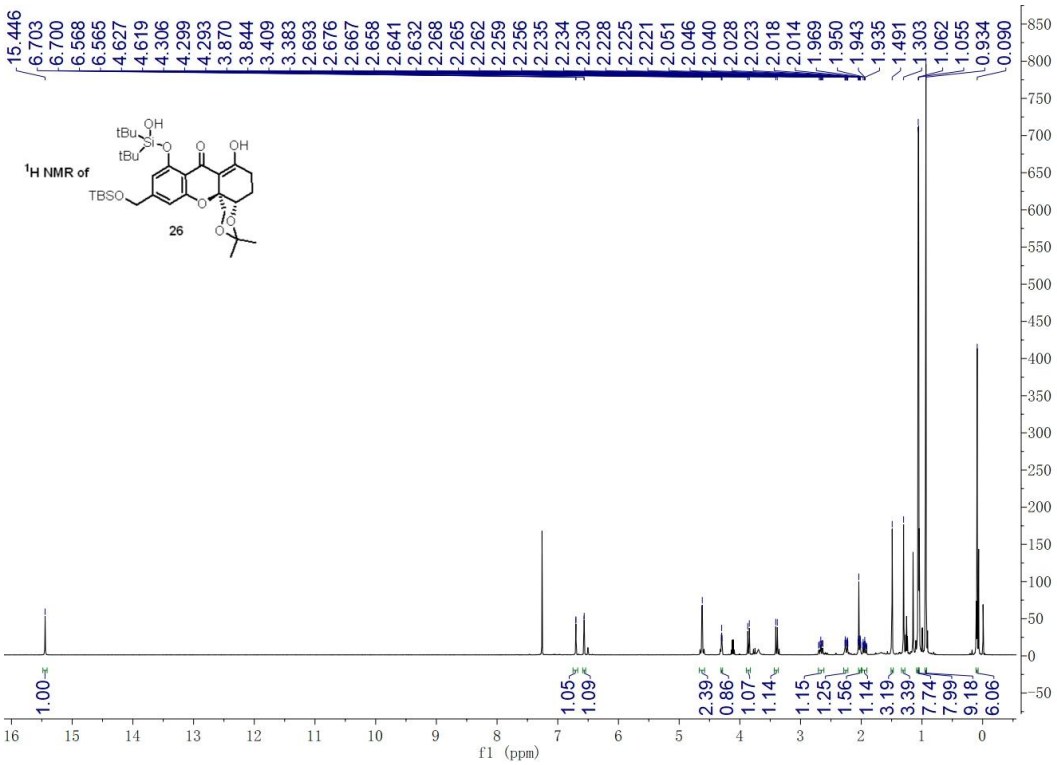
^{13}C NMR spectrum of compound 24



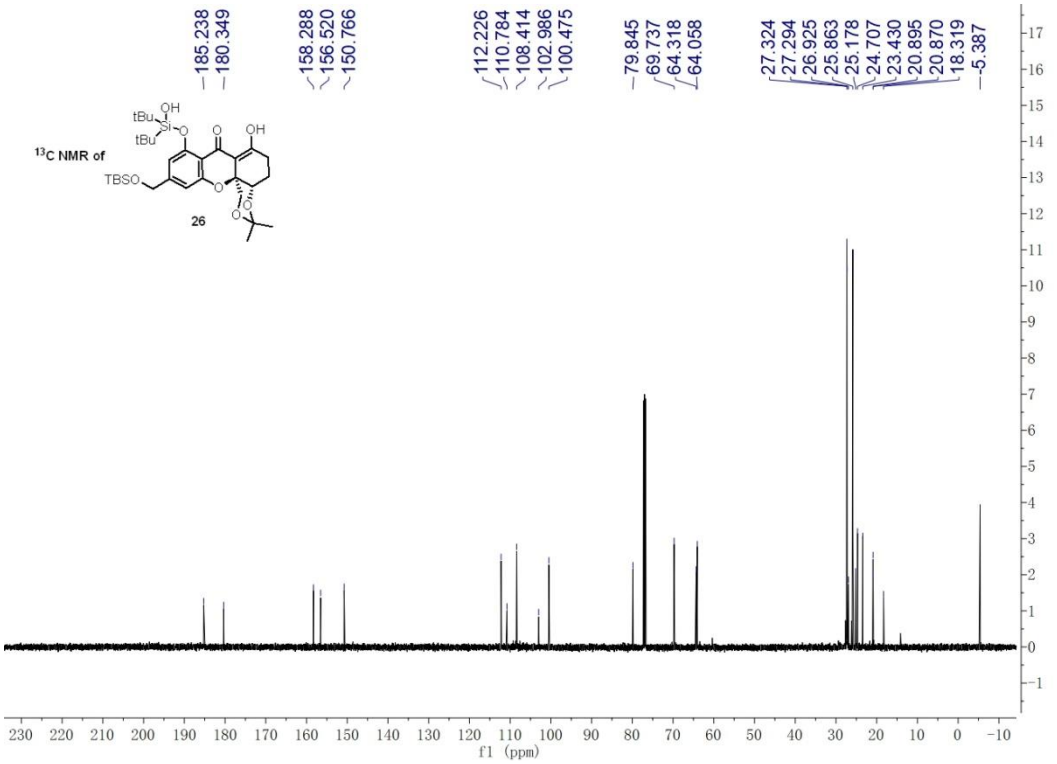
^{1}H NMR spectrum of compound 25



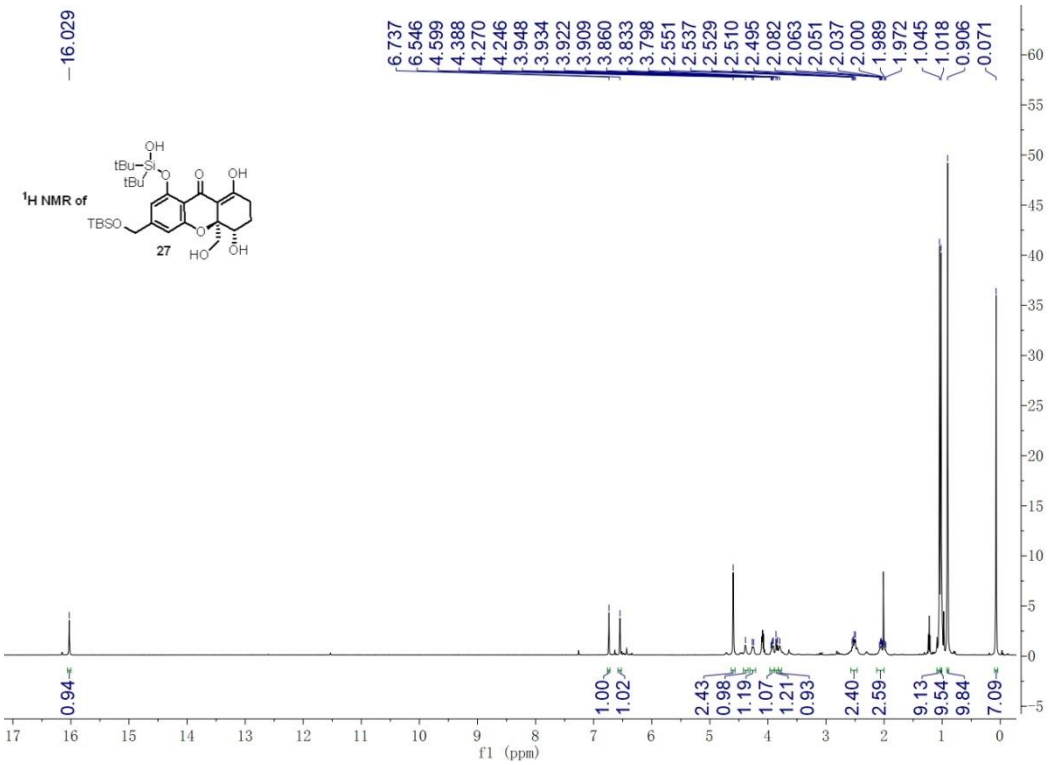
^{13}C NMR spectrum of compound 25



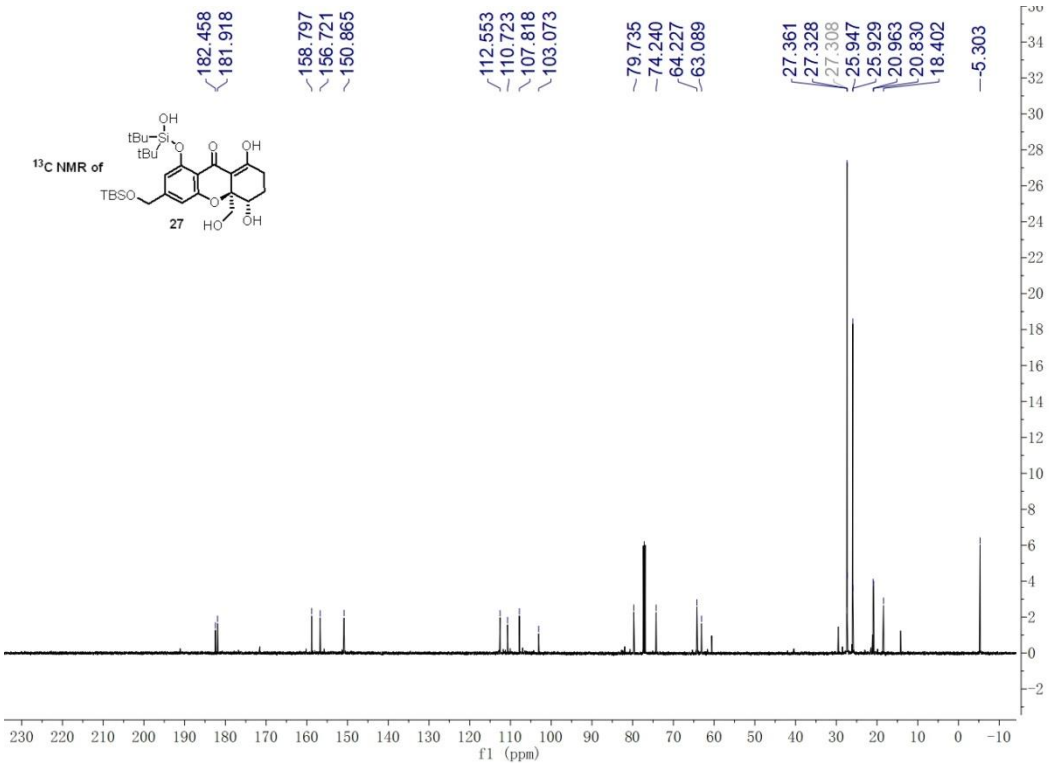
^{1}H NMR spectrum of compound 26



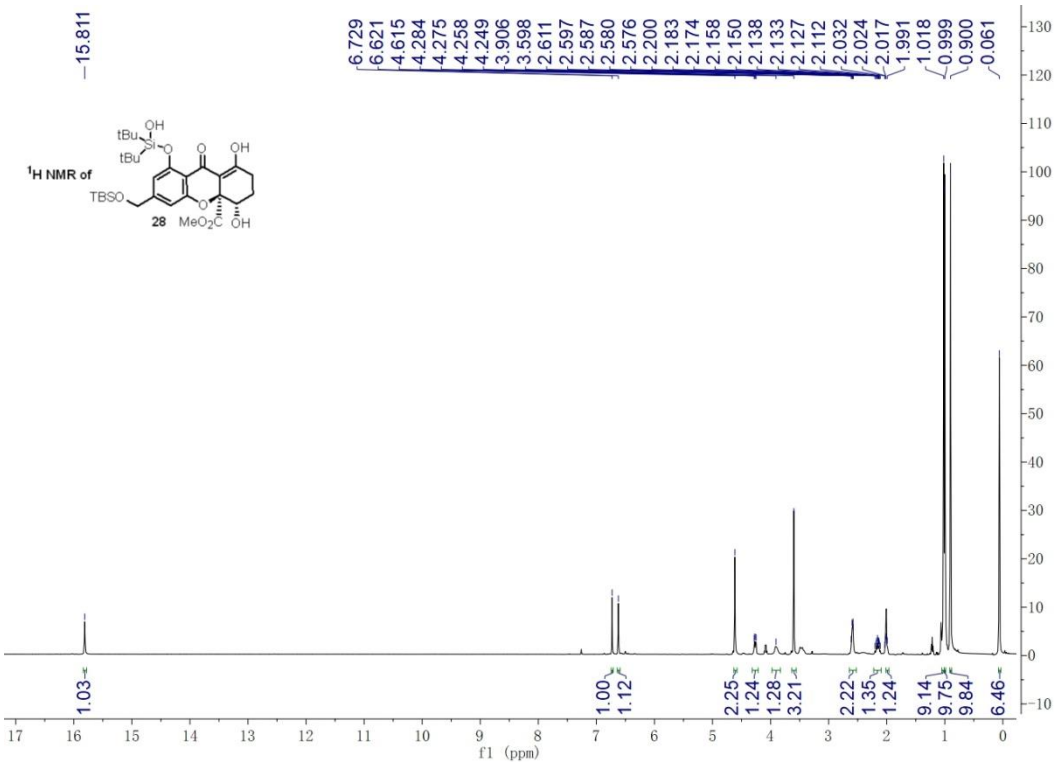
^{13}C NMR spectrum of compound 26



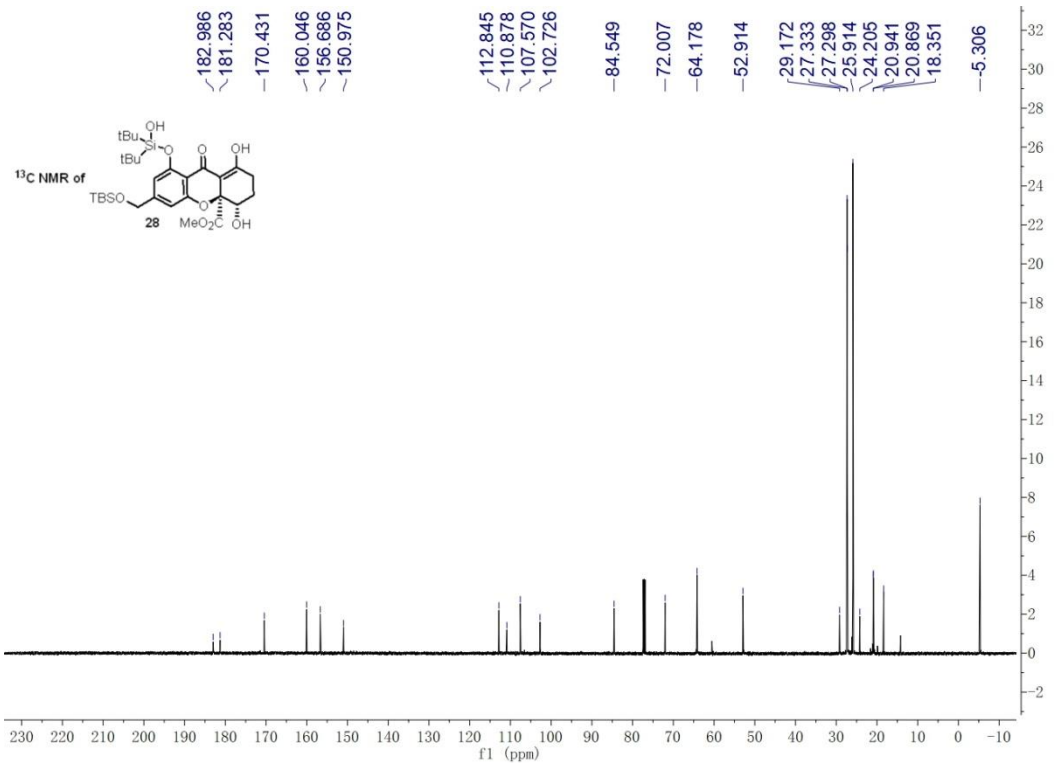
^{1}H NMR spectrum of compound 27



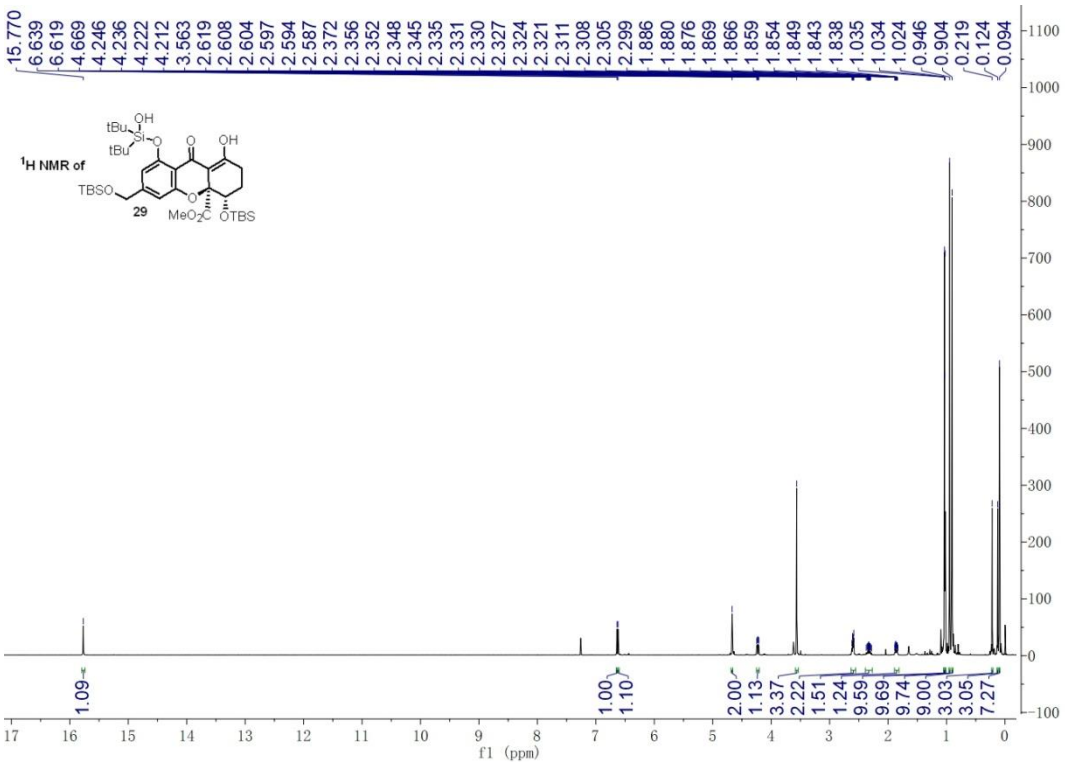
^{13}C NMR spectrum of compound 27



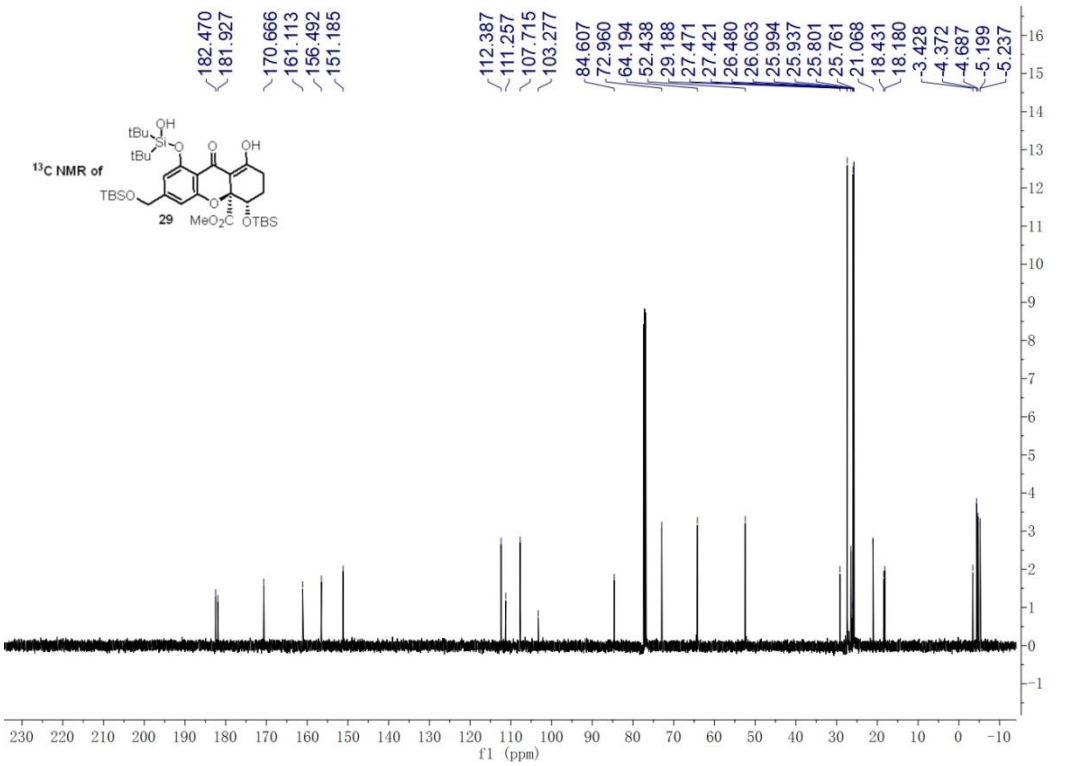
^{1}H NMR spectrum of compound 28



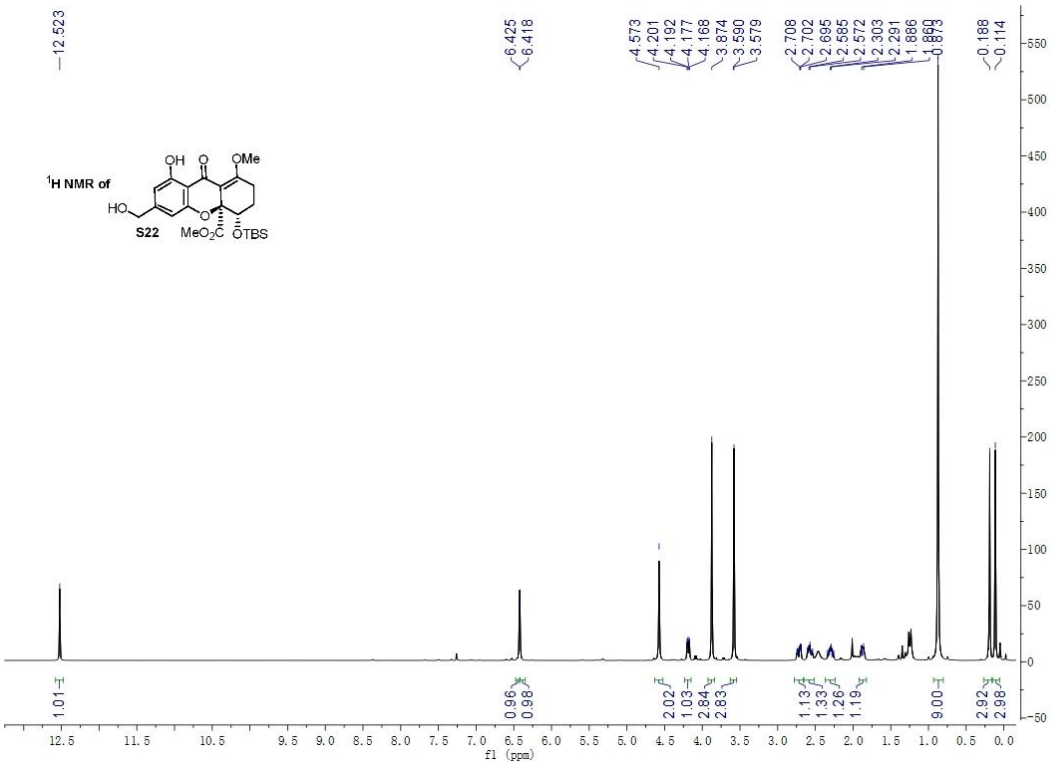
^{13}C NMR spectrum of compound 28



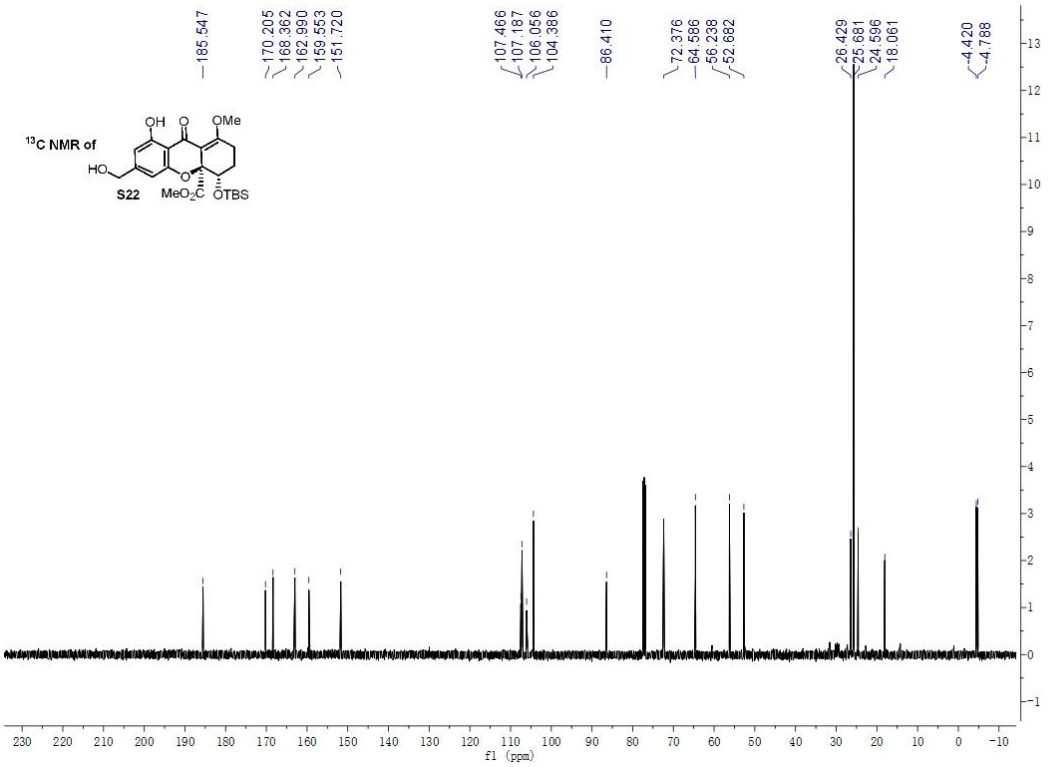
^{1}H NMR spectrum of compound 29



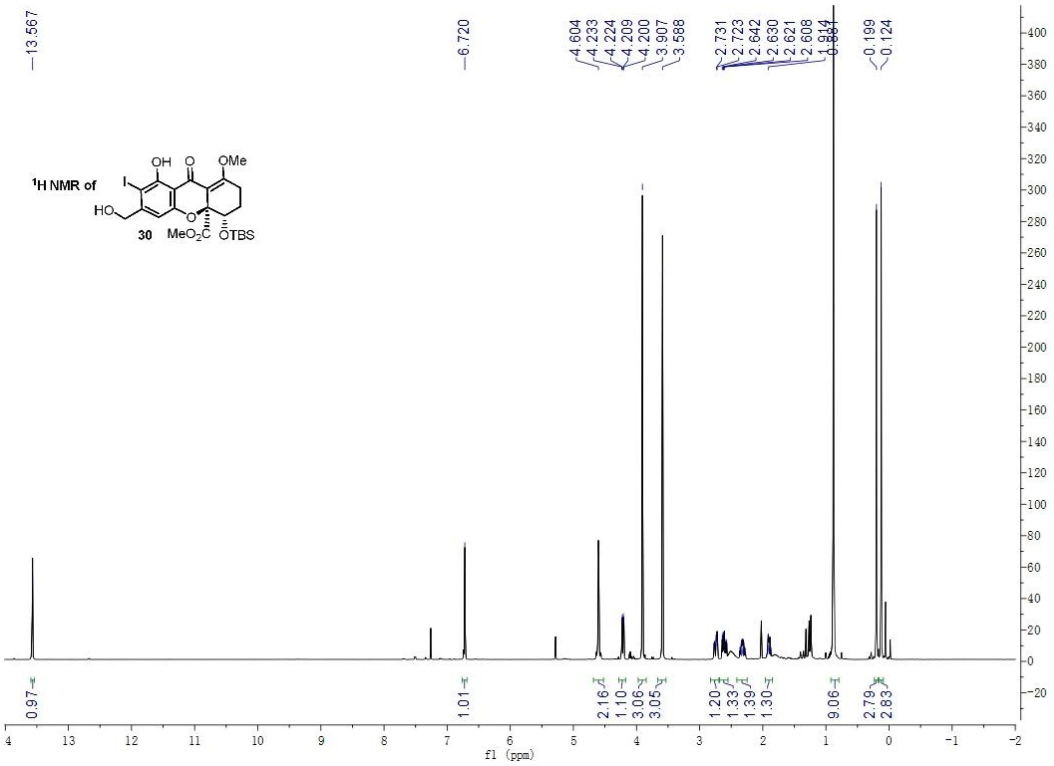
^{13}C NMR spectrum of compound 29



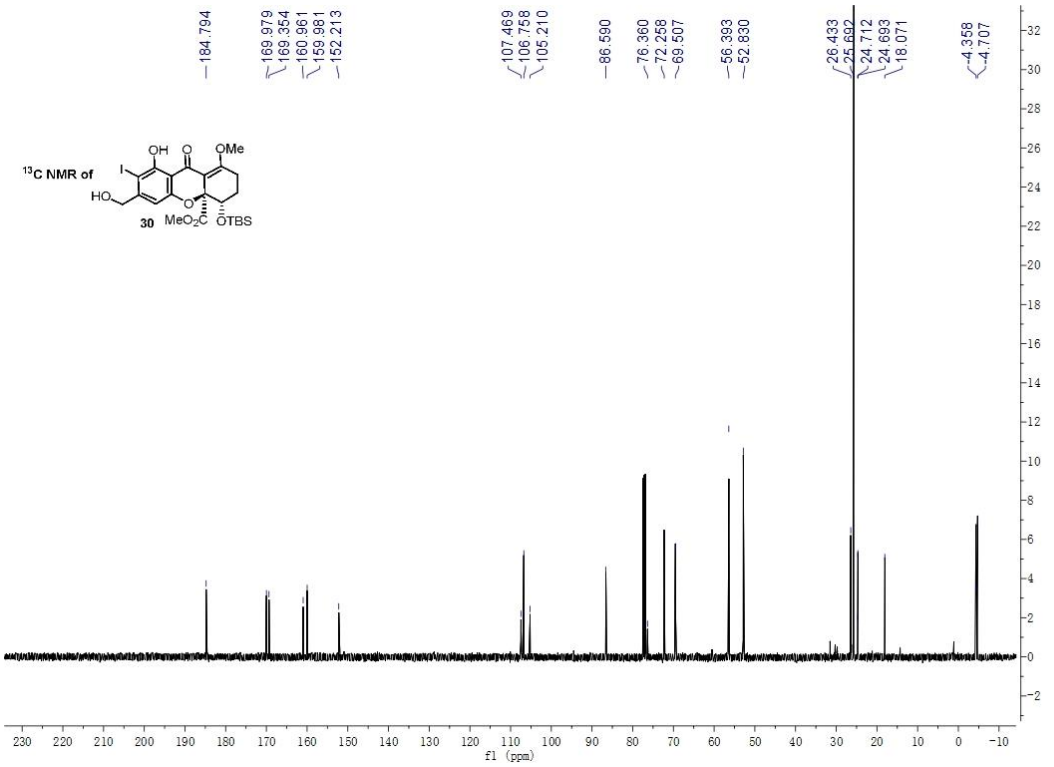
^{1}H NMR spectrum of compound S22



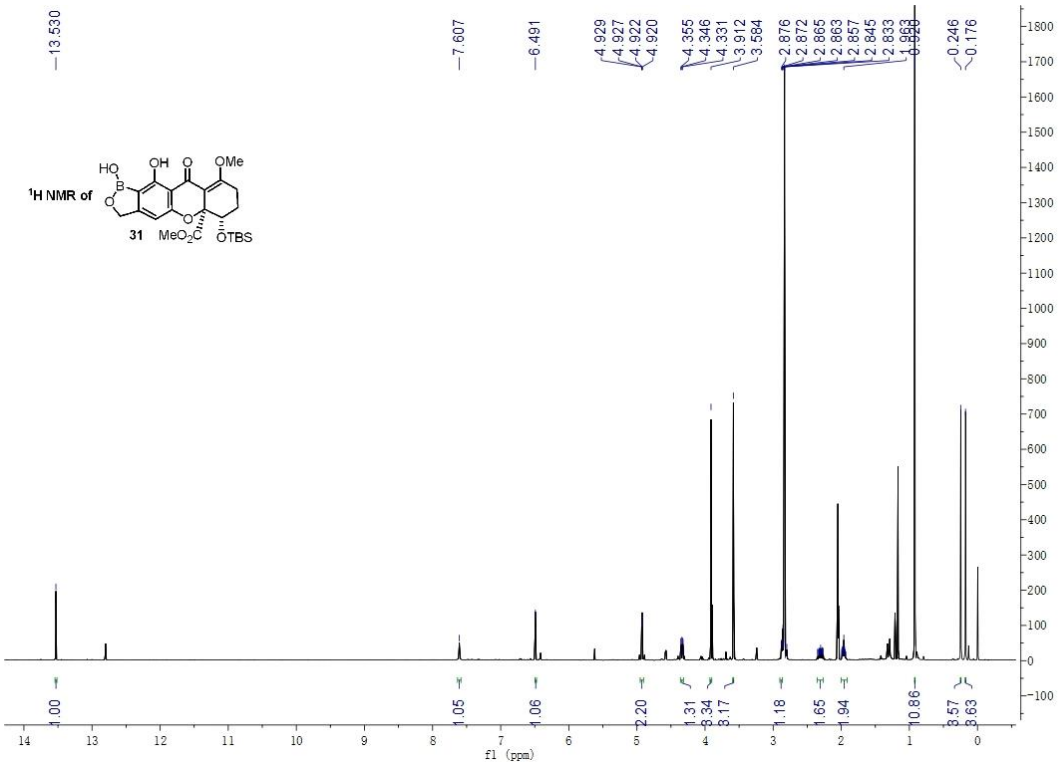
^{13}C NMR spectrum of compound S22



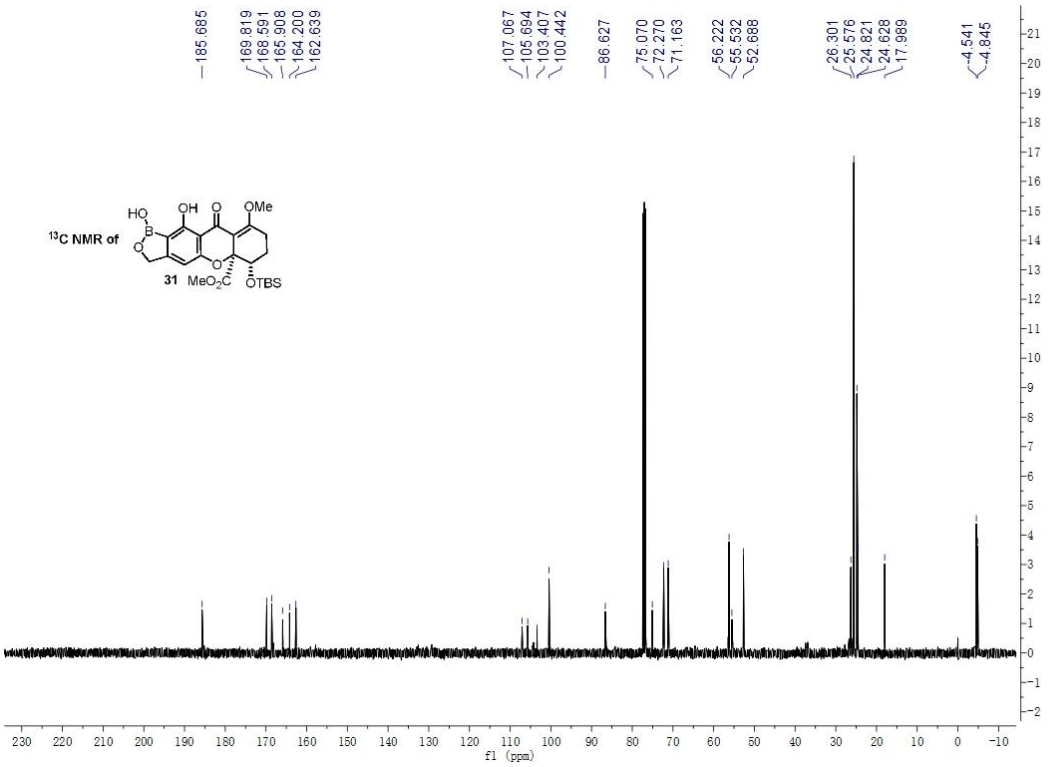
^{1}H NMR spectrum of compound 30



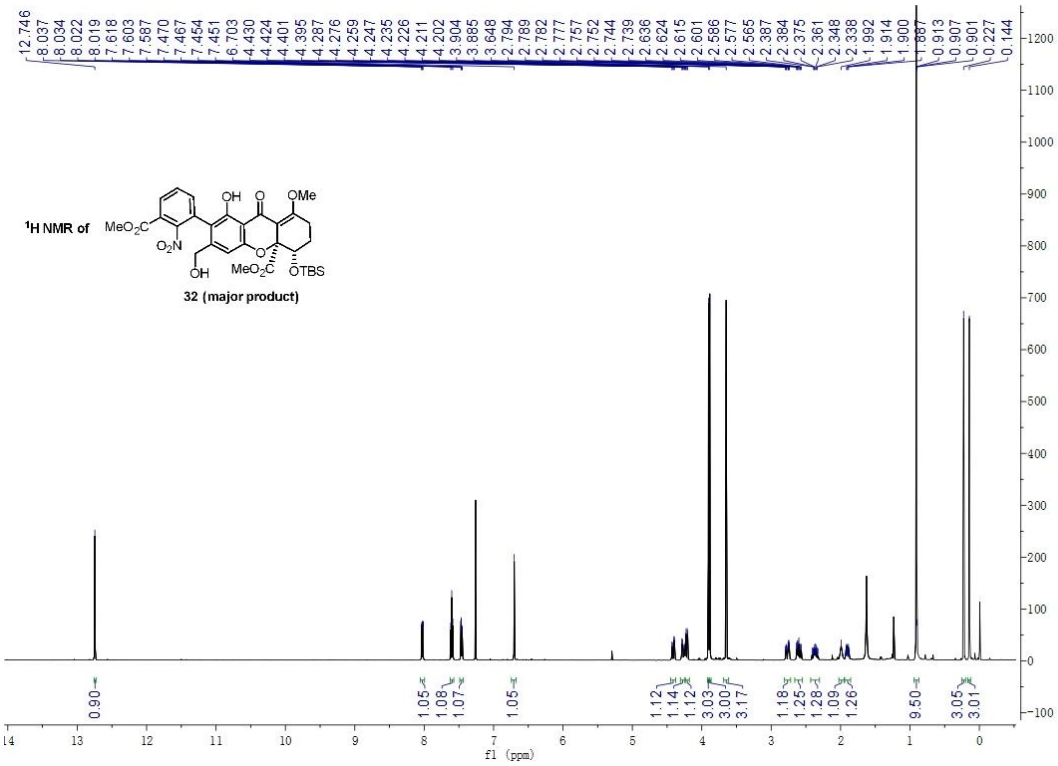
^{13}C NMR spectrum of compound 30



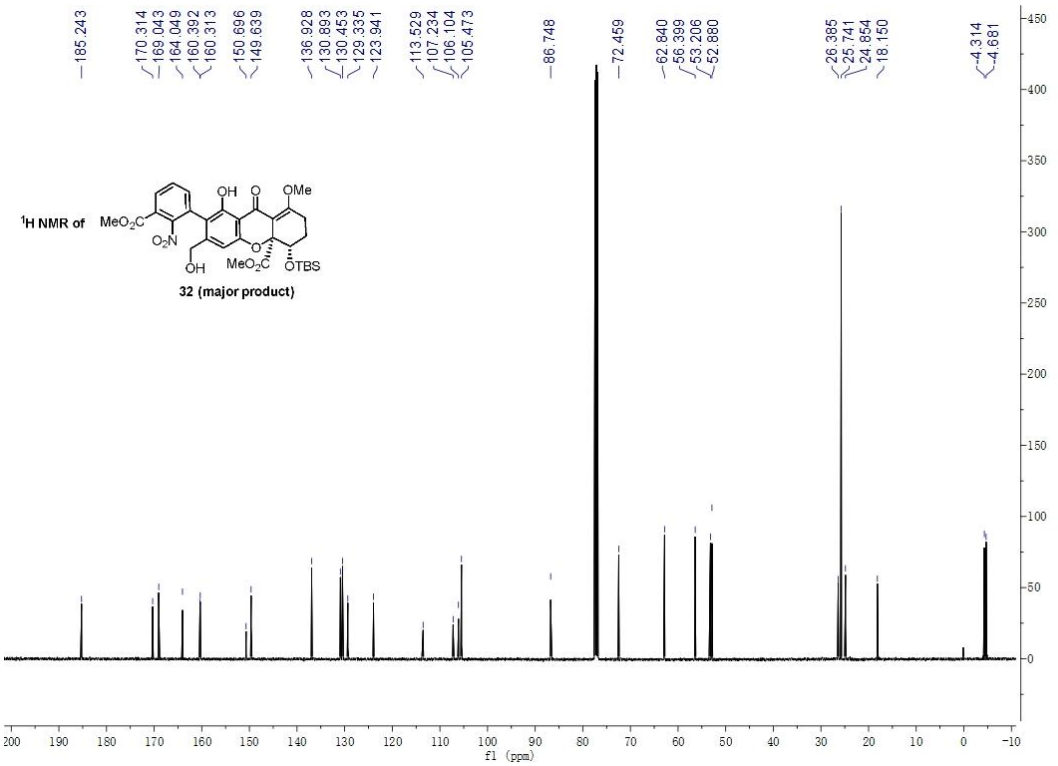
^{1}H NMR spectrum of compound 31



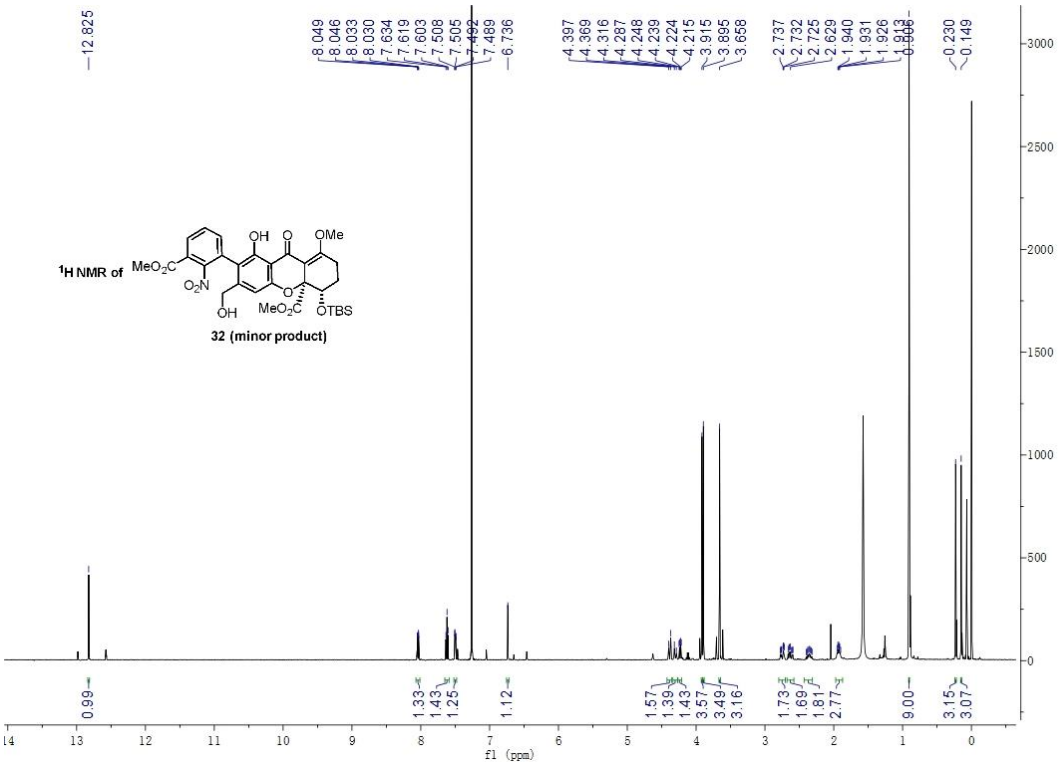
^{13}C NMR spectrum of compound 31



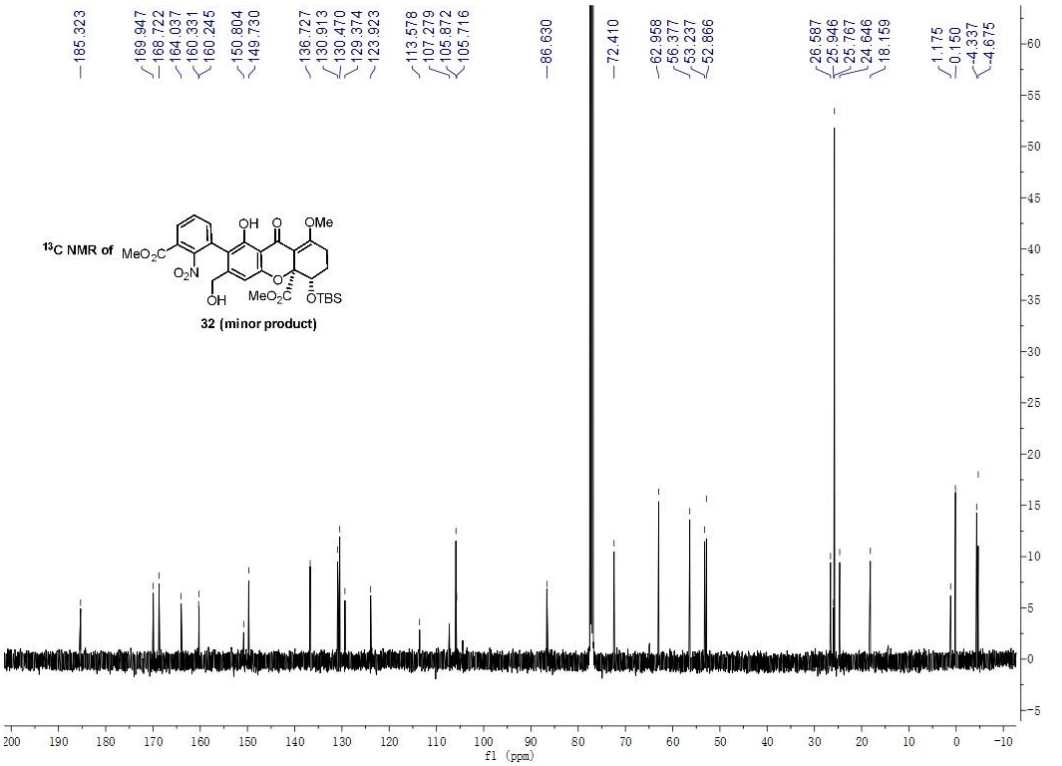
^{1}H NMR spectrum of compound 32 (major)



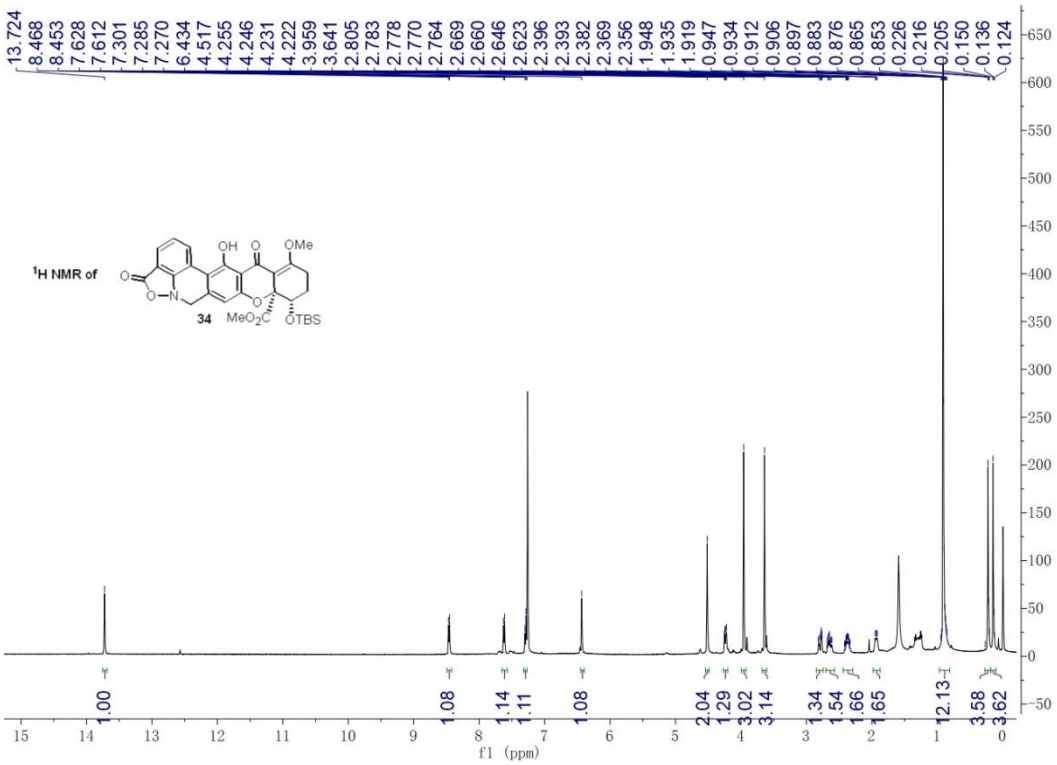
^{13}C NMR spectrum of compound 32 (major)



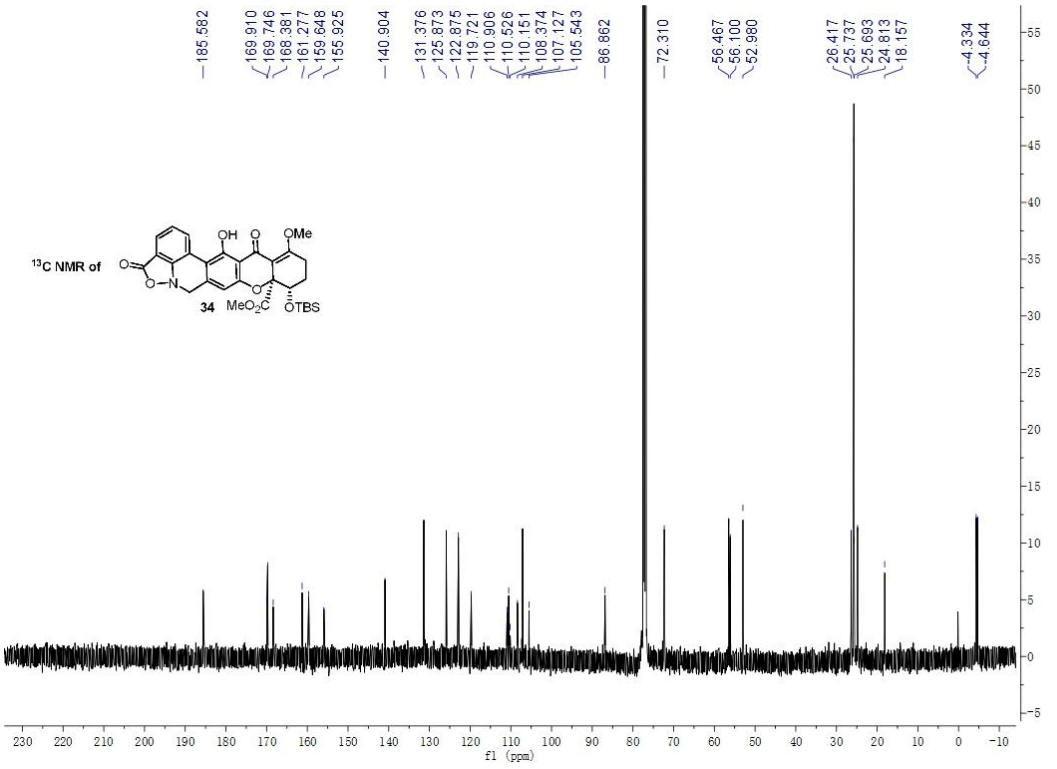
^{1}H NMR spectrum of compound 32 (minor)



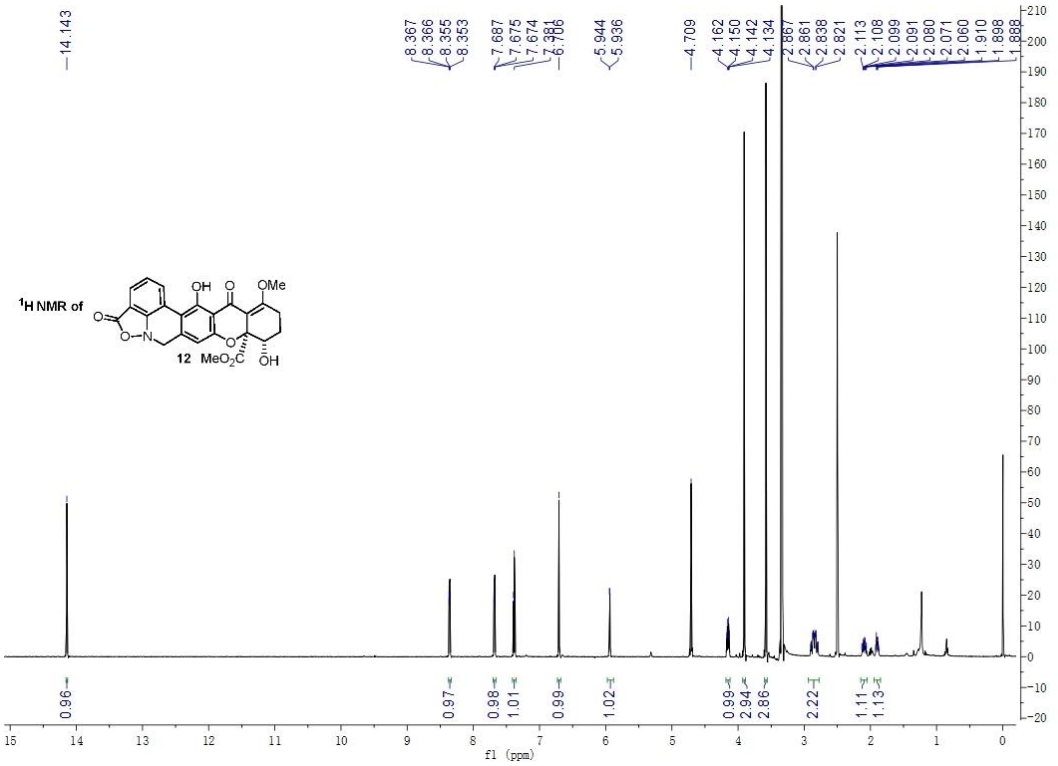
^{1}H NMR spectrum of compound 32 (minor)



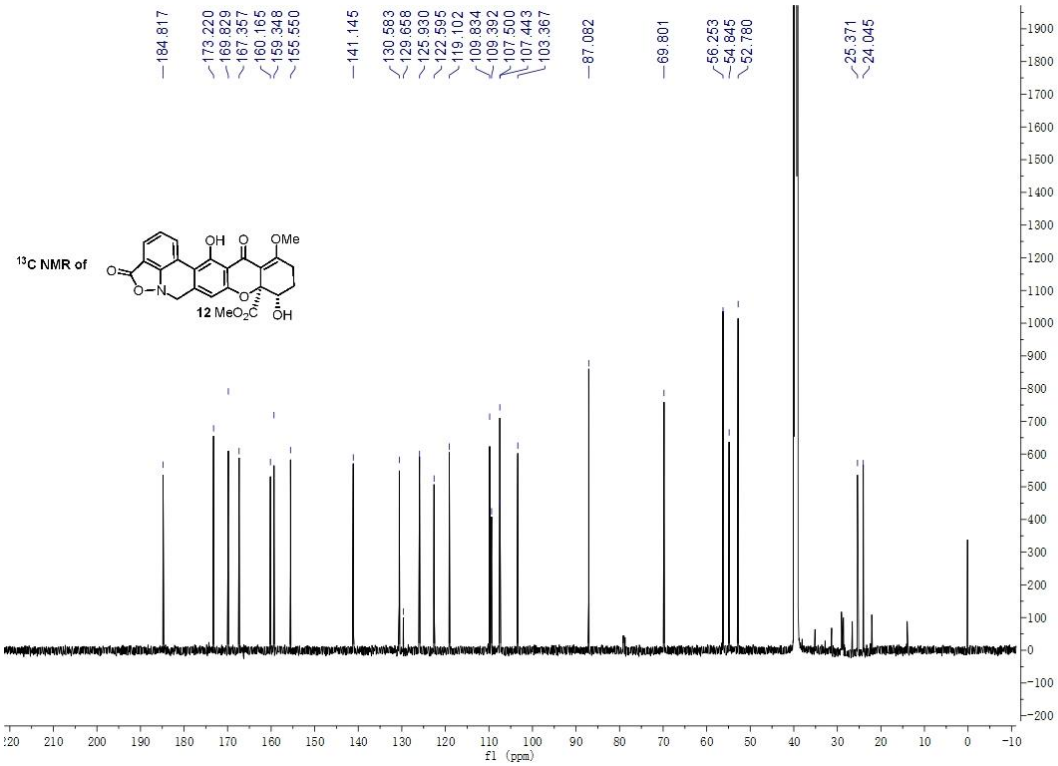
^{1}H NMR spectrum of compound 34



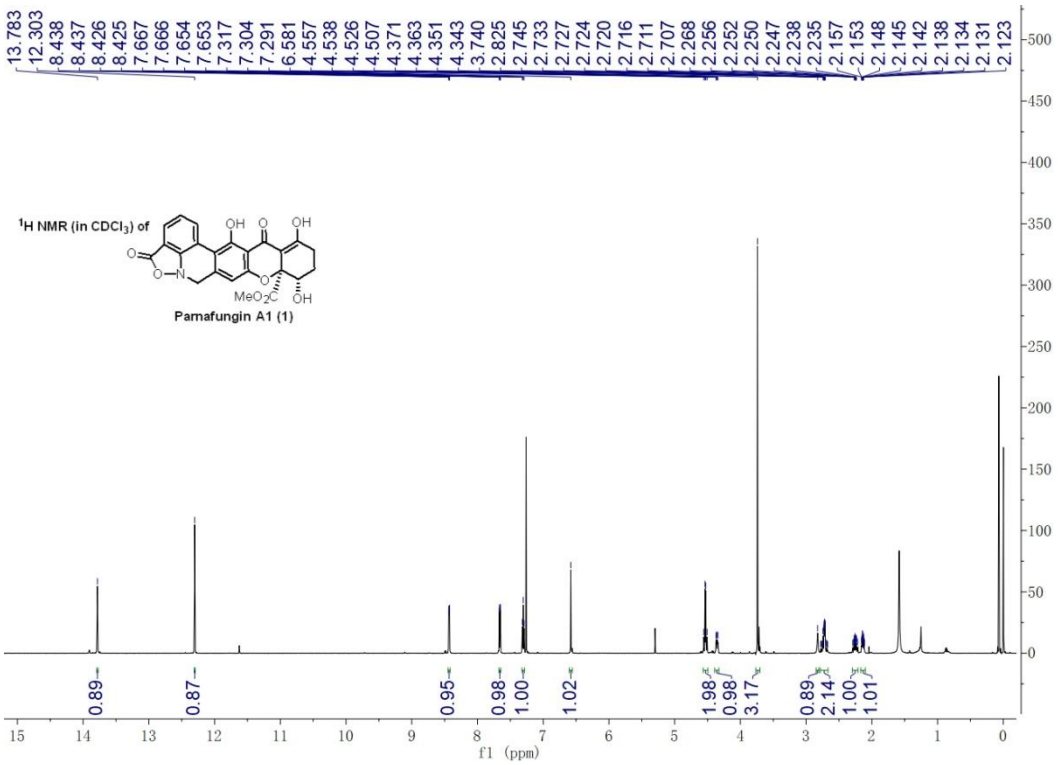
^{13}C NMR spectrum of compound 34



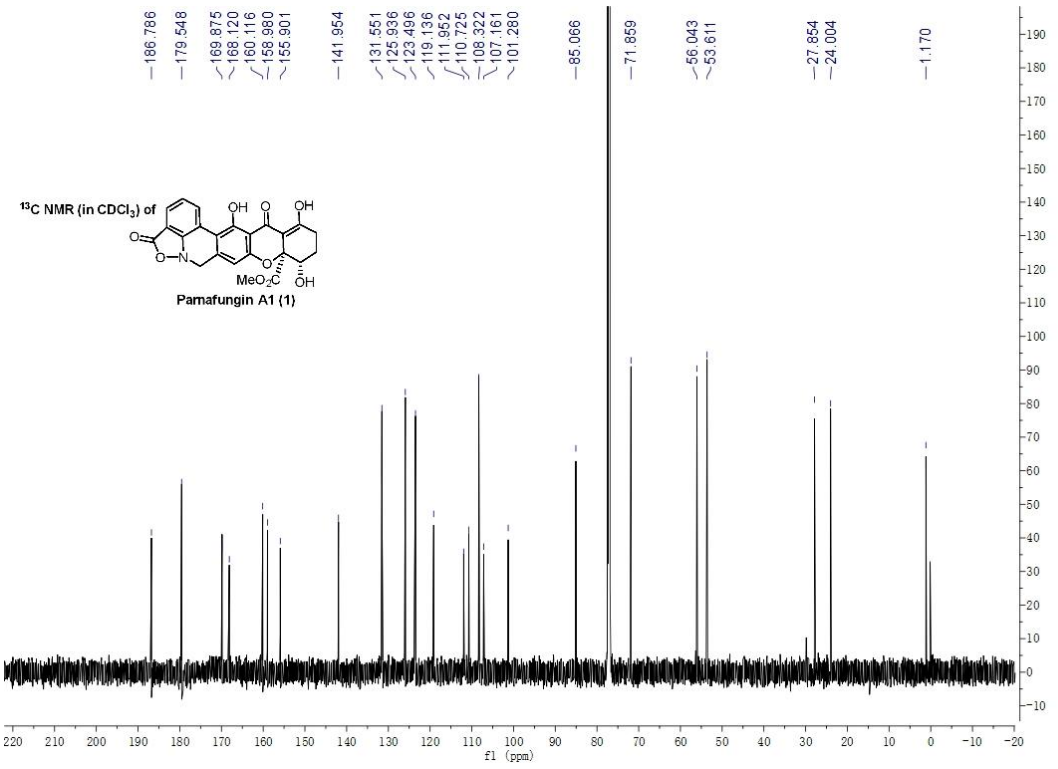
^{1}H NMR spectrum of compound 12



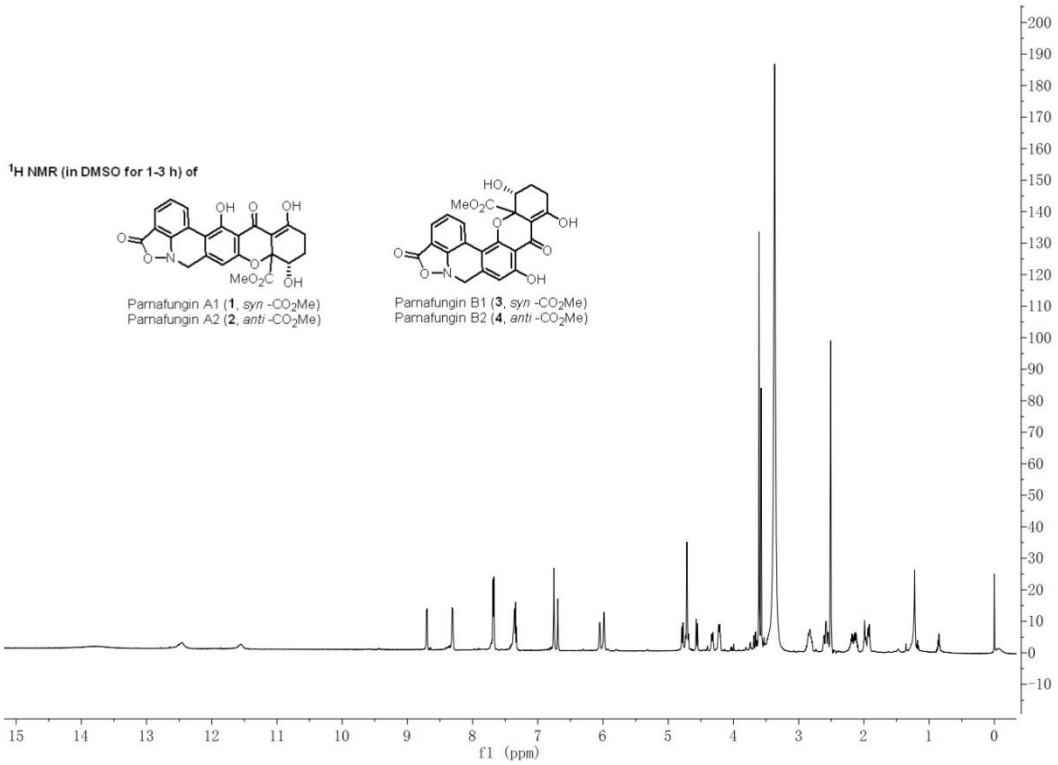
^{13}C NMR spectrum of compound 12



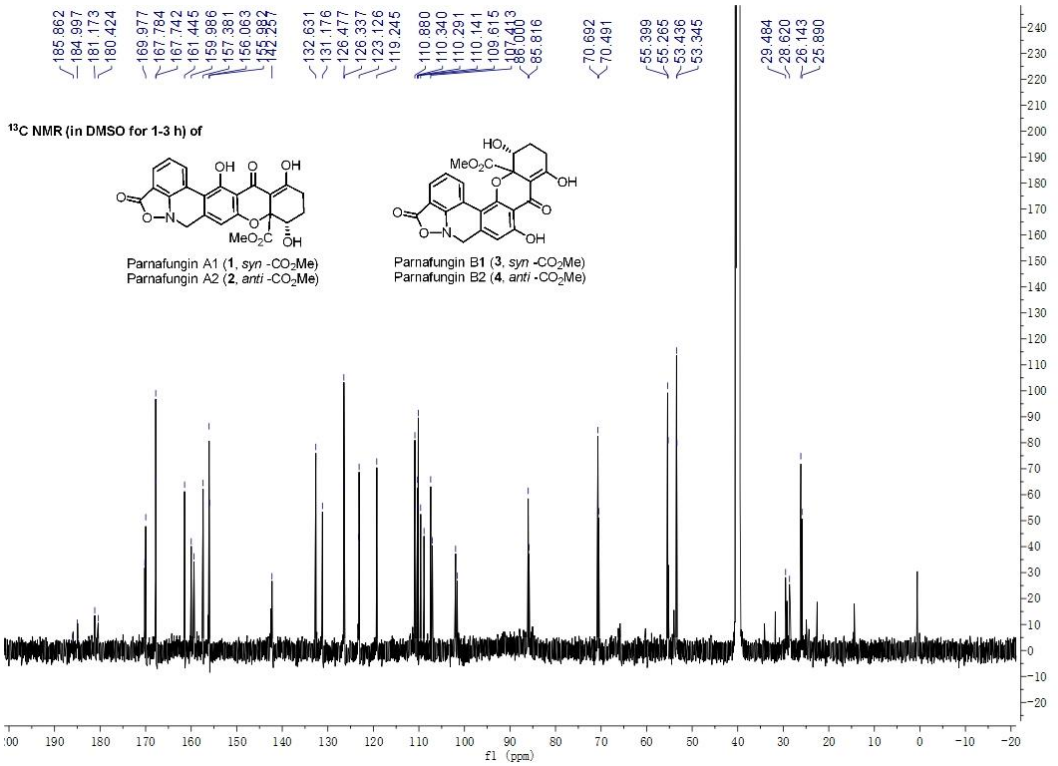
^{1}H NMR spectrum of compound 1



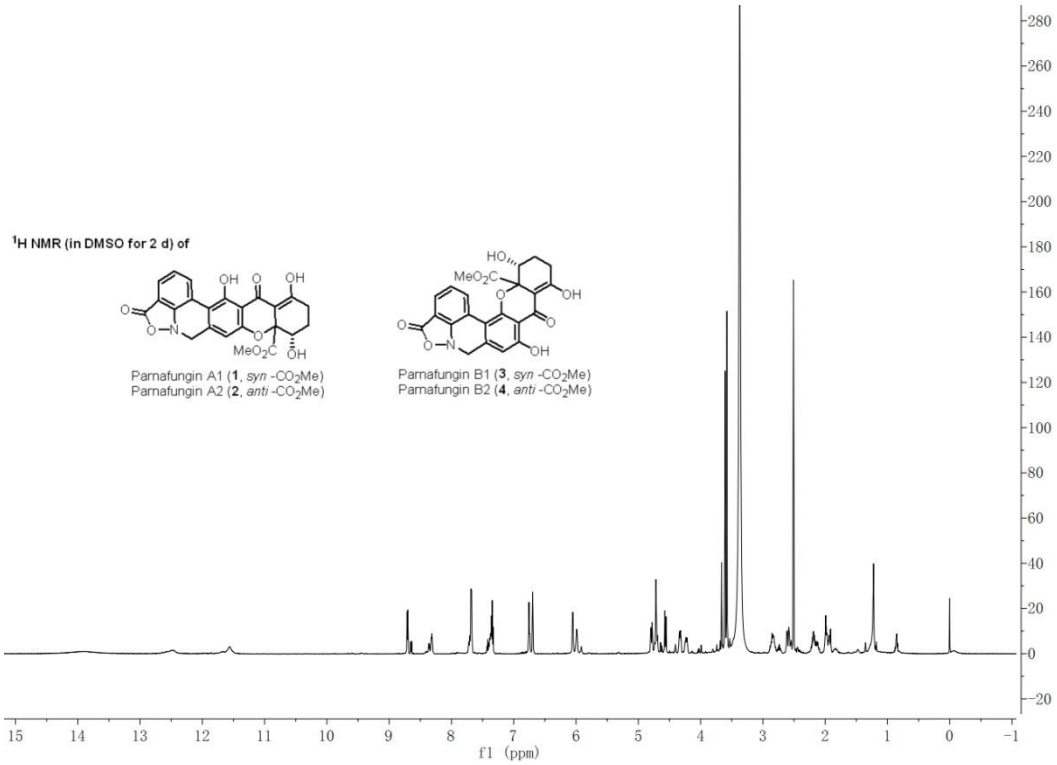
^{13}C NMR spectrum of compound 1



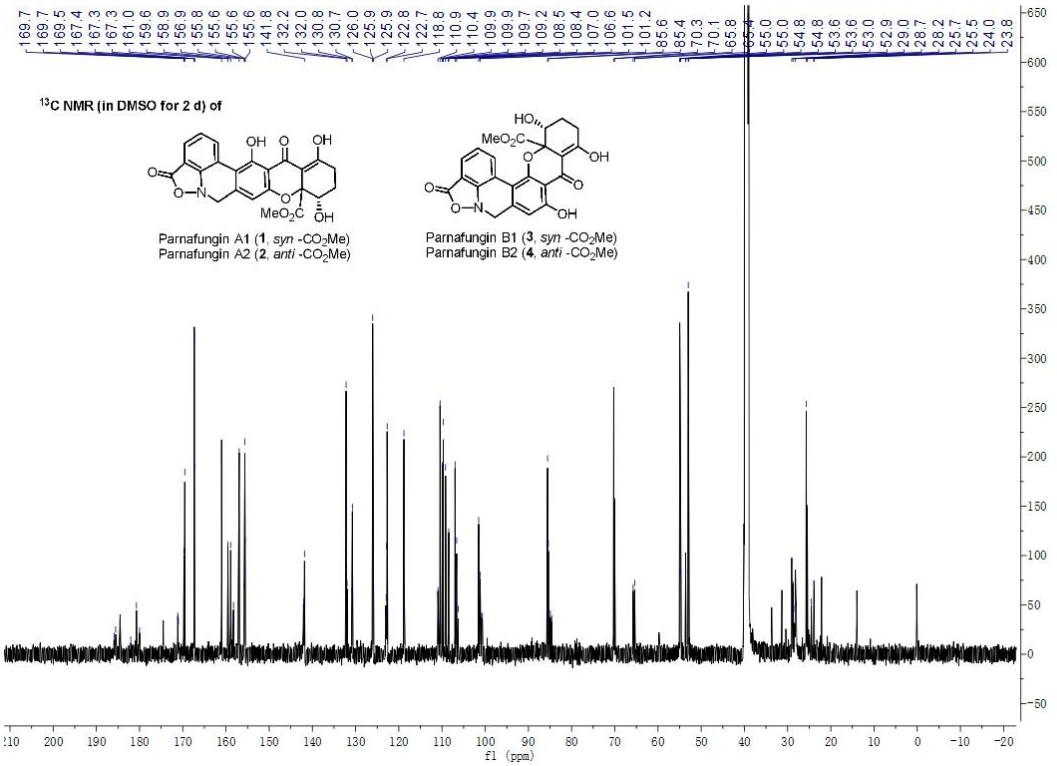
^{1}H NMR spectrum of interconverting mixture of parnafungins



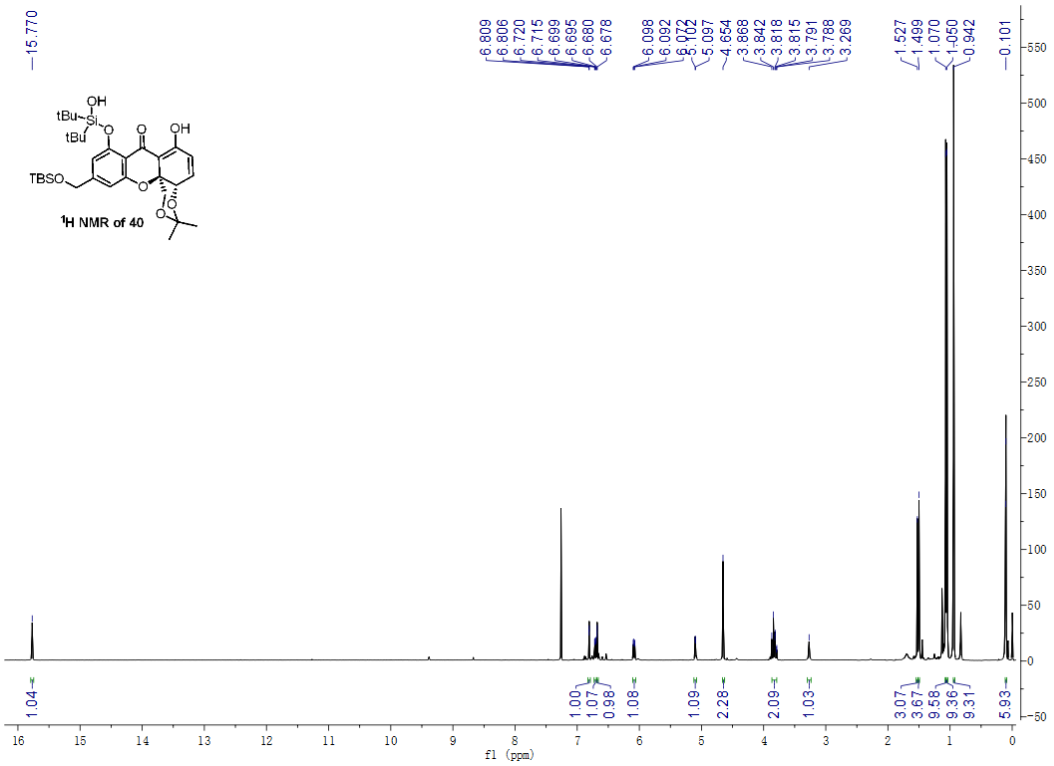
^{13}C NMR spectrum of interconverting mixture of parnafungins



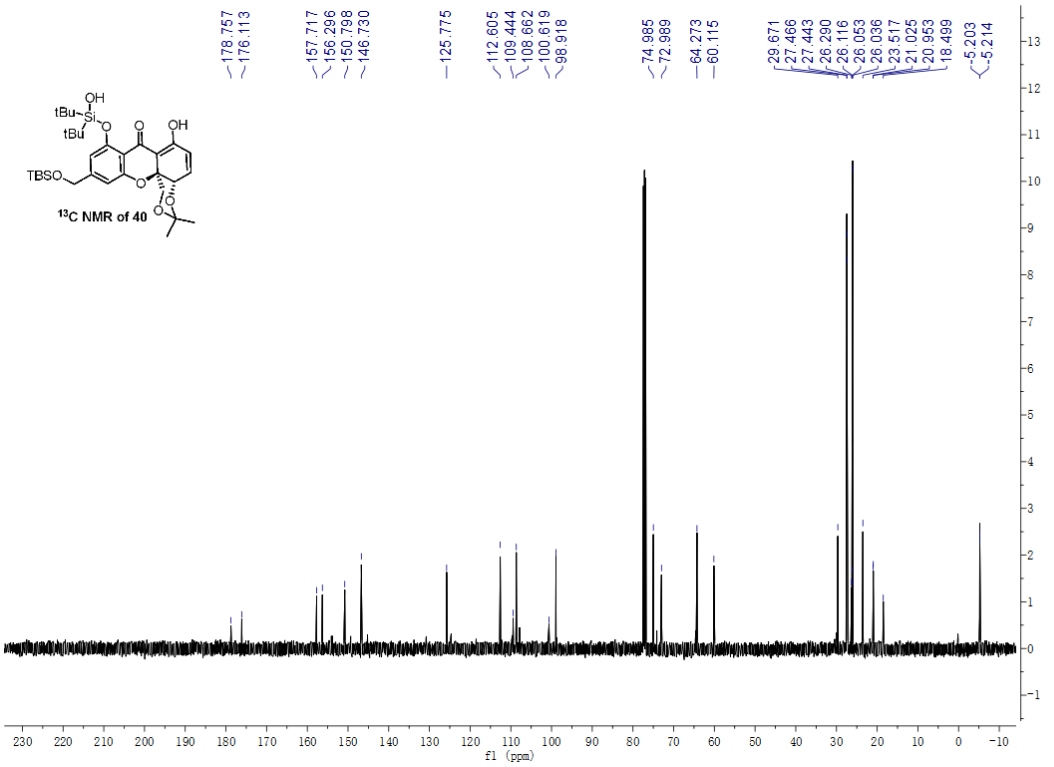
^{1}H NMR spectrum of interconverting mixture of parnafungins



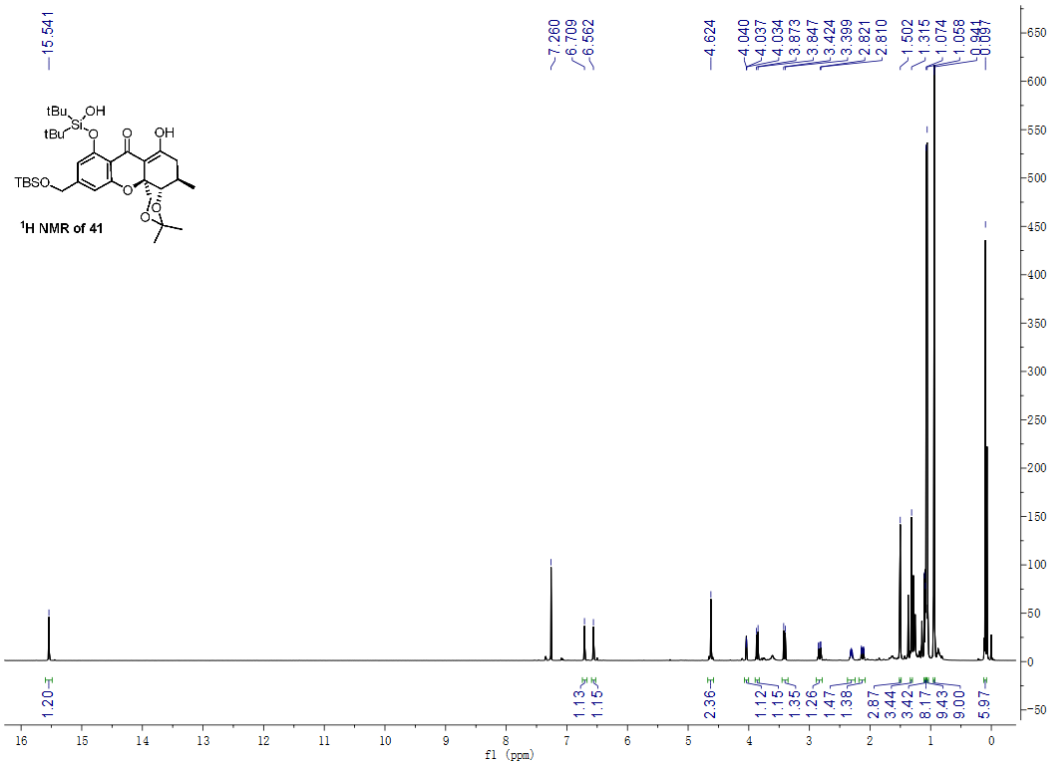
^{13}C NMR spectrum of interconverting mixture of parnafungins



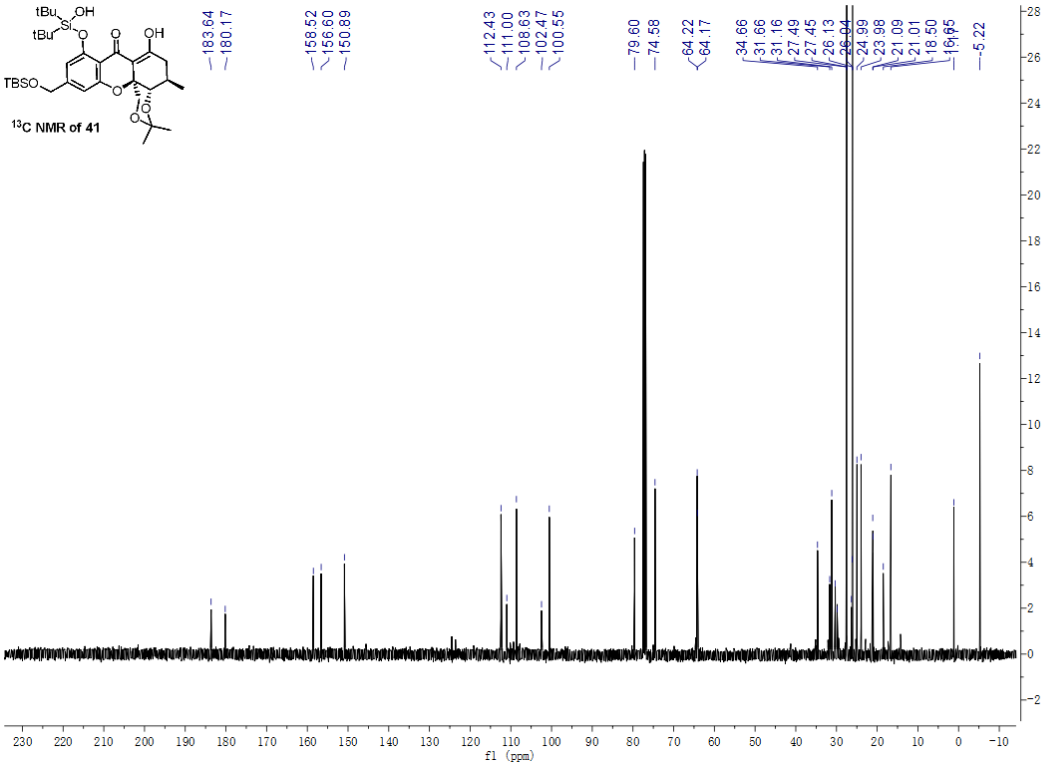
^{1}H NMR spectrum of compound 40



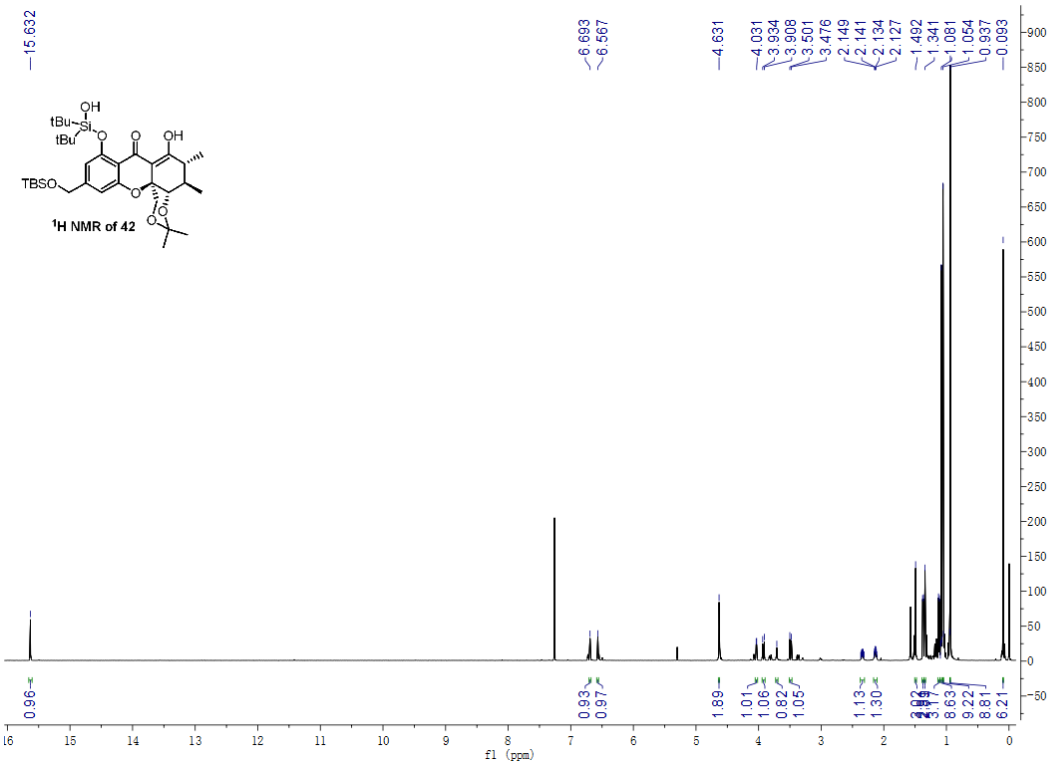
^{13}C NMR spectrum of compound 40



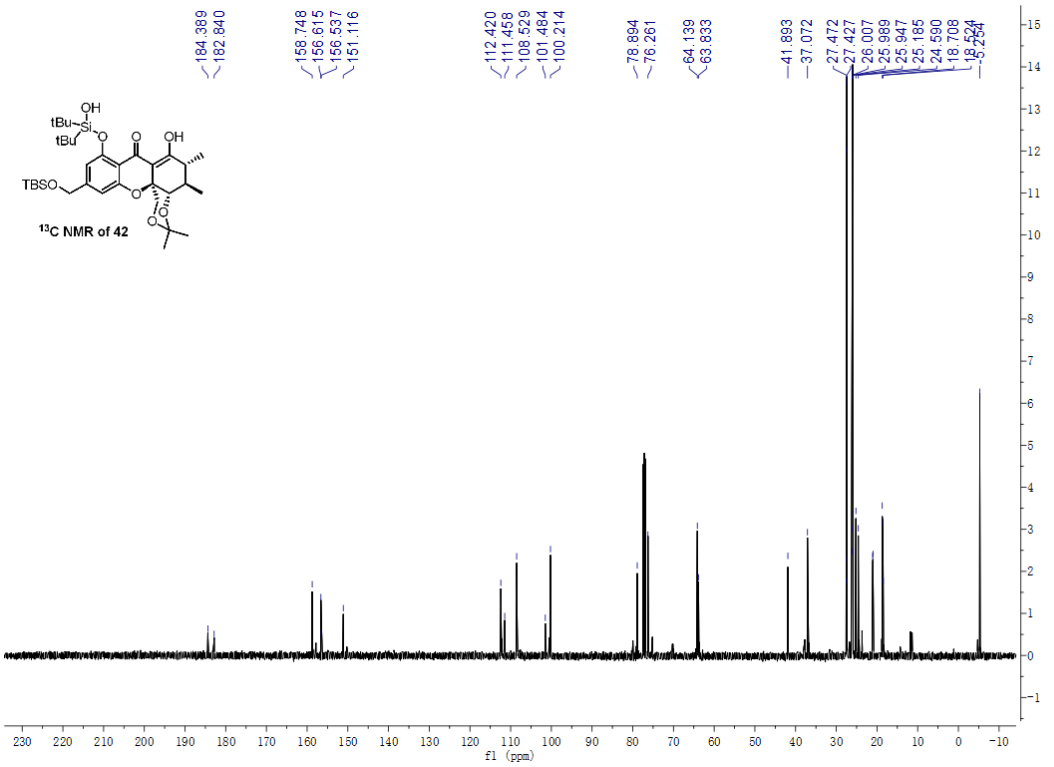
^{1}H NMR spectrum of compound 41



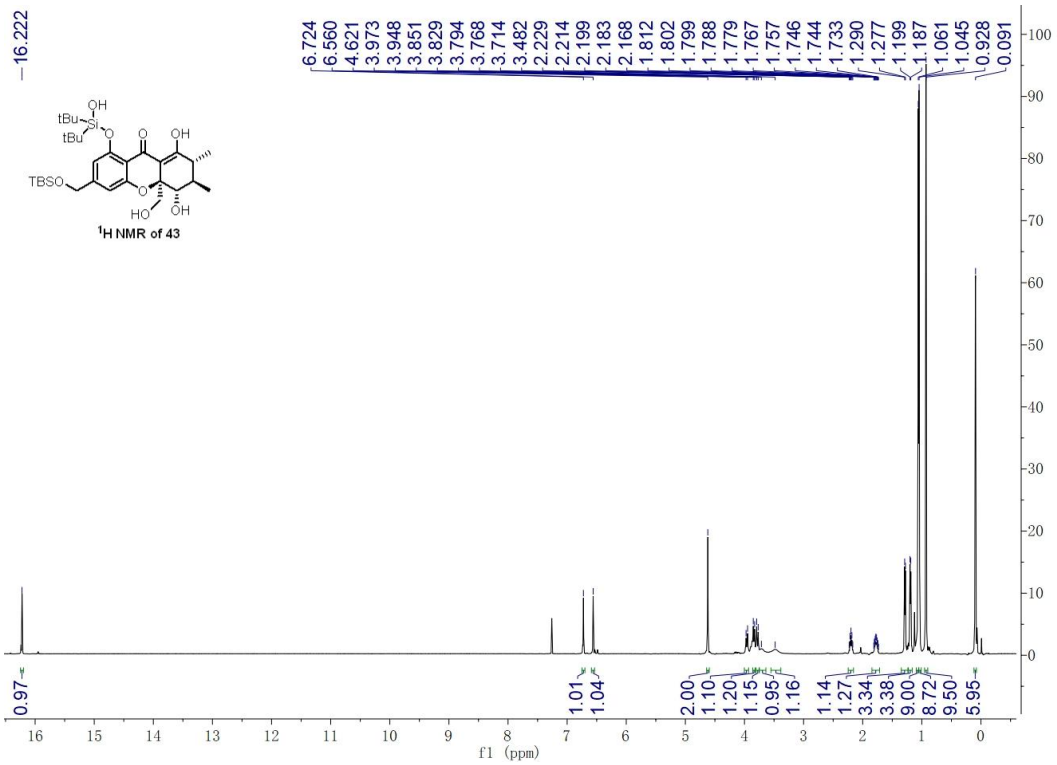
^{13}C NMR spectrum of compound 41



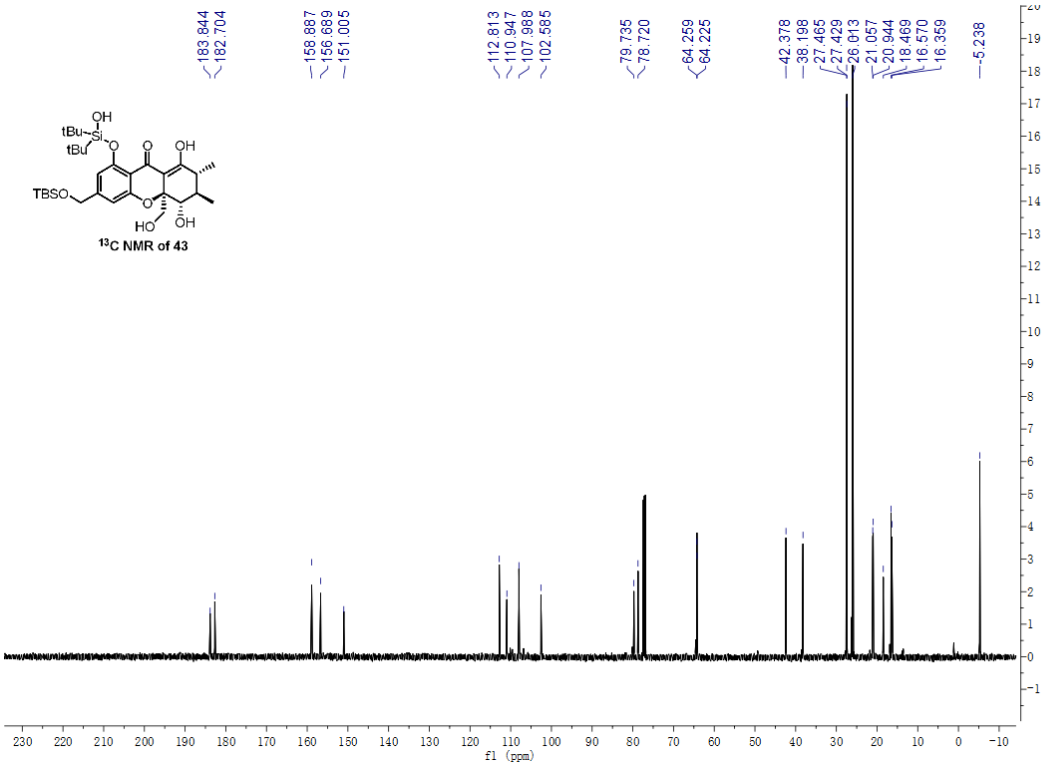
^{1}H NMR spectrum of compound 42



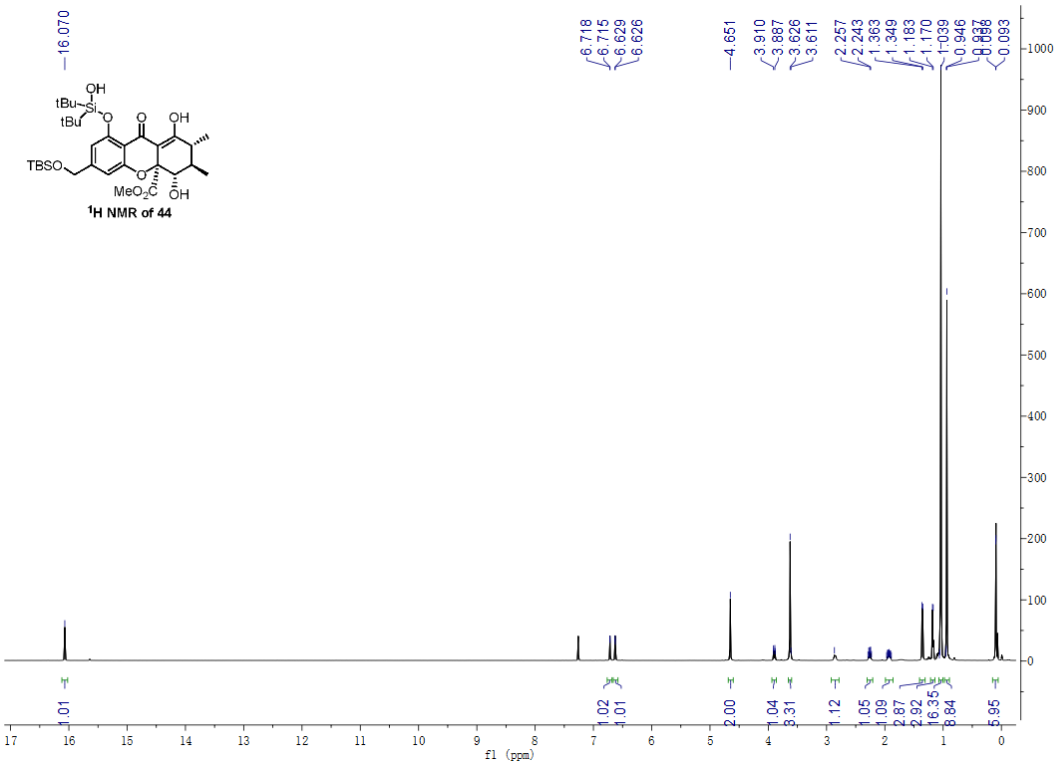
^{13}C NMR spectrum of compound 42



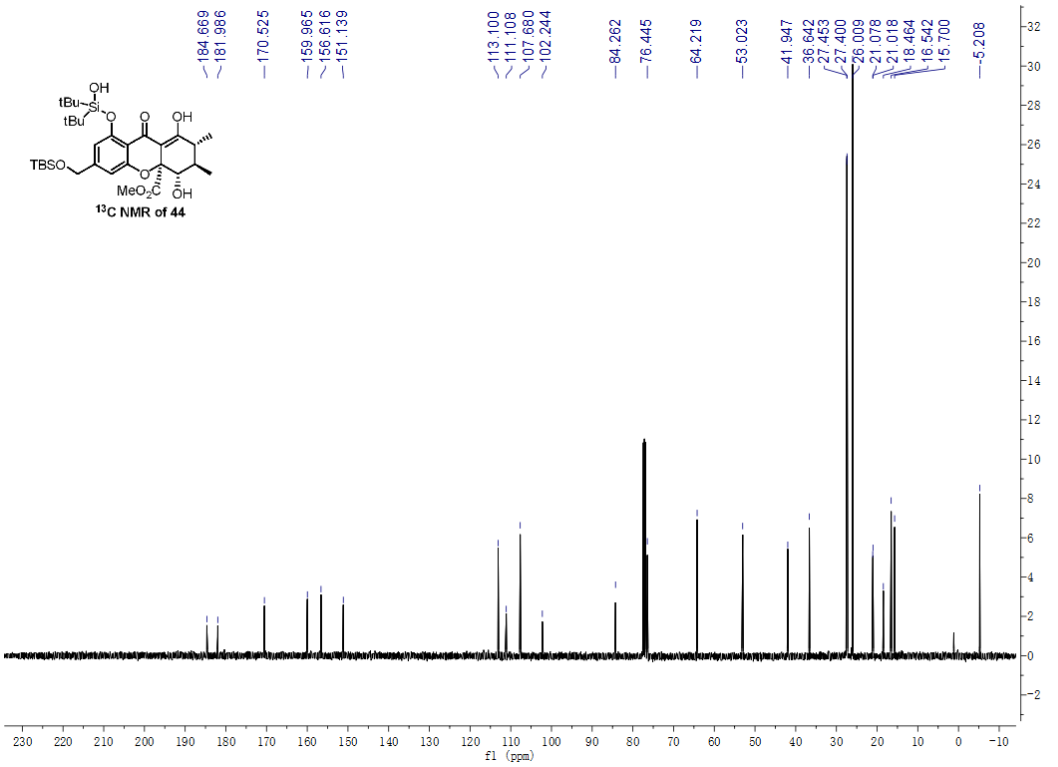
^{1}H NMR spectrum of compound 43



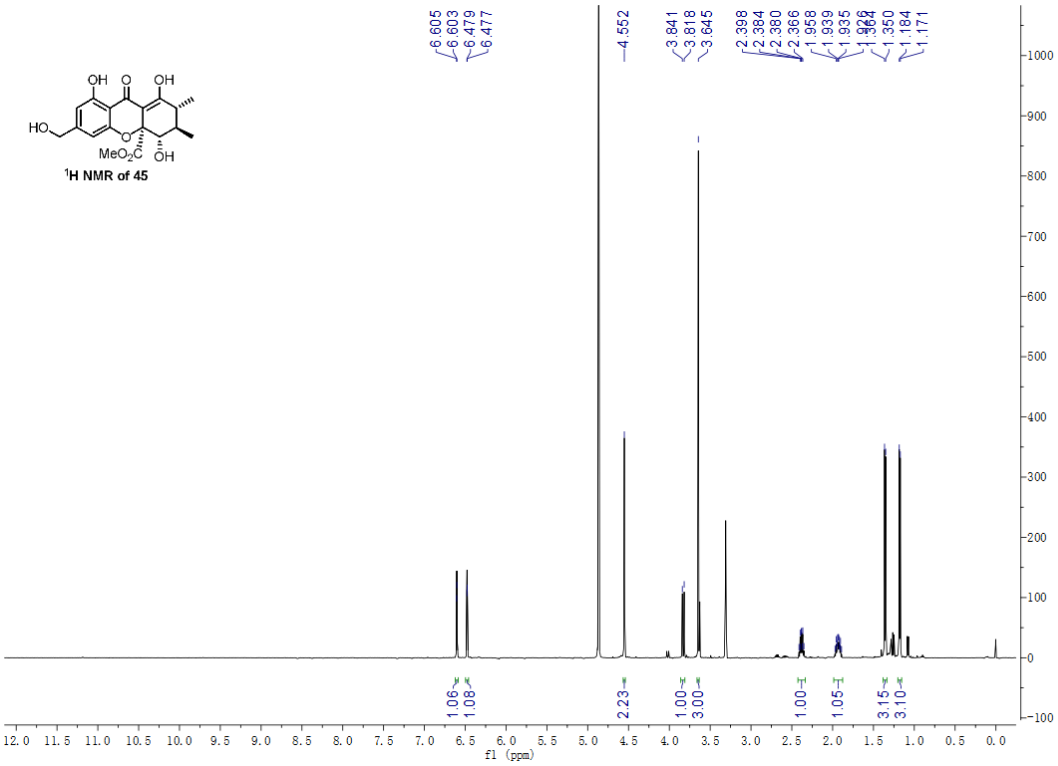
^{13}C NMR spectrum of compound 43



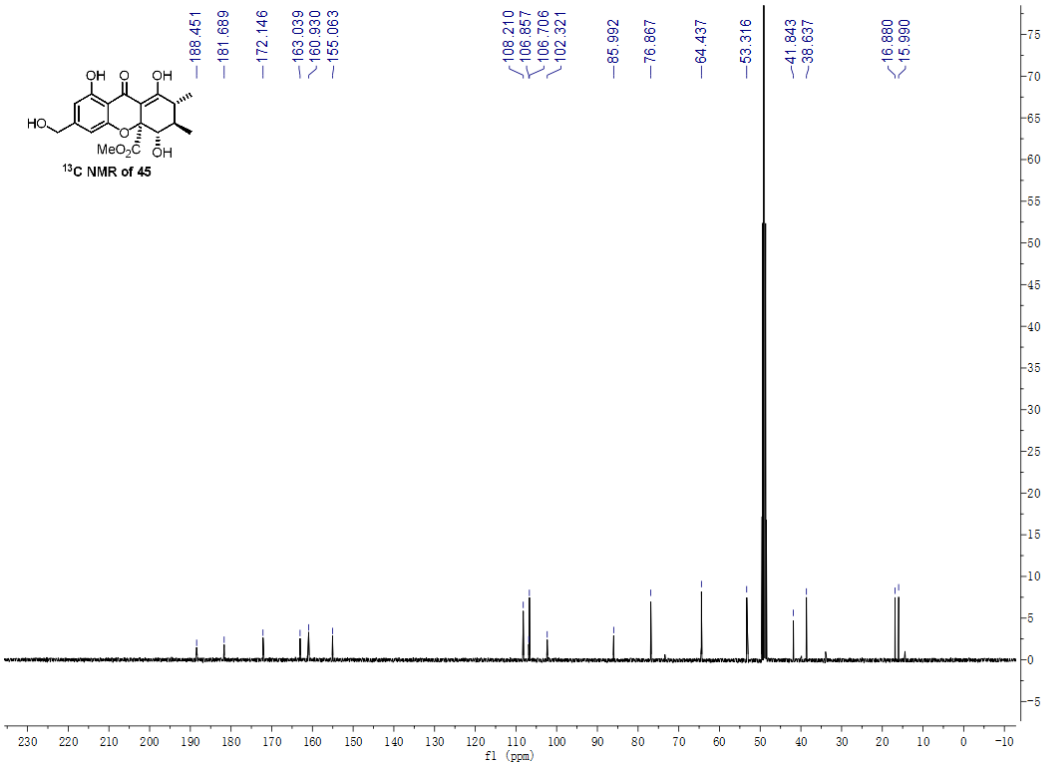
^{1}H NMR spectrum of compound 44



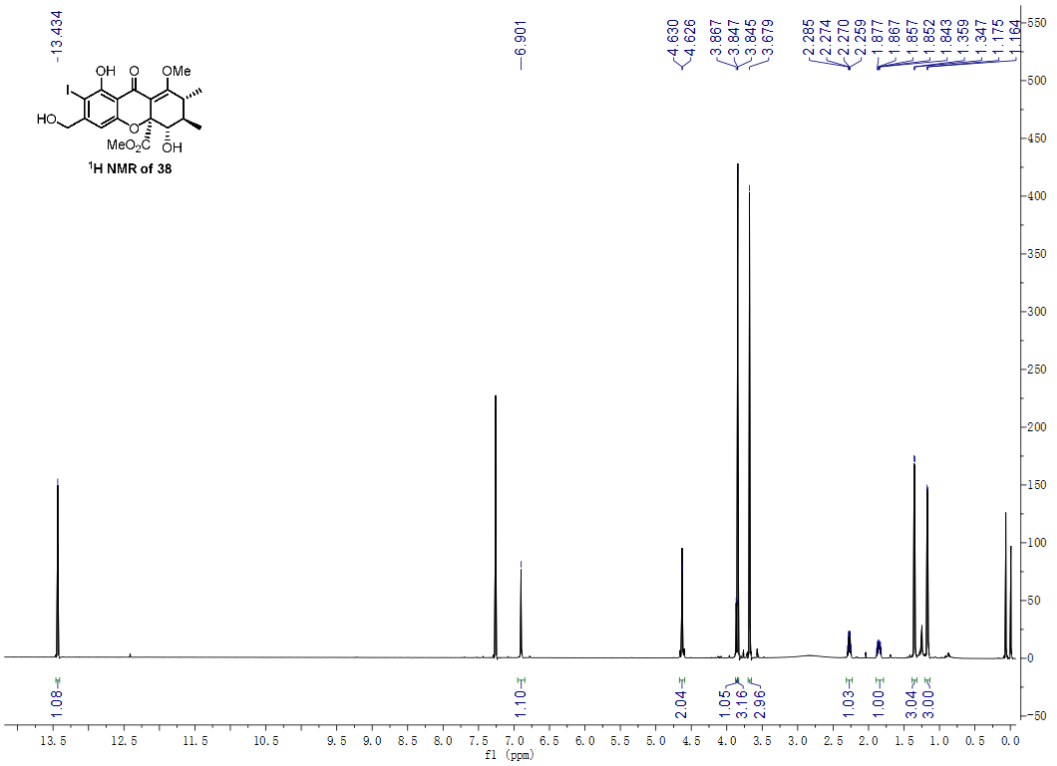
^{13}C NMR spectrum of compound 44



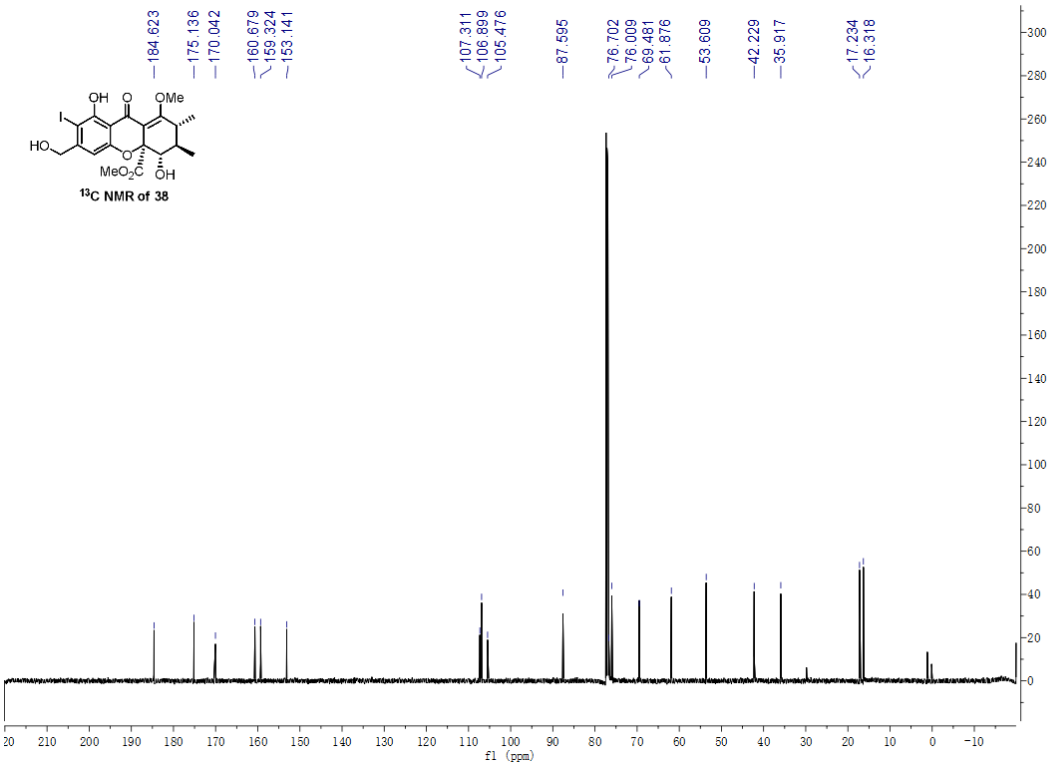
^{1}H NMR spectrum of compound 45



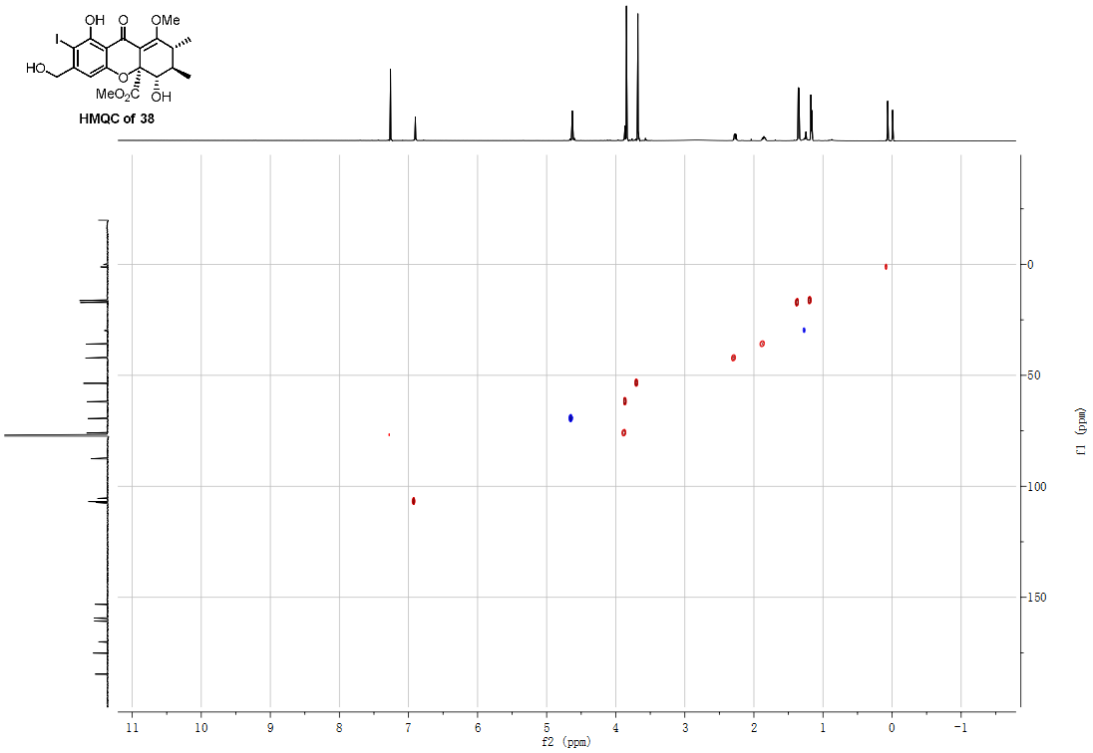
^{13}C NMR spectrum of compound 45



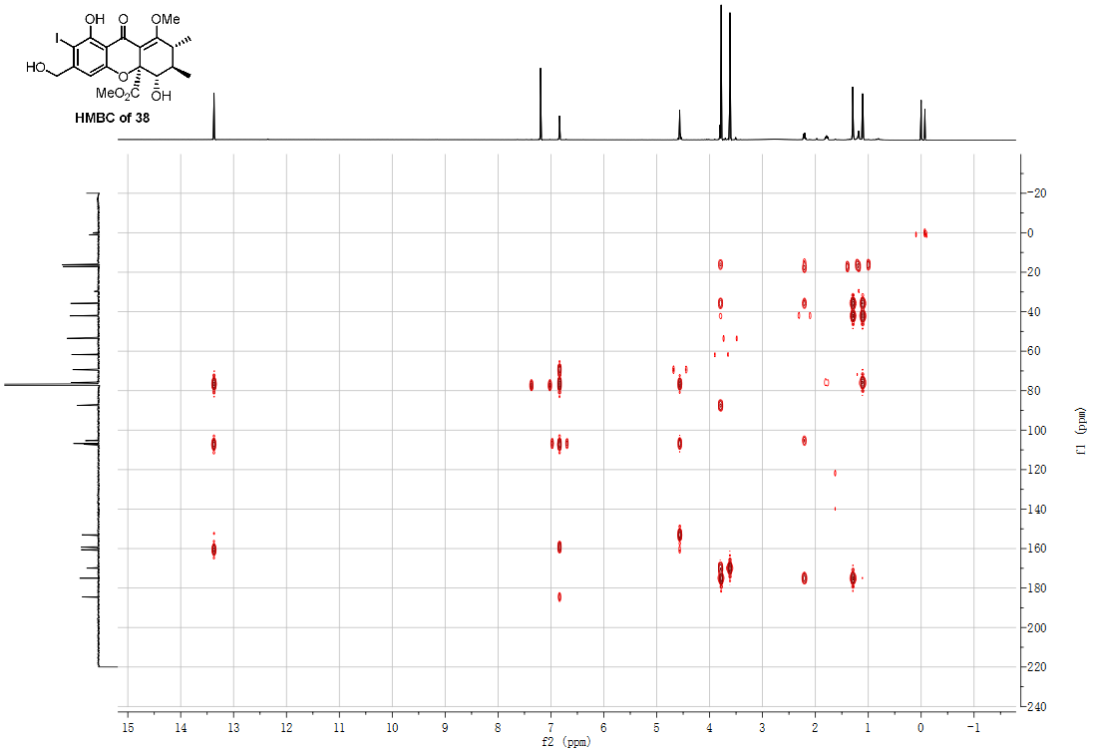
^{1}H NMR spectrum of compound 38



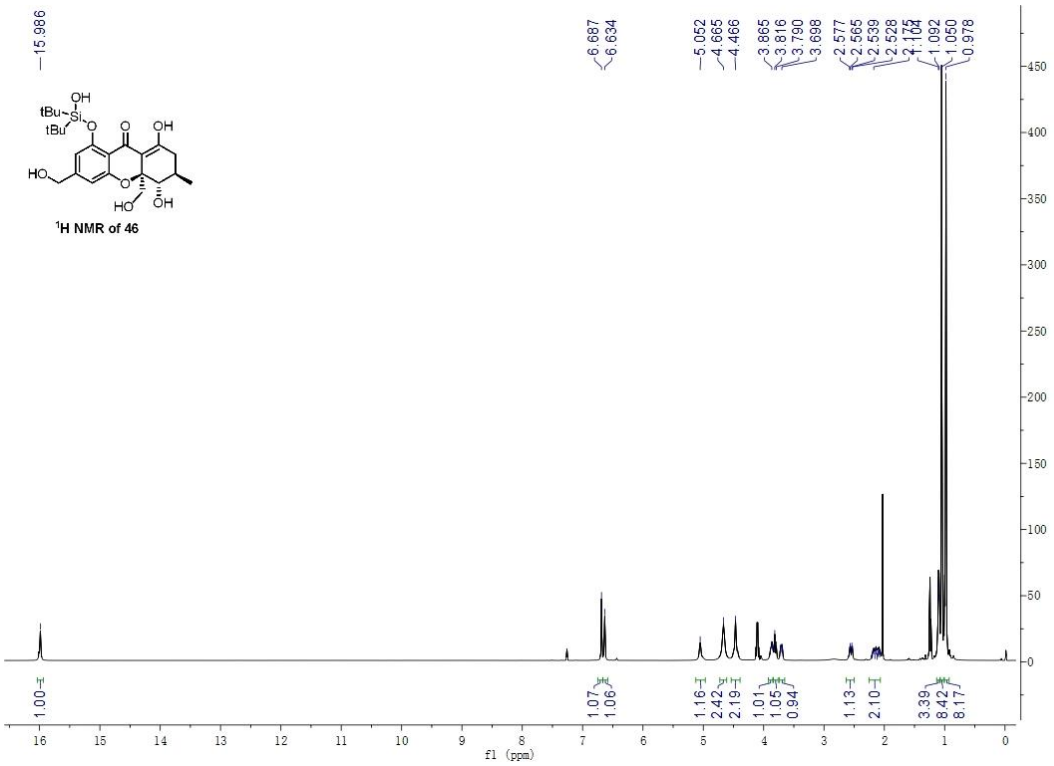
^{13}C NMR spectrum of compound 38



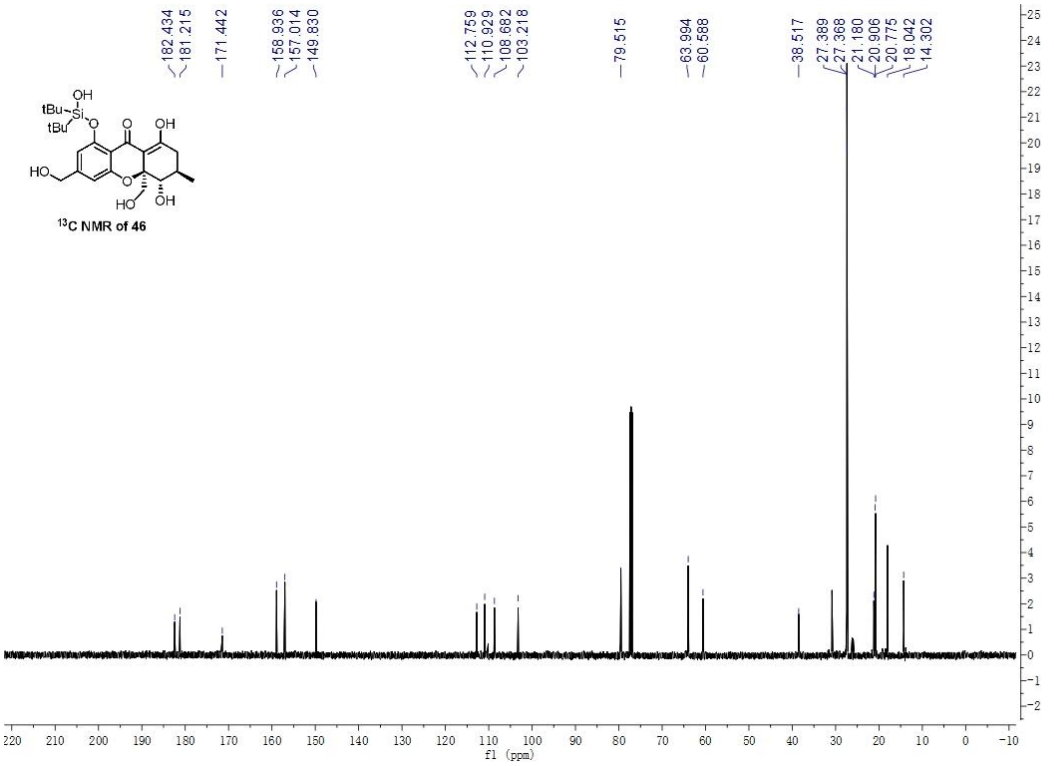
HMQC spectrum of compound 38



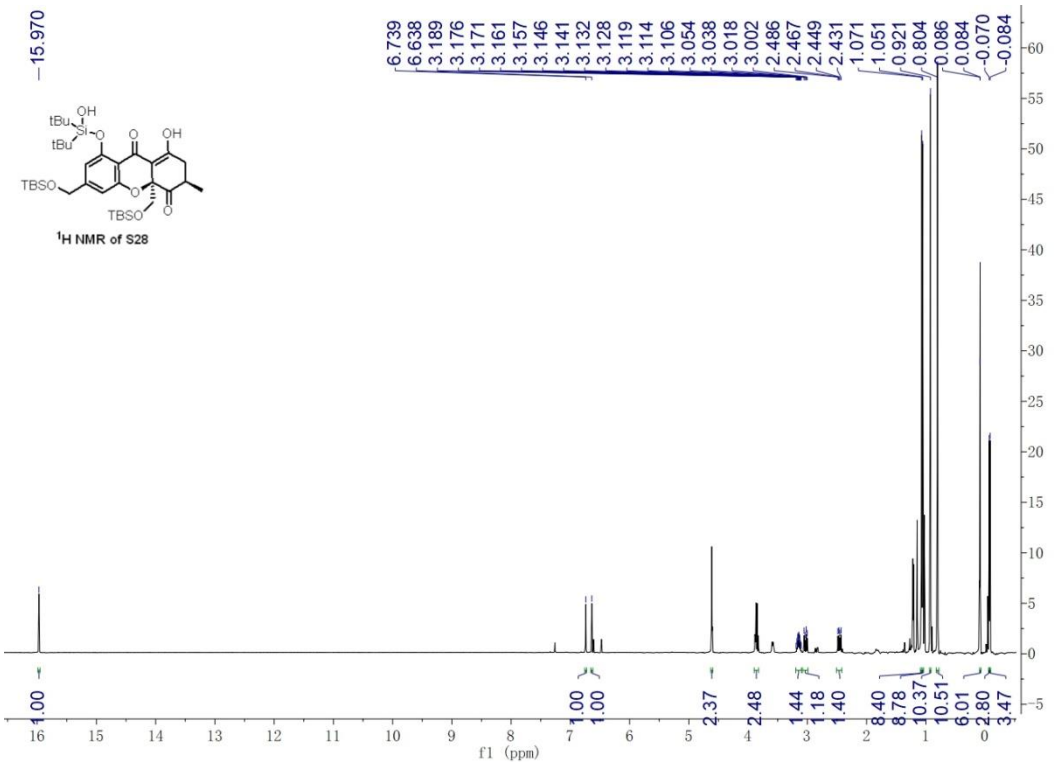
HMBC spectrum of compound 36



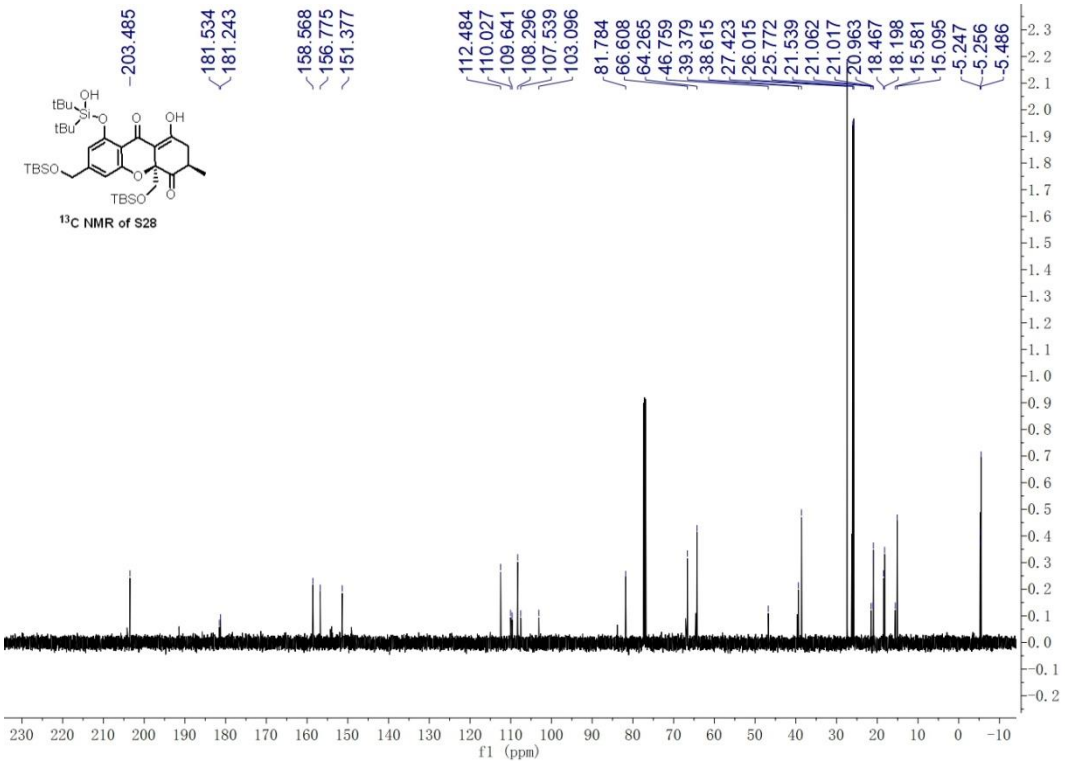
^{1}H NMR spectrum of compound 46



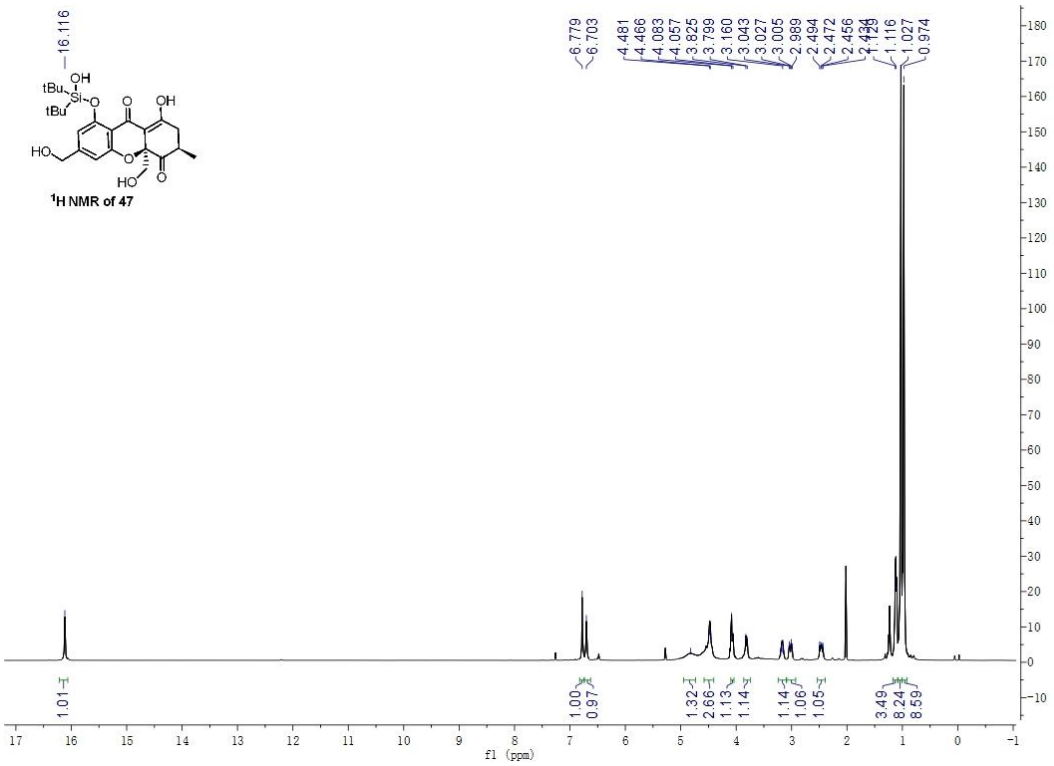
^{13}C NMR spectrum of compound 46



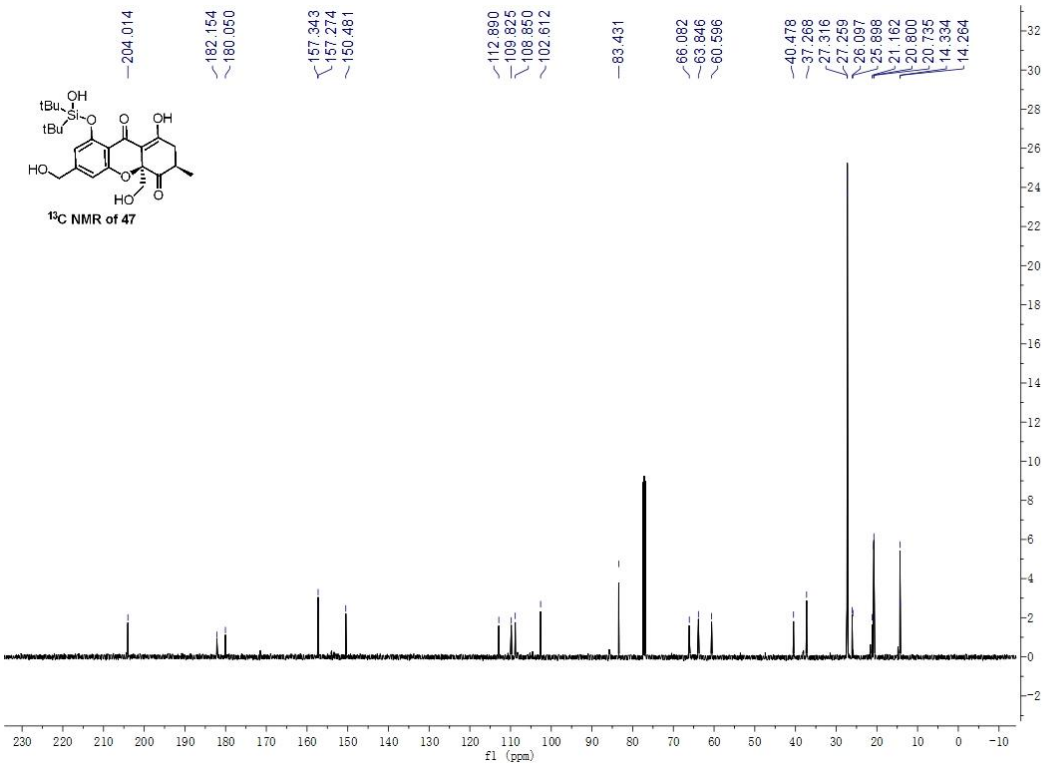
^{1}H NMR spectrum of compound S28



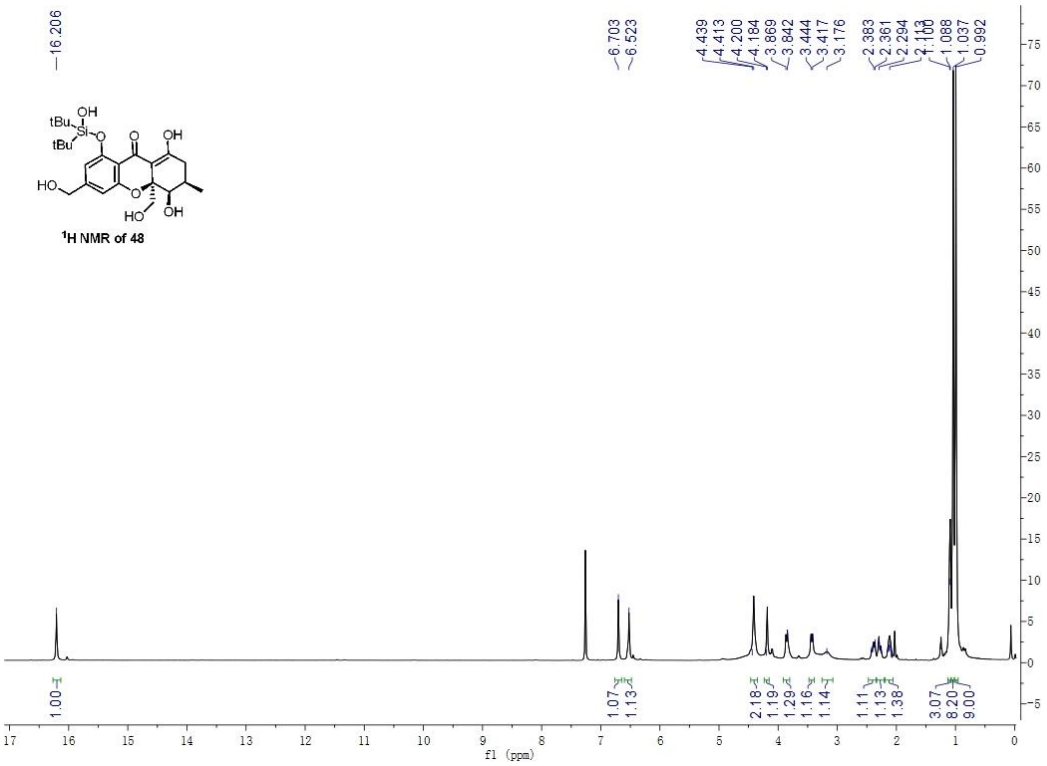
^{13}C NMR spectrum of compound S28



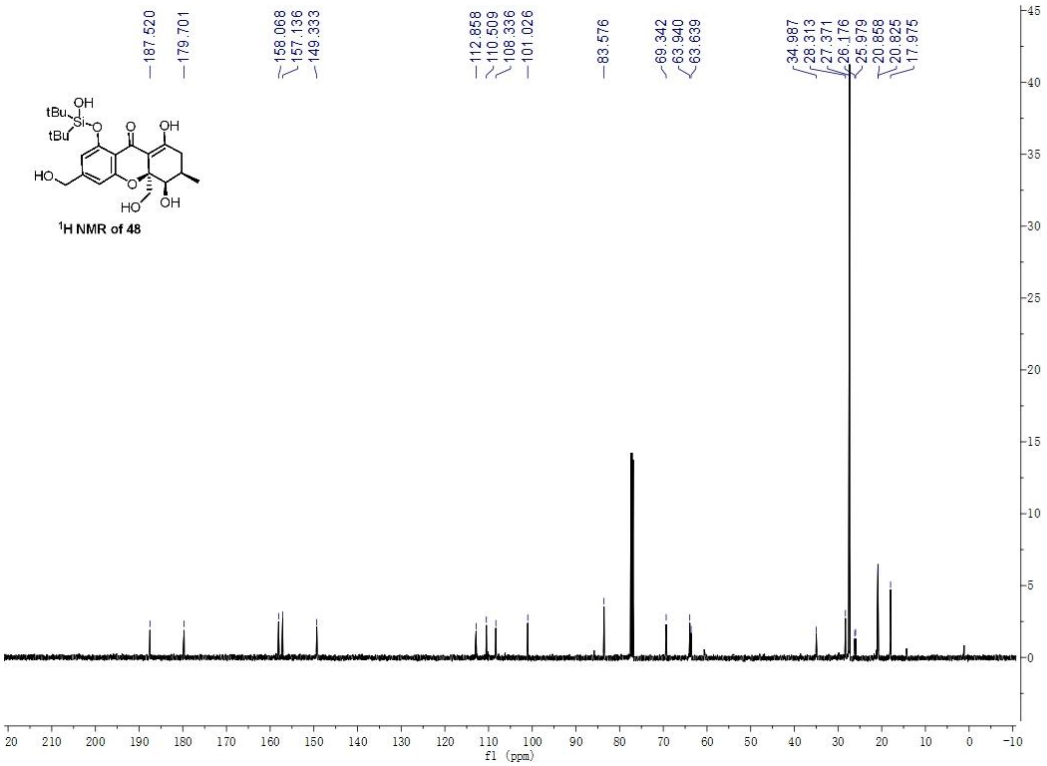
. ^{1}H NMR spectrum of compound 47



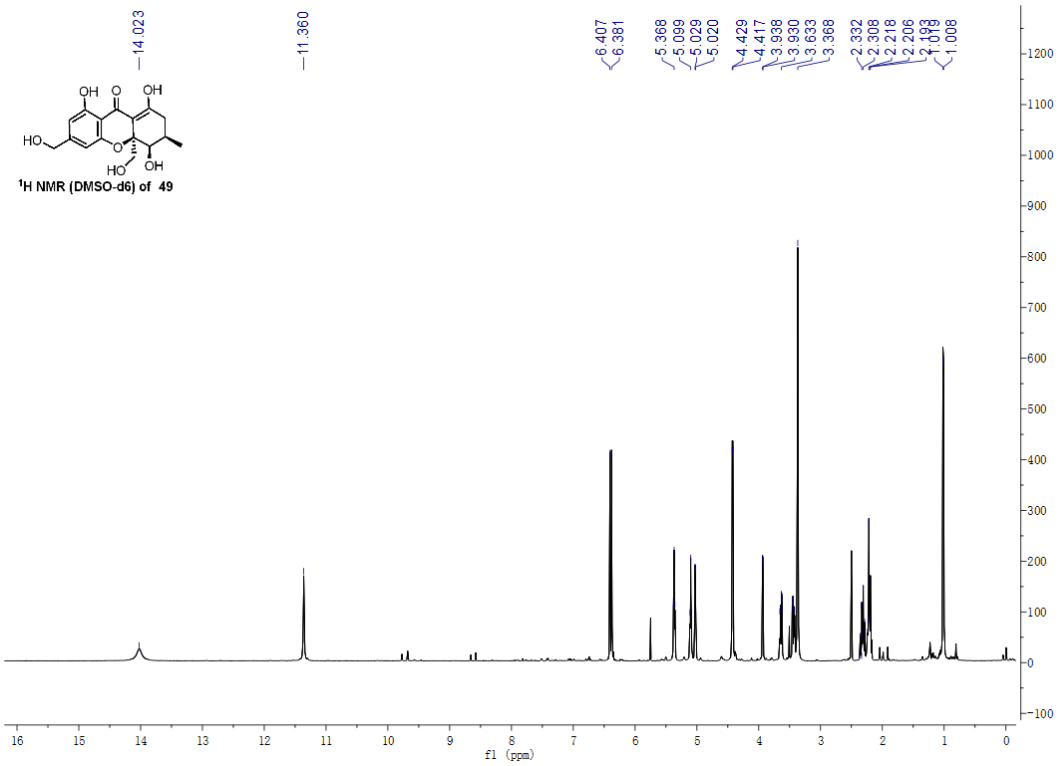
^{13}C NMR spectrum of compound 47



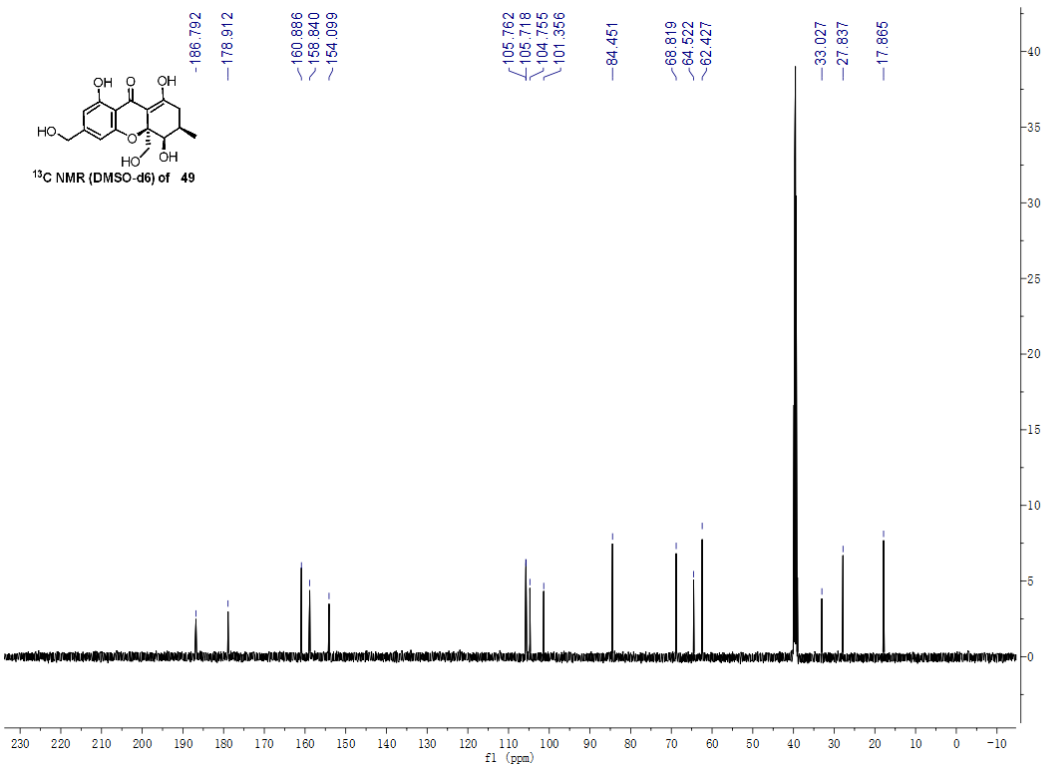
^{1}H NMR spectrum of compound 48



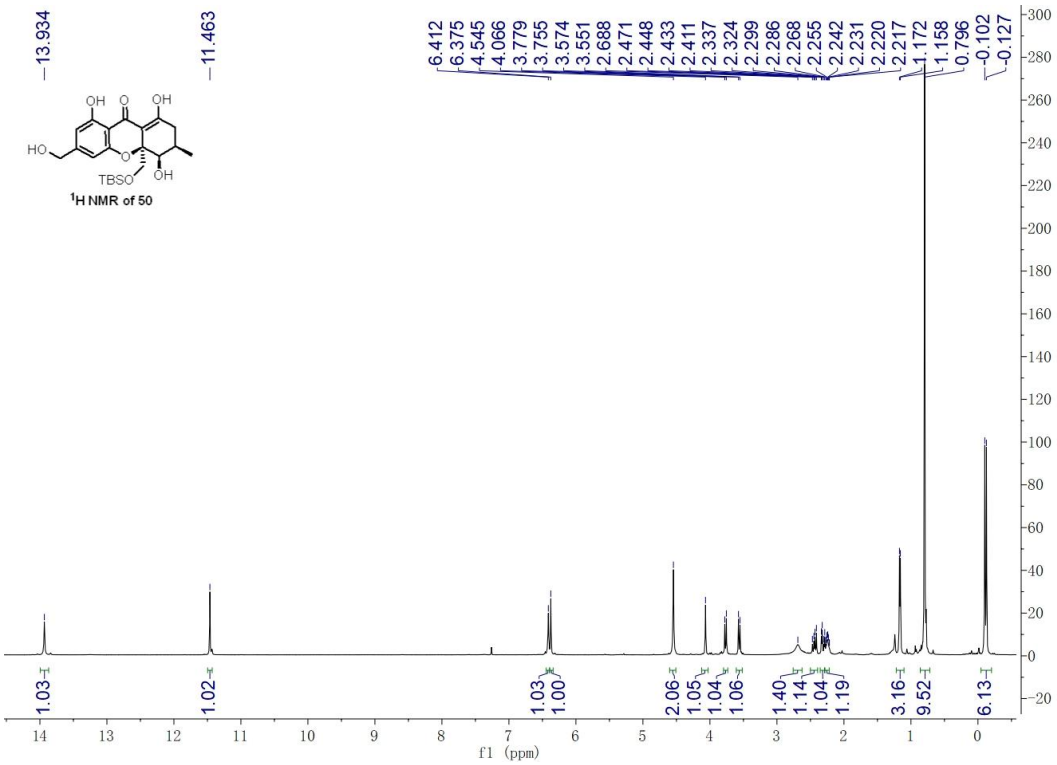
^{13}C NMR spectrum of compound 48



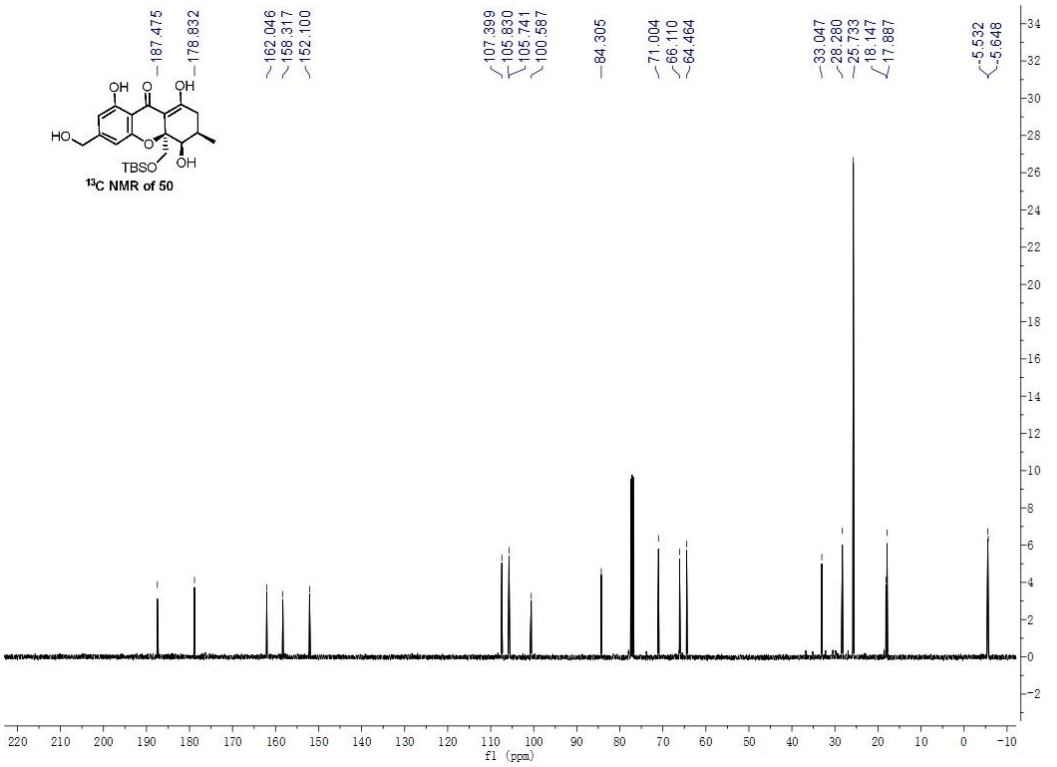
^{1}H NMR spectrum of compound 49



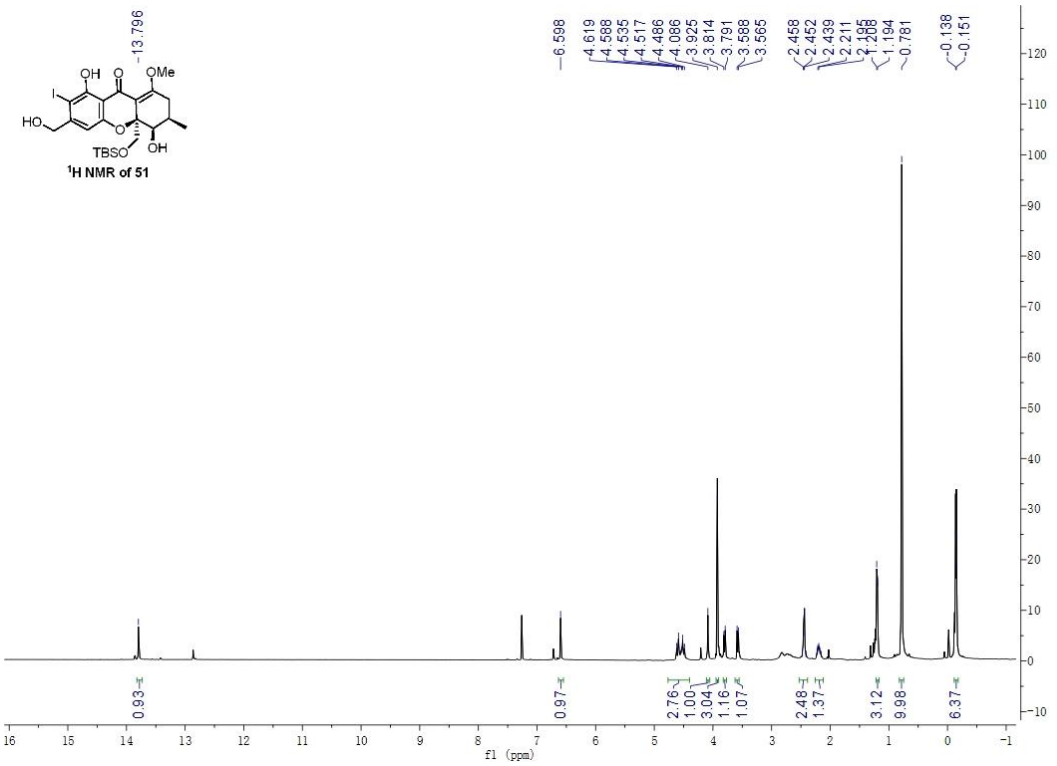
^{13}C NMR spectrum of compound 49



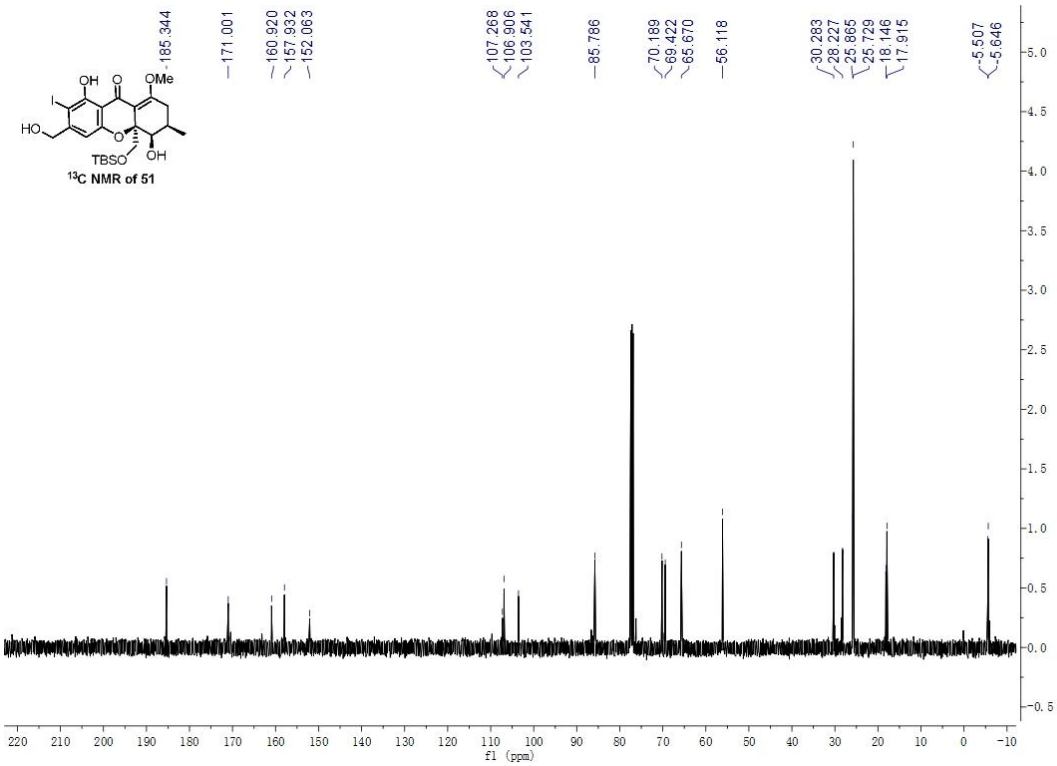
^{1}H NMR spectrum of compound 50



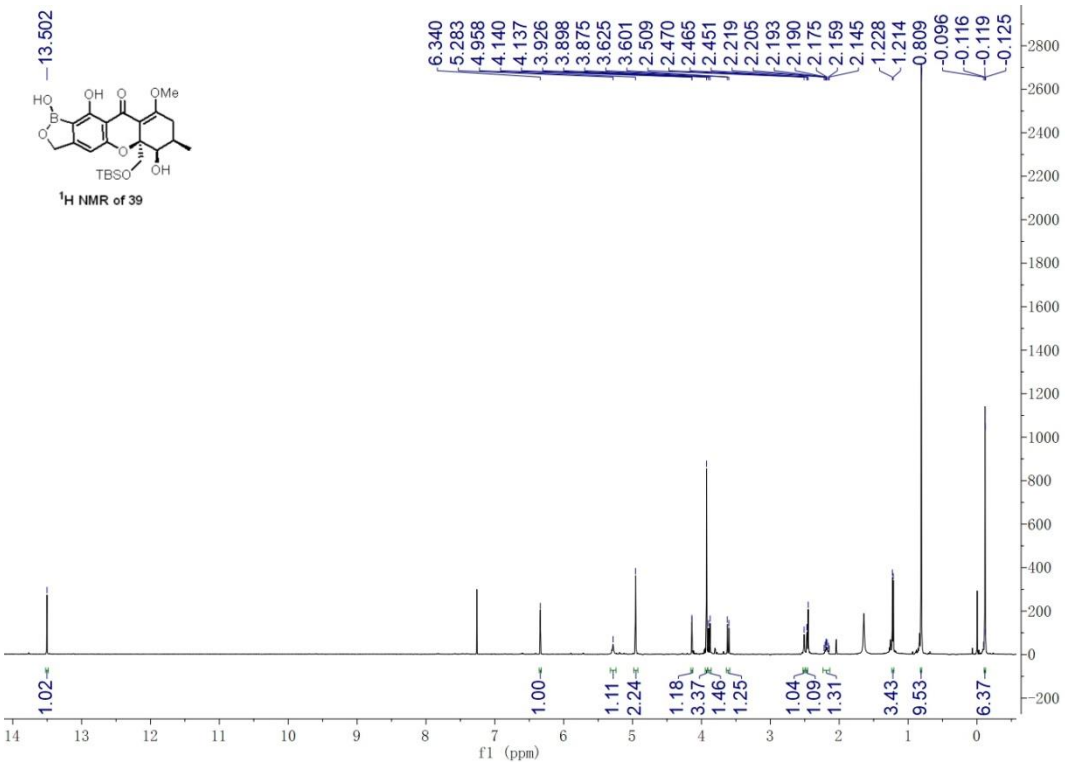
^{13}C NMR spectrum of compound 50



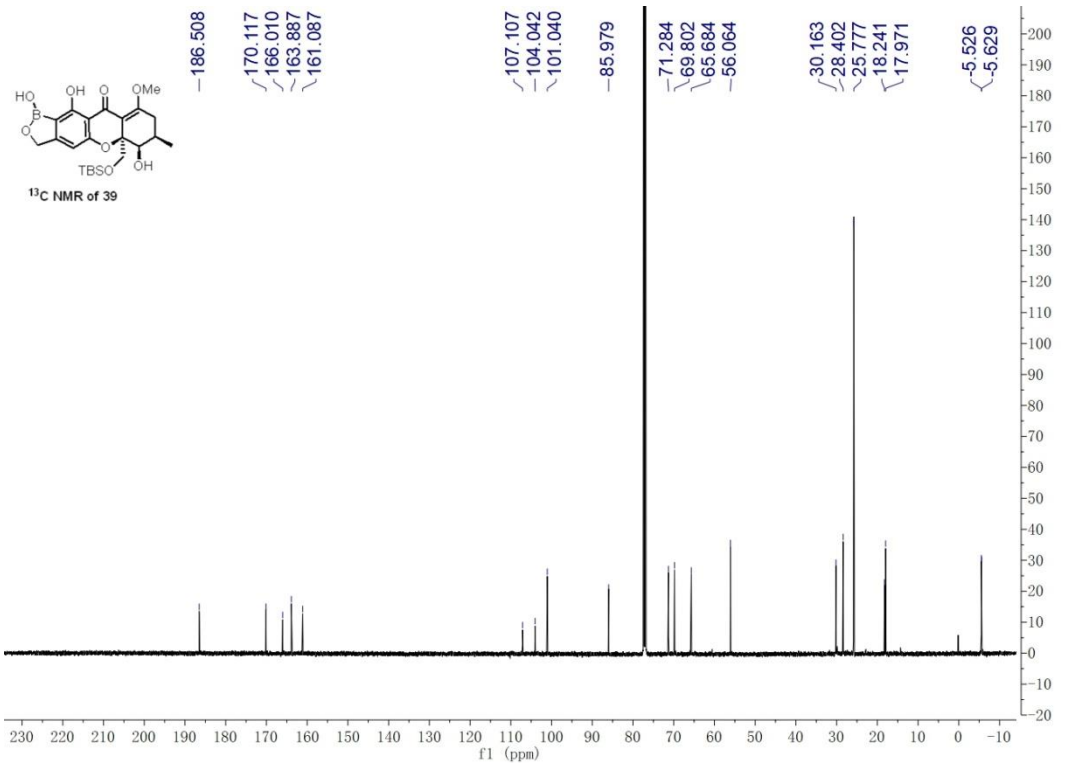
^{1}H NMR spectrum of compound 51



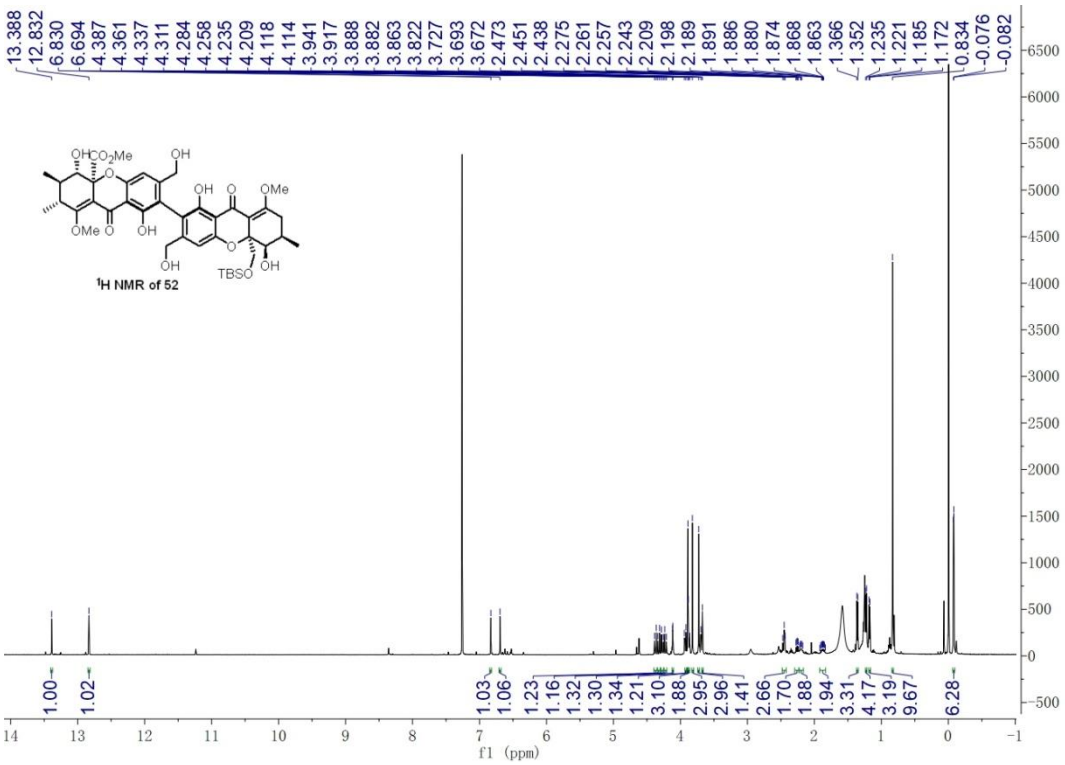
^{13}C NMR spectrum of compound 51



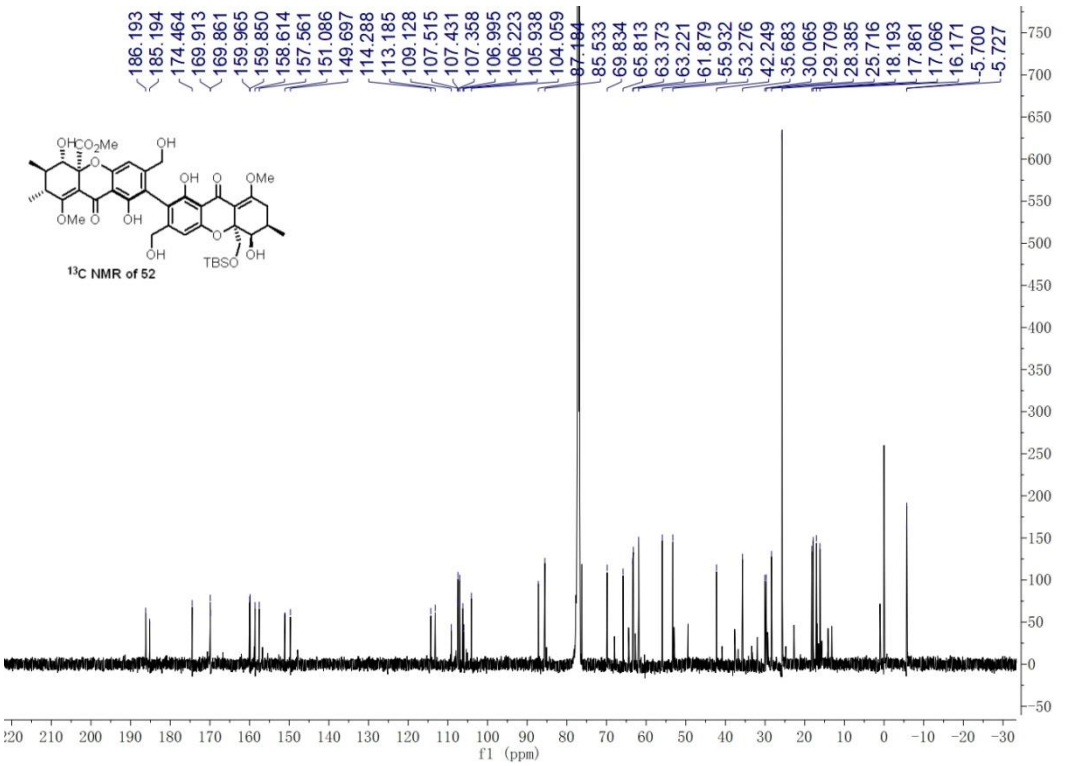
^{1}H NMR spectrum of compound 39



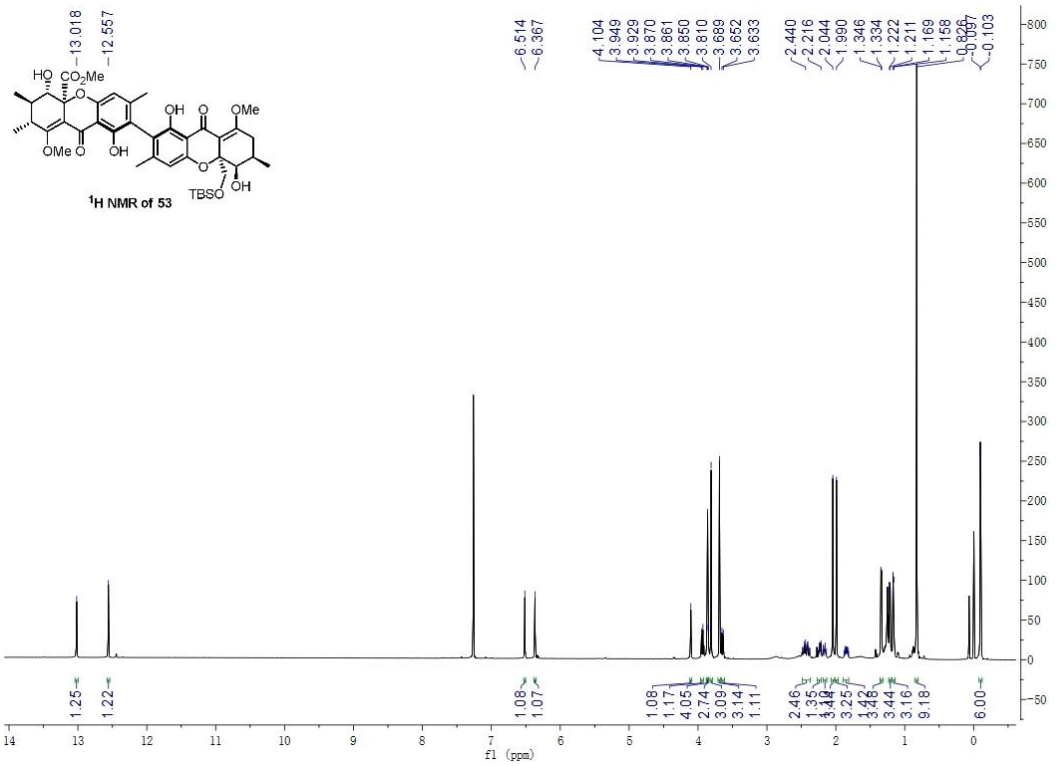
^{13}C NMR spectrum of compound 39



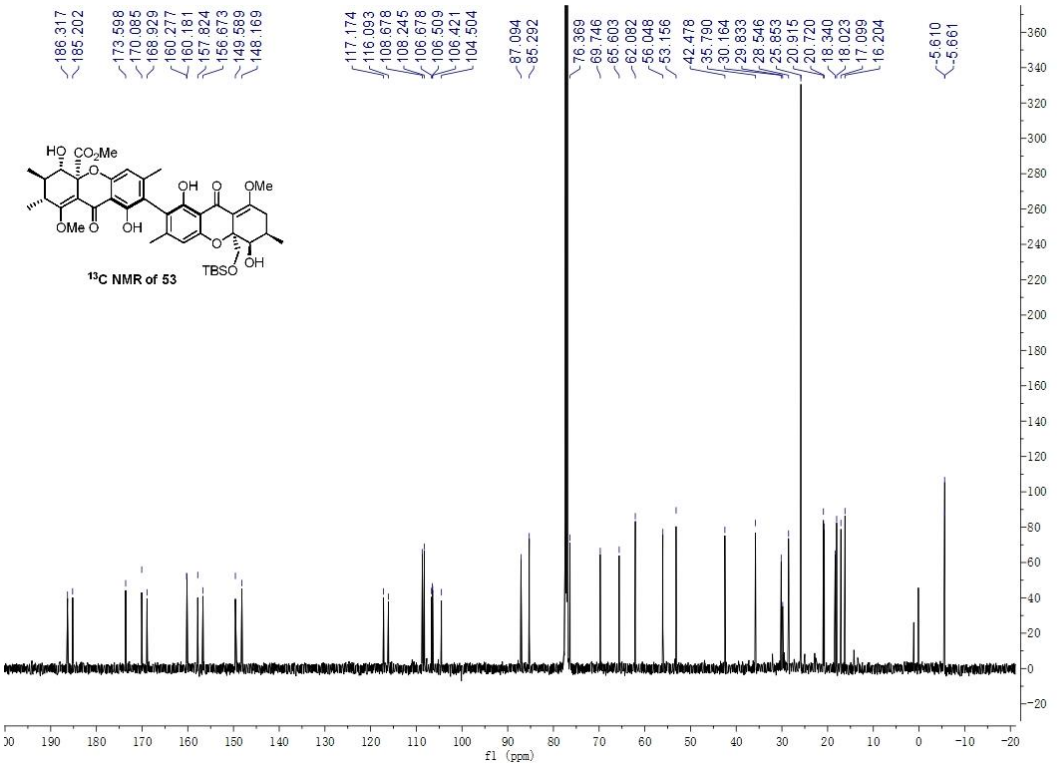
^{1}H NMR spectrum of compound 52



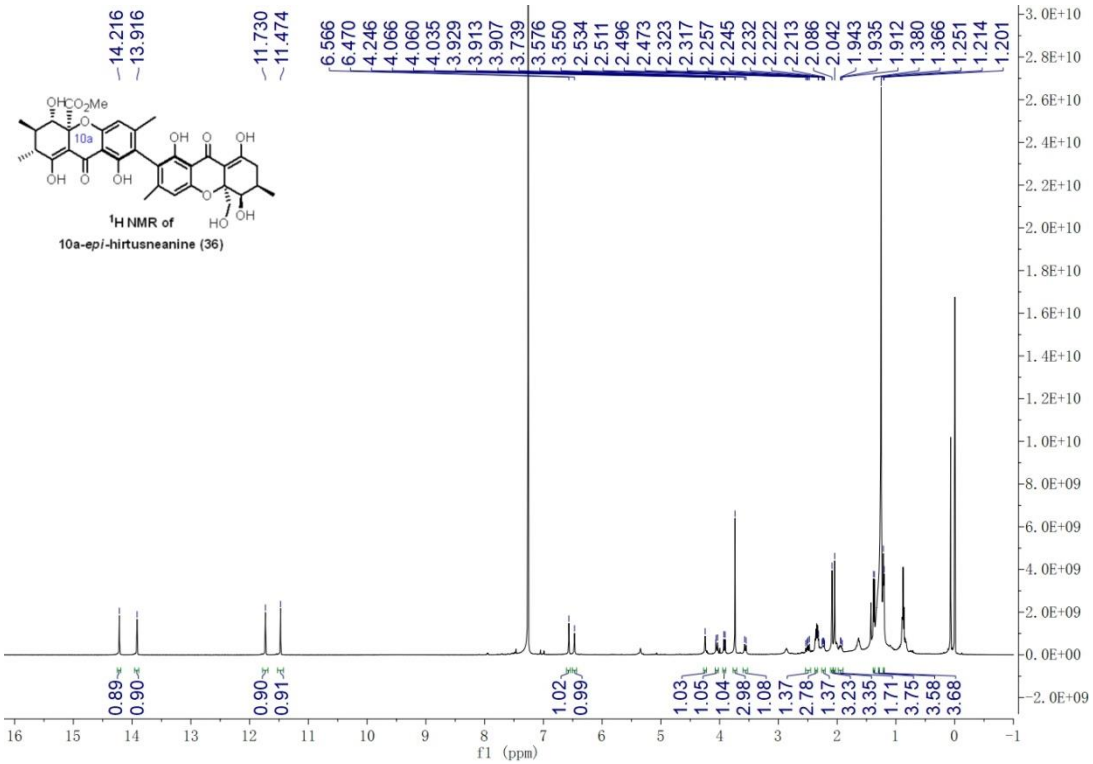
^{13}C NMR spectrum of compound 52



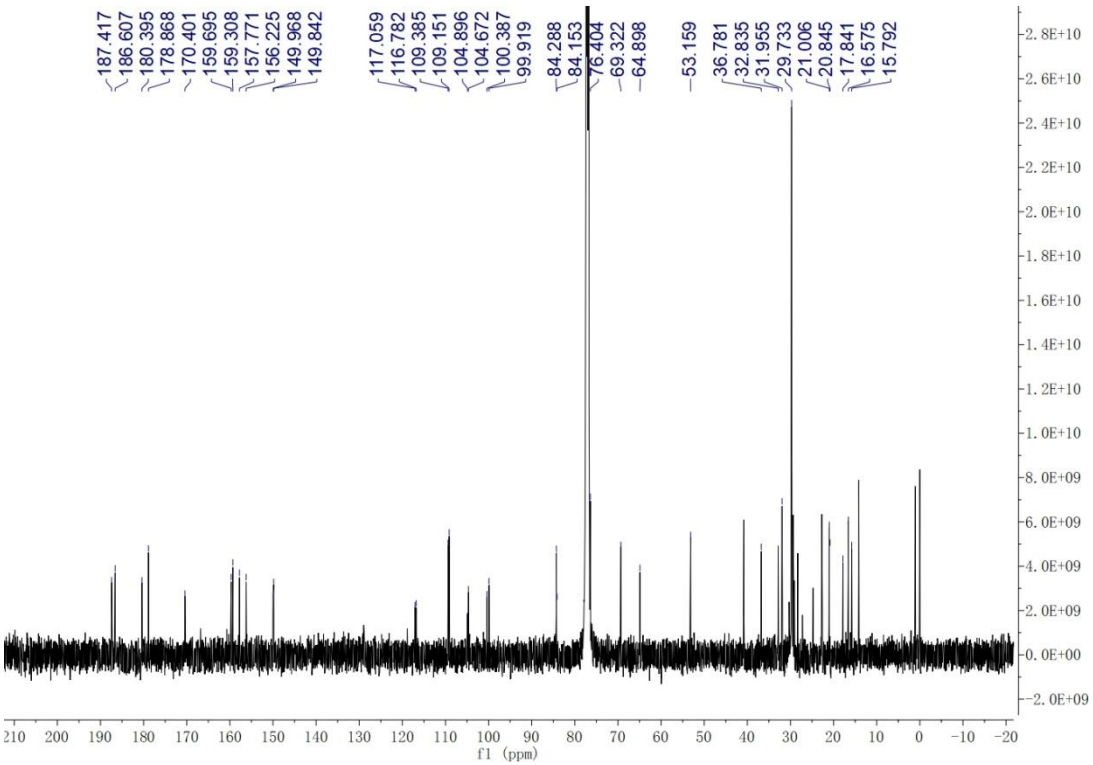
^{1}H NMR spectrum of compound 53



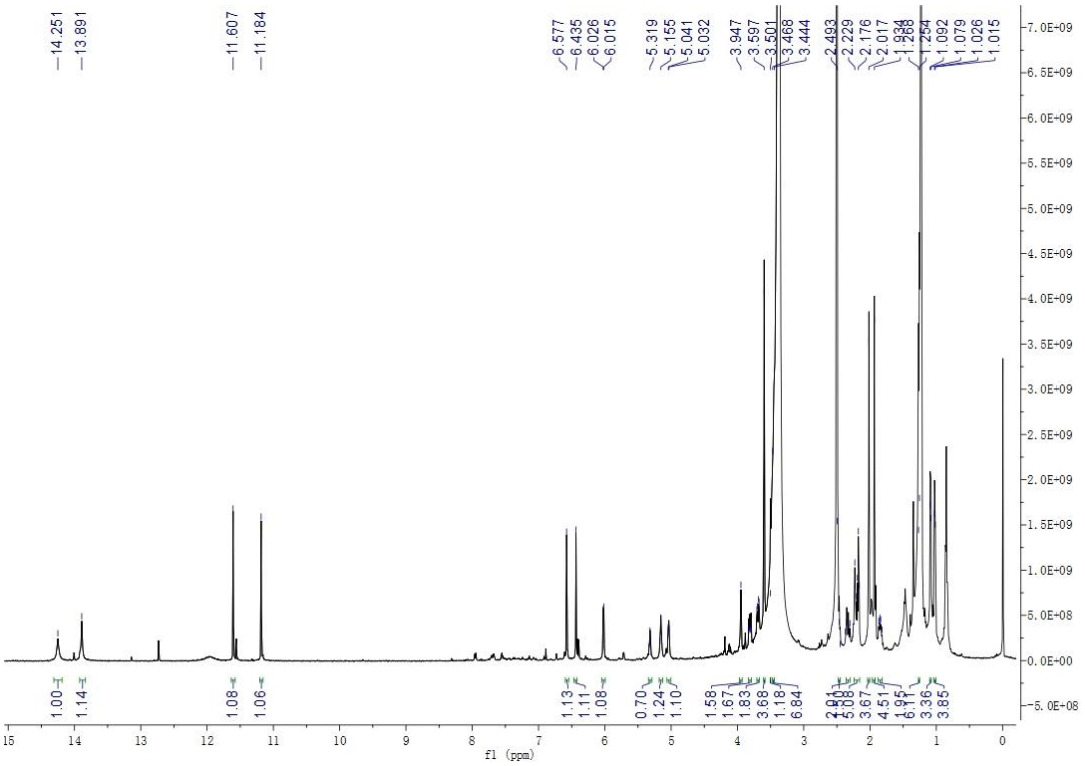
^{13}C NMR spectrum of compound 53



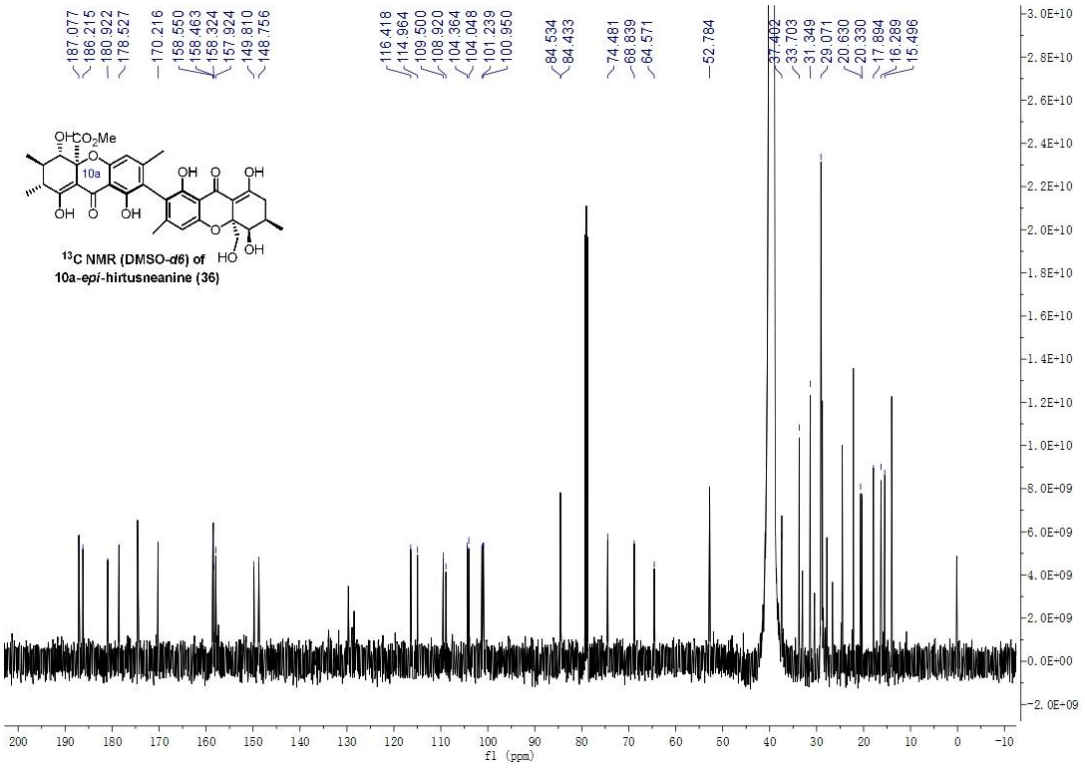
^{1}H NMR ($CDCl_3$) spectrum of compound 36



^{13}C NMR ($CDCl_3$) spectrum of compound 36



^{1}H NMR (DMSO-*d6*) spectrum of compound 36



^{13}C NMR(DMSO-*d6*) spectrum of compound 36