Supporting Information

Synthesis of (±)-Amathaspiramide F and Discovery of an Unusual Stereocontrolling Element for the [2,3]-Stevens Rearrangement

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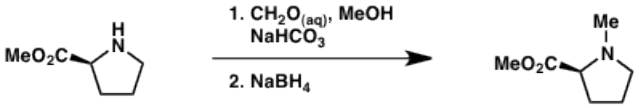
I. Materials and Methods

General Information: All reactions were carried out under an atmosphere of nitrogen with magnetic stirring unless otherwise indicated. Commercially obtained reagents were used as received. Solvents were dried by passage through an activated alumina column under argon. Liquids and solutions were transferred via syringe. All reactions were monitored by thin-layer chromatography with E. Merck silica gel 60 F254 pre-coated plates (0.25 mm). All purifications were performed on a Teledyne Isco CombiFlash® Rf unless otherwise indicated. ^{1}H and ^{13}C NMR spectra were recorded on Varian Inova-400 spectrometers. Data for ^{1}H NMR spectra are reported relative to chloroform as an internal standard (7.26 ppm) and are reported as follows: chemical shift (δ ppm), multiplicity, coupling constant (Hz), and integration. Data for ^{13}C NMR spectra are reported relative to chloroform as an internal standard (77.2 ppm) and are reported in terms of chemical shift (δ ppm). Infrared spectra were recorded on a Perkin-Elmer 1000 series FTIR. HRMS data were obtained at The Scripps Center for Mass Spectrometry.

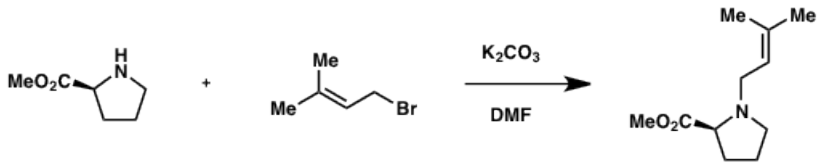
II. Synthesis of Aminoesters



7a

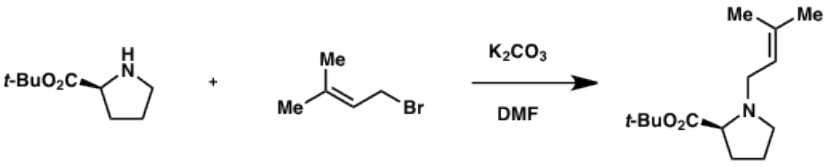
Methyl 1-methylpyrrolidine-2-carboxylate (7a): In a round-bottom flask, a solution of L-proline methyl ester hydrochloride (1.6 g, 10.0 mmol) in MeOH (10 mL) was cooled to 0 °C.

Solid $NaHCO_3$ (840 mg, 10 mmol) was added, and the reaction was stirred for 5 min. Aqueous formaldehyde (1.7 mL, 20 mmol, 35 wt%) was subsequently added, and the reaction was stirred for 2 h. The mixture was treated with $NaBH_4$ (570 mg, 15 mmol) in small portions. After 1 h, the solution was diluted with 1N NaOH (50 mL) and extracted with EtOAc (3 x 100 mL). The combined organic phase was washed with brine, dried over $MgSO_4$, and concentrated under reduced pressure. Purification by CombiFlash Rf (100% CH_2Cl_2 to 7:3 CH_2Cl_2:EtOAc with 1% MeOH eluent, 14 min) provided the desired product as a clear oil (1.16 g, 81%): Spectral data was identical to literature values.[1]



7b

Methyl 1-(3-methylbut-2-en-1-yl) pyrrolidine-2-carboxylate (7b): A round-bottom flask containing L-proline methyl ester hydrochloride (0.98 g, 5.9 mmol) in DMF (12 mL) was charged with K_2CO_3 (3.3 g, 23.6 mmmol) and 3,3-dimethylallyl bromide (1.06 g, 7.1 mmol). The reaction was stirred for 16 h and then diluted with H_2O (30 mL). The mixture was extracted with EtOAc (3 x 75 mL). The combined organic phase was washed with brine, dried over $MgSO_4$, and concentrated under reduced pressure. Purification by CombiFlash Rf (100% hexanes to 7:3 hexanes:EtOAc eluent, 12 min) provided the desired product as a clear oil (0.87 g, 75%): ^{1}H NMR (400 MHz, $CDCl_3$) δ 5.25 (t, *J* = 7.0 Hz, 1H), 3.67 (s, 3H), 3.26-3.20 (m, 1H), 3.16-3.02 (m, 3H), 2.32 (q, *J* = 8.2 Hz, 1H), 2.13-2.03 (m, 1.0), 1.94-1.84 (m, 2H), 1.80-1.64 (m, 1H), 1.67 (s, 3H), 1.61 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 174.6, 135.0, 120.9, 65.3, 53.4, 51.6, 29.4, 25.7, 23.0, 17.7; IR (film) 2952, 1748, 1435, 1277, 1196, 1171, 1039, 1005, 755 cm $^{-1}$; HRMS (ESI-TOF) calc'd for $[C_{11}H_{19}NO_2]^+$($[M+H]^+$): *m/z* 198.1488, found 198.1495.

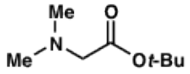


7c

***Tert*-butyl 1-(3-methylbut-2-en-1-yl) pyrrolidine-2-carboxylate (7c):** A round-bottom flask containing L-proline *tert*-butyl ester (690 mg, 4.0 mmol) in DMF (8.0 mL) was charged with K_2CO_3 (2.2 g, 16.0 mmmol) and 3,3,-dimethylallyl bromide (715 mg, 4.8 mmol). The reaction was stirred for 16 h and then diluted with H_2O (30 mL). The mixture was extracted with EtOAc (3 x 75 mL). The organic phase was washed with brine, dried over $MgSO_4$, and concentrated under reduced pressure. Purification by CombiFlash Rf (100% hexanes to 7:3 hexanes:EtOAc eluent, 12 min) provided the desired product as a clear oil (590 mg, 62%): ^{1}H NMR (400 MHz, $CDCl_3$) δ 5.22 (t, *J* = 7.0 Hz, 1H), 3.27-3.20 (m, 1H), 3.08-3.92 (m, 3H), 2.28 (q, *J* = 8.2 Hz, 1H), 2.05-1.94 (m, 1.0), 1.87-1.75 (m, 2H), 1.71-1.55 (m, 1H), 1.63 (s, 3H), 1.57 (s, 3H), 1.38 (s, 9H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 173.3, 134.3, 121.3, 80.2, 65.7, 53.3, 51.4, 29.2, 28.0, 25.8,

[1] Langenskioeld, T.; Lounasmaa, M. *Heterocycles*, **1983** , *20*, 671.

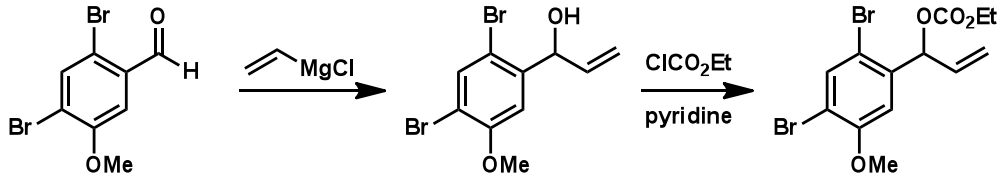
22.8, 17.8; IR (film) 2957, 1743, 1455, 1367, 1153, 848, 771 cm $^{-1}$; HRMS (ESI-TOF) calc'd for $[C_{14}H_{25}NO_2]^+$($[M+H]^+$): *m/z* 240.1958, found 240.1987.



11

***N,N*-Dimethylglycine *tert*-butyl ester (11):** The compound was synthesized according to a method reported in the literature. Spectral data was identical to literature values.[2]

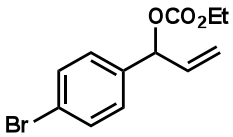
III. Synthesis of Ethyl 1-Arylallyl Carbonates



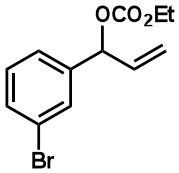
Ethyl 1-(2,4-dibromo-5-methoxyphenyl)allyl carbonate (6a): In a flame dried round-bottom flask, vinyl magnesium chloride (3.2 mL, 5.2 mmol, 1.6 M THF) was diluted in THF (15 mL) and cooled to –10 °C (acetone/ice). A solution of 2,4-dibromo-5-methoxylbenzaldehyde[3] (1.27 g, 4.3 mmol) in THF (3 mL) was added dropwise. After 1 h, the reaction was diluted with aqueous NH4Cl (50 mL) and extracted with EtOAc (3 x 100 mL). The organic phase was washed with brine, dried over $MgSO_4$, and concentrated under reduced pressure. Purification by CombiFlash Rf (100% hexanes to 8:2 hexanes:EtOAc eluent, 12 min) provided the desired vinyl alcohol as a white solid (1.11 g, 80%).

The obtained vinyl alcohol (1.11 g, 3.4 mmol) and pyridine (0.90 mL, 10.2 mmol) were dissolved in CH_2Cl_2 (7.0 mL). The reaction was cooled to 0 °C and charged dropwise with ethyl chloroformate (0.49 mL, 5.1 mmol). Upon complete addition, the reaction was allowed to warm to room temperature and monitored by TLC for full conversion. The mixture was diluted with EtOAc (100 mL) and washed with aqueous 1N HCl (2 x 30 mL), saturated aqueous $NaHCO_3$ (30 mL) and brine. Purification by CombiFlash Rf (100% hexanes to 8:2 hexanes:EtOAc eluent, 12 min) provided the desired product as a clear oil (1.3 g, 99%): ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.72 (s, 1H), 6.95 (s, 1H), 6.38 (dt, *J* = 5.9 Hz, *J* = 1.3 Hz, 1H), 6.00-5.90 (m, 1H), 5.35 (dt, *J* = 17.2 Hz, *J* = 1.2 Hz, 1H), 5.29 (dt, *J* = 10.5 Hz, *J* = 1.2 Hz, 1H), 4.25-4.17 (m, 2H), 3.88 (s, 3H), 1.31 (t, *J* = 7.2 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 155.8, 153.9, 138.2, 136.4, 133.9, 118.2, 113.0, 112.3, 110.9, 78.1, 64.5, 56.5, 14.2; IR (film) 2982, 1748, 1584, 1472, 1370, 1220, 1169, 1007, 874, 789 cm $^{-1}$; HRMS (ESI-TOF) calc'd for $[C_{13}H_{14}Br_2O_4]^+$($[M+Na]^+$): *m/z* 414.9151, found 414.9136.

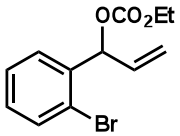
[2] Soheili, A.; Tambar, U. K. *J. Am. Chem. Soc.* **2011**, *133*, 12956.
[3] Osuna, M. R.; Aguirre, G.; Somanathan, R; Molins, E. *Tetrahedron: Asymmetr*y, **2002** , *13*, 2261



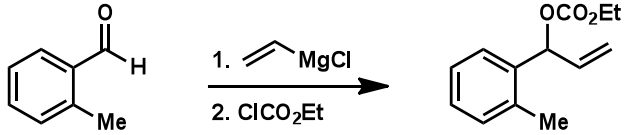
Ethyl 1-(4-bromophenyl)allyl carbonate (6b): Following the procedure for synthesizing carbonate **6a**, carbonate **6b** was obtained as a clear oil. Spectral data was identical to literature values.[2]



Ethyl 1-(3-bromophenyl)allyl carbonate (6c): Following the procedure for synthesizing carbonate **6a**, carbonate **6c** was obtained as a clear oil: ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.53 (t, J = 1.8 Hz, 1H), 7.44 (ddd, J = 7.4 Hz, J = 1.9 Hz, J = 1.2 Hz, 1H), 7.30 (d, J = 7.7 Hz, 1H), 7.23 (t, J = 7.8 Hz, 1H), 6.05-5.95 (m, 2H), 5.40-5.28 (m, 2H), 4.26-4.16 (m, 2H), 1.32 (t, J = 7.1 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 154.2, 140.6, 135.2, 131.4, 130.2, 130.0, 125.7, 122.7, 118.1, 79.0, 64.3, 14.2; IR (film) 2985, 1747, 1573, 1476, 1371, 1222, 1093, 1008, 937, 880, 787, 702 cm $^{-1}$; HRMS (ESI-TOF) calc'd for $[C_{12}H_{13}BrO_3]^+$([M+Na]$^+$): *m/z* 306.9940, found 306.9937.

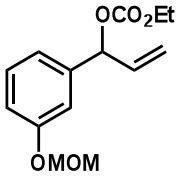


Ethyl 1-(2-bromophenyl)allyl carbonate (6d): Following the procedure for synthesizing carbonate **6a**, carbonate **6d** was obtained as a clear oil: ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.57 (dd, J = 8.0 Hz, J = 1.1 Hz, 1H), 7.47 (dd, J = 7.8 Hz, J = 1.7 Hz, 1H), 7.34 (td, J = 7.8 Hz, J = 1.1 Hz, 1H), 7.18 (td, J = 8.0 Hz, J = 1.7 Hz, 1H), 6.48 (dt, J = 5.8 Hz, J = 1.4 Hz, 1H), 6.05-5.96 (m, 1H), 5.37 (dt, J = 17.2 Hz, J = 1.5 Hz, 1H), 5.30 (dt, J = 10.5 Hz, J = 1.2 Hz, 1H), 4.27-4.15 (m, 2H), 1.31 (t, J = 7.1 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 154.1, 137.9, 134.3, 132.9, 129.6, 128.1, 127.8, 122.7, 117.9, 78.4, 64.3, 14.2; IR (film) 2983, 1746, 1573, 1476, 1371, 1221, 1093, 1005, 937, 880, 787, 702 cm $^{-1}$; HRMS (ESI-TOF) calc'd for $[C_{12}H_{13}BrO_3]^+$([M+Na]$^+$): *m/z* 306.9940, found 306.9937.



Ethyl 1-(2-methylphenyl)allyl carbonate (6e): In a flame dried round-bottom flask, vinyl magnesium chloride (4.4 mL, 7.0 mmol, 1.6 M THF) was diluted in THF (15 mL) and cooled to –10 °C (acetone/ice). A solution of 2-methylbenzaldehyde (600 mg, 5.0 mmol) in THF (3 mL) was added dropwise. After 45 min, the reaction was charged with ethyl chloroformate (813 mg, 7.5 mmol) dropwise and stirred for 10 min before warming to room temperature. After 1 h, the reaction was diluted with aqueous NH_4Cl (50 mL) and extracted with EtOAc (3 x 100 mL). The organic phase was washed with brine, dried over $MgSO_4$, and concentrated under reduced

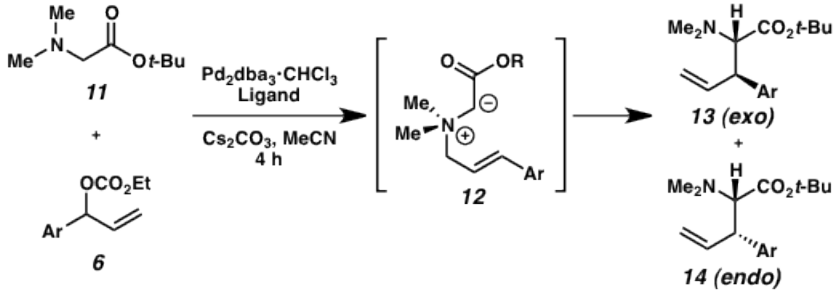
pressure. Purification by CombiFlash Rf (100% hexanes to 8:2 hexanes:EtOAc eluent, 12 min) provided the desired product as a clear oil (770 mg, 70%): ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.44-7.40 (m, 1H), 7.25-7.25 (m, 2H), 7.20-7.16 (m, 1H), 6.30 (dt, *J* = 5.9 Hz, *J* = 1.2 Hz, 1H), 6.09-5.99 (m, 1H), 5.29 (dt, *J* = 6.2 Hz, *J* = 1.3 Hz, 1H), 5.26 (d, *J* = 1.4 Hz, 1H), 4.27-4.14 (m, 2H), 2.41 (s, 3H), 1.31 (t, *J* = 7.1 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 154.5, 136.6, 135.5, 135.3, 130.5, 128.2, 126.8, 126.3, 117.4, 64.1, 19.2, 14.3; IR (film) 2985, 1747, 1371, 1221, 1087, 1008, 968, 939, 879, 790, 759, 729 cm $^{-1}$; HRMS (ESI-TOF) calc'd for $[C_{13}H_{16}O_3]^+$([M+Na]$^+$): *m/z* 243.0992, found 243.0998.



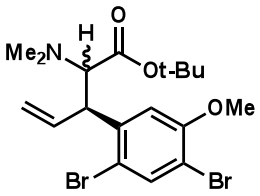
Ethyl 1-[3-(methoxymethoxy)phenyl]allyl carbonate (6f): Following the procedure for synthesizing carbonate **6e**, carbonate **6f** was obtained as a clear oil: ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.30-7.24 (m, 1H), 7.05-6.97 (m, 3H), 6.06-5.97 (m, 2H), 5.40-5.32 (m, 1H), 5.31-5.23 (m, 1H), 5.16 (s, 2H), 4.25-4.12 (m, 2H), 3.46 (s, 3H), 1.29 (t, *J* = 7.1 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 157.4, 154.3, 140.0, 135.7, 129.7, 120.4, 117.5, 115.9, 115.0, 94.4, 79.7, 64.1, 56.0, 14.2; IR (film) 2985, 1747, 1588, 1488, 1253, 1152, 1080, 1010, 924, 867, 789. 700 cm $^{-1}$; HRMS (ESI-TOF) calc'd for $[C_{14}H_{18}O_5]^+$([M+Na]$^+$): *m/z* 289.1046, found 289.1044.

IV. Table 1

General Information: All reactions were performed on a 0.40 mmol scale in 4 dram screw top vials unless otherwise indicated. The diastereomeric products were separated whenever possible, and reported ratios are based on crude ^{1}H NMR analysis. The spectral data for the major isomers are reported.

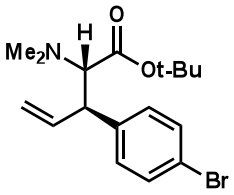


The typical procedure for the [2,3]-Stevens rearrangement is as follows: A vial fitted with a screw cap septum was charged with Pd_2dba_3•$CHCl_3$ (4.1 mg, 4 μmol), P(2-furyl)$_3$ (5.2 mg, 20 μmol), and Cs_2CO_3 (390 mg, 1.2 mmol). The reaction vial was placed under vacuum for several minutes and then back-filled with nitrogen. This purging procedure was repeated twice. The vial was sequentially charged with MeCN (2.0 mL), ethyl 1-arylallyl carbonate (0.40 mmol), and glycine ester (0.60 mmol). After stirring for 4-16 h at room temperature, the reaction was filtered through a Büchner funnel under vacuum filtration with EtOAc and then concentrated under reduced pressure. Purification on a Teledyne Isco CombiFlash® Rf provided the desired product.



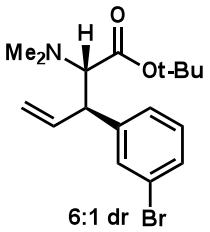
1:1 dr

Table 1, Entry 1: Following the typical procedure for the [2,3]-Stevens rearrangement, purification (100% hexanes to 85:15 hexanes:EtOAc eluent, 12 min) provided the product as light yellow solid (160 mg, 0.34 mmol, 85%). **Diastereomer 1:** ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.71 (s, 1H), 6.70 (s, 1H), 5.74 (ddd, *J* = 17.0 Hz, *J* = 10.2 Hz, *J* = 7.9 Hz, 1H), 5.14 (dt, *J* = 17.0 Hz, *J* = 1.2 Hz, 1H), 5.09 (d, *J* = 10.1 Hz, 1H), 4.27 (dd, *J* = 11.7 Hz, *J* = 8.1, 1H), 3.88 (s, 3H), 3.49 (d, *J* = 11.7 Hz, 1H), 2.28 (s, 6H), 1.51 (s, 9H); ^{13}C NMR (151 MHz, $CDCl_3$) δ 169.2, 155.3, 140.1, 136.5, 136.3, 117.8, 115.5, 112.0, 110.3, 81.6, 70.6, 56.3, 48.4, 41.3, 28.4; IR (film) 2976, 2935, 1723, 1473, 1366, 1247, 1147, 1055, 844, 697 cm $^{-1}$; HRMS (ESI-TOF) calc'd for $[C_{18}H_{25}Br_2NO_3]^+$($[M+H]^+$): *m/z* 462.0274, found 462.0277.
Diastereomer 2: ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.72 (s, 1H), 6.72 (s, 1H), 5.98 (ddd, *J* = 17.3 Hz, *J* = 10.3 Hz, 7.3 Hz, 1H), 5.12 (dt, *J* = 10.3 Hz, *J* = 1.3 Hz, 1H), 5.06 (dt, *J* = 17.2 Hz, *J* = 1.4 Hz, 1H), 4.27 (dd, *J* = 11.7 Hz, *J* = 7.3, 1H), 3.88 (s, 3H), 3.51 (d, *J* = 11.7 Hz, 1H), 2.46 (s, 6H), 1.19 (s, 9H); ^{13}C NMR (151 MHz, $CDCl_3$) δ 168.4, 155.3, 140.2, 137.5, 136.3, 116.8, 116.0, 112.1, 110.4, 81.2, 71.9, 56.5, 47.2, 41.5, 27.9; IR (film) 2978, 2933, 1722, 1473, 1366, 1247, 1147, 1055, 922, 872, 697 cm $^{-1}$; HRMS (ESI-TOF) calc'd for $[C_{18}H_{25}Br_2NO_3]^+$($[M+H]^+$): *m/z* 462.0274, found 462.0277.



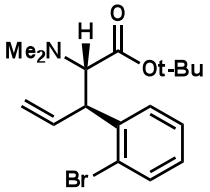
7:1 dr

Table 1, Entry 2. Following the typical procedure for the [2,3]-Stevens rearrangement, purification by flash chromatography (9:1 to 8:2 hexanes:Et_2O gradient eluent) provided the product as a white solid (126 mg, 0.35 mmol, 89%). **Major Diastereomer (13b):** ^{1}H NMR (600 MHz, $CDCl_3$) δ 7.40 (d, *J* = 8.0 Hz, 2H), 7.09 (d, *J* = 8.0 Hz, 2H), 6.09-6.02 (m, 1H), 5.11 (d, *J* = 10.0 Hz, 1H), 5.04 (d, *J* = 17.0 Hz, 1H), 3.66 (dd, *J* = 12.0 Hz, *J* = 9.0 Hz, 1H), 3.39 (d, *J* = 12.0 Hz, 1H), 2.41 (s, 6H), 1.19 (s, 9H); ^{13}C NMR (151 MHz, $CDCl_3$) δ 160.0, 140.1, 138.9, 131.6, 130.5, 120.7, 116.4, 81.1, 72.2, 49.4, 41.4, 28.2; IR (film) 2977, 2936, 1722, 1367, 1488, 1257, 1147 cm^{-1}; HRMS (ESI-TOF) calc'd for $[C_{17}H_{24}BrNO_2]^+$($[M+H]^+$): *m/z* 354.1063, found 354.1073. The relative stereochemistry of the major diastereomer **13b** was determined by x-ray analysis of a single crystal (vide infra).



6:1 dr

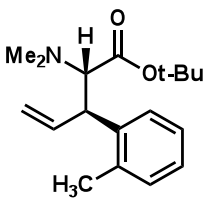
Table 1, Entry 3: Following the typical procedure for the [2,3]-Stevens rearrangement, purification (100% hexanes to 85:15 hexanes:EtOAc eluent, 12 min) provided the product as a light yellow solid (113 mg, 0.32 mmol, 80%). **Major Diastereomer (13c):** ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.40-7.36 (m, 1H), 7.36-7.31 (m, 1H), 7.18-7.14 (m, 2H), 6.07 (ddd, *J* = 17.1 Hz, *J* = 10.2 Hz, *J* = 8.3 Hz, 1H), 5.15 (d, *J* = 10.2, Hz, 1H), 5.09 (dt, *J* = 17.1 Hz, *J* = 1.3 Hz, 1H), 3.66 (dd, *J* = 11.8 Hz, *J* = 8.2 Hz, 1H), 3.42 (d, *J* = 11.8 Hz, 1H), 2.43 (s, 6H), 1.21 (s, 9H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 168.8, 143.3, 138.5, 131.7, 129.9, 129.8, 127.2, 122.3, 116.5, 81.0, 71.9, 49.5, 41.2, 27.9; IR (film) 2977, 2935, 1722, 1475, 1367, 1258, 1146, 1073, 779, 698 cm^{-1}; HRMS (ESI-TOF) calc'd for $[C_{17}H_{24}BrNO]^{+}$([M+H]$^{+}$): *m/z* 354.1063, found 354.1067. The relative stereochemistry of the major diastereomer **13c** was determined by x-ray analysis of a single crystal (vide infra).



2:1 dr

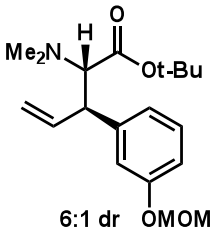
Table 1, Entry 4: Following the typical procedure for the [2,3]-Stevens rearrangement, purification (100% hexanes to 85:15 hexanes:EtOAc eluent, 12 min) provided the product as light yellow solid (131 mg, 0.37 mmol, 93%). **Major Diastereomer (13d):** ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.50 (d, *J* = 8.4 Hz, 2H), 7.32-7.18 (m, 1H), 7.07-7.02 (m, 1H), 5.98 (ddd, *J* = 17.5 Hz, *J* = 10.4 Hz, *J* = 7.7 Hz, 1H), 5.13-5.06 (m, 2H), 4.36 (dd, *J* = 11.8 Hz, *J* = 7.7 Hz, 1H), 3.56 (d, *J* = 11.8 Hz, 1H), 2.47 (s, 6H), 1.15 (s, 9H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 168.5, 139.8, 138.1, 133.1, 128.9, 128.0, 125.5, 127.56, 116.4, 80.9, 71.9, 47.2, 41.4, 27.8; IR (film) 2978, 2936, 1724, 1471, 1367, 1257, 1147, 1022, 920, 753 cm^{-1}; HRMS (ESI-TOF) calc'd for $[C_{17}H_{24}BrNO]^{+}$([M+H]$^{+}$): *m/z* 354.1063, found 354.1053.

Minor Diastereomer (14d): ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.54 (d, *J* = 8.0 Hz, 2H), 7.28-7.19 (m, 1H), 7.08-7.03 (m, 1H), 5.75 (ddd, *J* = 17.6 Hz, *J* = 10.1 Hz, *J* = 7.6 Hz, 1H), 5.16-5.04 (m, 2H), 4.35 (m, 1H), 3.56 (d, *J* = 13.5 Hz, 1H), 2.04 (s, 6H), 1.49 (s, 9H). The relative stereochemistry of the minor diastereomer **14d** was determined by x-ray analysis of a single crystal (vide infra).



2:1 dr

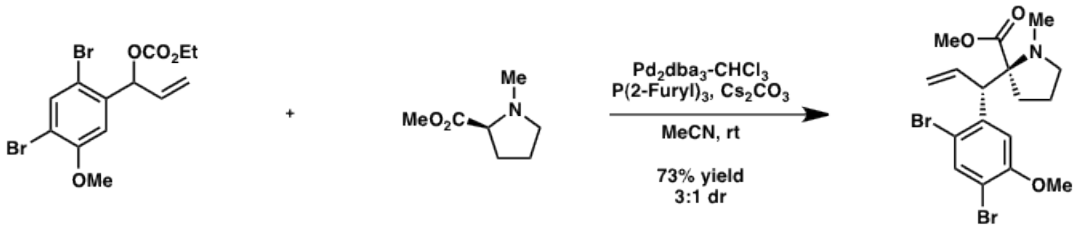
Table 1, Entry 5: Following the typical procedure for the [2,3]-Stevens rearrangement, purification (100% hexanes to 85:15 hexanes:EtOAc eluent, 12 min) provided the product as a clear oil (90 mg, 0.31 mmol, 78%). **Major Diastereomer (13e):** ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.23-7.04 (m, 4H), 6.03 (ddd, *J* = 17.0 Hz, *J* = 10.2 Hz, *J* = 7.9 Hz, 1H), 5.08, (d, *J* = 10.2 Hz, 1H), 5.02 (d, *J* = 17.2 Hz, 1H), 4.01 (dd, *J* = 11.8 Hz, *J* = 8.0 Hz, Hz, 1H), 3.57 (d, *J* = 11.8 Hz, 1H), 2.47 (s, 6H), 2.39 (s, 3H), 1.12 (s, 9H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 169.2, 139.2, 138.7, 136.4, 130.4, 127.2, 126.4, 125.9, 115.5, 80.5, 71.9, 44.2, 41.3, 27.8, 19.8; IR (film) 2936, 1722, 1454, 1367, 1257, 1221, 1037, 917, 844, 754 cm^{-1}; HRMS (ESI-TOF) calc'd for $[C_{18}H_{27}NO_2]^+$($[M+H]^+$): *m/z* 290.2114, found 290.2123.
Minor Diastereomer (14e): ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.23-7.06 (m, 4H), 5.73 (ddd, *J* = 17.0, *J* = *J* = 10.1, *J* = 8.2 Hz, 1H), 5.07-4.95 (m, 2H), 3.97 (dd, *J* = 11.3, *J* = 8.3 Hz, 1H), 3.58 (d, *J* = 11.3 Hz, 1H), 2.37 (s, 3H), 2.26 (s, 6H), 1.50 (s, 9H). The relative stereochemistry of the minor diastereomer **14e** was determined by x-ray analysis of a single crystal (vide infra).



6:1 dr

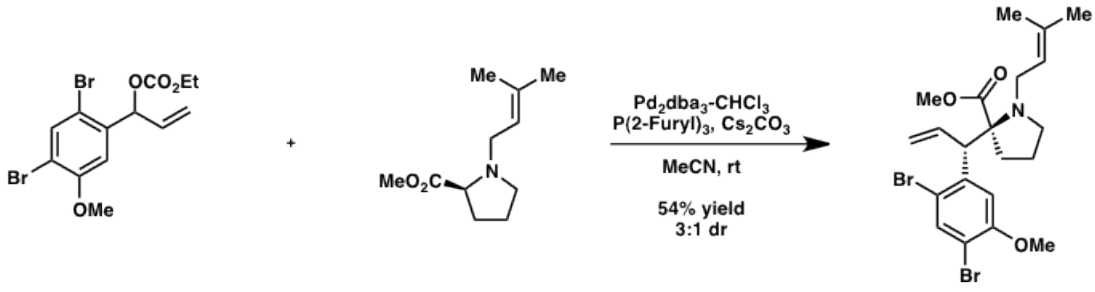
Table 1, Entry 6: Following the typical procedure for the [2,3]-Stevens rearrangement, purification (100% hexanes to 8:2 hexanes:EtOAc eluent, 12 min) provided the product as a clear oil (117 mg, 0.35 mmol, 87%). **Major Diastereomer (13f):** ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.18 (t, *J* = 7.6 Hz, 1H), 6.93-6.82 (m, 3H), 6.07 (ddd, *J* = 16.6 Hz, *J* = 10.6 Hz, *J* = 8.5 Hz, 1H), 5.16-5.12 (m, 1H), 5.15 (s, 2H), 5.11 – 5.07 (m, 1H), 3.66 (dd, *J* = 11.7 Hz, *J* = 8.6 Hz, 1H), 3.51 – 3.40 (m, 4H), 2.43 (s, 6H), 1.18 (s, 9H); ^{13}C NMR (151 MHz, $CDCl_3$) δ 169.0, 157.2, 142.4, 139.0, 129.3, 122.0, 116.7, 115.9, 114.3, 94.3, 80.7, 72.0, 55.9, 49.9, 41.2, 27.9; IR (film) 2977, 2936, 1722, 1599, 1487, 1454, 1367, 1257, 1150, 1080, 1020, 922, 789, 701 cm^{-1}; HRMS (ESI-TOF) calc'd for $[C_{19}H_{29}NO_4]^+$($[M+H]^+$): *m/z* 336.2169, found 336.2159.

V. Scheme 2 Compounds



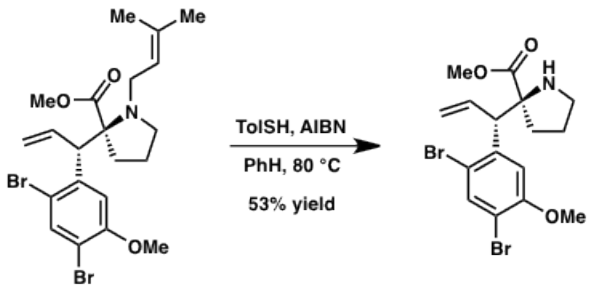
6a *7a* *8b*

Compound 8b: Following the typical procedure for the [2,3]-Stevens rearrangement, purification (100% hexanes to 85:15 hexanes:EtOAc eluent, 12 min) provided the product as light yellow solid (770 mg, 1.72 mmol, 78%): ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.72 (s, 1H), 7.08 (s, 1H), 6.10 (ddd, J = 17.4 Hz, J = 10.3 Hz, J = 7.5 Hz, 1H), 5.10 (d, J = 10.3, 1H), 5.04 (d, J = 17.1 Hz, 1H), 4.62 (d, J = 7.5 Hz, 1H), 3.85 (s, 3H), 3.76 (s, 3H), 2.97 (t, J = 7.6 Hz, 1H), 2.59 (q, J = 9.3 Hz, 1H), 2.39–2.29 (m, 1H), 2.28 (s, 3H), 2.12 (ddd, J = 13.6 Hz, J = 9.8 Hz, J = 3.8 Hz, 1H), 1.86–1.61 (m, 2H); ^{13}C NMR (151 MHz, $CDCl_3$) δ 173.5, 154.7, 140.7, 137.9, 136.0, 117.4, 117.0, 113.4, 110.1, 74.1, 56.2, 55.6, 52.1, 51.2, 37.3, 33.1, 22.5; IR (film) 2948, 2844, 1722, 1581, 1471, 1365, 1248, 1215, 1190, 1056, 999, 920, 874, 698 cm^{-1}; HRMS (ESI-TOF) calc'd for $[C_{17}H_{21}Br_2NO_3]^+$([M+H]$^+$): *m/z* 445.9961, found 445.9965. The relative stereochemistry of the major diastereomer **8b** was determined by x-ray analysis of a single crystal (vide infra).



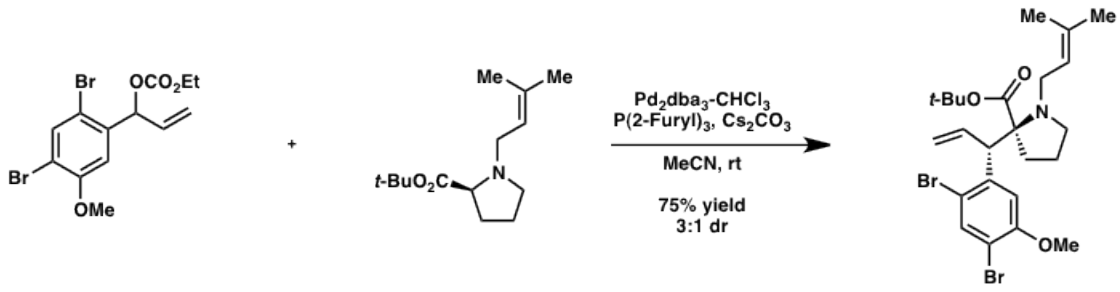
6a *7b* *9b*

Compound 9b: Following the typical procedure for the [2,3]-Stevens rearrangement, purification (100% hexanes to 8:2 hexanes:EtOAc eluent, 12 min) provided the product as light yellow solid (280 mg, 0.56 mmol, 56%): ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.72 (s, 1H), 7.09 (s, 1H), 6.16–6.04 (m, 1H), 5.09 (dt, *J* = 10.2 Hz, *J* = 1.4 Hz, 1H), 5.03 (dt, *J* = 17.0 Hz, *J* = 1.5 Hz, 1H), 4.90 (t, *J* = 6.9 Hz, 1H), 4.65 (d, *J* = 7.5 Hz, 1H), 3.85 (s, 3H), 3.77 (s, 3H), 3.30 (dd, *J* = 13.6 Hz, *J* = 5.6 Hz, 1H), 3.05 (t, *J* = 9.4 Hz, 1H), 2.75 (dd, *J* = 13.3 Hz, *J* = 8.5 Hz, 1H), 2.45 (q, *J* = 9.2 Hz, 1H), 2.37–2.24 (m, 1H), 2.18–2.02 (m, 1H), 1.87–1.65 (m, 2H), 1.64 (s, 3H), 1.53 (s, 3H); ^{13}C NMR (151 MHz, $CDCl_3$) δ 173.9, 154.7, 140.7, 137.8, 136.0, 133.4, 122.5, 117.4, 117.1, 113.6, 110.0, 73.9, 56.3, 52.4, 52.1, 51.3, 47.8, 33.0, 25.8, 22.3, 17.8; IR (film) 2968, 2948, 1721, 1473, 1365, 1248, 1212, 1152, 1057, 920, 872 cm^{-1}; HRMS (ESI-TOF) calc'd for $[C_{21}H_{27}Br_2NO_3]^+$([M+H]$^+$): *m/z* 500.0430, found 500.0429. The relative stereochemistry of the major diastereomer **9b** was determined by converting it to **S1** (vide infra).



9b *S1*

Compound S1: Our procedure was modified from a method reported in the literature for the cleavage of N-prenyl groups[4]: In a round-bottom flask, a solution of compound **9b** (120 mg, 0.30 mmol) in degassed benzene (3.0 mL) was sequentially charged with 4-methylbenzenethiol (56 mg, 0.45 mmol) and AIBN (10 mg, 0.06 mmol). The solution was heated to reflux for 14 h then cooled to room temperature and quenched with 1N HCl (10 mL). The aqueous layer was washed with Et_2O (30 mL) and then basified using Na_2CO_3. The aqueous layer was extracted with EtOAc (3 x 30 mL), washed with brine, dried over $MgSO_4$, and concentrated under reduced pressure. Purification by CombiFlash Rf (100% hexanes to 7:3 hexanes:EtOAc eluent, 14 min) provided the product as a single diastereomer (55 mg, 0.16 mmol, 53%). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.64 (s, 1H), 7.57 (s, 1H), 6.05 (ddd, J = 17.1, J = 10.1, J = 9.1 Hz, 1H), 5.22 (dd, J = 17.1, J = 1.8, Hz, 1H), 5.17 (dd, J = 10.1, J = 1.8 Hz, 1H), 4.23 (d, J = 9.1 Hz, 1H), 3.87 (s, 3H), 3.52 (s, 3H), 3.14-3.06 (m, 1H), 2.88-2.80 (m, 1H), 2.25-2.27 (m, 1H), 2.13-2.04 (m, 1H), 1.83-1.73 (m, 1H), 1.58–1.45 (m, 1H). ^{13}C NMR (151 MHz, $CDCl_3$) δ 172.1, 150.4, 136.3, 131.9, 131.1, 113.7, 109.9, 107.9, 105.6, 67.5, 51.7, 49.2, 47.6, 43.9, 31.4, 21.3. IR (film) 2949, 1729, 1471, 1365, 1249, 1129, 1053. HRMS (ESI-TOF) calc'd for $[C_{16}H_{19}Br_2NO_3]^+$($[M+H]^+$): *m/z* 431.9804, found 431.9807. The relative stereochemistry of **S1** was determined by x-ray analysis of a single crystal (vide infra).

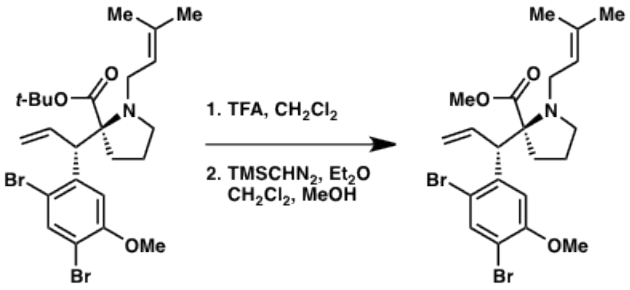


6a *7c* *10b*

Compound 10b: Following the typical procedure for the [2,3]-Stevens rearrangement, purification (100% hexanes to 8:1 hexanes:EtOAc eluent, 12 min) provided the product as light yellow solid (160 mg, 0.30 mmol, 75%): ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.70 (s, 1H), 7.10 (s, 1H), 6.14-6.01 (m, 1H), 5.06 (dt, J = 10.3, J = 1.4 Hz, 1H), 4.99 (dt, J = 17.1, J = 1.5 Hz, 1H), 4.82 (t, J = 8.4 Hz, 1H), 4.65 (dd, J = 7.5, J = 1.2 Hz, 1H), 3.83 (s, 3H), 3.33 (dd, J = 13.4, J = 3.0 Hz, 1H), 3.16-3.01 (m, 2H), 2.84 (dd, J = 13.4, J = 8.6 Hz, 1H), 2.52-2.41 (m, 1H), 2.31-2.22 (m, 1H), 2.13-2.02 (m, 1H), 1.85-1.75 (m, 1H), 1.62 (s, 3H), 1.52 (s, 12H); ^{13}C NMR (151 MHz, $CDCl_3$) δ 172.3, 154.6, 140.8, 138.0, 135.9, 133.1, 122.9, 117.2, 117.0, 113.8, 109.9, 81.4, 74.1,

[4] Escoubet, S.; Gastaldi, S.; Timokhin, V. I.; Bertrand, M. P.; Siri, D. *J. Am. Chem. Soc.* **2004**, *126*, 12343-12352.

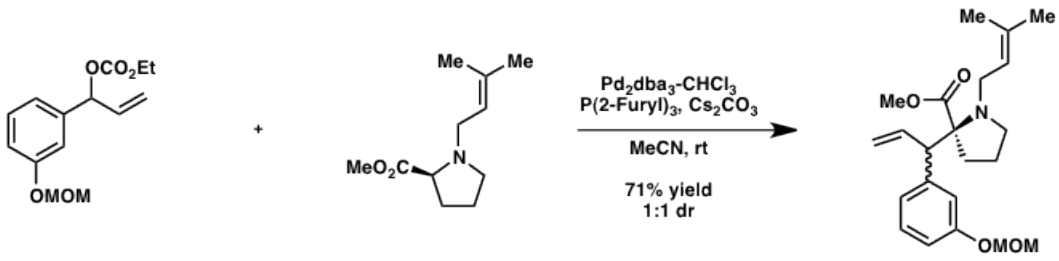
56.3, 52.3, 52.1, 47.6, 32.8, 28.4, 25.8, 22.2, 17.8; IR (film) 2973, 1714, 1472, 1367, 1249, 1153, 1057, 917, 849; HRMS (ESI-TOF) calc'd for $[C_{24}H_{34}Br_2NO_3]^+$([M+H]$^+$): *m/z* 542.0827, found 542.0904. The relative stereochemistry of the major diastereomer **10b** was determined by converting it to **9b** (vide infra).



10b *9b*

Compound 9b: In a round-bottom flask, a solution of compound **10b** (46 mg, 0.09 mmol) in CH_2Cl_2 (0.5 mL) and trifluoroacetic acid (0.5 mL) was stirred for 3 h at room temperature. The solution was concentrated under reduced pressure and placed under high vacuum for 1 h. The crude mixture was dissolved in a CH_2Cl_2 (0.5 mL) and MeOH (0.5 mL) and treated with $TMSCHN_2$ (0.2 mL, 0.40 mmol, 2.0 M Et_2O) dropwise. The reaction was stirred for 30 min and then quenched with saturated aqueous $NaHCO_3$ (10 mL). The mixture was extracted with EtOAc (3 x 20 mL), washed with brine, dried over $MgSO_4$, and concentrated under reduced pressure. Purification by CombiFlash Rf (100% hexanes to 8:1/Hex:EtOAc provided compound **9b** as a single diastereomer.

VI. Scheme 3 Compounds

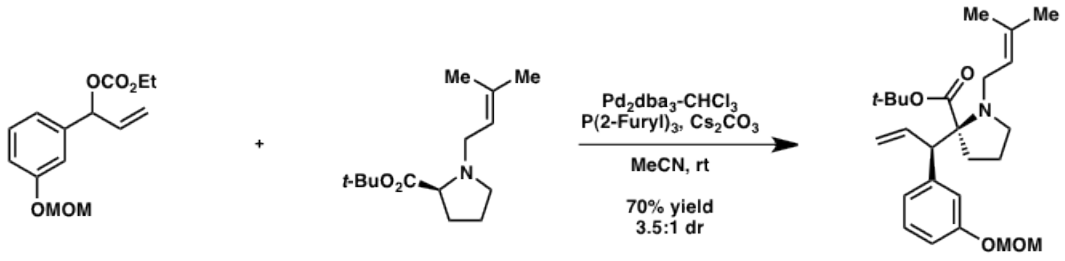


6f *7b* *16a : 16b*

Compound 16a/16b: Following the typical procedure for the [2,3]-Stevens rearrangement, purification (100% hexanes to 8:2 hexanes:EtOAc eluent, 12 min) provided the product as inseparable 1:1 mixture of diastereomers (210 mg, 0.56 mmol, 56%): ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.16 (q, *J* = 8.2 Hz, 1H), 6.97-6.85 (m, 3H), 6.26 (ddd, *J* = 17.1 Hz, J = 10.3 Hz, *J* = 7.8 Hz, 0.5H), 6.18-6.04 (m, 0.5H), 5.26-5.07 (m, 4.5H), 5.04 (dt, *J* = 17.1, 1.6 Hz, 0.5H), 4.10 (d, *J* = 7.8 Hz, 0.5H), 4.05 (d, *J* = 9.0 Hz, 0.5H), 3.70 (s, 1.5H), 3.60 (s, 1.5H), 3.51-3.41 (m, 1H), 3.47 (s, 1.5H), 3.46 (s, 1.5H), 3.19 (td, *J* = 8.8 Hz, *J* = 2.8 Hz, 0.5H), 2.97 (td, *J* = 8.6 Hz, J = 2.2 Hz, 0.5H), 2.87-2.78 (m, 1H), 2.34-2.18 (m, 1.5H), 2.12-1.92 (m, 1.5H), 1.79-1.67 (m, 1.5H), 1.72 (s, 1.5H), 1.67 (s, 1.5H), 1.65 (s, 1.5H), 1.61 (s, 1.5H), 1.45-1.32 (m, 0.5H); ^{13}C NMR (151 MHz, $CDCl_3$) δ 173.1, 172.3, 156.9, 156.6, 142.3, 141.9, 137.5, 137.1, 133.6, 133.0, 128.9, 128.4, 125.4, 123.5, 123.1, 123.0, 122.7, 118.3, 117.7, 117.1, 114.3, 114.0, 94.5, 74.0,

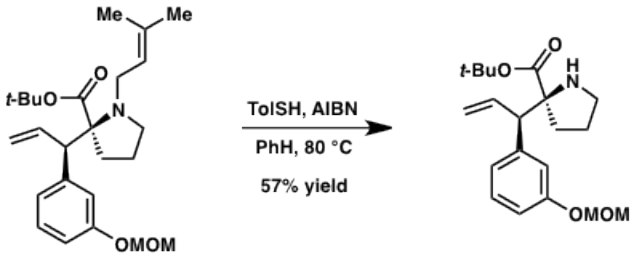
55.9, 51.8, 51.4, 51.2, 51.1, 50.8, 50.7, 47.5, 46.8, 30.7, 30.3, 25.9, 25.8, 21.4, 21.1, 18.0, 17.9; IR (film) 2950, 1723, 1600, 1489, 1449, 1240, 1152, 1080, 1019, 922, 786, 701 cm^{-1}; HRMS (ESI-TOF) calc'd for $[C_{22}H_{31}NO_4]^+$($[M+H]^+$): *m/z* 374.2326, found 374.2329.

VII. Formal Total Synthesis of (±)–Amathaspiramide F



6f *7c* *17a*

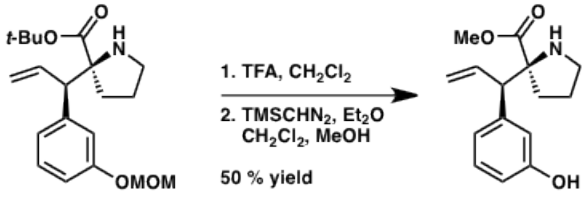
Compound 17a: Following the typical procedure for the [2,3]-Stevens rearrangement, purification (100% hexanes to 8:2 hexanes:EtOAc eluent, 12 min) provided the product as an inseparable 3.5:1 mixture of diastereomers (730 mg, 1.75 mmol, 70%): ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.21–7.10 (m, 1H), 7.01–6.83 (m, 3H), 6.25 (ddd, *J* = 17.4 Hz, J = 10.4 Hz, *J* = 7.3 Hz, 1H), 5.24 (t, *J* = 7.1 Hz, 1H), 5.20–5.07 (m, 3H), 4.96 (dt, *J* = 17.2 Hz, J = 1.6 Hz, 1H), 4.04 (d, *J* = 7.3 Hz, 1H), 3.56–3.49 (m, 2H), 3.45 (s, 3H), 3.19 (td, *J* = 8.7 Hz, J = 2.5 Hz, 1H), 3.04–2.87 (m, 1H), 2.33 (q, *J* = 8.6 Hz, 1H), 2.29–2.10 (m, 1H), 2.04-1.86 (m, 1H), 1.82-1.72 (m, 1H), 1.73 (s, 3H), 1.66 (s, 3H), 1.34 (s, 9H); ^{13}C NMR (151 MHz, $CDCl_3$) δ 170.7, 156.9, 142.5, 137.7, 133.4, 128.7, 123.3, 123.1, 118.1, 116.8, 113.9, 94.4, 80.8, 73.9, 55.9, 51.1, 51.0, 46.8, 30.6, 28.2, 25.9, 21.3, 17.9; IR (film) 2973, 1714, 1600, 1489, 1452, 1367, 1245, 1153, 1081, 1021, 922, 859, 773 cm^{-1}; HRMS (ESI-TOF) calc'd for $[C_{25}H_{37}NO_4]^+$($[M+H]^+$): *m/z* 416.2795, found 416.2798.



17a *18*

Compound 18: Our procedure was modified from a method reported in the literature for the cleavage of N-prenyl groups[4]: In a round-bottom flask, a solution of compound **17a** (720 mg, 1.73 mmol) in degassed benzene (17 mL) was sequentially charged with 4-methylbenzenethiol (320 mg, 2.6 mmol) and then AIBN (57 mg, 0.35 mmol). The solution was heated to reflux for 3 h then cooled to room temperature and quenched with 1N HCl (20 mL). The aqueous layer was washed with Et_2O (30 mL) then basified using Na_2CO_3. The aqueous layer was extracted with EtOAc (3 x 75 mL), washed with brine, dried over $MgSO_4$, and concentrated under reduced pressure. Purification by CombiFlash Rf (100% hexanes to 7:3 hexanes:EtOAc eluent, 14 min) provided the product as a single diastereomer (340 mg, 1.0 mmol, 57%): ^{1}H NMR (400 MHz,

$CDCl_3$) δ 7.19 (d, *J* = 7.9 Hz, 1H), 7.17–7.13 (m, 1H), 7.05 (dt, *J* = 7.7, 1.2 Hz, 1H), 6.91 (ddd, *J* = 8.2 Hz, J = 2.6 Hz, *J* = 1.0 Hz, 1H), 6.22 (ddd, *J* = 16.7 Hz, J = 10.5, *J* = 9.2 Hz, 1H), 5.17 (s, 2H), 5.10–4.98 (m, 2H), 3.62 (d, J = 9.2 Hz, 1H), 3.48 (s, 3H), 2.96-2.88 (m, 1H), 2.77-2.70 (m, 1H), 2.63 (s, 1H), 2.08–1.92 (m, 1H), 1.72 (dt, J = 13.0 Hz, J = 7.9 Hz, 1H), 1.51-1.39 (m, 1H), 1.44 (s, 9H), 1.35–1.25 (m, 1H); ^{13}C NMR (151 MHz, $CDCl_3$) δ 175.8, 156.8, 142.3, 138.5, 138.5, 128.7, 123.5, 117.9, 116.3, 116.3, 114.3, 94.5, 81.1, 73.1, 56.9, 56.9, 55.9, 55.9, 46.7, 34.2, 27.9, 25.0; IR (film) 3350, 2957, 1721, 1583, 1487, 1452, 1368, 1249, 1154, 1080, 1021, 922, 849, 782, 702 cm^{-1}; HRMS (ESI-TOF) calc'd for $[C_{20}H_{29}NO_4]^+$([M+H]$^+$): *m/z* 348.2169, found 348.2167.

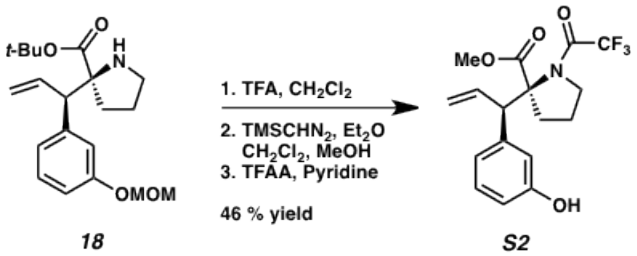


18 *19*

Compound 19: In a round-bottom flask, a solution of compound **18** (70 mg, 0.20 mmol) in CH_2Cl_2 (2.0 mL) and trifluoroacetic acid (2.0 mL) was stirred for 19 h at room temperature. The solution was concentrated under reduced pressure and placed under high vacuum for 1 h. The crude mixture was dissolved in a CH_2Cl_2 (2.0 mL) and MeOH (2.0 mL) and treated with $TMSCHN_2$ (0.4 mL, 0.80 mmol, 2.0 M Et_2O) dropwise. The reaction was stirred for 7 h and then quenched with $NaHCO_3$ (20 mL). The mixture was extracted with EtOAc (3 x 25 mL), washed with brine, dried over $MgSO_4$, and concentrated under reduced pressure. Purification by CombiFlash Rf (100% hexanes to 100% EtOAc (1% TEA) eluent, 16 min) provided the product as a single diastereomer (26 mg, 0.10 mmol, 50%): ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.15 (t, *J* = 7.8 Hz, 1H), 6.91-6.89 (m, 1H), 6.84 (d, *J* = 7.8 Hz, 1H), 6.72 (ddd, *J* = 7.8 Hz, *J* = 2.7 Hz, *J* = 1.0 Hz, 1H), 6.24 (ddd, *J* = 16.6 Hz, *J* = 10.6 Hz, *J* = 9.3 Hz, 1H), 5.10-5.03 (m, 2H), 3.70 (s, 3H), 3.61 (d, *J* = 9.5 Hz, 1H), 2.95-2.87 (m, 1H), 2.85-2.78 (m, 1H), 2.17–2.02 (m, 1H), 1.90-1.74 (m, 1H), 1.60-1.38 (m, 2H); ^{13}C NMR (151 MHz, $CDCl_3$) δ 176.8, 155.8, 141.8, 137.9, 129.2, 121.4, 116.7, 116.3, 114.1, 73.6, 57.3, 52.3, 46.3, 33.9, 24.6 ; IR (film) 3347 (broad), 2952, 1729, 1587, 1455, 1223, 997, 921, 783, 704 cm^{-1}; HRMS (ESI-TOF) calc'd for $[C_{15}H_{19}NO_3]^+$([M+H]$^+$): *m/z* 262.1438, found 262.1443.

Comparison Spectra for Compound 19

δ_H (synthesized) (400 MHz, $CDCl_3$)	δ_H (reported)[5] (400 MHz, $CDCl_3$)
7.15	7.13
6.91-6.89	6.92
6.84	6.82
6.72	6.71
6.24	6.23
5.10-5.03	5.08-5.03
	3.80-4.10
3.70	3.69
3.61	3.63
2.85-2.78, 2.95-2.88	2.93-2.83
2.17-2.02	2.08
1.90-1.74	1.82
1.60-1.38	1.54-1.44



18 S2

Compound S2: In a round bottom flask, a solution of compound **18** (0.51 g, 1.50 mmol) in dichloromethane (15 ml) and trifluoroacetic acid (2.0 mL) was stirred for 19 h at room temperature. The solution was concentrated under reduced pressure and placed under high vacuum for 1 h**.** The crude mixture was dissolved in a CH_2Cl_2 (15.0 mL) and MeOH (15.0 mL) and treated with $TMSCHN_2$ (3.3 mL, 6.7 mmol, 2.0 M Et_2O) dropwise. The reaction was stirred for 4 h and then quenched with $NaHCO_3$ (50 mL). The mixture was extracted with EtOAc (3 x 50 mL), washed with brine, dried over $MgSO_4$, and concentrated under reduced pressure. The crude mixture was dissolved in pyridine (8.0 ml) and treated with trifluoracetic anhydride (0.62 ml, 4.5 mmol) at 0° C dropwise. The reaction was allowed to stir at room temperature for 1.5 hrs then quenched with $NaHCO_3$ (40 mL). The mixture was extracted with EtOAc (3 x 50 mL), washed with brine, dried over $MgSO_4$, and concentrated under reduced pressure. Purification by CombiFlash Rf (100% hexanes to 97:3 hexanes:EtOAc eluent, 14 min) provided the product as a single diastereomer (0.25 g, 0.70 mmol, 46%): ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.15 (t, J = 7.9 Hz, 1H), 6.96 (q, J = 2.3 Hz, 1H), 6.88 (d, J = 7.8 Hz, 1H), 6.75 (dd, J = 8.1 Hz, J = 2.5 Hz, 1H), 6.14 (dt, J = 17.3 Hz, J = 9.5 Hz, 1H), 5.15- 4.98 (m, 2H), 4.58 (dd, J = 9.5 Hz, J = 2.5 Hz, 1H), 4.02- 3.85 (m, 1H), 3.66 (s, 3H), 3.6- 3.46 (m, 1H), 2.52- 2.31 (m, 1H), 2.16-1.89 (m, 2H), 1.90-1.71 (m, 1H); ^{13}C NMR (151 MHz, $CDCl_3$) δ 171.8, 155.9, 141.2, 136.0, 129.2, 121.7, 120.5, 117.9, 117.4, 114.2, 73.7, 52.7, 52.6, 52.3, 49.2, 34.0, 24.1; IR (film) 3417 (broad), 1747, 1693,

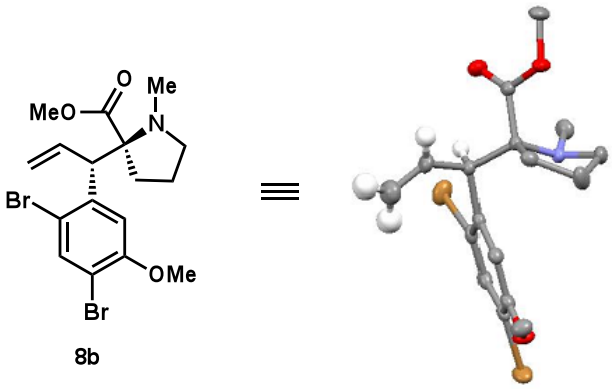
[5] Sakaguchi, K.; Ayabe, M.; Watanabe, Y.; Takuya Okada; Kawamura, K.; Shiada, T.; Ohfune, Y. *Org. Lett.* **2008**, *10*, 5449-5452.

1599, 1455, 1229, 1150, 999, 927, 758; LCMS (ESI) calc'd for $[C_{17}H_{18}F_3NO_4]^+$($[M+H]^+$): *m/z* 358.12, found 358.1. The relative stereochemistry of **S2** was determined by x-ray analysis of a single crystal (vide infra).

VIII. Determination of Relative Stereochemistry of Products

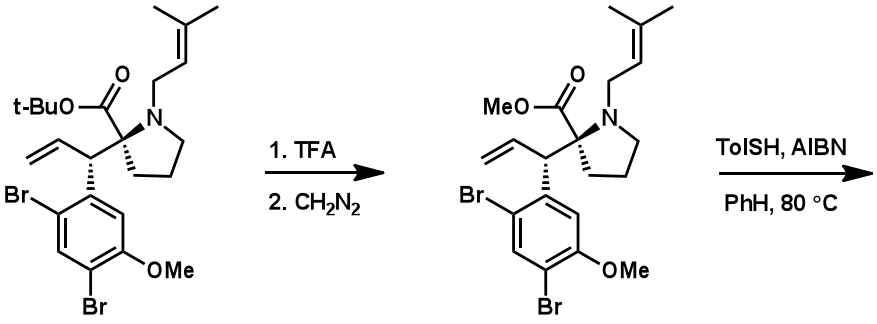
We thank Dr. Vincent Lynch (Manager of the X-ray Diffraction Lab at UT Austin) for all the X-ray structural analysis.

A sample of **8b** was recrystallized from hexanes (slow evaporation). The resulting crystals were suitable for X-ray diffraction and the structure was solved. This structure allowed the assignment of relative configuration as shown.

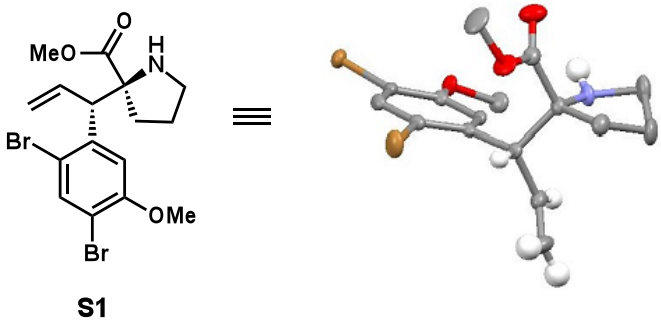


8b

A sample of **S1** was recrystallized from hexanes (slow evaporation). The resulting crystals were suitable for X-ray diffraction and the structure was solved. This structure allowed the assignment of relative configuration of **S1**, **9b**, and **10b**, as shown.



10b **9b**



S1

Table 1, Entry 2: A sample of compound **13b** was recrystallized from hexanes (slow evaporation). The resulting crystals were suitable for X-ray diffraction and the structure was solved. This structure allowed the assignment of relative configuration as shown.

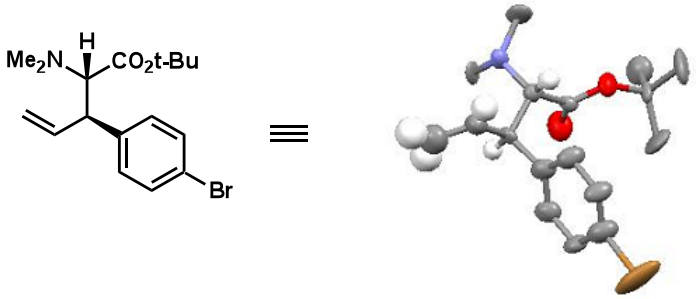


Table 1, Entry 3: A sample of compound **13c** was recrystallized from hexanes (slow evaporation). The resulting crystals were suitable for X-ray diffraction and the structure was solved. This structure allowed the assignment of relative configuration as shown.

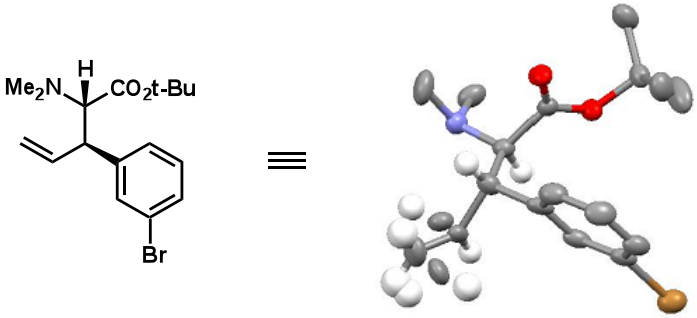


Table 1, Entry 4: A sample of compound **14d** was recrystallized from hexanes (slow evaporation). The resulting crystals were suitable for X-ray diffraction and the structure was solved. This structure allowed the assignment of relative configuration as shown.

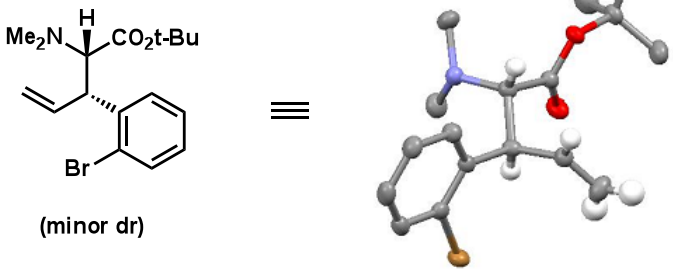
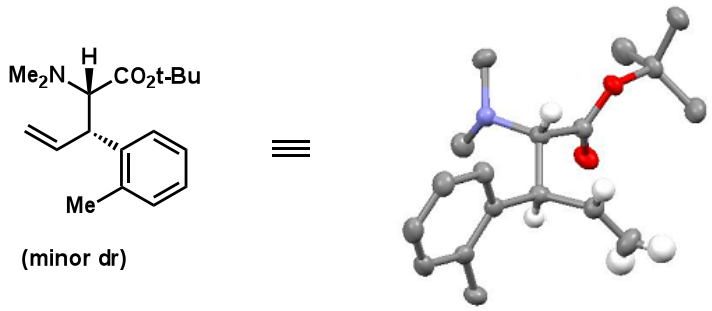
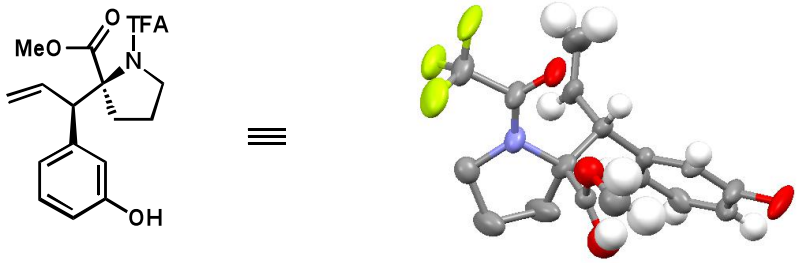


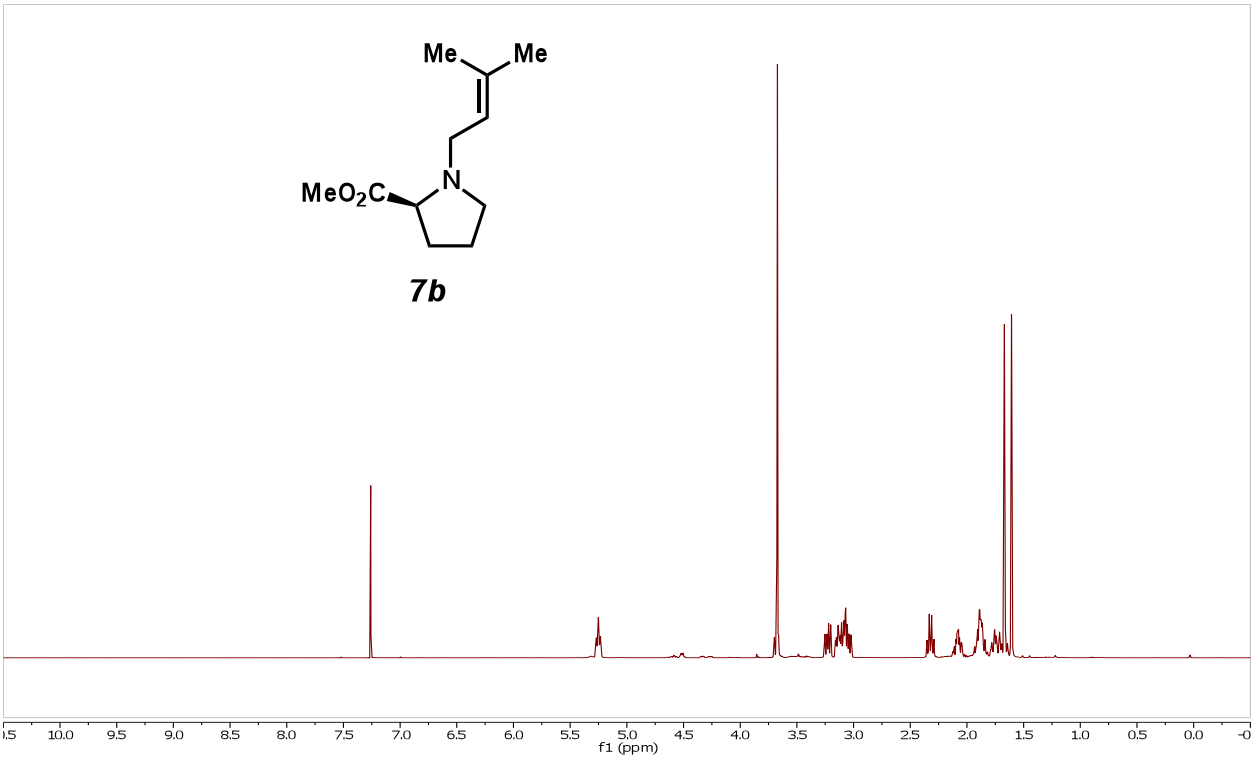
Table 1, Entry 5: A sample of compound **14e** was recrystallized from hexanes (slow evaporation). The resulting crystals were suitable for X-ray diffraction and the structure was solved. This structure allowed the assignment of relative configuration as shown.

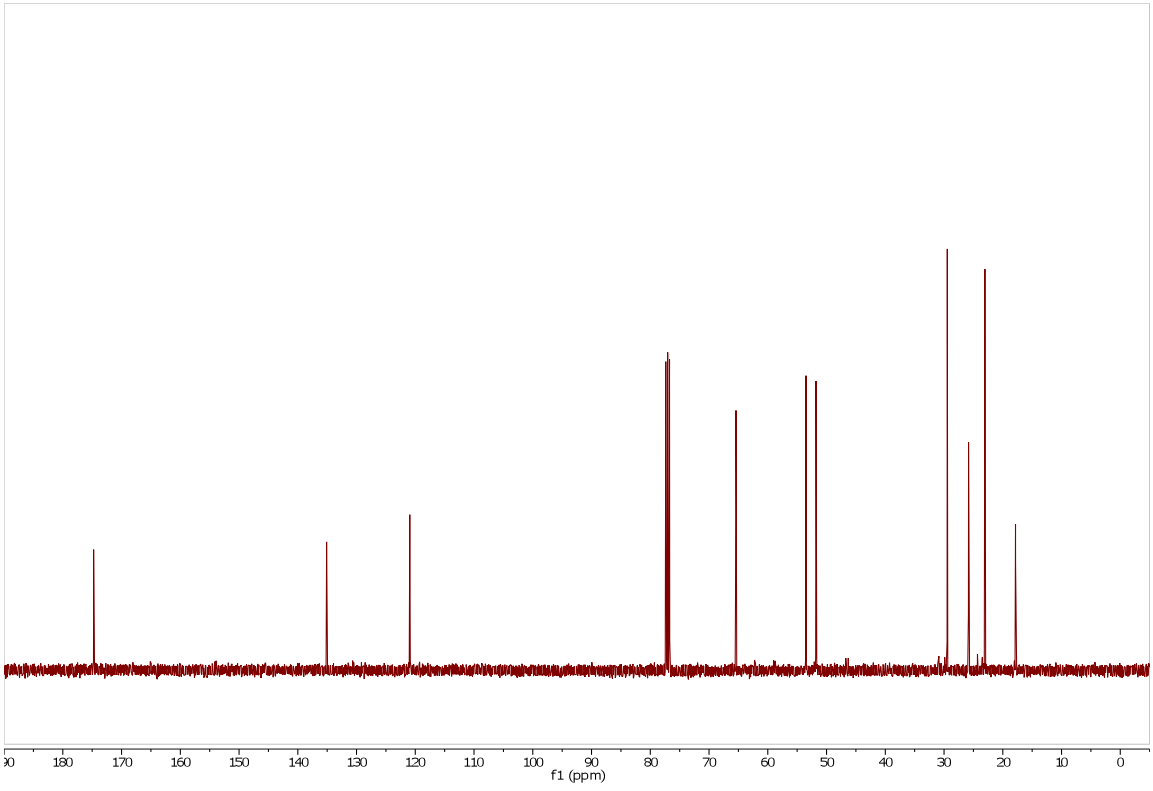


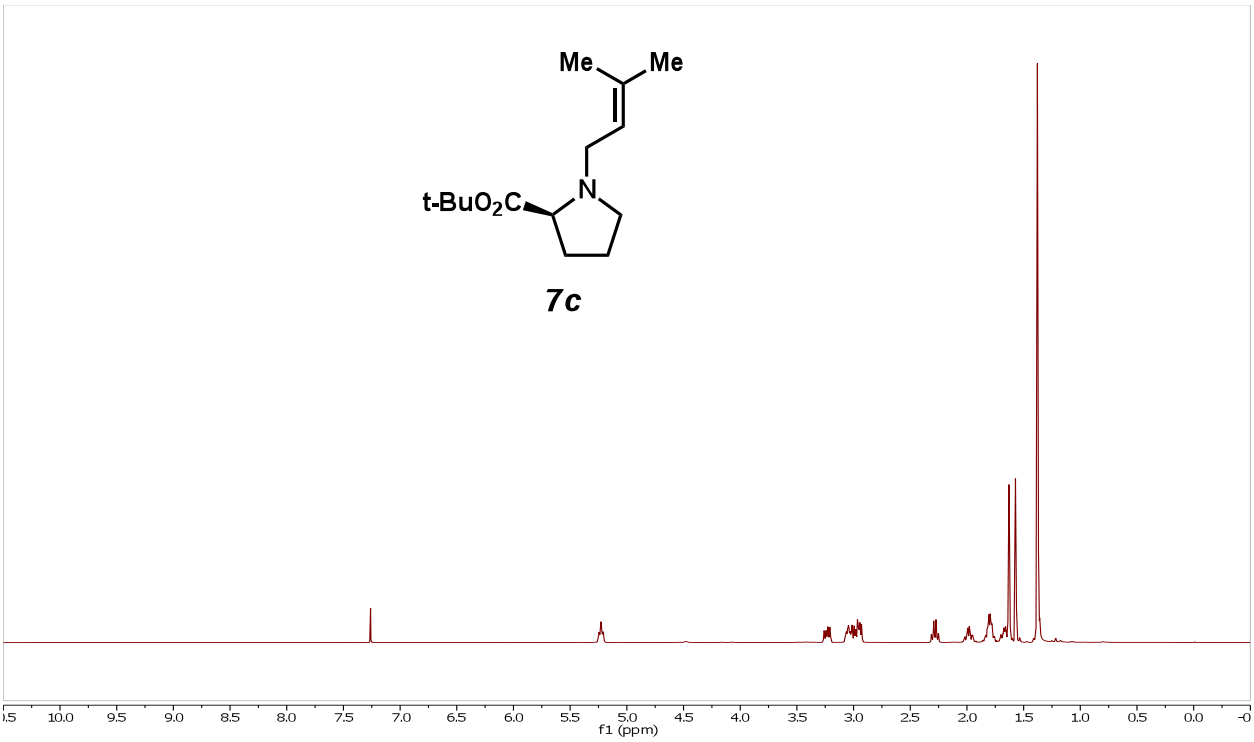
Compound S2: A sample of compound **S2** was recrystallized from 1:1/hexanes:chloroform (slow evaporation). The resulting crystals were suitable for X-ray diffraction and the structure was solved. This structure allowed the assignment of relative configuration as shown.

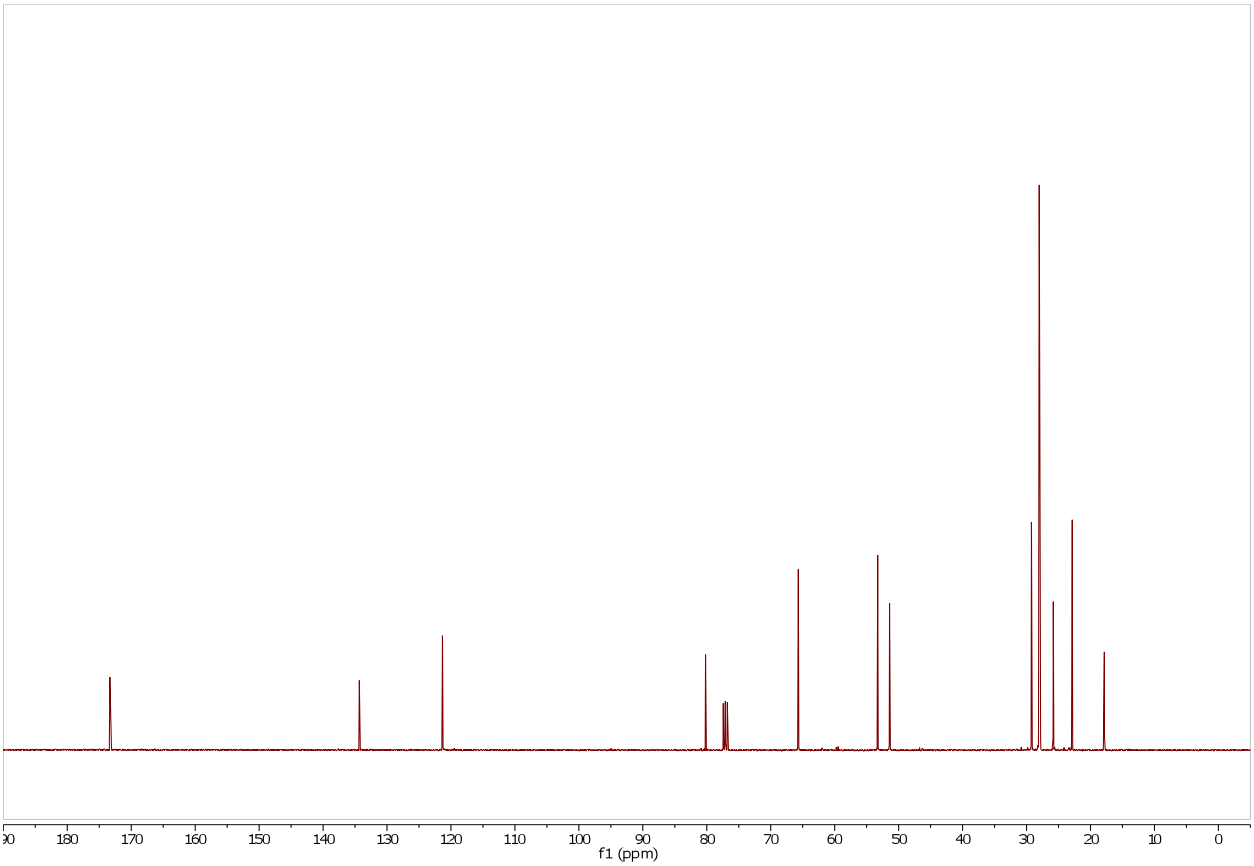


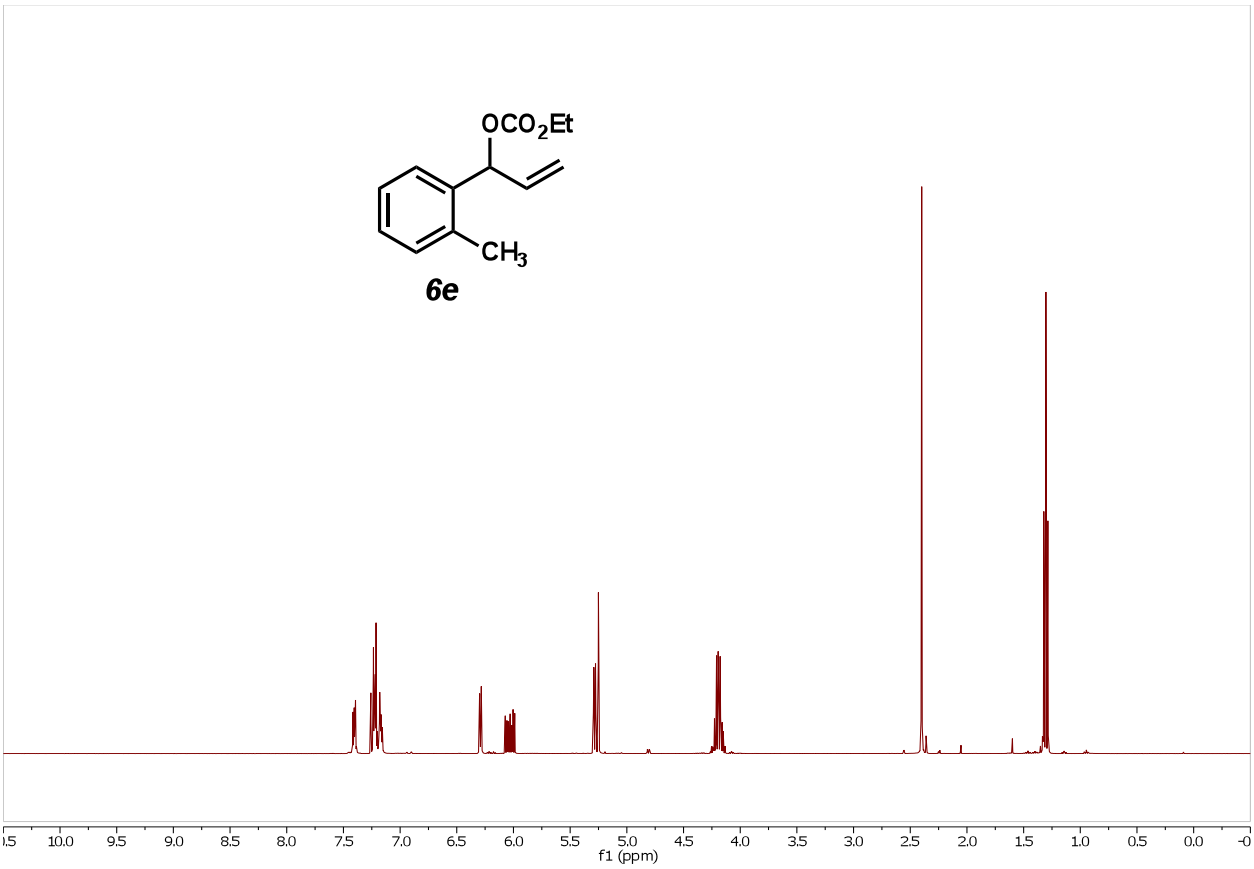
IX. ^{1}H and ^{13}C NMR Spectra

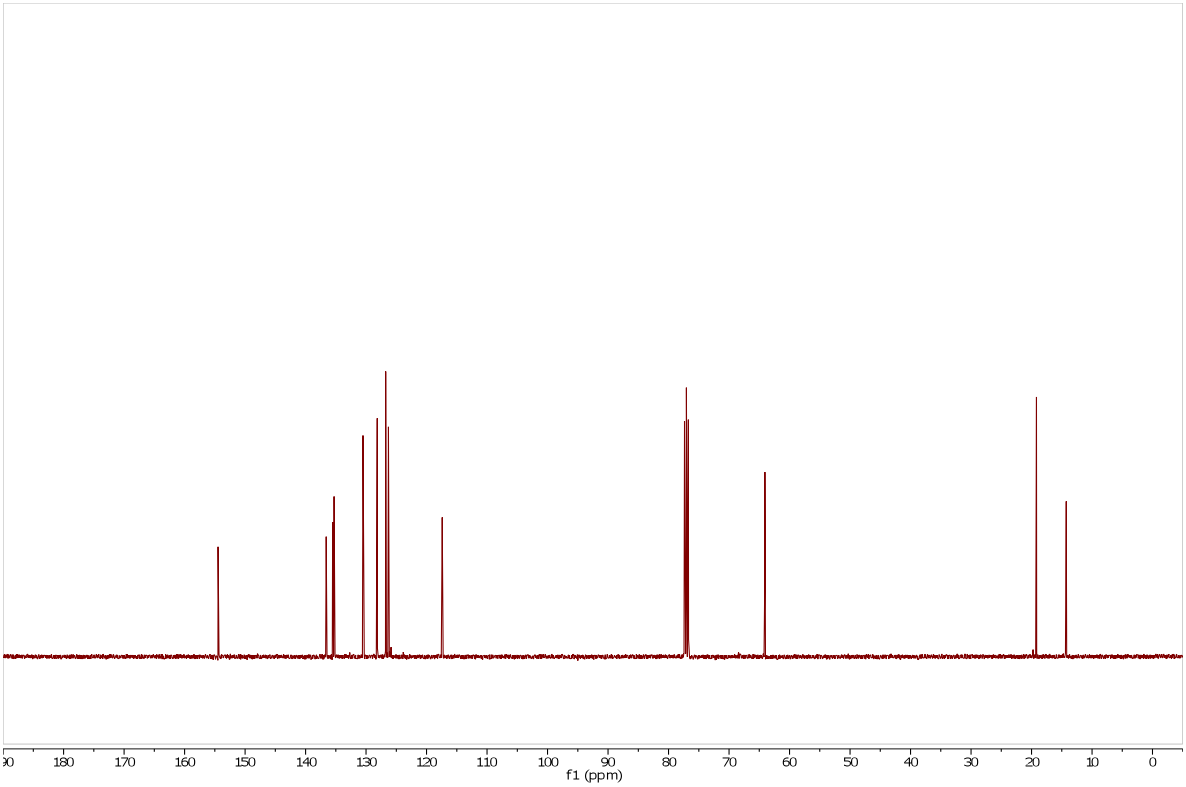


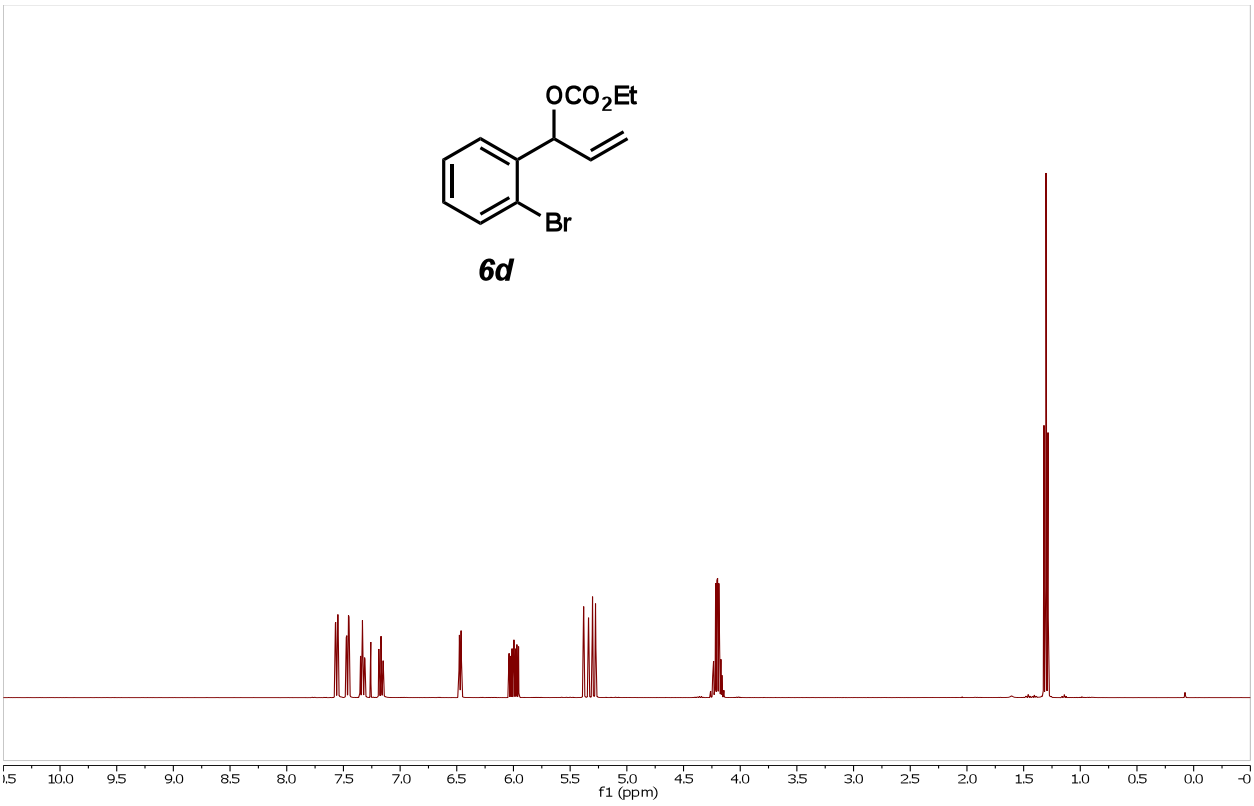



Me
Me
N
t-BuO2C
7c
f1 (ppm)


f1 (ppm)


OCO2Et
CH3
6e
f1 (ppm)


f1 (ppm)


OCO2Et
Br
6d
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
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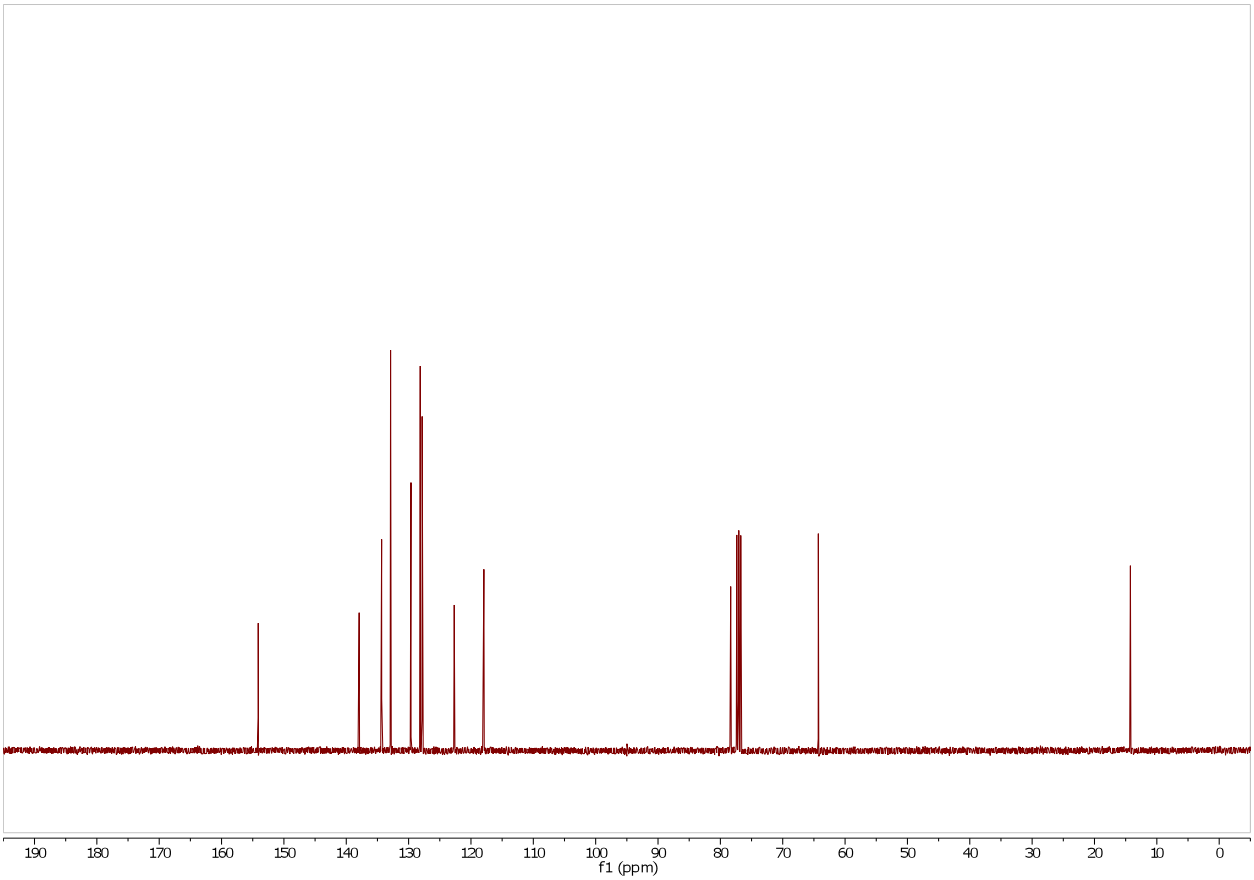
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)


190
180
170
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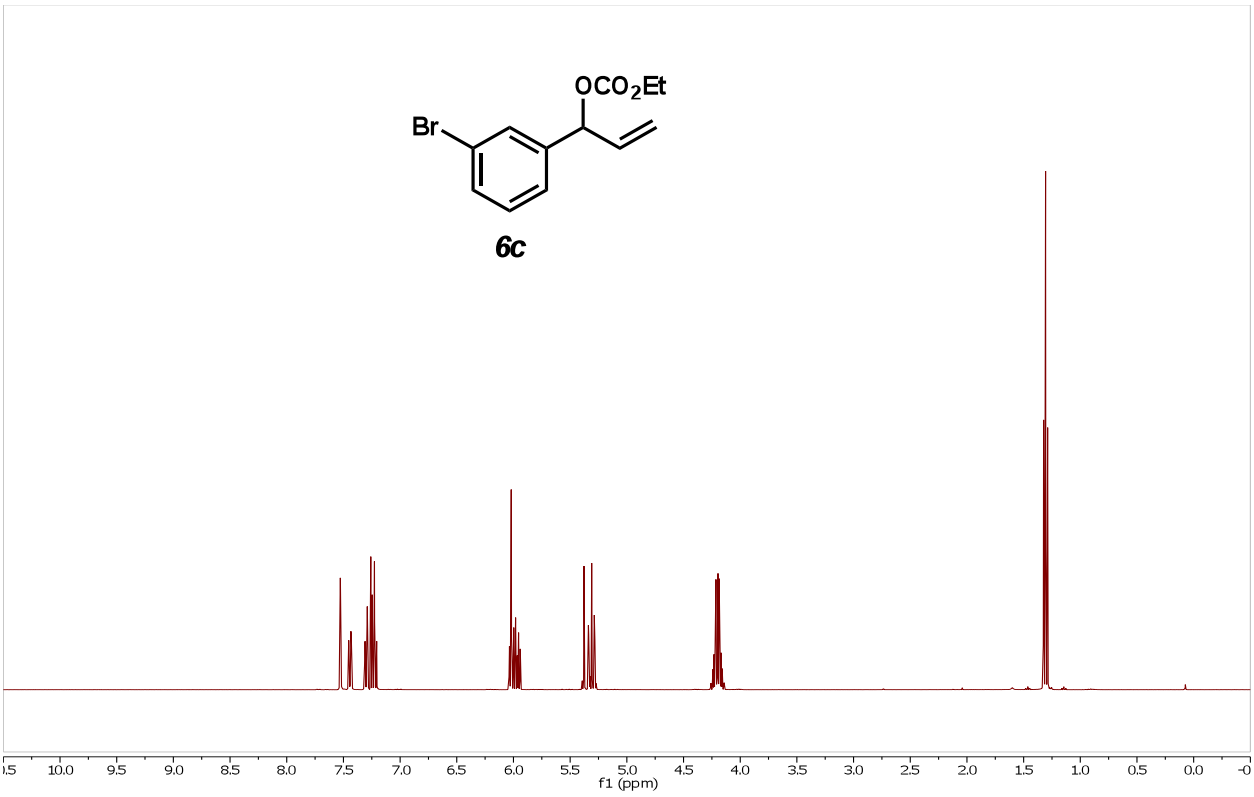
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)


OCO2Et
Br
6c
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9.0
8.5
8.0
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7.0
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5.5
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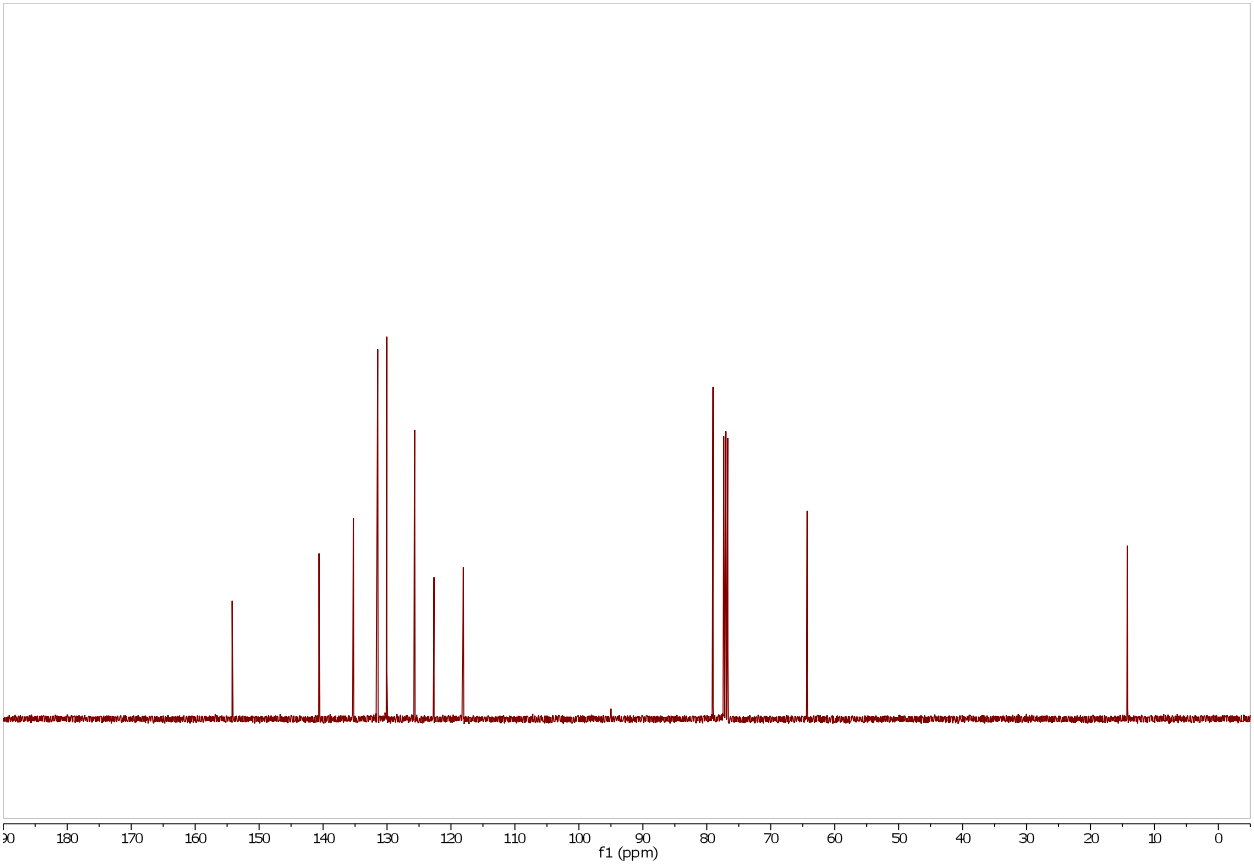
f1 (ppm)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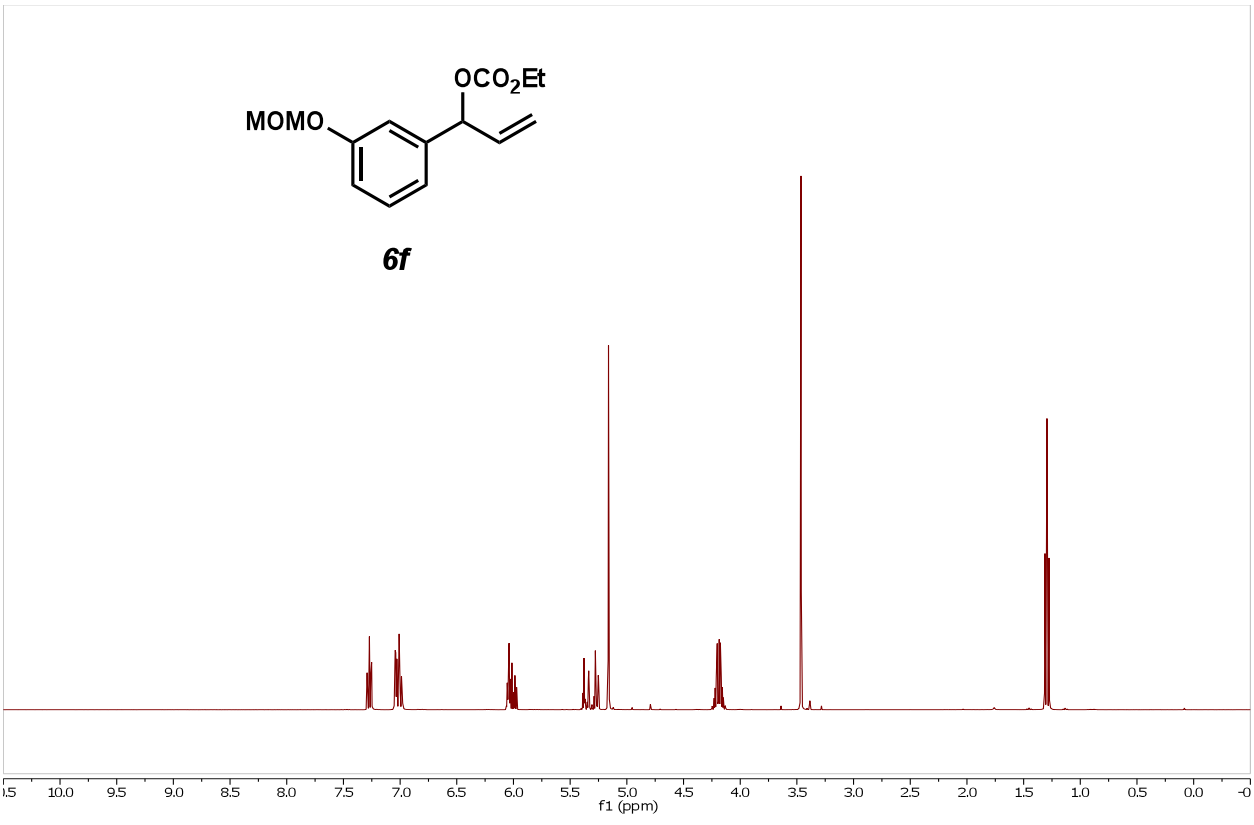
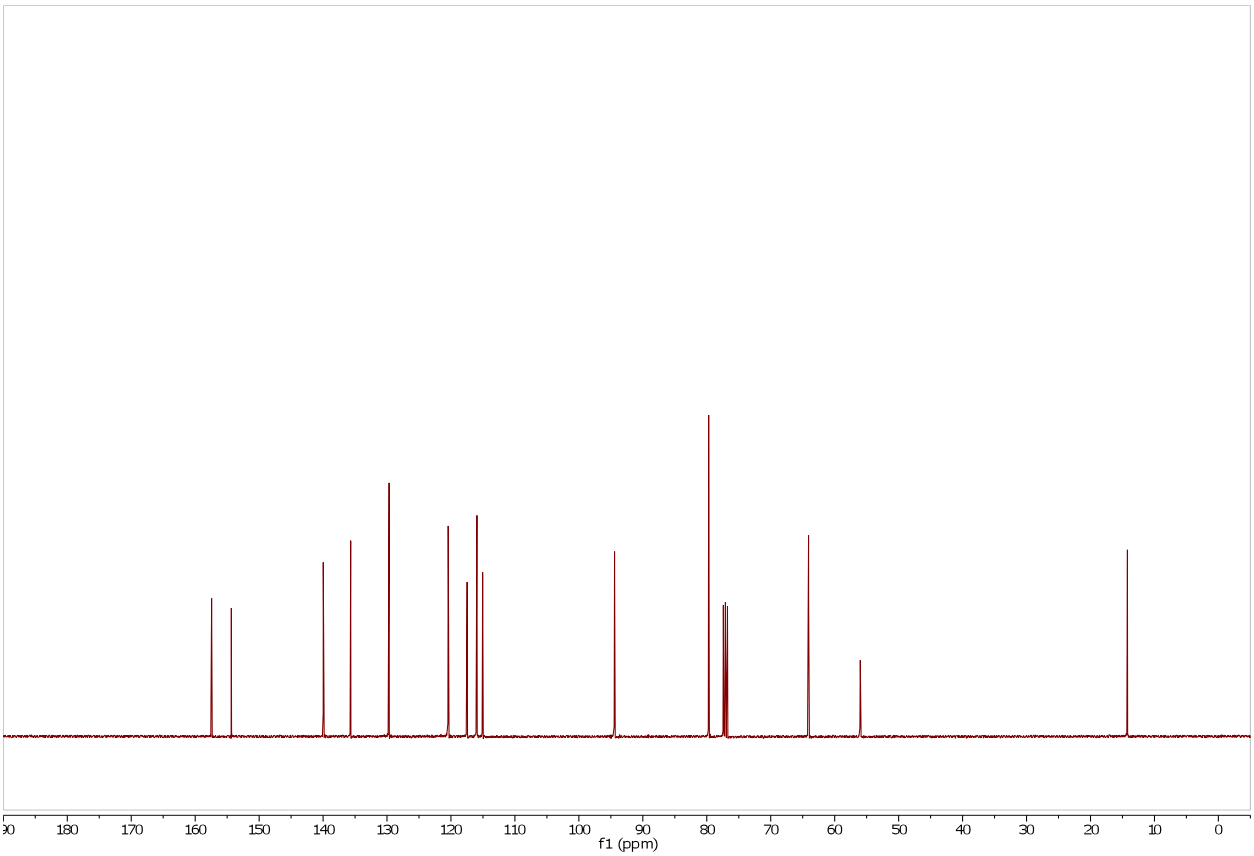
f1 (ppm)


OCO2Et
MOMO
6f
f1 (ppm)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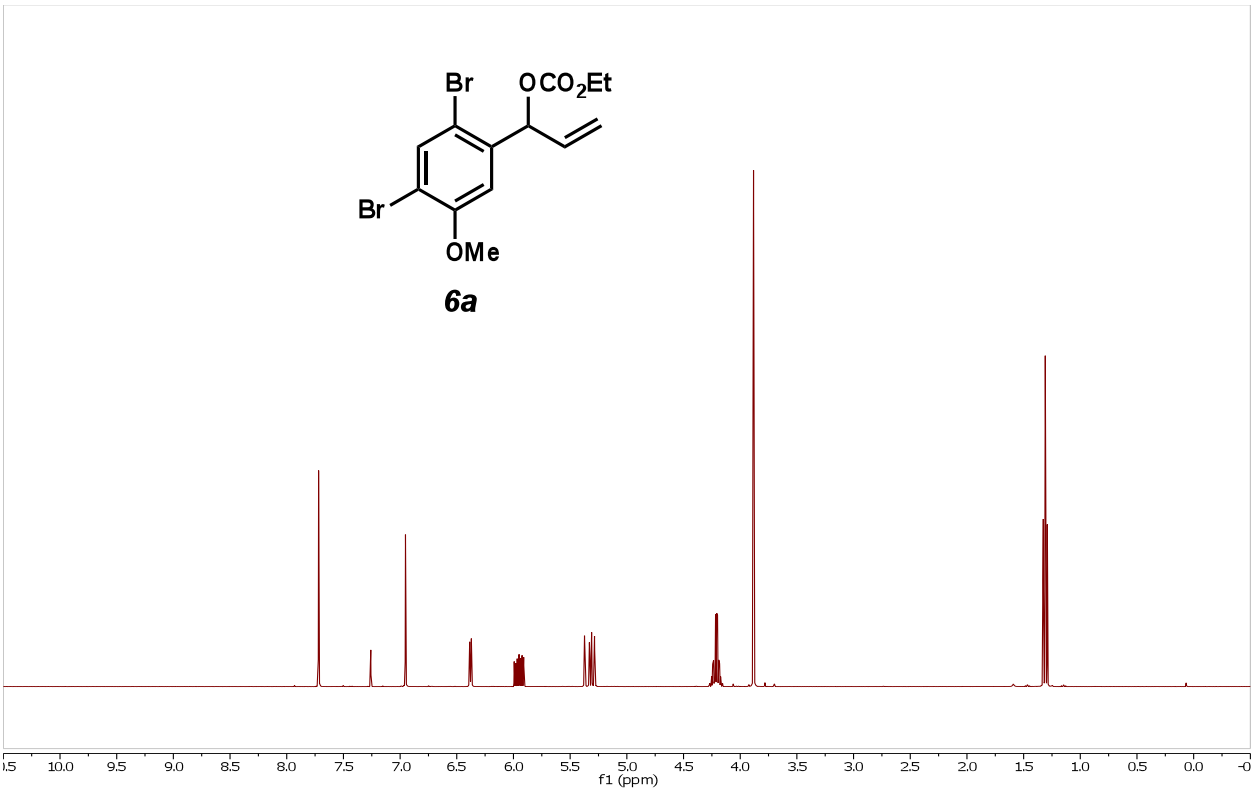
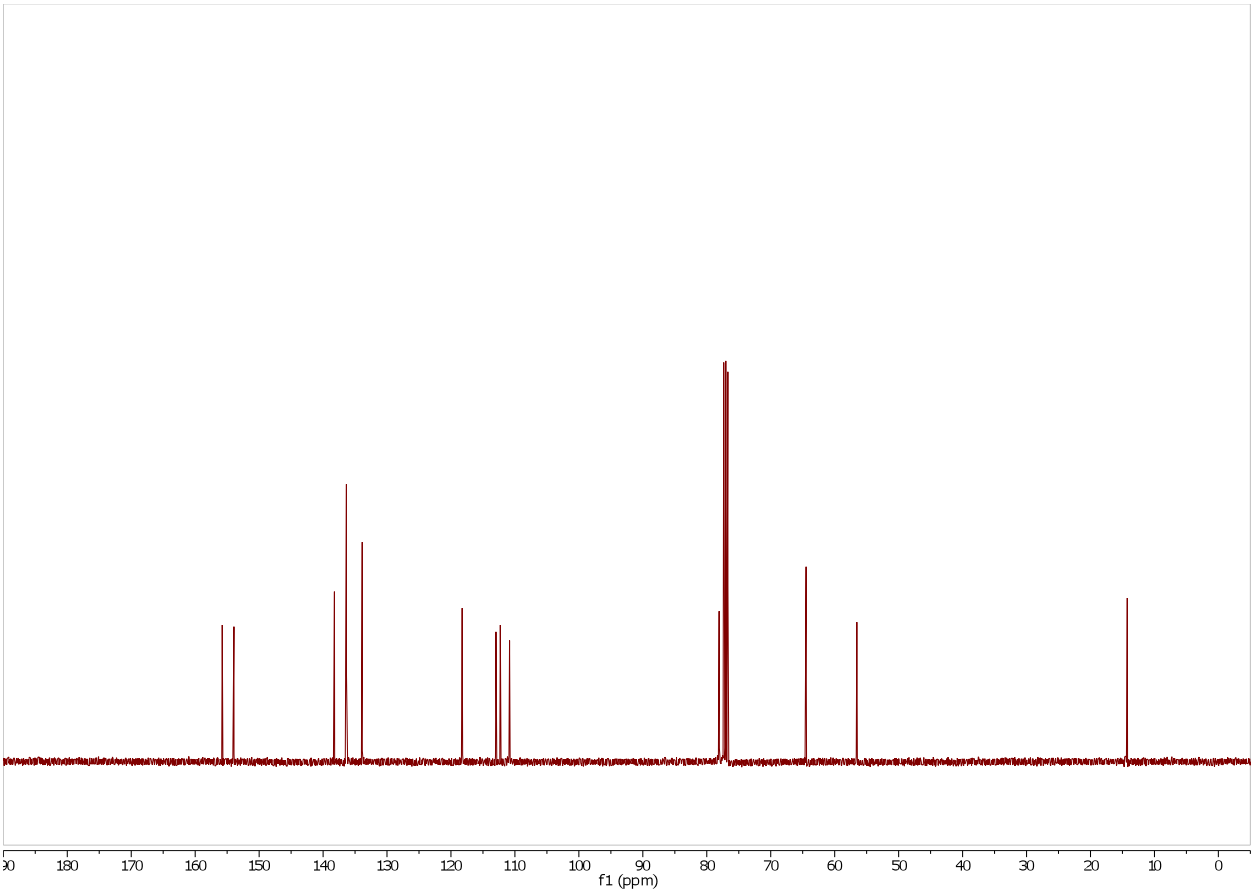
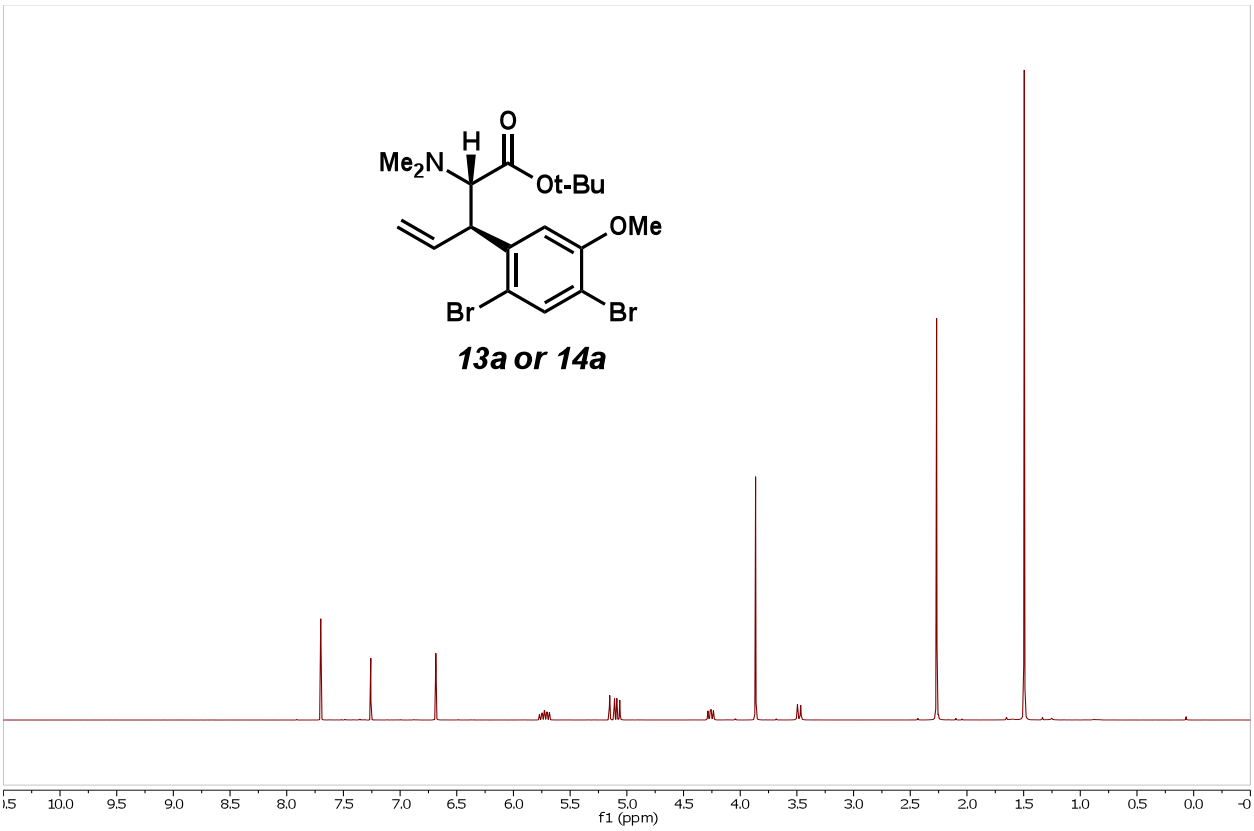
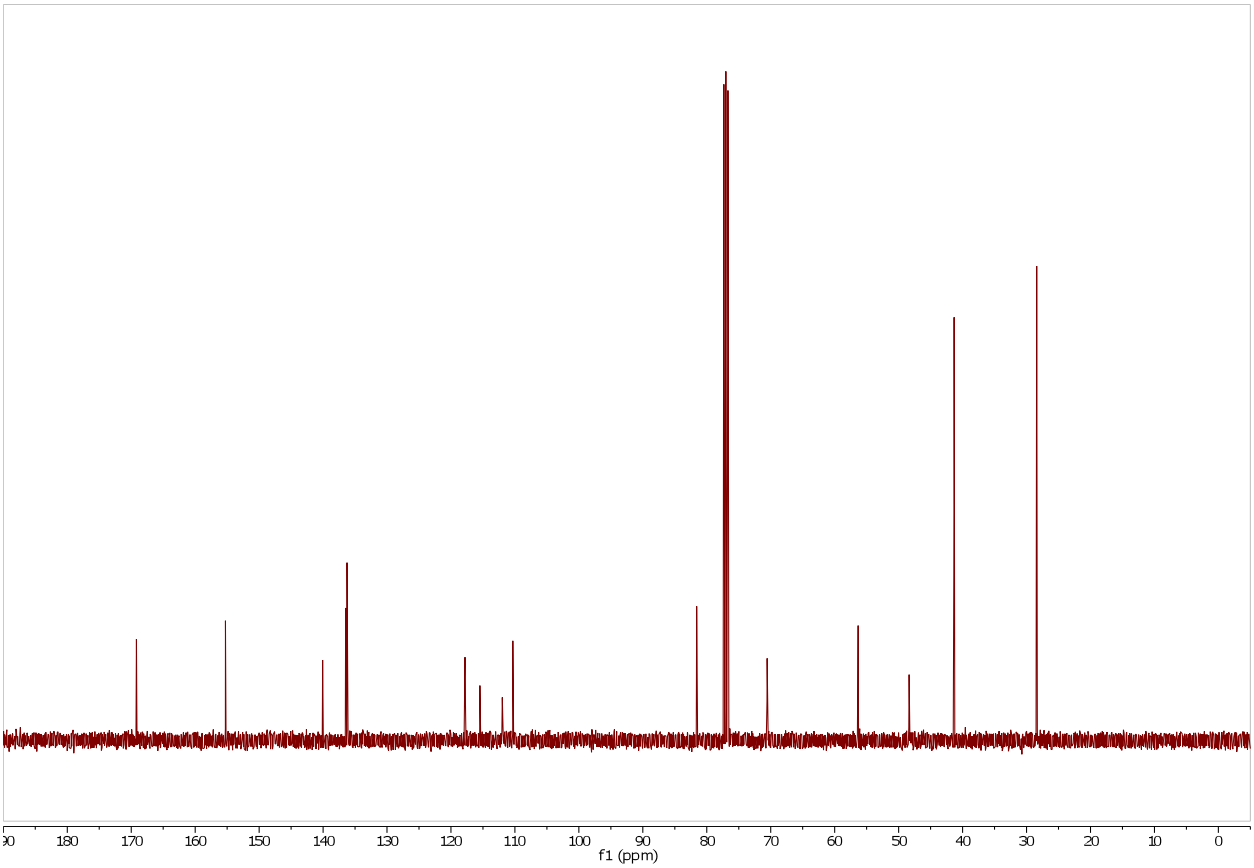
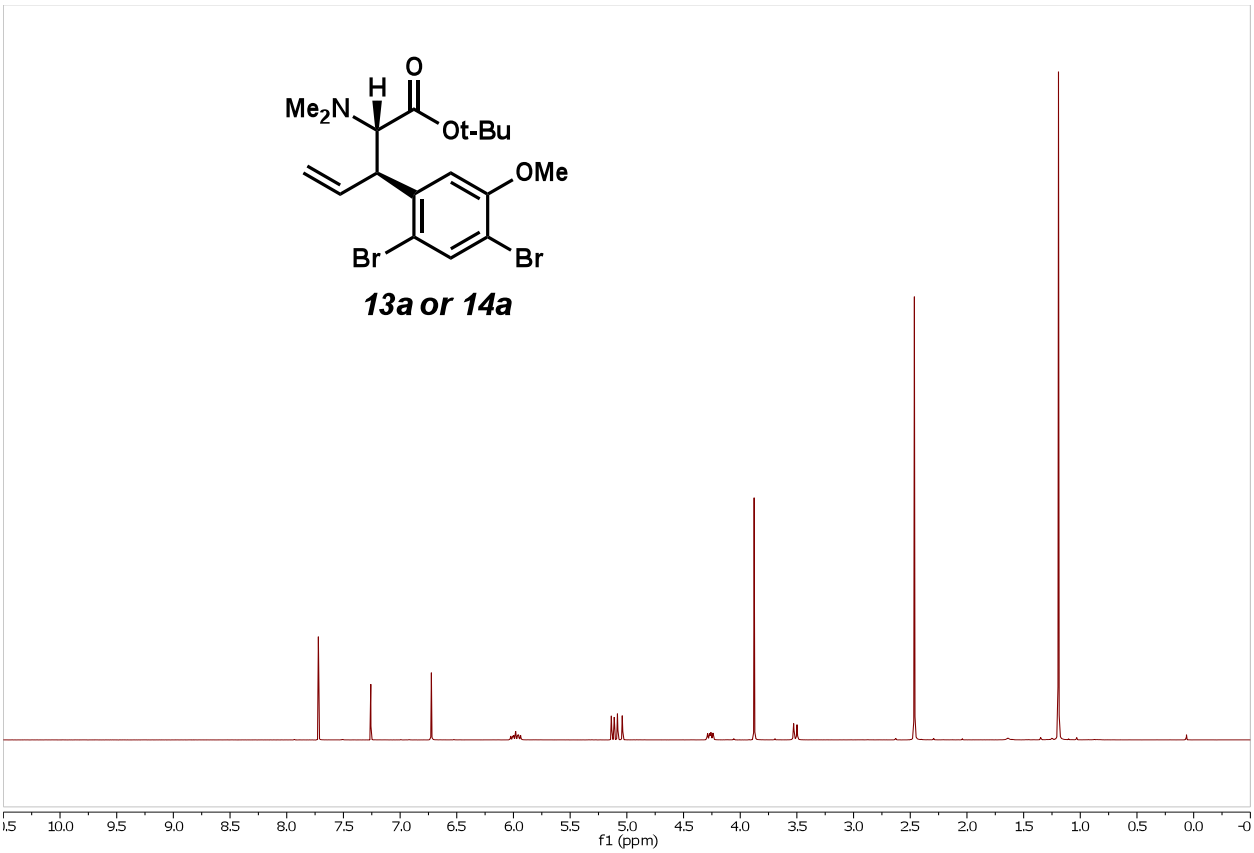
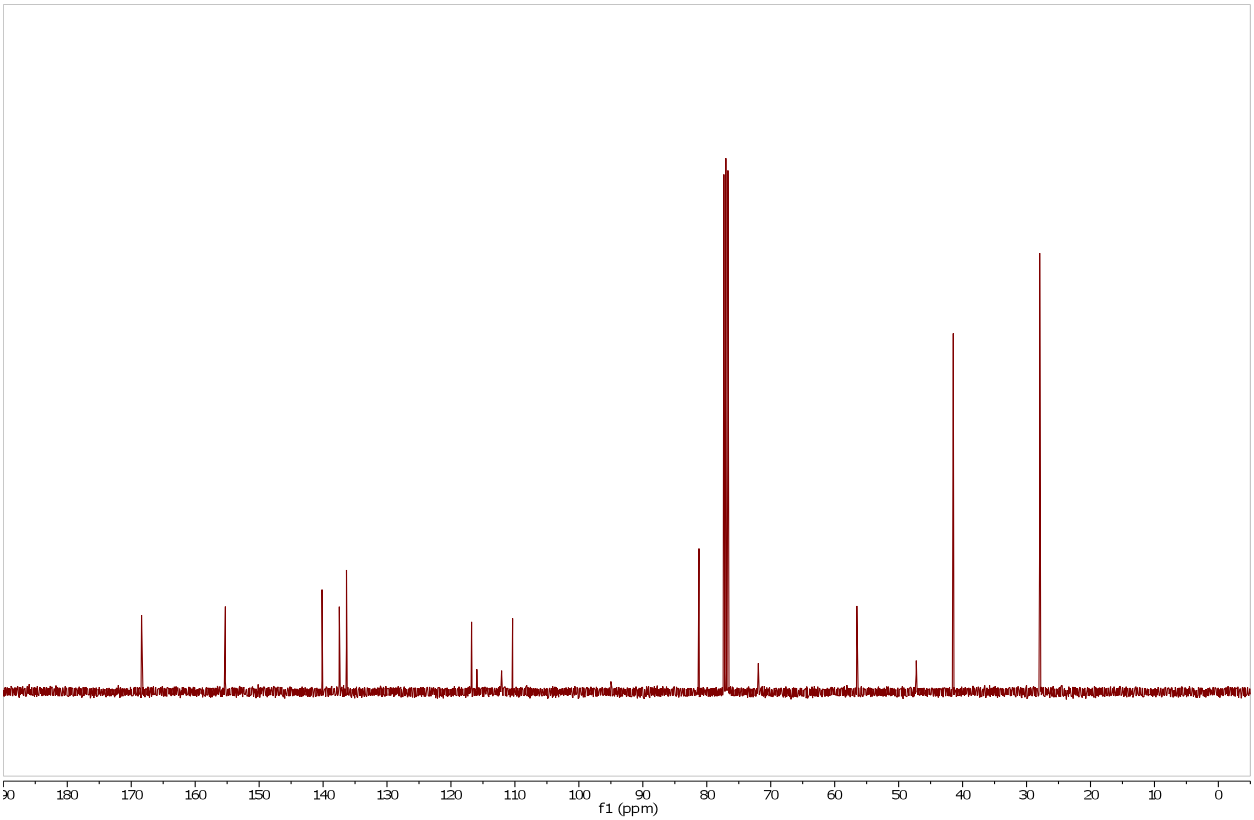

Br
OCO2Et
Br
OMe
6a
f1 (ppm)

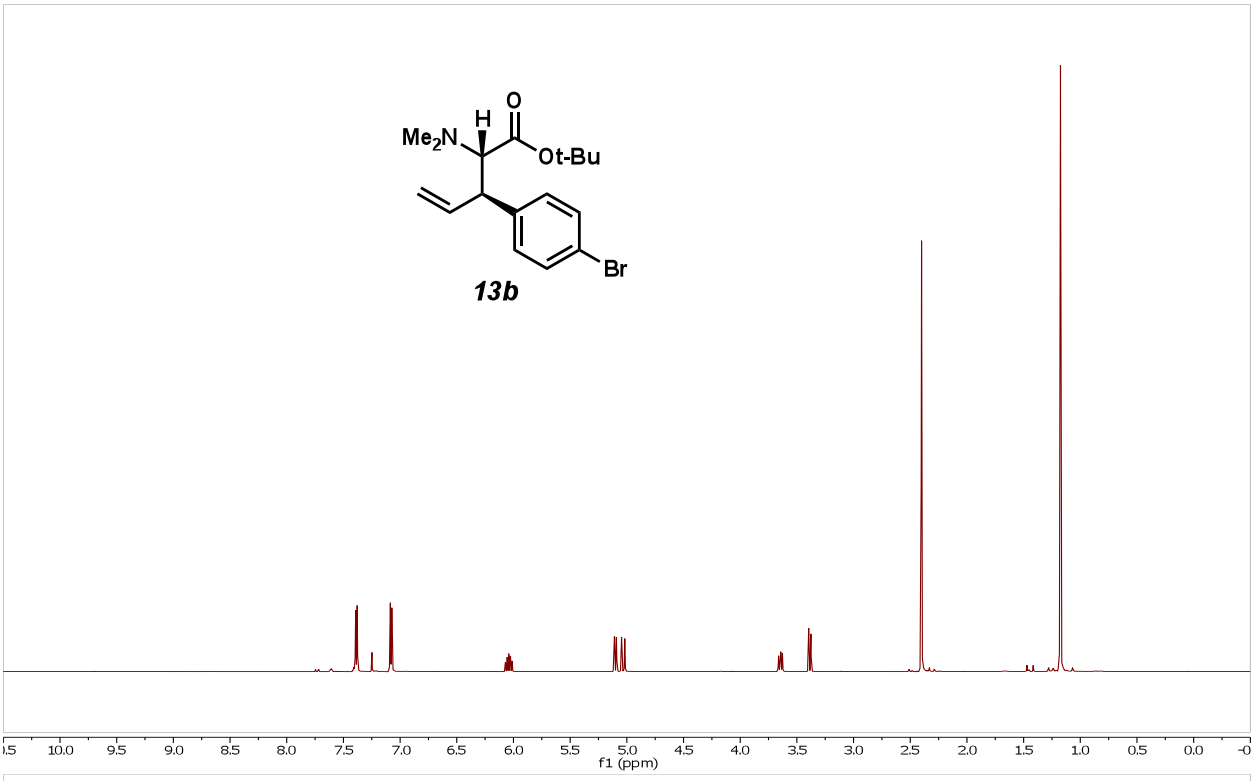

f1 (ppm)

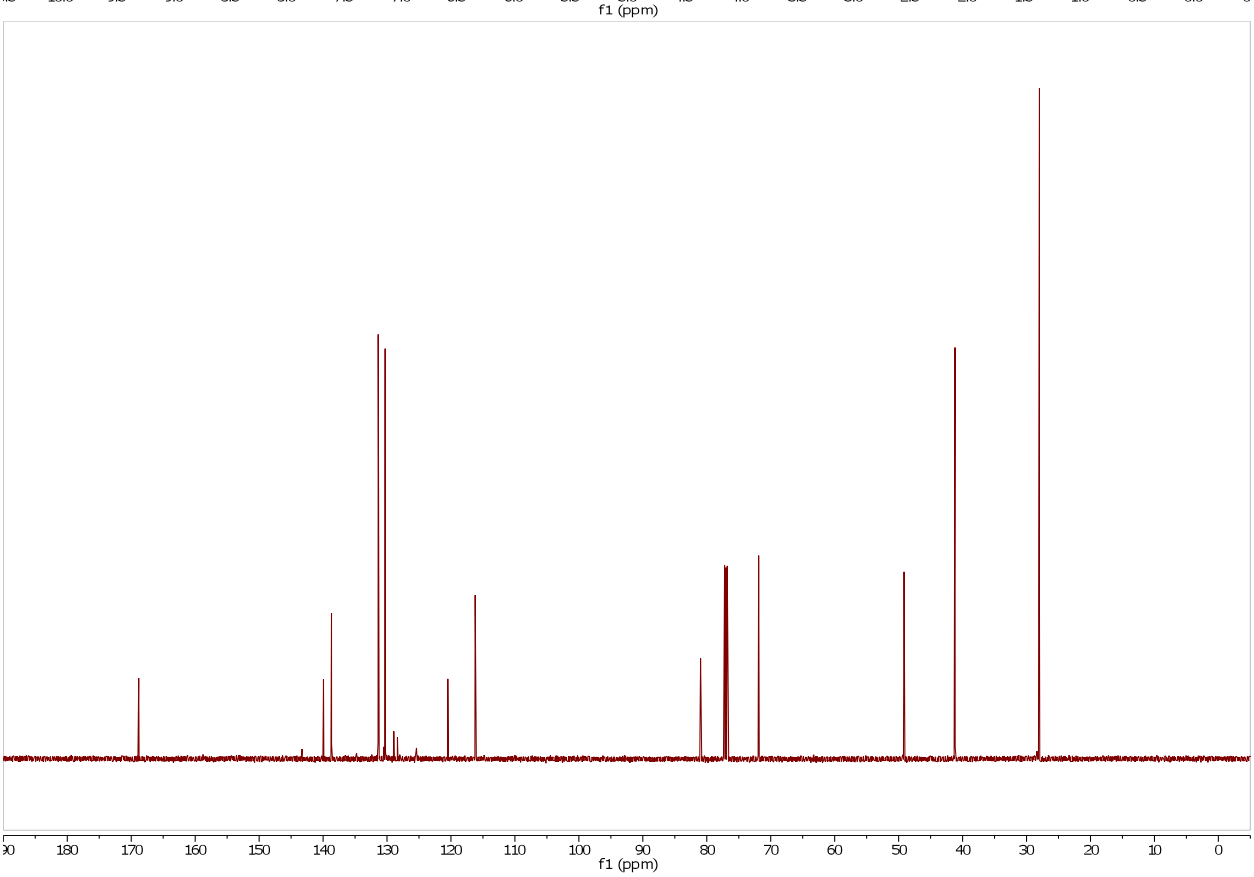

O
H
Me2N
Ot-Bu
OMe
Br
Br
13a or 14a
f1 (ppm)

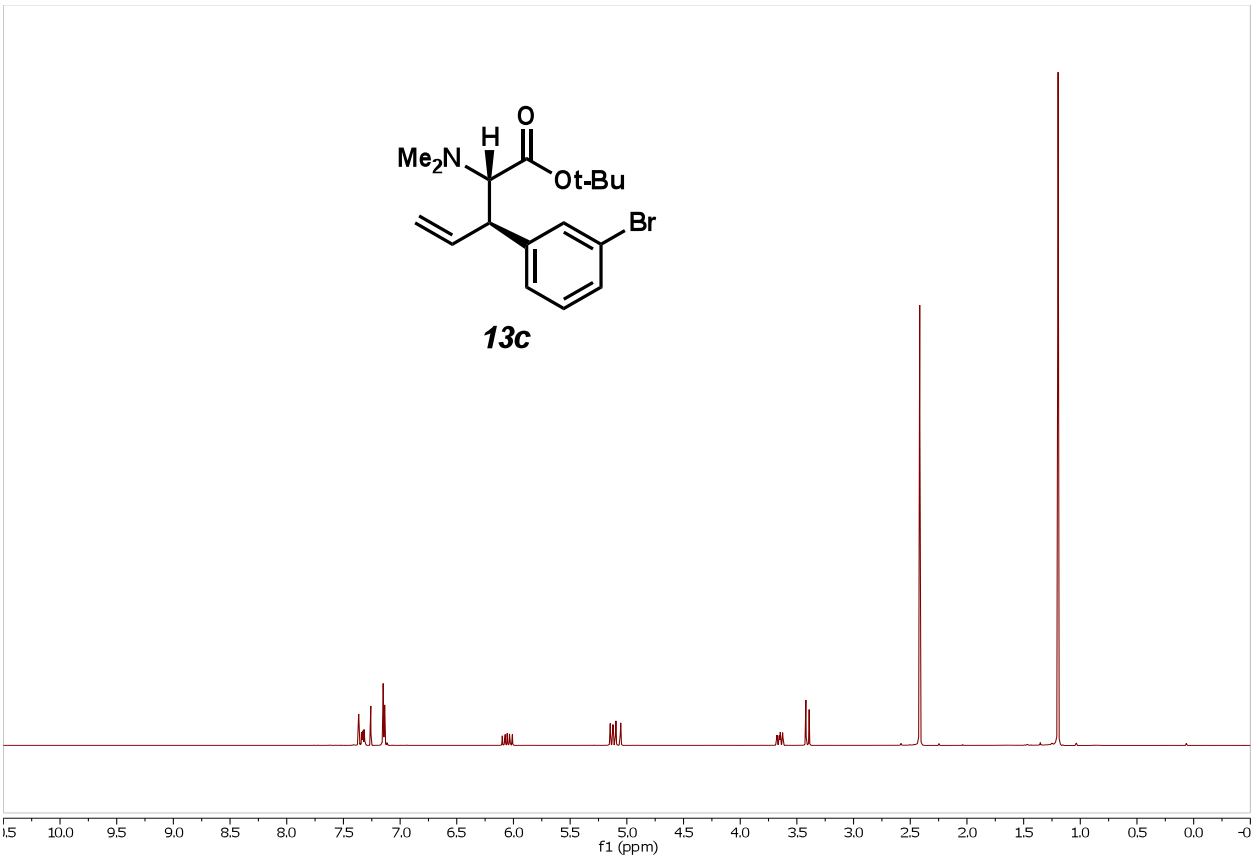

f1 (ppm)


Me2N
H
O
Ot-Bu
OMe
Br
Br
13a or 14a
f1 (ppm)


f1 (ppm)


Me2N
H
O
Ot-Bu
Br
13b
f1 (ppm)


f1 (ppm)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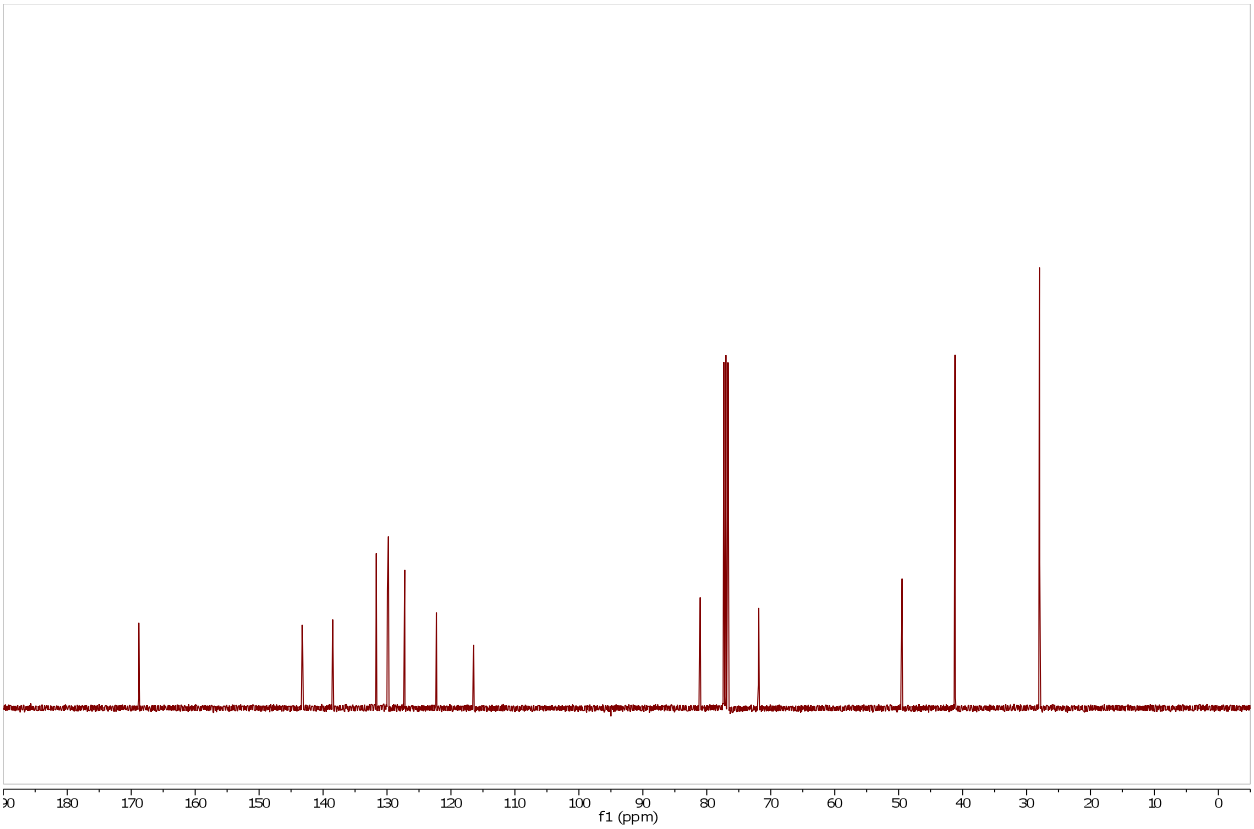
H
Me2N
Ot-Bu
Br
13c
f1 (ppm)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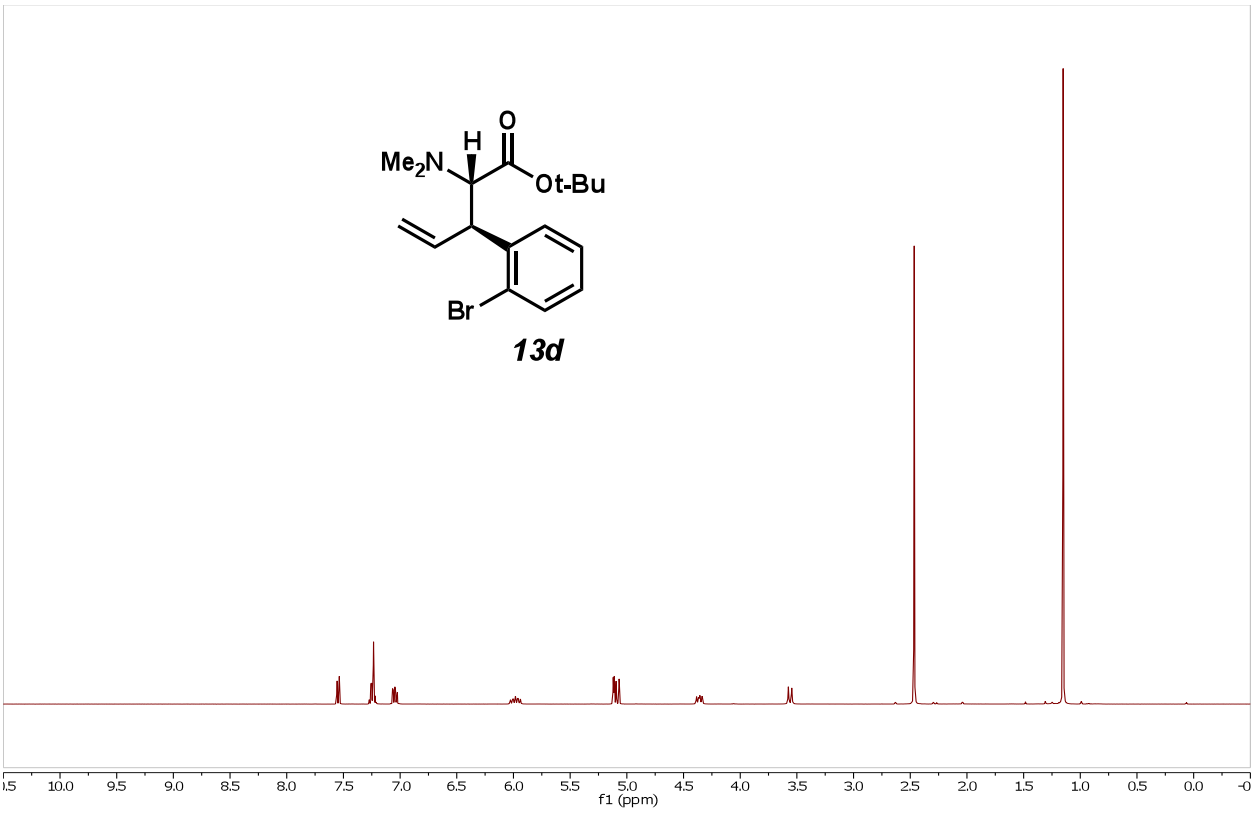
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H
Me2N
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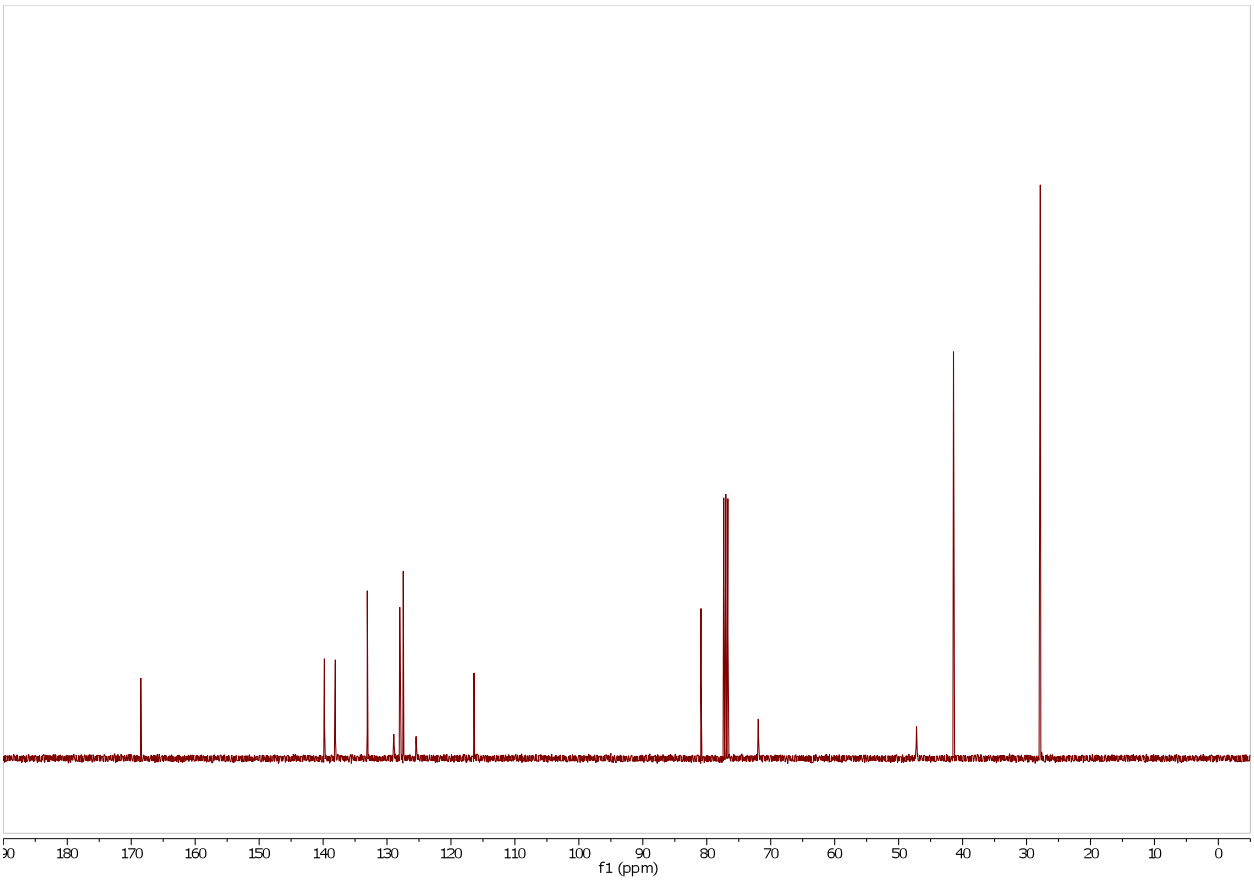
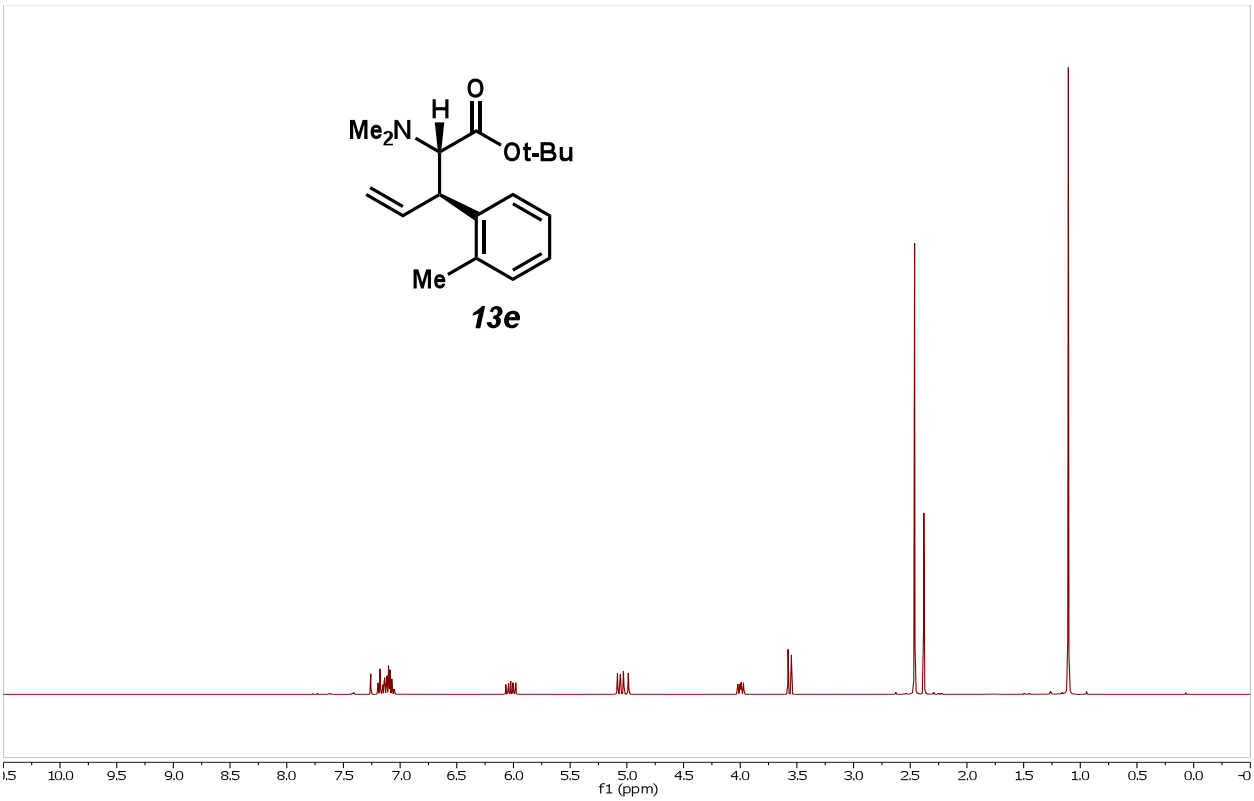
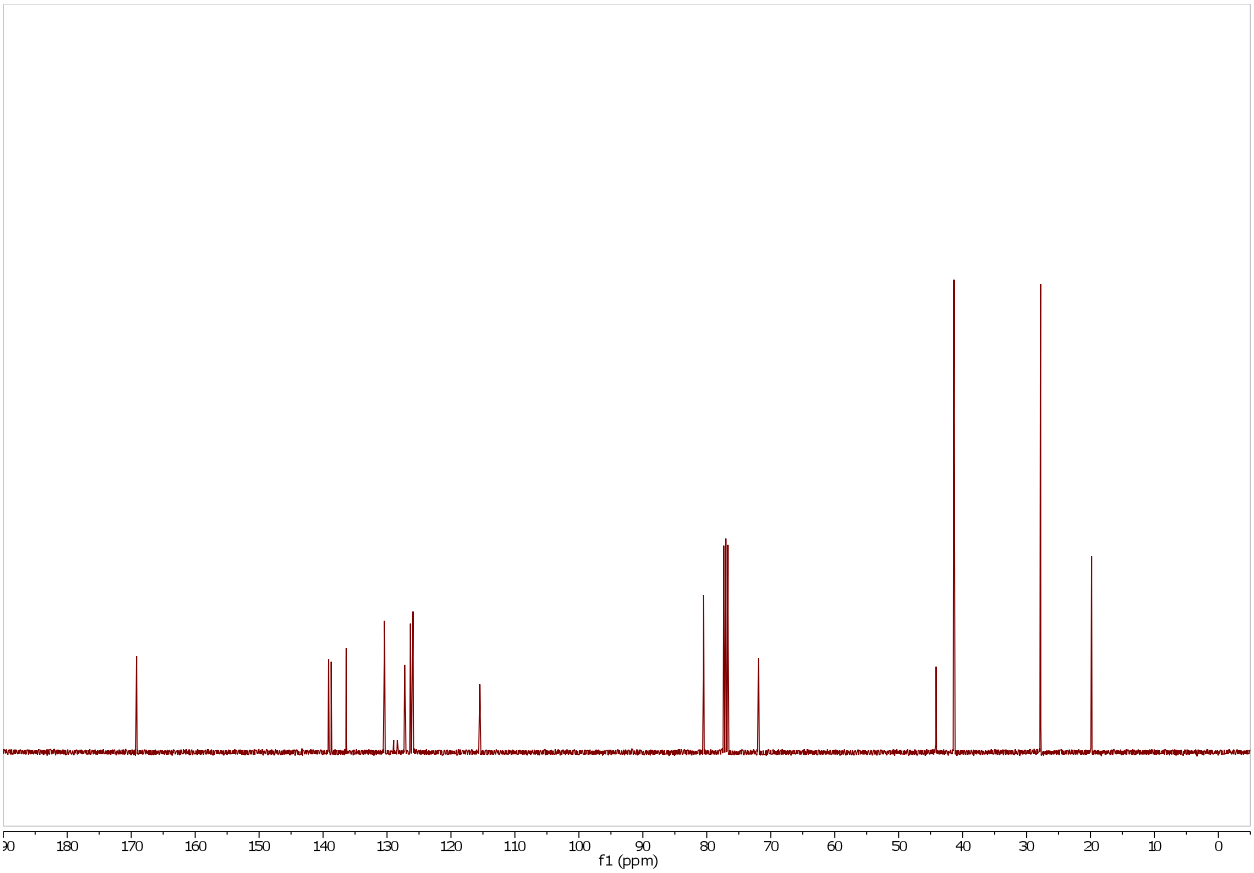
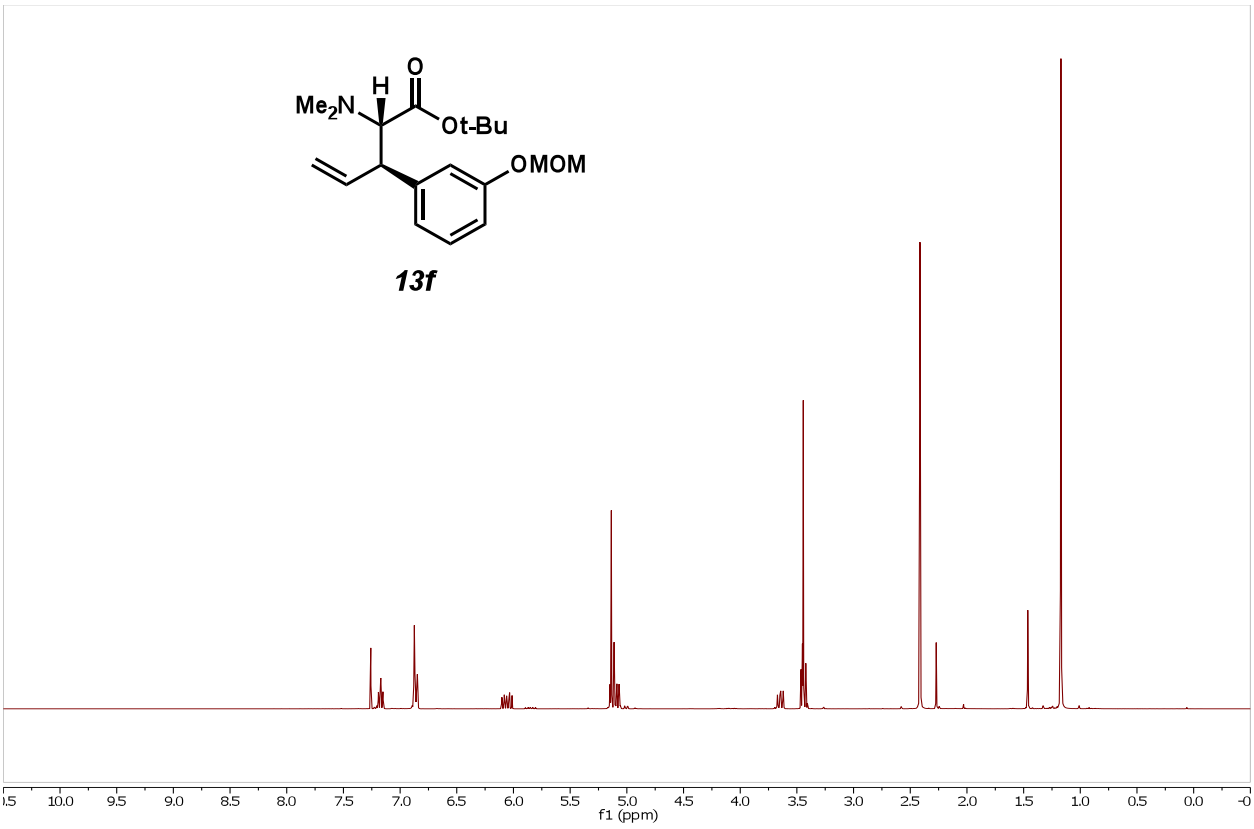
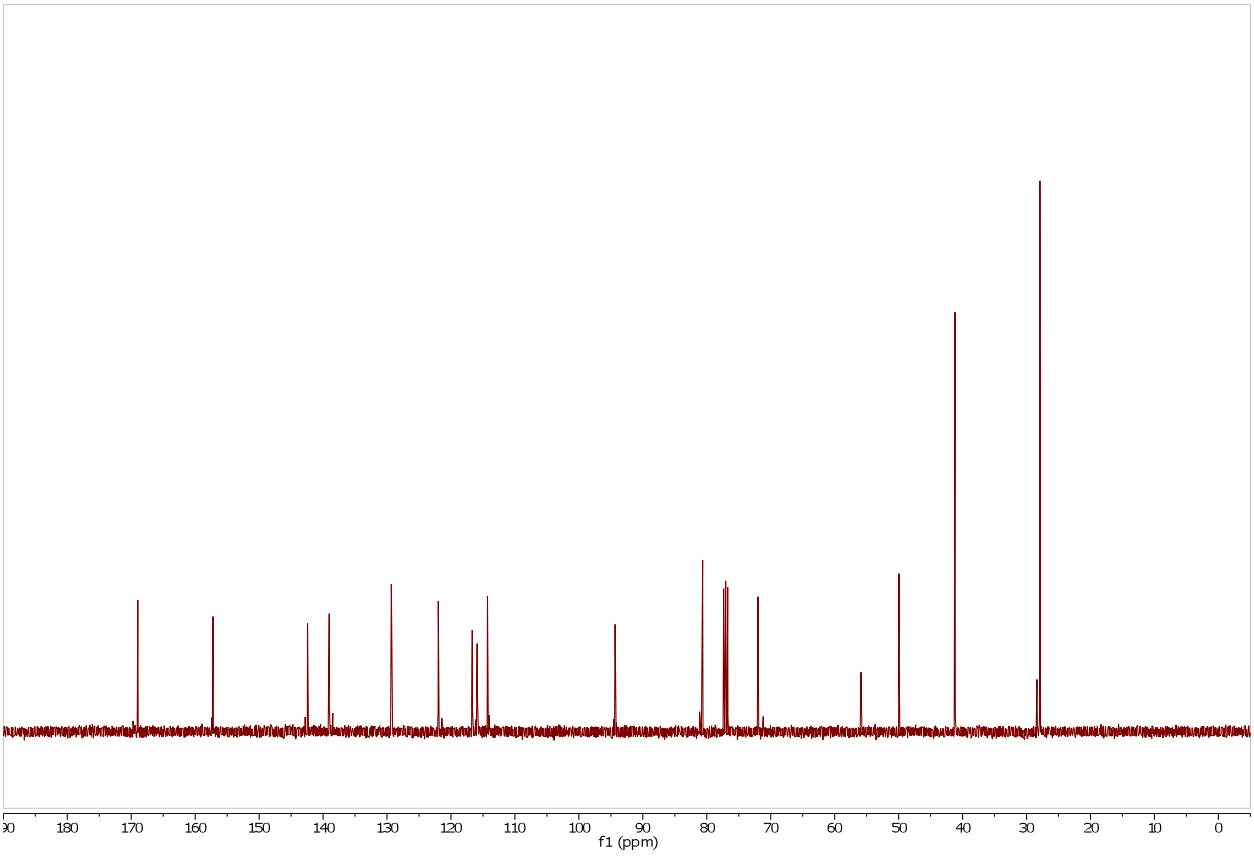
Br
13d
f1 (ppm)

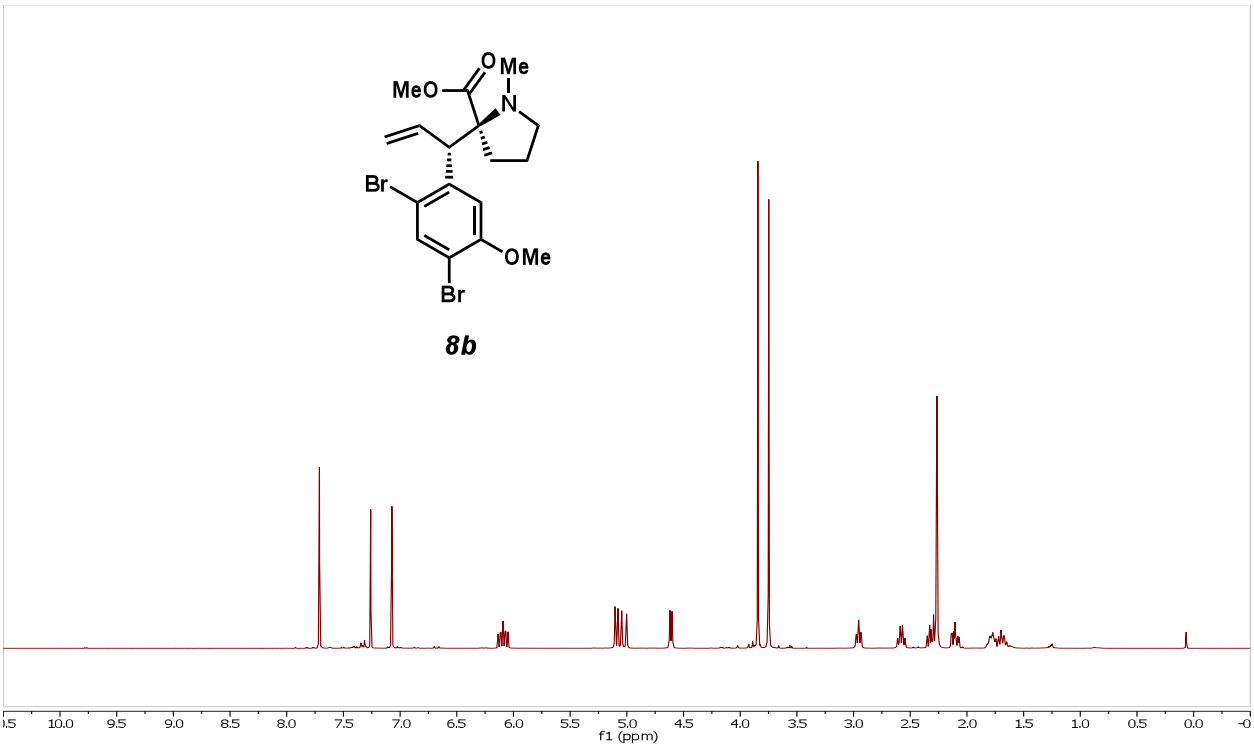

f1 (ppm)


Me2N
H
O
Ot-Bu
Me
13e
f1 (ppm)

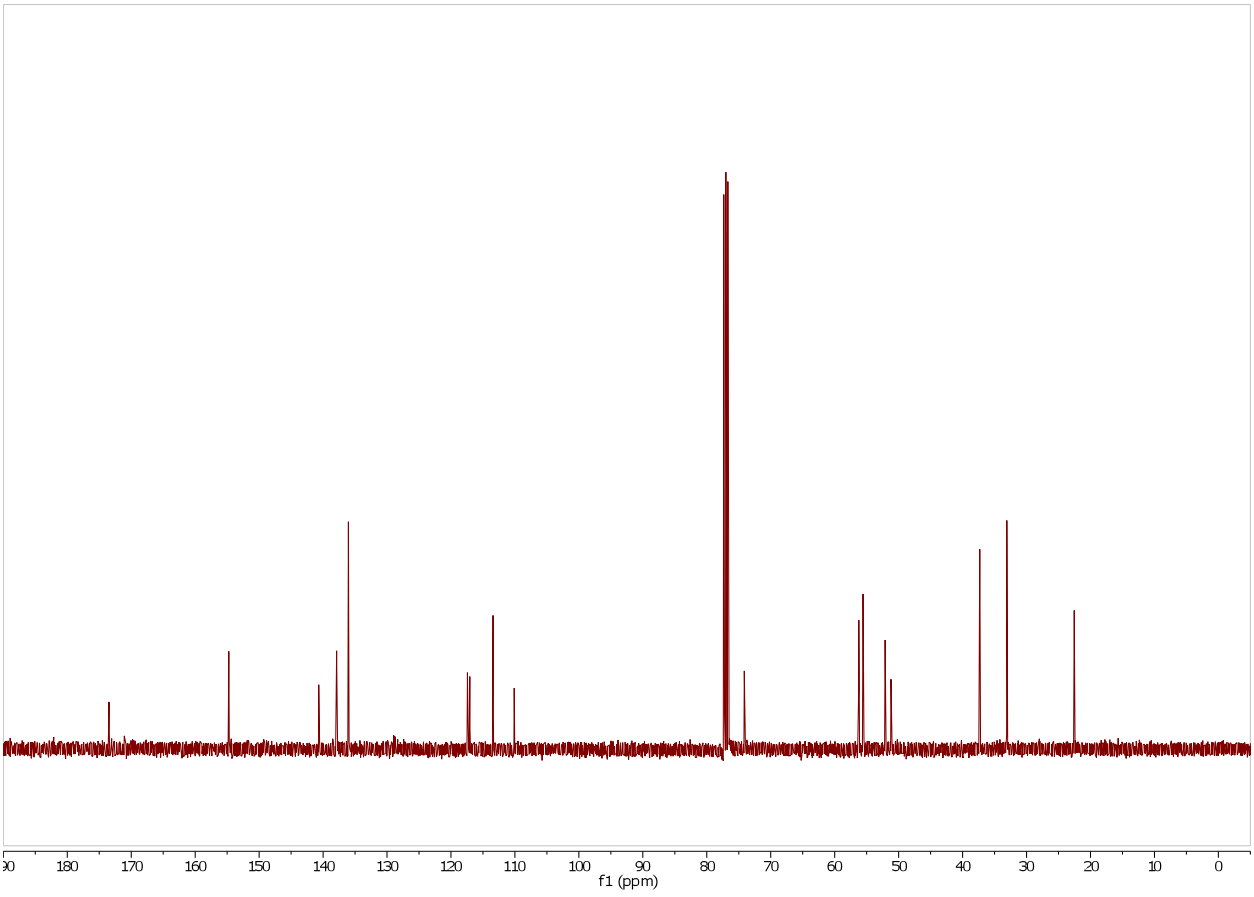

f1 (ppm)

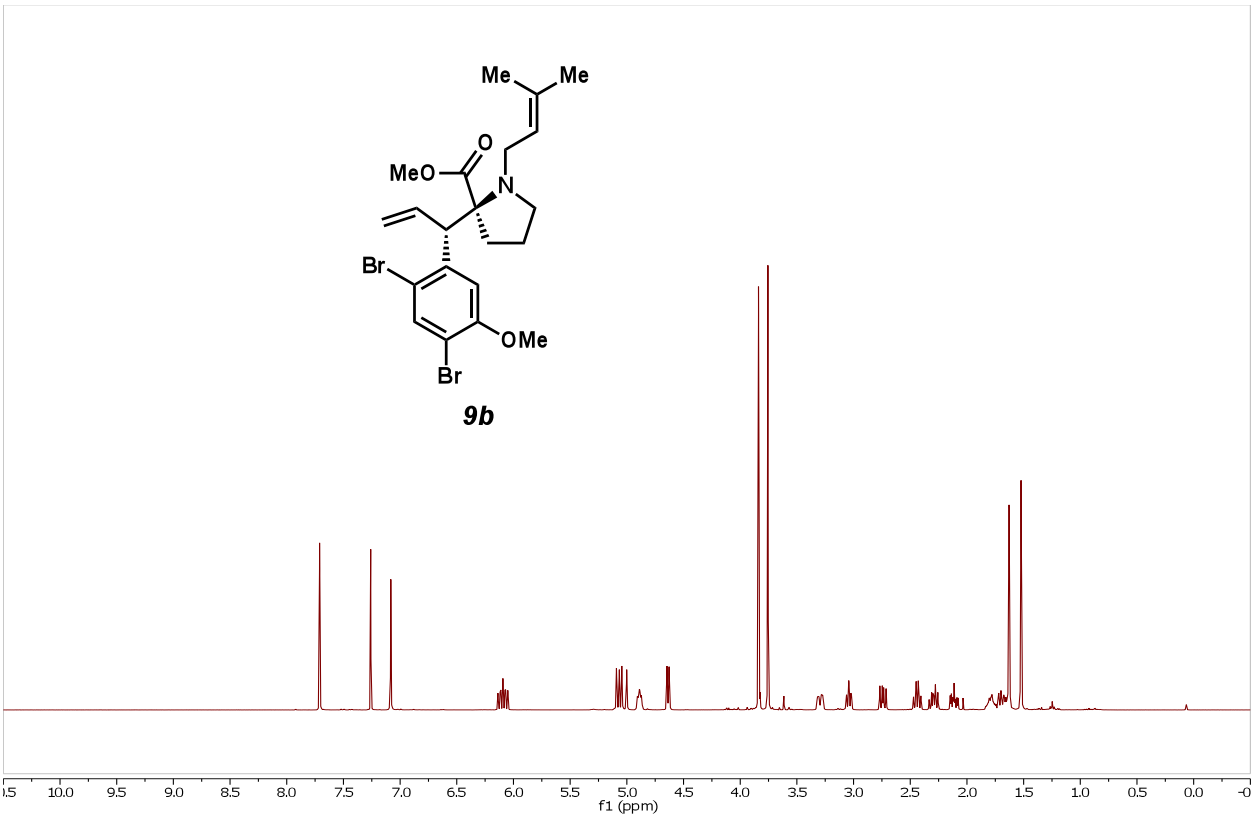

O
H
Me2N
Ot-Bu
OMOM
13f
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)

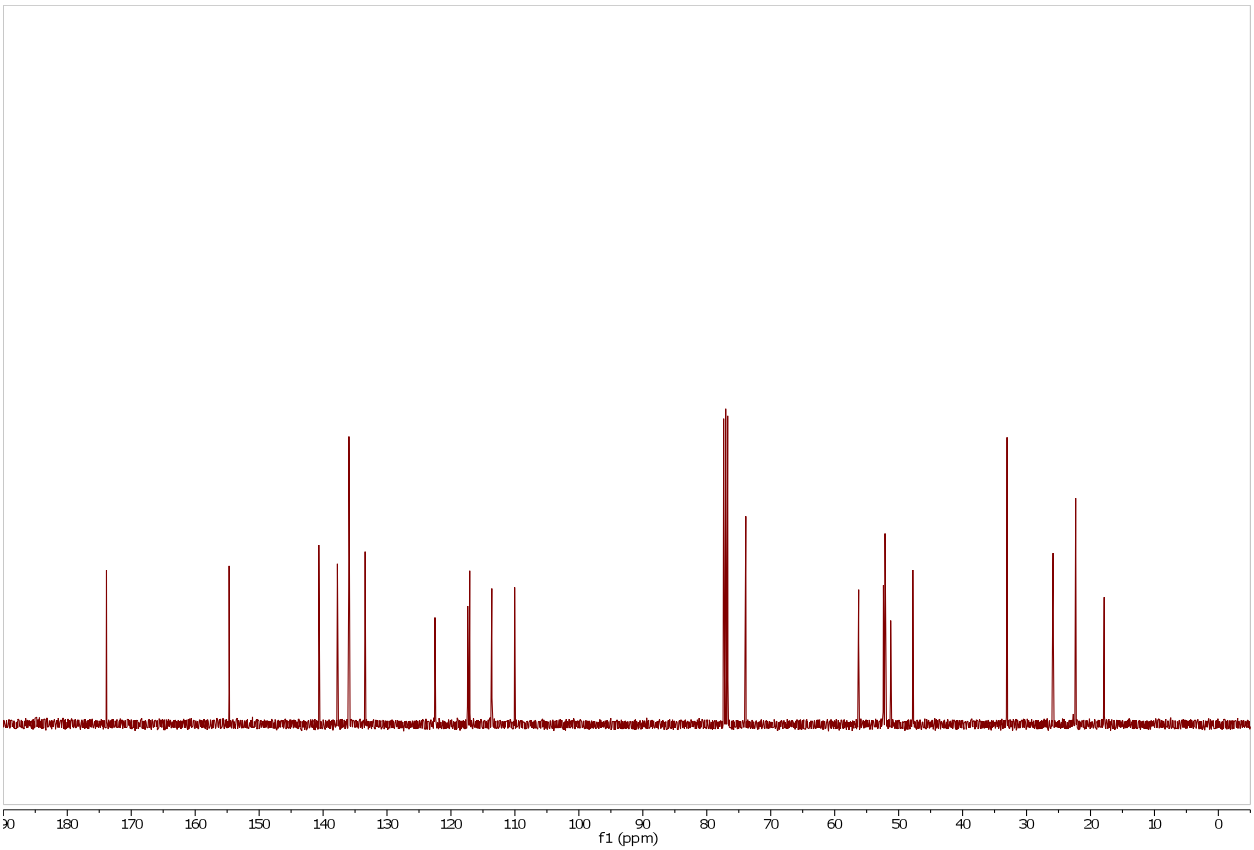

180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

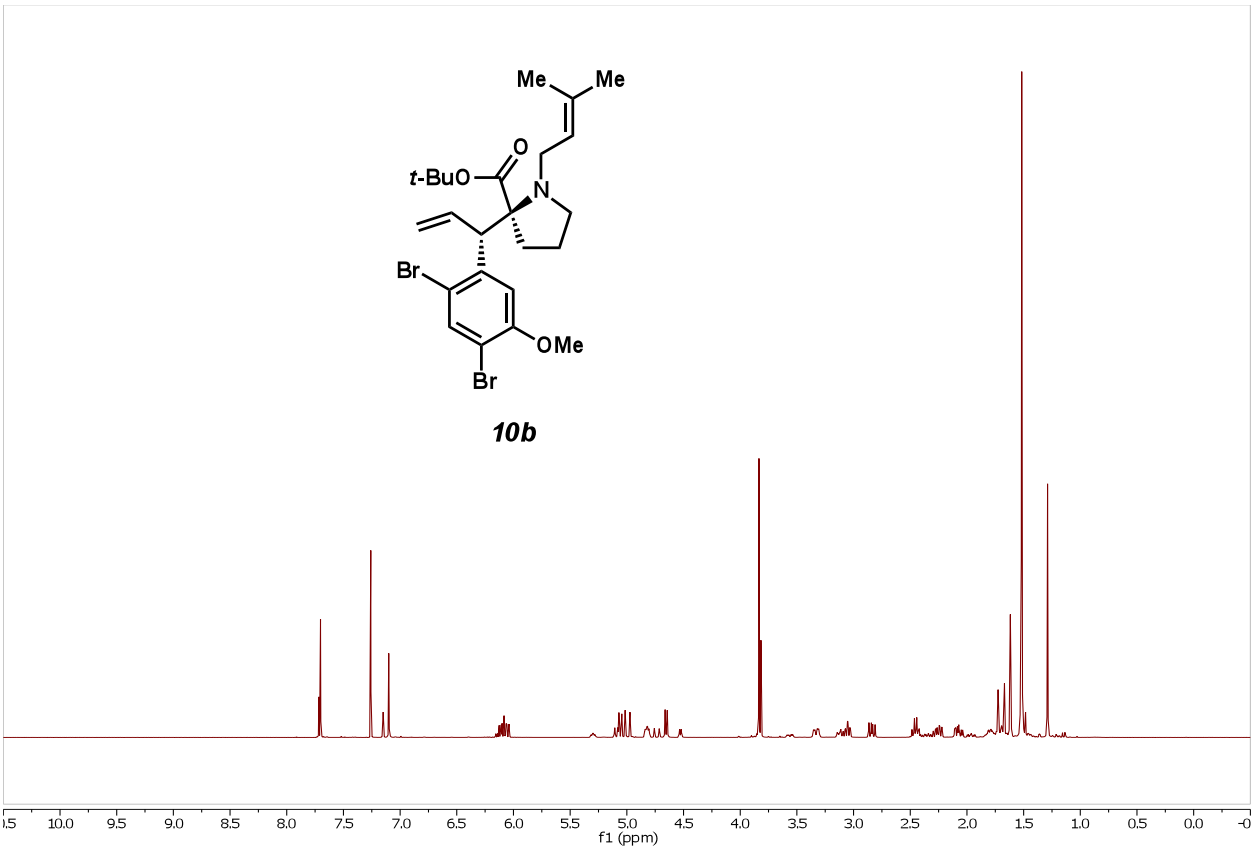


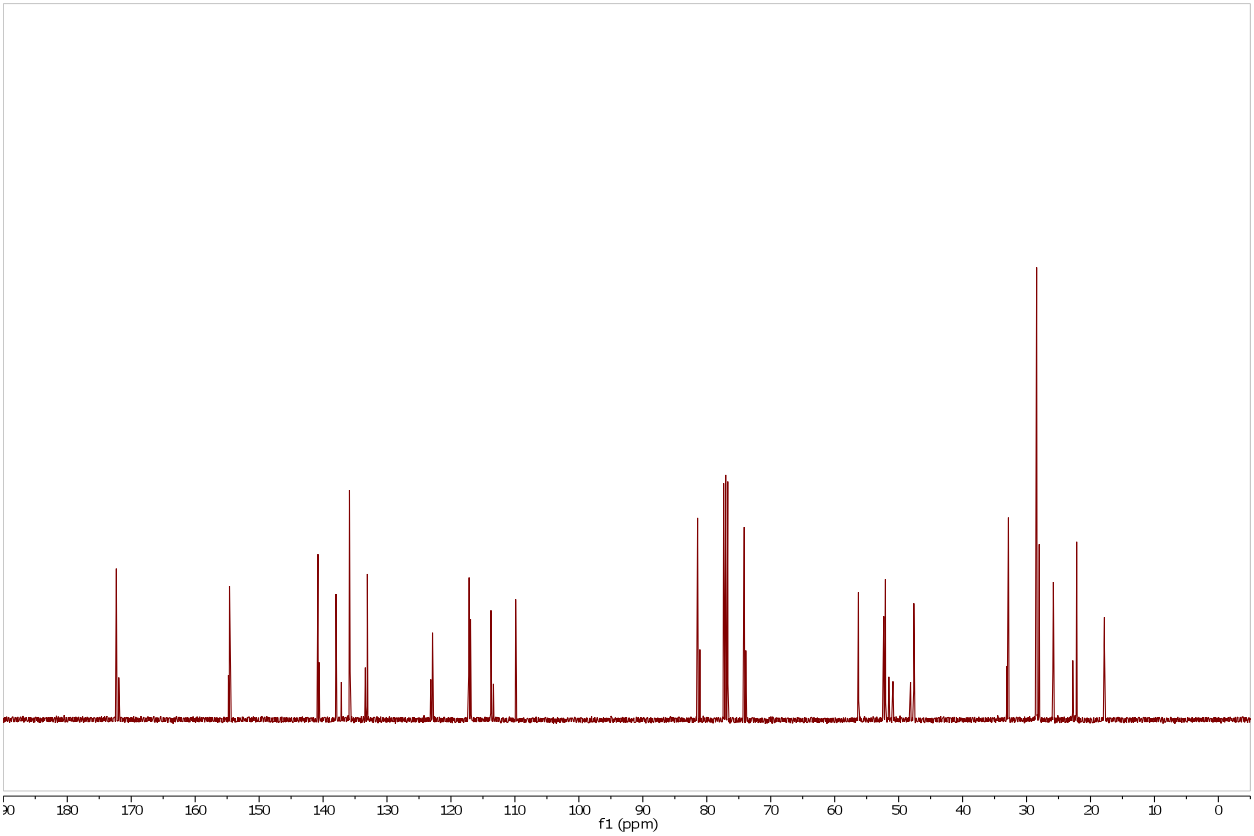
8b

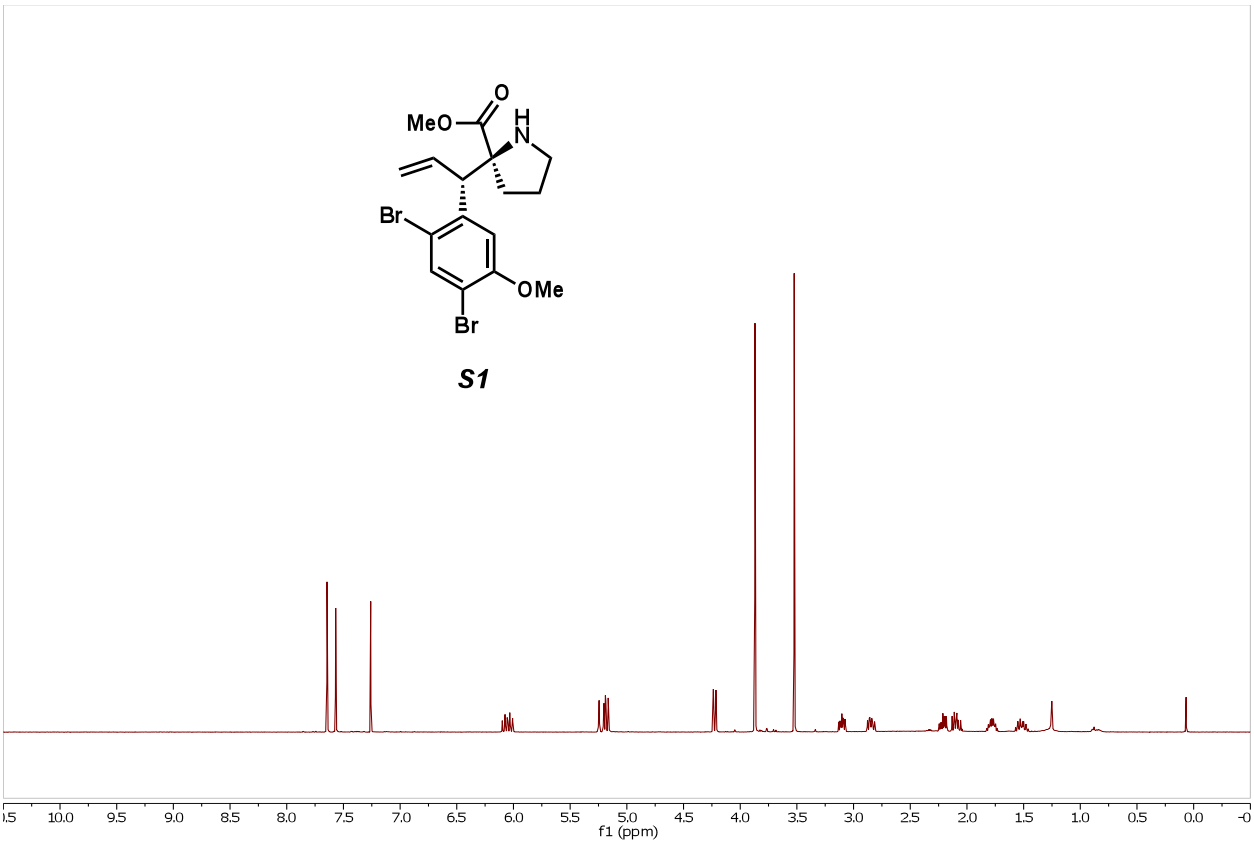



Me
Me
O
MeO
N
Br
OMe
Br
9b
f1 (ppm)

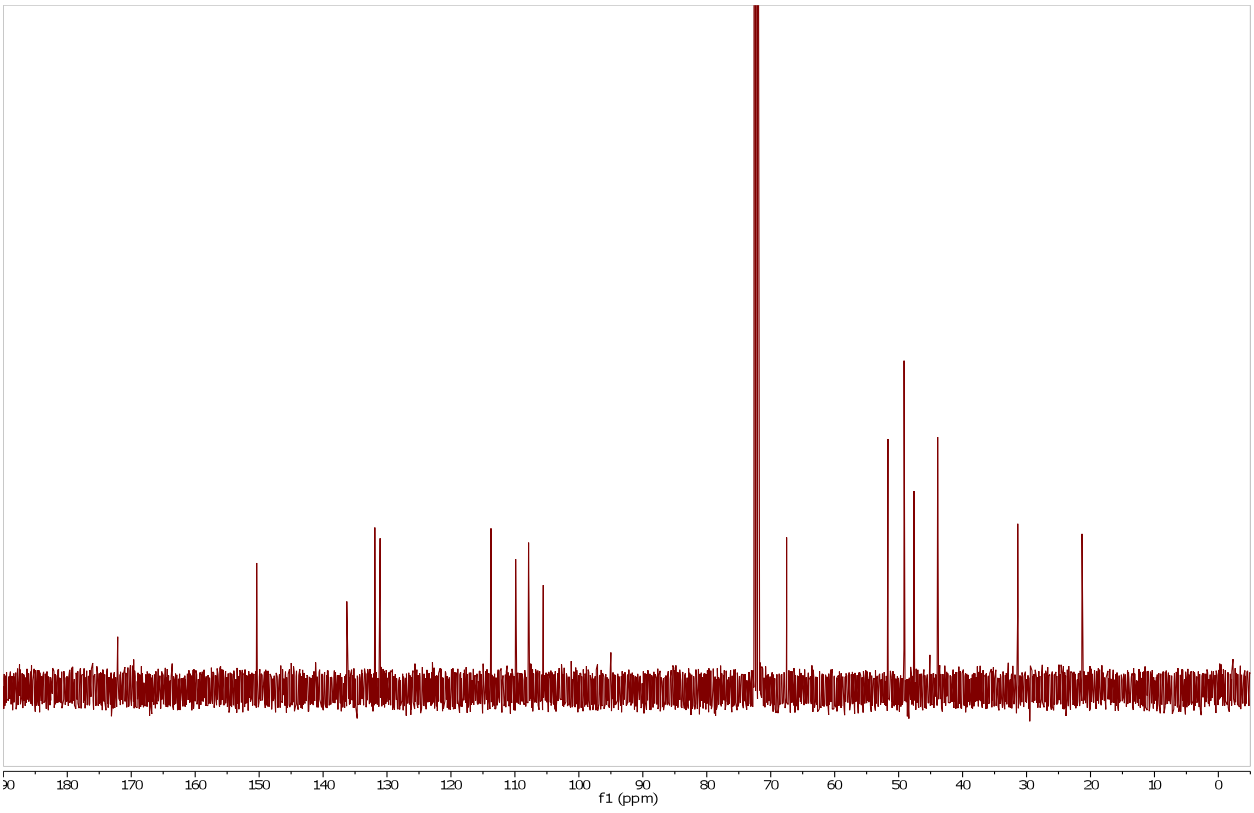

f1 (ppm)

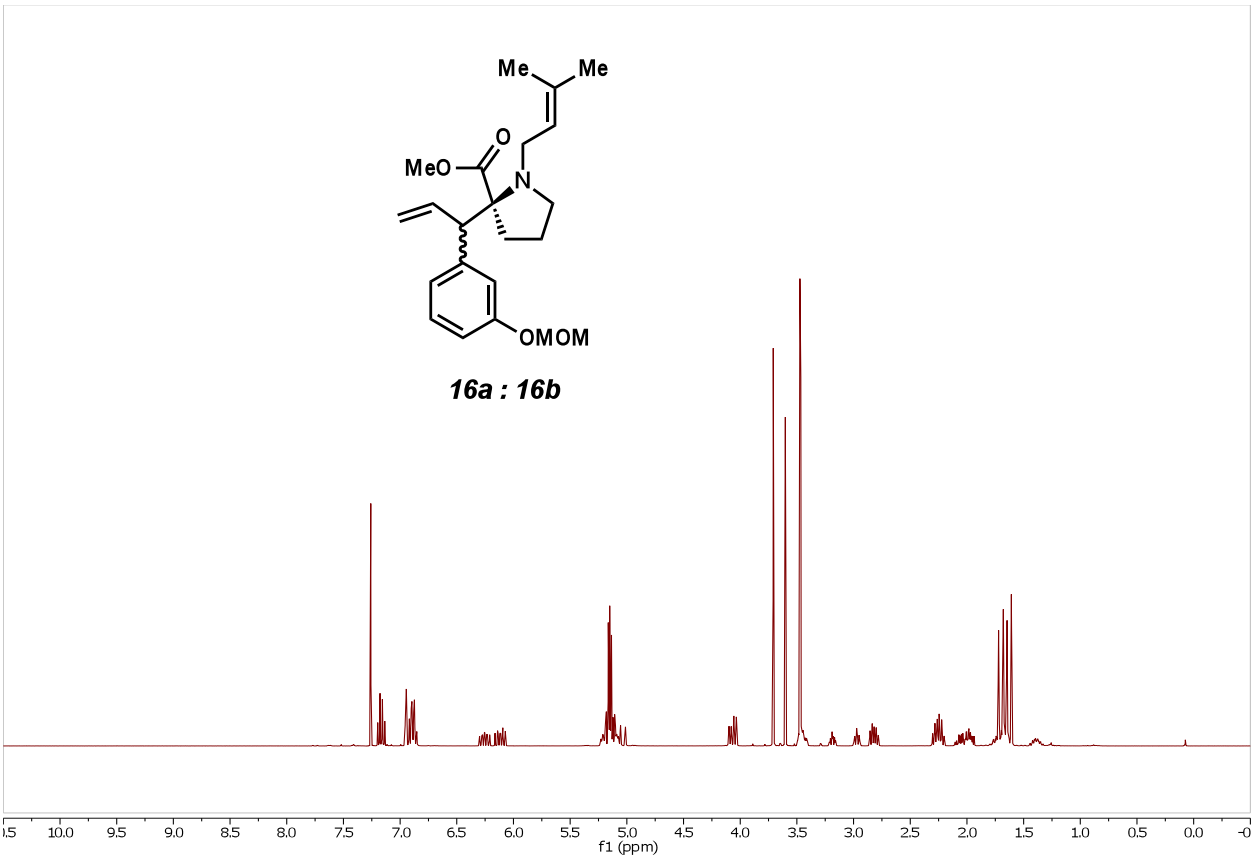

Me
Me
O
t-BuO
N
Br
OMe
Br
10b
f1 (ppm)

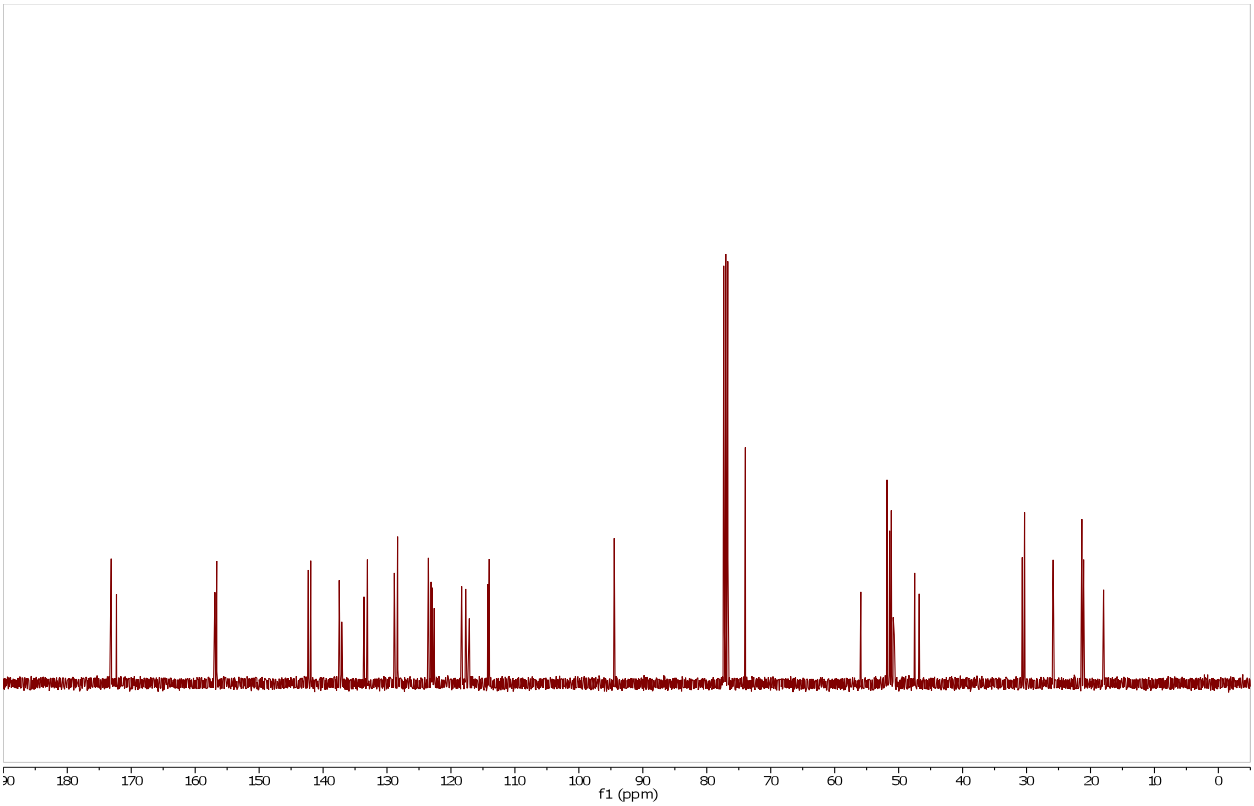

f1 (ppm)

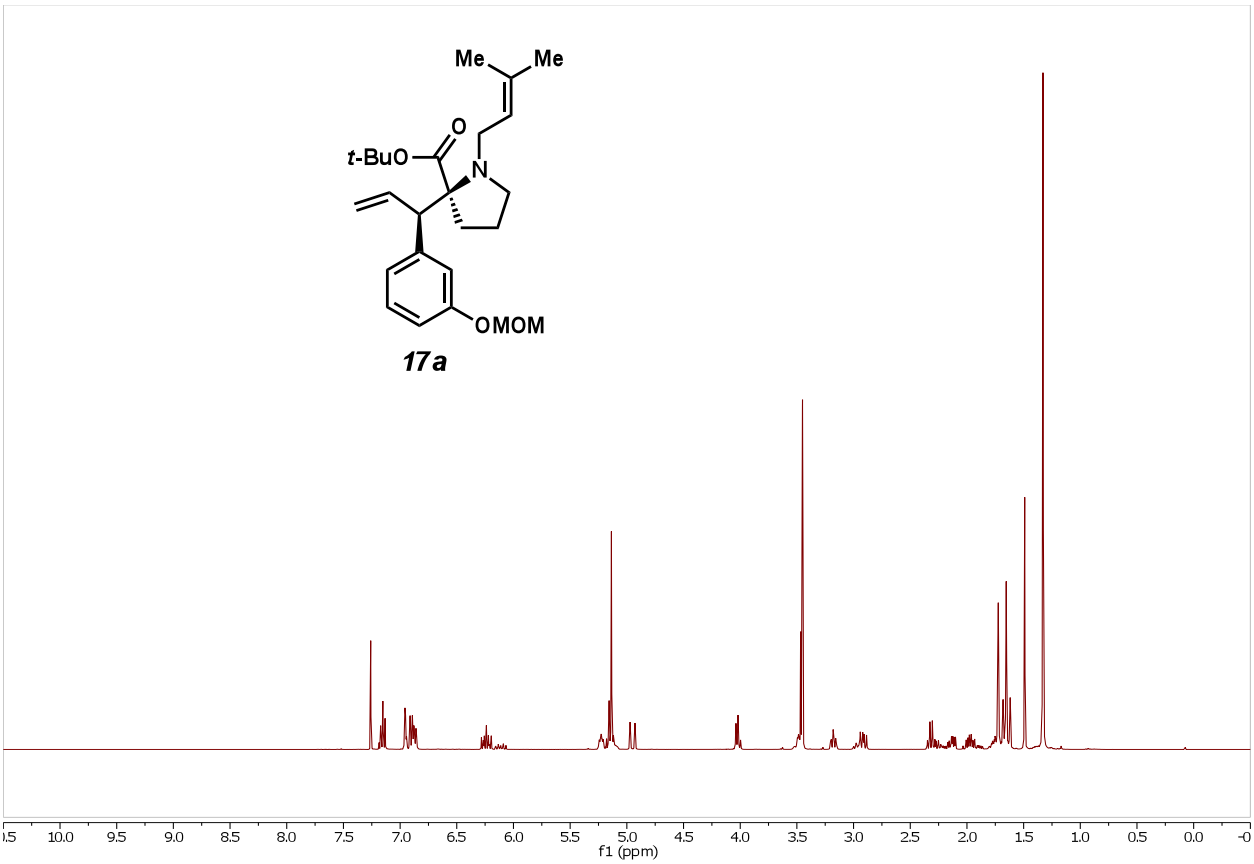


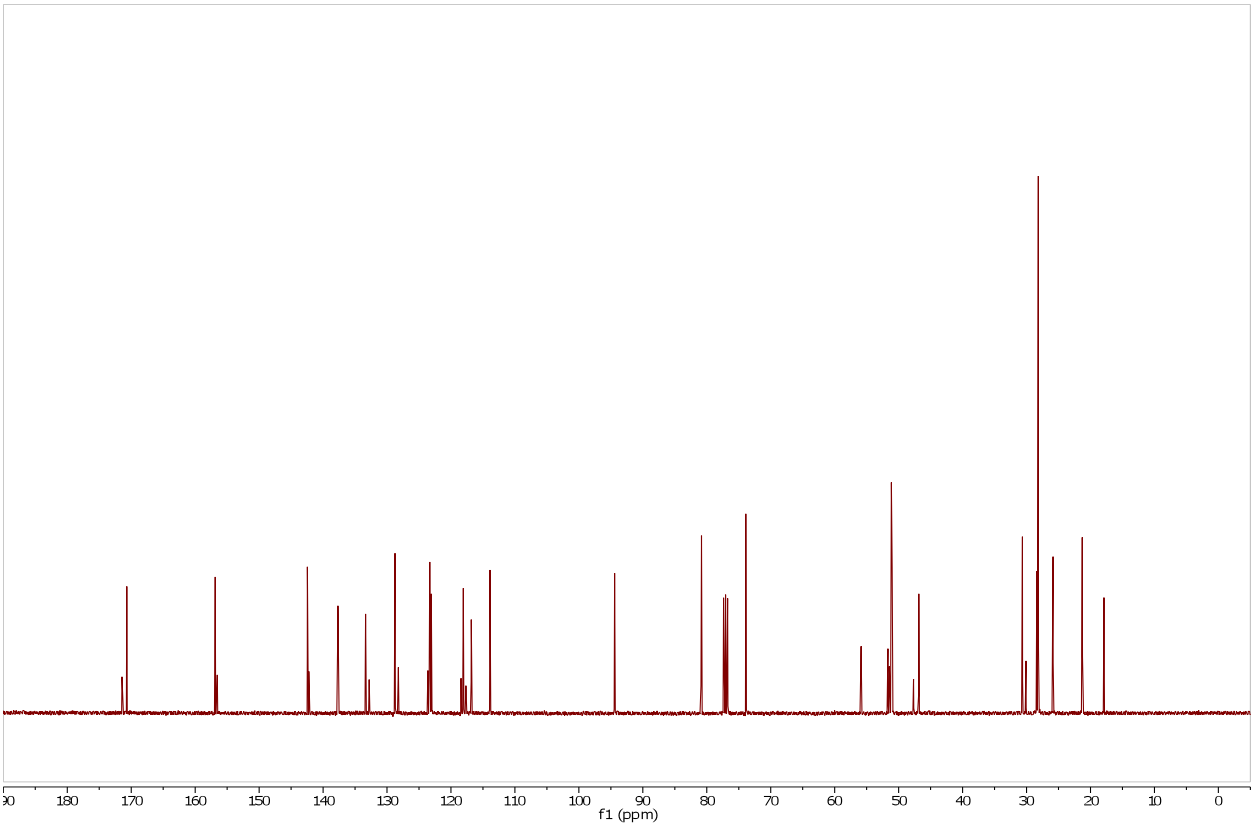
S1

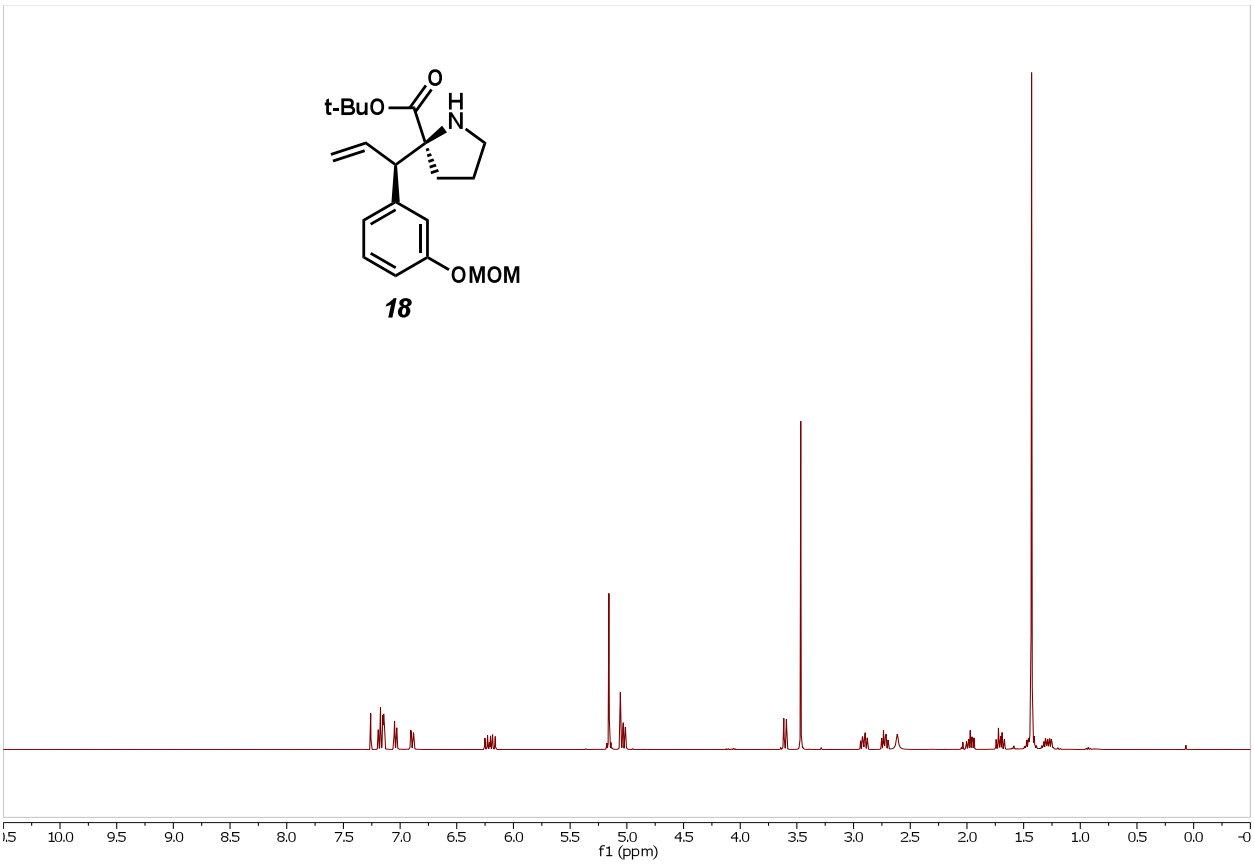


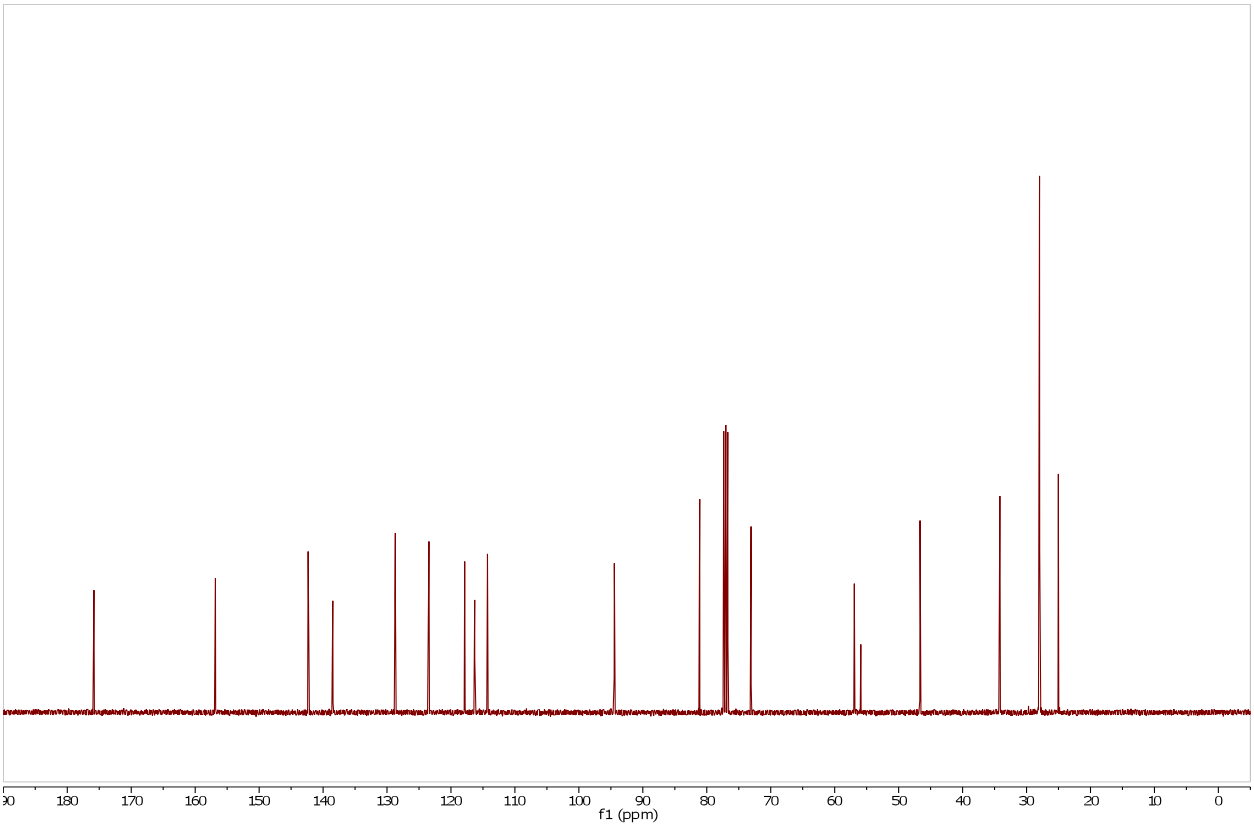

Me
Me
O
MeO
N
OMOM
16a : 16b
f1 (ppm)

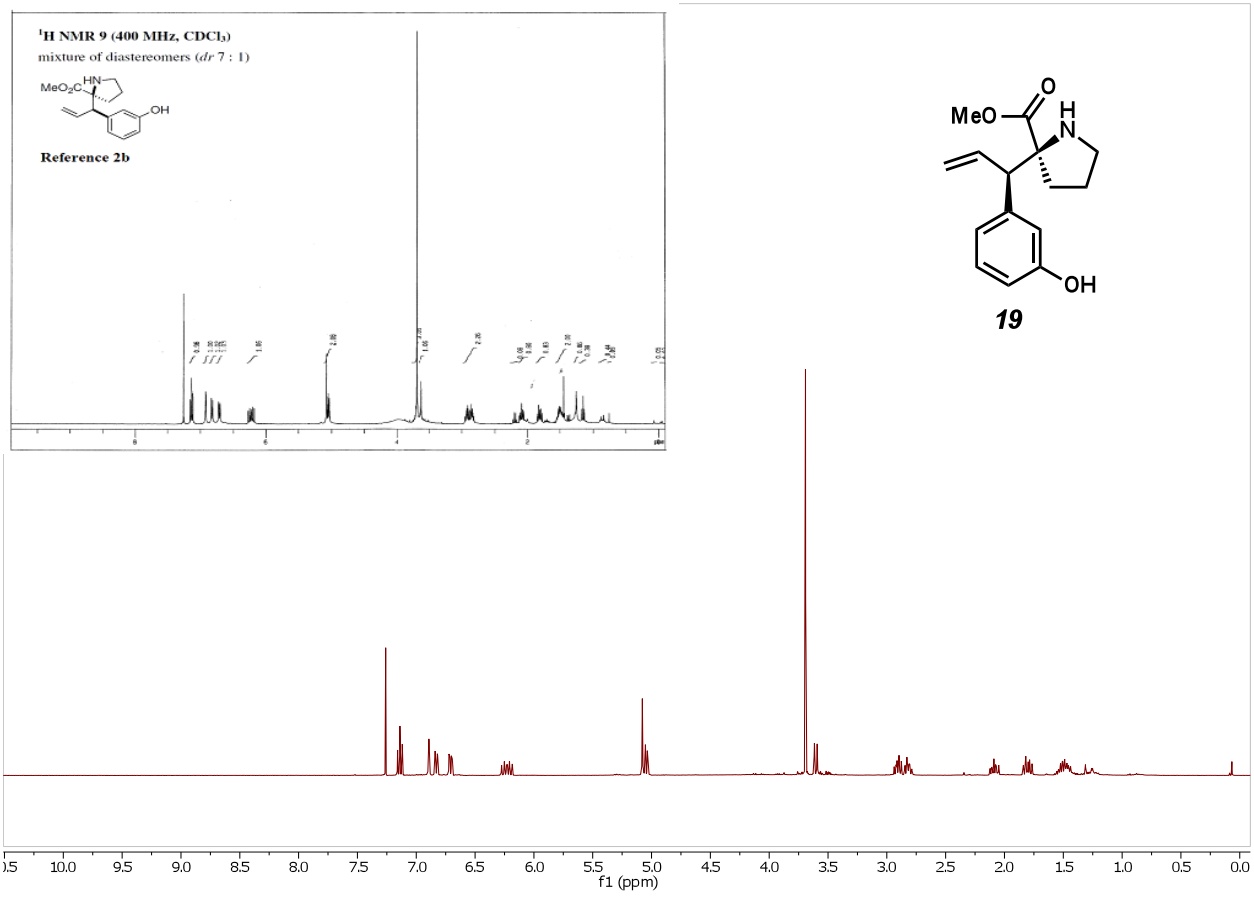

f1 (ppm)

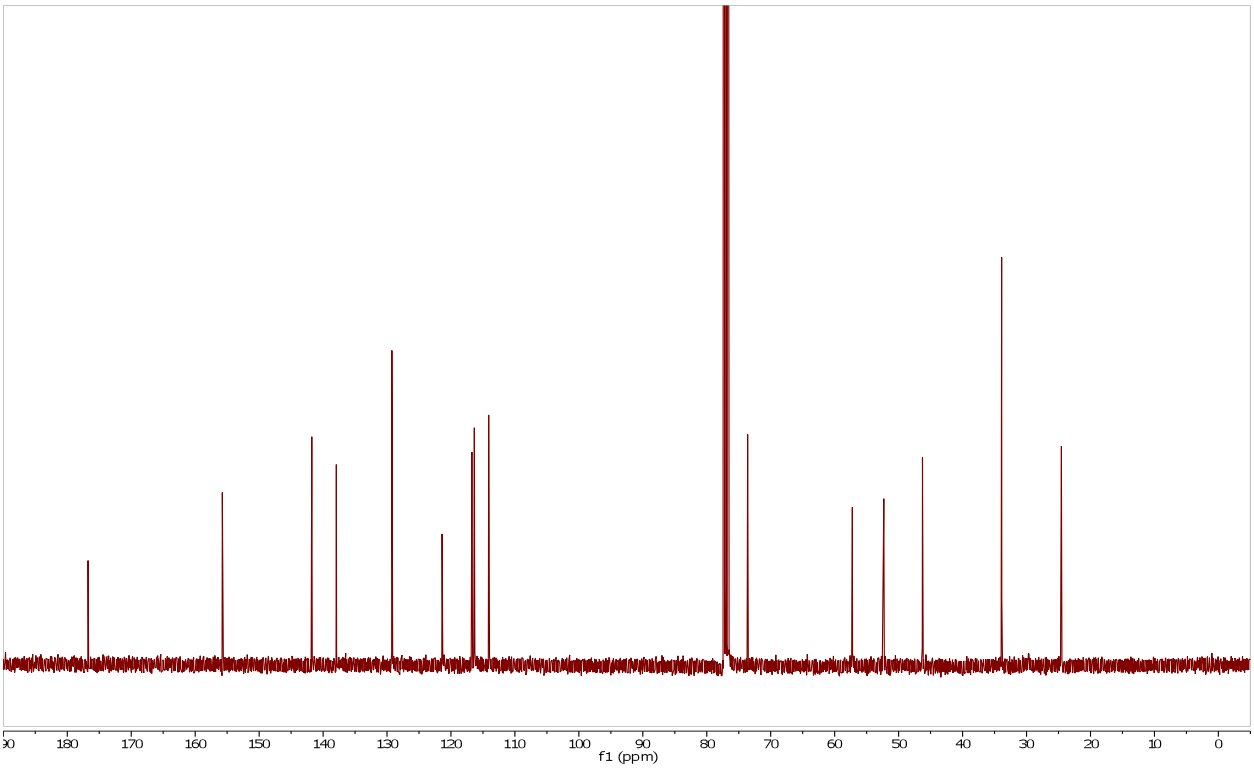

Me
Me
O
t-BuO
N
OMOM
17a
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)

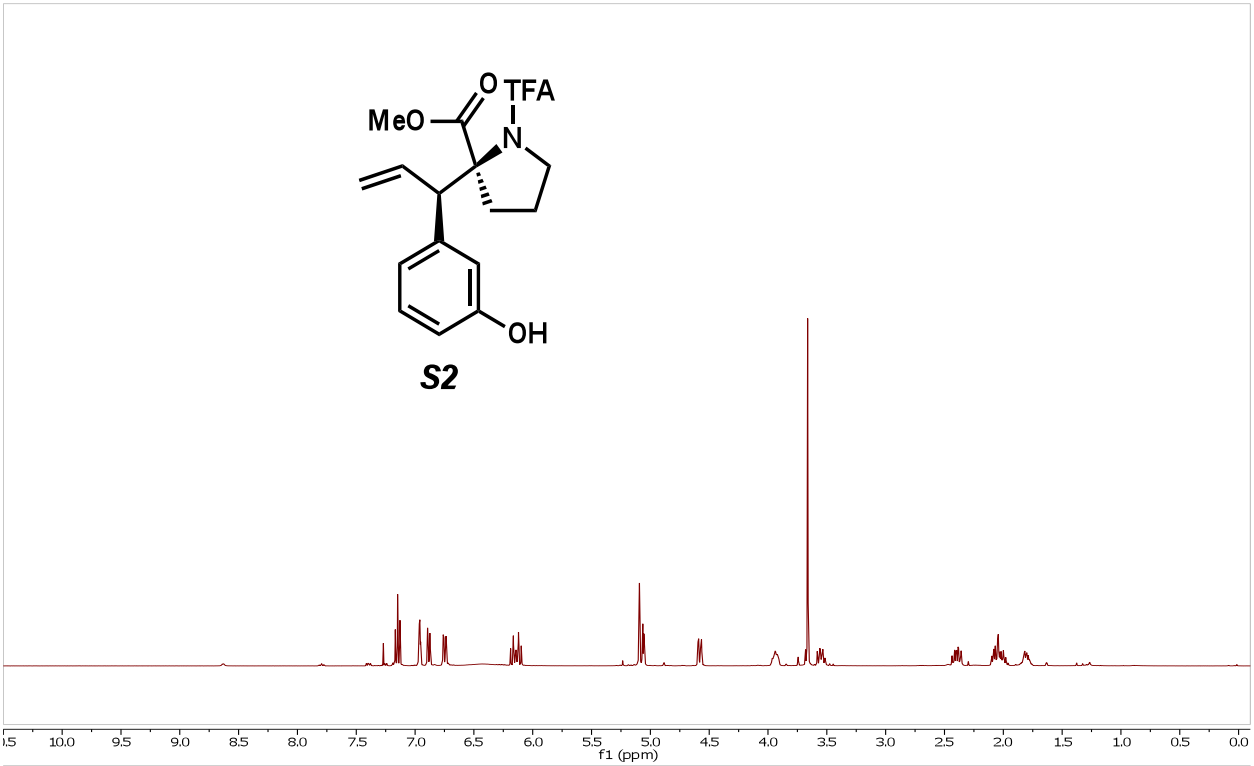

180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)


t-BuO
O
H
N
OMOM
18
10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)


180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

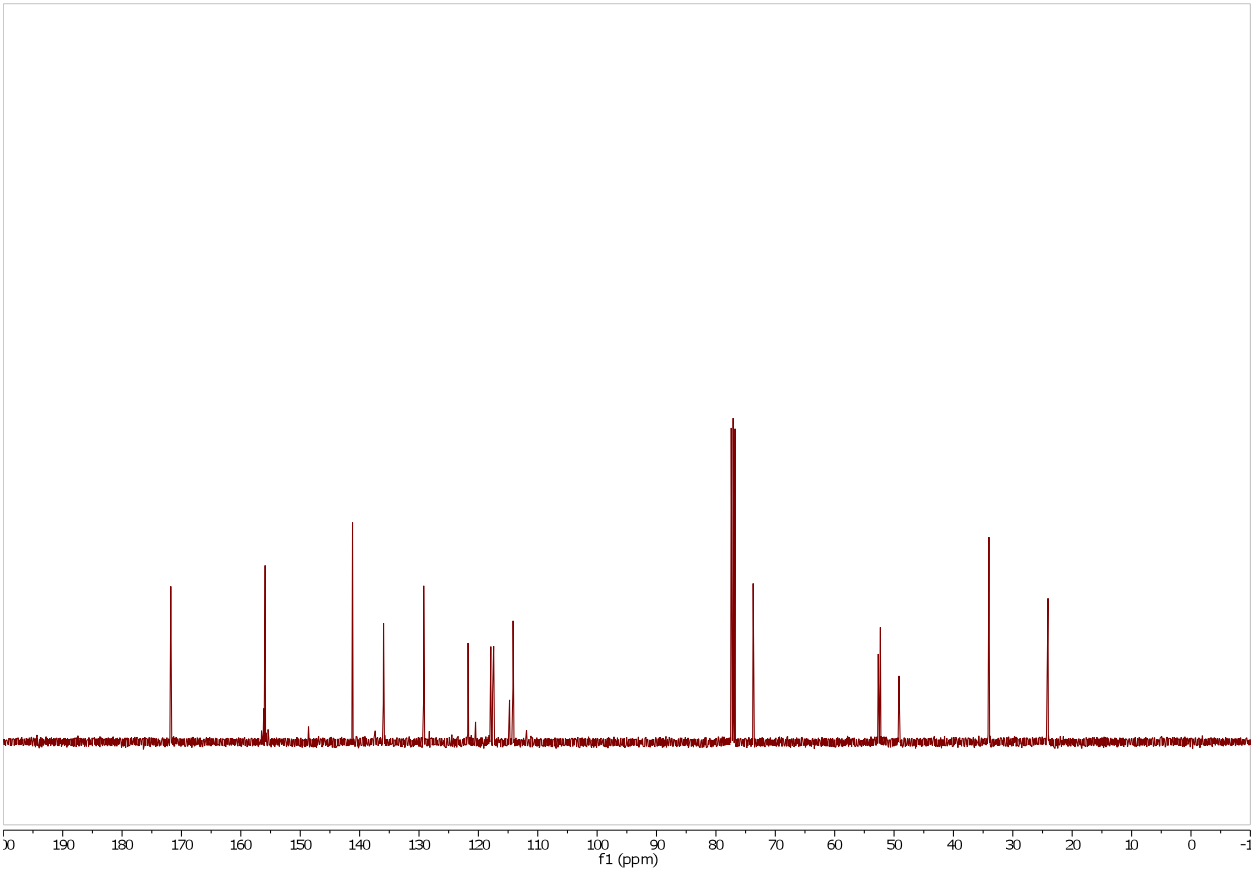

^{1}H NMR 9 (400 MHz, CDCl$_3$)
mixture of diastereomers (*dr* 7 : 1)
Reference 2b
MeO
O
H
N
OH
19
f1 (ppm)


f1 (ppm)


O
TFA
MeO
N
OH

S2

10.0
9.5
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)


190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)