Supporting Information

Synthesis of Methoxy-, Methylenedioxy-, Hydroxy-, and Halo-Substituted Benzophenanthridinone Derivatives as DNA Topoisomerase IB (TOP1) and Tyrosyl-DNA Phosphodiesterase 1 (TDP1) Inhibitors and Their Biological Activity for Drug-Resistant Cancer

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Content

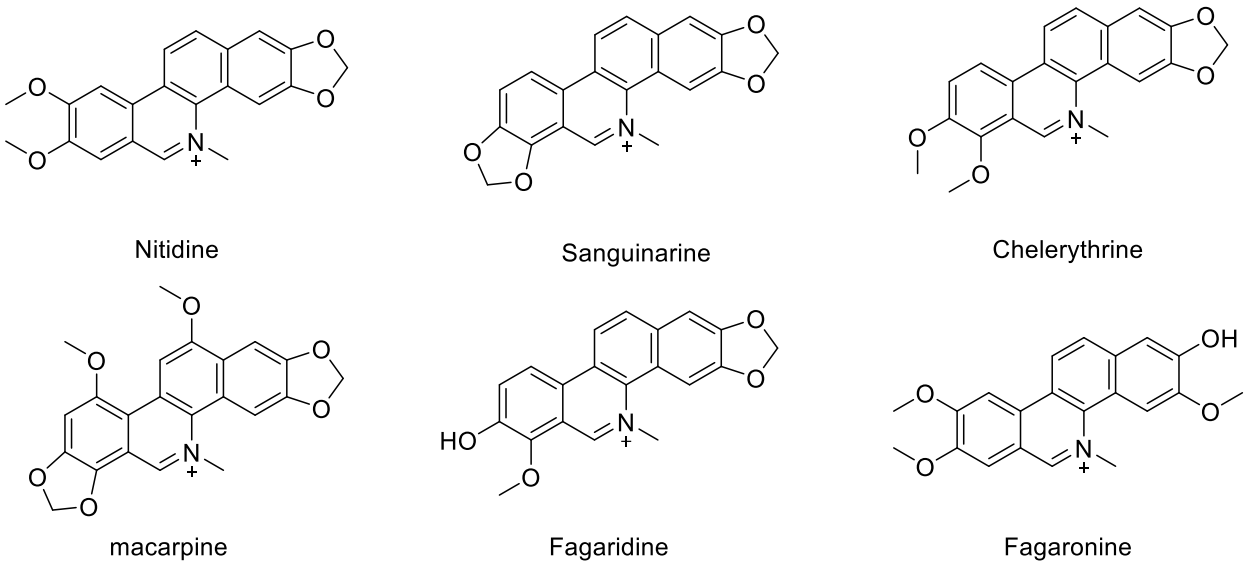
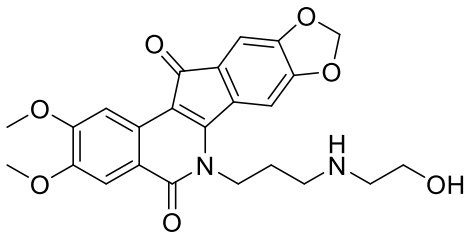


Figure S1. The structures of natural benzo[c]phenanthridine alkaloids.



LMP744

Figure S2. The structure of LMP744.

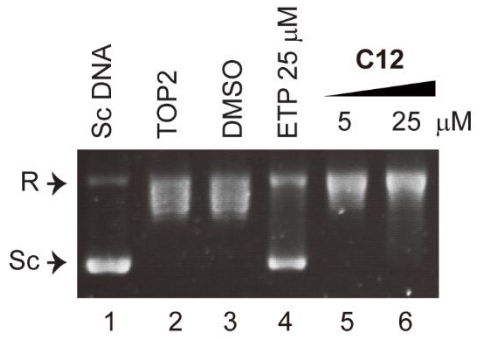


Figure S3. The TOP2 relaxing assay gel of **C12**. Lane 1, supercoiled pBR322 DNA alone; lane 2, DNA and TOP2; lane 2, DNA, TOP2 and DMSO; lanes 4, DNA, TOP2 and the positive control etoposide (ETP) at 25 μM concentration; lanes 5-6, DNA, TOP2 and **C12** at 5 and 25 μM concentration, respectively. R, relaxed DNA; Sc, supercoiled DNA.

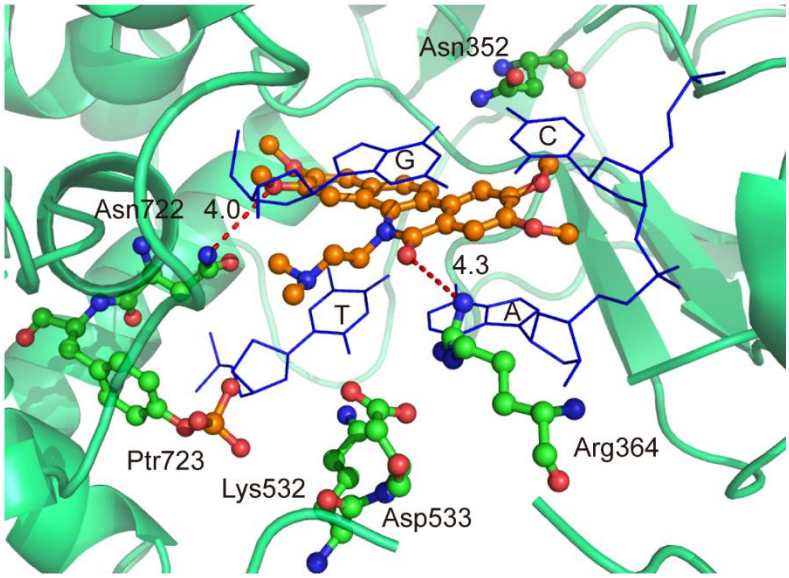
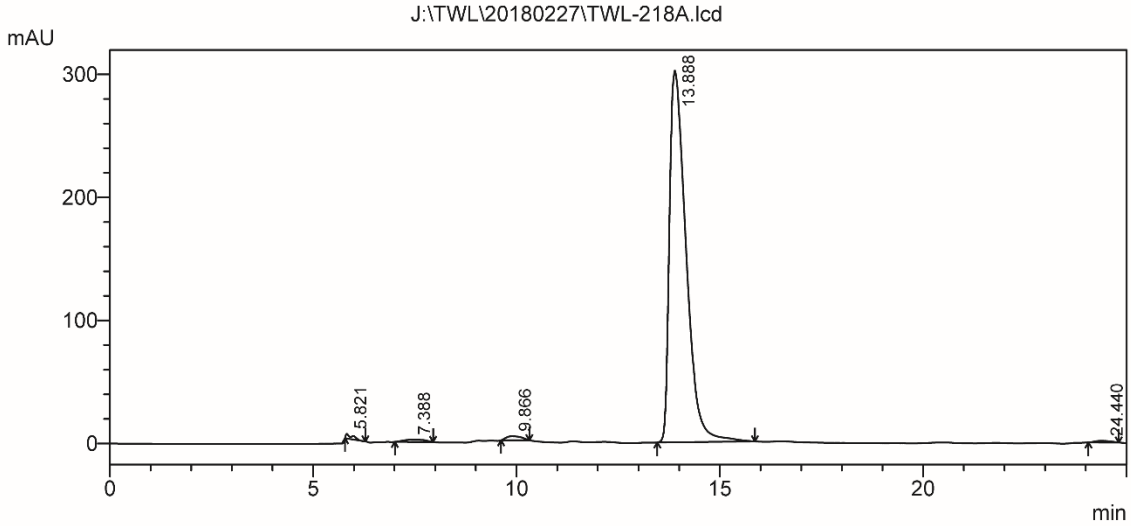


Figure S4. Hypothetical binding mode of **C26** with TOP1cc (PDB: 1K4T).

<Chromatogram>



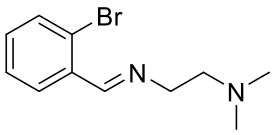
PeakTable

PDA Ch2 220nm 4nm

Peak#	Ret. Time	Area	Height	Area %	Height %
1	5.821	43635	3784	0.495	1.212
2	7.388	67339	1825	0.764	0.585
3	9.866	86747	3305	0.984	1.059
4	13.888	8579055	301854	97.358	96.701
5	24.440	35094	1382	0.398	0.443
Total		8811871	312151	100.000	100.000

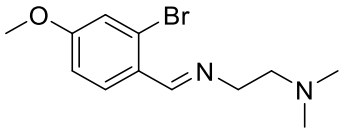
Figure S5. The HPLC profile of compound **C12**.

Characterization Data of the Intermediates.



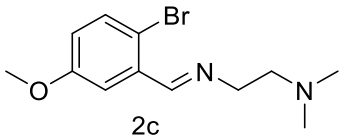
2a

N-(2-N,N-Dimethylethyl)-2-bromobenzaldimine (2a). Light yellow liquid, yield 100%. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.59 (s, 1H), 7.93 (dd, *J* = 7.6, 1.6 Hz, 1H), 7.47 (dd, *J* = 8.0, 1.2 Hz, 1H), 7.25–7.20 (m, 1H), 7.19–7.13 (m, 1H), 3.71 (t, *J* = 6.8 Hz ,2H), 2.58 (t, *J* = 6.8 Hz, 2H), 2.24 (s, 6H).



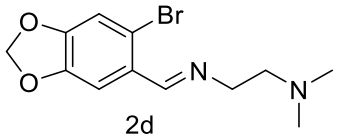
2b

N-(2-N,N-Dimethylethyl)-2-bromo-4-methoxylbenzaldimine (2b). Yellow liquid, yield 100%. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.58(s, 1H), δ 7.96 (d, *J* = 8.8 Hz, 1H), 7.08 (d, *J* = 2.8 Hz, 1H), 6.86 (dd, *J* = 8.8, 2.8 Hz, 1H), 3.82 (s, 3H), 3.75 (t, *J* = 6.8 Hz, 2H), 2.64 (t, *J* = 6.8 Hz, 2H), 2.32 (s, 6H).



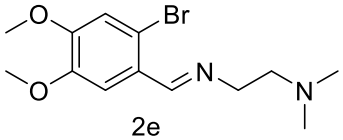
2c

N-(2-N,N-Dimethylethyl)-2-bromo-5-methoxylbenzaldimine (2c). Light yellow liquid, yield 100%. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.63 (s, 1H), 7.54 (d, *J* = 3.2 Hz, 1H), 7.42 (d, *J* = 8.8 Hz, 1H), 6.84 (dd, *J* = 8.8, 3.2 Hz, 1H), 3.83 (s, 3H), 3.80 (t, *J* = 6.8 Hz, 2H), 2.65 (t, *J* = 6.8 Hz, 2H), 2.32 (s, 6H).



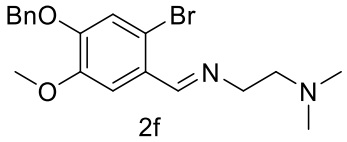
2d

(E)-2-(((6-Bromobenzo[*d*][1,3]dioxol-5-yl)methylene)amino)-N,N-dimethylethan-1-amine (2d). Yellow liquid, yield 100%. The ^{1}H NMR spectrum is similar to that reported.[1]



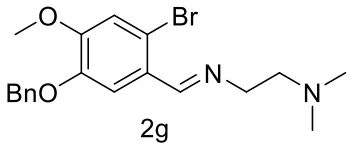
2e

N-(2-N,N-Dimethylethyl)-2-bromo-4,5-dimethoxylbenzaldimine (2e). White solid, yield 100%. The ^{1}H NMR spectrum is similar to that reported.[2]



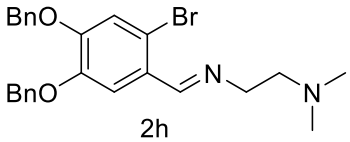
2f

N-(2-N,N-Dimethylethyl)-2-bromo-4-benzyloxy-5-methoxylbenzaldimine (2f). White solid, yield 100%. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.57 (s, 1H), 7.59 (s, 1H), 7.45 (d, *J* = 7.6 Hz, 2H), 7.40 (dd, *J* = 7.6, 7.2 Hz, 2H), 7.35 (d, *J* = 7.2 Hz, 1H), 7.06 (s, 1H), 5.16 (s, 2H), 3.94 (s, 3H), 3.78 (t, *J* = 6.8 Hz, 2H), 2.67 (t, *J* = 6.8 Hz, 2H), 2.34 (s, 6H).



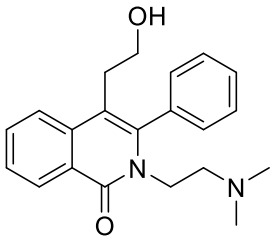
2g

N-(2-N,N-Dimethylethyl)-2-bromo-4-methoxy-5-benzyloxyllbenzaldimine (2g). White solid, yield 100%. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.55 (s, 1H), 7.66 (s, 1H), 7.47 (d, *J* = 7.4 Hz, 2H), 7.38 (dd, *J* = 7.4, 6.8 Hz, 2H), 7.32 (d, *J* = 6.8 Hz, 1H), 7.03 (s, 1H), 5.16 (s, 2H), 3.90 (s, 3H), 3.77 (t, *J* = 6.8 Hz, 2H), 2.66 (t, *J* = 6.8 Hz, 2H), 2.33 (s, 6H).



2h

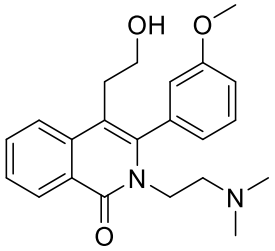
N-(2-N,N-Dimethylethyl)-2-bromo-4,5-dibenzyloxylbenzaldimine (2h). White solid, yield 100%. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.53 (s, 1H), 7.67 (s, 1H), 7.46–7.41 (m, 4H), 7.39–7.34 (m, 4H), 7.34–7.29 (m, 2H), 7.08 (s, 1H), 5.16 (s, 2H), 5.14 (s, 2H), 3.69 (t, *J* = 6.8 Hz, 2H), 2.61 (t, *J* = 6.8 Hz, 2H), 2.30 (s, 6H).



4aa'

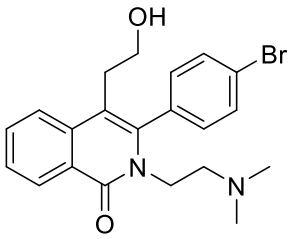
2-(2-(Dimethylamino)ethyl)-4-(2-hydroxyethyl)-3-phenylisoquinolin-1(2H)-one (4aa'). Yellow solid, yield 70%. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.49 (dd, *J* = 8.0, 0.8 Hz, 1H), 7.79–7.74

(m, 1H), 7.72–7.66 (m, 1H), 7.53–7.43 (m, 4H), 7.33–7.31 (m, 2H), 4.80 (s, 1H), 3.92–3.79 (m, 2H), 3.64 (t, *J* = 7.2 Hz, 2H), 2.67 (t, *J* = 7.2 Hz, 2H), 2.46–2.44 (m, 2H), 2.00 (s, 6H).



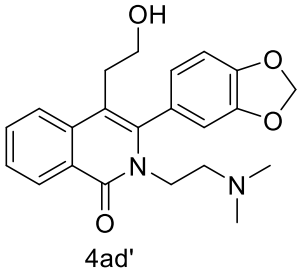
4ab'

2-(2-(Dimethylamino)ethyl)-4-(2-hydroxyethyl)-3-(3-methoxyphenyl)isoquinolin-1(2H)-one (4ab'). Yellow solid, yield 61%. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.46 (dd, *J* = 8.0, 0.8 Hz, 1H), 7.75 (d, *J* = 8.0 Hz, 1H), 7.68–7.62 (m, 1H), 7.49–7.44 (m, 1H), 7.39–7.34 (m, 1H), 6.98–6.94 (m, 1H), 6.89–6.83 (m, 2H), 3.87–3.82 (m, 2H), 3.79 (s, 3H), 3.63 (t, *J* = 7.2 Hz, 2H), 2.68 (t, *J* = 7.2 Hz, 2H), 2.48–2.41 (m, 2H), 2.02 (s, 6H).



4ac'

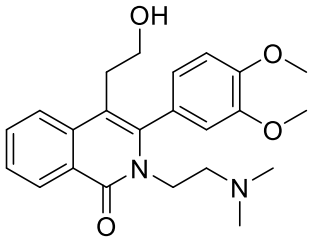
3-(4-Bromophenyl)-2-(2-(dimethylamino)ethyl)-4-(2-hydroxyethyl)isoquinolin-1(2H)-one (4ac'). White solid, yield 64%. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.50 (d, *J* = 8.0 Hz, 1H), 7.77 (d, *J* = 8.0 Hz, 1H), 7.71 (dd, *J* = 8.0, 7.6 Hz, 1H), 7.66 (d, *J* = 8.0 Hz, 1H), 7.53 (dd, *J* = 8.0, 7.6 Hz, 1H), 7.29–7.22 (m, 3H), 3.89–3.79 (m, 2H), 3.67 (t, *J* = 7.2 Hz, 2H), 2.68 (t, *J* = 7.2 Hz, 2H), 2.57–2.54 (m, 2H), 2.07 (s, 6H).



4ad'

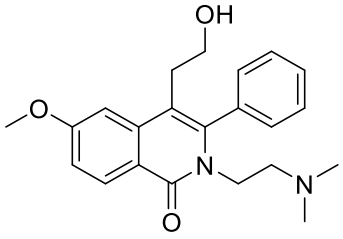
3-(Benzo[d][1,3]dioxol-5-yl)-2-(2-(dimethylamino)ethyl)-4-(2-hydroxyethyl)isoquinolin-1(2H)-one (4ad'). Yellow solid, yield 90%. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.49 (dd, *J* = 8.0, 1.2

Hz, 1H), 7.77 (d, *J* = 8.0 Hz, 1H), 7.73–7.67 (m, 1H), 7.54–7.48 (m, 1H), 6.96–6.89 (m, 1H), 6.80–6.76 (m, 2H), 6.06 (s, 2H), 4.06–3.88 (m, 2H), 3.69 (t, *J* = 7.2 Hz, 2H), 2.78 (t, *J* = 7.2 Hz, 2H), 2.64–2.49 (m, 2H), 2.21 (s, 6H).



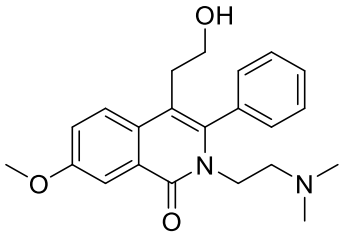
4ae'

3-(3,4-Dimethoxyphenyl)-2-(2-(dimethylamino)ethyl)-4-(2-hydroxyethyl)isoquinolin-1(2H)-one (4ae'). White solid, yield 24%. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.44 (d, *J* = 8.0 Hz, 1H), 7.70 (d, *J* = 8.0 Hz, 1H), 7.63 (dd, *J* = 8.0, 7.6 Hz, 1H), 7.44 (dd, *J* = 8.0, 7.6 Hz, 1H), 6.91 (d, *J* = 8.0 Hz, 1H), 6.82 (dd, *J* = 8.0, 1.6 Hz, 1H), 6.76 (d, *J* = 1.6 Hz, 1H), 3.98–3.84 (m, 2H), 3.82 (s, 3H), 3.75 (s, 3H), 3.64 (t, *J* = 7.2 Hz, 2H), 2.67 (t, *J* = 7.2 Hz, 2H), 2.48–2.45 (m, 2H), 2.02 (s, 6H).



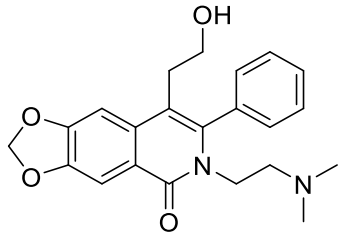
4ba'

2-(2-(Dimethylamino)ethyl)-4-(2-hydroxyethyl)-6-methoxy-3-phenylisoquinolin-1(2H)-one (4ba'). Yellow solid, yield 60%. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.44 (d, *J* = 8.8 Hz, 1H), 7.56–7.45 (m, 3H), 7.34–7.31 (m, 2H), 7.12 (d, *J* = 2.4 Hz, 1H), 7.11 (dd, *J* = 8.8, 2.4 Hz, 1H), 3.93 (s, 3H), 3.88–3.81 (m, 2H), 3.67 (t, *J* = 7.2 Hz, 2H), 2.65 (t, *J* = 7.2 Hz, 2H), 2.46–2.41 (m, 2H), 2.03 (s, 6H).



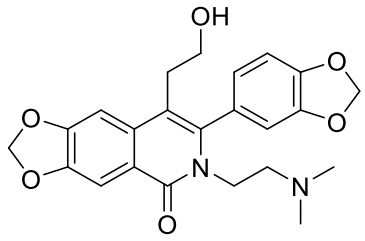
4ca'

2-(2-(Dimethylamino)ethyl)-4-(2-hydroxyethyl)-7-methoxy-3-phenylisoquinolin-1(2H)-one (4ca'). White solid, yield 78%. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.86 (d, *J* = 2.8 Hz, 1H), 7.63 (d, *J* = 8.8 Hz, 1H), 7.43–7.40 (m, 3H), 7.27–7.22 (m, 3H), 3.87 (s, 3H), 3.84–3.80 (m, 2H), 3.58 (t, *J* = 7.2 Hz, 2H), 2.61 (t, *J* = 7.2 Hz, 2H), 2.41–2.37 (m, 2H), 1.98 (s, 6H).



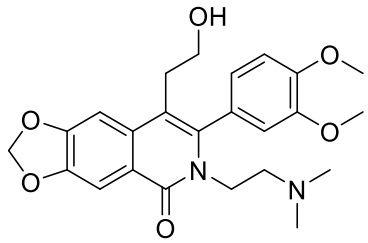
4da'

6-(2-(Dimethylamino)ethyl)-8-(2-hydroxyethyl)-7-phenyl-[1,3]dioxolo[4,5-g]isoquinolin-5(6H)-one (4da'). White solid, yield 57%. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.87 (s, 1H), 7.52–7.47 (m, 3H), 7.39–7.31 (m, 2H), 7.15 (s, 1H), 6.10 (s, 2H), 3.87–3.82 (m, 2H), 3.65 (t, *J* = 7.6 Hz, 2H), 2.62 (t, *J* = 7.6 Hz, 2H), 2.47–2.43 (m, 2H), 2.04 (s, 6H).



4dd'

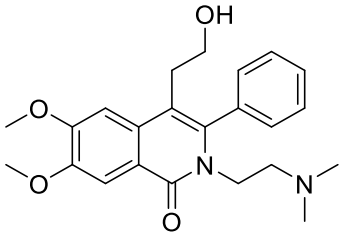
7-(Benzo[d][1,3]dioxol-5-yl)-6-(2-(dimethylamino)ethyl)-8-(2-hydroxyethyl)-[1,3]dioxolo [4,5-g]isoquinolin-5(6H)-one (4dd'). Yellow solid, yield 57%. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.75 (s, 1H), 7.07 (s, 1H), 6.84 (d, *J* = 8.4 Hz, 1H), 6.73–6.65 (m, 2H), 6.01 (s, 2H), 5.98 (s, 2H), 3.96–3.73 (m, 2H), 3.57 (t, *J* = 7.6 Hz, 2H), 2.56 (t, *J* =7.6 Hz, 2H), 2.42–2.38 (m, 2H), 2.03 (s, 6H).



4de'

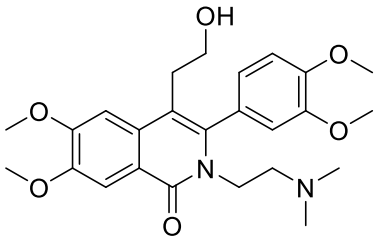
7-(3,4-Dimethoxyphenyl)-6-(2-(dimethylamino)ethyl)-8-(2-hydroxyethyl)-[1,3]dioxolo[4,5-g]isoquinolin-5(6H)-one (4de'). Yellow solid, yield 90%. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.78 (s,

1H), 7.05 (s, 1H), 6.90 (d, *J* = 8.0 Hz, 1H), 6.80 (d, *J* = 8.0 Hz, 1H), 6.75 (s, 1H), 6.02 (s, 2H), 3.87 (s, 3H), 3.82 (s, 3H), 3.79–3.70 (m, 2H), 3.60 (t, *J* = 7.2 Hz, 2H), 2.59 (t, *J* = 7.2 Hz, 2H), 2.44–2.40 (m, 2H), 2.03 (s, 6H).



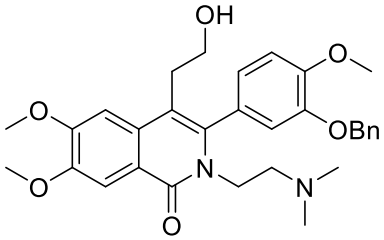
4ea'

2-(2-(Dimethylamino)ethyl)-4-(2-hydroxyethyl)-6,7-dimethoxy-3-phenylisoquinolin-1(2H)-one (4ea'). White solid, yield 23%. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.84 (s, 1H), 7.48–7.42 (m, 3H), 7.32–7.26 (m, 2H), 7.05 (s, 1H), 3.99 (s, 3H), 3.96 (s, 3H), 3.85–3.79 (m, 2H), 3.61 (t, *J* = 7.2 Hz, 2H), 2.60 (t, *J* = 7.2 Hz, 2H), 2.47–2.43 (m, 2H), 1.99 (s, 6H).



4ee'

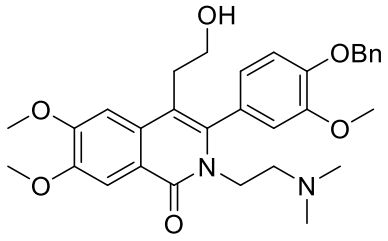
3-(3,4-Dimethoxyphenyl)-2-(2-(dimethylamino)ethyl)-4-(2-hydroxyethyl)-6,7-dimethoxy isoquinolin-1(2H)-one (4ee'). Yellow solid, yield 84%. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.83 (s, 1H), 7.04 (s, 1H), 6.90 (d, *J* = 8.0 Hz, 1H), 6.81 (d, *J* = 8.0, 2.0 Hz, 1H), 6.76 (d, *J* = 2.0 Hz, 1H), 3.95 (s, 3H), 3.94 (s, 3H), 3.92–3.85 (m, 5H), 3.82 (s, 3H), 3.64 (t, *J* = 7.2 Hz, 2H), 2.63 (t, *J* = 7.2 Hz, 2H), 2.50–2.46 (m, 2H), 2.03 (s, 6H).



4ef'

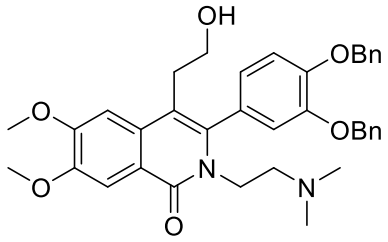
3-(3-(Benzyloxy)-4-methoxyphenyl)-2-(2-(dimethylamino)ethyl)-4-(2-hydroxyethyl)-6,7-dimethoxyisoquinolin-1(2H)-one (4ef'). Yellow solid, yield 65%. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.81 (s, 1H), 7.35 (d, *J* = 7.2 Hz, 2H), 7.31–7.28 (m, 2H), 7.24 (d, *J* = 7.2 Hz, 1H), 7.00 (s, 1H),

6.91 (d, *J* = 8.0 Hz, 1H), 6.79 (dd, *J* = 8.0, 1.2 Hz, 1H), 6.72 (d, *J* = 1.2 Hz, 1H), 5.14 (s, 2H), 3.93 (s, 3H), 3.92 (s, 3H), 3.89 (s, 3H), 3.86–3.80 (m, 2H), 3.68 (t, *J* = 7.2 Hz, 2H), 2.55 (t, *J* = 7.2 Hz, 2H), 2.42–2.38 (m, 2H), 2.00 (s, 6H).



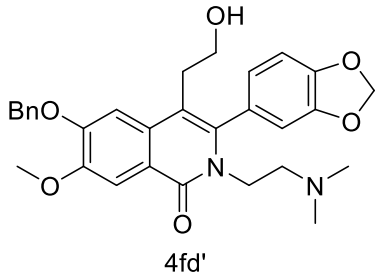
4eg'

3-(4-(Benzyloxy)-3-methoxyphenyl)-2-(2-(dimethylamino)ethyl)-4-(2-hydroxyethyl)-6,7-dimethoxyisoquinolin-1(2H)-one (4eg'). White solid, yield 60%. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.84 (s, 1H), 7.43 (d, *J* = 7.2 Hz, 2H), 7.38–7.34 (m, 2H), 7.30 (d, *J* = 7.2 Hz, 1H), 7.10 (s, 1H), 6.96 (d, *J* = 8.0 Hz, 1H), 6.83–6.70 (m, 2H), 5.17 (s, 2H), 4.02 (s, 3H), 3.94 (s, 3H), 3.91–3.86 (m, 5H), 3.65 (t, *J* = 7.2 Hz, 2H), 2.66 (t, *J* = 7.2 Hz, 2H), 2.51–2.37 (m, 2H), 2.01 (s, 6H).



4eh'

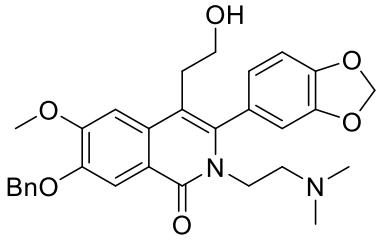
3-(3,4-Bis(benzyloxy)phenyl)-2-(2-(dimethylamino)ethyl)-4-(2-hydroxyethyl)-6,7-dimethoxyisoquinolin-1(2H)-one (4eh'). Yellow liquid, yield 65%. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.81 (s, 1H), 7.45–7.39 (m, 2H), 7.38–7.32 (m, 4H), 7.31–7.22 (m, 4H), 7.00 (s, 1H), 6.95 (d, *J* = 8.0 Hz, 1H), 6.79–6.69 (m, 2H), 5.17 (s, 2H), 5.14 (s, 2H), 3.94 (s, 3H), 3.92 (s, 3H), 3.88–3.79 (m, 2H), 3.65 (t, *J* = 7.2 Hz, 2H), 2.53 (t, *J* = 7.2 Hz, 2H), 2.40–2.36 (m, 2H), 1.95 (s, 6H).



4fd'

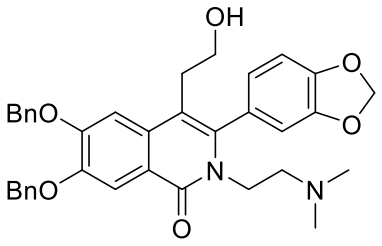
3-(Benzo[d][1,3]dioxol-5-yl)-6-(benzyloxy)-2-(2-(dimethylamino)ethyl)-4-(2-hydroxyethyl)-7-methoxyisoquinolin-1(2H)-one (4fd'). Yellow solid, yield 70%. ^{1}H NMR (400 MHz, $CDCl_3$)

δ 7.91 (s, 1H), 7.43 (d, *J* = 7.2 Hz, 2H), 7.40–7.36 (m, 2H), 7.25 (d, *J* = 7.2 Hz, 1H), 7.05 (s, 1H), 6.84 (d, *J* = 8.0 Hz, 1H), 6.72–6.70 (m, 2H), 5.99 (s, 2H), 5.21 (s, 2H), 3.92 (s, 3H), 3.85–3.73 (m, 2H), 3.63 (t, *J* = 7.2 Hz, 2H), 2.65 (t, *J* = 7.2 Hz, 2H), 2.49–2.35 (m, 2H), 2.07 (s, 6H).



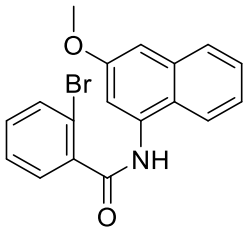
4gd'

3-(Benzo[d][1,3]dioxol-5-yl)-7-(benzyloxy)-2-(2-(dimethylamino)ethyl)-4-(2-hydroxyethyl)-6-methoxyisoquinolin-1(2H)-one (4gd'). Yellow solid, yield 65%. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.82 (s, 1H), 7.39 (d, *J* = 7.2 Hz, 2H), 7.32–7.28 (m, 2H), 7.24 (d, *J* = 7.2 Hz, 1H), 7.00 (s, 1H), 6.81 (d, *J* = 8.0 Hz, 1H), 6.67–6.65 (m, 2H), 5.97 (s, 2H), 5.24 (s, 2H), 3.95 (s, 3H), 3.93–3.84 (m, 2H), 3.68 (t, *J* = 7.2 Hz, 2H), 2.53 (t, *J* = 7.2 Hz, 2H), 2.44–2.36 (m, 2H), 2.05 (s, 6H).



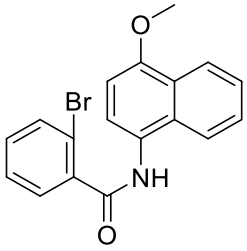
4hd'

3-(Benzo[d][1,3]dioxol-5-yl)-6,7-bis(benzyloxy)-2-(2-(dimethylamino)ethyl)-4-(2-hydroxy ethyl)isoquinolin-1(2H)-one (4hd'). Yellow gel, yield 65%. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.99 (s, 1H), 7.52 (d, *J* = 7.2 Hz, 2H), 7.47 (d, *J* = 7.2 Hz, 2H), 7.42–7.36 (m, 4H), 7.34–7.30 (m, 2H), 7.10 (s, 1H), 6.98 (d, *J* = 8.0 Hz, 1H), 6.74–6.68 (m, 2H), 6.08 (s, 2H), 5.31 (s, 2H), 5.30 (s, 2H), 4.06–3.87 (m, 2H), 3.79 (t, *J* = 7.2 Hz, 2H), 2.61 (t, *J* = 7.2 Hz, 2H), 2.53–2.38 (m, 2H), 2.11 (s, 6H).



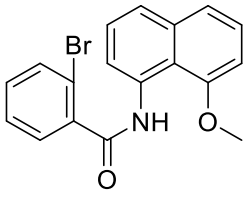
7ab'

2-Bromo-N-(3-methoxynaphthalen-1-yl)benzamide (7ab'). White solid, yield 85%. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.00–7.94 (m, 2H), 7.89–7.82 (m, 2H), 7.78 (d, *J* = 8.4 Hz, 1H), 7.66–7.61 (m, 1H), 7.50–7.44 (m, 2H), 7.41–7.37 (m, 1H), 7.21–7.17 (m, 1H), 7.07 (s, 1H), 3.95 (s, 3H).



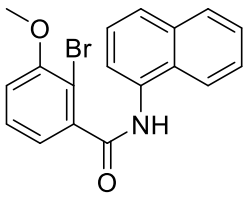
7ac'

2-Bromo-N-(4-methoxynaphthalen-1-yl)benzamide (7ac'). White solid, yield 60%. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.33 (d, *J* = 8.4 Hz, 1H), 7.97 (d, *J* = 8.4 Hz, 1H), 7.91 (d, *J* = 8.4 Hz, 1H), 7.66 (d, *J* = 9.2 Hz, 1H), 7.58–7.46 (m, 4H), 7.23–7.17 (m, 2H), 6.88 (d, *J* = 8.4 Hz, 1H), 4.04 (s, 3H).



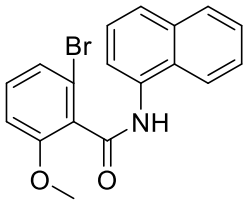
7ad'

2-Bromo-N-(8-methoxynaphthalen-1-yl)benzamide (7ad'). White solid, yield 85%. ^{1}H NMR (400 MHz, $CDCl_3$) δ 11.11 (s, 1H), 8.89 (d, *J* = 7.6 Hz, 1H), 7.70–7.66 (m, 2H), 7.58 (dd, *J* = 8.0, 0.8 Hz, 1H), 7.52 (d, *J* = 8.0 Hz, 1H), 7.49–7.41 (m, 2H), 7.38–7.31 (m, 2H), 6.86 (d, *J* = 7.6 Hz, 1H), 3.92 (s, 3H).



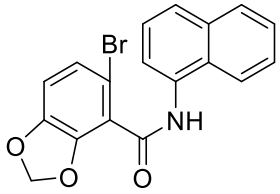
7ba'

2-Bromo-3-methoxy-N-(naphthalen-1-yl)benzamide (7ba'). Pale yellow solid, yield 81%. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.03 (d, *J* = 7.6 Hz, 1H), 7.93 (dd, *J* = 6.8, 2.0 Hz, 1H), 7.83 (dd, *J* = 6.8, 2.0 Hz, 1H), 7.70 (d, *J* = 8.0 Hz, 1H), 7.51–7.43 (m, 3H), 7.36 (dd, *J* = 8.0, 7.6 Hz, 1H), 7.24 (d, *J* = 7.6 Hz, 1H), 6.97 (d, *J* = 8.0 Hz, 1H), 3.90 (s, 3H).



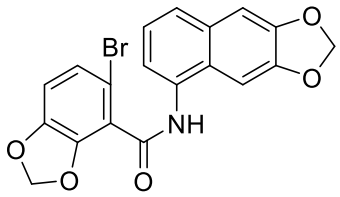
7ca'

2-Bromo-6-methoxy-N-(naphthalen-1-yl)benzamide (7ca'). White solid, yield 85%. The ^{1}H NMR spectrum is similar to that reported.[3]



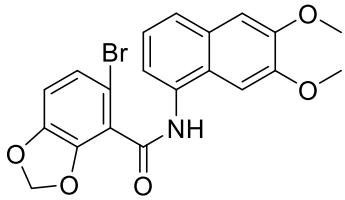
7da'

5-Bromo-N-(naphthalen-1-yl)benzo[d][1,3]dioxole-4-carboxamide (7da'). White solid, yield 84%. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.14 (d, *J* = 7.2 Hz, 1H), 8.07 (s, 1H), 8.01 (d, *J* = 7.2 Hz, 1H), 7.89 (dd, *J* = 7.2, 1.2 Hz, 1H), 7.75 (d, *J* = 8.4 Hz, 1H), 7.58–7.48 (m, 3H), 7.17 (d, *J* = 8.4 Hz, 1H), 6.80 (d, *J* = 8.4 Hz, 1H), 6.14 (s, 2H).



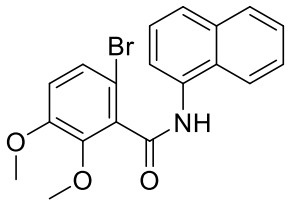
7de'

5-Bromo-N-(naphtho[2,3-d][1,3]dioxol-5-yl)benzo[d][1,3]dioxole-4-carboxamide (7de'). White solid, yield 90%. The ^{1}H NMR spectrum is similar to that reported.[4]



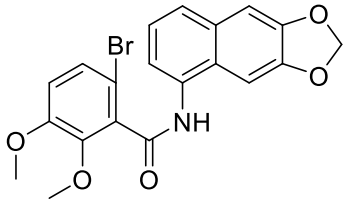
7df'

5-Bromo-N-(6,7-dimethoxynaphthalen-1-yl)benzo[d][1,3]dioxole-4-carboxamide (7df'). White solid, yield 90%. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.86 (s, 1H), 7.69 (d, *J* = 7.2 Hz, 1H), 7.63 (d, *J* = 8.0 Hz, 1H), 7.37 (dd, *J* = 8.4, 8.0 Hz, 1H), 7.34 (s, 1H), 7.17–7.12 (m, 2H), 6.78 (d, *J* = 8.4 Hz, 1H), 6.11 (s, 2H), 4.01 (s, 3H), 3.98 (s, 3H).



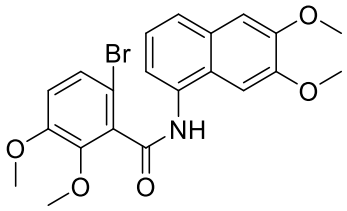
7ea'

6-Bromo-2,3-dimethoxy-N-(naphthalen-1-yl)benzamide (7ea'). White solid, yield 80%. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.04–8.00 (m, 1H), 7.97 (d, *J* = 7.6 Hz, 1H), 7.85–7.79 (m, 1H), 7.74–7.68 (m, 2H), 7.52–7.40 (m, 3H), 7.28 (d, *J* = 8.8 Hz, 1H), 6.82 (d, *J* = 8.8 Hz, 1H), 3.88 (s, 3H), 3.85 (s, 3H).



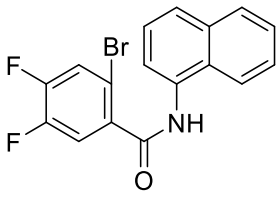
7ee'

6-Bromo-2,3-dimethoxy-N-(naphtho[2,3-d][1,3]dioxol-5-yl)benzamide (7ee'). White solid, yield 90%. The ^{1}H NMR spectrum is similar to that reported.[4]



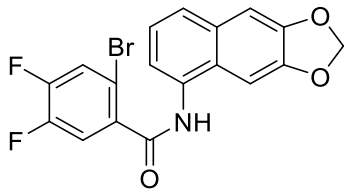
7ef'

6-Bromo-N-(6,7-dimethoxynaphthalen-1-yl)-2,3-dimethoxybenzamide (7ef'). White solid, yield 81%. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.70–7.59 (m, 2H), 7.54 (s, 1H), 7.48 (s, 1H), 7.42–7.38 (m, 1H), 7.40–7.35 (d, *J* = 8.8 Hz, 1H), 7.19 (s, 1H), 6.92 (d, *J* = 8.8 Hz, 1H), 4.05 (s, 3H), 4.03 (s, 3H), 3.99 (s, 3H), 3.94 (s, 3H).



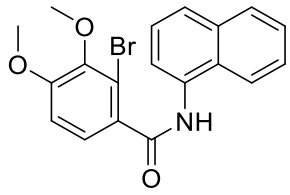
7fa'

2-Bromo-4,5-difluoro-N-(naphthalen-1-yl)benzamide (7fa'). White solid, yield 65%. The ^{1}H NMR spectrum is similar to that reported.[3]



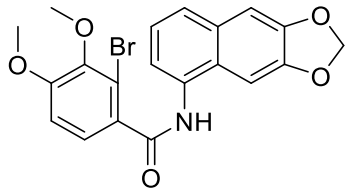
7fe'

2-Bromo-4,5-difluoro-N-(naphtho[2,3-d][1,3]dioxol-5-yl)benzamide (7fe'). White solid, yield 77%. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.88 (s, 1H), 7.75–7.66 (m, 2H), 7.62 (d, *J* = 8.4 Hz, 1H), 7.56–7.51 (m, 1H), 7.40–7.35 (m, 2H), 7.17 (s, 1H), 6.06 (s, 2H).



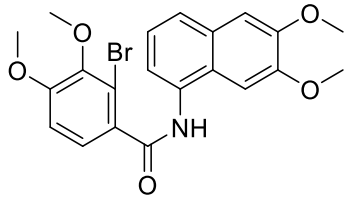
7ga'

2-Bromo-3,4-dimethoxy-N-(naphthalen-1-yl)benzamide (7ga'). White solid, yield 85%. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.24–8.10 (m, 2H), 8.01 (d, *J* = 7.2 Hz, 1H), 7.90 (dd, *J* = 7.2, 2.4 Hz, 1H), 7.75 (d, *J* = 8.0 Hz, 1H), 7.60 (d, *J* = 8.4 Hz, 1H), 7.58–7.50 (m, 3H), 7.00 (d, *J* = 8.4 Hz, 1H), 3.95 (s, 3H), 3.92 (s, 3H).



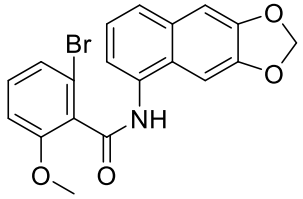
7ge'

2-Bromo-3,4-dimethoxy-N-(naphtho[2,3-d][1,3]dioxol-5-yl)benzamide (7ge'). White solid, yield 85%. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.92 (s, 1H), 7.79 (d, *J* = 7.6 Hz, 1H), 7.65–7.56 (m, 2H), 7.39–7.35 (m, 1H), 7.32 (s, 1H), 7.16 (s, 1H), 6.99 (d, *J* = 8.4 Hz, 1H), 6.06 (s, 2H), 3.95 (s, 3H), 3.91 (s, 3H).



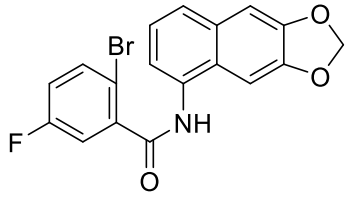
7gf'

2-Bromo-N-(6,7-dimethoxynaphthalen-1-yl)-3,4-dimethoxybenzamide (7gf'). White solid, yield 90%. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.70–7.59 (m, 2H), 7.54 (s, 1H), 7.48 (s, 1H), 7.42 (d, *J* = 7.6 Hz, 1H), 7.40–7.35 (m, 1H), 7.19 (s, 1H), 6.92 (d, *J* = 8.4 Hz, 1H), 4.05 (s, 3H), 4.03 (s, 3H), 3.99 (s, 3H), 3.94 (s, 3H).



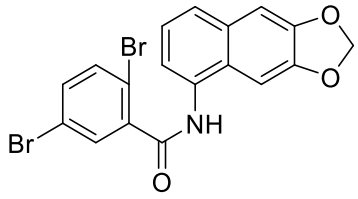
7he'

2-Bromo-6-methoxy-N-(naphtho[2,3-d][1,3]dioxol-5-yl)benzamide (7he'). White solid, yield 93%. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.72 (d, *J* = 8.0 Hz, 1H), 7.61 (d, *J* = 8.0 Hz, 1H), 7.47 (s, 1H), 7.44 (s, 1H), 7.40–7.36 (m, 1H), 7.29–7.27 (m, 1H), 7.27–7.26 (m, 1H), 7.16 (s, 1H), 6.99–6.95 (m, 1H), 6.06 (s, 2H), 3.96 (s, 3H).



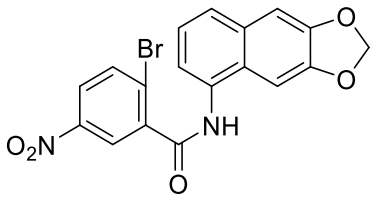
7ie'

2-Bromo-5-fluoro-N-(naphtho[2,3-d][1,3]dioxol-5-yl)benzamide (7ie'). White solid, yield 90%. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.84 (s, 1H), 7.76 (d, *J* = 7.2 Hz, 1H), 7.65–7.59 (m, 2H), 7.55–7.48 (m, 2H), 7.41–7.35 (m, 1H), 7.30 (s, 1H), 7.17 (s, 1H), 6.06 (s, 2H).



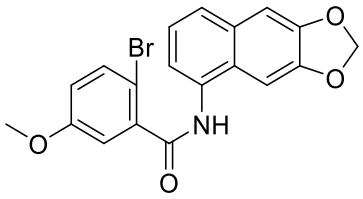
7je'

2,5-Dibromo-N-(naphtho[2,3-d][1,3]dioxol-5-yl)benzamide (7je'). White solid, yield 83%. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.91 (d, *J* = 2.4 Hz, 1H), 7.78–7.72 (m, 2H), 7.62 (d, *J* = 8.8 Hz, 1H), 7.57–7.54 (m, 1H), 7.49 (dd, *J* = 8.8, 2.4 Hz, 1H), 7.41–7.36 (m, 1H), 7.30 (s, 1H), 7.17 (s, 1H), 6.07 (s, 2H).



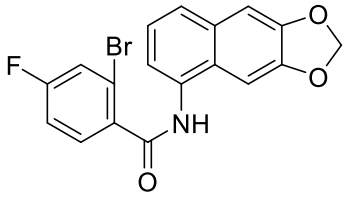
7ke'

2-Bromo-N-(naphtho[2,3-d][1,3]dioxol-5-yl)-5-nitrobenzamide (7ke'). White solid, yield 32%. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.60 (d, *J* = 2.4 Hz, 1H), 8.21 (dd, *J* = 8.8, 2.4 Hz, 1H), 7.90 (d, *J* = 8.8 Hz, 1H), 7.81 (s, 1H), 7.75 (d, *J* = 7.2 Hz, 1H), 7.64 (d, *J* = 8.4 Hz, 1H), 7.42–7.37 (m, 1H), 7.28 (s, 1H), 7.18 (s, 1H), 6.07 (s, 2H).



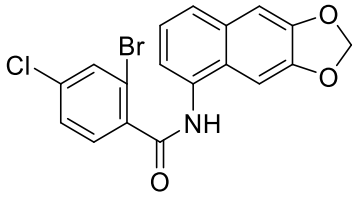
7le'

2-Bromo-5-methoxy-N-(naphtho[2,3-d][1,3]dioxol-5-yl)benzamide (7le'). White solid, yield 67%. ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.87 (s, 1H), 7.79 (d, *J* = 7.5 Hz, 1H), 7.61 (d, *J* = 7.5 Hz, 1H), 7.56 (d, *J* = 8.5 Hz, 1H), 7.40–7.36 (m, 1H), 7.34 (s, 2H), 7.17 (s, 1H), 6.93 (d, *J* = 8.5 Hz, 1H), 6.06 (s, 2H), 3.87 (s, 3H).



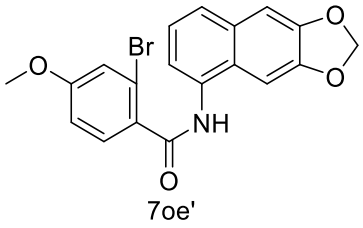
7me'

2-Bromo-4-fluoro-N-(naphtho[2,3-d][1,3]dioxol-5-yl)benzamide (7me'). White solid, yield 60%. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.84 (s, 1H), 7.76 (d, *J* = 8.4 Hz, 1H), 7.68–7.60 (m, 2H), 7.53 (dd, *J* = 8.4, 3.2 Hz, 1H), 7.41–7.36 (m, 2H), 7.30 (s, 1H), 7.17 (s, 1H), 6.06 (s, 2H).



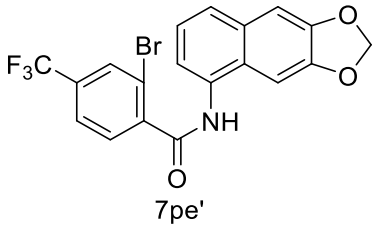
7ne'

2-Bromo-4-chloro-N-(naphtho[2,3-d][1,3]dioxol-5-yl)benzamide (7ne'). Pale red solid, yield 89%. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.81 (s, 1H), 7.77–7.71 (m, 2H), 7.61 (d, *J* = 8.4 Hz, 1H), 7.46 (d, *J* = 8.0 Hz, 1H), 7.40–7.35 (m, 2H), 7.29 (s, 1H), 7.17 (s, 1H), 6.06 (s, 2H).



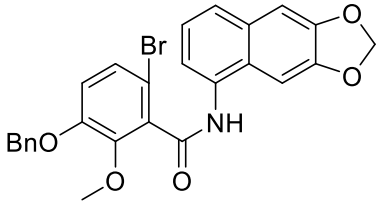
7oe'

2-Bromo-4-methoxy-N-(naphtho[2,3-d][1,3]dioxol-5-yl)benzamide (7oe'). White solid, yield 84%. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.96 (s, 1H), 7.86–7.75 (m, 2H), 7.59 (d, *J* = 7.6 Hz, 1H), 7.40–7.35 (m, 1H), 7.33 (s, 1H), 7.23–7.19 (m, 1H), 7.16 (s, 1H), 7.02–6.95 (m, 1H), 6.06 (s, 2H), 3.86 (s, 3H).



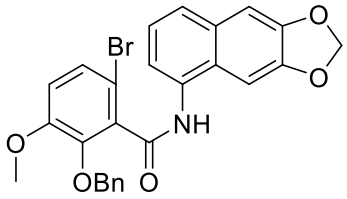
7pe'

2-Bromo-N-(naphtho[2,3-d][1,3]dioxol-5-yl)-4-(trifluoromethyl)benzamide (**7pe'**). White solid, yield 48%. ^{1}H NMR (400 MHz, DMSO) δ 10.48 (s, 1H), 8.14 (d, *J* = 1.8 Hz, 1H), 8.01 (d, *J* = 8.4 Hz, 1H), 7.81 (dd, *J* = 8.4, 1.8 Hz, 1H), 7.68 (d, *J* = 8.0 Hz, 1H), 7.60 (d, *J* = 7.2 Hz, 1H), 7.52 (s, 1H), 7.40–7.35 (m, 2H), 6.15 (s, 2H).



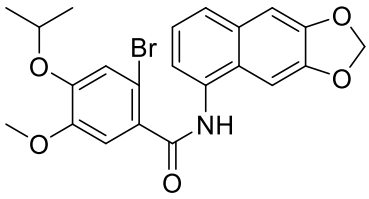
7qe'

3-(Benzyloxy)-6-bromo-2-methoxy-N-(naphtho[2,3-d][1,3]dioxol-5-yl)benzamide (**7qe'**). White solid, yield 90%. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.70 (d, *J* = 7.2 Hz, 1H), 7.64 (d, *J* = 8.4 Hz, 1H), 7.56–7.38 (m, 8H), 7.32 (d, *J* = 8.8 Hz, 1H), 7.18 (s, 1H), 6.95 (d, *J* = 8.8 Hz, 1H), 6.07 (s, 2H), 5.19 (s, 2H), 4.05 (s, 3H).



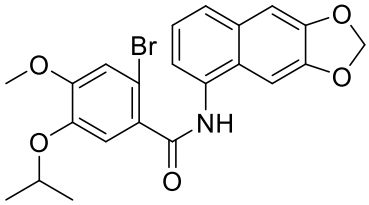
7re'

2-(Benzyloxy)-6-bromo-3-methoxy-N-(naphtho[2,3-d][1,3]dioxol-5-yl)benzamide (7re'). White solid, yield 85%. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.60–7.56 (m, 2H), 7.46–7.43 (m, 2H), 7.39–7.30 (m, 5H), 7.26–7.24 (m, 2H), 7.13 (s, 1H), 6.91 (d, *J* = 8.8 Hz, 1H), 6.01 (s, 2H), 5.13 (s, 2H), 3.93 (s, 3H).



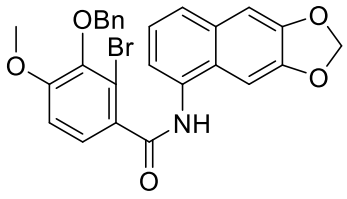
7se'

2-Bromo-4-isopropoxy-5-methoxy-N-(naphtho[2,3-d][1,3]dioxol-5-yl)benzamide (7se'). White solid, yield 60%. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.14 (s, 1H), 7.79 (d, *J* = 7.2 Hz, 1H), 7.59 (d, *J* = 8.4 Hz, 1H), 7.44 (s, 1H), 7.39–7.33 (m, 2H), 7.16 (s, 1H), 7.12 (s, 1H), 6.04 (s, 2H), 4.65–4.59 (m, 1H), 3.92 (s, 3H), 1.42 (d, *J* = 6.0 Hz, 6H).



7te'

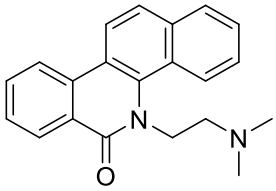
2-Bromo-5-isopropoxy-4-methoxy-N-(naphtho[2,3-d][1,3]dioxol-5-yl)benzamide (7te'). White solid, yield 30%. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.13 (s, 1H), 7.79 (d, *J* = 7.2 Hz, 1H), 7.62–7.58 (m, 1H), 7.46 (s, 1H), 7.39–7.35 (m, 2H), 7.16 (s, 1H), 7.10 (s, 1H), 6.05 (s, 2H), 4.66–4.60 (m, 1H), 3.91 (s, 3H), 1.40 (d, *J* = 6.0 Hz, 6H).



7ue'

3-(Benzyloxy)-2-bromo-4-methoxy-N-(naphtho[2,3-d][1,3]dioxol-5-yl)benzamide (7ue'). White solid, yield 70%. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.95 (s, 1H), 7.82 (d, *J* = 7.2 Hz, 1H), 7.63–7.58 (m, 4H), 7.50–7.34 (m, 5H), 7.18 (s, 1H), 7.03 (d, *J* = 8.8 Hz, 1H), 6.08 (s, 2H), 5.11 (s, 2H), 3.97 (s, 3H).

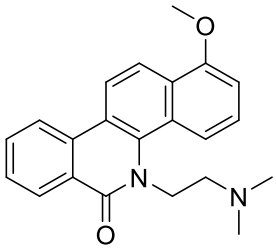
Characterization Data of the Target Products.



A1

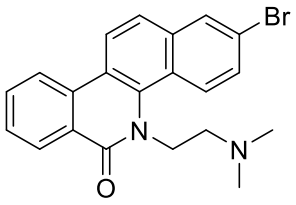
5-(2-(Dimethylamino)ethyl)benzo[c]phenanthridin-6(5H)-one (A1).[5] The compound **A1** was prepared from **4aa'**. White solid, yield 48%, mp = 79.5–80.9 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.56–8.51 (m, 1H), 8.34–8.30 (m, 1H), 8.26 (d, *J* = 8.0 Hz, 1H), 8.21 (d, *J* = 8.8 Hz, 1H), 7.91–7.86 (m, 1H), 7.81–7.75 (m, 1H), 7.72 (d, *J* = 8.8 Hz, 1H), 7.62–7.56 (m, 1H), 7.55–7.50 (m, 2H), 4.74 (t, *J* = 6.8 Hz, 2H), 2.78 (t, *J* = 6,8 Hz, 2H), 2.16 (s, 6H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 165.1, 136.2, 134.9, 134.1, 132.9, 128.8, 128.7, 128.1, 126.6, 126.0, 125.5, 125.4, 124.8, 124.3, 122.2, 120.1, 118.1, 57.7, 50.4, 45.7. HRMS (ESI) *m/z*: 317.1643 $[M + H]^+$, calcd for $C_{21}H_{21}N_2O$ 317.1648.

Using intermediate **4ab'** as material, the reaction gave two target products **A2** (48%) and **A5** (10%) at the same time.



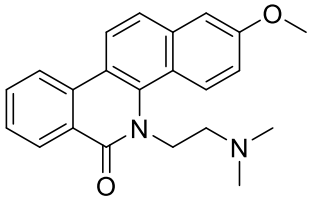
A2

5-(2-(Dimethylamino)ethyl)-1-methoxybenzo[c]phenanthridin-6(5H)-one (A2).[5] White solid, mp = 139.4–140.0 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.53 (d, *J* = 8.0 Hz, 1H), 8.27 (d, *J* = 8.0 Hz, 1H), 8.09 (d, *J* = 8.8 Hz, 1H), 7.83–7.75 (m, 2H), 7.67 (d, *J* = 8.8 Hz, 1H), 7.62–7.56 (m, 2H), 7.21 (d, *J* = 8.8 Hz, 1H), 4.74 (t, *J* = 6.8 Hz, 2H), 4.00 (s, 3H), 2.75 (t, *J* = 6.8 Hz, 2H), 2.13 (s, 6H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 165.4, 157.4, 135.2, 134.2, 132.9, 130.3, 130.2, 128.8, 128.1, 126.0, 125.9, 124.2, 122.3, 119.0, 118.7, 117.8, 105.2, 57.8, 55.7, 50.1, 45.7. HRMS (ESI) *m/z*: 347.1745 $[M + H]^+$, calcd for $C_{22}H_{23}N_2O_2$ 347.1754.



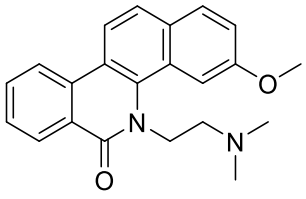
A3

5-(2-(Dimethylamino)ethyl)-2-bromobenzo[c]phenanthridin-6(5H)-one (A3).[5] The compound **A3** was prepared from **4ac'**. White solid, yield 10%, mp = 115.4–119.7 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.53 (d, *J* = 7.6 Hz, 1H), 8.27–8.21 (m, 3H), 8.04 (d, *J* = 1.6 Hz, 1H), 7.83–7.76 (m, 1H), 7.64–7.58 (m, 3H), 4.66 (t, *J* = 6.8 Hz, 2H), 2.79 (t, *J* = 6.8 Hz, 2H), 2.16 (s, 6H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 165.0, 136.3, 136.0, 133.8, 133.1, 130.6, 128.8, 128.6, 128.4, 127.2, 125.9, 123.3, 122.2, 121.4, 120.8, 118.3, 57.8, 50.5, 45.8. HRMS (ESI) *m/z*: 395.0764 $[M + H]^+$, calcd for $C_{21}H_{20}N_2OBr$ 395.0754.



A4

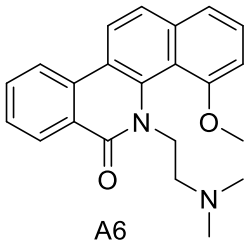
5-(2-(Dimethylamino)ethyl)-2-methoxybenzo[c]phenanthridin-6(5H)-one (**A4**).[5] The compound **A4** was synthesized from the nucleophilic substitution reaction of **A3**. White solid, yield 47%, mp = 85.5–86.1 ℃. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.51 (d, *J* = 8.0 Hz, 1H), 8.29–8.21 (m, 2H), 8.18 (d, *J* = 8.4 Hz, 1H), 7.79–7.72 (m, 1H), 7.63 (d, *J* = 8.8 Hz, 1H), 7.60–7.52 (m, 1H), 7.23–7.16 (m, 2H), 4.71 (t, *J* = 6.8 Hz, 2H), 3.97 (s, 3H), 2.82 (t, *J* = 6.8 Hz, 2H), 2.19 (s, 6H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 165.2, 158.1, 136.7, 136.6, 134.4, 132.8, 128.8, 127.7, 127.1, 125.6, 123.4, 121.9, 120.8, 119.8, 117.4, 116.5, 107.3, 57.7, 55.6, 50.4, 45.7. HRMS (ESI) *m/z*: 347.1745 $[M + H]^+$, calcd for $C_{22}H_{23}N_2O_2$ 347.1754.



A5

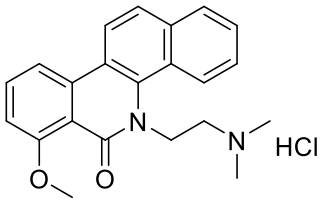
5-(2-(Dimethylamino)ethyl)-3-methoxybenzo[c]phenanthridin-6(5H)-one (A5).[5] White solid, yield 10%, mp = 83.2–85.2 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.53 (dd, *J* = 8.0, 1.2 Hz, 1H), 8.28

(d, *J* = 8.0 Hz, 1H), 8.21 (s, 2H), 7.83 (d, *J* = 8.8 Hz, 1H), 7.81–7.76 (m, 1H), 7.62–7.57 (m, 1H), 7.47–7.42 (m, 1H), 6.90 (d, *J* = 8.0 Hz, 1H), 4.76 (t, *J* = 7.2 Hz, 2H), 4.05 (s, 3H), 2.74 (t, *J* = 7.2 Hz, 2H), 2.16 (s, 6H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 165.2, 155.8, 135.8, 134.0, 132.9, 128.8, 128.2, 126.8, 126.0, 125.8, 125.6, 122.3, 119.3, 118.8, 118.2, 117.6, 104.9, 57.4, 55.9, 50.1, 45.6. HRMS (ESI) *m/z*: 347.1756 $[M + H]^+$, calcd for $C_{22}H_{23}N_2O_2$ 347.1754.



A6

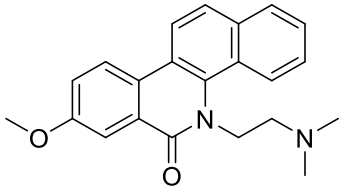
5-(2-(Dimethylamino)ethyl)-4-methoxybenzo[c]phenanthridin-6(5H)-one (A6).[6] The compound **A6** was prepared from **7ad'**. White solid, yield 45%, mp = 78.2–78.8 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.54 (dd, *J* = 8.0, 0.8 Hz, 1H), 8.22 (d, *J* = 8.0 Hz, 1H), 8.14 (d, *J* = 8.4 Hz, 1H), 7.79–7.73 (m, 1H), 7.62 (d, *J* = 8.4 Hz, 1H), 7.60–7.55 (m, 1H), 7.48–7.42 (m, 2H), 6.91 (dd, *J* = 6.0, 2.4 Hz, 1H), 5.04–4.96 (m, 1H), 4.10–4.00 (m, 1H), 3.97 (s, 3H), 2.45–2.36 (m, 1H), 2.06–1.97 (m, 1H), 1.91 (s, 6H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 163.4, 155.7, 136.5, 134.7, 133.8, 132.6, 128.7, 127.8, 127.4, 126.1, 123.4, 122.0, 120.4, 120.2, 118.2, 116.6, 106.4, 57.2, 55.7, 50.2, 45.4. HRMS (ESI) *m/z*: 347.1733 $[M + H]^+$, calcd for $C_{22}H_{23}N_2O_2$ 347.1754.



A7

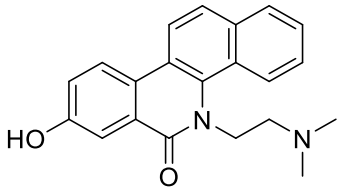
5-(2-(Dimethylamino)ethyl)-7-methoxybenzo[c]phenanthridin-6(5H)-one (A7).[6] The compound **A7** was prepared from **7ca'** as a hydrochloric acid salt. Yellow solid, yield 35%, mp = 125.6–129.3 °C. ^{1}H NMR (400 MHz, D_2O) δ 7.60 (d, *J* = 8.0 Hz, 1H), 7.49 (dd, *J* = 8.0, 7.6 Hz, 1H), 7.45–7.36 (m, 2H), 7.11 (d, *J* = 8.8 Hz, 1H), 7.05–6.99 (m, 2H), 6.99–6.93 (m, 2H), 3.94 (s, 3H), 3.77 (t, *J* = 5.6 Hz, 2H), 3.31 (t, *J* = 5.6 Hz, 2H), 2.89 (s, 6H). ^{13}C NMR (100 MHz, D_2O) δ 163.9, 159.6, 135.4, 134.6, 133.8, 133.1, 128.7, 126.8, 125.7, 124.4, 123.2, 122.2, 119.5, 117.1, 114.22, 112.0, 110.5, 57.2, 55.8, 46.7, 43.4. HRMS (ESI) *m/z*: 347.1742 $[M + H]^+$, calcd for $C_{22}H_{23}N_2O_2$ 347.1754.

Using intermediate **4ca'** as material, the reaction gave two target products, **A8** (24%) and the demethylated product **A9** (36%) at the same time.



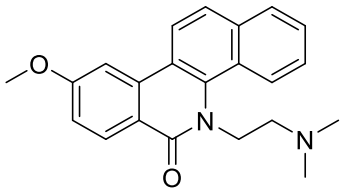
A8

5-(2-(Dimethylamino)ethyl)-8-methoxybenzo[c]phenanthridin-6(5H)-one (A8).[5] White solid, mp = 102.3–103.5 ºC. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.31 (d, *J* = 8.0 Hz, 1H), 8.19 (d, *J* = 8.8 Hz, 1H), 8.15 (d, *J* = 8.8 Hz, 1H), 7.95 (d, *J* = 2.4 Hz, 1H), 7.91–7.86 (m, 1H), 7.71 (d, *J* = 8.8 Hz, 1H), 7.55–7.48 (m, 2H), 7.37 (dd, *J* = 8.8, 2.4 Hz, 1H), 4.74 (t, *J* = 6.8 Hz, 2H), 3.98 (s, 3H), 2.82 (t, *J* = 6.8 Hz, 2H), 2.20 (s, 6H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 164.9, 159.7, 134.5, 134.4, 128.8, 127.7, 127.2, 126.2, 125.4, 125.2, 124.8, 124.4, 124.0, 122.9, 120.0, 118.2, 109.0, 57.7, 55.8, 50.4, 45.8. HRMS (ESI) *m/z*: 347.1749 $[M + H]^+$, calcd for $C_{22}H_{23}N_2O_2$ 347.1754.



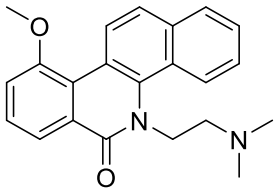
A9

5-(2-(Dimethylamino)ethyl)-8-hydroxybenzo[c]phenanthridin-6(5H)-one (A9).[5] White solid, mp = 244.2–244.8 ºC. ^{1}H NMR (400 MHz, DMSO) δ 10.24 (s, 1H), 8.39 (d, *J* = 8.8 Hz, 1H), 8.36 (d, *J* = 8.8 Hz, 1H), 8.34–8.30 (m, 1H), 8.03–7.97 (m, 1H), 7.81 (d, *J* = 8.8 Hz, 1H), 7.69 (d, *J* = 2.4 Hz, 1H), 7.58–7.53 (m, 2H), 7.31 (dd, *J* = 8.8, 2.4 Hz, 1H), 4.63 (t, *J* = 6.8 Hz, 2H), 2.56 (t, *J* = 6.8 Hz, 2H), 1.93 (s, 6H). ^{13}C NMR (100 MHz, DMSO) δ 163.5, 157.6, 133.6, 133.4, 128.5, 126.7, 125.9, 125.6, 125.2, 124.8, 124.7, 124.1, 124.0, 122.1, 120.2, 117.8, 111.9, 56.9, 49.2, 45.1. HRMS (ESI) *m/z*: 333.1598 $[M + H]^+$, calcd for $C_{21}H_{21}N_2O_2$. 333.1525.



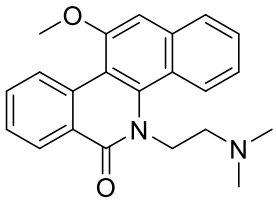
A10

5-(2-(Dimethylamino)ethyl)-9-methoxybenzo[c]phenanthridin-6(5H)-one (A10).[5] The compound **A10** was prepared from **4ba'**. Pale yellow solid, yield 24%, mp = 82.4–85.3 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.47 (d, *J* = 8.8 Hz, 1H), 8.34–8.29 (m, 1H), 8.14 (d, *J* = 8.8 Hz, 1H), 7.92–7.88 (m, 1H), 7.71 (d, *J* = 8.8 Hz, 1H), 7.63 (d, *J* = 2.4 Hz, 1H), 7.55–7.50 (m, 2H), 7.15 (dd, *J* = 8.8, 2.4 Hz, 1H), 4.71 (t, *J* = 6.8 Hz, 2H), 4.00 (s, 3H), 2.76 (t, *J* = 6.8 Hz, 2H), 2.16 (s, 6H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 164.9, 163.4, 136.8, 136.1, 135.0, 131.0, 128.7, 126.7, 125.5, 125.4, 124.8, 124.1, 120.1, 119.7, 117.9, 116.0, 105.1, 57.7, 55.7, 50.2, 45.7. HRMS (ESI) *m/z*: 347.1762 $[M + H]^+$, calcd for $C_{22}H_{23}N_2O_2$ 347.1754.



A11

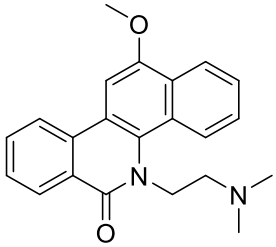
5-(2-(Dimethylamino)ethyl)-10-methoxybenzo[c]phenanthridin-6(5H)-one (A11).[6] The compound **A11** was prepared from **7ba'**. White solid, yield 40%, mp = 85.6–87.2 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 9.21 (d, *J* = 8.8 Hz, 1H), 8.23–8.17 (m, 2H), 7.91–7.87 (m, 1H), 7.68 (d, *J* = 8.8 Hz, 1H), 7.55–7.49 (m, 3H), 7.31 (d, *J* = 8.0 Hz, 1H), 4.79 (t, *J* = 6.8 Hz, 2H), 4.09 (s, 3H), 2.68 (t, *J* = 6.8 Hz, 2H), 2.15 (s, 6H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 164.7, 157.4, 135.4, 134.0, 128.5, 128.1, 126.4, 125.4, 125.0, 124.9, 124.35, 123.8, 123.4, 121.1, 118.9, 115.1, 111.6, 57.2, 56.2, 50.4, 45.5. HRMS (ESI) *m/z*: 347.1736 $[M + H]^+$, calcd for $C_{22}H_{23}N_2O_2$ 347.1754.



A12

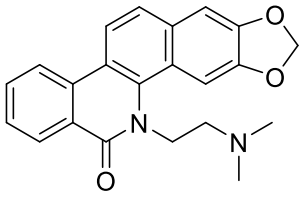
5-(2-(Dimethylamino)ethyl)-11-methoxybenzo[c]phenanthridin-6(5H)-one (A12). The compound **A12** was prepared from **7ab'**. Yellow gel, yield: 65%. ^{1}H NMR (400 MHz, $CDCl_3$) δ 9.18 (d, *J* = 8.4 Hz, 1H), 8.56 (dd, *J* = 8.0, 1.2 Hz, 1H), 8.08 (d, *J* = 8.4 Hz, 1H), 7.78–7.70 (m, 2H), 7.60–7.55 (m, 1H), 7.50–7.45 (m, 1H), 7.38–7.33 (m, 1H), 7.10 (s, 1H), 4.74 (t, *J* = 6.8 Hz, 2H), 4.15 (s, 3H), 2.57 (t, *J* = 6.8 Hz, 2H), 2.07 (s, 6H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 165.0, 156.1, 138.4, 134.2, 133.6, 132.6, 128.3, 127.8, 127.6, 127.2, 127.0, 126.1, 125.6, 123.0, 120.6,

112.6, 102.6, 57.5, 55.9, 51.0, 45.6. HRMS (ESI) *m/z*: 347.1750 $[M + H]^+$, calcd for $C_{22}H_{23}N_2O_2$ 347.1754.



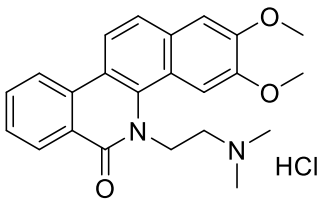
A13

5-(2-(Dimethylamino)ethyl)-12-methoxybenzo[c]phenanthridin-6(5H)-one (A13). The compound **A13** was prepared from **7ac'**. White solid, yield 45%, mp = 129.9–130.5 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 9.18 (d, *J* = 8.4 Hz, 1H), 8.56 (dd, *J* = 8.0, 1.2 Hz, 1H), 8.08 (d, *J* = 8.4 Hz, 1H), 7.78–7.70 (m, 2H), 7.61–7.55 (m, 1H), 7.50–7.44 (m, 1H), 7.38–7.33 (m, 1H), 7.10 (s, 1H), 4.78–4.72 (t, *J* = 6.8 Hz, 2H), 4.15 (s, 3H), 2.60–2.54 (t, *J* = 6.8 Hz, 2H), 2.07 (s, 6H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 164.9, 152.1, 134.0, 132.6, 130.3, 128.9, 128.0, 127.1, 126.3, 126.1, 126.0, 125.8, 125.1, 122.7, 122.0, 118.1, 97.3, 57.6, 55.8, 50.2, 45.7. HRMS (ESI) *m/z*: 347.1765 $[M + H]^+$, calcd for $C_{22}H_{23}N_2O_2$ 347.1754.



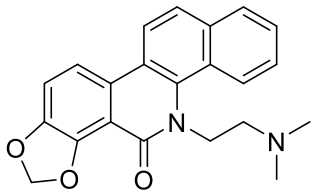
B1

12-(2-(Dimethylamino)ethyl)-[1,3]dioxolo[4',5':4,5]benzo[1,2-c]phenanthridin-13(12H)-one (B1).[5] The compound **B1** was prepared from **4ad'**. White solid, yield 80%, mp = 129.1–131.4 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.48 (d, *J* = 8.0 Hz, 1H), 8.22 (d, *J* = 8.0 Hz, 1H), 8.07 (d, *J* = 8.4 Hz, 1H), 7.78–7.74 (m, 1H), 7.59–7.53 (m, 3H), 7.17 (s, 1H), 6.11 (s, 2H), 4.75 (t, *J* = 6.0 Hz, 2H), 2.87 (t, *J* = 6.0 Hz, 2H), 2.29 (s, 6H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 165.4, 148.0, 147.7, 135.9, 134.3, 132.9, 132.4, 128.8, 127.9, 125.7, 123.8, 122.0, 121.2, 118.6, 117.9, 105.0, 102.5, 101.8, 57.3, 49.7, 45.3. HRMS (ESI) *m/z*: 361.1550 $[M + H]^+$, calcd for $C_{22}H_{21}N_2O_3$ 361.1547.



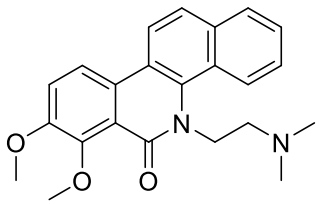
B2

5-(2-(Dimethylamino)ethyl)-2, 3-dimethoxybenzo[c]phenanthridin-6(5H)-one (B2).[5] The compound **B2** was prepared from **4ae'** as a hydrochloric acid salt. White solid, yield 80%, mp = 172.8–174.9 °C. ^{1}H NMR (400 MHz, D_2O) δ 7.86 (d, *J* = 8.0 Hz, 1H), 7.58–7.52 (m, 2H), 7.45–7.38 (m, 1H), 7.19 (d, *J* = 8.8 Hz, 1H), 6.79 (d, *J* = 8.8 Hz, 1H), 6.51 (s, 1H), 5.76 (s, 1H), 3.84 (t, *J* = 4.8 Hz, 2H), 3.67 (s, 3H), 3.66 (s, 3H), 3.20 (t, *J* = 4.8 Hz, 2H), 2.80 (s, 6H). ^{13}C NMR (100 MHz, D_2O) δ 165.6, 147.8, 147.1, 133.8, 133.2, 131.3, 130.0, 128.1, 127.1, 123.4, 122.1, 121.7, 117.6, 116.8, 116.1, 107.2, 102.5, 57.5, 55.5, 55.2, 46.7, 43.4. HRMS (ESI) *m/z*: 377.1859 $[M + H]^+$, calcd for $C_{23}H_{25}N_2O_3$ 377.1860.



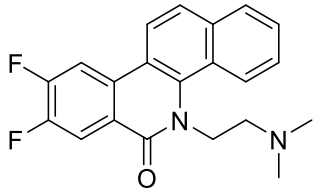
B3

12-(2-(Dimethylamino)ethyl)benzo[c][1,3]dioxolo[4,5-i]phenanthridin-13(12H)-one (B3).[5] The compound **B3** was prepared from **7da'**. White solid, yield 30%, mp = 152.3–153.4 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.27–8.21 (m, 1H), 8.09 (d, *J* = 8.8 Hz, 1H), 7.90–7.86 (m, 1H), 7.77 (d, *J* = 8.8 Hz, 1H), 7.69 (d, *J* = 8.8 Hz, 1H), 7.54–7.49 (m, 2H), 7.26 (d, *J* = 8.8 Hz, 1H), 6.30 (s, 2H), 4.64 (t, *J* = 7.2 Hz, 2H), 2.84 (t, *J* = 7.2 Hz, 2H), 2.20 (s, 6H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 163.0, 148.2, 147.9, 135.1, 134.4, 128.8, 128.6, 126.3, 125.5, 125.1, 124.9, 124.5, 120.2, 118.5, 115.9, 113.4, 111.5, 103.1, 57.5, 49.9, 45.7. HRMS (ESI) *m/z*: 361.1548 $[M + H]^+$, calcd for $C_{22}H_{21}N_2O_3$ 361.1547.



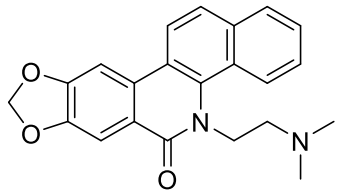
B4

5-(2-(Dimethylamino)ethyl)-7,8-dimethoxybenzo[c]phenanthridin-6(5H)-one (B4).[6] The compound **B4** was prepared from **7ea'**. White solid, yield 35%, mp = 72.8–73.5 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.22 (dd, *J* = 8.8 Hz, 1.2 Hz, 1H), 8.09 (d, *J* = 8.8 Hz, 1H), 7.98 (d, *J* = 8.8 Hz, 1H), 7.88–7.83 (m, 1H), 7.68 (d, *J* = 8.8 Hz, 1H), 7.53–7.49 (m, 2H), 7.39 (d, 1H), 4.65 (t, *J* = 7.2 Hz, 2H), 4.07 (s, 3H), 3.98 (s, 3H), 2.80 (t, *J* = 7.2 Hz, 2H), 2.18 (s, 6H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 162.9, 153.0, 150.5, 135.1, 134.3, 128.9, 128.6, 126.3, 125.52, 125.2, 124.8, 124.3, 120.4, 112.0, 118.5, 118.1, 118.0, 61.9, 57.5, 56.8, 49.7, 45.7. HRMS (ESI) *m/z*: 377.1863 $[M + H]^+$, calcd for $C_{23}H_{25}N_2O_3$ 377.1860.



B5

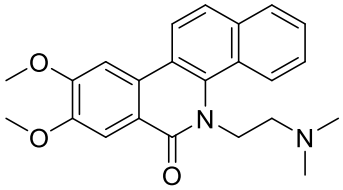
5-(2-(Dimethylamino)ethyl)-8,9-difluorobenzo[c]phenanthridin-6(5H)-one (B5). The compound **B5** was prepared from **7fa'**. White solid, yield 80%, mp = 122.3–123.1 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.35–8.27 (m, 2H), 8.04–7.97 (m, 2H), 7.93–7.89 (m, 1H), 7.75 (d, *J* = 8.8 Hz, 1H), 7.59–7.54 (m, 2H), 4.73 (t, *J* = 6.8 Hz, 2H), 2.74 (t, *J* = 6.8 Hz, 2H), 2.12 (s, 6H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 163.6, 154.2 (dd, *J* = 255.4, 14.3 Hz), 150.5 (dd, *J* = 252.3, 14.1 Hz), 136.5, 135.0, 132.1 (dd, *J* = 7.7, 2.9 Hz), 128.8, 127.0, 125.8, 125.4, 124.8, 124.7, 123.2 (dd, *J* = 5.9, 2.3 Hz), 119.9, 117.1 (dd, *J* = 18.6, 1.9 Hz), 110.9, 110.7, 57.6, 50.6, 45.7. HRMS (ESI) *m/z*: 353.1418 $[M + H]^+$, calcd for $C_{21}H_{19}N_2OF_2$ 353.1460.



B6

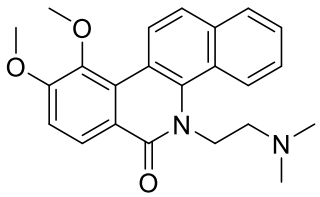
5-(2-(Dimethylamino)ethyl)benzo[c][1,3]dioxolo[4,5-j]phenanthridin-6(5H)-one (B6).[5] The compound **B6** was prepared from **4da'**. White solid, yield 25%, mp = 111.2–113.5 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.35–8.29 (m, 1H), 8.04 (d, *J* = 8.4 Hz, 1H), 7.92–7.85 (m, 2H), 7.71 (d, *J* = 8.4 Hz, 1H), 7.63 (s, 1H), 7.56–7.48 (m, 2H), 6.12 (s, 2H), 4.72 (t, *J* = 6.8 Hz, 2H), 2.80 (t, *J* = 6.8 Hz, 2H), 2.18 (s, 6H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 164.3, 152.6, 148.5, 135.4, 134.5, 131.1,

128.7, 126.4, 125.4, 125.3, 124.7, 124.2, 121.6, 120.0, 117.9, 106.8, 102.1, 100.9, 57.8, 50.4, 45.8. HRMS (ESI) *m/z*: 361.1540 $[M + H]^+$, calcd for $C_{22}H_{21}N_2O_3$ 361.1547.



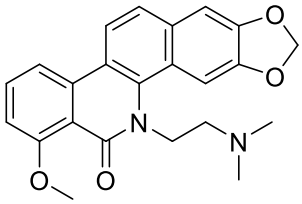
B7

5-(2-(Dimethylamino)ethyl)-8,9-dimethoxybenzo[c]phenanthridin-6(5H)-one (B7).[5] The compound **B7** was prepared from **4ea'**. White solid, yield 20%, mp = 129.3–131.9 °C . ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.36–8.31 (m, 1H), 8.12 (d, *J* = 8.8 Hz, 1H), 7.94 (s, 1H), 7.92–7.89 (m, 1H), 7.73 (d, J = 8.8 Hz, 1H), 7.62 (s, 1H), 7.56–7.51 (m, 2H), 4.74 (t, *J* = 7.2 Hz, 2H), 4.12 (s, 3H), 4.07 (s, 3H), 2.85 (t, *J* = 7.2 Hz, 2H), 2.23 (s, 6H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 164.6, 153.8, 150.1, 135.4, 134.5, 129.0, 128.7, 126.4, 125.5, 125.3, 124.8, 124.2, 120.0, 119.9, 117.9, 108.9, 103.2, 57.6, 56.4, 56.3, 50.0, 45.6. HRMS (ESI) *m/z*: 377.1850 $[M + H]^+$, calcd for $C_{23}H_{25}N_2O_3$ 377.1860.



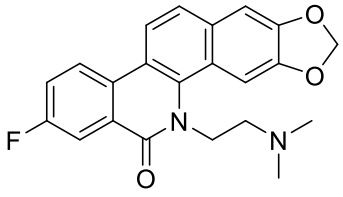
B8

5-(2-(Dimethylamino)ethyl)-9,10-dimethoxybenzo[c]phenanthridin-6(5H)-one (B8).[6] The compound **B8** was prepared from **7ga'**. White solid, yield 30%, mp = 86.4°C–87.4 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 9.18 (d, *J* = 8.8 Hz, 1H), 8.38 (d, *J* = 8.8 Hz, 1H), 8.21 (d, *J* = 8.0 Hz, 1H), 7.88 (d, *J* = 8.0 Hz, 1H), 7.70 (d, *J* = 8.8 Hz, 1H), 7.56–7.46 (m, 2H), 7.22 (d, *J* = 8.8 Hz, 1H), 4.71 (t, *J* = 6.8 Hz, 2H), 4.03 (s, 3H), 3.90 (s, 3H), 2.63 (t, *J* = 6.8 Hz, 2H), 2.10 (s, 6H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 164.9, 157.0, 145.8, 136.4, 134.5, 128.2, 128.0, 126.6, 126.0, 125.6, 124.9, 124.6, 124.2, 123.8, 120.9, 118.4, 112.6, 60.4, 57.5, 56.4, 50.5, 45.6. HRMS (ESI) *m/z*: 377.1848 $[M + H]^+$, calcd for $C_{23}H_{25}N_2O_3$ 377.1860.



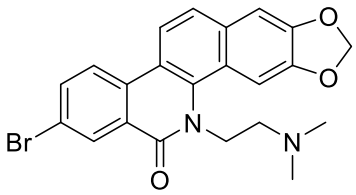
C1

12-(2-(Dimethylamino)ethyl)-1-methoxy-[1,3]dioxolo[4',5':4,5]benzo[1,2-c]phenanthridine-13(12H)-one (C1). The compound **C1** was prepared from **7he'**. White solid, yield 50%, mp = 133.6–134.2 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.99 (d, *J* = 8.8 Hz, 1H), 7.79 (d, *J* = 8.8 Hz, 1H), 7.67–7.61 (m, 1H), 7.60 (s, 1H), 7.50 (d, *J* = 8.8 Hz, 1H), 7.14 (s, 1H), 7.01 (d, *J* = 8.8 Hz, 1H), 6.08 (s, 2H), 4.52 (t, *J* = 6.8 Hz, 2H), 4.04 (s, 3H), 2.80 (t, *J* = 6.8 Hz, 2H), 2.20 (s, 6H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 163.4, 161.4, 148.0, 147.5, 137.1, 136.8, 133.4, 132.3, 123.3, 121.0, 119.1, 117.8, 115.2, 114.1, 110.1, 104.7, 102.8, 101.7, 57.8, 56.5, 50.0, 45.8. HRMS (ESI) *m/z*: 391.1621 $[M + H]^+$, calcd for $C_{23}H_{23}N_2O_4$ 391.1652.



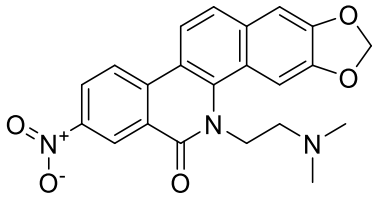
C2

12-(2-(Dimethylamino)ethyl)-2-fluor-[1,3]dioxolo[4',5':4,5]benzo[1,2-c]phenanthridin-13(12H)-one (C2). The compound **C2** was prepared from **7ie'**. White solid, yield 46%, mp = 152.8–153.4 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.23–8.18 (m, 1H), 8.14 (dd, *J* = 8.8, 2.8 Hz, 1H), 8.00 (d, *J* = 8.4 Hz, 1H), 7.63 (s, 1H), 7.56 (d, *J* = 8.4 Hz, 1H), 7.49–7.44 (m, 1H), 7.17 (s, 1H), 6.10 (s, 2H), 4.64 (t, *J* = 6.8 Hz, 2H), 2.69 (t, *J* = 6.8 Hz, 2H), 2.14 (s, 6H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 164.5 (d, *J* = 3.2 Hz), 162.2 (d, *J* = 249.0 Hz), 148.0, 147.7, 135.5, 132.20, 130.8 (d, *J* = 2.5 Hz), 127.6 (d, *J* = 7.8 Hz), 124.6 (d, *J* = 7.8 Hz), 123.9, 121.2 (d, *J* = 23.3 Hz), 121.1, 118.5, 117.3, 114.1 (d, *J* = 22.8 Hz), 105.0, 102.6, 101.8, 57.6, 50.5, 45.7. HRMS (ESI) *m/z*: 379.1432 $[M + H]^+$, calcd for $C_{22}H_{20}N_2O_3F$ 379.1452.



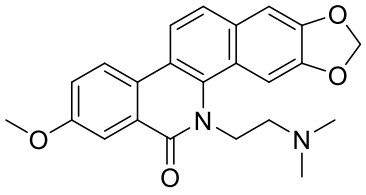
C3

12-(2-(Dimethylamino)ethyl)-2-bromo-[1,3]dioxolo[4',5':4,5]benzo[1,2-c]phenanthridin-13(12H)-one (C3). The compound **C3** was prepared from **7je'**. White solid, yield 19%, mp = 172.6–174.1 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.49 (dd, *J* = 8.0, 1.2 Hz, 1H), 8.22 (d, *J* = 8.0 Hz, 1H), 8.07 (d, *J* = 8.8 Hz, 1H), 7.78–7.73 (m, 1H), 7.60 (s, 1H), 7.56–7.53 (m, 1H), 7.17 (s, 1H), 6.10 (s, 2H), 4.67 (t, *J* = 6.8 Hz, 2H), 2.75 (t, *J* = 6.8 Hz, 2H), 2.19 (s, 6H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 165.4, 147.9, 147.6, 135.9, 134.2, 132.8, 132.3, 128.7, 127.8, 125.7, 123.7, 122.0, 121.2, 118.6, 117.8, 104.9, 102.6, 101.7, 57.5, 50.1, 45.6. HRMS (ESI) *m/z*: 439.0675 $[M + H]^+$, calcd for $C_{22}H_{20}N_2O_3Br$ 439.0652.



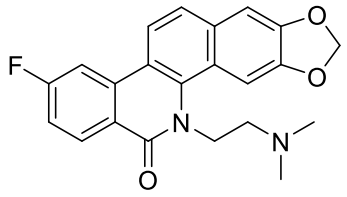
C4

12-(2-(Dimethylamino)ethyl)-2-nitro-[1,3]dioxolo[4',5':4,5]benzo[1,2-c]phenanthridin-13(12H)-one (C4). The compound **C4** was prepared from **7ke'**. Pale red solid, yield 29%, mp = 167.7–168.4 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 9.34 (d, *J* = 2.4 Hz, 1H), 8.53 (dd, *J* = 8.8, 2.4 Hz, 1H), 8.35 (d, *J* = 8.8 Hz, 1H), 8.05 (d, *J* = 8.8 Hz, 1H), 7.66 (s, 1H), 7.61 (d, *J* = 8.8 Hz, 1H), 7.20 (s, 1H), 6.14 (s, 2H), 4.68 (t, *J* = 6.8 Hz, 2H), 2.68 (t, *J* = 6.8 Hz, 2H), 2.09 (s, 6H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 163.9, 148.9, 148.0, 146.7, 139.1, 138.0, 133.6, 126.7, 126.0, 124.9, 124.3, 123.5, 121.0, 118.8, 116.3, 105.0, 102.8, 102.0, 57.4, 50.7, 45.6. HRMS (ESI) *m/z*: 406.1339 $[M + H]^+$, calcd for $C_{22}H_{20}N_3O_5$ 406.1397.



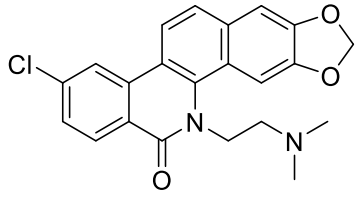
C5

12-(2-(Dimethylamino)ethyl)-2-methoxy-[1,3]dioxolo[4',5':4,5]benzo[1,2-c]phenanthridine-13(12H)-one (C5). The compound **C5** was prepared from **7le'**. White solid, yield 53%, mp = 141.5–142.1 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.13 (d, *J* = 8.8 Hz, 1H), 7.99 (d, *J* = 8.8 Hz, 1H), 7.92 (d, *J* = 2.8 Hz, 1H), 7.62 (s, 1H), 7.53 (d, *J* = 8.8 Hz, 1H), 7.34 (dd, *J* = 8.8, 2.8 Hz, 1H), 7.15 (s, 1H), 6.08 (s, 2H), 4.64 (t, *J* = 6.8 Hz, 2H), 3.96 (s, 3H), 2.75 (t, *J* = 6.8 Hz, 2H), 2.17 (s, 6H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 165.1, 159.5, 147.5, 134.6, 131.7, 127.9, 126.9, 123.8, 123.7 122.7, 121.1, 118.4, 117.8, 109.0, 104.9, 102.5, 101.6, 57.7, 55.8, 50.3, 45.7. HRMS (ESI) *m/z*: 391.1647 $[M + H]^+$, calcd for $C_{23}H_{23}N_2O_4$ 391.1652.



C6

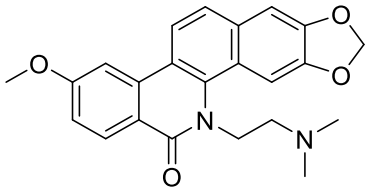
12-(2-(Dimethylamino)ethyl)-3-fluoro-[1,3]dioxolo[4',5':4,5]benzo[1,2-c]phenanthridin-13(12H)-one (C6). The compound **C6** was prepared from **7me'**. White solid, yield 48%, mp = 141.7–142.4 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.50 (dd, *J* = 8.8, 6.0 Hz, 1H), 7.92 (d, *J* = 8.8 Hz, 1H), 7.81 (dd, *J* = 10.4, 2.4 Hz, 1H), 7.64 (s, 1H), 7.55 (d, *J* = 8.8 Hz, 1H), 7.26 – 7.21 (m, 1H), 7.17 (s, 1H), 6.11 (s, 2H), 4.63 (t, *J* = 6.8 Hz, 2H), 2.71 (t, *J* = 6.8 Hz, 2H), 2.14 (s, 6H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 166.0 (d, *J* = 253.1 Hz), 164.7, 148.2, 147.7, 136.9 (d, *J* = 9.5 Hz), 136.8, 132.8, 131.9 (d, *J* = 10.0 Hz), 123.8, 122.3, 121.2, 118.6, 117.1 (d, *J* = 2.8 Hz), 116.0 (d, *J* = 23.1 Hz), 107.9 (d, *J* = 23.5 Hz), 105.0, 102.8, 101.8, 57.7, 50.4, 45.7. HRMS (ESI) *m/z*: 379.1417 $[M + H]^+$, calcd for $C_{22}H_{20}N_2O_3F$ 379.1452.



C7

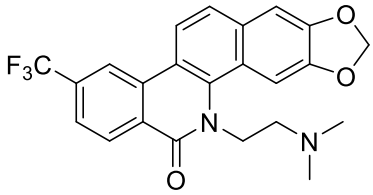
12-(2-(Dimethylamino)ethyl)-3-chloro-[1,3]dioxolo[4',5':4,5]benzo[1,2-c]phenanthridin-13(12H)-one (C7). The compound **C7** was prepared from **7ne'**. White solid, yield 51%, mp = 127.6–129.1 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.42 (d, *J* = 8.8 Hz, 1H), 8.17 (d, *J* = 2.0 Hz, 1H), 7.96 (d, *J* = 8.8 Hz, 1H), 7.63 (s, 1H), 7.55 (d, *J* = 8.8 Hz, 1H), 7.49 (dd, *J* = 8.8, 2.0 Hz, 1H), 7.17 (s, 1H), 6.10 (s, 2H), 4.62 (t, *J* = 6.8 Hz, 2H), 2.69 (t, *J* = 6.8 Hz, 2H), 2.13 (s, 6H). ^{13}C NMR (100

MHz, $CDCl_3$) δ 164.7, 148.2, 147.7, 139.5, 136.8, 135.7, 132.7, 130.5, 128.1, 124.1, 123.8, 121.9, 121.1, 118.5, 116.7, 104.9, 102.7, 101.8, 57.6, 50.5, 45.7. HRMS (ESI) *m/z*: 395.1128 $[M + H]^+$, calcd for $C_{22}H_{20}N_2O_3Cl$ 395.1157.



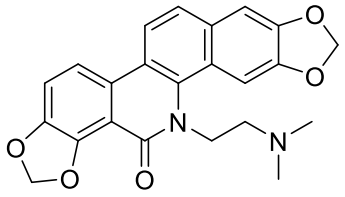
C8

12-(2-(Dimethylamino)ethyl)-3-methoxy-[1,3]dioxolo[4',5':4,5]benzo[1,2-c]phenanthridine-13(12H)-one (C8). The compound **C8** was prepared from **7oe'**. White solid, yield 57%, mp = 133.2–134.4 ºC. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.43 (d, *J* = 8.8 Hz, 1H), 7.97 (d, *J* = 8.8 Hz, 1H), 7.62 (s, 1H), 7.57 (d, *J* = 2.4 Hz, 1H), 7.52 (d, *J* = 8.8 Hz, 1H), 7.15 (s, 1H), 7.11 (dd, *J* = 8.8, 2.4 Hz, 1H), 6.09 (s, 2H), 4.61 (t, *J* = 6.8 Hz, 2H), 3.99 (s, 3H), 2.69 (t, *J* = 6.8 Hz, 2H), 2.15 (s, 6H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 165.2, 163.3, 147.9, 147.5, 136.7, 136.2, 132.4, 130.9, 123.4, 121.2, 119.6, 118.6, 117.6, 115.6, 104.9, 104.8, 102.8, 101.7, 57.8, 55.7, 50.3, 45.7. HRMS (ESI) *m/z*: 391.1621 $[M + H]^+$, calcd for $C_{23}H_{23}N_2O_4$ 391.1652.



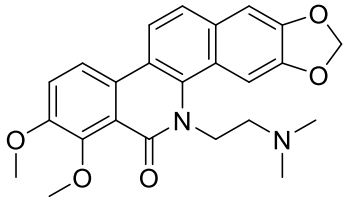
C9

12-(2-(Dimethylamino)ethyl)-3-(trifluoromethyl)-[1,3]dioxolo[4',5':4,5]benzo[1,2-c] phenanthridin-13(12H)-one (C9). The compound **C9** was prepared from **7pe'**. White solid, yield 42%, mp = 157.4–158.5 ºC. ^{1}H NMR (500 MHz, $CDCl_3$) δ 8.78 (s, 1H), 8.31 (d, *J* = 8.5 Hz, 1H), 8.04 (d, *J* = 8.5 Hz, 1H), 7.94 (d, *J* = 8.5 Hz, 1H), 7.62 (s, 1H), 7.58 (d, *J* = 8.5 Hz, 1H), 7.17 (s, 1H), 6.12 (s, 2H), 4.66 (t, *J* = 6.0 Hz, 2H), 2.71 (t, *J* = 6.0 Hz, 2H), 2.14 (s, 6H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 164.4, 148.4, 147.8, 137.0, 136.9, 133.0, 129.7, 129.4, 128.9 (q, *J* = 3.3 Hz), 126.3 (q, *J* = 4.2 Hz), 125.6, 124.0, 122.9, 121.0, 118.6, 116.7, 105.0, 102.7, 101.9, 57.4, 50.4, 45.5. HRMS (ESI) *m/z*: 429.1379 $[M + H]^+$, calcd for $C_{23}H_{20}N_2O_3F_3$ 429.1421.



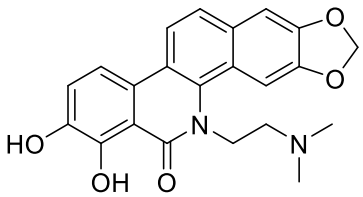
C10

13-(2-(Dimethylamino)ethyl)-[1,3]dioxolo[4',5':4,5]benzo[1,2-c][1,3]dioxolo[4,5-i]phenanthridin-14(13H)-one (C10).[5] The compound **C10** was prepared from **7de'**. White solid, yield 45%, mp = 180.3–181.4 ºC. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.94 (d, *J* = 8.8 Hz, 1H), 7.72 (d, *J* = 8.4 Hz, 1H), 7.57 (s, 1H), 7.51 (d, *J* = 8.8 Hz, 1H), 7.22 (d, *J* = 8.4 Hz, 1H), 7.14 (s, 1H), 6.26 (s, 2H), 6.09 (s, 2H), 4.56 (t, *J* = 7.2 Hz, 2H), 2.76 (t, *J* = 7.2 Hz, 2H), 2.17 (s, 6H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 163.3, 148.0, 147.9, 147.7, 147.6, 135.1, 131.8, 129.0, 123.8, 121.4, 118.8, 118.3, 115.6, 113.4, 111.4, 104.9, 103.0, 102.5, 101.7, 57.5, 49.9, 45.7. HRMS (ESI) *m/z*: 405.1454 $[M + H]^+$, calcd for $C_{23}H_{21}N_2O_5$ 405.1445.



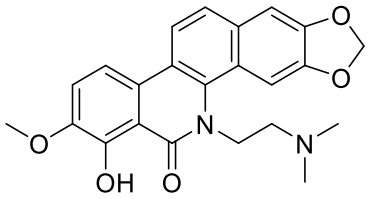
C11

12-(2-(Dimethylamino)ethyl)-1,2-dimethoxy-[1,3]dioxolo[4',5':4,5]benzo[1,2-c] phenanthridin-13(12H)-one (C11).[6] The compound **C11** was prepared from **7ee'**. White solid, yield 35%, mp = 143.5–146.4 ºC. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.95 (d, *J* = 8.8 Hz, 1H), 7.92 (d, *J* = 8.8 Hz, 1H), 7.57 (s, 1H), 7.51 (d, *J* = 8.8 Hz, 1H), 7.36 (d, *J* = 8.8 Hz, 1H), 7.14 (s, 1H), 6.08 (s, 2H), 4.55 (t, *J* = 6.8 Hz, 2H), 4.06 (s, 3H), 3.97 (s, 3H), 2.70 (t, *J* = 6.8 Hz, 2H), 2.16 (s, 6H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 163.2, 152.7, 150.5, 147.7, 147.5, 135.1, 131.6, 129.1, 123.5, 121.3, 120.2, 118.5, 118.3, 118.01, 117.8, 104.8, 102.5, 101.6, 61.9, 57.7, 56.8, 49.9, 45.8. HRMS (ESI) *m/z*: 421.1777 $[M + H]^+$, calcd for $C_{24}H_{25}N_2O_5$ 421.1758.



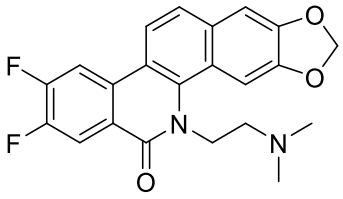
C12

12-(2-(Dimethylamino)ethyl)-1,2-dihydroxy-[1,3]dioxolo[4',5':4,5]benzo[1,2-c] phenanthridine-13(12H)-one (C12).[5] The compound **C12** was prepared from **7qe'**. Yellow solid, yield 50%, mp = 225.8–226.9 °C. ^{1}H NMR (400 MHz, DMSO) δ 13.17 (s, 1H), 9.55 (s, 1H), 8.15 (d, *J* = 8.8 Hz, 1H), 7.75 (d, *J* = 8.8 Hz, 1H), 7.70 (s, 1H), 7.68 (d, *J* = 8.8 Hz, 1H), 7.42 (s, 1H), 7.30 (d, *J* = 8.8 Hz, 1H), 6.19 (s, 2H), 4.58 (t, *J* = 6.8 Hz, 2H), 2.59 (t, *J* = 6.8 Hz, 2H), 1.95 (s, 6H). ^{13}C NMR (100 MHz, DMSO) δ 168.9, 148.5, 147.4, 147.2, 144.3, 132.7, 131.1, 125.9, 124.3, 122.4, 120.4, 118.8, 118.3, 112.6, 110.3, 104.7, 101.8, 56.7, 49.0, 45.0. HRMS (ESI) *m/z*: 393.1456 $[M + H]^+$, calcd for $C_{22}H_{21}N_2O_5$ 393.1445.



C13

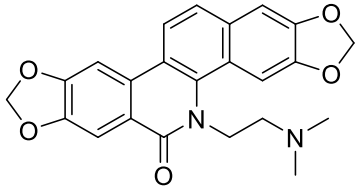
12-(2-(Dimethylamino)ethyl)-1-hydroxy-2-methoxy-[1,3]dioxolo[4',5':4,5]benzo[1,2-c] phenanthridin-13(12H)-one (C13).[5] The compound **C13** was prepared from **7re'**. White solid, yield 21%, mp = 142.4–143.1 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 13.41 (s, 1H), 7.97 (d, *J* = 8.8 Hz, 1H), 7.62 (d, *J* = 8.8 Hz, 1H), 7.57 (s, 1H), 7.55 (d, *J* = 8.8 Hz, 1H), 7.32 (d, *J* = 8.8 Hz, 1H), 7.16 (s, 1H), 6.09 (s, 2H), 4.63 (t, *J* = 6.8 Hz, 2H), 4.00 (s, 3H), 2.67 (t, *J* = 6.8 Hz, 2H), 2.12 (s, 6H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 169.9, 151.4, 147.7, 147.6, 146.8, 133.8, 131.7, 127.6, 124.4, 121.2, 118.7, 118.6, 117.9, 111.7, 111.1, 105.0, 102.3, 101.7, 57.6, 56.6, 50.0, 45.7. HRMS (ESI) *m/z*: 407.1604 $[M + H]^+$, calcd for $C_{23}H_{23}N_2O_5$ 407.1601.



C14

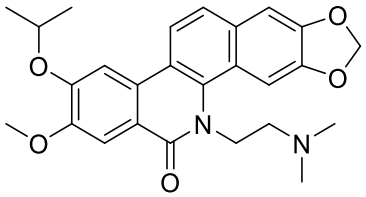
12-(2-(Dimethylamino)ethyl)-2,3-difluoro-[1,3]dioxolo[4',5':4,5]benzo[1,2-c]phenanthridin-13(12H)-one (C14). The compound **C14** was prepared from **7fe'**. White solid, yield 25%, mp = 159.1–161.9 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.26 (dd, *J* = 10.8, 8.4 Hz, 1H), 7.95 (dd, *J* = 11.6, 7.2 Hz, 1H), 7.86 (d, *J* = 8.8 Hz, 1H), 7.64 (s, 1H), 7.57 (d, *J* = 8.8 Hz, 1H), 7.18 (s, 1H), 6.12 (s, 2H), 4.63 (t, *J* = 6.8 Hz 2H), 2.68 (t, *J* = 6.8 Hz, 2H), 2.12 (s, 6H). ^{13}C NMR (100 MHz, $CDCl_3$) δ

163.8, 154.2 (dd, *J* = 255.2, 14.3 Hz), 150.3 (dd, *J* = 251.7, 13.8 Hz), 148.2, 147.8, 136.4, 132.6, 132.3 (dd, *J* = 7.9, 2.7 Hz), 124.0, 123.0 (dd, *J* = 5.5, 1.7 Hz), 121.2, 118.5, 117.1 (dd, *J* = 18.7, 1.7 Hz), 110.7, 110.5, 105.0, 102.6, 101.9, 57.6, 50.6, 45.7. HRMS (ESI) *m/z*: 397.1331 $[M + H]^+$, calcd for $C_{22}H_{19}N_2O_3F_2$ 397.1358.



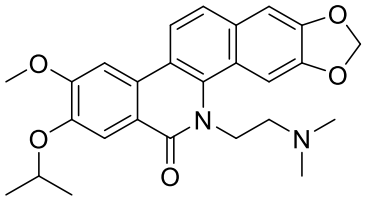
C15

5-(2-(Dimethylamino)ethyl)-[1,3]dioxolo[4',5':4,5]benzo[1,2-c][1,3]dioxolo[4,5-j] phenanthridine-6(5H)-one (C15).[5] The compound **C15** was prepared from **4d**e'. White solid, yield 71%, mp = 183.5–184.2 ºC. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.88–7.77 (m, 2H), 7.60 (s, 1H), 7.53 (s, 1H), 7.48 (d, *J* = 7.6 Hz, 1H), 7.12 (s, 1H), 6.10 (s, 2H), 6.08 (s, 2H), 4.59 (t, *J* = 6.8 Hz, 2H), 2.72 (t, *J* = 6.8 Hz, 2H), 2.16 (s, 6H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 164.6, 152.5, 148.2, 147.7, 147.5, 135.4, 131.9, 131.2, 123.5, 121.3, 121.0, 118.6, 117.6, 106.8, 104.9, 102.7, 102.1, 101.7, 100.8, 57.8, 50.4, 45.8. HRMS (ESI) *m/z*: 405.1442 $[M + H]^+$, calcd for $C_{23}H_{21}N_2O_5$ 405.1445.



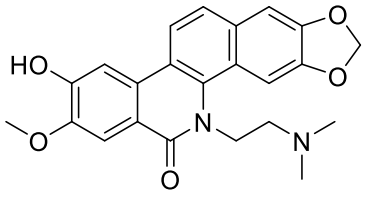
C16

12-(2-(Dimethylamino)ethyl)-2-methoxy-3-isopropoxy-[1,3]dioxolo[4',5':4,5]benzo[1,2-c] phenanthridin-13(12H)-one (C16). The compound **C16** was prepared from **7te'**. White solid, yield 45%, mp = 137.1–137.9 ºC. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.93 (d, *J* = 8.8 Hz, 1H), 7.90 (s, 1H), 7.65 (s, 1H), 7.60 (s, 1H), 7.54 (d, *J* = 8.8 Hz, 1H), 7.17 (s, 1H), 6.09 (s, 2H), 4.87–4.81 (m, 1H), 4.64 (t, *J* = 6.8 Hz, 2H), 4.02 (s, 3H), 2.75 (t, *J* = 6.8 Hz, 2H), 2.20 (s, 6H), 1.50 (d, *J* = 6.8 Hz, 6H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 164.9, 152.2, 150.9, 147.6, 147.5, 135.4, 131.8, 128.9, 123.5, 121.3, 119.6, 118.5, 117.7, 109.4, 106.4, 104.9, 102.7, 101.7, 71.7, 57.9, 56.3, 50.3, 45.8, 22.1. HRMS (ESI) *m/z*: 449.2050 $[M + H]^+$, calcd for $C_{26}H_{29}N_2O_5$ 449.2071.



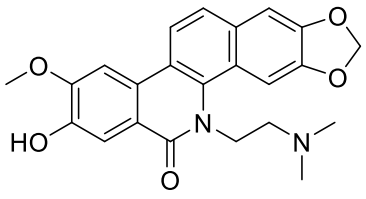
C17

12-(2-(Dimethylamino)ethyl)-2-isopropoxy-3-methoxy-[1,3]dioxolo[4',5':4,5]benzo[1,2-c] phenanthridin-13(12H)-one (C17). The compound **C17** was prepared from **7ue**'. White solid, yield 60%, mp = 154.7–155.2 ºC. ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.96 (d, *J* = 8.5 Hz, 1H), 7.91 (s, 1H), 7.66 (s, 1H), 7.58–7.52 (m, 2H), 7.16 (s, 1H), 6.09 (s, 2H), 4.86–4.78 (m, 1H), 4.62 (t, *J* = 6.8 Hz, 2H), 4.05 (s, 3H), 2.78 (t, *J* = 6.8 Hz, 2H), 2.18 (s, 6H), 1.46 (d, *J* = 5.0 Hz, 6H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 164.9, 154.6, 148.1, 147.6, 147.5, 135.4, 131.7, 128.7, 123.4, 121.2, 119.6, 118.5, 117.6, 111.5, 104.9, 103.4, 102.7, 101.7, 71.3, 57.9, 56.3, 50.4, 45.8, 22.1. HRMS (ESI) *m/z*: 449.2028 $[M + H]^+$, calcd for $C_{26}H_{29}N_2O_5$ 449.2071.



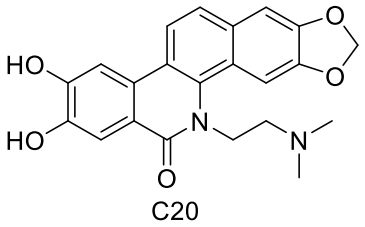
C18

12-(2-(Dimethylamino)ethyl)-2-hydroxy-3-methoxy-[1,3]dioxolo[4',5':4,5]benzo[1,2-c] phenanthridin-13(12H)-one (C18).[5] The compound **C18** was prepared from **4gd'**. White solid, yield 69%, mp = 243.9–246.3 ºC. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.90 (d, *J* = 8.8 Hz, 1H), 7.87 (s, 1H), 7.65 (s, 1H), 7.58 (s, 1H), 7.53 (d, *J* = 8.8 Hz, 1H), 7.15 (s, 1H), 6.07 (s, 2H), 4.70 (t, *J* = 6.8 Hz, 2H), 4.03 (s, 3H), 2.80 (t, *J* = 6.8 Hz, 2H), 2.24 (s, 6H). ^{13}C NMR (100 MHz, DMSO) δ 163.5, 151.9, 148.6, 147.1, 147.0, 134.7, 131.3, 128.8, 123.2, 120.3, 118.6, 117.7, 116.7, 108.8, 107.4, 104.6, 101.9, 101.7, 57.2, 55.6, 49.1, 45.1. HRMS (ESI) *m/z*: 407.1591 $[M + H]^+$, calcd for $C_{23}H_{23}N_2O_5$ 407.1601.



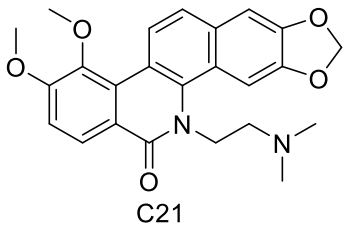
C19

12-(2-(Dimethylamino)ethyl)-2-methoxy-3-hydroxy-[1,3]dioxolo[4',5':4,5]benzo[1,2-c] phenanthridin-13(12H)-one (C19).[5] The compound **C19** was prepared from **4fd'**. White solid, yield 70%, mp = 210.2–213.5 ºC. ^{1}H NMR (400 MHz, DMSO) δ 9.82 (s, 1H), 8.26 (d, *J* = 8.8 Hz, 1H), 7.80 (s, 1H), 7.69 (s, 1H), 7.67–7.61 (m, 2H), 7.40 (s, 1H), 6.18 (s, 2H), 4.50 (t, *J* = 6.8 Hz, 2H), 4.02 (s, 3H), 2.57 (t, *J* = 6.8 Hz, 2H), 1.97 (s, 6H). ^{13}C NMR (100 MHz, DMSO) δ 163.4, 152.9, 147.4, 147.0, 146.9, 134.3, 131.1, 127.4, 123.0, 120.3, 119.1, 119.0, 117.2, 112.2, 104.6, 104.3, 101.9, 101.6, 57.1, 56.0, 49.1, 45.1. HRMS (ESI) *m/z*: 407.1591 $[M + H]^+$, calcd for $C_{23}H_{23}N_2O_5$ 407.1601.



C20

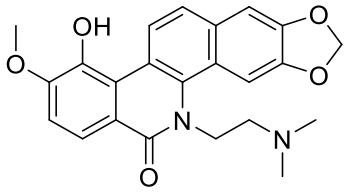
12-(2-(Dimethylamino)ethyl)-2,3-dihydroxy-[1,3]dioxolo[4',5':4,5]benzo[1,2-c] phenanthridin-13(12H)-one (C20).[5] The compound **C20** was prepared from **4hd'**. White solid, yield 15%, mp = 173.6–175.9 ºC. ^{1}H NMR (400 MHz, DMSO) δ 7.97 (d, *J* = 8.8 Hz, 1H), 7.70 (s, 1H), 7.64 (s, 2H), 7.62 (d, *J* = 8.8 Hz, 1H), 7.39 (s, 1H), 6.18 (s, 2H), 4.48 (t, *J* = 6.8 Hz, 2H), 2.55 (t, *J* = 6.8 Hz, 2H), 1.97 (s, 6H). ^{13}C NMR (100 MHz, DMSO) δ 163.5, 151.4, 147.1, 147.0, 146.7, 134.3, 131.1, 127.6, 123.2, 120.4, 118.6, 118.0, 117.1, 112.7, 107.6, 104.6, 101.9, 101.6, 57.3, 49.1, 45.2. HRMS (ESI) *m/z*: 393.1464 $[M + H]^+$, calcd for $C_{22}H_{21}N_2O_5$ 393.1445.



C21

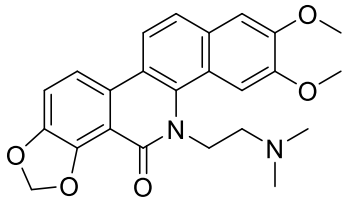
12-(2-(Dimethylamino)ethyl)-3,4-dimethoxy-[1,3]dioxolo[4',5':4,5]benzo[1,2-c] phenanthridin-13(12H)-one (C21).[6] The compound **C21** was prepared from **7ge'**. White solid, yield 25%, mp = 120.8 ºC–121.4 ºC. ^{1}H NMR (400 MHz, $CDCl_3$) δ 9.04 (d, *J* = 8.8 Hz, 1H), 8.34 (d, *J* = 8.8 Hz, 1H), 7.53 (d, *J* = 8.8 Hz, 1H), 7.50 (s, 1H), 7.18 (d, *J* = 8.8 Hz, 1H), 7.16 (s, 1H), 6.08 (s, 2H), 4.62 (t, *J* = 6.8 Hz, 2H), 4.02 (s, 3H), 3.90 (s, 3H), 2.54 (t, *J* = 6.8 Hz, 2H), 2.08 (s, 6H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 165.2, 157.0, 148.0, 147.2, 145.6, 136.2, 132.0, 128.1, 126.0,

123.3, 122.7, 121.1, 120.8, 118.2, 112.2, 104.4, 102.8, 101.6, 60.4, 57.5, 56.3, 50.6, 45.7. HRMS (ESI) *m/z*: 421.1759 $[M + H]^+$, calcd for $C_{24}H_{25}N_2O_5$ 421.1758.



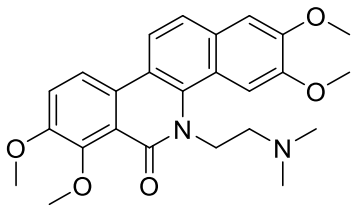
C22

12-(2-(Dimethylamino)ethyl)-3-methoxy-4-hydroxy-[1,3]dioxolo[4',5':4,5]benzo[1,2-c] phenanthridin-13(12H)-one (C22).[6] The compound **C22** was prepared from **7ve'**. White solid, yield 40%, mp = 187.3–189.7 ºC. ^{1}H NMR (400 MHz, $CDCl_3$) δ 9.11 (d, *J* = 8.8 Hz, 1H), 8.14 (d, *J* = 8.8 Hz, 1H), 7.53 (d, *J* = 8.8 Hz, 1H), 7.48 (s, 1H), 7.15 (s, 1H), 7.12 (d, *J* = 8.8 Hz, 1H), 6.86 (s, 1H), 6.07 (s, 2H), 4.65 (t, *J* = 6.8 Hz, 2H), 4.04 (s, 3H), 2.56 (t, *J* = 6.8 Hz, 2H), 2.10 (s, 6H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 165.3, 149.6, 147.8, 147.1, 142.4, 135.5, 131.6, 123.5, 123.0, 121.4, 121.1, 121.0, 120.9, 118.8, 110.2, 104.4, 102.5, 101.5, 57.3, 56.7, 50.4, 45.6. HRMS (ESI) *m/z*: 405.1607 $[M + H]^+$, calcd for $C_{23}H_{23}N_2O_5$ 407.1601.



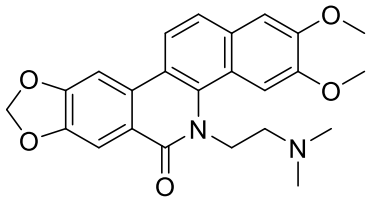
C23

12-(2-(Dimethylamino)ethyl)-9,10-dimethoxybenzo[c][1,3]dioxolo[4,5-i]phenanthridin-13(12H)-one (C23).[5] The compound **C23** was prepared from **7df'**. White solid, yield 45%, mp = 183.3–181.4 ºC. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.96 (d, *J* = 8.8 Hz, 1H), 7.73 (d, *J* = 8.8 Hz, 1H), 7.55 (d, *J* = 8.8 Hz, 1H), 7.51 (s, 1H), 7.23 (d, *J* = 8.8 Hz, 1H), 7.15 (s, 1H), 6.26 (s, 2H), 4.62 (t, *J* = 6.8 Hz, 2H), 4.08 (s, 3H), 4.03 (s, 3H), 2.79 (t, *J* = 6.8 Hz, 2H), 2.14 (s, 6H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 163.3, 149.6, 148.8, 147.9, 147.8, 134.4, 130.6, 129.2, 123.2, 120.1, 118.7, 117.8, 115.5, 113.4, 111.3, 107.3, 105.1, 103.0, 57.8, 56.2, 56.1, 49.9, 45.8. HRMS (ESI) *m/z*: 421.1776 $[M + H]^+$, calcd for $C_{24}H_{25}N_2O_5$ 421.1758.



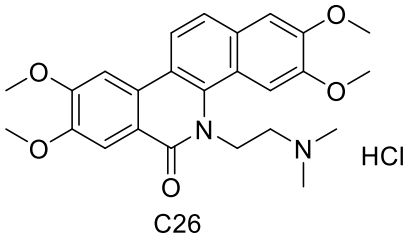
C24

5-(2-(Dimethylamino)ethyl)-2,3,7,8-tetramethoxybenzo[c]phenanthridin-6(5H)-one (C24).[6] The compound **C24** was prepared from **7ef'**. White solid, yield 40%, mp = 173.5–175.9 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.97 (d, *J* = 8.8 Hz, 1H), 7.94 (d, *J* = 8.8 Hz, 1H), 7.55 (d, *J* = 8.8 Hz, 1H), 7.51 (s, 1H), 7.37 (d, *J* = 8.8 Hz, 1H), 7.15 (s, 1H), 4.61 (t, *J* = 6.8 Hz, 2H), 4.09 (s, 3H), 4.07 (s, 3H), 4.03 (s, 3H), 3.98 (s, 3H), 2.76 (t, *J* = 6.8 Hz, 2H), 2.12 (s, 6H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 163.2, 152.7, 150.6, 149.6, 148.9, 134.4, 130.5, 129.4, 123.0, 120.1, 120.0, 118.4, 118.2, 117.8, 117.8, 107.3, 105.2, 61.9, 57.8, 56.8, 56.3, 56.0, 49.7, 45.6. HRMS (ESI) *m/z*: 437.2096 $[M + H]^+$, calcd for $C_{25}H_{29}N_2O_5$ 437.2071.



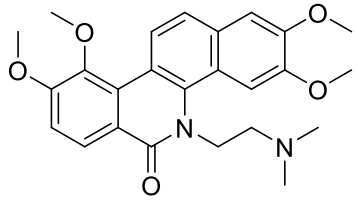
C25

5-(2-(Dimethylamino)ethyl)-2,3-dimethoxybenzo[c][1,3]dioxolo[4,5-j]phenanthridin-6(5H)-one (C25).[5] The compound **C25** was prepared from **4de'**. White solid, yield 80%, mp = 195.6–197.2 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.90 (d, *J* = 8.8 Hz, 1H), 7.86 (s, 1H), 7.60–7.53 (m, 3H), 7.17 (s, 1H), 6.12 (s, 2H), 4.70 (t, *J* = 6.8 Hz, 2H), 4.10 (s, 3H), 4.04 (s, 3H), 2.81 (t, *J* = 6.8 Hz, 2H), 2.17 (s, 6H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 164.6, 152.6, 149.6, 148.7, 148.2, 134.7, 131.5, 130.7, 123.0, 121.1, 119.8, 118.5, 117.2, 107.34, 106.8, 105.2, 102.1, 100.8, 57.9, 56.3, 56.1, 50.1, 45.7. HRMS (ESI) *m/z*: 421.1745 $[M + H]^+$, calcd for $C_{24}H_{25}N_2O_5$ 421.1758.



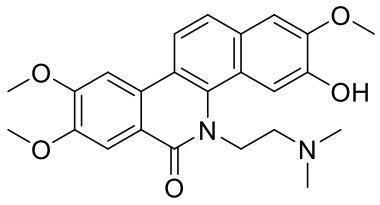
C26

5-(2-(Dimethylamino)ethyl)-2,3,8,9-tetramethoxybenzo[c]phenanthridin-6(5H)-one (C26).[5] The compound **C26** was prepared from **4ee'** as a hydrochloric acid salt. White solid, yield 80%, mp = 195.5–197.8 °C. ^{1}H NMR (400 MHz, D_2O) δ 6.91 (d, *J* = 8.8 Hz, 1H), 6.78 (s, 1H), 6.74 (d, *J* = 8.8 Hz, 1H), 6.41 (s, 1H), 6.34 (s, 1H), 5.75 (s, 1H), 3.86 (t, *J* = 6.8 Hz, 2H), 3.70 (s, 3H), 3.67 (s, 3H), 3.66 (s, 3H), 3.61 (s, 3H), 3.32 (t, *J* = 6.8 Hz, 2H), 2.88 (s, 6H). ^{13}C NMR (100 MHz, D_2O) δ 164.5, 152.7, 148.2, 147.6, 147.1, 130.5, 129.4, 128.6, 123.1, 117.2, 116.4, 115.5, 115.2, 106.9, 105.9, 102.4, 101.8, 57.9, 55.6, 55.5, 55.1, 55.1, 47.0, 43.5. HRMS (ESI) *m/z*: 437.2064 $[M + H]^+$, calcd for $C_{25}H_{29}N_2O_5$ 437.2071.



C27

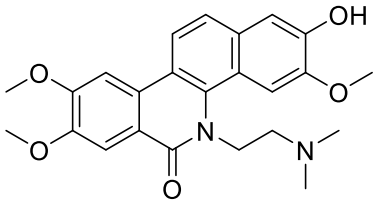
5-(2-(Dimethylamino)ethyl)-2,3,9,10-tetramethoxybenzo[c]phenanthridin-6(5H)-one (C27).[6] The compound **C27** was prepared from **7gf'**. White solid, yield 15%, mp = 126.6–127.5 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 9.05 (d, *J* = 8.8 Hz, 1H), 8.34 (d, *J* = 8.8 Hz, 1H), 7.57 (d, *J* = 8.8 Hz, 1H), 7.42 (s, 1H), 7.19 (d, *J* = 8.8 Hz, 1H), 7.16 (s, 1H), 4.72 (t, *J* = 6.8 Hz, 2H), 4.06 (s, 3H), 4.04 (s, 3H), 4.02 (s, 3H), 3.91 (s, 3H), 2.59 (t, *J* = 6.8 Hz, 2H), 2.09 (s, 6H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 165.2, 157.0, 145.0, 148.5 145.6, 135.3, 130.8, 128.3, 126.0, 122.7, 122.6, 120.7, 119.9, 117.8, 112.1, 106.8, 105.3, 60.4, 57.4, 56.3, 56.2, 56.1, 50.0, 45.4. HRMS (ESI) *m/z*: 437.2087 $[M + H]^+$, calcd for $C_{25}H_{29}N_2O_5$ 437.2071.



C28

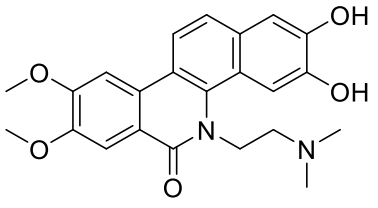
5-(2-(Dimethylamino)ethyl)-3-hydroxy-2,8,9-trimethoxybenzo[c]phenanthridin-6(5H)-one (C28).[5] The compound **C28** was prepared from **4ef'**. White solid, yield 85%, mp = 220.0–223.1 °C. ^{1}H NMR (400 MHz, DMSO) δ 9.69 (s, 1H), 8.22 (d, *J* = 8.8 Hz, 1H), 7.82 (s, 1H), 7.71 (s, 1H), 7.66 (d, *J* = 8.8 Hz, 1H), 7.59 (s, 1H), 7.41 (s, 1H), 4.62 (t, *J* = 6.8 Hz, 2H), 4.02 (s, 3H), 3.94 (s, 3H), 3.91 (s, 3H), 2.47 (t, *J* = 6.8 Hz, 2H), 1.93 (s, 6H). ^{13}C NMR (100 MHz, DMSO) δ 163.5, 153.5, 149.1, 148.8, 146.2, 133.4, 129.6, 128.9, 122.8, 119.6, 118.5, 118.1, 116.3, 108.2, 108.1,

107.7, 103.9, 56.8, 56.1, 55.6, 55.5, 48.4, 45.1. HRMS (ESI) *m/z*: 423.1916 $[M + H]^+$, calcd for $C_{24}H_{27}N_2O_5$ 423.1914.



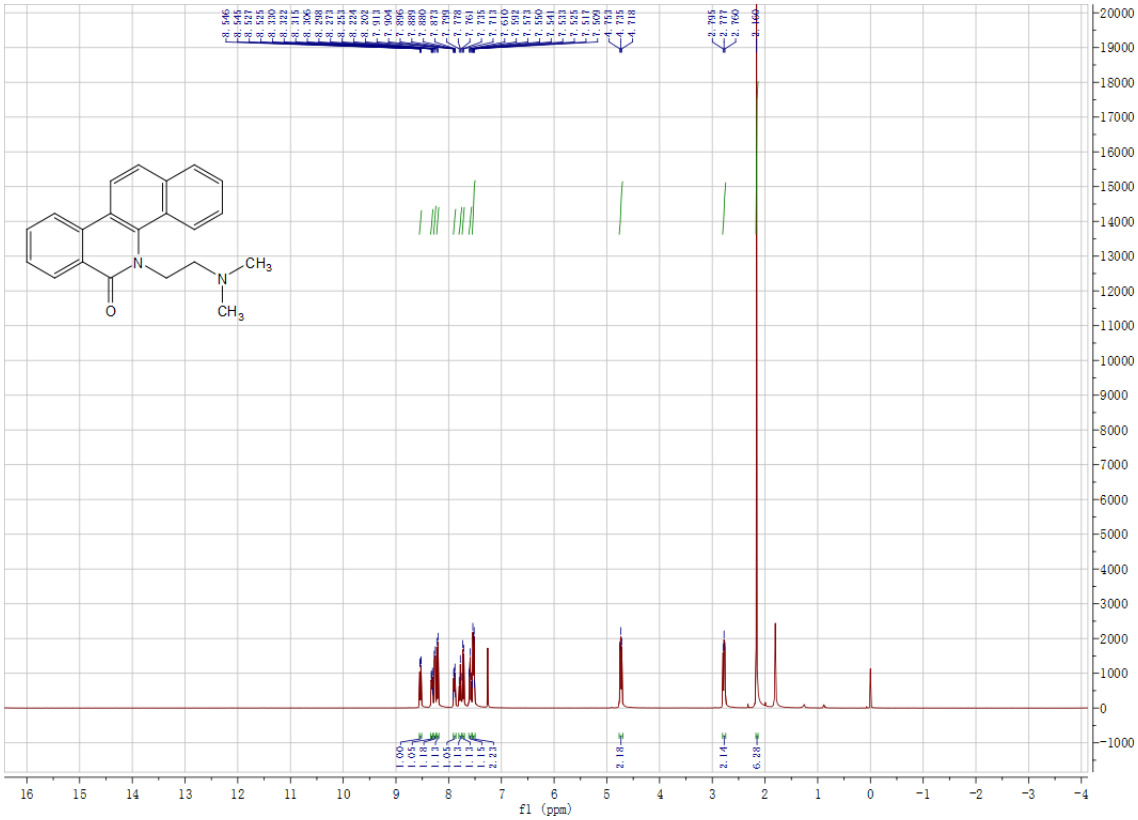
C29

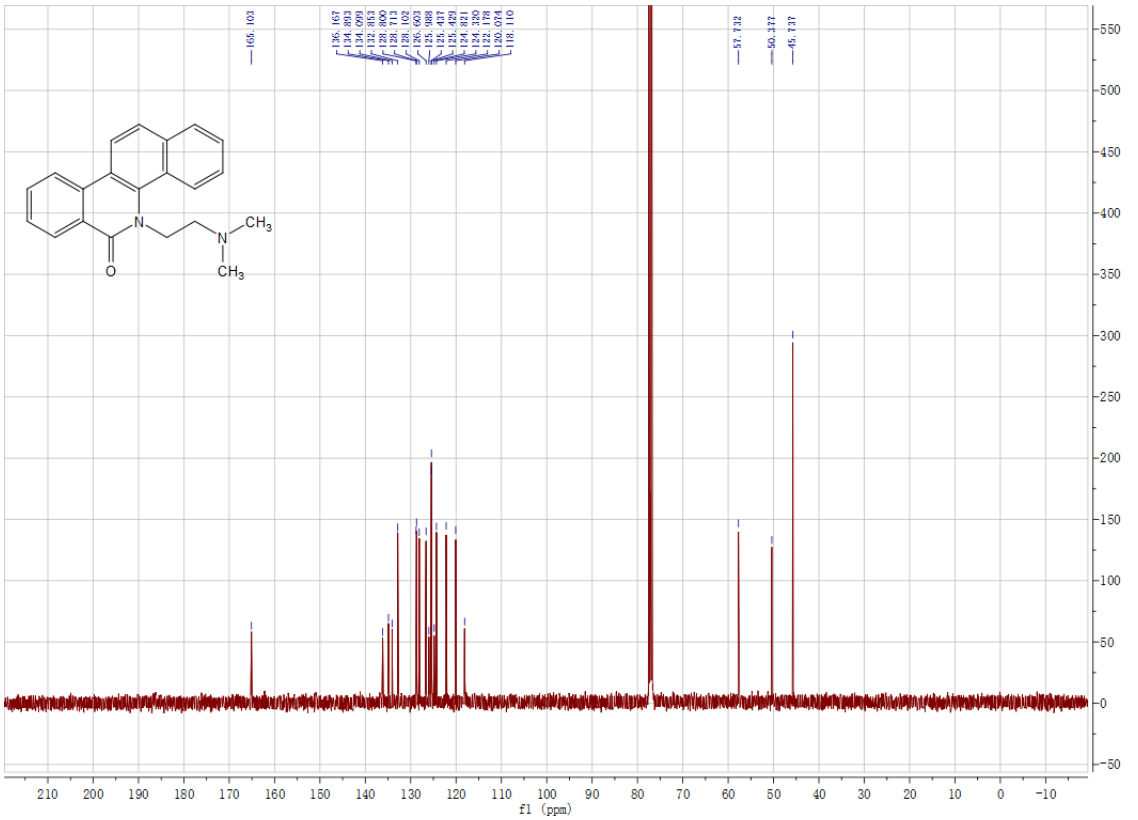
5-(2-(Dimethylamino)ethyl)-2-hydroxy-3,8,9-trimethoxybenzo[c]phenanthridin-6(5H)-one (C29).[5] The compound **C29** was prepared from **4eg'**. White solid, yield 80%, mp = 222.6–224.5 °C. ^{1}H NMR (400 MHz, DMSO) δ 9.79 (s, 1H), 8.23 (d, *J* = 8.8 Hz, 1H), 7.82 (s, 1H), 7.71 (s, 1H), 7.58 (d, *J* = 8.8 Hz, 1H), 7.56 (s, 1H), 7.24 (s, 1H), 4.59 (t, *J* = 6.8 Hz, 2H), 4.02 (s, 3H), 4.01 (s, 3H), 3.91 (s, 3H), 2.69 (t, *J* = 6.8 Hz, 2H), 1.99 (s, 6H). ^{13}C NMR (100 MHz, DMSO) δ 163.4, 153.5, 149.1, 148.0, 147.2, 134.2, 130.6, 129.0, 122.1, 118.8, 118.5, 118.2, 115.6, 110.8, 108.1, 105.3, 103.8, 57.3, 56.1, 55.7, 55.6, 49.3, 45.2. HRMS (ESI) *m/z*: 423.1918 $[M + H]^+$, calcd for $C_{24}H_{27}N_2O_5$ 423.1914.



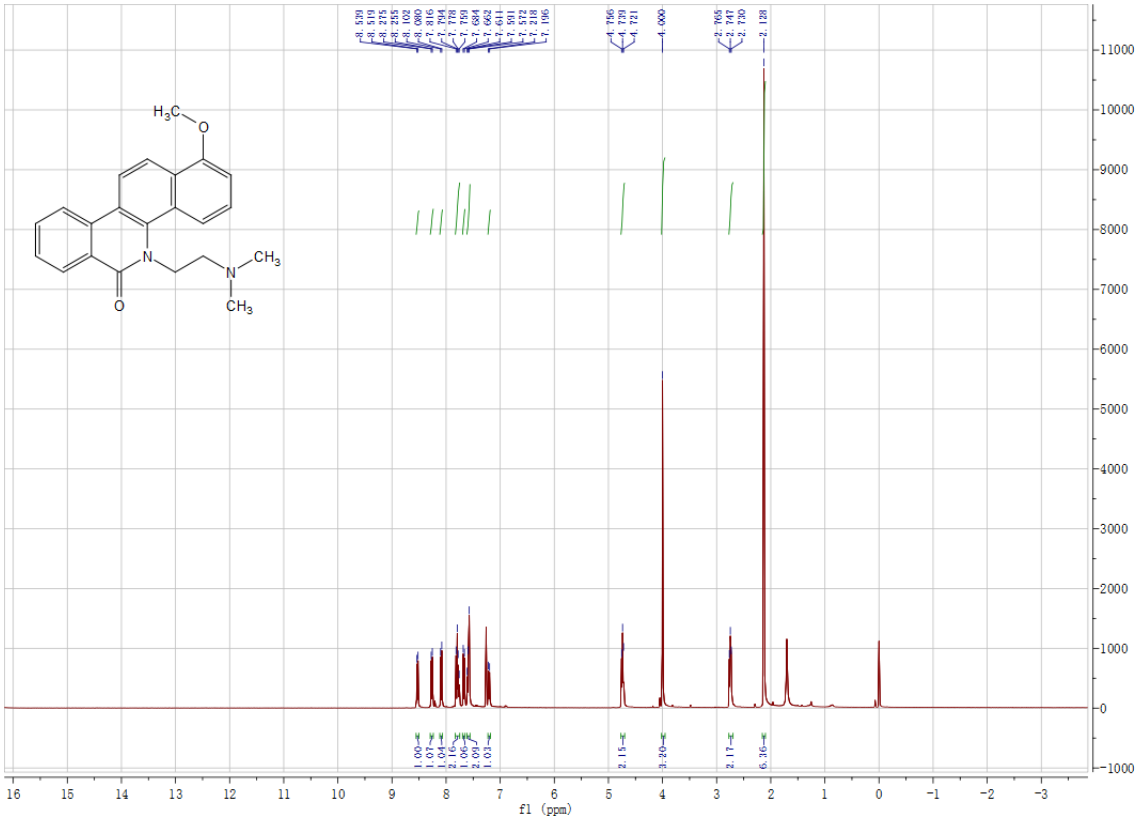
C30

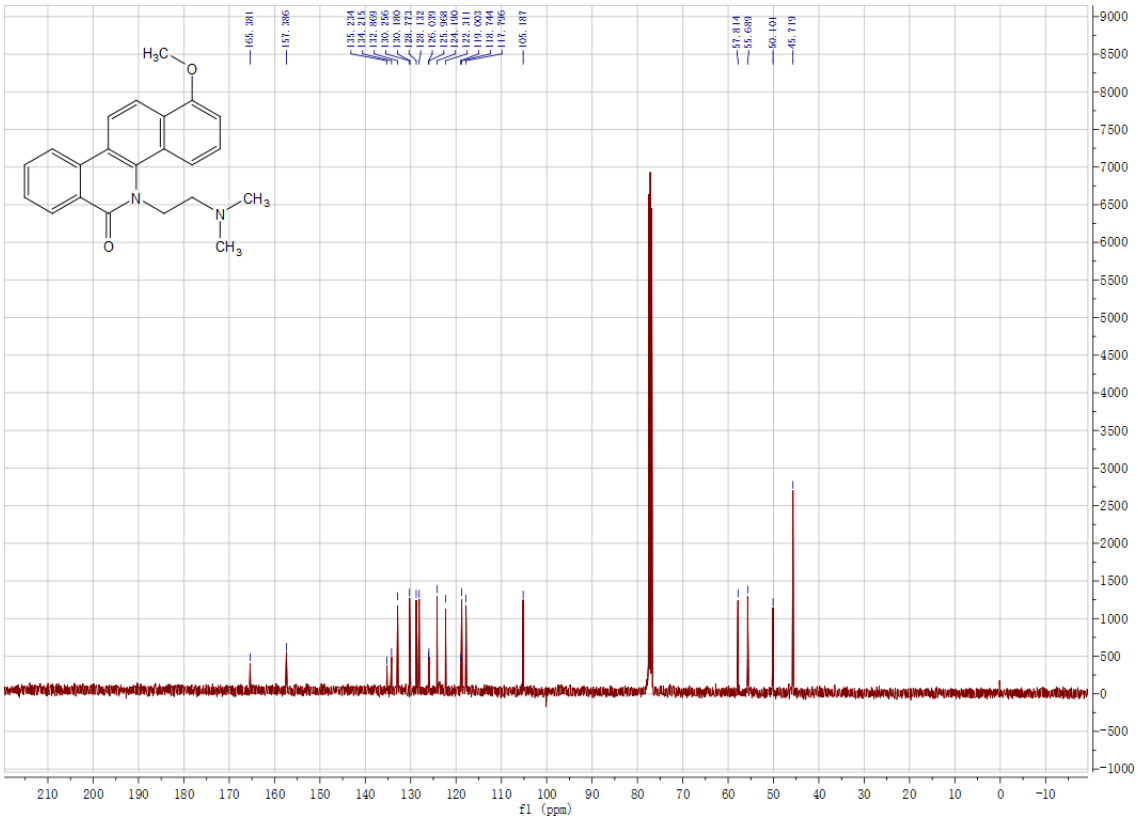
5-(2-(Dimethylamino)ethyl)-2,3-dihydroxy-8,9-dimethoxybenzo[c]phenanthridin-6(5H)-one (C30).[5] The compound **C30** was prepared from **4eh'**. White solid, yield 50%, mp = 159.6–162.8 °C. ^{1}H NMR (400 MHz, DMSO) δ 9.79 (s, 2H), 8.15 (d, *J* = 8.8 Hz, 1H), 7.80 (s, 1H), 7.71 (s, 1H), 7.55 (d, *J* = 8.8 Hz, 1H), 7.53 (s, 1H), 7.21 (s, 1H), 4.63 (t, *J* = 6.8 Hz, 2H), 4.02 (s, 3H), 3.91 (s, 3H), 2.55 (t, *J* = 6.8 Hz, 2H), 1.99 (s, 6H). ^{13}C NMR (100 MHz, DMSO) δ 163.5, 153.5, 149.0, 146.9, 146.0, 133.5, 129.9, 129.1, 122.3, 119.1, 118.3, 117.8, 115.7, 110.8, 108.3, 108.2, 103.8, 56.7, 56.1, 55.6, 48.4, 45.0. HRMS (ESI) *m/z*: 409.1738 $[M + H]^+$, calcd for $C_{23}H_{25}N_2O_5$ 409.1758.



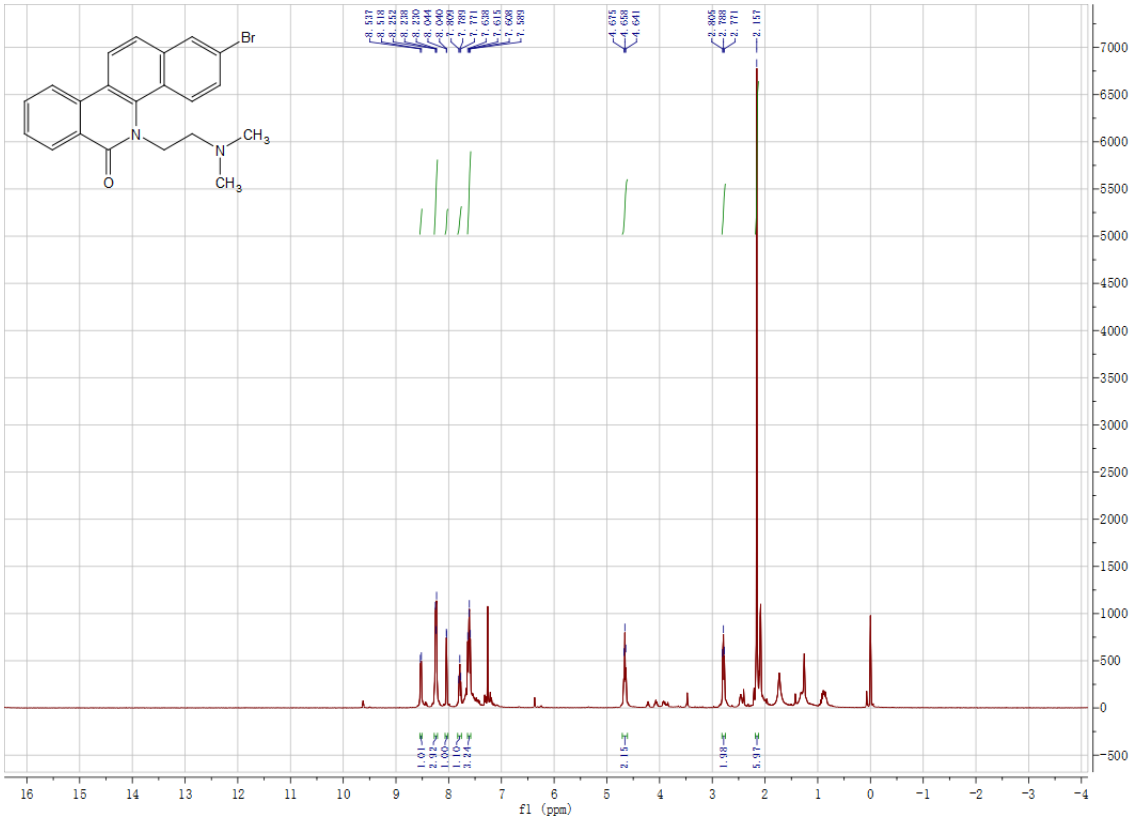


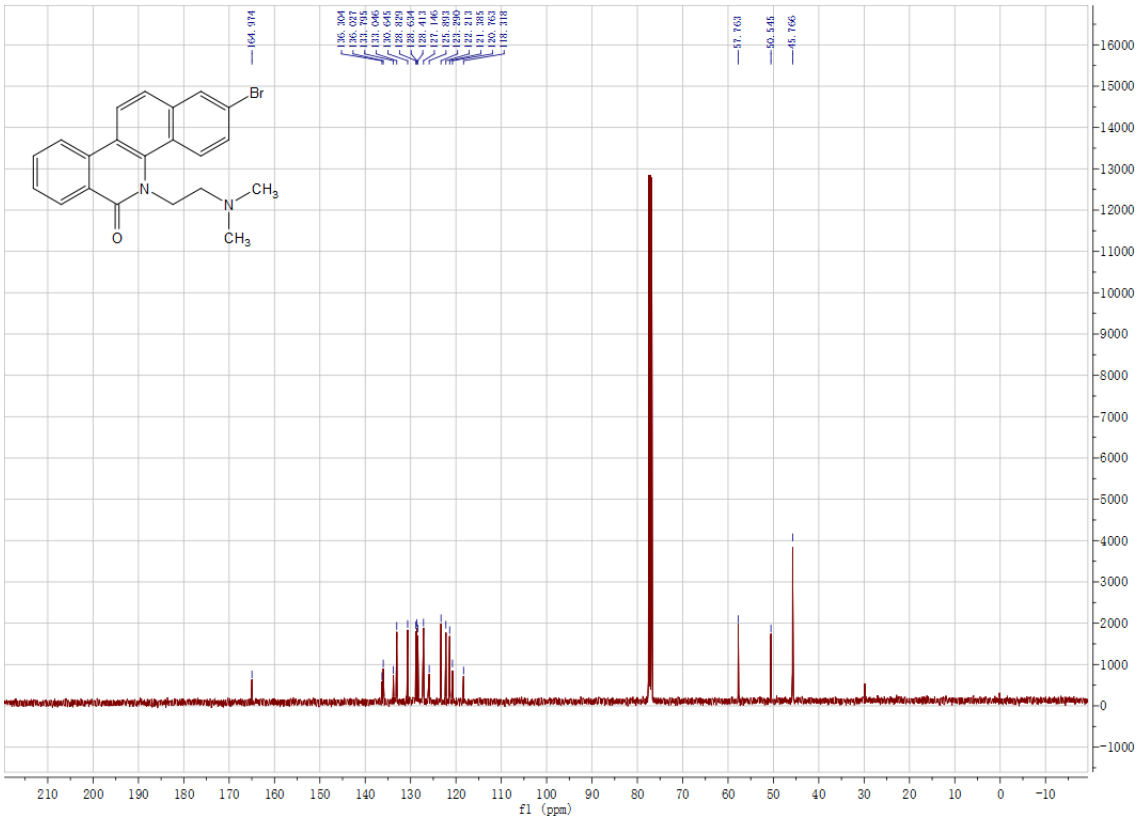
^{1}H NMR and ^{13}C NMR spectra of compound **A1**



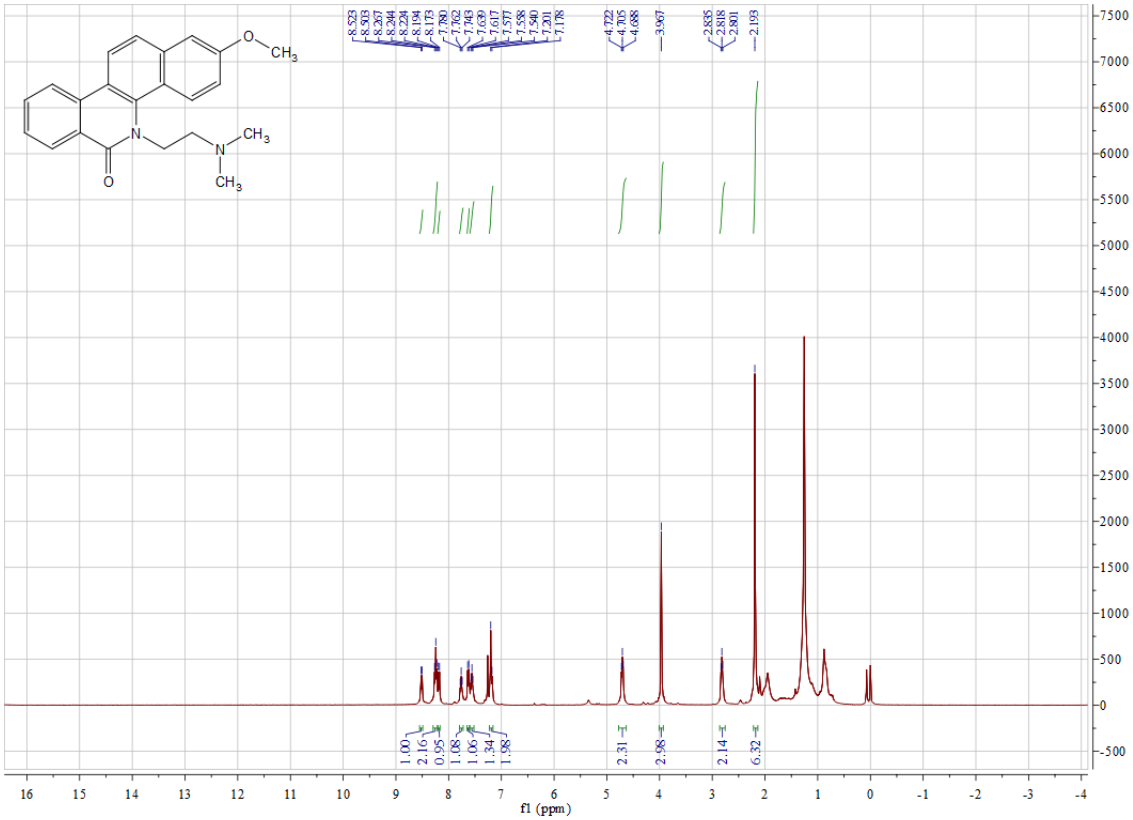


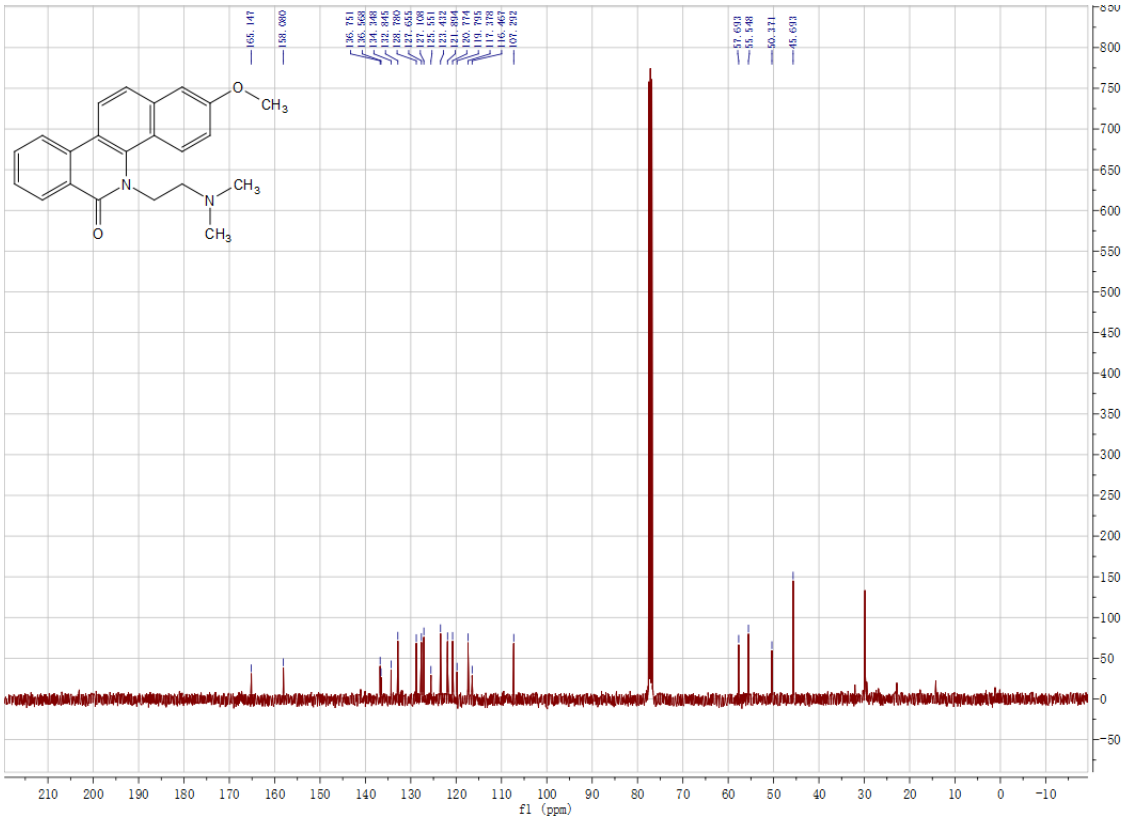
^{1}H NMR and ^{13}C NMR spectra of compound **A2**



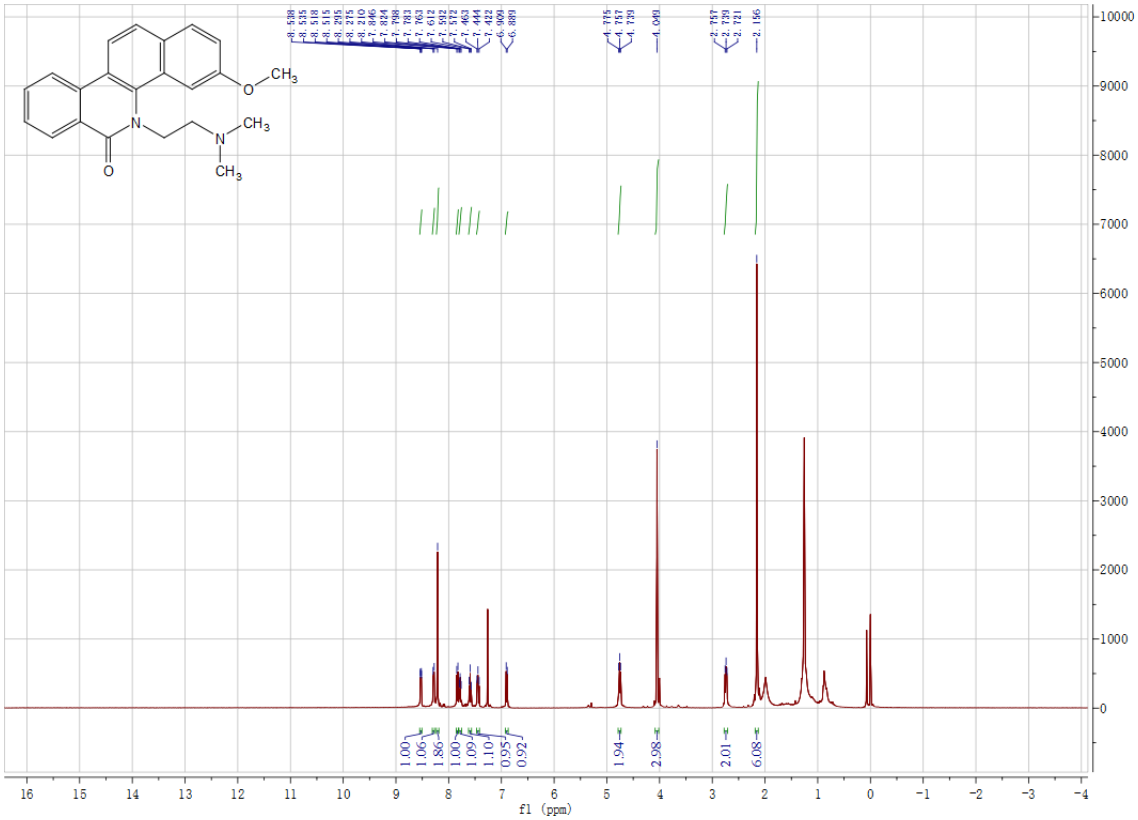


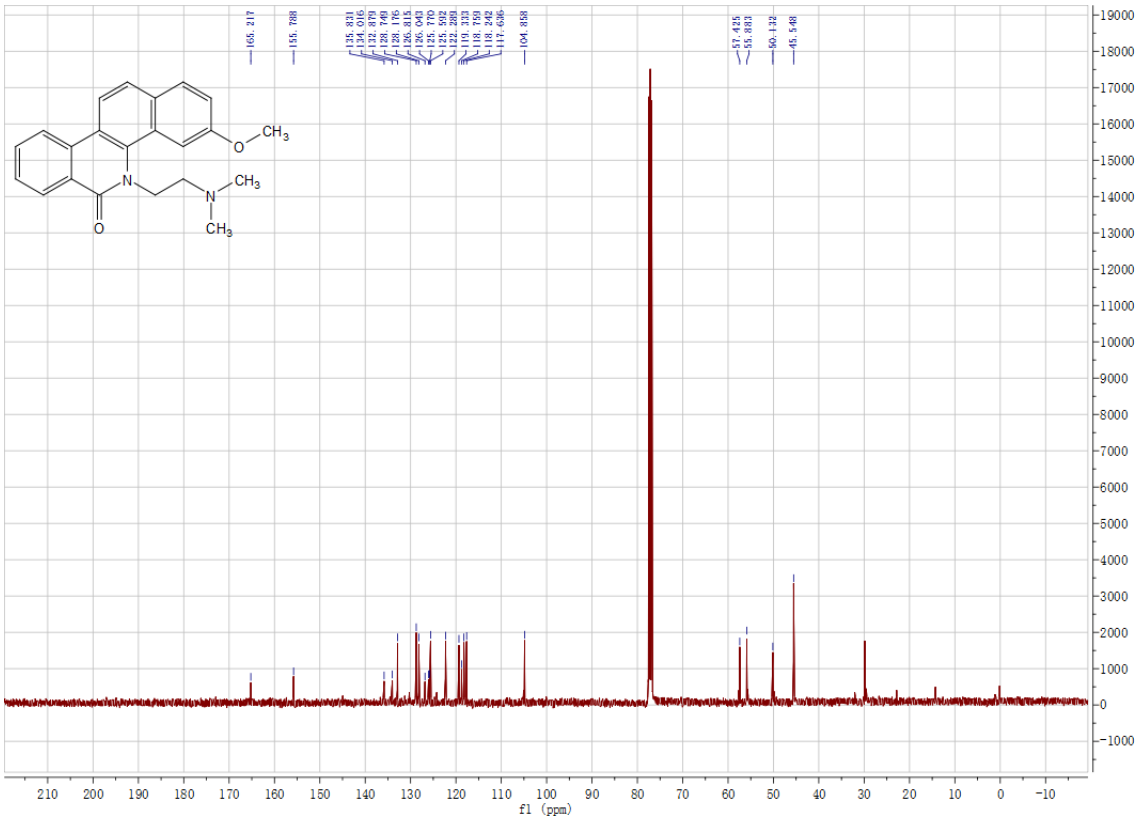
^{1}H NMR and ^{13}C NMR spectra of compound **A3**



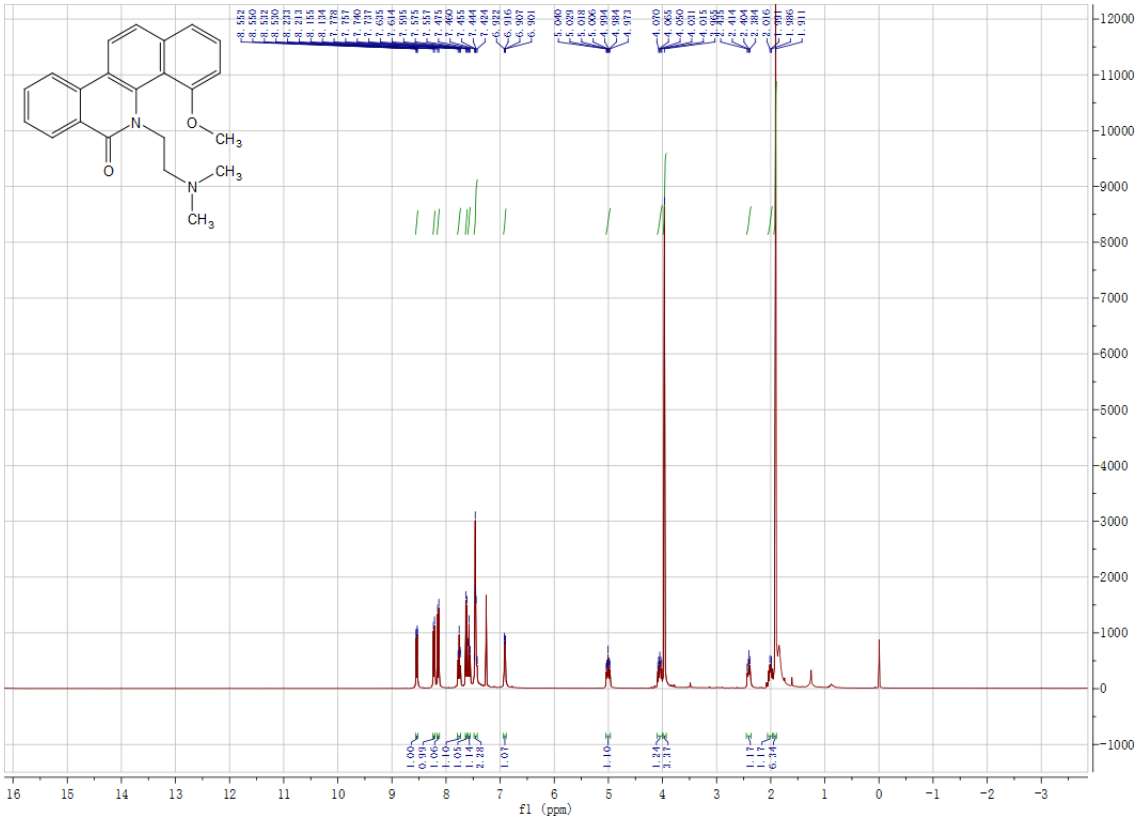


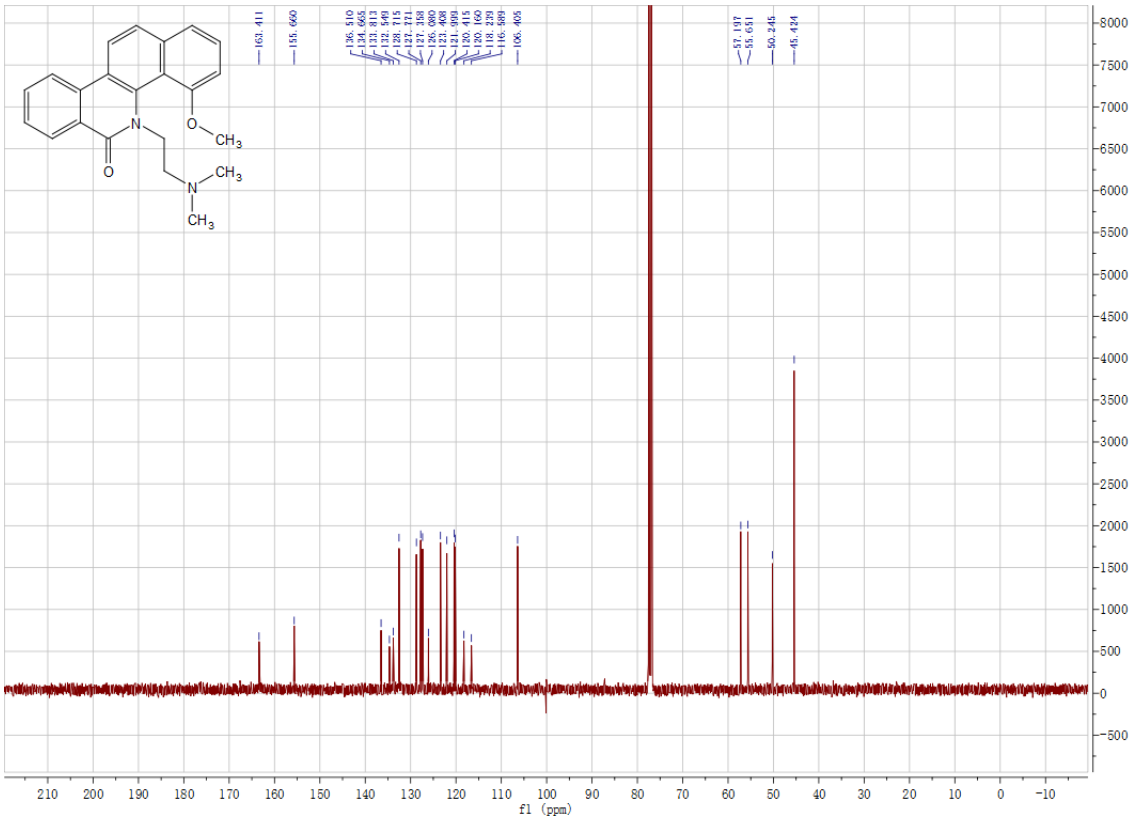
^{1}H NMR and ^{13}C NMR spectra of compound **A4**



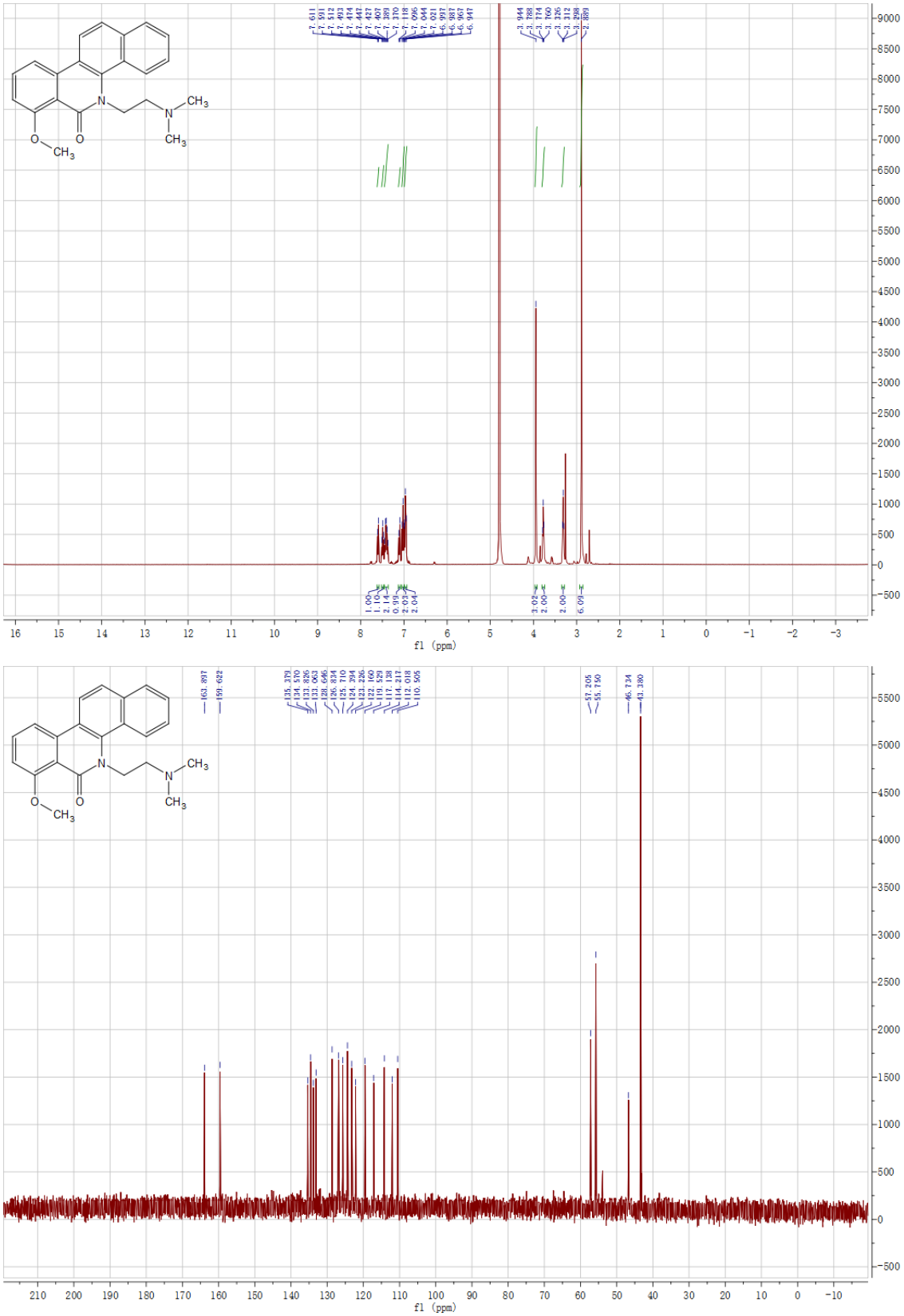


^{1}H NMR and ^{13}C NMR spectra of compound **A5**

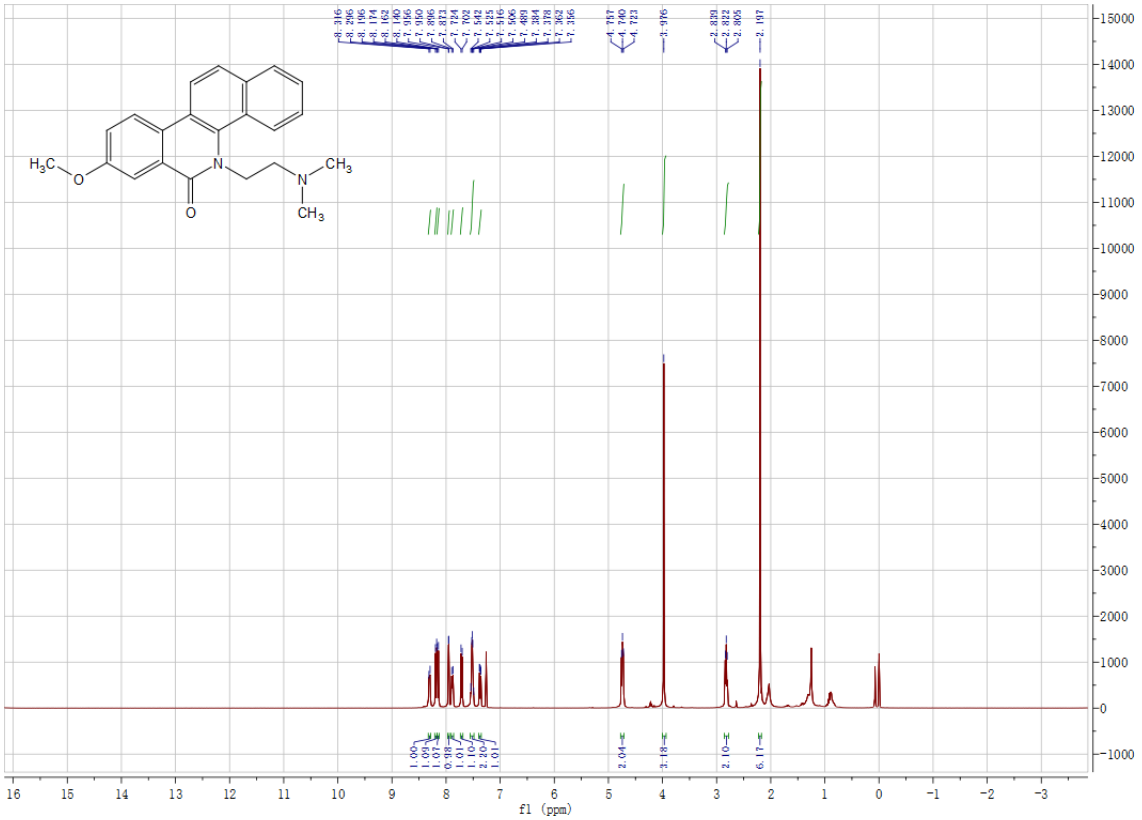


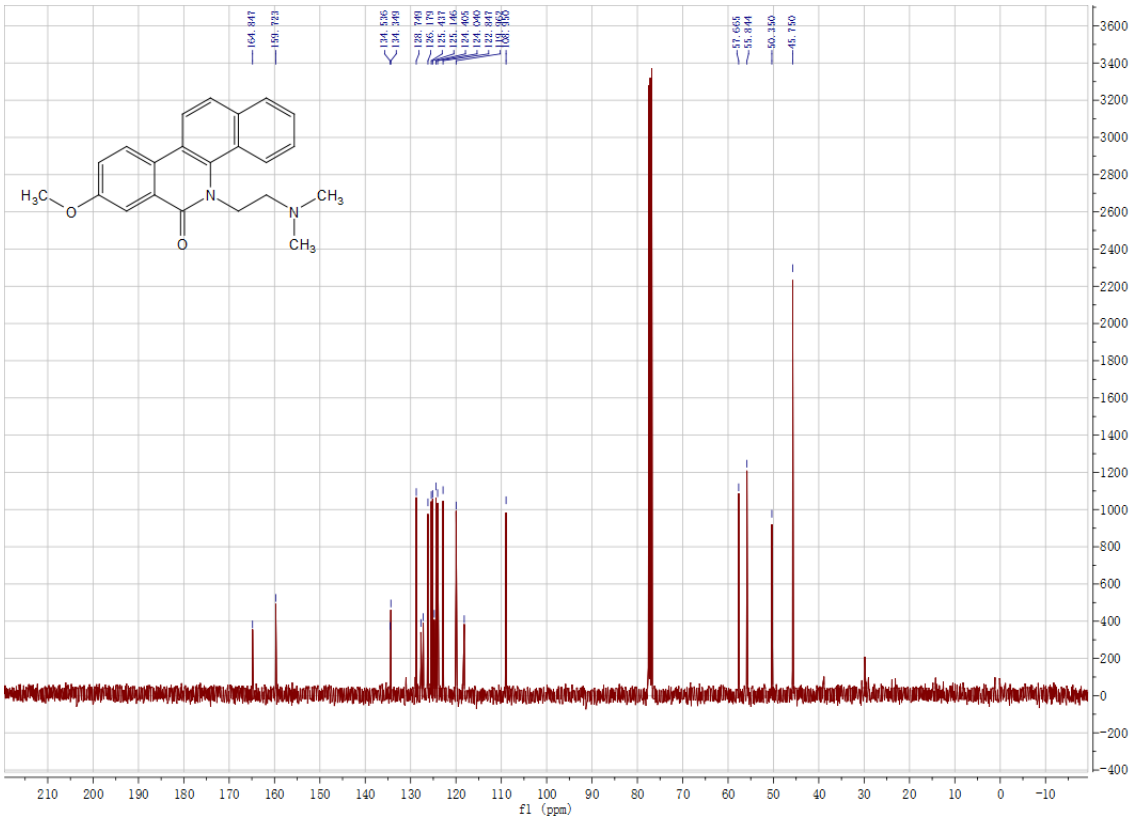


^{1}H NMR and ^{13}C NMR spectra of compound **A6**

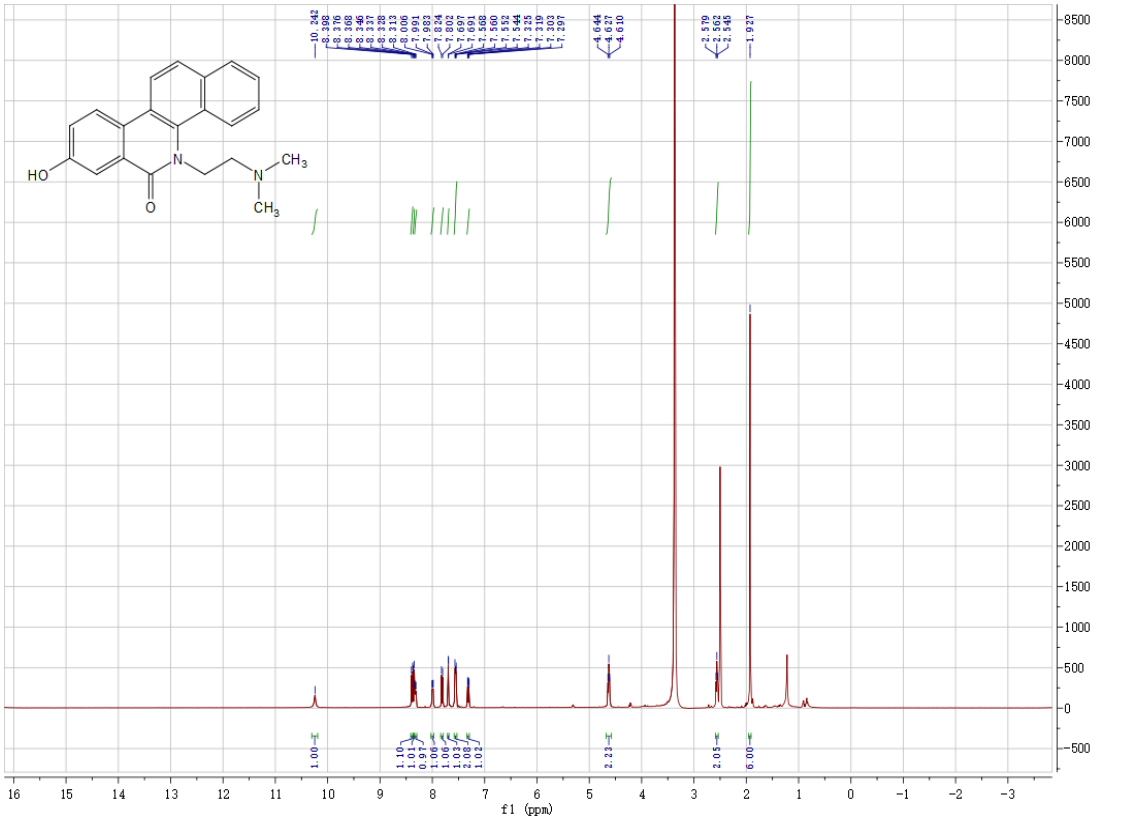


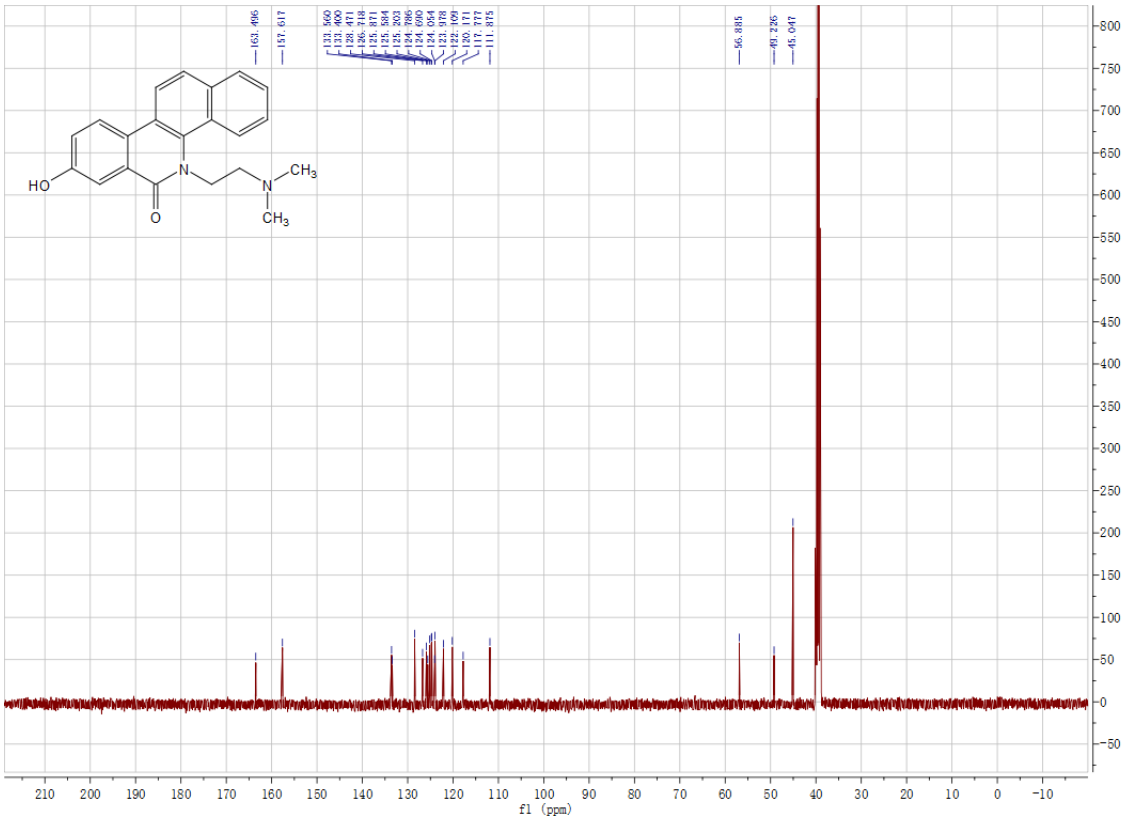
^{1}H NMR and ^{13}C NMR spectra of compound **A7**



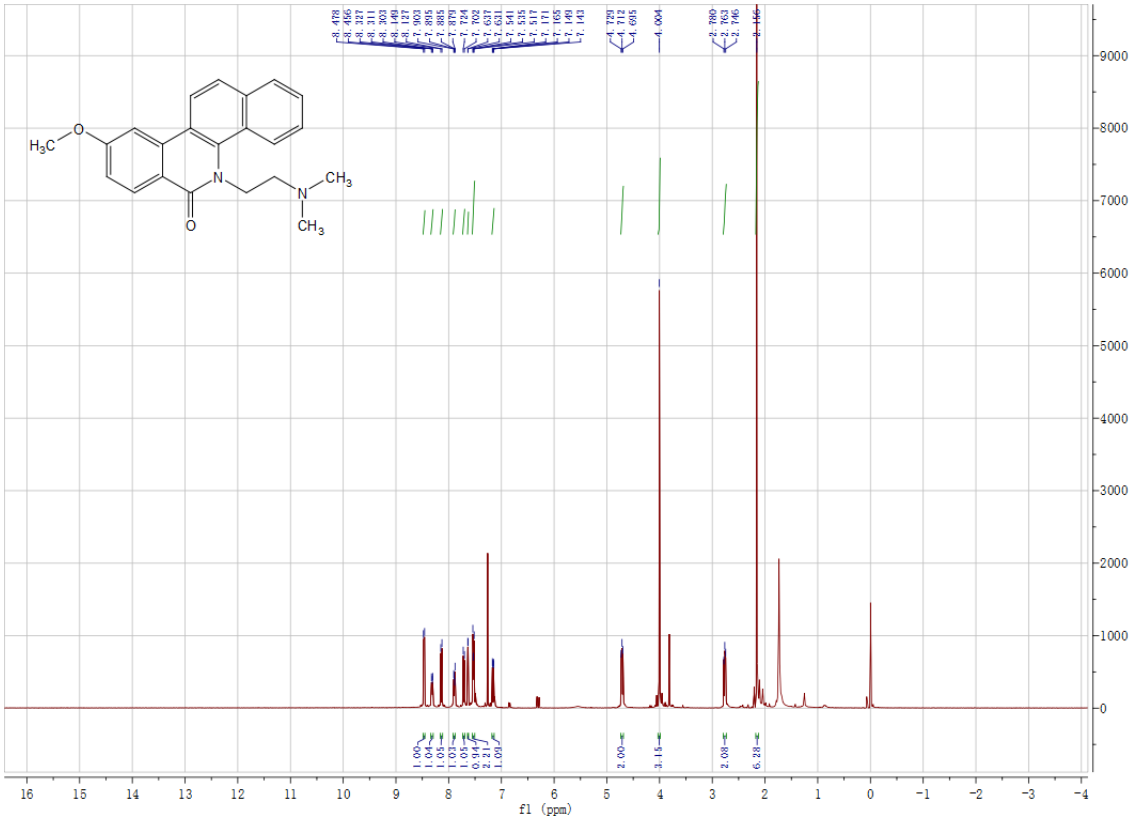


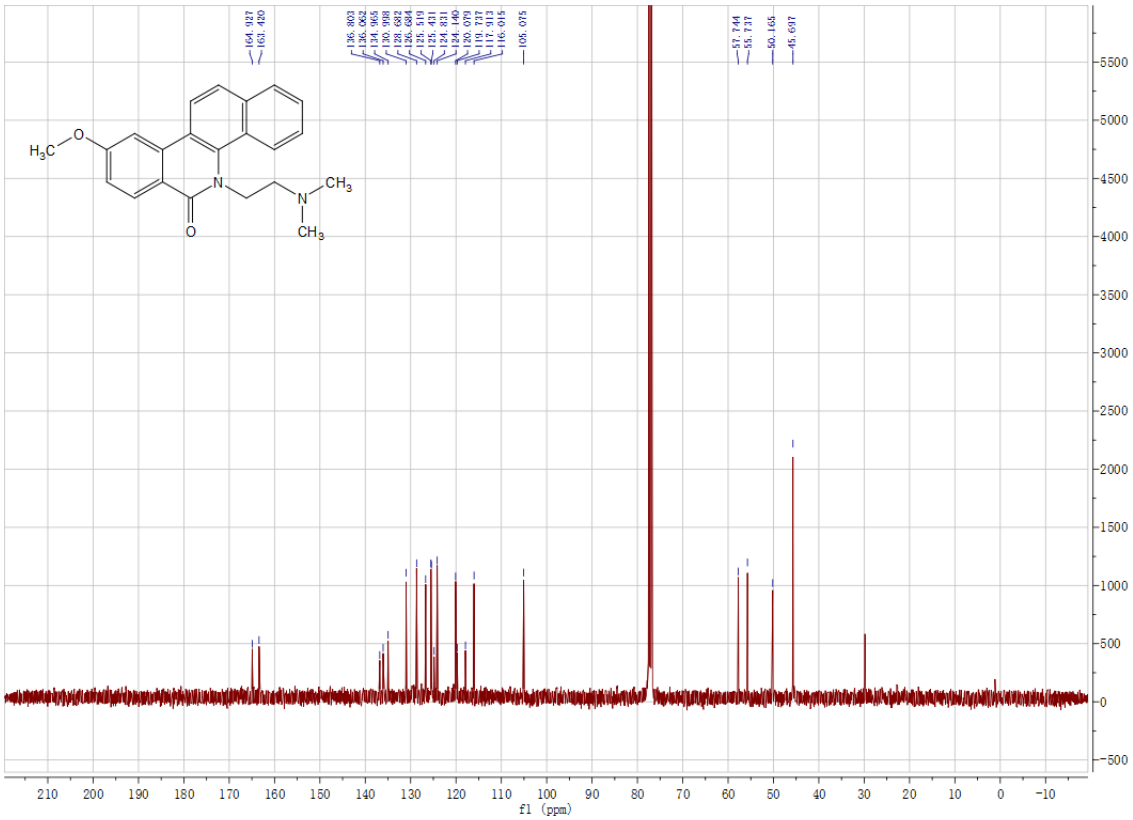
^{1}H NMR and ^{13}C NMR spectra of compound **A8**



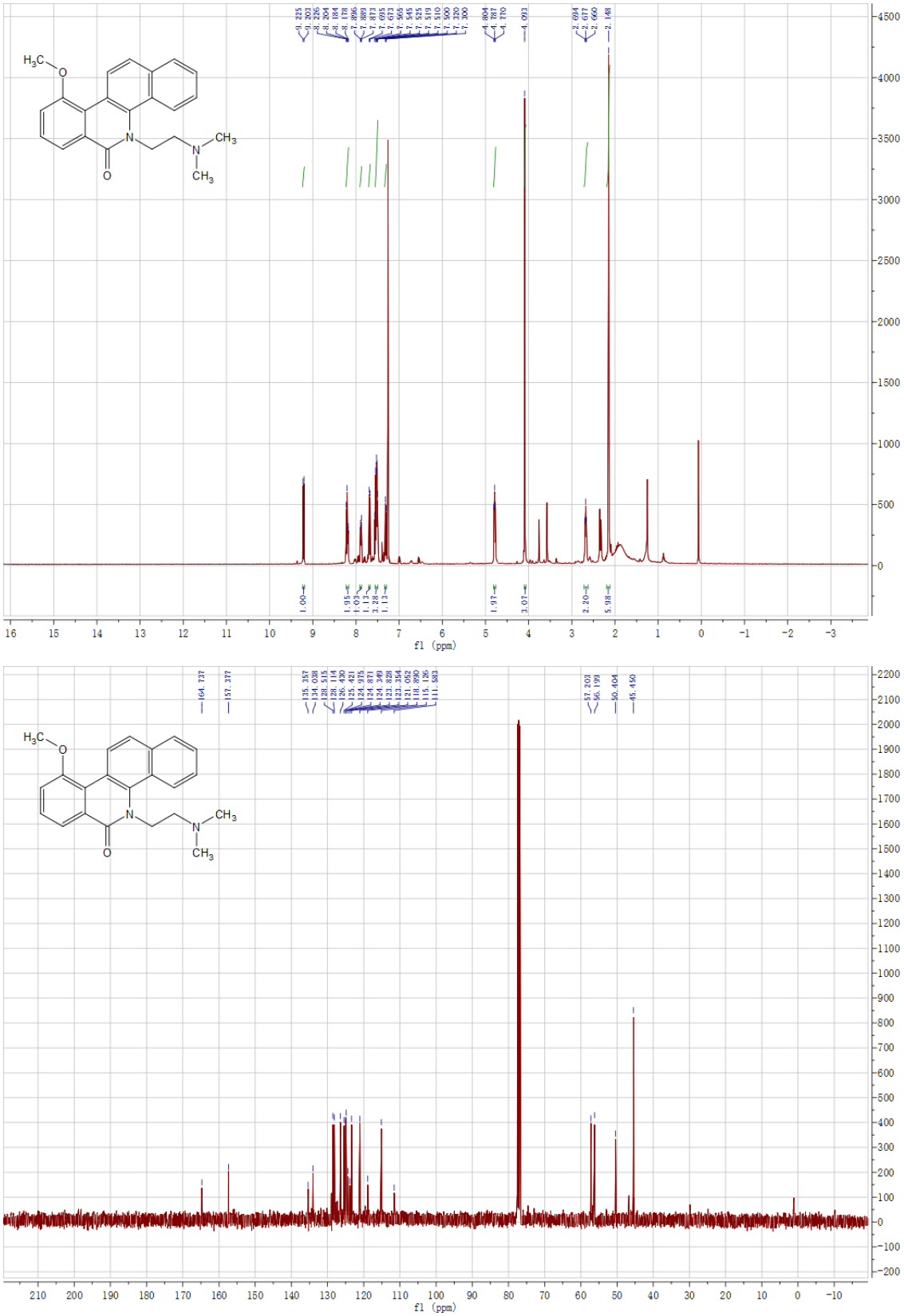


^{1}H NMR and ^{13}C NMR spectra of compound **A9**

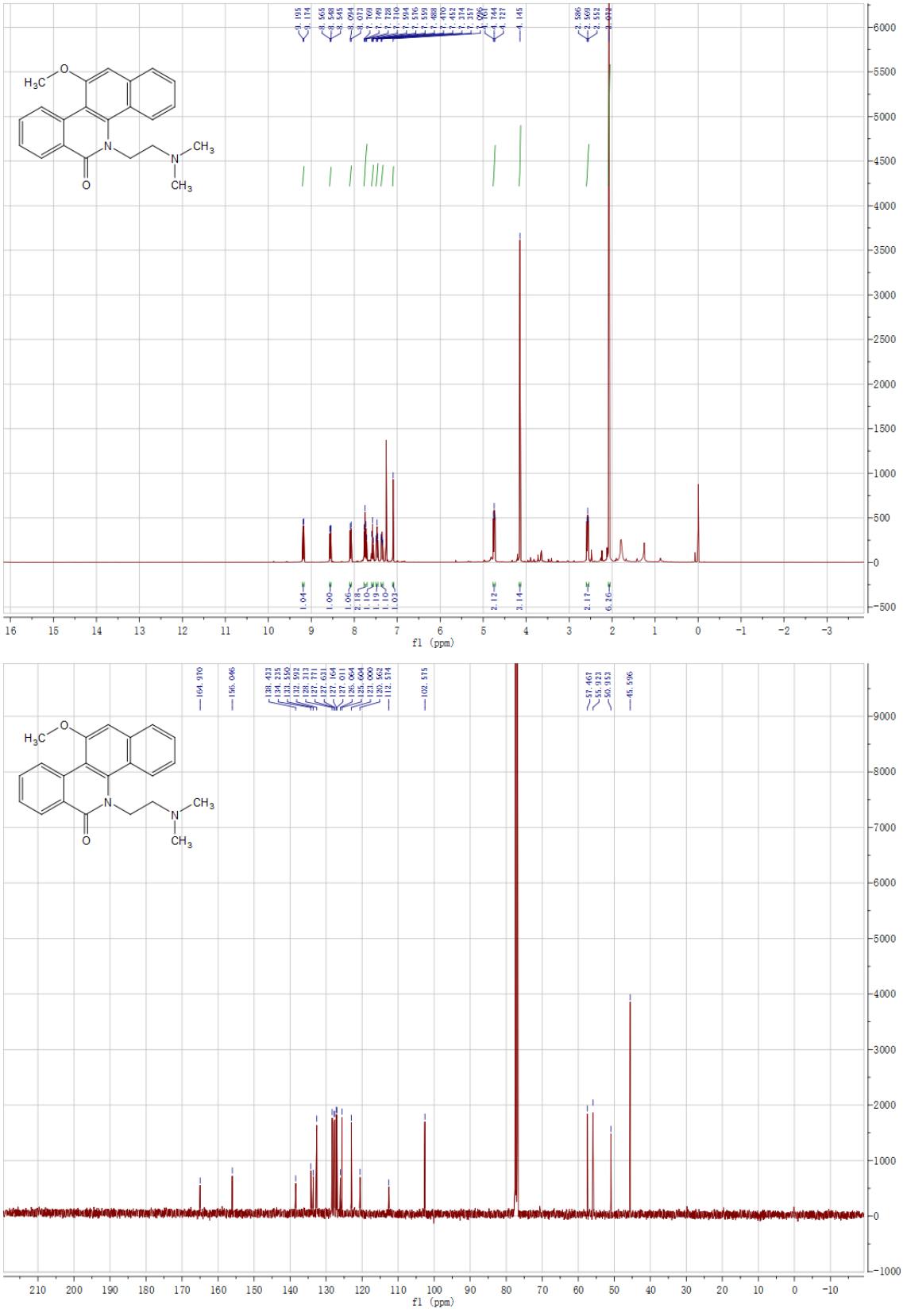




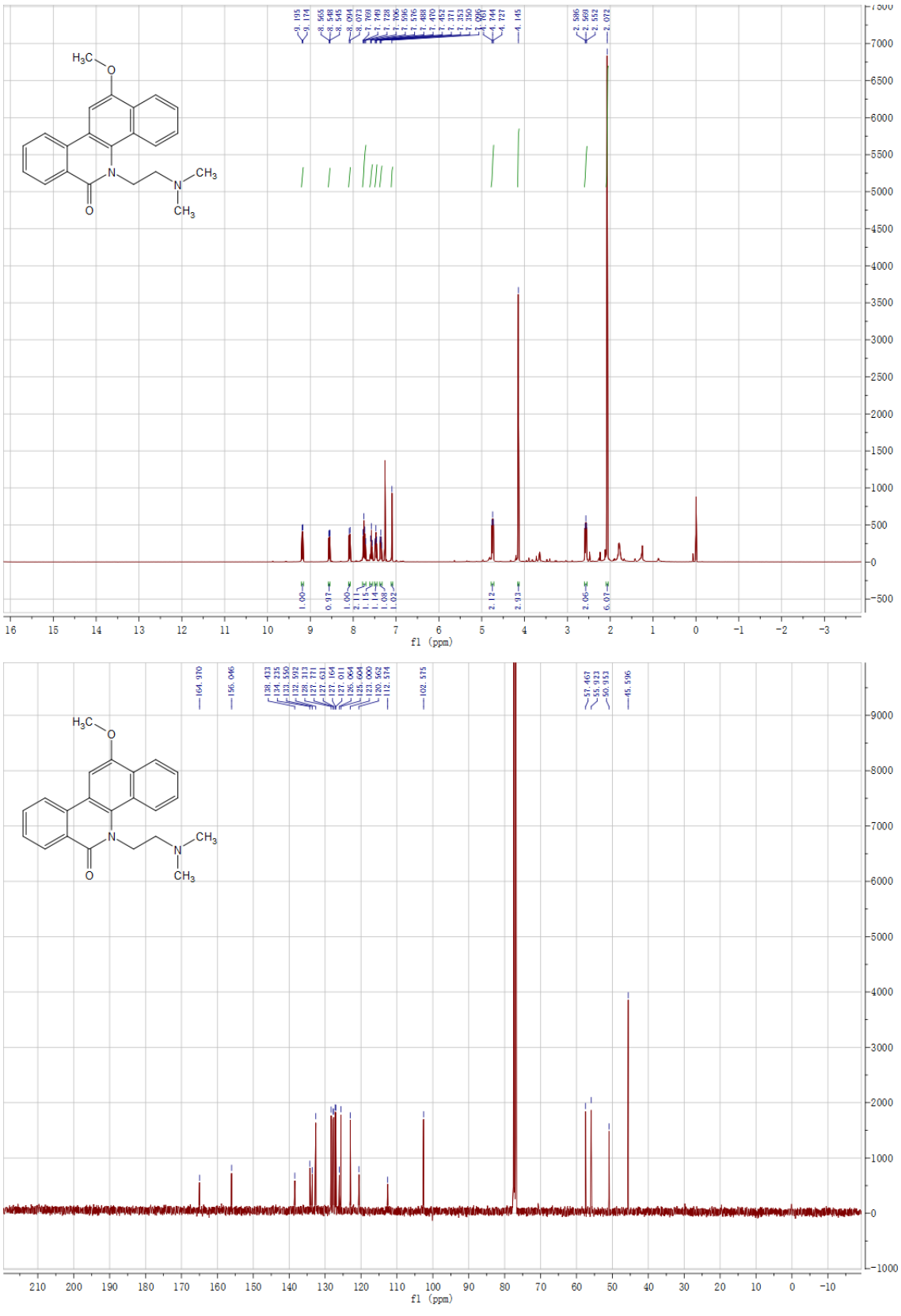
^{1}H NMR and ^{13}C NMR spectra of compound **A10**



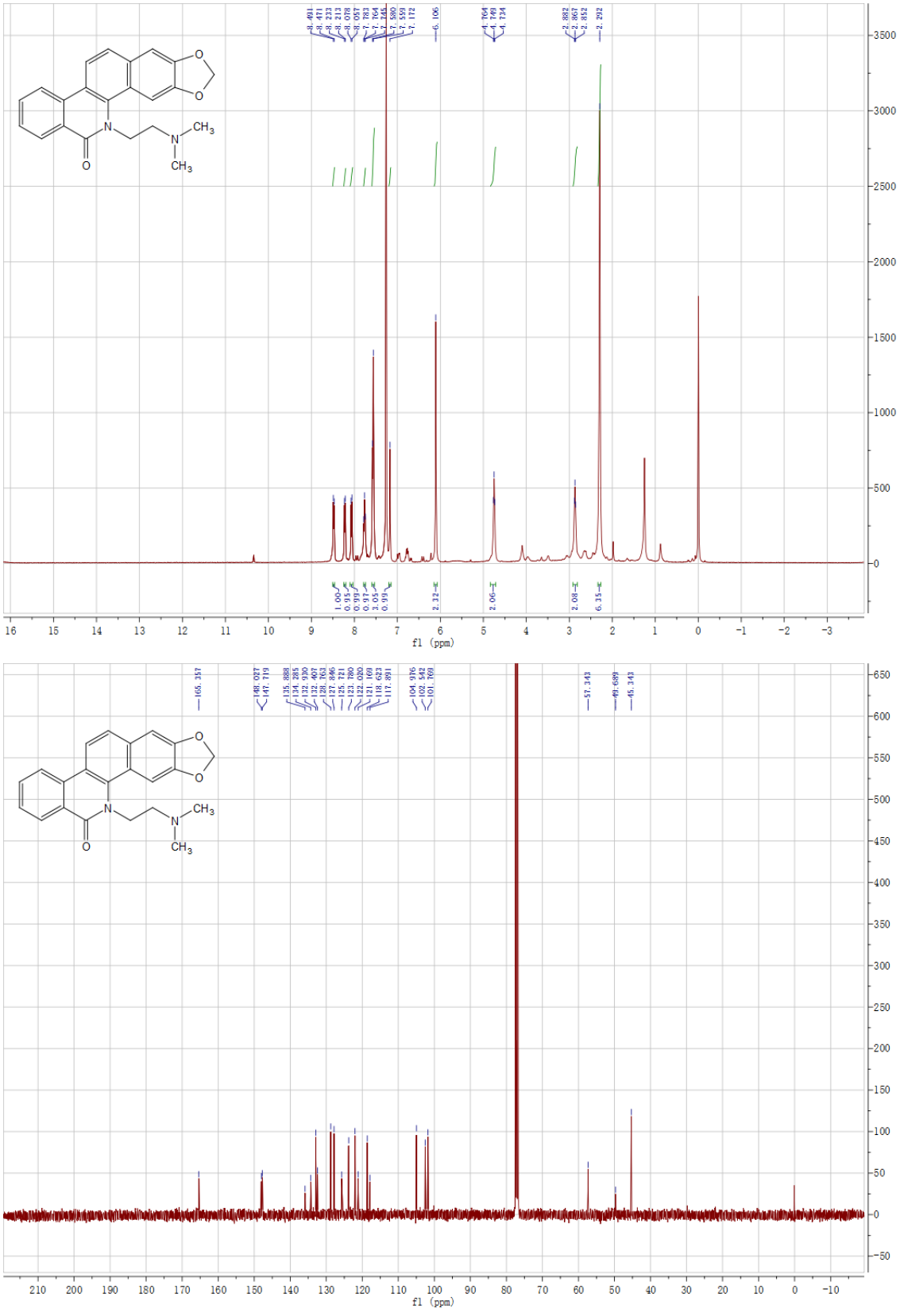
^{1}H NMR and ^{13}C NMR spectra of compound **A11**



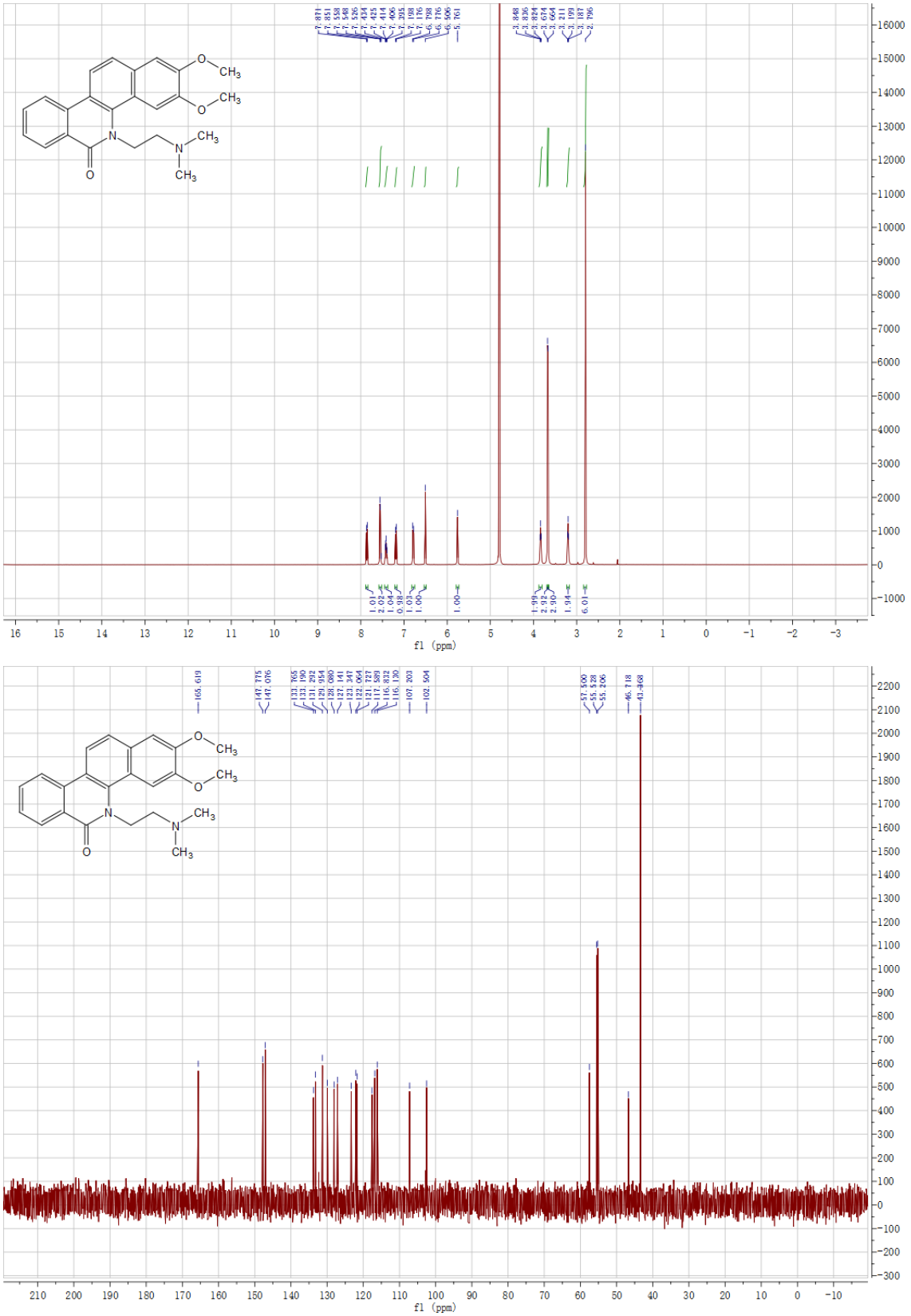
^{1}H NMR and ^{13}C NMR spectra of compound **A12**



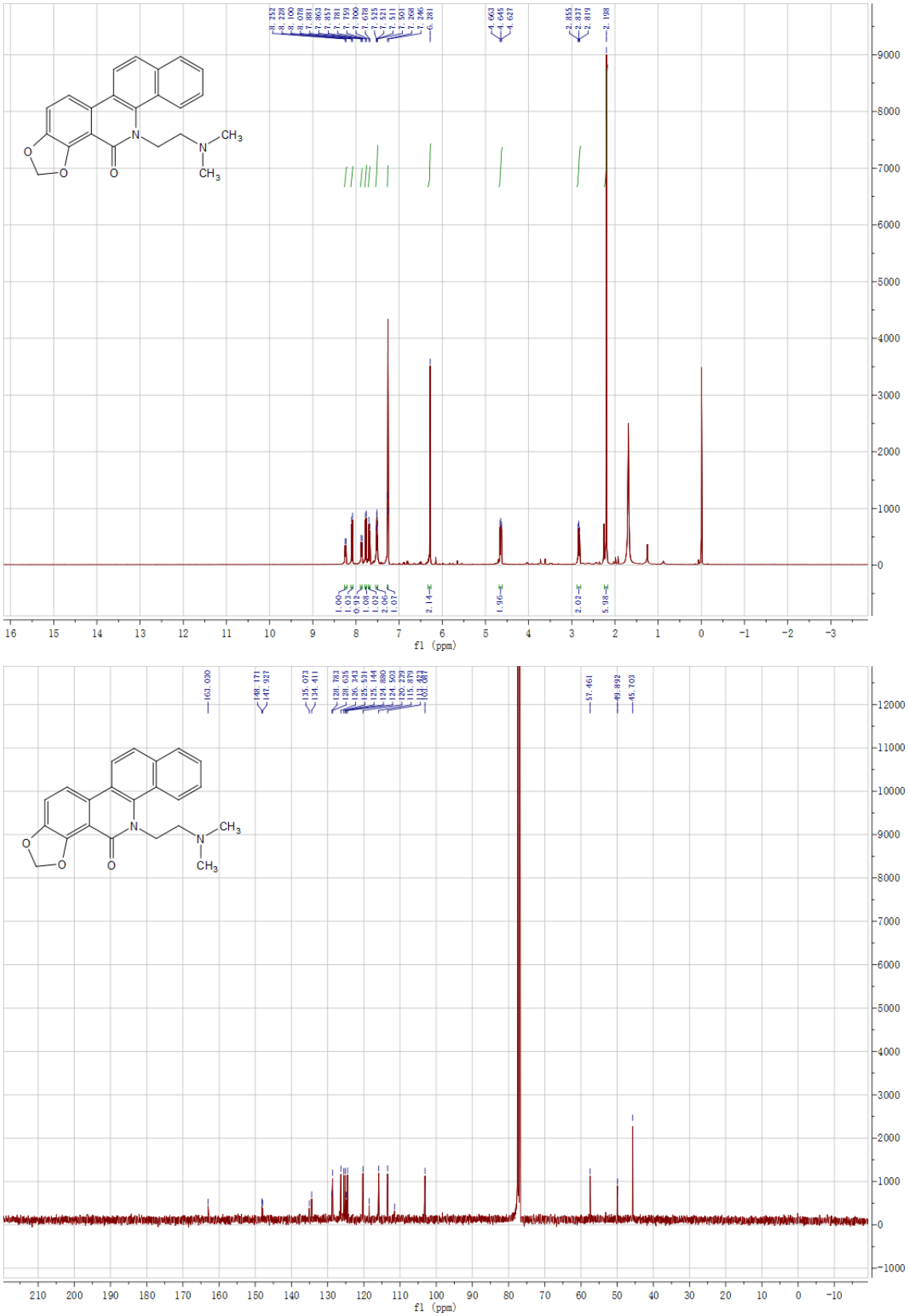
^{1}H NMR and ^{13}C NMR spectra of compound **A13**



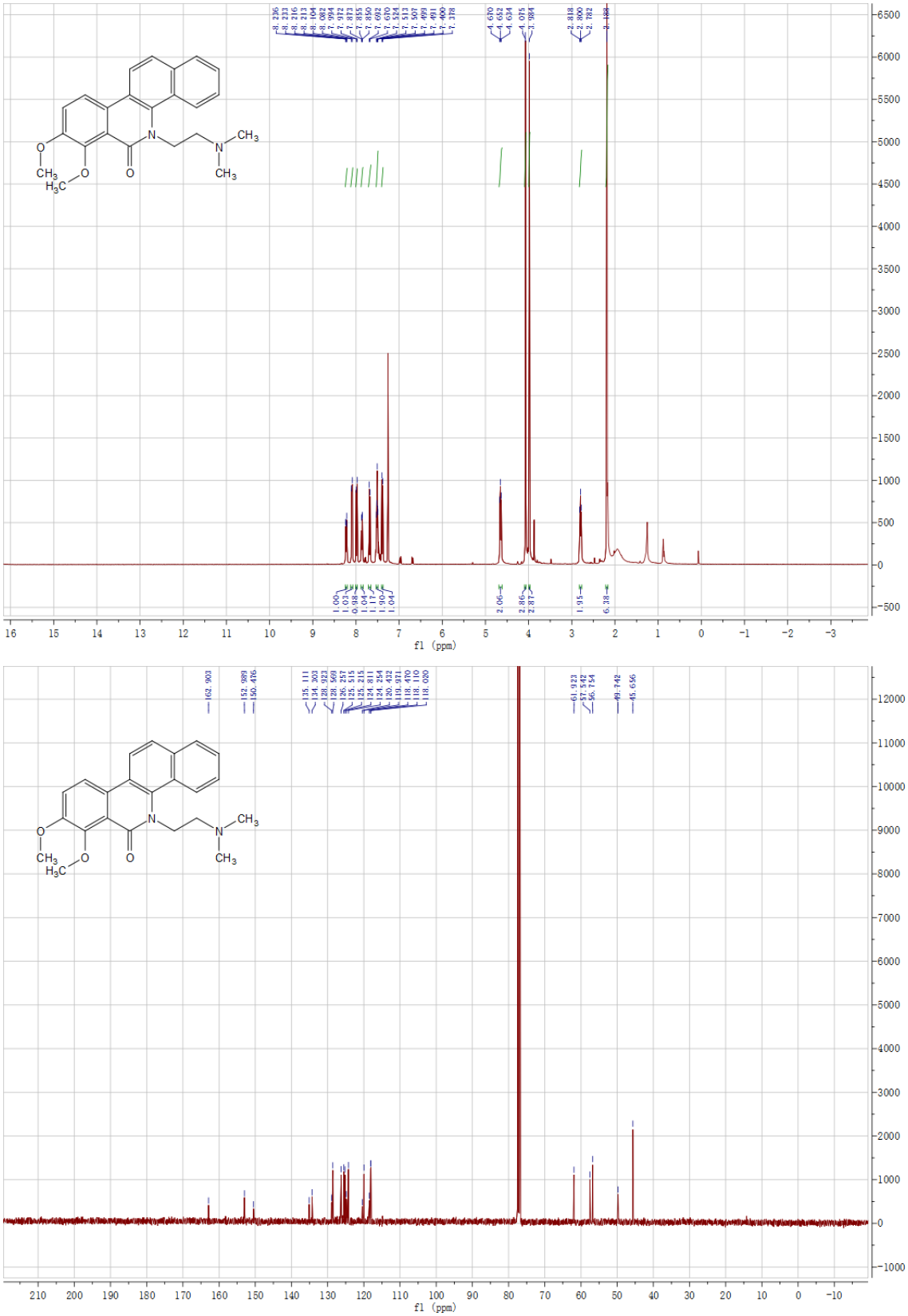
^{1}H NMR and ^{13}C NMR spectra of compound **B1**



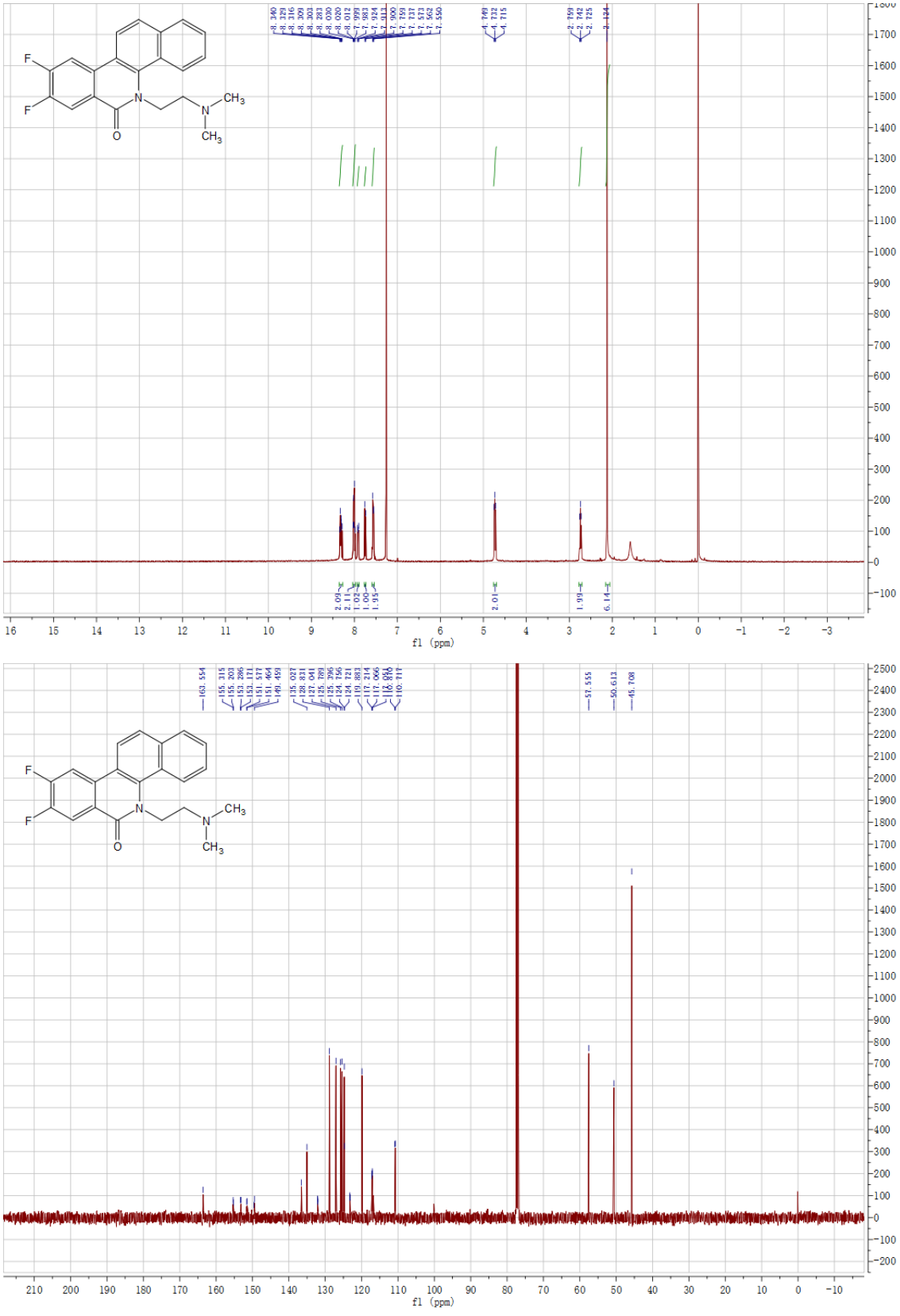
^{1}H NMR and ^{13}C NMR spectra of compound **B2**



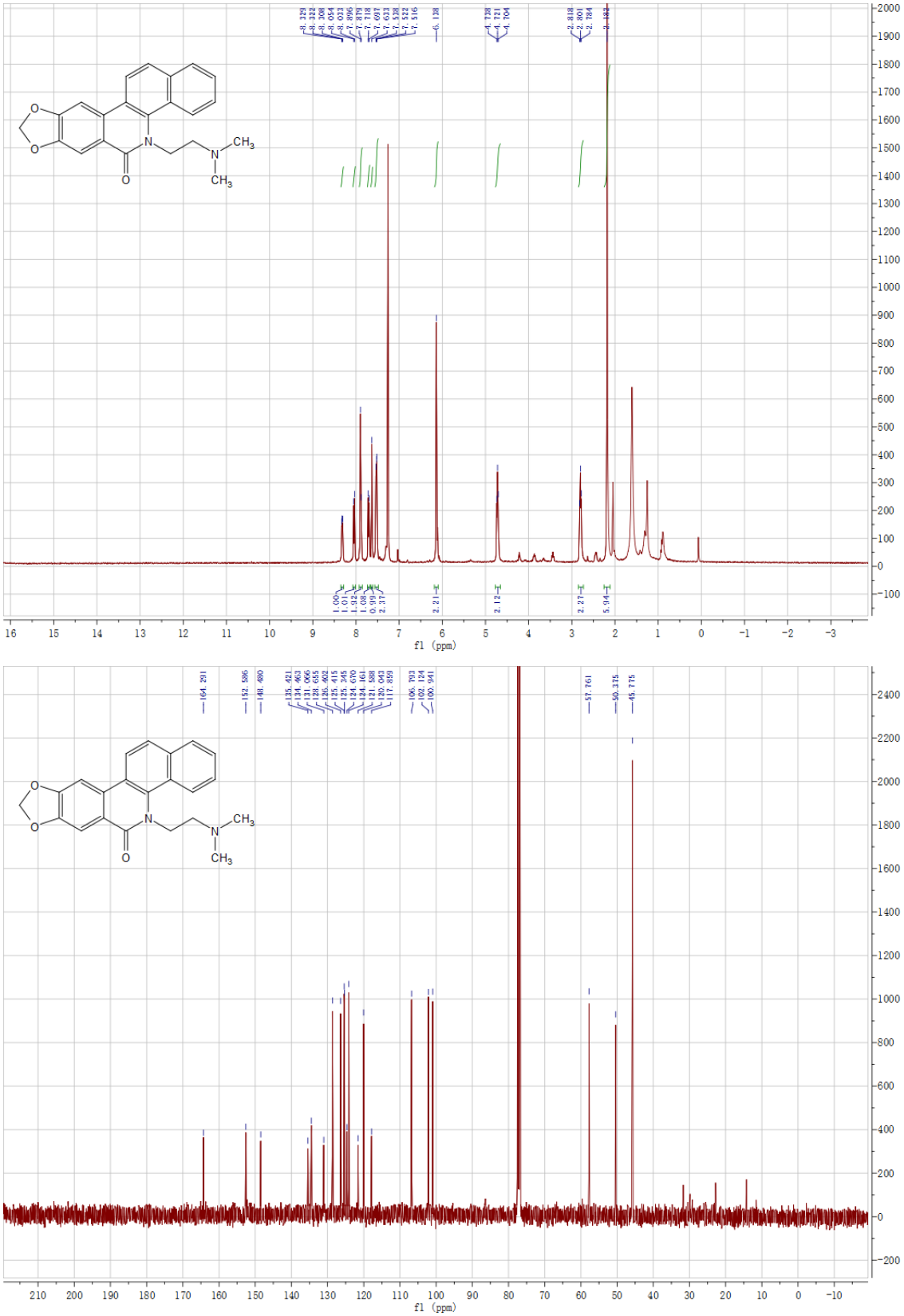
^{1}H NMR and ^{13}C NMR spectra of compound **B3**



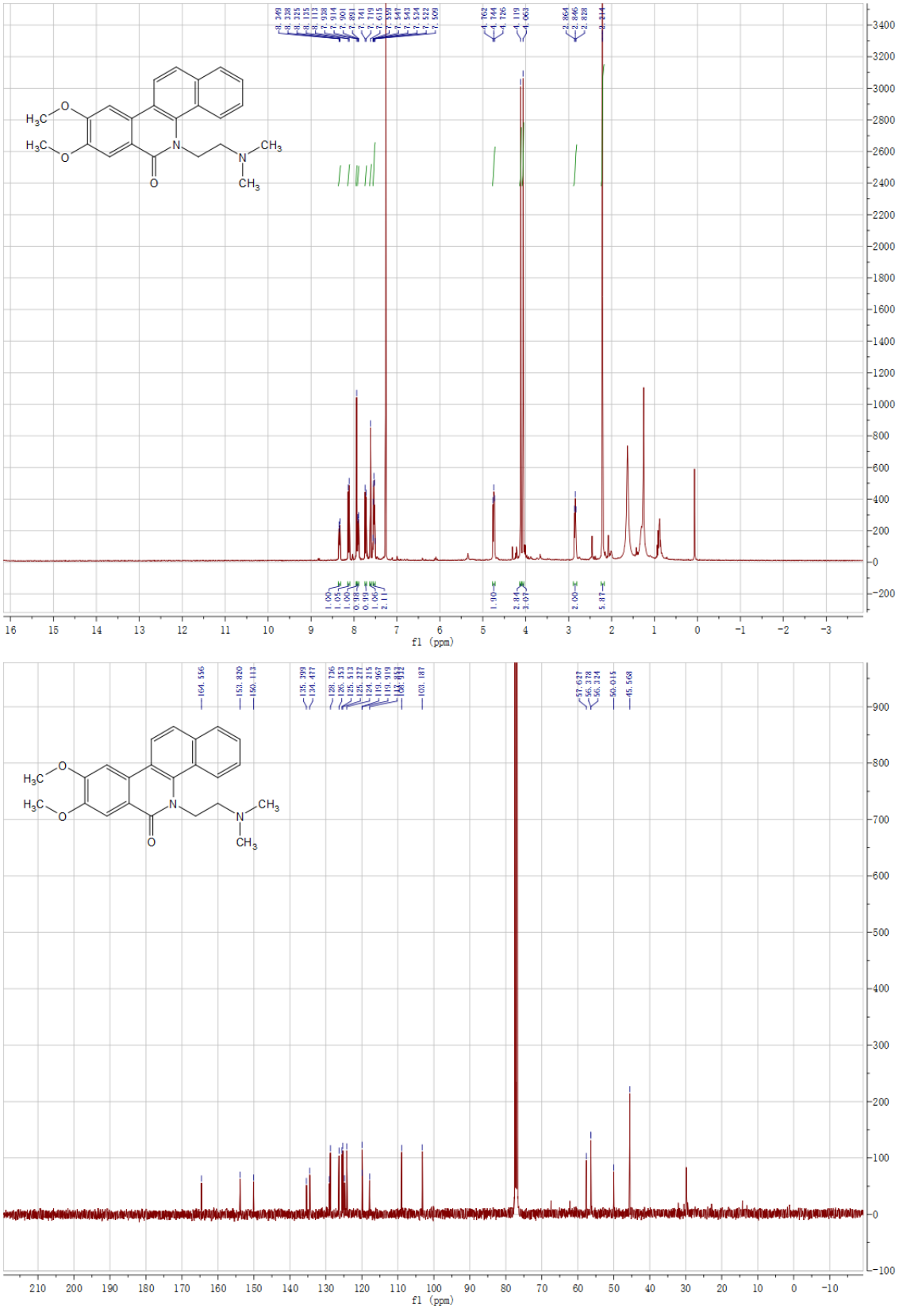
^{1}H NMR and ^{13}C NMR spectra of compound **B4**



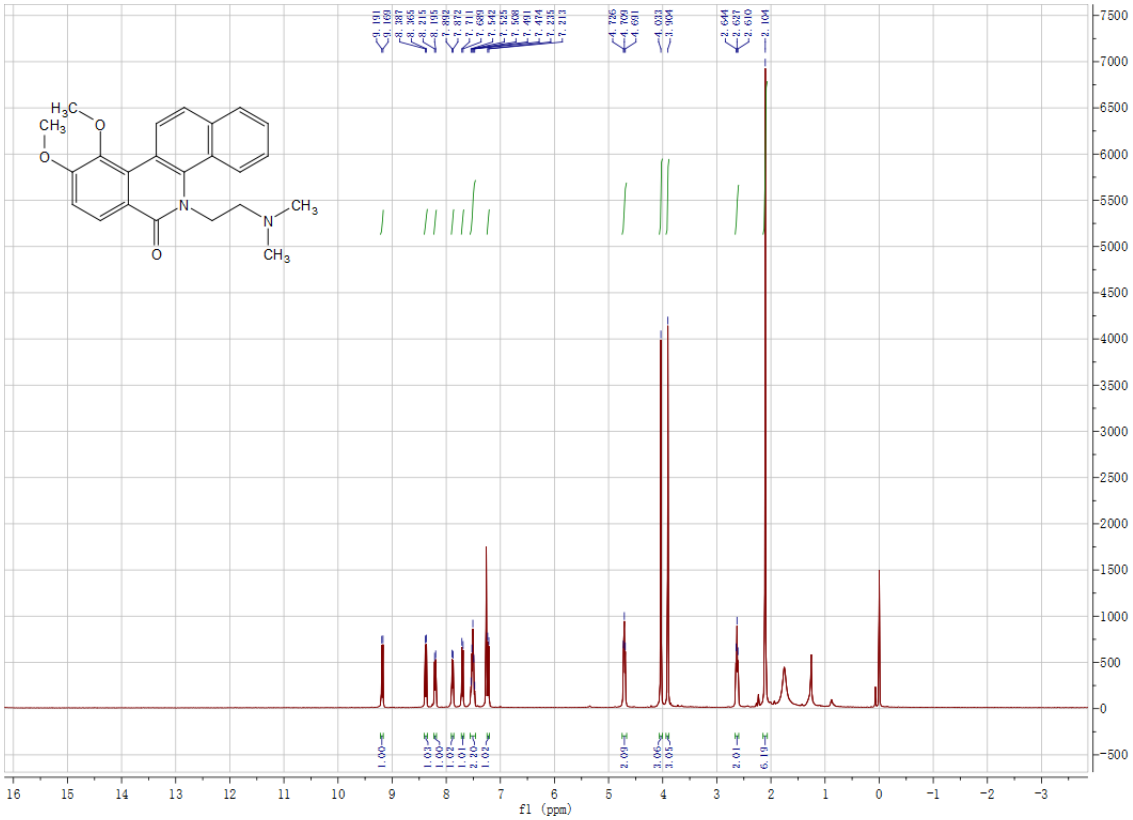
^{1}H NMR and ^{13}C NMR spectra of compound **B5**

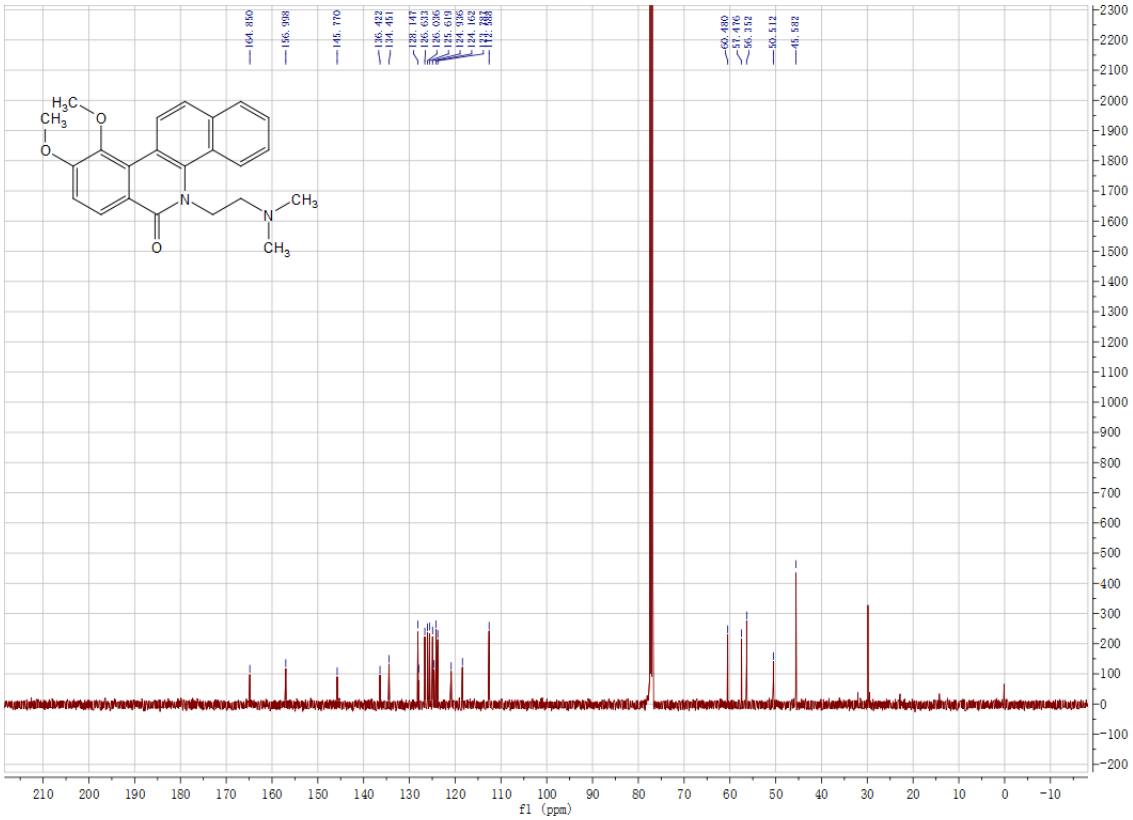


^{1}H NMR and ^{13}C NMR spectra of compound **B6**

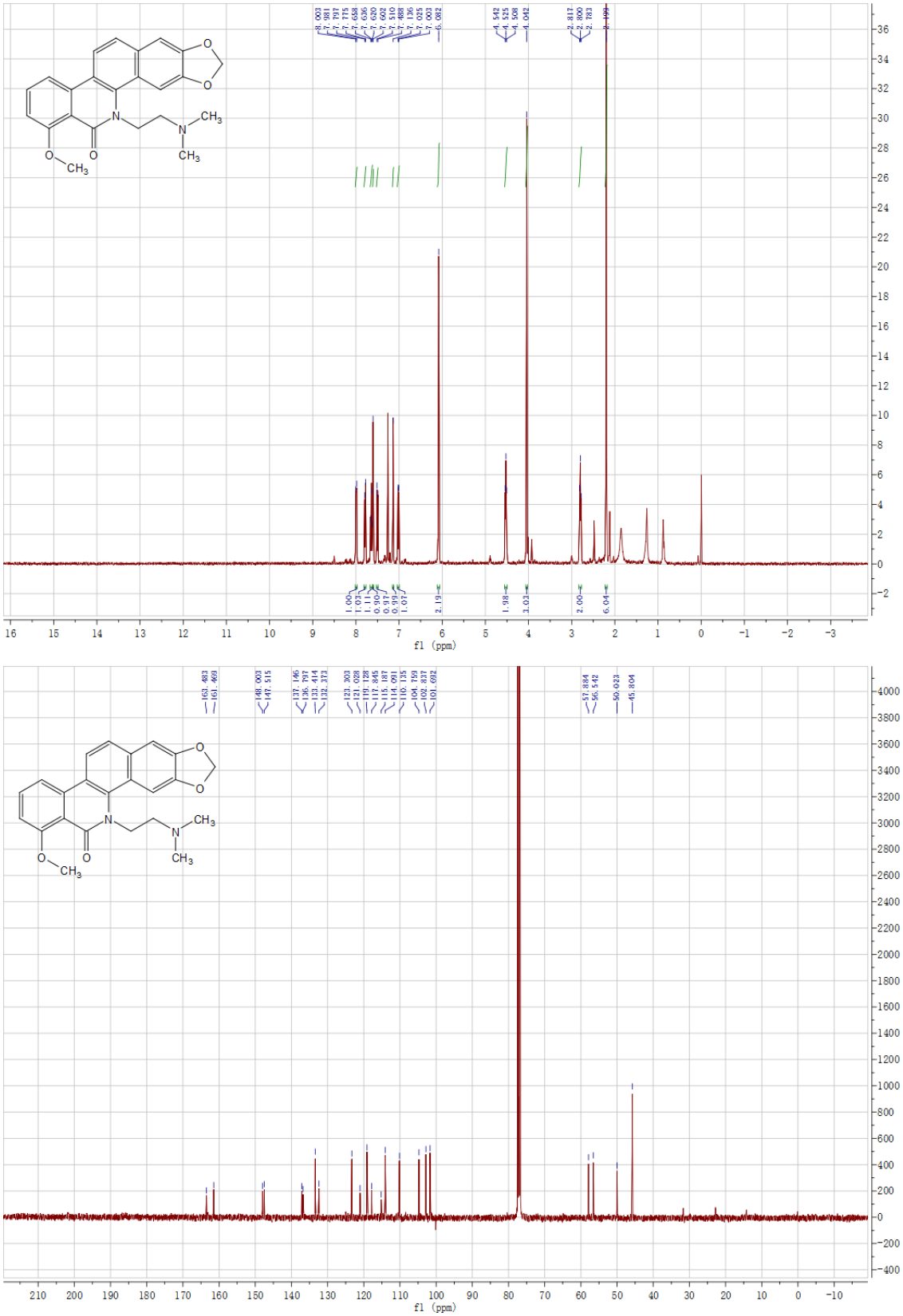


^{1}H NMR and ^{13}C NMR spectra of compound **B7**

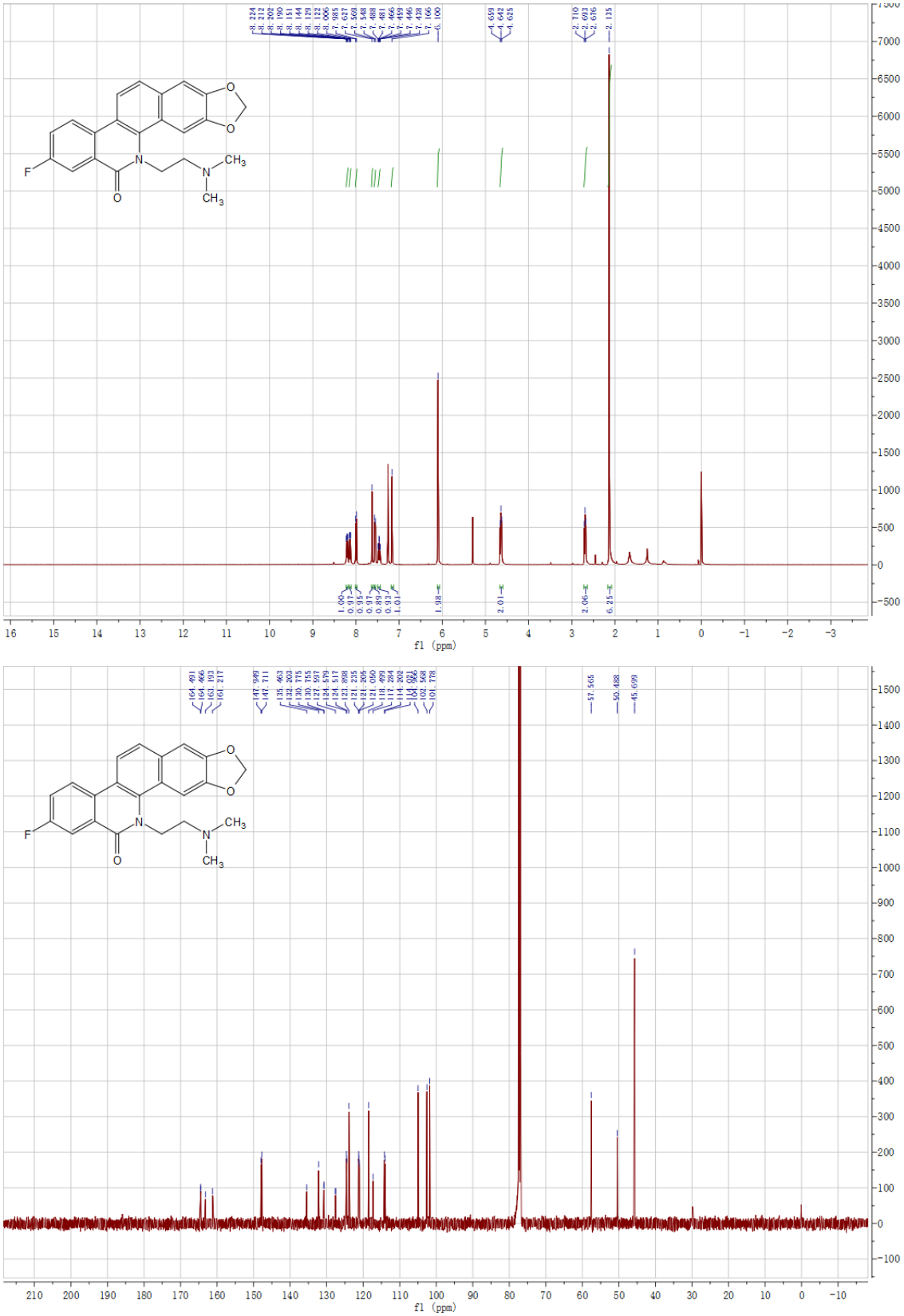




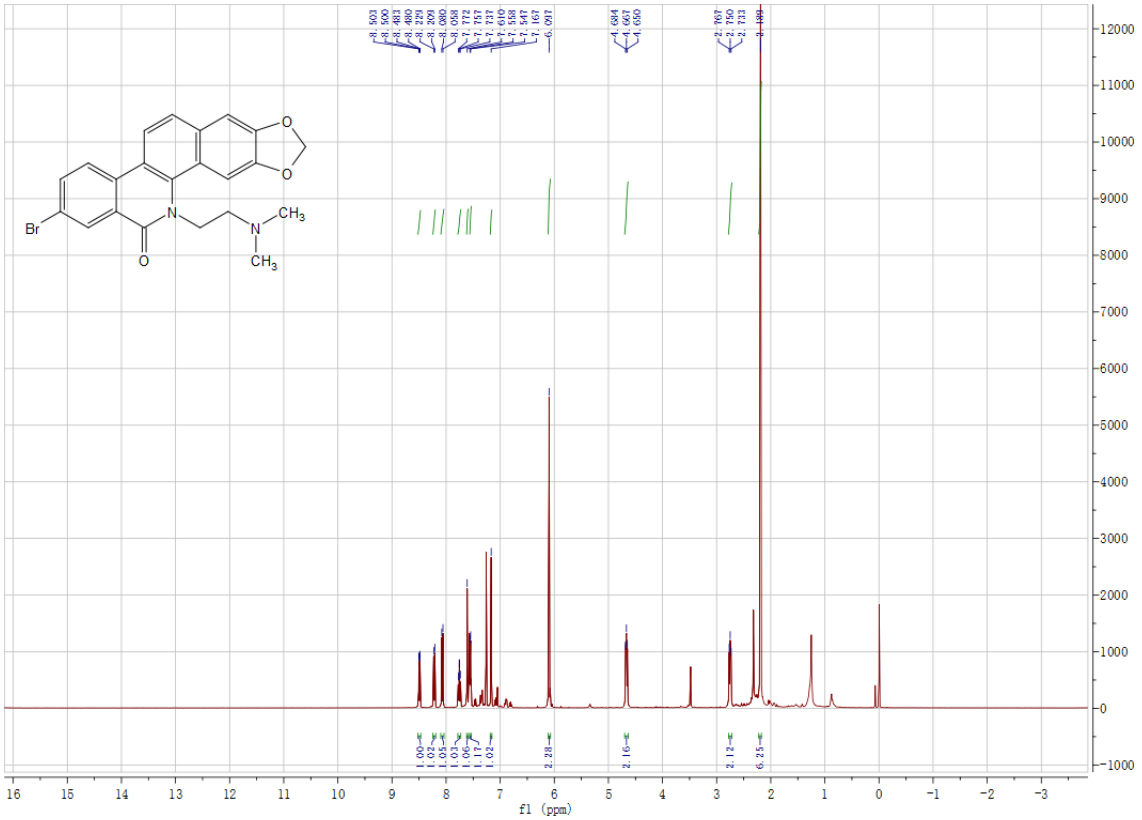
^{1}H NMR and ^{13}C NMR spectra of compound **B8**

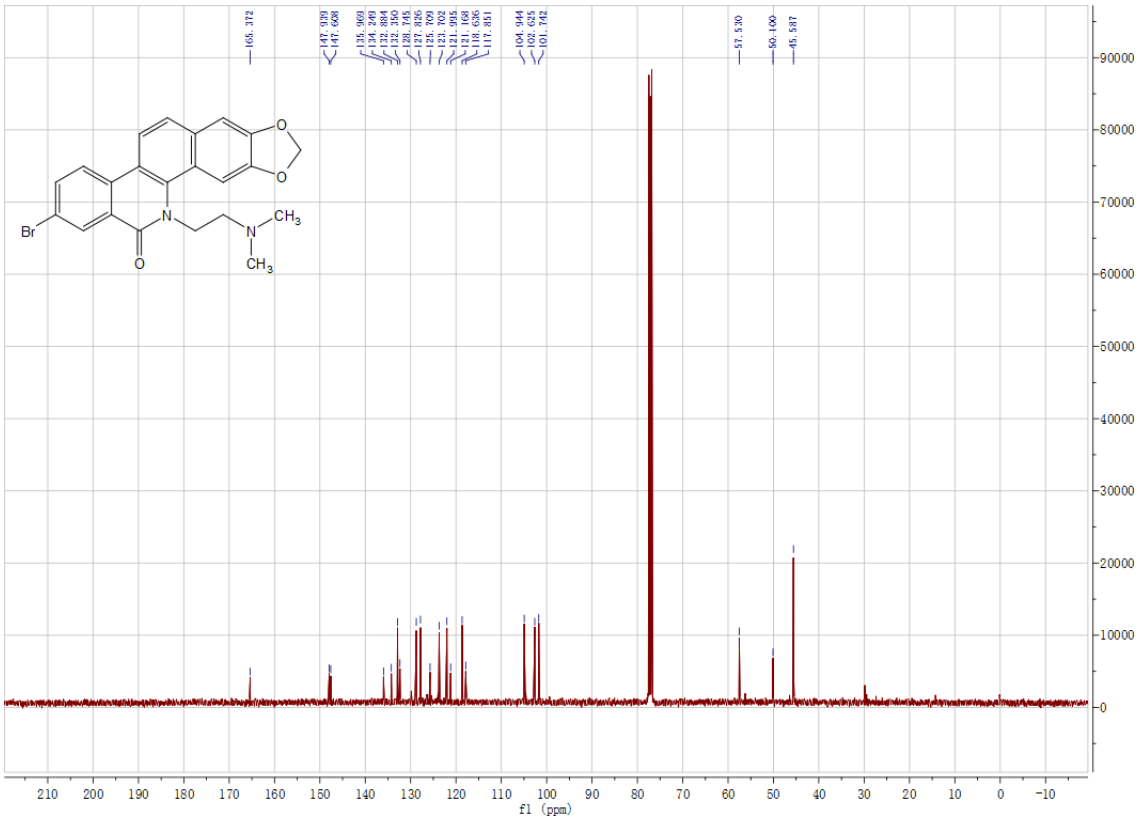


^{1}H NMR and ^{13}C NMR spectra of compound **C1**

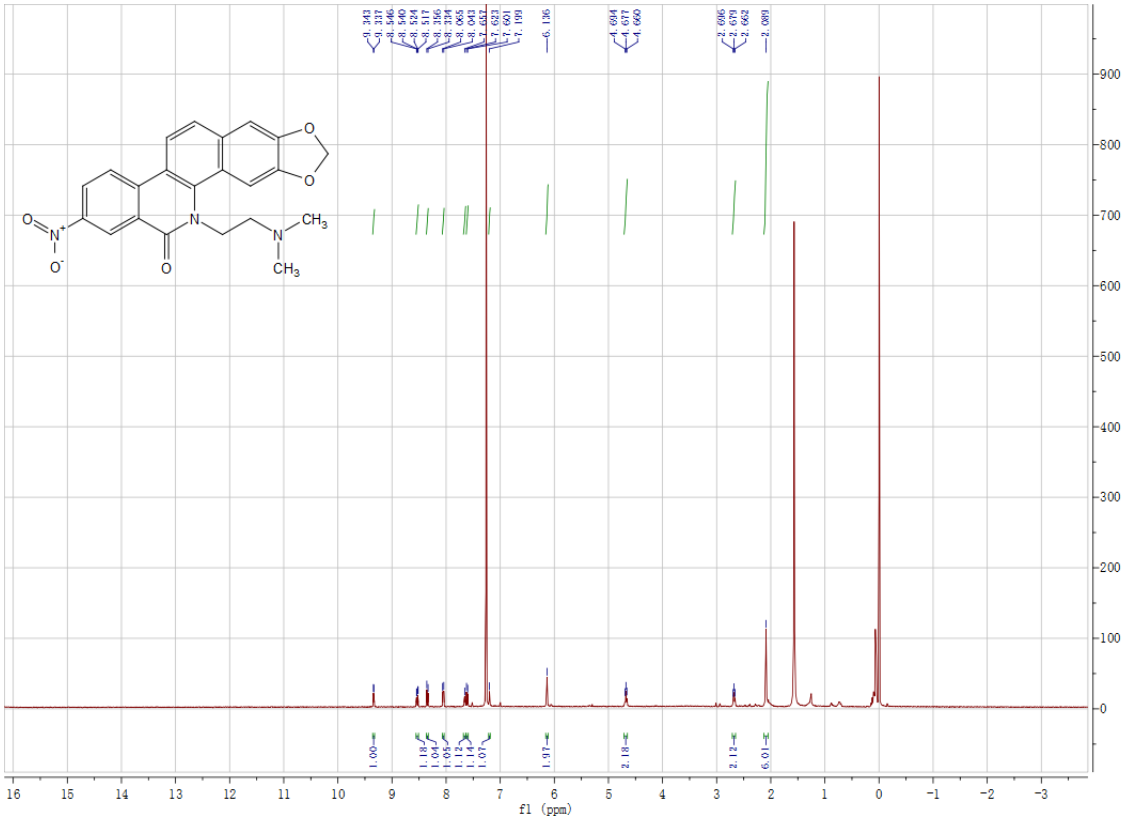


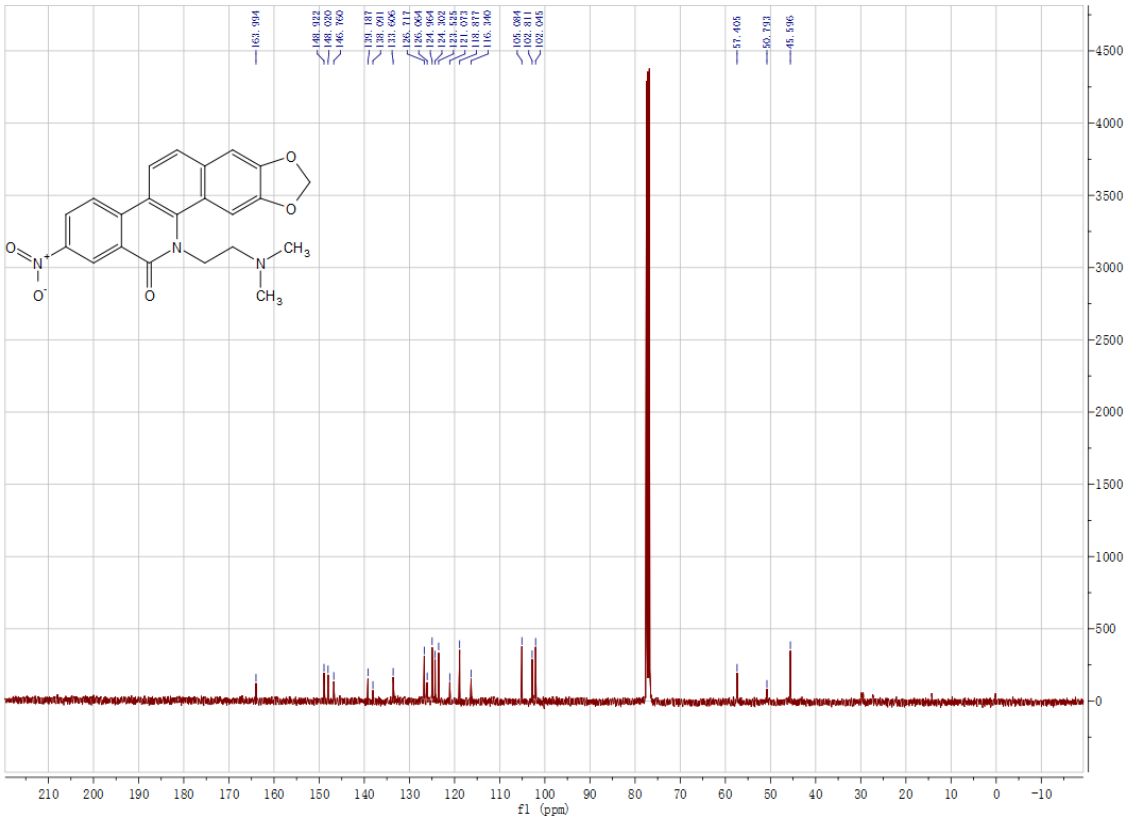
^{1}H NMR and ^{13}C NMR spectra of compound **C2**



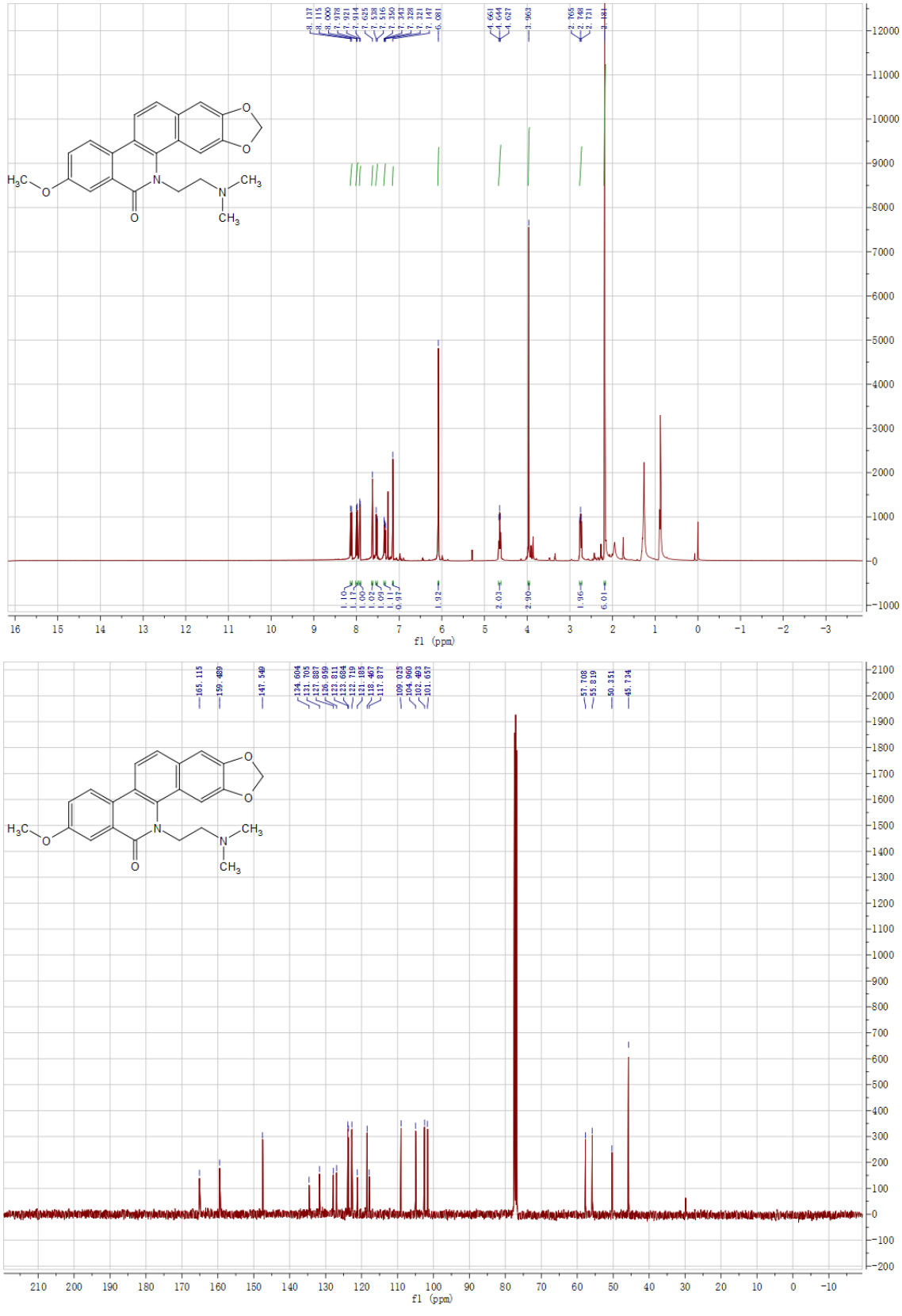


^{1}H NMR and ^{13}C NMR spectra of compound **C3**

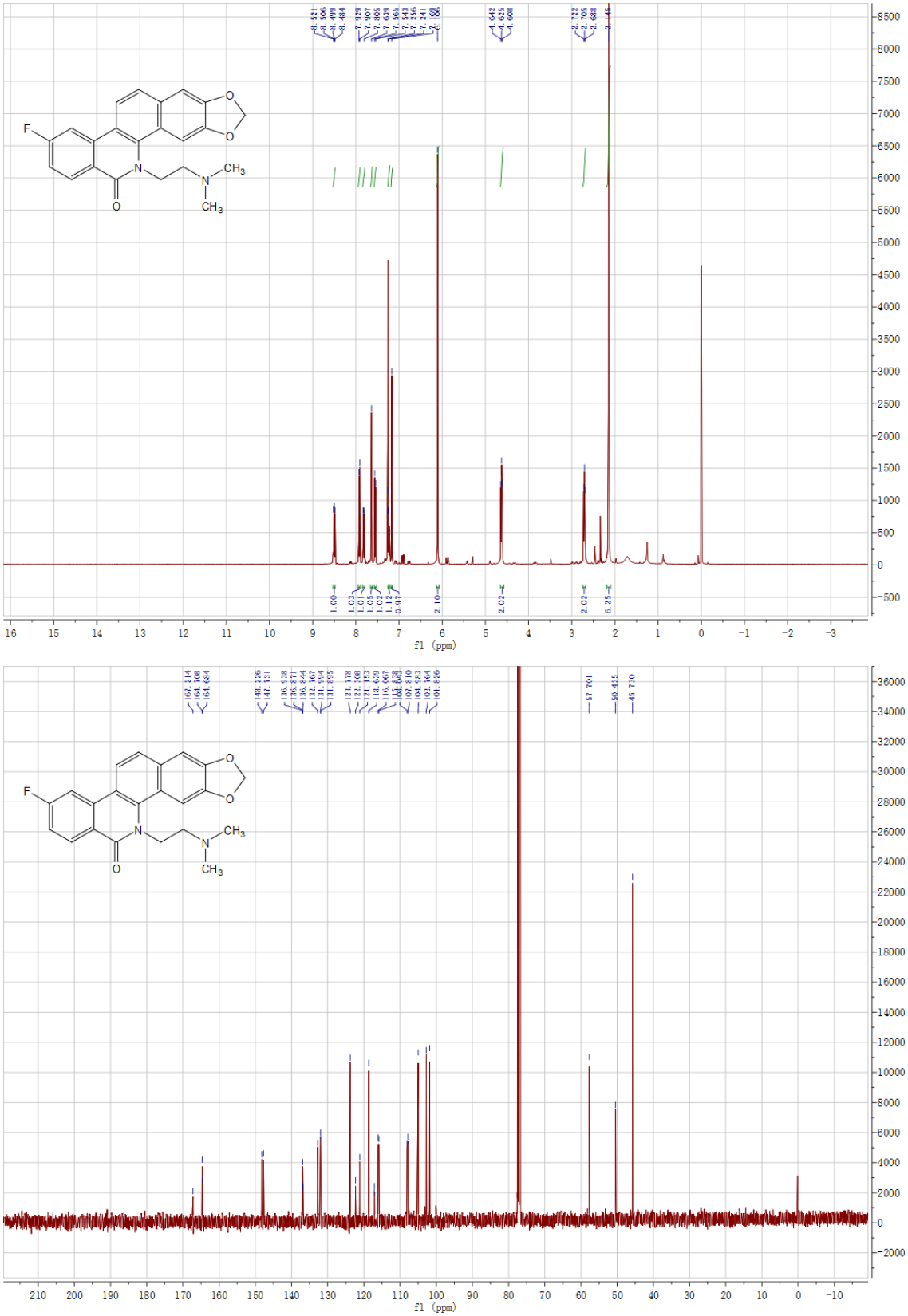




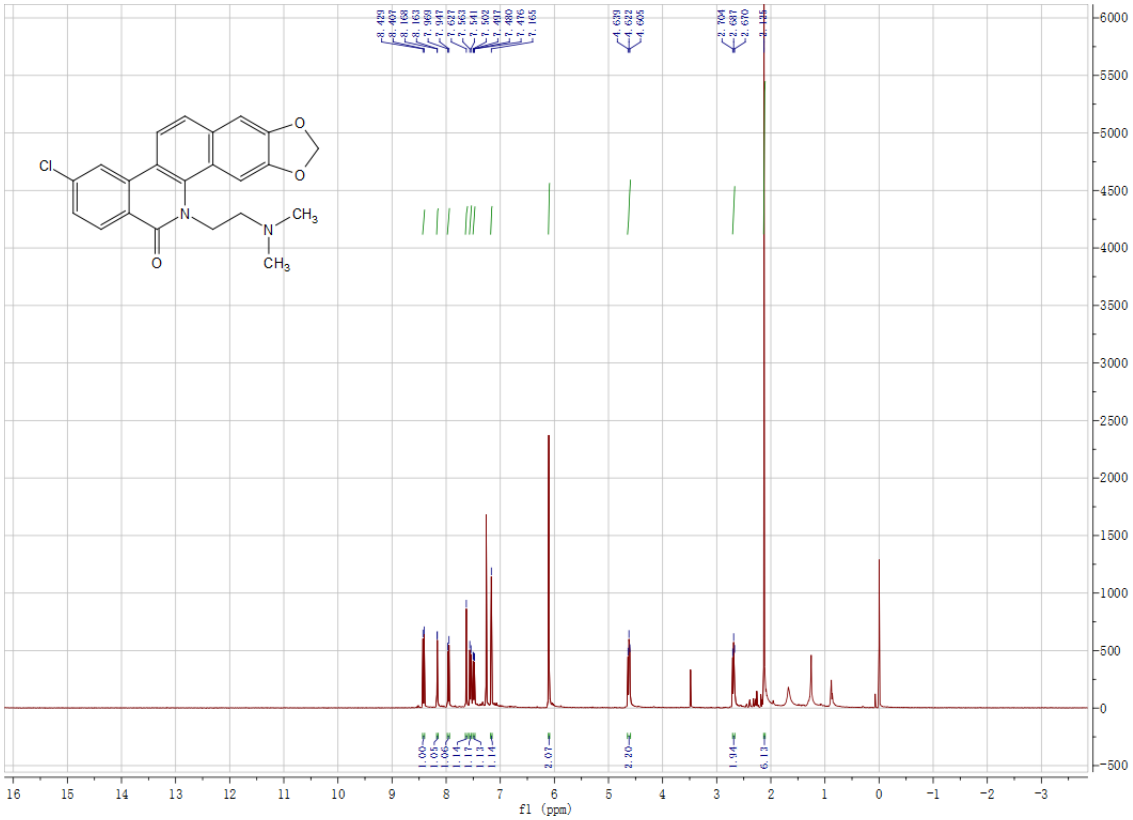
^{1}H NMR and ^{13}C NMR spectra of compound **C4**

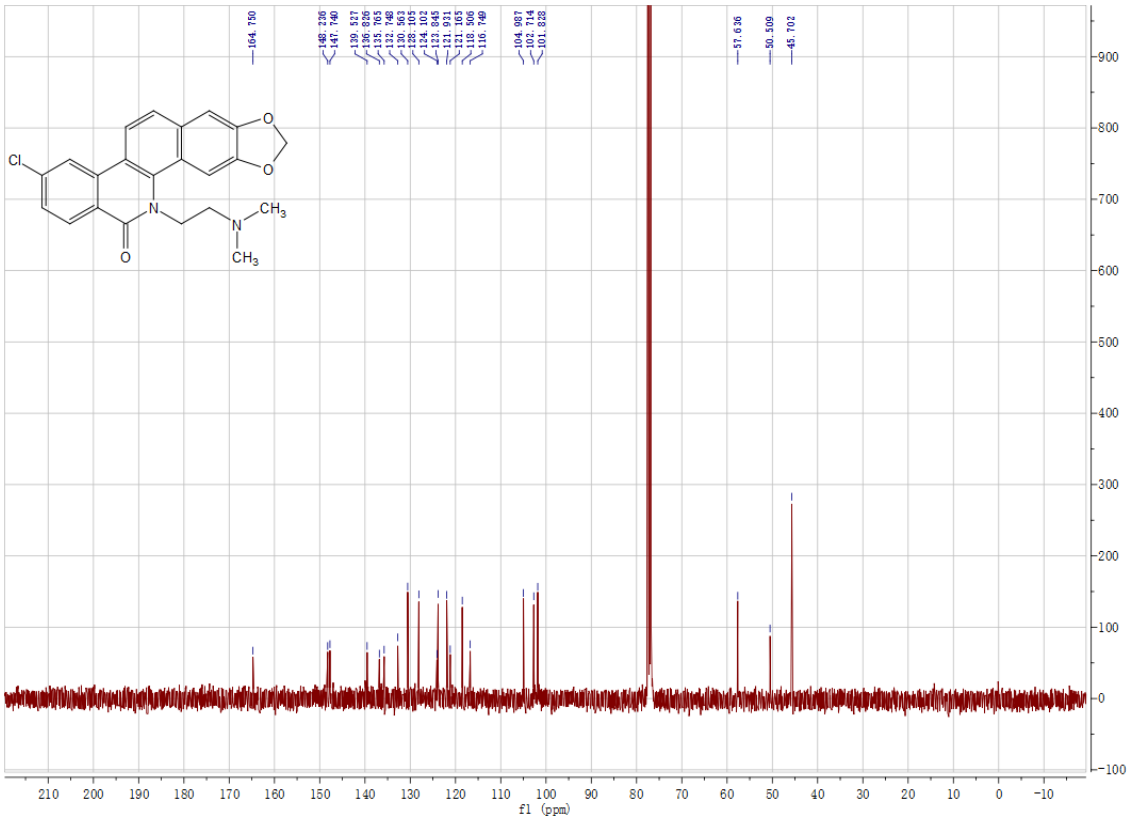


^{1}H NMR and ^{13}C NMR spectra of compound **C5**

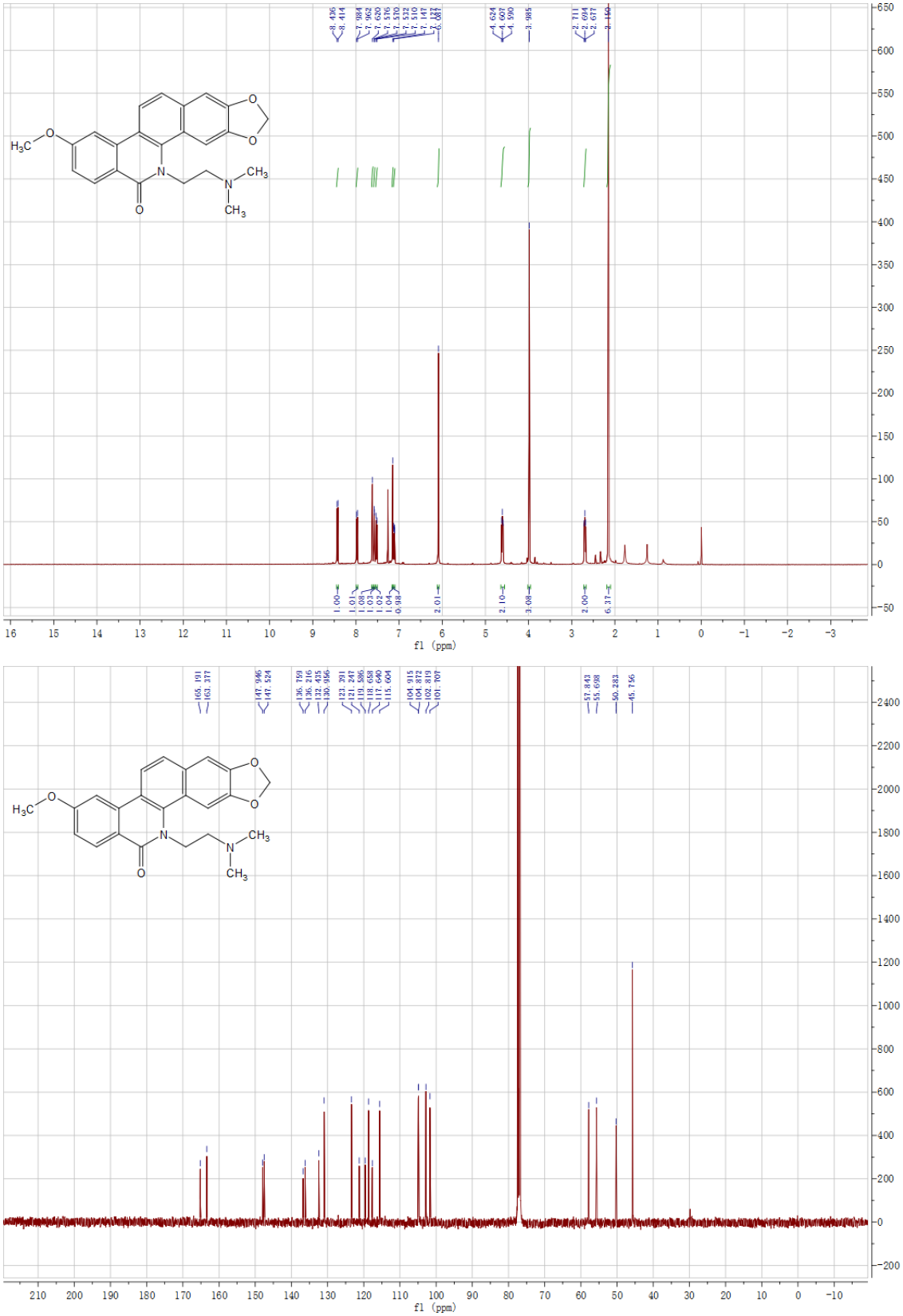


^{1}H NMR and ^{13}C NMR spectra of compound **C6**

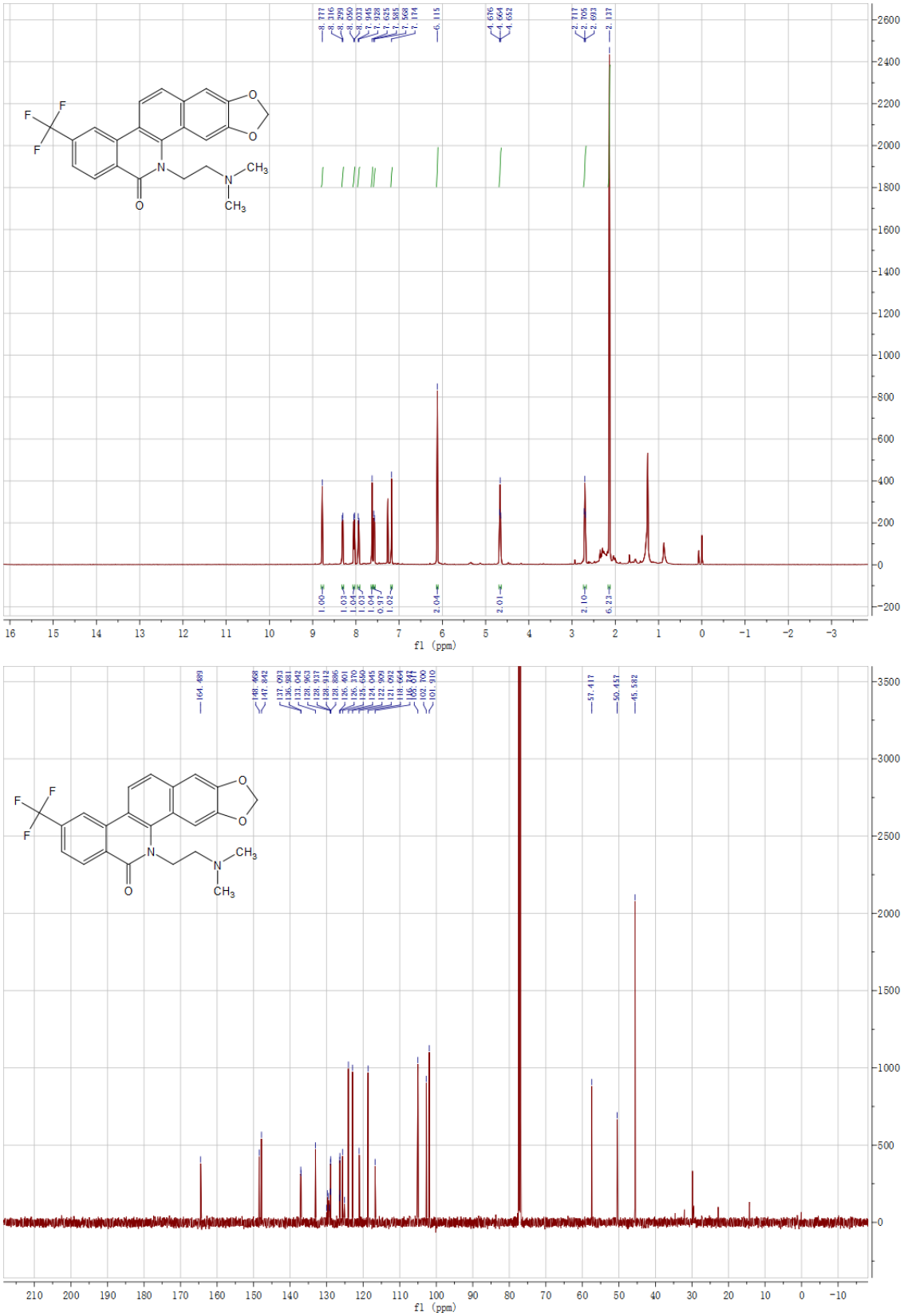




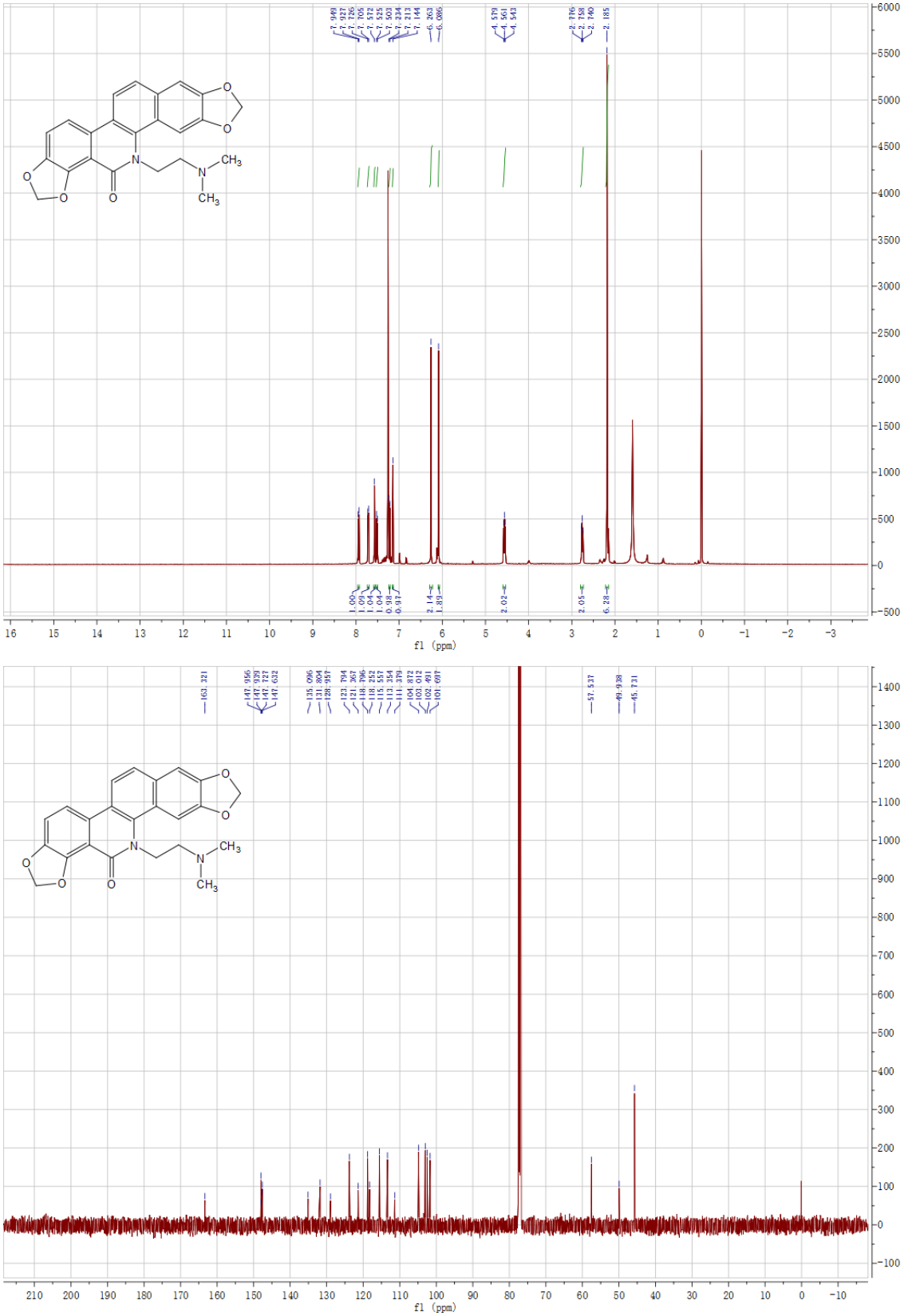
^{1}H NMR and ^{13}C NMR spectra of compound **C7**



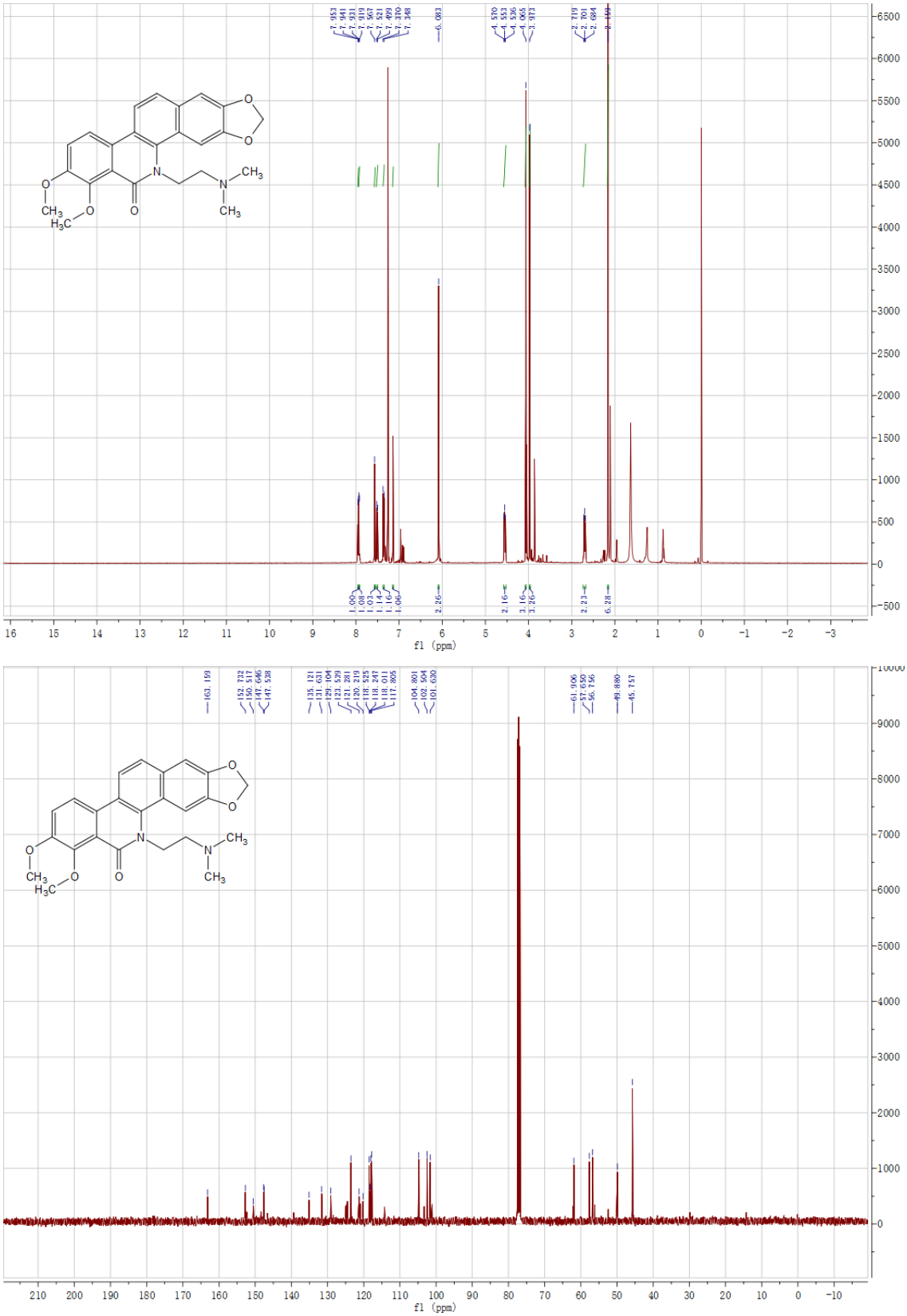
^{1}H NMR and ^{13}C NMR spectra of compound **C8**



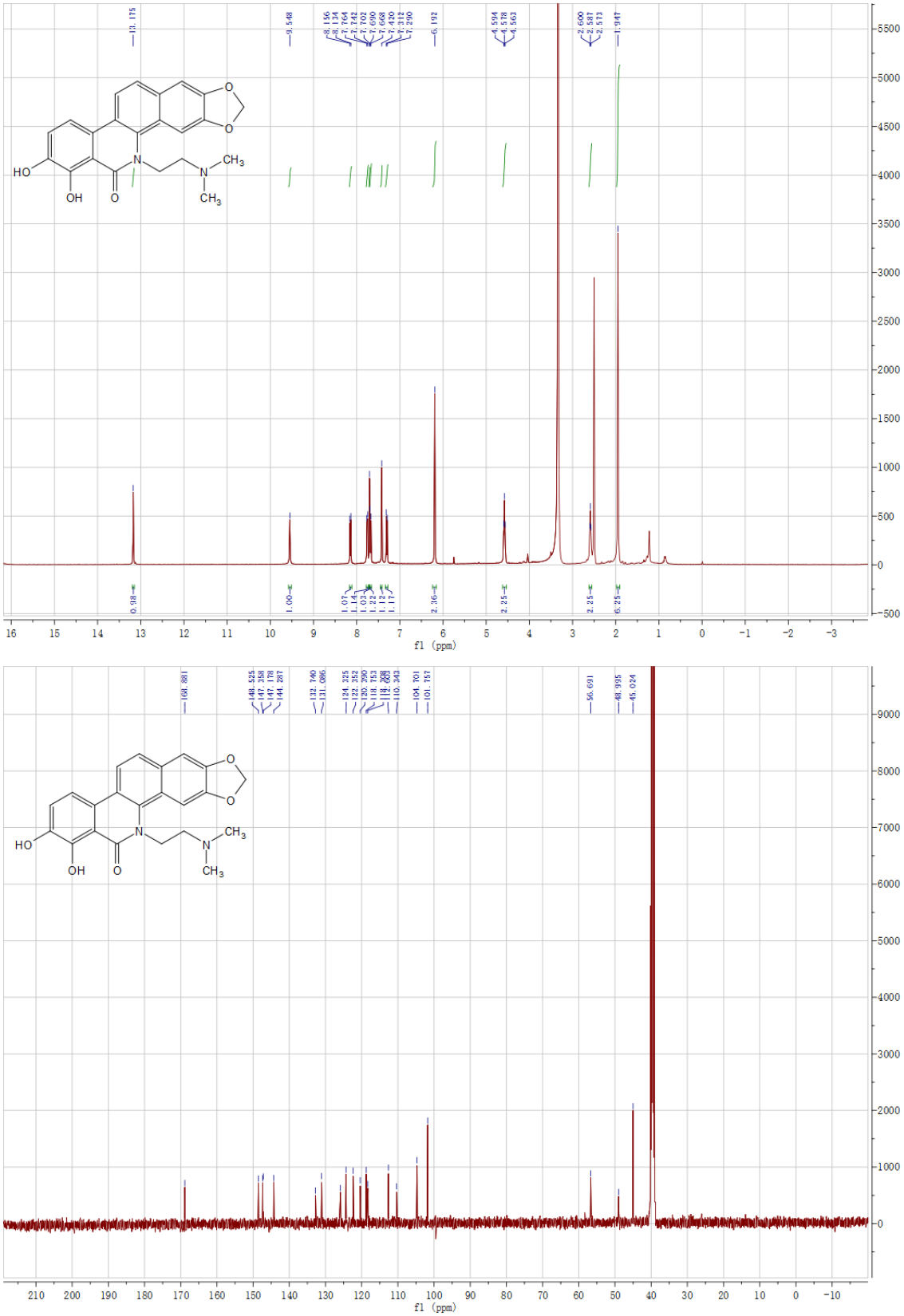
^{1}H NMR and ^{13}C NMR spectra of compound **C9**



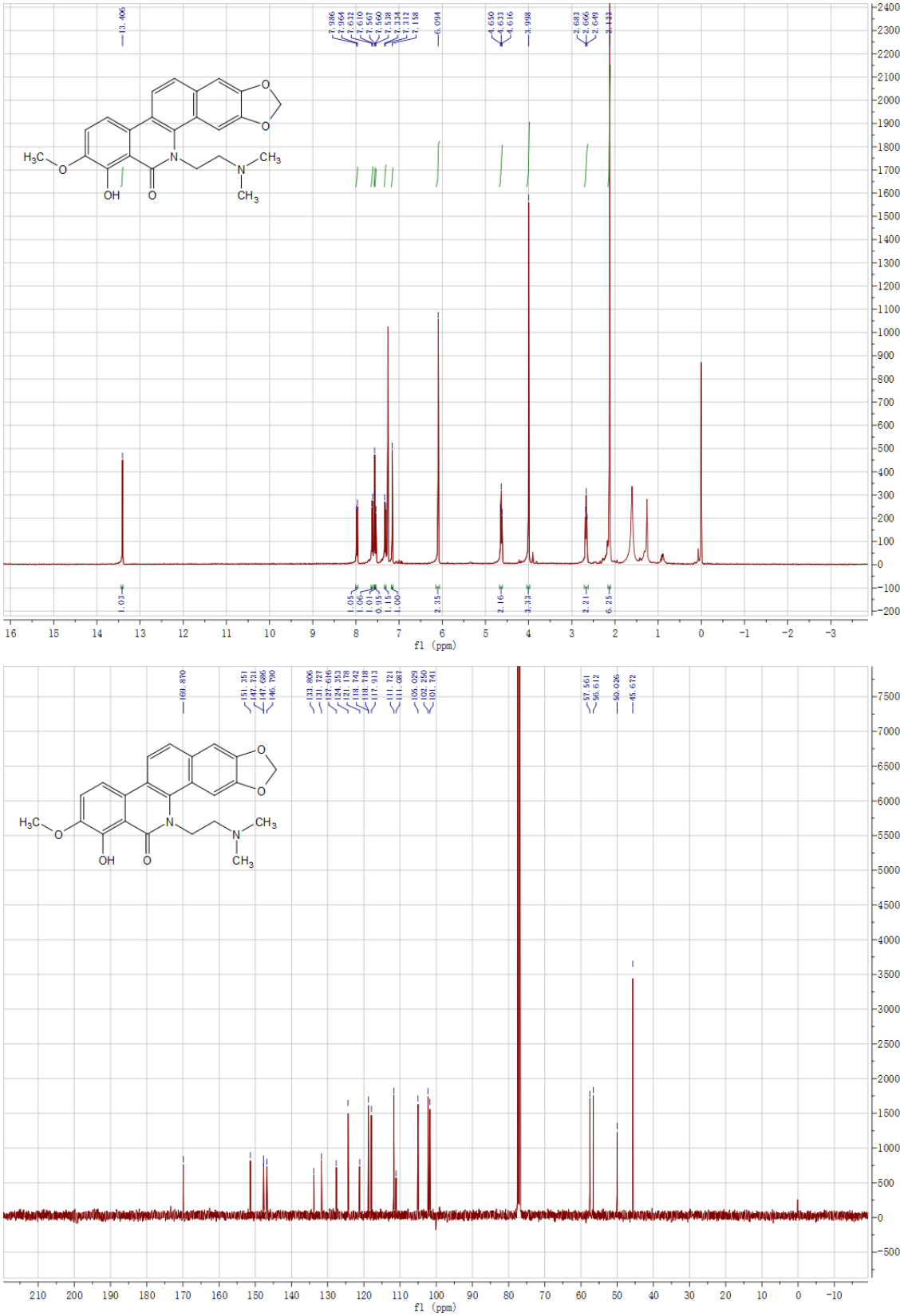
^{1}H NMR and ^{13}C NMR spectra of compound **C10**



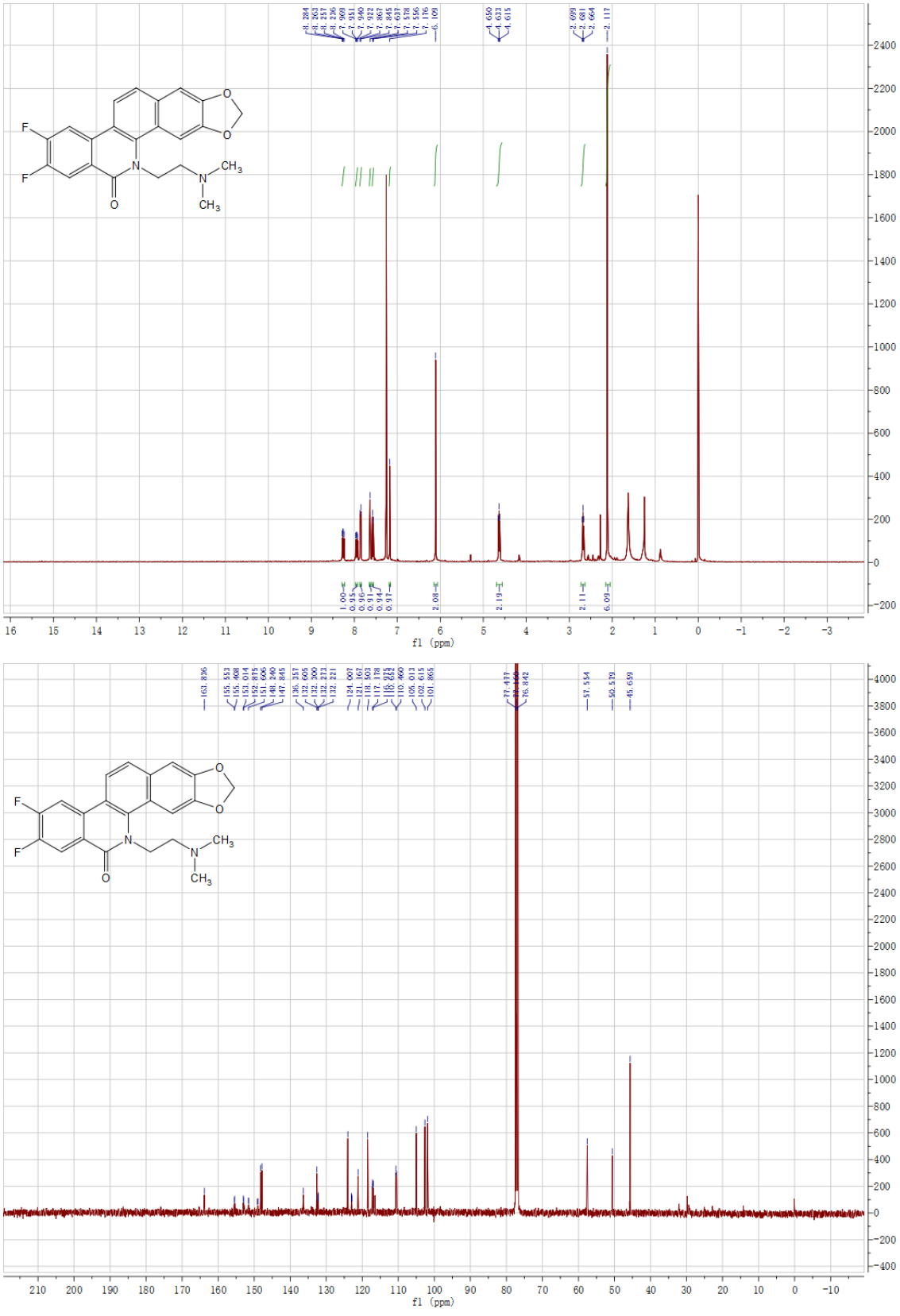
^{1}H NMR and ^{13}C NMR spectra of compound **C11**



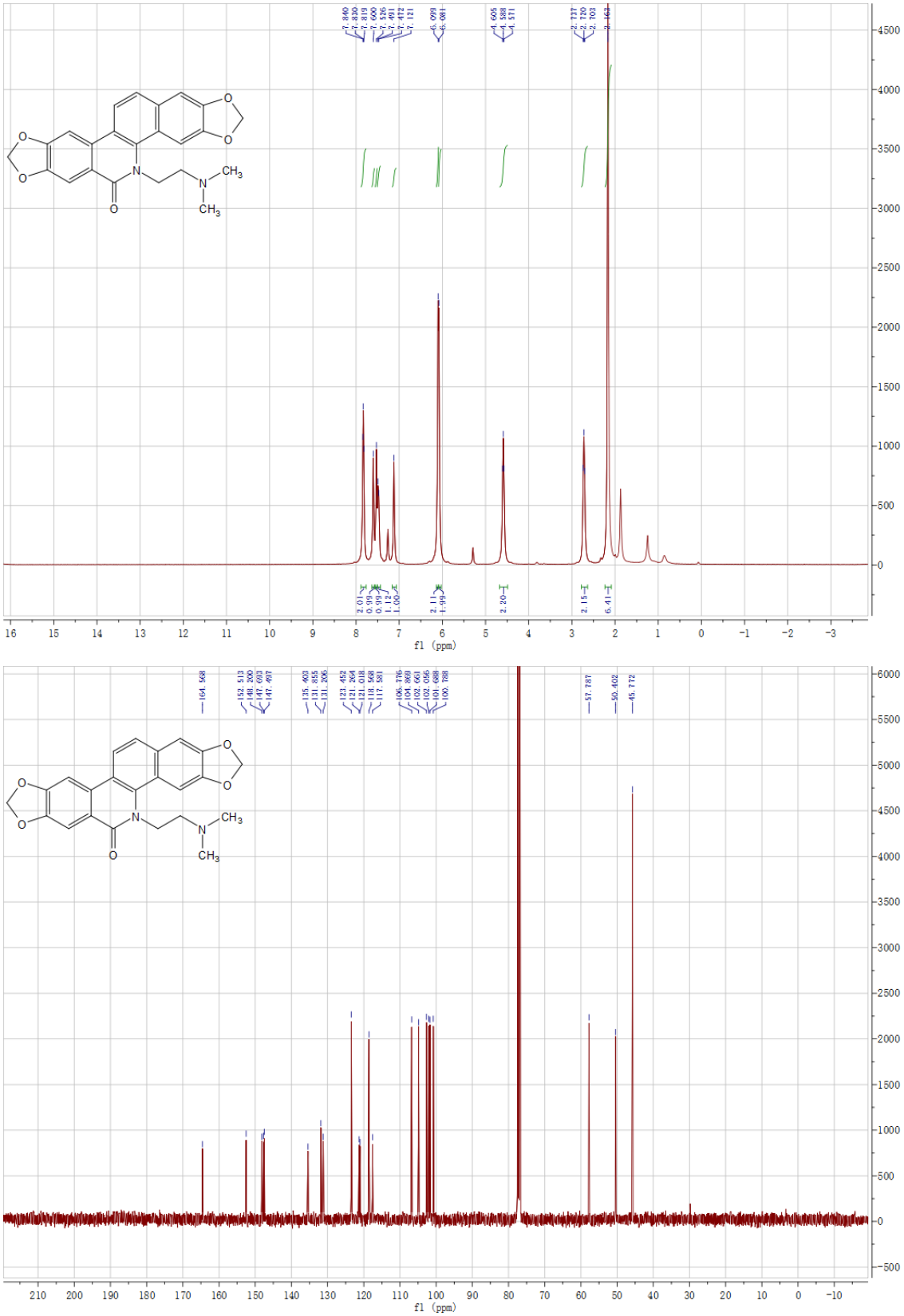
^{1}H NMR and ^{13}C NMR spectra of compound **C12**



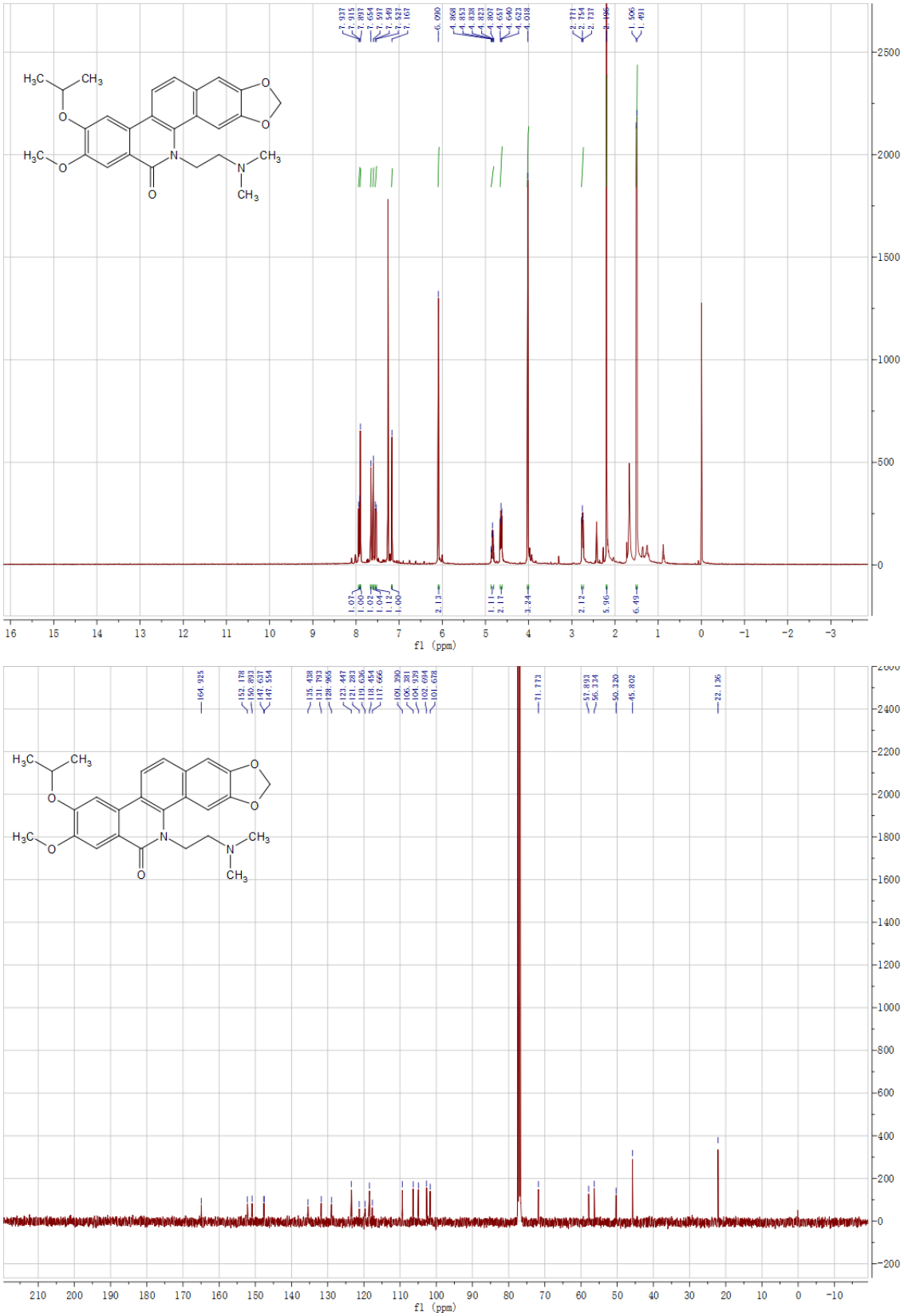
^{1}H NMR and ^{13}C NMR spectra of compound **C13**



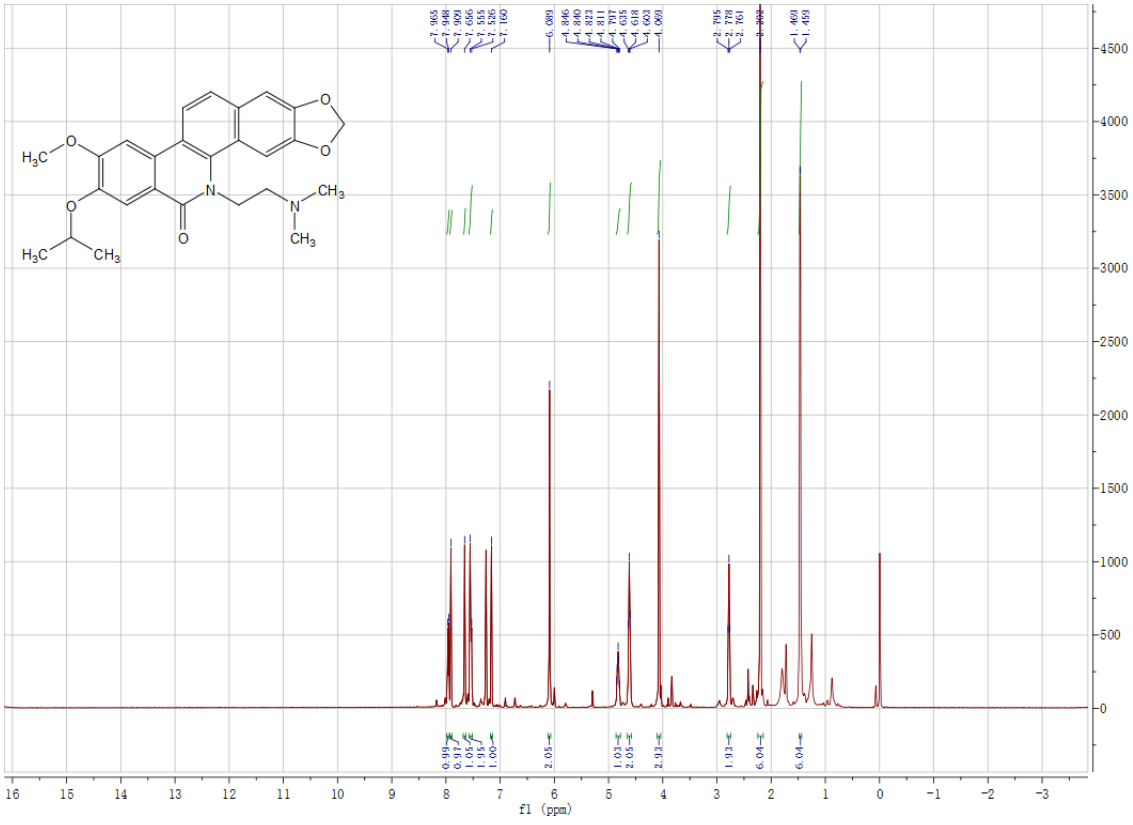
^{1}H NMR and ^{13}C NMR spectra of compound **C14**

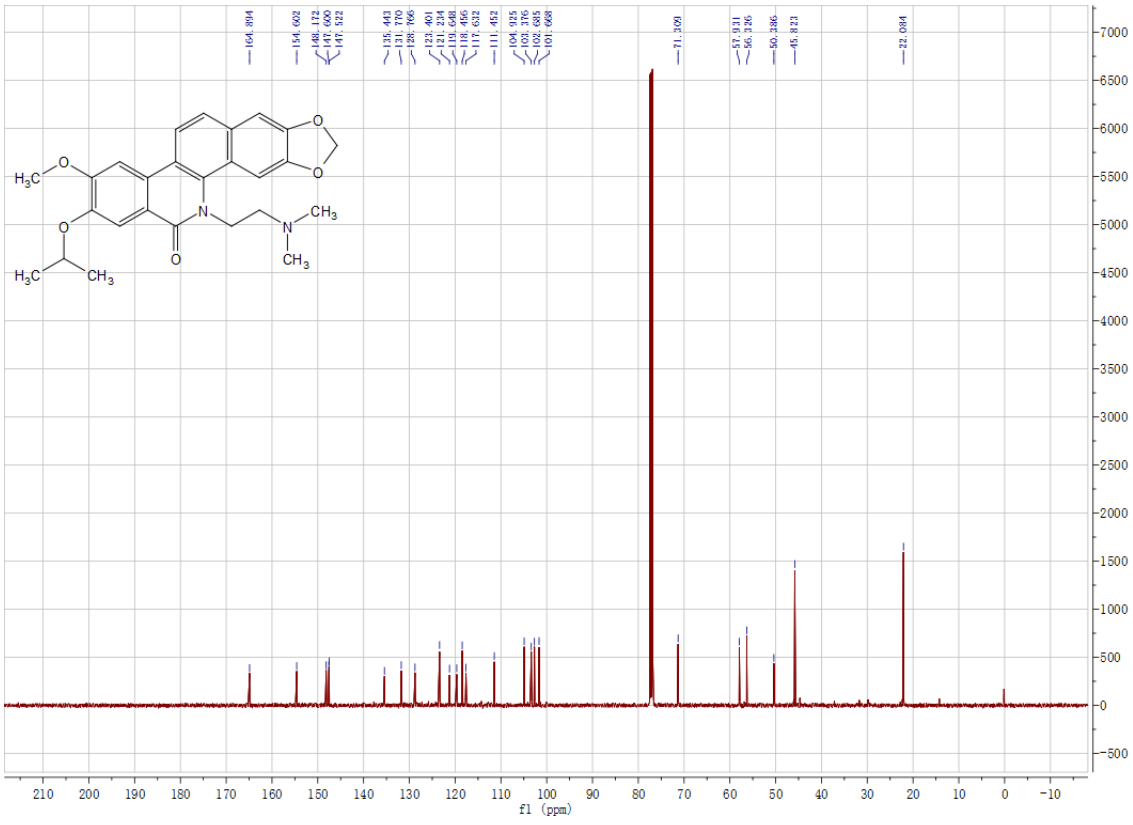


^{1}H NMR and ^{13}C NMR spectra of compound **C15**

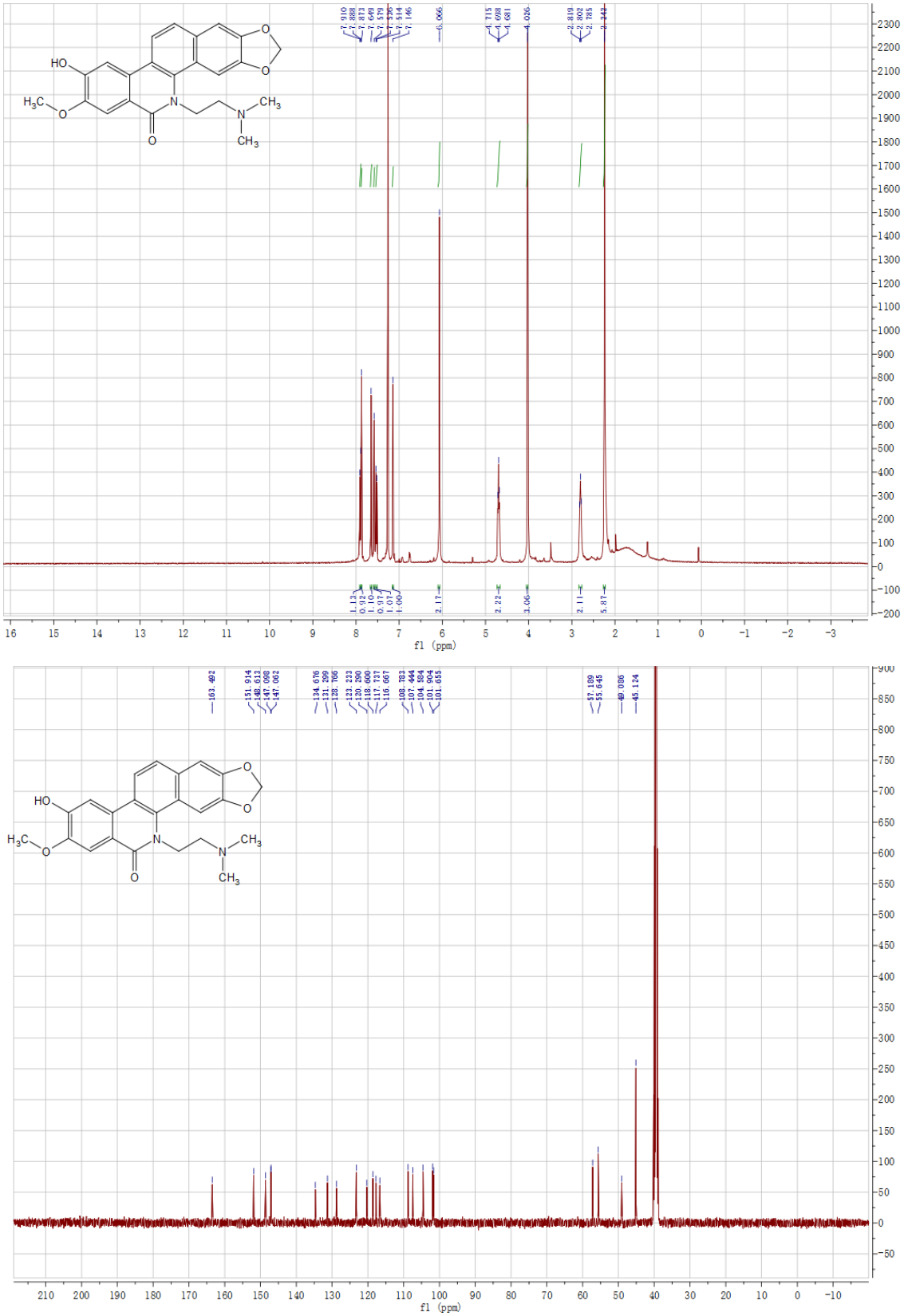


^{1}H NMR and ^{13}C NMR spectra of compound **C16**

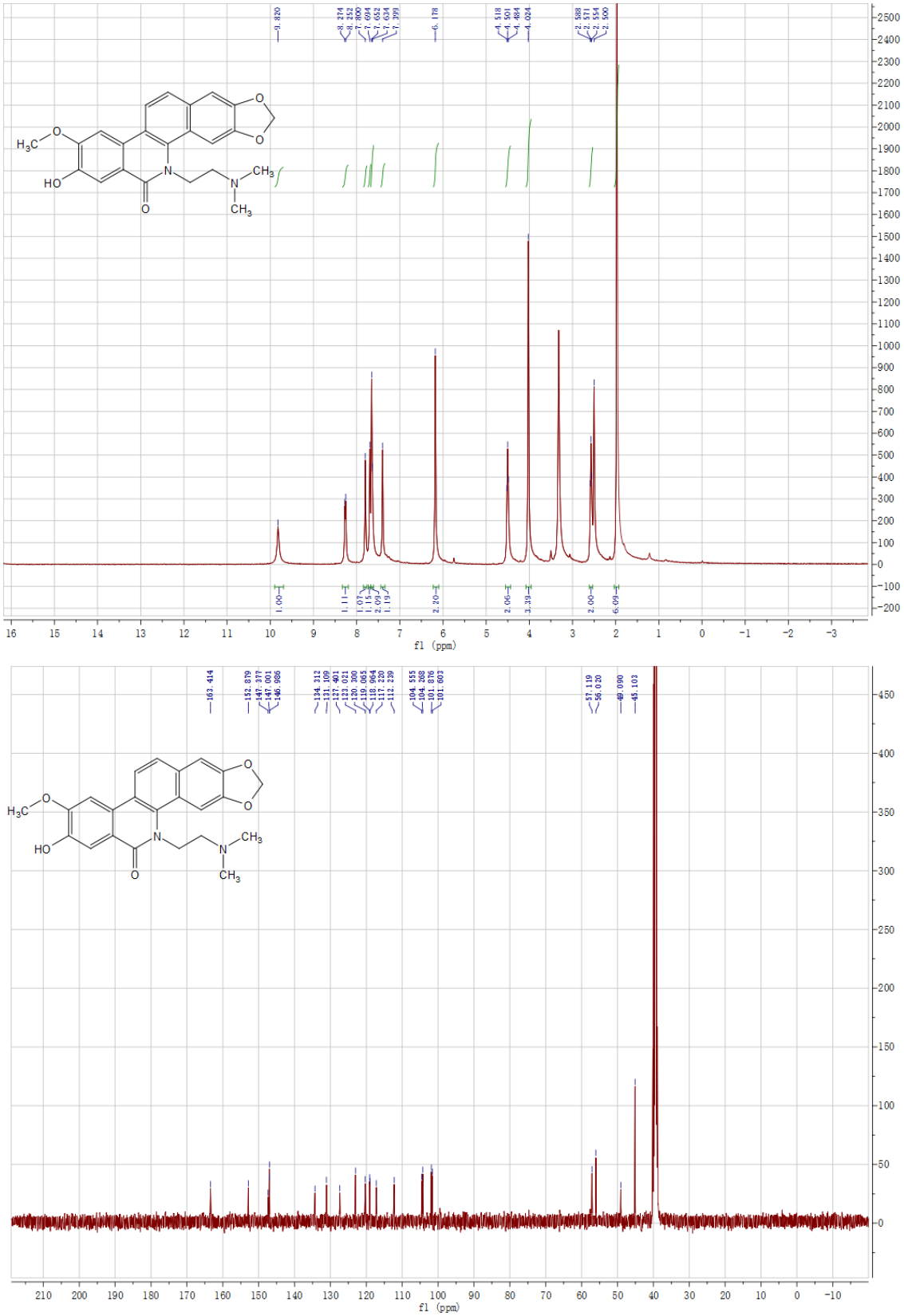




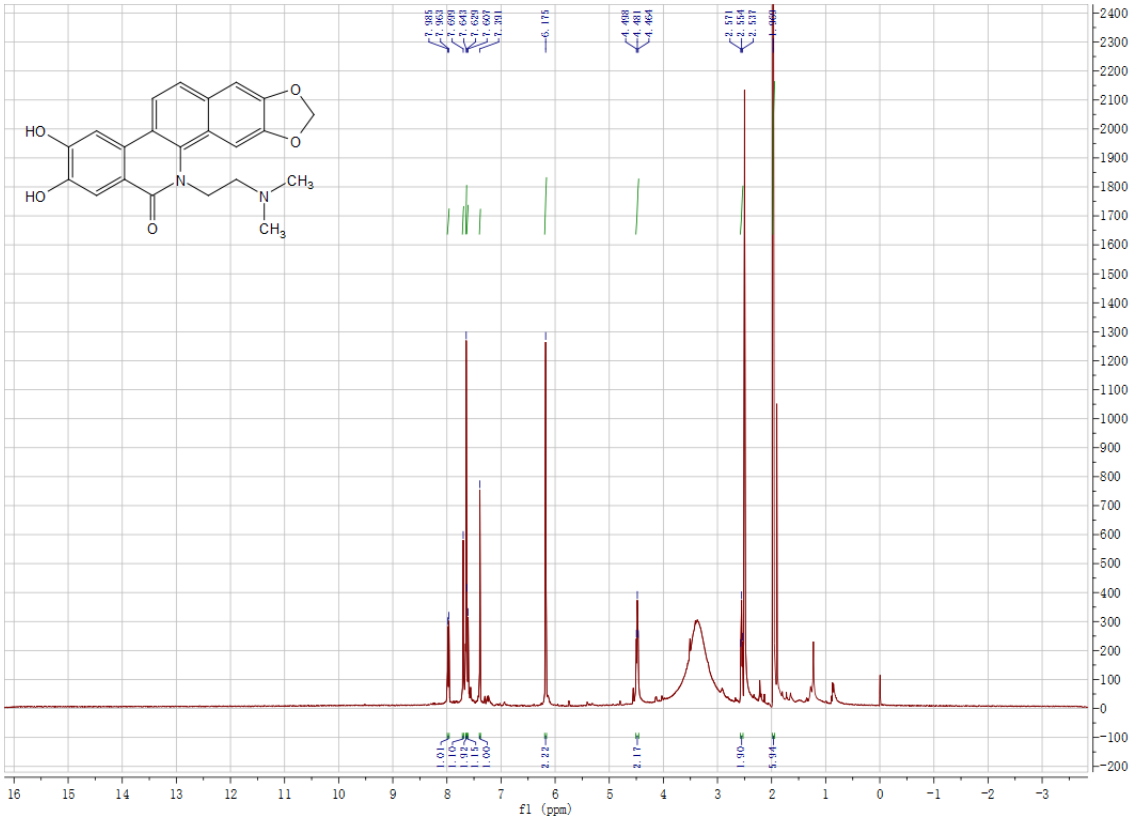
^{1}H NMR and ^{13}C NMR spectra of compound **C17**

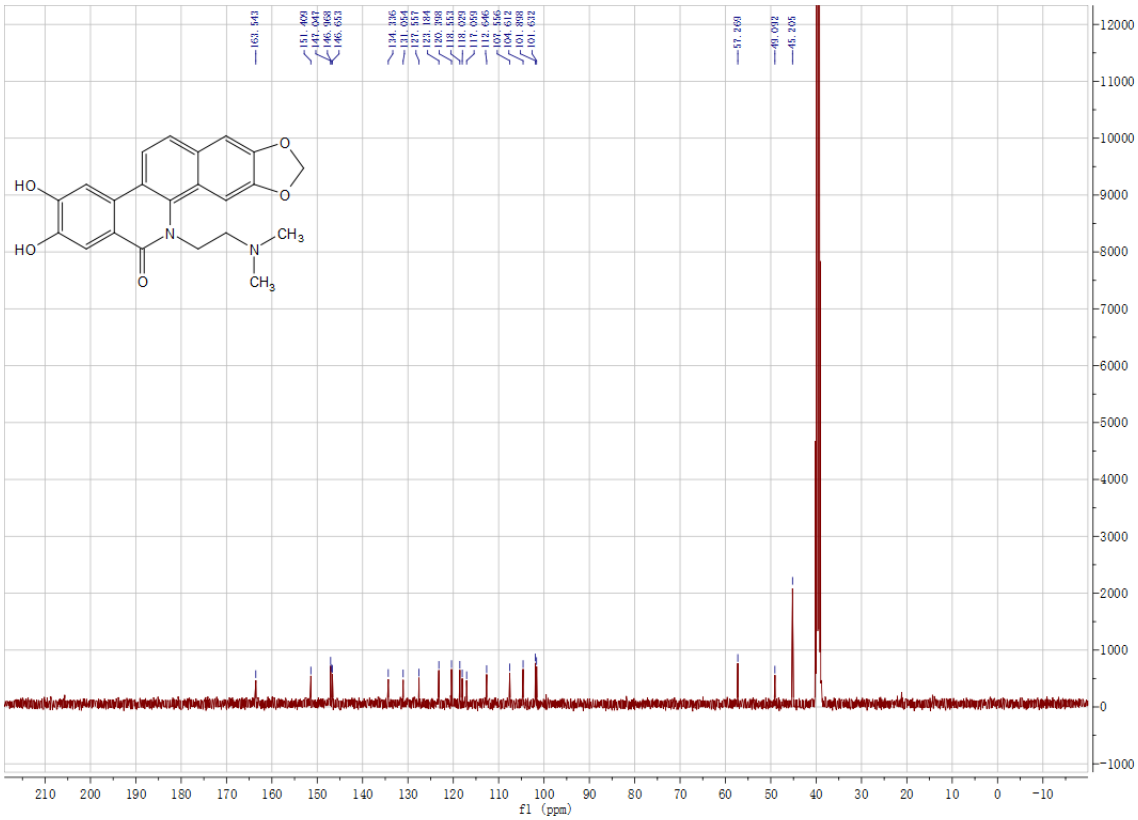


^{1}H NMR and ^{13}C NMR spectra of compound **C18**

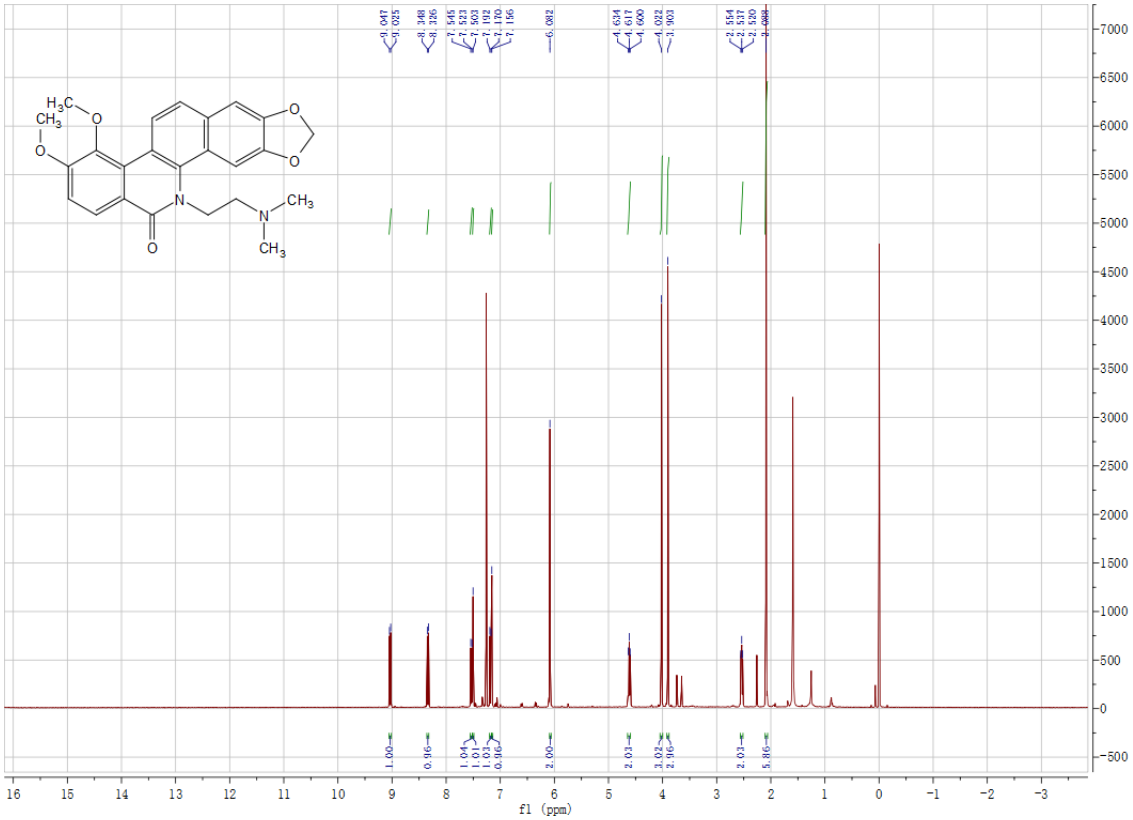


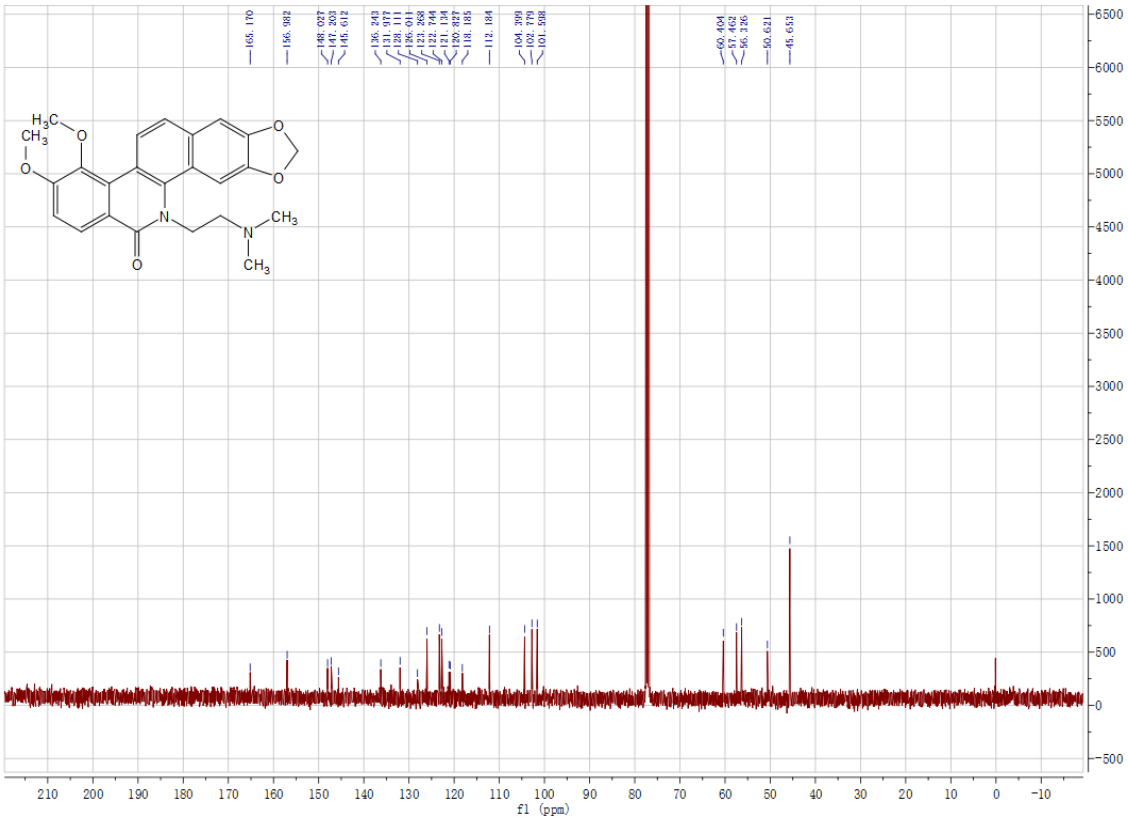
^{1}H NMR and ^{13}C NMR spectra of compound **C19**



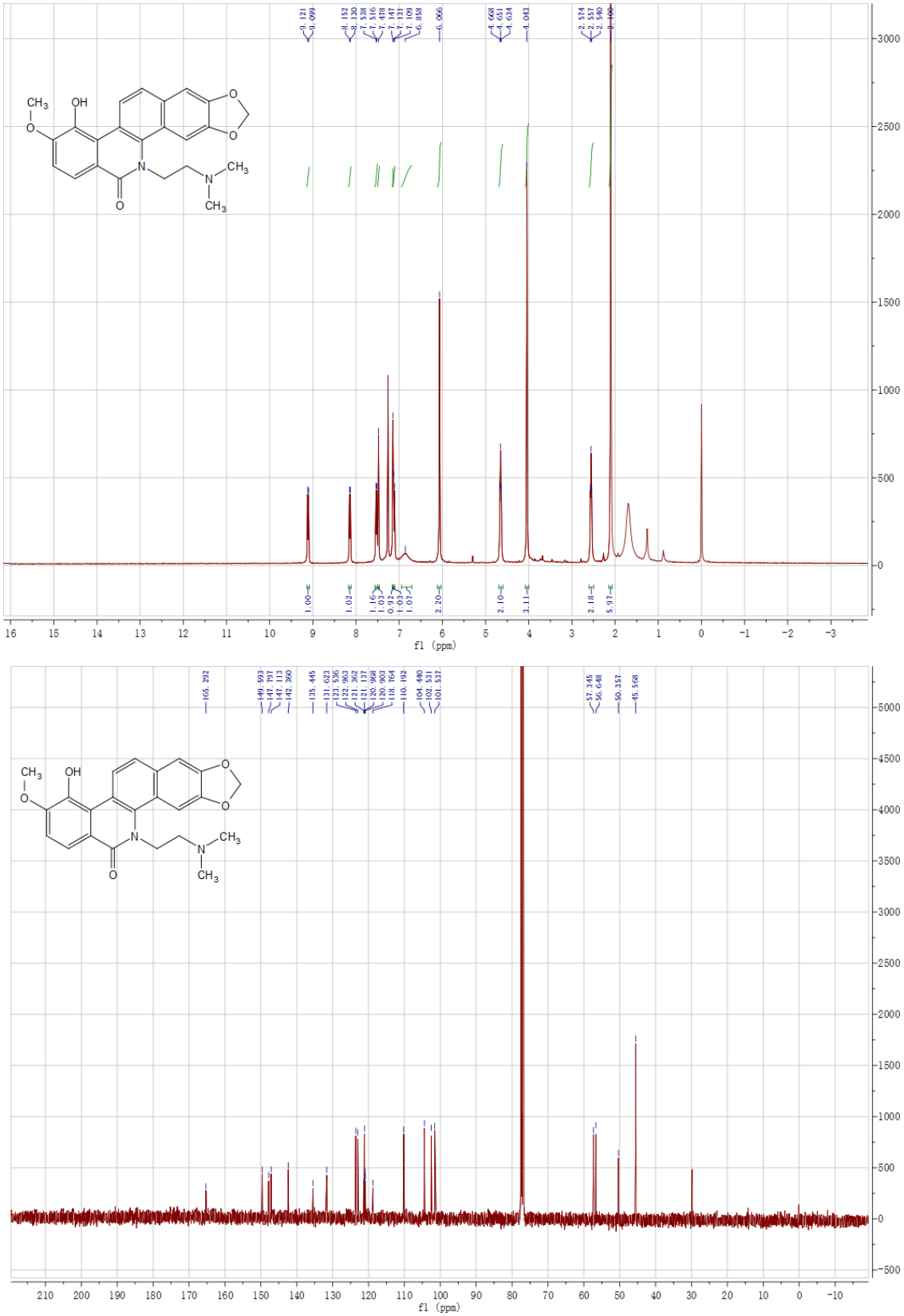


^{1}H NMR and ^{13}C NMR spectra of compound **C20**

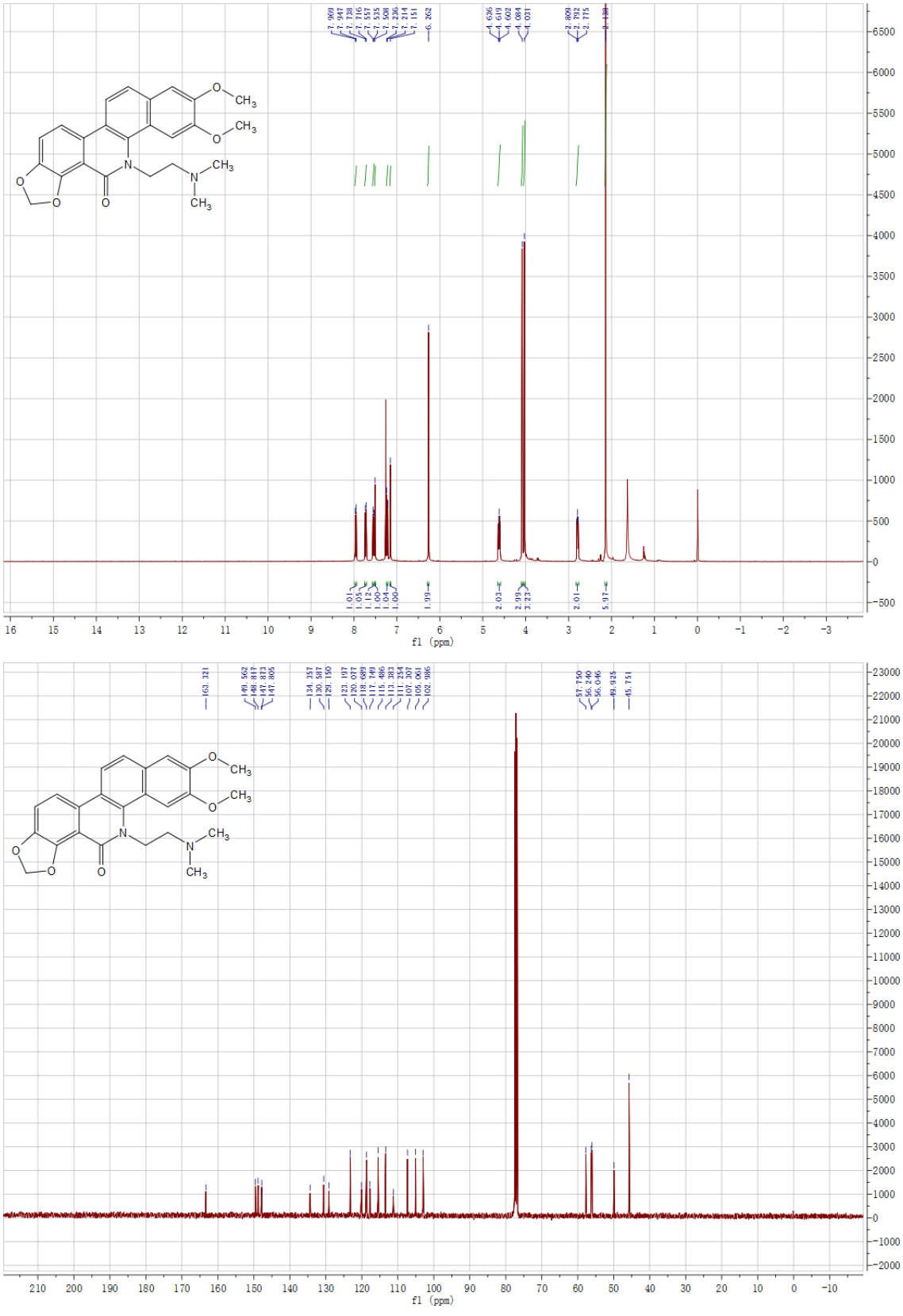




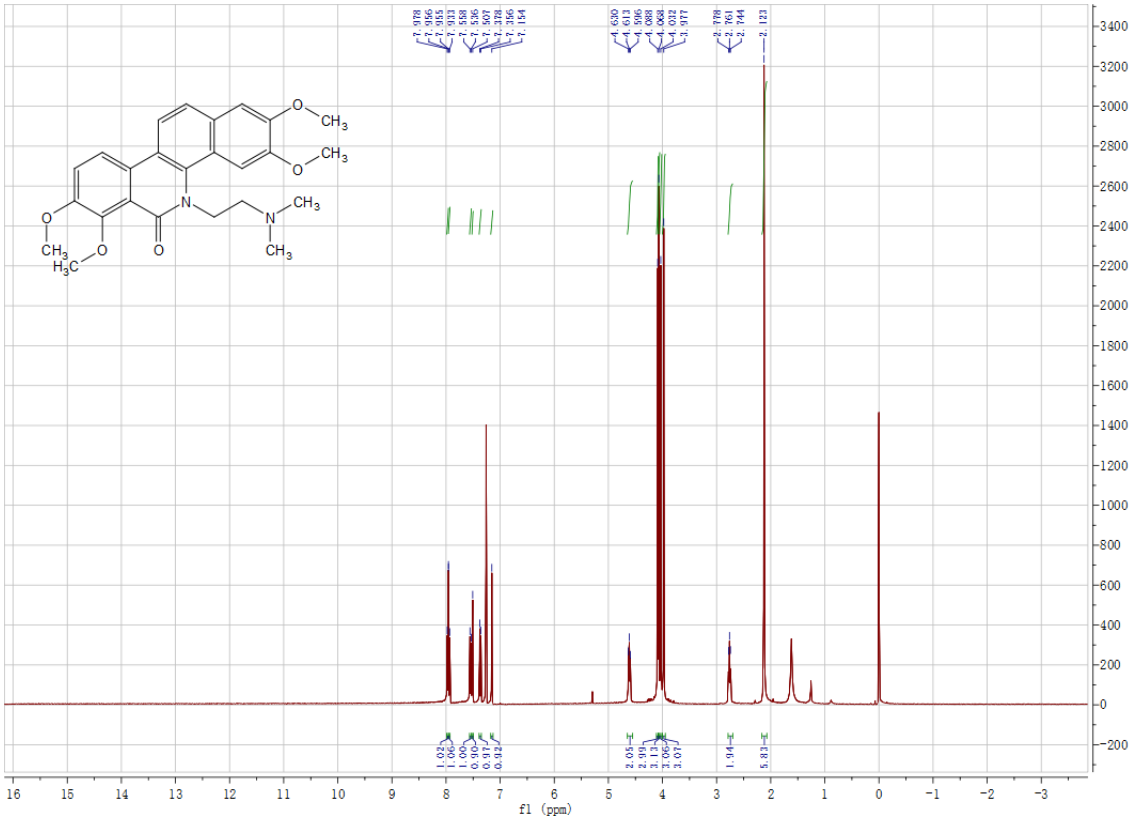
^{1}H NMR and ^{13}C NMR spectra of compound **C21**

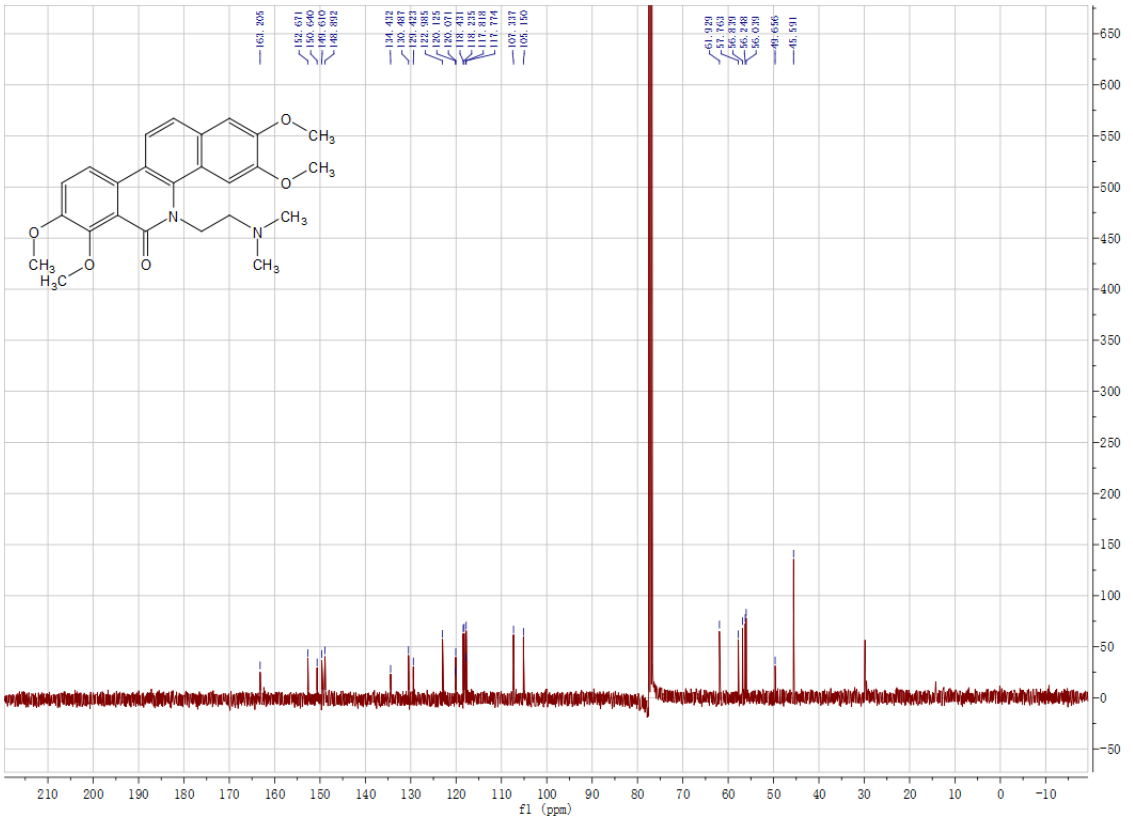


^{1}H NMR and ^{13}C NMR spectra of compound **C22**

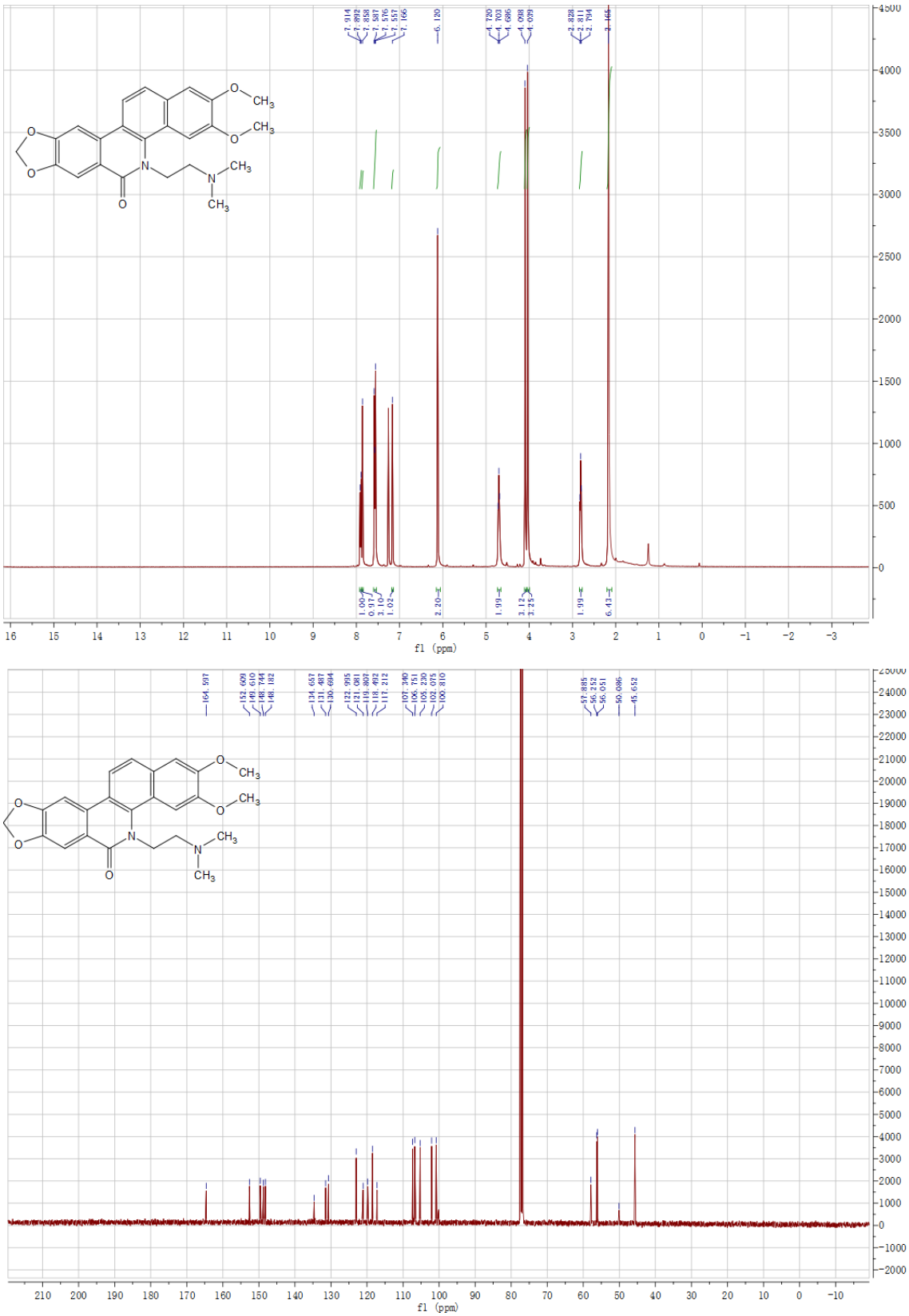


^{1}H NMR and ^{13}C NMR spectra of compound **C23**

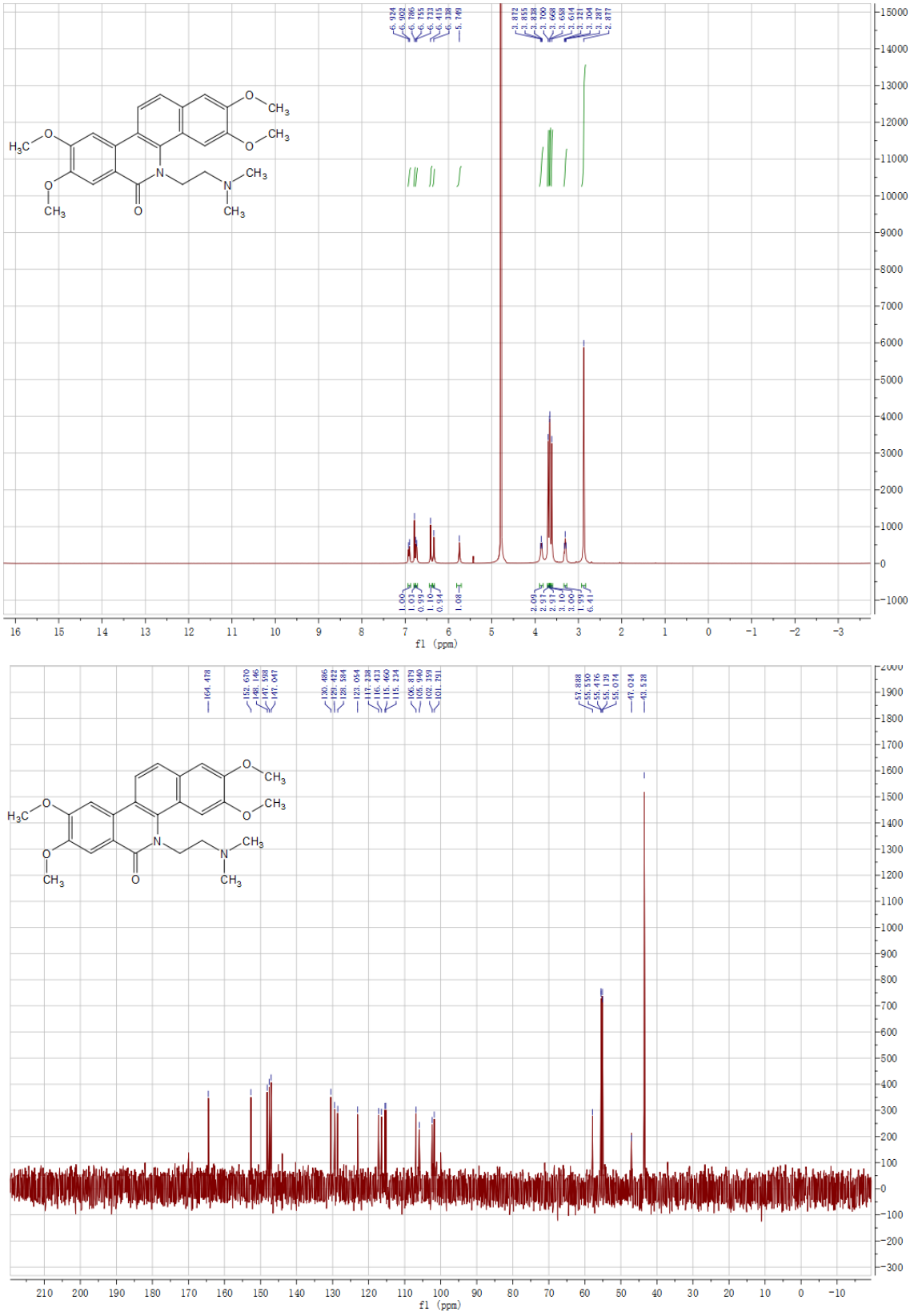




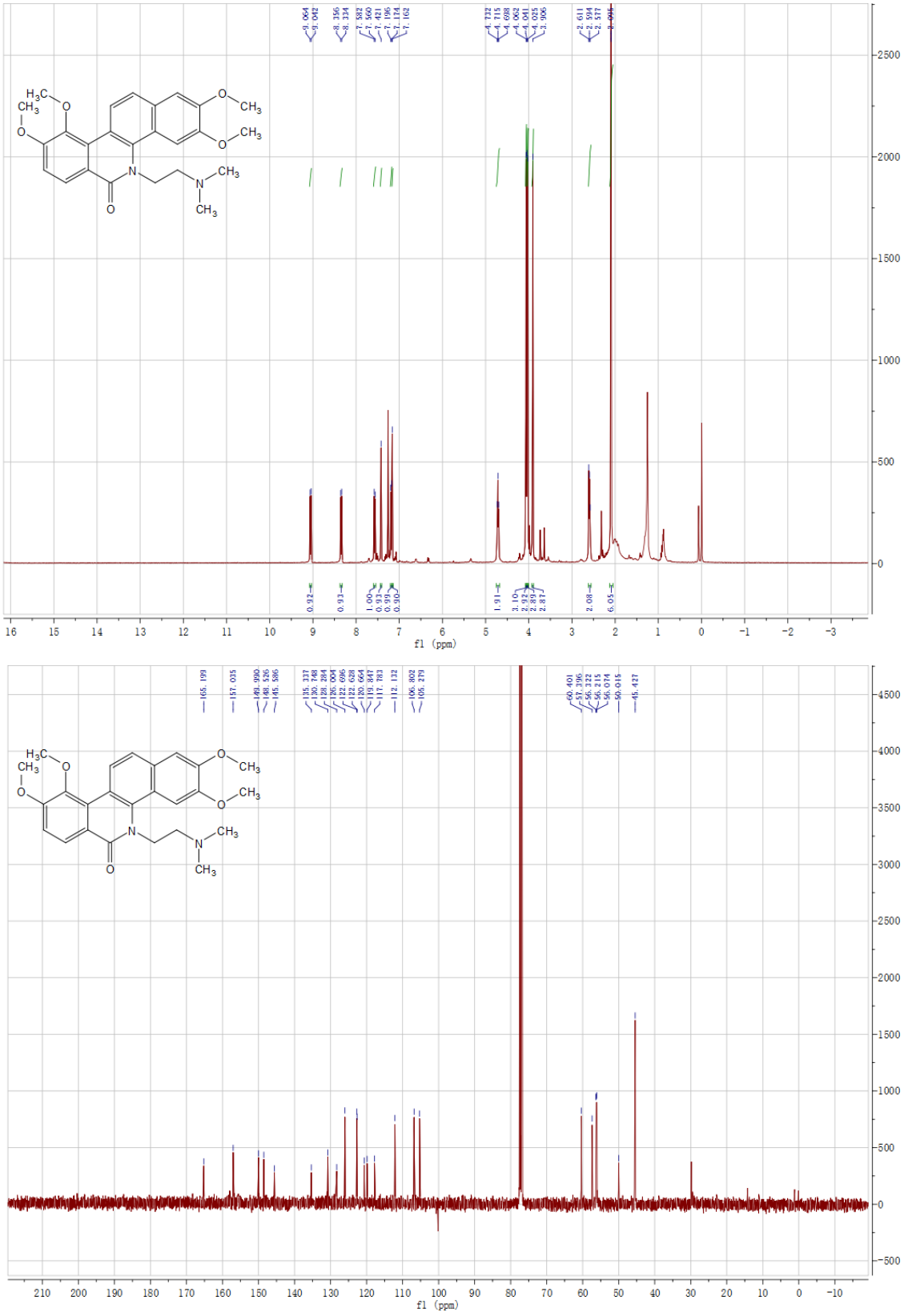
^{1}H NMR and ^{13}C NMR spectra of compound **C24**



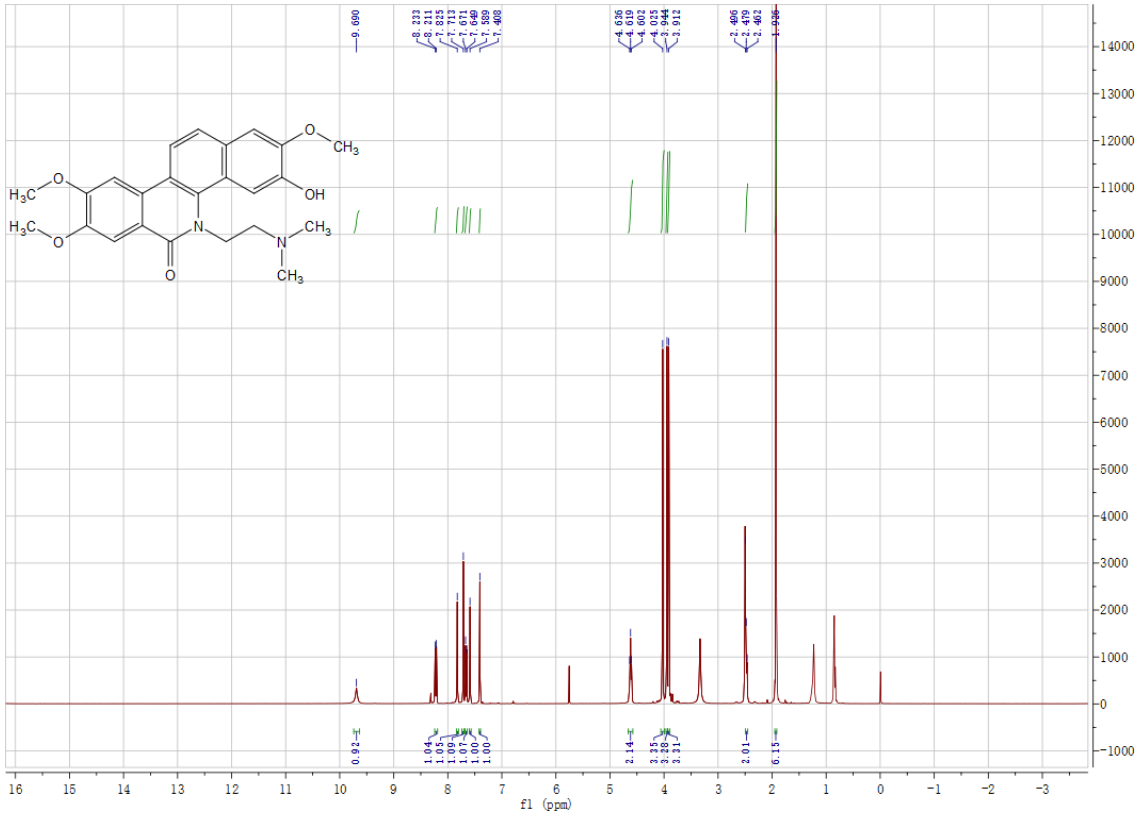
^{1}H NMR and ^{13}C NMR spectra of compound **C25**

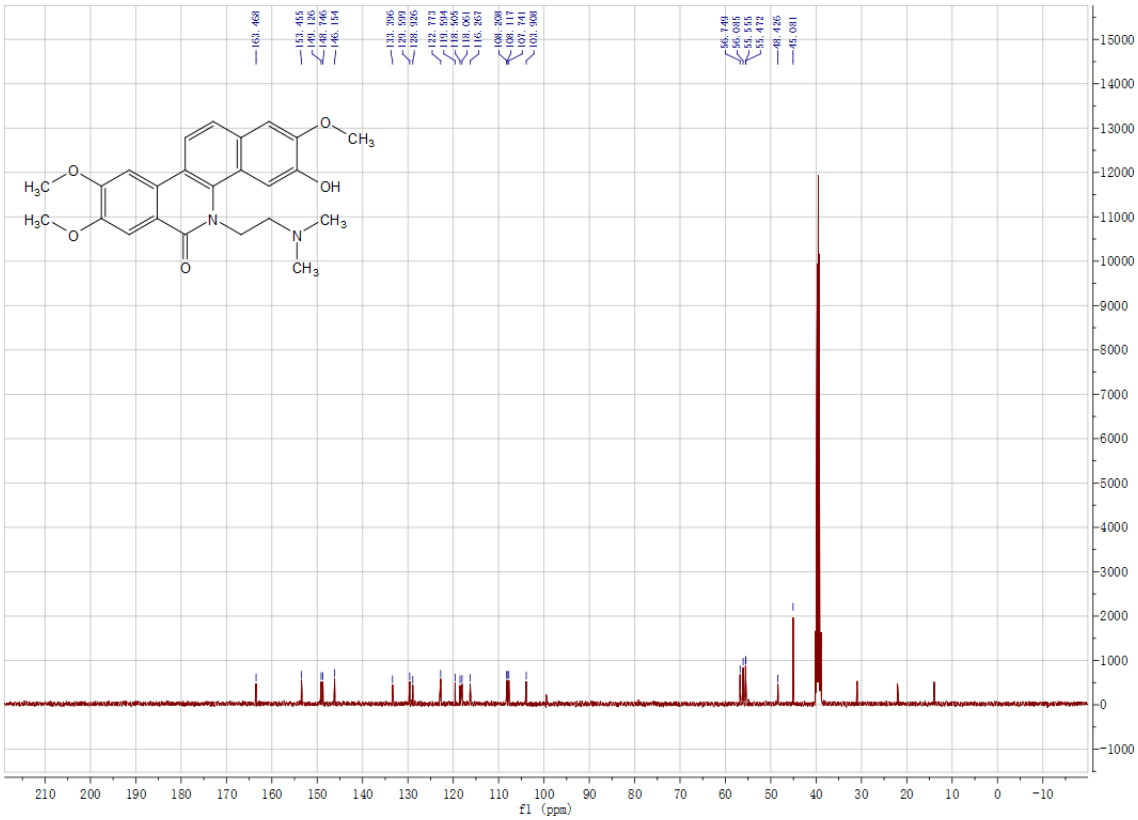


^{1}H NMR and ^{13}C NMR spectra of compound **C26**

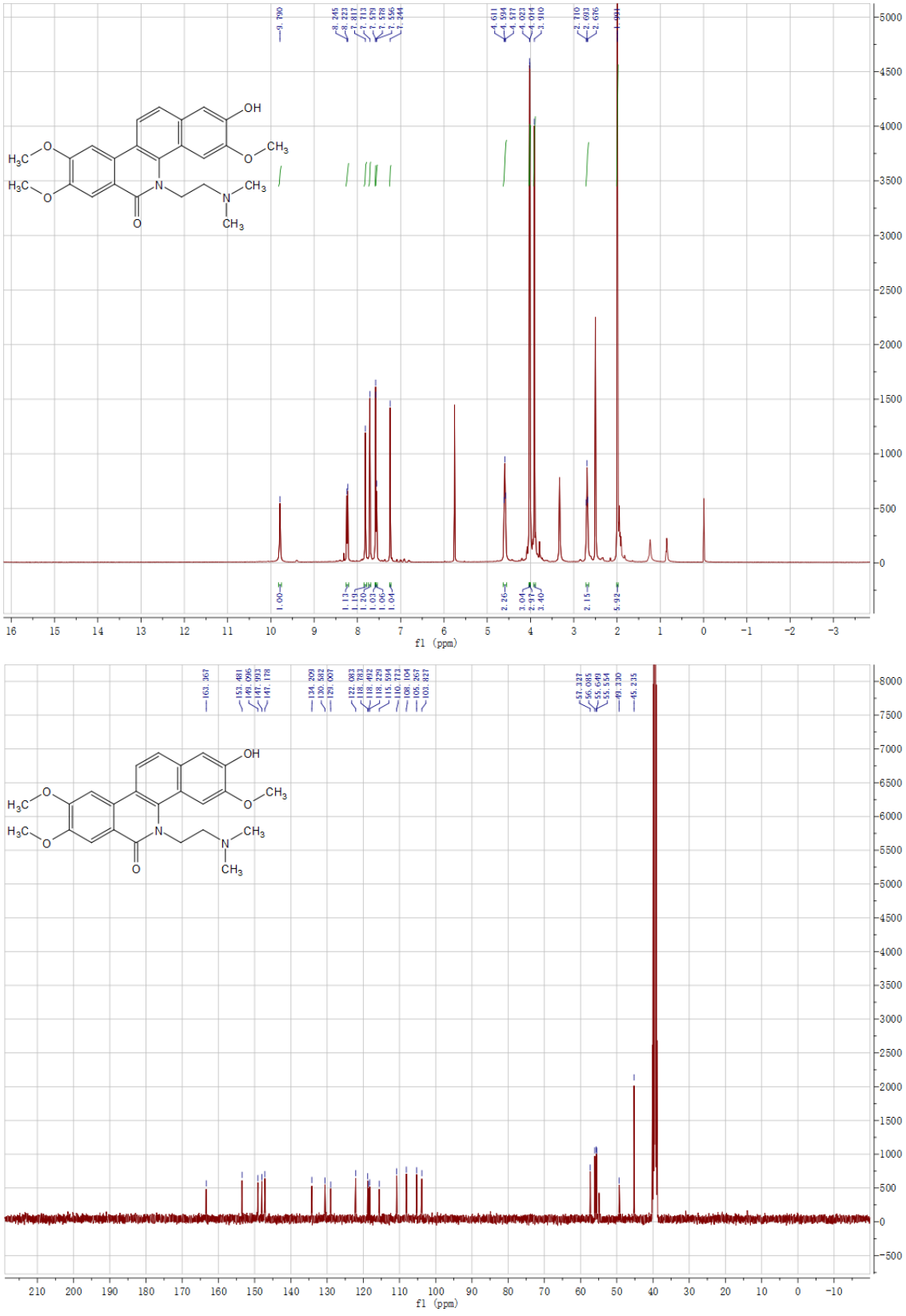


^{1}H NMR and ^{13}C NMR spectra of compound **C27**

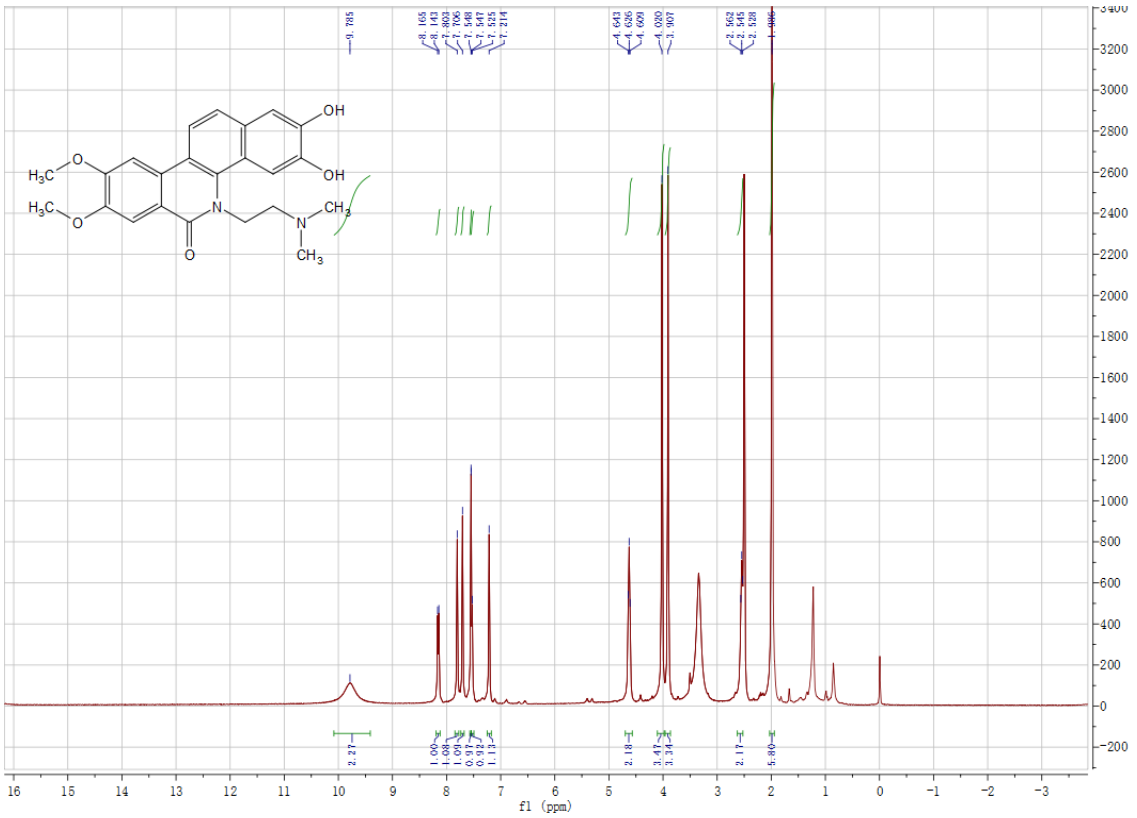


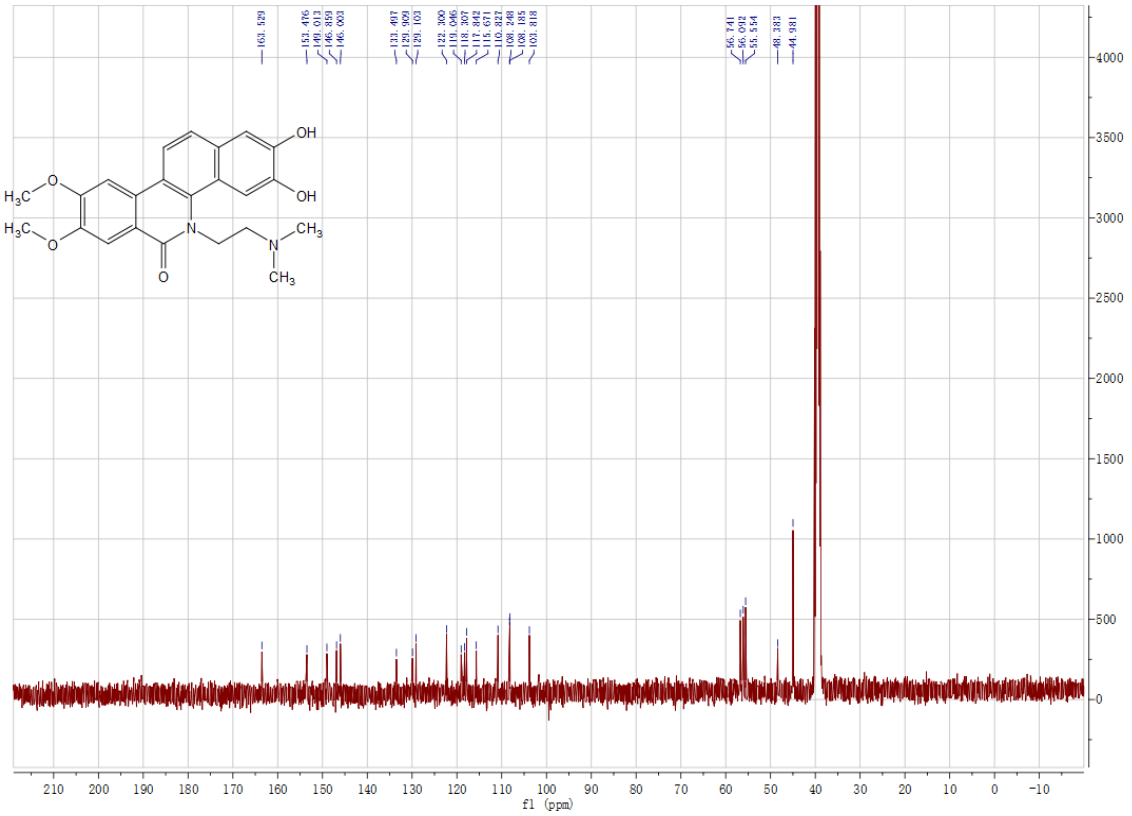


^{1}H NMR and ^{13}C NMR spectra of compound **C28**



^{1}H NMR and ^{13}C NMR spectra of compound **C29**





^{1}H NMR and ^{13}C NMR spectra of compound **C30**

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