

Supporting Information

Potassium Boc-Protected Secondary

Aminomethyltrifluoroborates: Synthesis and Suzuki–Miyaura

Cross-Coupling Reactions

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General.

Pd preformed catalyst (XPhos-Pd-G2) was synthesized prior to use.^a All halides were used as received. Toluene was used from Grubbs distillation.^b H₂O was degassed prior to use. Melting points (°C) are uncorrected. ¹H, ¹³C and ¹⁹F NMR spectra were recorded at 500, 125.8, and 470.8 MHz, respectively. ¹⁹F NMR chemical shifts were referenced to external CFCl₃ (0.0 ppm). ¹¹B NMR spectra at 128.4 MHz were obtained on a spectrometer equipped with the appropriate decoupling accessories. All ¹¹B NMR chemical shifts were referenced to external BF₃•OEt₂ (0.0 ppm) with a negative sign indicating an upfield shift. Analytical thin layer chromatography (TLC) was performed on TLC silica gel plates (250 μm) precoated with a fluorescent indicator. Standard flash chromatography procedures^c were followed using 32–63 μm silica gel. Visualization was effected with ultraviolet light and ninhydrin and *p*-anisaldehyde solution.

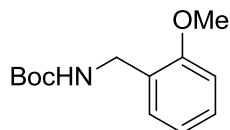
General Procedure for Boc Protection of Amines.



tert-Butyl Cyclopropylcarbamate **1d**.

A round bottomed flask was charged with (Boc)₂O (1.6 g, 7.22 mmol, 1.0 equiv). Cyclopropanamine (412 mg, 0.5 mL, 7.22 mmol, 1.0 equiv) was slowly added to the flask at rt. The reaction mixture was stirred at rt for 2 h. The the crude reaction mixture was purified by column chromatography (hexanes/EtOAc = 10:1 to 3:1) to afford the product **1d** (1.09 g, 6.95 mmol) as a white solid in 96% yield.

mp: 60–62 °C; ¹H NMR (500 MHz, CDCl₃) δ 4.78 (br, 1H), 2.53 (s, 1H), 1.45 (s, 9H), 0.68 (d, *J* = 6.0 Hz, 2H), 0.49 (s, 2H); ¹³C NMR (125.8 MHz, CDCl₃) δ 156.8, 79.5, 28.5, 22.9, 6.8; IR (neat) 3360, 1687, 1508, 1160 cm⁻¹; HRMS (CI⁺) calcd. for C₈H₁₆NO₂ [M+H]⁺ 158.1181, found 158.1180.



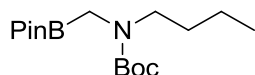
tert-Butyl 2-Methoxybenzylcarbamate **1f**.

The reaction was carried out with 2-methoxybenzylamine (1.05 g, 1.0 mL, 7.66 mmol, 1.0 equiv) according to the general procedure for Boc protection of amines to obtain product **1f** (1.82 g, 7.66 mmol) as a colorless oil in quantitative yield after column chromatography (hexanes/EtOAc = 6:1).

¹H NMR (500 MHz, CDCl₃) δ 7.31–7.21 (m, 2H), 6.91 (dd, *J* = 7.5, 7.5 Hz, 1H), 6.84 (d, *J* = 7.5 Hz, 1H), 5.06 (br, 1H), 4.30 (d, *J* = 6.0 Hz, 2H), 3.82 (s, 3H), 1.44 (s, 9H); ¹³C NMR (125.8

MHz, CDCl₃) δ 157.5, 156.0, 129.4, 128.7, 127.1, 120.6, 110.2, 79.2, 55.3, 40.5, 28.5; IR (neat) 3357, 2976, 1699, 1493, 1242, 1168 cm⁻¹; HRMS (ES⁺) calcd. for C₁₃H₁₉NO₃Na [M+Na]⁺ 260.1263, found 260.1253.

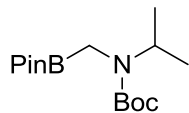
General Procedure for the Preparation of Boc-Protected Secondary Aminomethyl Pinacolborates.



***tert*-Butyl *n*-Butyl{(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)methyl}carbamate **2a**.**

A round bottomed flask was charged with *tert*-butyl *n*-butylcarbamate (5.9 g, 34.2 mmol, 1.2 equiv) in THF (171 mL). The solution was cooled to -78 °C, and *n*-BuLi in hexanes (2.5 M, 14 mL, 34.2 mmol, 1.2 equiv) was added slowly to the solution at -78 °C. The resulting mixture was stirred at rt for 10 min. Iodomethylpinacolboronate (7.4 g, 27.6 mmol, 1.0 equiv) was added to reaction mixture at rt, and stirred at rt overnight. Then the reaction was quenched by the addition of saturated aq NH₄Cl solution (30 mL). The mixture was extracted with EtOAc (2 × 40 mL). The organic layer was dried (MgSO₄), concentrated in vacuo, and purified by column chromatography (hexanes/EtOAc = 9:1 to 1:1) to afford the product **2a** (5.6 g, 18.0 mmol) as a colorless oil in 65% yield.

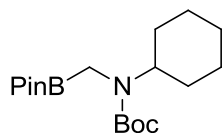
¹H NMR (500 MHz, CDCl₃) δ 3.18 (t, *J* = 7.0 Hz, 2H), 2.35 (s, 2H), 1.59–1.40 (m, 11H), 1.31–1.19 (m, 14H), 0.89 (t, *J* = 7.5 Hz, 3H); ¹³C NMR (125.8 MHz, CDCl₃) δ 161.1, 85.3, 80.5, 46.3, 29.2, 28.5, 25.2, 19.8, 13.7, one carbon was not detected; ¹¹B NMR (128.4 MHz, CDCl₃) δ 15.2; IR (neat) 2972, 1682, 1613, 1369, 1161, 1143 cm⁻¹; HRMS (ES⁺) calcd. for C₁₆H₃₂NO₄BNa [M+Na]⁺ 336.2322, found 336.2328.



***tert*-Butyl Isopropyl{(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)methyl}carbamate **2b**.**

The reaction was carried out with *tert*-butyl isopropylcarbamate (705 mg, 4.43 mmol, 1.2 equiv) according to the general procedure for the preparation of Boc-protected secondary aminomethyl pinacolboronates to obtain product **2b** (761 mg, 2.54 mmol) as a white solid in 69% yield after column chromatography (hexanes/EtOAc = 7:1 to 3:1).

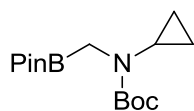
mp: 54–58 °C; ^1H NMR (500 MHz, CDCl_3) δ 4.12–3.88 (m, 1H), 2.23 (s, 2H), 1.52 (s, 9H), 1.19 (s, 12H), 1.09 (d, J = 6.5 Hz, 6 H); ^{13}C NMR (125.8 MHz, CDCl_3) δ 160.8, 86.2, 80.0, 45.4, 28.6, 25.2, 19.9, one carbon was not detected; ^{11}B NMR (128.4 MHz, CDCl_3) δ 13.1; IR (neat) 2975, 1688, 1602, 1523, 1371, 1162 cm^{-1} ; HRMS (ES^+) calcd. for $\text{C}_{15}\text{H}_{30}\text{BNO}_4\text{Na}$ $[\text{M}+\text{Na}]^+$ 322.2166, found 322.2173.



***tert*-Butyl Cyclohexyl{(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)methyl}carbamate **2c**.**

The reaction was carried out with *tert*-butyl cyclohexylcarbamate (1.5 g, 7.53 mmol, 1.2 equiv) according to the general procedure for the preparation of Boc-protected secondary aminomethyl pinacolboronates to obtain product **2c** (1.45 g, 4.27 mmol) as a colorless oil in 68% yield after column chromatography (hexanes/EtOAc = 8:1 to 2:1).

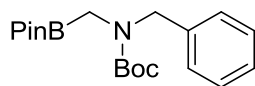
^1H NMR (500 MHz, CDCl_3) δ 3.52–3.44 (m, 1H), 2.56 (s, 2H), 1.82–1.74 (m, 2H), 1.66–1.57 (m, 3H), 1.52 (s, 9H), 1.46–1.35 (m, 2H), 1.33–1.20 (s, 2H), 1.19 (s, 12H), 1.13–1.02 (m, 1H); ^{13}C NMR (125.8 MHz, CDCl_3) δ 161.0, 86.2, 79.9, 53.9, 30.2, 28.6, 25.5, 25.4, 25.2, one carbon was not detected; ^{11}B NMR (128.4 MHz, CDCl_3) δ 13.9; IR (neat) 2932, 1600, 1519, 1158, 1124 cm^{-1} ; HRMS (ES^+) calcd. for $\text{C}_{18}\text{H}_{35}\text{BNO}_4$ $[\text{M}+\text{H}]^+$ 340.2659, found 340.2659.



***tert*-Butyl Cyclopropyl{(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)methyl}carbamate **2d**.**

The reaction was carried out with *tert*-butyl cyclopropylcarbamate (641 mg, 4.08 mmol, 1.2 equiv) according to the general procedure for the preparation of Boc-protected secondary aminomethyl pinacolborates to obtain product **2d** (556 mg, 1.87 mmol) as a colorless oil in 55% yield after column chromatography (hexanes/EtOAc = 6:1 to 3:1).

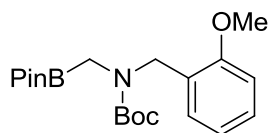
^1H NMR (500 MHz, CDCl_3) δ 2.55 (s, 1H), 2.35 (s, 2H), 1.51 (s, 9H), 1.20 (s, 12H), 0.69–0.61 (m, 4H); ^{13}C NMR (asterisk denotes minor rotamer peaks, 125.8 MHz, CDCl_3) δ 161.8, 84.9, 80.6, 37.8, 28.4, 28.2*, 25.0, 24.8*, 6.3, one carbon was not detected; ^{11}B NMR (128.4 MHz, CDCl_3) δ 16.8; IR (neat) 2975, 1686, 1366, 1144 cm^{-1} ; HRMS (ES^+) calcd. for $\text{C}_{15}\text{H}_{29}\text{BNO}_4$ $[\text{M}+\text{H}]^+$ 298.2190, found 298.2197.



***tert*-Butyl Benzyl{(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)methyl}carbamate **2e**.**

The reaction was carried out with *tert*-butyl benzylcarbamate (800 mg, 3.86 mmol, 1.1 equiv) according to the general procedure for the preparation of Boc-protected secondary aminomethyl pinacolborates to obtain product **2e** (556 mg, 1.87 mmol) as a colorless oil in 41% yield after column chromatography (hexanes/EtOAc = 10:1 to 5:1).

^1H NMR (500 MHz, CDCl_3) δ 7.32–7.23 (m, 3H), 7.20–7.16 (m, 2H), 4.35 (s, 2H), 2.36 (s, 2H), 1.52 (s, 9H), 1.21 (s, 12H); ^{13}C NMR (125.8 MHz, CDCl_3) δ 160.3, 136.3, 128.6, 128.0, 127.7, 84.9, 81.0, 51.3, 28.5, 25.1, one carbon was not detected; ^{11}B NMR (128.4 MHz, CDCl_3) δ 18.2; IR (neat) 2977, 2358, 1695, 1455, 1368, 1152 cm^{-1} ; HRMS (ES^+) calcd. for $\text{C}_{19}\text{H}_{30}\text{BNO}_4\text{Na}$ $[\text{M}+\text{Na}]^+$ 370.2166, found 370.2170.

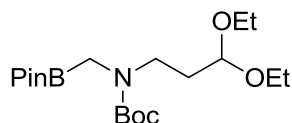


***tert*-Butyl 2-Methoxybenzyl{(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)methyl} carbamate **2f**.**

The reaction was carried out with *tert*-butyl 2-methoxybenzylcarbamate (1.1 g, 4.64 mmol, 1.2 equiv) according to the general procedure for the preparation of Boc-protected secondary aminomethyl pinacolborates to obtain product **2f** (877 mg, 2.32 mmol) as a white solid in 60% yield after column chromatography (hexanes/EtOAc = 8:1 to 2:1).

mp: 78–81 °C; ^1H NMR (500 MHz, CDCl_3) δ 7.26–7.20 (m, 1H), 7.13–7.08 (m, 1H), 6.92–6.87 (m, 1H), 6.86–6.81 (m, 1H), 4.38 (s, 2H), 3.80 (s, 3H), 2.34 (s, 2H), 1.52 (s, 9H), 1.20 (s, 12H); ^{13}C NMR (125.8 MHz, CDCl_3) δ 160.8, 157.5, 129.4, 128.9, 124.2, 120.4, 110.3, 84.9, 80.6, 55.2,

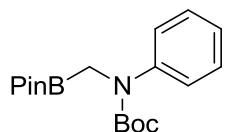
45.8, 28.5, 25.2, one carbon was not detected; ^{11}B NMR (128.4 MHz, CDCl_3) δ 17.0; IR (neat) 2970, 1610, 1532, 1158, 1158, 1140, 1110 cm^{-1} ; HRMS (ES^+) calcd. for $\text{C}_{20}\text{H}_{33}\text{BNO}_5$ $[\text{M}+\text{H}]^+$ 378.2452, found 378.2462.



***tert*-Butyl (3,3-Diethoxypropyl)((4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)methyl)carbamate 2g.**

The reaction was carried out with *tert*-butyl (3,3-diethoxypropyl)carbamate (1.5 g, 6.18 mmol, 1.2 equiv) according to the general procedure for the preparation of Boc-protected secondary aminomethyl pinacolborates to obtain product **2g** (1.5 g, 3.88 mmol) as a colorless oil in 49% yield after column chromatography (hexanes/EtOAc = 2:1).

^1H NMR (500 MHz, CDCl_3) δ 4.48 (dd, $J = 5.5, 5.5$ Hz, 1H), 3.68–3.59 (m, 2H), 3.52–3.44 (m, 2H), 3.26 (dd, $J = 7.5, 7.5$ Hz, 2H), 2.39 (s, 2H), 1.85–1.78 (m, 2H), 1.23 (s, 9H), 1.23–1.18 (m, 18H); ^{13}C NMR (125.8 MHz, CDCl_3) δ 160.6, 100.5, 85.1, 80.5, 61.2, 42.9, 31.4, 28.4, 25.0, 15.3, one carbon was not detected; ^{11}B NMR (128.4 MHz, CDCl_3) δ 16.3; IR (neat) 2975, 1693, 1611, 1371, 1141, 1062 cm^{-1} ; HRMS (ES^+) calcd. for $\text{C}_{19}\text{H}_{38}\text{BNO}_6\text{Na}$ $[\text{M}+\text{Na}]^+$ 410.2690, found 410.2687.

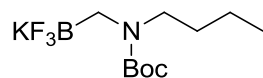


***tert*-Butyl Phenyl((4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)methyl)carbamate 2h.**

The reaction was carried out with *tert*-butyl phenylcarbamate (1.0 g, 5.17 mmol, 1.2 equiv) according to the general procedure for the preparation of Boc-protected secondary aminomethyl pinacolborates to obtain product **2h** (916 mg, 2.75 mmol) as a light yellow oil in 64% yield after column chromatography (hexanes/EtOAc = 7:1).

^1H NMR (500 MHz, CDCl_3) δ 7.33–7.28 (m, 2H), 7.27–7.21 (m, 2H), 7.18–7.13 (m, 1H), 2.93 (s, 2H), 1.50 (s, 9H), 1.25 (s, 12H); ^{13}C NMR (125.8 MHz, CDCl_3) δ 159.1, 140.9, 128.6, 125.7, 124.1, 85.6, 81.3, 40.8, 28.4, 25.1; ^{11}B NMR (128.4 MHz, CDCl_3) δ 18.3; IR (neat) 2976, 1686, 1369, 1143 cm^{-1} ; HRMS (ES^+) calcd. for $\text{C}_{18}\text{H}_{28}\text{BNO}_4\text{Na}$ $[\text{M}+\text{Na}]^+$ 356.2009, found 356.2005.

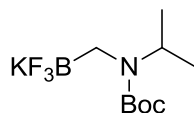
General Procedure for the Preparation of Potassium Boc-Protected Secondary Aminomethyltrifluoroborates.



Potassium *tert*-Butyl Butyl((trifluoroborato)methyl)carbamate **3a**.

Boronate ester **2a** (7.0 g, 22.2 mmol, 1.0 equiv) was dissolved in acetone (44 mL) and cooled to 0 °C. KHF_2 (5.2 g, 66.7 mmol, 3.0 equiv) was added to solution, and then H_2O (15 mL) was added at 0 °C. The reaction mixture was stirred for 30 min at rt. The solution was concentrated in vacuo and then dried in vacuo overnight. The crude mixture was extracted with acetone (3 \times 30 mL), and the extracts were combined and concentrated. Et_2O (100 mL) was added to precipitate the product. The solution was sonicated for 15 min and stored in the refrigerator overnight. The solid was filtered and dried in vacuo to provide the product **3a** (4.4 g, 14.9 mmol) as a white solid in 67% yield.

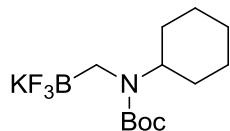
mp (transition): 135–138 °C; ^1H NMR (500 MHz, acetone- d_6) δ 3.21 (dd, $J = 7.5, 7.5$ Hz, 2H), 2.35–2.29 (m, 2H), 1.55–1.47 (m, 2H), 1.41 (s, 9H), 1.31–1.23 (m, 2H), 0.90 (t, $J = 7.5$ Hz, 3H); ^{13}C NMR (125.8 MHz, acetone- d_6) δ 156.6, 77.9, 48.6, 30.7, 28.9, 20.7, 14.3, one carbon was not detected; ^{19}F NMR (470.8 MHz, acetone- d_6) δ -142.5; ^{11}B NMR (128.4 MHz, acetone- d_6) δ 4.03; IR (neat) 2956, 2928, 1664 cm^{-1} ; HRMS (ES^-) calcd. for $\text{C}_{10}\text{H}_{20}\text{BF}_3\text{NO}_2$ [$\text{M}-\text{K}$] $^-$ 254.1539, found 254.1538.



Potassium *tert*-Butyl Isopropyl{(trifluoroborato)methyl}carbamate **3b.**

The reaction was carried out with boronate ester **2b** (688 mg, 2.30 mmol, 1.0 equiv) according to the general procedure for the preparation of potassium Boc-protected secondary aminomethyltrifluoroborates to obtain product **3b** (456 mg, 1.63 mmol) as a white solid in 71% yield.

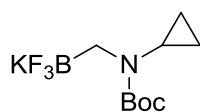
mp: 203–206 °C; ^1H NMR (500 MHz, acetone- d_6) δ 4.02–3.91 (m, 1H), 2.21 (s, 2H), 1.41 (s, 9H), 1.12 (d, $J = 6.5$ Hz, 6H); ^{13}C NMR (125.8 MHz, acetone- d_6) δ 156.4, 77.8, 49.1, 29.1, 20.8, one carbon was not detected; ^{19}F NMR (470.8 MHz, acetone- d_6) δ -141.6; ^{11}B NMR (128.4 MHz, acetone- d_6) δ 4.24; IR (neat) 2973, 1677, 1099 cm^{-1} ; HRMS (ES^-) calcd. for $\text{C}_{10}\text{H}_{21}\text{BF}_2\text{NO}_3$ [$\text{M}-(\text{FK})+(\text{OMe})$] $^-$ 252.1583, found 252.1596.



Potassium *tert*-Butyl Cyclohexyl{(trifluoroborato)methyl}carbamate **3c.**

The reaction was carried out with boronate ester **2c** (1.35 g, 3.98 mmol, 1.0 equiv) according to the general procedure for the preparation of potassium Boc-protected secondary aminomethyltrifluoroborates to obtain product **3c** (1.11 g, 3.48 mmol) as a white solid in 87% yield.

mp (transition): 207–210 °C; ^1H NMR (500 MHz, MeOD) δ 3.66–3.59 (m, 1H), 2.34–2.21 (m, 2H), 1.85–1.02 (m, 19H); ^{13}C NMR (125.8 MHz, DMSO- d_6) δ 162.8, 90.9, 79.3, 55.6, 31.6*, 30.9, 29.1, 28.5*, 27.5, 26.9*, 26.7, 26.2*; ^{19}F NMR (470.8 MHz, acetone- d_6) δ –144.4, –146.7*; ^{11}B NMR (128.4 MHz, MeOD) δ 3.71; IR (neat) 2931, 1679, 1109 cm^{-1} ; HRMS (ES $^-$) calcd. for $\text{C}_{14}\text{H}_{28}\text{BFNO}_4$ [$\text{M}-(\text{F}_2\text{K})+(\text{OMe})$] $^-$ 304.2095, found 304.2093.

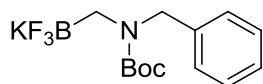


Potassium *tert*-Butyl Cyclopropyl{(trifluoroborato)methyl}carbamate **3d.**

The reaction was carried out with boronate ester **2d** (384 mg, 1.29 mmol, 1.0 equiv) according to the general procedure for the preparation of potassium Boc-protected secondary aminomethyltrifluoroborates to obtain product **3d** (322 mg, 1.16 mmol) as a white solid in 90% yield.

mp (transition): 113–115 °C; ^1H NMR (500 MHz, acetone- d_6) δ 2.57–2.50 (m, 1H), 2.33–2.25 (m, 2H), 1.41 (s, 9H), 0.61–0.51 (m, 4H); ^{13}C NMR (125.8 MHz, acetone- d_6) δ 158.1, 78.0, 31.4,

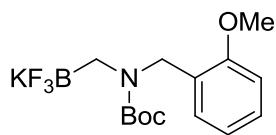
29.0, 8.8, one carbon was not detected; ^{19}F NMR (470.8 MHz, acetone- d_6) δ -141.9; ^{11}B NMR (128.4 MHz, acetone- d_6) δ 4.01; IR (neat) 2976, 1669, 1408, 1128 cm^{-1} ; HRMS (ES^-) calcd. for $\text{C}_9\text{H}_{16}\text{BF}_3\text{NO}_2$ [M-K] $^-$ 238.1226, found 238.1226.



Potassium *tert*-Butyl Benzyl((trifluoroborato)methyl)carbamate 3e.

The reaction was carried out with boronate ester **2e** (439 mg, 1.26 mmol, 1.0 equiv) according to the general procedure for the preparation of potassium Boc-protected secondary aminomethyltrifluoroborates to obtain product **3e** (305 mg, 0.93 mmol) as a white solid in 74% yield.

mp: 210–213 $^\circ\text{C}$; ^1H NMR (500 MHz, acetone- d_6) δ 7.29–7.14 (m, 5H), 4.48 (s, 2H), 2.37–2.31 (m, 2H), 1.37 (s, 9H); ^{13}C NMR (125.8 MHz, acetone- d_6) δ 156.8, 141.2, 128.8, 128.1, 127.1, 78.4, 51.9, 28.8, one carbon was not detected; ^{19}F NMR (470.8 MHz, acetone- d_6) δ -142.1; ^{11}B NMR (128.4 MHz, acetone- d_6) δ 4.16; IR (neat) 2987, 1665, 997 cm^{-1} ; HRMS (ES^-) calcd. for $\text{C}_{13}\text{H}_{18}\text{BF}_3\text{NO}_2$ [M-K] $^-$ 288.1383, found 288.1386.

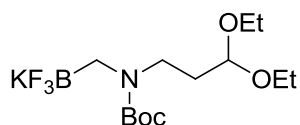


Potassium *tert*-Butyl 2-Methoxybenzyl((trifluoroborato)methyl)carbamate 3f.

The reaction was carried out with boronate ester **2f** (613 mg, 1.62 mmol, 1.0 equiv) according to the general procedure for the preparation of potassium Boc-protected secondary

aminomethyltrifluoroborates to obtain product **3f** (511 mg, 1.43 mmol) as a white solid in 88% yield.

mp (transition): 158–161 °C; ¹H NMR (500 MHz, acetone-*d*₆) δ 7.17 (dd, *J* = 7.5, 7.5 Hz, 1H), 7.08 (d, *J* = 7.0 Hz, 1H), 6.94–6.87 (m, 2H), 4.49 (s, 2H), 3.80 (s, 3H), 2.40–2.34 (m, 2H), 1.33 (s, 9H); ¹³C NMR (125.8 MHz, acetone-*d*₆) δ 158.0, 157.2, 128.6, 127.9, 127.4, 120.8, 110.8, 78.2, 55.5, 47.4, 28.8, one carbon was not detected; ¹⁹F NMR (470.8 MHz, acetone-*d*₆) δ –142.4; ¹¹B NMR (128.4 MHz, acetone-*d*₆) δ 4.40; IR (neat) 2969, 1680, 1240, 1000 cm⁻¹; HRMS (ES⁻) calcd. for C₁₄H₂₀BF₃NO₃ [M–K]⁻ 318.1488, found 318.1493.



Potassium *tert*-Butyl (3,3-Diethoxypropyl){(trifluoroborato)methyl}carbamate **3g.**

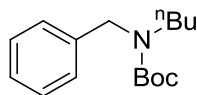
Boronate ester **2g** (787 mg, 2.03 mmol, 1.0 equiv) was dissolved in the acetone (4 mL) and cooled to 0 °C. K₂CO₃ (280 mg, 2.03 mmol, 1.0 equiv) was added to the solution, then H₂O (2 mL) was added at 0 °C. After stirring for 10 min at 0 °C, KHF₂ (793 mg, 10.15 mmol, 5 equiv) was added. The reaction mixture was stirred for 1.5 h at rt. The solution was concentrated in vacuo and then dried in vacuo overnight. The crude mixture was extracted with acetone (3 × 15 mL), and the extracts were combined and concentrated. Hexanes (40 mL) were added to precipitate the product. The solution was sonicated for 15 min and the solid was filtered and dried in vacuo to provide the product **3g** (395 mg, 1.08 mmol) as a white solid in 53% yield.

mp (transition): 138–140 °C; ¹H NMR (500 MHz, acetone-*d*₆) δ 4.47 (dd, *J* = 5.5, 5.5 Hz, 1H), 3.64–3.57 (m, 2H), 3.50–3.41 (m, 2H), 3.35–3.20 (m, 2H), 2.30 (s, 2H), 1.88–1.79 (m, 2H), 1.42

(s, 9H), 1.14 (dd, $J = 7.0, 7.0$ Hz, 6H); ^{13}C NMR (125.8 MHz, acetone- d_6) δ 156.5, 102.0, 78.0, 60.9, 45.3, 32.7, 28.9, 15.7, one carbon was not detected; ^{19}F NMR (470.8 MHz, acetone- d_6) δ -142.3; ^{11}B NMR (128.4 MHz, acetone- d_6) δ 4.11; IR (neat) 2975, 1660, 1061 cm^{-1} ; HRMS (ES^-) calcd. for $\text{C}_{13}\text{H}_{26}\text{BF}_3\text{NO}_4$ [$\text{M}-\text{K}$] $^-$ 328.1907, found 328.1898.

General Procedure for the Suzuki–Miyaura Cross-coupling Reaction.

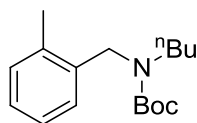
A sealed tube was charged with potassium *tert*-butyl butyl{(trifluoroborato)methyl}carbamate **3a** (77 mg, 0.263 mmol, 1.05 equiv), an aryl or heteroaryl chloride (0.250 mmol, 1.0 equiv), Pd-preformed catalyst **A** (XPhos-Pd-G2, 8 mg, 0.010 mmol, 0.04 equiv), and Cs_2CO_3 (244 mg, 0.750 mmol, 3.0 equiv). The mixture was then was purged three times with argon. Toluene/ H_2O (0.5 M, 4:1, 0.4 mL/0.1 mL) was then added to the reaction tube. The reaction mixture was stirred for 3 or 18 h as denoted at 85 °C and then cooled to rt. H_2O (2 mL) was added, and the resulting mixture was extracted with EtOAc (2 \times 3 mL). The organic layer was combined, dried (MgSO_4) and filtered. The solvent was removed in vacuo and the product was purified by column chromatography.



tert-Butyl Benzyl(butyl)carbamate **4a**.

The reaction was carried out with chlorobenzene (28 mg, 0.25 mmol, 1.0 equiv) for 3 h according to the general Suzuki–Miyaura cross-coupling reaction procedure to obtain **4a** (60 mg, 0.228 mmol) as a colorless oil in 91% yield after column chromatography (hexanes/EtOAc = 20:1).

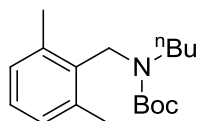
^1H NMR (asterisk denotes minor rotamer peaks, 500 MHz, CDCl_3) δ 7.37–7.18 (m, 5H), 4.44 (s, 2H), 4.41* (s, 2H), 3.26–3.09 (m, 2H), 1.56–1.37 (m, 11H), 1.33–1.21 (m, 2H), 0.89 (t, $J = 7.5$ Hz, 3H); ^{13}C NMR (asterisk denotes minor rotamer peaks, 125.8 MHz, CDCl_3) δ 156.3, 155.8*, 139.0, 138.8*, 128.5, 127.8, 127.1, 79.6, 50.5, 49.8*, 46.6, 46.2*, 30.3, 30.1*, 28.6, 20.1, 14.0. Data is consistent with that reported in the literature.^d



***tert*-Butyl Butyl(2-methylbenzyl)carbamate **4b**.**

The reaction was carried out with *o*-chlorotoluene (28 mg, 0.25 mmol, 1.0 equiv) for 3 h according to the general Suzuki–Miyaura cross-coupling reaction procedure to obtain **4b** (62 mg, 0.224 mmol) as a colorless oil in 89% yield after column chromatography (hexanes/EtOAc = 20:1).

^1H NMR (asterisk denotes minor rotamer peaks, 500 MHz, CDCl_3) δ 7.18–7.09 (m, 4H), 4.46 (s, 2H), 4.40* (s, 2H), 3.22–3.04 (m, 2H), 2.28 (s, 3H), 1.53–1.37 (m, 11H), 1.31–1.22 (m, 2H), 0.88 (t, $J = 7.5$ Hz, 3H); ^{13}C NMR (asterisk denotes minor rotamer peaks, 125.8 MHz, CDCl_3) δ 155.9, 136.5, 136.0, 130.4, 127.7, 127.1, 126.0, 79.5, 48.3, 47.8*, 46.3, 45.9*, 30.3, 28.5, 28.2*, 20.2, 19.1, 14.0; IR (neat) 2961, 1693, 1414, 1249, 1170, 1143 cm^{-1} ; HRMS (ES⁺) calcd. for $\text{C}_{17}\text{H}_{27}\text{NO}_2\text{Na}$ $[\text{M}+\text{Na}]^+$ 300.1939, found 300.1949.

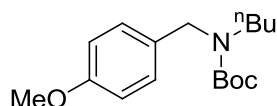


tert-Butyl Butyl(2,6-dimethylbenzyl)carbamate 4c.

The reaction was carried out with 2,6-dimethyl-1-chlorobenzene (35 mg, 0.25 mmol, 1.0 equiv) for 3 h according to the general Suzuki–Miyaura cross-coupling reaction procedure to obtain **4c** (69 mg, 0.237 mmol) as a colorless oil in 95% yield after column chromatography (hexanes/EtOAc = 20:1).

^1H NMR (500 MHz, CDCl_3) δ 7.10–7.06 (m, 1H), 7.00 (d, $J = 7.5$ Hz, 2H), 4.58 (s, 2H), 2.85 (s, 2H), 2.32 (s, 6H), 1.49 (s, 9H), 1.41–1.33 (m, 2H), 1.21–1.12 (m, 2H), 0.82 (t, $J = 7.5$ Hz, 3H);

^{13}C NMR (.8 MHz, CDCl_3) δ 155.6, 138.1, 133.9, 128.6, 127.5, 79.4, 44.3, 43.3, 30.5, 28.6, 20.2, 20.1, 13.9; IR (neat) 2961, 1692, 1413, 1172, 1141 cm^{-1} ; HRMS (ES+) calcd. for $\text{C}_{18}\text{H}_{29}\text{NO}_2\text{Na}$ $[\text{M}+\text{Na}]^+$ 314.2096, found 314.2084.

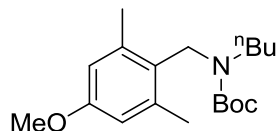


tert-Butyl Butyl(4-methoxybenzyl)carbamate 4d.

The reaction was carried out with 4-chloroanisole (36 mg, 0.25 mmol, 1.0 equiv) for 3 h according to the general Suzuki–Miyaura cross-coupling reaction procedure to obtain **4d** (71 mg, 0.242 mmol) as a colorless oil in 97% yield after column chromatography (hexanes/EtOAc = 20:1).

^1H NMR (asterisk denotes minor rotamer peaks, 500 MHz, CDCl_3) δ 7.16 (s, 2H), 6.85 (d, $J = 9.0$ Hz, 2H), 4.36 (s, 2H), 3.79 (s, 3H), 3.17* (s, 2H), 3.09 (s, 2H), 1.52–1.40 (m, 11H), 1.31–

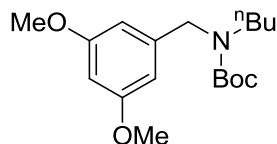
1.21 (m, 2H), 0.89 (t, $J = 7.0$ Hz, 3H); ^{13}C NMR (asterisk denotes minor rotamer peaks, 125.8 MHz, CDCl_3) δ 158.9, 130.9, 129.2, 128.5, 113.9, 79.5, 55.4, 49.8, 49.2*, 46.2, 46.0*, 30.3, 28.6, 20.1, 14.0; IR (neat) 2960, 1690, 1512, 1412, 1247, 1170, 1141 cm^{-1} ; HRMS (ES+) calcd. for $\text{C}_{17}\text{H}_{27}\text{NO}_3\text{Na}$ $[\text{M}+\text{Na}]^+$ 316.1889, found 316.1896.



tert-Butyl Butyl(4-methoxy-2,6-dimethylbenzyl)carbamate 4e.

The reaction was carried out with 2-chloro-5-methoxy-1,3-dimethylbenzene (43 mg, 0.25 mmol, 1.0 equiv) for 3 h according to the general Suzuki–Miyaura cross-coupling reaction procedure to obtain **4e** (80 mg, 0.249 mmol) as a colorless oil in 100% yield after column chromatography (hexanes/EtOAc = 20:1).

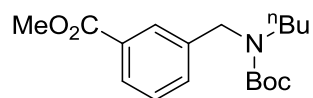
^1H NMR (500 MHz, CDCl_3) δ 6.57 (s, 2H), 4.52 (s, 2H), 3.77 (s, 3H), 2.84 (s, 2H), 2.30 (s, 6H), 1.49 (s, 9H), 1.41–1.33 (m, 2H), 1.22–1.13 (m, 2H), 0.82 (t, $J = 7.5$ Hz, 3H); ^{13}C NMR (125.8 MHz, CDCl_3) δ 1158.4, 155.6, 139.5, 126.2, 113.8, 79.3, 55.1, 44.0, 42.8, 30.4, 28.6, 20.4, 20.2, 13.9; IR (neat) 2970, 1689, 1172, 1140 cm^{-1} ; HRMS (ES+) calcd. for $\text{C}_{19}\text{H}_{31}\text{NO}_3\text{Na}$ $[\text{M}+\text{Na}]^+$ 344.2202, found 344.2191.



tert-Butyl Butyl(3,5-dimethoxybenzyl)carbamate 4f.

The reaction was carried out with 1-chloro-3,5-dimethoxybenzene (43 mg, 0.25 mmol, 1.0 equiv) for 3 h according to the general Suzuki–Miyaura cross-coupling reaction procedure to obtain **4f** (78 mg, 0.241 mmol) as a colorless oil in 96% yield after column chromatography (hexanes/EtOAc = 20:1).

^1H NMR (asterisk denotes minor rotamer peaks, 500 MHz, CDCl_3) δ 6.42–6.33 (m, 3H), 4.38 (s, 2H), 4.34* (s, 2H), 3.77 (s, 6H), 3.23–3.09 (m, 2H), 1.54–1.41 (m, 11H), 1.33–1.23 (m, 2H), 0.90 (t, $J = 7.5$ Hz, 3H); ^{13}C NMR (asterisk denotes minor rotamer peaks, 125.8 MHz, CDCl_3) δ 161.0, 156.2, 155.7*, 141.5, 141.2*, 105.6, 105.1*, 99.0, 79.6, 55.4, 50.6, 49.9*, 46.5, 46.3*, 30.4, 30.1*, 28.6, 20.1, 14.0; IR (neat) 2960, 1691, 1597, 1414, 1205, 1156 cm^{-1} ; HRMS (ES+) calcd. for $\text{C}_{18}\text{H}_{29}\text{NO}_4\text{Na}$ $[\text{M}+\text{Na}]^+$ 346.1994, found 346.1989.

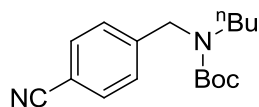


Methyl 3-[(*tert*-Butoxycarbonyl)(butyl)amino]methyl benzoate **4g.**

The reaction was carried out with methyl-3-chlorobenzoate (43 mg, 0.25 mmol, 1.0 equiv) for 3 h according to the general Suzuki–Miyaura cross-coupling reaction procedure to obtain **4g** (78 mg, 0.243 mmol) as a colorless oil in 97% yield after column chromatography (hexanes/EtOAc = 15:1).

^1H NMR (asterisk denotes minor rotamer peaks, 500 MHz, CDCl_3) δ 7.96–7.87 (m, 2H), 7.49–7.36 (m, 2H), 4.49 (s, 2H), 4.44* (s, 2H), 3.91 (s, 3H), 3.32–3.08 (m, 2H), 1.57–1.37 (m, 11H), 1.34–1.23 (m, 2H), 0.89 (t, $J = 7.5$ Hz, 3H); ^{13}C NMR (asterisk denotes minor rotamer peaks,

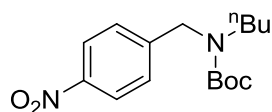
125.8 MHz, CDCl₃) δ 167.1, 156.2, 155.6*, 139.5, 139.2*, 132.2, 131.6, 130.4, 128.6, 79.8, 52.2, 50.3, 49.6*, 46.8, 46.5*, 30.3, 30.2*, 28.5, 20.0, 13.9; IR (neat) 2965, 2360, 2342, 1725, 1692, 1285, 1170 cm⁻¹; HRMS (ES+) calcd. for C₁₈H₂₇NO₄Na [M+Na]⁺ 344.1838, found 344.1843.



tert-Butyl Butyl(4-cyanobenzyl)carbamate 4h.

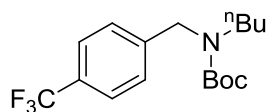
The reaction was carried out with 4-chlorobenzonitrile (34 mg, 0.25 mmol, 1.0 equiv) for 3 h according to the general Suzuki–Miyaura cross-coupling reaction procedure to obtain **4h** (67 mg, 0.232 mmol) as a colorless oil in 93% yield after column chromatography (hexanes/EtOAc = 10:1).

¹H NMR (asterisk denotes minor rotamer peaks, 500 MHz, CDCl₃) δ 7.62 (d, *J* = 8.0 Hz, 2H), 7.33 (s, 2H), 4.54–4.41 (m, 2H), 3.25–3.15 (m, 2H), 1.62–1.23 (m, 13H), 0.90 (t, *J* = 7.0 Hz, 3H); ¹³C NMR (asterisk denotes minor rotamer peaks, 125.8 MHz, CDCl₃) δ 156.1, 144.8*, 144.5, 132.4, 128.1, 127.5*, 118.9, 111.0, 80.5, 50.6*, 49.9, 47.0, 30.4, 28.4, 20.0, 13.9; IR (neat) 2961, 2359, 2228, 1691, 1409, 1169, 1146 cm⁻¹; HRMS (ES+) calcd. for C₁₇H₂₄N₂O₂Na [M+Na]⁺ 311.1735, found 311.1726.



tert-Butyl Butyl(4-nitrobenzyl)carbamate 4i.

The reaction was carried out with 4-chloronitrobenzene (39 mg, 0.25 mmol, 1.0 equiv) for 3 h according to the general Suzuki–Miyaura cross-coupling reaction procedure to obtain **4i** (66 mg, 0.214 mmol) as a yellow oil in 86% yield after column chromatography (hexanes/EtOAc = 10:1). ¹H NMR (asterisk denotes minor rotamer peaks, 500 MHz, CDCl₃) δ 8.19 (d, *J* = 7.5 Hz, 2H), 7.39 (s, 2H), 4.54–4.92 (m, 2H), 3.31–3.10 (m, 2H), 1.63–1.19 (m, 13H), 0.91 (t, *J* = 7.5 Hz, 3H); ¹³C NMR (asterisk denotes minor rotamer peaks, 125.8 MHz, CDCl₃) δ 156.1, 147.2, 146.6*, 128.1, 127.5, 123.8, 80.2, 50.4*, 49.8, 47.4*, 47.1, 30.5, 28.5, 20.1, 13.9; IR (neat) 2963, 2360, 1692, 1521, 1344 cm⁻¹; HRMS (ES⁺) calcd. for C₁₆H₂₄N₂O₄Na [M+Na]⁺ 331.1634, found 331.1629.

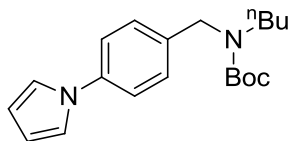


***tert*-Butyl Butyl{4-(trifluoromethyl)benzyl}carbamate **4j**.**

The reaction was carried out with 4-chlorobenzotrifluoride (45 mg, 0.25 mmol, 1.0 equiv) for 3 h according to the general Suzuki–Miyaura cross-coupling reaction procedure to obtain **4j** (66 mg, 0.199 mmol) as a colorless oil in 80% yield after column chromatography (hexanes/EtOAc = 20:1).

¹H NMR (asterisk denotes minor rotamer peaks, 500 MHz, CDCl₃) δ 7.58 (d, *J* = 7.5 Hz, 2H), 7.39–7.30 (m, 2H), 4.51–4.45 (m, 2H), 3.29–3.12 (m, 2H), 1.58–1.37 (m, 11H), 1.33–1.25 (m, 2H), 0.90 (t, *J* = 7.5 Hz, 3H); ¹³C NMR (asterisk denotes minor rotamer peaks, 125.8 MHz, CDCl₃) δ 156.3, 155.6*, 143.3*, 143.0, 129.5 (q, *J* = 32.2 Hz), 127.8, 127.2*, 125.5 (q, *J* = 3.4 Hz), 124.3 (q, *J* = 271.7 Hz), 80.0, 50.4*, 49.7*, 46.7, 30.4, 28.5, 28.1*, 20.1, 13.9; IR (neat)

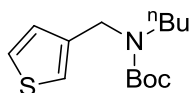
2966, 2360, 1693, 1325, 1163, 1126 cm^{-1} ; HRMS (ES+) calcd. for $\text{C}_{17}\text{H}_{24}\text{F}_3\text{NO}_2\text{Na}$ $[\text{M}+\text{Na}]^+$ 354.1657, found 354.1648.



tert-Butyl 4-(1H-Pyrrol-1-yl)benzyl(butyl)carbamate 4k.

The reaction was carried out with 1-(4-chlorophenyl)-1H-pyrrole (44 mg, 0.25 mmol, 1.0 equiv) for 3 h according to the general Suzuki–Miyaura cross-coupling reaction procedure to obtain **4k** (77 mg, 0.234 mmol) as a colorless oil in 94% yield after column chromatography (hexanes/EtOAc = 20:1).

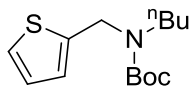
^1H NMR (asterisk denotes minor rotamer peaks, 500 MHz, CDCl_3) δ 7.34 (d, $J = 8.5$ Hz, 2H), 7.32–7.25 (m, 2H), 7.09–7.05 (m, 2H), 6.36–6.31 (m, 2H), 4.47–4.39 (m, 2H), 3.26–3.09 (m, 2H), 1.56–1.38 (m, 11H), 1.33–1.24 (m, 2H), 0.90 (t, $J = 7.5$ Hz, 3H); ^{13}C NMR (asterisk denotes minor rotamer peaks, 125.8 MHz, CDCl_3) δ 156.3, 155.7*, 139.9, 136.3, 128.9, 128.4*, 120.6, 119.4, 110.5, 79.8, 50.1*, 49.4, 46.7*, 46.5, 30.4, 30.3*, 28.6, 20.1, 14.0; IR (neat) 2961, 2360, 1689, 1522, 1413, 1329, 1169, 1143 cm^{-1} ; HRMS (ES+) calcd. for $\text{C}_{20}\text{H}_{28}\text{N}_2\text{O}_2\text{Na}$ $[\text{M}+\text{Na}]^+$ 351.2048, found 351.2037.



tert-Butyl Butyl(thiophen-3-ylmethyl)carbamate 5a.

The reaction was carried out with 3-chlorothiophene (30 mg, 0.25 mmol, 1.0 equiv) for 3 h according to the general Suzuki–Miyaura cross-coupling reaction procedure to obtain **5a** (63 mg, 0.234 mmol) as a colorless oil in 94% yield after column chromatography (hexanes/EtOAc = 20:1).

^1H NMR (asterisk denotes minor rotamer peaks, 500 MHz, CDCl_3) δ 7.28–7.24 (m, 1H), 7.11–6.96 (m, 2H), 4.41 (s, 2H), 4.37* (s, 2H), 3.24–3.11 (m, 2H), 1.53–1.40 (m, 11H), 1.31–1.22 (m, 2H), 0.81 (t, $J = 7.0$ Hz, 3H); ^{13}C NMR (asterisk denotes minor rotamer peaks, 125.8 MHz, CDCl_3) δ 156.0, 155.5*, 139.9, 127.7, 127.3*, 126.0, 122.1, 121.6*, 79.5, 46.3, 46.0, 45.3*, 30.4, 30.2*, 28.6, 20.1, 14.0; IR (neat) 2961, 2931, 1689, 1169 cm^{-1} ; HRMS (ES+) calcd. for $\text{C}_{14}\text{H}_{23}\text{NO}_2\text{SNa}$ $[\text{M}+\text{Na}]^+$ 292.1347, found 292.1342.

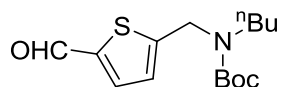


***tert*-Butyl Butyl(thiophen-2-ylmethyl)carbamate **5b**.**

The reaction was carried out with 2-chlorothiophene (30 mg, 0.25 mmol, 1.0 equiv) for 3 h according to the general Suzuki–Miyaura cross-coupling reaction procedure to obtain **5b** (54 mg, 0.200 mmol) as a light yellow oil in 80% yield after column chromatography (hexanes/EtOAc = 20:1).

^1H NMR (asterisk denotes minor rotamer peaks, 500 MHz, CDCl_3) δ 7.24–7.18 (m, 1H), 6.95–6.88 (m, 2H), 4.56* (s, 2H), 4.51 (s, 2H), 3.33–3.15 (m, 2H), 1.55–1.43 (m, 11H), 1.33–1.23 (m, 2H), 0.90 (t, $J = 7.5$ Hz, 3H); ^{13}C NMR (asterisk denotes minor rotamer peaks, 125.8 MHz, CDCl_3) δ 155.8*, 155.2, 141.8, 126.5, 126.0*, 125.8, 125.1, 80.0, 79.7*, 46.2, 45.6, 45.0*, 30.5*,

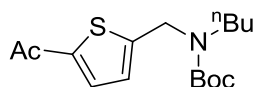
30.2, 28.6, 20.2, 14.0; IR (neat) 2960, 2932, 1693, 1154 cm^{-1} ; HRMS (ES+) calcd. for $\text{C}_{14}\text{H}_{23}\text{NO}_2\text{SNa}$ $[\text{M}+\text{Na}]^+$ 292.1347, found 292.1341.



***tert*-Butyl Butyl{(5-formylthiophen-2-yl)methyl}carbamate 5c.**

The reaction was carried out with 5-chlorothiophene-2-carboxaldehyde (37 mg, 0.25 mmol, 1.0 equiv) for 3 h according to the general Suzuki–Miyaura cross-coupling reaction procedure to obtain **5c** (68 mg, 0.229 mmol) as a yellow oil in 91% yield after column chromatography (hexanes/EtOAc = 6:1).

^1H NMR (asterisk denotes minor rotamer peaks, 500 MHz, CDCl_3) δ 9.85 (s, 1H), 7.64 (d, J = 3.5 Hz, 1H), 7.03 (s, 1H), 4.59 (s, 2H), 4.56* (s, 2H), 3.23 (s, 2H), 1.52–1.46 (m, 11H), 1.34–1.27 (m, 2H), 0.91 (t, J = 7.5 Hz, 3H); ^{13}C NMR (asterisk denotes minor rotamer peaks, 125.8 MHz, CDCl_3) δ 182.9, 155.7, 154.8*, 153.5, 143.0, 136.6, 126.6, 80.5*, 80.3, 47.0, 46.4*, 45.9, 30.6, 30.3*, 28.5, 20.0, 13.9; IR (neat) 2962, 2932, 1673, 1152 cm^{-1} ; HRMS (ES+) calcd. for $\text{C}_{15}\text{H}_{23}\text{NO}_3\text{SNa}$ $[\text{M}+\text{Na}]^+$ 320.1296, found 320.1287.

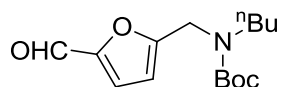


***tert*-Butyl {(5-Acetylthiophen-2-yl)methyl}(butyl)carbamate 5d.**

The reaction was carried out with 2-acetyl-5-chlorothiophene (40 mg, 0.25 mmol, 1.0 equiv) for 18 h according to the general Suzuki–Miyaura cross-coupling reaction procedure to obtain **5d**

(71 mg, 0.228 mmol) as a light yellow oil in 93% yield after column chromatography (hexanes/EtOAc = 10:1).

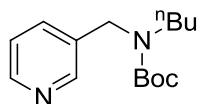
^1H NMR (asterisk denotes minor rotamer peaks, 500 MHz, CDCl_3) δ 7.55 (s, 1H), 6.95 (s, 1H), 4.56 (s, 2H), 4.54* (s, 2H), 3.22 (s, 2H), 2.52 (s, 3H), 1.52–1.44 (m, 11H), 1.32–1.25 (m, 2H), 0.91 (t, $J = 7.0$ Hz, 3H); ^{13}C NMR (asterisk denotes minor rotamer peaks, 125.8 MHz, CDCl_3) δ 190.6, 155.7*, 154.9, 151.6, 143.5, 132.5, 132.4*, 126.5, 126.3*, 80.4*, 80.1, 46.8, 46.2*, 45.7, 30.5, 30.2*, 28.5, 26.6, 19.9, 13.9; IR (neat) 2960, 2931, 1691, 1662, 1275, 1153 cm^{-1} ; HRMS (ES+) calcd. for $\text{C}_{16}\text{H}_{25}\text{NO}_3\text{SNa}$ $[\text{M}+\text{Na}]^+$ 334.1453, found 334.1458.



***tert*-Butyl Butyl{(5-formylfuran-2-yl)methyl}carbamate **5e**.**

The reaction was carried out with 5-chloro-2-furaldehyde (33 mg, 0.25 mmol, 1.0 equiv) for 3 h according to the general Suzuki–Miyaura cross-coupling reaction procedure to obtain **5e** (64 mg, 0.227 mmol) as a yellow oil in 91% yield after column chromatography (hexanes/EtOAc = 9:1).

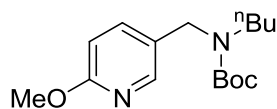
^1H NMR (asterisk denotes minor rotamer peaks, 500 MHz, CDCl_3) δ 9.58 (s, 1H), 7.20 (d, $J = 3.0$ Hz, 1H), 6.46–6.44 (m, 1H), 4.42 (s, 2H), 4.43* (s, 2H), 3.32–3.25 (m, 2H), 1.54–1.38 (m, 11H), 1.35–1.25 (m, 2H), 0.91 (t, $J = 7.5$ Hz, 3H); ^{13}C NMR (asterisk denotes minor rotamer peaks, 125.8 MHz, CDCl_3) δ 177.4, 159.5, 155.7, 155.1*, 152.3, 127.8, 110.4, 109.6*, 80.3, 47.5, 44.6*, 43.9, 30.5, 29.8*, 28.5, 20.0, 13.9; IR (neat) 2962, 2932, 1682, 1165 cm^{-1} ; HRMS (ES+) calcd. for $\text{C}_{15}\text{H}_{23}\text{NO}_4\text{Na}$ $[\text{M}+\text{Na}]^+$ 304.1525, found 304.1524.



tert-Butyl Butyl(pyridin-3-ylmethyl)carbamate 5f.

The reaction was carried out with 3-chloropyridine (28 mg, 0.25 mmol, 1.0 equiv) for 18 h according to the general Suzuki–Miyaura cross-coupling reaction procedure to obtain **5f** (56 mg, 0.212 mmol) as a colorless oil in 85% yield after column chromatography (hexanes/EtOAc = 4:1).

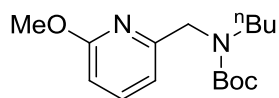
^1H NMR (asterisk denotes minor rotamer peaks, 500 MHz, CDCl_3) δ 8.55–8.50 (m, 2H), 7.64–7.55 (m, 1H), 7.27 (dd, $J = 7.5, 4.5$ Hz, 1H), 4.51–4.48 (m, 2H), 3.24–3.10 (m, 2H), 1.57–1.37 (m, 11H), 1.33–1.22 (m, 2H), 0.90 (t, $J = 7.5$ Hz, 3H); ^{13}C NMR (asterisk denotes minor rotamer peaks, 125.8 MHz, CDCl_3) δ 156.2, 149.1, 148.7, 135.7, 134.9*, 134.4, 123.6, 80.0, 48.4*, 47.7, 47.0*, 46.6, 30.4, 28.5, 20.1, 13.9; IR (neat) 2961, 2932, 1690, 1412, 1168, 1144 cm^{-1} ; HRMS (ES⁺) calcd. for $\text{C}_{15}\text{H}_{25}\text{N}_2\text{O}_2$ $[\text{M}+\text{H}]^+$ 265.1916, found 265.1909.



tert-Butyl Butyl{(6-methoxypyridin-3-yl)methyl}carbamate 5g.

The reaction was carried out with 2-chloro-5-methoxypyridine (36 mg, 0.25 mmol, 1.0 equiv) for 3 h according to the general Suzuki–Miyaura cross-coupling reaction procedure to obtain **5g** (68 mg, 0.231 mmol) as a light yellow oil in 92% yield after column chromatography (hexanes/EtOAc = 10:1).

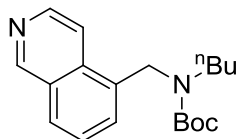
^1H NMR (asterisk denotes minor rotamer peaks, 500 MHz, CDCl_3) δ 8.02 (d, $J = 2.0$ Hz, 1H), 7.52 (s, 1H), 6.71 (d, $J = 8.5$ Hz, 1H), 4.35 (s, 2H), 3.93 (s, 3H), 3.23–3.09 (m, 2H), 1.51–1.45 (m, 11H), 1.32–1.26 (m, 2H), 0.90 (t, $J = 7.5$ Hz, 3H); ^{13}C NMR (asterisk denotes minor rotamer peaks, 125.8 MHz, CDCl_3) δ 163.7, 156.1, 155.4*, 145.9, 138.8, 138.2*, 127.0, 110.9, 79.7, 53.4, 47.5, 46.9*, 46.1, 30.4, 28.5, 20.1, 13.9; IR (neat) 2960, 1691, 1493, 1289, 1169 cm^{-1} ; HRMS (ES+) calcd. for $\text{C}_{16}\text{H}_{27}\text{N}_2\text{O}_3$ $[\text{M}+\text{H}]^+$ 295.2022, found 295. 2020.



***tert*-Butyl Butyl{(6-methoxypyridin-2-yl)methyl}carbamate **5h**.**

The reaction was carried out with 2-chloro-6-methoxypyridine (36 mg, 0.25 mmol, 1.0 equiv) for 18 h according to the general Suzuki–Miyaura cross-coupling reaction procedure to obtain **5h** (36 mg, 0.122 mmol) as a colorless oil in 49% yield after column chromatography (hexanes/EtOAc = 20:1).

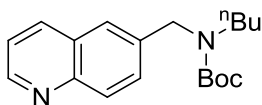
^1H NMR (asterisk denotes minor rotamer peaks, 500 MHz, CDCl_3) δ 7.51 (dd, $J = 7.5, 7.5$ Hz, 1H), 6.76 (dd, $J = 25.0, 6.0$ Hz, 1H), 6.59 (d, $J = 8.0$ Hz, 1H), 4.45* (s, 2H), 4.38 (s, 2H), 3.90 (s, 3H), 3.37–3.19 (m, 2H), 1.60–1.22 (m, 13H), 0.91 (t, $J = 7.0$ Hz, 3H); ^{13}C NMR (asterisk denotes minor rotamer peaks, 125.8 MHz, CDCl_3) δ 163.8, 156.8, 156.4*, 156.2*, 155.8, 139.1*, 138.9, 113.8*, 113.3, 108.6, 79.5, 53.3, 52.4, 51.8*, 47.6, 47.4*, 30.6*, 30.4, 28.6*, 28.5, 20.3, 20.1*, 14.0; IR (neat) 2958, 2931, 1696, 1467, 1171 cm^{-1} ; HRMS (ES+) calcd. for $\text{C}_{16}\text{H}_{27}\text{N}_2\text{O}_3$ $[\text{M}+\text{H}]^+$ 295.2022, found 295. 2018.



tert-Butyl Butyl(5-(benzo[5,4-d]isoquinolin-5-yl)methyl)carbamate 5i.

The reaction was carried out with 5-chloroisoquinoline (41 mg, 0.25 mmol, 1.0 equiv) for 18 h according to the general Suzuki–Miyaura cross-coupling reaction procedure to obtain **5i** (77 mg, 0.245 mmol) as a light yellow oil in 98% yield after column chromatography (hexanes/EtOAc = 4:1).

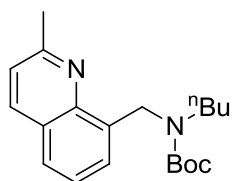
^1H NMR (asterisk denotes minor rotamer peaks, 500 MHz, CDCl_3) δ 9.29 (s, 1H), 8.57 (d, J = 6.0 Hz, 1H), 8.01–7.78 (m, 2H), 7.62–7.54 (m, 2H), 4.90 (s, 2H), 3.29–3.02 (m, 2H), 1.59–1.32 (m, 11H), 1.31–1.18 (m, 2H), 0.92–0.81 (m, 3H); ^{13}C NMR (asterisk denotes minor rotamer peaks, 125.8 MHz, CDCl_3) δ 155.9, 153.2, 143.3, 134.7, 133.5, 130.3, 129.0, 128.6*, 127.7, 126.9, 117.2, 116.2*, 80.0, 47.6*, 47.2, 46.5*, 45.8, 30.1, 28.5, 20.1, 13.9; IR (neat) 2970, 1687, 1170, 1144 cm^{-1} ; HRMS (ES $^+$) calcd. for $\text{C}_{19}\text{H}_{27}\text{N}_2\text{O}_2$ $[\text{M}+\text{H}]^+$ 315.2073, found 315.2072.



tert-Butyl Butyl(6-(quinolin-6-yl)methyl)carbamate 5j.

The reaction was carried out with 6-chloroquinoline (41 mg, 0.25 mmol, 1.0 equiv) for 3 h according to the general Suzuki–Miyaura cross-coupling reaction procedure to obtain **5j** (78 mg, 0.248 mmol) as a light yellow oil in 99% yield after column chromatography (hexanes/EtOAc = 3:1).

^1H NMR (asterisk denotes minor rotamer peaks, 500 MHz, CDCl_3) δ 8.90 (s, 1H), 8.12 (d, $J = 8.5$ Hz, 1H), 8.08 (d, $J = 8.5$ Hz, 1H), 7.68–7.51 (m, 2H), 7.42–7.31 (m, 1H), 4.66–4.47 (m, 2H), 3.32–3.10 (m, 2H), 1.59–1.34 (m, 11H), 1.34–1.18 (m, 2H), 0.89 (t, $J = 7.0$ Hz, 3H); ^{13}C NMR (asterisk denotes minor rotamer peaks, 125.8 MHz, CDCl_3) δ 156.3, 155.7*, 150.2, 147.8, 137.2, 135.9, 129.8, 129.6, 129.0*, 128.3, 125.9, 125.2*, 121.4, 79.8, 50.5*, 49.8, 46.8*, 46.5, 30.3, 28.5, 20.1, 13.9; IR (neat) 2961, 2931, 1690, 1170, 1145 cm^{-1} ; HRMS (ES+) calcd. for $\text{C}_{19}\text{H}_{27}\text{N}_2\text{O}_2$ $[\text{M}+\text{H}]^+$ 315.2073, found 315.2064.

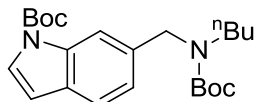


***tert*-Butyl Butyl{(2-methylquinolin-8-yl)methyl}carbamate 5k.**

The reaction was carried out with 8-chloro-2-methylquinoline (44 mg, 0.25 mmol, 1.0 equiv) for 18 h according to the general Suzuki–Miyaura cross-coupling reaction procedure to obtain **5k** (63 mg, 0.192 mmol) as a yellow oil in 77% yield after column chromatography (hexanes/EtOAc = 20:1).

^1H NMR (asterisk denotes minor rotamer peaks, 500 MHz, CDCl_3) δ 8.06–8.98 (m, 1H), 7.69–7.47 (m, 2H), 7.43 (dd, $J = 7.5, 7.5$ Hz, 1H), 7.29–7.21 (m, 1H), 5.16* (s, 2H), 5.12 (s, 2H), 3.43–3.26 (m, 2H), 2.73 (s, 3H), 2.71* (s, 3H), 1.64–1.53 (m, 2H), 1.51* (s, 9H), 1.40 (s, 9H), 1.38–1.25 (m, 2H), 0.90 (t, $J = 7.0$ Hz, 3H); ^{13}C NMR (asterisk denotes minor rotamer peaks,

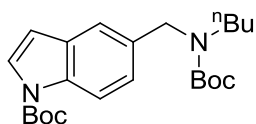
125.8 MHz, CDCl₃) δ 158.0, 156.4, 146.3*, 146.1, 136.2, 127.6, 126.6, 126.4, 126.3, 125.6*, 125.3, 121.9, 121.7*, 79.3, 79.2*, 47.2, 46.6, 45.7*, 30.7*, 30.4, 28.6*, 28.5, 25.6, 20.3, 20.1*, 14.0; IR (neat) 2960, 2931, 1690, 1172, 1143 cm⁻¹; HRMS (ES+) calcd. for C₂₀H₂₉N₂O₂ [M+H]⁺ 329. 2229, found 329.2223.



***tert*-Butyl 6-[(*tert*-Butoxycarbonyl)(butyl)amino]methyl-1H-indole-1-carboxylate **5l**.**

The reaction was carried out with *tert*-butyl 6-chloro-1H-indole-1-carboxylate (63 mg, 0.25 mmol, 1.0 equiv) for 3 h according to the general Suzuki–Miyaura cross-coupling reaction procedure to obtain **5l** (83 mg, 0.206 mmol) as a colorless oil in 82% yield after column chromatography (hexanes/EtOAc = 20:1).

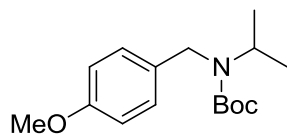
¹H NMR (asterisk denotes minor rotamer peaks, 500 MHz, CDCl₃) δ 8.05 (s, 1H), 7.56 (s, 1H), 7.49 (d, *J* = 7.5 Hz, 1H), 7.18–7.04 (m, 1H), 6.53 (s, 1H), 4.58* (s, 2H), 4.54 (s, 2H), 3.26–3.10 (m, 2H), 1.67 (s, 9H), 1.56–1.38 (m, 11H), 1.31–1.22 (m, 2H), 0.89 (t, *J* = 7.0 Hz, 3H); ¹³C NMR (asterisk denotes minor rotamer peaks, 125.8 MHz, CDCl₃) δ 156.2, 155.7*, 149.8, 135.4, 135.1, 129.7, 122.0*, 121.0, 114.6, 114.1*, 107.2, 83.7, 79.4, 50.8*, 50.1, 46.3*, 45.9, 30.3, 30.0*, 28.6, 28.3, 20.1, 14.0; IR (neat) 2973, 1735, 1693, 1168, 1145 cm⁻¹; HRMS (ES+) calcd. for C₂₃H₃₄N₂O₄ Na [M+Na]⁺ 425.2416, found 425.2413.



***tert*-Butyl 5-[(*tert*-Butoxycarbonyl)(butyl)amino]methyl]-1H-indole-1-carboxylate **5m**.**

The reaction was carried out with *tert*-butyl 5-chloro-1H-indole-1-carboxylate (63 mg, 0.25 mmol, 1.0 equiv) for 3 h according to the general Suzuki–Miyaura cross-coupling reaction procedure to obtain **5m** (96 mg, 0.138 mmol) as a yellow oil in 95% yield after column chromatography (hexanes/EtOAc = 20:1).

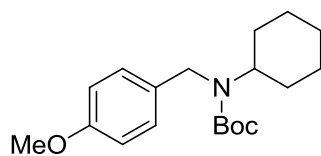
¹H NMR (asterisk denotes minor rotamer peaks, 500 MHz, CDCl₃) δ 8.12–8.05 (m, 1H), 7.59–7.54 (m, 1H), 7.44–7.36 (m, 1H), 7.26–7.13 (m, 1H), 6.52 (d, *J* = 3.5 Hz, 1H), 4.56–4.47 (m, 2H), 3.26–3.18 (m, 2H), 1.66 (s, 9H), 1.52–1.44 (m, 11H), 1.29–1.23 (m, 2H), 0.89 (t, *J* = 7.0 Hz, 3H); ¹³C NMR (asterisk denotes minor rotamer peaks, 125.8 MHz, CDCl₃) δ 156.2, 155.8*, 149.8, 134.5, 133.1, 131.0, 126.3, 124.4, 123.7*, 120.2, 119.4*, 115.2, 107.3, 83.7, 79.5, 50.4*, 49.8, 46.3, 45.9*, 30.2, 28.6, 28.3, 20.1, 14.0; IR (neat) 2974, 1734, 1691, 1368, 1354, 1163 cm⁻¹; HRMS (ES⁺) calcd. for C₂₃H₃₅N₂O₄ [M+H]⁺ 403.2597, found 403.2592.



***tert*-Butyl Isopropyl(4-methoxybenzyl)carbamate **6a**.**

The reaction was carried out with trifluoroborate **3b** (73 mg, 0.263 mmol, 1.05 equiv) and 4-chloroanisole (36 mg, 0.25 mmol, 1.0 equiv) for 3 h according to the general Suzuki–Miyaura cross-coupling reaction procedure to obtain **6a** (58 mg, 0.208 mmol) as a colorless oil in 83% yield after column chromatography (hexanes/EtOAc = 20:1).

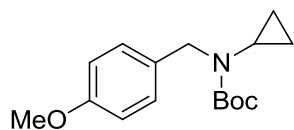
^1H NMR (500 MHz, CDCl_3) δ 7.16 (d, $J = 7.5$ Hz, 2H), 6.83 (d, $J = 8.5$ Hz, 2H), 4.37–4.25 (m, 3H), 3.79 (s, 3H), 1.42 (s, 9H), 1.09 (d, $J = 7.0$ Hz, 6H); ^{13}C NMR (asterisk denotes minor rotamer peaks, 125.8 MHz, CDCl_3) δ 158.4, 155.7, 132.6, 128.0, 113.7, 79.5, 55.3, 48.5*, 47.2, 45.6, 28.6, 21.0; IR (neat) 2974, 1687, 1245, 1161 cm^{-1} ; HRMS (ES+) calcd. for $\text{C}_{16}\text{H}_{25}\text{NO}_3\text{Na}$ $[\text{M}+\text{Na}]^+$ 302.1732, found 302.1733.



***tert*-Butyl Cyclohexyl(4-methoxybenzyl)carbamate **6b**.**

The reaction was carried out with trifluoroborate **3c** (84 mg, 0.263 mmol, 1.05 equiv) and 4-chloroanisole (36 mg, 0.25 mmol, 1.0 equiv) for 3 h according to the general Suzuki–Miyaura cross-coupling reaction procedure to obtain **6b** (55 mg, 0.172 mmol) as a colorless oil in 69% yield after column chromatography (hexanes/EtOAc = 25:1).

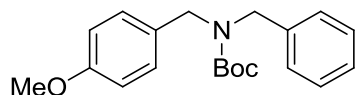
^1H NMR (500 MHz, CDCl_3) δ 7.15 (d, $J = 7.0$ Hz, 2H), 6.83 (d, $J = 8.5$ Hz, 2H), 4.30 (s, 2H), 3.99 (s, 1H), 3.79 (s, 3H), 1.78–0.94 (m, 19H); ^{13}C NMR (125.8 MHz, CDCl_3) δ 158.4, 155.8, 132.7, 127.8, 113.6, 79.5, 57.2, 55.3, 46.1, 31.4, 28.6, 26.2, 25.7; IR (neat) 2932, 1685, 1244, 1166 cm^{-1} ; HRMS (ES+) calcd. for $\text{C}_{19}\text{H}_{30}\text{NO}_3$ $[\text{M}+\text{H}]^+$ 320.2226, found 320.2233.



***tert*-Butyl Cyclopropyl(4-methoxybenzyl)carbamate **6c**.**

The reaction was carried out with trifluoroborate **3d** (73 mg, 0.263 mmol, 1.05 equiv) and 4-chloroanisole (36 mg, 0.25 mmol, 1.0 equiv) for 3 h according to the general Suzuki–Miyaura cross-coupling reaction procedure to obtain **6c** (56 mg, 0.202 mmol) as a colorless oil in 81% yield after column chromatography (hexanes/EtOAc = 25:1).

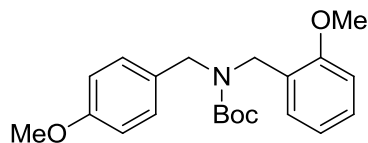
^1H NMR (500 MHz, CDCl_3) δ 7.18 (d, $J = 8.0$ Hz, 2H), 6.85 (d, $J = 8.0$ Hz, 2H), 4.36 (s, 2H), 3.79 (s, 3H), 2.40 (s, 1H), 1.46 (s, 9H), 0.71–0.63 (m, 4H); ^{13}C NMR (125.8 MHz, CDCl_3) δ 158.8, 156.9, 131.1, 128.9, 113.9, 79.7, 55.3, 50.9, 29.1, 28.6, 8.2.; IR (neat) 2976, 1694, 1247, 1171 cm^{-1} ; HRMS (ES+) calcd. for $\text{C}_{16}\text{H}_{23}\text{NO}_3\text{Na}$ $[\text{M}+\text{Na}]^+$ 300.1576, found 300.1585.



***tert*-Butyl Benzyl(4-methoxybenzyl)carbamate 6d.**

The reaction was carried out with trifluoroborate **3e** (86 mg, 0.263 mmol, 1.05 equiv) and 4-chloroanisole (36 mg, 0.25 mmol, 1.0 equiv) for 3 h according to the general Suzuki–Miyaura cross-coupling reaction procedure to obtain **6d** (74 mg, 0.226 mmol) as a colorless oil in 90% yield after column chromatography (hexanes/EtOAc = 25:1).

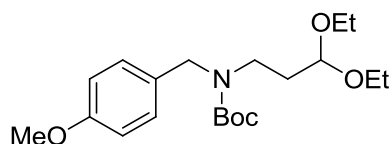
^1H NMR (500 MHz, CDCl_3) δ 7.35–7.06 (m, 7H), 6.85 (d, $J = 8.5$ Hz, 2H), 4.42–4.21 (m, 4H), 3.79 (s, 3H), 1.50 (s, 9H); ^{13}C NMR (asterisk denotes minor rotamer peaks, 125.8 MHz, CDCl_3) δ 159.0, 156.1, 138.3, 130.1, 129.5, 128.9*, 128.6, 128.1*, 127.5, 127.3, 114.0, 80.1, 55.3, 49.1, 48.7, 48.5*, 28.6; IR (neat) 2974, 1690, 1245, 1163 cm^{-1} ; HRMS (ES+) calcd. for $\text{C}_{20}\text{H}_{25}\text{NO}_3\text{Na}$ $[\text{M}+\text{Na}]^+$ 350.1732, found 350.1724.



***tert*-Butyl 2-Methoxybenzyl(4-methoxybenzyl)carbamate 6e.**

The reaction was carried out with trifluoroborate **3f** (94 mg, 0.263 mmol, 1.05 equiv) and 4-chloroanisole (36 mg, 0.25 mmol, 1.0 equiv) for 3 h according to the general Suzuki–Miyaura cross-coupling reaction procedure to obtain **6e** (65 mg, 0.182 mmol) as a colorless oil in 73% yield after column chromatography (hexanes/EtOAc = 20:1).

^1H NMR (asterisk denotes minor rotamer peaks, 500 MHz, CDCl_3) δ 7.26–7.10 (m, 4H), 6.93 (dd, $J = 7.5, 7.5$ Hz, 1H), 6.88–6.82 (m, 3H), 4.48–4.30 (m, 4H), 3.79 (s, 3H), 3.77 (s, 3H), 1.48* (s, 9H), 1.46 (s, 9H); ^{13}C NMR (asterisk denotes minor rotamer peaks, 125.8 MHz, CDCl_3) δ 158.8, 157.6*, 157.3, 156.4, 156.0*, 130.8*, 130.7, 129.3, 128.9*, 128.8, 128.2, 126.4, 120.6*, 120.5, 113.8, 110.2, 79.8, 55.3, 55.2, 49.5*, 49.0, 44.4, 44.1*, 29.8*, 28.6; IR (neat) 2931, 1690, 1239, 1161 cm^{-1} ; HRMS (ES+) calcd. for $\text{C}_{21}\text{H}_{27}\text{NO}_4\text{Na}$ $[\text{M}+\text{Na}]^+$ 300.1838, found 380.1826.



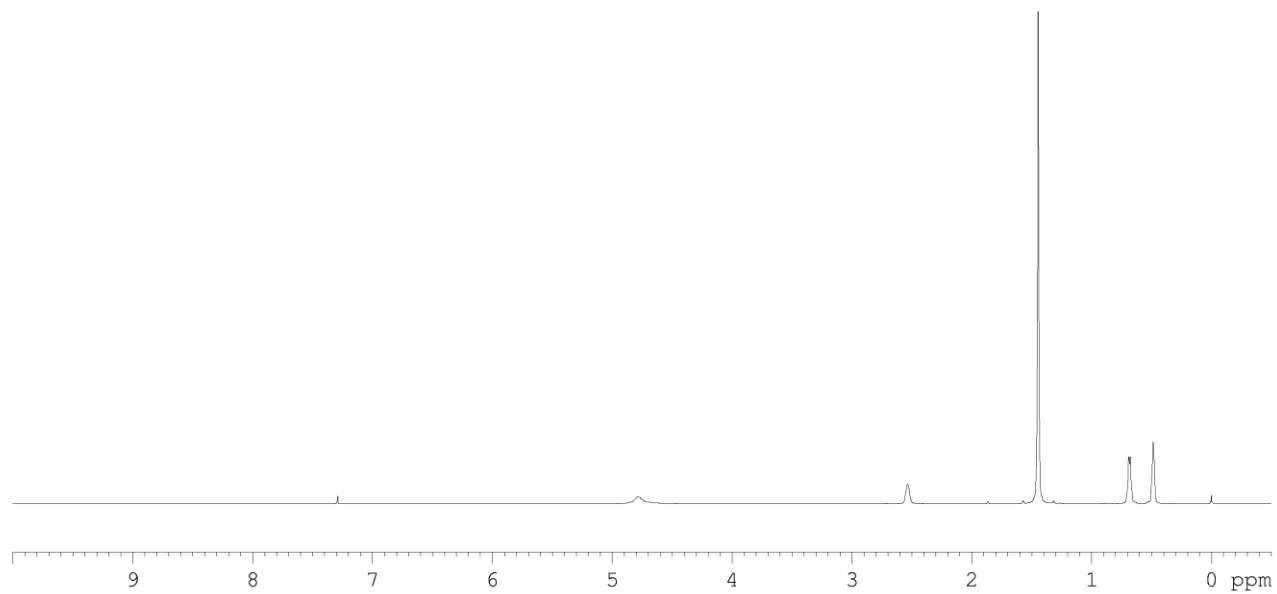
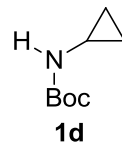
***tert*-Butyl (3,3-Diethoxypropyl)(4-methoxybenzyl)carbamate 6f.**

The reaction was carried out with trifluoroborate **3g** (96 mg, 0.263 mmol, 1.05 equiv) and 4-chloroanisole (36 mg, 0.25 mmol, 1.0 equiv) for 3 h according to the general Suzuki–Miyaura cross-coupling reaction procedure to obtain **6f** (78 mg, 0.212 mmol) as a colorless oil in 85% yield after column chromatography (hexanes/EtOAc = 10:1).

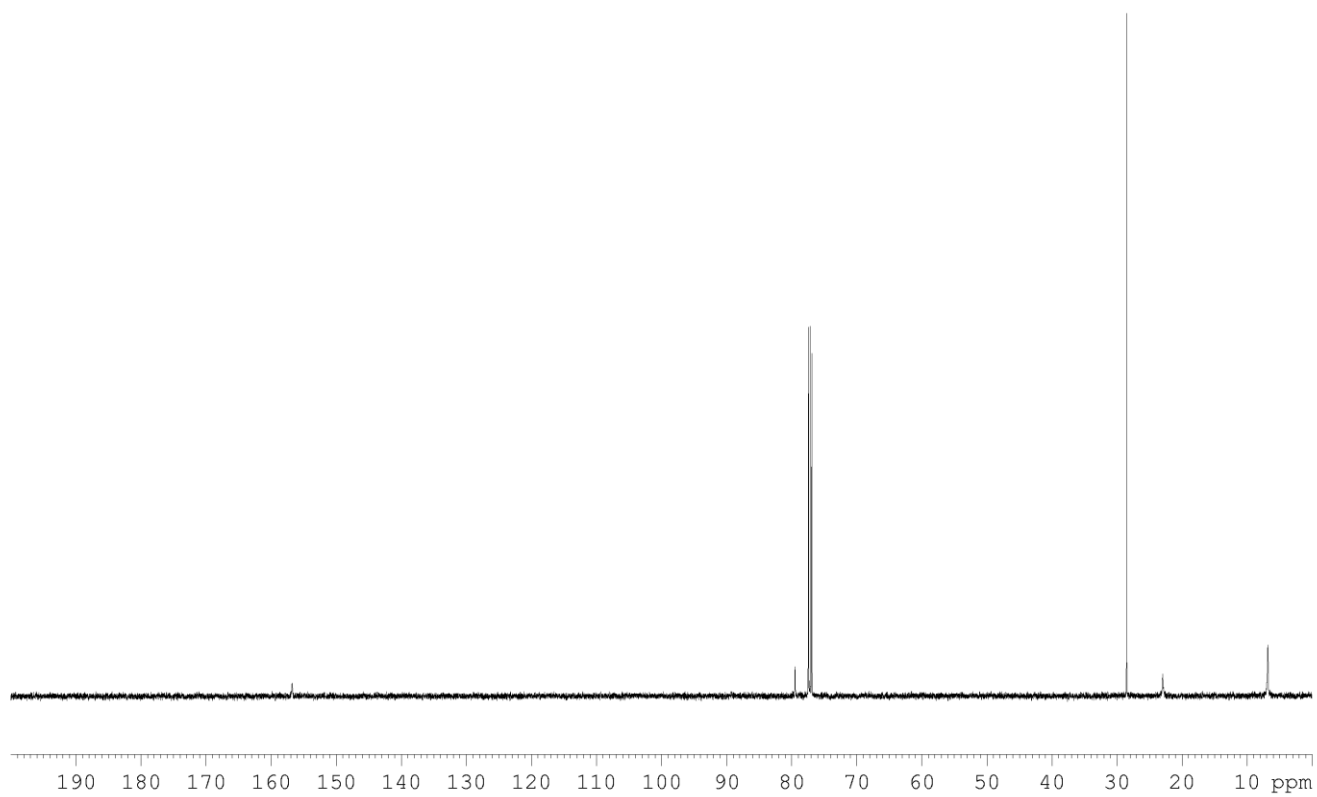
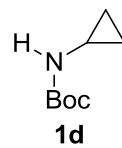
^1H NMR (asterisk denotes minor rotamer peaks, 500 MHz, CDCl_3) δ 7.17 (s, 2H), 6.85 (d, $J = 8.5$ Hz, 2H), 4.51–4.41 (m, 1H), 4.41–4.32 (m, 2H), 3.79 (s, 3H), 3.65–3.58 (m, 2H), 3.50–3.41 (m, 2H), 3.25* (s, 2H), 3.17 (s, 2H), 1.85–1.79 (m, 2H), 1.48 (s, 9H), 1.18 (t, $J = 7.0$ Hz, 6H); ^{13}C NMR (asterisk denotes minor rotamer peaks, 125.8 MHz, CDCl_3) δ 158.9, 156.0, 155.6*, 130.7, 129.2, 128.7*, 113.9, 101.0, 79.6, 61.0, 55.3, 50.3*, 49.7, 42.5, 32.4, 32.1*, 28.5, 15.4; IR (neat) 2975, 1691, 1247, 1169 cm^{-1} ; HRMS (ES+) calcd. for $\text{C}_{20}\text{H}_{33}\text{NO}_5\text{Na}$ $[\text{M}+\text{Na}]^+$ 390.2256, found 390.2261.

References:

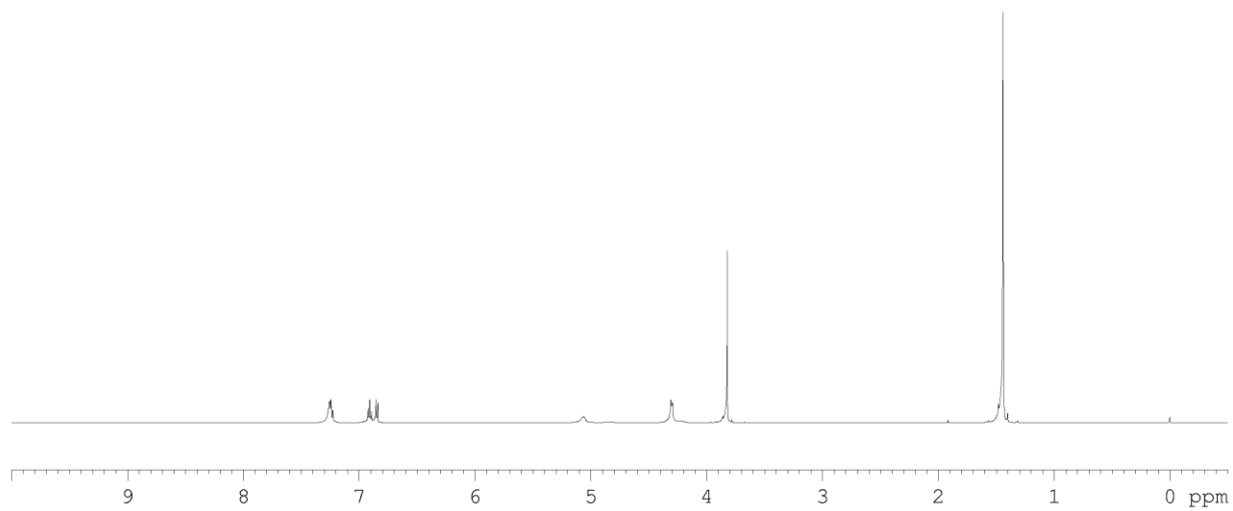
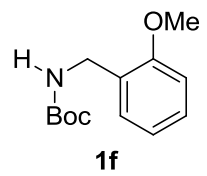
- (a) Kinzel, T.; Zhang, Y.; Buchwald, S. L. *J. Am. Chem. Soc.* **2010**, *132*, 14073.
- (b) Alaimo, P. J.; Peters, D. W.; Arnold, J.; Bergman, R. G. *J. Chem. Edu.* **2001**, *78*, 64.
- (c) Still, W. C.; Kahn, M.; Mitra, A. *J. Org. Chem.* **1978**, *43*, 2923.
- (d) Blackburn, L.; Taylor, R. J. K. *Org. Lett.* **2001**, *3*, 1637.



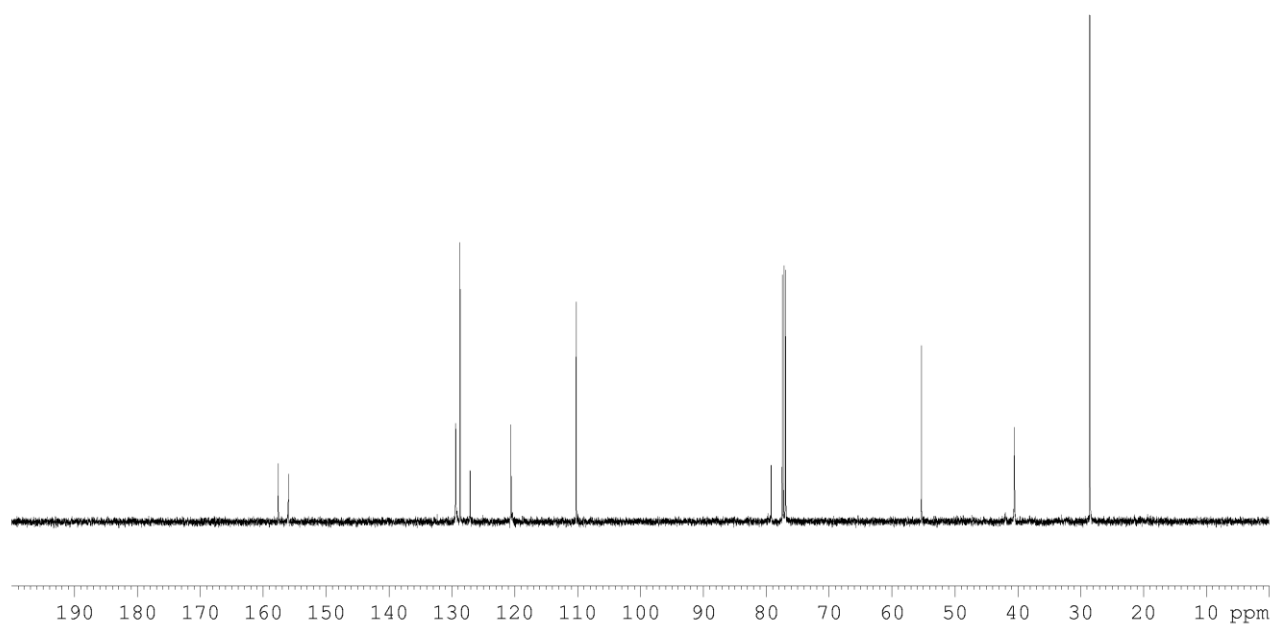
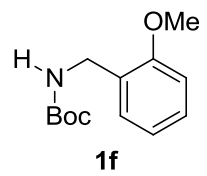
^1H NMR (500 MHz, CDCl_3) Spectrum of **1d**



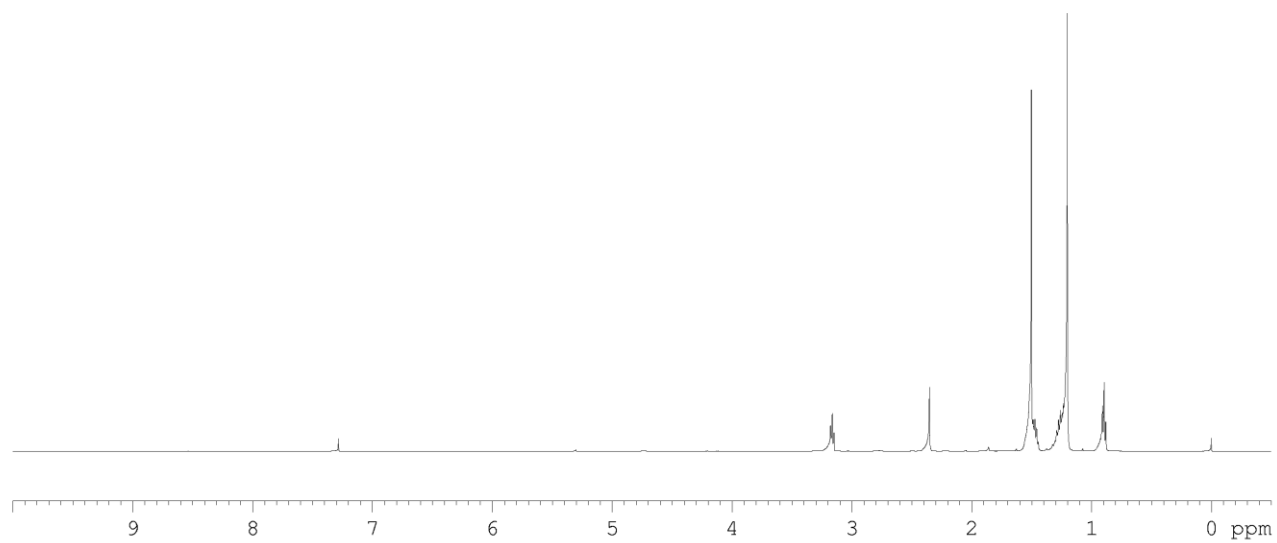
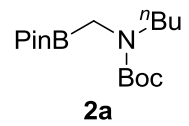
^{13}C NMR (125.8 MHz, CDCl_3) Spectrum of **1d**



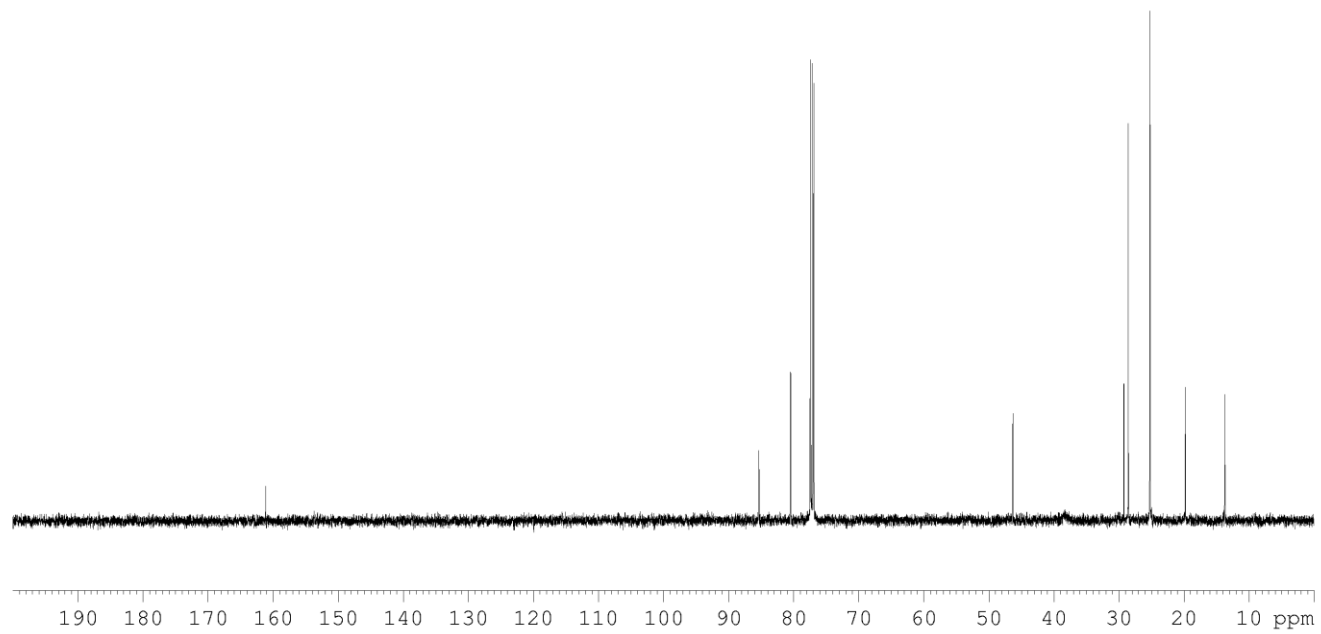
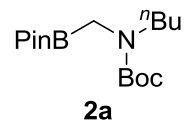
^1H NMR (500 MHz, CDCl_3) Spectrum of **1f**



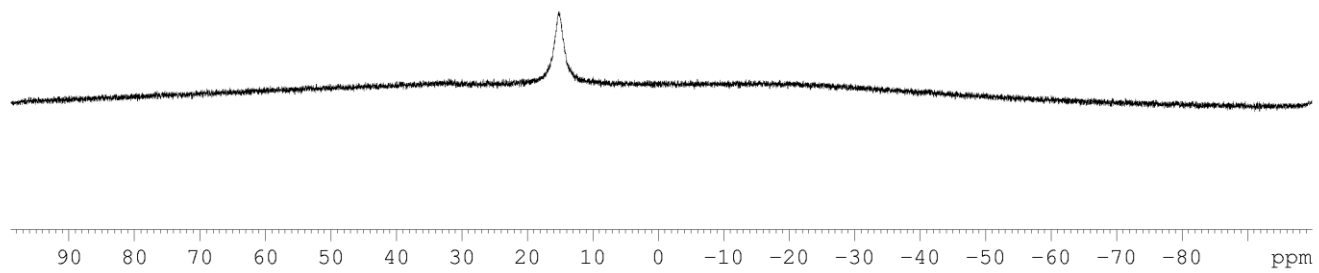
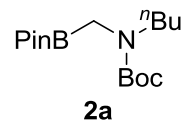
^{13}C NMR (125.8 MHz, CDCl_3) Spectrum of **1f**



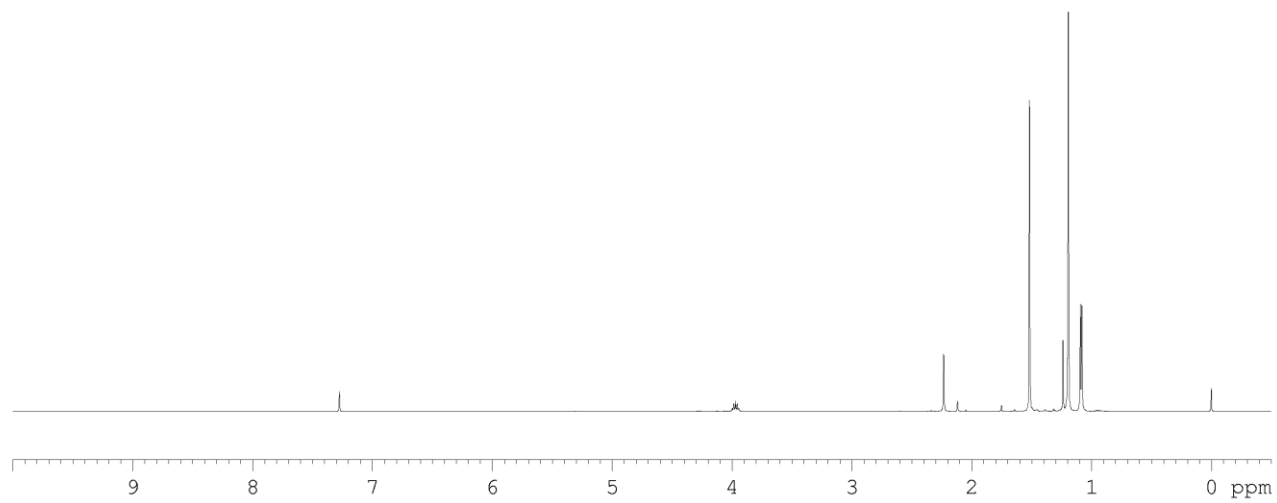
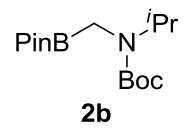
^1H NMR (500 MHz, CDCl_3) Spectrum of **2a**



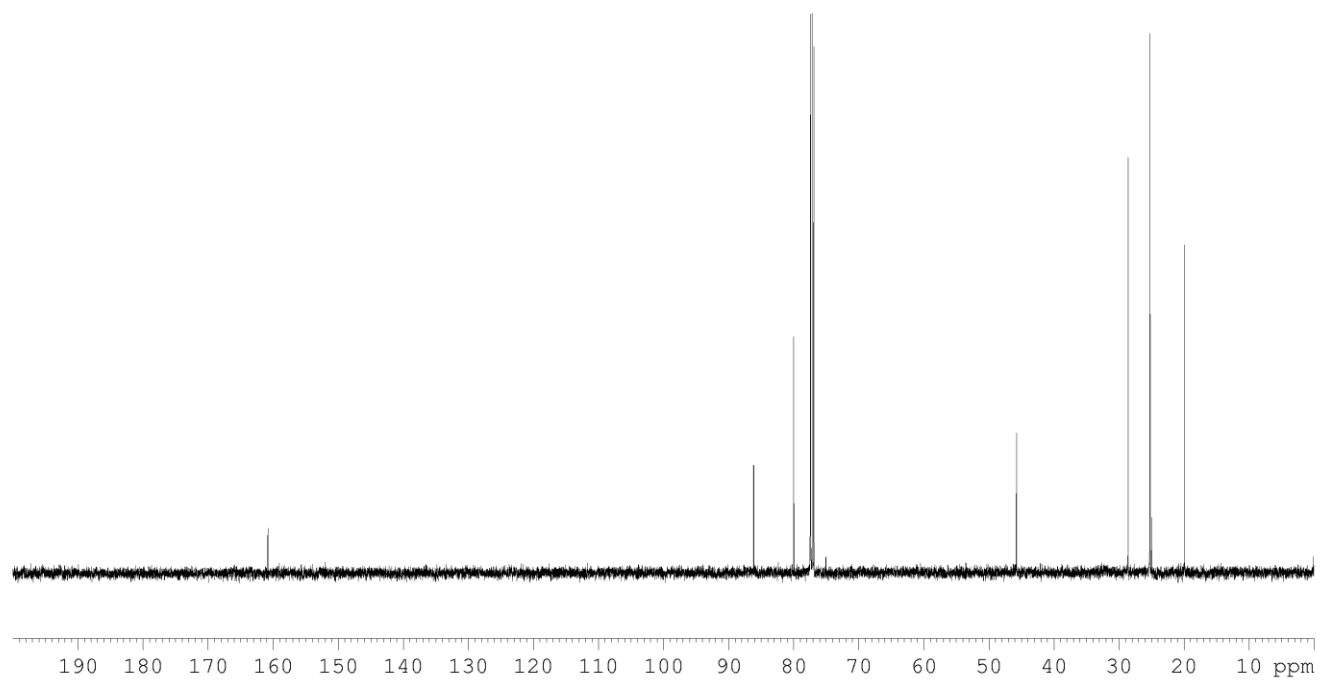
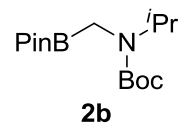
^{13}C NMR (125.8 MHz, CDCl_3) Spectrum of **2a**



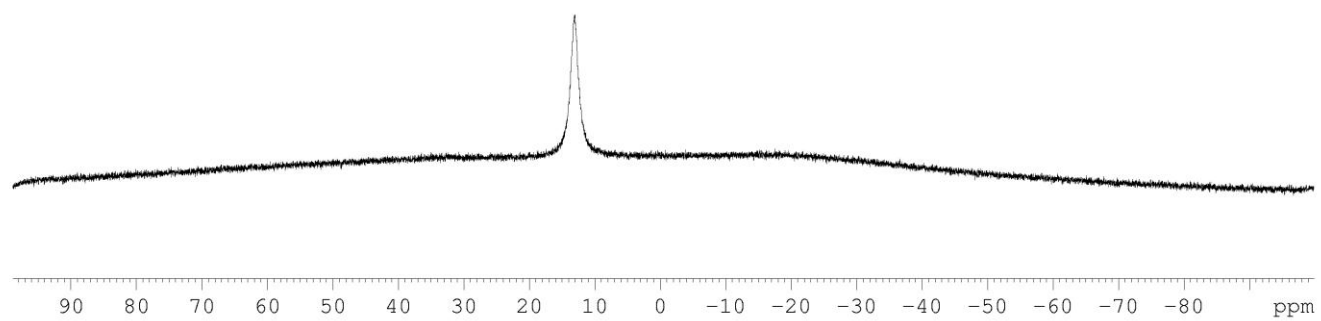
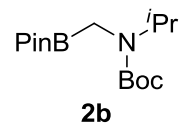
^{11}B NMR (128.4 MHz, CDCl_3) Spectrum of **2a**



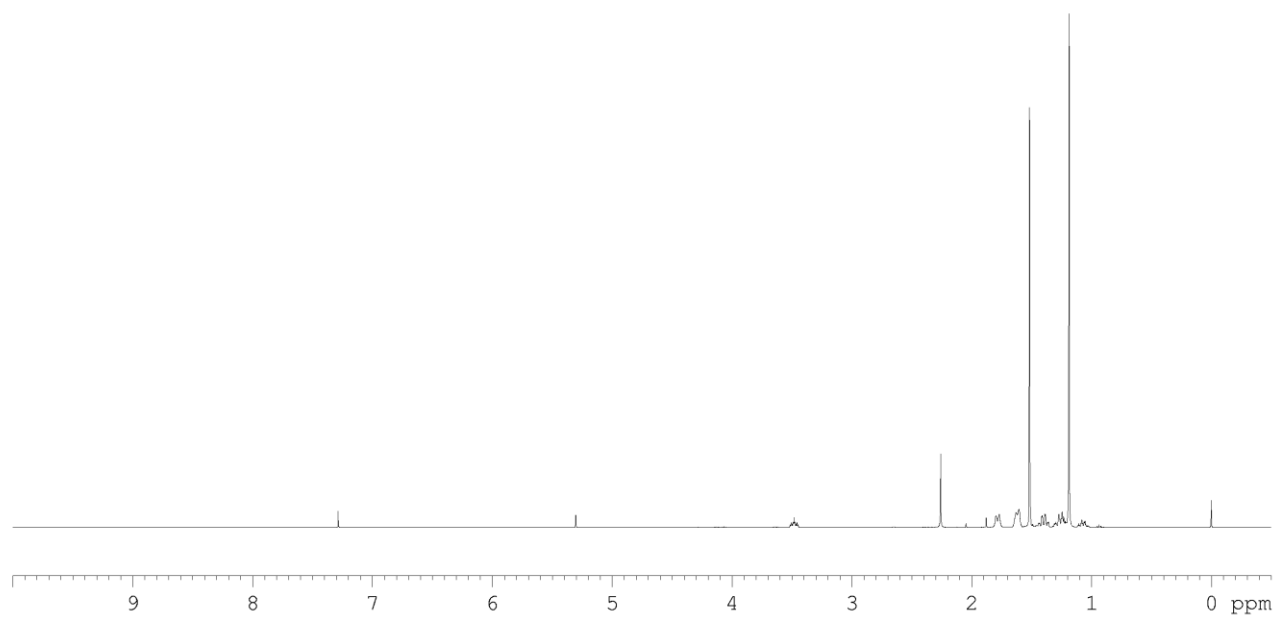
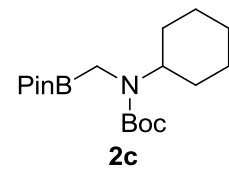
¹H NMR (500 MHz, CDCl₃) Spectrum of **2b**



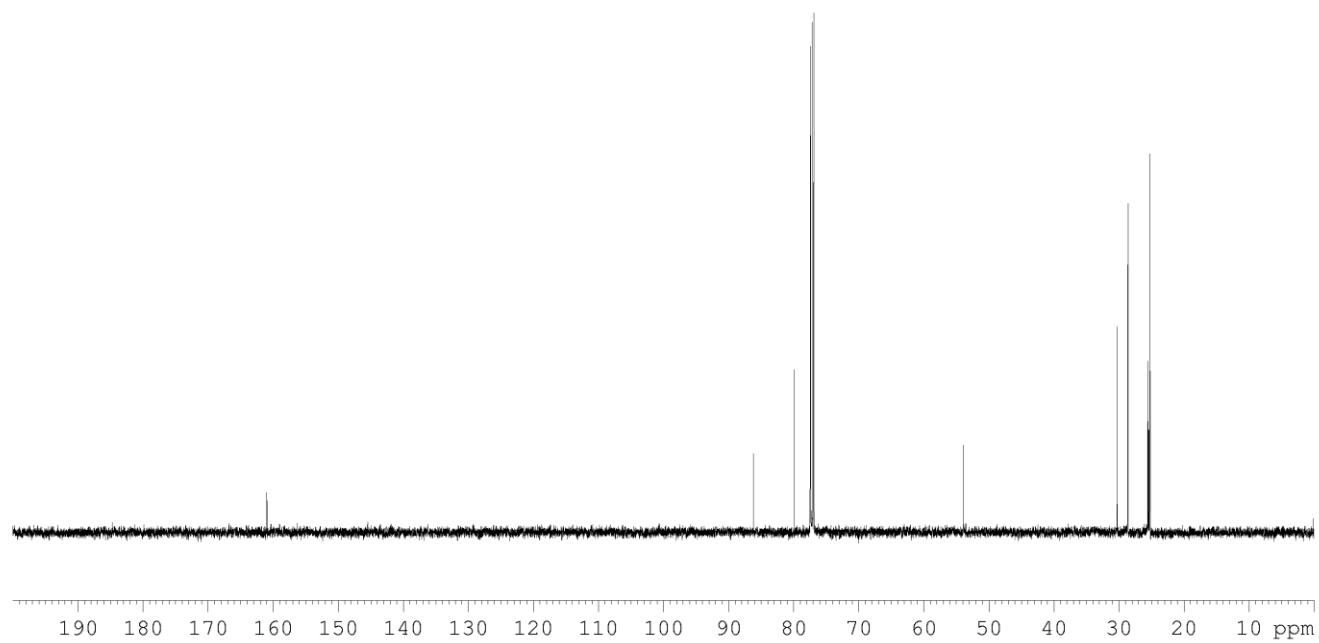
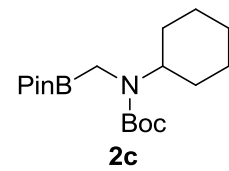
^{13}C NMR (125.8 MHz, CDCl_3) Spectrum of **2b**



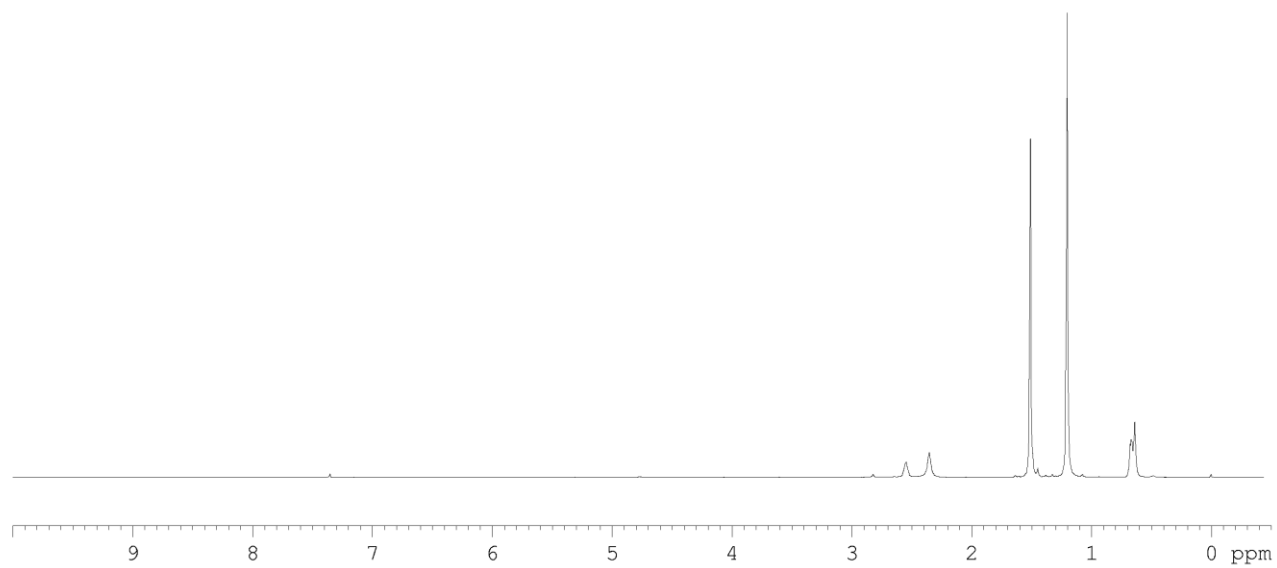
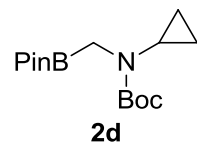
^{11}B NMR (128.4 MHz, CDCl_3) Spectrum of **2b**



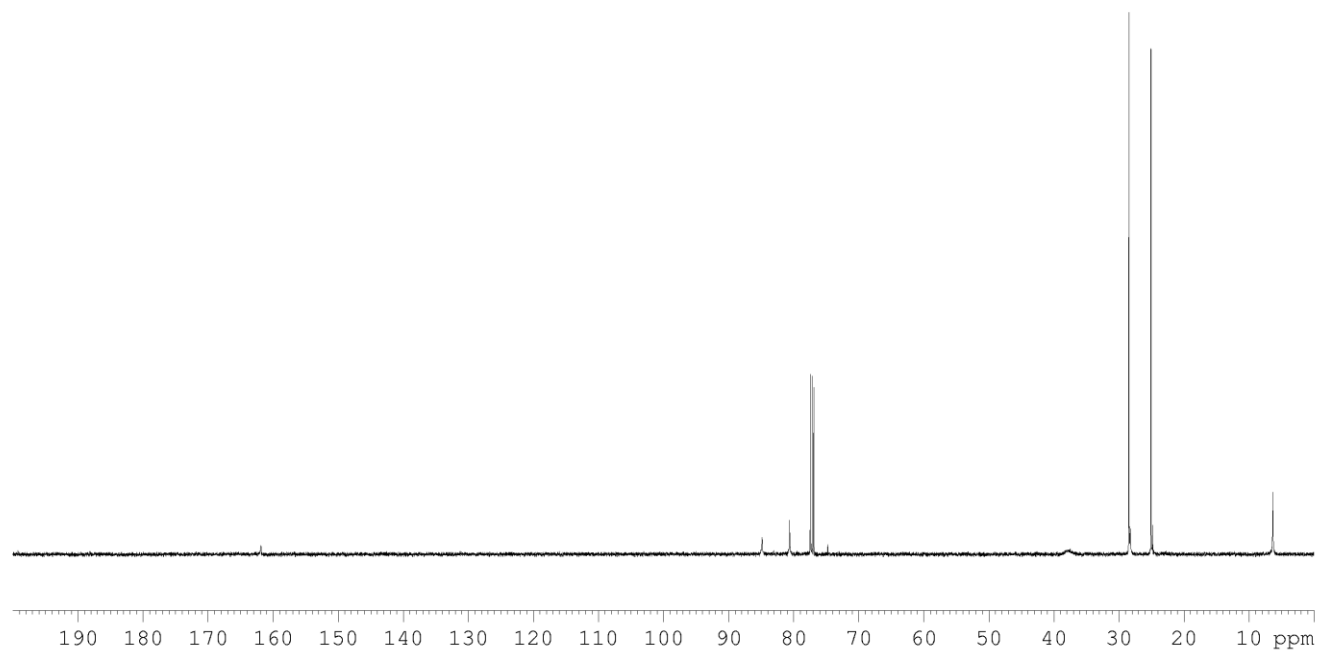
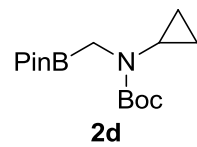
^1H NMR (500 MHz, CDCl_3) Spectrum of **2c**
S45



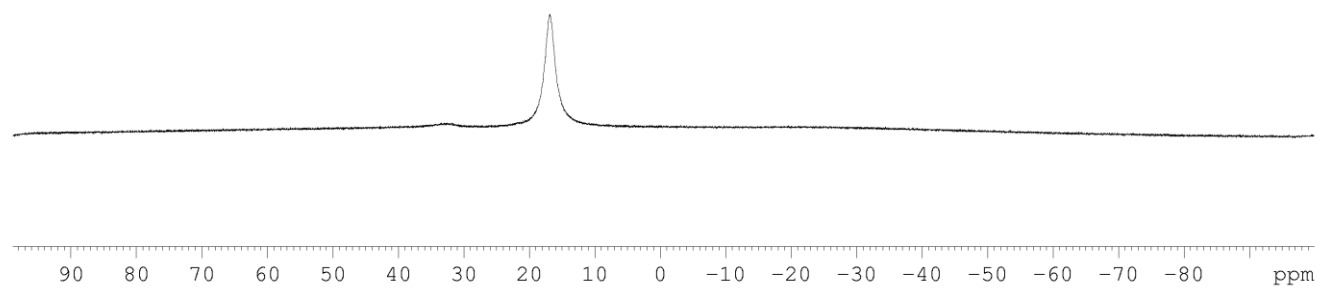
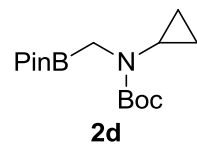
^{13}C NMR (125.8 MHz, CDCl_3) Spectrum of **2c**
S46



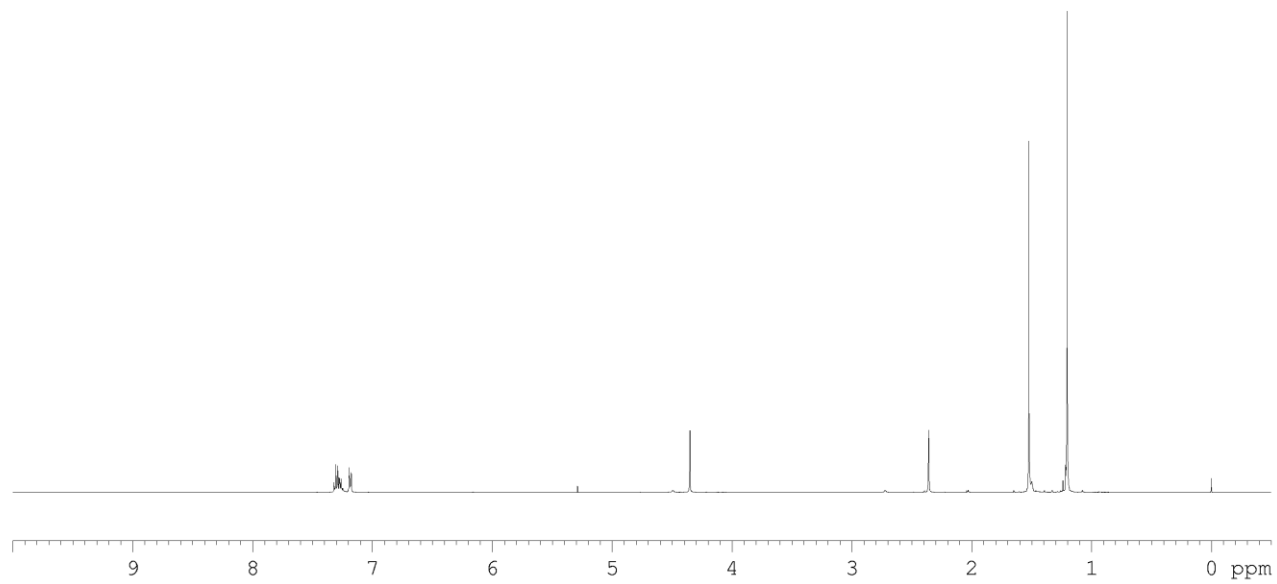
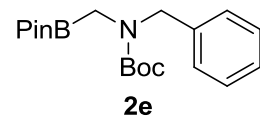
^1H NMR (500 MHz, CDCl_3) Spectrum of **2d**



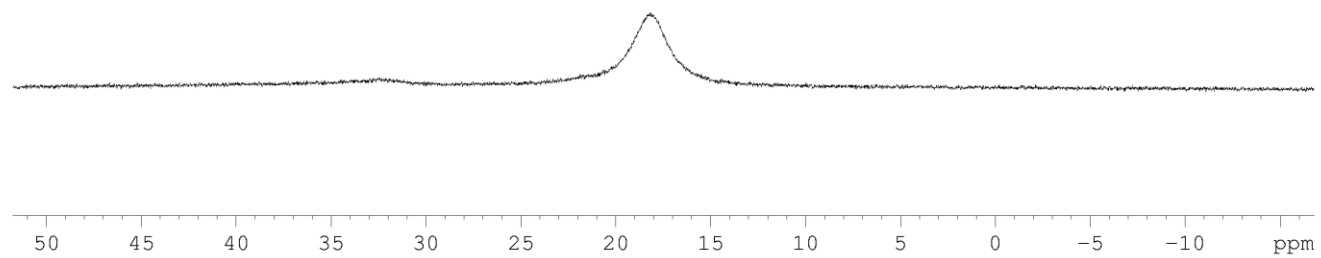
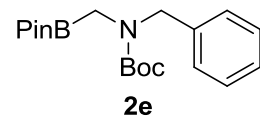
^{13}C NMR (125.8 MHz, CDCl_3) Spectrum of **2d**



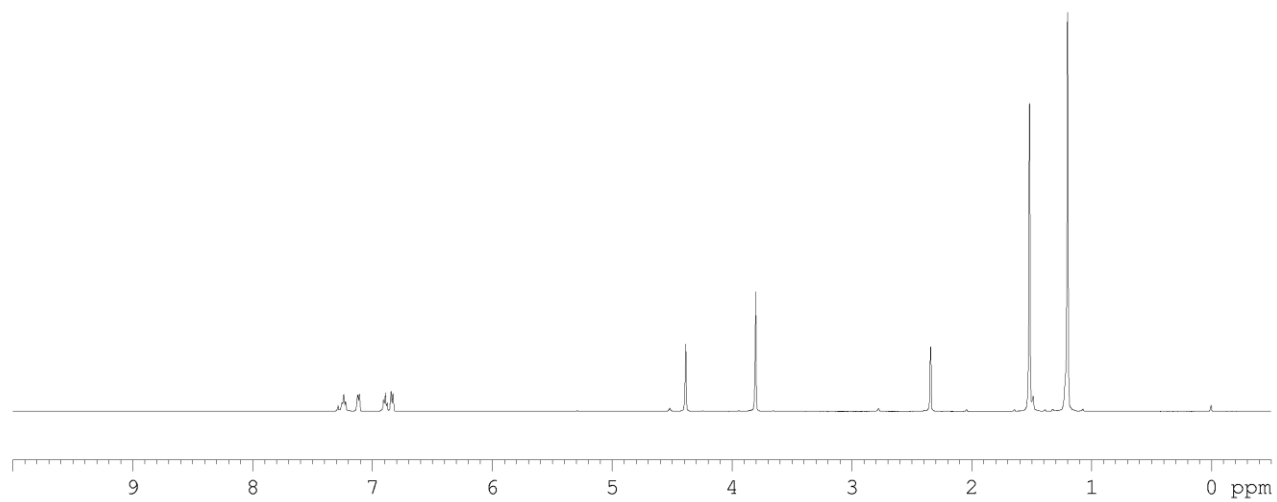
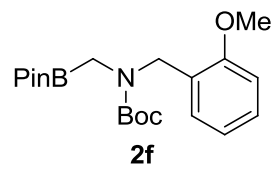
^{11}B NMR (128.4 MHz, CDCl_3) Spectrum of **2d**



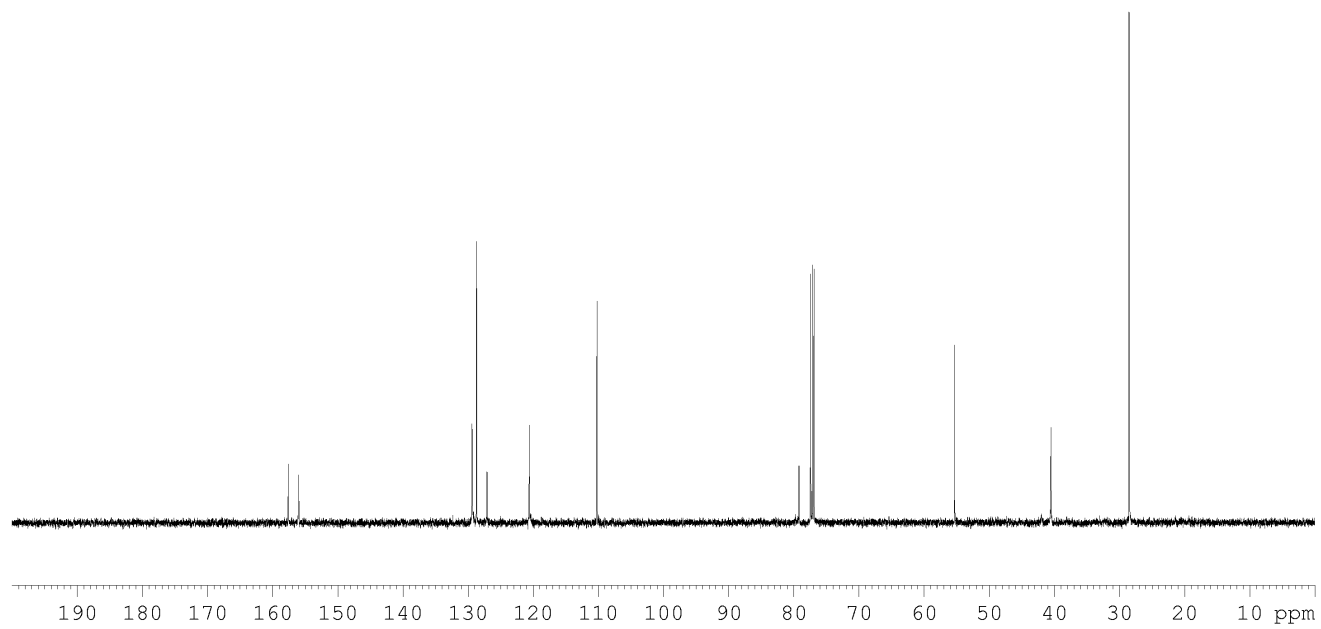
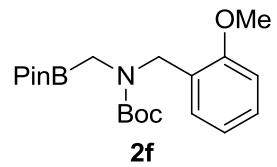
¹H NMR (500 MHz, CDCl₃) Spectrum of **2e**



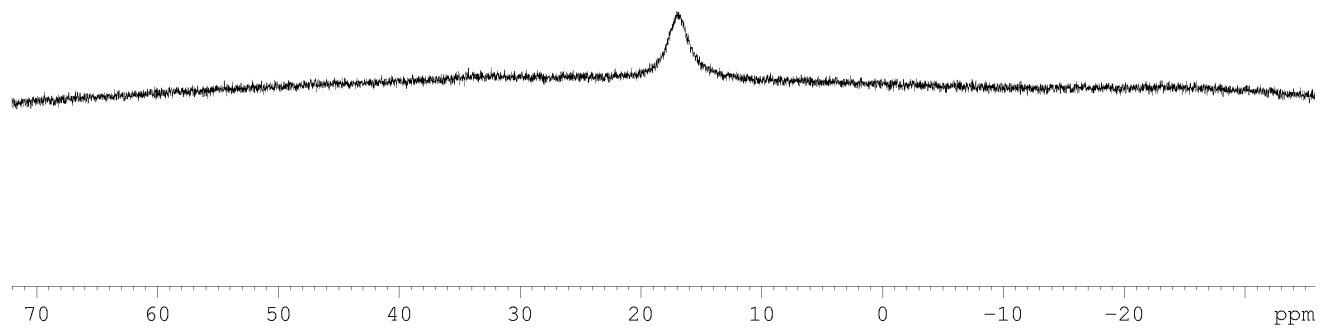
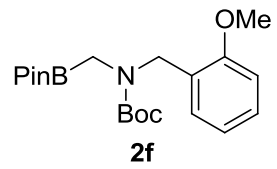
^{11}B NMR (128.4 MHz, CDCl_3) Spectrum of **2e**



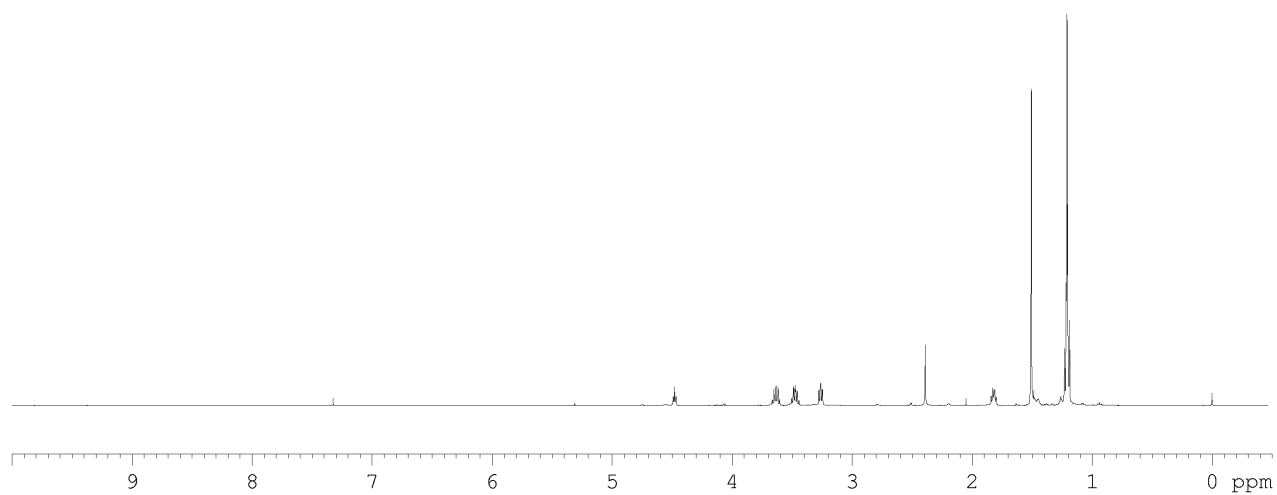
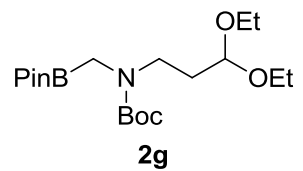
^1H NMR (500 MHz, CDCl_3) Spectrum of **2f**



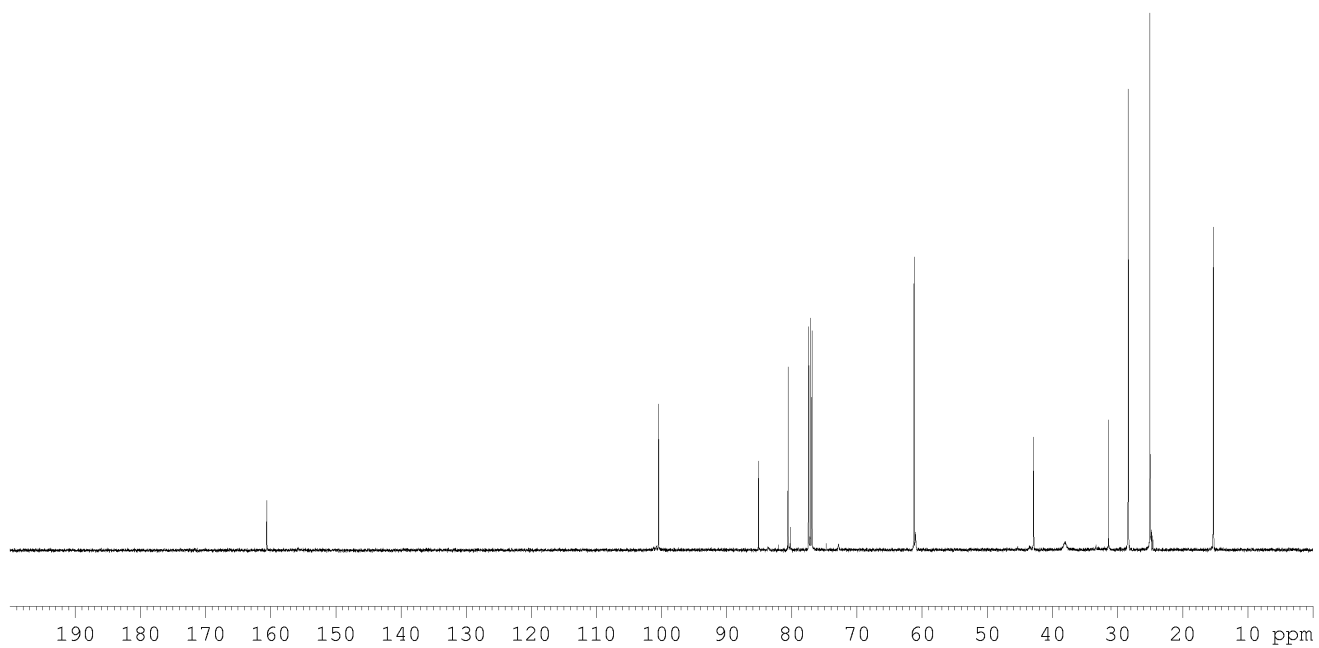
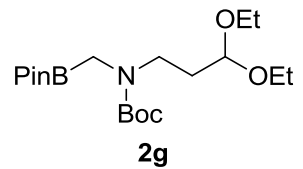
^{13}C NMR (125.8 MHz, CDCl_3) Spectrum of **2f**
S55



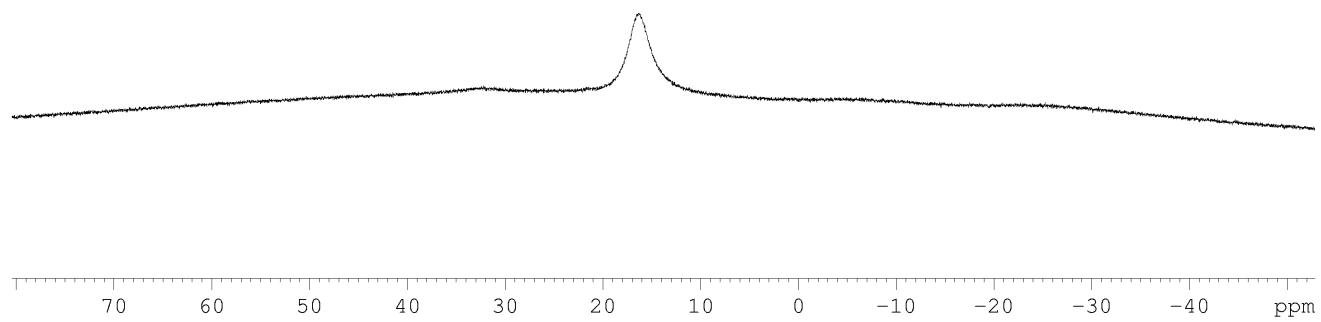
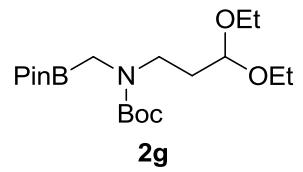
^{11}B NMR (128.4 MHz, CDCl_3) Spectrum of **2f**
S56



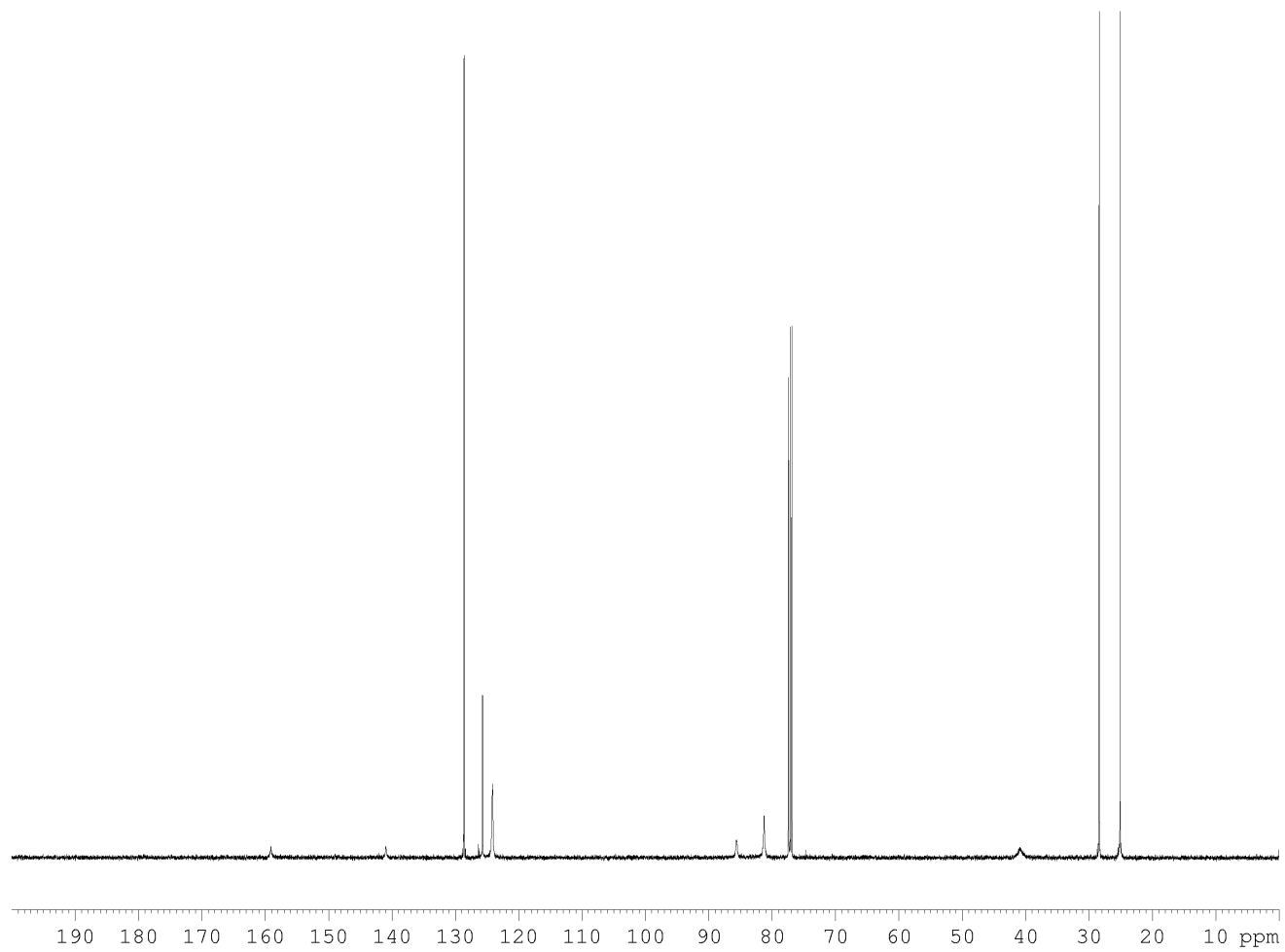
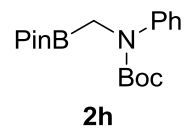
¹H NMR (500 MHz, CDCl₃) Spectrum of **2g**
S57



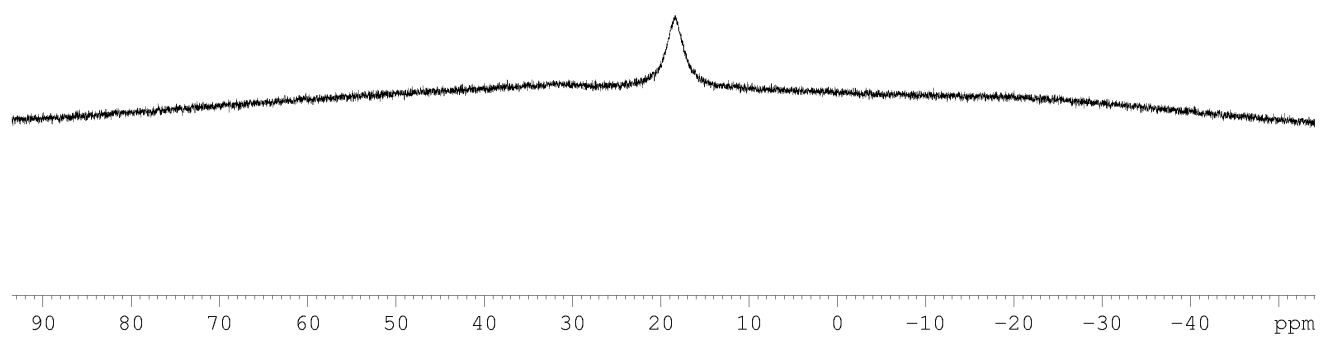
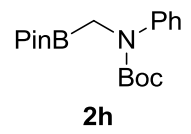
^{13}C NMR (125.8 MHz, CDCl_3) Spectrum of **2g**
S58



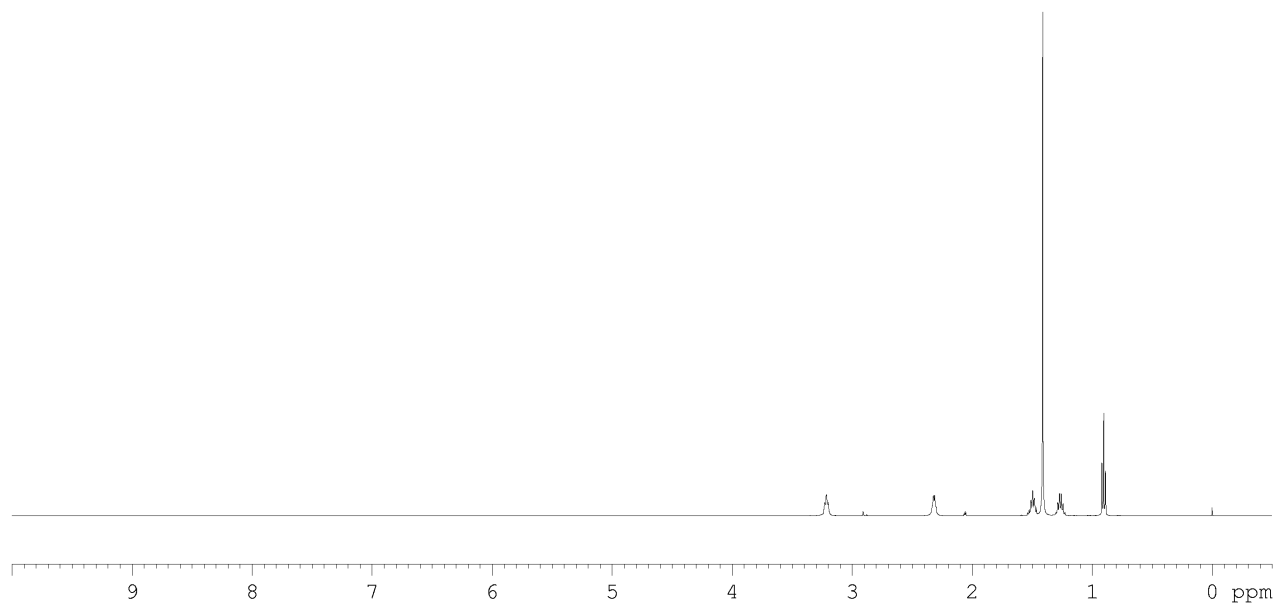
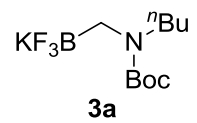
^{11}B NMR (128.4 MHz, CDCl_3) Spectrum of **2g**
S59



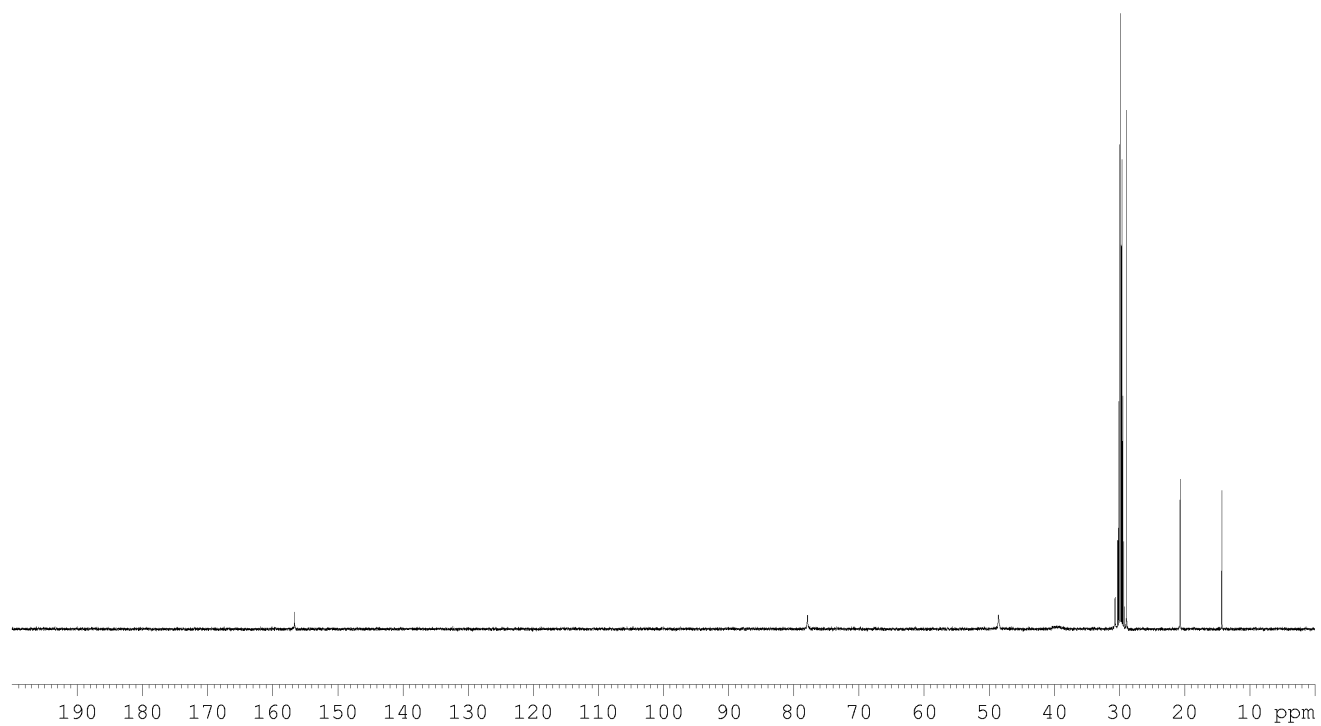
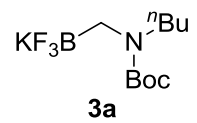
^{13}C NMR (125.8 MHz, CDCl_3) Spectrum of **2h**



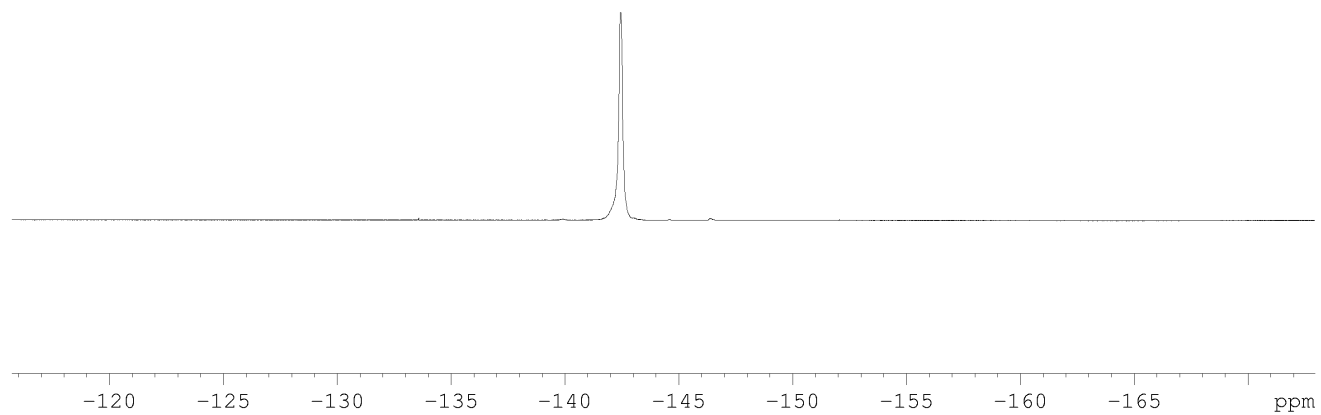
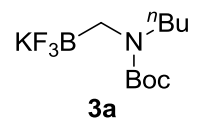
^{11}B NMR (128.4 MHz, CDCl_3) Spectrum of **2h**



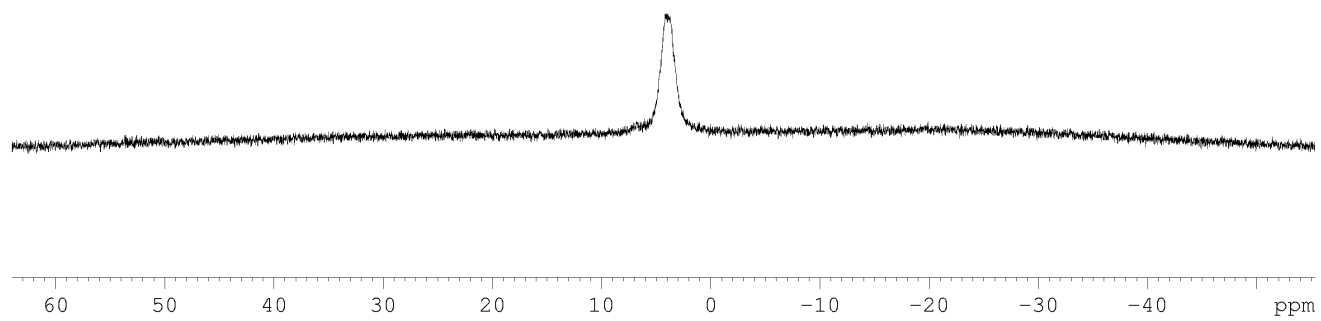
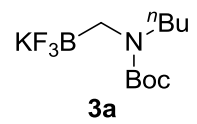
¹H NMR (500 MHz, acetone-*d*₆) Spectrum of **3a**



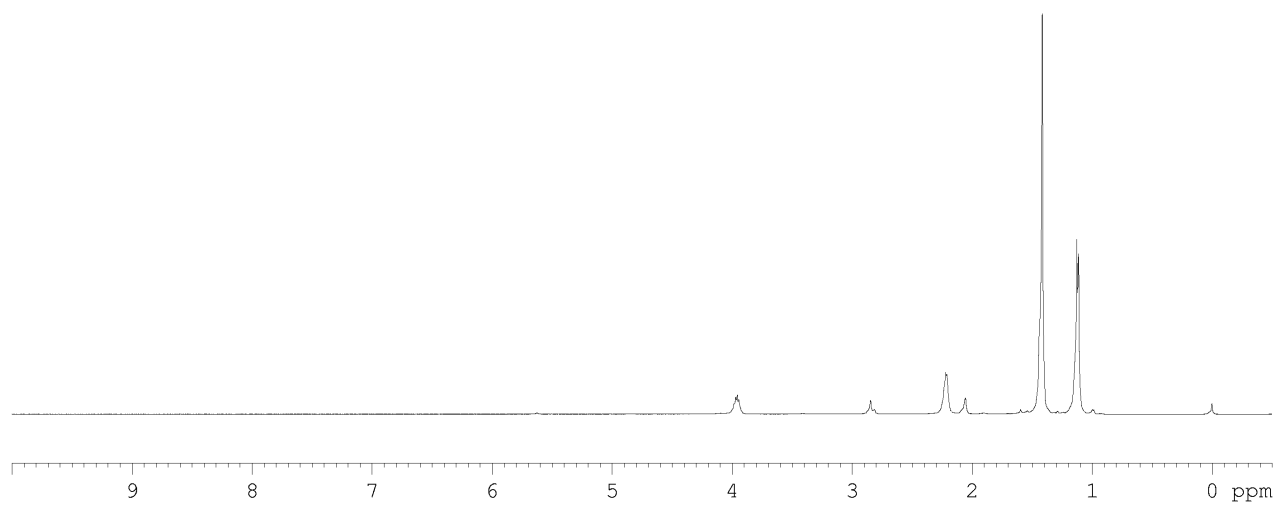
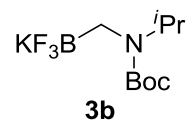
^{13}C NMR (125.8 MHz, acetone- d_6) Spectrum of **3a**



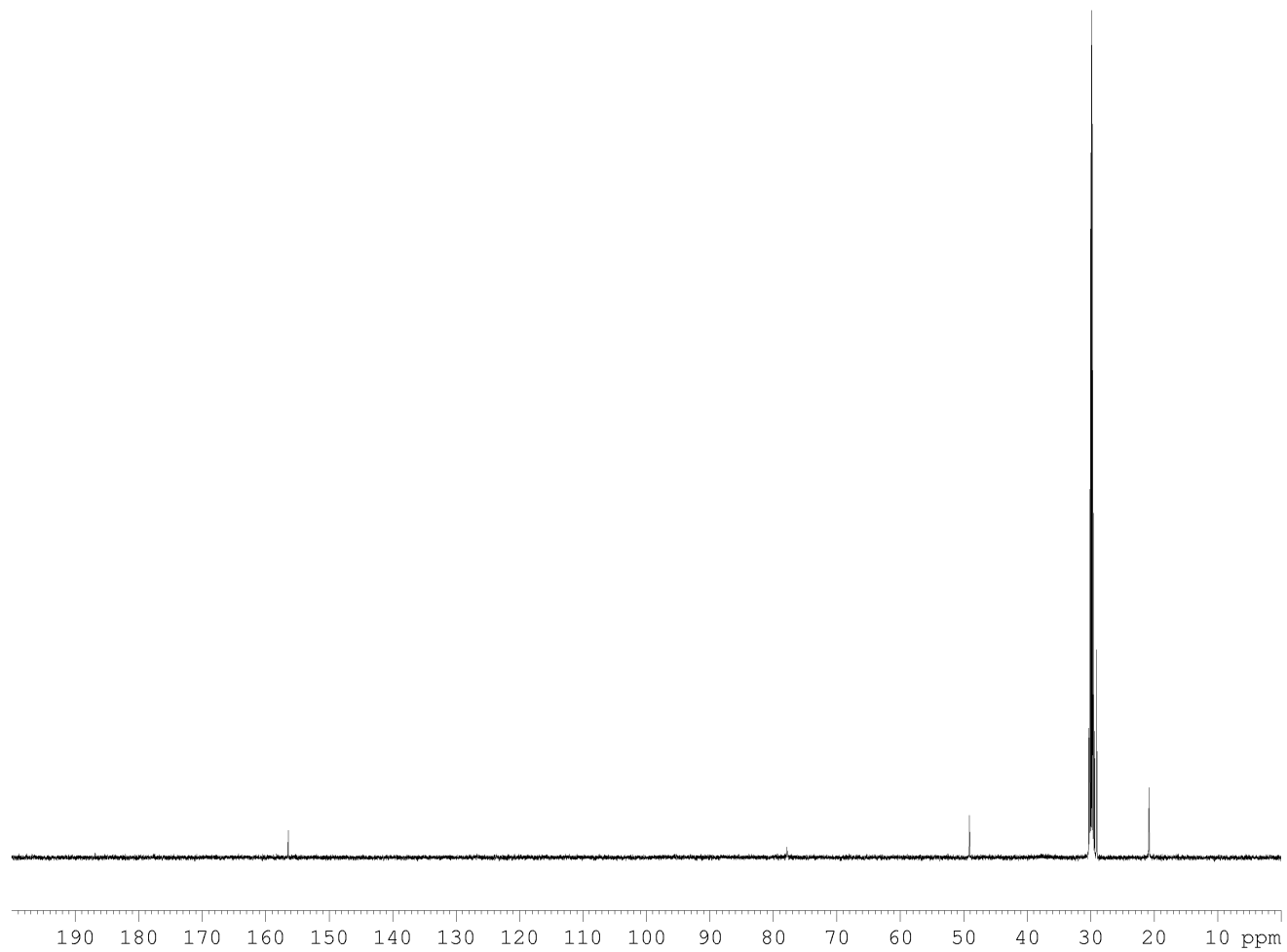
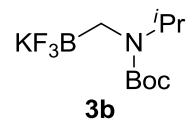
^{19}F NMR (470.8 MHz, acetone- d_6) Spectrum of **3a**



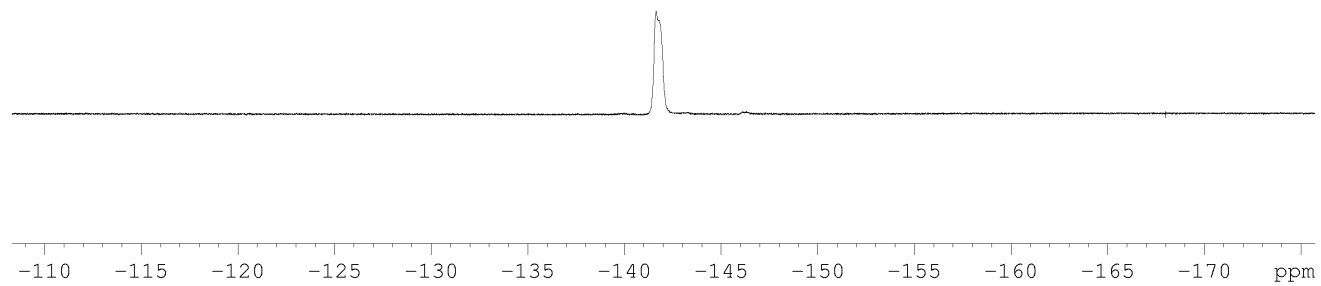
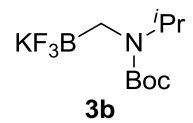
^{11}B NMR (128.4 MHz, acetone- d_6) Spectrum of **3a**



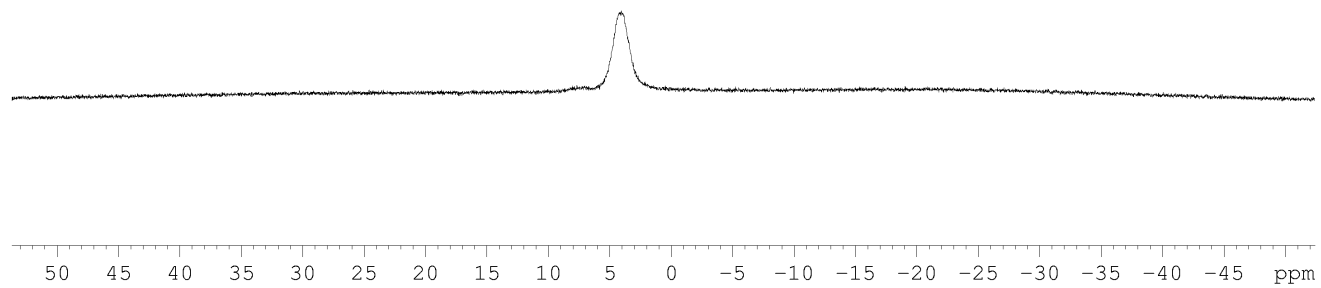
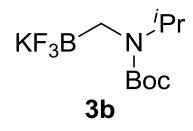
^1H NMR (500 MHz, acetone- d_6) Spectrum of **3b**



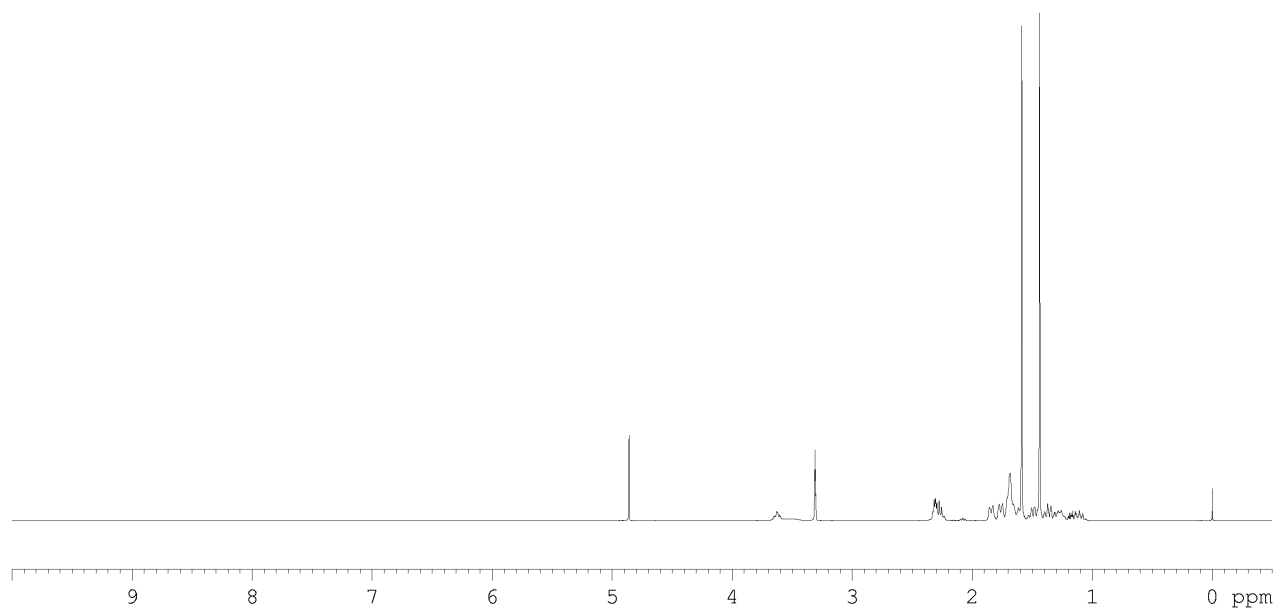
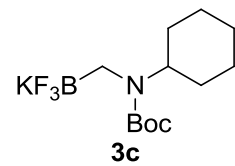
^{13}C NMR (125.8 MHz, acetone- d_6) Spectrum of **3b**



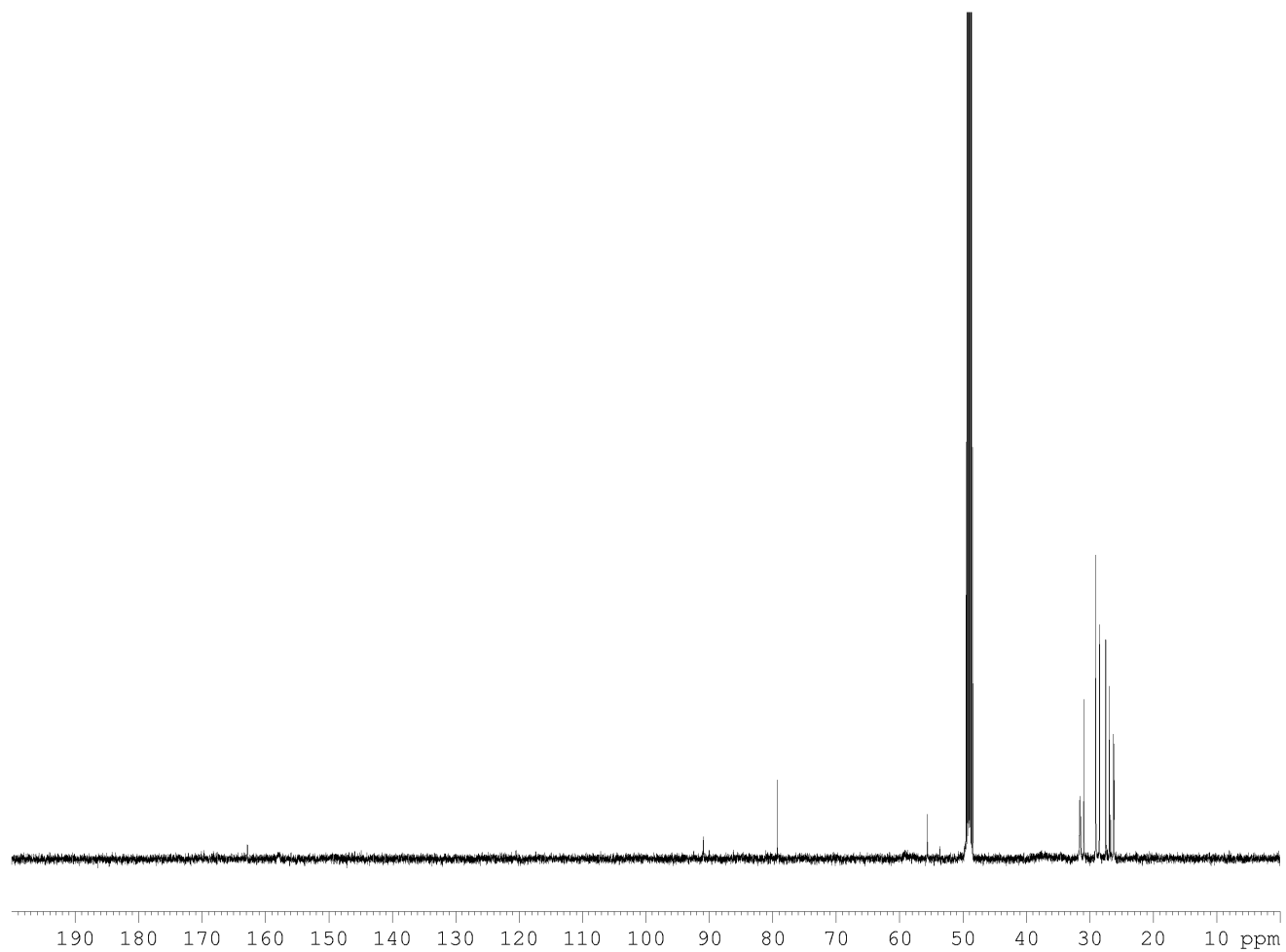
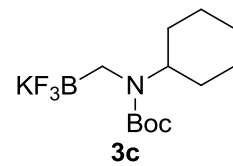
^{19}F NMR (470.8 MHz, acetone- d_6) Spectrum of **3b**



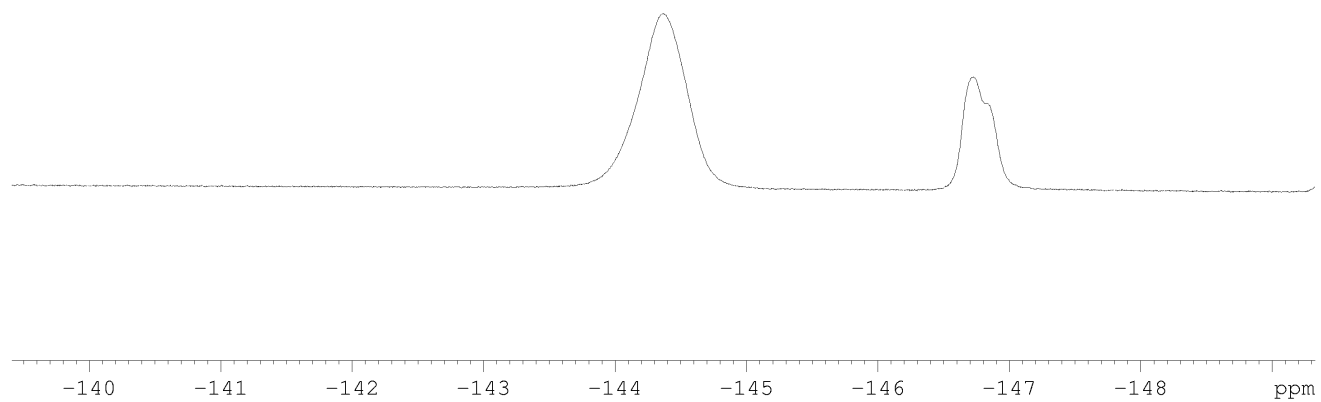
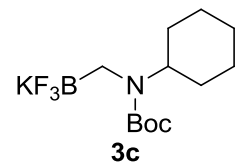
^{11}B NMR (128.4 MHz, acetone- d_6) Spectrum of **3b**



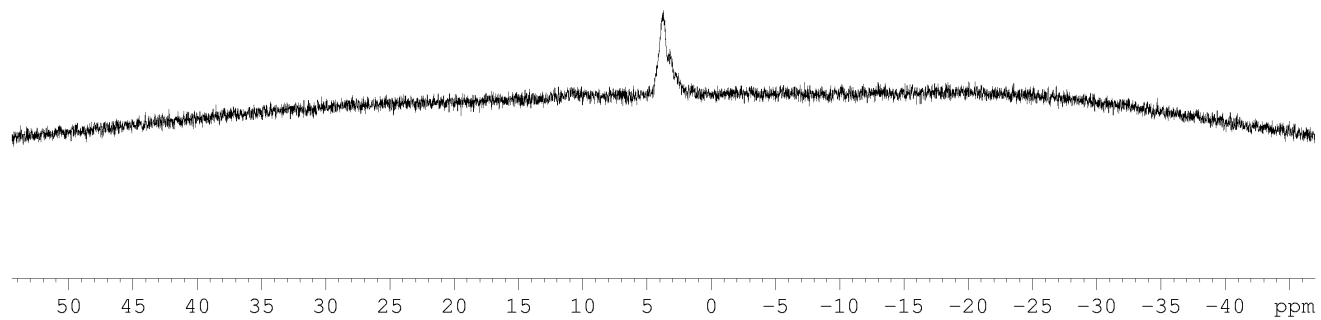
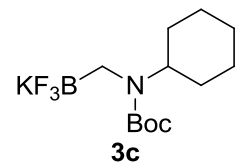
¹H NMR (500 MHz, MeOD) Spectrum of **3c**
S71



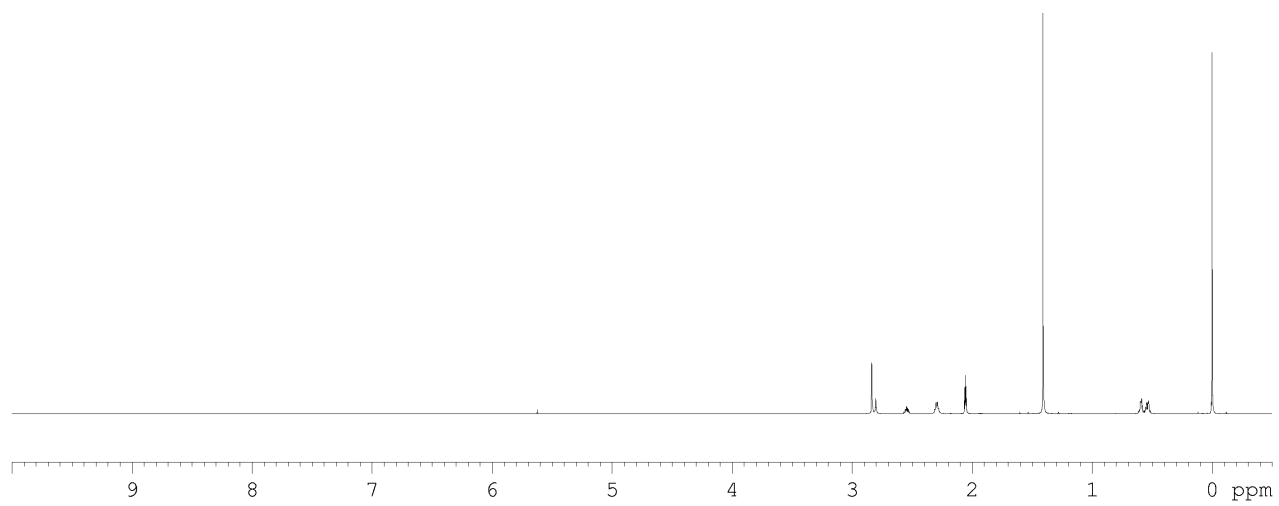
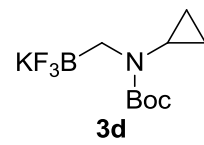
^{13}C NMR (125.8 MHz, $\text{DMSO-}d_6$) Spectrum of **3c**
S72



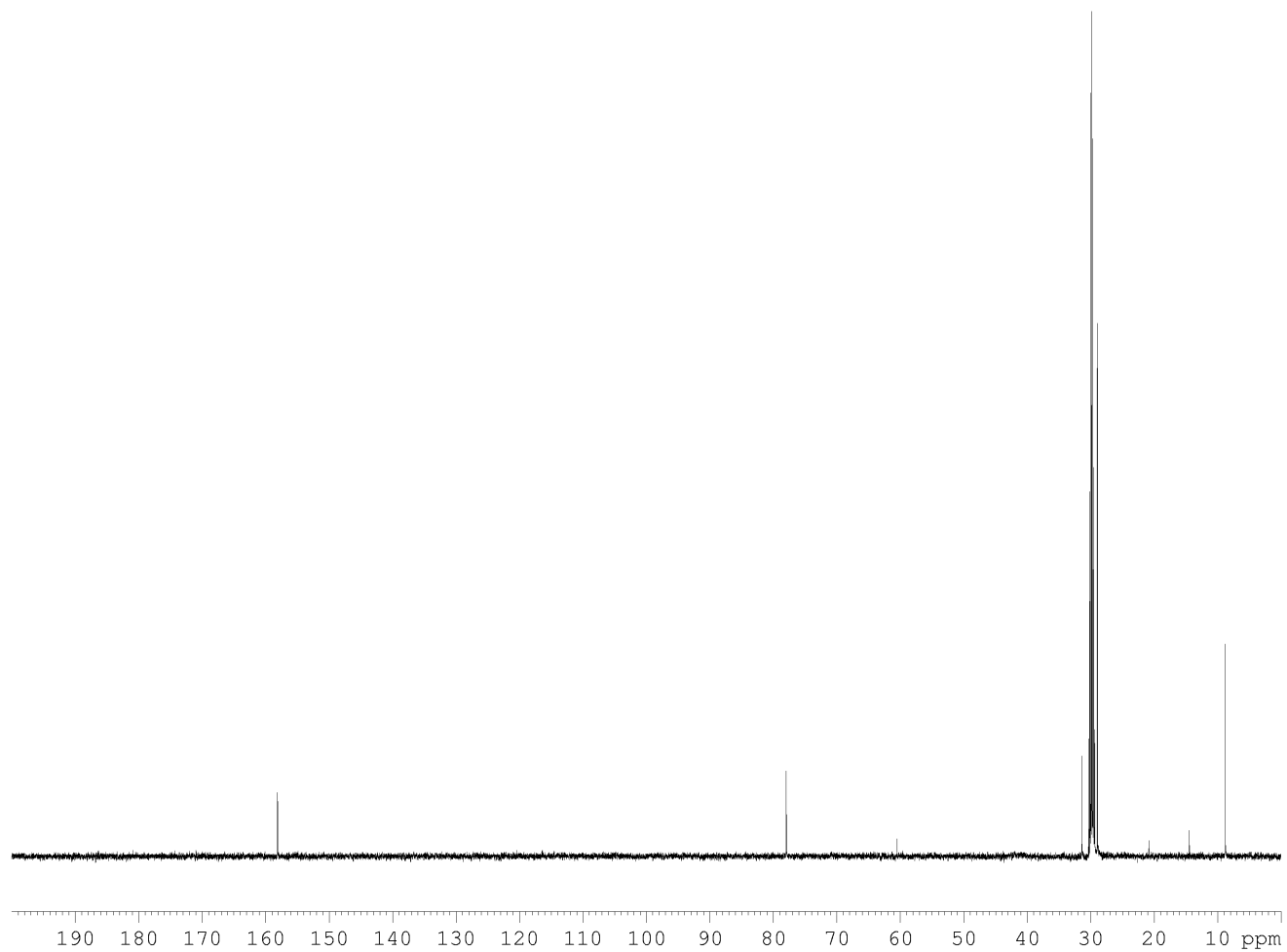
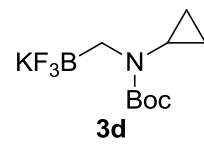
^{19}F NMR (470.8 MHz, acetone- d_6) Spectrum of **3c**
S73



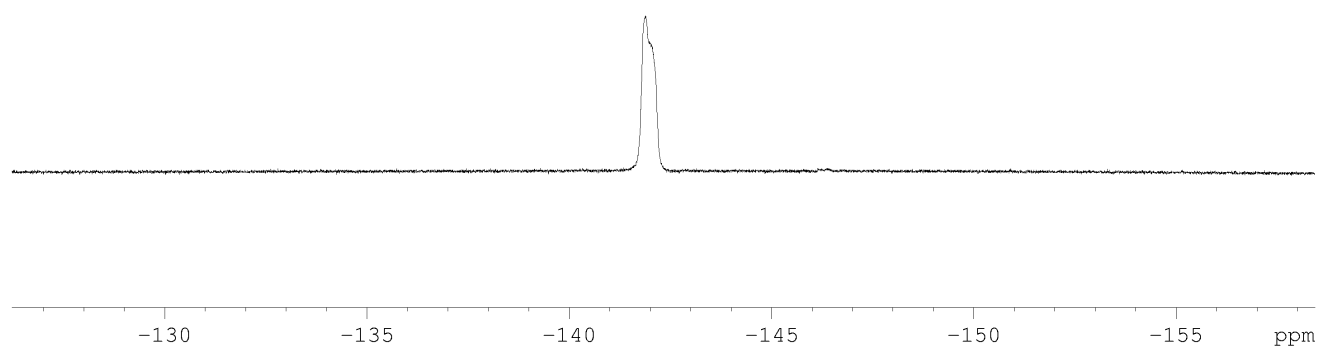
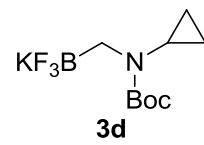
^{11}B NMR (128.4 MHz, MeOD) Spectrum of **3c**



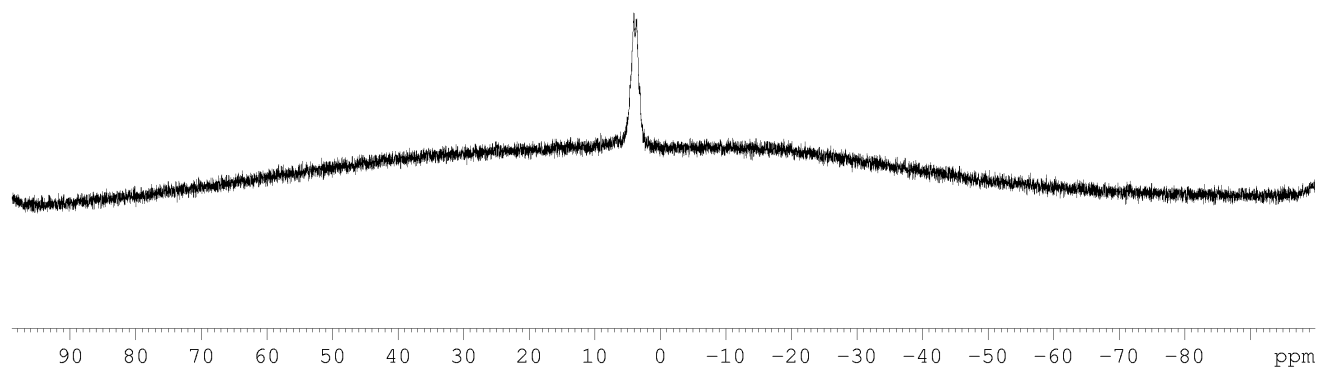
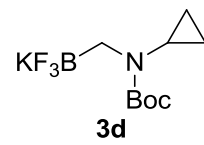
^1H NMR (500 MHz, acetone- d_6) Spectrum of **3d**



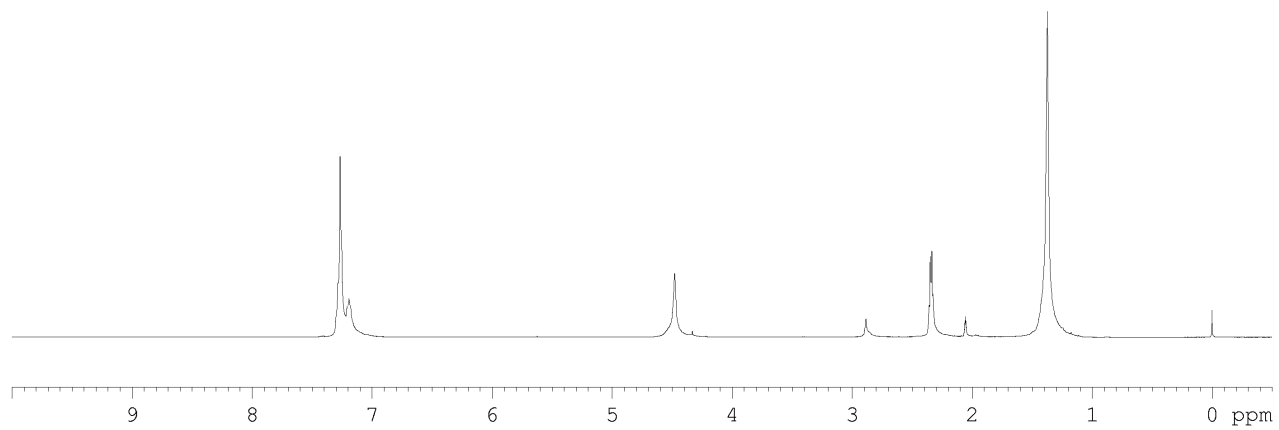
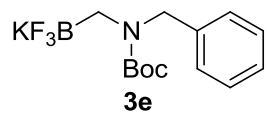
^{13}C NMR (125.8 MHz, acetone- d_6) Spectrum of **3d**



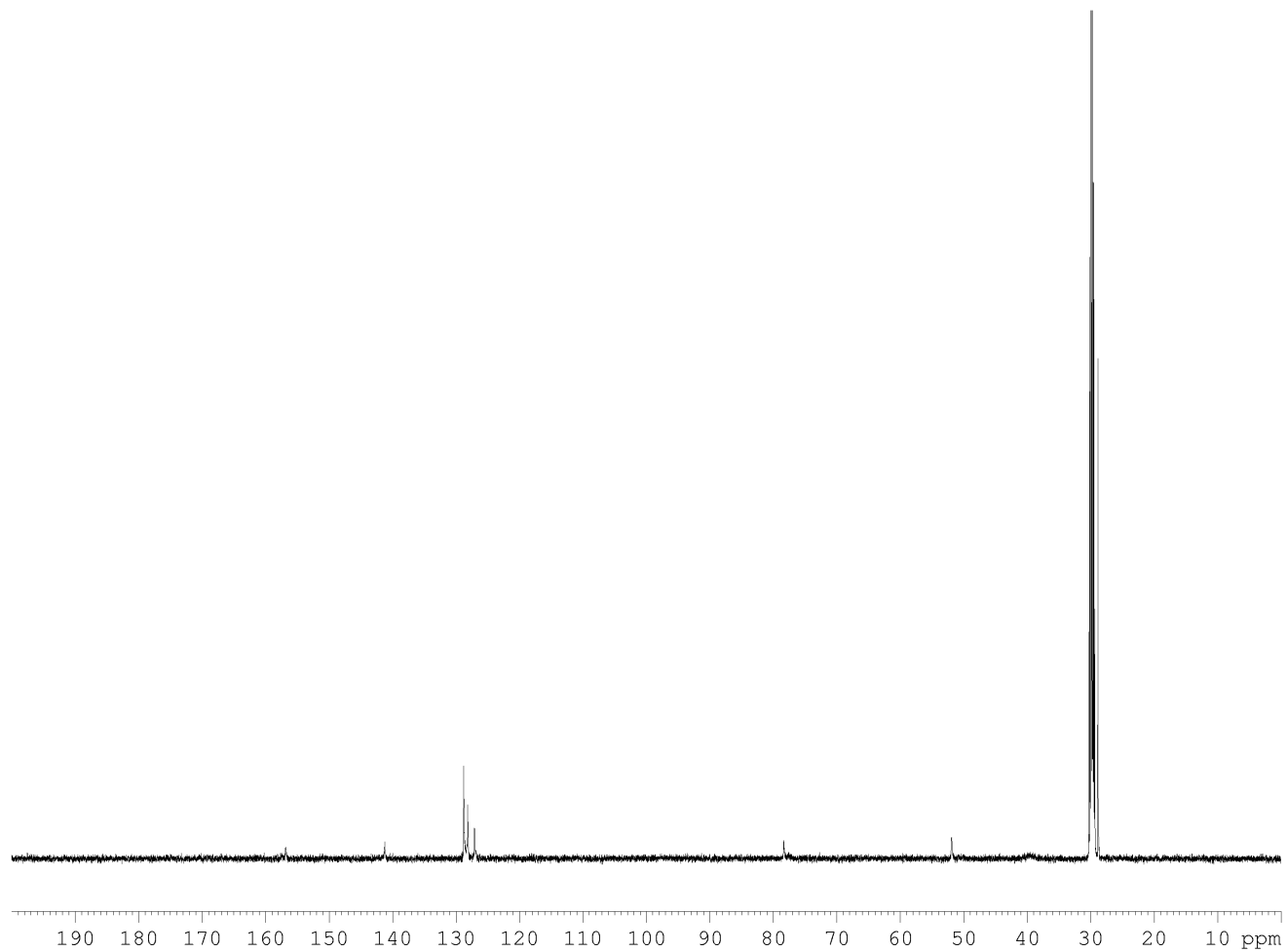
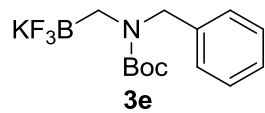
^{19}F NMR (470.8 MHz, acetone- d_6) Spectrum of **3d**



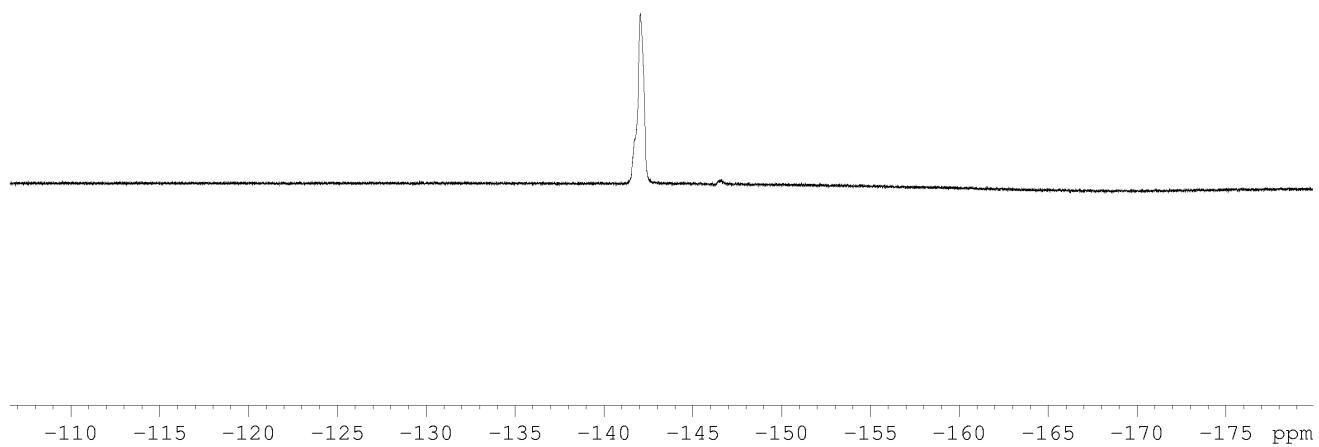
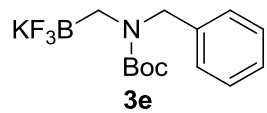
^{11}B NMR (128.4 MHz, acetone- d_6) Spectrum of **3d**



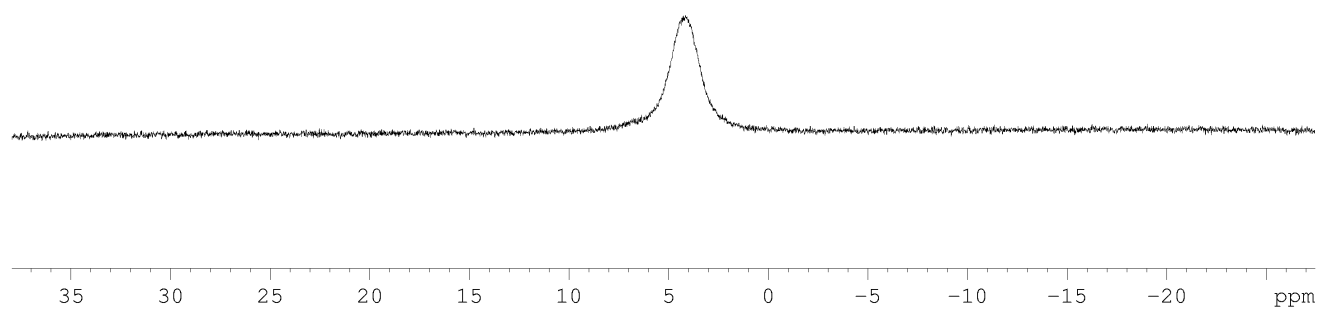
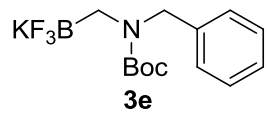
^1H NMR (500 MHz, acetone- d_6) Spectrum of **3e**



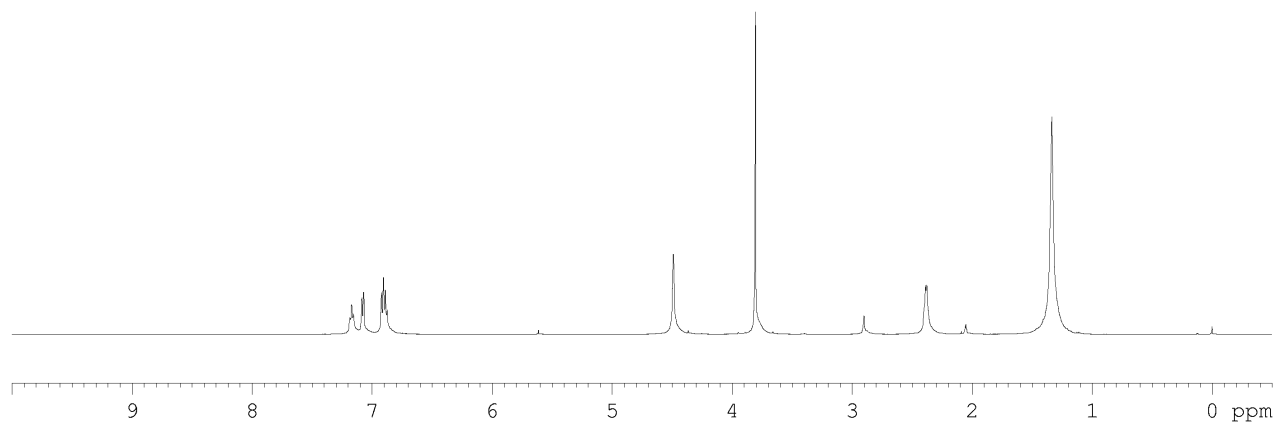
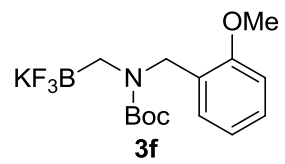
^{13}C NMR (125.8 MHz, acetone- d_6) Spectrum of **3e**



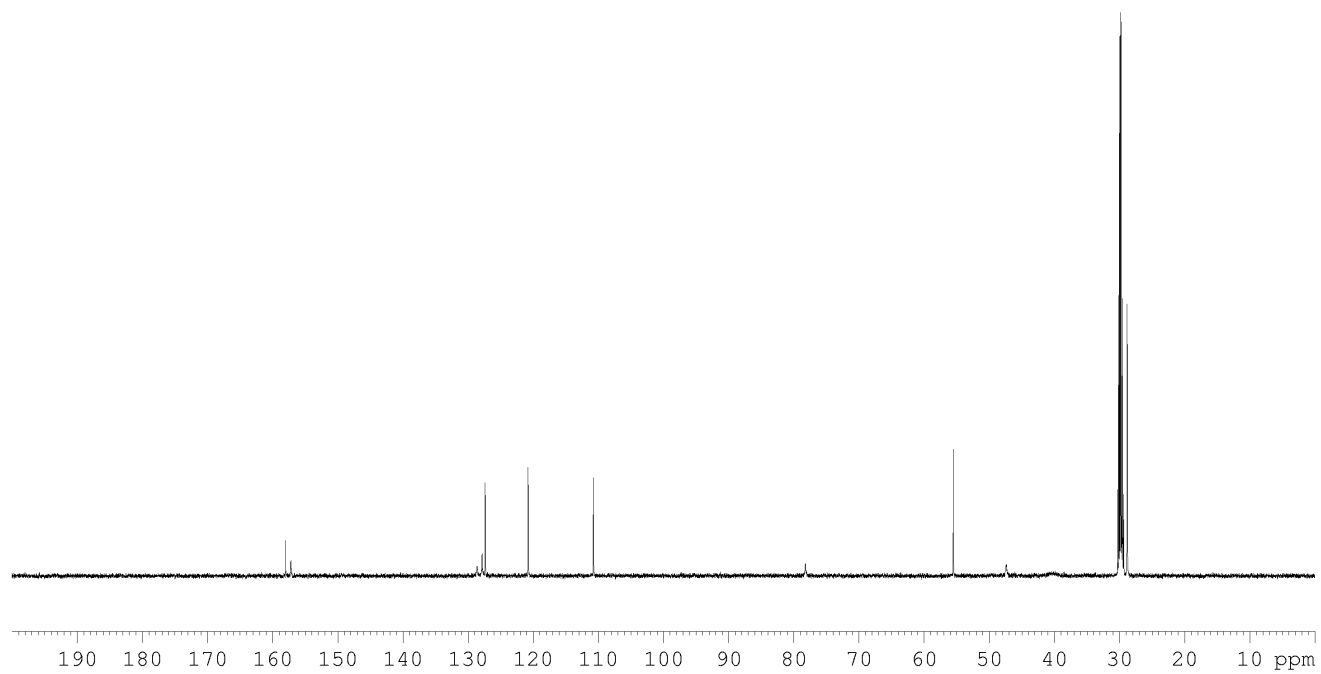
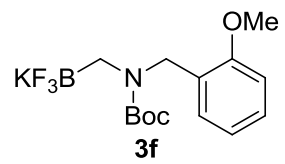
^{19}F NMR (470.8 MHz, acetone- d_6) Spectrum of **3e**



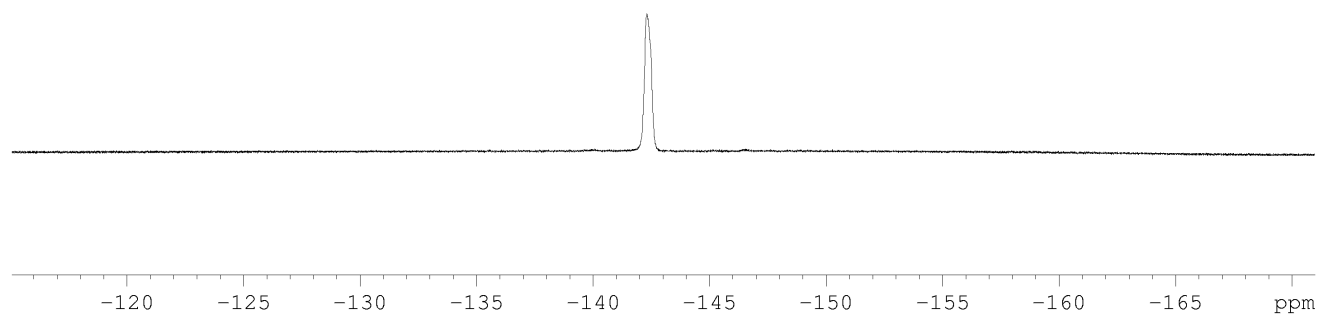
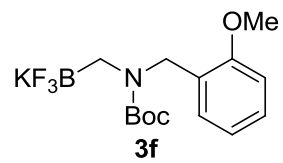
^{11}B NMR (128.4 MHz, acetone- d_6) Spectrum of **3e**



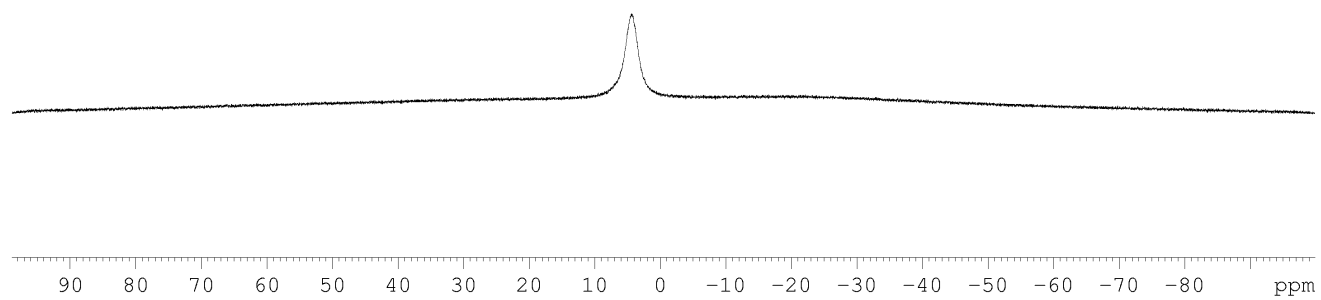
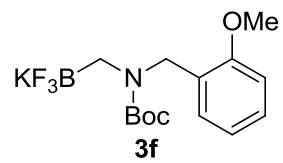
¹H NMR (500 MHz, acetone-*d*₆) Spectrum of **3f**



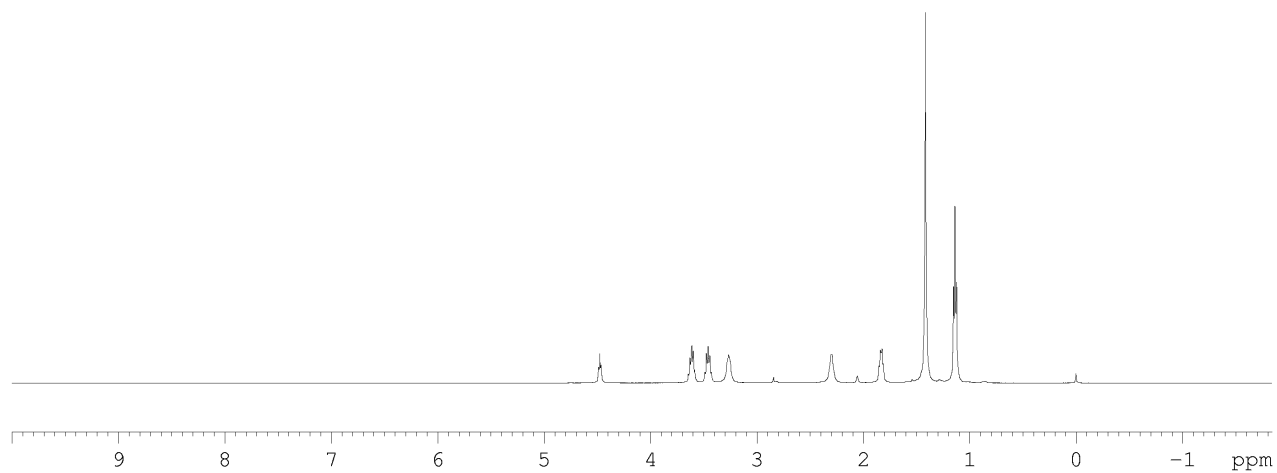
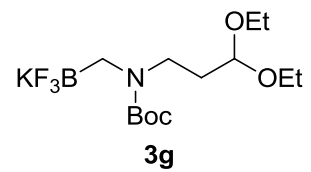
^{13}C NMR (125.8 MHz, acetone- d_6) Spectrum of **3f**



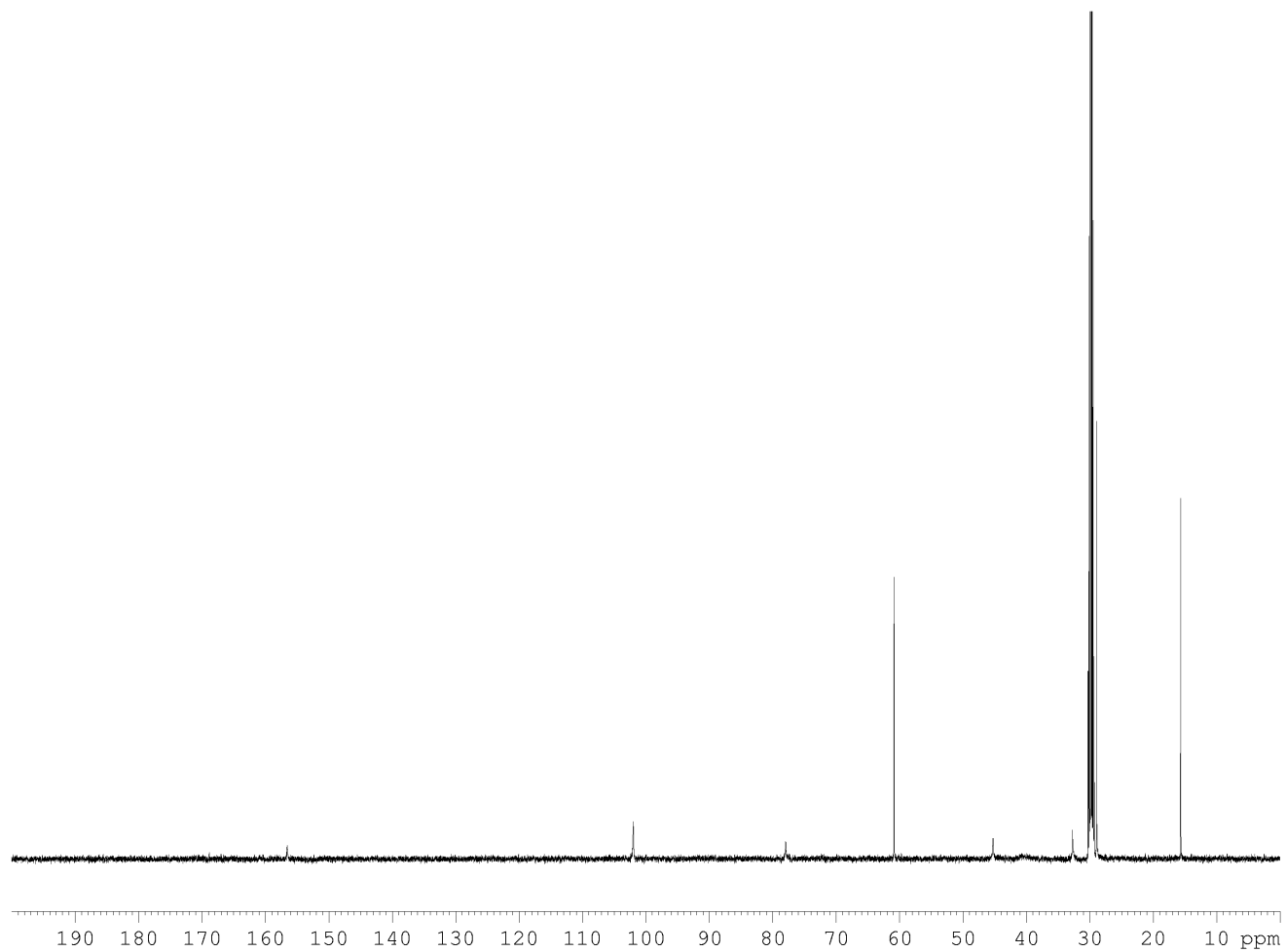
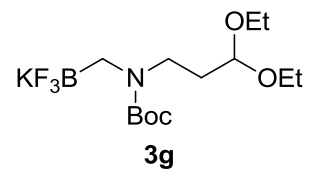
^{19}F NMR (470.8 MHz, acetone- d_6) Spectrum of **3f**



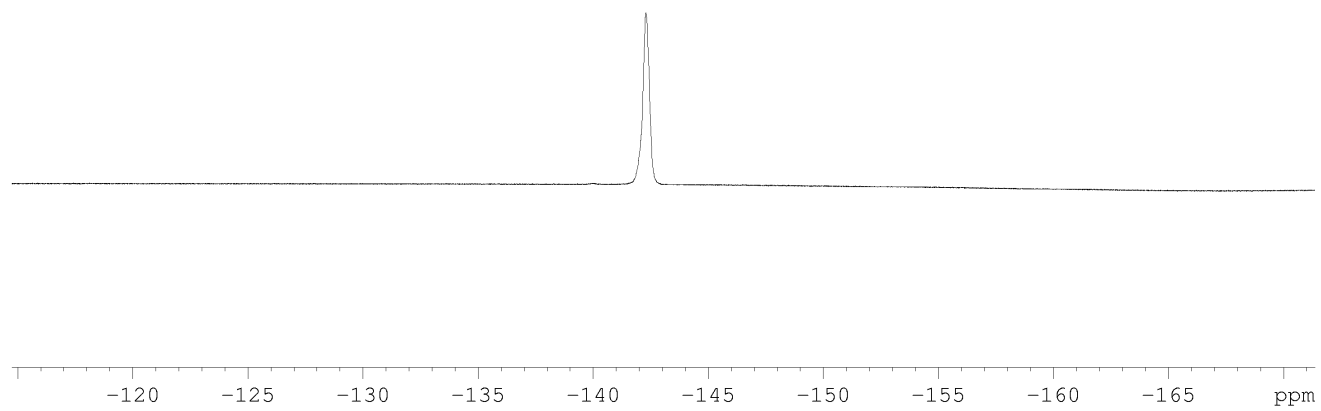
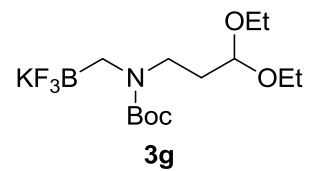
^{11}B NMR (128.4 MHz, acetone- d_6) Spectrum of **3f**



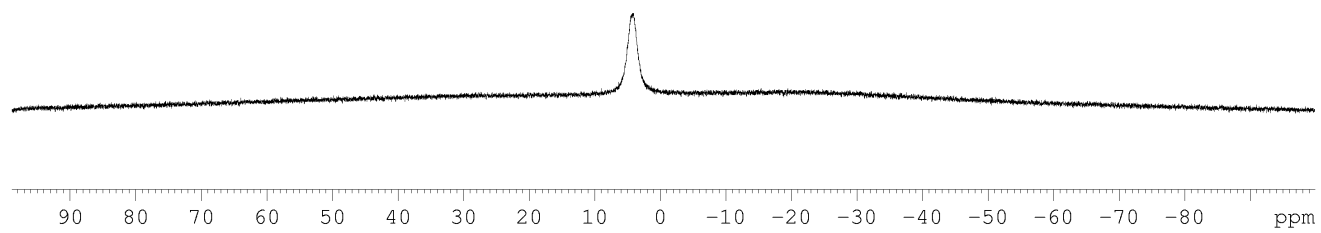
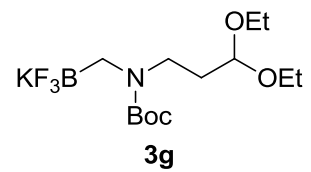
^1H NMR (500 MHz, acetone- d_6) Spectrum of **3g**
S87



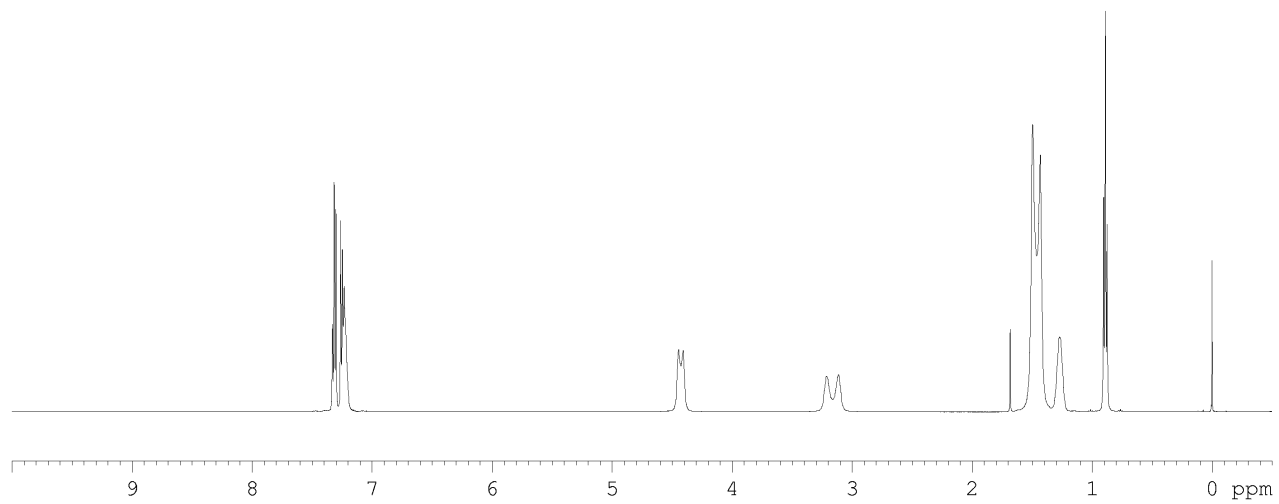
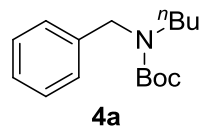
^{13}C NMR (125.8 MHz, acetone- d_6) Spectrum of **3g**
S88



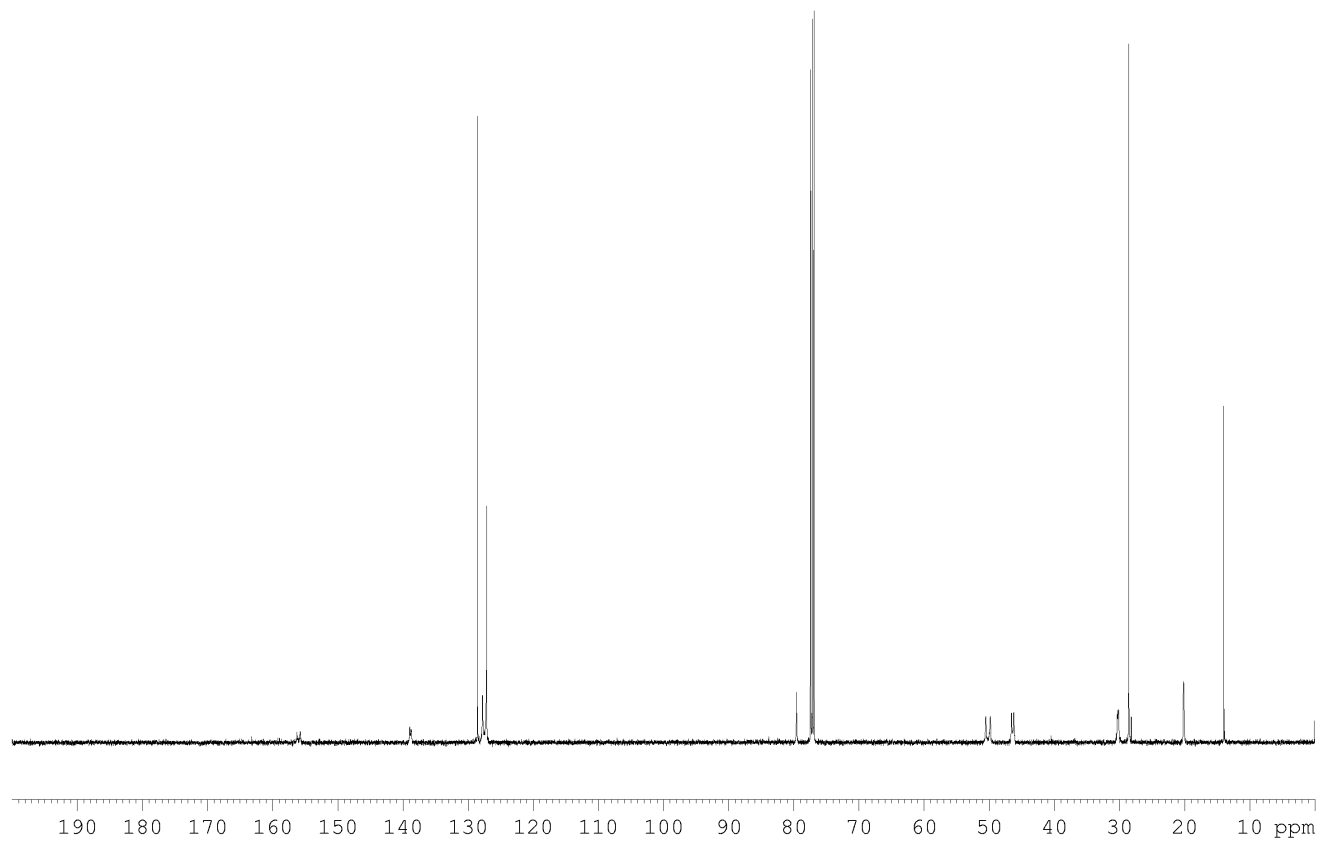
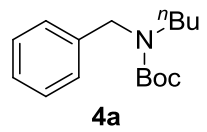
^{19}F NMR (470.8 MHz, acetone- d_6) Spectrum of **3g**
S89



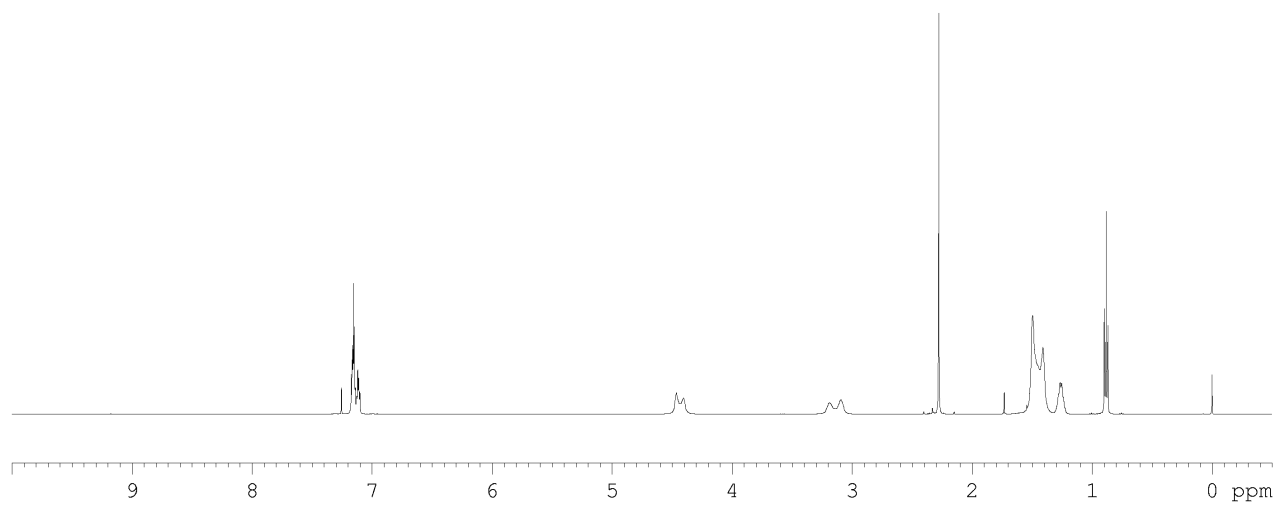
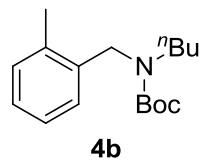
^{11}B NMR (128.4 MHz, acetone- d_6) Spectrum of **3g**
S90



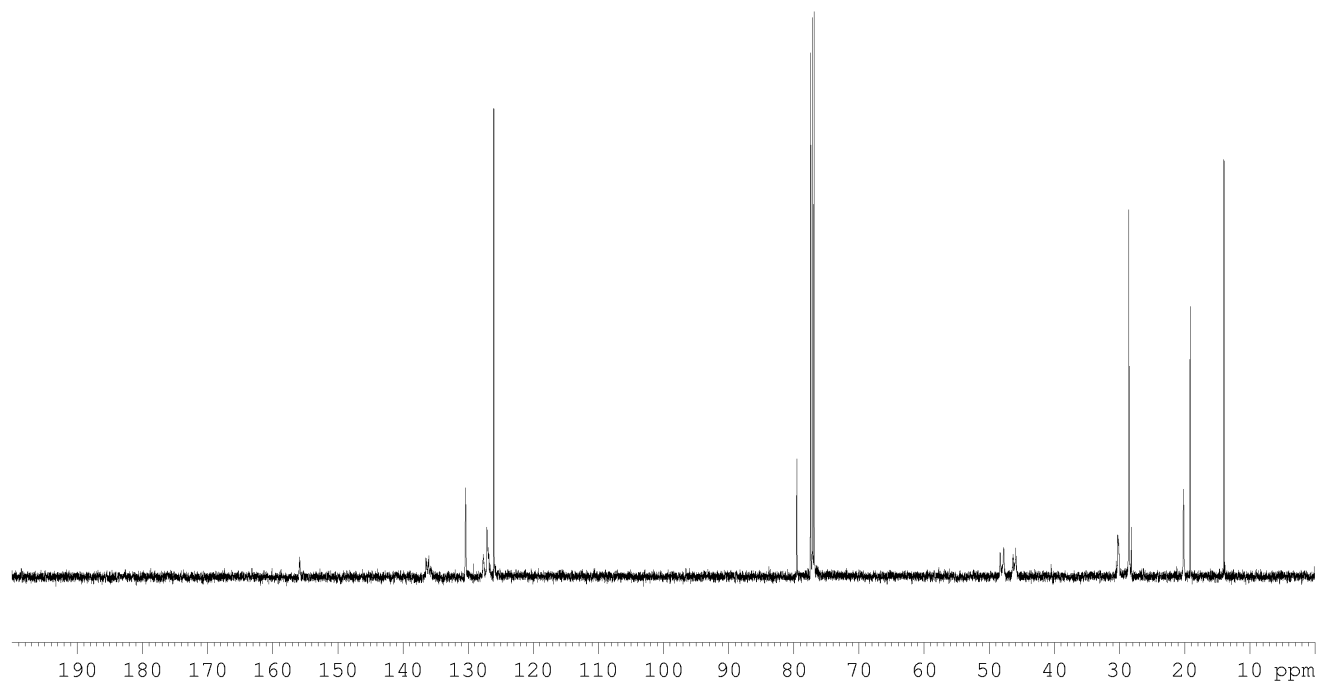
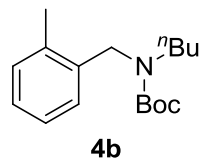
^1H NMR (500 MHz, CDCl_3) Spectrum of **4a**



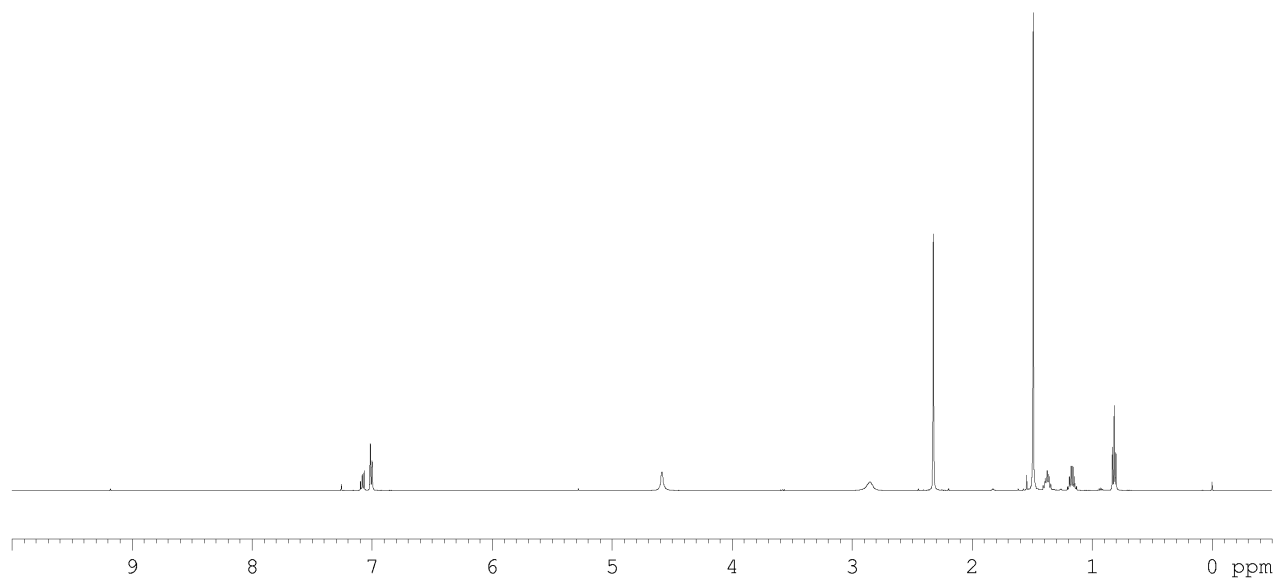
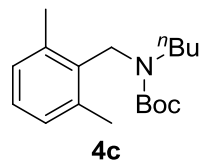
^{13}C NMR (125.8 MHz, CDCl₃) Spectrum of **4a**



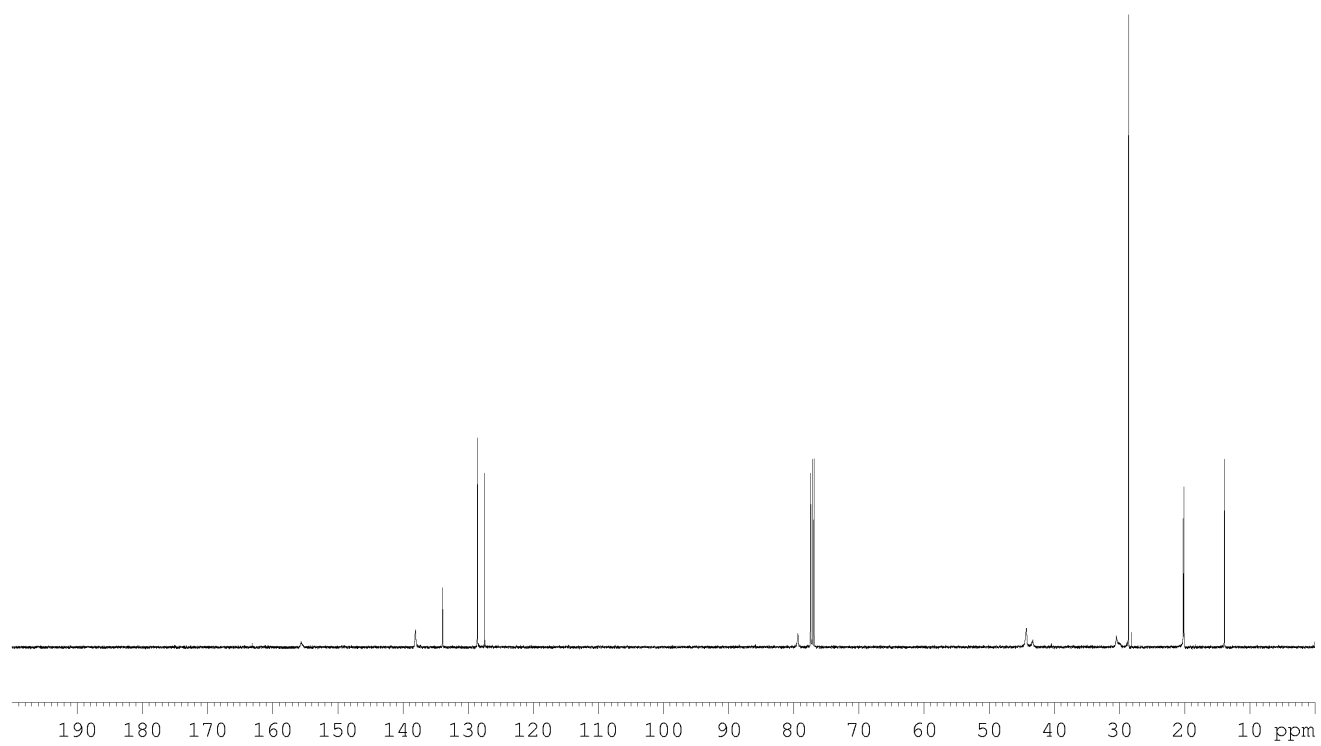
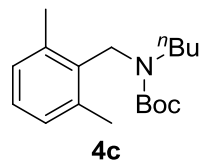
¹H NMR (500 MHz, CDCl₃) Spectrum of **4b**



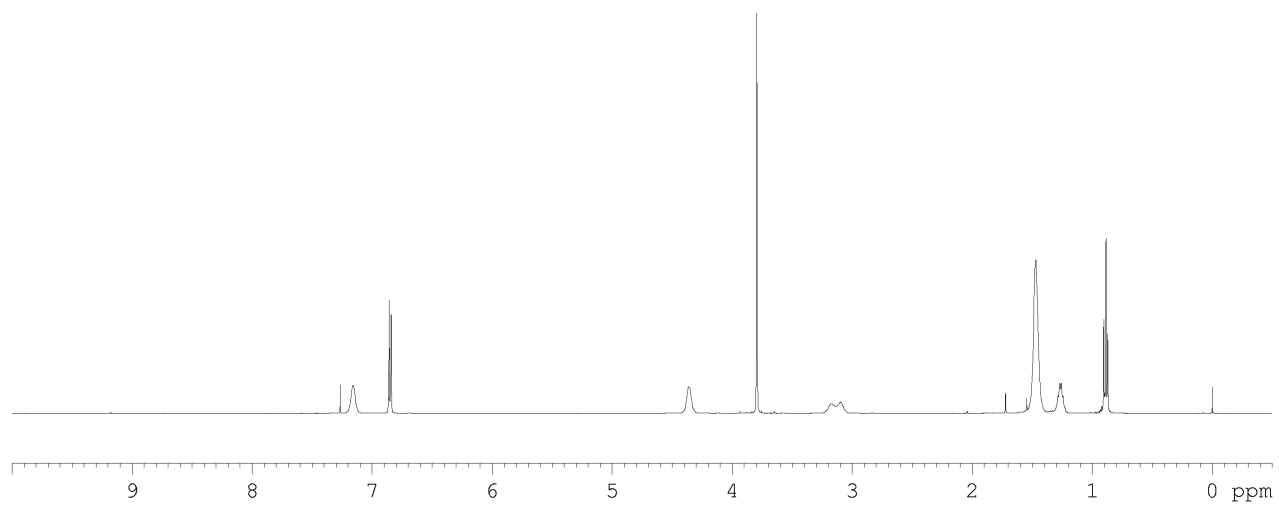
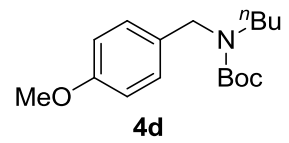
^{13}C NMR (125.8 MHz, CDCl_3) Spectrum of **4b**



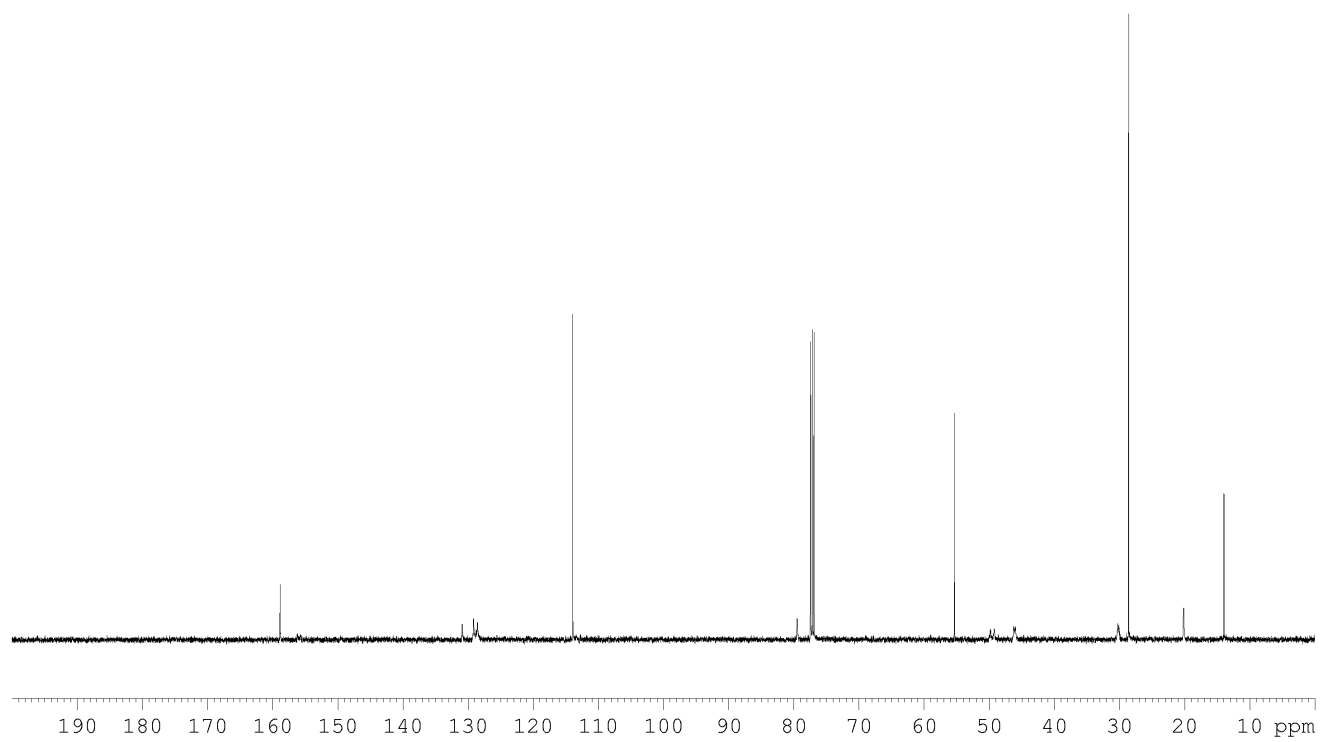
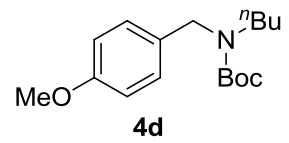
¹H NMR (500 MHz, CDCl₃) Spectrum of **4c**
S95



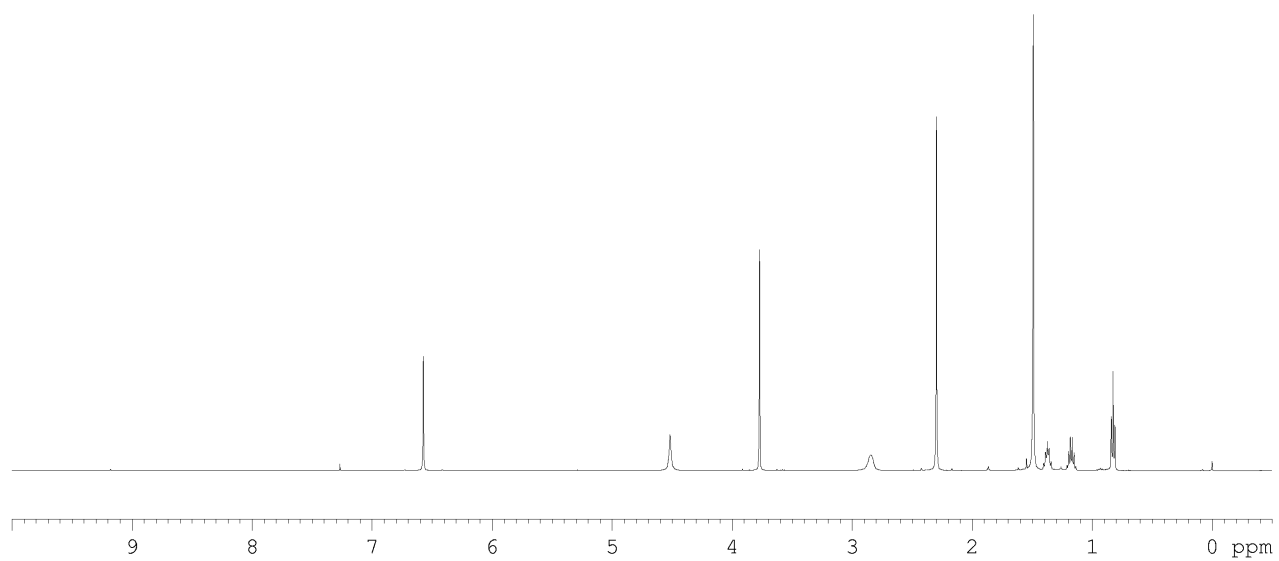
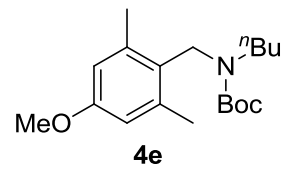
^{13}C NMR (125.8 MHz, CDCl_3) Spectrum of **4c**



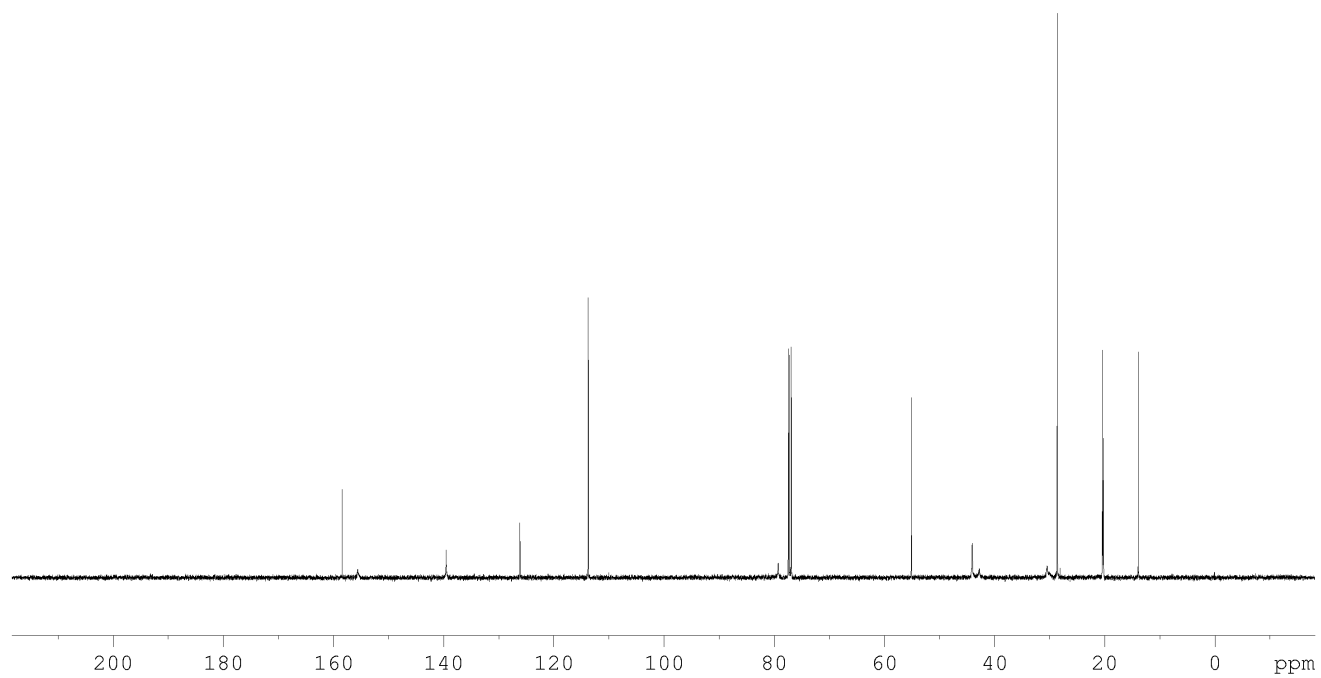
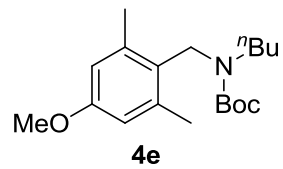
^1H NMR (500 MHz, CDCl_3) Spectrum of **4d**



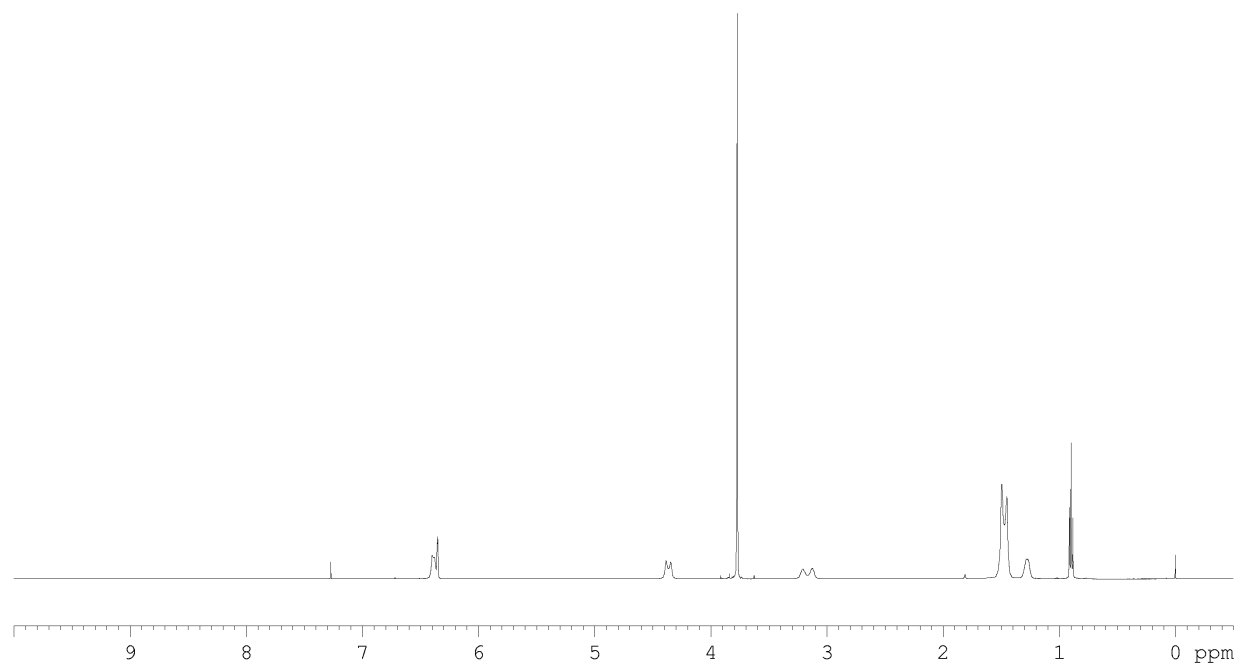
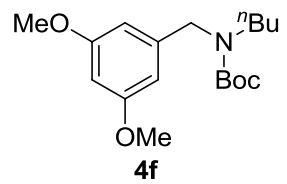
^{13}C NMR (125.8 MHz, CDCl₃) Spectrum of **4d**



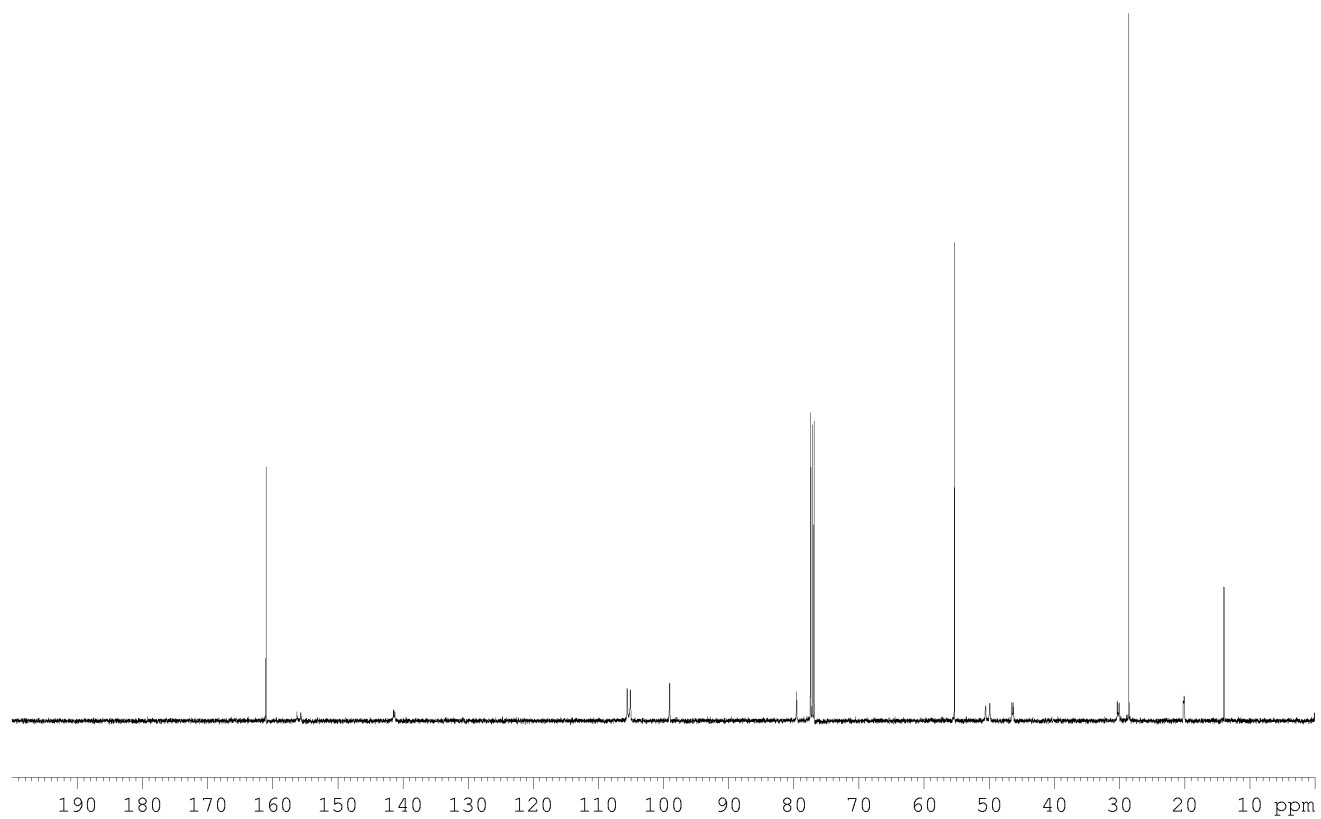
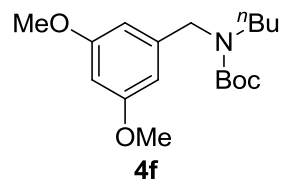
¹H NMR (500 MHz, CDCl₃) Spectrum of **4e**
S99



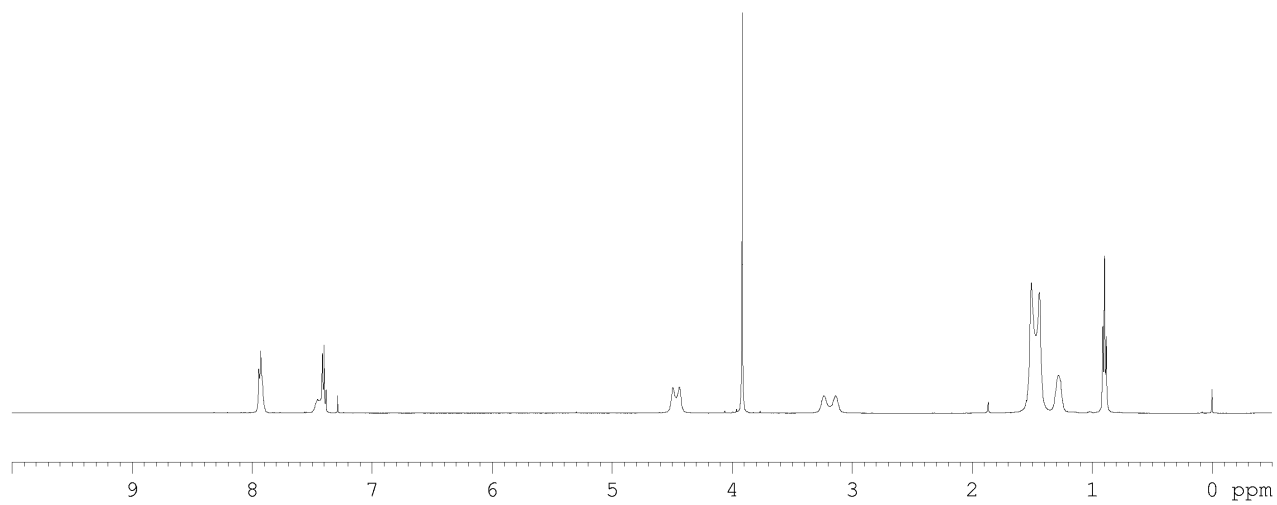
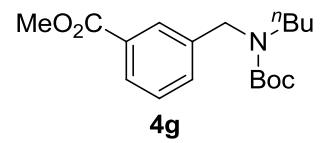
^{13}C NMR (125.8 MHz, CDCl_3) Spectrum of **4e**



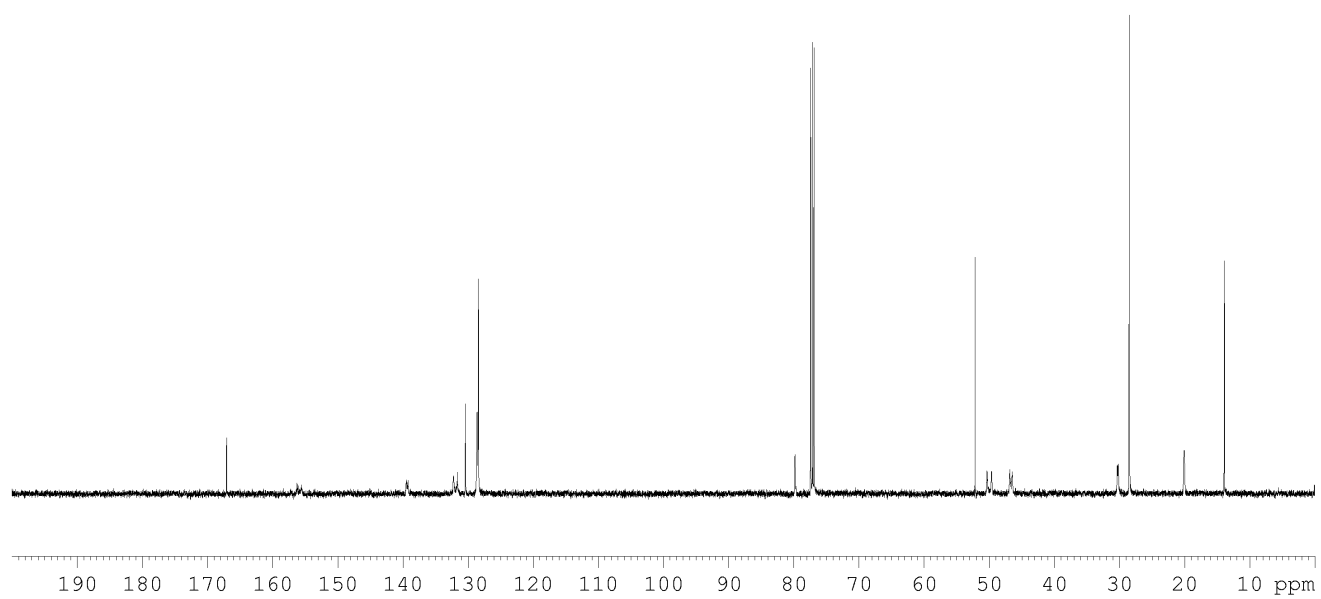
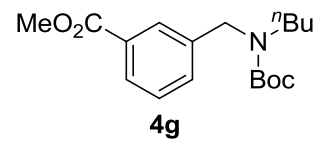
^1H NMR (500 MHz, CDCl_3) Spectrum of **4f**



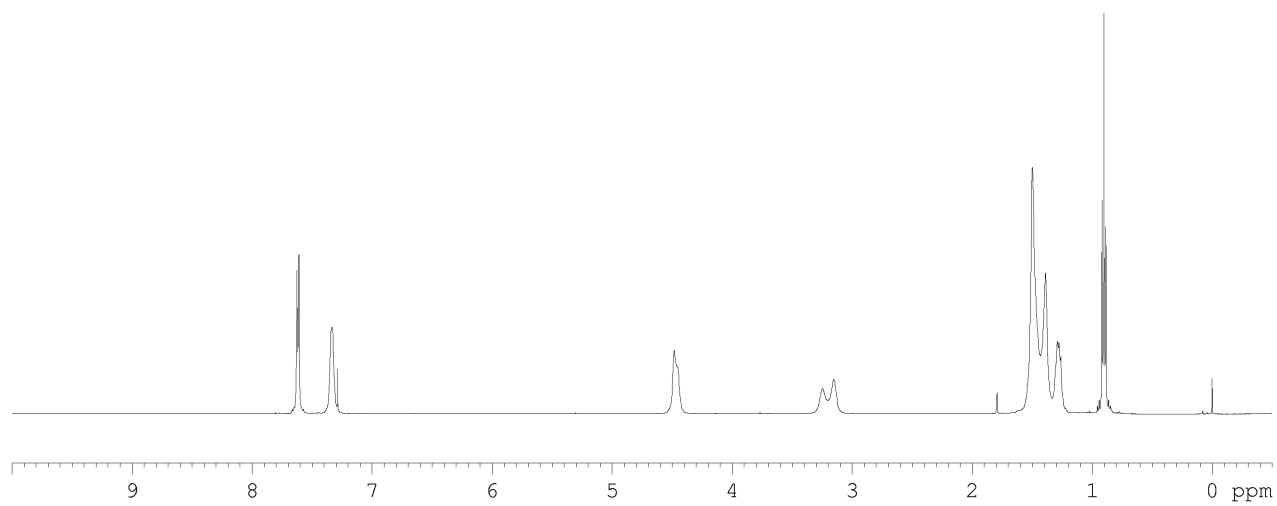
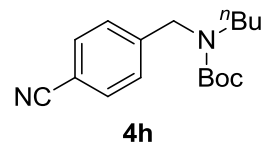
^{13}C NMR (125.8 MHz, CDCl_3) Spectrum of **4f**



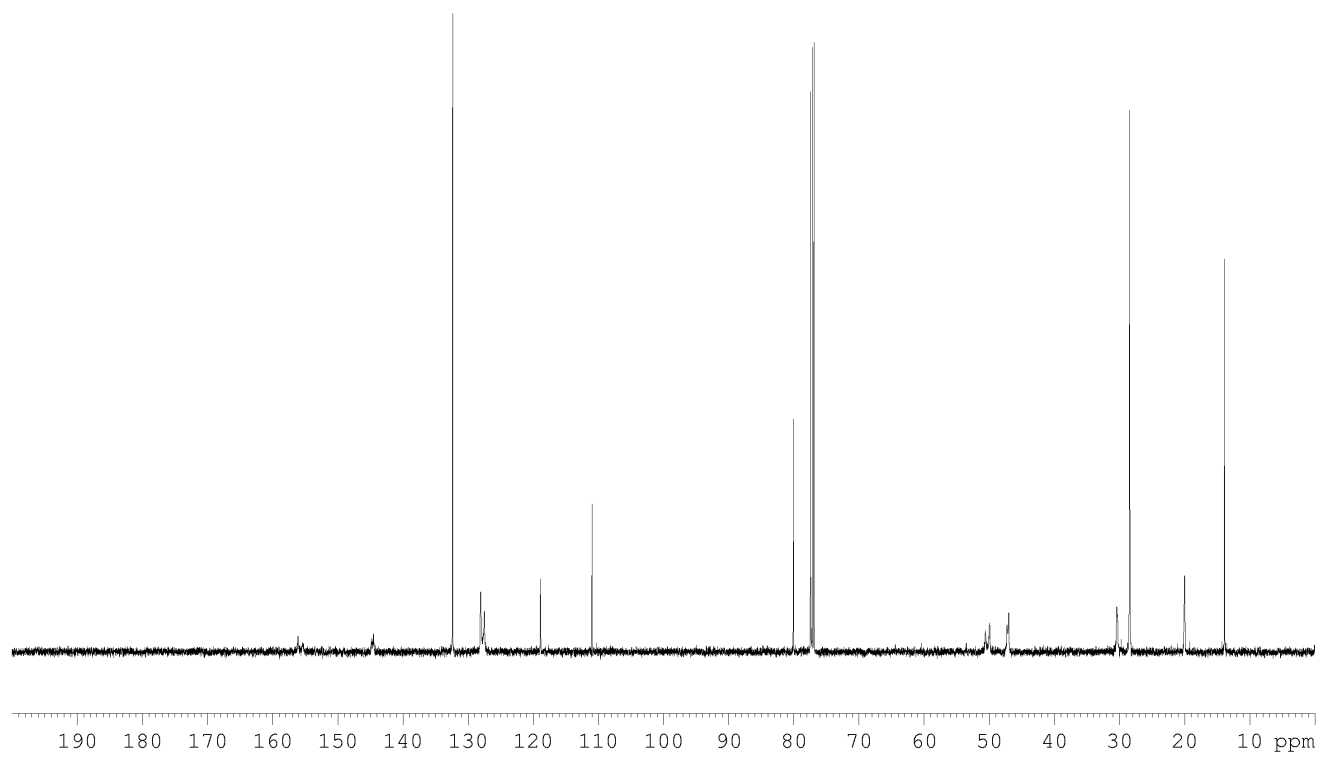
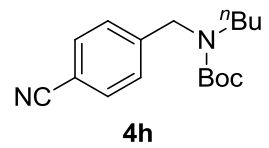
¹H NMR (500 MHz, CDCl₃) Spectrum of **4g**



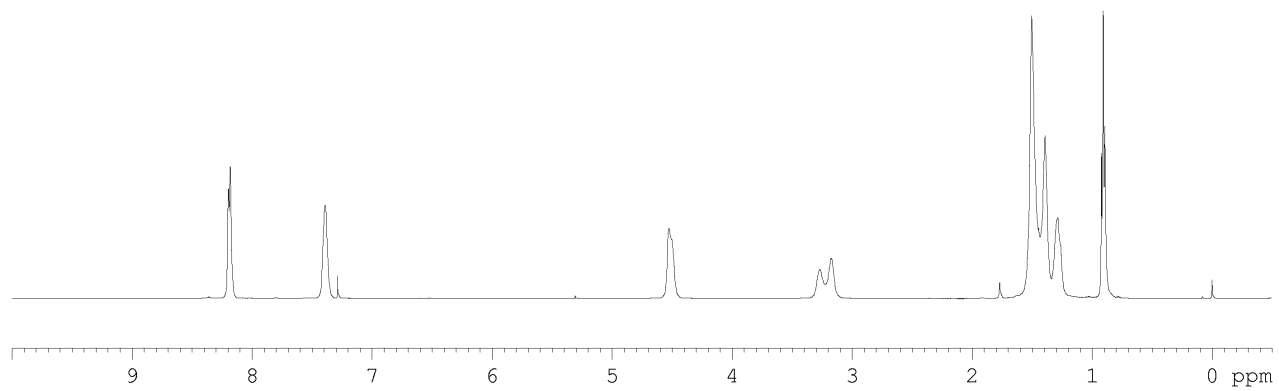
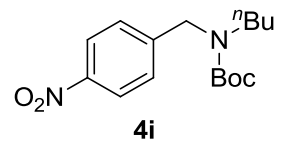
^{13}C NMR (125.8 MHz, CDCl_3) Spectrum of **4g**



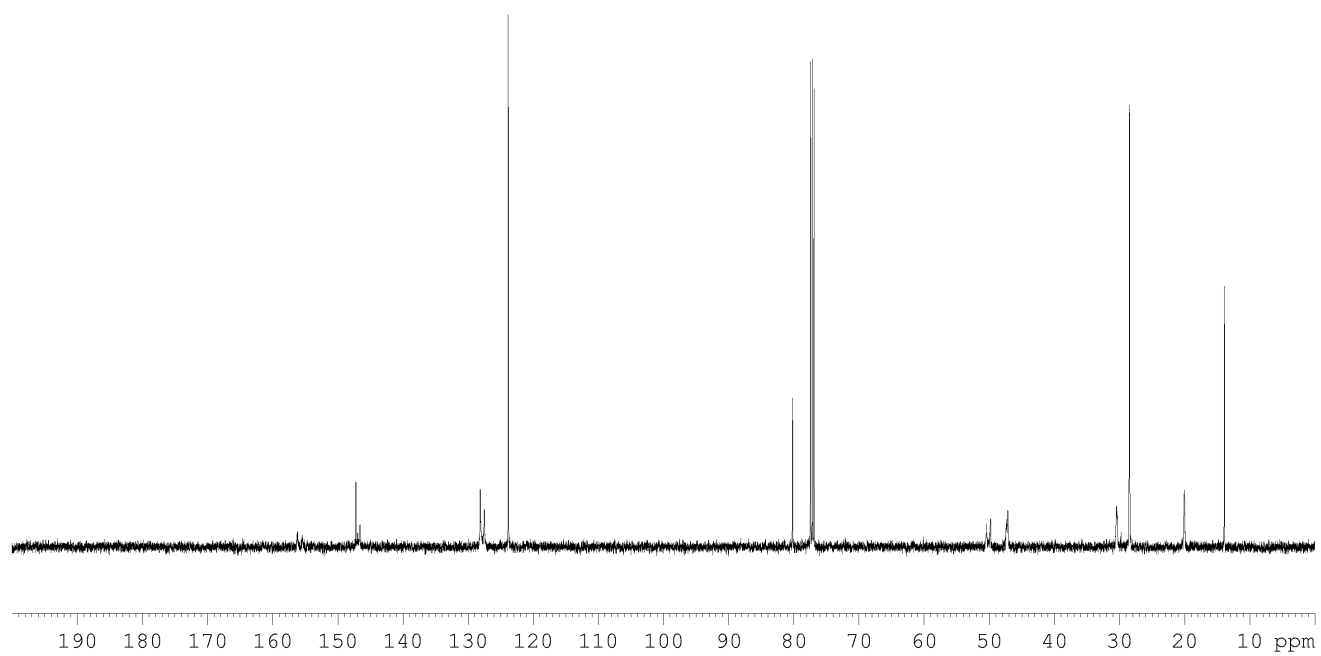
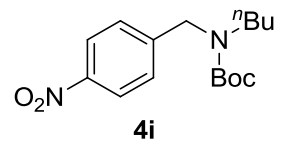
^1H NMR (500 MHz, CDCl_3) Spectrum of **4h**

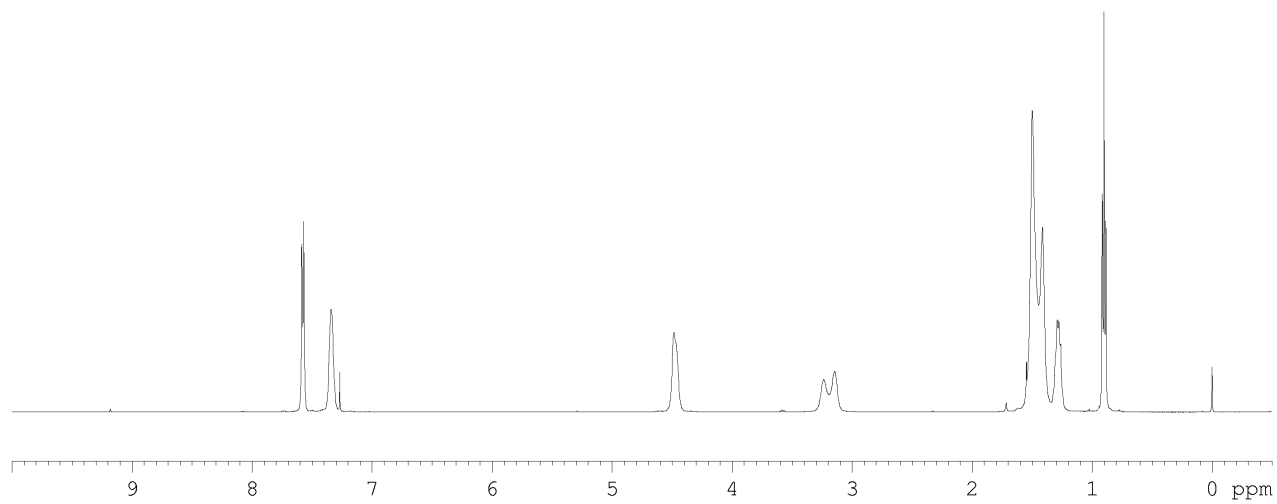
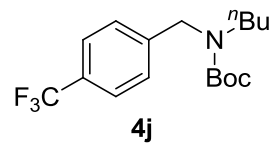


^{13}C NMR (125.8 MHz, CDCl_3) Spectrum of **4h**

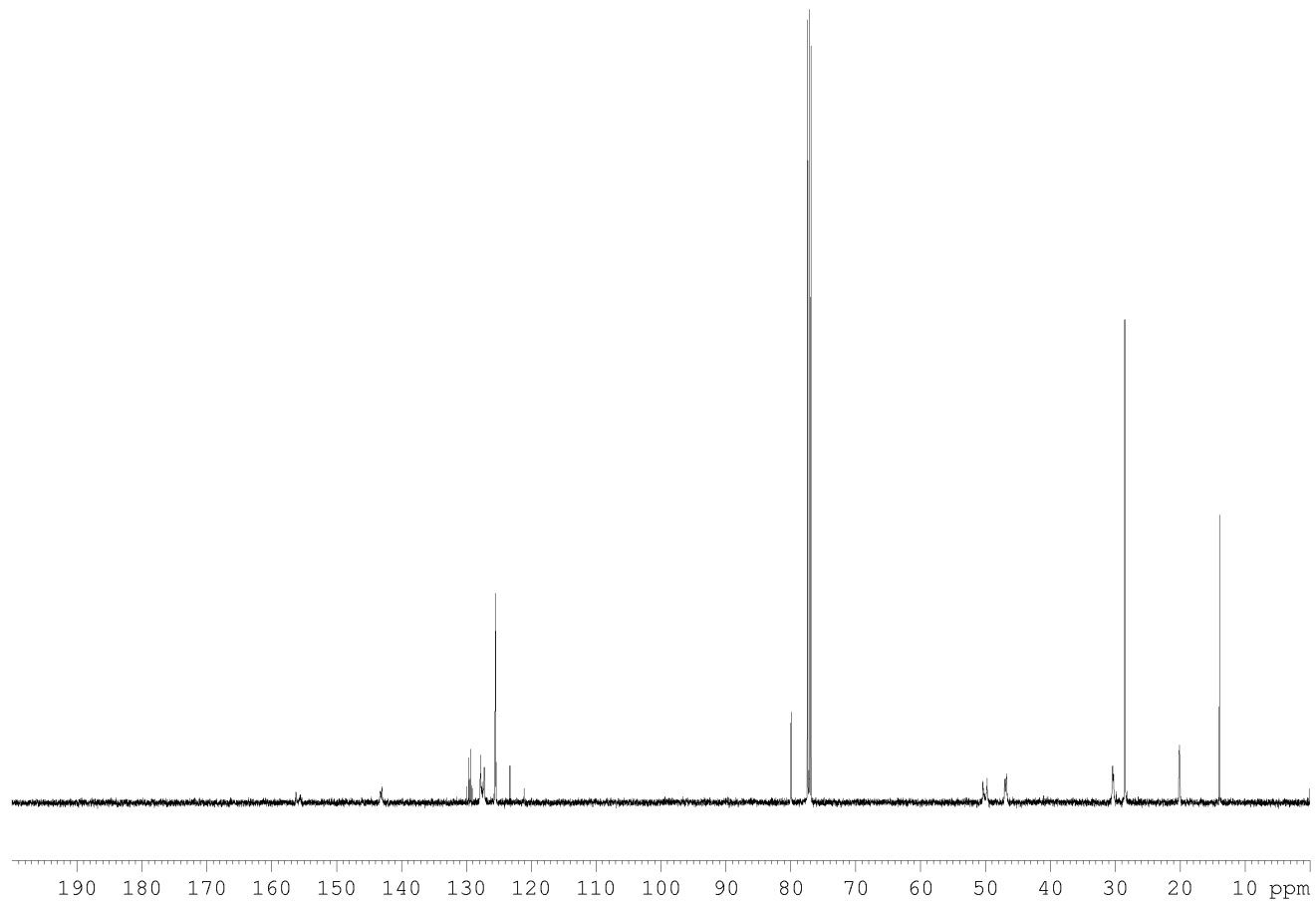
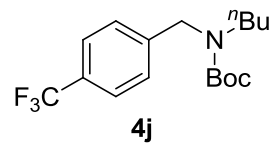


^1H NMR (500 MHz, CDCl_3) Spectrum of **4i**

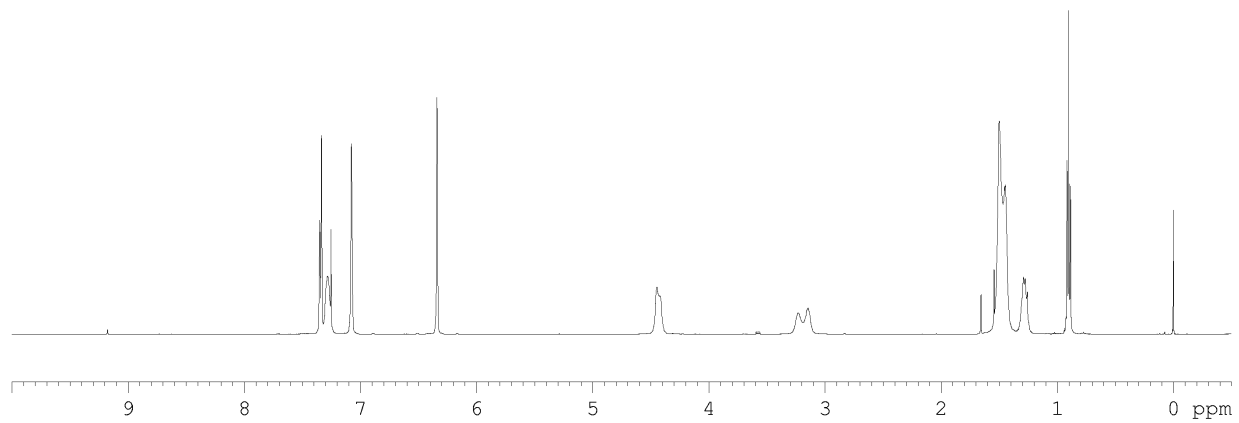
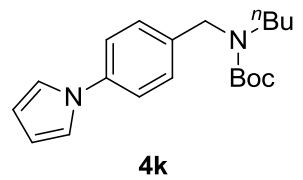




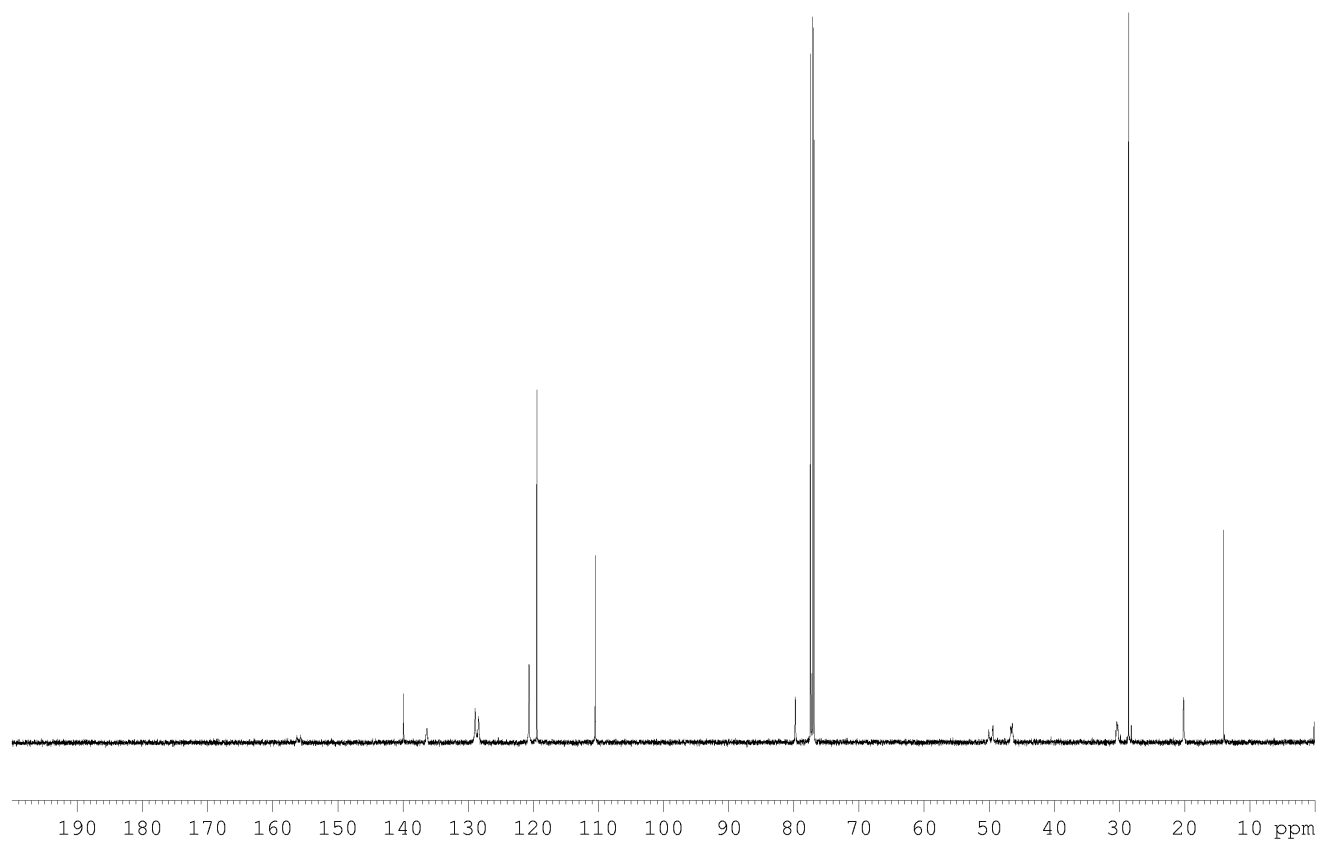
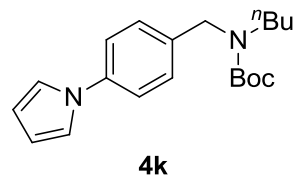
^1H NMR (500 MHz, CDCl_3) Spectrum of **4j**



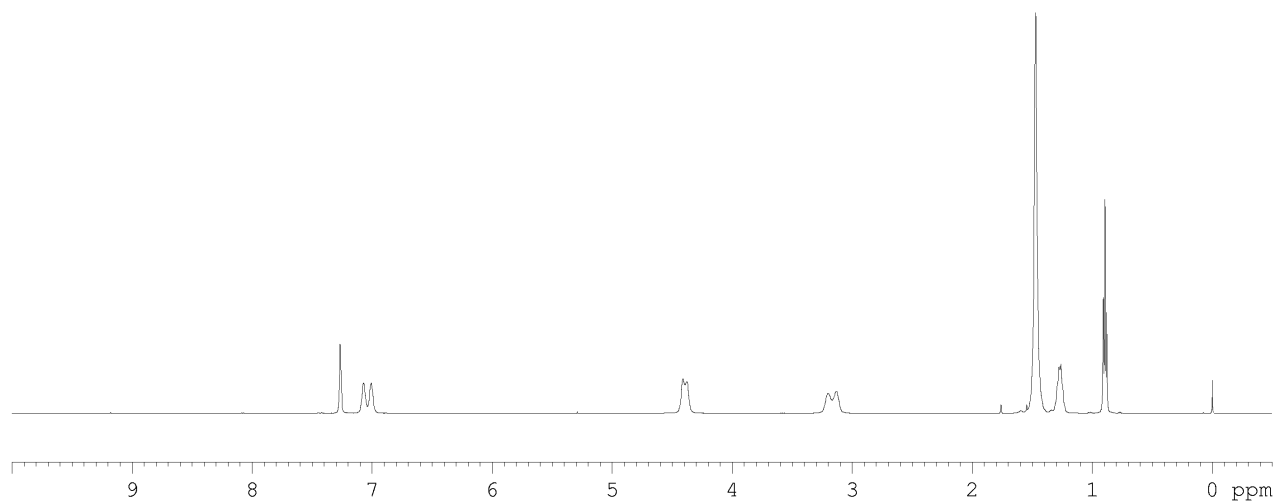
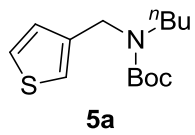
^{13}C NMR (125.8 MHz, CDCl_3) Spectrum of **4j**



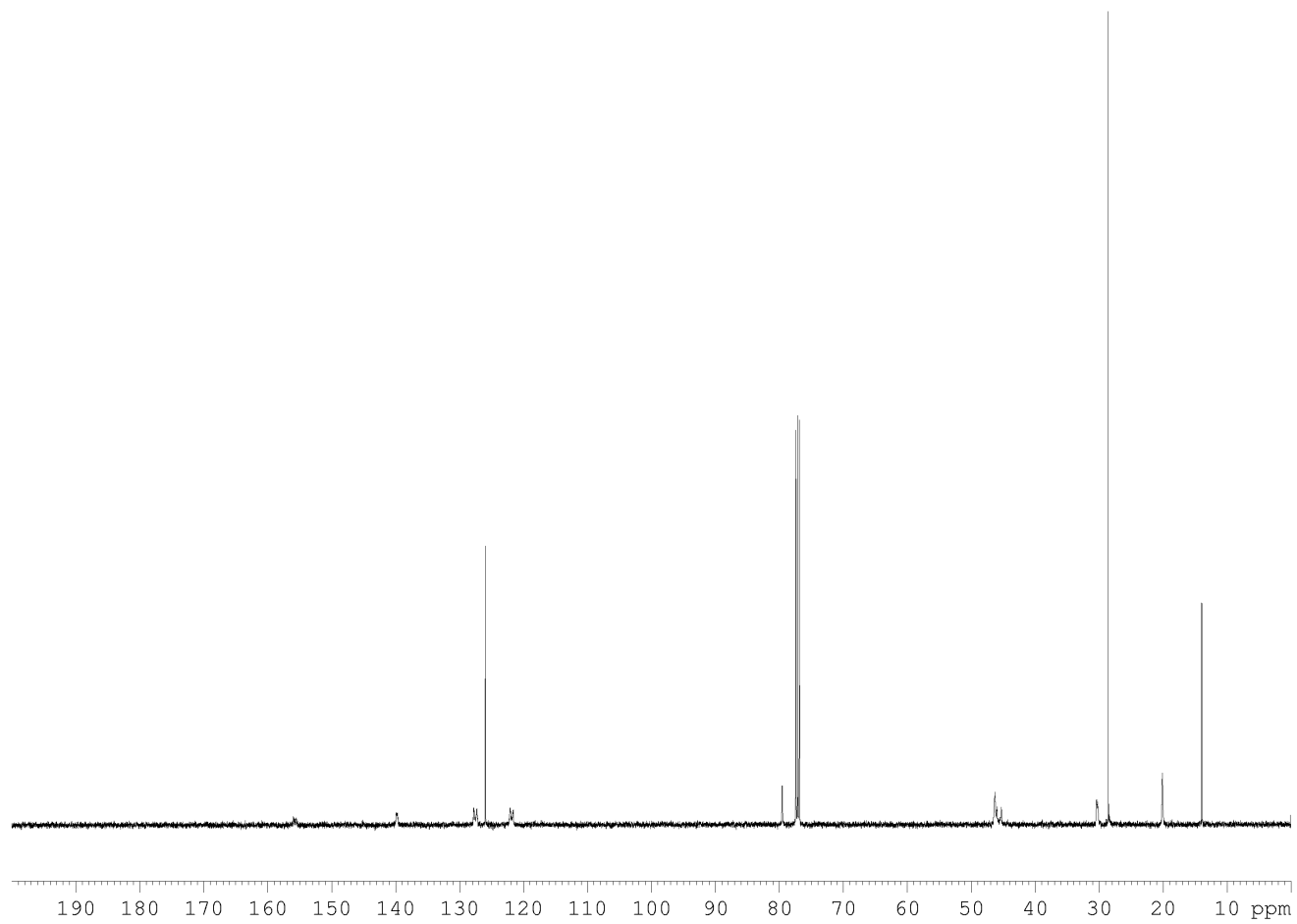
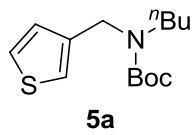
^1H NMR (500 MHz, CDCl_3) Spectrum of **4k**



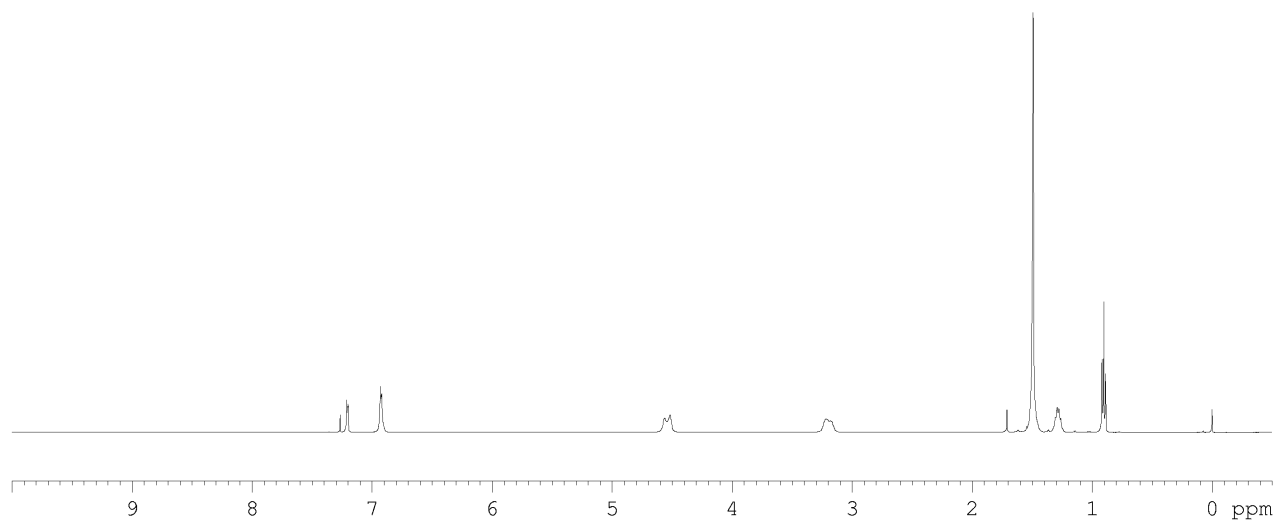
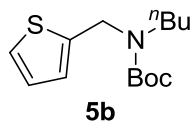
^{13}C NMR (125.8 MHz, CDCl_3) Spectrum of **4k**



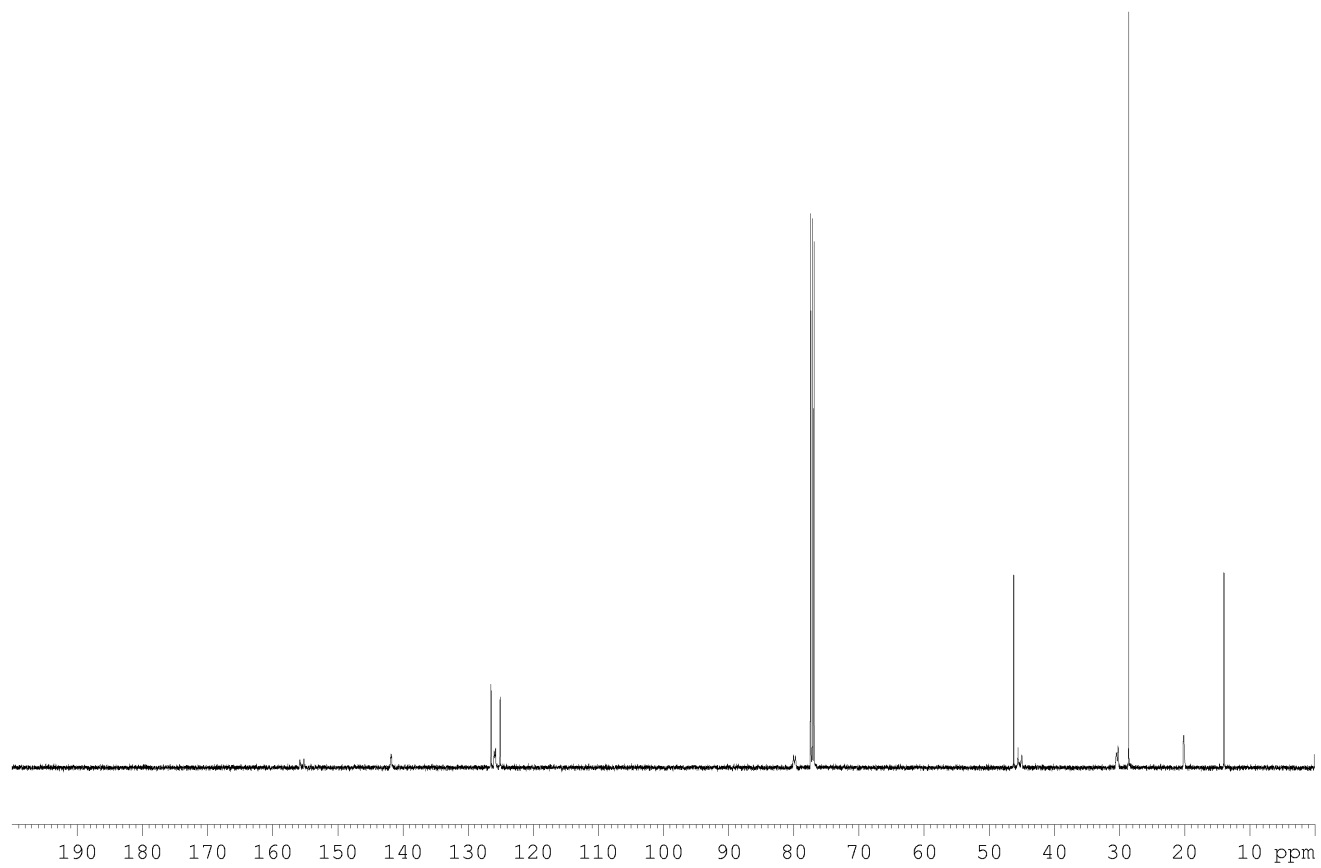
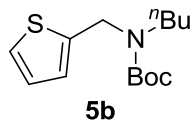
¹H NMR (500 MHz, CDCl₃) Spectrum of **5a**



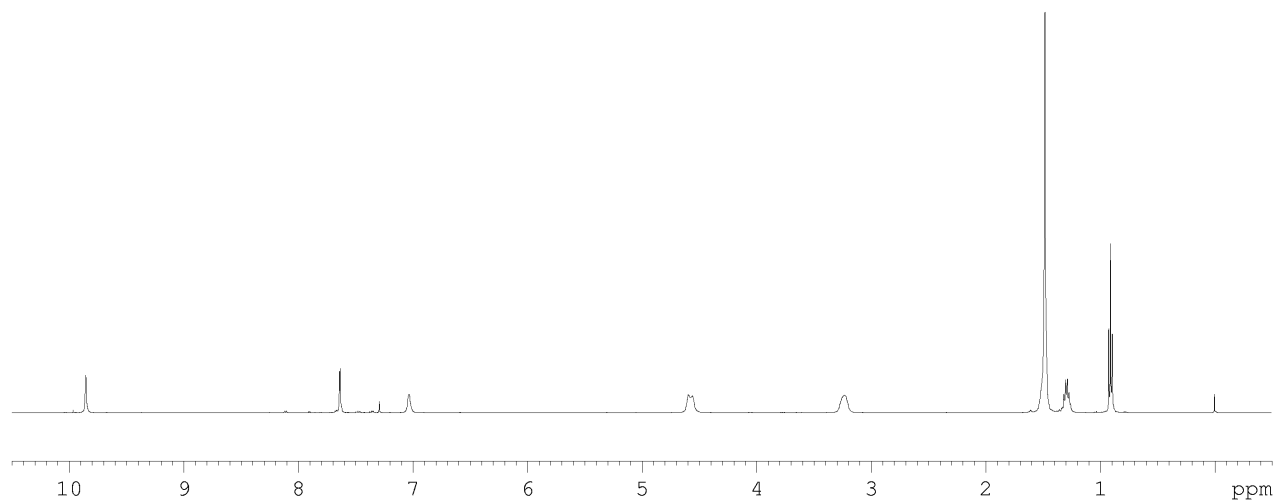
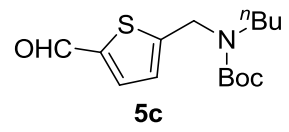
^{13}C NMR (125.8 MHz, CDCl_3) Spectrum of **5a**



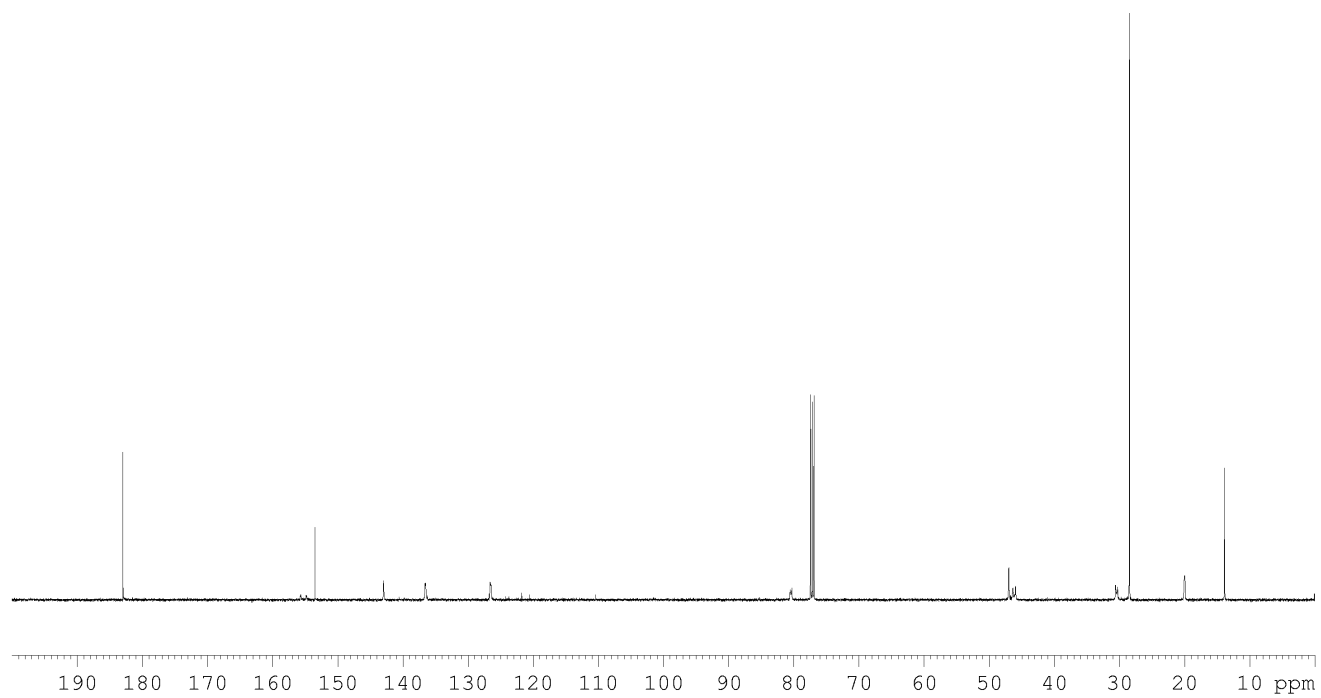
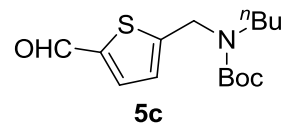
^1H NMR (500 MHz, CDCl_3) Spectrum of **5b**



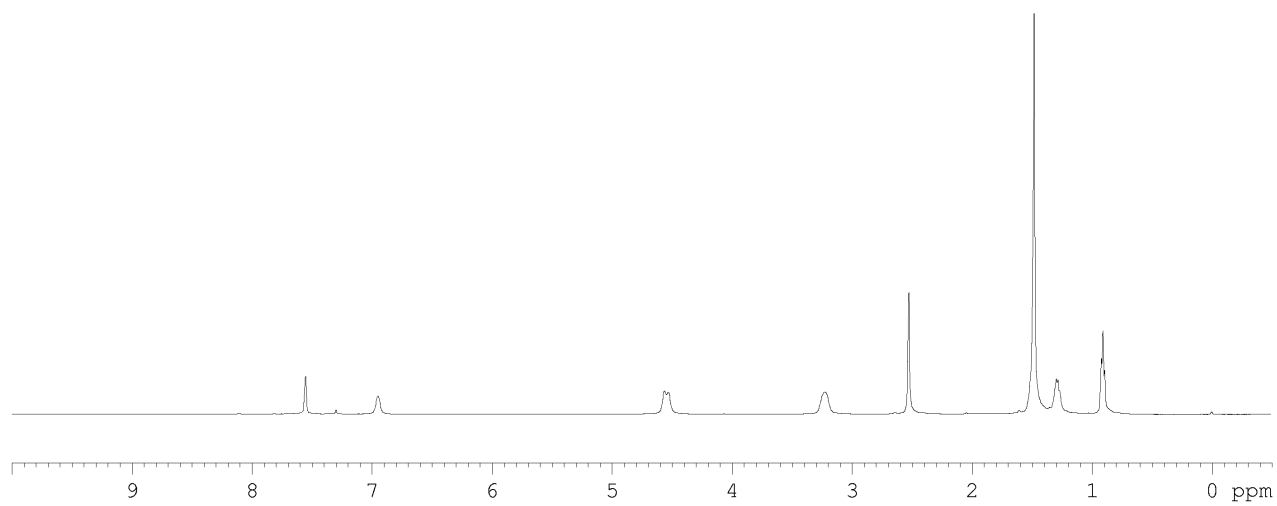
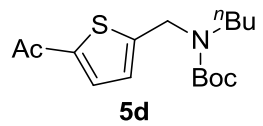
^{13}C NMR (125.8 MHz, CDCl_3) Spectrum of **5b**



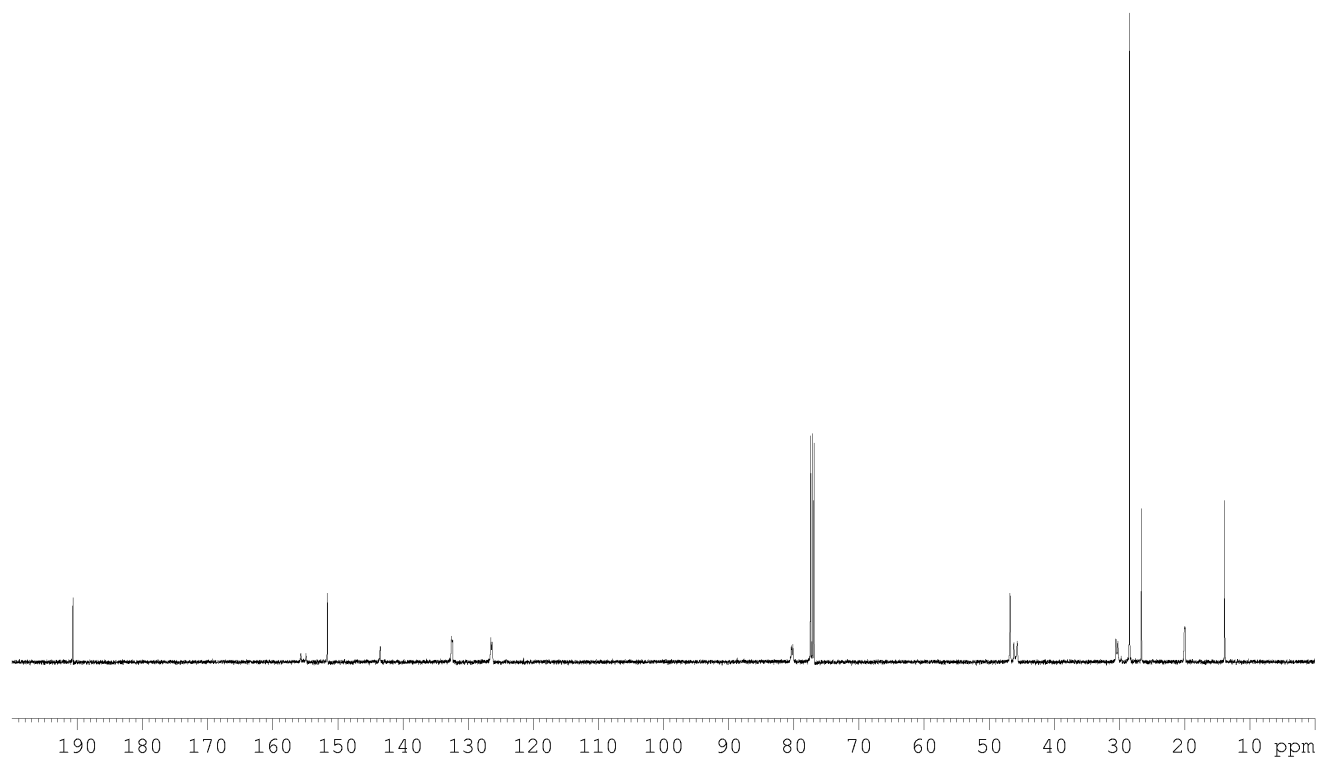
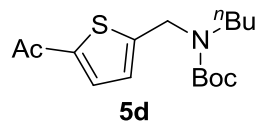
^1H NMR (500 MHz, CDCl_3) Spectrum of **5c**

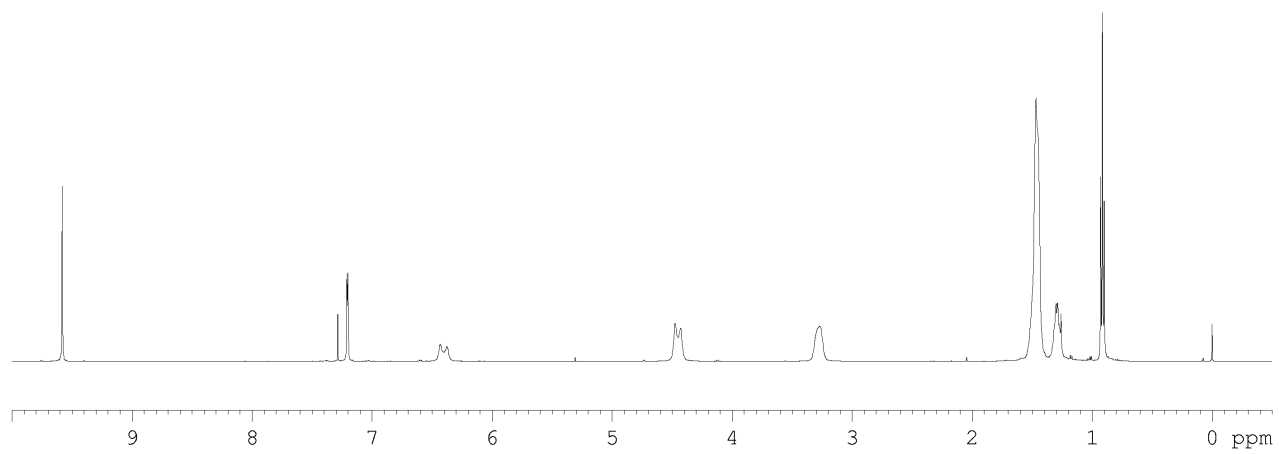
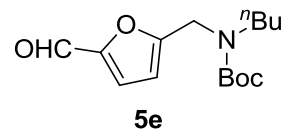


^{13}C NMR (125.8 MHz, CDCl_3) Spectrum of **5c**

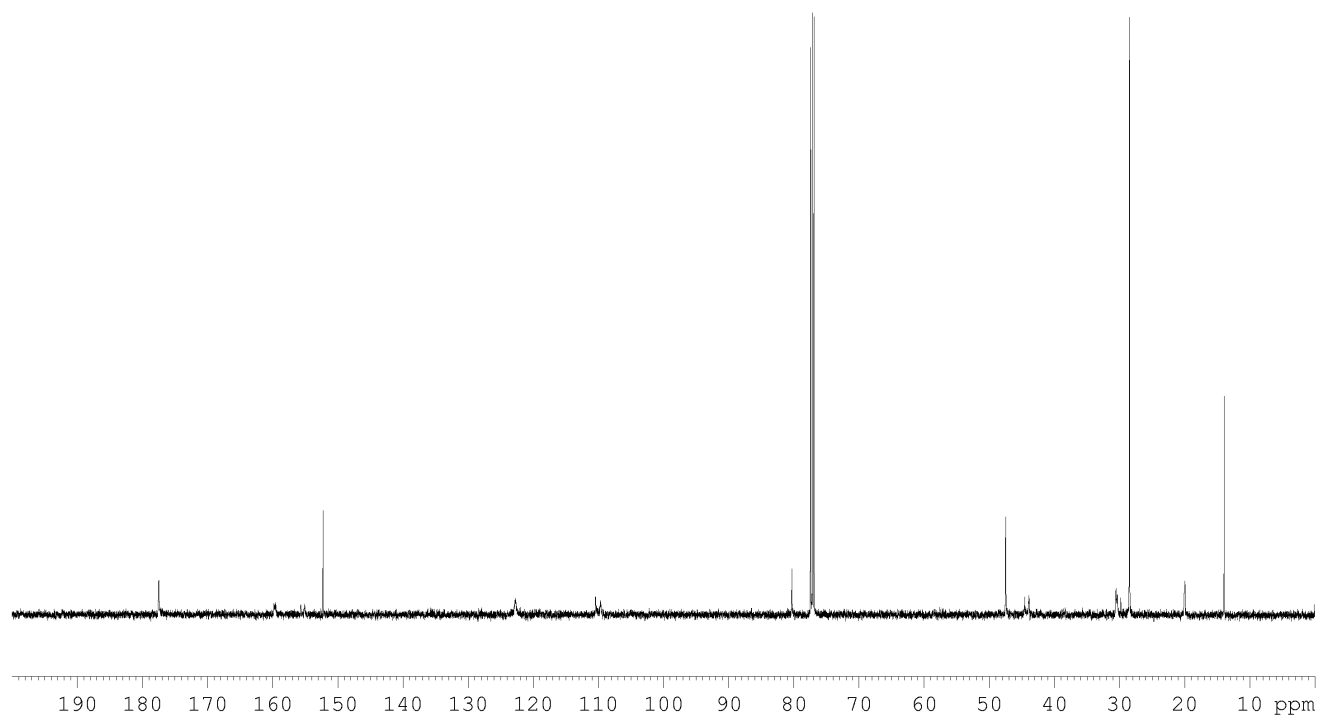
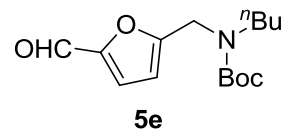


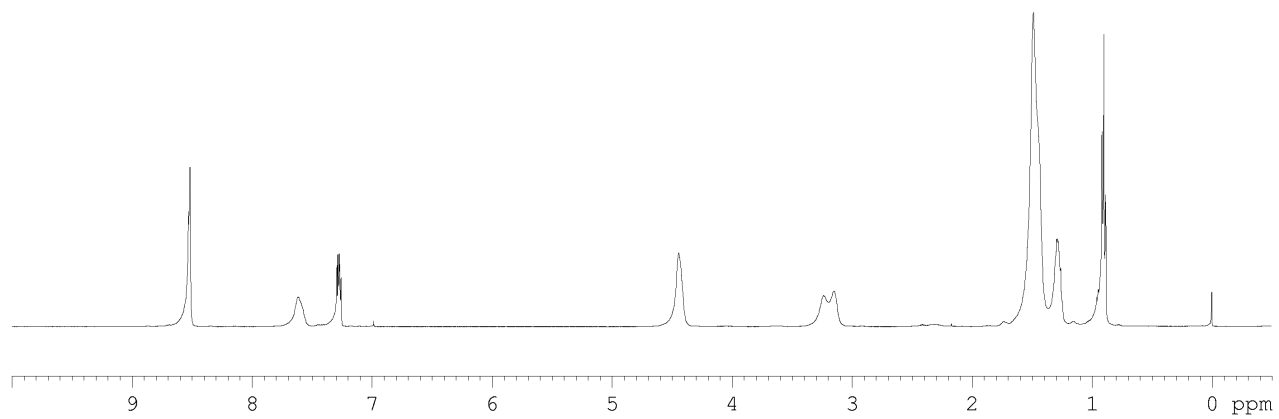
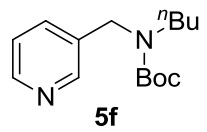
¹H NMR (500 MHz, CDCl₃) Spectrum of **5d**



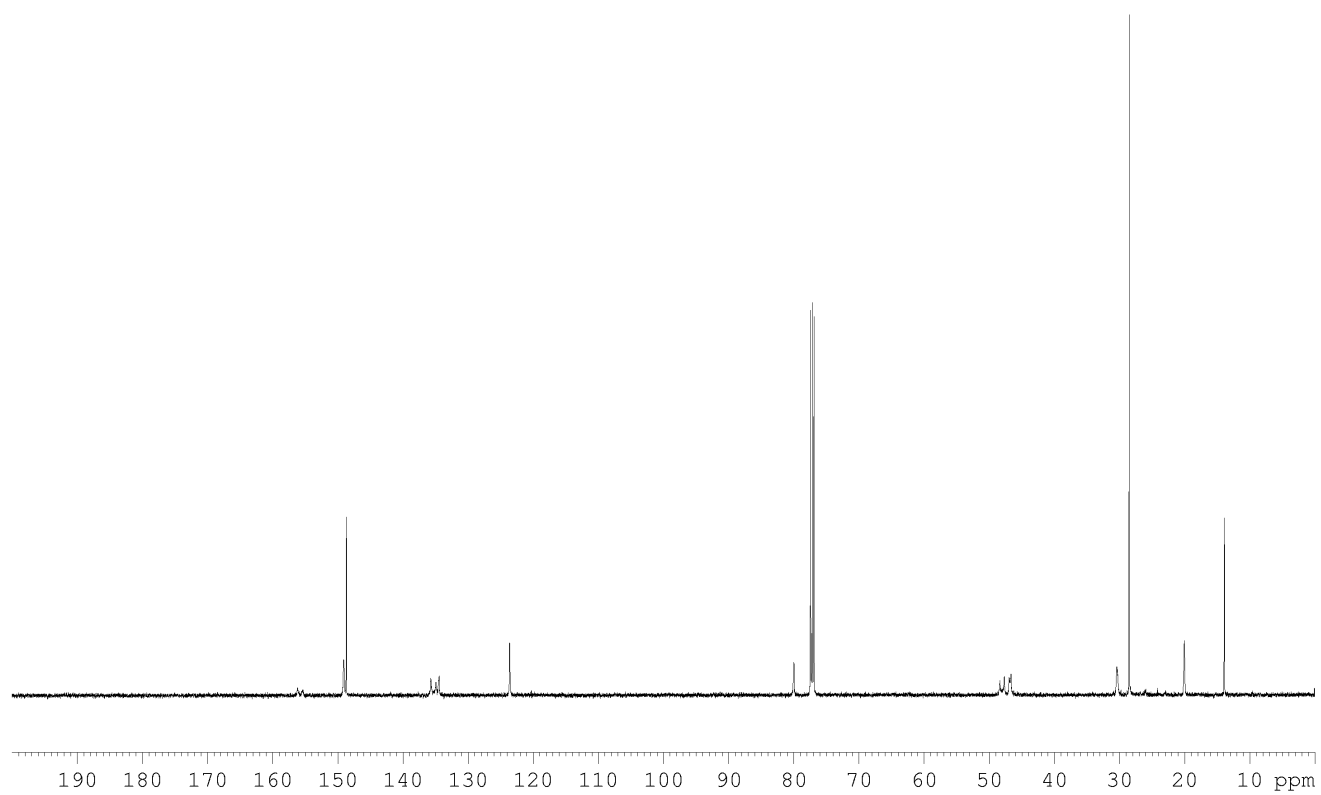
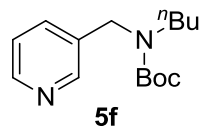


^1H NMR (500 MHz, CDCl_3) Spectrum of **5e**

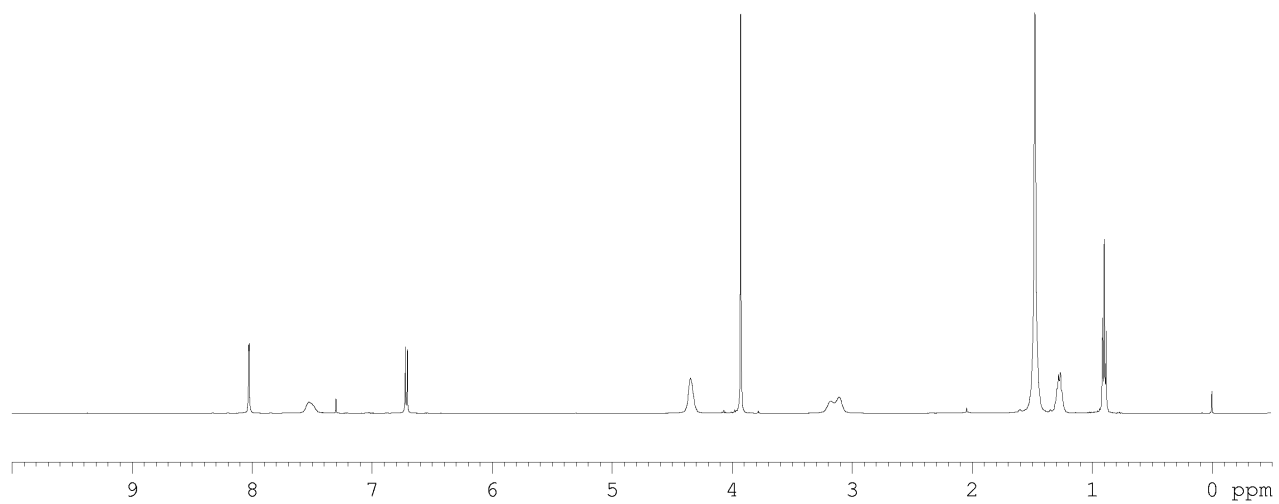
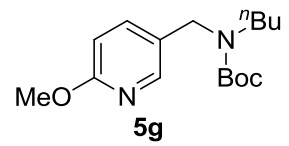




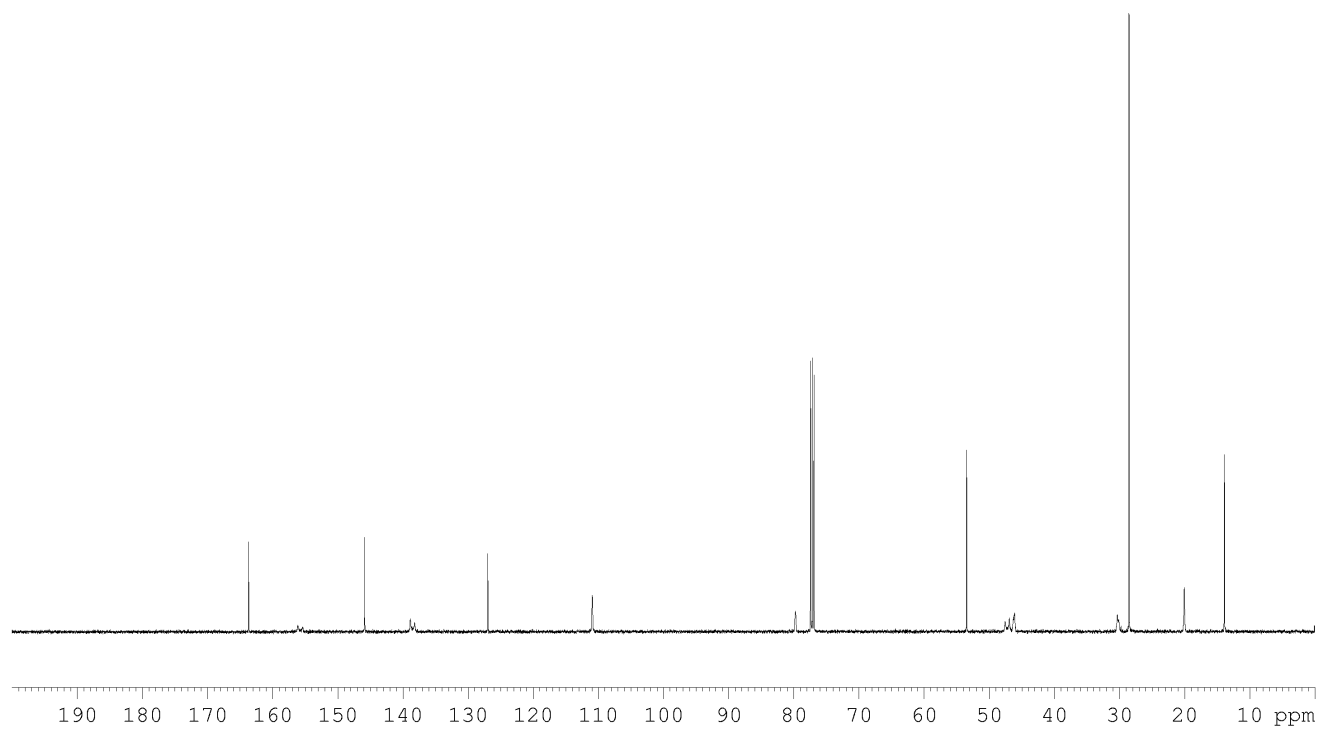
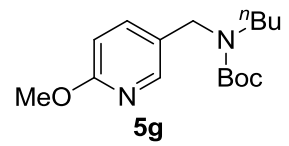
¹H NMR (500 MHz, CDCl₃) Spectrum of **5f**



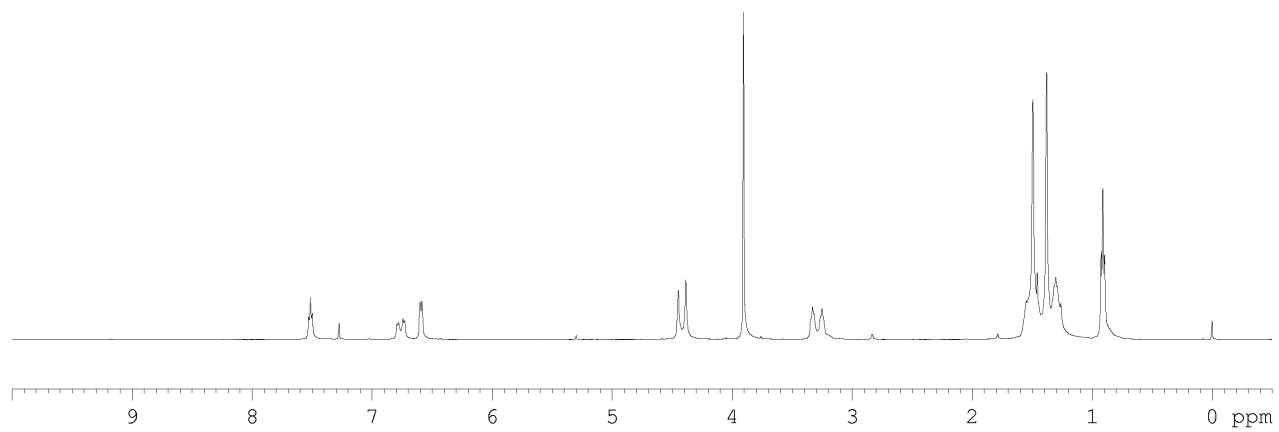
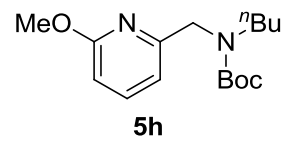
^{13}C NMR (125.8 MHz, CDCl_3) Spectrum of **5f**



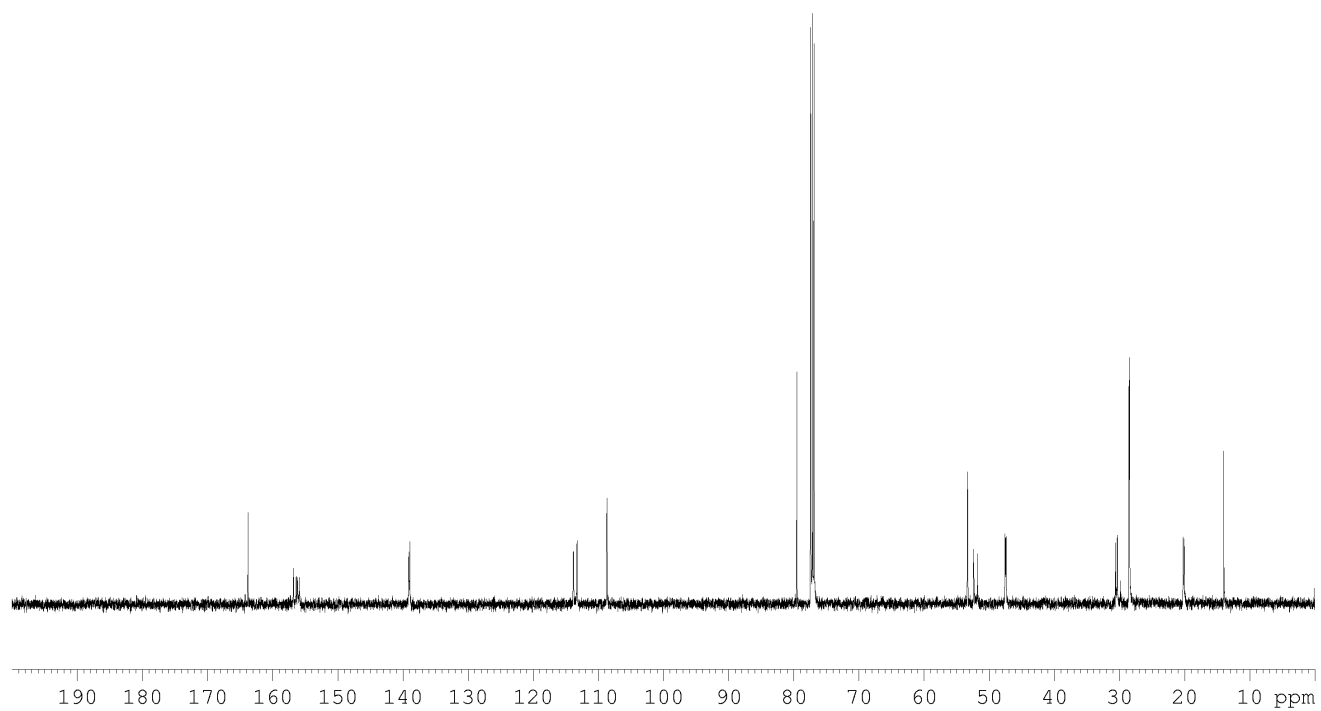
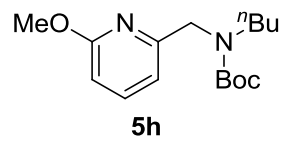
¹H NMR (500 MHz, CDCl₃) Spectrum of **5g**



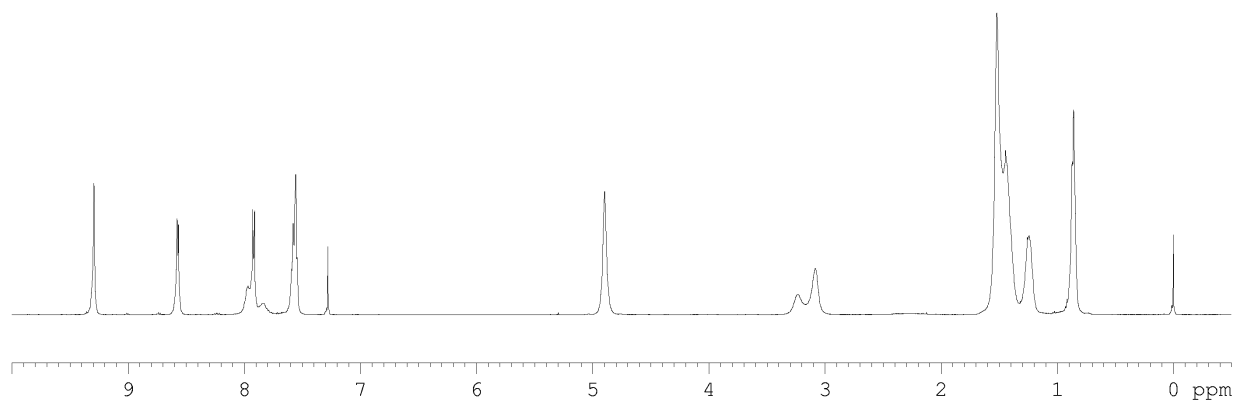
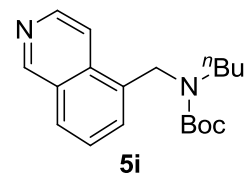
^{13}C NMR (125.8 MHz, CDCl_3) Spectrum of **5g**



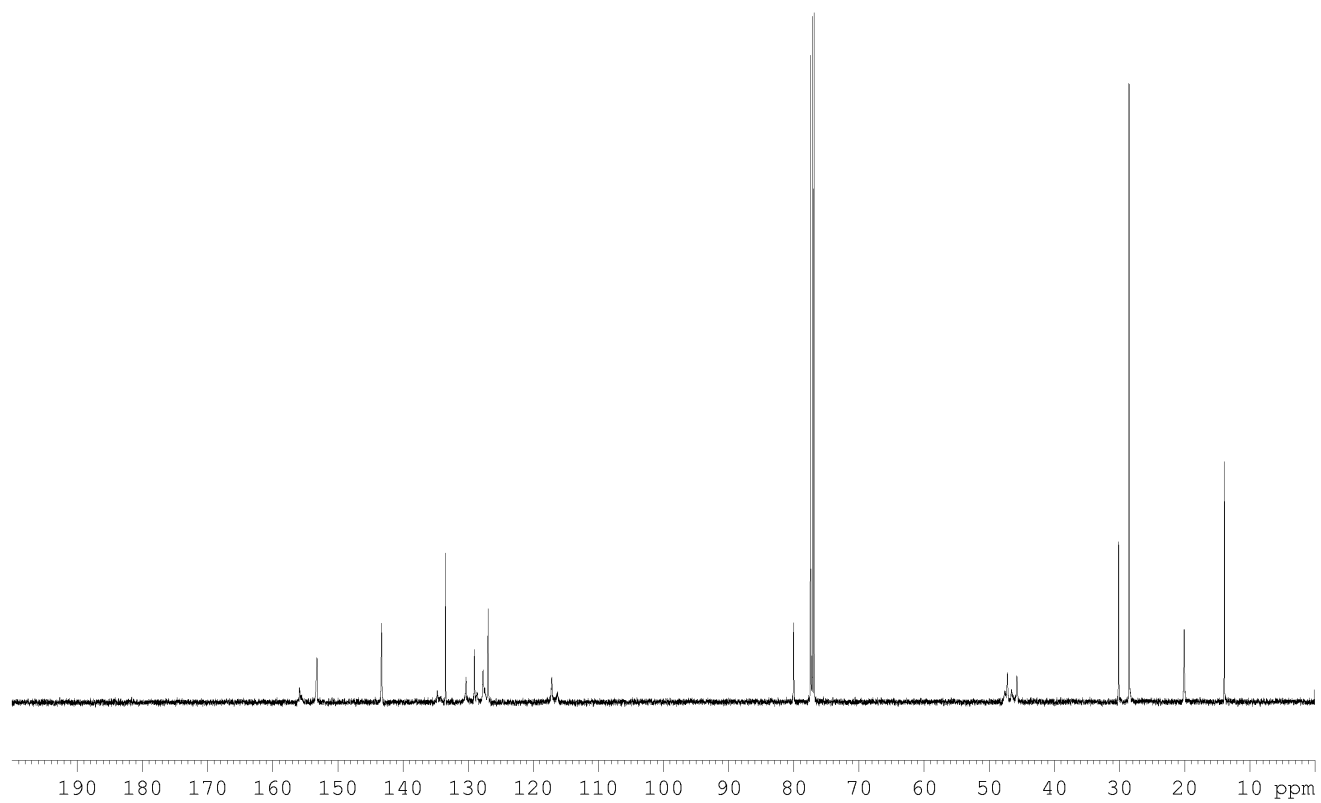
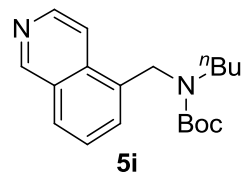
^1H NMR (500 MHz, CDCl_3) Spectrum of **5h**



^{13}C NMR (125.8 MHz, CDCl₃) Spectrum of **5h**

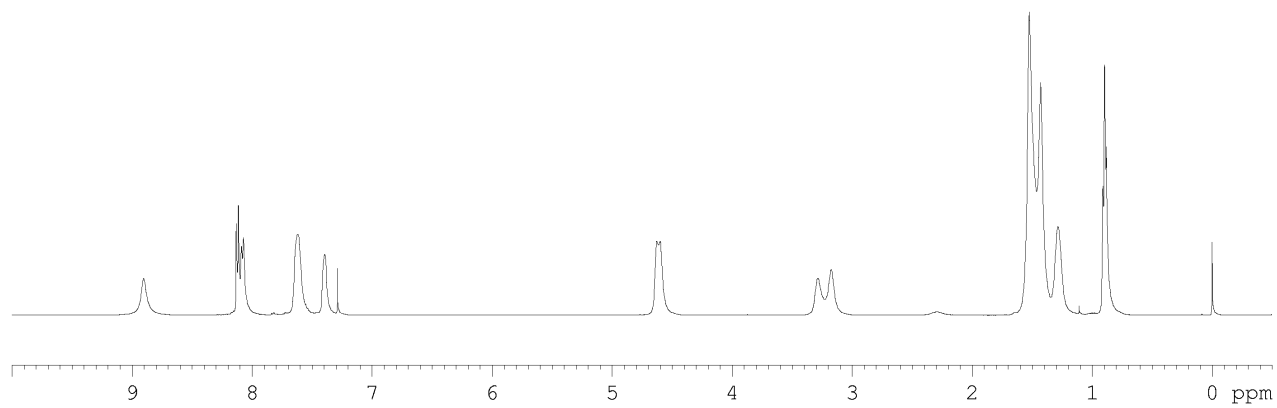
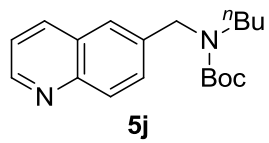


¹H NMR (500 MHz, CDCl₃) Spectrum of **5i**

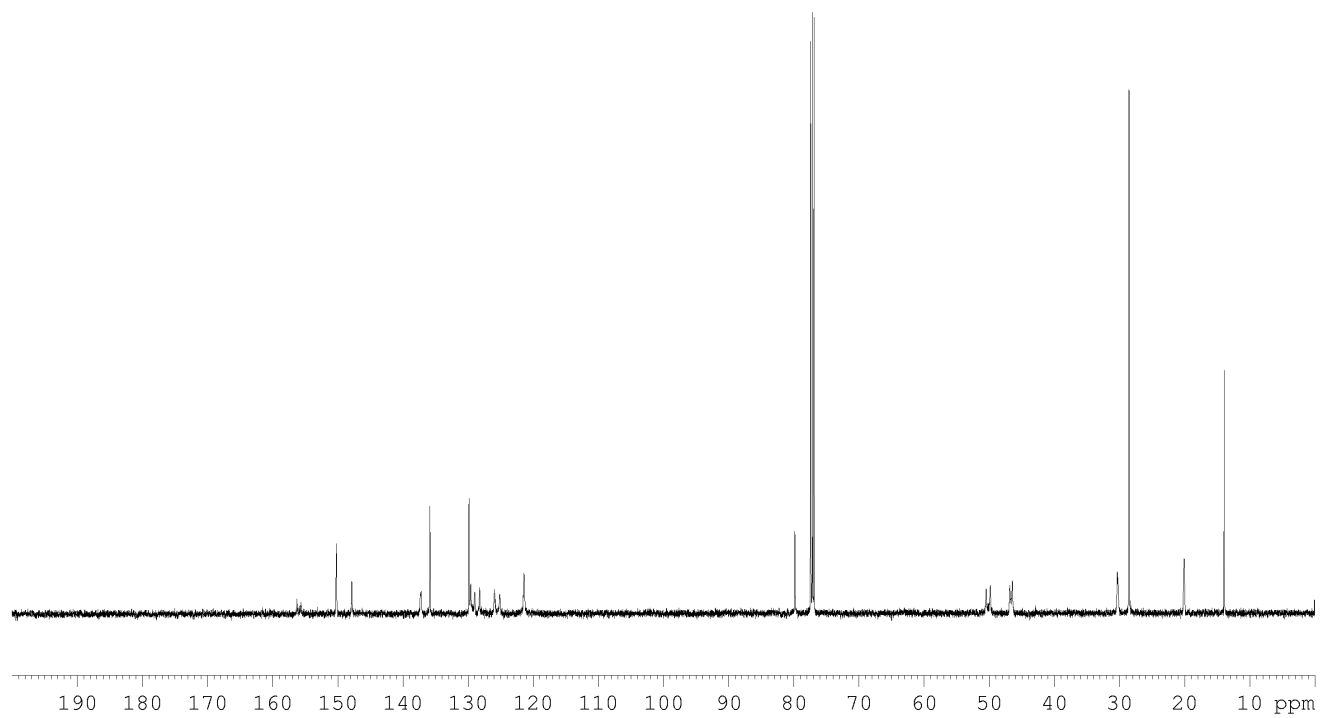
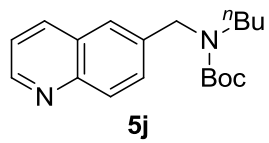


^{13}C NMR (125.8 MHz, CDCl_3) Spectrum of **5i**

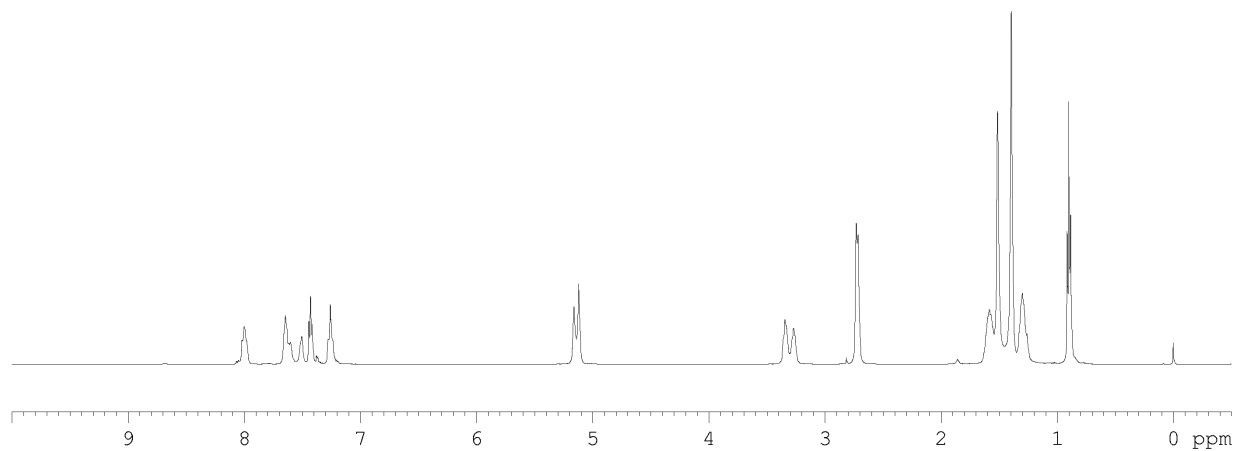
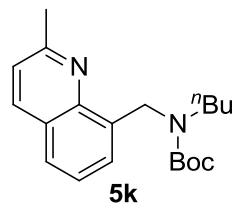
S130



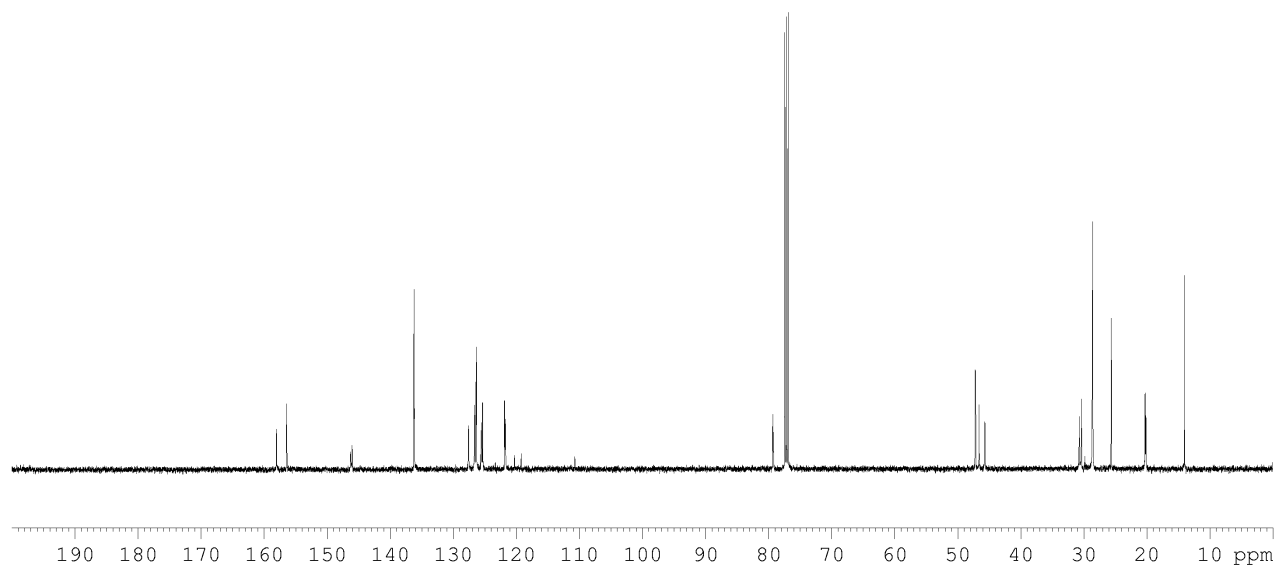
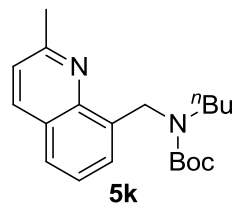
¹H NMR (500 MHz, CDCl₃) Spectrum of **5j**



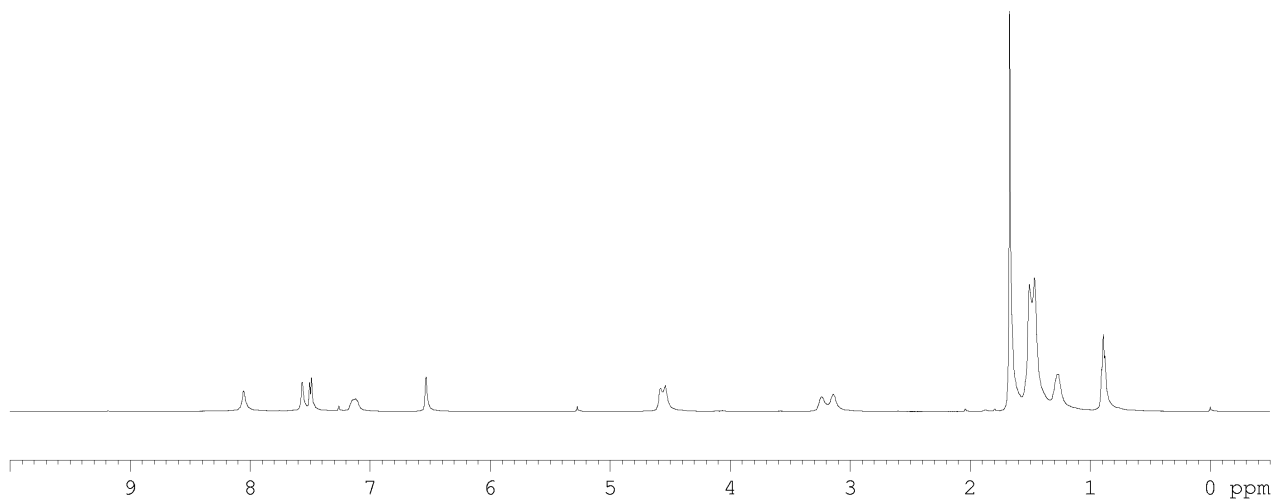
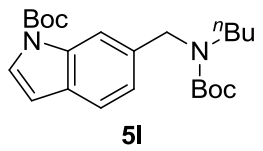
^{13}C NMR (125.8 MHz, CDCl_3) Spectrum of **5j**



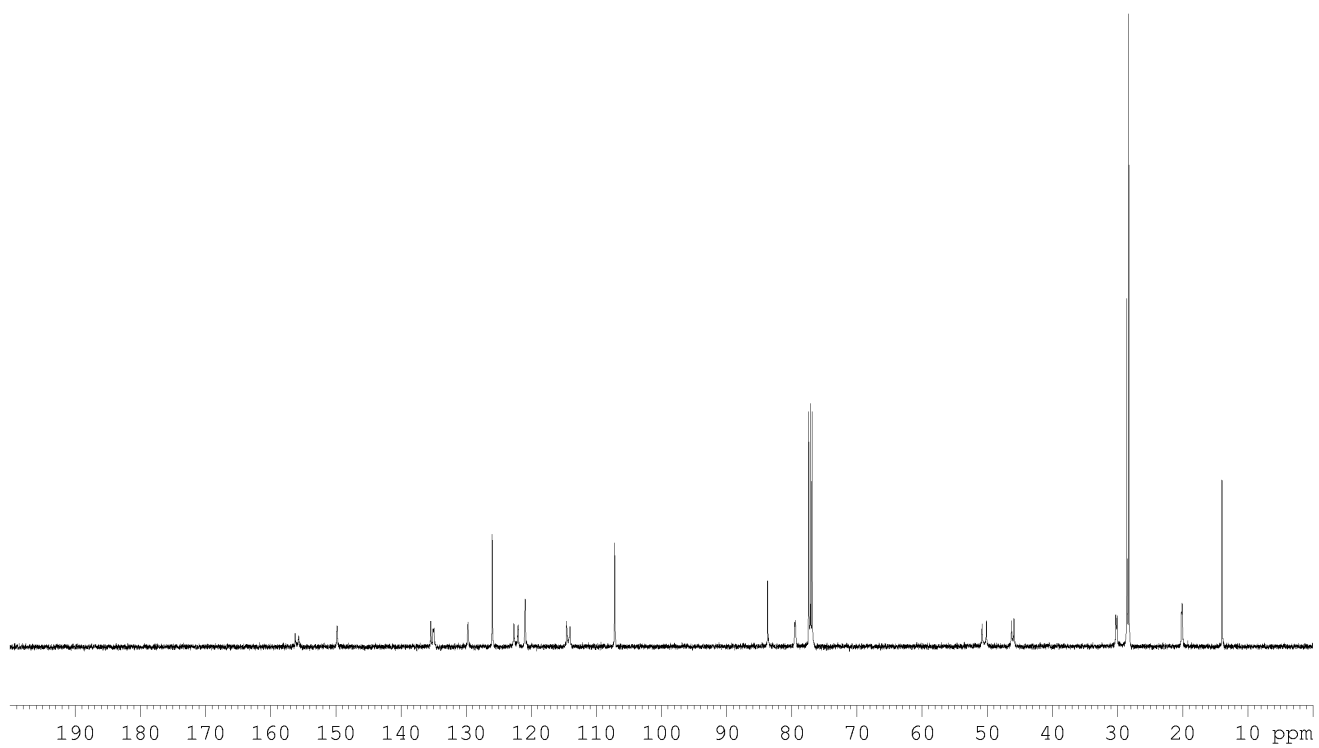
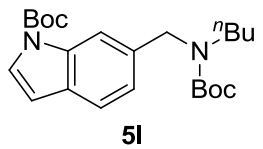
¹H NMR (500 MHz, CDCl₃) Spectrum of **5k**
S133



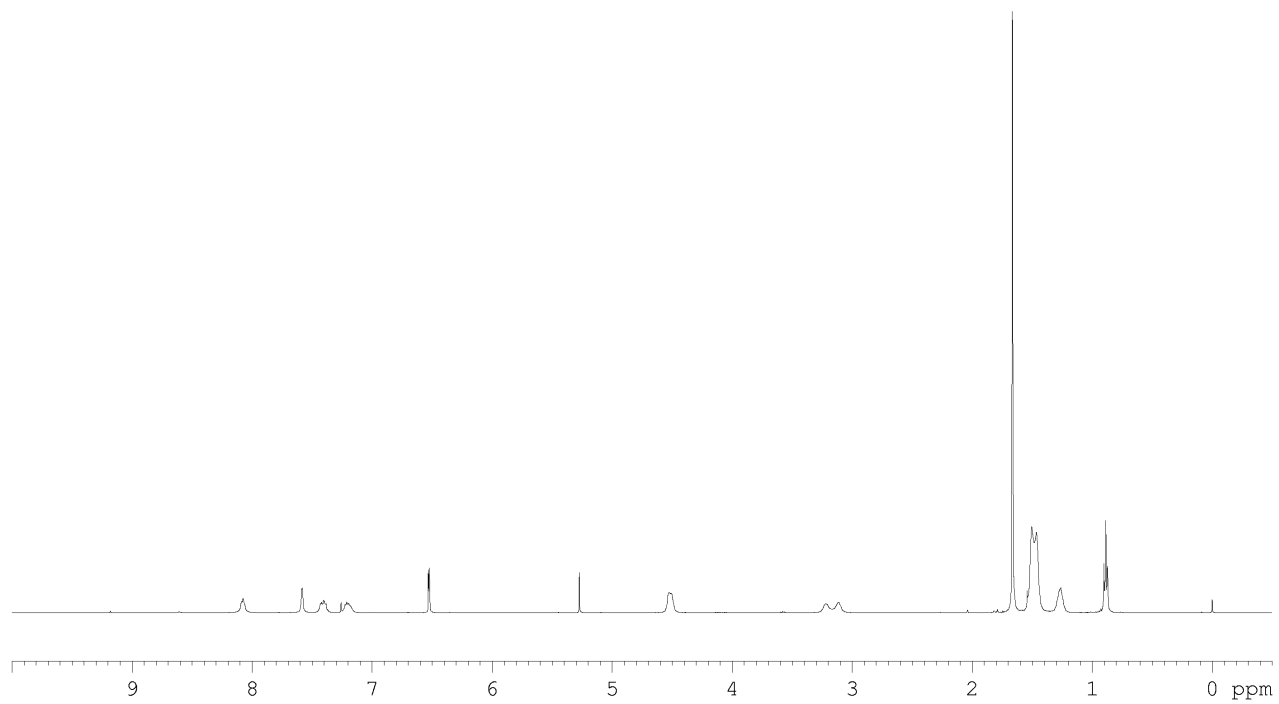
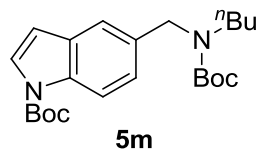
^{13}C NMR (125.8 MHz, CDCl_3) Spectrum of **5k**



¹H NMR (500 MHz, CDCl₃) Spectrum of **5I**

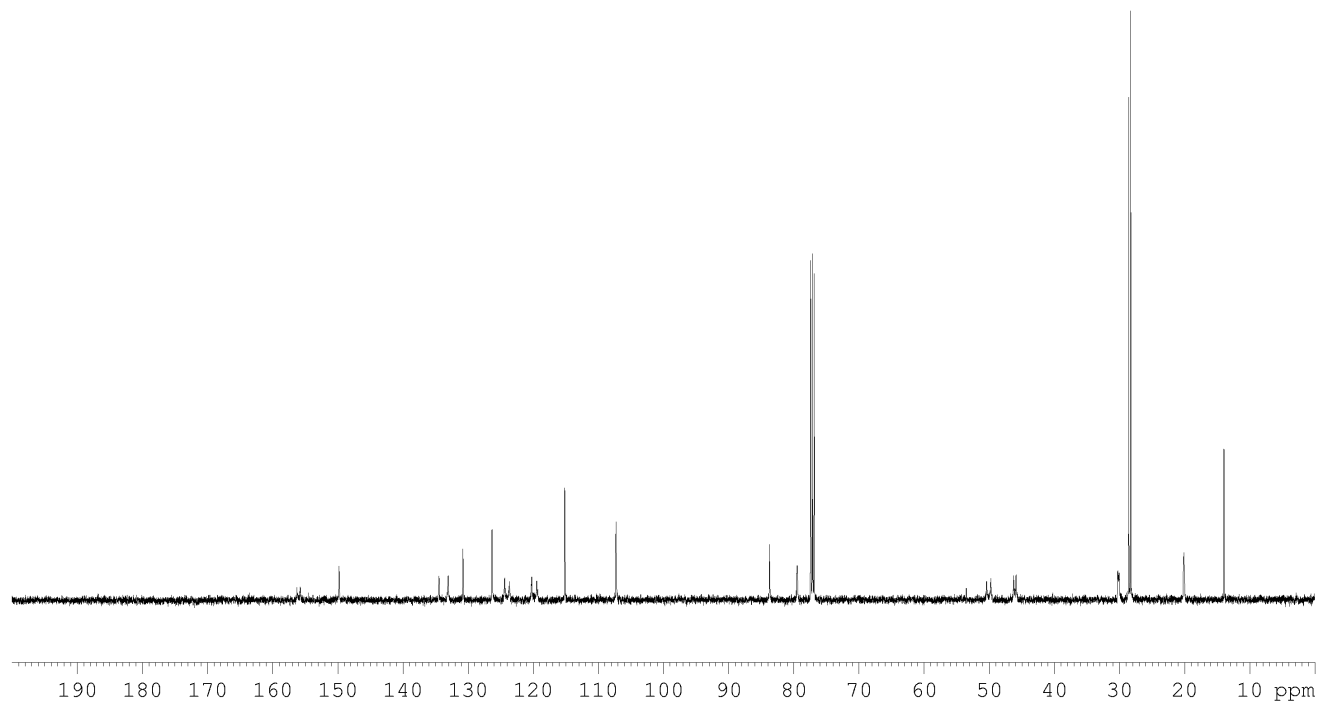
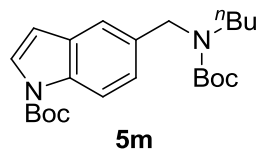


^{13}C NMR (125.8 MHz, CDCl_3) Spectrum of **5I**

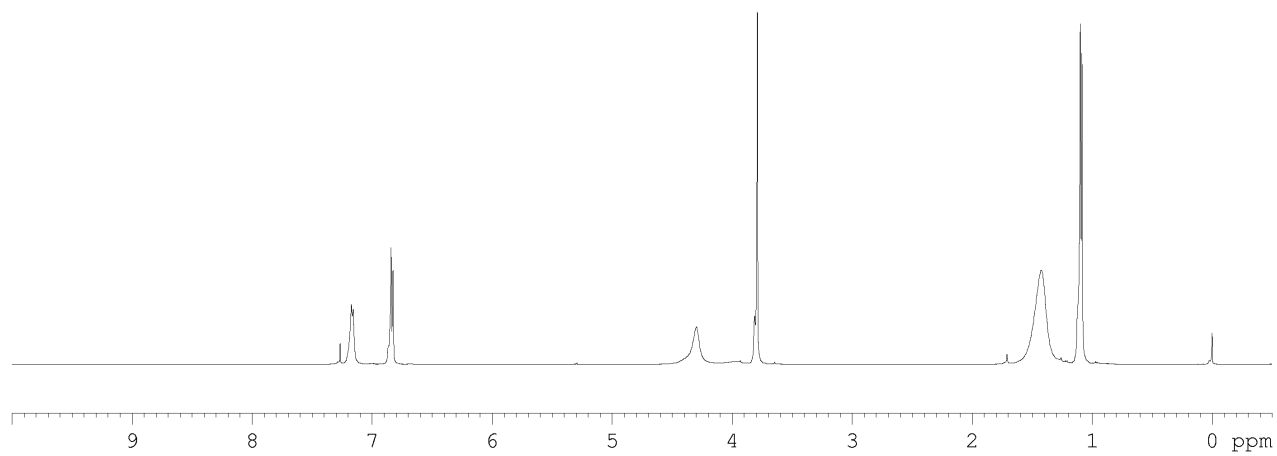
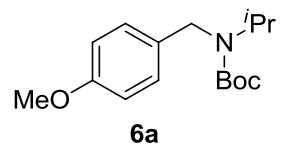


^1H NMR (500 MHz, CDCl_3) Spectrum of **5m**

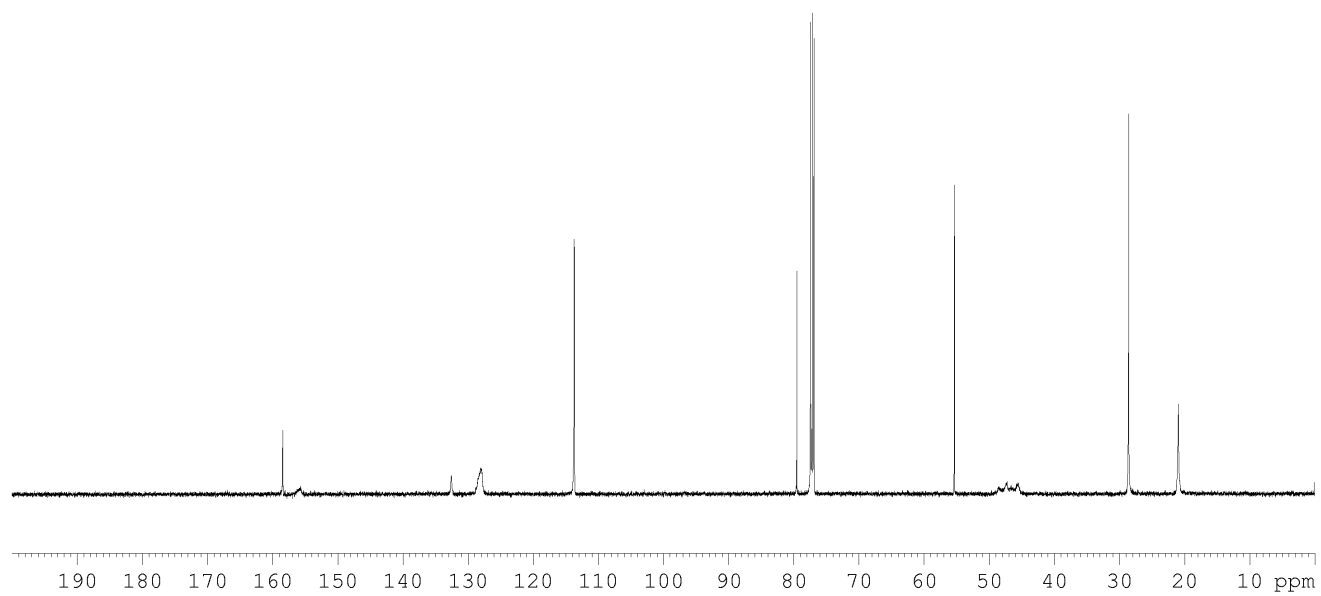
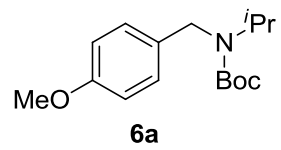
S137



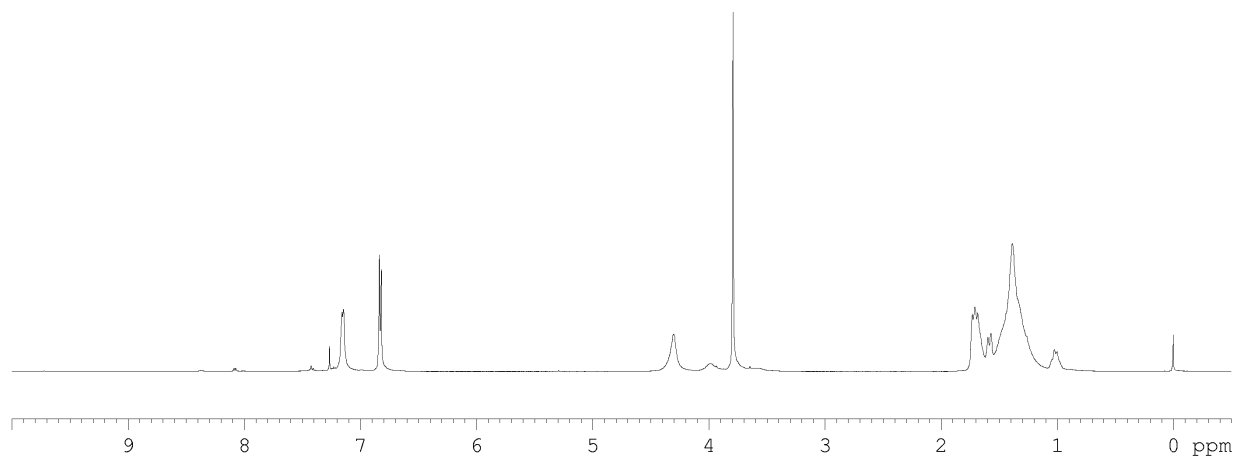
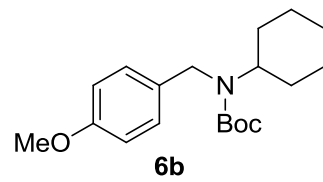
^{13}C NMR (125.8 MHz, CDCl_3) Spectrum of **5m**



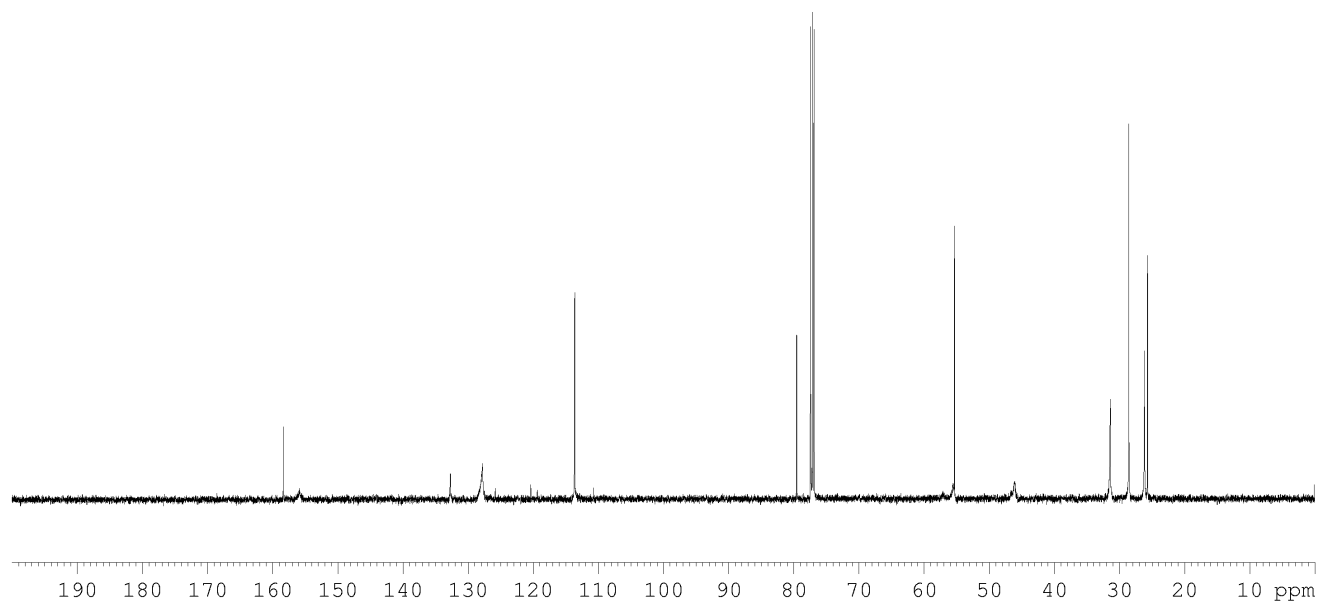
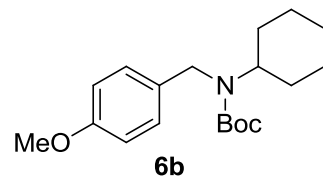
¹H NMR (500 MHz, CDCl₃) Spectrum of **6a**



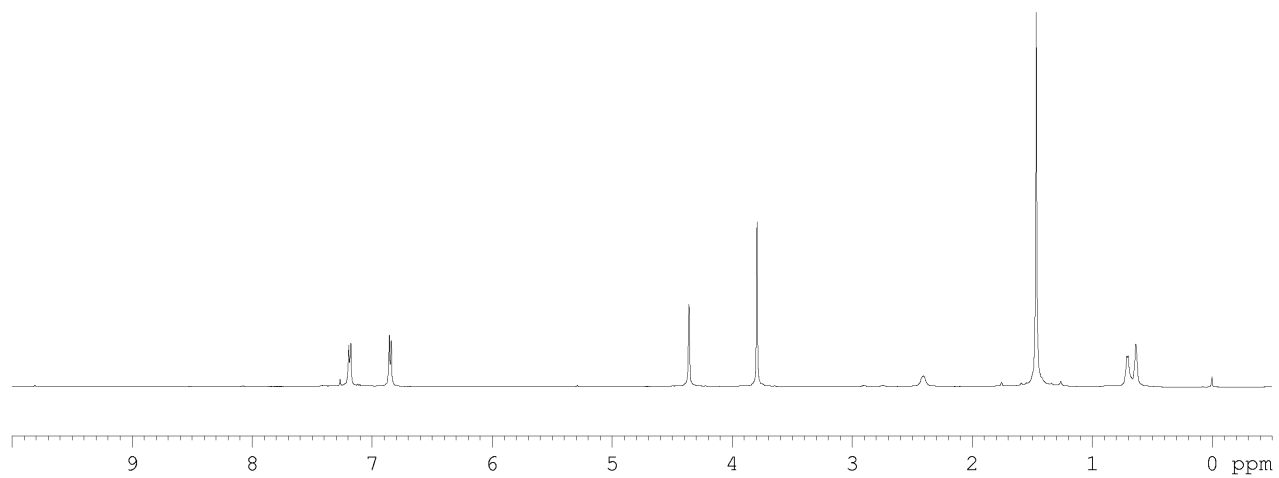
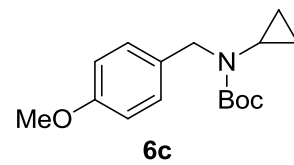
^{13}C NMR (125.8 MHz, CDCl₃) Spectrum of **6a**



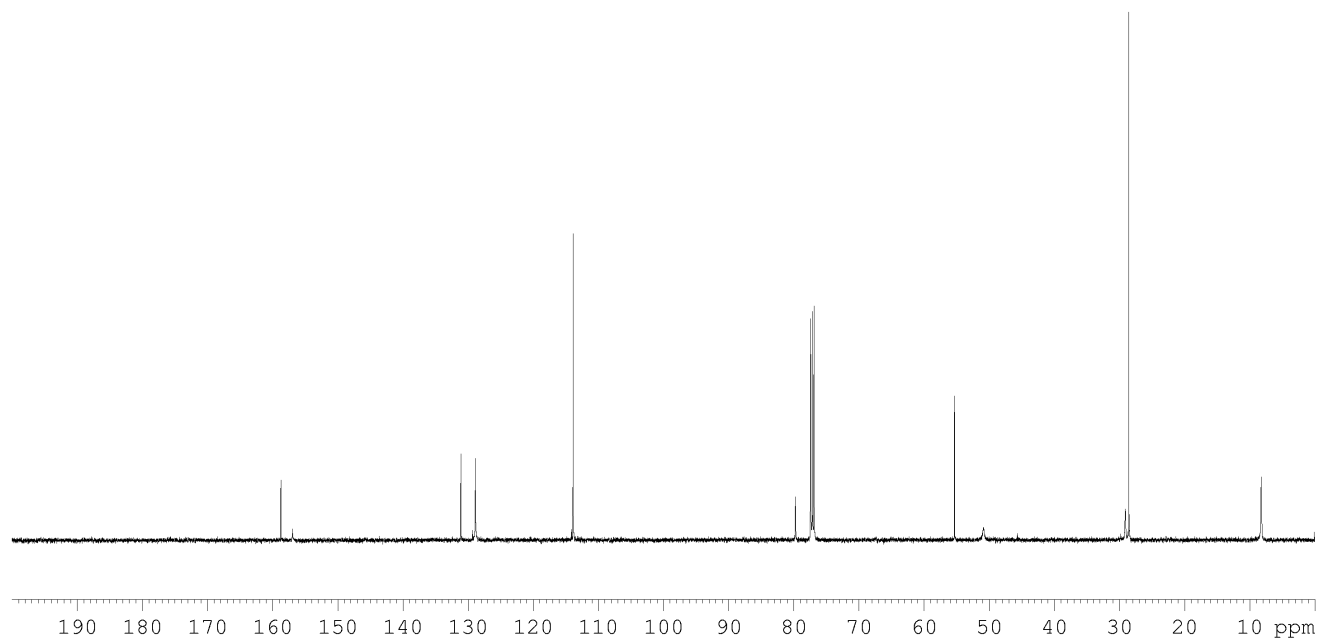
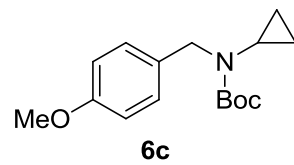
^1H NMR (500 MHz, CDCl_3) Spectrum of **6b**



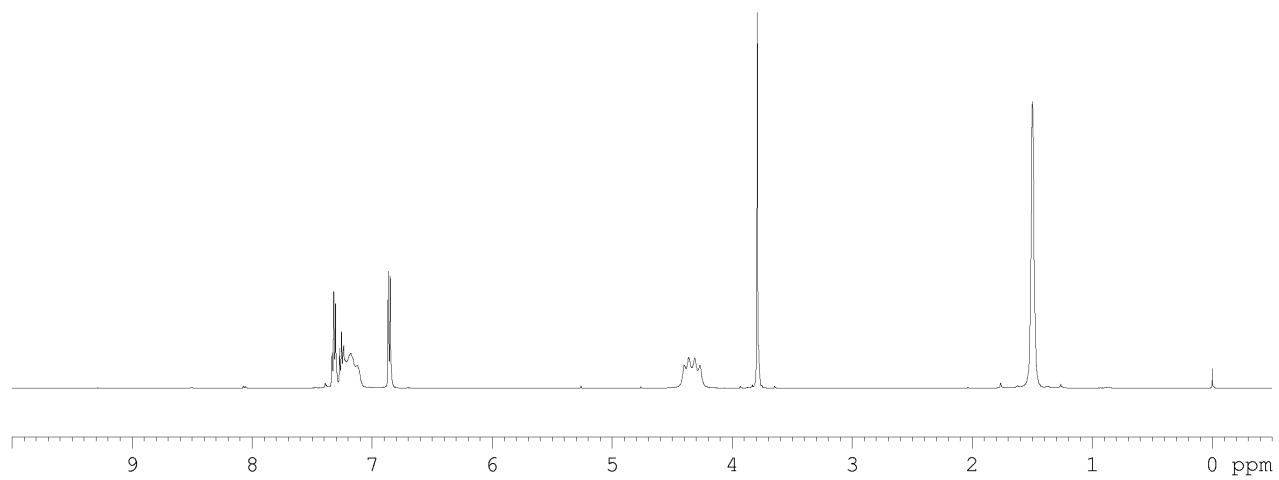
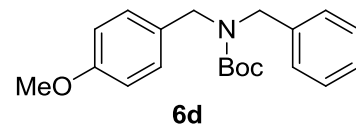
^{13}C NMR (125.8 MHz, CDCl_3) Spectrum of **6b**



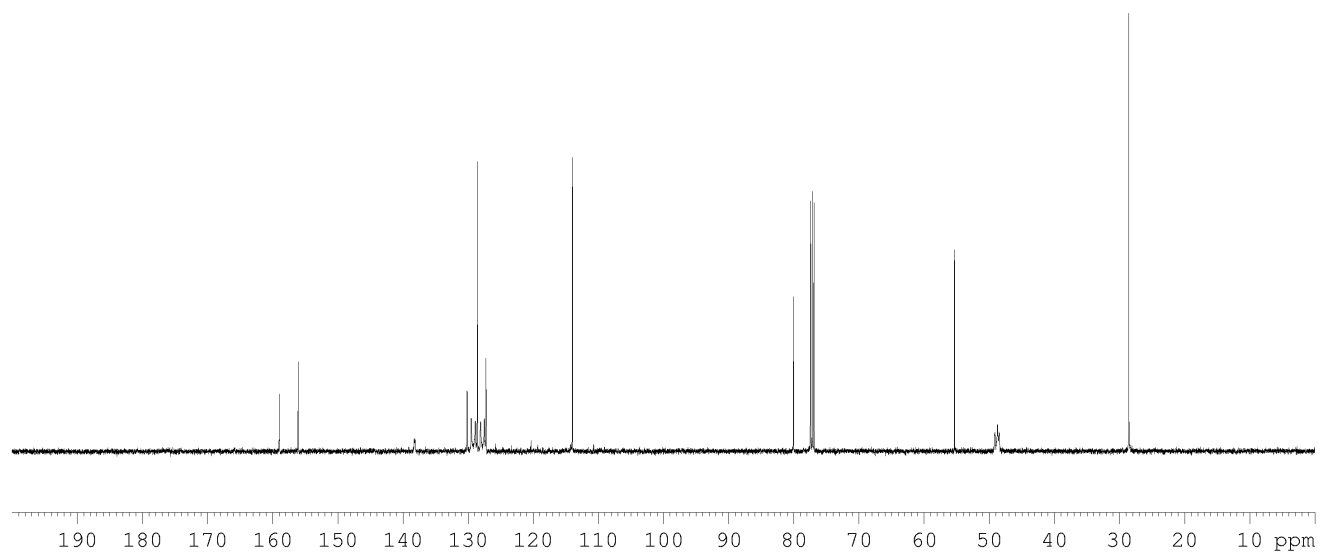
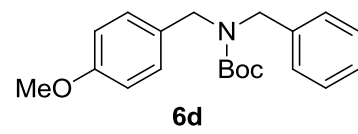
^1H NMR (500 MHz, CDCl_3) Spectrum of **6c**
S143



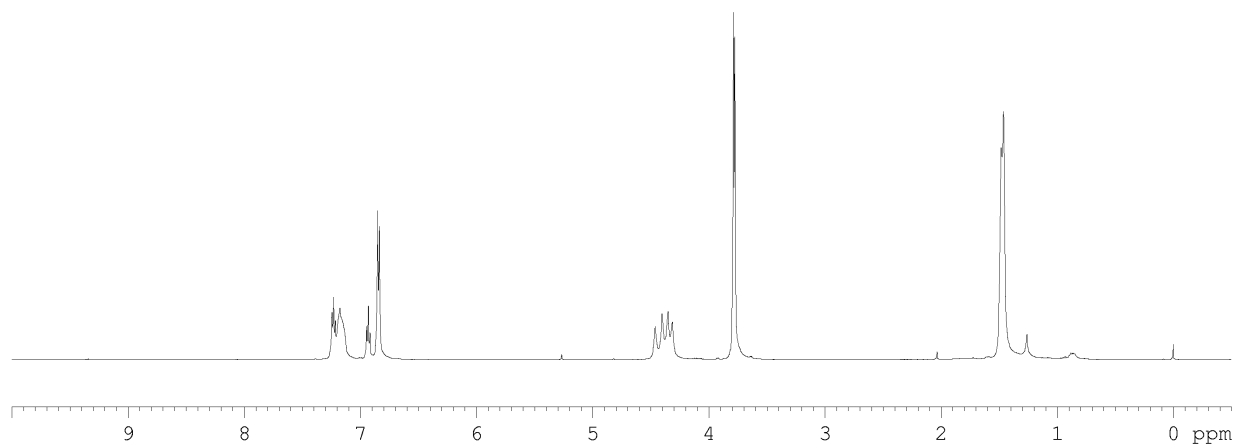
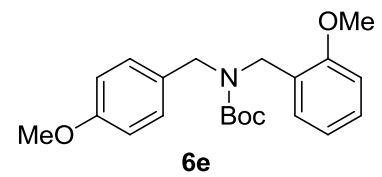
^{13}C NMR (125.8 MHz, CDCl₃) Spectrum of **6c**



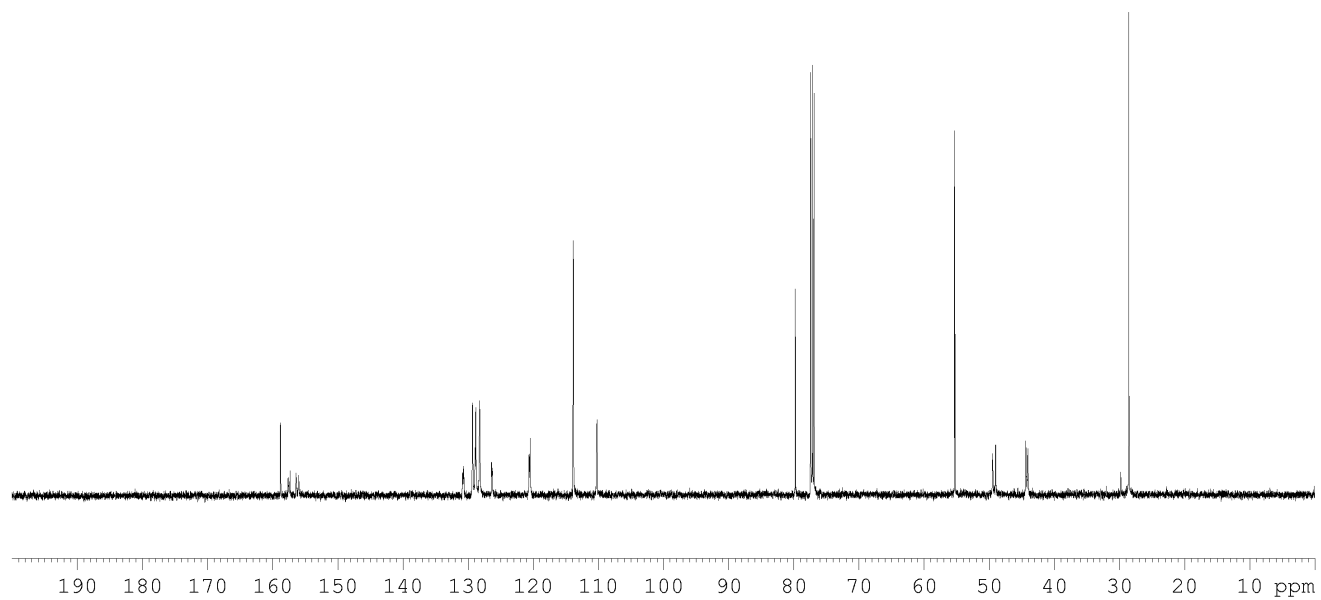
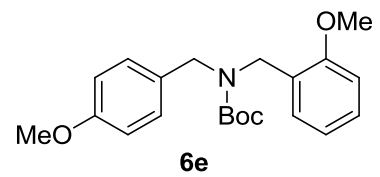
¹H NMR (500 MHz, CDCl₃) Spectrum of **6d**



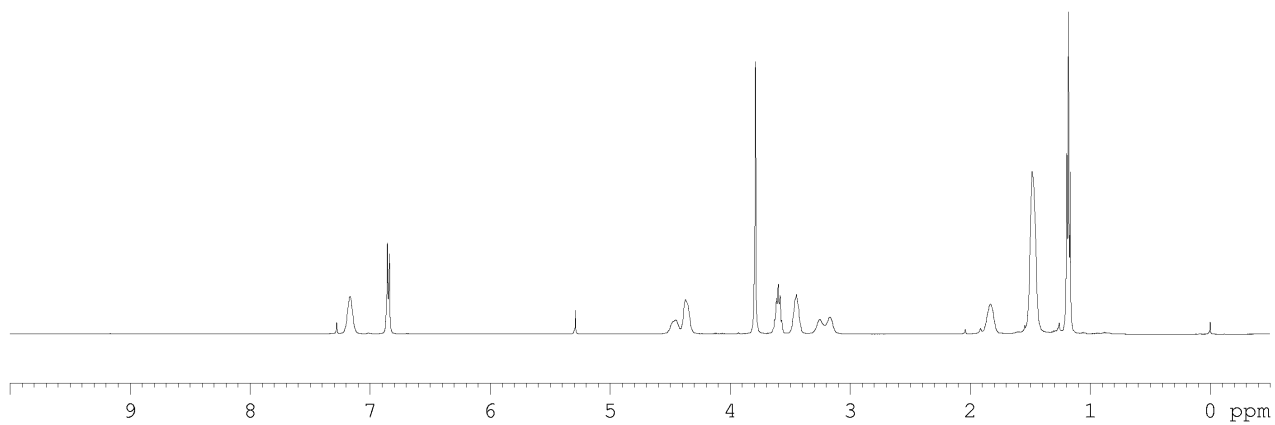
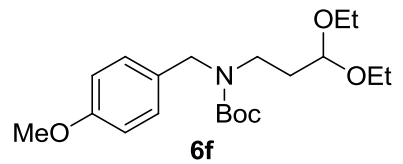
^{13}C NMR (125.8 MHz, CDCl_3) Spectrum of **6d**



$^1\text{H NMR}$ (500 MHz, CDCl_3) Spectrum of **6e**



^{13}C NMR (125.8 MHz, CDCl_3) Spectrum of **6e**



¹H NMR (500 MHz, CDCl₃) Spectrum of **6f**
S149

