

Supporting Information for

Construction of Erythrinane Skeleton via Pd(0)-Catalyzed Intramolecular Dearomatization of *para*-Aminophenols

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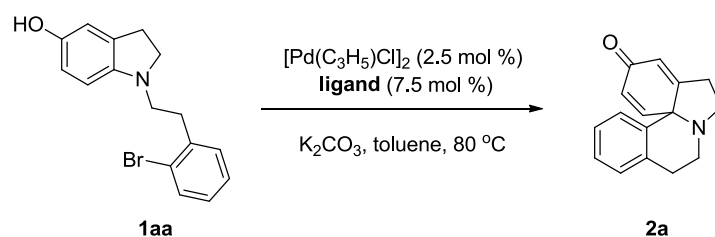
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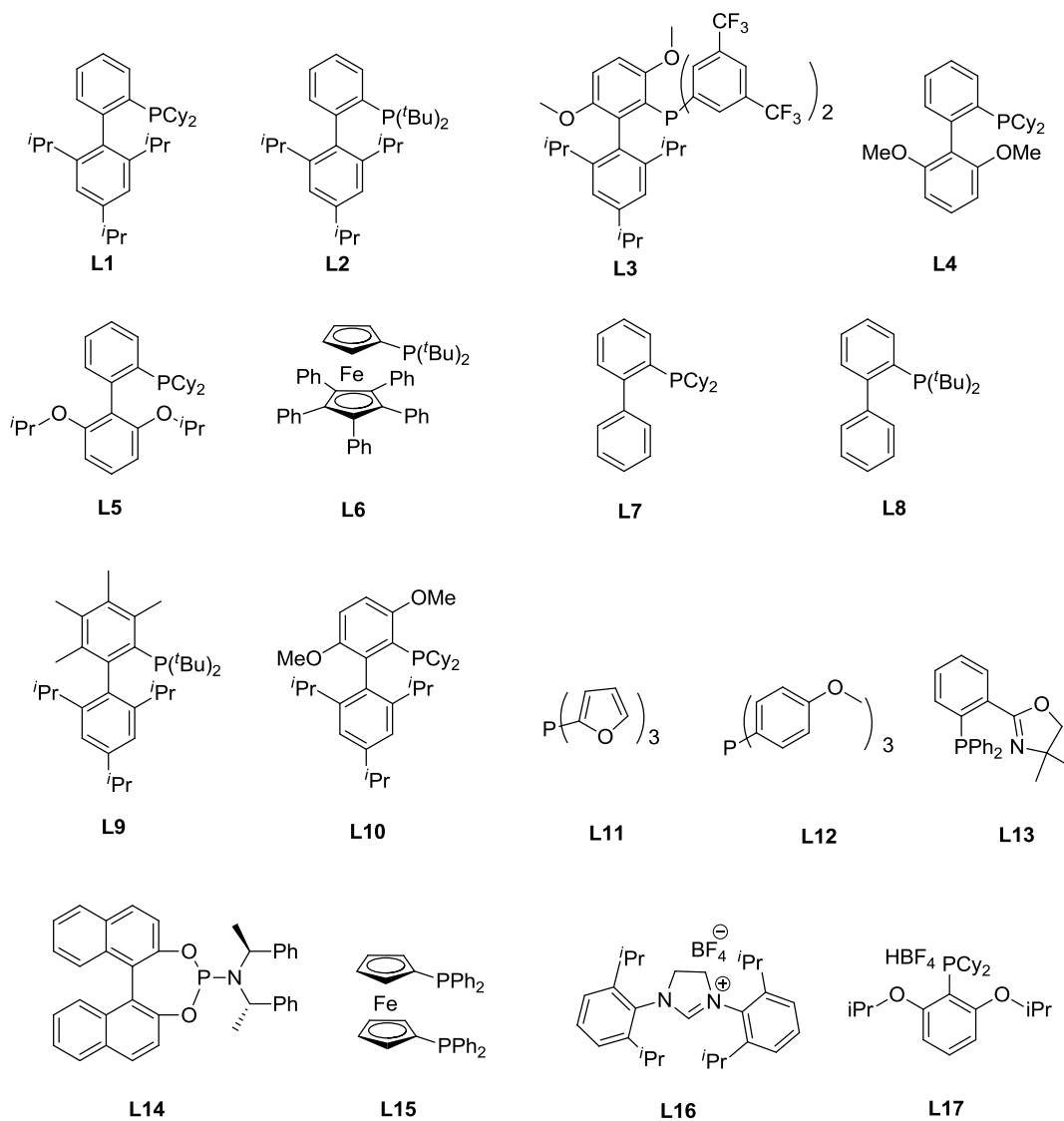
General Methods. Unless stated otherwise, all reactions were carried out in flame-dried glassware under a dry argon atmosphere. All solvents were purified and dried according to standard methods prior to use. ^1H and ^{19}F NMR spectra were recorded on a Varian or Agilent instrument (400 MHz and 376 MHz, respectively) and internally referenced to tetramethylsilane signal or residual protio solvent signals and CFCl_3 , respectively. ^{13}C NMR spectra were recorded on a Varian (100 MHz or 75 MHz) or Agilent instrument (100 MHz) and internally referenced to residual solvent signals. Data for ^1H NMR are recorded as follows: chemical shift (δ , ppm), multiplicity (s = singlet, d = doublet, t = triplet, m = multiplet or unresolved, br = broad singlet, coupling constant (s) in Hz, integration). Data for ^{13}C NMR and ^{19}F NMR are reported in terms of chemical shift (δ , ppm).

Compounds **A**¹ and **B**^{2,3} were prepared according to the known procedures. All other starting materials were commercially available.

Complete optimization data

Table S1. Screening ligands.^a



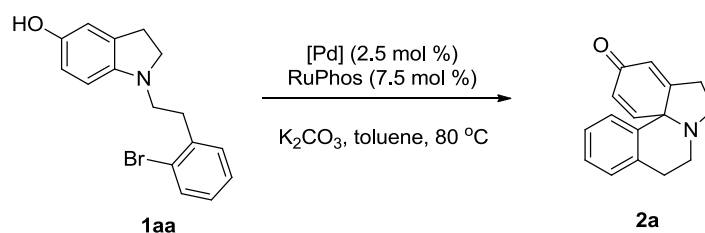


entry	Ligand	yield (%) ^b
1	L1	44 (36 ^c)
2	L2	15
3	L3	11
4	L4	61
5	L5	74 (64^c)
6	L6	19
7	L7	6

8	L8	7
9	L9	0
10	L10	trace
11	L11	0
12	L12	0
13	L13	trace
14	L14	trace
15	L15	0
16	L16	0
17	L17	0
18	PPh ₃	0

^a Reaction conditions: **1aa** (0.2 mmol), [Pd(C₃H₅)Cl]₂ (0.005 mmol), ligand (0.015 mmol), K₂CO₃ (0.3 mmol) in toluene (1.0 mL), 80 °C, 8 h. ^b Determined by ¹H NMR using CH₂Br₂ (0.2 mmol) as internal standard. ^c Isolated yield.

Table S2. Examination of palladium precursors.^a



entry	[Pd]	yield ^b
1	[Pd(C₃H₅)Cl]₂	74
2	Pd ₂ (dba) ₃	64
3	Pd(MeCN) ₂ Cl ₂	65
4	Pd(COD)Cl ₂	61
5	Pd(OAc) ₂	18

^a Reaction conditions: **1aa** (0.2 mmol), [Pd] (0.01 mmol based on Pd), RuPhos (**L5**) (0.015 mmol), K₂CO₃ (0.3 mmol) in toluene (1.0 mL), 80 °C, 8 h. ^b Determined by ¹H NMR using CH₂Br₂ (0.2 mmol) as internal standard.

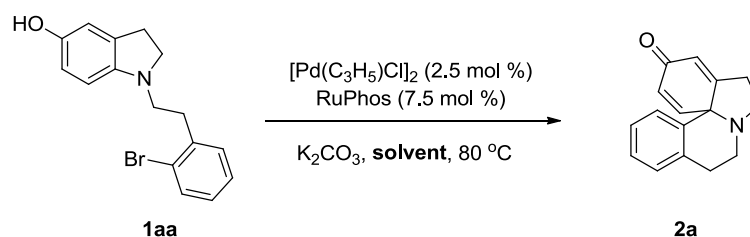
Table S3. Examination of base.^a

1aa → **2a**

entry	base	yield (%) ^b
1	Li ₂ CO ₃	0
2	K₂CO₃	74
3	Cs ₂ CO ₃	10
4	K ₃ PO ₄	64
5	DBU	0
6	KOAc	0
7	KHCO ₃	0
8	t-BuOK	20
9	t-BuONa	10

^a Reaction conditions: **1aa** (0.2 mmol), [Pd(C₃H₅)Cl]₂ (0.005 mmol), RuPhos (**L5**) (0.015 mmol), base (0.3 mmol) in toluene (1.0 mL), 80 °C, 8 h. ^b Determined by ¹H NMR using CH₂Br₂ (0.2 mmol) as internal standard.

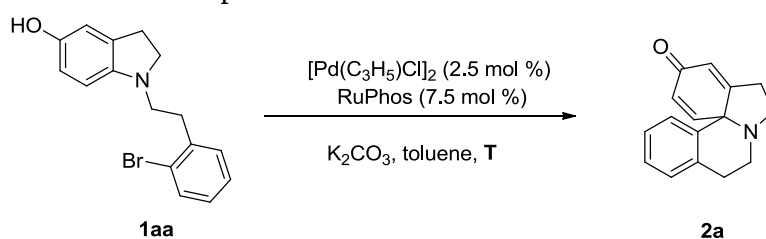
Table S4. Examination of solvent.^a



entry	solvent	yield (%) ^b
1	toluene	74
2	xylene	63
3	dioxane	19
4	THF	53
5	benzene	73
6	PhF	70
7	PhCl	30
8	DCE	43
9	DMF	0

^a Reaction conditions: **1aa** (0.2 mmol), [Pd(C₃H₅)Cl]₂ (0.005 mmol), RuPhos (**L5**) (0.015 mmol), K₂CO₃ (0.3 mmol) in solvent (1.0 mL), 80 °C, 8 h. ^b Determined by ¹H NMR using CH₂Br₂ (0.2 mmol) as internal standard.

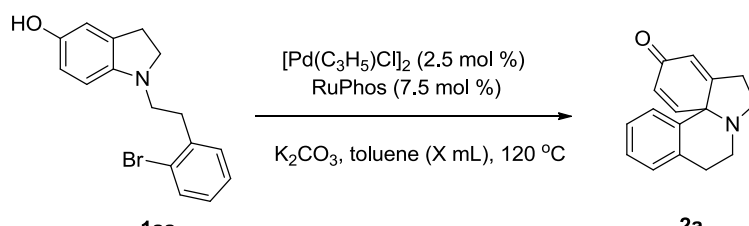
Table S5. Examination of temperature.^a



entry	T(°C)	yield (%) ^b
1	60	54
2	80	74 (64 ^c)
3	120	91 (86^c)

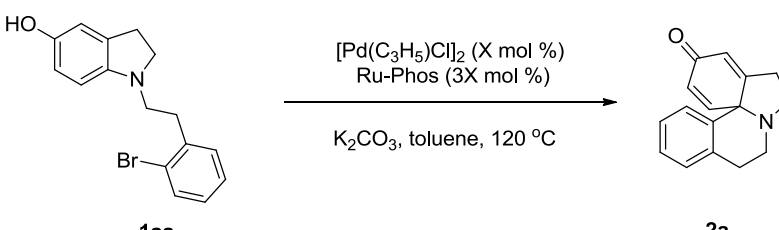
^a Reaction conditions: **1aa** (0.2 mmol), [Pd(C₃H₅)Cl]₂ (0.005 mmol), RuPhos (**L5**) (0.015 mmol), K₂CO₃ (0.3 mmol) in toluene (1.0 mL), T, 8 h. ^b Determined by ¹H NMR using CH₂Br₂ (0.2 mmol) as internal standard. ^c Isolated yield.

Table S6. Examination of substrate concentration.^a

			
entry	X	c (mol/L)	yield (%) ^b
1	2	0.1	67
2	1	0.2	91 (86^c)
3	0.5	0.4	81

^a Reaction conditions: **1aa** (0.2 mmol), [Pd(C₃H₅)Cl]₂ (0.005 mmol), RuPhos (0.015 mmol), K₂CO₃ (0.3 mmol) in toluene (X mL), 120°C, 8 h. ^b Determined by ¹H NMR using CH₂Br₂ (0.2 mmol) as internal standard. ^c Isolated yield.

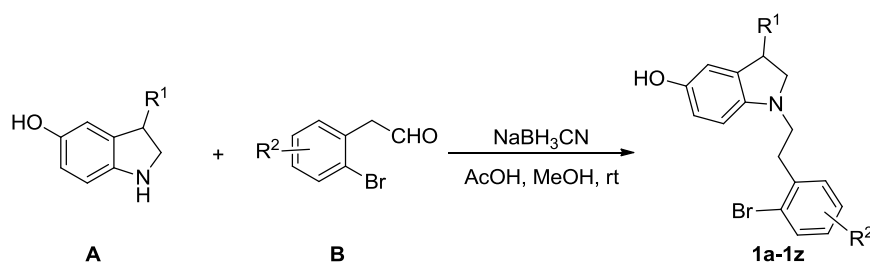
Table S7. Examination of catalyst loading.^a

		
entry	X	yield (%) ^b
1 ^c	0.5	81
2	1.25	90
3	2.5	86
4	5	62

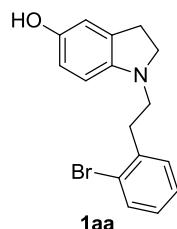
^a Reaction conditions: **1aa** (X/2 mmol), [Pd(C₃H₅)Cl]₂ (0.005 mmol), RuPhos (0.015 mmol), K₂CO₃ (3X/4 mmol) in toluene (5X/2 mL), 120°C, 8 h. ^b Isolated yield. ^c **1aa**

(0.8 mmol), $[\text{Pd}(\text{C}_3\text{H}_5)\text{Cl}]_2$ (0.0038 mmol), RuPhos (0.0126 mmol), K_2CO_3 (1.2 mmol) in toluene (4.0 mL), 120°C, 8 h.

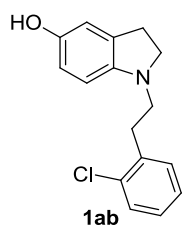
General procedure for the preparation of 5-hydroxyl indolines (1a-1z)



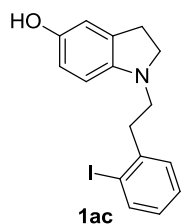
A flame-dried two-necked, round-bottomed flask was cooled down to room temperature under argon. To this flask were added 5-hydroxyindoline (**A**) (4.0 mmol, 1.0 equiv.) and methanol (10 mL). Then the solution of 2-(2-bromophenyl)acetaldehyde (**B**) (5.0 mmol, 1.25 equiv.) in methanol (30 mL) were added to the flask followed by NaBH₃CN (0.31 g, 5.0 mmol, 1.25 equiv.) and AcOH (0.4 mL). After completion (monitored by TLC), the reaction mixture was quenched with saturated NaHCO₃ (20 mL) and methanol was removed under reduced pressure. The mixture was diluted with H₂O (20 mL) and extracted with ethyl acetate (50 mL x 3). The combined ethyl acetate extract was washed with brine, dried over anhydrous Na₂SO₄ and filtrated. After the solvent was concentrated under reduced pressure, the crude product was purified by silica gel column chromatography.



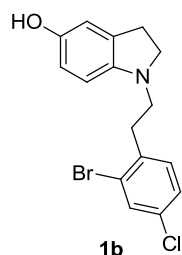
Light yellow solid, m.p. = 68-70 °C. ¹H NMR (400 MHz, Acetone-d₆) δ 7.59 (dd, *J* = 8.0, 1.2 Hz, 1H), 7.49 (d, *J* = 2.4 Hz, 1H), 7.44 (dd, *J* = 7.6, 1.6 Hz, 1H), 7.32 (td, *J* = 7.6, 1.2 Hz, 1H), 7.16 (td, *J* = 7.6, 1.6 Hz, 1H), 6.62 (d, *J* = 2.4 Hz, 1H), 6.52 (dd, *J* = 8.4, 2.4 Hz, 1H), 6.42 (d, *J* = 8.0 Hz, 1H), 3.35 (t, *J* = 8.0 Hz, 2H), 3.25-3.21 (m, 2H), 3.04-3.00 (m, 2H), 2.87-2.83 (m, 2H); ¹³C NMR (100 MHz, Acetone-d₆) δ 150.8, 146.3, 140.2, 133.5, 132.1, 132.0, 129.0, 128.6, 124.8, 113.7, 113.3, 108.6, 54.3, 51.0, 34.0, 29.4; IR (thin film): ν_{max} (cm⁻¹) = 3219, 3049, 2959, 2931, 2861, 1493, 1458, 1440, 1361, 1249, 1210, 1133, 1078, 1037, 1017, 937, 861, 835, 802, 747, 727, 662; HRMS (ESI) calcd for C₁₆H₁₇BrNO[M + H]⁺: 318.0488; Found: 318.0487.



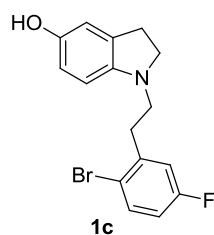
Light yellow oil. ^1H NMR (400 MHz, Acetone- d_6) δ 7.48 (s, 1H), 7.43-7.38 (m, 2H), 7.30-7.20 (m, 2H), 6.62 (s, 1H), 6.52 (dd, J = 8.0, 2.4 Hz, 1H), 6.40 (d, J = 8.4 Hz, 1H), 3.32 (t, J = 8.0 Hz, 2H), 3.24-3.20 (m, 2H), 3.02-2.98 (m, 2H), 2.83 (t, J = 8.0 Hz, 2H); ^{13}C NMR (100 MHz, Acetone- d_6) δ 150.7, 146.3, 138.4, 134.3, 132.1, 131.9, 130.0, 128.6, 127.9, 113.8, 113.3, 108.6, 54.2, 50.9, 31.6, 29.4; IR (thin film): ν_{max} (cm^{-1}) = 3355, 3027, 2951, 2840, 1600, 1491, 1470, 1353, 1238, 1215, 1183, 1130, 1054, 837, 802, 748, 680; HRMS (ESI) calcd for $\text{C}_{16}\text{H}_{17}\text{ClNO}[\text{M} + \text{H}]^+$: 274.0993; Found: 274.0988.



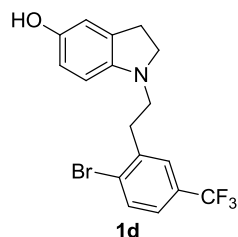
White solid, m.p. = 99-100 $^{\circ}\text{C}$. ^1H NMR (400 MHz, Acetone- d_6) δ 7.86 (d, J = 8.0 Hz, 1H), 7.49 (s, 1H), 7.43 (dd, J = 7.6, 1.2 Hz, 1H), 7.35 (t, J = 7.6 Hz, 1H), 6.98 (td, J = 7.6, 1.2 Hz, 1H), 6.63 (s, 1H), 6.52 (dd, J = 8.0, 1.6 Hz, 1H), 6.45 (d, J = 8.4 Hz, 1H), 3.37 (t, J = 8.0 Hz, 2H), 3.22-3.18 (m, 2H), 3.03-2.99 (m, 2H), 2.87-2.83 (m, 2H); ^{13}C NMR (100 MHz, Acetone- d_6) δ 150.8, 146.2, 143.6, 140.2, 132.1, 131.0, 129.4, 129.0, 113.8, 113.3, 108.7, 100.9, 54.3, 51.4, 38.6, 29.5; IR (thin film): ν_{max} (cm^{-1}) = 3672, 3305, 3239, 2966, 2902, 2804, 1601, 1560, 1492, 1461, 1350, 1300, 1232, 1183, 1132, 1052, 1020, 859, 795, 766, 747, 719, 640; HRMS (ESI) calcd for $\text{C}_{16}\text{H}_{17}\text{INO}[\text{M} + \text{H}]^+$: 366.0349; Found: 366.0349.



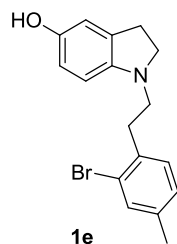
Light yellow solid, m.p. = 136-138 °C. ^1H NMR (400 MHz, Acetone- d_6) δ 7.64 (d, J = 2.0 Hz, 1H), 7.49-7.47 (m, 2H), 7.37 (dd, J = 8.0, 2.0 Hz, 1H), 6.62 (d, J = 2.0 Hz, 1H), 6.51 (dd, J = 8.4, 2.0 Hz, 1H), 6.41 (d, J = 8.4 Hz, 1H), 3.34 (t, J = 8.4 Hz, 2H), 3.25-3.21 (m, 2H), 3.04-3.00 (m, 2H), 2.86-2.82 (m, 2H). ^{13}C NMR (100 MHz, Acetone- d_6) δ 150.8, 146.1, 139.2, 132.94, 132.91, 132.6, 132.1, 128.5, 125.2, 113.7, 113.3, 108.6, 54.3, 50.8, 33.5, 29.4; IR (thin film): ν_{max} (cm^{-1}) = 3673, 2970, 2902, 2822, 1582, 1557, 1487, 1447, 1407, 1231, 1182, 1136, 1054, 868, 819, 691, 631; HRMS (ESI) calcd for $\text{C}_{16}\text{H}_{16}\text{BrClNO}[\text{M} + \text{H}]^+$: 352.0098; Found: 352.0081.



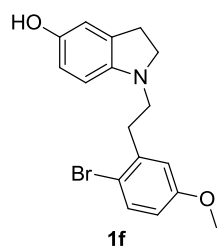
Yellow solid, m.p. = 98-100 °C. ^1H NMR (400 MHz, Acetone- d_6) δ 7.62 (dd, J = 8.8, 5.2 Hz, 1H), 7.49 (s, 1H), 7.28 (dd, J = 9.6, 2.8 Hz, 1H), 6.98 (td, J = 8.4, 2.8 Hz, 1H), 6.62 (d, J = 1.6 Hz, 1H), 6.52 (dd, J = 8.4, 2.0 Hz, 1H), 6.43 (d, J = 8.4 Hz, 1H), 3.35 (t, J = 8.0 Hz, 2H), 3.28-3.24 (m, 2H), 3.05-3.01 (m, 2H), 2.87-2.83 (m, 3H); ^{13}C NMR (100 MHz, Acetone- d_6) δ 162.8 (d, J = 243.5 Hz), 150.9, 146.2, 142.7 (d, J = 7.8 Hz), 134.8 (d, J = 8.3 Hz), 132.1, 119.2 (d, J = 3.0 Hz), 118.6 (d, J = 22.7 Hz), 115.9 (d, J = 22.6 Hz), 113.8, 113.3, 108.7, 54.3, 50.7, 34.2, 29.5; ^{19}F NMR (386 Hz, Acetone- d_6) δ -116.9(m); IR (thin film): ν_{max} (cm^{-1}) = 3672, 3222, 2968, 2903, 1602, 1576, 1493, 1457, 1407, 1361, 1251, 1229, 1149, 1131, 1054, 1027, 862, 836, 810, 726; HRMS (ESI) calcd for $\text{C}_{16}\text{H}_{16}\text{BrFNO}[\text{M} + \text{H}]^+$: 336.0394; Found: 336.0380.



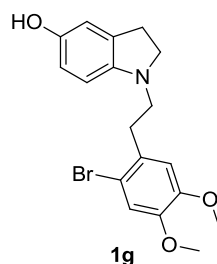
Yellow solid, m.p. = 107-109 °C. ^1H NMR (400 MHz, Acetone- d_6) δ 7.85-7.81 (m, 2H), 7.51-7.49 (m, 2H), 6.62 (s, 1H), 6.52 (dd, J = 8.4, 2.0 Hz, 1H), 6.44 (d, J = 8.4 Hz, 1H), 3.36 (t, J = 8.4 Hz, 2H), 3.32-3.28 (m, 2H), 3.16-3.12 (m, 2H), 2.87-2.83 (m, 2H); ^{13}C NMR (100 MHz, Acetone- d_6) δ 150.9, 146.2, 141.9, 134.5, 132.2, 130.3 (q, J = 32.3 Hz), 129.2, 128.6 (q, J = 3.7 Hz), 125.5 (q, J = 3.7 Hz), 125.0 (q, J = 270.0 Hz), 113.8, 113.4, 108.7, 54.3, 50.7, 34.1, 29.5; ^{19}F NMR (386 Hz, Acetone- d_6) δ -63.5 (m); IR (thin film): ν_{max} (cm^{-1}) = 3672, 3401, 2970, 2903, 1603, 1493, 1456, 1408, 1331, 1247, 1169, 1110, 1078, 1025, 894, 861, 828, 803, 728; HRMS (ESI) calcd for $\text{C}_{17}\text{H}_{16}\text{BrF}_3\text{NO}[\text{M} + \text{H}]^+$: 386.0362; Found: 386.0352.



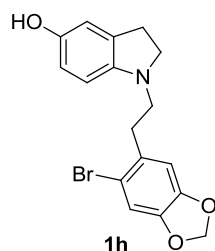
Yellow solid, m.p. = 118-120 °C. ^1H NMR (400 MHz, Acetone- d_6) δ 7.49 (s, 1H), 7.41 (s, 1H), 7.31 (d, J = 8.0 Hz, 1H), 7.13 (d, J = 9.2 Hz, 1H), 6.62 (d, J = 2.4 Hz, 1H), 6.51 (dd, J = 8.4, 2.4 Hz, 1H), 6.41 (d, J = 8.4 Hz, 1H), 3.34 (t, J = 8.0 Hz, 2H), 3.22-3.18 (m, 2H), 2.99-2.95 (m, 2H), 2.86-2.82 (m, 2H), 2.30 (s, 3H); ^{13}C NMR (100 MHz, Acetone- d_6) δ 150.8, 146.4, 138.9, 137.0, 133.8, 132.2, 131.7, 129.3, 124.6, 113.8, 113.3, 108.6, 54.3, 51.2, 33.7, 20.5; IR (thin film): ν_{max} (cm^{-1}) = 3673, 2972, 2902, 1488, 1449, 1407, 1230, 1182, 1130, 1054, 864, 824, 735; HRMS (ESI) calcd for $\text{C}_{17}\text{H}_{19}\text{BrNO}[\text{M} + \text{H}]^+$: 332.0645; Found: 332.0639.



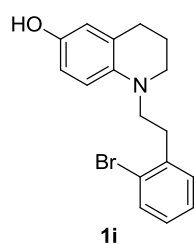
Light purple crystal, m.p. = 74-76 °C. ^1H NMR (400 MHz, Acetone- d_6) δ 7.48 (s, 1H), 7.46 (d, J = 8.8 Hz, 1H), 7.03 (d, J = 2.8 Hz, 1H), 6.75 (dd, J = 8.8, 2.8 Hz, 1H), 6.62 (s, 1H), 6.52 (dd, J = 8.0, 2.0 Hz, 1H), 6.44 (d, J = 8.0 Hz, 1H), 3.78 (s, 3H), 3.35 (t, J = 8.0 Hz, 2H), 3.25-3.21 (m, 2H), 3.00-2.96 (m, 2H), 2.85 (t, J = 8.0 Hz, 2H); ^{13}C NMR (100 MHz, Acetone- d_6) δ 160.2, 150.8, 146.4, 141.3, 134.0, 132.2, 117.5, 115.1, 114.6, 113.8, 113.3, 108.7, 55.8, 54.3, 51.0, 34.3, 29.5; IR (thin film): ν_{max} (cm^{-1}) = 3672, 3355, 2963, 1595, 1572, 1468, 1414, 1354, 1238, 1162, 1132, 1052, 1013, 857, 839, 802, 749, 665; HRMS (ESI) calcd for $\text{C}_{17}\text{H}_{19}\text{BrNO}_2[\text{M} + \text{H}]^+$: 348.0594; Found: 348.0586.



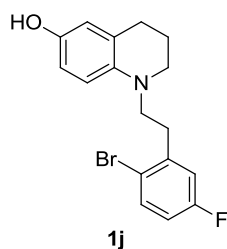
Colorless crystal, m.p. = 107-109 °C. ^1H NMR (400 MHz, Acetone- d_6) δ 7.48 (s, 1H), 7.08 (s, 1H), 7.04 (s, 1H), 6.62 (s, 1H), 6.52 (d, J = 8.4 Hz, 1H), 6.42 (d, J = 8.0 Hz, 1H), 3.81 (s, 3H), 3.80 (s, 3H), 3.34 (t, J = 8.0 Hz, 2H), 3.22-3.18 (m, 2H), 2.95-2.90 (m, 2H), 2.86-2.82 (m, 2H); ^{13}C NMR (100 MHz, Acetone- d_6) δ 150.6, 149.7, 149.4, 146.3, 132.1, 132.0, 116.5, 114.9, 114.4, 113.7, 113.3, 108.6, 56.3, 56.2, 54.2, 51.2, 33.7, 29.5; IR (thin film): ν_{max} (cm^{-1}) = 3493, 2937, 2798, 1602, 1493, 1452, 1433, 1385, 1333, 1244, 1212, 1157, 1054, 1030, 993, 956, 936, 859, 836, 801, 784, 725, 665; HRMS (ESI) calcd for $\text{C}_{18}\text{H}_{21}\text{BrNO}_3[\text{M} + \text{H}]^+$: 378.0699; Found: 378.0706.



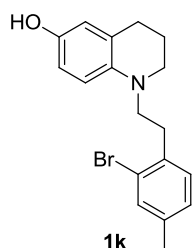
Light purple needle crystal, m.p. = 134-135 °C. ^1H NMR (400 MHz, Acetone- d_6) δ 7.48 (s, 1H), 7.06 (s, 1H), 6.97 (s, 1H), 6.62 (s, 1H), 6.52 (d, J = 8.4 Hz, 1H), 6.42 (d, J = 8.0 Hz, 1H), 6.02 (s, 2H), 3.34 (t, J = 8.0 Hz, 2H), 3.20-3.16 (m, 2H), 2.95-2.91 (m, 2H), 2.86-2.82 (m, 2H); ^{13}C NMR (100 MHz, Acetone- d_6) δ 150.8, 148.5, 148.0, 146.4, 133.2, 132.1, 114.7, 113.8, 113.3, 113.0, 111.3, 108.6, 102.7, 54.3, 51.2, 34.0, 29.5; IR (thin film): ν_{max} (cm^{-1}) = 3673, 3295, 2971, 2905, 2802, 1602, 1497, 1495, 1412, 1392, 1351, 1297, 1228, 1184, 1170, 1139, 1110, 1079, 1038, 963, 926, 858, 834, 795, 771, 733, 703, 676, 655, 633; HRMS (ESI) calcd for $\text{C}_{17}\text{H}_{17}\text{BrNO}_3[\text{M} + \text{H}]^+$: 362.0386; Found: 362.0389.



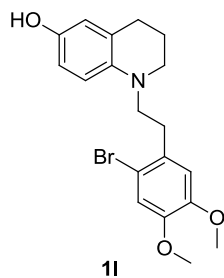
Light yellow oil. ^1H NMR (400 MHz, Acetone- d_6) δ 7.59 (d, J = 8.0 Hz, 1H), 7.39-7.37 (m, 2H), 7.32 (t, J = 7.6 Hz, 1H), 7.16 (td, J = 7.6, 1.6 Hz, 1H), 6.65 (d, J = 8.8 Hz, 1H), 6.55 (dd, J = 8.4, 2.0 Hz, 1H), 6.46 (d, J = 2.0 Hz, 1H), 3.43 (t, J = 8.0 Hz, 2H), 3.23-3.20 (m, 2H), 3.02-2.98 (m, 2H), 2.66 (t, J = 6.4 Hz, 2H), 1.90-1.84 (m, 2H); ^{13}C NMR (100 MHz, Acetone- d_6) δ 149.1, 140.4, 139.1, 133.5, 132.3, 129.0, 128.7, 124.8, 124.6, 117.0, 114.5, 113.3, 52.8, 50.0, 33.0, 28.9, 23.2; IR (thin film): ν_{max} (cm^{-1}) = 3360, 3058, 3019, 2931, 2840, 1692, 1504, 1468, 1440, 1346, 1271, 1236, 1197, 1156, 1070, 1024, 942, 911, 882, 853, 800, 749, 689, 658; HRMS (ESI) calcd for $\text{C}_{17}\text{H}_{19}\text{BrNO}[\text{M} + \text{H}]^+$: 332.0645; Found: 332.0632.



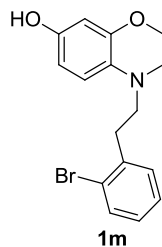
Orange solid, m.p. = 89-91 °C. ^1H NMR (400 MHz, Acetone- d_6) δ 7.61 (dd, J = 8.8, 5.2 Hz, 1H), 7.40 (br, 1H), 7.21 (dd, J = 9.6, 3.2 Hz, 1H), 6.98 (td, J = 8.4, 2.8 Hz, 1H), 6.65 (d, J = 8.4 Hz, 1H), 6.55 (dd, J = 8.8, 2.4 Hz, 1H), 6.47 (s, 1H), 3.45 (t, J = 7.6 Hz, 2H), 3.22 (t, J = 5.6 Hz, 2H), 3.00 (t, J = 7.6 Hz, 2H), 2.66 (t, J = 6.0 Hz, 2H), 1.90-1.84 (m, 2H); ^{13}C NMR (75 MHz, Acetone- d_6) δ 162.9 (d, J = 243.5 Hz), 149.1, 142.9 (d, J = 7.7 Hz), 139.7, 134.9 (d, J = 8.3 Hz), 124.6, 119.1 (d, J = 3.0 Hz), 118.8 (d, J = 22.5 Hz), 116.9, 115.9 (d, J = 22.6 Hz), 114.5, 113.3, 52.5, 50.0, 33.2, 28.9, 23.2; ^{19}F NMR (386 Hz, Acetone- d_6) δ -116.6 (m); IR (thin film): ν_{max} (cm^{-1}) = 3480, 3405, 3324, 3067, 2933, 2878, 1605, 1577, 1503, 1467, 1408, 1345, 1277, 1229, 1202, 1182, 1151, 1105, 1048, 1027, 995, 946, 907, 867, 812, 799, 726, 706, 689, 635; HRMS (ESI) calcd for $\text{C}_{17}\text{H}_{18}\text{BrFNO}[\text{M} + \text{H}]^+$: 350.0550; Found: 350.0548.



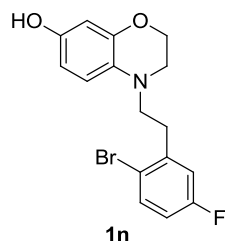
Light yellow oil. ^1H NMR (400 MHz, Acetone- d_6) δ 7.41 (s, 1H), 7.25 (d, J = 8.0 Hz, 1H), 7.13 (d, J = 7.6 Hz, 1H), 6.64 (d, J = 8.8 Hz, 1H), 6.56 (dd, J = 8.8, 2.8 Hz, 1H), 6.46 (d, J = 2.8 Hz, 1H), 3.39 (t, J = 7.6 Hz, 2H), 3.21 (t, J = 5.6 Hz, 2H), 2.94 (t, J = 7.6 Hz, 2H), 2.65 (t, J = 6.4 Hz, 2H), 2.30 (s, 3H), 1.90-1.84 (m, 2H); ^{13}C NMR (100 MHz, Acetone- d_6) δ 149.0, 139.2, 139.0, 137.1, 133.8, 131.9, 129.4, 124.6, 124.5, 116.9, 114.4, 113.3, 52.9, 50.0, 32.5, 28.9, 23.3, 20.5; IR (thin film): ν_{max} (cm^{-1}) = 333.1, 3023, 2925, 2840, 1606, 1503, 1451, 1344, 1271, 1237, 1197, 1154, 1114, 1076, 1041, 1000, 943, 910, 865, 815, 798, 729, 690, 673, 627; HRMS (ESI) calcd for $\text{C}_{18}\text{H}_{21}\text{BrNO}[\text{M} + \text{H}]^+$: 346.0801; Found: 346.0801.



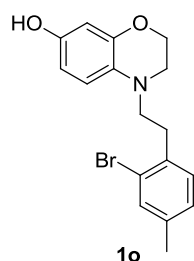
Yellow solid, m.p. = 50-52 °C. ^1H NMR (400 MHz, Acetone- d_6) δ 7.34 (br, 1H), 7.08 (s, 1H), 6.95 (s, 1H), 6.65 (d, J = 8.8 Hz, 1H), 6.54 (dd, J = 8.8, 2.8 Hz, 1H), 6.45 (d, J = 2.8 Hz, 1H), 3.81 (s, 3H), 3.78 (s, 3H), 3.41 (t, J = 7.6 Hz, 2H), 3.20 (t, J = 5.6 Hz, 2H), 2.91 (t, J = 7.6 Hz, 2H), 2.65 (t, J = 6.4 Hz, 2H), 1.89-1.83 (m, 2H); ^{13}C NMR (100 MHz, Acetone- d_6) δ 149.8, 149.5, 148.8, 139.3, 132.1, 124.4, 116.9, 116.5, 115.2, 114.4, 114.3, 113.2, 56.3, 56.2, 52.8, 50.0, 32.7, 28.9, 23.2; IR (thin film): ν_{max} (cm^{-1}) = 3463, 3004, 2931, 2839, 1602, 1502, 1439, 1381, 1340, 1316, 1254, 1216, 1160, 1116, 1028, 1002, 959, 945, 880, 851, 798, 750, 694, 665; HRMS (ESI) calcd for $\text{C}_{19}\text{H}_{23}\text{BrNO}_3[\text{M} + \text{H}]^+$: 392.0856; Found: 392.0851.



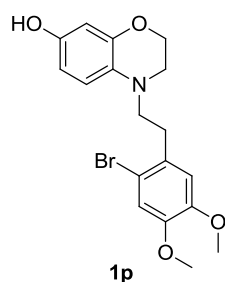
Light yellow oil. ^1H NMR (400 MHz, Acetone- d_6) δ 7.61 (s, 1H), 7.58 (d, J = 8.0 Hz, 1H), 7.40 (dd, J = 7.6, 1.2 Hz, 1H), 7.32 (t, J = 7.6 Hz, 1H), 7.16 (td, J = 8.0, 1.6 Hz, 1H), 6.71 (d, J = 8.8 Hz, 1H), 6.34 (dd, J = 8.8, 2.8 Hz, 1H), 6.28 (d, J = 2.8 Hz, 1H), 4.16 (t, J = 4.4 Hz, 2H), 3.45-3.41 (m, 2H), 3.29 (t, J = 4.4 Hz, 2H), 3.04-3.00 (m, 2H); ^{13}C NMR (100 MHz, Acetone- d_6) δ 150.3, 146.0, 140.0, 133.4, 132.1, 129.0, 128.7, 128.6, 124.8, 114.7, 108.7, 104.7, 65.3, 52.4, 47.6, 32.8; IR (thin film): ν_{max} (cm^{-1}) = 3673, 3384, 2972, 1592, 1509, 1469, 1351, 1250, 1214, 1154, 1047, 1026, 956, 896, 843, 791, 749, 656; HRMS (ESI) calcd for $\text{C}_{16}\text{H}_{17}\text{BrNO}_2[\text{M} + \text{H}]^+$: 334.0437; Found: 334.0425.



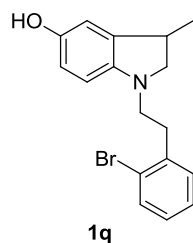
Brown oil. ^1H NMR (300 MHz, Acetone- d_6) δ 7.65-7.60 (m, 2H), 7.26 (dd, J = 9.6, 3.0 Hz, 1H), 6.99 (td, J = 8.4, 3.0 Hz, 1H), 6.72 (d, J = 8.4 Hz, 1H), 6.33 (dd, J = 8.7, 2.7 Hz, 1H), 6.27 (d, J = 2.7 Hz, 1H), 4.17 (t, J = 4.2 Hz, 2H), 3.48-3.43 (m, 2H), 3.31 (t, J = 4.2 Hz, 2H), 3.06-3.01 (m, 2H); ^{13}C NMR (100 MHz, Acetone- d_6) δ 162.8 (d, J = 243.9 Hz), 150.5, 146.1, 142.5 (d, J = 7.6 Hz), 134.9 (d, J = 8.1 Hz), 128.6, 119.1 (d, J = 3.1 Hz), 118.7 (d, J = 22.5 Hz), 115.9 (d, J = 22.6 Hz), 114.9, 108.7, 104.8, 65.3, 52.2, 47.6, 33.0; ^{19}F NMR (386 Hz, Acetone- d_6) δ -116.7 (m); IR (thin film): ν_{max} (cm^{-1}) = 3371, 2937, 2878, 2831, 1690, 1623, 1600, 1579, 1509, 1468, 1407, 1351, 1305, 1253, 1233, 1153, 1127, 1108, 1049, 955, 894, 865, 844, 806, 755, 733, 696, 651, 611; HRMS (ESI) calcd for $\text{C}_{16}\text{H}_{16}\text{BrFNO}_2[\text{M} + \text{H}]^+$: 352.0343; Found: 352.0341.



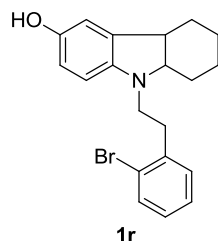
Yellow oil. ^1H NMR (400 MHz, Acetone- d_6) δ 7.58 (s, 1H), 7.41 (s, 1H), 7.27 (d, J = 8.0 Hz, 1H), 7.13 (d, J = 7.6 Hz, 1H), 6.70 (d, J = 8.8 Hz, 1H), 6.33 (dd, J = 8.8, 2.4 Hz, 1H), 6.27 (d, J = 2.4 Hz, 1H), 4.16 (t, J = 4.4 Hz, 2H), 3.42-3.38 (m, 2H), 3.29 (t, J = 4.4 Hz, 2H), 2.99-2.95 (m, 2H), 2.30 (s, 3H); ^{13}C NMR (100 MHz, Acetone- d_6) δ 150.3, 146.0, 138.9, 136.8, 133.7, 131.8, 129.4, 128.7, 124.5, 114.7, 108.7, 104.8, 65.3, 52.5, 47.6, 32.4, 20.5; IR (thin film): ν_{max} (cm^{-1}) = 3365, 2926, 2876, 2829, 1624, 1593, 1509, 1469, 1450, 1350, 1305, 1250, 1212, 1155, 1044, 993, 956, 897, 845, 818, 789, 753, 698, 671, 650; HRMS (ESI) calcd for $\text{C}_{17}\text{H}_{19}\text{BrNO}_2[\text{M} + \text{H}]^+$: 348.0594; Found: 348.0596.



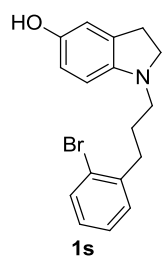
Light yellow sticky oil. ^1H NMR (300 MHz, Acetone- d_6) δ 7.61 (s, 1H), 7.09 (s, 1H), 7.00 (s, 1H), 6.72 (d, J = 8.7 Hz, 1H), 6.33 (dd, J = 8.4, 2.7 Hz, 1H), 6.27 (d, J = 3.0 Hz, 1H), 4.15 (t, J = 4.2 Hz, 2H), 3.81 (s, 3H), 3.78 (s, 3H), 3.43-3.38 (m, 2H), 3.28 (t, J = 4.5 Hz, 2H), 2.96-2.87 (m, 2H); ^{13}C NMR (100 MHz, Acetone- d_6) δ 150.4, 149.9, 149.5, 146.0, 131.8, 128.8, 116.5, 115.1, 114.8, 114.3, 108.7, 104.7, 65.4, 56.3, 56.2, 52.5, 47.7, 32.5; IR (thin film): ν_{max} (cm^{-1}) = 3429, 2933, 2840, 1626, 1599, 1505, 1463, 1437, 1381, 1344, 1304, 1254, 1215, 1160, 1028, 988, 958, 904, 847, 788, 752, 732, 698, 647; HRMS (ESI) calcd for $\text{C}_{18}\text{H}_{21}\text{BrNO}_4[\text{M} + \text{H}]^+$: 394.0648; Found: 394.0646.



Light yellow oil. ^1H NMR (400 MHz, Acetone- d_6) δ 7.59 (dd, J = 8.0, 0.8 Hz, 1H), 7.48 (s, 1H), 7.44 (dd, J = 7.6, 1.6 Hz, 1H), 7.32 (td, J = 7.6, 0.8 Hz, 1H), 7.16 (td, J = 8.0, 1.6 Hz, 1H), 6.60 (d, J = 1.6 Hz, 1H), 6.53 (dd, J = 8.4, 2.0 Hz, 1H), 6.42 (d, J = 8.4 Hz, 1H), 3.60 (t, J = 8.4 Hz, 1H), 3.34-3.29 (m, 1H), 3.19-3.08 (m, 2H), 3.04-3.00 (m, 2H), 2.86-2.82 (m, 1H), 1.25 (d, J = 6.8 Hz, 3H); ^{13}C NMR (100 MHz, Acetone- d_6) δ 150.9, 145.9, 140.2, 137.1, 133.4, 132.0, 128.9, 128.6, 124.8, 113.9, 112.0, 108.7, 62.4, 50.8, 36.2, 34.1, 18.7; IR (thin film): ν_{max} (cm^{-1}) = 3345, 3052, 3028, 2958, 2926, 2867, 2815, 1692, 1599, 1566, 1492, 1461, 1443, 1351, 1295, 1224, 1182, 1144, 1025, 914, 862, 804, 747, 702, 658; HRMS (ESI) calcd for $\text{C}_{17}\text{H}_{19}\text{BrNO}[\text{M} + \text{H}]^+$: 332.0645; Found: 332.0643.

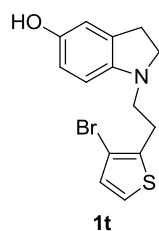


Light yellow solid, m.p. = 99-101 °C. ^1H NMR (400 MHz, Acetone- d_6) δ 7.59 (dd, J = 8.0, 1.2 Hz, 1H), 7.46 (s, 1H), 7.41 (dd, J = 7.6, 2.0 Hz, 1H), 7.32 (td, J = 7.6, 1.2 Hz, 1H), 7.15 (td, J = 7.6, 1.6 Hz, 1H), 6.62 (d, J = 2.0 Hz, 1H), 6.55 (dd, J = 8.4, 2.4 Hz, 1H), 6.51 (d, J = 8.0 Hz, 1H), 3.46-3.42 (m, 1H), 3.39-3.31 (m, 1H), 3.21-3.14 (m, 1H), 3.05-2.93 (m, 2H), 2.89-2.84 (m, 1H), 1.93-1.87 (m, 1H), 1.72-1.58 (m, 2H), 1.50-1.47 (m, 1H), 1.37-1.27 (m, 4H); ^{13}C NMR (100 MHz, Acetone- d_6) δ 150.6, 145.3, 140.3, 136.9, 133.3, 132.2, 128.8, 128.5, 124.8, 113.5, 111.9, 108.9, 64.1, 47.0, 41.6, 33.9, 29.6, 25.8, 24.3, 21.5; IR (thin film): ν_{max} (cm^{-1}) = 3318, 2924, 2848, 1599, 1566, 1484, 1462, 1440, 1405, 1364, 1344, 1301, 1280, 1234, 1181, 1136, 1092, 1035, 1018, 990, 932, 882, 862, 823, 804, 750, 730, 674, 655; HRMS (ESI) calcd for $\text{C}_{20}\text{H}_{23}\text{BrNO}[\text{M} + \text{H}]^+$: 372.0958; Found: 372.0957.

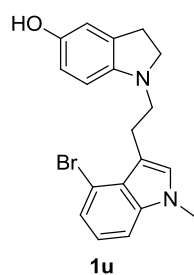


Light yellow oil. ^1H NMR (400 MHz, Acetone- d_6) δ 7.56 (dd, J = 7.6, 0.8 Hz, 1H), 7.47 (br, 1H), 7.36 (dd, J = 7.6, 1.6 Hz, 1H), 7.30 (td, J = 7.6, 0.8 Hz, 1H), 7.13 (td, J = 7.6, 1.6 Hz, 1H), 6.61 (d, J = 2.0 Hz, 1H), 6.50 (dd, J = 8.4, 2.4 Hz, 1H), 6.32 (d, J = 8.4 Hz, 1H), 3.23 (t, J = 8.0 Hz, 2H), 3.00 (t, J = 6.8 Hz, 2H), 2.88-2.80 (m, 4H), 1.93-1.86 (m, 2H); ^{13}C NMR (100 MHz, Acetone- d_6) δ 150.6, 146.9, 142.0, 133.3, 132.1, 131.4, 128.5, 128.3, 124.7, 113.7, 113.2, 108.6, 54.3, 50.7, 34.1, 29.4, 28.3; IR (thin film): ν_{max} (cm^{-1}) = 3119, 3067, 2951, 2839, 1608, 1565, 1490, 1455, 1433, 1398, 1299, 1272, 1240, 1218, 1186, 1165, 1134, 1119, 1066, 1055, 1018, 992, 937, 859, 837, 799, 773, 743, 654; HRMS (ESI) calcd for $\text{C}_{17}\text{H}_{19}\text{BrNO}[\text{M} + \text{H}]^+$: 332.0645;

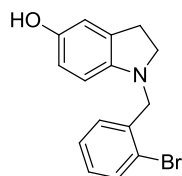
Found: 332.0632.



Light yellow oil. ^1H NMR (400 MHz, Acetone- d_6) δ 7.52 (br, 1H), 7.40 (d, J = 5.2 Hz, 1H), 6.99 (d, J = 5.6 Hz, 1H), 6.64-6.63 (m, 1H), 6.52 (dd, J = 8.4, 2.8 Hz, 1H), 6.40 (d, J = 8.0 Hz, 1H), 3.33 (t, J = 8.0 Hz, 2H), 3.25 (t, J = 7.6 Hz, 2H), 3.08 (t, J = 7.2 Hz, 2H), 2.88-2.82 (m, 2H); ^{13}C NMR (100 MHz, Acetone- d_6) δ 150.6, 146.0, 137.5, 132.1, 130.1, 125.2, 113.7, 113.2, 109.3, 108.5, 54.2, 51.3, 29.3, 27.6; IR (thin film): ν_{max} (cm^{-1}) = 3310, 3106, 3029, 2922, 2819, 1731, 1601, 1490, 1459, 1346, 1299, 1223, 1185, 1132, 1084, 1052, 990, 959, 934, 907, 859, 838, 801, 753, 728, 699, 620; HRMS (ESI) calcd for $\text{C}_{14}\text{H}_{15}\text{BrNOS}[\text{M} + \text{H}]^+$: 324.0052; Found: 324.0052.

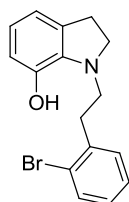


Light grey crystal, m.p. = 162-163 $^{\circ}\text{C}$. ^1H NMR (400 MHz, Acetone- d_6) δ 7.46 (s, 1H), 7.38 (d, J = 8.4 Hz, 1H), 7.26 (s, 1H), 7.23 (d, J = 7.6 Hz, 1H), 7.04 (t, J = 8.0 Hz, 1H), 6.63 (s, 1H), 6.51 (dd, J = 8.4, 2.0 Hz, 1H), 6.40 (d, J = 8.4 Hz, 1H), 3.79 (s, 3H), 3.37 (t, J = 8.0 Hz, 2H), 3.32-3.22 (m, 4H), 2.87-2.83 (m, 2H); ^{13}C NMR (100 MHz, $(\text{CD}_3)_2\text{SO}$) δ 149.7, 145.2, 138.0, 131.0, 129.8, 125.0, 122.8, 122.0, 113.0, 112.8, 112.4, 111.8, 109.6, 107.8, 53.3, 52.5, 32.6, 28.5, 23.3; IR (thin film): ν_{max} (cm^{-1}) = 3048, 2935, 2868, 1601, 1546, 1467, 1414, 1369, 1316, 1250, 1217, 1189, 1125, 1083, 1049, 1010, 987, 951, 855, 833, 796, 767, 756, 733; HRMS (ESI) calcd for $\text{C}_{19}\text{H}_{20}\text{BrN}_2\text{O}[\text{M} + \text{H}]^+$: 371.0754; Found: 371.0752.



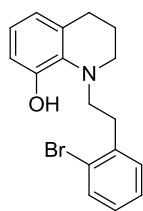
1v

Light pink solid, m.p. = 104-105 °C. ^1H NMR (400 MHz, Acetone- d_6) δ 7.62 (dd, J = 8.0, 1.2 Hz, 1H), 7.55-7.53 (m, 2H), 7.37 (td, J = 7.6, 1.2 Hz, 1H), 7.25-7.20 (m, 1H), 6.67-6.66 (m, 1H), 6.51 (dd, J = 8.4, 2.4 Hz, 1H), 6.34 (d, J = 8.4 Hz, 1H), 4.20 (s, 2H), 3.28 (t, J = 8.4 Hz, 2H), 2.88 (t, J = 8.4 Hz, 2H); ^{13}C NMR (100 MHz, Acetone- d_6) δ 151.2, 146.6, 138.8, 133.4, 132.2, 130.8, 129.6, 128.4, 124.1, 113.7, 113.4, 108.7, 56.2, 55.6; IR (thin film): ν_{max} (cm^{-1}) = 3371, 3046, 2962, 2796, 1489, 1460, 1437, 1400, 1356, 1267, 1238, 1217, 1174, 1142, 1050, 1026, 936, 870, 839, 795, 776, 752, 718, 657, 641; HRMS (ESI) calcd for $\text{C}_{15}\text{H}_{15}\text{BrNO}[\text{M} + \text{H}]^+$: 304.0332; Found: 304.0333.



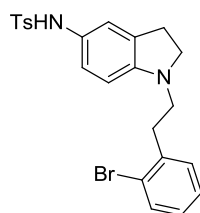
1w

Yellow solid, m.p. = 110-111 °C. ^1H NMR (400 MHz, Acetone- d_6) δ 7.98 (s, 1H), 7.56 (dd, J = 8.0, 0.8 Hz, 1H), 7.41 (dd, J = 7.6, 1.6 Hz, 1H), 7.29 (td, J = 7.6, 1.2 Hz, 1H), 7.12 (td, J = 8.0, 1.6 Hz, 1H), 6.62-6.59 (m, 2H), 6.52-6.48 (m, 1H), 3.71-3.67 (m, 2H), 3.43 (t, J = 8.4 Hz, 2H), 3.05-3.01 (m, 2H), 2.91 (t, J = 8.4 Hz, 2H); ^{13}C NMR (100 MHz, Acetone- d_6) δ 143.8, 140.8, 139.5, 133.4, 133.2, 132.0, 128.8, 128.5, 125.0, 119.9, 117.3, 116.0, 54.1, 51.6, 34.5, 29.9; IR (thin film): ν_{max} (cm^{-1}) = 3671, 2931, 2849, 2547, 1594, 1468, 1439, 1373, 1318, 1295, 1259, 1172, 1107, 1067, 1043, 1007, 980, 841, 750, 696, 657; HRMS (ESI) calcd for $\text{C}_{16}\text{H}_{17}\text{BrNO}[\text{M} + \text{H}]^+$: 318.0488; Found: 318.0483.



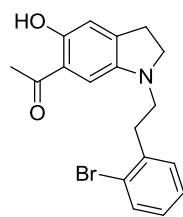
1x

Brown oil. ^1H NMR (400 MHz, CD_3CN) δ 7.58 (dd, J = 8.0, 1.2 Hz, 1H), 7.36 (dd, J = 7.6, 1.6 Hz, 1H), 7.31 (td, J = 7.2, 1.2 Hz, 1H), 7.17-7.12 (m, 1H), 6.74-6.70 (m, 1H), 6.56 (d, J = 7.6 Hz, 2H), 5.84 (br, 1H), 3.19-3.17 (m, 2H), 3.10-3.05 (m, 4H), 2.72 (t, J = 6.8 Hz, 2H), 1.89-1.83 (m, 2H); ^{13}C NMR (100 MHz, CD_3CN) δ 150.0, 140.2, 137.2, 133.7, 132.5, 131.0, 129.3, 128.7, 125.2, 122.8, 121.7, 113.2, 54.8, 48.0, 35.9, 27.6, 18.7; IR (thin film): ν_{max} (cm^{-1}) = 3439, 3052, 3030, 2935, 2860, 1583, 1467, 1439, 1351, 1264, 1211, 1171, 1128, 1105, 1065, 1024, 958, 893, 844, 742, 655; HRMS (ESI) calcd for $\text{C}_{17}\text{H}_{19}\text{BrNO}[\text{M} + \text{H}]^+$: 332.0645; Found: 332.0649.



1y

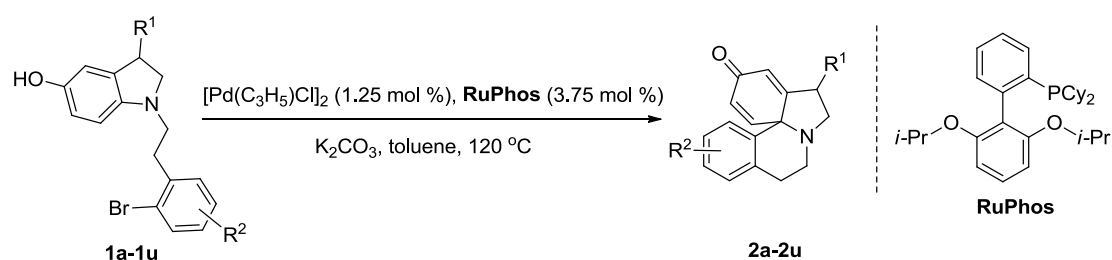
Yellow solid, m.p. = 99-101 $^{\circ}\text{C}$. ^1H NMR (400 MHz, Acetone- d_6) δ 8.31 (s, 1H), 7.59-7.57 (m, 3H), 7.42 (dd, J = 7.6, 1.6 Hz, 1H), 7.33-7.29 (m, 3H), 7.16 (td, J = 8.0, 2.0 Hz, 1H), 6.88 (s, 1H), 6.73 (dd, J = 8.4, 2.0 Hz, 1H), 6.37 (d, J = 8.4 Hz, 1H), 3.44 (t, J = 8.4 Hz, 2H), 3.32-3.28 (m, 2H), 3.03-2.99 (m, 2H), 2.86 (t, J = 8.4 Hz, 2H), 2.37 (s, 3H); ^{13}C NMR (100 MHz, Acetone- d_6) δ 150.8, 143.6, 139.6, 138.0, 133.3, 131.8, 131.2, 129.9, 128.9, 128.4, 127.8, 124.7, 123.6, 121.6, 107.0, 53.4, 49.4, 33.8, 28.7, 21.3; IR (thin film): ν_{max} (cm^{-1}) = 3675, 3232, 2988, 2901, 1617, 1495, 1469, 1382, 1323, 1271, 1254, 1227, 1156, 1134, 1057, 1018, 901, 870, 811, 799, 767, 745, 691, 665; HRMS (ESI) calcd for $\text{C}_{23}\text{H}_{24}\text{BrN}_2\text{O}_2\text{S}[\text{M} + \text{H}]^+$: 471.0736; Found: 471.0718.



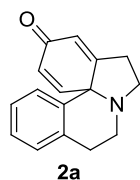
1z

Yellow oil. ^1H NMR (400 MHz, CDCl_3) δ 12.25 (s, 1H), 7.56 (d, $J = 7.6$ Hz, 1H), 7.29-7.23 (m, 2H), 7.12-7.08 (m, 1H), 6.75 (s, 1H), 6.62 (s, 1H), 3.44 (t, $J = 8.0$ Hz, 2H), 3.33-3.29 (m, 2H), 3.06-3.02 (m, 2H), 2.98 (t, $J = 8.0$ Hz, 2H), 2.54 (s, 3H); ^{13}C NMR (100 MHz, CDCl_3) δ 203.5, 157.1, 144.4, 141.8, 138.9, 132.9, 131.0, 128.1, 127.7, 124.4, 117.4, 114.6, 105.0, 52.7, 49.5, 33.4, 29.2, 26.8; IR (thin film): ν_{max} (cm^{-1}) = 3229, 3053, 2928, 2830, 1755, 1640, 1616, 1592, 1487, 1470, 1425, 1364, 1322, 1262, 1210, 1141, 1107, 1024, 987, 943, 869, 833, 746, 654; HRMS (ESI) calcd for $\text{C}_{18}\text{H}_{18}\text{BrNNaO}_2$ $[\text{M} + \text{Na}]^+$: 382.0413; Found: 382.0411.

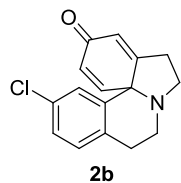
General procedure for palladium-catalyzed dearomatization reaction



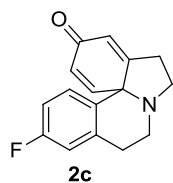
A flame-dried Schlenk tube was cooled down to room temperature under argon. To this tube were added $[Pd(C_3H_5)Cl]_2$ (1.8 mg, 0.005 mmol, 1.25 mol%), **RuPhos** (7.0 mg, 0.015 mmol, 3.75 mol%), K_2CO_3 (83.0 mg, 0.6 mmol, 1.5 equiv.), 5-hydroxyl indolines (**1a-1u**) (0.4 mmol, 1.0 equiv.) and toluene (2.0 mL). Then the reaction mixture was stirred at 120 °C. After completion (monitored by TLC), the reaction mixture was cooled to room temperature and diluted with ethyl acetate (3mL). The mixture was filtered through celite, and the filtrate was concentrated under reduced pressure. The crude product was purified by silica gel column chromatography (PE/acetone = 3/1) to afford the desired product (**2a-2u**).



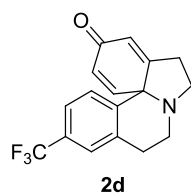
Yellow solid, m.p. = 132-134 °C, 84.8 mg, 90% yield (from **1aa**); 80.8 mg, 86% yield (from **1ab**); 85.1 mg, 90% yield (from **1ac**). 1H NMR (400 MHz, $CDCl_3$) δ 7.19-7.07 (m, 4H), 6.99 (d, J = 7.6 Hz, 1H), 6.26 (s, 1H), 6.12 (d, J = 9.6 Hz, 1H), 3.56-3.47 (m, 1H), 3.33-3.22 (m, 3H), 3.16 (td, J = 9.6, 6.0 Hz, 1H), 2.70-2.54 (m, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 187.2, 166.5, 147.7, 134.3, 131.0, 130.1, 127.5, 126.7, 126.6, 125.9, 122.9, 64.4, 46.5, 40.6, 27.8, 20.4; IR (thin film): ν_{max} (cm^{-1}) = 2958, 2919, 2872, 1721, 1670, 1641, 1597, 1478, 1451, 1440, 1380, 1339, 1302, 1286, 1263, 1202, 1133, 1111, 1063, 1042, 1028, 974, 918, 890, 860, 811, 757, 727, 691, 674, 643; HRMS (ESI) calcd for $C_{16}H_{16}NO[M + H]^+$: 238.1226; Found: 238.1230.



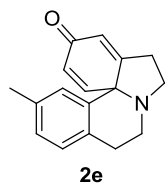
Grey solid, m.p. = 135-137 °C, 36.7 mg, 68% yield (0.2 mmol scale). ¹H NMR (400 MHz, CDCl₃) δ 7.14 (dd, *J* = 8.0, 1.6 Hz, 1H), 7.08-7.06 (m, 2H), 6.96 (d, *J* = 1.6 Hz, 1H), 6.28 (s, 1H), 6.16 (d, *J* = 10.0 Hz, 1H), 3.53-3.45 (m, 1H), 3.33-3.07 (m, 4H), 2.72-2.57 (m, 3H); ¹³C NMR (100 MHz, CDCl₃) δ 186.8, 165.7, 147.0, 133.3, 132.8, 132.2, 131.5, 127.9, 126.5, 126.4, 123.3, 64.3, 46.6, 40.5, 27.8, 19.9; IR (thin film): ν_{max} (cm⁻¹) = 2924, 2853, 1724, 1671, 1642, 1598, 1481, 1467, 1431, 1381, 1338, 1301, 1277, 1262, 1161, 1122, 1090, 1064, 1034, 974, 923, 888, 868, 810, 754, 692, 659; HRMS (ESI) calcd for C₁₆H₁₅ClNO[M + H]⁺: 272.0837; Found: 272.0834.



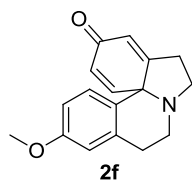
Brown solid, m.p. = 122-124 °C, 93.3 mg, 92% yield. ¹H NMR (400 MHz, CDCl₃) δ 7.09 (d, *J* = 9.6 Hz, 1H), 6.97 (dd, *J* = 8.4, 5.6 Hz, 1H), 6.83-6.78 (m, 2H), 6.26 (d, *J* = 1.2 Hz, 1H), 6.12 (dd, *J* = 9.6, 1.2 Hz, 1H), 3.54-3.45 (m, 1H), 3.32-3.21 (m, 3H), 3.13 (td, *J* = 10.0, 1.6 Hz, 1H), 2.71-2.54 (m, 3H); ¹³C NMR (100 MHz, CDCl₃) δ 186.9, 166.1, 161.5 (d, *J* = 246.2 Hz), 147.5, 136.8 (d, *J* = 7.7 Hz), 128.6 (d, *J* = 8.4 Hz), 126.7 (d, *J* = 2.8 Hz), 125.8, 122.9, 116.1 (d, *J* = 20.6 Hz), 114.2 (d, *J* = 21.6 Hz), 63.9, 46.5, 40.3, 27.7, 20.7; ¹⁹F NMR (386 Hz, CDCl₃) δ -114.6 (m); IR (thin film): ν_{max} (cm⁻¹) = 2942, 2855, 1665, 1640, 1613, 1581, 1488, 1451, 1427, 1384, 1336, 1290, 1263, 1232, 1181, 1151, 1111, 1101, 1062, 1045, 989, 913, 893, 821, 795, 716, 687; HRMS (ESI) calcd for C₁₆H₁₅FNO[M + H]⁺: 256.1132; Found: 256.1140.



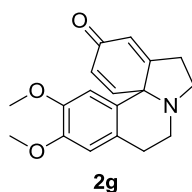
Yellow oil, 94.4 mg, 78% yield. ^1H NMR (400 MHz, CDCl_3) δ 7.40 (s, 1H), 7.33 (d, J = 8.4 Hz, 1H), 7.12 (d, J = 8.0 Hz, 1H), 7.09 (d, J = 10.0 Hz, 1H), 6.30 (s, 1H), 6.17 (dd, J = 10.0, 5.6 Hz, 1H), 3.58-3.50 (m, 1H), 3.38-3.27 (m, 3H), 3.13 (td, J = 10.0, 6.0 Hz, 1H), 2.74-2.63 (m, 2H), 2.62-2.55 (m, 1H); ^{13}C NMR (100 MHz, CDCl_3) δ 186.8, 165.6, 146.9, 135.7, 135.3, 129.7 (q, J = 32.3 Hz), 127.5, 127.0 (q, J = 3.7 Hz), 126.5, 123.7 (q, J = 270.8 Hz), 123.4 (q, J = 3.7 Hz), 123.3, 64.3, 46.6, 40.4, 27.8, 20.5; ^{19}F NMR (386 Hz, CDCl_3) δ -62.8 (m); IR (thin film): ν_{max} (cm^{-1}) = 2932, 2874, 1670, 1645, 1485, 1458, 1421, 1385, 1324, 1289, 1174, 1155, 1116, 1076, 1039, 980, 915, 894, 828, 807, 751, 736, 688; HRMS (ESI) calcd for $\text{C}_{17}\text{H}_{15}\text{F}_3\text{NO}[\text{M} + \text{H}]^+$: 306.1100; Found: 306.1110.



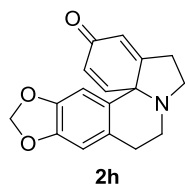
Light yellow solid, m.p. = 87-89 $^{\circ}\text{C}$, 91.1 mg, 91% yield. ^1H NMR (400 MHz, CDCl_3) δ 7.11 (d, J = 9.6 Hz, 1H), 7.03-6.98 (m, 2H), 6.77 (s, 1H), 6.27 (s, 1H), 6.13 (dd, J = 9.6, 1.2 Hz, 1H), 3.54-3.46 (m, 1H), 3.32-3.12 (m, 4H), 2.70-2.55 (m, 3H), 2.21 (s, 3H); ^{13}C NMR (100 MHz, CDCl_3) δ 187.3, 166.6, 147.8, 136.3, 131.1, 130.6, 130.0, 128.4, 126.7, 125.8, 122.8, 64.4, 46.4, 40.6, 27.8, 20.9, 20.1; IR (thin film): ν_{max} (cm^{-1}) = 3023, 2928, 2865, 1726, 1666, 1634, 1593, 1499, 1453, 1429, 1385, 1338, 1284, 1231, 1214, 1183, 1136, 1111, 1038, 978, 928, 897, 862, 846, 811, 751, 689, 639; HRMS (ESI) calcd for $\text{C}_{17}\text{H}_{18}\text{NO}[\text{M} + \text{H}]^+$: 252.1383; Found: 252.1387.



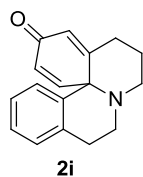
Light yellow solid, m.p. = 117-119 °C, 74.5 mg, 70% yield. ^1H NMR (400 MHz, CDCl_3) δ 7.10 (d, J = 9.6 Hz, 1H), 6.90 (d, J = 8.8 Hz, 1H), 6.67 (dd, J = 8.8, 2.4 Hz, 1H), 6.63 (d, J = 2.4 Hz, 1H), 6.24 (d, J = 1.6 Hz, 1H), 6.10 (dd, J = 10.0, 1.6 Hz, 1H), 3.77 (s, 3H), 3.53-3.45 (m, 1H), 3.31-3.20 (m, 3H), 3.15 (td, J = 10.0, 6.4 Hz, 1H), 2.69-2.55 (m, 3H); ^{13}C NMR (100 MHz, CDCl_3) δ 187.2, 166.6, 158.6, 147.9, 135.8, 127.9, 125.4, 122.7, 122.6, 114.2, 113.3, 64.0, 55.1, 46.4, 40.6, 27.8, 20.8; IR (thin film): $\nu_{\text{max}}(\text{cm}^{-1})$ = 2937, 2868, 1664, 1636, 1603, 1493, 1468, 1453, 1433, 1380, 1317, 1295, 1274, 1238, 1172, 1131, 1109, 1032, 985, 921, 869, 821, 747, 693, 648; HRMS (ESI) calcd for $\text{C}_{17}\text{H}_{18}\text{NO}_2[\text{M} + \text{H}]^+$: 268.1332; Found: 268.1336.



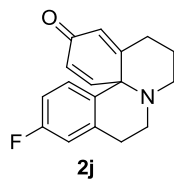
Light yellow solid, m.p. = 64-66 °C, 106.5 mg, 90% yield. ^1H NMR (400 MHz, CDCl_3) δ 7.11 (d, J = 10.0 Hz, 1H), 6.57 (s, 1H), 6.41 (s, 1H), 6.27 (s, 1H), 6.14 (d, J = 9.6 Hz, 1H), 3.85 (s, 3H), 3.70 (s, 3H), 3.52-3.44 (m, 1H), 3.32-3.12 (m, 4H), 2.71-2.60 (m, 2H), 2.53 (dd, J = 17.2, 5.2 Hz, 1H); ^{13}C NMR (100 MHz, CDCl_3) δ 187.1, 166.8, 148.5, 147.9, 147.8, 126.6, 125.6, 122.7, 122.2, 112.0, 108.3, 64.1, 55.7, 55.7, 46.3, 40.6, 27.8, 20.0; IR (thin film): $\nu_{\text{max}}(\text{cm}^{-1})$ = 2930, 2849, 1667, 1640, 1602, 1505, 1460, 1398, 1356, 1335, 1322, 1290, 1249, 1222, 1209, 1170, 1133, 1096, 1030, 1006, 906, 854, 812, 784, 691; HRMS (ESI) calcd for $\text{C}_{18}\text{H}_{20}\text{NO}_3[\text{M} + \text{H}]^+$: 298.1438; Found: 298.1437.



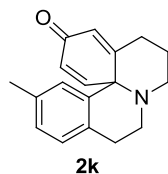
Light yellow solid, m.p. = 126-128 °C, 94.5 mg, 84% yield. ^1H NMR (400 MHz, CDCl_3) δ 7.07 (d, J = 10.0 Hz, 1H), 6.56 (s, 1H), 6.44 (s, 1H), 6.24 (d, J = 1.2 Hz, 1H), 6.12 (dd, J = 10.0, 1.2 Hz, 1H), 5.88 (d, J = 2.0 Hz, 2H), 3.49-3.41 (m, 1H), 3.28-3.20 (m, 2H), 3.18-3.10 (m, 2H), 2.70-2.59 (m, 2H), 2.51 (dd, J = 17.2, 5.6 Hz, 1H); ^{13}C NMR (100 MHz, CDCl_3) δ 187.1, 166.6, 147.7, 147.2, 146.5, 127.9, 125.9, 123.7, 122.9, 109.2, 106.0, 101.0, 64.4, 46.5, 40.7, 27.8, 20.8; IR (thin film): ν_{max} (cm^{-1}) = 2951, 2924, 2875, 1666, 1635, 1598, 1502, 1475, 1424, 1374, 1338, 1290, 1259, 1227, 1149, 1130, 1112, 1069, 1034, 934, 913, 861, 822, 799, 756, 693, 660; HRMS (ESI) calcd for $\text{C}_{17}\text{H}_{16}\text{NO}_3[\text{M} + \text{H}]^+$: 282.1125; Found: 282.1121.



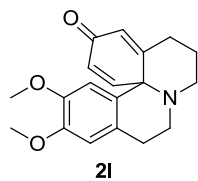
White solid, m.p. = 105-107 °C, 97.1 mg, 97% yield. ^1H NMR (400 MHz, CDCl_3) δ 7.28 (d, J = 10.4 Hz, 1H), 7.24-7.16 (m, 2H), 7.10 (t, J = 7.6 Hz, 1H), 6.87 (d, J = 8.0 Hz, 1H), 6.37 (s, 1H), 6.10 (dd, J = 10.4, 2.0 Hz, 1H), 3.92-3.85 (m, 1H), 3.34-3.25 (m, 1H), 3.13 (dd, J = 14.8, 8.0 Hz, 1H), 2.95 (td, J = 11.6, 3.2 Hz, 1H), 2.88-2.84 (m, 1H), 2.71 (dd, J = 18.0, 6.4 Hz, 1H), 2.45 (d, J = 12.8 Hz, 1H), 2.21-2.12 (m, 1H), 1.95-1.77 (m, 2H); ^{13}C NMR (100 MHz, CDCl_3) δ 186.3, 160.5, 149.4, 133.7, 132.7, 130.1, 127.7, 127.0, 126.7, 126.1, 124.7, 61.1, 48.4, 45.1, 32.7, 27.1, 21.4; IR (thin film): ν_{max} (cm^{-1}) = 3049, 2924, 2856, 2823, 1665, 1629, 1604, 1484, 1444, 1392, 1346, 1304, 1288, 1216, 1197, 1151, 1127, 1102, 1086, 1044, 1023, 986, 964, 936, 900, 879, 816, 802, 758, 726, 672, 628; HRMS (ESI) calcd for $\text{C}_{17}\text{H}_{18}\text{NO}[\text{M} + \text{H}]^+$: 252.1383; Found: 252.1380.



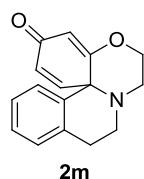
Yellow solid, m.p. = 118-120 °C, 95.6 mg, 89% yield. ^1H NMR (400 MHz, CDCl_3) δ 7.25 (d, J = 10.4 Hz, 1H), 6.89-6.79 (m, 3H), 6.36 (s, 1H), 6.09 (d, J = 10.0 Hz, 1H), 3.91-3.82 (m, 1H), 3.33-3.24 (m, 1H), 3.12 (dd, J = 14.8, 8.0 Hz, 1H), 2.94-2.84 (m, 2H), 2.70 (dd, J = 18.0, 6.4 Hz, 1H), 2.46 (d, J = 12.8 Hz, 1H), 2.14 (td, J = 13.6, 4.8 Hz, 1H), 1.94-1.91 (m, 1H), 1.87-1.76 (m, 1H); ^{13}C NMR (100 MHz, CDCl_3) δ 186.2, 161.7 (d, J = 245.7 Hz), 160.2, 149.2, 136.3 (d, J = 7.6 Hz), 128.4 (d, J = 2.9 Hz), 128.0 (d, J = 8.2 Hz), 126.7, 124.7, 116.3 (d, J = 20.7 Hz), 114.4 (d, J = 21.4 Hz), 60.7, 48.3, 44.8, 32.6, 27.1, 21.7; ^{19}F NMR (386 Hz, CDCl_3) δ -114.1 (m); IR (thin film): ν_{max} (cm^{-1}) = 2944, 2846, 1666, 1610, 1584, 1488, 1437, 1419, 1395, 1291, 1274, 1256, 1235, 1218, 1199, 1132, 1102, 1087, 1050, 1025, 992, 977, 937, 901, 872, 856, 814, 751, 661, 628; HRMS (ESI) calcd for $\text{C}_{17}\text{H}_{17}\text{FNO}[\text{M} + \text{H}]^+$: 270.1289; Found: 270.1291.



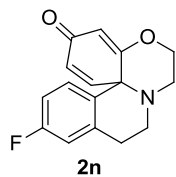
Colorless oil, 97.3 mg, 92% yield. ^1H NMR (400 MHz, CDCl_3) δ 7.27 (d, J = 10.0 Hz, 1H), 7.07-7.02 (m, 2H), 6.65 (s, 1H), 6.38 (t, J = 1.6 Hz, 1H), 6.10 (dd, J = 10.4, 2.0 Hz, 1H), 3.91-3.83 (m, 1H), 3.29-3.20 (m, 1H), 3.11 (dd, J = 14.8, 8.0 Hz, 1H), 2.95 (td, J = 12.0, 3.2 Hz, 1H), 2.87-2.83 (m, 1H), 2.66 (dd, J = 17.6, 6.8 Hz, 1H), 2.46 (d, J = 13.2 Hz, 1H), 2.22 (s, 1H), 2.22-2.14 (m, H), 1.95-1.77 (m, 2H); ^{13}C NMR (100 MHz, CDCl_3) δ 186.6, 160.8, 149.6, 136.7, 132.4, 130.5, 130.0, 128.7, 126.7, 126.3, 124.7, 61.2, 48.4, 45.2, 32.9, 27.2, 21.2, 21.0; IR (thin film): ν_{max} (cm^{-1}) = 3010, 2943, 2848, 1666, 1631, 1609, 1498, 1439, 1395, 1286, 1218, 1197, 1131, 1088, 1049, 1024, 968, 901, 878, 844, 807, 748, 663, 621; HRMS (ESI) calcd for $\text{C}_{18}\text{H}_{20}\text{NO}[\text{M} + \text{H}]^+$: 266.1539; Found: 266.1539.



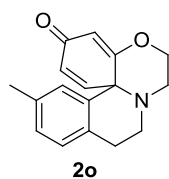
Purple sticky oil, 110.4 mg, 89% yield. ^1H NMR (400 MHz, CDCl_3) δ 7.28 (d, $J = 9.6$ Hz, 1H), 6.63 (s, 1H), 6.37 (s, 1H), 6.29 (s, 1H), 6.10 (d, $J = 9.6$ Hz, 1H), 3.87(s, 3H), 3.87-3.81 (m, 1H), 3.70 (s, 3H), 3.26-3.17 (m, 1H), 3.10 (dd, $J = 14.4, 7.6$ Hz, 1H), 2.96 (td, $J = 11.6, 2.4$ Hz, 1H), 2.84 (d, $J = 11.2$ Hz, 1H), 2.60 (dd, $J = 17.2, 6.8$ Hz, 1H), 2.46 (d, $J = 12.8$ Hz, 1H), 2.21-2.13 (m, 1H), 1.93-1.76 (m, 2H); ^{13}C NMR (100 MHz, CDCl_3) δ 186.4, 160.8, 149.6, 148.6, 148.0, 126.5, 126.0, 124.4, 123.9, 112.2, 108.1, 60.8, 55.8, 55.7, 48.2, 45.1, 32.8, 27.6, 21.1; IR (thin film): ν_{max} (cm^{-1}) = 3003, 2938, 2848, 1665, 1630, 1607, 1507, 1462, 1441, 1397, 1351, 1324, 1294, 1251, 1212, 1172, 1131, 1099, 1028, 1006, 982, 904, 878, 860, 805, 785, 749, 664; HRMS (ESI) calcd for $\text{C}_{19}\text{H}_{22}\text{NO}_3[\text{M} + \text{H}]^+$: 312.1594; Found: 312.1600.



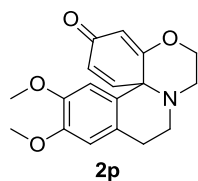
White solid, m.p. = 108-110 $^{\circ}\text{C}$, 101.0 mg, 99% yield. ^1H NMR (400 MHz, CDCl_3) δ 7.24-7.11 (m, 4H), 6.98 (d, $J = 10.0$ Hz, 1H), 6.04 (s, 1H), 6.01 (d, $J = 10.4$ Hz, 1H), 4.12 (t, $J = 4.8$ Hz, 2H), 3.71-3.63 (m, 1H), 3.29-3.10 (m, 4H), 2.74-2.69 (m, 1H); ^{13}C NMR (100 MHz, CDCl_3) δ 188.2, 172.6, 145.3, 134.8, 132.5, 130.0, 128.0, 127.4, 126.1, 123.7, 110.6, 68.6, 59.6, 48.4, 45.9, 22.5; IR (thin film): ν_{max} (cm^{-1}) = 2957, 2900, 2854, 1656, 1626, 1595, 1484, 1465, 1445, 1390, 1332, 1306, 1260, 1238, 1186, 1126, 1094, 1061, 1044, 1016, 965, 893, 857, 823, 759, 732, 684, 628; HRMS (ESI) calcd for $\text{C}_{16}\text{H}_{16}\text{NO}_2[\text{M} + \text{H}]^+$: 254.1176; Found: 254.1176.



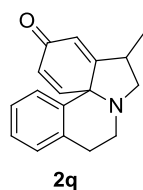
Grey solid, m.p. = 145-147 °C, 101.7 mg, 94% yield. ^1H NMR (400 MHz, CDCl_3) δ 7.12-7.08 (m, 1H), 6.95 (d, J = 10.0 Hz, 1H), 6.89-6.85 (m, 2H), 6.04-6.00 (m, 2H), 4.13-4.10 (m, 2H), 3.69- 3.62 (m, 1H), 3.27-3.09 (m, 4H), 2.74-2.67 (m, 1H); ^{13}C NMR (100 MHz, CDCl_3) δ 187.9, 172.2, 161.8 (d, J = 246.6 Hz), 145.1, 137.2 (d, J = 7.7 Hz), 128.2 (d, J = 8.2 Hz), 123.6, 116.1 (d, J = 20.9 Hz), 114.7 (d, J = 20.5 Hz), 110.6, 68.6, 59.1, 48.2, 45.4, 22.7; ^{19}F NMR (386 Hz, CDCl_3) δ -113.8 (m); IR (thin film): ν_{max} (cm^{-1}) = 3056, 2962, 2945, 2929, 2854, 1657, 1625, 1613, 1594, 1487, 1465, 1420, 1391, 1356, 1333, 1309, 1261, 1233, 1186, 1151, 1126, 1104, 1060, 1017, 979, 923, 888, 859, 812, 709, 681, 628; HRMS (ESI) calcd for $\text{C}_{16}\text{H}_{15}\text{FNO}_2[\text{M} + \text{H}]^+$: 272.1081; Found: 272.1084.



Light yellow solid, m.p. = 90-92 °C, 104.8 mg, 97% yield. ^1H NMR (400 MHz, CDCl_3) δ 7.04 (s, 2H), 6.97 (d, J = 10.0 Hz, 1H), 6.91 (s, 1H), 6.04 (s, 1H), 6.02 (d, J = 10.0 Hz, 1H), 4.15-4.09 (m, 2H), 3.69-3.60 (m, 1H), 3.28-3.05 (m, 4H), 2.70-2.64 (m, 1H), 2.24 (s, 3H); ^{13}C NMR (100 MHz, CDCl_3) δ 188.2, 172.7, 145.3, 137.0, 132.0, 131.6, 129.8, 128.9, 126.1, 123.6, 110.5, 68.6, 59.5, 48.3, 45.9, 22.0, 21.0; IR (thin film): ν_{max} (cm^{-1}) = 2979, 2959, 2915, 2853, 1654, 1619, 1592, 1498, 1465, 1387, 1363, 1342, 1330, 1307, 1259, 1233, 1186, 1129, 1097, 1060, 1042, 1016, 975, 909, 866, 831, 816, 797, 749, 720, 684, 631; HRMS (ESI) calcd for $\text{C}_{17}\text{H}_{18}\text{NO}_2[\text{M} + \text{H}]^+$: 268.1332; Found: 268.1337.

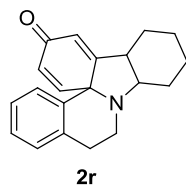


White solid, m.p. = 146-147 °C, 124.2 mg, 99% yield. ^1H NMR (400 MHz, CDCl_3) δ 6.97 (d, J = 9.6 Hz, 1H), 6.60 (s, 1H), 6.54 (s, 1H), 6.03-6.01 (m, 2H), 4.19-4.09 (m, 2H), 3.86 (s, 3H), 3.72 (s, 3H), 3.67-3.59 (m, 1H), 3.30-3.24 (m, 1H), 3.21-3.02 (m, 3H), 2.61 (dd, J = 16.4, 4.4 Hz, 1H); ^{13}C NMR (100 MHz, CDCl_3) δ 188.1, 172.9, 148.7, 148.2, 145.4, 127.2, 123.6, 123.4, 112.0, 110.1, 108.0, 68.5, 59.2, 55.7, 55.7, 48.2, 46.0, 22.1; IR (thin film): ν_{max} (cm^{-1}) = 2958, 2900, 2857, 1659, 1630, 1601, 1511, 1459, 1438, 1391, 1354, 1333, 1311, 1250, 1222, 1203, 1178, 1138, 1100, 1018, 1000, 898, 867, 803, 779, 722, 688, 654; HRMS (ESI) calcd for $\text{C}_{18}\text{H}_{20}\text{NO}_4[\text{M} + \text{H}]^+$: 314.1387; Found: 314.1392.

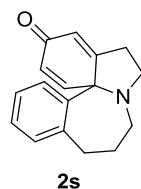


Light yellow solid, m.p. = 143-144 °C, 81.2 mg, 81% yield (dr = 2.5:1). Major: ^1H NMR (400 MHz, CDCl_3) δ 7.18-7.07 (m, 4H), 6.95 (d, J = 7.6 Hz, 1H), 6.18 (s, 1H), 6.15 (d, J = 9.6 Hz, 1H), 3.48-3.38 (m, 2H), 3.32-3.22 (m, 2H), 2.93 (dd, J = 9.6, 6.4 Hz, 1H), 2.77-2.71 (m, 1H), 2.62-2.56 (m, 1H), 1.19 (d, J = 6.8 Hz, 3H); ^{13}C NMR (100 MHz, CDCl_3) δ 187.5, 171.1, 148.1, 134.7, 132.2, 130.1, 127.4, 126.7, 126.5, 125.7, 120.4, 64.8, 55.9, 41.2, 33.5, 20.6, 15.7; Minor: ^1H NMR (400 MHz, CDCl_3) δ 7.18-7.07 (m, 4H), 7.02 (d, J = 7.6 Hz, 1H), 6.30 (s, 1H), 6.09 (d, J = 9.6 Hz, 1H), 3.59-3.50 (m, 1H), 3.39 (t, J = 8.4 Hz, 1H), 3.34-3.19 (m, 2H), 3.09-3.03 (m, 1H), 2.74-2.62 (m, 2H), 0.89 (d, J = 7.2 Hz, 3H); ^{13}C NMR (100 MHz, CDCl_3) δ 187.8, 171.6, 147.7, 133.8, 130.7, 130.2, 127.4, 127.3, 126.8, 125.9, 122.8, 65.2, 54.7, 40.3, 35.3, 20.6, 19.4; IR (thin film): ν_{max} (cm^{-1}) = 3051, 2970, 2926, 2865, 1664, 1638, 1599, 1483, 1448, 1425, 1387, 1344, 1272, 1209, 1147, 1129, 1034, 979, 915, 872, 814, 760, 728, 675, 627; HRMS (ESI) calcd for $\text{C}_{17}\text{H}_{18}\text{NO}[\text{M} + \text{H}]^+$: 252.1383; Found:

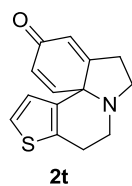
252.1383.



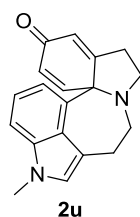
Brown oil, 102.3 mg, 88% yield (dr >= 20:1). ^1H NMR (400 MHz, CDCl_3) δ 7.17-7.07 (m, 4H), 6.96 (d, J = 8.0 Hz, 1H), 6.16-6.13 (m, 2H), 3.39-3.26 (m, 3H), 3.14 (ddd, J = 16.8, 12.0, 6.4 Hz, 1H), 2.77-2.71 (m, 1H), 2.58 (dd, J = 16.8, 2.4 Hz, 1H), 1.88-1.74 (m, 2H), 1.71-1.58 (m, 2H), 1.46-1.40 (m, 2H), 1.33-1.16 (m, 2H); ^{13}C NMR (100 MHz, CDCl_3) δ 187.5, 169.8, 149.1, 135.6, 133.1, 130.0, 127.1, 126.5, 126.4, 125.3, 120.7, 64.5, 60.1, 41.4, 38.9, 29.7, 22.8, 22.2, 21.1, 20.4; IR (thin film): $\nu_{\text{max}} (\text{cm}^{-1})$ = 3015, 2928, 2859, 1667, 1641, 1602, 1483, 1447, 1384, 1345, 1308, 1282, 1251, 1214, 1189, 1158, 1129, 1116, 1097, 1074, 1031, 978, 917, 893, 875, 859, 806, 753, 734, 677, 634; HRMS (ESI) calcd for $\text{C}_{20}\text{H}_{22}\text{NO}[\text{M} + \text{H}]^+$: 292.1696; Found: 292.1693.



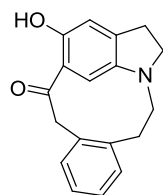
Light yellow solid, m.p. = 100-102 $^{\circ}\text{C}$, 48.0 mg, 48% yield. ^1H NMR (400 MHz, CDCl_3) δ 7.59 (d, J = 10.0 Hz, 1H), 7.17-7.15 (m, 3H), 7.08-7.04 (m, 1H), 6.26 (s, 1H), 6.16 (dd, J = 10.0, 1.6 Hz, 1H), 3.65-3.57 (m, 1H), 3.39-3.33 (m, 1H), 3.25-3.17 (m, 1H), 3.05-2.94 (m, 3H), 2.83-2.75 (m, 1H), 2.65-2.57 (m, 1H), 2.15-2.04 (m, 1H), 1.76-1.69 (m, 1H); ^{13}C NMR (100 MHz, CDCl_3) δ 186.6, 167.2, 142.9, 142.4, 138.8, 131.3, 128.4, 128.3, 127.8, 126.9, 121.8, 68.2, 50.7, 46.4, 37.7, 28.0, 23.2; IR (thin film): $\nu_{\text{max}} (\text{cm}^{-1})$ = 2922, 2848, 1667, 1638, 1598, 1482, 1451, 1434, 1388, 1364, 1343, 1311, 1292, 1268, 1233, 1174, 1133, 1098, 1070, 1034, 945, 902, 887, 861, 802, 755, 688, 649; HRMS (ESI) calcd for $\text{C}_{17}\text{H}_{18}\text{NO}[\text{M} + \text{H}]^+$: 252.1383; Found: 252.1380.



Light yellow solid. m.p. = 124-126 °C, 69.8 mg, 72% yield. ^1H NMR (400 MHz, CDCl_3) δ 7.06 (d, J = 10.0 Hz, 1H), 7.03 (d, J = 5.2 Hz, 1H), 6.51 (d, J = 5.6 Hz, 1H), 6.20-6.19 (m, 1H), 6.14 (dd, J = 10.0, 1.6 Hz, 1H), 3.47-3.34 (m, 2H), 3.29-3.15 (m, 2H), 3.12-3.08 (m, 1H), 2.71-2.65 (m, 3H); ^{13}C NMR (100 MHz, CDCl_3) δ 186.8, 166.1, 146.8, 135.8, 130.0, 126.2, 124.8, 122.5, 122.3, 64.2, 46.5, 41.4, 27.8, 17.9; IR (thin film): ν_{max} (cm^{-1}) = 3094, 3063, 2973, 2928, 2871, 1725, 1666, 1633, 1590, 1473, 1453, 1429, 1386, 1339, 1325, 1288, 1234, 1216, 1186, 1133, 1109, 1083, 1056, 1013, 979, 934, 921, 904, 861, 853, 799, 740, 714, 694, 653, 634, 623; HRMS (ESI) calcd for $\text{C}_{14}\text{H}_{14}\text{NOS}[\text{M} + \text{H}]^+$: 244.0791; Found: 244.0792.



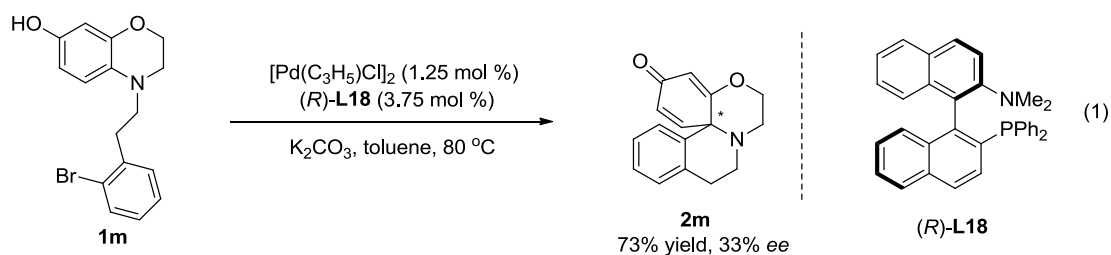
Light yellow solid. m.p. = 162-163 °C, 50.6 mg, 88% yield (0.2 mmol scale). ^1H NMR (400 MHz, CDCl_3) δ 7.18-7.15 (m, 2H), 7.06 (t, J = 8.0 Hz, 1H), 6.94 (s, 1H), 6.82 (dd, J = 7.6, 0.8 Hz, 1H), 6.22 (d, J = 2.0 Hz, 1H), 6.07 (dd, J = 10.0, 1.6 Hz, 1H), 3.79-3.70 (m, 1H), 3.75 (s, 1H), 3.53-3.39 (m, 3H), 3.19 (td, J = 8.8, 3.6 Hz, 1H), 3.10-3.04 (m, 1H), 2.77-2.69 (m, 1H), 2.65-2.57 (m, 1H); ^{13}C NMR (100 MHz, CDCl_3) δ 187.6, 167.1, 147.0, 137.8, 131.7, 126.7, 126.4, 126.0, 121.7, 120.7, 118.4, 112.5, 108.7, 69.1, 45.1, 44.4, 32.7, 27.7, 25.5; IR (thin film): ν_{max} (cm^{-1}) = 2909, 2853, 1666, 1638, 1600, 1550, 1451, 1416, 1386, 1336, 1311, 1290, 1239, 1192, 1173, 1136, 1055, 1037, 971, 937, 893, 876, 835, 781, 740, 690, 651; HRMS (ESI) calcd for $\text{C}_{19}\text{H}_{19}\text{N}_2\text{O}[\text{M} + \text{H}]^+$: 291.1492; Found: 291.1494.



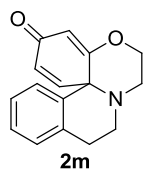
2z

Yellow solid. > 300 °C (decomposed), 27.6 mg, 25% yield. ^1H NMR (400 MHz, CDCl_3) δ 12.04 (s, 1H), 7.33-7.32 (m, 2H), 7.28-7.25 (m, 1H), 7.17 (d, $J = 7.2$ Hz, 1H), 6.66 (s, 1H), 6.54 (s, 1H), 4.37 (s, 2H), 3.38-3.30 (m, 4H), 2.93 (t, $J = 8.0$ Hz, 2H), 2.84 (t, $J = 8.0$ Hz, 2H); ^{13}C NMR (100 MHz, CDCl_3) δ 201.2, 157.2, 144.2, 142.3, 138.5, 132.5, 131.6, 129.6, 127.7, 126.6, 116.5, 115.5, 101.4, 52.7, 50.7, 42.2, 29.8, 29.0; IR (thin film): ν_{max} (cm^{-1}) = 2921, 2851, 1640, 1615, 1488, 1410, 1348, 1269, 1211, 1184, 1096, 1047, 991, 952, 857, 802, 744, 683; HRMS (EI) calcd for $\text{C}_{18}\text{H}_{17}\text{NO}_2[\text{M}]^+$: 279.1259; Found: 279.1258.

Palladium-catalyzed asymmetric dearomatization reaction

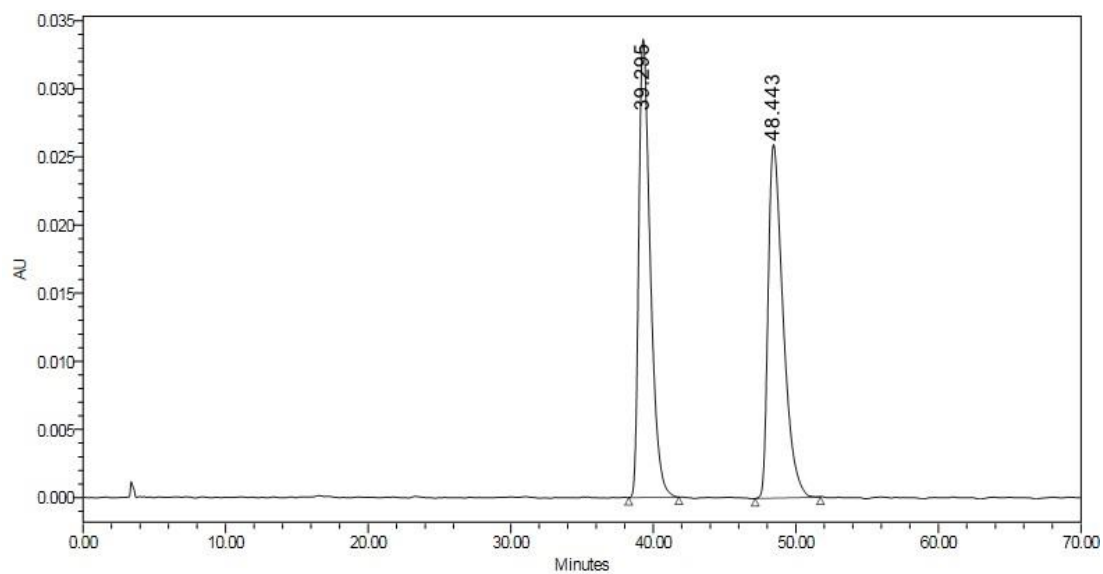


A flame-dried Schlenk tube was cooled down to room temperature under argon. To this tube were added $[\text{Pd}(\text{C}_3\text{H}_5\text{Cl})_2]$ (1.8 mg, 0.005 mmol, 1.25 mol %), $(R)\text{-L18}$ (7.2 mg, 0.015 mmol, 3.75 mol %), K_2CO_3 (83.0 mg, 0.6 mmol, 1.5 equiv.) and toluene (1.0 mL). After the reaction was stirred at room temperature for 30 minutes, to this mixture were added **1m** (133.7 mg, 0.4 mmol) and toluene (1.0 mL). Then the reaction was stirred at 80°C . After completion (about 18h), the reaction mixture was cooled to room temperature and diluted with ethyl acetate (3mL). The mixture was filtered through celite, and the filtrate was concentrated under reduced pressure. The crude product was purified by silica gel column chromatography (PE/acetone = 3/1) to afford the desired product **2m**.



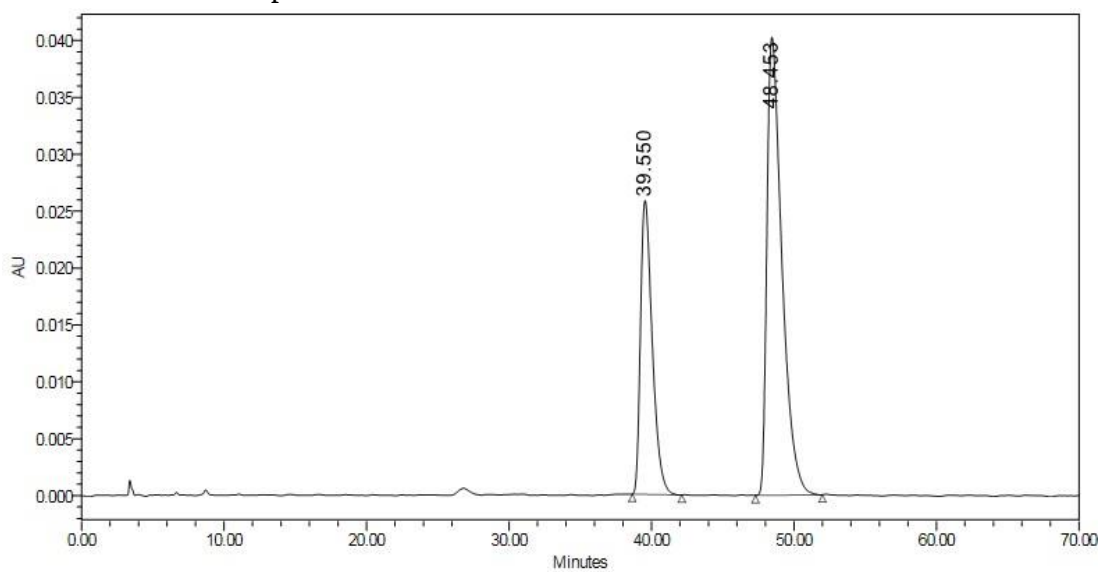
White solid, m.p. = $108\text{--}110^\circ\text{C}$, 73.0 mg, 73% yield, 33% ee [Daicel Chiralpak AD-H, $n\text{-hexane}/2\text{-propanol} = 95/5$, $v = 1.0\text{ mL}\cdot\text{min}^{-1}$, $\lambda = 254\text{ nm}$, t (minor) = 39.550 min, t (major) = 48.453 min]; $[\alpha]_{\text{D}}^{20} = -30.3$ ($c = 0.1$, CHCl_3).

Racemic sample

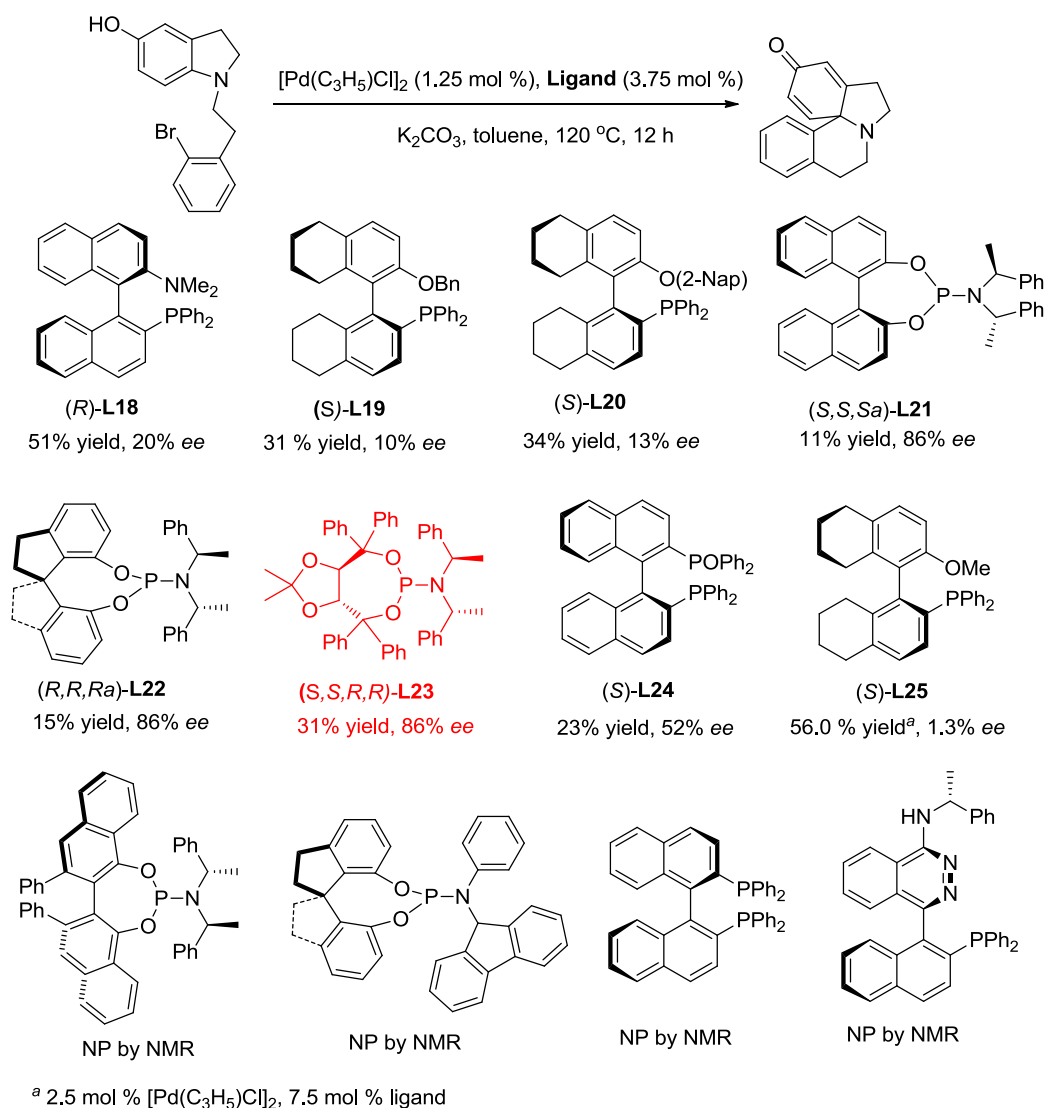


	RT (min)	Area ($\mu\text{V}\cdot\text{sec}$)	% Area	Height (μV)	% Height
1	39.295	1888077	49.96	33637	56.45
2	48.443	1891129	50.04	25951	43.55

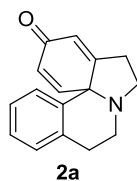
Enantioenriched sample



	RT (min)	Area ($\mu\text{V}\cdot\text{sec}$)	% Area	Height (μV)	% Height
1	39.550	1482353	33.48	25836	39.09
2	48.453	2945563	66.52	40260	60.91

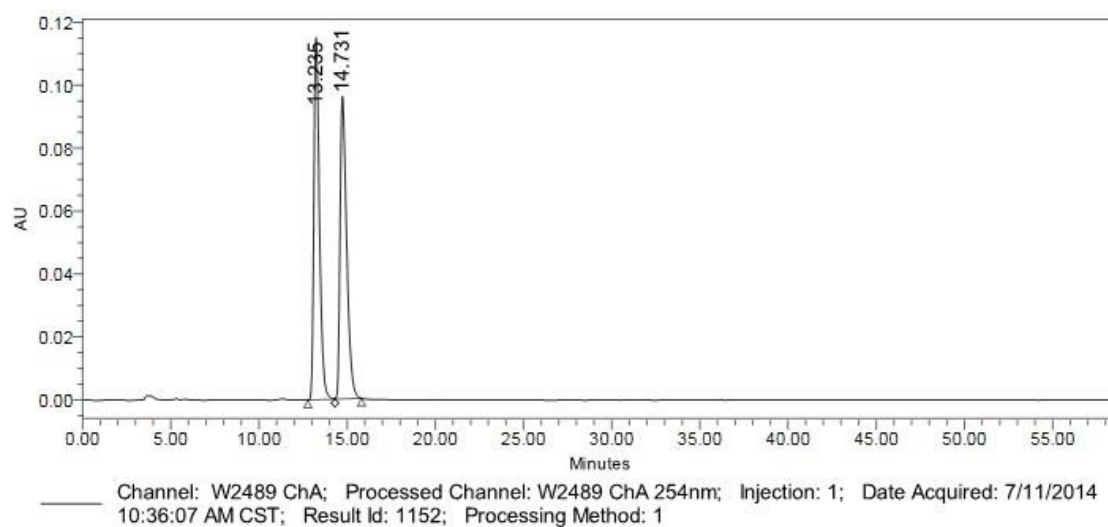


A flame-dried Schlenk tube was cooled down to room temperature under argon. To this tube were added $[\text{Pd}(\text{C}_3\text{H}_5\text{Cl})_2]$ (1.8 mg, 0.005 mmol, 1.25 mol %), **Ligand** (0.015 mmol, 3.75 mol %), K_2CO_3 (83.0 mg, 0.6 mmol, 1.5 equiv.) and toluene (2.0 mL). After the reaction was stirred at room temperature for 30 minutes, to this mixture were added **1aa** (127.2 mg, 0.4 mmol). Then the reaction was stirred at 120 °C. After about 12h, the reaction mixture was cooled to room temperature and diluted with ethyl acetate (3mL). The mixture was filtered through celite, and the filtrate was concentrated under reduced pressure. The crude product was purified by silica gel column chromatography (PE/acetone = 4/1) to afford the desired product **2a**.



Yellow solid, m.p. = 132-134 °C. 29.3 mg, 31% yield, 86% ee (**Ligand 6**) [Daicel Chiralpak OD-H, *n*-hexane/2-propanol =90/10, ν = 1.0 mL·min⁻¹, λ = 254 nm, t (minor) = 15.065 min, t (major) = 13.295 min]; $[\alpha]_D^{20}$ = +82.5 (c = 0.1, CHCl₃).

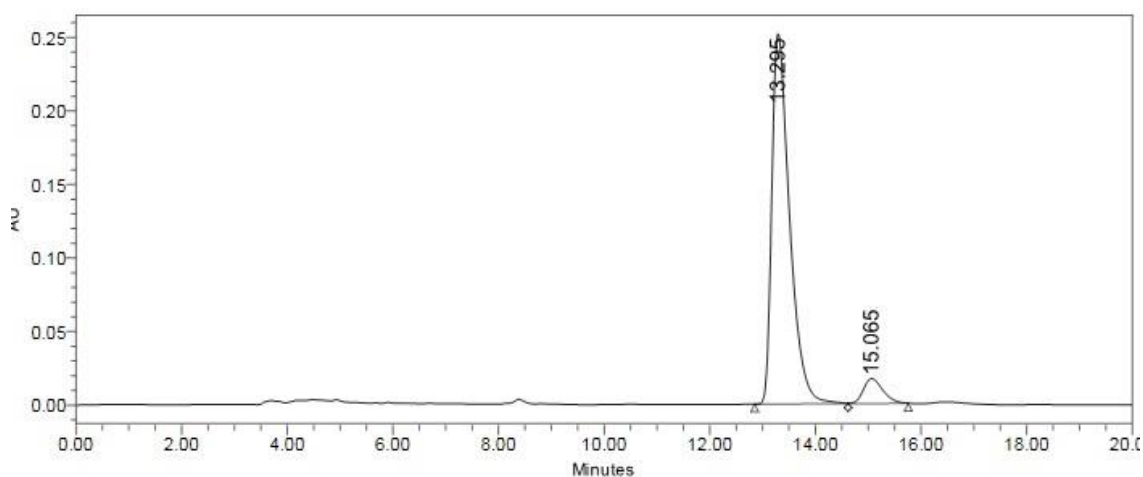
Racemic sample



Peak Name:

	Injection	RT	Area	% Area	Height
1	1	14.731	2492376	49.69	96223
2	1	13.235	2523104	50.31	115163
Mean		13.983			
Std. Dev.		1.058			
% RSD		7.57			

Enantioenriched sample

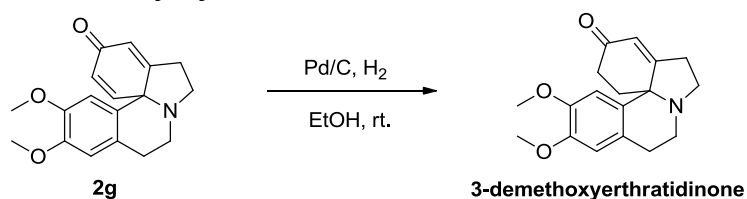


Channel: W2489 ChA; Processed Channel: W2489 ChA 254nm; Injection: 1; Date Acquired: 7/17/2014 6:44:20 PM CST; Result Id: 1229; Processing Method: 11

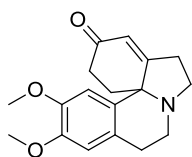
Peak Name:

	Injection	RT	Area	% Area	Height
1	1	15.065	435070	6.89	16894
2	1	13.295	5878972	93.11	251708
Mean		14.180			
Std. Dev.		1.252			
% RSD		8.83			

Synthesis of 3-demethoxyerythratidinone.⁴



A flame-dried Schlenk tube was cooled down to room temperature under argon. To this tube were added **2g** (81.8 mg, 0.27 mmol), EtOH (30 mL) and Pd/C (50 mg). Then the reaction mixture was subjected to hydrogen (1 atm.). The mixture was stirred at room temperature for 10 h. After completion, the mixture was filtered and the filtrate was concentrated under reduced pressure. The crude product was purified by silica gel column chromatography (PE/acetone = 1/1) to afford 3-demethoxyerythratidinone (58.0 mg, 71% yield).



3-demethoxyerythratidinone

White solid, 58.0 mg, 71% yield. ¹H NMR (400 MHz, CDCl₃) δ 6.66 (s, 1H), 6.56 (s, 1H), 6.11 (s, 1H), 3.86 (s, 3H), 3.75 (s, 3H), 3.53-3.45 (m, 1H), 3.28-3.22 (m, 1H), 3.12-3.01 (m, 2H), 2.86 (dd, *J* = 16.8, 8.4 Hz, 1H), 2.75-2.69 (m, 1H), 2.64-2.43 (m, 4H), 2.34-2.29 (m, 1H), 2.19 (td, *J* = 14.0, 5.6 Hz, 1H). ¹³C NMR (100 MHz, CDCl₃) δ 199.4, 169.1, 148.3, 146.8, 125.6, 124.6, 123.6, 112.7, 110.2, 63.5, 56.0, 55.8, 45.7, 40.0, 36.1, 32.8, 28.6, 21.4.

X-ray of 2a

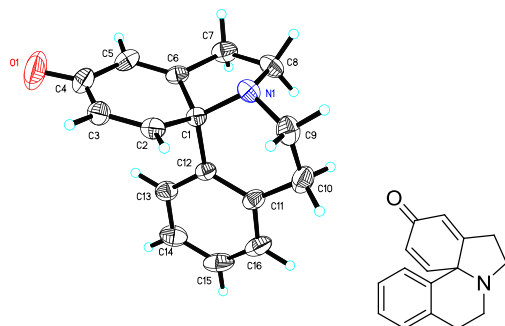
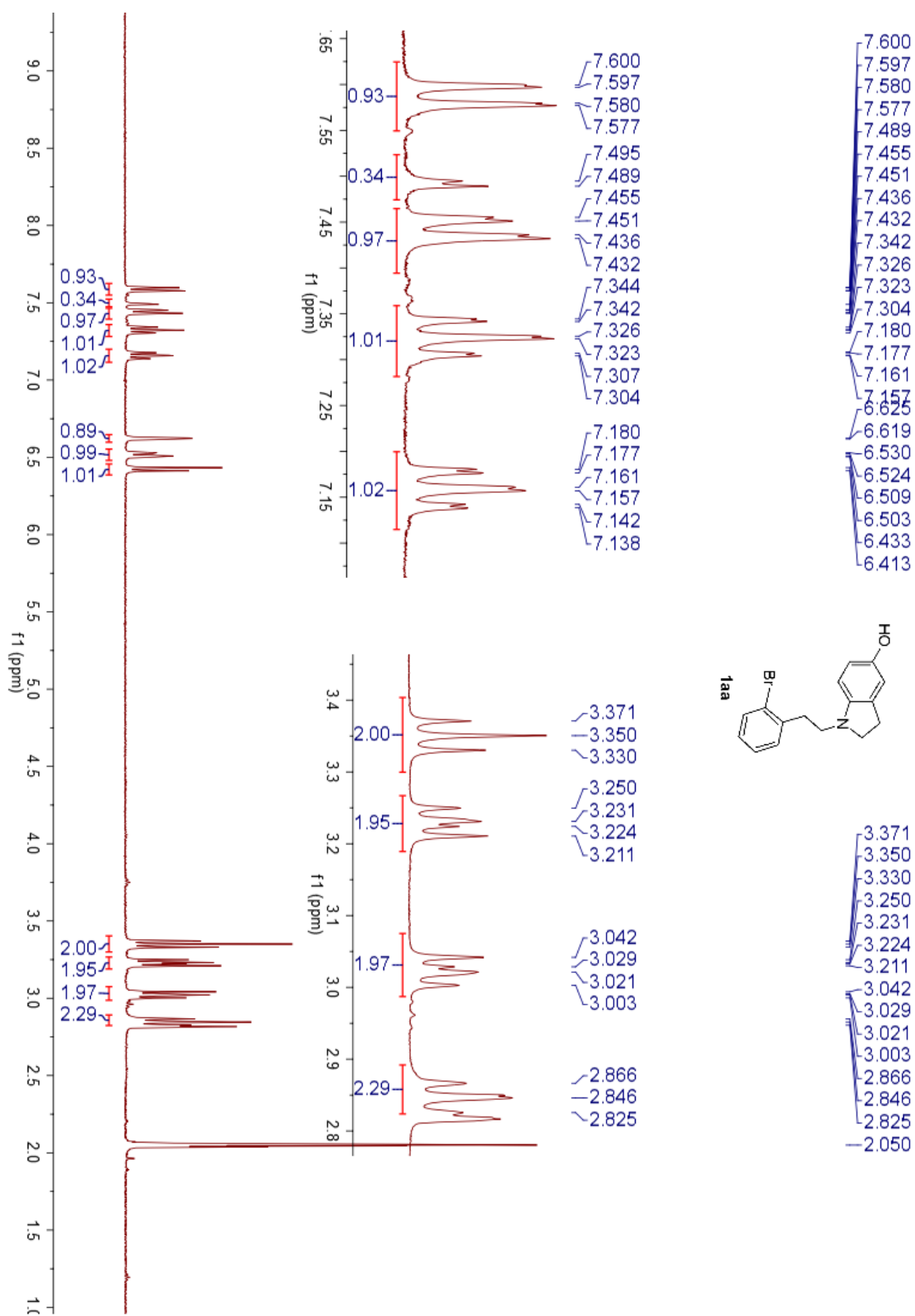
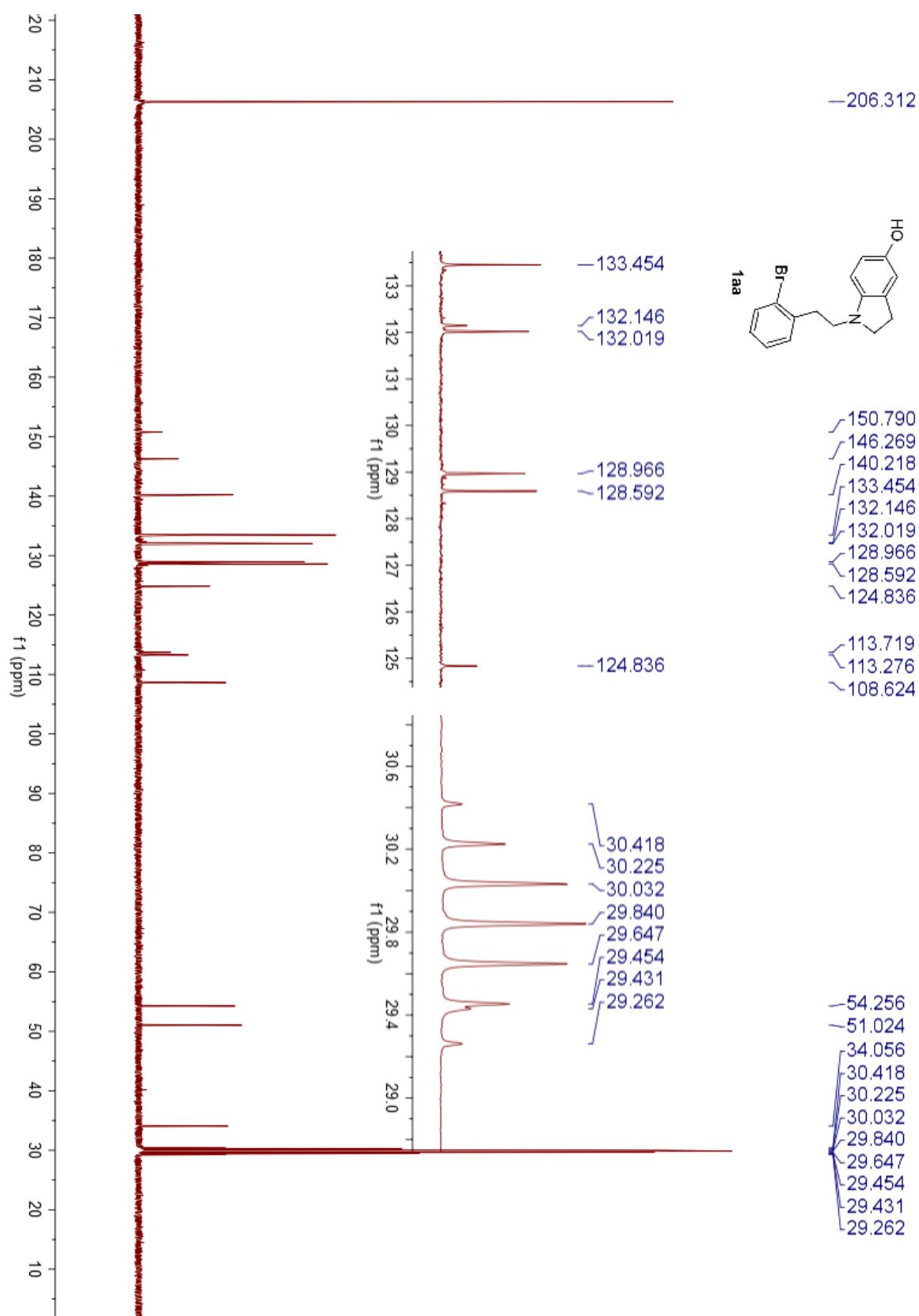


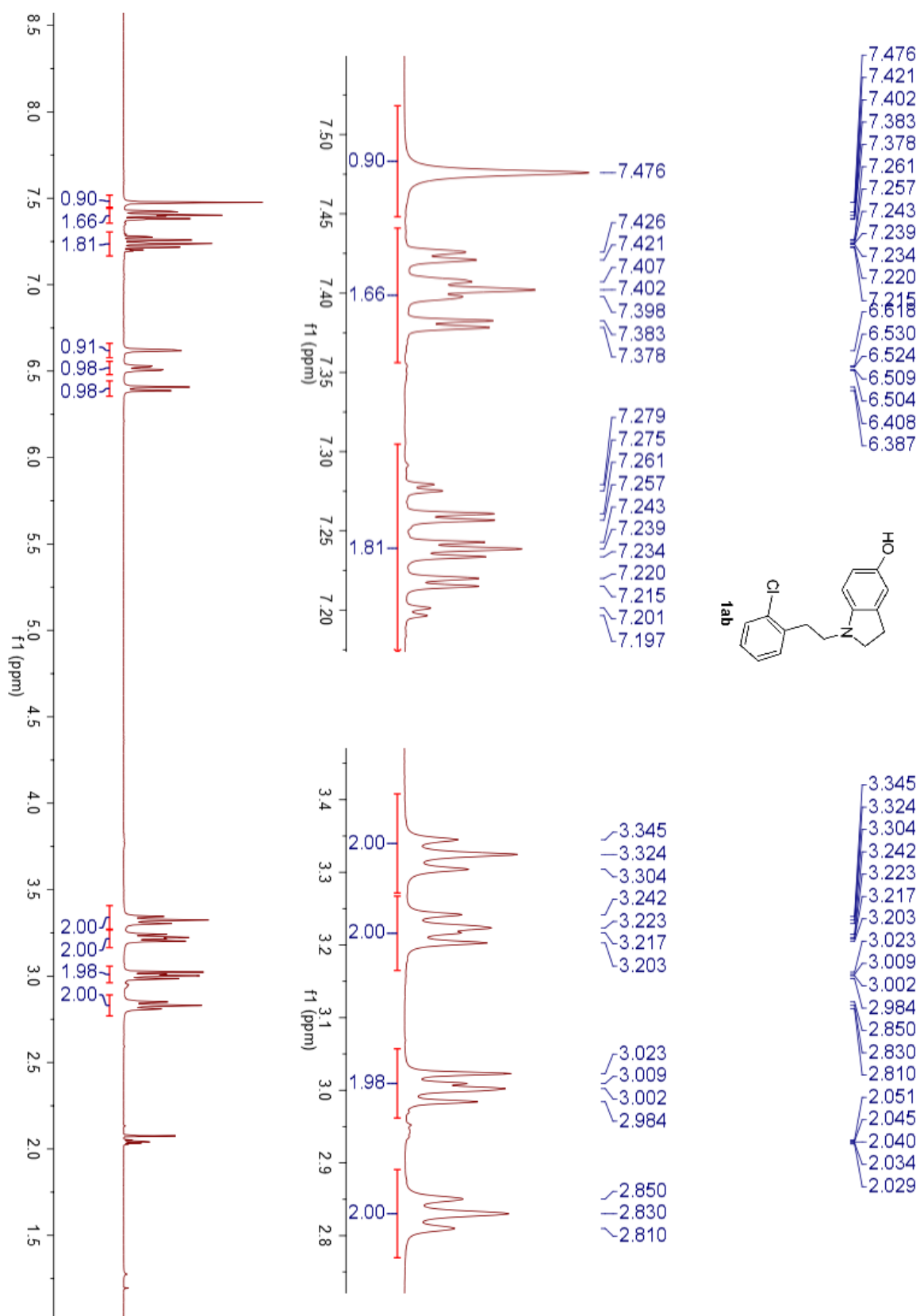
Table 1. Crystal data and structure refinement for cd21488.

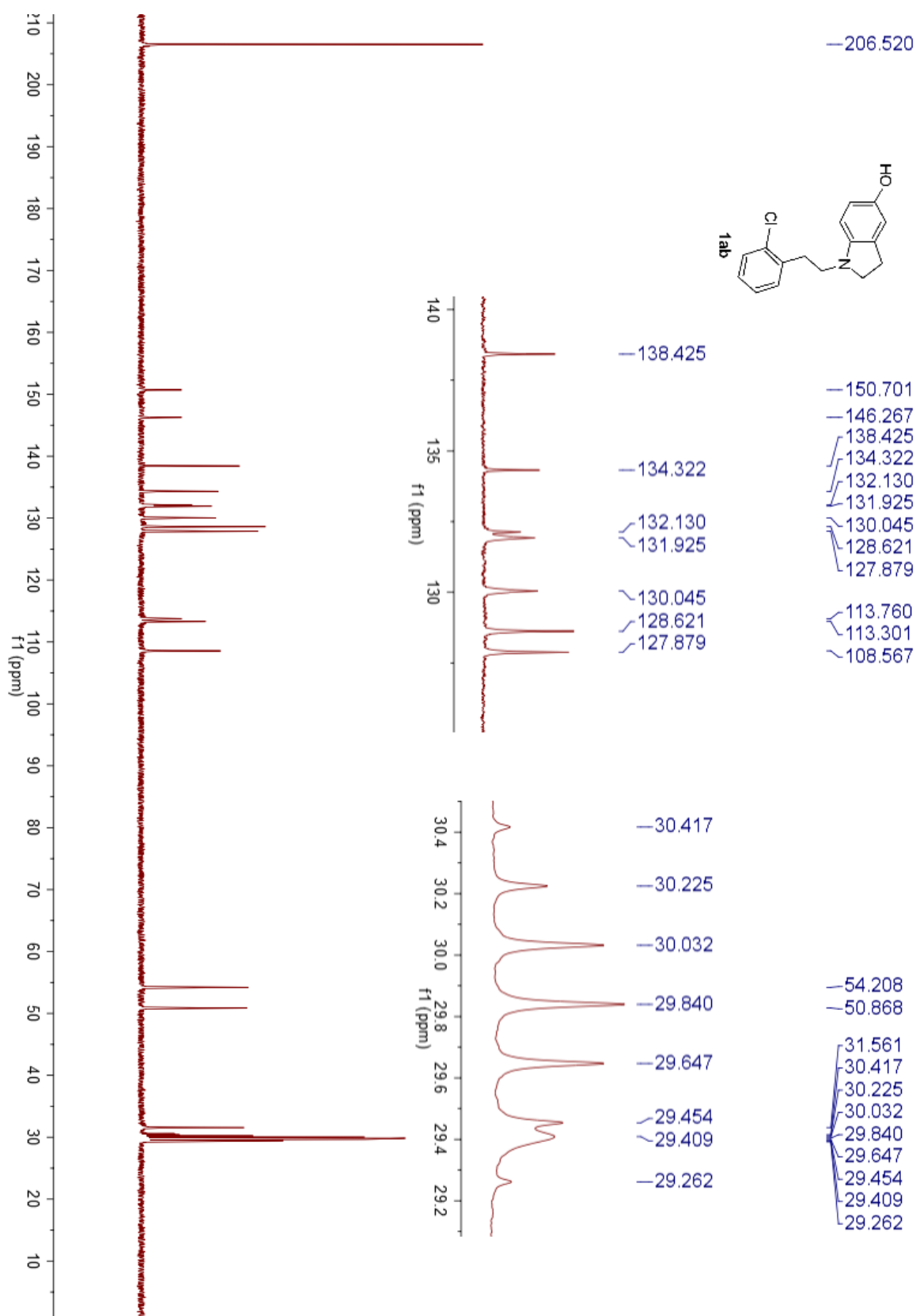
Identification code	cd21488	
Empirical formula	C ₁₆ H ₁₅ N O	
Formula weight	237.29	
Temperature	293(2) K	
Wavelength	0.71073 Å	
Crystal system	Monoclinic	
Space group	P 21/c	
Unit cell dimensions	a = 12.945(2) Å	α = 90 °
	b = 7.1669(13) Å	β = 114.553(3) °
	c = 14.497(3) Å	γ = 90 °
Volume	1223.4(4) Å ³	
Z	4	
Density (calculated)	1.288 Mg/m ³	
Absorption coefficient	0.080 mm ⁻¹	
F(000)	504	
Crystal size	0.211 x 0.175 x 0.123 mm ³	
Theta range for data collection	1.730 to 25.992 °	
Index ranges	-11 ≤ h ≤ 15, -8 ≤ k ≤ 8, -17 ≤ l ≤ 17	
Reflections collected	7090	
Independent reflections	2402 [R(int) = 0.0474]	
Completeness to theta = 25.242 °	100.0 %	
Absorption correction	Semi-empirical from equivalents	
Max. and min. transmission	0.7456 and 0.6202	
Refinement method	Full-matrix least-squares on F ²	
Data / restraints / parameters	2402 / 0 / 164	
Goodness-of-fit on F ²	1.018	
Final R indices [I > 2σ(I)]	R1 = 0.0552, wR2 = 0.1343	
R indices (all data)	R1 = 0.0678, wR2 = 0.1443	

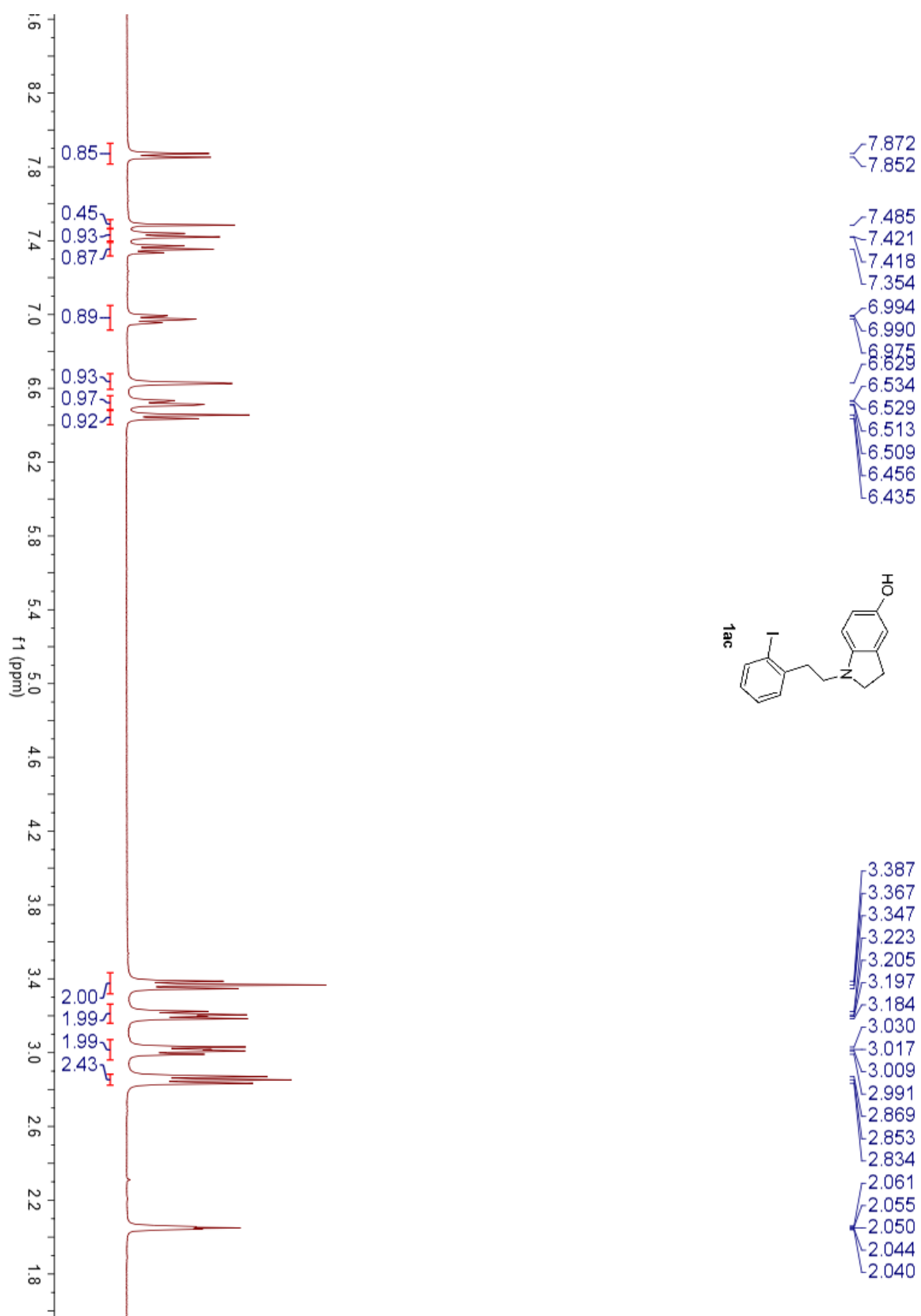
Extinction coefficient	0.023(4)
Largest diff. peak and hole	0.274 and -0.215 e.Å ⁻³

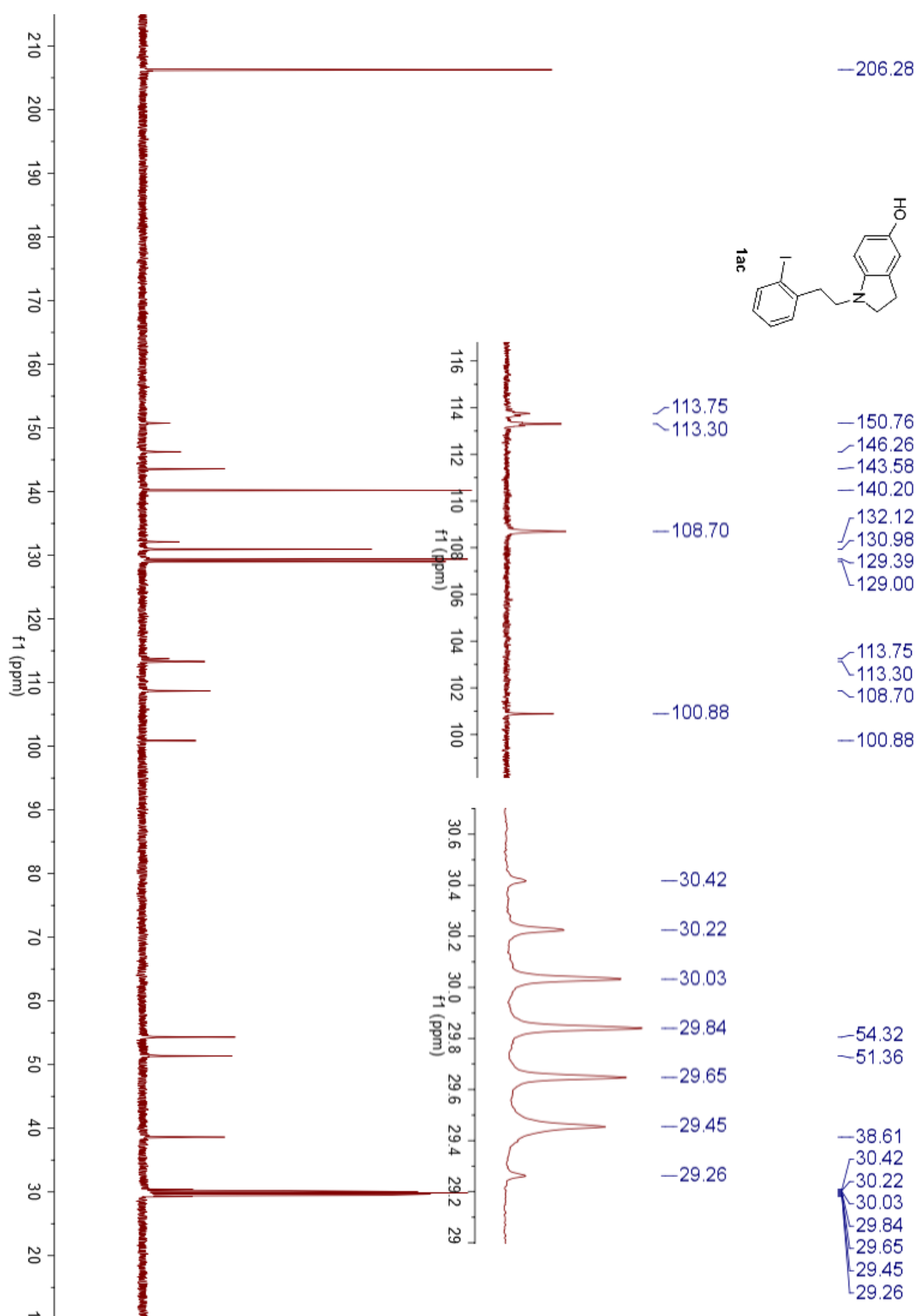


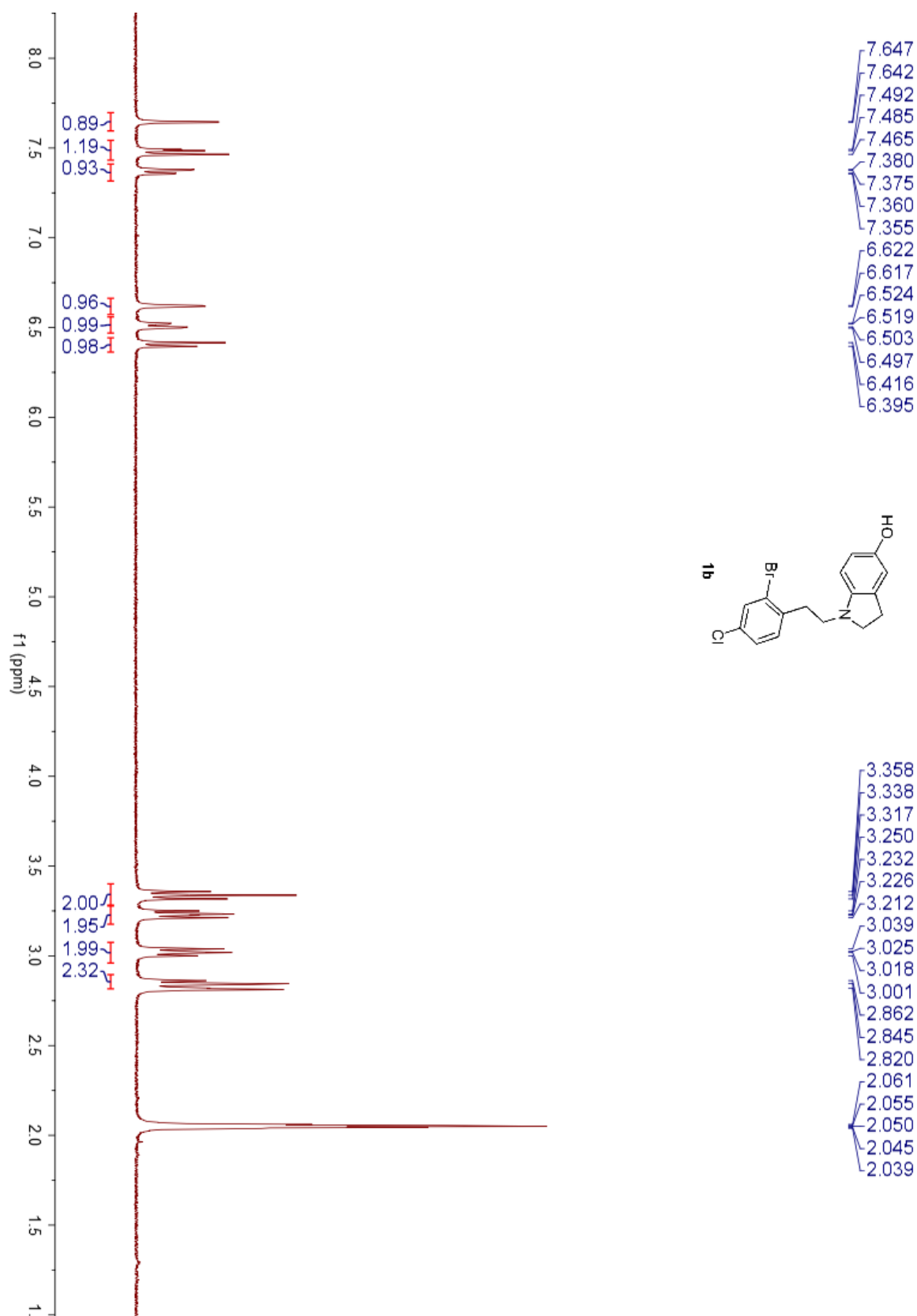


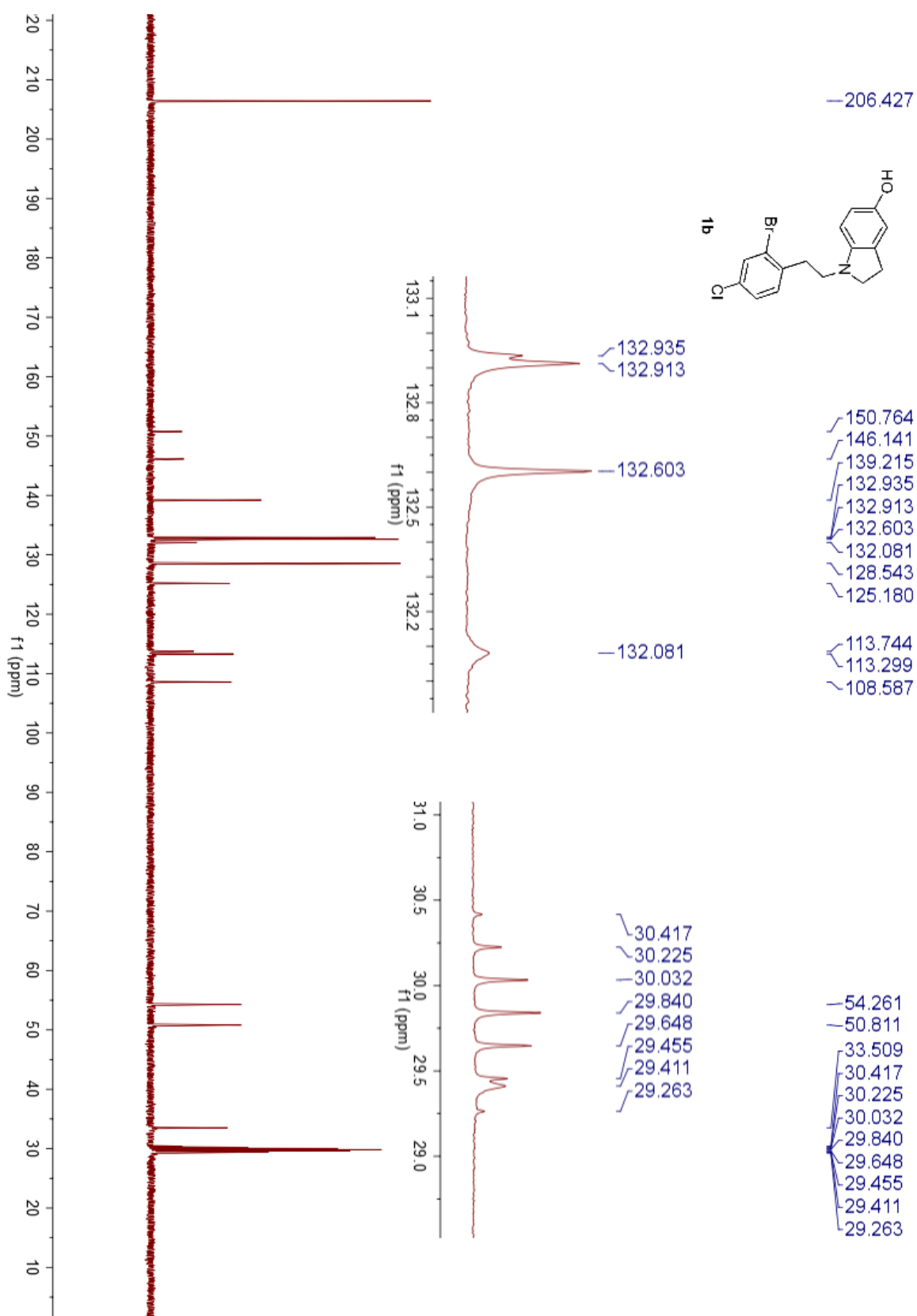


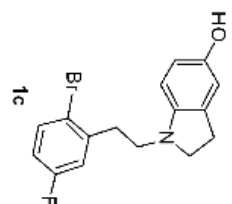






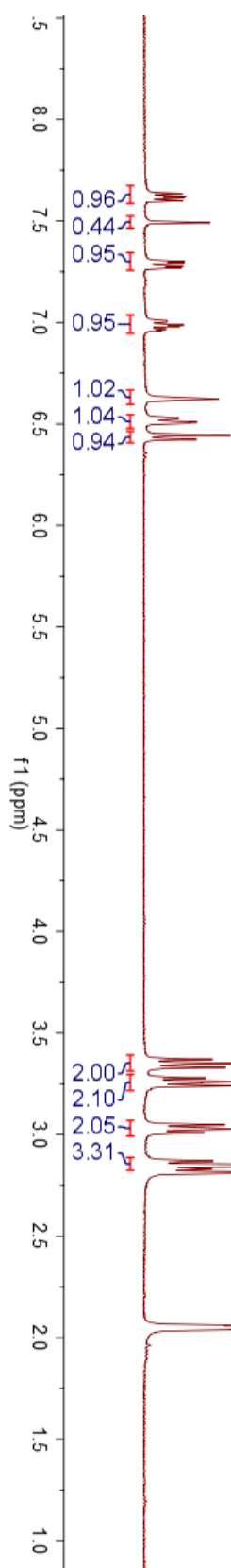
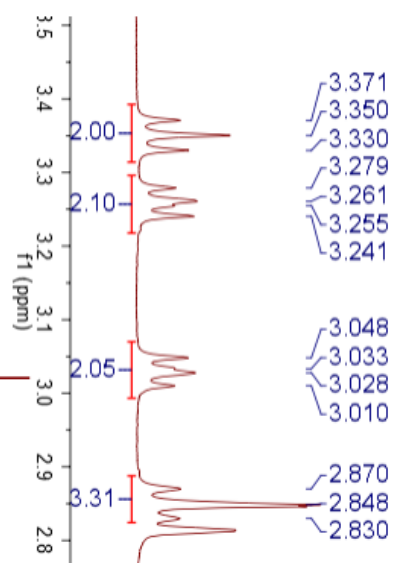
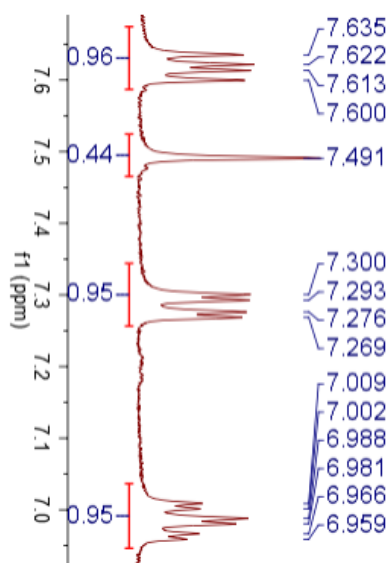


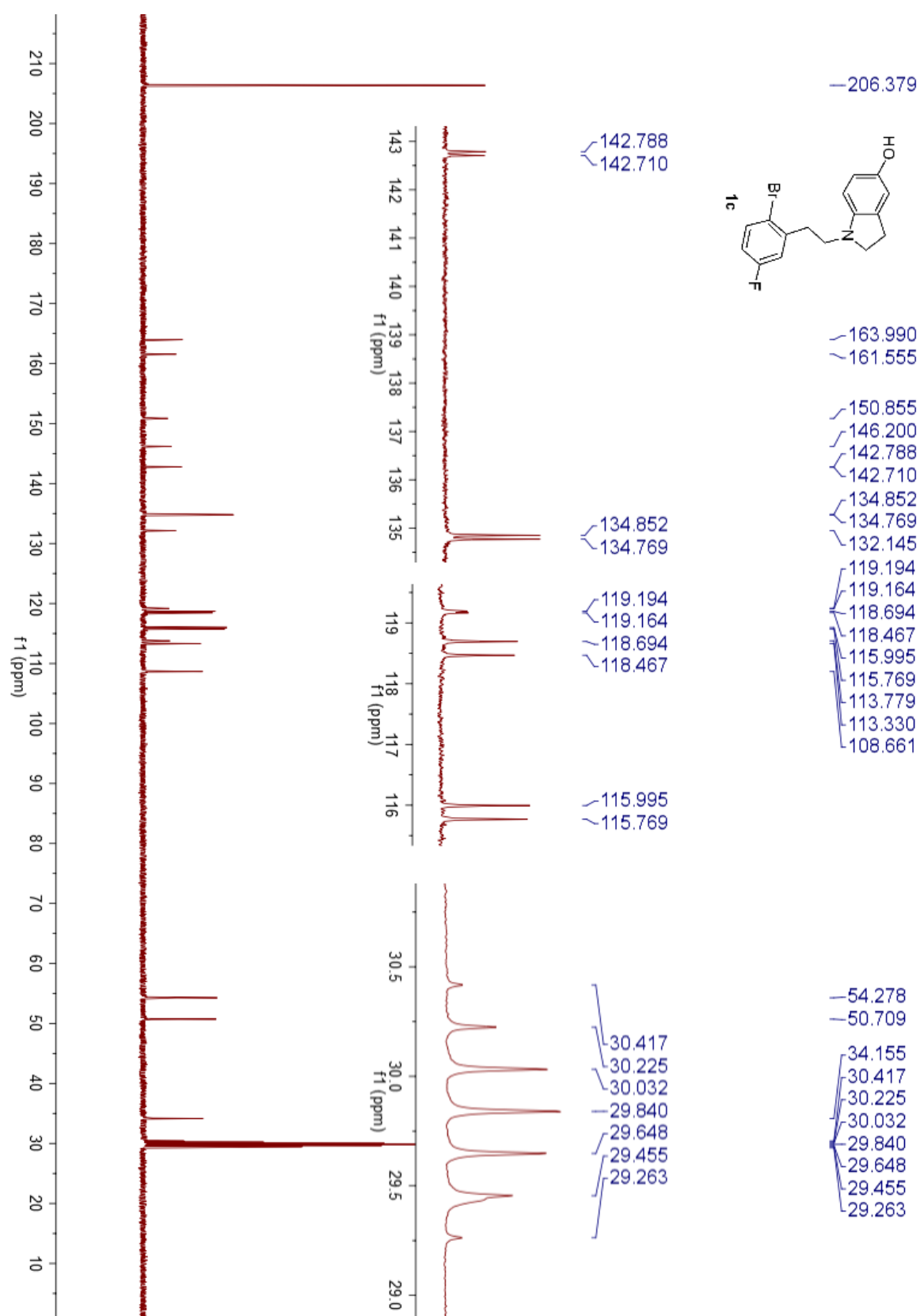


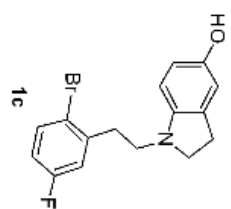


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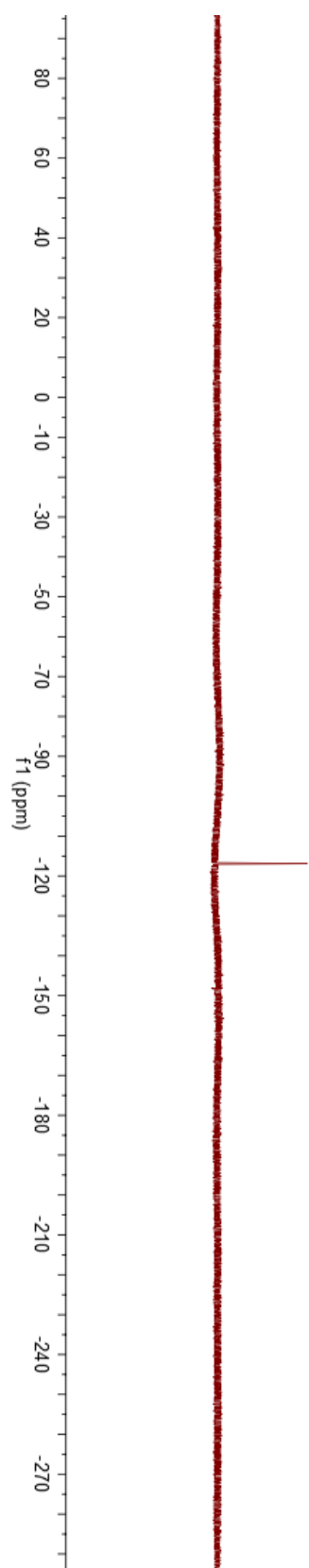
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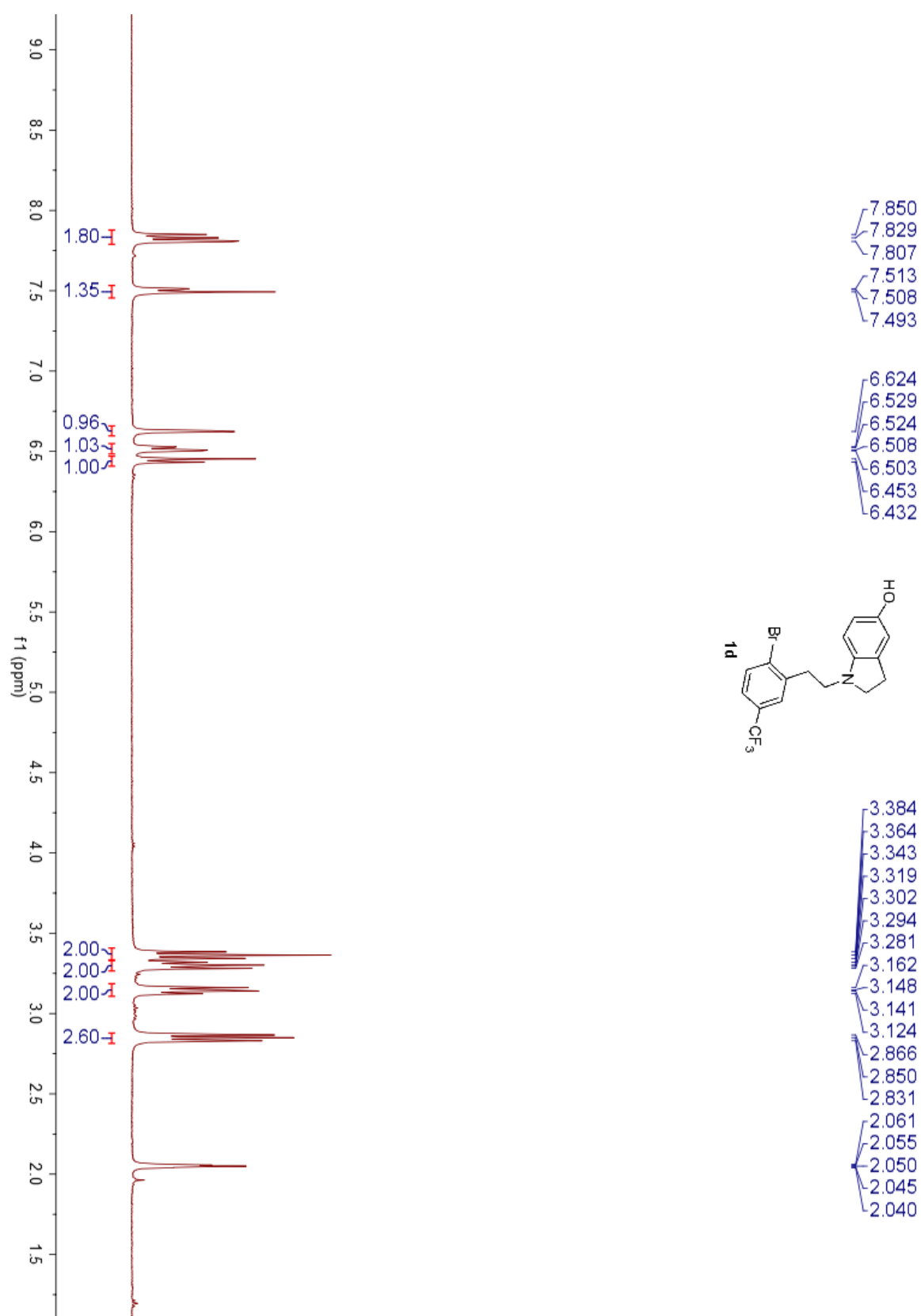


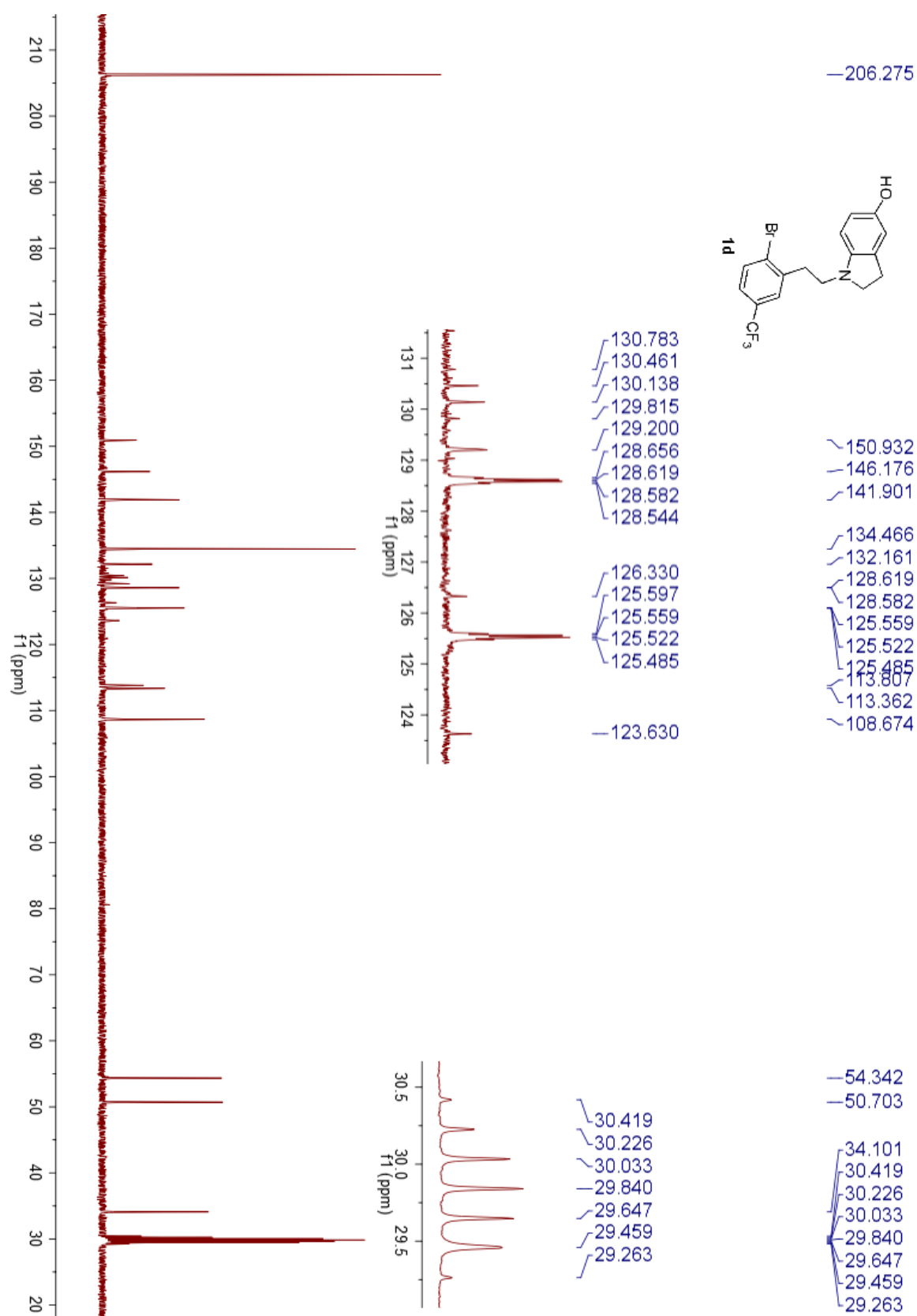


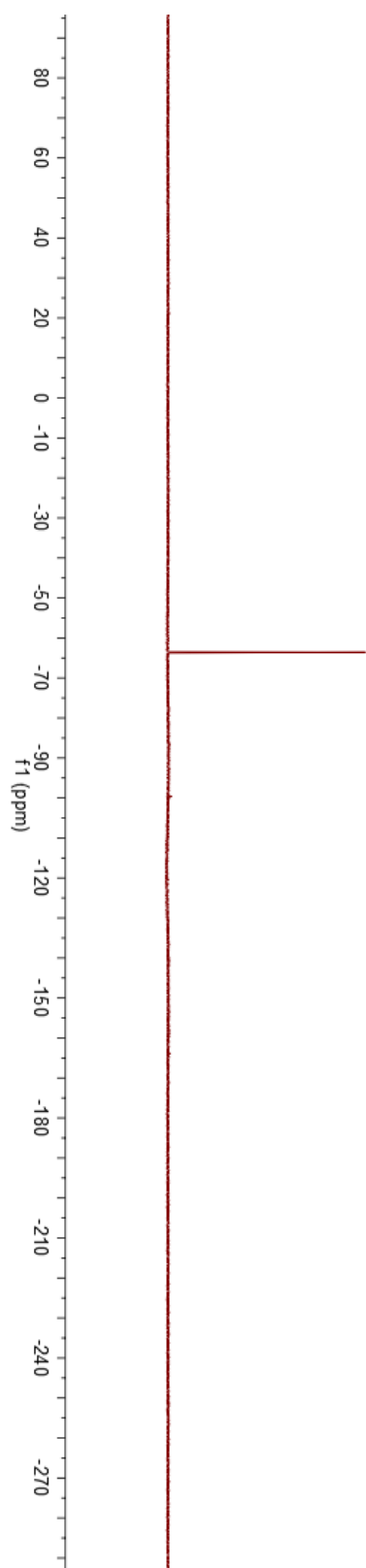
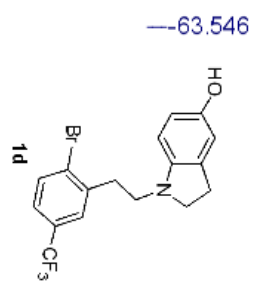


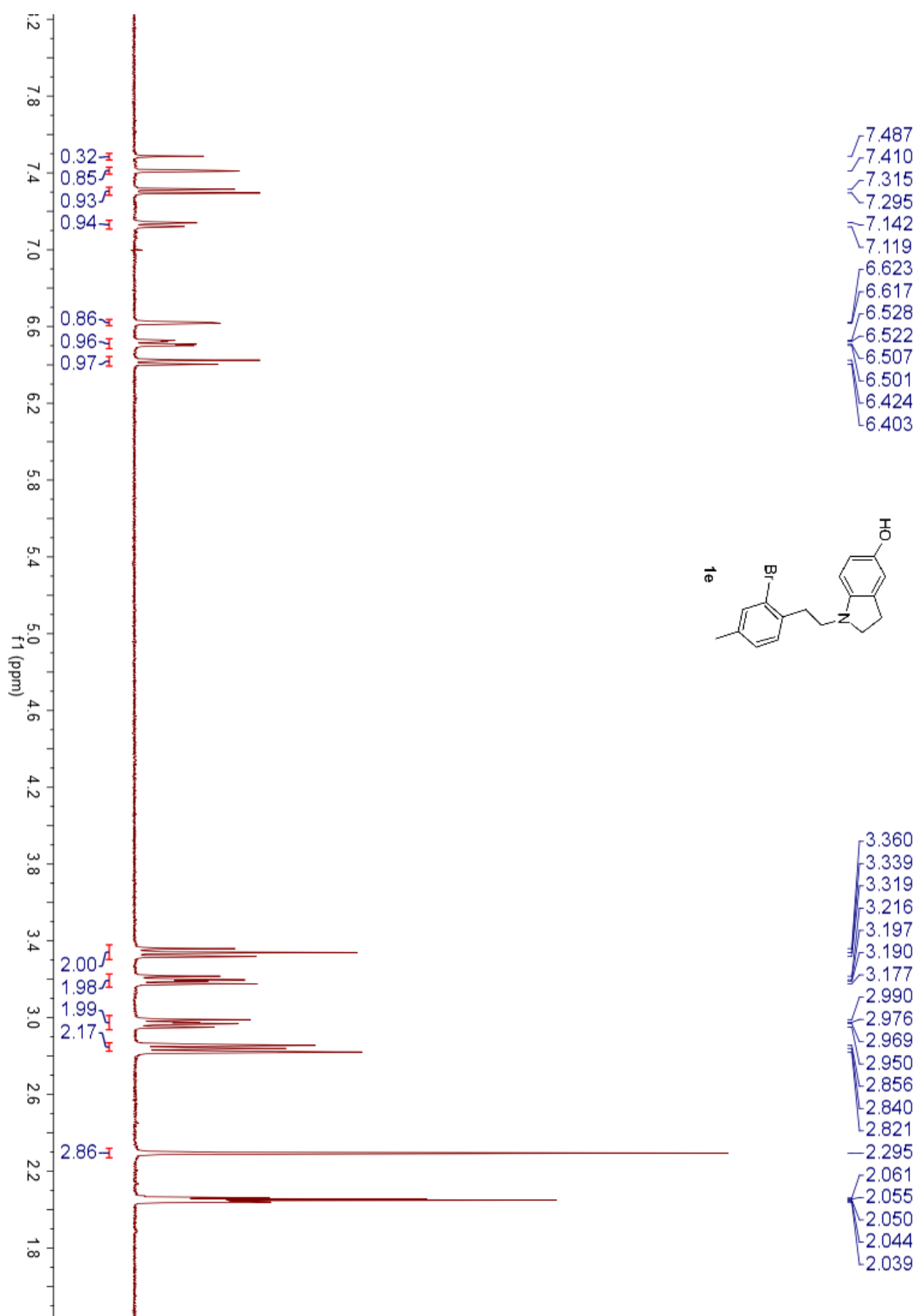
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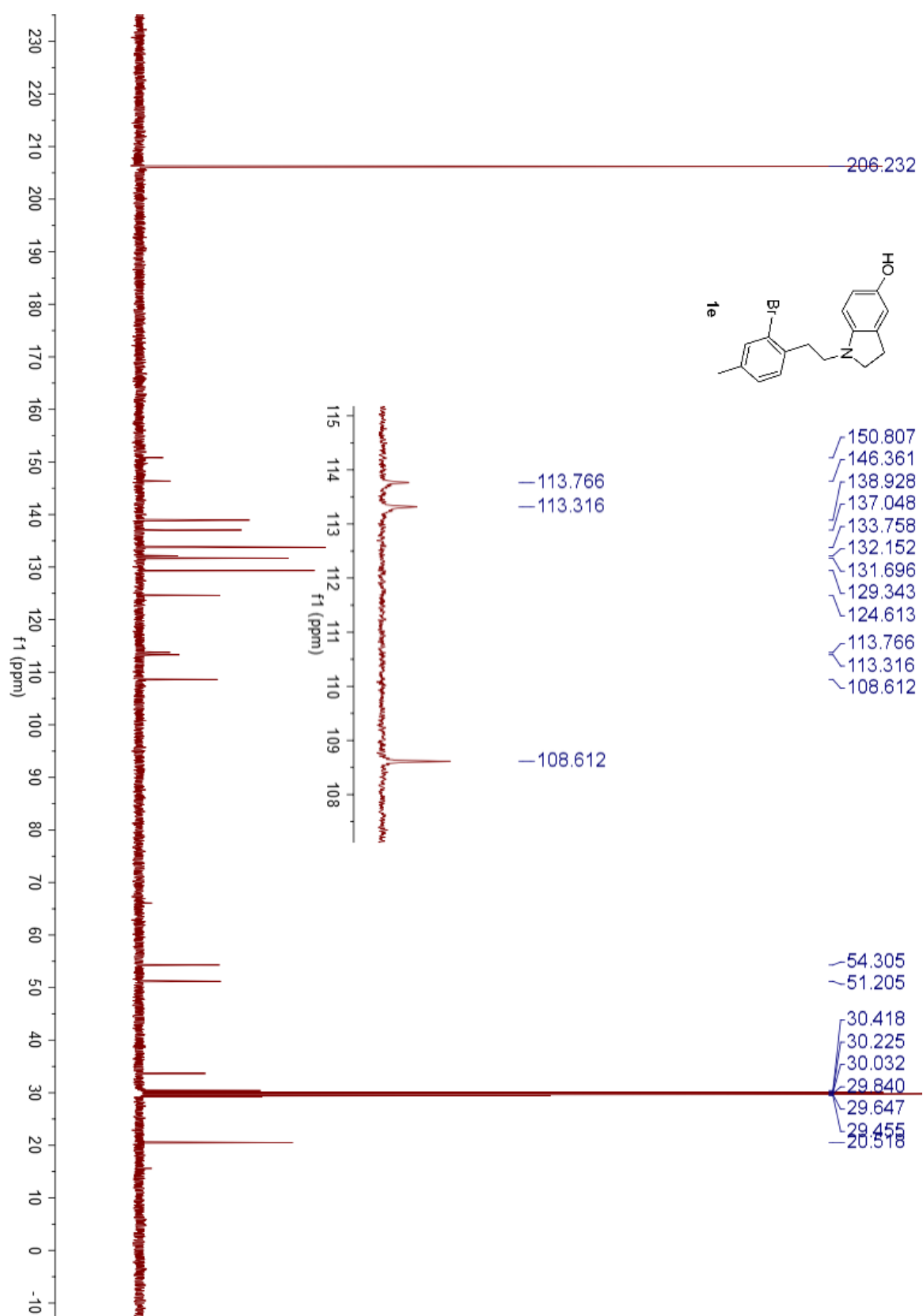


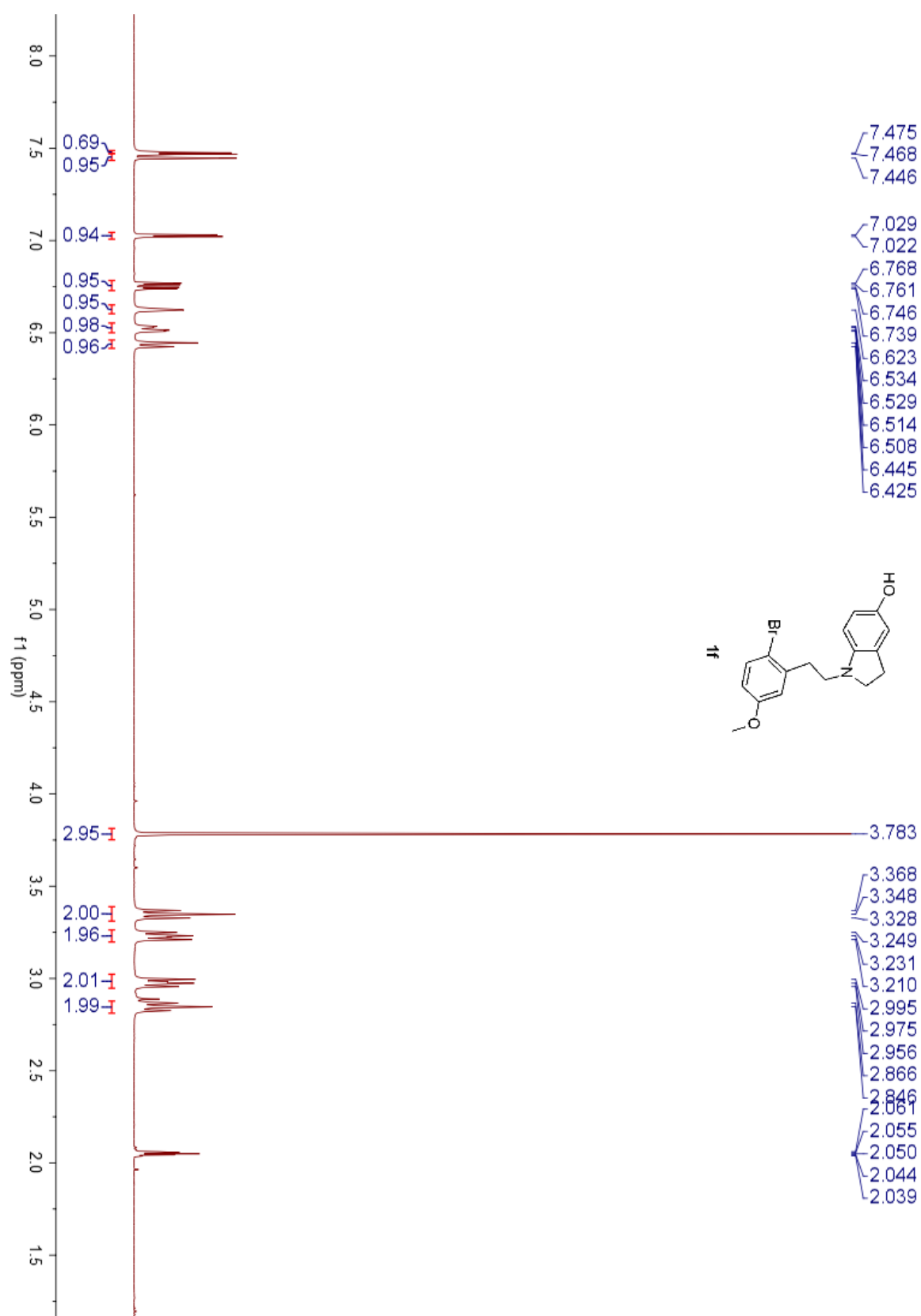


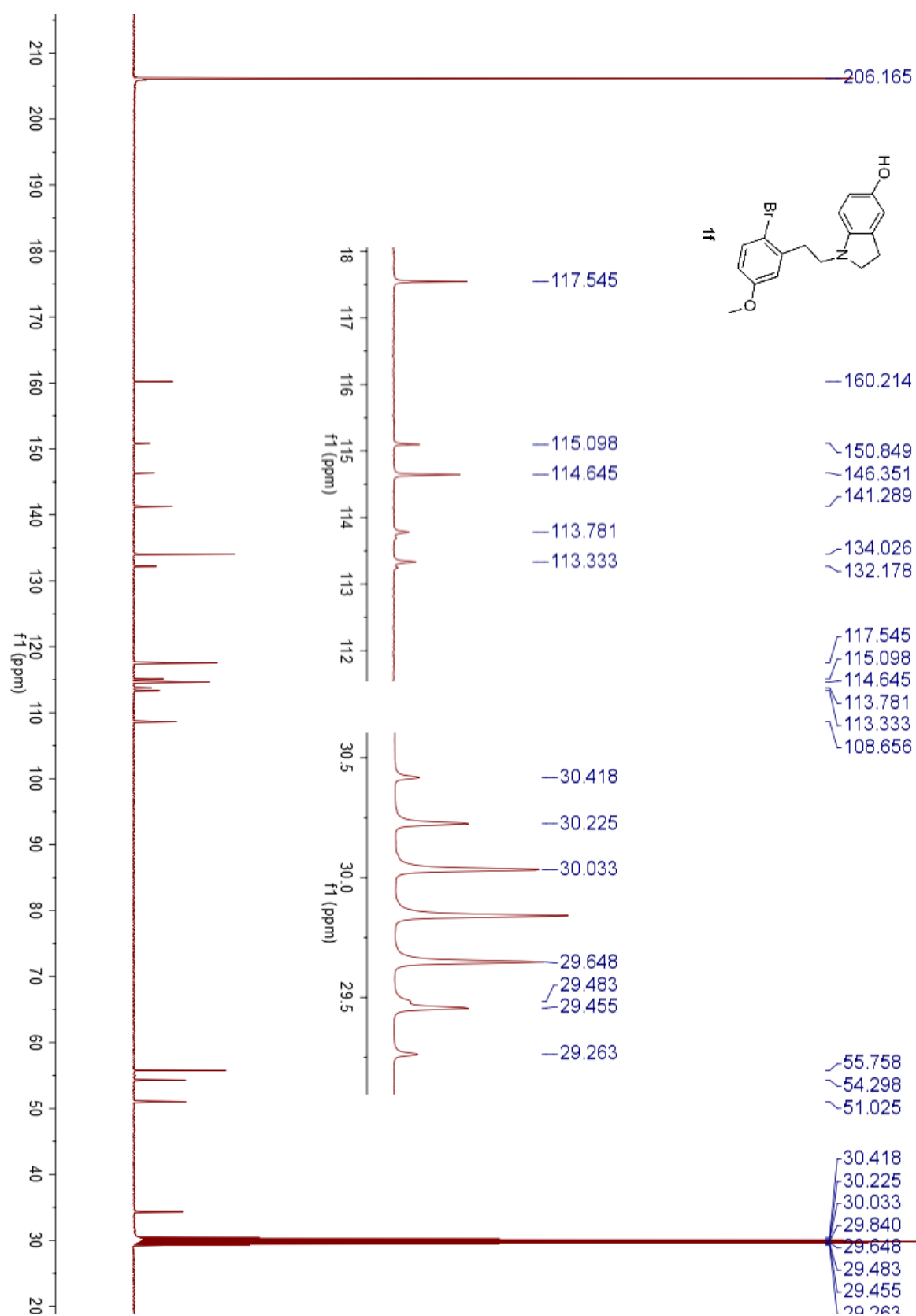


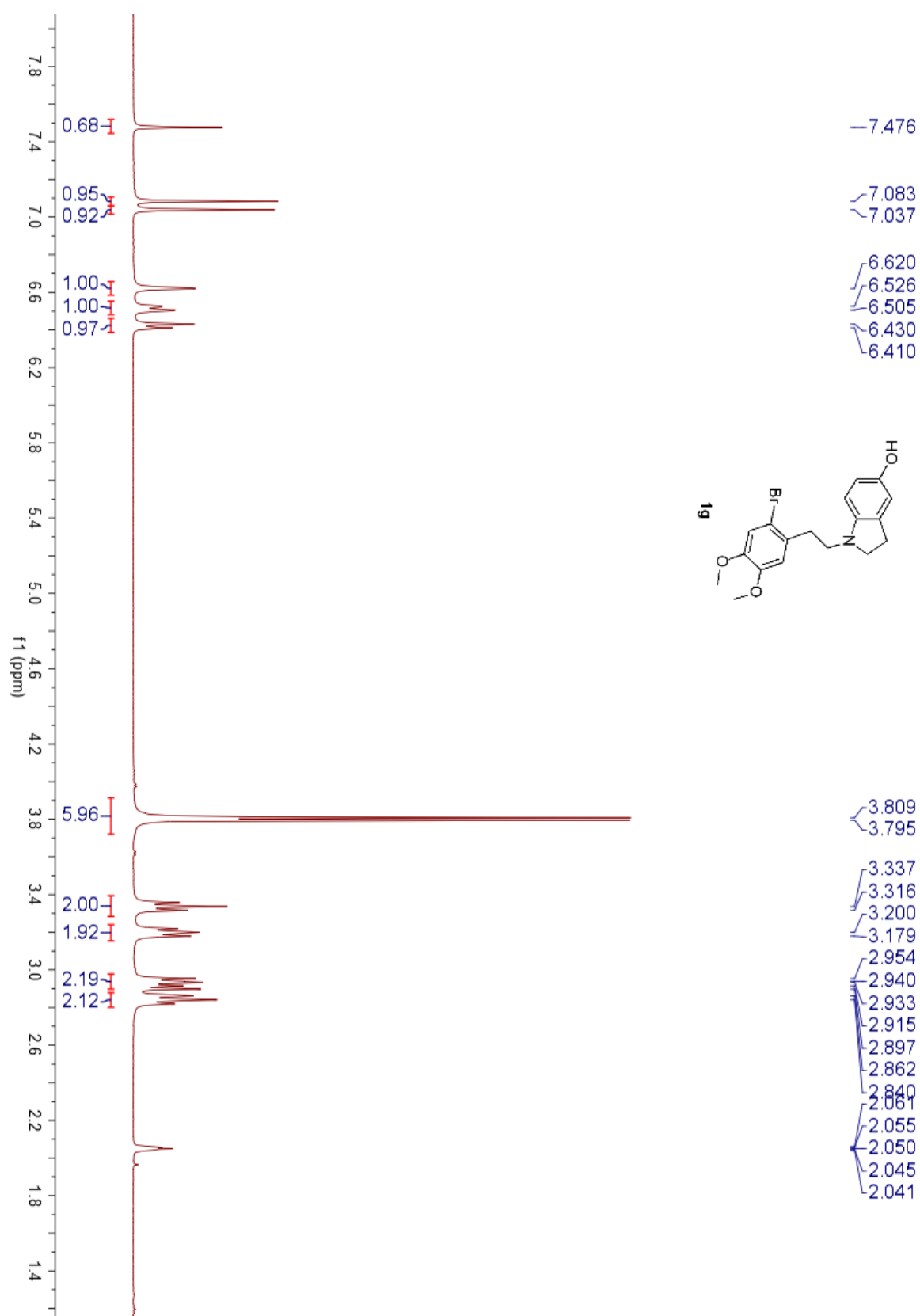


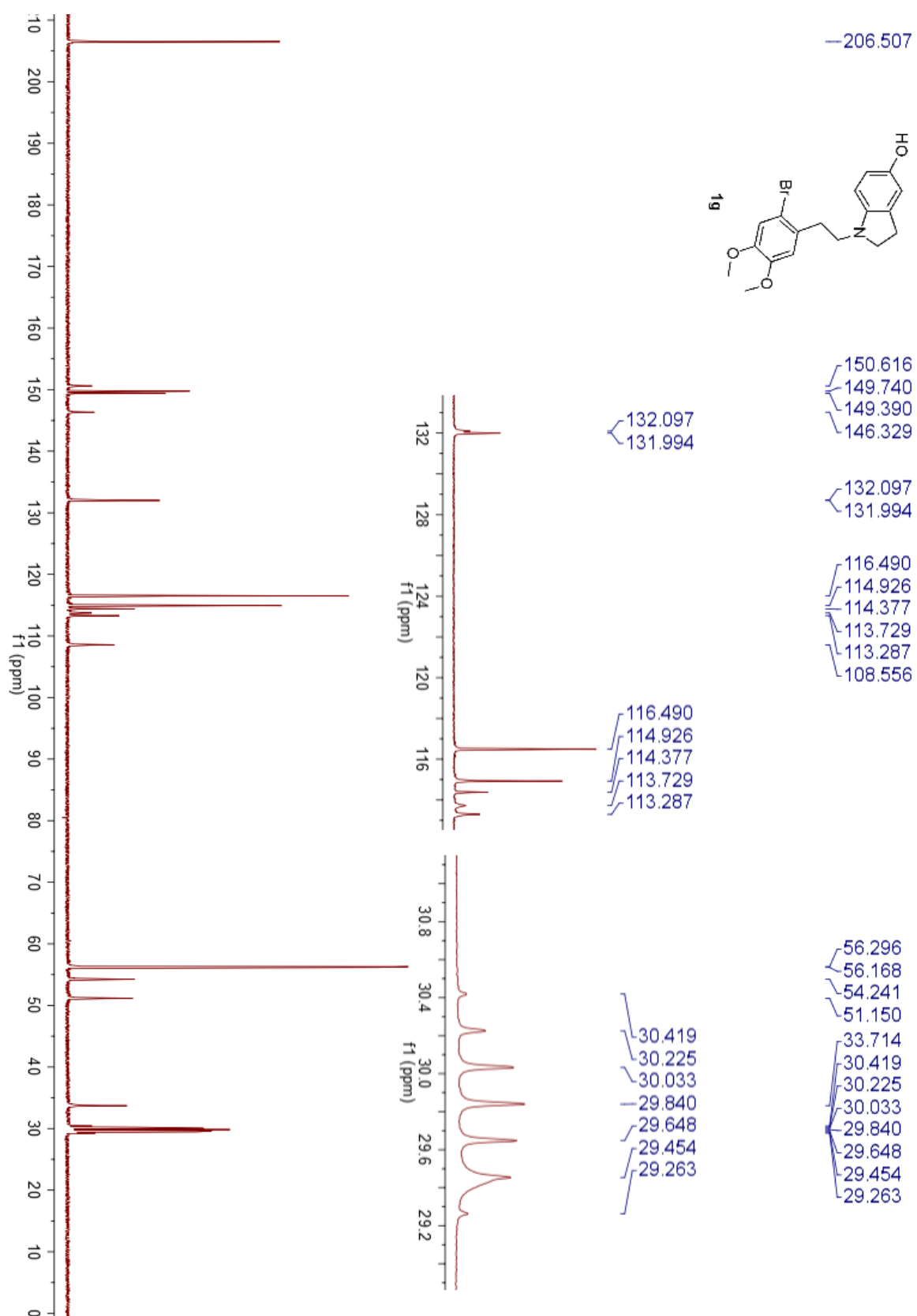


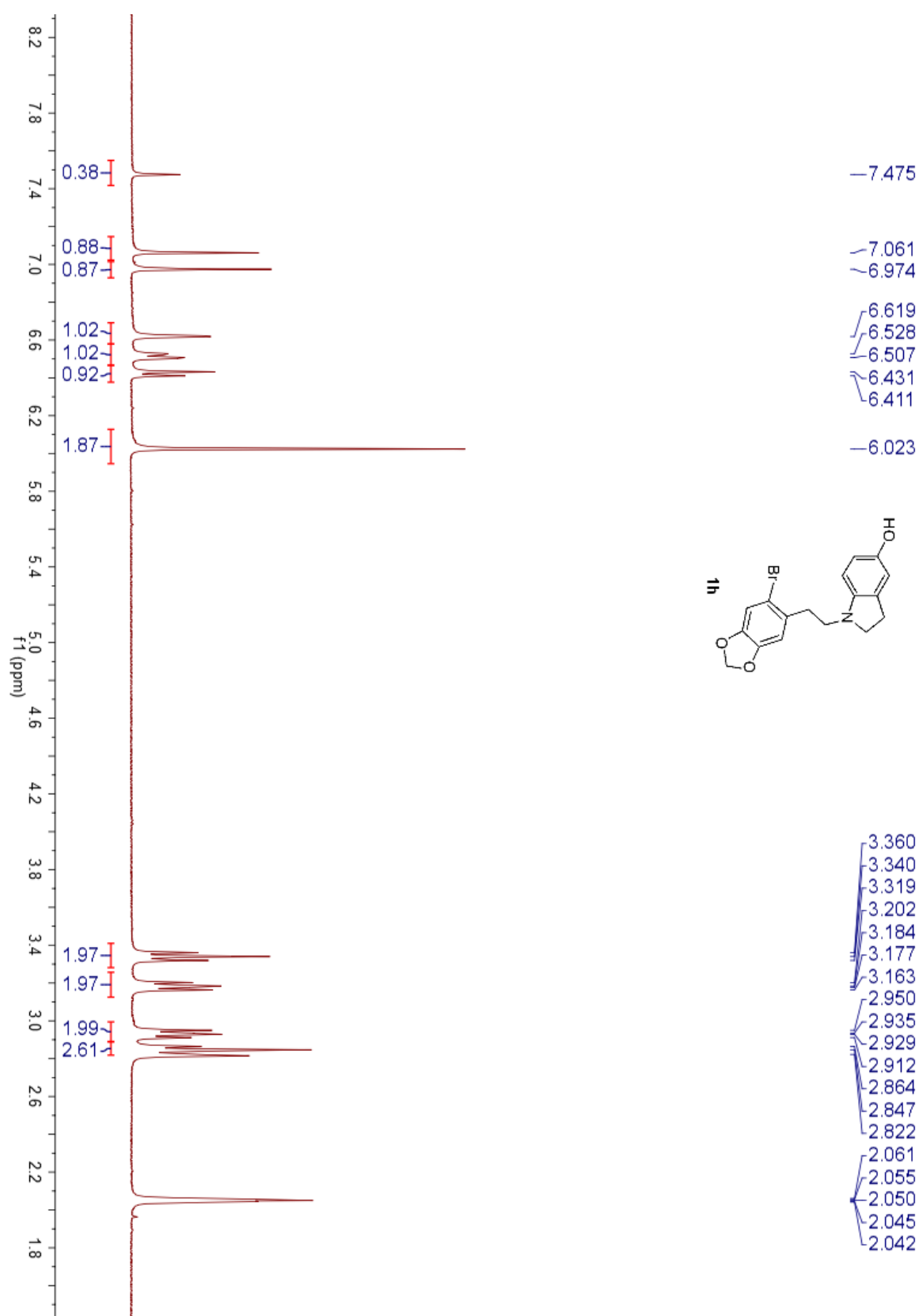


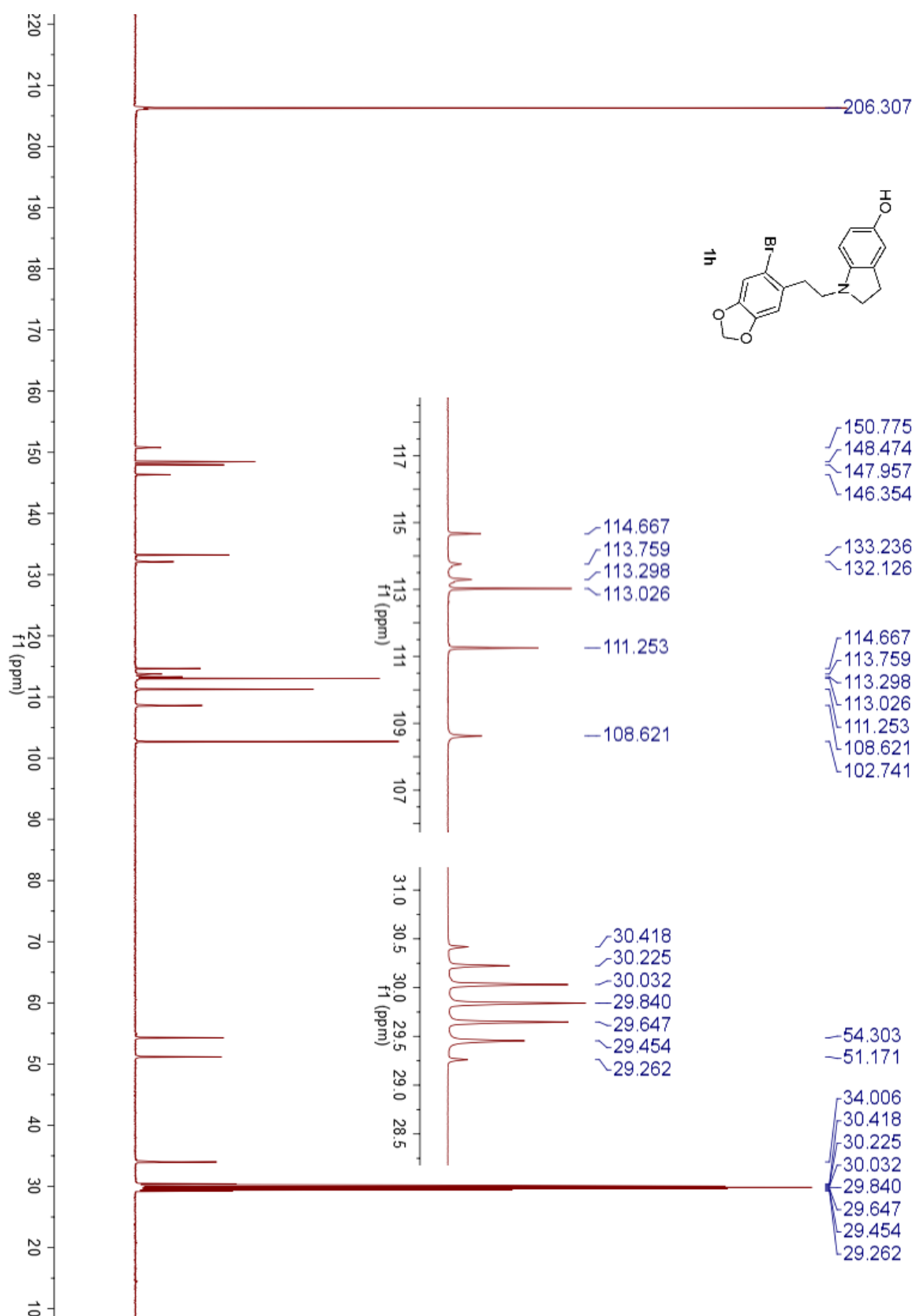


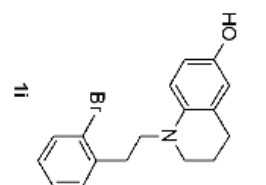




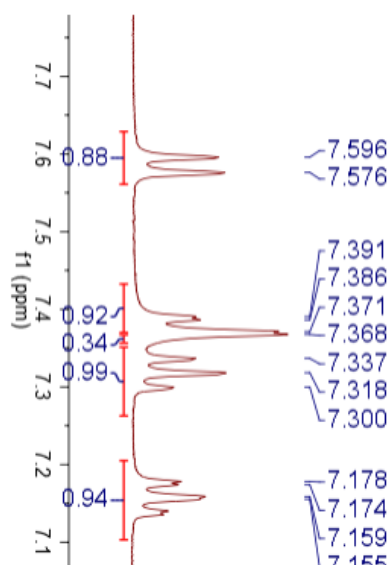




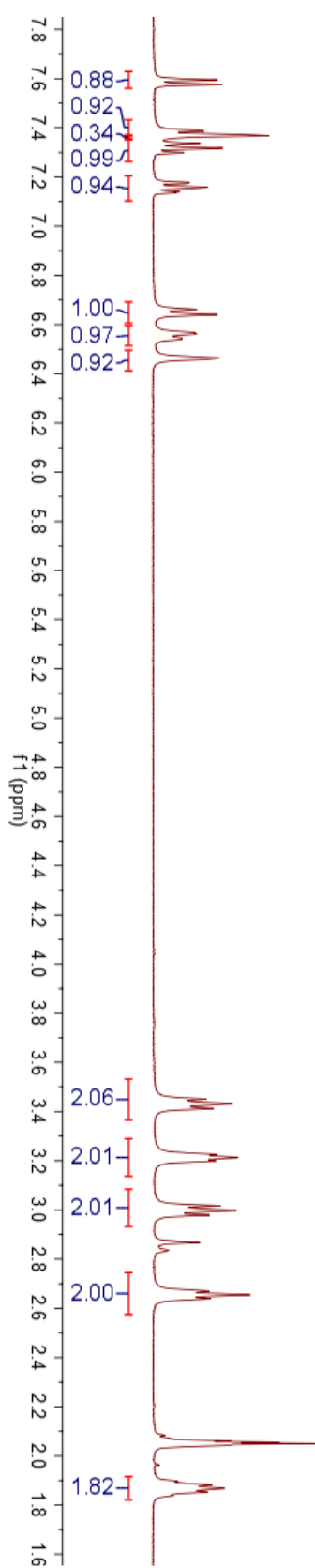
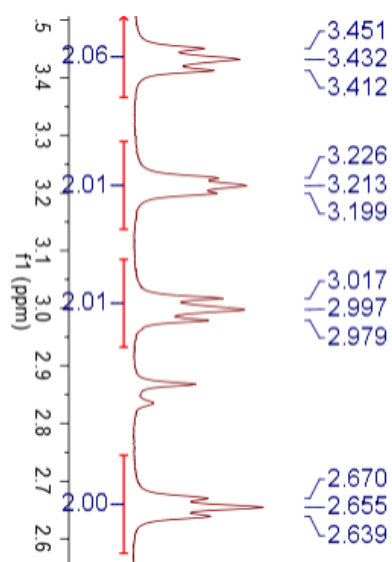


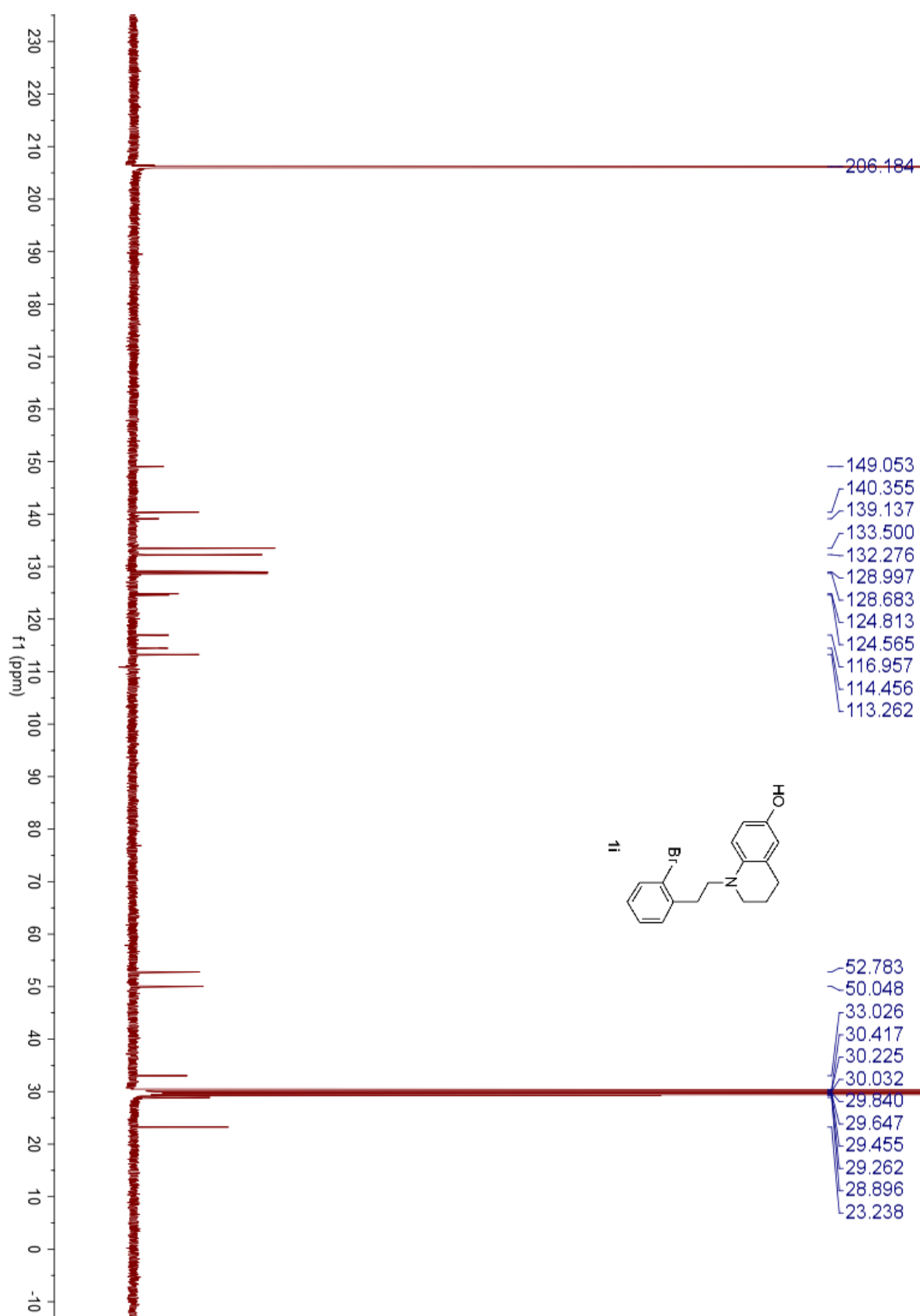


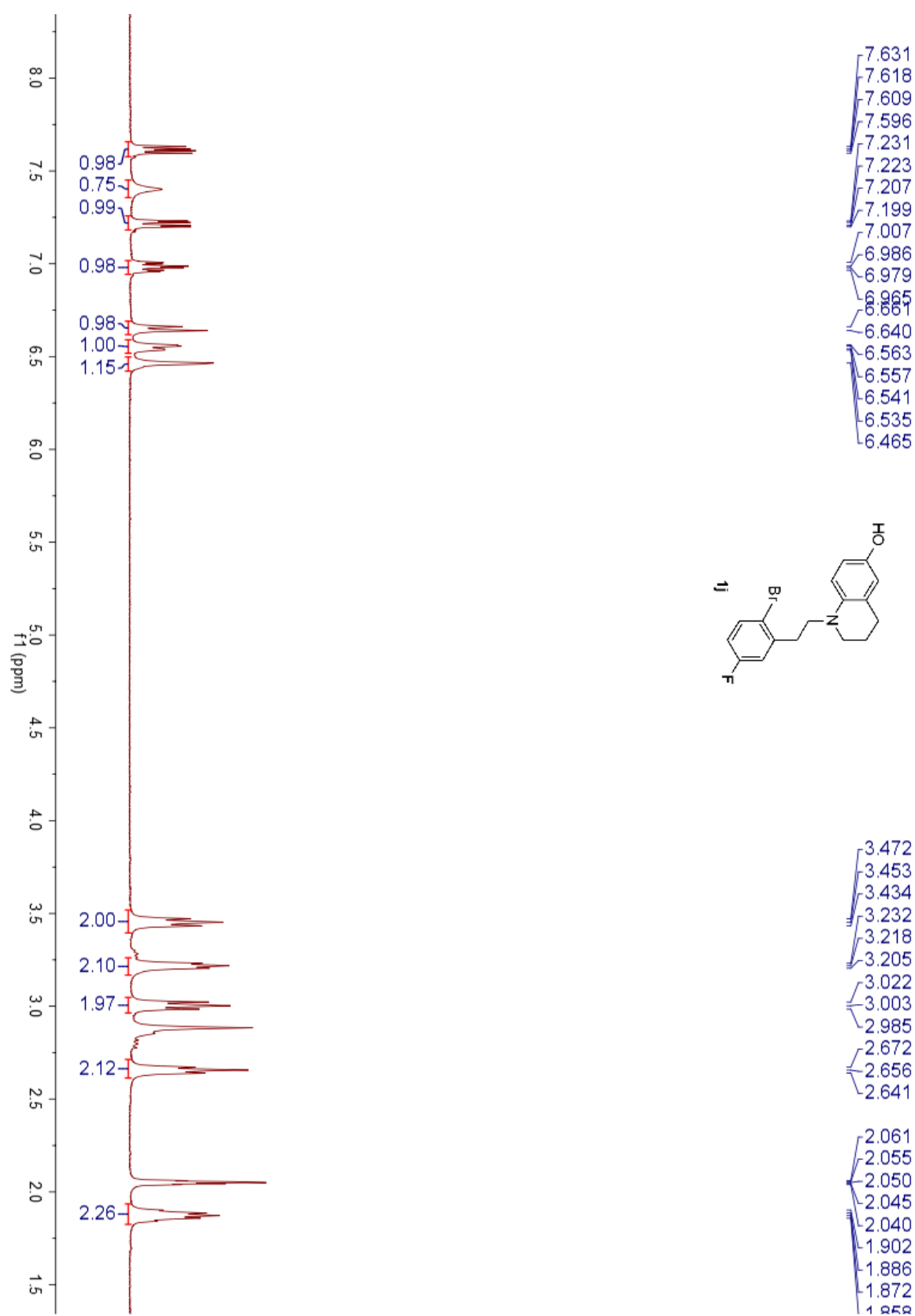
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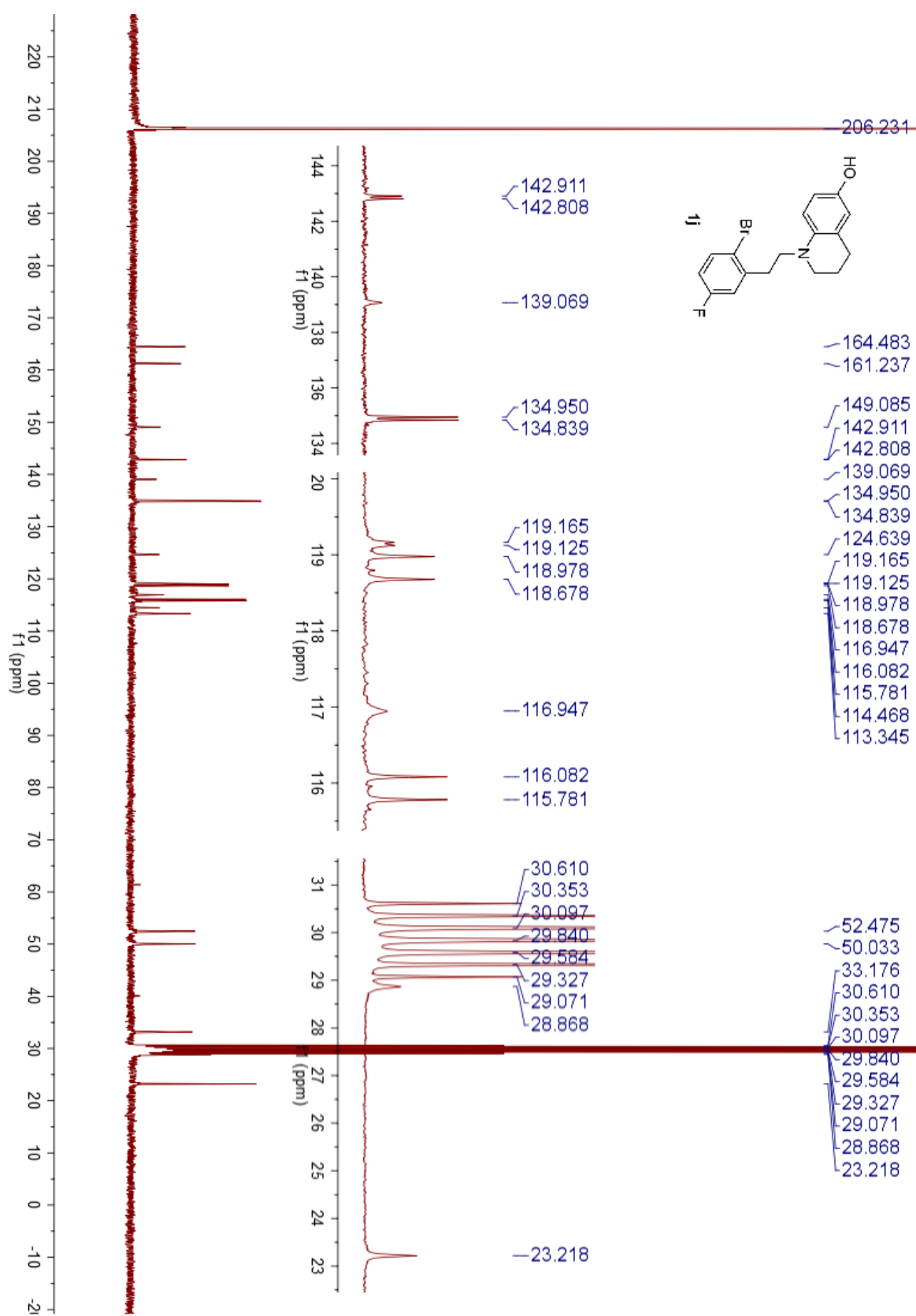


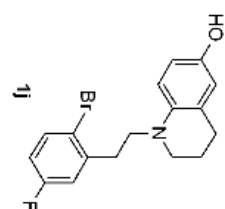
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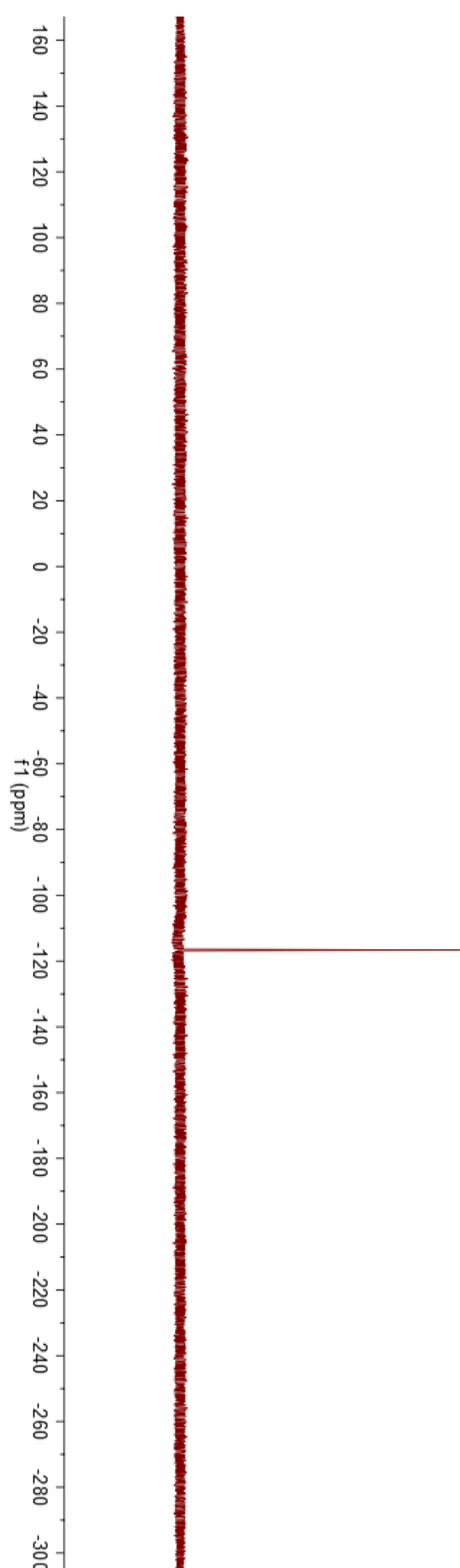


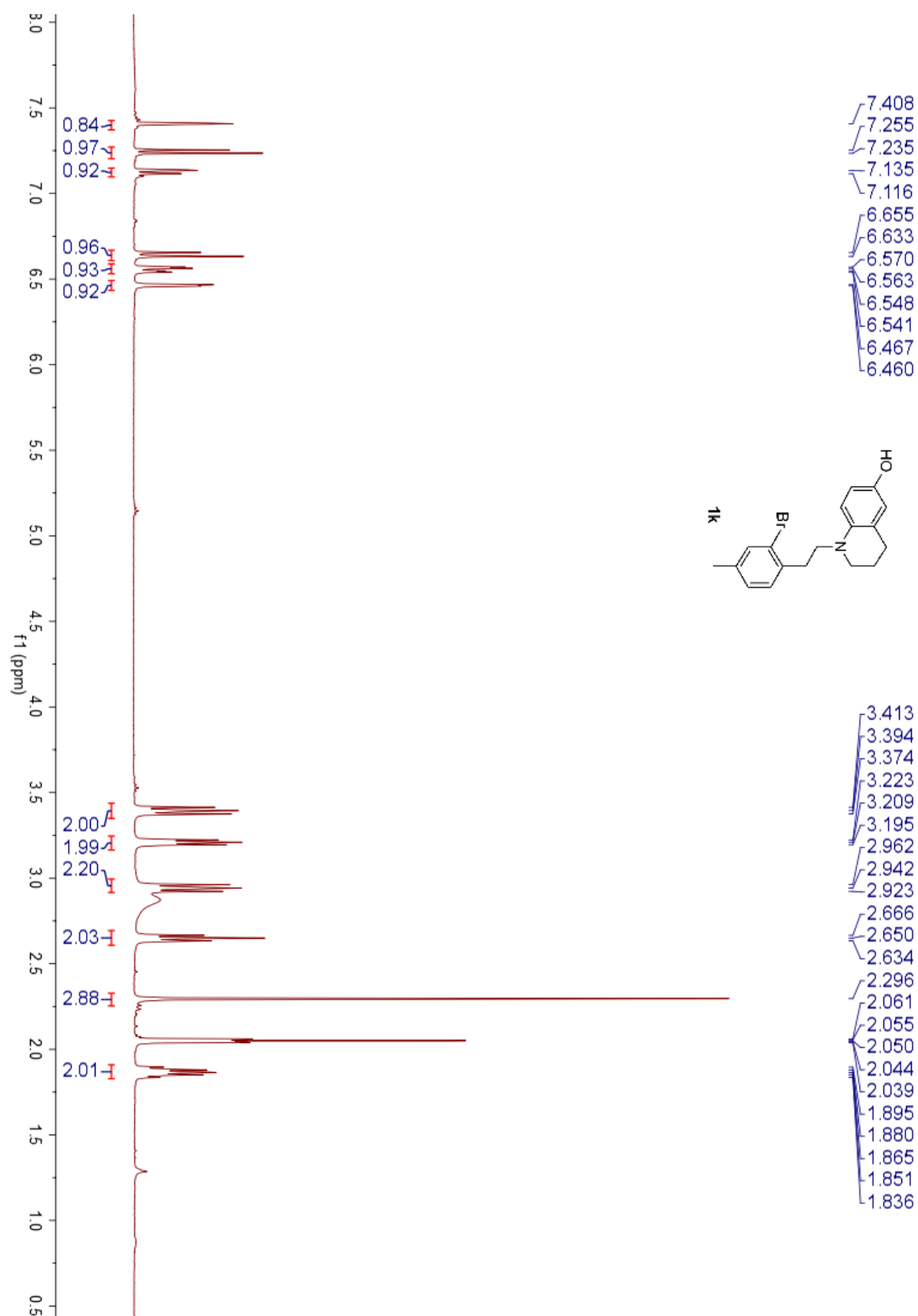


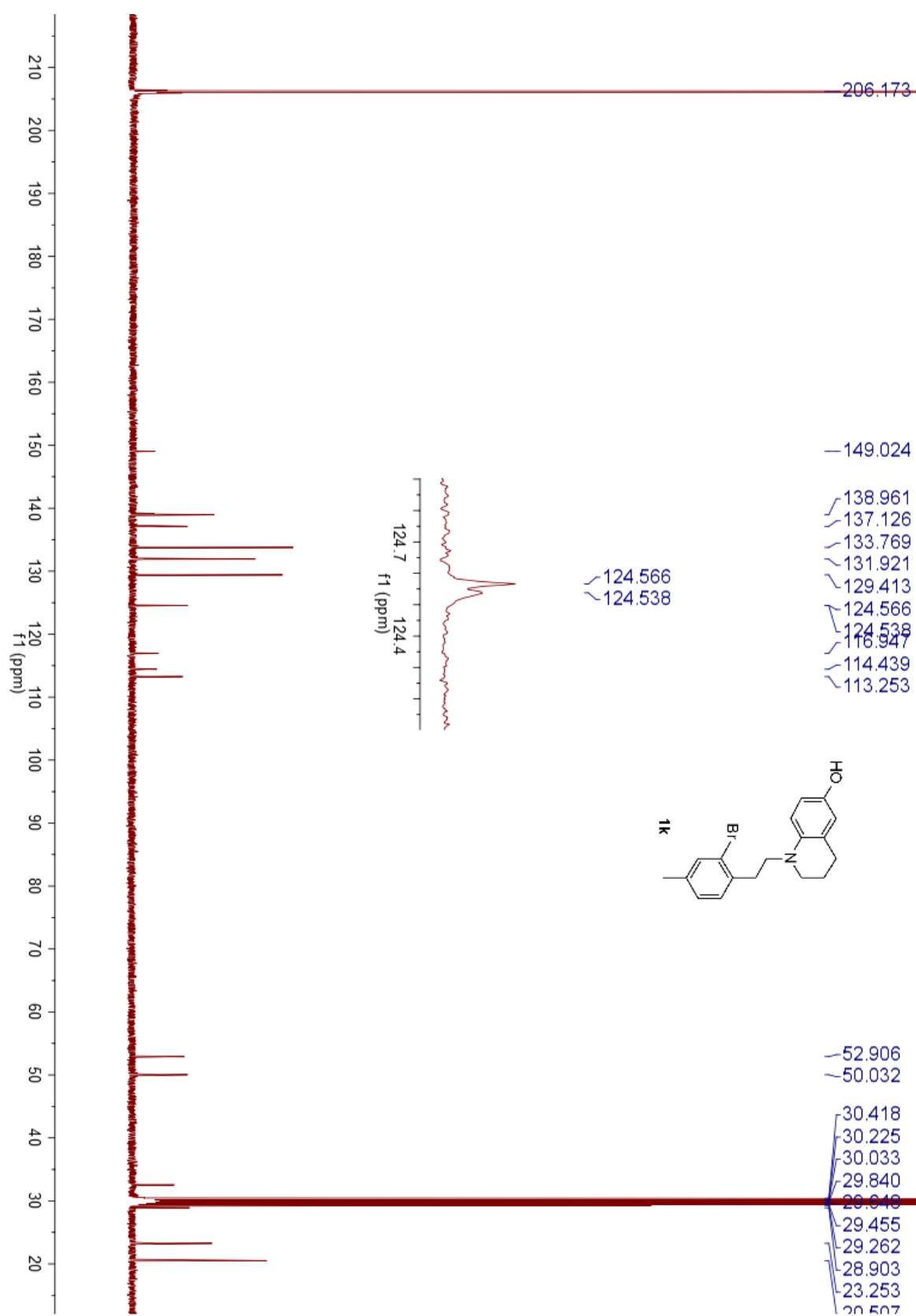


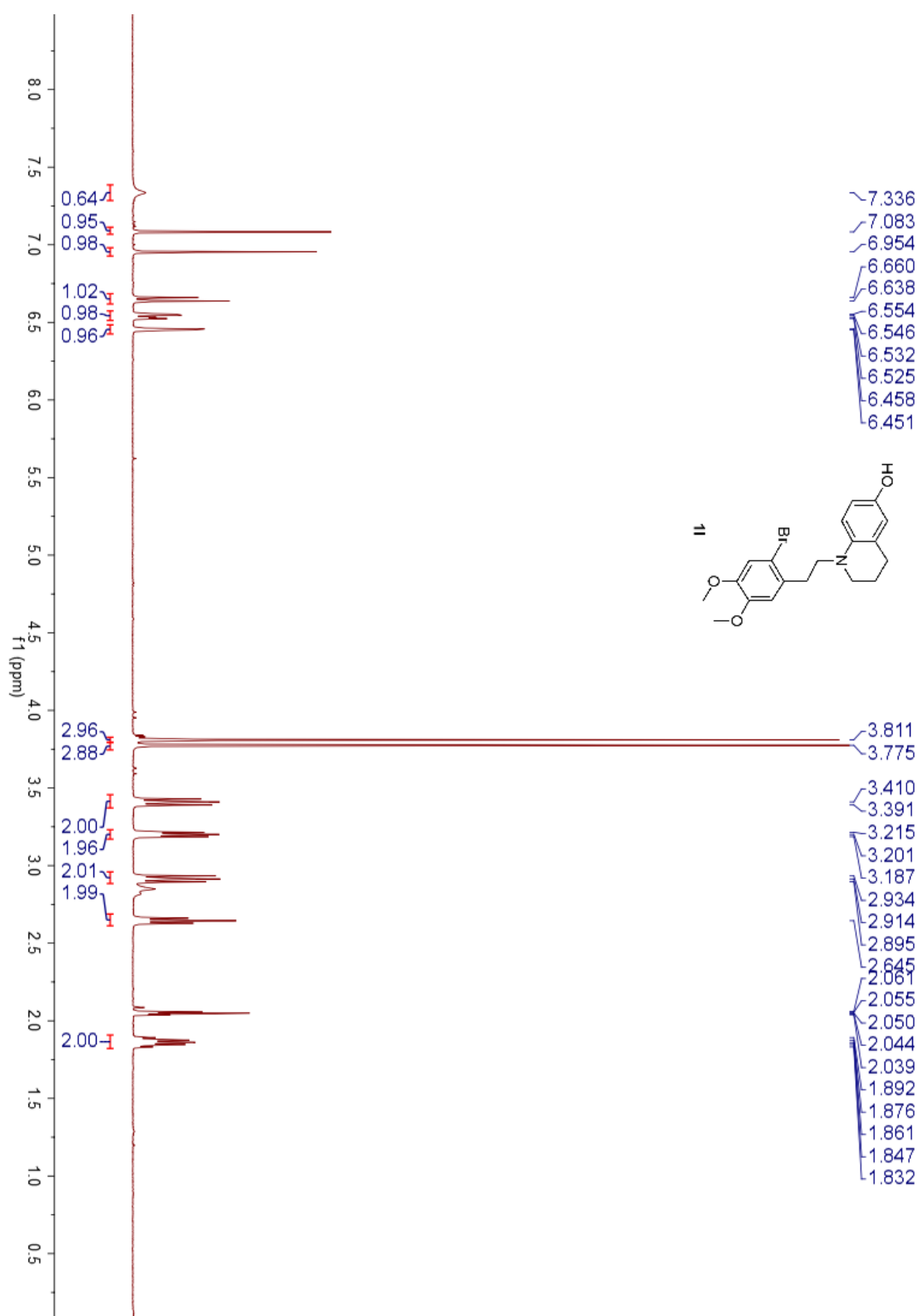


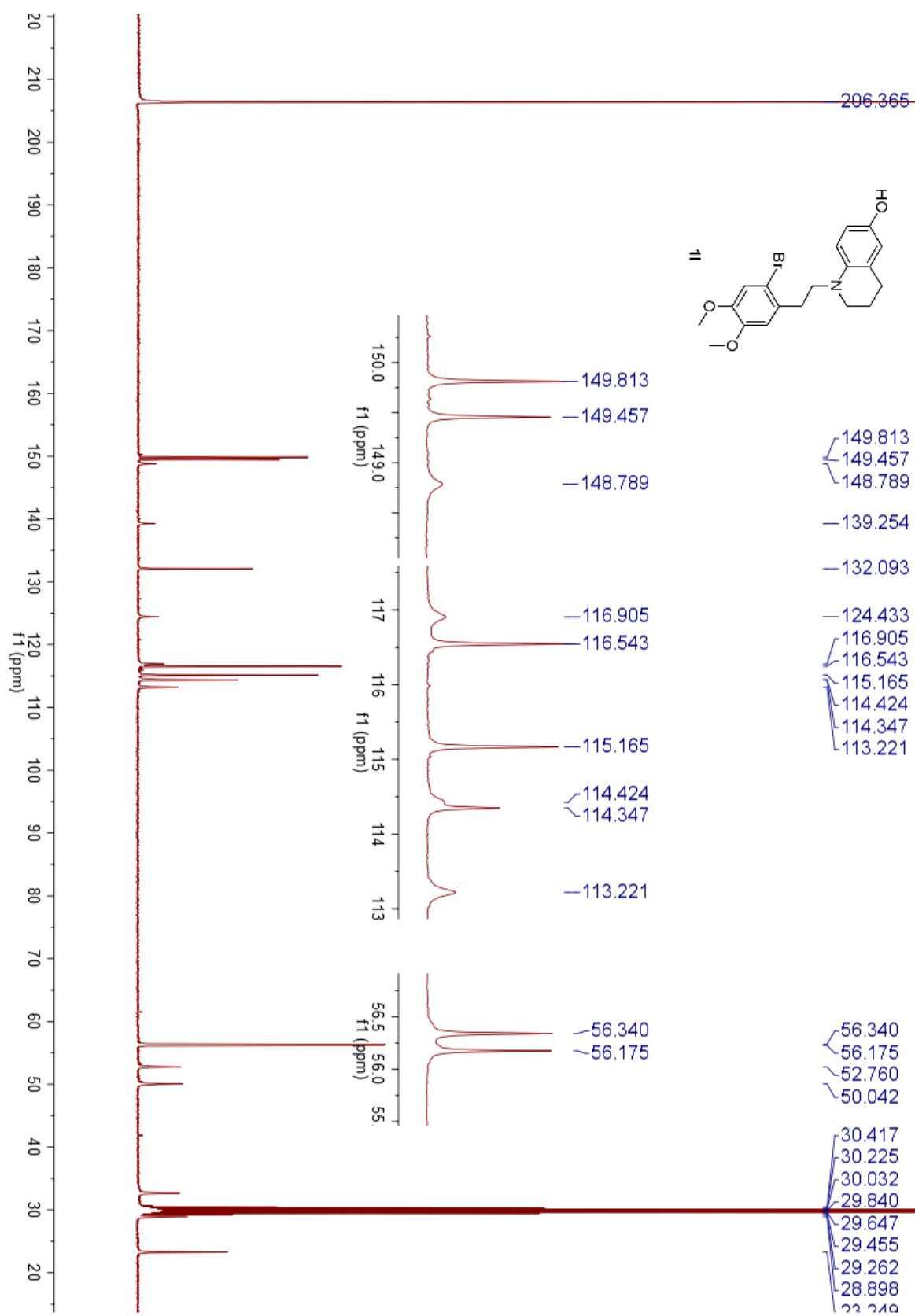
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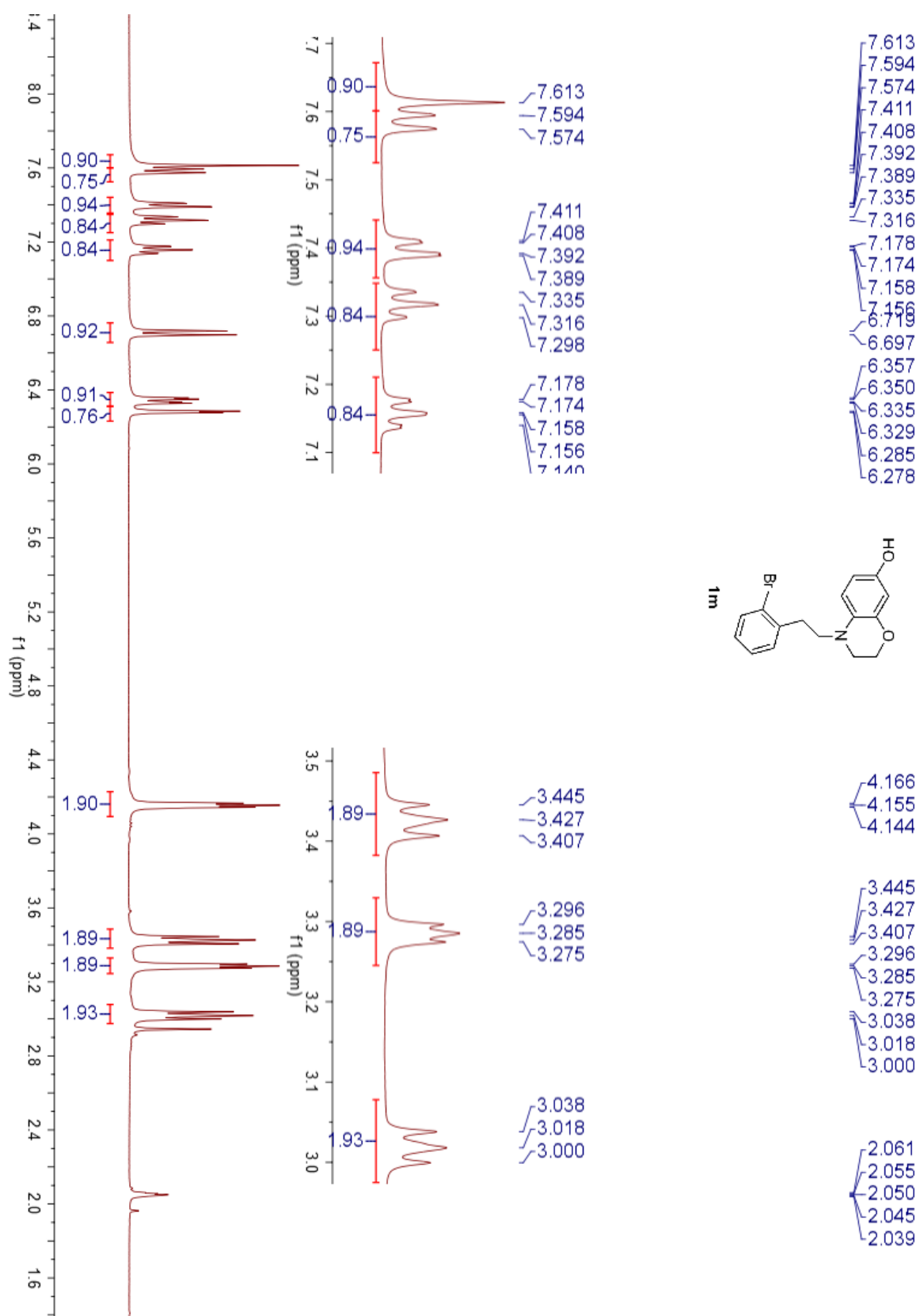


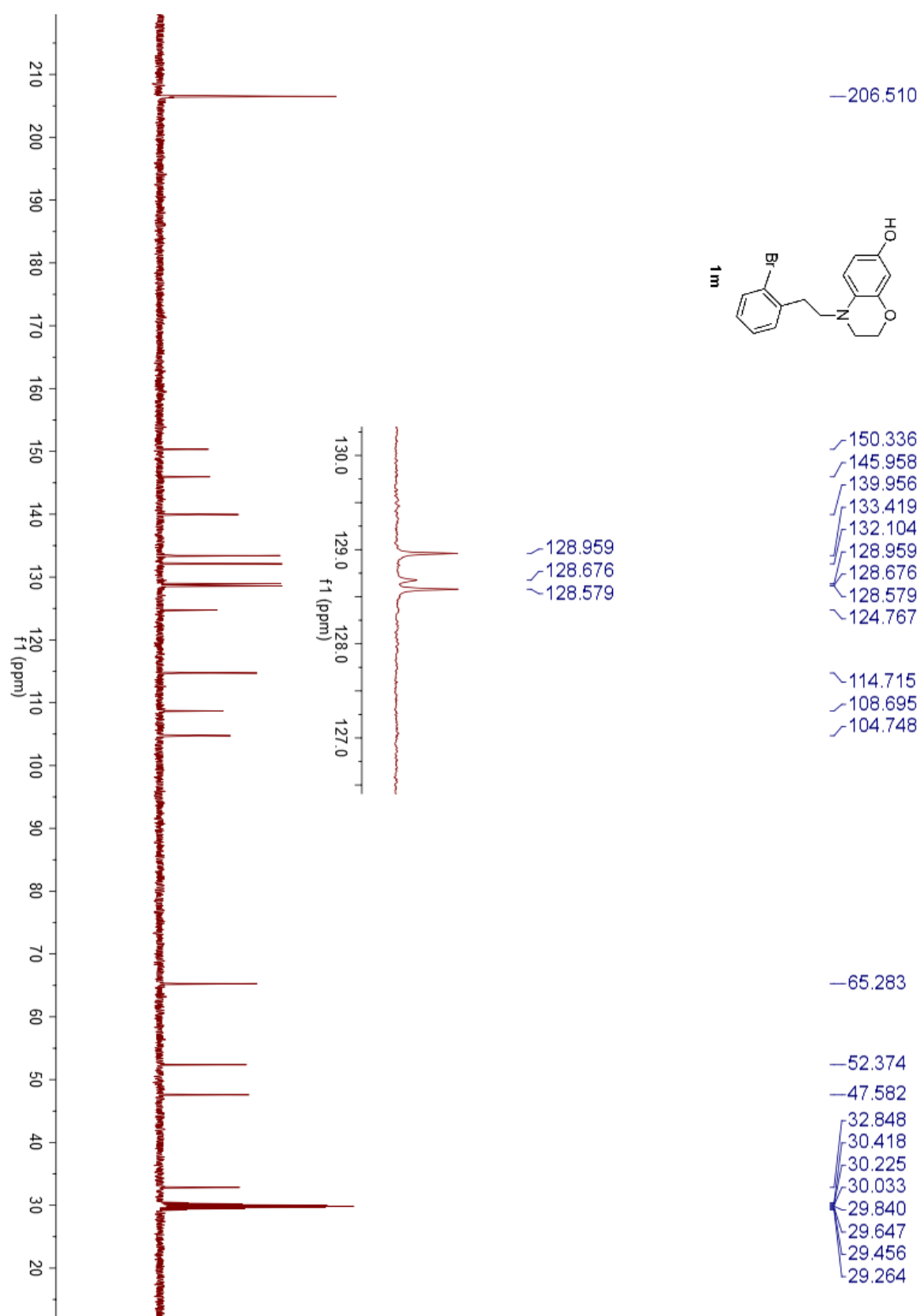


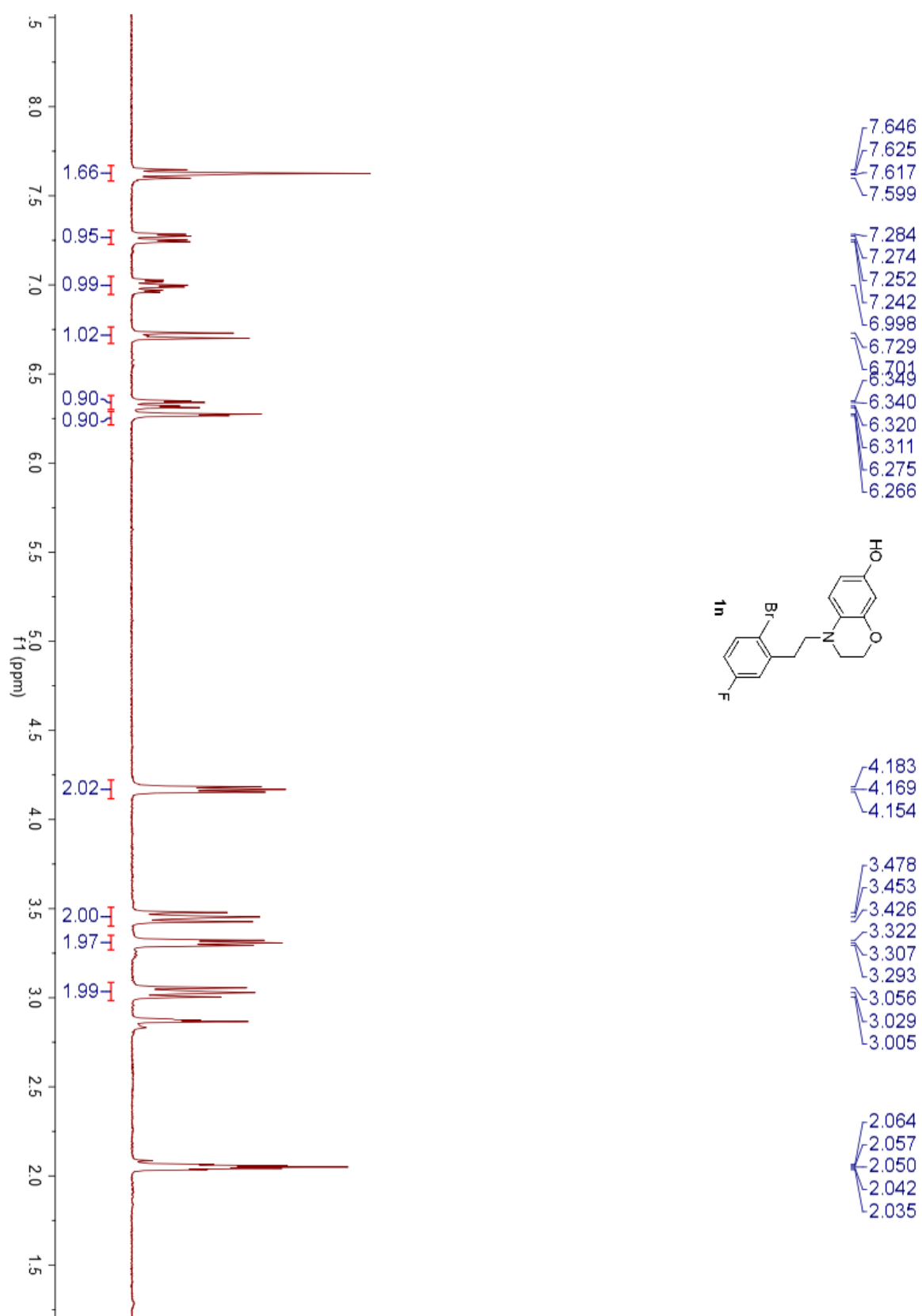


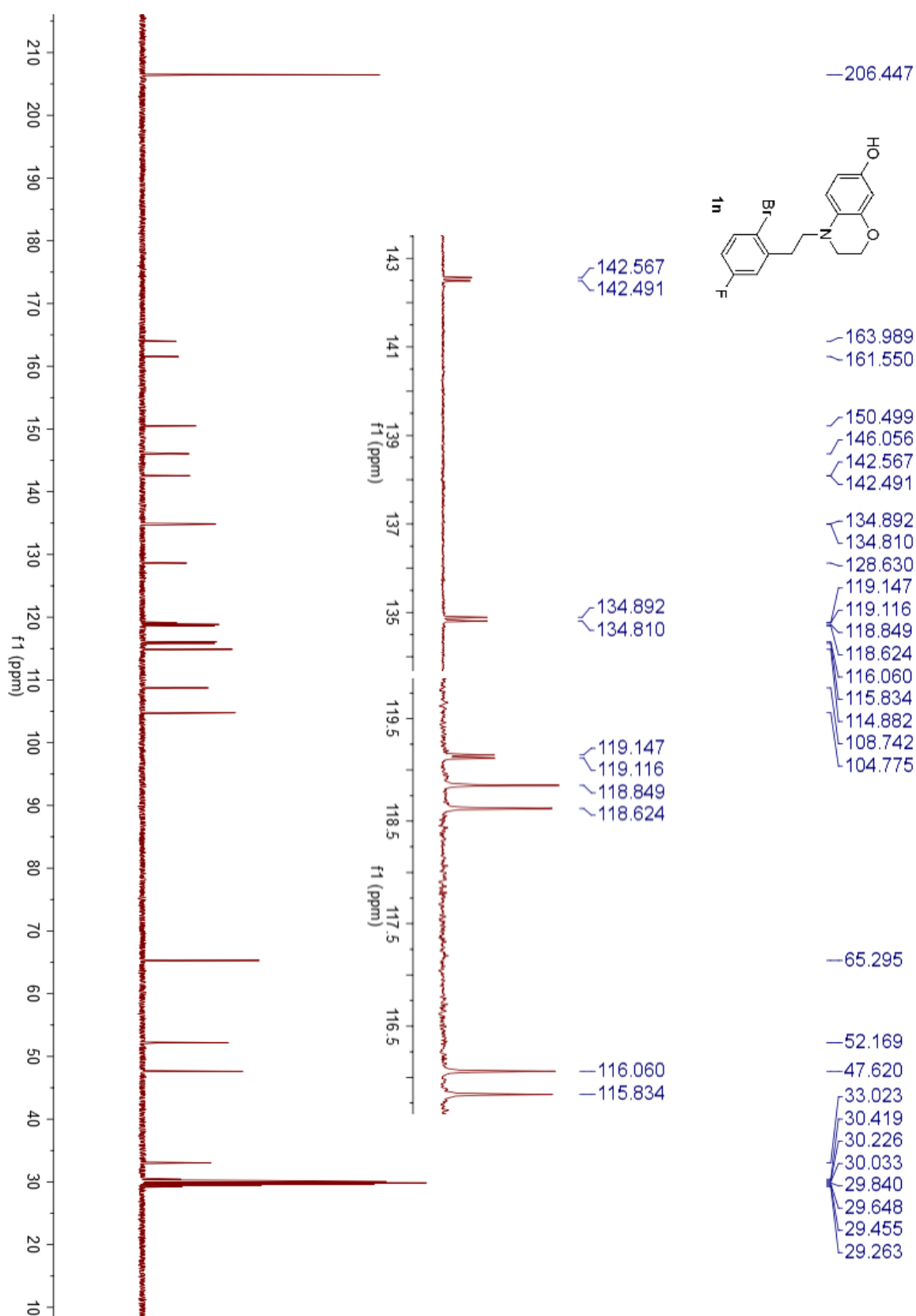


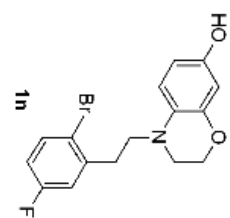




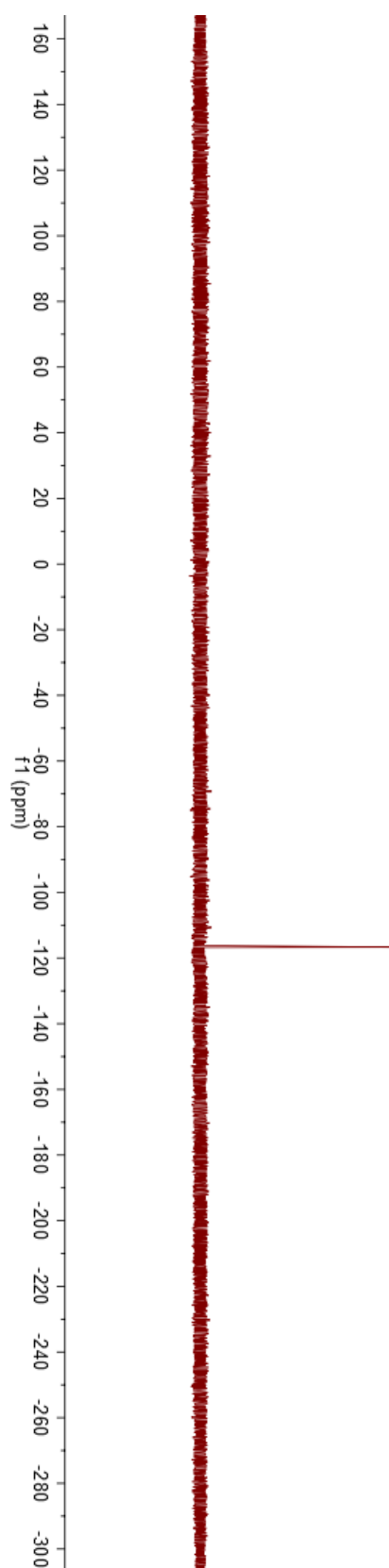


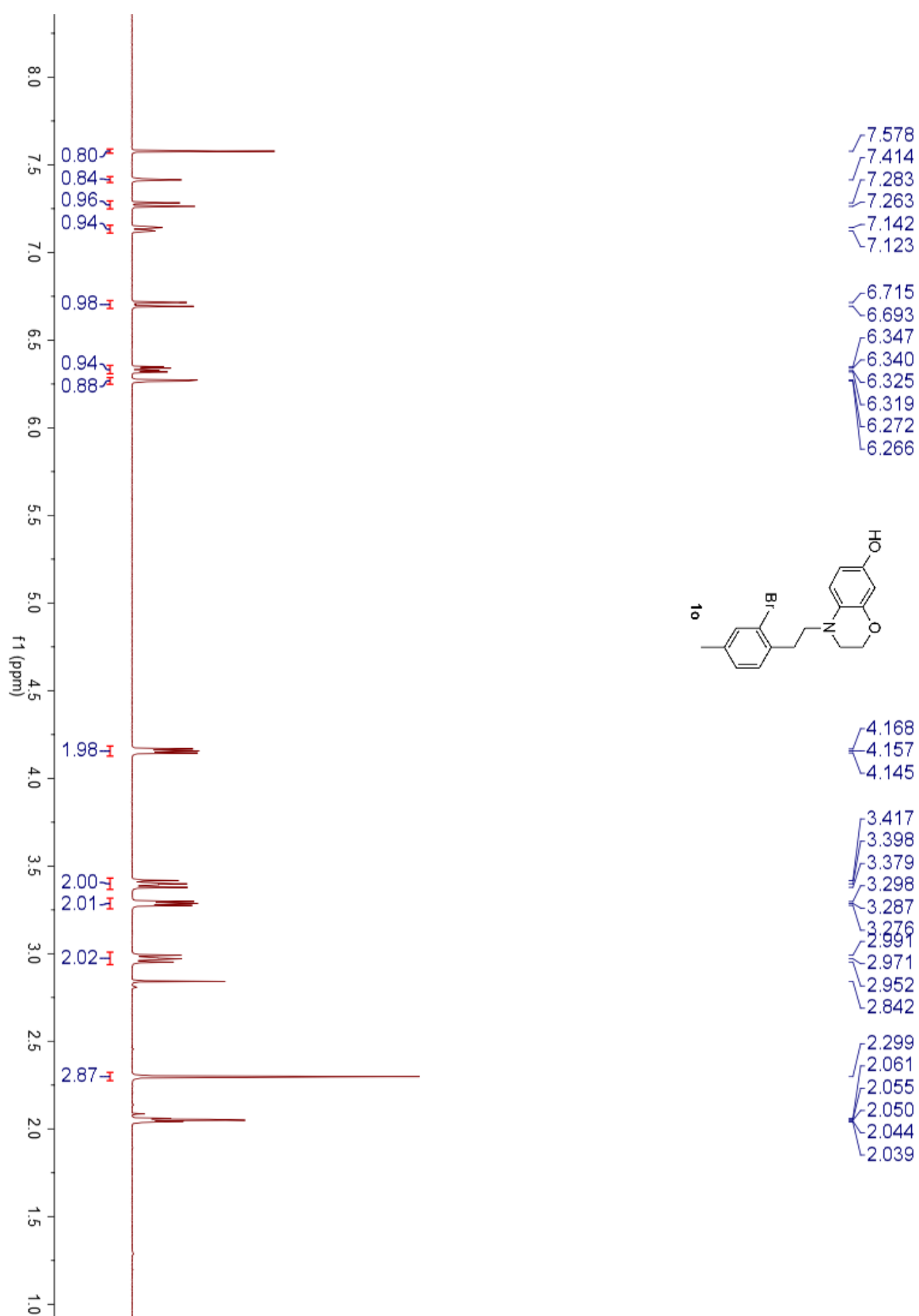


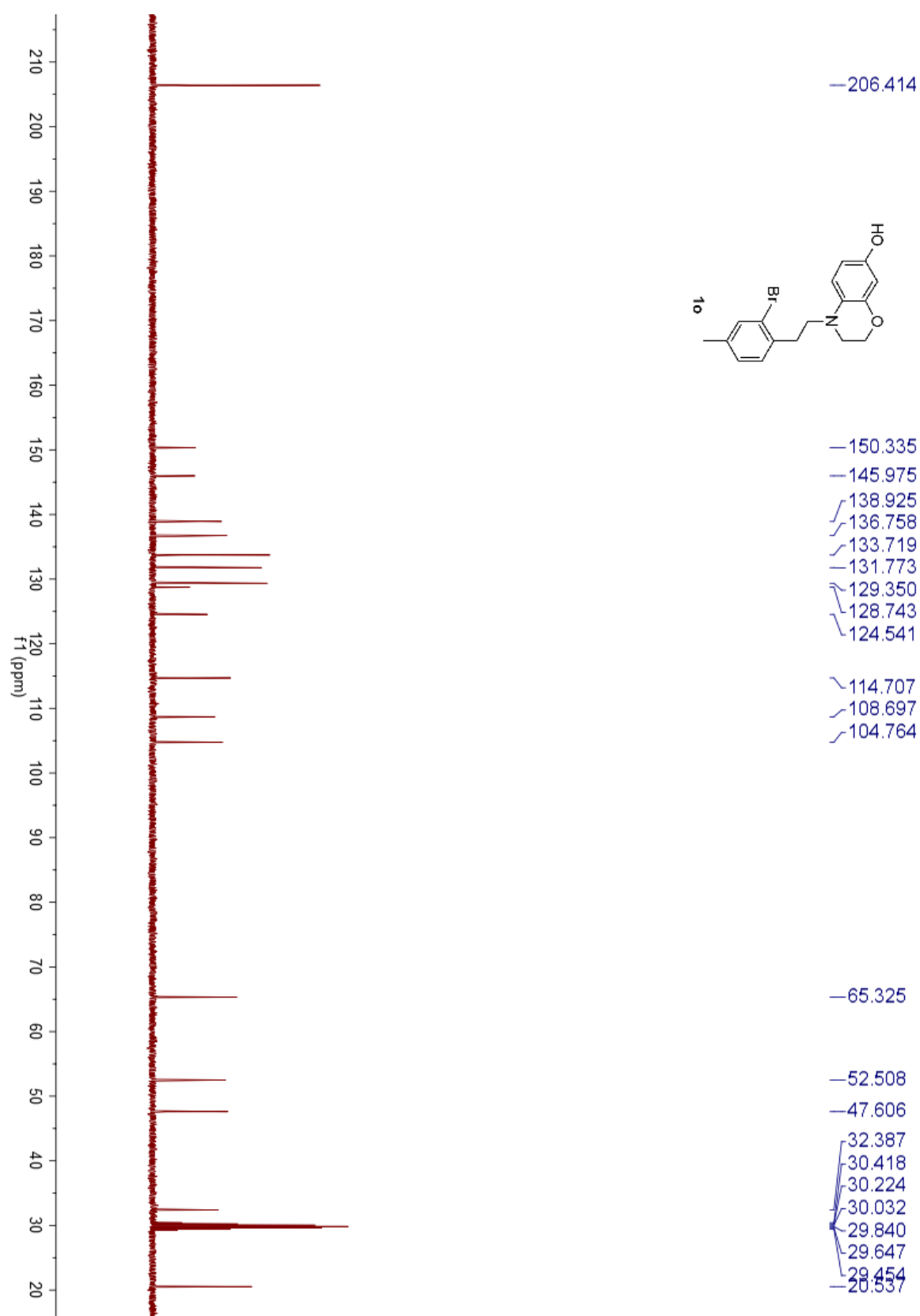


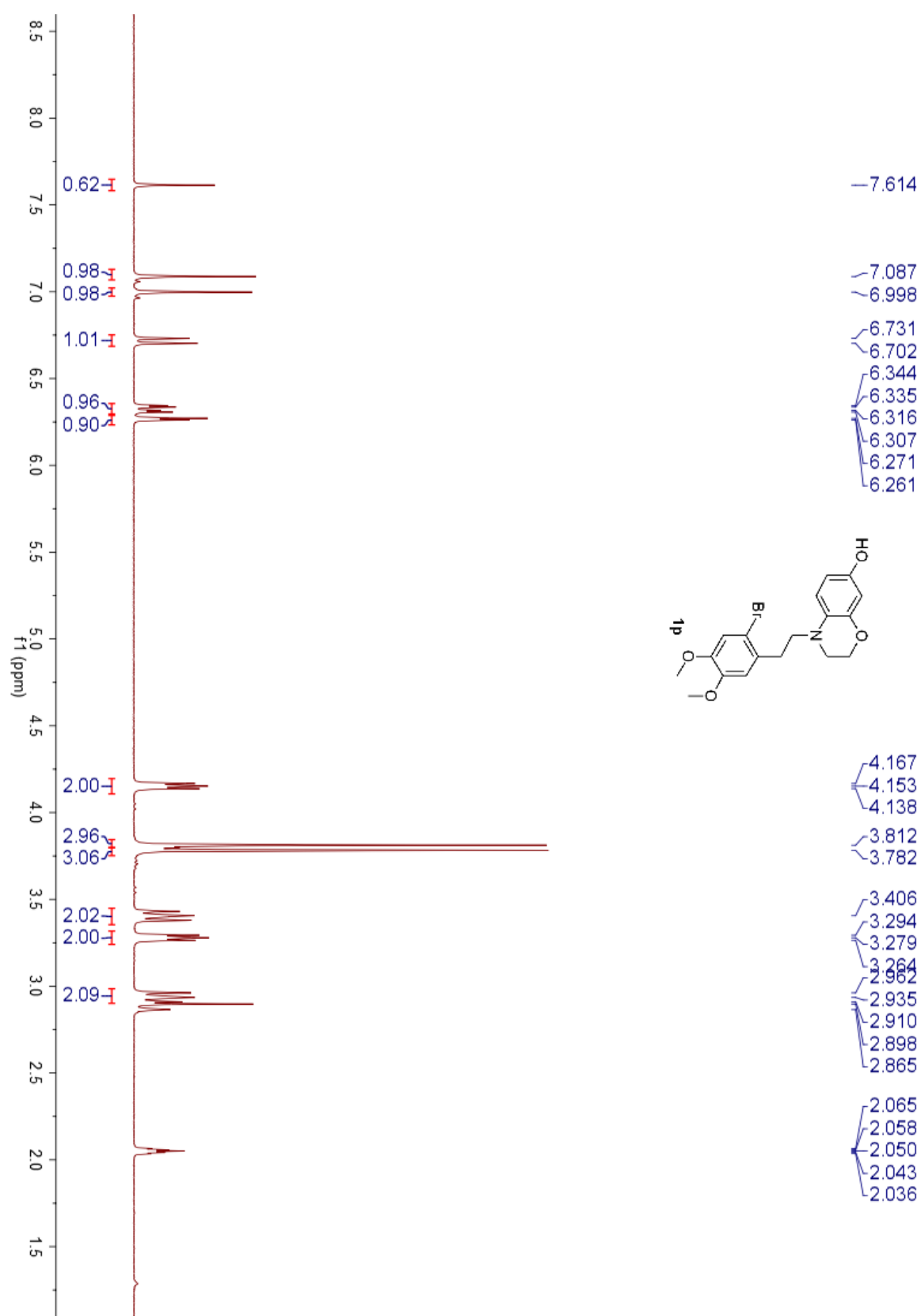


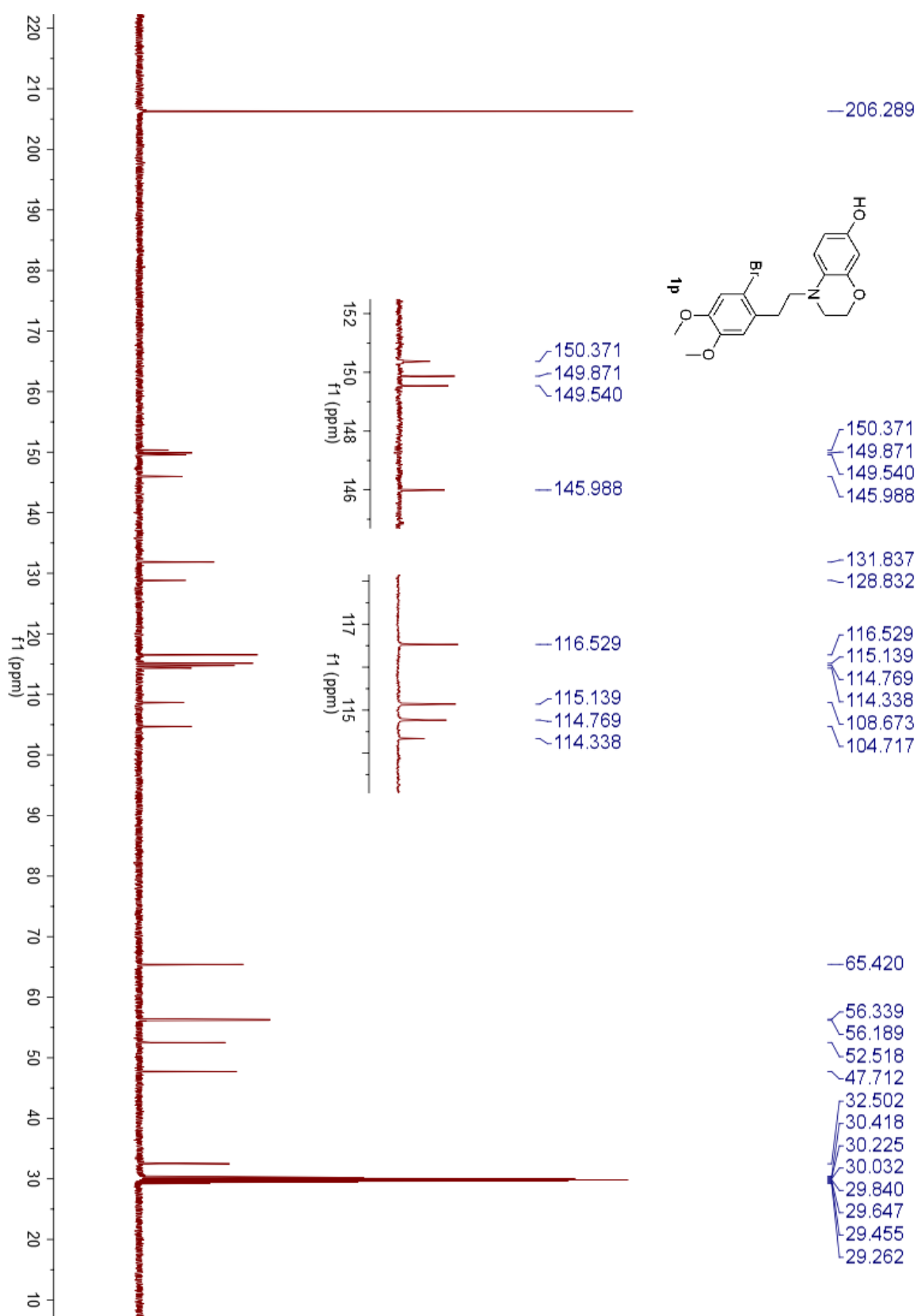
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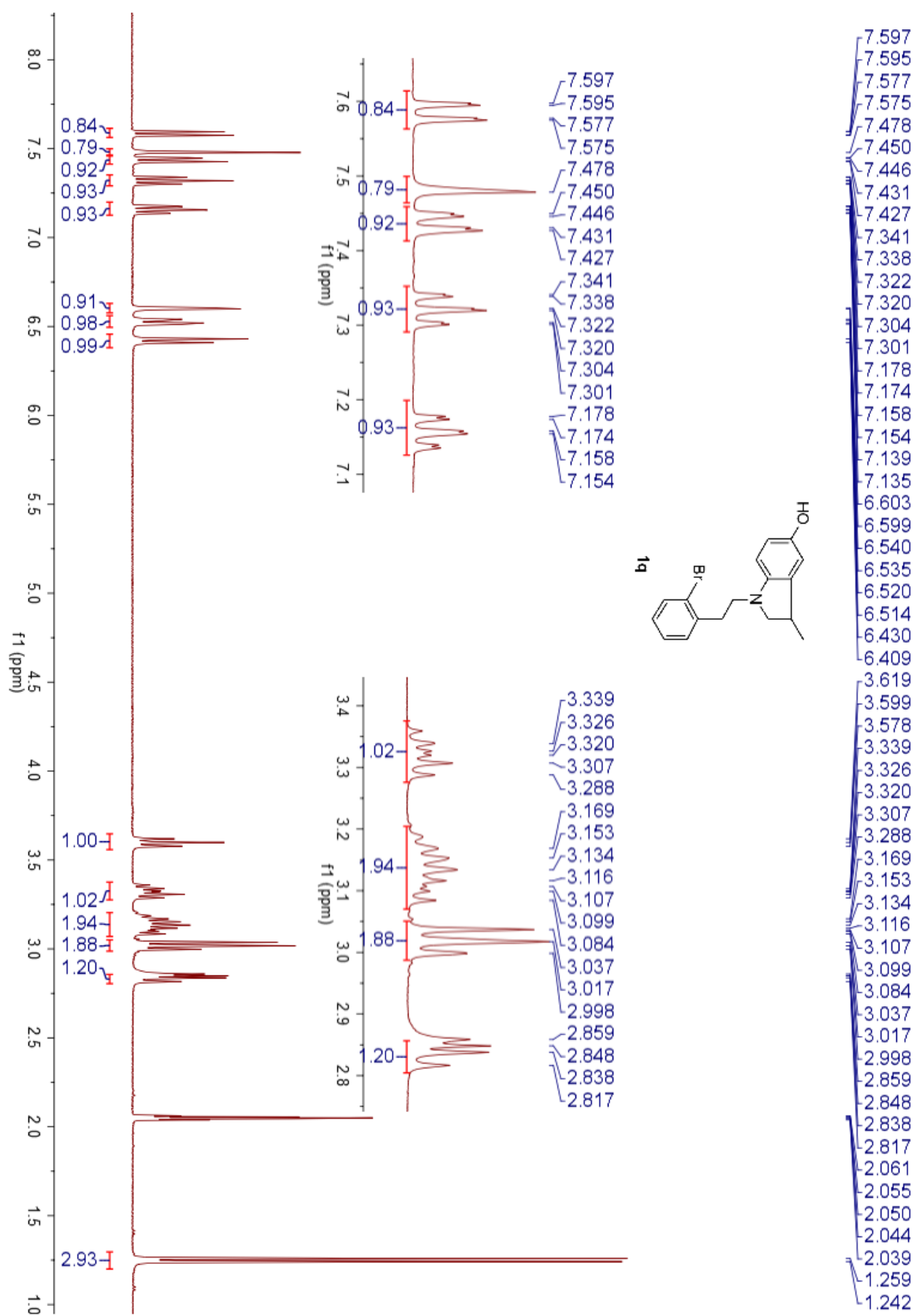


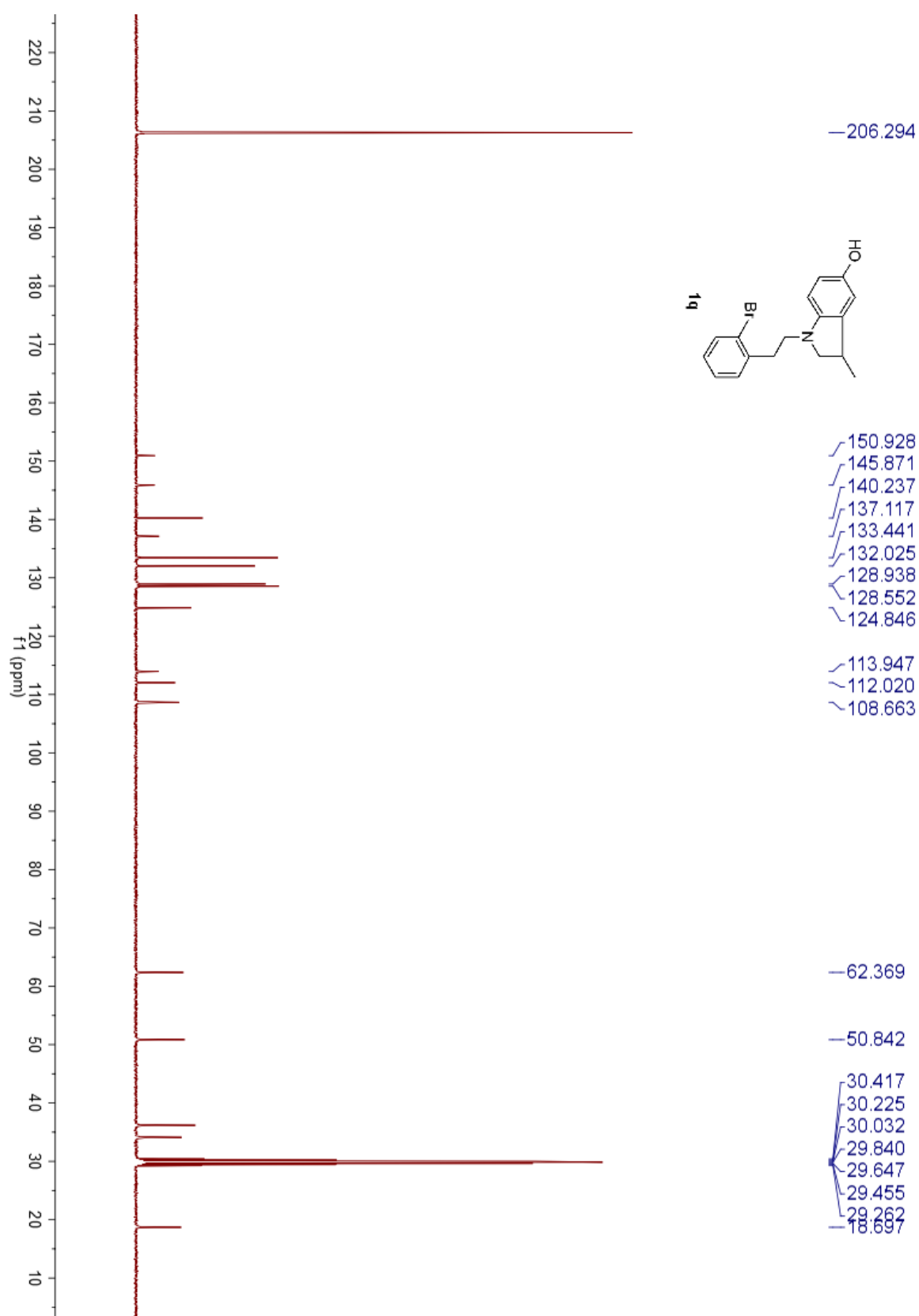


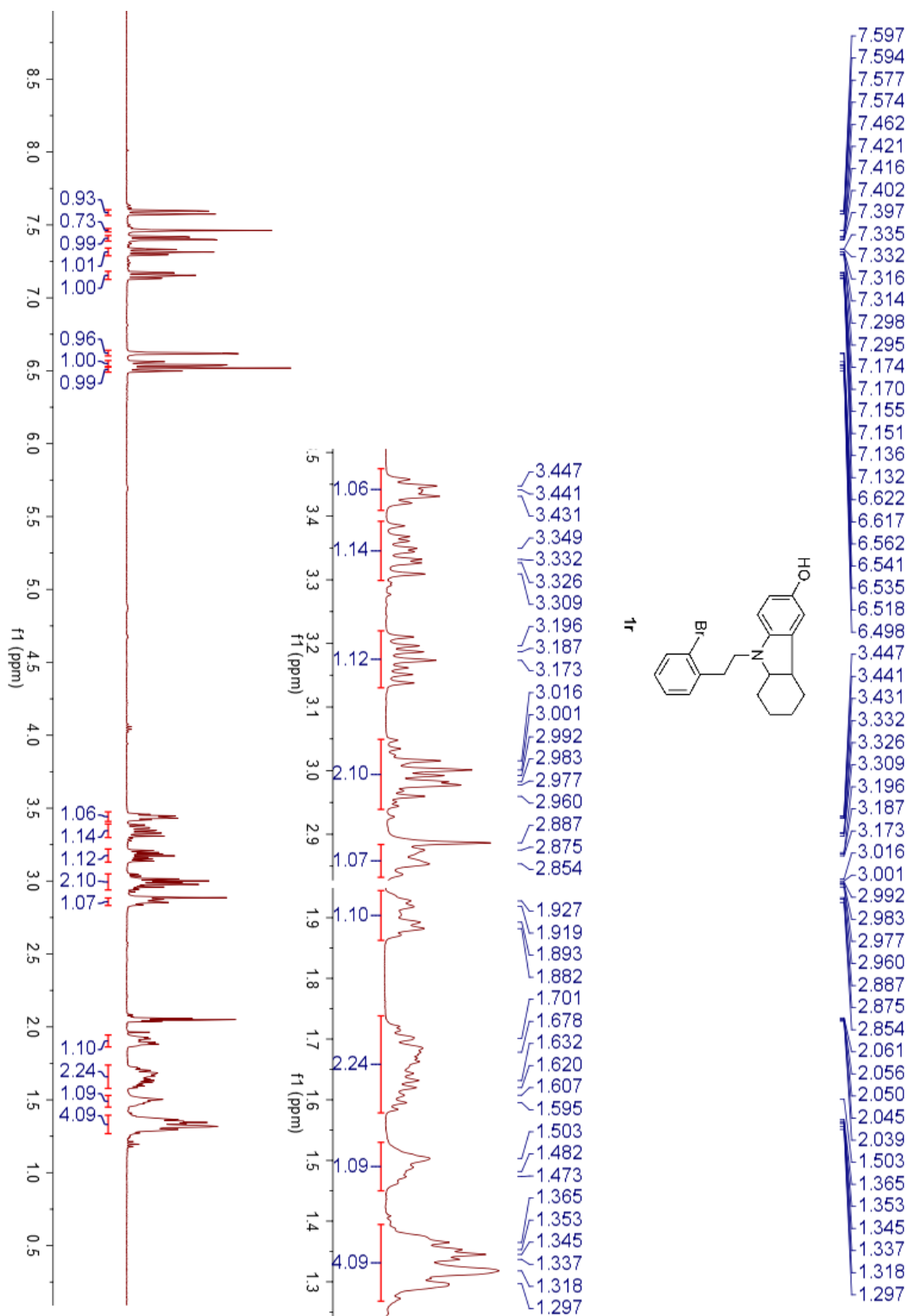


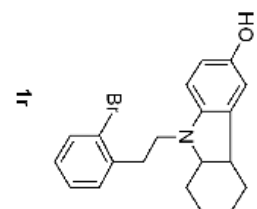










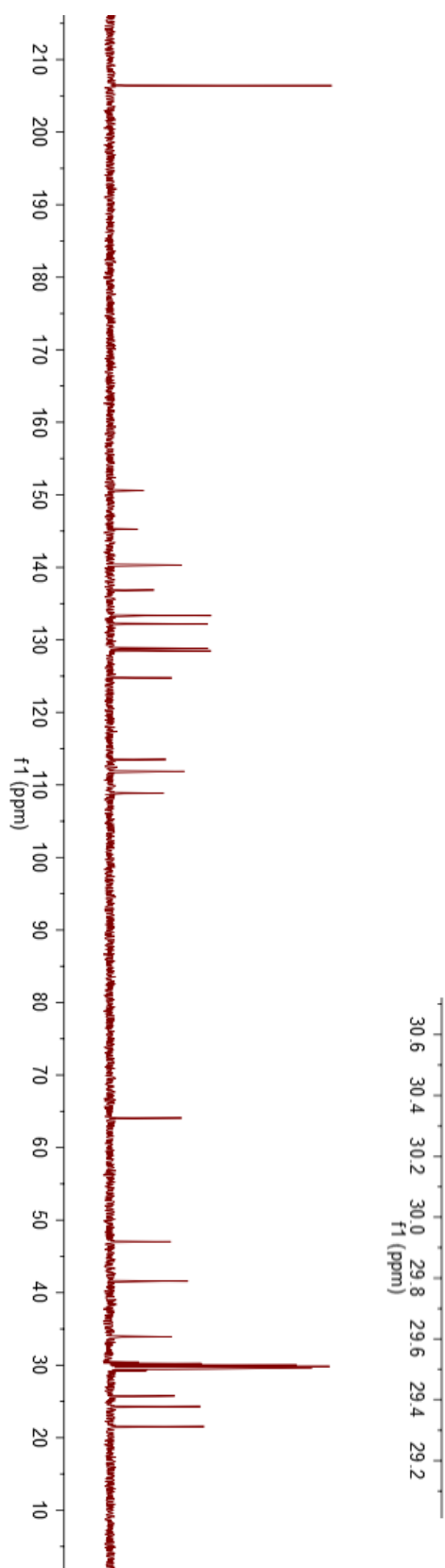


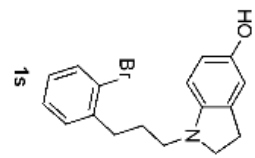
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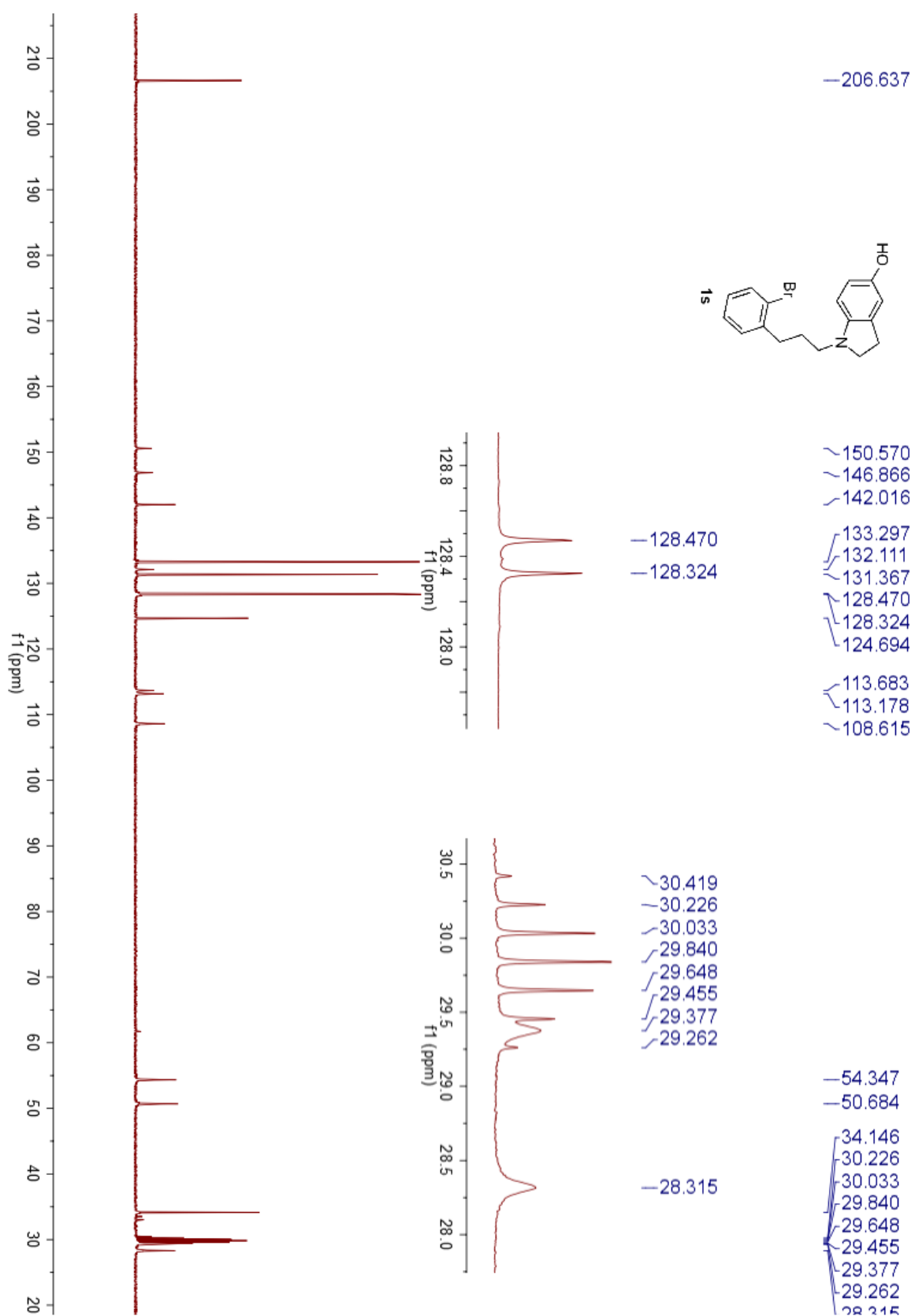
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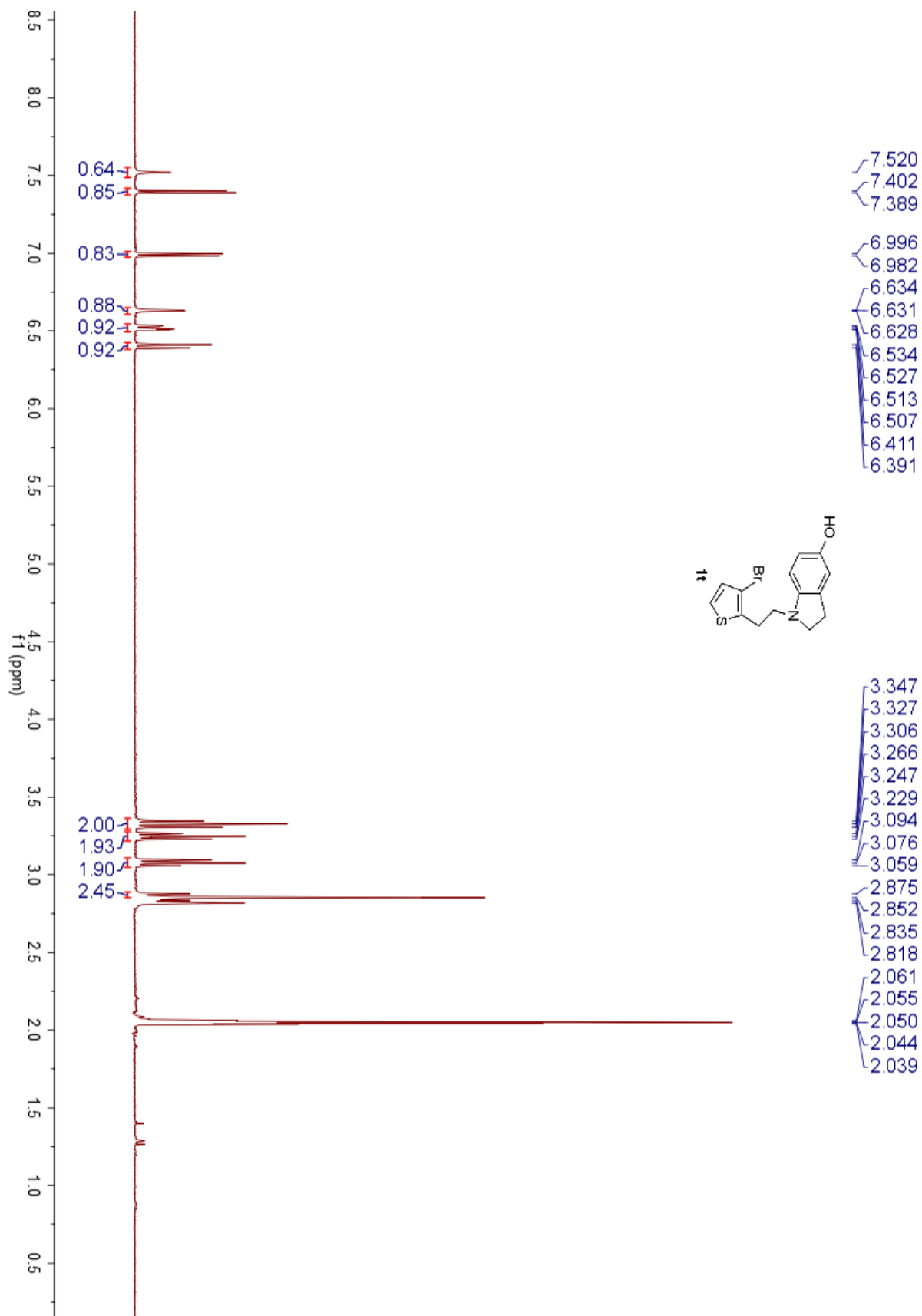
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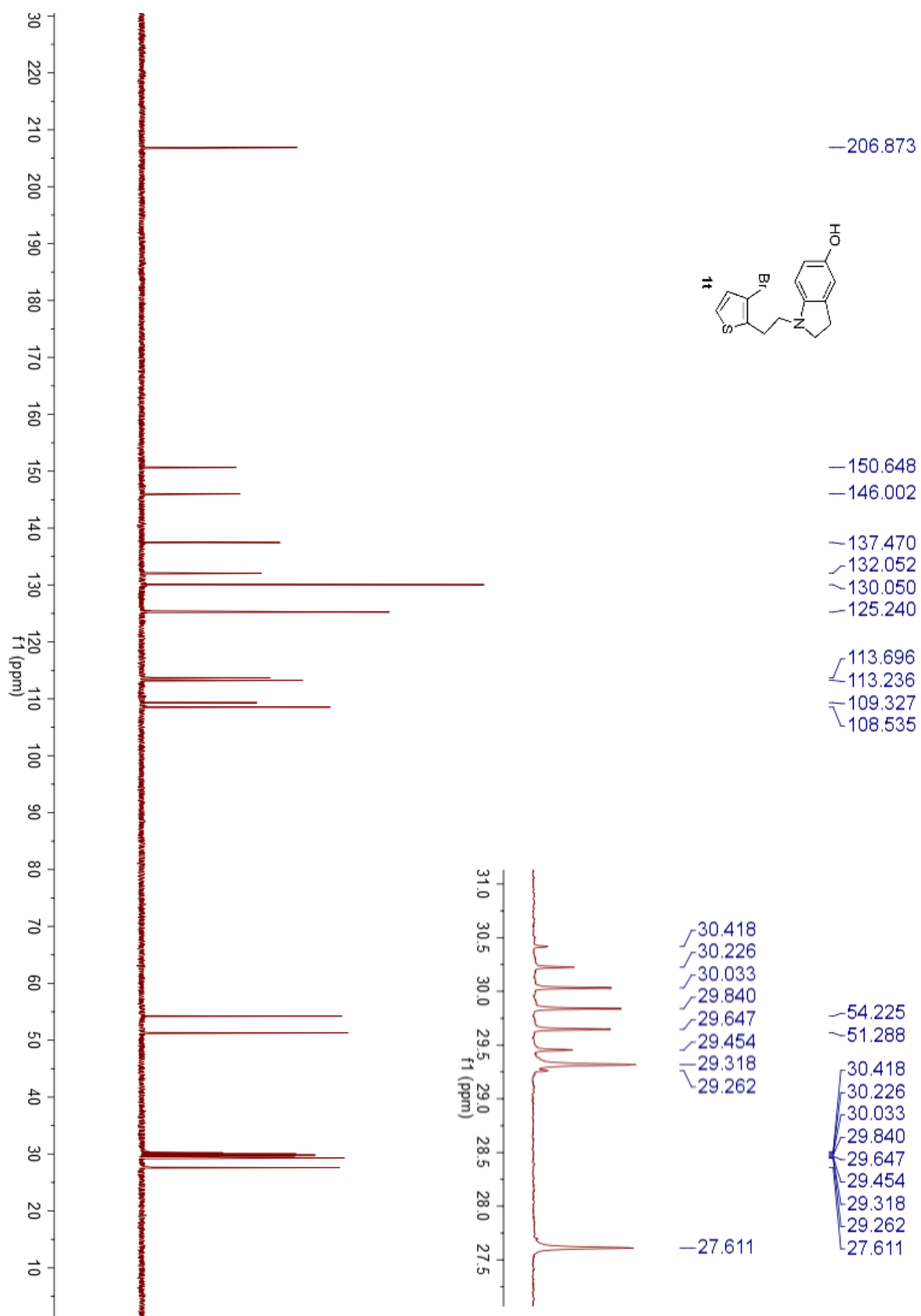
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—29.262

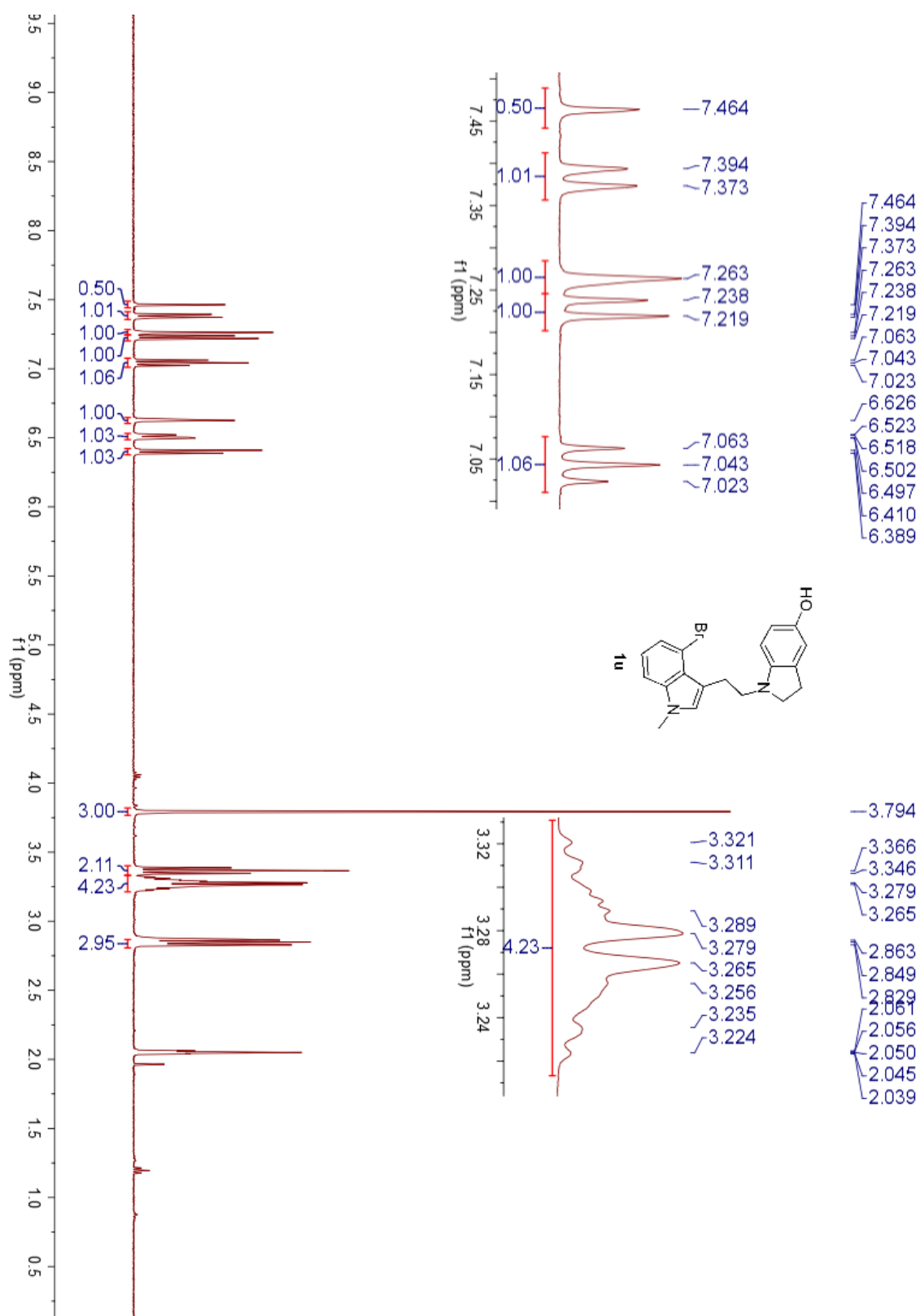


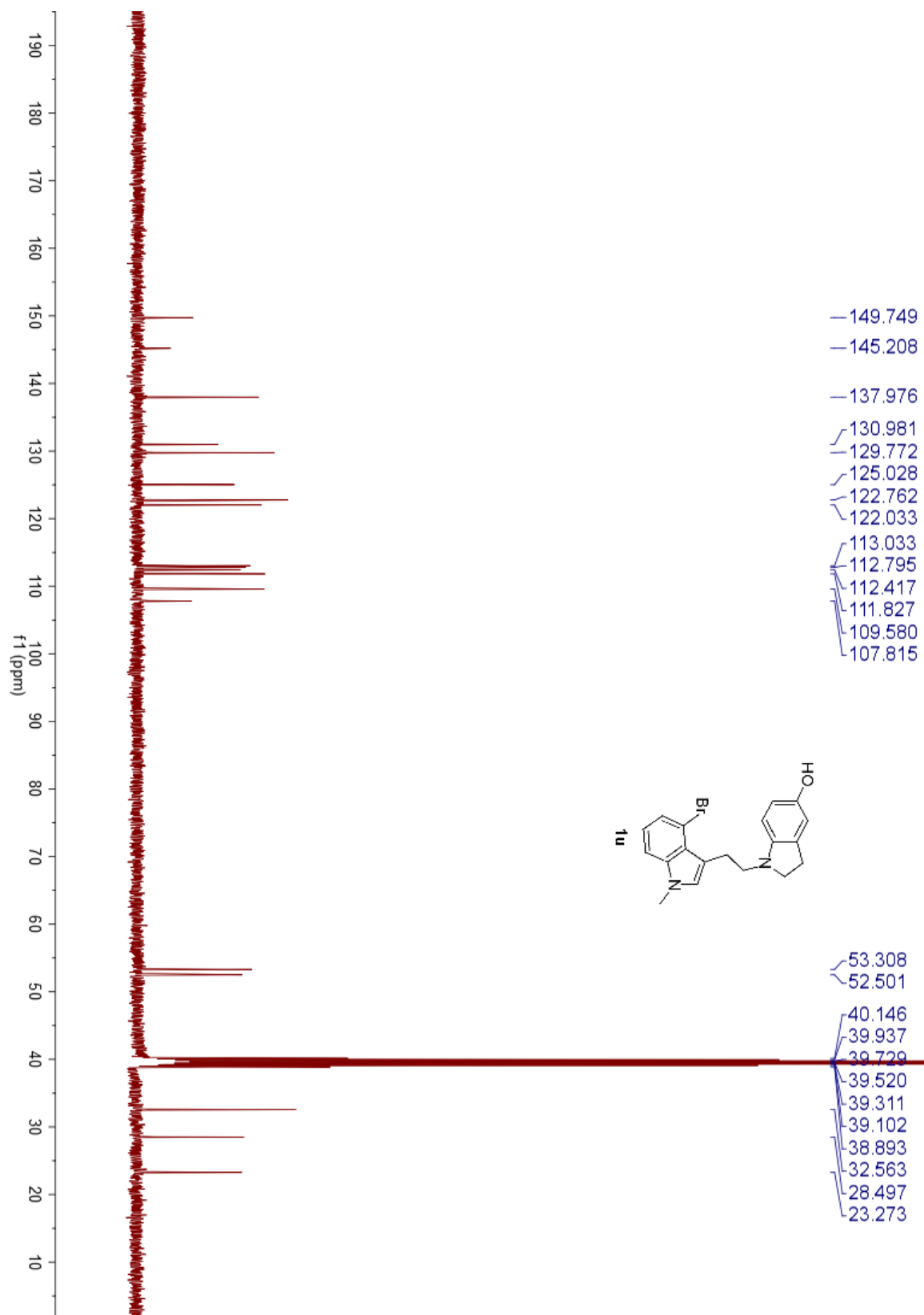


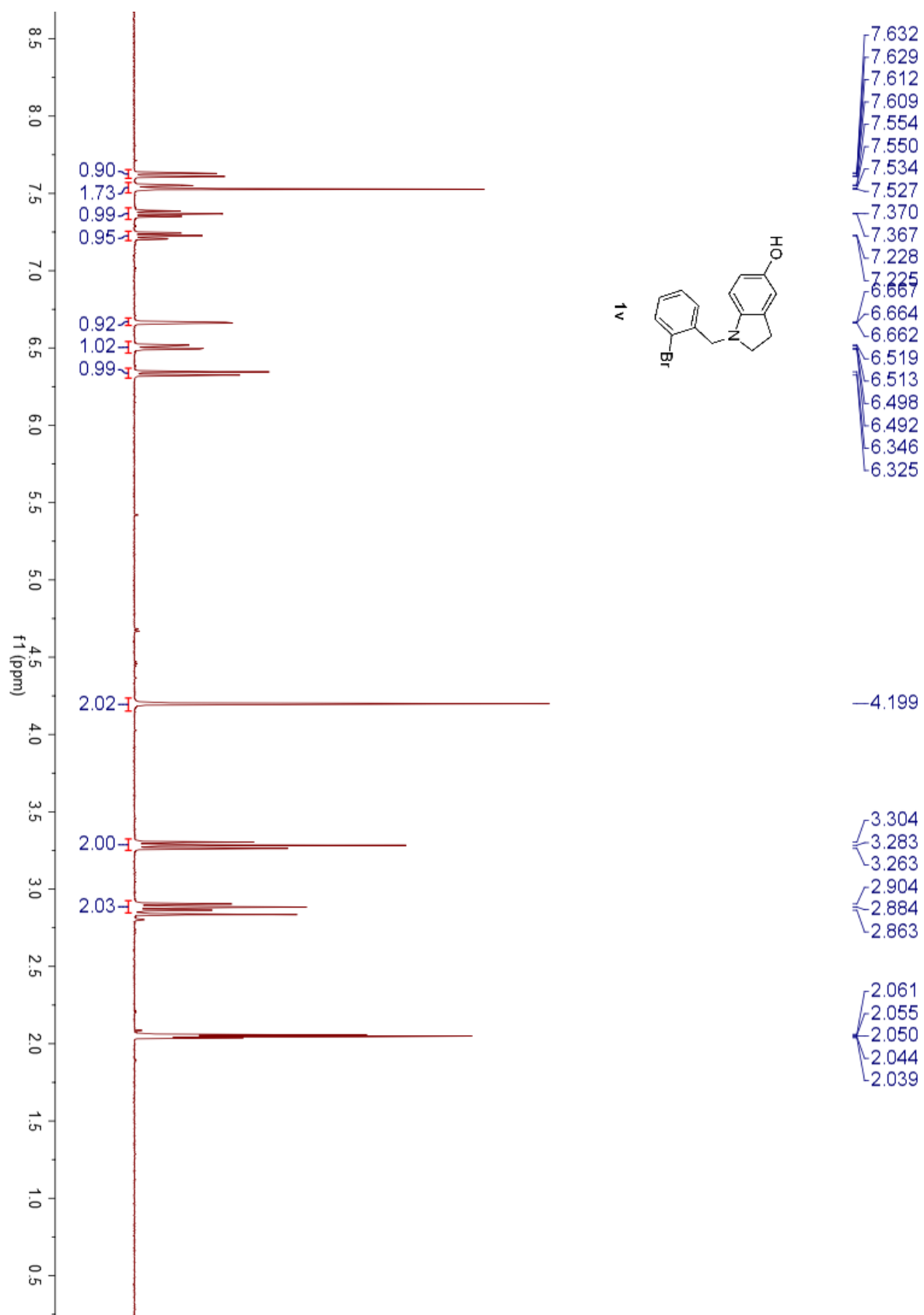


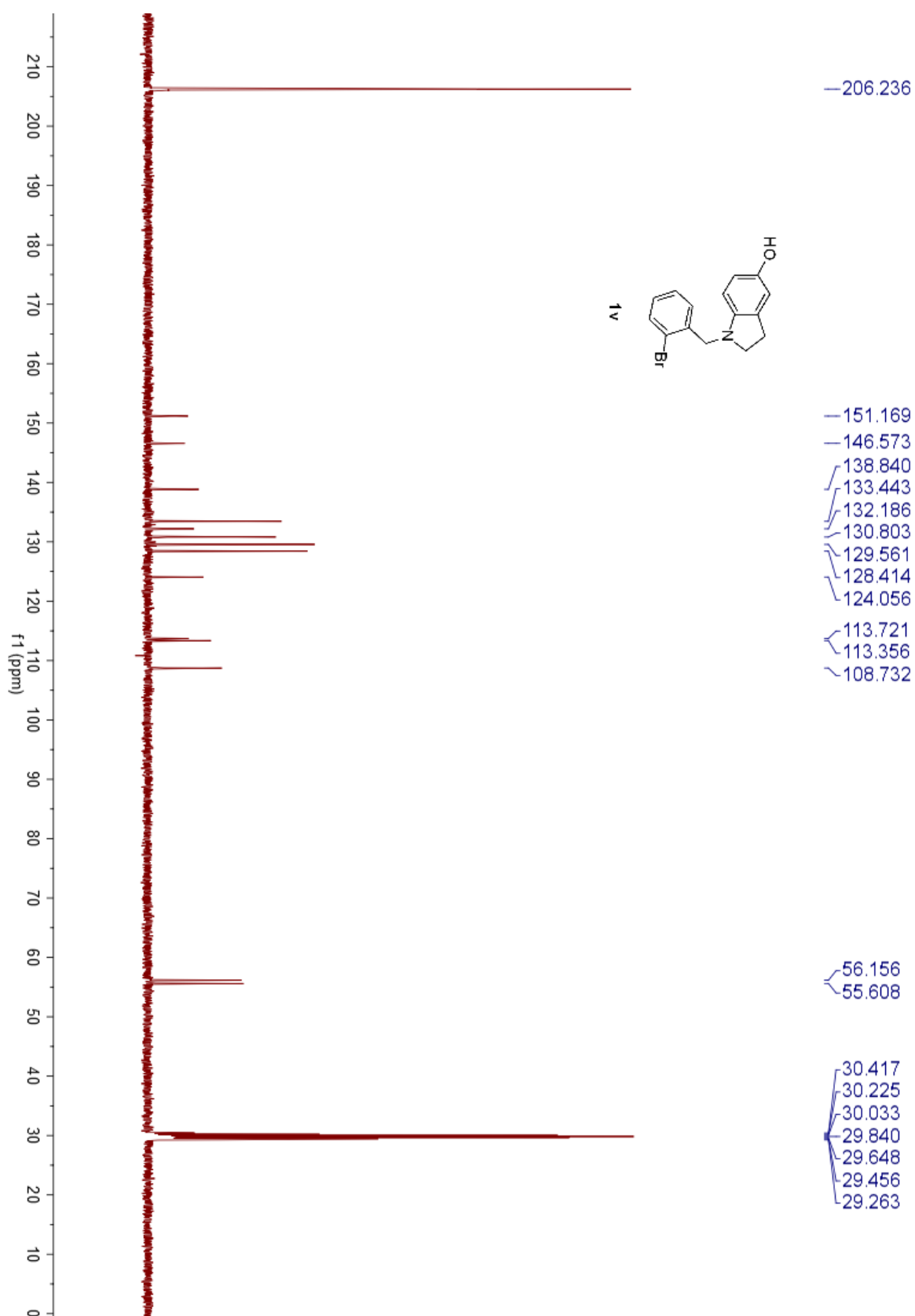


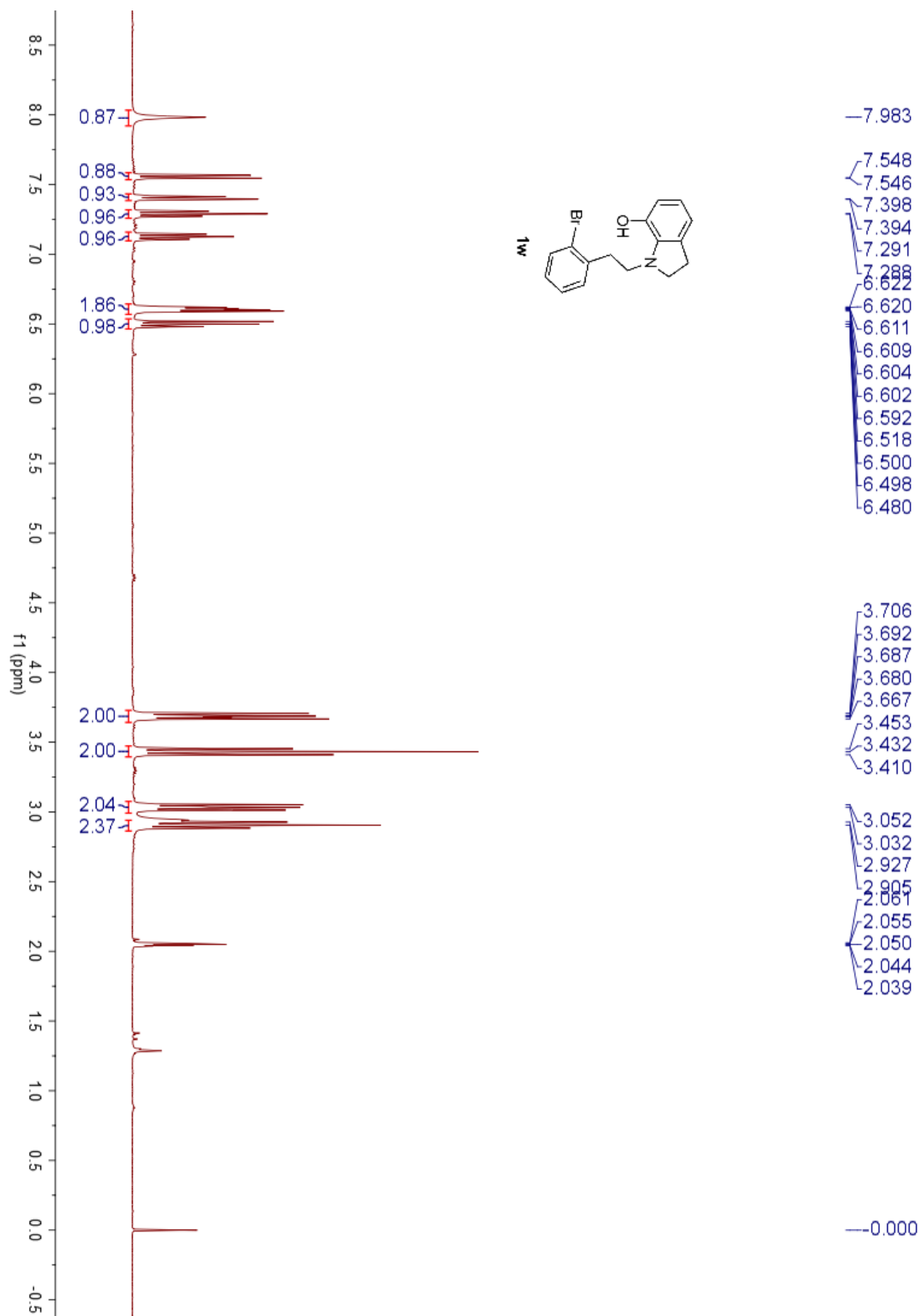


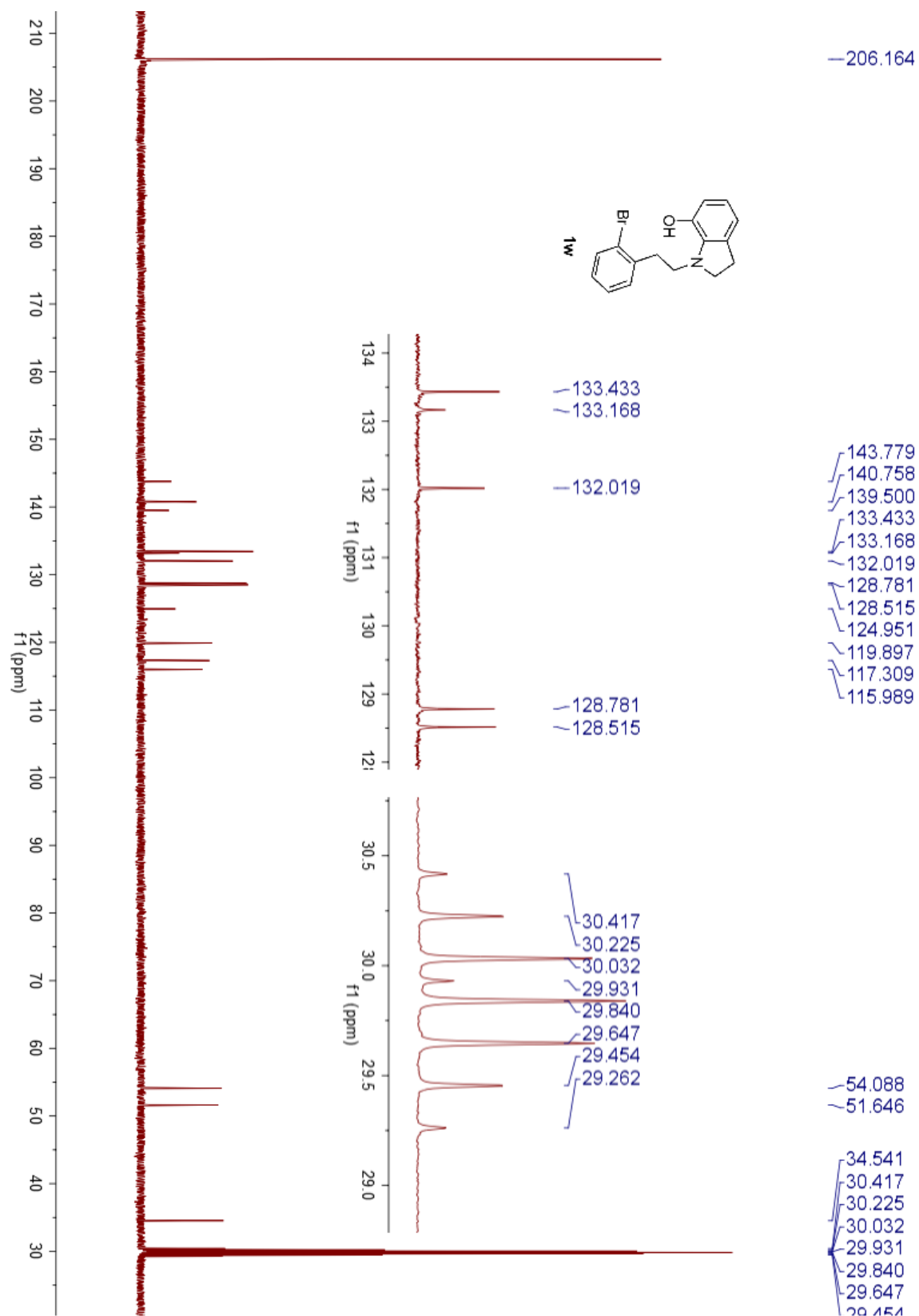


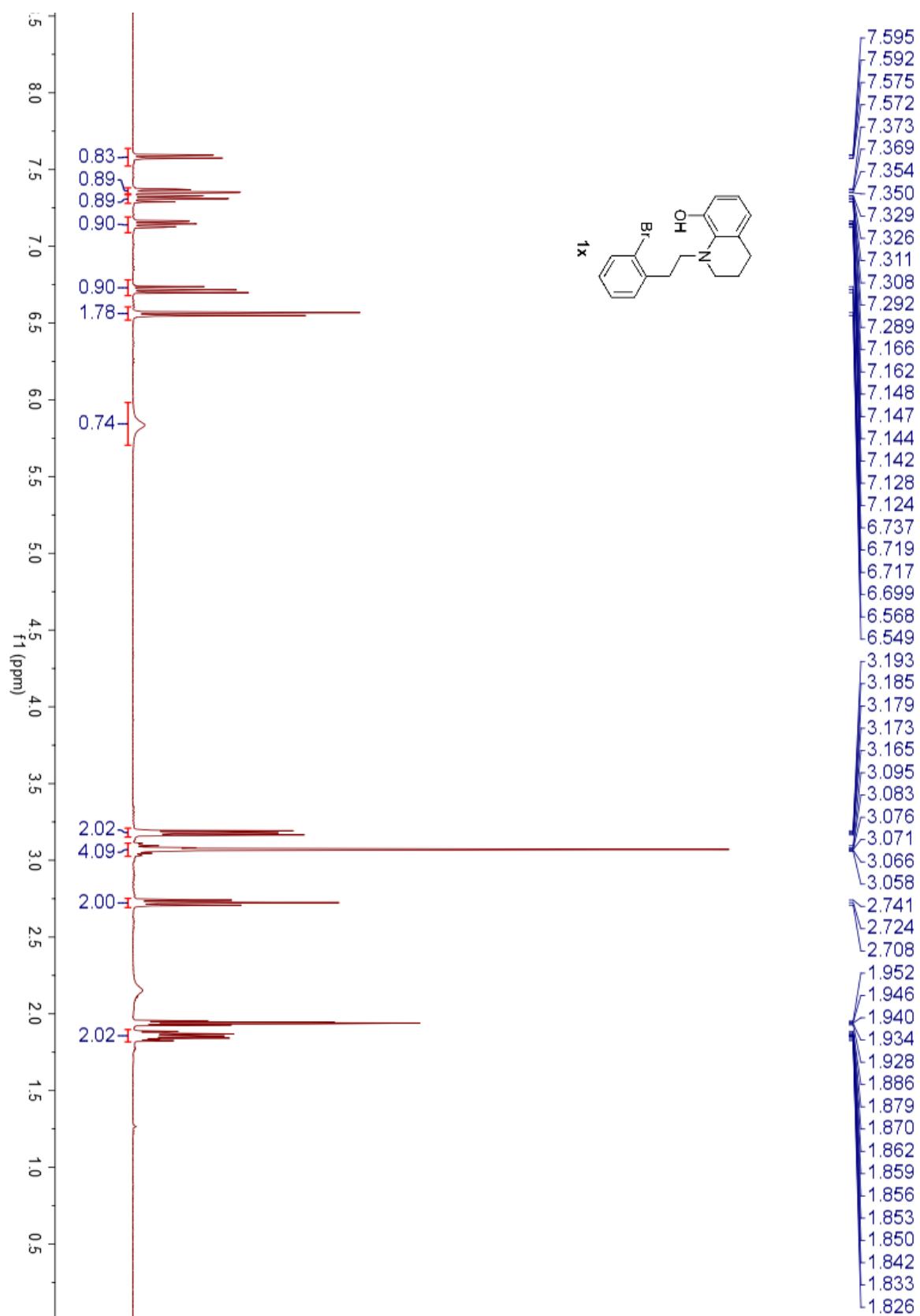


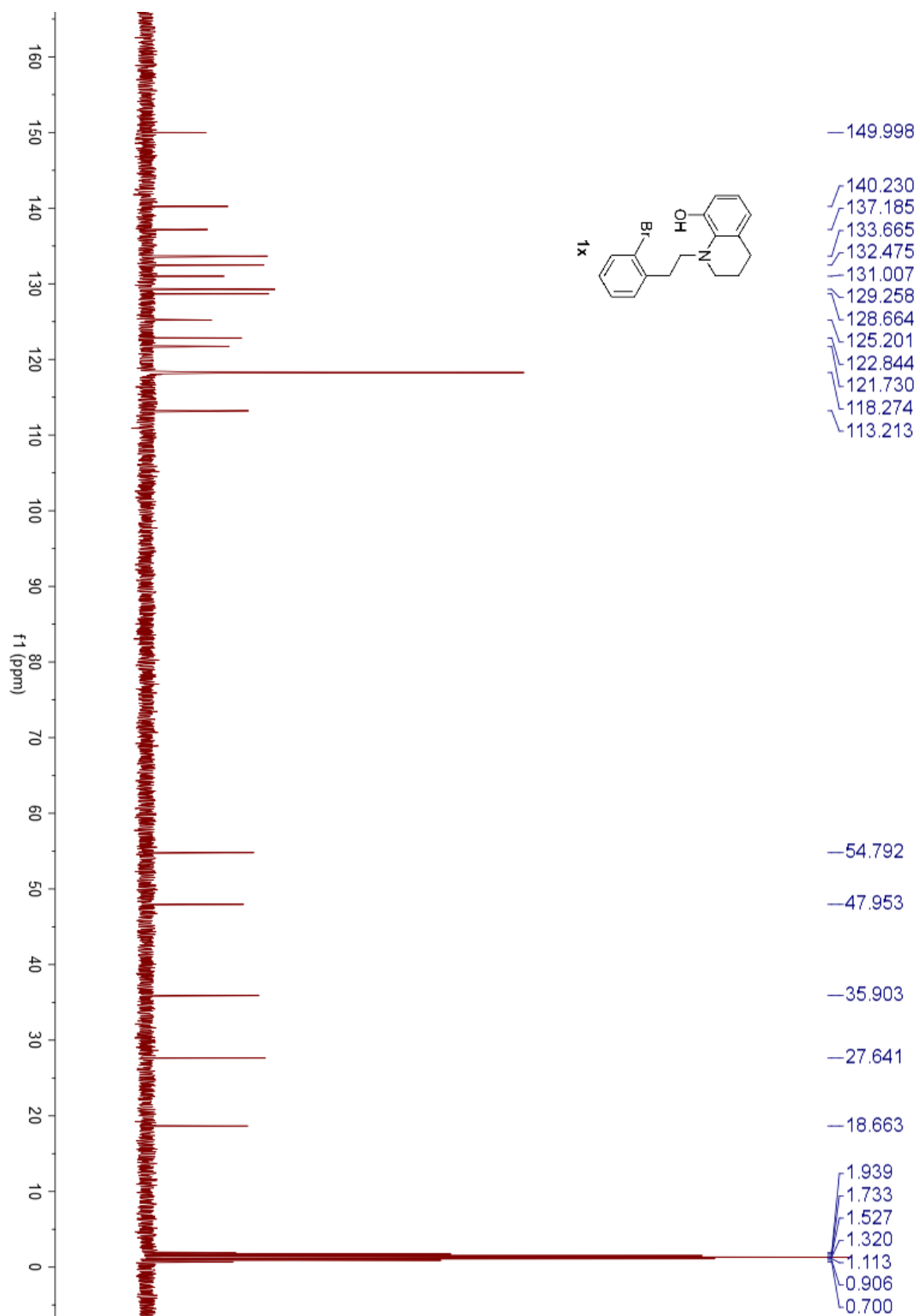


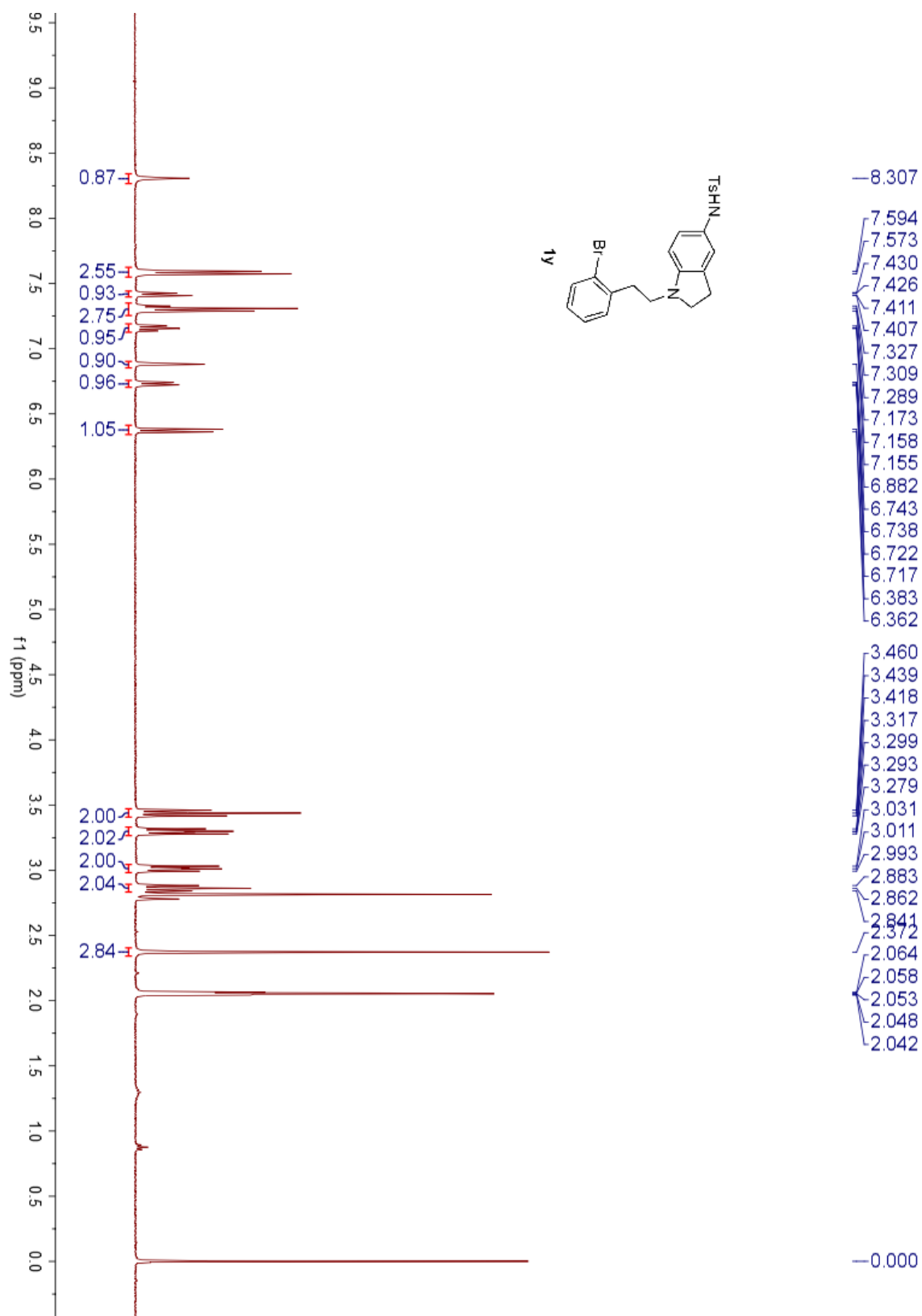


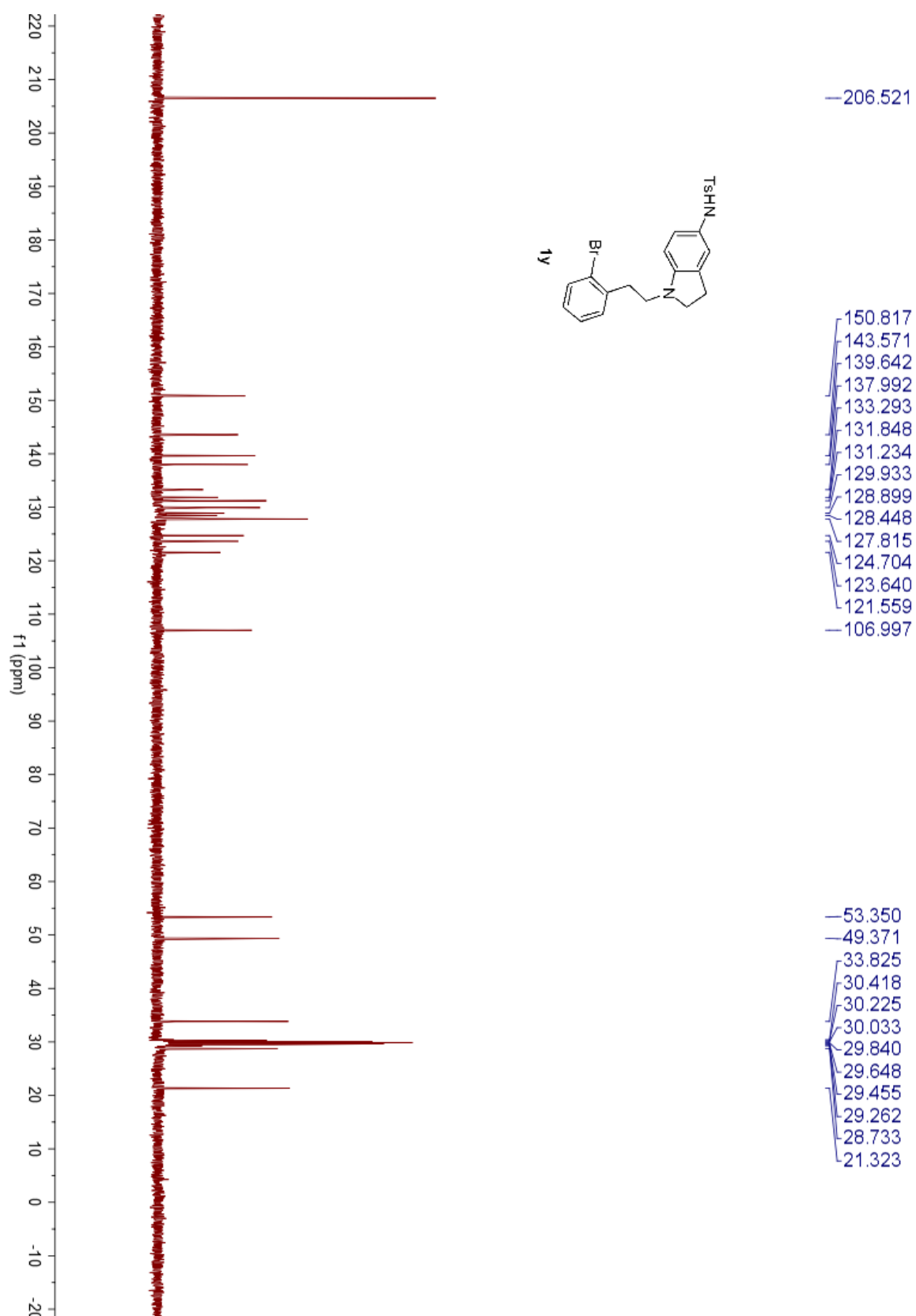


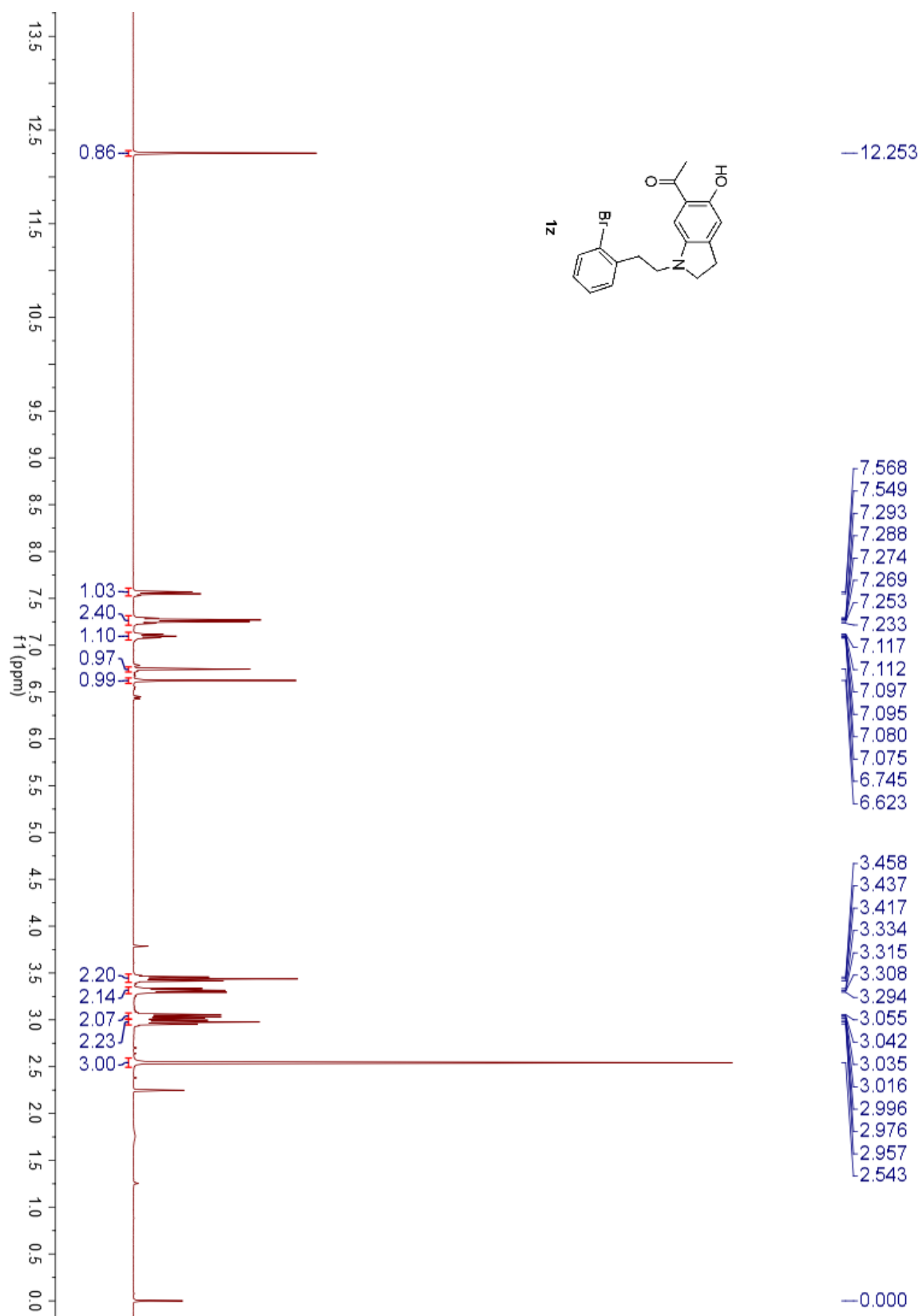


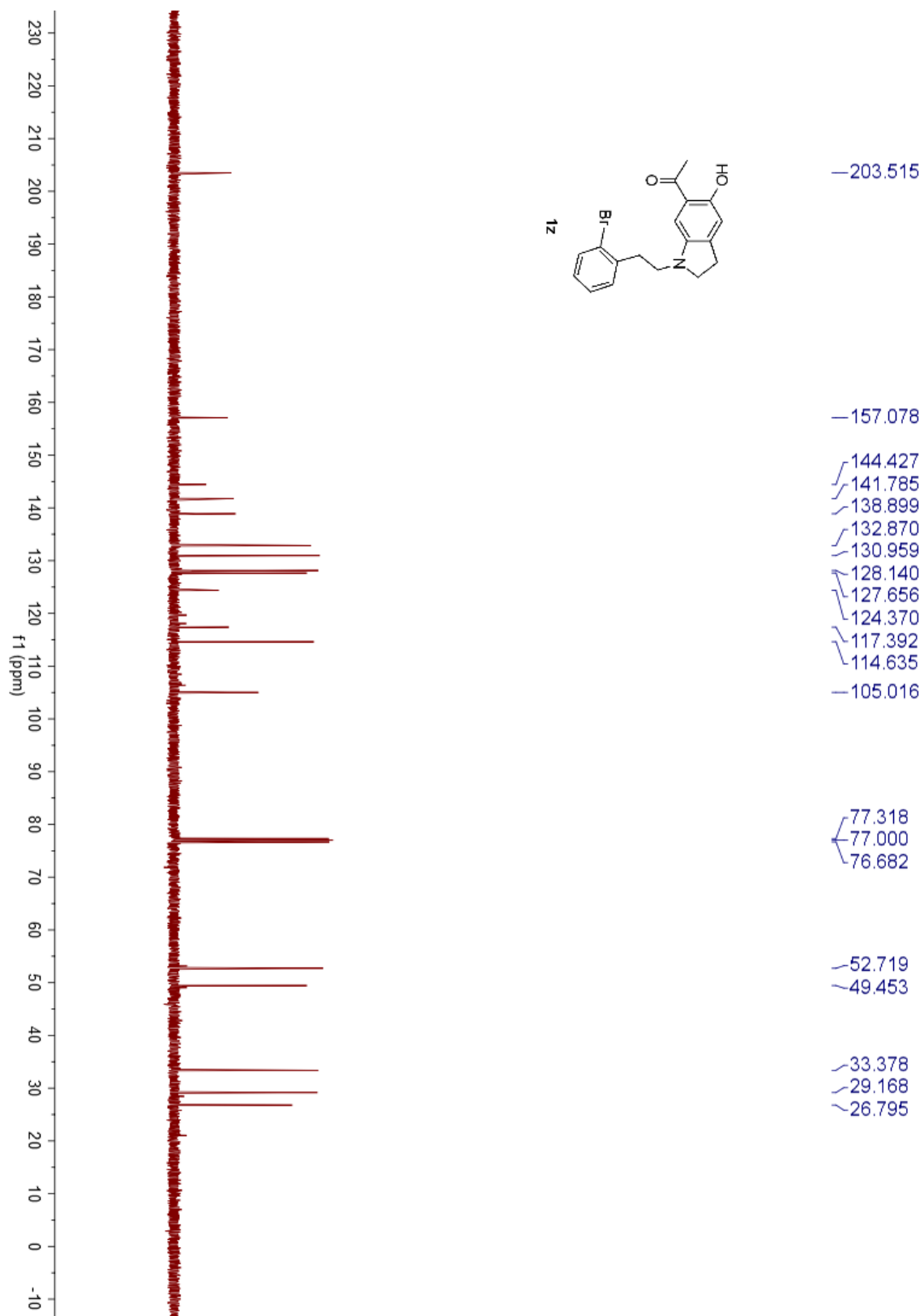


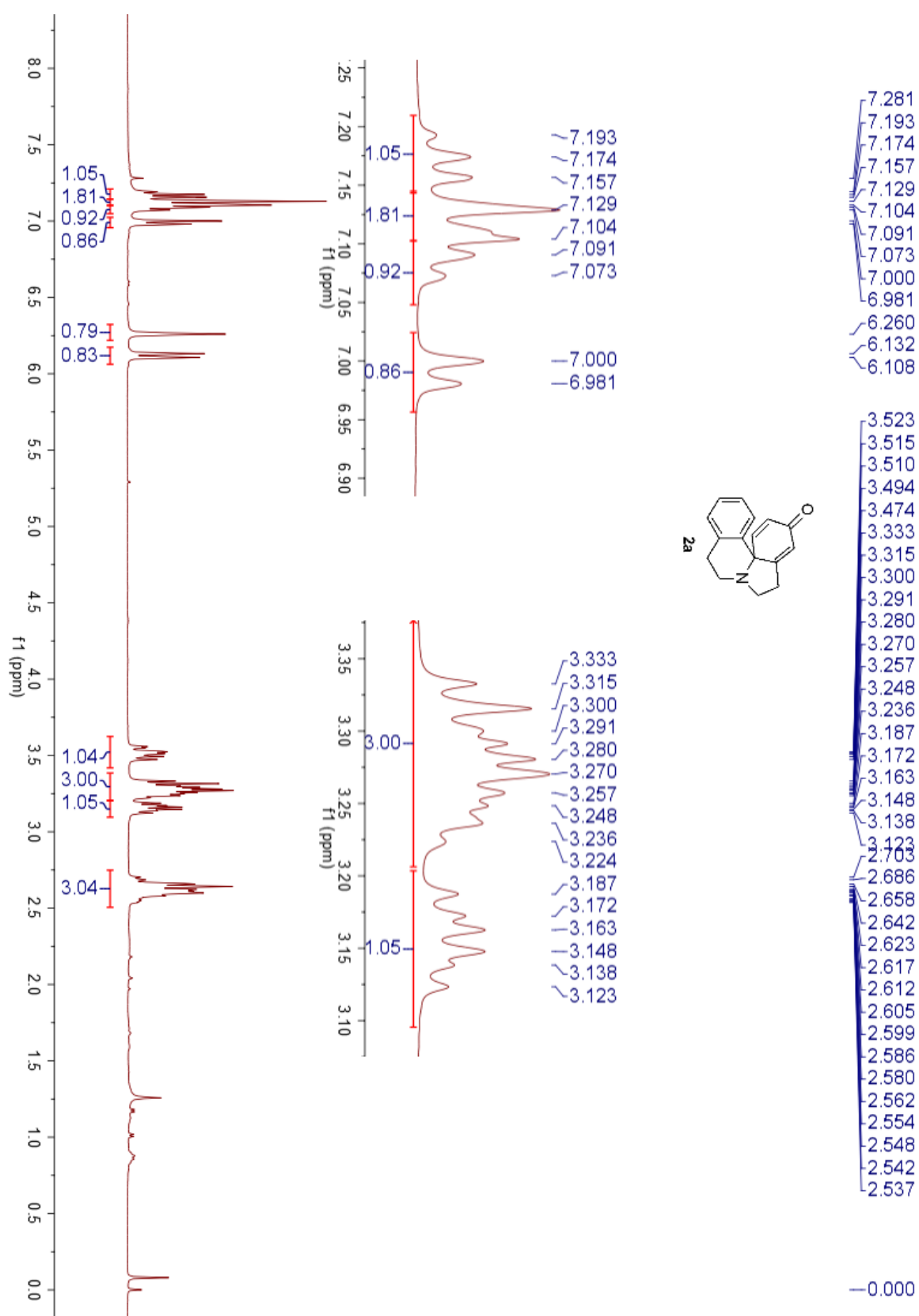


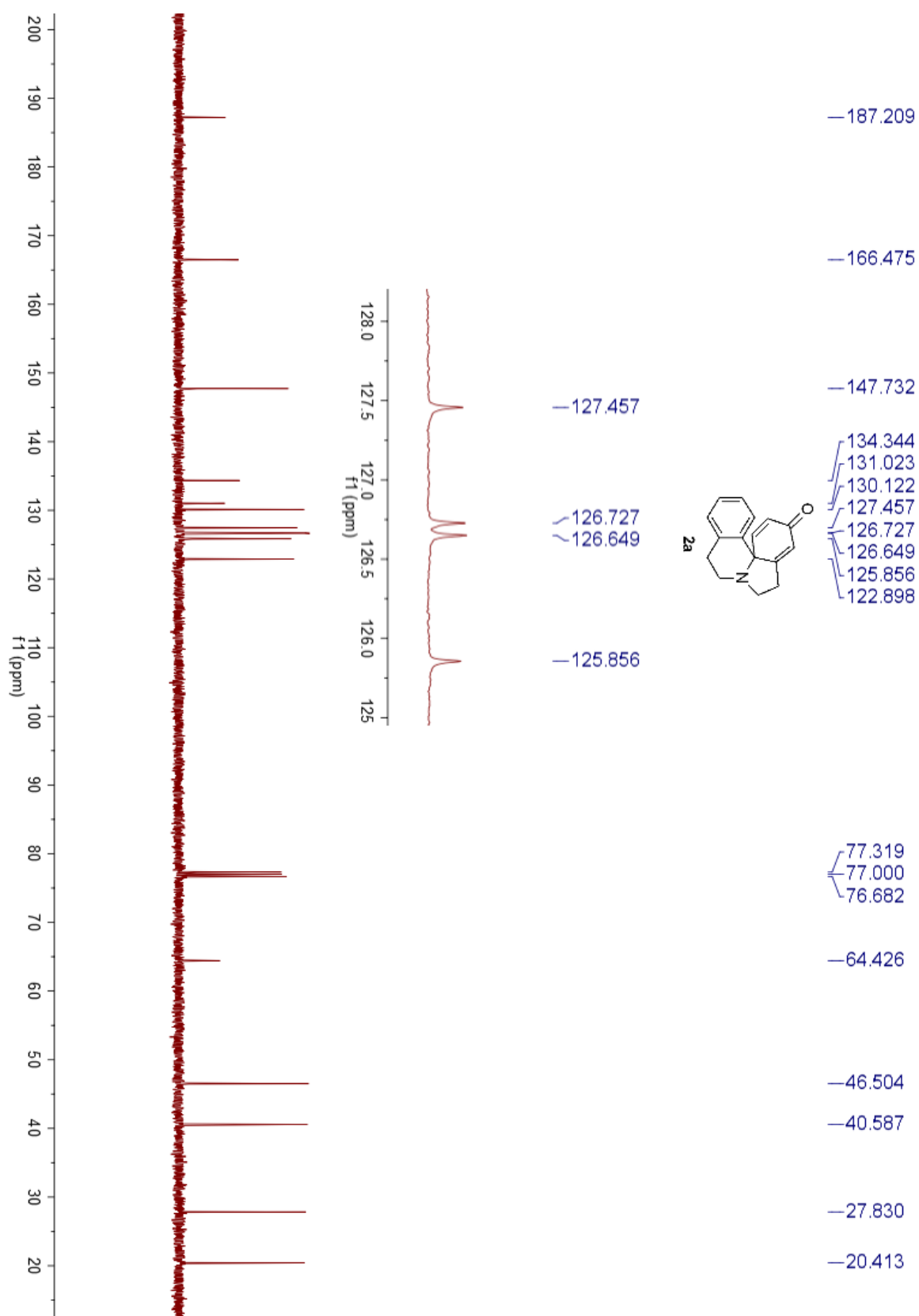


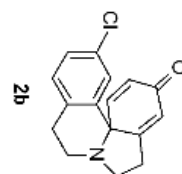
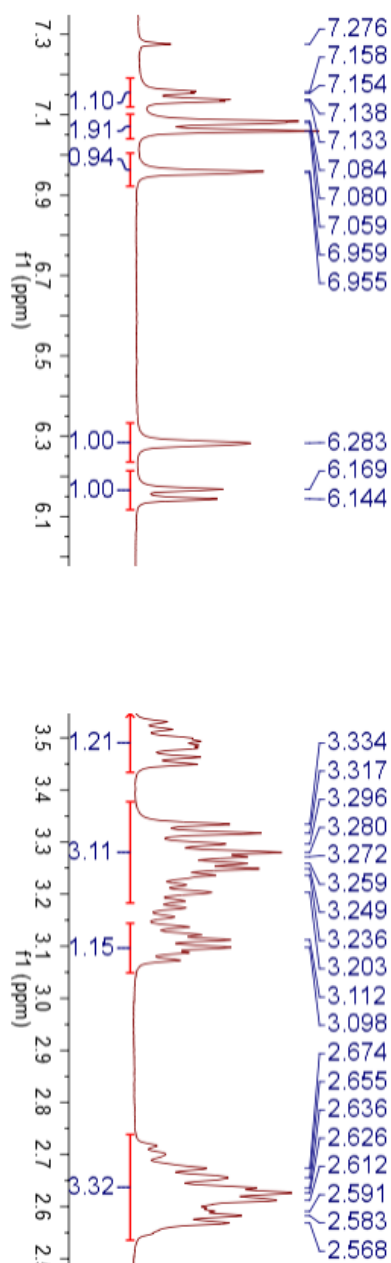
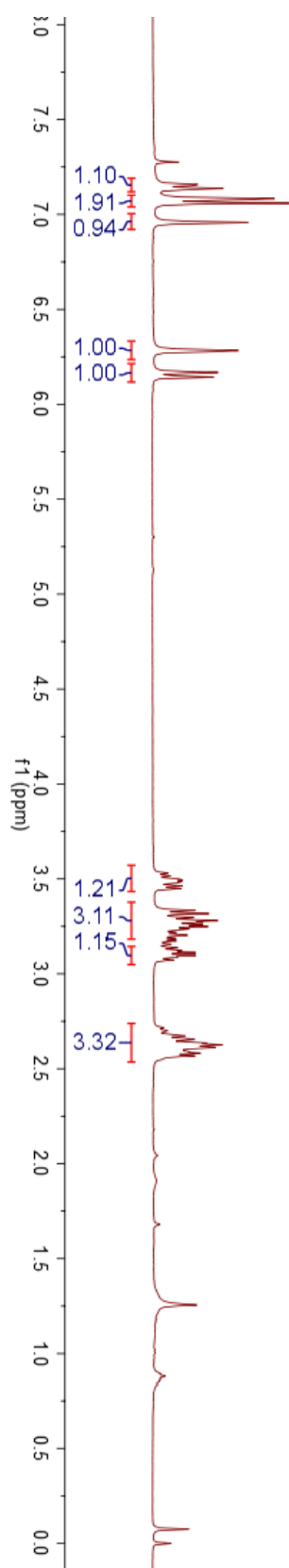


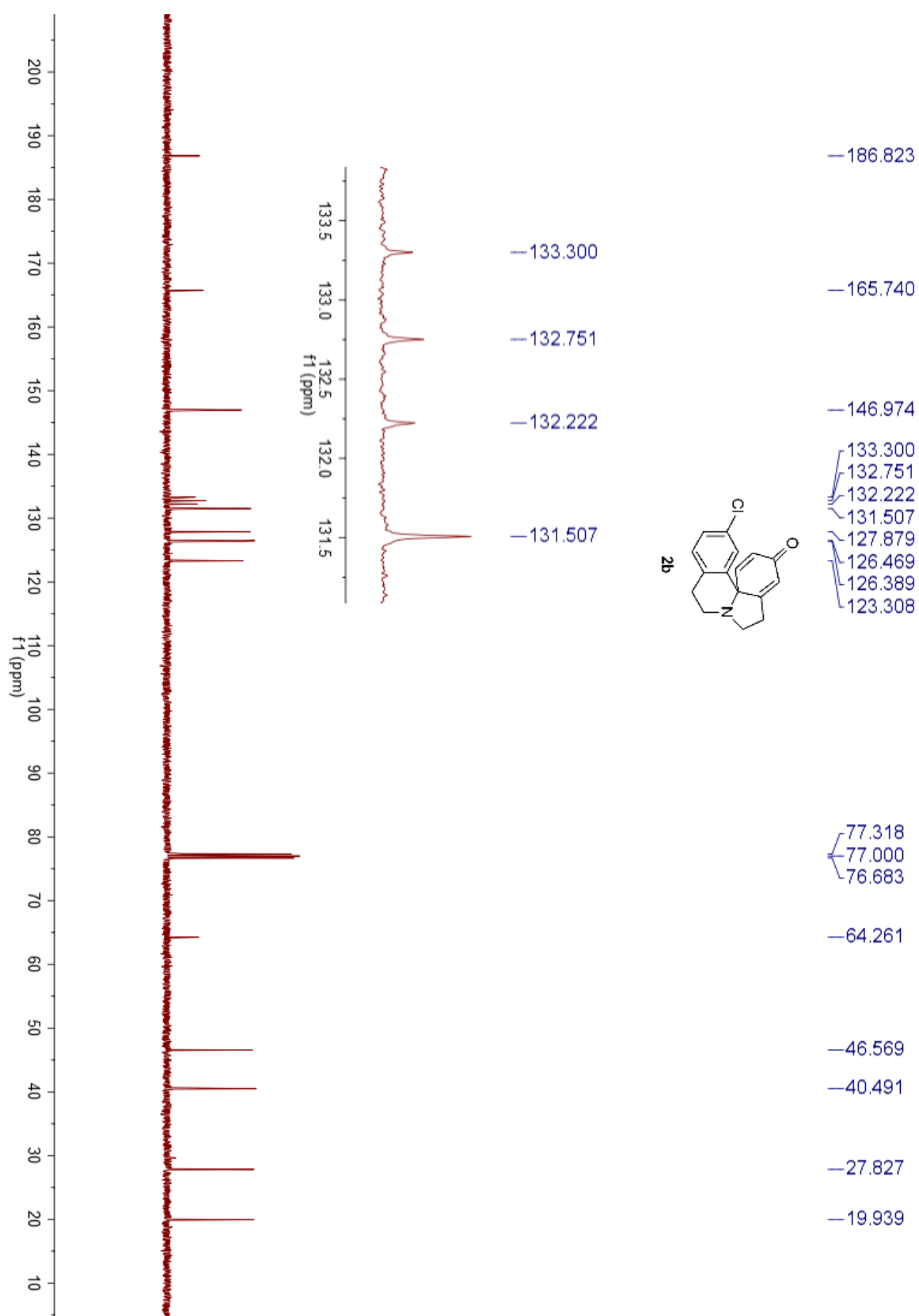


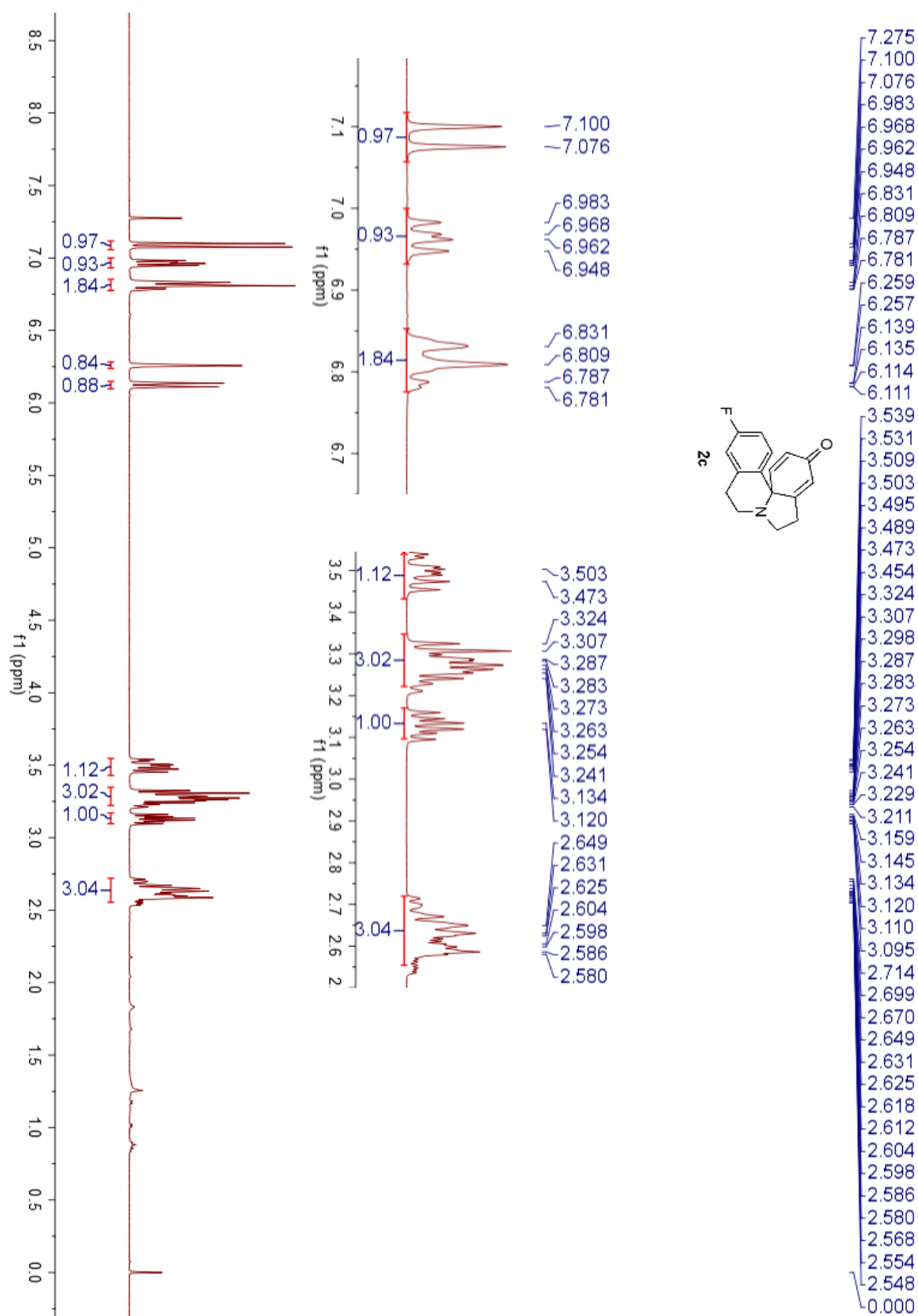


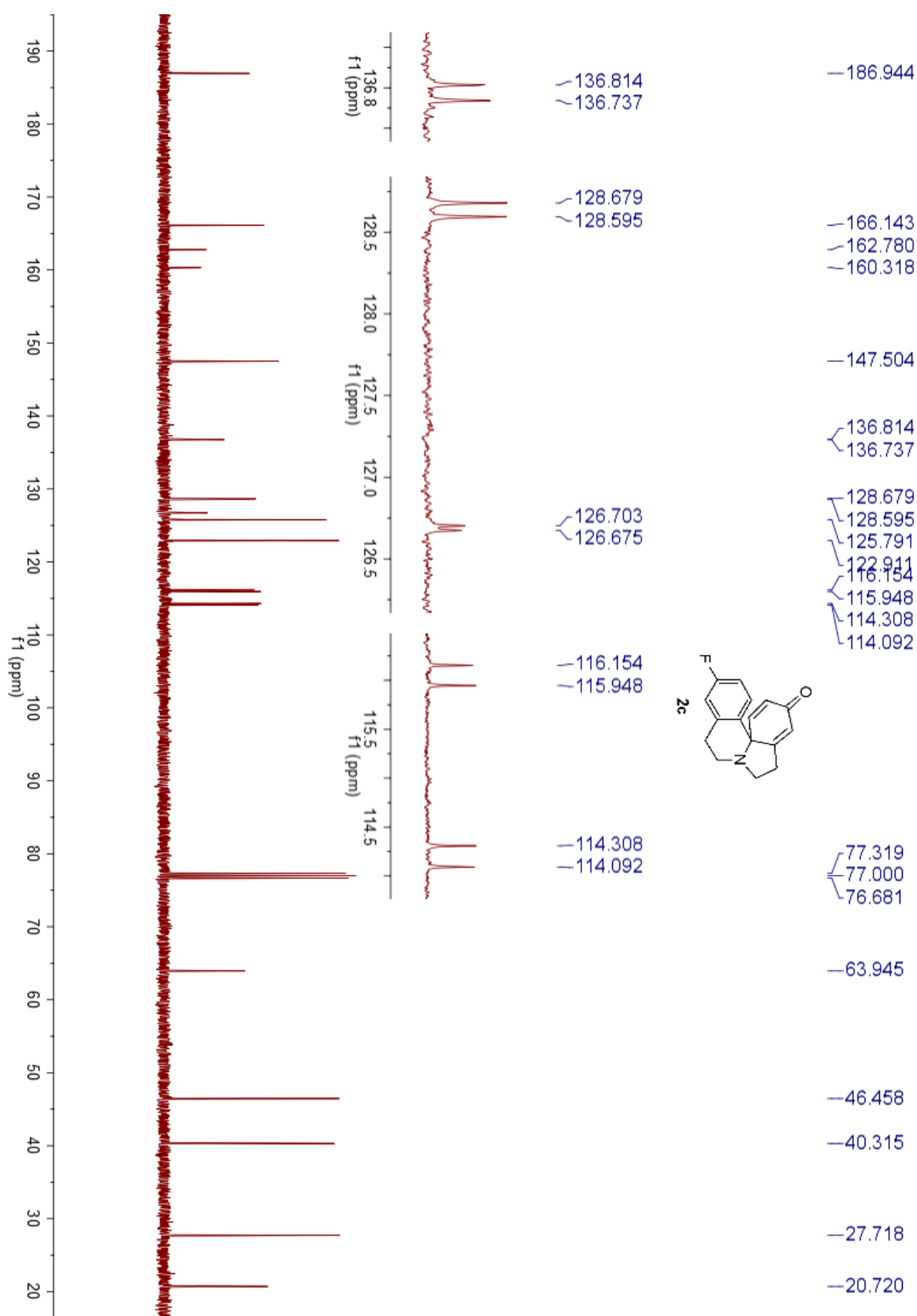


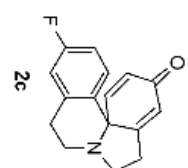




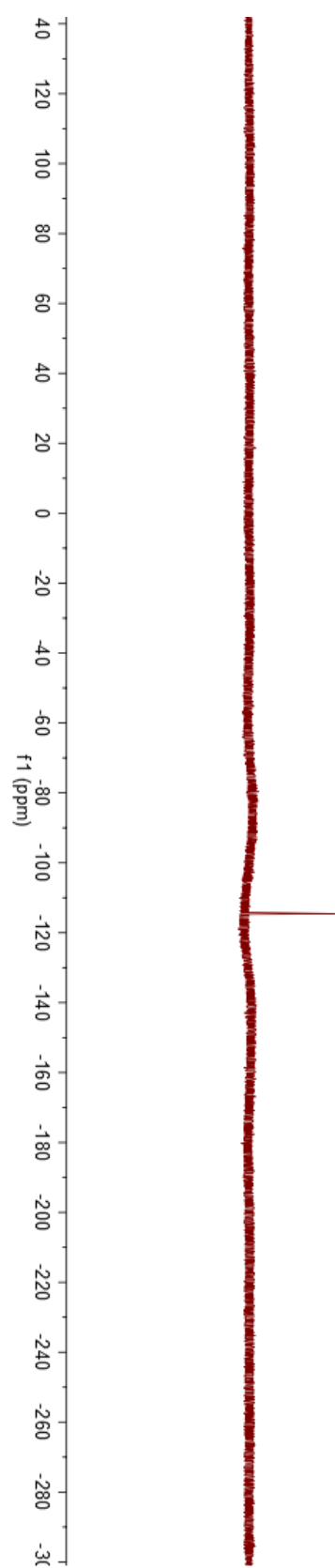


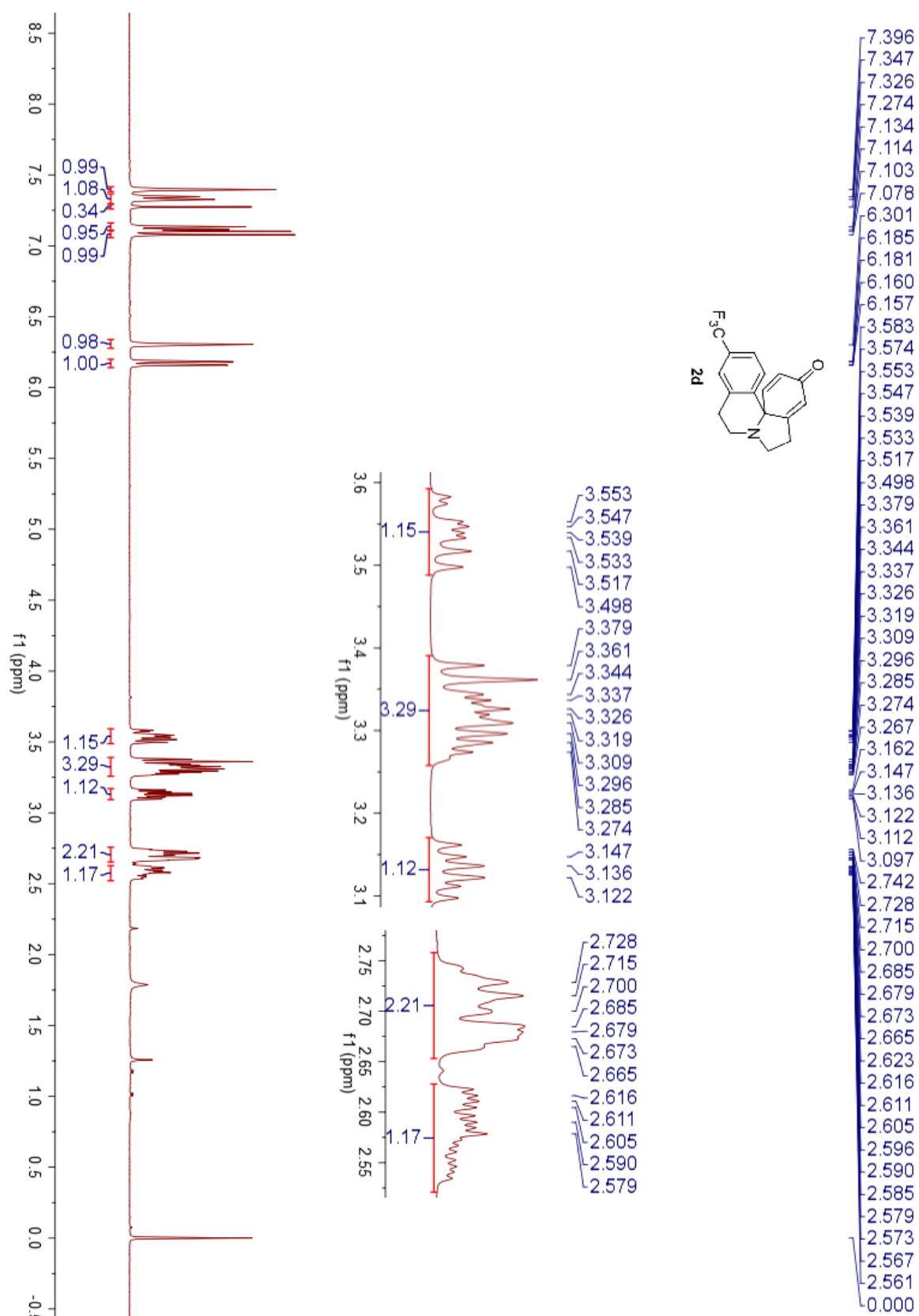


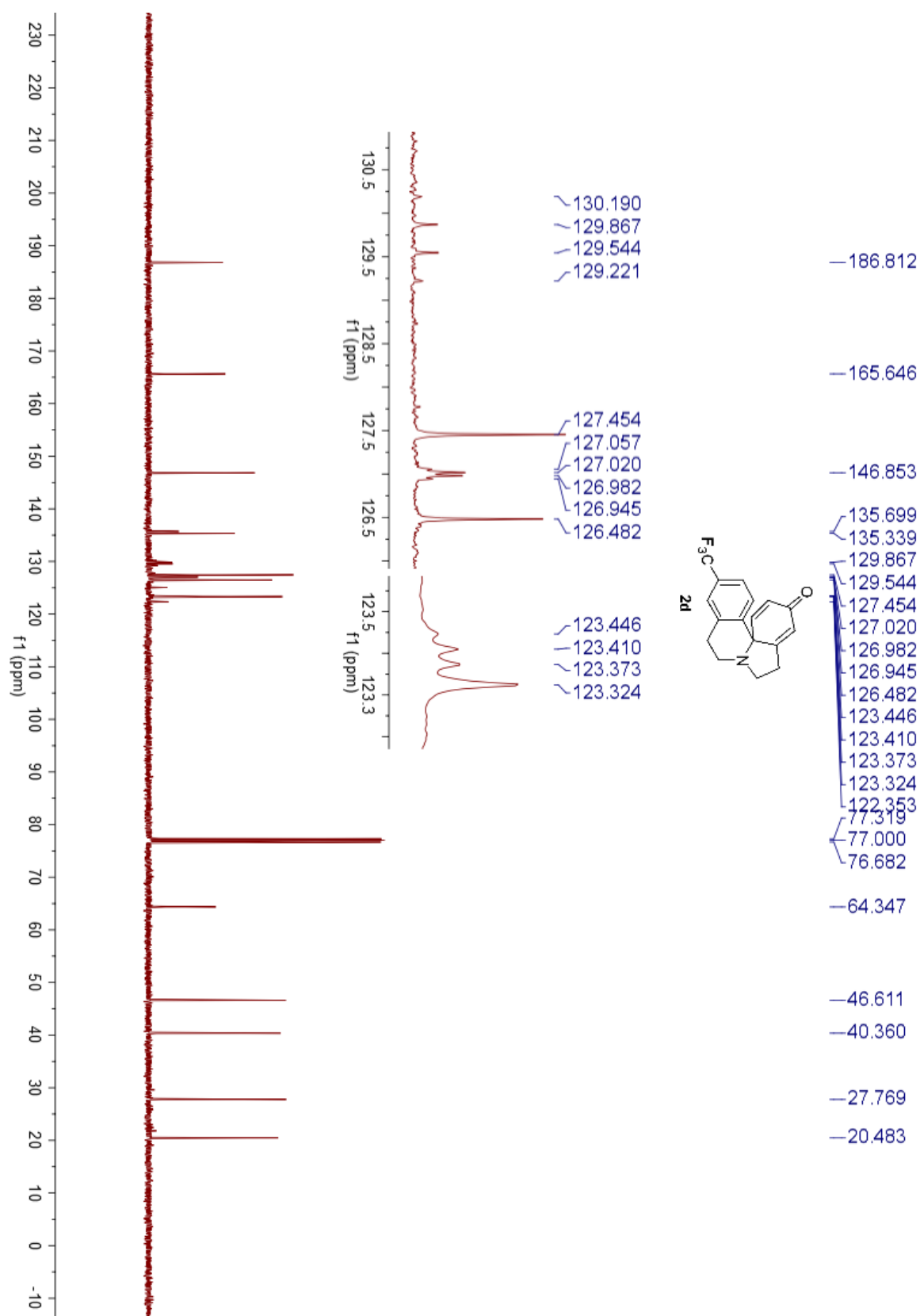


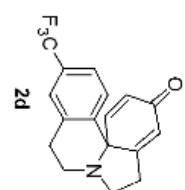


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114.580
114.603

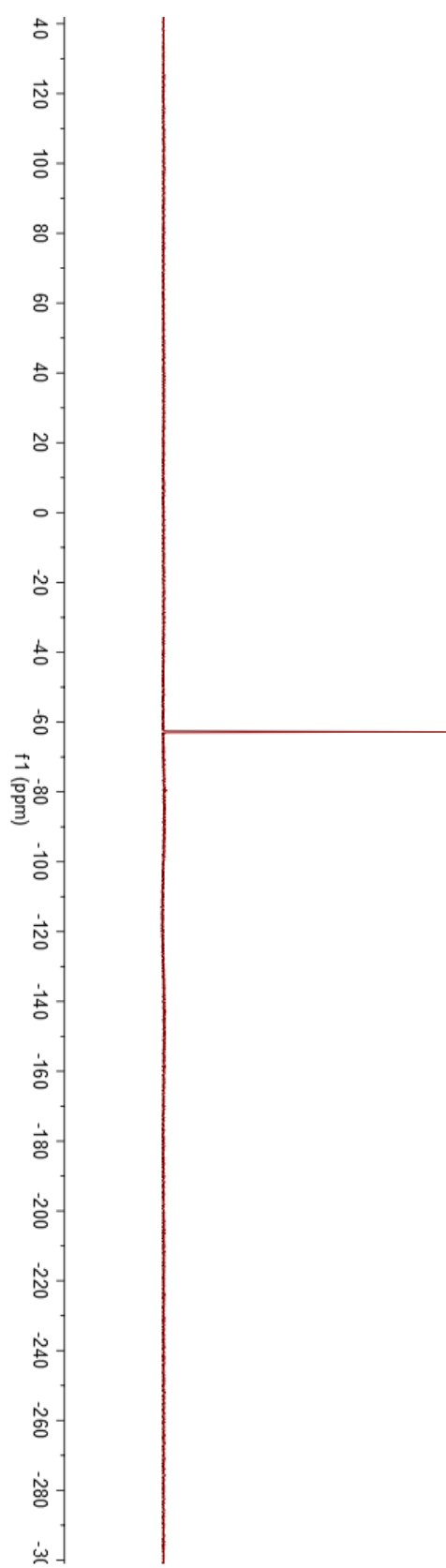


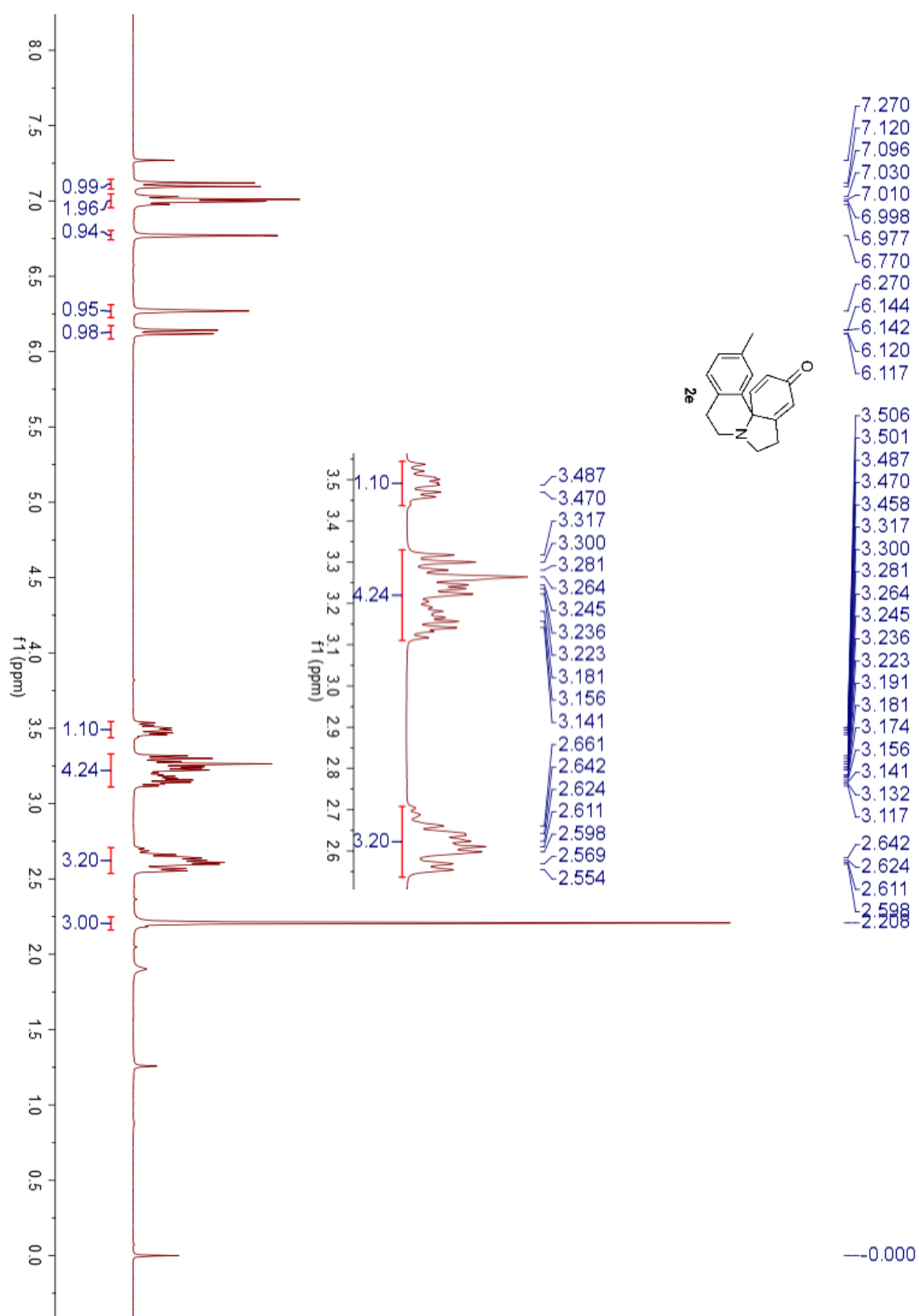


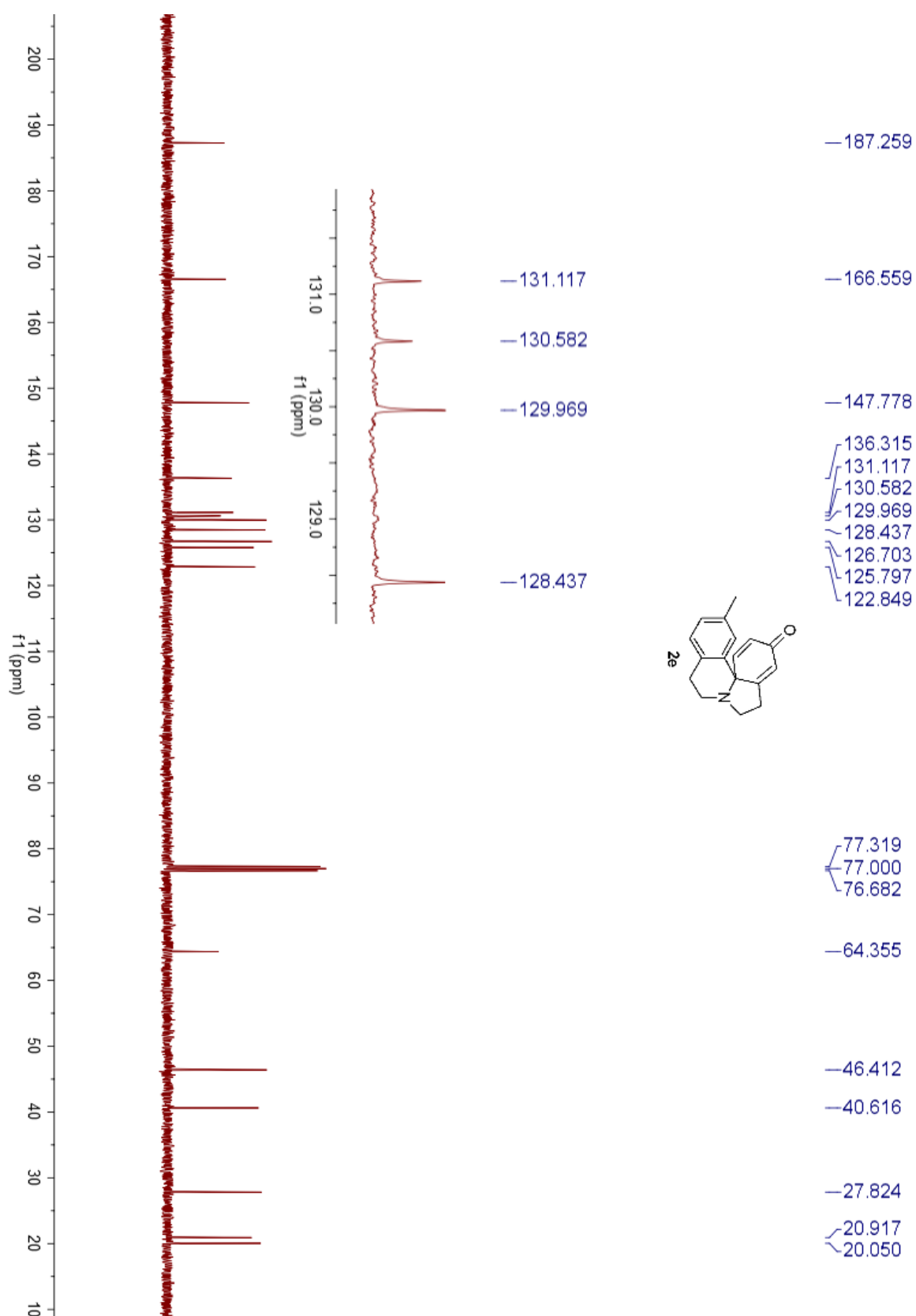


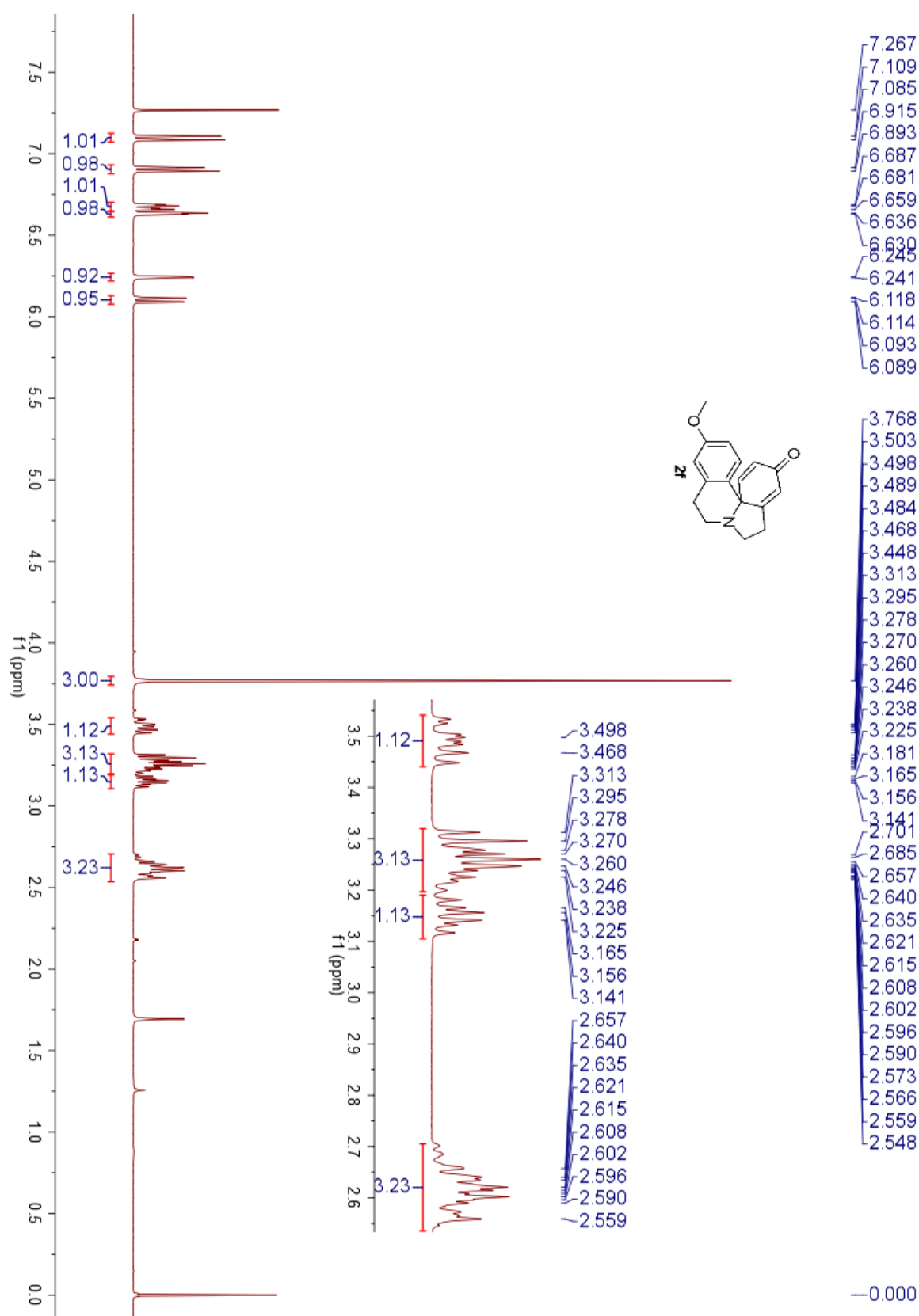


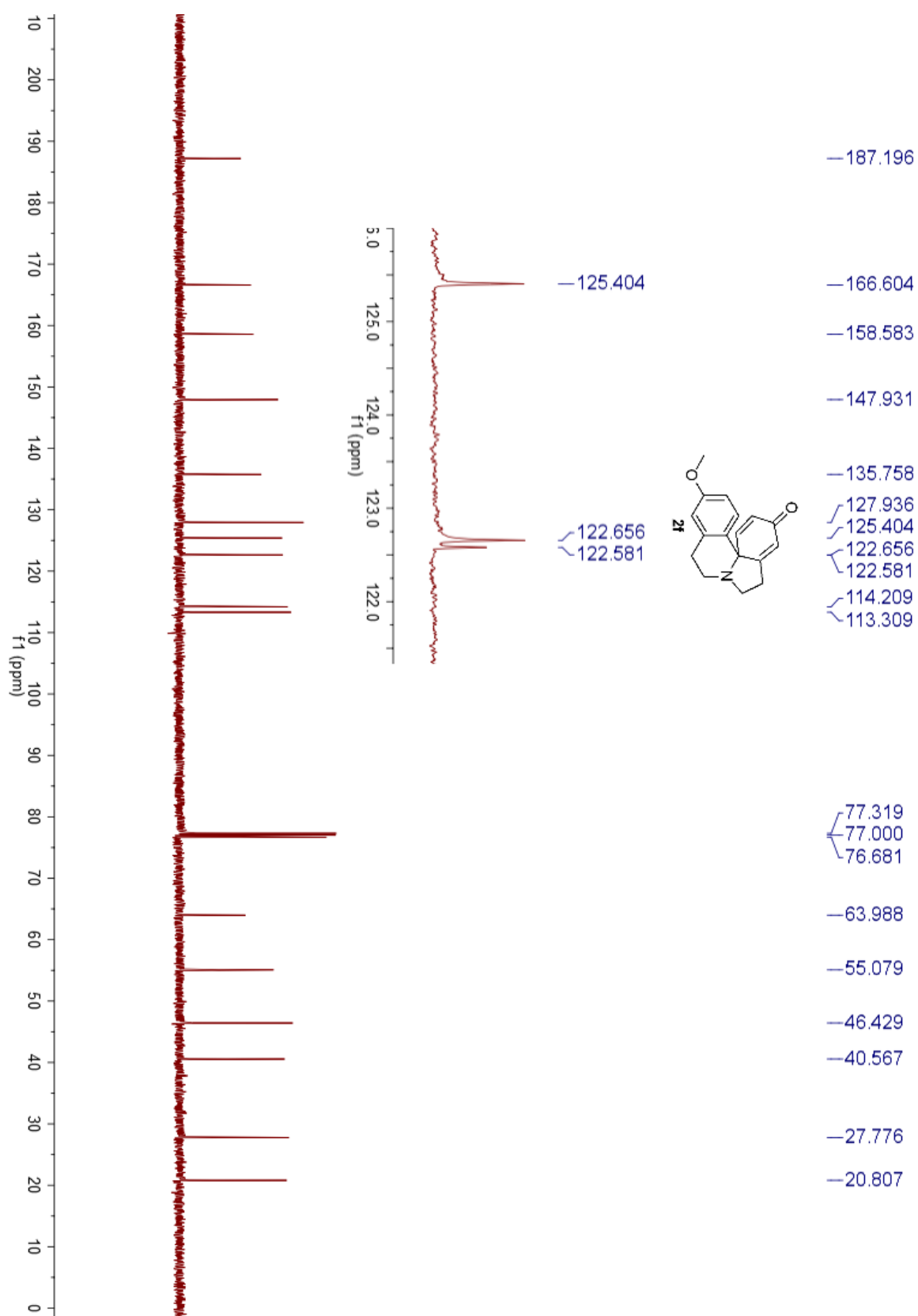
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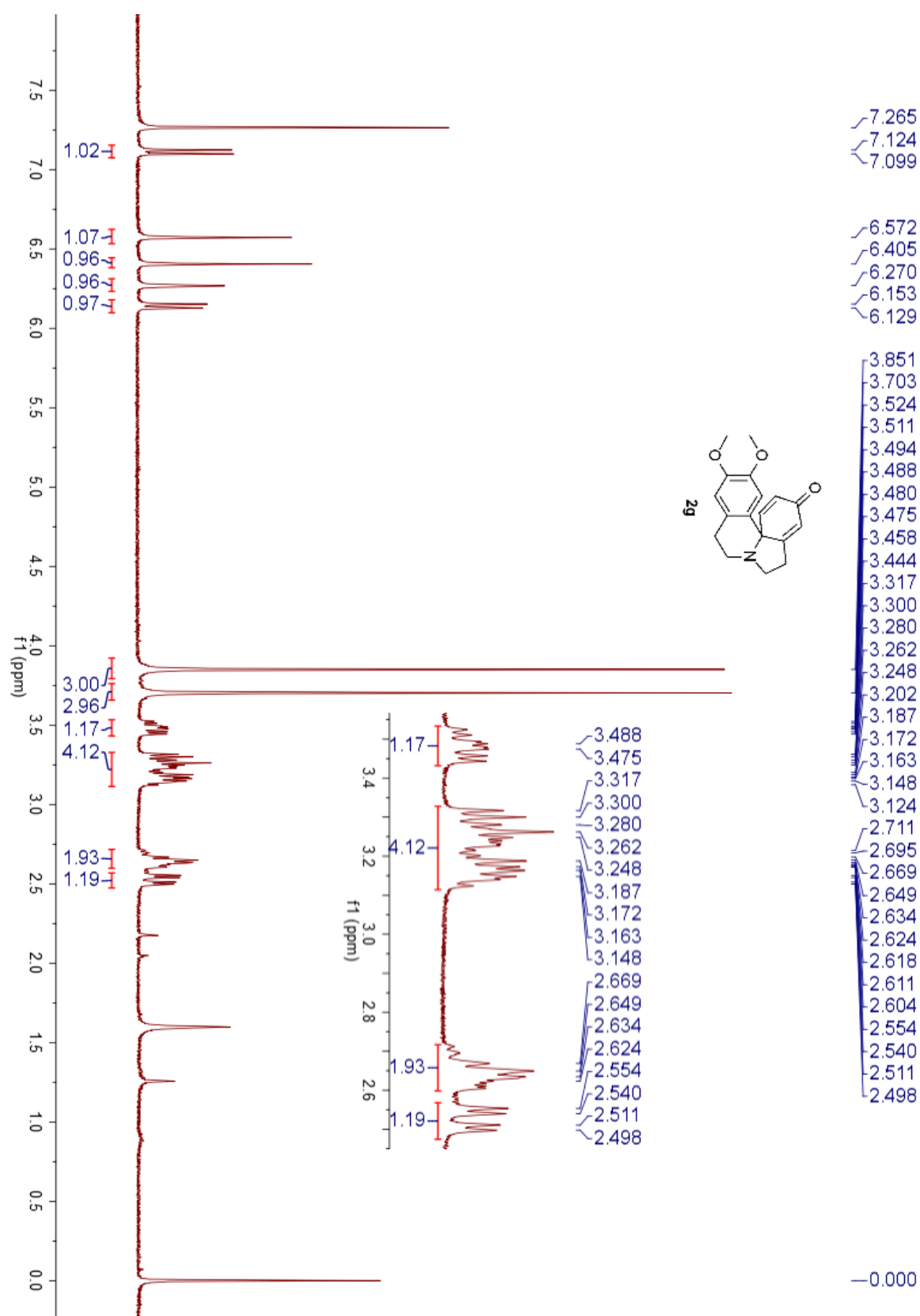


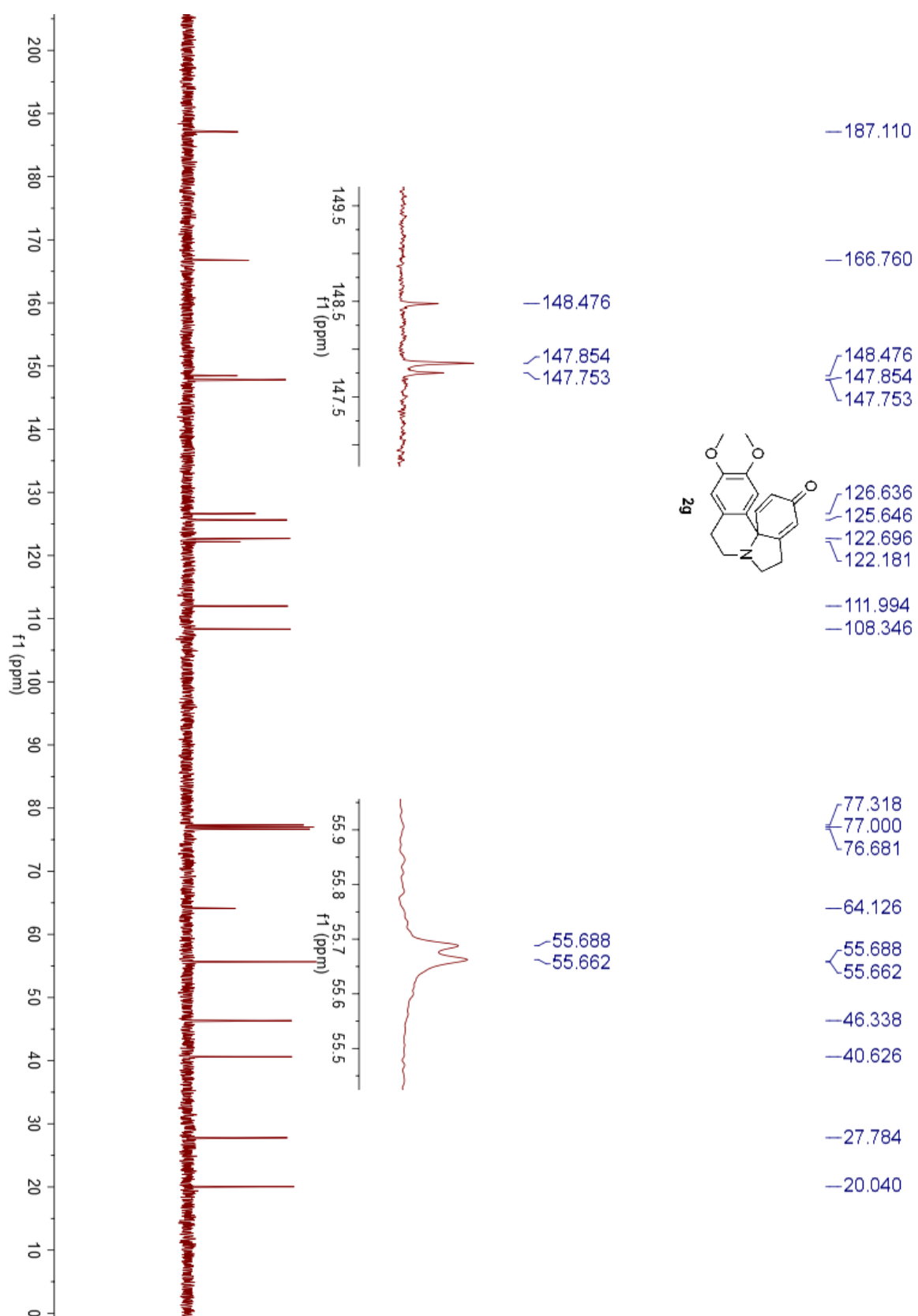


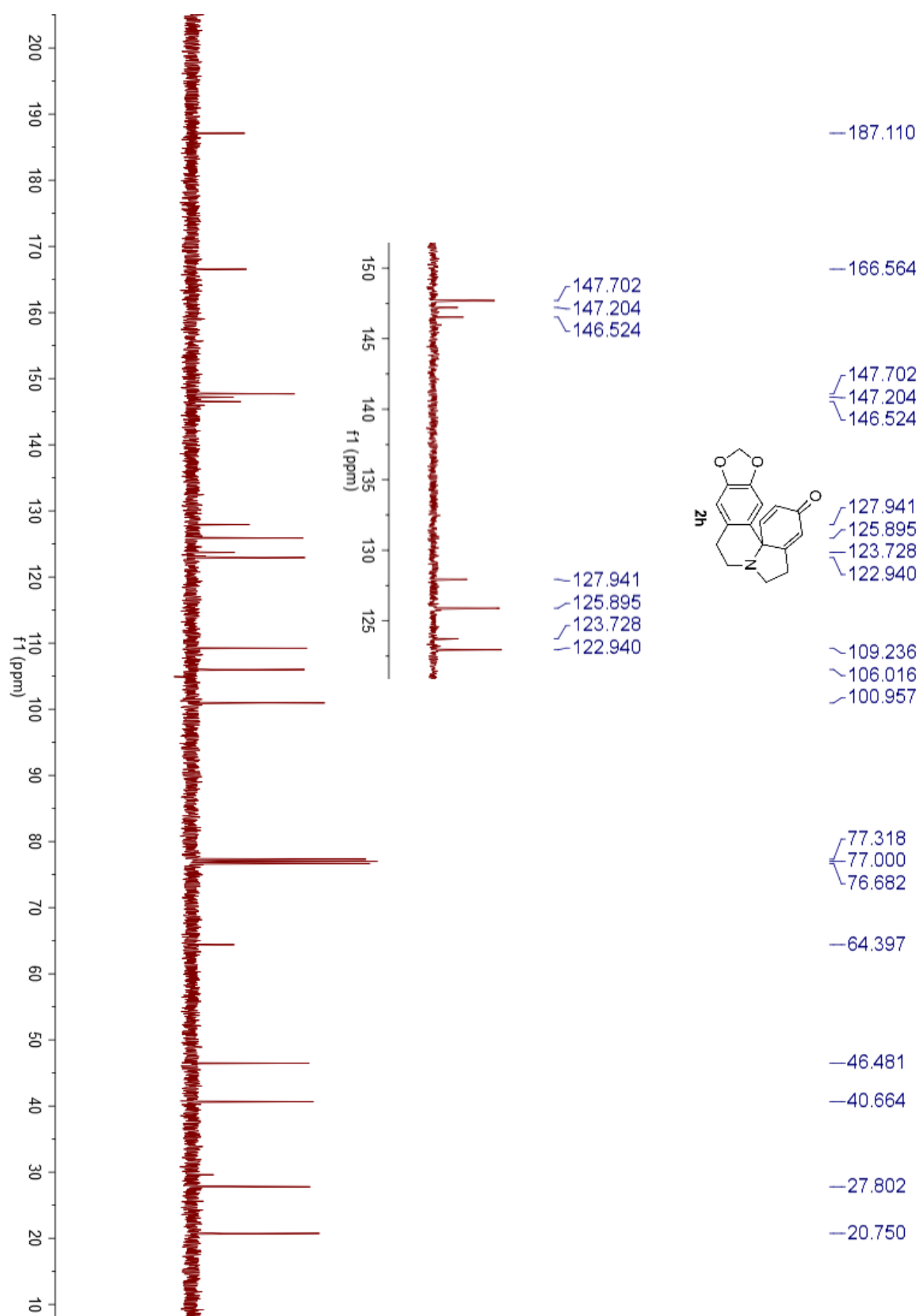


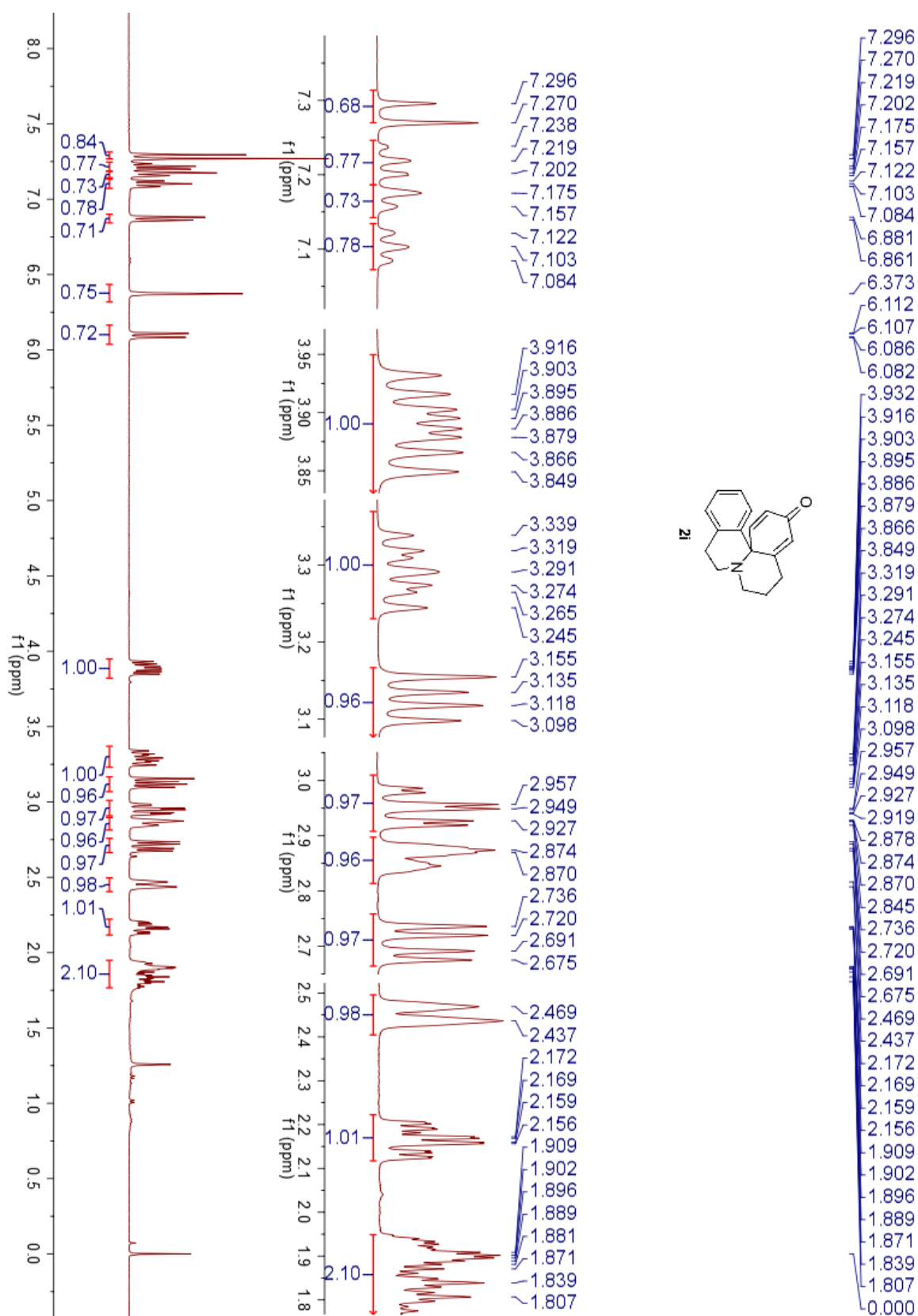


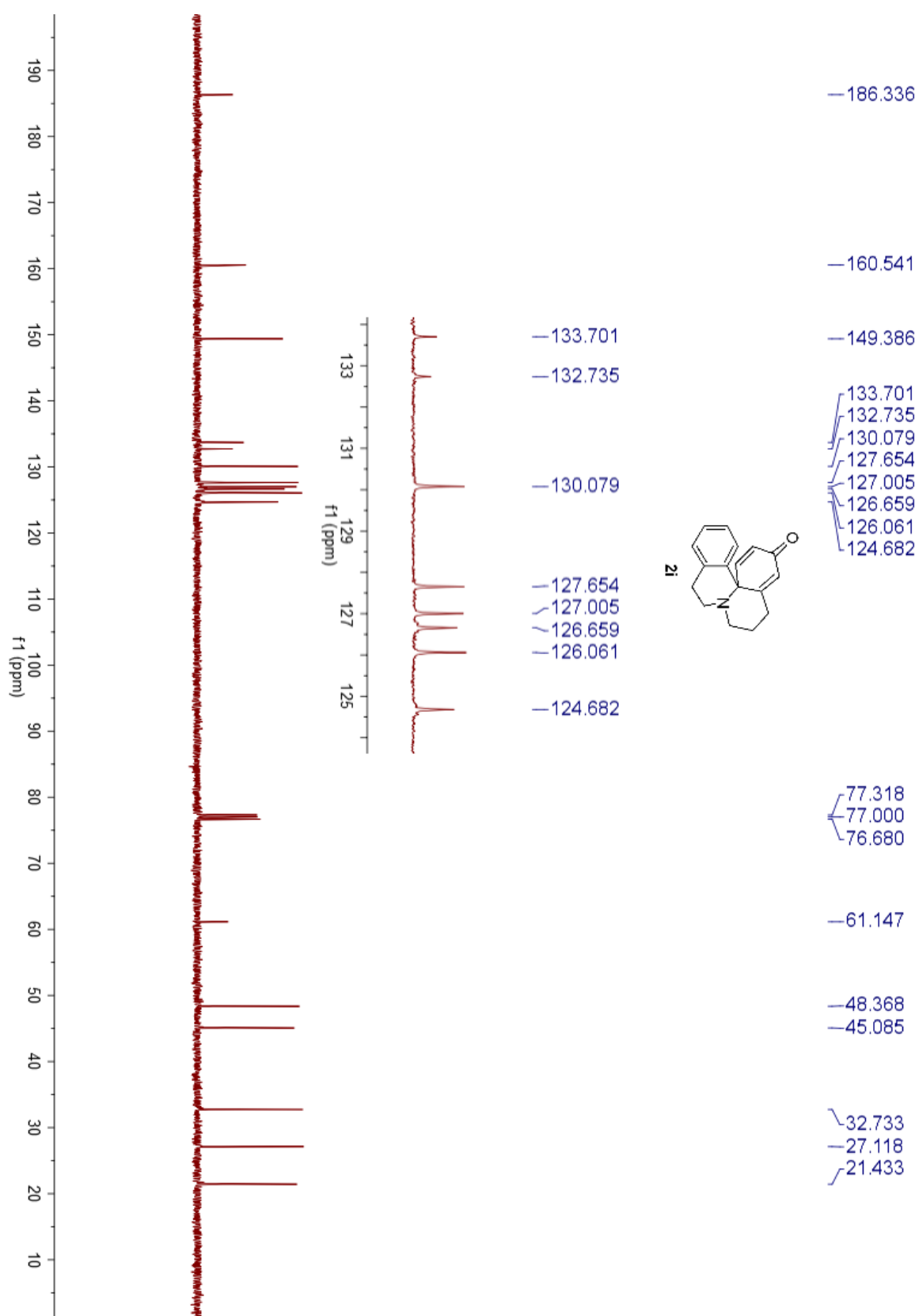


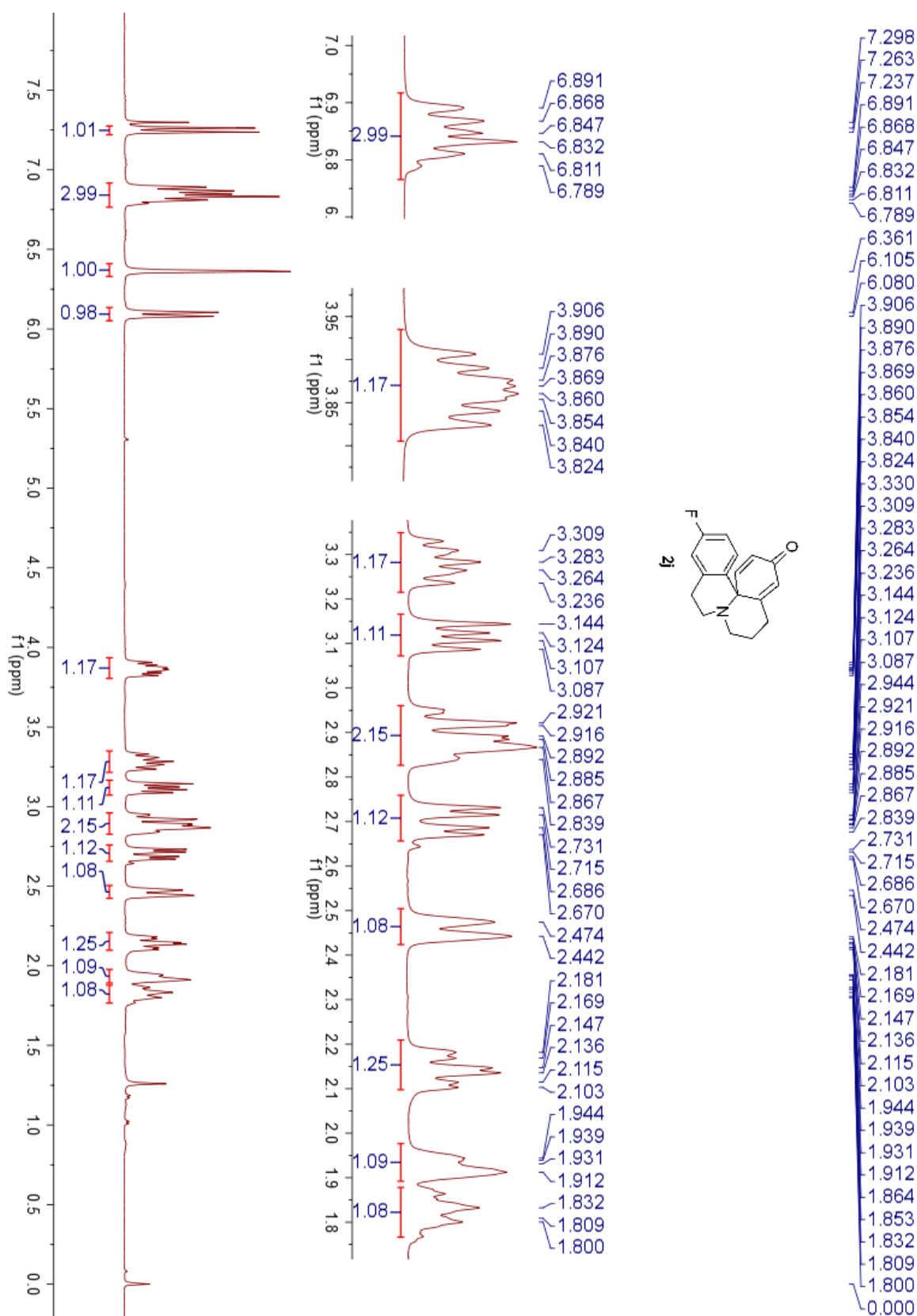


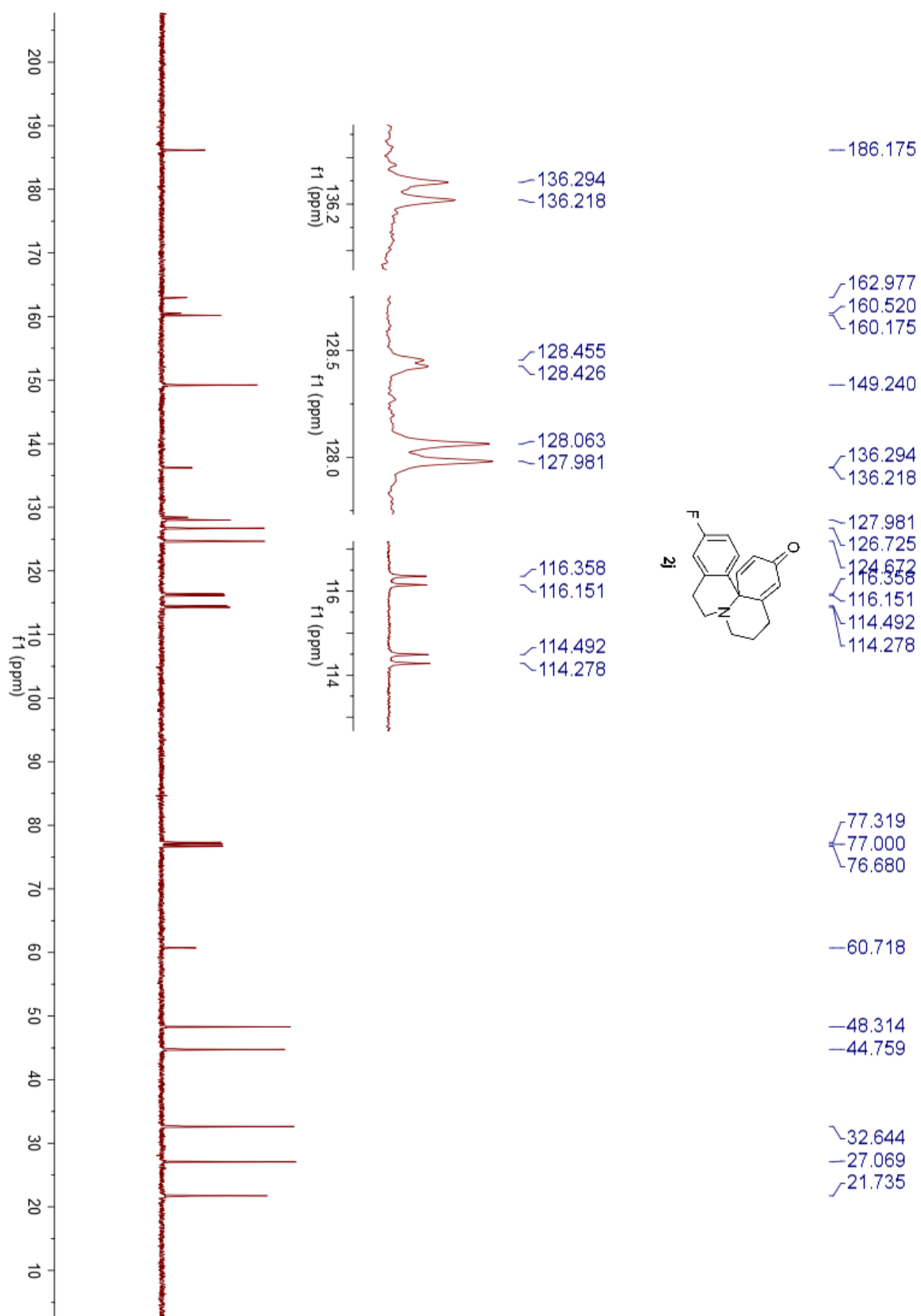


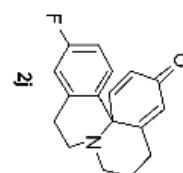




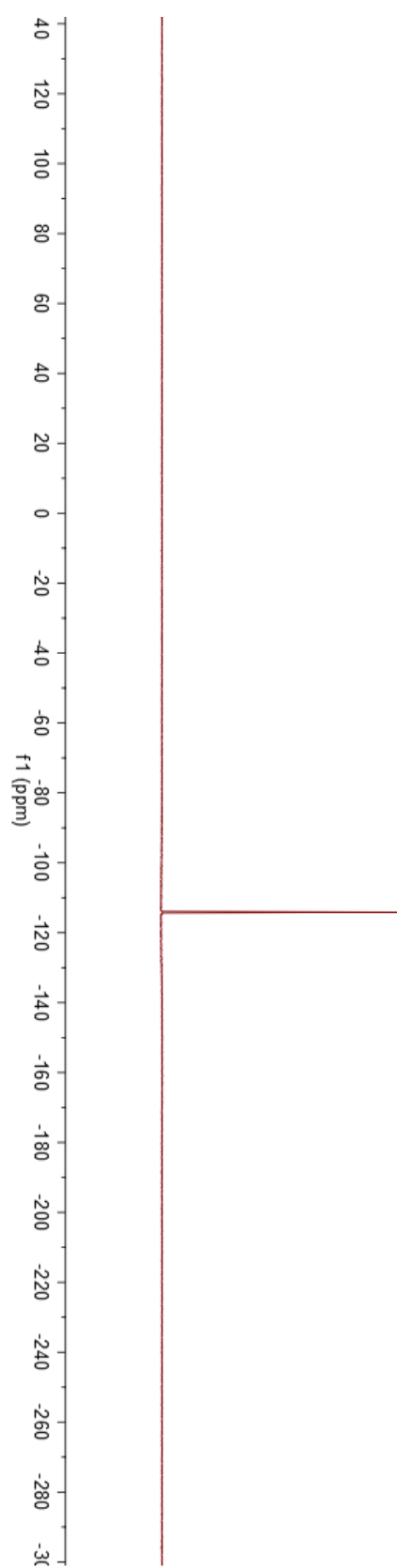


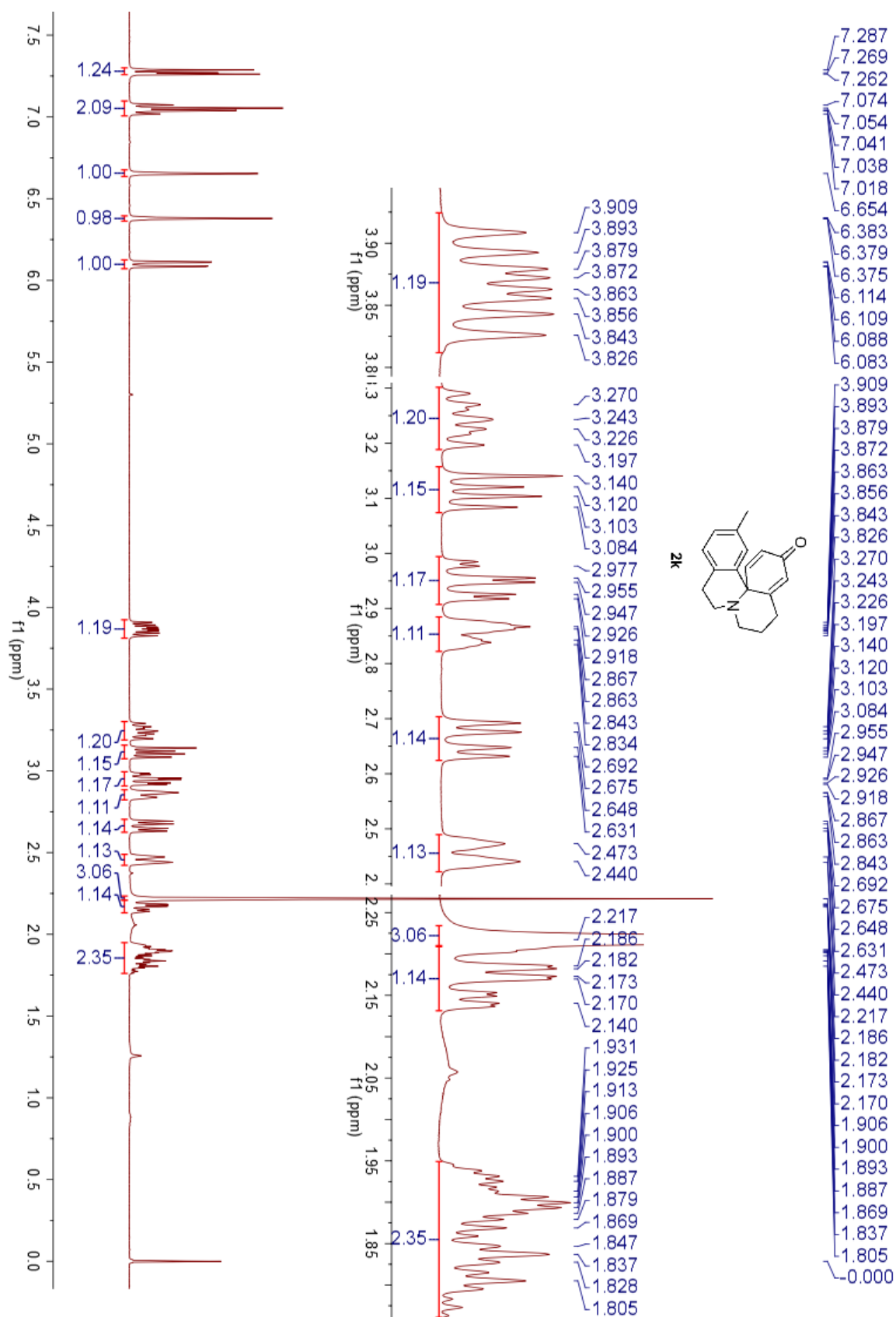


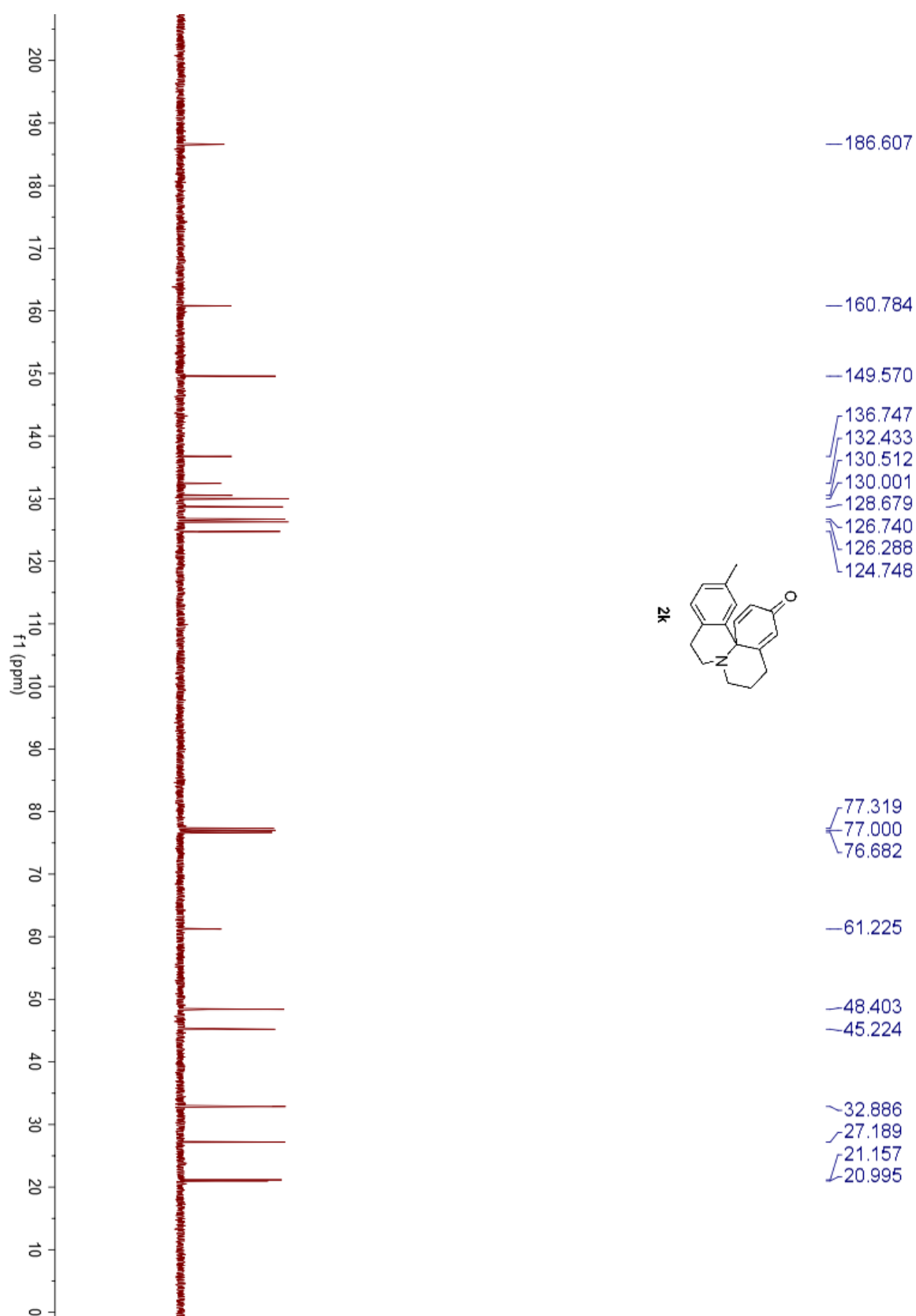


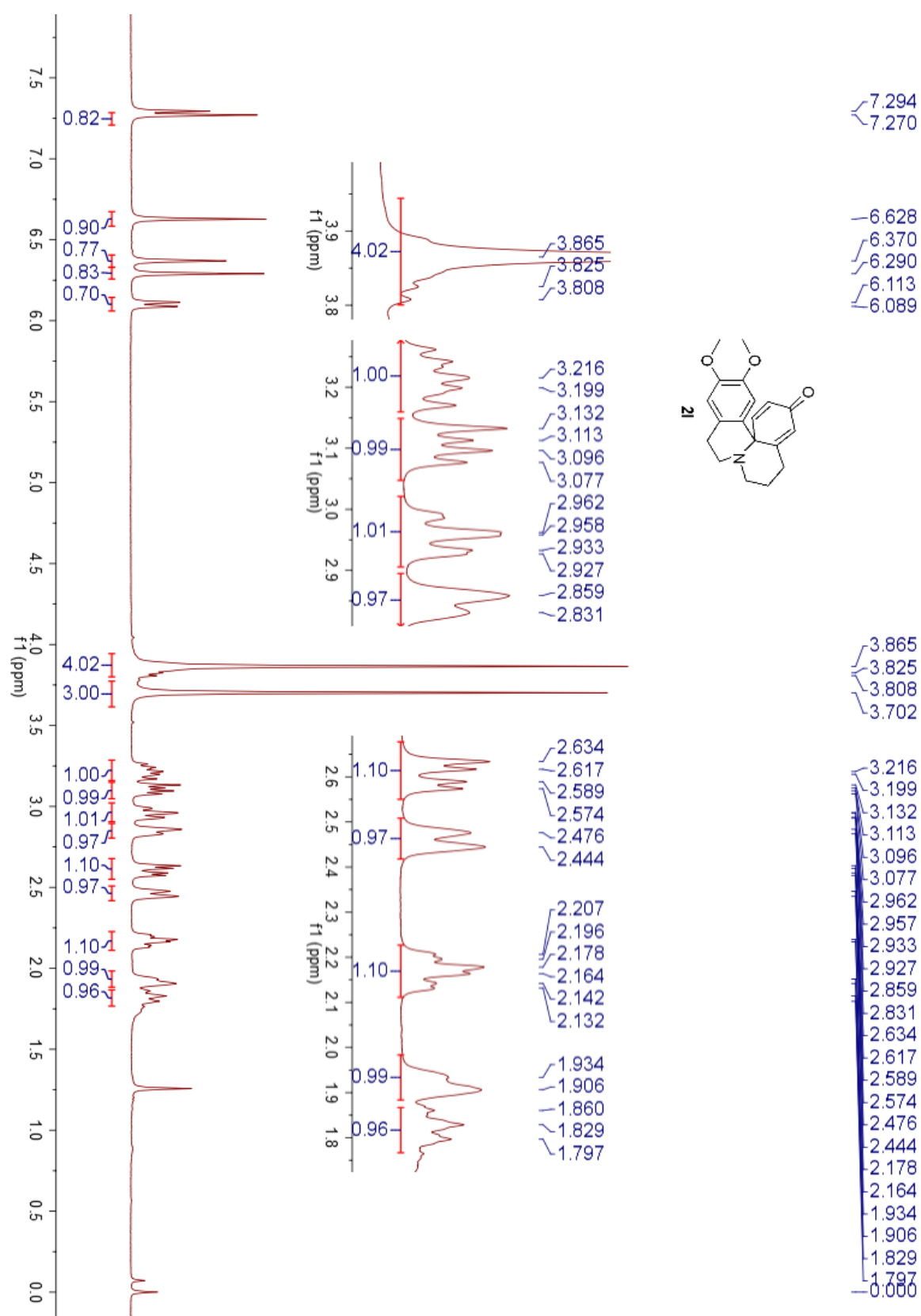


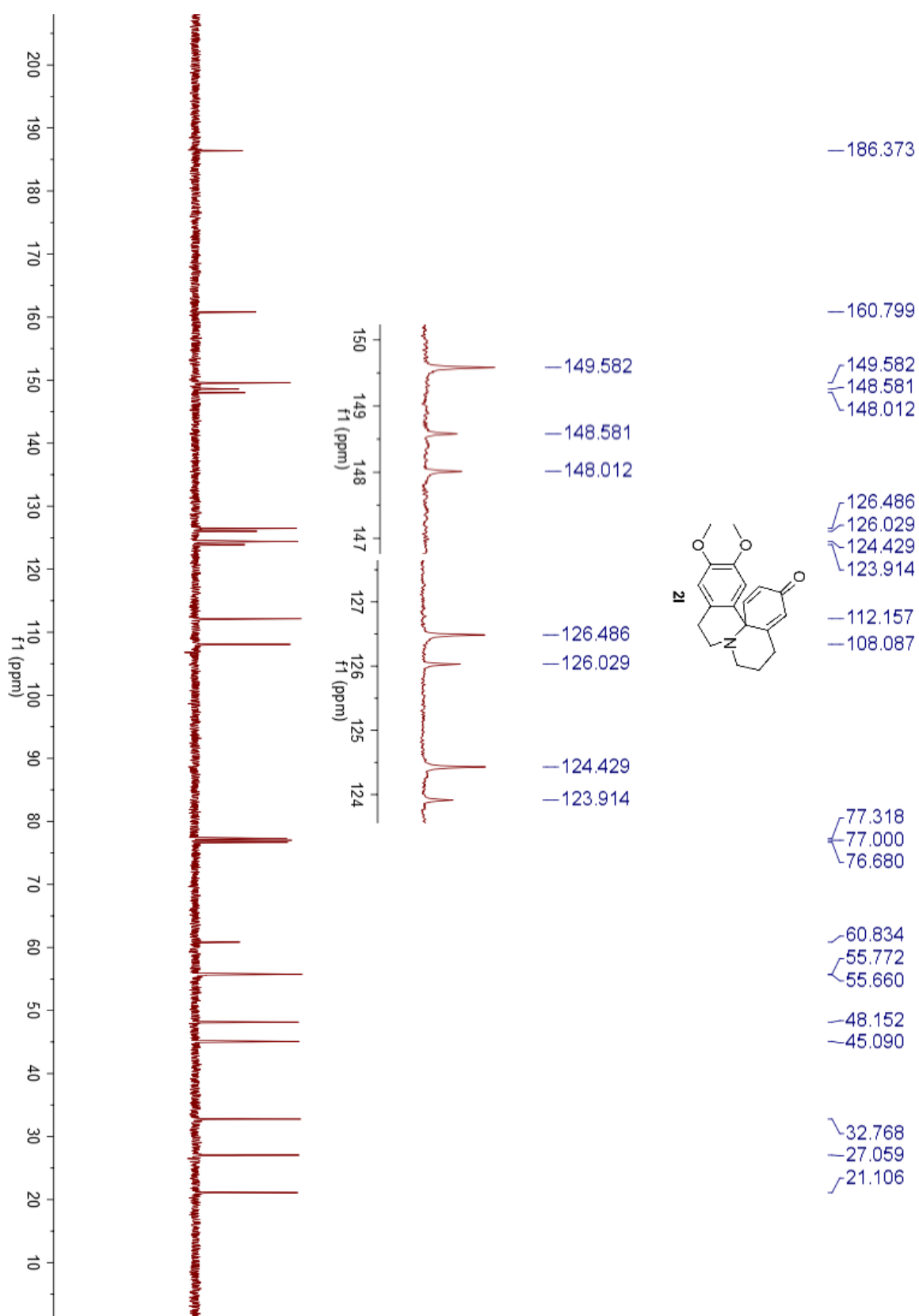
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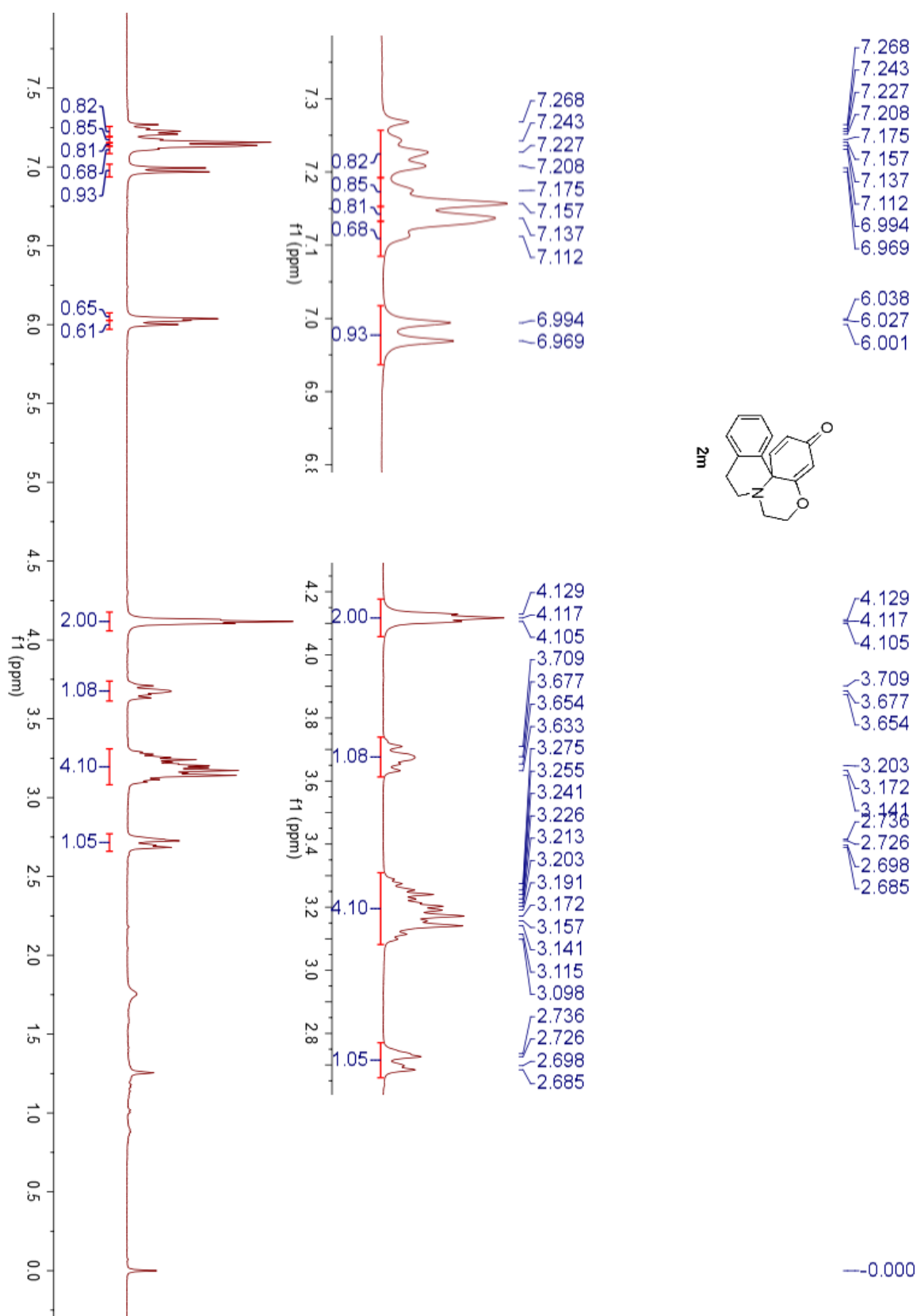


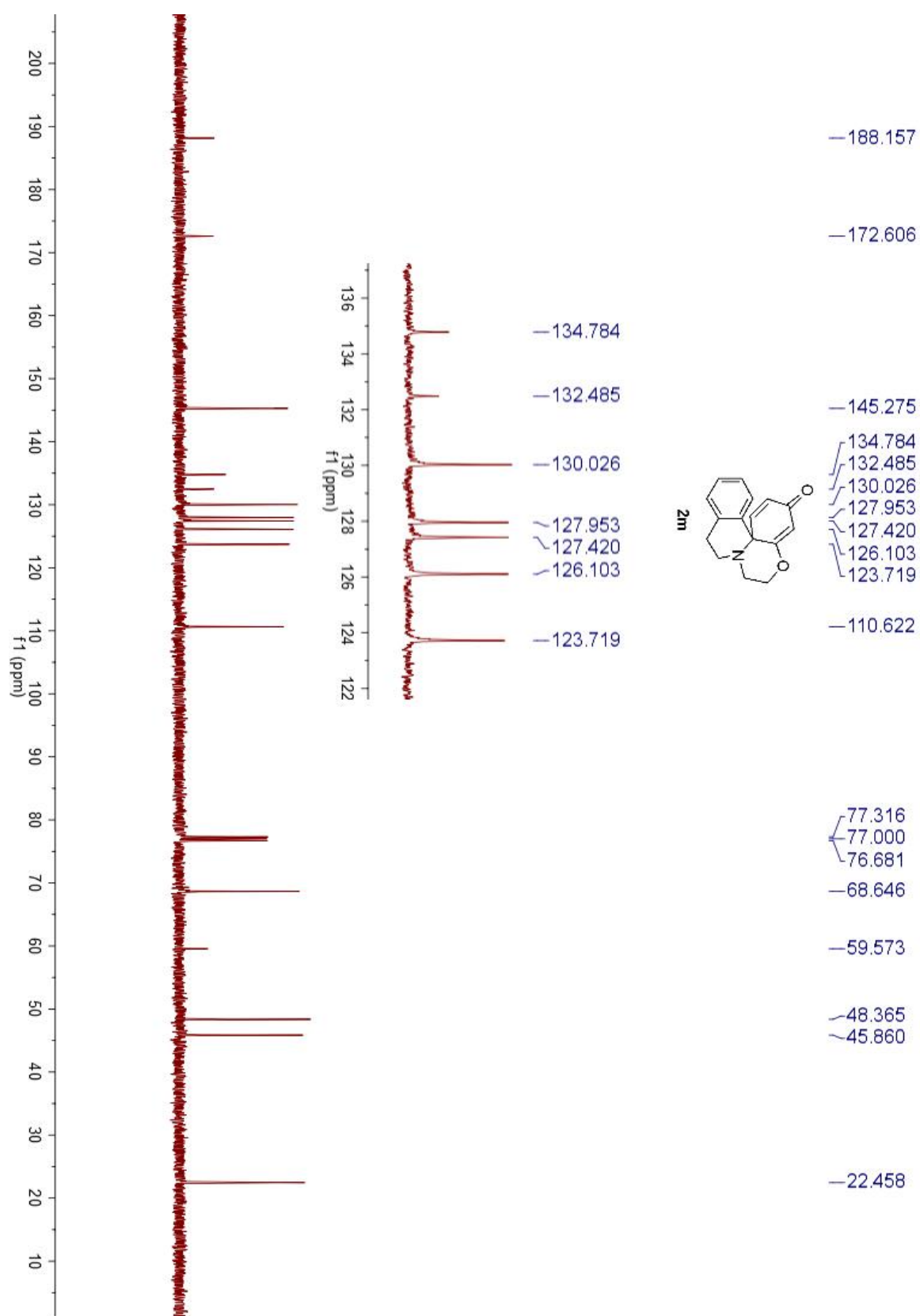


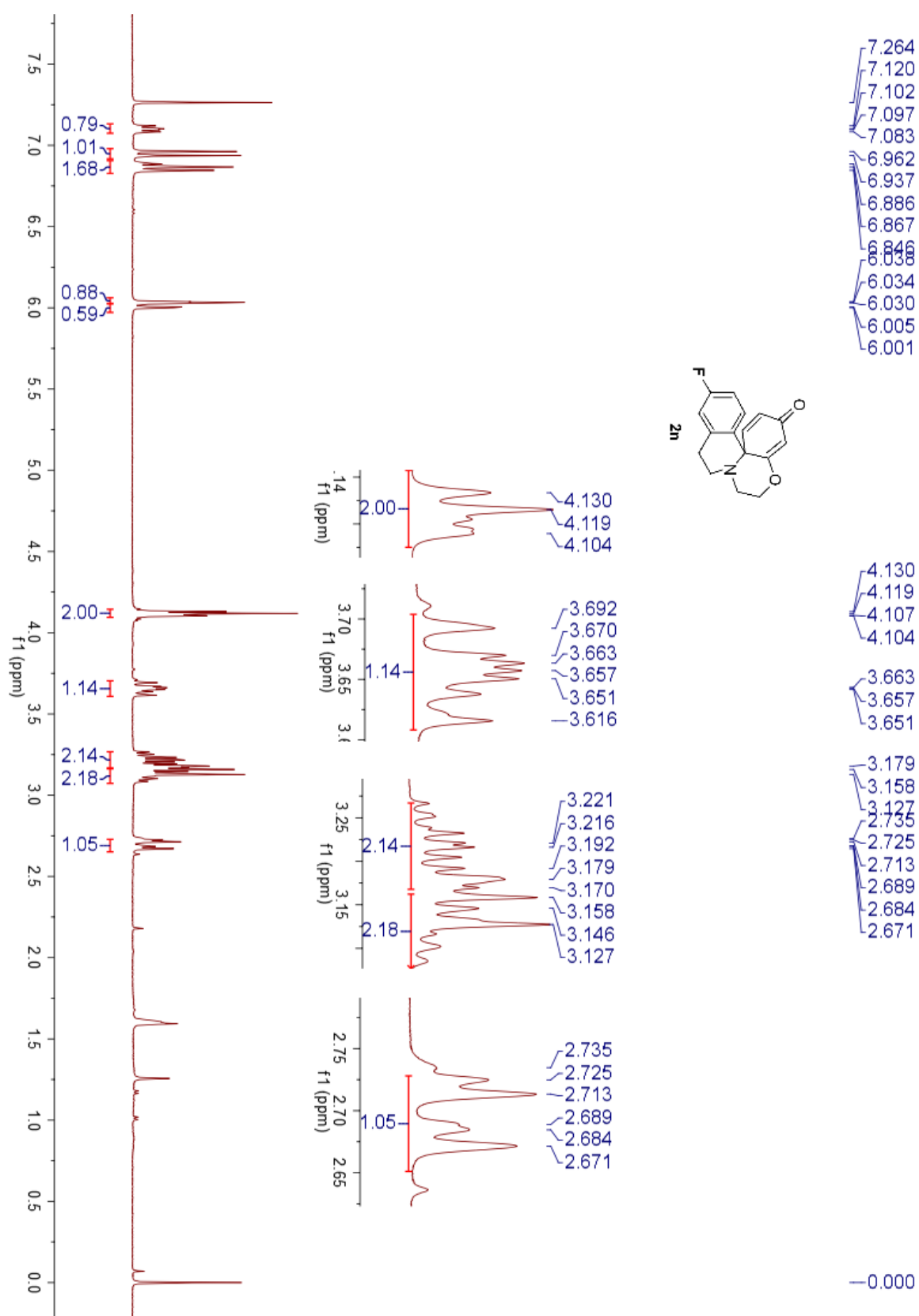


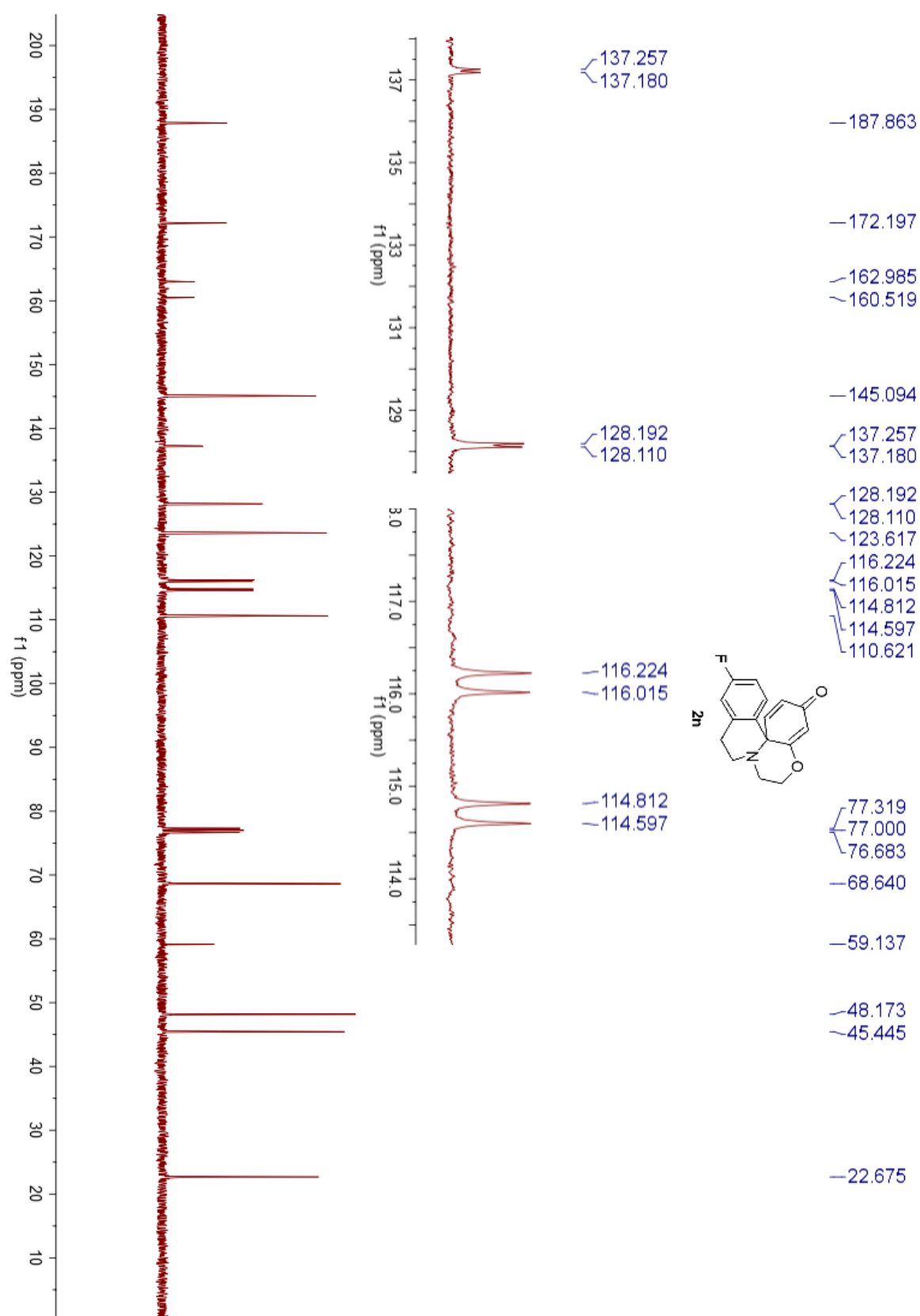


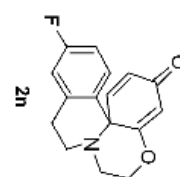




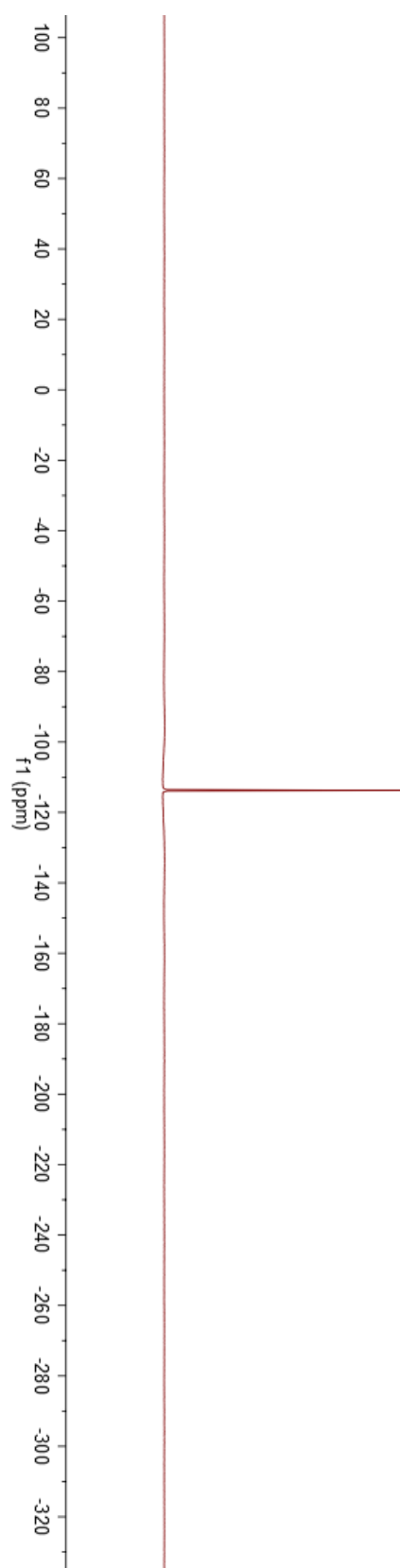


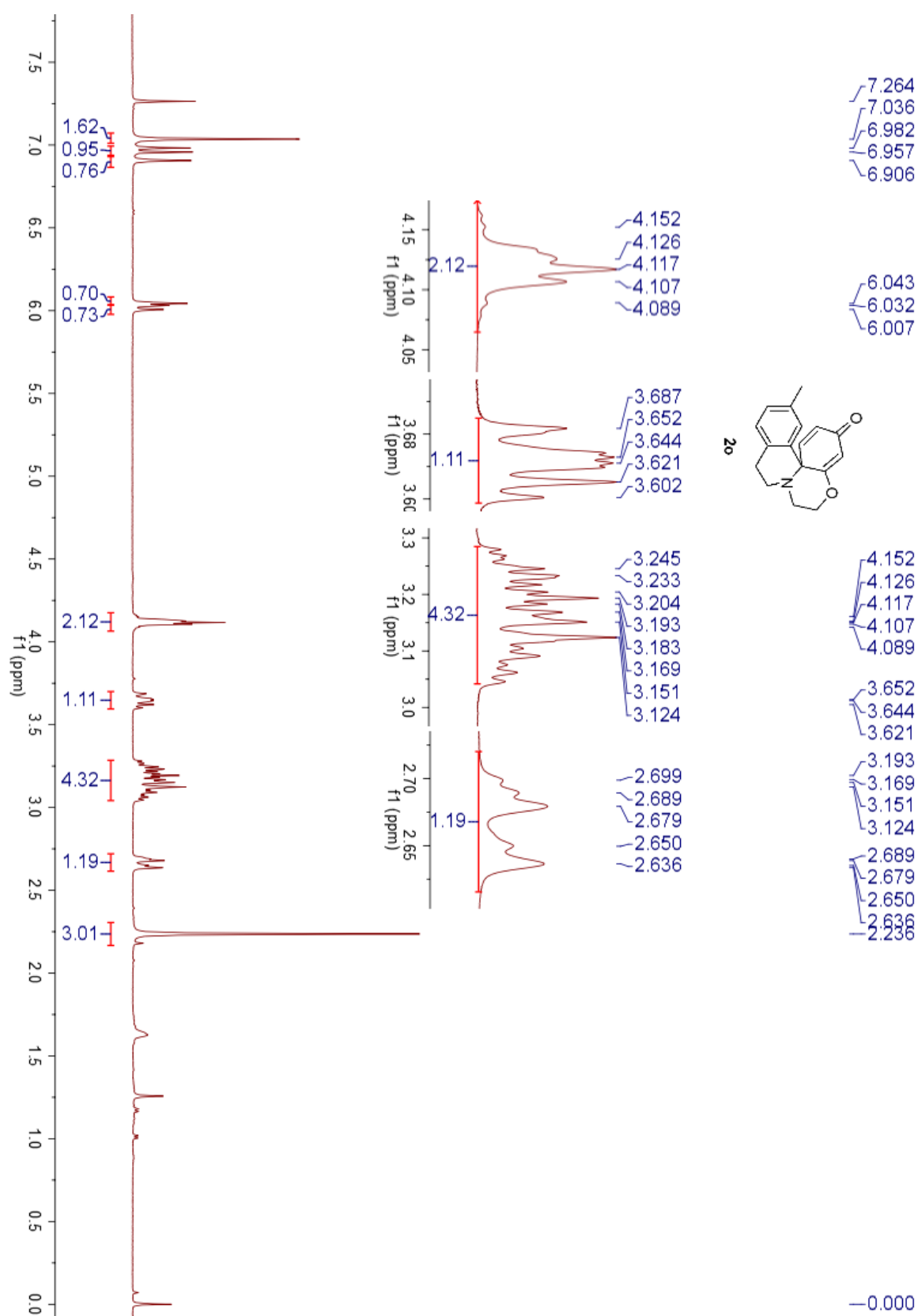


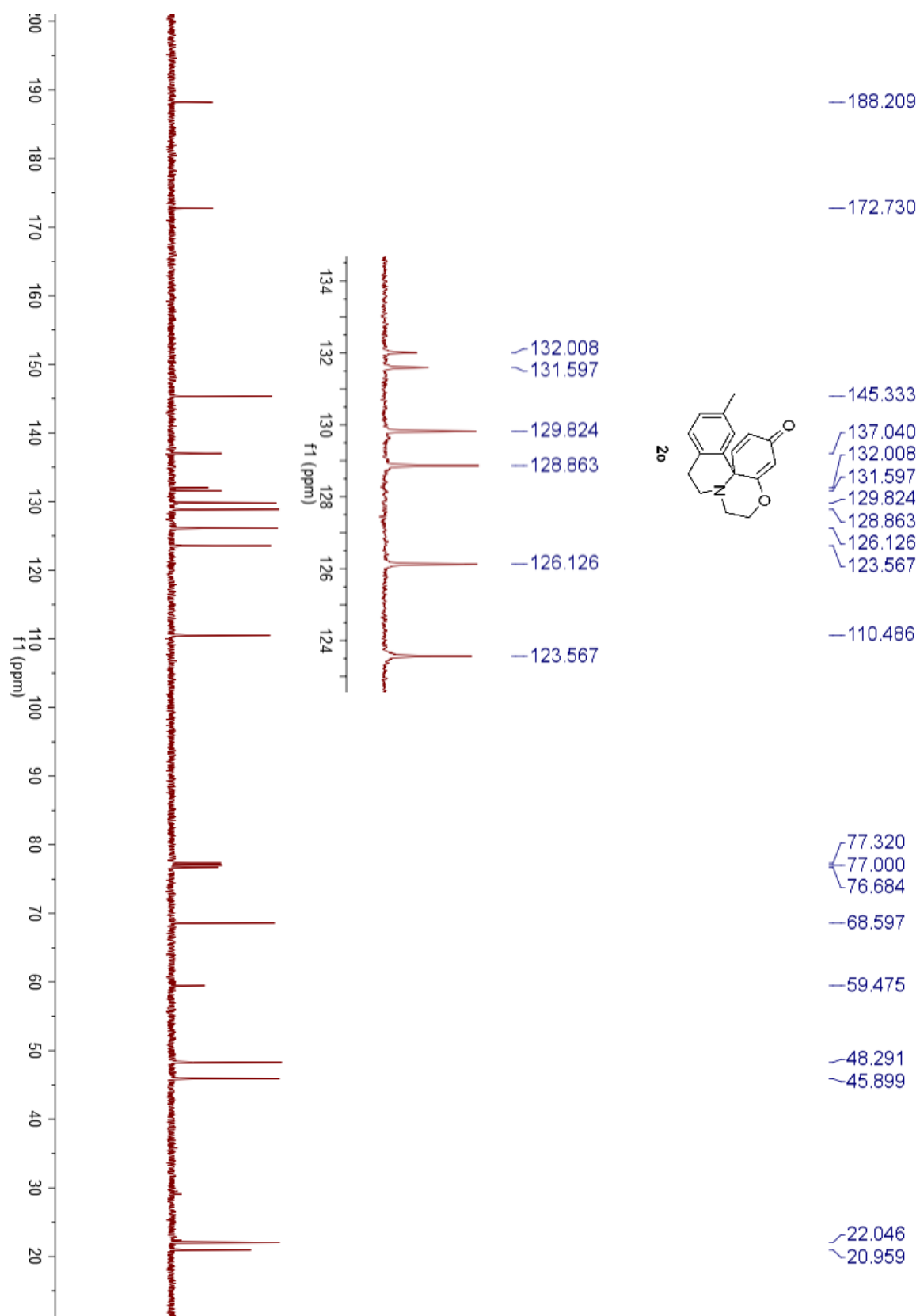


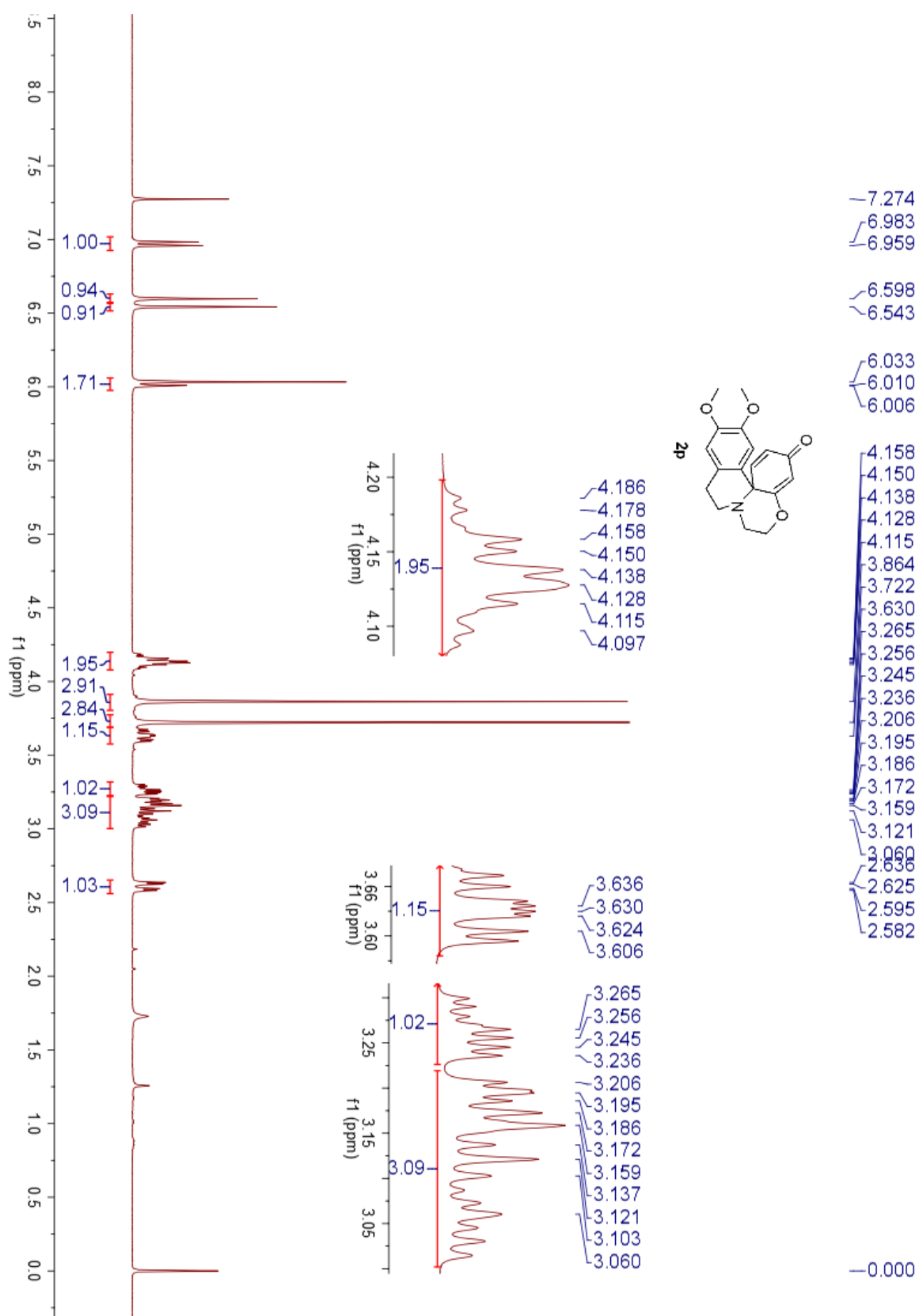


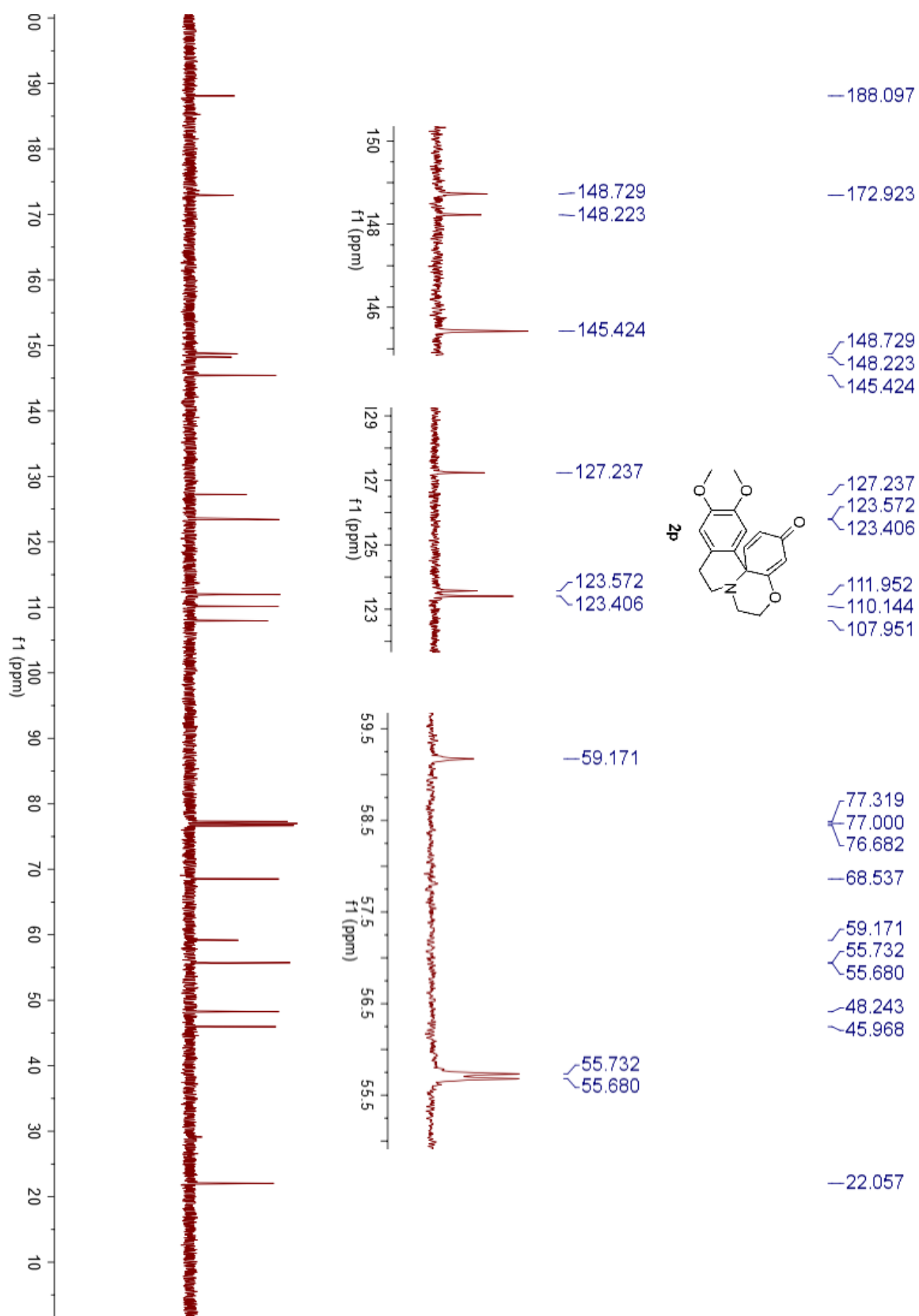
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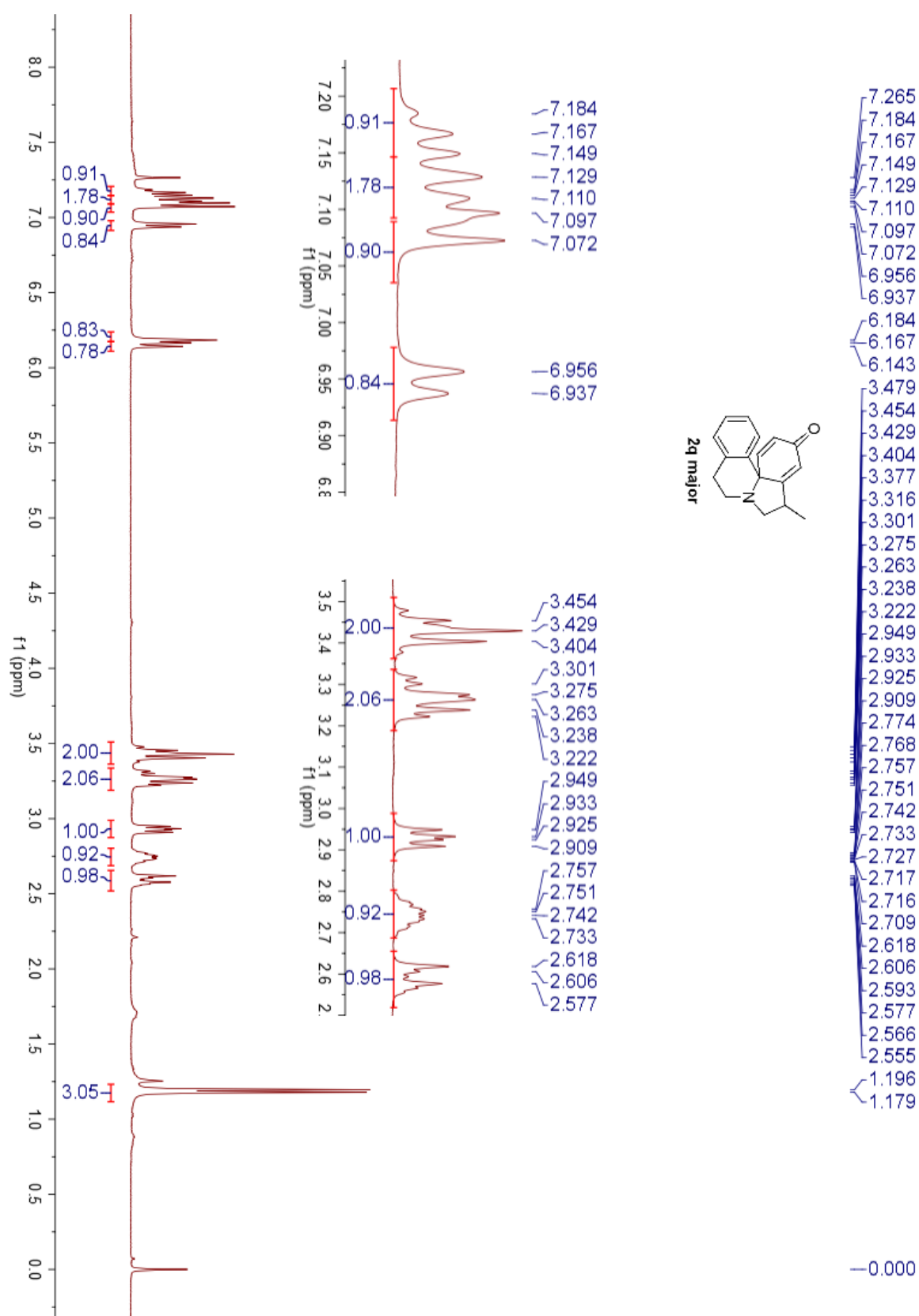


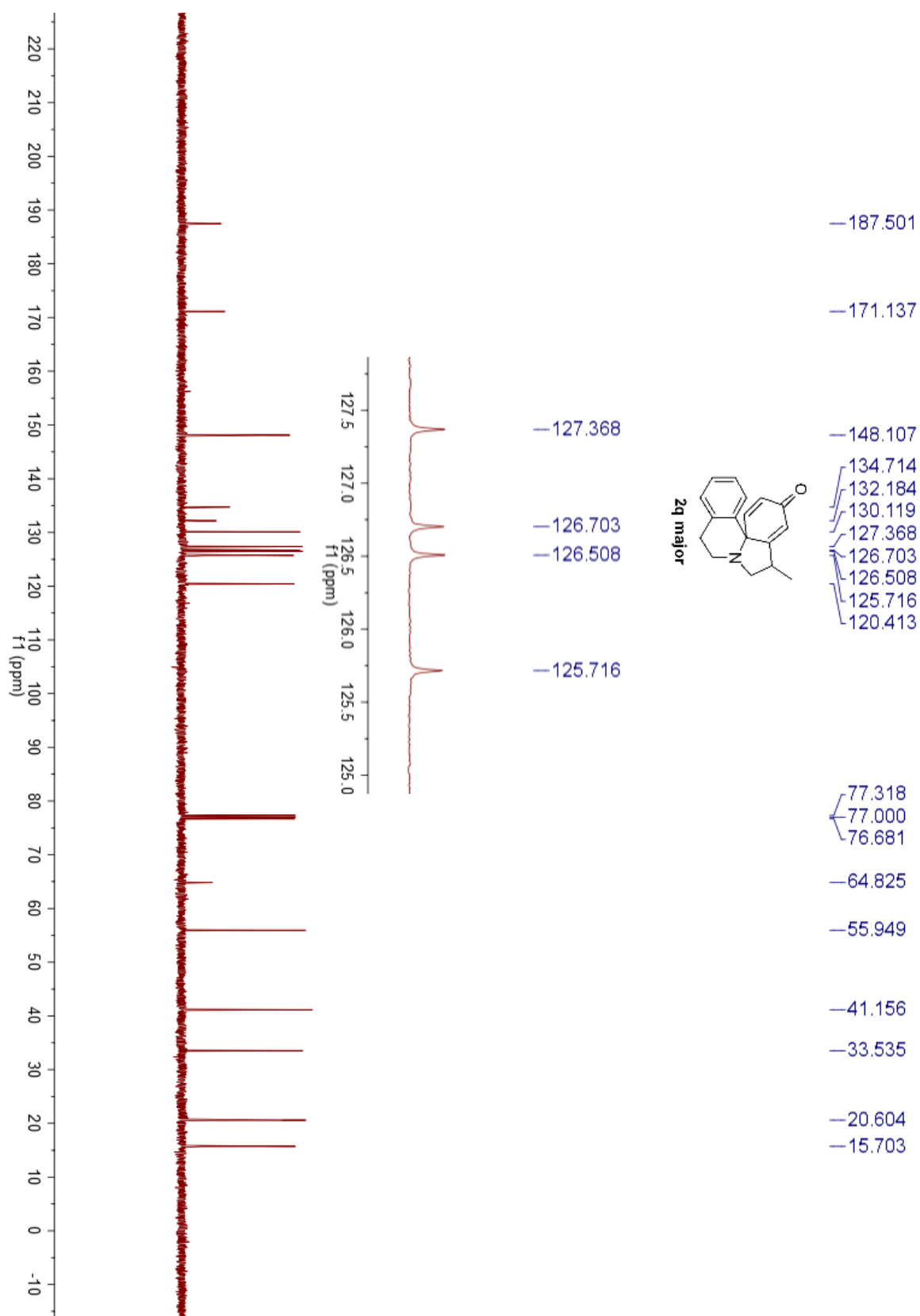


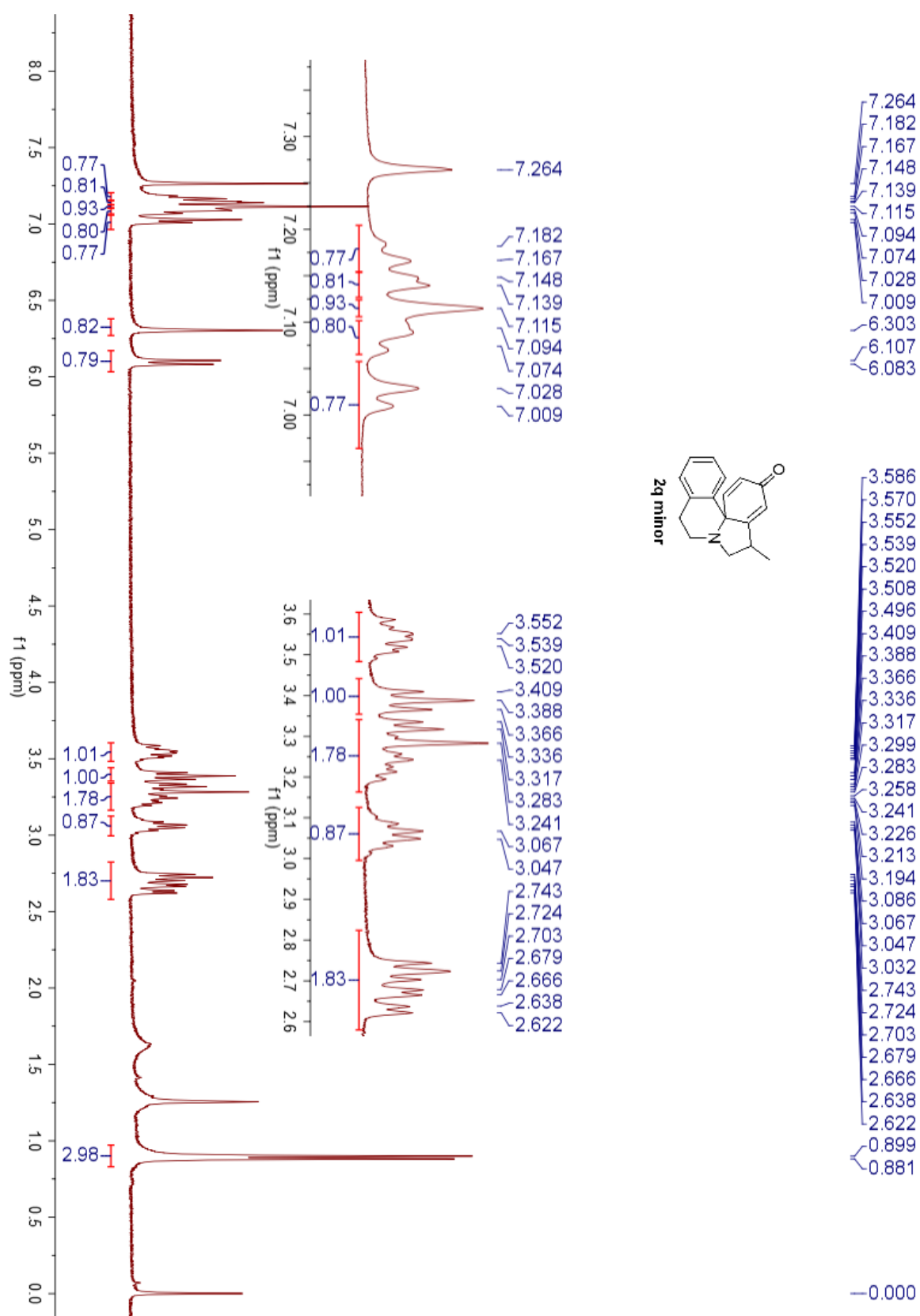


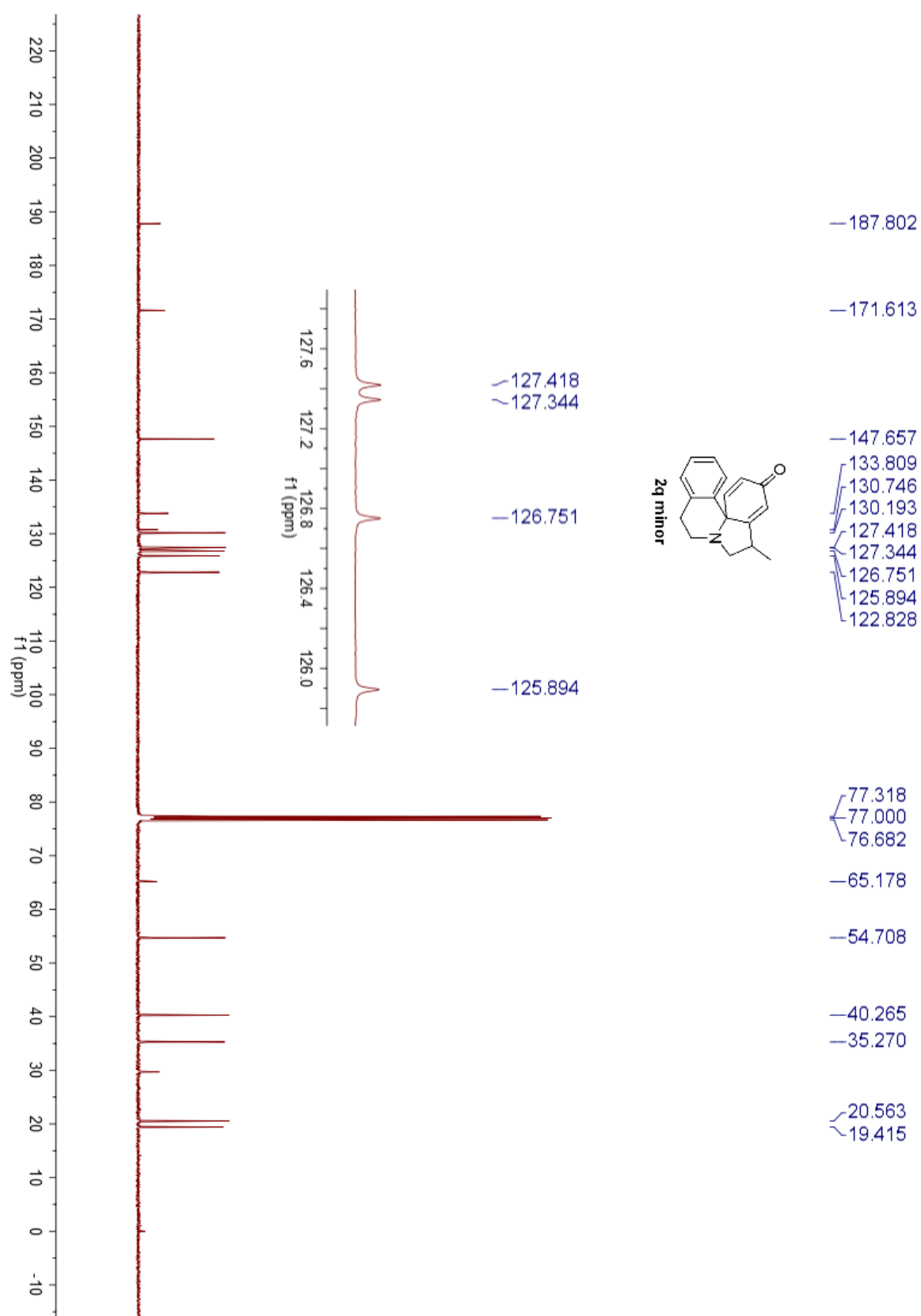


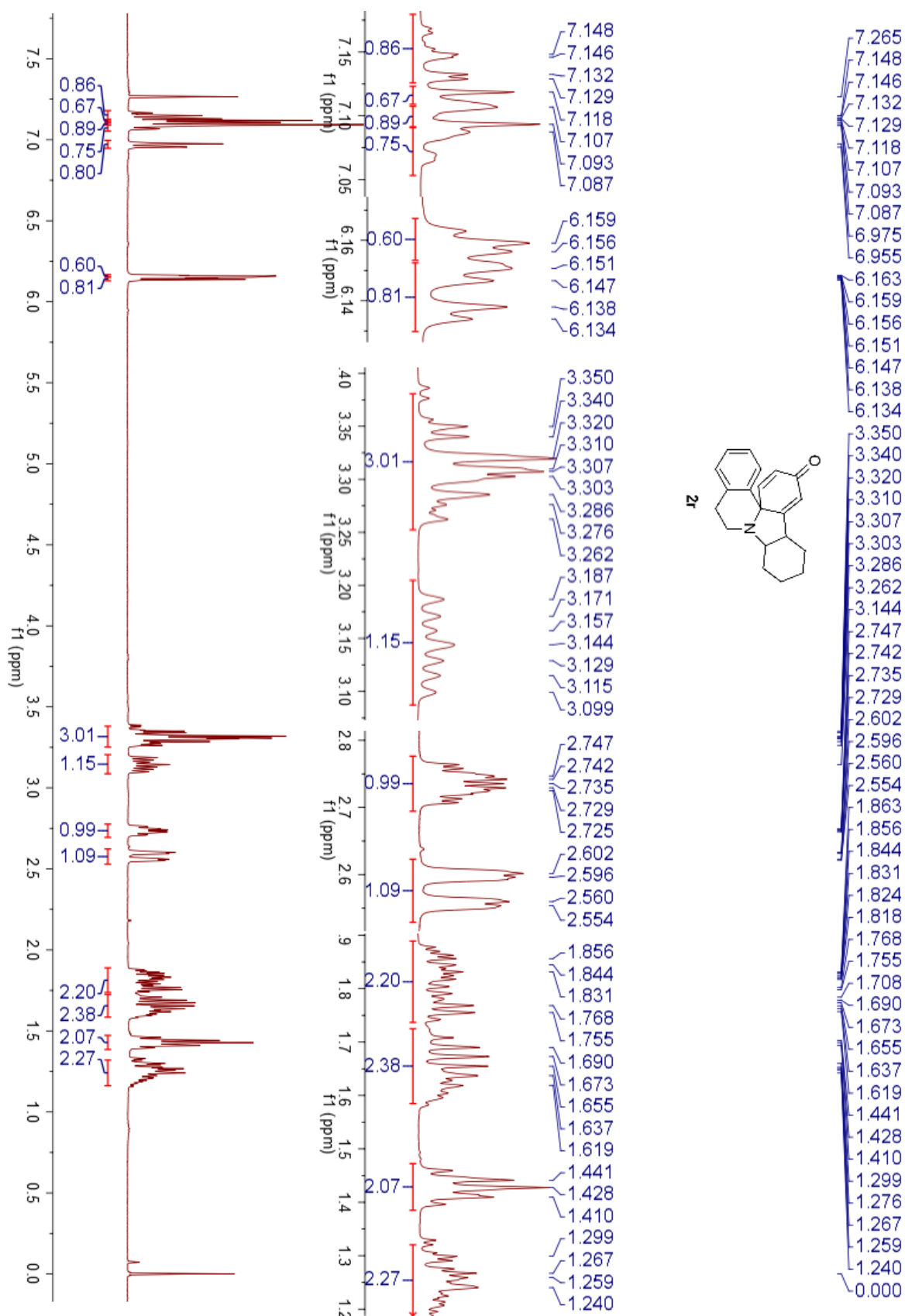


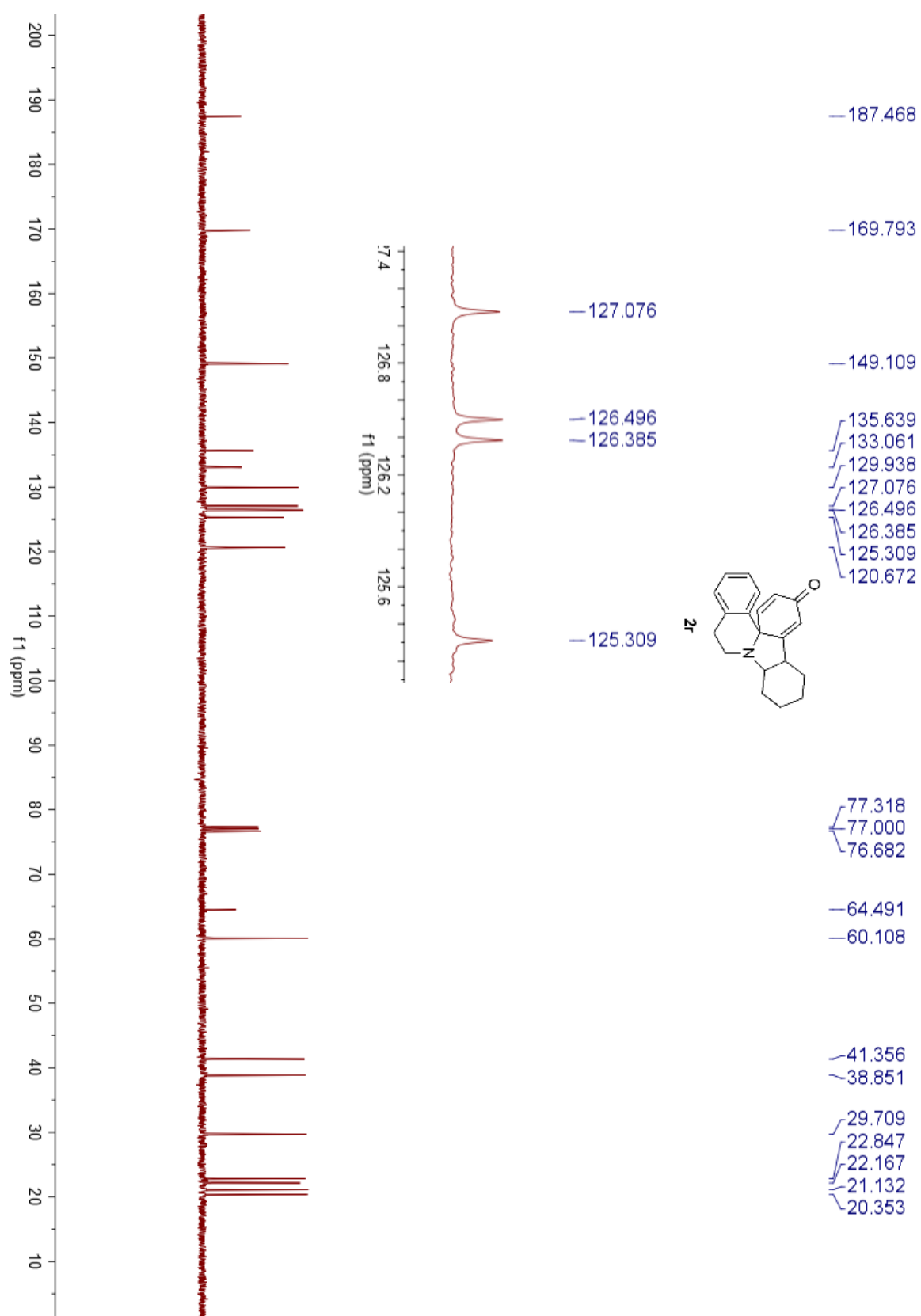


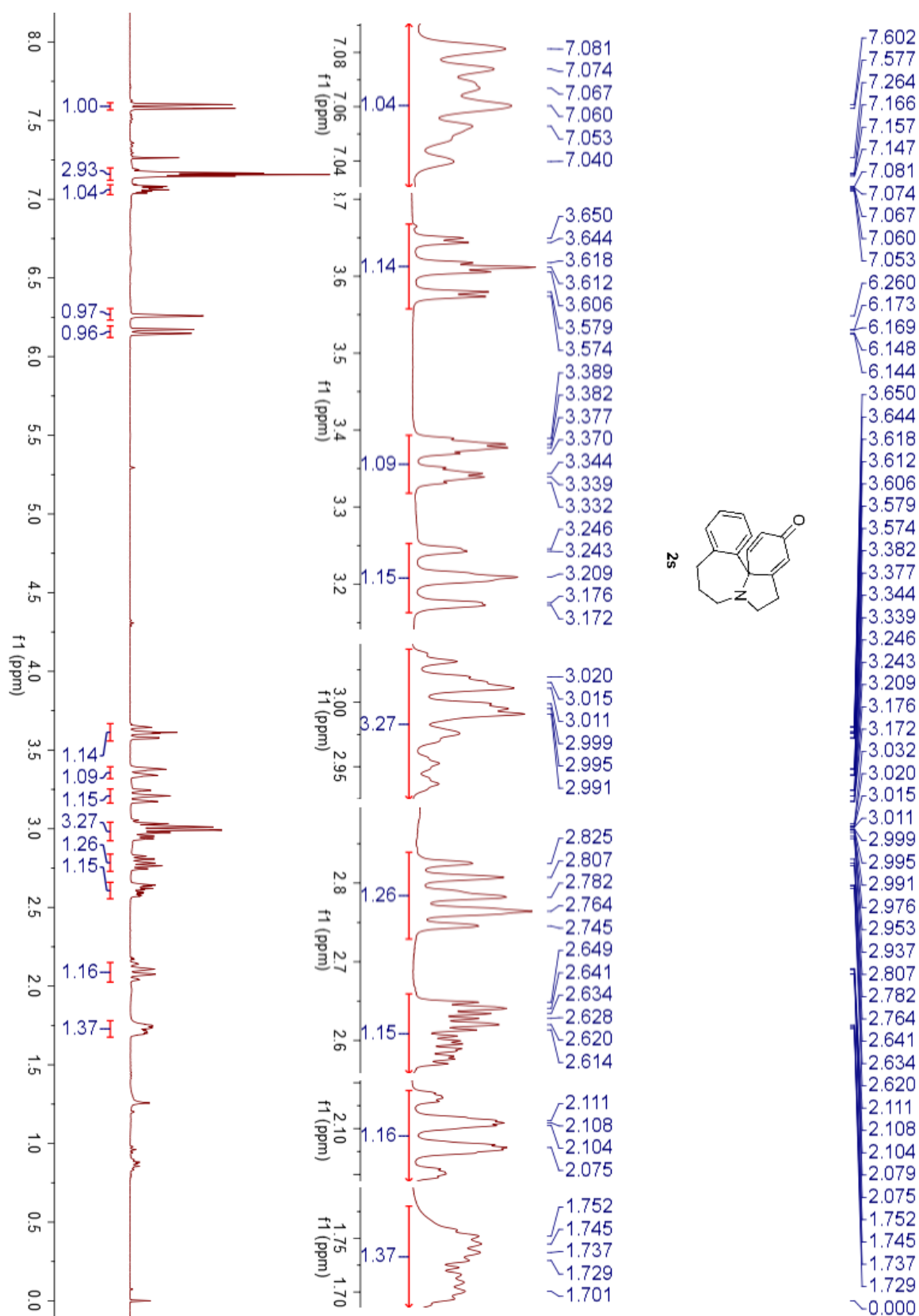


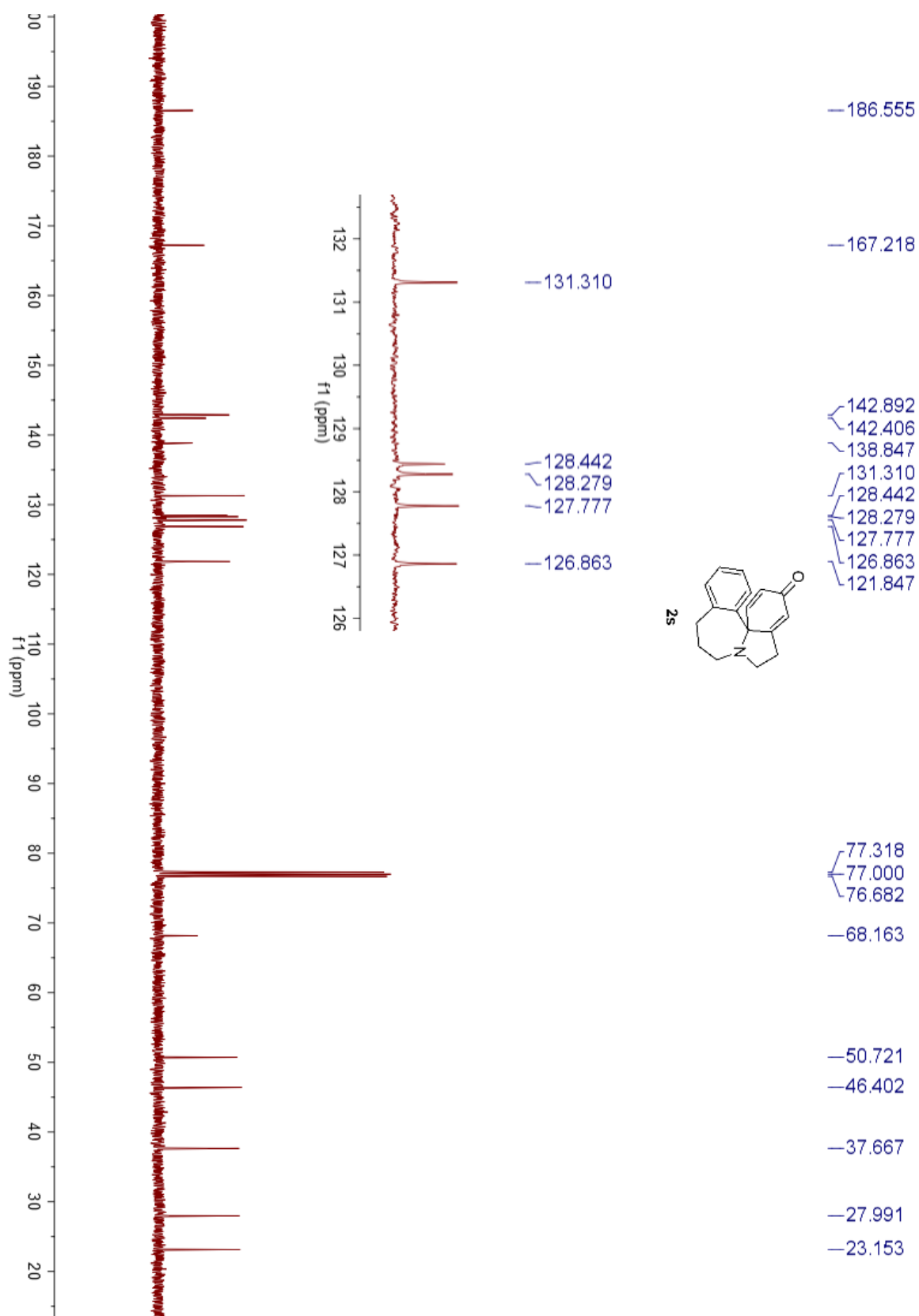


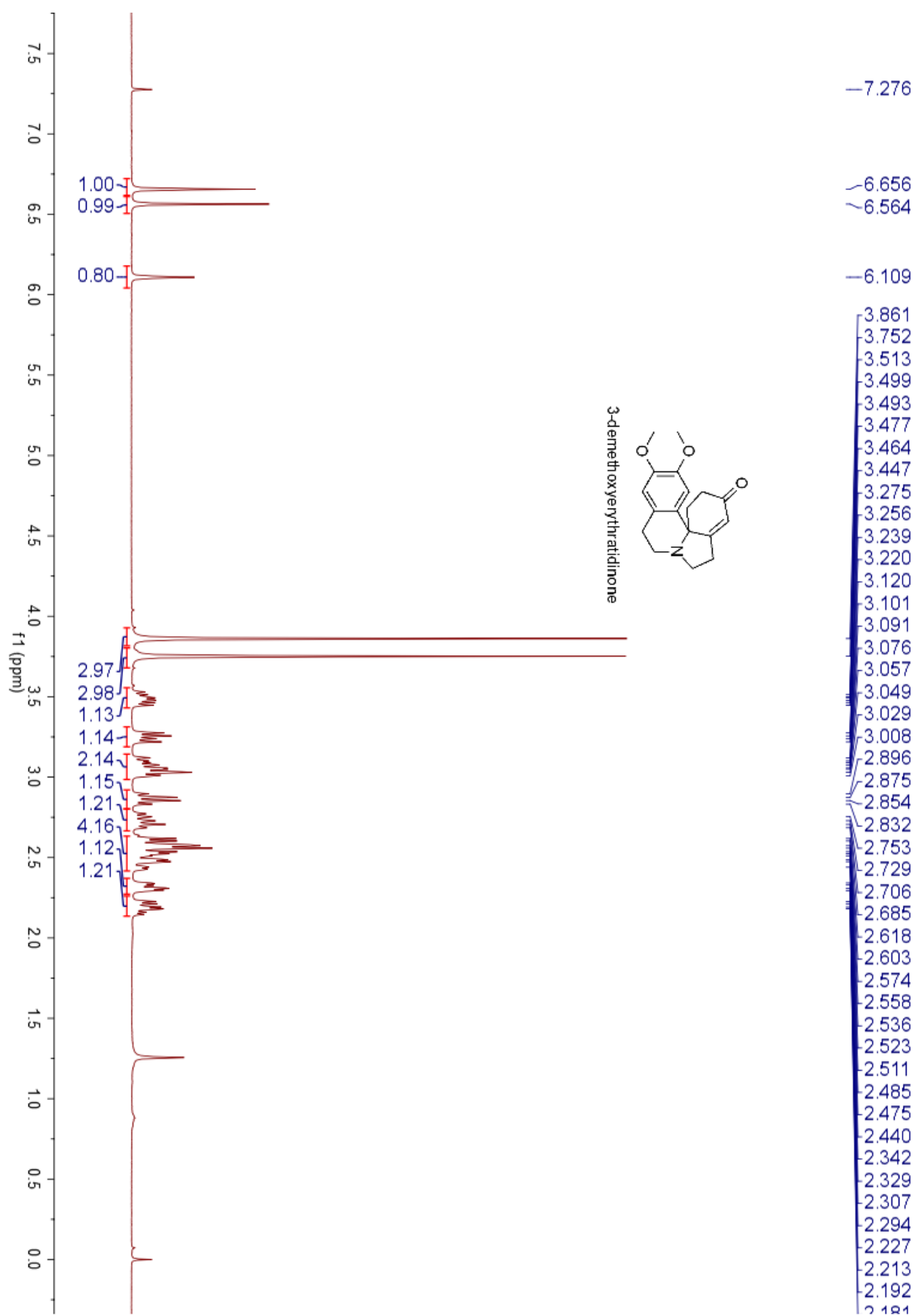


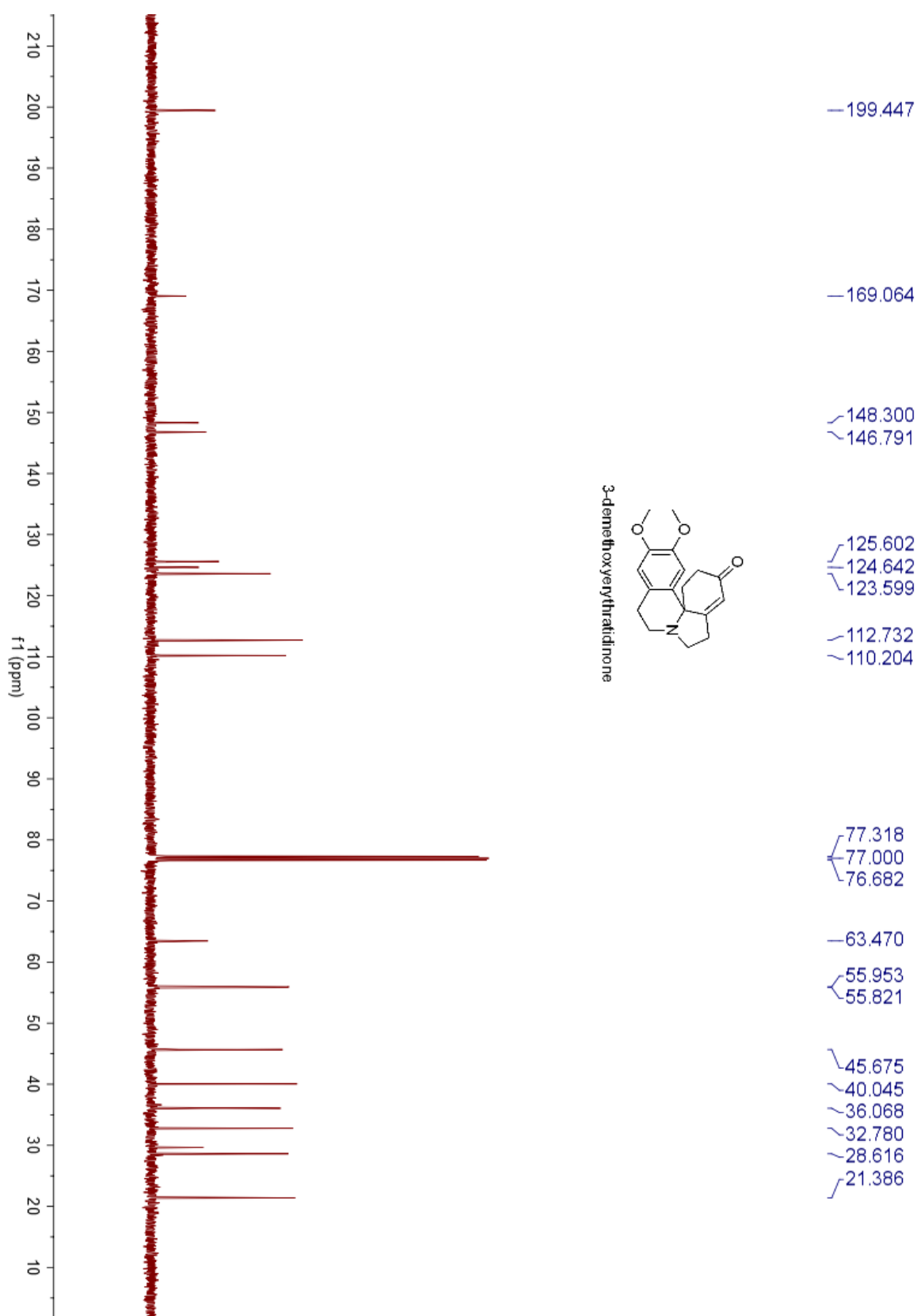


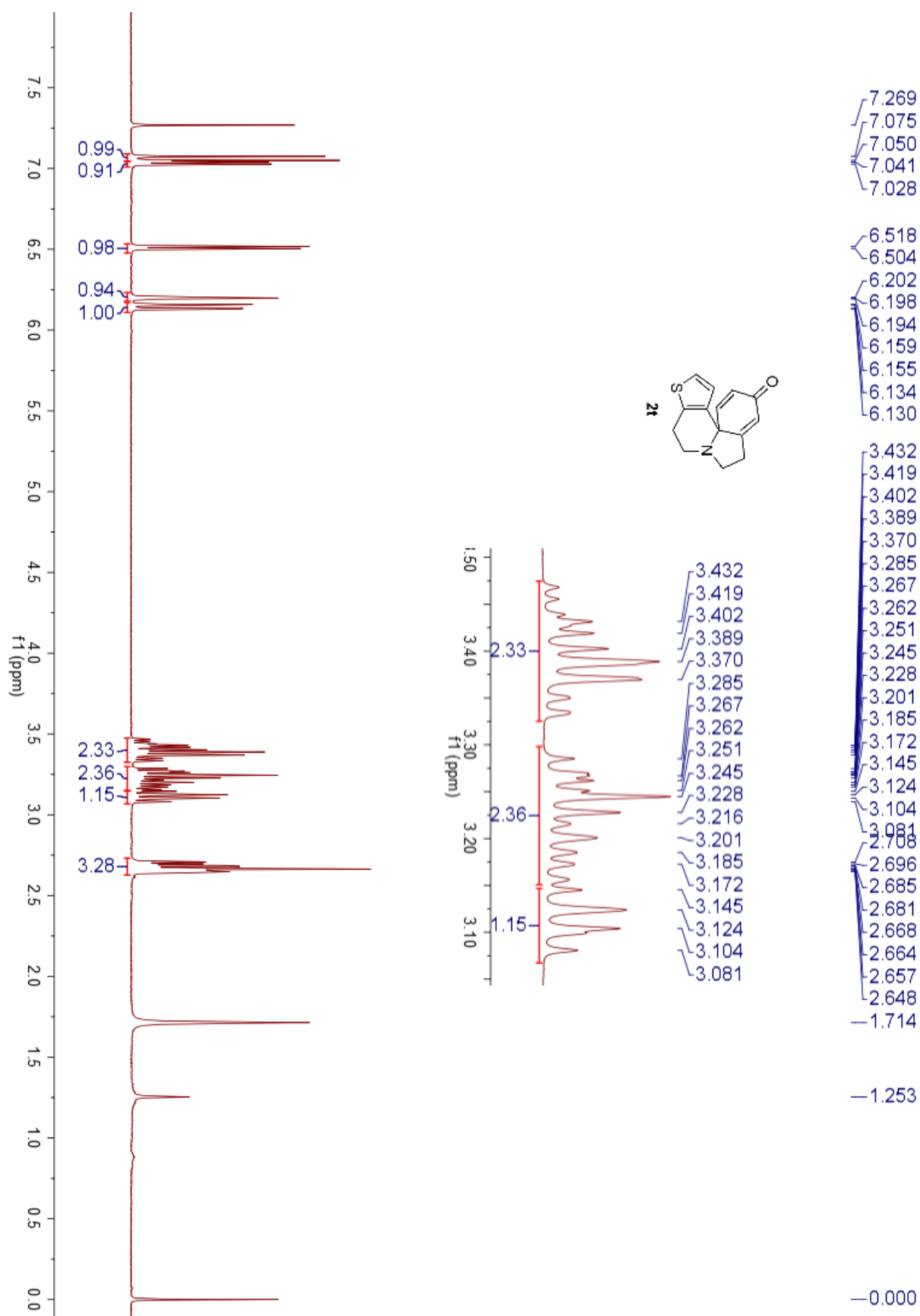


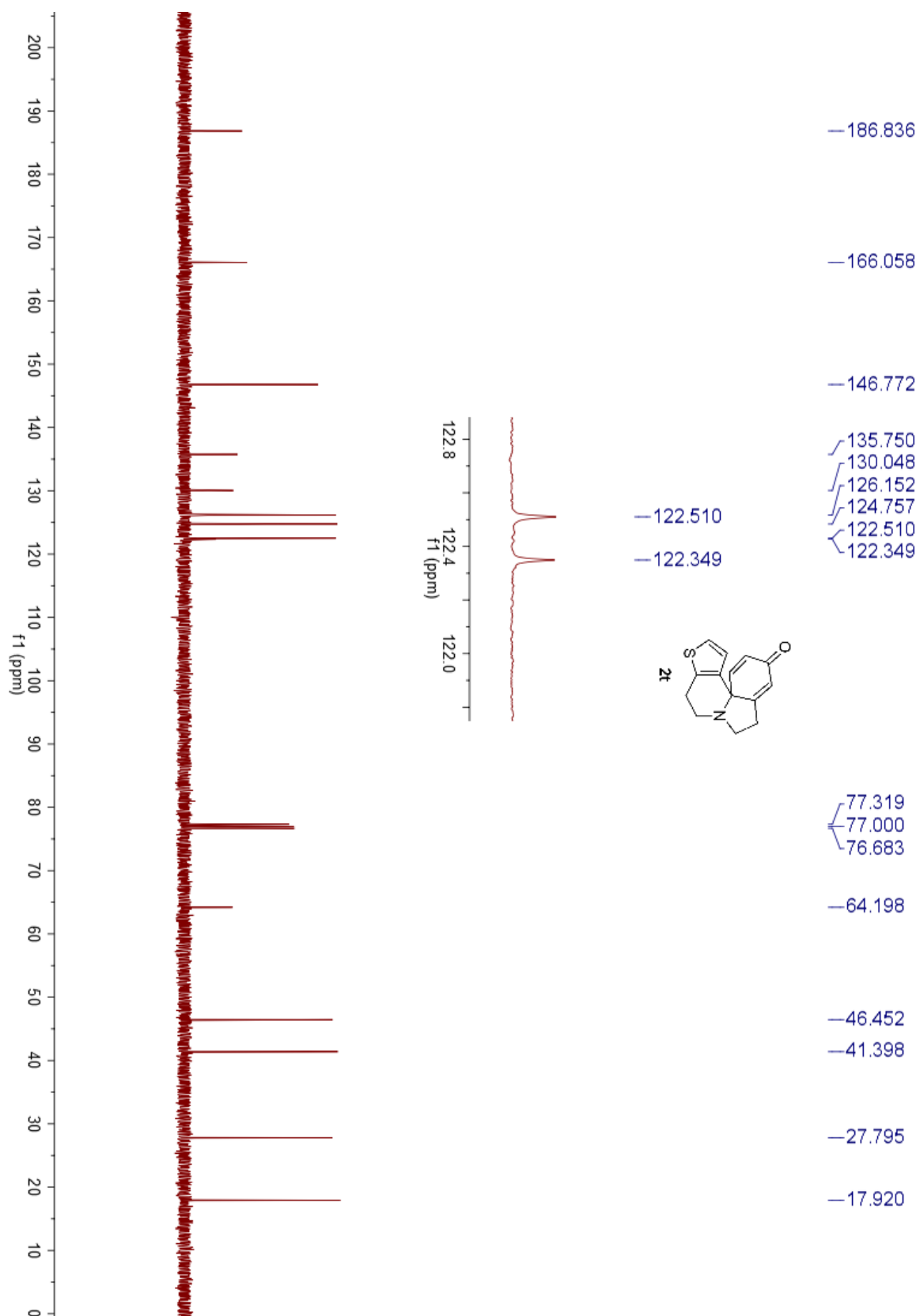


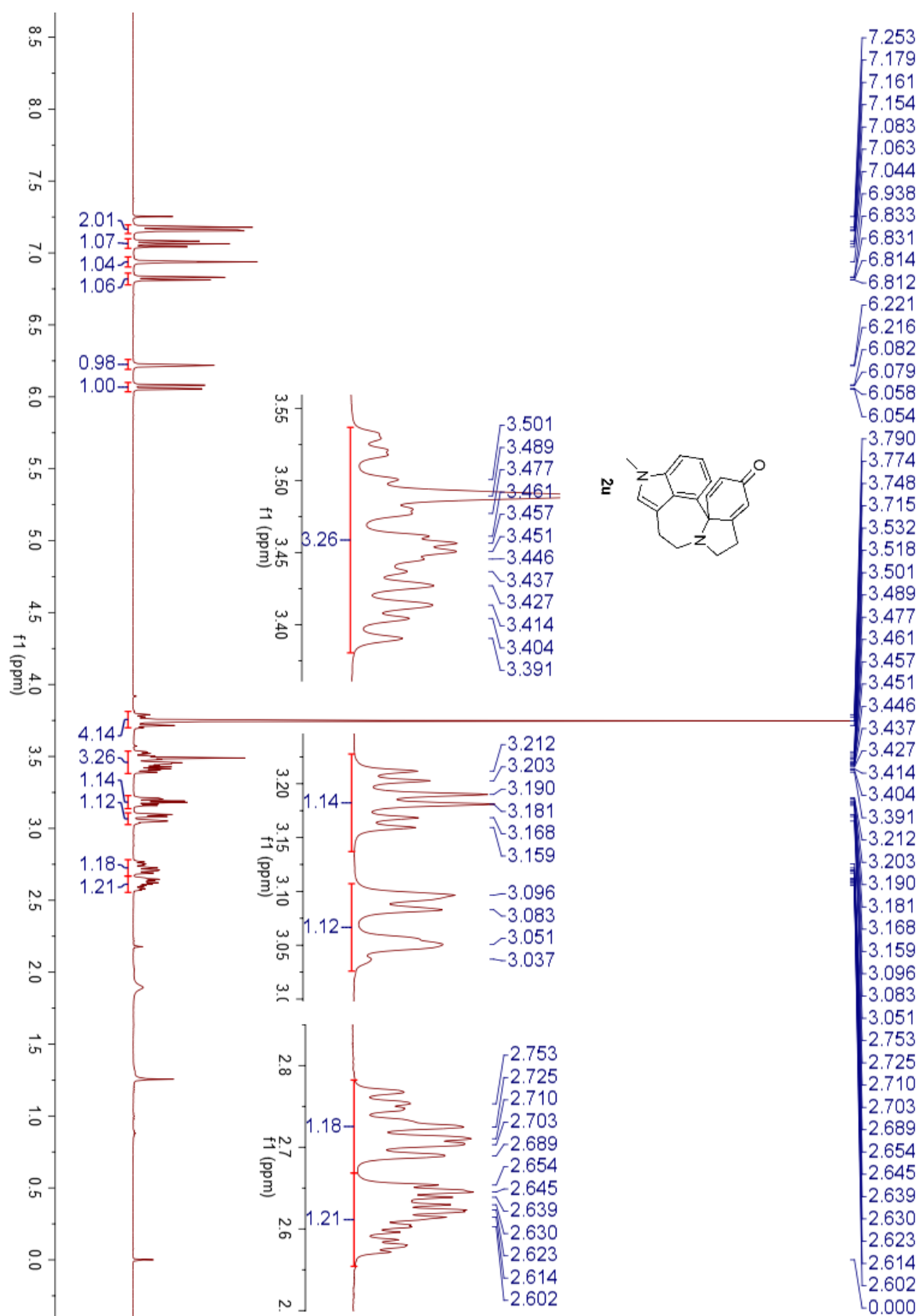


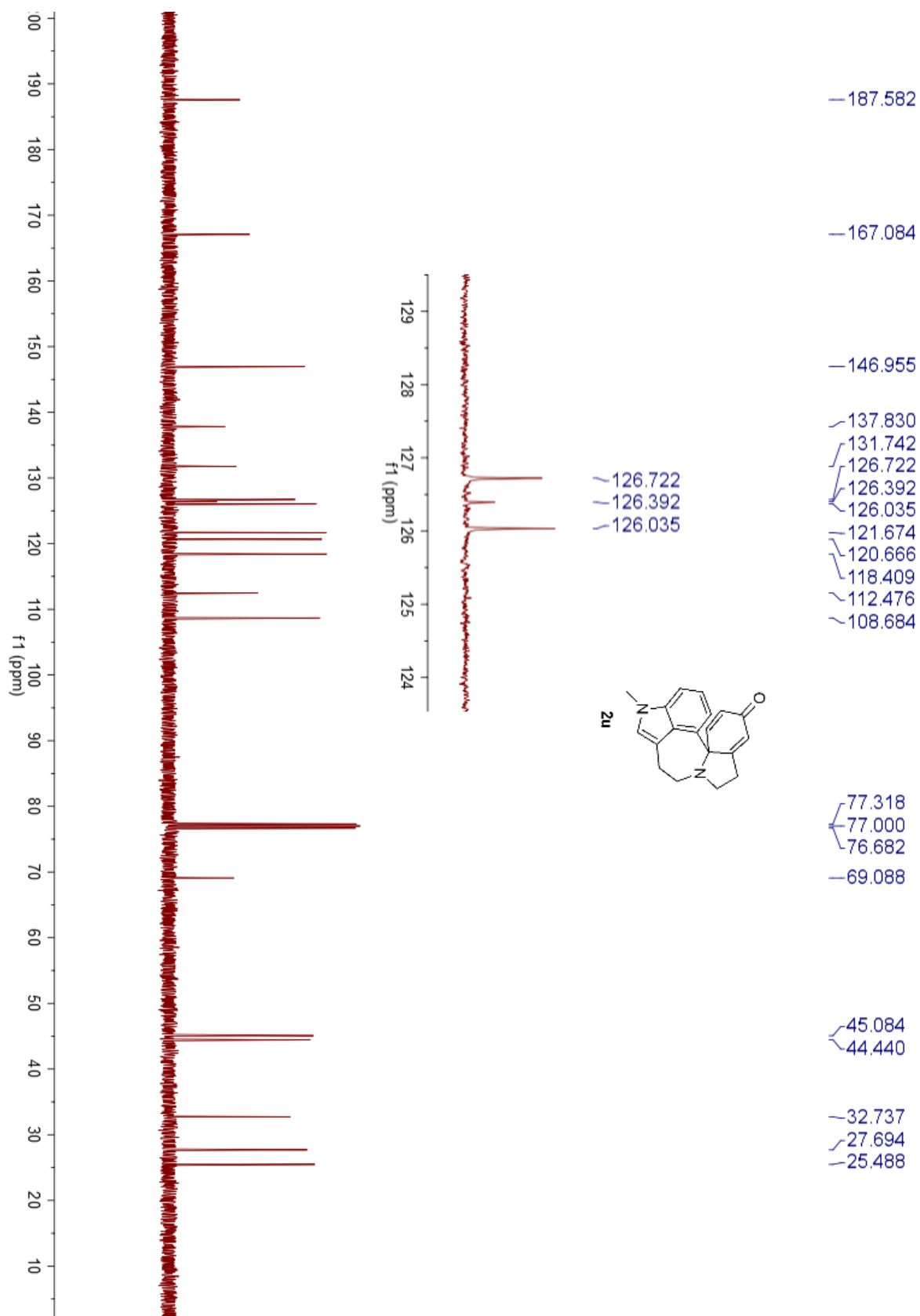


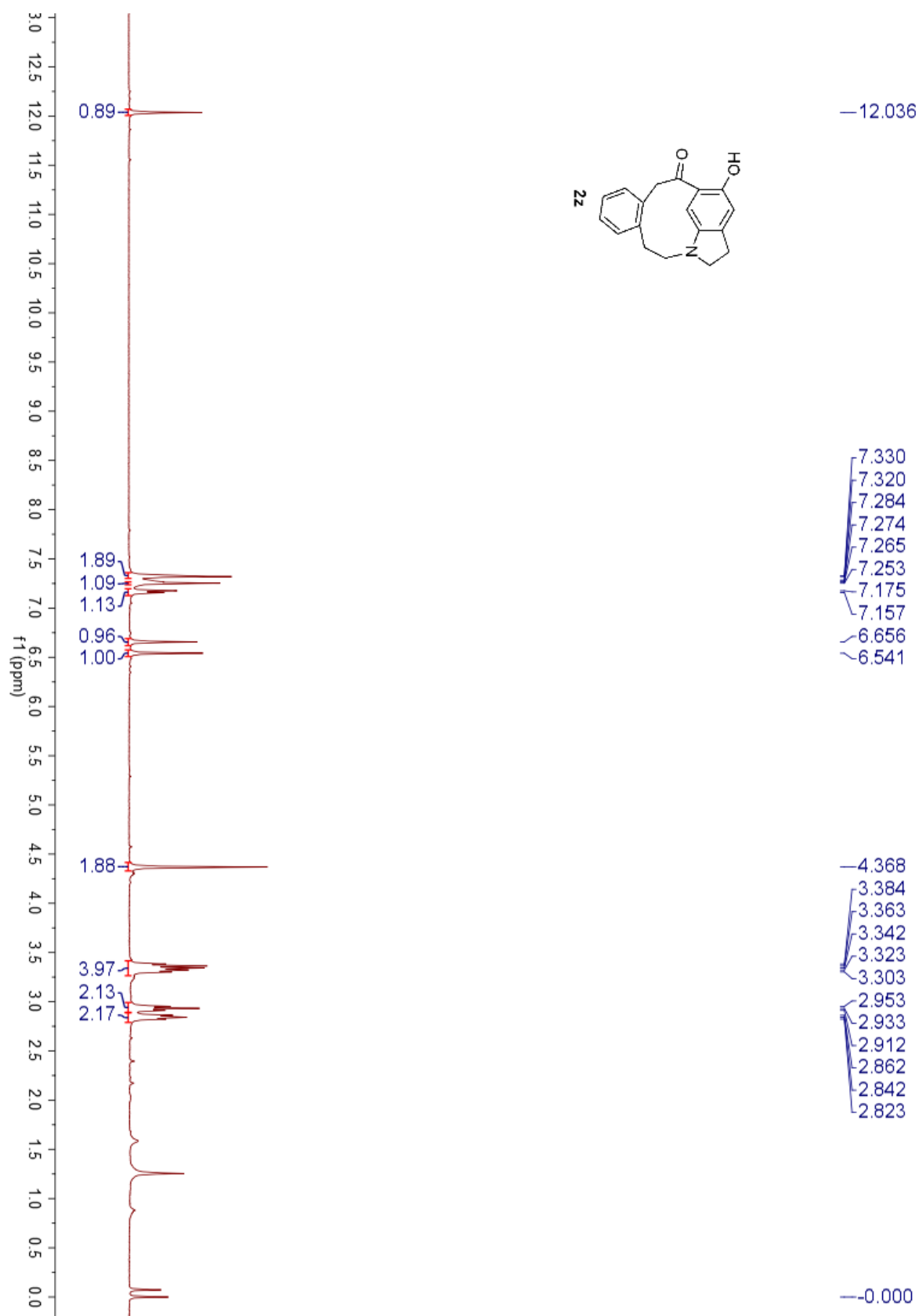


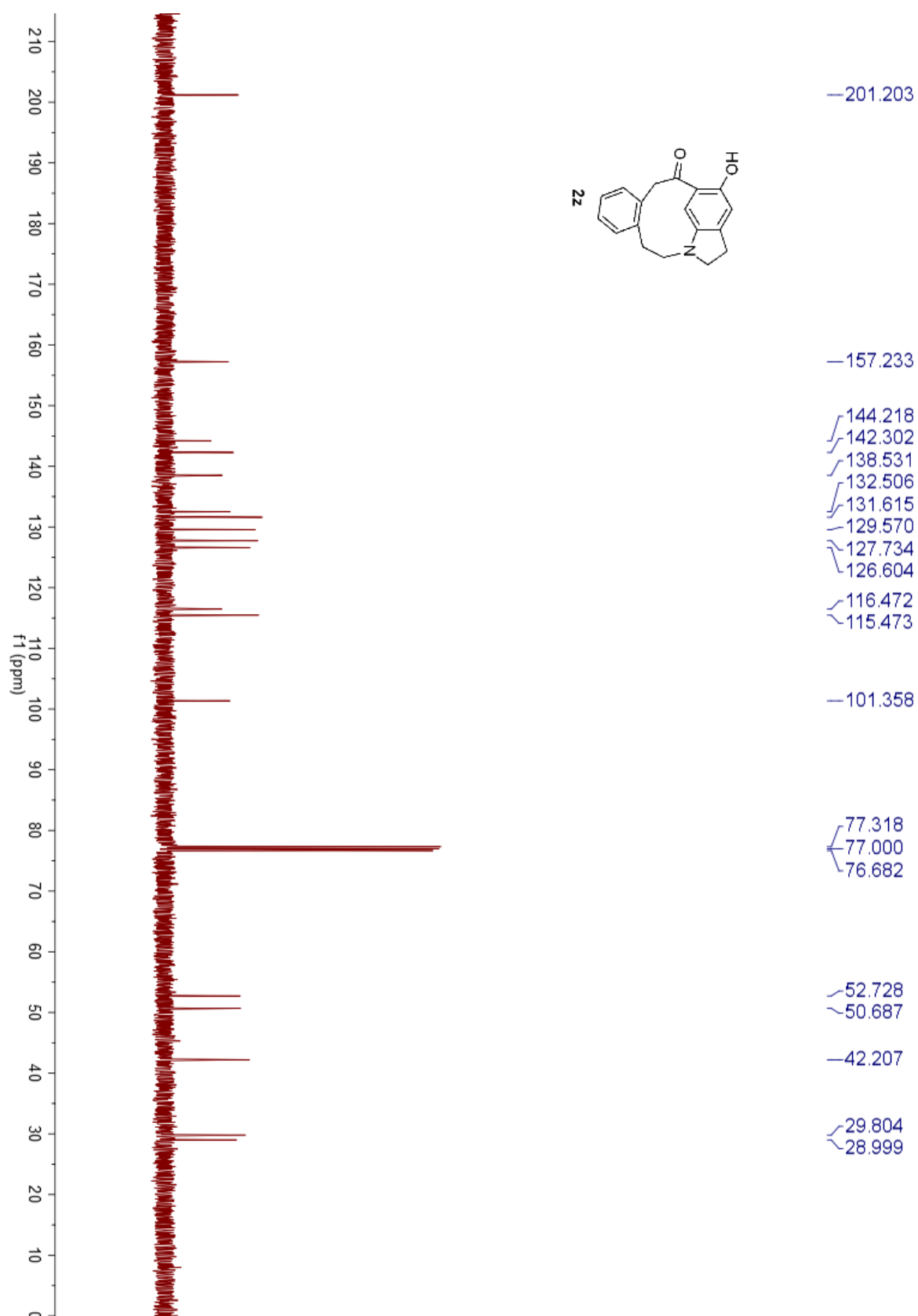












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