Supporting Information

Silver(I)-Catalyzed Selective Hydroalkoxylation of C2-Alkynyl Quinazolinones to Synthesize Quinazolinone-Fused Eight-Membered N,O-Heterocycles

Xiang-Fei Kong,[a,b,‡] Xiu-Yun Guo,[a,‡] Zi-Yu Gu,[a] Lin-Su Wei,[a] Lu-Lu Liu,[a] Dong-Liang Mo,[a,*] Cheng-Xue Pan,[a,*] Gui-Fa Su[a,*]

[a]*State Key Laboratory for Chemistry and Molecular Engineering of Medicinal Resources, Ministry of Science and Technology of China; School of Chemistry and Pharmaceutical Sciences, Guangxi Normal University, 15 Yu Cai Road, Guilin 541004, China. E-mail: moeastlight@mailbox.gxnu.edu.cn; chengxuepan@163.com; gfysglgx@163.com*

[b]*College of Chemistry and Bioengineering, Guilin University of Technology, 12 Jian Gan Road, Guilin 541004, China*

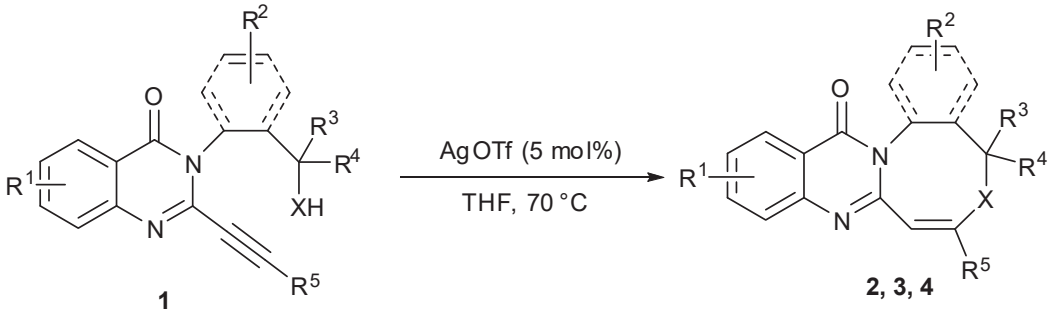
[‡]These authors contributed equally.

Contents

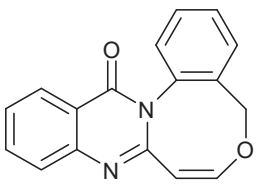
1. General Experimental Information:

^{1}H NMR and ^{13}C NMR spectra were recorded at ambient temperature using 400 or 500 MHz spectrometers. The data are reported as follows: chemical shift in ppm from internal tetramethylsilane on the δ scale, multiplicity (br = broad, s = singlet, d = doublet, t = triplet, q = quartet, m = multiplet), coupling constants (Hz), and integration. High resolution mass spectra were acquired on an LTQ FT spectrometer, and were obtained by peak matching. Melting points are reported uncorrected. Analytical thin layer chromatography was performed on 0.25 mm extra hard silica gel plates with UV254 fluorescent indicator. Chromatography was performed using with 300-400 mesh silica gel (SiO_2). Unless otherwise noted, all reactions were performed under air atmosphere. All reagents and solvents were obtained from commercial sources and, where appropriate, purified prior to use.

2. Synthesis of compounds 2, 3, 4, and 5

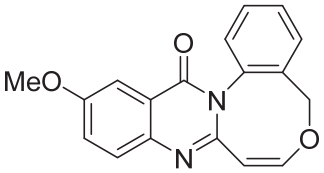


General procedure A: In a Teflon-sealed flask was charged with compound **1** (0.36 mmol), AgOTf (5 mol%) and THF (10.0 mL) under N_2. The reaction vessel was stirred vigorously at 70 °C for 11 h until the substrate **1** disappeared (monitored by TLC). At this time, the solvent was removed under reduced pressure and the crude product was purified by flash column chromatography (the crude residue was dry loaded with silica gel, dichloromethane as the eluent) to afford compounds **2**, **3**, **4**, and **5.**



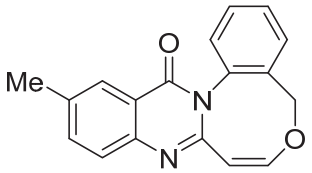
2a

(*Z*)-5*H*,14*H*-Benzo[6,7][1,5]oxazocino[4,5-*b*]quinazolin-14-one (2a). white solid; 0.090 g, 90% yield; m.p. 238–239 ºC. ^{1}H NMR (500 MHz, $CDCl_3$) δ 8.29–8.25 (m, 1H), 7.80–7.75 (m, 1H), 7.70 (d, J = 8.1 Hz, 1H), 7.58–7.53 (m, 3H), 7.47 (t, J = 7.5 Hz, 1H), 7.43–7.40 (m, 1H), 6.13 (d, J = 9.0 Hz, 1H), 5.39 (d, J = 9.0 Hz, 1H), 5.09 (d, J = 12.2 Hz, 1H), 4.93 (d, J = 12.2 Hz, 1H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 162.4, 151.3, 147.9, 146.3, 138.4, 134.8, 131.2, 129.9, 128.9, 127.6, 127.1, 127.0, 126.9, 120.7, 99.7, 66.7. IR (KBr): 2951, 1634, 1608, 1560, 1406, 1326, 1074, 747, 699 cm^{-1}; HRMS (ESI) *m/z* calcd for $C_{17}H_{13}N_2O_2$ $[M+H]^+$ 277.0972, found 277.0953.



2b

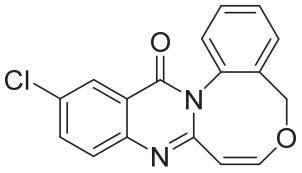
(*Z*)-12-Methoxy-5*H*,14*H*-benzo[6,7][1,5]oxazocino[4,5-*b*]quinazolin-14-one (2b). white solid; 0.102 g, 93% yield; m.p. 254–256 °C. ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.67–7.61 (m, 2H), 7.57–7.53 (m, 3H), 7.43–7.36 (m, 2H), 6.11 (d, J = 9.0 Hz, 1H), 5.36 (d, J = 9.0 Hz, 1H), 5.08 (d, J = 12.2 Hz, 1H), 4.92 (d, J = 12.2 Hz, 1H), 3.91 (s, 3H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 162.3, 158.6, 149.1, 146.0, 142.5, 138.7, 131.2, 129.9, 129.0, 128.8, 127.7, 125.1, 121.5, 106.6, 99.7, 66.7, 55.8. IR (KBr): 2924, 1666, 1624, 1551, 1485, 1328, 1269, 1023, 833, 741 cm^{-1}; HRMS (ESI) *m/z* calcd for $C_{18}H_{15}N_2O_3$ $[M+H]^+$ 307.1077, found 307.1068.



2c

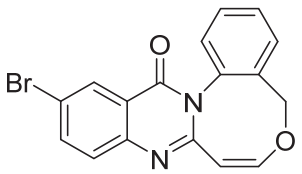
(*Z*)-12-Methyl-5*H*,14*H*-benzo[6,7][1,5]oxazocino[4,5-*b*]quinazolin-14-one (2c). white solid; 0.077 g, 74% yield; m.p. 229–231 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.05 (s, 1H), 7.61–7.52 (m, 5H), 7.42–7.38 (m, 1H), 6.12 (d, J = 9.0 Hz, 1H), 5.37 (d, J = 9.0 Hz, 1H), 5.08 (d, J = 12.2 Hz, 1H), 4.92 (d, J = 12.2 Hz, 1H), 2.49 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 162.4, 150.5, 146.1, 145.9, 138.6, 137.2, 136.3, 131.2, 129.91, 129.86, 129.0, 127.7, 127.0, 126.5, 120.5, 99.8, 66.7, 21.3. IR (KBr): 2922,

1667, 1629, 1487, 1270, 999, 751, 658 cm^{-1}; HRMS (ESI) *m/z* calcd for $C_{18}H_{15}N_2O_2$ $[M+H]^+$ 291.1128, found 291.1118.



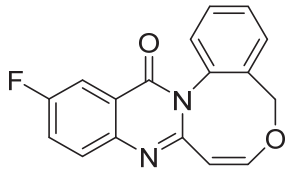
2d

(*Z*)-12-Chloro-5*H*,14*H*-benzo[6,7][1,5]oxazocino[4,5-*b*]quinazolin-14-one (2d). white solid; 0.098 g, 88% yield; m.p. 226–227 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.21 (d, J = 2.4 Hz, 1H), 7.72–7.68 (m, 1H), 7.66–7.62 (m, 1H), 7.58–7.54 (m, 3H), 7.42–7.37 (m, 1H), 6.15 (d, J = 9.0 Hz, 1H), 5.36 (d, J = 9.0 Hz, 1H), 5.08 (d, J = 12.2 Hz, 1H), 4.94 (d, J = 12.2 Hz, 1H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 161.4, 151.6, 146.7, 146.4, 138.2, 135.3, 132.7, 131.3, 130.13, 130.06, 128.82, 128.77, 127.5, 126.4, 121.8, 99.4, 66.7. IR (KBr): 3156, 2849, 1693, 1630, 1550, 1471, 1270, 1084, 876, 749 cm^{-1}; HRMS (ESI) *m/z* calcd for $C_{17}H_{12}N_2O_2Cl$ $[M+H]^+$ 311.0582, found 311.0572.



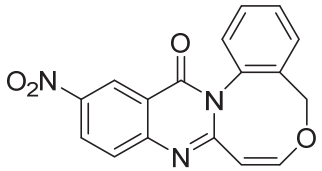
2e

(*Z*)-12-Bromo-5*H*,14*H*-benzo[6,7][1,5]oxazocino[4,5-*b*]quinazolin-14-one (2e). white solid; 0.108 g, 85% yield; m.p. 228–229 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.37 (d, J = 2.3 Hz, 1H), 7.87–7.82 (m, 1H), 7.58–7.54 (m, 4H), 7.41–7.37 (m, 1H), 6.15 (d, J = 9.0 Hz, 1H), 5.35 (d, J = 9.0 Hz, 1H), 5.08 (d, J = 12.2 Hz, 1H), 4.94 (d, J = 12.2 Hz, 1H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 161.3, 151.8, 146.8, 146.6, 138.2, 138.0, 131.3, 130.1, 130.0, 129.6, 128.9, 128.8, 127.5, 122.1, 120.4, 99.5, 66.7. IR (KBr): 2909, 1676, 1630, 1467, 1320, 1112, 1023, 832, 770 cm^{-1}; HRMS (ESI) *m/z* calcd for $C_{17}H_{12}N_2O_2Br$ $[M+H]^+$ 355.0077, found 355.0065.



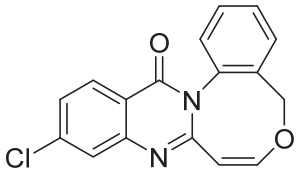
2f

(*Z*)-12-Fluoro-5*H*,14*H*-benzo[6,7][1,5]oxazocino[4,5-*b*]quinazolin-14-one (2f). white solid; 0.101 g, 95% yield; m.p. 160–162 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.92–7.87 (m, 1H), 7.73–7.68 (m, 1H), 7.59–7.54 (m, 3H), 7.52–7.46 (m, 1H), 7.44–7.38 (m, 1H), 6.14 (d, J = 9.0 Hz, 1H), 5.36 (d, J = 9.0 Hz, 1H), 5.08 (d, J = 12.2 Hz, 1H), 4.94 (d, J = 12.2 Hz, 1H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 162.1 (d, J = 247.3), 161.7 (d, J = 3.4 Hz), 150.7 (d, J = 2.2 Hz), 146.4, 144.6, 138.2, 131.3, 130.1, 130.0, 129.6 (d, J = 8.2 Hz), 128.9, 127.5, 123.5 (d, J = 24.0 Hz), 122.0 (d, J = 8.8 Hz), 112.1 (d, J = 23.6 Hz), 99.4, 66.6. IR (KBr): 2909, 1634, 1608, 1470, 1325, 1268, 1 1074, 774, 699 cm^{-1}; HRMS (ESI) *m/z* calcd for $C_{17}H_{12}N_2O_2F$ $[M+H]^+$ 295.0877, found 295.0869.



2g

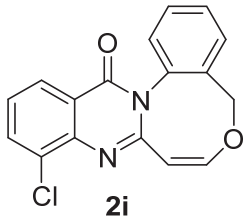
(*Z*)-12-Nitro-5*H*,14*H*-benzo[6,7][1,5]oxazocino[4,5-*b*]quinazolin-14-one (2g). white solid; 0.089 g, 77% yield; m.p. 242–243 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 9.10 (d, J = 2.6 Hz, 1H), 7.57–7.52 (m, 1H), 7.79 (d, J = 9.0 Hz, 1H), 7.62–7.56 (m, 3H), 7.42–7.37 (m, 1H), 6.23 (d, J = 9.0 Hz, 1H), 5.40 (d, J = 9.0 Hz, 1H), 5.12 (d, J = 12.2 Hz, 1H), 4.99 (d, J = 12.2 Hz, 1H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 161.4, 154.8, 152.1, 147.7, 145.6, 137.8, 131.5, 130.5, 130.3, 128.9, 128.7, 127.4, 123.8, 120.8, 99.3, 66.8. IR (KBr): 2941, 1627, 1611, 1549, 1470, 1346, 1270, 1060, 847, 697 cm^{-1}; HRMS (ESI) *m/z* calcd for $C_{17}H_{12}N_3O_4$ $[M+H]^+$ 322.0822, found 322.0823.



2h

(*Z*)-11-Chloro-5*H*,14*H*-benzo[6,7][1,5]oxazocino[4,5-*b*]quinazolin-14-one (2h).

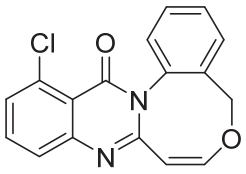
white solid; 0.105 g, 94% yield; m.p. 231–232 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.19 (d, J = 8.5 Hz, 1H), 7.69 (d, J = 1.9 Hz, 1H), 7.59–7.53 (m, 3H), 7.44–7.37 (m, 2H), 6.15 (d, J = 9.0 Hz, 1H), 5.36 (d, J = 9.0 Hz, 1H), 5.08 (d, J = 12.2 Hz, 1H), 4.94 (d, J = 12.2 Hz, 1H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 161.8, 152.7, 148.9, 146.7, 141.1, 138.2, 131.3, 130.1, 130.0, 128.8, 128.6, 127.6, 127.5, 126.7, 119.2, 99.5, 66.7. IR (KBr): 2962, 1627, 1599, 1460, 1404, 1349, 1262, 928, 877, 763 cm^{-1}; HRMS (ESI) *m/z* calcd for $C_{17}H_{12}N_2O_2Cl$ $[M+H]^+$ 311.0582, found 311.0571.



2i

(*Z*)-10-Chloro-5*H*,14*H*-benzo[6,7][1,5]oxazocino[4,5-*b*]quinazolin-14-one (2i).

white solid; 0.102 g, 91% yield; m.p. 176–178 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.21–8.17 (m, 1H), 7.87–7.83 (m, 1H), 7.59–7.53 (m, 3H), 7.41–7.35 (m, 2H), 6.16 (d, J = 9.0 Hz, 1H), 5.48 (d, J = 9.0 Hz, 1H), 5.10 (d, J = 12.2 Hz, 1H), 4.94 (d, J = 12.2 Hz, 1H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 162.0, 152.2, 146.9, 144.8, 138.3, 135.0, 131.5, 131.3, 130.2, 130.1, 128.9, 127.5, 126.8, 125.9, 122.4, 99.7, 66.7. IR (KBr): 2904, 1638, 1570, 1439, 1267, 1081, 742 cm^{-1}; HRMS (ESI) *m/z* calcd for $C_{17}H_{12}N_2O_2Cl$ $[M+H]^+$ 311.0582, found 311.0573.

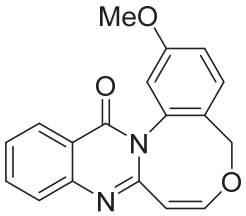


2j

(*Z*)-13-Chloro-5*H*,14*H*-benzo[6,7][1,5]oxazocino[4,5-*b*]quinazolin-14-one (2j).

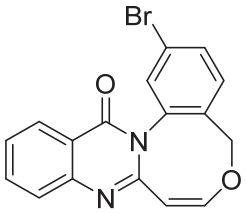
white solid; 0.102 g, 91% yield; m.p. 228–229 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.21 (d, J = 2.4 Hz, 1H), 7.72–7.68 (m, 1H), 7.64 (d, J = 8.7 Hz, 1H), 7.59–7.53 (m, 3H), 7.41–7.36 (m, 1H), 6.15 (d, J = 9.0 Hz, 1H), 5.36 (d, J = 9.0 Hz, 1H), 5.08 (d, J = 12.2 Hz, 1H), 4.94 (d, J = 12.2 Hz, 1H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 161.4, 151.6, 146.7, 146.4, 138.2, 135.3, 132.7, 131.3, 130.1, 130.0, 128.8, 128.7, 127.5, 126.4,

121.8, 99.4, 66.7. IR (KBr): 3160, 2909, 1630, 1549, 1325, 1113, 997, 833, 771 cm^{-1}; HRMS (ESI) *m/z* calcd for $C_{17}H_{12}N_2O_2Cl$ $[M+H]^+$ 311.0582, found 311.0573.



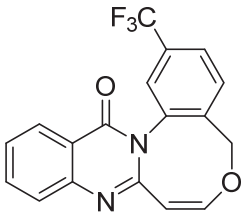
2k

(*Z*)-2-Methoxy-5*H*,14*H*-benzo[6,7][1,5]oxazocino[4,5-*b*]quinazolin-14-one (2k). white solid; 0.073 g, 66% yield; m.p. 155–156 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.28 (d, J = 8.0 Hz, 1H), 7.81–7.68 (m, 2H), 7.50–7.42 (m, 2H), 7.10–7.06 (m, 1H), 6.90 (d, J = 2.6 Hz, 1H), 6.14 (d, J = 9.0 Hz, 1H), 5.38 (d, J = 9.0 Hz, 1H), 5.02 (d, J = 12.3 Hz, 1H), 4.88 (d, J = 12.3 Hz, 1H), 3.84 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 162.3, 160.5, 151.4, 147.9, 146.5, 139.6, 134.8, 132.1, 127.1, 126.9, 121.3, 120.7, 116.9, 111.9, 99.5, 66.4, 55.6. IR (KBr): 3011, 2909, 1633, 1608, 1510, 1469, 1299, 1170, 1026, 805, 698 cm^{-1}; HRMS (ESI) *m/z* calcd for $C_{18}H_{15}N_2O_3$ $[M+H]^+$ 307.1077, found 307.1068.



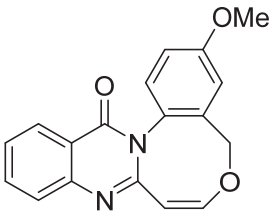
2l

(*Z*)-2-Bromo-5*H*,14*H*-benzo[6,7][1,5]oxazocino[4,5-*b*]quinazolin-14-one (2l). white solid; 0.105 g, 82% yield; m.p. 175–176 °C. ^{1}H NMR (500 MHz, $CDCl_3$) δ 8.26 (d, J = 8.0 Hz, 1H), 7.79 (t, J = 7.7 Hz, 1H), 7.72–7.65 (m, 2H), 7.60 (d, J = 1.8 Hz, 1H), 7.49 (t, J = 7.5 Hz, 1H), 7.41 (d, J = 8.3 Hz, 1H), 6.14 (d, J = 9.0 Hz, 1H), 5.39 (d, J = 9.0 Hz, 1H), 5.04 (d, J = 12.3 Hz, 1H), 4.90 (d, J = 12.3 Hz, 1H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 162.1, 150.8, 147.7, 146.3, 139.4, 135.1, 133.3, 132.4, 130.8, 128.0, 127.2, 127.1, 127.1, 123.3, 120.5, 99.6, 66.1. IR (KBr): 2941, 1635, 1607, 1406, 1325, 1256, 1078, 827, 766 cm^{-1}; HRMS (ESI) *m/z* calcd for $C_{17}H_{12}N_2O_2Br$ $[M+H]^+$ 355.0077, found 355.0066.



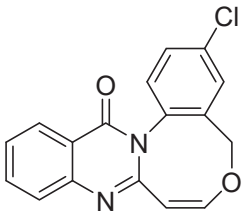
2m

(*Z*)-2-(Trifluoromethyl)-5*H*,14*H*-benzo[6,7][1,5]oxazocino[4,5-*b*]quinazolin-14-one (2m). white solid; 0.121 g, 98% yield; m.p. 147–150 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.27 (d, J = 7.9 Hz, 1H), 7.84–7.64 (m, 5H), 7.50 (t, J = 7.5 Hz, 1H), 6.15 (d, J = 9.0 Hz, 1H), 5.42 (d, J = 9.0 Hz, 1H), 5.12 (d, J = 12.2 Hz, 1H), 4.98 (d, J = 12.2 Hz, 1H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 162.2, 150.6, 147.8, 146.3, 138.8, 135.2, 132.6 (q, J = 16.0 Hz), 132.1 (q, J = 16.0 Hz), 132.0, 127.3, 127.2, 127.1, 126.7 (q, J = 3.5 Hz), 125.3 (q, J = 3.9 Hz), 124.6 (q, J = 271.2 Hz), 120.5, 99.7, 66.0. IR (KBr): 3057, 2941, 1634, 1609, 1558, 1425, 1255, 1145, 1076, 886, 697 cm^{-1}; HRMS (ESI) *m/z* calcd for $C_{18}H_{12}N_2O_2F_3$ $[M+H]^+$ 345.0845, found 345.0831.



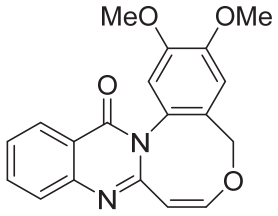
2n

(*Z*)-3-Methoxy-5*H*,14*H*-benzo[6,7][1,5]oxazocino[4,5-*b*]quinazolin-14-one (2n). white solid; 0.067 g, 61% yield; m.p. 251–253 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.29–8.24 (m, 1H), 7.79–7.73 (m, 1H), 7.71–7.67 (m, 1H), 7.49–7.43 (m, 1H), 7.33 (d, J = 8.8 Hz, 1H), 7.10–7.06 (m, 1H), 7.01 (d, J = 2.8 Hz, 1H), 6.15 (d, J = 9.0 Hz, 1H), 5.39 (d, J = 9.0 Hz, 1H), 5.04 (d, J = 12.1 Hz, 1H), 4.86 (d, J = 12.1 Hz, 1H), 3.88 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 162.6, 160.2, 151.6, 147.9, 146.3, 134.8, 131.1, 129.9, 128.7, 127.1, 127.0, 126.8, 120.7, 116.2, 115.2, 99.7, 66.9, 55.6. IR (KBr): 2906, 1637, 1604, 1502, 1290, 1143, 930, 783, 697 cm^{-1}; HRMS (ESI) *m/z* calcd for $C_{18}H_{15}N_2O_3$ $[M+H]^+$ 307.1077, found 307.1064.



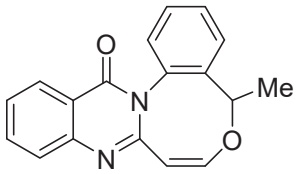
2o

(*Z*)-3-Chloro-5*H*,14*H*-benzo[6,7][1,5]oxazocino[4,5-*b*]quinazolin-14-one (2o). white solid; 0.076 g, 68% yield; m.p. 219–211 °C. ^{1}H NMR (500 MHz, $CDCl_3$) δ 8.27–8.24 (m, 1H), 7.81–7.76 (m, 1H), 7.69 (d, J = 8.1 Hz, 1H), 7.55–7.45 (m, 3H), 7.37 (d, J = 8.4 Hz, 1H), 6.15 (d, J = 9.0 Hz, 1H), 5.39 (d, J = 9.0 Hz, 1H), 5.04 (d, J = 12.3 Hz, 1H), 4.88 (d, J = 12.3 Hz, 1H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 162.3, 150.9, 147.8, 146.2, 136.8, 135.5, 135.0, 131.1, 130.5, 130.2, 129.2, 127.3, 127.2, 127.1, 120.5, 99.7, 66.2. IR (KBr): 2909, 1647, 1607, 1564, 1407, 1291, 1102, 898, 766, 693 cm^{-1}; HRMS (ESI) *m/z* calcd for $C_{17}H_{12}N_2O_2Cl$ $[M+H]^+$ 311.0582, found 311.0570.



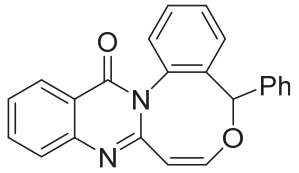
2p

(*Z*)-2,3-Dimethoxy-5*H*,14*H*-benzo[6,7][1,5]oxazocino[4,5-*b*]quinazolin-14-one (2p). white solid; 0.025 g, 21% yield; m.p. 213–215 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.28 (d, J = 7.8 Hz, 1H), 7.81–7.68 (m, 2H), 7.48 (t, J = 7.4 Hz, 1H), 6.95–6.84 (m, 2H), 6.17 (d, J = 7.9 Hz, 1H), 5.40 (d, J = 8.2 Hz, 1H), 5.03 (d, J = 12.1 Hz, 1H), 4.86 (d, J = 12.1 Hz, 1H), 3.96 (s, 3H), 3.90 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 162.5, 151.8, 150.2, 150.1, 147.9, 146.6, 134.9, 131.7, 127.1, 126.9, 121.2, 120.7, 112.2, 109.9, 99.6, 67.0, 56.2, 56.1. IR (KBr): 2974, 1673, 1627, 1551, 1470, 1308, 1172, 825, 785 cm^{-1}; HRMS (ESI) *m/z* calcd for $C_{19}H_{17}N_2O_4$ $[M+H]^+$ 337.1183, found 337.1169.



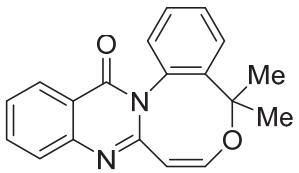
2q

(*Z*)-5-Methyl-5*H*,14*H*-benzo[6,7][1,5]oxazocino[4,5-*b*]quinazolin-14-one (2q). white solid; 0.059 g, 56% yield; m.p. 240–242 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.30–8.26 (m, 1H), 7.80–7.75 (m, 1H), 7.70 (d, J = 7.6 Hz, 1H), 7.64–7.60 (m, 1H), 7.59–7.44 (m, 3H), 7.39–7.36 (m, 1H), 6.12 (d, J = 9.0 Hz, 1H), 5.45 (q, J = 6.5 Hz, 1H), 5.33 (d, J = 9.0 Hz, 1H), 1.71 (d, J = 6.5 Hz, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 162.5, 151.8, 148.0, 147.1, 137.9, 134.8, 132.5, 129.9, 129.4, 127.5, 127.1, 127.0, 126.9, 126.0, 120.8, 99.5, 70.0, 18.1. IR (KBr): 2924, 1674, 1627, 1457, 1266, 1198, 950, 752 cm^{-1}; HRMS (ESI) *m/z* calcd for $C_{18}H_{15}N_2O_2$ $[M+H]^+$ 291.1128, found 291.1117.



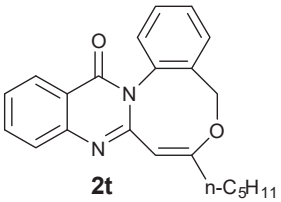
2r

(*Z*)-5-Phenyl-5*H*,14*H*-benzo[6,7][1,5]oxazocino[4,5-*b*]quinazolin-14-one (2r). The reaction time was 18 h; white solid; 0.094 g, 74% yield; m.p. 160–162 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.91–7.88 (m, 1H), 7.67–7.56 (m, 4H), 7.44 (d, J = 8.1 Hz, 1H), 7.33–7.25 (m, 2H), 7.15 (d, J = 8.3 Hz, 2H), 6.90 (t, J = 7.8 Hz, 2H), 6.64–6.58 (m, 1H), 6.52 (s, 1H), 6.33 (d, J = 8.9 Hz, 1H), 5.49 (d, J = 8.9 Hz, 1H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 161.0, 151.0, 147.5, 145.2, 137.9, 137.3, 134.1, 133.4, 131.2, 130.2, 129.9, 129.6, 127.7, 126.8, 126.5, 126.4, 126.3, 123.7, 120.1, 102.6, 83.5. IR (KBr): 3160, 2909, 1675, 1638, 1607, 1473, 1348, 1130, 999, 774, 695 cm^{-1}; HRMS (ESI) *m/z* calcd for $C_{23}H_{17}N_2O_2$ $[M+H]^+$ 353.1285, found 353.1272.



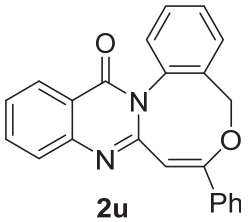
2s

(*Z*)-5,5-Dimethyl-5*H*,14*H*-benzo[6,7][1,5]oxazocino[4,5-*b*]quinazolin-14-one (2s). white solid; 0.053 g, 48% yield; m.p. 235–236 °C. ^{1}H NMR (500 MHz, $CDCl_3$) δ 8.34–8.30 (m, 1H), 7.81–7.72 (m, 2H), 7.52–7.43 (m, 2H), 7.40–7.34 (m, 2H), 7.02 (d, J = 7.2 Hz, 1H), 6.42 (d, J = 5.0 Hz, 1H), 6.14 (d, J = 5.0 Hz, 1H), 1.84 (s, 3H), 1.61 (s, 3H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 163.0, 152.1, 149.1, 147.3, 140.4, 137.5, 134.6, 130.8, 129.7, 129.0, 127.3, 127.2, 126.9, 126.6, 121.5, 117.3, 82.4, 29.9, 26.2. IR (KBr): 3080, 2981, 1669, 1627, 1583, 1488, 1334, 1260, 1063, 887, 701 cm^{-1}; HRMS (ESI) *m/z* calcd for $C_{19}H_{17}N_2O_2$ $[M+H]^+$ 305.1285, found 305.1273.



2t

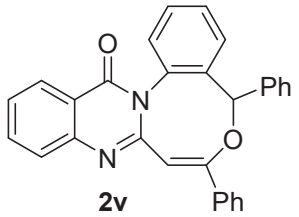
(*Z*)-7-Pentyl-5*H*,14*H*-benzo[6,7][1,5]oxazocino[4,5-*b*]quinazolin-14-one (2t). white solid; 0.046 g, 37% yield; m.p. 138–140 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.27 (d, J = 7.4 Hz, 1H), 7.81–7.70 (m, 2H), 7.58–7.41 (m, 5H), 5.41 (s, 1H), 5.08 (d, J = 12.2 Hz, 1H), 4.92 (d, J = 12.2 Hz, 1H), 2.17–2.08 (m, 1H), 1.98–1.88 (m, 1H), 1.36–1.25 (m, 4H), 1.19–1.07 (m, 2H), 0.77 (t, J = 7.3 Hz, 3H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 162.3, 152.0, 138.3, 134.9, 130.9, 129.7, 129.5, 127.3, 127.1, 126.9, 126.8, 120.5, 96.4, 66.5, 36.9, 30.5, 26.5, 22.3, 13.9. IR (KBr): 2924, 2854, 1681, 1641, 1557, 1339, 1272, 771, 670 cm^{-1}; HRMS (ESI) *m/z* calcd for $C_{22}H_{23}N_2O_2$ $[M+H]^+$ 347.1754, found 347.1744.



2u

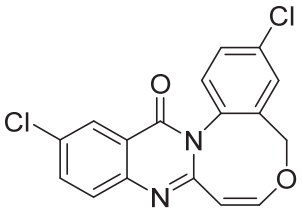
(*Z*)-7-Phenyl-5*H*,14*H*-benzo[6,7][1,5]oxazocino[4,5-*b*]quinazolin-14-one (2u). The reaction time was 34 h. white solid; 0.070 g, 55% yield; m.p. 219–220 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.35–8.28 (m, 1H), 7.83–7.73 (m, 2H), 7.64–7.59 (m, 1H), 7.57–7.44 (m, 6H), 7.34–7.27 (m, 3H), 6.04 (s, 1H), 5.26 (d, J = 12.3 Hz, 1H), 5.14 (d, J = 12.3 Hz, 1H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 162.3, 155.2, 151.8, 148.0, 138.3,

136.3, 134.9, 130.9, 129.9, 129.5, 129.1, 128.2, 127.4, 127.2, 127.1, 126.9, 126.4, 120.7, 97.8, 67.2. IR (KBr): 3160, 2909, 1682, 1637, 1608, 1558, 1332, 1269, 1075, 896, 686 cm^{-1}; HRMS (ESI) *m/z* calcd for $C_{23}H_{17}N_2O_2$ $[M+H]^+$ 353.1285, found 353.1272.



2v

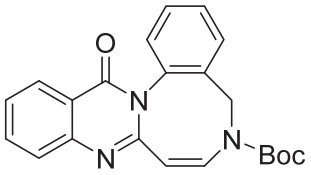
(*Z*)-5,7-Diphenyl-5*H*,14*H*-benzo[6,7][1,5]oxazocino[4,5-*b*]quinazolin-14-one (2v). The reaction time was 67 h. white solid; 0.143 g, 93% yield; m.p. 212–214 °C. ^1H NMR (400 MHz, $CDCl_3$) δ 8.39–8.35 (m, 1H), 7.84–7.75 (m, 2H), 7.70–7.63 (m, 2H), 7.55–7.44 (m, 5H), 7.42–7.31 (m, 7H), 7.19 (d, J = 7.5 Hz, 1H), 6.66 (s, 1H), 6.11 (s, 1H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 162.4, 155.4, 151.9, 148.1, 138.5, 138.0, 136.7, 135.0, 133.4, 130.0, 129.6, 129.5, 129.0, 128.4, 128.3, 128.0, 127.3, 127.2, 127.0, 126.9, 126.6, 126.3, 120.9, 98.1, 75.4. IR (KBr): 2918, 1631, 1606, 1579, 1556, 1471, 1344, 1026, 753, 695 cm^{-1}; HRMS (ESI) *m/z* calcd for $C_{29}H_{21}N_2O_2$ $[M+H]^+$ 429.1598, found 429.1587.



2w

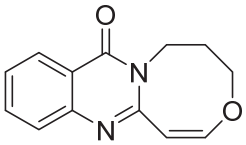
(*Z*)-3,12-Dichloro-5*H*,14*H*-benzo[6,7][1,5]oxazocino[4,5-*b*]quinazolin-14-one (2w). white solid; 0.093 g, 75% yield; m.p. 233–235 °C. ^1H NMR (400 MHz, $CDCl_3$) δ 8.19 (d, J = 2.4 Hz, 1H), 7.73–7.68 (m, 1H), 7.63 (d, J = 8.7 Hz, 1H), 7.54 – 7.50 (m, 2H), 7.35 (d, J = 8.7 Hz, 1H), 6.16 (d, J = 9.0 Hz, 1H), 5.36 (d, J = 9.0 Hz, 1H), 5.02 (d, J = 12.3 Hz, 1H), 4.88 (d, J = 12.3 Hz, 1H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 161.3, 151.1, 146.5, 146.4, 136.5, 135.7, 135.4, 132.9, 131.2, 130.5, 130.4, 129.1, 128.9, 126.4, 121.6, 99.5, 66.2. IR (KBr): 3092, 2954, 1676, 1631, 1572, 1555, 1300, 1097, 827, 767 cm^{-1}; HRMS (ESI) *m/z* calcd for $C_{17}H_{11}N_2O_2Cl$ $[M+H]^+$ 345.0192, found

345.0181.



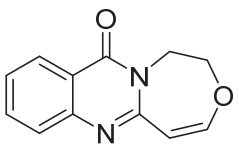
2x

***Tert*-Butyl (*Z*)-14-oxo-5*H*-benzo[7,8][1,5]diazocino[2,1-*b*]quinazoline-6(14*H*)-carboxylate (2x).** white solid; 0.037 g, 27% yield; m.p. 124–126 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.27 (d, J = 7.2 Hz, 1H), 7.80–7.74 (m, 1H), 7.70 (d, J = 8.1 Hz, 1H), 7.51–7.45 (m, 4H), 7.40–7.35 (m, 1H), 6.81 (s, 1H), 5.44 (d, J = 9.5 Hz, 2H), 4.18 (s, 1H), 1.52 (s, 9H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 171.1, 162.4, 151.8, 151.7, 147.8, 137.6, 134.8, 130.6, 130.1, 128.9, 127.6, 127.1, 126.9, 120.8, 101.5, 83.2, 60.3, 28.1, 21.0, 14.2. IR (KBr): 2924, 1637, 1615, 1551, 1360, 1130, 1089, 837, 754, 699 cm^{-1}; HRMS (ESI) *m/z* calcd for $C_{22}H_{22}N_3O_3$ $[M+H]^+$ 376.1656, found 376.1636.



2y

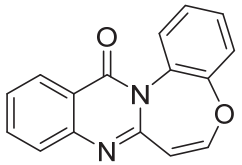
(*Z*)-5,6-Dihydro-4*H*,8*H*-[1,5]oxazocino[4,5-*b*]quinazolin-8-one (2y). white solid; 0.033 g, 40% yield; m.p. 176–178 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.26–8.22 (m, 1H), 7.74–7.69 (m, 1H), 7.62 (d, J = 8.0 Hz, 1H), 7.45–7.39 (m, 1H), 6.69 (d, J = 8.6 Hz, 1H), 5.34 (d, J = 8.6 Hz, 1H), 4.44 (s, 2H), 4.16–4.10 (m, 2H), 2.15–2.07 (m, 2H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 162.0, 152.9, 152.7, 148.1, 134.4, 126.9, 126.6, 126.4, 120.2, 97.8, 66.0, 41.7, 26.6. IR (KBr): 3042, 2974, 1637, 1607, 1557, 1473, 1251, 1068, 771, 702 cm^{-1}; HRMS (ESI) *m/z* calcd for $C_{13}H_{13}N_2O_2$ $[M+H]^+$ 229.0972, found 229.0963.



3

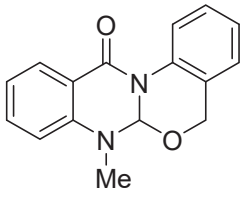
1,2-Dihydro-11*H*-[1,4]oxazepino[5,4-*b*]quinazolin-11-one (3). white solid; 0.025 g, 33% yield; m.p. 164–166 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.25–8.21 (m, 1H),

7.74–7.69 (m, 1H), 7.61 (d, J = 8.0 Hz, 1H), 7.43–7.38 (m, 1H), 6.75 (d, J = 8.5 Hz, 1H), 5.64 (d, J = 8.5 Hz, 1H), 4.45 (s, 2H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 161.4, 152.2, 150.6, 148.3, 134.5, 127.0, 126.9, 126.2, 118.8, 101.5, 71.4, 42.7. IR (KBr): 2922, 1640, 1605, 1470, 1361, 1086, 837, 699 cm^{-1}; HRMS (ESI) *m/z* calcd for $C_{12}H_{11}N_2O_2$ $[M+H]^+$ 215.0815, found 215.0806.



4

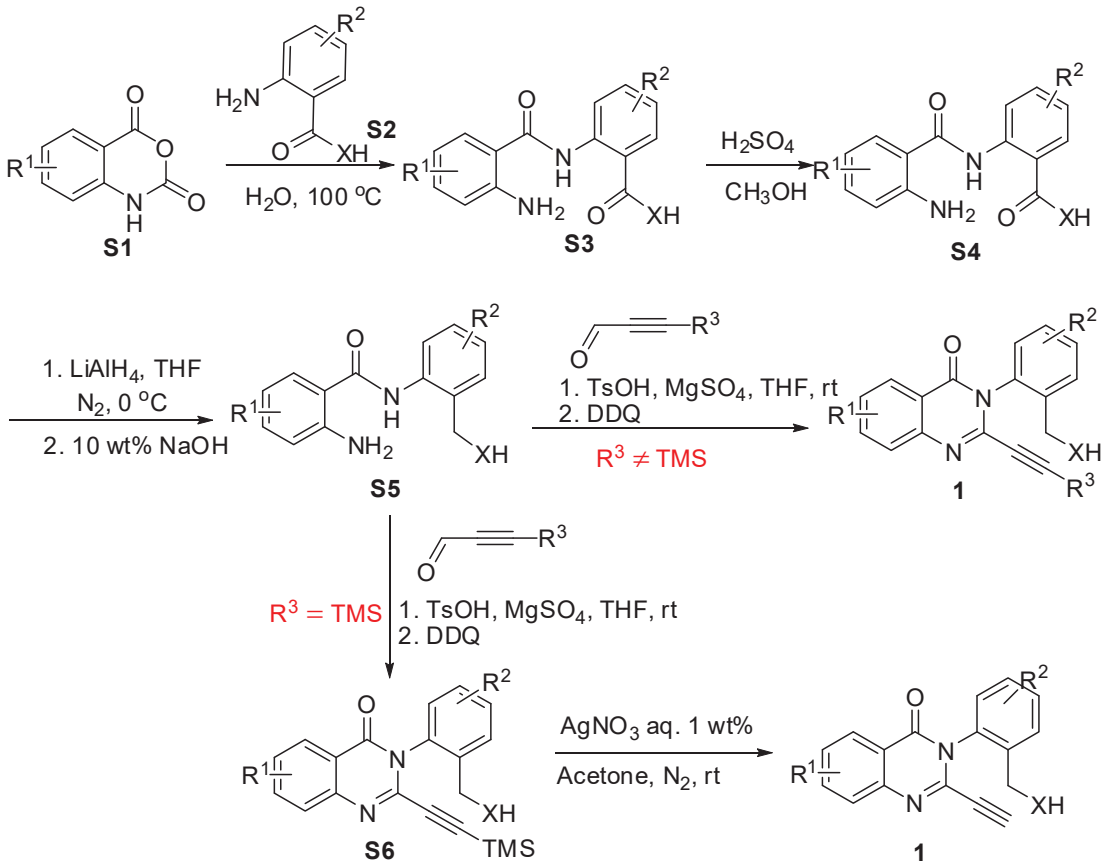
13*H*-Benzo[2,3][1,4]oxazepino[5,4-*b*]quinazolin-13-one (4). white solid; 0.027 g, 29% yield; m.p. 187–188 °C. ^{1}H NMR (500 MHz, $CDCl_3$) δ 8.25 (d, *J* = 7.7 Hz, 1H), 7.80–7.76 (m, 2H), 7.50–7.44 (m, 1H), 7.30–7.26 (m, 1H), 6.84 (d, *J* = 5.9 Hz, 1H), 6.67 (d, *J* = 5.9 Hz, 1H), 6.62–6.57 (m, 1H), 6.45 (d, *J* = 10.0 Hz, 1H), 6.07 (d, *J* = 8.7 Hz, 1H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 160.9, 158.6, 158.0, 149.3, 142.4, 141.4, 134.6, 134.5, 129.5, 128.0, 127.7, 127.0, 126.7, 125.2, 120.9. IR (KBr): 2922, 1638, 1631, 1556, 1323, 1137, 1070, 843, 750 cm^{-1}; HRMS (ESI) *m/z* calcd for $C_{16}H_{11}N_2O_2$ $[M+H]^+$ 263.0815, found 263.0805.



5

7-Methyl-6a,7-dihydro-5H,12H-benzo[4,5][1,3]oxazino[2,3-b]quinazolin-12-one (5). white solid; 0.022 g, 23% yield; m.p. 101–102 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.12–8,08 (m, 1H), 7.84 (d, *J* = 8.1 Hz, 1H), 7.51–7.45 (m, 1H), 7.33 (t, *J* = 8.0 Hz, 1H), 7.25–7.19 (m, 1H), 7.06 (d, *J* = 7.6 Hz, 1H), 6.94 (t, *J* = 7.4 Hz, 1H), 6.77 (d, *J* = 8.3 Hz, 1H), 5.92 (s, 1H), 5.16 (d, *J* = 15.4 Hz, 1H), 5.04 (d, *J* = 15.4 Hz, 1H), 3.14 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 161.0, 144.2, 136.4, 134.5, 129.0, 127.2, 126.5, 126.1, 125.8, 124.3, 118.9, 113.6, 111.3, 94.6, 67.2, 34.9. HRMS (ESI) *m/z* calcd for $C_{16}H_{15}N_2O_2$ $[M+H]^+$ 267.1128, found 267.1132.

3. Synthesis of compound 1



General procedure B[1-4]**: S1** (15.3 mmol) and **S2** (16.8 mmol) were added to water (50 mL), and the mixture was stirred at 100 °C for 12 h in air. After the completion of the reaction (TLC), the reaction mixture was cooled for a while, and then filtrated. The filter cake was washed by warm water, then dried and give **S3** as a pale yellow solid.

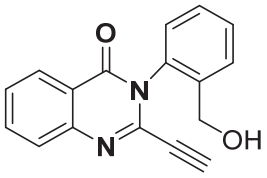
S3 (15 mmol) was added to methanol (75 mL), and then concentrated sulfuric acid (98%, 3 mL) was added dropwise to the solution. The mixture was stirred at 70 °C for 48 h under nitrogen. After the completion of the reaction (TLC), methanol was removed under reduced pressure. NaOH 10 wt% aqueous solution was added to the residue till the pH value is 7. The precipitation obtained was filtrated, and the filter cake collected was purified by column chromatography on silica gel (dichloro-methane/petroleum ether 1/1) to give intermediate product **S4**.

Lithium aluminium hydride (0.38 g, 10 mmol) was added in portions to a stirred

solution of **S4** (5 mmol) in THF (30 mL) at 0 ^{o}C. Then the mixture was stirred for 4 h at 0 ^{o}C under nitrogen. After the completion of the reaction (TLC), NaOH solution (10 wt%) was added dropwise at 0 ^{o}C until the precipitate of $Al(OH)_3$ was formed. The filtrate was collected by filtration. After removal of the solvent under reduced pressure, the residue was purified by column chromatography on silica gel (dichloromethane) to afford intermediate product **S5**.

The *p*-toluenesulfonic acid (0.130 g, 0.76 mmol) was added to a stirred mixture of **S5** (2.53 mmol), aldehyde (0.48 g, 3.80 mmol) and anhydrous magnesium sulfate (1.40 g, 11.67 mmol) in THF (20 mL) under N_2 atmosphere. The mixture was stirred at rt for 3 h. After the completion of the reaction (TLC), DDQ was added to it. Continuing to stir for 0.5 h at rt, the solvent was removed under reduced pressure. The crude product was purified by column chromatography on silica gel (dichloromethane) to give intermediate product **S6**.

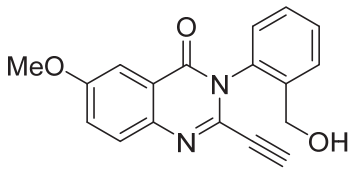
A solution of $AgNO_3$ (1 wt%, 2.6 mL, 0.15 mmol) was added to a stirred solution of **S6** (1.5 mmol) in acetone (20 mL). Then the mixture was stirred for 2.5 h at rt in the dark. After the completion of the reaction (TLC), NaCl (0.2 g) was added to the clear solution to precipitate the silver ion. After dried (Na_2SO_4) and removal of the solvent by vacuum, the residue was purified by column chromatography on silica gel (dichloromethane/ethyl acetate 40/1) to give compounds **1**.



1a

2-Ethynyl-3-(2-(hydroxymethyl)phenyl)quinazolin-4(3*H*)-one (1a). White solid; 0.330 g, 63% yield for the last step; m.p. 183–184 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.30–8.26 (m, 1H), 7.85–7.77 (m, 2H), 7.65 (d, J = 7.6 Hz, 1H), 7.58–7.50 (m, 2H), 7.48–7.42 (m, 1H), 7.27–7.22 (m, 1H), 4.48 (s, 2H), 3.07 (s, 1H), 2.85 (s, 1H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 161.6, 147.4, 138.6, 138.5, 135.14, 135.07, 130.3, 129.7,

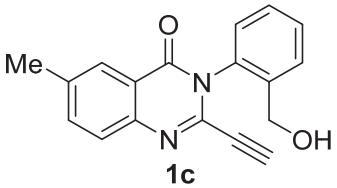
128.9, 128.8, 128.4, 127.7, 127.2, 121.7, 83.4, 76.1, 61.2. IR (KBr): 3452, 2972, 2110, 1670, 1556, 1470, 1385, 1337, 1268, 1049, 772, 695 cm^{-1}; HRMS (ESI) *m/z* calcd for $C_{17}H_{12}N_2O_2$ $[M+H]^+$ 277.0972, found 277.0951.



1b

2-Ethynyl-3-(2-(hydroxymethyl)phenyl)-6-methoxyquinazolin-4(3*H*)-one (1b).

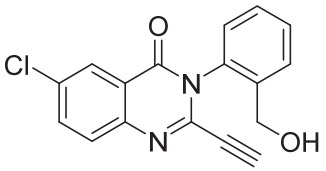
White solid; 0.250 g, 43% yield for the last step; m.p. 301–303 °C. ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.74 (d, J = 9.0 Hz, 1H), 7.68–7.65 (m, 2H), 7.58–7.54 (m, 1H), 7.50–7.46 (m, 1H), 7.44–7.40 (m, 1H), 7.29–7.26 (m, 1H), 4.52–4.48 (m, 2H), 3.93 (s, 3H), 3.03 (s, 1H), 2.45–2.37 (m, 1H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 161.8, 159.8, 142.1, 138.3, 136.3, 135.6, 130.4, 130.1, 129.6, 129.1, 129.0, 125.3, 122.8, 106.7, 82.7, 76.3, 61.6, 56.0. IR (KBr): 3285, 2924, 1693, 1615, 1551, 1490, 1450, 1360, 1325, 1261, 1127, 1086, 1048, 1014, 837, 761, 704 cm^{-1}; HRMS (ESI) *m/z* calcd for $C_{18}H_{15}N_2O_3$ $[M+H]^+$ 307.1077, found 307.1068.



1c

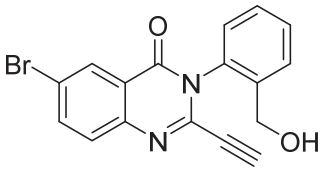
2-Ethynyl-3-(2-(hydroxymethyl)phenyl)-6-methylquinazolin-4(3*H*)-one (1c)

White solid; 0.342 g, 62% yield for the last step; m.p. 162–163 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.08 (s, 1H), 7.71–7.68 (m, 1H), 7.66–7.62 (m, 2H), 7.56–7.51 (m, 1H), 7.49–7.43 (m, 1H), 7.27–7.23 (m, 1H), 4.48 (d, J = 5.9 Hz, 2H), 3.03 (s, 1H), 2.63 (t, J = 6.1 Hz, 1H), 2.51 (s, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 161.8, 145.5, 139.0, 138.4, 137.8, 136.5, 135.4, 130.3, 129.9, 129.0, 128.9, 127.6, 126.7, 121.5, 83.0, 76.2, 61.4, 21.4. IR (KBr): 3203, 2922, 1684, 1611, 1579, 1553, 1489, 1340, 1323, 1273, 1198, 1137, 1013, 950, 828, 749, 665 cm^{-1}; HRMS (ESI) *m/z* calcd for $C_{18}H_{15}N_2O_2$ $[M+H]^+$ 291.1128, found 291.1119.



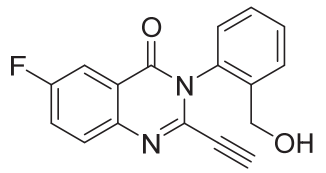
1d

6-Chloro-2-ethynyl-3-(2-(hydroxymethyl)phenyl)quinazolin-4(3*H*)-one (1d). White solid; 0.424 g, 72% yield for the last step; m.p. 185–187 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.25 (d, J = 1.7 Hz, 1H), 7.78–7.71 (m, 2H), 7.66–7.62 (m, 1H), 7.58–7.52 (m, 1H), 7.50–7.45 (m, 1 H), 7.27–7.22 (m, 1H), 4.49 (d, J = 6.1 Hz, 2H), 3.09 (s, 1H), 2.45 (t, J = 6.1 Hz, 1H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 160.7, 145.9, 138.8, 138.3, 135.5, 135.1, 134.4, 130.5, 129.9, 129.4, 129.1, 128.9, 126.6, 122.8, 83.8, 76.0, 61.5. IR (KBr): 3280, 3169, 2849, 1690, 1573, 1548, 1470, 1336, 1318, 1270, 1207, 1025, 829, 788, 709 cm^{-1}; HRMS (ESI) *m/z* calcd for $C_{17}H_{12}N_2O_2Cl$ $[M+H]^+$ 311.0582, found 311.0570.



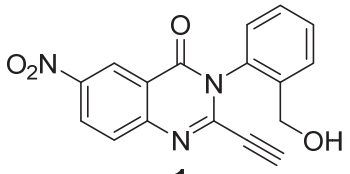
1e

6-Bromo-2-ethynyl-3-(2-(hydroxymethyl)phenyl)quinazolin-4(3*H*)-one (1e). White solid; 0.377 g, 56% yield for the last step; m.p. 178–180 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.41 (d, J = 2.3 Hz, 1H), 7.92–7.87 (m, 1H), 7.67–7.61 (m, 2H), 7.57–7.52 (m, 1H), 7.50–7.45 (m, 1H), 7.27–7.23 (m, 1H), 4.49 (d, J = 6.0 Hz, 2H), 3.10 (s, 1H), 2.47 (t, J = 6.1 Hz, 1H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 160.5, 146.3, 139.0, 138.28, 138.26, 135.1, 130.5, 129.9, 129.7, 129.5, 129.1, 128.9, 123.1, 122.2, 83.8, 76.0, 61.5. IR (KBr): 3281, 3173, 3071, 2879, 1670, 1571, 1546, 1466, 1335, 1315, 1270, 1207, 1132, 1016, 828, 768, 680 cm^{-1}; HRMS (ESI) *m/z* calcd for $C_{17}H_{12}N_2O_2Br$ $[M+H]^+$ 355.0077, found 355.0064.



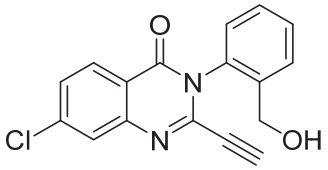
1f

2-Ethynyl-6-fluoro-3-(2-(hydroxymethyl)phenyl)quinazolin-4(3*H*)-one (1f). White solid; 0.430 g, 77% yield for the last step; m.p. 175–177 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.96–7.91 (m, 1H), 7.85–7.79 (m, 1H), 7.67–7.63 (m, 1H), 7.58–7.53 (m, 2H), 7.51–7.46 (m, 2H), 7.28–7.25 (m, 1H), 4.51 (d, J = 6.0 Hz, 2H), 3.07 (s, 1H), 2.36 (t, J = 6.1 Hz, 1H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 163.1 (d, J = 247. 4 Hz), 161.0 (d, J = 3.4 Hz), 144.2 (d, J = 2.1 Hz), 138.3, 138.0 (d, J = 2.7 Hz), 135.2, 130.51, 130.45, 130.4, 130.0, 129.2, 128.9, 123.8, 123.6, 123.3 (d, J = 8.9 Hz), 112.4, 112.2, 83.4, 76.0, 61.6. IR (KBr): 3234, 3156, 2849, 1697, 1557, 1482, 1405, 1343, 1322, 1250, 1123, 1058, 839, 749, 713 cm^{-1}; HRMS (ESI) *m/z* calcd for $C_{17}H_{12}N_2O_2F$ $[M+H]^+$ 295.0877, found 295.0868.



1g

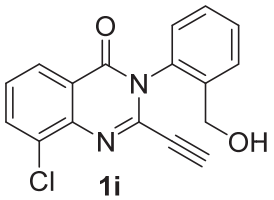
2-Ethynyl-3-(2-(hydroxymethyl)phenyl)-6-nitroquinazolin-4(3*H*)-one (1g). White solid; 0.476 g, 78% yield for the last step; m.p. 209~211 °C. ^{1}H NMR (500 MHz, $CDCl_3$) δ 9.14 (d, J = 2.6 Hz, 1H), 8.62–8.58 (m, 1H), 7.92 (d, J = 9.0 Hz, 1H), 7.66–7.62 (m, 1H), 7.61–7.56 (m, 1H), 7.54–7.48 (m, 1H), 7.31–7.27 (m, 1H), 4.55 (d, J = 6.1 Hz, 2H), 3.21 (s, 1H), 2.07 (t, J = 6.1 Hz, 1H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 160.5, 151.4, 146.6, 141.7, 138.0, 134.9, 130.8, 130.0, 129.5, 129.4, 129.0, 128.9, 123.8, 122.2, 85.5, 75.9, 61.9. IR (KBr): 3265, 3090, 3036, 2922, 1969, 1678, 1615, 1554, 1522, 1470, 1345, 1268, 1189, 1131, 1070, 1028, 937, 861, 763, 680 cm^{-1}; HRMS (ESI) *m/z* calcd for $C_{17}H_{12}N_3O_4$ $[M+H]^+$ 322.0822, found 322.0824.



1h

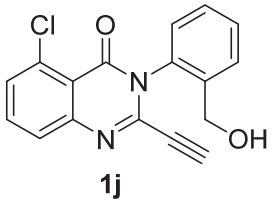
7-Chloro-2-ethynyl-3-(2-(hydroxymethyl)phenyl)quinazolin-4(3*H*)-one (1h). White solid; 0.566 g, 96% yield for the last step; m.p. 85–86 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.24–8.19 (m, 1H), 7.81–7.75 (m, 1H), 7.64 (d, J = 7.6 Hz, 1H), 7.57–7.45

(m, 3H), 7.26–7.20 (m, 1H), 4.49 (s, 2H), 3.10 (s, 1H), 2.50 (s, 1H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 161.1, 148.4, 141.4, 139.8, 138.3, 135.1, 130.5, 129.9, 129.1, 129.0, 128.9, 128.6, 127.3, 120.2, 84.0, 75.9, 61.5. IR (KBr): 2954, 1686, 1601, 1570, 1552, 1461, 1421, 1320, 1272, 1127, 1074, 1016, 926, 879, 782, 763 cm^{-1}; HRMS (ESI) *m/z* calcd for $C_{17}H_{12}N_2O_2Cl$ $[M+H]^+$ 311.0582, found 311.0572.



1i

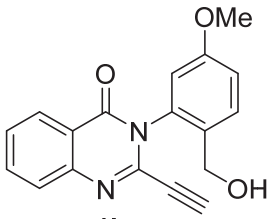
8-Chloro-2-ethynyl-3-(2-(hydroxymethyl)phenyl)quinazolin-4(3*H*)-one (1i). White solid; 0.483 g, 82% yield for the last step; m.p. 120–121 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.24–8.18 (m, 1H), 7.93–7.87 (m, 1H), 7.67–7.61 (m, 1H), 7.58–7.52 (m, 1H), 7.50–7.43 (m, 2H), 7.27–7.23 (m, 1H), 4.49 (s, 2H), 3.12 (s, 1H), 2.50–2.28 (m, 1H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 161.2, 144.4, 139.2, 138.2, 135.3, 135.1, 132.2, 130.5, 129.8, 129.1, 128.8, 128.4, 126.0, 123.4, 84.4, 76.1, 61.5. IR (KBr): 3141, 2904, 1683, 1596, 1569, 1549, 1437, 1334, 1315, 1274, 1185, 1023, 896, 766, 652 cm^{-1}; HRMS (ESI) *m/z* calcd for $C_{17}H_{12}N_2O_2Cl$ $[M+H]^+$ 311.0582, found 311.0572.



1j

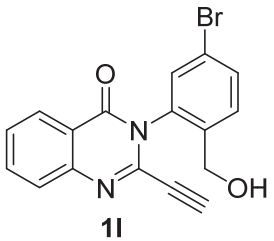
5-Chloro-2-ethynyl-3-(2-(hydroxymethyl)phenyl)quinazolin-4(3*H*)-one (1j). White solid; 0.407 g, 69% yield for the last step; m.p. 183–184 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.28–8.25 (m, 1H), 7.79–7.72 (m, 2H), 7.67–7.63 (m, 1H), 7.59–7.53 (m, 1H), 7.52–7.46 (m, 1H), 7.29–7.26 (m, 1H), 4.51 (d, J = 6.0 Hz, 2H), 3.09 (s, 1H), 2.28 (t, J = 6.1 Hz, 1H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 160.7, 146.0, 138.8, 138.2, 135.5, 135.2, 134.5, 130.5, 130.0, 129.5, 129.2, 128.9, 126.6, 122.9, 83.8, 76.0, 61.6. IR (KBr): 3160, 2879, 1699, 1570, 1549, 1467, 1333, 1316, 1281, 1131, 1055, 1015, 838, 785, 722 cm^{-1}; HRMS (ESI) *m/z* calcd for $C_{17}H_{12}N_2O_2Cl$ $[M+H]^+$ 311.0582,

found 311.0571.



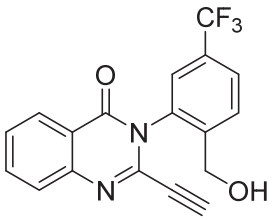
1k

2-Ethynyl-3-(2-(hydroxymethyl)-5-methoxyphenyl)quinazolin-4(3*H*)-one (1k). White solid; 0.471 g, 81% yield for the last step; m.p. 75–77 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.32 (d, J = 7.9 Hz, 1H), 7.87–7.79 (m, 2H), 7.61–7.53 (m, 2H), 7.11–7.06 (m, 1H), 6.81 (d, J = 2.5 Hz, 1H), 4.44 (d, J = 6.3 Hz, 2H), 3.84 (s, 3H), 3.10 (s, 1H), 2.35–2.20 (m, 1H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 161.9, 160.1, 147.5, 138.6, 136.5, 135.1, 131.4, 130.4, 128.5, 127.9, 127.3, 121.8, 116.1, 114.4, 83.2, 76.2, 61.3, 55.6. IR (KBr): 3067, 2909, 1671, 1616, 1579, 1555, 1506, 1470, 1321, 1246, 1175, 1029, 773, 702, 577 cm^{-1}; HRMS (ESI) *m/z* calcd for $C_{18}H_{15}N_2O_3$ $[M+H]^+$ 307.1077, found 307.1069.



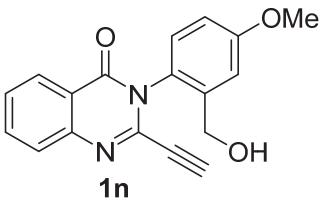
1l

3-(5-Bromo-2-(hydroxymethyl)phenyl)-2-ethynylquinazolin-4(3*H*)-one (1l). White solid; 0.538 g, 80% yield for the last step; m.p. 188–190 °C. ^{1}H NMR (500 MHz, $CDCl_3$) δ 8.31–8.29 (m, 1H), 7.88–7.83 (m, 1H), 7.82–7.80 (m, 1H), 7.70–7.67 (m, 1H), 7.61–7.54 (m, 2H), 7.45 (d, J = 1.9 Hz, 1H), 4.47 (d, J = 6.1 Hz, 2H), 3.14 (s, 1H), 2.41 (t, J = 6.1 Hz, 1H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 161.5, 147.4, 138.0, 137.7, 136.3, 135.3, 133.5, 132.0, 131.1, 128.7, 128.0, 127.3, 121.9, 121.6, 83.7, 76.0, 61.0. IR (KBr): 3314, 3245, 3057, 2941, 1682, 1606, 1582, 1555, 1474, 1331, 1269, 1134, 1033, 891, 824, 780, 696 cm^{-1}; HRMS (ESI) *m/z* calcd for $C_{17}H_{12}N_2O_2Br$ $[M+H]^+$ 355.0077, found 355.0066.



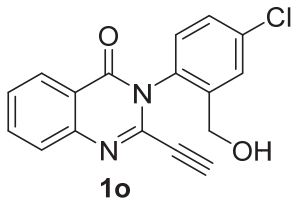
1m

2-Ethynyl-3-(2-(hydroxymethyl)-5-(trifluoromethyl)phenyl)quinazolin-4(3*H*)-one (1m). White solid; 0.536 g, 82% yield for the last step; m.p. 186–187 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.33–8.28 (m, 1H), 7.89–7.78 (m, 4H), 7.63–7.54 (m, 2H), 4.58 (d, J = 6.1 Hz, 2H), 3.10 (s, 1H), 2.43 (t, J = 6.1 Hz, 1H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 161.4, 147.4, 142.6, 137.9, 135.5, 135.4, 131.4 (d, J = 33.2 Hz), 130.1, 128.8, 128.0, 127.3, 127.2 (d, J = 3.6 Hz), 126.3 (d, J = 3.7 Hz), 123.3 (d, J = 270.9 Hz), 121.6, 83.8, 75.9, 61.0. IR (KBr): 3308, 3261, 3064, 2947, 1689, 1606, 1586, 1556, 1474, 1422, 1333, 1267, 1170, 1124, 1076, 1042, 900, 837, 782, 696 cm^{-1}; HRMS (ESI) *m/z* calcd for $C_{18}H_{12}N_2O_2F_3$ $[M+H]^+$ 345.0845, found 345.0832.



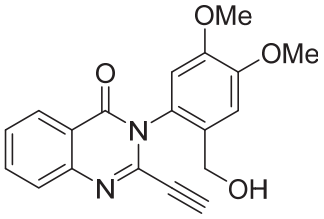
1n

2-Ethynyl-3-(2-(hydroxymethyl)-4-methoxyphenyl)quinazolin-4(3*H*)-one (1n). White solid; 0.541 g, 93% yield for the last step; m.p. 157–158 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.27 (d, J = 7.9 Hz, 1H), 7.83–7.75 (m, 2H), 7.56–7.51 (m, 1H), 7.18–7.12 (m, 2H), 6.96–6.92 (m, 1H), 4.43 (s, 2H), 3.86 (s, 3H), 3.09 (s, 1H), 2.75 (s, 1H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 161.9, 160.7, 147.4, 139.8, 139.1, 135.0, 129.9, 128.3, 127.7, 127.5, 127.2, 121.7, 114.3, 114.2, 83.3, 76.2, 61.4, 55.5. IR (KBr): 2922, 1636, 1651, 1555, 1489, 1303, 1270, 1086, 1033, 849, 766, 699 cm^{-1}; HRMS (ESI) *m/z* calcd for $C_{18}H_{15}N_2O_3$ $[M+H]^+$ 307.1077, found 307.1065.



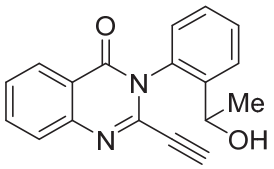
1o

3-(4-Chloro-2-(hydroxymethyl)phenyl)-2-ethynylquinazolin-4(3*H*)-one (1o). White solid; 0.465 g, 79% yield for the last step; m.p. 65–67 °C. ^{1}H NMR (500 MHz, $CDCl_3$) δ 8.30–8.25 (m, 1H), 7.85–7.78 (m, 2H), 7.67 (d, J = 2.4 Hz, 1H), 7.59–7.55 (m, 1H), 7.45–7.41 (m, 1H), 7.20 (d, J = 8.4 Hz, 1H), 4.47 (d, J = 6.2 Hz, 2H), 3.11 (s, 1H), 2.57 (t, J = 6.2 Hz, 1H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 161.4, 147.4, 140.4, 138.3, 136.3, 135.3, 133.5, 130.2, 129.6, 129.0, 128.6, 127.9, 127.2, 121.7, 83.6, 76.0, 60.9. IR (KBr): 2909, 1678, 1607, 1564, 1477, 1407, 1328, 1291, 1266, 1235, 1102, 1050, 1022, 898, 766, 698 cm^{-1}; HRMS (ESI) *m/z* calcd for $C_{17}H_{12}N_2O_2Cl$ $[M+H]^+$ 311.0582, found 311.0572.



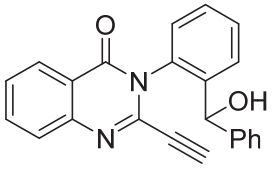
1p

2-Ethynyl-3-(2-(hydroxymethyl)-4,5-dimethoxyphenyl)quinazolin-4(3*H*)-one (1p). White solid; 0.434 g, 68% yield for the last step; m.p. 226–227 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.34–8.30 (m, 1H), 7.87–7.78 (m, 2H), 7.60–7.55 (m, 1H), 7.13 (s, 1H), 6.74 (s, 1H), 4.44–4.40 (m, 2H), 3.98 (s, 3H), 3.88 (s, 3H), 3.11 (s, 1H), 2.41–2.36 (m, 1H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 162.2, 150.3, 149.3, 147.5, 138.9, 135.2, 130.9, 128.5, 127.9, 127.5, 127.3, 121.8, 112.2, 111.6, 83.3, 76.3, 61.4, 56.2, 56.1. IR (KBr): 3481, 3197, 3012, 2941, 1681, 1606, 1579, 1557, 1518, 1470, 1314, 1285, 1253, 1233, 1147, 1080, 1015, 918, 883, 772 cm^{-1}; HRMS (ESI) *m/z* calcd for $C_{19}H_{17}N_2O_4$ $[M+H]^+$ 337.1183, found 337.1169.



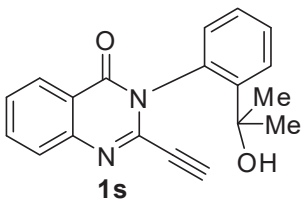
1q

2-Ethynyl-3-(2-(1-hydroxyethyl)phenyl)quinazolin-4(3*H*)-one (1q). White solid; 0.447 g, 81% yield for the last step; m.p. 153–154 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.30 (d, J = 7.9 Hz, 1H), 7.85–7.76 (m, 2H), 7.72 (d, J = 7.7 Hz, 1H), 7.60–7.52 (m, 2H), 7.44 (t, J = 7.7 Hz, 1H), 7.21 (d, J = 7.8 Hz, 1H), 4.83–4.75 (m, 1H), 3.05 (s, 1H), 2.23 (d, J = 3.3 Hz, 1H), 1.42 (d, J = 6.4 Hz, 3H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 161.3, 147.4, 143.0, 138.8, 134.9, 134.4, 130.5, 128.9, 128.7, 128.4, 127.8, 127.21, 127.18, 122.0, 83.3, 76.4, 65.8, 24.1. IR (KBr): 3298, 3157, 2930, 1689, 1583, 1557, 1473, 1323, 1275, 1190, 1097, 1012, 889, 771, 688 cm^{-1}; HRMS (ESI) *m/z* calcd for $C_{18}H_{15}N_2O_2$ $[M+H]^+$ 291.1128, found 291.1118.



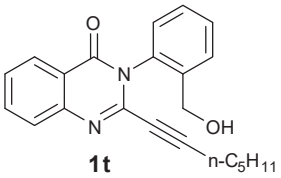
1r

2-Ethynyl-3-(2-(hydroxy(phenyl)methyl)phenyl)quinazolin-4(3*H*)-one (1r). White solid; 0.074 g, 11% yield for the last step; m.p. 155–157 °C. ^{1}H NMR (500 MHz, $CDCl_3$) δ 8.35 (d, J = 7.9 Hz, 1H), 7.88–7.79 (m, 2H), 7.60 (t, J = 7.4 Hz, 1H), 7.52–7.46 (m, 2H), 7.45–7.41 (m, 1H), 7.28–7.23 (m, 6H), 5.72 (s, 1H), 3.25 (s, 1H), 3.05 (s, 1H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 162.1, 147.5, 142.1, 141.4, 138.6, 135.3, 135.1, 130.6, 129.1, 128.9, 128.7, 128.6, 128.3, 127.9, 127.5, 127.4, 126.5, 126.3, 121.7, 83.7, 76.2, 70.8. IR (KBr): 2909, 1678, 1608, 1583, 1556, 1471, 1385, 1321, 1278, 1181, 1122, 1025, 771, 700 cm^{-1}; HRMS (ESI) *m/z* calcd for $C_{23}H_{17}N_2O_2$ $[M+H]^+$ 353.1285, found 353.1271.



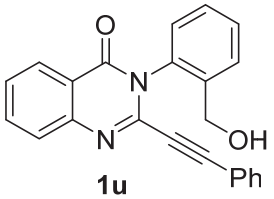
1s

2-Ethynyl-3-(2-(2-hydroxypropan-2-yl)phenyl)quinazolin-4(3*H*)-one (1s). White solid; 0.503 g, 87% yield for the last step; m.p. 86–88 °C. ^{1}H NMR (500 MHz, $CDCl_3$) δ 8.31–8.28 (m, 1H), 7.81–7.76 (m, 2H), 7.57–7.47 (m, 3H), 7.43–7.38 (m, 1H), 7.18–7.14 (m, 1H), 3.07 (s, 1H), 2.05 (s, 1H), 1.59 (s, 3H), 1.56 (s, 3H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 162.5, 147.6, 145.1, 139.6, 134.6, 134.5, 131.0, 129.9, 128.3, 128.0, 127.9, 127.7, 127.1, 122.1, 83.1, 77.3, 73.6, 32.3, 31.9. IR (KBr): 3436, 3080, 2925, 1675, 1608, 1581, 1556, 1471, 1323, 1273, 1118, 1010, 963, 891, 772, 704 cm^{-1}; HRMS (ESI) *m/z* calcd for $C_{19}H_{17}N_2O_2$ $[M+H]^+$ 305.1285, found 305.1274.



1t

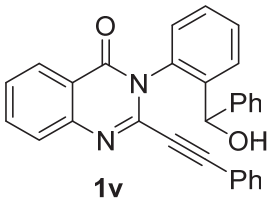
2-(Hept-1-yn-1-yl)-3-(2-(hydroxymethyl)phenyl)quinazolin-4(3*H*)-one (1t). White solid; 0.178 g, 27% yield for the last step; m.p. 184–186 °C. ^{1}H NMR (500 MHz, $CDCl_3$) δ 8.26 (d, J = 7.9 Hz, 1H), 7.80–7.73 (m, 2H), 7.64 (d, J = 7.6 Hz, 1H), 7.52–7.47 (m, 2H), 7.45–7.40 (m, 1H), 7.22 (d, J = 7.7 Hz, 1H), 4.49–4.42 (m, 2H), 2.90 (s, 1H), 2.11 (t, J = 6.9 Hz, 2H), 1.20–1.09 (m, 4H), 1.03–0.95 (m, 2H), 0.82 (t, J = 7.3 Hz, 3H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 162.1, 147.7, 139.8, 138.4, 135.7, 134.9, 130.0, 129.7, 128.8, 128.7, 127.7, 127.4, 127.1, 121.3, 99.3, 74.7, 61.2, 30.5, 27.0, 21.9, 19.0, 13.7. IR (KBr): 3229, 3074, 2924, 2853, 2226, 1695, 1554, 1474, 1357, 1275, 1121, 1049, 772, 692 cm^{-1}; HRMS (ESI) *m/z* calcd for $C_{22}H_{23}N_2O_2$ $[M+H]^+$ 347.1754, found 347.1748.



1u

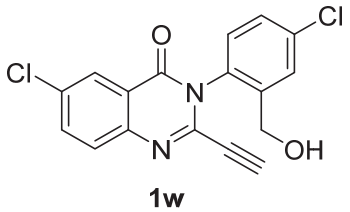
3-(2-(Hydroxymethyl)phenyl)-2-(phenylethynyl)quinazolin-4(3*H*)-one (1u) White solid; 0.207 g, 31% yield for the last step; m.p. 195–197 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.30 (d, J = 7.9 Hz, 1H), 7.82 (d, J = 3.7 Hz, 2H), 7.73 (d, J = 7.6 Hz, 1H), 7.60 (t, J = 7.5 Hz, 1H), 7.55–7.48 (m, 2H), 7.38–7.31 (m, 2H), 7.23 (t, J = 7.7 Hz,

2H), 7.03 (d, J = 7.3 Hz, 2H), 4.59–4.50 (m, 2H), 2.74 (s, 1H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 161.9, 147.8, 140.0, 138.8, 135.9, 135.0, 132.4, 130.3, 130.2, 129.8, 129.1, 128.9, 128.4, 128.0, 127.7, 127.2, 121.4, 119.8, 96.0, 82.7, 61.4. IR (KBr): 2909, 1684, 1553, 1471, 1358, 1282, 1254, 1204, 1174, 1121, 1049, 1011, 893, 756, 689 cm^{-1}; HRMS (ESI) *m/z* calcd for $C_{23}H_{17}N_2O_2$ $[M+H]^+$ 353.1285, found 353.1271.



1v

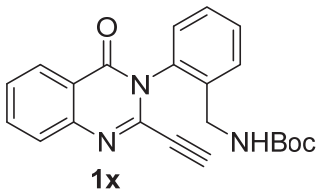
3-(2-(Hydroxy(phenyl)methyl)phenyl)-2-(phenylethynyl)quinazolin-4(3*H*)-one (1v). White solid; 0.090 g, 11% yield for the last step; m.p. 122–124 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.22 (d, J = 7.8 Hz, 1H), 7.80–7.70 (m, 3H), 7.60 (t, J = 7.5 Hz, 1H), 7.54–7.45 (m, 2H), 7.37–7.20 (m, 4H), 7.17 (d, J = 6.8 Hz, 2H), 7.11–6.99 (m, 5H), 5.89 (s, 1H), 3.42 (s, 1H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 162.0, 147.5, 141.6, 141.4, 139.8, 135.6, 134.8, 132.4, 130.4, 130.3, 130.1, 130.0, 129.1, 128.4, 128.1, 127.8, 127.4, 127.2, 127.1, 125.8, 121.5, 119.9, 95.8, 83.0, 73.2. IR (KBr): 3434, 2918, 1698, 1607, 1578, 1552, 1473, 1349, 1279, 1202, 1023, 761, 691 cm^{-1}; HRMS (ESI) *m/z* calcd for $C_{29}H_{21}N_2O_2$ $[M+H]^+$ 429.1598, found 429.1587.



1w

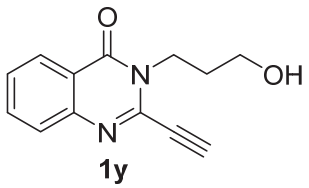
6-Chloro-3-(4-chloro-2-(hydroxymethyl)phenyl)-2-ethynylquinazolin-4(3*H*)-one (1w). White solid; 0.647 g, 99% yield for the last step; m.p. 184–185 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.23 (d, J = 2.2 Hz, 1H), 7.78–7.71 (m, 2H), 7.66 (d, J = 2.3 Hz, 1H), 7.46–7.42 (m, 1H), 7.19 (d, J = 8.4 Hz, 1H), 4.47 (d, J = 6.1 Hz, 2H), 3.14 (s, 1H), 2.45–2.40 (m, 1H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 160.4, 145.9, 140.3, 138.4, 136.5, 135.7, 134.7, 133.3, 130.2, 129.7, 129.5, 129.1, 126.6, 122.7, 84.1, 75.9, 61.0. IR (KBr): 3427, 3186, 2919, 1695, 1573, 1547, 1470, 1314, 1280, 1181, 1048, 1015,

876, 838, 730, 688 cm^{-1}; HRMS (ESI) *m/z* calcd for $C_{17}H_{11}N_2O_2Cl$ $[M+H]^+$ 345.0192, found 345.0179.



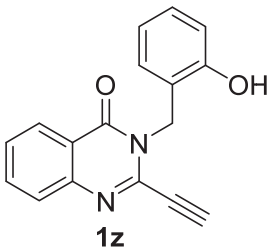
1x

Tert-butyl (2-(2-ethynyl-4-oxoquinazolin-3(4*H*)-yl)benzyl)carbamate (1x). White solid; 0.706 g, 99% yield for the last step; m.p. 184–185 °C. ^{1}H NMR (500 MHz, $CDCl_3$) δ 8.32 (d, J = 8.0 Hz, 1H), 7.85–7.77 (m, 2H), 7.59–7.49 (m, 3H), 7.47–7.42 (m, 1H), 7.27–7.22 (m, 1H), 4.92 (s, 1H), 4.42–4.35 (m, 1H), 4.07–4.00 (m, 1H), 3.07 (s, 1H), 1.34 (s, 9H). ^{13}C NMR (125 MHz, $CDCl_3$) δ 161.3, 155.6, 147.5, 138.6, 136.8, 135.8, 135.0, 130.3, 130.1, 129.1, 128.9, 128.4, 127.9, 127.2, 122.0, 83.2, 79.5, 76.2, 40.9, 28.3. IR (KBr): 3410, 3195, 3063, 2975, 1694, 1667, 1575, 1557, 1506, 1470, 1363, 1336, 1322, 1283, 1170, 1129, 1011, 890, 768, 700 cm^{-1}; HRMS (ESI) *m/z* calcd for $C_{22}H_{22}N_3O_3$ $[M+H]^+$ 376.1656, found 376.1638.



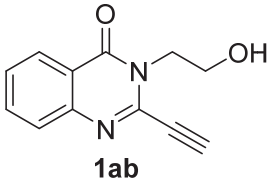
1y

2-Ethynyl-3-(3-hydroxypropyl)quinazolin-4(3*H*)-one (1y). White solid; 0.347 g, 80% yield for the last step; m.p. 137–138 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.30–8.26 (m, 1H), 7.81–7.71 (m, 2H), 7.56–7.51 (m, 1H), 4.50 (t, J = 6.4 Hz, 2H), 3.63–3.56 (m, 2H), 3.48 (s, 1H), 3.17 (t, J = 6.2 Hz, 1H), 2.11–2.03 (m, 2H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 162.2, 147.3, 138.6, 134.8, 128.3, 127.6, 127.0, 121.3, 81.8, 76.3, 58.4, 42.5, 31.9. IR (KBr): 3299, 3148, 2938, 2885, 1675, 1608, 1577, 1555, 1472, 1393, 1364, 1334, 1263, 1172, 1054, 937, 778 cm^{-1}; HRMS (ESI) *m/z* calcd for $C_{13}H_{13}N_2O_2$ $[M+H]^+$ 229.0972, found 229.0963.



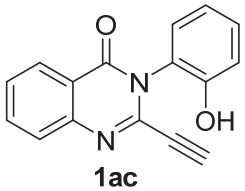
1z

2-Ethynyl-3-(2-hydroxybenzyl)quinazolin-4(3*H*)-one (1z). White solid; 0.514 g, 98% yield for the last step; m.p. 151–153 °C. ^{1}H NMR (400 MHz, $CDCl_3$) δ 9.35 (s, 1H), 8.32–8.28 (m, 1H), 7.83–7.72 (m, 2H), 7.71–7.67 (m, 1H), 7.58–7.52 (m, 1H), 7.28–7.22 (m, 1H), 7.00–6.96 (m, 1H), 6.90–6.85 (m, 1H), 5.52 (s, 2H), 3.72 (s, 1H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 163.0, 156.1, 147.2, 138.0, 135.3, 131.6, 130.9, 128.7, 127.7, 127.0, 121.7, 120.9, 120.3, 118.7, 83.5, 53.4, 45.8. IR (KBr): 3226, 2909, 1672, 1608, 1581, 1554, 1478, 1456, 1386, 1290, 1235, 1171, 1097, 974, 843, 773, 733, 652, 534 cm^{-1}; HRMS (ESI) *m/z* calcd for $C_{17}H_{13}N_2O_2$ $[M+H]^+$ 277.0972, found 277.0961.



1ab

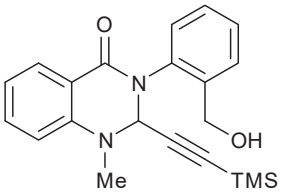
2-Ethynyl-3-(2-hydroxyethyl)quinazolin-4(3*H*)-one (1ab). White solid; 0.041 g, 10% yield for the last step; m.p. 151–153 °C. ^{1}H NMR (500 MHz, DMSO-d_6) δ 8.16–8.12 (m, 1H), 7.87–7.82 (m, 1H), 7.67 (d, J = 7.8 Hz, 1H), 7.60–7.55 (m, 1H), 4.91 (s, 1H), 4.30 (t, J = 6.1 Hz, 2H), 3.69 (t, J = 6.1 Hz, 2H), 3.34 (s, 1H). ^{13}C NMR (125 MHz, DMSO-d_6) δ 160.7, 147.4, 140.0, 135.1, 128.3, 127.6, 126.7, 121.9, 85.5, 77.2, 58.4, 48.5. IR (KBr): 2924, 1642, 1555, 1450, 1355, 1325, 1284, 1152, 1023, 1048, 831, 766, 642 cm^{-1}; HRMS (ESI) *m/z* calcd for $C_{12}H_{11}N_2O_2$ $[M+H]^+$ 215.0815, found 215.0807.



1ac

2-Ethynyl-3-(2-hydroxyphenyl)quinazolin-4(3*H*)-one (1ac) White solid; 0.344 g,

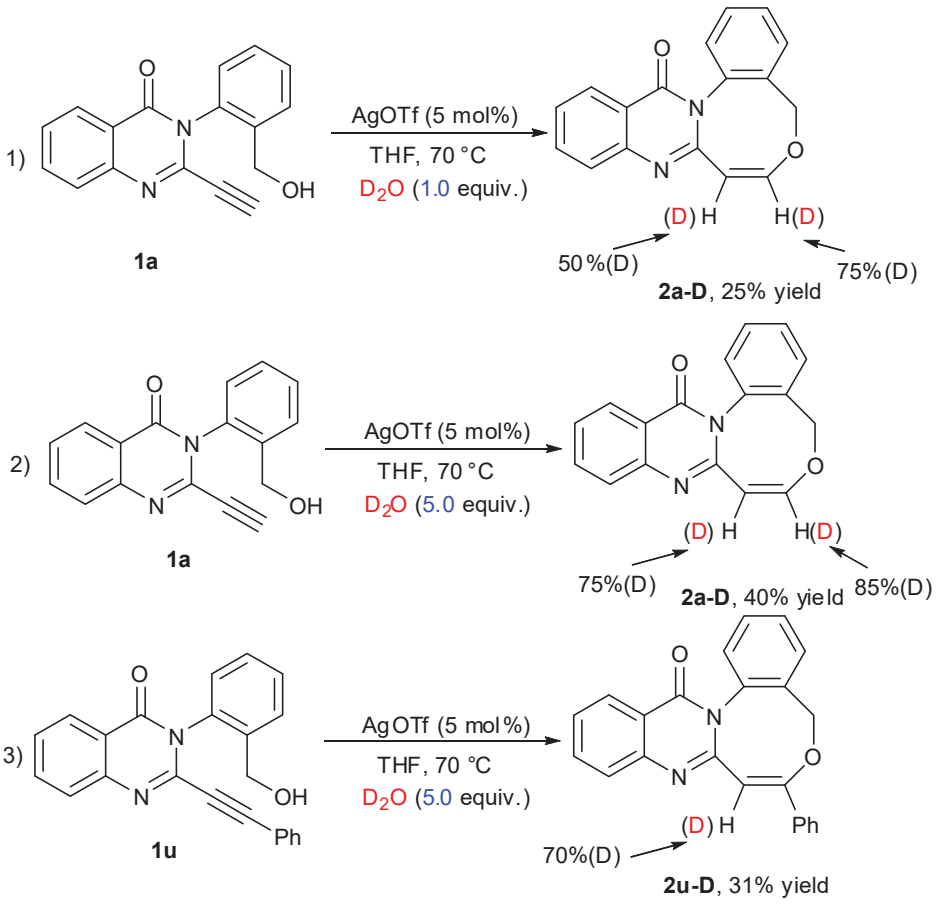
69% yield for the last step; m.p. 288–289 °C. ^{1}H NMR (400 MHz, DMSO-d_6) δ 9.97 (s, 1H), 8.18–8.12 (m, 1H), 7.93–7.87 (m, 1H), 7.74 (d, J = 8.0 Hz, 1H), 7.64–7.59 (m, 1H), 7.36–7.31 (m, 2H), 7.04–6.99 (m, 1H), 6.96–6.91 (m, 1H), 4.45 (s, 1H). ^{13}C NMR (100 MHz, DMSO-d_6) δ 160.1, 153.4, 147.2, 139.6, 134.8, 130.6, 130.0, 128.0, 127.3, 126.4, 124.5, 122.0, 119.2, 116.5, 84.9, 76.8. IR (KBr): 2922, 1638, 1620, 1555, 1407, 1320, 1271, 1137, 1074, 829, 749, 654 cm^{-1}; HRMS (ESI) *m/z* calcd for $C_{16}H_{11}N_2O_2$ $[M+H]^+$ 263.0815, found 263.0803.



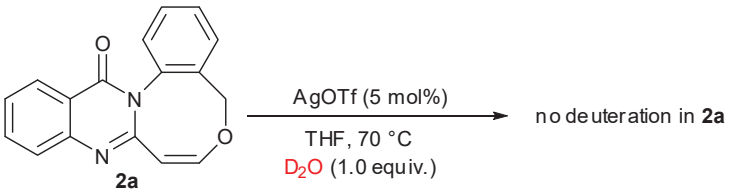
1ad

3-(2-(Hydroxymethyl)phenyl)-1-methyl-2-((trimethylsilyl)ethynyl)-2,3-dihydroquinazolin-4(1H)-one (1ad). white solid; 0.23 g, 56% yield; *one isomer*: ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.08–8.05 (m, 1H), 7.67–7.63 (m, 1H), 7.57–7.53 (m, 1H), 7.52–7.50 (m, 1H), 7.45–7.42 (m, 2H), 7.04–7.00 (m, 1H), 6.79 (s, 1H), 5.38 (s, 1H), 4.88 (d, J = 11.9 Hz, 1H), 4.55–4.48 (m, 1H), 2.95 (s, 3H), 0.07 (s, 9H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 163.5, 147.5, 140.0, 138.3, 134.3, 131.8, 129.8, 129.3, 129.1, 127.4, 112.0, 118.0, 113.2, 99.6, 91.8, 71.7, 62.2, 35.6, -0.4. *another isomer*: ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.05–8.00 (m, 1H), 7.63–7.59 (m, 1H), 7.50–7.47 (m, 1H), 7.42–7.38 (m, 2H), 7.34–7.28 (m, 1H), 7.00–6.96 (m, 1H), 6.77 (s, 1H), 5.22 (s, 1H), 4.64–4.56 (m, 1H), 4.40 (d, J = 11.9 Hz, 1H), 2.91 (s, 3H), 0.04 (s, 9H). ^{13}C NMR (100 MHz, $CDCl_3$) δ 163.1, 147.4, 138.7, 137.7, 134.1, 130.6, 129.6, 129.2, 128.9, 127.0, 119.9, 117.0, 113.1, 98.1, 91.1, 70.5, 62.0, 35.6, -0.5. HRMS (ESI) *m/z* calcd for $C_{21}H_{25}N_2O_2Si$ $[M+H]^+$ 365.1680, found 365.1693.

4. The deuteration experiments

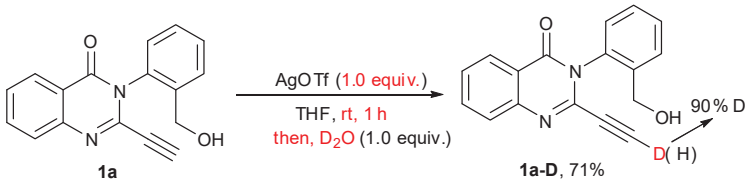


In a Teflon-sealed flask was charged with compound **1a** or **1u** (0.36 mmol), AgOTf (5 mol%), THF (10.0 mL), and D_2O (1.0 equiv., or 5.0 equiv.) under N_2. The reaction vessel was stirred vigorously at 70 °C for 11 h until the substrate disappeared (monitored by TLC). At this time, the solvent was removed under reduced pressure and the crude product was purified by flash column chromatography (the crude residue was dry loaded with silica gel, dichloromethane as the eluent) to afford compounds **2a-D** or **2u-D**.



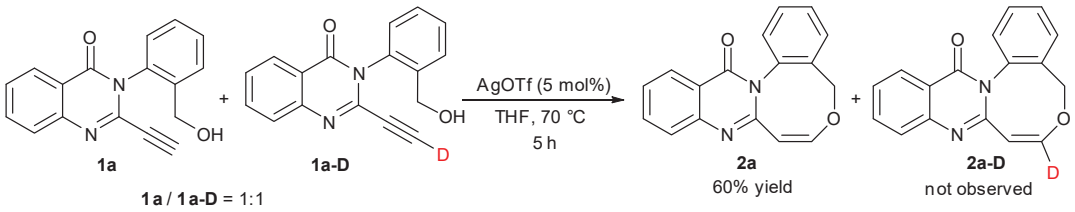
In a Teflon-sealed flask was charged with compound **2a** (0.36 mmol), AgOTf (5 mol%), THF (10.0 mL), and D_2O (1.0 equiv.) under N_2. The reaction vessel was

stirred vigorously at 70 °C for 11 h. At this time, the solvent was removed under reduced pressure and the crude product was detected by ^{1}H NMR.

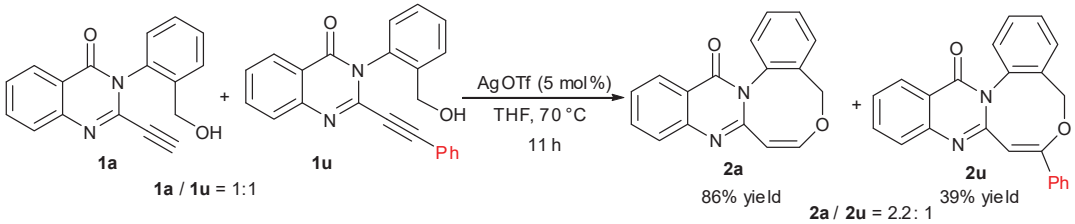


In a Teflon-sealed flask was charged with compound **1a** (0.36 mmol), AgOTf (5 mol%), and THF (10.0 mL) under N_2. The reaction vessel was stirred vigorously at 70 °C for 1 h. Then, D_2O (1.0 equiv.) was added to quench the reaction. At this time, the solvent was removed under reduced pressure and the crude product was purified by flash column chromatography (the crude residue was dry loaded with silica gel, dichloromethane as the eluent) to afford compound **1a-D** (71% yield).

5. Cross-over experiments

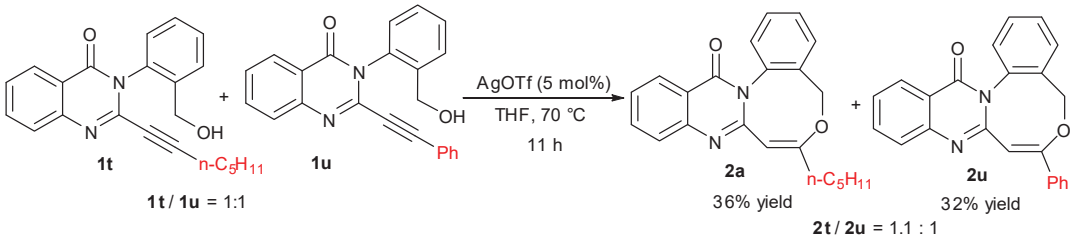


In a Teflon-sealed flask was charged with compound **1a** (0.18 mmol) and **1a-D** (0.18 mmol), AgOTf (5 mol%), and THF (10.0 mL) under N_2. The reaction vessel was stirred vigorously at 70 °C for 5 h. At this time, the solvent was removed under reduced pressure and the crude product was purified by flash column chromatography (the crude residue was dry loaded with silica gel, dichloromethane as the eluent) to only afford compound **2a** (60% yield).



In a Teflon-sealed flask was charged with compound **1a** (0.18 mmol) and **1u** (0.18

mmol), AgOTf (5 mol%), and THF (10.0 mL) under N_2. The reaction vessel was stirred vigorously at 70 °C for 11 h. At this time, the solvent was removed under reduced pressure and the crude product was purified by flash column chromatography (the crude residue was dry loaded with silica gel, dichloromethane as the eluent) to afford compound **2a** (86% yield) and **2u** (39% yield).



In a Teflon-sealed flask was charged with compound **1t** (0.18 mmol) and **1u** (0.18 mmol), AgOTf (5 mol%), and THF (10.0 mL) under N_2. The reaction vessel was stirred vigorously at 70 °C for 11 h. At this time, the solvent was removed under reduced pressure and the crude product was purified by flash column chromatography (the crude residue was dry loaded with silica gel, dichloromethane as the eluent) to afford compound **2t** (36% yield) and **2u** (32% yield).

6. Biological activity studies of compound 2

Cell Cuture: Murine monocyte-macrophage RAW264.7 cells maintained inDMEM (Gibco, USA) incubated at 37 °C in a humidified atmosphere containing 5% CO_2. Mouse peritoneal macrophages purchased from Procell Life Science&Technology Co., Ltd.

Cell viability assay: Cell cytotoxicity was evaluated by MTT. The MTT solution was added into each well and after incubation at 37 °C for 4 h, the culture media containing MTT were removed, and then DMSO was added into each well and the absorbance at 570 nm was measured by a microplate reader[5].

Assay for NO production NO production was quantified by nitrite accumulation in the culture medium using the Griess reaction. Briefly, RAW264.7 cells were pretreated with compounds for 1 h, and then stimulated with or without LPS (1 mg/mL) for 24 h. The isolated supernatants were mixed with an equal volume of

Griess reagent (Beyotime Biotechnology, China). $NaNO_2$ was used to generate a standard curve, and nitrite production was determined by measuring the optical density at 540 nm by a microplate reader [5].

Table S1. The effects of the target compounds on the cell viability of RAW 264.7 at the concentration of 100 uM. (the MTT assay).

Compounds	Cell survival (% of normal)	Compounds	Cell survival (% of normal)）
2a	99.33±0.40	**2m**	90.34±0.15
2c	100.01±0.41	**2r**	99.00±0.17
2d	67.33±0.25	**2s**	89.33±0.28
2e	66.67±0.20	**2t**	97.56±0.25
2f	96.00±0.45	**2u**	57.39±0.30
2g	96.33±0.40	**2v**	97.57±0.25
2i	85.00±0.30	**2w**	80.00±0.26
2j	51.00±0.36	**2x**	97.25±0.25
2k	100.00±0.30	**Indometacin**	87.66±0.47

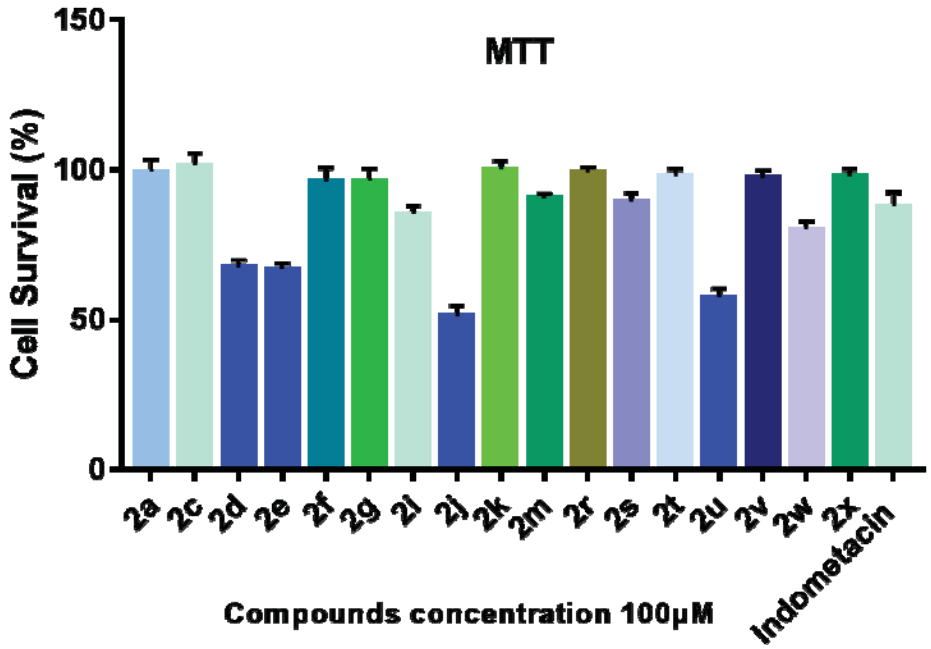
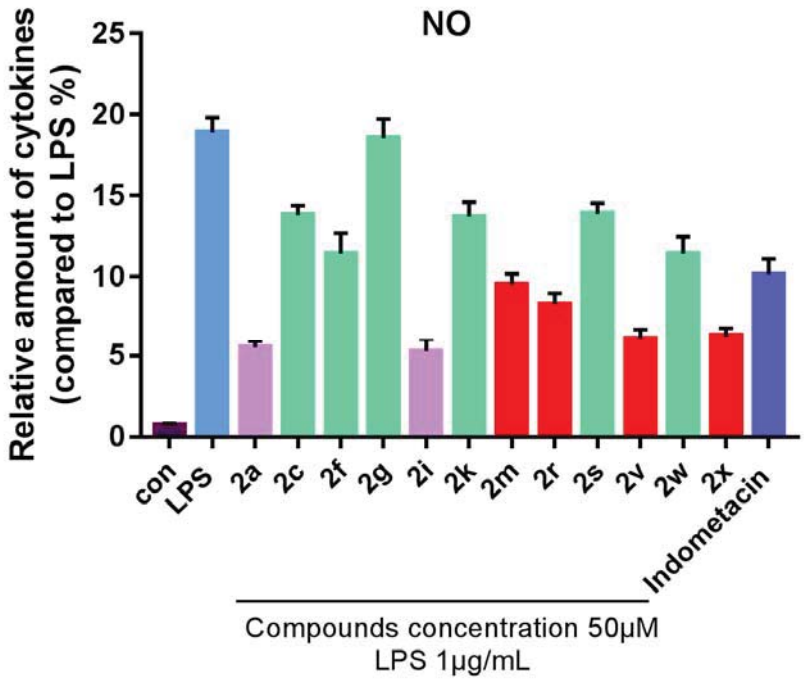


Table S2 The Effect of the compounds **2a**、**2c**、**2f**、**2g**、**2i**、**2k**、**2m**、**2r**、**2s**、**2v**、**2w**、**2x** on the inhibition of NO produced by RAW 264.7 cells induced by LPS. In the 50 uM compound concentration, LPS concentration 1 ug/mL.

Compounds	Concentration of NO (μmol/L)	Compounds	Concentration of NO (μmol/L)
con	0.71±0.12	**2m**	9.49±0.69
LPS	18.43±0.57	**2r**	8.27±0.69
2a	5.53±0.38	**2s**	13.89±0.64
2c	13.81±0.57	**2v**	6.15±0.57
2f	12.10±0.63	**2w**	10.86±0.43
2g	17.87±0.53	**2x**	6.06±0.41
2i	5.27±0.76	**Indometacin**	10.13±0.97
2k	13.72±0.88		



The concentration-dependently suppressed LPS-induced NO generation of **2r, 2m, 2v** and **2x** are shown in table 3, 4, 5 and 6, respectively.

Table S3. The concentration-dependently suppressed LPS-induced NO generation of the compound **2r**

2r (μmol/L)	Concentration of NO (μmol/L)
0	22.77±0.47
6.25	20.67±0.28
12.5	18.30±0.93
25.0	17.71±0.74
50.0	13.24±0.74

Table S4. The concentration-dependently suppressed LPS-induced NO generation of the compound **2m**

2m (μmol/L)	Concentration of NO (μmol/L)
0	22.77±0.47
6.25	21.82±2.80
12.5	19.98±2.65
25.0	18.5±1.21
50.0	15.14±0.28

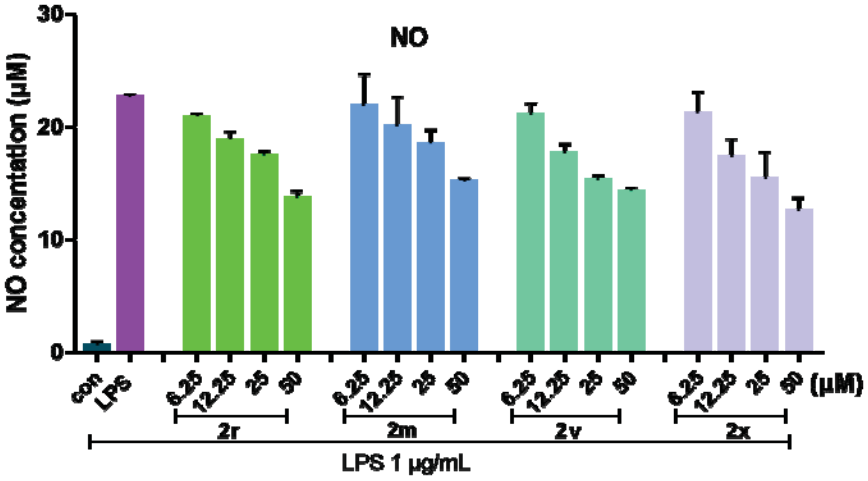
Table S5. The concentration-dependently suppressed LPS-induced NO generation of the compound **2v**

2v (μmol/L)	Concentration of NO (μmol/L)
0	22.77±0.47
6.25	20.38±1.06
12.5	17.08±1.72
25.0	14.95±0.74
50.0	14.49±0.84

Table S6. The concentration-dependently suppressed LPS-induced NO generation of the compound **2x**

2x (μmol/L)	Concentration of NO (μmol/L)

0	22.77±0.47
6.25	21.19±0.37
12.5	17.28±0.88
25.0	15.34±0.01
50.0	12.55±0.37



7. References

[1] M. C. Tseng, H. Yang, and Y. H. Chu, *Org. Biomol. Chem*. 2010, **8**, 419.

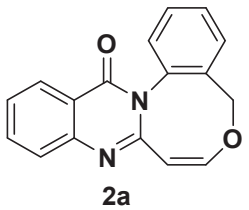
[2] V. Percec, J. Rudick, M. Peterca, M. Wagner, M. Obata, C. Mitchell, W. Cho, V. Balagurusamy, and P. Heiney, *J. Am. Chem. Soc*. 2005, **127**, 15257.

[3] X.-F. Kong, F. Zhan, G.-X. He, C.-X. Pan, X. Gu, K. Lu, D.-L. Mo, and G.-F. Su, *J. Org. Chem*. 2018, **83**, 2006.

[4] A. Carpita, L. Mannocci, and R. Rossi, *Eur. J. Org. Chem*. 2005, **2005**, 1859.

[5] S. Y. Liu, P. Xu, X. L. Luo, J. F. Hu, and X. H. Liu, *Neurochem. Res*. 2016, **41**, 1570.

8. X-ray structure for compound 2a



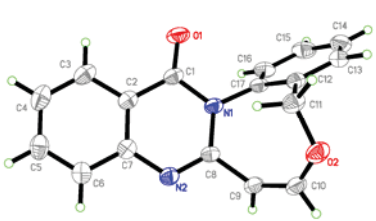
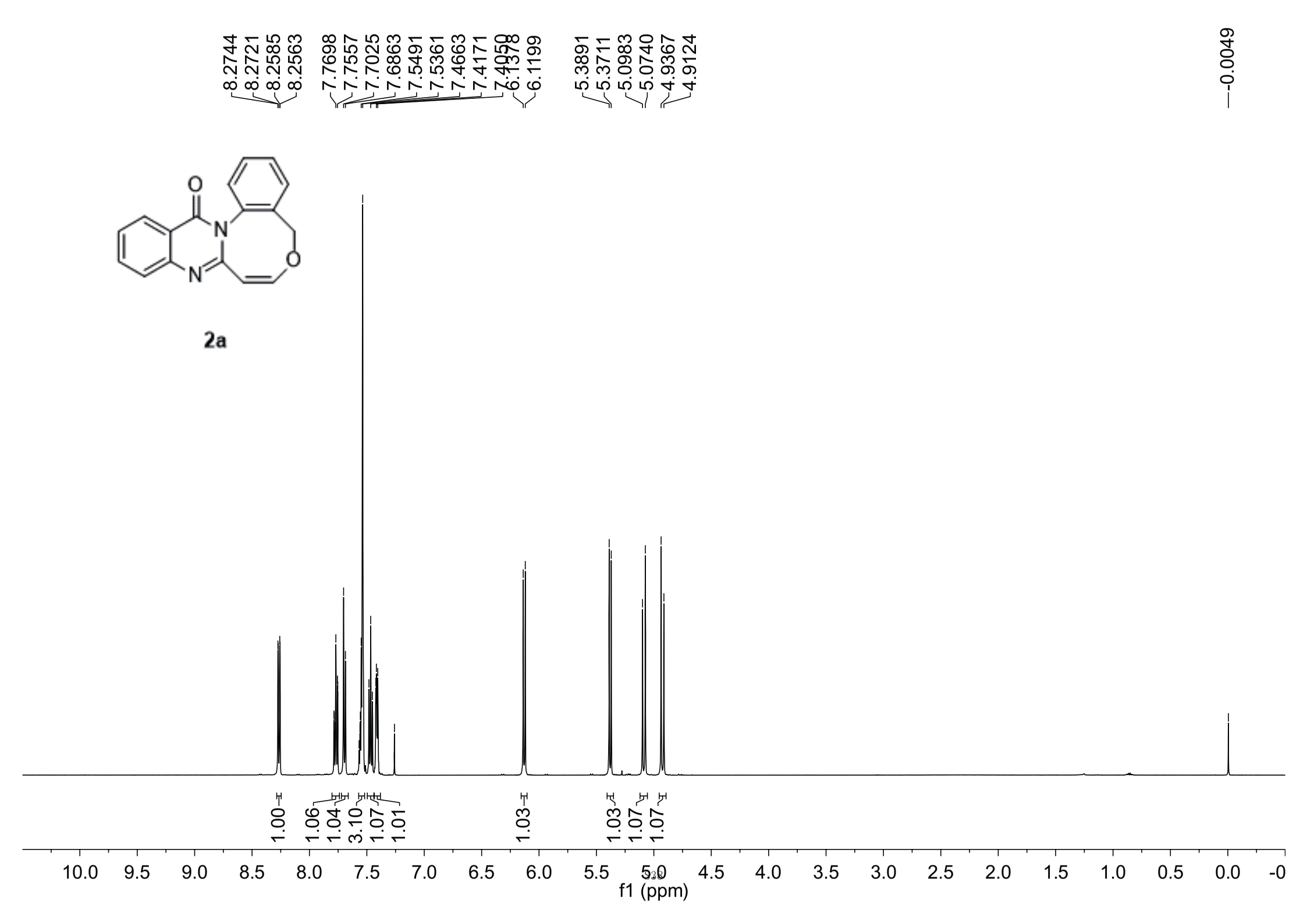


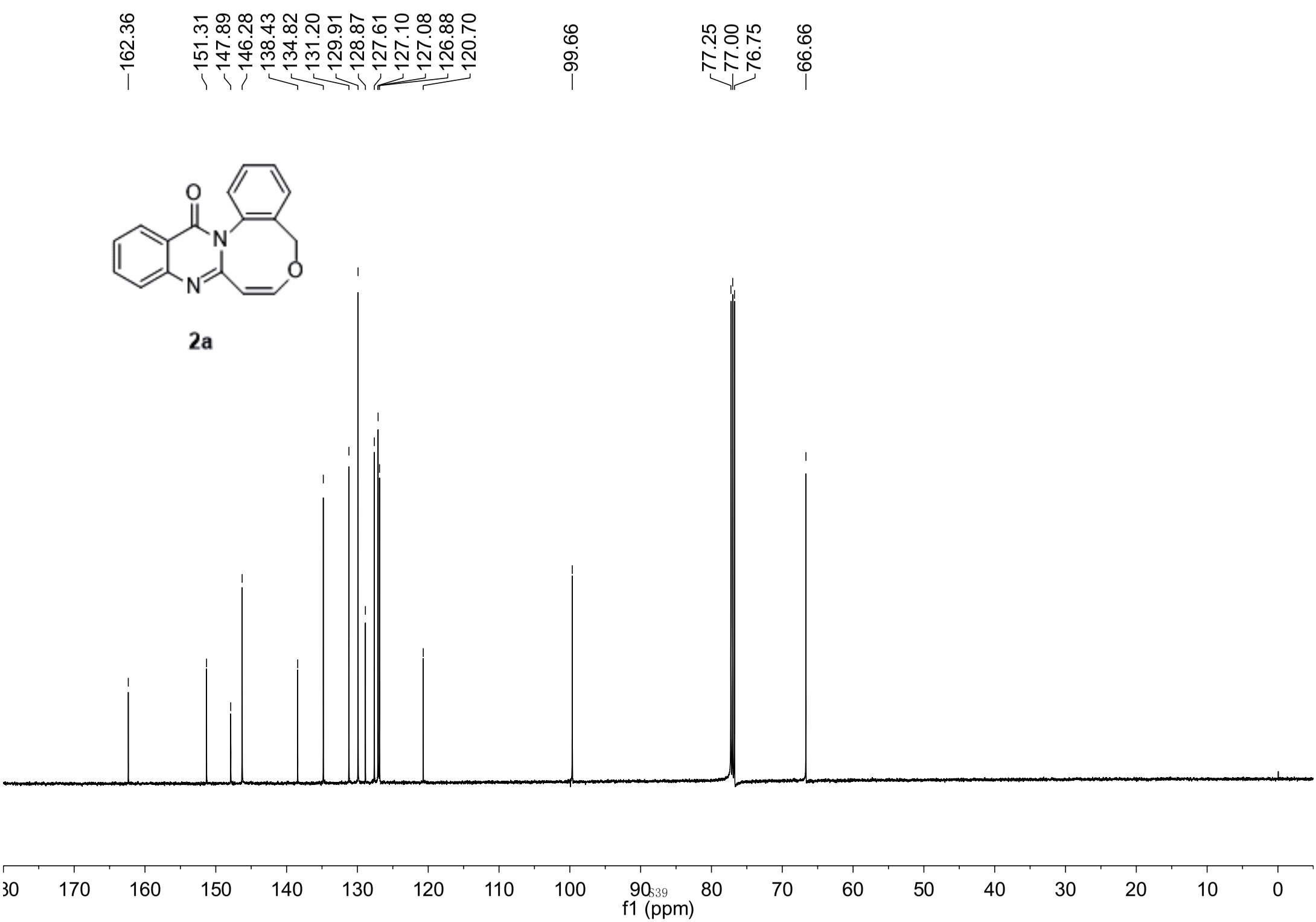
Figure S1: ORTEP diagram of **2a** at 50% ellipsoid probability

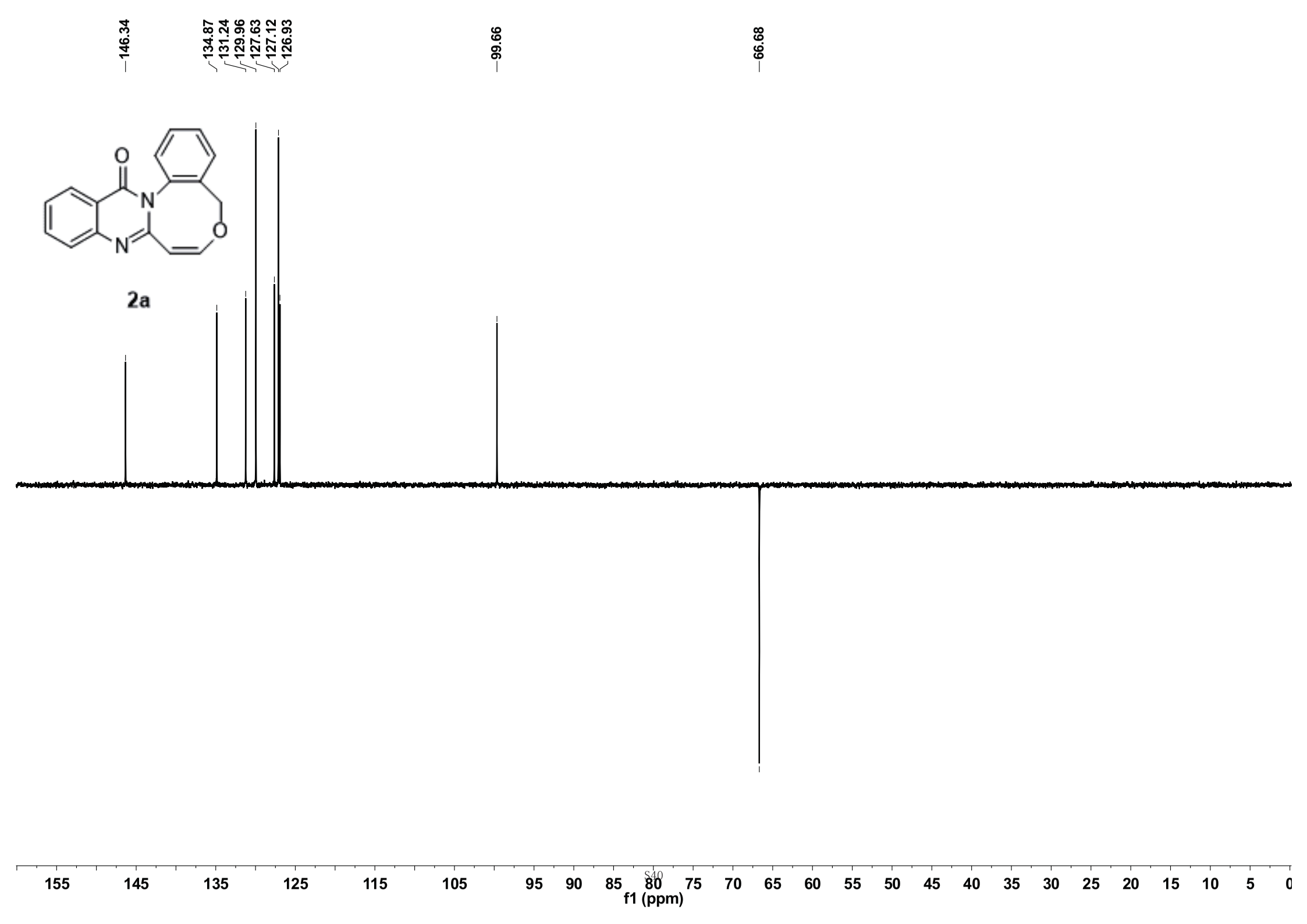
Table S7. Crystal data and structure refinement details for compound **2a**.

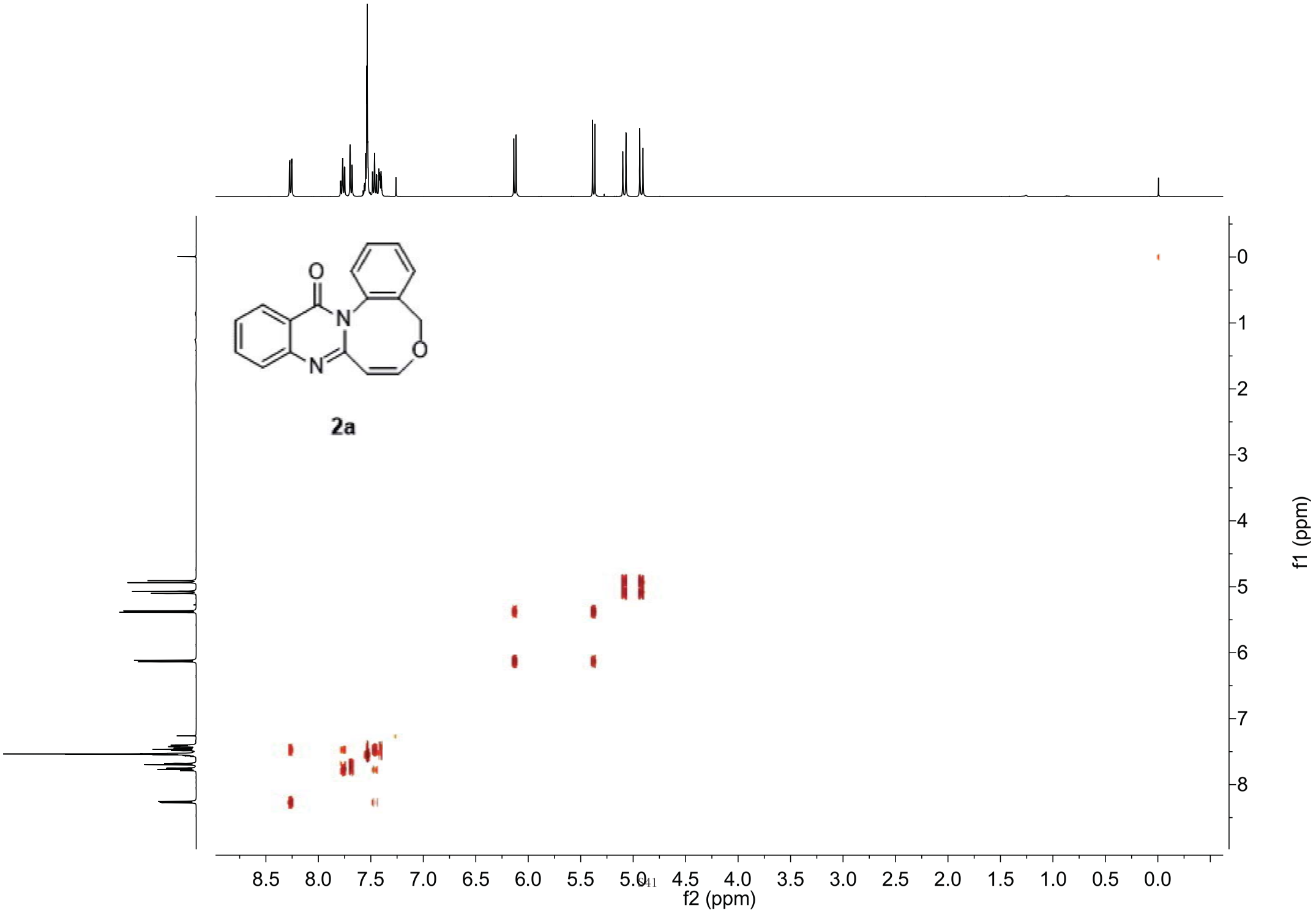
Compound	**2a**
Empirical formula	$C_{17}H_{12}N_2O_2$
Formula weight	276.30
Crystal system	Triclinic
Space group	P-1
a (Å)	8.699 (16)
b (Å)	9.386 (18)
c (Å)	9.490 (19)
α (˚)	72.722 (18)
β (˚)	89.275 (16)
γ (˚)	64.582 (19)
V (Å^3)	662.3 (2)
Z	2
D_c (g/cm^3)	1.385
*F*000	288.0
μ(mm^{-1})	0.093
θ_{max} (˚)	25.000
Total reflections	4124
Unique reflections	2335
Reflections [$I > 2\sigma(I)$]	1563
Parameters	190
R_{int}	0.0205
Goodness-of-fit	1.060
R [$F^2 > 2\sigma(F^2)$]	0.0512
wR (F^2, all data)	0.1426
CCDC No.	1921935

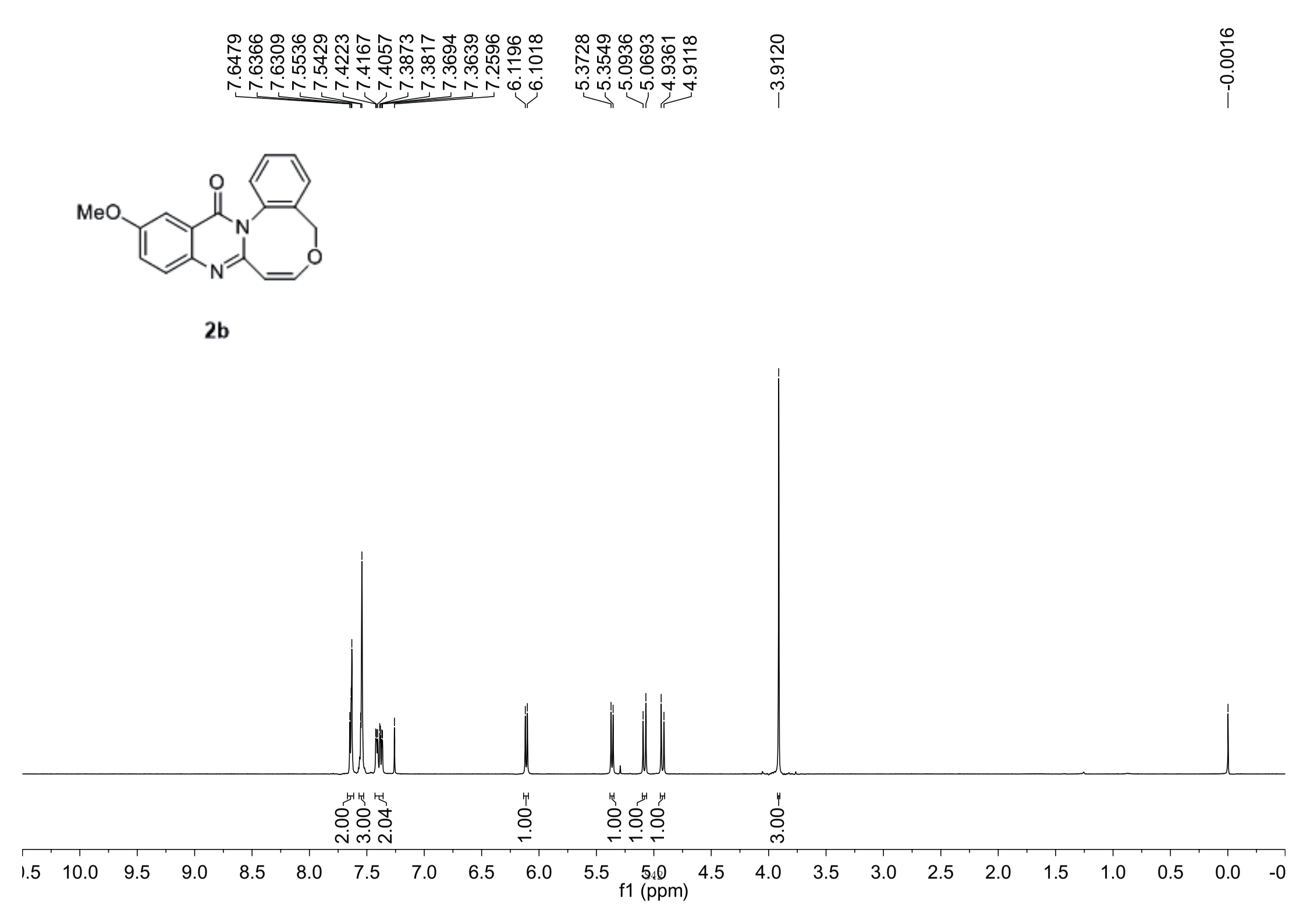
9. NMR spectra for 2, 3, 4, 5, 1, and deuteration spectra

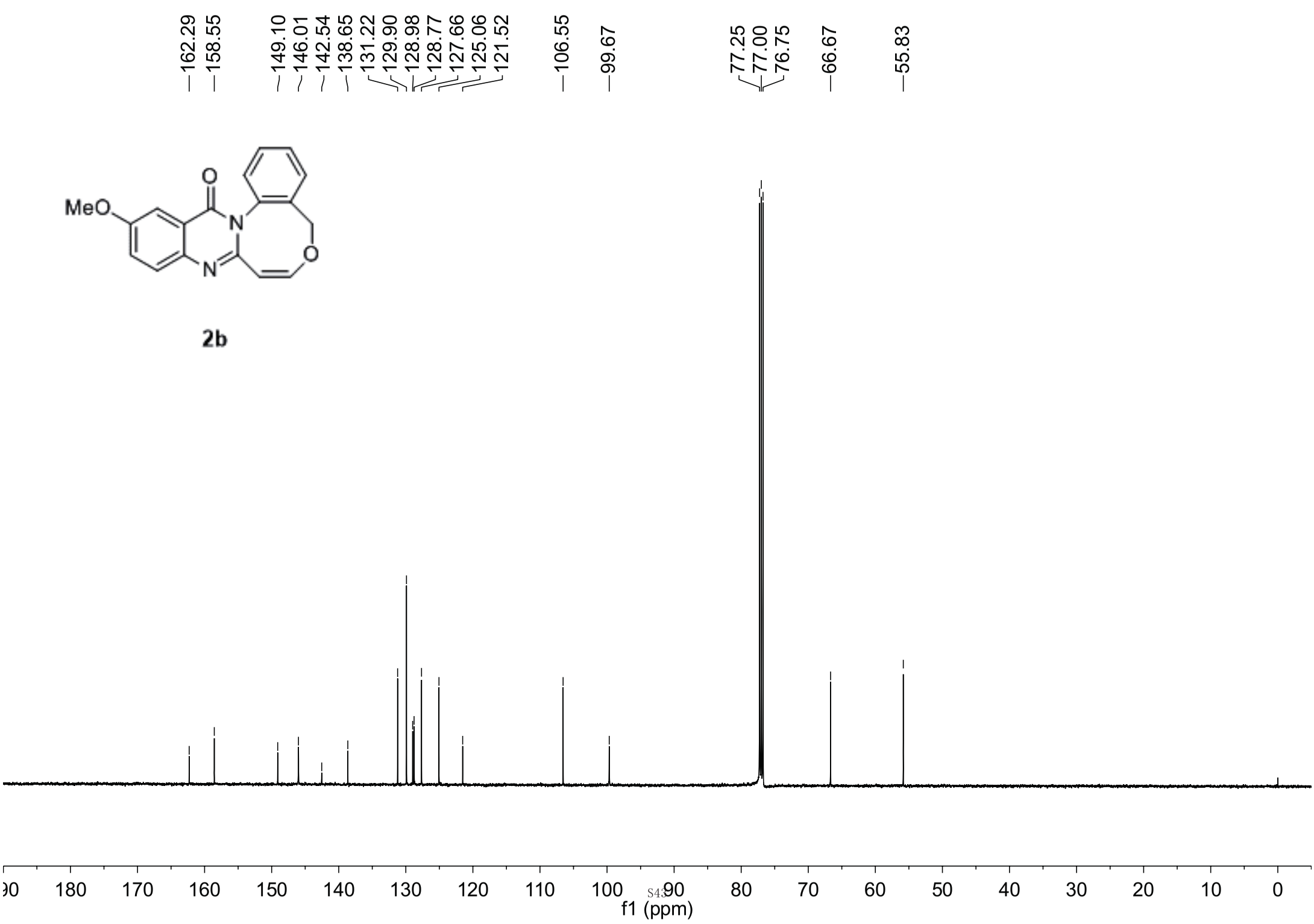

8.2744
8.2721
8.2585
8.2563
7.7698
7.7557
7.7025
7.6863
7.5491
7.5361
7.4663
7.4171
7.4050
7.1378
6.1199
5.3891
5.3711
5.0983
5.0740
4.9367
4.9124
-0.0049
O
N
N
O
2a
1.00
1.06
1.04
3.10
1.07
1.01
1.03
1.03
1.07
1.07
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0
f1 (ppm)

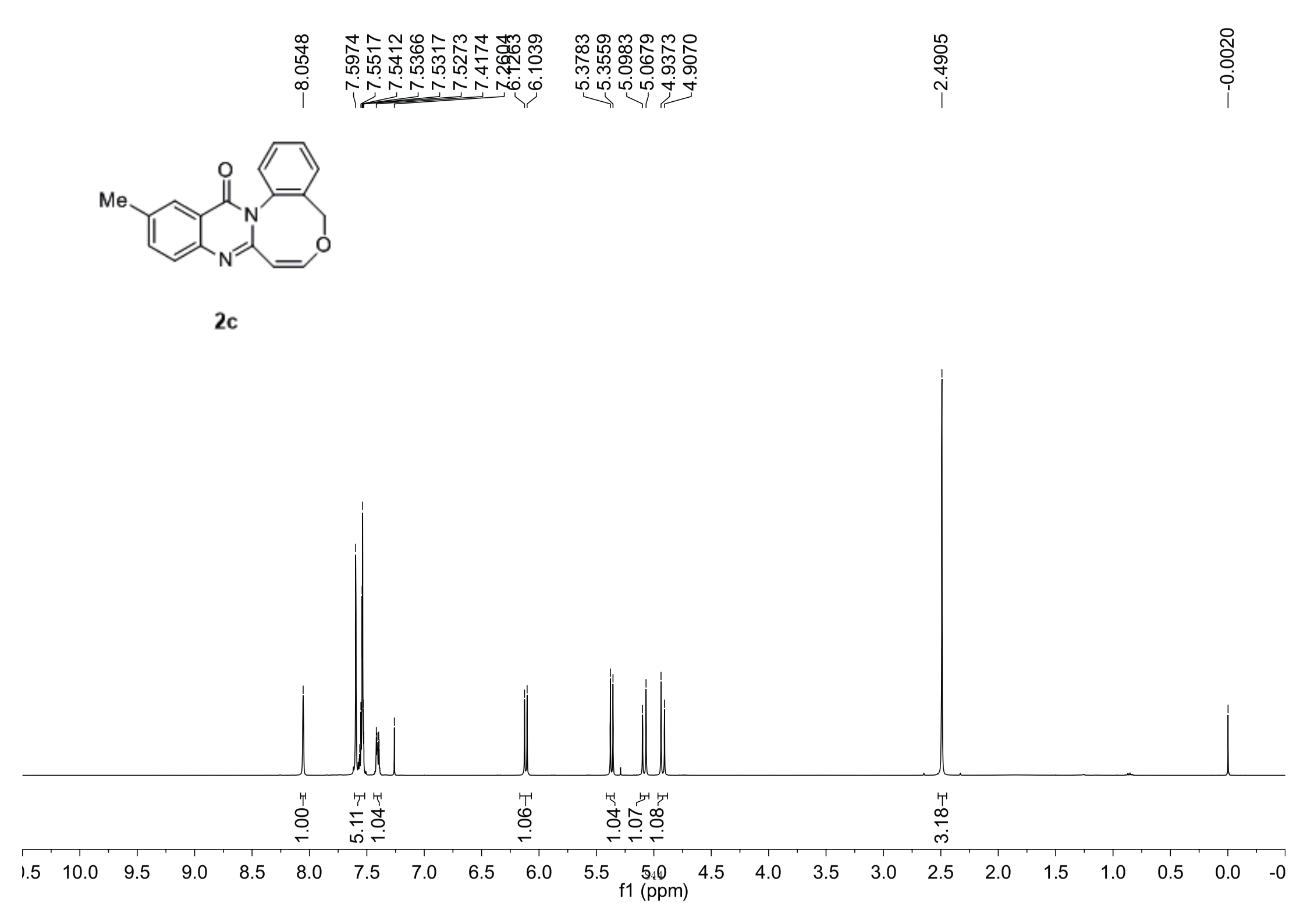

162.36
151.31
147.89
146.28
138.43
134.82
131.20
129.91
128.87
127.61
127.10
127.08
126.88
120.70
99.66
77.25
77.00
76.75
66.66
O
N
N
O
2a
f1 (ppm)

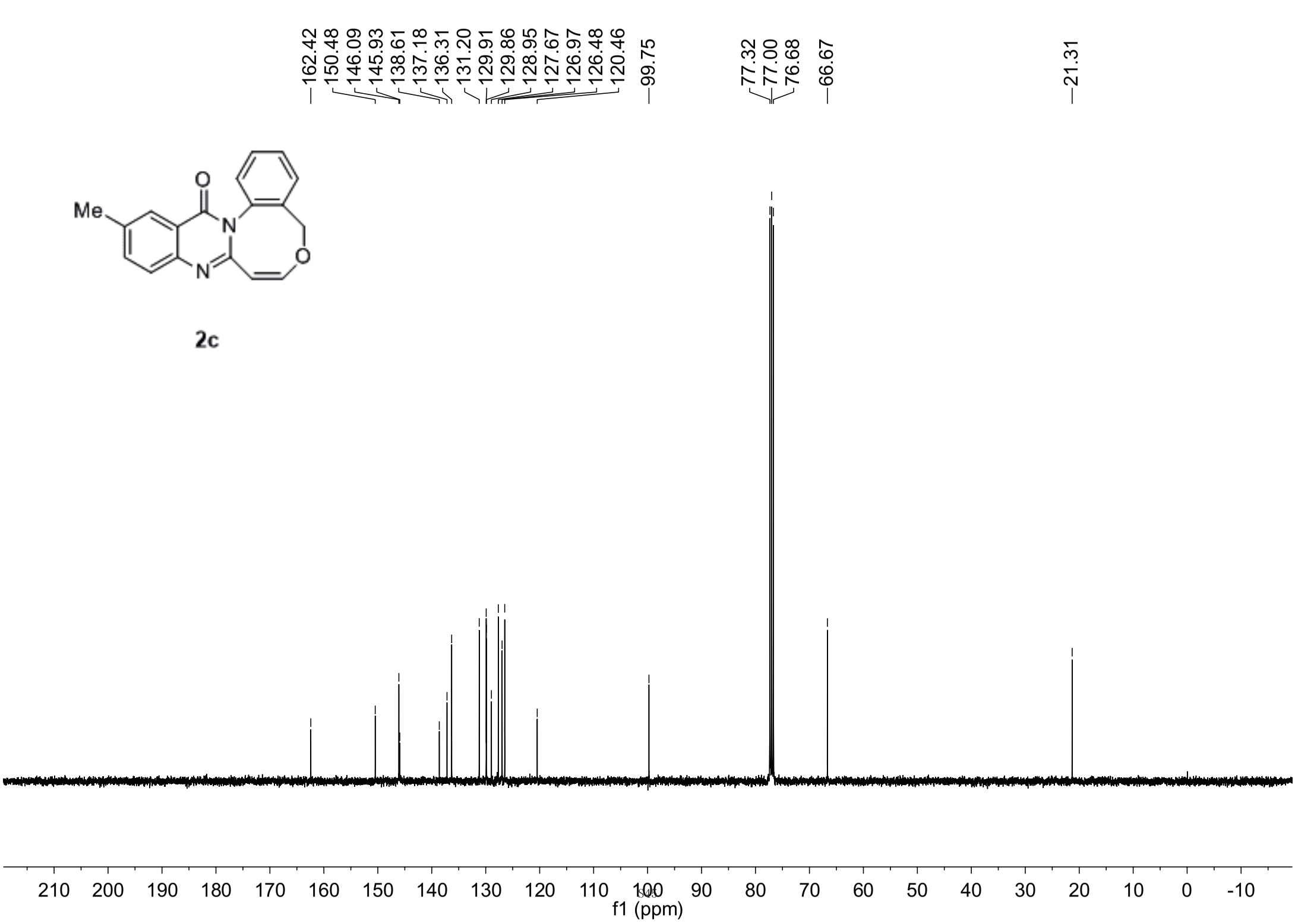

146.34
134.87
131.24
129.96
127.63
127.12
126.93
99.66
66.68
O
N
N
O
2a
155
145
135
125
115
105
95
90
85
80
75
70
65
60
55
50
45
40
35
30
25
20
15
10
5
0
f1 (ppm)

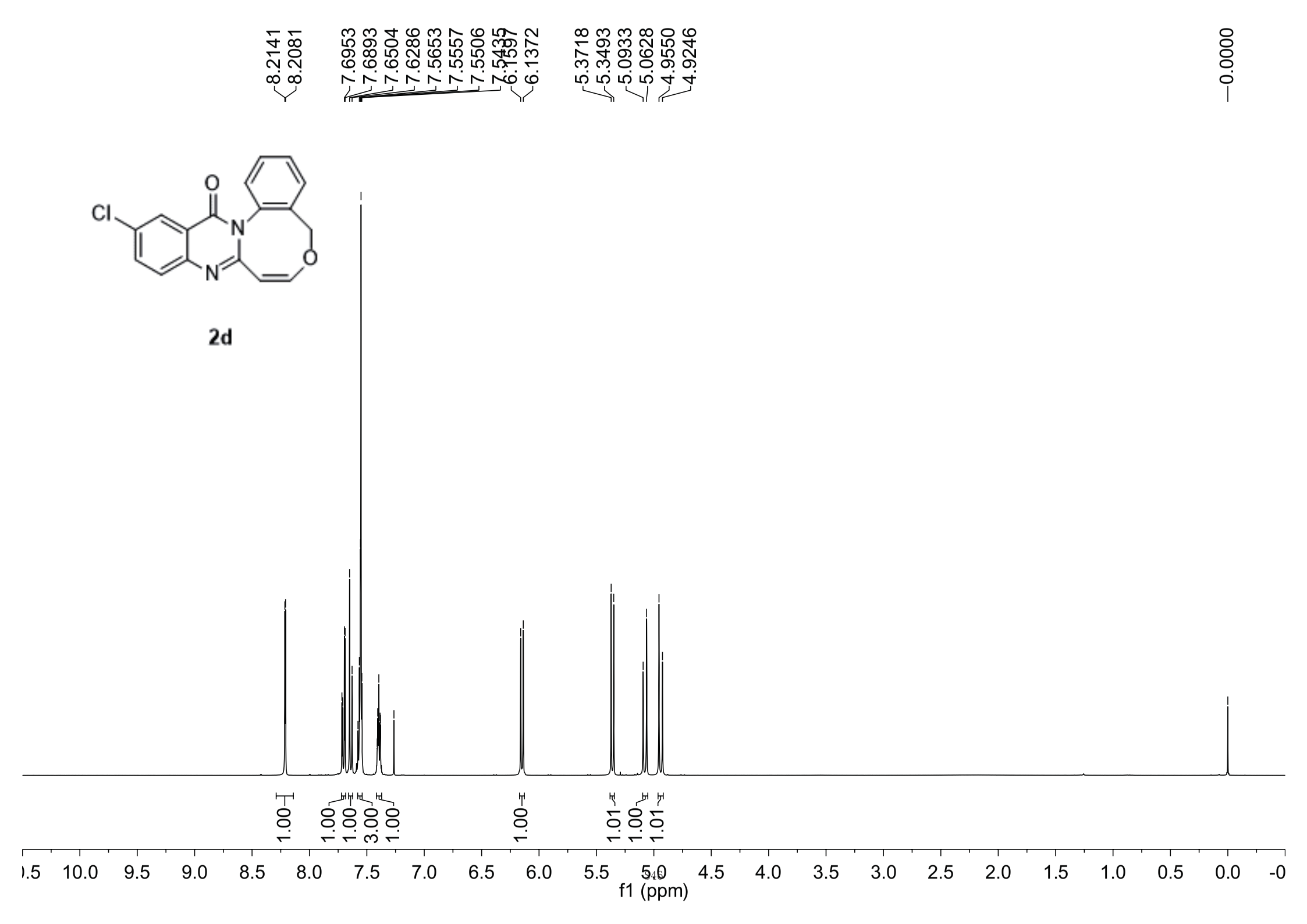

O
N
N
O
2a
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f2 (ppm)
0
1
2
3
4
5
6
7
8
f1 (ppm)

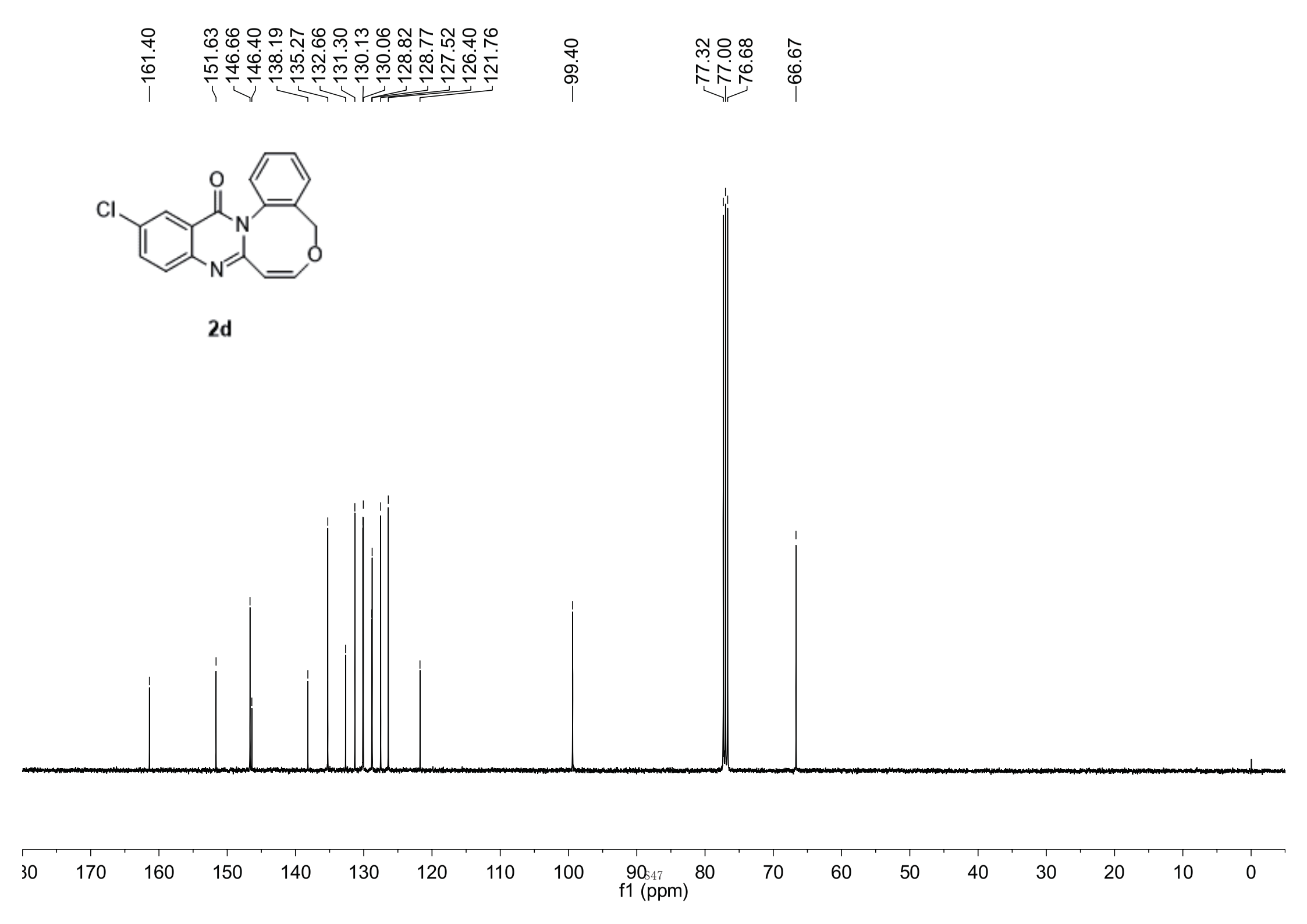

7.6479
7.6366
7.6309
7.5536
7.5429
7.4223
7.4167
7.4057
7.3873
7.3817
7.3694
7.3639
7.2596
6.1196
6.1018
5.3728
5.3549
5.0936
5.0693
4.9361
4.9118
3.9120
-0.0016
MeO
O
N
N
O
2b
2.00
3.00
2.04
1.00
1.00
1.00
1.00
3.00
f1 (ppm)

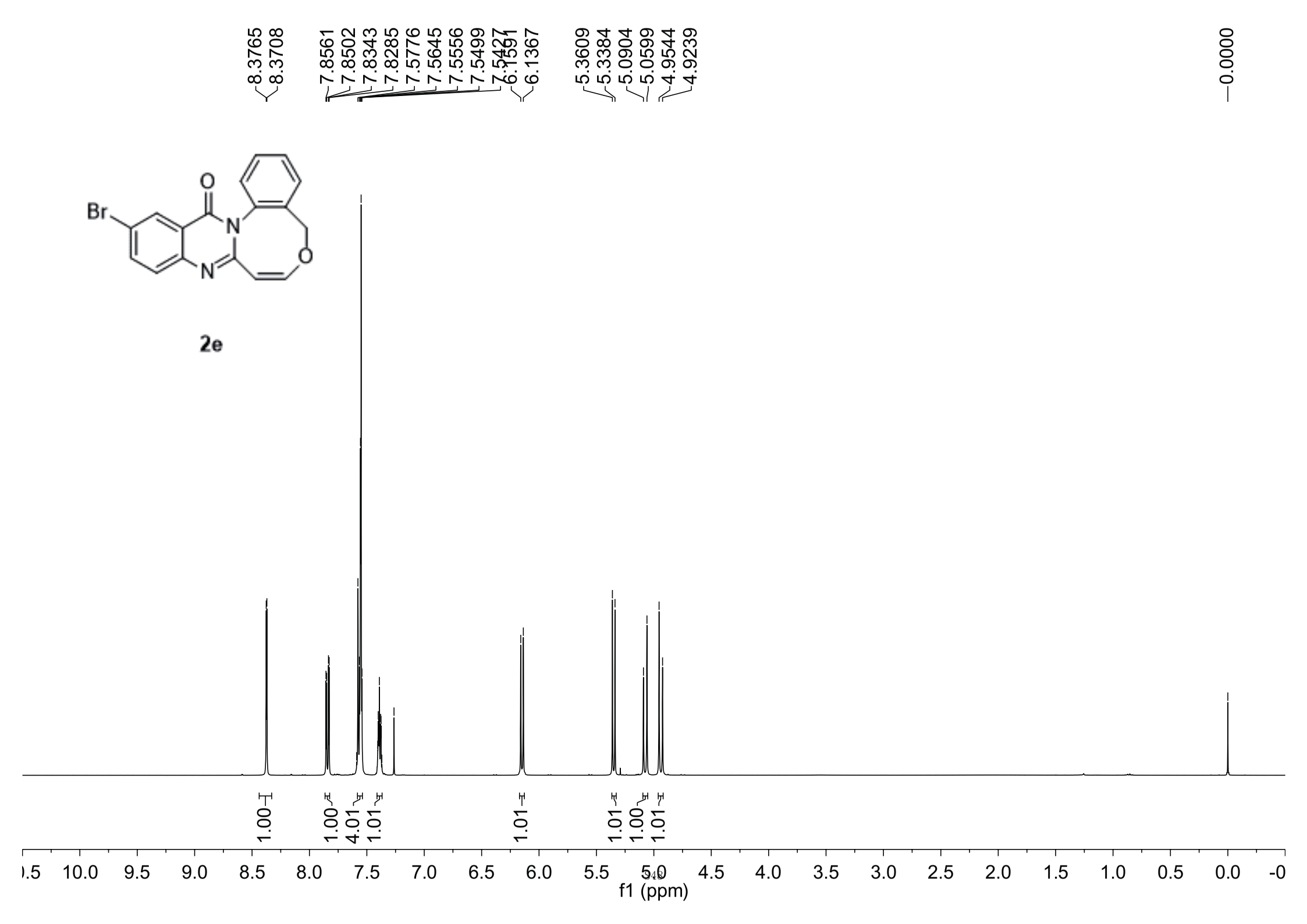

162.29
158.55
149.10
146.01
142.54
138.65
131.22
129.90
128.98
128.77
127.66
125.06
121.52
106.55
99.67
77.25
77.00
76.75
66.67
55.83
MeO
O
N
N
O
2b
f1 (ppm)

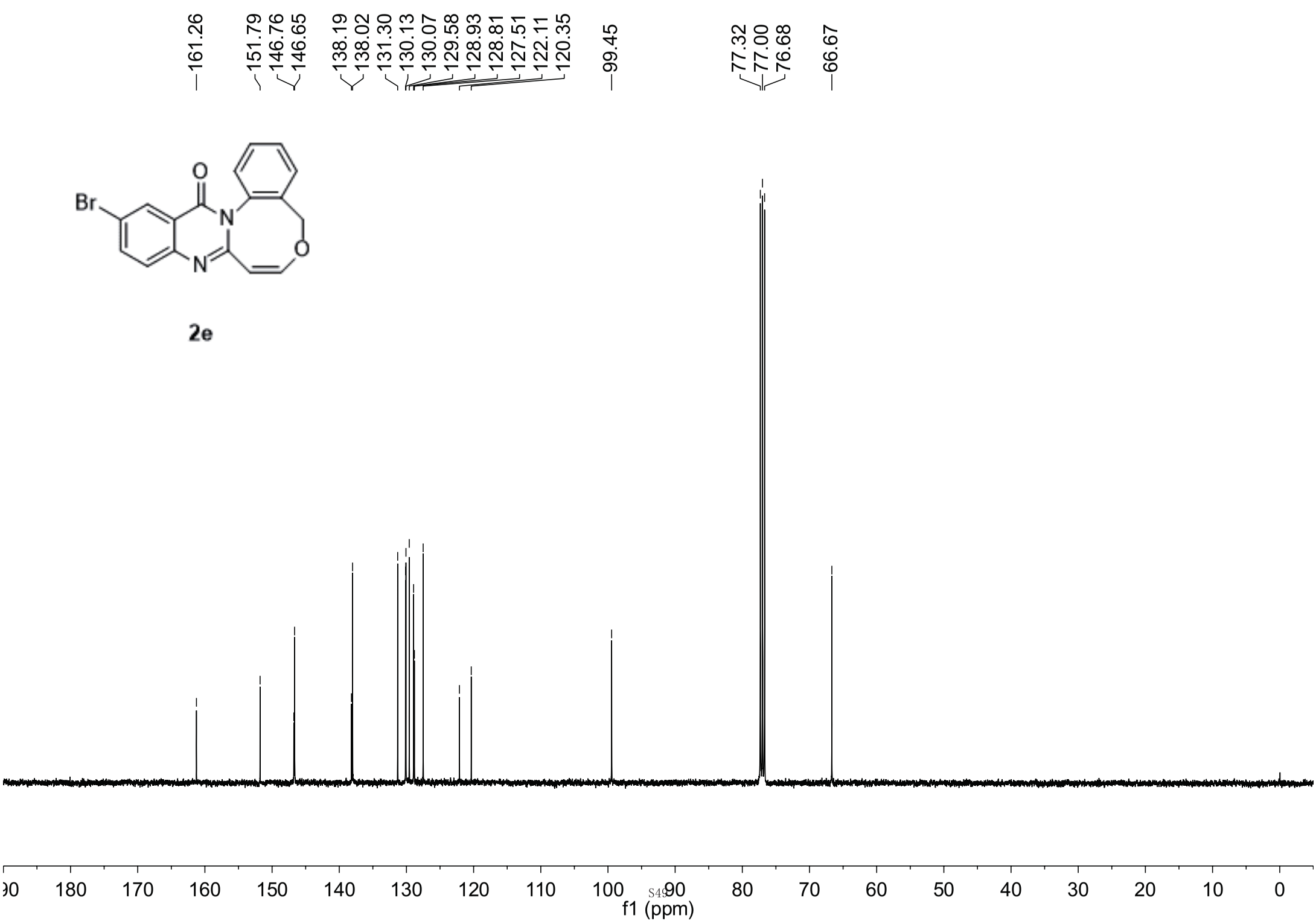

8.0548
7.5974
7.5517
7.5412
7.5366
7.5317
7.5273
7.4174
7.2604
6.1263
6.1039
5.3783
5.3559
5.0983
5.0679
4.9373
4.9070
2.4905
-0.0020
Me
O
N
N
O
2c
1.00
5.11
1.04
1.06
1.04
1.07
1.08
3.18
f1 (ppm)

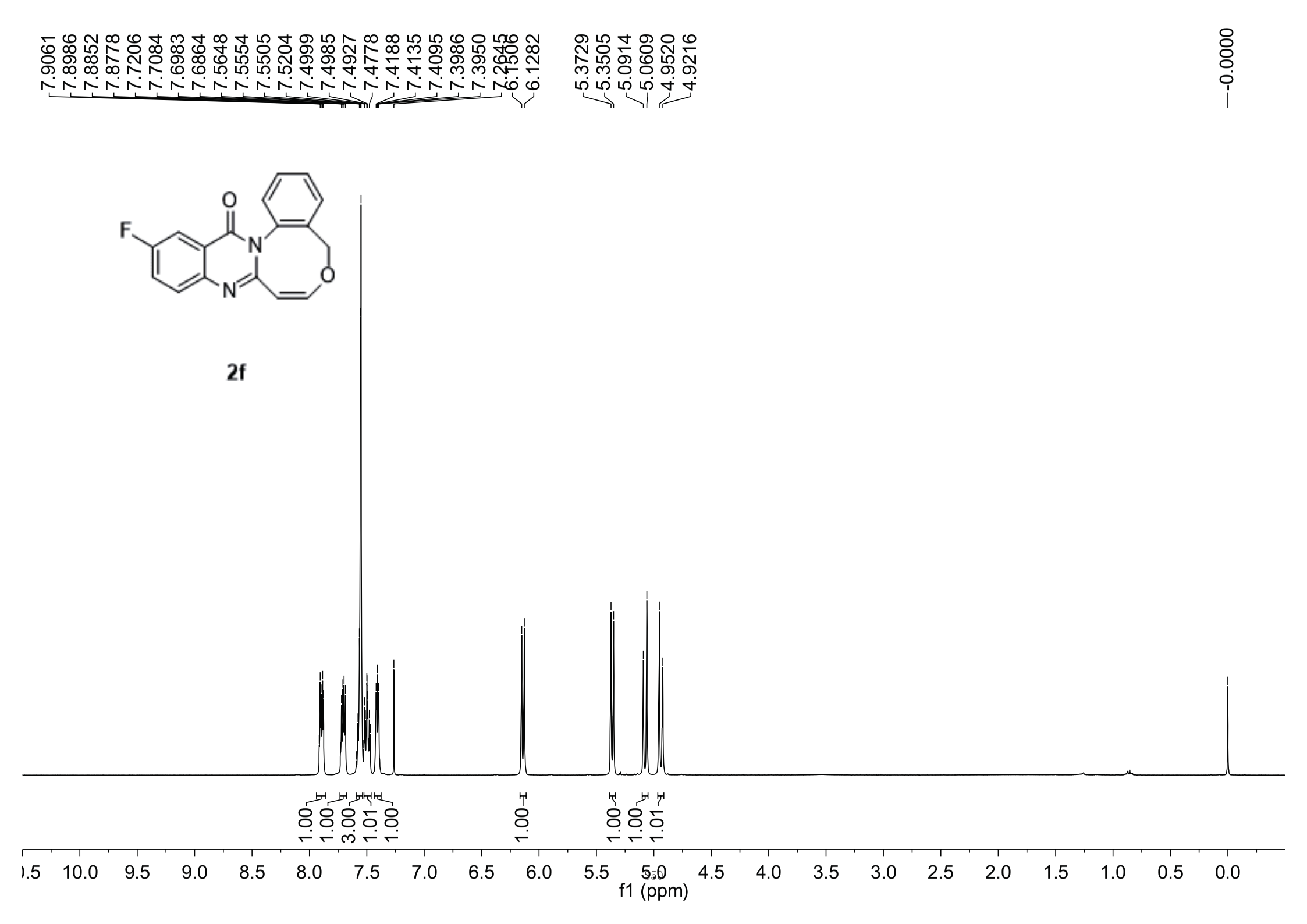

162.42
150.48
146.09
145.93
138.61
137.18
136.31
131.20
129.91
129.86
128.95
127.67
126.97
126.48
120.46
99.75
77.32
77.00
76.68
66.67
21.31
Me
O
N
N
O
2c
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
-10
f1 (ppm)

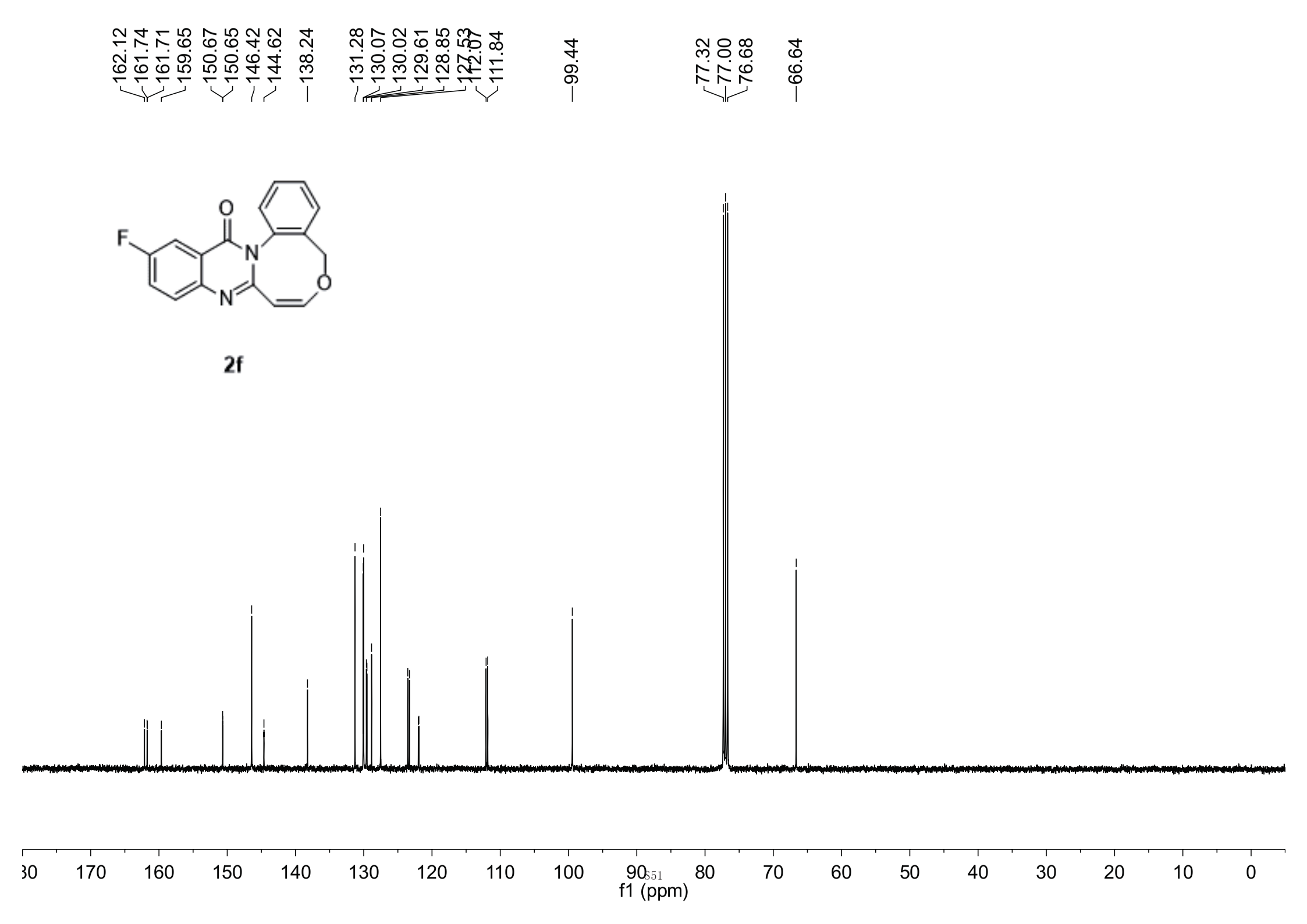

8.2141
8.2081
7.6953
7.6893
7.6504
7.6286
7.5653
7.5557
7.5506
7.5435
7.1597
6.1372
5.3718
5.3493
5.0933
5.0628
4.9550
4.9246
0.0000
Cl
O
N
N
O
2d
1.00
1.00
1.00
3.00
1.00
1.00
1.01
1.00
1.01
f1 (ppm)

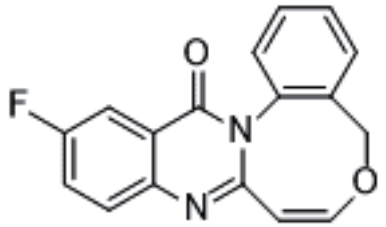

161.40
151.63
146.66
146.40
138.19
135.27
132.66
131.30
130.13
130.06
128.82
128.77
127.52
126.40
121.76
99.40
77.32
77.00
76.68
66.67
Cl
O
N
N
O
2d
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)


8.3765
8.3708
7.8561
7.8502
7.8343
7.8285
7.5776
7.5645
7.5556
7.5499
7.5427
7.5391
6.1367
5.3609
5.3384
5.0904
5.0599
4.9544
4.9239
0.0000
Br
O
N
N
O
2e
1.00
1.00
4.01
1.01
1.01
1.01
1.00
1.01
f1 (ppm)


161.26
151.79
146.76
146.65
138.19
138.02
131.30
130.13
130.07
129.58
128.93
128.81
127.51
122.11
120.35
99.45
77.32
77.00
76.68
66.67
Br
O
N
N
O
2e
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

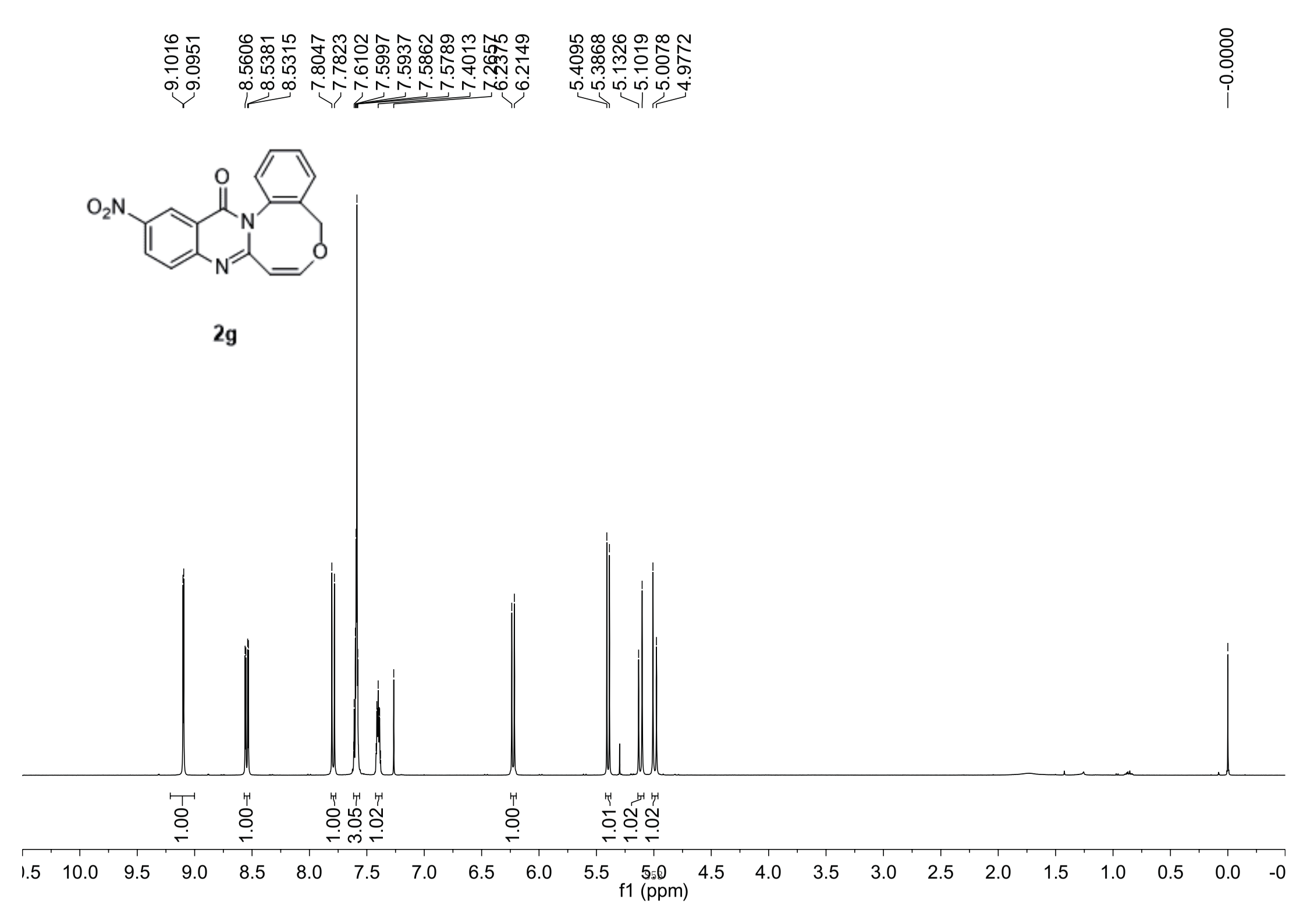

7.9061
7.8986
7.8852
7.8778
7.7206
7.7084
7.6983
7.6864
7.5648
7.5554
7.5505
7.5204
7.4999
7.4985
7.4927
7.4778
7.4188
7.4135
7.4095
7.3986
7.3950
7.2645
6.1506
6.1282
5.3729
5.3505
5.0914
5.0609
4.9520
4.9216
0.0000
F
O
N
N
O
2f
1.00
1.00
3.00
1.01
1.00
1.00
1.00
1.00
1.01
f1 (ppm)

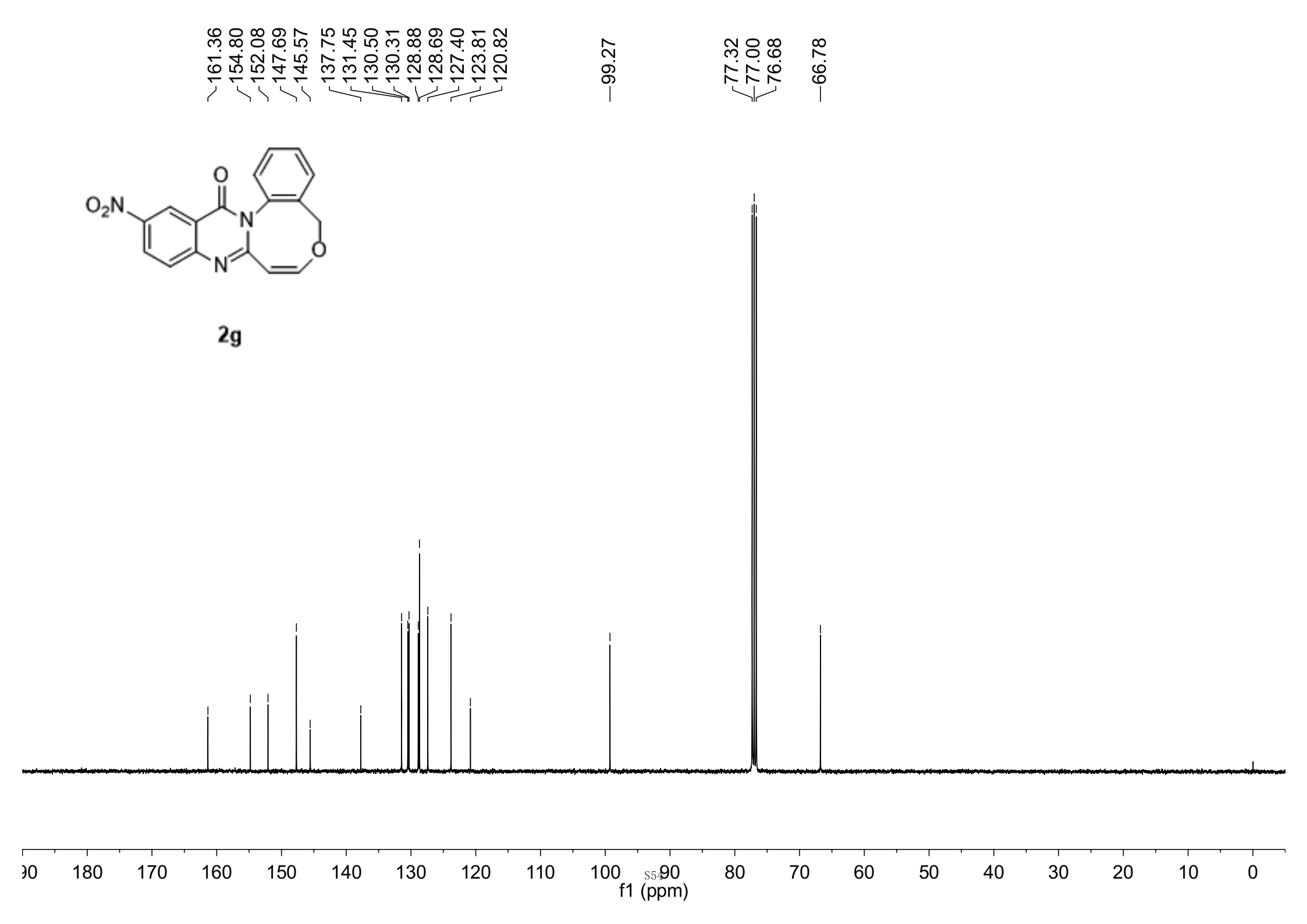

162.12
161.74
161.71
159.65
150.67
150.65
146.42
144.62
138.24
131.28
130.07
130.02
129.61
128.85
127.53
112.07
111.84
99.44
77.32
77.00
76.68
66.64
F
O
N
N
O
2f
f1 (ppm)

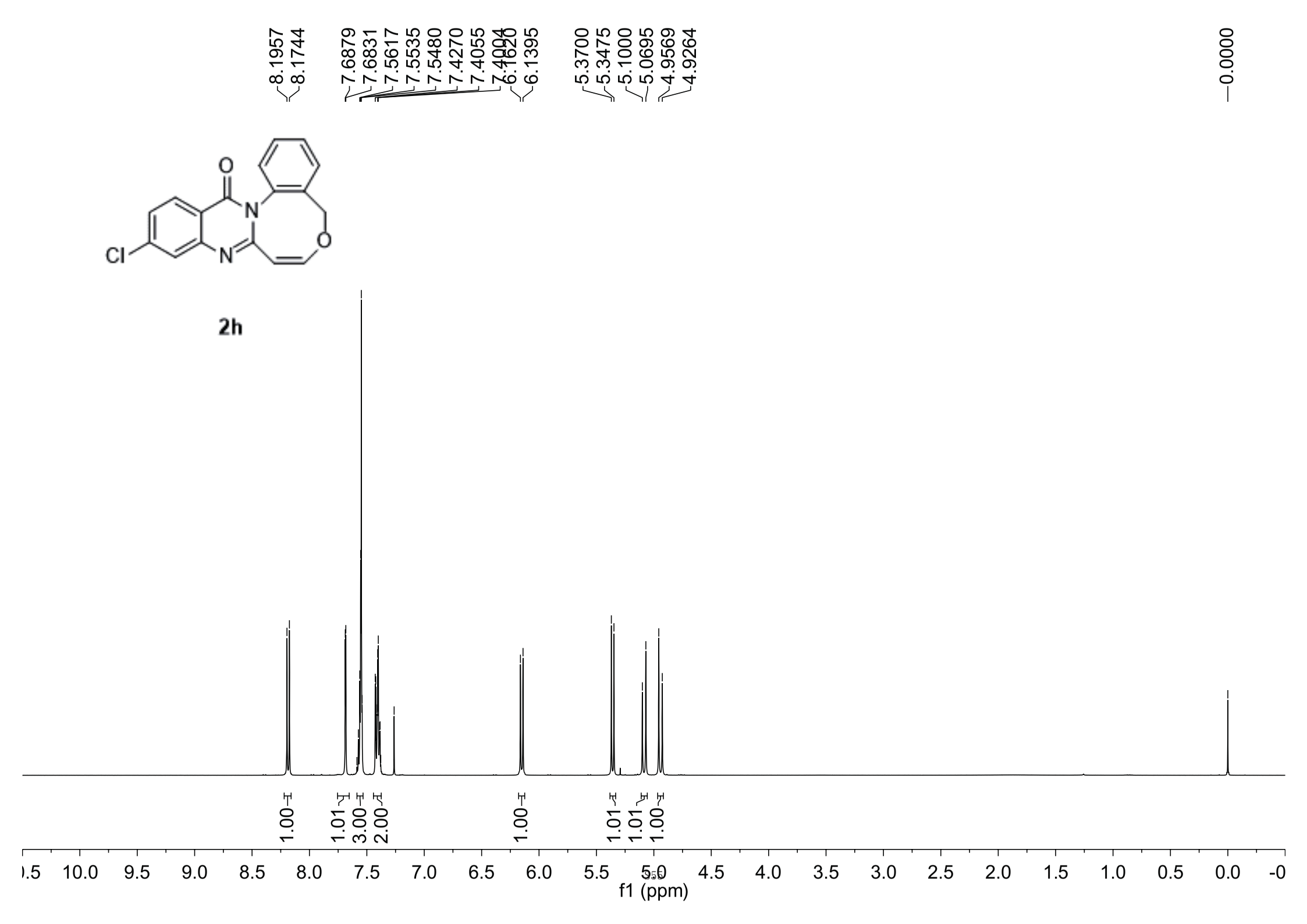

O
F
N
N
O

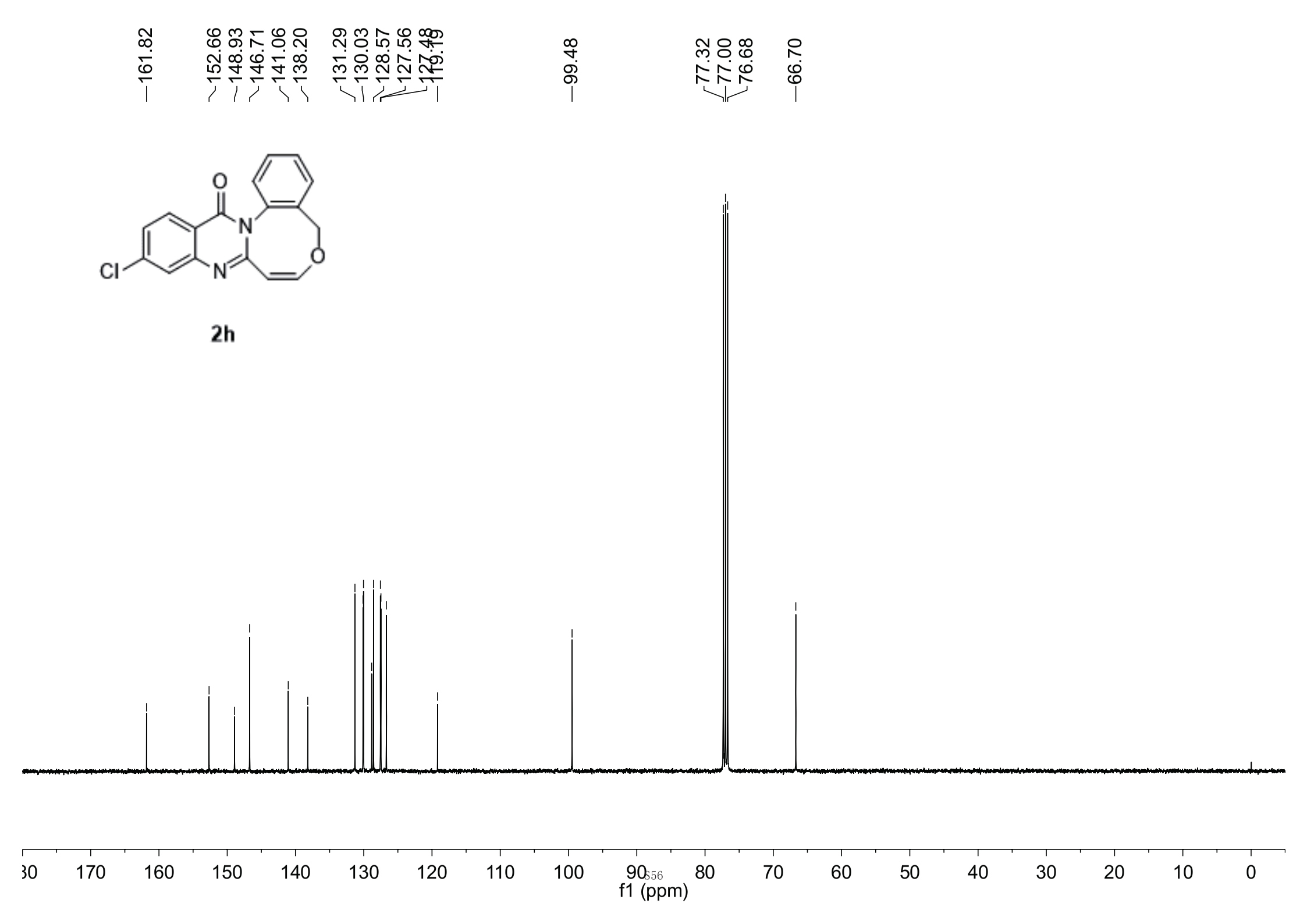
2f

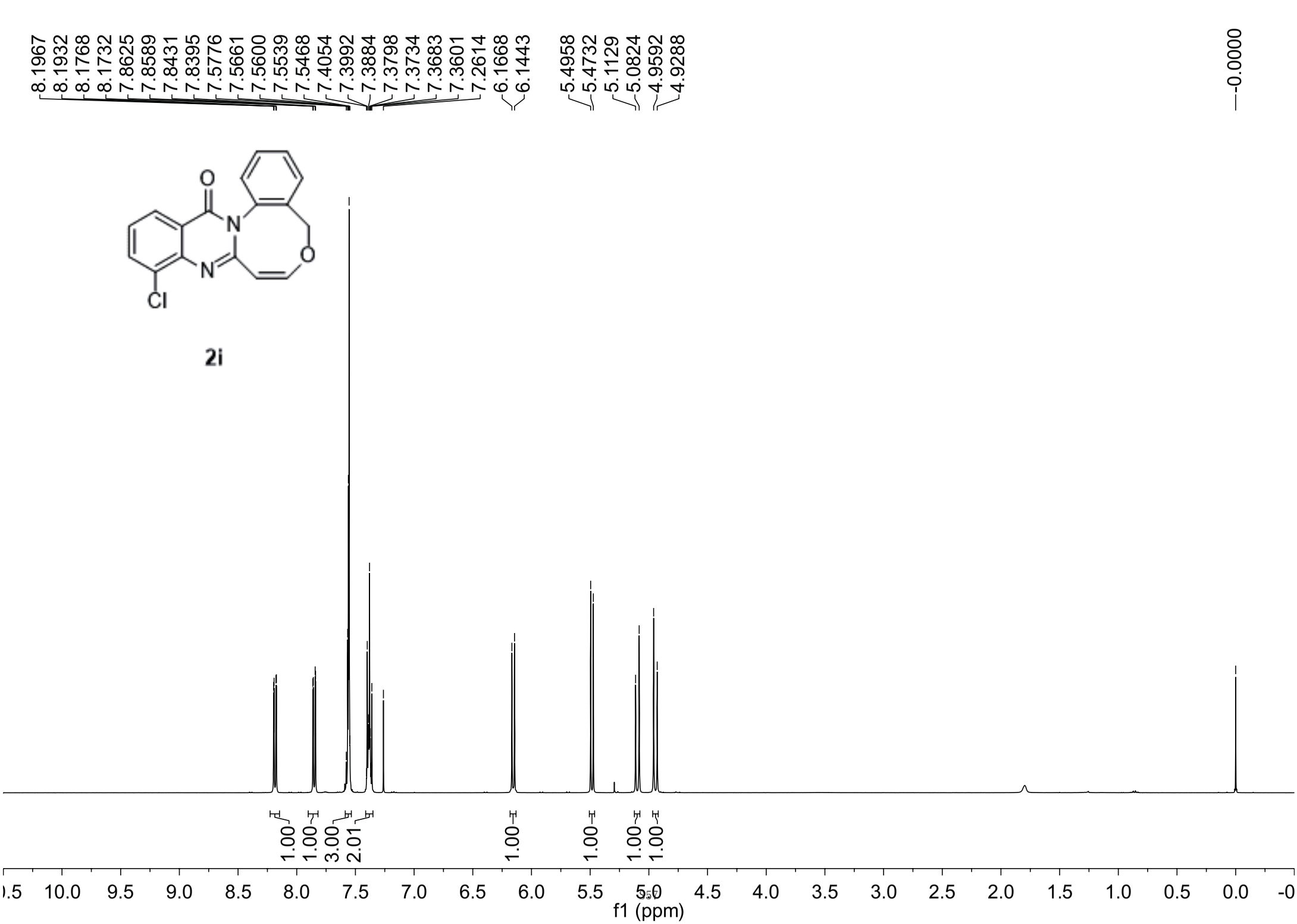
-112.3452
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
-120
-140
-160
-180
-200
f1 (ppm)

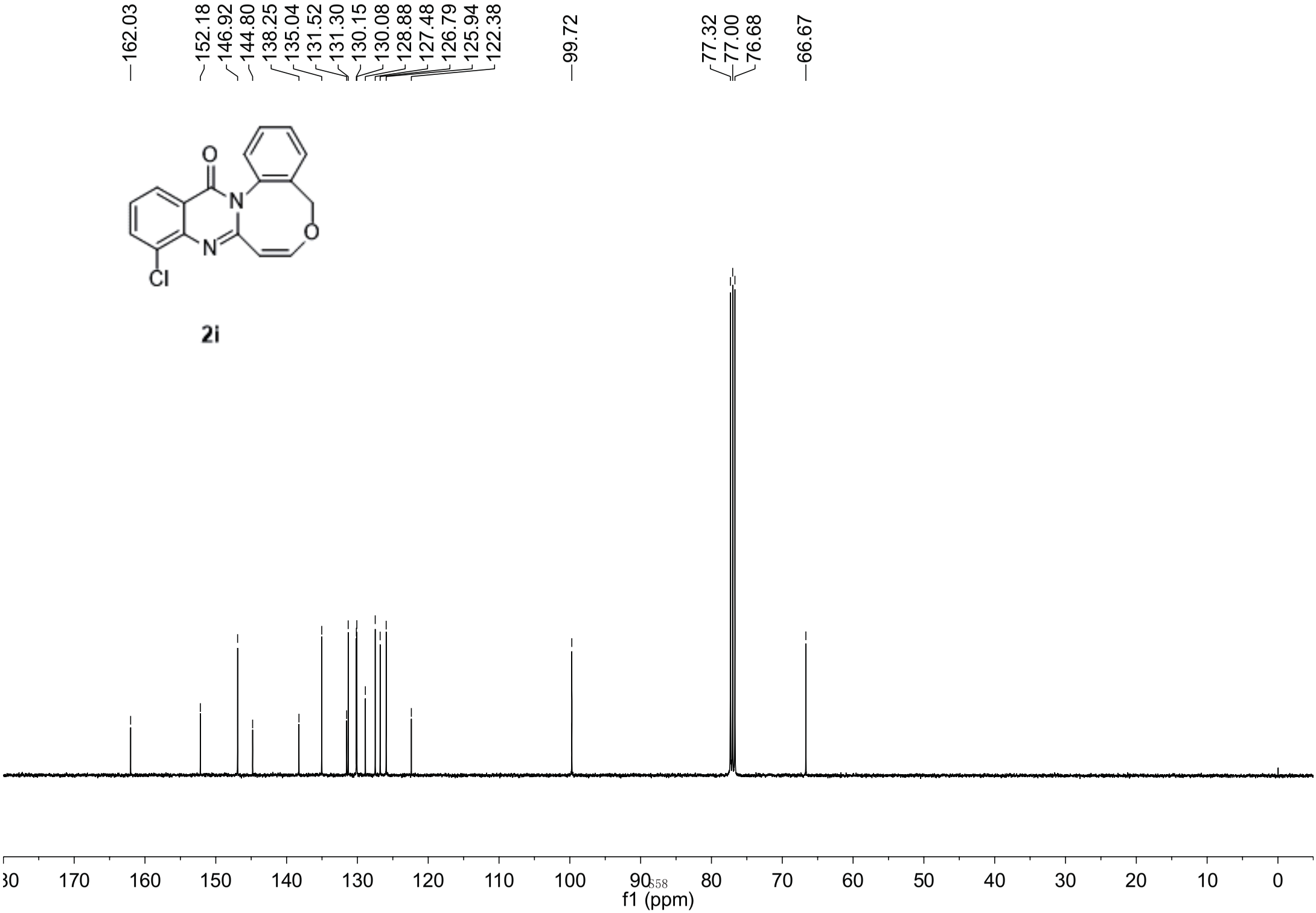

9.1016
9.0951
8.5606
8.5381
8.5315
7.8047
7.7823
7.6102
7.5997
7.5937
7.5862
7.5789
7.4013
7.2657
6.2375
6.2149
5.4095
5.3868
5.1326
5.1019
5.0078
4.9772
0.0000
O
O2N
N
N
O
2g
1.00
1.00
1.00
3.05
1.02
1.00
1.01
1.02
1.02
f1 (ppm)

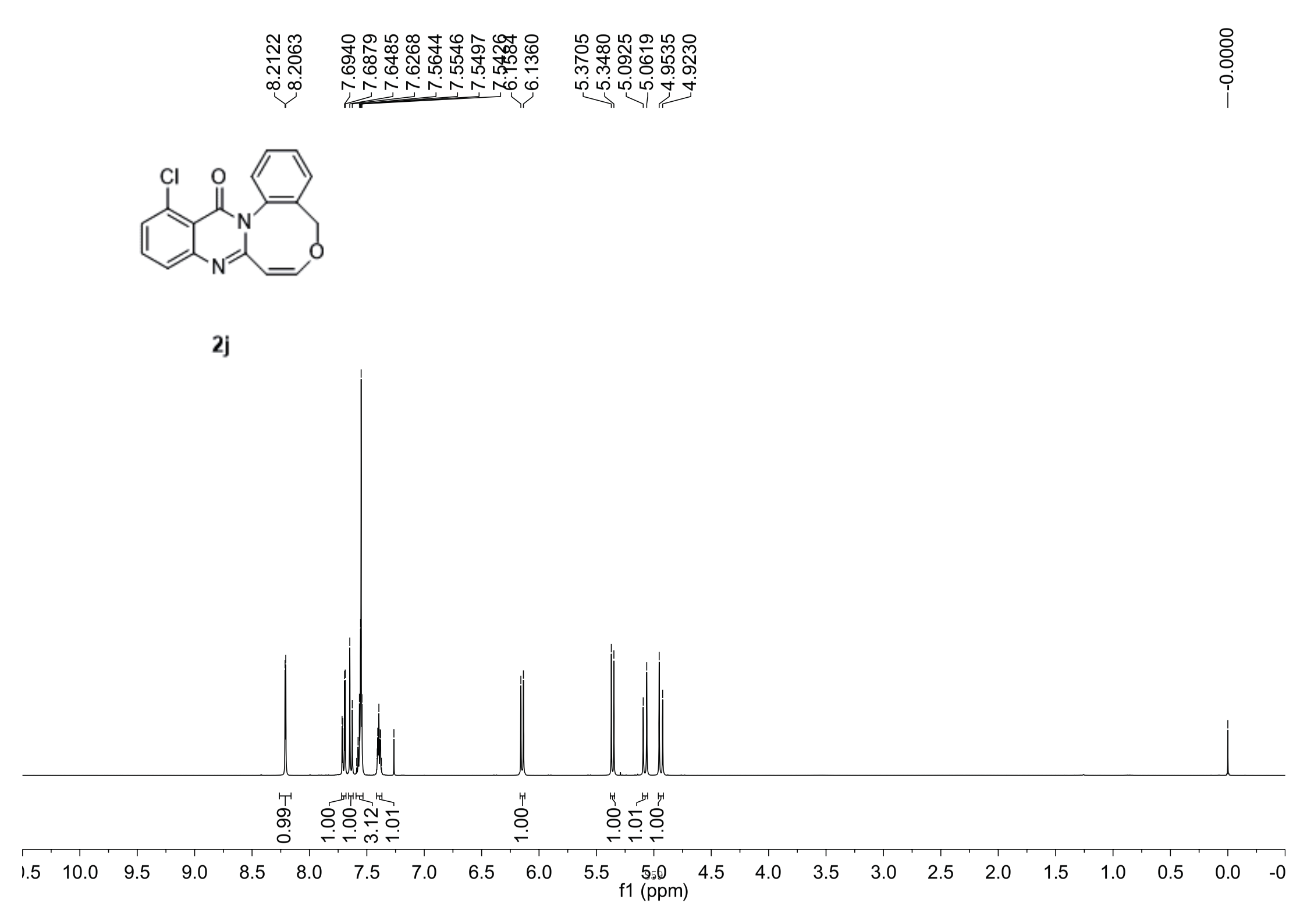

161.36
154.80
152.08
147.69
145.57
137.75
131.45
130.50
130.31
128.88
128.69
127.40
123.81
120.82
99.27
77.32
77.00
76.68
66.78
O2N
O
N
N
O
2g
f1 (ppm)

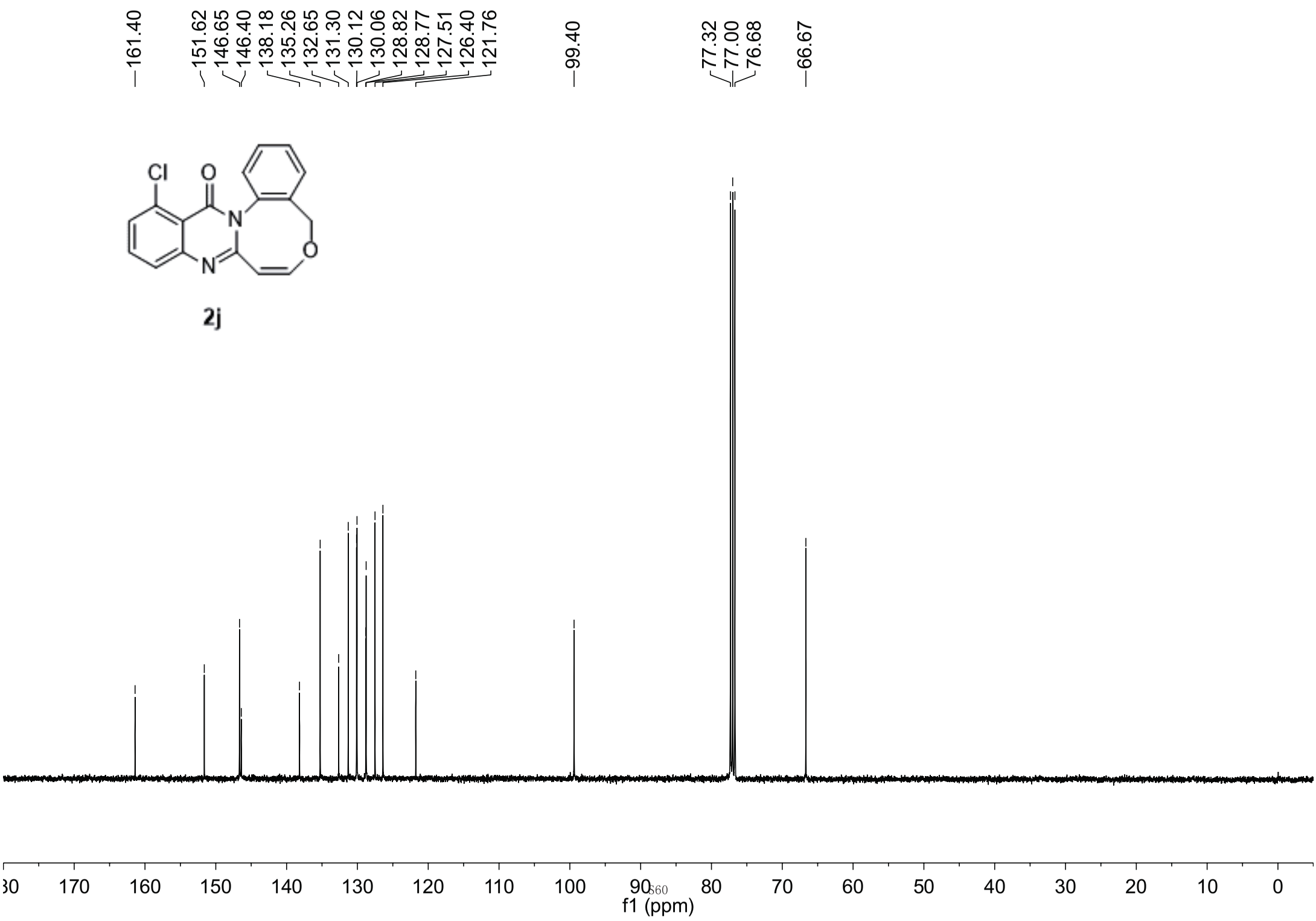

8.1957
8.1744
7.6879
7.6831
7.5617
7.5535
7.5480
7.4270
7.4055
7.4004
6.1620
6.1395
5.3700
5.3475
5.1000
5.0695
4.9569
4.9264
0.0000
O
N
O
N
Cl
2h
1.00
1.01
3.00
2.00
1.00
1.01
1.01
1.00
f1 (ppm)

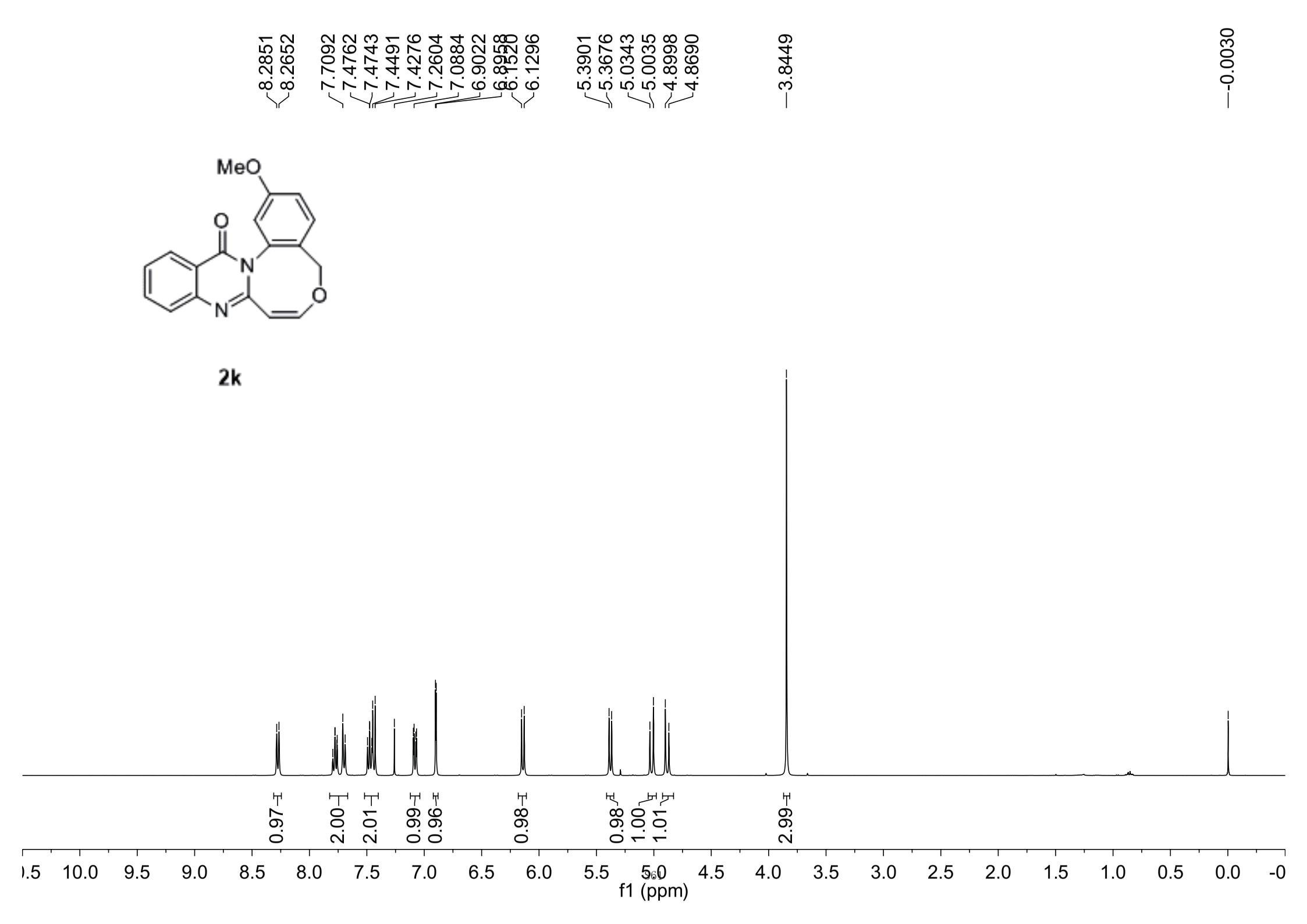

161.82
152.66
148.93
146.71
141.06
138.20
131.29
130.03
128.57
127.56
127.48
119.19
99.48
77.32
77.00
76.68
66.70
O
N
O
N
Cl
2h
f1 (ppm)

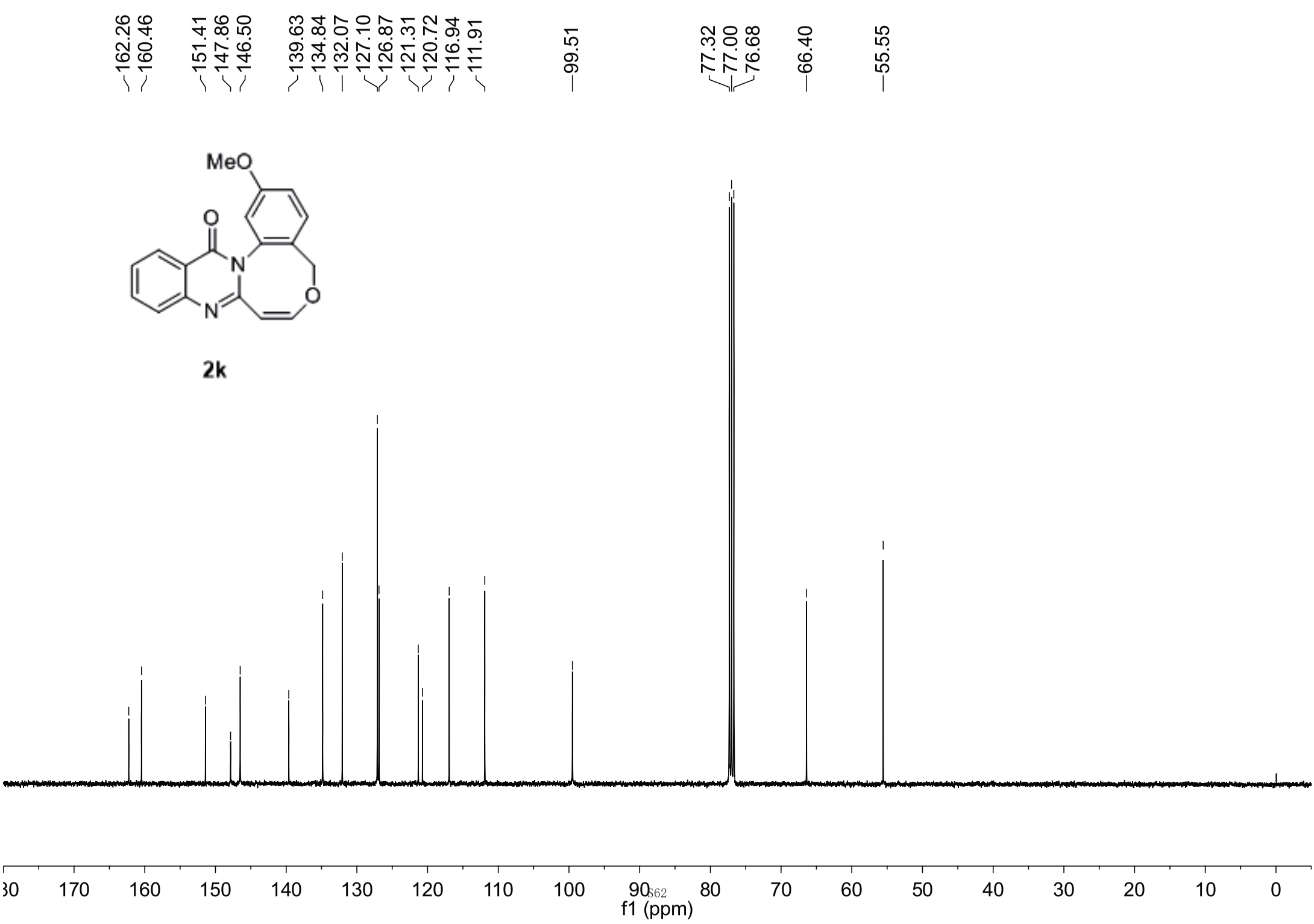

8.1967
8.1932
8.1768
8.1732
7.8625
7.8589
7.8431
7.8395
7.5776
7.5661
7.5600
7.5539
7.5468
7.4054
7.3992
7.3884
7.3798
7.3734
7.3683
7.3601
7.2614
6.1668
6.1443
5.4958
5.4732
5.1129
5.0824
4.9592
4.9288
0.0000
O
N
N
O
Cl
2i
1.00
1.00
3.00
2.01
1.00
1.00
1.00
1.00
f1 (ppm)

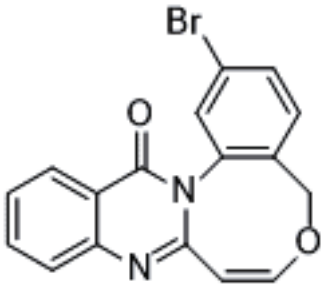

162.03
152.18
146.92
144.80
138.25
135.04
131.52
131.30
130.15
130.08
128.88
127.48
126.79
125.94
122.38
99.72
77.32
77.00
76.68
66.67
O
N
N
O
Cl
2i
f1 (ppm)


8.2122
8.2063
7.6940
7.6879
7.6485
7.6268
7.5644
7.5546
7.5497
6.1360
5.3705
5.3480
5.0925
5.0619
4.9535
4.9230
-0.0000
Cl
O
N
N
O
2j
0.99
1.00
1.00
3.12
1.01
1.00
1.00
1.01
1.00
f1 (ppm)


161.40
151.62
146.65
146.40
138.18
135.26
132.65
131.30
130.12
130.06
128.82
128.77
127.51
126.40
121.76
99.40
77.32
77.00
76.68
66.67
Cl
O
N
N
O
2j
f1 (ppm)

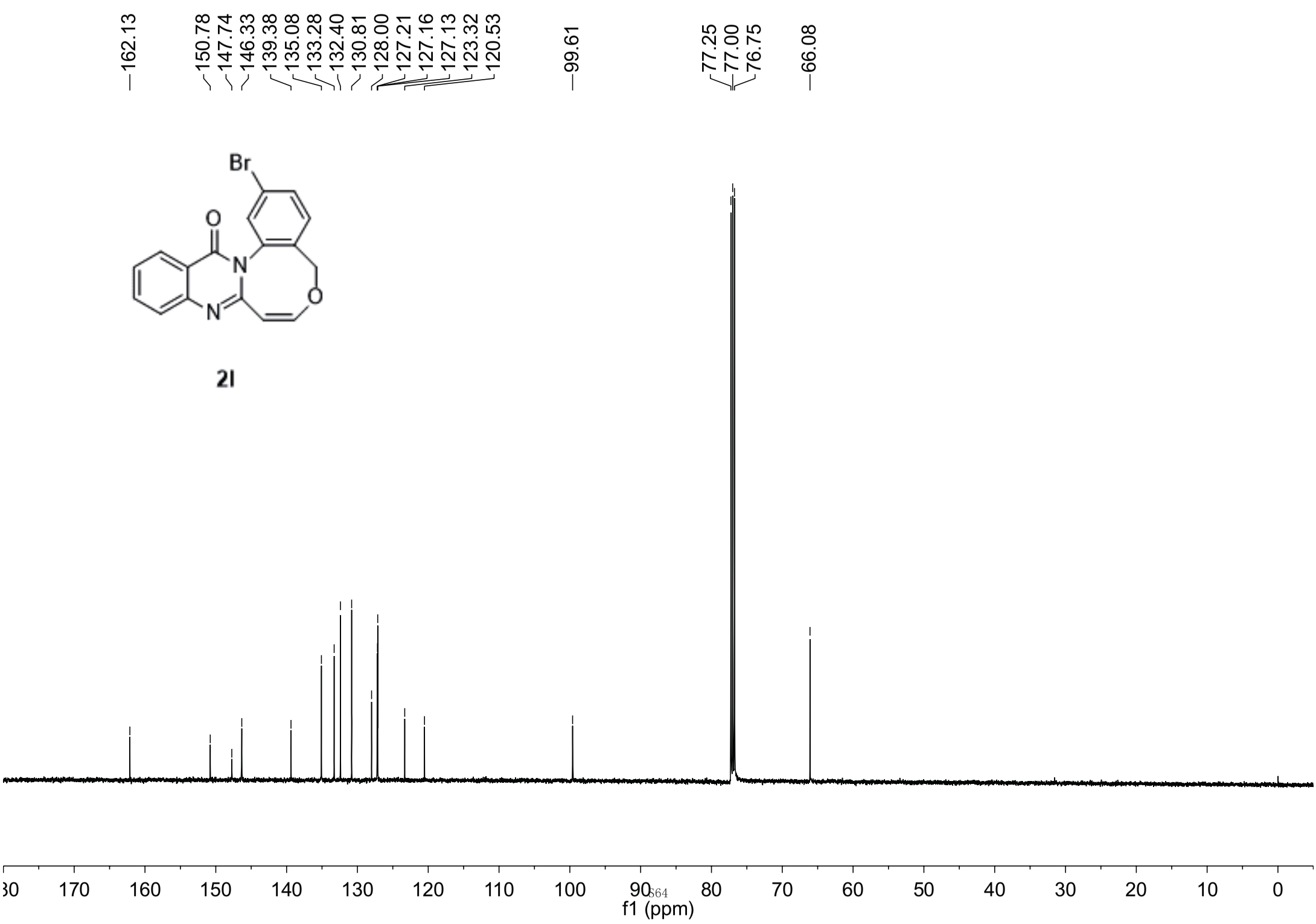

8.2851
8.2652
7.7092
7.4762
7.4743
7.4491
7.4276
7.2604
7.0884
6.9022
6.1296
5.3901
5.3676
5.0343
5.0035
4.8998
4.8690
3.8449
-0.0030
MeO
O
N
N
O
2k
0.97
2.00
2.01
0.99
0.96
0.98
0.98
1.00
1.01
2.99
f1 (ppm)

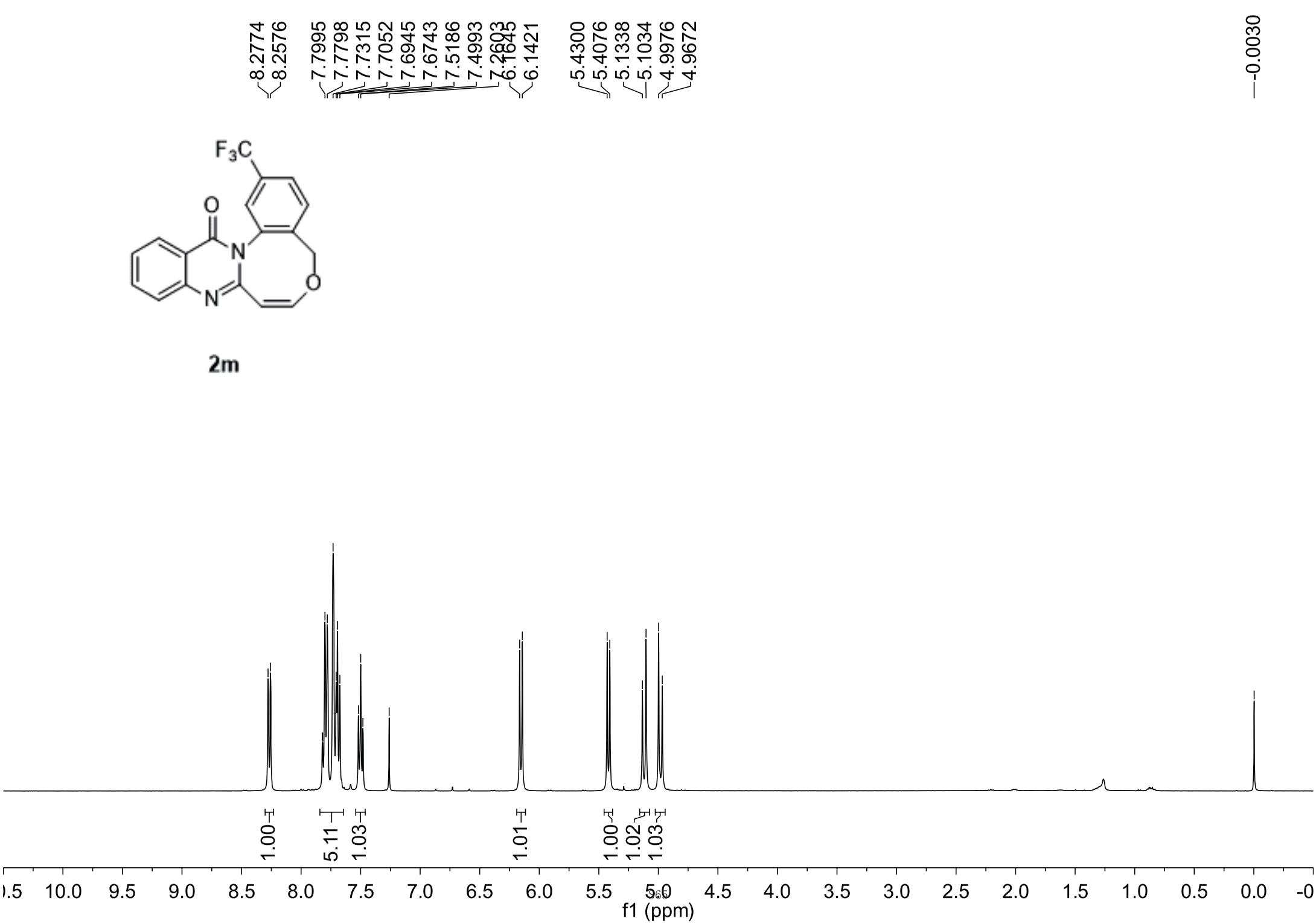

162.26
160.46
151.41
147.86
146.50
139.63
134.84
132.07
127.10
126.87
121.31
120.72
116.94
111.91
99.51
77.32
77.00
76.68
66.40
55.55
MeO
O
N
N
O
2k
f1 (ppm)

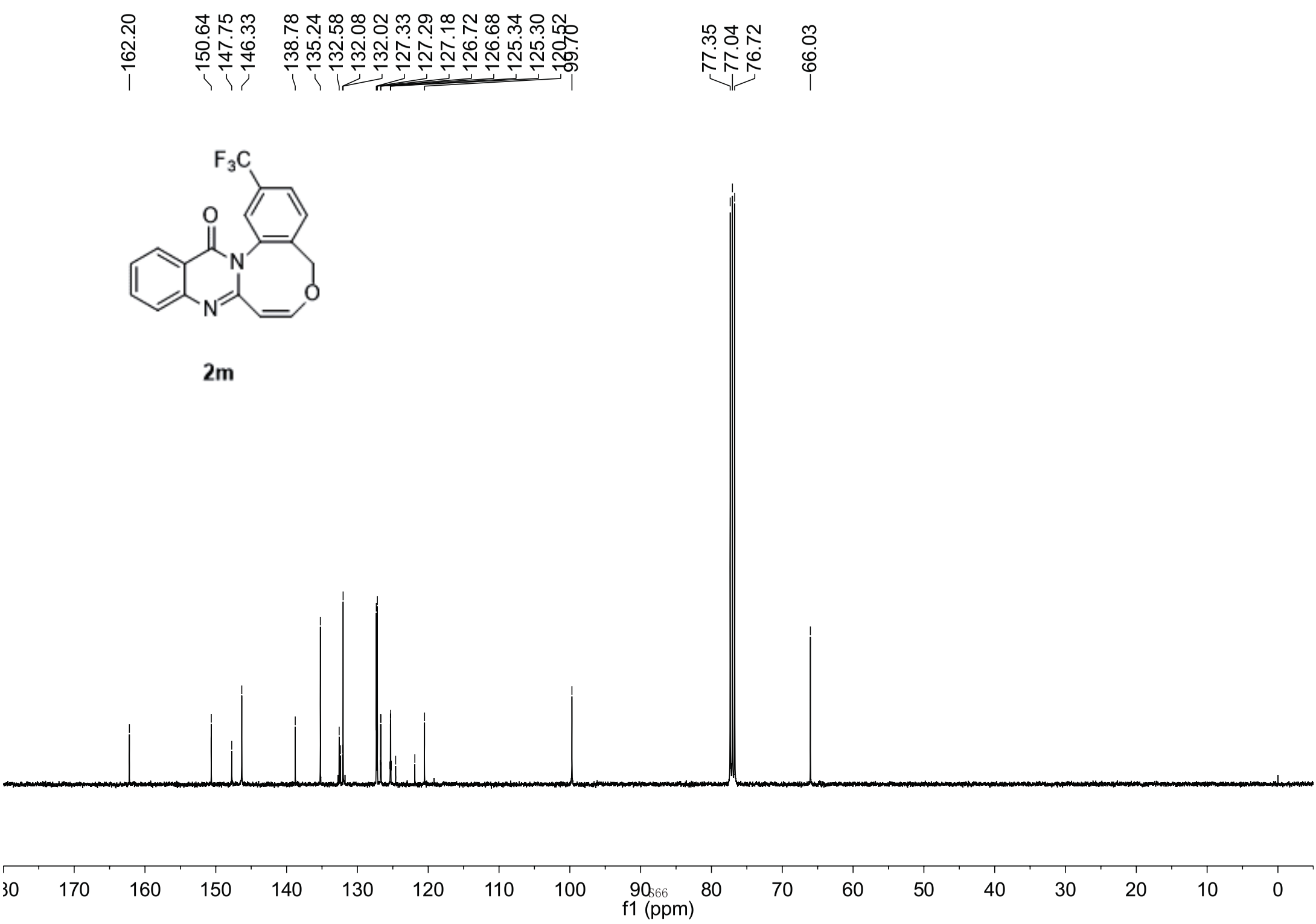

Br
O
N
N
O

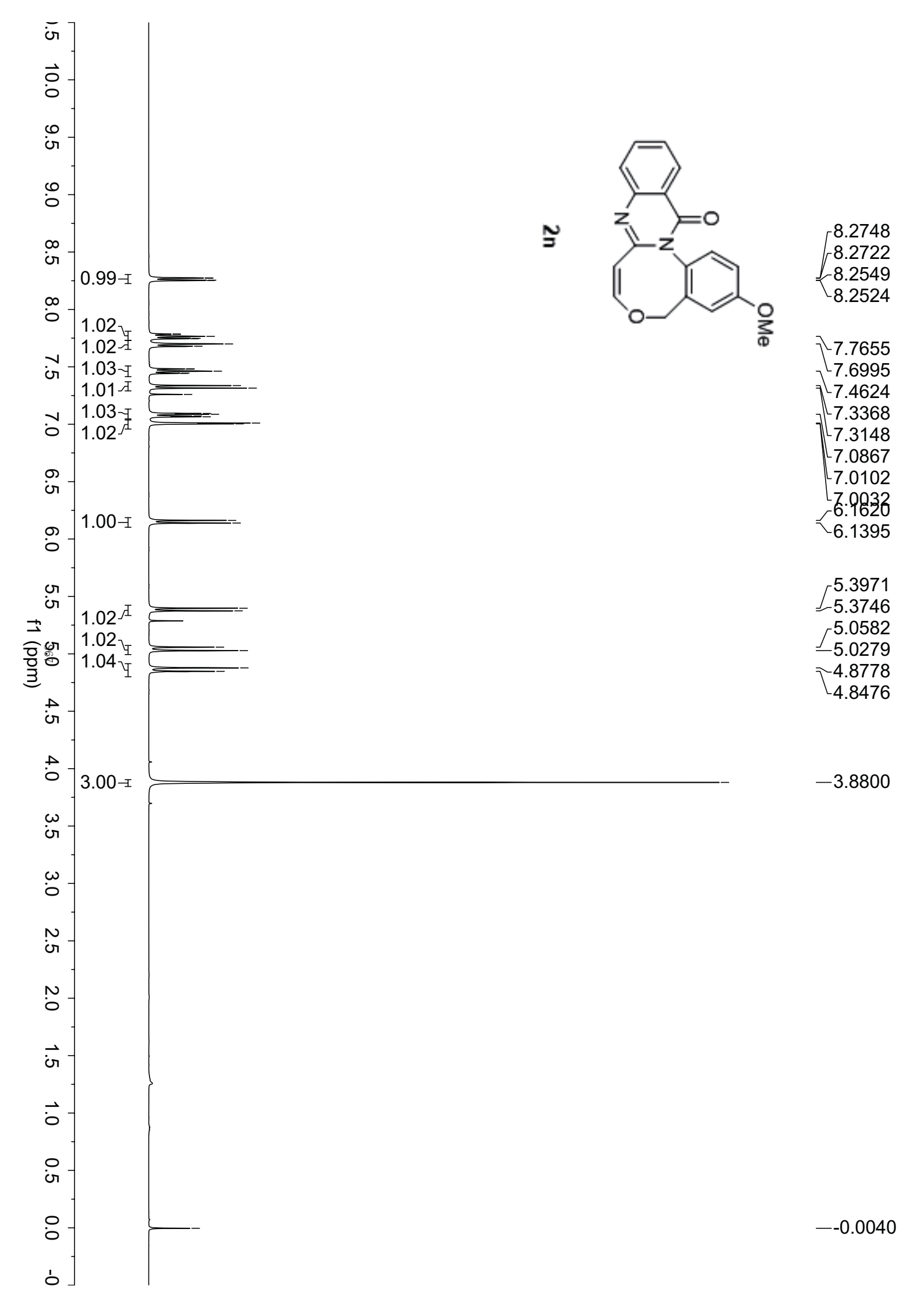
2l

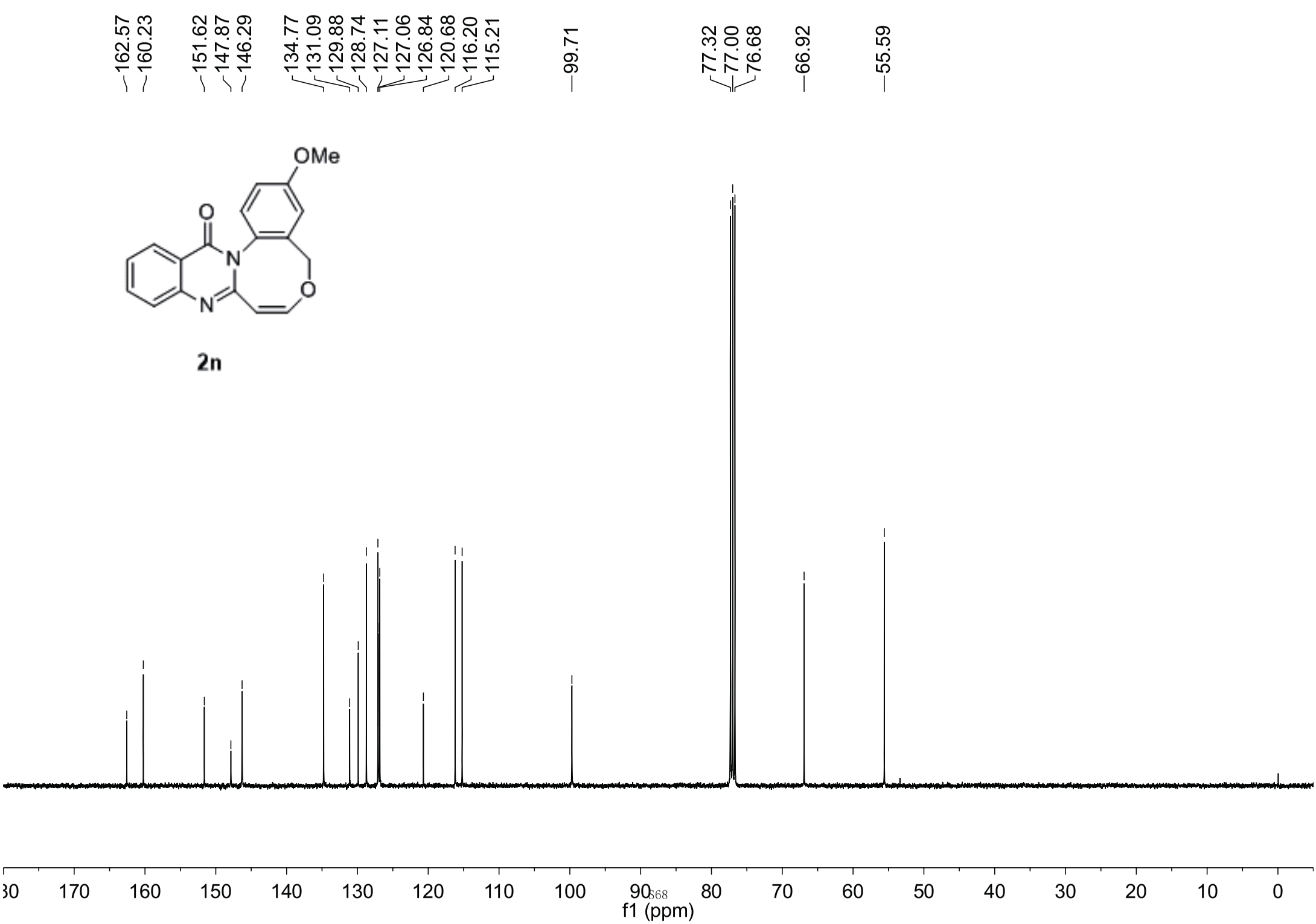
8.2723
8.2564
7.7888
7.6580
7.6553
7.6021
7.5985
7.4891
7.4230
7.4065
7.2598
6.1501
6.1323
5.4016
5.3837
5.0497
5.0252
4.9141
4.8896
-0.0042
1.00
1.02
2.01
0.98
1.03
1.00
1.02
1.01
1.02
1.02
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0
f1 (ppm)

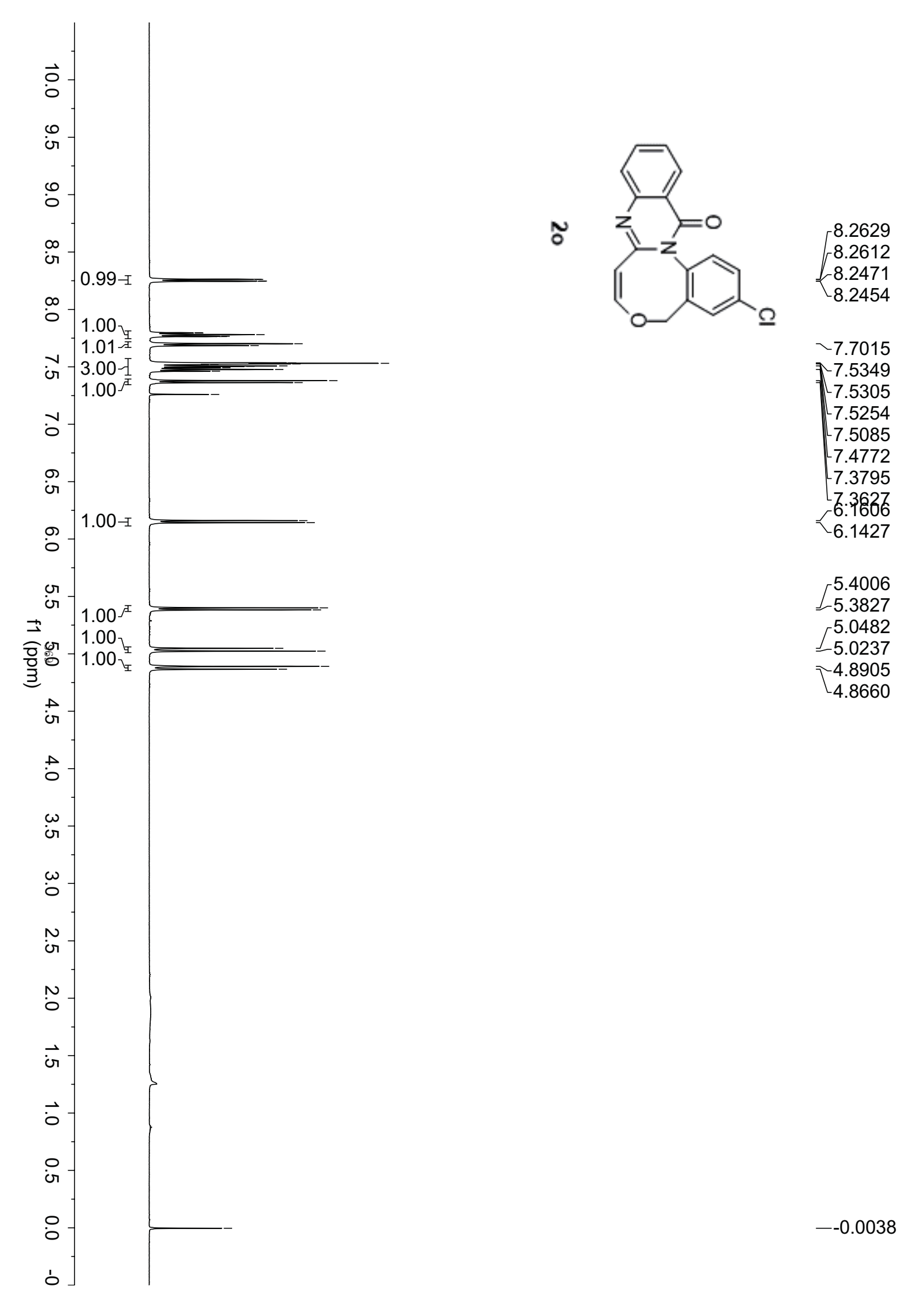

162.13
150.78
147.74
146.33
139.38
135.08
133.28
132.40
130.81
128.00
127.21
127.16
127.13
123.32
120.53
99.61
77.25
77.00
76.75
66.08
Br
O
N
N
O
2l
f1 (ppm)

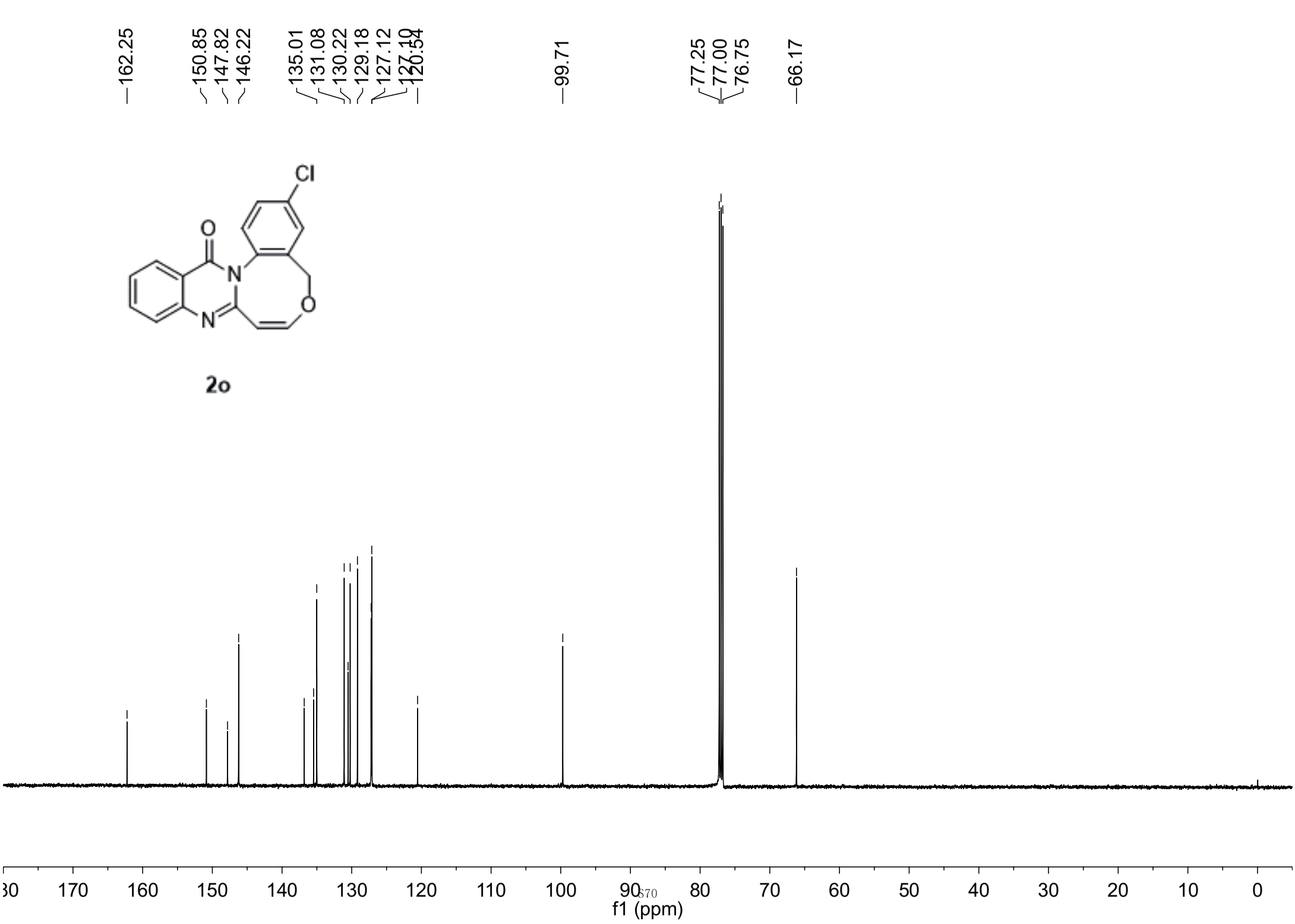

8.2774
8.2576
7.7995
7.7798
7.7315
7.7052
7.6945
7.6743
7.5186
7.4993
7.2603
6.1645
6.1421
5.4300
5.4076
5.1338
5.1034
4.9976
4.9672
-0.0030
F3C
O
N
N
O
2m
1.00
5.11
1.03
1.01
1.00
1.02
1.03
f1 (ppm)

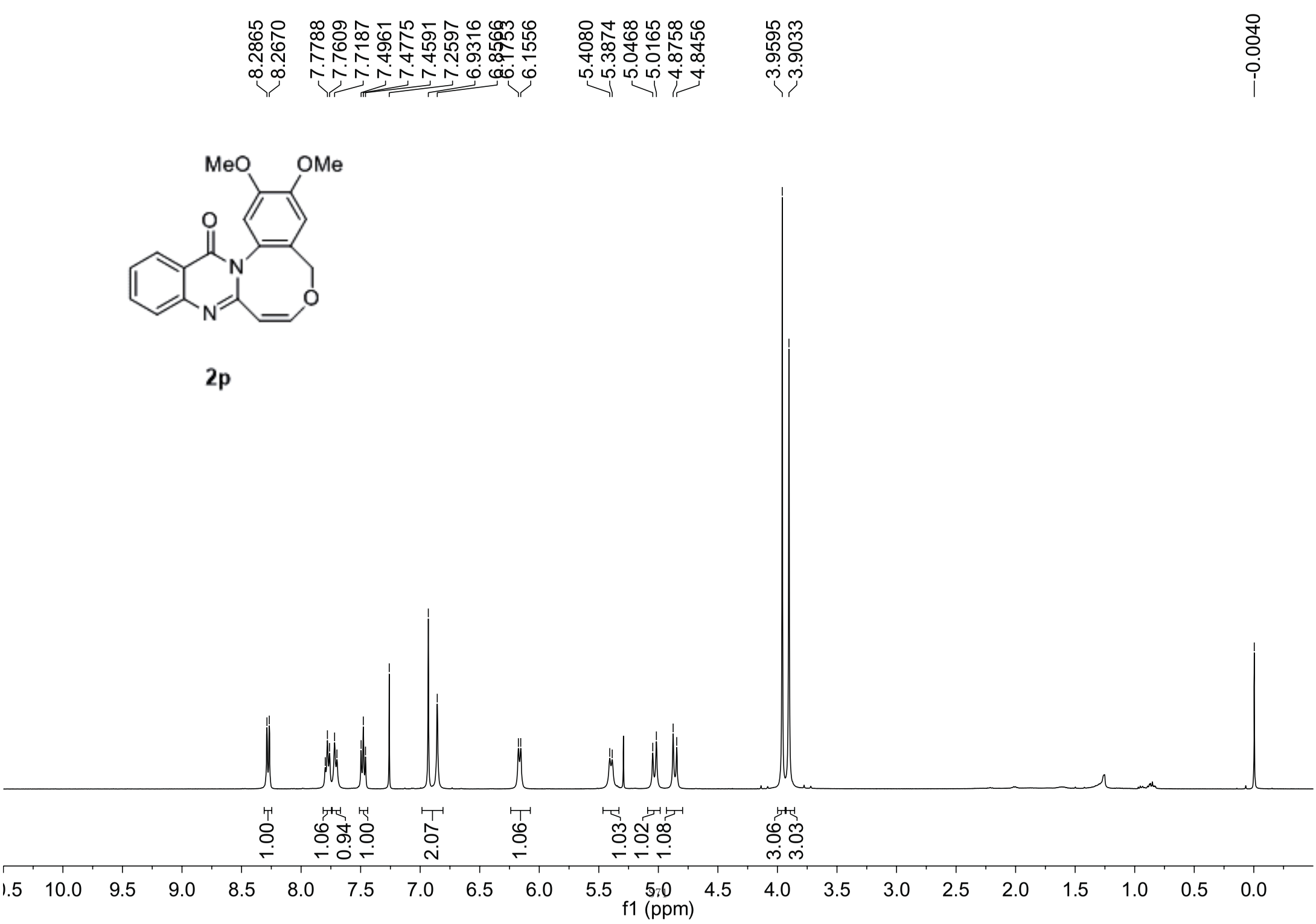

162.20
150.64
147.75
146.33
138.78
135.24
132.58
132.08
132.02
127.33
127.29
127.18
126.72
126.68
125.34
125.30
120.52
99.70
77.35
77.04
76.72
66.03
F3C
O
N
N
O
2m
f1 (ppm)

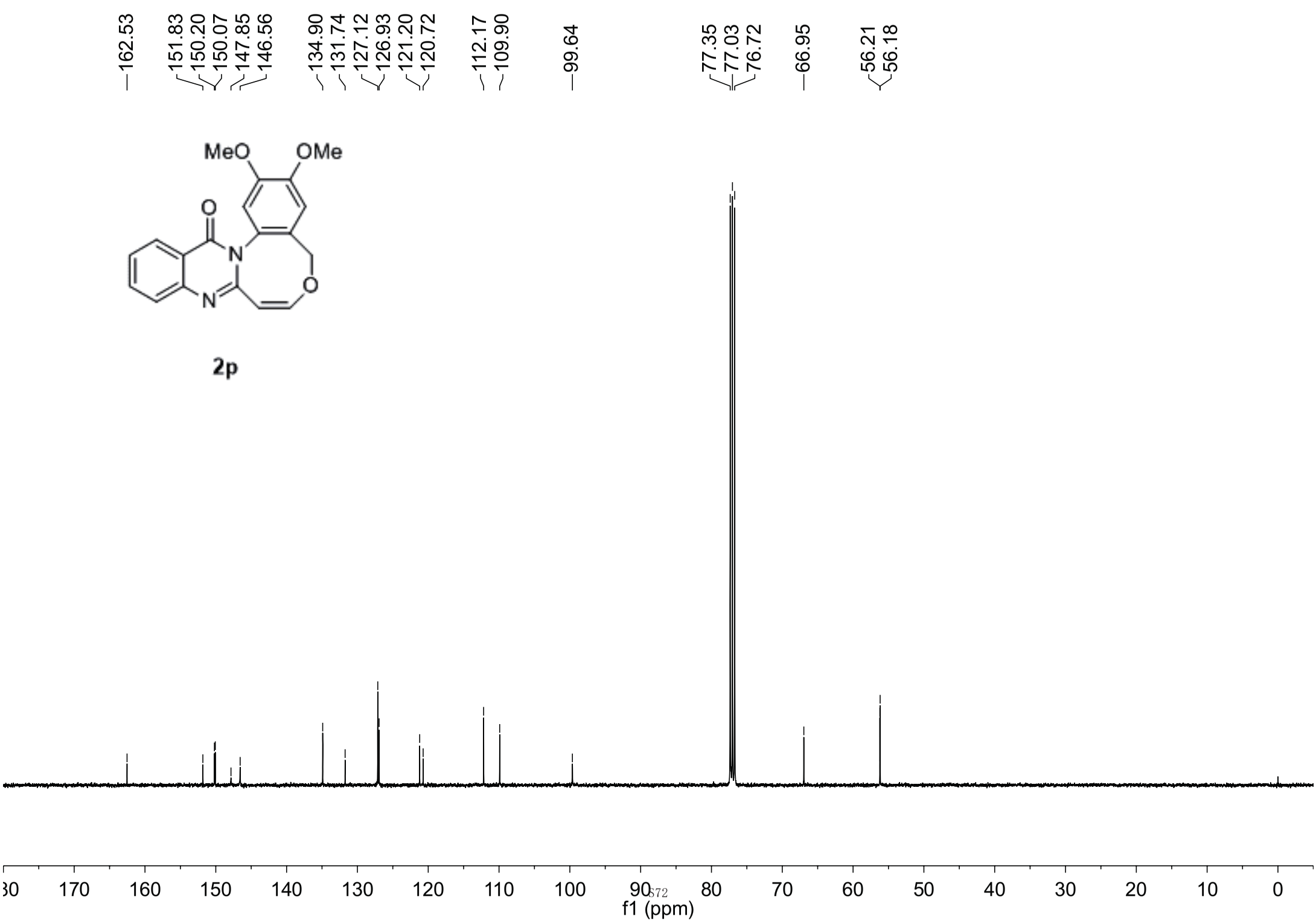

2n
N
N
O
O
OMe
8.2748
8.2722
8.2549
8.2524
7.7655
7.6995
7.4624
7.3368
7.3148
7.0867
7.0102
7.0032
6.1620
6.1395
5.3971
5.3746
5.0582
5.0279
4.8778
4.8476
3.8800
-0.0040
0.99
1.02
1.02
1.03
1.01
1.03
1.02
1.00
1.02
1.02
1.04
3.00
f1 (ppm)

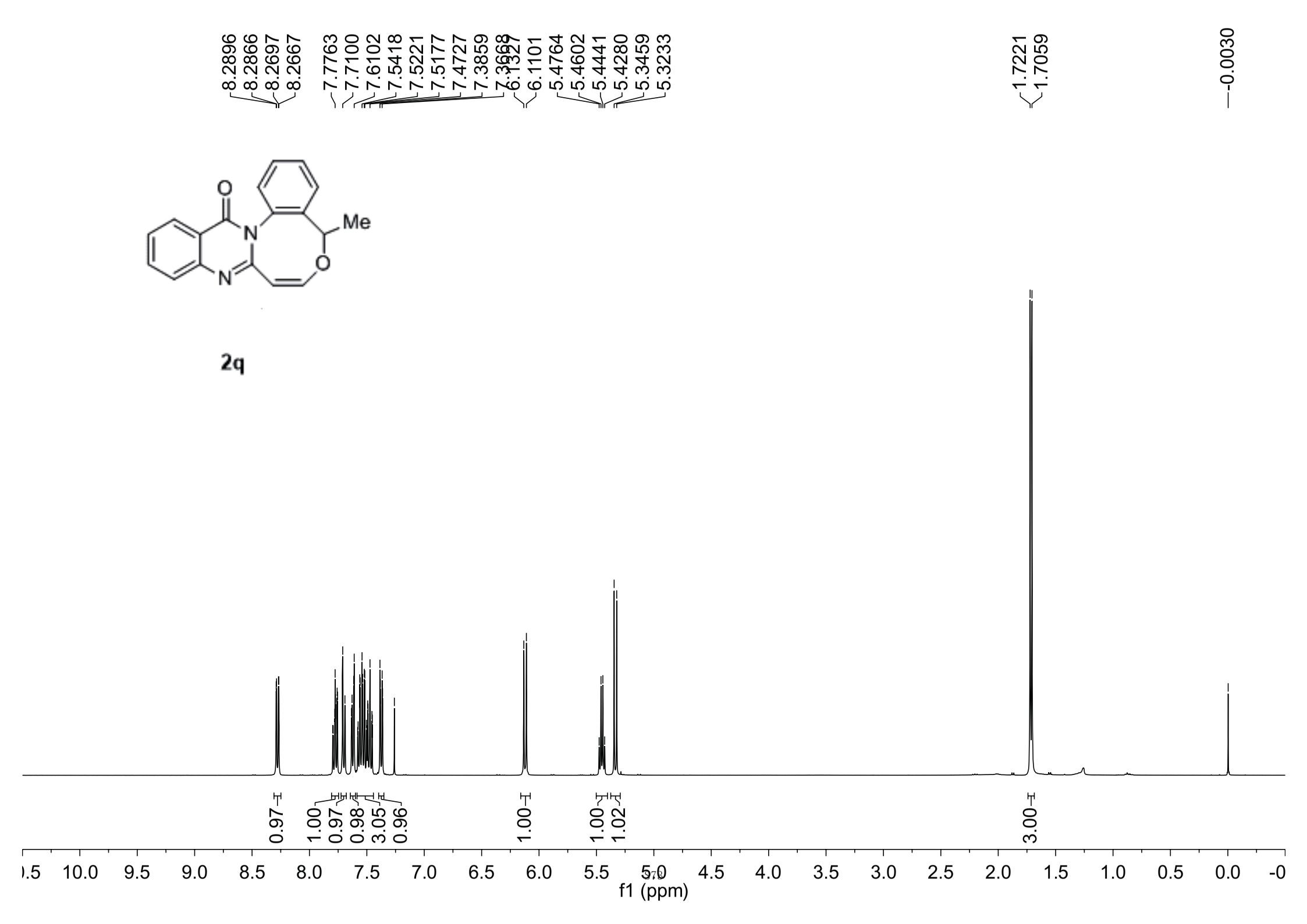

162.57
160.23
151.62
147.87
146.29
134.77
131.09
129.88
128.74
127.11
127.06
126.84
120.68
116.20
115.21
99.71
77.32
77.00
76.68
66.92
55.59
OMe
O
N
N
O
2n
f1 (ppm)

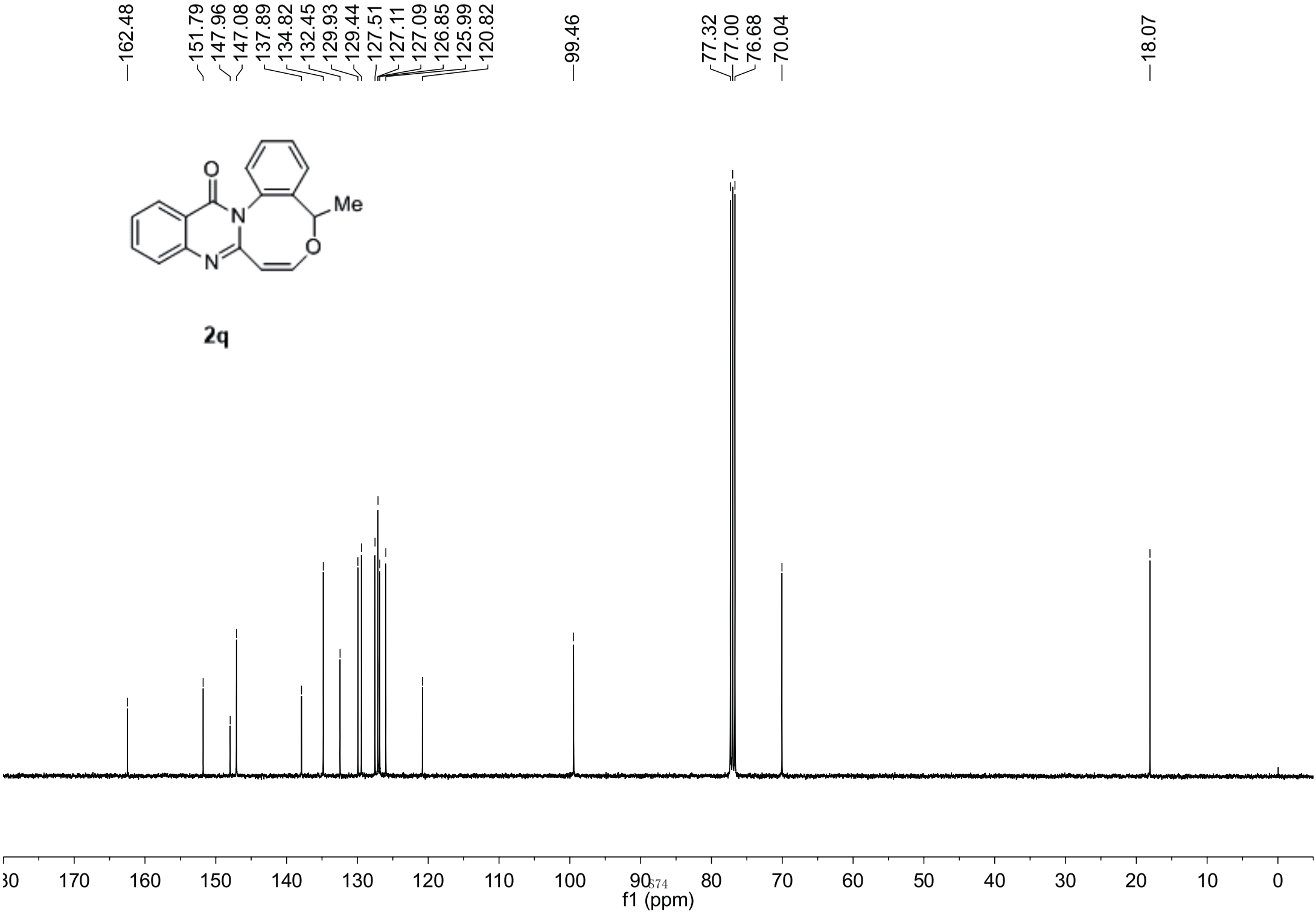

2o
O
N
N
O
Cl
8.2629
8.2612
8.2471
8.2454
7.7015
7.5349
7.5305
7.5254
7.5085
7.4772
7.3795
7.3627
6.1606
6.1427
5.4006
5.3827
5.0482
5.0237
4.8905
4.8660
-0.0038
0.99
1.00
1.01
3.00
1.00
1.00
1.00
1.00
1.00
f1 (ppm)

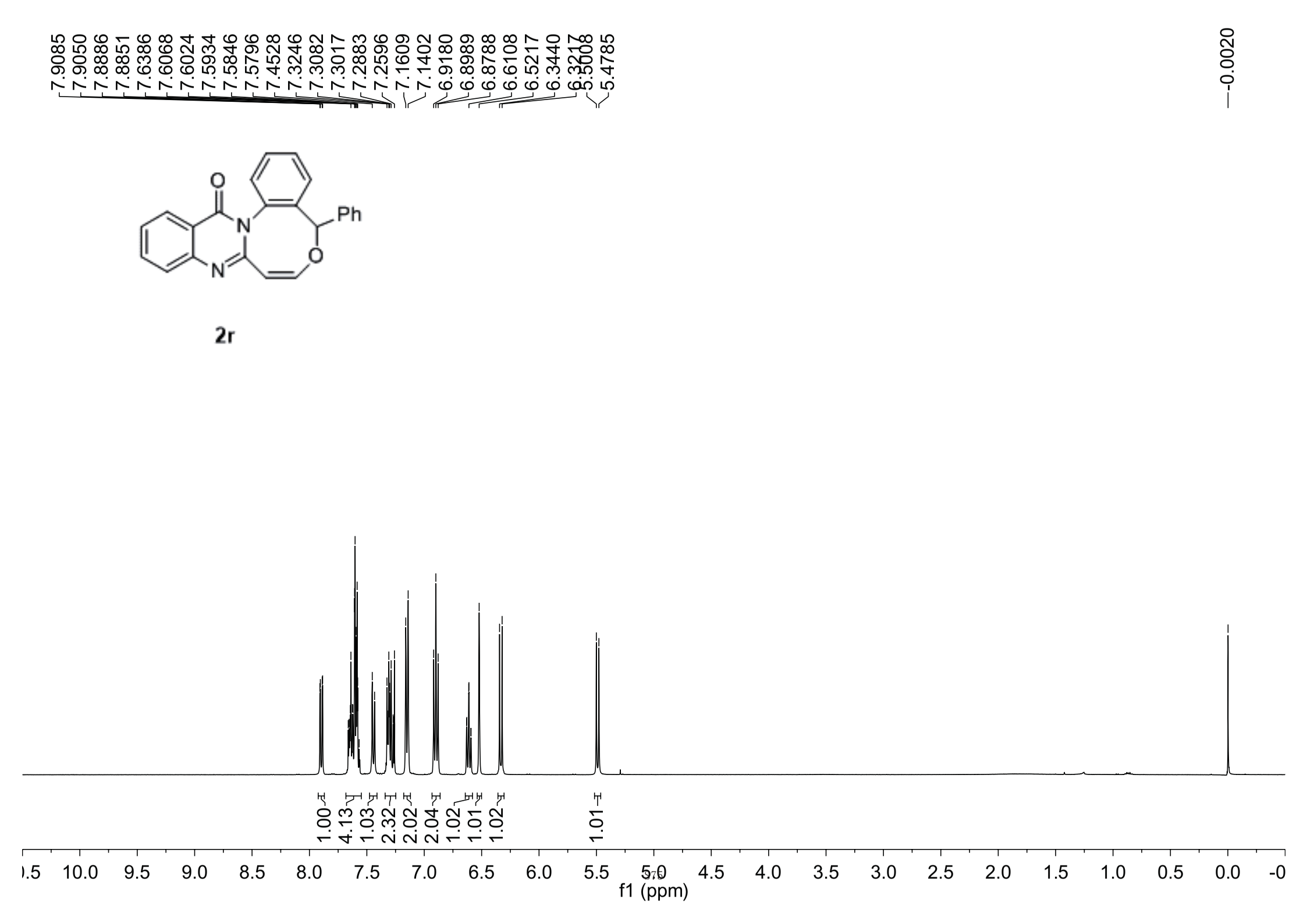

162.25
150.85
147.82
146.22
135.01
131.08
130.22
129.18
127.12
127.10
120.54
99.71
77.25
77.00
76.75
66.17
Cl
O
N
N
O
2o
f1 (ppm)


8.2865
8.2670
7.7788
7.7609
7.7187
7.4961
7.4775
7.4591
7.2597
6.9316
6.8566
6.1753
6.1556
5.4080
5.3874
5.0468
5.0165
4.8758
4.8456
3.9595
3.9033
-0.0040
MeO
OMe
O
N
N
O
2p
1.00
1.06
0.94
1.00
2.07
1.06
1.03
1.02
1.08
3.06
3.03
f1 (ppm)

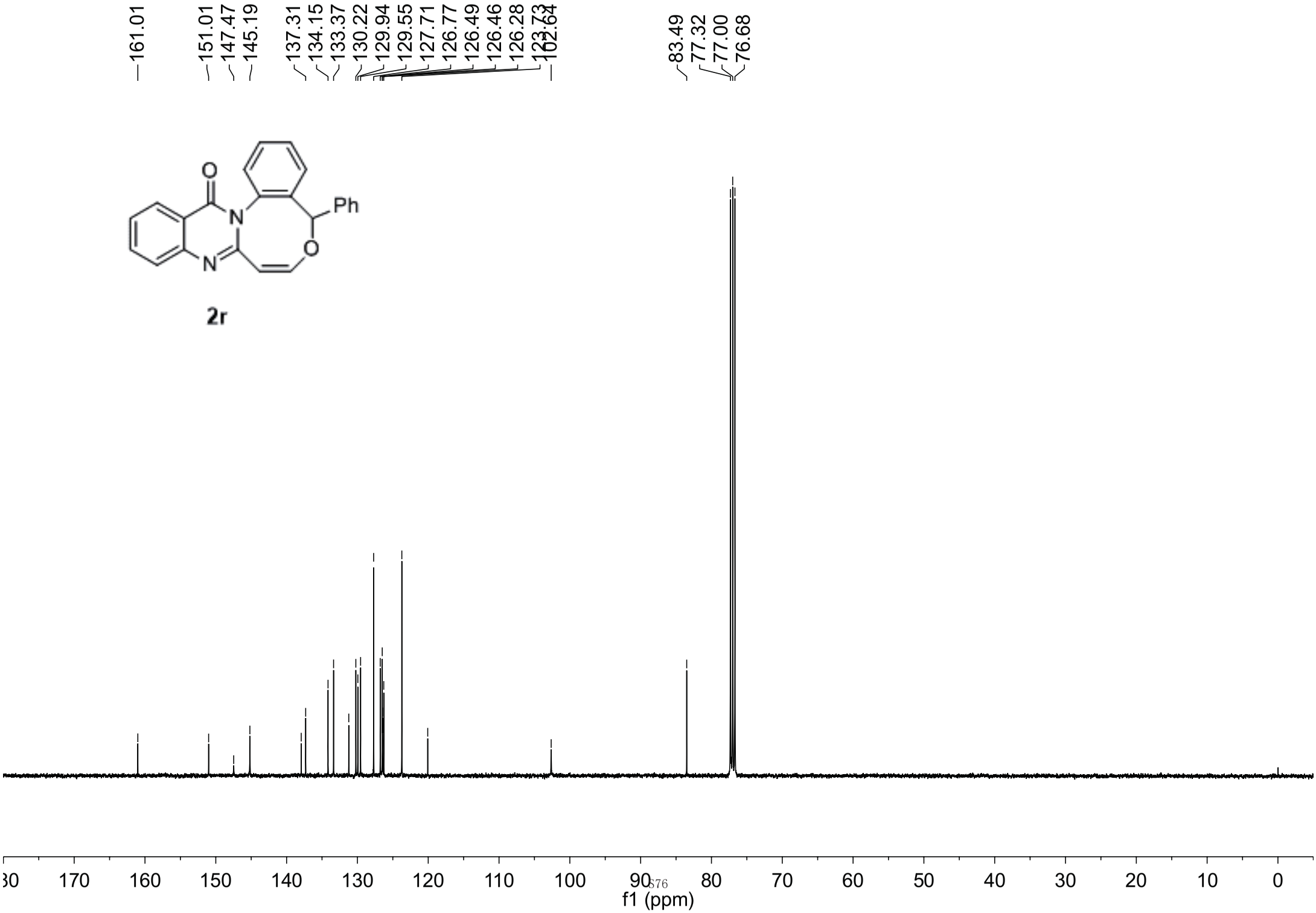

162.53
151.83
150.20
150.07
147.85
146.56
134.90
131.74
127.12
126.93
121.20
120.72
112.17
109.90
99.64
77.35
77.03
76.72
66.95
56.21
56.18
MeO
OMe
O
N
N
O
2p
f1 (ppm)

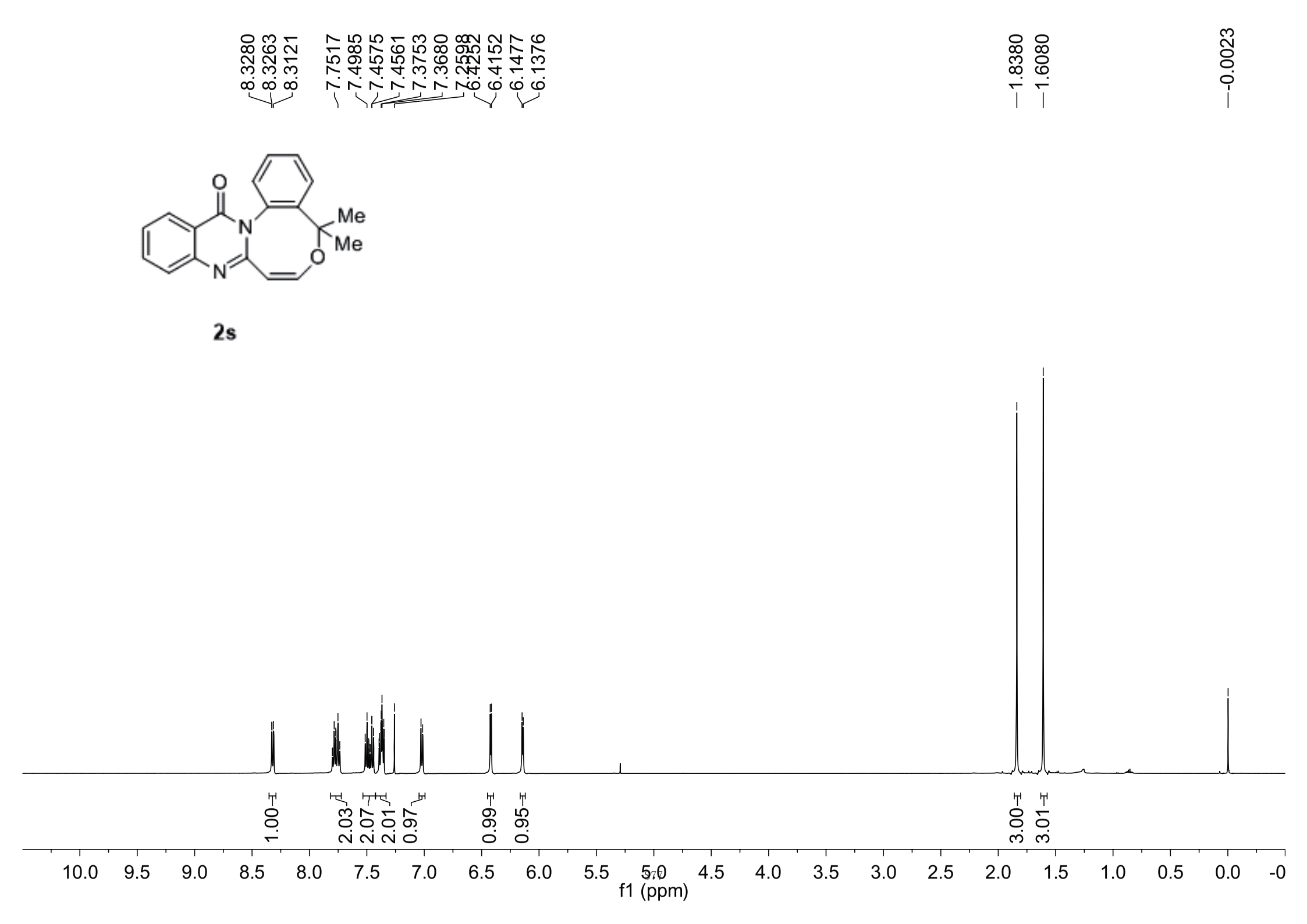

8.2896
8.2866
8.2697
8.2667
7.7763
7.7100
7.6102
7.5418
7.5221
7.5177
7.4727
7.3859
7.3668
7.1327
6.1101
5.4764
5.4602
5.4441
5.4280
5.3459
5.3233
1.7221
1.7059
-0.0030
O
N
N
O
Me
2q
0.97
1.00
0.97
0.98
3.05
0.96
1.00
1.00
1.02
3.00
f1 (ppm)

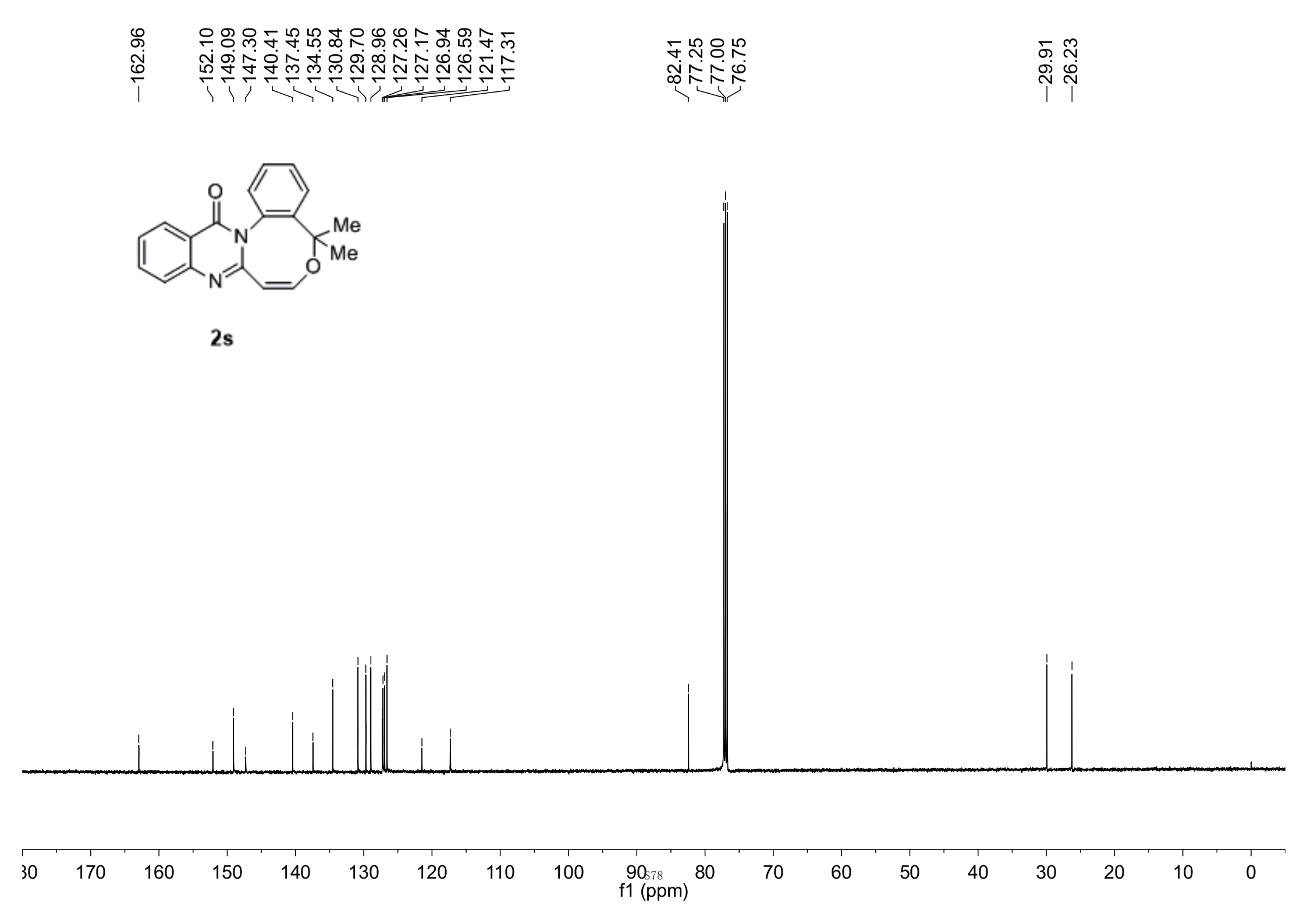

162.48
151.79
147.96
147.08
137.89
134.82
132.45
129.93
129.44
127.51
127.11
127.09
126.85
125.99
120.82
99.46
77.32
77.00
76.68
70.04
18.07
O
N
N
O
Me
2q
f1 (ppm)

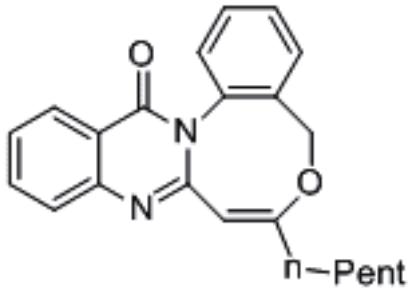

7.9085
7.9050
7.8886
7.8851
7.6386
7.6068
7.6024
7.5934
7.5846
7.5796
7.4528
7.3246
7.3082
7.3017
7.2883
7.2596
7.1609
7.1402
6.9180
6.8989
6.8788
6.6108
6.5217
6.3440
6.3217
5.5008
5.4785
-0.0020
O
N
Ph
O
N
1.00
4.13
1.03
2.32
2.02
2.04
1.02
1.01
1.02
1.01
f1 (ppm)

2r

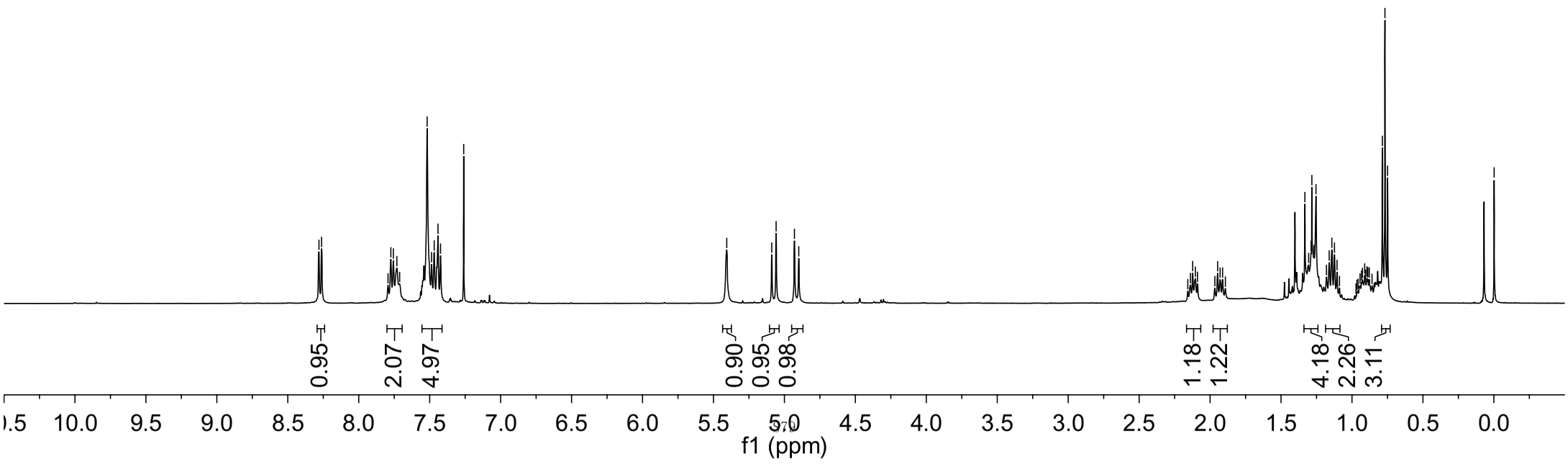

161.01
151.01
147.47
145.19
137.31
134.15
133.37
130.22
129.94
129.55
127.71
126.77
126.49
126.46
126.28
123.73
102.64
83.49
77.32
77.00
76.68
O
N
N
O
Ph
2r
f1 (ppm)

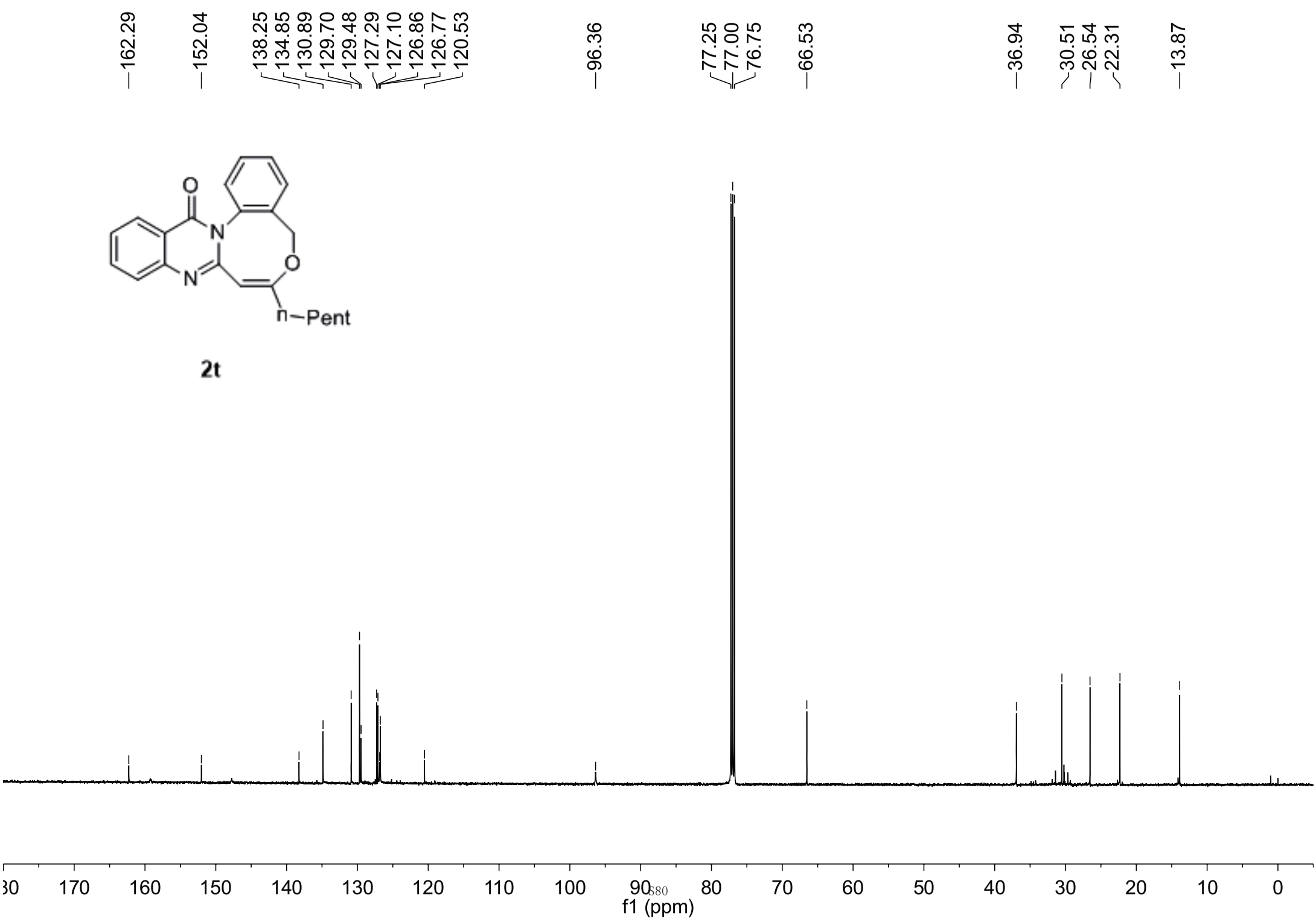

8.3280
8.3263
8.3121
7.7517
7.4985
7.4575
7.4561
7.3753
7.3680
7.2598
6.4252
6.4152
6.1477
6.1376
1.8380
1.6080
-0.0023
O
N
N
O
Me
Me
2s
1.00
2.03
2.07
2.01
0.97
0.99
0.95
3.00
3.01
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0
f1 (ppm)

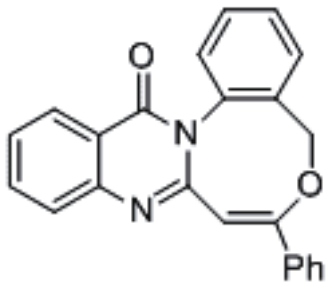

162.96
152.10
149.09
147.30
140.41
137.45
134.55
130.84
129.70
128.96
127.26
127.17
126.94
126.59
121.47
117.31
82.41
77.25
77.00
76.75
29.91
26.23
O
N
N
O
Me
Me
2s
f1 (ppm)


O
N
N
O
n–Pent

2t

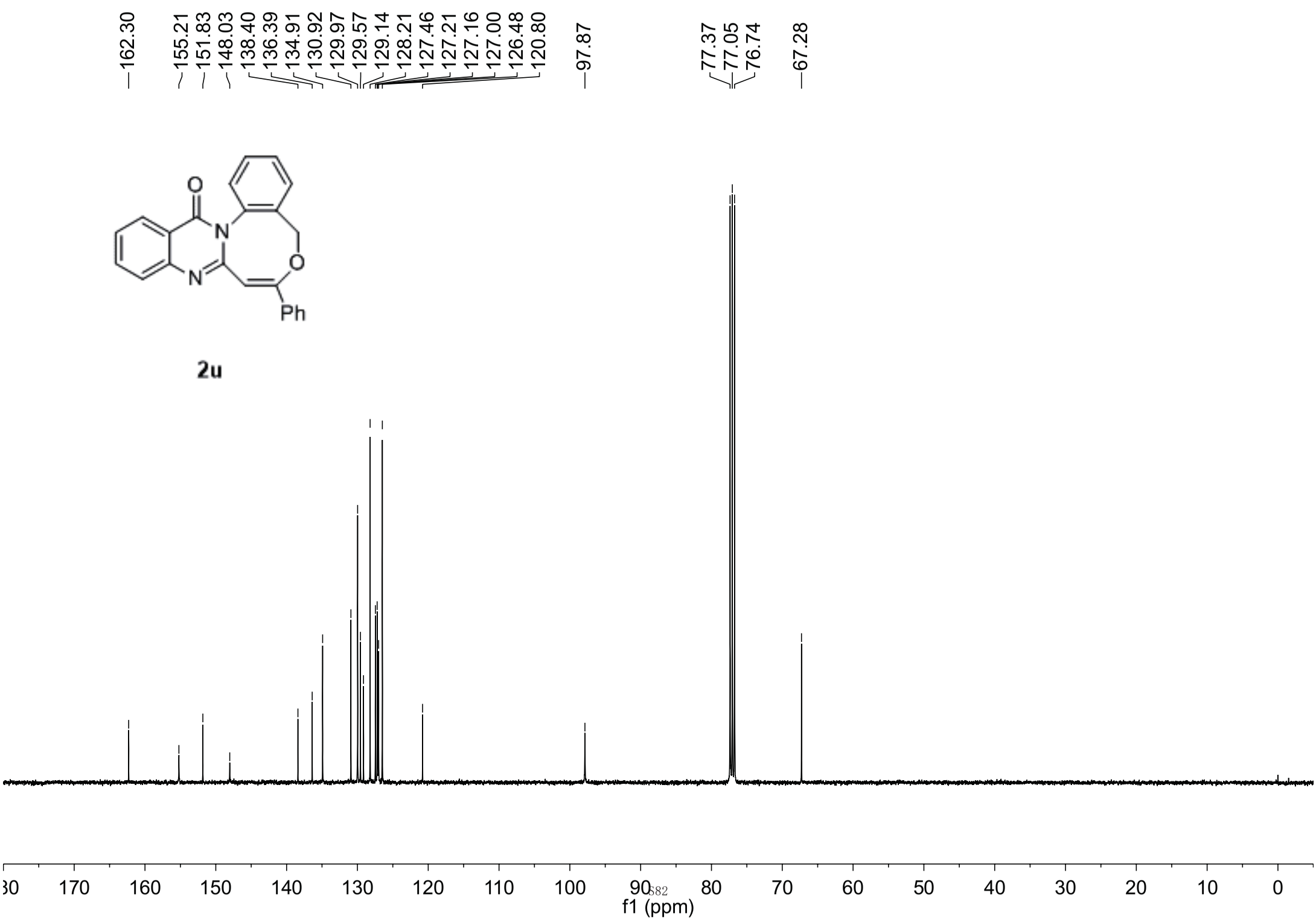

8.2803
8.2619
7.7937
7.7736
7.7561
7.7314
7.7116
7.5179
7.4870
7.4681
7.4414
7.4236
7.2602
5.4064
5.0890
5.0585
4.9293
4.8988
2.1571
2.1383
2.1226
2.1037
2.0886
1.9663
1.9467
1.9295
1.9119
1.8924
1.3320
1.2882
1.2827
1.2538
1.1418
0.7859
0.7676
0.7492
0.0020
0.95
2.07
4.97
0.90
0.95
0.98
1.18
1.22
4.18
2.26
3.11
f1 (ppm)

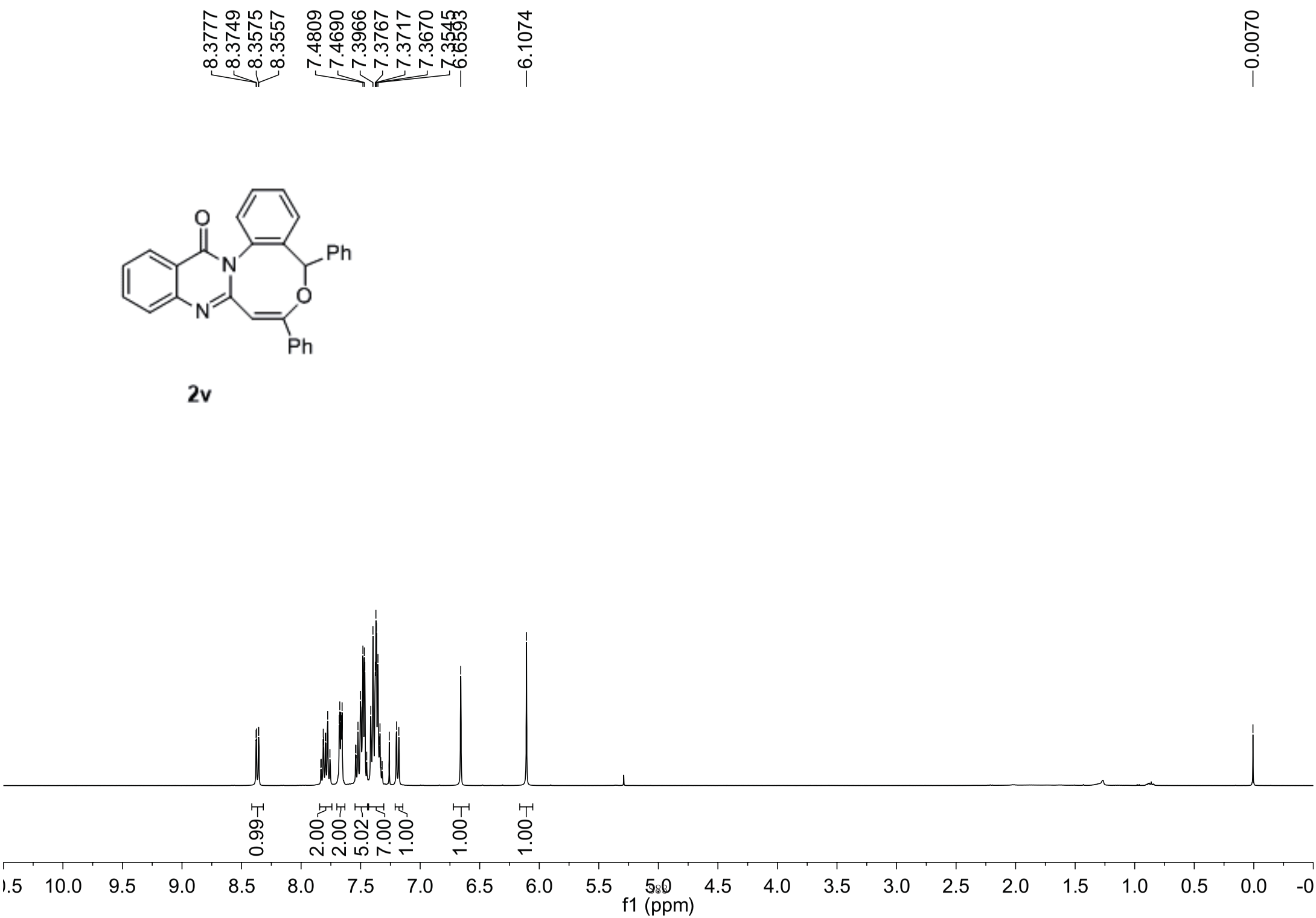

162.29
152.04
138.25
134.85
130.89
129.70
129.48
127.29
127.10
126.86
126.77
120.53
96.36
77.25
77.00
76.75
66.53
36.94
30.51
26.54
22.31
13.87
O
N
N
O
n–Pent
2t
f1 (ppm)

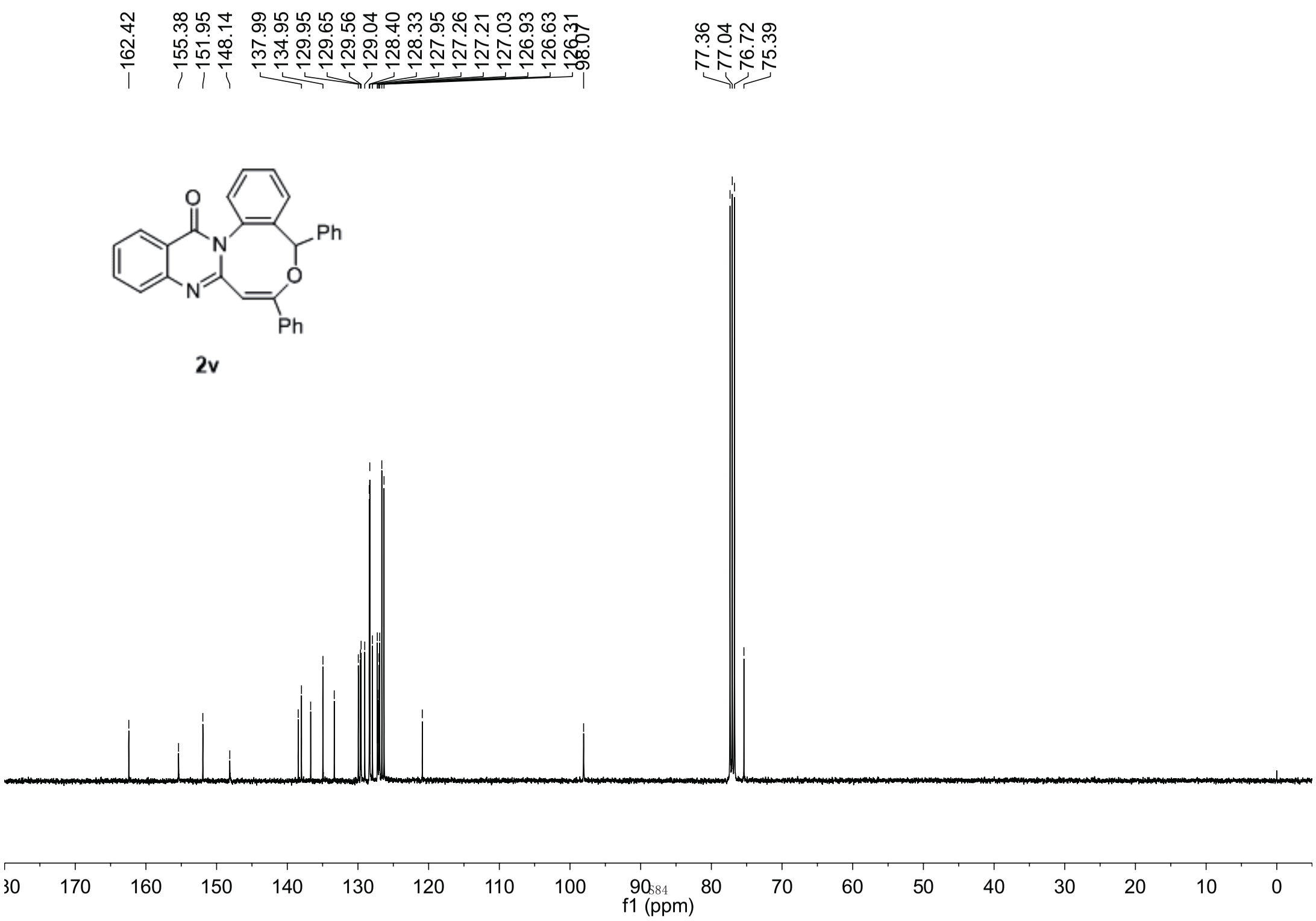

O
N
N
O
Ph

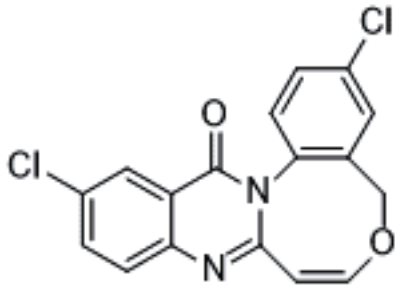
2u

8.3249
8.3223
8.3047
8.3026
7.5633
7.5595
7.5445
7.5393
7.5197
7.5131
7.4768
7.3151
7.3104
7.2967
6.0365
5.2766
5.2459
5.1558
5.1250
0.0050
1.00
2.07
1.04
6.09
3.10
1.00
1.05
1.02
f1 (ppm)


162.30
155.21
151.83
148.03
138.40
136.39
134.91
130.92
129.97
129.57
129.14
128.21
127.46
127.21
127.16
127.00
126.48
120.80
97.87
77.37
77.05
76.74
67.28
O
N
N
O
Ph
2u
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

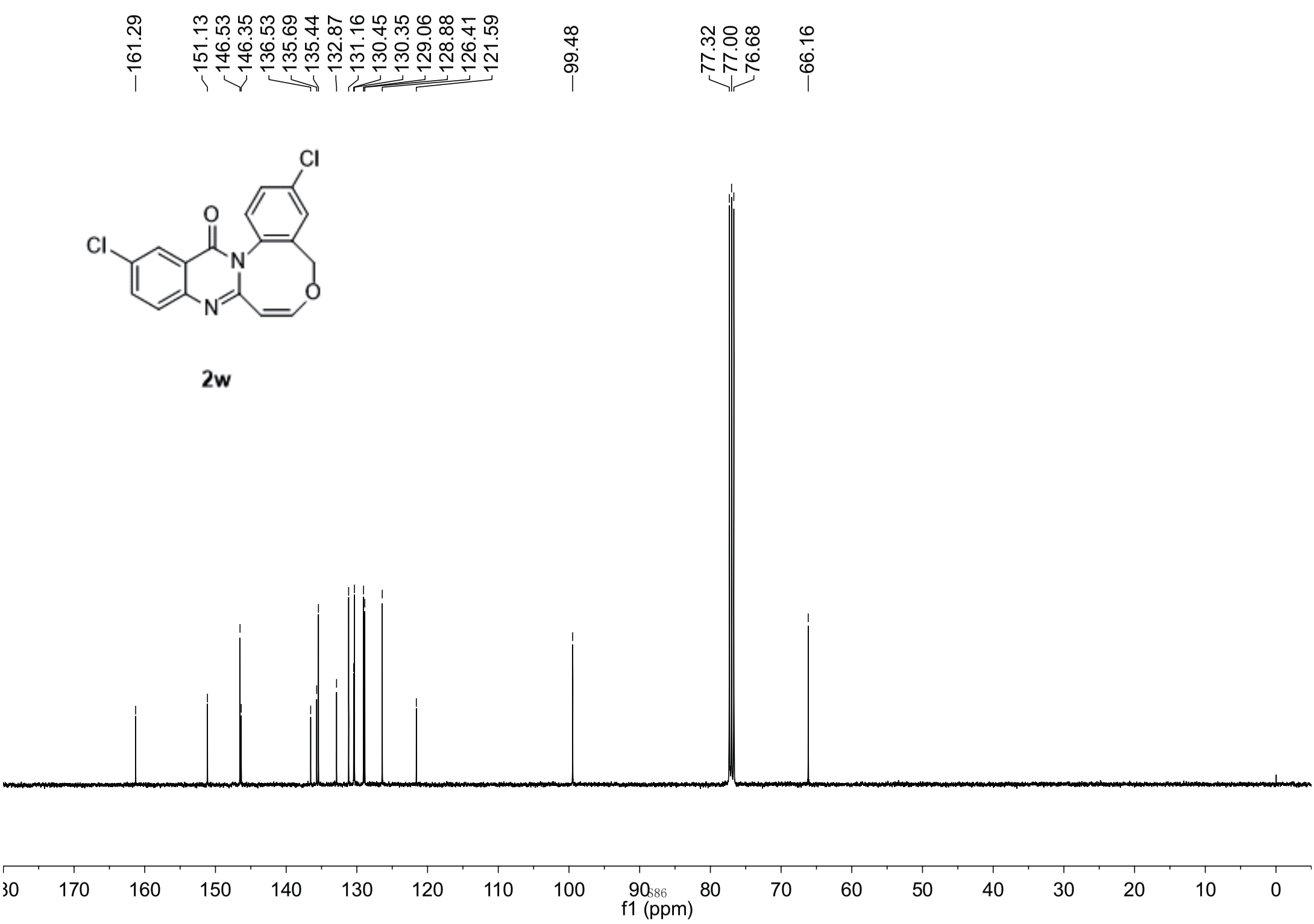

8.3777
8.3749
8.3575
8.3557
7.4809
7.4690
7.3966
7.3767
7.3717
7.3670
7.3545
6.6393
6.1074
0.0070
O
N
N
O
Ph
Ph
2v
0.99
2.00
2.00
5.02
7.00
1.00
1.00
1.00
f1 (ppm)

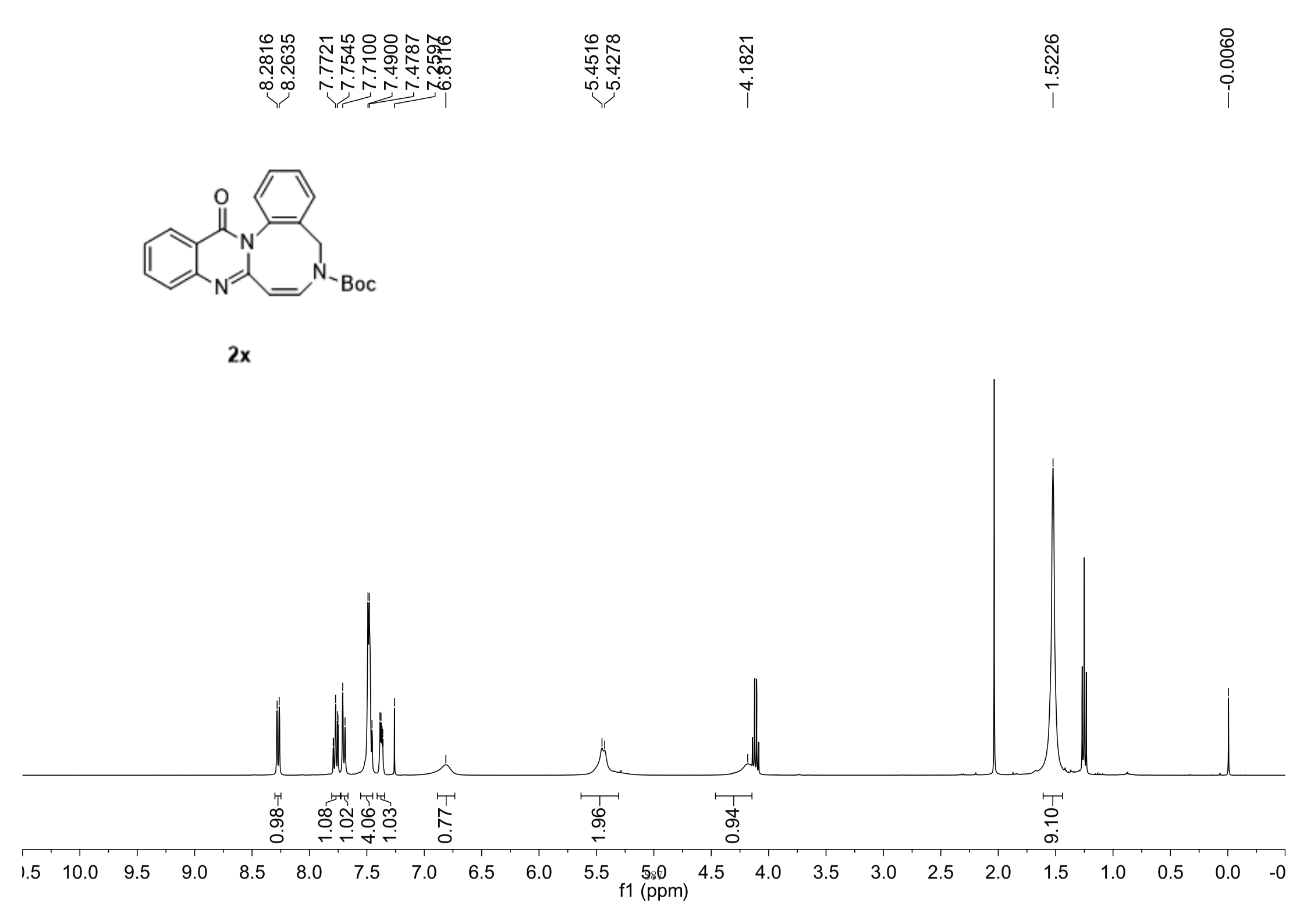

162.42
155.38
151.95
148.14
137.99
134.95
129.95
129.65
129.56
129.04
128.40
128.33
127.95
127.26
127.21
127.03
126.93
126.63
126.31
98.07
77.36
77.04
76.72
75.39
O
N
N
O
Ph
Ph
2v
f1 (ppm)

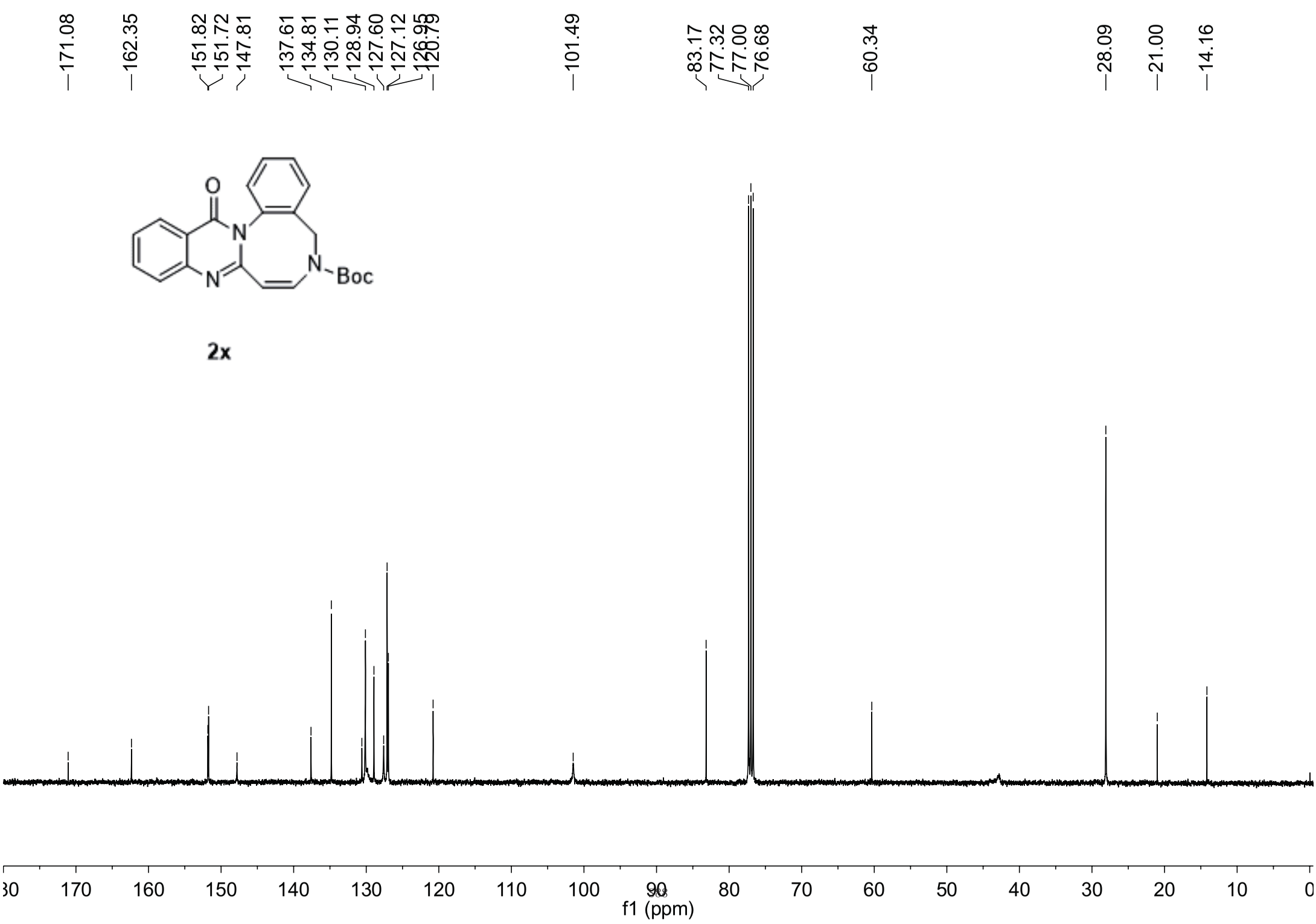

Cl
O
Cl
N
N
O

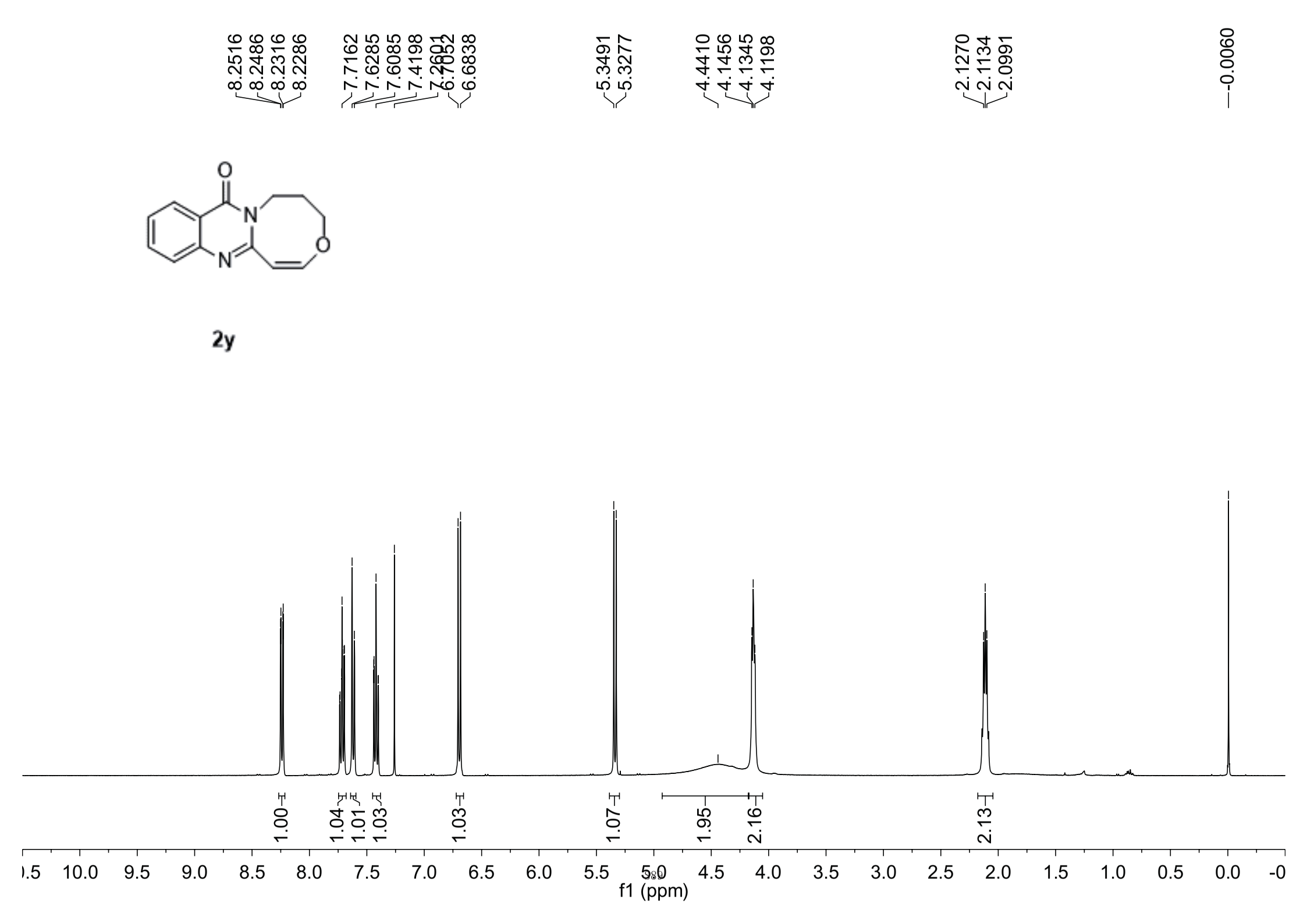
2w

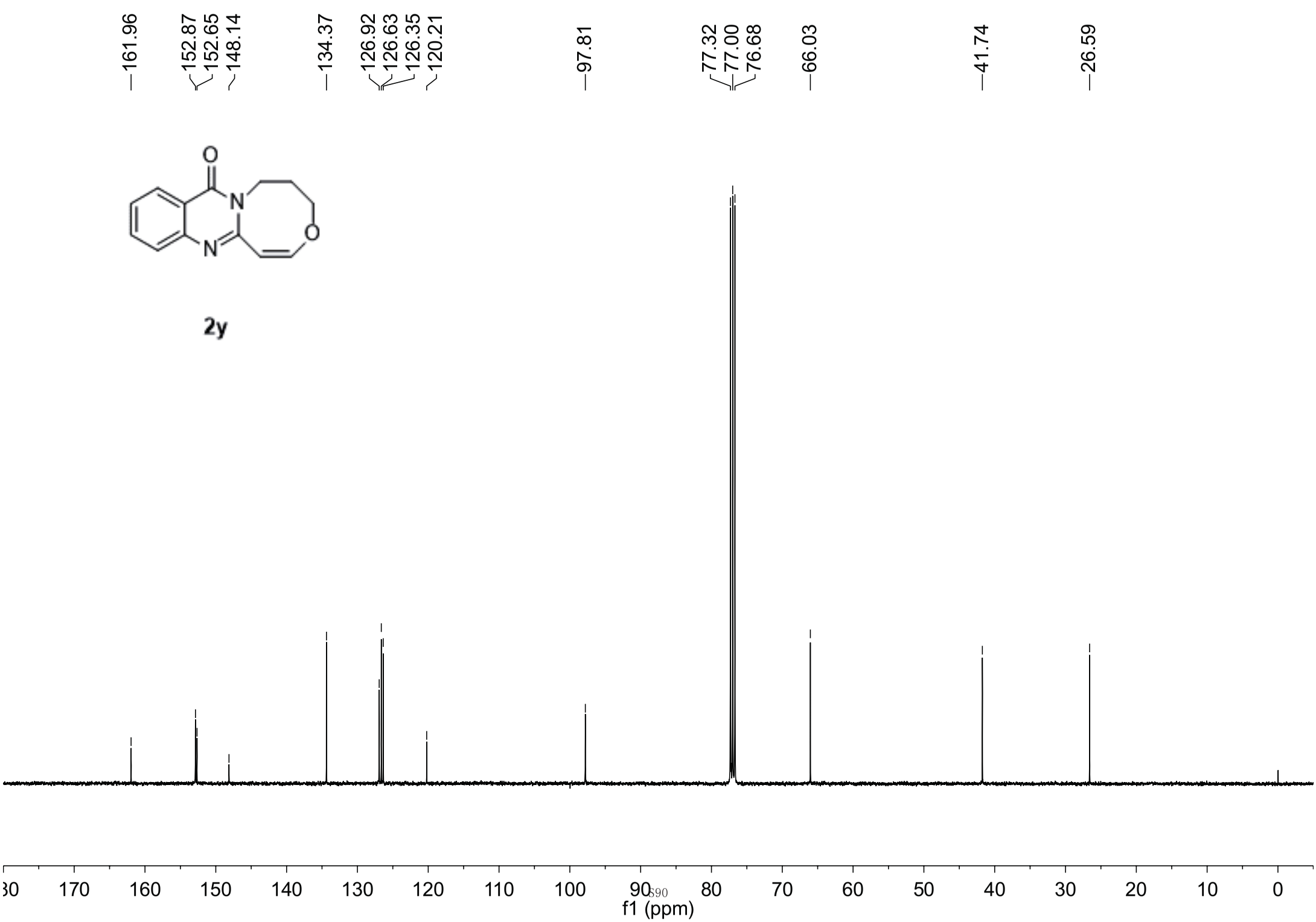
8.1920
8.1860
7.6969
7.6908
7.6383
7.6166
7.5336
7.5134
7.3570
6.1735
6.1511
5.3739
5.3514
5.0357
5.0049
4.8988
4.8682
-0.0040
0.91
0.99
0.99
1.95
0.98
0.99
0.99
0.99
1.00
f1 (ppm)

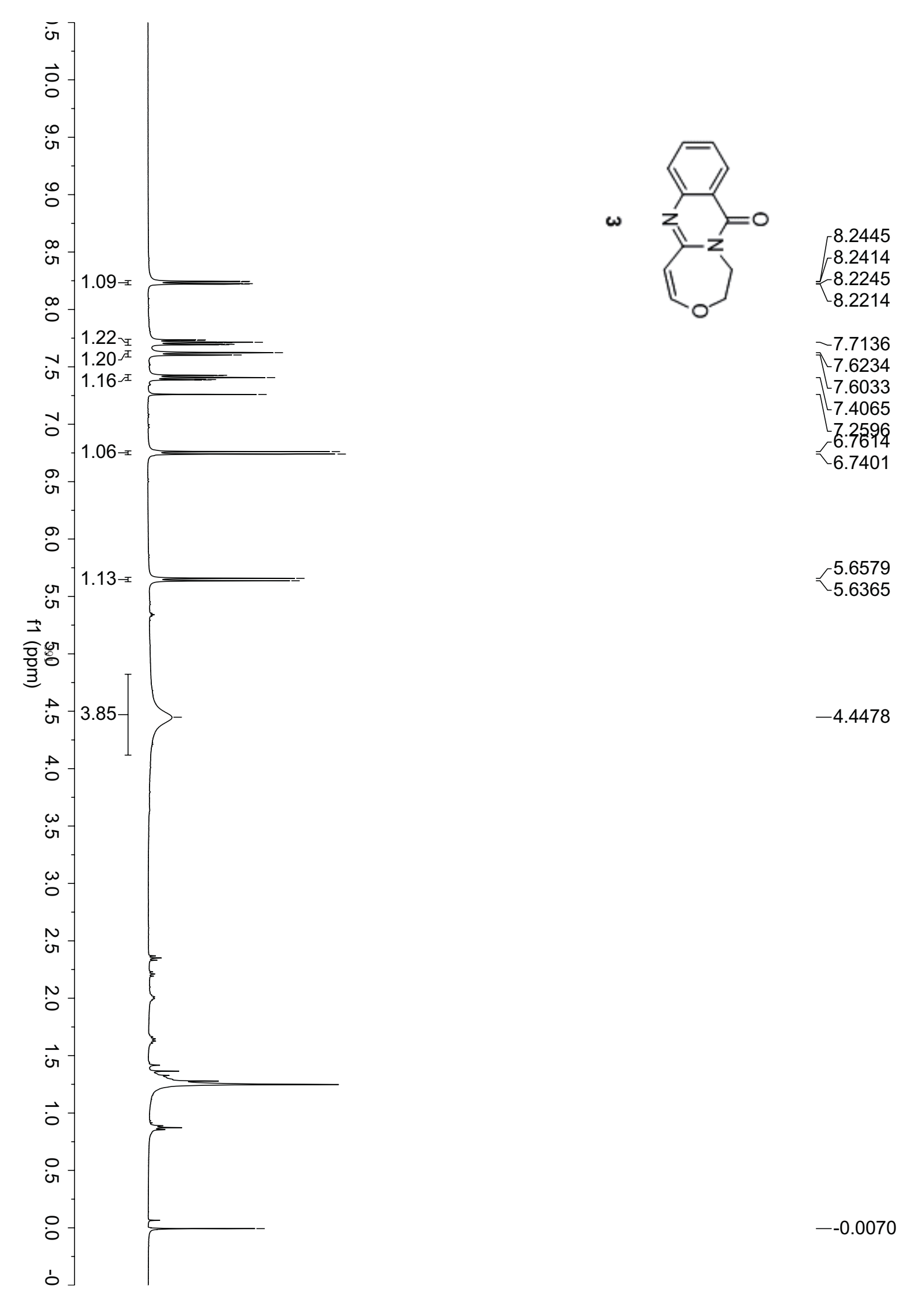

161.29
151.13
146.53
146.35
136.53
135.69
135.44
132.87
131.16
130.45
130.35
129.06
128.88
126.41
121.59
99.48
77.32
77.00
76.68
66.16
Cl
Cl
O
N
N
O
2w
f1 (ppm)

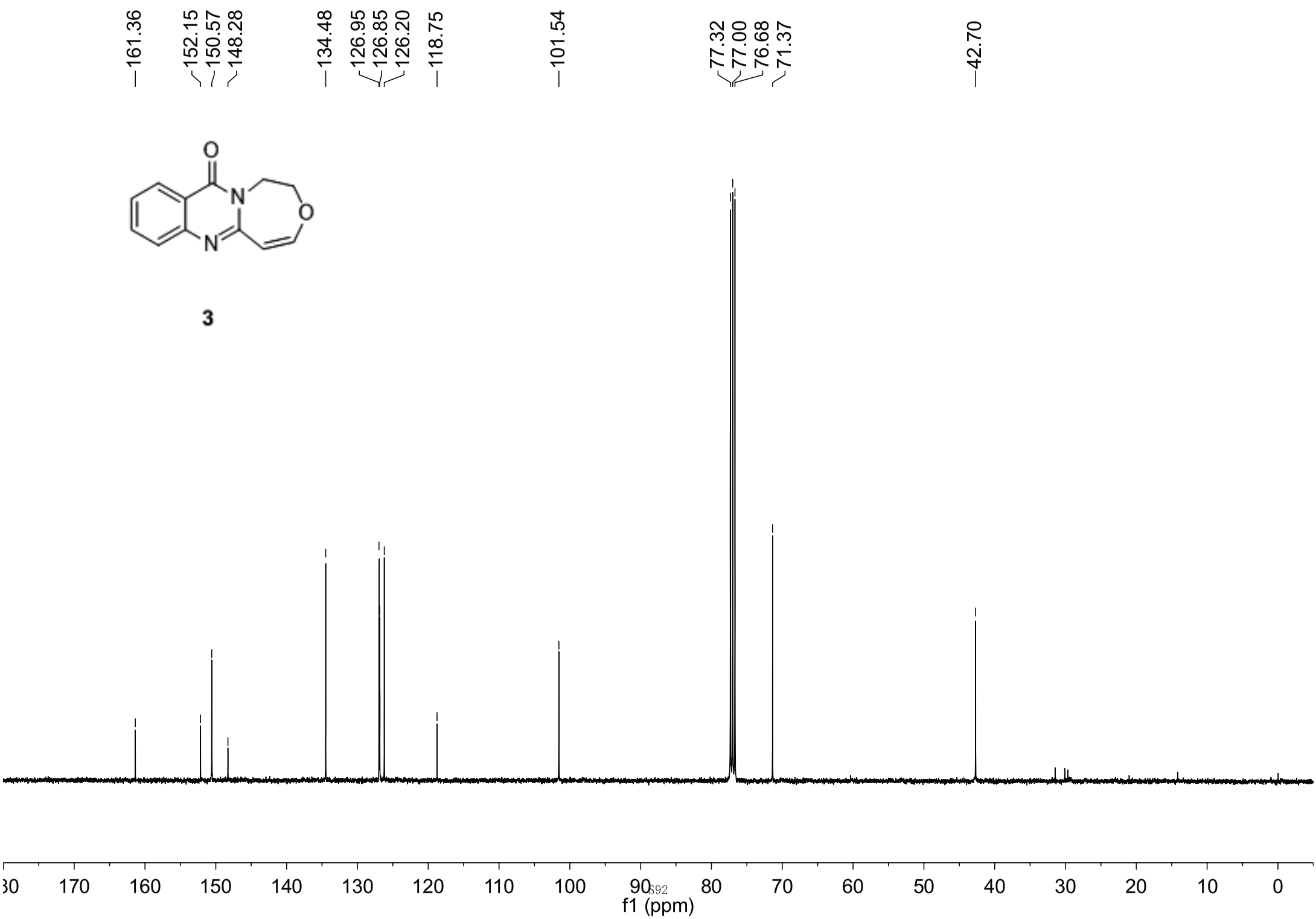

8.2816
8.2635
7.7721
7.7545
7.7100
7.4900
7.4787
7.2597
6.8116
5.4516
5.4278
4.1821
1.5226
-0.0060
O
N
N
N
Boc
2x
0.98
1.08
1.02
4.06
1.03
0.77
1.96
0.94
9.10
f1 (ppm)

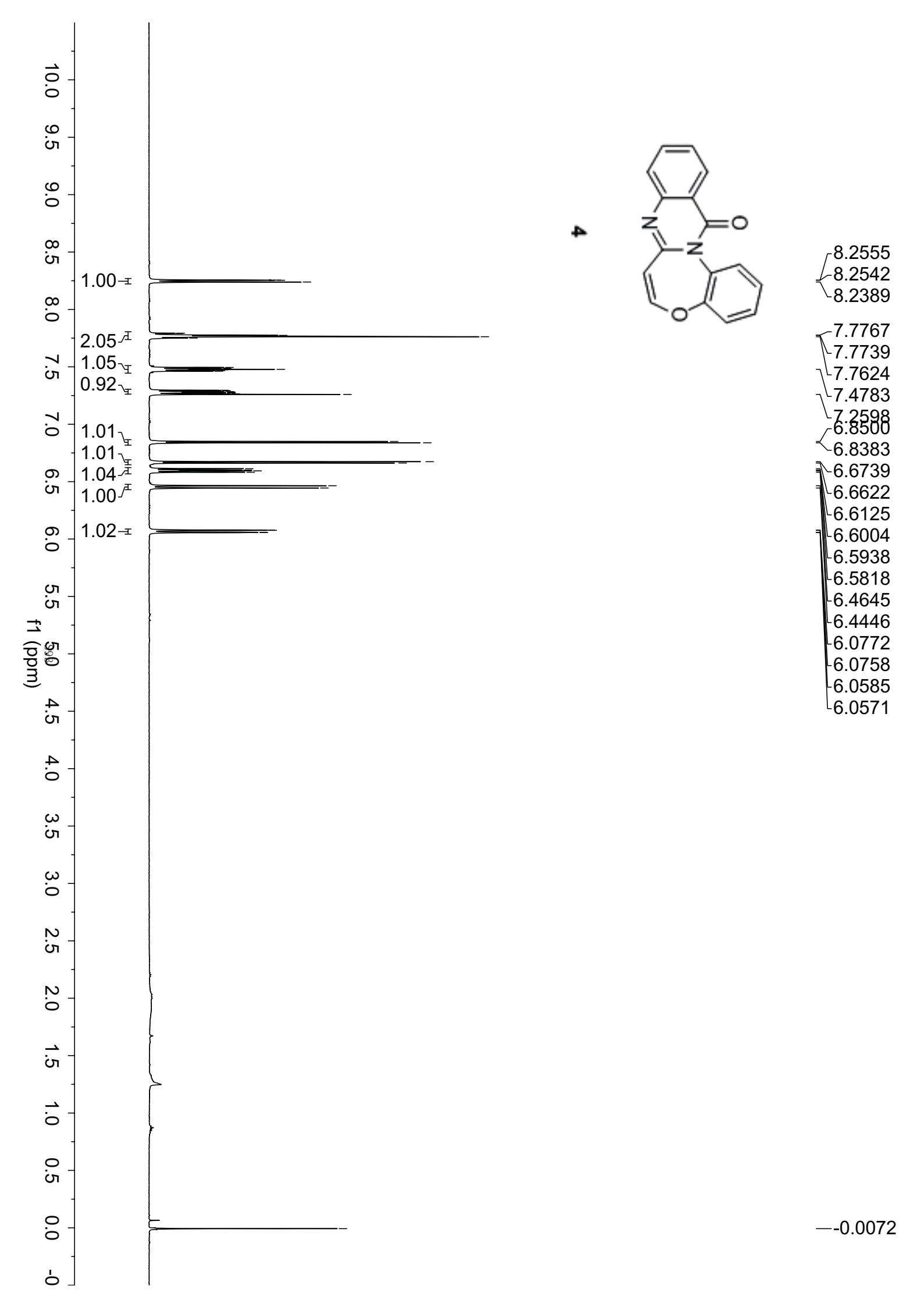

171.08
162.35
151.82
151.72
147.81
137.61
134.81
130.11
128.94
127.60
127.12
101.49
83.17
77.32
77.00
76.68
60.34
28.09
21.00
14.16
O
N
N
N
Boc
2x
f1 (ppm)

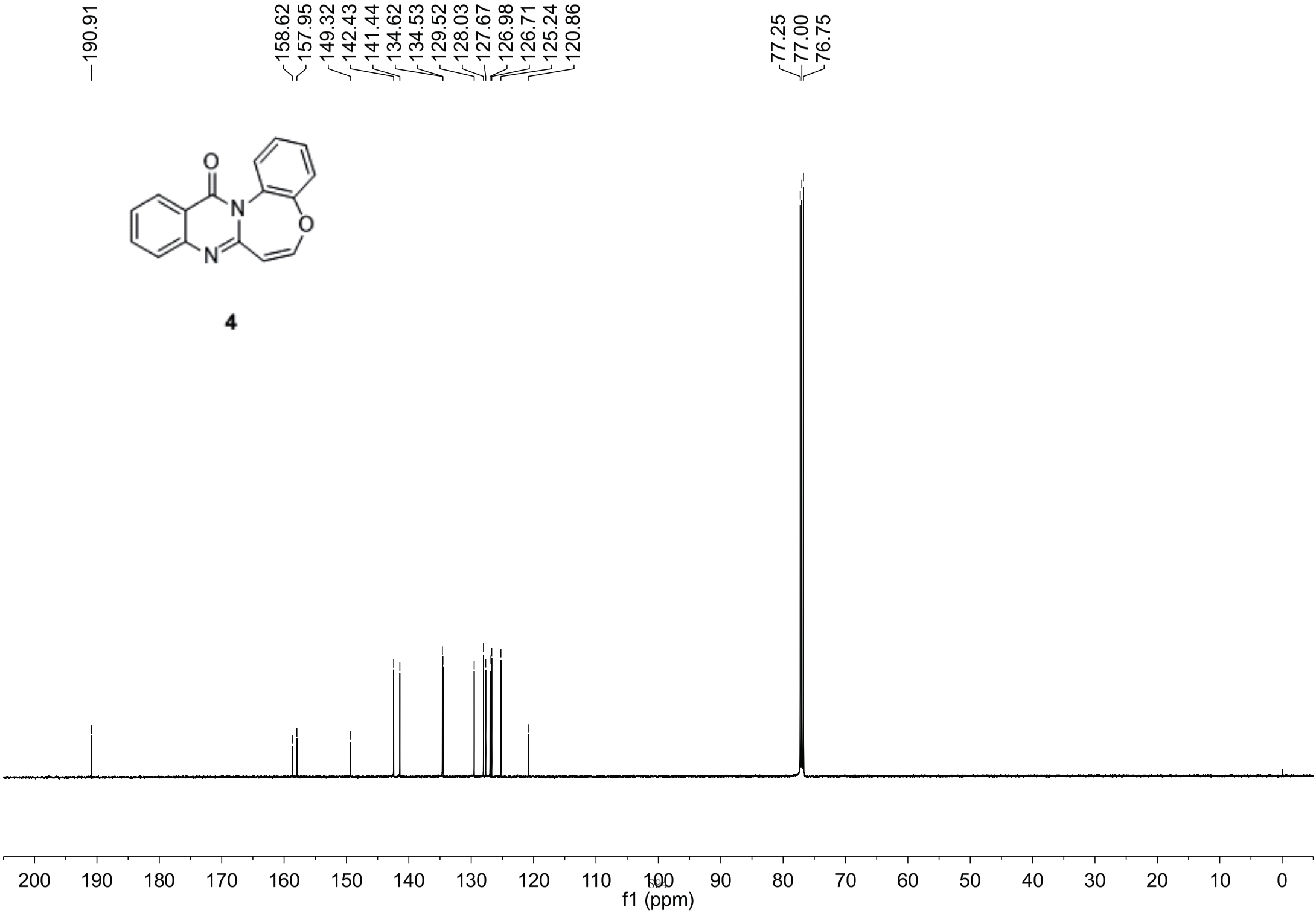

8.2516
8.2486
8.2316
8.2286
7.7162
7.6285
7.6085
7.4198
7.2601
6.7052
6.6838
5.3491
5.3277
4.4410
4.1456
4.1345
4.1198
2.1270
2.1134
2.0991
0.0060
O
N
N
O
2y
1.00
1.04
1.01
1.03
1.03
1.07
1.95
2.16
2.13
f1 (ppm)


161.96
152.87
152.65
148.14
134.37
126.92
126.63
126.35
120.21
97.81
77.32
77.00
76.68
66.03
41.74
26.59
O
N
N
O
2y
f1 (ppm)


3
8.2445
8.2414
8.2245
8.2214
7.7136
7.6234
7.6033
7.4065
7.2596
6.7614
6.7401
5.6579
5.6365
4.4478
-0.0070
1.09
1.22
1.20
1.16
1.06
1.13
3.85
f1 (ppm)

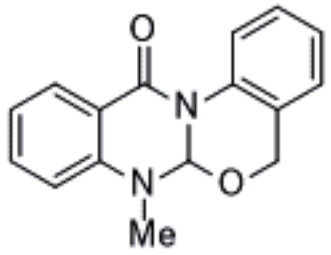

161.36
152.15
150.57
148.28
134.48
126.95
126.85
126.20
118.75
101.54
77.32
77.00
76.68
71.37
42.70
O
N
O
N
3
f1 (ppm)


4
8.2555
8.2542
8.2389
7.7767
7.7739
7.7624
7.4783
7.2598
6.8500
6.8383
6.6739
6.6622
6.6125
6.6004
6.5938
6.5818
6.4645
6.4446
6.0772
6.0758
6.0585
6.0571
-0.0072
1.00
2.05
1.05
0.92
1.01
1.01
1.04
1.00
1.02
f1 (ppm)


190.91
158.62
157.95
149.32
142.43
141.44
134.62
134.53
129.52
128.03
127.67
126.98
126.71
125.24
120.86
77.25
77.00
76.75
O
N
O
N
4
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

gxy-168-1

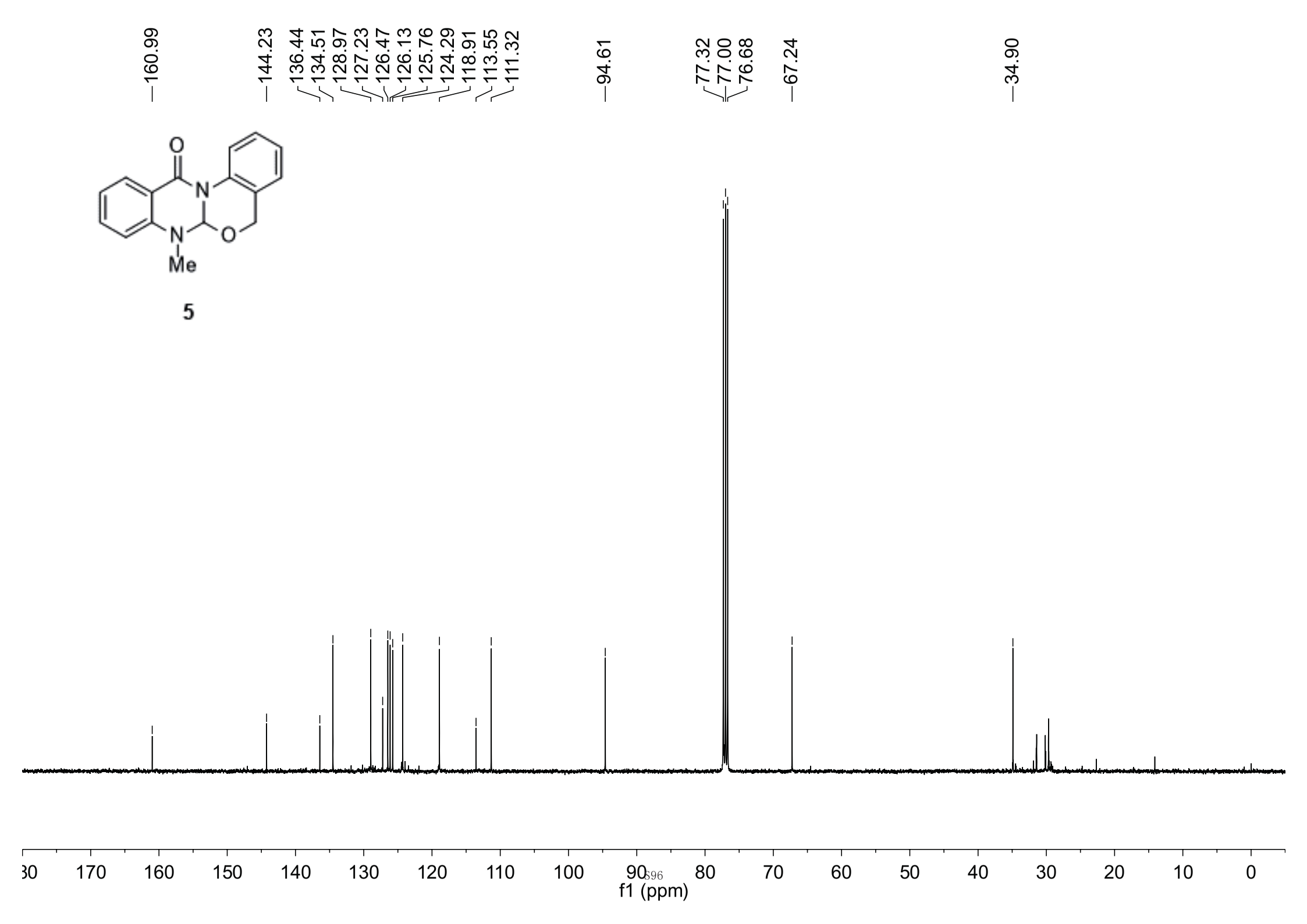
8.1132
8.1095
8.0938
8.0901
7.8525
7.8322
7.4857
7.3293
7.2601
7.2209
7.2190
7.0694
7.0503
6.9447
6.7818
6.7611
5.9243
5.1804
5.1420
5.0572
5.0188
3.1401
0.0020

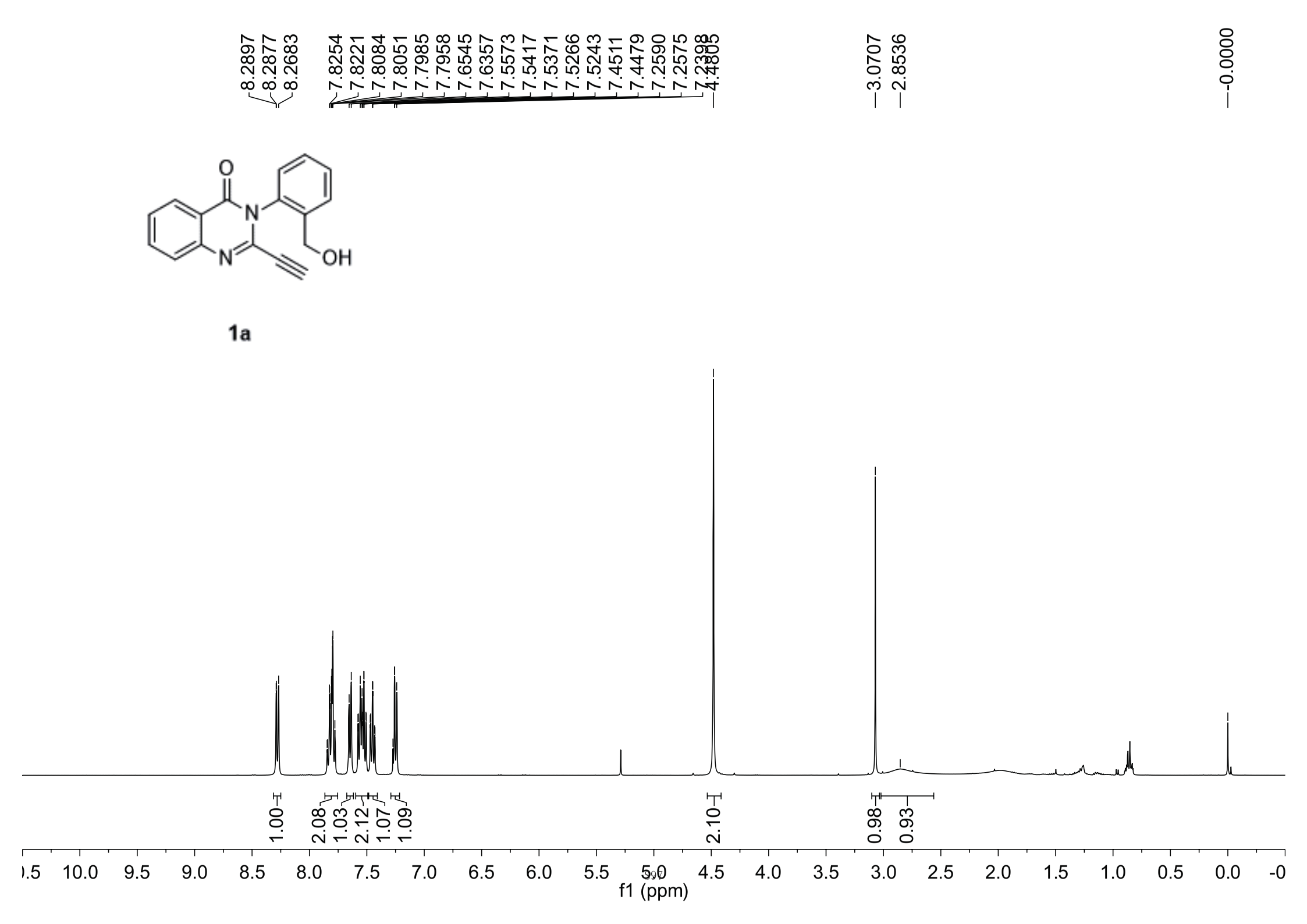


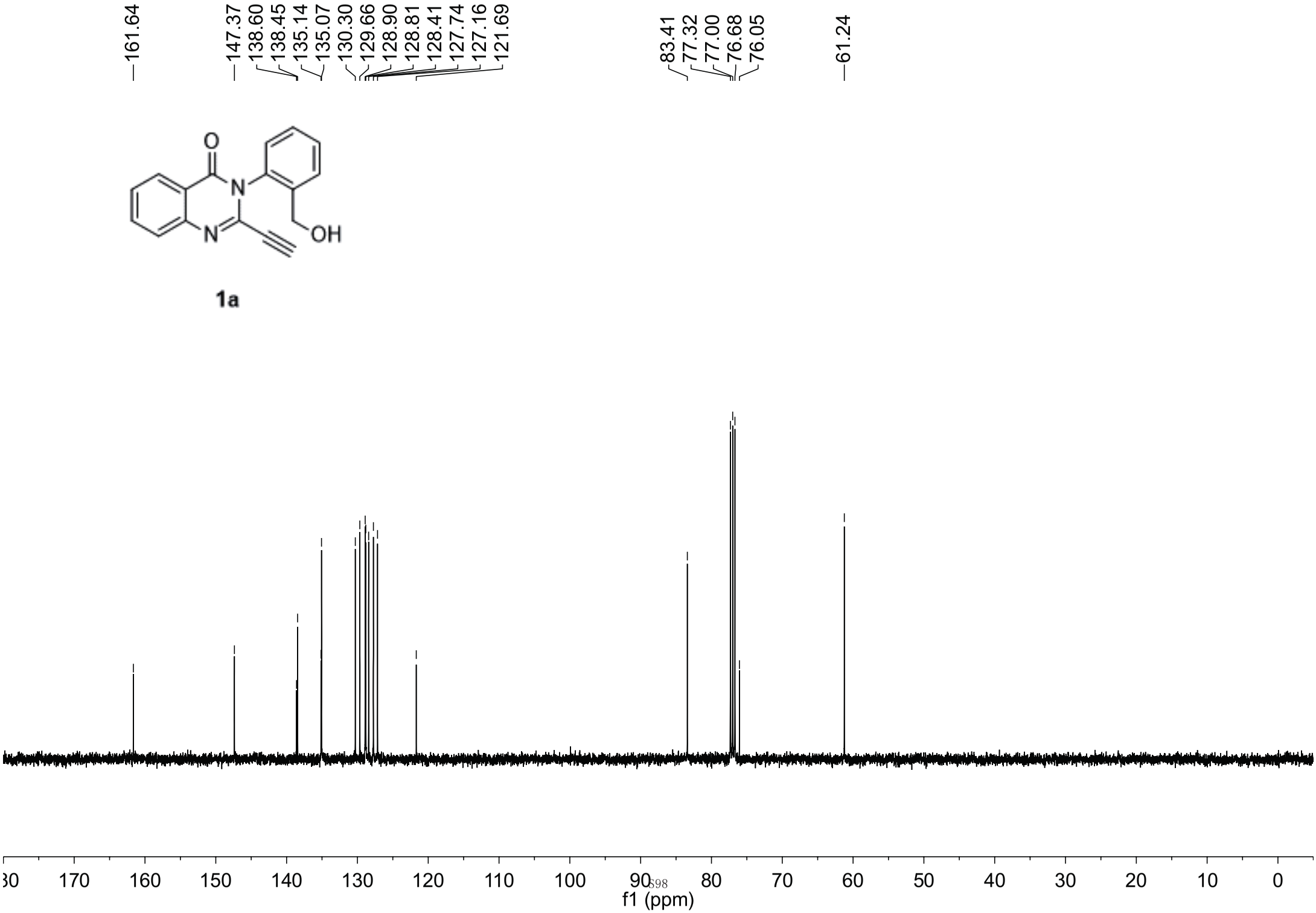
5

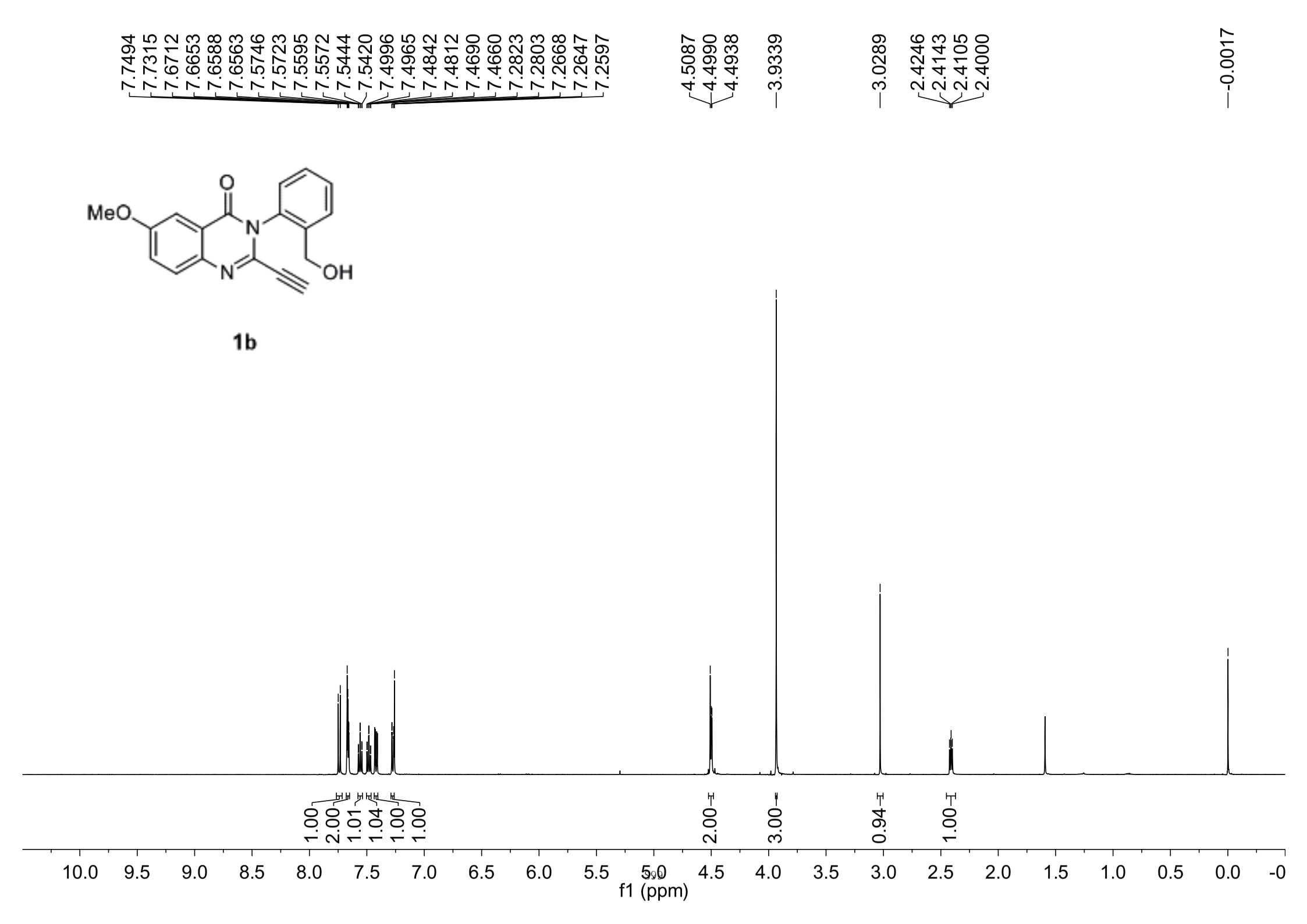
1.00
1.02
1.06
1.21
1.08
1.07
1.05
1.05
1.06
1.07
1.09
3.14

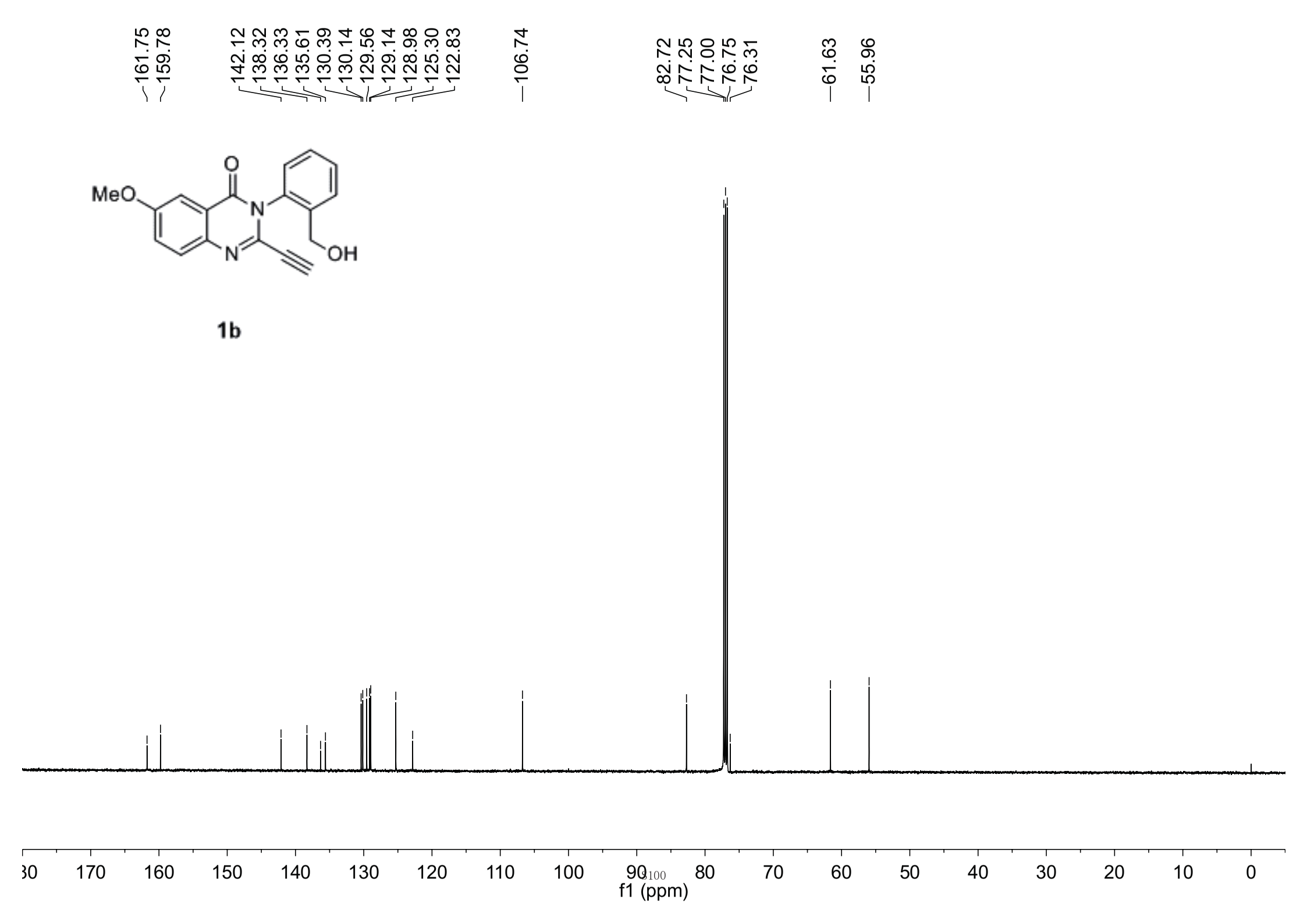
f1 (ppm)

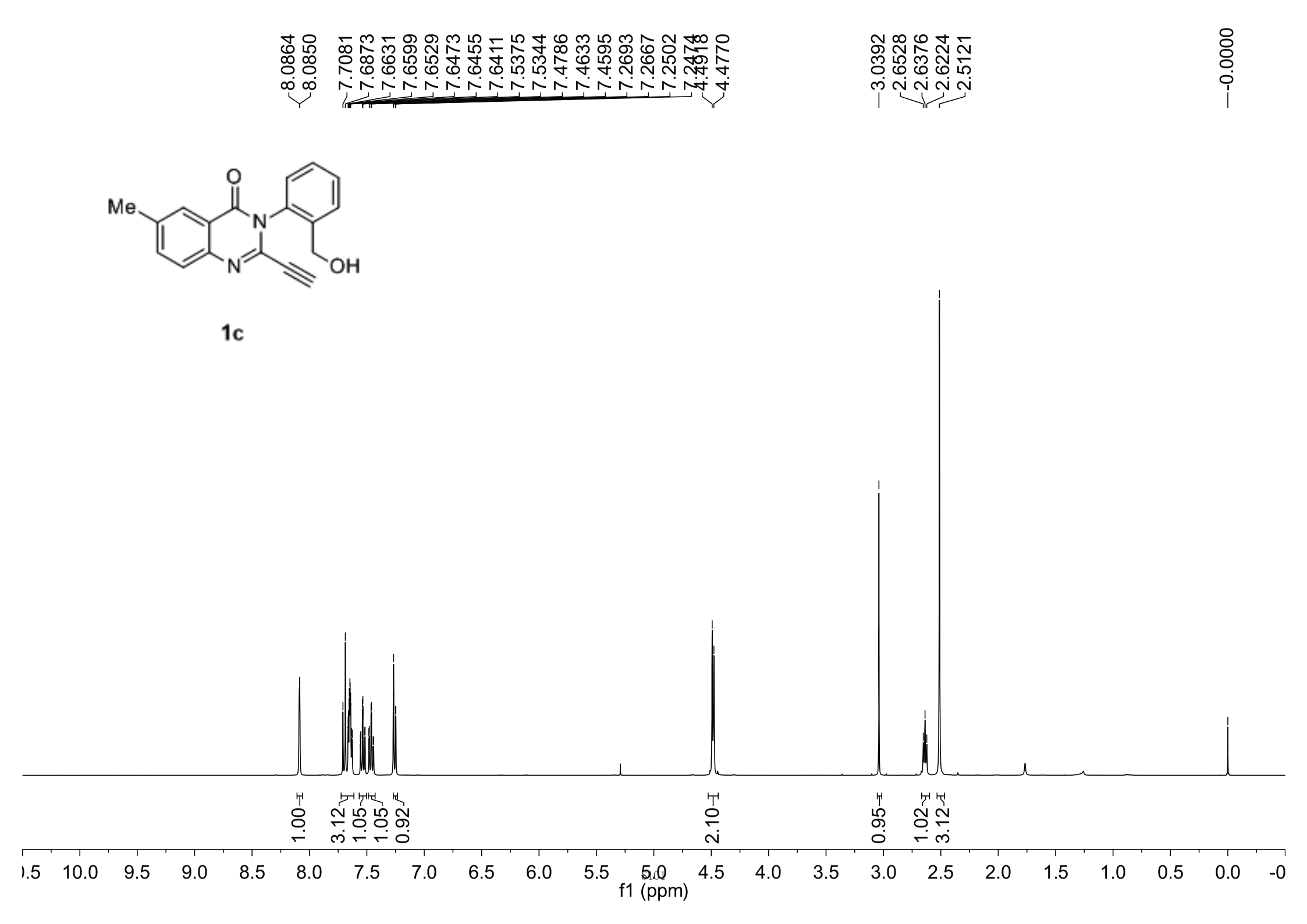

160.99
144.23
136.44
134.51
128.97
127.23
126.47
126.13
125.76
124.29
118.91
113.55
111.32
94.61
77.32
77.00
76.68
67.24
34.90
O
N
N
O
Me
5
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

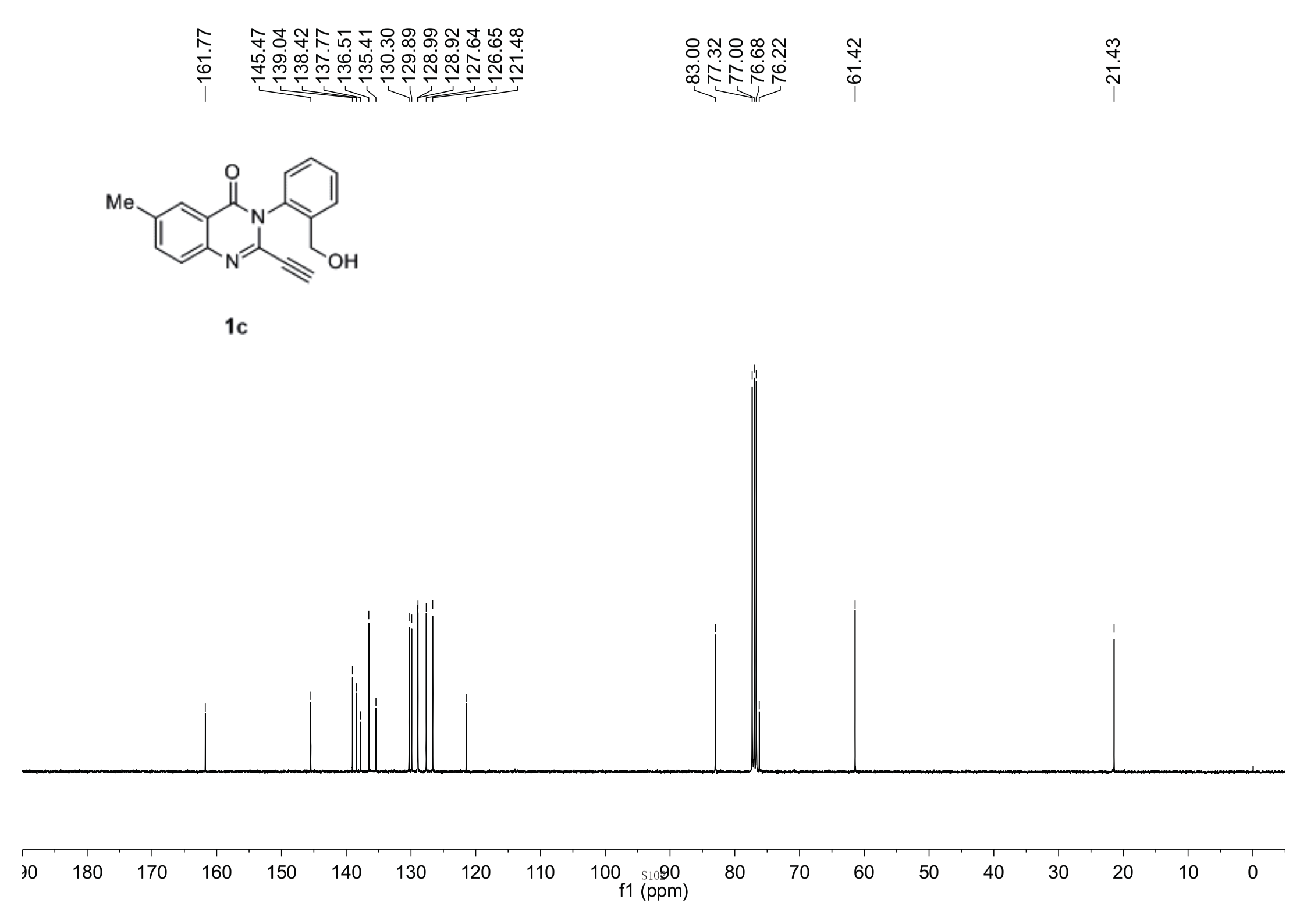

8.2897
8.2877
8.2683
7.8254
7.8221
7.8084
7.8051
7.7985
7.7958
7.6545
7.6357
7.5573
7.5417
7.5371
7.5266
7.5243
7.4511
7.4479
7.2590
7.2575
4.4805
3.0707
2.8536
-0.0000
O
N
N
OH
1a
1.00
2.08
1.03
2.12
1.07
1.09
2.10
0.98
0.93
f1 (ppm)

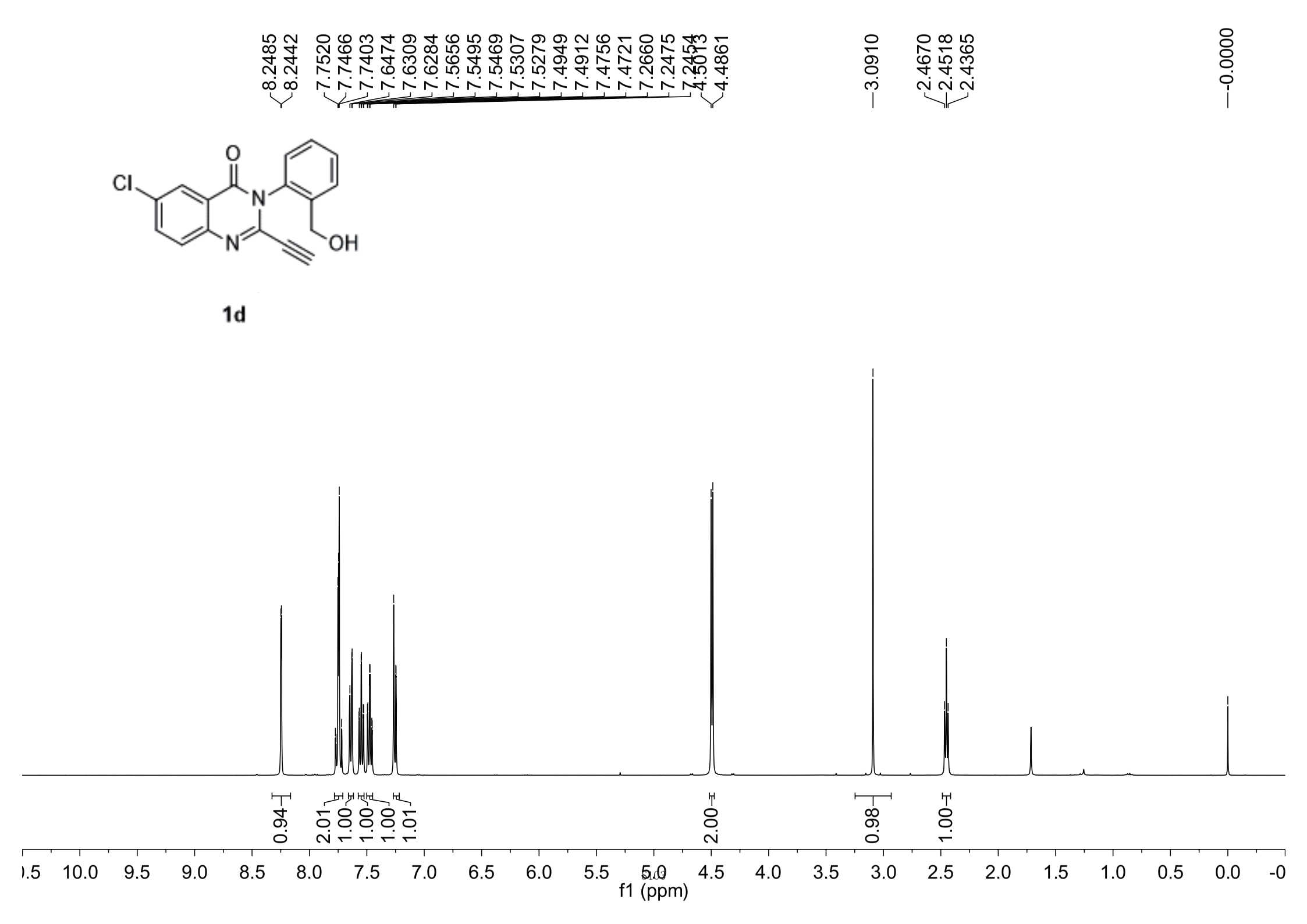

161.64
147.37
138.60
138.45
135.14
135.07
130.30
129.66
128.90
128.81
128.41
127.74
127.16
121.69
83.41
77.32
77.00
76.68
76.05
61.24
O
N
N
OH
1a
f1 (ppm)

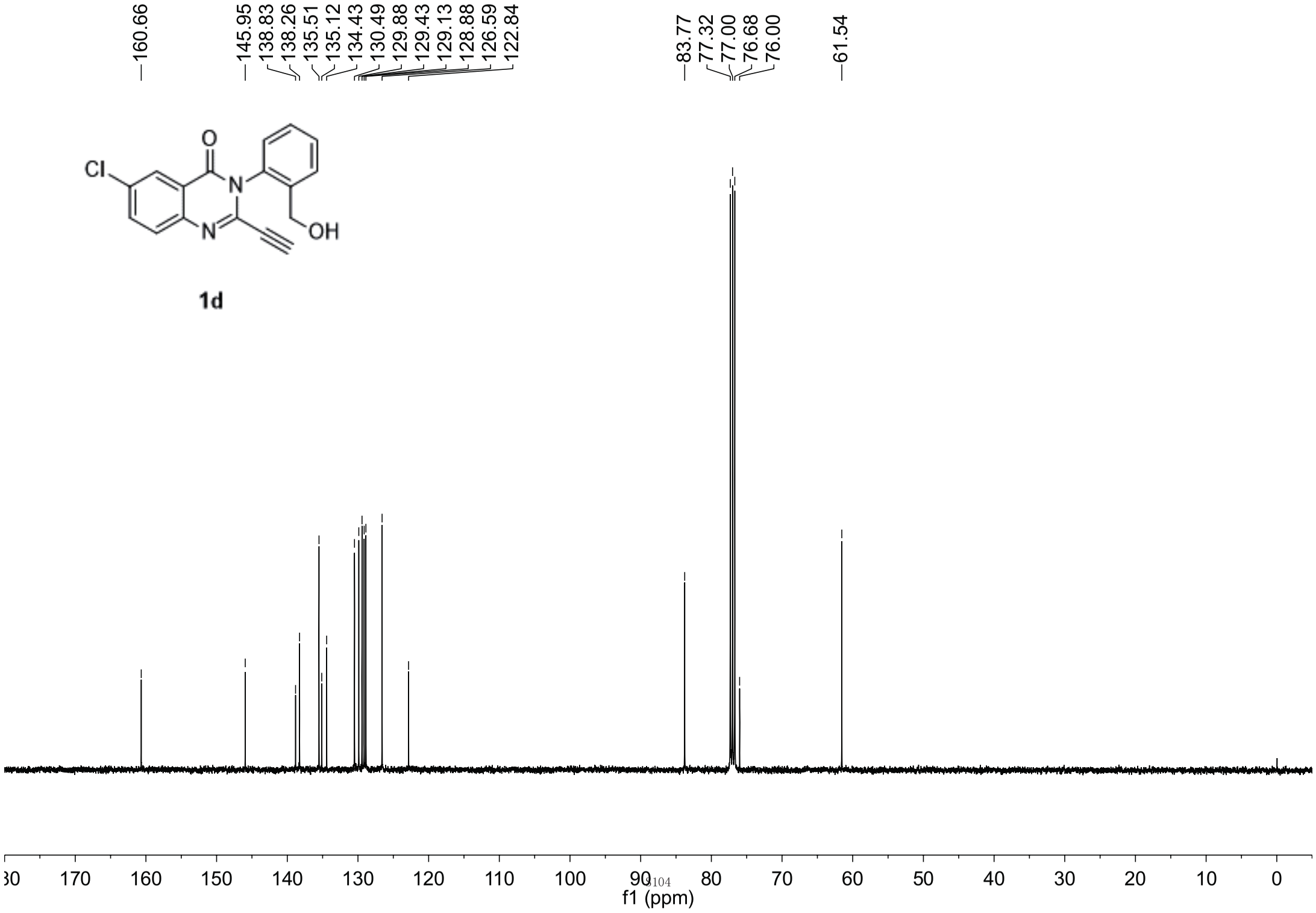

7.7494
7.7315
7.6712
7.6653
7.6588
7.6563
7.5746
7.5723
7.5595
7.5572
7.5444
7.5420
7.4996
7.4965
7.4842
7.4812
7.4690
7.4660
7.2823
7.2803
7.2668
7.2647
7.2597
4.5087
4.4990
4.4938
3.9339
3.0289
2.4246
2.4143
2.4105
2.4000
-0.0017
MeO
O
N
N
OH
1b
1.00
2.00
1.01
1.04
1.00
1.00
2.00
3.00
0.94
1.00
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0
f1 (ppm)

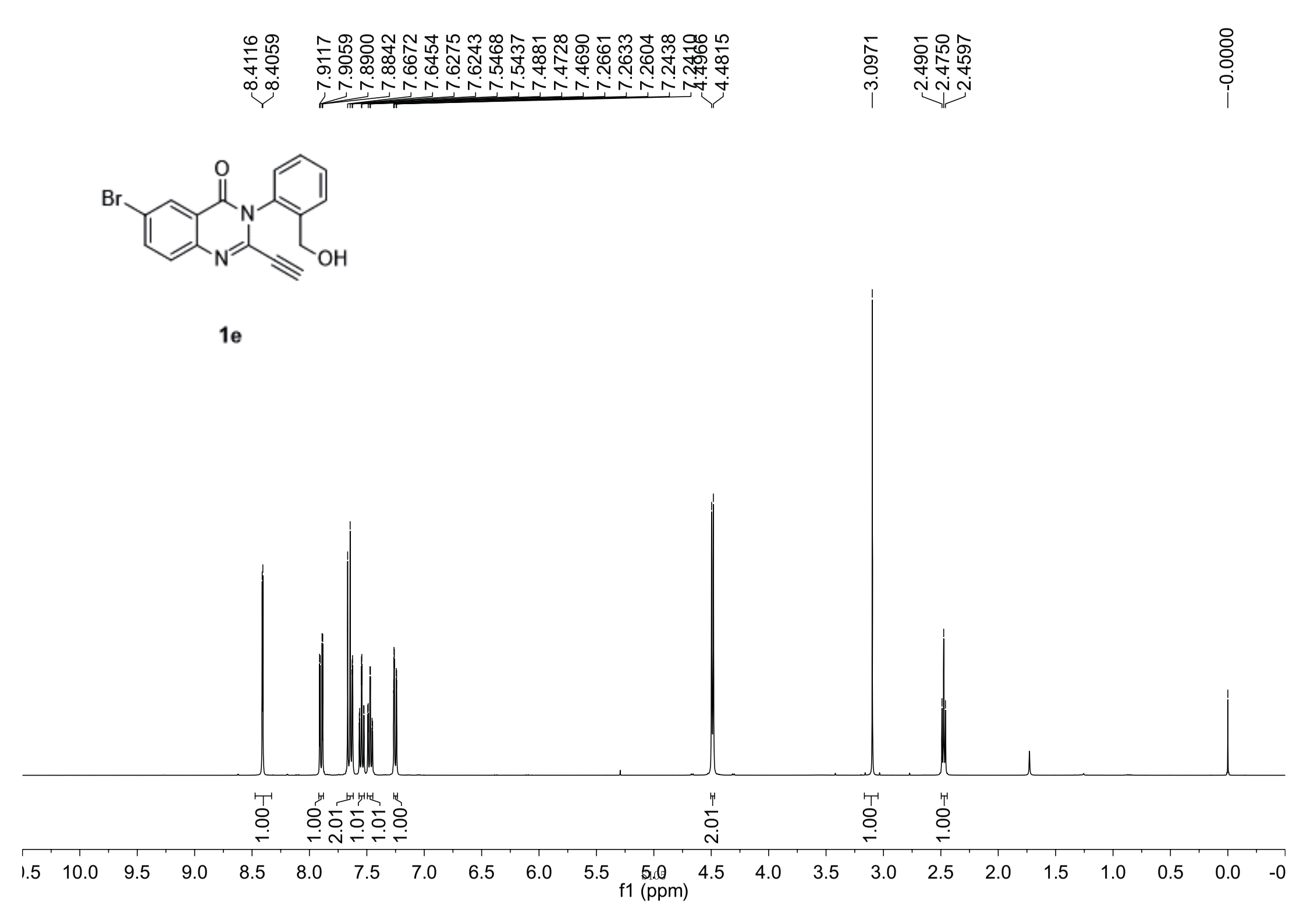

161.75
159.78
142.12
138.32
136.33
135.61
130.39
130.14
129.56
129.14
128.98
125.30
122.83
106.74
82.72
77.25
77.00
76.75
76.31
61.63
55.96
MeO
O
N
N
OH
1b
f1 (ppm)

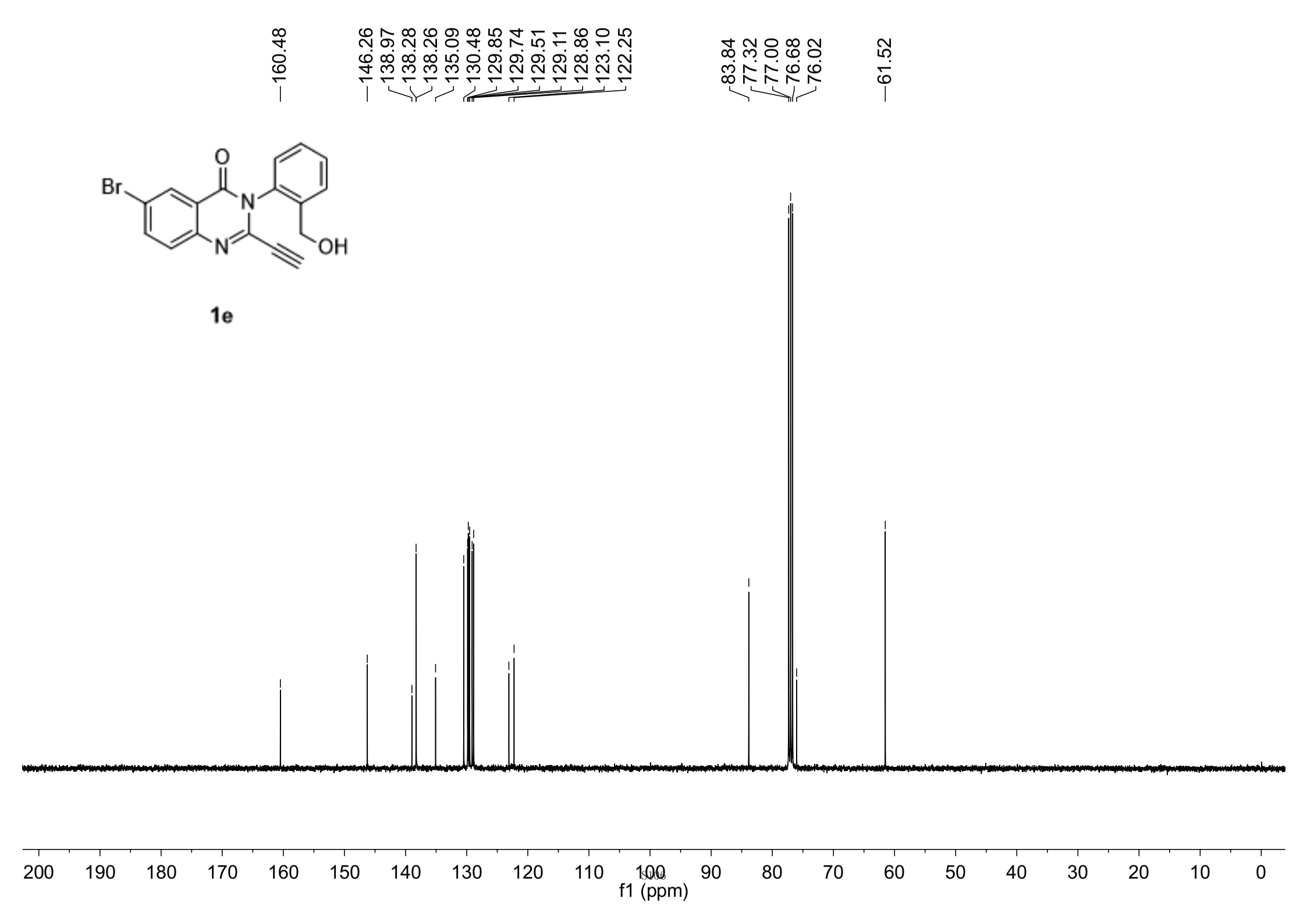

8.0864
8.0850
7.7081
7.6873
7.6631
7.6599
7.6529
7.6473
7.6455
7.6411
7.5375
7.5344
7.4786
7.4633
7.4595
7.2693
7.2667
7.2502
4.4918
4.4770
3.0392
2.6528
2.6376
2.6224
2.5121
0.0000
Me
O
N
N
OH
1c
1.00
3.12
1.05
1.05
0.92
2.10
0.95
1.02
3.12
f1 (ppm)

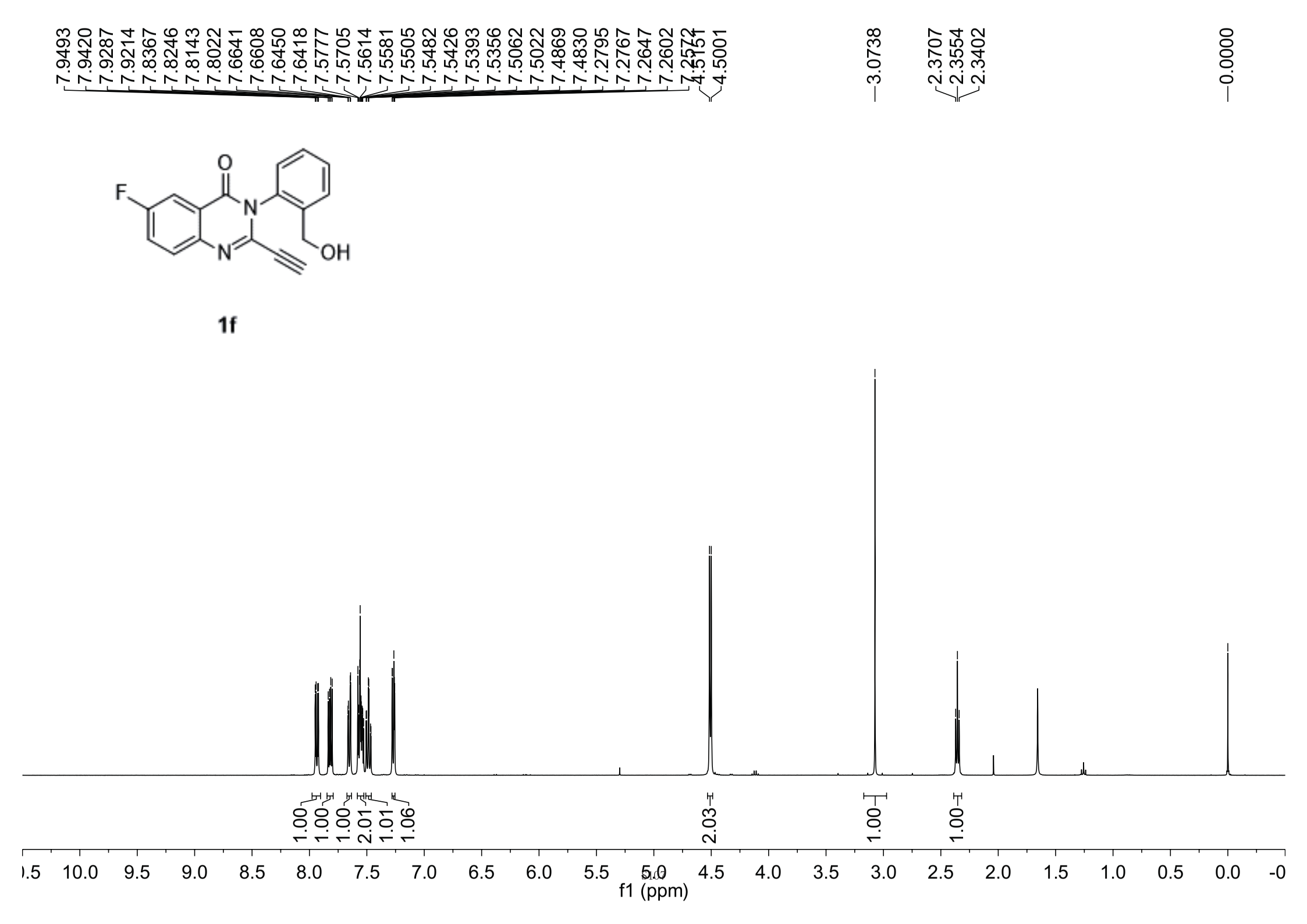

161.77
145.47
139.04
138.42
137.77
136.51
135.41
130.30
129.89
128.99
128.92
127.64
126.65
121.48
83.00
77.32
77.00
76.68
76.22
61.42
21.43
Me
O
N
N
OH
1c
f1 (ppm)

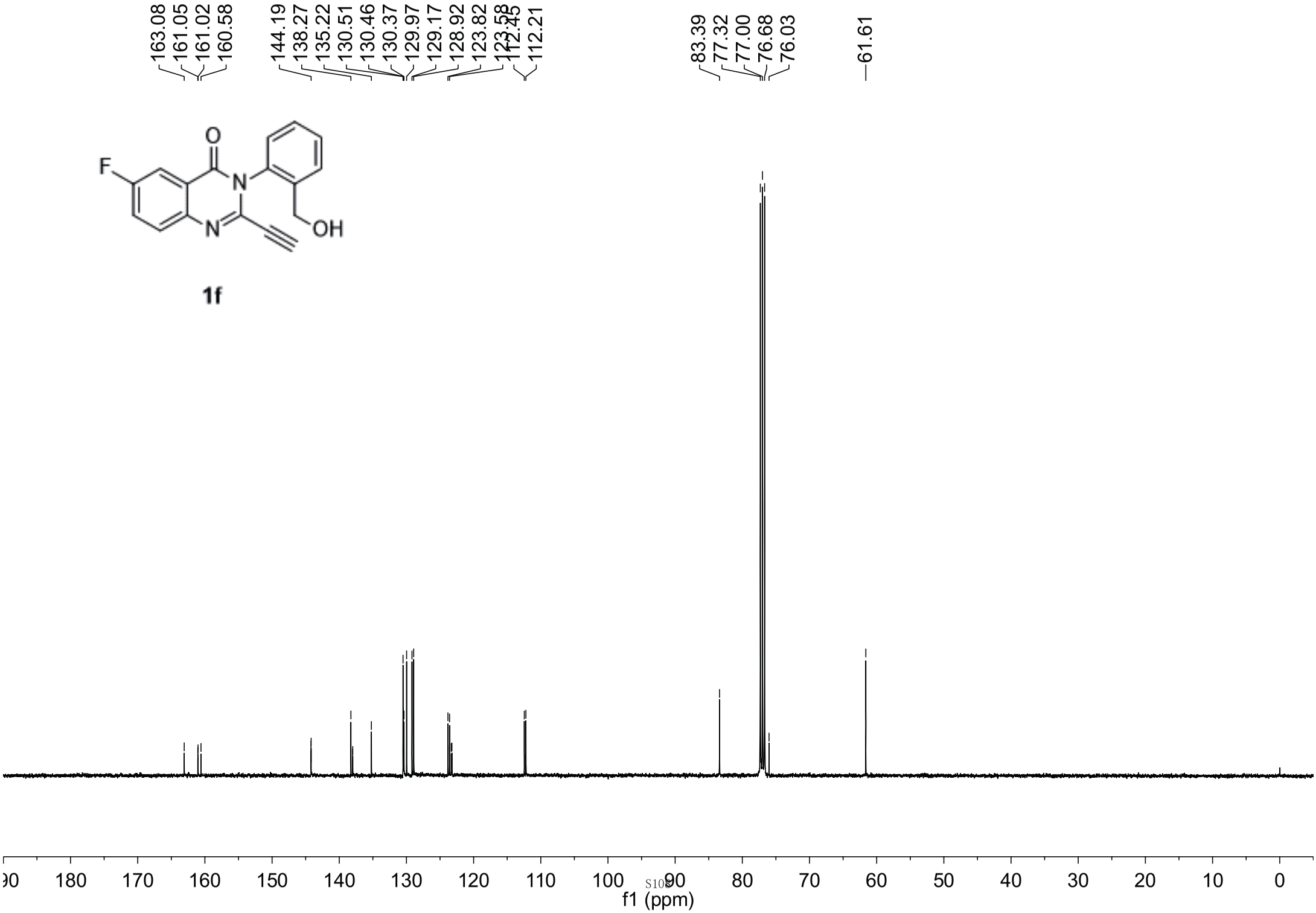

8.2485
8.2442
7.7520
7.7466
7.7403
7.6474
7.6309
7.6284
7.5656
7.5495
7.5469
7.5307
7.5279
7.4949
7.4912
7.4756
7.4721
7.2660
7.2475
7.2454
4.5013
4.4861
3.0910
2.4670
2.4518
2.4365
-0.0000
Cl
O
N
N
OH
1d
0.94
2.01
1.00
1.00
1.00
1.01
2.00
0.98
1.00
f1 (ppm)

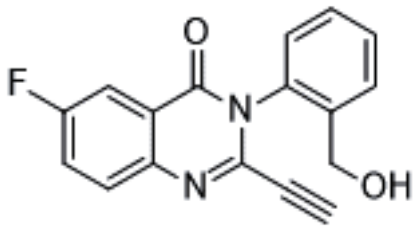

160.66
145.95
138.83
138.26
135.51
135.12
134.43
130.49
129.88
129.43
129.13
128.88
126.59
122.84
83.77
77.32
77.00
76.68
76.00
61.54
Cl
O
N
N
OH
1d
f1 (ppm)


8.4116
8.4059
7.9117
7.9059
7.8900
7.8842
7.6672
7.6454
7.6275
7.6243
7.5468
7.5437
7.4881
7.4728
7.4690
7.2661
7.2633
7.2604
7.2438
4.4966
4.4815
3.0971
2.4901
2.4750
2.4597
0.0000
Br
O
N
N
OH
1e
1.00
1.00
2.01
1.01
1.01
1.00
2.01
1.00
1.00
f1 (ppm)


160.48
146.26
138.97
138.28
138.26
135.09
130.48
129.85
129.74
129.51
129.11
128.86
123.10
122.25
83.84
77.32
77.00
76.68
76.02
61.52
Br
O
N
N
OH
1e
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)


7.9493
7.9420
7.9287
7.9214
7.8367
7.8246
7.8143
7.8022
7.6641
7.6608
7.6450
7.6418
7.5777
7.5705
7.5614
7.5581
7.5505
7.5482
7.5426
7.5393
7.5356
7.5062
7.5022
7.4869
7.4830
7.2795
7.2767
7.2647
7.2602
4.5151
4.5001
3.0738
2.3707
2.3554
2.3402
0.0000
O
F
N
N
OH
1f
1.00
1.00
1.00
2.01
1.01
1.06
2.03
1.00
1.00
f1 (ppm)


163.08
161.05
161.02
160.58
144.19
138.27
135.22
130.51
130.46
130.37
129.97
129.17
128.92
123.82
123.58
112.45
112.21
83.39
77.32
77.00
76.68
76.03
61.61
O
F
N
N
OH
1f
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

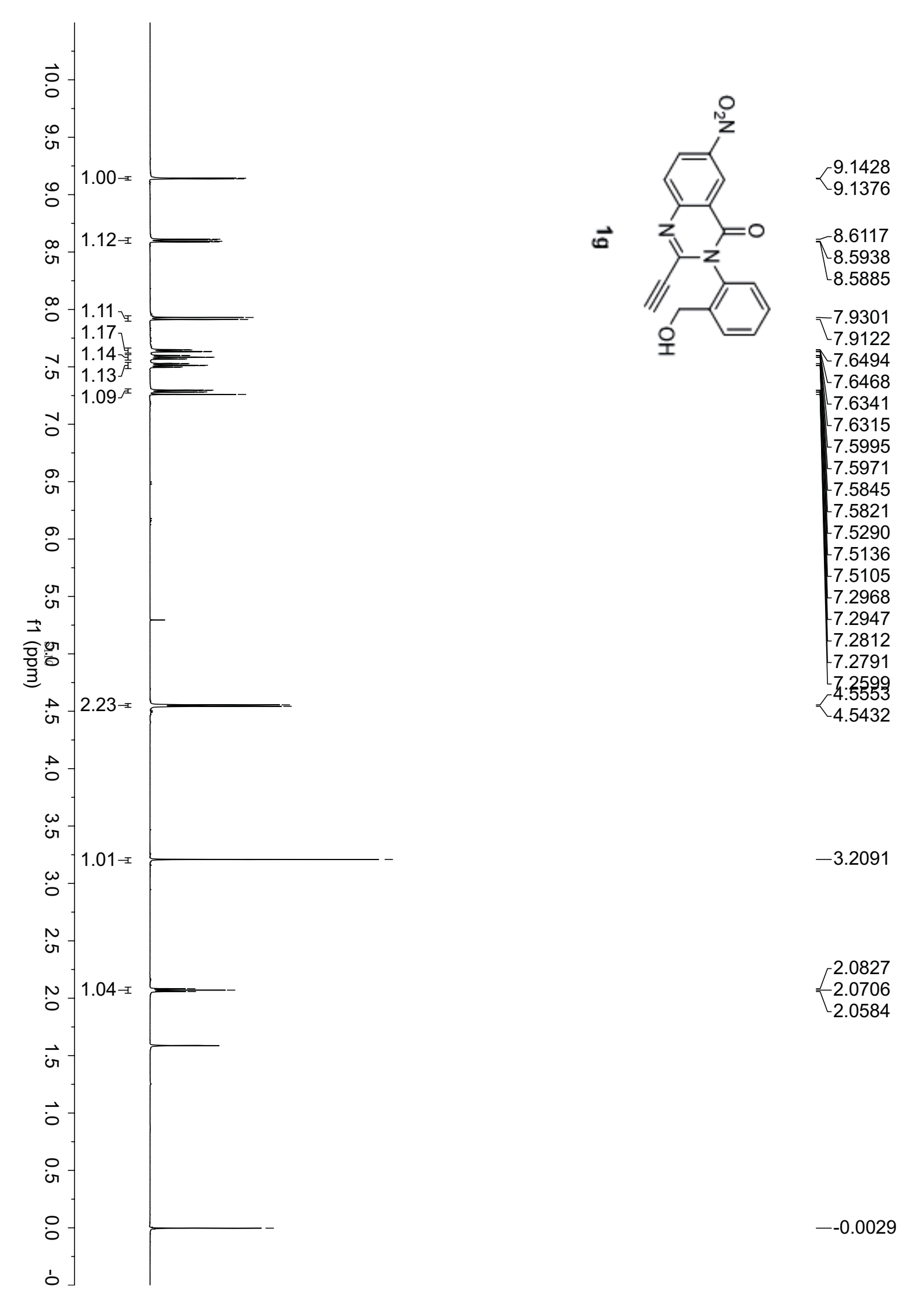


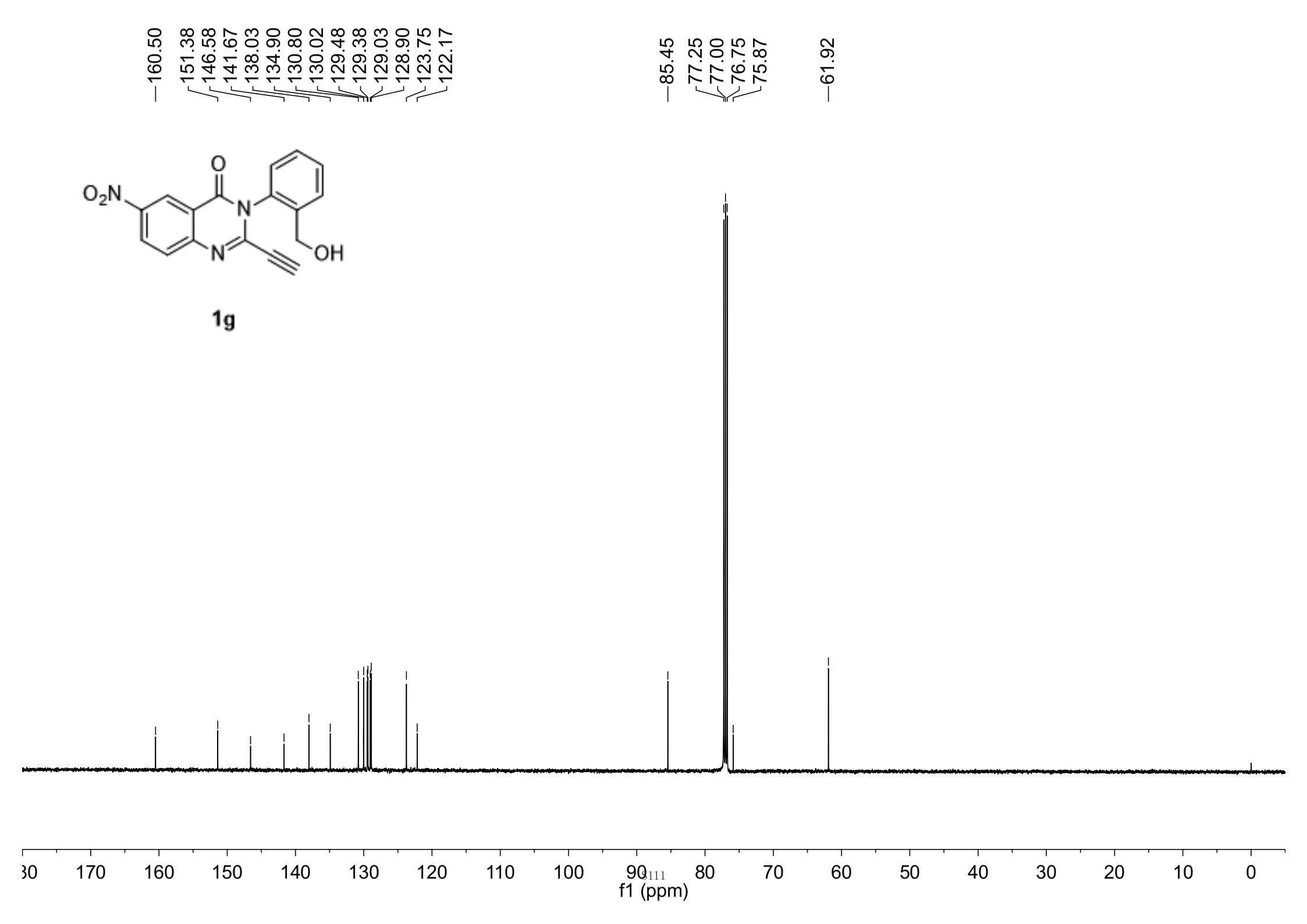
1f

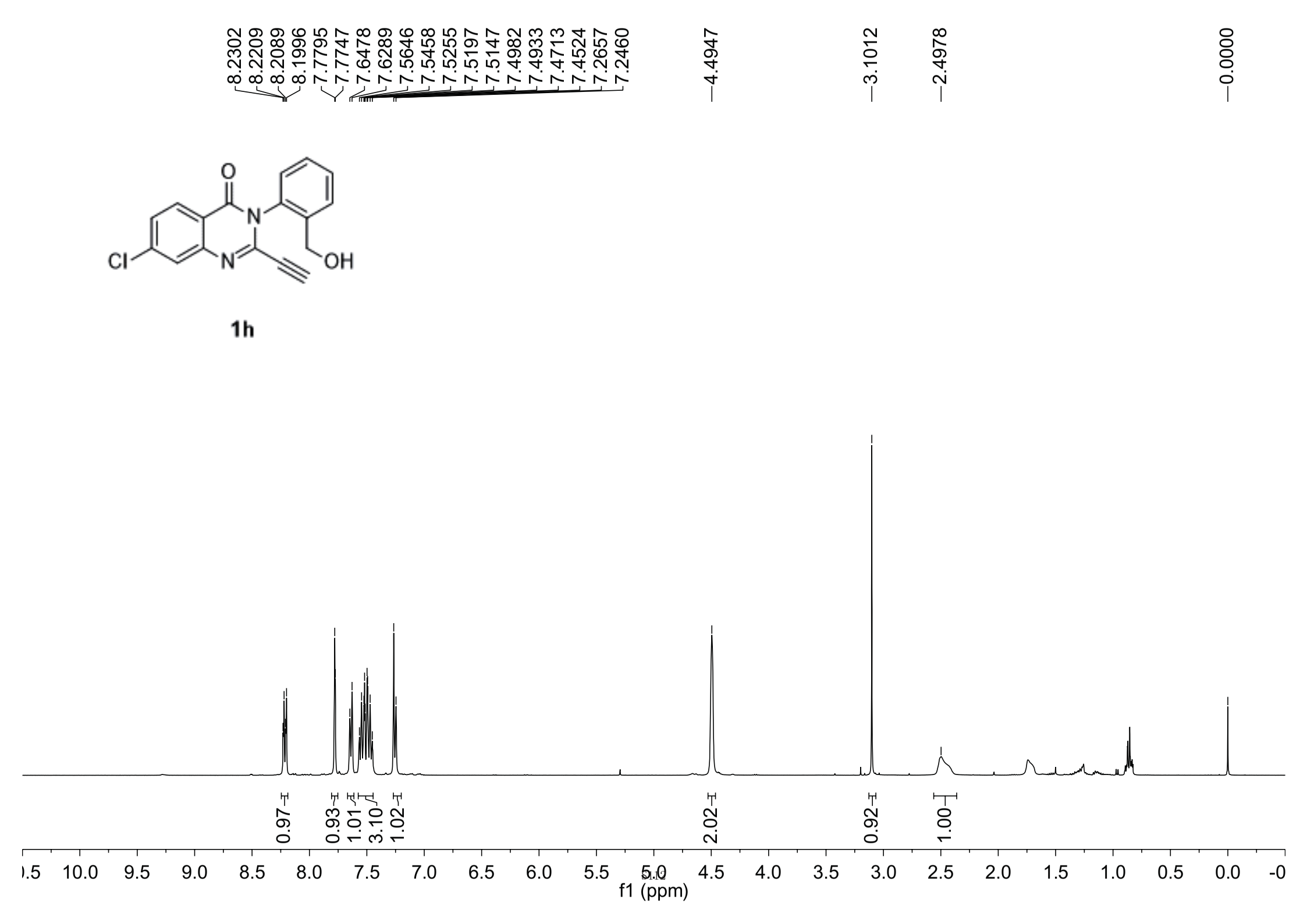
-109.5044

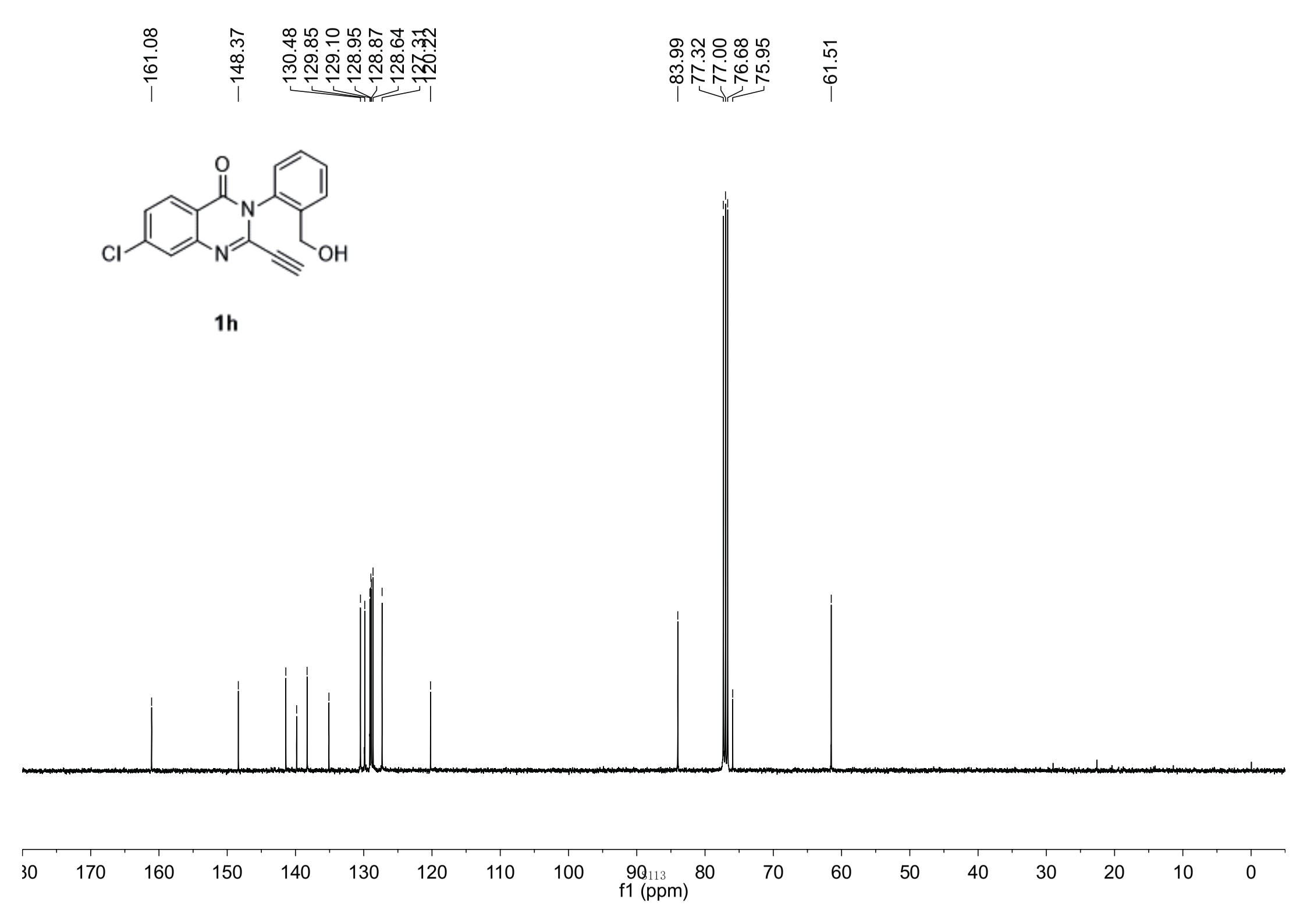
10 0 -10 -20 -30 -40 -50 -60 -70 -80 -90 -100 -120 -140 -160 -180 -200

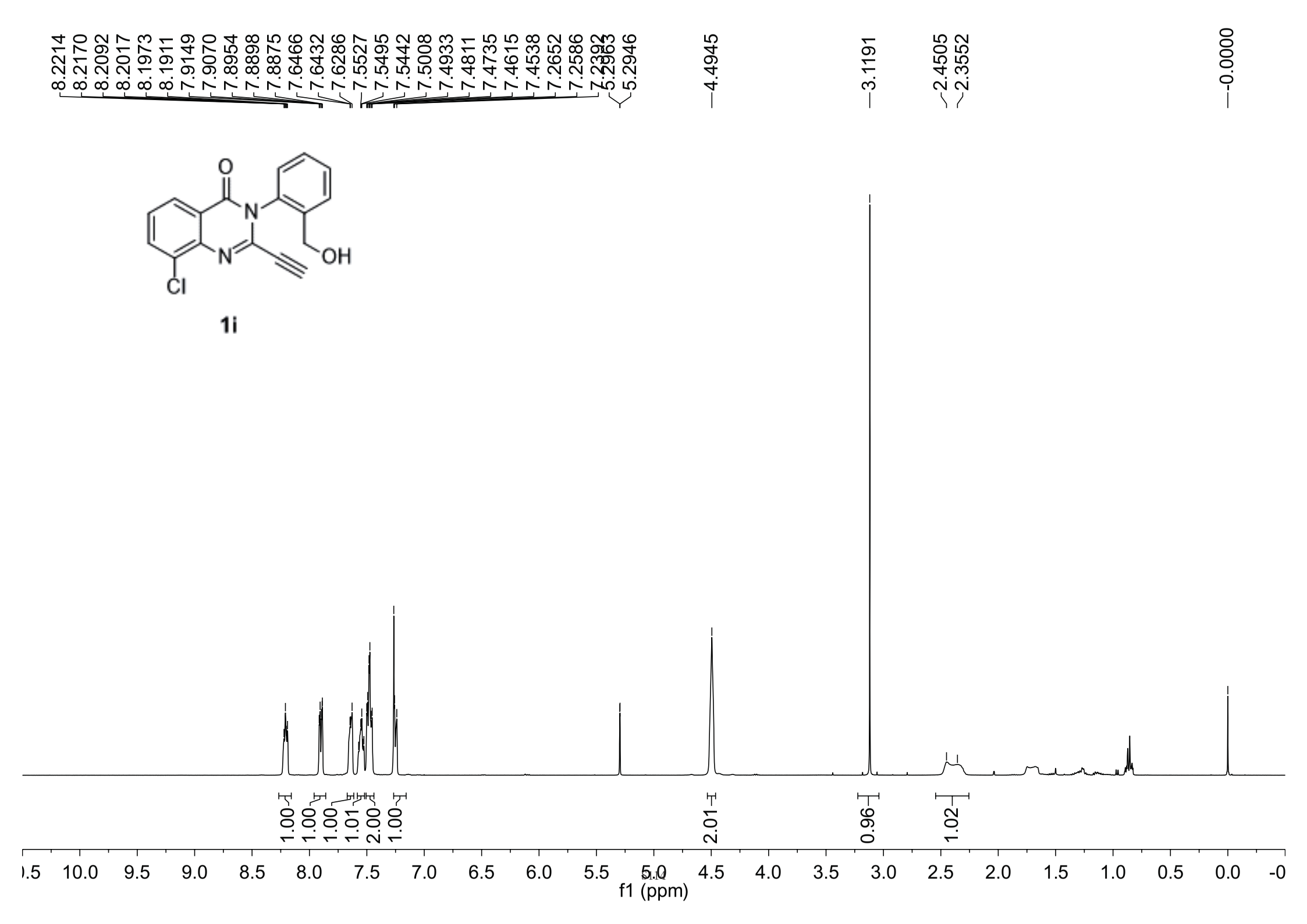
f1 (ppm)

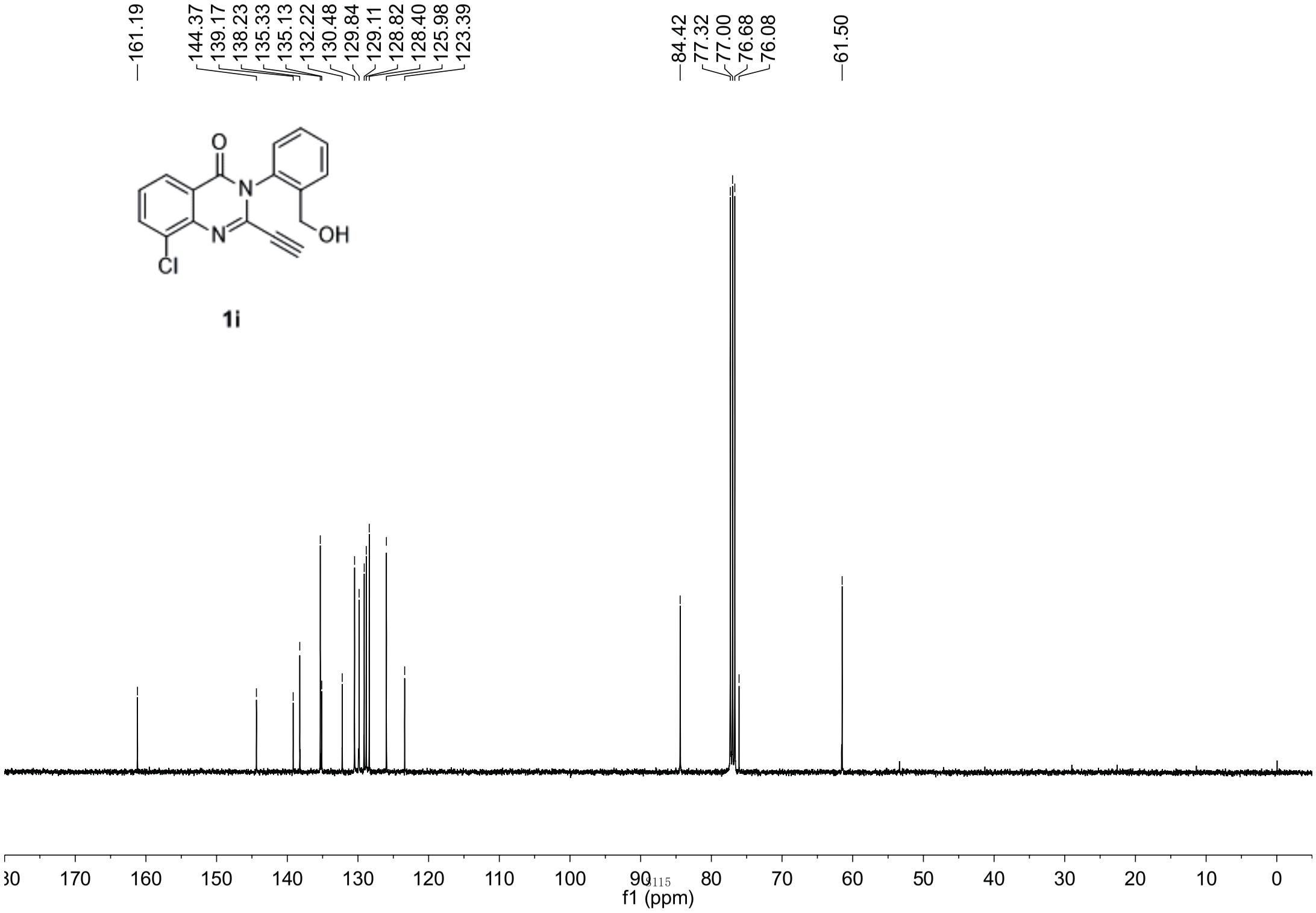

1.00
1.12
1.11
1.17
1.14
1.13
1.09
2.23
1.01
1.04
f1 (ppm)
1g
9.1428
9.1376
8.6117
8.5938
8.5885
7.9301
7.9122
7.6494
7.6468
7.6341
7.6315
7.5995
7.5971
7.5845
7.5821
7.5290
7.5136
7.5105
7.2968
7.2947
7.2812
7.2791
7.2599
4.5553
4.5432
3.2091
2.0827
2.0706
2.0584
-0.0029

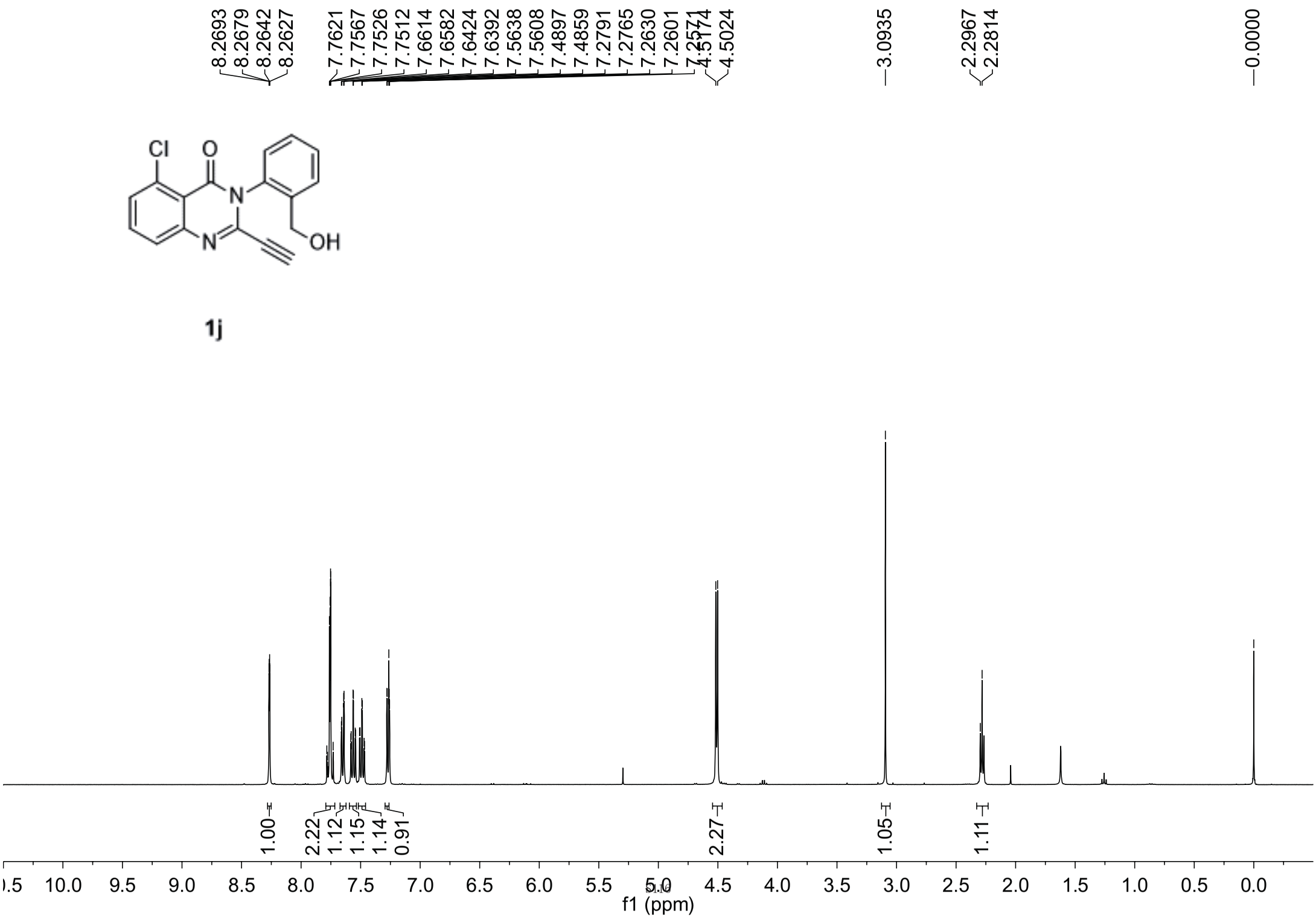

160.50
151.38
146.58
141.67
138.03
134.90
130.80
130.02
129.48
129.38
129.03
128.90
123.75
122.17
85.45
77.25
77.00
76.75
75.87
61.92
O
O2N
N
N
OH
1g
f1 (ppm)


8.2302
8.2209
8.2089
8.1996
7.7795
7.7747
7.6478
7.6289
7.5646
7.5458
7.5255
7.5197
7.5147
7.4982
7.4933
7.4713
7.4524
7.2657
7.2460
4.4947
3.1012
2.4978
0.0000
O
N
Cl
N
OH
1h
0.97
0.93
1.01
3.10
1.02
2.02
0.92
1.00
f1 (ppm)


161.08
148.37
130.48
129.85
129.10
128.95
128.87
128.64
127.31
120.22
83.99
77.32
77.00
76.68
75.95
61.51
O
N
N
Cl
OH
1h
f1 (ppm)

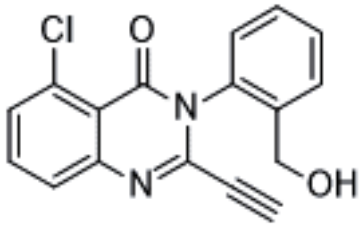

8.2214
8.2170
8.2092
8.2017
8.1973
8.1911
7.9149
7.9070
7.8954
7.8898
7.8875
7.6466
7.6432
7.6286
7.5527
7.5495
7.5442
7.5008
7.4933
7.4811
7.4735
7.4615
7.4538
7.2652
7.2586
5.2946
4.4945
3.1191
2.4505
2.3552
-0.0000
O
N
N
OH
Cl
1i
1.00
1.00
1.00
1.01
2.00
1.00
2.01
0.96
1.02
f1 (ppm)


161.19
144.37
139.17
138.23
135.33
135.13
132.22
130.48
129.84
129.11
128.82
128.40
125.98
123.39
84.42
77.32
77.00
76.68
76.08
61.50
O
N
N
OH
Cl
1i
f1 (ppm)


8.2693
8.2679
8.2642
8.2627
7.7621
7.7567
7.7526
7.7512
7.6614
7.6582
7.6424
7.6392
7.5638
7.5608
7.4897
7.4859
7.2791
7.2765
7.2630
7.2601
4.5174
4.5024
3.0935
2.2967
2.2814
0.0000
Cl
O
N
N
OH
1.00
2.22
1.12
1.15
1.14
0.91
2.27
1.05
1.11
f1 (ppm)

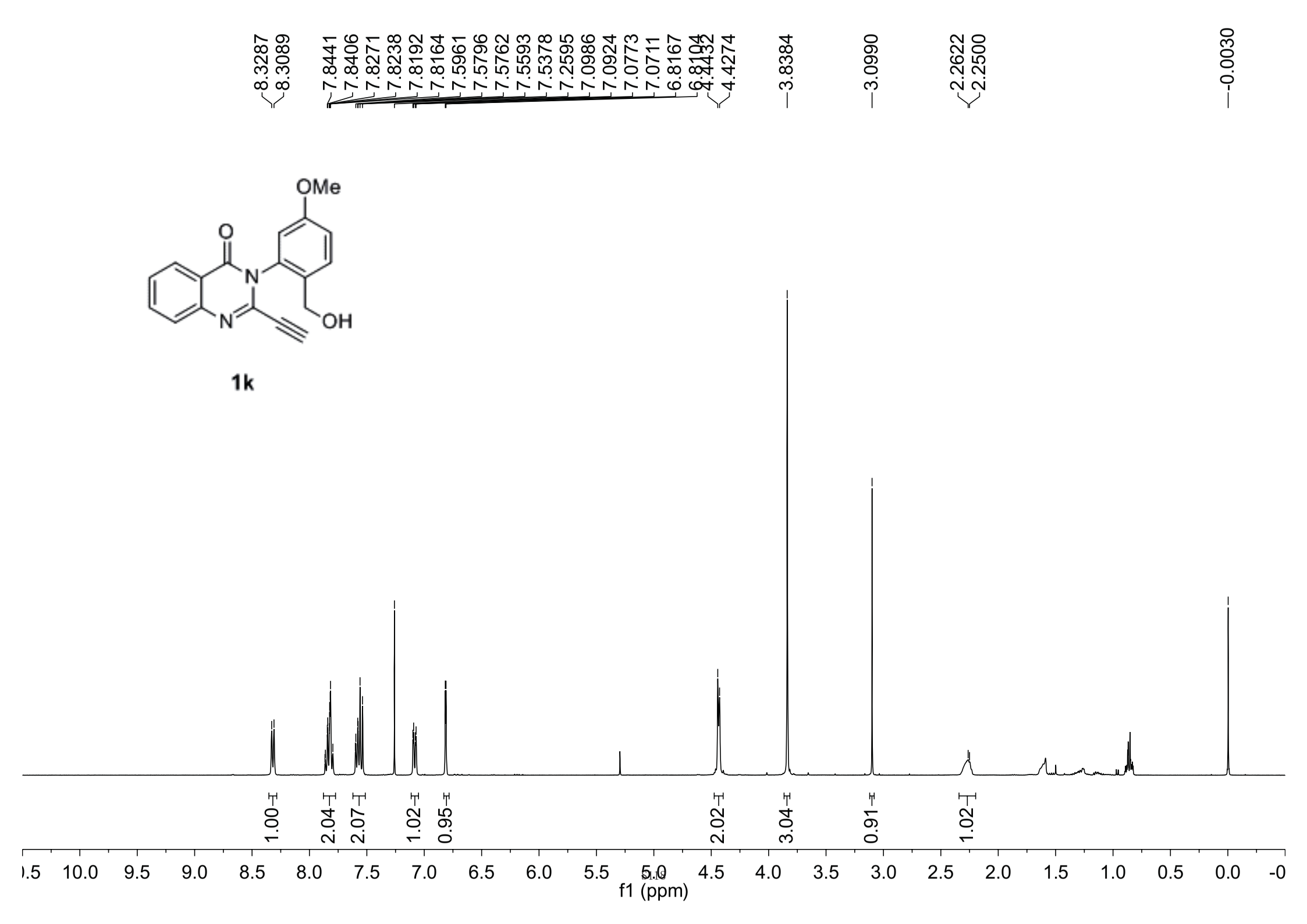
1j

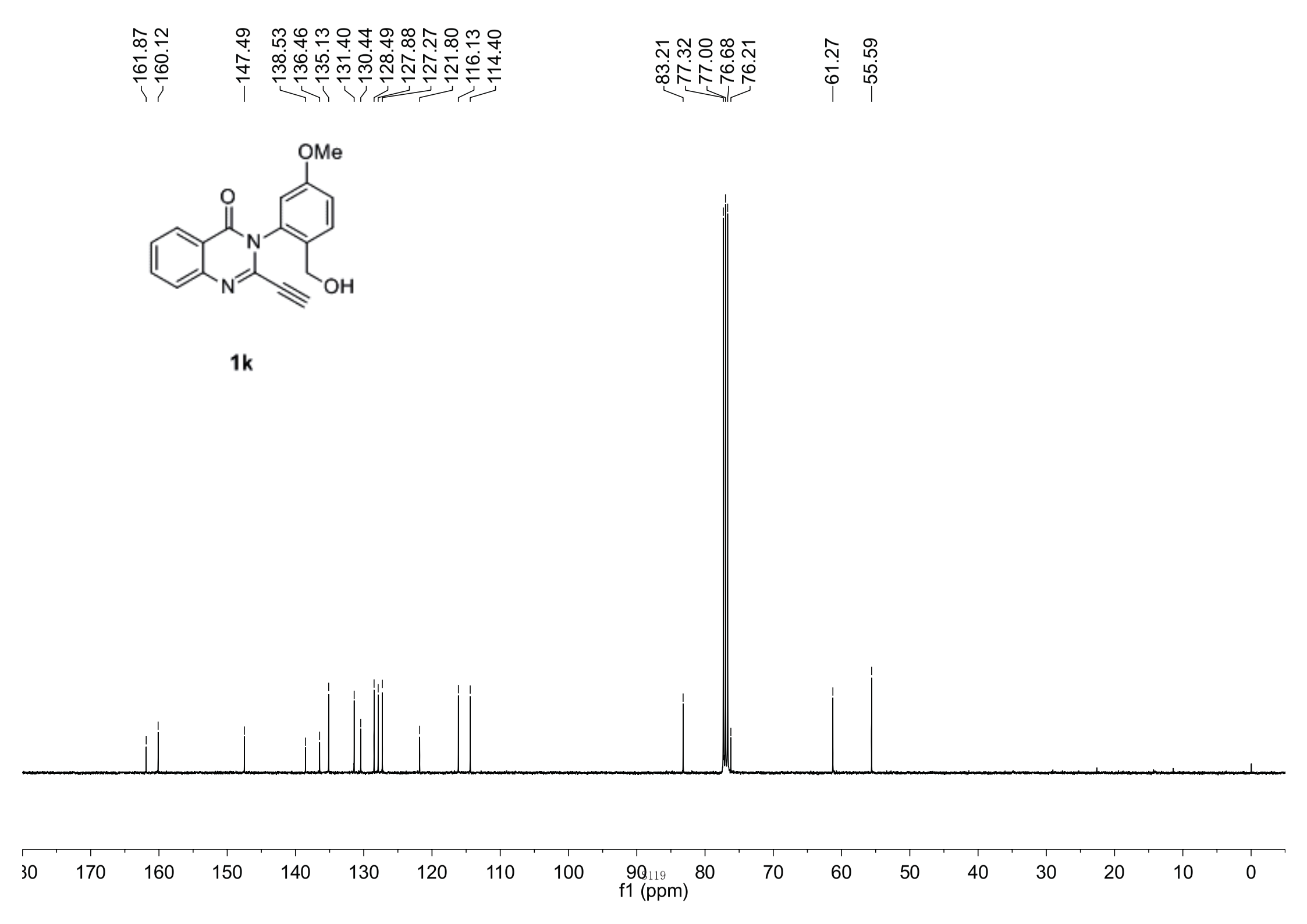
GZF-10

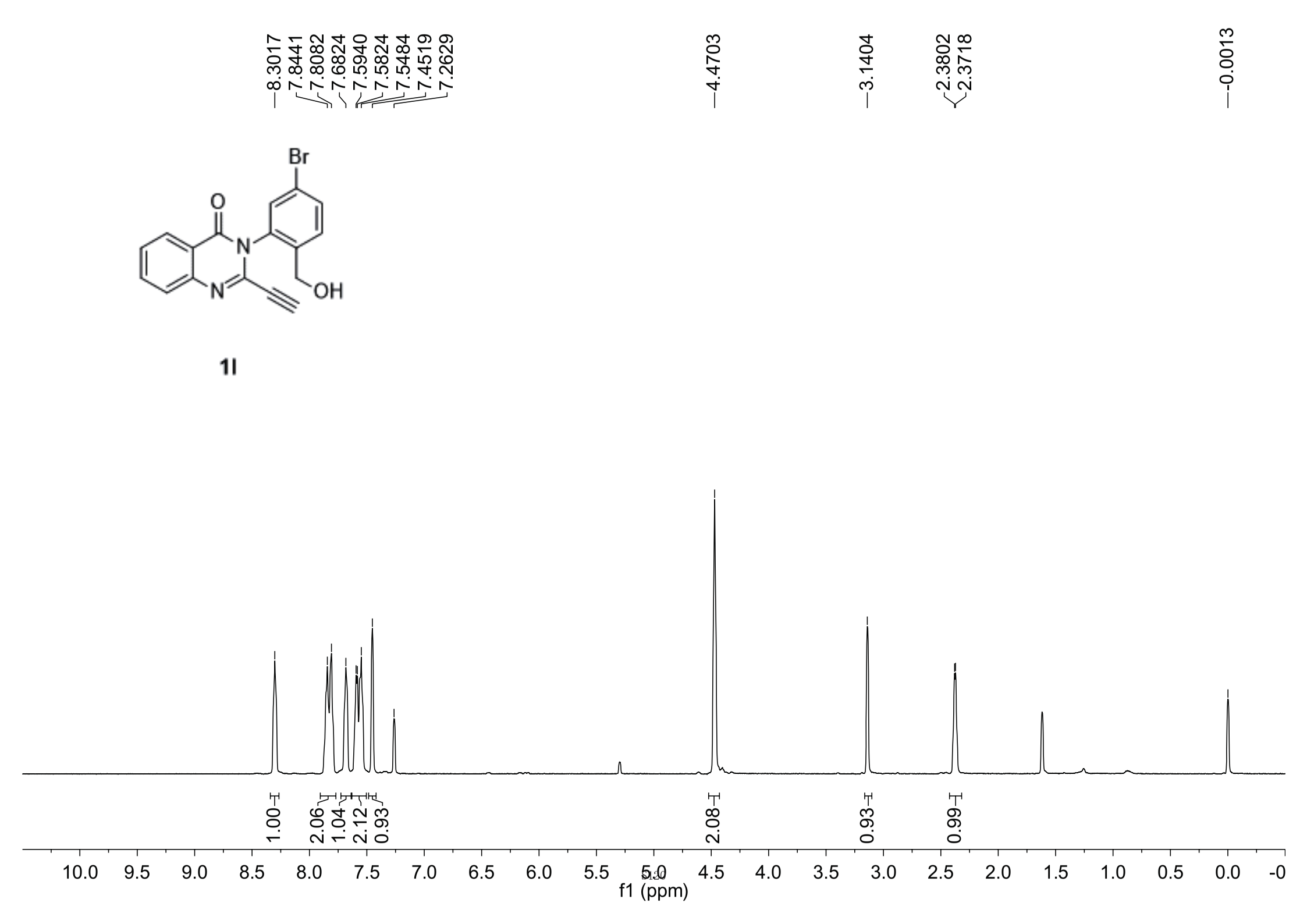

Cl
O
N
N
OH

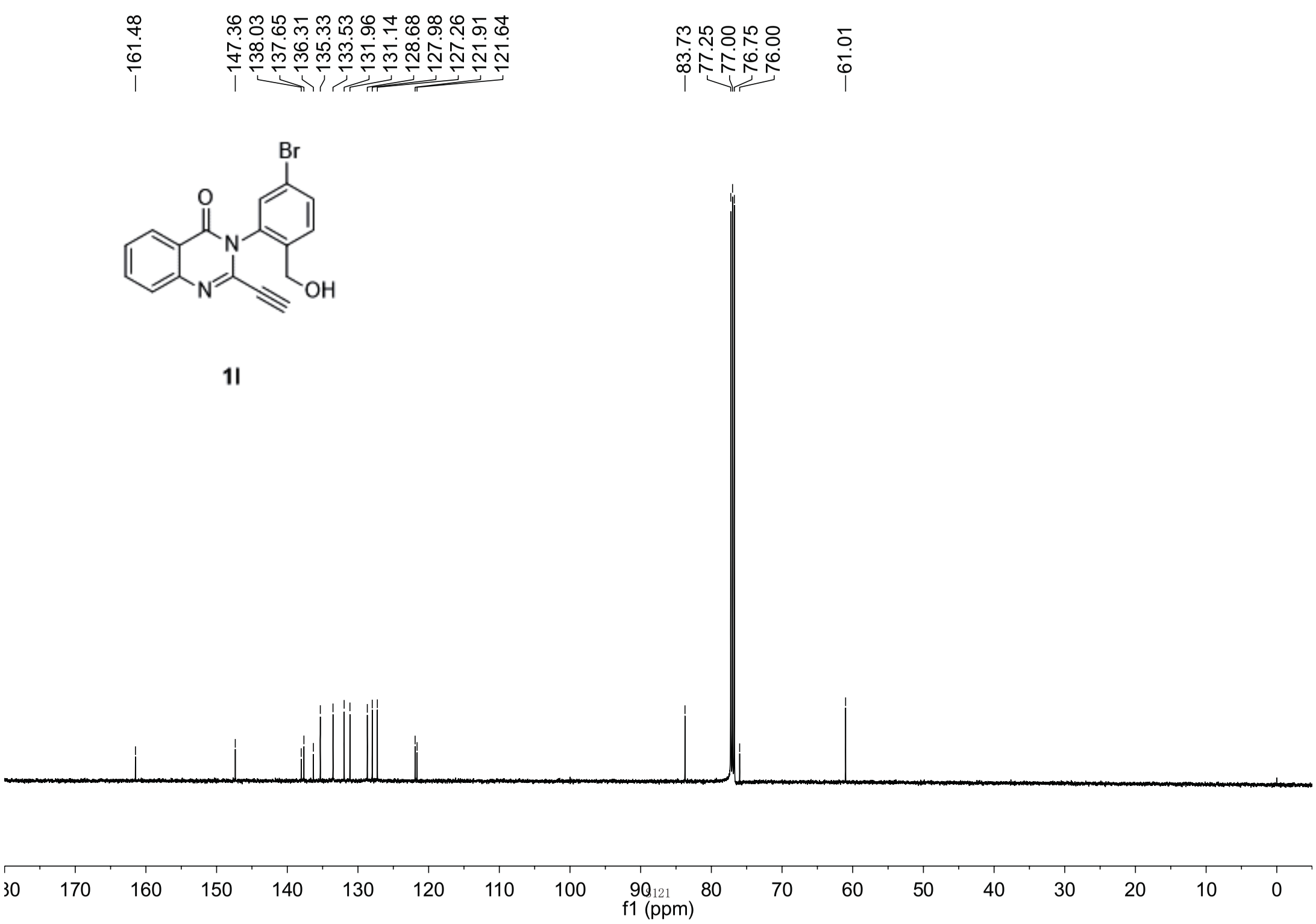
1j

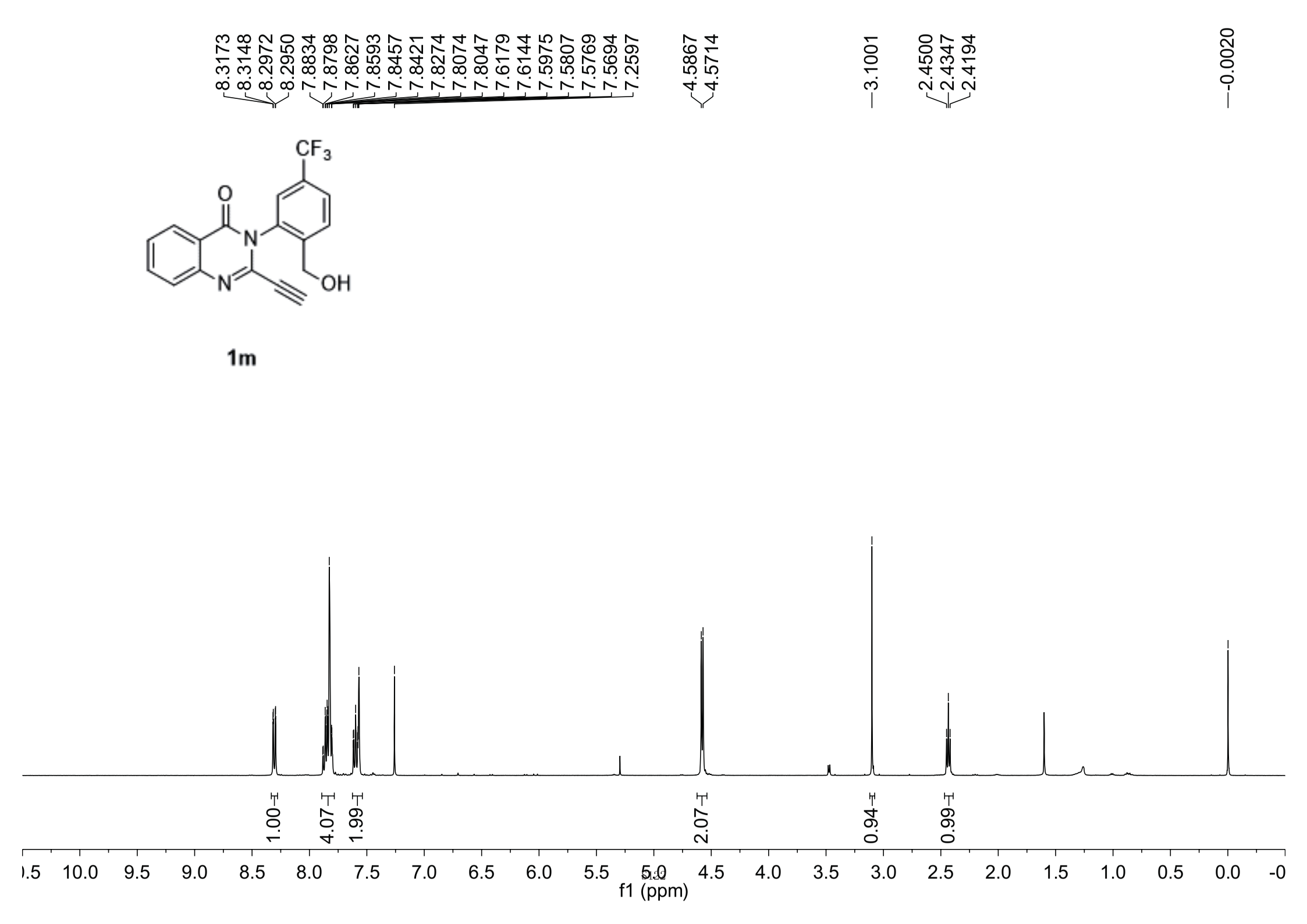
160.73
145.98
138.83
138.24
135.54
135.19
134.47
130.54
129.99
129.47
129.20
128.92
126.62
122.87
83.75
77.32
77.00
76.68
76.04
61.64
f1 (ppm)

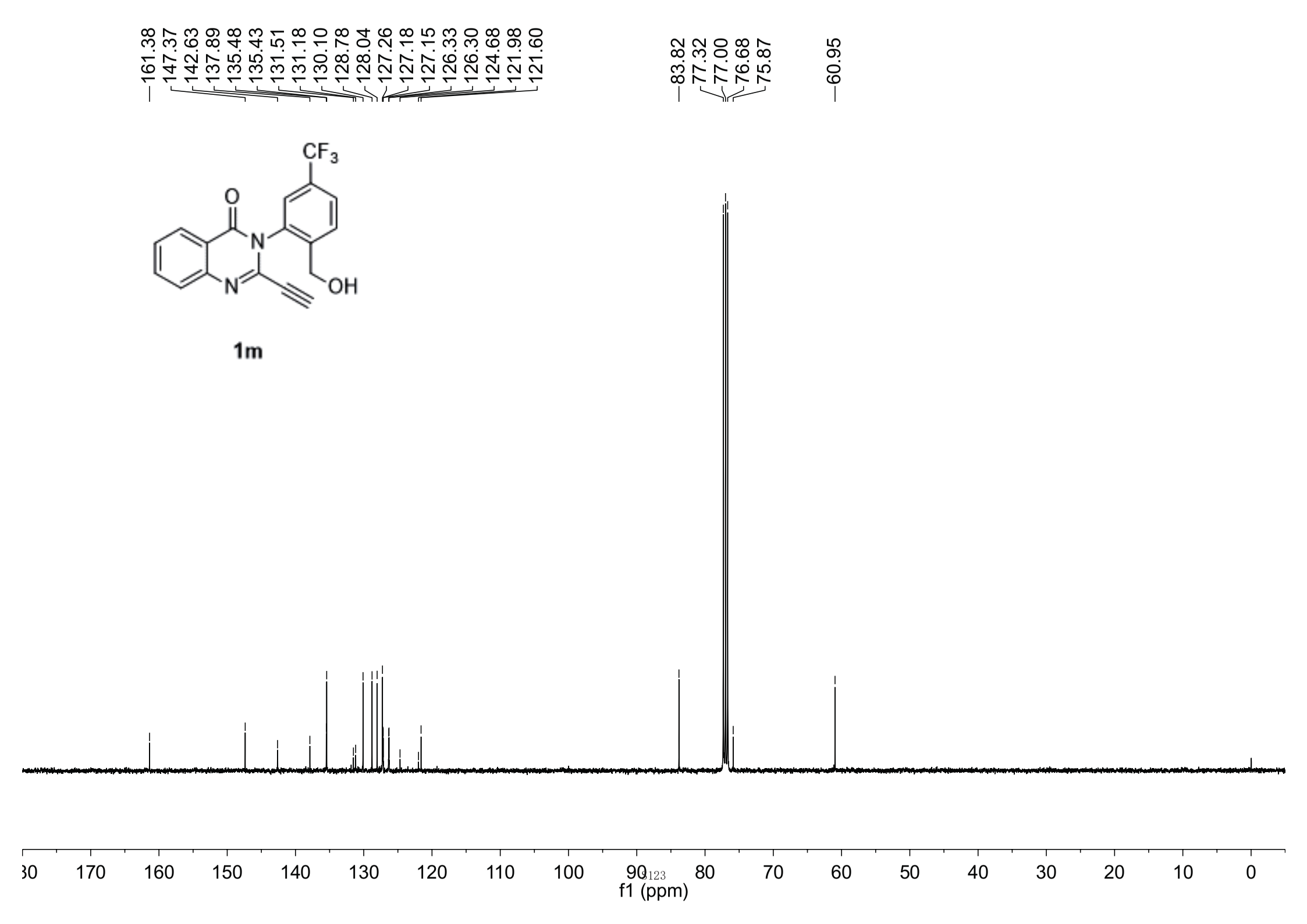

8.3287
8.3089
7.8441
7.8406
7.8271
7.8238
7.8192
7.8164
7.5961
7.5796
7.5762
7.5593
7.5378
7.2595
7.0986
7.0924
7.0773
7.0711
6.8167
4.4274
3.8384
3.0990
2.2622
2.2500
-0.0030
OMe
O
N
N
OH
1k
1.00
2.04
2.07
1.02
0.95
2.02
3.04
0.91
1.02
f1 (ppm)

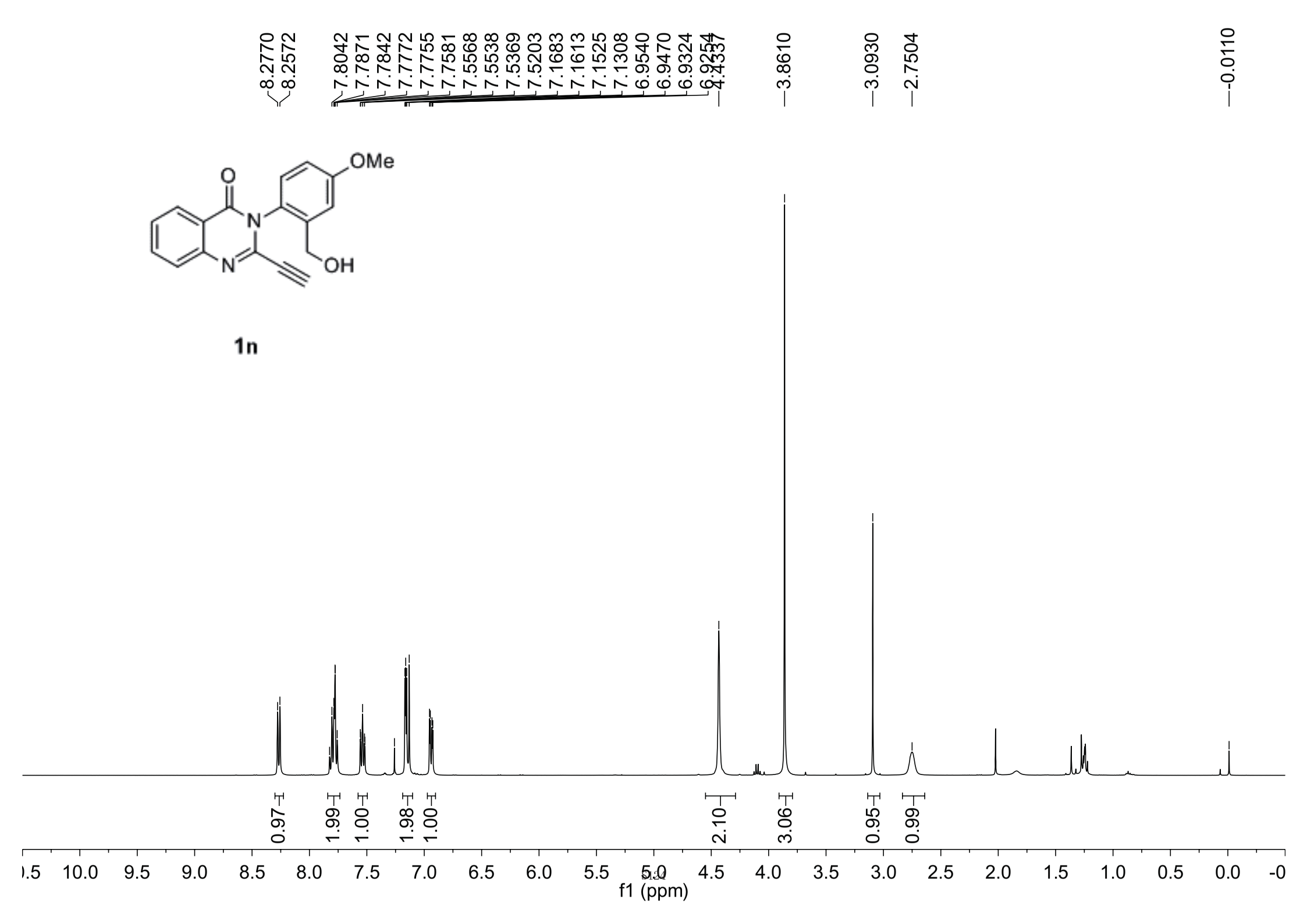

161.87
160.12
147.49
138.53
136.46
135.13
131.40
130.44
128.49
127.88
127.27
121.80
116.13
114.40
83.21
77.32
77.00
76.68
76.21
61.27
55.59
OMe
O
N
N
OH
1k
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

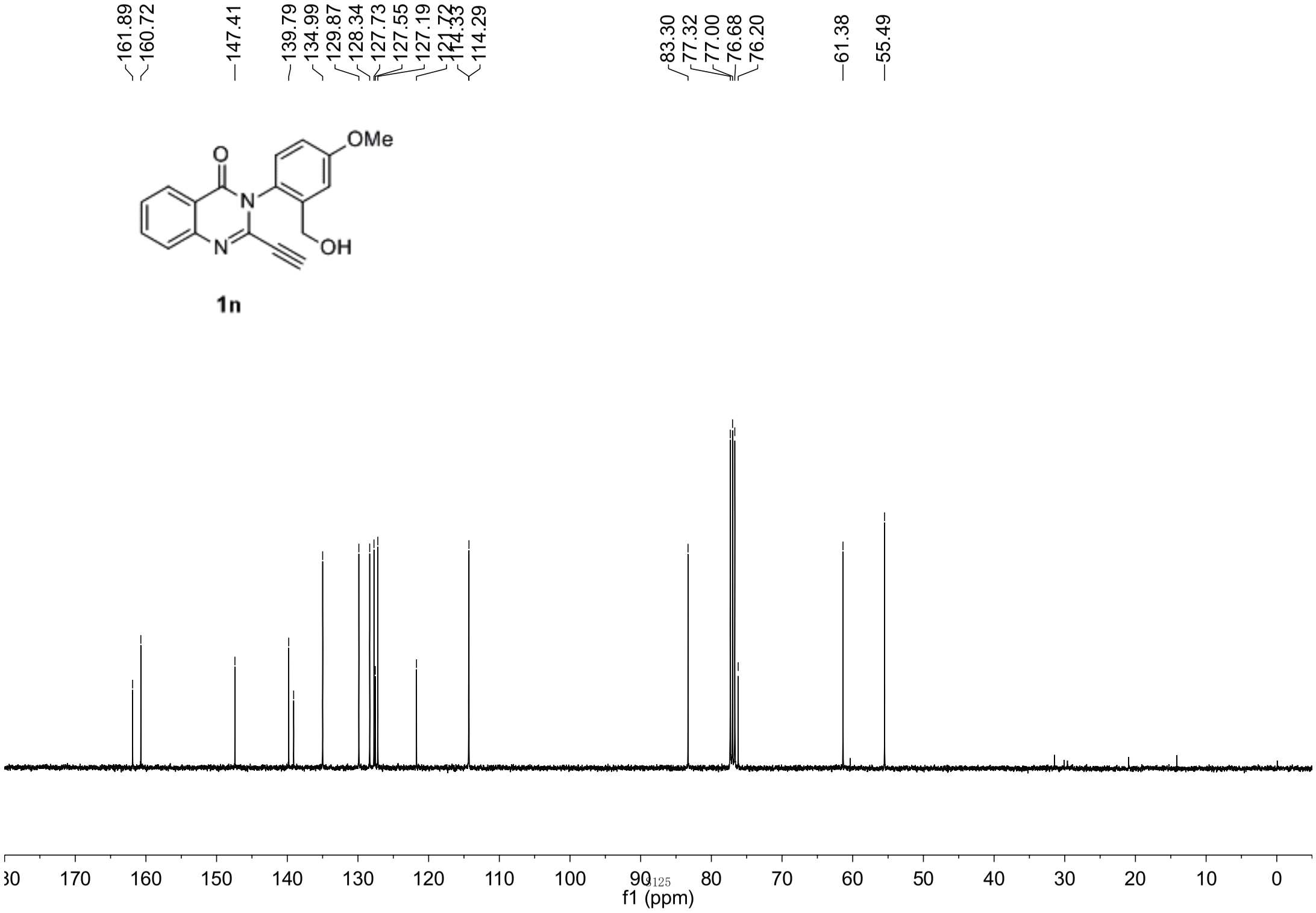

8.3017
7.8441
7.8082
7.6824
7.5940
7.5824
7.5484
7.4519
7.2629
4.4703
3.1404
2.3802
2.3718
-0.0013
Br
O
N
N
OH
1I
1.00
2.06
1.04
2.12
0.93
2.08
0.93
0.99
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0
f1 (ppm)

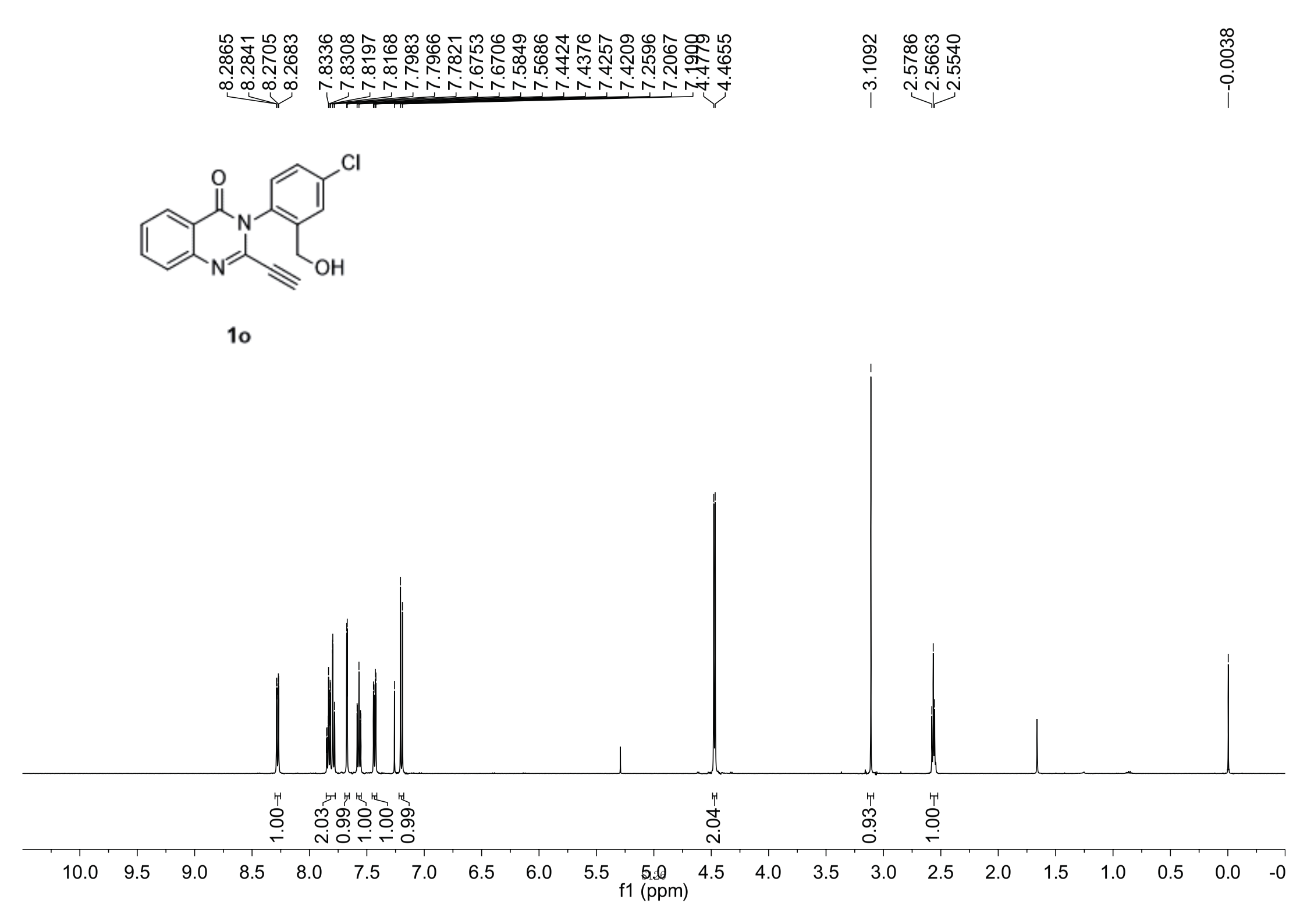

161.48
147.36
138.03
137.65
136.31
135.33
133.53
131.96
131.14
128.68
127.98
127.26
121.91
121.64
83.73
77.25
77.00
76.75
76.00
61.01
Br
O
N
N
OH
1l
f1 (ppm)

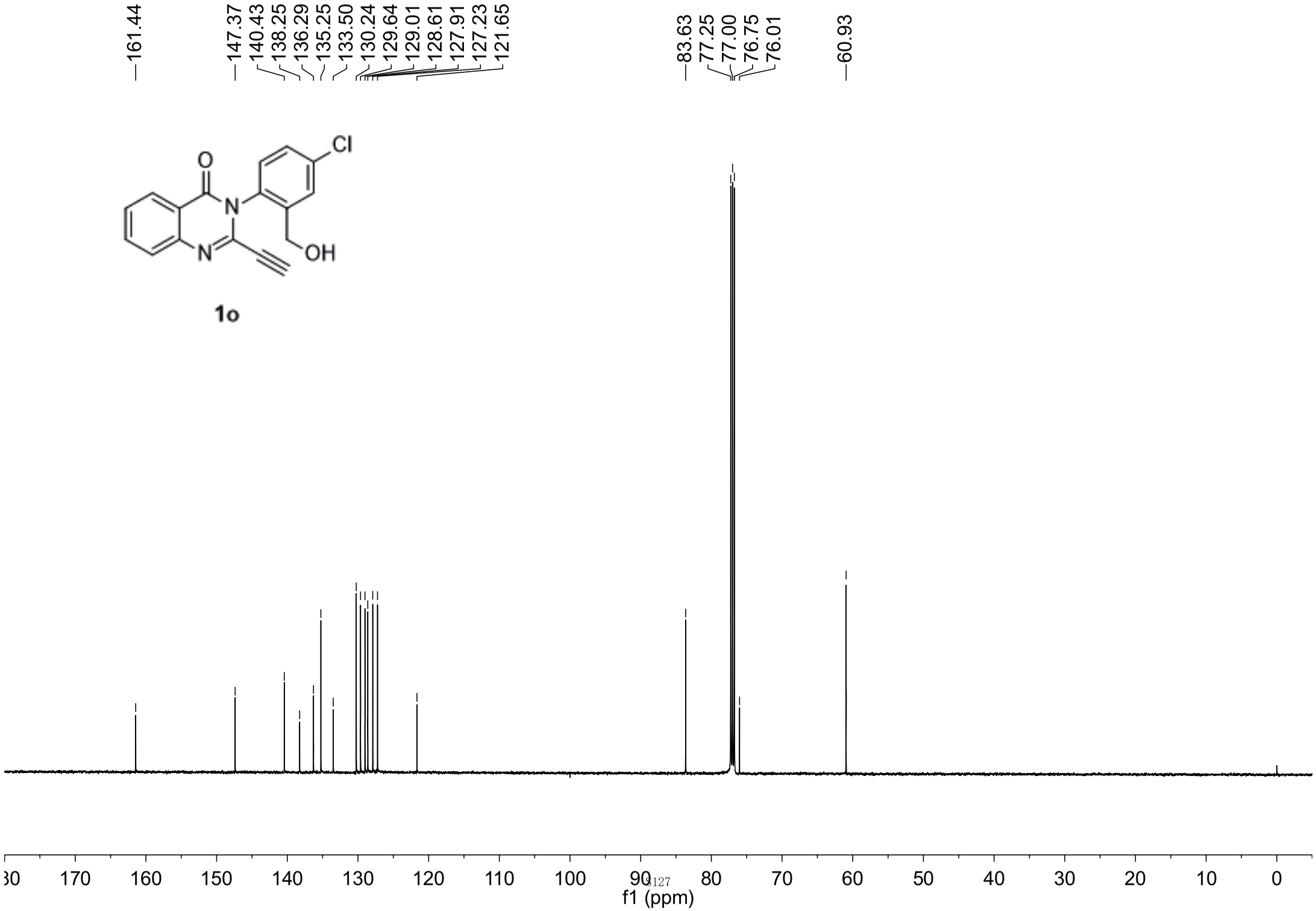

8.3173
8.3148
8.2972
8.2950
7.8834
7.8798
7.8627
7.8593
7.8457
7.8421
7.8274
7.8074
7.8047
7.6179
7.6144
7.5975
7.5807
7.5769
7.5694
7.2597
4.5867
4.5714
3.1001
2.4500
2.4347
2.4194
-0.0020
CF3
O
N
N
OH
1m
1.00
4.07
1.99
2.07
0.94
0.99
f1 (ppm)

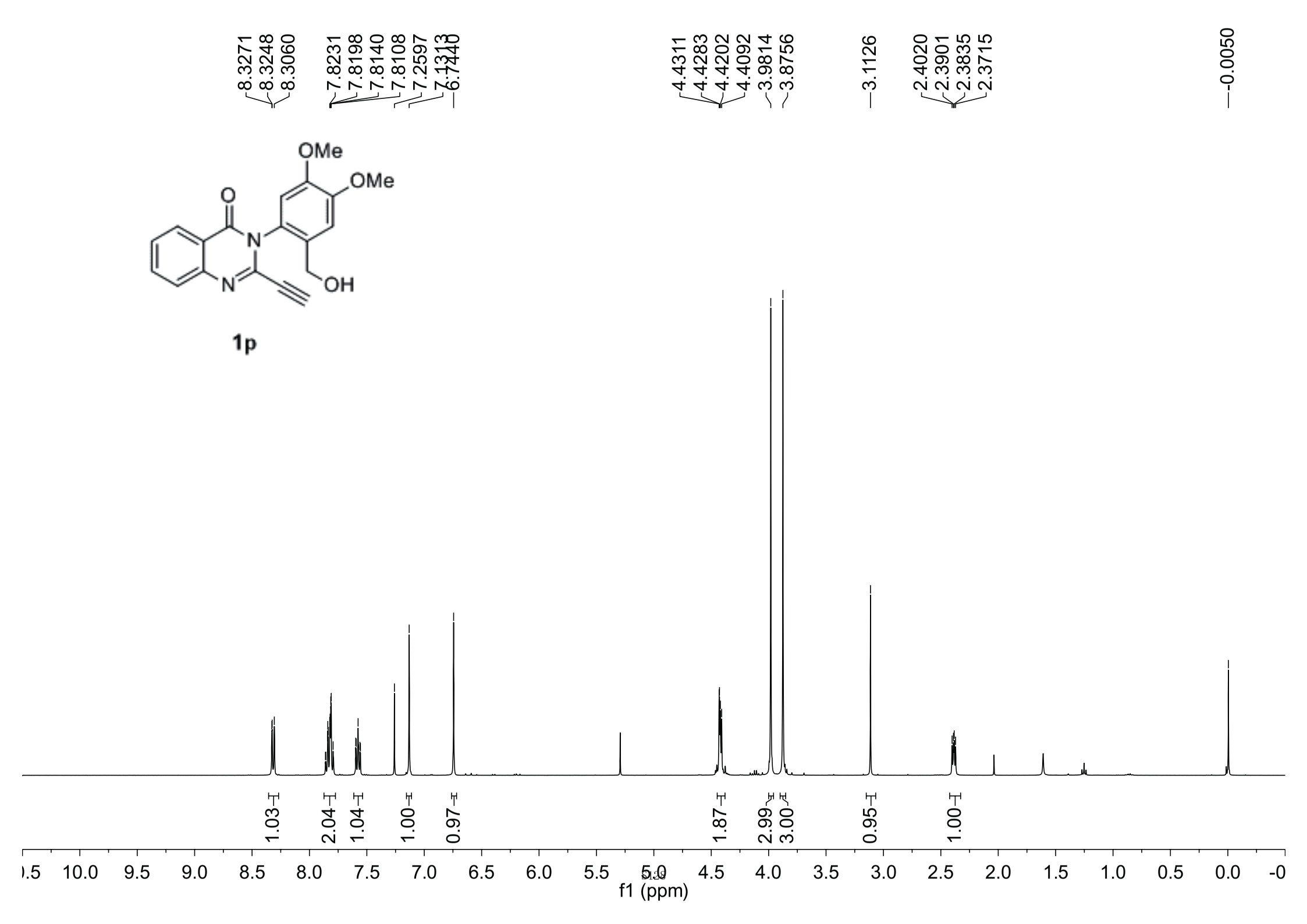

161.38
147.37
142.63
137.89
135.48
135.43
131.51
131.18
130.10
128.78
128.04
127.26
127.18
127.15
126.33
126.30
124.68
121.98
121.60
83.82
77.32
77.00
76.68
75.87
60.95
CF3
O
N
N
OH
1m
f1 (ppm)

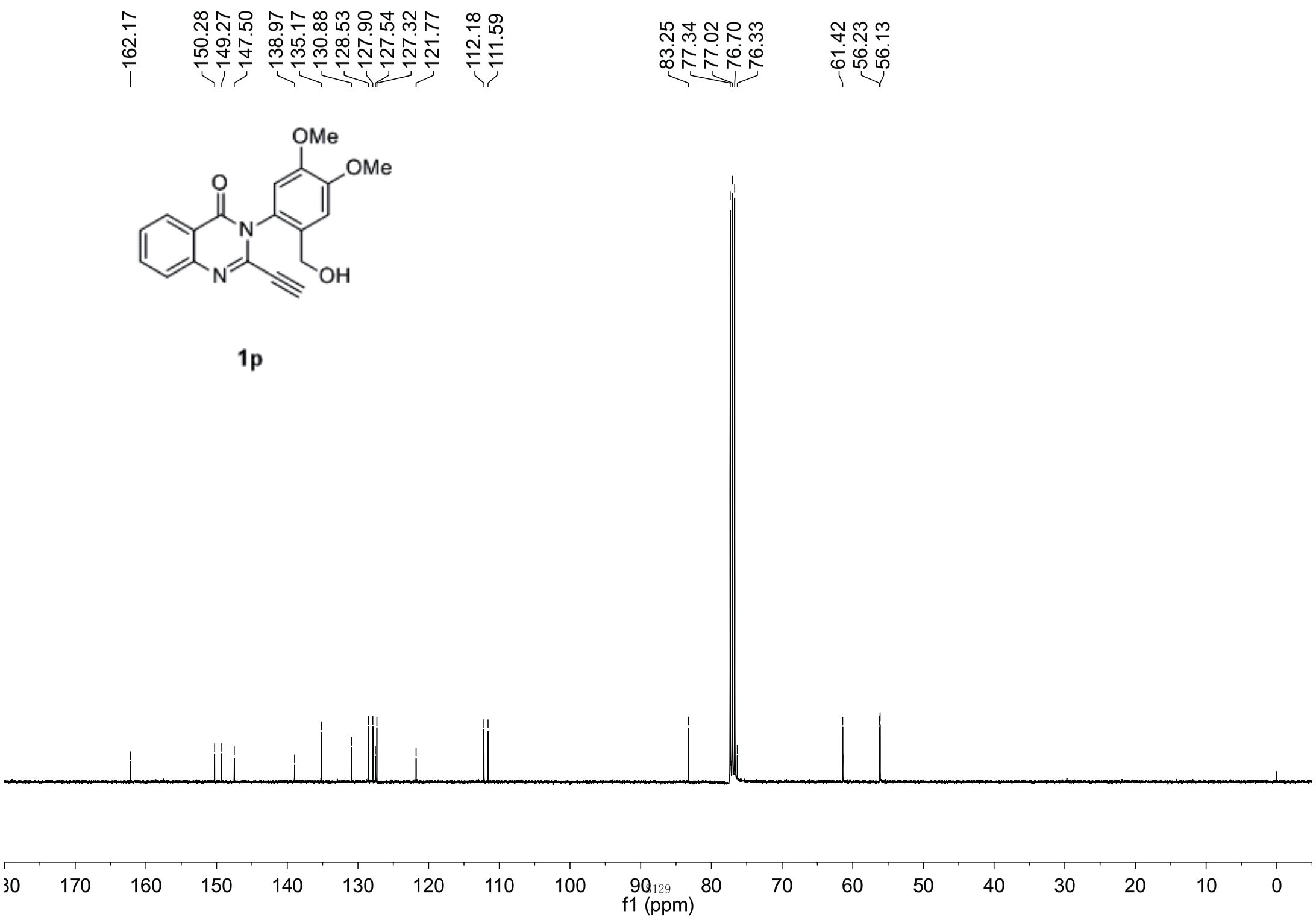

8.2770
8.2572
7.8042
7.7871
7.7842
7.7772
7.7755
7.7581
7.5568
7.5538
7.5369
7.5203
7.1683
7.1613
7.1525
7.1308
6.9540
6.9470
6.9324
6.9254
4.4337
3.8610
3.0930
2.7504
-0.0110
OMe
O
N
N
OH
1n
0.97
1.99
1.00
1.98
1.00
2.10
3.06
0.95
0.99
f1 (ppm)

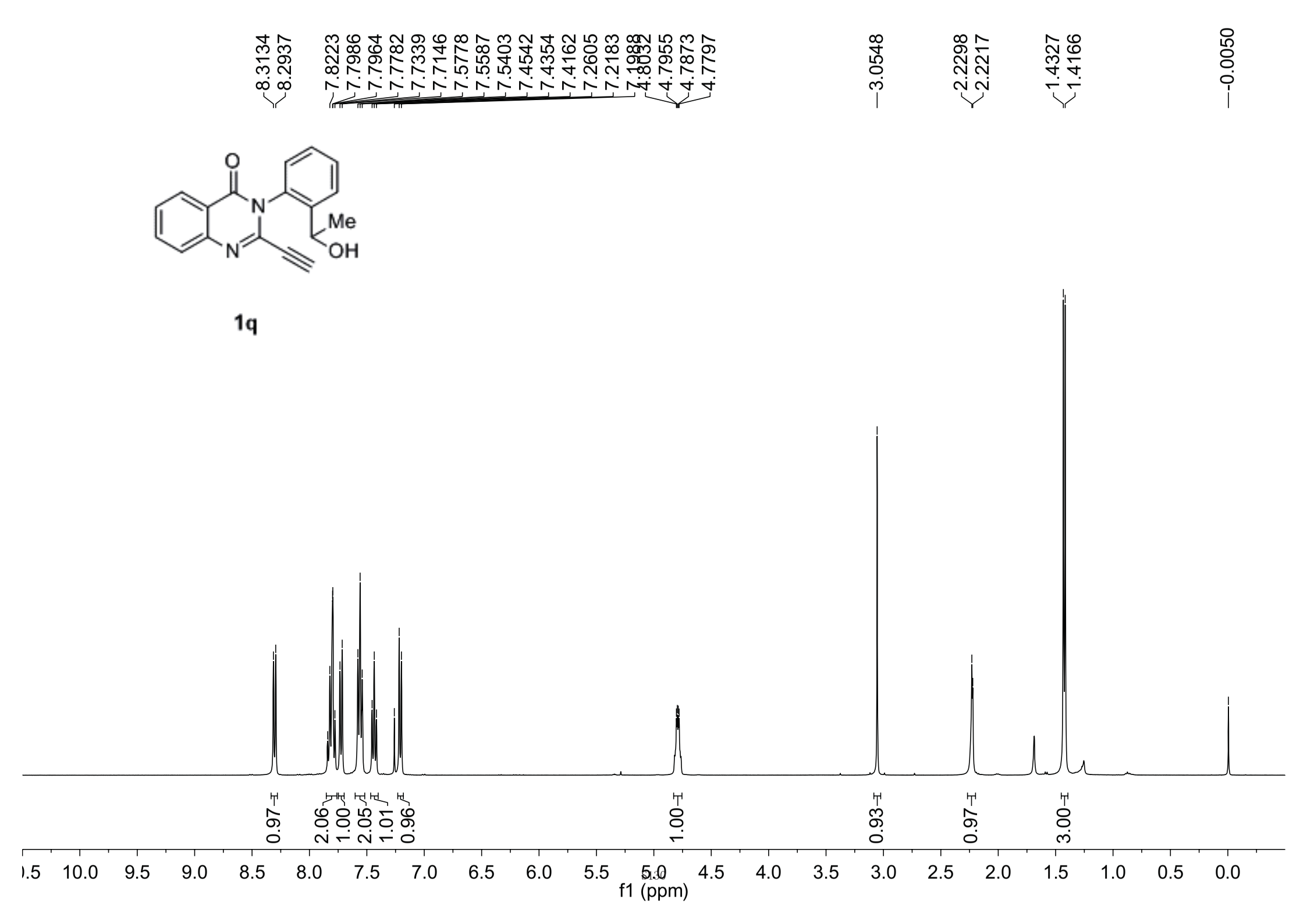

161.89
160.72
147.41
139.79
134.99
129.87
128.34
127.73
127.55
127.19
121.72
114.33
114.29
83.30
77.32
77.00
76.68
76.20
61.38
55.49
OMe
O
N
N
OH
1n
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

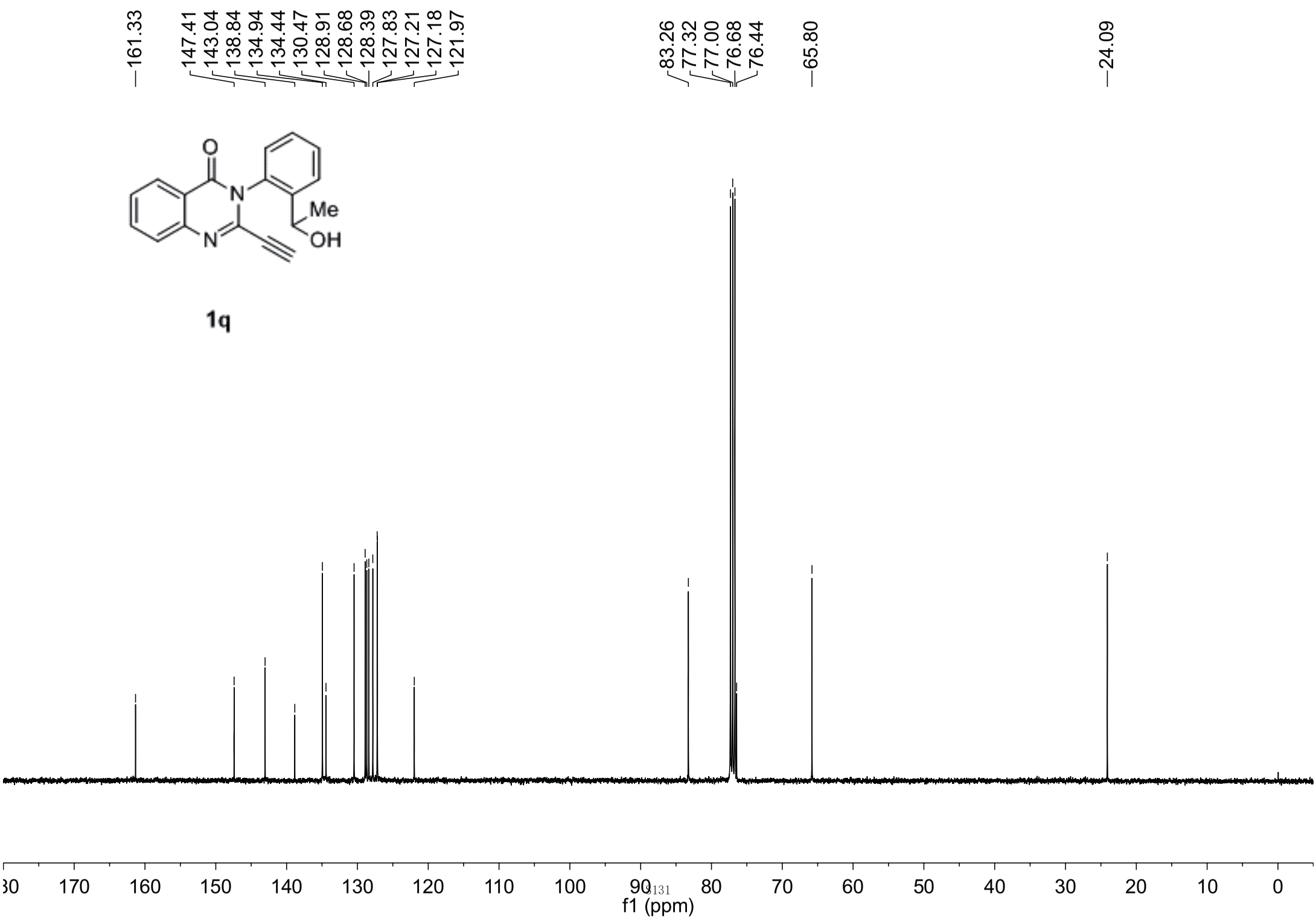

8.2865
8.2841
8.2705
8.2683
7.8336
7.8308
7.8197
7.8168
7.7983
7.7966
7.7821
7.6753
7.6706
7.5849
7.5686
7.4424
7.4376
7.4257
7.4209
7.2596
7.2067
7.1900
4.4779
4.4655
3.1092
2.5786
2.5663
2.5540
0.0038
Cl
O
N
N
OH
1o
1.00
2.03
0.99
1.00
1.00
0.99
2.04
0.93
1.00
f1 (ppm)

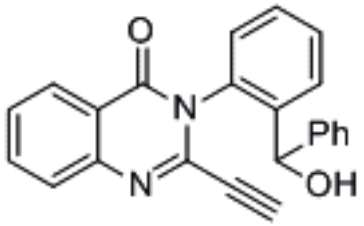

161.44
147.37
140.43
138.25
136.29
135.25
133.50
130.24
129.64
129.01
128.61
127.91
127.23
121.65
83.63
77.25
77.00
76.75
76.01
60.93
O
N
N
Cl
OH
1o
f1 (ppm)


8.3271
8.3248
8.3060
7.8231
7.8198
7.8140
7.8108
7.2597
7.1313
6.7440
4.4311
4.4283
4.4202
4.4092
3.9814
3.8756
3.1126
2.4020
2.3901
2.3835
2.3715
-0.0050
OMe
OMe
O
N
N
OH
1p
1.03
2.04
1.04
1.00
0.97
1.87
2.99
3.00
0.95
1.00
f1 (ppm)


162.17
150.28
149.27
147.50
138.97
135.17
130.88
128.53
127.90
127.54
127.32
121.77
112.18
111.59
83.25
77.34
77.02
76.70
76.33
61.42
56.23
56.13
OMe
OMe
O
N
N
OH
1p
f1 (ppm)

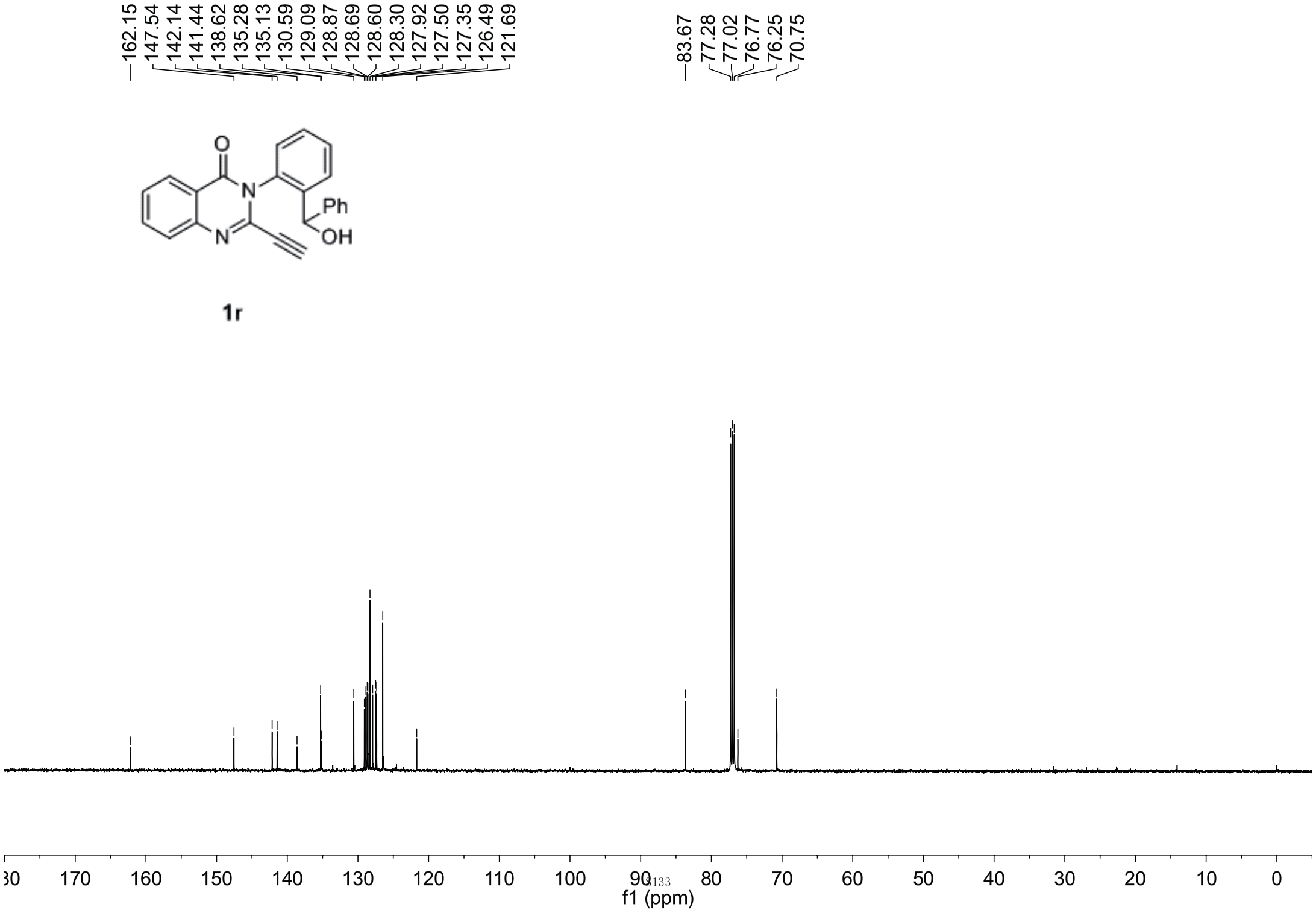

8.3134
8.2937
7.8223
7.7986
7.7964
7.7782
7.7339
7.7146
7.5778
7.5587
7.5403
7.4542
7.4354
7.4162
7.2605
7.2183
4.8032
4.7955
4.7873
4.7797
3.0548
2.2298
2.2217
1.4327
1.4166
-0.0050
O
N
N
Me
OH
1q
0.97
2.06
1.00
2.05
1.01
0.96
1.00
0.93
0.97
3.00
f1 (ppm)

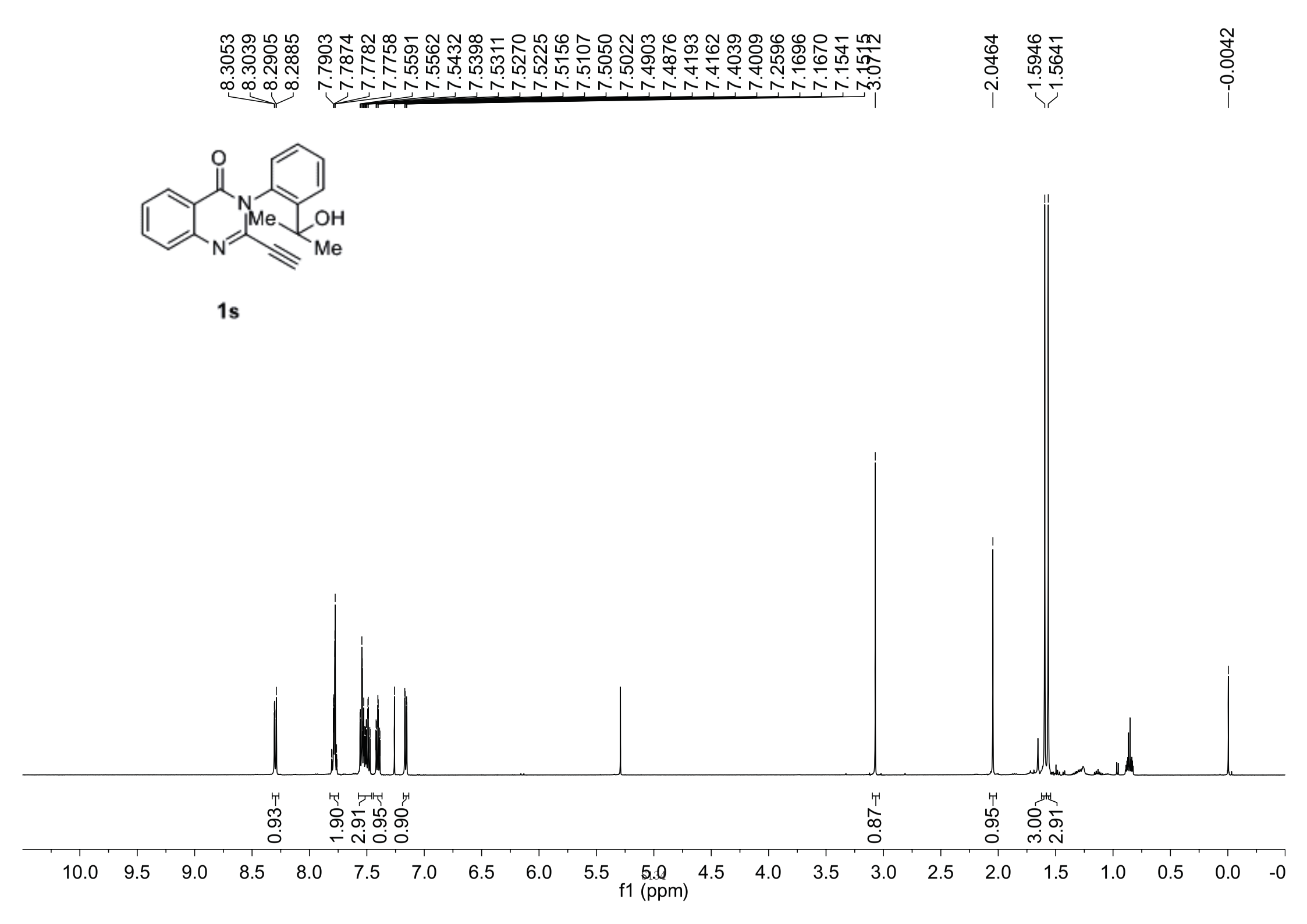

161.33
147.41
143.04
138.84
134.94
134.44
130.47
128.91
128.68
128.39
127.83
127.21
127.18
121.97
83.26
77.32
77.00
76.68
76.44
65.80
24.09
O
N
N
Me
OH
1q
f1 (ppm)

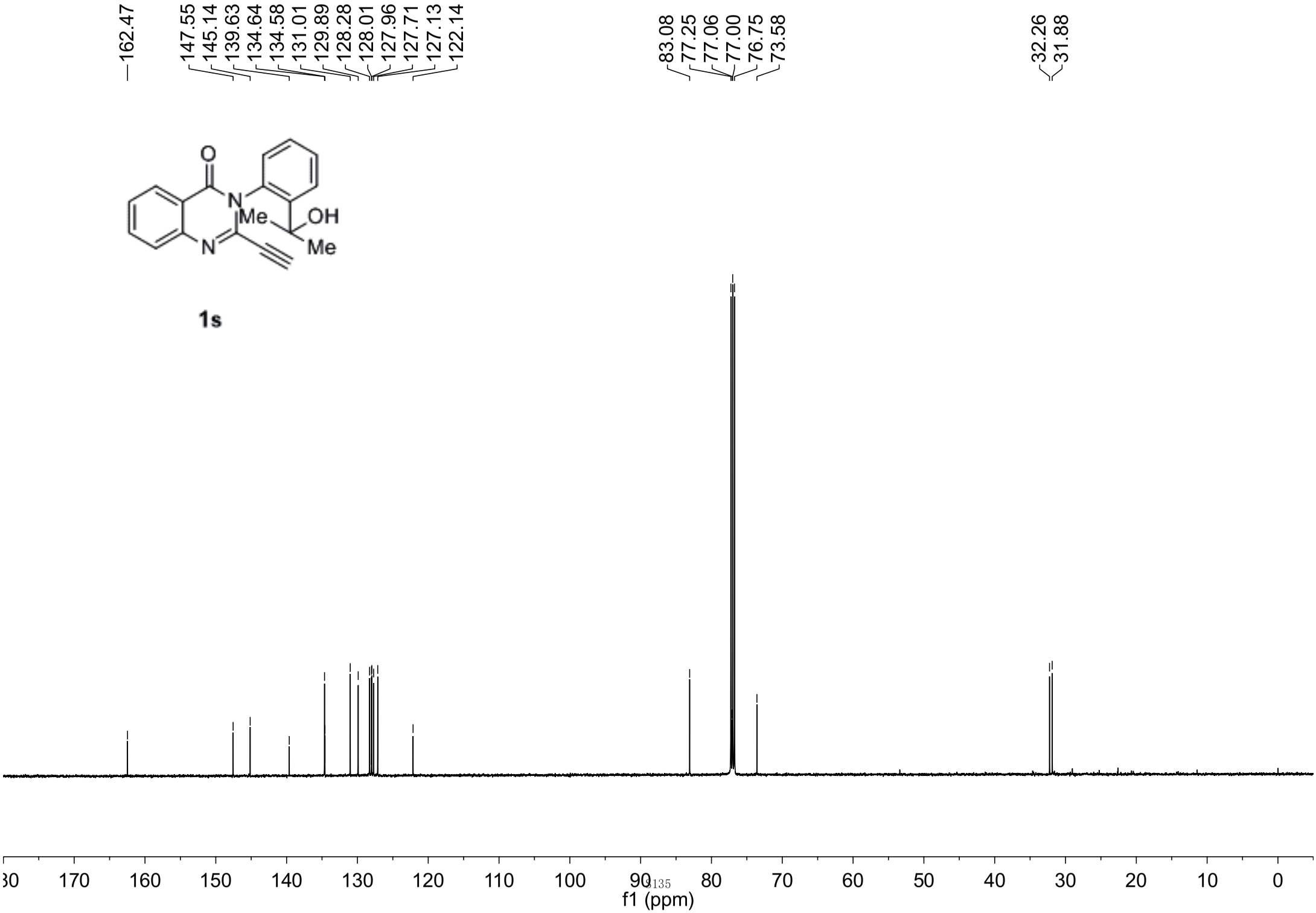

O
N
N
Ph
OH

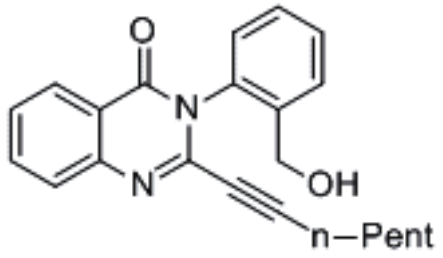
1r

8.3564
8.3406
7.8551
7.8410
7.8388
7.8166
7.5971
7.4958
7.4836
7.4331
7.2742
7.2657
7.2569
7.2381
7.2224
3.2464
3.0525
0.0001
1.08
2.17
1.20
2.32
1.16
6.44
1.08
1.11
1.00
f1 (ppm)

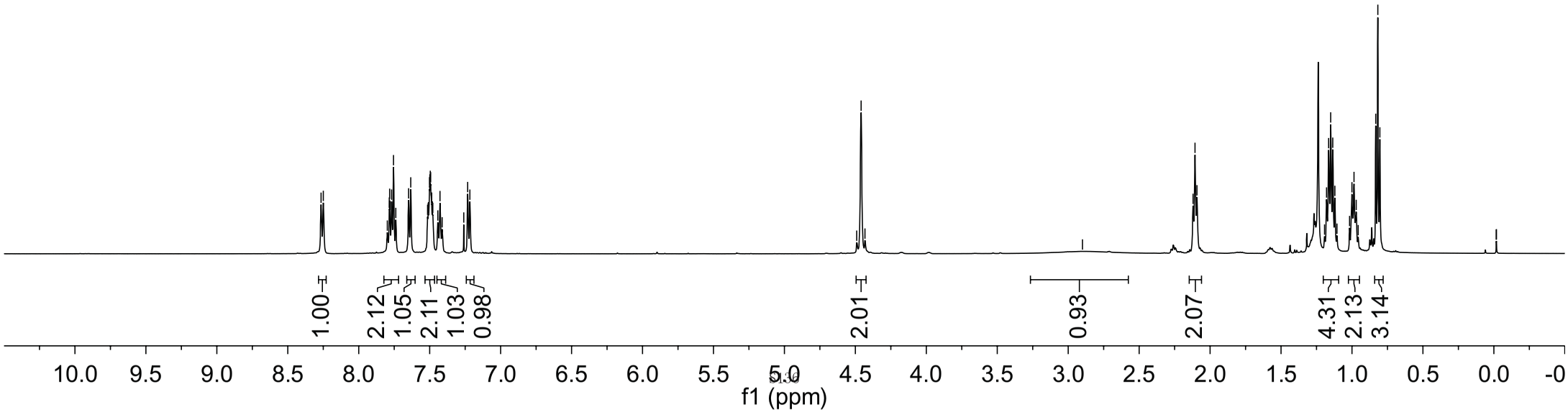

162.15
147.54
142.14
141.44
138.62
135.28
135.13
130.59
129.09
128.87
128.69
128.60
128.30
127.92
127.50
127.35
126.49
121.69
83.67
77.28
77.02
76.77
76.25
70.75
O
N
N
Ph
OH
1r
f1 (ppm)

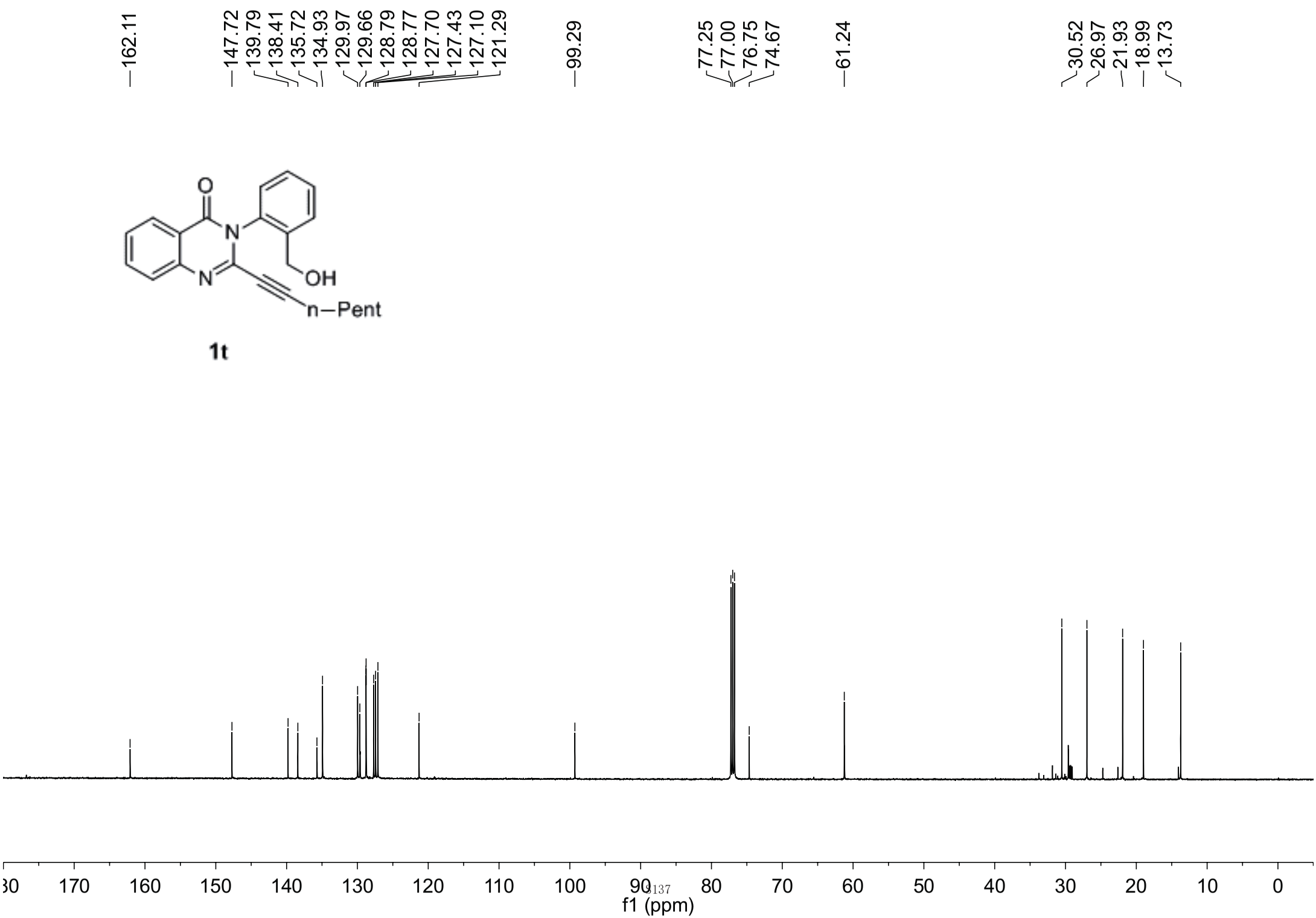

8.3053
8.3039
8.2905
8.2885
7.7903
7.7874
7.7782
7.7758
7.5591
7.5562
7.5432
7.5398
7.5311
7.5270
7.5225
7.5156
7.5107
7.5050
7.5022
7.4903
7.4876
7.4193
7.4162
7.4039
7.4009
7.2596
7.1696
7.1670
7.1541
3.0712
2.0464
1.5946
1.5641
-0.0042
O
N
Me
OH
Me
N
1s
0.93
1.90
2.91
0.95
0.90
0.87
0.95
3.00
2.91
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0
f1 (ppm)

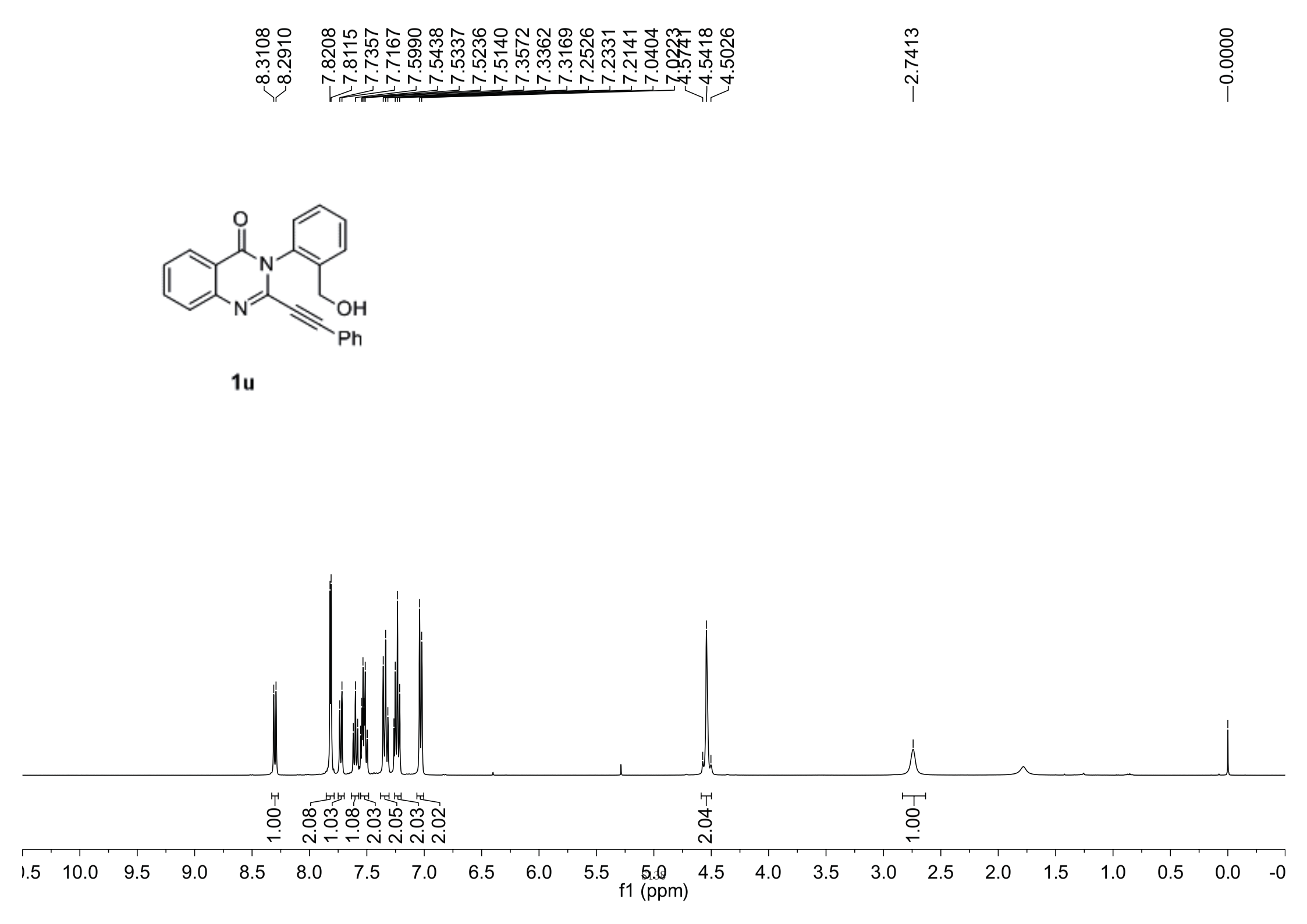

162.47
147.55
145.14
139.63
134.64
134.58
131.01
129.89
128.28
128.01
127.96
127.71
127.13
122.14
83.08
77.25
77.06
77.00
76.75
73.58
32.26
31.88
O
N
Me
OH
N
Me
1s
f1 (ppm)

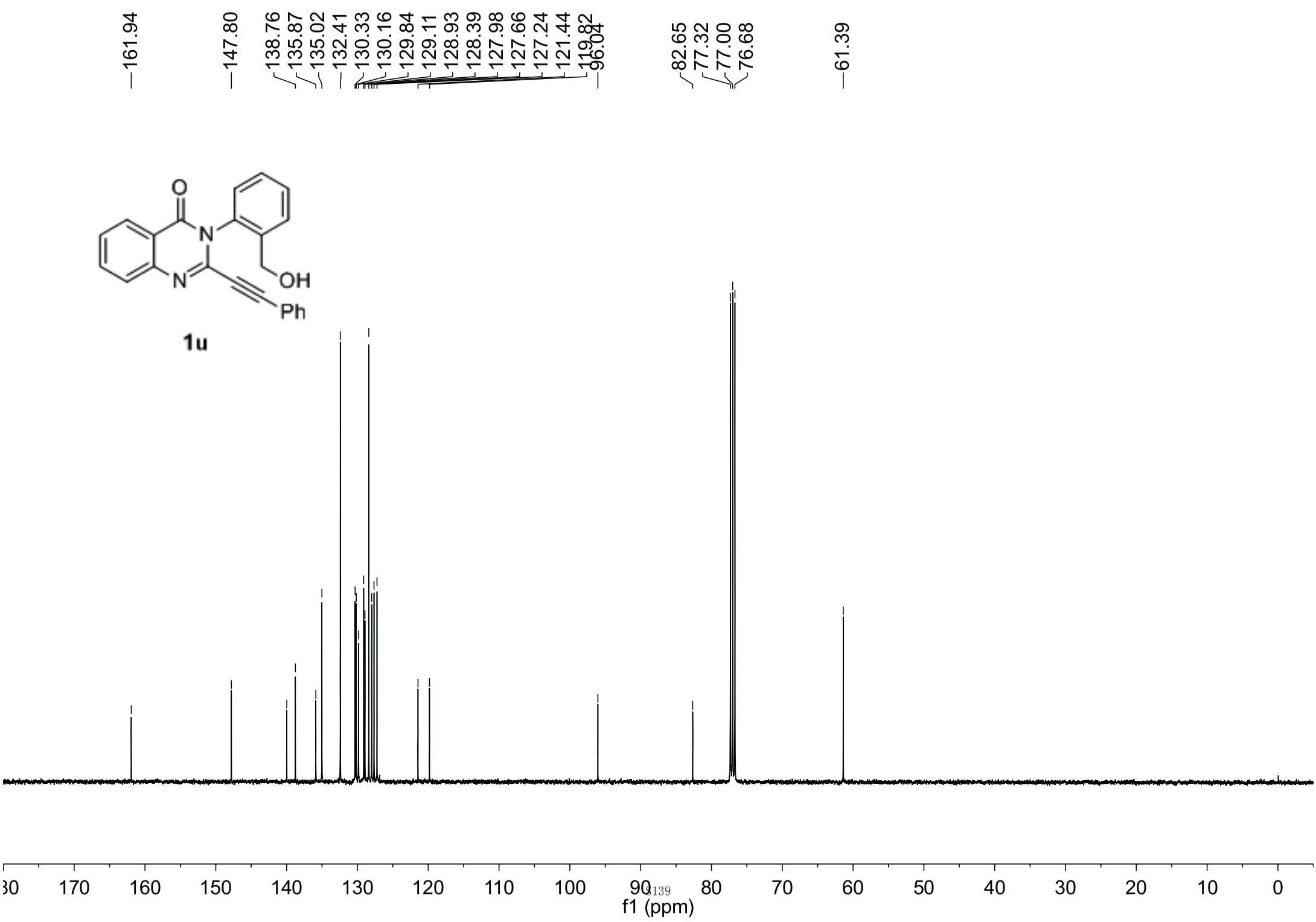

O
N
N
OH
n—Pent

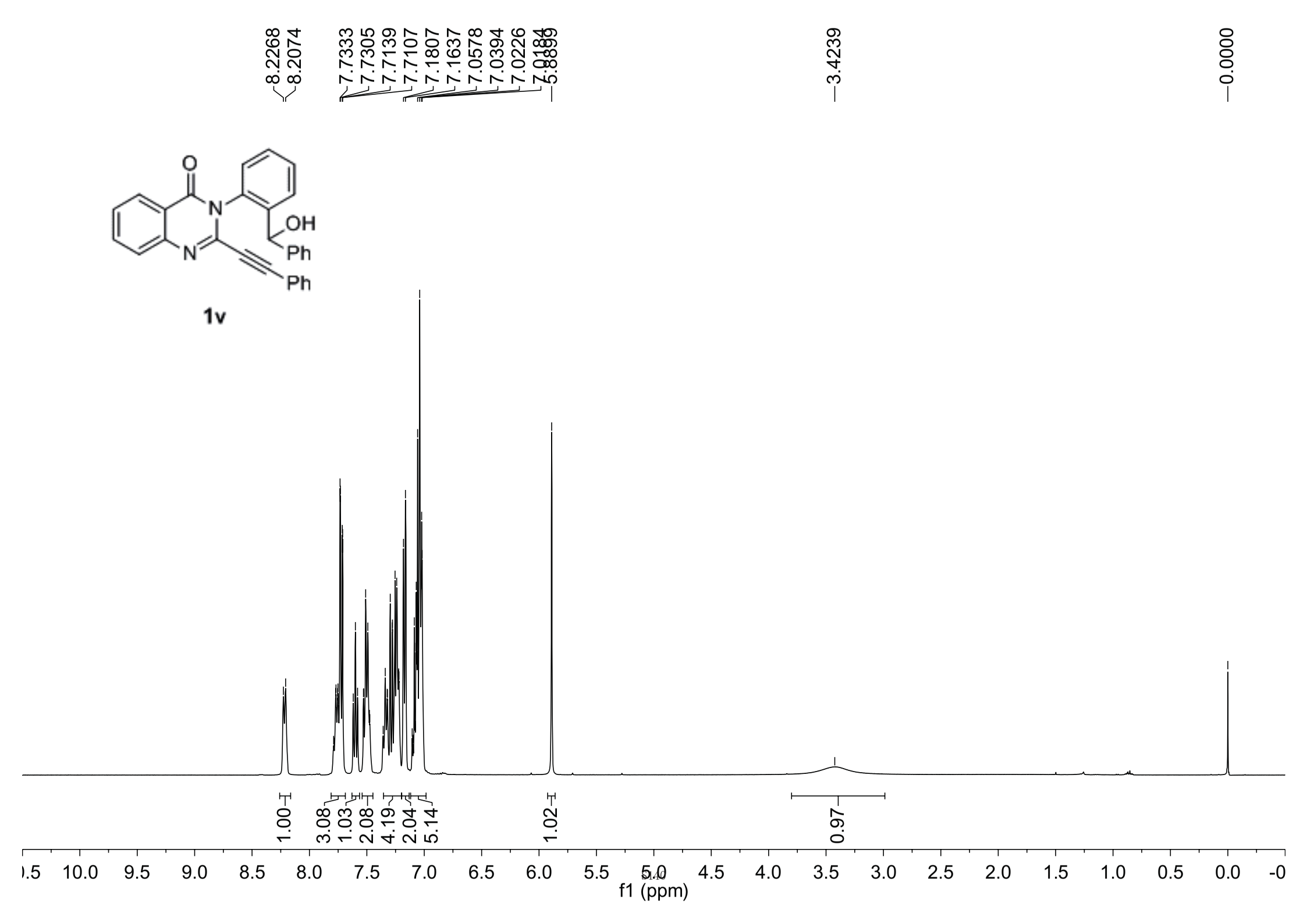
1t

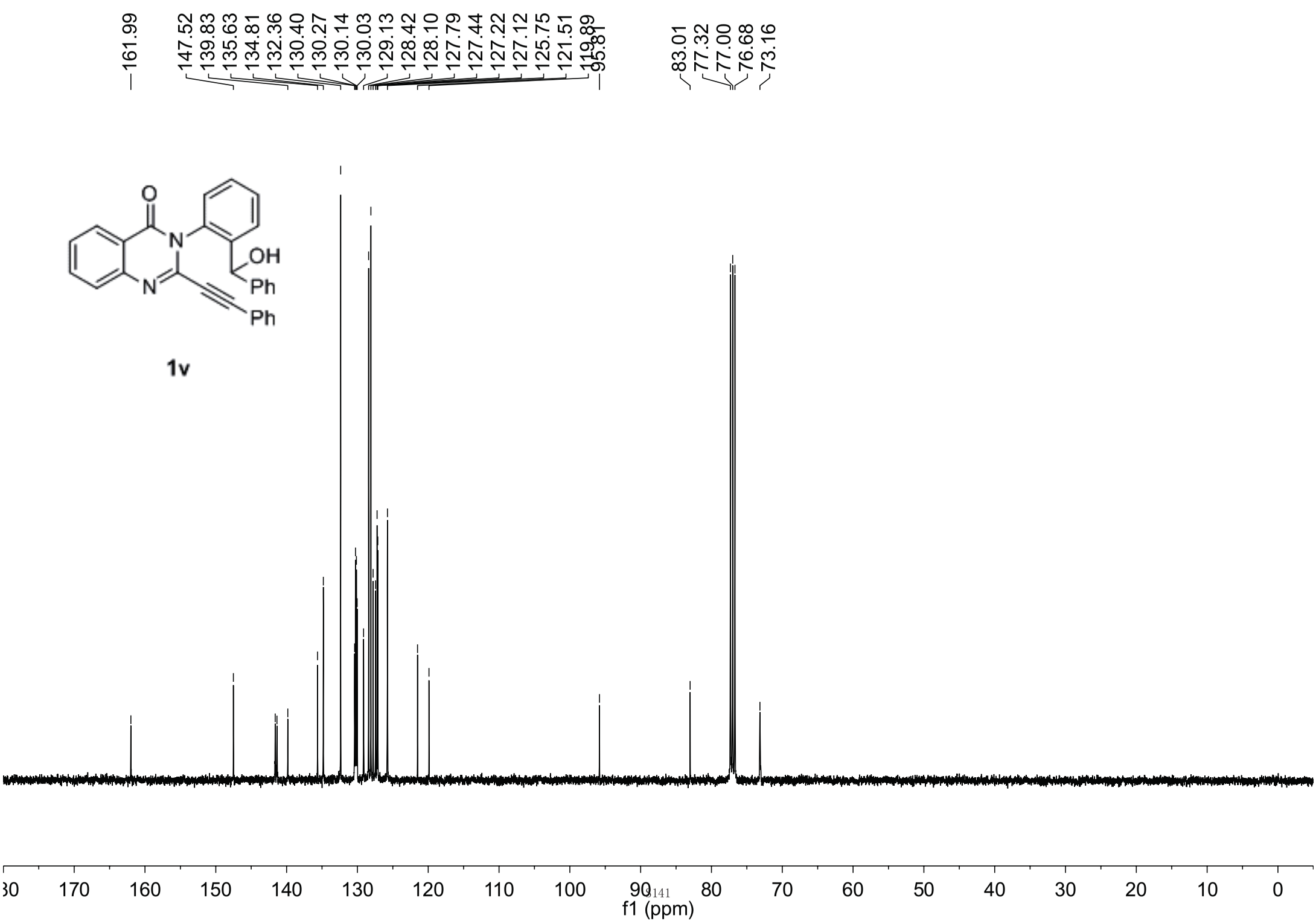

8.2655
8.2497
7.7847
7.7822
7.7684
7.7550
7.6486
7.6334
7.5105
7.5081
7.5012
7.4988
7.4958
7.4932
7.4857
7.4806
7.4274
7.2323
7.2168
4.4594
4.4323
2.8994
2.1200
2.1063
2.0926
1.1645
1.1501
1.1355
1.0003
0.9857
0.8325
0.8178
-0.0169
-0.0179
1.00
2.12
1.05
2.11
1.03
0.98
2.01
0.93
2.07
4.31
2.13
3.14
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)

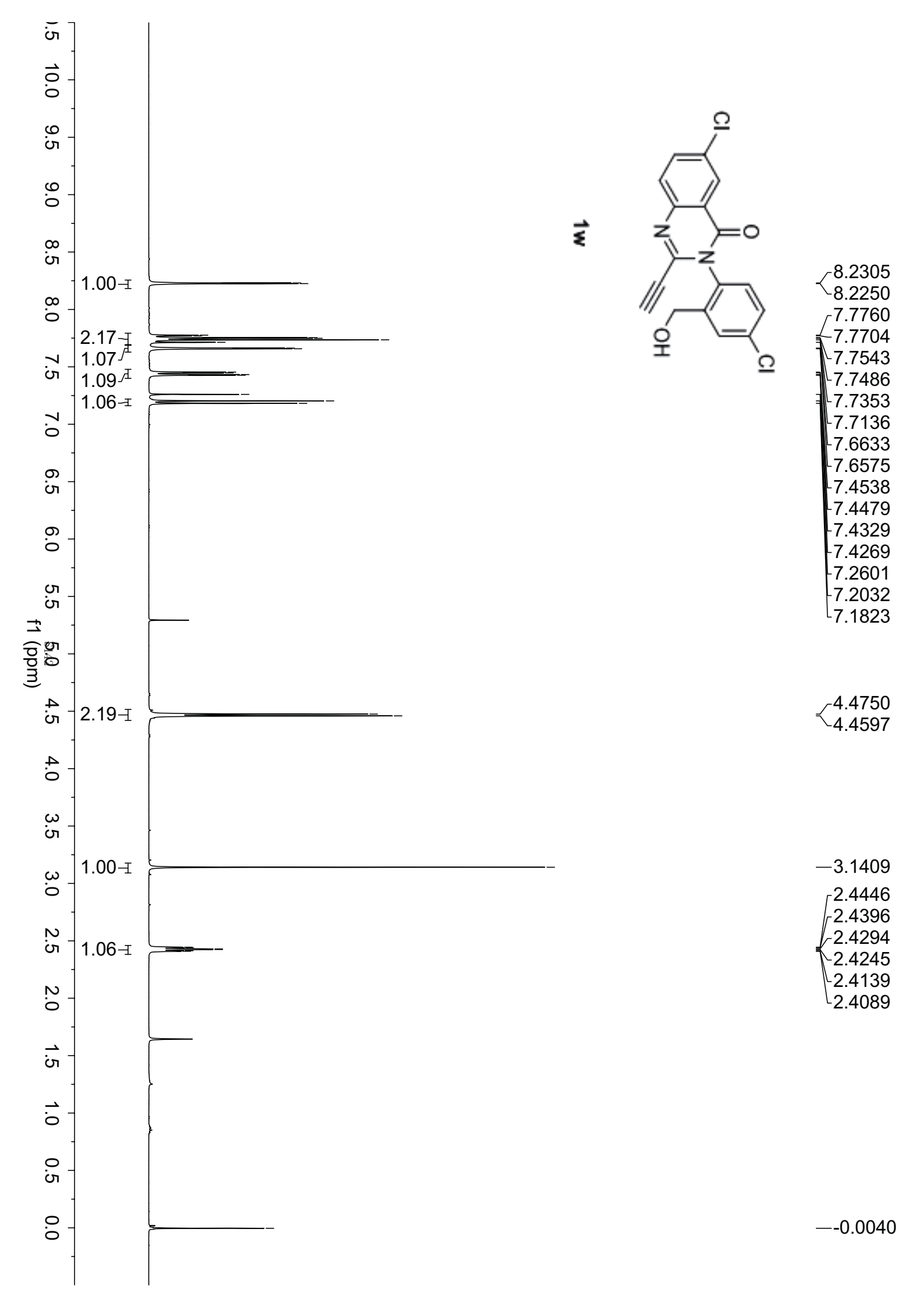

162.11
147.72
139.79
138.41
135.72
134.93
129.97
129.66
128.79
128.77
127.70
127.43
127.10
121.29
99.29
77.25
77.00
76.75
74.67
61.24
30.52
26.97
21.93
18.99
13.73
O
N
N
OH
n—Pent
1t
f1 (ppm)

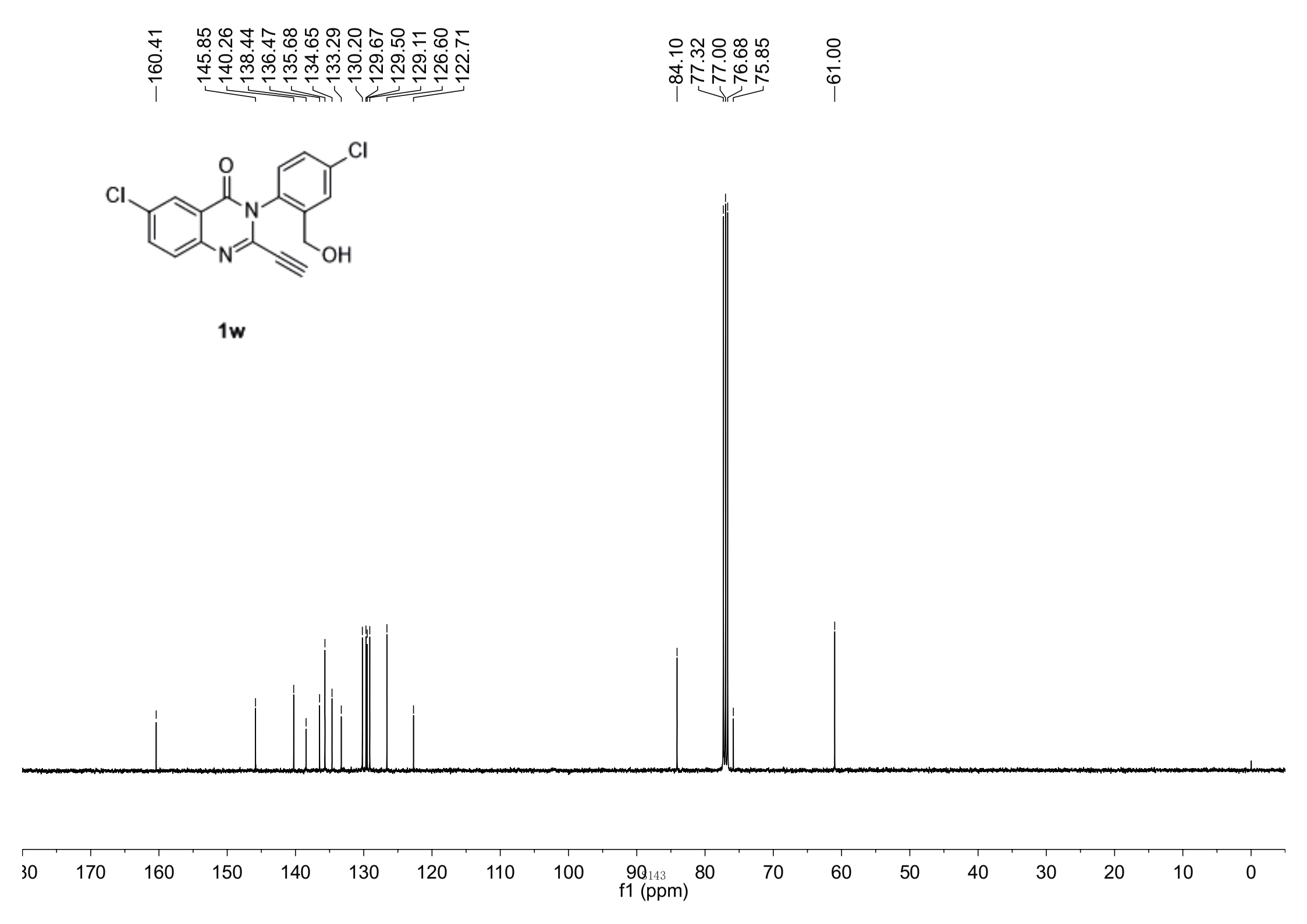

8.3108
8.2910
7.8208
7.8115
7.7357
7.7167
7.5990
7.5438
7.5337
7.5236
7.5140
7.3572
7.3362
7.3169
7.2526
7.2331
7.2141
7.0404
7.0223
4.5741
4.5418
4.5026
2.7413
0.0000
O
N
N
OH
Ph
1u
1.00
2.08
1.03
1.08
2.03
2.05
2.03
2.02
2.04
1.00
f1 (ppm)

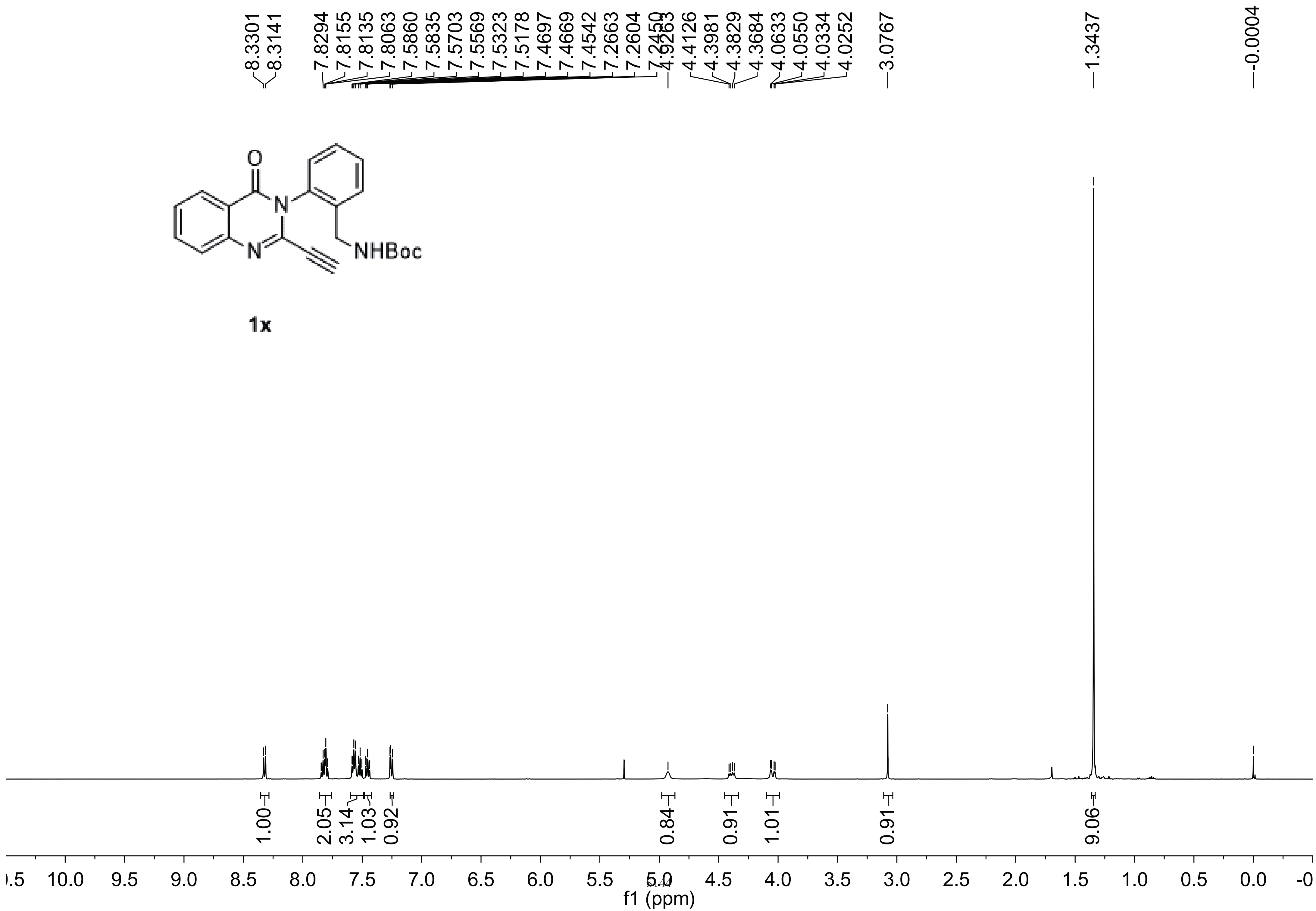

161.94
147.80
138.76
135.87
135.02
132.41
130.33
130.16
129.84
129.11
128.93
128.39
127.98
127.66
127.24
121.44
119.82
96.04
82.65
77.32
77.00
76.68
61.39
O
N
N
OH
Ph
1u
f1 (ppm)

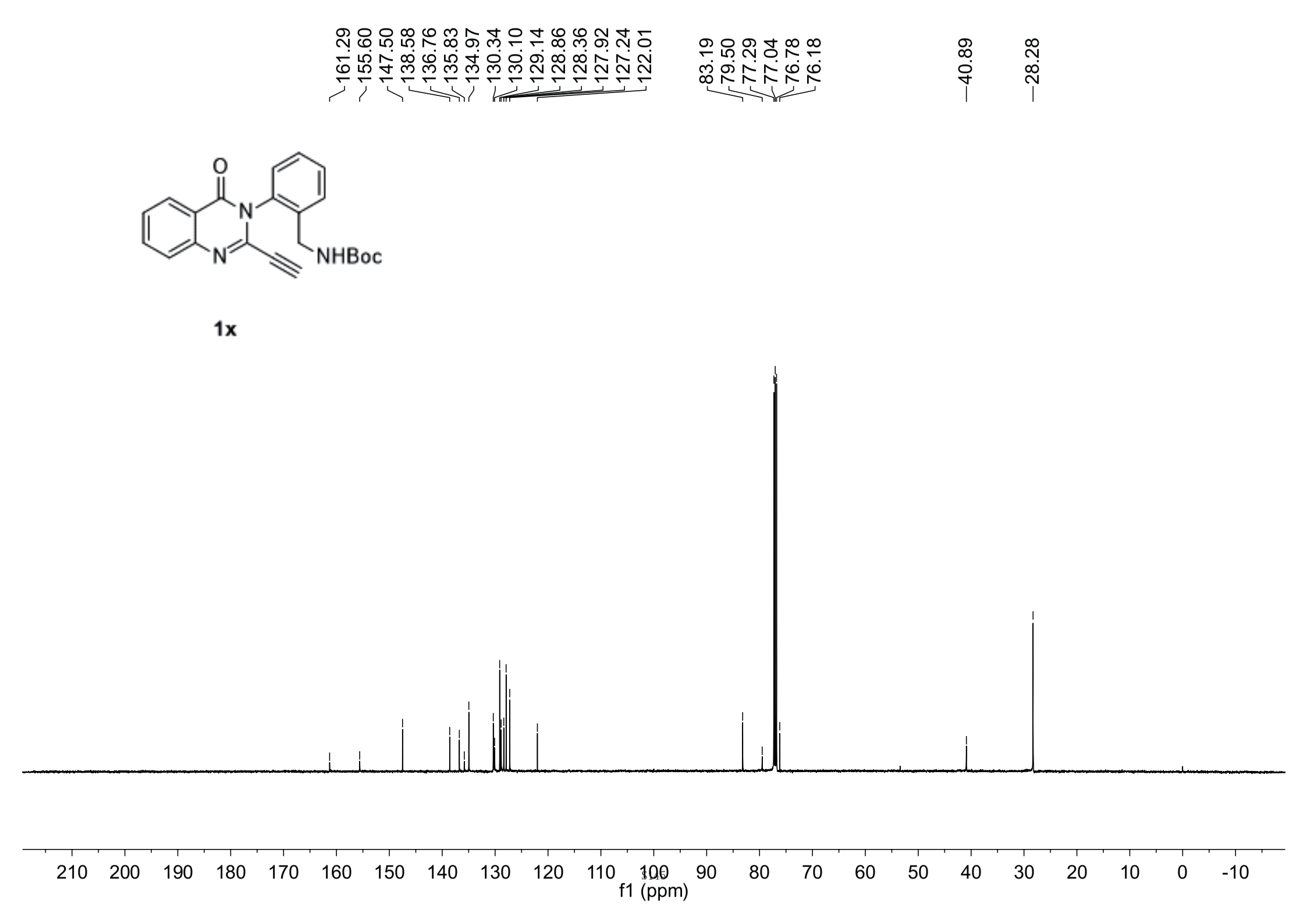

8.2268
8.2074
7.7333
7.7305
7.7139
7.7107
7.1807
7.1637
7.0578
7.0394
7.0226
7.0184
5.8899
3.4239
0.0000
O
N
N
OH
Ph
Ph
1v
1.00
3.08
1.03
2.08
4.19
2.04
5.14
1.02
0.97
f1 (ppm)

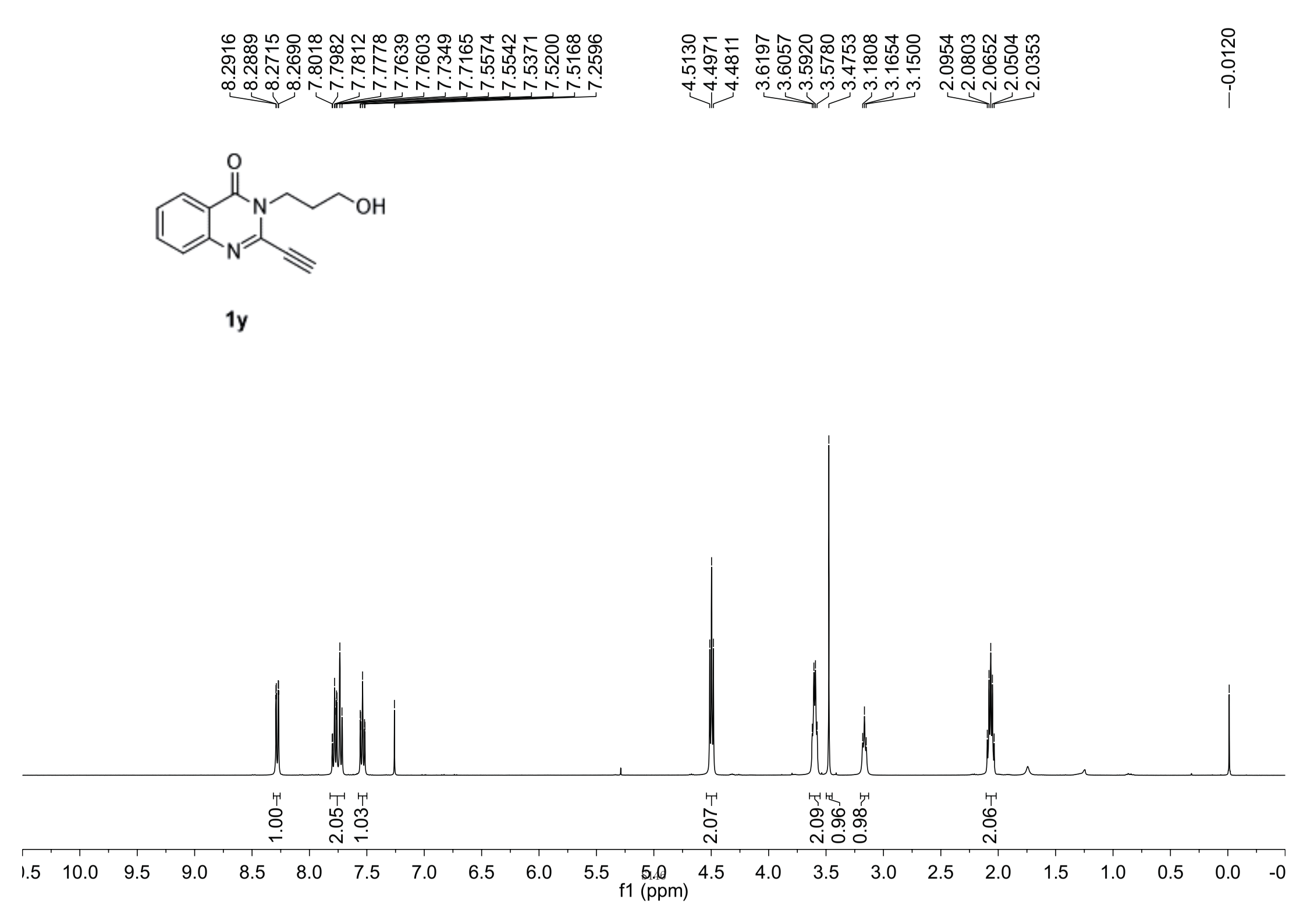

161.99
147.52
139.83
135.63
134.81
132.36
130.40
130.27
130.14
130.03
129.13
128.42
128.10
127.79
127.44
127.22
127.12
125.75
121.51
119.89
95.81
83.01
77.32
77.00
76.68
73.16
O
N
N
OH
Ph
Ph
1v
f1 (ppm)

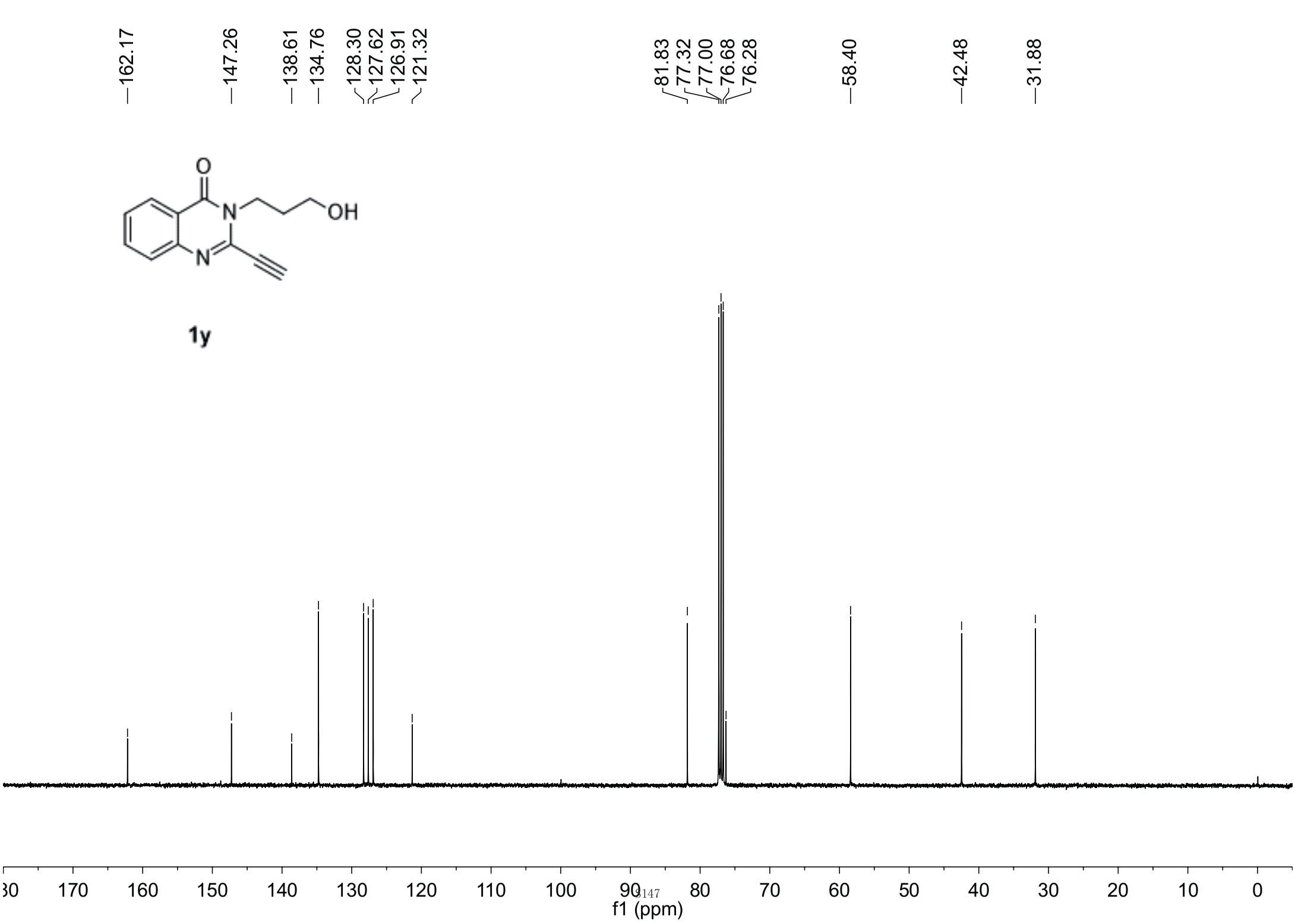

1w
Cl
O
N
N
OH
Cl
8.2305
8.2250
7.7760
7.7704
7.7543
7.7486
7.7353
7.7136
7.6633
7.6575
7.4538
7.4479
7.4329
7.4269
7.2601
7.2032
7.1823
4.4750
4.4597
3.1409
2.4446
2.4396
2.4294
2.4245
2.4139
2.4089
-0.0040
1.00
2.17
1.07
1.09
1.06
2.19
1.00
1.06
f1 (ppm)

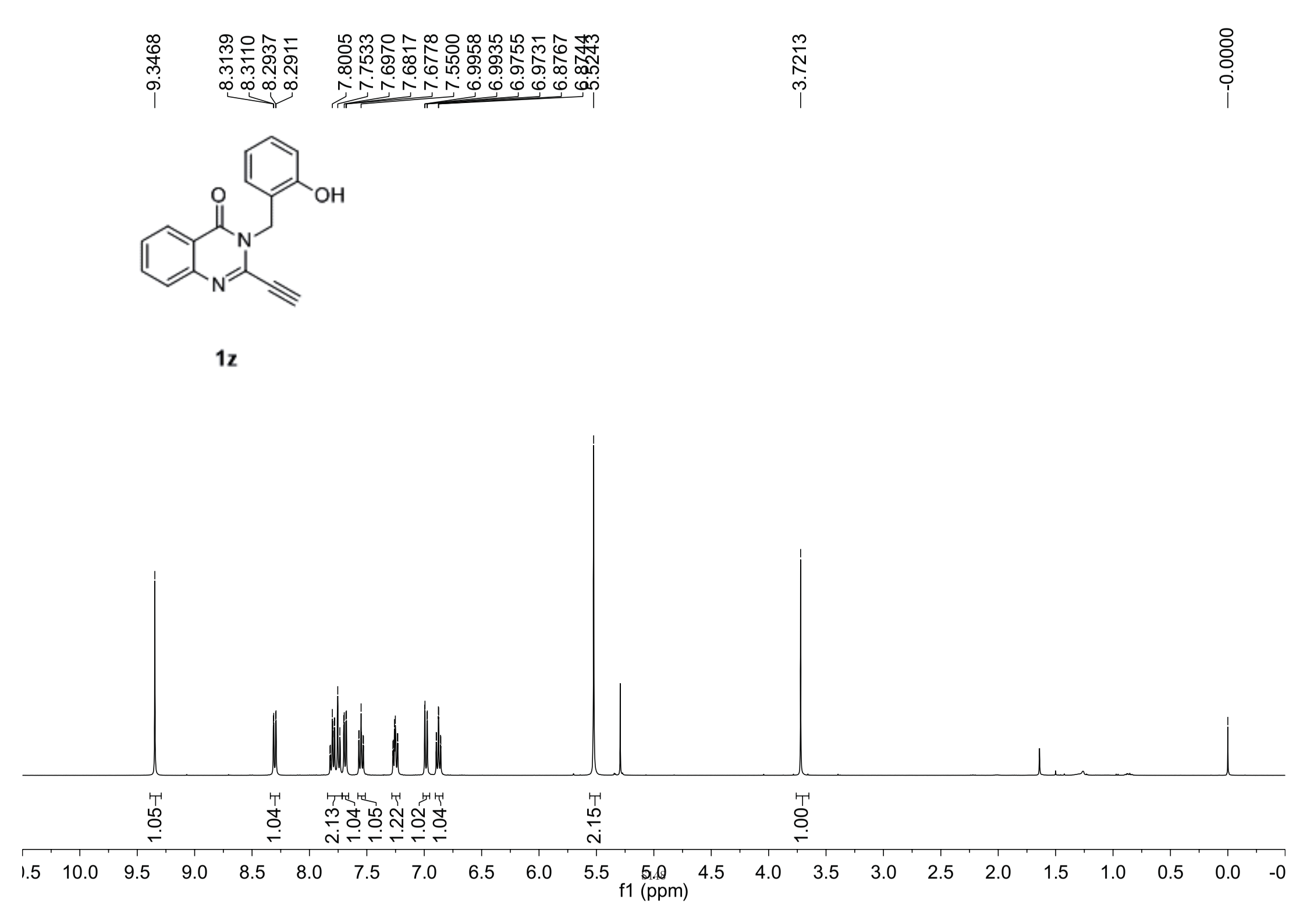

160.41
145.85
140.26
138.44
136.47
135.68
134.65
133.29
130.20
129.67
129.50
129.11
126.60
122.71
84.10
77.32
77.00
76.68
75.85
61.00
Cl
O
N
Cl
N
OH
1w
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

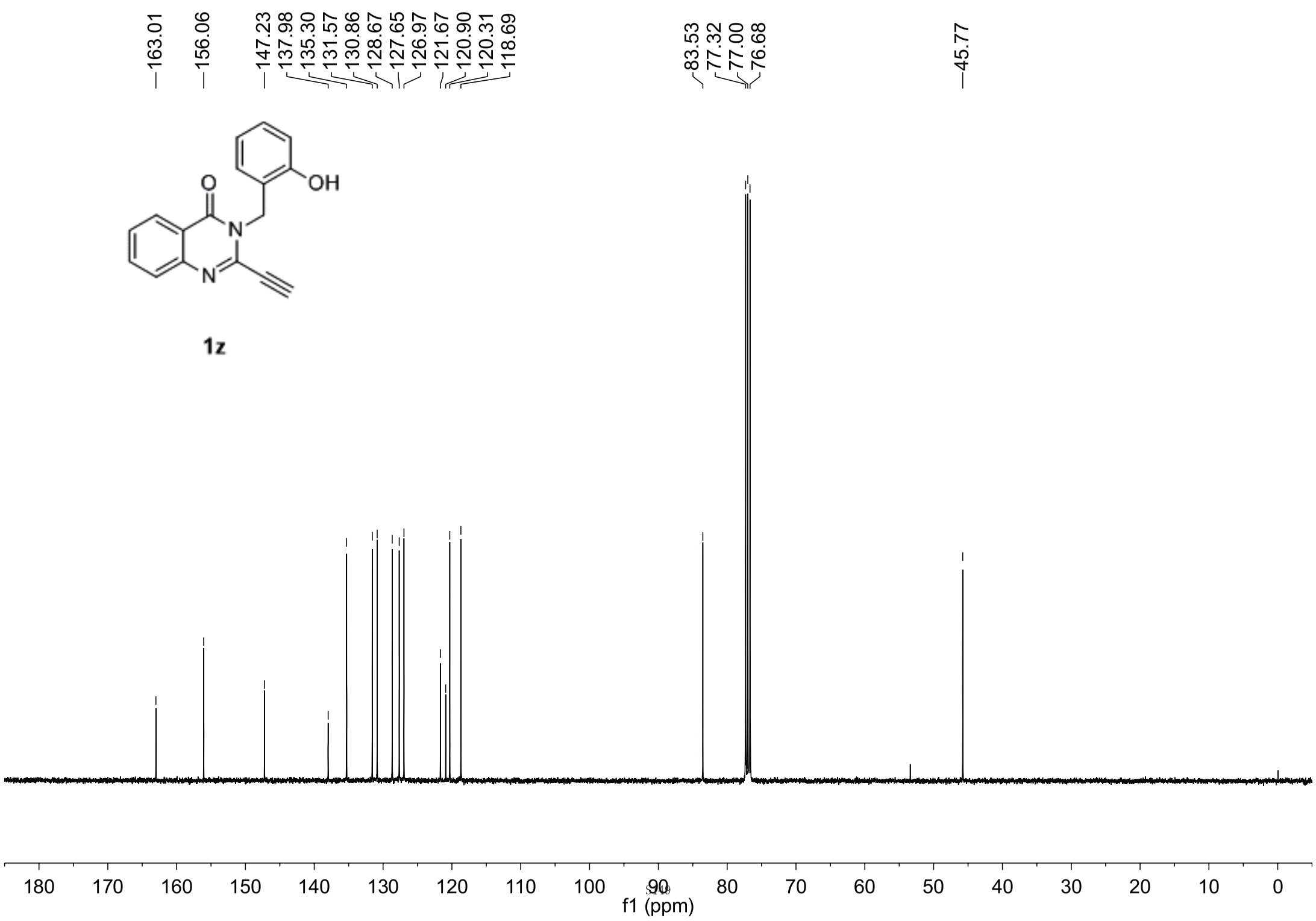

8.3301
8.3141
7.8294
7.8155
7.8135
7.8063
7.5860
7.5835
7.5703
7.5569
7.5323
7.5178
7.4697
7.4669
7.4542
7.2663
7.2604
7.2450
4.9263
4.4126
4.3981
4.3829
4.3684
4.0633
4.0550
4.0334
4.0252
3.0767
1.3437
-0.0004
NHBoc
N
N
O
1x
1.00
2.05
3.14
1.03
0.92
0.84
0.91
1.01
0.91
9.06
f1 (ppm)

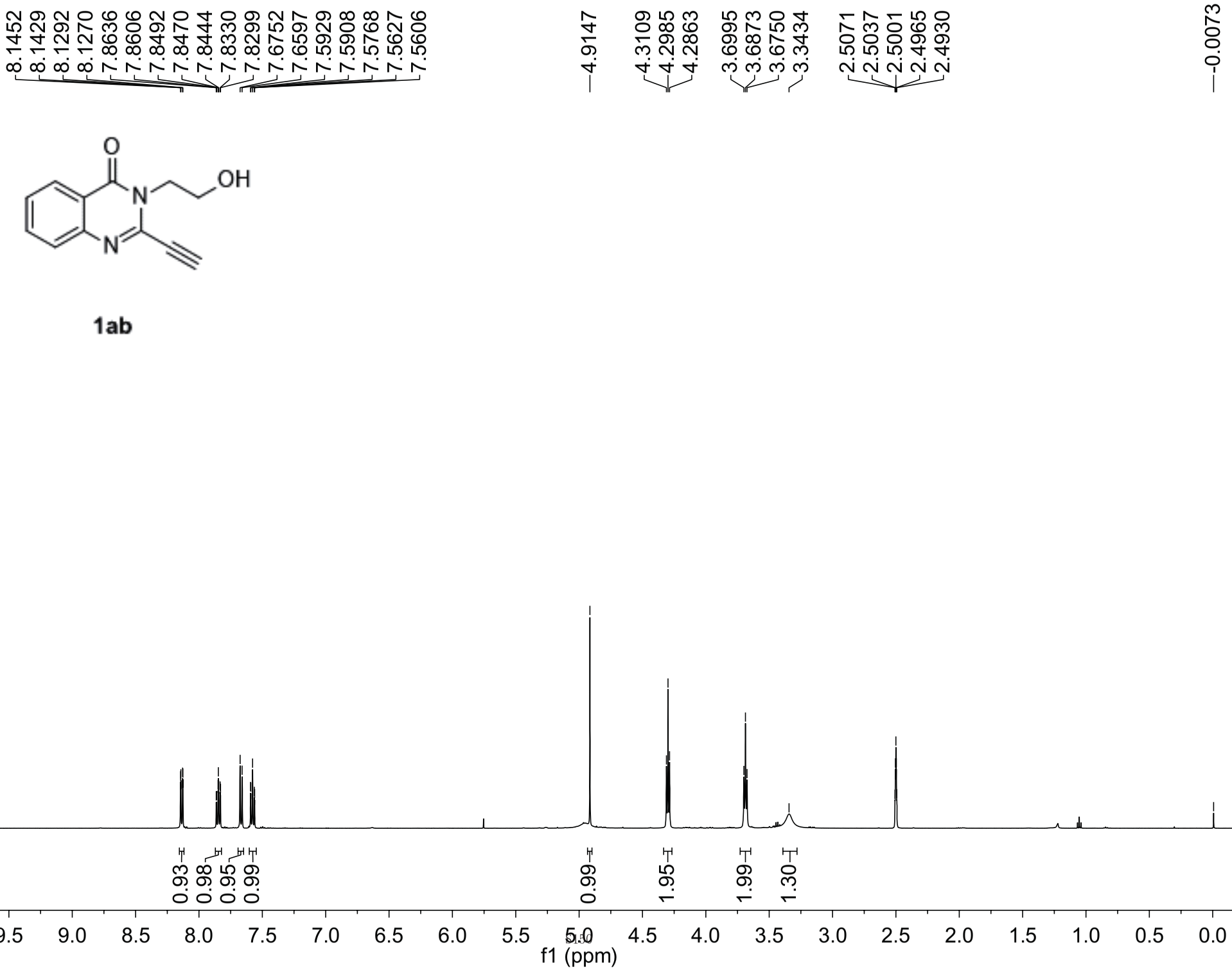

161.29
155.60
147.50
138.58
136.76
135.83
134.97
130.34
130.10
129.14
128.86
128.36
127.92
127.24
122.01
83.19
79.50
77.29
77.04
76.78
76.18
40.89
28.28
O
N
N
NHBoc
1x
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
-10
f1 (ppm)


8.2916
8.2889
8.2715
8.2690
7.8018
7.7982
7.7812
7.7778
7.7639
7.7603
7.7349
7.7165
7.5574
7.5542
7.5371
7.5200
7.5168
7.2596
4.5130
4.4971
4.4811
3.6197
3.6057
3.5920
3.5780
3.4753
3.1808
3.1654
3.1500
2.0954
2.0803
2.0652
2.0504
2.0353
-0.0120
O
N
OH
N
1y
1.00
2.05
1.03
2.07
2.09
0.96
0.98
2.06
f1 (ppm)

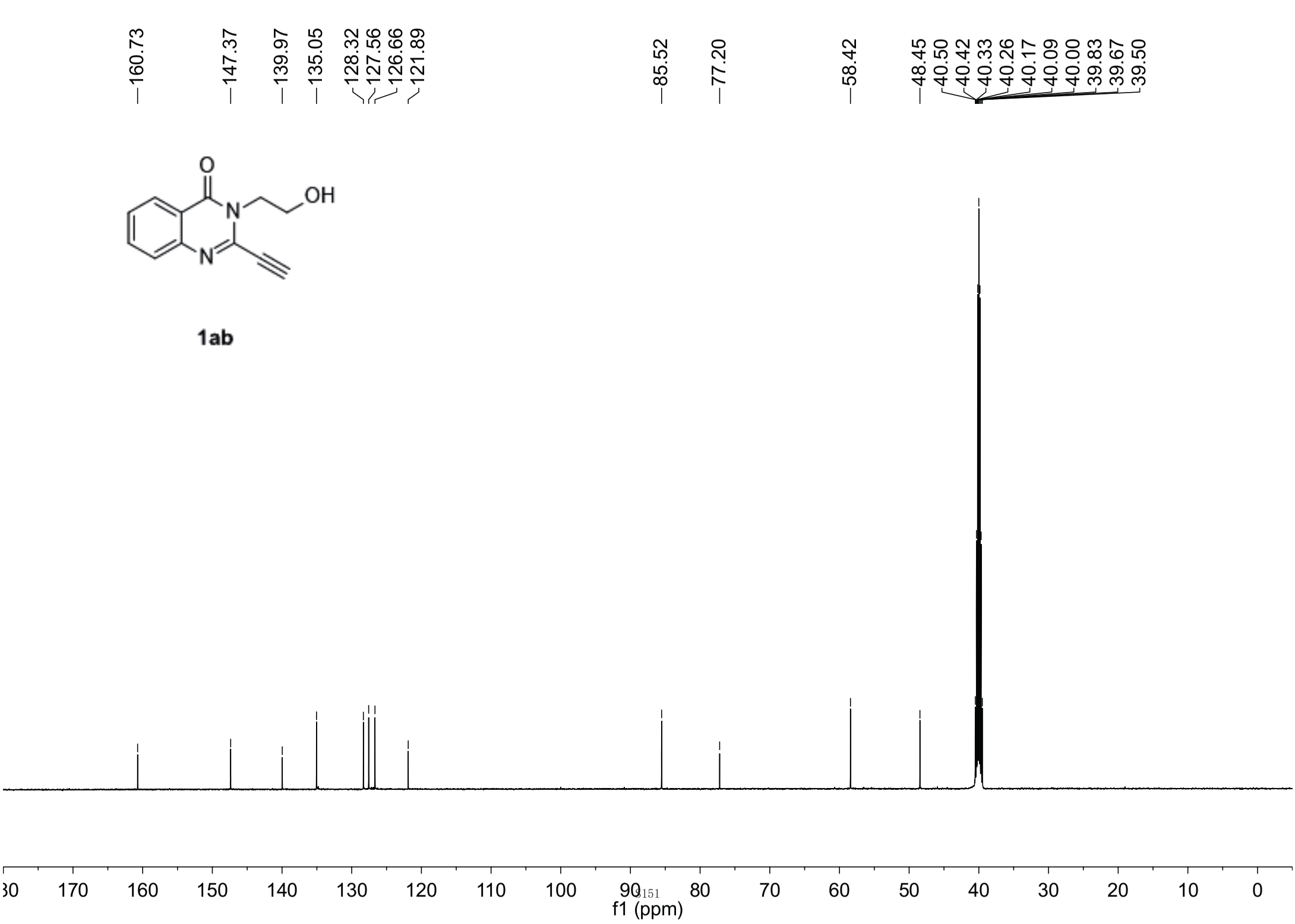

162.17
147.26
138.61
134.76
128.30
127.62
126.91
121.32
81.83
77.32
77.00
76.68
76.28
58.40
42.48
31.88
O
N
N
OH
1y
f1 (ppm)

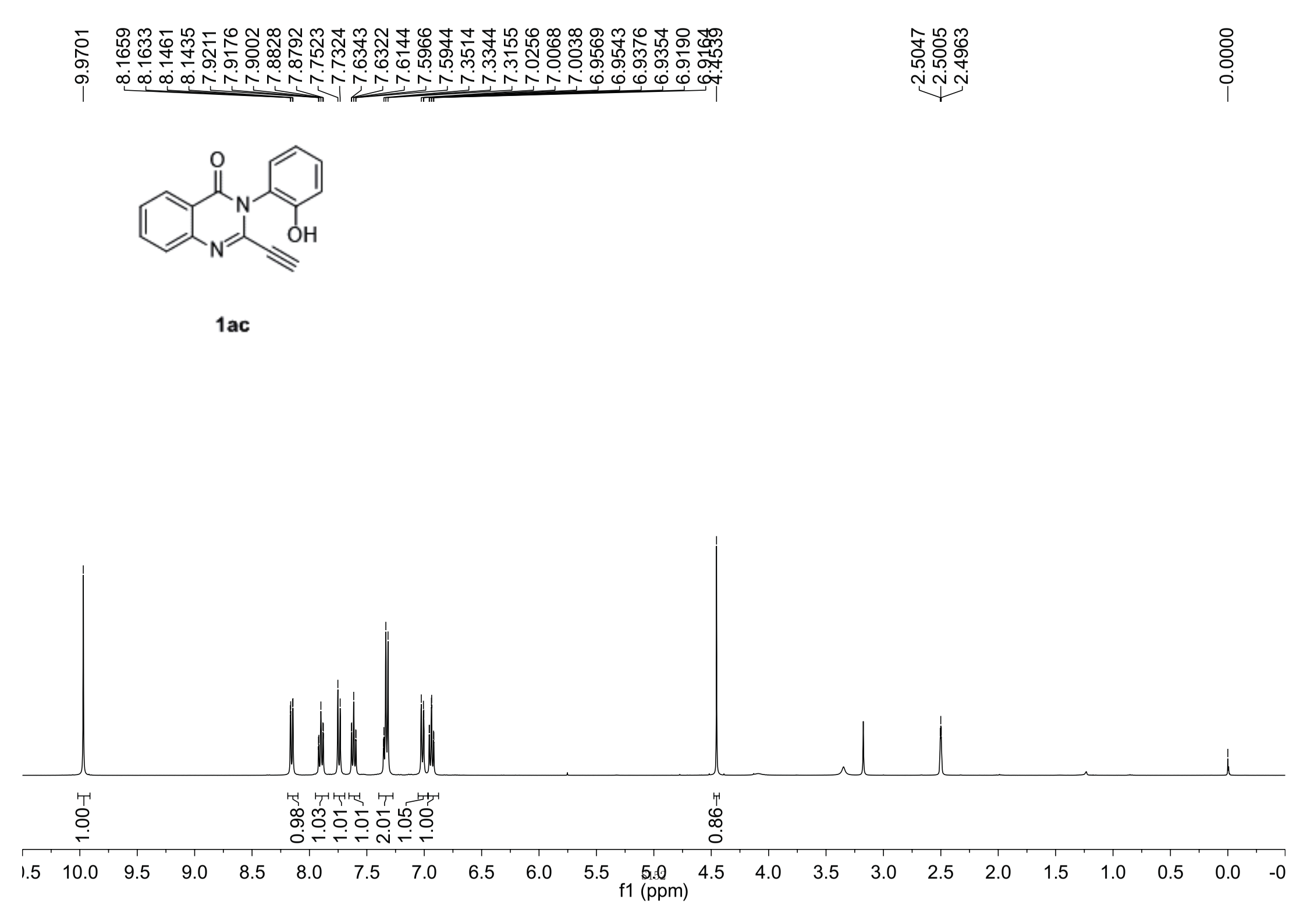

9.3468
8.3139
8.3110
8.2937
8.2911
7.8005
7.7533
7.6970
7.6817
7.6778
7.5500
6.9958
6.9935
6.9755
6.9731
6.8767
6.8744
6.8243
3.7213
-0.0000
O
OH
N
N
1z
1.05
1.04
2.13
1.04
1.05
1.22
1.02
1.04
2.15
1.00
f1 (ppm)

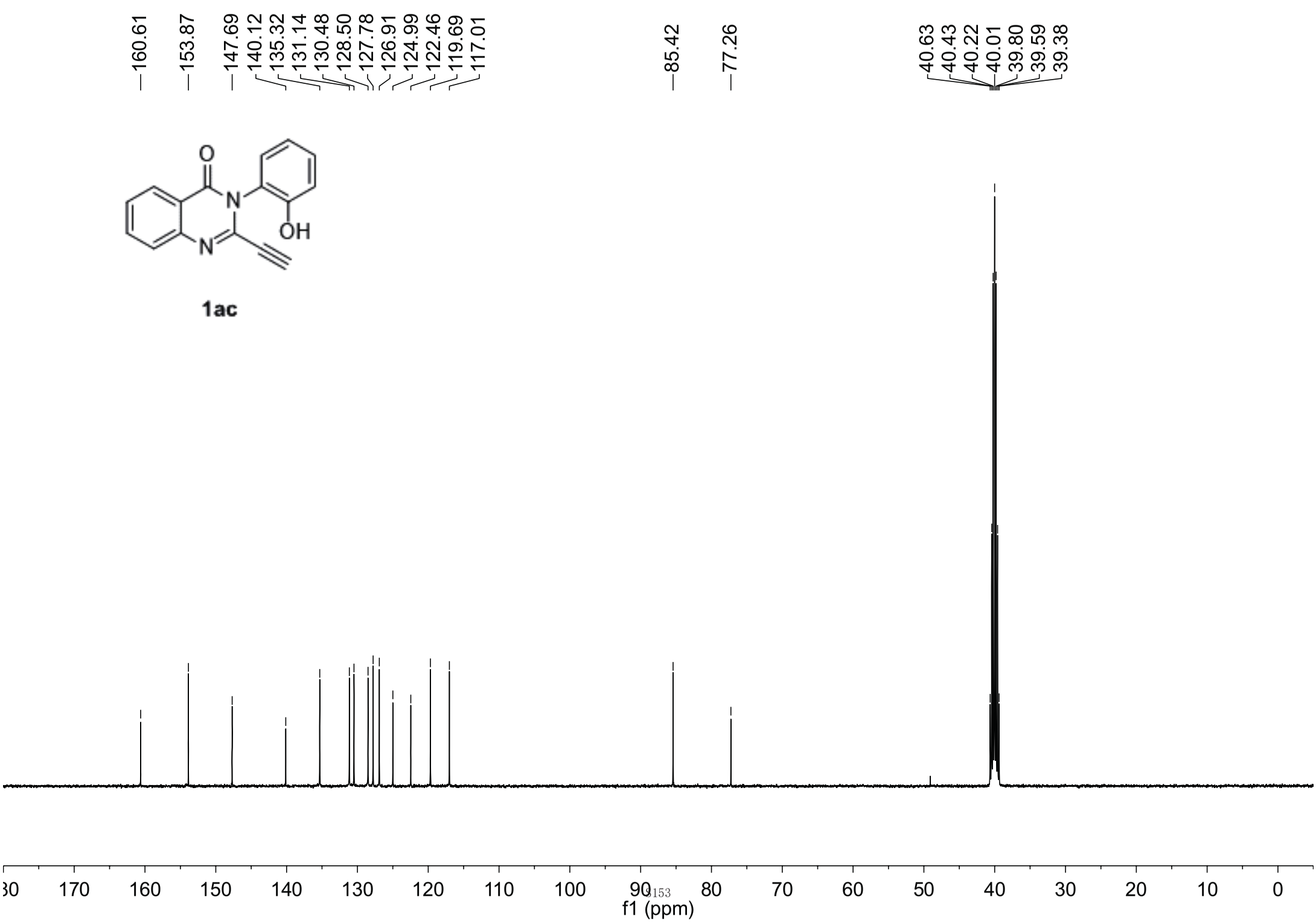

163.01
156.06
147.23
137.98
135.30
131.57
130.86
128.67
127.65
126.97
121.67
120.90
120.31
118.69
83.53
77.32
77.00
76.68
45.77
O
OH
N
N
1z
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

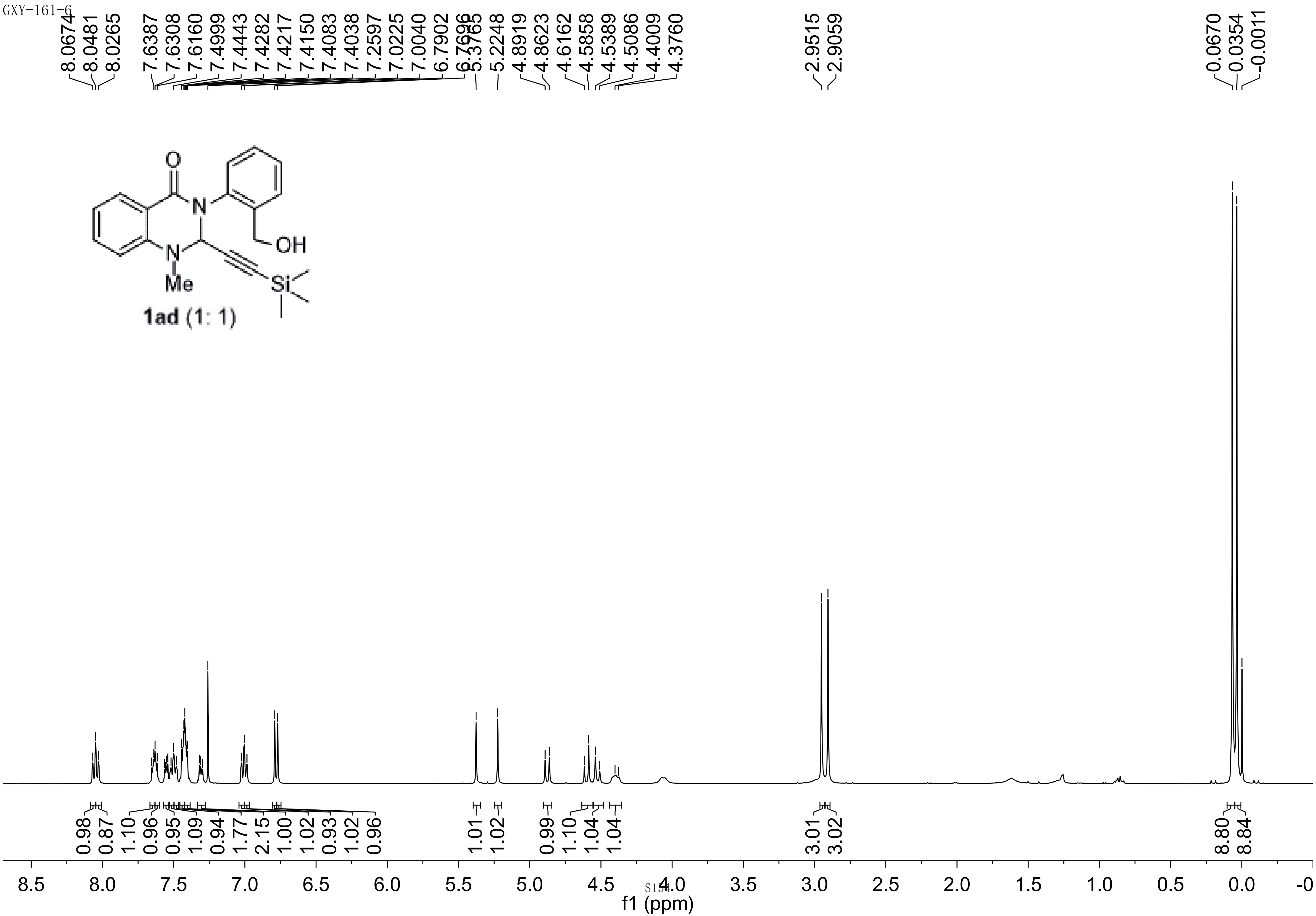

8.1452
8.1429
8.1292
8.1270
7.8636
7.8606
7.8492
7.8470
7.8444
7.8330
7.8299
7.6752
7.6597
7.5929
7.5908
7.5768
7.5627
7.5606
4.9147
4.3109
4.2985
4.2863
3.6995
3.6873
3.6750
3.3434
2.5071
2.5037
2.5001
2.4965
2.4930
-0.0073
O
N
OH
N
0.93
0.98
0.95
0.99
0.99
1.95
1.99
1.30
f1 (ppm)

1ab


160.73
147.37
139.97
135.05
128.32
127.56
126.66
121.89
85.52
77.20
58.42
48.45
40.50
40.42
40.33
40.26
40.17
40.09
40.00
39.83
39.67
39.50
O
N
OH
N
1ab
f1 (ppm)

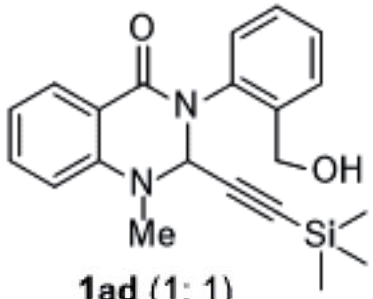

9.9701
8.1659
8.1633
8.1461
8.1435
7.9211
7.9176
7.9002
7.8828
7.8792
7.7523
7.7324
7.6343
7.6322
7.6144
7.5966
7.5944
7.3514
7.3344
7.3155
7.0256
7.0068
7.0038
6.9569
6.9543
6.9376
6.9354
6.9190
6.9164
4.4539
2.5047
2.5005
2.4963
0.0000
O
N
N
OH
1ac
1.00
0.98
1.03
1.01
1.01
2.01
1.05
1.00
0.86
f1 (ppm)


160.61
153.87
147.69
140.12
135.32
131.14
130.48
128.50
127.78
126.91
124.99
122.46
119.69
117.01
85.42
77.26
40.63
40.43
40.22
40.01
39.80
39.59
39.38
O
N
N
OH
1ac
f1 (ppm)


GXY-161-6
8.0674
8.0481
8.0265
7.6387
7.6308
7.6160
7.4999
7.4443
7.4282
7.4217
7.4150
7.4083
7.4038
7.2597
7.0225
7.0040
6.7902
6.7696
5.3765
5.2248
4.8919
4.8623
4.6162
4.5858
4.5389
4.5086
4.4009
4.3760
2.9515
2.9059
0.0670
0.0354
-0.0011
O
N
N
Me
OH
Si
1ad (1: 1)
0.98
0.87
1.10
0.96
0.95
1.09
0.94
1.77
2.15
1.00
1.02
0.93
1.02
0.96
1.01
1.02
0.99
1.10
1.04
1.04
3.01
3.02
8.80
8.84
8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0
f1 (ppm)

GXY-161-6

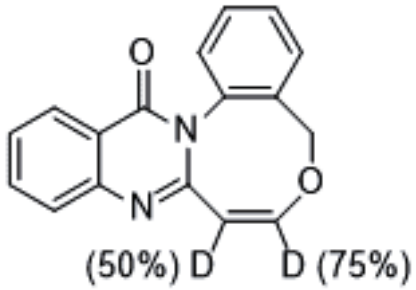
163.49
163.14
147.53
147.39
130.61
129.29
129.17
129.14
128.85
127.00
119.95
119.89
118.01
116.95
113.24
113.09
99.64
98.11
91.83
91.11
77.32
77.00
76.68
71.65
70.49
62.16
62.03
35.64
35.59
-0.36
-0.45



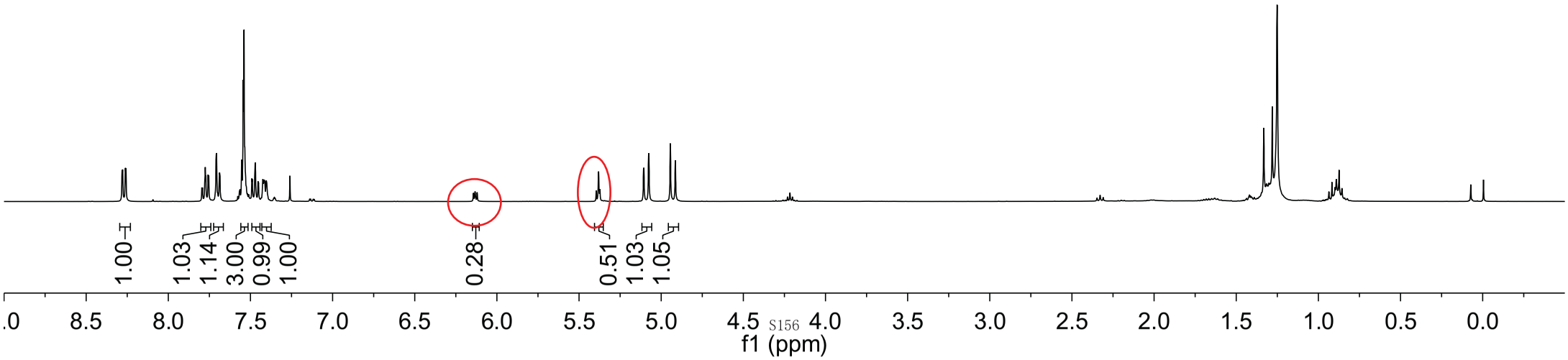
1ad (1: 1)

GXY-159-1

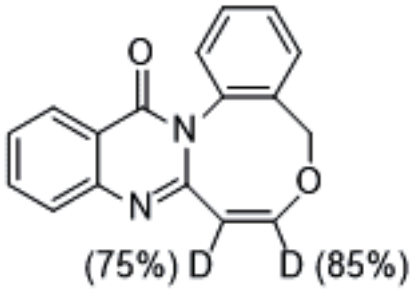
8.2809
8.2781
8.2610
8.2582
7.7750
7.7576
7.7539
7.7070
7.6879
7.5536
7.5439
7.5391
7.5348
7.4711
7.4427
6.1328
6.1204
5.3952
5.3811
5.3729
5.1058
5.0755
4.9443
4.9139
-0.0050



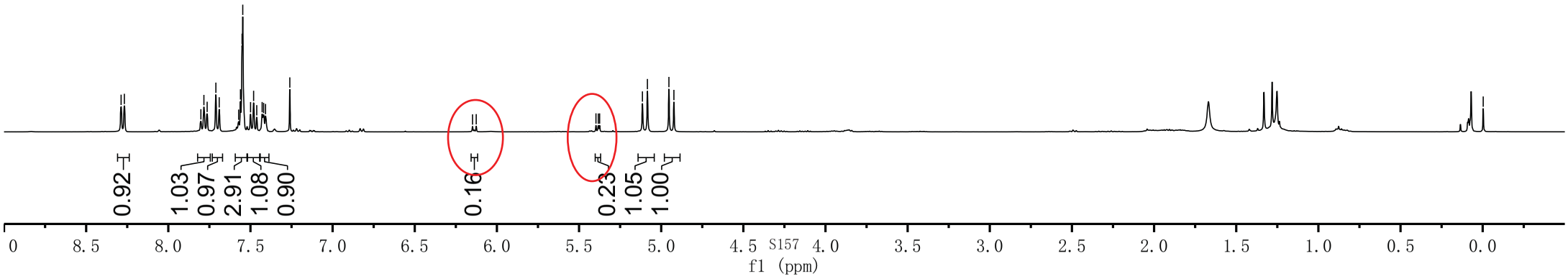
2a-D



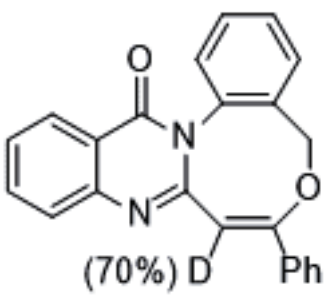
gxy-188-6


O
N
N
O
(75%) D
D (85%)

2a-D


0.92
1.03
0.97
2.91
1.08
0.90
0.16
0.23
1.05
1.00
0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)

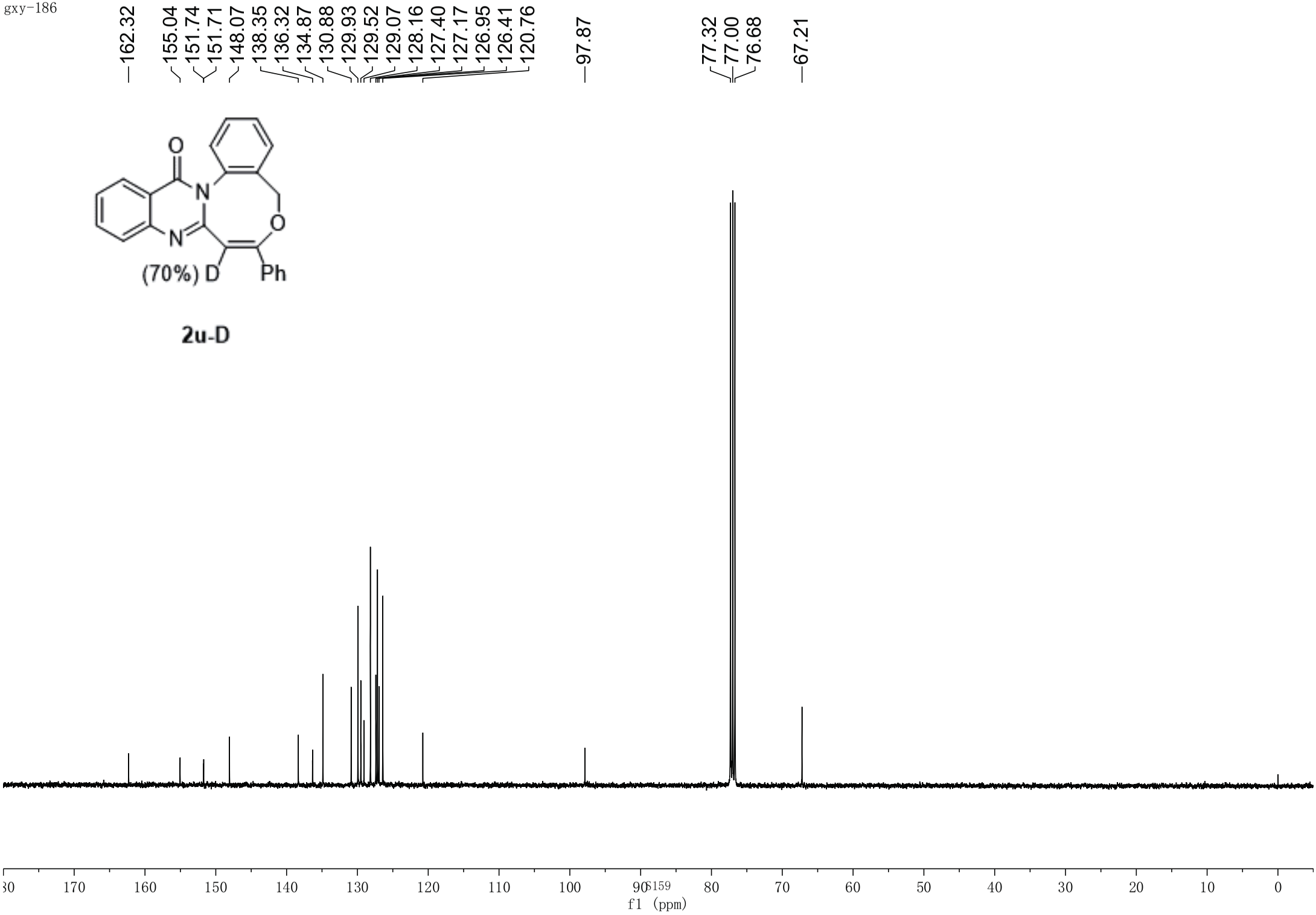
gxy-186



2u-D

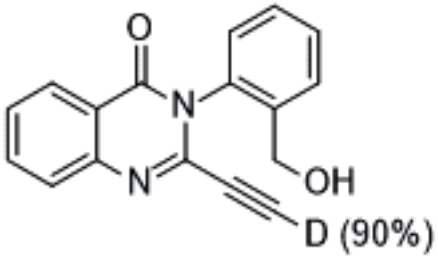
f1 (ppm)

gxy-186


162.32
155.04
151.74
151.71
148.07
138.35
136.32
134.87
130.88
129.93
129.52
129.07
128.16
127.40
127.17
126.95
126.41
120.76
97.87
77.32
77.00
76.68
67.21
O
N
N
O
(70%) D
Ph
2u-D
f1 (ppm)

GXY-184-4

8.3225
8.3033
7.8419
7.8390
7.8186
7.8150
7.7979
7.6698
7.6512
7.5968
7.5932
7.5761
7.5561
7.5370
7.5001
7.4971
7.4808
7.4782
7.4620
7.4593
7.2839
7.2600
4.5198
4.5065
3.0666
2.4267
2.4116
2.3967
-0.0030



1a-D