Electronic Supplementary Material (ESI) for Organic Chemistry Frontiers.

Supporting Information

Asymmetric Total Syntheses of Callistrilones B, G and J

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1. Synthetic experimental procedures

1.1. General Information

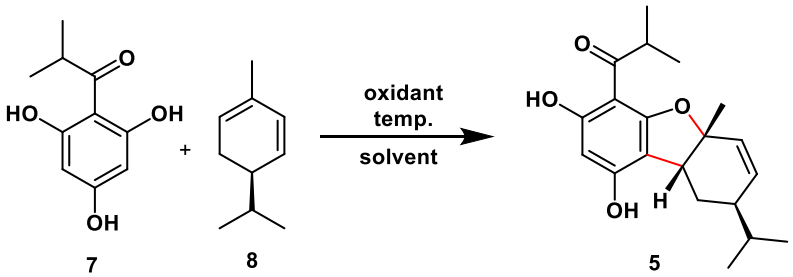
Unless otherwise mentioned, all reactions were carried out under a nitrogen atmosphere under anhydrous conditions and all reagents were purchased from commercial suppliers without further purification. Solvent purification was conducted according to *Purification of Laboratory Chemicals* (Peerrin, D. D.; Armarego, W. L. and Perrins, D. R., Pergamon Press: Oxford, 1980). Yields refer to chromatographically and spectroscopically (^{1}H NMR) homogeneous materials, unless otherwise stated. Reactions were monitored by Thin Layer Chromatography on plates (GF254) supplied by Yantai Chemicals (China) using UV light as visualizing agent, an ethanolic solution of phosphomolybdic acid, anisaldehyde or basic aqueous potassium permanganate ($KMnO_4$), and heat as developing agents. If not specially mentioned, flash column chromatography uses silica gel (200-300 mesh) supplied by Tsingtao Haiyang Chemicals (China), Preparative thin layer chromatography (PTLC) separations were carried out 0.50 mm Yantai (China) silica gel plates. NMR spectra were recorded on Bruker AV500, Bruker ARX400, and calibrated using residual undeuterated solvent as an internal reference ($CHCl_3$, δ 7.26 ppm ^{1}H NMR, δ 77.00 ^{13}C NMR). The following abbreviations were used to explain the multiplicities: s = singlet, d = doublet, t = triplet, q = quartet, b = broad, m = multiplet.

High-resolution mass spectra (HRMS) were recorded on a Bruker Apex IV FTMS mass spectrometer using ESI (electrospray ionization). Infrared spectra were recorded on a Shimadzu IR Prestige 21, using thin films of the sample on KBr plates. Optical rotations were measured with a Rudolph autopol I automatic polarimeter using 10 cm glass cells with a sodium 589 nm filter.

1.2 Synthesis of 2-5 and 13

1.2.1 Synthesis of 5

Table S1-1. Optimization of the oxidative [3+2] cycloaddition reaction.



7 8 5

entry	oxidant	solvent	*T* (°C)	yield [%][b]
1	$Mn(OAc)_3$[a]	MeCN	80 °C	28[c]
2	CuOTf[a]	MeCN	80 °C	0
3	$Cu(OAc)_2$[a]	MeCN	80 °C	11[c]
4	$K_3Fe(CN)_6$[a]	MeCN	80 °C	18[c]
5	AgOAc[a]	MeCN	80 °C	28[c]
6	Ag_2O[a]	MeCN	80 °C	30[c]
7	**Ag_2CO_3[a]**	**MeCN**	**80 °C**	**40[c]**
8	AgOTf[a]	MeCN	80 °C	0
9	CAN[a]	MeCN	80 °C	0
10	$Mn(OAc)_3$[a]	HOAc	120 °C	15[c]
11	Ag_2CO_3[e, f]	MeCN	80 °C	72[d]
12	**Ag_2CO_3[e, g]**	**MeCN**	**80 °C**	**73[d]**
13	Ag_2CO_3[e, g]	MeOH	65 °C	12[d]
14	Ag_2CO_3[e, g]	CF_3CH_2OH	80 °C	30[d]
15	Ag_2CO_3[e, g]	toluene	80 °C	39[d]
16	Ag_2CO_3[e, g]	THF	65 °C	0
17	**Ag_2CO_3[e, g]**	**MeCN**	**80 °C**	**70[h]**

[a] The reaction of entries 1-10 were performed with **7** (0.1 mmol), **8** (0.15 mmol), metallic oxidant (0.1 mmol), solvent (2 ml), 2.5 h. [b] Yield based on ^{1}H-NMR analysis of the crude product using 4-nitroacetophenone as an internal standard. [c] Yield based on **7**. [d] Yield based on **8**. [e] The reaction of entries 11-16 were performed with **7** (0.2 mmol), **8** (0.1 mmol), metallic oxidant (0.25 mmol), solvent (2 ml), 3 h. [f] 4 Å molecular sieve was added. [g] Celite was added. [h] Isolated yield (1.5 g scale of **8**).

General procedure A (entries 1-10):

Silver carbonate (Ag_2CO_3; 1.0 equiv.) under argon were added to a solution of compound **8** ((-)-α -phellandrene; 65 wt%, 1.5 equiv.) and compound **7**[1] (1.0 equiv) in solvent (2 mL), and the resulting solution was reflux for 2.5 h. The mixture was cooled down to room temperature, filtered and concentrated in vacuo. The yield based on ^{1}H-NMR analysis of the crude product using

4-nitroacetophenone as an internal standard.

General procedure B (entries 11-17):

Silver carbonate (Ag_2CO_3; 2.5 equiv.) and celite (100% w/w celite/Ag_2CO_3) under argon were added to a solution of compound **8** ((-)-α-phellandrene; 65 wt%, 1.0 equiv.) and compound **7**[1] (2.0 equiv) in solvent (2 mL), and the resulting solution was reflux for 3 h. The reaction mixture was turned to ash color with time and the formation of a silver mirror was observed on the inside of the employed flask. The mixture was cooled down to room temperature, filtered and concentrated in vacuo. The yield based on ^{1}H-NMR analysis of the crude product using 4-nitroacetophenone as an internal standard.

Note: The crude residue of entry 17 was purified by silica gel column chromatography (1%-2% ethyl acetate/hexanes) to afford the title compound **5** (1.7 g, 70%) as a yellowish crystal.

Compound **5**:

R_f= 0.5 (hexane/ethyl acetate = 4/1);

$[\alpha]_D^{25}$ = -48.9 (c = 0.1 in MeOH);

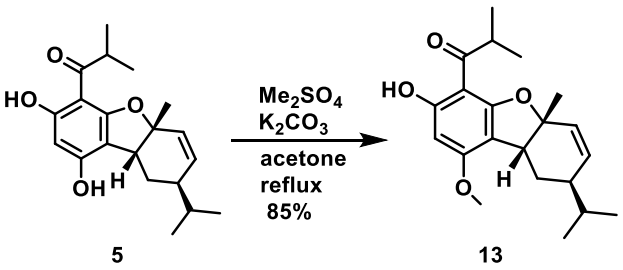
IR (film) λ_{max} 3327, 2963, 2928, 2870, 1634, 1612, 1512, 1425, 1377, 1252, 1182, 1047, 980, 822;

^{1}H NMR (500 MHz, $CDCl_3$) δ 13.49 (s, 1H), 5.88 (dd, *J* = 10.2, 2.0 Hz, 1H), 5.82 (s, 1H), 5.62 (dd, *J* = 10.2, 2.4 Hz, 1H), 5.39 (s, 1H), 3.77 – 3.68 (m, 1H), 3.46 (t, *J* = 4.6 Hz, 1H), 2.35 – 2.31 (m, 1H), 2.07 – 1.92 (m, 1H), 1.66 – 1.60 (m, 2H), 1.59 (s, 3H), 1.15 (d, *J* = 4.7 Hz, 3H), 1.14 (d, *J* = 4.7 Hz, 3H), 0.92 (d, *J* = 2.3 Hz, 3H), 0.90 (d, *J* = 2.4 Hz, 3H);

^{13}C NMR (126 MHz, $CDCl_3$) δ 209.2, 165.4, 162.4, 159.0, 135.2, 129.1, 107.1, 101.8, 96.1, 89.0, 43.9, 38.4, 37.9, 31.4, 26.3, 26.0, 19.7, 19.6, 19.1, 18.7;

HRMS (ESI) calcd for $C_{20}H_{27}O_4$ [$(M+H)^+$] Exact Mass: 331.1904; found: 331.1897.

1.2.2 Synthesis of 13



5 **13**

To a solution of compound **5** (2.0 g, 6.1 mmol) in acetone (20 mL) were added dimethyl sufate (Me_2SO_4; 0.77 g, 6.1 mmol, 1 equiv) and potassium carbonate (K_2CO_3; 1.0 g, 7.3 mmol, 1.2 equiv), and the resulting mixture was refluxed for 2 h. The mixture was cooled down to room temperature and quenched with 1M HCl (10 mL). The mixture was extracted with ethyl acetate (3×20 mL) and the combined organic layers were dried over Na_2SO_4, filtered and concentrated in vacuo. The crude residue was purified by silica gel column chromatography (1%-2% ethyl acetate/hexanes) to afford the title compound **13** (1.8 g, 85%) as a yellowish crystal.

Compound **13**: mp = 98-100 °C;

$\mathbf{R_f}$= 0.4 (hexane/ethyl acetate = 20/1);

Natural **13**: $[\boldsymbol{\alpha}]_{\mathbf{D}}^{\mathbf{25}}$ = -90.5 (*c* = 0.2 in MeOH);

Synthetic **13**: $[\boldsymbol{\alpha}]_{\mathbf{D}}^{\mathbf{25}}$ = -89.0 (*c* = 0.1 in MeOH);

IR (film) λ_{max} 3120, 2968, 2832, 2868, 1650, 1601, 1452, 1379, 1254, 1148, 1061, 968, 862, 741;

^{1}H NMR (500 MHz, $CDCl_3$) δ 13.56 (s, 1H), 5.96 (s, 1H), 5.85 (dd, *J* = 10.2, 2.6 Hz, 1H), 5.59 (dd, *J* = 10.2, 2.3 Hz, 1H), 3.79 (s, 3H), 3.74 – 3.67 (m, 1H), 3.38 (t, *J* = 4.8 Hz, 1H), 2.28 – 2.23 (m, 1H), 1.89 – 1.86 (m, 1H), 1.61 – 1.57 (m, 2H), 1.57 (s, 3H), 1.13 (d, *J* = 6.1 Hz, 3H), 1.12 (d, *J* = 5.9 Hz, 3H), 0.89 (d, *J* = 4.6 Hz, 3H), 0.88 (d, *J* = 4.6 Hz, 3H);

^{13}C NMR (125 MHz, $CDCl_3$) δ 209.2, 166.5, 162.6, 161.4, 135.4, 129.3, 108.0, 101.8, 92.4, 88.8, 55.7, 44.2, 38.6, 38.2, 31.6, 26.5, 26.3, 20.0, 19.8, 19.2, 18.9;

HRMS (ESI) calcd for $C_{21}H_{29}O_4$ [$(M+H)^+$] Exact Mass: 345.2060; found: 345.2054.

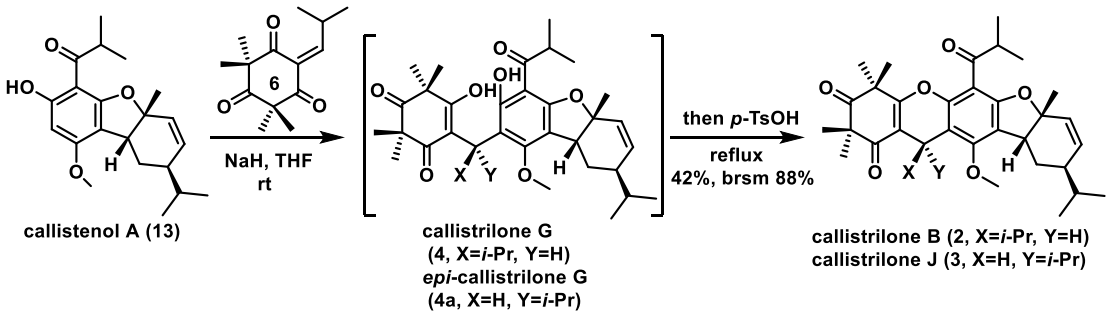
Table S1-2 Compared NMR data [$CDCl_3$] between our synthetic 13 and the isolated natural product.

position	^1H & ppm (J) isolated (500M)	synthesized (500M)	error (iso. - syn.)	^{13}C & ppm isolated (125M)	synthesized (125M)	error (iso. - syn.)
1	-	-	-	162.6	162.6	0
2	5.95 (s, 1H)	5.96 (s, 1H)	0.01	92.4	92.4	0
3	13.55* (s, 1H)	13.56* (s, 1H)	0.01	166.5	166.5	0
4	-	-	-	101.9	101.8	-0.1
4a	-	-	-	161.4	161.4	0
5a	-	-	-	88.8	88.8	0
6	5.59 (d, J = 10.2, 1H)	5.59 (dd, J = 10.2, 2.3 Hz, 1H)	0	129.4	129.3	-0.1
7	5.85 (dd, J = 10.2, 2.0 Hz, 1H)	5.85 (dd, J = 10.2, 2.6 Hz, 1H)	0	135.4	135.4	0
8	1.87 (m, 1H)	1.87 (m, 1H)	0	38.2	38.2	0
9	2.25 (m, 1H)	2.25 (m, 1H)	0	26.3	26.3	0
	1.59 (m, 1H)	1.59 (m, 1H)	0	44.3	44.2	0
9a	3.38 (m, 1H)	3.38 (m, 1H)	0			
9b	-	-	-	108.0	108.0	0
1'	-	-	-	209.2	209.2	0
2'	3.70 (m, 1H)	3.70 (m, 1H)	0	38.6	38.6	0
3'	1.13 (d, J = 5.8 Hz, 3H)	1.13 (d, J = 6.1 Hz, 3H)	0	19.3	19.2	-0.1
4'	1.13 (d, J = 5.8 Hz, 3H)	1.12 (d, J = 5.9 Hz, 3H)	0	18.9	18.9	0
5'	1.55 (s, 3H)	1.57 (s, 3H)	0.02	26.5	26.5	0
6'	1.60 (m, 1H)	1.60 (m, 1H)	0	31.6	31.6	0
7'	0.89 (d, J = 5.8 Hz, 3H)	0.89 (d, J = 4.6 Hz, 3H)	0	20.0	20.0	0
8'	0.88 (d, J = 5.8 Hz, 3H)	0.88 (d, J = 4.6 Hz, 3H)	0	19.8	19.8	0
9'	3.79 (s, 3H)	3.79 (s, 3H)	0	55.7	55.7	0

*OH

Note: According to the route, a total of 5 g of **13** was prepared readily after 3 simple parallel operations.

1.2.3 Synthesis of callistrilone B (2) and callistrilone J (3)



To a solution of compound **13** (1.5 g, 4.4 mmol) in tetrahydrofuran (THF; 20 mL) under argon was added sodium hydride (NaH; 60 wt%, 0.21 g, 5.3 mmol, 1.2 equiv), and the resulting solution was stirred for 30 min at room temperature. Compound **6**[1] (1.2 g, 5.3 mmol, 1.2 equiv) was added and stirred overnight. *p*-Toluenesulfonic acid (*p*-TsOH; 2.1 g, 11 mmol, 2.5 equiv) was added and stirred refluxed for 12 h. The mixture was quenched with saturated sodium bicarbonate (20 mL) and extracted with ethyl acetate (3×20 mL) and the combined organic layers were dried over Na_2SO_4, filtered and concentrated in vacuo. The crude residue was purified by silica gel column chromatography (1%-3.3% ethyl acetate/hexanes) to afford compound callistrilone B (**2**)

(0.57 g, 23.4%) as a white crystal, compound callistrilone J (**3**) (0.45 g, 18.6%) as a white crystal, and recovered compound **13** (0.8 g) as a yellowish crystal.

Note: as we would not separate the mixture of **4** and **4a** by silica gel column chromatography or precipitation thin-layer chromatography (PTLC), so further cyclization of the mixture of **4** and **4a** was carried out to afford specify **2** or **3** by silica gel column chromatography.

Compound callistrilone B (**2**): mp = 245-247 °C;

R_f= 0.5 (hexane/ethyl acetate = 10/1);

Natural **2**: $[\alpha]_D^{25}$ = +22.6 (*c* = 0.75 in MeOH);

Synthetic **2**: $[\alpha]_D^{25}$ = +61.9 (c = 0.1 in MeOH);

IR (film) λ_{max} 3416, 2968, 2932, 2872, 1705, 1653, 1601, 1466, 1383, 1310, 1186, 1126, 1001, 876;

^{1}H NMR (500 MHz, $CDCl_3$) δ 5.87 (dd, *J* = 10.2, 3.3 Hz, 1H), 5.64 (dd, *J* = 10.2, 1.8 Hz, 1H), 4.28 (d, *J* = 3.6 Hz, 1H), 3.91 (s, 3H), 3.50 (dd, *J* = 6.8, 4.6 Hz, 1H), 3.30 – 3.22 (m, 1H), 2.06 – 1.98 (m, 1H), 1.93 – 1.86 (m, 1H), 1.82 – 1.74 (m, 2H), 1.65 – 1.57 (m, 1H), 1.53 (s, 3H), 1.49 (s, 3H), 1.39 (s, 3H), 1.38 (s, 3H), 1.33 (s, 3H), 1.14 (d, *J* = 7.0 Hz, 3H), 1.11 (d, *J* = 6.9 Hz, 3H), 0.92 (s, 3H), 0.91 (s, 3H), 0.76 (d, *J* = 6.9 Hz, 3H), 0.70 (d, *J* = 6.8 Hz, 3H);

^{13}C NMR (125 MHz, $CDCl_3$) δ 212.9, 204.6, 198.1, 168.9, 157.0, 155.9, 149.7, 134.6, 129.2, 117.8, 110.7, 110.2, 109.0, 87.6, 60.6, 56.1, 47.8, 44.5, 41.3, 38.5, 36.0, 32.6, 31.6, 27.3, 26.7, 25.2, 25.2, 24.8, 24.5, 20.3, 20.2, 20.0, 18.3, 18.2, 18.1;

HRMS (ESI) calcd for $C_{35}H_{47}O_6$ [$(M+H)^+$] Exact Mass: 563.3367; found: 563.3362.

Table S1-3 Compared NMR data [$CDCl_3$] between our synthetic callistrilone B (2) and the isolated natural product.

	^1H & ppm (J)			^{13}C & ppm		
position	isolated (500M)	synthesized (500M)	error (iso. - syn.)	isolated (125M)	synthesized (125M)	error (iso. - syn.)
1	-	-	-	198.1	198.1	0
2	-	-	-	56.1	56.1	0
3	-	-	-	213.0	212.9	-0.1
4	-	-	-	47.8	47.8	0
4a	-	-	-	168.9	168.9	0
5	-	-	-	-	-	-
5a	-	-	-	149.8	149.7	-0.1
6	-	-	-	110.8	110.7	-0.1
6a	-	-	-	157.1	157.0	-0.1
7	-	-	-	-	-	-
7a	-	-	-	87.6	87.6	0
8	5.64 (dd, J = 10.3, 2.0 Hz, 1H)	5.64 (dd, J = 10.2, 1.8 Hz, 1H)	0	129.2	129.2	0
9	5.87 (dd, J = 10.3, 3.3 Hz, 1H)	5.87 (dd, J = 10.2, 3.3 Hz, 1H)	0	134.7	134.6	-0.1
10	1.91 (m, 1H)	1.91 (m, 1H)	0	38.5	38.5	0
11	2.02 (m, 1H)	2.02 (m, 1H)	0	27.4	27.3	-0.1
	1.77 (m, 1H)	1.77 (m, 1H)	0	-	-	-
11a	3.50 (dd, J = 5.1, 4.5 Hz, 1H)	3.50 (dd, J = 6.8, 4.6 Hz, 1H)	0	44.6	44.5	-0.1
11b	-	-	-	117.8	117.8	0
12	-	-	-	156.0	155.9	-0.1
12a	-	-	-	110.3	110.2	-0.1
13	4.28 (d, J = 4.0 Hz, 1H)	4.28 (d, J = 3.6 Hz, 1H)	0	32.7	32.6	-0.1
13a	-	-	-	109.0	109.0	0
1'	1.39 (s, 3H)	1.39 (s, 3H)	0	25.2	25.2	0
2'	1.49 (s, 3H)	1.49 (s, 3H)	0	25.3	25.2	-0.1
3'	1.33 (s, 3H)	1.33 (s, 3H)	0	24.5	24.5	0
4'	1.38 (s, 3H)	1.38 (s, 3H)	0	24.9	24.8	-0.1
5'	-	-	-	204.6	204.6	0
6'	3.26 (m, 1H)	3.26 (m, 3H)	0	41.4	41.3	-0.1
7'	1.13 (d, J = 6.9 Hz, 3H)	1.14 (d, J = 7.0 Hz, 3H)	0.01	18.3	18.3	0
8'	1.11 (d, J = 6.9 Hz, 3H)	1.11 (d, J = 6.9 Hz, 3H)	0	18.1	18.1	0
9'	1.53 (s, 3H)	1.53 (s, 3H)	0	26.7	26.7	0
10'	1.60 (m, 1H)	1.60 (m, 1H)	0	31.7	31.6	-0.1
11'	0.92 (d, J = 6.7 Hz, 3H)	0.91 (s, 3H)	-0.01	20.2	20.2	0
12'	0.92 (d, J = 6.7 Hz, 3H)	0.92 (s, 3H)	0	20.3	20.3	0
13'	1.80 (m, 1H)	1.80 (m, 1H)	0	36.0	36.0	0
14'	0.70 (d, J = 6.8 Hz, 3H)	0.70 (d, J = 6.8 Hz, 3H)	0	18.2	18.2	0
15'	0.76 (d, J = 6.8 Hz, 3H)	0.76 (d, J = 6.9 Hz, 3H)	0	20.1	20.0	-0.1
16'	3.91 (s, 3H)	3.91 (s, 3H)	0	60.6	60.6	0

Compound callistrilone J (**3**): mp = 198-200 °C;

$\mathbf{R_f}$= 0.4 (hexane/ethyl acetate = 10/1);

Natural **3**: $[\alpha]_D^{25}$ = - 54.4 (c = 0.1 in MeOH);

Synthetic **3**: $[\alpha]_D^{25}$ = -32.3 (c = 0.1 in MeOH);

IR (film) λ_{max} 3416, 2966, 2874, 1701, 1656, 1605, 1464, 1383, 1186, 1123, 1059, 800;

^{1}H NMR (500 MHz, $CDCl_3$) δ 5.82 (dd, *J* = 10.2, 2.4 Hz, 1H), 5.56 (dd, *J* = 10.2, 2.3 Hz, 1H), 4.13 (d, *J* = 4.0 Hz, 1H), 3.73 (s, 3H), 3.51 (t, *J* = 4.8 Hz, 1H), 3.27 – 3.21 (m, 1H), 2.23 – 2.19 (m, 1H), 1.90 – 1.85 (m, 1H), 1.82 – 1.77 (m, 1H), 1.71 – 1.61 (m, 2H), 1.55 (s, 3H), 1.49 (s, 3H), 1.38 (s, 3H), 1.37 (s, 3H), 1.33 (s, 3H), 1.14 (d, *J* = 7.0 Hz, 3H), 1.12 (d, *J* = 7.0 Hz, 3H), 0.90 (d, *J* = 2.7 Hz, 3H), 0.88 (d, *J* = 2.7 Hz, 3H), 0.74 (d, *J* = 6.9 Hz, 3H), 0.65 (d, *J* = 6.9 Hz, 3H);

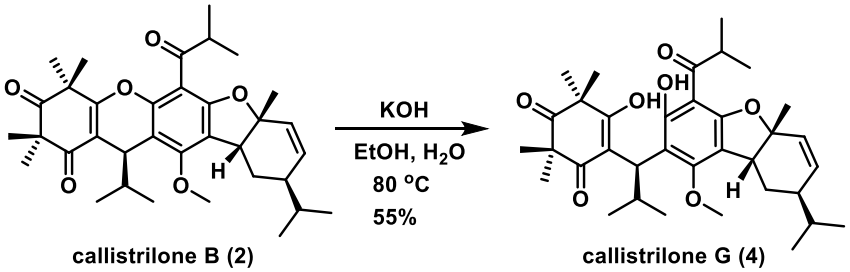
^{13}C NMR (125 MHz, $CDCl_3$) δ 212.8, 204.9, 198.1, 168.7, 157.0, 156.1, 149.4, 134.9, 129.4, 118.2, 111.5, 109.5, 109.3, 88.6, 60.1, 56.1, 47.7, 45.1, 41.5, 38.3, 35.8, 32.8, 31.5, 26.3, 25.6, 25.1, 24.9, 24.9, 24.6, 19.9, 19.8, 19.3, 18.9, 18.2, 18.1;

HRMS (ESI) calcd for $C_{35}H_{47}O_6$ [$(M+H)^+$] Exact Mass: 563.3367; found: 563.3362.

Table S1-4 Compared NMR data [$CDCl_3$] between our synthetic callistrilone J (3) and the isolated natural product.

	^1H & ppm (J)			^{13}C & ppm		
position	isolated (500M)	synthesized (500M)	error (iso. - syn.)	isolated (125M)	synthesized (125M)	error (iso. - syn.)
1	-	-	-	198.1	198.1	0
2	-	-	-	56.1	56.1	0
3	-	-	-	212.8	212.8	0
4	-	-	-	47.7	47.7	0
4a	-	-	-	168.8	168.7	-0.1
5a	-	-	-	149.4	149.4	0
6	-	-	-	109.3	109.3	0
6a	-	-	-	157.0	157.0	0
7a	-	-	-	88.7	88.6	-0.1
8	5.56 (dd, J = 10.3, 2.0 Hz, 1H)	5.56 (dd, J = 10.2, 2.3 Hz, 1H)	0	129.4	129.4	0
9	5.82 (dd, J = 10.3, 2.3 Hz, 1H)	5.82 (dd, J = 10.2, 2.4 Hz, 1H)	0	134.9	134.9	0
10	1.88 (m, 1H)	1.87 (m, 1H)	-0.01	38.3	38.3	0
11	2.22 (m, 1H)	2.21 (m, 1H)	-0.01	25.7	25.6	-0.1
	1.66 (m, 1H)	1.66 (m, 1H)	0			
11a	3.51 (dd, J = 5.1, 4.5 Hz, 1H)	3.51 (t, J = 4.8 Hz, 1H)	0	45.2	45.1	-0.1
11b	-	-	-	118.2	118.2	0
12	-	-	-	156.2	156.1	-0.1
12a	-	-	-	111.6	111.5	-0.1
13	4.14 (d, J = 4.0 Hz, 1H)	4.13 (d, J = 4.0 Hz, 1H)	-0.01	32.9	32.8	-0.1
13a	-	-	-	109.5	109.5	0
1'	1.39 (s, 3H)	1.38 (s, 3H)	-0.01	25.0	24.9	-0.1
2'	1.48 (s, 3H)	1.49 (s, 3H)	0.01	25.2	25.1	-0.1
3'	1.34 (s, 3H)	1.33 (s, 3H)	-0.01	24.6	24.6	0
4'	1.38 (s, 3H)	1.37 (s, 3H)	-0.01	24.9	24.9	0
5'	-	-	-	205.0	204.9	-0.1
6'	3.24 (m, 1H)	3.23 (m, 1H)	-0.01	41.5	41.5	0
7'	1.14 (d, J = 6.9 Hz, 3H)	1.14 (d, J = 7.0 Hz, 3H)	0	18.1	18.1	0
8'	1.12 (d, J = 6.9 Hz, 3H)	1.12 (d, J = 7.0 Hz, 3H)	0	18.2	18.2	0
9'	1.55 (s, 3H)	1.55 (s, 3H)	0	26.4	26.3	-0.1
10'	1.62 (m, 1H)	1.62 (m, 1H)	0	31.6	31.5	-0.1
11'	0.89 (d, J = 6.7 Hz, 3H)	0.88 (d, J = 2.7 Hz, 3H)	-0.01	20.0	19.9	-0.1
12'	0.90 (d, J = 6.7 Hz, 3H)	0.90 (d, J = 2.7 Hz, 3H))	0	19.8	19.8	-0
13'	1.78 (m, 1H)	1.78 (m, 1H)	0	35.8	35.8	0
14'	0.74 (d, J = 6.8 Hz, 3H)	0.74 (d, J = 6.9 Hz, 3H)	0	19.3	19.3	0
15'	0.66 (d, J = 6.8 Hz, 3H)	0.65 (d, J = 6.9 Hz, 3H);	-0.01	18.9	18.9	0
16'	3.74 (s, 3H)	3.73 (s, 3H)	0	60.2	60.1	-0.1

1.2.4 Synthesis of callistrilone G (4)



To a solution of compound callistrilone B (**2**) (562 mg, 1 mmol) in ethanol-water (EtOH-H_2O; 1:1, v/v) (100 mL) was added potassium hydroxide (KOH; 5.6 g, 100 mmol, 100 equiv), and the resulting solution was stirred overnight at 80 °C. The mixture was cooled down to room temperature and quenched with 1M HCl (100 mL). The mixture was extracted with ethyl acetate

(3×100 mL) and the combined organic layers were dried over Na_2SO_4, filtered and concentrated in vacuo. The crude residue was purified by silica gel column chromatography (2%-3.3% ethyl acetate/hexanes) to afford the title compound callistrilone G (**4**) (320 mg, 55%) as a yellowish crystal.

Note: The potassium hydroxide (KOH) concentration would be kept at about 1 mol/L and the reaction temperature would be controlled at 80 °C, at the same time the ratio of ethyl alcohol and water would be about 1:1 and in this condition few of substrate **2** and product **4** would be decomposed. If the concentration of KOH or temperature is too high, the substrate **2** and product **4** may be decomposed and the yield will be decreased. If the concentration of KOH or temperature is too low, the reaction would be very slow, even not take place.

Compound callistrilone G (**4**): mp = 137-139 °C;

$\mathbf{R_f}$= 0.5 (hexane/ethyl acetate = 10/1);

Natural **4**: $[\alpha]_D^{25}$ = + 103.2 (c = 0.88, MeOH);

Synthetic **4**: $[\alpha]_D^{25}$ = +63.3 (c = 0.1 in MeOH);

IR (film) λ_{max} 3138, 2971, 2935, 2869, 1716, 1653, 1624, 1473, 1378, 1249, 1070, 1047, 880;

^{1}H NMR (500 MHz, $CDCl_3$) δ 15.30 (s, 1H), 9.80 (s, 1H), 5.80 (dd, *J* = 10.2 Hz, 2.0 Hz, 1H), 5.57 (dd, *J* = 10.2, 2.0 Hz, 1H), 4.41 (d, *J* = 11.8 Hz, 1H), 3.76 (s, 3H), 3.76 – 3.69 (m, 1H), 3.49 (t, *J* = 4.5 Hz, 1H), 2.90 – 2.85 (m, 1H), 2.16 (dd, *J* = 8.8, 4.4 Hz, 1H), 1.72 – 1.63 (m, 1H), 1.60 (s, 3H), 1.57 – 1.46 (m, 2H), 1.35 (s, 3H), 1.30 (s, 3H), 1.30 (s, 3H), 1.16 (d, *J* = 6.4 Hz, 3H), 1.15 (s, 3H), 1.14 (d, *J* = 4 Hz, 3H), 0.86 (d, *J* = 6.5 Hz, 3H), 0.83 (d, *J* = 6.2 Hz, 3H), 0.80 (d, *J* = 1.2 Hz, 3H), 0.79 (d, *J* = 1.0 Hz, 3H);

^{13}C NMR (125 MHz, $CDCl_3$) δ 213.6, 211.2, 198.4, 171.2, 163.0, 161.1, 161.0, 135.3, 129.2, 115.2, 114.3, 114.2, 103.4, 89.4, 59.4, 55.5, 48.9, 44.7, 39.0, 38.6, 37.9, 31.5, 27.5, 26.7, 26.6, 26.5, 25.9, 23.7, 22.6, 21.8, 21.4, 19.8, 19.6, 19.2, 18.9;

HRMS (ESI) calcd for $C_{35}H_{49}O_7$ [$(M+H)^+$] Exact Mass: 581.3473; found: 581.3477.

Table S1-5 Compared NMR data [$CDCl_3$] between our synthetic callistrilone G (4) and the isolated natural product.

	^{1}H & ppm (J)			^{13}C & ppm		
position	isolated (500M)	synthesized (500M)	error (iso. - syn.)	isolated (125M)	synthesized (125M)	error (iso. - syn.)
1	-	-	-	198.5	198.4	-0.1
2	-	-	-	55.5	55.5	0
3	-	-	-	213.5	213.6	-0.1
4	-	-	-	48.9	48.9	0
4a	9.84* (s, 1H)	9.80* (s, 1H)	-0.04	171.3	171.2	-0.1
5a	15.31* (s, 1H)	15.30* (s, 1H)	-0.01	161.0	161.0	0
6	-	-	-	103.4	103.4	0
6a	-	-	-	161.1	161.1	0
7a	-	-	-	89.4	89.4	0
8	5.57 (dd, J = 10.3, 2.3 Hz, 1H)	5.57 (dd, J = 10.2, 2.0 Hz, 1H)	0	129.2	129.2	0
9	5.80 (dd, J = 10.3, 2.0Hz, 1H)	5.80 (dd, J = 10.2, 2.0 Hz, 1H)	0	135.3	135.3	0
10	1.68 (m, 1H)	1.68 (m, 1H)	0	37.9	37.9	0
11	2.16 (m, 1H)	2.16 (dd, J = 8.8, 4.4 Hz, 1H)	0	25.9	25.9	0
	1.54 (m, 1H)	1.54 (m, 1H)	0			
11a	3.49 (dd, J = 5.4, 4.5 Hz, 1H)	3.49 (t, J = 4.5 Hz, 1H)	0	44.7	44.7	0
11b	-	-	-	114.3	114.3	0
12	-	-	-	163.0	163.0	0
12a	-	-	-	115.2	115.2	0
13	4.41 (d, J = 11.7 Hz, 1H)	4.41 (d, J = 11.8 Hz, 1H)	0	38.6	38.6	0
13a	-	-	-	114.2	114.2	0
1'	1.30 (s, 3H)	1.30 (s, 3H)	0	21.4	21.4	0
2'	1.15 (s, 3H)	1.16 (s, 3H)	0.01	27.5	27.5	0
3'	1.30 (s, 3H)	1.30 (s, 3H)	0	23.7	23.7	0
4'	1.35 (s, 3H)	1.35 (s, 3H)	0	26.7	26.6	-0.1
5'	-	-	-	211.2	211.2	0
6'	3.73 (m, 1H)	3.73 (m, 1H)	0	39.0	39.0	0
7'	1.15 (d, J = 6.6 Hz, 3H)	1.15 (s, 3H)	0	19.2	19.2	0
8'	1.15 (d, J = 6.6 Hz, 3H)	1.14 (d, J = 4 Hz, 3H)	-0.01	18.9	18.9	0
9'	1.61 (s, 3H)	1.60 (s, 3H)	-0.01	26.6	26.6	0
10'	1.49 (m, 1H)	1.49 (m, 1H)	0	31.5	31.5	0
11'	0.80 (d, J = 6.8 Hz, 3H)	0.80 (d, J = 1.2 Hz, 3H)	0	19.8	19.8	0
12'	0.80 (d, J = 6.8 Hz, 3H)	0.79 (d, J = 1.0 Hz, 3H)	-0.01	19.6	19.6	0
13'	2.88 (m, 1H)	2.88 (m, 1H)	0	26.5	26.5	0
14'	0.83 (d, J = 6.5 Hz, 3H)	0.83 (d, J = 6.2 Hz, 3H)	0	22.6	22.6	0
15'	0.86 (d, J = 6.5 Hz, 3H)	0.86 (d, J = 6.5 Hz, 3H)	0	21.8	21.8	0
16'	3.76 (s, 3H)	3.76 (s, 3H)	0	59.4	59.4	0

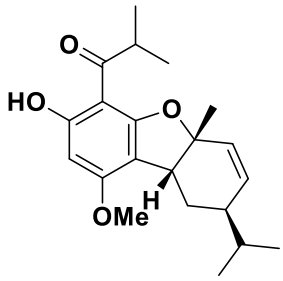
*OH

Reference

[1] M.-J. Cheng, J.-Q. Cao, X.-Y. Yang, L.-P. Zhong, L.-J. Hu, X. Lu, B.-L. Hou, Y.-J. Hu, Y. Wang, X.-F. You, L. Wang, W.-C. Ye, C.-C. Li, *Chem. Sci.* 2018, **9**,1488.

2. X-ray crystal structures

X-ray crystal structure of 13



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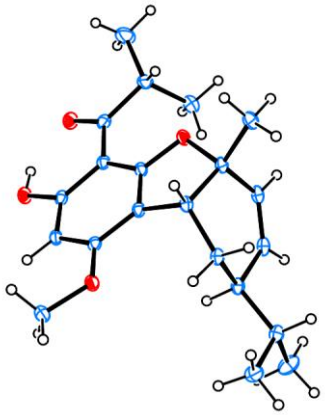
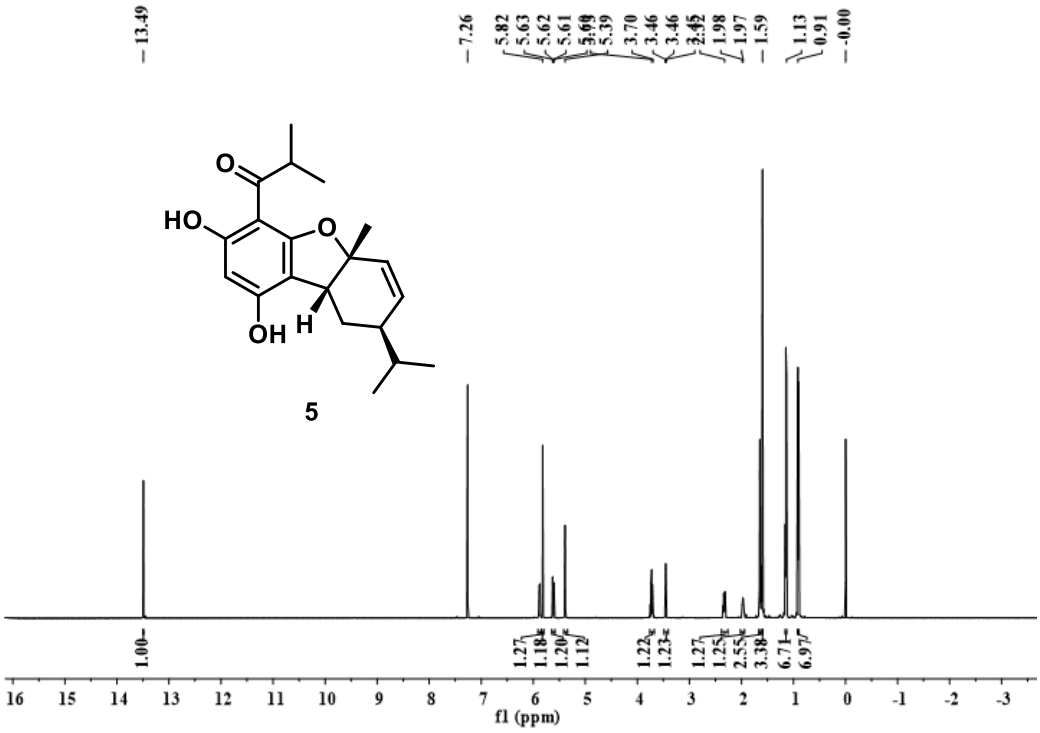


3. Synthetic ^{1}H and ^{13}C NMR Spectra of 2-5, 13



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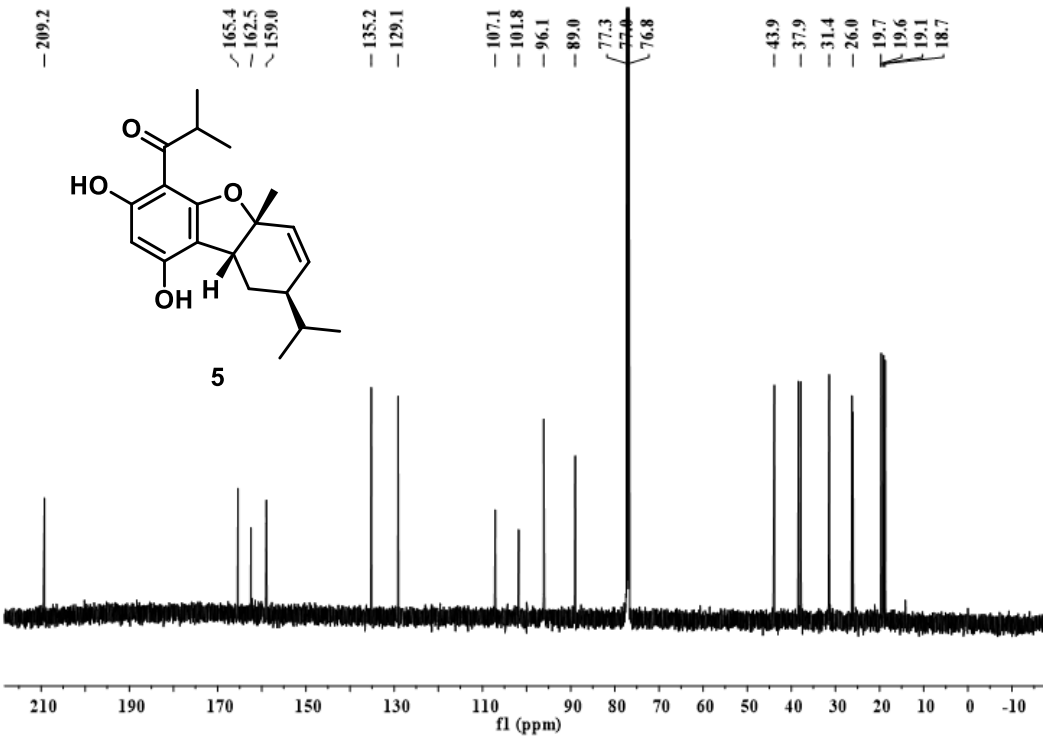
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135.2
129.1
107.1
101.8
96.1
89.0
77.3
77.0
76.8
43.9
37.9
31.4
26.0
19.7
19.6
19.1
18.7
O
HO
O
OH
H
5
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190
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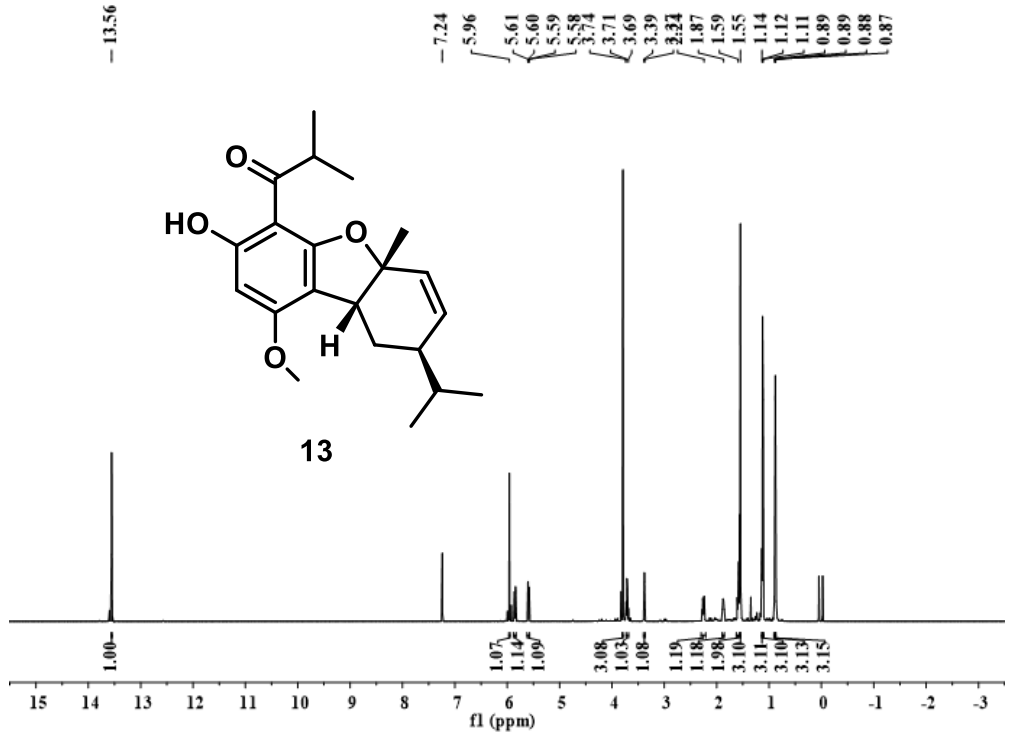
150
130
110
90
80
70
60
50
40
30
20
10
0
-10
f1 (ppm)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5.59
5.58
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3.69
3.39
2.31
1.87
1.59
1.55
1.14
1.12
1.11
0.89
0.89
0.88
0.87
O
HO
O
H
O
13
1.00
1.07
1.14
1.09
3.08
1.03
1.08
1.19
1.18
1.98
3.10
3.11
3.10
3.13
3.15
15
14
13
12
11
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7
6
5
4
3
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1
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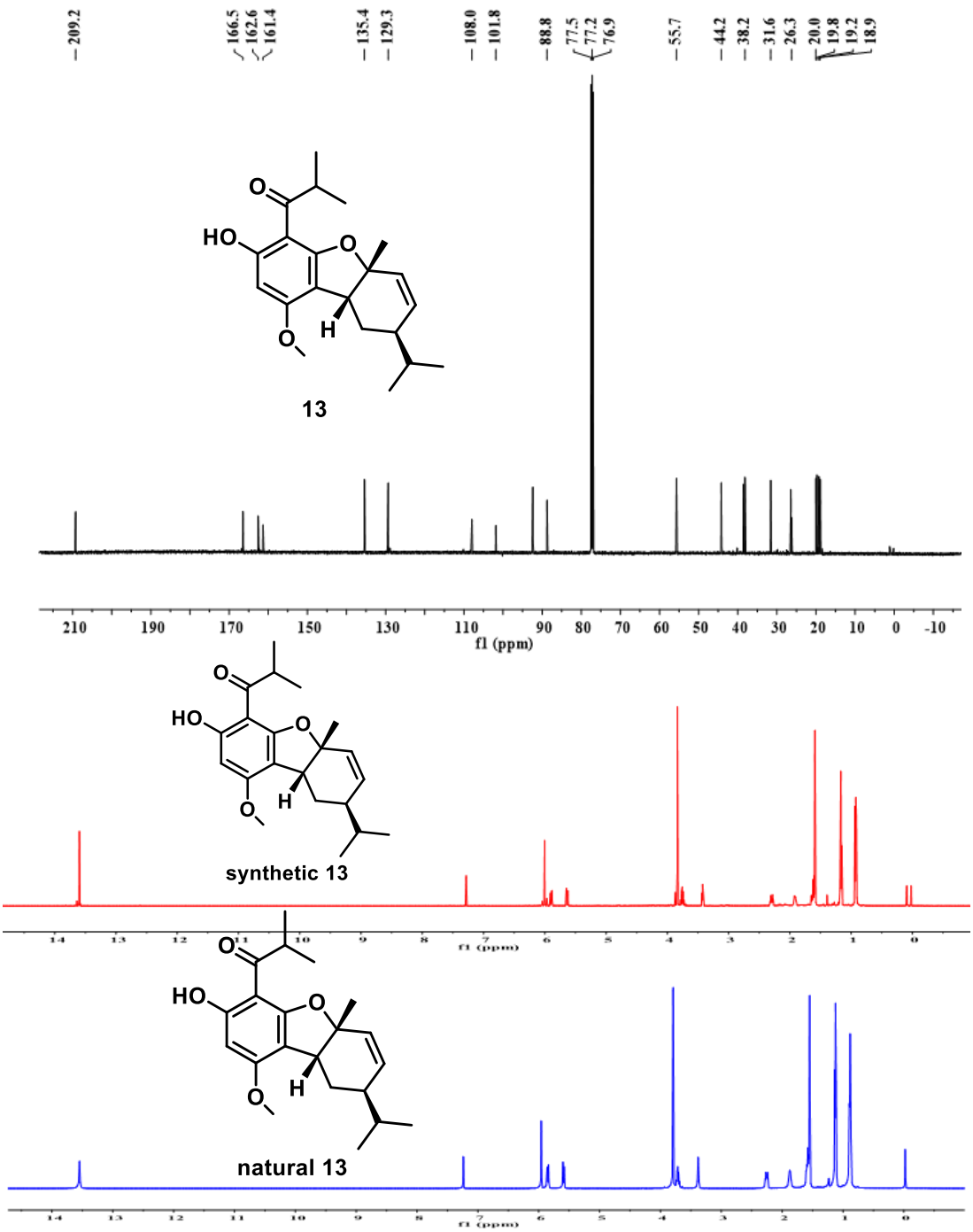
-1
-2
-3
f1 (ppm)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77.2
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44.2
38.2
31.6
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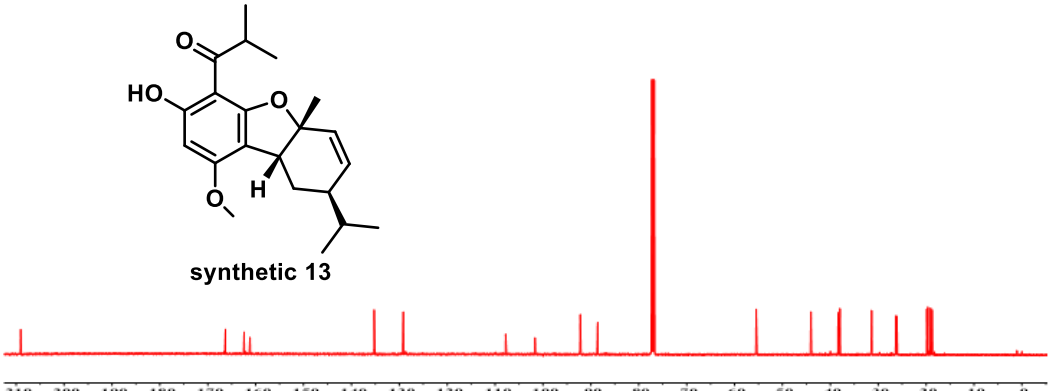
20.0
19.8
19.2
18.9
HO
O
H
13
fl (ppm)
synthetic 13
natural 13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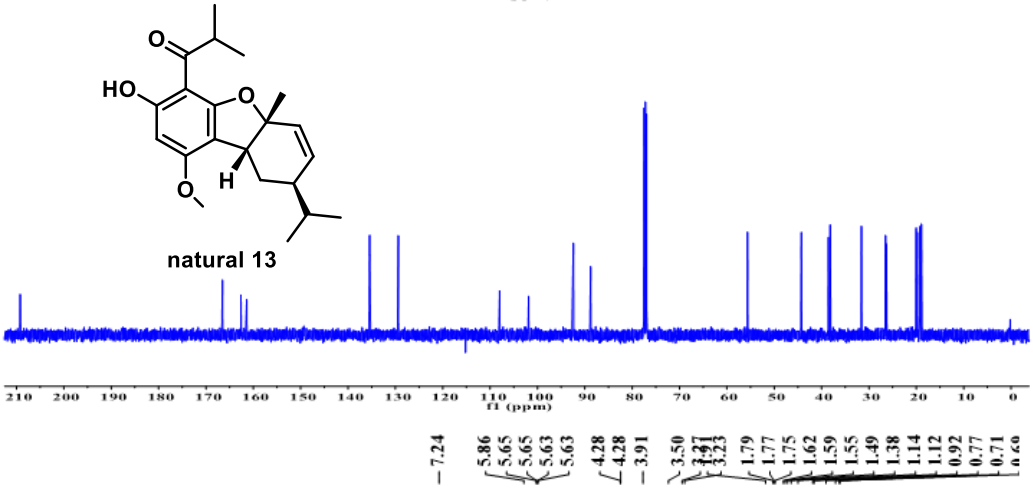
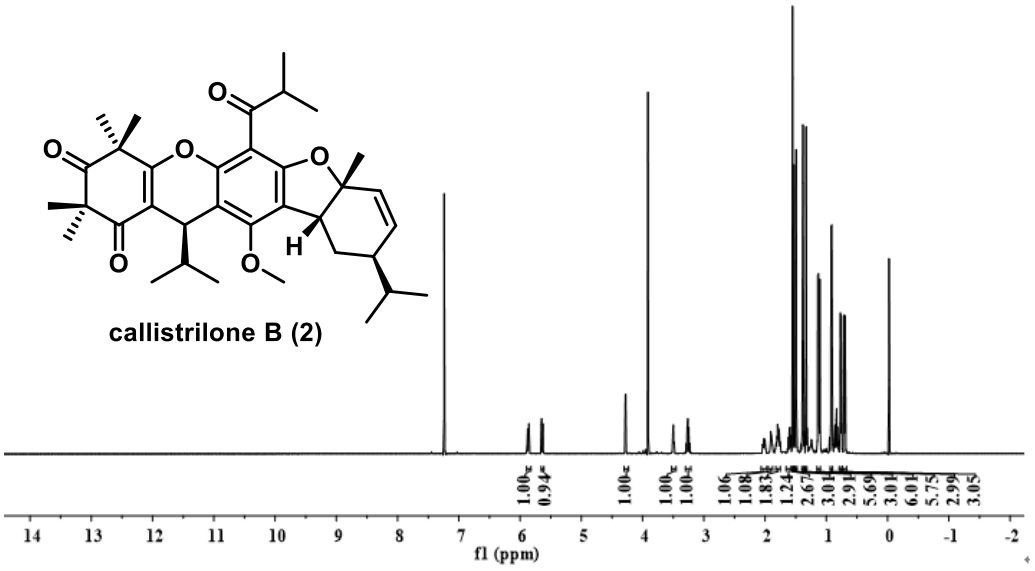
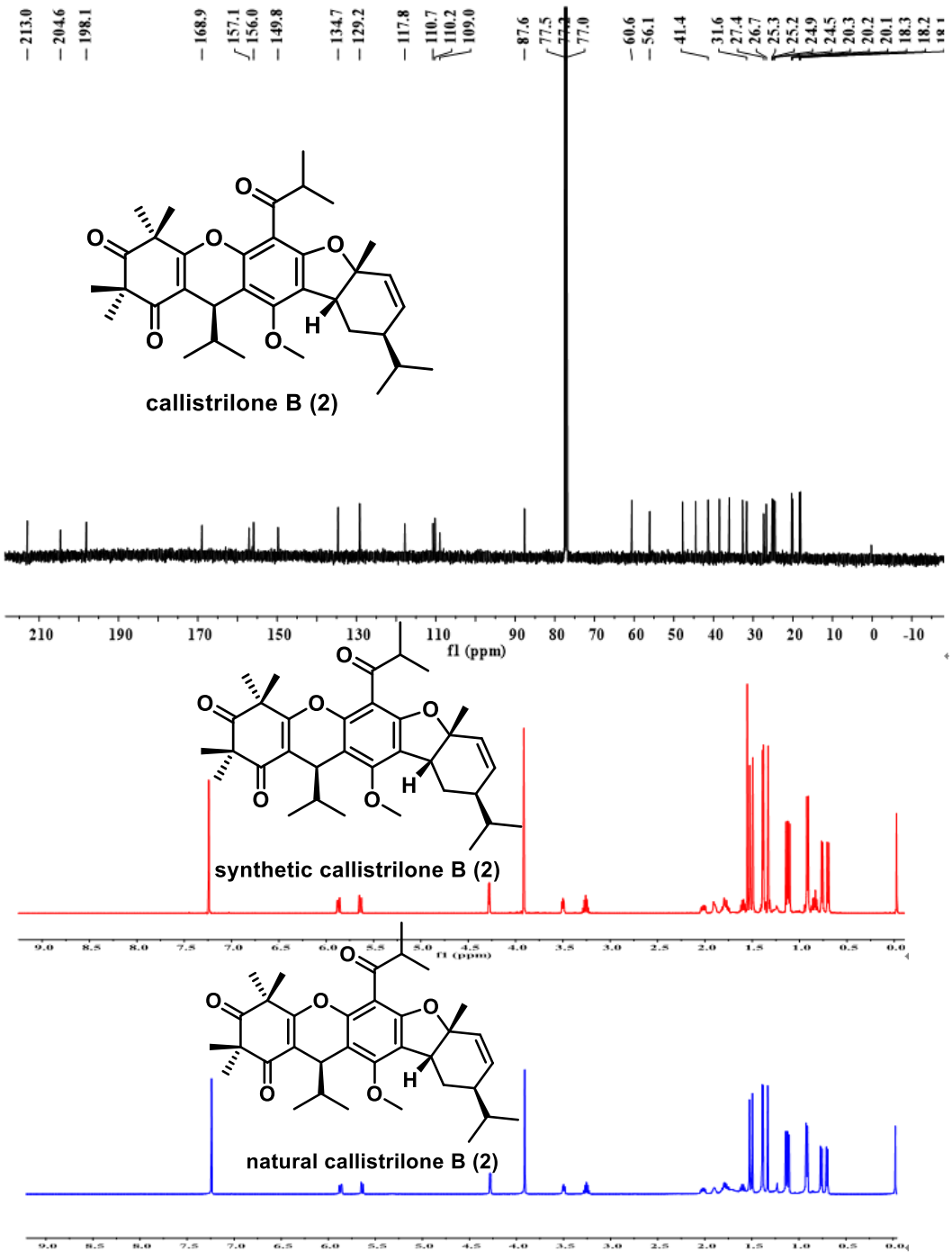
f1 (ppm)


natural 13
f1 (ppm)


callistrilone B (2)
f1 (ppm)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109.0
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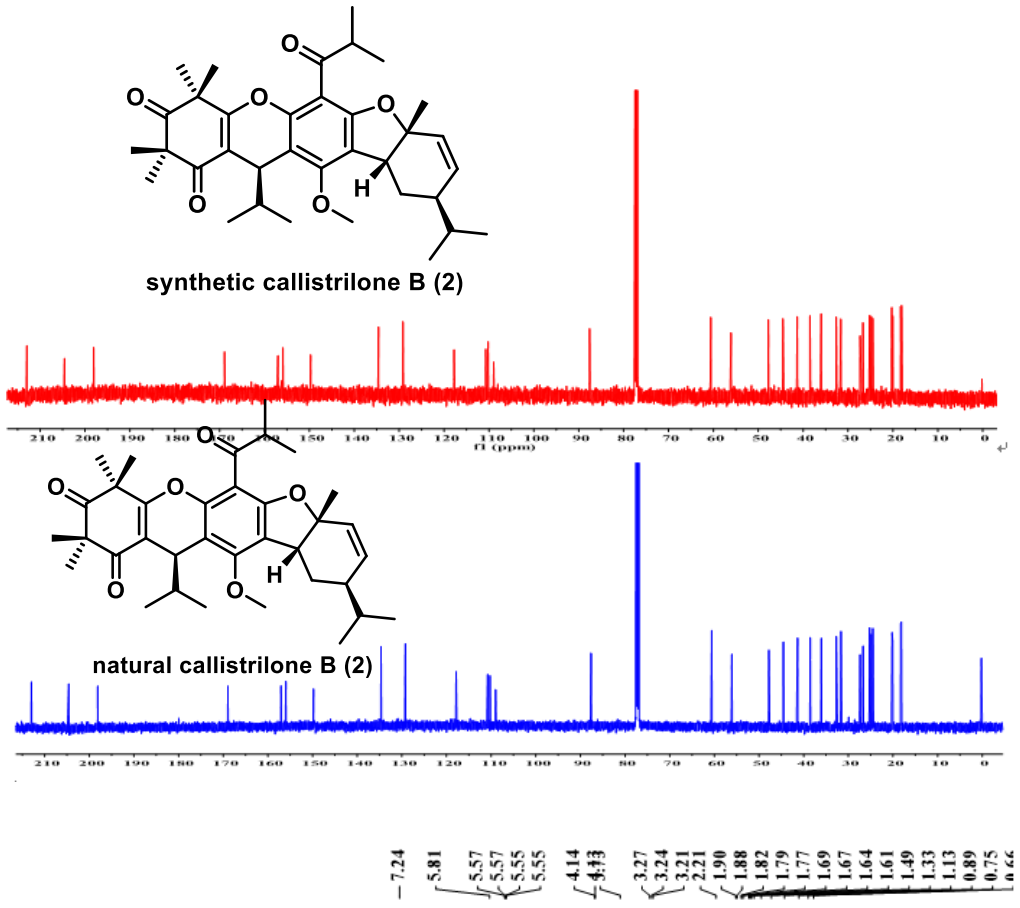
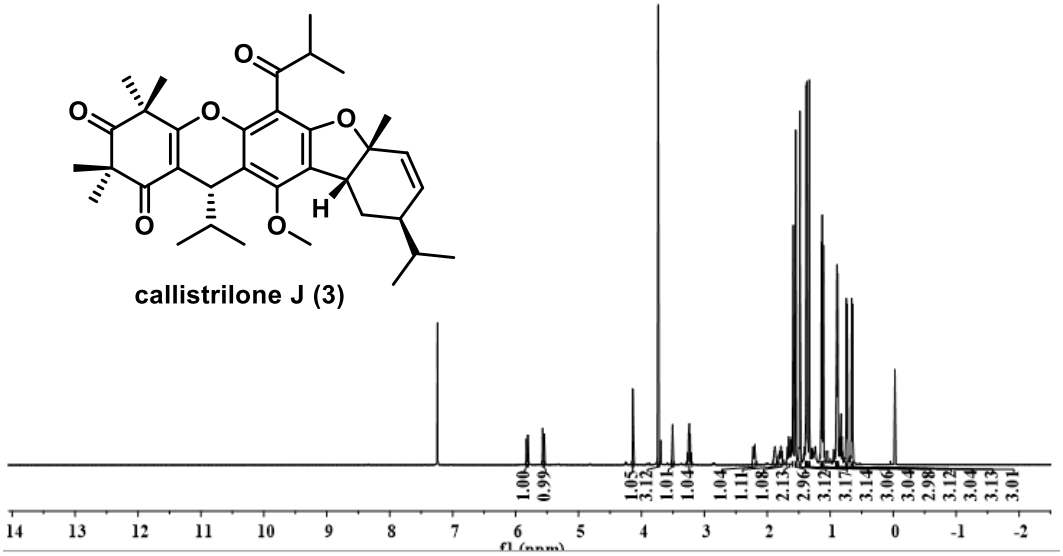
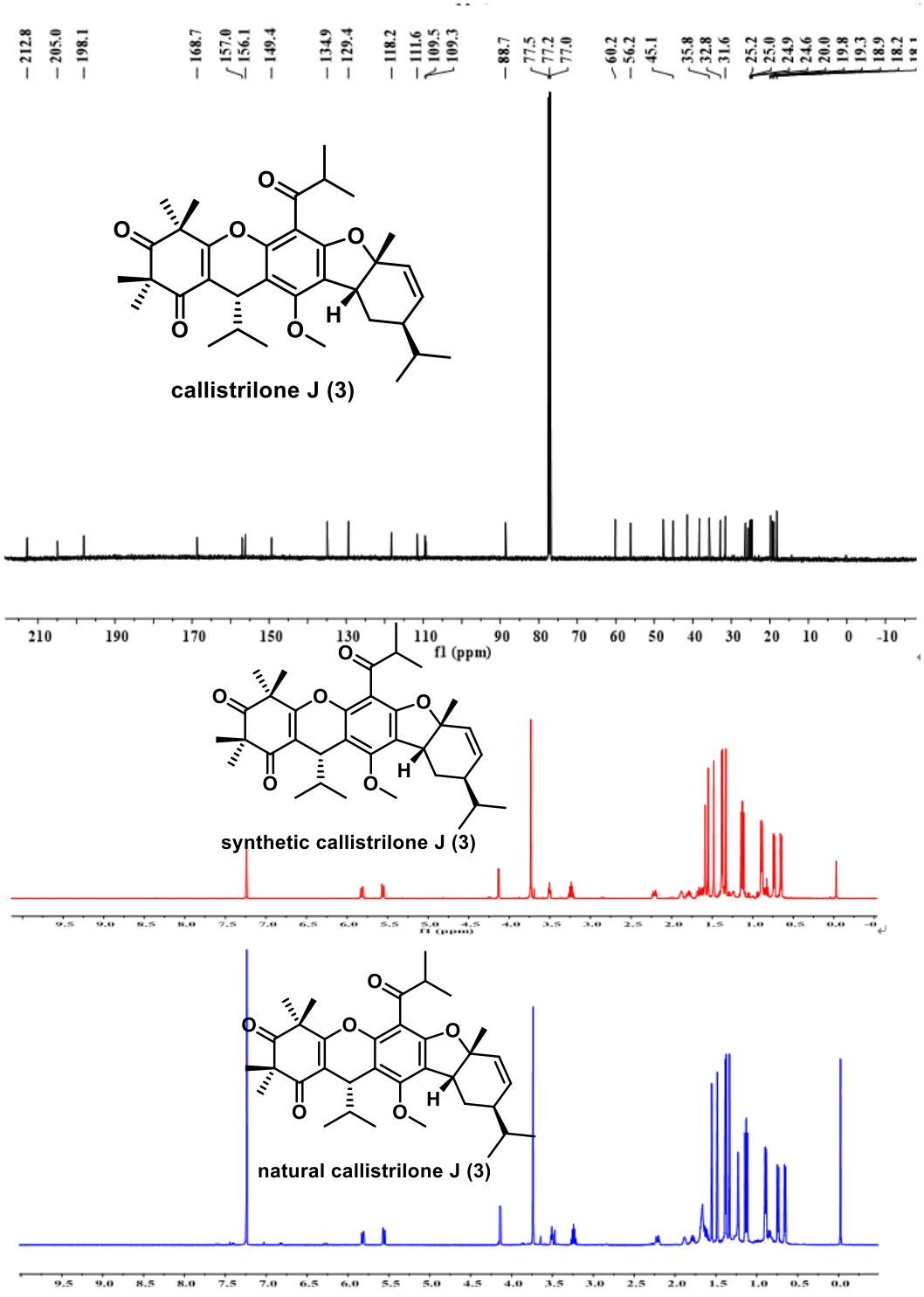
77.5
77.0
60.6
56.1
41.4
31.6
27.4
26.7
25.3
25.2
24.9
24.5
20.3
20.2
20.1
18.3
18.2
callistrilone B (2)
f1 (ppm)
synthetic callistrilone B (2)
natural callistrilone B (2)


synthetic callistrilone B (2)
natural callistrilone B (2)


callistrilone J (3)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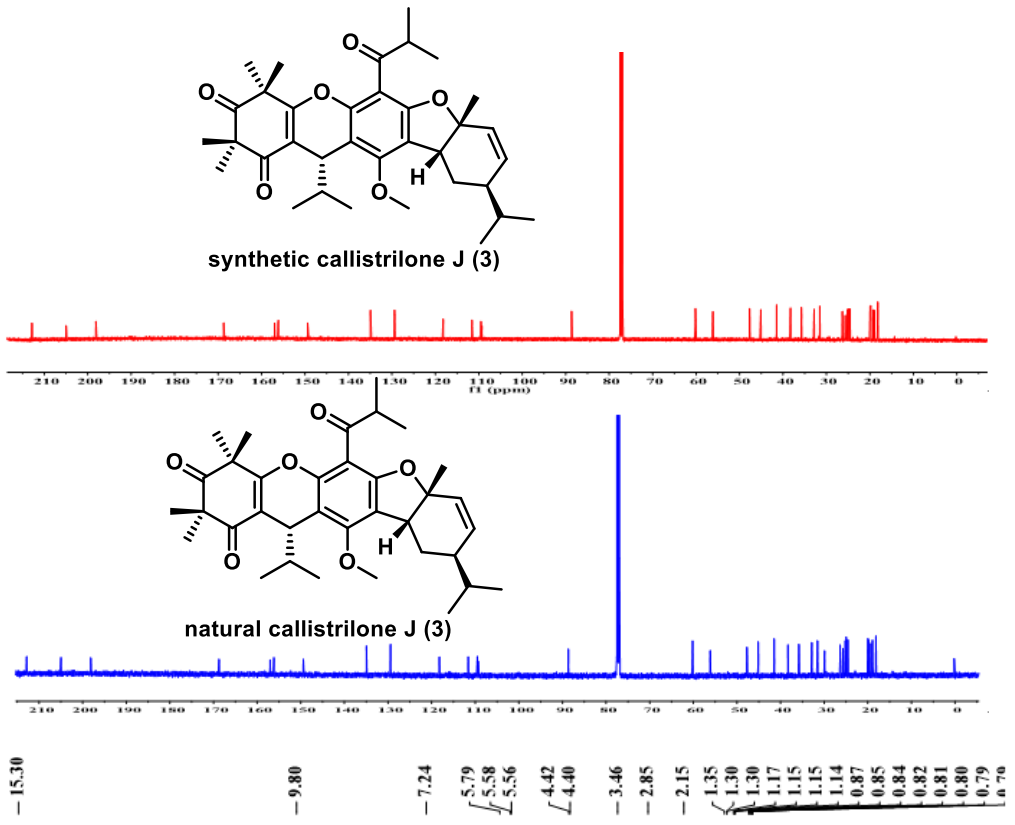
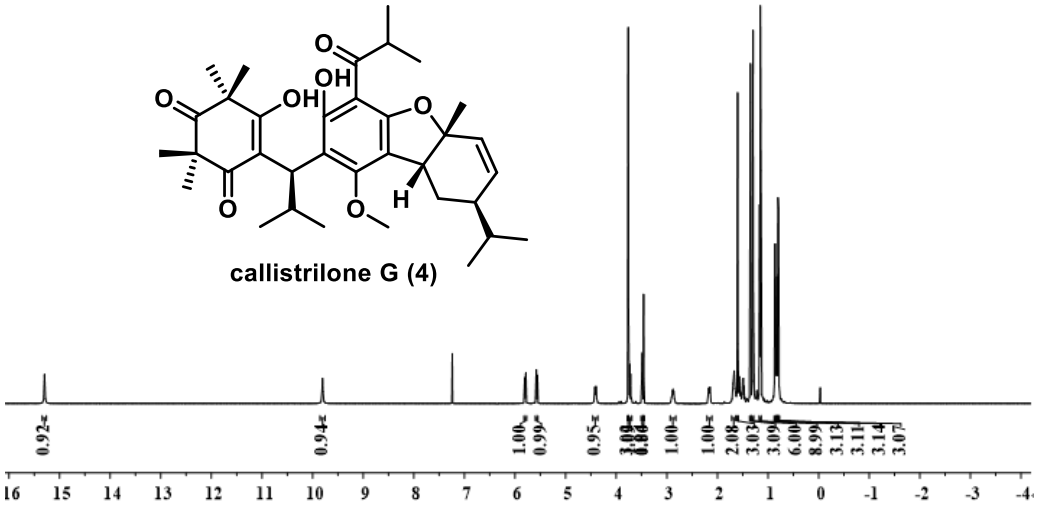
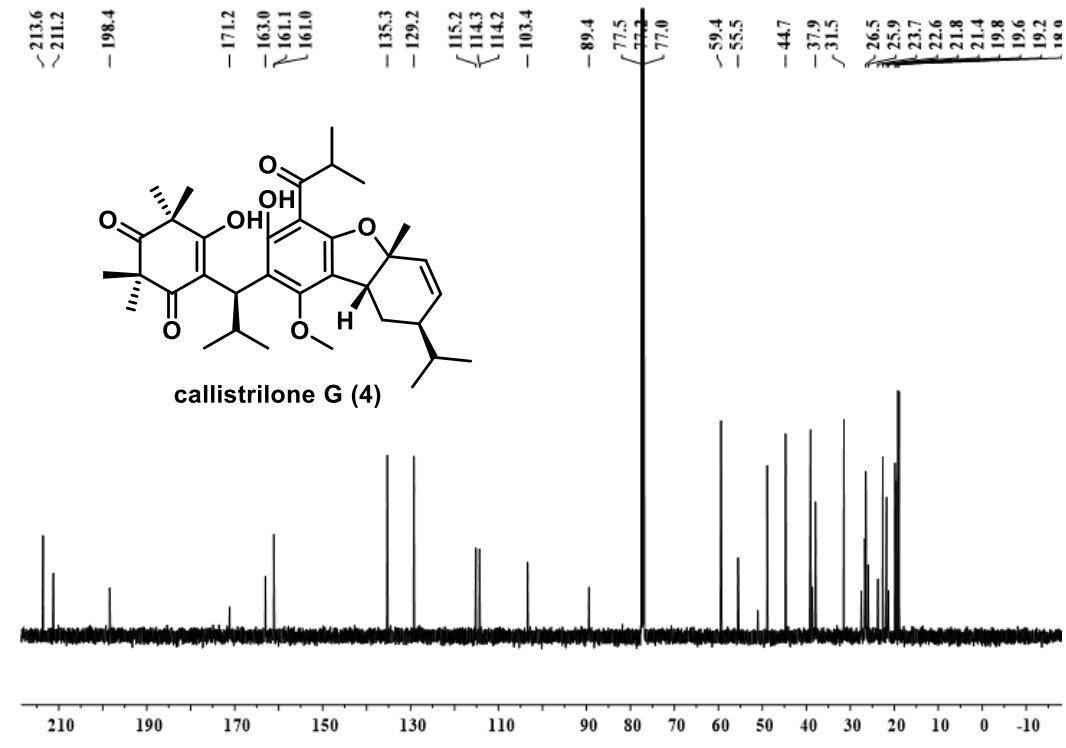
157.0
156.1
149.4
134.9
129.4
118.2
111.6
109.5
109.3
88.7
77.5
77.2
77.0
60.2
56.2
45.1
35.8
32.8
31.6
25.2
25.0
24.9
24.6
20.0
19.8
19.3
18.9
18.2
callistrilone J (3)
f1 (ppm)
synthetic callistrilone J (3)
natural callistrilone J (3)


synthetic callistrilone J (3)
natural callistrilone J (3)


callistrilone G (4)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171.2
163.0
161.1
161.0
135.3
129.2
115.2
114.3
114.2
103.4
89.4
77.5
77.0
59.4
55.5
44.7
37.9
31.5
26.5
25.9
23.7
22.6
21.8
21.4
19.8
19.6
19.2
OH
O
O
O
O
H
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170
150
130
110
90
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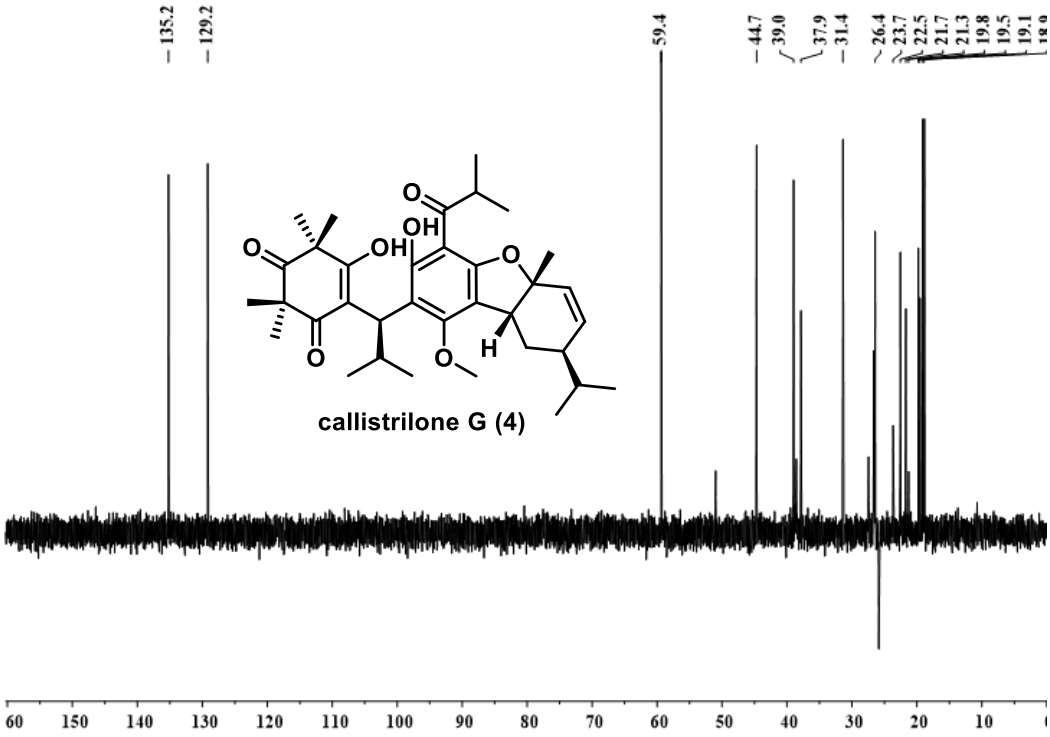
70
60
50
40
30
20
10
0
-10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19.5
19.1
OH
O
O
O
O
H
callistrilone G (4)
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150
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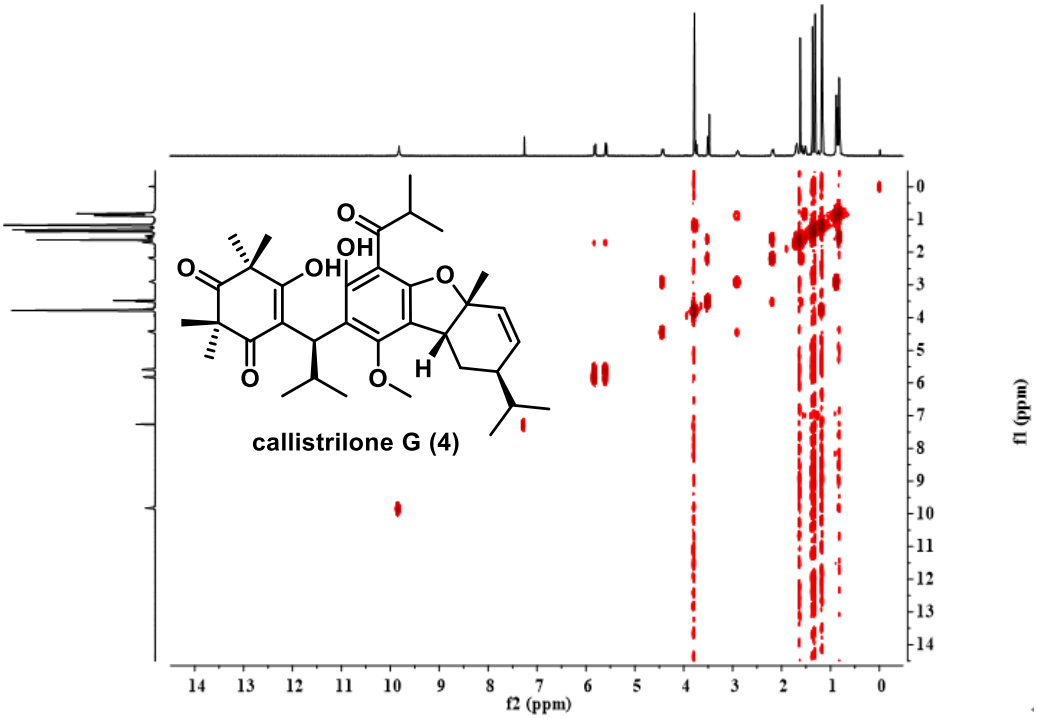
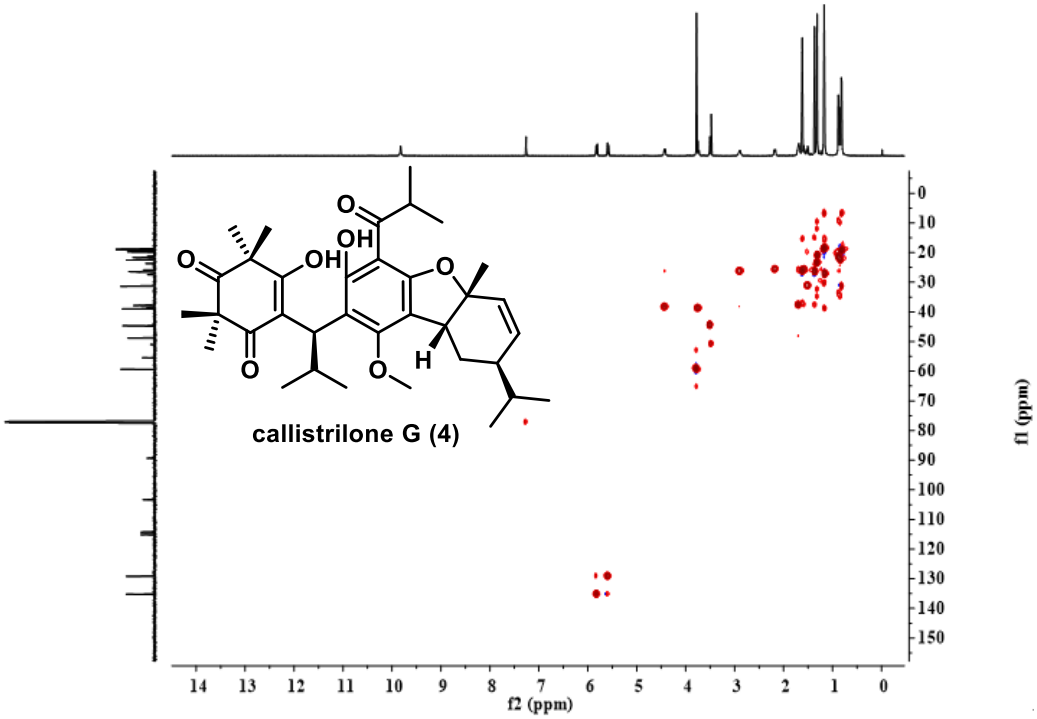
120
110
100
90
80
70
60
50
40
30
20
10


callistrilone G (4)
f2 (ppm)
f1 (ppm)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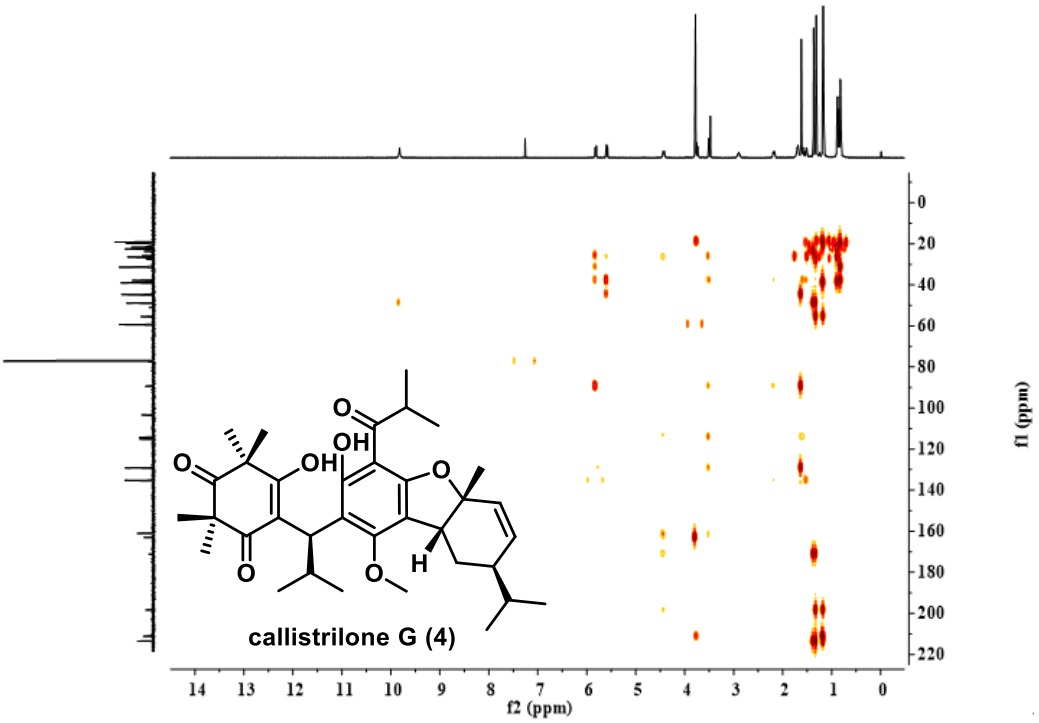
f2 (ppm)
f1 (ppm)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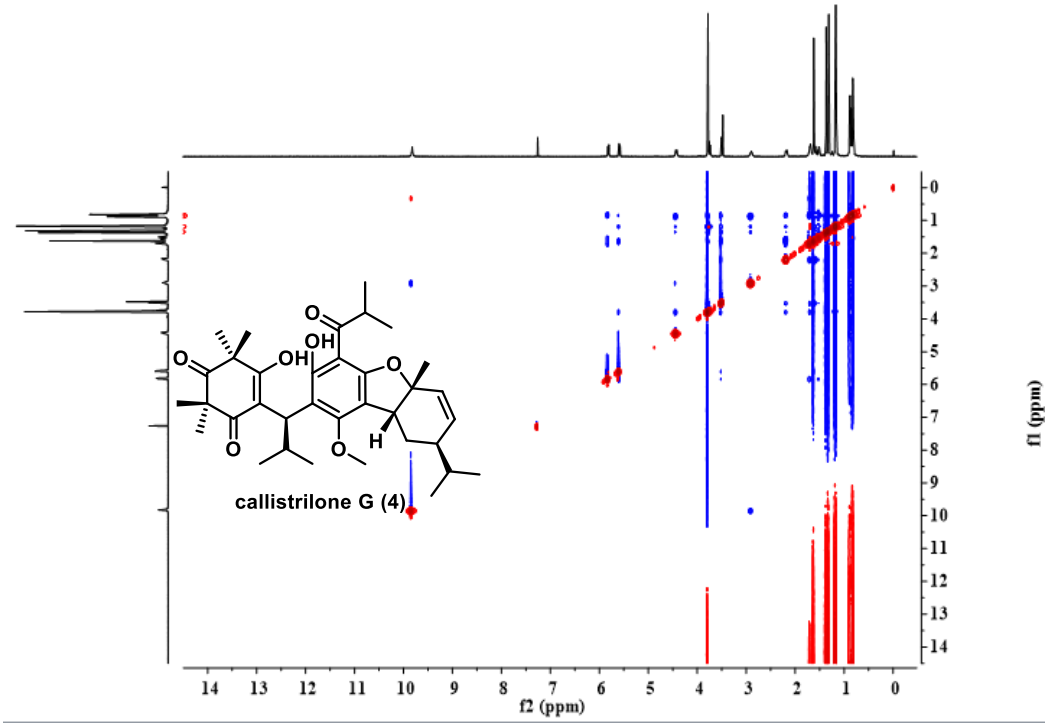
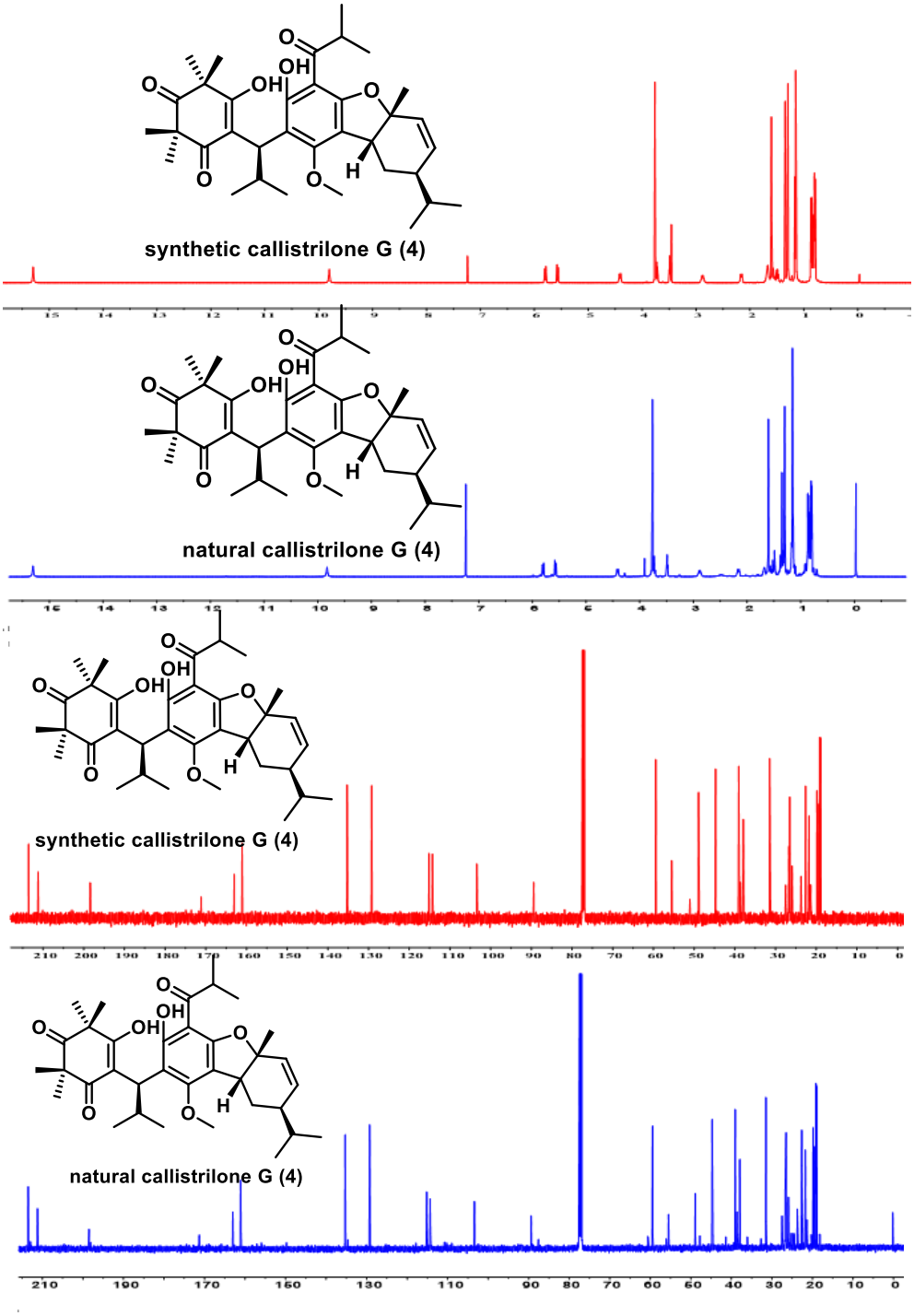
f2 (ppm)
f1 (ppm)


callistrilone G (4)
f2 (ppm)
f1 (ppm)


synthetic callistrilone G (4)
natural callistrilone G (4)
synthetic callistrilone G (4)
natural callistrilone G (4)