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Supporting Information

Palladium-Catalyzed Cascade to Benzoxepins by Using Vinyl-Substituted Donor–Acceptor Cyclopropanes

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SUPPORTING INFORMATION

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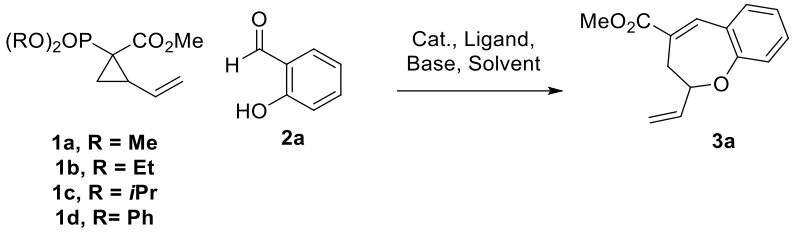
General information

Commercially available reagents were purchased from Sigma-Aldrich, Fischer, Strem Chemicals or Fluorochem and were used as purchased unless mentioned otherwise. Solvents were purchased from VWR Chemicals or Sigma-Aldrich and used without purification, unless stated otherwise. Anhydrous, air-free solvents were obtained from a PureSolv MD 5 solvent purification system. Infrared (IR) spectra were recorded neat using a Shimadzu FTIR-8400s spectrophotometer and wavelengths are reported in cm^{-1}. Nuclear magnetic resonance (NMR) spectra were recorded on a Bruker Avance 600, Bruker Avance 500 or Bruker Avance 300 using the residual $CHCl_3$ as internal standard (^1H: δ 7.26 ppm, $^{13}C\{1H\}$: δ 77.16 ppm). Chemical shifts (δ) are given in ppm and coupling constants (J) are quoted in hertz (Hz). Resonances are described as s (singlet), d (doublet), t (triplet), q (quartet), br (broad singlet) and m (multiplet) or combinations thereof. Electrospray Ionization (ESI) high-resolution mass spectrometry was carried out using a Bruker micrOTOF-Q instrument in positive ion mode (capillary potential of 4500 V). Flash chromatography was performed on Silicycle Silica-P Flash Silica Gel (particle size 40-63 μm, pore diameter 60 Å) using the indicated eluent. Thin Layer Chromatography (TLC) was performed using TLC plates from Merck (SiO_2, Kieselgel 60 F254 neutral, on aluminium with fluorescence indicator) and compounds were visualized by UV detection (254 nm) and/or $KMnO_4$ stain. SFC-MS analysis was conducted using a Shimadzu Nexera SFC-MS equipped with a Nexera X2 SIL-30AC autosampler, Nexera UC LC-30AD SF CO_2 pump, Nexera X2 LC-30AD liquid chromatograph, Nexera UC SFC-30A back pressure regulator, prominence SPD-M20A diode array detector, prominence CTO-20AC column oven and CBM-20A system controller. Enantiomeric excess was determined by SFC-MS analysis using: Lux® 3 μm Cellulose-1 column (cellulose tris(3,5-dimethylphenylcarbamate) (Column 1), Lux® 3 μm Cellulose-2 column (cellulose tris(3-chloro-4-methylphenylcarbamate) (Column 2), Lux® 3 μm Cellulose-3 column (cellulose tris(4-methylbenzoate), 150 x 4.6 mm) (Column 3), Lux® 3 μm Amylose-2 (Column 5). A gradient of supercritical CO_2 (A) and methanol (B) was used. Method 1 (Column 1): 2% B/98% A to 25% B/75% A over the course of 8 min. and was maintained at 25% B/75% A for 1 min (flow: 1.5 mL/min.). Method 2 (Column 2): 2% B/98% A to 30% B/70% A over the course of 4 min. and was maintained at 30% B/70% A for 2 min (flow: 2 mL/min.). Method 3 (Column 3): 2% B/98% A to 3% B/97% A over the course of 5 min., then to 30% B/70 % A over the course of 1 min and was maintained at 30% B/70% A for 1 min (flow: 1mL/min). Method 4 (Column 5): 2% B/98% A to 5% B/95% A over the course of 15 min., then to 30% B/70 % A over the course of 1 min and was maintained at 30% B/70% A for 1 min (flow: 1.5mL/min. Method 5 (Column 2): 2% B/98% A to 30% B/70% A over the course of 12 min. and was maintained at 30% B/70% A for 2 min (flow: 2mL/min.) The sample injection volume was 5 μL. Mass spectrometry analyses were performed using a Shimadzu LCMS-2020 mass spectrometer. The data were acquired in full-scan APCI mode (MS) from m/z 100 to 800 in positive ionisation mode. Data was processed using Shimadzu Labsolutions 5.82. Specific rotations were measured with an automatic AA-10 polarimeter. CD spectroscopy experiment were performed using Jas.co J-1500 Circular Dichroism Spectrometer.

SUPPORTING INFORMATION

Reaction optimization



1a, R = Me
1b, R = Et
1c, R = *i*Pr
1d, R= Ph

2a

3a

Table S1. Optimization Table.

Entry[a]	VCP (eq.)	Cat (%)	Lig. (%)	Solvent [M]	Base (eq.)	Addit. (eq.)	µL H_2O	T (°C)	Yield (%)[b]	e.r.[c]
1	**1a** (1.2)	$Pd(PPh_3)_4$ (10%)	-	THF (0.2)	KO*t*Bu (1.2)	-		50	43	-
2	**1a** (1.2)	Pd_2dba_3 (5%)	**L1** (20%)	THF (0.2)	KO*t*Bu (1.2)	-		50	47	-
3	**1a** (1.2)	Pd_2dba_3 (5%)	**L1** (20%)	THF (0.2)	KO*t*Bu (1.5)	-		50	53	-
4	**1a** (1.2)	Pd_2dba_3 (5%)	**L1** (20%)	THF (0.2)	KO*t*Bu (2)	-		50	62	-
5	**1a** (1.2)	Pd_2dba_3 (5%)	**L1** (20%)	THF (0.2)	KO*t*Bu (2.5)	-		50	54	-
6	**1a** (1.2)	Pd_2dba_3 (5%)	**L1** (20%)	THF (0.2)	KO*t*Bu (2)	LiCl (1.2)[d]		50	75	-
7	**1a** (1.5)	Pd_2dba_3 (5%)	**L1** (20%)	THF (0.2)	KO*t*Bu (2)	LiCl (1.2) [d]		50	83	-
8	**1a** (2.0)	Pd_2dba_3 (5%)	**L1** (20%)	THF (0.2)	KO*t*Bu (2)	LiCl (1.2) [d]		50	89	-
9	**1a** (2.5)	Pd_2dba_3 (5%)	**L1** (20%)	THF (0.2)	KO*t*Bu (2)	LiCl (1.2) [d]		50	95	-
10	**1a** (3.0)	Pd_2dba_3 (5%)	**L1** (20%)	THF (0.2)	KO*t*Bu (2)	LiCl (1.2) [d]		50	95	-
11	**1a** (2.5)	Pd_2dba_3 (5%)	**L2** (20%)	THF (0.2)	KO*t*Bu (2)	LiCl (1.2) [d]		r.t.	traces	-
12	**1a** (2.5)	Pd_2dba_3 (5%)	**L3** (20%)	THF (0.2)	KO*t*Bu (2)	LiCl (1.2) [d]		r.t.	traces	-
13	**1a** (2.5)	Pd_2dba_3 (5%)	**L4** (20%)	THF (0.2)	KO*t*Bu (2)	LiCl (1.2) [d]		r.t.	traces	-
14	**1a** (2.5)	Pd_2dba_3 (5%)	**L5** (10%)	THF (0.2)	KO*t*Bu (2)	LiCl (1.2) [d]		r.t.	traces	-
15	**1a** (2.5)	Pd_2dba_3 (5%)	**L6** (10%)	THF (0.2)	KO*t*Bu (2)	LiCl (1.2) [d]		r.t.	traces	-
16	**1a** (2.5)	Pd_2dba_3 (5%)	**L7** (10%)	THF (0.2)	KO*t*Bu (2)	LiCl (1.2) [d]		r.t.	traces	-
17	**1a** (2.5)	Pd_2dba_3 (5%)	**L8** (10%)	THF (0.2)	KO*t*Bu (2)	LiCl (1.2) [d]		r.t.	15	64:36
18	**1a** (2.5)	Pd_2dba_3 (5%)	**L9** (20%)	THF (0.2)	KO*t*Bu (2)	LiCl (1.2) [d]		r.t.	traces	-
19	**1a** (2.5)	Pd_2dba_3 (5%)	**L10** (20%)	THF (0.2)	KO*t*Bu (2)	LiCl (1.2) [d]		r.t.	traces	-
20	**1a** (2.5)	Pd_2dba_3 (5%)	**L11** (20%)	THF (0.2)	KO*t*Bu (2)	LiCl (1.2) [d]		r.t.	30	51:49
21	**1a** (2.5)	Pd_2dba_3 (5%)	**L12** (20%)	THF (0.2)	KO*t*Bu (2)	LiCl (1.2) [d]		r.t.	31	50:50
22	**1a** (2.5)	Pd_2dba_3 (5%)	**L13** (20%)	THF (0.2)	KO*t*Bu (2)	LiCl (1.2) [d]		r.t.	64	50:50
23	**1a** (2.5)	Pd_2dba_3 (5%)	**L14** (20%)	THF (0.2)	KO*t*Bu (2)	LiCl (1.2) [d]		r.t.	traces	-
24	**1a** (2.5)	Pd_2dba_3 (5%)	**L15** (20%)	THF (0.2)	KO*t*Bu (2)	LiCl (1.2) [d]		r.t.	40	77:23
25	**1a** (2.5)	Pd_2dba_3 (5%)	**L16** (20%)	THF (0.2)	KO*t*Bu (2)	LiCl (1.2) [d]		r.t.	45	61:39
26	**1a** (2.5)	Pd_2dba_3 (5%)	**L17** (20%)	THF (0.2)	KO*t*Bu (2)	LiCl (1.2) [d]		r.t.	22	72:28

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Entry[a]	VCP (eq.)	Cat (%)[b]	Lig. (%)[c]	Solvent [M]	Base (eq.)	Addit. (eq.)	µL H_2O	T (°C)	Yield (%)	e.r.
27	**1a** (2.5)	Pd_2dba_3 (5%)	**L18** (20%)	THF (0.2)	KO*t*Bu (2)	LiCl (1.2) [d]		r.t.	79	56:44
28	**1a** (2.5)	Pd_2dba_3 (5%)	**L19** (20%)	THF (0.2)	KO*t*Bu (2)	LiCl (1.2) [d]		r.t.	20	76:24
29	**1a** (2.5)	Pd_2dba_3 (5%)	**L20** (20%)	THF (0.2)	KO*t*Bu (2)	LiCl (1.2) [d]		r.t.	98	64:36
30	**1a** (2.5)	Pd_2dba_3 (5%)	**L21** (20%)	THF (0.2)	KO*t*Bu (2)	LiCl (1.2) [d]		r.t.	15	66:34
31	**1a** (2.5)	Pd_2dba_3 (5%)	**L22** (20%)	THF (0.2)	KO*t*Bu (2)	LiCl (1.2) [d]		r.t.	11	66:34
32	**1a** (2.5)	Pd_2dba_3 (5%)	**L23** (20%)	THF (0.2)	KO*t*Bu (2)	LiCl (1.2) [d]		r.t.	traces	-
33	**1a** (2.5)	Pd_2dba_3 (5%)	**L24** (20%)	THF (0.2)	KO*t*Bu (2)	LiCl (1.2) [d]		r.t.	98	77:23
34	**1a** (2.5)	Pd_2dba_3 (5%)	**L25** (20%)	THF (0.2)	KO*t*Bu (2)	LiCl (1.2) [d]		r.t.	4	80:20
35	**1a** (2.5)	Pd_2dba_3 (5%)	**L26** (20%)	THF (0.2)	KO*t*Bu (2)	LiCl (1.2) [d]		r.t.	traces	-
36	**1a** (3.5)	Pd_2dba_3 (5%)	**L24** (20%)	THF (0.2)	KO*t*Bu (2)	LiCl (1.2) [d]		r.t.	98	80:20
37	**1a** (4.5)	Pd_2dba_3 (5%)	**L24** (20%)	THF (0.2)	KO*t*Bu (2)	LiCl (1.2) [d]		r.t.	98	80:20
38	**1a** (5.5)	Pd_2dba_3 (5%)	**L24** (20%)	THF (0.2)	KO*t*Bu (2)	LiCl (1.2) [d]		r.t.	98	80:20
39	**1a** (3.5)	Pd_2dba_3 (5%)	**L24** (20%)	DCM (0.2)	KO*t*Bu (2)	LiCl (1.2) [d]		r.t.	11	79:21
40	**1a** (3.5)	Pd_2dba_3 (5%)	**L24** (20%)	DMF (0.2)	KO*t*Bu (2)	LiCl (1.2) [d]		r.t.	6	80:20
41	**1a** (3.5)	Pd_2dba_3 (5%)	**L24** (20%)	Diox (0.2)	KO*t*Bu (2)	LiCl (1.2) [d]		r.t.	87	79:21
42	**1a** (3.5)	Pd_2dba_3 (5%)	**L24** (20%)	Tol. (0.2)	KO*t*Bu (2)	LiCl (1.2) [d]		r.t.	8	64:36
43	**1a** (3.5)	Pd_2dba_3 (5%)	**L24** (20%)	ClPh (0.2)	KO*t*Bu (2)	LiCl (1.2) [d]		r.t.	74	71:29
44	**1a** (3.5)	Pd_2dba_3 (5%)	**L24** (20%)	MeO*t*Bu (0.2)	KO*t*Bu (2)	LiCl (1.2) [d]		r.t.	69	65:35
45	**1a** (3.5)	Pd_2dba_3 (5%)	**L24** (20%)	2-MeTHF (0.2)	KO*t*Bu (2)	LiCl (1.2) [d]		r.t.	97	80:20
46	**1a** (3.5)	Pd_2dba_3 (5%)	**L24** (20%)	MeCN (0.2)	KO*t*Bu (2)	LiCl (1.2) [d]		r.t.	17	76:24
47	**1a** (3.5)	Pd_2dba_3 (5%)	**L24** (20%)	THF (0.2)	KO*t*Bu (2)	LiCl (1.2)[e]		r.t.	traces	-
48	**1a** (3.5)	Pd_2dba_3 (5%)	**L24** (20%)	THF (0.2)	KO*t*Bu (2)	LiCl (1.2) [e]	10	r.t.	44	77:23
49	**1a** (3.5)	Pd_2dba_3 (5%)	**L24** (20%)	THF (0.2)	KO*t*Bu (2)	LiCl (1.2) [e]	25	r.t.	99	80:20
50	**1a** (3.5)	Pd_2dba_3 (5%)	**L24** (20%)	THF (0.2)	KO*t*Bu (2)	LiCl (1.2) [e]	40	r.t.	67	80:20
51	**1a** (3.5)	Pd_2dba_3 (5%)	**L24** (20%)	THF (0.2)	KO*t*Bu (2)	LiCl (1.2) [e]	60	r.t.	62	75:25
52	**1a** (3.5)	Pd_2dba_3 (5%)	**L24** (20%)	THF (0.2)	KO*t*Bu (2)	LiCl (1.2) [e]	80	r.t.	55	73:27
53	**1a** (3.5)	Pd_2dba_3 (5%)	**L24** (20%)	THF (0.2)	KO*t*Bu (2)	LiCl (1.2) [e]	100	r.t.	57	73:27
54	**1a** (3.5)	Pd_2dba_3 (5%)	**L24** (20%)	THF (0.2)	KO*t*Bu (2)	LiCl (1.0)	25	r.t.	97	80:20
55	**1a** (3.5)	Pd_2dba_3 (5%)	**L24** (20%)	THF (0.2)	KO*t*Bu (2)	LiCl (1.5)	25	r.t.	98	80:20
56	**1a** (3.5)	Pd_2dba_3 (5%)	**L24** (20%)	THF (0.2)	KO*t*Bu (2)	LiCl (2.0)	25	r.t.	98	80:20
57	**1a** (3.5)	Pd_2dba_3 (5%)	**L24** (20%)	THF (0.2)	KO*t*Bu (2)	$ZnCl_2$ (1.2)	25	r.t.	24	61:39
58	**1a** (3.5)	Pd_2dba_3 (5%)	**L24** (20%)	THF (0.2)	KO*t*Bu (2)	TBAC (1.2)	25	r.t.	17	63:37
59	**1a** (3.5)	Pd_2dba_3 (5%)	**L24** (20%)	THF (0.2)	KO*t*Bu (2)	TBAF (1.2)	25	r.t.	-	-
60	**1a** (3.5)	Pd_2dba_3 (5%)	**L24** (20%)	THF (0.2)	KO*t*Bu (2)	TBAB (1.2)	25	r.t.	8	53:47
61	**1a** (3.5)	Pd_2dba_3 (5%)	**L24** (20%)	THF (0.2)	KO*t*Bu (2)	$MgCl_2$ (1.2)	25	r.t.	4	80:20

SUPPORTING INFORMATION

Entry[a]	VCP (eq.)	Cat (%)[b]	Lig. (%)[c]	Solvent [M]	Base (eq.)	Addit. (eq.)	µL H_2O	T (°C)	Yield (%)	e.r.
62	**1b** (3.5)	Pd_2dba_3 (5%)	**L24** (20%)	THF (0.2)	KO*t*Bu (2)	LiCl (1.2) [e]	25	r.t.	35	82:18
63	**1c** (3.5)	Pd_2dba_3 (5%)	**L24** (20%)	THF (0.2)	KO*t*Bu (2)	LiCl (1.2) [e]	25	r.t.	17	83:17
64	**1d** (3.5)	Pd_2dba_3 (5%)	**L24** (20%)	THF (0.2)	KO*t*Bu (2)	LiCl (1.2) [e]	25	r.t.	8	85:15
65	**1a** (3.5)	Pd_2dba_3 (5%)	**L24** (20%)	THF (0.2)	KOH (2)	LiCl (1.2) [e]	25	r.t.	57	80:20
66	**1a** (3.5)	Pd_2dba_3 (5%)	**L24** (20%)	THF (0.2)	LiOH (2)	LiCl (1.2) [e]	25	r.t.	-	-
67	**1a** (3.5)	Pd_2dba_3 (5%)	**L24** (20%)	THF (0.2)	LiO*t*Bu (2)	LiCl (1.2) [e]	25	r.t.	-	-
68	**1a** (3.5)	Pd_2dba_3 (5%)	**L24** (20%)	THF (0.2)	K_3PO_4 (2)	LiCl (1.2) [e]	25	r.t.	35	57:43
69	**1a** (3.5)	Pd_2dba_3 (5%)	**L24** (20%)	THF (0.2)	Cs_2CO_3 (2)	LiCl (1.2) [e]	25	r.t.	12	55:45
70	**1a** (3.5)	Pd_2dba_3 (5%)	**L24** (20%)	THF (0.2)	TMG (2)	LiCl (1.2) [e]	25	r.t.	-	-
71	**1a** (3.5)	Pd_2dba_3 (5%)	**L24** (20%)	THF (0.2)	DBU (2)	LiCl (1.2) [e]	25	r.t.	-	-
72	**1a** (3.5)	Pd_2dba_3 (5%)	**L24** (20%)	THF (0.2)	KO*t*Bu (1)	LiCl (1.2) [e]	25	r.t.	37	76:24
73	**1a** (3.5)	Pd_2dba_3 (5%)	**L24** (20%)	THF (0.2)	KO*t*Bu (1.5)	LiCl (1.2) [e]	25	r.t.	61	77:23
74	**1a** (3.5)	Pd_2dba_3 (5%)	**L24** (20%)	THF (0.2)	KO*t*Bu (2.5)	LiCl (1.2) [e]	25	r.t.	47	80:20
75	**1a** (3.5)	Pd_2dba_3 (5%)	**L24** (20%)	THF (0.05)	KO*t*Bu (2.0)	LiCl (1.2) [e]	25	r.t.	61	77:23
76	**1a** (3.5)	Pd_2dba_3 (5%)	**L24** (20%)	THF (0.1)	KO*t*Bu (2.0)	LiCl (1.2) [e]	25	r.t.	85	78:22
77	**1a** (3.5)	Pd_2dba_3 (5%)	**L24** (20%)	THF (0.3)	KO*t*Bu (2.0)	LiCl (1.2) [e]	25	r.t.	84	79:21
78	**1a** (3.5)	Pd_2dba_3 (5%)	**L24** (20%)	THF (0.4)	KO*t*Bu (2.0)	LiCl (1.2) [e]	25	r.t.	73	77:23
79	**1a** (3.5)	Pd_2dba_3 (5%)	**L24** (10%)	THF (0.2)	KO*t*Bu (2.0)	LiCl (1.2) [e]	25	r.t.	41	65:35
80	**1a** (3.5)	Pd_2dba_3 (5%)	**L24** (40%)	THF (0.2)	KO*t*Bu (2.0)	LiCl (1.2) [e]	25	r.t.	81	80:20
81	**1a** (3.5)	Pd_2dba_3 (2.5%)	**L24** (10%)	THF (0.2)	KO*t*Bu (2.0)	LiCl (1.2) [e]	25	r.t.	61	78:22
82	**1a** (3.5)	Pd_2dba_3 (5%)	**L24** (20%)	THF (0.2)	KO*t*Bu (2.0)	LiCl (1.2) [e]	25	0 °C	79	80:20
83	**1a** (3.5)	Pd_2dba_3 (5%)	**L24** (10%)	THF (0.2)	KO*t*Bu (2.0)	LiCl (1.2) [e]	25	- 20 °C	64	80:20
84	**1a** (3.5)	$Ir_2[cod]_2Cl_2$ (5%)	**L24** (20%)	THF (0.2)	KO*t*Bu (2.0)	LiCl (1.2) [e]	25	r.t.	-	-
85	**1a** (3.5)	$Pd(dba)_2$ (5%)	**L24** (20%)	THF (0.2)	KO*t*Bu (2.0)	LiCl (1.2) [e]	25	r.t.	72	80:20
86	**1a** (3.5)	$PdCl_2$ (10%)	**L24** (40%)	THF (0.2)	KO*t*Bu (2.0)	LiCl (1.2) [e]	25	r.t.	98	80:20
87	**1a** (3.5)	$Pd(OAc)_2$ (10%)	**L24** (20%)	THF (0.2)	KO*t*Bu (2.0)	LiCl (1.2) [e]	25	r.t.	47	80:20

[a] All reaction were performed using 0.236 mmol of **2a**. [b] Determine by internal standard ^{1}H-NMR. [c] Determined by chiral SFC-MS. [d] Solid LiCl. [e] 0.5 M solution in THF.

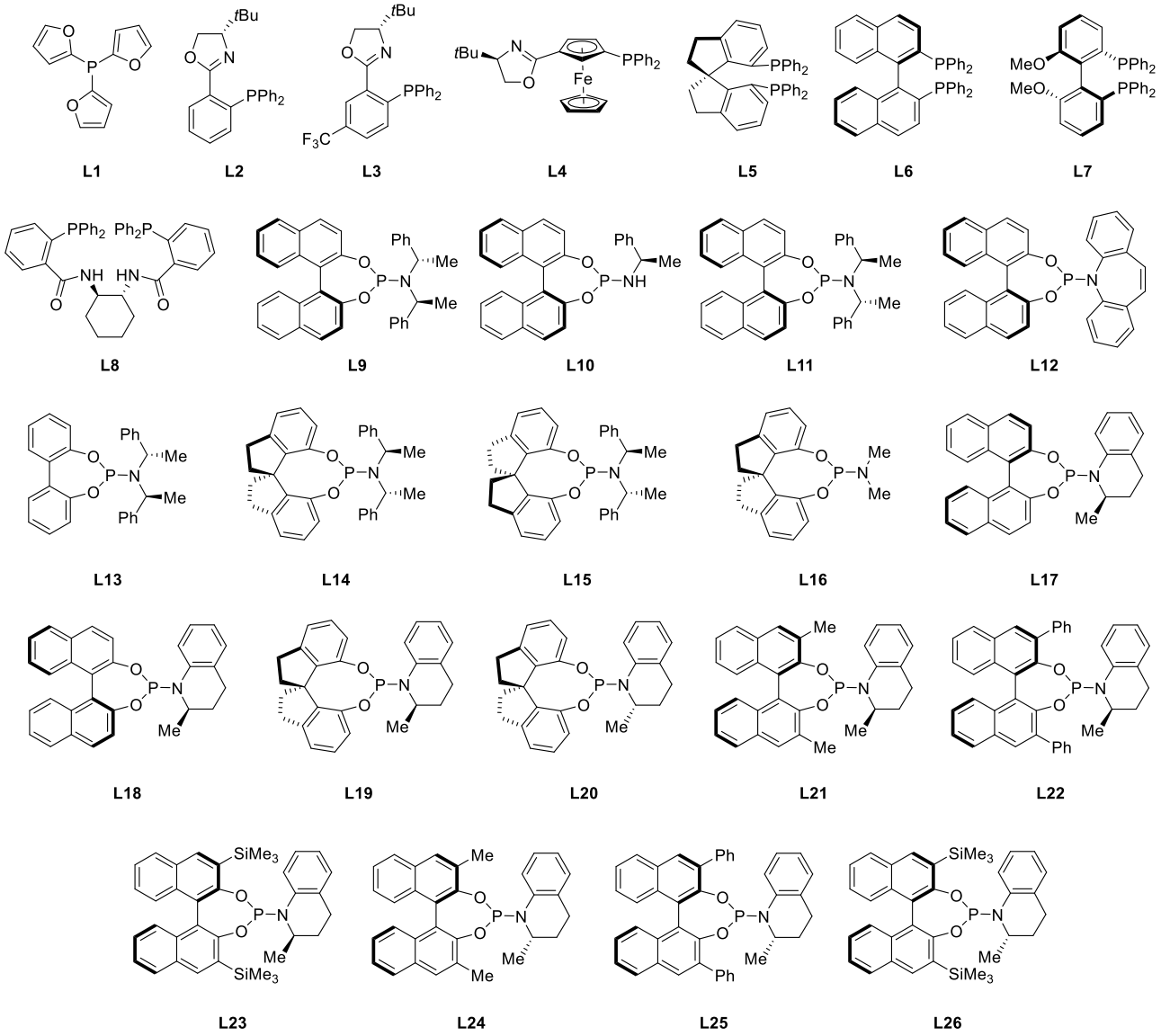
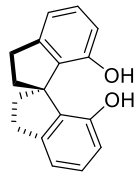


Figure S1. Ligands used.

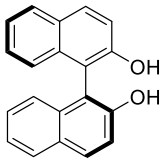
SUPPORTING INFORMATION

Ligand synthesis

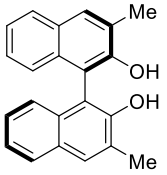
Compounds **S1**, **B1** and **B2** are commercially available.
Compounds **B5**, **B6** and **B7** were prepared according to literature procedures.[1]



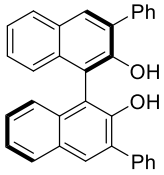
(R)
S1



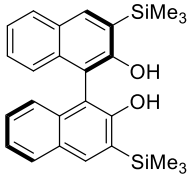
(S)
B1



(R)
B2

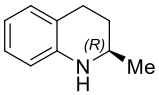


(R)
B3

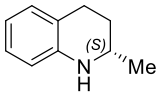


(R)
B4

Compounds **A1** and **A2** were prepared according to literature procedure.[2]

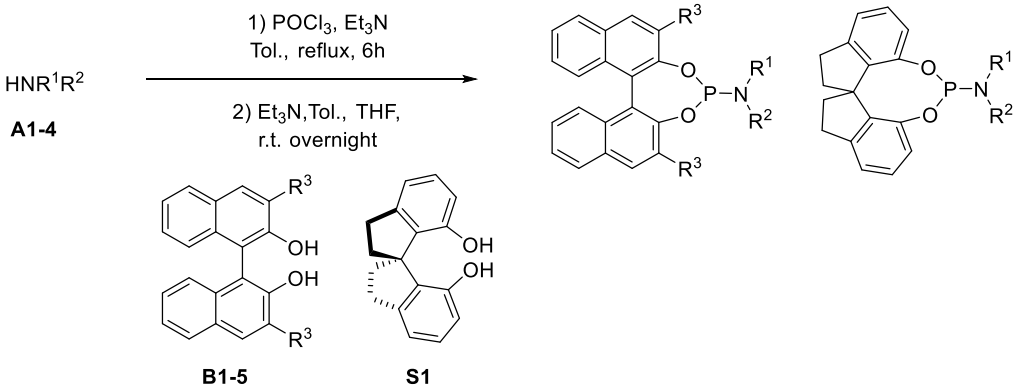


A1



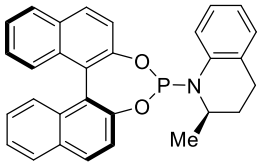
A2

Synthesis of the ligands - General Procedure 1 (GP-1)



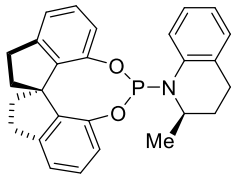
To a solution of $POCl_3$ (286 µL, 3.3 mmol, 1.1 eq.) in toluene (21.4 mL, 0.14 M) cooled to 0 °C was added dropwise a solution of the corresponding amine (3.3 mmol, 1.1 eq.) and Et_3N (751 µL, 5.4 mmol, 1.8 eq.) in toluene (3.4 mL, 0.875 M). The mixture was heated at 80 °C for 6h, then cooled to 0 °C slowly. To this flask, a solution of the corresponding BINOL or SPINOL (3.0 mmol, 1.0 eq.) and Et_3N (1669 µL, 12 mmol, 4 eq.) in toluene (13.0 mL, 0.23 M) and THF (2.6 mL, 1.16 M) was added slowly. The resulting mixture was stirred at room temperature overnight, then filtered through celite, and washed with Et_2O. The organic phase was concentrated in vacuo. The product was purified by column chromatography.

(2*R*)-1-((11b*S*)-dinaphtho[2,1-*d*:1',2'-*f*][1,3,2]dioxaphosphepin-4-yl)-2-methyl-1,2,3,4-tetrahydroquinoline (**L18**).



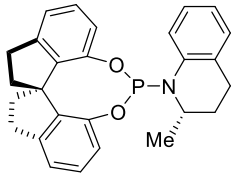
Prepared according to **GP-1** using **B1** and **A1**. Purification of the crude material by silica gel column chromatography (5% EtOAc/*c*Hex) providing the title compound as a colorless powder in 96% yield (1.329 g, 2.88 mmol). $\mathbf{R_F}$ = 0.77 (10% EtOAc/*c*Hex). **^{1}H NMR** (500 MHz, $CDCl_3$) δ 7.87 (d, J = 8.7 Hz, 1H), 7.83 (d, J = 8.3 Hz, 2H), 7.79 (d, J = 8.7 Hz, 1H), 7.39 (d, J = 8.7 Hz, 1H), 7.37 – 7.30 (m, 4H), 7.26 – 7.13 (m, 4H), 7.00 (dd, J = 7.5, 1.5 Hz, 1H), 6.96 (td, J = 7.7, 1.7 Hz, 1H), 6.88 (td, J = 7.5, 1.2 Hz, 1H), 3.79 (qt, J = 6.6, 3.3 Hz, 1H), 2.76 – 2.63 (m, 2H), 1.90 – 1.81 (m, 1H), 1.43 – 1.37 (m, 1H), 0.77 (d, J = 6.7 Hz, 3H). **^{13}C NMR** {^{1}H} (126 MHz, $CDCl_3$) δ 149.7 (d, J = 6.6 Hz), 149.2 (d, J =1.2 Hz), 139.9 (d, J = 25.6 Hz), 133.0 (d, J = 1.5 Hz), 132.7 (d, J = 0.9 Hz), 131.6, 130.9, 130.6, 129.74, 129.70, 128.5, 128.43, 127.36 (d, J = 4.2 Hz), 127.20, 127.19, 126.4, 126.3, 126.1, 125.0, 124.7, 124.2 (d, J = 5.2 Hz), 122.42 (d, J = 1.2 Hz), 122.36, 122.30 (d, J = 2.4 Hz), 122.1 (d, J = 1.8 Hz), 121.5 (d, J = 25.4 Hz), 45.4, 28.5, 22.4, 17.9. **^{31}P NMR** (202 MHz, $CDCl_3$) δ 142.84. **IR (neat):** ν_{max} (cm^{-1}): 1225, 943, 820, 797, 781, 748, 681, 629, 559. **HRMS (ESI) m/z** calcd. for $C_{30}H_{25}NO_2P^+$ $[M + H]^+$ 462.1617, found 462.1619. $[\alpha]_D^{20} = +204°$ (c = 1.1, $CHCl_3$).

(*R*)-2-methyl-1-(4,5,6,7-tetrahydrodiindeno[7,1-*de*:1',7'-*fg*][1,3,2]dioxaphosphocin-12-yl)-1,2,3,4-tetrahydroquinoline (**L19**).



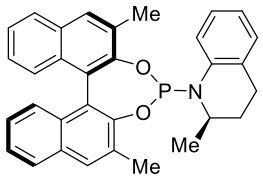
Prepared according to **GP-1** using **S1** and **A1**. Purification of the crude material by silica gel column chromatography (5% EtOAc/*c*Hex) providing the title compound as a colorless powder in 68% yield (872 mg, 2.04 mmol). R_F = 0.77 (10% EtOAc/*c*Hex). **^{1}HNMR** (500 MHz, $CDCl_3$) δ 7.32 – 7.28 (m, 1H), 7.23 (t, J = 7.7 Hz, 1H), 7.19 (td, J = 7.7, 1.6 Hz, 1H), 7.15 – 7.08 (m, 3H), 7.05 (d, J = 7.4 Hz, 1H), 7.00 (td, J = 7.4, 1.2 Hz, 1H), 6.95 (d, J = 7.9 Hz, 1H), 6.78 (d, J = 7.7 Hz, 1H), 3.95 – 3.86 (m, 1H), 3.18 – 3.10 (m, 2H), 2.94 – 2.84 (m, 3H), 2.77 (dd, J = 17.2, 6.6 Hz, 1H), 2.34 (dd, J = 11.9, 6.3 Hz, 1H), 2.27 (dd, J = 12.0, 6.3 Hz, 1H), 2.14 – 2.07 (m, 1H), 2.06 – 1.98 (m, 1H), 1.93 (tdd, J = 12.8, 6.7, 4.0 Hz, 1H), 1.65 – 1.59 (m, 1H), 0.51 (d, J = 6.8 Hz, 3H). **^{13}C NMR** {^{1}H} (126 MHz, $CDCl_3$) δ 147.8 (d, J = 5.7 Hz), 146.1 (d, J = 1.9 Hz), 145.8 (d, J = 8.8 Hz), 145.1, 142.3 (d, J = 3.6 Hz), 140.9 (d, J = 28.5 Hz), 140.5 (d, J = 1.3 Hz), 129.6, 128.7 (d, J = 1.7 Hz), 128.3, 127.1 (d, J = 4.3 Hz), 126.5, 122.1 (d, J = 1.4 Hz), 121.8, 121.6 (d, J = 2.0 Hz), 121.4 (d, J = 4.9 Hz), 121.0, 120.2 (d, J = 23.7), 59.1, 45.1, 38.4, 38.3, 31.1, 30.7, 29.1, 22.6, 17.2. **^{31}P NMR** (202 MHz, $CDCl_3$) δ 121.64. **IR (neat):** ν_{max} (cm^{-1}): 1223, 1009, 795, 756, 719, 689, 635, 474, 461. **HRMS (ESI) m/z** calcd. for $C_{27}H_{27}NO_2P^+$ $[M + H]^+$ 428.1774, found 428.1775. $[\alpha]_D^{20} = +27°$ (c = 1.8, $CHCl_3$).

(*S*)-2-methyl-1-(4,5,6,7-tetrahydrodiindeno[7,1-*de*:1',7'-*fg*][1,3,2]dioxaphosphocin-12-yl)-1,2,3,4-tetrahydroquinoline (**L20**).



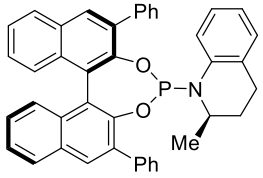
Prepared according to **GP-1** using **S1** and **A2**. Purification of the crude material by silica gel column chromatography (5% EtOAc/*c*Hex) providing the title compound as a colorless powder in 61% yield (782 mg, 1.83 mmol). R_F = 0.77 (10% EtOAc/*c*Hex). **^{1}HNMR** (500 MHz, $CDCl_3$) δ 7.54 (t, J = 7.3 Hz, 1H), 7.30 – 7.27 (m, 1H), 7.14 (d, J = 7.4 Hz, 1H), 7.12 – 7.05 (m, 4H), 7.03 (d, J = 7.9 Hz, 1H), 6.86 (td, J = 7.3, 1.1 Hz, 1H), 6.62 (dd, J = 7.2, 1.6 Hz, 1H), 3.43 (tq, J = 6.5, 3.1 Hz, 1H), 3.19 – 3.10 (m, 2H), 2.95 – 2.88 (m, 2H), 2.87 – 2.80 (m, 1H), 2.62 (ddd, J = 16.6, 5.5, 2.2 Hz, 1H), 2.34 (dd, J = 11.8, 6.2 Hz, 1H), 2.28 (dd, J = 12.0, 6.3 Hz, 1H), 2.12 – 2.02 (m, 2H), 1.51 – 1.46 (m, 1H), 1.40 – 1.35 (m, 1H), 1.13 (d, J = 6.5 Hz, 3H). **^{13}C NMR** {^{1}H} (126 MHz, $CDCl_3$) δ 148.2 (d, J = 7.0 Hz), 146.0 (d, J = 2.0 Hz), 145.9 (d, J = 8.2 Hz), 145.4, 142.4 (d, J = 3.7 Hz), 141.1 (d, J = 19.6 Hz), 140.1 (d, J = 1.2 Hz), 130.2, 128.8 (d, J = 1.9 Hz), 128.3, 126.5 (d, J = 3.7 Hz), 124.5 (d, J = 4.2 Hz), 122.0 (d, J = 1.3 Hz), 121.8 (d, J = 2.2 Hz), 121.4 (d, J = 5.2 Hz), 121.0, 119.6 (d, J = 2.0 Hz), 116.0 (d, J = 40.1 Hz), 59.1, 46.5, 38.7, 38.1, 31.1, 30.7, 26.8, 23.0, 20.6. **^{31}P NMR** (202 MHz, $CDCl_3$) δ 123.58. **IR (neat):** ν_{max} (cm^{-1}): 1703, 1490, 1219, 1205, 1128, 1009, 989, 918, 768, 754. **HRMS (ESI) m/z** calcd. for $C_{27}H_{27}NO_2P^+$ $[M + H]^+$ 428.1774, found 428.1768. $[\alpha]_D^{20} = +116°$ (c = 1.1, $CHCl_3$).

(2*R*)-1-(2,6-dimethyldinaphtho[2,1-*d*:1',2'-*f*][1,3,2]dioxaphosphepin-4-yl)-2-methyl-1,2,3,4-tetrahydroquinoline (**L21**).



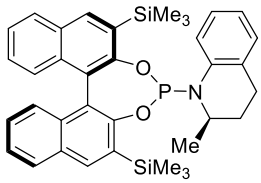
Prepared according to **GP-1** using **B2** and **A1**. Purification of the crude material by silica gel column chromatography (5% EtOAc/*c*Hex) providing the title compound as a colorless powder in 84% yield (1.234 g, 2.52 mmol). R_F = 0.77 (10% EtOAc/*c*Hex). **^{1}HNMR** (500 MHz, $CDCl_3$) δ 7.90 – 7.86 (m, 3H), 7.79 (s, 1H), 7.75 (dd, J = 8.3, 5.5 Hz, 1H), 7.45 – 7.39 (m, 2H), 7.37 (d, J = 8.5 Hz, 1H), 7.27 – 7.17 (m, 3H), 7.12 (d, J = 7.5 Hz, 1H), 7.10 – 7.06 (m, 1H), 6.90 (td, J = 7.3, 1.1 Hz, 1H), 3.78 – 3.69 (m, 1H), 2.82 (td, J = 12.8, 11.7, 6.2 Hz, 1H), 2.74 – 2.69 (m, 1H), 2.67 (s, 3H), 2.43 (s, 3H), 1.65 (dddd, J = 12.9, 10.6, 6.2, 3.1 Hz, 1H), 1.40 – 1.34 (m, 1H), 1.02 (d, J = 6.6 Hz, 3H). **^{13}C NMR** {^{1}H} (126 MHz, $CDCl_3$) δ 149.1 (d, J = 5.4 Hz), 148.7, 140.4 (d, J = 21.8 Hz), 131.85 (d, J = 1.6 Hz), 131.75, 131.5, 130.8, 130.43, 130.39 (d, J = 1.9 Hz), 130.2, 130.1, 129.7, 127.69, 127.64, 127.2, 127.0, 126.5 (d, J = 3.2 Hz), 125.32, 125.25, 125.23, 125.0, 124.7, 124.3 (d, J = 5.7 Hz), 122.4 (d, J = 2.3 Hz), 120.7 (d, J = 2.5 Hz), 117.8 (d, J = 41.0 Hz), 46.4, 27.0, 22.8, 20.0, 18.2, 17.5. **^{31}P NMR** (202 MHz, $CDCl_3$) δ 140.02. **IR (neat):** ν_{max} (cm^{-1}): 3483, 3447, 2324, 2306, 2212, 2150, 2039, 1983, 1969, 903, 752. **HRMS (ESI) m/z** calcd. for $C_{32}H_{29}NO_2P^+$ $[M + H]^+$ 490.1930, found 490.1933. $[\alpha]_D^{20} = -220°$ (c = 1.1, $CHCl_3$).

(2*R*)-1-(2,6-diphenyldinaphtho[2,1-*d*:1',2'-*f*][1,3,2]dioxaphosphepin-4-yl)-2-methyl-1,2,3,4-tetrahydroquinoline (**L22**).



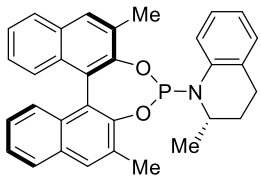
Prepared according to **GP-1** using **B3** and **A1**. Purification of the crude material by silica gel column chromatography (5% EtOAc/*c*Hex) providing the title compound as a colorless powder in 51% yield (938 mg, 1.53 mmol). R_F = 0.67 (10% EtOAc/*c*Hex). **^{1}HNMR** (500 MHz, $CDCl_3$) δ 8.14 (s, 1H), 8.10 (s, 1H), 8.03 (t, J = 7.6 Hz, 2H), 7.79 (d, J = 7.0 Hz, 2H), 7.73 (d, J = 7.0 Hz, 2H), 7.55 – 7.47 (m, 5H), 7.47 – 7.43 (m, 1H), 7.38 (d, J = 8.7 Hz, 1H), 7.35 – 7.24 (m, 5H), 6.89 (dd, J = 7.5, 1.6 Hz, 1H), 6.77 (td, J = 7.4, 1.2 Hz, 1H), 6.71 (td, J = 7.7, 1.7 Hz, 1H), 6.48 (ddd, J = 8.1, 3.0, 1.2 Hz, 1H), 3.77 – 3.69 (m, 1H), 2.44 (ddd, J = 16.5, 10.5, 6.1 Hz, 1H), 2.07 (dt, J = 16.2, 5.4 Hz, 1H), 1.31 (ddd, J = 10.4, 7.5, 5.3 Hz, 1H), 1.17 – 1.10 (m, 1H), 0.80 (d, J = 6.6 Hz, 3H).**^{13}C NMR** {^{1}H} (126 MHz, $CDCl_3$) δ 148.2 (d, J = 8.3 Hz), 147.1, 139.5 (d, J = 21.4 Hz), 137.8, 137.7, 135.2 (d, J = 2.5 Hz), 134.4, 132.8 (d, J = 1.8 Hz), 132.6 (d, J = 0.9 Hz), 131.5, 130.7, 130.58, 130.56, 130.3 (d, J = 1.4 Hz, 2C), 130.2 (2C), 128.8, 128.6, 128.4, 128.25 (2C), 128.17 (2C), 127.8 (d, J = 4.1 Hz), 127.6, 127.4, 127.3, 127.2, 126.2, 126.1, 126.0 (d, J = 1.7 Hz), 125.6 (d, J = 6.2 Hz), 125.4, 125.0, 123.2 (d, J = 2.6 Hz), 121.3 (d, J = 1.4 Hz), 119.6 (d, J = 31.0 Hz), 47.1 (d, J = 3.2 Hz), 28.9, 23.3, 20.4. **^{31}P NMR** (202 MHz, $CDCl_3$) δ 139.56. **IR (neat):** ν_{max} (cm^{-1}): 957, 946, 837, 748, 723, 696, 648, 632. **HRMS (ESI) m/z** calcd. for $C_{42}H_{33}NO_2P^+$ $[M + H]^+$ 614.2243, found 614.2245. $[\alpha]_D^{20} = -320°$ (c = 1.5, $CHCl_3$).

(2*R*)-1-(2,6-bis(trimethylsilyl)dinaphtho[2,1-*d*:1',2'-*f*][1,3,2]dioxaphosphepin-4-yl)-2-methyl-1,2,3,4-tetrahydroquinoline (**L23**).



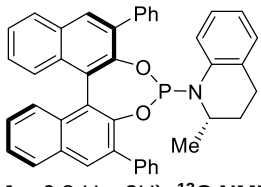
Prepared according to **GP-1** using **B4** and **A1**. Purification of the crude material by silica gel column chromatography (5% EtOAc/*c*Hex) providing the title compound as a colorless powder in 52% yield (945 mg, 1.56 mmol). R_F = 0.79 (10% EtOAc/*c*Hex). **^{1}HNMR** (500 MHz, $CDCl_3$) δ 8.12 – 8.09 (m, 2H), 7.98 – 7.93 (m, 2H), 7.46 (ddd, J = 8.1, 5.8, 2.1 Hz, 1H), 7.42 (ddd, J = 8.0, 6.7, 1.2 Hz, 1H), 7.36 – 7.29 (m, 3H), 7.22 (ddd, J = 8.2, 6.8, 1.3 Hz, 1H), 7.18 – 7.07 (m, 3H), 6.99 (t, J = 7.5 Hz, 1H), 3.99 – 3.86 (m, 1H), 2.86 – 2.72 (m, 2H), 1.92 (tdd, J = 12.7, 7.0, 4.1 Hz, 1H), 1.52 – 1.48 (m, 1H), 0.71 (d, J = 6.6 Hz, 3H), 0.43 (s, 9H), 0.40 (s, 9H). **^{13}C NMR** {^{1}H} (126 MHz, $CDCl_3$) δ 153.28, 153.27, 139.9 (d, J = 28.3 Hz), 137.2, 136.7, 134.2 (d, J = 0.9 Hz), 134.0 (d, J = 0.9 Hz), 132.68 (d, J = 1.9 Hz), 132.64, 131.1, 130.5, 129.7, 128.5, 128.4, 127.1, 126.9, 126.45, 126.41, 126.3, 126.2, 124.7, 124.5, 123.0 (d, J = 5.0 Hz), 121.72, 121.65, 121.4 (d, J = 29.8 Hz), 45.1, 28.4, 22.3, 0.6, 0.24 (3C), 0.20 (3C). **^{31}P NMR** (202 MHz, $CDCl_3$) δ 142.23. **IR (neat):** ν_{max} (cm^{-1}): 3841, 2968, 2957, 2941, 2924, 2897, 2370, 2351, 2328, 2316, 2307, 943, 781, 683, 636. **HRMS (ESI) m/z** calcd. for $C_{36}H_{41}NO_2PSi_2^+$ $[M + H]^+$ 606.2408, found 606.2414. $[\alpha]_D^{20} = -226°$ (c = 1.6, $CHCl_3$).

(2S)-1-(2,6-dimethyldinaphtho[2,1-*d*:1',2'-*f*][1,3,2]dioxaphosphepin-4-yl)-2-methyl-1,2,3,4-tetrahydroquinoline (**L24**).



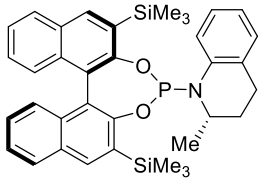
Prepared according to **GP-1** using **B2** and **A2**. Purification of the crude material by silica gel column chromatography (5% EtOAc/*c*Hex) providing the title compound as a colorless powder in 81% yield (1.191 g, 2.43 mmol). R_F = 0.79 (10% EtOAc/*c*Hex). **^{1}HNMR** (500 MHz, $CDCl_3$) δ 7.87 – 7.81 (m, 3H), 7.76 (s, 1H), 7.43 – 7.37 (m, 2H), 7.36 (d, J = 8.2 Hz, 1H), 7.33 (d, J = 7.6 Hz, 2H), 7.25 – 7.20 (m, 2H), 7.19 – 7.15 (m, 1H), 7.14 – 7.07 (m, 2H), 7.01 (td, J = 7.4, 1.2 Hz, 1H), 4.07 – 3.96 (m, 1H), 2.87 – 2.75 (m, 2H), 2.55 (s, 3H), 2.48 (s, 3H), 1.89 (tdd, J = 12.7, 7.2, 4.0 Hz, 1H), 1.53 (ddt, J = 13.0, 7.0, 2.3 Hz, 1H), 0.69 (d, J = 6.8 Hz, 3H). **^{13}C NMR** {^{1}H} (126 MHz, $CDCl_3$) δ 148.8 (d, J = 5.0 Hz), 148.4 (d, J = 2.5 Hz), 140.2 (d, J = 27.5 Hz), 131.8 (d, J = 1.7 Hz), 131.7 (d, J = 1.3 Hz), 131.5, 130.9, 130.7, 130.4 (d, J = 1.6 Hz), 130.0, 129.70, 129.66, 127.69, 127.68, 127.5 (d, J = 4.2 Hz), 127.1, 127.0, 126.4, 125.3, 125.2, 125.0, 124.7, 124.2 (d, J = 5.4 Hz), 122.9 (d, J = 2.0 Hz), 122.5, 121.0 (d, J = 25.6 Hz), 45.1, 29.3, 22.5, 18.2, 17.5, 16.9. **^{31}P NMR** (202 MHz, $CDCl_3$) δ 141.09. **IR (neat):** ν_{max} (cm^{-1}): 1032, 901, 858, 795, 752, 743, 623, 565. **HRMS (ESI) m/z** calcd. for $C_{32}H_{29}NO_2P^+$ $[M + H]^+$ 490.1930, found 490.1931. $[\alpha]_D^{20} = -133°$ (c = 1.2, $CHCl_3$).

(2*S*)-1-(2,6-diphenyldinaphtho[2,1-*d*:1',2'-*f*][1,3,2]dioxaphosphepin-4-yl)-2-methyl-1,2,3,4-tetrahydroquinoline (**L25**).



Prepared according to **GP-1** using **B3** and **A2**. Purification of the crude material by silica gel column chromatography (5% EtOAc/*c*Hex) providing the title compound as a colorless powder in 56% yield (1.031 g, 1.68 mmol). R_F = 0.67 (10% EtOAc/*c*Hex). **^{1}HNMR** (500 MHz, $CDCl_3$) δ 8.11 (s, 1H), 8.04 – 8.01 (m, 1H), 7.98 (dd, J = 7.8, 1.6 Hz, 1H), 7.94 (s, 1H), 7.79 – 7.75 (m, 2H), 7.57 – 7.54 (m, 2H), 7.53 – 7.50 (m, 3H), 7.45 (dd, J = 8.3, 6.8 Hz, 2H), 7.41 – 7.32 (m, 7H), 6.94 (dd, J = 7.6, 1.5 Hz, 1H), 6.80 (td, J = 7.4, 1.2 Hz, 1H), 6.50 (td, J = 7.7, 1.6 Hz, 1H), 6.37 (d, J = 8.1 Hz, 1H), 4.16 – 4.06 (m, 1H), 2.66 (dt, J = 18.4, 9.6 Hz, 1H), 2.48 (dt, J = 17.0, 4.5 Hz, 1H), 1.48 – 1.41 (m, 2H), 0.60 (d, J = 6.8 Hz, 3H). **^{13}C NMR** {^{1}H} (126 MHz, $CDCl_3$) δ 147.3 (d, J = 4.7 Hz), 146.8 (d, J = 1.3 Hz), 139.5 (d, J = 18.4 Hz), 137.78, 137.76, 135.0, 134.9 (d, J = 1.7 Hz), 132.7 (d, J = 1.1 Hz), 132.51 (d, J = 0.9 Hz), 131.45, 130.9, 130.7, 130.4 (2C), 130.1 (d, J = 2.1 Hz, 2C), 130.0, 128.8, 128.6, 128.5, 128.2 (2C), 128.0 (2C), 127.6, 127.25, 127.21 (d, J = 3.2 Hz), 127.1, 126.9, 126.2, 126.1, 125.8, 125.35, 125.26 (d, J = 5.3 Hz), 125.0, 124.0 (d, J = 2.3 Hz), 121.9, 121.1 (d, J = 18. 1 Hz), 46.1 (d, J = 12.0 Hz), 29.0, 22.7, 17.7. **^{31}P NMR** (202 MHz, $CDCl_3$) δ 142.89. **IR (neat):** ν_{max} (cm^{-1}): 960, 947, 839, 748, 725, 696, 648, 635, 600, 419, 404. **HRMS (ESI) m/z** calcd. for $C_{42}H_{33}NO_2P^+$ $[M + H]^+$ 614.2243, found 614.2238. $[\alpha]_D^{20} = -100°$ (c = 1.5, $CHCl_3$).

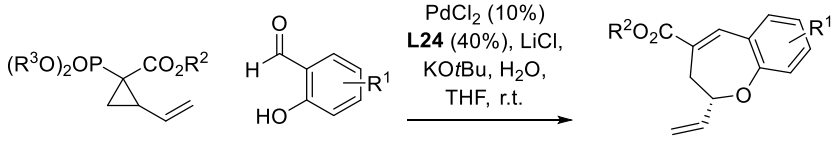
(2*S*)-1-(2,6-bis(trimethylsilyl)dinaphtho[2,1-*d*:1',2'-*f*][1,3,2]dioxaphosphepin-4-yl)-2-methyl-1,2,3,4-tetrahydroquinoline (**L26**).



Prepared according to **GP-1** using **B4** and **A2**. Purification of the crude material by silica gel column chromatography (5% EtOAc/*c*Hex) providing the title compound as a colorless powder in 61% yield (1.109 g, 1.56 mmol). R_F = 0.79 (10% EtOAc/*c*Hex). **^{1}HNMR** (500 MHz, $CDCl_3$) δ 8.04 (s, 1H), 7.96 (s, 1H), 7.86 – 7.83 (m, 2H), 7.59 (s, 1H), 7.36 – 7.29 (m, 2H), 7.21 – 7.17 (m, 2H), 7.12 – 7.08 (m, 1H), 7.01 – 6.95 (m, 3H), 6.79 (td, J = 7.3, 1.1 Hz, 1H), 3.51 (s, 1H), 2.72 – 2.64 (m, 1H), 2.58 (dd, J = 17.2, 6.7 Hz, 1H), 1.54 – 1.49 (m, 1H), 1.10 – 1.03 (m, 1H), 0.85 (d, J = 6.7 Hz, 3H), 0.44 (s, 9H), 0.13 (s, 9H). **^{13}C NMR** {^{1}H} (126 MHz, $CDCl_3$) δ 153.7, 153.1 (d, J= 5.1 Hz), 140.7 (d, J = 22.8 Hz), 137.9, 137.3, 136.7, 134.1 (d, J = 0.9 Hz), 134.0 (d, J = 0.9 Hz), 132.8 (d, J = 2.0 Hz), 132.4, 131.1, 130.5, 130.4, 128.5, 128.4, 127.0, 126.8, 126.5, 126.4, 125.2 (d, J = 4.4 Hz), 124.8, 124.5, 122.9 (d, J = 4.9 Hz), 121.5 (d, J = 2.6 Hz), 120.9 (d, J = 2.8 Hz), 118.5 (d, J = 40.0 Hz), 45.7, 26.5, 22.4, 0.33 (3C), 0.28 (3C), 0.1. **^{31}P NMR** (202 MHz, $CDCl_3$) δ 140.78. **IR (neat):** ν_{max} (cm^{-1}): 1219, 1009, 974, 945, 837, 822, 795, 743, 631, 590. **HRMS (ESI) m/z** calcd. for $C_{36}H_{41}NO_2PSi_2^+$ $[M + H]^+$ 606.2408, found 606.2406. $[\alpha]_D^{20} = -293°$ (c = 1.1, $CHCl_3$).

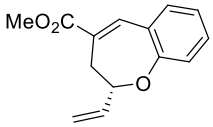
SUPPORTING INFORMATION

Reaction scope



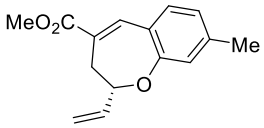
General Procedure 2 (GP-2) In a dried vial, under inert atmosphere, a solution of cyclopropane x (0.826 mmol, 3.5 eq.), $PdCl_2$ (4.2 mg, 0.024 mmol, 0.1 eq.), **L24** (47 mg, 0.094 mmol, 0.4 eq.), LiCl (566 µL, 0.283 mmol, 0.5 M in THF,), H_2O (26 µL, 1.416 mmol, 6 eq.) and THF (614 µL) was stirred for 1 hour. Subsequently, the corresponding aldehyde (0.236 mmol, 1.0 eq.) and KO*t*Bu (53 mg, 0.472 mmol, 2.0 eq.) were added and the mixture was stirred overnight. After filtration of the solids, the solvent was removed under vacuum and the crude purified by column chromatography.

methyl 2-vinyl-2,3-dihydrobenzo[*b*]oxepine-4-carboxylate (3a)



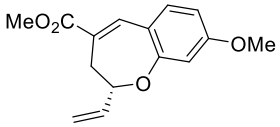
Prepared according to **GP-2**. Purification of the crude material by silica gel column chromatography (10% EtOAc/*c*Hex) providing the title compound as an orange-yellow solid in 98% yield (52 mg, 0.22 mmol). R_F = 0.66 (20% EtOAc/*c*Hex). **^{1}H NMR** (500 MHz, $CDCl_3$) δ 7.61 (d, *J* = 2.3 Hz, 1H), 7.34 – 7.29 (m, 1H), 7.26 (td, *J* = 7.4, 1.7 Hz, 1H), 7.10 – 6.97 (m, 2H), 6.07 (ddd, *J* = 17.2, 10.6, 5.4 Hz, 1H), 5.42 (dt, *J* = 17.2, 1.4 Hz, 1H), 5.25 (dt, *J* = 10.6, 1.3 Hz, 1H), 4.57 – 4.46 (m, 1H), 3.82 (s, 3H), 3.11 (dd, *J* = 18.7, 1.5 Hz, 1H), 2.87 (ddd, *J* = 18.7, 9.5, 2.3 Hz, 1H). **^{13}C NMR** (126 MHz, $CDCl_3$) δ 168.3, 159.1, 138.2, 137.1, 135.0, 131.0, 128.8, 124.1, 122.7, 120.7, 116.3, 79.0, 52.3, 38.0. **IR (neat):** ν_{max} (cm^{-1}): 1701, 1288, 1249, 1213, 1193, 1159, 1080, 1011, 989, 764, 754, 743, 723. **HRMS (ESI) m/z** calcd. for $C_{14}H_{15}O_3^+$ $[M + H]^+$ 231.1016, found 231.1018. $[\alpha]_D^{20} = +100°$ (c = 0.5, $CHCl_3$). **SFC-MS** (method 3) e.r.: 20/80: tret. (minor) = 4.021 min. (20%), tret. (major) = 4.236 min. (80%).

methyl 8-methyl-2-vinyl-2,3-dihydrobenzo[*b*]oxepine-4-carboxylate (3b)



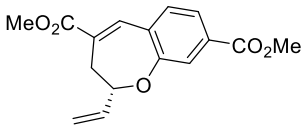
Prepared according to **GP-2**. Purification of the crude material by silica gel column chromatography (10% EtOAc/*c*Hex) providing the title compound as a colorless solid in 87% yield (50 mg, 0.21 mmol). R_F = 0.69 (20% EtOAc/*c*Hex). **^{1}H NMR** (500 MHz, $CDCl_3$) δ 7.58 (d, *J* = 2.3 Hz, 1H), 7.19 (d, *J* = 8.2 Hz, 1H), 6.84 (d, *J* = 5.5 Hz, 2H), 6.06 (ddd, *J* = 17.2, 10.6, 5.5 Hz, 1H), 5.41 (dt, *J* = 17.2, 1.3 Hz, 1H), 5.24 (dt, *J* = 10.6, 1.3 Hz, 1H), 4.62 – 4.42 (m, 1H), 3.81 (s, 3H), 3.10 (dd, *J* = 18.6, 1.4 Hz, 1H), 2.85 (ddd, *J* = 18.6, 9.4, 2.3 Hz, 1H), 2.32 (s, 3H). **^{13}C NMR** (126 MHz, $CDCl_3$) δ 168.5, 158.9, 141.9, 138.3, 137.3, 135.0, 127.6, 123.7, 121.4, 121.1, 116.2, 78.9, 52.3, 38.0, 21.3. **IR (neat):** ν_{max} (cm^{-1}): 2982, 2951, 2914, 1699, 1610, 1431, 1288, 1269, 1257, 1234, 1215, 1188, 1165, 1136, 1084, 1067, 1024. **HRMS (ESI)**: *m/z* calcd. for $C_{15}H_{16}NO_3$ $[M+H]^+$ 245.1172, found 245.1162. $[\alpha]_D^{20} = +115°$ (c = 0.3, $CHCl_3$). **SFC-MS** (method 3) e.r.: 24.5/75.5: tret. (minor) = 4.364 min. (24.5%), tret. (major) = 4.569 min. (75.5%).

methyl 8-methoxy-2-vinyl-2,3-dihydrobenzo[*b*]oxepine-4-carboxylate (3c)



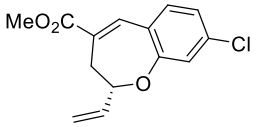
Prepared according to **GP-2**. Purification of the crude material by silica gel column chromatography (10% EtOAc/*c*Hex) providing the title compound as a colorless solid in 66% yield (44 mg, 0.16 mmol). R_F = 0.59 (20% EtOAc/*c*Hex). **^{1}H NMR** (500 MHz, $CDCl_3$) δ 7.56 (d, *J* = 2.2 Hz, 1H), 7.21 (d, *J* = 8.6 Hz, 1H), 6.60 (dd, *J* = 8.6, 2.6 Hz, 1H), 6.55 (d, *J* = 2.5 Hz, 1H), 6.07 (ddd, *J* = 17.1, 10.6, 5.6 Hz, 1H), 5.41 (dt, *J* = 17.2, 1.3 Hz, 1H), 5.25 (dt, *J* = 10.6, 1.2 Hz, 1H), 4.75 – 4.40 (m, 1H), 3.81 (s, 3H), 3.80 (s, 3H), 3.10 (dd, *J* = 18.5, 1.4 Hz, 1H), 2.84 (ddd, *J* = 18.5, 9.4, 2.2 Hz, 1H). **^{13}C NMR** (126 MHz, $CDCl_3$) δ 168.7, 162.2, 160.7, 138.4, 137.4, 136.5, 125.9, 117.3, 116.5, 109.8, 105.3, 79.4, 55.8, 52.4, 38.1. **IR (neat):** ν_{max} (cm^{-1}): 2920, 2849, 1697, 1607, 1439, 1339, 1277, 1234, 1205, 1188, 1167, 1122, 1082, 1034, 1016. **HRMS (ESI)**: *m/z* calcd. for $C_{15}H_{16}O_4Na^+$ $[M+Na]^+$ 283.0941, found 283.0943. $[\alpha]_D^{20} = +218°$ (c = 0.1, $CHCl_3$). **SFC-MS** (method 1) e.r.: 64.5/35.5: tret. (major) = 4.738 min. (64.5%), tret. (minor) = 4.889 min. (35.5%).

dimethyl 2-vinyl-2,3-dihydrobenzo[*b*]oxepine-4,8-dicarboxylate (3d)



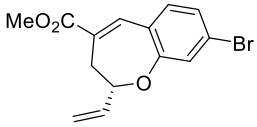
Prepared according to **GP-2**. Purification of the crude material by silica gel column chromatography (10% EtOAc/*c*Hex) providing the title compound as a yellow solid in 71% yield (49 mg, 0.17 mmol). R_F = 0.49 (10% EtOAc/*c*Hex). **^{1}H NMR** (500 MHz, $CDCl_3$) δ 7.69 – 7.65 (m, 2H), 7.61 (d, *J* = 2.3 Hz, 1H), 7.37 (d, *J* = 8.5 Hz, 1H), 6.06 (ddd, *J* = 17.2, 10.6, 5.3 Hz, 1H), 5.44 (dt, *J* = 17.2, 1.3 Hz, 1H), 5.27 (dt, *J* = 10.6, 1.3 Hz, 1H), 4.50 (ddq, *J* = 8.4, 4.7, 1.5 Hz, 1H), 3.91 (s, 3H), 3.83 (s, 3H), 3.13 (dd, *J* = 19.0, 1.6 Hz, 1H), 2.90 (ddd, *J* = 19.0, 9.4, 2.4 Hz, 1H). **^{13}C NMR** (126 MHz, $CDCl_3$) δ 167.9, 166.4, 158.8, 137.0, 136.7, 134.9, 132.0, 131.4, 128.4, 123.5, 122.0, 116.6, 79.2, 52.5, 52.5, 38.2. **IR (neat):** ν_{max} (cm^{-1}): 1710, 1443, 1281, 1259, 1209, 1196, 1134, 1095, 1072, 984, 901, 766. **HRMS (ESI)**: *m/z* calcd. for $C_{16}H_{17}O_5^+$ $[M+H]^+$ 289.1071, found 289.1067. $[\alpha]_D^{20} = +113°$ (c = 0.7, $CHCl_3$). **SFC-MS** (method 3) e.r.: 27.5/72.5: tret. (minor) = 5.910 min. (27.5%), tret. (major) = 6.226 min. (72.5%).

methyl 8-chloro-2-vinyl-2,3-dihydrobenzo[*b*]oxepine-4-carboxylate (3e)



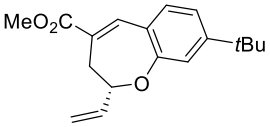
Prepared according to **GP-2**. Purification of the crude material by silica gel column chromatography (10% EtOAc/*c*Hex) providing the title compound as a colorless-yellow solid in 44% yield (27 mg, 0.10 mmol). $\mathbf{R_F}$ = 0.66 (20% EtOAc/*c*Hex). **^{1}H NMR** (500 MHz, $CDCl_3$) δ 7.55 (d, *J* = 2.2 Hz, 1H), 7.23 (d, *J* = 8.3 Hz, 1H), 7.04 (d, *J* = 2.1 Hz, 1H), 7.01 (dd, *J* = 8.3, 2.1 Hz, 1H), 6.04 (ddd, *J* = 17.2, 10.6, 5.4 Hz, 1H), 5.41 (dt, *J* = 17.2, 1.3 Hz, 1H), 5.26 (dt, *J* = 10.6, 1.3 Hz, 1H), 4.56 – 4.46 (m, 1H), 3.82 (s, 3H), 3.11 (dd, *J* = 18.8, 1.5 Hz, 1H), 2.86 (ddd, *J* = 18.8, 9.3, 2.3 Hz, 1H). **^{13}C NMR** (126 MHz, $CDCl_3$) δ 168.1, 159.4, 137.1, 136.7, 136.3, 135.7, 129.1, 123.0, 122.8, 121.0, 116.6, 79.3, 52.4, 37.9. **IR (neat):** ν_{max} (cm^{-1}): 2951, 2920, 2849, 1711, 1595, 1259, 1230, 1209, 1190, 1074, 1053, 1041, 1020, 1005. **HRMS (ESI)**: *m/z* calcd. for $C_{14}H_{14}ClO_3^+$ $[M+H]^+$ 265.0626, found 265.0625. $[\alpha]_D^{20} = +224°$ (c = 0.1, $CHCl_3$). **SFC-MS** (method 5) e.r.: 78.5/21.5: tret. (major) = 3.584 min. (78.5%), tret. (minor) = 3.691 min. (21.5%).

methyl 8-bromo-2-vinyl-2,3-dihydrobenzo[*b*]oxepine-4-carboxylate (3f)



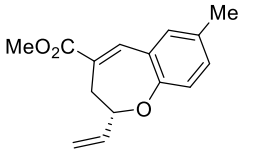
Prepared according to **GP-2**. Purification of the crude material by silica gel column chromatography (10% EtOAc/*c*Hex) providing the title compound as a yellow solid in 65% yield (48 mg, 0.15 mmol). $\mathbf{R_F}$ = 0.58 (10% EtOAc/*c*Hex). **^{1}H NMR** (500 MHz, $CDCl_3$) δ 7.53 (d, *J* = 2.3 Hz, 1H), 7.20 (s, 1H), 7.16 – 7.14 (m, 2H), 6.03 (ddd, *J* = 17.2, 10.6, 5.4 Hz, 1H), 5.41 (dt, *J* = 17.2, 1.3 Hz, 1H), 5.26 (dt, *J* = 10.6, 1.3 Hz, 1H), 4.49 (dddd, *J* = 8.4, 5.3, 3.0, 1.5 Hz, 1H), 3.81 (s, 3H), 3.09 (dd, *J* = 18.8, 1.6 Hz, 1H), 2.85 (ddd, *J* = 18.8, 9.4, 2.4 Hz, 1H). **^{13}C NMR** (126 MHz, $CDCl_3$) δ 168.1, 159.4, 137.2, 136.6, 135.8, 129.4, 126.0, 124.3, 124.0, 123.2, 116.7, 79.3, 52.5, 37.9. **IR (neat):** ν_{max} (cm^{-1}): 1286, 1257, 1223, 1190, 1067, 995, 949, 905, 870, 804, 797, 756, 712, 482, 446. **HRMS (ESI)**: *m/z* calcd. for $C_{14}H_{14}BrO_3^+$ $[M+H]^+$ 309.0121, found 309.0118. $[\alpha]_D^{20} = +90°$(c = 0.5, $CHCl_3$). **SFC-MS** (method 3) e.r.: 29/71: tret. (minor) = 5.766 min. (29%), tret. (major) = 6.119 min. (71%).

methyl (S)-8-(tert-butyl)-2-vinyl-2,3-dihydrobenzo[*b*]oxepine-4-carboxylate (3g)



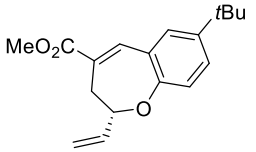
Prepared according to **GP-2**. Purification of the crude material by silica gel column chromatography (10% EtOAc/*c*Hex) providing the title compound as a yellow solid in 79% yield (53 mg, 0.19 mmol). $\mathbf{R_F}$ = 0.72(10% EtOAc/*c*Hex). **^{1}H NMR** (500 MHz, $CDCl_3$) δ 7.61 (d, J = 2.4 Hz, 1H), 7.26 (d, J = 8.1 Hz, 1H), 7.08 (dd, J = 8.1, 1.9 Hz, 1H), 7.05 (d, J = 1.9 Hz, 1H), 6.11 (ddd, J = 16.7, 10.6, 5.5 Hz, 1H), 5.45 (d, J = 17.3 Hz, 1H), 5.28 (d, J = 10.8 Hz, 1H), 4.56 – 4.48 (m, 1H), 3.83 (s, 3H), 3.14 (d, J = 18.5 Hz, 1H), 2.86 (ddd, J = 18.6, 9.5, 2.4 Hz, 1H), 1.32 (s, 9H). **^{13}C NMR** (126 MHz, $CDCl_3$) δ 168.4, 158.8, 155.2, 138.2, 137.4, 134.8, 127.8, 121.2, 119.9, 117.6, 116.2, 79.0, 66.3, 52.3, 38.0, 31.2 (3C). **IR (neat):** ν_{max} (cm^{-1}): 2960, 1705, 1609, 1279, 1242, 1211, 1190, 1003, 758. **HRMS (ESI)**: *m/z* calcd. for $C_{18}H_{23}O_3^+$ $[M+H]^+$ 287.1642, found 287.1645. $[\alpha]_D^{20} = +136°$ (c = 0.7, $CHCl_3$). **SFC-MS** (method 3) e.r.: 27/73: tret. (minor) = 3.669 min. (27%), tret. (major) = 4.080 min. (73%).

methyl 7-methyl-2-vinyl-2,3-dihydrobenzo[*b*]oxepine-4-carboxylate (3h)



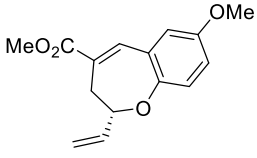
Prepared according to **GP-2**. Purification of the crude material by silica gel column chromatography (10% EtOAc/*c*Hex) providing the title compound as a colorless solid in 92% yield (63 mg, 0.26 mmol). $\mathbf{R_F}$ = 0.72 (20% EtOAc/*c*Hex). **^{1}H NMR** (500 MHz, $CDCl_3$) δ 7.57 (d, *J* = 2.2 Hz, 1H), 7.11 (d, *J* = 1.7 Hz, 1H), 7.06 (dd, *J* = 8.3, 2.0 Hz, 1H), 6.91 (d, *J* = 8.2 Hz, 1H), 6.06 (ddd, *J* = 17.2, 10.6, 5.4 Hz, 1H), 5.41 (dt, *J* = 17.2, 1.3 Hz, 1H), 5.24 (dt, *J* = 10.6, 1.3 Hz, 1H), 4.51 – 4.44 (m, 1H), 3.81 (s, 3H), 3.09 (dd, *J* = 18.7, 1.5 Hz, 1H), 2.85 (ddd, *J* = 18.7, 9.5, 2.3 Hz, 1H), 2.30 (s, 3H). **^{13}C NMR** (126 MHz, $CDCl_3$) δ 168.4, 157.0, 138.3, 137.3, 135.2, 131.9, 131.7, 128.7, 123.9, 120.5, 116.2, 79.0, 52.3, 38.0, 28.3. **IR (neat):** ν_{max} (cm^{-1}): 2951, 2908, 1701, 1256, 1217, 1169, 1157, 1080, 1018, 989, 960. **HRMS (ESI)**: *m/z* calcd. for $C_{15}H_{17}O_3^+$ $[M+H]^+$ 245.1172, found 245.1168. $[\alpha]_D^{20} = +126°$ (c = 0.6, $CHCl_3$). **SFC-MS** (method 2) e.r.: 17/83: tret. (minor) = 2.755 min. (17%), tret. (major) = 3.123 min. (83%).

methyl 7-(*tert*-butyl)-2-vinyl-2,3-dihydrobenzo[*b*]oxepine-4-carboxylate (3i)



Prepared according to **GP-2**. Purification of the crude material by silica gel column chromatography (10% EtOAc/*c*Hex) providing the title compound as a colorless solid in 98% yield (79 mg, 0.23 mmol). $\mathbf{R_F}$ = 0.71 (20% EtOAc/*c*Hex). **^{1}H NMR** (500 MHz, $CDCl_3$) δ 7.62 (d, *J* = 2.3 Hz, 1H), 7.29 (dd, *J* = 6.5, 2.5 Hz, 2H), 6.95 (d, *J* = 9.2 Hz, 1H), 6.07 (ddd, *J* = 17.2, 10.6, 5.5 Hz, 1H), 5.41 (dt, *J* = 17.2, 1.3 Hz, 1H), 5.24 (dt, *J* = 10.6, 1.3 Hz, 1H), 4.57 – 4.43 (m, 1H), 3.82 (s, 3H), 3.10 (dd, *J* = 18.6, 1.5 Hz, 1H), 2.85 (ddd, *J* = 18.7, 9.5, 2.3 Hz, 1H), 1.31 (s, 9H). **^{13}C NMR** (126 MHz, $CDCl_3$) δ 168.4, 156.9, 145.3, 138.9, 137.3, 131.8, 128.4, 128.3, 123.3, 120.2, 116.2, 79.0, 52.3, 38.0, 34.2, 31.5 (3C). **IR (neat):** ν_{max} (cm^{-1}): 2957, 1699, 1626, 1499, 1252, 1207, 1188, 1076, 1014, 997, 924. **HRMS (ESI)**: *m/z* calcd. for $C_{18}H_{23}O_3^+$ $[M+H]^+$ 287.1642, found 287.1637. $[\alpha]_D^{20} = +67°$ (c = 0.8, $CHCl_3$). **SFC-MS** (method 4) e.r.: 68/32: tret. (major) = 4.279 min. (68%), tret. (minor) = 4.676 min. (32%).

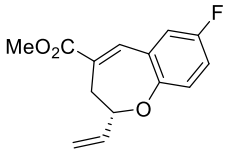
methyl 7-methoxy-2-vinyl-2,3-dihydrobenzo[*b*]oxepine-4-carboxylate (3j)



Prepared according to **GP-2**. Purification of the crude material by silica gel column chromatography (10% EtOAc/*c*Hex) providing the title compound as a slightly yellow solid in 99% yield (69 mg, 0.23 mmol). $\mathbf{R_F}$ = 0.56 (20% EtOAc/*c*Hex). **^{1}H NMR** (500 MHz, $CDCl_3$) δ 7.55 (d, *J* = 2.2 Hz, 1H), 6.95 (d, *J* = 8.6 Hz, 1H), 6.85 – 6.76 (m, 2H), 6.05 (ddd, *J* = 17.2, 10.6, 5.4 Hz, 1H), 5.41 (dt, *J* = 17.2, 1.4 Hz, 1H), 5.24 (dt, *J* = 10.6, 1.3 Hz, 1H), 4.45 (ddt, *J* = 9.6, 5.4, 1.5 Hz, 1H), 3.82 (s, 3H), 3.79 (s, 3H), 3.07 (dd, *J* = 18.8, 1.6 Hz, 1H), 2.86 (ddd, *J* = 18.8, 9.6, 2.3 Hz, 1H). **^{13}C NMR** (126 MHz, $CDCl_3$) δ 168.3, 154.8, 153.3, 137.9, 137.3, 129.4, 124.8, 121.6, 118.2, 117.2, 116.2, 79.2, 55.8, 52.4, 38.1. **IR (neat):** ν_{max} (cm^{-1}): 2957,

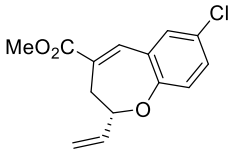
2905, 2833, 1715, 1497, 1221, 1190, 1169, 1122, 1034, 995. **HRMS (ESI)**: *m/z* calcd. for $C_{15}H_{17}O_4^+$ [M+H]$^+$ 261.1121, found 261.1122. $[\alpha]_D^{20} = +135°$ (c = 1.2, $CHCl_3$). **SFC-MS** (method 4) e.r.: 73/27: tret. (major) = 12.211 min. (73%), tret. (minor) = 13.315 min. (27%).

methyl 7-fluoro-2-vinyl-2,3-dihydrobenzo[*b*]oxepine-4-carboxylate (3k)



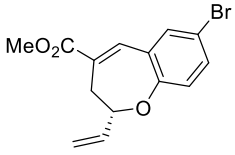
Prepared according to **GP-2**. Purification of the crude material by silica gel column chromatography (10% EtOAc/*c*Hex) providing the title compound as a slightly yellow solid in 74% yield (43 mg, 0.17 mmol). R_F = 0.63 (20% EtOAc/*c*Hex). **^{1}H NMR** (500 MHz, $CDCl_3$) δ 7.50 (d, *J* = 2.4 Hz, 1H), 7.14 – 6.85 (m, 3H), 6.05 (ddd, *J* = 17.2, 10.6, 5.4 Hz, 1H), 5.41 (dt, *J* = 17.2, 1.3 Hz, 1H), 5.26 (dt, *J* = 10.6, 1.3 Hz, 1H), 4.69 – 4.37 (m, 1H), 3.82 (s, 3H), 3.09 (dd, *J* = 18.9, 1.6 Hz, 1H), 2.87 (ddd, *J* = 18.9, 9.6, 2.4 Hz, 1H). **^{13}C NMR** (126 MHz, $CDCl_3$) δ 168.0, 158.0 (d, *J* = 240.5 Hz), 155.2 (d, *J* = 2.3 Hz), 136.9, 136.8 (d, *J* = 1.8 Hz), 130.4, 125.4 (d, *J* = 7.8 Hz), 121.9 (d, *J* = 8.2 Hz), 119.8 (d, *J* = 23.1 Hz), 117.5 (d, *J* = 23.1 Hz), 116.4, 79.3, 52.5, 38.1. **IR (neat):** ν_{max} (cm^{-1}): 1707, 1489, 1254, 1236, 1219, 1151, 997, 928, 864, 829, 795. **HRMS (ESI)**: *m/z* calcd. for $C_{14}H_{13}FO_3Na^+$ [M+Na]$^+$ 271.0741, found 271.0745. $[\alpha]_D^{20} = +171°$ (c = 0.1, $CHCl_3$). **SFC-MS** (method 2) e.r.: 20/80: tret. (minor) = 2.341 min. (20%), tret. (major) = 2.425 min. (80%).

methyl 7-chloro-2-vinyl-2,3-dihydrobenzo[*b*]oxepine-4-carboxylate (3l)



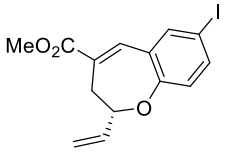
Prepared according to **GP-2**. Purification of the crude material by silica gel column chromatography (10% EtOAc/*c*Hex) providing the title compound as a slightly yellow solid in 83% yield (52 mg, 0.20 mmol). R_F = 0.70 (20% EtOAc/*c*Hex). **^{1}H NMR** (500 MHz, $CDCl_3$) δ 7.51 (d, J = 2.3 Hz, 1H), 7.30 (d, J = 2.6 Hz, 1H), 7.21 (dd, J = 8.7, 2.6 Hz, 1H), 6.97 (d, J = 8.6 Hz, 1H), 6.06 (ddd, J = 17.3, 10.6, 5.4 Hz, 1H), 5.43 (dt, J = 17.2, 1.3 Hz, 1H), 5.27 (dt, J = 10.6, 1.3 Hz, 1H), 4.55 – 4.45 (m, 1H), 3.84 (s, 3H), 3.12 (dd, J = 18.9, 1.7 Hz, 1H), 2.89 (ddd, J = 18.8, 9.3, 2.4 Hz, 1H). **^{13}C NMR** (126 MHz, $CDCl_3$) δ 167.9, 157.6, 136.76, 136.74, 133.9, 130.5, 130.4, 127.5, 125.6, 122.2, 116.5, 79.3, 52.4, 37.9. **IR (neat):** ν_{max} (cm^{-1}): 2957, 2918, 1709, 1481, 1252, 1188, 1080, 1014, 933, 835, 814. **HRMS (ESI)**: *m/z* calcd. for $C_{14}H_{14}ClO_3^+$ [M+H]$^+$ 265.0626, found 265.0640. $[\alpha]_D^{20} = +100°$ (c = 0.7, $CHCl_3$). **SFC-MS** (method 3) e.r.: 19.5/80.5: tret. (minor) = 4.880 min. (19.5%), tret. (major) = 5.265 min. (80.5%).

methyl 7-bromo-2-vinyl-2,3-dihydrobenzo[*b*]oxepine-4-carboxylate (3m)



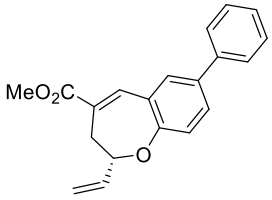
Prepared according to **GP-2**. Purification of the crude material by silica gel column chromatography (10% EtOAc/*c*Hex) providing the title compound as a yellow solid in 73% yield (53 mg, 0.17 mmol). R_F = 0.62 (20% EtOAc/*c*Hex). **^{1}H NMR** (500 MHz, $CDCl_3$) δ 7.51 (d, J = 2.3 Hz, 1H), 7.45 (d, J = 2.5 Hz, 1H), 7.35 (dd, J = 8.6, 2.5 Hz, 1H), 6.91 (d, J = 8.6 Hz, 1H), 6.06 (ddd, J = 17.3, 10.6, 5.4 Hz, 1H), 5.42 (dt, J = 17.2, 1.4 Hz, 1H), 5.27 (dt, J = 10.6, 1.3 Hz, 1H), 4.53 – 4.47 (m, 1H), 3.84 (s, 3H), 3.13 (dd, J = 18.9, 1.7 Hz, 1H), 2.89 (ddd, J = 18.9, 9.3, 2.4 Hz, 1H). **^{13}C NMR** (126 MHz, $CDCl_3$) δ 167.9, 158.1, 136.8, 136.72, 136.67, 133.4, 130.4, 126.1, 122.6, 116.6, 114.8, 79.3, 52.5, 37.9. **IR (neat):** ν_{max} (cm^{-1}) 1703, 1246, 1227, 1188, 1165, 1067, 989, 933, 928, 754. **HRMS (ESI)**: *m/z* calcd. for $C_{14}H_{14}BrO_3^+$ [M+H]$^+$ 309.0121, found 309.1022. $[\alpha]_D^{20} = +162$ (c = 0.2, $CHCl_3$). **SFC-MS** (method 1) e.r.: 27/73: tret. (minor) = 6.310 min. (31%), tret. (major) = 6.873 min. (69%).

methyl 7-iodo-2-vinyl-2,3-dihydrobenzo[*b*]oxepine-4-carboxylate (3n)



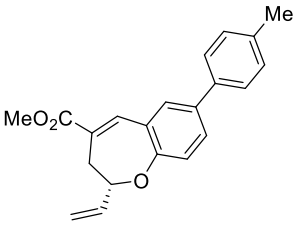
Prepared according to **GP-2**. Purification of the crude material by silica gel column chromatography (10% EtOAc/cHex) providing the title compound as an orange solid in 68% yield (57 mg, 0.16 mmol) and 80:20 e.r. R_F = 0.61 (10% EtOAc). **^{1}H NMR** (500 MHz, $CDCl_3$) δ 7.62 (d, J = 2.2 Hz, 1H), 7.54 – 7.45 (m, 2H), 6.78 (d, J = 8.5 Hz, 1H), 6.04 (ddd, J = 17.2, 10.6, 5.4 Hz, 1H), 5.40 (dt, J = 17.2, 1.3 Hz, 1H), 5.25 (dt, J = 10.6, 1.3 Hz, 1H), 4.52 – 4.43 (m, 1H), 3.81 (s, 3H), 3.11 (dd, J = 18.8, 1.6 Hz, 1H), 2.86 (ddd, J = 18.9, 9.3, 2.3 Hz, 1H). **^{13}C NMR** (126 MHz, $CDCl_3$) δ 167.9 158.9, 143.0, 139.4, 136.69, 136.66, 130.1, 126.56, 123.6, 123.0, 116.6, 79.3, 52.5, 37.9. **IR (neat):** ν_{max} (cm-1): 1705, 1257, 1225, 1990, 1132, 945, 906, 891, 806, 752, 420, 403. **HRMS (ESI)**: *m/z* calcd. for $C_{14}H_{14}IO_3^+$ [M+H]$^+$ 356.9982, found 356.9978. $[\alpha]_D^{20} = +160°$ (c = 0.2, $CHCl_3$). **SFC-MS** (method 4) e.r.: 80/20: tret. (major) = 10.448 min. (80%), tret. (minor) = 11.306 min. (20%).

methyl 7-phenyl-2-vinyl-2,3-dihydrobenzo[*b*]oxepine-4-carboxylate (3o)



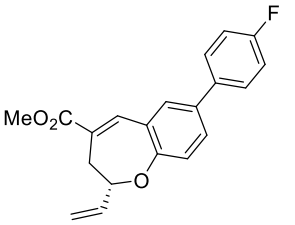
Prepared according to **GP-2**. Purification of the crude material by silica gel column chromatography (10% EtOAc/*c*Hex) providing the title compound as a slightly yellow solid in 81% yield (58 mg, 0.19 mmol). R_F = 0.69 (20% EtOAc/*c*Hex). **^{1}H NMR** (500 MHz, $CDCl_3$) δ 7.69 (d, *J* = 2.2 Hz, 1H), 7.62 – 7.53 (m, 3H), 7.50 (dd, *J* = 8.4, 2.3 Hz, 1H), 7.47 – 7.41 (m, 2H), 7.34 (t, *J* = 7.4 Hz, 1H), 7.10 (d, *J* = 8.4 Hz, 1H), 6.10 (ddd, *J* = 17.2, 10.6, 5.5 Hz, 1H), 5.45 (dt, *J* = 17.2, 1.3 Hz, 1H), 5.28 (dt, *J* = 10.6, 1.3 Hz, 1H), 4.61 – 4.49 (m, 1H), 3.83 (s, 3H), 3.14 (dd, *J* = 18.7, 1.5 Hz, 1H), 2.90 (ddd, *J* = 18.7, 9.4, 2.3 Hz, 1H). **^{13}C NMR** (126 MHz, $CDCl_3$) δ 168.3, 158.5, 140.0, 138.3, 137.1, 135.7, 133.6, 129.6, 129.2, 129.0 (2C), 127.3, 126.9 (2C), 124.3, 121.2, 116.4, 79.2, 52.4, 37.9. **IR (neat):** ν_{max} (cm^{-1}): 1703, 1254, 1229, 1215, 1188, 11369, 945, 754, 690. **HRMS (ESI)**: *m/z* calcd. for $C_{20}H_{18}NaO_3^+$ [M+Na]$^+$ 329.1148, found 329.1143. $[\alpha]_D^{20} = +88°$ (c = 0.7, $CHCl_3$). **SFC-MS** (method 3) e.r.: 16.5/83.5: tret. (minor) = 4.123 min. (16.5%), tret. (major) = 4.345 min. (83.5%).

methyl 7-(p-tolyl)-2-vinyl-2,3-dihydrobenzo[*b*]oxepine-4-carboxylate (3p)



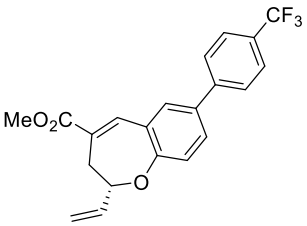
Prepared according to **GP-2**. Purification of the crude material by silica gel column chromatography (10% EtOAc/*c*Hex) providing the title compound as a slightly yellow solid in 85% yield (64 mg, 0.20 mmol). $\mathbf{R_F}$ = 0.70 (20% EtOAc/*c*Hex). **^{1}H NMR** (500 MHz, $CDCl_3$) δ 7.68 (d, *J* = 2.2 Hz, 1H), 7.52 (d, *J* = 2.2 Hz, 1H), 7.50 – 7.39 (m, 3H), 7.25 (d, *J* = 7.9 Hz, 2H), 7.08 (d, *J* = 8.4 Hz, 1H), 6.09 (ddd, *J* = 17.2, 10.6, 5.5 Hz, 1H), 5.44 (dt, *J* = 17.2, 1.3 Hz, 1H), 5.27 (dt, *J* = 10.6, 1.3 Hz, 1H), 4.66 – 4.47 (m, 1H), 3.83 (s, 3H), 3.14 (dd, *J* = 18.7, 1.4 Hz, 1H), 2.90 (ddd, *J* = 18.7, 9.4, 2.3 Hz, 1H), 2.40 (s, 3H). **^{13}C NMR** (126 MHz, $CDCl_3$) δ 168.3, 158.3, 138.3, 137.15, 137.12, 137.06, 135.7, 133.3, 129.7 (2C), 129.4, 129.1, 126.7 (2C), 124.2, 121.1, 116.4, 79.2, 52.4, 38.0, 21.2. **IR (neat):** ν_{max} (cm^{-1}): 1705, 1279, 1254, 1225, 1182, 1136, 935, 808, 754, 484. **HRMS (ESI)**: *m/z* calcd. for $C_{21}H_{21}O_3^+$ $[M+H]^+$ 321.1485, found 321.1470. $[\alpha]_D^{20} = +94°$ (c = 0.9, $CHCl_3$). **SFC-MS** (method 3) e.r.: 26/74: tret. (minor) = 3.953 min. (26%), tret. (major) = 4.167 min. (74%).

methyl 7-(4-fluorophenyl)-2-vinyl-2,3-dihydrobenzo[*b*]oxepine-4-carboxylate (3q)



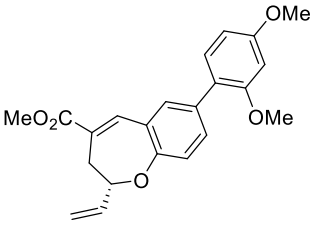
Prepared according to **GP-2**. Purification of the crude material by silica gel column chromatography (10% EtOAc/*c*Hex) providing the title compound as a slightly yellow solid in 79% yield (60 mg, 0.19 mmol). $\mathbf{R_F}$ = 0.56 (10% EtOAc/*c*Hex). **^{1}H NMR** (500 MHz, $CDCl_3$) δ 7.69 (d, J = 2.3 Hz, 1H), 7.55 – 7.48 (m, 3H), 7.45 (dd, J = 8.4, 2.3 Hz, 1H), 7.17 – 7.08 (m, 3H), 6.11 (ddd, J = 17.3, 10.6, 5.5 Hz, 1H), 5.46 (dt, J = 17.2, 1.4 Hz, 1H), 5.29 (dt, J = 10.7, 1.3 Hz, 1H), 4.61 – 4.53 (m, 1H), 3.85 (s, 3H), 3.16 (dd, J = 18.7, 1.6 Hz, 1H), 2.92 (ddd, J = 18.7, 9.4, 2.4 Hz, 1H). **^{13}C NMR** (126 MHz, $CDCl_3$) δ 168.1, δ 162.4 (d, J = 246.5 Hz), 158.4, 138.0, 136.9, 136.1 (d, J = 3.2 Hz), 134.7, 133.3, 129.31, 129.27, 128.3 (d, J = 8.0 Hz, 2C), 124.2, 121.1, 116.3, 115.7 (d, J = 21.4 Hz, 2C), 79.1, 52.3, 37.8. **IR (neat):** ν_{max} (cm^{-1}) 1707, 1481, 1257, 1223, 1159, 908, 814, 538, 519. **HRMS (ESI)**: *m/z* calcd. for $C_{20}H_{18}FO_3^+$ $[M+H]^+$ 325.1234, found 325.1232. $[\alpha]_D^{20} = +95°$ (c = 0.5, $CHCl_3$). **SFC-MS** (method 4) e.r.: 71.5/28.5: tret. (major) = 12.245 min. (71.5%), tret. (minor) = 13.312 min. (28.5%).

methyl 7-(4-(trifluoromethyl)phenyl)-2-vinyl-2,3-dihydrobenzo[*b*]oxepine-4-carboxylate (3r)



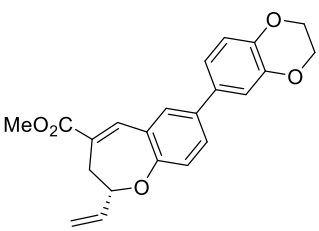
Prepared according to **GP-2**. Purification of the crude material by silica gel column chromatography (10% EtOAc/*c*Hex) providing the title compound as a yellow-orange solid in 69% yield (61 mg, 0.16 mmol). $\mathbf{R_F}$ = 0.45 (20% EtOAc/*c*Hex). **^{1}H NMR** (500 MHz, $CDCl_3$) δ 7.78 – 7.61 (m, 5H), 7.55 (d, *J* = 2.3 Hz, 1H), 7.50 (dd, *J* = 8.4, 2.3 Hz, 1H), 7.12 (d, *J* = 8.4 Hz, 1H), 6.09 (ddd, *J* = 17.1, 10.6, 5.5 Hz, 1H), 5.45 (dt, *J* = 17.2, 1.2 Hz, 1H), 5.28 (dt, *J* = 10.6, 1.2 Hz, 1H), 4.68 – 4.49 (m, 1H), 3.84 (s, 3H), 3.15 (dd, *J* = 18.7, 1.4 Hz, 1H), 2.91 (ddd, *J* = 18.7, 9.3, 2.3 Hz, 1H). **^{13}C NMR** (126 MHz, $CDCl_3$) δ 168.1, 159.2, 143.5, 137.9, 136.9, 134.2, 133.7, 129.7, 129.6, 129.3 (q, *J* = 32.4 Hz), 127.1 (2C), 125.9 (q, *J* = 3.7 Hz, 2C), 124.44, 124.39 (d, *J* = 271.9 Hz), 121.5, 116.6, 79.3, 52.5, 37.9. **IR (neat):** ν_{max} (cm^{-1}): 1707, 1325, 1285, 1256, 1234, 1167, 1119, 1109, 1070, 1003, 928. **HRMS (ESI)**: *m/z* calcd. for $C_{21}H_{18}F_3O_3^+$ $[M+H]^+$ 375.1203, found 375.1196. $[\alpha]_D^{20} = +104°$ (c = 0.4, $CHCl_3$). **SFC-MS** (method 3) e.r.: 20/80: tret. (minor) = 3.973 min. (20%), tret. (major) = 4.154 min. (80%).

methyl 7-(2,4-dimethoxyphenyl)-2-vinyl-2,3-dihydrobenzo[*b*]oxepine-4-carboxylate (3s)



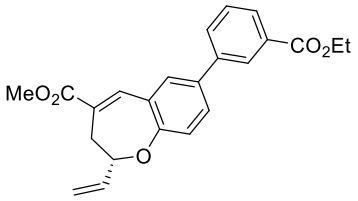
Prepared according to **GP-2**. Purification of the crude material by silica gel column chromatography (10% EtOAc/*c*Hex) providing the title compound as a colourless oil in 83% yield (72 mg, 0.20 mmol). $\mathbf{R_F}$ = 0.44 (10% EtOAc/cHex). **^{1}H NMR** (600 MHz, $CDCl_3$) δ 7.65 (d, J = 2.1 Hz, 1H), 7.45 (d, J = 2.0 Hz, 1H), 7.41 (dd, J = 8.3, 2.1 Hz, 1H), 7.24 – 7.19 (m, 1H), 7.04 (d, J = 8.3 Hz, 1H), 6.57 – 6.54 (m, 2H), 6.10 (ddd, J = 16.8, 10.6, 5.5 Hz, 1H), 5.43 (d, J = 17.2 Hz, 1H), 5.26 (d, J = 10.6 Hz, 1H), 4.57 – 4.53 (m, 1H), 3.85 (s, 3H), 3.82 (s, 3H), 3.81 (s, 3H), 3.16 – 3.09 (m, 1H), 2.89 (ddd, J = 18.6, 9.5, 2.2 Hz, 1H).**^{13}C NMR** (151 MHz, $CDCl_3$) δ 168.4, 160.4, 157.9, 157.5, 138.7, 137.3, 135.9, 132.8, 132.2, 132.1, 131.1, 128.7, 123.7, 122.4, 120.3, 116.3, 104.8, 99.1, 79.2, 55.7, 52.3, 38.0. **IR (neat):** ν_{max} (cm^{-1}): 1703, 1487, 1247, 1225, 1205, 1184, 1157, 1130, 1030, 924. **HRMS (ESI)**: *m/z* calcd. for $C_{22}H_{23}O_5^+$ $[M+H]^+$ 367.1540, found 367.1539. $[\alpha]_D^{20} = +63°$ (c = 0.1, $CHCl_3$). **SFC-MS** (method 1) e.r.: 21/79: tret. (minor) = 8.495 min. (21%), tret. (major) = 8.640 min. (79%).

methyl 7-(2,3-dihydrobenzo[*b*][1,4]dioxin-6-yl)-2-vinyl-2,3-dihydrobenzo[*b*]oxepine-4-carboxylate (3t)



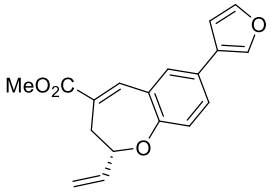
Prepared according to **GP-2**. Purification of the crude material by silica gel column chromatography (10% EtOAc/*c*Hex) providing the title compound as a colorless solid in 93% yield (80 mg, 0.22 mmol). $\mathbf{R_F}$ = 0.41 (10% EtOAc/cHex). **^{1}H NMR** (600 MHz, $CDCl_3$) δ 7.66 (d, J = 2.1 Hz, 1H), 7.46 (d, J = 2.2 Hz, 1H), 7.42 (dd, J = 8.4, 2.3 Hz, 1H), 7.10 – 6.99 (m, 3H), 6.92 (d, J = 8.3 Hz, 1H), 6.08 (ddd, J = 17.1, 10.6, 5.4 Hz, 1H), 5.43 (d, J = 17.2 Hz, 1H), 5.26 (d, J = 10.6 Hz, 1H), 4.57 – 4.49 (m, 1H), 4.29 (s, 4H), 3.83 (s, 3H), 3.13 (dd, J = 18.7, 1.3 Hz, 1H), 2.89 (ddd, J = 18.7, 9.4, 2.2 Hz, 1H). **^{13}C NMR** (151 MHz, $CDCl_3$) δ 168.2, 158.2, 143.9, 143.2, 138.3, 137.1, 135.2, 133.7, 133.1, 129.2, 129.1, 124.2, 121.1, 119.9, 117.7, 116.3, 115.6, 79.2, 64.6, 52.3, 38.0, 27.0. **IR (neat):** ν_{max} (cm^{-1}): 1701, 1487, 1281, 1244, 1223, 1207, 1186, 1159, 1128, 1065, 1057, 923. **HRMS (ESI)**: *m/z* calcd. for $C_{22}H_{21}O_5^+$ $[M+H]^+$ 365.1384, found 365.1389. $[\alpha]_D^{20} = +149°$. (c = 0.2, $CHCl_3$). **SFC-MS** (method 2) e.r.: 19/81: tret. (minor) = 5.563 min. (19%), tret. (major) = 5.826 min. (81%).

methyl 7-(3-(ethoxycarbonyl)phenyl)-2-vinyl-2,3-dihydrobenzo[*b*]oxepine-4-carboxylate (3u)



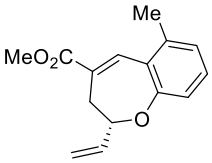
Prepared according to **GP-2**. Purification of the crude material by silica gel column chromatography (10% EtOAc/*c*Hex) providing the title compound as a yellow oil in 60% yield (53 mg, 0.14 mmol). R_F = 0.49 (10% EtOAc/cHex). **^{1}H NMR** (500 MHz, $CDCl_3$) δ 8.23 (t, J = 1.7 Hz, 1H), 8.01 (dt, J = 7.7, 1.3 Hz, 1H), 7.77 – 7.72 (m, 1H), 7.69 (d, J = 2.1 Hz, 1H), 7.57 (d, J = 2.3 Hz, 1H), 7.55 – 7.47 (m, 2H), 7.11 (d, J = 8.4 Hz, 1H), 6.09 (ddd, J = 17.2, 10.6, 5.4 Hz, 1H), 5.44 (dt, J = 17.2, 1.3 Hz, 1H), 5.27 (dt, J = 10.6, 1.2 Hz, 1H), 4.59 – 4.53 (m, 1H), 4.42 (q, J = 7.1 Hz, 2H), 3.84 (s, 3H), 3.15 (dd, J = 18.7, 1.5 Hz, 1H), 2.91 (ddd, J = 18.7, 9.3, 2.3 Hz, 1H), 1.42 (t, J = 7.1 Hz, 3H). **^{13}C NMR** (126 MHz, $CDCl_3$) δ 168.2, 166.7, 158.8, 140.3, 138.1, 137.0, 134.7, 133.6, 131.3, 131.1, 129.6, 129.4, 129.0, 128.3, 127.9, 124.4, 121.46, 116.5, 79.2, 61.3, 52.4, 37.9, 14.5. **IR (neat):** ν_{max} (cm^{-1}): 1701, 1487, 1281, 1244, 1223, 1207, 1188, 1067, 924. **HRMS (ESI)**: *m/z* calcd. for $C_{23}H_{23}O_5^+$ $[M+H]^+$ 379.1540, found 379.1544. $[\alpha]_D^{20} = +148°$ (c = 0.2, $CHCl_3$). **SFC-MS** (method 5) e.r.: 24/76: tret. (minor) = 7.487 min. (24%), tret. (major) = 7.667 min. (74%).

methyl 7-(furan-3-yl)-2-vinyl-2,3-dihydrobenzo[*b*]oxepine-4-carboxylate (3v)



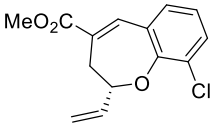
Prepared according to **GP-2**. Purification of the crude material by silica gel column chromatography (10% EtOAc/*c*Hex) providing the title compound as a yellow solid in 62% yield (43 mg, 0.15 mmol). R_F = 0.54 (10% EtOAc/cHex). **^{1}H NMR** (500 MHz, $CDCl_3$) δ 7.68 (s, 1H), 7.63 (d, J = 2.2 Hz, 1H), 7.47 (t, J = 1.7 Hz, 1H), 7.42 (d, J = 2.2 Hz, 1H), 7.37 (dd, J = 8.4, 2.3 Hz, 1H), 7.03 (d, J = 8.4 Hz, 1H), 6.66 (dd, J = 1.8, 0.9 Hz, 1H), 6.07 (ddd, J = 17.2, 10.6, 5.4 Hz, 1H), 5.43 (dt, J = 17.2, 1.3 Hz, 1H), 5.26 (dt, J = 10.6, 1.3 Hz, 1H), 4.58 – 4.48 (m, 1H), 3.83 (s, 3H), 3.12 (dd, J = 18.7, 1.5 Hz, 1H), 2.89 (ddd, J = 18.7, 9.4, 2.3 Hz, 1H). **^{13}C NMR** (126 MHz, $CDCl_3$) δ 168.2, 158.1, 143.9, 138.2, 138.1, 137.1, 132.2, 129.3, 128.5, 127.1, 125.5, 124.4, 121.2, 116.4, 108.9, 79.2, 52.4, 38.0. **IR (neat):** ν_{max} (cm^{-1}): 1701, 1489, 1281, 1244, 1223, 1190, 1067, 924, 889. **HRMS (ESI)**: *m/z* calcd. for $C_{18}H_{17}O_4^+$ $[M+H]^+$ 297.1121, found 297.1119. $[\alpha]_D^{20} = +254°$ (c = 0.1, $CHCl_3$). **SFC-MS** (method 2) e.r.: 21.5/78.5: tret. (minor) = 3.762 min. (21.5%), tret. (major) = 3.917 min. (78.5%).

methyl 6-methyl-2-vinyl-2,3-dihydrobenzo[*b*]oxepine-4-carboxylate (3w)



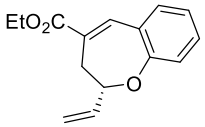
Prepared according to **GP-2**. Purification of the crude material by silica gel column chromatography (10% EtOAc/*c*Hex) providing the title compound as a colorless solid in 47% yield (27 mg, 0.11 mmol). R_F = 0.61 (20% EtOAc/*c*Hex). **^{1}H NMR** (500 MHz, $CDCl_3$) δ 7.91 (d, J = 2.0 Hz, 1H), 7.14 (t, J = 7.8 Hz, 1H), 6.92 (d, J = 7.1 Hz, 1H), 6.89 (d, J = 8.1 Hz, 1H), 6.06 (ddd, J = 17.2, 10.6, 5.5 Hz, 1H), 5.41 (dt, J = 17.2, 1.4 Hz, 1H), 5.24 (dt, J = 10.6, 1.3 Hz, 1H), 4.61 – 4.53 (m, 1H), 3.83 (s, 3H), 3.01 (dd, J = 18.3, 2.2 Hz, 1H), 2.86 (ddd, J = 18.3, 10.0, 2.1 Hz, 1H), 2.46 (s, 3H).**^{13}C NMR** (126 MHz, $CDCl_3$) δ 168.6, 159.8, 140.5, 137.3, 134.0, 130.3, 129.1, 125.4, 124.6, 119.3, 116.2, 81.8, 52.4, 37.4, 20.9. **IR (neat):** ν_{max} (cm^{-1}): 2951, 1705, 1429, 1261, 1238, 1219, 1202, 1080, 1034, 1014, 986. **HRMS (ESI)**: *m/z* calcd. for $C_{15}H_{17}O_3$ $[M+H]^+$ 245.1172, found 245.1169. $[\alpha]_D^{20} = +130°$ (c = 1.8, $CHCl_3$). **SFC-MS** (method 3) e.r.: 30.5/69.5: tret. (minor) = 3.573 min. (30.5%), tret. (major) = 3.701 min. (69.5%).

methyl 9-chloro-2-vinyl-2,3-dihydrobenzo[*b*]oxepine-4-carboxylate (3x)



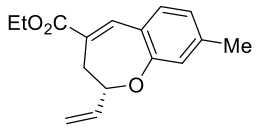
Prepared according to **GP-2**. Purification of the crude material by silica gel column chromatography (10% EtOAc/*c*Hex) providing the title compound as a colorless solid in 18% yield (11 mg, 0.04 mmol). R_F = 0.59 (20% EtOAc/*c*Hex). **^{1}H NMR** (500 MHz, $CDCl_3$) δ 7.59 (d, J = 2.3 Hz, 1H), 7.37 (dd, J = 7.9, 1.6 Hz, 1H), 7.22 (dd, J = 7.8, 1.4 Hz, 1H), 6.97 (t, J = 7.8 Hz, 1H), 6.09 (ddd, J = 17.2, 10.7, 4.6 Hz, 1H), 5.64 (dt, J = 17.2, 1.4 Hz, 1H), 5.31 (dt, J = 10.7, 1.4 Hz, 1H), 4.60 – 4.53 (m, 1H), 3.83 (s, 3H), 3.13 (dd, J = 19.0, 1.6 Hz, 1H), 2.92 (ddd, J = 19.0, 9.6, 2.4 Hz, 1H). **^{13}C NMR** (126 MHz, $CDCl_3$) δ 168.1, 154.6, 137.3, 136.4, 133.4, 131.3, 130.0, 126.0, 125.9, 123.0, 116.9, 79.8, 52.5, 37.8. **IR (neat):** ν_{max} (cm^{-1}) 2957, 2922, 2853, 1693, 1448, 1283, 1263, 1240, 1213, 1113, 1086, 1076, 1061, 1000. **HRMS (ESI)**: *m/z* calcd. for $C_{14}H_{14}ClO_3$ $[M+H]^+$ 265.0626, found 265.0628. $[\alpha]_D^{20} = +29°$ (c = 0.5, $CHCl_3$). **SFC-MS** (method 3) e.r.: 42.5/57.5: tret. (minor) = 6.179 min. (42.5%), tret. (major) = 6.471 min. (57.5%).

ethyl 2-vinyl-2,3-dihydrobenzo[*b*]oxepine-4-carboxylate (3y)



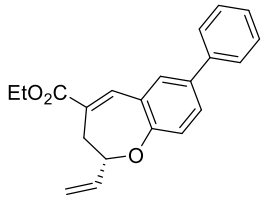
Prepared according to **GP-2**. Purification of the crude material by silica gel column chromatography (10% EtOAc/*c*Hex) providing the title compound as a colorless solid in 45% yield (26 mg, 0.11 mmol). R_F = 0.64 (20% EtOAc/*c*Hex). **^{1}H NMR** (500 MHz, $CDCl_3$) δ 7.60 (d, J = 2.3 Hz, 1H), 7.32 (dd, J = 7.6, 1.4 Hz, 1H), 7.27 – 7.24 (m, 1H), 7.13 – 6.91 (m, 2H), 6.08 (ddd, J = 17.2, 10.6, 5.4 Hz, 1H), 5.43 (dt, J = 17.2, 1.3 Hz, 1H), 5.25 (dt, J = 10.6, 1.3 Hz, 1H), 4.67 – 4.41 (m, 1H), 4.27 (q, J = 7.1 Hz, 2H), 3.11 (dd, J = 18.7, 1.5 Hz, 1H), 2.87 (ddd, J = 18.7, 9.5, 2.3 Hz, 1H), 1.35 (t, J = 7.1 Hz, 3H). **^{13}C NMR** (126 MHz, $CDCl_3$) δ 167.9, 159.1, 137.9, 137.2, 135.0, 130.9, 129.2, 124.2, 122.7, 120.7, 116.3, 79.1, 61.2, 62.0, 38.0, 14.0. **IR (neat):** ν_{max} (cm^{-1}): 2979, 1697, 1485, 1444, 1282, 1245, 1226, 1211, 1191, 1155, 1118, 1093, 1074, 1018. **HRMS (ESI)**: *m/z* calcd. for $C_{15}H_{16}O_3Na$ $[M+Na]^+$ 267.0992, found 267.1000. $[\alpha]_D^{20} = +201°$ (c = 0.6, $CHCl_3$). **SFC-MS** (method 3) e.r.: 23/77: tret. (minor) = 3.629 min. (23%), tret. (major) = 3.900 min. (77%).

ethyl 8-methyl-2-vinyl-2,3-dihydrobenzo[*b*]oxepine-4-carboxylate (3z)



Prepared according to **GP-2**. Purification of the crude material by silica gel column chromatography (10% EtOAc/*c*Hex) providing the title compound as a colorless solid in 61% yield (37 mg, 0.14 mmol). **R_F** = 0.64 (10% EtOAc/cHex). **^{1}H NMR** (600 MHz, $CDCl_3$) δ 7.58 (d, J = 2.1 Hz, 1H), 7.20 (d, J = 8.3 Hz, 1H), 6.84 (d, J = 6.1 Hz, 2H), 6.07 (ddd, J = 17.1, 10.6, 5.4 Hz, 1H), 5.42 (d, J = 17.2 Hz, 1H), 5.24 (d, J = 10.6 Hz, 1H), 4.54 – 4.45 (m, 1H), 4.26 (q, J = 7.1 Hz, 2H), 3.10 (dd, J = 18.6 Hz, 1.2 Hz, 1H), 2.84 (ddd, J = 18.6, 9.4, 2.1 Hz, 1H), 2.32 (s, 3H), 1.34 (t, J = 7.1 Hz, 3H). **^{13}C NMR** (151 MHz, $CDCl_3$) δ 168.0, 158.9, 141.8, 138.0, 137.4, 134.9, 128.0, 123.7, 121.5, 121.1, 116.1, 79.0, 61.1, 38.1, 21.3, 14.5. **IR (neat):** ν_{max} (cm^{-1}): 1697, 1283, 1271, 1256, 1229, 1207, 1192, 1165, 1136, 1067, 989, 808. **HRMS (ESI)**: *m/z* calcd. for $C_{16}H_{19}O_3^+$ $[M+H]^+$ 259.1329, found 259.1327. $[\alpha]_D^{20} = +232°$ (c = 0.1, $CHCl_3$). **SFC-MS** (method 3) e.r.: 33/67: tret. (minor) = 3.835 min. (33%), tret. (major) = 4.169 min. (67%).

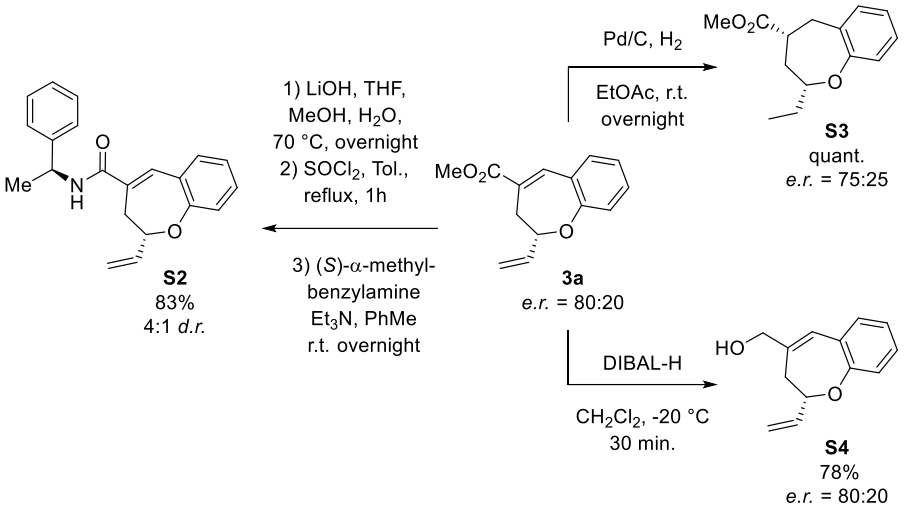
ethyl 7-phenyl-2-vinyl-2,3-dihydrobenzo[*b*]oxepine-4-carboxylate (3za)



Prepared according to **GP-2**. Purification of the crude material by silica gel column chromatography (10% EtOAc/*c*Hex) providing the title compound as a yellow oil in 48% yield (36 mg, 0.11 mmol). **R_F** = 0.64 (10% EtOAc/cHex). **^{1}H NMR** (600 MHz, $CDCl_3$) δ 7.68 (d, J = 2.2 Hz, 1H), 7.60 – 7.52 (m, 3H), 7.49 (dd, J = 8.4, 2.3 Hz, 1H), 7.43 (t, J = 7.7 Hz, 2H), 7.34 (t, J = 7.4 Hz, 1H), 7.09 (d, J = 8.4 Hz, 1H), 6.10 (ddd, J = 17.1, 10.6, 5.4 Hz, 1H), 5.45 (d, J = 17.2 Hz, 1H), 5.27 (d, J = 10.6 Hz, 1H), 4.60 – 4.51 (m, 1H), 4.29 (q, J = 7.1 Hz, 2H), 3.14 (dd, J = 18.7, 1.3 Hz, 1H), 2.90 (ddd, J = 18.7, 9.4, 2.3 Hz, 1H), 1.36 (t, J = 7.1 Hz, 3H). **^{13}C NMR** (151 MHz, $CDCl_3$) δ 167.6, 158.4, 140.0, 137.8, 137.0, 135.6, 133.4, 129.5, 129.4, 128.8 (2C), 127.1, 126.8 (2C), 124.2, 121.0, 116.3, 79.14, 61.1, 37.8, 14.4. **IR (neat):** ν_{max} (cm^{-1}): 1655, 1475, 1250, 1223, 1180, 750, 696, 675, 660. **HRMS (ESI)**: *m/z* calcd. for $C_{21}H_{21}O_3^+$ $[M+H]^+$ 321.1485, found 321.1487. $[\alpha]_D^{20} = +305°$ (c = 0.1, $CHCl_3$). **SFC-MS** (method 1) e.r.: 23.5/76.5: tret. (minor) = 3.612 min. (23.5%), tret. (major) = 3.892 min. (76.5%).

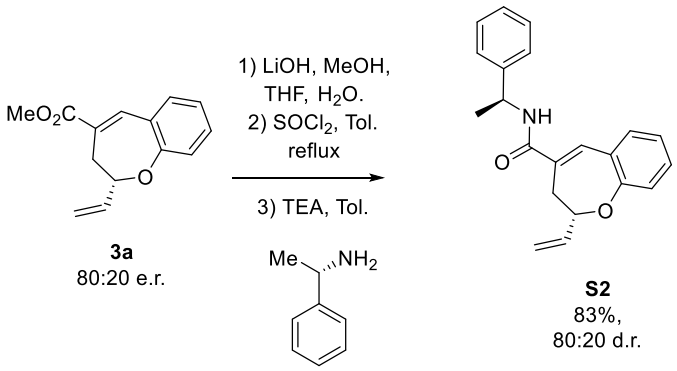
Post functionalizations

We sought to illustrate the potential synthetic application of our methodology by performing several post-modifications on benzoxepin **3a** (Scheme 5). First, the ester moiety of **3a** was converted into amide **S2** in 83% yield. Both alkenes could be reduced by catalytic hydrogenation to afford **S3** in quantitative yield as a single diastereoisomer. Apparently, hydrogenation occurs from the less hindered face of the seven-membered ring. The ester moiety in **3a** was also reduced using DIBAL-H in CH_2Cl_2 to give the corresponding allylic alcohol **S4** in 78% yield with unchanged *e.r.*



Scheme S1. Post-transformations of compound **3a**.

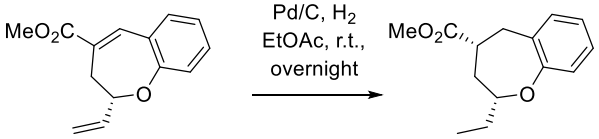
Synthesis of amide S2



To a solution of **3a** (100 mg, 0.434 mmol, 1 eq.) in THF (2.70 mL, 0.160 M) and MeOH (0.65 mL, 0.673 M) was added a solution of LiOH (47 mg, 1.954 mmol, 4.5 eq.) in H_2O (0.65 mL, 0.673 M) and stirred at 70 °C overnight. Aqueous HCl (1 M) was added at 0 °C until pH 2, then the mixture was extracted with three times with EtOAc (3x10 mL) and the combined organic phases was washed with brine, dried over sodium sulfate and the solvent removed under vacuum.
Without further purification, the crude product was dissolved in toluene (0.75 mL, 0.580 M), $SOCl_2$ (95 µL, 1.302 mmol, 3 eq.) was added and the solution was heated to reflux for one hour. The solvent was removed under vacuum, resulting in a dark oil, which was dissolved in toluene (2.60 mL, 0.167 M) and cooled to 0 °C, then Et_3N (90 µL, 0.651 mmol, 1.5 eq.) and (*S*)-α-methylbenzylamine (56 µL, 0.434 mmol, 1.0 eq.) were added and stirred at room temperature overnight. Aqueous HCl (5 mL, 1 M) was added to the mixture at 0 °C, then the mixture was extracted with three times with EtOAc (3 x 10 mL) and the combined organic phases was washed with brine, dried over sodium sulfate and the solvent removed under vacuum. The crude product was purified by silica gel chromatography affording **S2** as a colorless solid in 83% yield (115 mg, 0.36 mmol). $\mathbf{R_F}$ = 0.31 (10% EtOAc/cHex). Two unseparable diastereoisomers were present in NMR (major : minor = 1 : 4) of which the signals of the major diastereoisomer are marked with ● and minor diastereoisomer are marked with ◊. **^{1}H NMR** (500 MHz, $CDCl_3$) δ 7.40 – 7.34 (m, ●4H, ◊4H), 7.32 – 7.28 (m, ●1H, ◊1H), 7.26 – 7.19 (m, ●2H, ◊2H), 7.12 (d, J = 2.0 Hz, ◊1H), 7.09 (d, J = 2.1 Hz, ●1H), 7.04 – 6.98 (m, ●2H, ◊2H), 6.11 – 6.01 (m, ●2H, ◊2H), 5.43 (dt, J = 17.2, 1.3 Hz, ●1H, ◊1H), 5.27 – 5.19 (m, ●2H, ◊2H), 4.55 – 4.48

(m, ●1H, ◊1H), 3.11 – 3.01 (m, ●1H, ◊1H), 2.84 (ddd, J = 18.2, 9.4, 2.3 Hz, ●1H, ◊1H), 1.58 (d, J = 6.9 Hz, ◊3H), 1.57 (d, J = 6.9 Hz, ●3H). **^{13}C NMR** (126 MHz, $CDCl_3$) δ ●◊ 168.3, ●◊ 158.6, ● 143.28, ◊ 143.21, ● 137.10, ◊ 137.06, ●◊ 134.3, ●◊ 133.8, ◊132.3, ● 132.2, ●◊ 130.2, ●◊ 128.9 (2C) , ●◊ 127.6, ◊ 126.40 (2C), ● 126.37 (2C), ◊ 124.56, ● 124.50, ◊122.81, ●122.79, ●◊ 120.6, ◊ 116.37, ● 116.35, ●◊ 79.2, ●◊ 49.4, ● 38.41, ◊ 38.38, ● 21.84, ◊ 21.81. **IR (neat):** ν_{max} (cm^{-1}): 1701, 1281, 1246, 1225, 1188, 1128, 1167, 1016, 989, 933, 926, 810, 754. **HRMS (ESI)**: *m/z* calcd. for $C_{21}H_{22}NO_2^+$ $[M+H]^+$ 320.1645, found 320.1637.

Hydrogenation

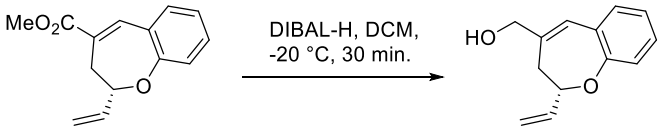


3a
80:20 e.r.

S3
quant.
75:25 e.r.

To a flame dried flask, **3a** (100 mg, 0.434 mmol, 1 eq.) and 10% Pd/C (10 mg) were added. Subsequently, EtOAc was added (8.68 mL, 0.05 M) and the flask was connected to an H_2 balloon, degassed under vacuum and refilled with H_2 (three times). After stirring overnight, the suspension was filtrated over celite, rinsed with EtOAc and the solvent was removed under reduced pressure affording **S3** as a colorless solid in quantitative yield (102 mg, 0.434 mmol) as a single diastereoisomer. **R_F** = 0.67 (10% EtOAc/cHex). **^{1}H NMR** (500 MHz, $CDCl_3$) δ 7.20 – 7.13 (m, 2H), 7.02 – 6.98 (m, 2H), 3.73 (s, 3H), 3.45 – 3.36 (m, 1H), 3.11 (dd, J = 13.9, 11.7 Hz, 1H), 2.91 (dt, J = 14.1, 1.6 Hz, 1H), 2.58 – 2.48 (m, 1H), 2.18 (dt, J = 14.1, 1.5 Hz, 1H), 2.05 – 1.97 (m, 1H), 1.82 – 1.75 (m, 1H), 1.64 – 1.59 (m, 1H), 1.11 (t, J = 7.4 Hz, 3H). **^{13}C NMR** (126 MHz, $CDCl_3$) δ 175.8, 159.7, 133.2, 130.6, 128.2, 123.9, 121.4, 83.8, 52.1, 43.3, 40.2, 36.2, 30.3, 10.7. **IR (neat):** ν_{max} (cm^{-1}): 1703, 1246, 1227, 1188, 1165, 1067, 989, 933, 928, 754. **HRMS (ESI)**: *m/z* calculated for $C_{14}H_{19}O_3^+$ $[M+H]^+$ 235.1329, found 235.1325.

Reduction of the ester



3a
80: 20 e.r.

S4
78%
80: 20 e.r.

To a solution of **3a** (100 mg, 0.434 mmol, 1 eq.) in DCM (2.61 mL, 0.166 M) at - 20 °C, a solution of DIBAL-H (1.30 mL, 1 M in hexane, 3 eq.) was added dropwise. The reaction was monitored via TLC. After 1 hour, the reaction was quenched by addition of MeOH (1 mL) and stirred for 30 min, then a saturated solution of sodium potassium tartrate (5 mL) was added, and extracted with DCM (3x15 mL). The combined organic phases were washed with brine, dried over sodium sulfate and the solvent removed under vacuum. The crude was purified by silica gel chromatography affording **S4** compound as a colorless solid in 78% yield (68 mg, 0.34 mmol. **R_F** = 0.10 (10% EtOAc/cHex). **^{1}H NMR** (500 MHz, $CDCl_3$) δ 7.17 – 7.11 (m, 2H), 7.04 – 6.97 (m, 2H), 6.39 (d, J = 2.2 Hz, 1H), 6.07 (ddd, J = 17.3, 10.6, 5.5 Hz, 1H), 5.42 (dt, J = 17.2, 1.5 Hz, 1H), 5.24 (dt, J = 10.7, 1.4 Hz, 1H), 4.57 – 4.48 (m, 1H), 4.22 (d, J = 13.2 Hz, 1H), 4.18 (d, J = 13.3 Hz, 1H), 2.75 (ddd, J = 18.3, 9.7, 2.1 Hz, 1H), 2.63 (dd, J = 18.3, 1.9 Hz, 1H), 2.01 (s, 1H). **^{13}C NMR** (126 MHz, $CDCl_3$) δ 157.6, 139.4, 137.6, 132.8, 128.2, 126.3, 124.9, 122.8, 120.5, 115.9, 79.2, 68.6, 39.2. **IR (neat):** ν_{max} (cm^{-1}): 1487, 1259, 1236, 1103, 991, 927, 754, 638. **HRMS (ESI)**: *m/z* calcd. for $C_{13}H_{15}O_2$ $[M+H]^+$ 203.1067, found 203.1074. $[\alpha]_D^{20} = +120°$ (c = 0.7, $CHCl_3$). **SFC-MS** (method 5) e.r.: 80/20: tret. (major) = 5.975 min. (80%), tret. (minor) = 6.247 min. (20%).

Computed CD Spectra

Results

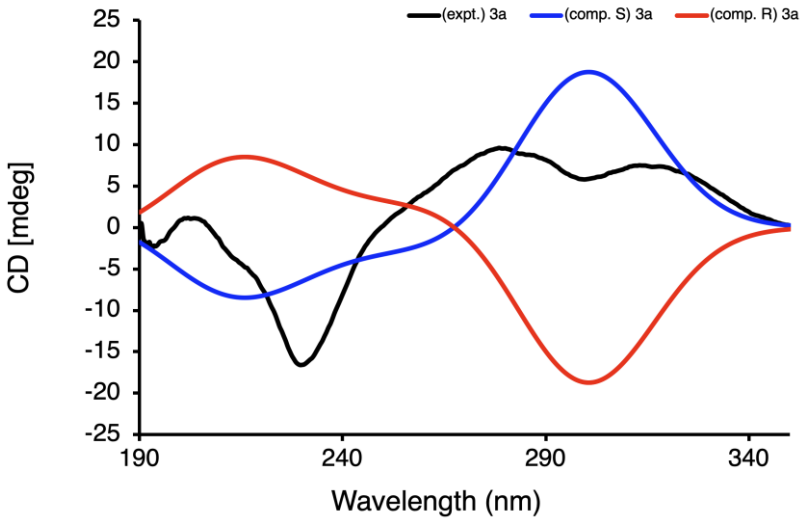


Figure S2. Experimental (black) and calculated (blue: *S*- and red: *R*-enantiomer) CD spectra for compound **3a**.

Table S2. Transition frequencies (nm) and reduced rotary strength (10**(-40) esu * cm * erg / G) for the *R*- and *S*-enantiomer of **3a**.

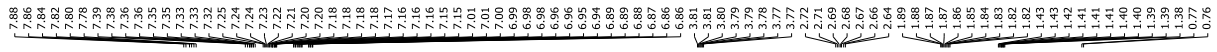
R-enantiomer of **3a**		*S*-enantiomer of **3a**	
Transition frequencies	Reduced rotary strength	Transition frequencies	Reduced rotary strength
503.832	0.4443	503.832	–0.4443
328.243	–0.0835	328.243	0.0835
319.518	–3.5787	319.518	3.5787
313.165	12.4344	313.165	–12.4344
300.534	–104.0110	300.534	104.0110
278.394	1.9085	278.394	–1.9085
269.027	10.9076	269.027	–10.9076
259.374	0.0070	259.374	–0.0070
248.014	1.4081	248.014	–1.4081
242.082	5.3815	242.082	–5.3815
227.829	0.2806	227.829	–0.2806
220.804	7.2014	220.804	–7.2014
219.164	9.6741	219.164	–9.6741
217.226	0.2185	217.226	–0.2185
210.539	0.6439	210.539	–0.6439
206.095	40.5534	206.095	–40.5534
203.822	–0.2157	203.822	0.2157
201.030	–6.0210	201.030	6.0210
198.357	–0.0349	198.357	0.0349
193.724	–16.2714	193.724	16.2714

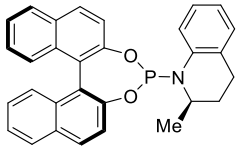
Computational Methods

All calculations were performed using the Amsterdam Density Functional (ADF) software.[3] Equilibrium structures were optimized using the BP86 functional[3] and the TZ2P basis set.[5] Dispersion interactions were included using Grimme's DFT-D3 correction with Becke-Johnson damping.[6] Solvent effects of methanol were accounted for using the conducter-like screen model (COSMO) of solvation.[7] This level is referred to as COSMO(methanol)-BP86-D3(BJ)/TZ2P. The stationary points were verified through vibrational analysis to be minima (zero imaginary frequencies). The circular dichroism (CD) spectra were computed using time-dependent density functional theory (TDDFT) and the range-separated hybrid (RSH) CAM-B3LYP[8] functional on COSMO(methanol)-BP86-D3(BJ)/TZ2P geometries. The data were fitted using the "Gaussian area" setting with a width of 40 nm using ADFview. The zeroth-order regular approximation (ZORA) was used to account for scalar relativistic effects.[9] This level is referred to as COSMO(methanol)-ZORA-CAM-B3LYP/TZ2P//COSMO(methanol)-BP86-D3(BJ)/TZ2P.

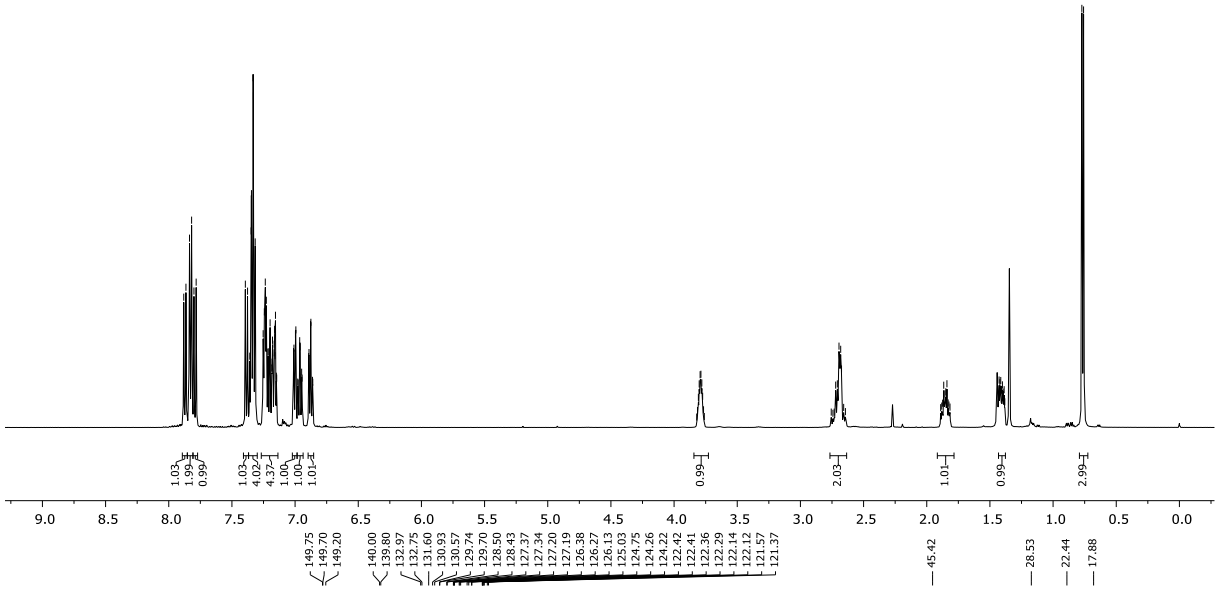
SUPPORTING INFORMATION

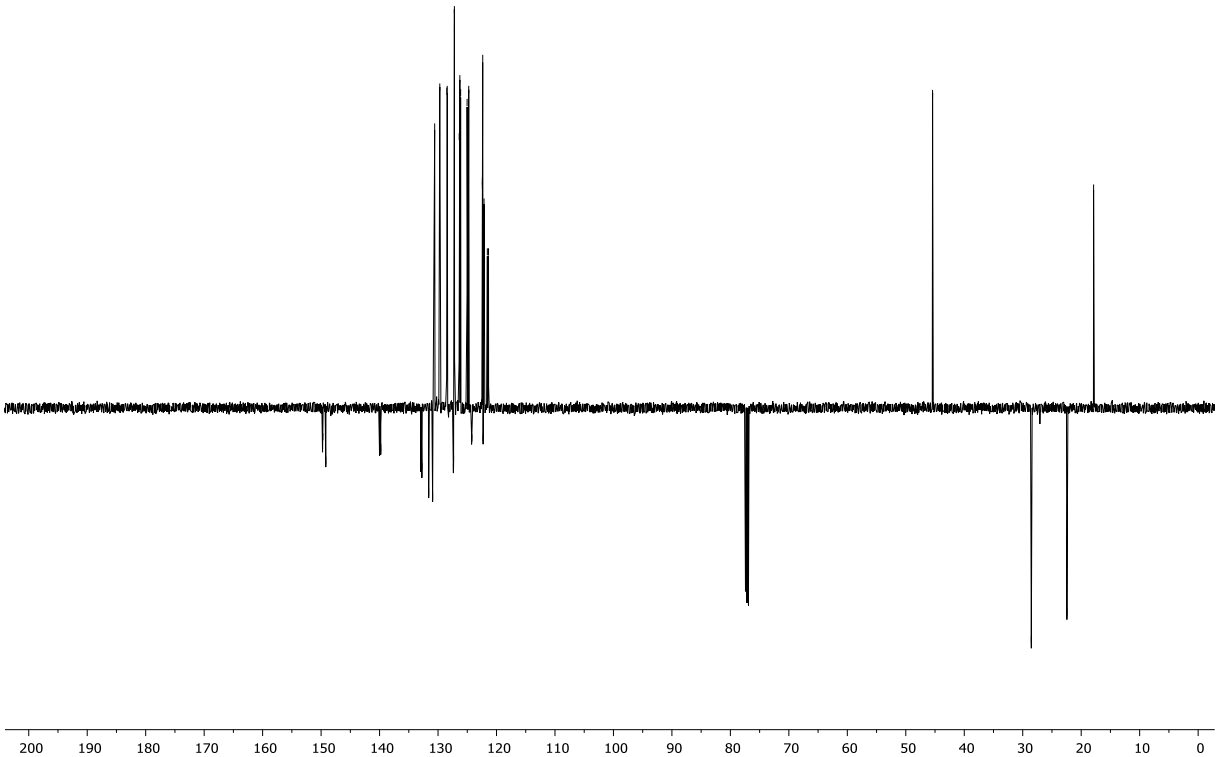
NMR Spectra

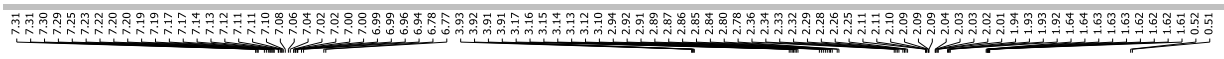


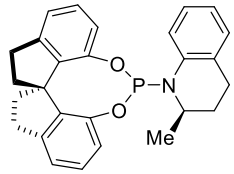


L18









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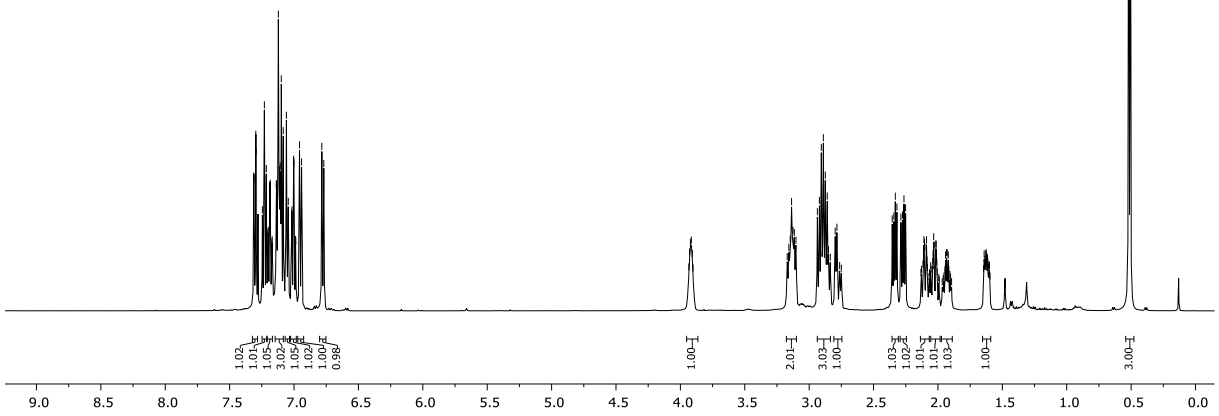
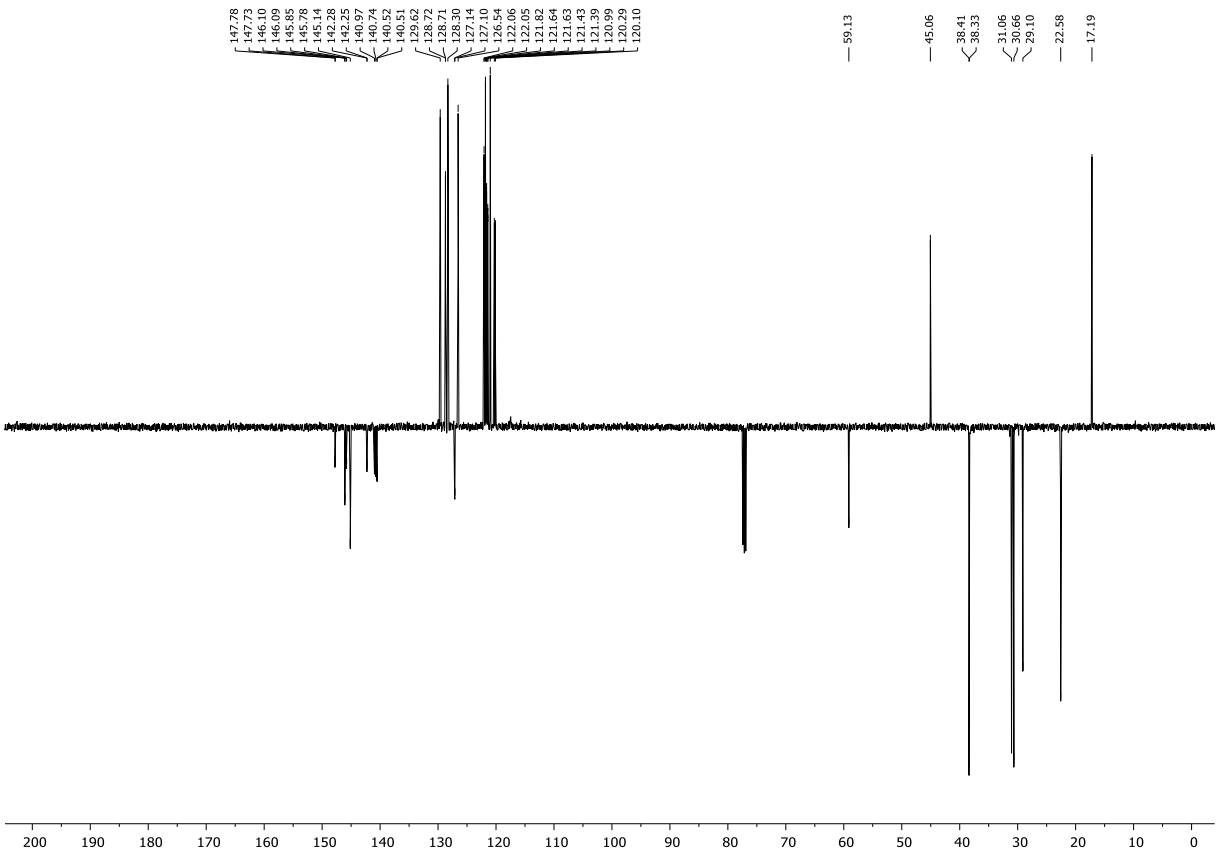
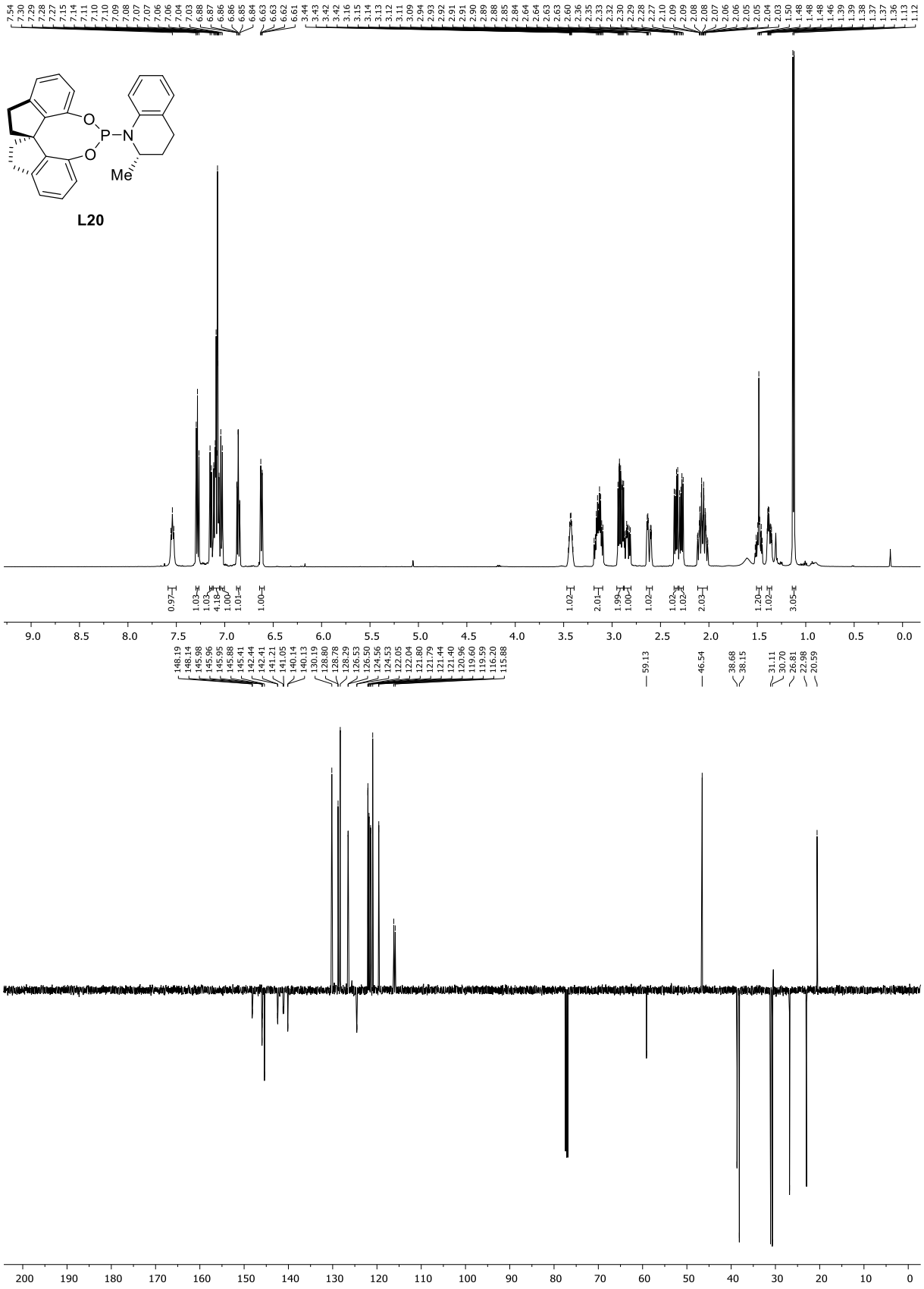
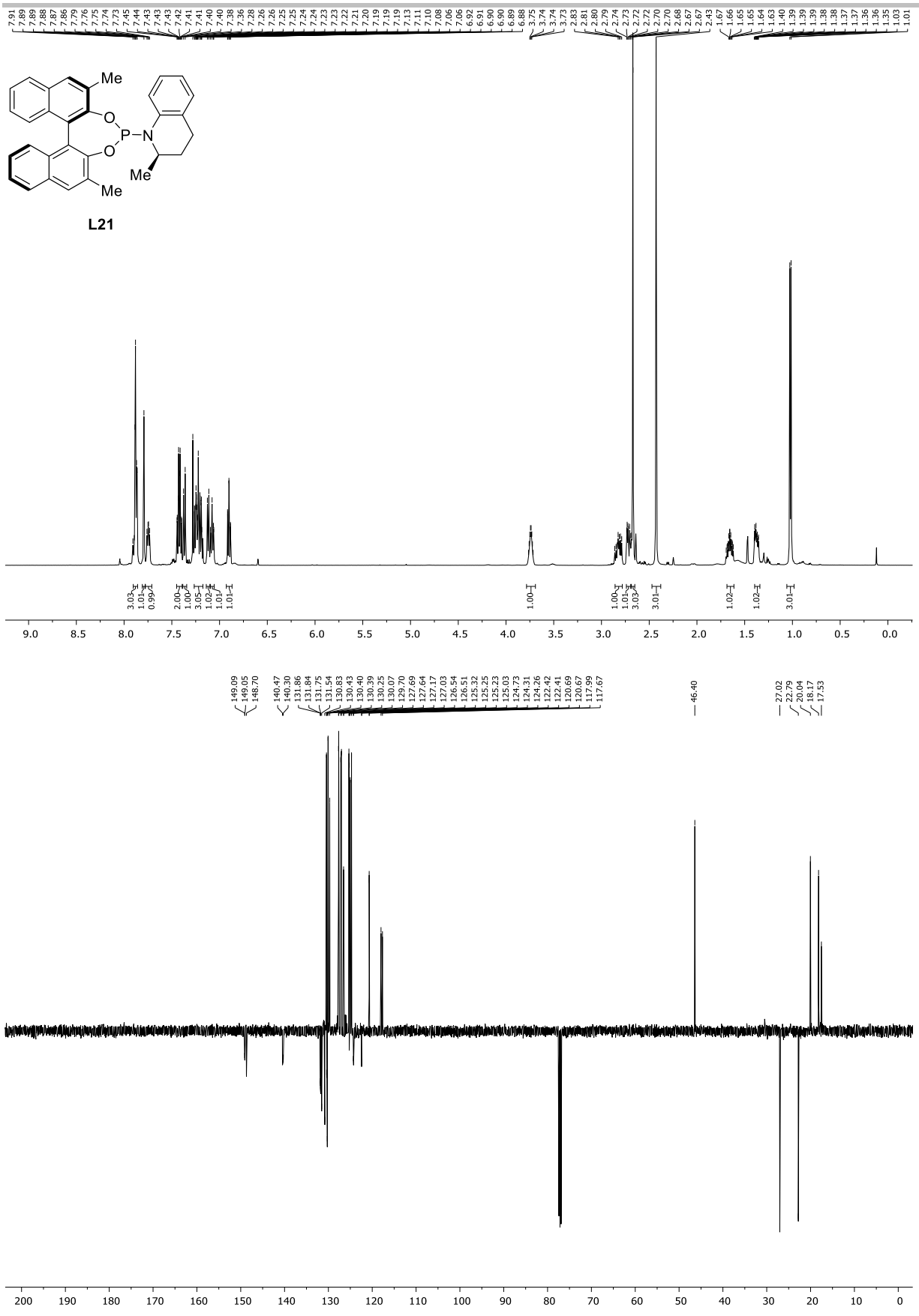





L20
Me



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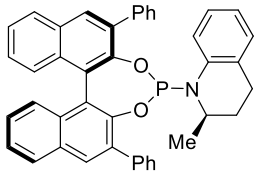

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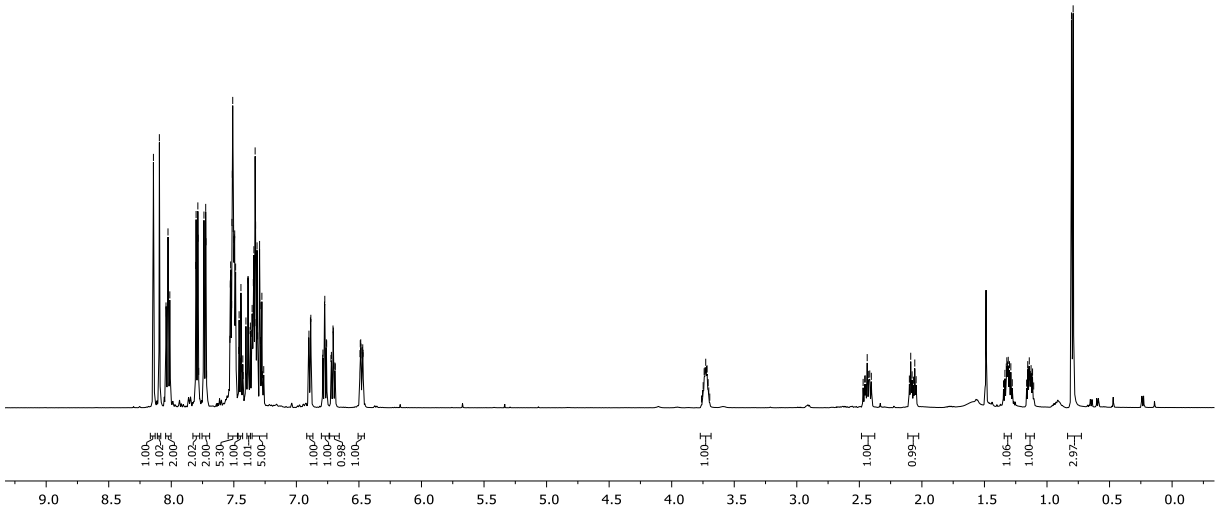

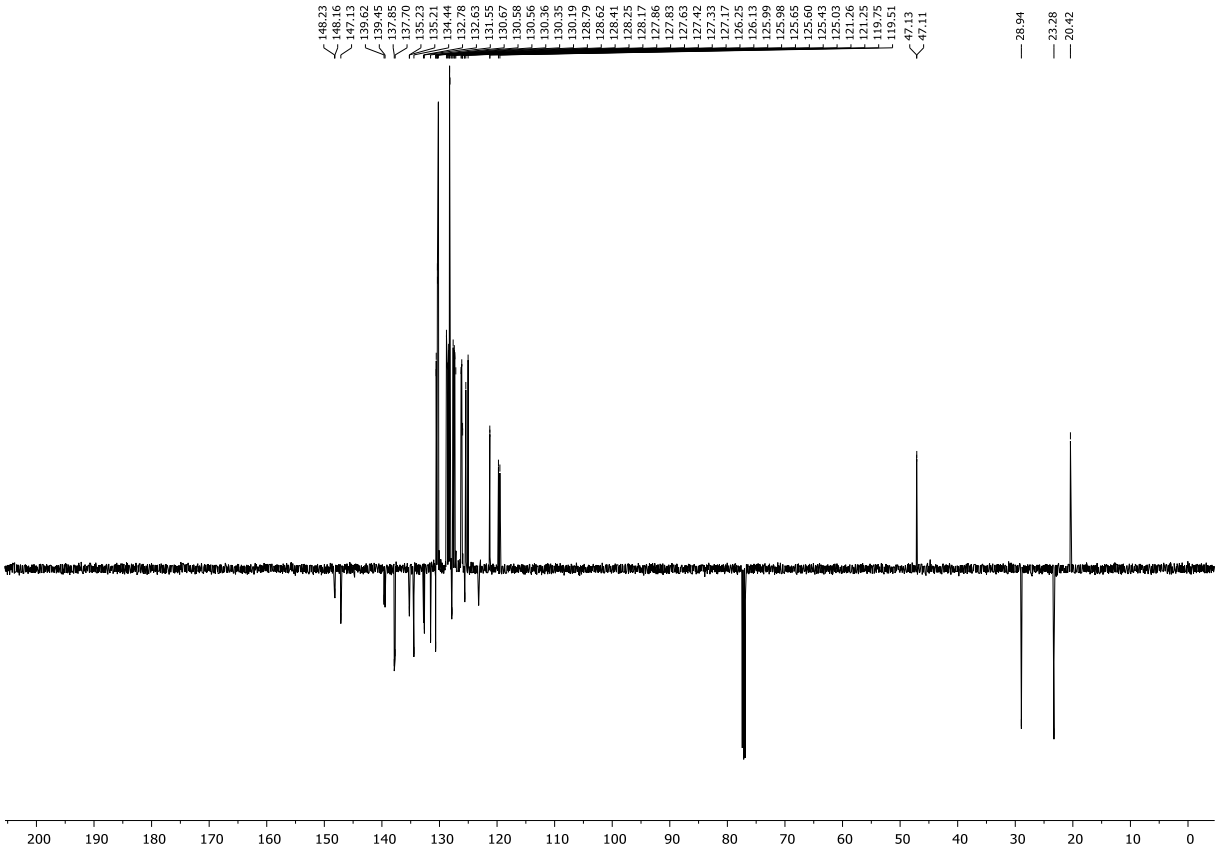

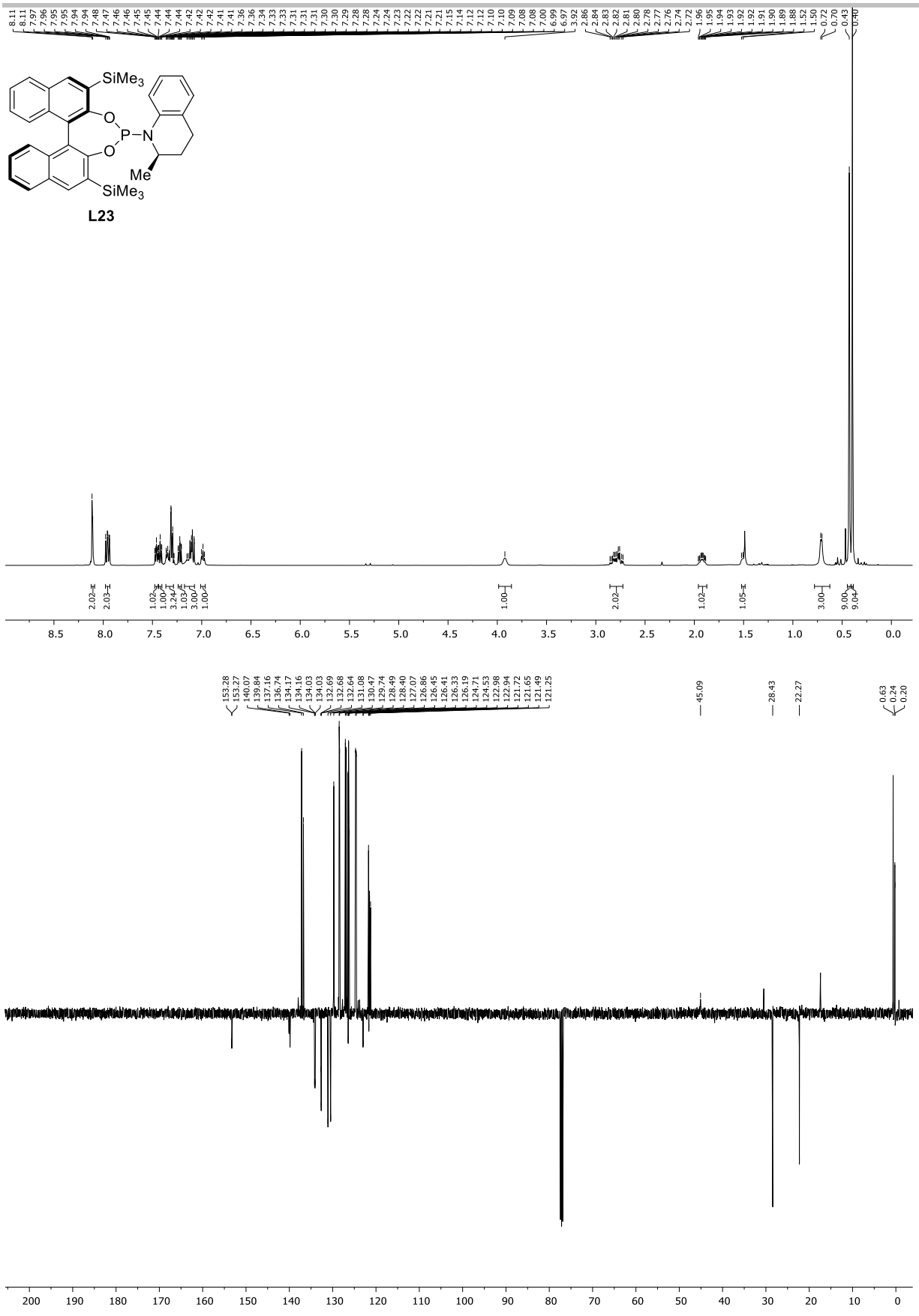

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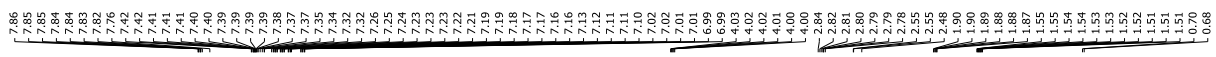

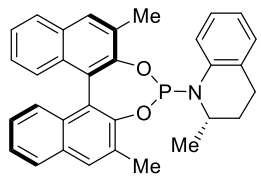

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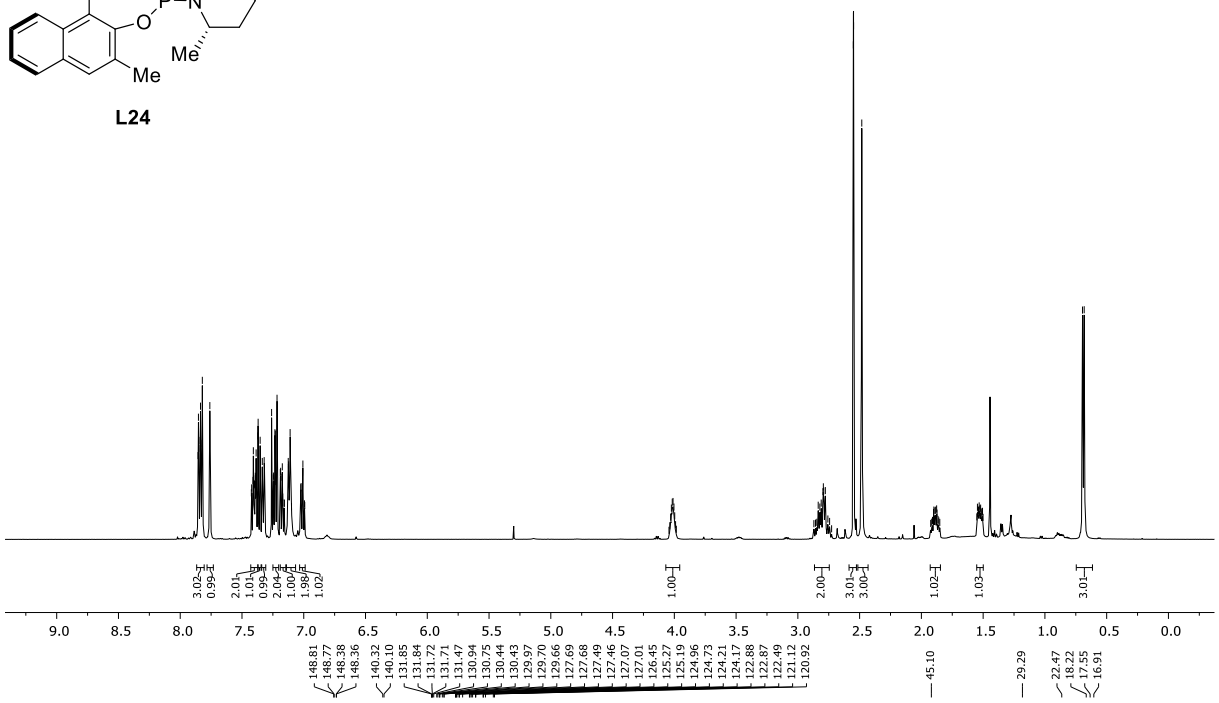
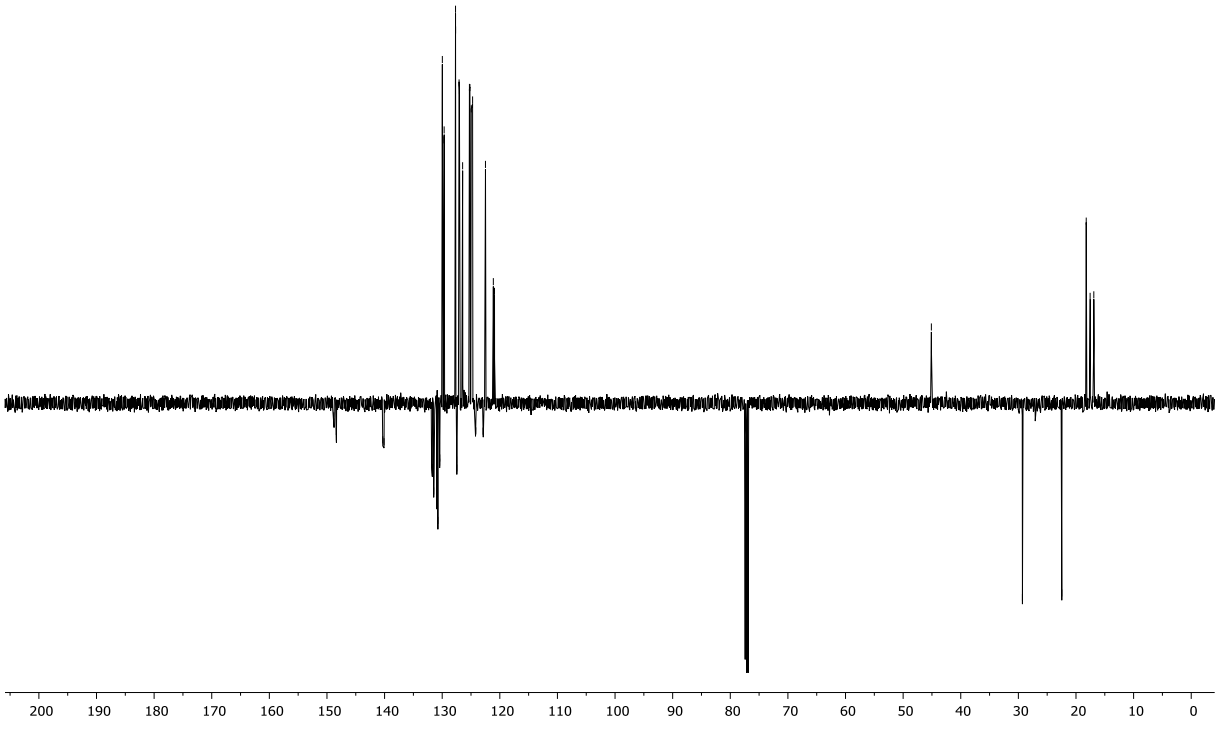
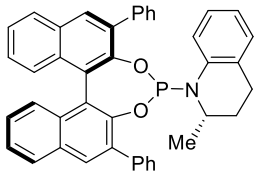
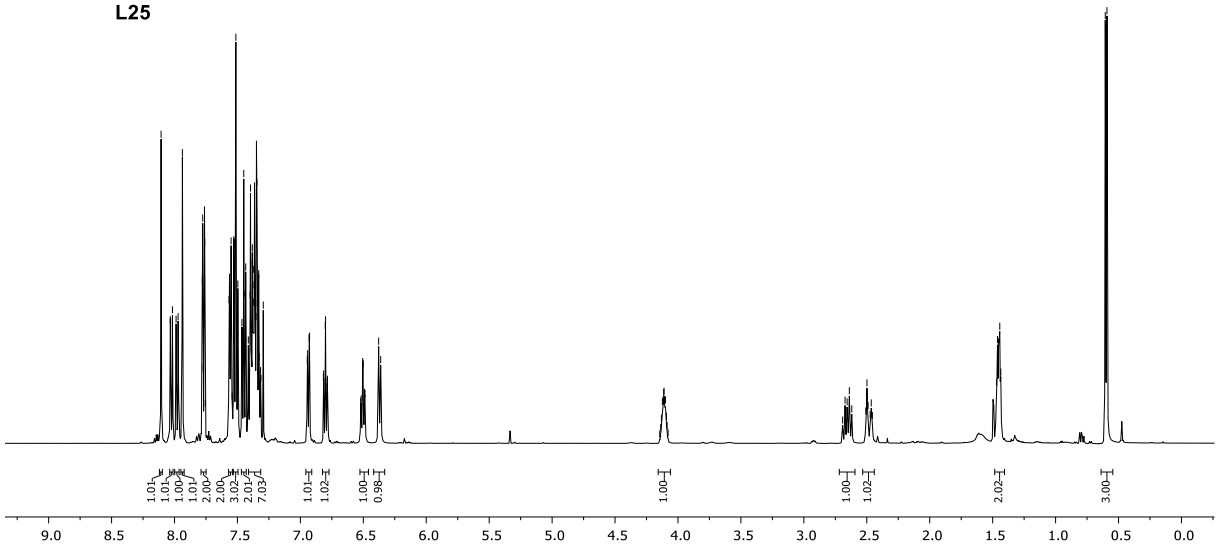
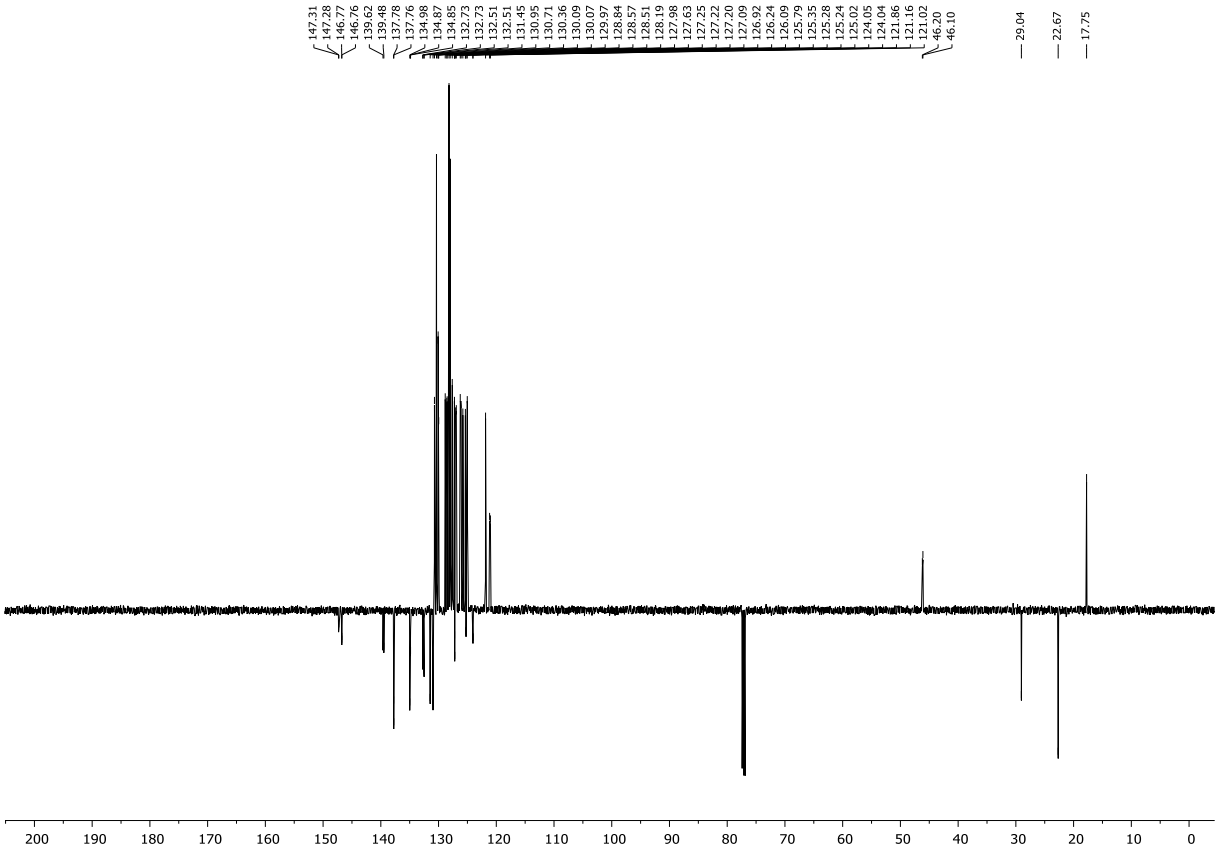


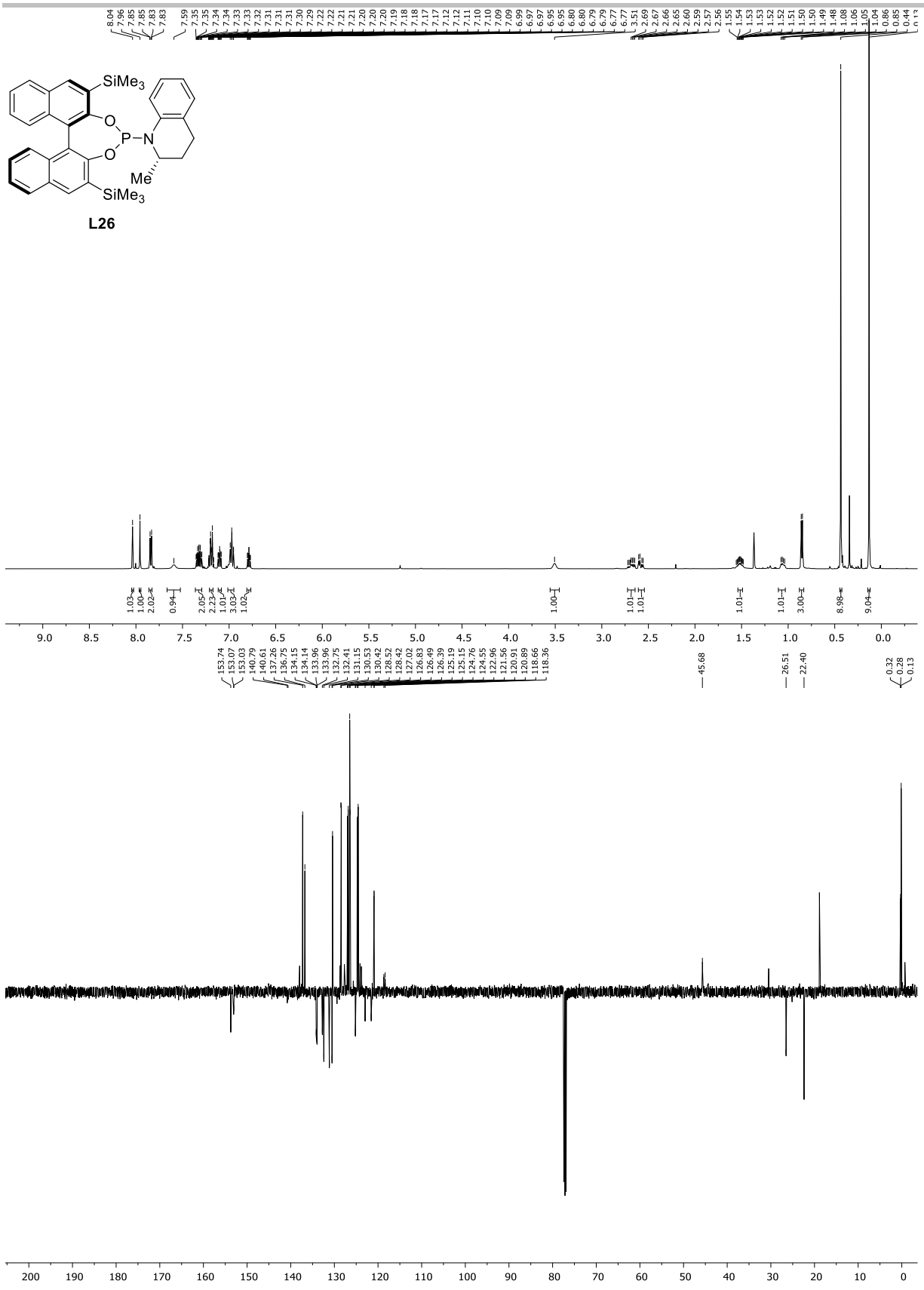




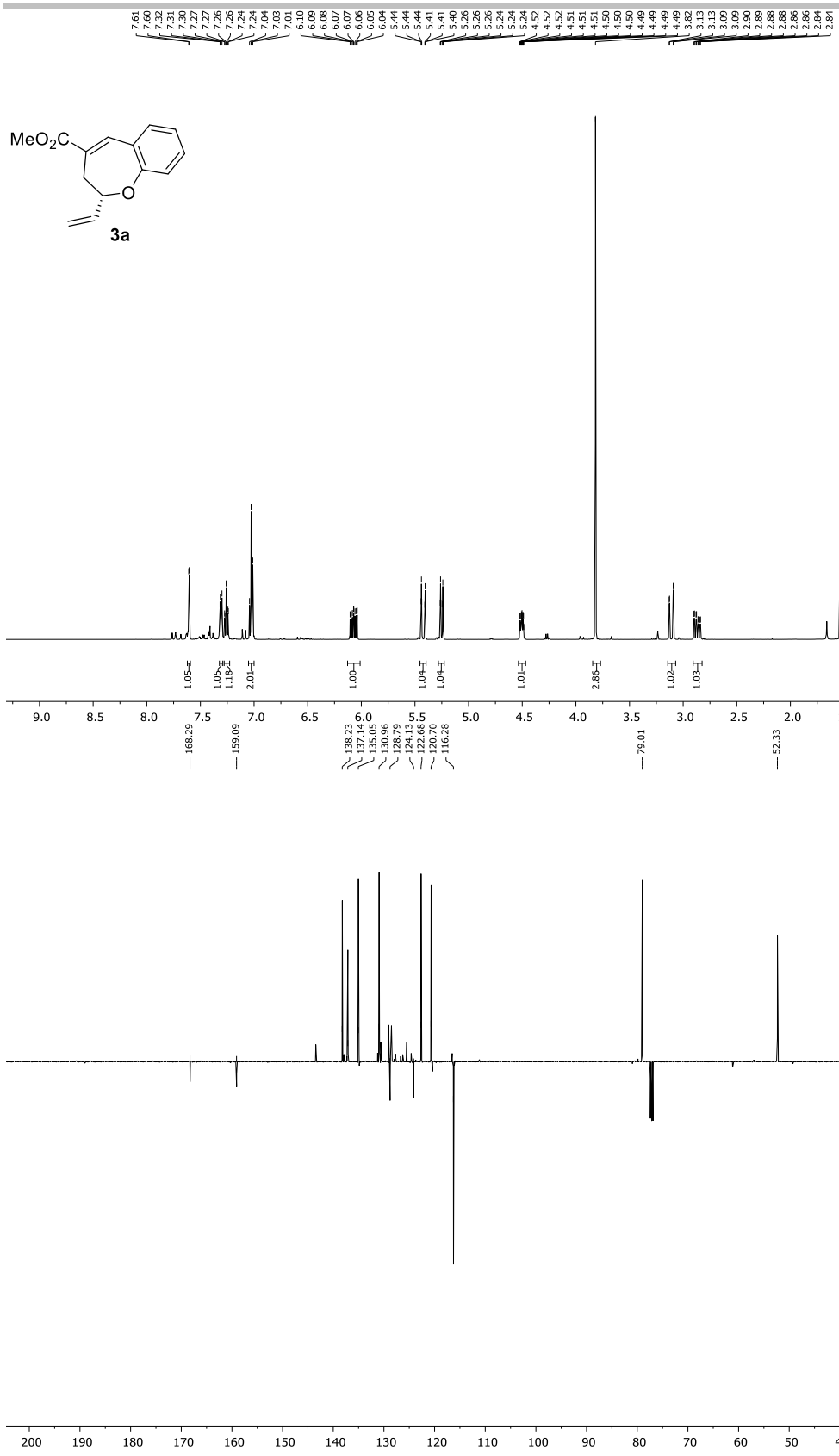
L25







L26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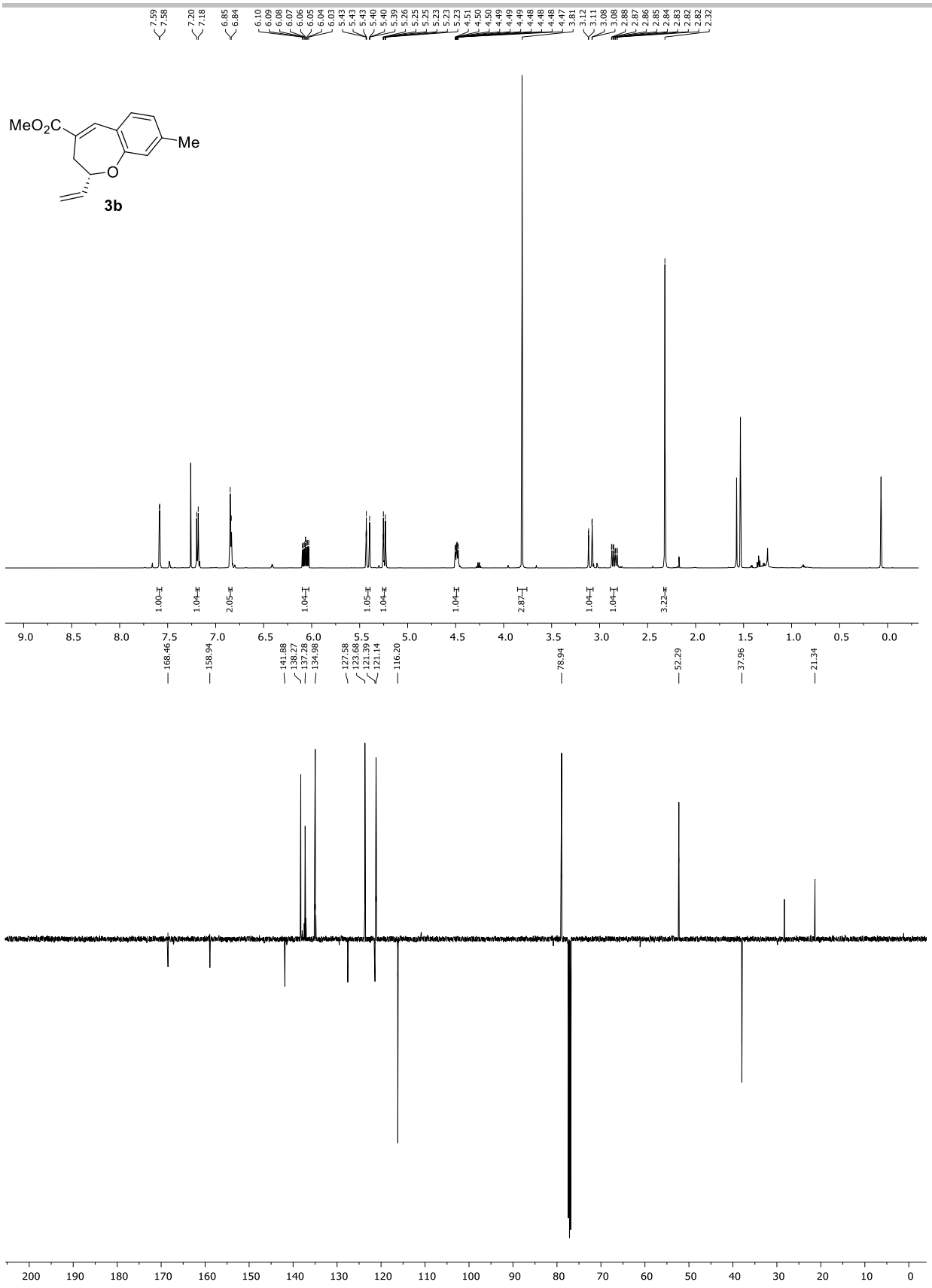
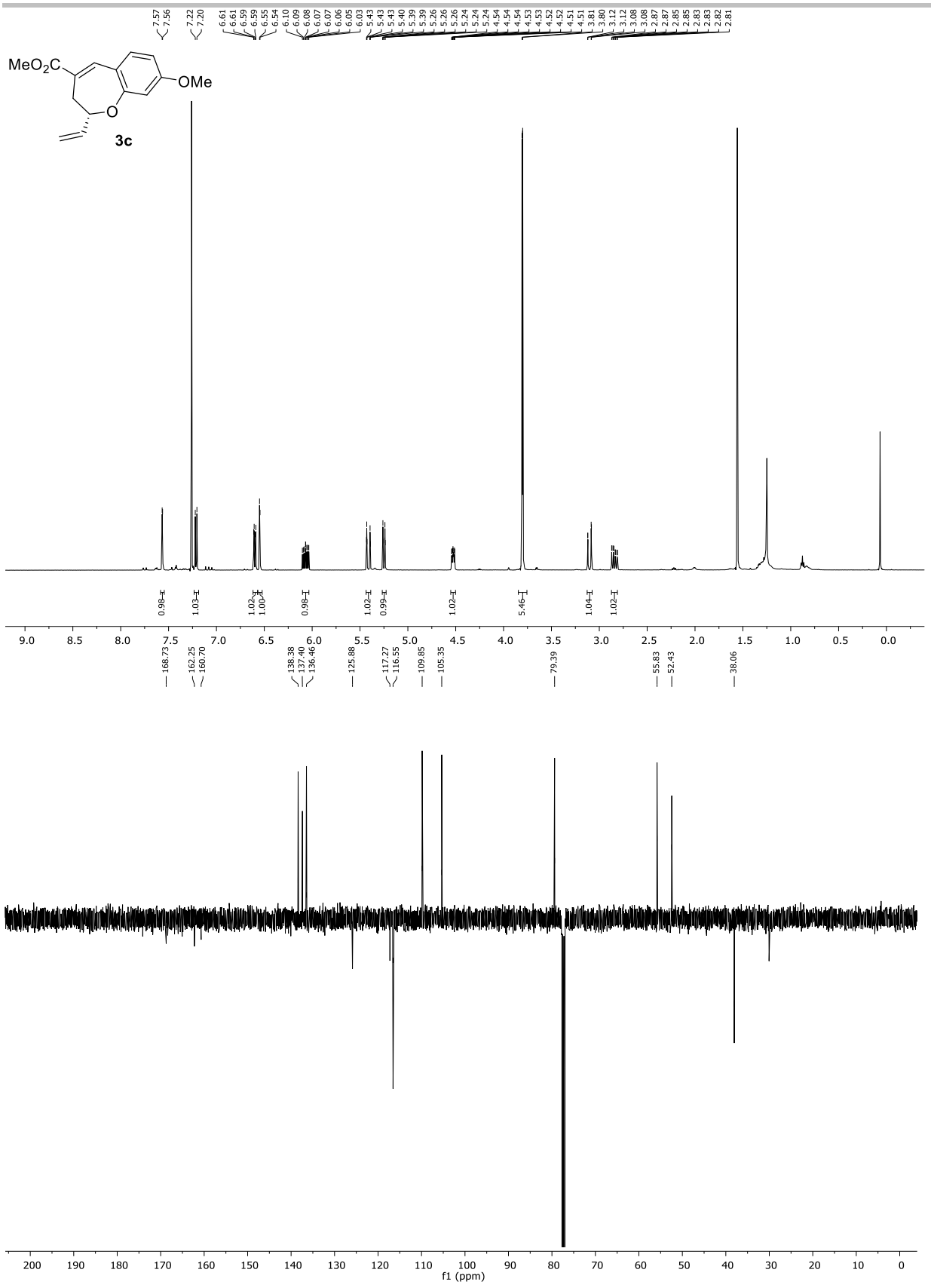
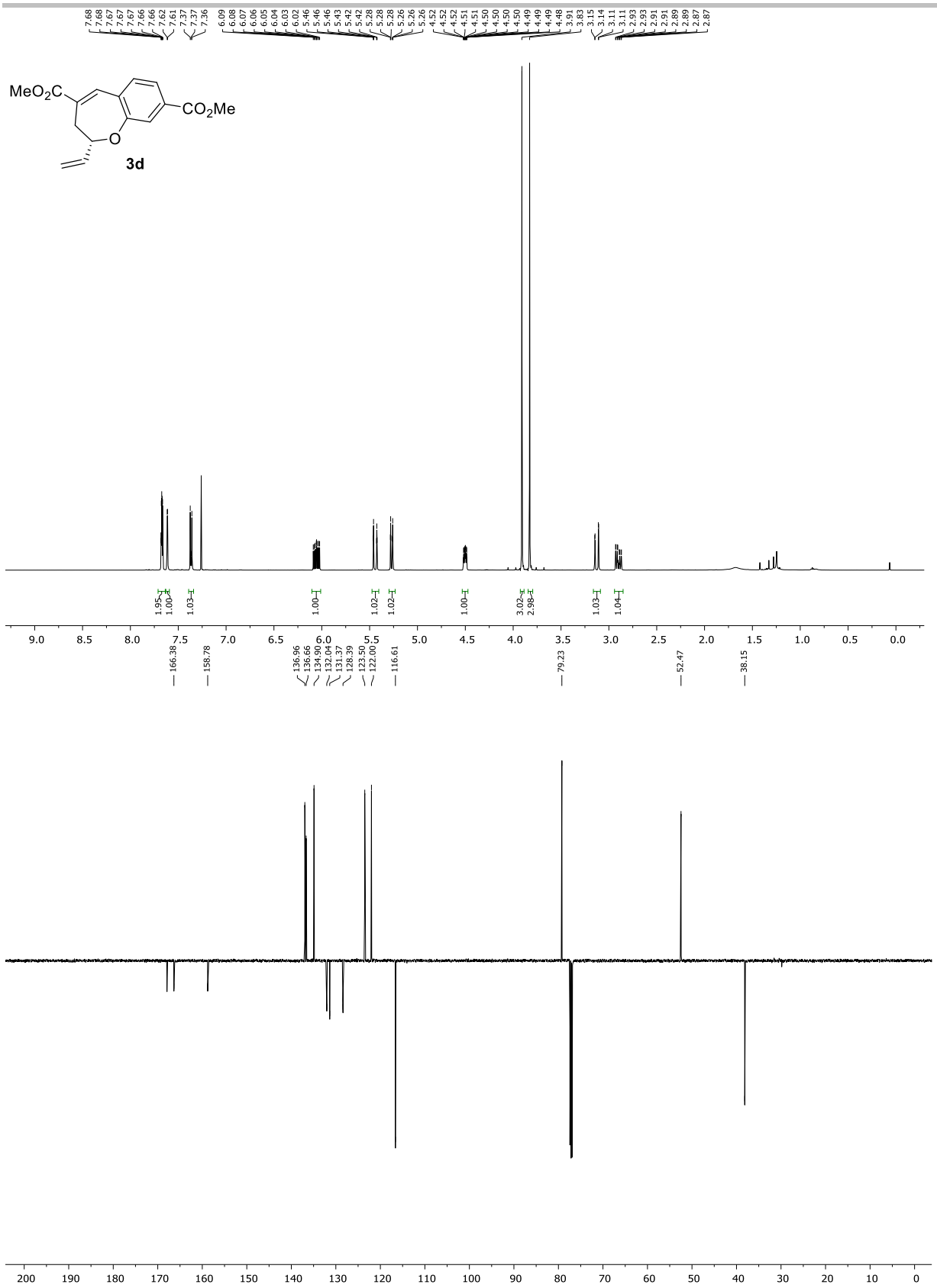
O
3a


MeO2C
Me
O
3b


MeO2C
OMe
O
3c
f1 (ppm)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O
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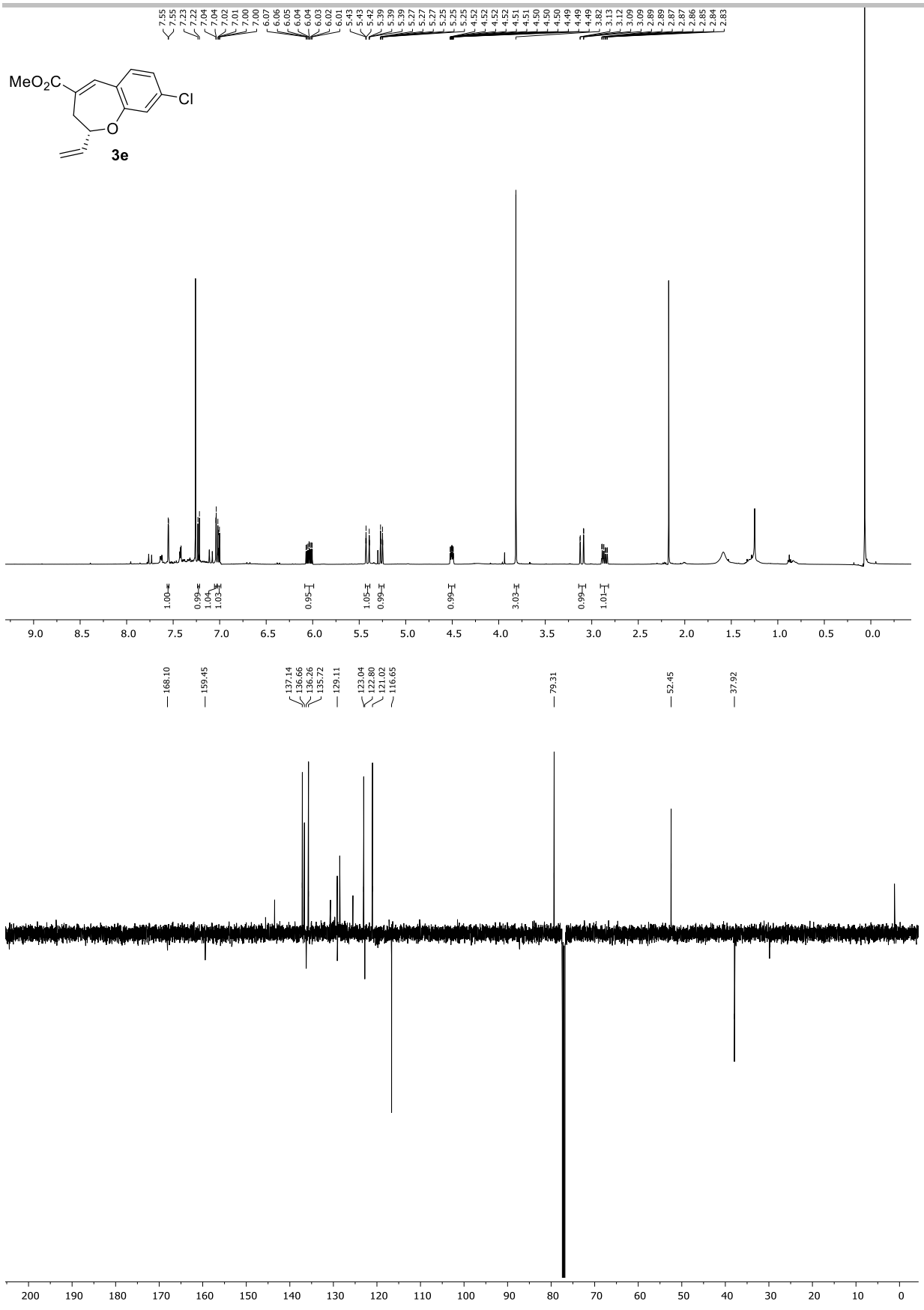
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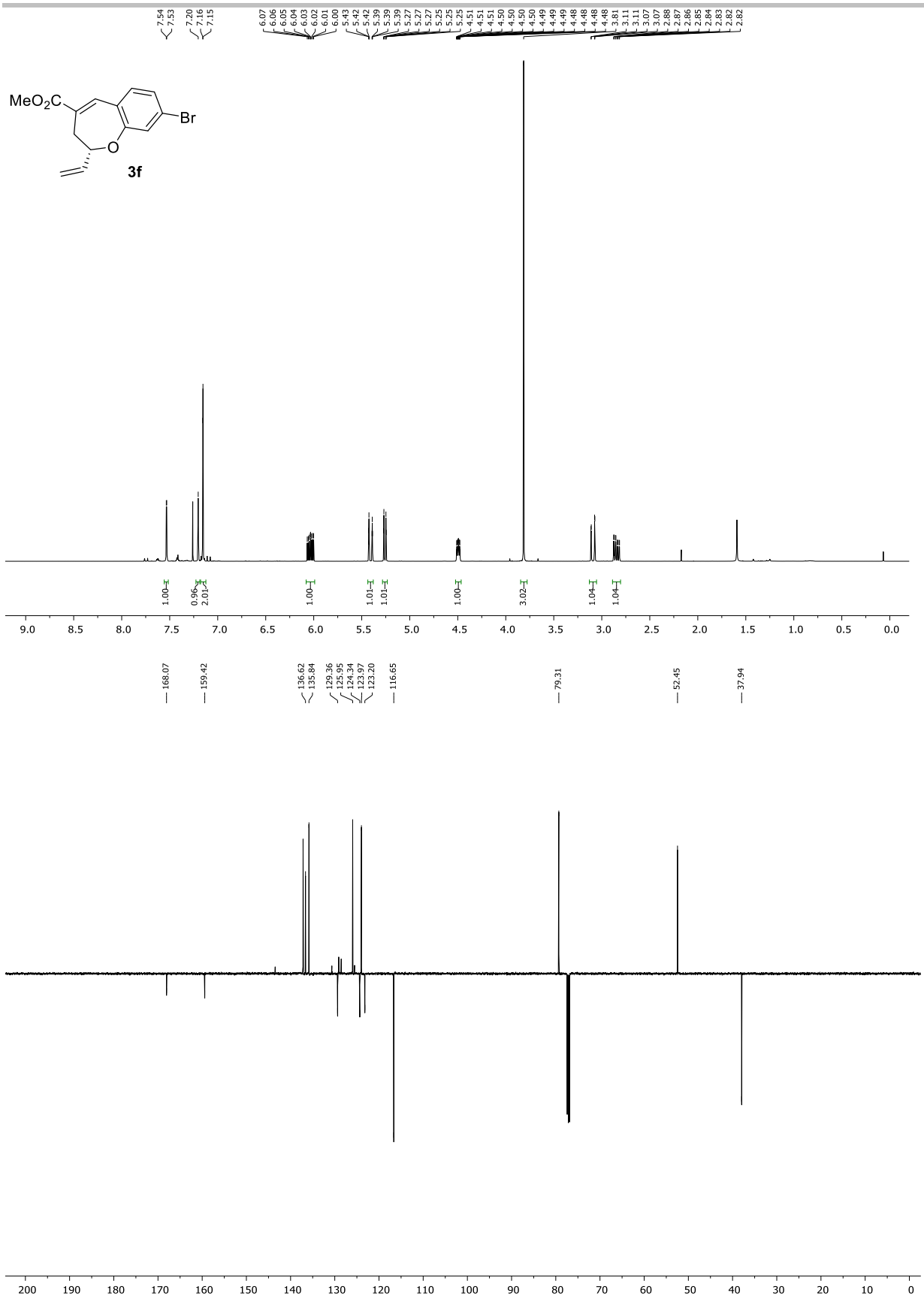
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O
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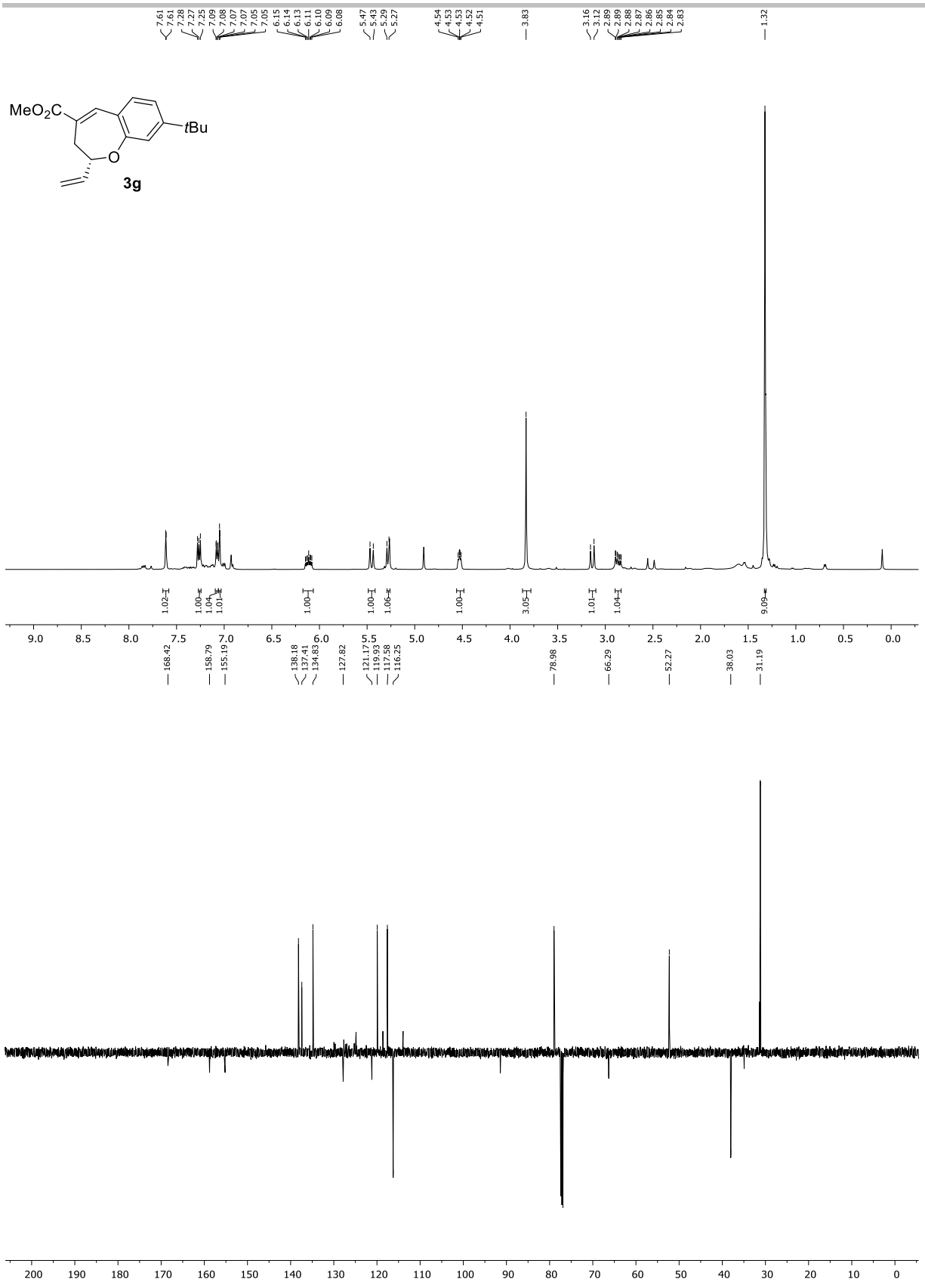
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1.32
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O
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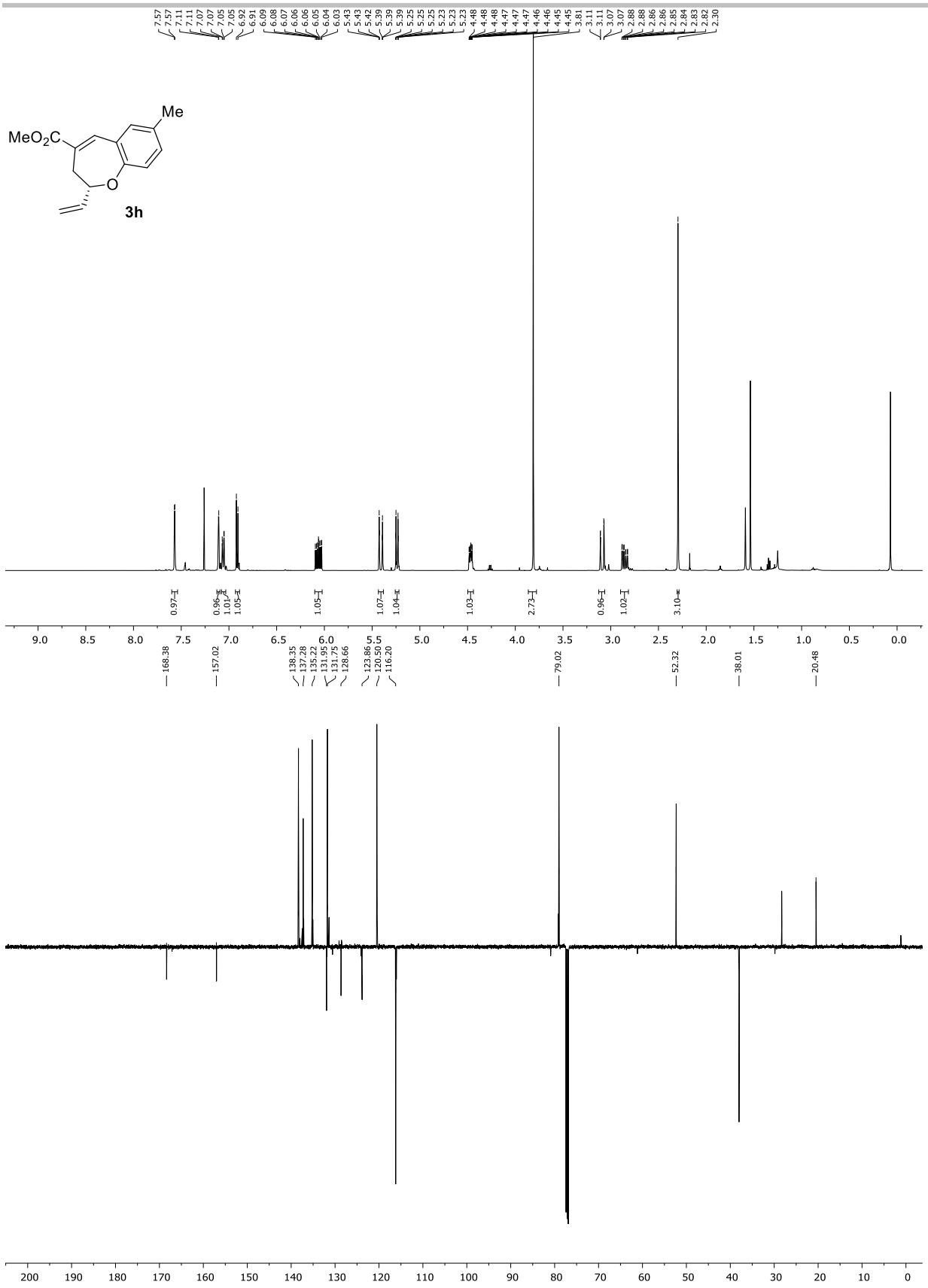
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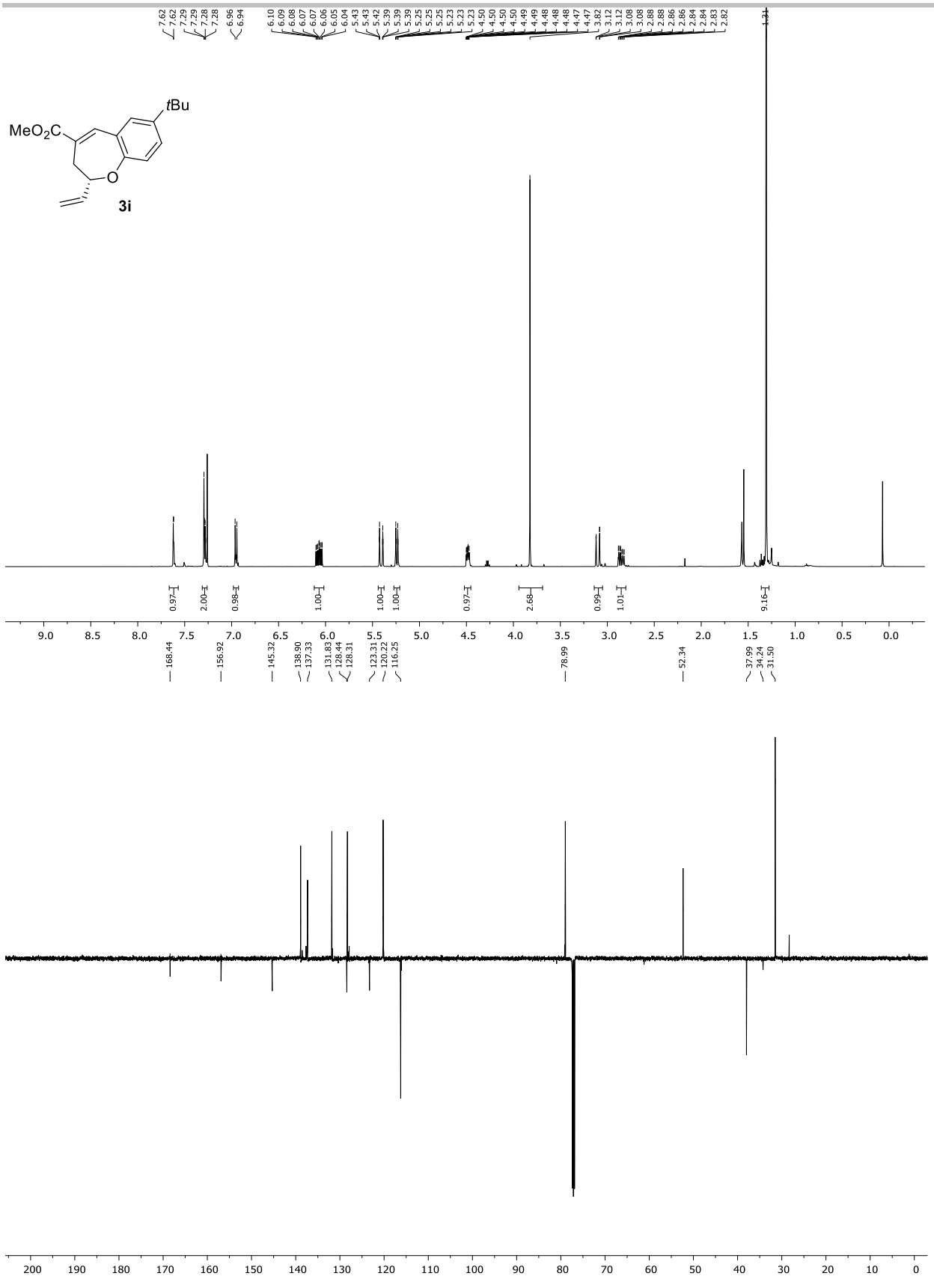
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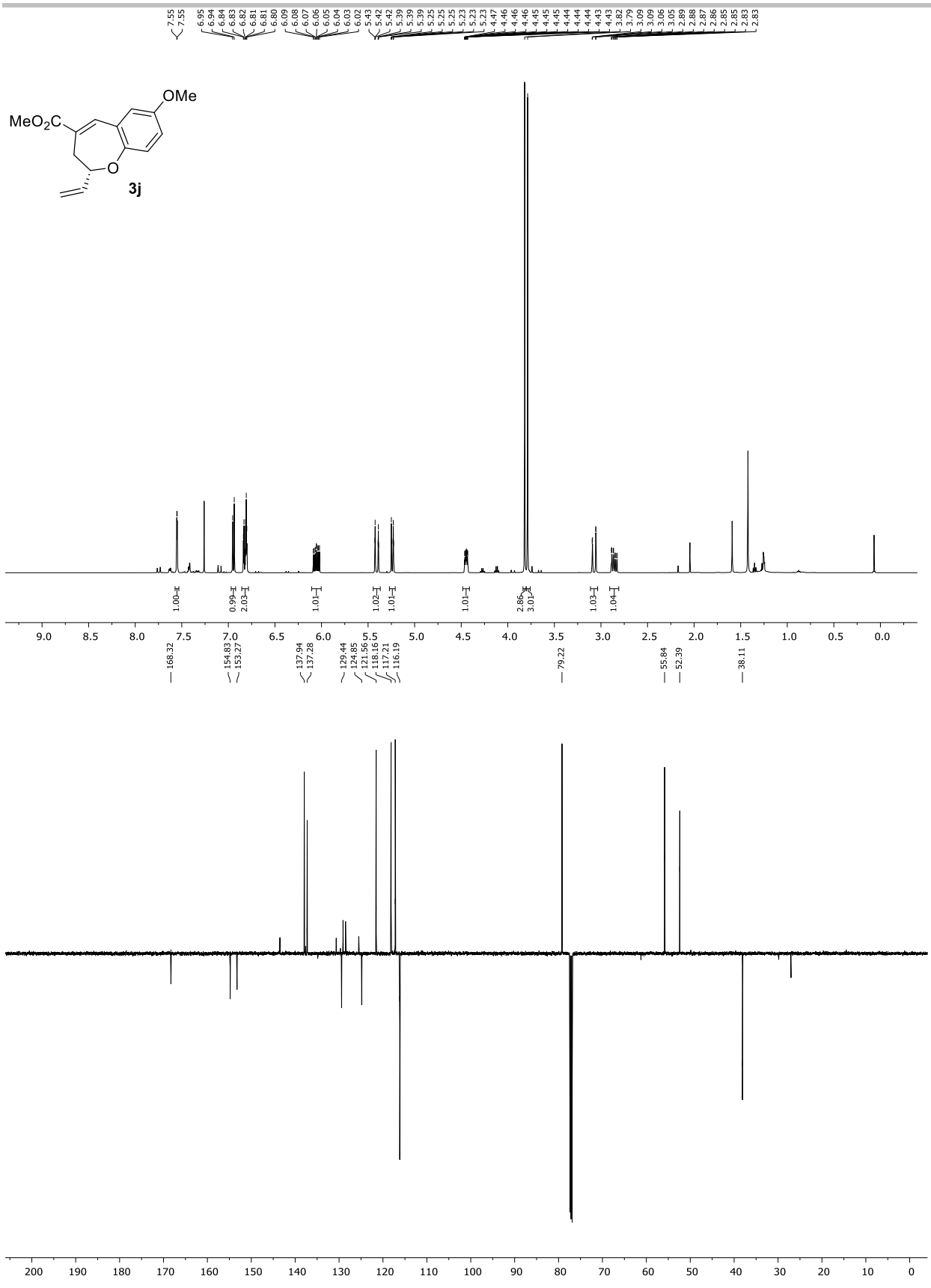
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OMe
MeO2C
O
3j
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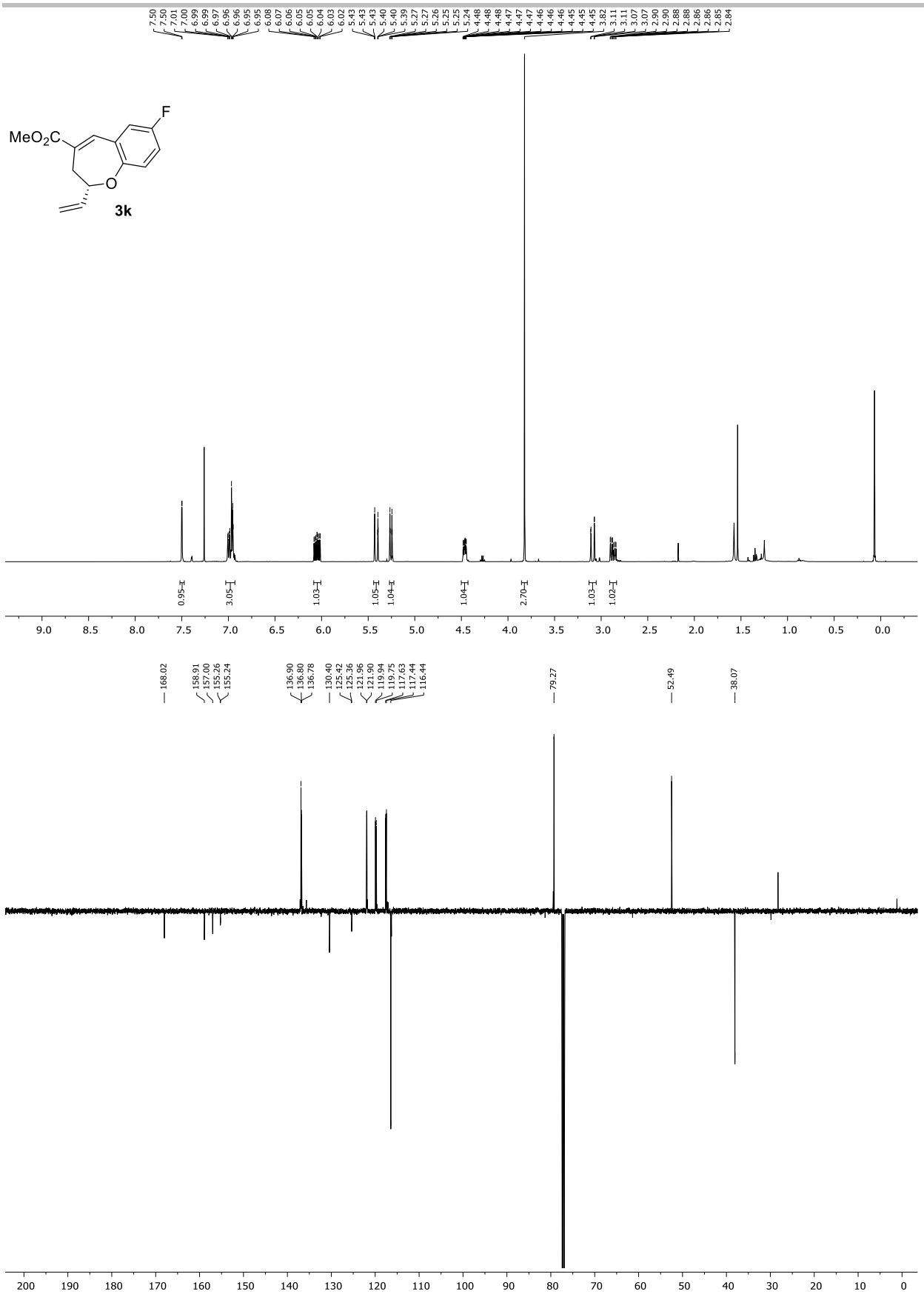
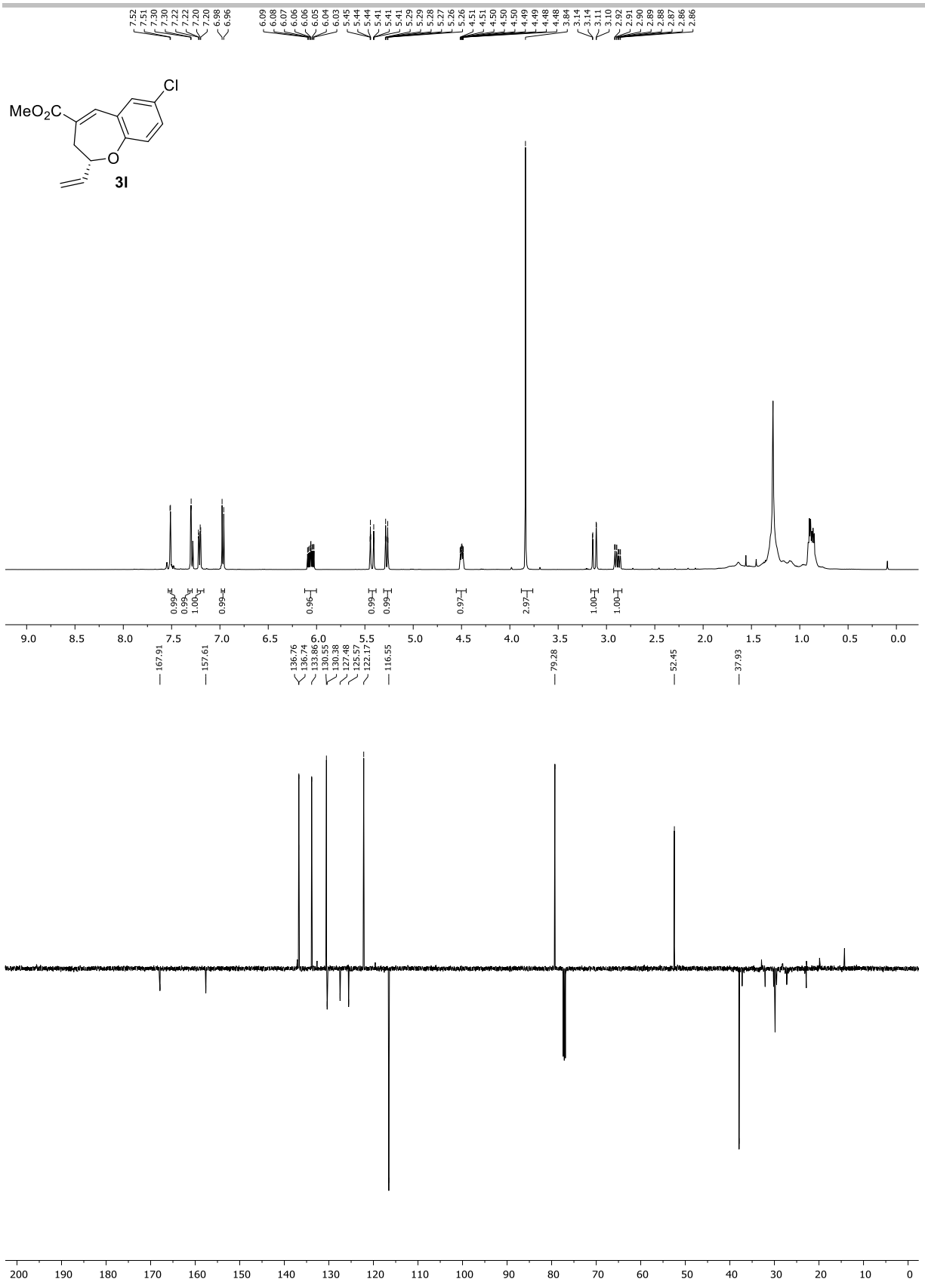
SUPPORTING INFORMATION

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Cl
MeO2C
O
3l
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0.99
1.00
0.99
0.96
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0.99
0.97
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1.00
1.00
9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
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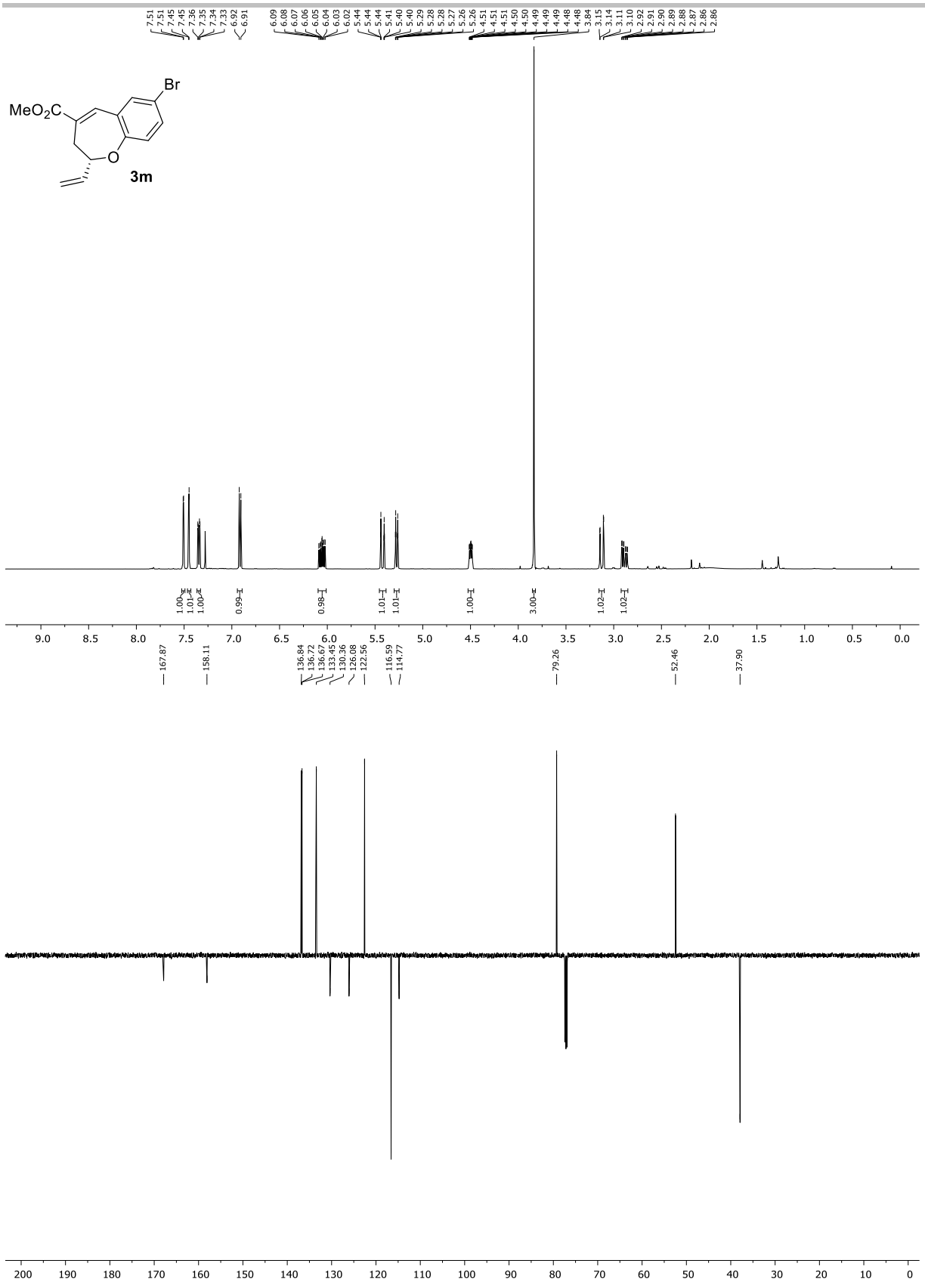
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O
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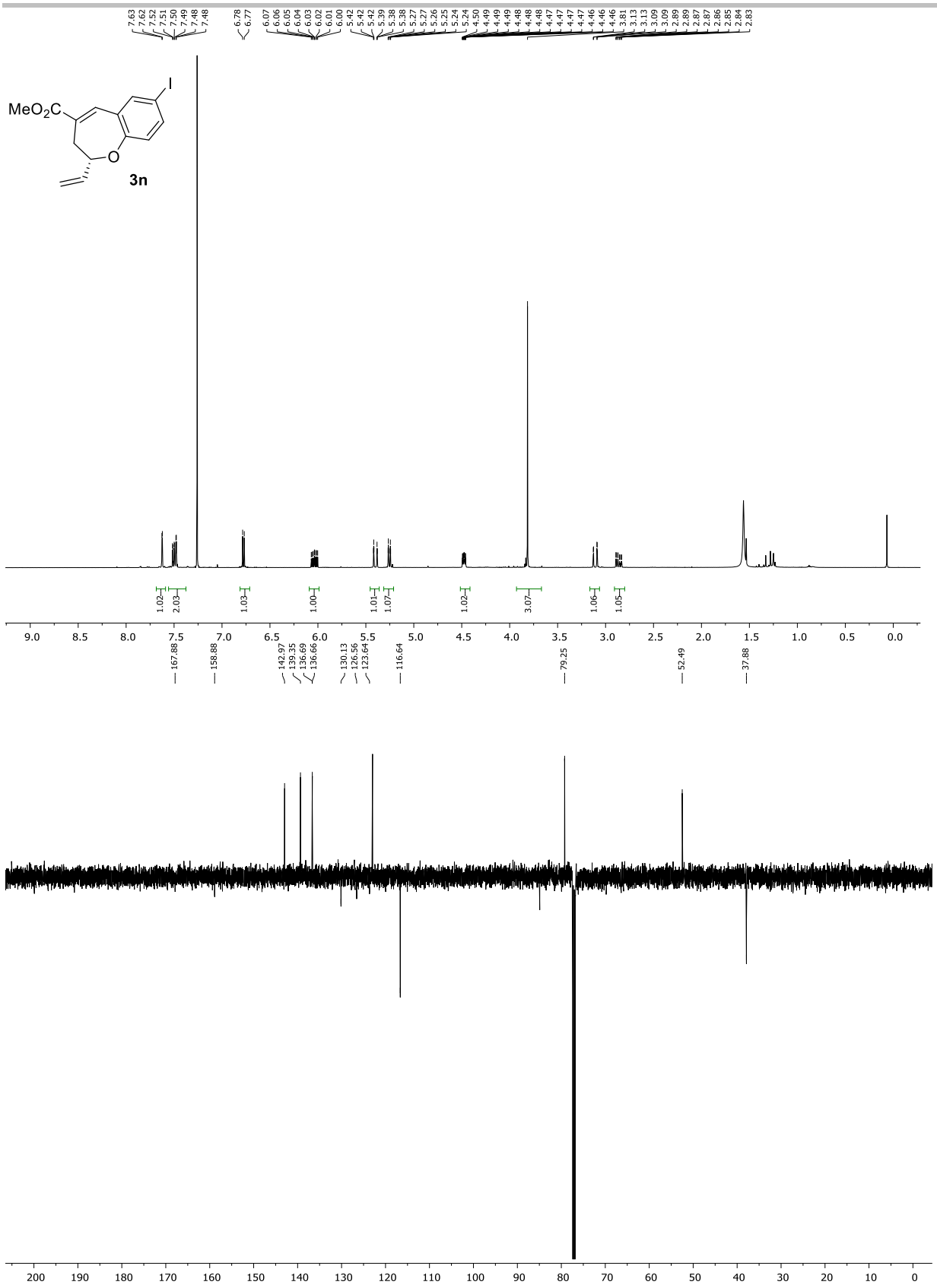
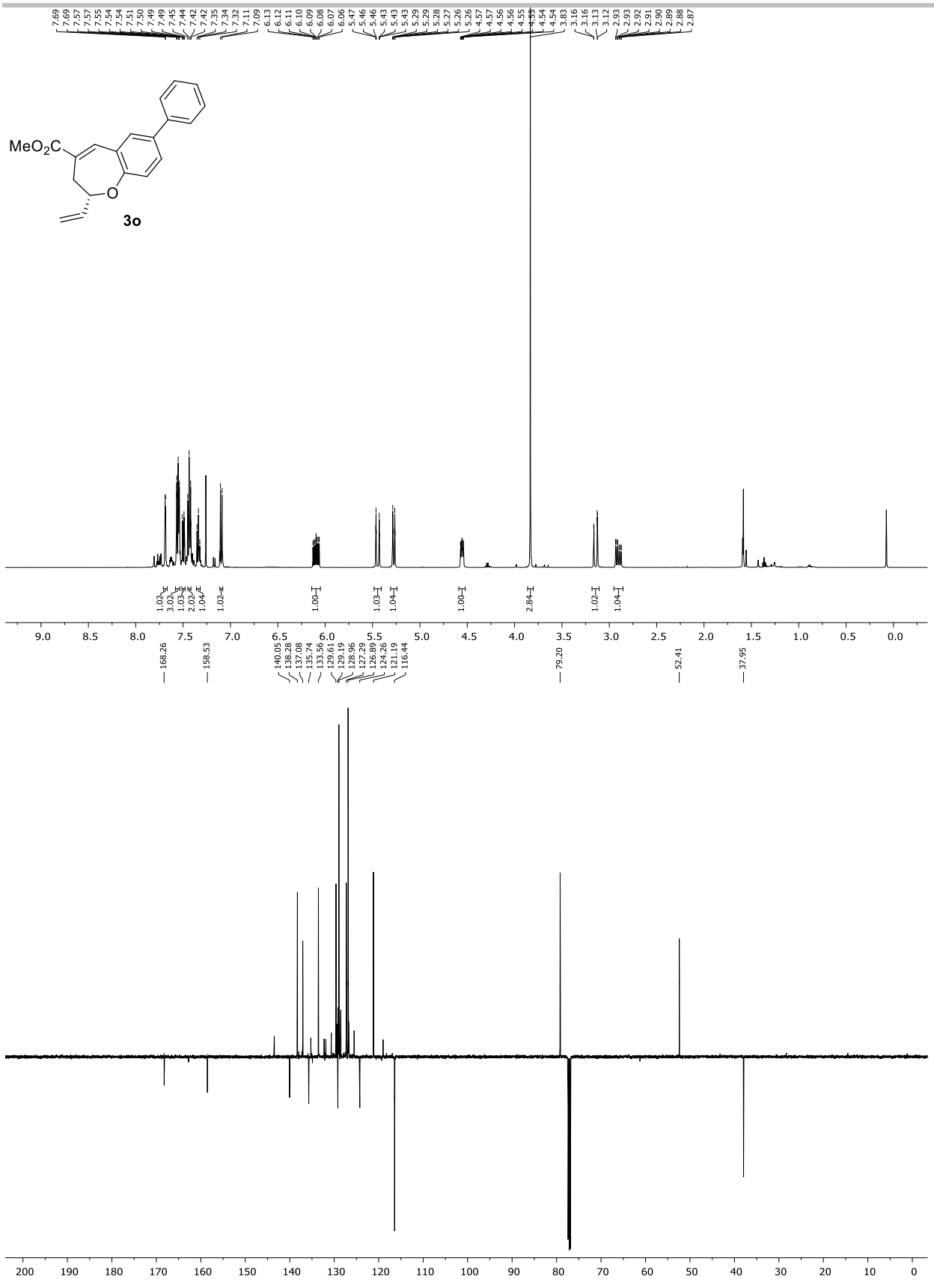
SUPPORTING INFORMATION

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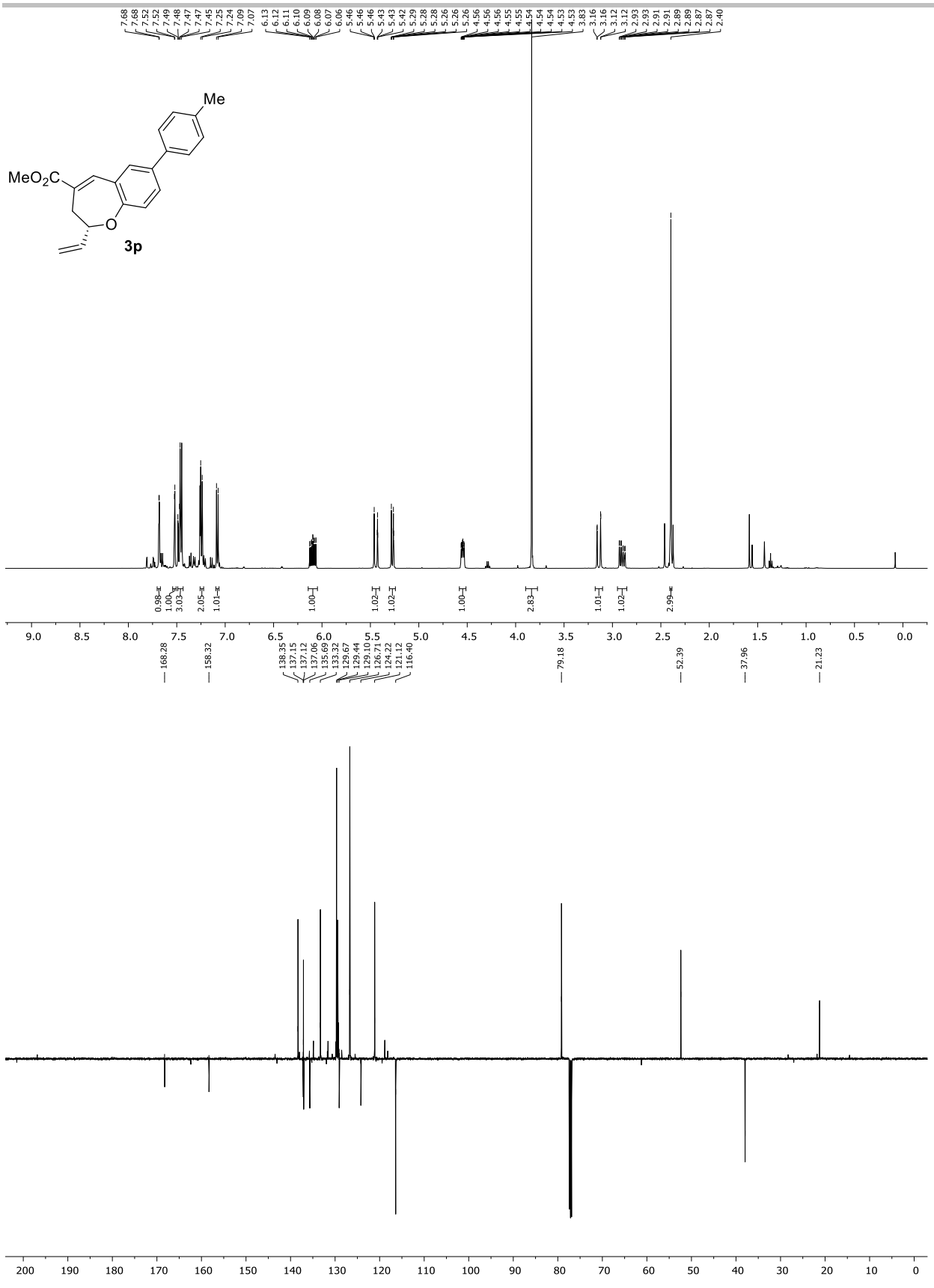
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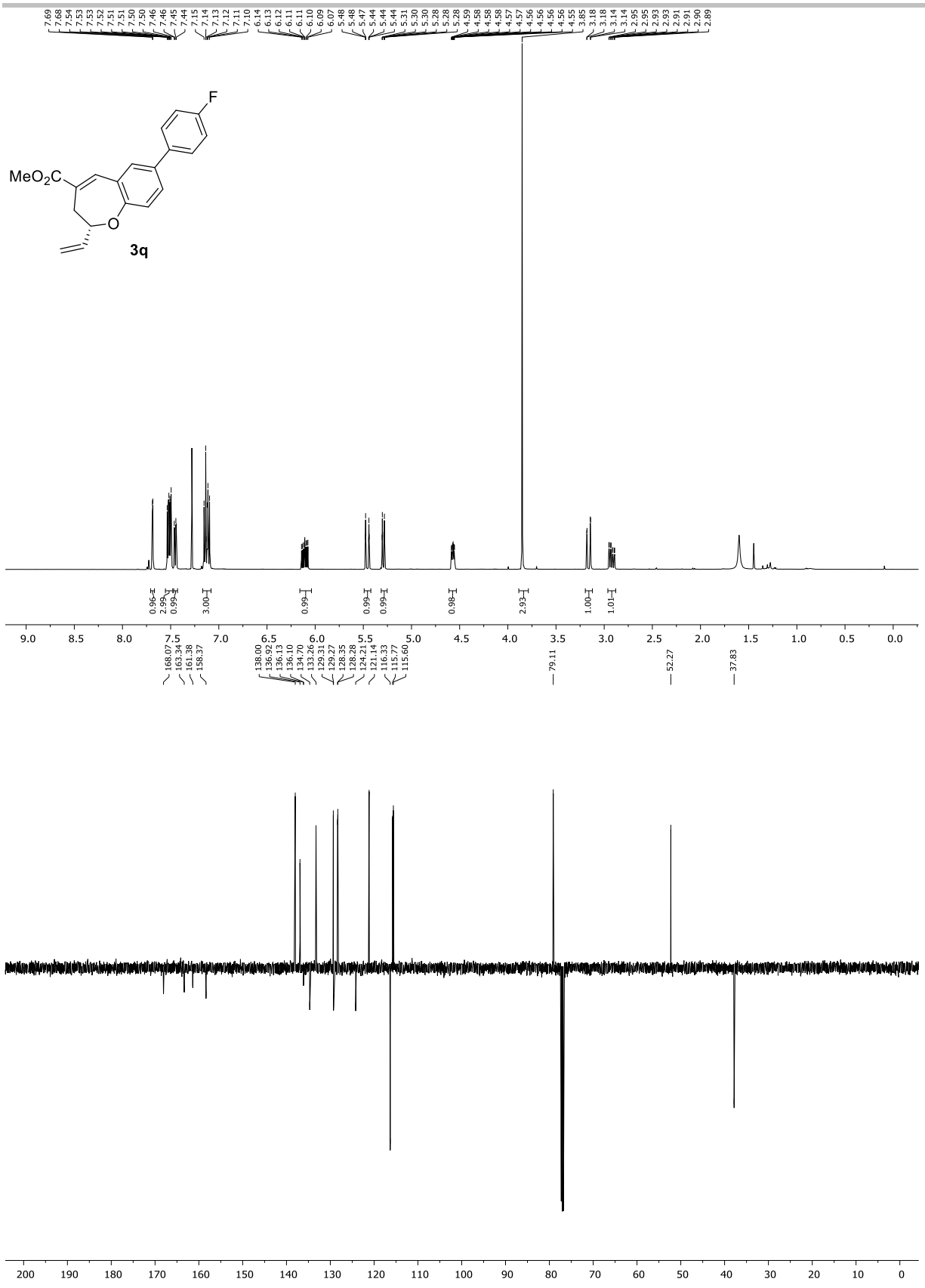
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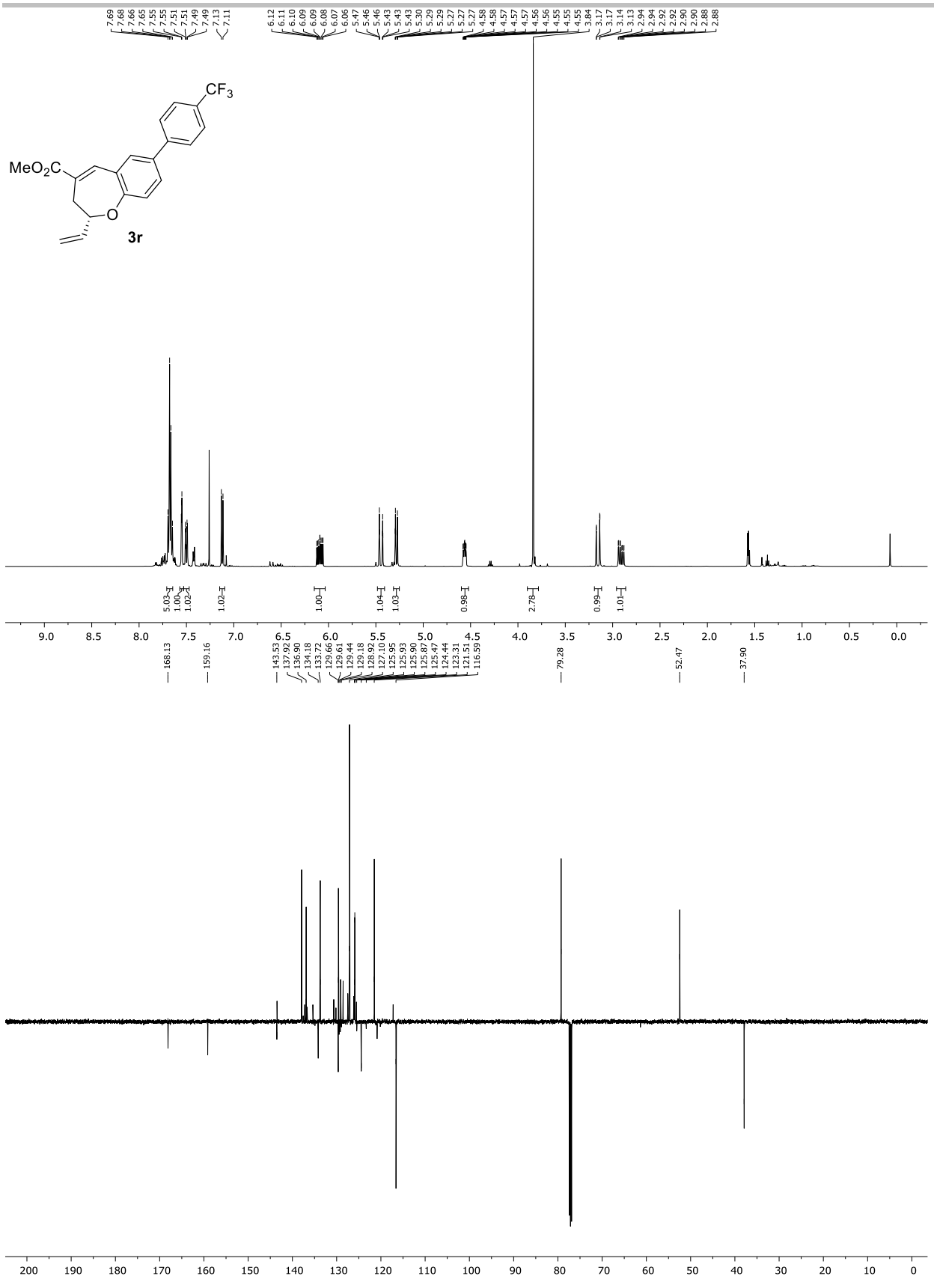
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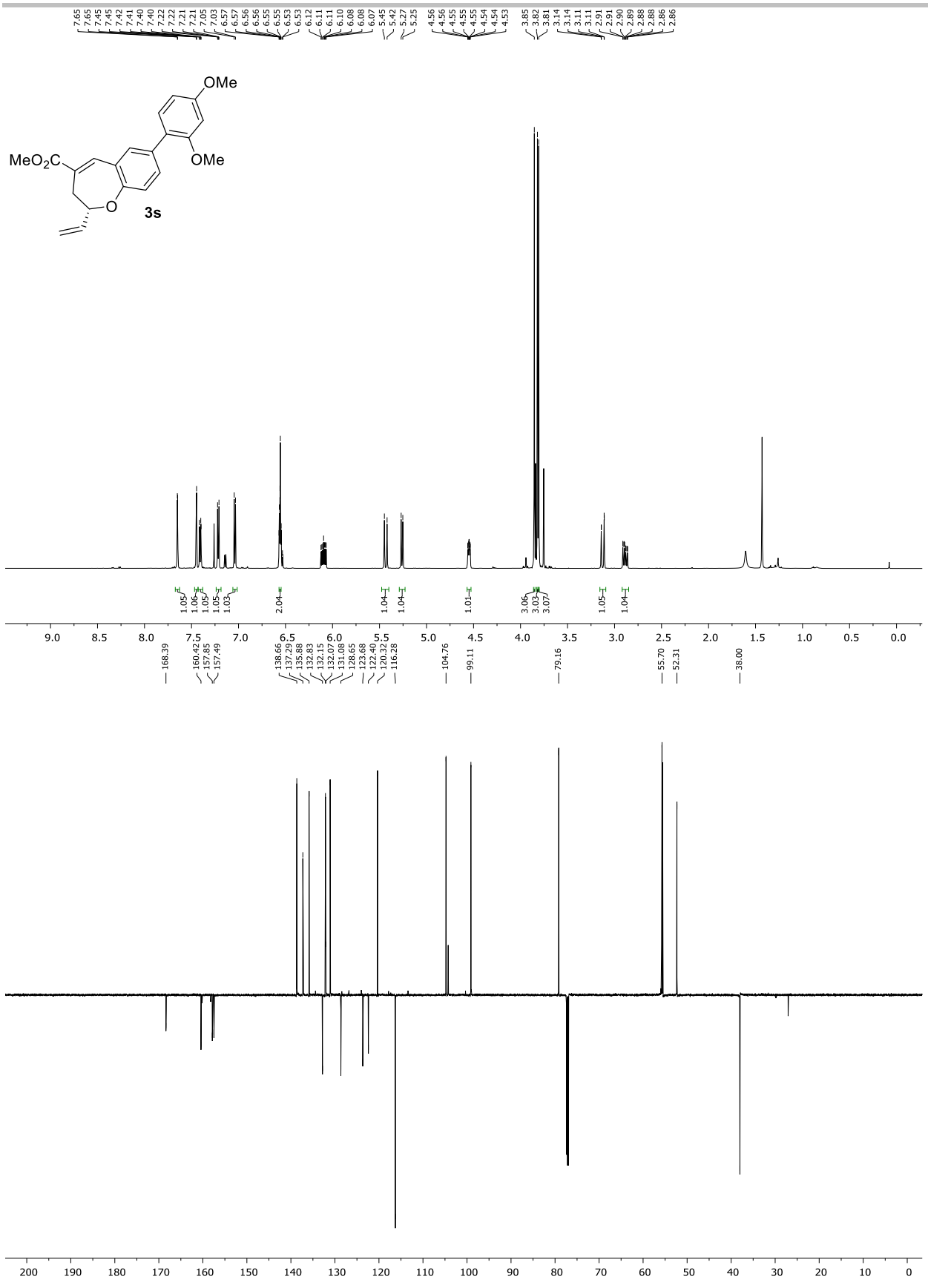
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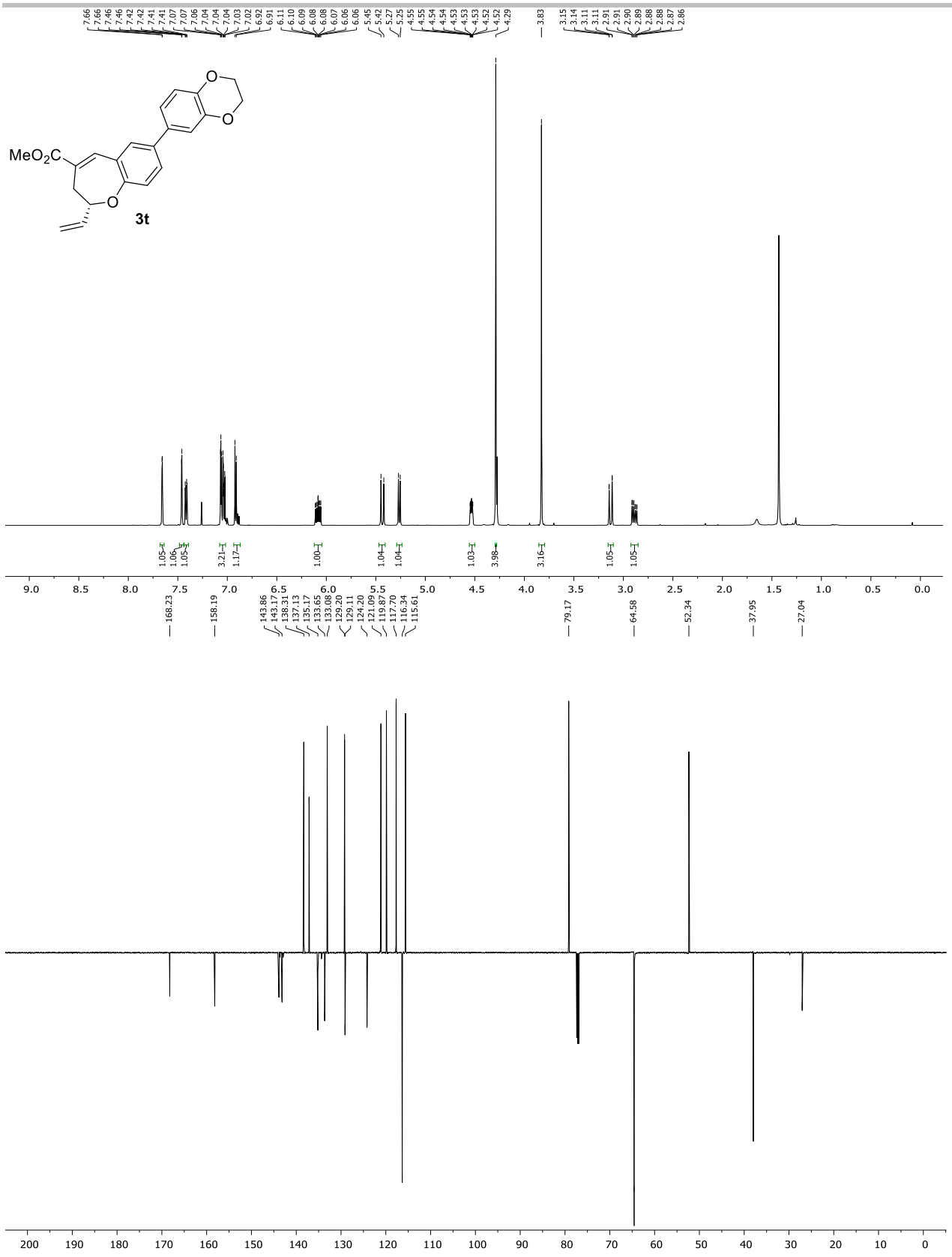
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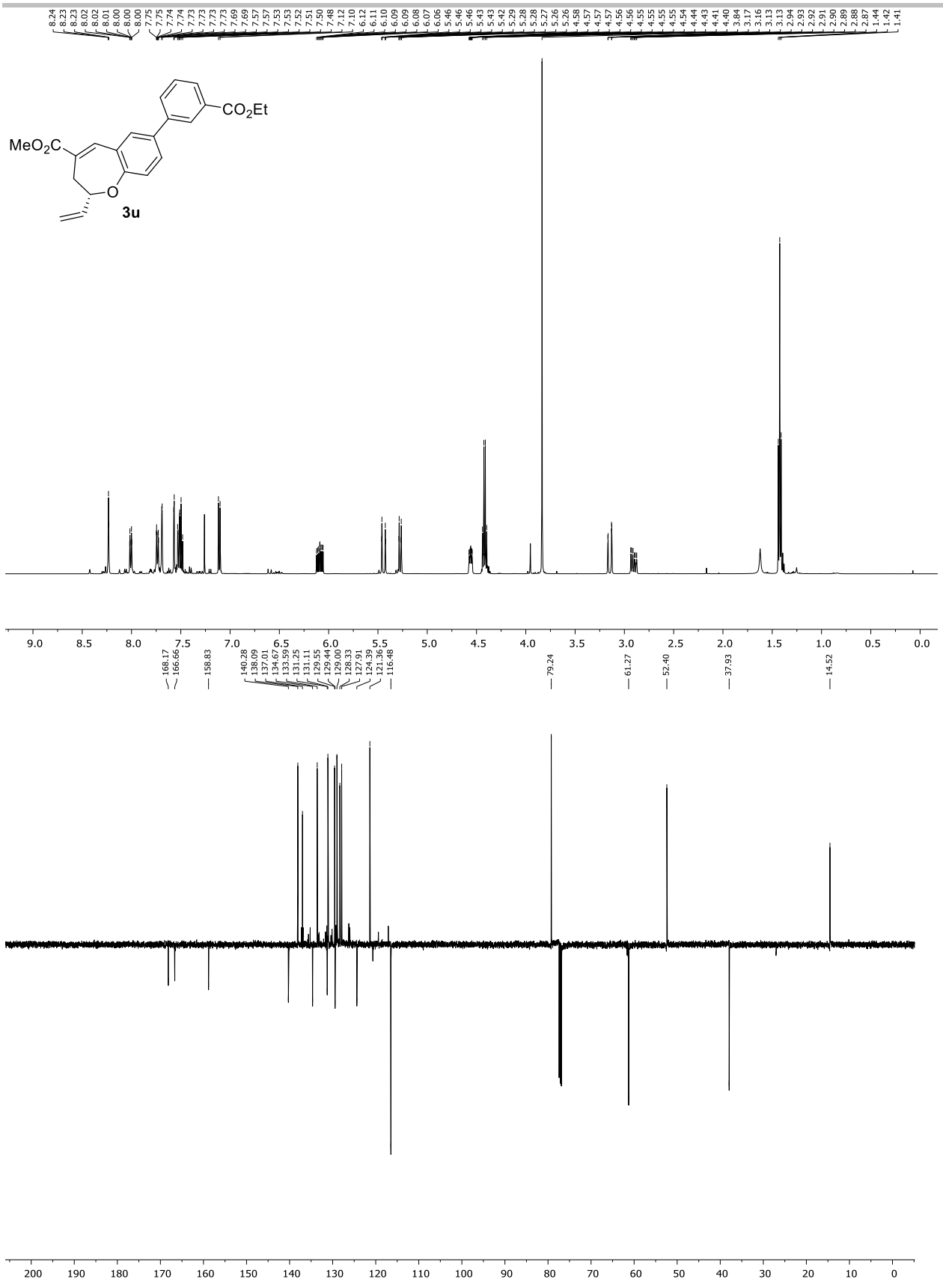
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CO2Et
MeO2C
O
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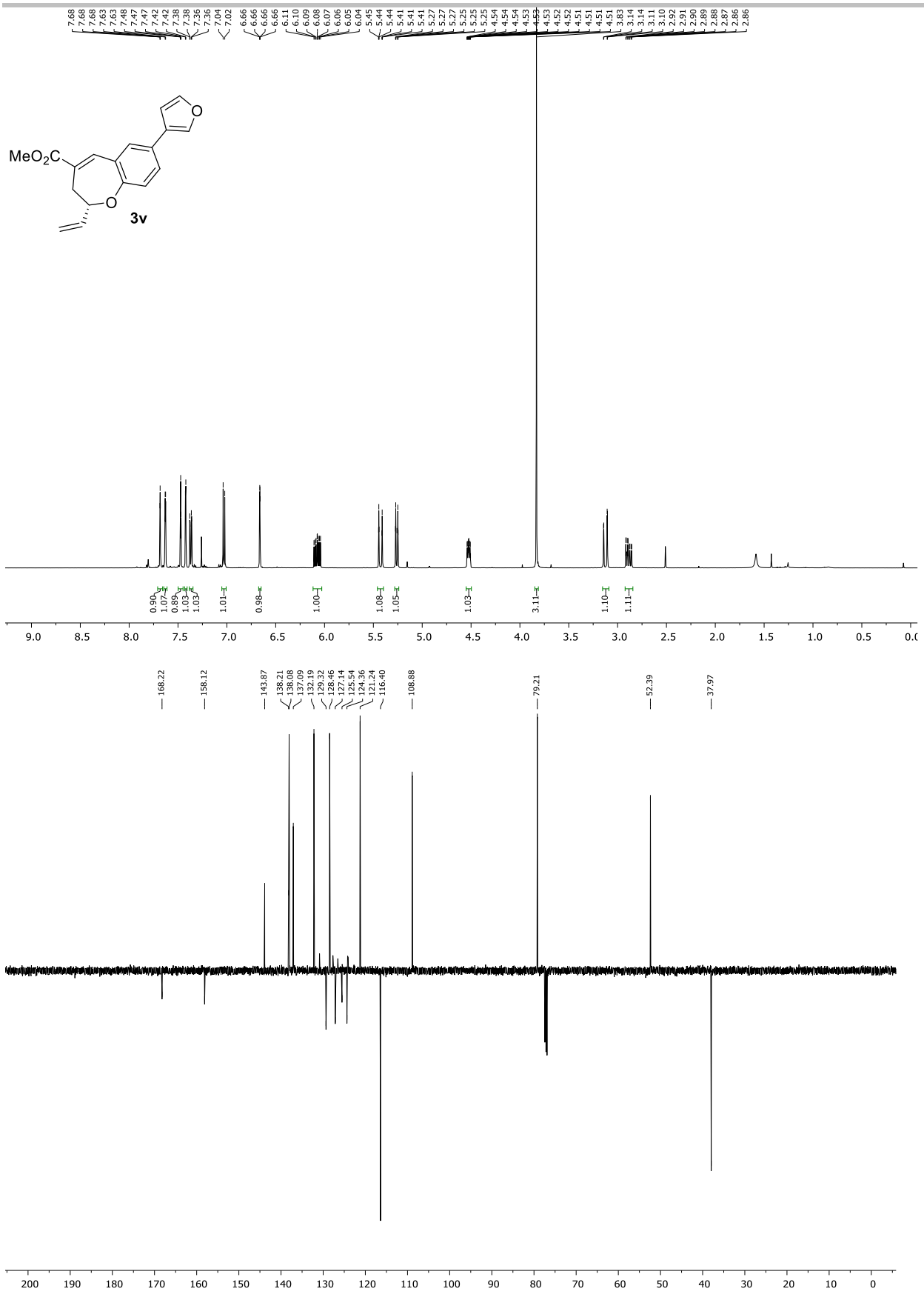
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O
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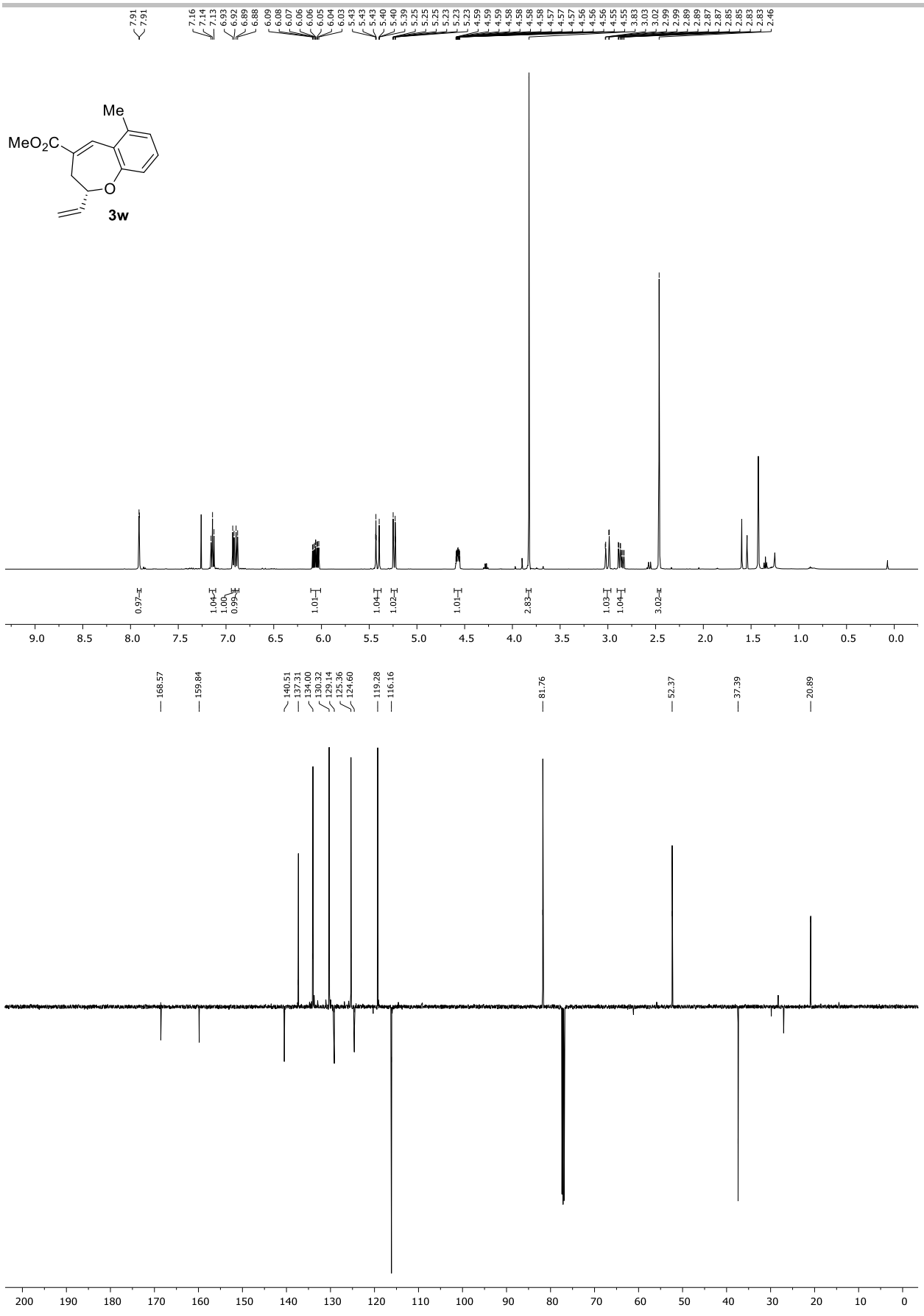
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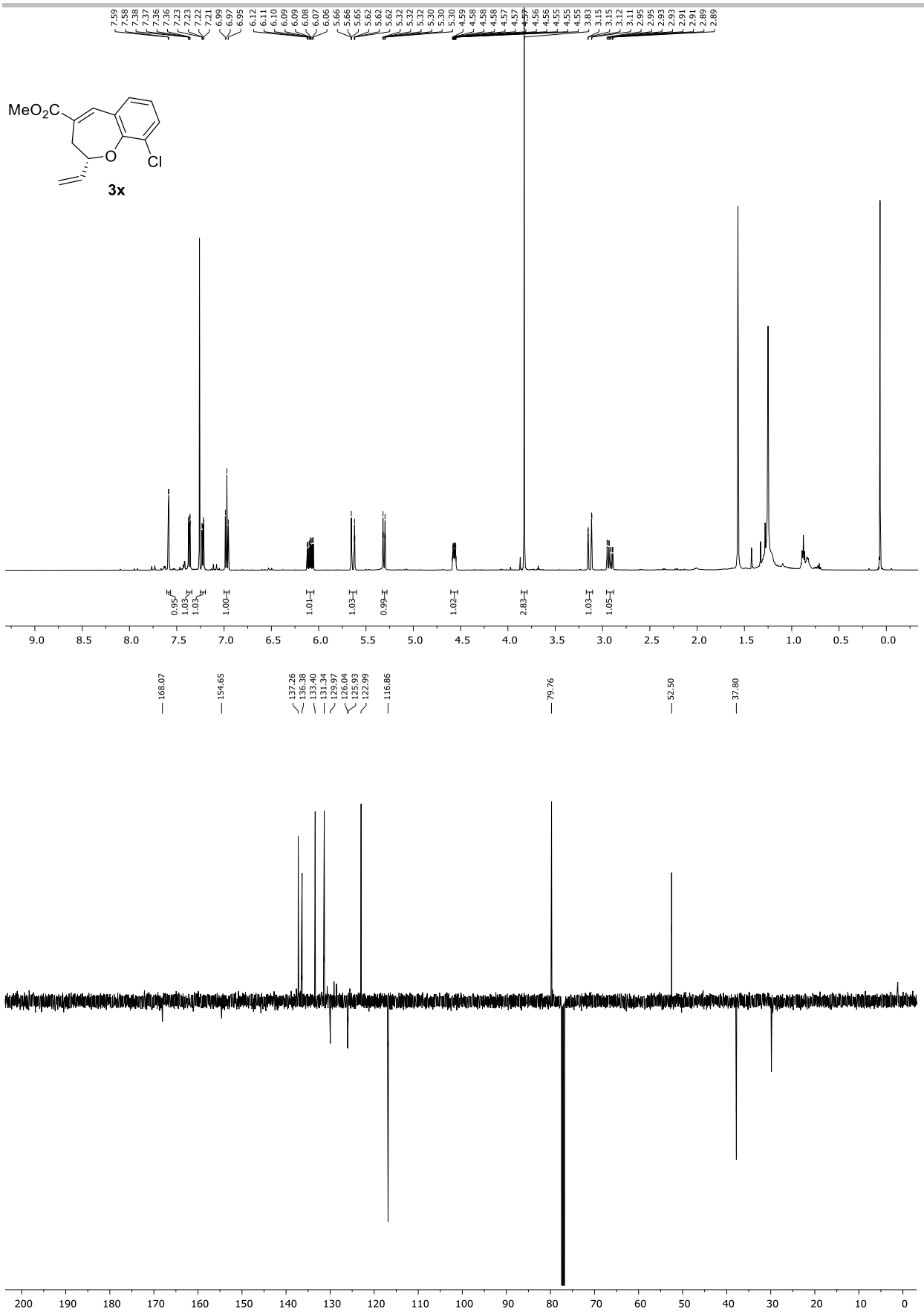
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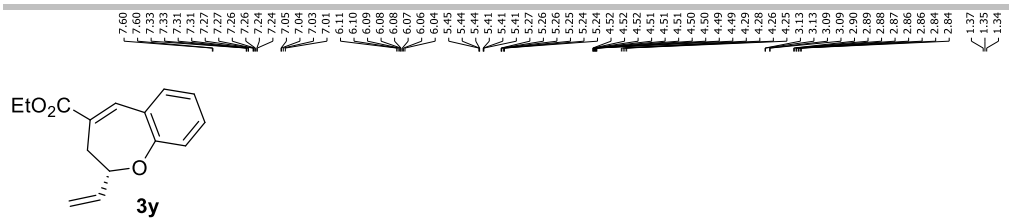
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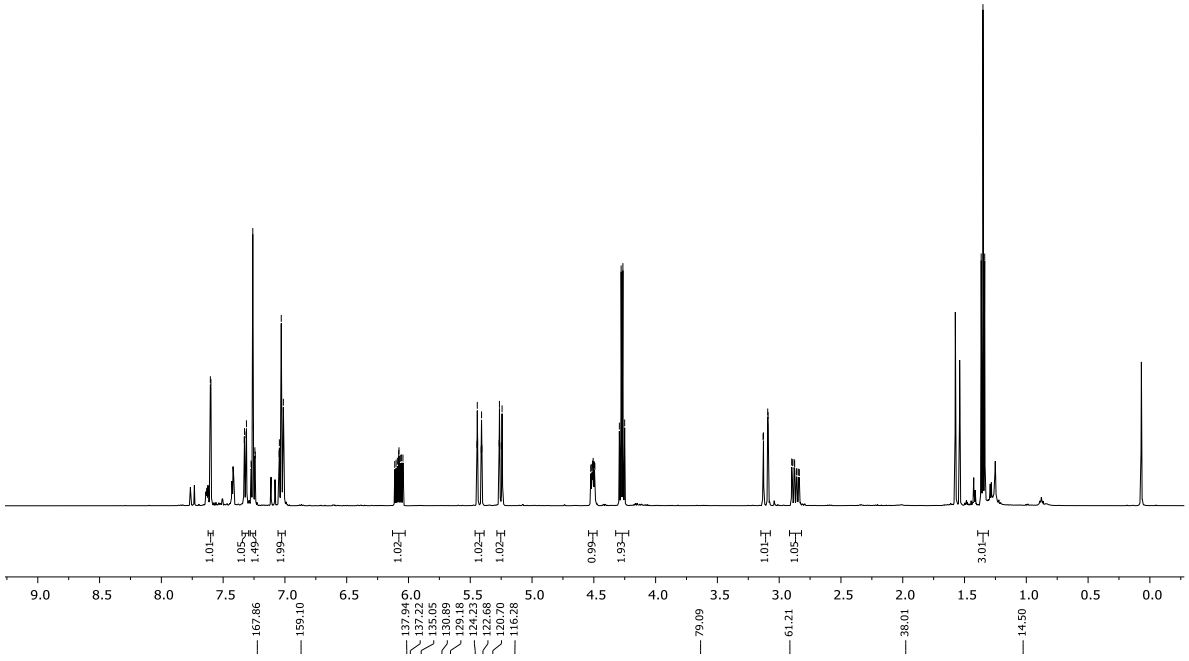
EtO2C
O

3y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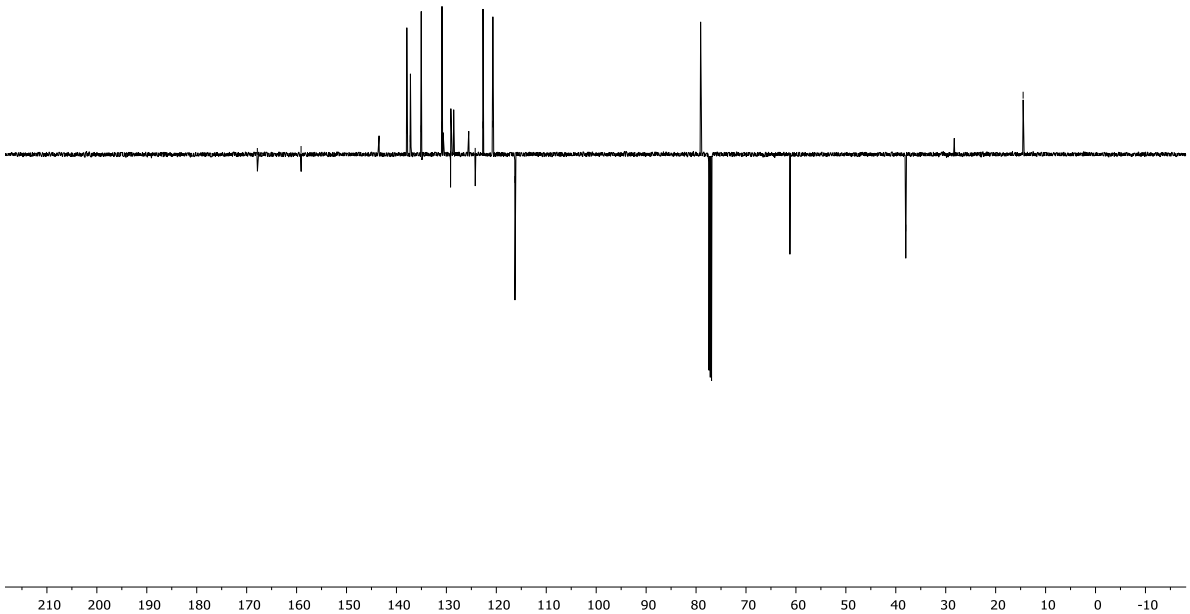
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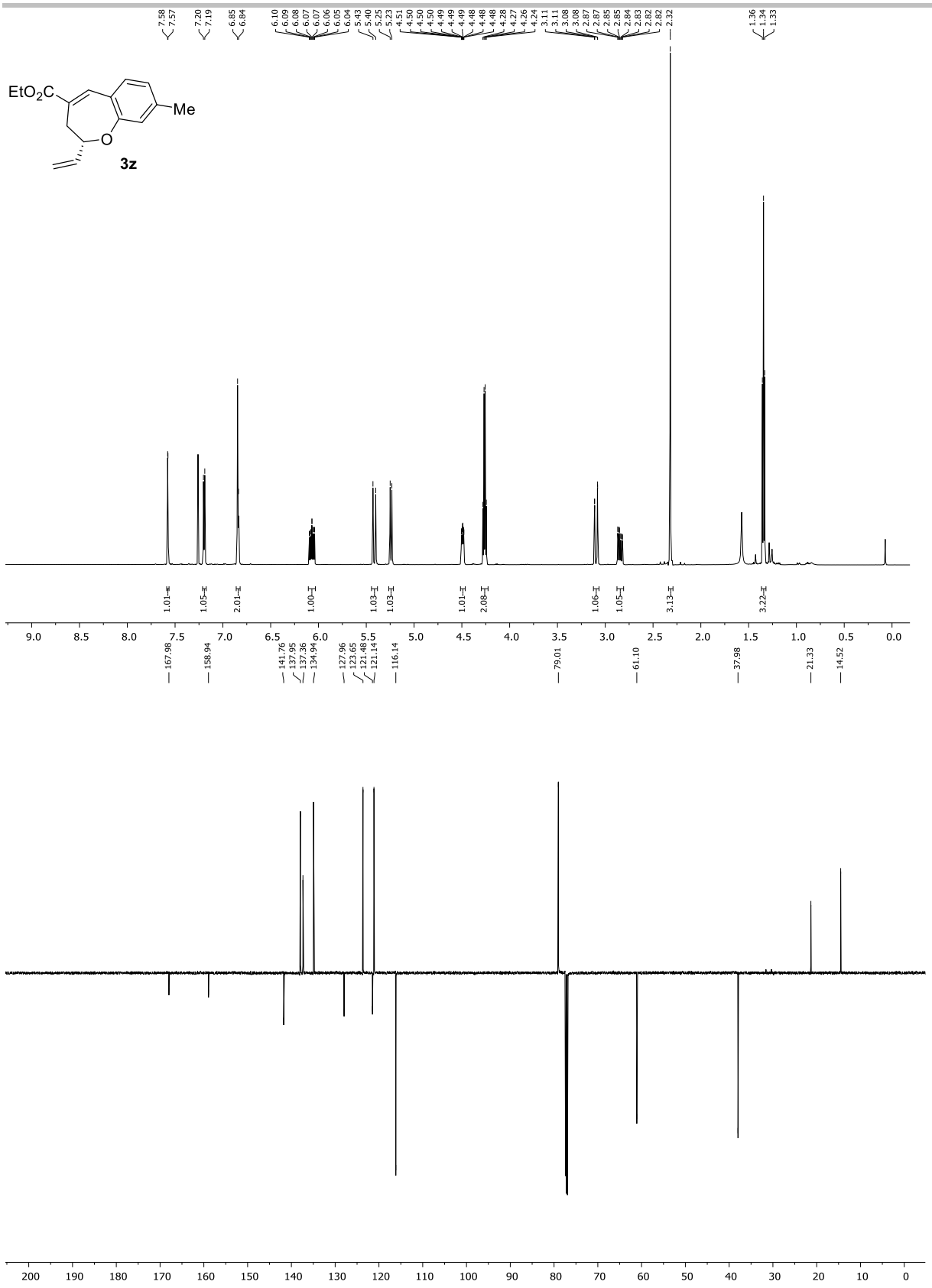
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Me
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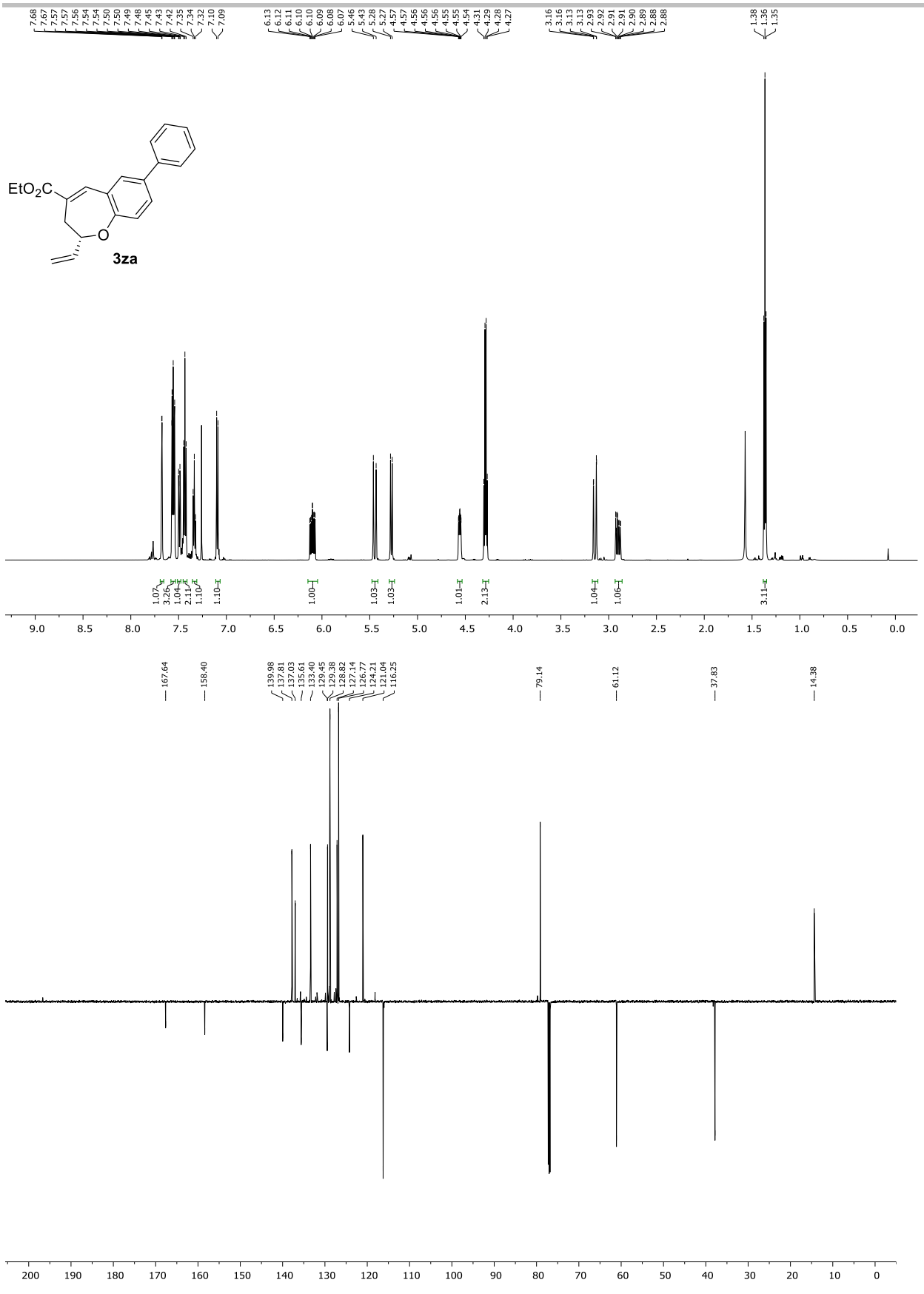
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6.13 6.12 6.11 6.10 6.10 6.09 6.08 6.07 5.46 5.43 5.28 5.27 4.57 4.57 4.56 4.56 4.56 4.55 4.55 4.54 4.31 4.29 4.28 4.27
3.16 3.16 3.13 3.13 2.93 2.92 2.91 2.91 2.90 2.89 2.88 2.88
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EtO2C
O
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1.07 3.26 1.04 2.11 1.10 1.10 1.00 1.03 1.03 1.01 2.13 1.04 1.06 3.11
9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
167.64 158.40 139.98 137.81 137.03 135.61 133.40 129.45 129.38 128.82 127.14 126.77 124.21 121.04 116.25 79.14 61.12 37.83 14.38
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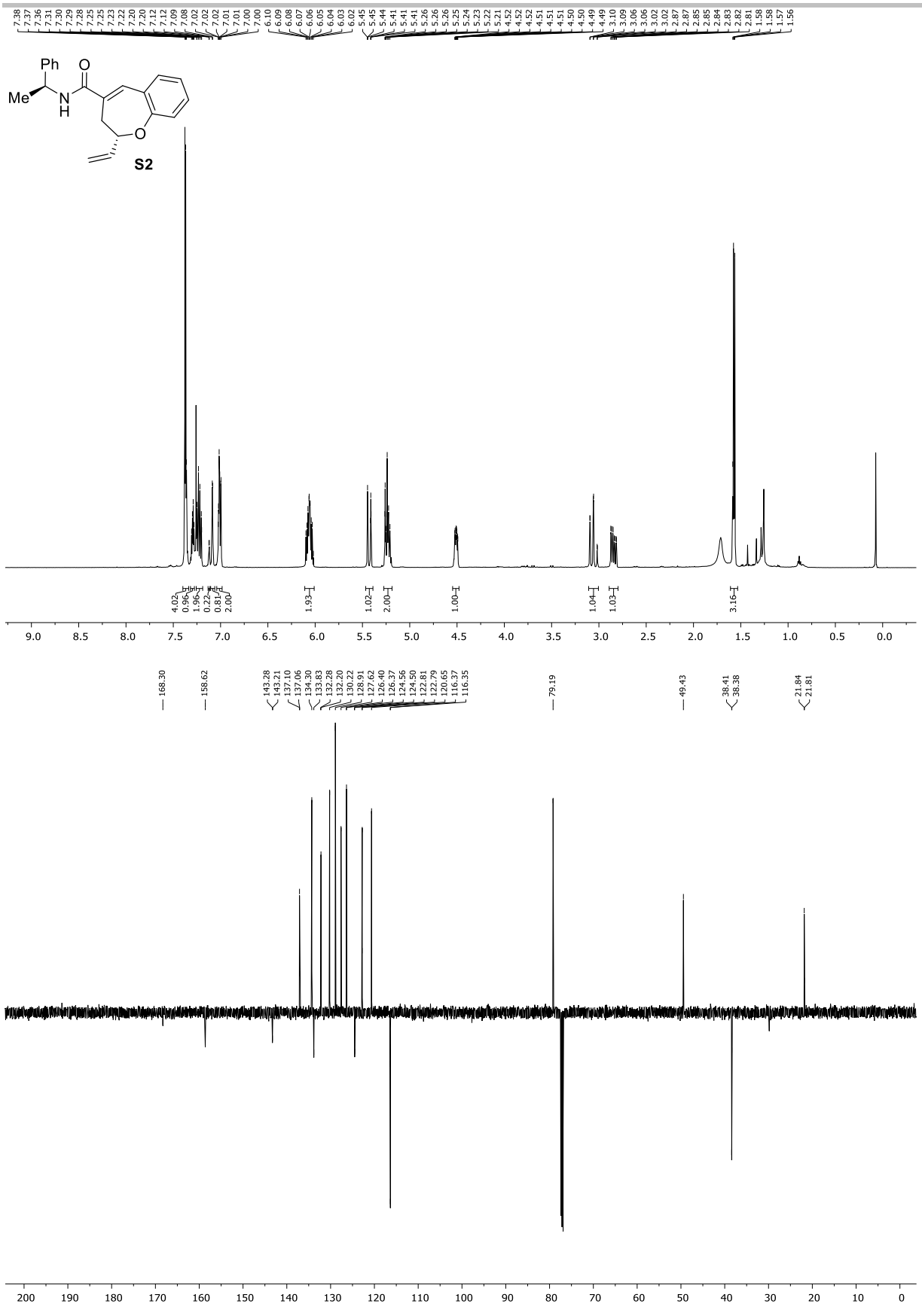
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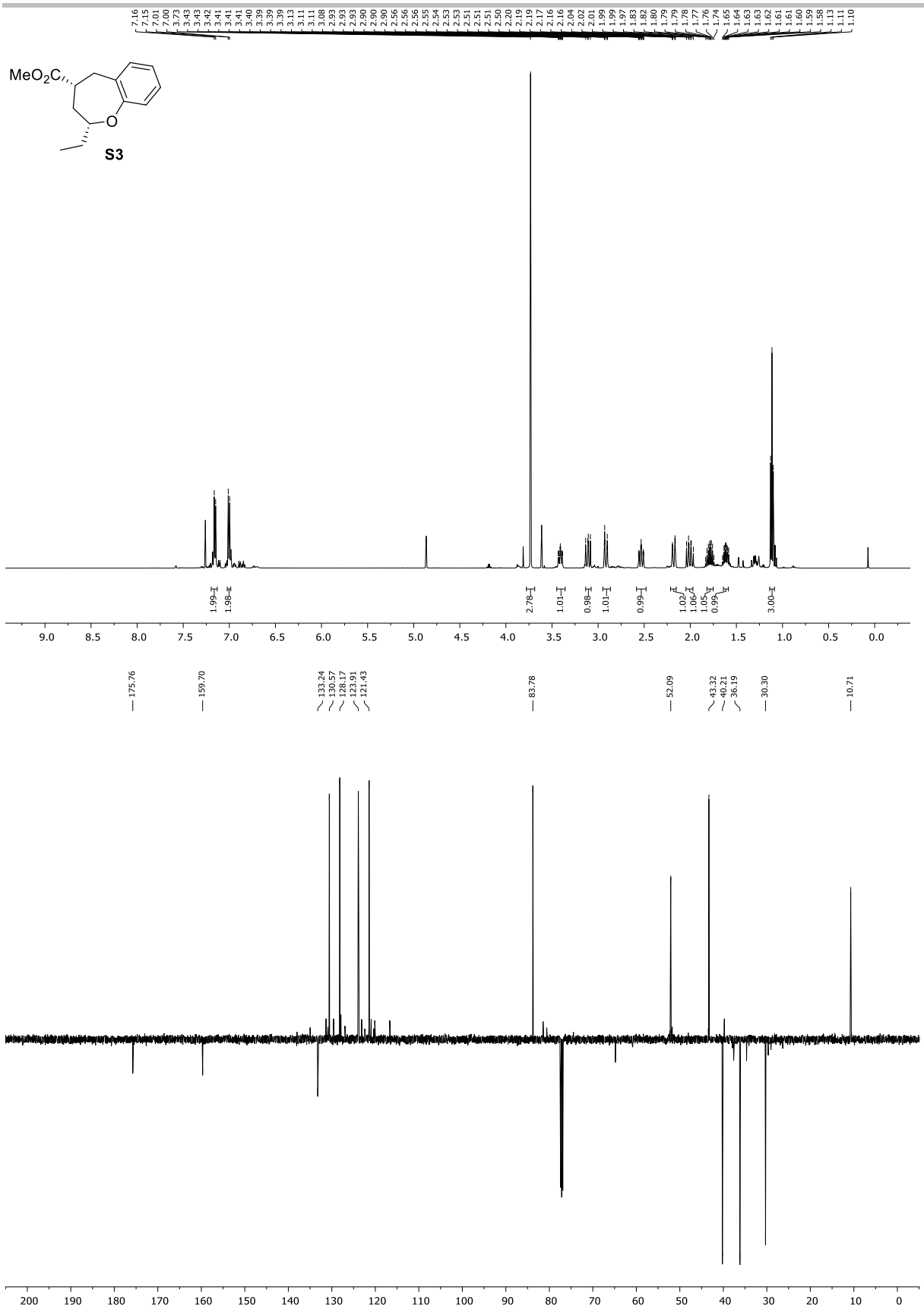
N
H
O
S2


MeO2C
O
S3
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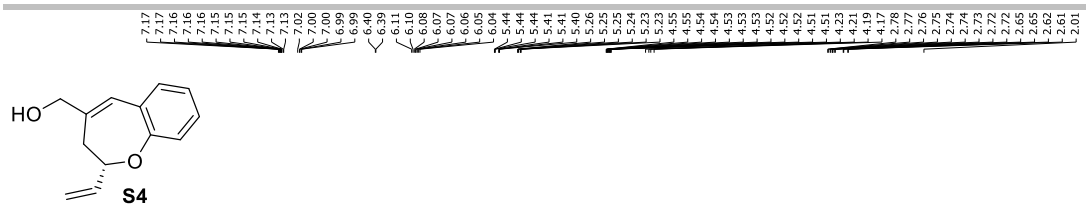
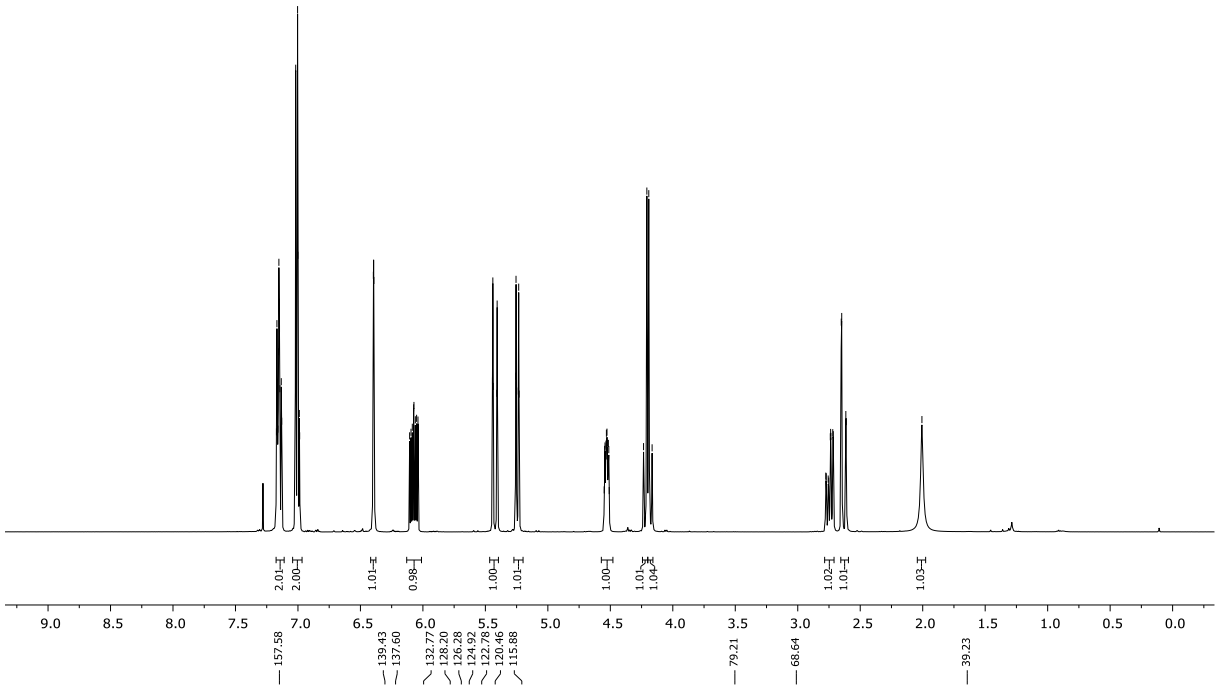
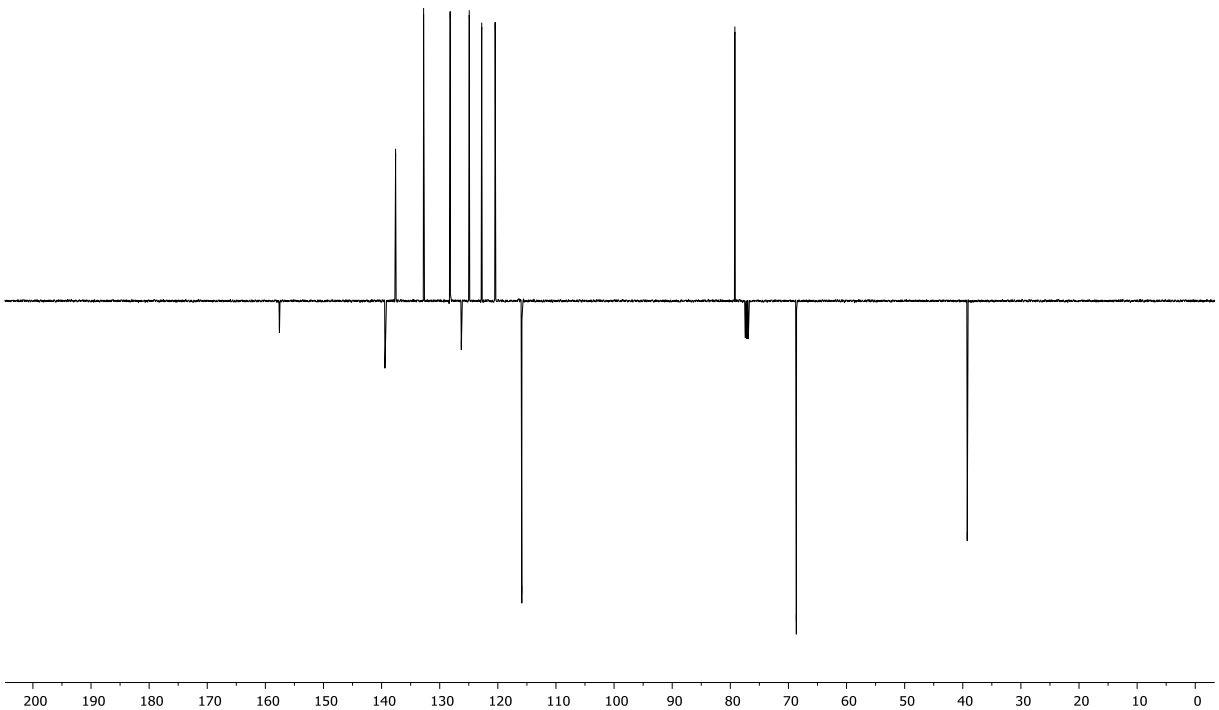


S4





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[4] A. D. Becke, *Phys. Rev. A* **1988**, *38*, 3098.

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Author Contributions

MF and ER conceived the project with input from JMS. MF, KNAvdV and MD performed the experiments and analyzed the results. TAH performed the simulation of CD spectra. MF, JMS and ER wrote the manuscript with input from KNAvdV, MD and TAH. All authors agreed on the final version of the manuscript.