

## Supplementary Materials for

# A Zinc-Mediated Deprotective Annulation Approach to New Polycyclic Heterocycles

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## Preparation and Characterization of *N*-Boc-2-alkynylbenzimidazole Substrates 1a-1o

Substrates **1a-1o** were prepared by Boc protection of 2-bromo-1*H*-benzo[d]imidazoles (as reported in the literature) [1-4] followed by Sonogashira coupling reaction with terminal alkynes, as described below.

### 1st Step: Boc protection of 2-bromo-1*H*-benzo[d]imidazoles

To a solution of the 2-bromo-1*H*-benzo[d]imidazole derivative (11.7 mmol) (2-bromo-1*H*-benzo[d]imidazole: 2.30 g; 2-bromo-5,6-dimethyl-1*H*-benzo[d]imidazole: 2.63 g; 2-bromo-5-methoxy-1*H*-benzo[d]imidazole: 2.11 g; 2-bromo-5,6-dichloro-1*H*-benzo[d]imidazole: 3.11 g; 2-bromo-5-nitro-1*H*-benzo[d]imidazole: 2.83 g) in an anhydrous DMF-CH<sub>3</sub>CN mixture (1:1, v/v; 92 mL), was added triethylamine (2 mL, 14 mmol) under nitrogen. The mixture was allowed to stir for 30 min at room temperature and then solution of Boc<sub>2</sub>O (3.82 g, 17.5 mmol) in anhydrous DMF (33 mL) was added dropwise. After the addition was complete, the reaction was allowed to stir at room temperature overnight. After evaporation of the solvent, products were purified by flash chromatography on silica gel using a 7:3 hexane-EtOAc (v/v) as eluent.

***N*-Boc-2-bromo-1*H*-benzo[d]imidazole.** Yield: 3.30 g, starting from 2.30 g of 2-bromo-1*H*-benzo[d]imidazole (95%). <sup>1</sup>H NMR (300 MHz, CDCl<sub>3</sub>): δ = 7.95 – 7.86 (m, 1 H aromatic), 7.72 – 7.66 (m, 1 H aromatic), 7.38 – 7.29 (m, 2 H aromatic), 1.75 (s, 9 H, *t*-Bu). <sup>13</sup>C NMR (75 MHz, CDCl<sub>3</sub>): δ = 147.7, 141.8, 132.3, 124.5, 124.4, 122.3, 118.2, 114.3, 87.8, 27.8. The spectroscopic data agreed with those reported in the literature [5].

***N*-Boc-2-bromo-5,6-dimethyl-1*H*-benzo[d]imidazole.** Yield: 2.59 g, starting from 2.63 g of 2-bromo-5,6-dimethyl-1*H*-benzo[d]imidazole (68%). Colorless solid, mp: 140 – 144 °C; IR (KBr): ν = 1744 (s), 1396 (m), 1342 (s), 1281 (m), 1196 (w), 1150 (s), 1119 (s), 841 (m) cm<sup>-1</sup>; <sup>1</sup>H NMR (300 MHz, CDCl<sub>3</sub>): δ = 7.70 (s, 1 H, aromatic), 7.41 (s, 1 H, aromatic), 2.36 (s, 3 H, CH<sub>3</sub>), 2.34 (s, 3 H, CH<sub>3</sub>), 1.72 (s, 9 H, *t*-Bu); <sup>13</sup>C NMR (75 MHz, CDCl<sub>3</sub>): δ = 147.6, 141.2, 134.4, 133.6, 132.3, 125.6, 119.6, 115.2, 86.6, 28.1, 20.8, 20.2; HRMS (ESI - TOF) *m/z*: [M + Na]<sup>+</sup> Calcd for C<sub>14</sub>H<sub>17</sub>BrN<sub>2</sub>NaO<sub>2</sub><sup>+</sup> 347.0366; Found: 347.0365.

**Mixture of Regioisomers *N*-Boc-2-bromo-6-methoxy-1*H*-benzo[d]imidazole (A) and *N*-Boc-2-bromo-5-methoxy-1*H*-benzo[d]imidazole (B) and (A/B ratio ca. 1, by <sup>1</sup>H NMR).** Yield: 2.83 g, starting from 2.11 g of 2-bromo-5-methoxy-1*H*-benzo[d]imidazole (74%). Colorless solid, mp: 64 – 67 °C; IR (KBr): ν = 1744 (s), 1620 (m), 1435 (m), 1397 (w), 1350 (w), 1319 (m), 1211 (m), 1150 (s), 825 (m) cm<sup>-1</sup>; <sup>1</sup>H-NMR (500 MHz, CDCl<sub>3</sub>): δ = 7.76 [d, *J* = 9.1, 1 H, H-4 (A) or H-7 (B)], 7.54 [(d, *J* = 8.7, 1 H, H-7 (B) or H-4 (A)), 7.47 [(d, *J* = 2.5, 1 H, H-7 (A) or H-4 (B)), 7.14 [(d, *J* = 2.5, 1 H, H-4 (B) or H-7 (A)), 6.98 – 6.90 [(m, 2 H, H-5 (A) + H-6 (B)), 3.86 [s, 3 H, OCH<sub>3</sub> (A or B)], 3.85 [s, 3 H, OCH<sub>3</sub> (B or A)], 1.73 [s, 9 H, *t*-Bu (A + B)]; NMR (125 MHz, CDCl<sub>3</sub>): δ = 158.0, 157.3, 147.5, 147.3, 143.7, 137.2, 134.7, 128.2, 126.9, 124.5, 119.9, 115.3, 114.1, 113.3, 102.3, 99.1, 86.7, 55.8, 55.7, 28.1; HRMS (ESI - TOF) *m/z*: [M + Na]<sup>+</sup> Calcd for C<sub>13</sub>H<sub>15</sub>BrN<sub>2</sub>NaO<sub>3</sub><sup>+</sup> 349.0158; Found: 349.0161.

***N*-Boc-2-bromo-5,6-dichloro-1*H*-benzo[d]imidazole.** Yield: 2.57 g, starting from 3.11 g of 2-bromo-5,6-dichloro-1*H*-benzo[d]imidazole (60%). Colorless solid, mp: 157 – 160 °C; IR (KBr): ν = 1751 (s), 1435 (w), 1373 (w), 1119 (s), 1072 (s), 849 (m) cm<sup>-1</sup>; <sup>1</sup>H NMR (300 MHz, CDCl<sub>3</sub>): δ = 8.07 (s, 1 H, aromatic), 7.74 (s, 1 H, aromatic), 1.74 (s, 9 H, *t*-Bu); <sup>13</sup>C NMR (75 MHz, CDCl<sub>3</sub>): δ = 146.6, 141.8, 132.8, 129.5, 128.9, 128.7, 120.5, 116.5, 87.9, 28.0; HRMS (ESI - TOF) *m/z*: [M – *t*-Bu]<sup>+</sup> Calcd for C<sub>7</sub>H<sub>2</sub>BrCl<sub>2</sub>N<sub>2</sub><sup>+</sup> 262.8784; Found: 262.8784.

**Mixture of Regioisomers *N*-Boc-2-bromo-6-nitro-1*H*-benzo[d]imidazole (A) and *N*-Boc-2-bromo-5-nitro-1*H*-benzo[d]imidazole (B) (A/B Ratio ca. 1, by <sup>1</sup>H NMR).** Yield: 2.12 g, starting from 2.83 g of 2-bromo-5-nitro-1*H*-benzo[d]imidazole (53%). Yellow solid, mp: 240 – 243 °C; IR (KBr): ν = 1751 (s), 1528 (s), 1474 (w), 1435 (m), 1327 (s), 1273 (m), 1150 (m), 826 (m) cm<sup>-1</sup>; <sup>1</sup>H-NMR (500 MHz, CDCl<sub>3</sub>): δ = 8.89 [d, *J* = 2.1, 1 H, H-7

(A) or H-4 (B)], 8.55 [d,  $J = 1.9$ , 1 H, H-4 (B) or H-7 (A)], 8.33 – 8.23 [m, 2 H, H-5 (A) + H-6 (B)], 8.09 [d,  $J = 9.1$ , 1 H, H-4 (A) or H-7 (B)], 7.78 [d,  $J = 8.9$ , 1 H, H-7 (B) or H-4 (A)], 1.78 [s, 9 H, *t*-Bu (A or B)], 1.76 [s, 9 H, *t*-Bu (B or A)];  $^{13}\text{C}$  NMR (75 MHz,  $\text{CDCl}_3$ ):  $\delta = 146.8, 146.7, 146.5, 146.4, 145.1, 142.3, 137.9, 133.2, 131.9, 130.4, 120.4, 120.3, 119.7, 115.5, 115.1, 111.7, 88.6, 85.2, 28.0, 27.5$ ; HRMS (ESI - TOF)  $m/z$ :  $[\text{M} - t\text{-Bu}]^-$  Calcd for  $\text{C}_7\text{H}_3\text{BrN}_3\text{O}_2^-$  239.9414; Found: 239.9413.

## 2nd Step: Sonogashira coupling of *N*-Boc-2-bromo-1*H*-benzo[d]imidazoles with terminal alkynes

To a stirred solution of the *N*-Boc-2-bromo-1*H*-benzo[d]imidazole derivative (3.36 mmol) (*N*-Boc-2-bromo-1*H*-benzo[d]imidazole: 1.00 g; *N*-Boc-2-bromo-5,6-dimethyl-1*H*-benzo[d]imidazole: 1.09 g; 1/1 mixture of *N*-Boc-2-bromo-6-methoxy-1*H*-benzo[d]imidazole and *N*-Boc-2-bromo-5-methoxy-1*H*-benzo[d]imidazole: 1.10 g; 1/1 mixture of *N*-Boc-2-bromo-6-nitro-1*H*-benzo[d]imidazole and *N*-Boc-2-bromo-5-nitro-1*H*-benzo[d]imidazole: 1.15 g; *N*-Boc-2-bromo-5,6-dichloro-1*H*-benzo[d]imidazole: 1.23 g) in triethylamine (34 mL) was added under nitrogen the terminal alkyne (5.04 mmol) (hex-1-yne: 414.1 mg; dec-1-yne: 696.8 mg; 5-methylhex-1-yne: 484.7 mg; but-3-yn-1-ylbenzene: 656.2 mg; prop-2-yn-1-ylcyclohexane: 615.9 mg; 1-ethynylcyclohex-1-ene: 535.1 mg; 3-methoxyprop-1-yne: 353.3 mg; but-3-yn-1-ol: 353.3 mg; methyl pent-4-ynoate:<sup>7</sup> 565.1 mg], followed by CuI (96 mg, 0.504 mmol) and Pd (OAc)<sub>2</sub> (75 mg, 0.0336 mmol). The reaction mixture was allowed to stir for 20 h under nitrogen at room temperature, and then was filtered on celite using a mixture of EtOAc-hexane (1:3, v/v). The solvent was evaporated under reduce pressure and the crude product dissolved in AcOEt (250 mL). To the resulting solution was added HCl (1% by weight solution, 50 mL), the organic layer was separated and then washed with water (50 mL) and brine (50 mL). After drying over  $\text{Na}_2\text{SO}_4$ , filtration and evaporation of the solvent, the product was purified by column chromatography on silica gel (9:1 hexane-AcOEt, v/v, for **1a**, **1b**, **1e** and **1h-o**; The purification of crude mixtures resulting from reaction of the 1/1 mixture of *N*-Boc-2-bromo-6-methoxy-1*H*-benzo[d]imidazole and *N*-Boc-2-bromo-6-methoxy-1*H*-benzo[d]imidazole and from reaction of 1/1 mixture of *N*-Boc-2-bromo-6-nitro-1*H*-benzo[d]imidazole and *N*-Boc-2-bromo-5-nitro-1*H*-benzo[d]imidazole were carried out by column chromatography on silica gel using 95:5 hexane-AcOEt. In the case of the mixture of *N*-Boc-2-bromo-methoxy-1*H*-benzo[d]imidazole derivatives, substrates **1c** and **1d** were obtained (order of elution: **1c** followed by **1d**). In the case of of the mixture of *N*-Boc-2-bromo-nitro-1*H*-benzo[d]imidazole derivatives, substrates **1f** and **1g** were obtained (order of elution: **1g**, **1f**).

***N*-Boc-2-(hex-1-yn-1-yl)-1*H*-benzo[d]imidazole (1a).** Yield: 890 mg, starting from 1.00 g of *N*-Boc-2-bromo-1*H*-benzo[d]imidazole (89%). Yellow solid, mp: 48-53°C; IR (KBr):  $\nu = 2222$  (w), 1728 (s), 1450 (w), 1366 (w), 1342 (m), 1134 (m), 764 (s)  $\text{cm}^{-1}$ ;  $^1\text{H}$  NMR (300 MHz,  $\text{CDCl}_3$ ):  $\delta = 7.99 - 7.92$  (m, 1 H, aromatic), 7.74 – 7.67 (m, 1 H, aromatic), 7.41 – 7.30 (m, 2 H, aromatic), 2.53 (t,  $J = 7.1$ , 2 H,  $\equiv\text{CCH}_2$ ), 1.80 – 1.61 (m, 2 H,  $\text{CH}_2\text{CH}_2\text{CH}_3$ ), 1.71 (s, 9 H, *t*-Bu), 1.52 (hexuplet,  $J = 7.2$ , 2 H,  $\text{CH}_2\text{CH}_3$ ), 0.95 (t,  $J = 7.2$ , 3 H,  $\text{CH}_3$ );  $^{13}\text{C}$  NMR (75 MHz,  $\text{CDCl}_3$ ):  $\delta = 147.9, 142.6, 136.3, 132.0, 125.5, 124.6, 120.0, 114.8, 97.8, 85.5, 72.3, 30.0, 28.1, 22.1, 19.5, 13.6$ ; HRMS (ESI-TOF)  $m/z$ :  $[\text{M} + \text{Na}]^+$  Calcd for  $\text{C}_{18}\text{H}_{22}\text{N}_2\text{O}_2\text{Na}^+$  321.1573; Found: 321.1579.

***N*-Boc-2-(hex-1-yn-1-yl)-5,6-dimethyl-1*H*-benzo[d]imidazole (1b).** Yield: 968 mg, starting from 1.09 g of *N*-Boc-2-bromo-5,6-dimethyl-1*H*-benzo[d]imidazole (88%). Colorless solid, mp: 73 - 75 °C; IR (KBr):  $\nu = 2230$  (w), 1751 (s), 1458 (m), 1350 (s), 1228 (m), 1157 (s), 1134 (s), 1026 (w), 849 (s), 764 (m)  $\text{cm}^{-1}$ ;  $^1\text{H}$  NMR (300 MHz,  $\text{CDCl}_3$ ):  $\delta = 7.75$  (s, 1 H, H-4 or H-7), 7.43 (s, 1 H, H-7 or H-4), 2.51 (t,  $J = 7.2$ , 2 H,  $\equiv\text{CCH}_2$ ), 2.37 (s, 3 H,  $\text{CH}_3$  at C-5 or C-6), 2.34 (s, 3 H,  $\text{CH}_3$  at C-6 or C-5), 1.75 – 1.60 (m, 2 H,  $\text{CH}_2\text{CH}_2\text{CH}_3$ ), 1.70 (s, 9 H, *t*-Bu), 1.51 (hexuplet,  $J = 7.3$ , 2 H,  $\text{CH}_2\text{CH}_3$ ), 0.95 (t,  $J = 7.3$ , 3 H,  $\text{CH}_2\text{CH}_3$ );  $^{13}\text{C}$  NMR (75 MHz,  $\text{CDCl}_3$ ):  $\delta = 148.1, 141.1, 135.4, 134.9, 133.5, 130.5, 120.0, 115.1, 97.0, 85.2, 72.5, 30.1, 28.1, 22.1, 20.7, 20.2, 19.5, 13.6$ ; HRMS (ESI - TOF)  $m/z$ :  $[\text{M} + \text{Na}]^+$  Calcd for  $\text{C}_{20}\text{H}_{26}\text{N}_2\text{O}_2\text{Na}^+$  349.1886; Found: 349.1891.

***N*-Boc-2-(hex-1-yn-1-yl)-6-methoxy-1*H*-benzo[d]imidazole (1c).** Yield: 423 mg, starting from 1.10 g of *N*-Boc-2-bromo-6-methoxy-1*H*-benzo[d]imidazole (38%). Colorless solid, mp: 54 - 55°C; IR (KBr):  $\nu = 2237$  (w),

1744 (s), 1612 (m), 1481 (m), 1435 (m), 1350 (m), 1335 (s), 1281 (w), 1219 (m), 1150 (s), 1026 (w), 849 (m)  $\text{cm}^{-1}$ ;  $^1\text{H}$  NMR (500 MHz,  $\text{CDCl}_3$ ):  $\delta$  = 7.56 (d,  $J$  = 8.8, 1 H, H-4), 7.51 (d,  $J$  = 2.4, 1 H, H-7), 6.95 (dd,  $J$  = 8.8, 2.4, 1 H, H-5), 3.86 (s, 3 H,  $\text{OCH}_3$ ), 2.51 (t,  $J$  = 7.3, 2 H,  $\equiv\text{CCH}_2$ ), 1.75 – 1.61 (m, 2 H,  $\text{CH}_2\text{CH}_2\text{CH}_3$ ), 1.71 (s, 9 H, *t*-Bu), 1.52 (hexuplet,  $J$  = 7.3, 2 H,  $\text{CH}_2\text{CH}_3$ ), 0.95 (t,  $J$  = 7.3, 3 H,  $\text{CH}_2\text{CH}_3$ );  $^{13}\text{C}$  NMR (75 MHz,  $\text{CDCl}_3$ ):  $\delta$  = 158.6, 148.1, 136.9, 135.1, 133.0, 120.4, 113.9, 98.6, 96.8, 85.4, 72.5, 55.7, 30.1, 28.1, 22.1, 19.5, 13.6; HRMS (ESI - TOF)  $m/z$ :  $[\text{M} + \text{Na}]^+$  Calcd for  $\text{C}_{19}\text{H}_{24}\text{N}_2\text{O}_3\text{Na}^+$  351.1679; Found: 351.1685.

***N*-Boc-2-(hex-1-yn-1-yl)-5-methoxy-1*H*-benzo[d]imidazole (1d).** Yield: 230 mg, starting from 1.10 g of *N*-Boc-2-bromo-5-methoxy-1*H*-benzo[d]imidazole (21%). Yellow oil; IR (KBr):  $\nu$  = 2237 (w), 1751 (s), 1612 (w), 1489 (m), 1435 (m), 1327 (s), 1288 (m), 1219 (m), 1150 (s), 1026 (m), 849 (m)  $\text{cm}^{-1}$ ;  $^1\text{H}$  NMR (500 MHz,  $\text{CDCl}_3$ ):  $\delta$  = 7.82 (d,  $J$  = 9.0, 1 H, H-7), 7.15 (d,  $J$  = 2.5, 1 H, H-4), 6.98 (dd,  $J$  = 9.0, 2.5, 1 H, H-6), 3.85 (s, 3 H,  $\text{OCH}_3$ ), 2.52 (t,  $J$  = 7.3, 2 H,  $\equiv\text{CCH}_2$ ), 1.75 – 1.62 (m, 2 H,  $\text{CH}_2\text{CH}_2\text{CH}_3$ ), 1.71 (s, 9 H, *t*-Bu), 1.53 (hexuplet,  $J$  = 7.3, 2 H,  $\text{CH}_2\text{CH}_3$ ), 0.95 (t,  $J$  = 7.3, 3 H,  $\text{CH}_2\text{CH}_3$ );  $^{13}\text{C}$  NMR (125 MHz,  $\text{CDCl}_3$ ):  $\delta$  = 157.5, 147.9, 143.6, 136.6, 126.4, 115.2, 115.0, 102.3, 97.8, 85.4, 72.4, 55.7, 30.1, 28.1, 22.1, 19.5, 13.6; HRMS (ESI - TOF)  $m/z$ :  $[\text{M} + \text{Na}]^+$  Calcd for  $\text{C}_{19}\text{H}_{24}\text{N}_2\text{O}_3\text{Na}^+$  351.1679; Found: 351.1686.

***N*-Boc-5,6-dichloro-2-(hex-1-yn-1-yl)-1*H*-benzo[d]imidazole (1e).** Yield: 976 mg, starting from 1.23 g of *N*-Boc-2-bromo-5,6-dichloro-1*H*-benzo[d]imidazole (79%). Colorless solid, mp: 70–71°C; IR (KBr):  $\nu$  = 2237 (w), 1751 (s), 1504 (m), 1443 (m), 1335 (s), 1219 (m), 1150 (s), 872 (m)  $\text{cm}^{-1}$ ;  $^1\text{H}$  NMR (300 MHz,  $\text{CDCl}_3$ ):  $\delta$  = 8.10 (s, 1 H, H-4 or H-7), 7.74 (s, 1 H, H-7 or H-4), 2.53 (t,  $J$  = 7.1, 2 H,  $\equiv\text{CCH}_2$ ), 1.75 – 1.61 (m, 2 H,  $\text{CH}_2\text{CH}_2\text{CH}_3$ ), 1.71 (s, 9 H, *t*-Bu), 1.59 – 1.44 (m, 2 H,  $\text{CH}_2\text{CH}_3$ ), 0.96 (t,  $J$  = 7.2, 3 H,  $\text{CH}_2\text{CH}_3$ );  $^{13}\text{C}$  NMR (75 MHz,  $\text{CDCl}_3$ ):  $\delta$  = 147.2, 141.8, 137.7, 131.1, 129.6, 128.8, 120.8, 116.4, 99.3, 86.5, 71.9, 29.9, 28.0, 22.1, 19.5, 13.6; HRMS (ESI - TOF)  $m/z$ :  $[\text{M} + \text{Na}]^+$  Calcd for  $\text{C}_{18}\text{H}_{20}\text{Cl}_2\text{N}_2\text{O}_2\text{Na}^+$  389.0794; Found: 389.0796.

***N*-Boc-2-(hex-1-yn-1-yl)-6-nitro-1*H*-benzo[d]imidazole (1f).** Yield: 427 mg, starting from 1.15 g of *N*-Boc-2-bromo-6-nitro-1*H*-benzo[d]imidazole (37%). Colorless solid, mp: 149 – 150°C; IR (KBr):  $\nu$  = 2230 (w), 1744 (s), 1520 (s), 1443 (w), 1342 (s), 1250 (w), 1157 (m), 756 (m)  $\text{cm}^{-1}$ ;  $^1\text{H}$  NMR (300 MHz,  $\text{CDCl}_3$ ):  $\delta$  = 8.92 (d,  $J$  = 2.2, 1 H, H-7), 8.27 (dd,  $J$  = 8.9, 2.2, 1 H, H-5), 7.77 (d,  $J$  = 8.9, 1 H, H-4), 2.57 (t,  $J$  = 7.1, 2 H,  $\equiv\text{CCH}_2$ ), 1.81 – 1.62 (m, 2 H,  $\text{CH}_2\text{CH}_2\text{CH}_3$ ), 1.75 (s, 9 H, *t*-Bu), 1.60 – 1.45 (m, 2 H,  $\text{CH}_2\text{CH}_3$ ), 0.97 (t,  $J$  = 7.2, 3 H,  $\text{CH}_2\text{CH}_3$ );  $^{13}\text{C}$  NMR (75 MHz,  $\text{CDCl}_3$ ):  $\delta$  = 147.0, 146.8, 145.5, 140.4, 131.5, 120.3, 120.0, 111.8, 101.1, 87.1, 71.9, 29.9, 28.0, 22.1, 19.6, 13.6; HRMS (ESI - TOF)  $m/z$ :  $[\text{M} + \text{Na}]^+$  Calcd for  $\text{C}_{18}\text{H}_{21}\text{N}_3\text{O}_4\text{Na}^+$  366.1424; Found: 366.1433.

***N*-Boc-2-(hex-1-yn-1-yl)-5-nitro-1*H*-benzo[d]imidazole (1g).** Yield: 431 mg, starting from 1.15 g of *N*-Boc-2-bromo-5-nitro-1*H*-benzo[d]imidazole (37%). Colorless solid, mp: 103 – 106°C; IR (KBr):  $\nu$  = 2237 (w), 1751 (s), 1528 (s), 1373 (w), 1335 (s), 1150 (s), 741 (m)  $\text{cm}^{-1}$ ;  $^1\text{H}$  NMR (300 MHz,  $\text{CDCl}_3$ ):  $\delta$  = 8.55 (d,  $J$  = 2.0, 1 H, H-4), 8.27 (dd,  $J$  = 9.0, 2.0, 1 H, H-6), 8.10 (distorted d,  $J$  = 9.0, 1 H, H-7), 2.56 (t,  $J$  = 7.0, 2 H,  $\equiv\text{CCH}_2$ ), 1.83 – 1.62 (m, 2 H,  $\text{CH}_2\text{CH}_2\text{CH}_3$ ), 1.74 (s, 9 H, *t*-Bu), 1.61 – 1.45 (m, 2 H,  $\text{CH}_2\text{CH}_3$ ), 0.97 (t,  $J$  = 7.2, 3 H,  $\text{CH}_2\text{CH}_3$ );  $^{13}\text{C}$  NMR (75 MHz,  $\text{CDCl}_3$ ):  $\delta$  = 147.1, 145.2, 142.3, 139.2, 136.2, 120.7, 116.0, 115.1, 100.2, 87.1, 71.7, 29.9, 28.0, 22.1, 19.5, 13.6; HRMS (ESI - TOF)  $m/z$ :  $[\text{M} + \text{Na}]^+$  Calcd for  $\text{C}_{18}\text{H}_{21}\text{N}_3\text{O}_4\text{Na}^+$  366.1424; Found: 366.1433.

***N*-Boc-2-(dec-1-yn-1-yl)-1*H*-benzo[d]imidazole (1h).** Yield: 910 mg, starting from 1.00 g of *N*-Boc-2-bromo-1*H*-benzo[d]imidazole (76%). Yellow oil; IR (KBr):  $\nu$  = 2237 (m), 1752 (s), 1504 (m), 1450 (m), 1340 (s), 1211 (m), 1158 (s), 849 (m), 764 (m)  $\text{cm}^{-1}$ ;  $^1\text{H}$  NMR (300 MHz,  $\text{CDCl}_3$ ):  $\delta$  = 8.00 – 7.92 (m, 1 H, aromatic), 7.73 – 7.66 (m, 1 H, aromatic), 7.40 – 7.28 (m, 2 H, aromatic), 2.52 (t,  $J$  = 7.1, 2 H,  $\equiv\text{CCH}_2$ ), 1.80 – 1.62 (m, 2 H,  $\equiv\text{CCH}_2\text{CH}_2$ ), 1.71 (s, 9 H, *t*-Bu), 1.55 – 1.42 (m, 2 H,  $\equiv\text{CCH}_2\text{CH}_2\text{CH}_2$ ), 1.39 – 1.20 (m, 8 H,  $\text{CH}_2(\text{CH}_2)_4\text{CH}_3$ ), 0.93–0.83 (m, 3 H,  $\text{CH}_2\text{CH}_3$ );  $^{13}\text{C}$  NMR (75 MHz,  $\text{CDCl}_3$ ):  $\delta$  = 147.9, 142.6, 136.4, 132.1, 125.6, 124.6, 120.0,

114.8, 97.9, 85.5, 72.3, 31.9, 29.18, 29.16, 29.07, 28.10, 28.06, 22.7, 19.8, 14.1; HRMS (ESI - TOF)  $m/z$ :  $[M + Na]^+$  Calcd for  $C_{22}H_{30}N_2O_2Na^+$  377.2199; Found: 377.2204.

***N*-Boc-2-(5-methylhex-1-yn-1-yl)-1*H*-benzo[d]imidazole (1i).** Yield: 795 mg, starting from 1.00 g of *N*-Boc-2-bromo-1*H*-benzo[d]imidazole (76%). Colorless oil, IR (KBr):  $\nu$  = 2237 (m), 1751 (s), 1504 (m), 1450 (w), 1126 (m), 1011 (m), 849 (m), 738 (m)  $cm^{-1}$ ;  $^1H$  NMR (300 MHz,  $CDCl_3$ ):  $\delta$  = 7.99 – 7.93 (m, 1 H, aromatic), 7.73 – 7.66 (m, 1 H, aromatic), 7.41 – 7.29 (m, 2 H, aromatic), 2.53 (t,  $J$  = 7.4, 2 H,  $\equiv CCH_2$ ), 1.88 – 1.66 (m, 10 H, *t*-Bu +  $CH(CH_3)_2$ ), 1.59 (q,  $J$  = 7.4, 2 H,  $CH_2CH$ ), 0.94 [d,  $J$  = 6.6, 6 H,  $CH(CH_3)_2$ ];  $^{13}C$  NMR (75 MHz,  $CDCl_3$ ):  $\delta$  = 147.9, 142.6, 136.3, 132.1, 125.5, 124.6, 120.0, 114.8, 97.8, 85.5, 72.2, 36.8, 28.1, 27.3, 22.2, 17.8. HRMS (ESI - TOF)  $m/z$ :  $[M + Na]^+$  Calcd for  $C_{19}H_{24}N_2O_2Na^+$  335.1730; Found: 335.1736.

***N*-Boc-2-(4-phenylbut-1-yn-1-yl)-1*H*-benzo[d]imidazole (1j).** Yield: 1.09 g, starting from 1.00 g of *N*-Boc-2-bromo-1*H*-benzo[d]imidazole (94%). Colorless solid, mp: 53 - 54 °C; IR (KBr):  $\nu$  = 2237 (w), 1751 (s), 1504 (w), 1451 (m), 1320 (s), 1219 (m), 1157 (s), 1126 (s), 741 (s)  $cm^{-1}$ ;  $^1H$  NMR (300 MHz,  $CDCl_3$ ):  $\delta$  = 8.01 – 7.92 (m, 1 H, aromatic), 7.75 – 7.66 (m, 1 H, aromatic), 7.42 – 7.17 (m, 8 H, aromatic), 3.01 (t,  $J$  = 7.5, 2 H,  $\equiv CCH_2$ ), 2.81 (t,  $J$  = 7.5, 2 H,  $CH_2Ph$ ), 1.66 (s, 9 H, *t*-Bu);  $^{13}C$  NMR (75 MHz,  $CDCl_3$ ):  $\delta$  = 147.9, 142.6, 140.1, 136.1, 132.1, 128.54, 128.46, 126.5, 125.6, 124.7, 120.1, 114.9, 96.6, 85.6, 72.9, 34.3, 28.0, 22.1; HRMS (ESI - TOF)  $m/z$ :  $[M + Na]^+$  Calcd for  $C_{22}H_{22}N_2O_2Na^+$  369.1573; Found: 369.1578.

***N*-Boc-2-(3-cyclohexylprop-1-yn-1-yl)-1*H*-benzo[d]imidazole (1k).** Yield: 1.02 g, starting from 1.00 g of *N*-Boc-2-bromo-1*H*-benzo[d]imidazole (90%). Yellow solid, mp: 65-68°C; IR (KBr):  $\nu$  = 2230 (m), 1736 (s), 1504 (m), 1451 (m), 1360 (s), 1211 (m), 1134 (s), 1057 (w), 849 (m), 764 (s)  $cm^{-1}$ ;  $^1H$  NMR (500 MHz,  $CDCl_3$ ):  $\delta$  = 7.97 – 7.94 (m, 1 H, aromatic), 7.73 – 7.68 (m, 1 H, aromatic), 7.39 – 7.31 (m, 2 H, aromatic), 2.41 (d,  $J$  = 6.8, 2 H,  $\equiv CCH_2$ ), 1.97 – 1.88 (m, 2 H, cyclohexyl ring), 1.80 – 1.62 (m, 4 H, cyclohexyl ring), 1.71 (s, 9 H, *t*-Bu), 1.34 – 1.24 (m, 2 H, cyclohexyl ring), 1.24 – 1.05 (m, 3 H, cyclohexyl ring);  $^{13}C$ -NMR (125 MHz,  $CDCl_3$ ):  $\delta$  = 148.0, 142.7, 136.4, 132.1, 125.5, 124.6, 120.1, 114.8, 96.8, 85.5, 73.2, 37.2, 32.9, 28.1, 27.6, 26.2, 26.1; HRMS (ESI - TOF)  $m/z$ :  $[M + Na]^+$  Calcd for  $C_{21}H_{26}N_2O_2Na^+$  361.1892; Found: 361.1894.

***N*-Boc-2-(cyclohex-1-en-1-ylethynyl)-1*H*-benzo[d]imidazole (1l).** Yield: 890 mg, starting from 1.00 g of *N*-Boc-2-bromo-1*H*-benzo[d]imidazole (82%). Yellow solid, mp: 78-80°C; IR (KBr):  $\nu$  = 2199 (w), 1736 (s), 1498 (m), 1451 (m), 1350 (s), 1227 (m), 1150 (s), 1111 (m), 849 (w), 764 (m)  $cm^{-1}$ ;  $^1H$  NMR (500 MHz,  $CDCl_3$ ):  $\delta$  = 7.98 – 7.93 (m, 1 H, aromatic), 7.74 – 7.68 (m, 1 H, aromatic), 7.41 – 7.32 (m, 2 H, aromatic), 6.45 (s, 1 H, =CH), 2.34 – 2.25 (m, 2 H, cyclohexenyl ring), 2.24 – 2.15 (m, 2 H, cyclohexenyl ring), 1.77 – 1.59 (m, 4 H, cyclohexenyl ring), 1.71 (s, 9 H, *t*-Bu);  $^{13}C$ -NMR (125 MHz,  $CDCl_3$ ):  $\delta$  = 147.9, 143.0, 139.2, 139.1, 136.6, 132.2, 125.6, 124.7, 120.1, 114.9, 97.3, 85.7, 78.4, 28.5, 28.2, 26.0, 22.2, 21.4; HRMS (ESI - TOF)  $m/z$ :  $[M + Na]^+$  Calcd for  $C_{20}H_{22}N_2O_2Na^+$  345.1573; Found: 345.1581.

***N*-Boc-2-(3-methoxyprop-1-yn-1-yl)-1*H*-benzo[d]imidazole (1m).** Yield: 755 mg, starting from 1.00 g of *N*-Boc-2-bromo-1*H*-benzo[d]imidazole (78%). Colorless solid, mp: 63 - 67°C; IR (KBr):  $\nu$  = 1751 (s), 1504 (w), 1450 (m), 1335 (s), 1219 (m), 1157 (m), 1103 (m), 849 (w), 741 (m)  $cm^{-1}$ ;  $^1H$  NMR (500 MHz,  $CDCl_3$ ):  $\delta$  = 8.03 – 7.96 (m, 1 H, aromatic), 7.77 – 7.71 (m, 1 H, aromatic), 7.44 – 7.33 (m, 2 H, aromatic), 4.42 (s, 2 H,  $\equiv CCH_2$ ), 3.51 (s, 3 H,  $OCH_3$ ), 1.72 (s, 9 H, *t*-Bu);  $^{13}C$ -NMR (125 MHz,  $CDCl_3$ ):  $\delta$  = 147.7, 142.7, 135.3, 132.2, 126.1, 124.8, 120.4, 115.0, 91.5, 86.1, 77.7, 60.3, 58.1, 28.1; HRMS (ESI - TOF)  $m/z$ :  $[M + Na]^+$  Calcd for  $C_{16}H_{18}N_2O_3Na^+$  309.1210; Found: 309.1217.

**Methyl *N*-Boc-5-(1*H*-benzo[d]imidazol-2-yl)pent-4-ynoate (1n).** Yield: 890 mg, starting from 1.00 g of *N*-Boc-2-bromo-1*H*-benzo[d]imidazole (81%). Colorless solid, mp: 110 - 111°C; IR (KBr):  $\nu$  = 2230 (w), 1744 (s),

1504 (w), 1443 (m), 1343 (s), 1289 (w), 1180 (m), 1157 (s), 764 (m)  $\text{cm}^{-1}$ ;  $^1\text{H}$  NMR (500 MHz,  $\text{CDCl}_3$ ):  $\delta$  = 7.98 – 7.93 (m, 1 H, aromatic), 7.73 – 7.67 (m, 1 H, aromatic), 7.40 – 7.31 (m, 2 H, aromatic), 3.73 (s, 3 H,  $\text{CO}_2\text{CH}_3$ ), 2.89 – 2.83 (m, 2 H,  $\equiv\text{CCH}_2$ ), 2.76 – 2.70 (m, 2 H,  $\text{CH}_2\text{CH}_2\text{CH}_3$ ), 1.71 (s, 9 H, *t*-Bu);  $^{13}\text{C}$ -NMR (125 MHz,  $\text{CDCl}_3$ ):  $\delta$  = 171.9, 147.8, 142.6, 135.9, 132.1, 125.8, 124.7, 120.1, 114.9, 95.0, 85.7, 72.9, 52.0, 32.4, 28.1, 15.6; HRMS (ESI - TOF)  $m/z$ :  $[\text{M} + \text{Na}]^+$  Calcd for  $\text{C}_{18}\text{H}_{20}\text{N}_2\text{O}_4\text{Na}^+$  351.1315; Found: 351.1324.

***N*-Boc-4-(1*H*-benzo[*d*]imidazol-2-yl)but-3-yn-1-ol (1o).** Yield: 800 mg, starting from 1.00 g of *N*-Boc-2-bromo-1*H*-benzo[*d*]imidazole (83%). Colorless solid, mp: 94 - 97°C; IR (KBr):  $\nu$  = 3240 (m, br), 2245 (w), 1767 (s), 1450 (m), 1350 (m), 1219 (w), 1126 (s), 1057 (m), 741 (m)  $\text{cm}^{-1}$ ;  $^1\text{H}$  NMR (500 MHz,  $\text{CDCl}_3$ ):  $\delta$  = 7.92 – 7.87 (m, 1 H, aromatic), 7.69 – 7.66 (m, 1 H, aromatic), 7.39 – 7.30 (m, 2 H, aromatic), 4.23 (s, br, 1 H, OH), 4.00 – 3.90 (m, 2 H,  $\text{CH}_2\text{OH}$ ), 2.81 (t,  $J$  = 6.3, 2 H,  $\equiv\text{CCH}_2$ ), 1.71 (s, 9 H, *t*-Bu);  $^{13}\text{C}$ -NMR (125 MHz,  $\text{CDCl}_3$ ):  $\delta$  = 147.9, 142.2, 136.1, 125.8, 124.8, 120.0, 114.9, 95.5, 86.2, 73.8, 60.3, 28.1, 24.3; HRMS (ESI - TOF)  $m/z$ :  $[\text{M} + \text{Na}]^+$  Calcd for  $\text{C}_{16}\text{H}_{18}\text{N}_2\text{O}_3\text{Na}^+$  309.1210; Found: 309.1217.

**X-Ray crystallographic data for products 2a, 2c, and 2f****Table 1**

Experimental details [6].

	<b>2a</b>	<b>2c</b>	<b>2f</b>
Crystal data			
Chemical formula	C <sub>14</sub> H <sub>14</sub> N <sub>2</sub> O <sub>2</sub>	C <sub>15</sub> H <sub>16</sub> N <sub>2</sub> O <sub>3</sub>	C <sub>14</sub> H <sub>13</sub> N <sub>3</sub> O <sub>4</sub>
$M_r$	242.27	272.30	
Crystal system	Triclinic	Monoclinic	Monoclinic
Space group	$P\bar{1}$	$P 2_1/c$	$P 2_1/c$
$a, b, c$ (Å)	7.1535(5), 7.7338(5), 12.4256(9)	7.0113(16), 17.861(4), 11.960(3)	29.074(3), 4.9642(5), 18.6784(19)
$\alpha, \beta, \gamma$ (°)	88.2344(18), 82.9643(18), 90, 64.7163(11)	90, 113.747(5), 90	90, 99.2187(18), 90
$V$ (Å <sup>3</sup> )	616.72(7)	1370.9(6)	2661.0(5)
$M(20)$	53.0	34.0	13.9
$D_x$ (Mg m <sup>-3</sup> )	1.305	1.319	1.434
$\mu$ (mm <sup>-1</sup> )	0.720	0.763	0.902
$Z$	2	4	8
Temperature (K)	293	293	293
Radiation type	Cu $K\alpha$ radiation	Cu $K\alpha$ radiation	Cu $K\alpha$ radiation
Data collection			
Diffractometer	Rigaku RINT2500	Rigaku RINT2500	Rigaku RINT2500
Specimen mounting	Special glass capillary	Special glass capillary	Special glass capillary
Data collection mode	Transmission	Transmission	Transmission
Scan Method	Continuous	Continuous	Continuous
Absorption correction	None	None	None
Counting time per step (s)	4	6	6
$2\theta$ (°)	$2\theta_{\min} = 6.00, 2\theta_{\max} =$ $80.00, 2\theta_{\text{step}} = 0.02$	$2\theta_{\min} = 8.00, 2\theta_{\max} =$ $65.00, 2\theta_{\text{step}} = 0.02$	$2\theta_{\min} = 5.00, 2\theta_{\max} =$ $65.00, 2\theta_{\text{step}} = 0.02$
Refinement			
$R$ factors and goodness of fit	$R_p = 0.03919, R_{wp} =$ $0.05978, R_{\text{exp}} = 0.02153,$ $R(F^2) = 0.03245,$ $\chi^2 = 2.77643$	$R_p = 0.03758, R_{wp} =$ $0.05888, R_{\text{exp}} = 0.02143,$ $R(F^2) = 0.07597, \chi^2 =$ $2.74734$	$R_p = 0.02740, R_{wp} =$ $0.03998, R_{\text{exp}} = 0.02123,$ $R(F^2) = 0.05738, \chi^2 =$ $1.88298$
Experimental points	3701	2851	3001
Profile function	Pearson VII	Pearson VII	Pearson VII
No. of parameters	96	101	166
No. of restraints	0	22	46
RMS (Å)	0.097	0.136	0.341

## Structural solutions and refinements

All the steps of the *ab initio* solution and refinement process were performed automatically by EXPO2014 software [7], a package capable of solving crystal structure from powder data by carrying out the following steps: a) determination of the unit-cell parameters and identification of the space group; b) structure solution by direct methods and/or real-space approach; d) structure model refinement by the Rietveld method [8].

The first low-angle well-defined peaks of the powder diffraction pattern were selected and fitted by EXPO2014 for carrying out the indexation *via* N-TREOR09 [9] and DICVOL04 [10] programs. The cell parameters and the M(20) [11] figures-of-merit are shown in Table 1. The space group determination was based on the evaluation of the systematic absences.

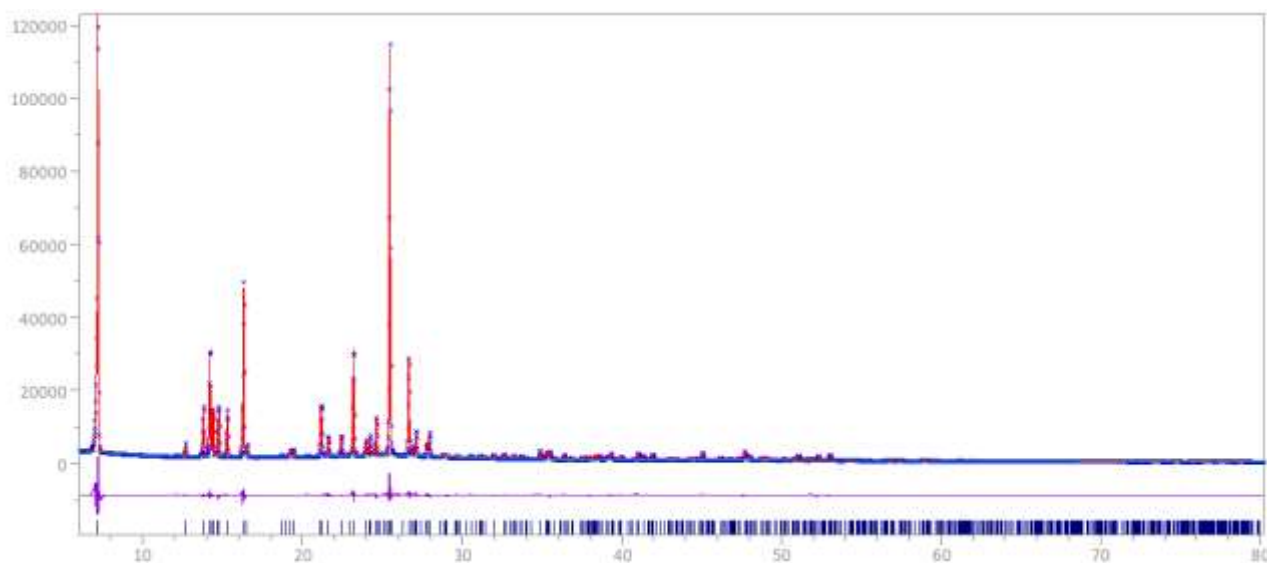
The structures were solved in the real-space using the simulated annealing algorithm implemented in EXPO2014. The method is based on the minimization of the difference between observed and calculated intensities moving, within the unit cell, an expected molecular model by varying its position, orientation and conformation. The starting models were assembled using the sketching facilities of ACD/ChemSketch [12] and the geometry optimization with the program MOPAC [13]. For each structure, the algorithm was run 100 times under Linux workstation in a default mode and in parallel over 25 CPUs. The best solutions with the lowest cost function were selected. The criterion to accept the solution was based also on the soundness of the crystal packing. All the solutions obtained by real space method was also confirmed by direct methods. The solutions derived from the real-space procedure were supplied as starting models to Rietveld refinement. Restraints were applied to bond distances when necessary to stabilize the refinement. The isotropic displacement factors of the atoms were refined in separate blocks; one  $U_{iso}$  for all non-H atoms of the benzoimidazo-oxazinone system and one  $U_{iso}$  for the butyl substituent. The isotropic displacement factor for all H atoms was refined as 1.2 times the  $U_{iso}$  of the parent atoms. The peak shapes were modelled using the Pearson VII function. Almost all bond lengths, bond angles, and torsion angles in the experimentally determined structures fall within the normal ranges indicated by a Mercury Mogul geometry check [14]. This validation process is based on the comparison with average bond distances, angles and torsions in structures reported in the Cambridge Structural Database (CSD) [15].

## DFT calculations

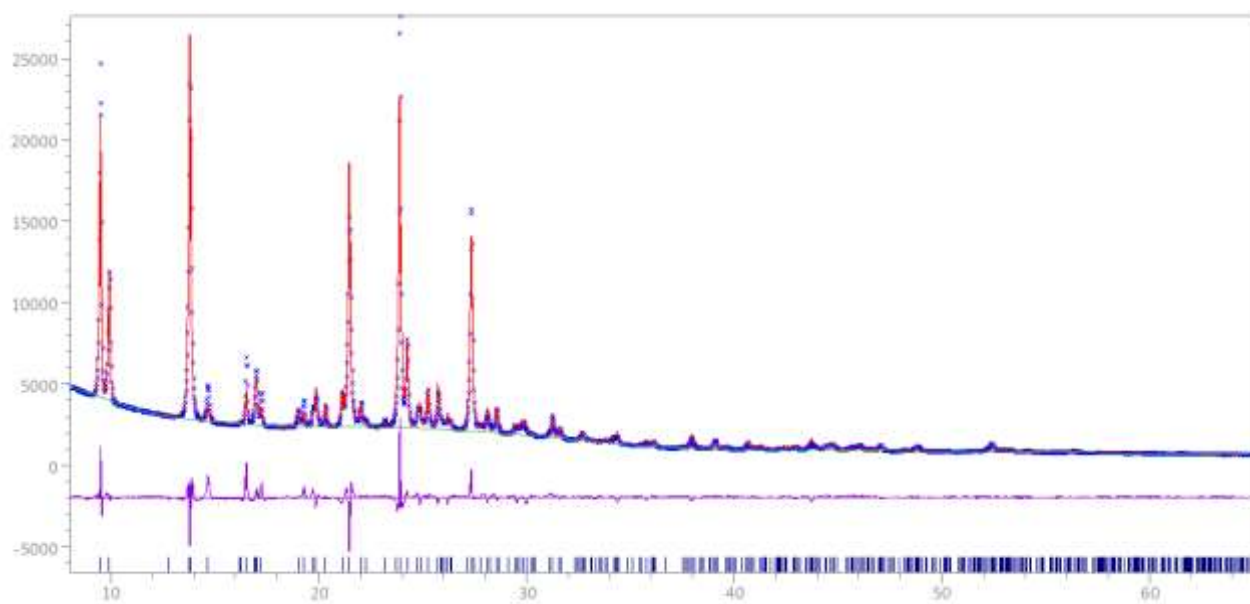
Periodic, solid-state calculations were performed using the Quantum ESPRESSO [16], an *ab initio* quantum-mechanical program employing plane waves and density-functional theory (DFT) to simulate the properties of solids. The following execution parameters were used: PBE potentials from the SSSP Efficiency PBE (version 1.1) library [17], an optional cut-off controlling the accuracy of the calculations set to 60 Ry, k-point spacing was  $0.15 \text{ \AA}^{-1}$ , van der Waals interactions were corrected by means of a Grimme's D3 dispersion correction [18]. Atomic-coordinate-only optimizations of the three compounds were performed using the experimental cell parameters and atomic positions obtained from the X-ray powder diffraction Rietveld refinement. The root-mean-square (RMS) displacements of all non-H atoms between the energy-minimized and



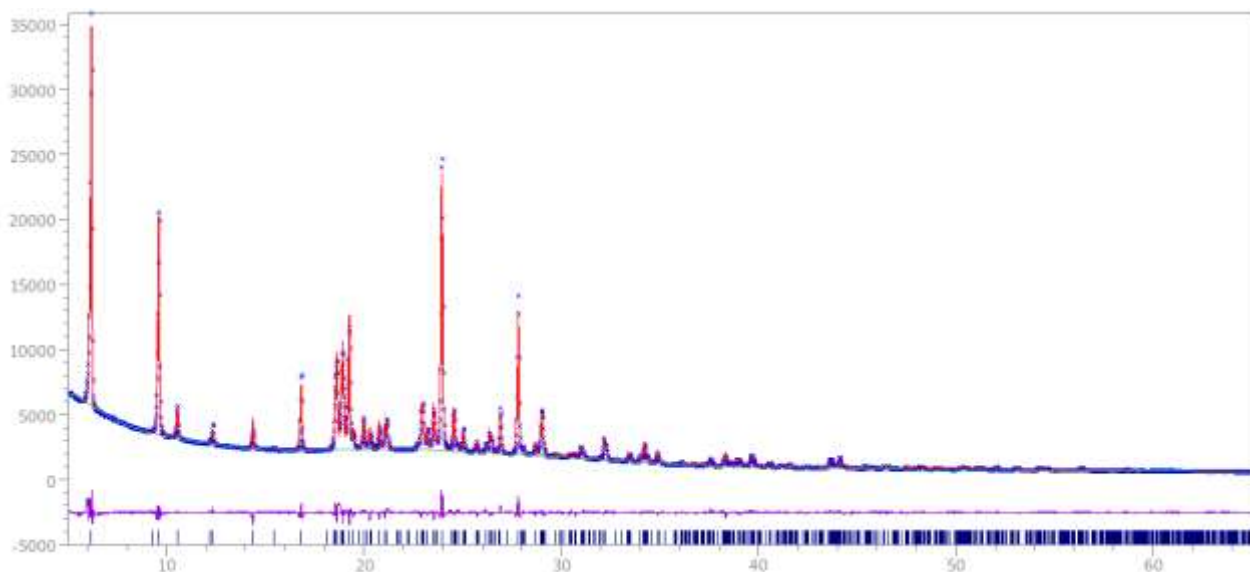
experimental crystal structures are shown in the table 1. The RMS values are within the range expected for DFT-D3 minimisation of a correct experimental structure [19].



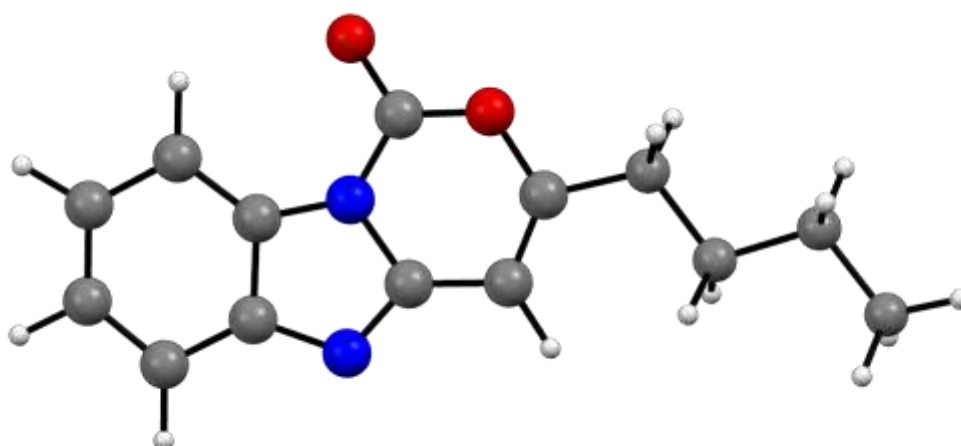
**Figure 1.** Final observed (points), calculated (lines) and difference profiles of the Rietveld plot for 2a.



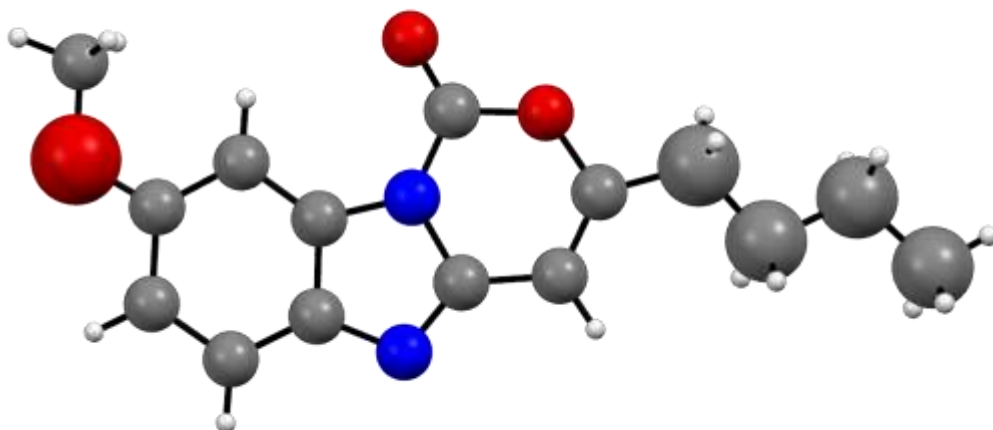
**Figure 2.** Final observed (points), calculated (lines) and difference profiles of the Rietveld plot for 2c.



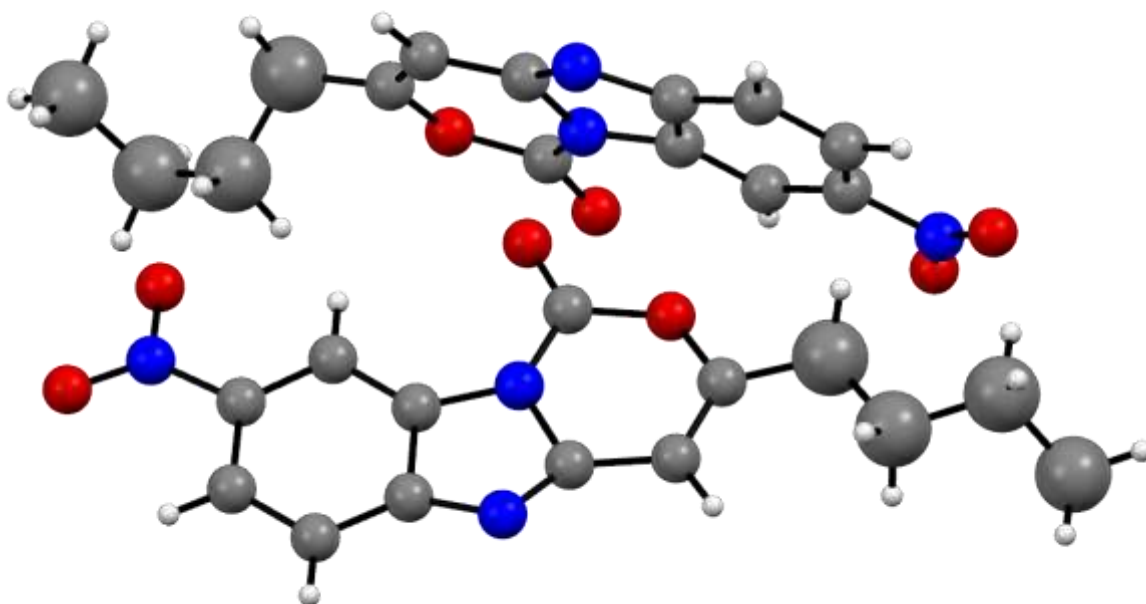
**Figure 3.** Final observed (points), calculated (lines) and difference profiles of the Rietveld plot for **2f**.



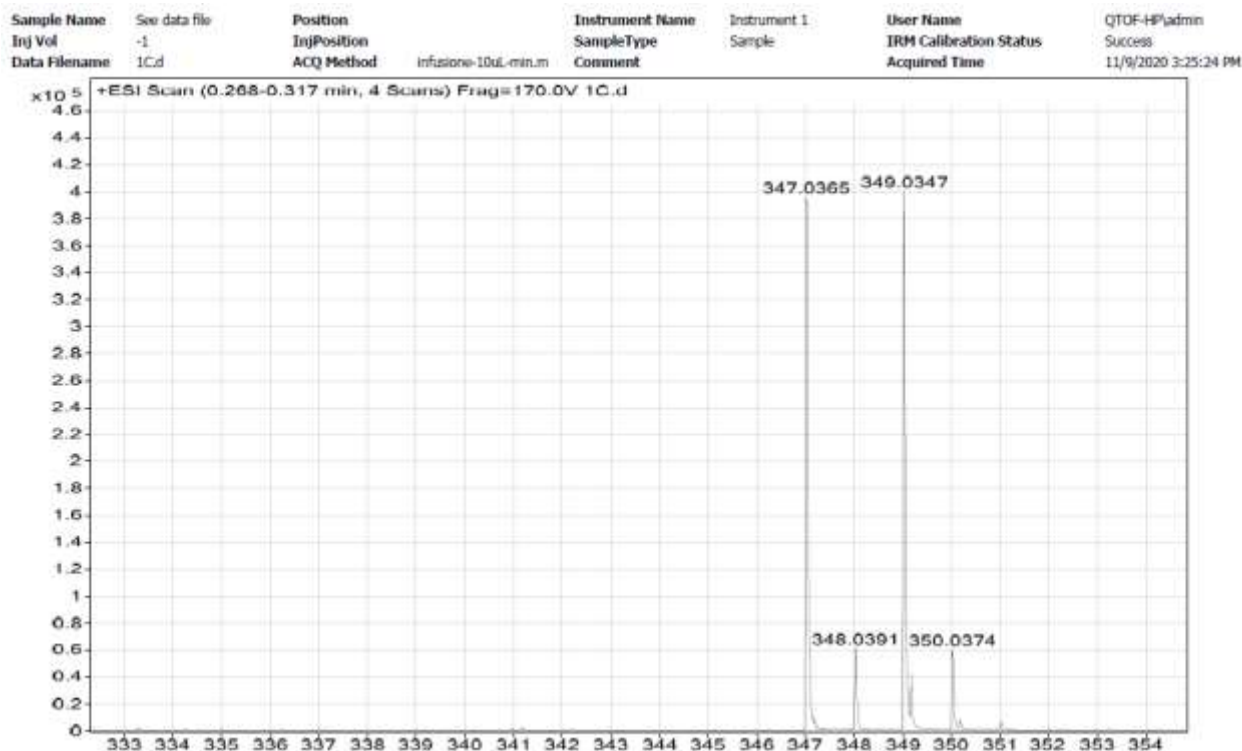
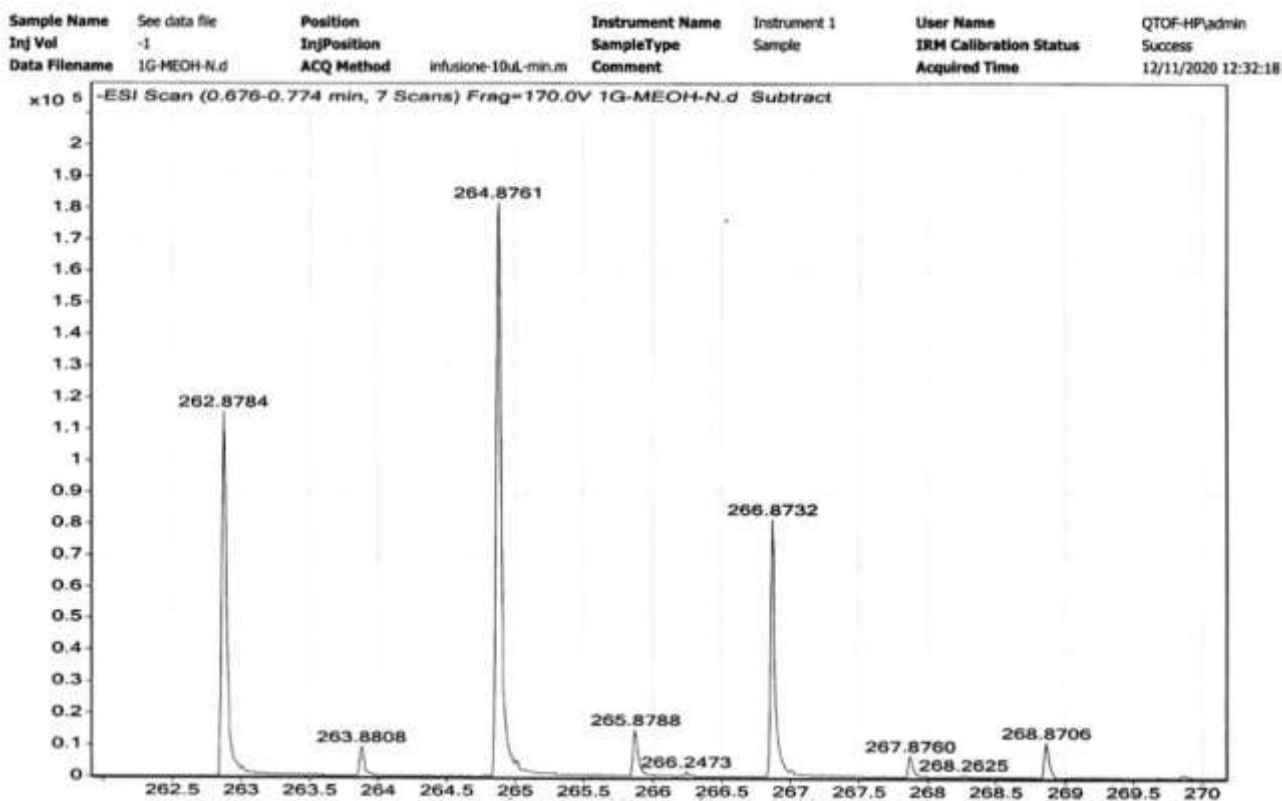
**Figure 4.** Asymmetric unit content of **2a** showing displacement ellipsoids at the 50% probability level. Color legend: carbon (light grey), hydrogen (white), oxygen (red), nitrogen (blue).



**Figure 5.** Asymmetric unit content of **2c** showing displacement ellipsoids at the 50% probability level. Color legend: carbon (light grey), hydrogen (white), oxygen (red), nitrogen (blue).



**Figure 6.** Asymmetric unit content of **2f** showing displacement ellipsoids at the 50% probability level. Color legend: carbon (light grey), hydrogen (white), oxygen (red), nitrogen (blue).

Copies of HRMS spectra***N*-Boc-2-bromo-5,6-dimethyl-1*H*-benzo[*d*]imidazole**Calcd for  $C_{14}H_{17}BrN_2NaO_2^+$  347.0366; Found: 347.0365***N*-Boc-2-bromo-5,6-dichloro-1*H*-benzo[*d*]imidazole**Calcd for  $C_7H_2BrCl_2N_2^-$  262.8784; Found: 262.8784

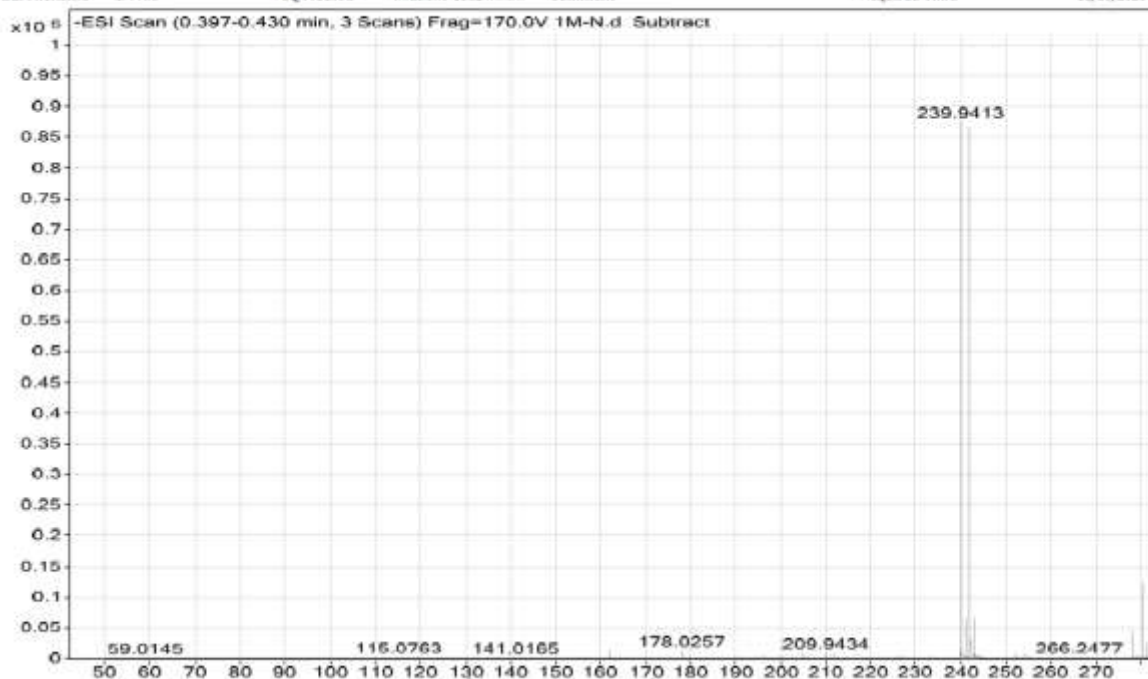
**Mixture of Regioisomers *N*-Boc-2-bromo-5-methoxy-1*H*-benzo[*d*]imidazole (A) and  
*N*-Boc-2-bromo-6-methoxy-1*H*-benzo[*d*]imidazole (B)**  
 Calcd for  $C_{13}H_{15}BrN_2NaO_3^+$  349.0158; Found: 349.0161

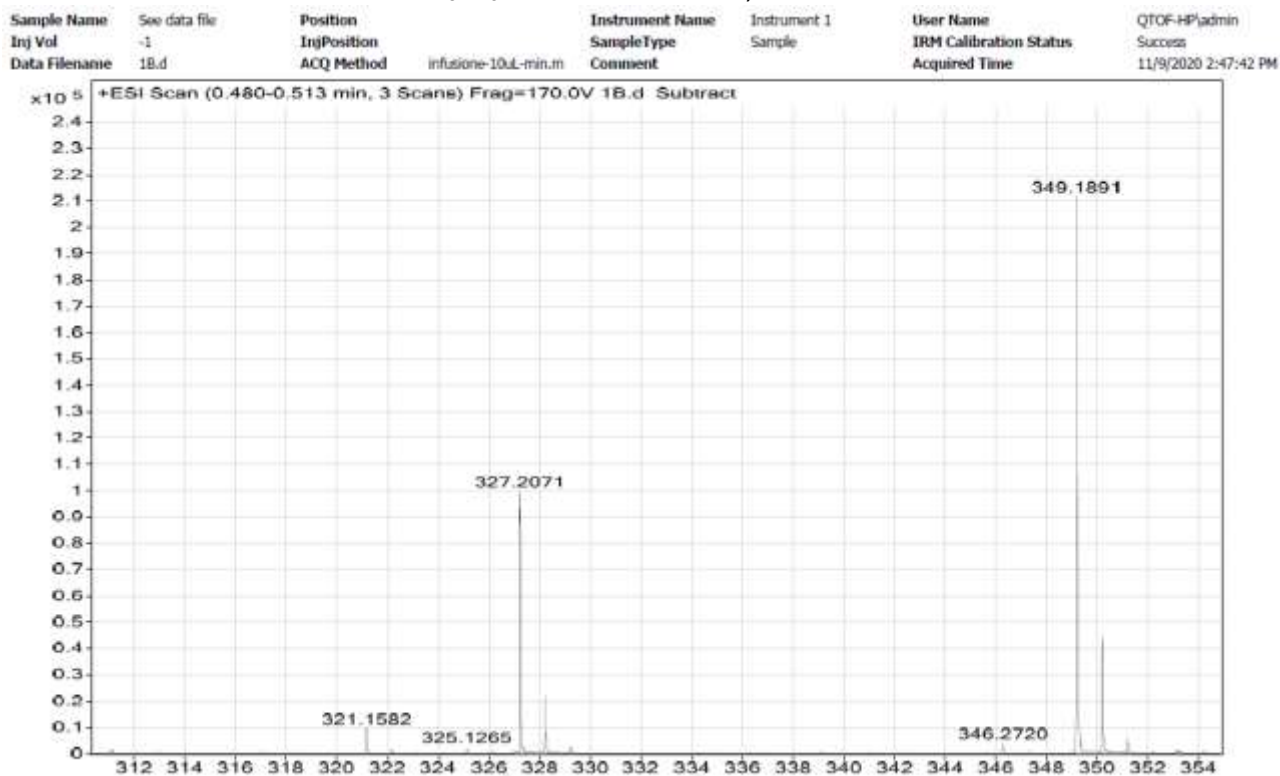
Sample Name	See data file	Position	Instrument Name	Instrument 1	User Name	QTOF-HP/admin
Inj Vol	-1	InjPosition	SampleType	Sample	IRM Calibration Status	Success
Data Filename	1R.d	ACQ Method	Infusione-10ul-min.m	Comment	Acquired Time	11/10/2020 12:20:02 PM



**Mixture of Regioisomers *N*-Boc-2-bromo-5-nitro-1*H*-benzo[*d*]imidazole (A) and  
*N*-Boc-2-bromo-6-nitro-1*H*-benzo[*d*]imidazole (B)**  
 Calcd for  $C_7H_3BrN_3O_2^-$  239.9414; Found: 239.9413

Sample Name	See data file	Position	Instrument Name	Instrument 1	User Name	QTOF-HP/admin
Inj Vol	-1	InjPosition	SampleType	Sample	IRM Calibration Status	Success
Data Filename	1M-N.d	ACQ Method	Infusione-10ul-min.m	Comment	Acquired Time	11/10/2020 9:45:16 AM



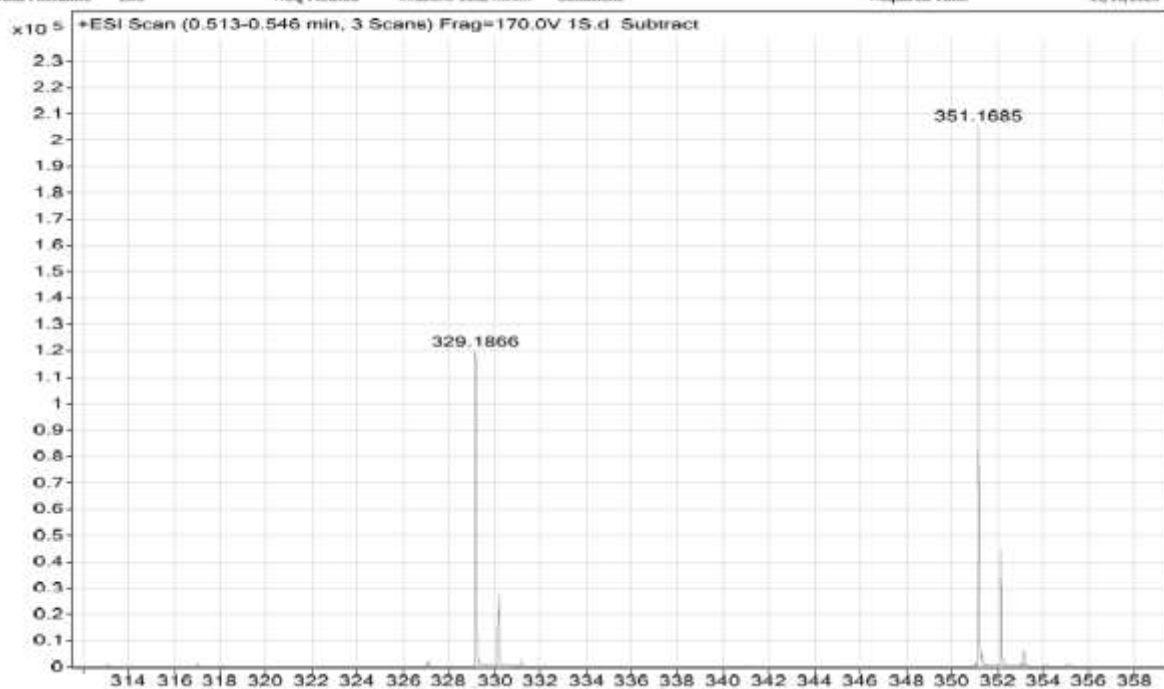
***N*-Boc-2-(hex-1-yn-1-yl)-1*H*-benzo[*d*]imidazole (1a)**Calcd for  $C_{18}H_{22}N_2O_2Na^+$  321.1573; Found: 321.1579.***N*-Boc-2-(hex-1-yn-1-yl)-5,6-dimethyl-1*H*-benzo[*d*]imidazole (1b)**Calcd for  $C_{20}H_{26}N_2O_2Na^+$  349.1886; Found: 349.1891

***N*-Boc-2-(hex-1-yn-1-yl)-6-methoxy-1*H*-benzo[*d*]imidazole (1c)**Calcd for  $C_{19}H_{24}N_2O_3Na^+$  351.1679; Found: 351.1685.

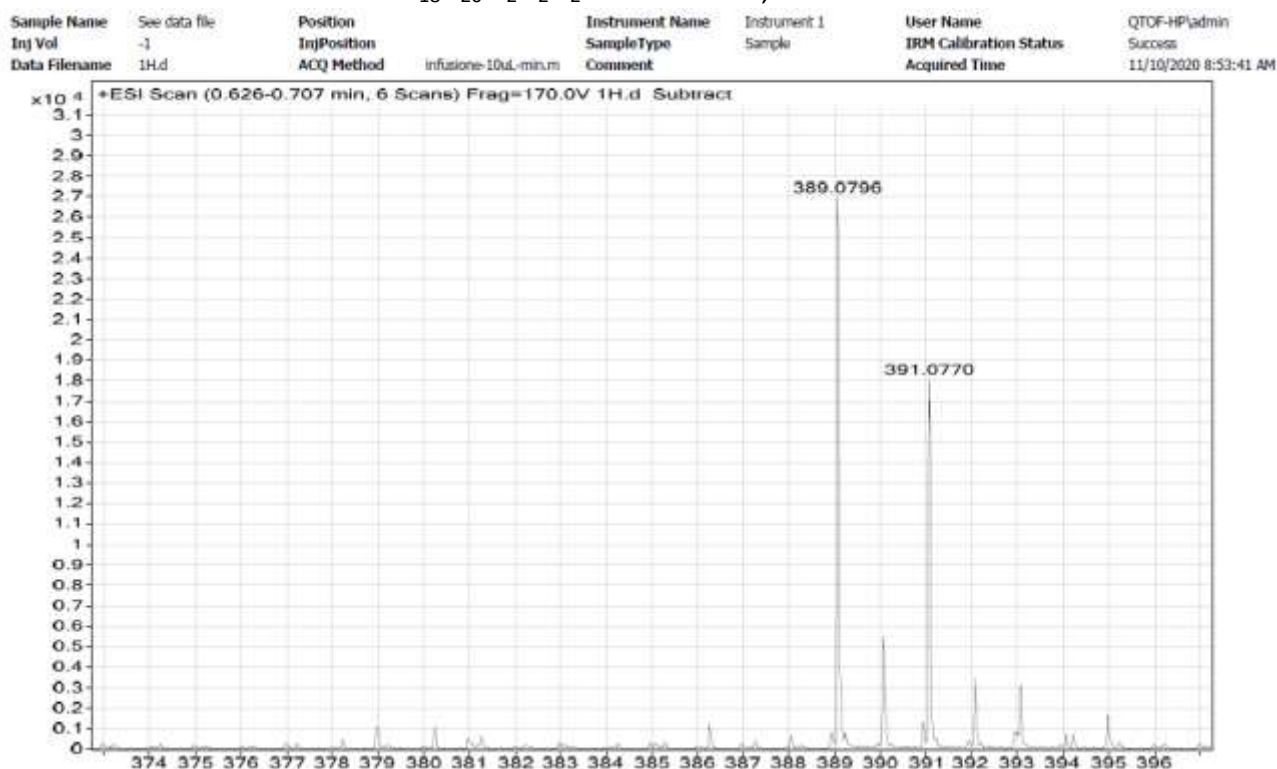
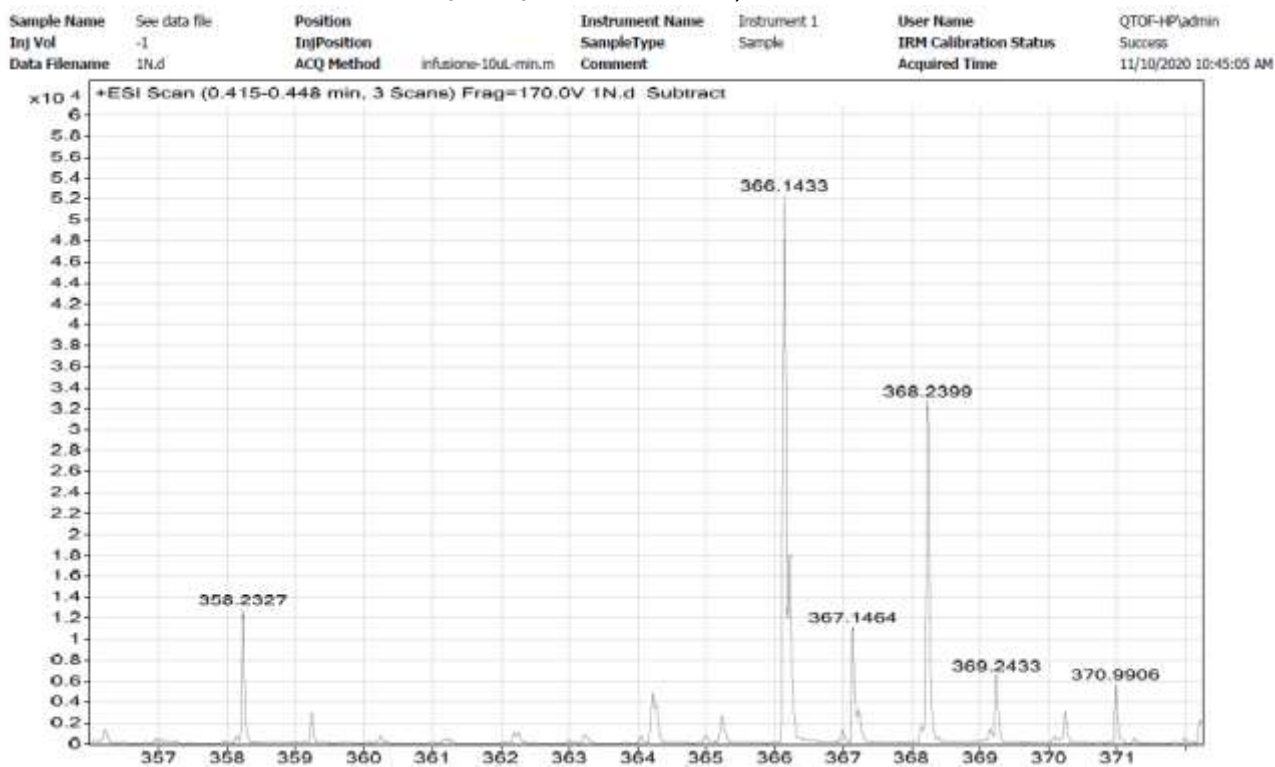
Sample Name	See data file	Position	Instrument Name	Instrument 1	User Name	QTOF-HP/admin
Inj Vol	-1	InjPosition	SampleType	Sample	IRM Calibration Status	Success
Data Filename	1U.d	ACQ Method	infusione-10uL-min.m	Comment	Acquired Time	11/10/2020 1:07:19 PM

***N*-Boc-2-(hex-1-yn-1-yl)-5-methoxy-1*H*-benzo[*d*]imidazole (1d)**Calcd for  $C_{19}H_{24}N_2O_3Na^+$  351.1679; Found: 351.1686.

Sample Name	See data file	Position	Instrument Name	Instrument 1	User Name	QTOF-HP/admin
Inj Vol	-1	InjPosition	SampleType	Sample	IRM Calibration Status	Success
Data Filename	1S.d	ACQ Method	infusione-10uL-min.m	Comment	Acquired Time	11/10/2020 12:36:17 PM



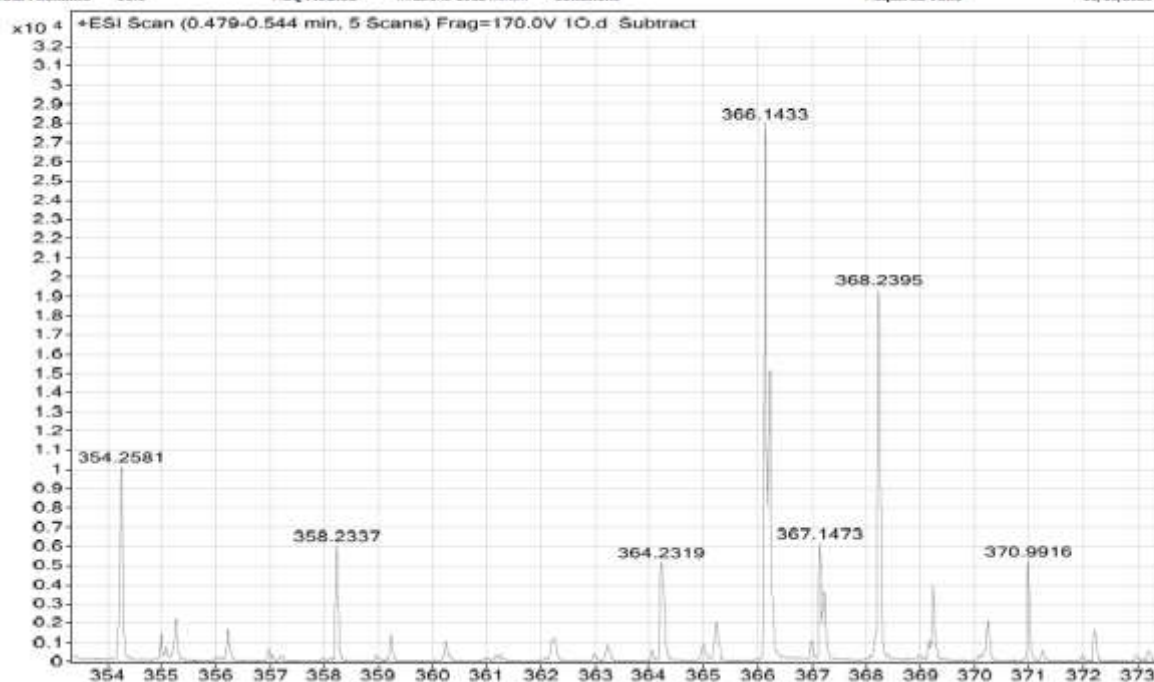


***N*-Boc-5,6-dichloro-2-(hex-1-yn-1-yl)-1*H*-benzo[*d*]imidazole (1e)**Calcd for  $C_{18}H_{20}Cl_2N_2O_2Na^+$  389.0794; Found: 389.0796.***N*-Boc-2-(hex-1-yn-1-yl)-6-nitro-1*H*-benzo[*d*]imidazole (1f)**Calcd for  $C_{18}H_{21}N_3O_4Na^+$  366.1424; Found: 366.1433.



***N*-Boc-2-(hex-1-yn-1-yl)-5-nitro-1*H*-benzo[d]imidazole (1g)**Calcd for  $C_{18}H_{21}N_3O_4Na^+$  366.1424; Found: 366.1433.

Sample Name	See data file	Position	Instrument Name	Instrument 1	User Name	QTOF-HP/admin
Inj Vol	-1	InjPosition	SampleType	Sample	IRM Calibration Status	Success
Data Filename	10.d	ACQ Method	Comment		Acquired Time	11/10/2020 11:01:22 AM

***N*-Boc-2-(dec-1-yn-1-yl)-1*H*-benzo[d]imidazole (1h)**Calcd for  $C_{22}H_{30}N_2O_2Na^+$  377.2199; Found: 377.2204.

Sample Name	See data file	Position	Instrument Name	Instrument 1	User Name	QTOF-HP/admin
Inj Vol	-1	InjPosition	SampleType	Sample	IRM Calibration Status	Success
Data Filename	1F.d	ACQ Method	Comment		Acquired Time	11/10/2020 8:15:24 AM



***N*-Boc-2-(5-methylhex-1-yn-1-yl)-1*H*-benzo[d]imidazole (1i)**Calcd for  $C_{19}H_{24}N_2O_2Na^+$  335.1730; Found: 335.1736

Sample Name	See data file	Position	Instrument Name	Instrument 1	User Name	QTOF-HP/admin
Inj Vol	-1	InjPosition	SampleType	Sample	IRM Calibration Status	Success
Data Filename	1D.d	Acq Method	infusione-10uL-min.m	Comment	Acquired Time	11/10/2020 7:47:10 AM

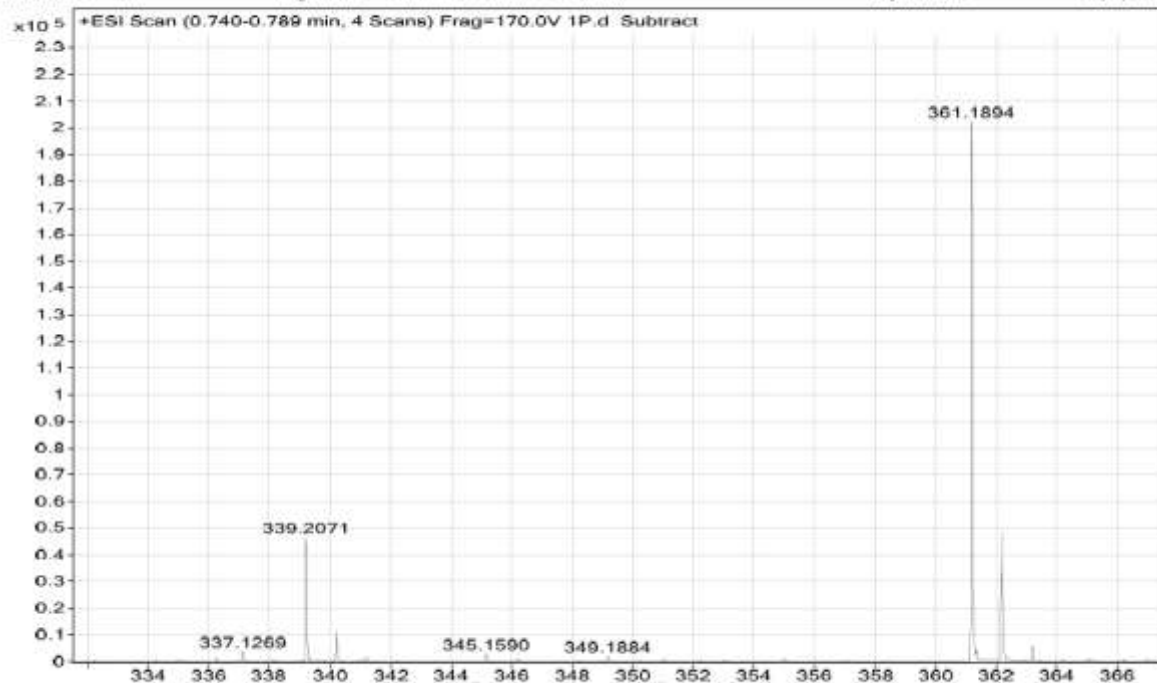
***N*-Boc-2-(4-phenylbut-1-yn-1-yl)-1*H*-benzo[d]imidazole (1j)**Calcd for  $C_{22}H_{22}N_2O_2Na^+$  369.1573; Found: 369.1578.

Sample Name	See data file	Position	Instrument Name	Instrument 1	User Name	QTOF-HP/admin
Inj Vol	-1	InjPosition	SampleType	Sample	IRM Calibration Status	Success
Data Filename	1E.d	Acq Method	infusione-10uL-min.m	Comment	Acquired Time	11/10/2020 8:00:10 AM



***N*-Boc-2-(3-cyclohexylprop-1-yn-1-yl)-1*H*-benzo[*d*]imidazole (1k)**Calcd for  $C_{21}H_{26}N_2O_2Na^+$  361.1892; Found: 361.1894

Sample Name	See data file	Position	Instrument Name	Instrument 1	User Name	QTOF-HP/admin
Inj Vol	-1	InjPosition	SampleType	Sample	IRM Calibration Status	Success
Data Filename	1P.d	ACQ Method	infusione-10uL-min.m	Comment	Acquired Time	11/10/2020 11:17:33 AM

***N*-Boc-2-(cyclohex-1-en-1-ylethynyl)-1*H*-benzo[*d*]imidazole (1l)**Calcd for  $C_{20}H_{22}N_2O_2Na^+$  345.1573; Found: 345.1581

Sample Name	See data file	Position	Instrument Name	Instrument 1	User Name	QTOF-HP/admin
Inj Vol	-1	InjPosition	SampleType	Sample	IRM Calibration Status	Success
Data Filename	1L.d	ACQ Method	infusione-10uL-min.m	Comment	Acquired Time	11/10/2020 9:23:10 AM

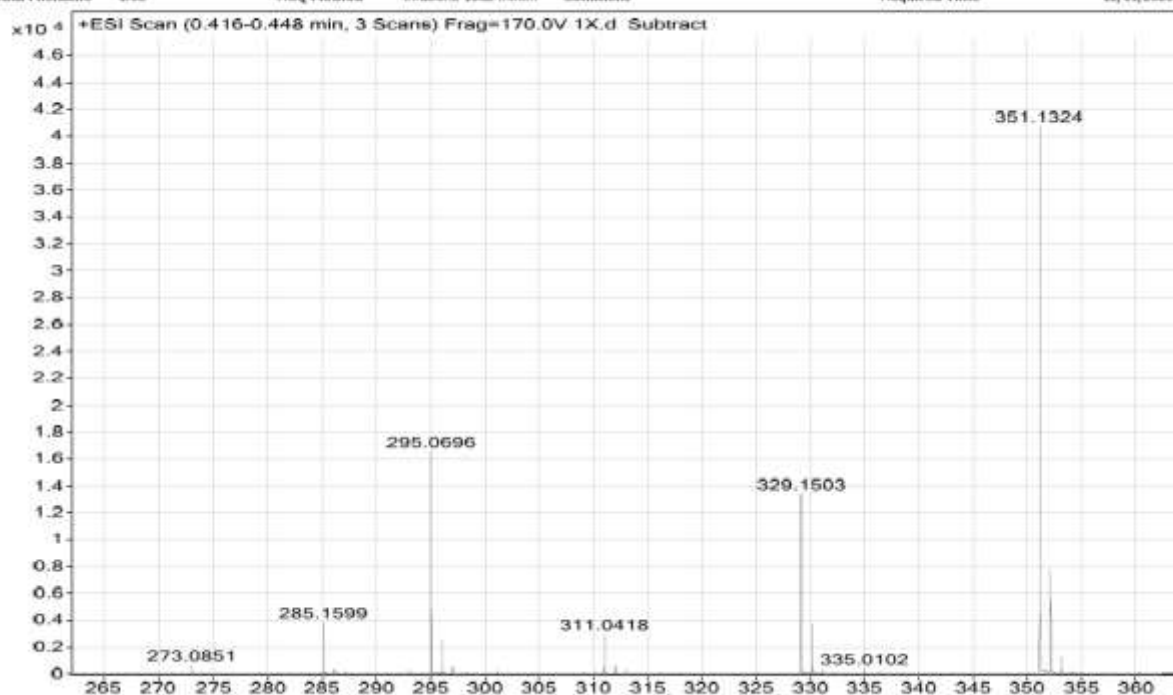


***N*-Boc-2-(3-methoxyprop-1-yn-1-yl)-1*H*-benzo[*d*]imidazole (1m)**Calcd for  $C_{16}H_{18}N_2O_3Na^+$  309.1210; Found: 309.1217.

Sample Name	See data file	Position	Instrument Name	Instrument 1	User Name	QTOF-HP/admin
Inj Vol	-1	InjPosition	SampleType	Sample	IRM Calibration Status	Success
Data Filename	1T.d	Acq Method	infusione-10uL-min.m	Comment	Acquired Time	11/10/2020 12:51:33 PM

**Methyl *N*-Boc-5-(1*H*-benzo[*d*]imidazol-2-yl)pent-4-ynoate (1n)**Calcd for  $C_{18}H_{20}N_2O_4Na^+$  351.1315; Found: 351.1324

Sample Name	See data file	Position	Instrument Name	Instrument 1	User Name	QTOF-HP/admin
Inj Vol	-1	InjPosition	SampleType	Sample	IRM Calibration Status	Success
Data Filename	1X.d	Acq Method	infusione-10uL-min.m	Comment	Acquired Time	12/11/2020 11:32:08 AM



***N*-Boc-4-(1*H*-benzo[*d*]imidazol-2-yl)but-3-yn-1-ol (1o)**Calcd for C<sub>16</sub>H<sub>18</sub>N<sub>2</sub>O<sub>3</sub>Na<sup>+</sup> 309.1210; Found: 309.1217

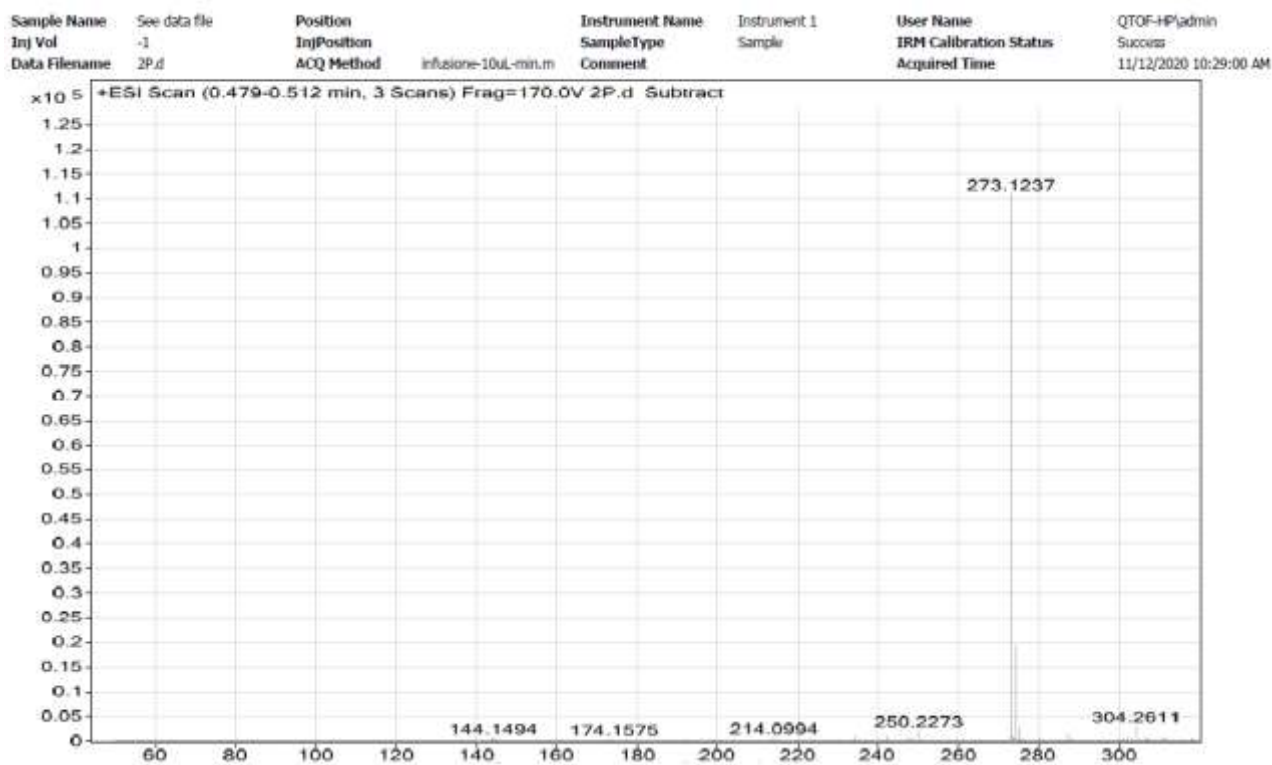
Sample Name	See data file	Position	Instrument Name	Instrument 1	User Name	QTOF-HP/admin
Inj Vol	-1	InjPosition	SampleType	Sample	IRM Calibration Status	Success
Data Filename	11.d	ACQ Method	infusione-10uL-min.m	Comment	Acquired Time	11/10/2020 9:05:38 AM

**3-Butyl-1*H*-benzo[4,5]imidazo[1,2-*c*][1,3]oxazin-1-one (2a)**Calcd for C<sub>14</sub>H<sub>15</sub>N<sub>2</sub>O<sub>2</sub><sup>+</sup> 243.1128; Found: 243.1132

Sample Name	See data file	Position	Instrument Name	Instrument 1	User Name	QTOF-HP/admin
Inj Vol	-1	InjPosition	SampleType	Sample	IRM Calibration Status	Success
Data Filename	2A.d	ACQ Method	infusione-10uL-min.m	Comment	Acquired Time	11/10/2020 3:04:03 PM

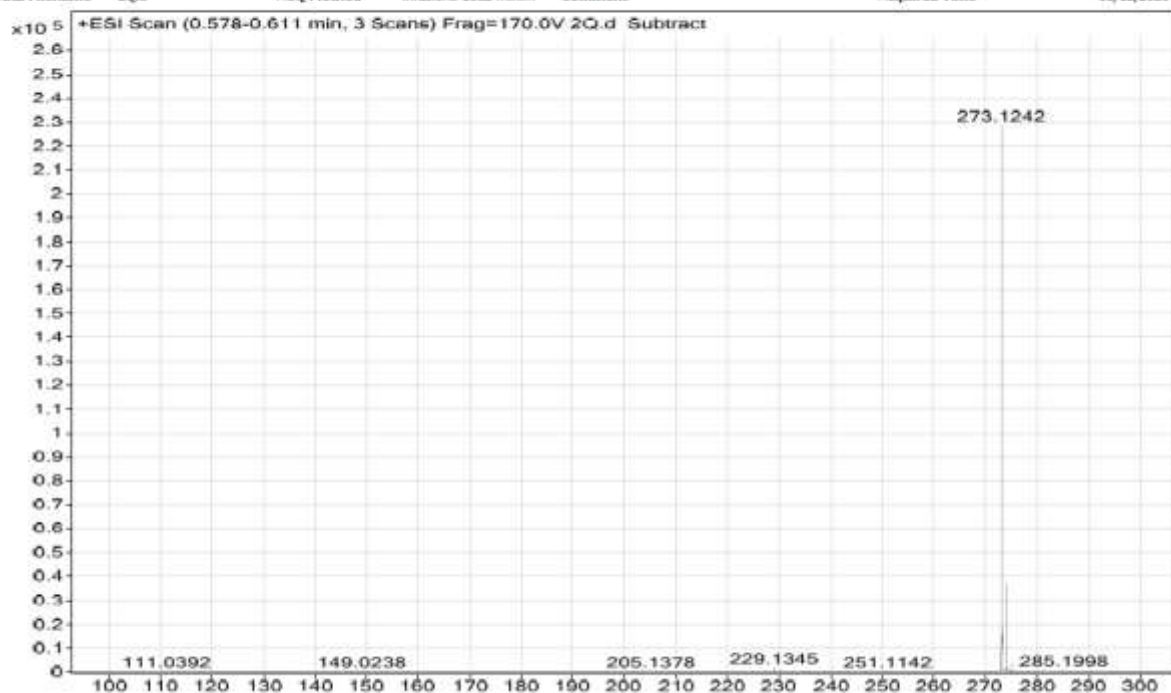




**3-Butyl-7,8-dimethyl-1H-benzo[4,5]imidazo[1,2-c][1,3]oxazin-1-one (2b)**Calcd for  $C_{16}H_{19}N_2O_2^+$  271.1441; Found: 271.1446**3-Butyl-8-methoxy-1H-benzo[4,5]imidazo[1,2-c][1,3]oxazin-1-one (2c)**Calcd for  $C_{15}H_{17}N_2O_3^+$  273.1234; Found: 273.1237.

**3-Butyl-7-methoxy-1*H*-benzo[4,5]imidazo[1,2-*c*][1,3]oxazin-1-one (2d)**Calcd for  $C_{15}H_{17}N_2O_3^+$  273.1234; Found: 273.1242.

Sample Name	See data file	Position	Instrument Name	Instrument 1	User Name	QTOF-HPadmin
Inj Vol	-1	InjPosition	SampleType	Sample	IRM Calibration Status	Success
Data Filename	2Q.d	ACQ Method	infusione-10uL-min.m	Comment	Acquired Time	11/12/2020 10:41:20 AM

**3-Butyl-7,8-dichloro-1*H*-benzo[4,5]imidazo[1,2-*c*][1,3]oxazin-1-one (2e)**Calcd for  $C_{14}H_{13}Cl_2N_2O_2^+$  311.0349; Found: 311.0348

Sample Name	See data file	Position	Instrument Name	Instrument 1	User Name	QTOF-HPadmin
Inj Vol	-1	InjPosition	SampleType	Sample	IRM Calibration Status	Success
Data Filename	2F.d	ACQ Method	infusione-10uL-min.m	Comment	Acquired Time	11/12/2020 8:53:06 AM



**3-Butyl-8-nitro-1*H*-benzo[4,5]imidazo[1,2-*c*][1,3]oxazin-1-one (2f)**Calcd for  $C_{15}H_{17}N_3O_5Na^+$  342.1060; Found: 342.1064.

Sample Name	See data file	Position	Instrument Name	Instrument 1	User Name	QTOF-HP/admin
Inj Vol	-1	InjPosition	SampleType	Sample	IRM Calibration Status	Success
Data Filename	2L.d	ACQ Method	Infusione-10uL-min.m	Comment	Acquired Time	11/13/2020 8:46:24 AM

**3-Butyl-7-nitro-1*H*-benzo[4,5]imidazo[1,2-*c*][1,3]oxazin-1-one (2g)**Calcd for  $C_{15}H_{17}N_3O_5Na^+$  342.1060; Found: 342.1064.

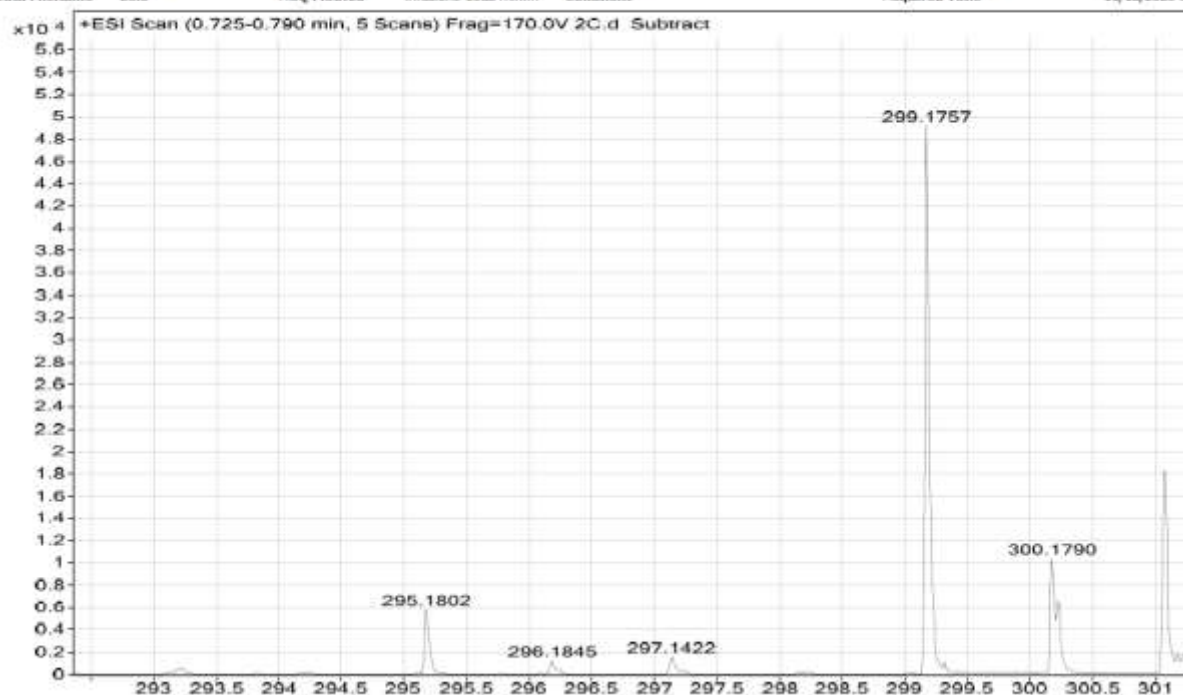
Sample Name	See data file	Position	Instrument Name	Instrument 1	User Name	QTOF-HP/admin
Inj Vol	-1	InjPosition	SampleType	Sample	IRM Calibration Status	Success
Data Filename	2L.d	ACQ Method	Infusione-10uL-min.m	Comment	Acquired Time	11/13/2020 8:29:34 AM



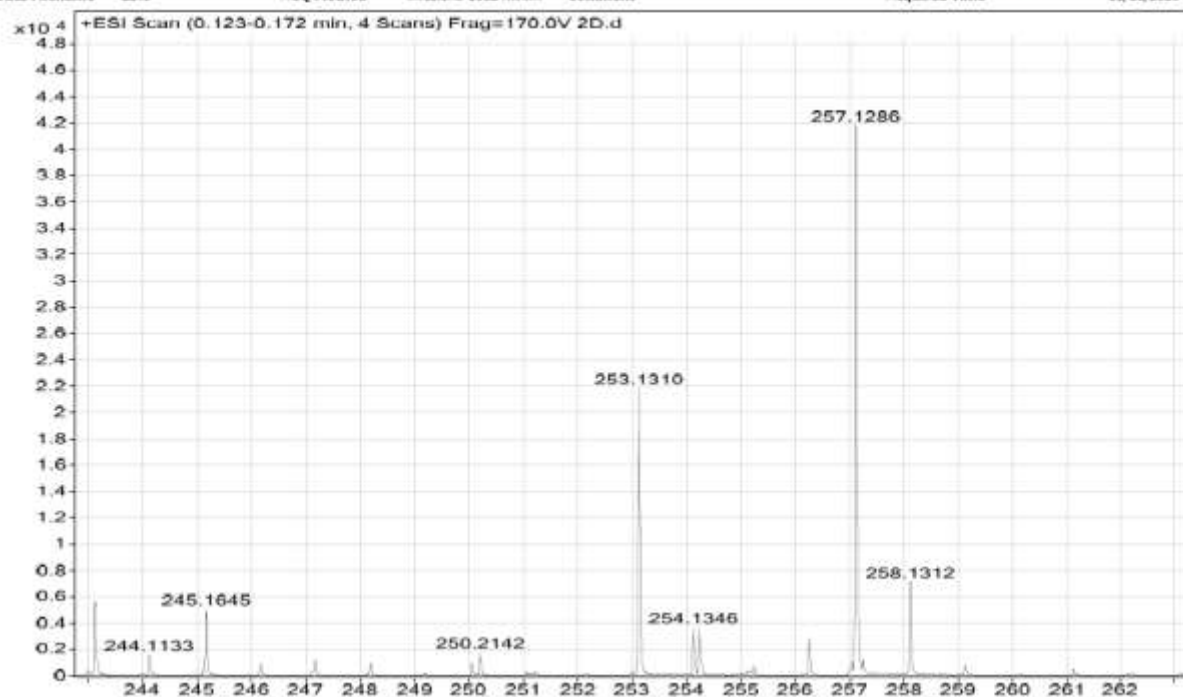


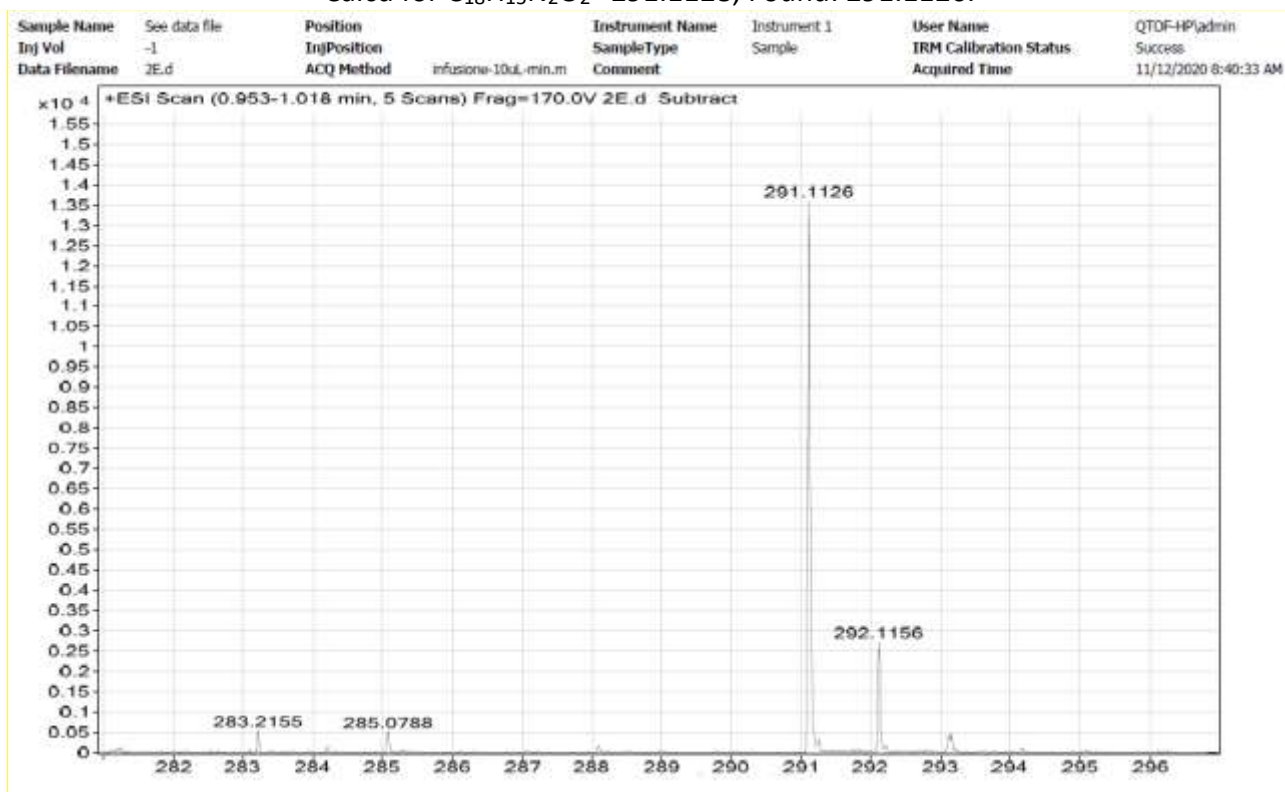
**3-Octyl-1H-benzo[4,5]imidazo[1,2-c][1,3]oxazin-1-one (2h)**Calcd for  $C_{18}H_{23}N_2O_2^+$  299.1754; Found: 299.1757.

Sample Name	See data file	Position	Instrument Name	Instrument 1	User Name	QTOF-HP/admin
Inj Vol	-1	InjPosition	SampleType	Sample	IRM Calibration Status	Success
Data Filename	2C.d	Acq Method	infusione-10uL-min.m	Comment	Acquired Time	11/12/2020 8:22:48 AM

**3-Isopentyl-1H-benzo[4,5]imidazo[1,2-c][1,3]oxazin-1-one (2i)**Calcd for  $C_{15}H_{17}N_2O_2^+$  257.1285; Found: 257.1286.

Sample Name	See data file	Position	Instrument Name	Instrument 1	User Name	QTOF-HP/admin
Inj Vol	-1	InjPosition	SampleType	Sample	IRM Calibration Status	Success
Data Filename	2D.d	Acq Method	infusione-10uL-min.m	Comment	Acquired Time	11/11/2020 8:55:35 AM

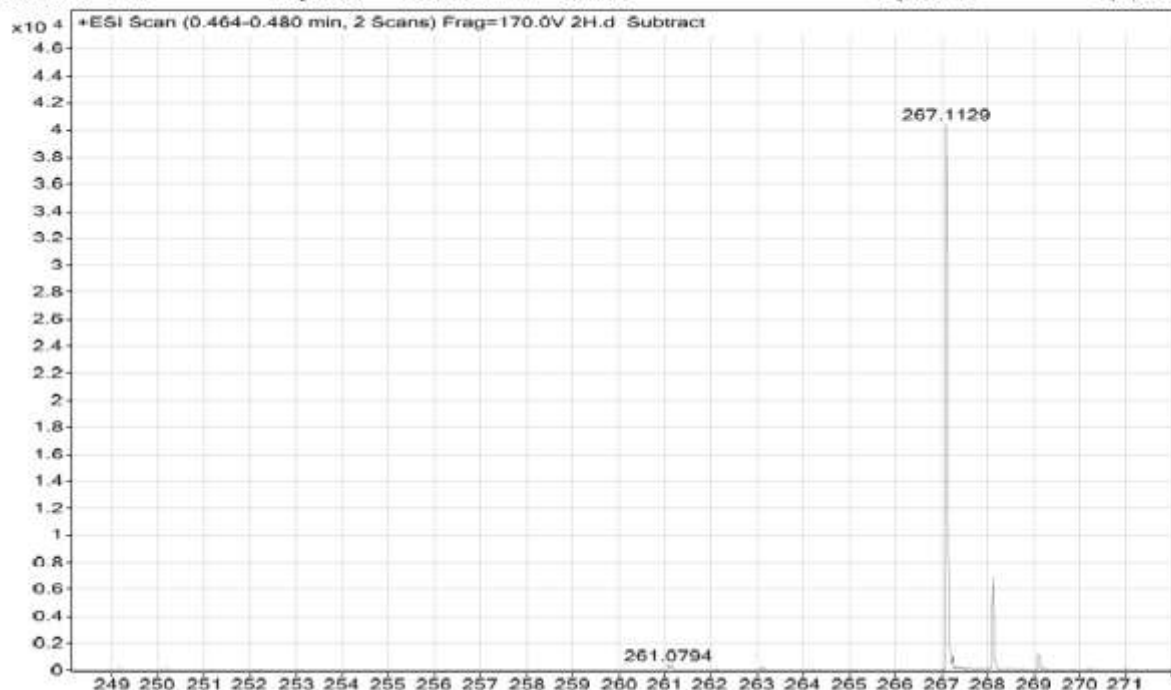


**3-Phenethyl-1H-benzo[4,5]imidazo[1,2-c][1,3]oxazin-1-one (2j)**Calcd for  $C_{18}H_{15}N_2O_2^+$  291.1128; Found: 291.1126.**3-(Cyclohexylmethyl)-1H-benzo[4,5]imidazo[1,2-c][1,3]oxazin-1-one (2k)**Calcd for  $C_{17}H_{19}N_2O_2^+$  283.1441; Found: 283.1448.

### 3-(Cyclohex-1-en-1-yl)-1*H*-benzo[4,5]imidazo[1,2-*c*][1,3]oxazin-1-one (2l)

Calcd for  $C_{16}H_{15}N_2O_2^+$  267.1128; Found: 267.1129.

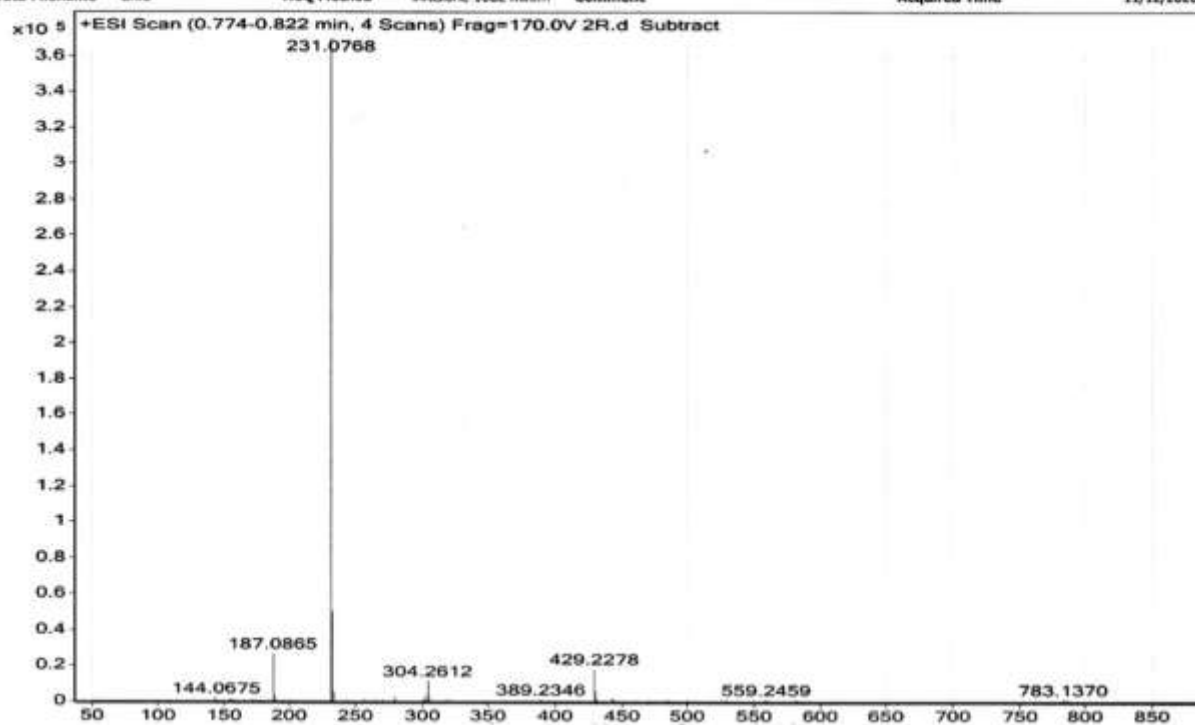
Sample Name	See data file	Position	Instrument Name	Instrument 1	User Name	QTOF-HP/admin
Inj Vol	-1	InjPosition	SampleType	Sample	IRM Calibration Status	Success
Data Filename	2H.d	ACQ Method	infusione-10uL-min.m	Comment	Acquired Time	11/11/2020 10:30:15 AM



### 3-(Methoxymethyl)-1*H*-benzo[4,5]imidazo[1,2-*c*][1,3]oxazin-1-one (2m)

Calcd for  $C_{12}H_{11}N_2O_3^+$  231.0764; Found: 231.0768

Sample Name	See data file	Position	Instrument Name	Instrument 1	User Name	QTOF-HP/admin
Inj Vol	-1	InjPosition	SampleType	Sample	IRM Calibration Status	Success
Data Filename	2R.d	ACQ Method	infusione-10uL-min.m	Comment	Acquired Time	11/12/2020 10:53:29



**Methyl 3-(1-oxo-1*H*-benzo[4,5]imidazo[1,2-*c*][1,3]oxazin-3-yl)propanoate (2n)**

Calcd for  $C_{14}H_{13}N_2O_4^+$  273.0870; Found: 273.0874.

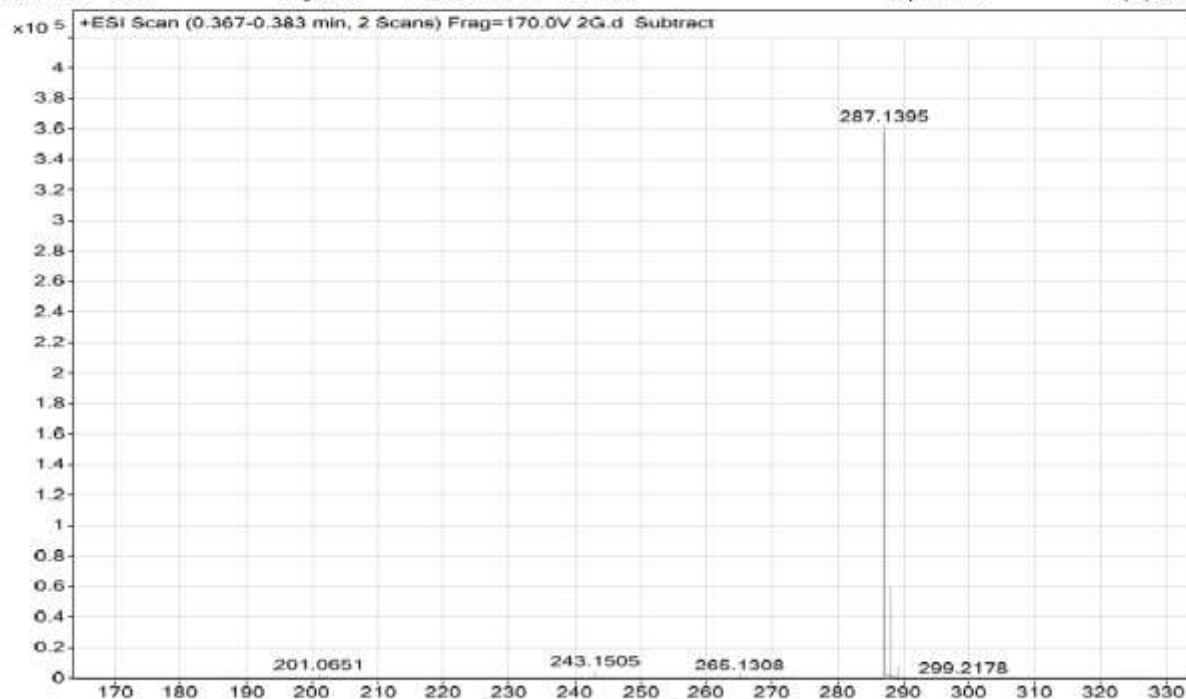
Sample Name	See data file	Position		Instrument Name	Instrument 1	User Name	QTOF-HP/admin
Inj Vol	-1	InjPosition		SampleType	Sample	IRM Calibration Status	Success
Data Filename	2X.d	ACQ Method	infusione-10uL-min.m	Comment		Acquired Time	12/11/2020 11:52:35 AM



**3-(2-(Tert-butoxy)ethyl)-1*H*-benzo[4,5]imidazo[1,2-*c*][1,3]oxazin-1-one (2o')**

Calcd for  $C_{16}H_{19}N_2O_3^+$  287.1390; Found: 287.1395.

Sample Name	See data file	Position		Instrument Name	Instrument 1	User Name	QTOF-HP/admin
Inj Vol	-1	InjPosition		SampleType	Sample	IRM Calibration Status	Success
Data Filename	2G.d	ACQ Method	infusione-10uL-min.m	Comment		Acquired Time	11/12/2020 9:22:09 AM



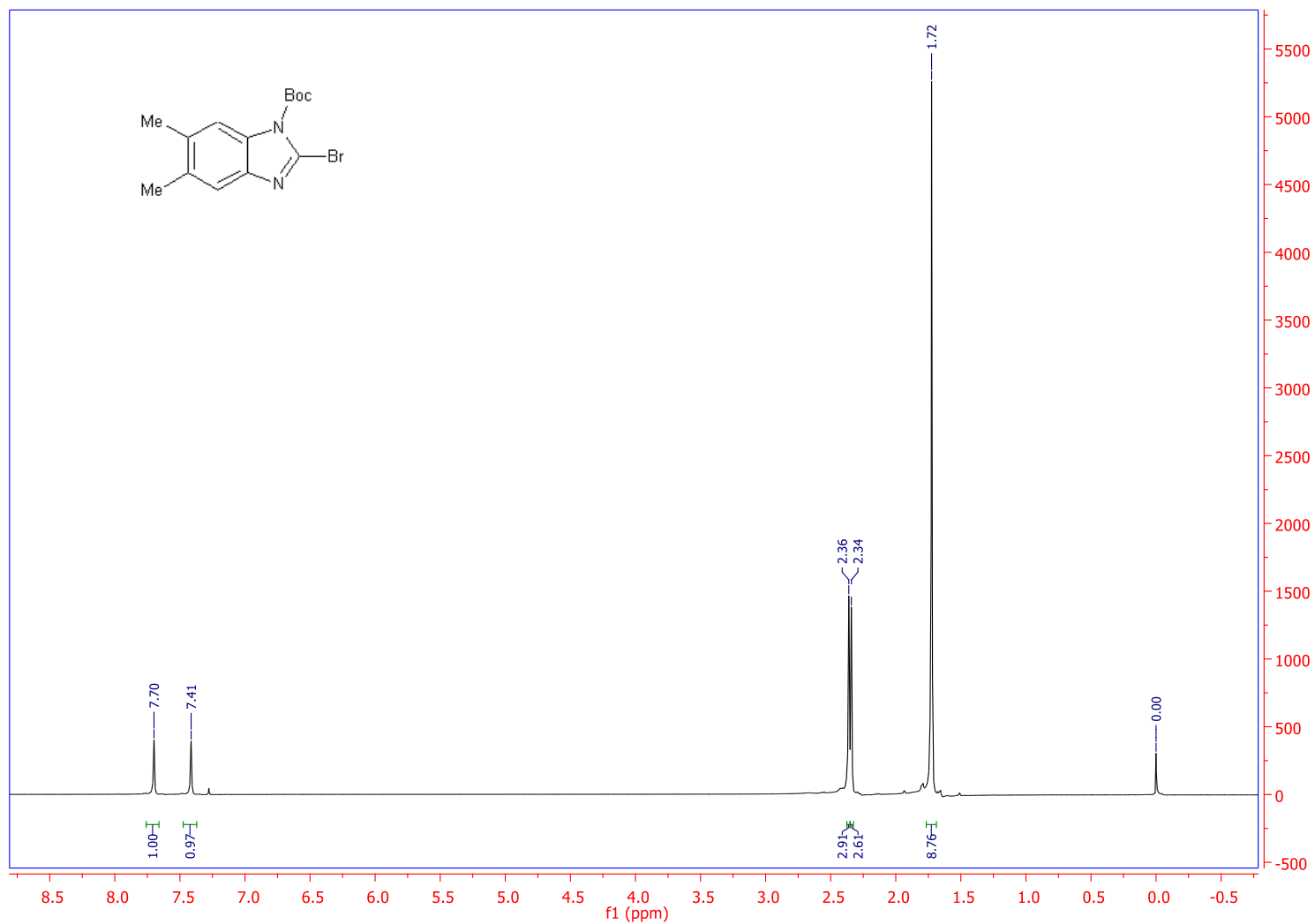
**2-(Hex-1-yn-1-yl)-6-nitro-1H-benzo[d]imidazole (3f)**Calcd for  $C_{13}H_{14}N_3O_2^+$  244.1081; Found: 244.1081.

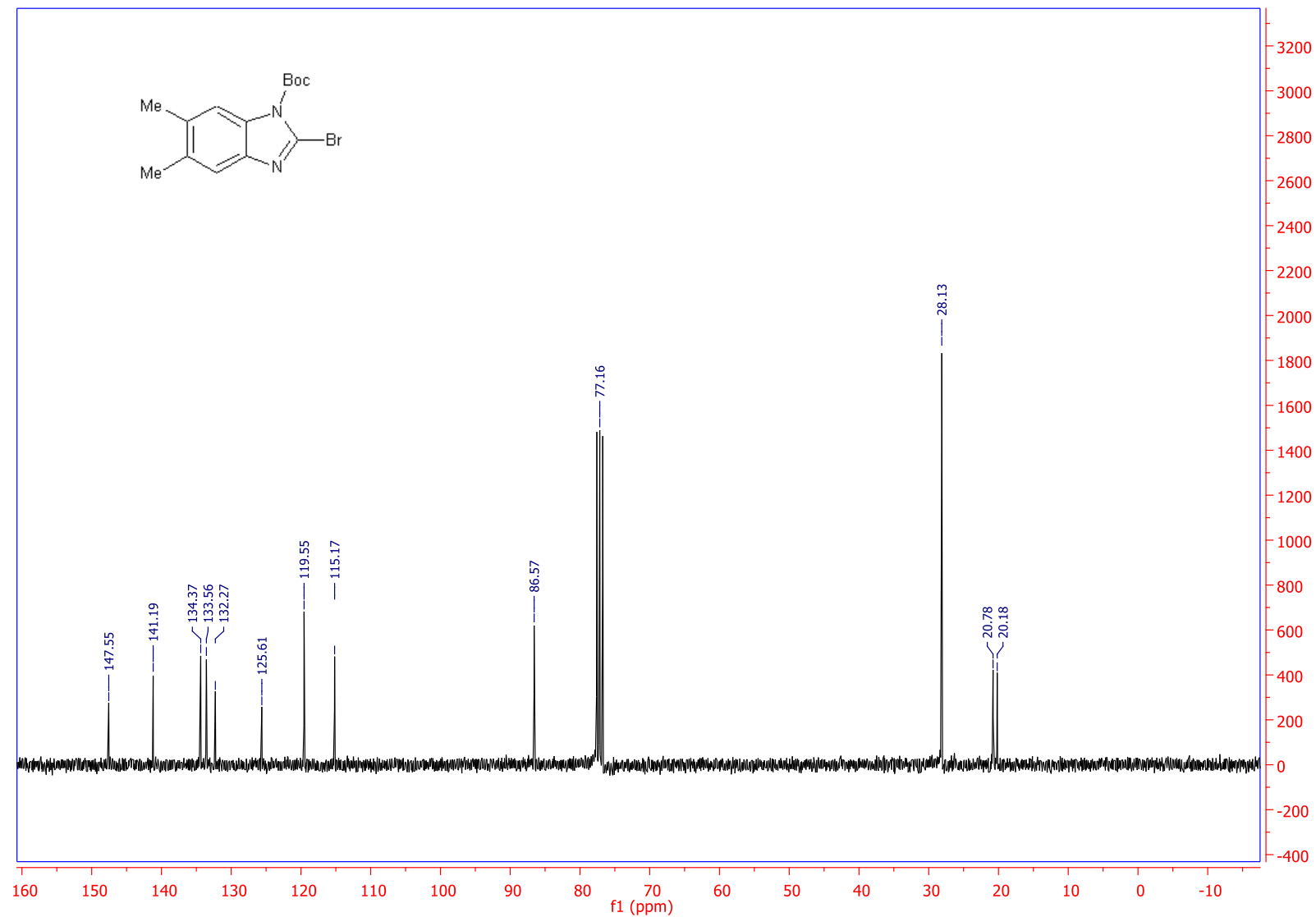
Sample Name	See data file	Position	Instrument Name	Instrument 1	User Name	QTOF-HP/admin
Inj Vol	-1	InjPosition	SampleType	Sample	IRM Calibration Status	Success
Data Filename	2N.d	ACQ Method	infusione-10uL-min.m	Comment	Acquired Time	11/12/2020 10:06:40 AM

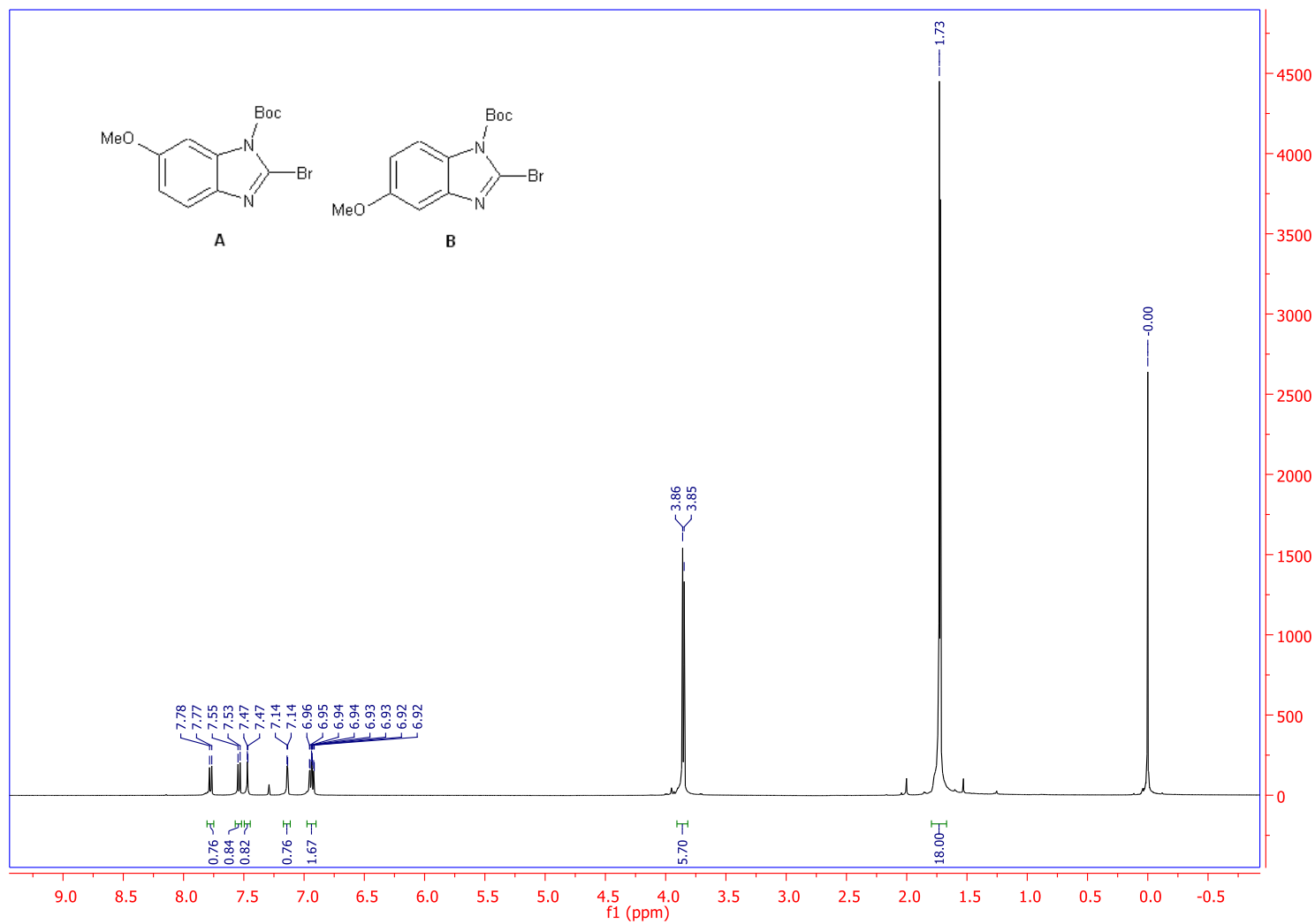
**2-(Hex-1-yn-1-yl)-5-nitro-1H-benzo[d]imidazole (3g)**Calcd for  $C_{13}H_{14}N_3O_2^+$  244.1081; Found: 244.1082.

Sample Name	See data file	Position	Instrument Name	Instrument 1	User Name	QTOF-HP/admin
Inj Vol	-1	InjPosition	SampleType	Sample	IRM Calibration Status	Success
Data Filename	2M.d	ACQ Method	infusione-10uL-min.m	Comment	Acquired Time	11/12/2020 9:50:55 AM

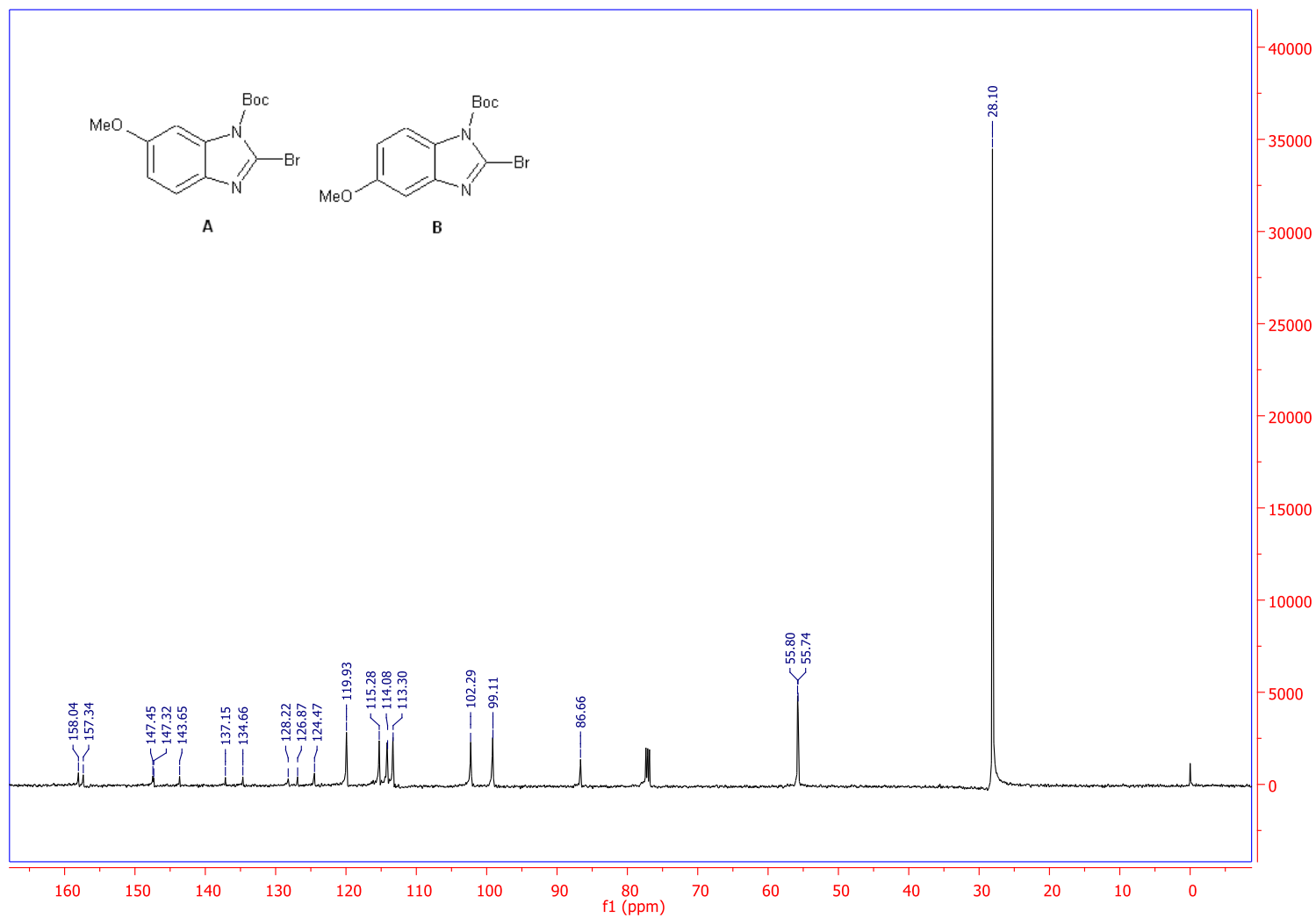


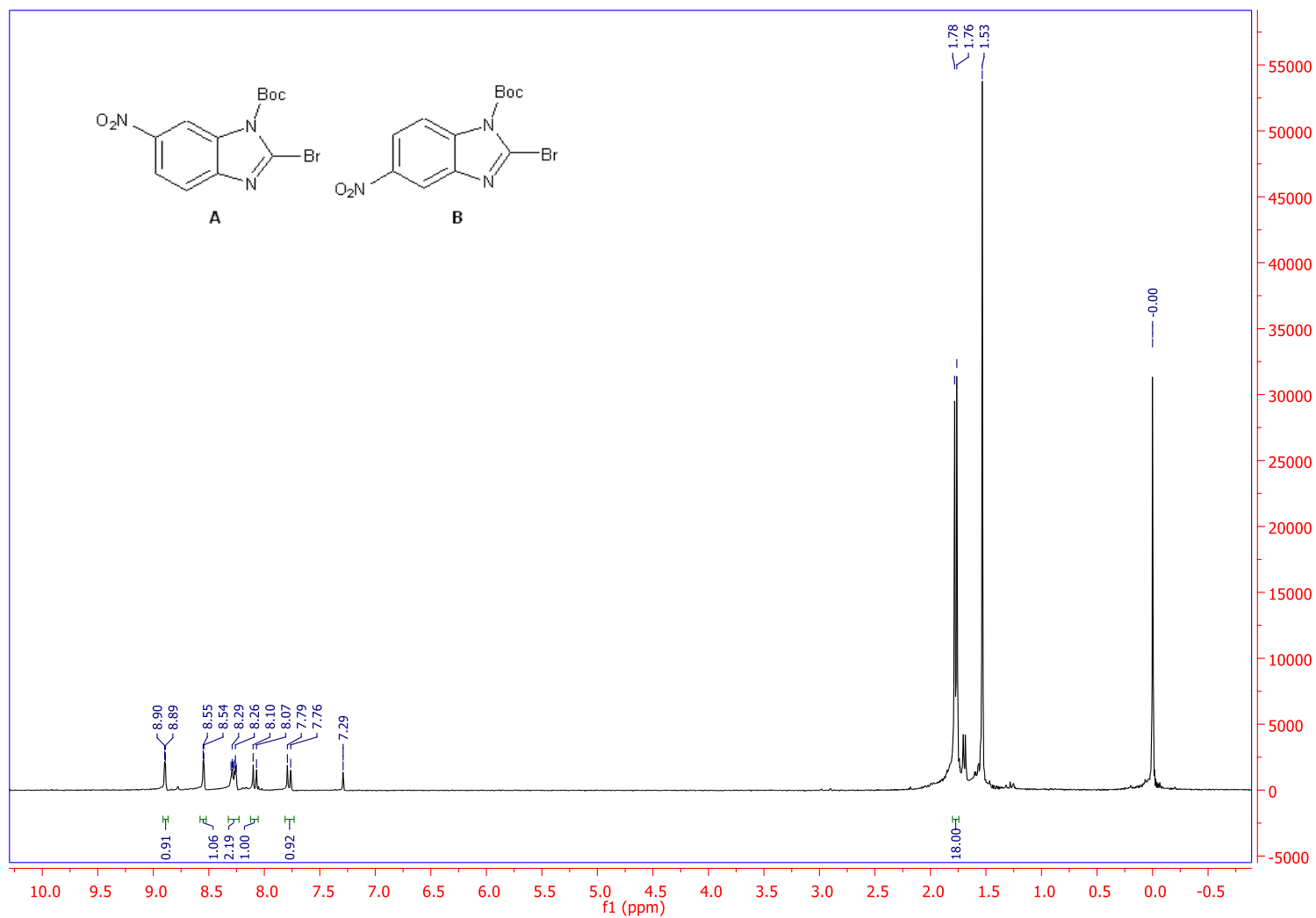
Copy of  $^1\text{H}$  and  $^{13}\text{C}$  NMR Spectra***N*-Boc-2-bromo-5,6-dimethyl-1*H*-benzo[d]imidazole** $^1\text{H}$  NMR (300 MHz  $\text{CDCl}_3$ )

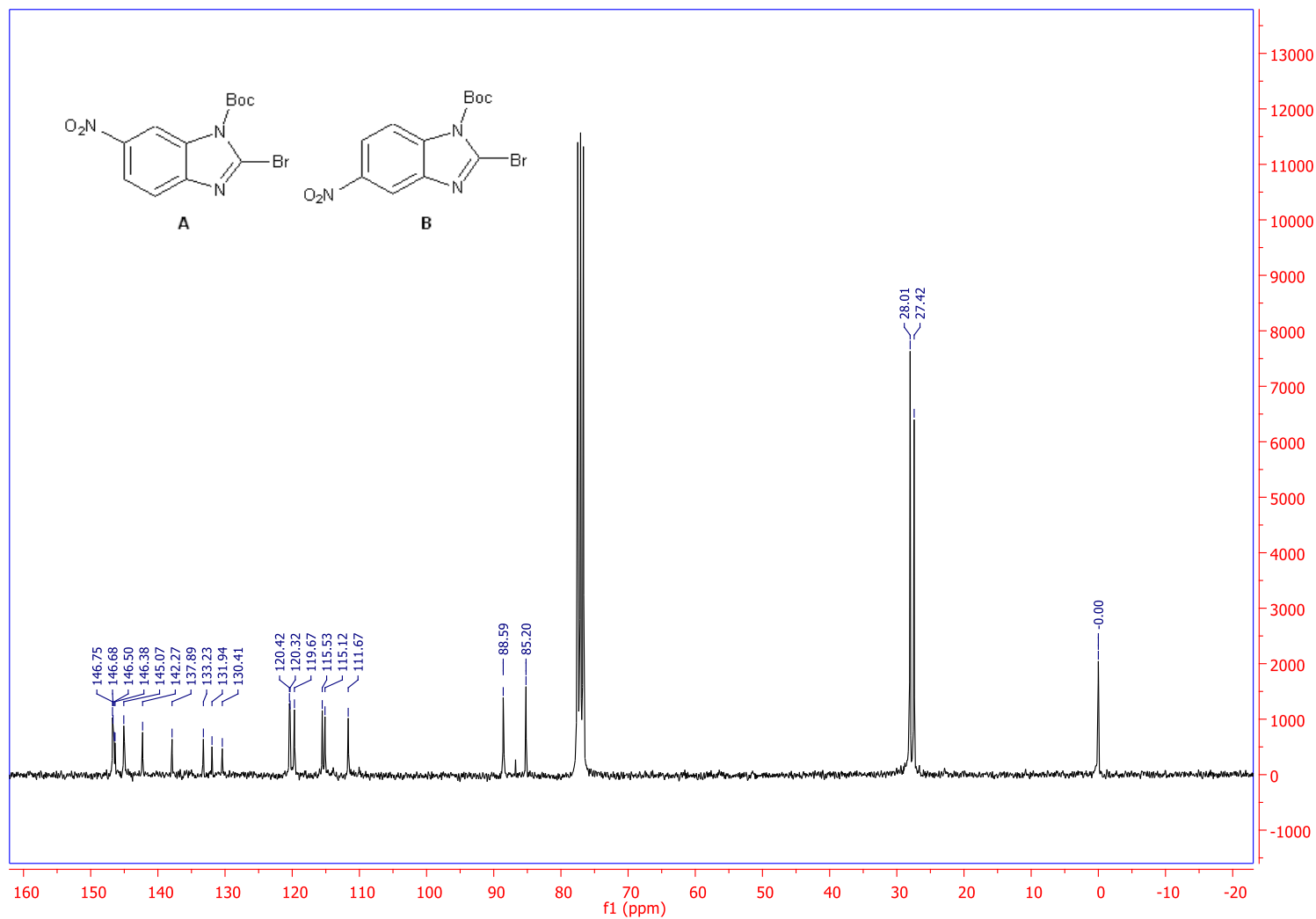
***N*-Boc-2-bromo-5,6-dimethyl-1*H*-benzo[d]imidazole.**<sup>13</sup>C NMR (75 MHz CDCl<sub>3</sub>)

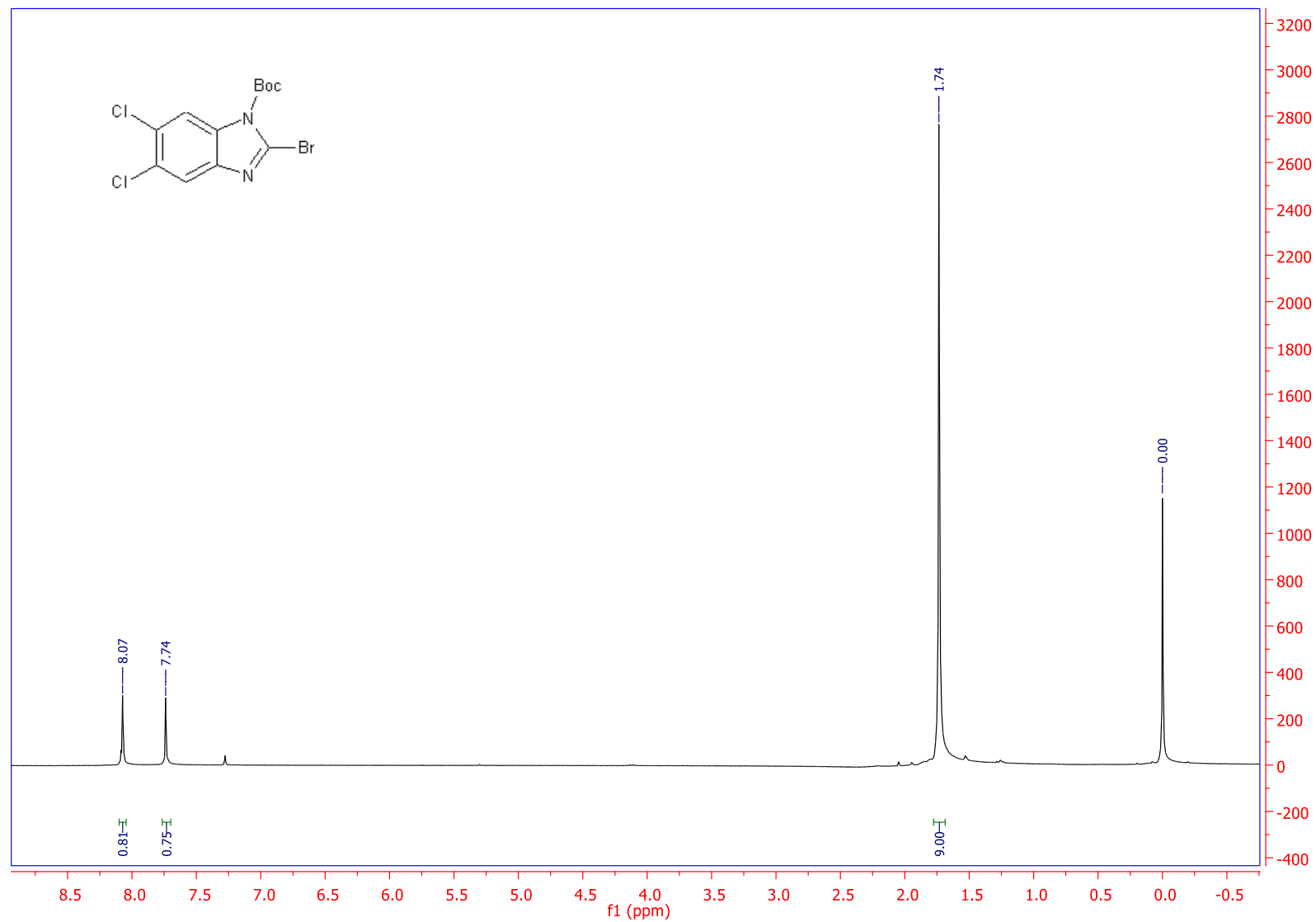
**Mixture of Regioisomers *N*-Boc-2-bromo-6-methoxy-1*H*-benzo[*d*]imidazole (A) and *N*-Boc-2-bromo-5-methoxy-1*H*-benzo[*d*]imidazole (B)****(A/B Ratio = 1 by  $^1\text{H}$  NMR)** $^1\text{H}$  NMR (500 MHz  $\text{CDCl}_3$ )



**Mixture of Regioisomers *N*-Boc-2-bromo-6-methoxy-1*H*-benzo[*d*]imidazole (A) and *N*-Boc-2-bromo-5-methoxy-1*H*-benzo[*d*]imidazole (B)****(A/B Ratio *ca* 1 by  $^1\text{H}$  NMR)** $^{13}\text{C}$  NMR (125 MHz  $\text{CDCl}_3$ )

**Mixture of Regioisomers *N*-Boc-2-bromo-6-nitro-1*H*-benzo[*d*]imidazole (A) and *N*-Boc-2-bromo-5-nitro-1*H*-benzo[*d*]imidazole (B)****(A/B Ratio *ca* 1 by  $^1\text{H}$  NMR)** $^1\text{H}$  NMR (300 MHz  $\text{CDCl}_3$ )

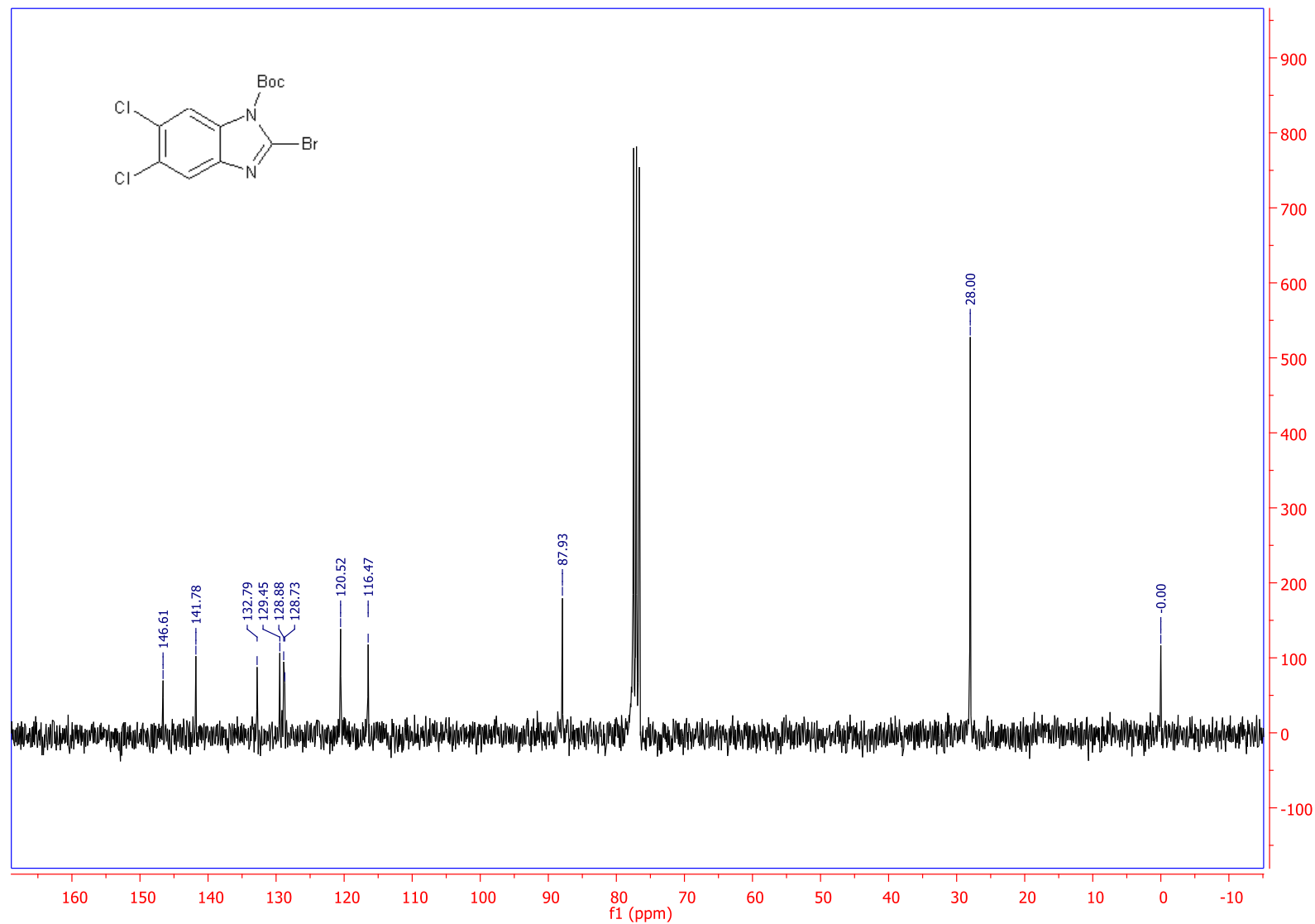
**Mixture of Regioisomers *N*-Boc-2-bromo-6-nitro-1*H*-benzo[*d*]imidazole (A) and *N*-Boc-2-bromo-5-nitro-1*H*-benzo[*d*]imidazole (B)****(A/B Ratio = 1 by  $^1\text{H}$  NMR)** $^{13}\text{C}$  NMR (75 MHz  $\text{CDCl}_3$ )

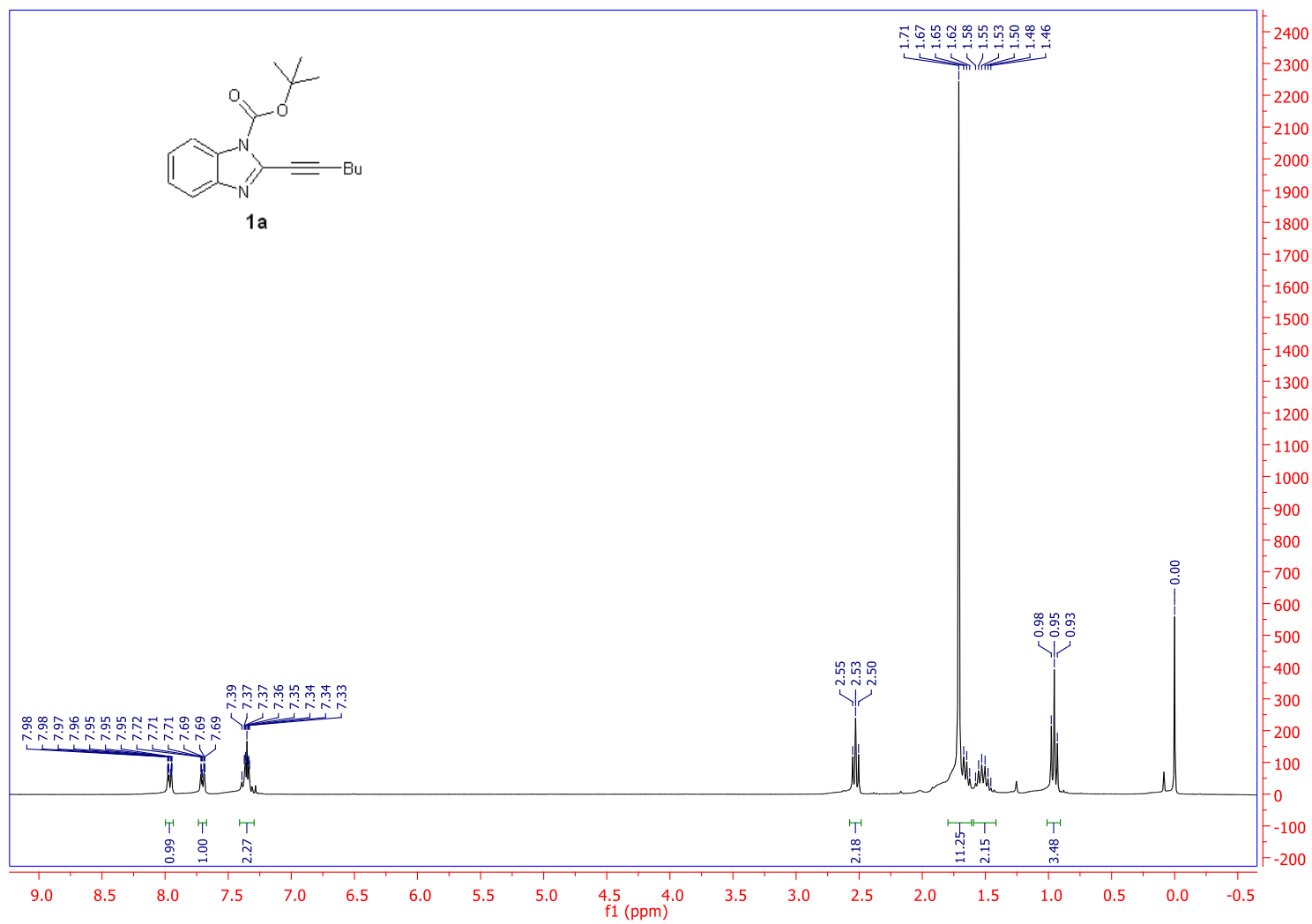
***N*-Boc-2-bromo-5,6-dichloro-1*H*-benzo[*d*]imidazole**<sup>1</sup>H NMR (300 MHz CDCl<sub>3</sub>)

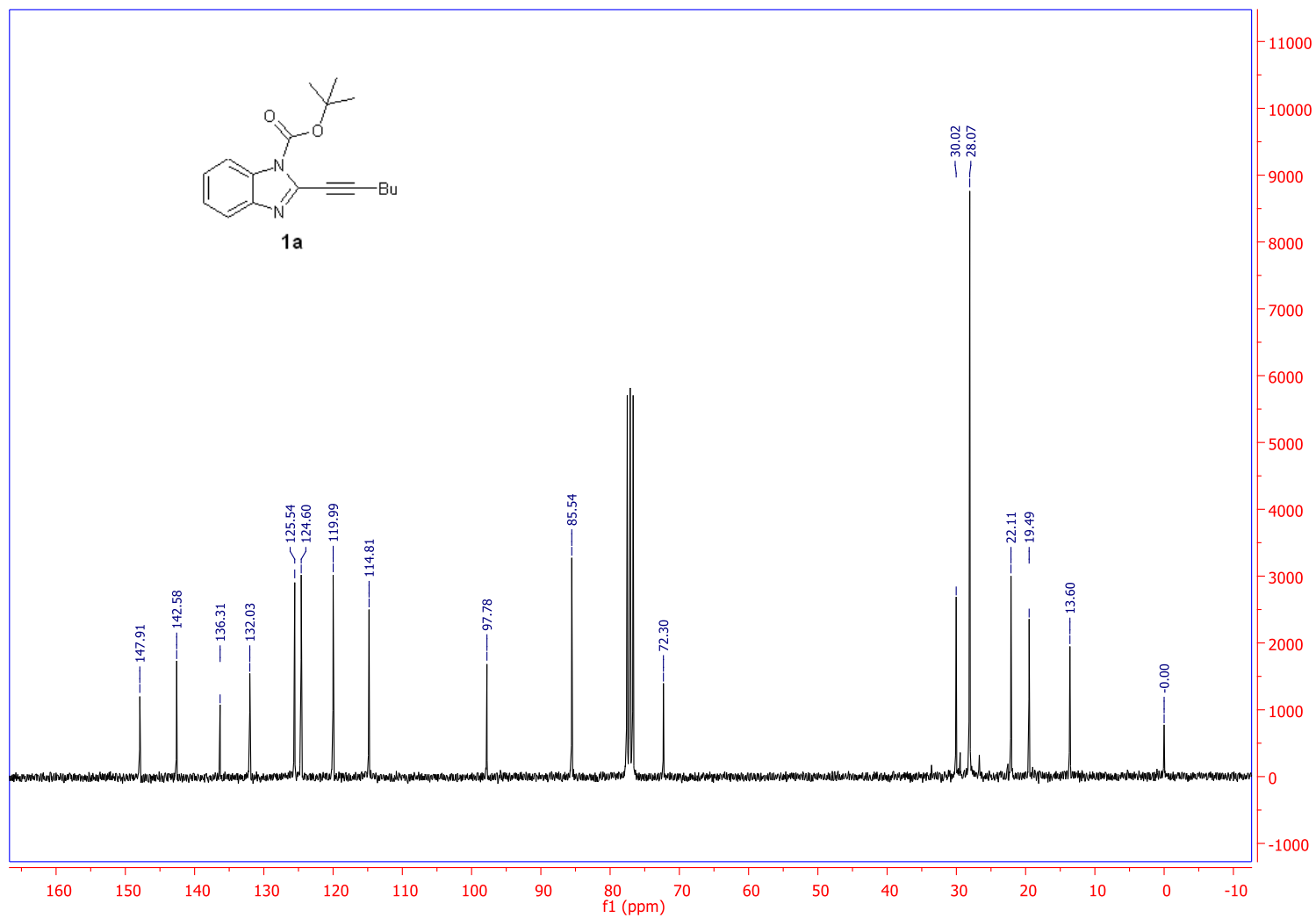
S37

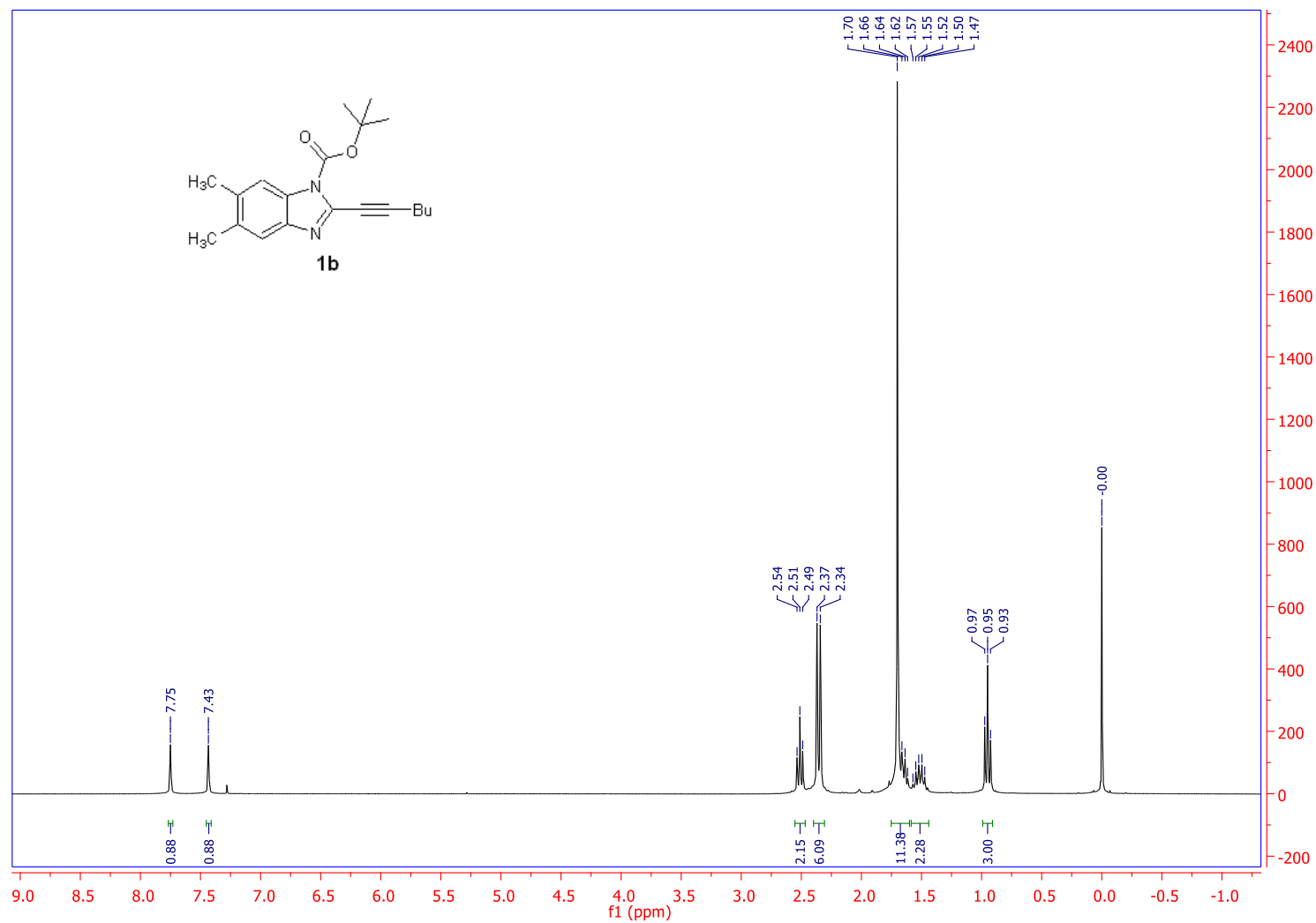
***N*-Boc-2-bromo-5,6-dichloro-1*H*-benzo[*d*]imidazole**

$^{13}\text{C}$  NMR (75 MHz  $\text{CDCl}_3$ )

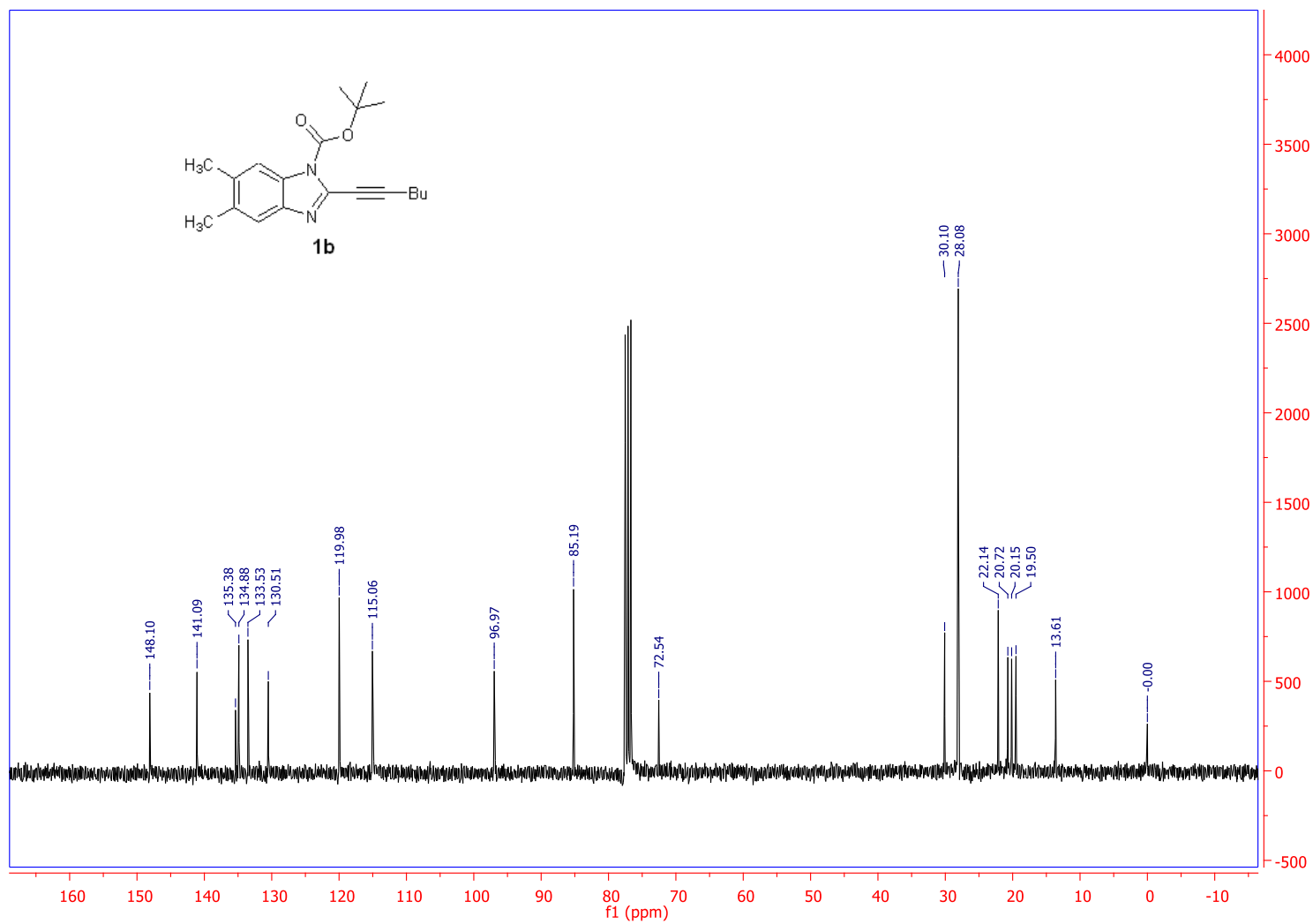


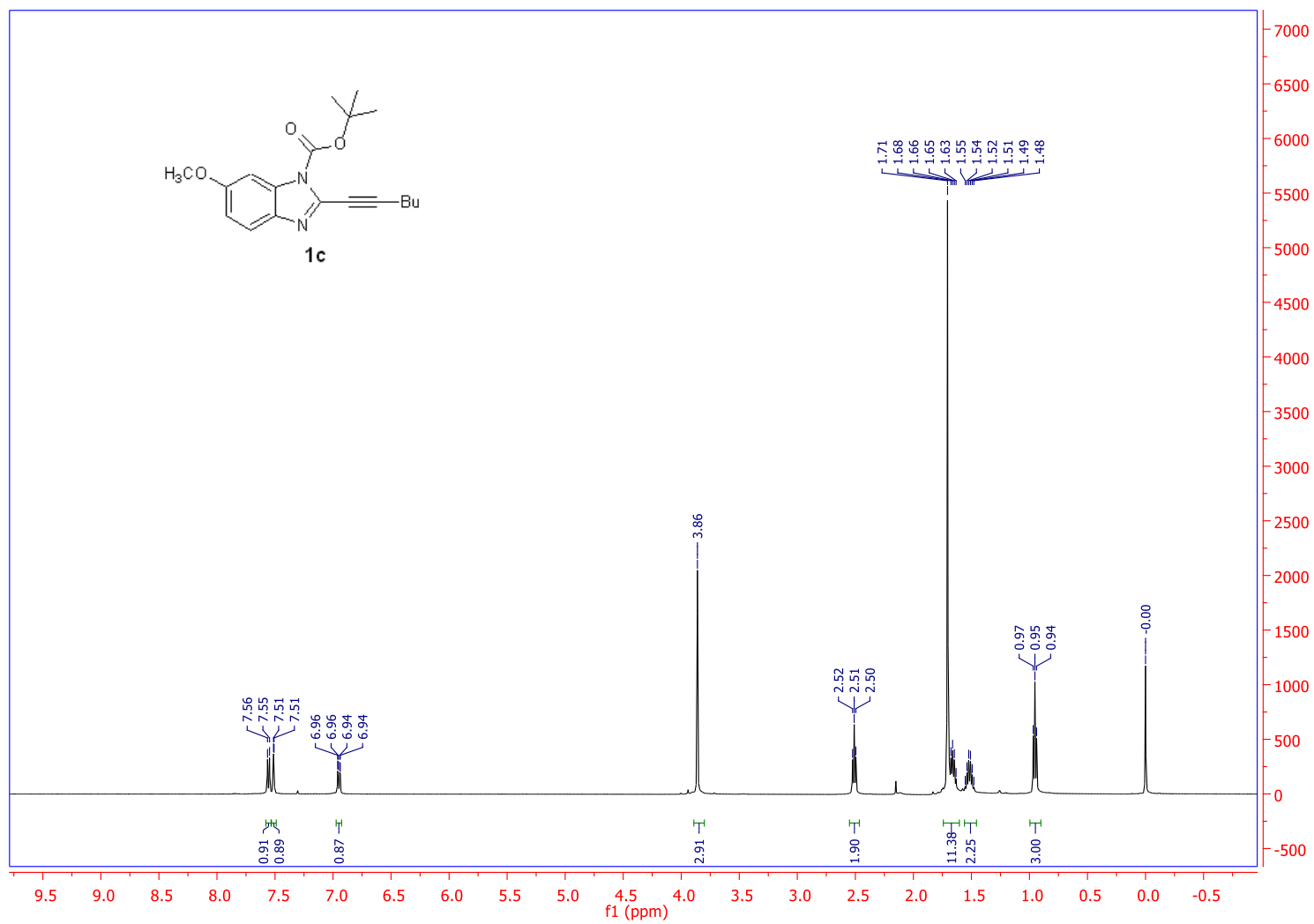
***N*-Boc-2-(hex-1-yn-1-yl)-1*H*-benzo[*d*]imidazole (1a)**<sup>1</sup>H NMR (300 MHz CDCl<sub>3</sub>)

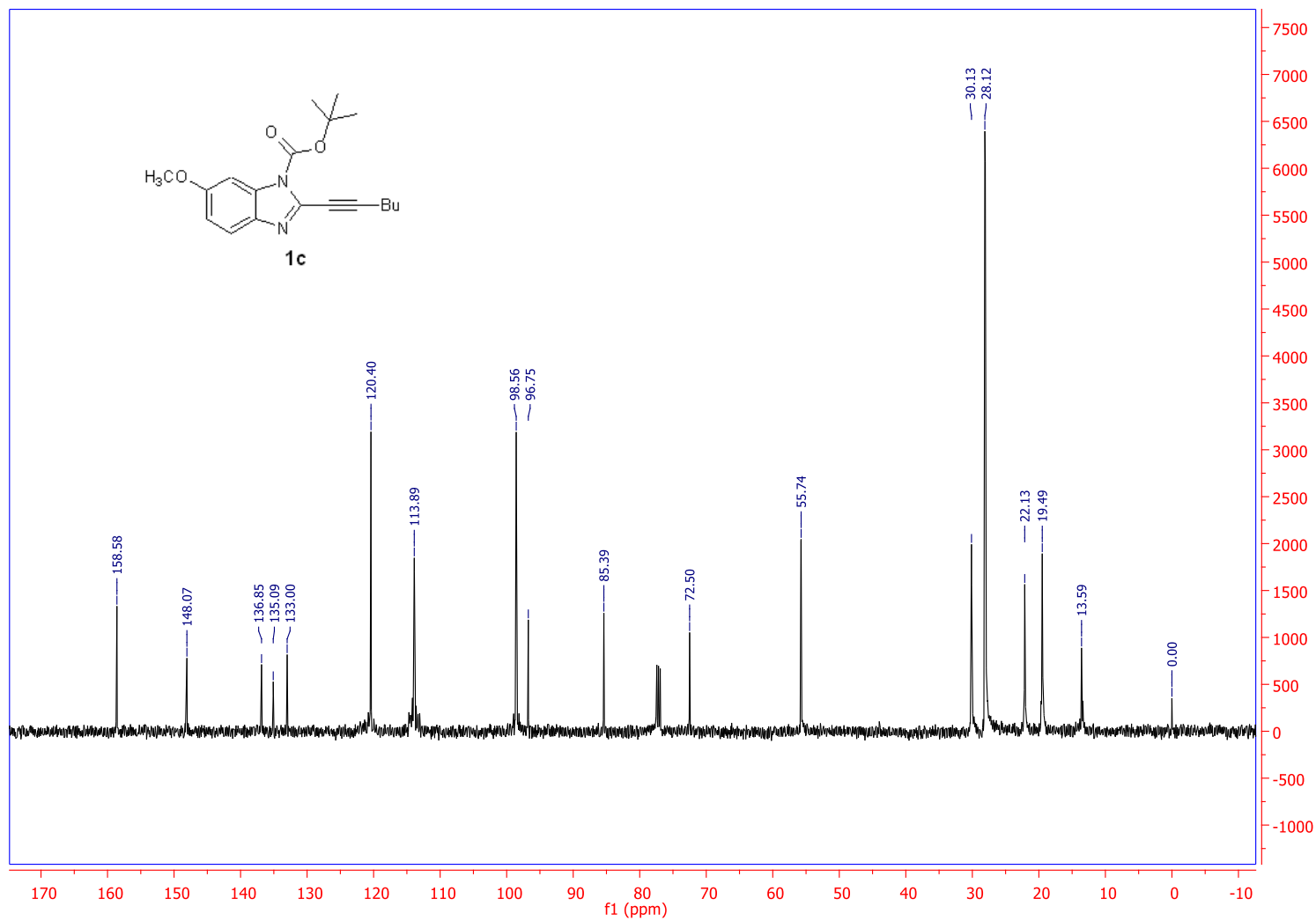
***N*-Boc-2-(hex-1-yn-1-yl)-1*H*-benzo[*d*]imidazole (1a)**<sup>13</sup>C NMR (75 MHz CDCl<sub>3</sub>)

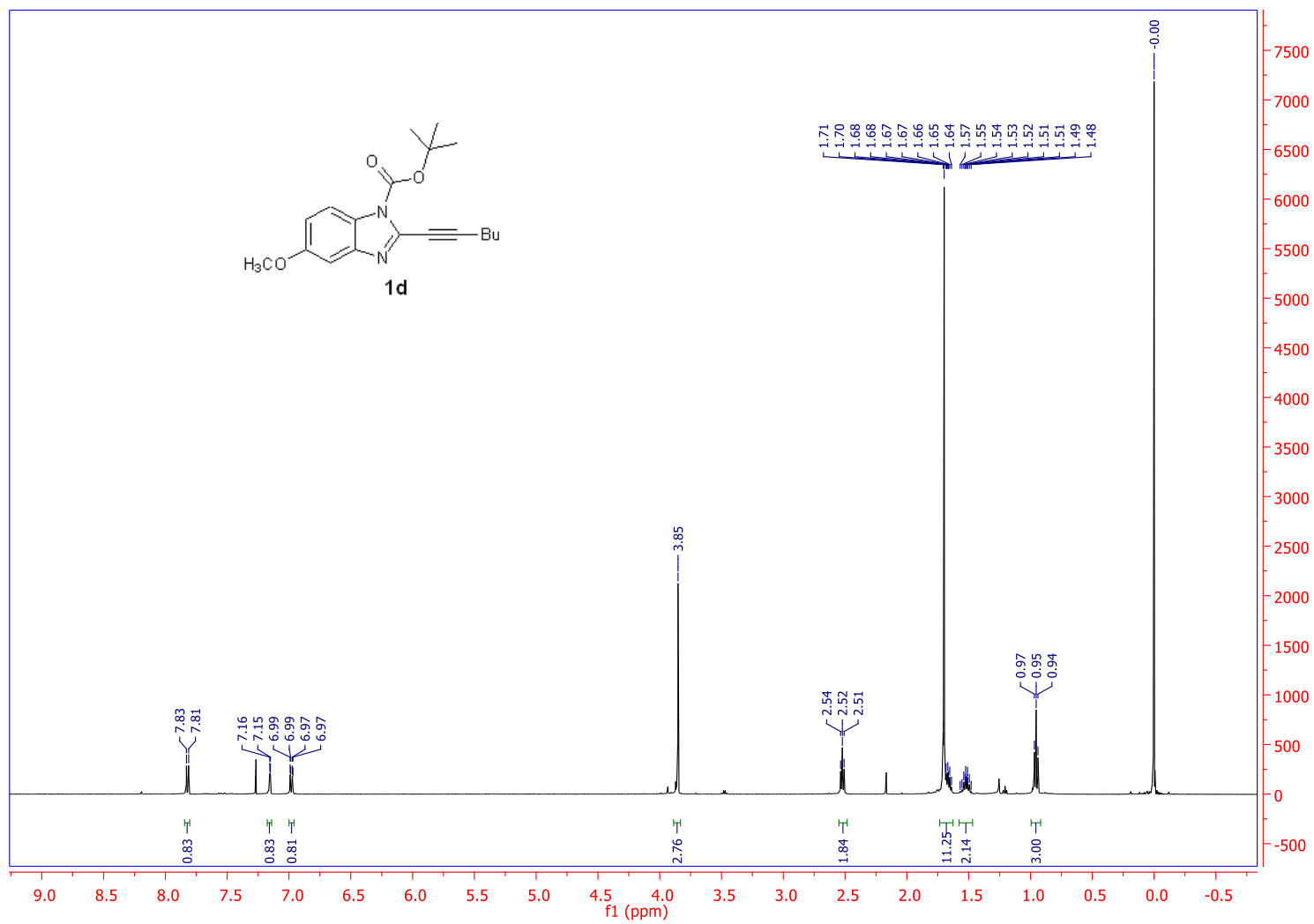
***N*-Boc-2-(hex-1-yn-1-yl)-5,6-dimethyl-1*H*-benzo[*d*]imidazole (1b)**<sup>1</sup>H NMR (300 MHz CDCl<sub>3</sub>)

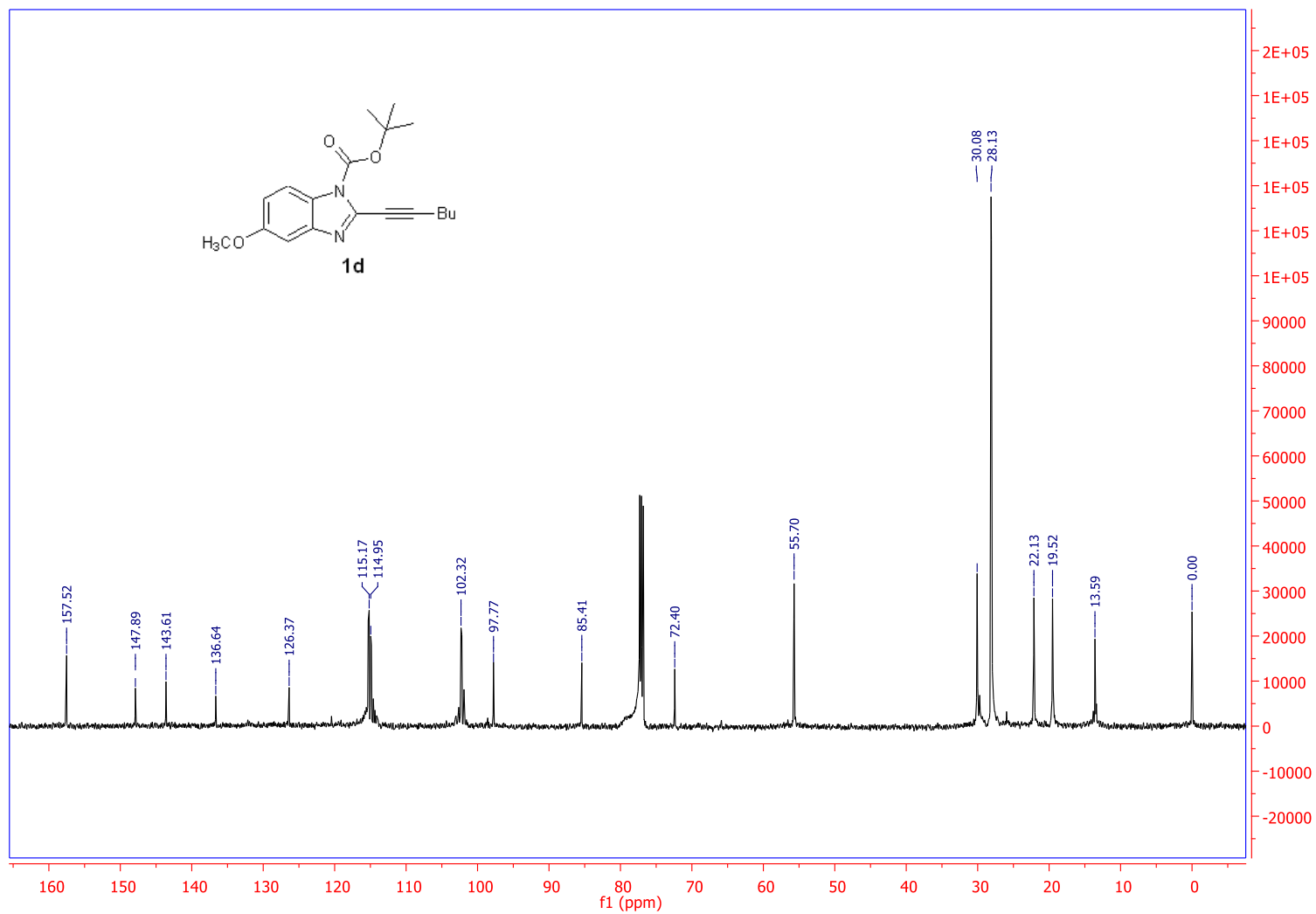


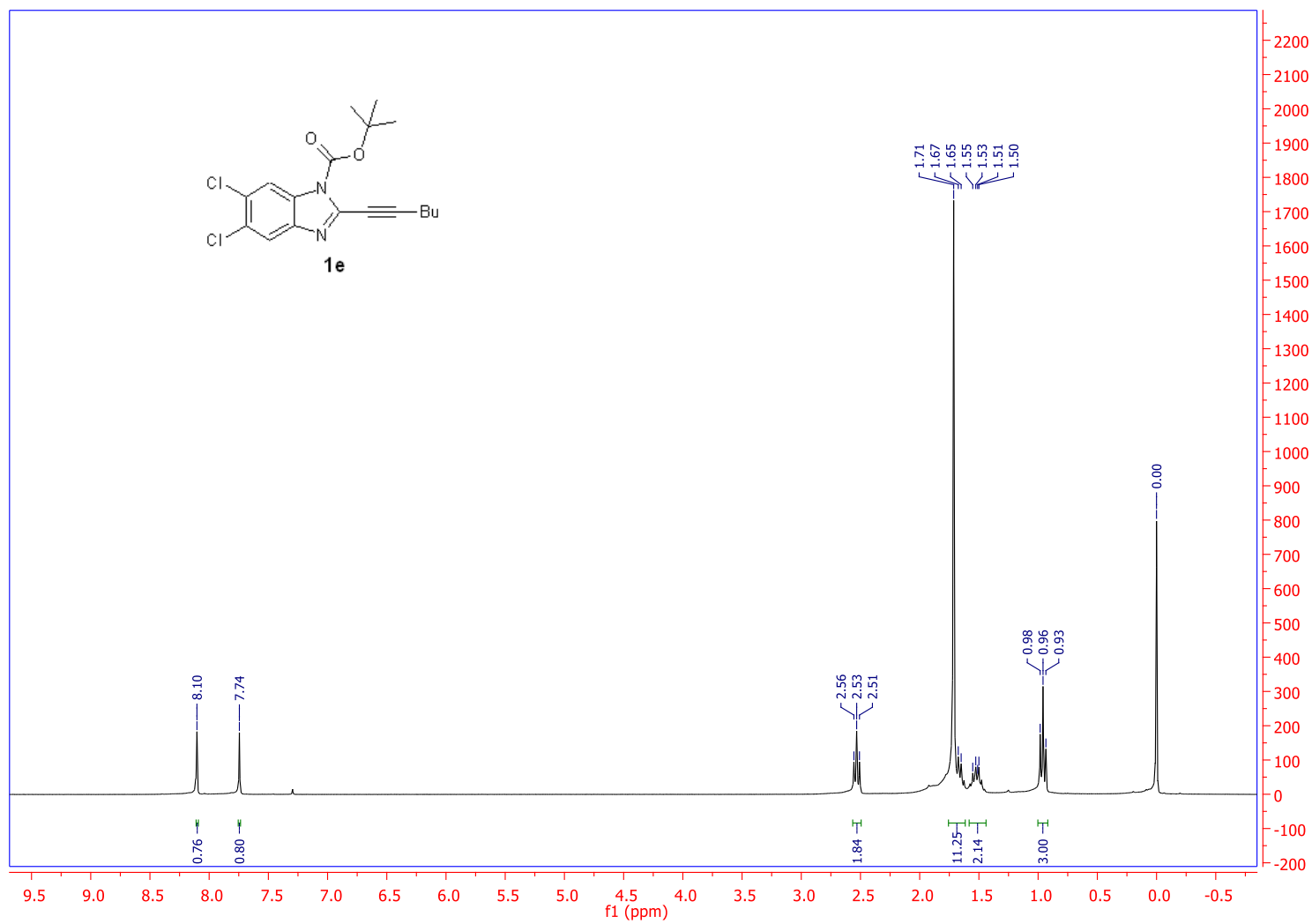
***N*-Boc-2-(hex-1-yn-1-yl)-5,6-dimethyl-1*H*-benzo[*d*]imidazole (1b)**<sup>13</sup>C NMR (75 MHz CDCl<sub>3</sub>)

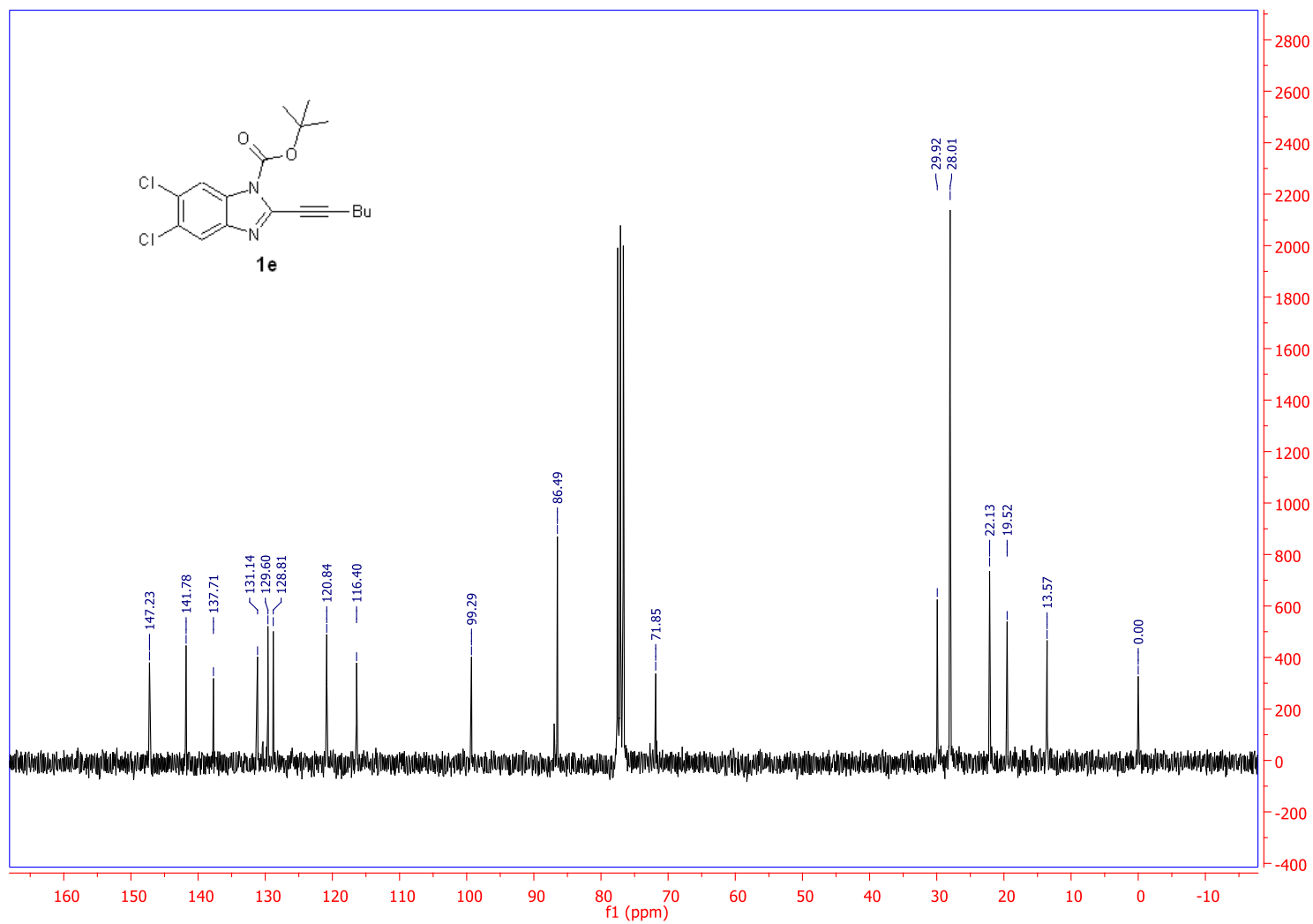
***N*-Boc-2-(hex-1-yn-1-yl)-6-methoxy-1*H*-benzo[*d*]imidazole (1c)**<sup>1</sup>H NMR (500 MHz CDCl<sub>3</sub>)

***N*-Boc-2-(hex-1-yn-1-yl)-6-methoxy-1*H*-benzo[*d*]imidazole (**1c**)**<sup>13</sup>C NMR (125 MHz CDCl<sub>3</sub>)

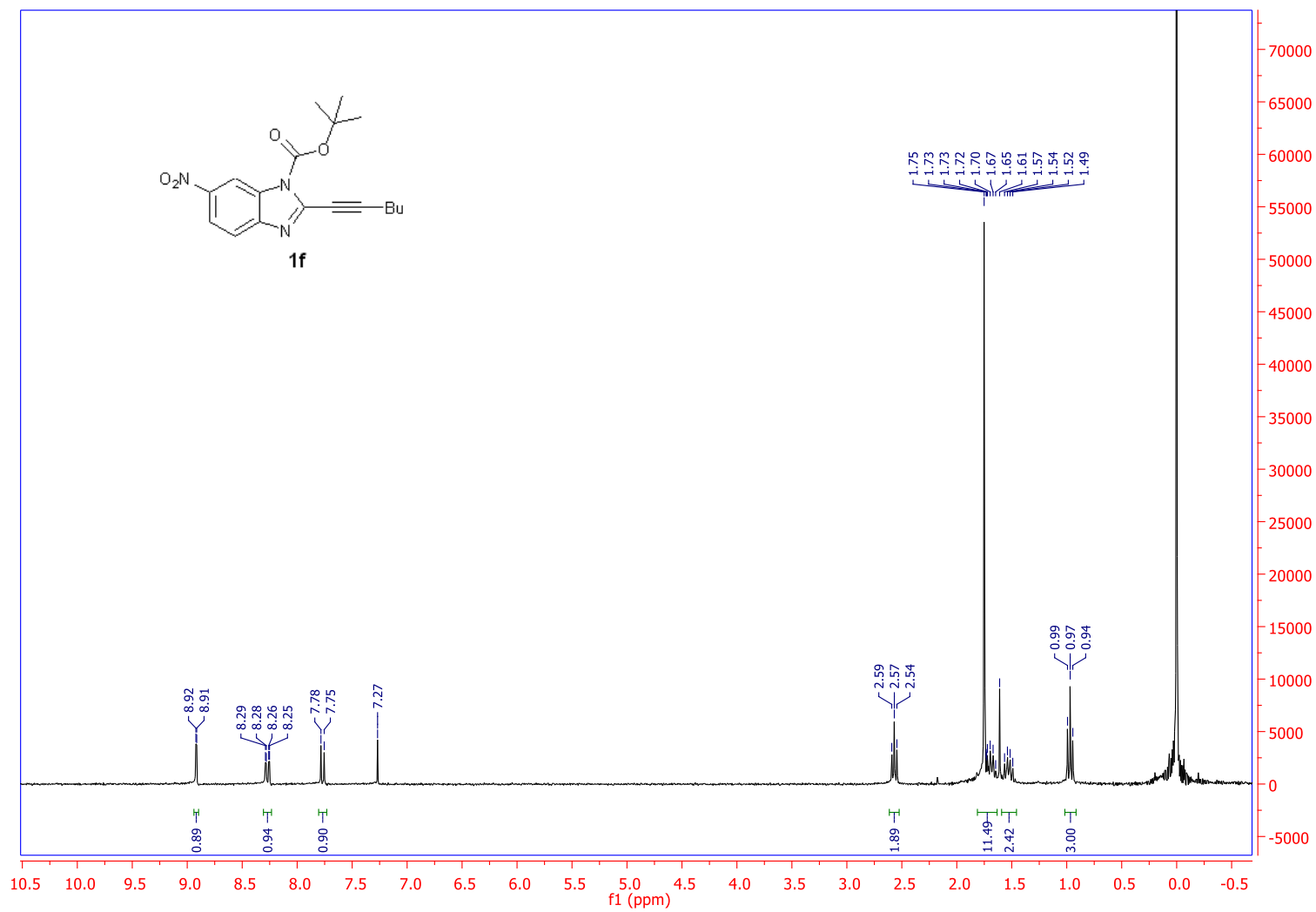
***N*-Boc-2-(hex-1-yn-1-yl)-5-methoxy-1*H*-benzo[*d*]imidazole (1d)**<sup>1</sup>H NMR (500 MHz CDCl<sub>3</sub>)

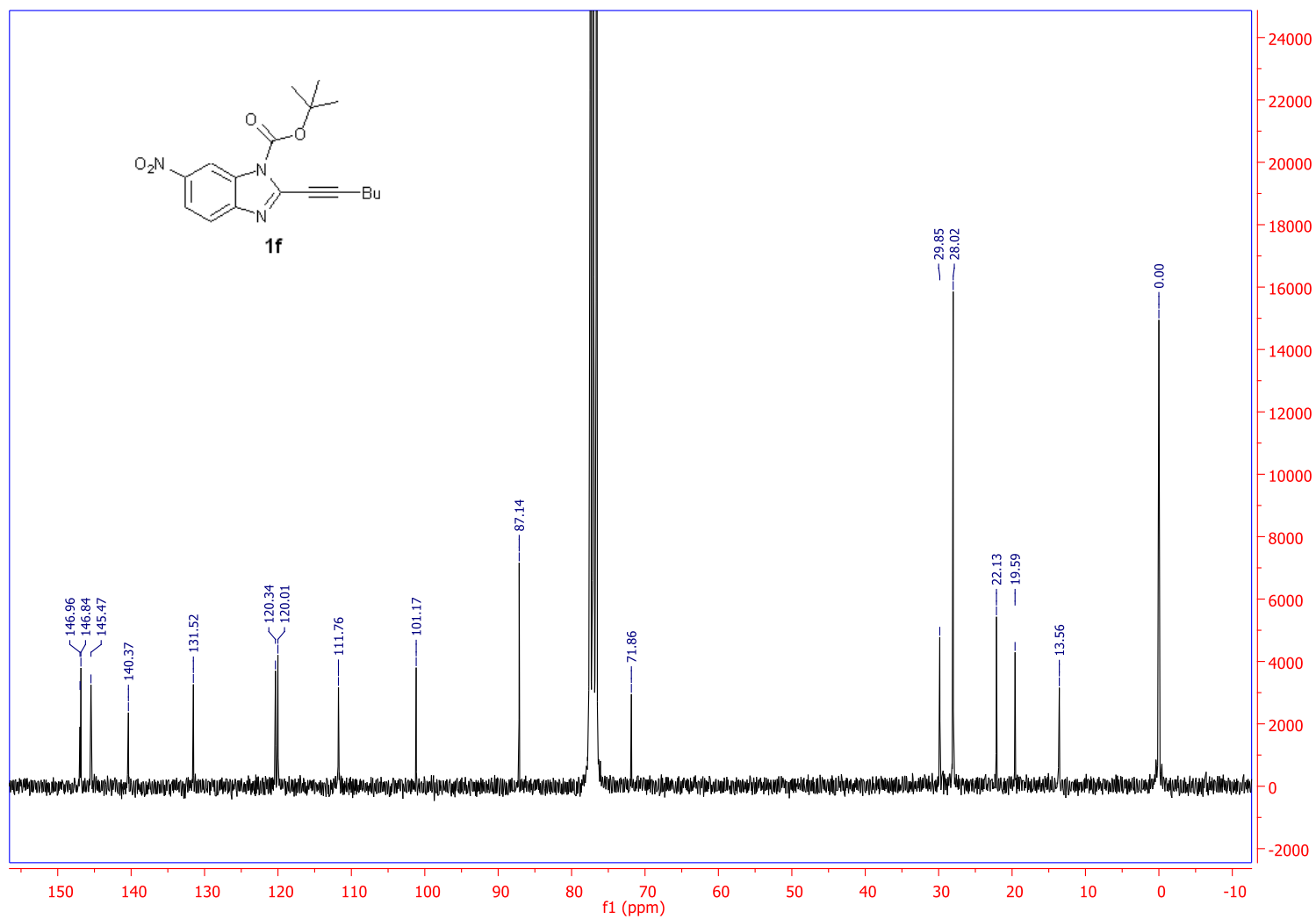
***N*-Boc-2-(hex-1-yn-1-yl)-5-methoxy-1*H*-benzo[*d*]imidazole (**1d**)**<sup>13</sup>C NMR (125 MHz CDCl<sub>3</sub>)

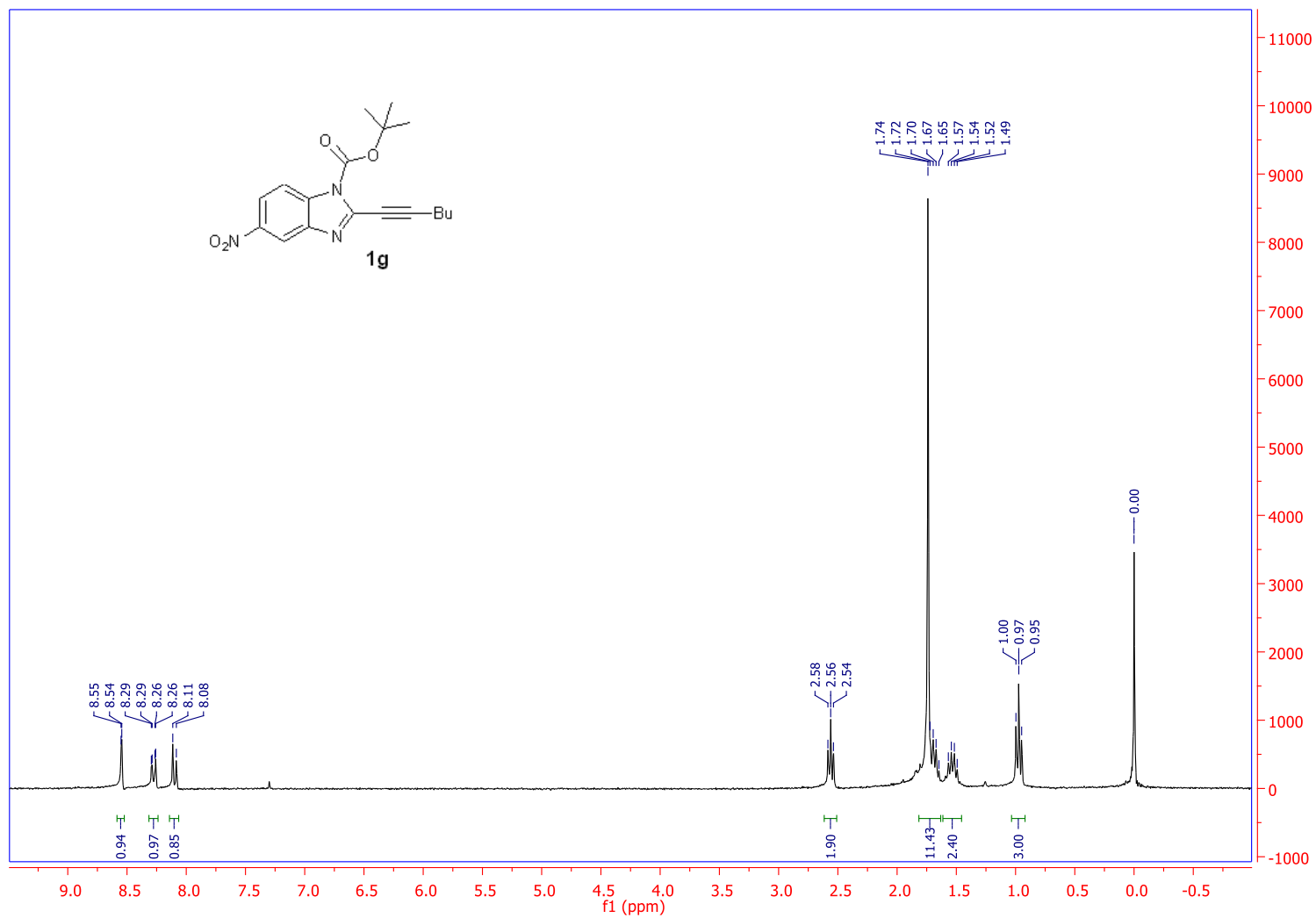
***N*-Boc-5,6-dichloro-2-(hex-1-yn-1-yl)-1*H*-benzo[*d*]imidazole (1e)**<sup>1</sup>H NMR (300 MHz CDCl<sub>3</sub>)

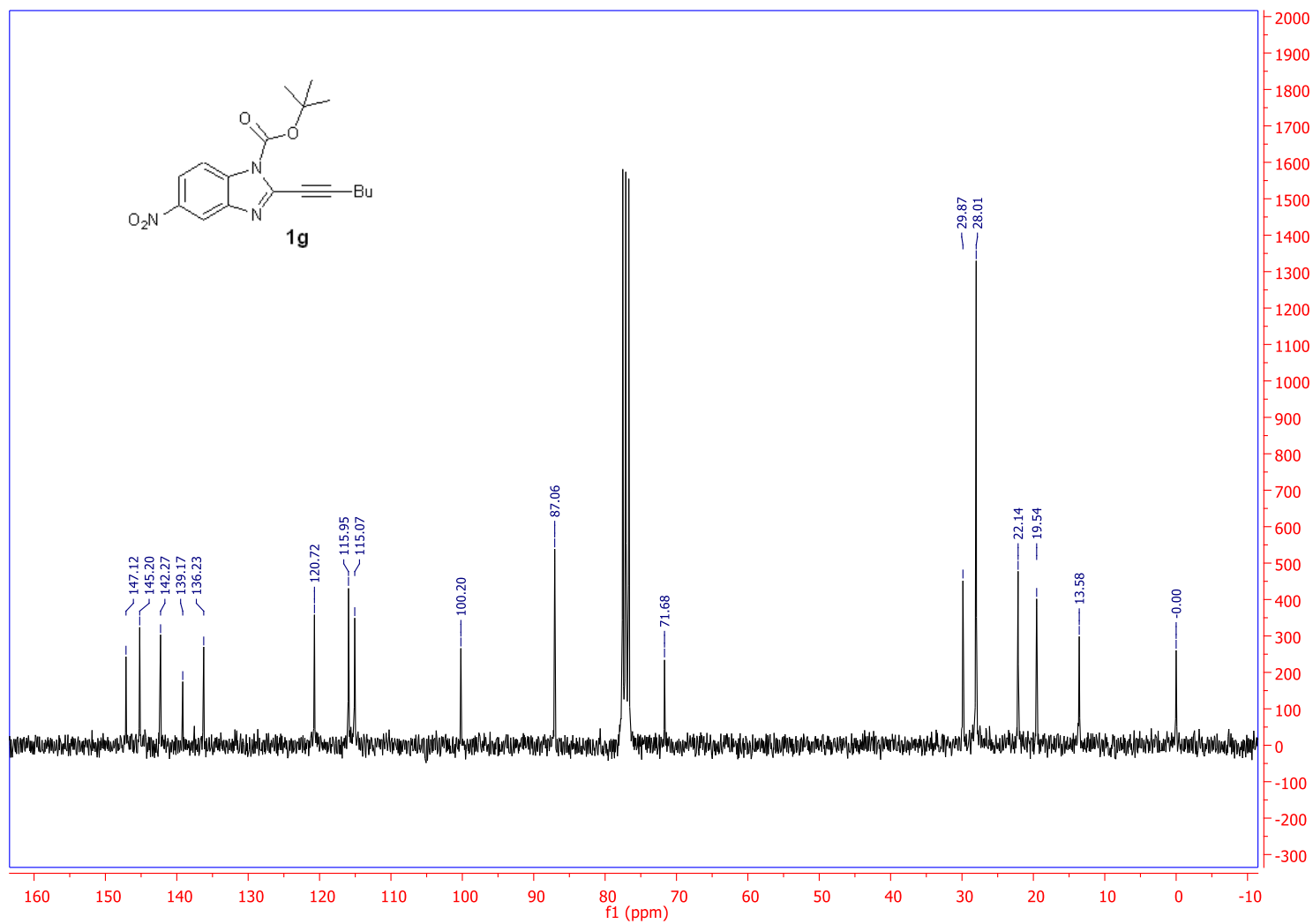
***N*-Boc-5,6-dichloro-2-(hex-1-yn-1-yl)-1*H*-benzo[*d*]imidazole (1e)**<sup>13</sup>C NMR (75 MHz CDCl<sub>3</sub>)

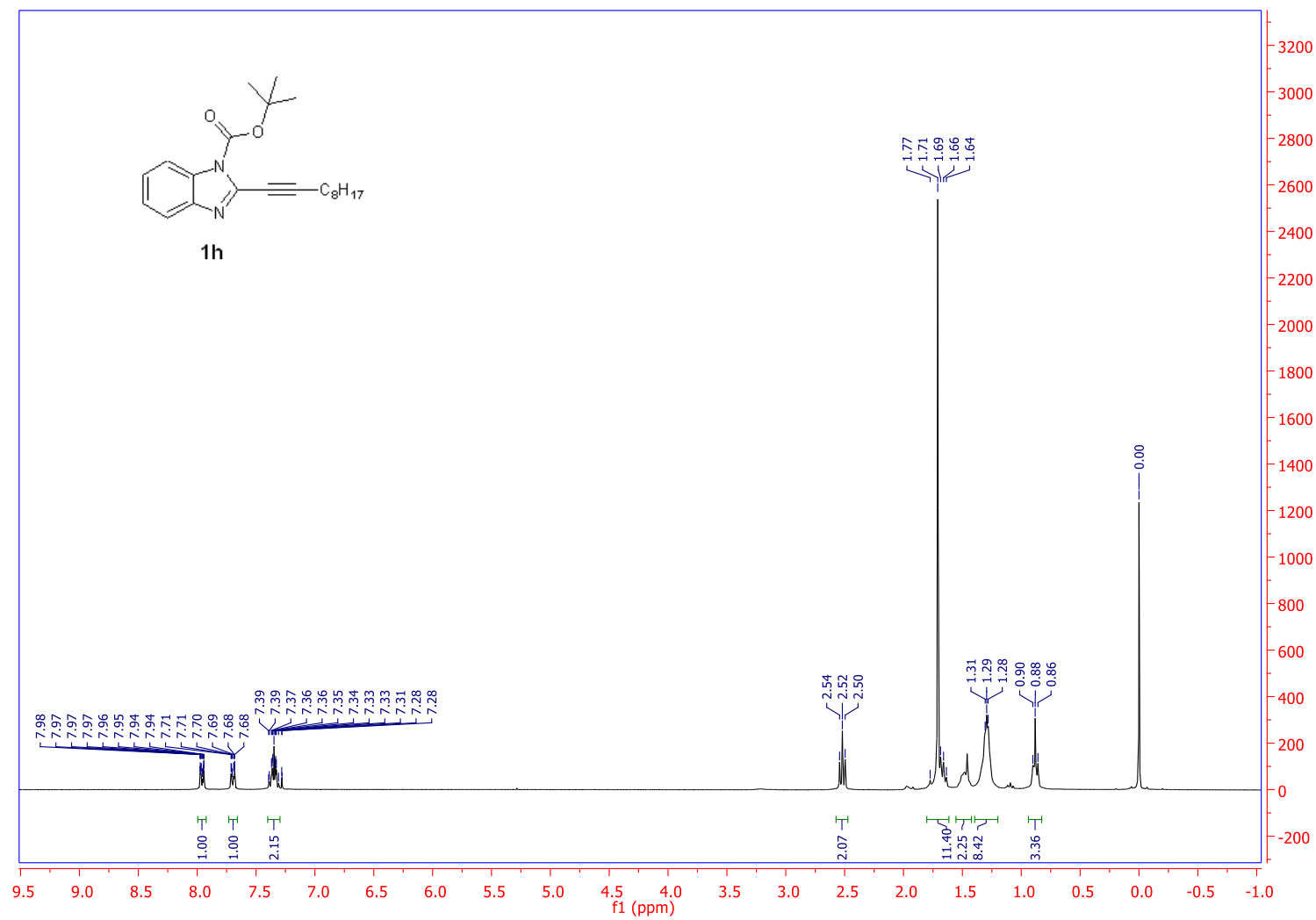


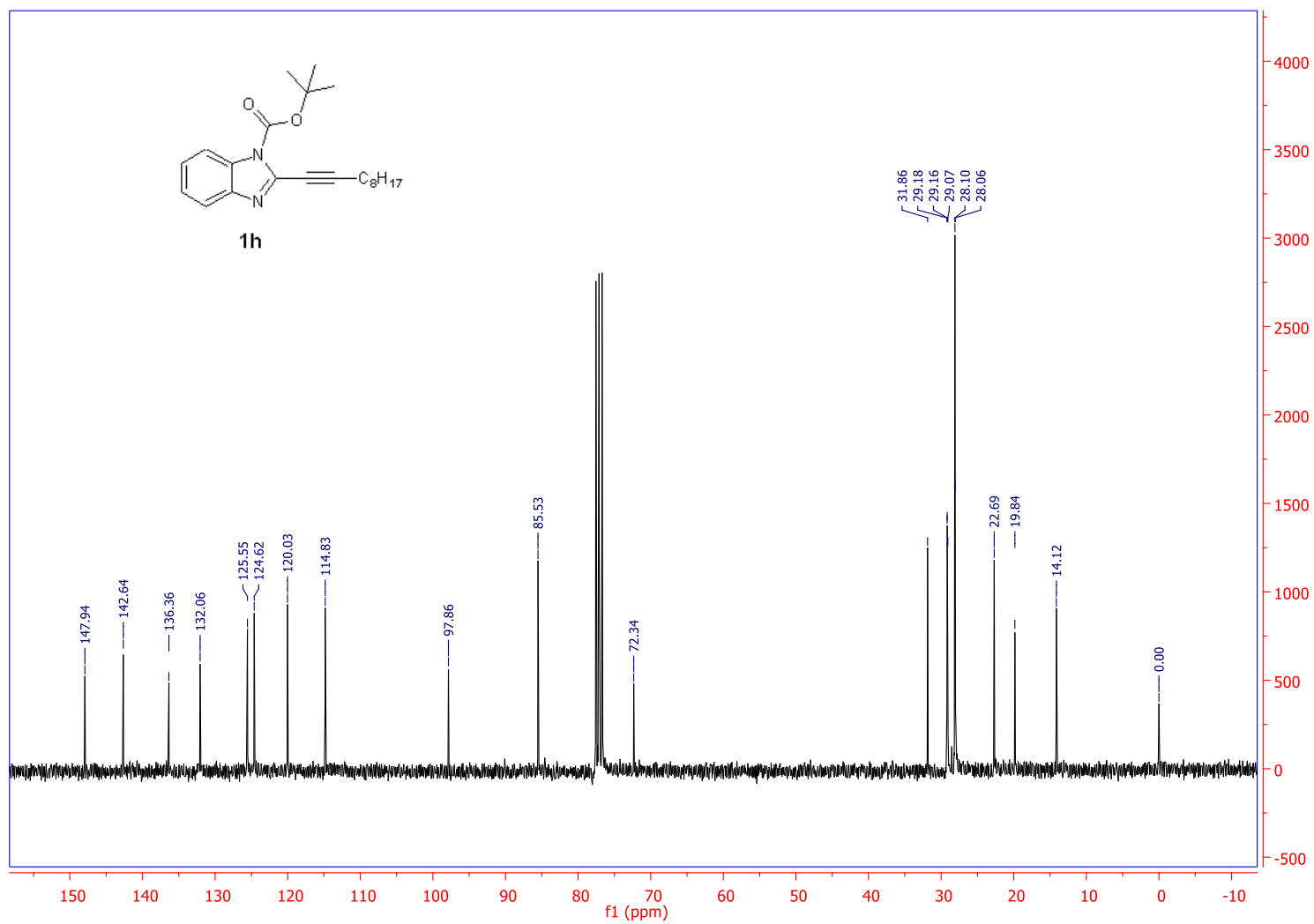
***N*-Boc-2-(hex-1-yn-1-yl)-6-nitro-1*H*-benzo[*d*]imidazole (1f)**<sup>1</sup>H NMR (300 MHz CDCl<sub>3</sub>)

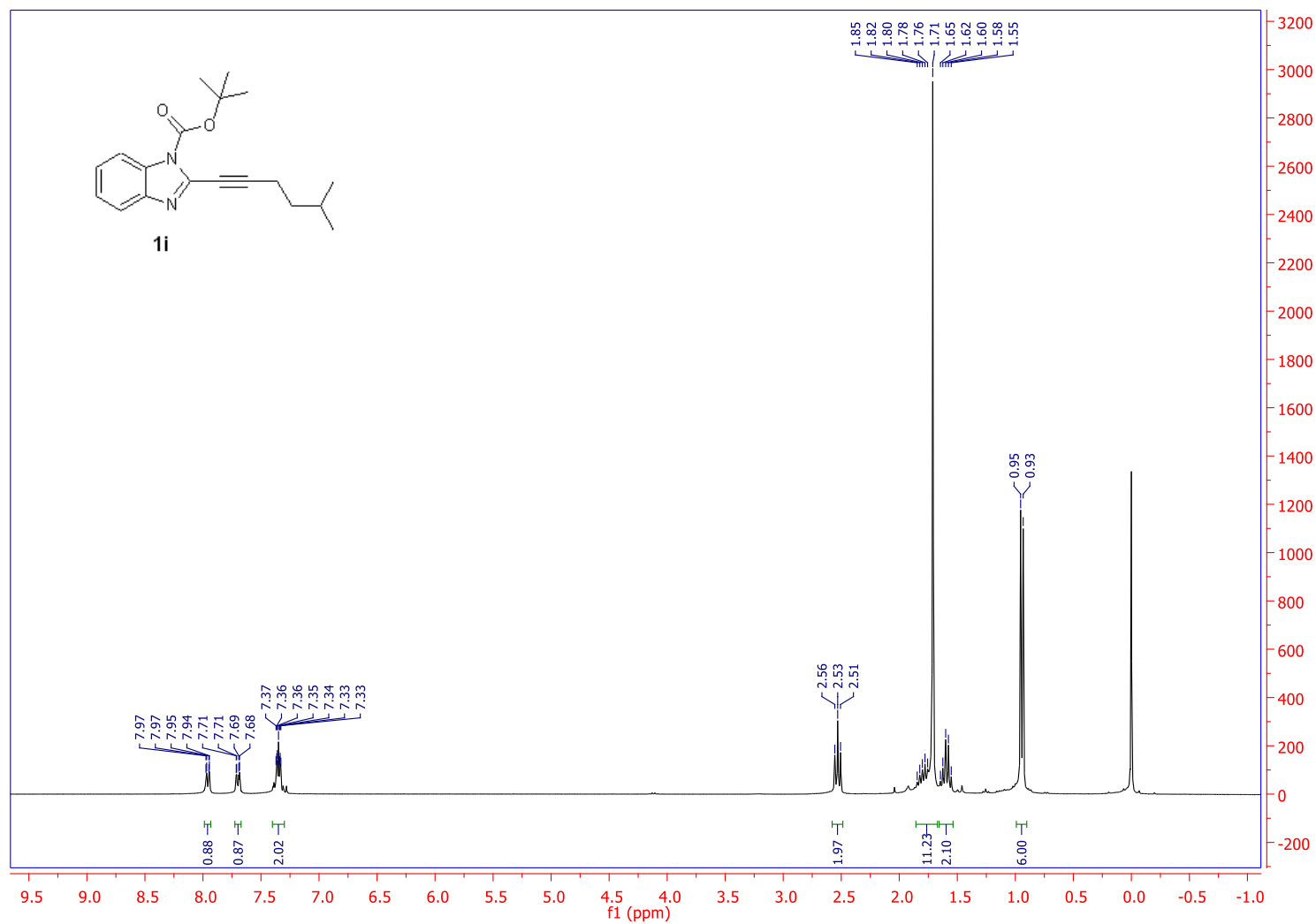
***N*-Boc-2-(hex-1-yn-1-yl)-6-nitro-1*H*-benzo[*d*]imidazole (1f)**<sup>13</sup>C NMR (75 MHz CDCl<sub>3</sub>)

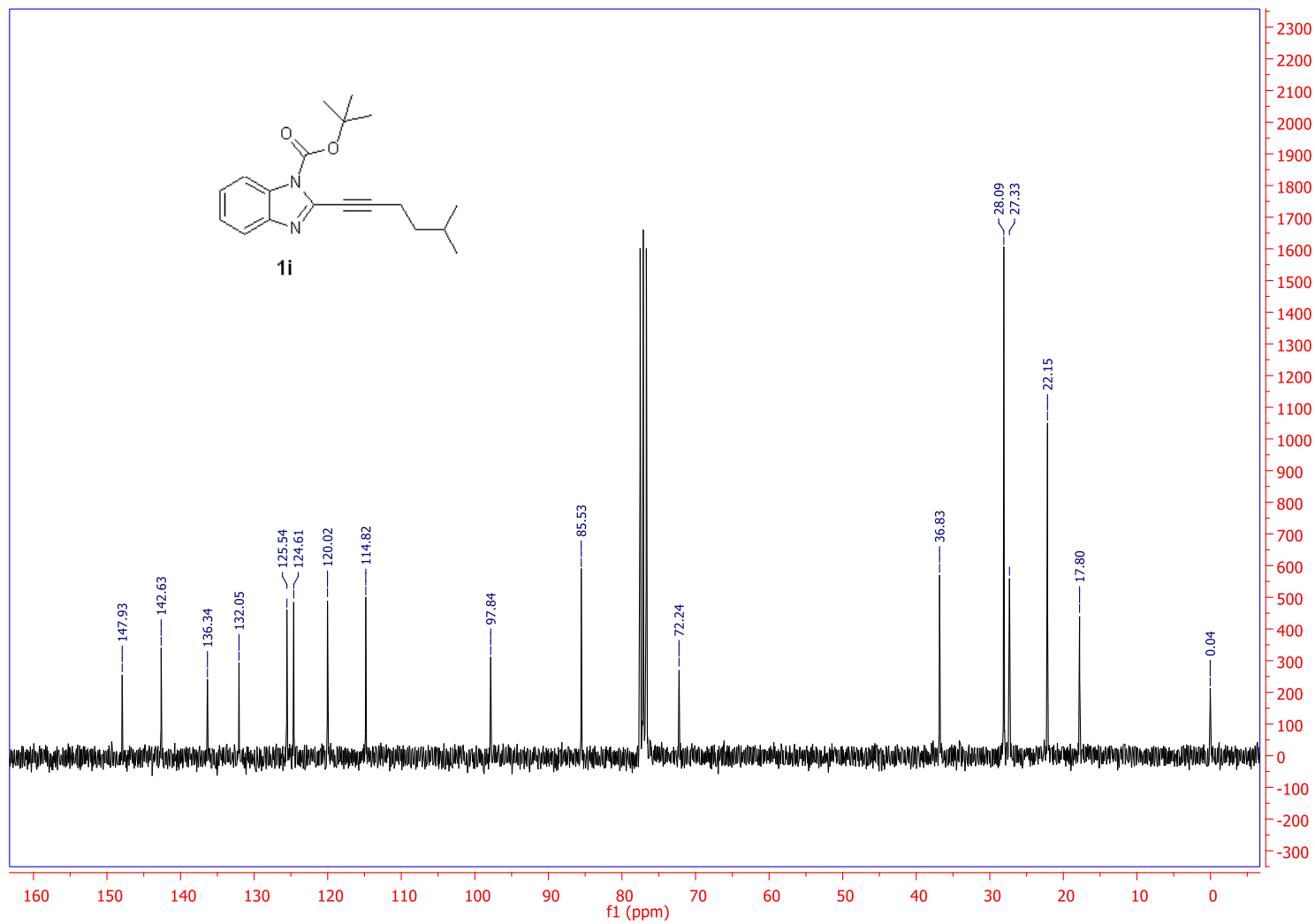
***N*-Boc-2-(hex-1-yn-1-yl)-5-nitro-1*H*-benzo[*d*]imidazole (1g)**<sup>1</sup>H NMR (300 MHz CDCl<sub>3</sub>)

***N*-Boc-2-(hex-1-yn-1-yl)-5-nitro-1*H*-benzo[*d*]imidazole (**1g**)**<sup>13</sup>C NMR (75 MHz CDCl<sub>3</sub>)

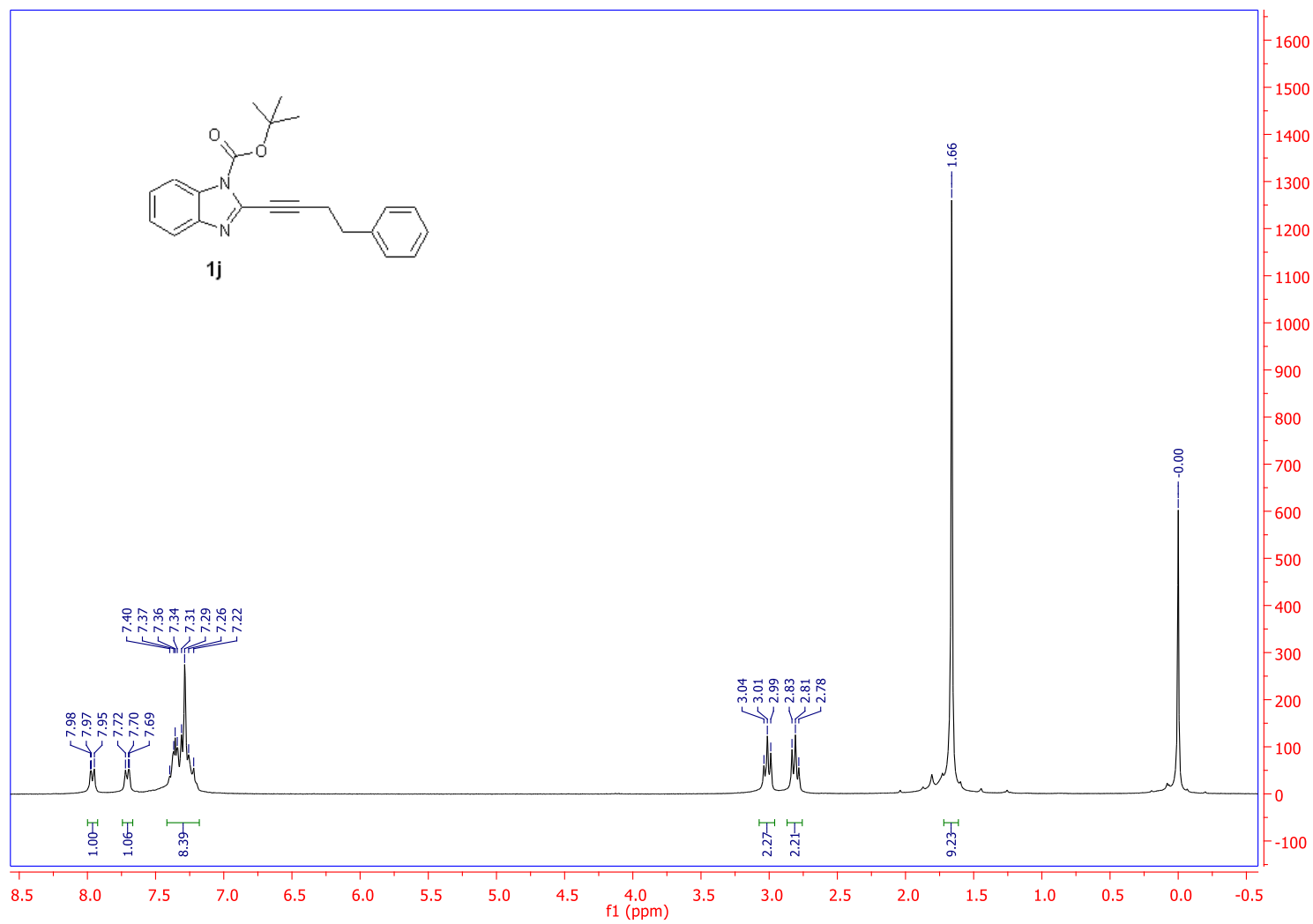
***N*-Boc-2-(dec-1-yn-1-yl)-1*H*-benzo[*d*]imidazole (1h)**<sup>1</sup>H NMR (300 MHz CDCl<sub>3</sub>)

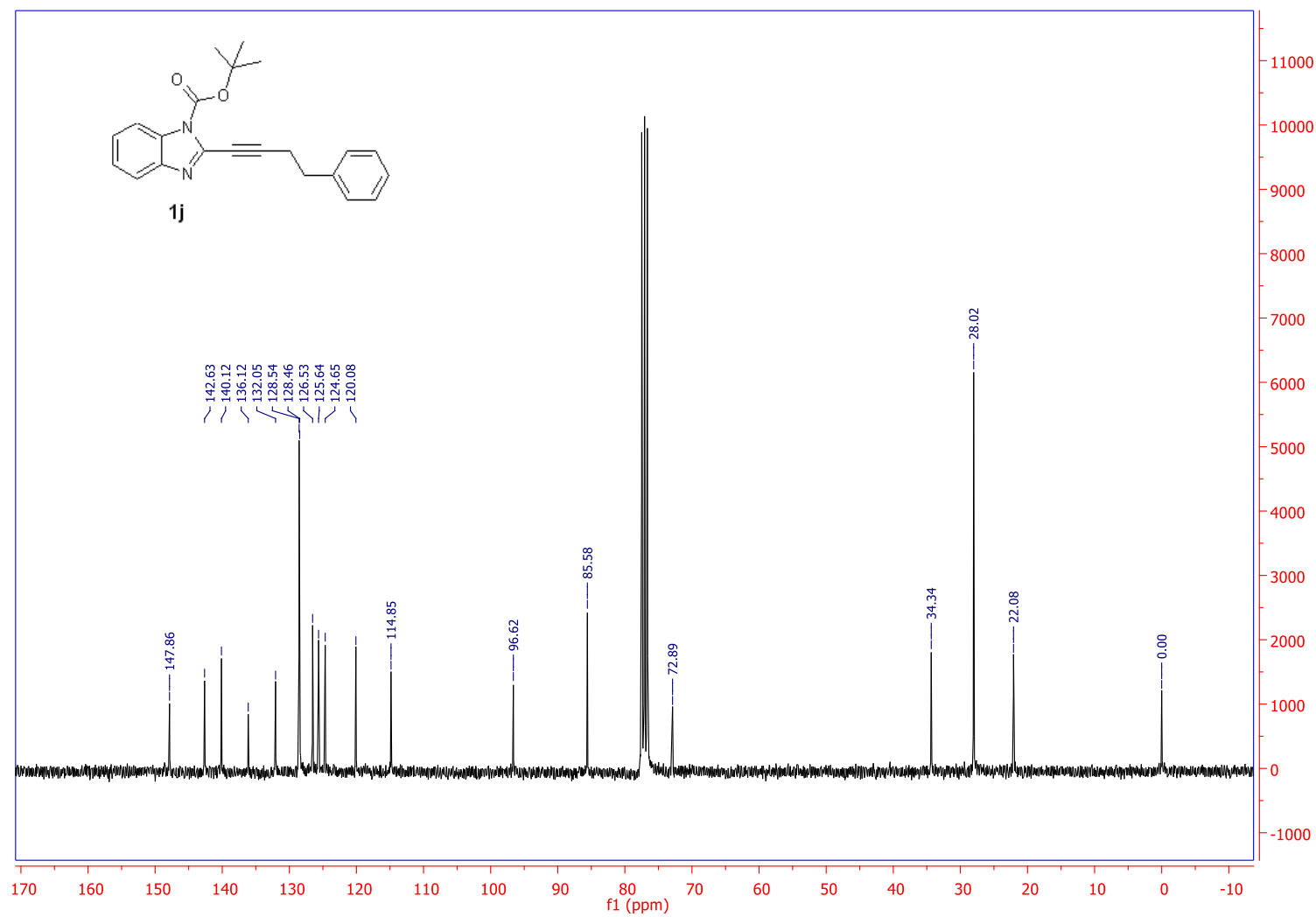
***N*-Boc-2-(dec-1-yn-1-yl)-1*H*-benzo[d]imidazole (1h)**<sup>13</sup>C NMR (75 MHz CDCl<sub>3</sub>)

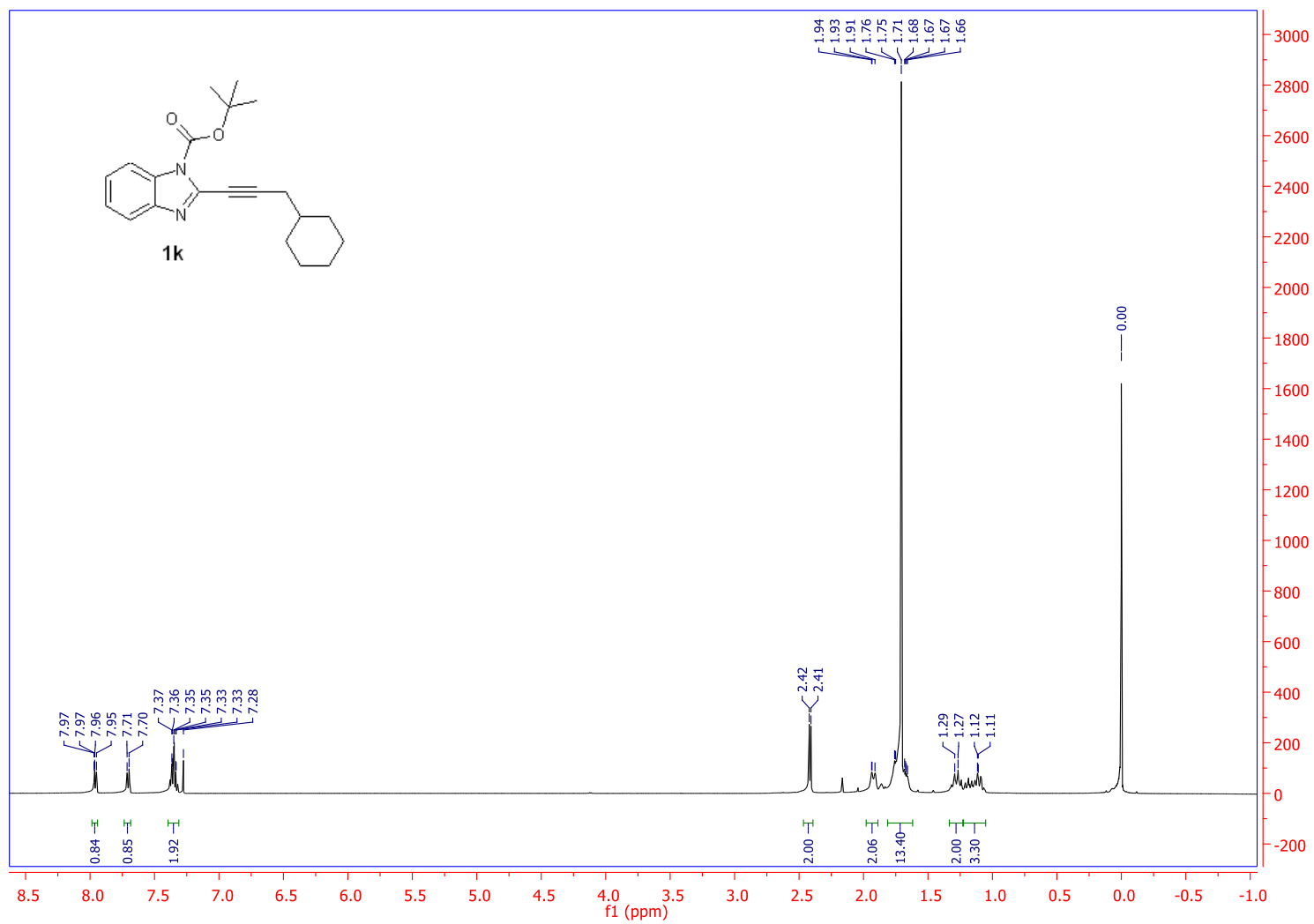
***N*-Boc-2-(5-methylhex-1-yn-1-yl)-1*H*-benzo[*d*]imidazole (1i)**<sup>1</sup>H NMR (300 MHz CDCl<sub>3</sub>)

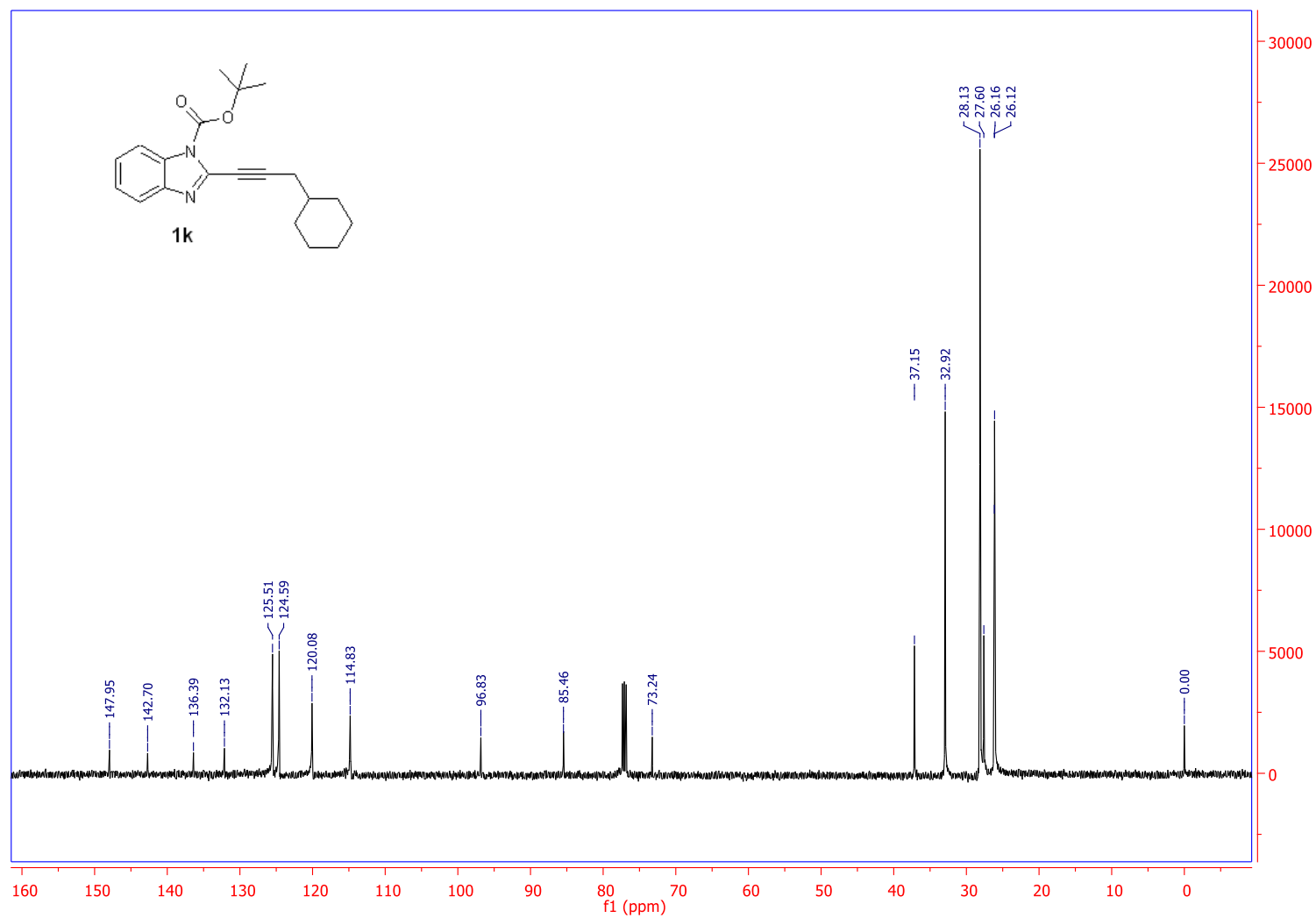
***N*-Boc-2-(5-methylhex-1-yn-1-yl)-1*H*-benzo[*d*]imidazole (1i)**<sup>13</sup>C NMR (75 MHz CDCl<sub>3</sub>)

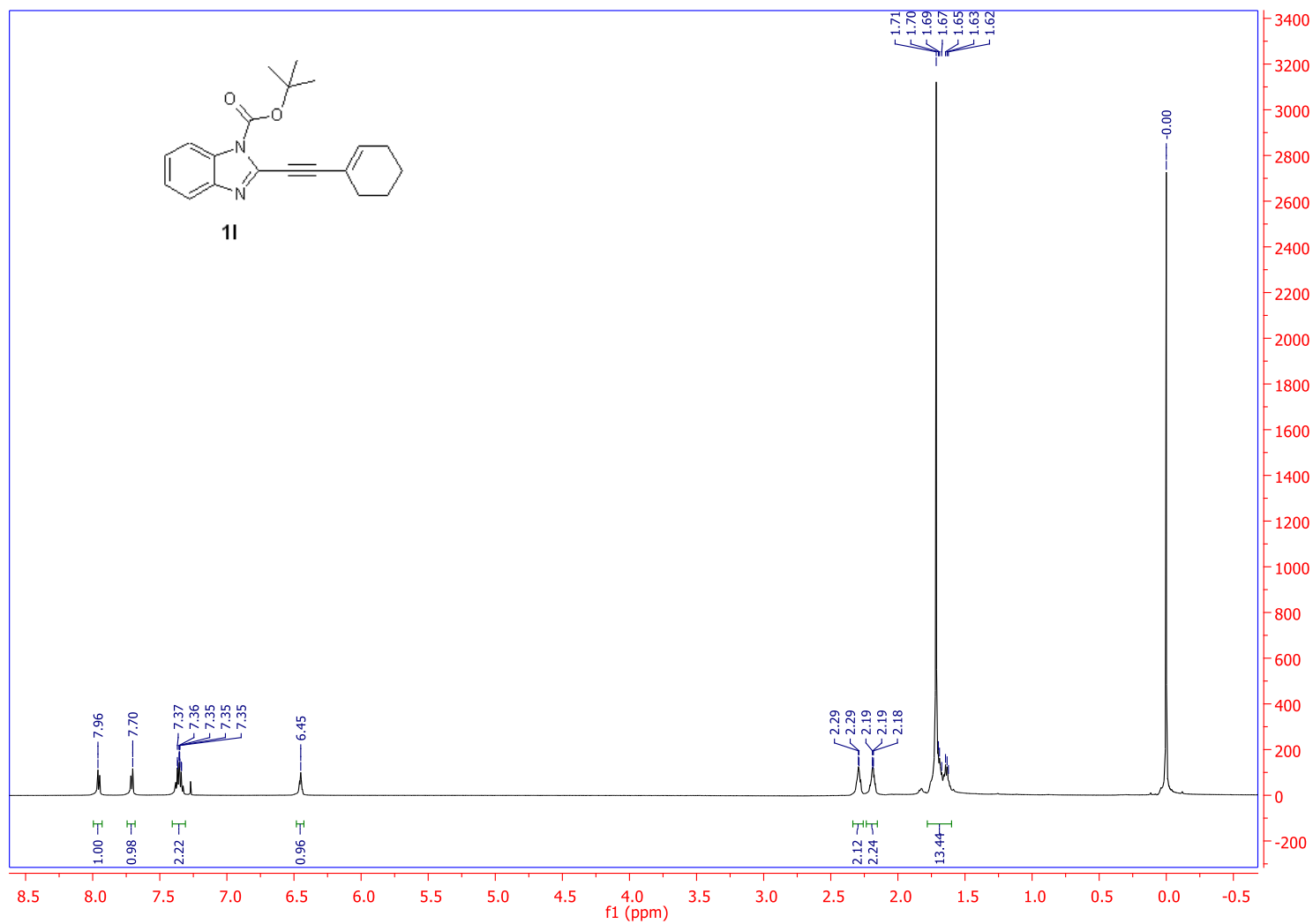


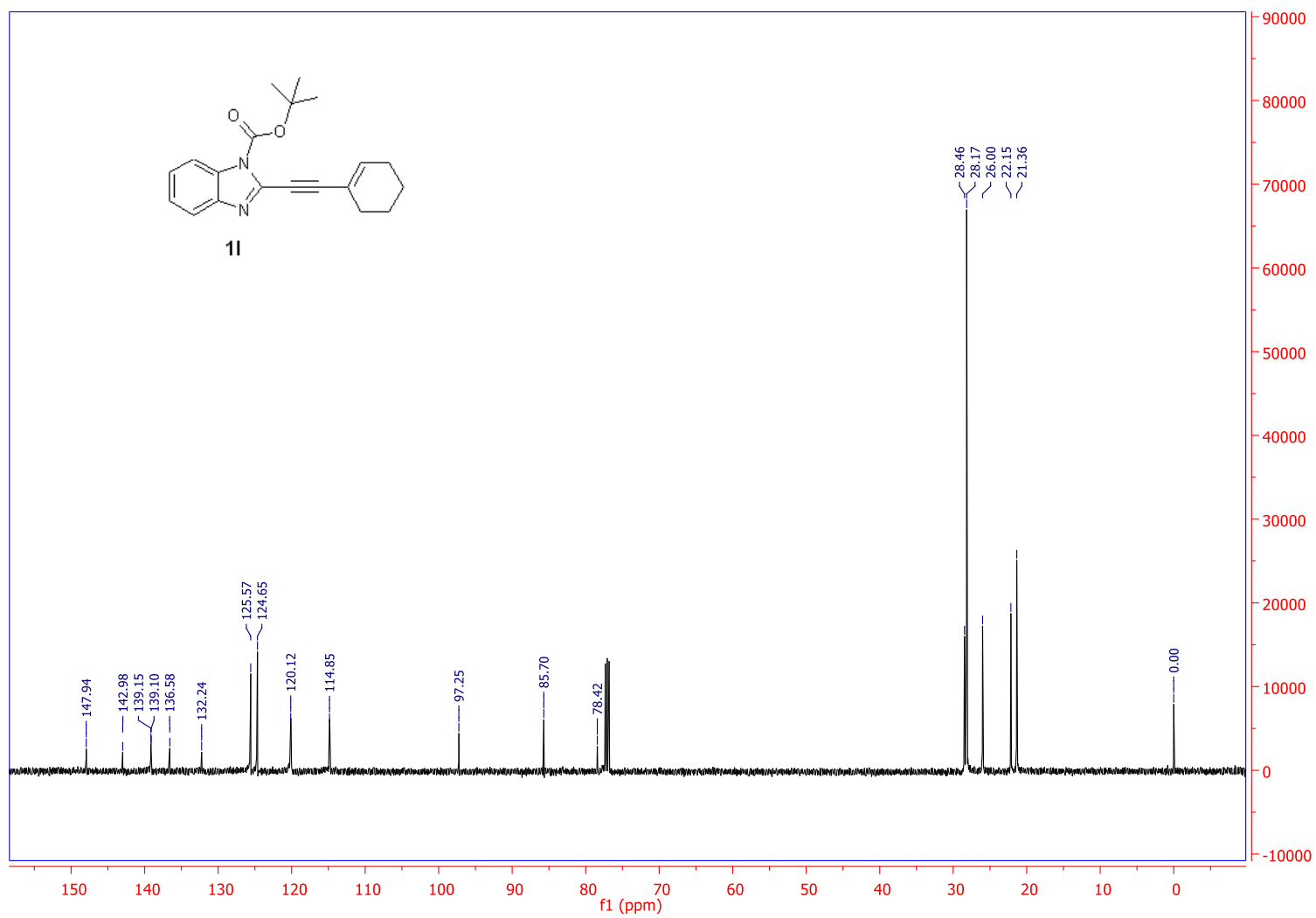
***N*-Boc-2-(4-phenylbut-1-yn-1-yl)-1*H*-benzo[*d*]imidazole (1j)**<sup>1</sup>H NMR (300 MHz CDCl<sub>3</sub>)

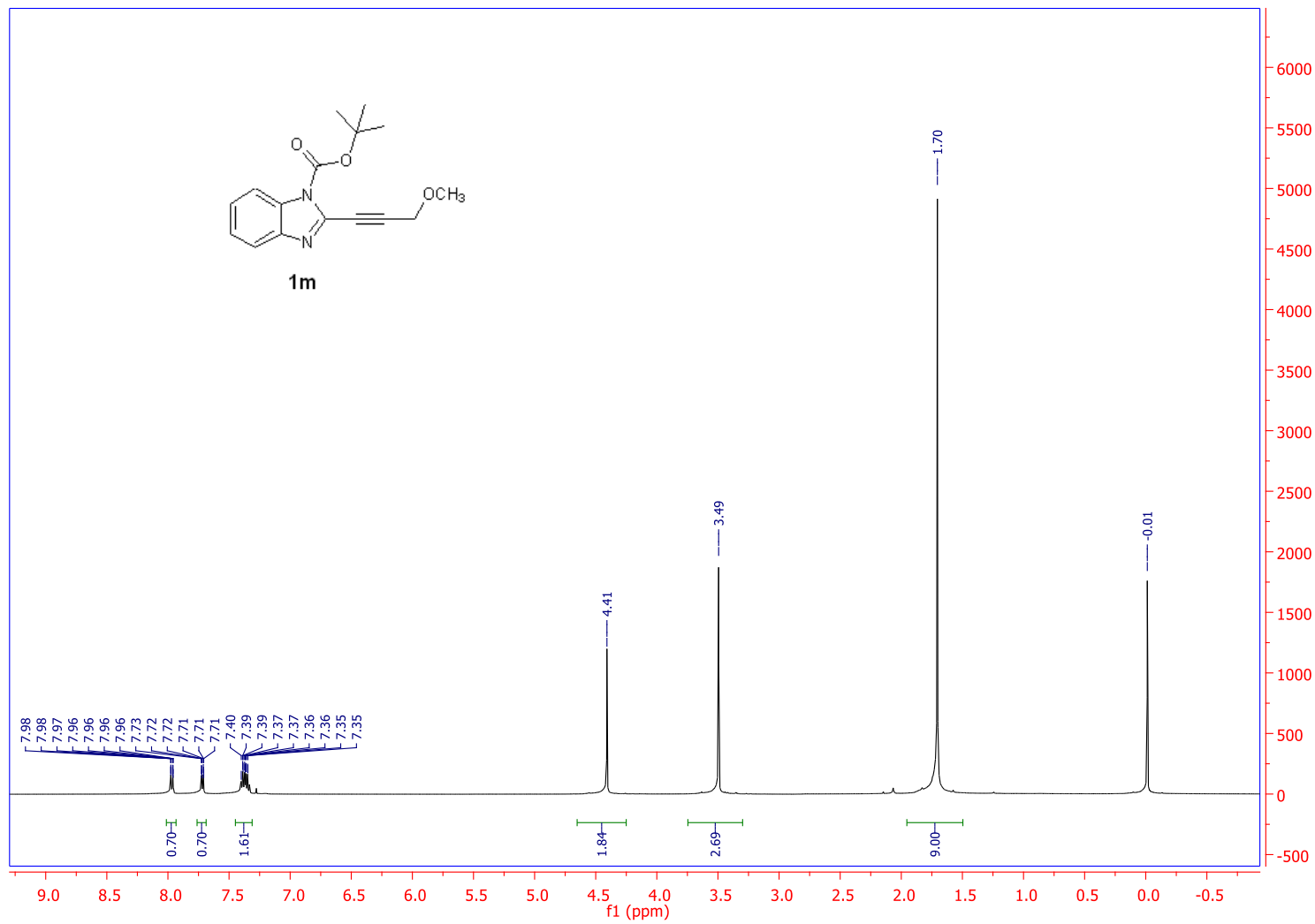
***N*-Boc-2-(4-phenylbut-1-yn-1-yl)-1*H*-benzo[*d*]imidazole (1j)**<sup>13</sup>C NMR (75 MHz CDCl<sub>3</sub>)

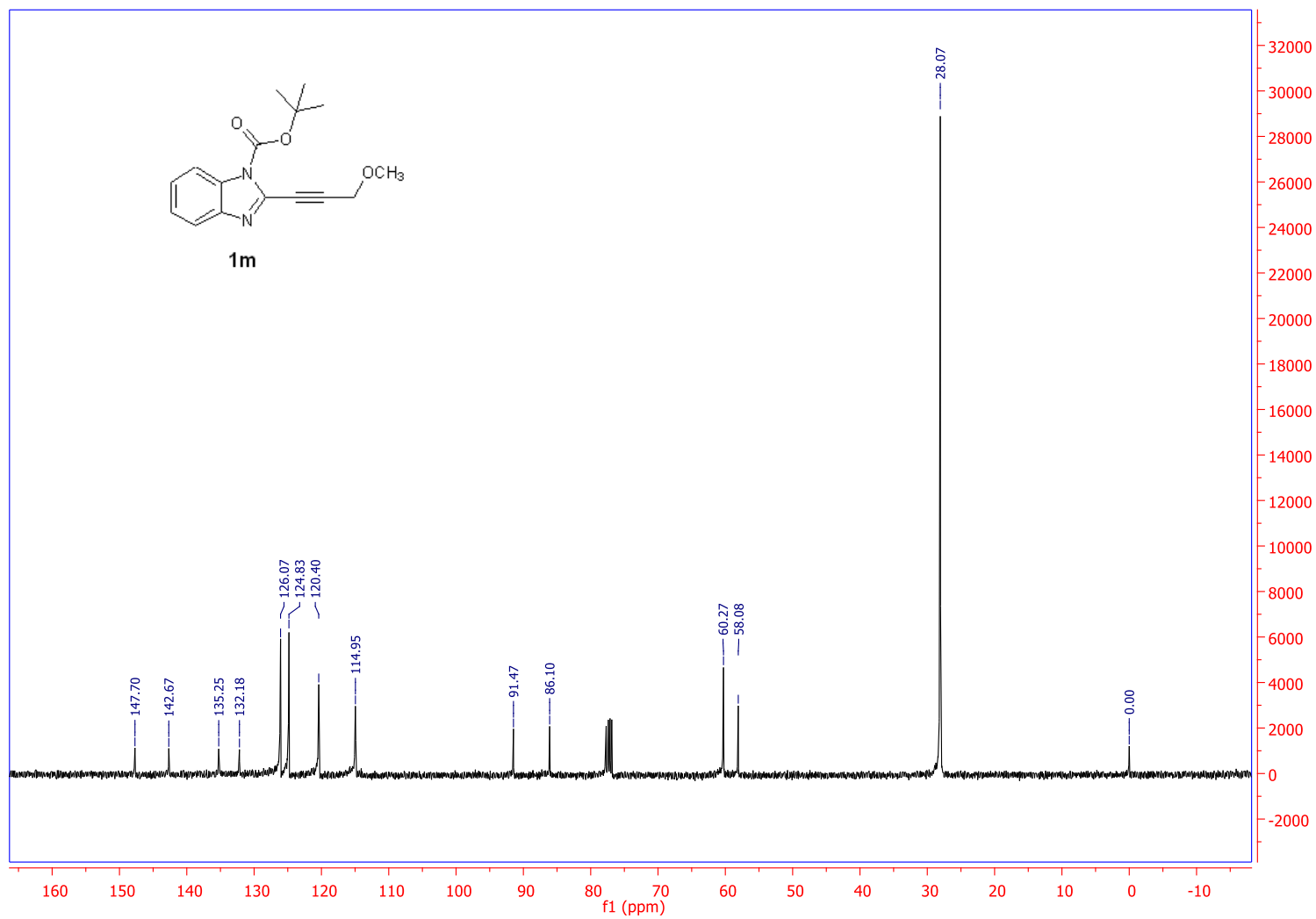
***N*-Boc-2-(3-cyclohexylprop-1-yn-1-yl)-1*H*-benzo[*d*]imidazole (1k)**<sup>1</sup>H NMR (500 MHz CDCl<sub>3</sub>)

***N*-Boc-2-(3-cyclohexylprop-1-yn-1-yl)-1*H*-benzo[*d*]imidazole (1k)**<sup>13</sup>C NMR (125 MHz CDCl<sub>3</sub>)

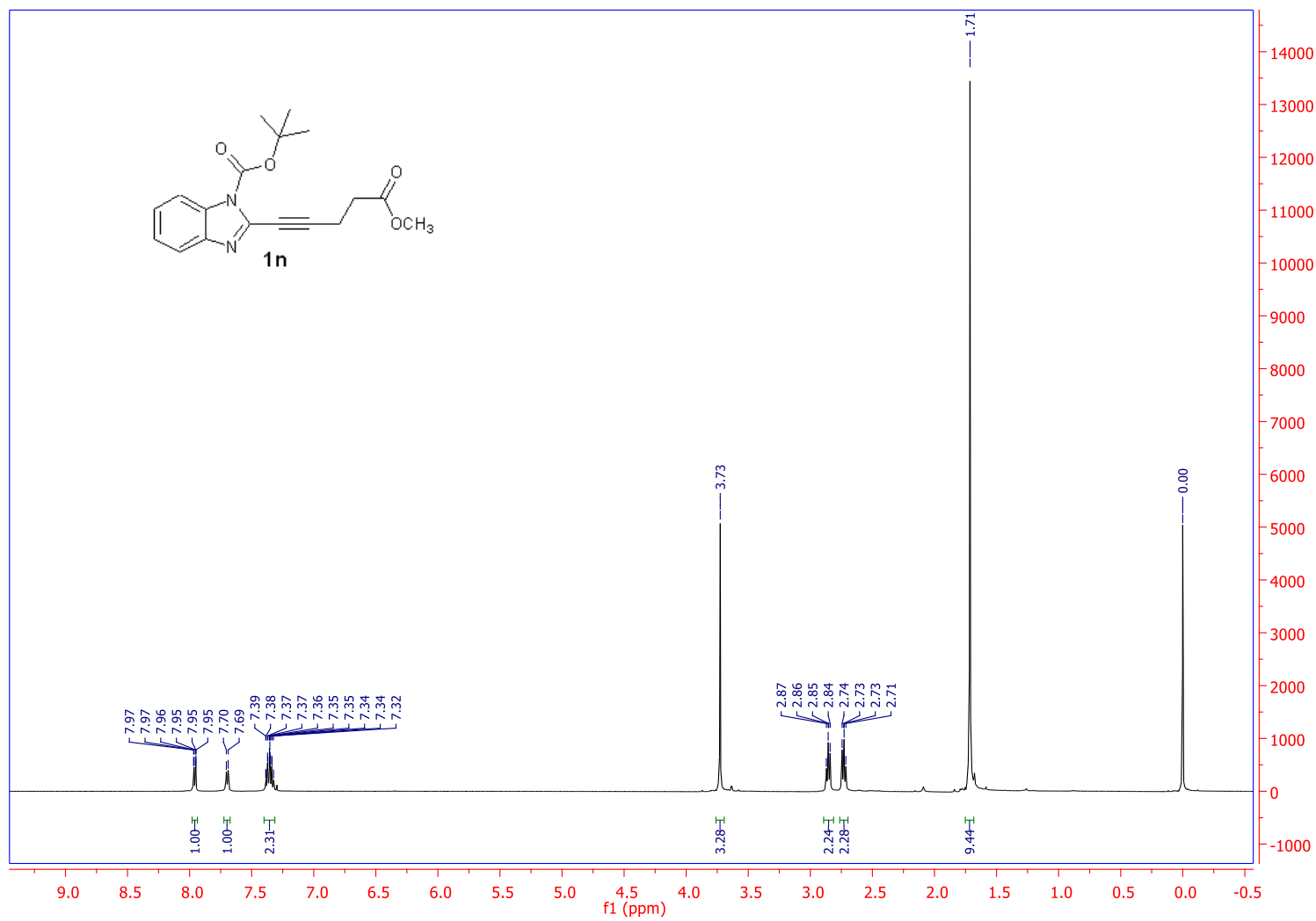
***N*-Boc-2-(cyclohex-1-en-1-ylethynyl)-1*H*-benzo[*d*]imidazole (1l)**<sup>1</sup>H NMR (500 MHz CDCl<sub>3</sub>)

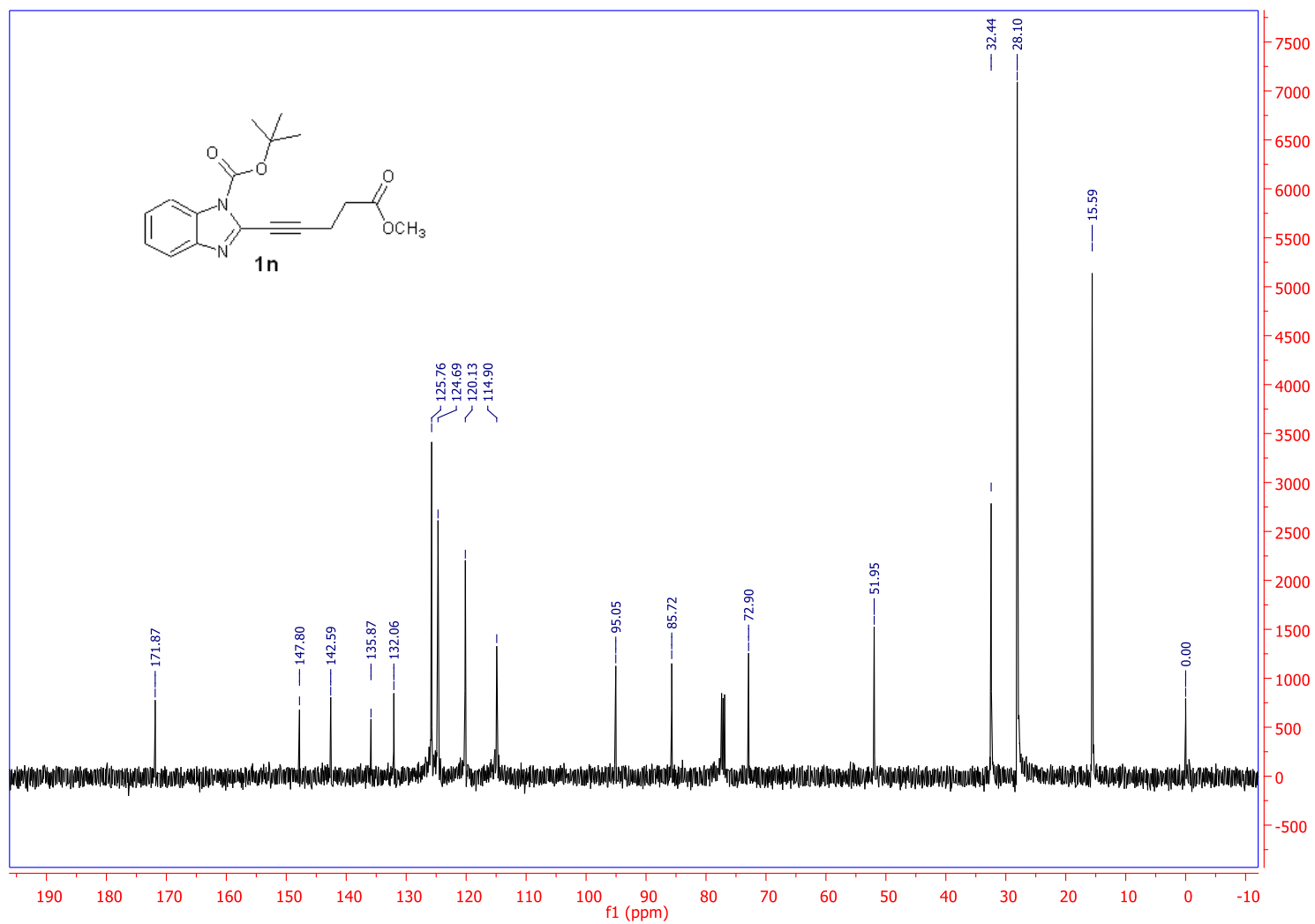
***N*-Boc-2-(cyclohex-1-en-1-ylethynyl)-1*H*-benzo[*d*]imidazole (11)**<sup>13</sup>C NMR (125 MHz CDCl<sub>3</sub>)

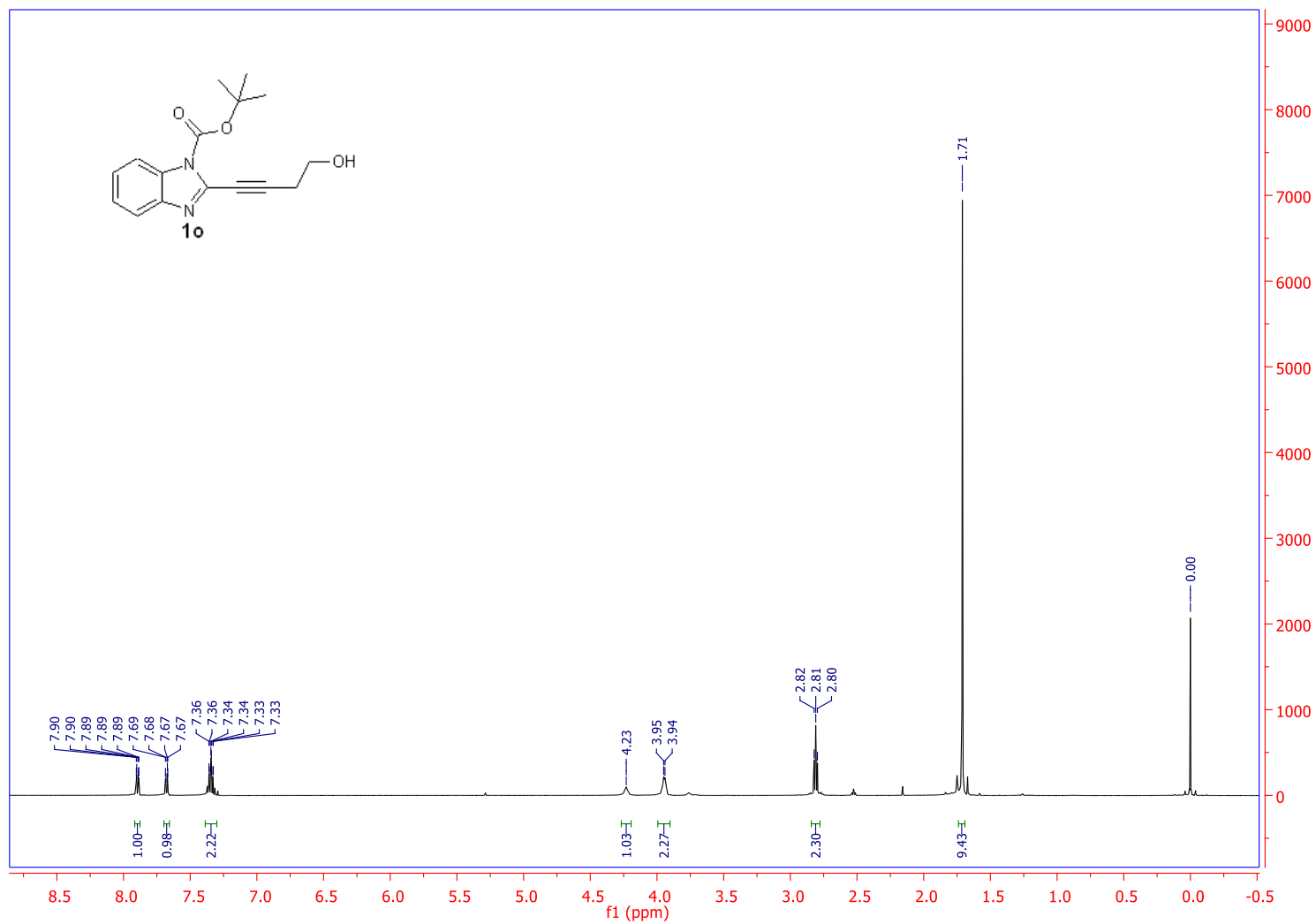
***N*-Boc-2-(3-methoxyprop-1-yn-1-yl)-1*H*-benzo[*d*]imidazole (1m)**<sup>1</sup>H NMR (500 MHz, CDCl<sub>3</sub>)

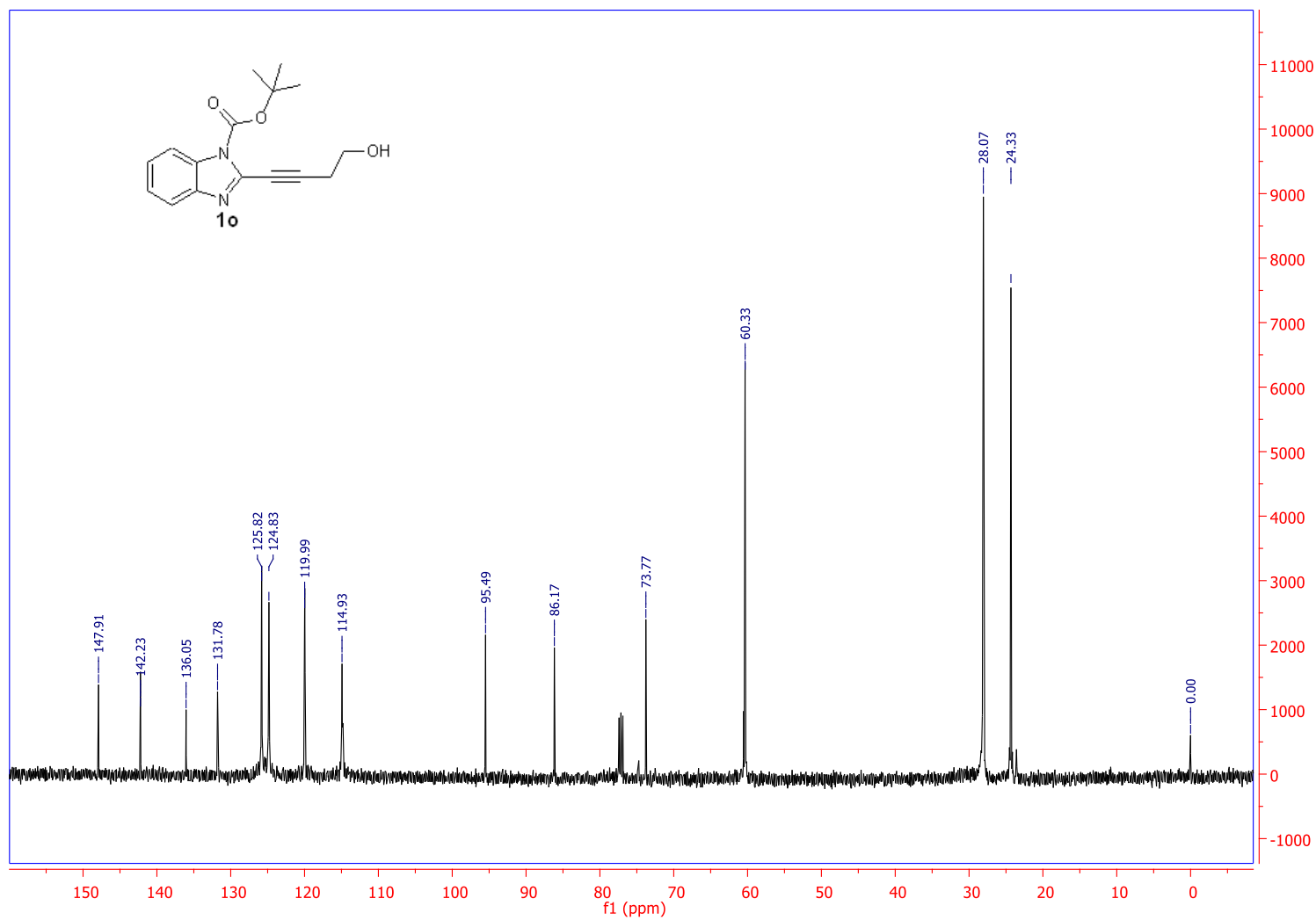
***N*-Boc-2-(3-methoxyprop-1-yn-1-yl)-1*H*-benzo[*d*]imidazole (1m)**<sup>13</sup>C NMR (125 MHz, CDCl<sub>3</sub>)

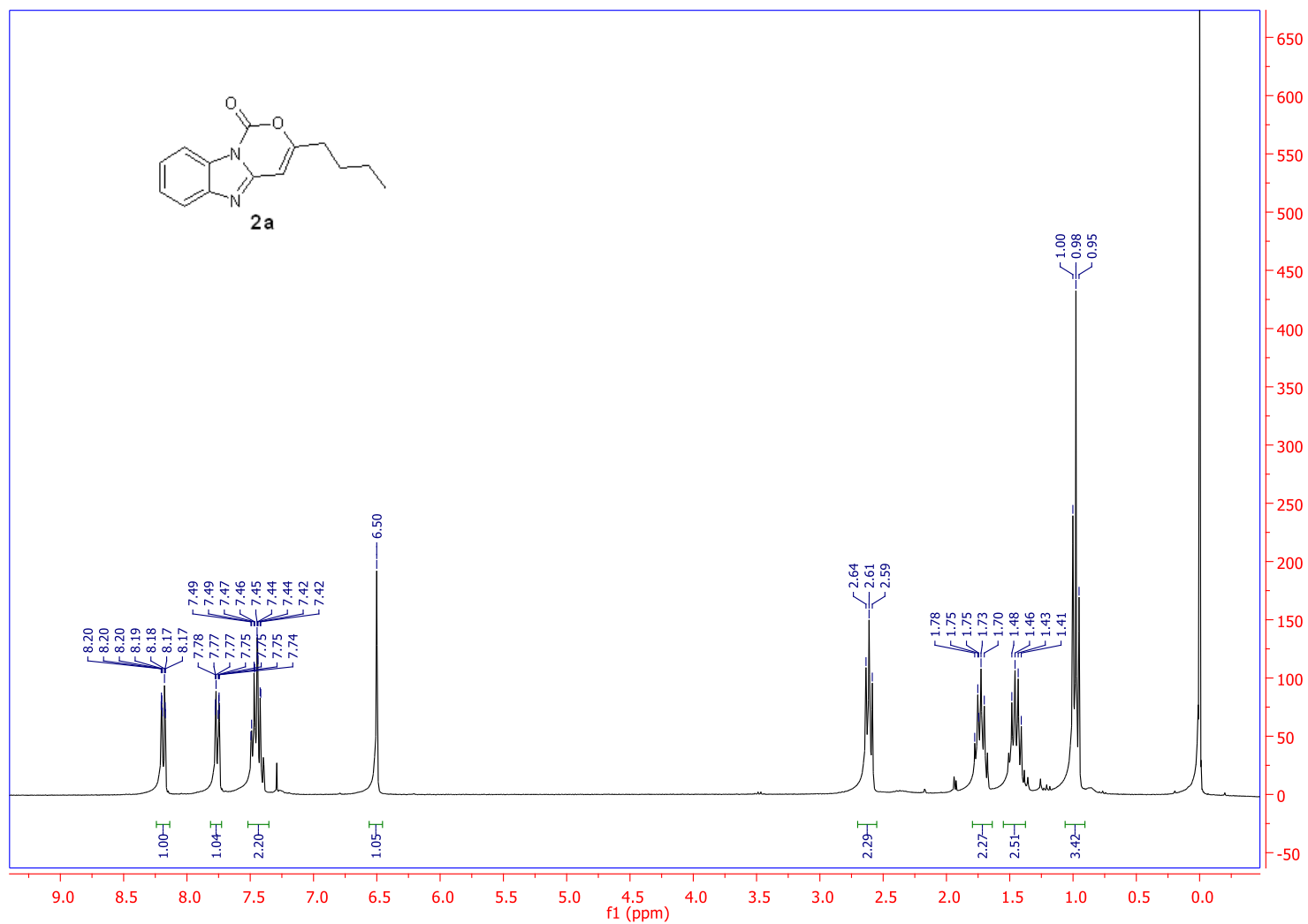


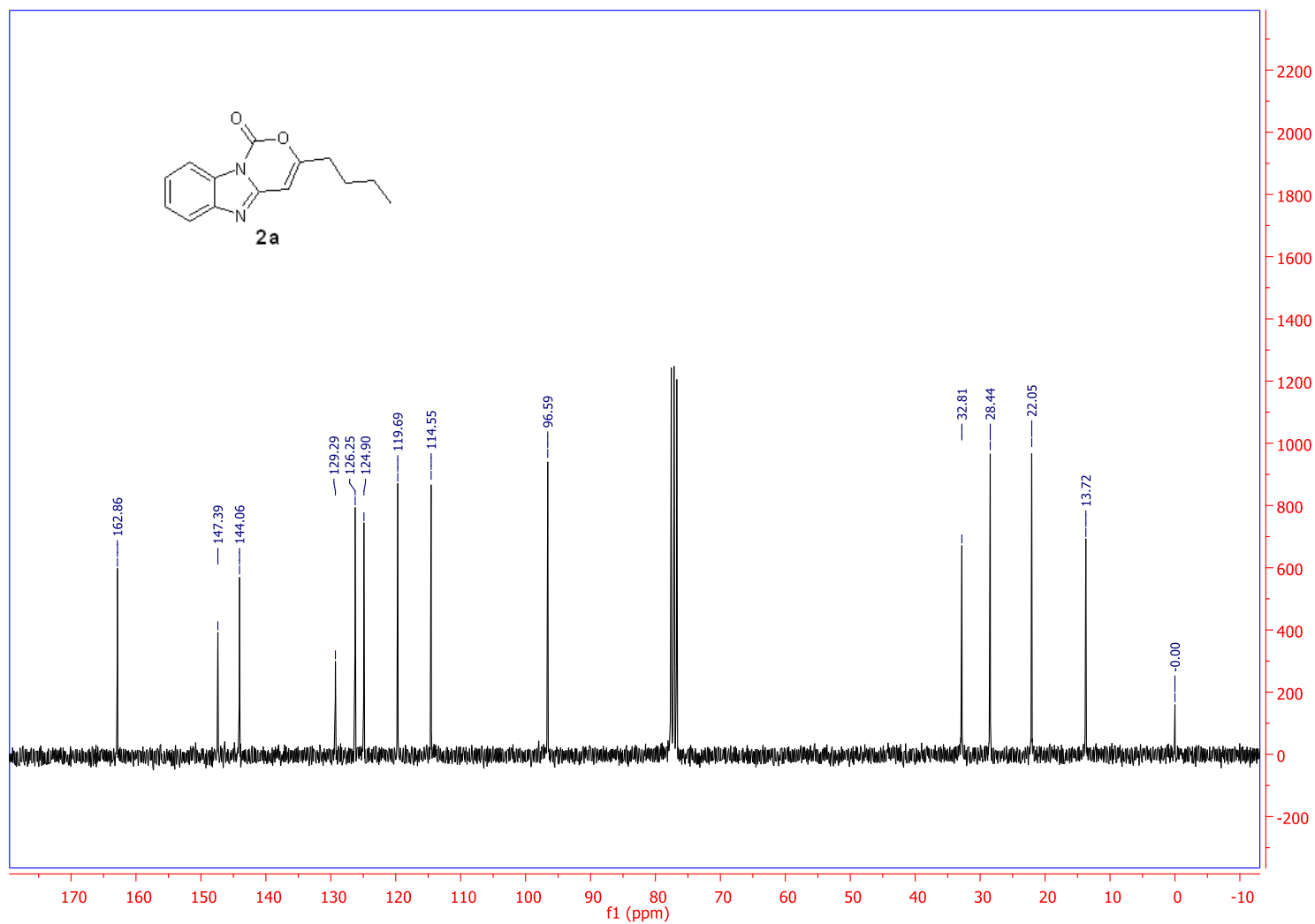
**Methyl *N*-Boc-5-(1*H*-benzo[*d*]imidazol-2-yl)pent-4-ynoate (1n)**<sup>1</sup>H NMR (500 MHz CDCl<sub>3</sub>)

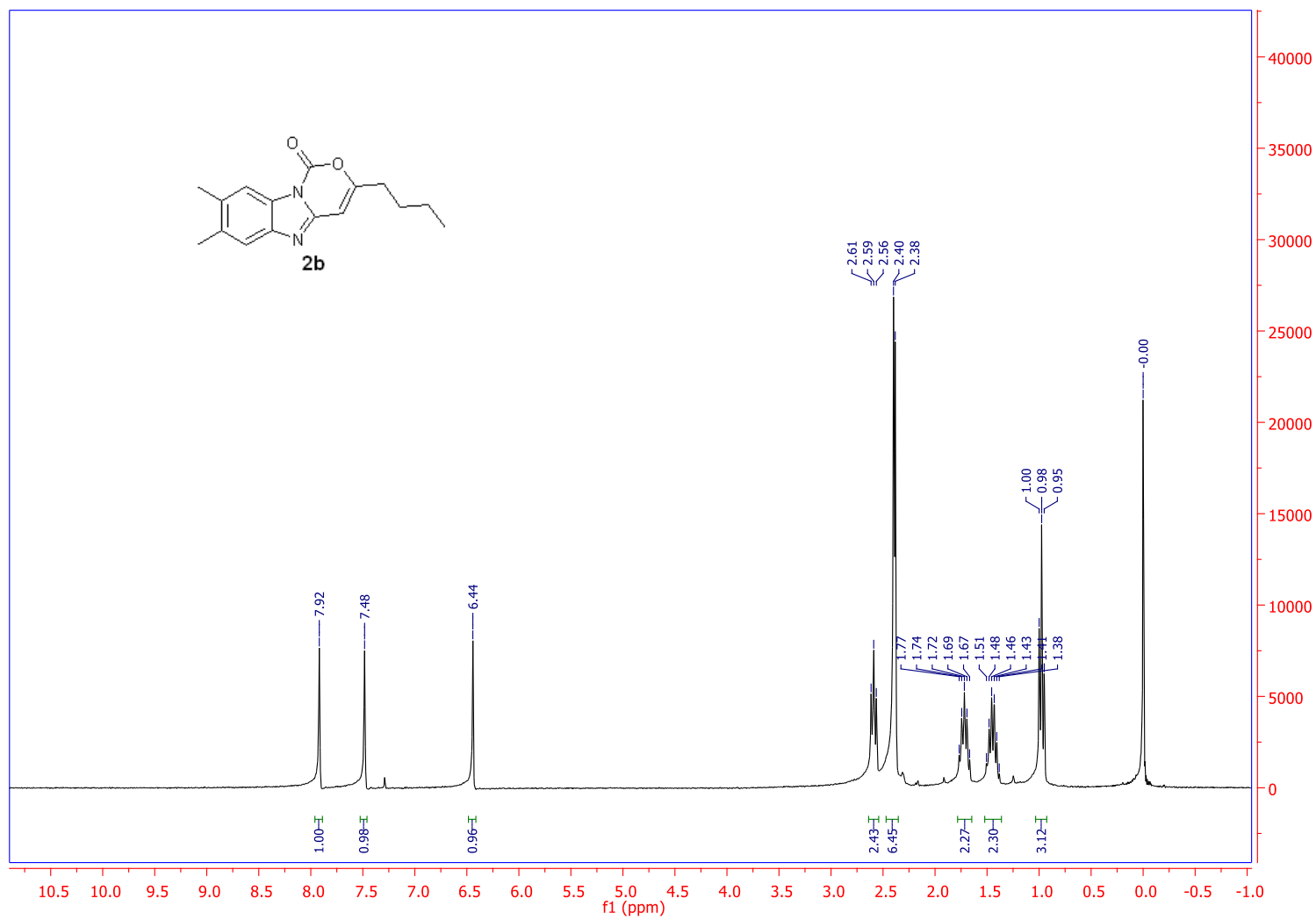
**Methyl *N*-Boc-5-(1*H*-benzo[*d*]imidazol-2-yl)pent-4-ynoate (1n)**<sup>13</sup>C NMR (125 MHz CDCl<sub>3</sub>)

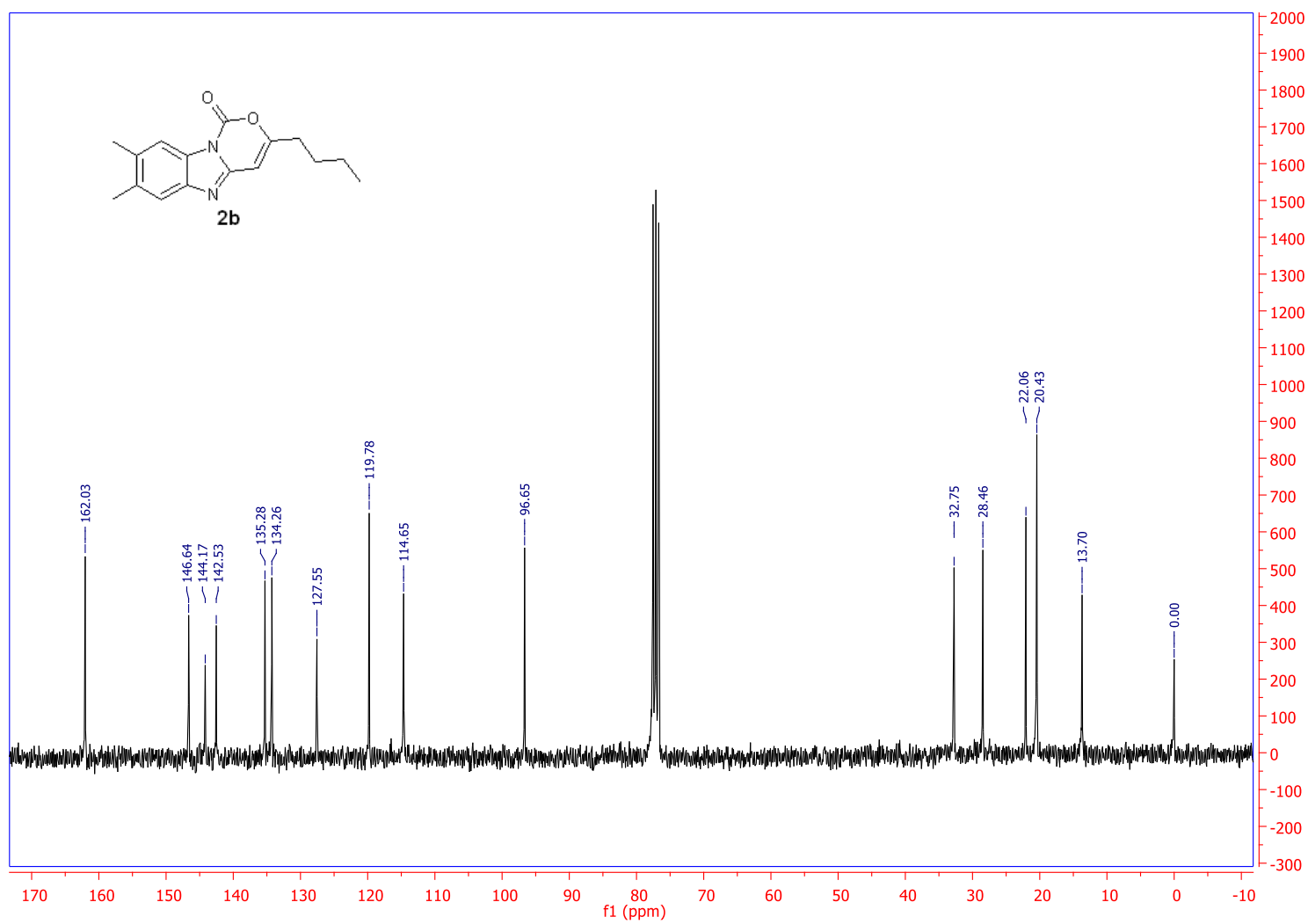
***N*-Boc-4-(1*H*-benzo[*d*]imidazol-2-yl)but-3-yn-1-ol (1o)**<sup>1</sup>H NMR (500 MHz CDCl<sub>3</sub>)

***N*-Boc-4-(1*H*-benzo[*d*]imidazol-2-yl)but-3-yn-1-ol (1o)**<sup>13</sup>C NMR (125 MHz CDCl<sub>3</sub>)

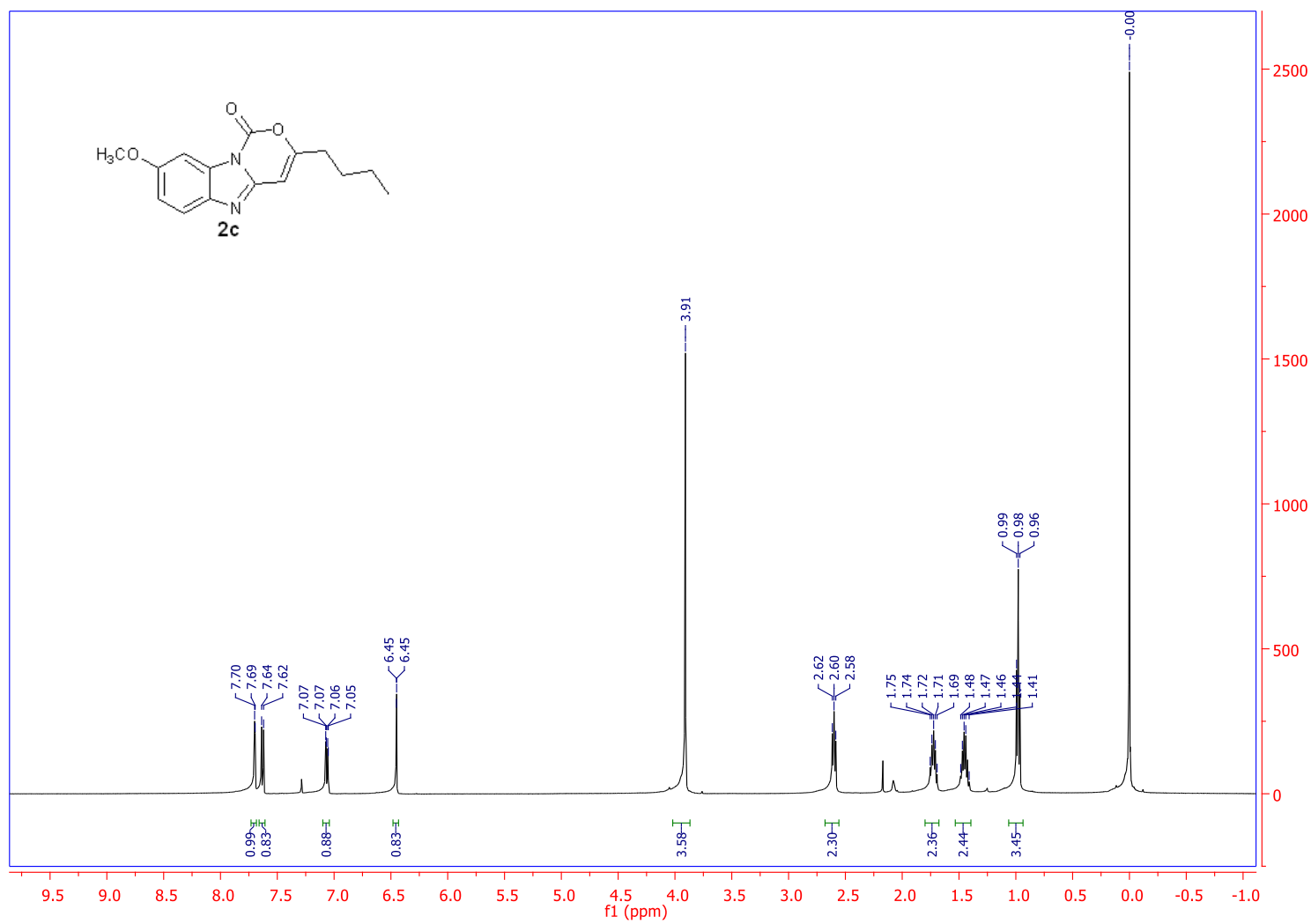
3-Butyl-1*H*-benzo[4,5]imidazo[1,2-*c*][1,3]oxazin-1-one (2a) $^1\text{H}$  NMR (300 MHz  $\text{CDCl}_3$ )

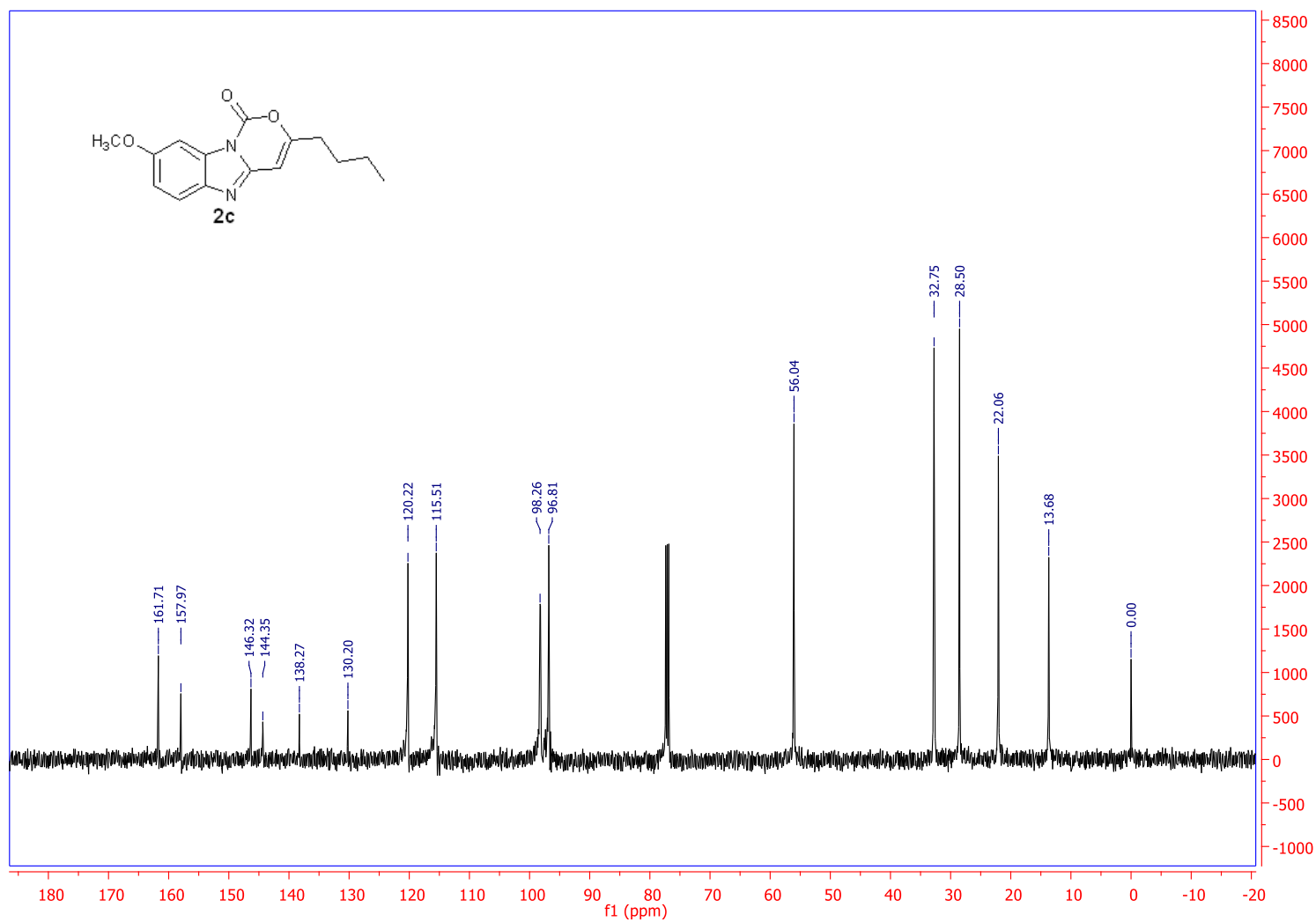
**3-Butyl-1*H*-benzo[4,5]imidazo[1,2-*c*][1,3]oxazin-1-one (2a)**<sup>13</sup>C NMR (75 MHz CDCl<sub>3</sub>)

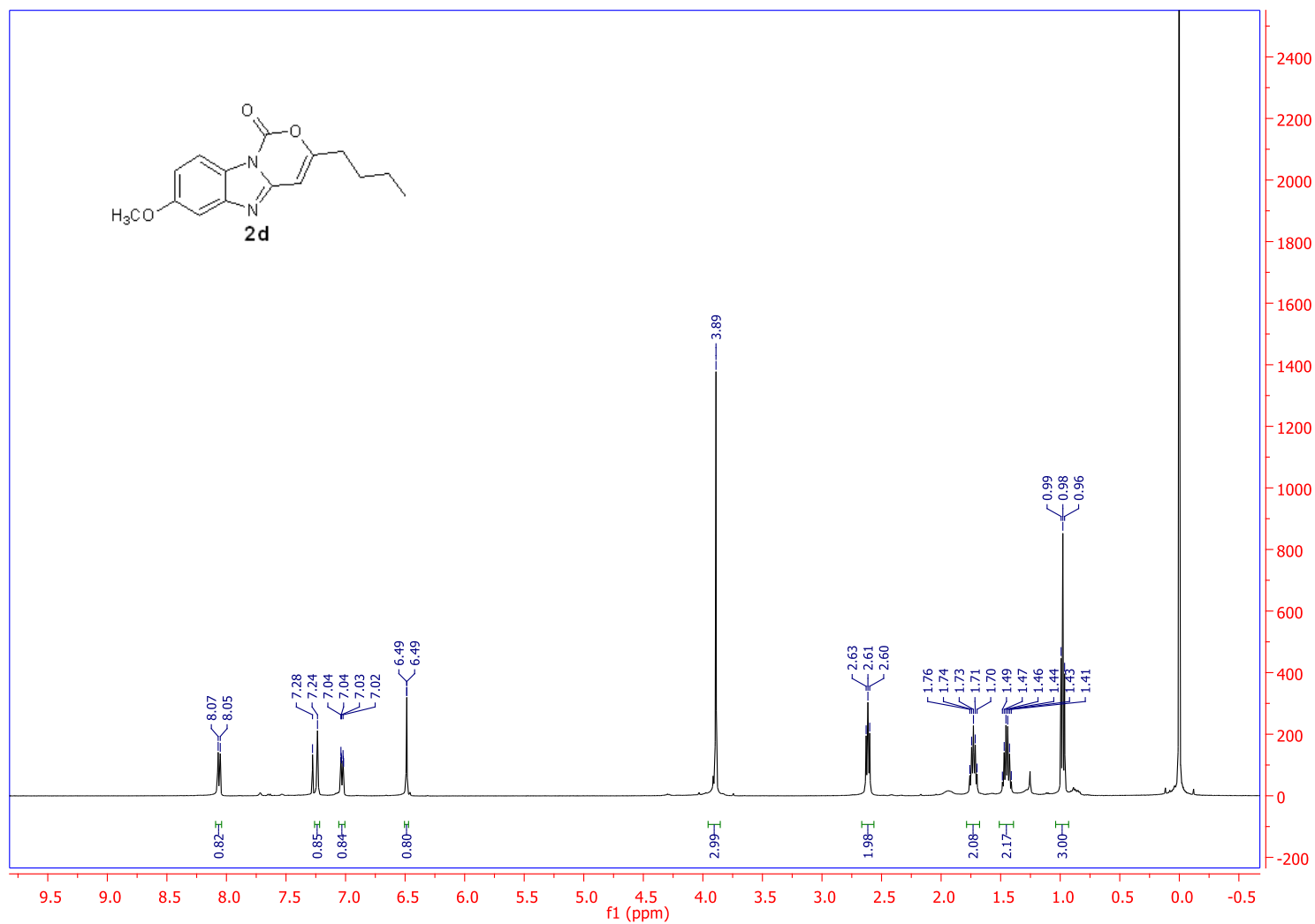
**3-Butyl-7,8-dimethyl-1*H*-benzo[4,5]imidazo[1,2-*c*][1,3]oxazin-1-one (2b)**<sup>1</sup>H NMR (300 MHz CDCl<sub>3</sub>)

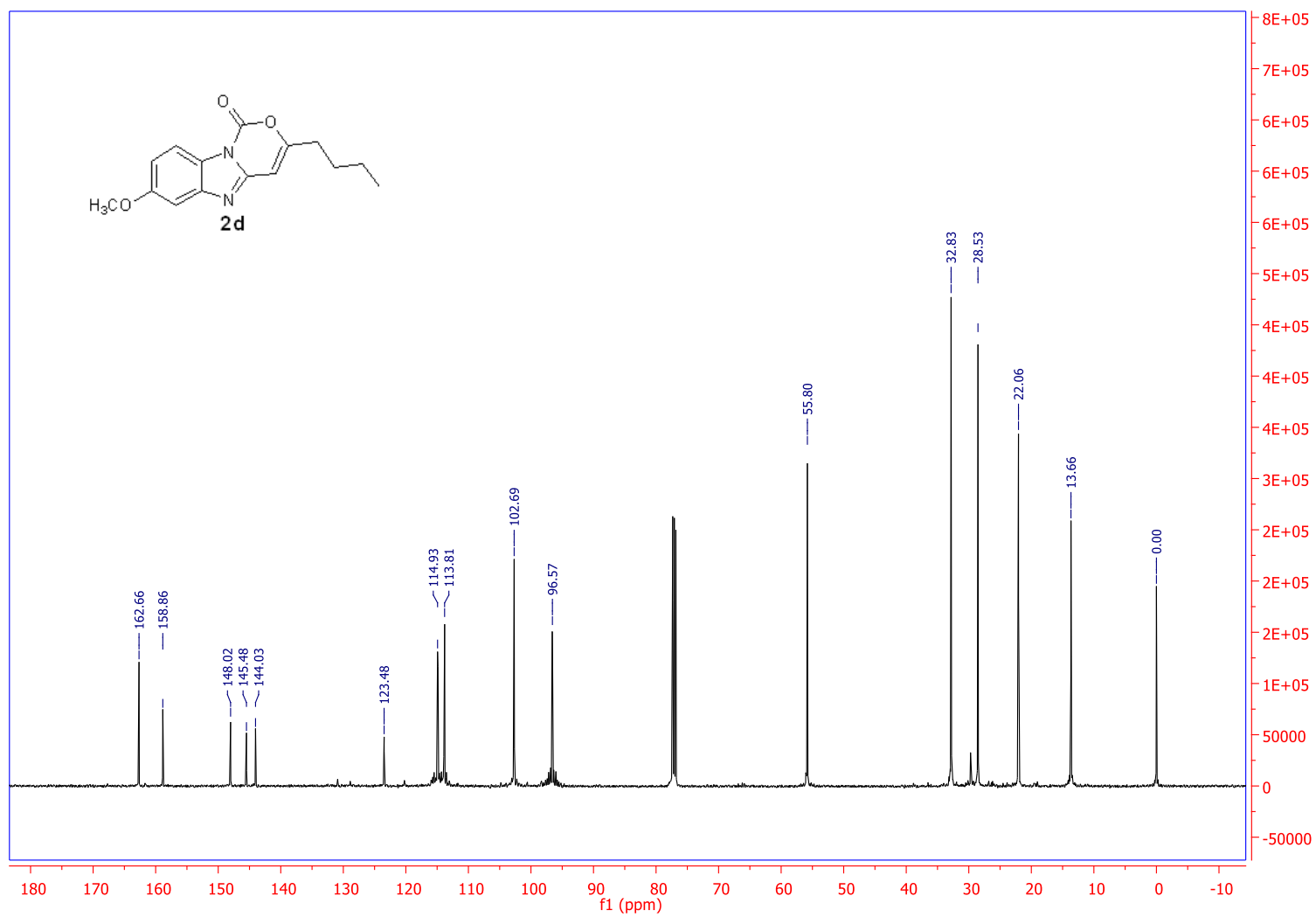
**3-Butyl-7,8-dimethyl-1*H*-benzo[4,5]imidazo[1,2-*c*][1,3]oxazin-1-one (2b)**<sup>13</sup>C NMR (75 MHz CDCl<sub>3</sub>)

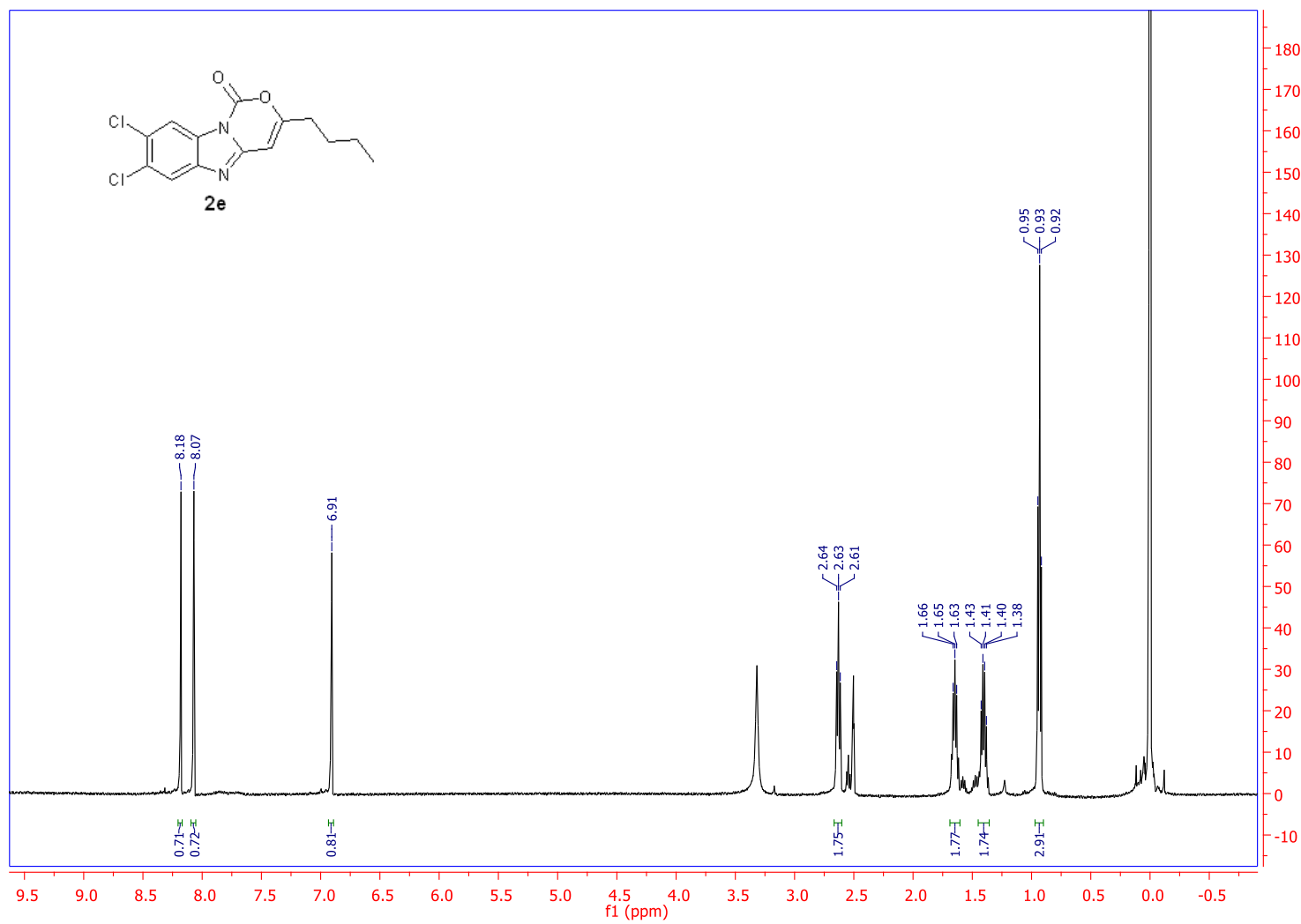


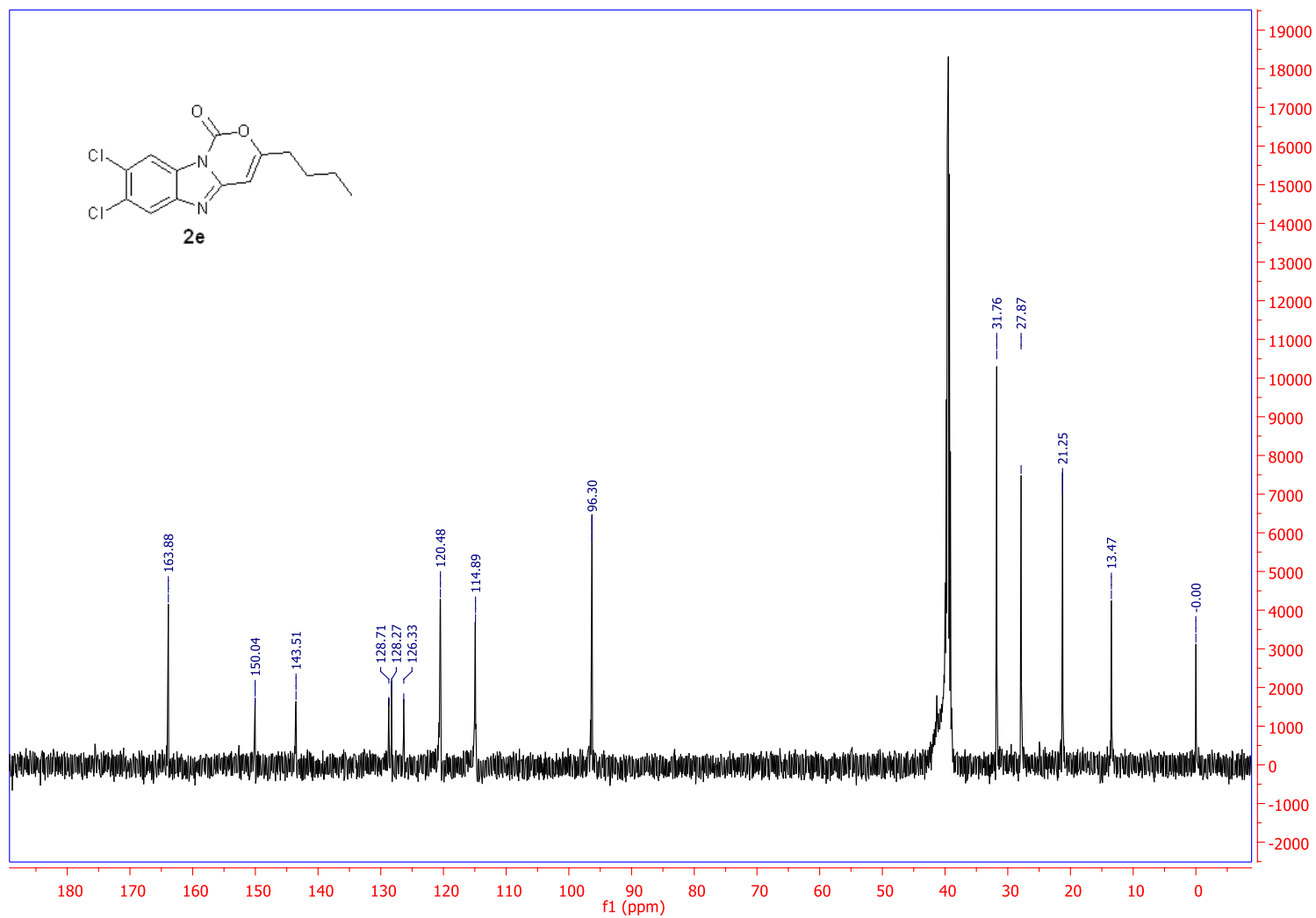
**3-Butyl-8-methoxy-1*H*-benzo[4,5]imidazo[1,2-*c*][1,3]oxazin-1-one (2c)**<sup>1</sup>H NMR (500 MHz CDCl<sub>3</sub>)

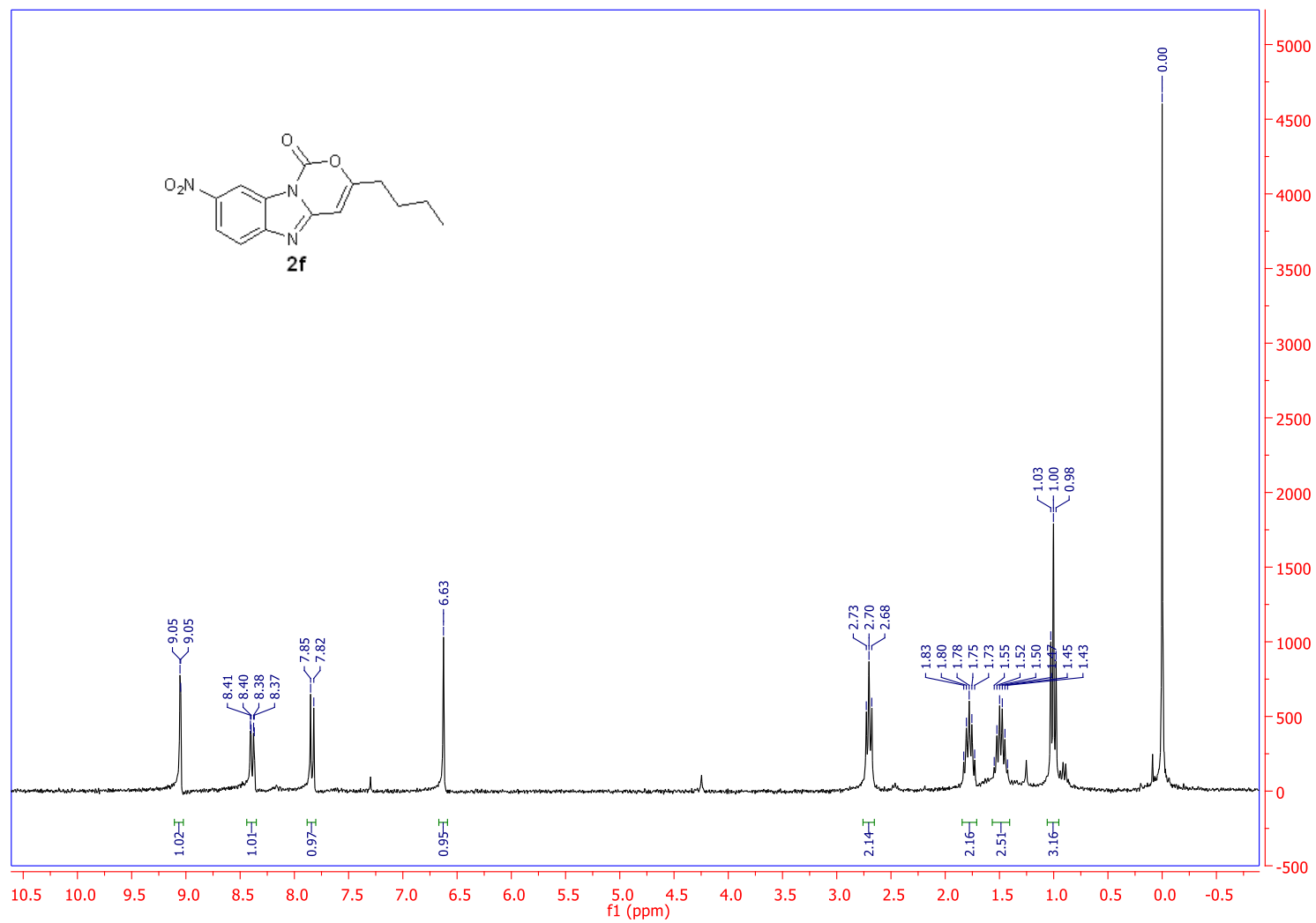
**3-Butyl-8-methoxy-1*H*-benzo[4,5]imidazo[1,2-*c*][1,3]oxazin-1-one (2c)**<sup>13</sup>C NMR (125 MHz CDCl<sub>3</sub>)

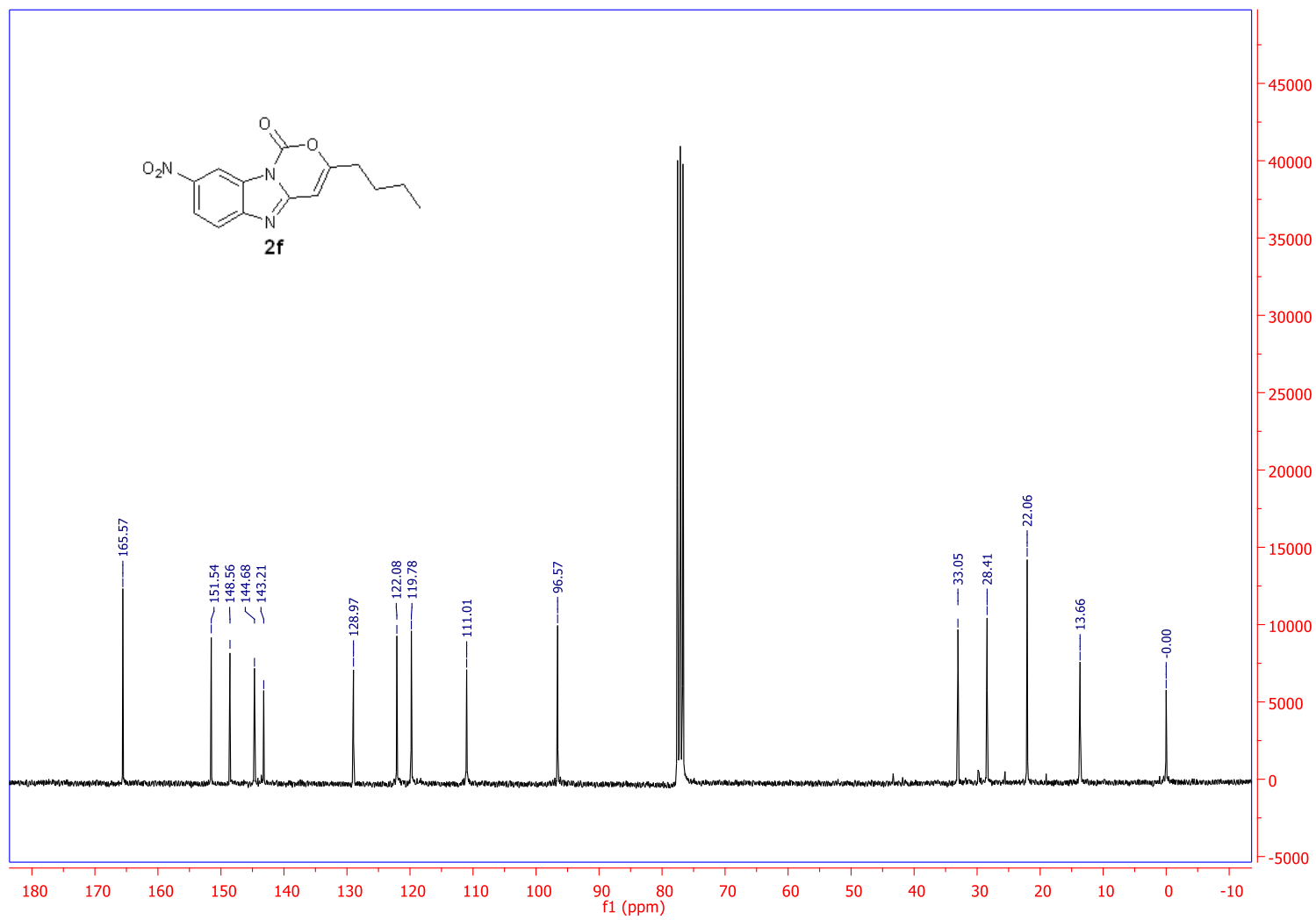
**3-Butyl-7-methoxy-1*H*-benzo[4,5]imidazo[1,2-*c*][1,3]oxazin-1-one (2d)**<sup>1</sup>H NMR (500 MHz CDCl<sub>3</sub>)

**3-Butyl-7-methoxy-1*H*-benzo[4,5]imidazo[1,2-*c*][1,3]oxazin-1-one (2d)**<sup>13</sup>C NMR (125 MHz CDCl<sub>3</sub>)

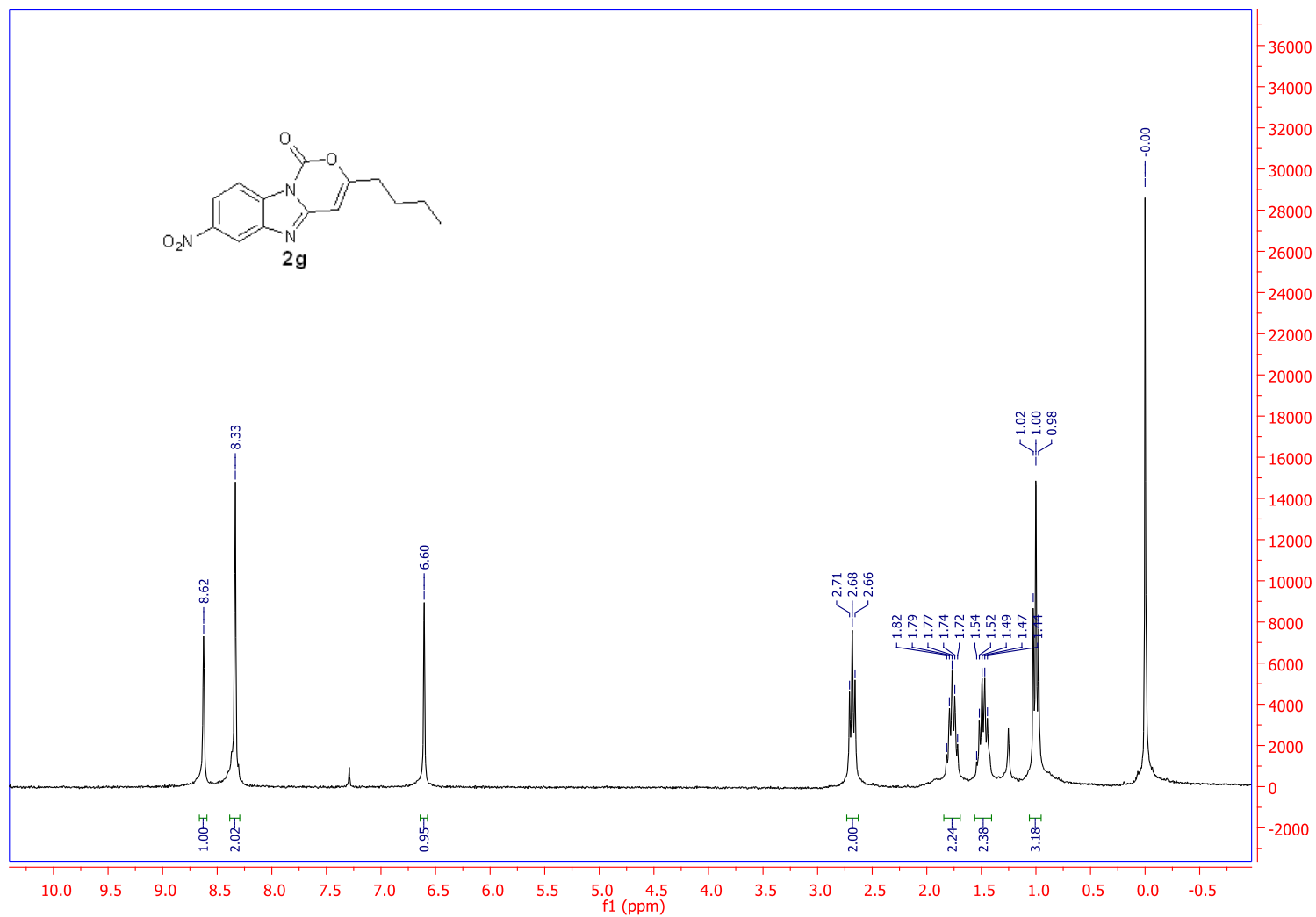
**3-Butyl-7,8-dichloro-1*H*-benzo[4,5]imidazo[1,2-*c*][1,3]oxazin-1-one (2e)**<sup>1</sup>H NMR (500 MHz DMSO-*d*<sub>6</sub>)

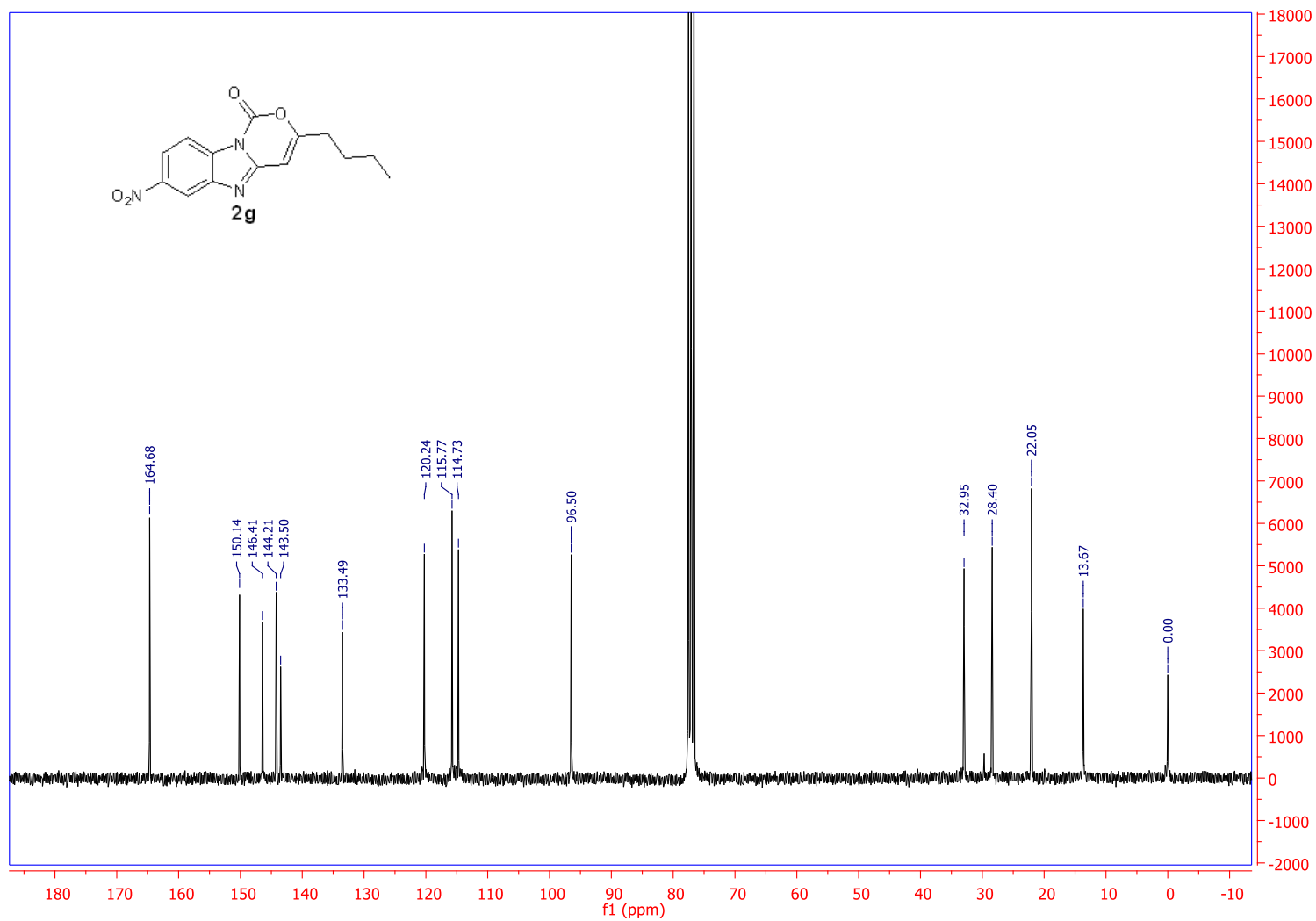
**3-Butyl-7,8-dichloro-1*H*-benzo[4,5]imidazo[1,2-*c*][1,3]oxazin-1-one (2e)**<sup>13</sup>C NMR (125 MHz DMSO-*d*<sub>6</sub>)

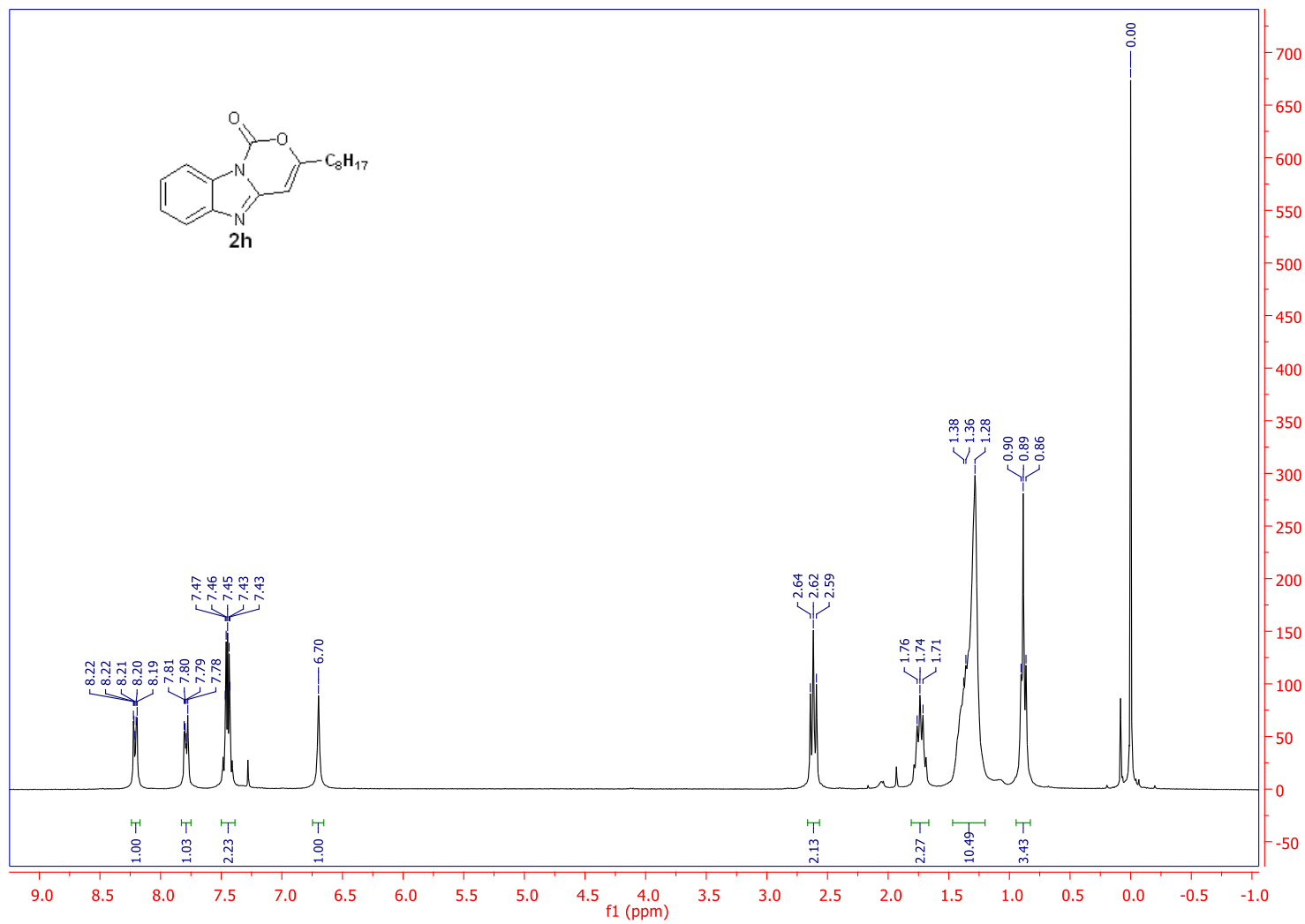
**3-Butyl-8-nitro-1*H*-benzo[4,5]imidazo[1,2-*c*][1,3]oxazin-1-one (2f)**<sup>1</sup>H NMR (300 MHz CDCl<sub>3</sub>)

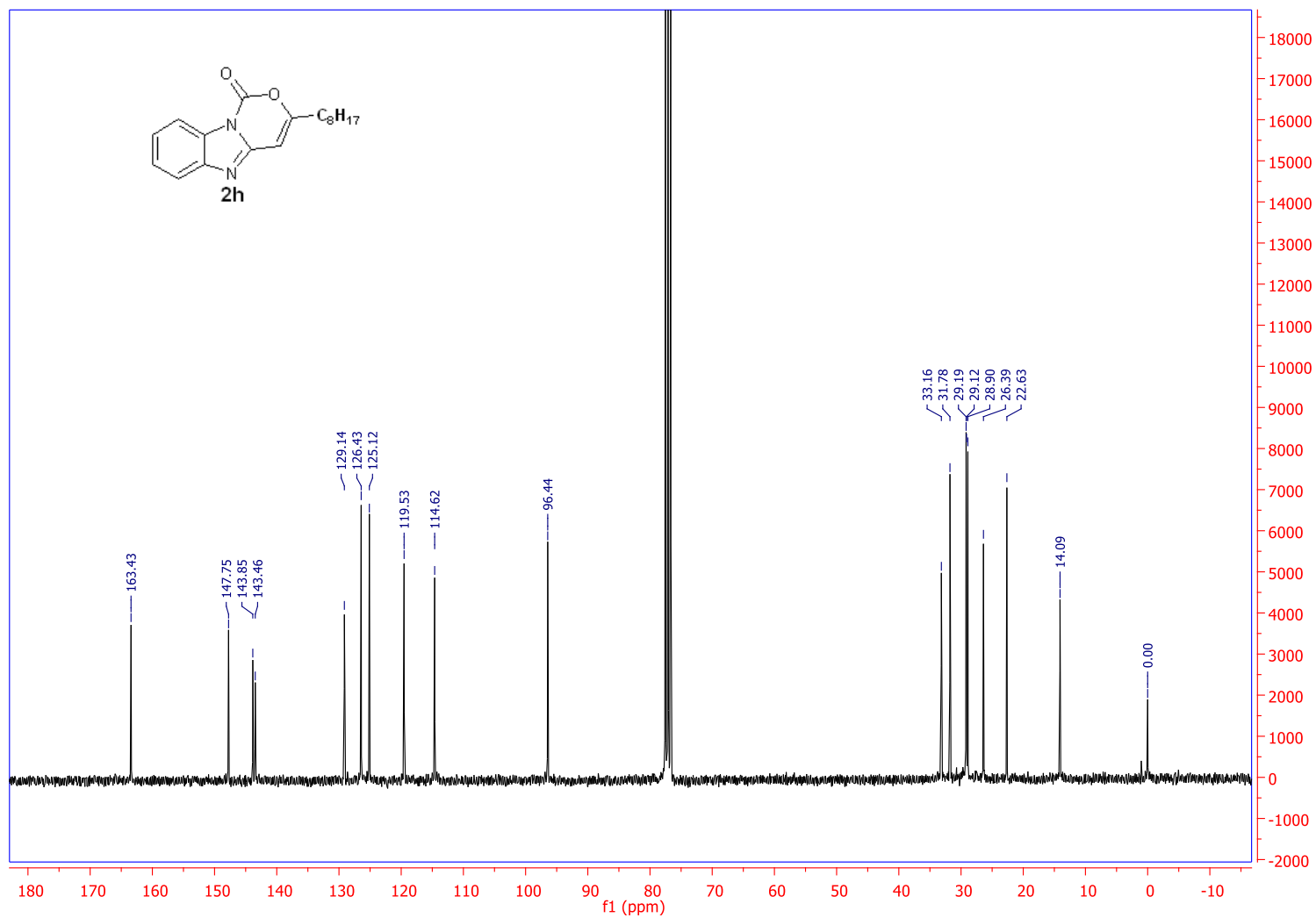
**3-Butyl-8-nitro-1*H*-benzo[4,5]imidazo[1,2-*c*][1,3]oxazin-1-one (2f)**<sup>13</sup>C NMR (75 MHz CDCl<sub>3</sub>)

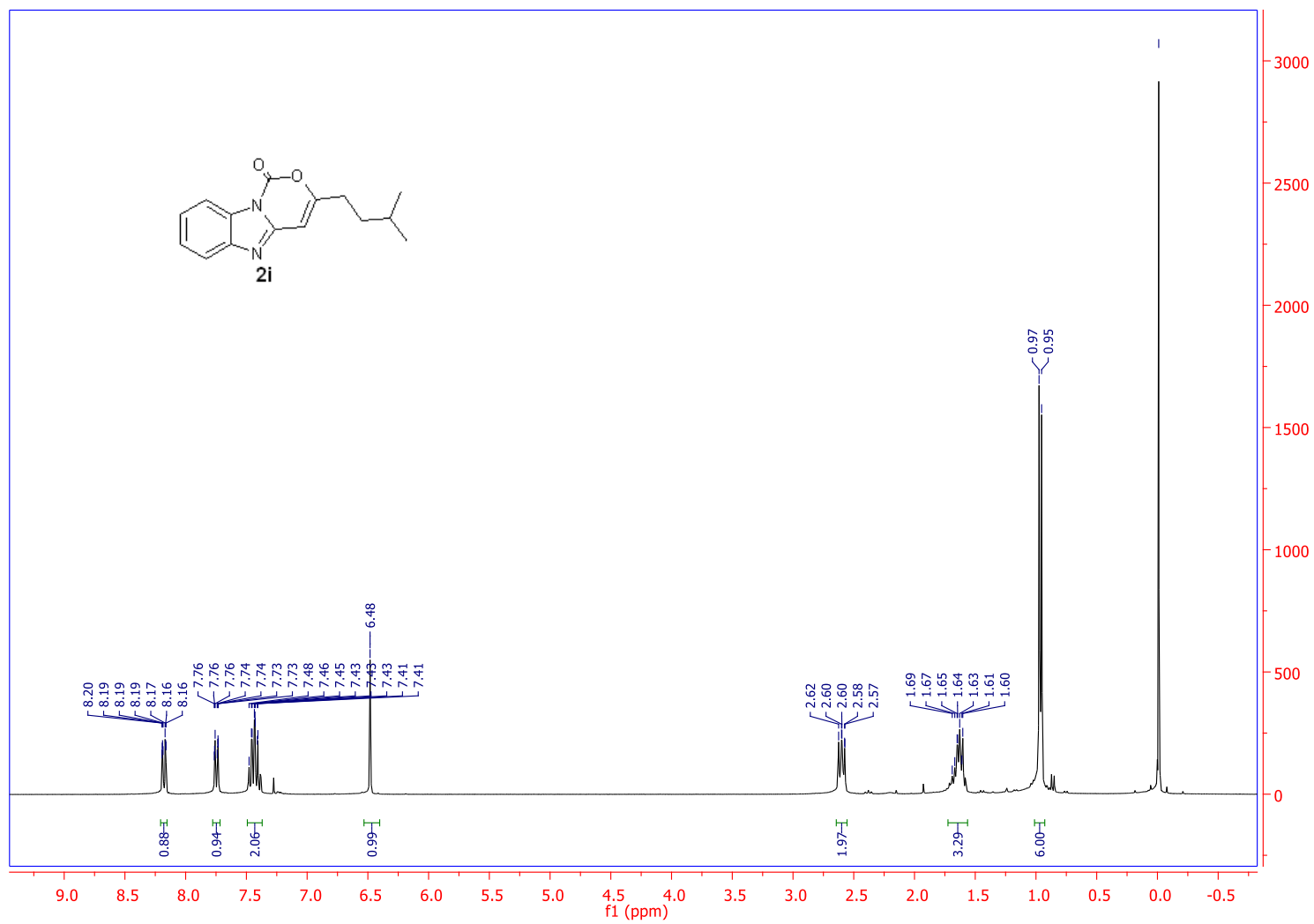


**3-Butyl-7-nitro-1*H*-benzo[4,5]imidazo[1,2-*c*][1,3]oxazin-1-one (2g)**<sup>1</sup>H NMR (300 MHz CDCl<sub>3</sub>)

**3-Butyl-7-nitro-1H-benzo[4,5]imidazo[1,2-c][1,3]oxazin-1-one (2g)**<sup>1</sup>H NMR (300 MHz CDCl<sub>3</sub>)

**3-Octyl-1*H*-benzo[4,5]imidazo[1,2-*c*][1,3]oxazin-1-one (2h)**<sup>1</sup>H NMR (300 MHz CDCl<sub>3</sub>)

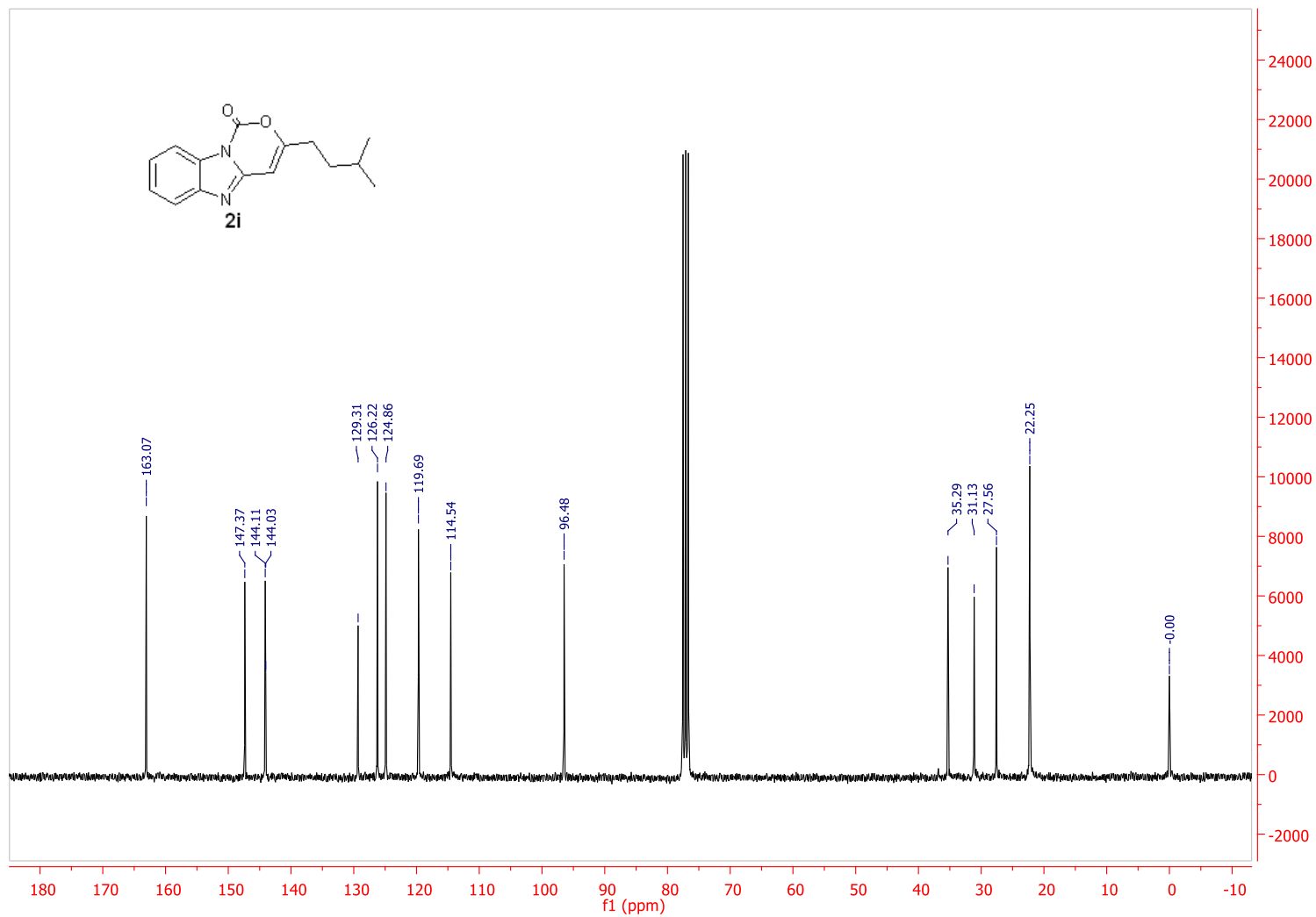
**3-Octyl-1*H*-benzo[4,5]imidazo[1,2-*c*][1,3]oxazin-1-one (2h)**<sup>13</sup>C NMR (75 MHz CDCl<sub>3</sub>)

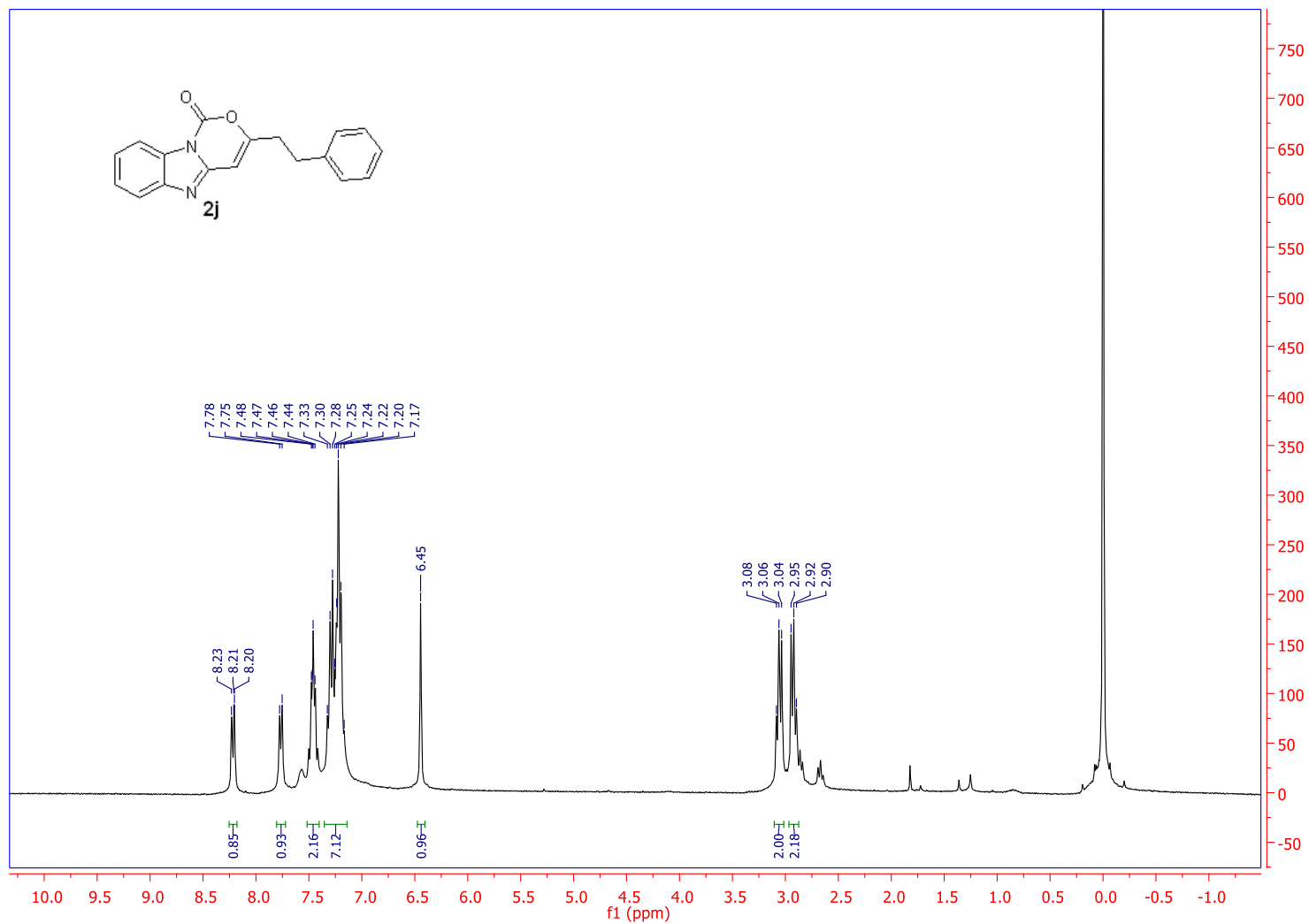
**3-Isopentyl-1*H*-benzo[4,5]imidazo[1,2-*c*][1,3]oxazin-1-one (2i)**<sup>1</sup>H NMR (300 MHz CDCl<sub>3</sub>)

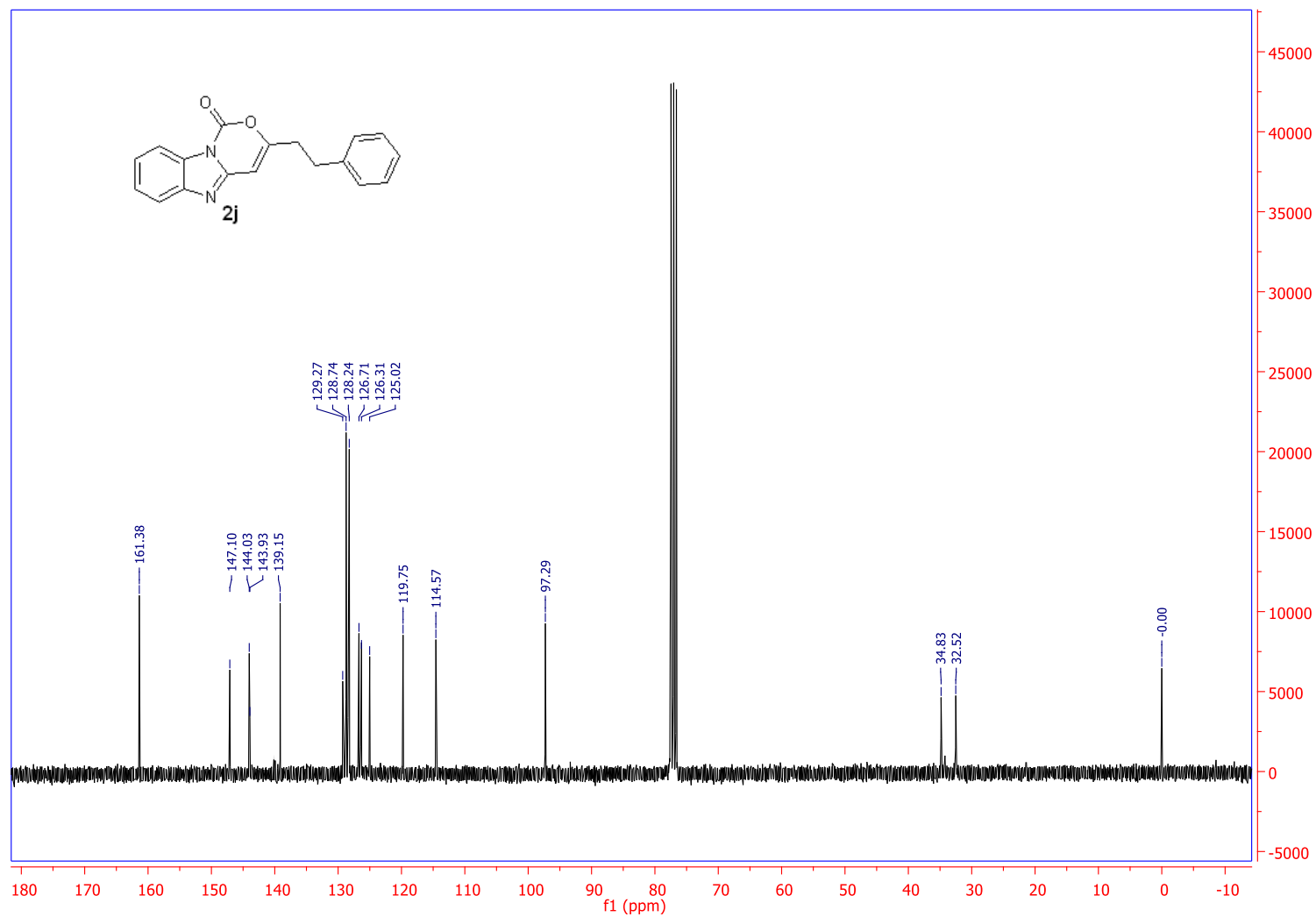
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**3-Isopentyl-1*H*-benzo[4,5]imidazo[1,2-*c*][1,3]oxazin-1-one (2i)**

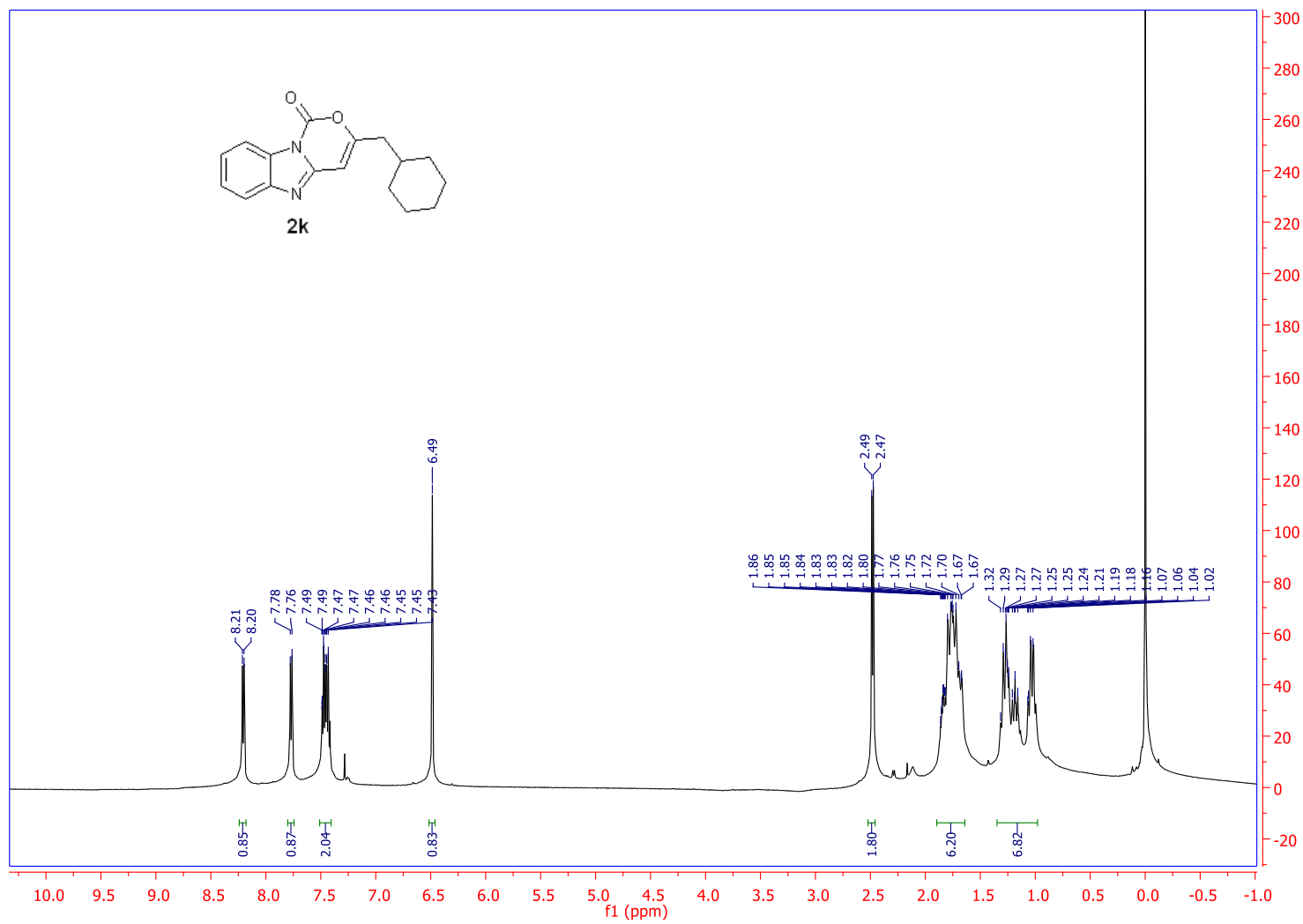
<sup>13</sup>C NMR (75 MHz CDCl<sub>3</sub>)

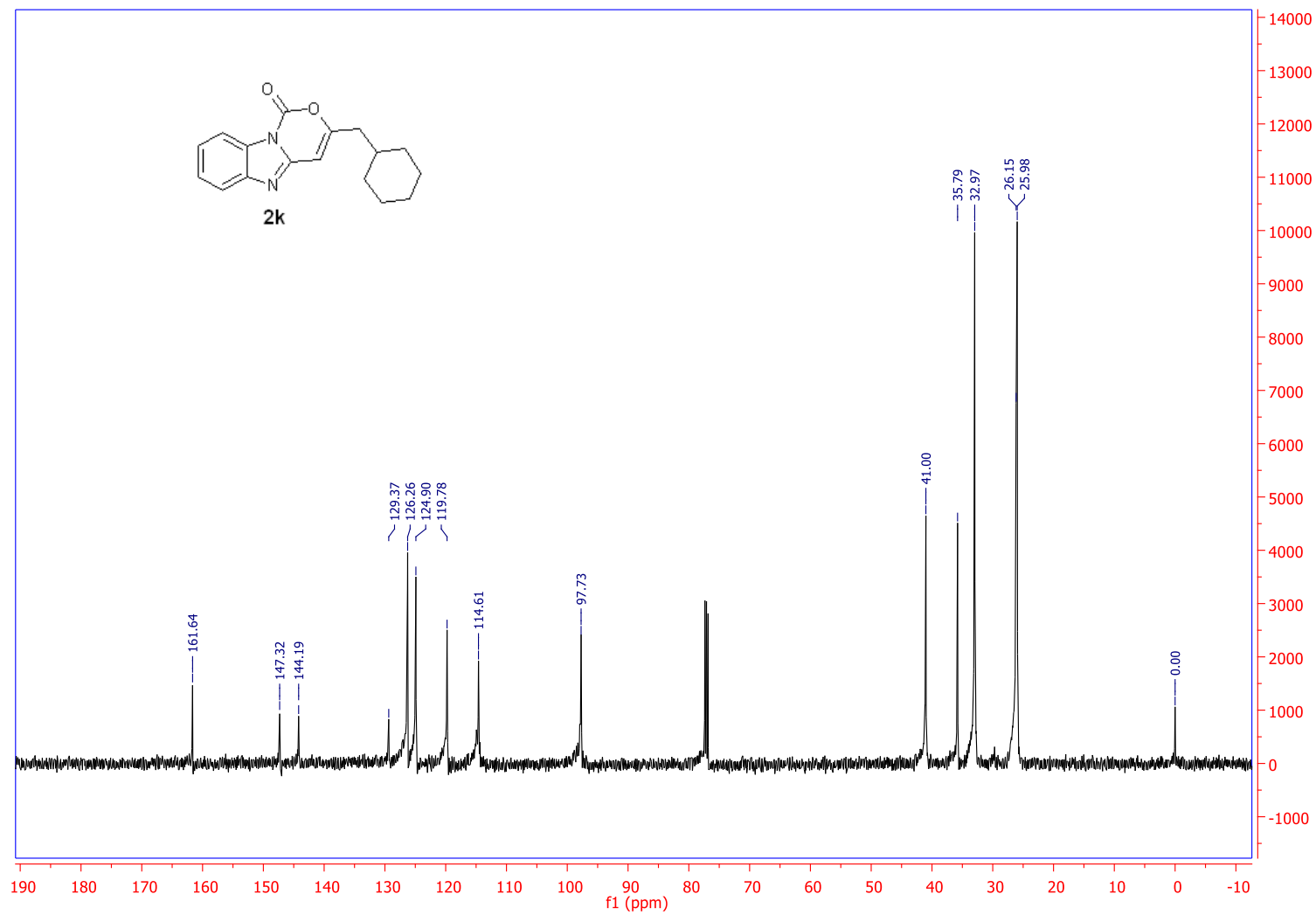


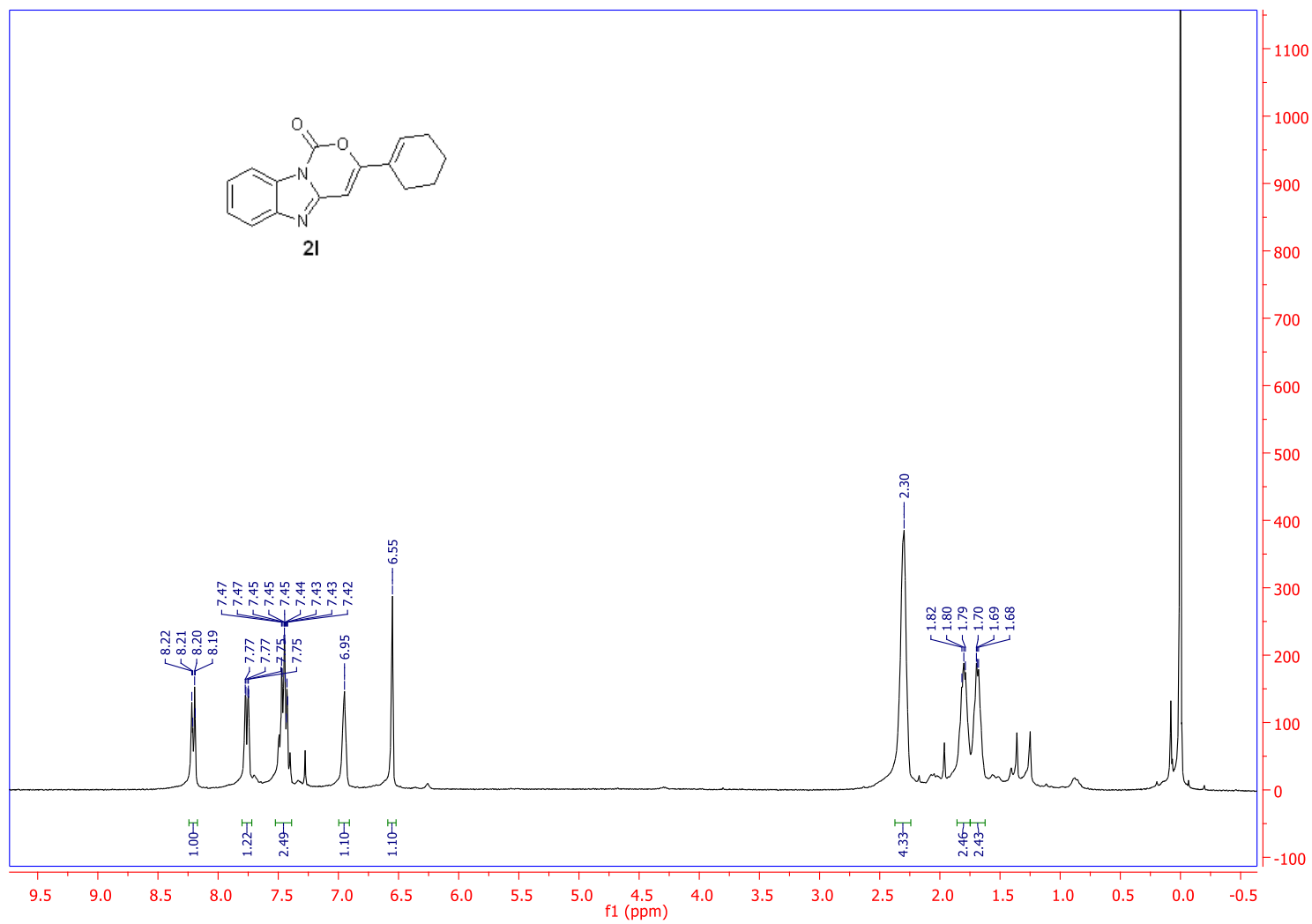
**3-Phenethyl-1H-benzo[4,5]imidazo[1,2-c][1,3]oxazin-1-one (2j)**<sup>1</sup>H NMR (300 MHz CDCl<sub>3</sub>)

**3-Phenethyl-1H-benzo[4,5]imidazo[1,2-c][1,3]oxazin-1-one (2j)** $^{13}\text{C}$  NMR (75 MHz  $\text{CDCl}_3$ )



**3-(Cyclohexylmethyl)-1*H*-benzo[4,5]imidazo[1,2-*c*][1,3]oxazin-1-one (2k)**<sup>1</sup>H NMR (500 MHz CDCl<sub>3</sub>)

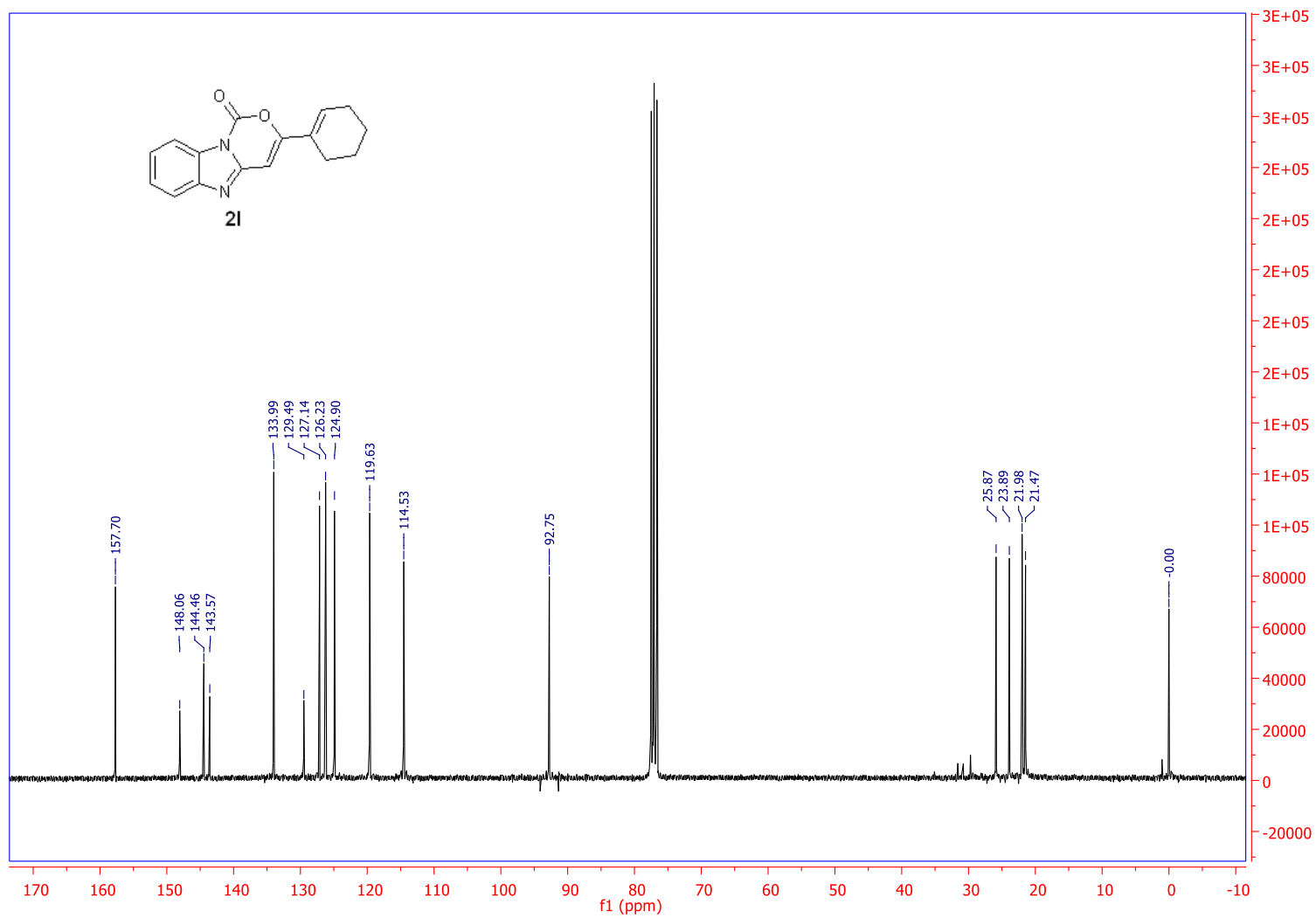
**3-(Cyclohexylmethyl)-1*H*-benzo[4,5]imidazo[1,2-*c*][1,3]oxazin-1-one (2k)**<sup>13</sup>C NMR (125 MHz CDCl<sub>3</sub>)

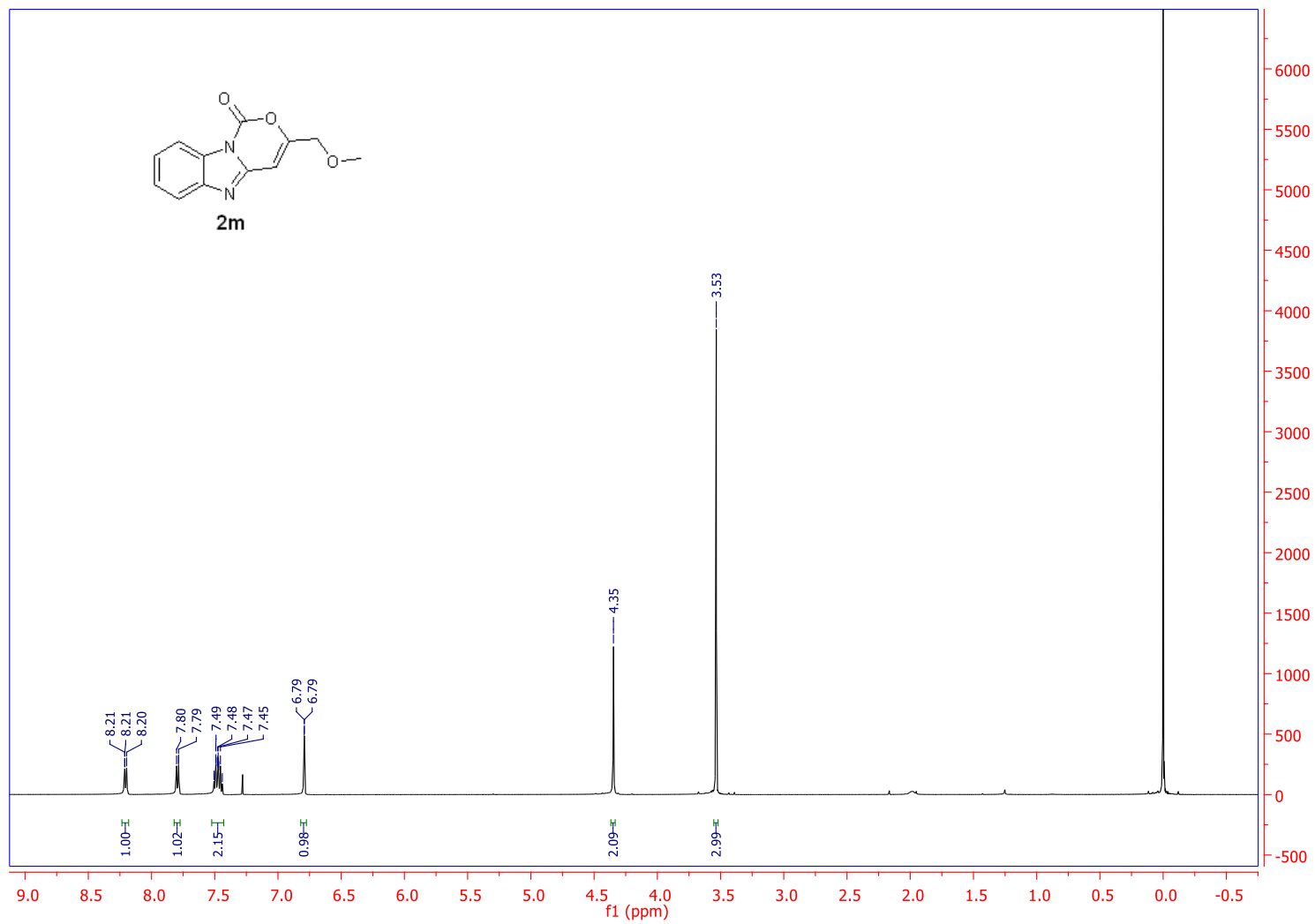
**3-(Cyclohex-1-en-1-yl)-1H-benzo[4,5]imidazo[1,2-c][1,3]oxazin-1-one (2I)**<sup>1</sup>H NMR (300 MHz CDCl<sub>3</sub>)

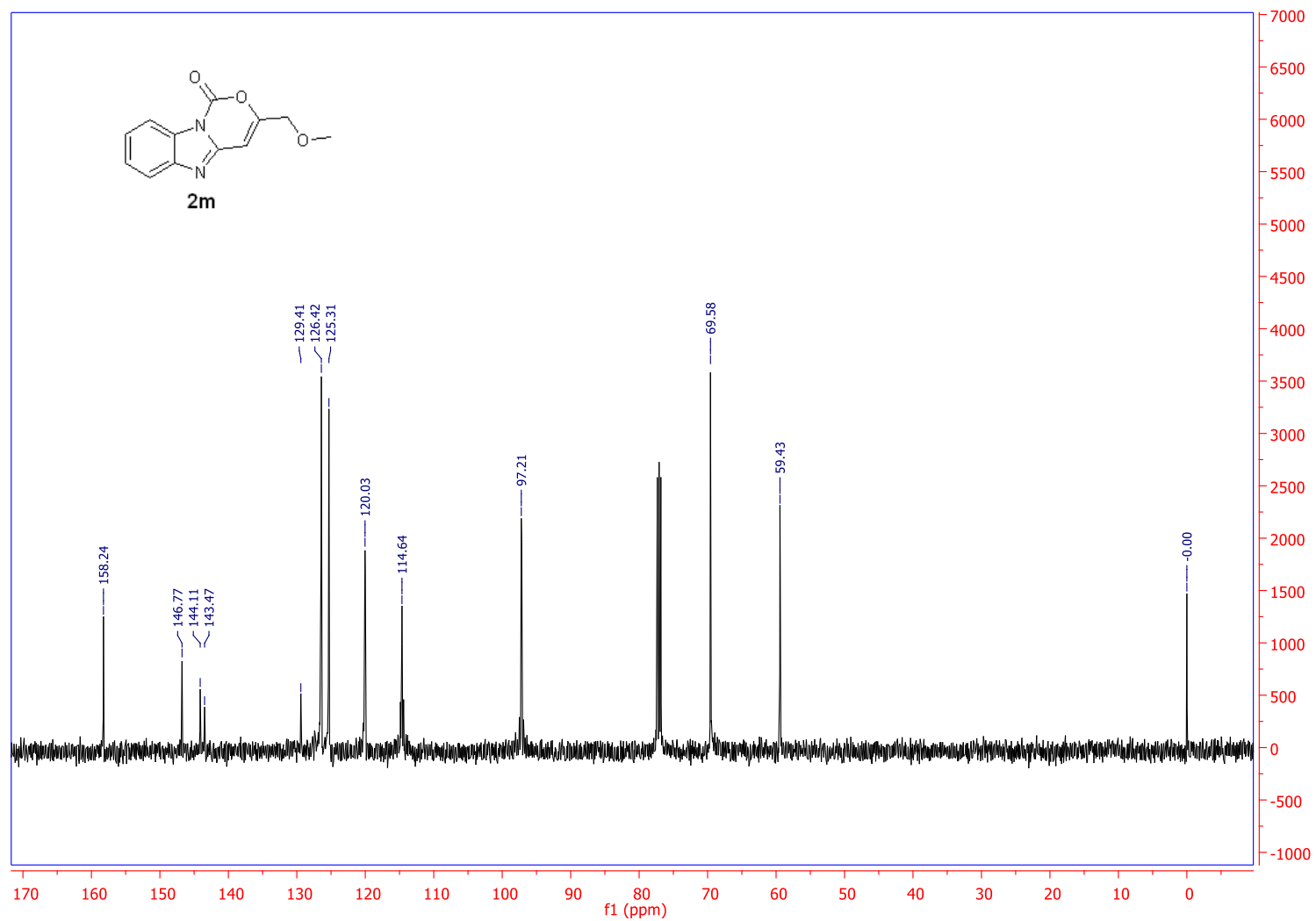
S91

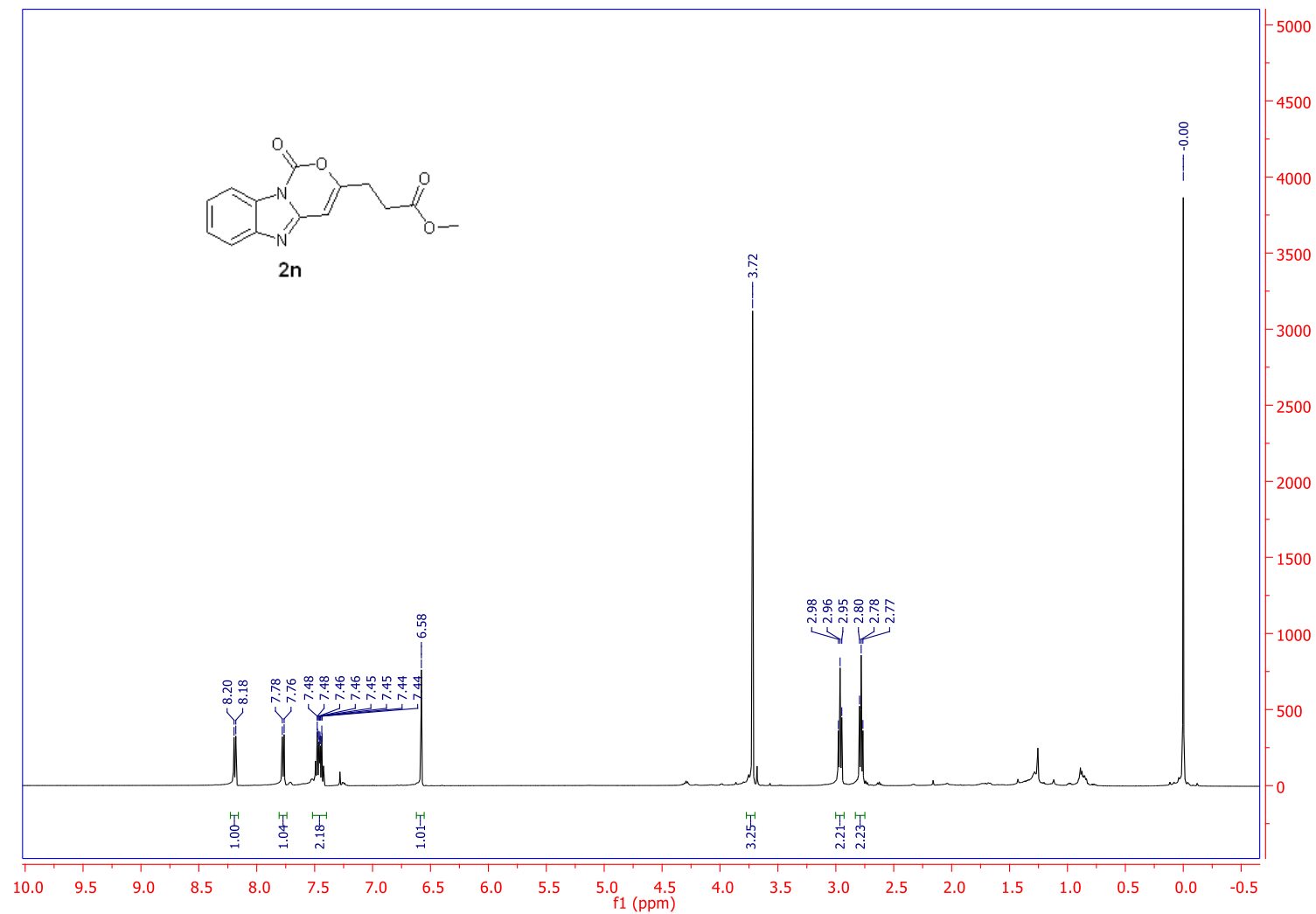
**3-(Cyclohex-1-en-1-yl)-1*H*-benzo[4,5]imidazo[1,2-*c*][1,3]oxazin-1-one (2I)**

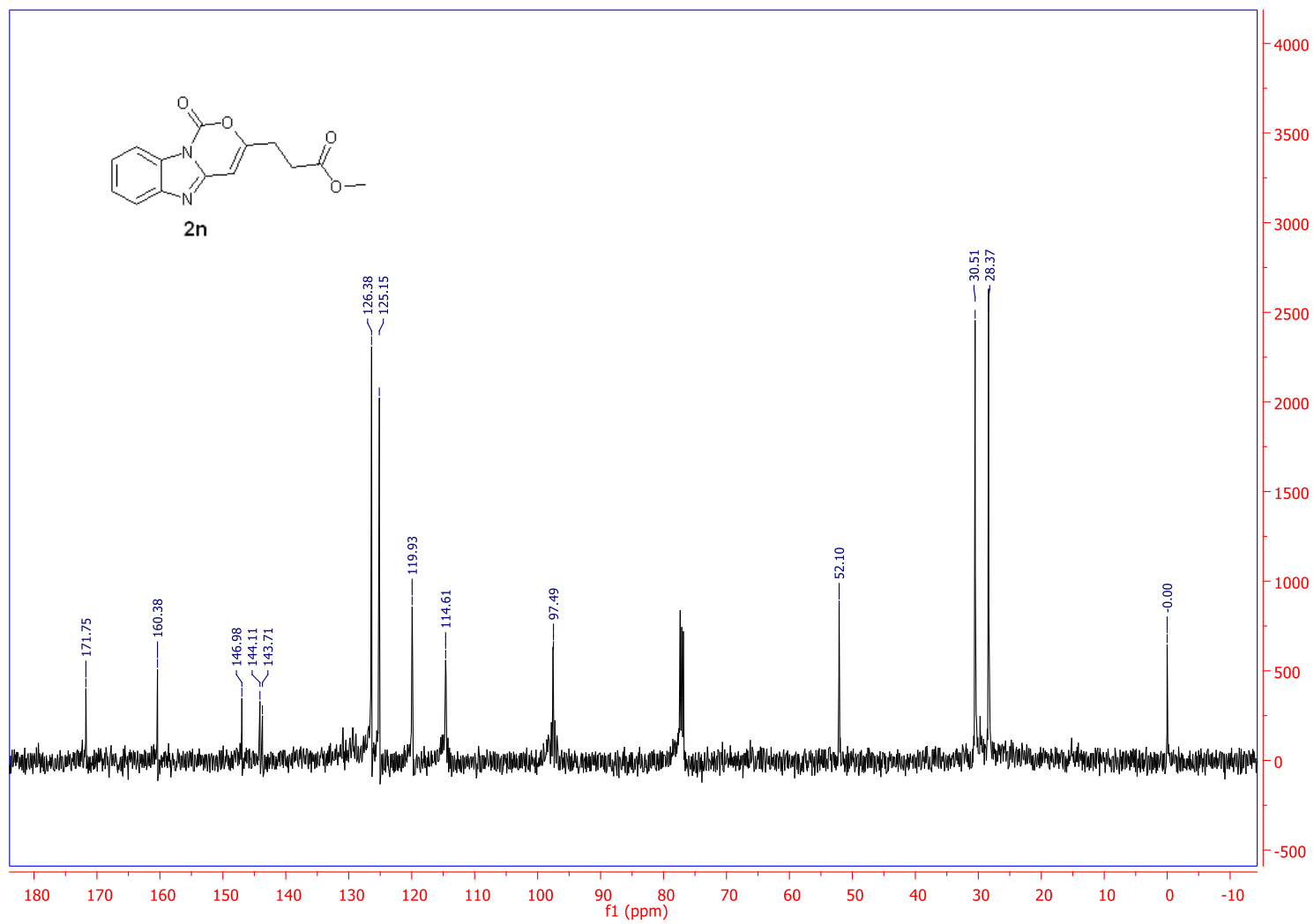
<sup>13</sup>C NMR (75 MHz CDCl<sub>3</sub>)



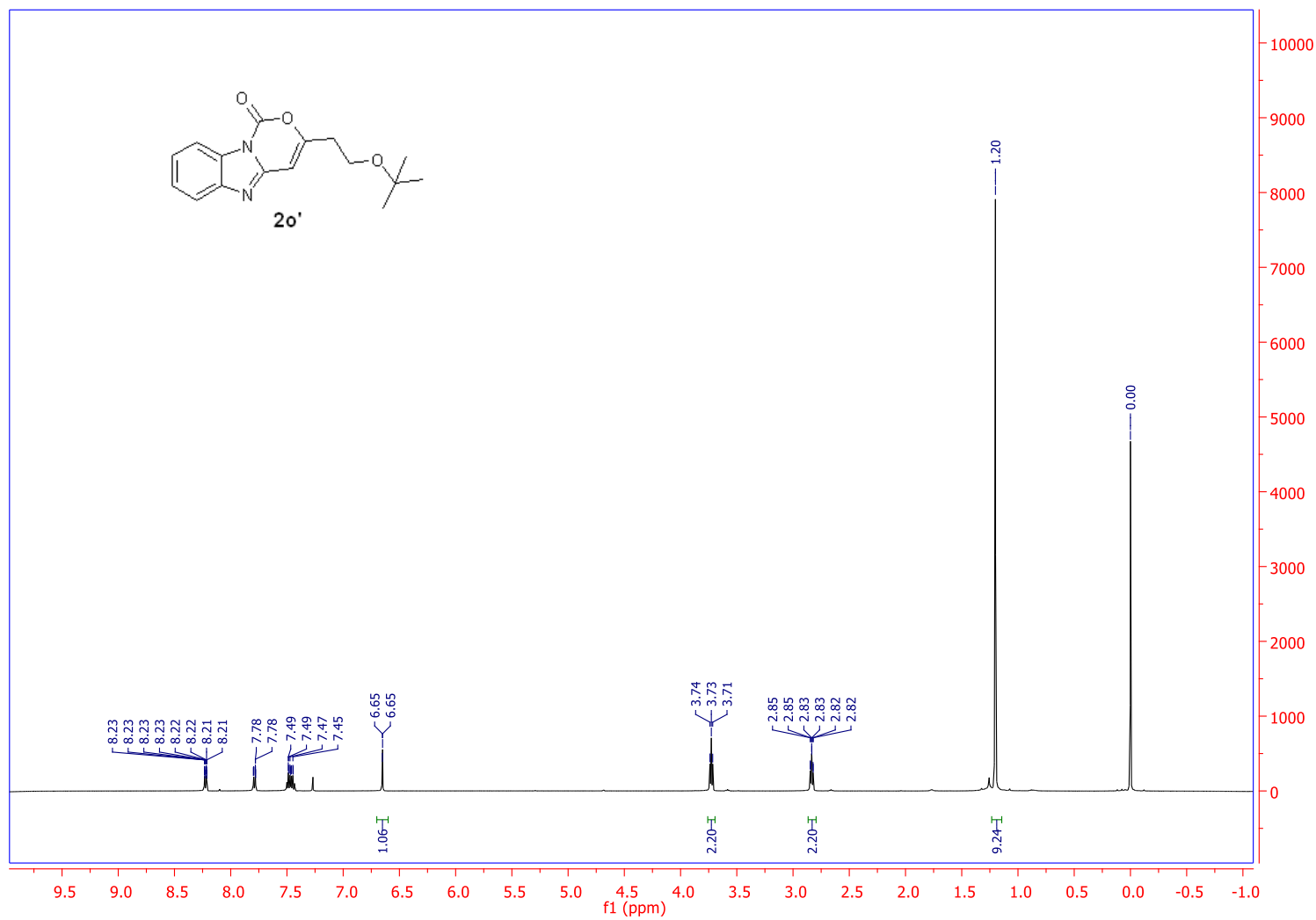
**3-(Methoxymethyl)-1*H*-benzo[4,5]imidazo[1,2-*c*][1,3]oxazin-1-one (2m)**<sup>1</sup>H NMR (500 MHz CDCl<sub>3</sub>)

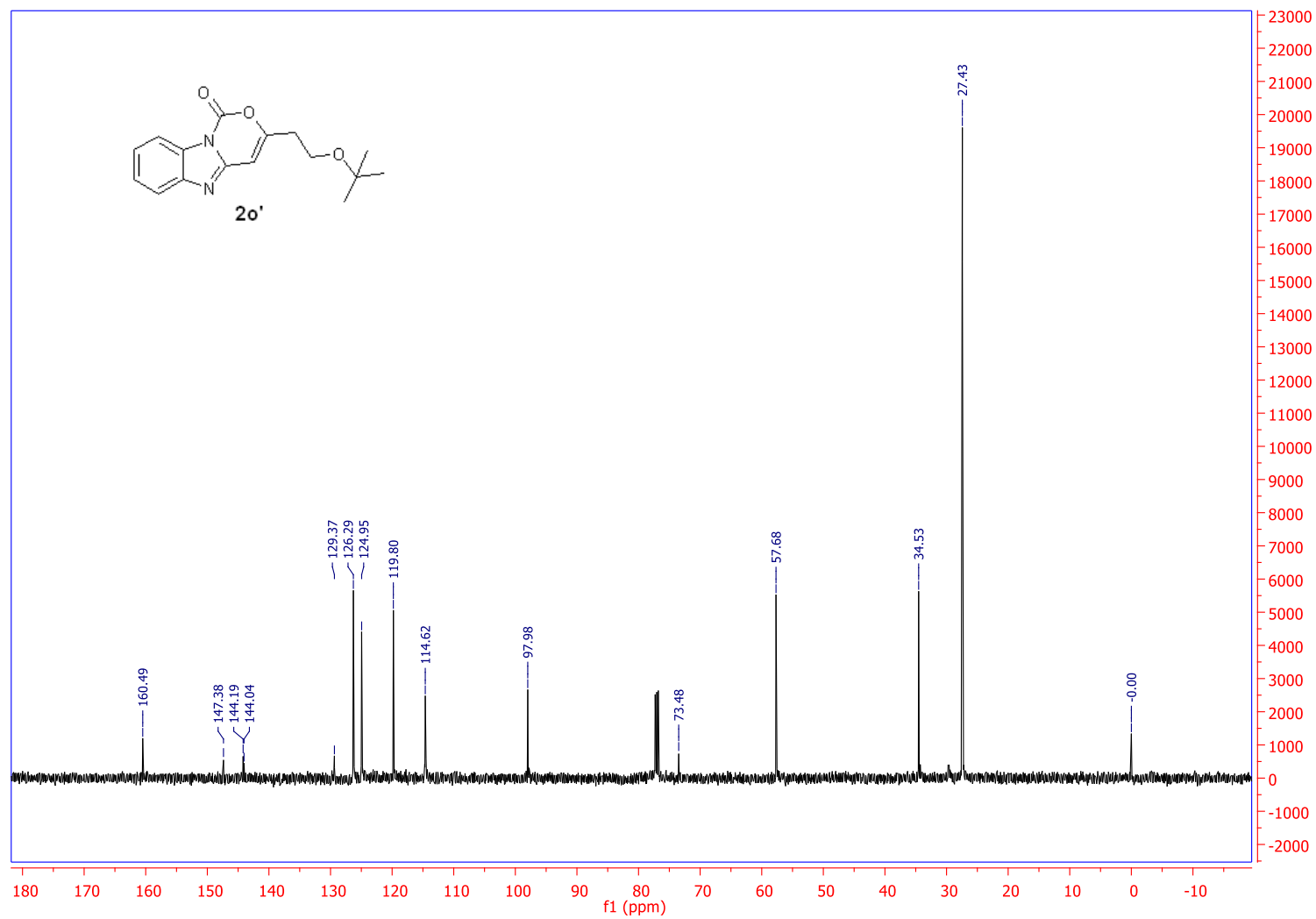
**3-(Methoxymethyl)-1*H*-benzo[4,5]imidazo[1,2-*c*][1,3]oxazin-1-one (2m)**<sup>13</sup>C NMR (125 MHz CDCl<sub>3</sub>)

**Methyl 3-(1-oxo-1*H*-benzo[4,5]imidazo[1,2-*c*][1,3]oxazin-3-yl)propanoate (2n)**<sup>1</sup>H NMR (500 MHz CDCl<sub>3</sub>)

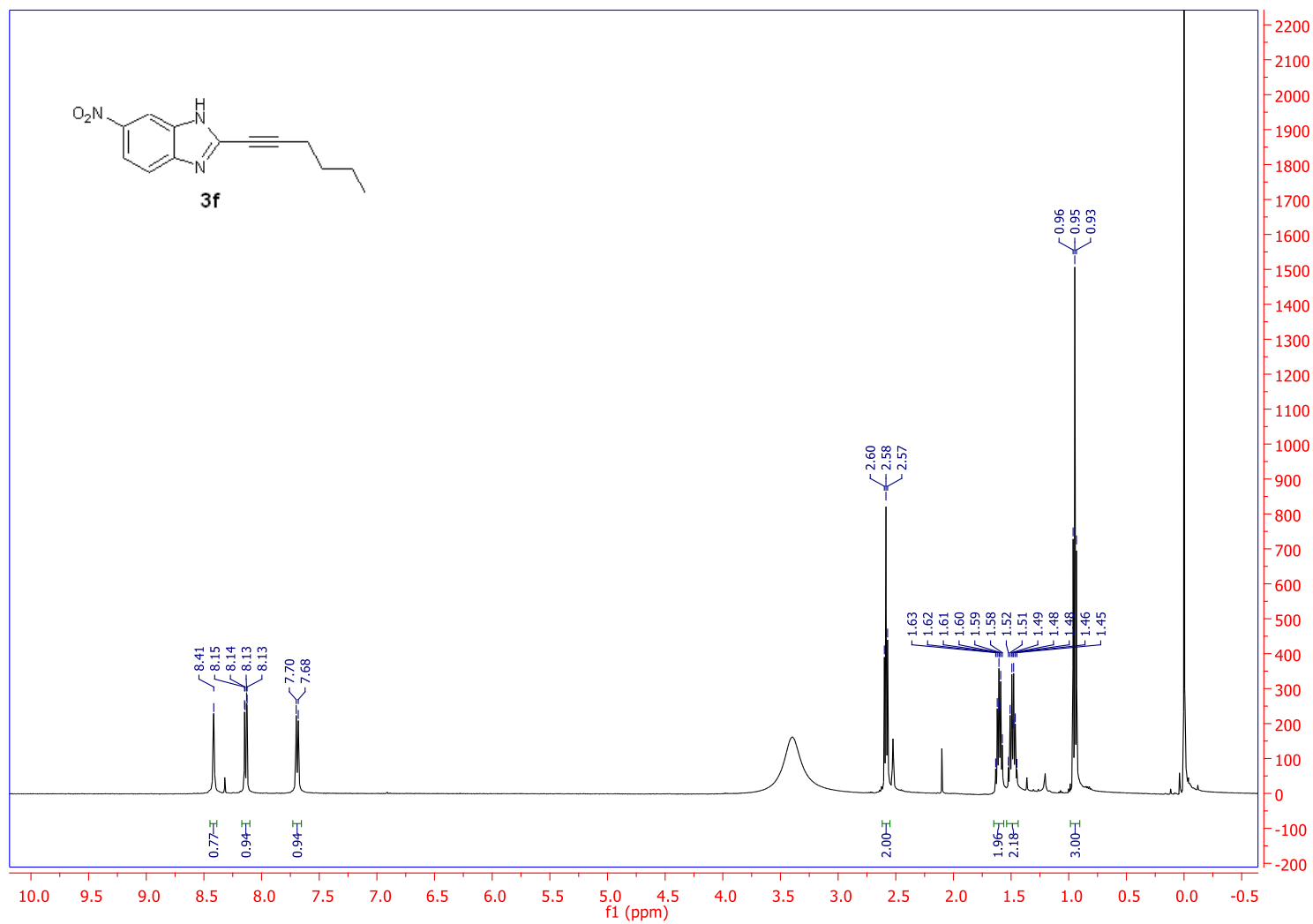
**Methyl 3-(1-oxo-1*H*-benzo[4,5]imidazo[1,2-*c*][1,3]oxazin-3-yl)propanoate (2n)**<sup>13</sup>C NMR (125 MHz CDCl<sub>3</sub>)

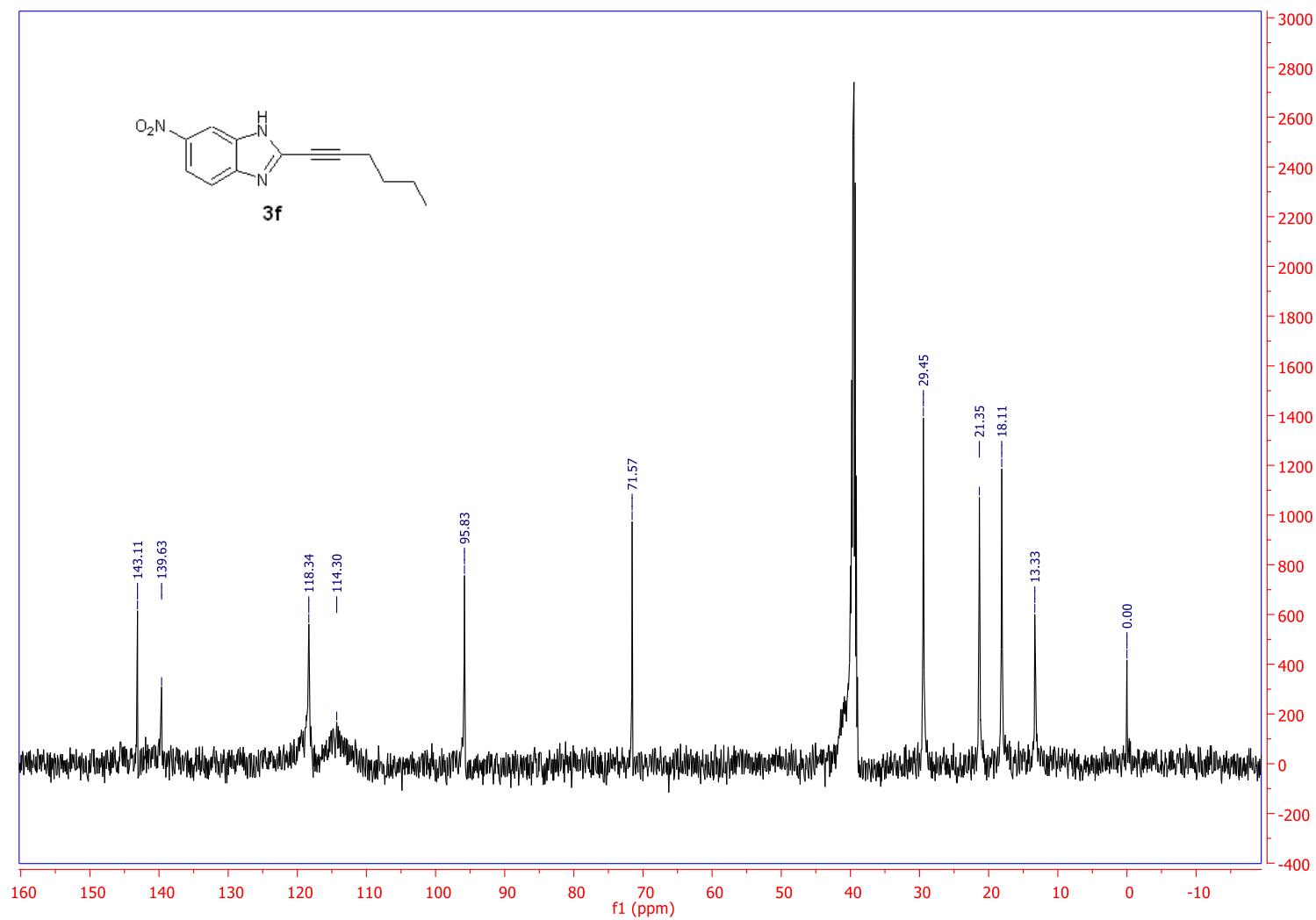


**3-(2-(*tert*-Butoxy)ethyl)-1*H*-benzo[4,5]imidazo[1,2-*c*][1,3]oxazin-1-one (2o')**<sup>1</sup>H NMR (500 MHz CDCl<sub>3</sub>)

**3-(2-(*tert*-Butoxy)ethyl)-1*H*-benzo[4,5]imidazo[1,2-*c*][1,3]oxazin-1-one (2o')**<sup>13</sup>C NMR (125 MHz CDCl<sub>3</sub>)

## 2-(Hex-1-yn-1-yl)-6-nitro-1H-benzo[d]imidazole (3f)

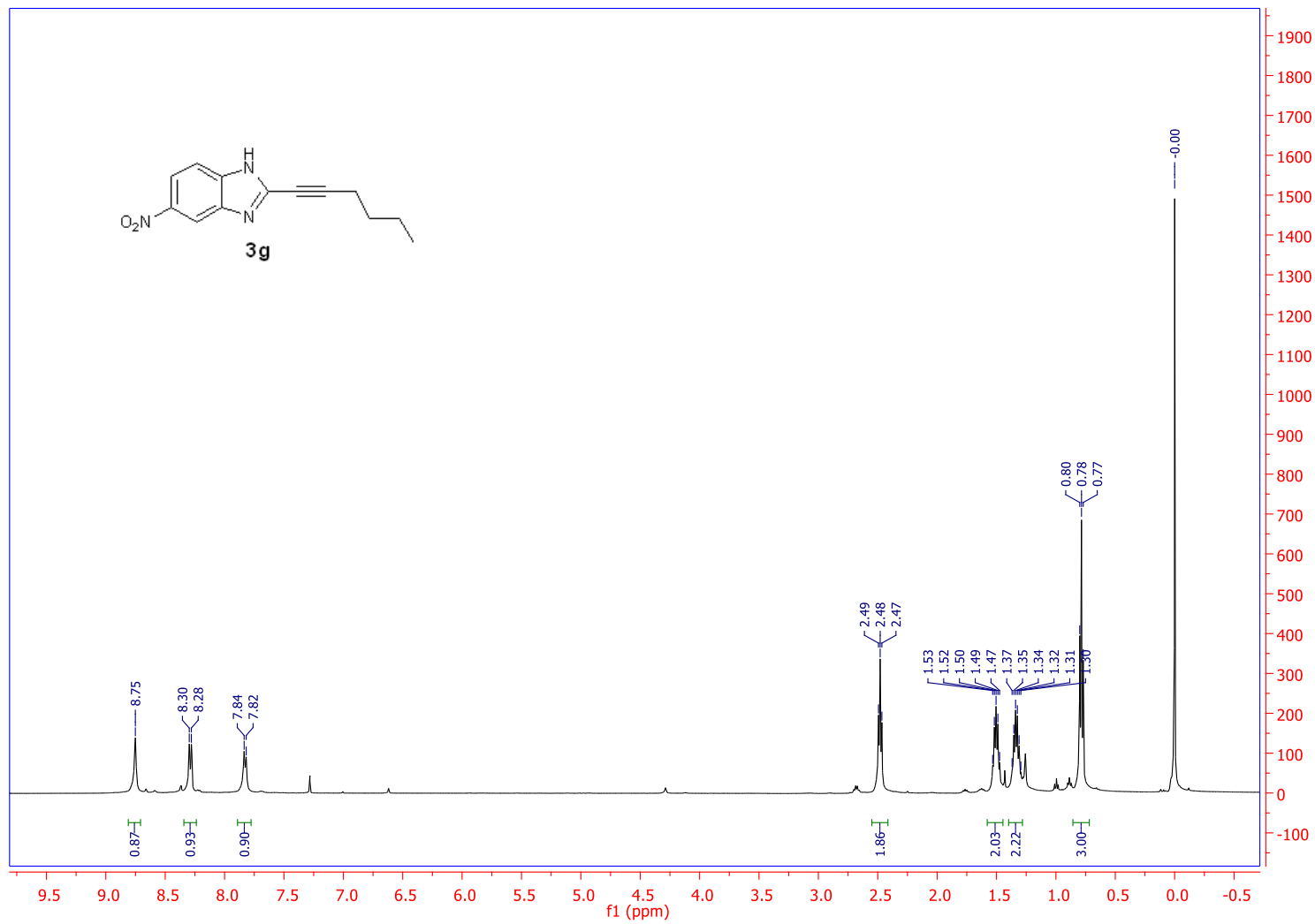
 $^1\text{H}$  NMR (500 MHz DMSO- $d_6$ )

**2-(Hex-1-yn-1-yl)-6-nitro-1*H*-benzo[*d*]imidazole (3f)**<sup>13</sup>C NMR (125 MHz DMSO-*d*<sub>6</sub>)

S100

**2-(Hex-1-yn-1-yl)-5-nitro-1H-benzo[d]imidazole (3g)**

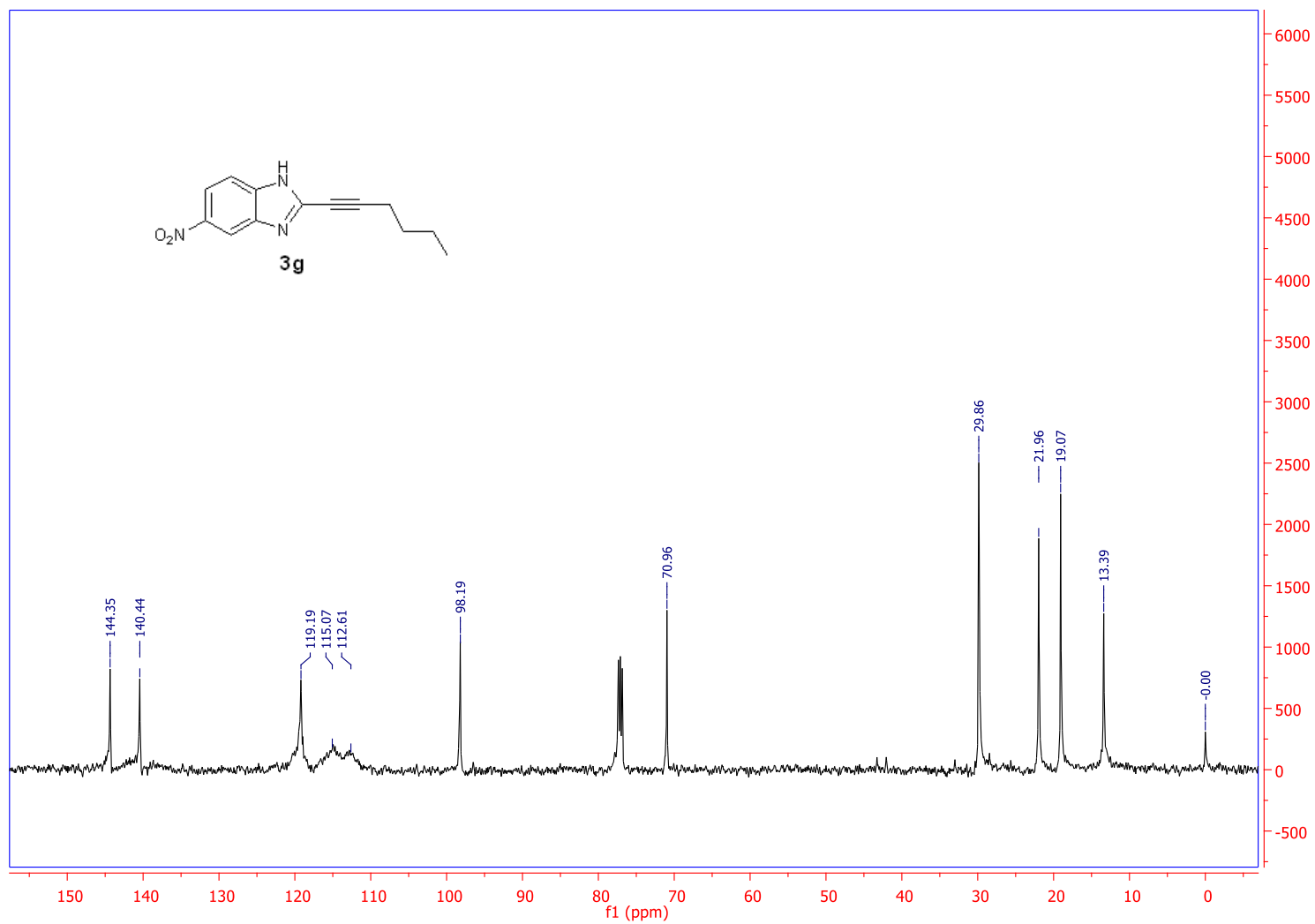
$^1\text{H}$  NMR (500 MHz  $\text{CDCl}_3$ )



S101

**2-(Hex-1-yn-1-yl)-5-nitro-1H-benzo[d]imidazole (3g).**

$^{13}\text{C}$  NMR (125 MHz  $\text{CDCl}_3$ )



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