Electronic Supplementary Material

A Recyclable Copper(II) Catalyst for the Annulation of Phenols with 1,3-Dienes

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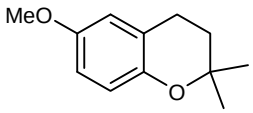
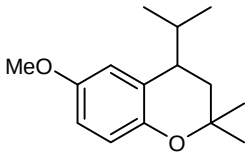
General Experimental. All precursors, catalysts and reagents were procured commercially and used as received. Catalytic reactions were generally performed in air, using a Radley's 12-place reaction carousel. All products were purifed by column chromatography, using a mixture of CH_2Cl_2 : n-hexane (15:85) as eluent. NMR spectra were recorded on Bruker AVANCE 400 MHz machines in $CDCl_3$ at room temperature. Melting points were recorded using an Electrothermal Gallenhamp apparatus, and were uncorrected. Infrared spectra were recorded using a Perkin Elmer Spectrum One Spectrometer, equipped with a beam-condensing accessory (samples were sandwiched between diamond compressor cells).

Typical catalytic reaction: A Radley's reaction tube was charged with a stir bar, phenol (1 mmol.), Cu(OTf)2 (18 mg, 0.05 mmol.) and 2,2'-bipyridyl (4 mg, 0.025 mmo.). DCE (1 mL) was added, followed by the corresponding diene (1.5 mmol.). The tube was positioned in a carousel and left to stir at 50 ºC for 18 h, before it was centrifuged. The decanted liquid was evaporated and purified by column chromatography.

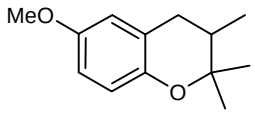


6-Methoxy-2,2-dimethyl-chroman (**1**).[1] Pale yellow oil. δ_H ($CDCl_3$, 400 MHz): 1.33 (6H, s), 1.80 (2H, t, *J* = 6.8 Hz), 2.77 (2H, t, *J* = 6.8 Hz), 3.76 (3H, s), 6.63 (1H, d, *J* = 2.8 Hz), 6.70 (1H, dd, *J* = 2.8, 8.8 Hz), 6.72 (1H, d, *J* = 8.8 Hz). δ_C ($CDCl_3$, 100.6 MHz): 22.8 (CH_2), 26.7 (2 x CH_3), 32.8 (CH_2), 55.7 (CH_3), 73.8 (C), 113.4 (CH), 113.9 (CH), 117.7 (CH), 121.4 (C), 148.0 (C), 152.9 (C). ν_{max}/cm^{-1} : 2974, 2930, 1612, 1497, 1382, 1367, 1247, 1202, 1157, 1123, 1042, 947, 890, 844, 812, 723. *m/z* (EI) 192 (M^+, 100%), 177 (27), 137 (92), 108 (25).

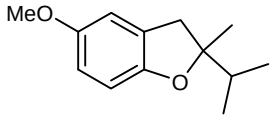


6-Methoxy-2,2-dimethyl-4-isopropyl-chroman (**2**). Yellow-orange oil. δ_H ($CDCl_3$, 400 MHz): 0.69 (3H, d, *J* = 6.8 Hz), 1.07 (3H, d, *J* = 6.9 Hz), 1.19 (3H, s), 1.43 (3H, s), 1.64 (2H, m), 2.48 (1H, m), 2.86 (1H, m), 3.76 (3H, s), 6.67 (1H, dd, *J* = 2.8, 8.8 Hz), 6.72 (1H, d, *J* = 8.8 Hz), 6.80 (1H, d, *J* = 2.8 Hz). δ_C ($CDCl_3$, 100.6 MHz): 15.6 (CH_3), 20.7 (CH_3), 23.7 (CH_3), 29.3 (CH_3), 30.5 (CH), 32.4 (CH_2), 36.9 (CH), 55.7 (CH_3), 73.9 (C), 112.3 (CH), 112.6 (CH), 117.9 (CH), 125.5 (C), 148.5 (C), 153.3 (C). ν_{max}/cm^{-1} : 2954, 1614, 1496, 1466, 1426, 1383, 1368, 1276, 1249, 1202, 1179, 1153, 1114, 1088, 1046, 934, 913, 867, 806, 775. *m/z* (EI) 234 (M^+, 54%), 191 (100), 163 (24), 137 (29).

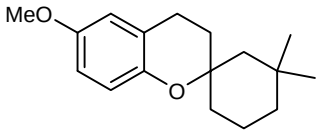
Compounds **3** and **4** were obtained as a mixture from the reaction, which are separated by column chromatography.



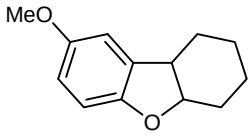
6-Methoxy-2,2,3-trimethyl-chroman (**3**). Yellow oil. δ_H ($CDCl_3$, 400 MHz): 1.00 (3H, d, *J* = 6.9 Hz), 1.14 (3H, s), 1.37 (3H, s), 1.90 (1H, m), 2.44 (1H, dd, *J* = 10.1, 16.8 Hz), 2.73 (1H, dd, *J* = 5.5, 16.8 Hz), 3.74 (3H, s), 6.58 (1H, d, *J* = 2.8 Hz), 6.67 (1H, dd, *J* = 2.8, 8.8 Hz), 6.71 (1H, d, *J* = 8.8 Hz). δ_C ($CDCl_3$, 100.6 MHz): 16.6 (CH_3), 20.0 (CH_3), 27.4 (CH_3), 31.4 (CH_2), 35.5 (CH), 55.7(CH_3), 77.2 (C), 113.2 (CH), 113.8 (CH), 117.5 (CH), 122.1 (C), 147.7 (C), 152.9 (C). ν_{max}/cm^{-1} : 2975, 2938, 2907, 2833, 1614, 1497, 1466, 1431, 1368, 1261, 1228, 1151, 1043, 943, 878, 811, 745. *m/z* (EI) 206 (M^+, 90%), 163 (73), 137 (100), 108 (17).



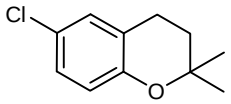
5-Methoxy-2-isopropyl-2-methyl-chroman (**4**). Orange-brown oil. δ_H ($CDCl_3$, 400 MHz): 0.94 (3H, d, *J* = 6.8 Hz), 0.99 (3H, d, *J* = 6.8 Hz), 1.33 (3H, s), 1.99 (1H, septet, *J* = 6.8 Hz), 2.77 (1H, d, *J* = 15.7 Hz), 3.12 (1H, d, *J* = 15.7 Hz), 3.75 (3H, s), 6.61-6.70 (2H, m), 6.73 (1H, m). δ_C ($CDCl_3$, 100.6 MHz): 17.4 (CH_3), 17.5 (CH_3), 23.2 (CH_3), 37.0 (CH), 39.4 (CH_2), 56.0 (CH_3), 91.7 (C), 109.0 (CH), 111.4 (CH), 112.7 (CH), 128.0 (C), 153.3 (C), 153.6 (C). ν_{max}/cm^{-1} : 2969, 2941, 2910, 2878, 2832, 1604, 1491, 1467, 1432, 1374, 1236, 1141, 1035, 900, 859, 810, 774, 729. *m/z* (EI) 206 (M^+, 77%), 163 (100), 137 (72), 108 (16).



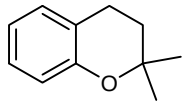
6-Methoxy-3',3'-dimethylspiro[chroman-2,1'-cyclohexane] (**5**). Yellow oil. δ_H ($CDCl_3$, 400 MHz): 0.88 (3H, s), 1.06 (3H, s), 1.19 (4H, m), 1.49 (2H, m), 1.70 (2H, m), 1.89 (2H, m), 3.10 (2H, m), 3.76 (3H, s), 6.60 (1H, d, *J* = 2.7 Hz), 6.68 (1H, dd, *J* = 2.7, 8.9 Hz), 6.72 (1H, d, *J* = 8.9 Hz). δ_C ($CDCl_3$, 100.6 MHz): 18.3(CH_2), 22.1 (CH_2), 26.6 (CH_3), 30.7 (C), 33.9 (CH_2), 33.9 (CH_3), 36.0 (CH_2), 39.4 (CH_2), 45.2 (CH_2), 55.7 (CH_3), 74.9 (C), 113.3 (CH), 113.8 (CH), 117.9 (CH), 121.9 (C), 147.7 (C), 152.9 (C). ν_{max}/cm^{-1} : 2918, 1613, 1493, 1465, 1431, 1364, 1303, 1268, 1227, 1176, 1149, 1042, 963, 906, 842, 801, 718. *m/z* (EI) 260 (M^+, 100%), 137 (85), 123 (44), 109 (33).



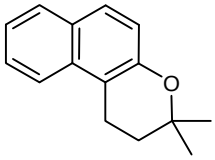
8-Methoxy-1,2,3,4,4a,9b-hexahydrodibenzo[b,d]furan (**6**).[2] Orange oil. δ_H ($CDCl_3$, 400 MHz): 1.64 (2H, m), 1.80 (1H, m), 2.01 (2H, m), 2.12 (2H, m), 3.55 (1H, m), 3.76 (3H, s), 5.79 (1H, dd, *J* = 2.1, 10.0 Hz), 6.04 (1H, m), 6.66 (1H, dd, *J* = 3.0, 8.6 Hz), 6.70 (1H, d, *J* = 3.0 Hz), 6.73 (1H, d, *J* = 8.6 Hz). δ_C ($CDCl_3$, 100.6 MHz): 20.7 (CH_2), 22.2 (CH_2), 27.6 (CH_2), 28.3(CH_2), 41.1 (CH), 56.0 (CH_3), 82.7 (CH), 109.8 (CH), 110.3 (CH), 112.1 (CH), 134.6 (C), 153.4 (C), 154.1 (C). ν_{max}/cm^{-1} : 2933, 2857, 1736, 1602, 1483, 1449, 1433, 1373, 1266, 1214, 1177, 1134, 1087, 1031, 950, 885, 855, 813, 746. *m/z* (EI) 204 (M^+, 100%), 161 (42), 150 (74), 137 (25).



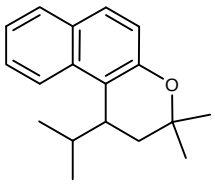
6-Chloro-2,2-dimethyl-chroman (**7**).[1] Yellow oil. δ_H ($CDCl_3$, 400 MHz): 1.32 (6H, s), 1.78 (2H, t, *J* = 6.8 Hz), 2.74 (2H, t, *J* = 6.8 Hz), 6.7 (1H, d, *J* = 9.2 Hz), 7.04 (2H, m). δ_C ($CDCl_3$, 100.6 MHz): 22.4 (CH_2), 26.8 (2 x CH_3), 32.4 (CH_2), 74.5 (C), 118.6 (CH), 122.5 (C), 124.2 (C), 127.2 (CH), 129.0 (CH), 152.6 (C). ν_{max}/cm^{-1} : 2976, 2931, 1717, 1477, 1452, 1417, 1385, 1370, 1295, 1262, 1182, 1158, 1123, 1085, 946, 887, 814, 773, 683. *m/z* (EI) 196 (M^+, 82%), 181 (55), 161 (40), 143 (46), 141 (100), 77 (33).



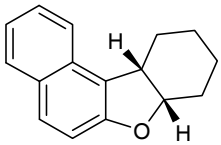
2,2-Dimethyl-chroman (8).[1] Yellow oil. δ_H ($CDCl_3$, 400 MHz): 1.37 (6H, s), 1.84 (2H, t, *J* = 6.8 Hz), 2.81 (2H, t, *J* = 6.8 Hz), 6.82 (1H, d, *J* = 8.1 Hz), 6.85 (1H, t, *J* = 7.3 Hz), 7.10 (2H, m). δ_C ($CDCl_3$, 100.6 MHz): 22.5 (CH_2), 26.9 (2 x CH_3), 32.8 (CH_2), 74.1 (C), 117.3 (CH), 119.6 (CH), 120.9 (C), 127.3 (CH), 129.5 (CH), 154.0 (C). ν_{max} /cm^{-1} : 2975, 2932, 2852, 1716, 1610, 1582, 1489, 1456, 1383, 1368, 1347, 1306, 1256, 1220, 1157, 1123, 1037, 948, 931, 884, 833, 709. *m/z* (EI) 162 (M^+, 53%), 147 (50), 107 (100).



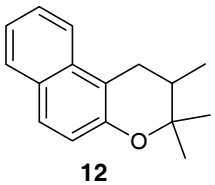
3,3-Dimethyl-2,3-dihydro-1H-benzo[f]chromene (9).[3] Pale yellow solid. m.p. 108-109 °C (lit.[3] 110 ºC). δ_H ($CDCl_3$, 400 MHz): 1.59 (6H, s), 2.09 (2H, t, *J* = 6.8 Hz), 3.17 (2H, t, *J* = 6.8 Hz), 7.31 (1H, d, *J* = 8.8 Hz), 7.55 (1H, t, *J* = 8.0 Hz), 7.70 (1H, t, *J* = 8.0 Hz), 7.83 (1H, d, *J* = 8.8 Hz), 7.96 (1H, d, *J* = 8.0 Hz), 8.01 (1H, d, *J* = 8.0 Hz). δ_C ($CDCl_3$, 100.6 MHz): 19.3 (CH_2), 26.5 (2 x CH_3), 32.7 (CH_2), 74.0 (C), 111.4 (C), 119.8 (CH), 121.9 (CH), 122.9 (CH), 126.2 (CH), 127.7 (CH), 128.4 (CH), 128.7 (C), 133.1 (C), 151.4 (C). ν_{max}/cm^{-1} : 3049, 2975, 2927, 2853, 1760, 1619, 1597, 1509, 1466, 1433, 1395, 1367, 1318, 1236, 1158, 1121, 1079, 971, 895, 814, 749, 684. *m/z* (EI) 212 (M^+, 67%), 157 (100), 128 (39).



1-Isopropyl-3,3-dimethyl-2,3-dihydro-1H-benzo[f]chromene (10): Pale-yellow solid. mp 70-72 °C. δ_H ($CDCl_3$, 400 MHz): 0.62 (3H, d, *J* = 6.8 Hz), 1.21 (3H, d, *J* = 6.9 Hz), 1.29 (3H, s), 1.66 (3H, s), 2.06 (1H, dd, *J* = 8.9, 13.9 Hz), 2.15 (1H, dd, *J* = 8.9, 13.9 Hz), 2.81 (1H, m), 3.62 (1H, dt, *J* = 4.2, 8.9 Hz), 7.20 (1H, d, *J* = 8.8 Hz), 7.44 (1H, t, *J* = 8.0 Hz), 7.57 (1H, t, *J* = 8.0 Hz), 7.72 (1H, d, *J* = 8.0 Hz), 7.89 (1H, d, *J* = 8.0 Hz), 8.01 (1H, d, *J* = 8.4 Hz). δ_C ($CDCl_3$, 100.6 MHz): 15.7 (CH_3), 21.2 (CH_3), 23.6 (CH_3), 30.4 (CH_3), 30.8 (CH), 35.0 (CH), 35.3 (CH_2), 74.8 (C), 119.3 (C), 120.1 (CH), 122.9 (CH), 123.6 (CH), 125.5 (CH), 127.8 (CH), 128.9 (CH), 130.0 (C), 132.4 (C), 152.7 (C). ν_{max}/cm^{-1} : 3062, 2967, 2931, 2869, 1620, 1598, 1512, 1461, 1390, 1368, 1313, 1268, 1242, 1199, 1138, 1075, 1019, 985, 942, 903, 813, 748, 709, 665. *m/z* (EI) 254 (M^+, 33%), 211 (100), 181 (25), 169 (31).



(7aS,11aS)-7a,8,9,10,11,11a-Hexahydrobenzo[d]naphtho[2,1-b]furan (11):[4] Pale yellow oil. δ_H ($CDCl_3$, 400 MHz): 1.27 (1H, m), 1.34 (1H, m), 1.61 (1H, m), 1.71 (2H, m), 1.88 (1H, m), 2.21 (1H, m), 2.39 (1H, m), 3.46 (1H, dt, *J* = 6.5, 10.5 Hz), 4.81 (1H, m), 7.18 (1H, d, *J* = 8.8 Hz), 7.31 (1H, t, *J* = 8.0 Hz), 7.47 (1H, t, *J* = 8.0 Hz), 7.68-7.71 (2H, m), 7.83 (1H, d, *J* = 8.8 Hz). δ_C ($CDCl_3$, 100.6 MHz): 20.4 (CH_2), 22.6 (CH_2), 27.4 (CH_2), 29.1 (CH_2), 39.8 (CH), 83.5 (CH), 112.6 (CH), 122.7 (2C) (CH), 126.4 (CH), 126.8 (C), 128.5 (CH), 128.9 (CH), 129.5 (C), 130.3 (C), 156.7 (C). ν_{max}/cm^{-1} : 3056, 3023, 2934, 2859, 1629, 1593, 1520, 1462, 1445, 1374, 1353, 1248, 1218, 1203, 1162, 1098, 1068, 974, 940, 883, 855, 814, 776, 746. *m/z* (EI) 224 (M^+, 95%), 181 (100), 152 (20).



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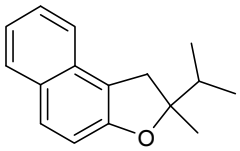

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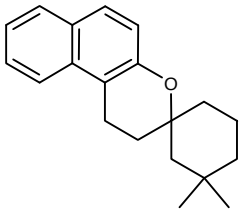
2,3,3-Trimethyl-2,3-dihydro-1H-benzo[f]chromene (12) and 2-isopropyl-2-methyl-1,2-dihydronaphtho[2,1-b]furan (13). Obtained as an inseparable mixture of isomers in a ratio of 40: 60, as a yellow-orange oil.

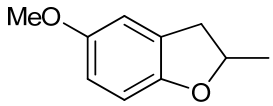
Observable signals attributed to the major isomer (**13**): δ_H ($CDCl_3$, 400 MHz): 1.08 (3H, d, *J* = 6.8 Hz), 1.14 (3H, d, *J* = 6.8 Hz), 1.52 (3H, s), 2.15 (1H, m), 3.14 (1H, d, *J* = 15.5 Hz), 3.45 (1H, d, *J* = 15.5 Hz), 7.18 (1H, d, *J* = 8.7 Hz), 7.36 (1H, t, *J* = 8.0 Hz), 7.54 (1H, t, *J* = 8.2 Hz), 7.65 (1H, d, *J* = 8.0 Hz), 7.74 (1H, d, *J* = 8.7 Hz), 7.87 (1H, d, *J* = 7.8 Hz). δ_C ($CDCl_3$, 100.6 MHz): 17.5 (2 x CH_3), 24.1 (CH_3), 37.3 (CH), 37.6 (CH_2), 92.8 (C), 112.4 (CH), 119.6 (CH), 122.6 (CH), 122.7 (CH), 126.6 (CH), 127.8 (CH), 128.8 (C), 129.0 (C), 131.2 (C), 156.6 (C).

Observable signals attributed to the minor isomer (**12**): δ_H ($CDCl_3$, 400 MHz): 1.19 (3H, d, *J* = 6.9 Hz), 1.28 (3H, s), 1.53 (3H, s), 2.13 (1H, m), 2.70 (1H, dd, *J* = 10.0, 16.8 Hz), 3.16 (1H, dd, *J* = 5.7, 16.8 Hz), 7.14 (1H, d, *J* = 8.9 Hz), 7.41 (1H, t, *J* = 8.0 Hz), 7.56 (1H, t, *J* = 8.4 Hz), 7.69 (1H, d, *J* = 8.9 Hz), 7.83 (1H, d, *J* = 8.0 Hz), 7.89 (1H, d, *J* = 8.0 Hz). δ_C ($CDCl_3$, 100.6 MHz): 17.0 (CH_3), 19.8 (CH_3), 27.4 (CH_3), 28.2 (CH_2), 35.6 (CH), 77.6 (C), 118.2 (C), 119.6 (CH), 122.0 (CH), 122.6 (CH), 123.0 (CH), 126.3 (CH), 128.5 (CH), 131.1 (C), 133.0 (C), 151.1 (C). ν_{max}/cm^{-1} : 3058, 2963, 2872, 1715, 1629, 1597, 1520, 1464, 1372, 1249, 1169, 1076, 978, 924, 811, 747. *m/z* (EI) 226 (M^+, 90%), 183 (80), 157 (100), 129 (31).



3',3'-Dimethyl-3,4-dihydrospiro[benzo[g]chromene-2,1'-cyclohexane] (**14**): Pale yellow oil. δ_H ($CDCl_3$, 400 MHz): 0.98 (3H, s), 1.18 (3H, s), 1.34 (4H, m), 1.59 (2H, m), 1.86 (2H, m), 1.95 (2H, m), 3.10 (2H, m), 7.15 (1H, d, *J* = 8.8 Hz), 7.42 (1H, t, *J* = 8.0 Hz), 7.57 (1H, t, *J* = 8.0 Hz), 7.71 (1H, d, *J* = 8.8 Hz), 7.85 (1H, d, *J* = 8.8 Hz), 7.90 (1H, d, *J* = 8.0 Hz). δ_C ($CDCl_3$, 100.6 MHz): 17.2 (C), 18.4 (CH_2), 18.8 (CH_2), 26.7 (CH_3), 30.8 (C), 33.8 (CH_2), 34.1 (CH_3), 35.9 (CH_2), 39.5 (CH_2), 45.0

(CH_2), 75.3 (C), 112.9 (C), 120.1 (CH), 121.9 (CH), 123.0 (CH), 126.2 (CH), 127.8 (CH), 128.5 (CH), 133.2 (C), 151.2 (C). ν_{max}/cm^{-1} : 3060, 2945, 2867, 1623, 1599, 1514, 1466, 1435, 1397, 1364, 1263, 1237, 1176, 1099, 1056, 981, 883, 811, 745, 685. *m/z* (EI) 280 (M^+, 73%), 195 (18), 157 (100).



5-Methoxy-2-methyl-2,3-dihydrobenzofuran (18b):[5] Yellow oil. δ_H ($CDCl_3$, 400 MHz): 1.45 (3H, d, *J* = 6.3 Hz), 2.79 (1H, dd, *J* = 7.8, 15.5 Hz), 3.27 (1H, dd, *J* = 8.7, 15.5 Hz), 3.75 (3H, s), 4.90 (1H, m), 6.65 (2H, m) 6.75 (1H, s).

References

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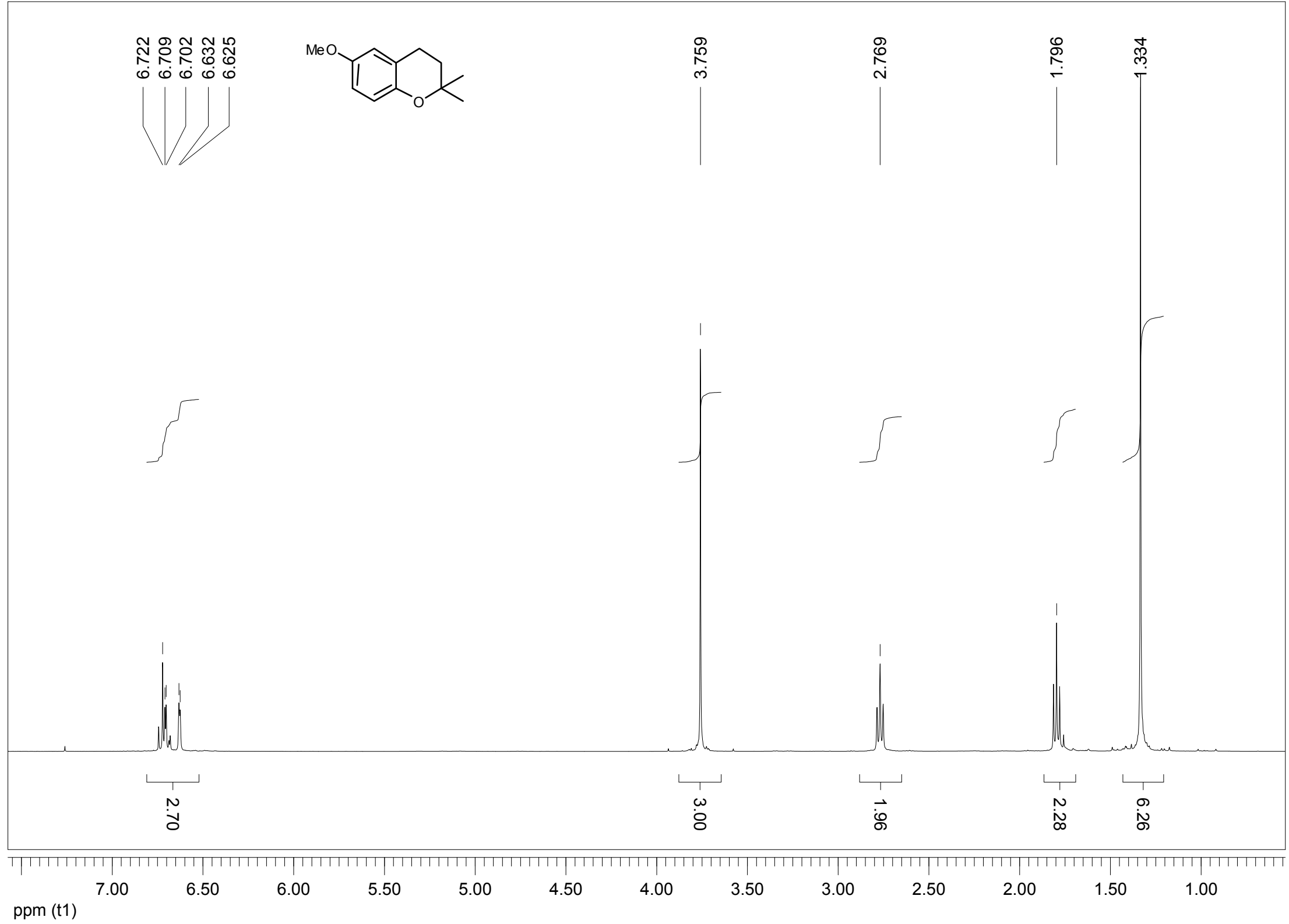
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6.702
6.632
6.625
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O
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2.769
1.796
1.334
2.70
3.00
1.96
2.28
6.26
7.00
6.50
6.00
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4.50
4.00
3.50
3.00
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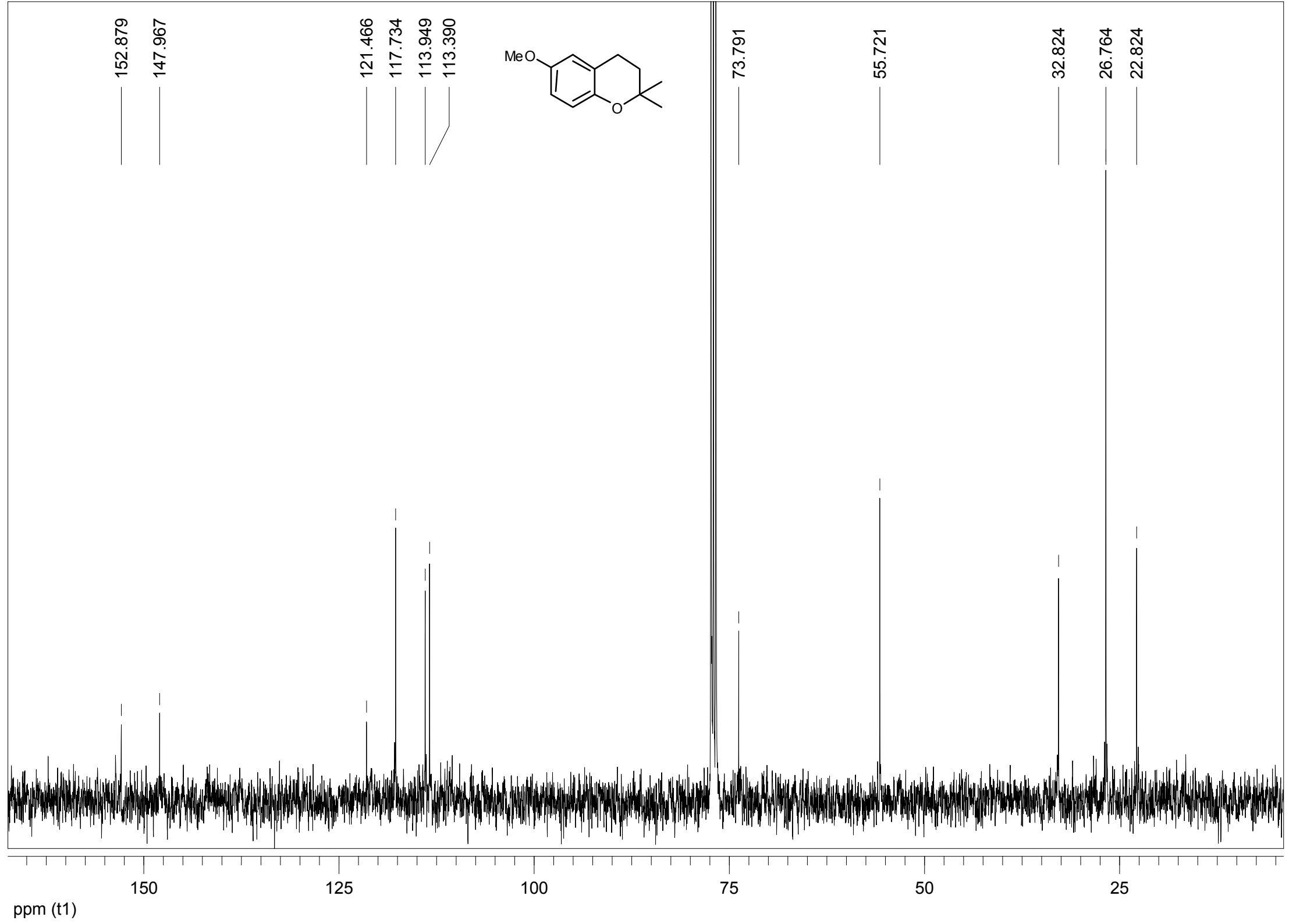
2.00
1.50
1.00
ppm (t1)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147.967
121.466
117.734
113.949
113.390
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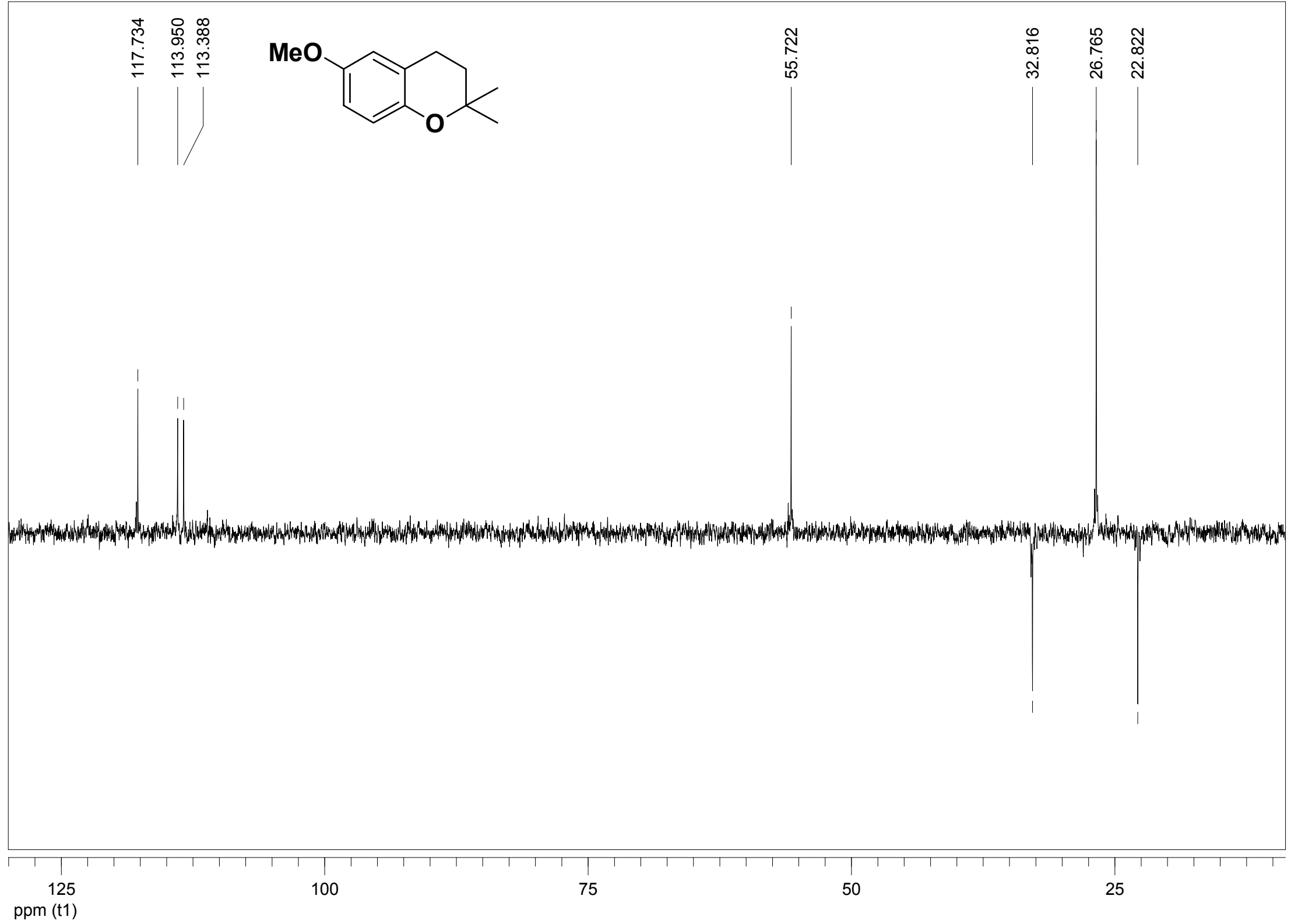
O
73.791
55.721
32.824
26.764
22.824
150
125
100
75
50
25
ppm (t1)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55.722
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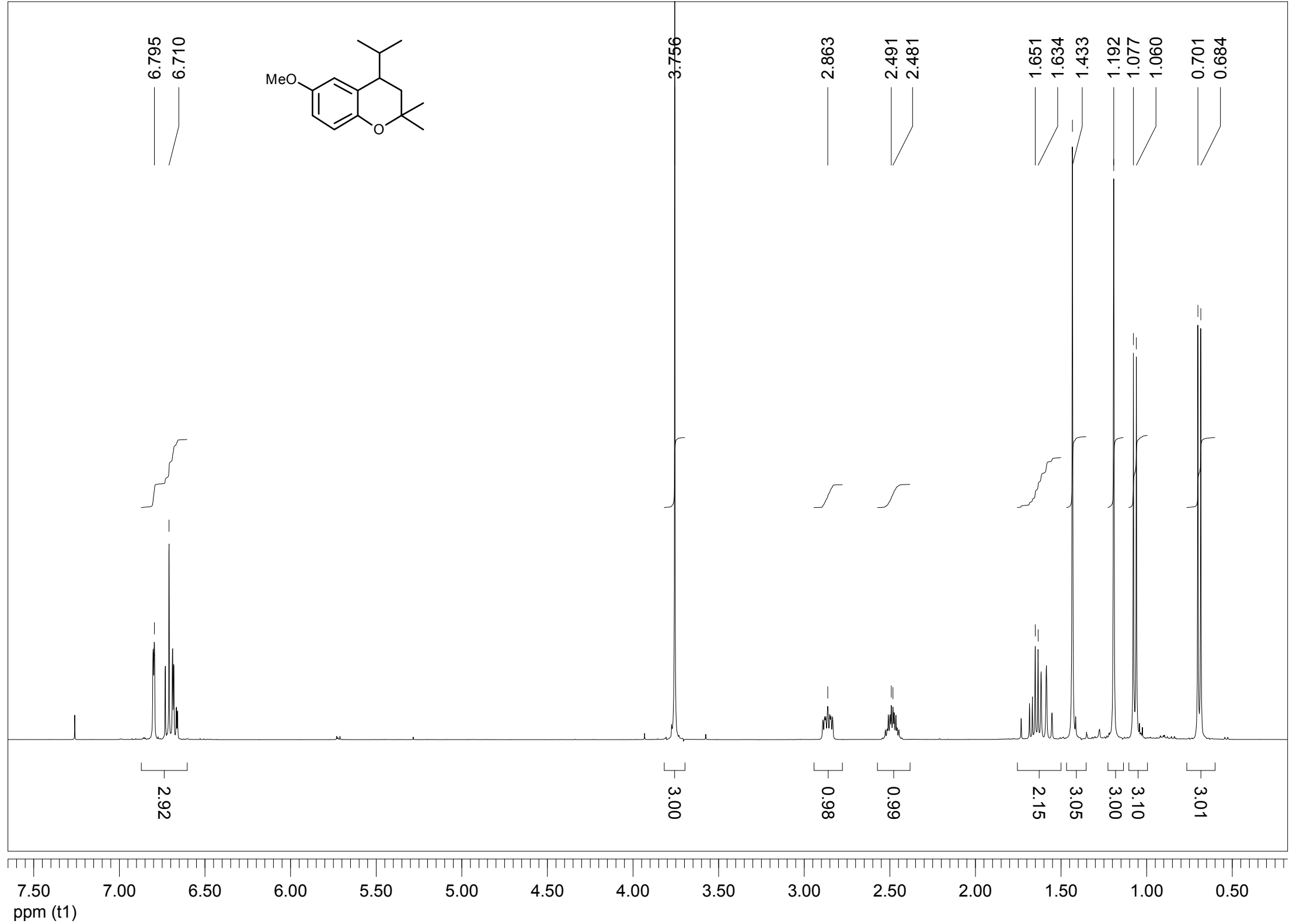
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1.634
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1.060
0.701
0.684
MeO
O
2.92
3.00
0.98
0.99
2.15
3.05
3.00
3.10
3.01
7.50
7.00
6.50
6.00
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4.00
3.50
3.00
2.50
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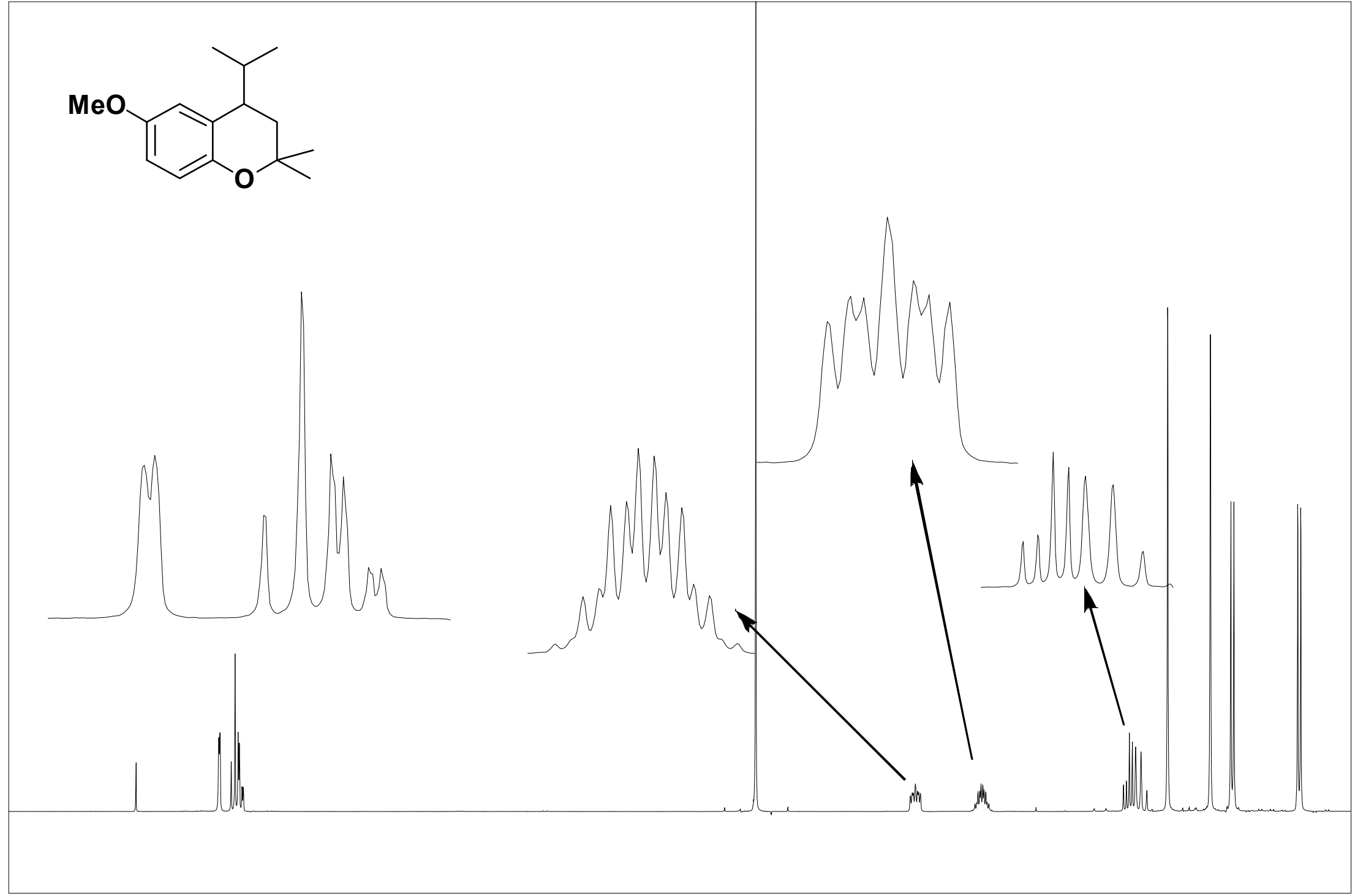
1.50
1.00
0.50
ppm (t1)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O
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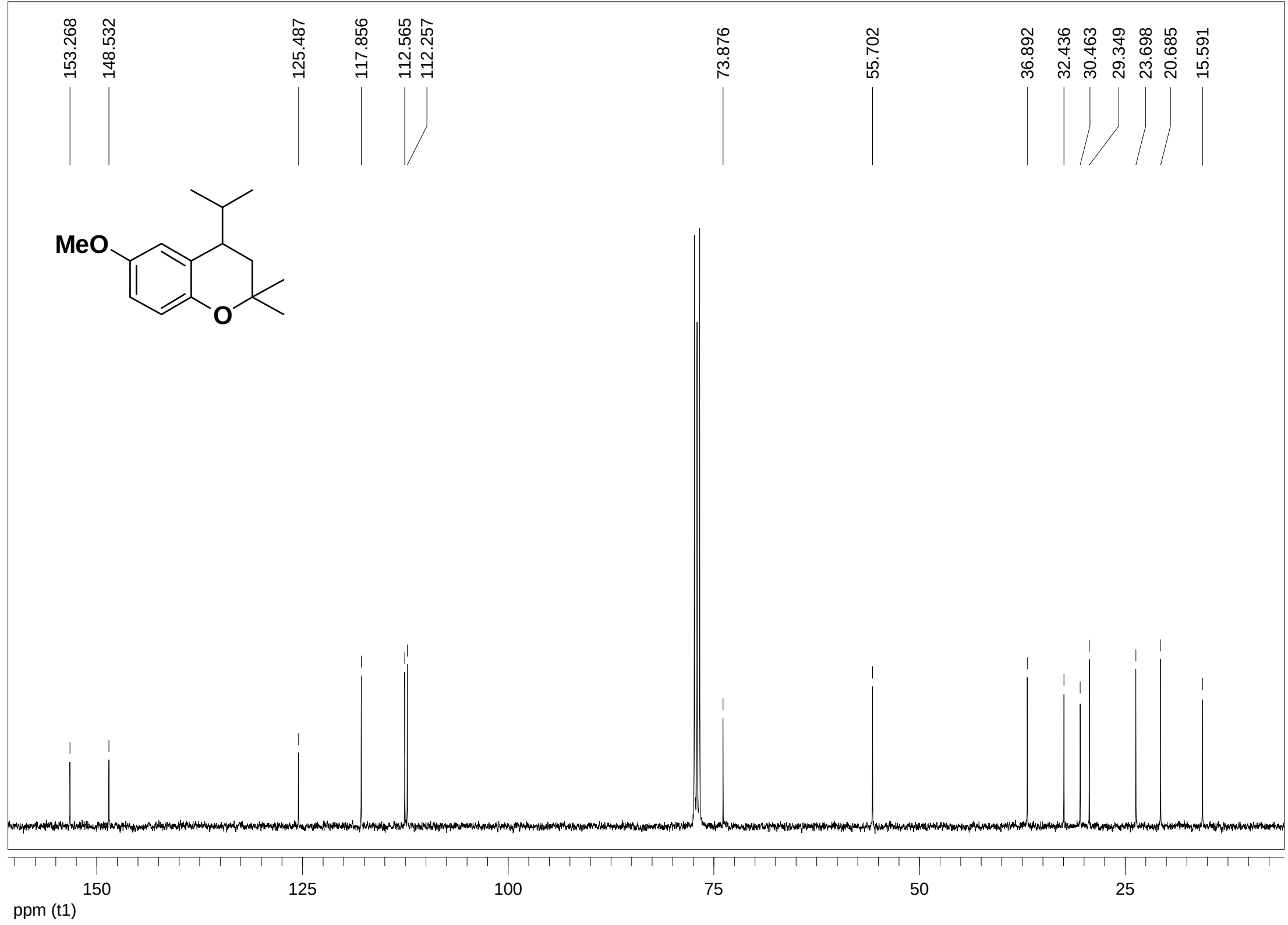
6.50
6.00
5.50
5.00
4.50
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
ppm (t1)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55.702
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MeO
O
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50
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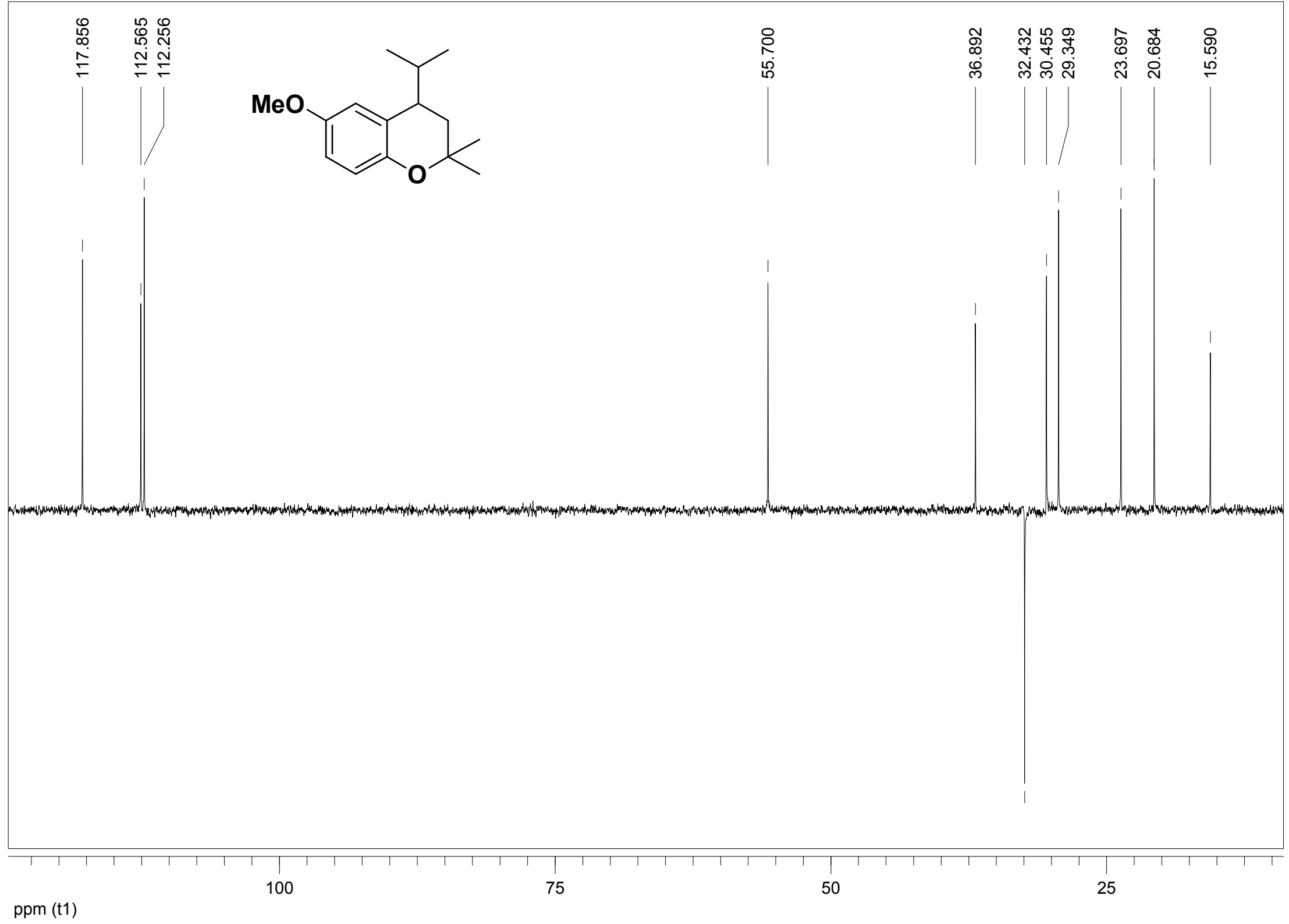
ppm (t1)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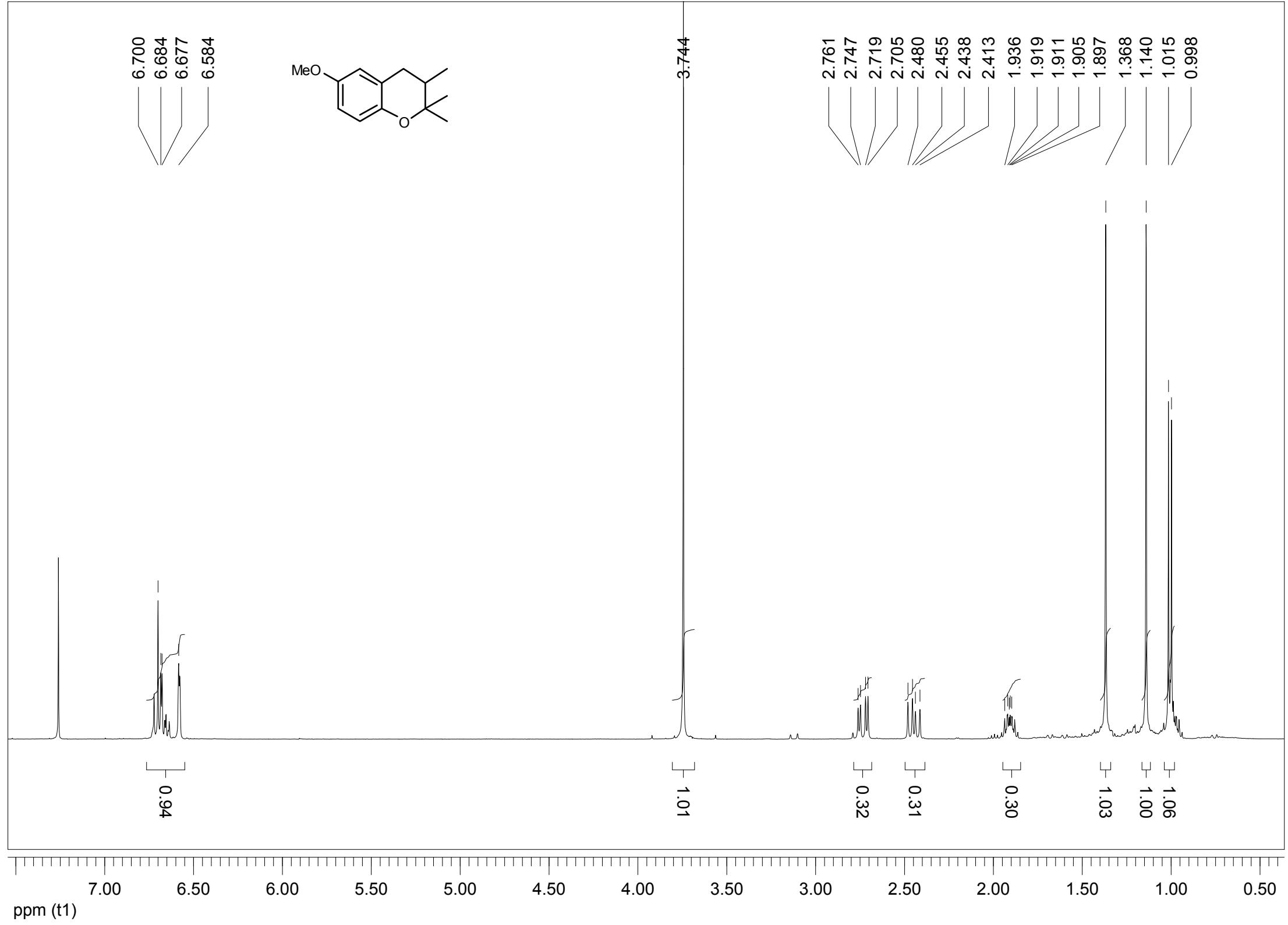
ppm (t1)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6.677
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2.705
2.480
2.455
2.438
2.413
1.936
1.919
1.911
1.905
1.897
1.368
1.140
1.015
0.998
0.94
1.01
0.32
0.31
0.30
1.03
1.00
1.06
7.00
6.50
6.00
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3.00
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1.00
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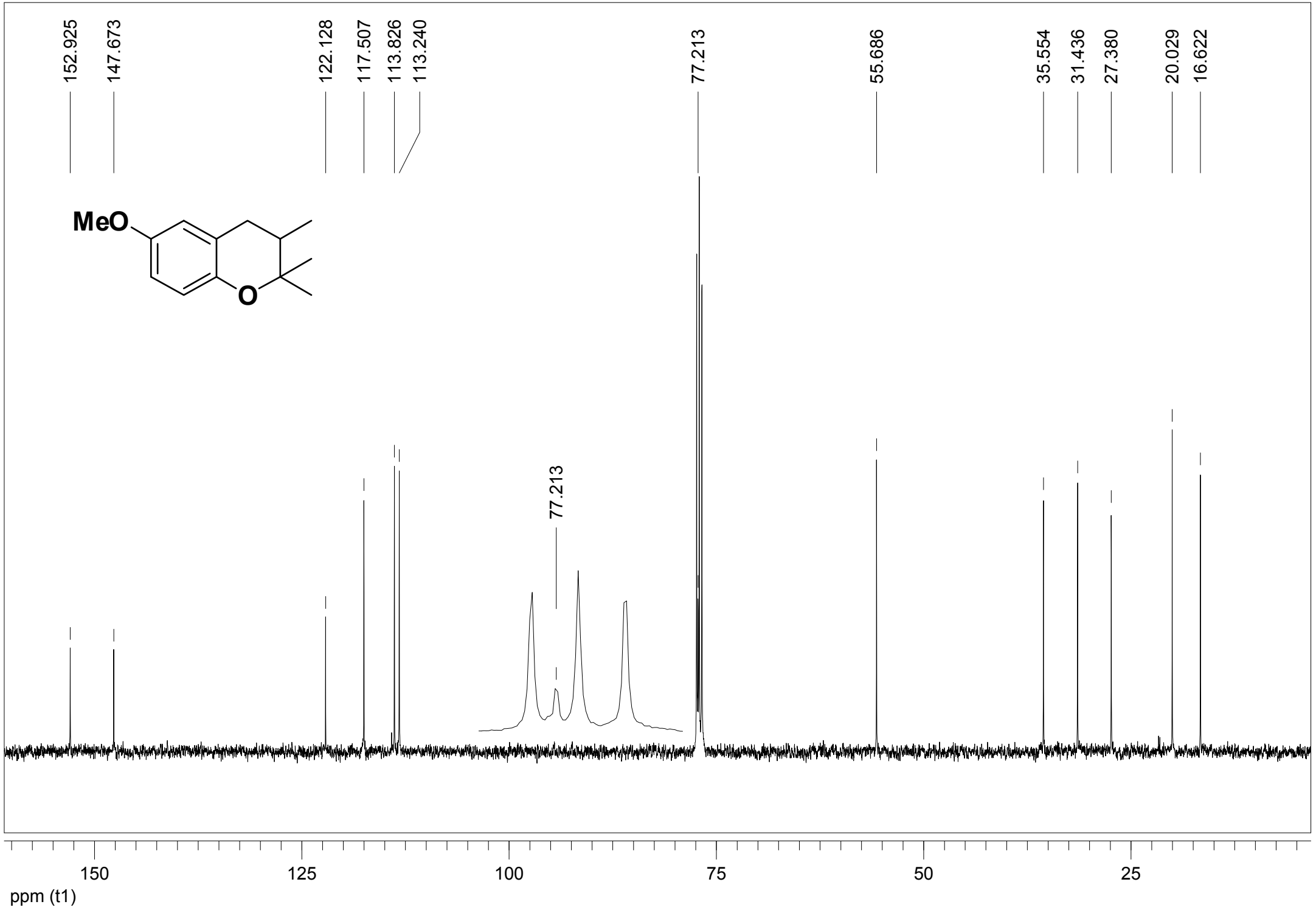
ppm (t1)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113.240
77.213
55.686
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20.029
16.622
MeO
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77.213
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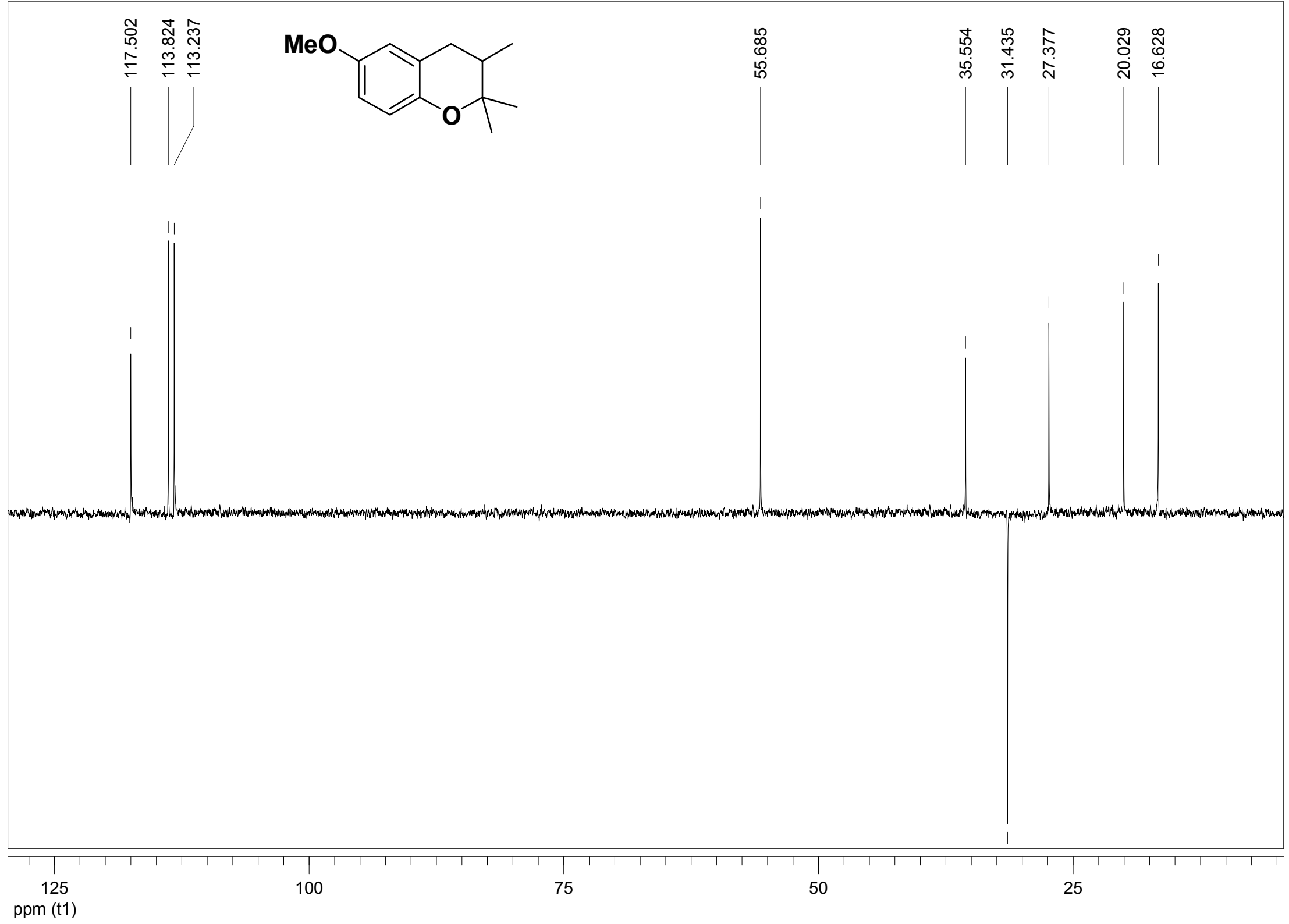
125
100
75
50
25
ppm (t1)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113.824
113.237
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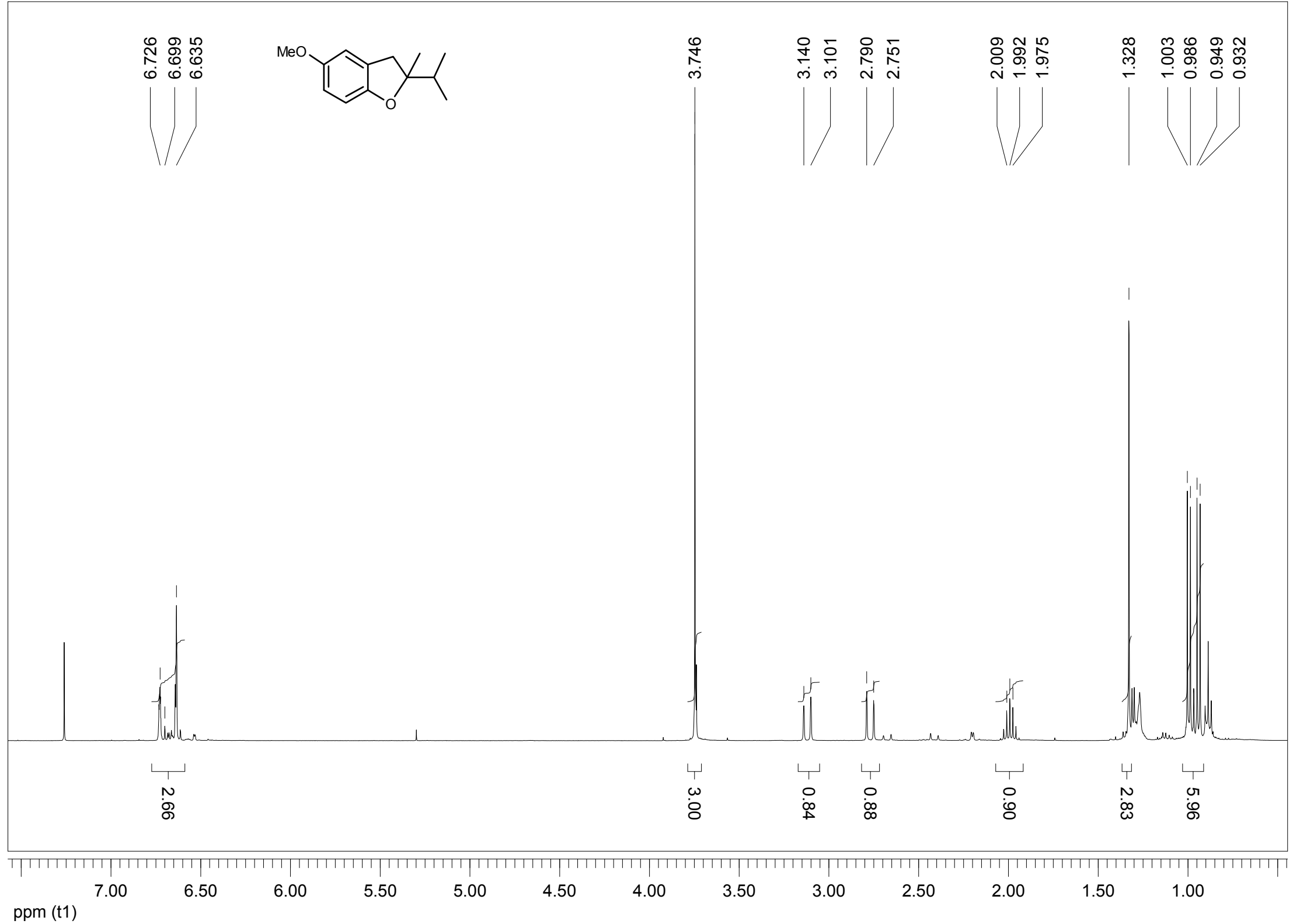
ppm (t1)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6.635
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3.101
2.790
2.751
2.009
1.992
1.975
1.328
1.003
0.986
0.949
0.932
2.66
3.00
0.84
0.88
0.90
2.83
5.96
7.00
6.50
6.00
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5.00
4.50
4.00
3.50
3.00
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2.00
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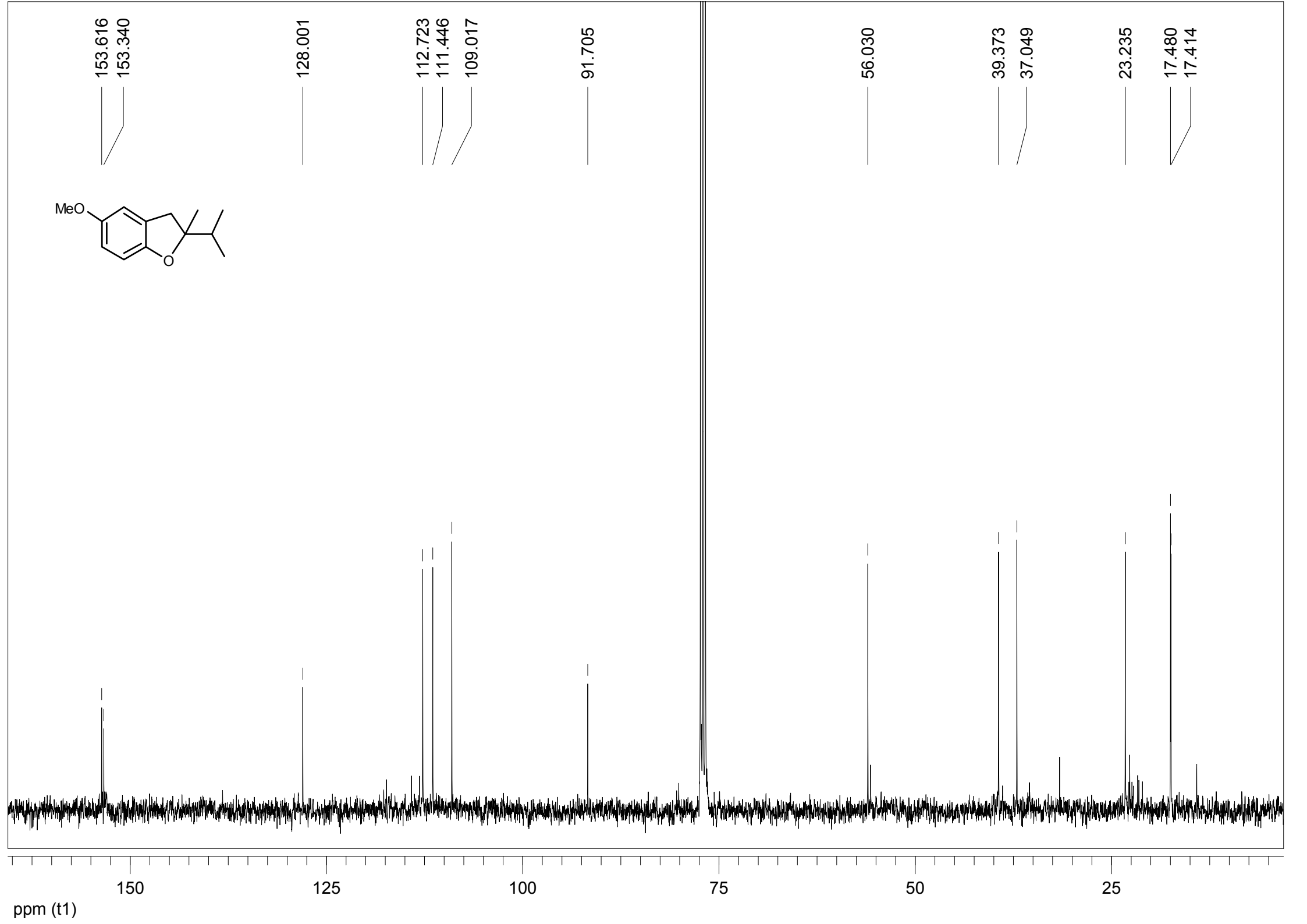
1.00
ppm (t1)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109.017
91.705
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23.235
17.480
17.414
MeO
O
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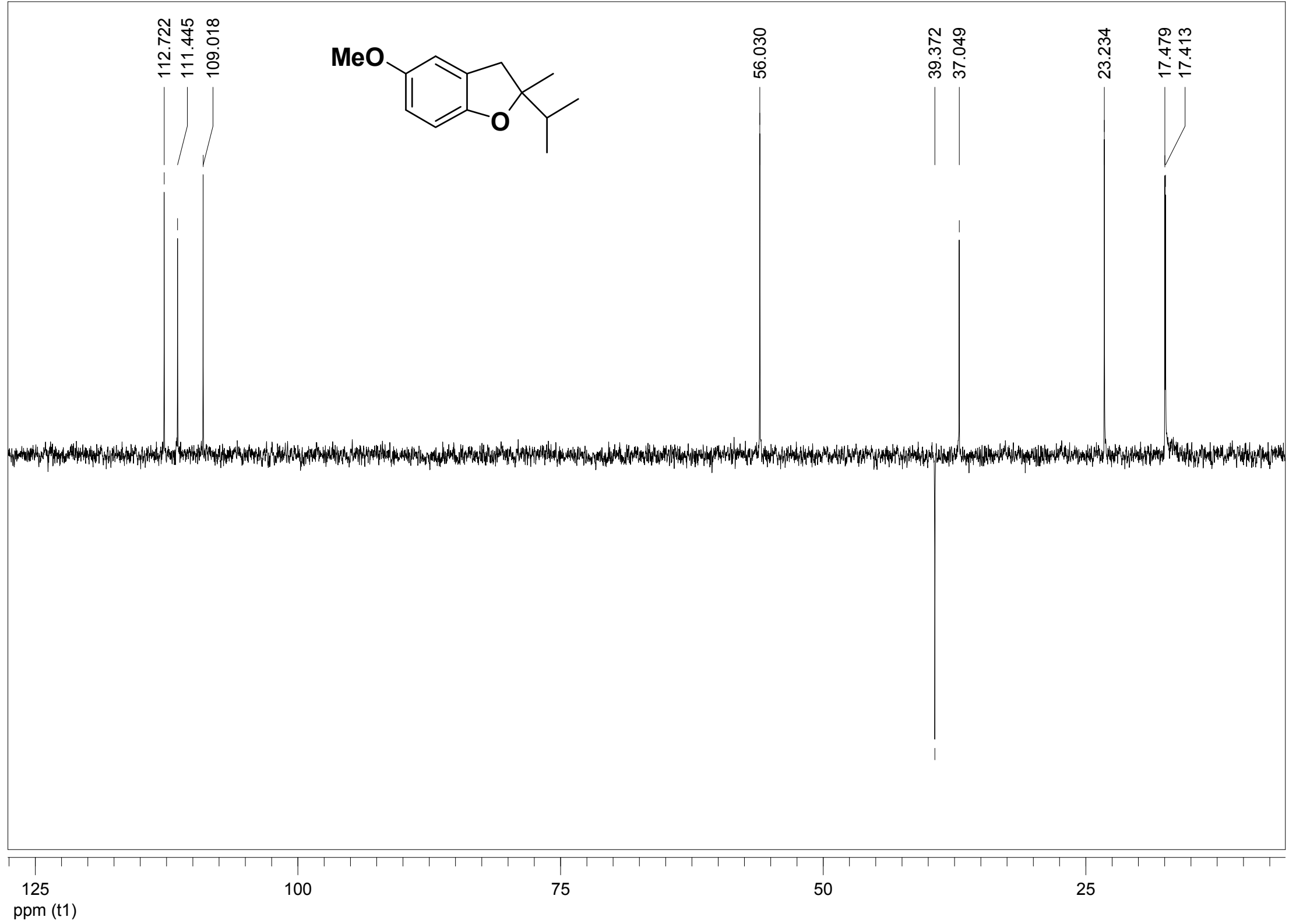
125
100
75
50
25
ppm (t1)


112.722
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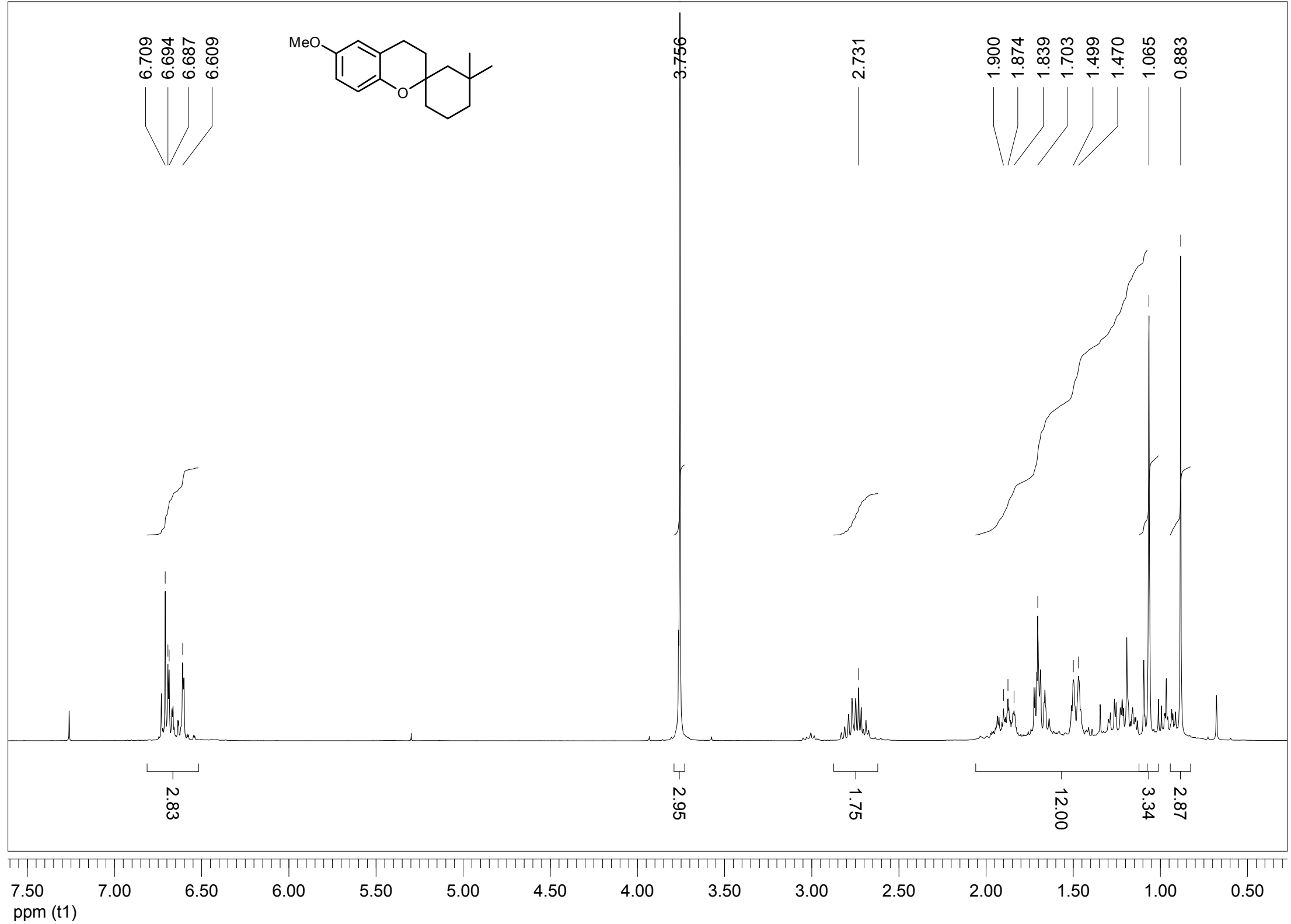
50
25
ppm (t1)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6.687
6.609
MeO
O
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1.874
1.839
1.703
1.499
1.470
1.065
0.883
2.83
2.95
1.75
12.00
3.34
2.87
7.50
7.00
6.50
6.00
5.50
5.00
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4.00
3.50
3.00
2.50
2.00
1.50
1.00
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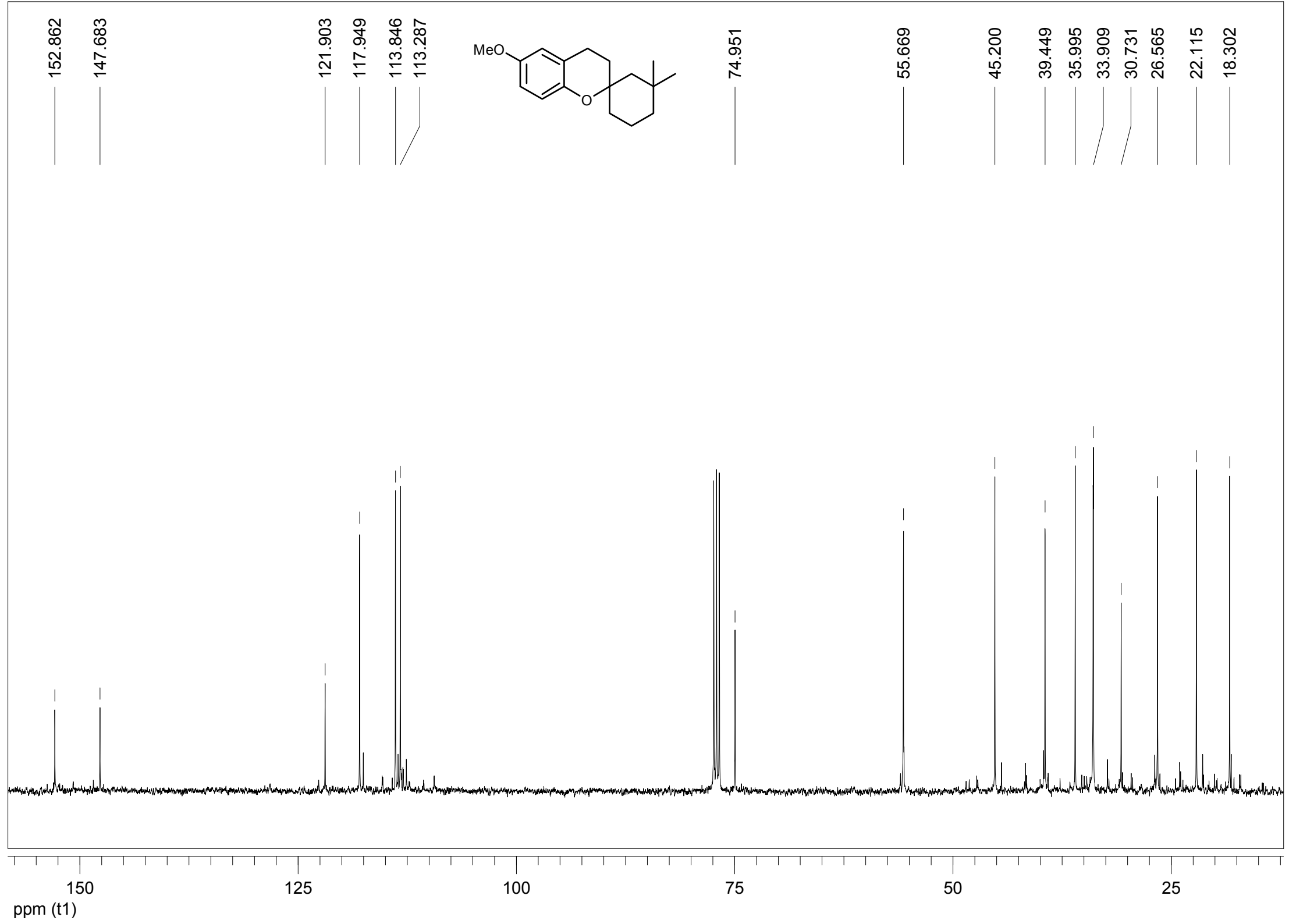
ppm (t1)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O
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22.115
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75
50
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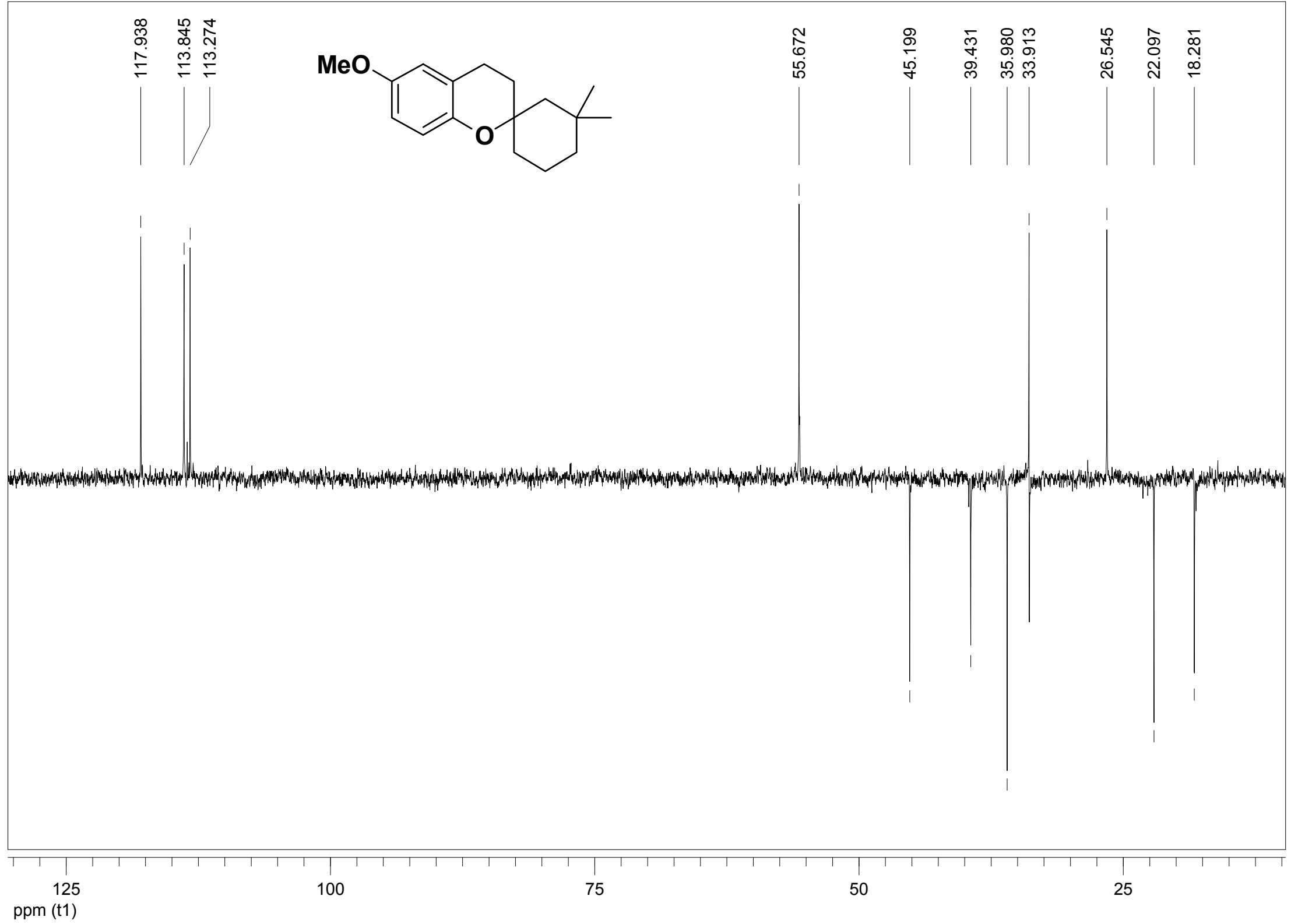
ppm (t1)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113.274
MeO
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75
50
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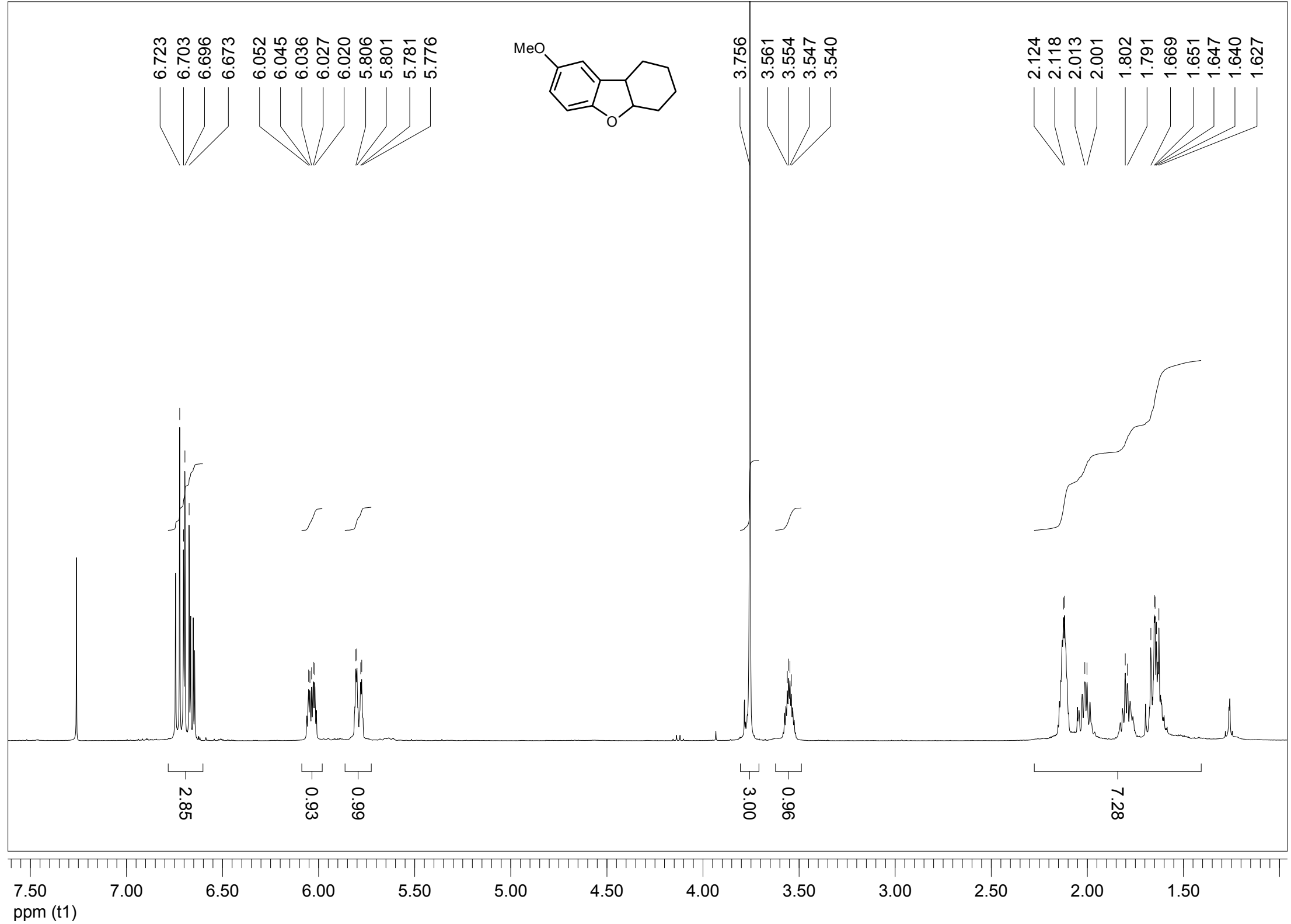
ppm (t1)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6.696
6.673
6.052
6.045
6.036
6.027
6.020
5.806
5.801
5.781
5.776
MeO
O
3.756
3.561
3.554
3.547
3.540
2.124
2.118
2.013
2.001
1.802
1.791
1.669
1.651
1.647
1.640
1.627
2.85
0.93
0.99
3.00
0.96
7.28
7.50
7.00
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6.00
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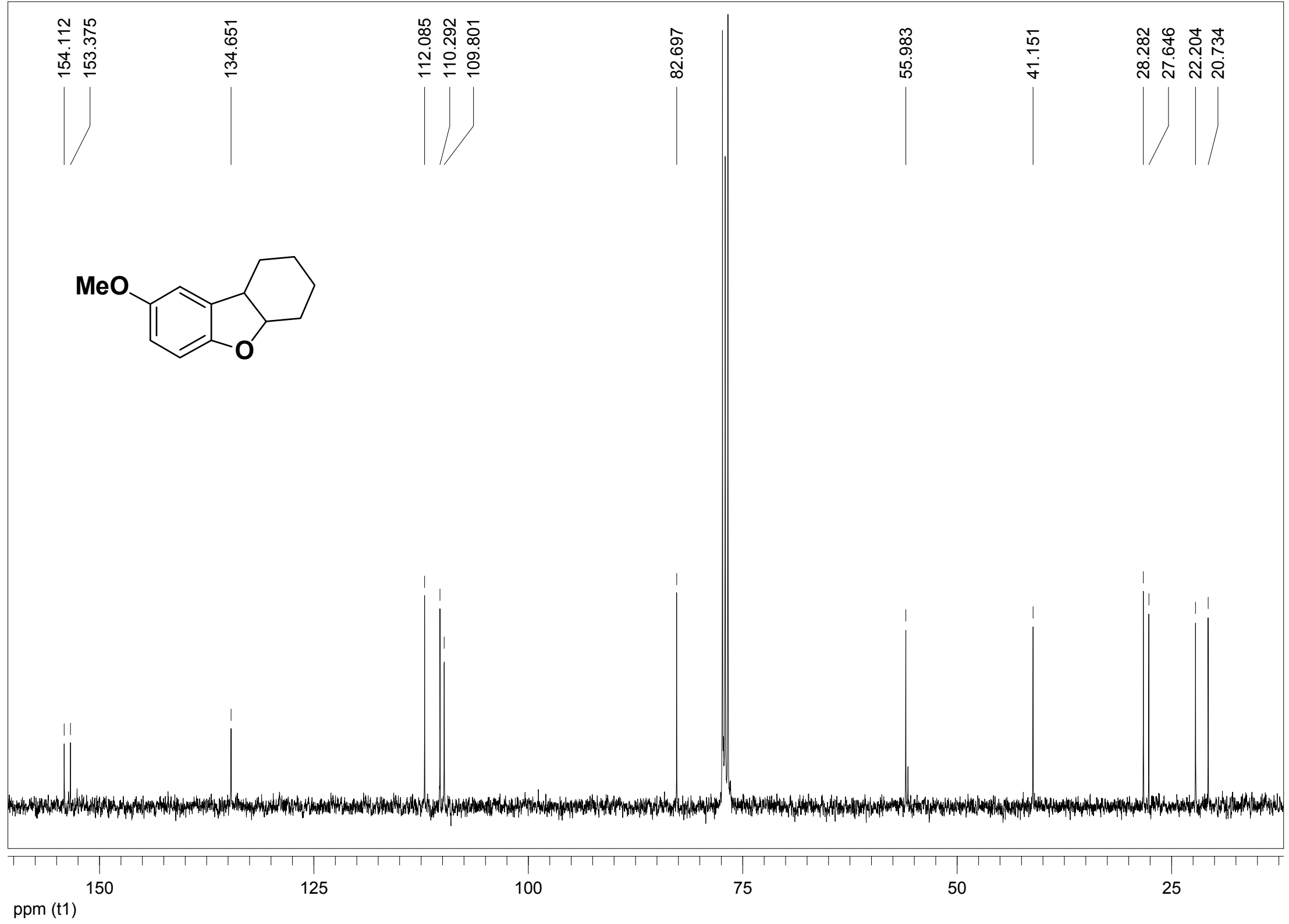
4.50
4.00
3.50
3.00
2.50
2.00
1.50
ppm (t1)


154.112
153.375
134.651
112.085
110.292
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55.983
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27.646
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20.734
MeO
O
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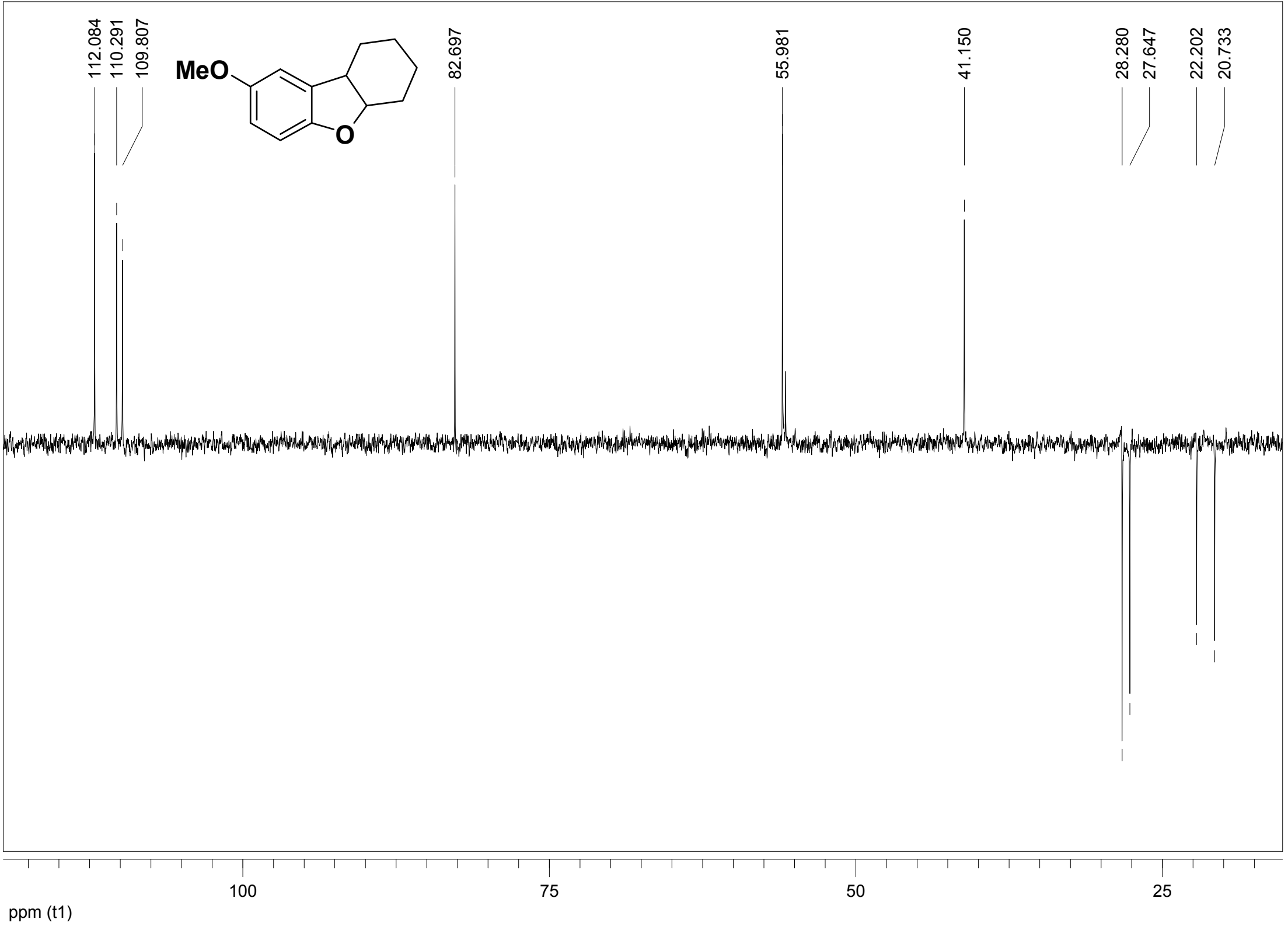
125
100
75
50
25
ppm (t1)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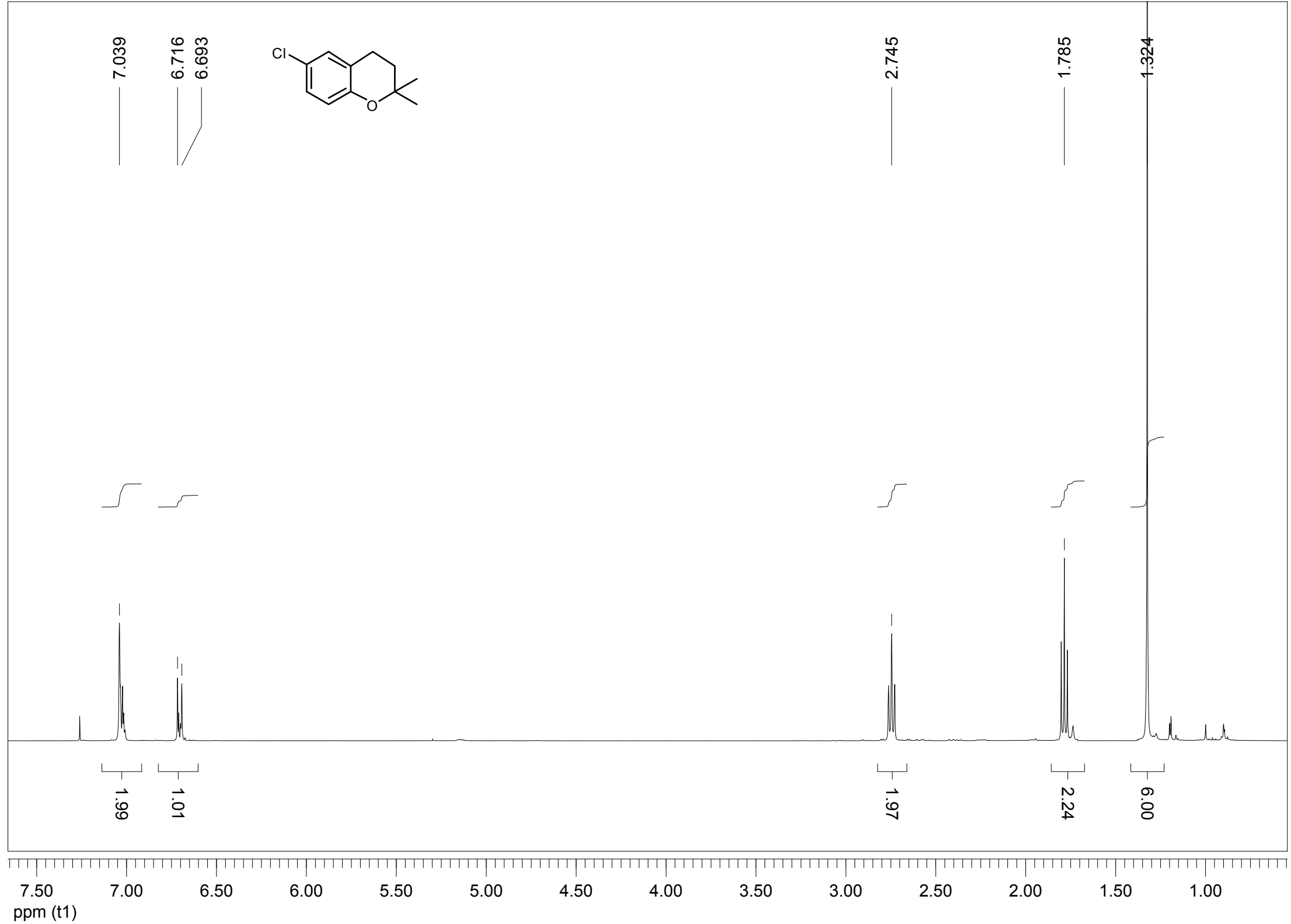
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6.716
6.693
2.745
1.785
1.324
Cl
O
1.99
1.01
1.97
2.24
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7.50
7.00
6.50
6.00
5.50
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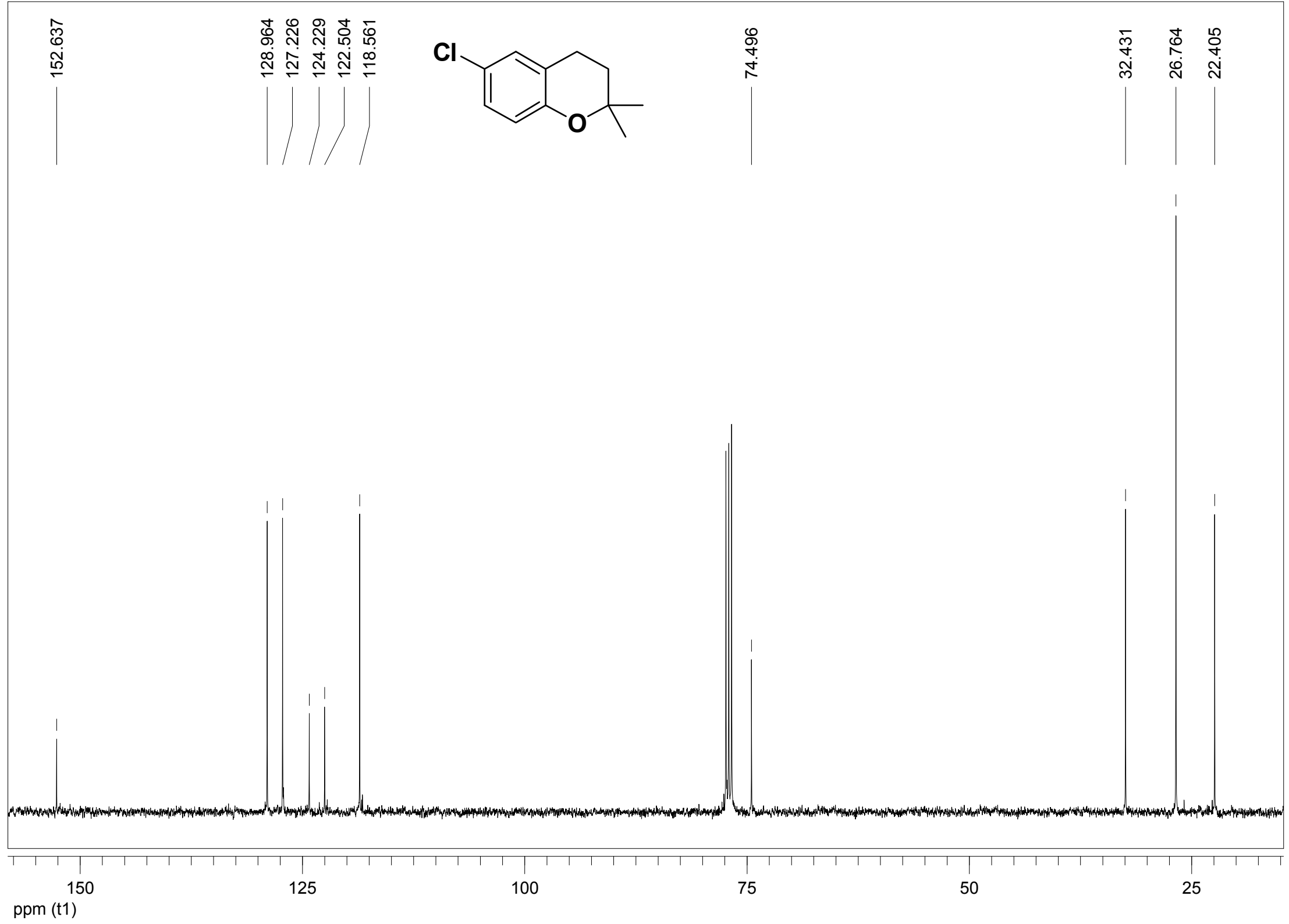
4.50
4.00
3.50
3.00
2.50
2.00
1.50
1.00
ppm (t1)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127.226
124.229
122.504
118.561
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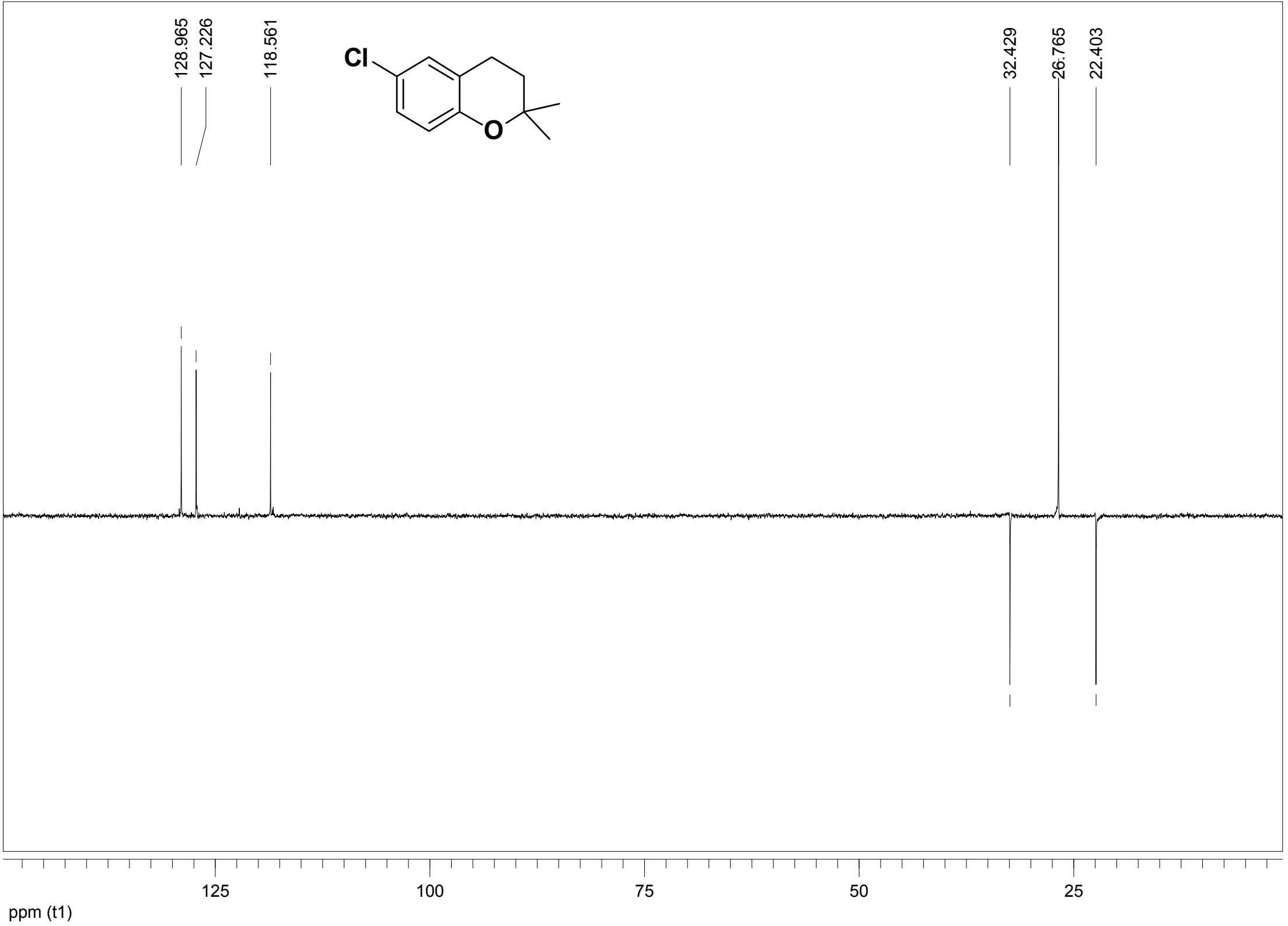
32.431
26.764
22.405
Cl
O
150
125
100
75
50
25
ppm (t1)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22.403
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O
125
100
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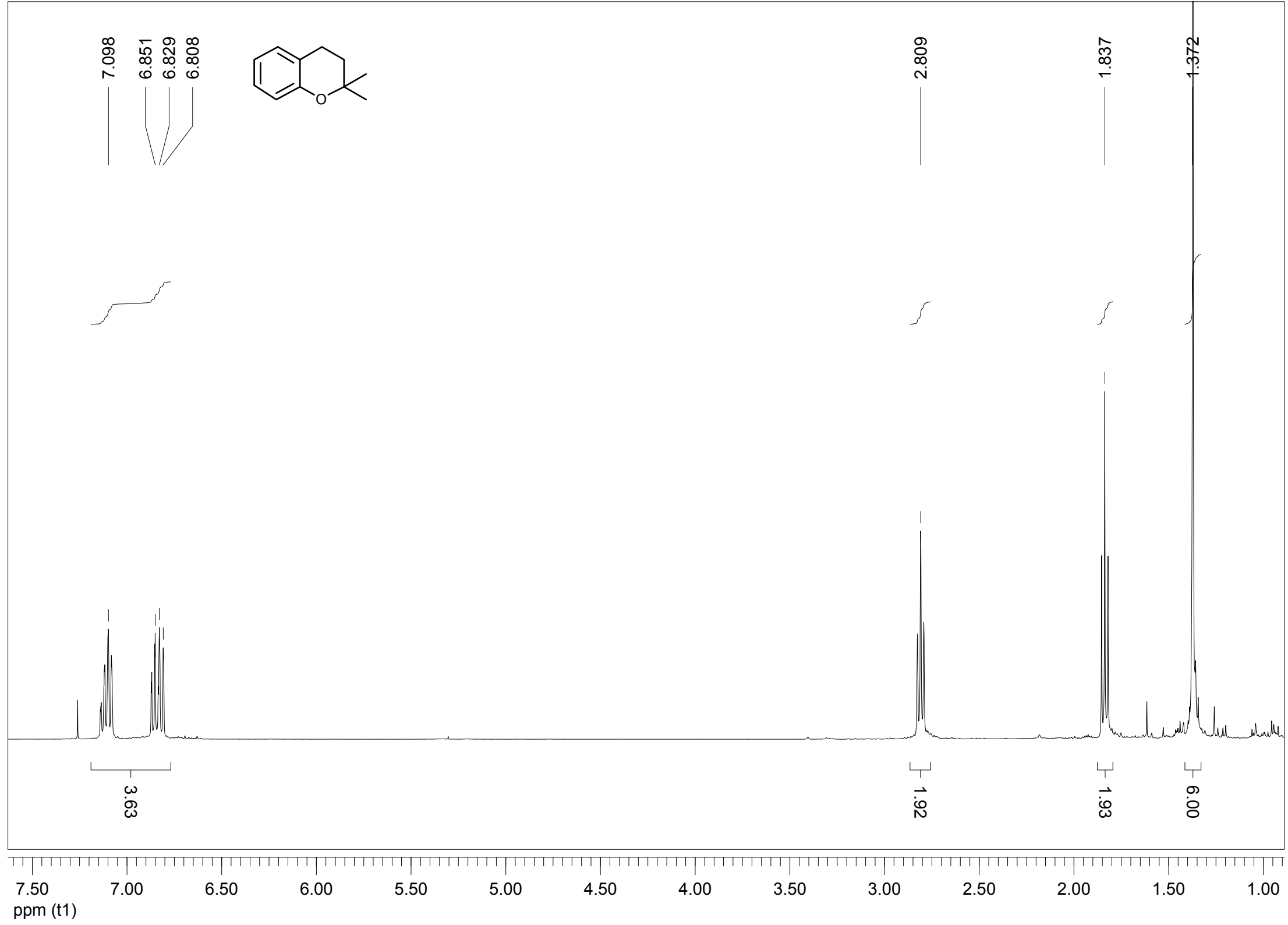
50
25
ppm (t1)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6.829
6.808
2.809
1.837
1.372
O
3.63
1.92
1.93
6.00
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7.00
6.50
6.00
5.50
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4.50
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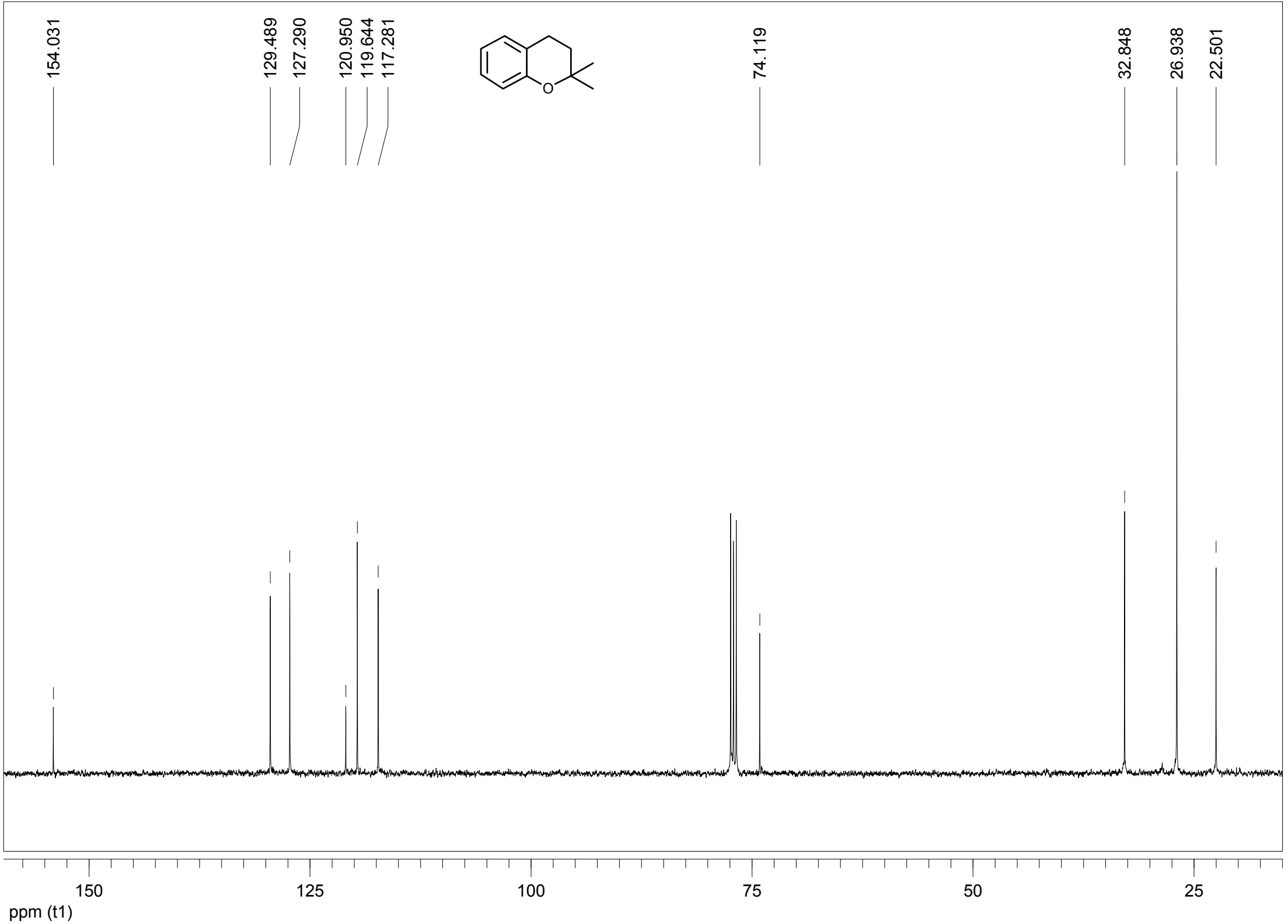
3.50
3.00
2.50
2.00
1.50
1.00
ppm (t1)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26.938
22.501
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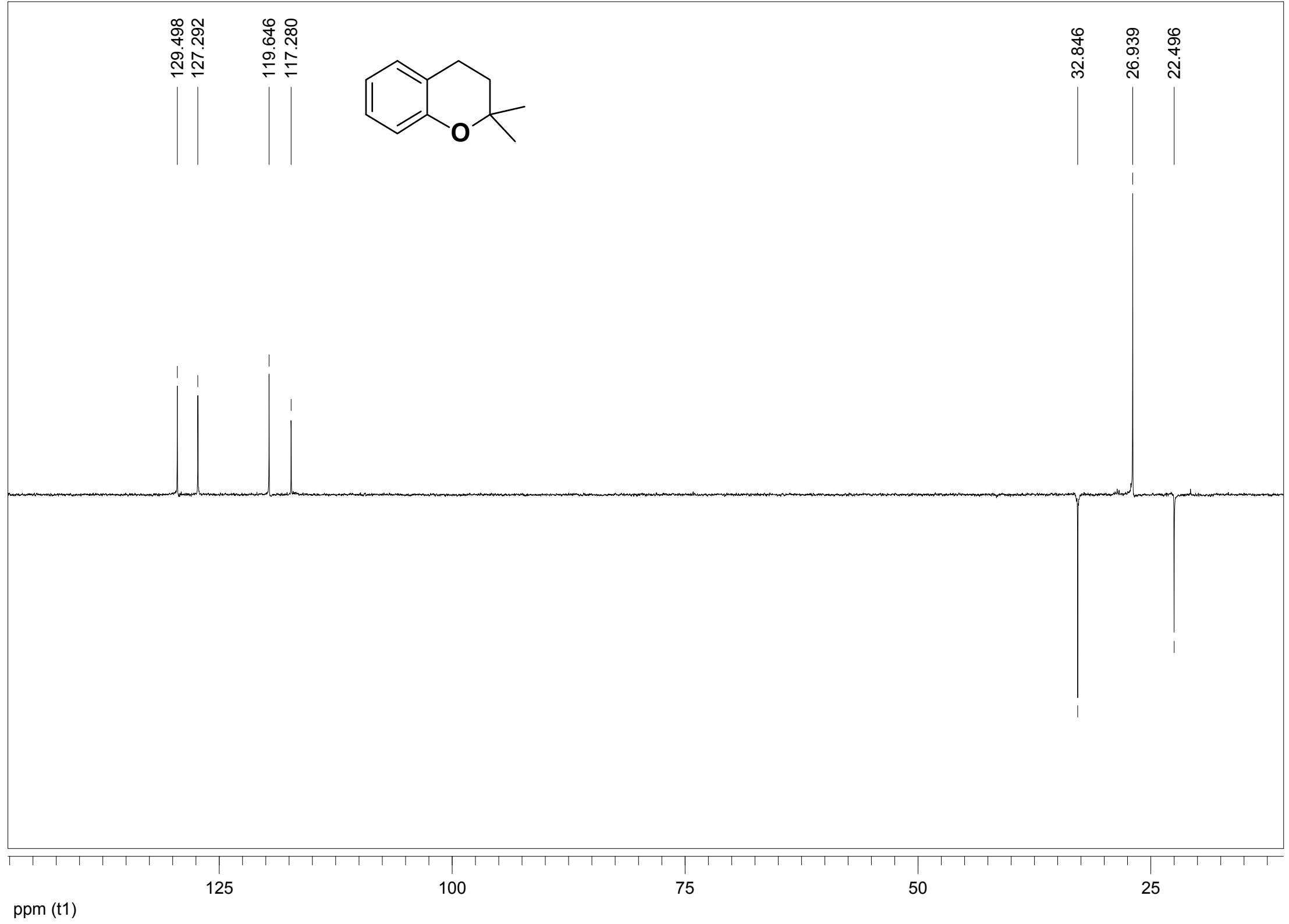
150
125
100
75
50
25
ppm (t1)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26.939
22.496
O
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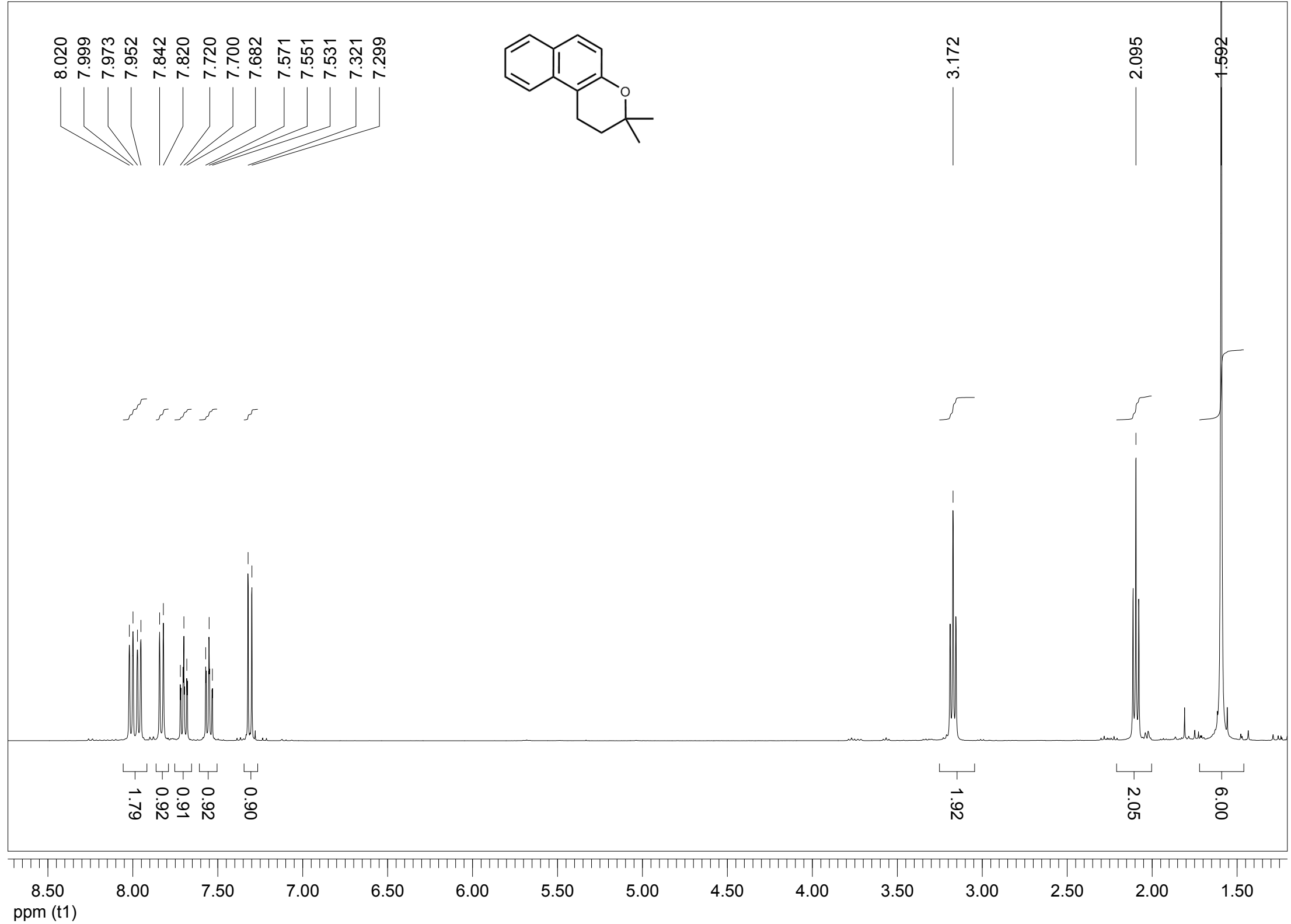
100
75
50
25
ppm (t1)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7.952
7.842
7.820
7.720
7.700
7.682
7.571
7.551
7.531
7.321
7.299
3.172
2.095
1.592
O
1.79
0.92
0.91
0.92
0.90
1.92
2.05
6.00
8.50
8.00
7.50
7.00
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5.00
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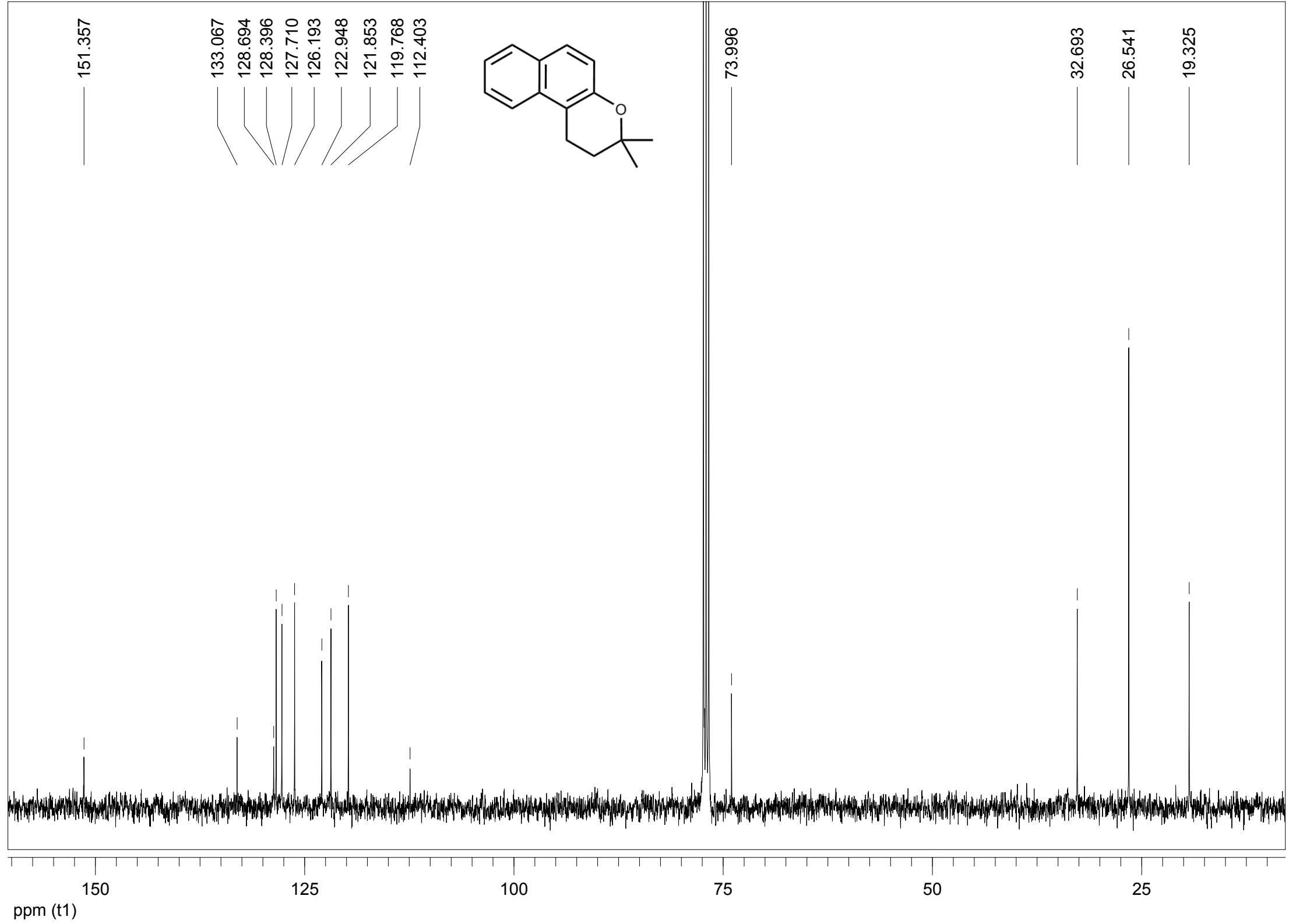
2.50
2.00
1.50
ppm (t1)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128.694
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127.710
126.193
122.948
121.853
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O
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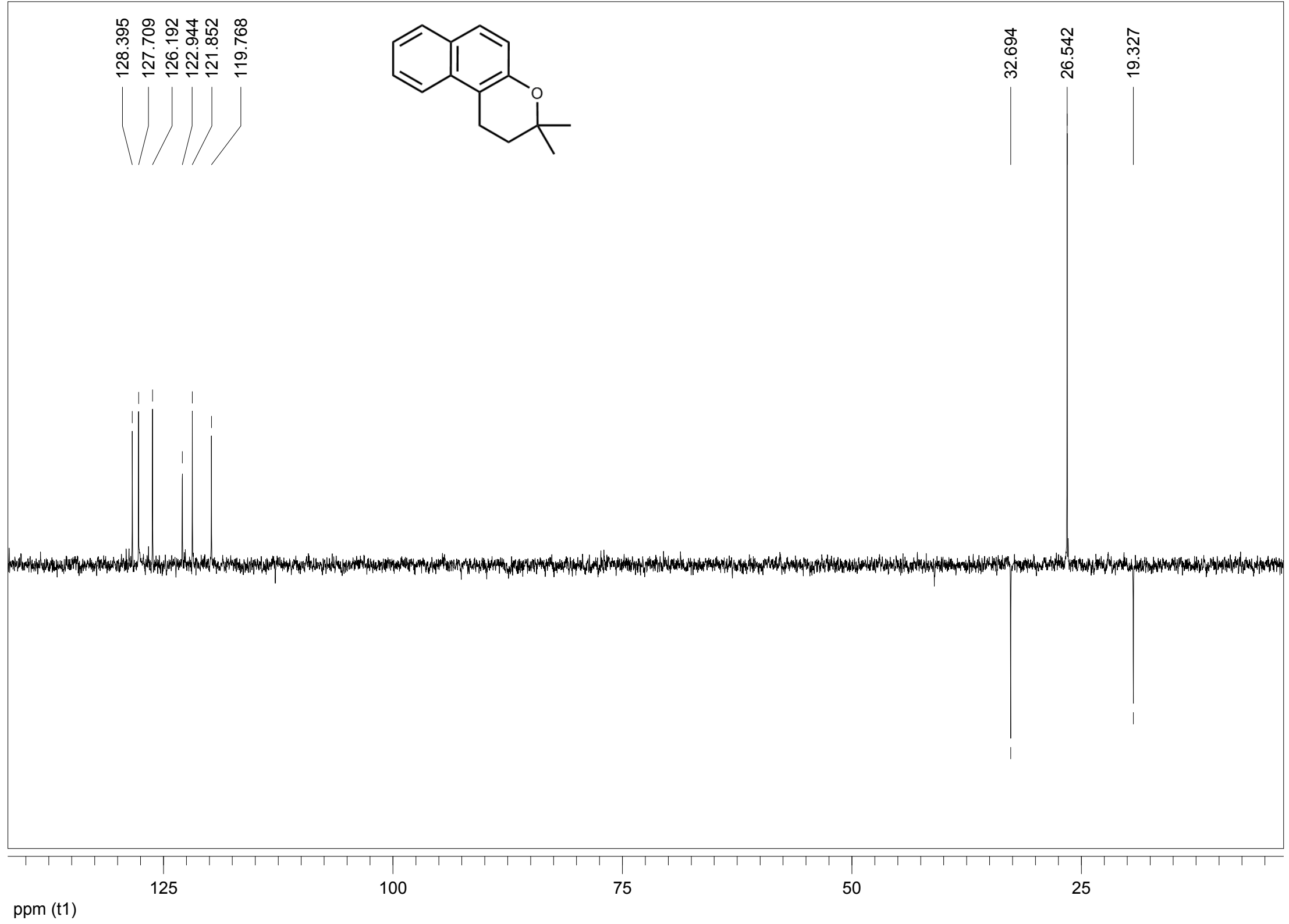
32.693
26.541
19.325
150
125
100
75
50
25
ppm (t1)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26.542
19.327
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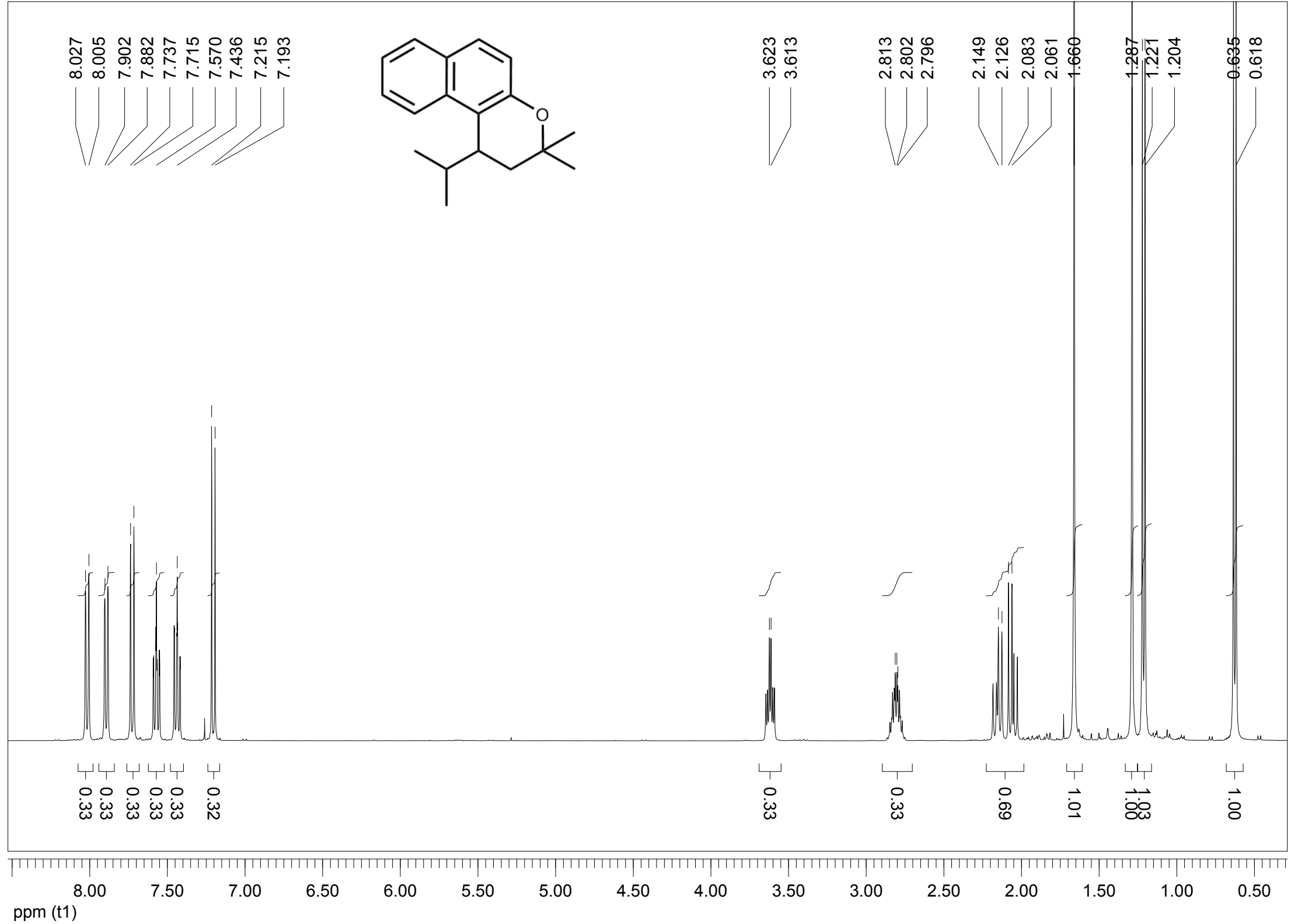
50
25
ppm (t1)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7.715
7.570
7.436
7.215
7.193
3.623
3.613
2.813
2.802
2.796
2.149
2.126
2.083
2.061
1.660
1.287
1.221
1.204
0.635
0.618
O
0.33
0.33
0.33
0.33
0.33
0.32
0.33
0.33
0.99
1.01
1.00
1.03
1.00
8.00
7.50
7.00
6.50
6.00
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5.00
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4.00
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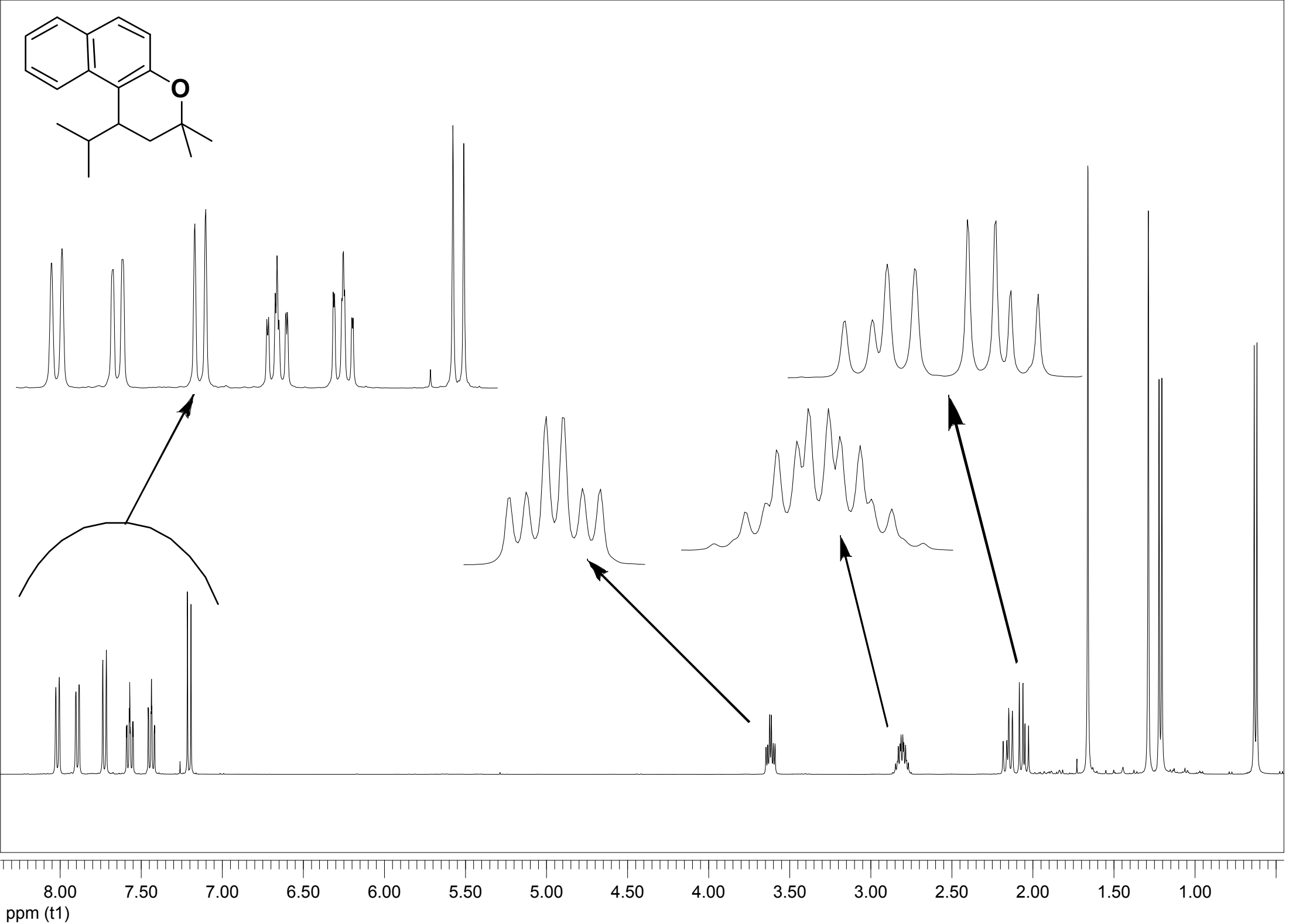
3.00
2.50
2.00
1.50
1.00
0.50
ppm (t1)


O
8.00
7.50
7.00
6.50
6.00
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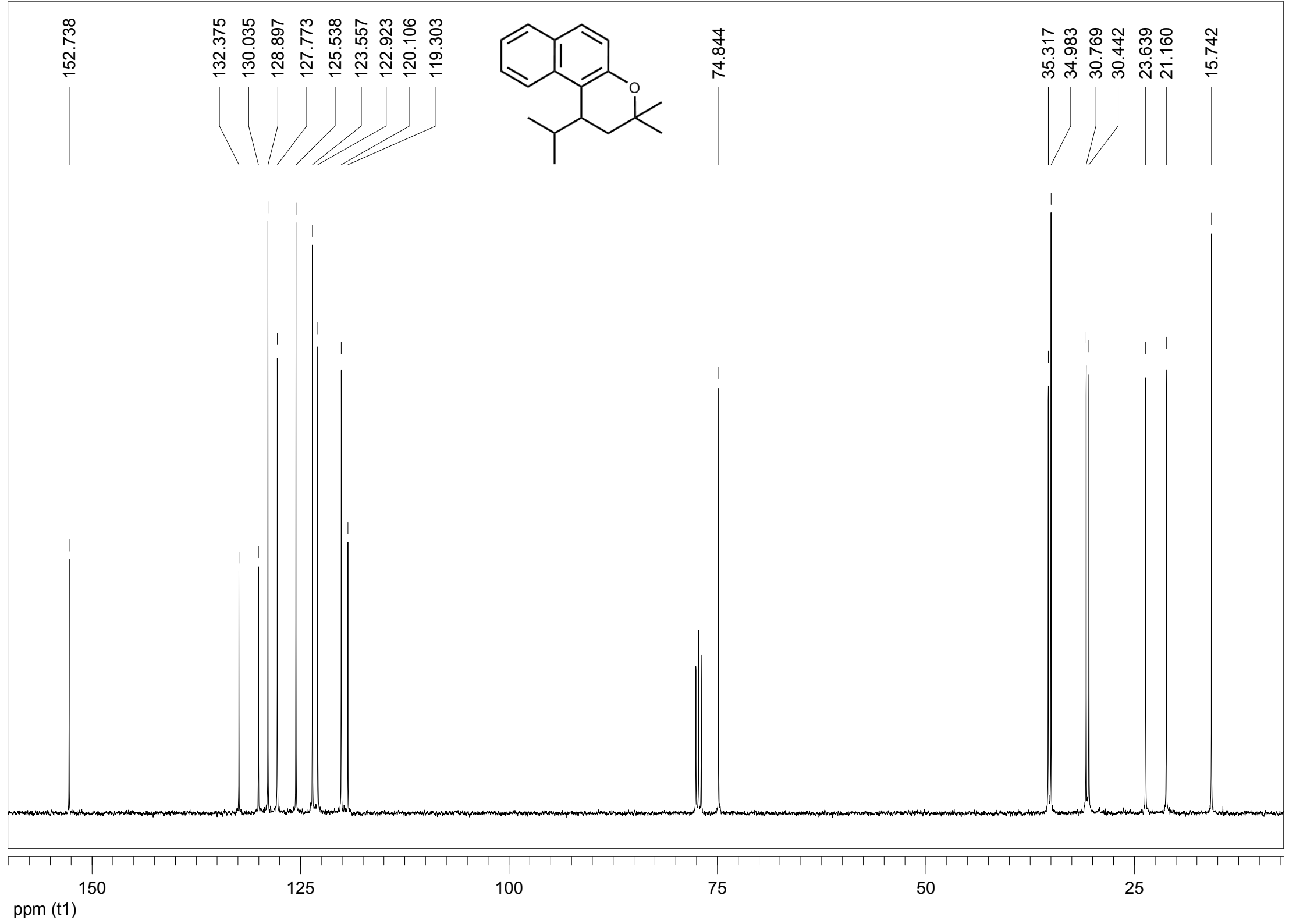
5.00
4.50
4.00
3.50
3.00
2.50
2.00
1.50
1.00
ppm (t1)


152.738
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128.897
127.773
125.538
123.557
122.923
120.106
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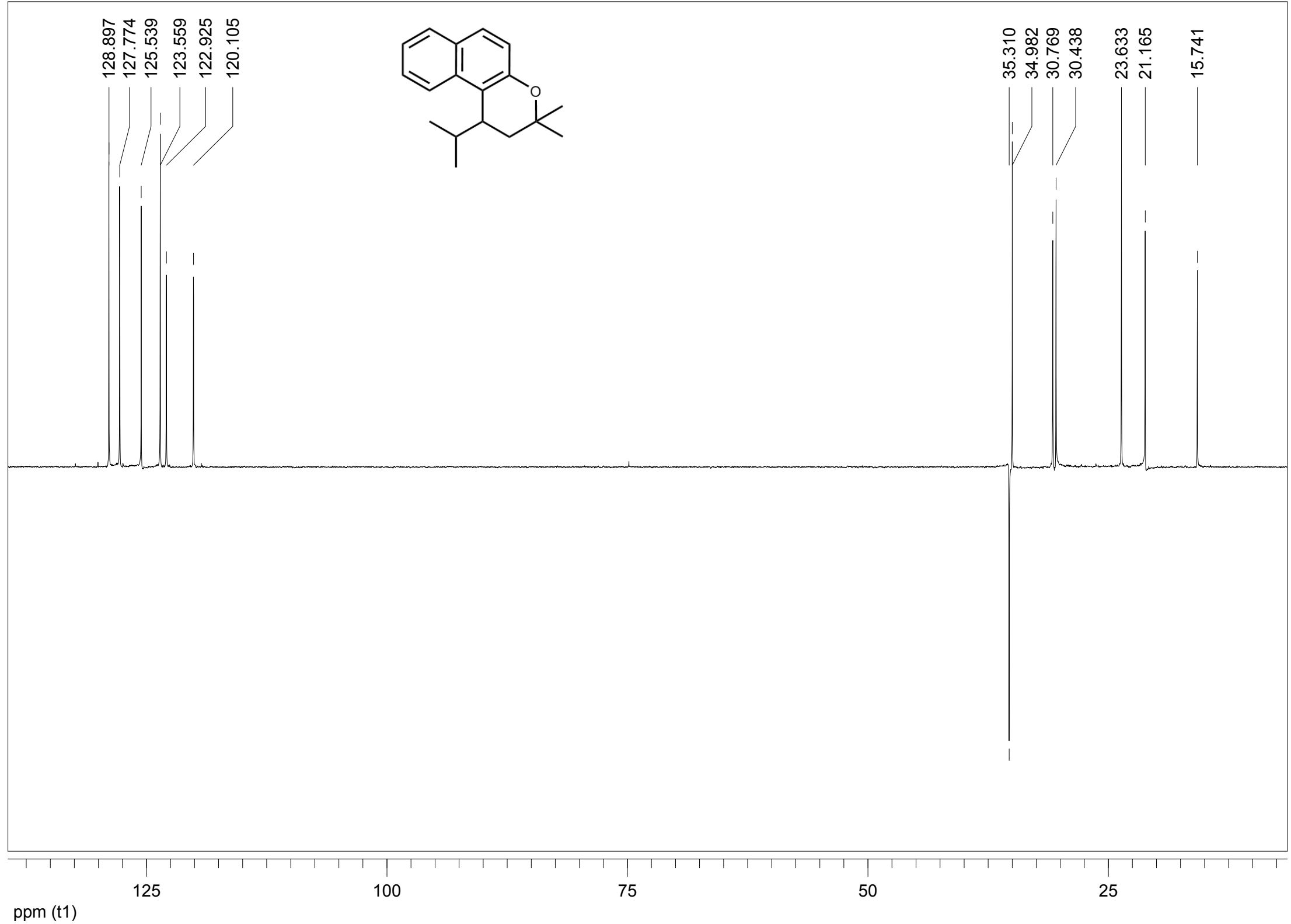
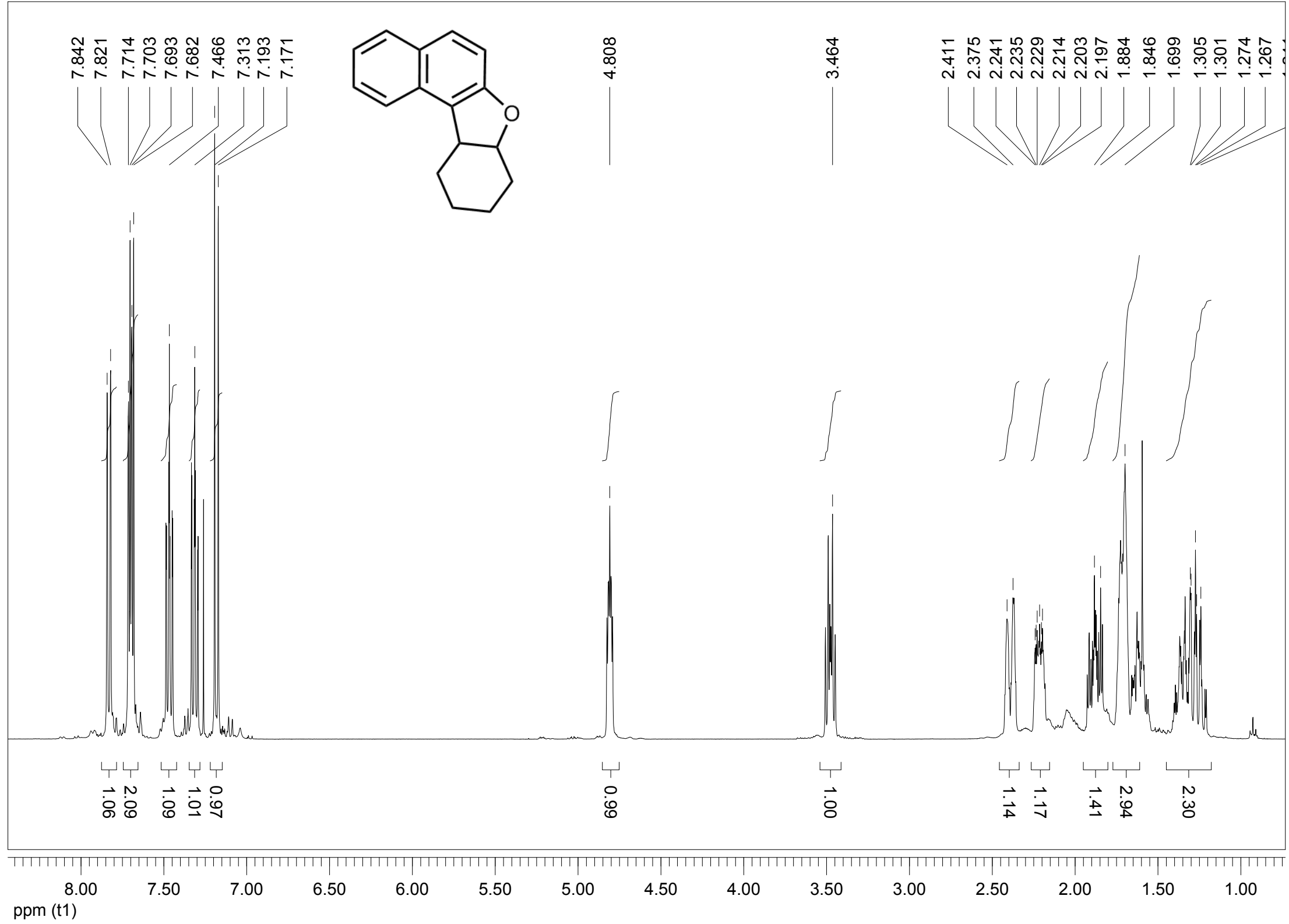
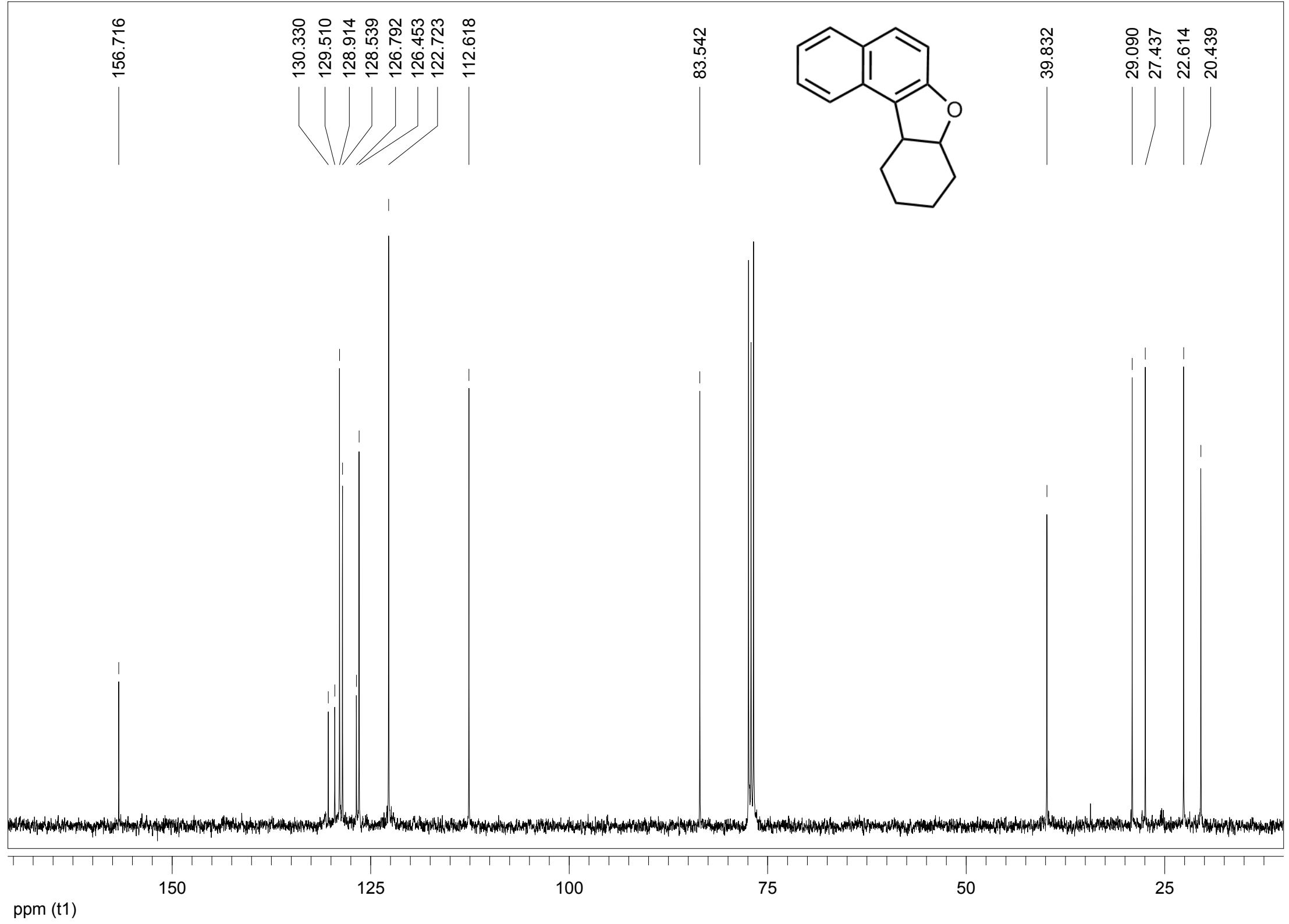
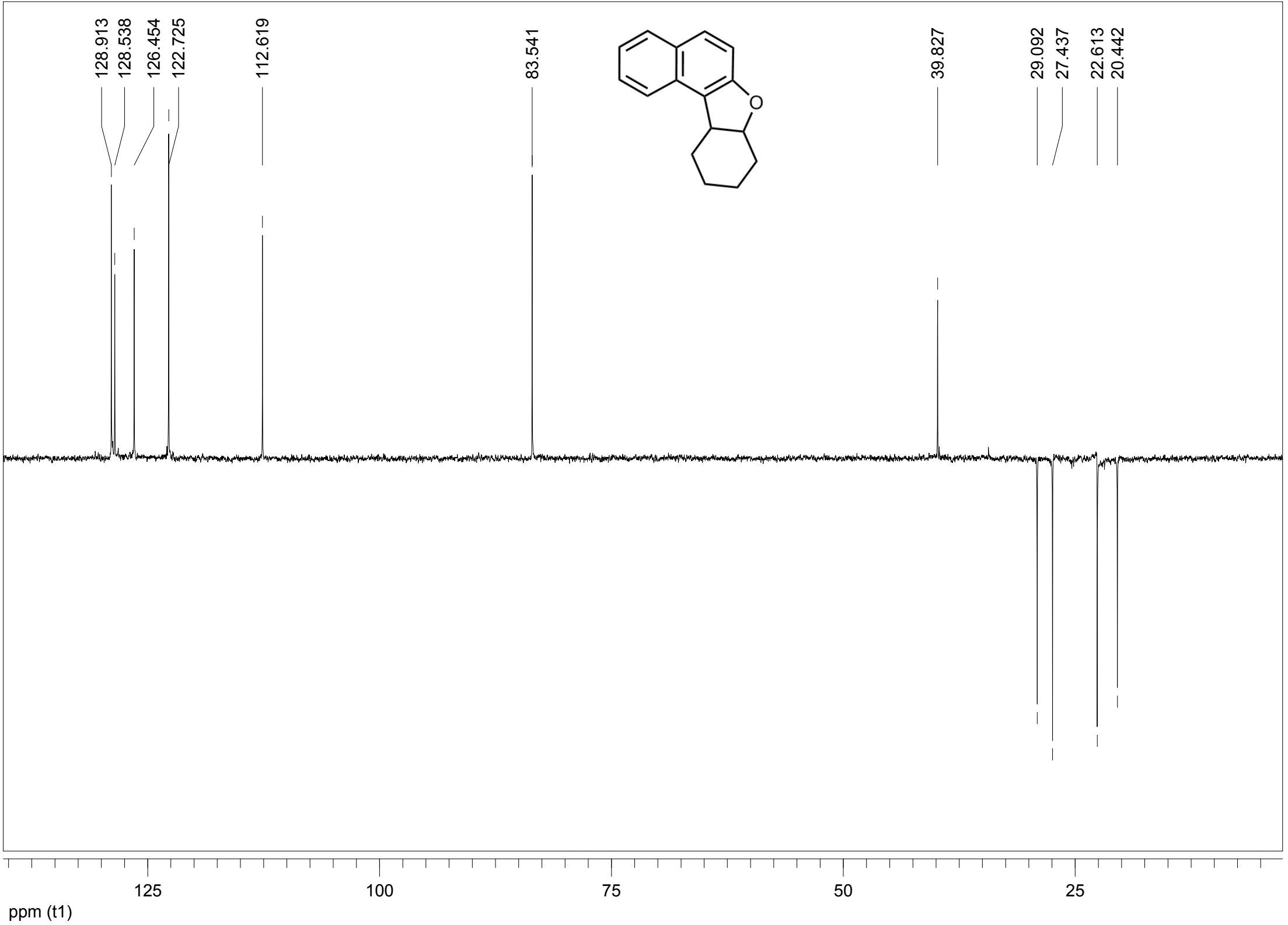
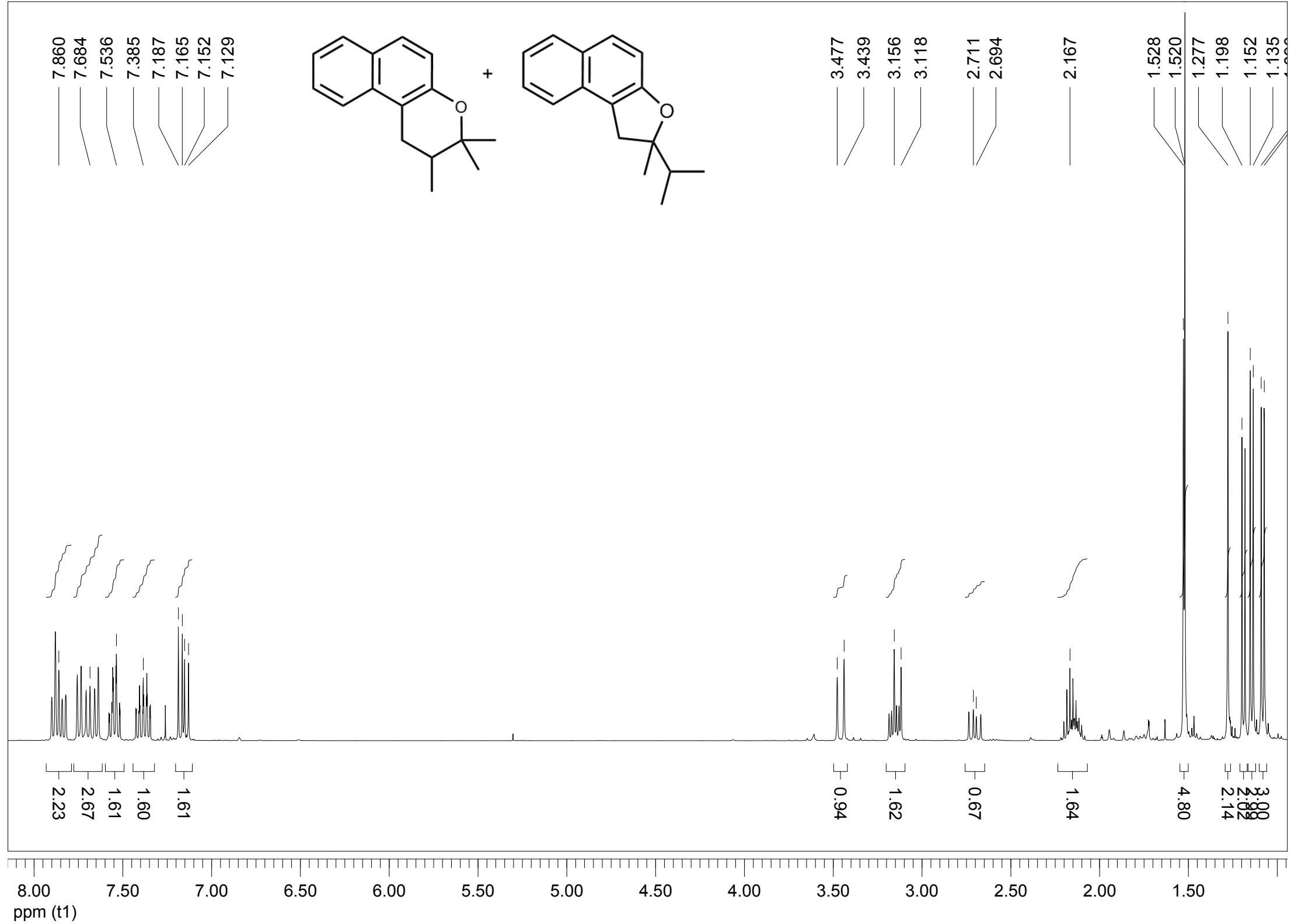
74.844
35.317
34.983
30.769
30.442
23.639
21.160
15.742
O
150
125
100
75
50
25
ppm (t1)

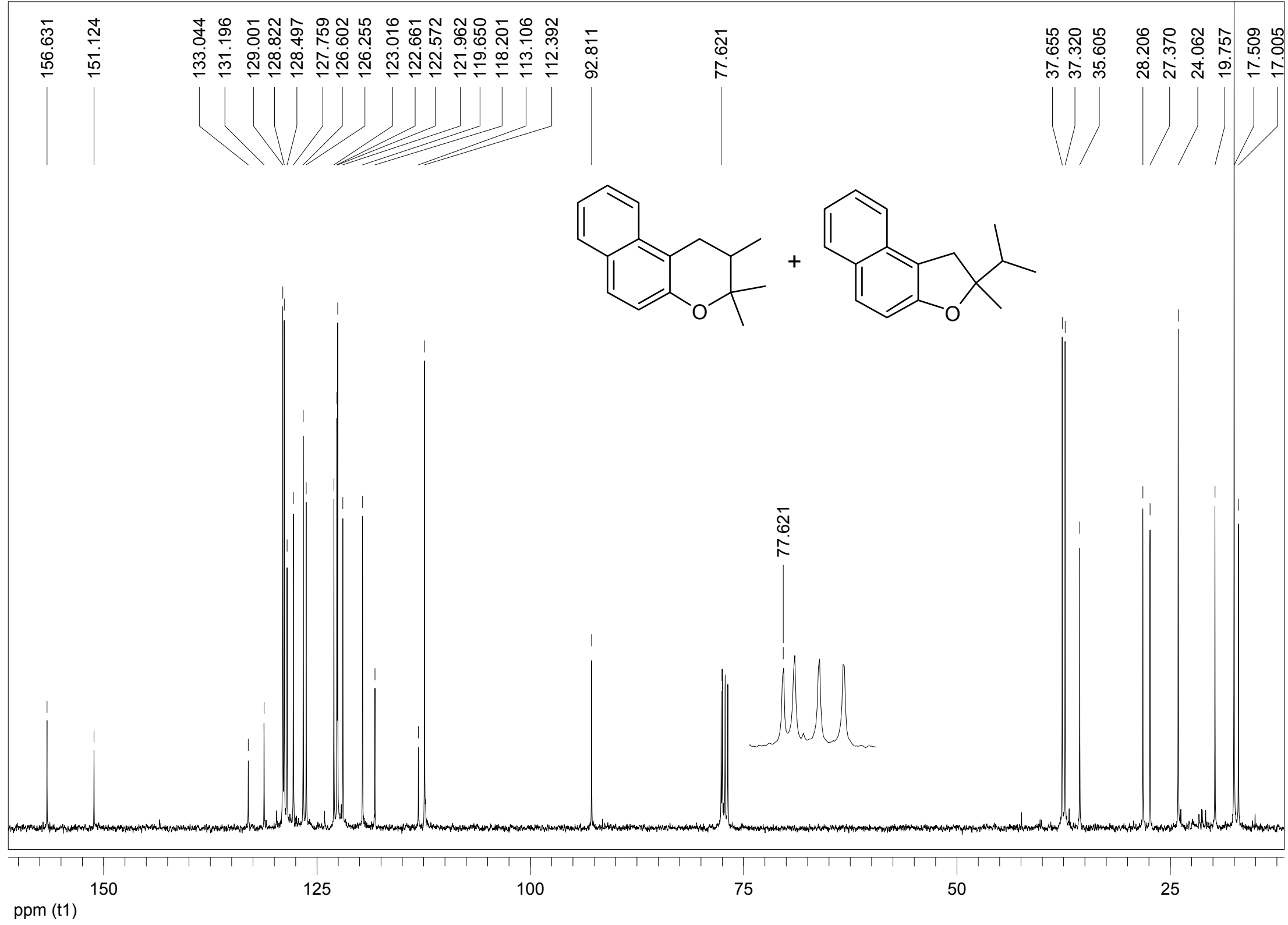

128.897
127.774
125.539
123.559
122.925
120.105
35.310
34.982
30.769
30.438
23.633
21.165
15.741
O
125
100
75
50
25
ppm (t1)

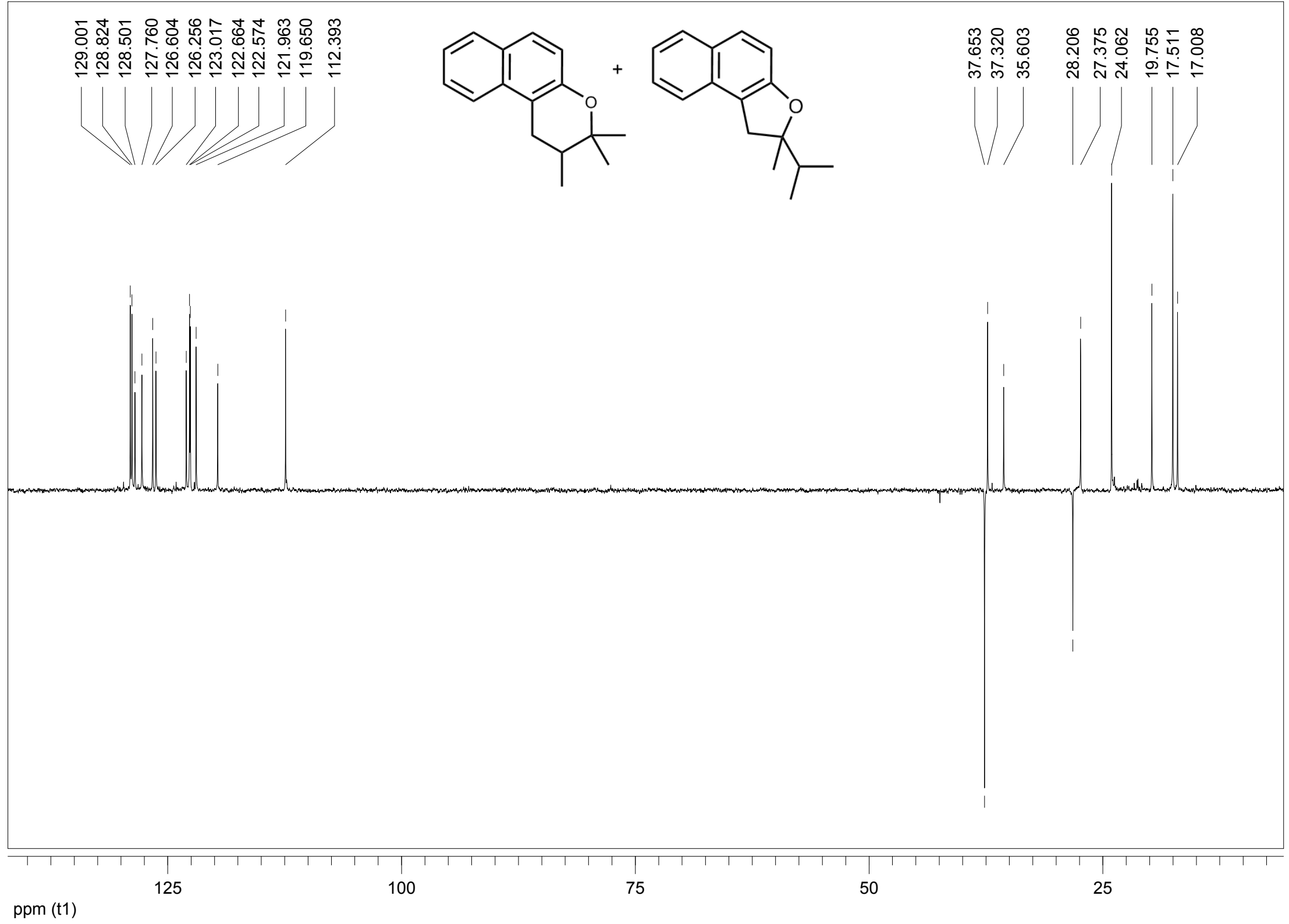

7.842
7.821
7.714
7.703
7.693
7.682
7.466
7.313
7.193
7.171
4.808
3.464
2.411
2.375
2.241
2.235
2.229
2.214
2.203
2.197
1.884
1.846
1.699
1.305
1.301
1.274
1.267
O
1.06
2.09
1.09
1.01
0.97
0.99
1.00
1.14
1.17
1.41
2.94
2.30
8.00
7.50
7.00
6.50
6.00
5.50
5.00
4.50
4.00
3.50
3.00
2.50
2.00
1.50
1.00
ppm (t1)

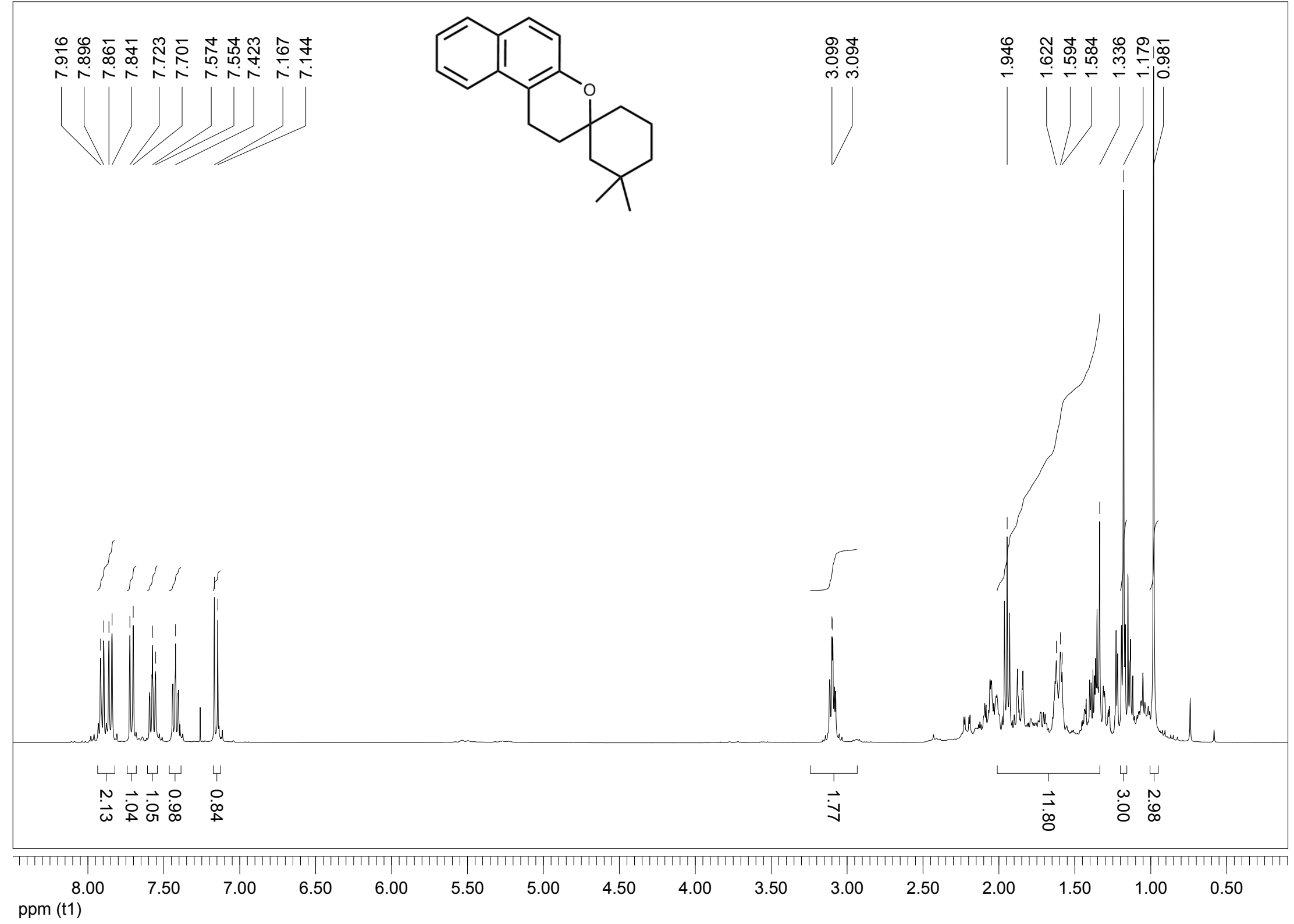

156.716
130.330
129.510
128.914
128.539
126.792
126.453
122.723
112.618
83.542
39.832
29.090
27.437
22.614
20.439
O
150
125
100
75
50
25
ppm (t1)

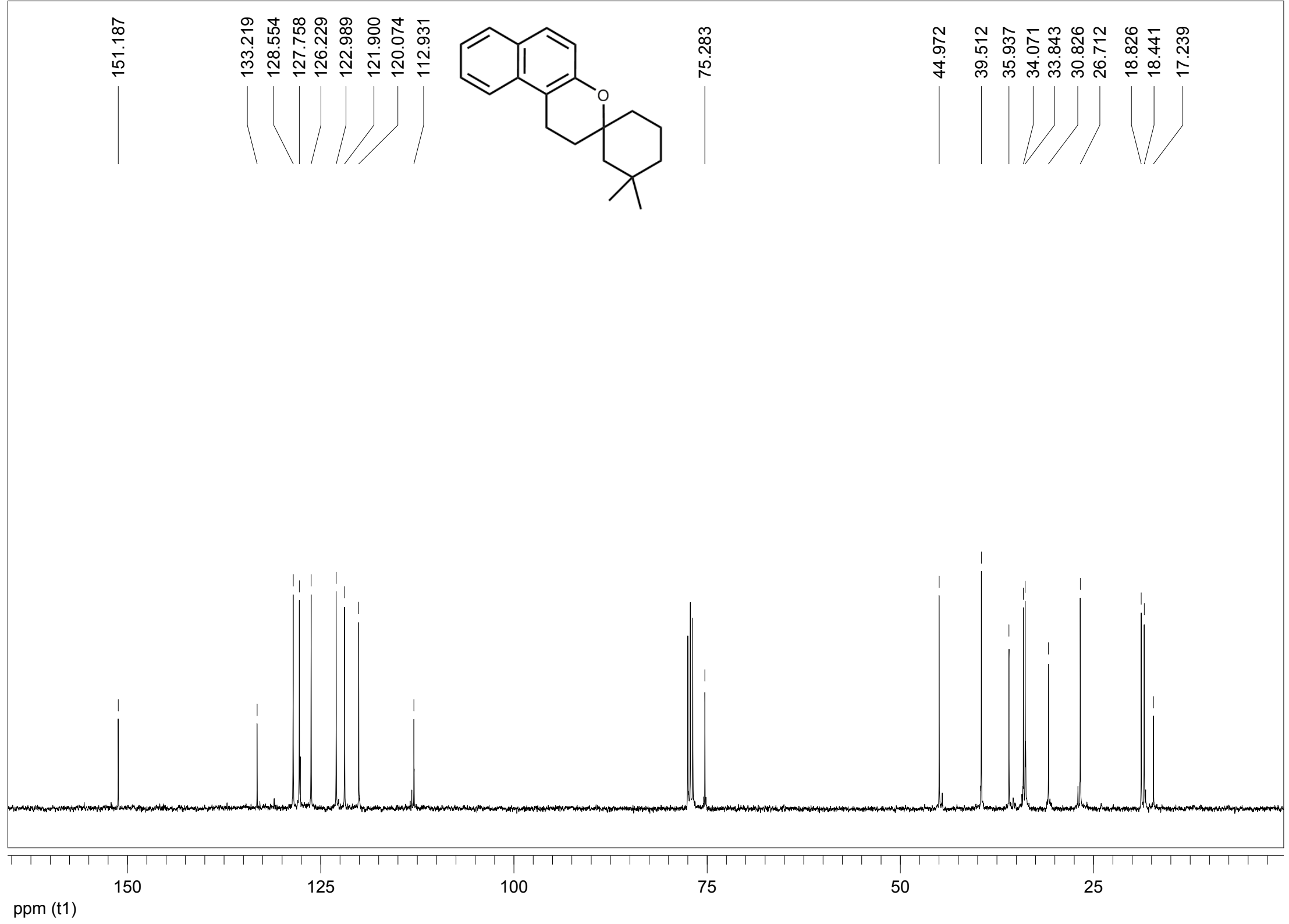

128.913
128.538
126.454
122.725
112.619
83.541
39.827
29.092
27.437
22.613
20.442
O
125
100
75
50
25
ppm (t1)

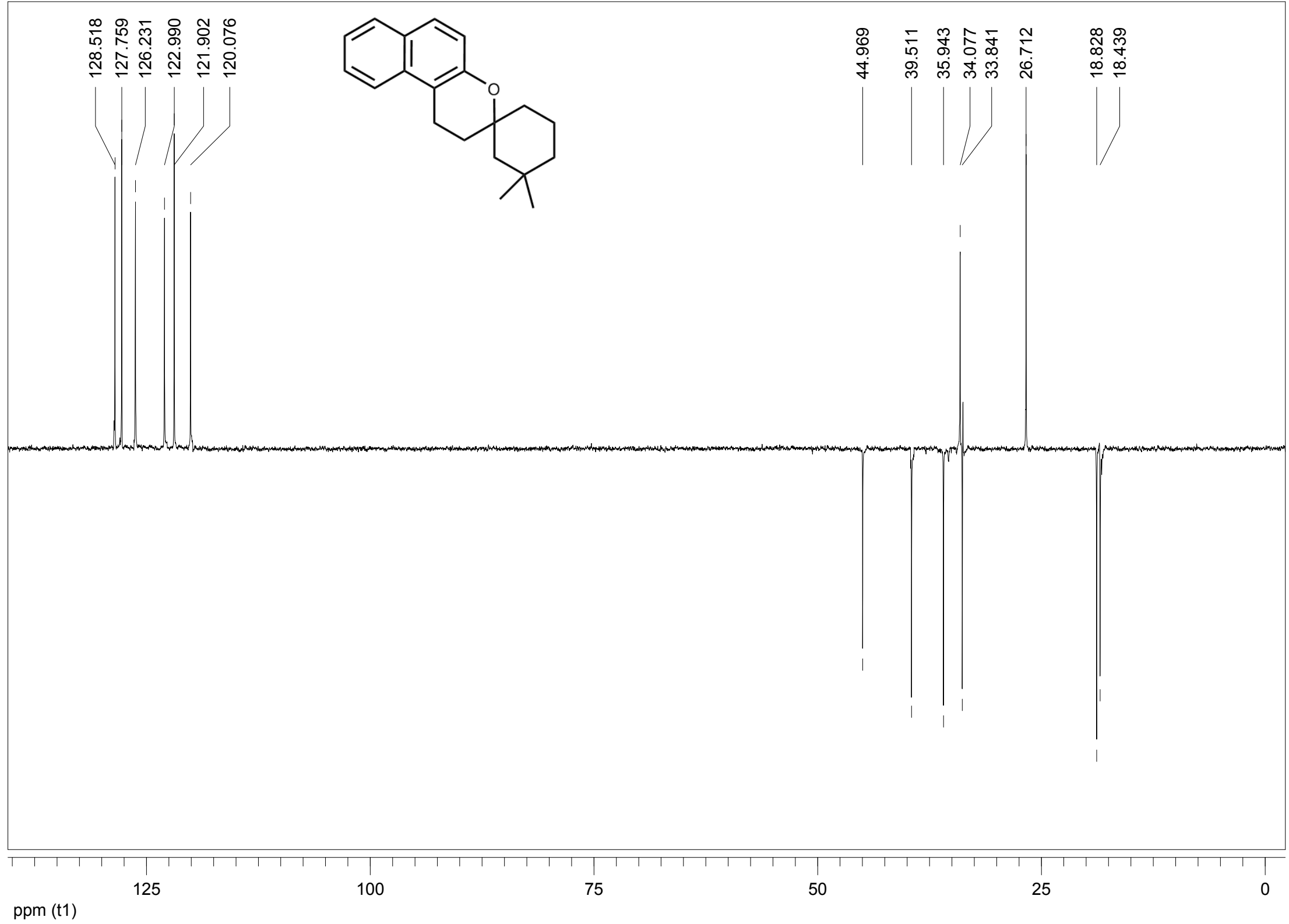

7.860
7.684
7.536
7.385
7.187
7.165
7.152
7.129
3.477
3.439
3.156
3.118
2.711
2.694
2.167
1.528
1.520
1.277
1.198
1.152
1.135
O
+
O
2.23
2.67
1.61
1.60
1.61
0.94
1.62
0.67
1.64
4.80
2.14
8.00
7.50
7.00
6.50
6.00
5.50
5.00
4.50
4.00
3.50
3.00
2.50
2.00
1.50
ppm (t1)

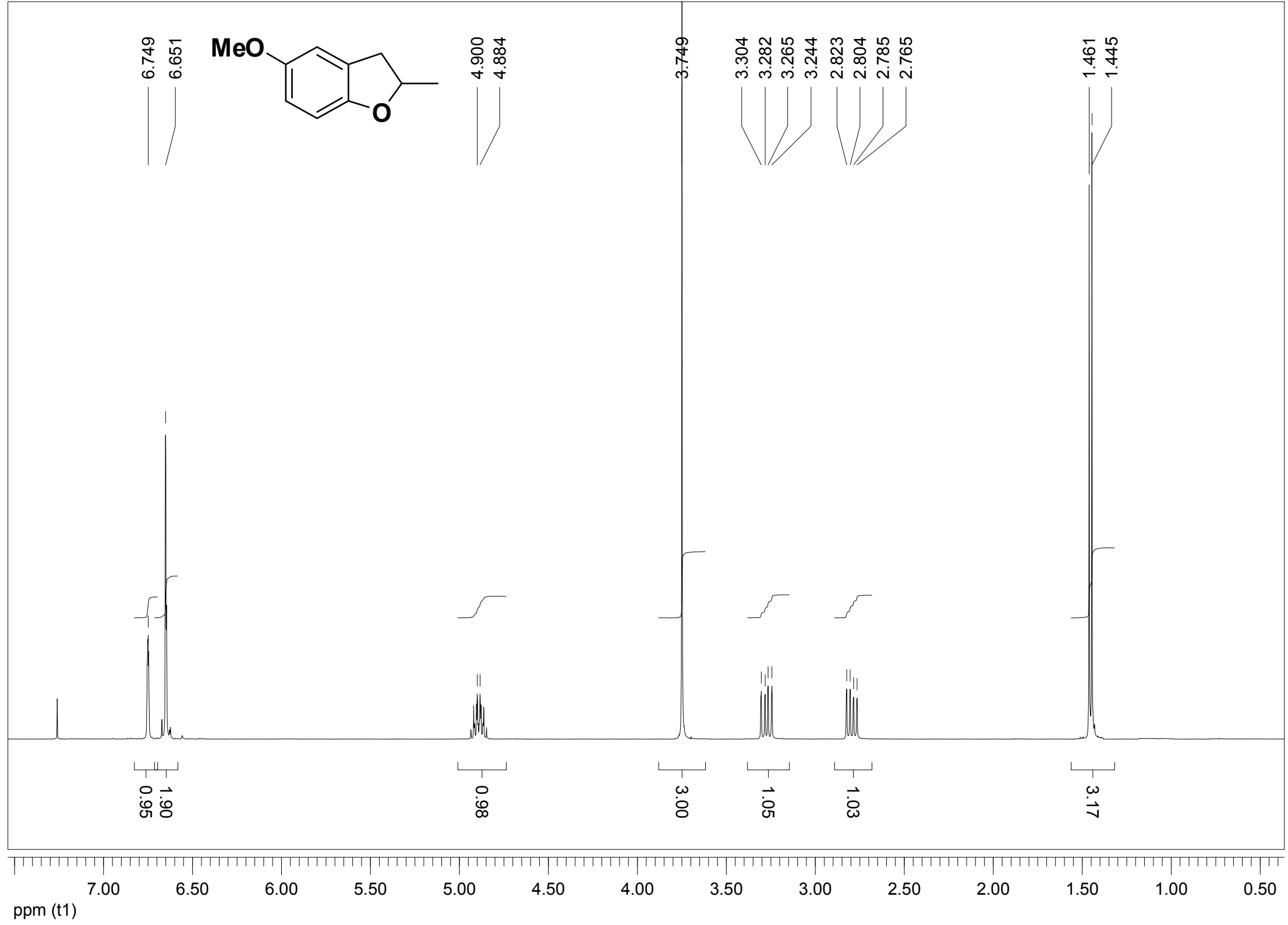

156.631
151.124
133.044
131.196
129.001
128.822
128.497
127.759
126.602
126.255
123.016
122.661
122.572
121.962
119.650
118.201
113.106
112.392
92.811
77.621
37.655
37.320
35.605
28.206
27.370
24.062
19.757
17.509
17.005
O
+
O
77.621
150
125
100
75
50
25
ppm (t1)


129.001
128.824
128.501
127.760
126.604
126.256
123.017
122.664
122.574
121.963
119.650
112.393
37.653
37.320
35.603
28.206
27.375
24.062
19.755
17.511
17.008
O
+
O
125
100
75
50
25
ppm (t1)


7.916
7.896
7.861
7.841
7.723
7.701
7.574
7.554
7.423
7.167
7.144
3.099
3.094
1.946
1.622
1.594
1.584
1.336
1.179
0.981
O
2.13
1.04
1.05
0.98
0.84
1.77
11.80
3.00
2.98
8.00
7.50
7.00
6.50
6.00
5.50
5.00
4.50
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
ppm (t1)


151.187
133.219
128.554
127.758
126.229
122.989
121.900
120.074
112.931
O
75.283
44.972
39.512
35.937
34.071
33.843
30.826
26.712
18.826
18.441
17.239
150
125
100
75
50
25
ppm (t1)


128.518
127.759
126.231
122.990
121.902
120.076
44.969
39.511
35.943
34.077
33.841
26.712
18.828
18.439
O
125
100
75
50
25
0
ppm (t1)


6.749
6.651
MeO
O
4.900
4.884
3.749
3.304
3.282
3.265
3.244
2.823
2.804
2.785
2.765
1.461
1.445
0.95
1.90
0.98
3.00
1.05
1.03
3.17
7.00
6.50
6.00
5.50
5.00
4.50
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
ppm (t1)