Supporting Information

for

A Total Synthesis of (±)-Leuconodines D and E

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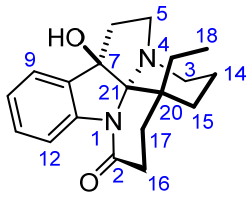
1. Comparison of spectroscopic data of naturally occurring and synthetic leuconodines D (1) and E (2)

Table S1. Comparison of the ^{1}H NMR data of naturally occurring[1] and synthetic leuconodine E **(2)**



Leuconodine E (2)

Position	δ_H in ppm (J in Hz)		
	Natural product[a]	Synthetic product[b]	$\Delta_{(S-N)}$
OH	-	2.42 (s, 1H)	
3	2.96 m	2.96 m	0
5a	2.70 m	2.70 m	0
5b	2.87 m	2.87 m	0
6a	2.08 (dd, 11, 6)	2.08 (dd, 12.4, 6.5)	0
6b	2.74 m	2.74 m	0
9	7.27 (d, 8)	7.27 (d, 8)	0
10	7.08 (td, 8, 1.5)	7.07 (td, 7.5, 1)	-0.01
11	7.23 (td, 8, 1.5)	7.23 (td, 7.8, 1.4)	0
12	8.11 (d, 8)	8.10 (d, 8)	-0.01
14a	1.70 m	1.70 m	0
14b	1.80 m	1.80 m	0
15	1.74 m	1.74 m	0
16a	2.31 (dt, 14, 3)	2.26 (ddd, 14.8, 5.5, 2.0)	0.05
16b	3.53 (ddd, 14, 12, 10)	3.49 (ddd, 14.7, 12.9, 8.5)	-0.04
17	1.77m	1.77m	0
18	0.74 (t, 7.6)	0.73 (t, 7.4)	-0.01
19a	1.14 (dq, 14, 7.6)	1.17 (dq, 14.6, 7.5)	0.03
19b	1.74 m	1.74 m	0

[a] ^{1}H NMR spectra were obtained at 400 MHz in $CDCl_3$.

[b] ^{1}H NMR spectra were obtained at 500 MHz in $CDCl_3$.

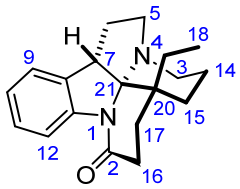
Table S2. Comparison of the ^{13}C-NMR data of naturally occurring[1] and synthetic leuconodine E **(2)**

Position	δ_c in ppm		
	Natural product[a]	Synthetic product[b]	$\Delta_{(S-N)}$
2	173.2	173.3	0.1
3	49.5	49.6	0.1
5	49.6	49.8	0.2
6	44.4	44.4	0
7	91.8	91.9	0.1
8	135.6	135.8	0.2
9	120.6	120.8	0.2
10	123.8	124.0	0.2
11	128.9	129.0	0.1
12	115.2	115.5	0.3
13	141.2	141.3	0.1
14	20.5	20.6	0.1
15	29.6	29.8	0.2
16	31.9	32.1	0.2
17	32.3	32.4	0.1
18	7.4	7.6	0.2
19	28.9	29.0	0.1
20	41.5	41.6	0.1
21	95.3	95.5	0.2

[a] ^{13}C NMR spectra were obtained at 100 MHz in $CDCl_3$.

[b] ^{13}C NMR spectra were obtained at 125 MHz in $CDCl_3$.

Table S3. Comparison of the ^{1}H NMR data of naturally occurring,[1] and Dai's[2] and our synthetic leuconodine D **(1)**



Leuconodine D (1)

Position	δ_H in ppm (J in Hz)		
	Natural product isolated[a]	Synthetic product By Dai[b]	Synthetic product By Han[c]
3a	2.52 (td, 13, 3.5)	2.55 (td, 12, 3.5)	2.55 (td, 12, 3.5)
3b	3.03(d, 13)	2.98 m	2.98 m
5a	2.72 (dd, 13, 6.5)	2.69 (dd, 12.5, 7)	2.69 (dd, 12.5, 7)
5b	2.93 (td, 13, 6.5)	2.91 (td, 12.5, 6)	2.91 (td, 12.5, 6)
6a	1.50 (dd, 11, 6)	1.48 (dd, 12, 6.5)	1.48 (dd, 12, 6.5)
6b	2.60 m	2.59 m	2.59 m
7	3.77 (d, 9.5)	3.75 (d, 9.5)	3.75 (d, 9.5)
9	7.13 (d, 7.3)	7.12 (d, 7.5)	7.12 (d, 7.5)
10	7.00 (td, 7.3, 1)	6.99 (td, 7.5, 1)	6.99 (td, 7.5, 1)
11	7.16 (td, 7.3, 1)	7.16 (td, 7.5, 1)	7.16 (td, 7.5, 1)
12	8.11 (d, 7.3)	8.10 (d, 8)	8.10 (d, 8)
14a	1.61 m	1.58 m	1.59 m
14b	1.82 m	1.80 m	1.81 m
15a	1.21(td, 13, 3.5)	1.18(td, 13.5, 3.5)	1.19 (td, 13.5, 3.5)
15b	1.79 m	1.76 m	1.77 m
16a	2.34 (ddd, 14, 5, 2.5)	2.33 (ddd, 14, 5, 2.5)	2.33 (ddd, 14, 5, 2.5)
16b	3.59 (td, 14, 8)	3.59 m	3.59 m
17a	1.70 m	1.71 m	1.71 m
17b	1.73 m	1.74 m	1.74 m
18	0.73 (t, 7.3)	0.72 (t, 7.5)	0.72 (t, 7.5)
19a	1.07 (dq, 13, 7.3)	1.06 (dq, 13.5, 7.5)	1.07 (dq, 13.5, 7.5)
19b	1.30 (dq, 13, 7.3)	1.30 (dq, 13.5, 7.5)	1.30 (dq, 13.5, 7.5)

[a] ^{1}H NMR spectra were obtained at 400 MHz in $CDCl_3$.

[b] ^{1}H NMR spectra were obtained at 500 MHz in $CDCl_3$.

[c] ^{1}H NMR spectra were obtained at 500 MHz in $CDCl_3$.

Table S4. Comparison of the ^{13}C NMR data of naturally occurring,[1] and Dai's[2] and our synthetic leuconodine D **(1)**

Position	δ_H in ppm		
	Natural product[a] ioslated	Synthetic product[b] Dai	Synthetic product[c] Han
2	172.6	172.9	172.9
3	50.9	51.0	51.0
5	52.2	52.4	52.5
6	33.3	33.5	33.5
7	47.0	47.1	47.1
8	133.7	134.1	134.1
9	127.5	127.6	127.6
10	123.5	123.7	123.7
11	123.5	123.6	123.6
12	114.5	114.5	114.5
13	143.0	143.1	143.2
14	19.9	20.2	20.2
15	32.0	31.7	31.7
16	32.8	32.3	32.1
17	28.9	29.3	29.4
18	7.4	7.7	7.7
19	31.4	31.7	31.7
20	40.3	40.6	40.6
21	97.6	97.7	97.7

[a] ^1H NMR spectra were obtained at 100 MHz in $CDCl_3$.

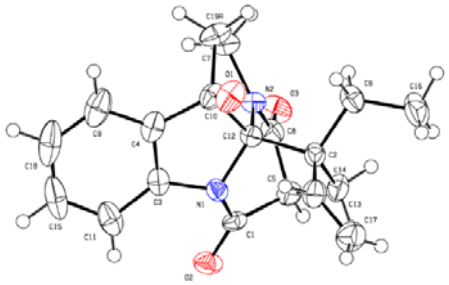
[b] ^1H NMR spectra were obtained at 125 MHz in $CDCl_3$.

[c] ^1H NMR spectra were obtained at 125 MHz in $CDCl_3$.

2. X-Ray data of compounds 26 and 2

Table S5. Crystal data and structure refinement for **26** (CCDC 1880949)

The single crystal of compound **26** was obtained by slow diffusion of n-hexane into a $CHCl_3$ solution of **26** at room temperature. X-ray crystallographic analysis was performed on a Bruker D8 ADVANCE diffractometer with Mo-Kα (λ = 0.71073 Å).

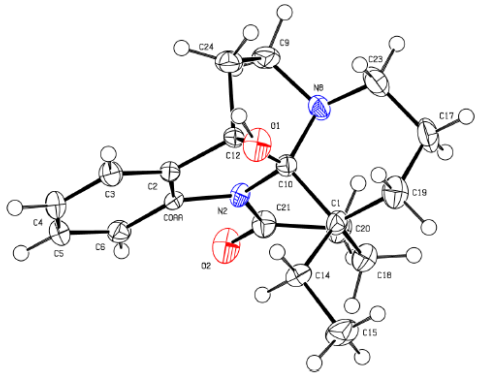


(50% probability)

formula	C_{19} H_{19} N_2 O_3
Formula weight	323.36
Temperature/K	120
Crystal system	orthorhombic
Space group	$Pc2_1/n$
Unit cell dimensions	a= 7.4919 (5) Å alpha=90°
	b= 13.2055 (9) Å beta= 90 °
	c= 15.9971 (11) Å gamma=90°
Volume/Å3	1582.66 (19)
Z	4
ρcalcg/cm3	1.358
μ/mm□1	0.093
F(000)	684.0
Crystal size/mm3	0.5 × 0.3 × 0.2
Radiation	MoKα (λ = 0.71073)
2Θ range for data collection/°	5.092 to 52.768
Index ranges	-9 ≤ h ≤ 9, -14 ≤ k ≤ 16, -19 ≤ l ≤ 19
Reflections collected	8514
Independent reflections	3084 [R_{int} = 0.0298, R_{sigma} = 0.0358]
Data/restraints/parameters	3840/0/245
Goodness-of-fit on F2	1.046
Final R indexes [I>=2σ (I)]	R_1 = 0.0399, wR_2 = 0.1013
Final R indexes [all data]	R_1 = 0.0465, wR_2 = 0.1084
Largest diff. peak/hole / e Å-3	0.34/-0.18

Table S6. Crystal data and structure refinement for **2** (CCDC 1872048)

The single crystal of compound **2** was obtained by slow diffusion of n-hexane into a $CHCl_3$ solution of **2** at room temperature. X-ray crystallographic analysis was performed on a Bruker D8 ADVANCE diffractometer with Mo-Kα (λ = 0.71073 Å).



(50% probability)

formula	$C_{19}H_{24}N_2O_2$
Formula weight	312.18
Temperature/K	120
Crystal system	orthorhombic
Space group	$P2_12_12_1$
Unit cell dimensions	a= 8.1530(6) Å alpha=90°
	b= 10.6538(8) Å beta= 90 °
	c= 18.3193(14)Å gamma=90°
Volume/Å3	1591.2(2)
Z	32
ρcalcg/cm3	1.308
μ/mm□1	0.085
F(000)	676.0
Crystal size/mm3	0.5 × 0.4 × 0.3
Radiation	MoKα (λ = 0.71073)
2Θ range for data collection/°	4.422 to 52.762
Index ranges	$-10 \le h \le 9$, $-13 \le k \le 12$, $-19 \le l \le 22$
Reflections collected	8958
Independent reflections	3241 [R_{int} = 0.0290, R_{sigma} = 0.0314]
Data/restraints/parameters	3241/0/211
Goodness-of-fit on F2	1.144
Final R indexes [I>=2σ (I)]	R_1 = 0.1045, wR_2 = 0.2425
Final R indexes [all data]	R_1 = 0.1082, wR_2 = 0.2494
Largest diff. peak/hole / e Å-3	1.48/-0.43

3. Copies of NMR spectra of substrates and products

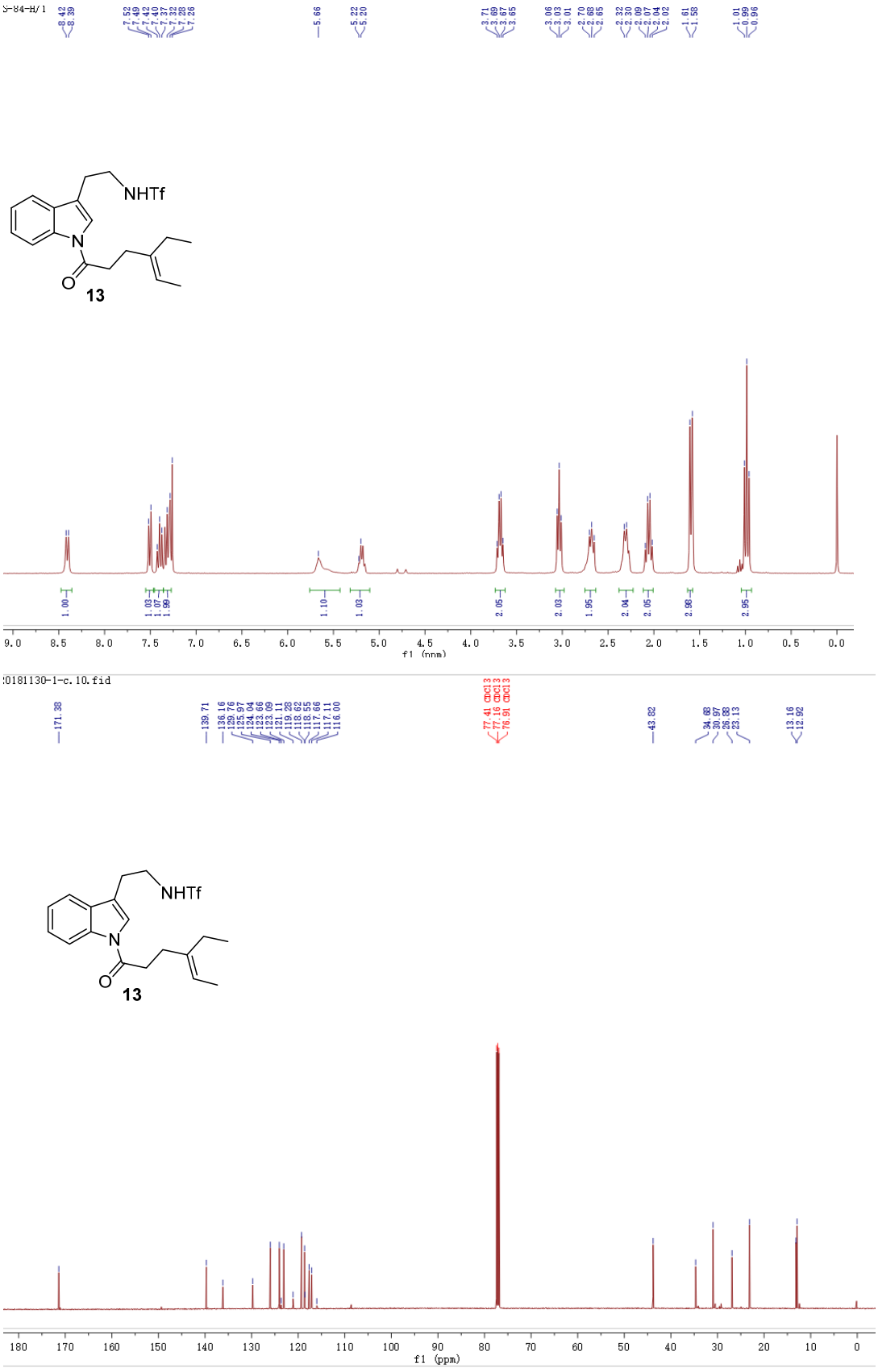


Figure S1. ^{1}H- (upper) and ^{13}C-NMR (lower) of compound **13** (see also ref. 3)

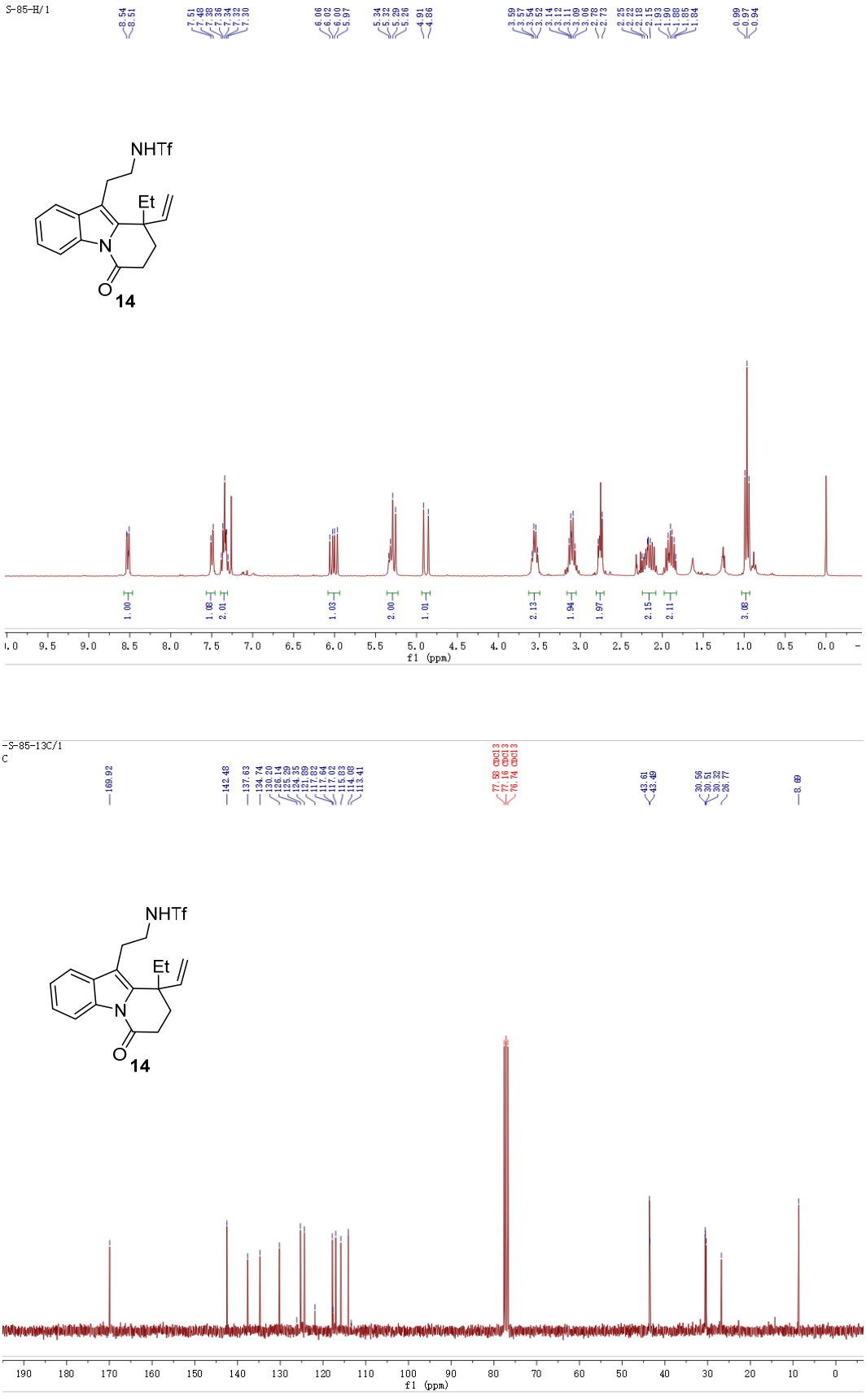


Figure S2. ^{1}H- (upper) and ^{13}C-NMR (lower) of compound **14** (see also ref. 3)

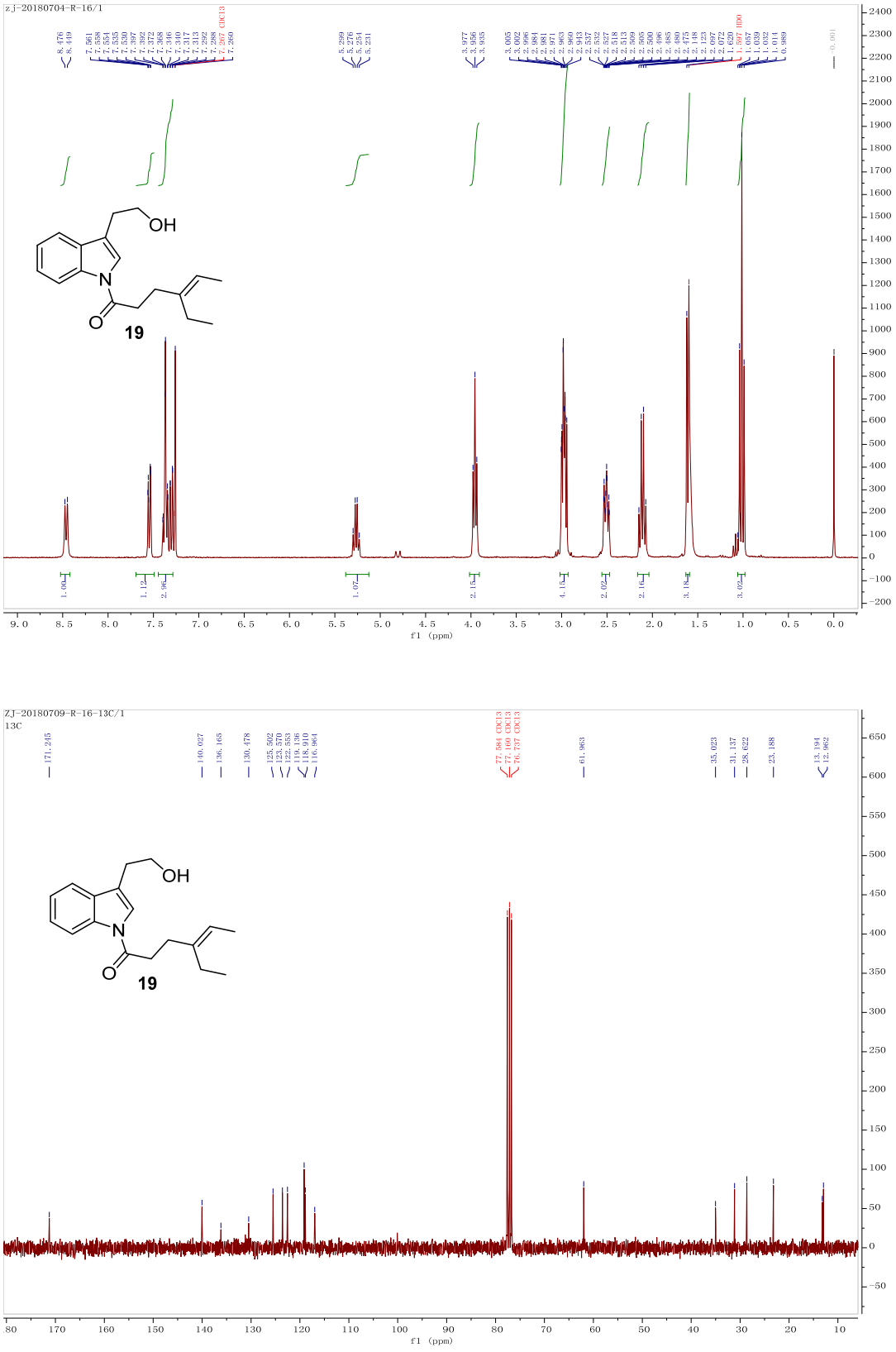
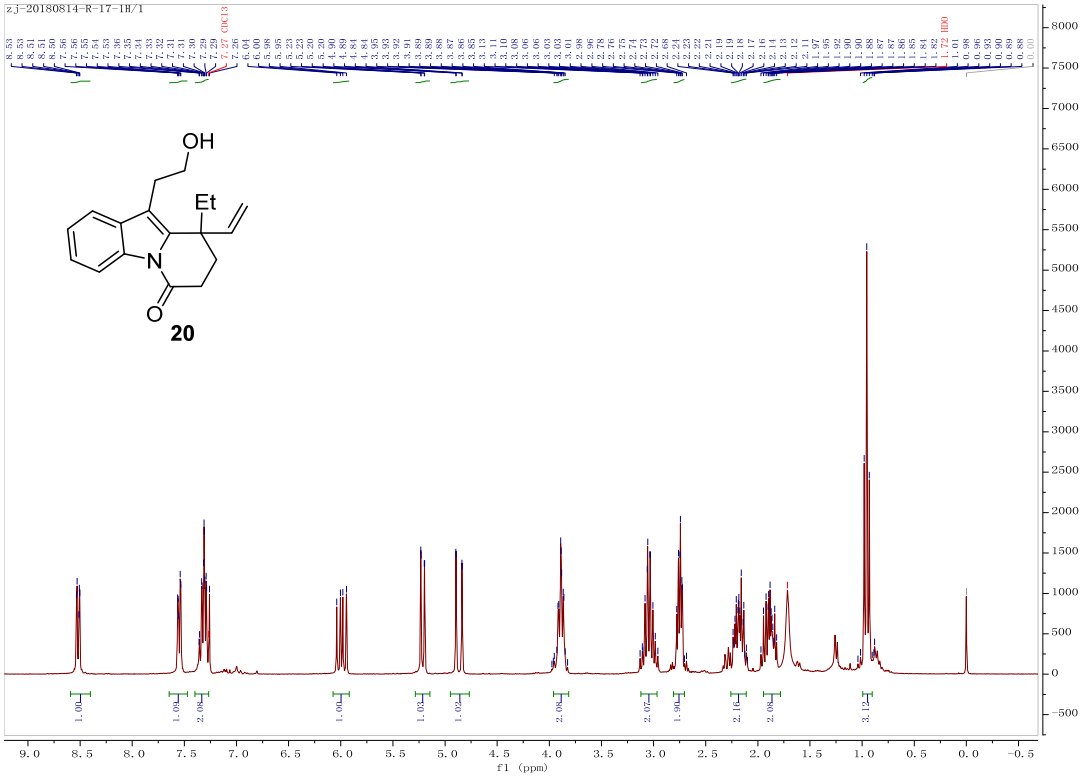


Figure S3. ^{1}H- (upper) and ^{13}C-NMR (lower) of compound **19** (see also ref. 3)



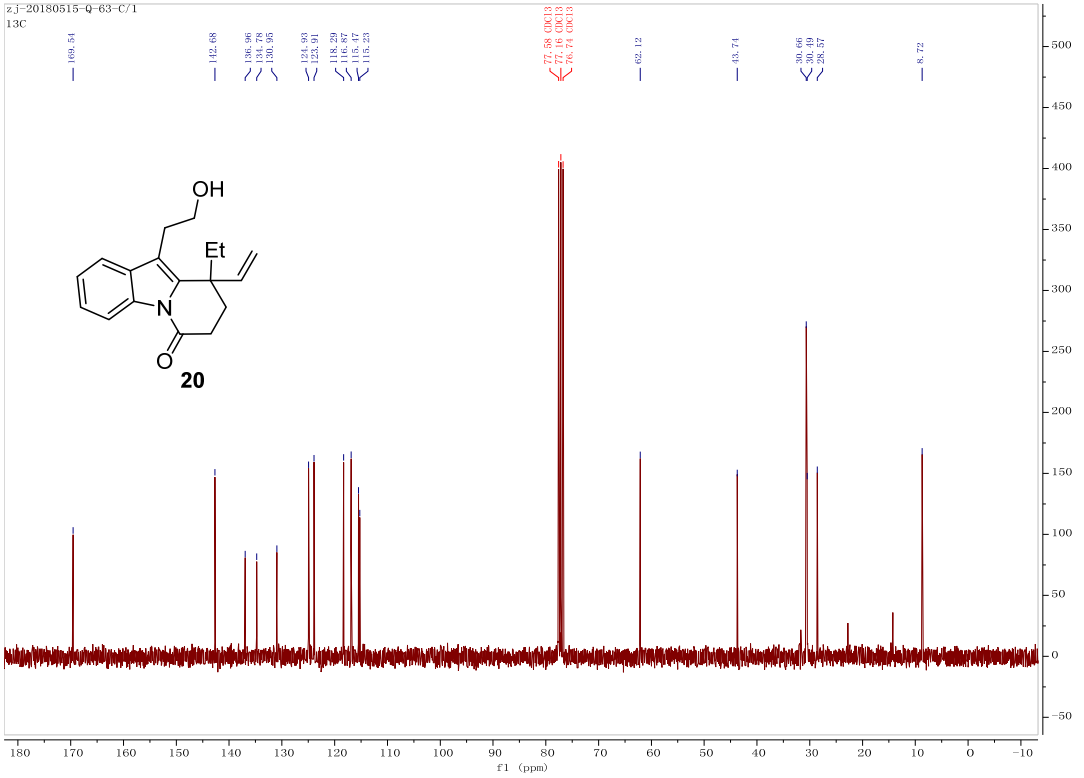


Figure S4. ^{1}H- (upper) and ^{13}C-NMR (lower) of compound **20** (see also ref. 3)

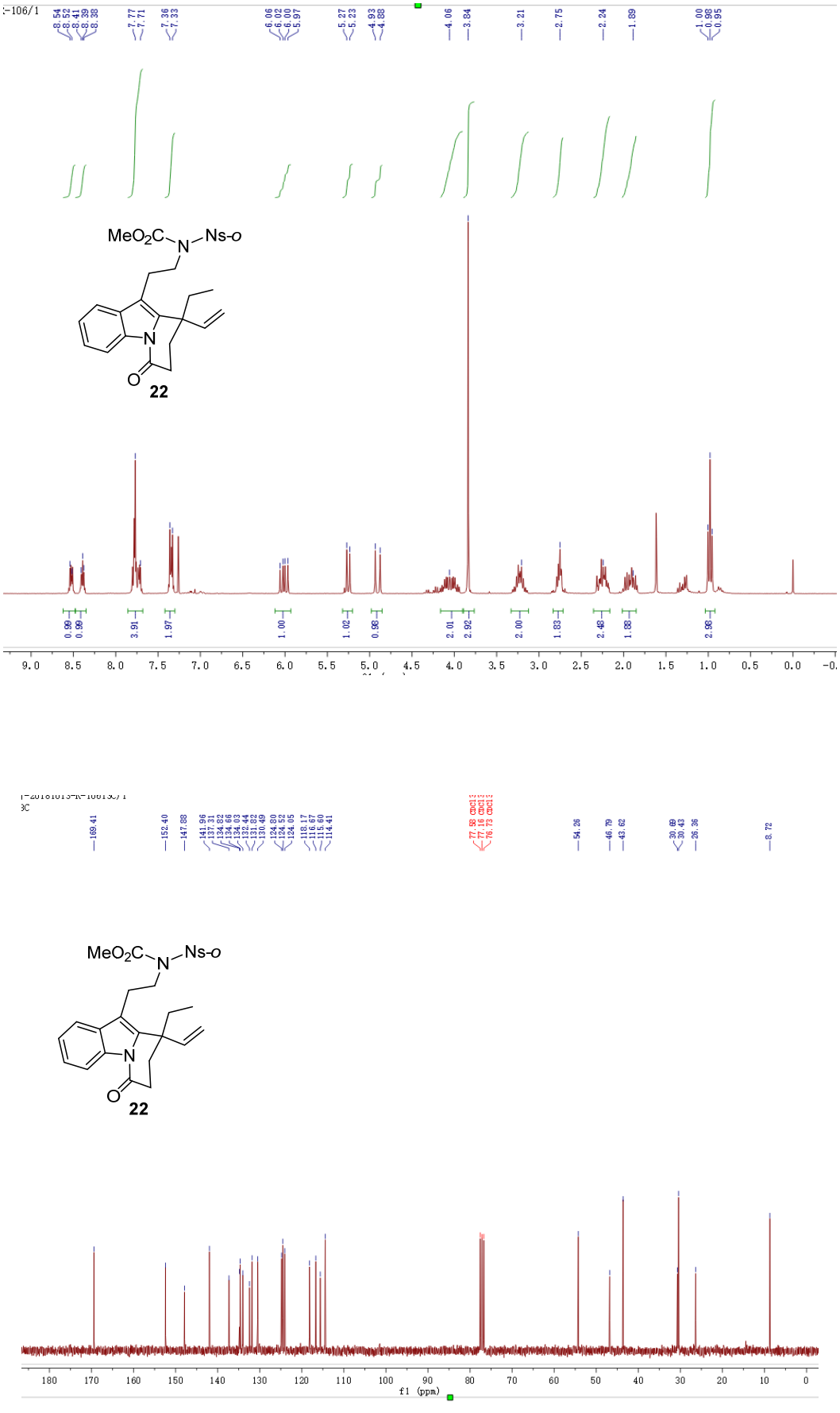


Figure S5. ^{1}H- (upper) and ^{13}C-NMR (lower) of compound **22**

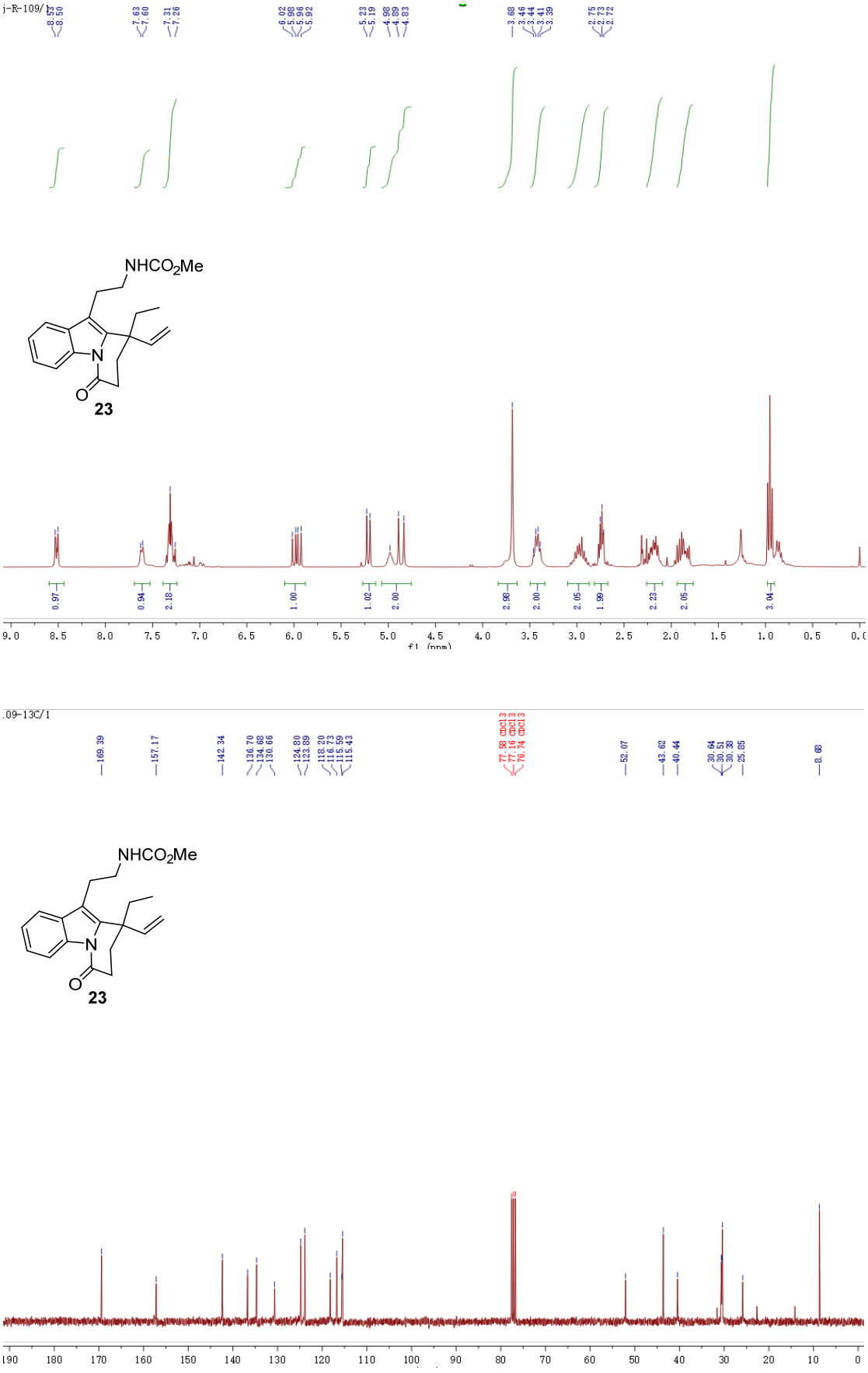


Figure S6. ^{1}H- (upper) and ^{13}C-NMR (lower) of compound **23**

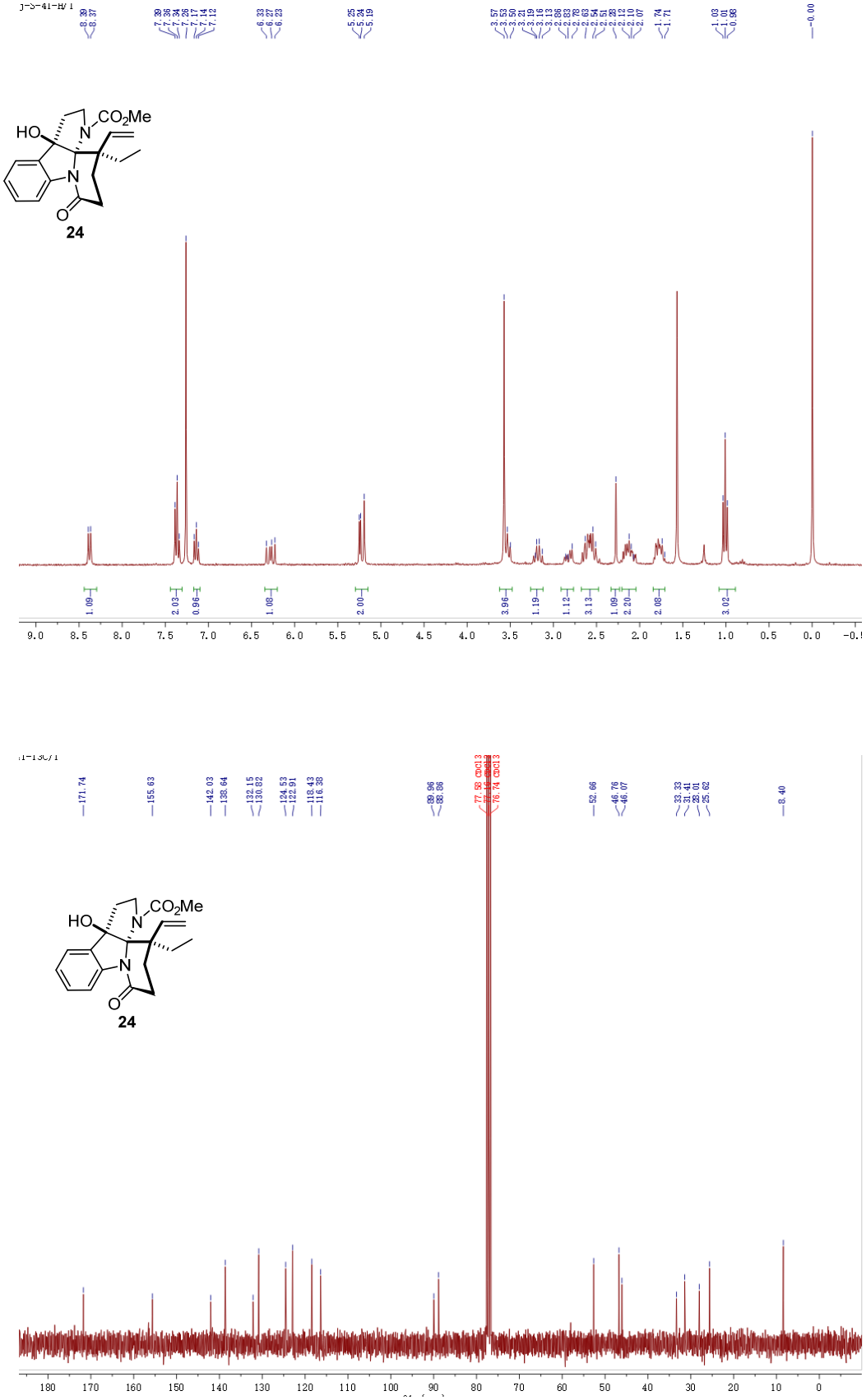


Figure S7. ^{1}H- (upper) and ^{13}C-NMR (lower) of compound **24**

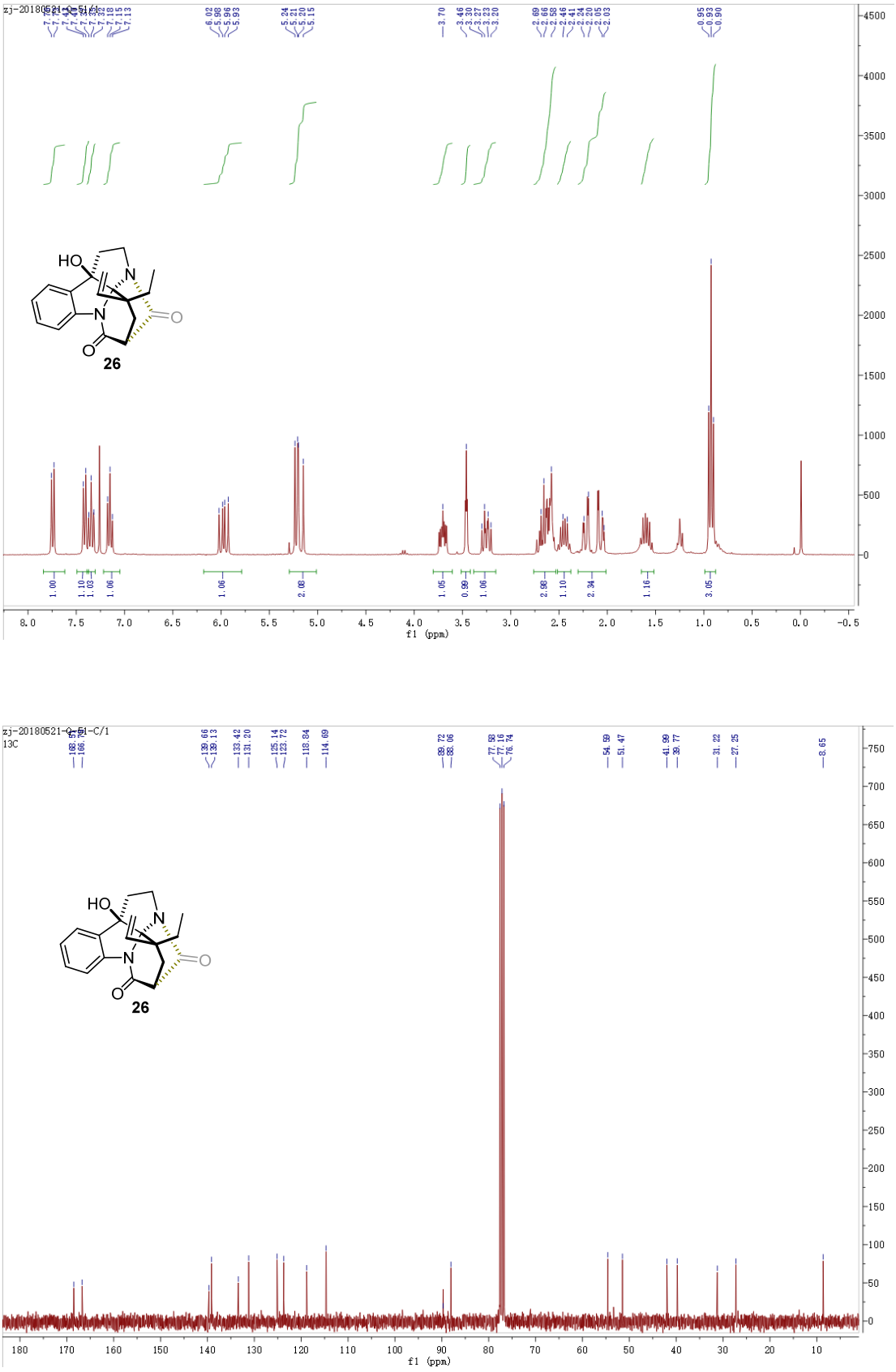
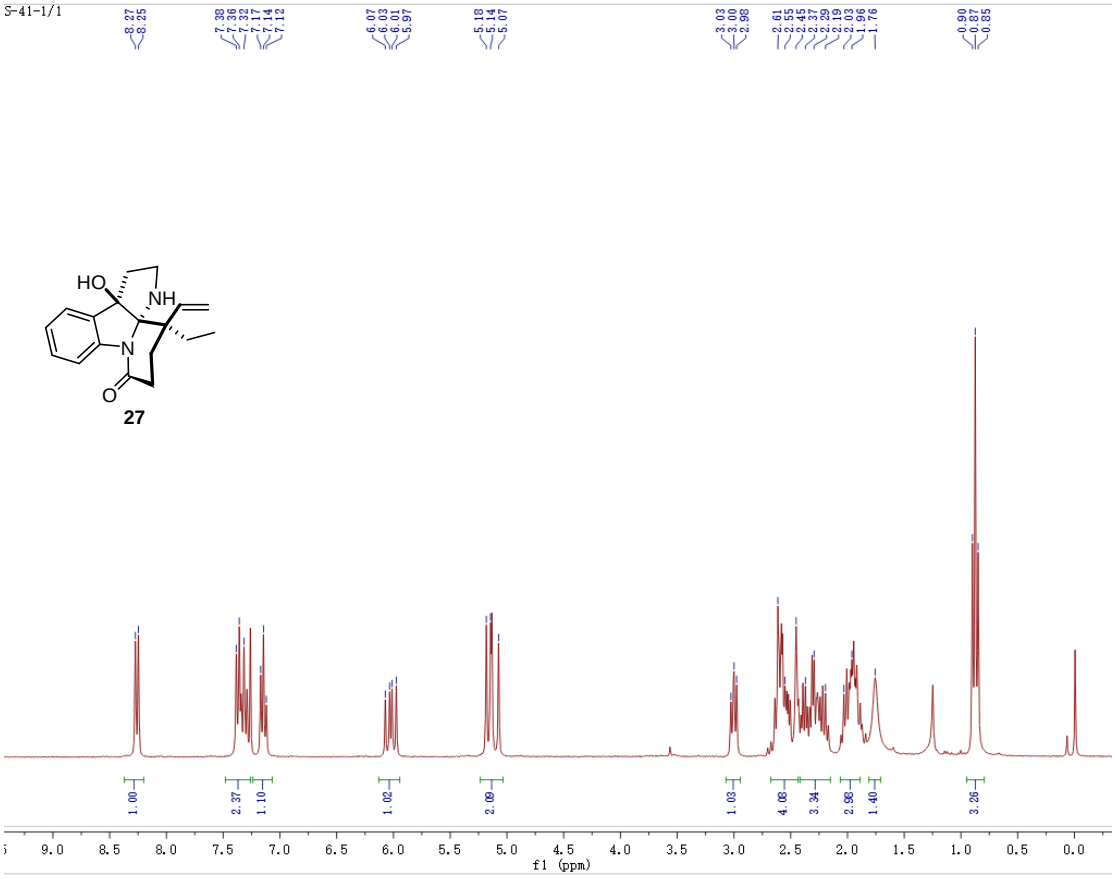


Figure S8. ^{1}H- (upper) and ^{13}C-NMR (lower) of compound **26**



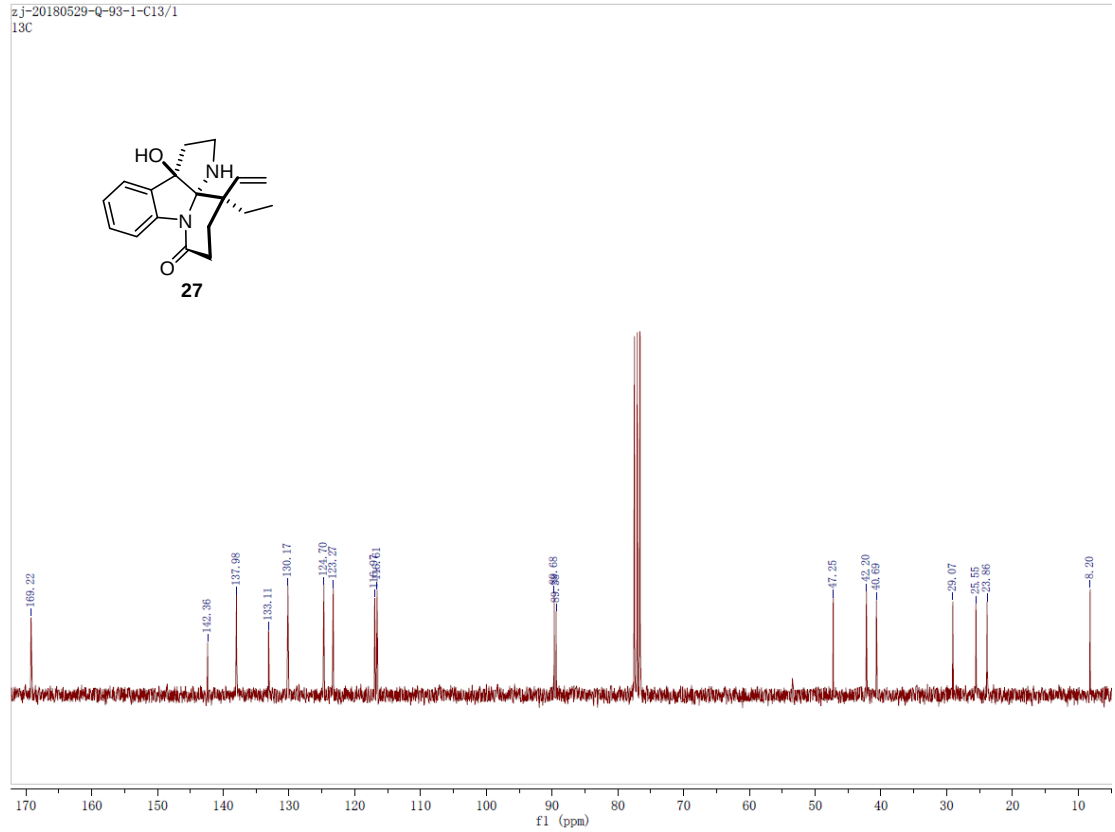


Figure S9. ^{1}H- (upper) and ^{13}C-NMR (lower) of compound **27**

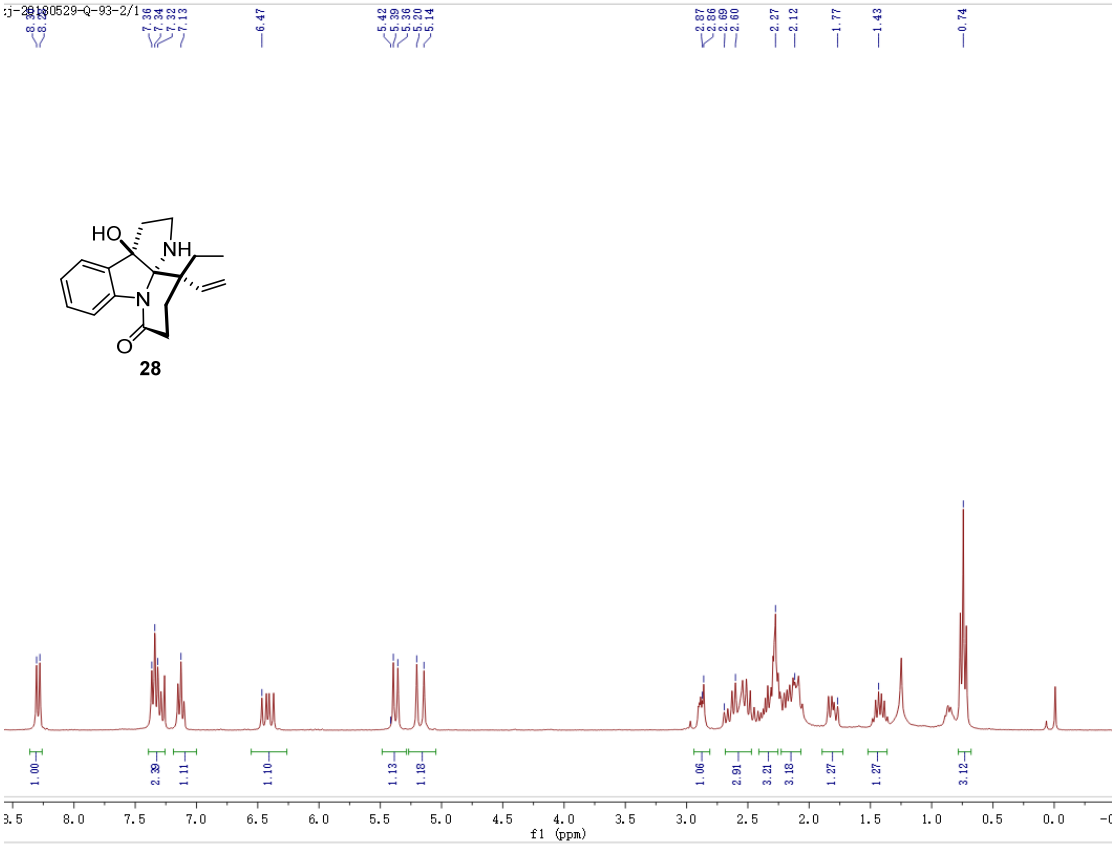


Figure S10. ^{1}H- (upper) and ^{13}C-NMR (lower) of compound **28**

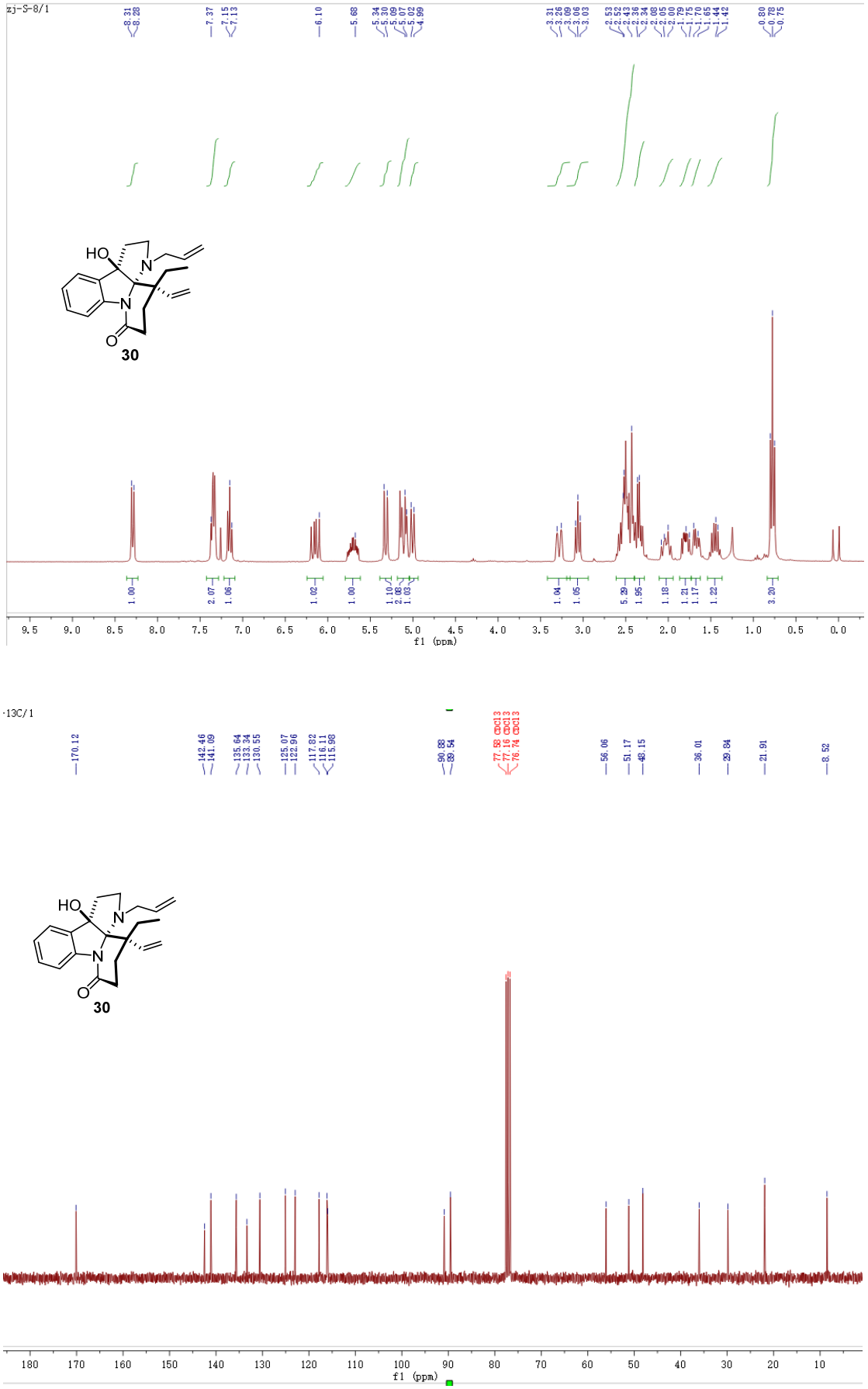


Figure S11. ^{1}H- (upper) and ^{13}C-NMR (lower) of compound **30**

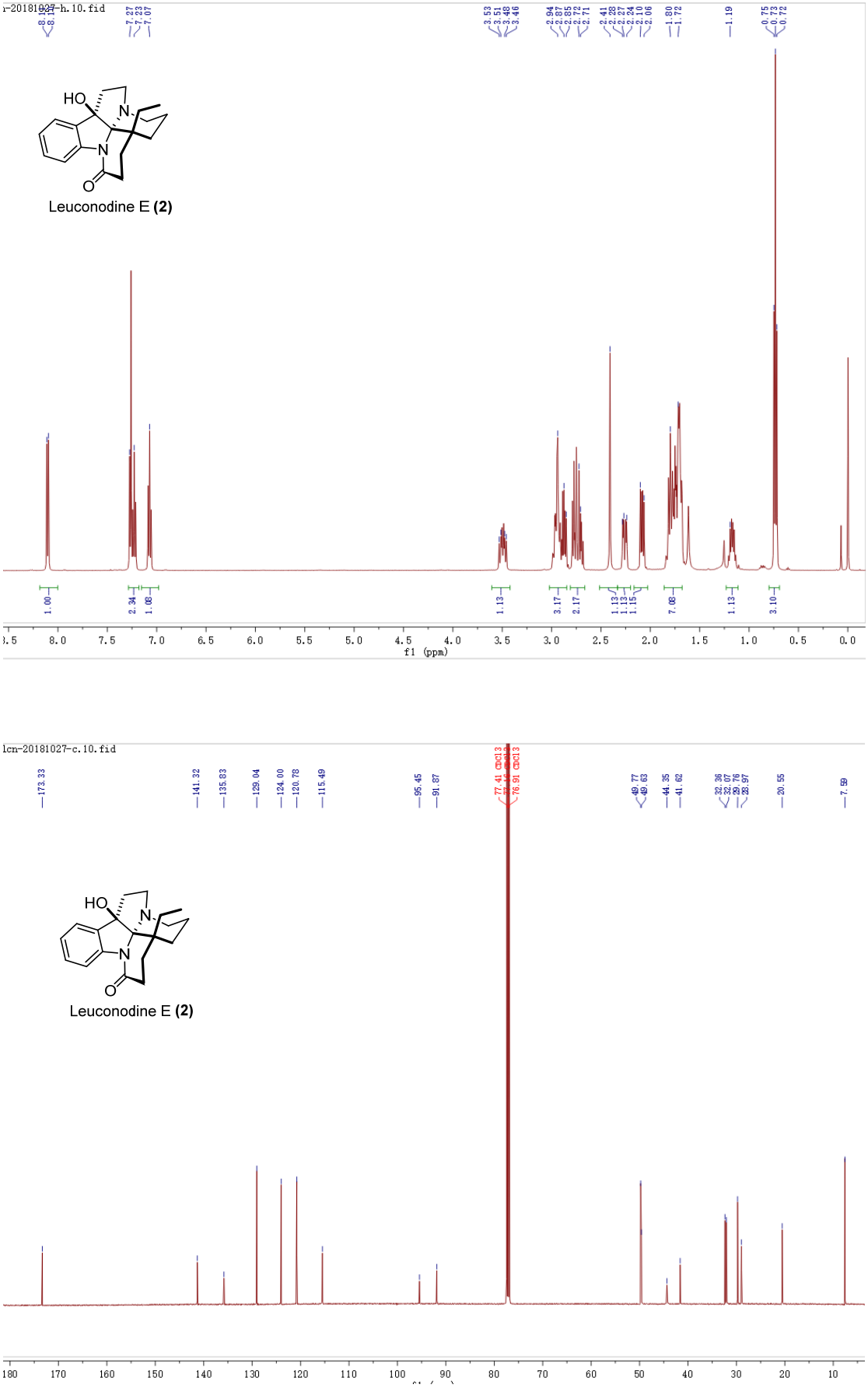


Figure S12. ^{1}H- (upper) and ^{13}C-NMR (lower) of compound leuconodine E

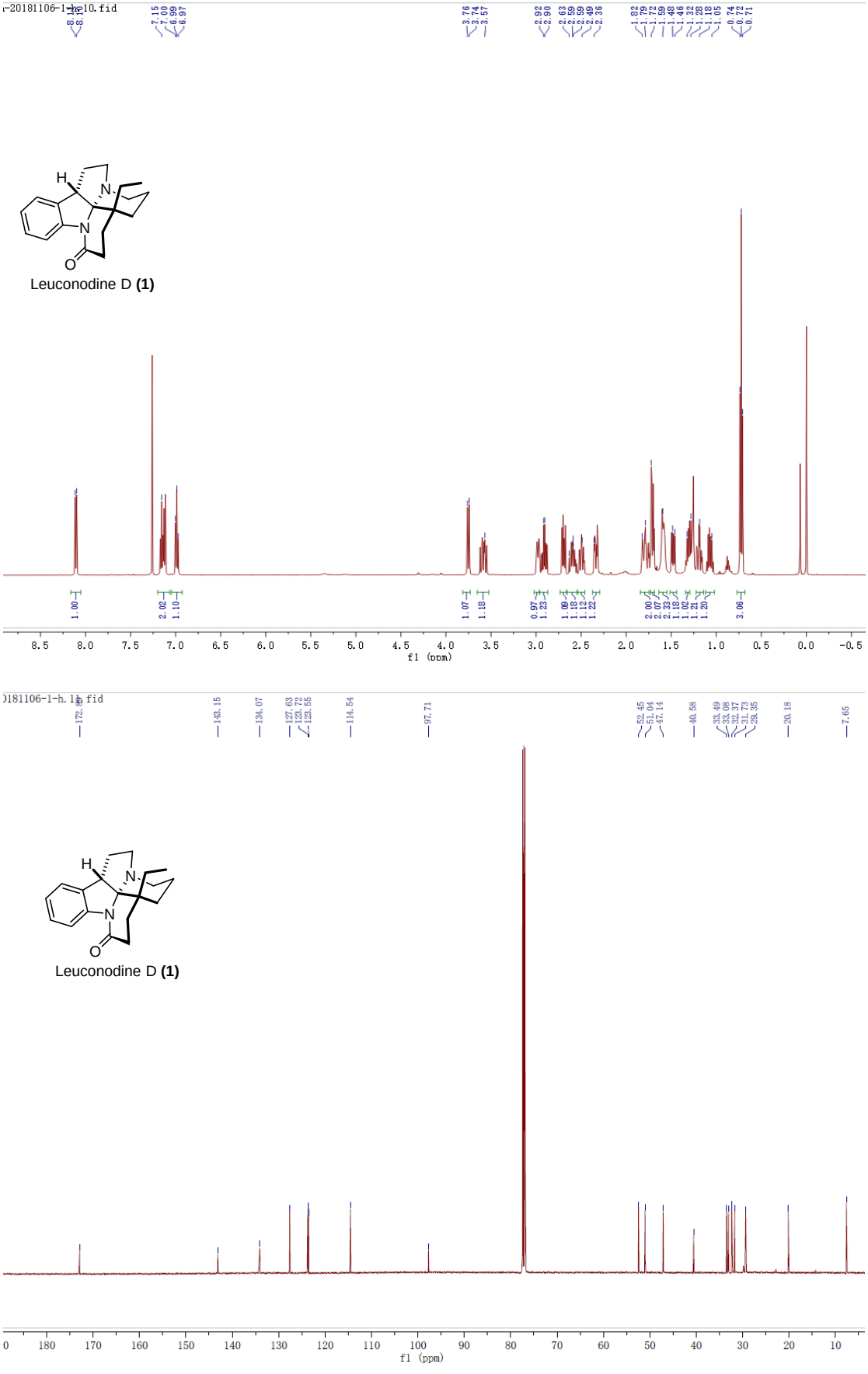


Figure S13. ^{1}H- (upper) and ^{13}C-NMR (lower) of compound leuconodine D

4. References

(1) Gan, C.-Y.; Low, Y.-Y.; Thomas, N. F.; Kam, T.-S. Rhazinilam-leuconolam-leuconoxine alkaloids from leuconotis griffithii. *J. Nat. Prod.* **2013**, *76*, 957.

(2) Yang, Y.; Bai, Y.; Sun S.; Dai, M. Biosynthetically inspired divergent approach to monoterpene indole alkaloids: total synthesis of mersicarpine, leuconodines B and D, leuconoxine, melodinine E, leuconolam, and rhazinilam. *Org. Lett.* **2014**, *16*, 6216.

(3) Zhang, J.; Han, F.-S. Pd-Catalyzed aerobic oxidative Heck cross-coupling for the straightforward construction of indole δ-lactams. *iScience* **2019**, *17*, 256.