Supplementary Material

Insertion of chiral carbenoids into pinanediol boronic esters

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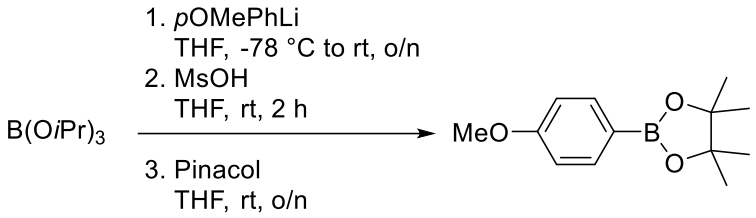
General Information

All reactions with non-aqueous media or reagents were performed under argon atmosphere using dried solvents and Schlenk-line techniques. Commercially available solvents and reagents were used as received without additional purification unless stated otherwise. These were obtained from *Abcr GmbH*, *Fisher Scientific*, *Carbolution GmbH*, *Fluorochem*, *Sigma Aldrich,* and *TCI*. Deuterated NMR solvents were received from *Deutero GmbH*. Grignard reagents were titrated using salicylaldehyde phenylhydrazone, following the method presented by Love and Jones.[1] Organolithium reagents were titrated using *N*-benzylbenzamide. THF, Et_2O and dichloromethane were dried with solvent purifier *SPS 5* by *MBRAUN*. Diisopropyl amine was dried over CaH_2 and distilled under Ar atmosphere. CPME and $CHCl_3$ were dried over 4 Å molecular sieves and stored under Ar atmosphere. Technical grade cyclohexane was distilled at 200 mbar and 40 °C and used for flash column chromatography. For determination of yield by internal Standard, 3% v/v solution of dichloromethane or CPME in $CDCl_3$ were used. Solvents were removed on a rotary evaporator under reduced pressure at 40 °C, if not stated otherwise. For thin-layer chromatography (TLC), *Polygram SIL G/UV254* silica plates from *Macherey-Nagel* were used. Spot visualization was performed using 254 and 365 nm or $KMnO_4$ stain. Flash-chromatography was carried out by using silica gel *MN 60 M* (0.04–0.063 mm) from *Macherey-Nagel*. High-resolution electrospray (ESI) mass spectra were measured on a *Bruker maXis 4G* spectrometer with data processing *Bruker Data Analysis* software. FT-IR spectra were measured using a *Jasco FT/IR-4600* spectrometer. NMR spectra were measured on a *Bruker AVNEO400* (^{1}H: 400 MHz, ^{13}C: 101 MHz) spectrometer. All measurements were performed at room temperature, ^{13}C-NMR spectra were recorded with proton decoupling. Spectra are given with frequency, solvent. Chemical shifts are given in parts per million (ppm). Coupling constants *J* are given in Hertz (Hz). The undeuterated residue of the solvent served as internal standard. For the assignment of ^{1}H-NMR, following abbreviations are used: s (singlet), d (doublet), t (triplet), q (quartet), p (pentet), m (multiplet), bs (broad singlet), dd (doublet of doublet), sxt (sextet)., hpt (heptet), ddd (doublet of doublet of doublet). For the complete assignment of ^{1}H-NMR and ^{13}C-NMR signals, 2D spectra such as HSQC, HMBC and COSY were employed. For ^{13}C-NMR, the carbon atom adjacent to boron is unobservable due to carbon-boron spin-spin coupling and partially relaxed scalar coupling between boron and carbon.[2] All raw-data were processed and analyzed by using the *Bruker TopSpin 4.4.0 software*.

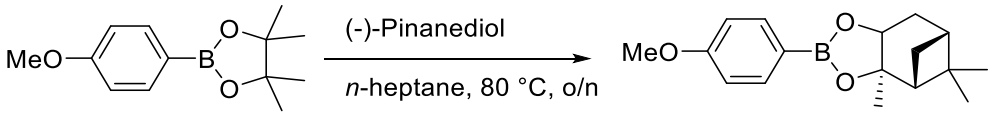
Synthesis of the miscellaneous Compounds

Preparation of general compounds

p-Anisyl-(-)-pinanediol boronic ester

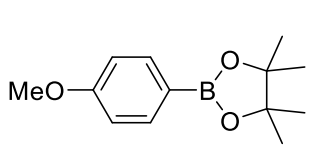


Bromoanisol (9.78 mL, 63.8 mmol, 1.20 eq.) was dissolved in THF (1.2 M) and cooled to -78 °C, before *n*-BuLi (24.9 mL, 58.5 mmol, 1.1 eq., 2.35 M in hexane) was added dropwise through a dropping funnel. The resulting mixture was stirred for 0.5 h at the same temperature before it was added to a 2 M solution of triisopropyl borate (12.3 mL, 53.2 mmol, 1.0 eq.) in THF at -78 °C. The resulting mixture was stirred for 2 h at the same temperature and then for 16 h (overnight) at rt. The mixture was cooled to at 0 °C and methanesulfonic acid (5.55 mL, 106 mmol, 2.0 eq.) was added. Then the mixture stirred for 2 h at rt. Pinacol (6.28 g, 53.2 mmol, 1.0 eq.) was added and the mixture was stirred at rt for 16 h (overnight). The reaction mixture was concentrated under reduced pressure, filtered through a pad of celite and washed with excess Et_2O. The filtrate was washed once with 1 M aq. NaOH. The organic layer was dried over $MgSO_4$, filtered and concentrated under reduced pressure. The crude product was used for next reaction without further purification. **^{1}H-NMR (400 MHz, $CDCl_3$):** δ = 7.76–7.74 (m, 2H), 6.91–6.88 (m, 2H), 3.83 (s, 3H), 1.33 (s, 12H) ppm. **^{13}C-NMR (100 MHz, $CDCl_3$)**: δ = 162.3, 136.6, 113.4, 83.7, 55.2, 25.0 ppm. NMR data complies with published data.[3]



Crude pinacol ester (1.50 g, 6.41 mmol, 1.0 eq.) and (-)-pinanediol (1.09 g, 6.41 mmol, 1.0 eq.) in 64 mL *n*-heptane (0.1 M) was stirred at 80 °C overnight. Upon completion (TLC), the organic layer was washed three times with water. The organic layer was dried over $MgSO_4$, filtered over silica, washed with excess pentane and concentrated under reduced pressure to furnish the product in a quantitative yield. **^{1}H-NMR (400 MHz, $CDCl_3$):** δ = 7.78–7.74 (m, 2H), 6.92–6.89 (m, 2H), 4.43 (dd, *J* = 8.76, 1.89 Hz, 1H), 2.45–2.38 (m, 1H), 2.25–2.19 (m, 1H), 2.15 (t, *J* = 5.52 Hz, 1H), 1.99–1.91 (m, 2H), 1.47 (s, 3H), 1.31 (s, 3H), 1.22 (d, *J* = 10.86 Hz, 1H), 0.90–0.87 (m, 3H) ppm. **^{13}C-NMR (100 MHz, $CDCl_3$)**: δ = 162.2, 136.7, 113.5, 86.2, 78.3, 55.2, 51.6, 39.7, 38.3, 35.8, 28.9, 27.3, 26.6, 24.2 ppm. NMR data complies with published data.[4]

Spectra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B
O
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7.74
6.91
6.88
3.83
1.33
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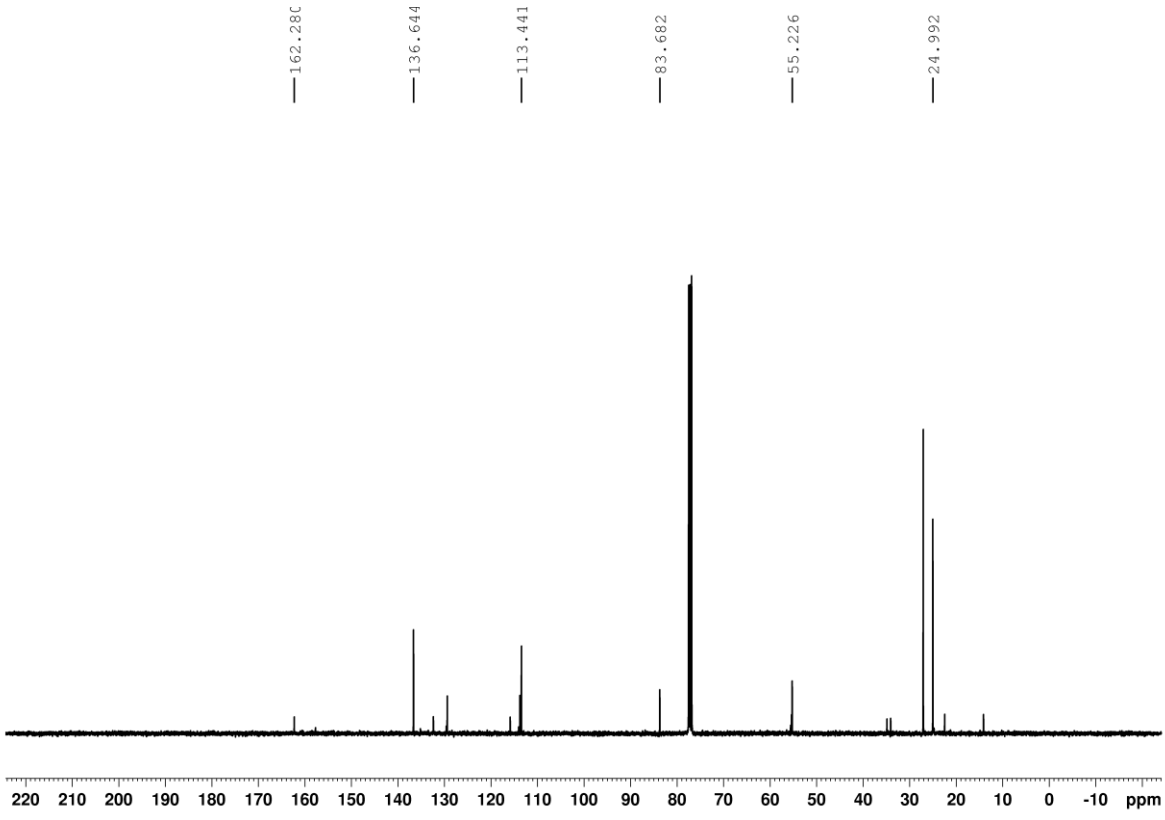
2
2
3
12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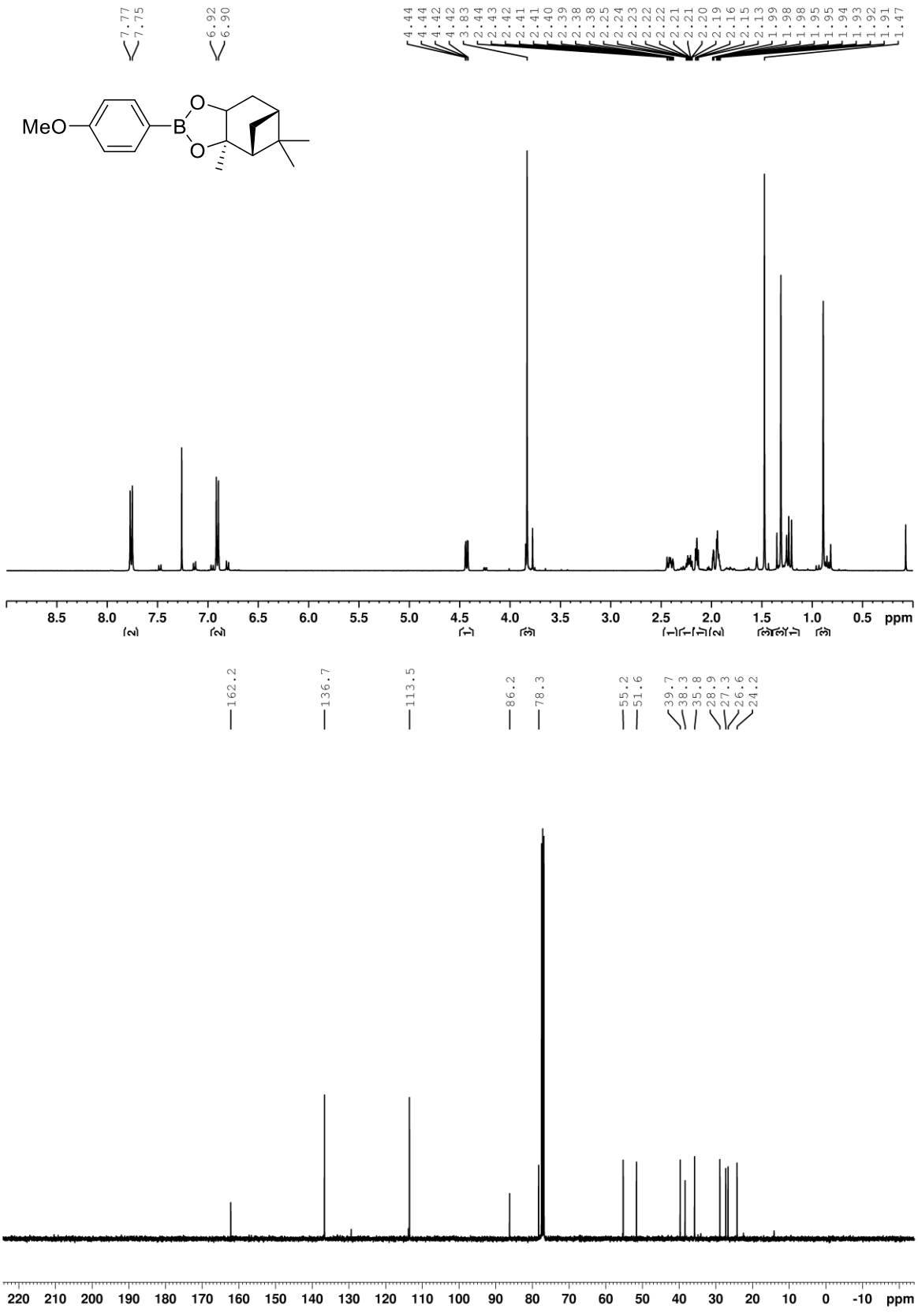
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2.38
2.25
2.24
2.23
2.22
2.22
2.21
2.21
2.20
2.19
2.16
2.15
2.13
1.99
1.98
1.98
1.95
1.95
1.94
1.93
1.92
1.91
1.47
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B
O
O
8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 ppm
162.2
136.7
113.5
86.2
78.3
55.2
51.6
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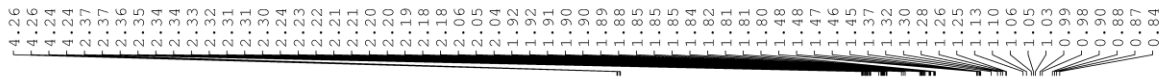
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2.20
2.19
2.18
2.18
2.06
2.05
2.04
1.92
1.91
1.90
1.90
1.89
1.88
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1.32
1.30
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1.26
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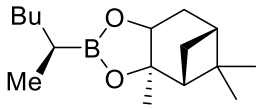
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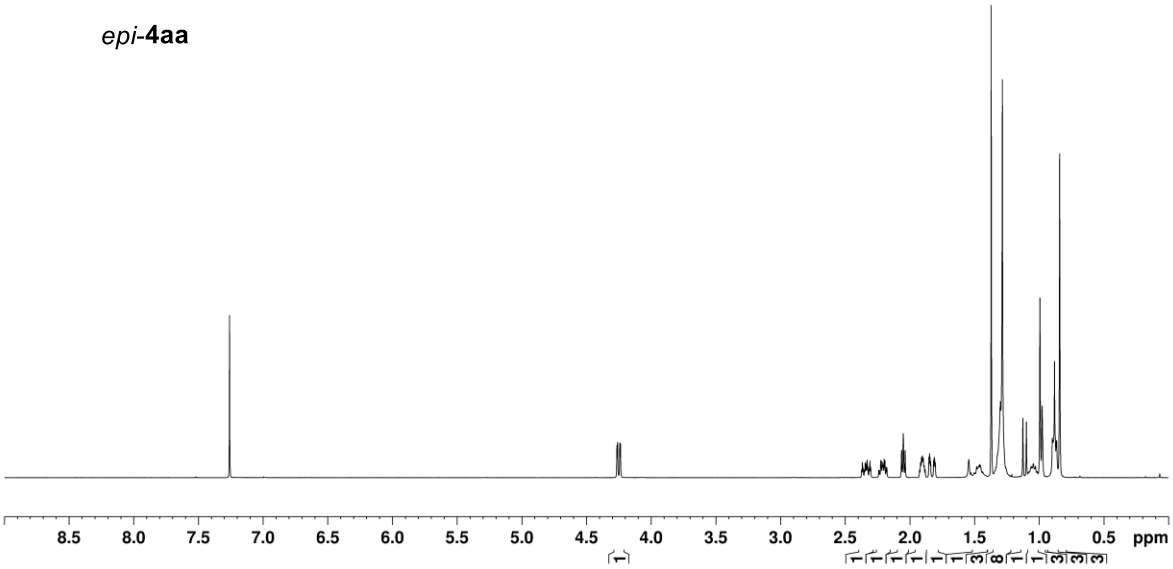
O
O

epi-**4aa**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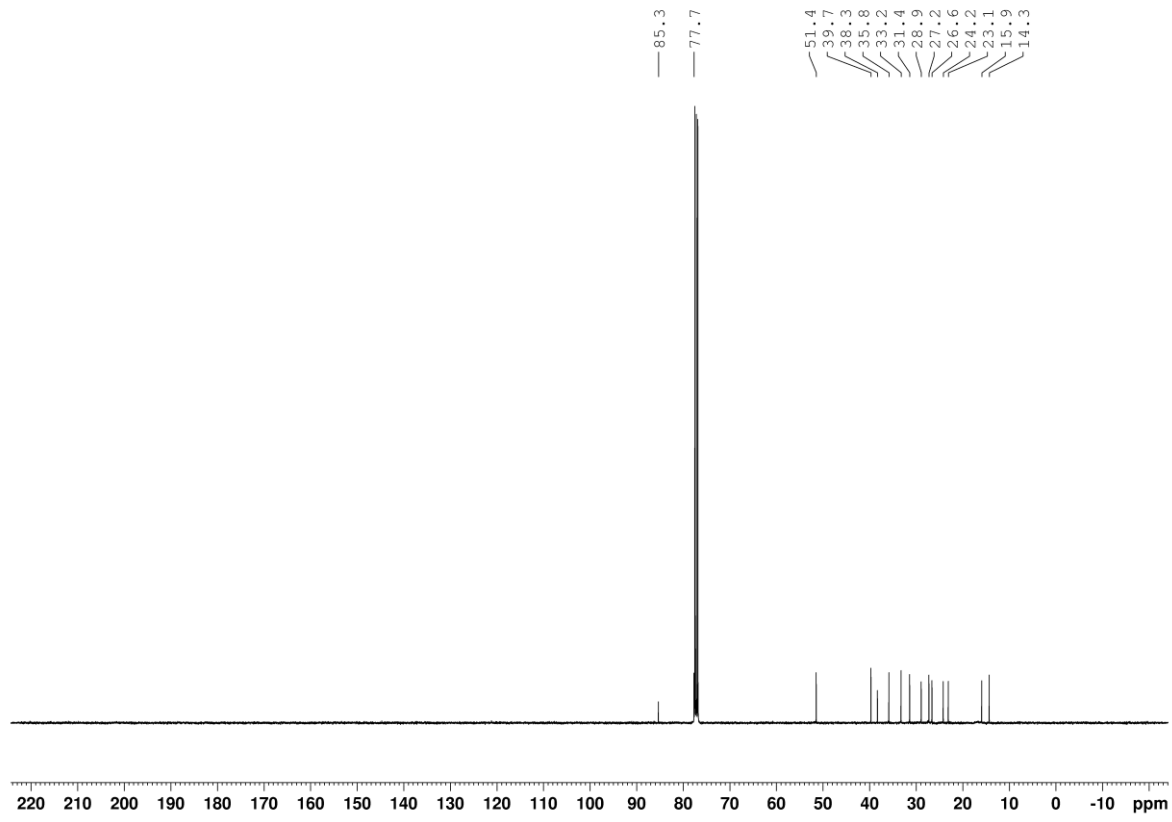
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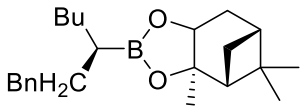
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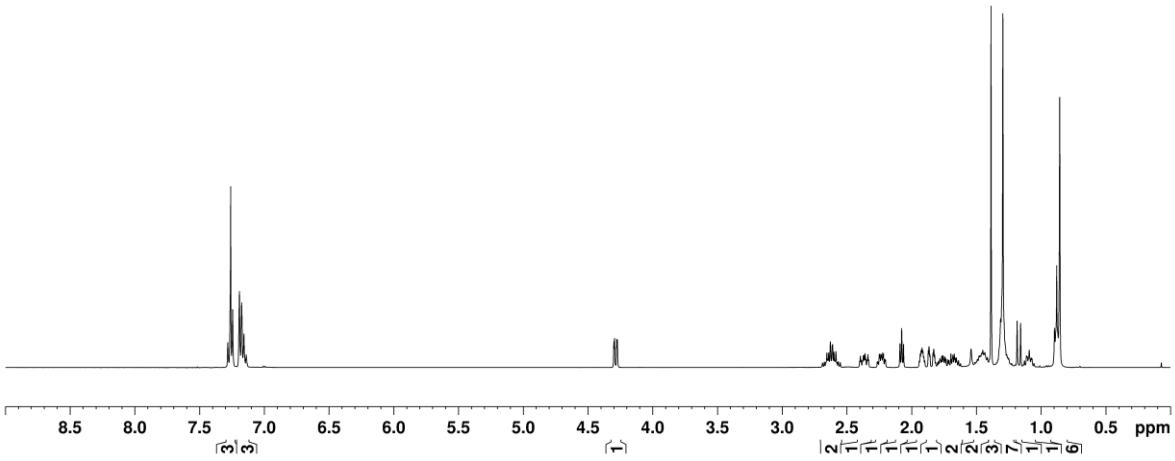
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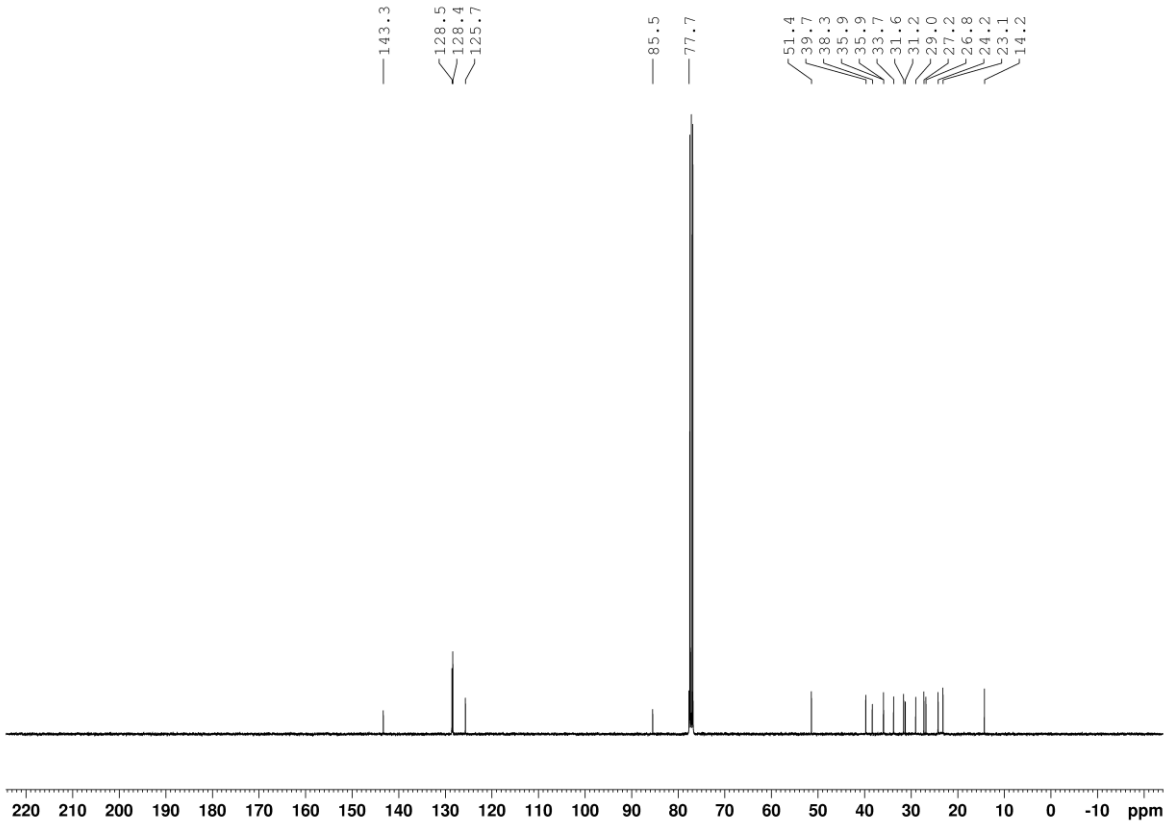
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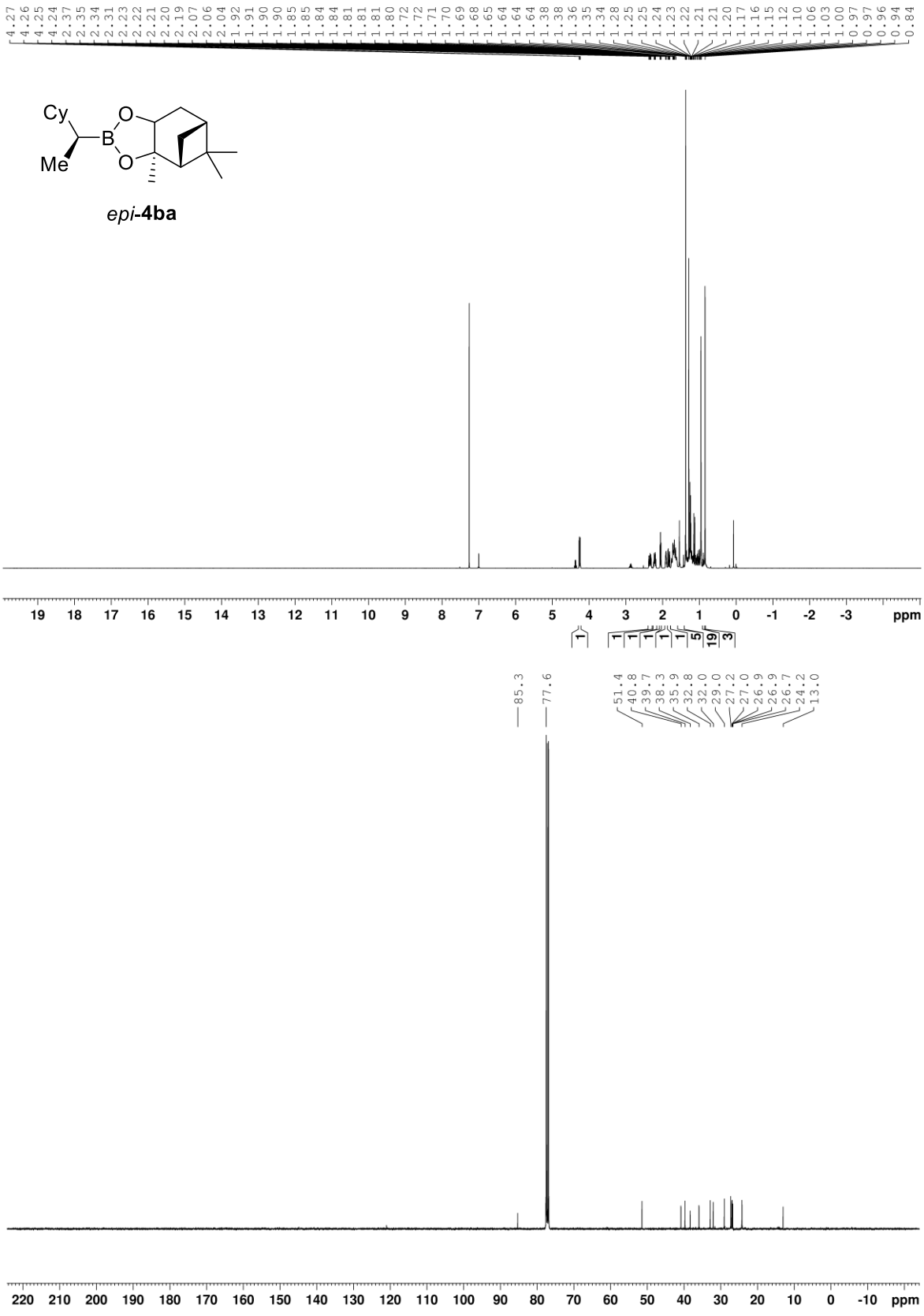
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B
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O
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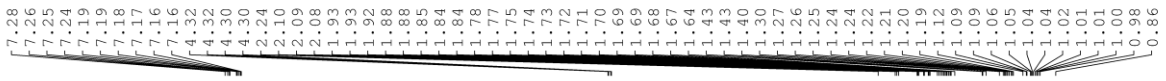

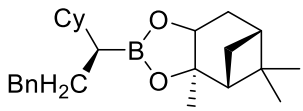

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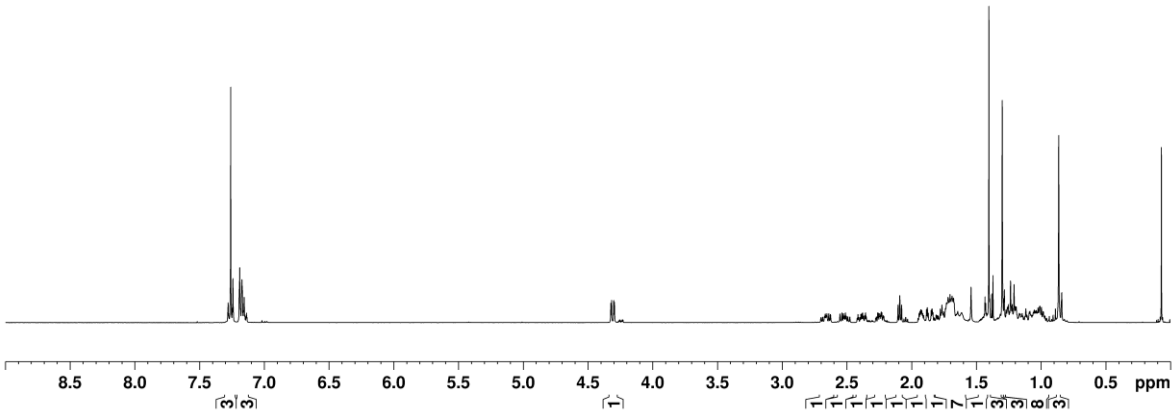

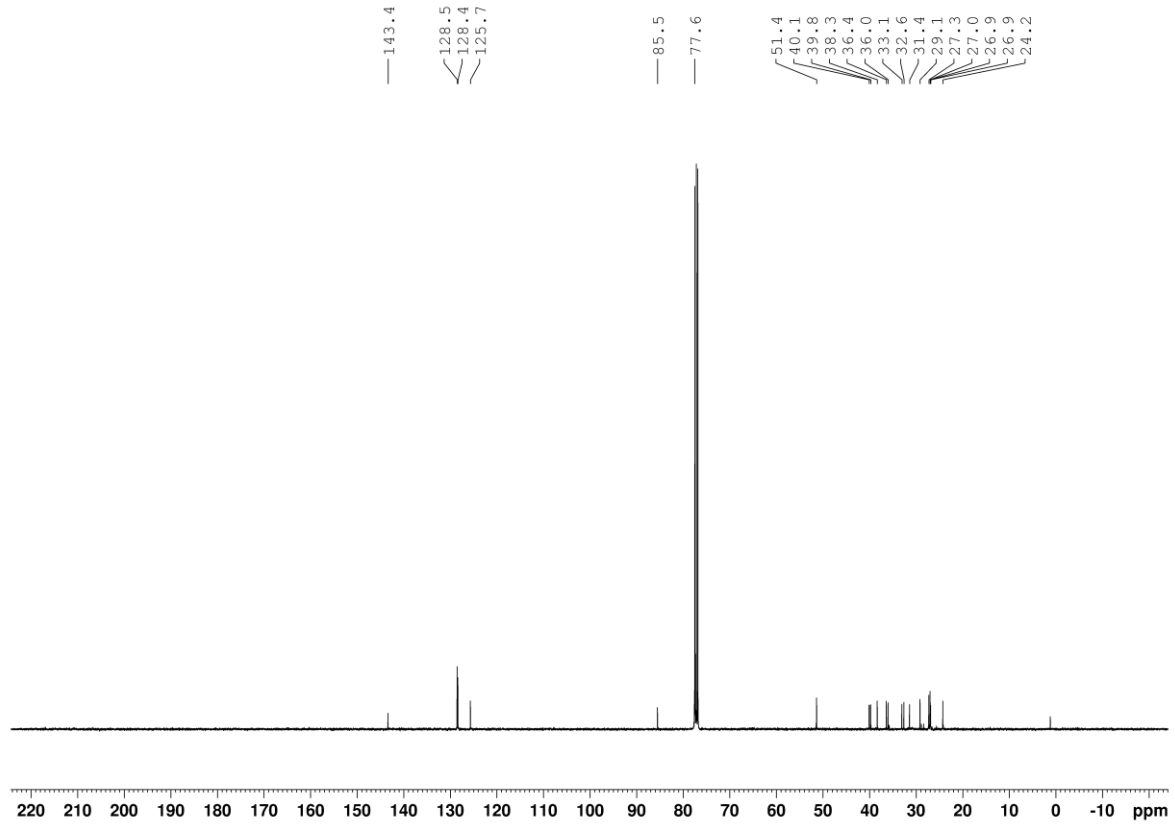

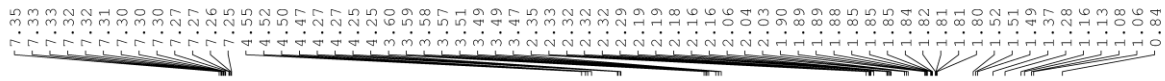
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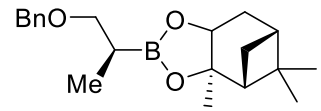
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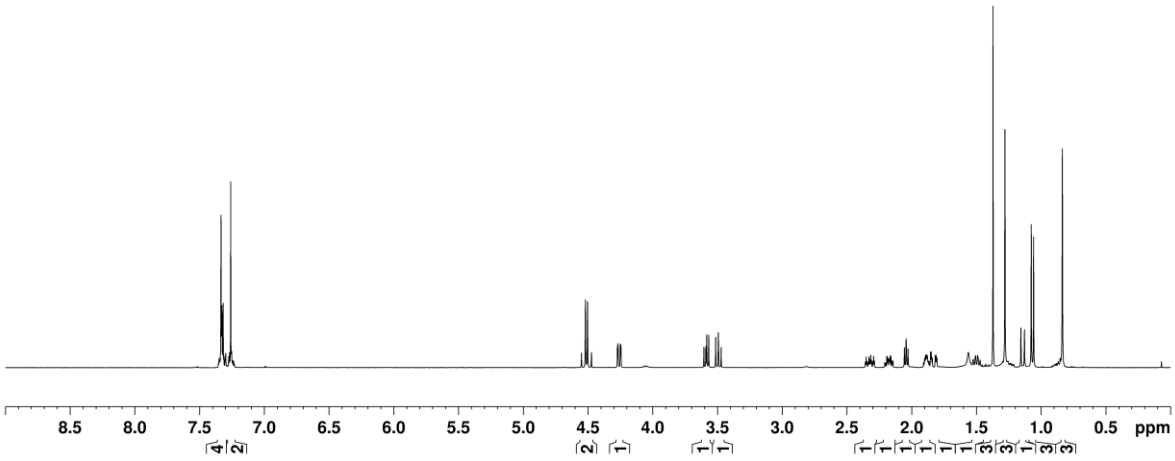
O
O
Me

epi-**4ca**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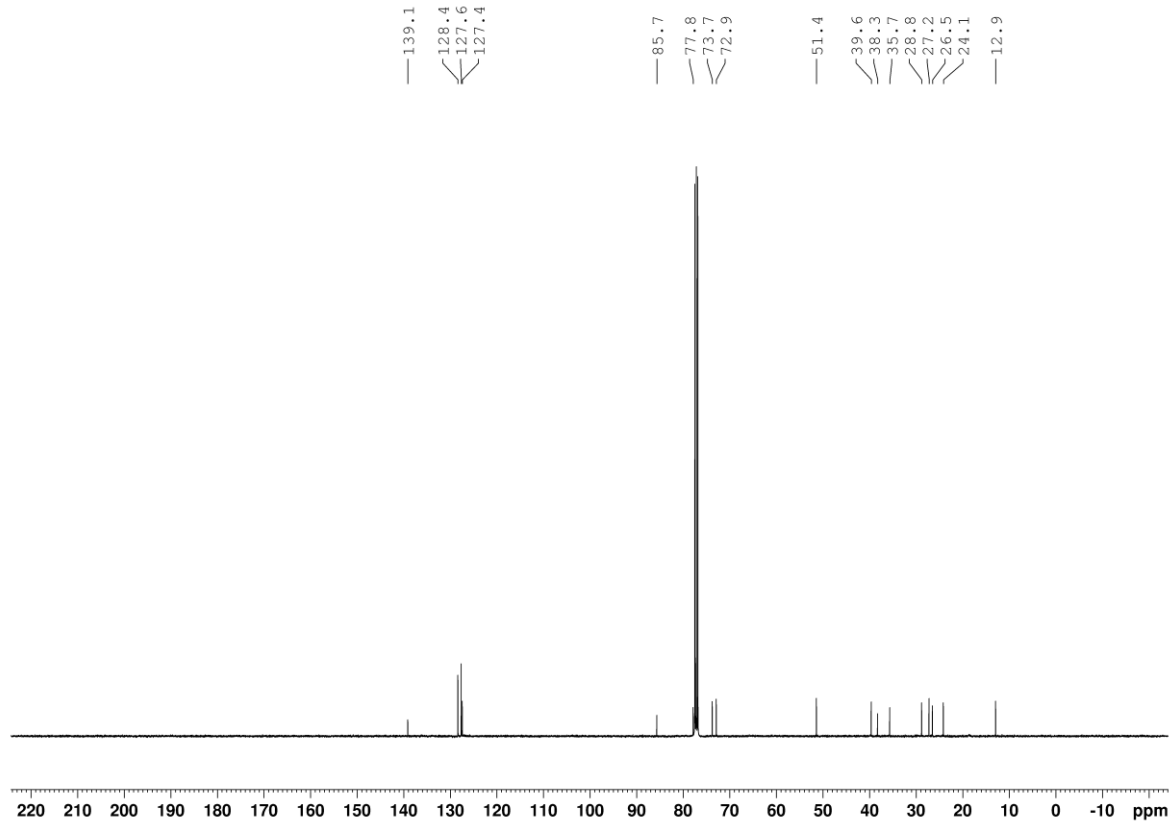
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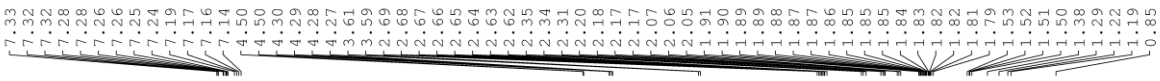
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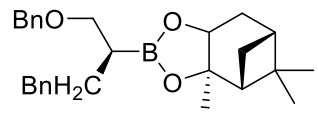
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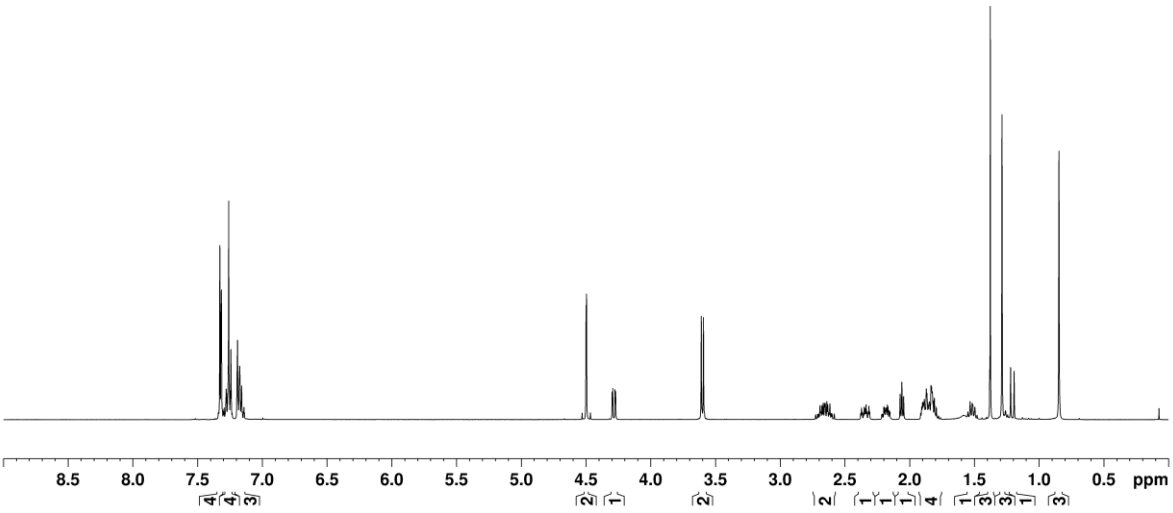
O
O
BnH2C

epi-**4cb**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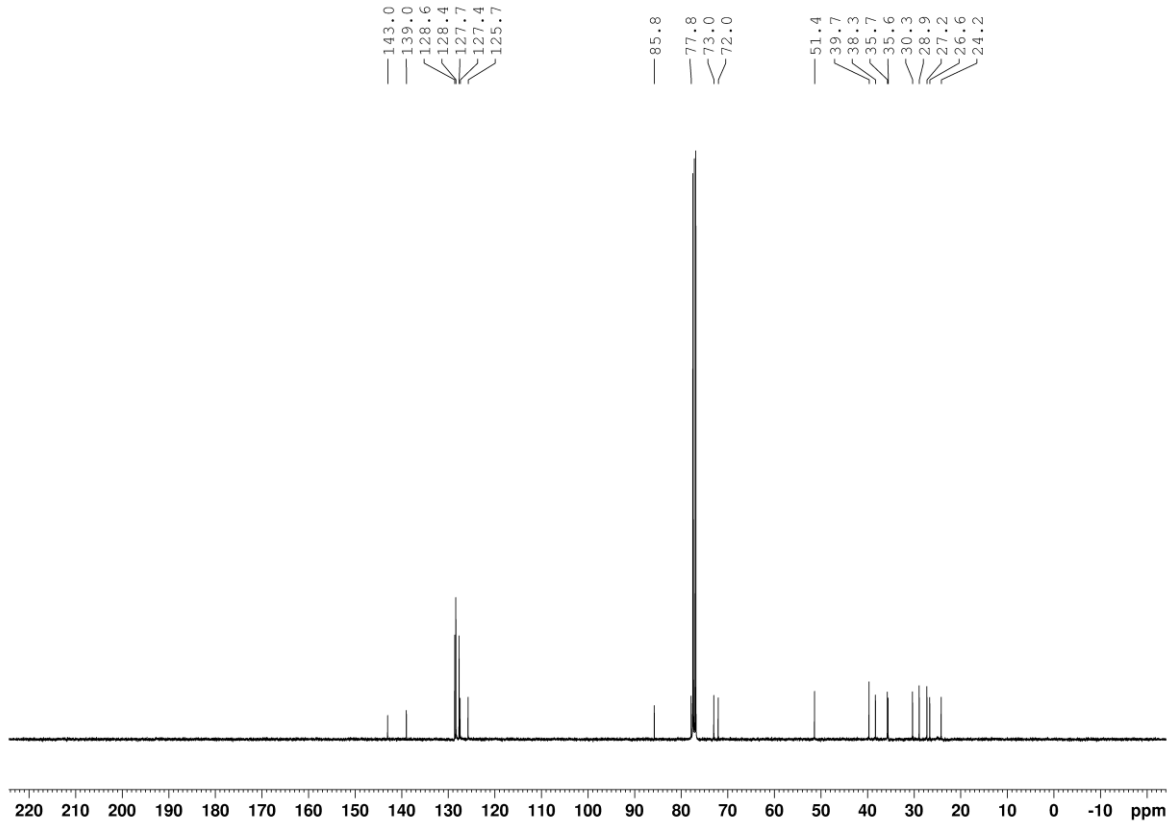
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39.7
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35.7
35.6
30.3
28.9
27.2
26.6
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220
210
200
190
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80
70
60
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40
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20
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ppm


7.17
7.16
7.16
7.15
7.14
7.13
6.84
6.83
6.83
6.82
6.81
6.80
4.27
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4.24
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2.46
2.44
2.42
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2.34
2.33
2.32
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2.31
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2.16
2.15
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2.14
2.13
2.06
2.04
2.03
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1.87
1.87
1.86
1.85
1.81
1.80
1.80
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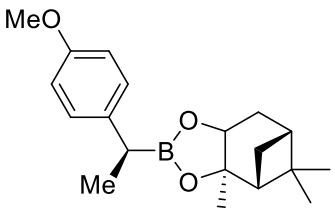
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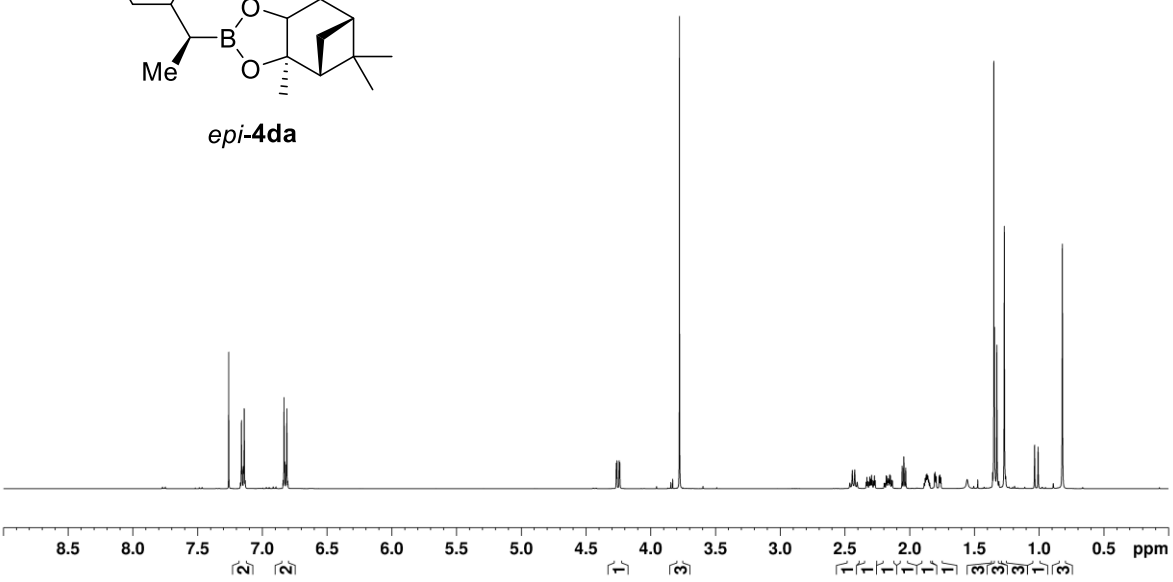
B
O
Me

epi-**4da**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4.0
3.5
3.0
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2.0
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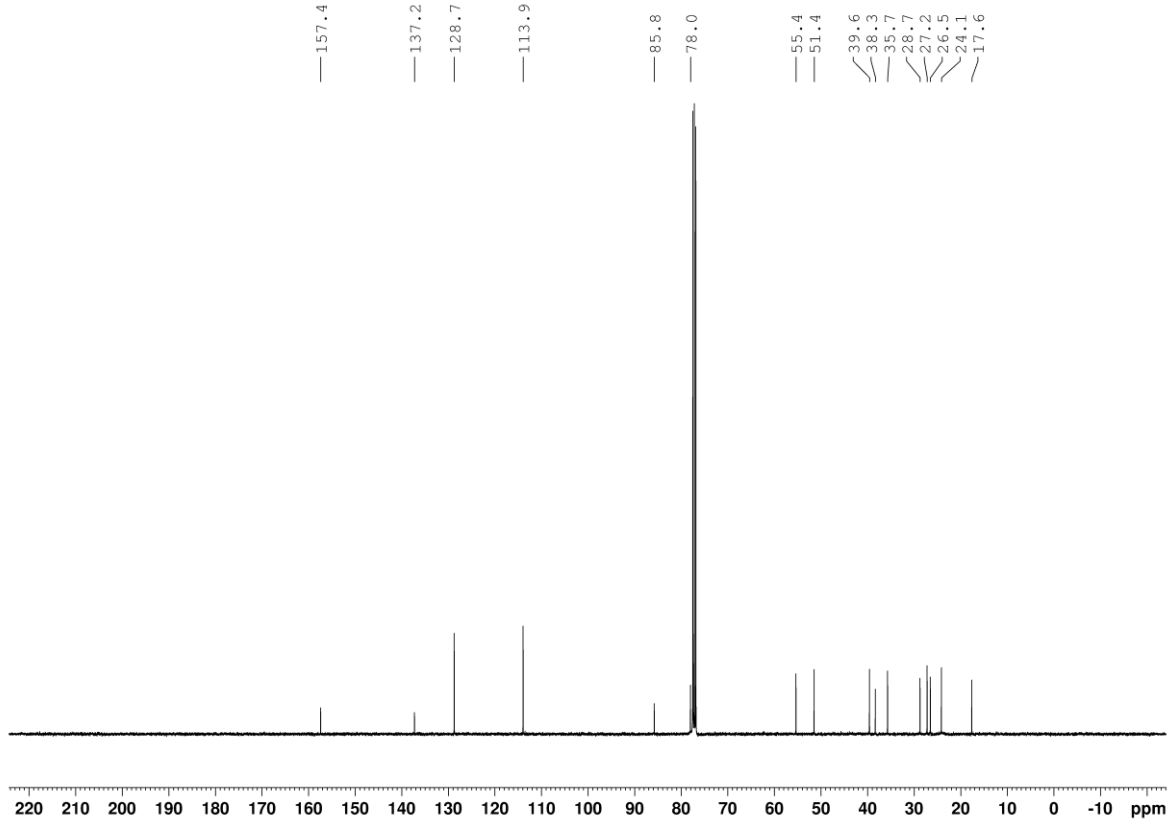
1.0
0.5
ppm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113.9
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55.4
51.4
39.6
38.3
35.7
28.7
27.2
26.5
24.1
17.6
220
210
200
190
180
170
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110
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90
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50
40
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10
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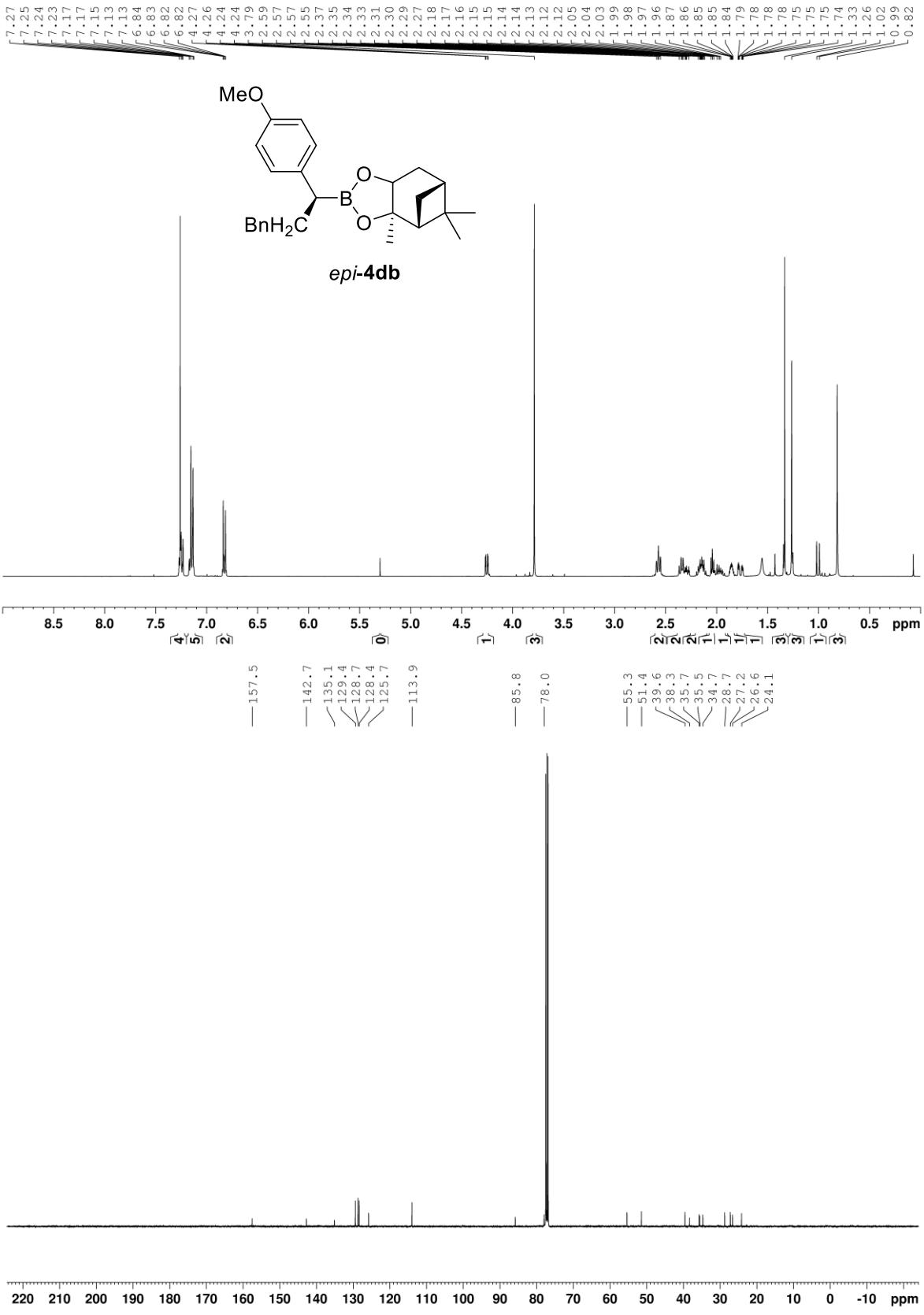
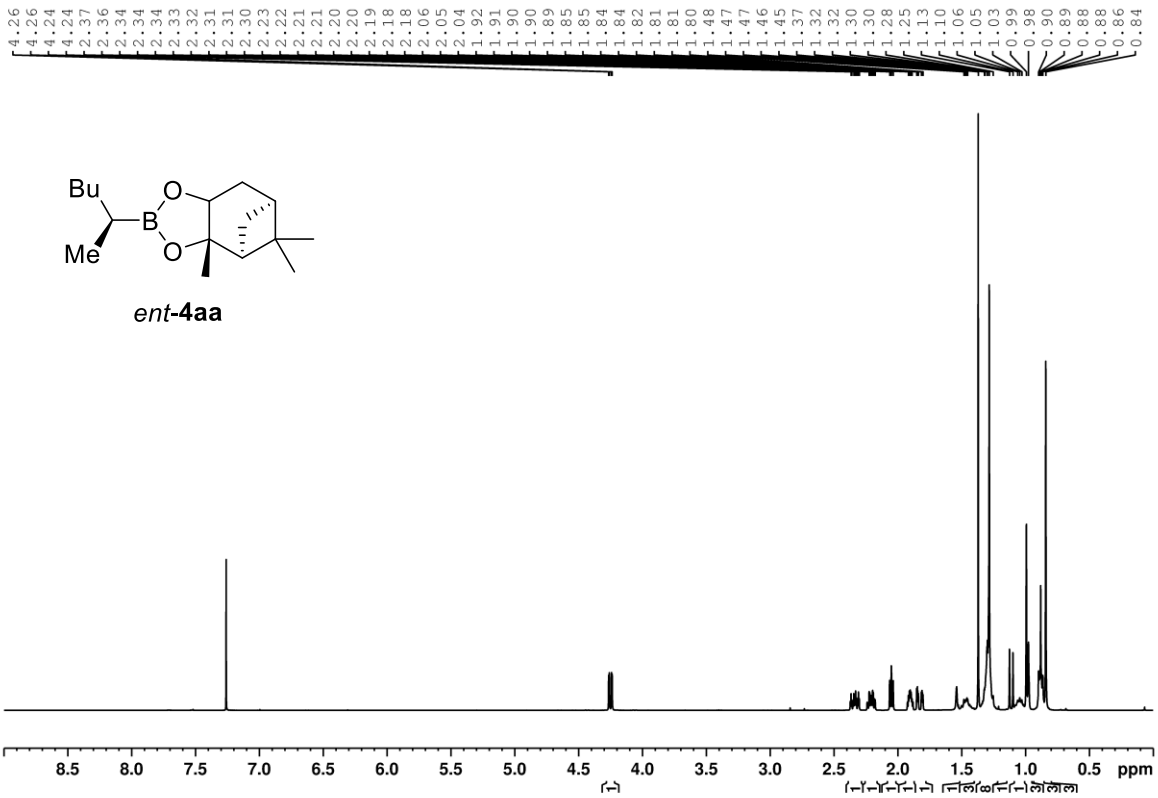
ppm


MeO
O
B
O
BnH2C
epi-4db
ppm
ppm


4.26 4.26 4.24 4.24 2.37 2.36 2.34 2.34 2.33 2.32 2.31 2.31 2.30 2.23 2.22 2.21 2.21 2.20 2.20 2.19 2.18 2.18 2.06 2.05 2.04 1.92 1.91 1.90 1.90 1.89 1.85 1.85 1.84 1.84 1.82 1.81 1.81 1.80 1.48 1.47 1.47 1.46 1.45 1.37 1.32 1.32 1.30 1.30 1.28 1.25 1.13 1.10 1.06 1.05 1.03 0.99 0.98 0.90 0.89 0.88 0.88 0.86 0.84
Bu
O
B
O
Me
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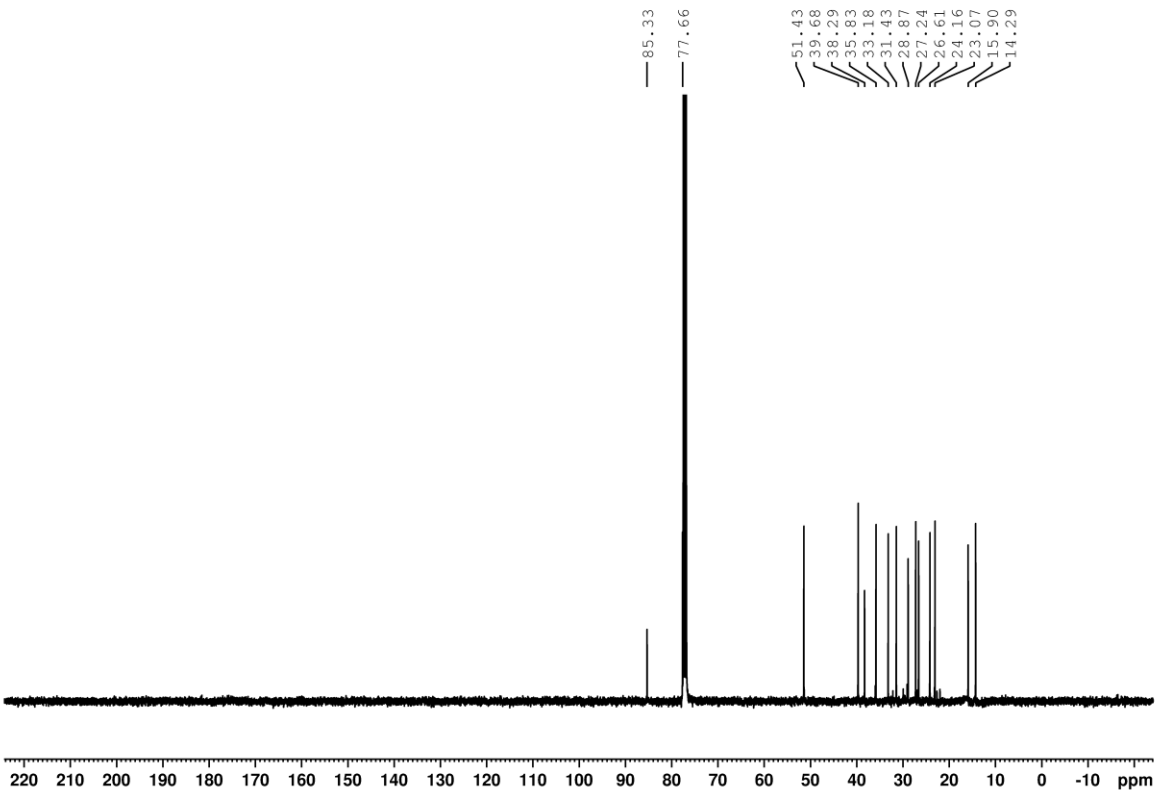
ent-**4aa**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77.66
51.43
39.68
38.29
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33.18
31.43
28.87
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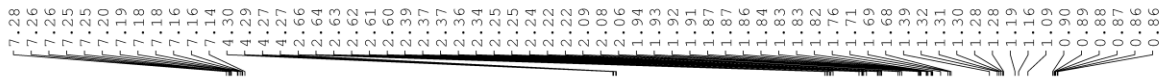
24.16
23.07
15.90
14.29
220 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10 ppm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7.18
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7.14
4.30
4.29
4.27
4.27
2.66
2.64
2.63
2.62
2.61
2.60
2.39
2.37
2.37
2.36
2.34
2.25
2.25
2.24
2.22
2.22
2.09
2.08
2.06
1.94
1.93
1.92
1.91
1.87
1.87
1.86
1.84
1.83
1.83
1.82
1.76
1.71
1.69
1.68
1.39
1.32
1.31
1.30
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1.28
1.19
1.16
1.09
0.90
0.89
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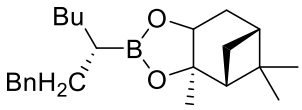
0.87
0.86
0.86


Bu
O
B
O
BnH2C

4aa

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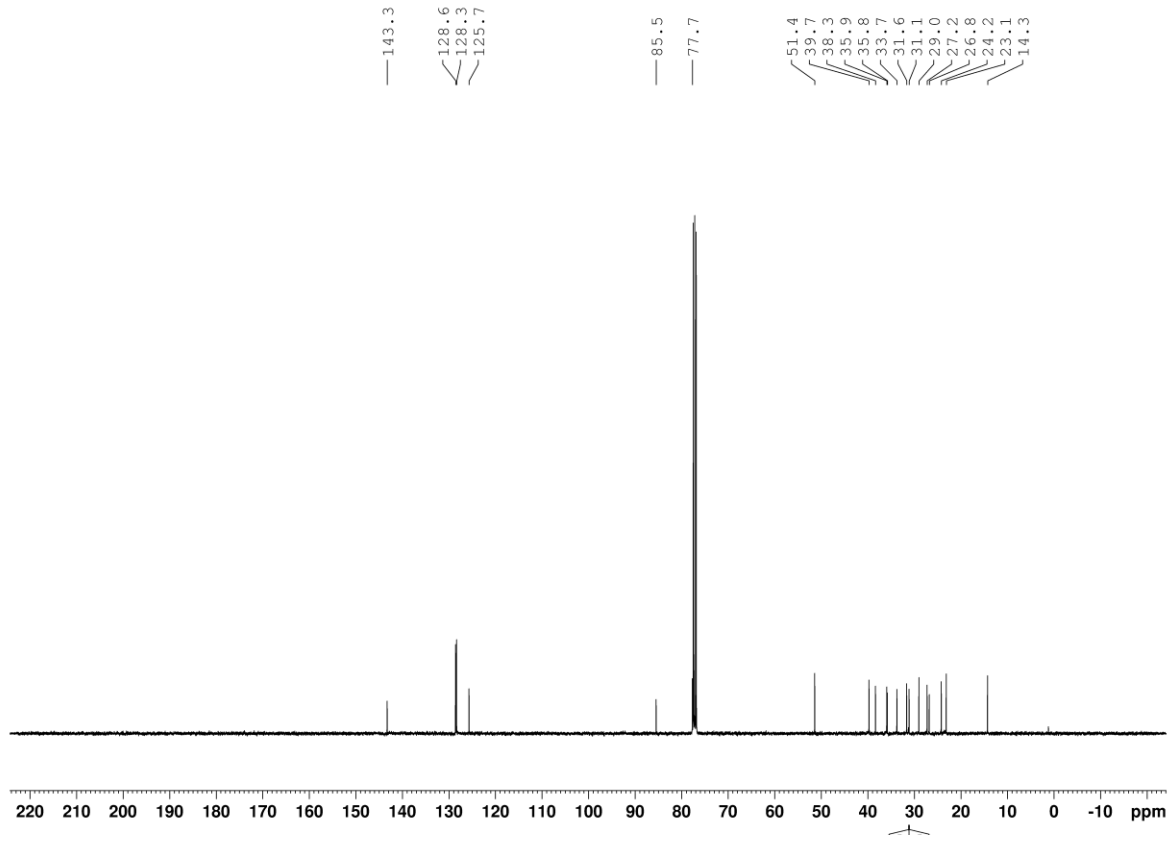
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
ppm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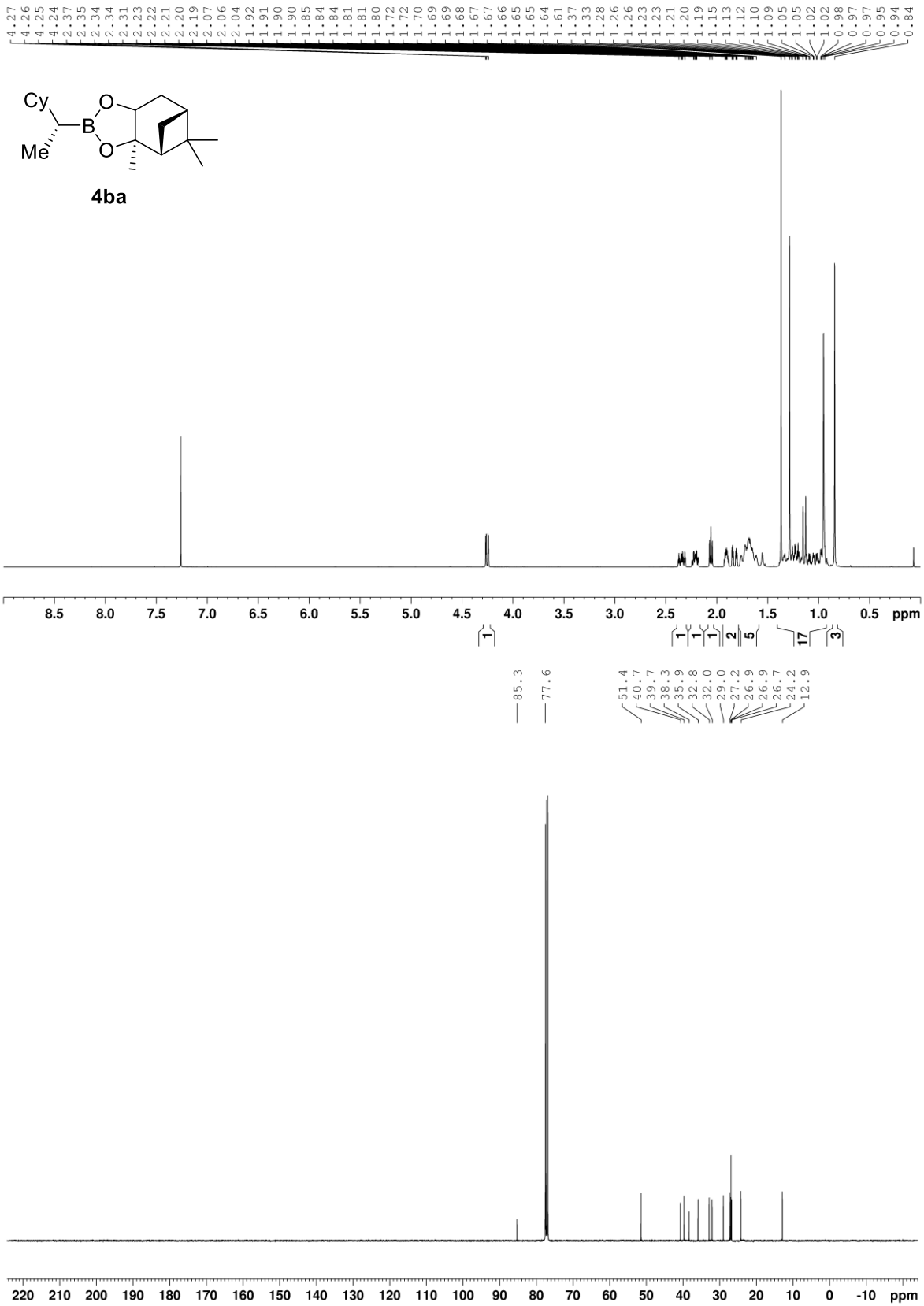
128.6
128.3
125.7
85.5
77.7
51.4
39.7
38.3
35.9
35.8
33.7
31.6
31.1
29.0
27.2
26.8
24.2
23.1
14.3
220
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
-10
ppm


4.27 4.26 4.25 4.24 2.37 2.35 2.34 2.34 2.31 2.23 2.22 2.21 2.20 2.19 2.07 2.06 2.04 1.92 1.91 1.90 1.90 1.85 1.84 1.84 1.81 1.81 1.80 1.72 1.72 1.70 1.69 1.69 1.68 1.67 1.67 1.66 1.65 1.65 1.64 1.61 1.37 1.33 1.28 1.26 1.26 1.23 1.23 1.21 1.20 1.19 1.15 1.13 1.12 1.10 1.09 1.05 1.05 1.02 1.02 0.98 0.97 0.97 0.95 0.94 0.84
Cy
B
O
O
Me
4ba
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 ppm
1 1 1 1 2 5 17 3
85.3 77.6 51.4 40.7 39.7 38.3 35.9 32.8 32.0 29.0 27.2 26.9 26.9 26.7 24.2 12.9
220 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10 ppm


7.28
7.25
7.24
7.19
7.17
7.16
7.15
4.31
4.31
4.29
4.29
2.63
2.55
2.54
2.52
2.37
2.26
2.26
2.24
2.23
2.11
2.09
2.08
1.94
1.93
1.93
1.92
1.88
1.88
1.87
1.85
1.84
1.83
1.77
1.77
1.76
1.75
1.74
1.72
1.71
1.71
1.70
1.69
1.68
1.68
1.68
1.43
1.40
1.30
1.25
1.24
1.22
1.21
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1.12
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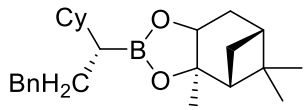
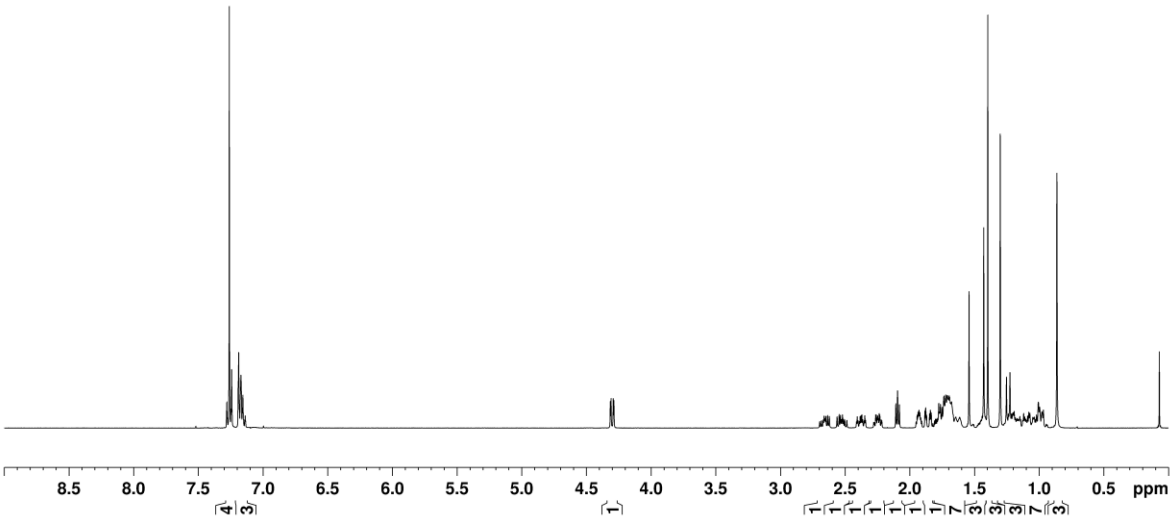
1.07
1.02
1.00
1.00
0.98
0.97
0.86


Cy
B
O
O
BnH2C

4bb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6.0
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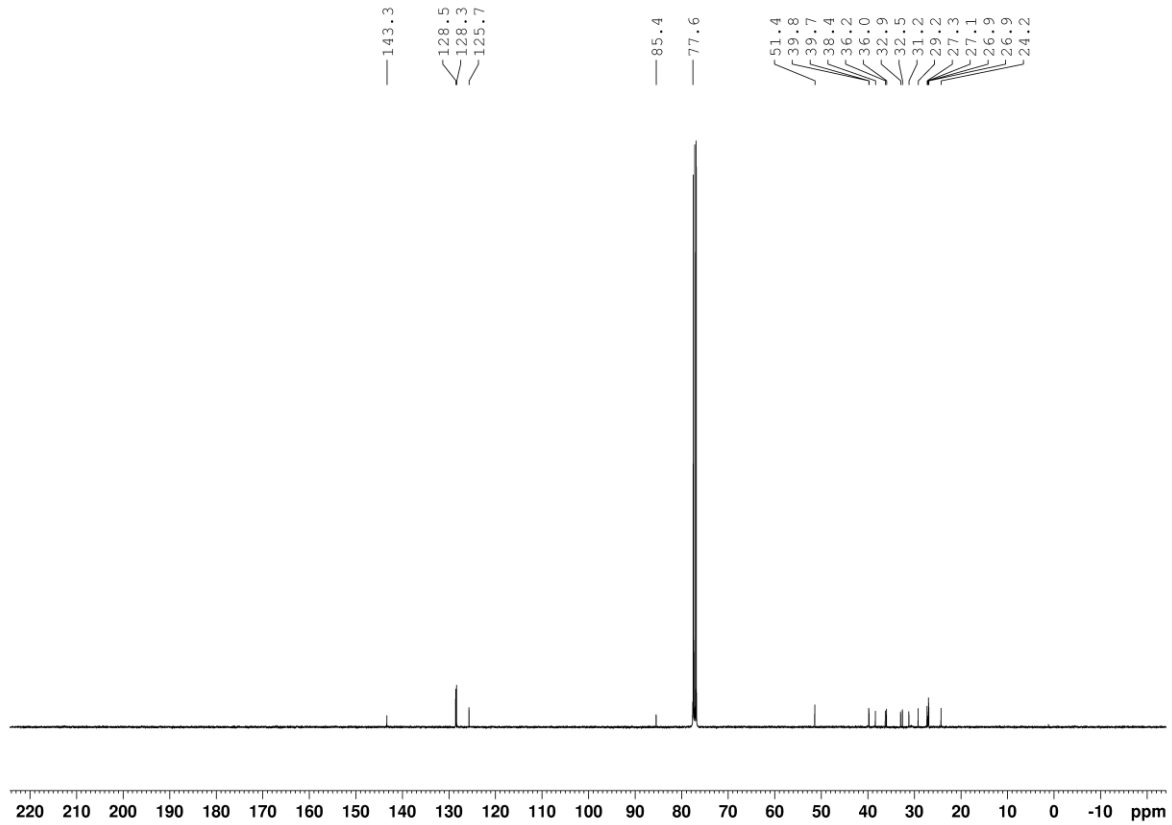
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
ppm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128.3
125.7
85.4
77.6
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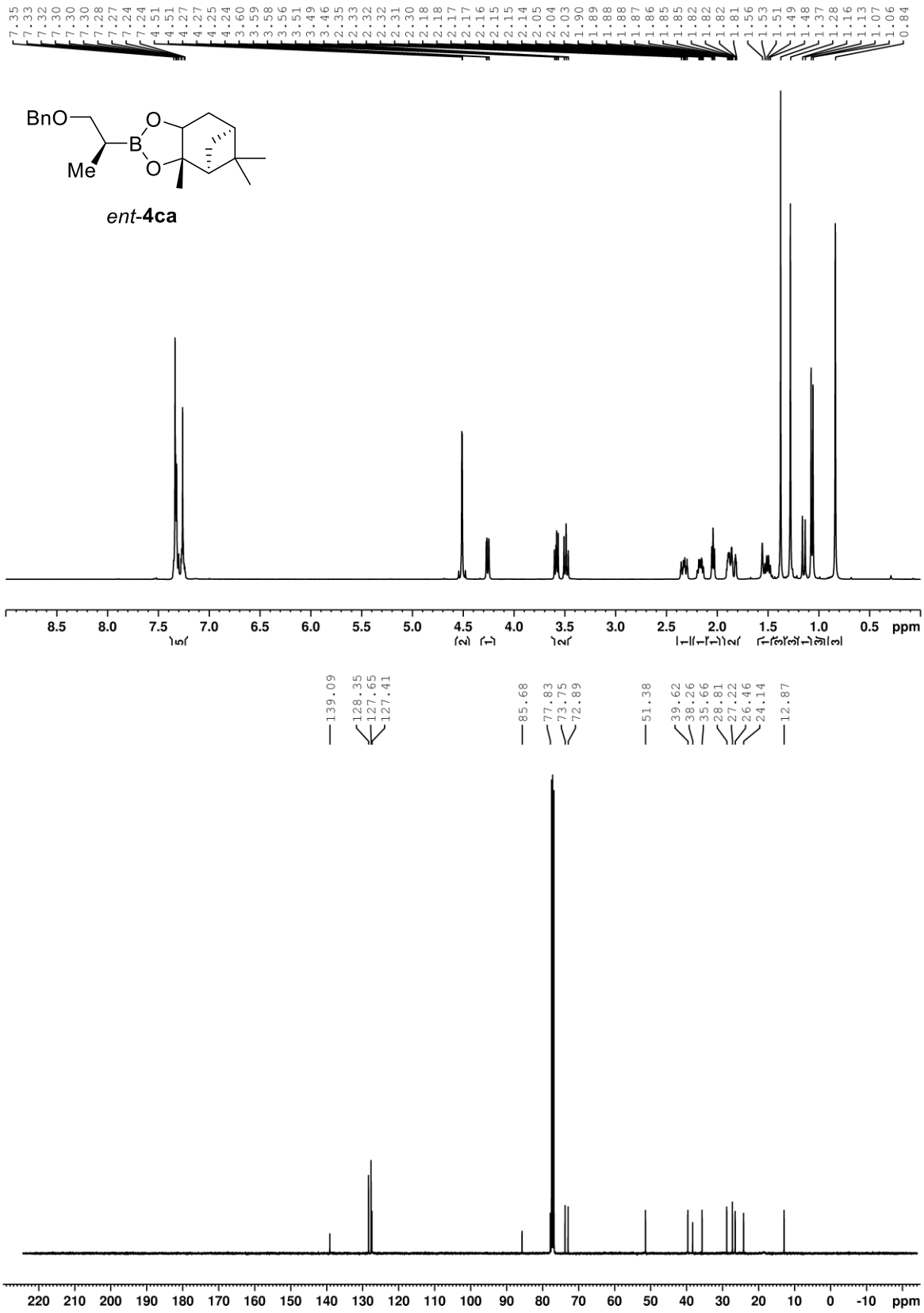
39.8
39.7
38.4
36.2
36.0
32.9
32.5
31.2
29.2
27.3
27.1
26.9
26.9
24.2
220
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
-10
ppm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7.30
7.30
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7.27
7.24
7.24
4.51
4.51
4.27
4.27
4.25
4.24
3.60
3.59
3.58
3.56
3.51
3.49
3.46
2.35
2.33
2.32
2.32
2.31
2.30
2.18
2.17
2.17
2.16
2.15
2.15
2.14
2.05
2.04
2.03
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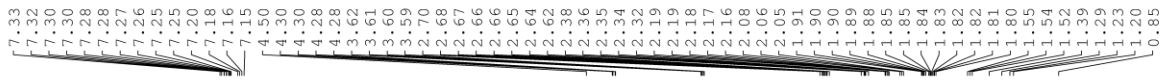
1.86
1.85
1.85
1.82
1.82
1.82
1.81
1.56
1.53
1.51
1.49
1.48
1.37
1.28
1.16
1.13
1.07
1.06
0.84
BnO
Me
O
B
O
8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 ppm
139.09
128.35
127.65
127.41
85.68
77.83
73.75
72.89
51.38
39.62
38.26
35.66
28.81
27.22
26.46
24.14
12.87
220 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10 ppm

ent-**4ca**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7.20
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7.16
7.15
4.50
4.30
4.28
4.28
3.62
3.61
3.60
3.59
2.70
2.68
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2.19
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2.16
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1.83
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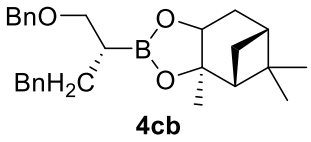
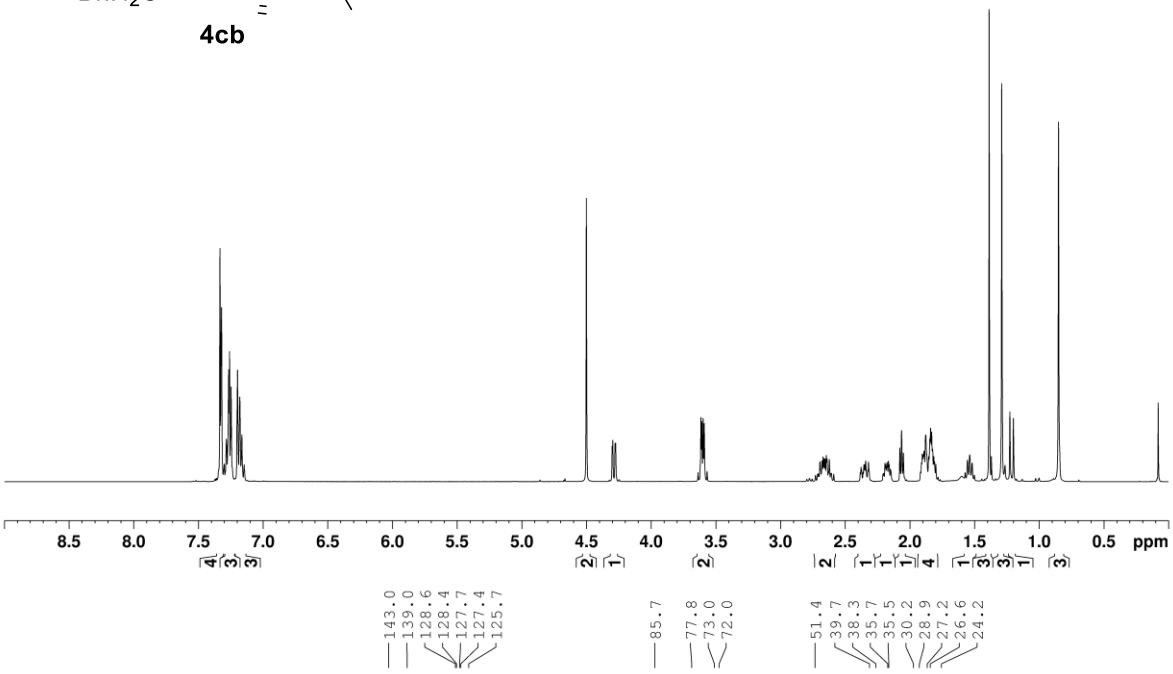
0.85


BnO
B
O
O
BnH2C

4cb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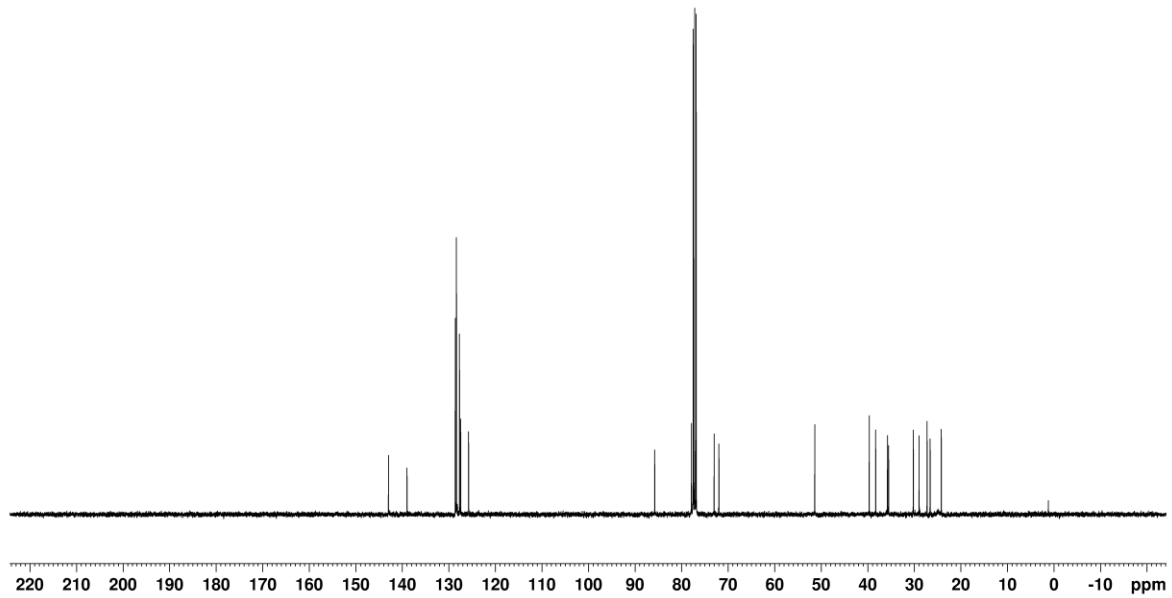
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
ppm

143.0
139.0
128.6
128.4
127.7
127.4
125.7
85.7
77.8
73.0
72.0
51.4
39.7
38.3
35.7
35.5
30.2
28.9
27.2
26.6
24.2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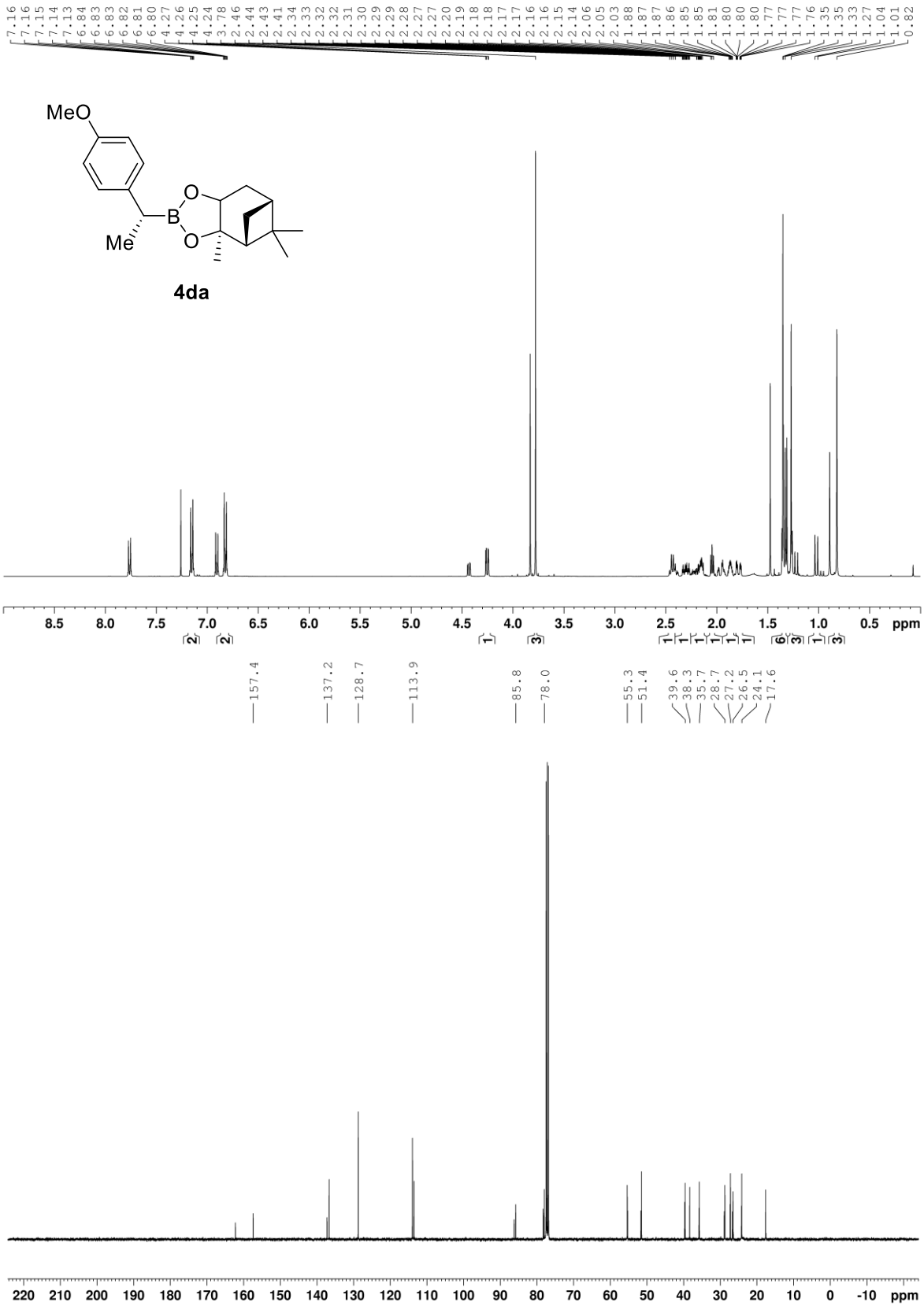
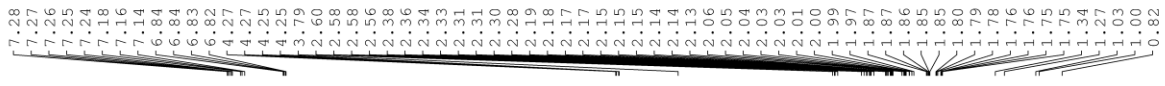
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
-10
ppm


7.16 7.16 7.15 7.14 7.13 6.84 6.83 6.83 6.82 6.81 6.80 4.27 4.26 4.25 4.24 3.78 2.46 2.44 2.43 2.41 2.34 2.33 2.32 2.32 2.31 2.30 2.29 2.29 2.28 2.27 2.27 2.20 2.19 2.18 2.18 2.17 2.17 2.16 2.16 2.15 2.14 2.06 2.05 2.03 1.88 1.87 1.87 1.86 1.85 1.85 1.81 1.80 1.80 1.77 1.77 1.76 1.35 1.35 1.33 1.27 1.04 1.01 0.82
MeO
O
B
O
Me
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 ppm
157.4 137.2 128.7 113.9 85.8 78.0 55.3 51.4 39.6 38.3 35.7 28.7 27.2 26.5 24.1 17.6
220 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10 ppm

4da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7.26
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7.24
7.18
7.16
7.14
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6.84
6.83
6.82
4.27
4.27
4.25
4.25
3.79
2.60
2.58
2.58
2.56
2.38
2.36
2.34
2.33
2.31
2.31
2.30
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2.17
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2.15
2.15
2.14
2.14
2.13
2.06
2.05
2.04
2.03
2.03
2.01
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1.87
1.86
1.85
1.85
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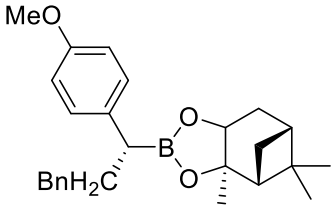
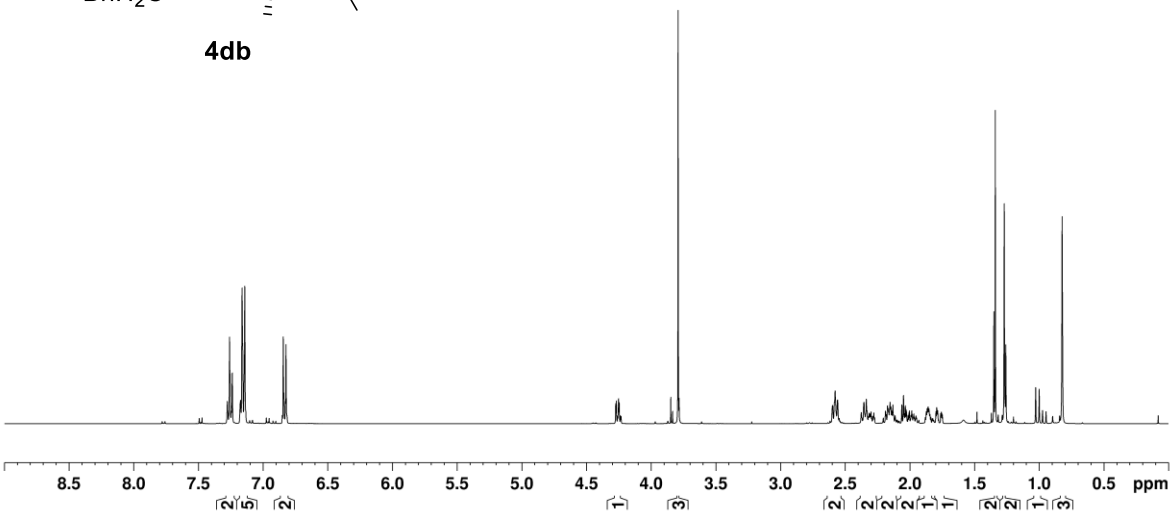
1.00
0.82


MeO
O
B
O
BnH2C

4db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4.0
3.5
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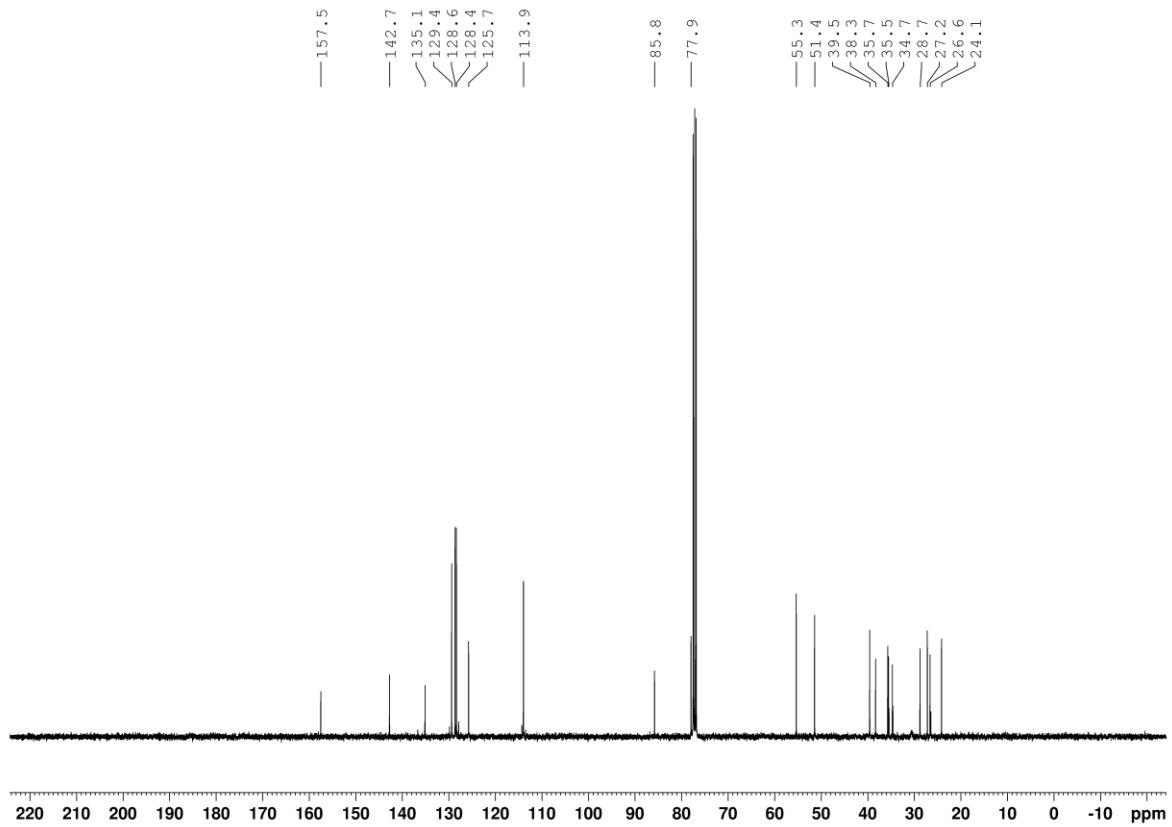
2.5
2.0
1.5
1.0
0.5
ppm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135.1
129.4
128.6
128.4
125.7
113.9
85.8
77.9
55.3
51.4
39.5
38.3
35.7
35.5
34.7
28.7
27.2
26.6
24.1
220
210
200
190
180
170
160
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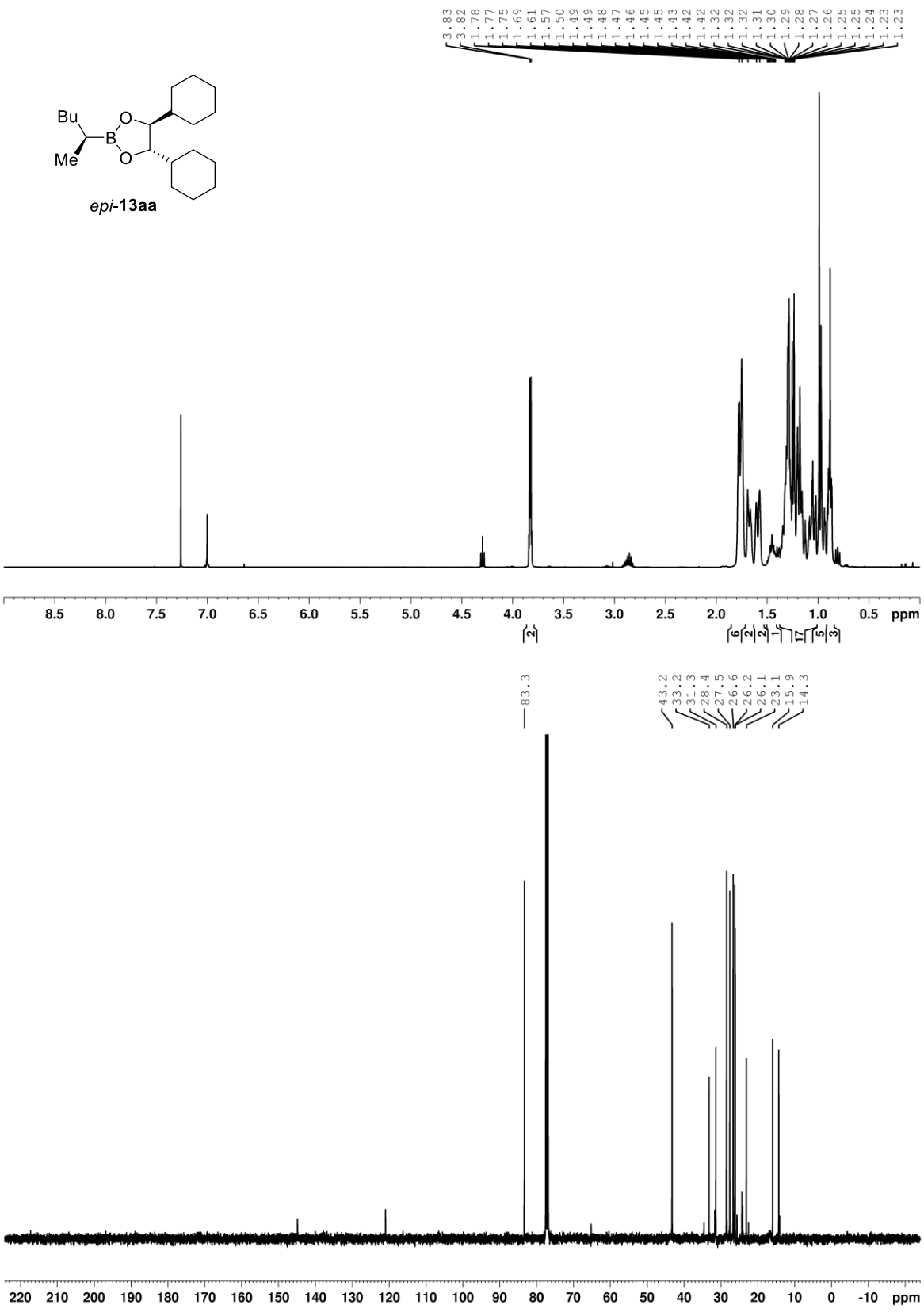
130
120
110
100
90
80
70
60
50
40
30
20
10
0
-10
ppm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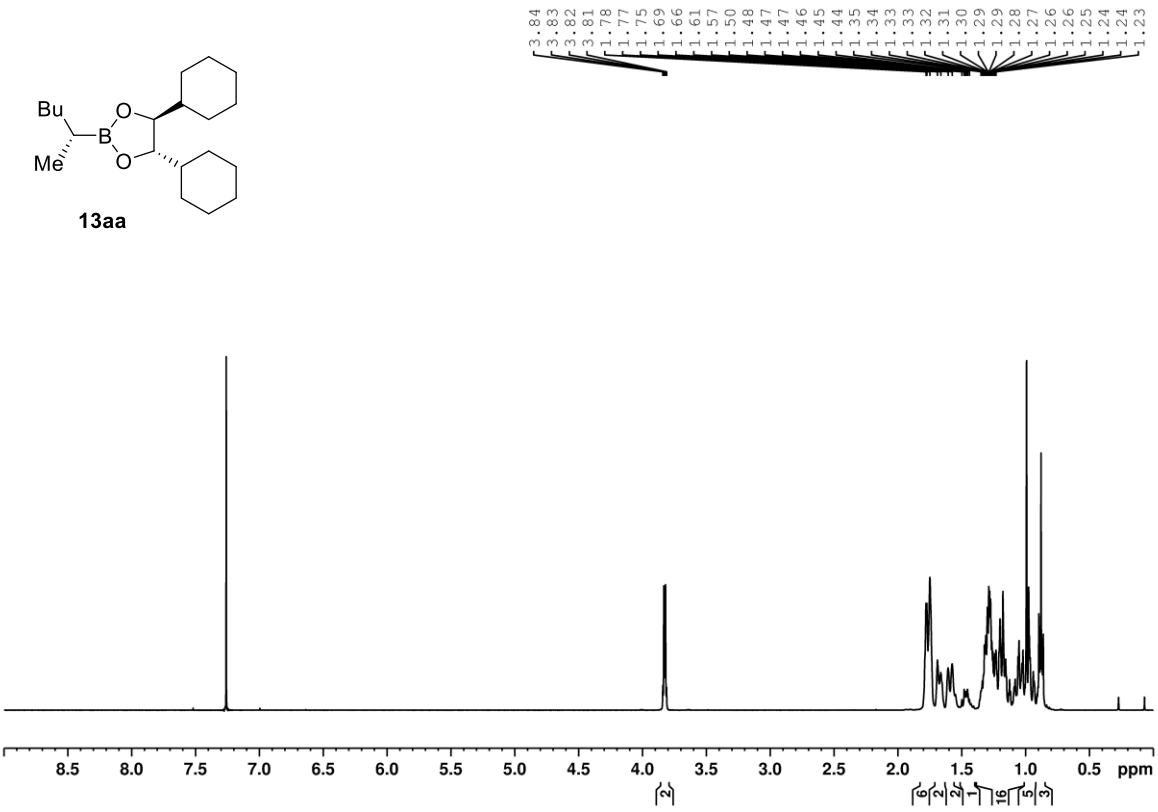
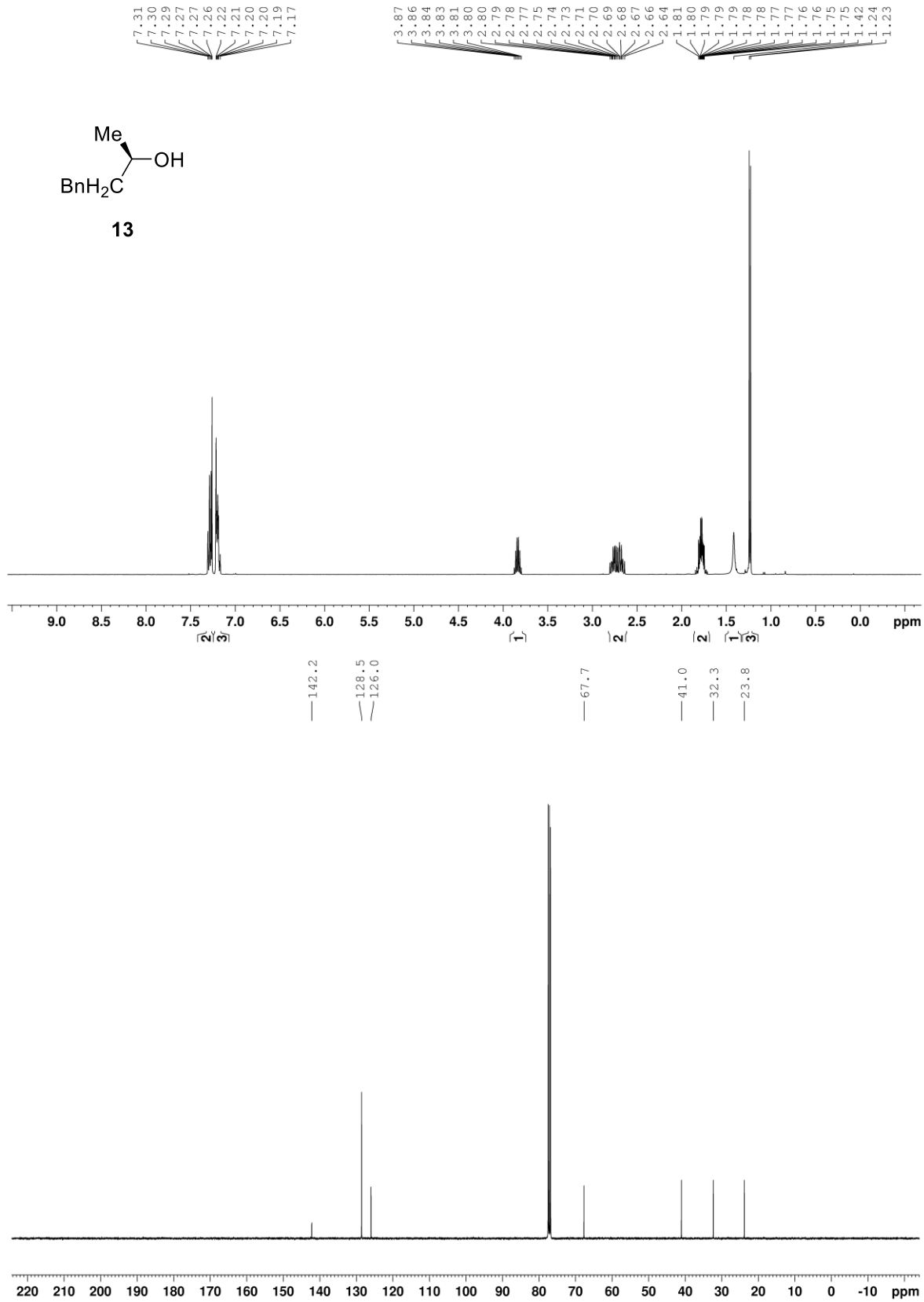
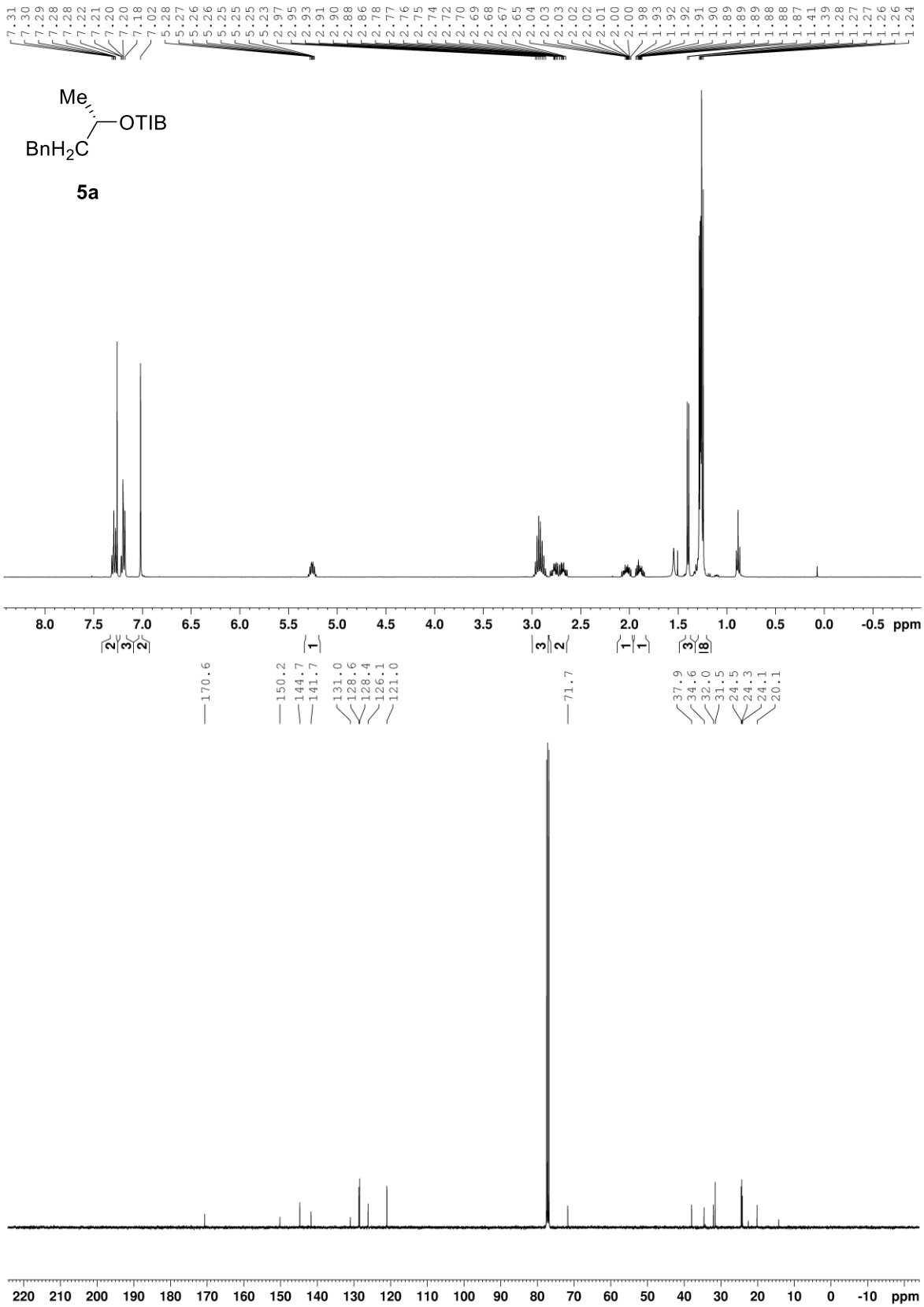
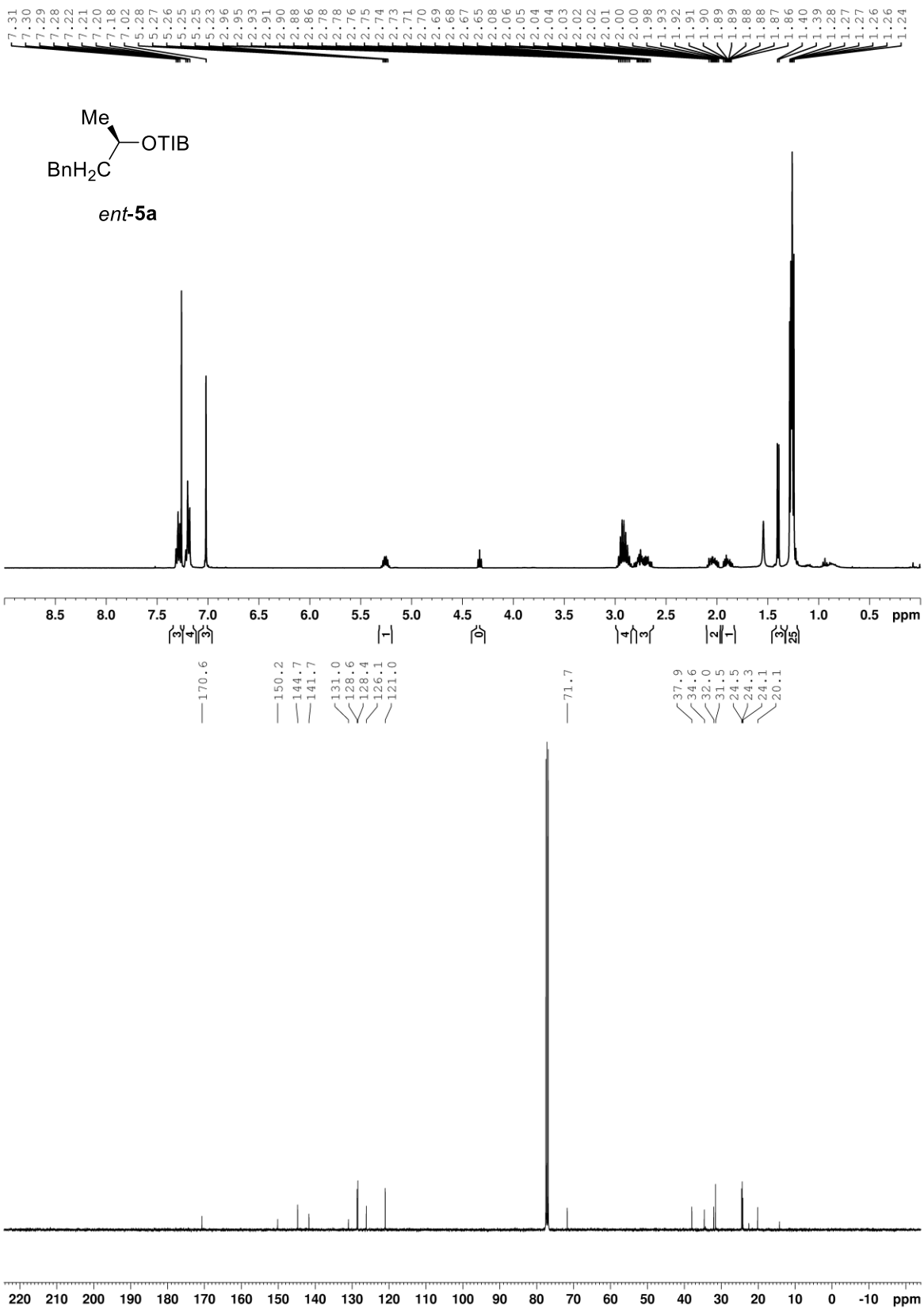
1.49
1.49
1.48
1.47
1.46
1.45
1.45
1.43
1.42
1.42
1.32
1.32
1.31
1.30
1.29
1.28
1.27
1.26
1.25
1.25
1.24
1.23
1.23
Bu
Me
B
O
O
8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 ppm
83.3
43.2
33.2
31.3
28.4
27.5
26.6
26.2
26.1
23.1
15.9
14.3
220 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10 ppm

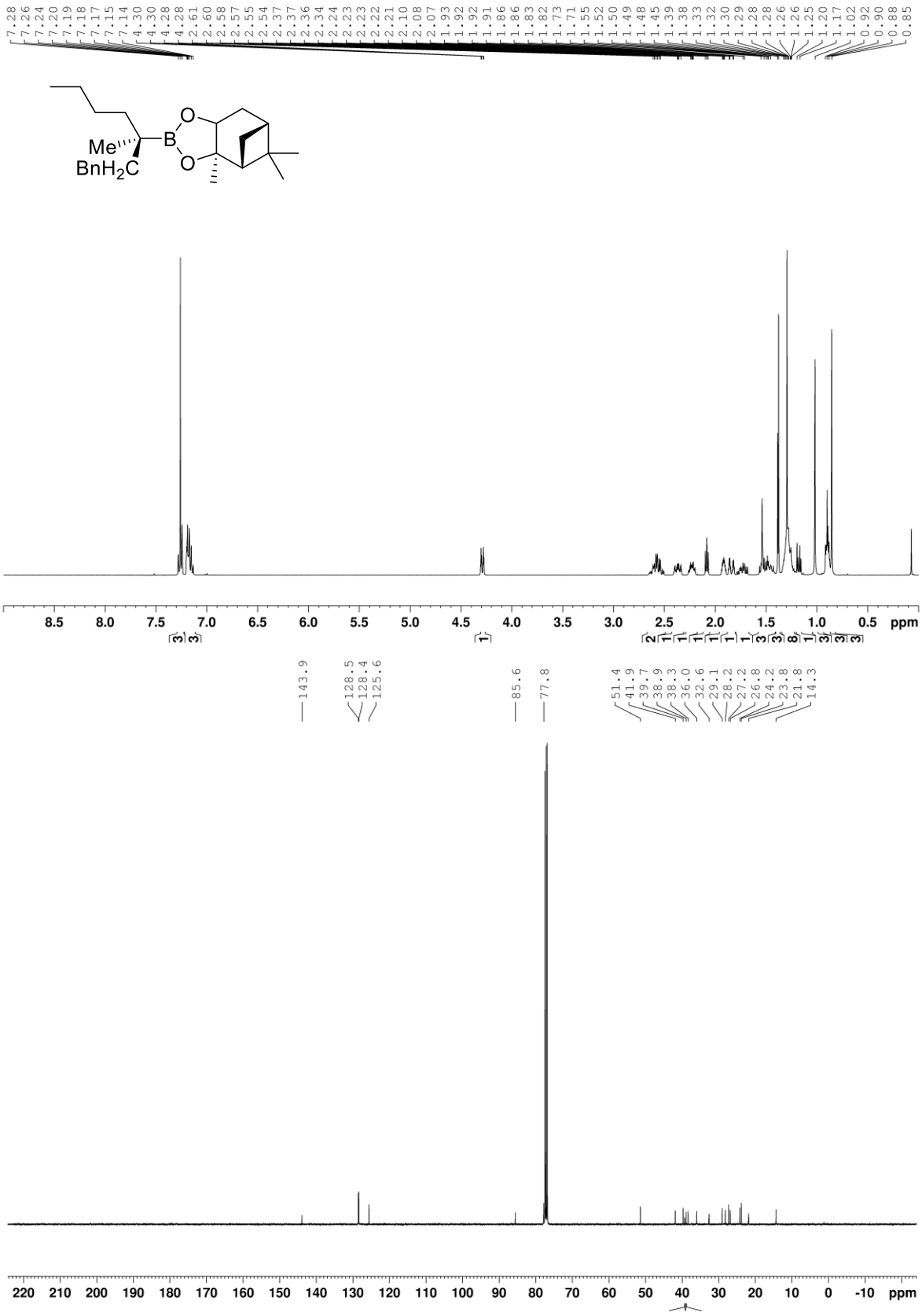
epi-**13aa**

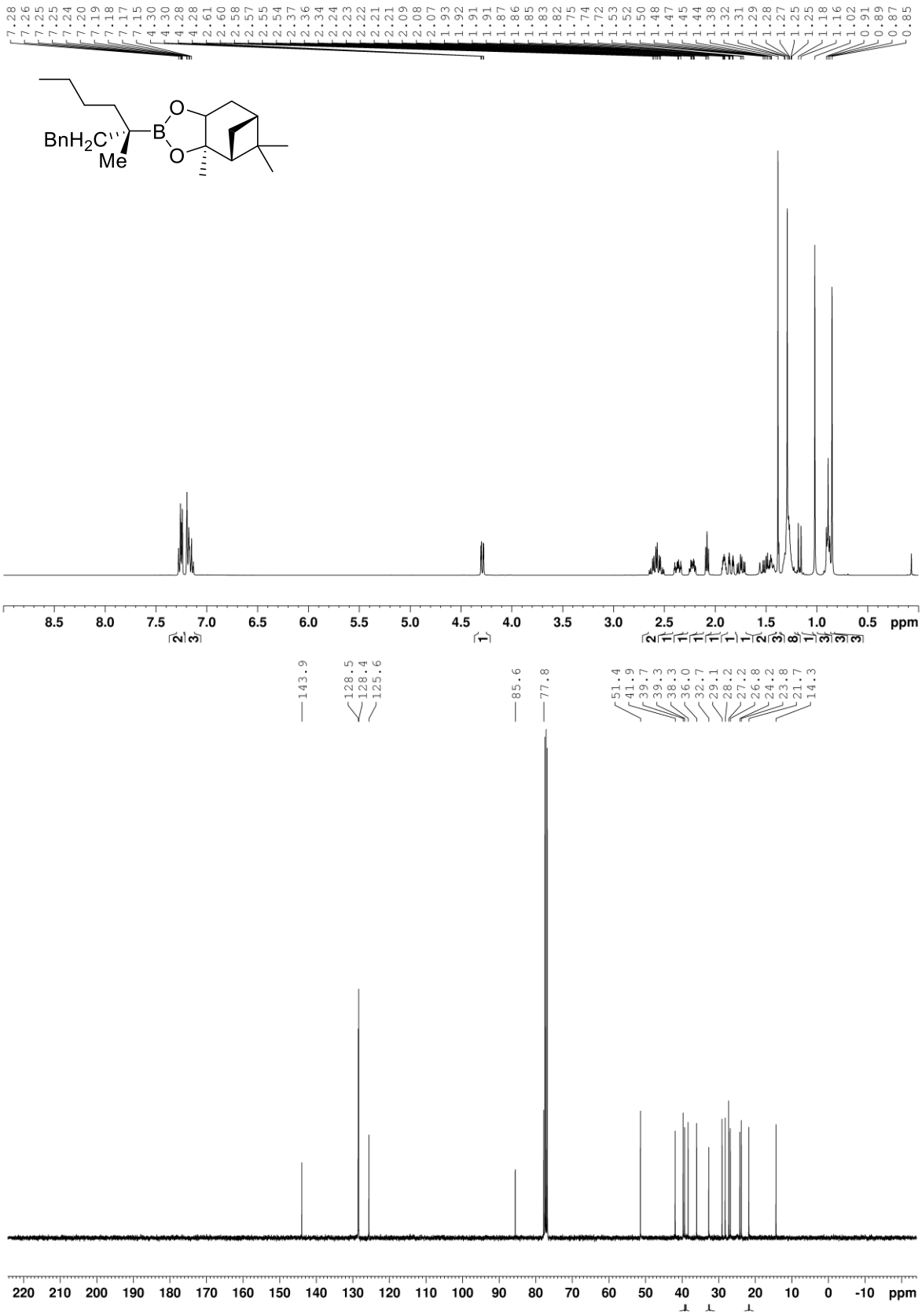

Bu
Me
B
O
O
13aa
3.84
3.83
3.82
3.81
1.78
1.77
1.75
1.69
1.66
1.61
1.57
1.50
1.48
1.47
1.47
1.46
1.45
1.44
1.35
1.34
1.33
1.33
1.32
1.31
1.30
1.29
1.29
1.28
1.27
1.26
1.26
1.25
1.24
1.24
1.23
8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 ppm
2
9 2 2 1 6 3 3
83.27
83.26
43.22
33.28
33.18
31.46
31.33
28.42
27.54
26.64
26.18
26.08
23.10
23.06
16.12
15.94
14.29
220 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10 ppm


7.31
7.30
7.29
7.27
7.27
7.26
7.22
7.21
7.20
7.20
7.19
7.17
3.87
3.86
3.84
3.83
3.81
3.80
2.80
2.79
2.78
2.77
2.75
2.74
2.73
2.71
2.70
2.69
2.68
2.67
2.66
2.64
1.81
1.80
1.79
1.79
1.79
1.78
1.78
1.77
1.77
1.76
1.76
1.75
1.75
1.42
1.24
1.23
Me
OH
BnH2C
13
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 ppm
142.2
128.5
126.0
67.7
41.0
32.3
23.8
220 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10 ppm

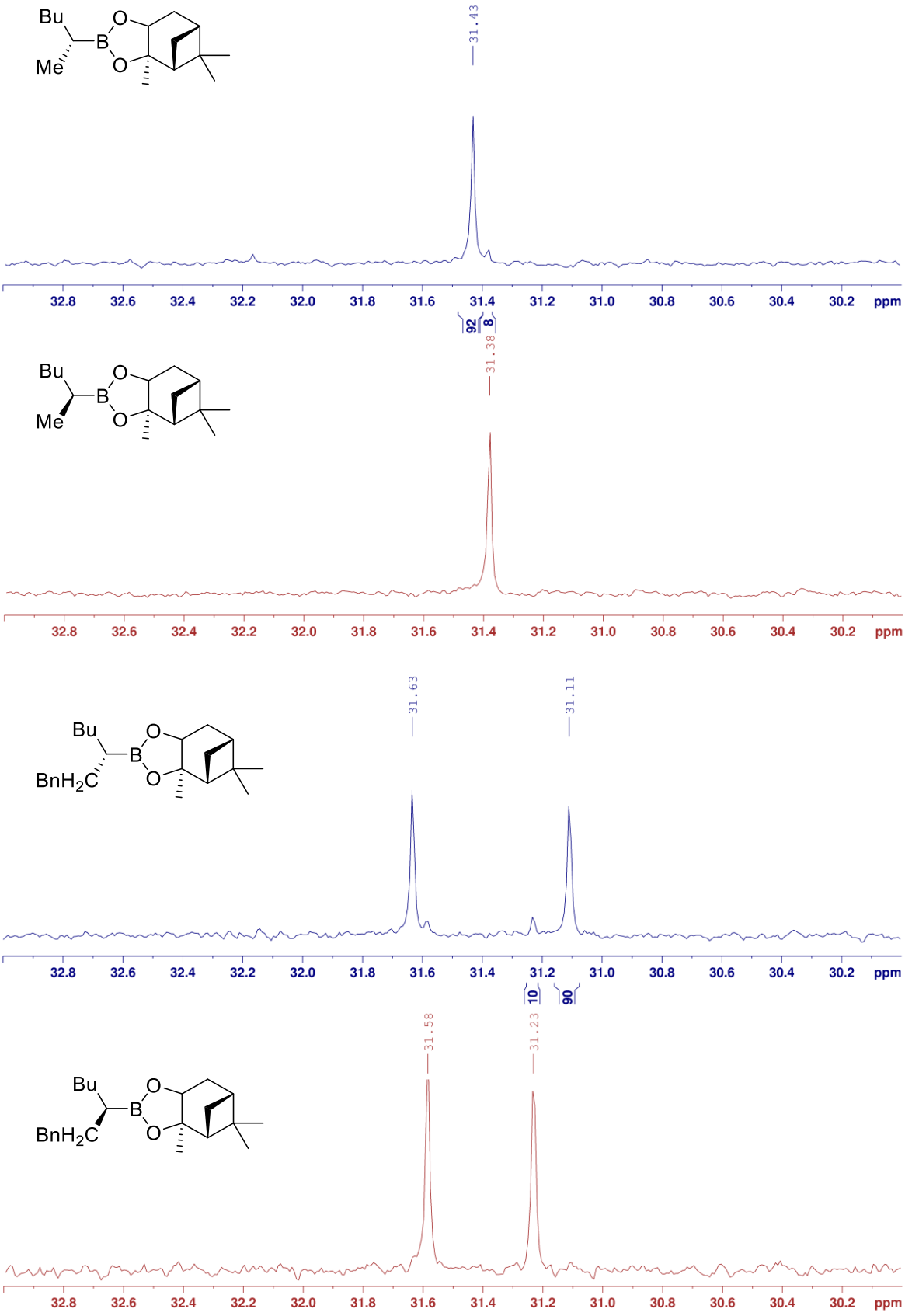

Me
OTIB
BnH2C
5a
7.31 7.30 7.29 7.28 7.28 7.22 7.21 7.20 7.20 7.18 7.02
5.28 5.27 5.26 5.26 5.25 5.25 5.23 2.97 2.95 2.93 2.91 2.90 2.88 2.86 2.78 2.77 2.76 2.75 2.74 2.72 2.70 2.69 2.68 2.67 2.65 2.04 2.03 2.03 2.02 2.02 2.01 2.00 2.00 1.98 1.93 1.92 1.91 1.90 1.89 1.89 1.89 1.88 1.88 1.87 1.41 1.39 1.28 1.27 1.27 1.26 1.26 1.24
8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5 ppm
2 3 2 1 3 2 1 1 3 18
170.6 150.2 144.7 141.7 131.0 128.6 128.4 126.1 121.0 71.7 37.9 34.6 32.0 31.5 24.5 24.3 24.1 20.1
220 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10 ppm

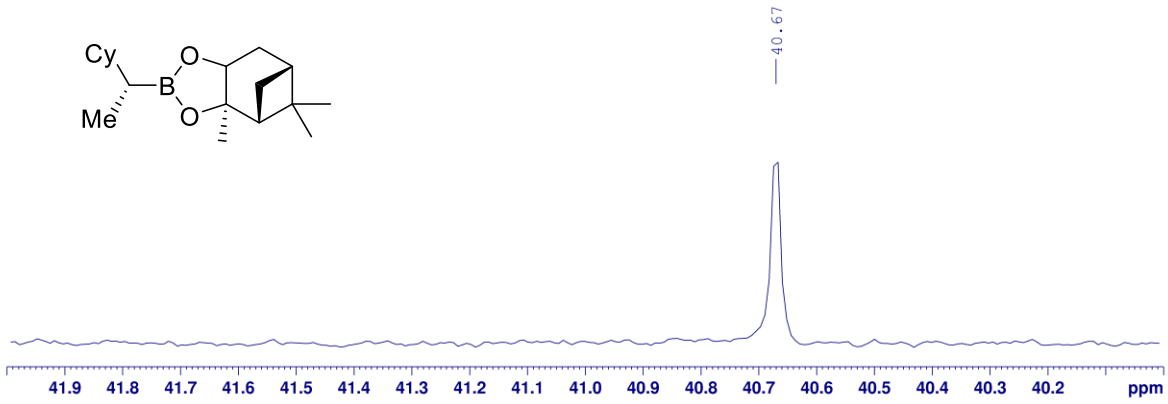

7.31 7.30 7.29 7.28 7.22 7.21 7.20 7.18 7.02 5.28 5.27 5.26 5.25 5.25 5.23 2.96 2.95 2.93 2.91 2.90 2.88 2.86 2.78 2.78 2.76 2.75 2.74 2.73 2.71 2.70 2.69 2.68 2.67 2.65 2.08 2.06 2.05 2.04 2.04 2.03 2.02 2.02 2.01 2.00 2.00 1.98 1.93 1.92 1.91 1.90 1.89 1.89 1.88 1.88 1.87 1.86 1.40 1.39 1.28 1.27 1.27 1.26 1.26 1.24
Me
OTIB
BnH2C
ent-5a
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 ppm
170.6 150.2 144.7 141.7 131.0 128.6 128.4 126.1 121.0 71.7 37.9 34.6 32.0 31.5 24.5 24.3 24.1 20.1
220 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10 ppm

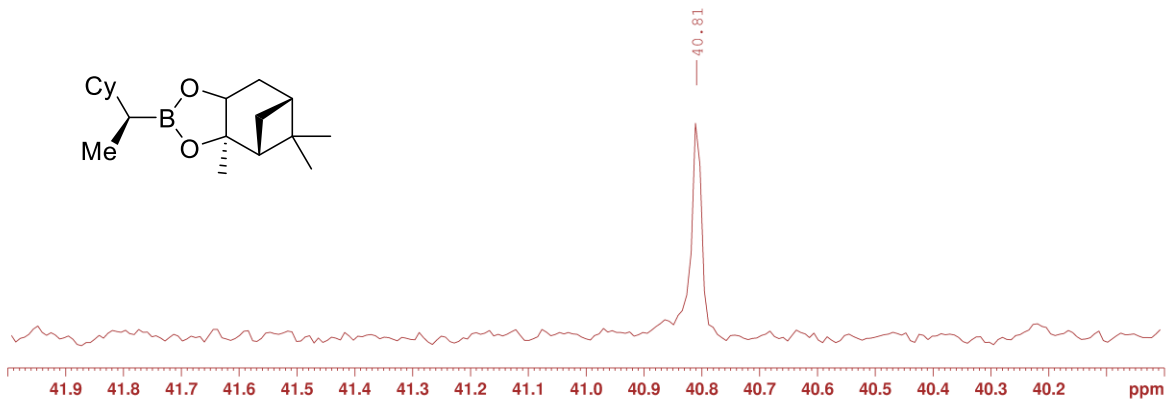

7.28
7.26
7.24
7.20
7.19
7.18
7.17
7.15
7.14
4.30
4.28
4.28
2.61
2.60
2.58
2.57
2.55
2.54
2.37
2.37
2.36
2.34
2.24
2.23
2.23
2.22
2.21
2.10
2.08
2.07
1.93
1.92
1.92
1.91
1.86
1.86
1.83
1.82
1.73
1.71
1.55
1.52
1.50
1.49
1.48
1.45
1.39
1.38
1.33
1.32
1.30
1.29
1.28
1.26
1.26
1.25
1.20
1.17
1.02
0.92
0.90
0.88
0.85
Me
BnH2C
O
B
O
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 ppm
143.9
128.5
128.4
125.6
85.6
77.8
51.4
41.9
39.7
38.9
38.3
36.0
32.6
29.1
28.2
27.2
26.8
24.2
23.8
21.8
14.3
220 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10 ppm

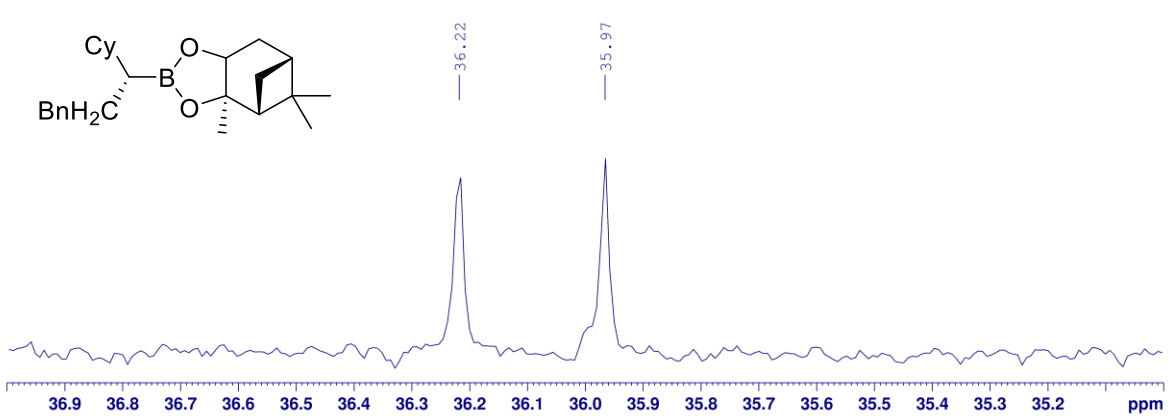

7.28 7.26 7.25 7.25 7.24 7.20 7.19 7.18 7.17 7.15 4.30 4.28 4.28 2.61 2.60 2.58 2.57 2.55 2.54 2.37 2.36 2.34 2.24 2.23 2.22 2.21 2.21 2.09 2.08 2.07 1.93 1.92 1.91 1.91 1.87 1.86 1.85 1.83 1.82 1.75 1.74 1.72 1.53 1.52 1.50 1.48 1.47 1.45 1.44 1.38 1.32 1.31 1.29 1.28 1.27 1.25 1.25 1.18 1.16 1.02 0.91 0.89 0.87 0.85
BnH2C
Me
B
O
O
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 ppm
143.9 128.5 128.4 125.6 85.6 77.8 51.4 41.9 39.7 39.3 38.3 36.0 32.7 29.1 28.2 27.2 26.8 24.2 23.8 21.7 14.3
220 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10 ppm

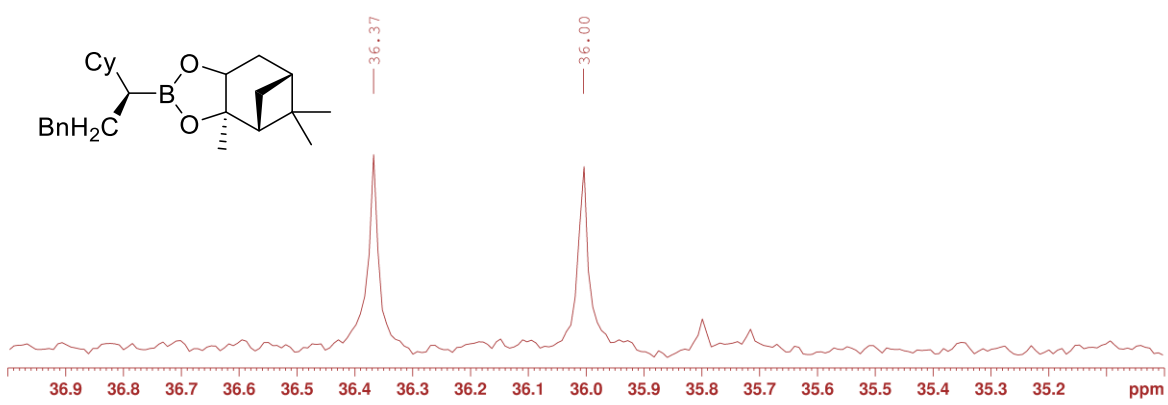
Spectra for determination of diastereomeric ratio

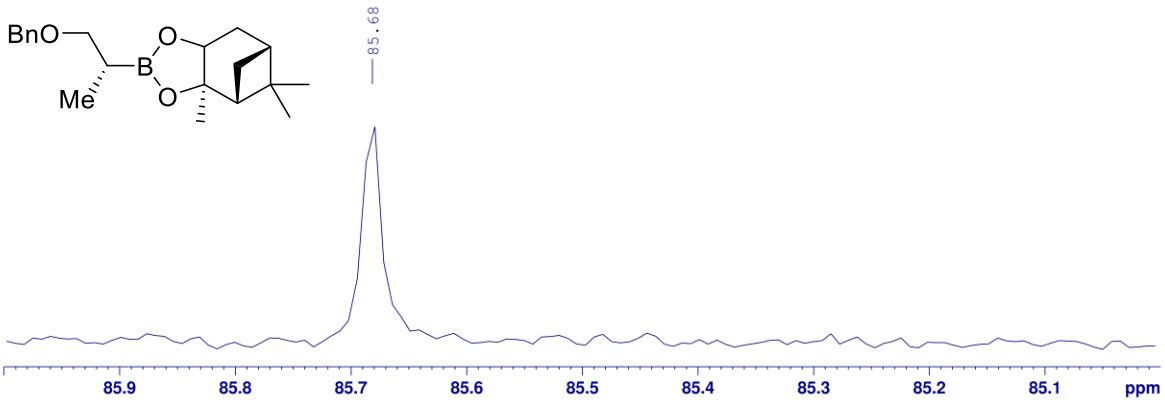


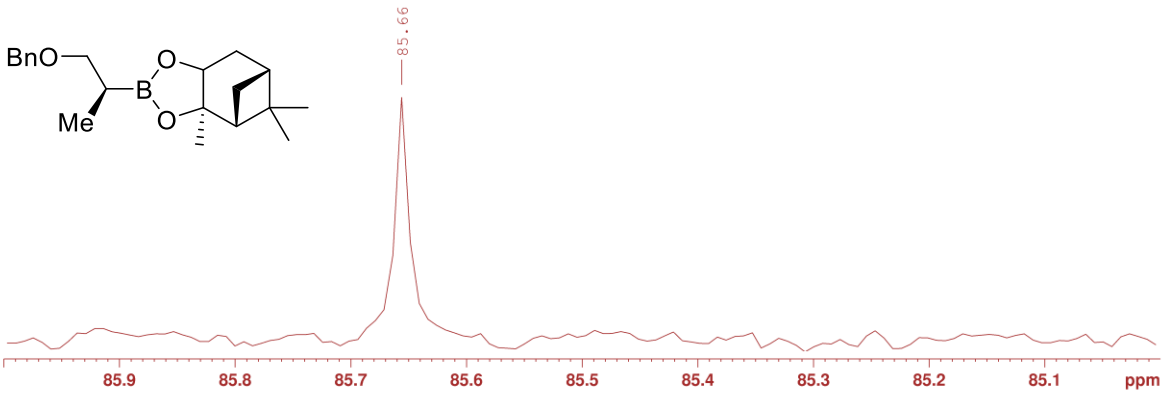

Cy
Me
B
O
O
40.67
41.9 41.8 41.7 41.6 41.5 41.4 41.3 41.2 41.1 41.0 40.9 40.8 40.7 40.6 40.5 40.4 40.3 40.2 ppm

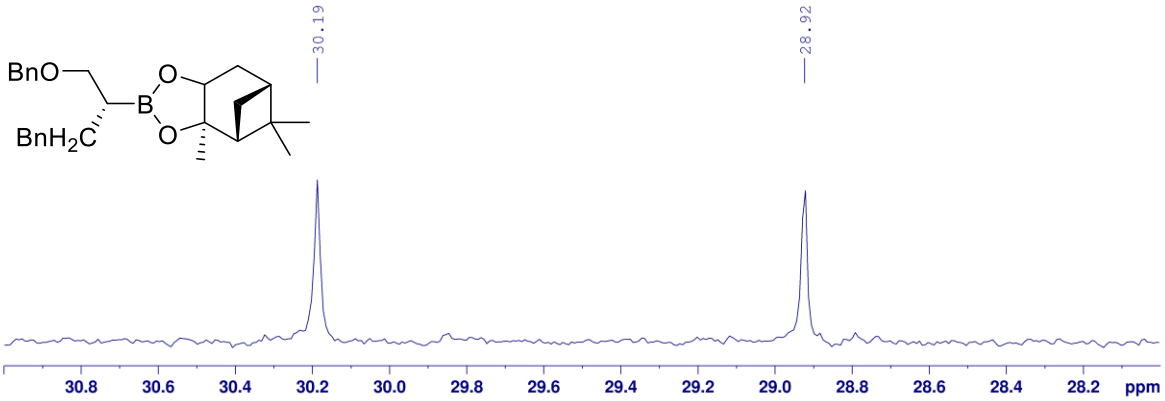

Cy
Me
B
O
O
40.81
41.9 41.8 41.7 41.6 41.5 41.4 41.3 41.2 41.1 41.0 40.9 40.8 40.7 40.6 40.5 40.4 40.3 40.2 ppm

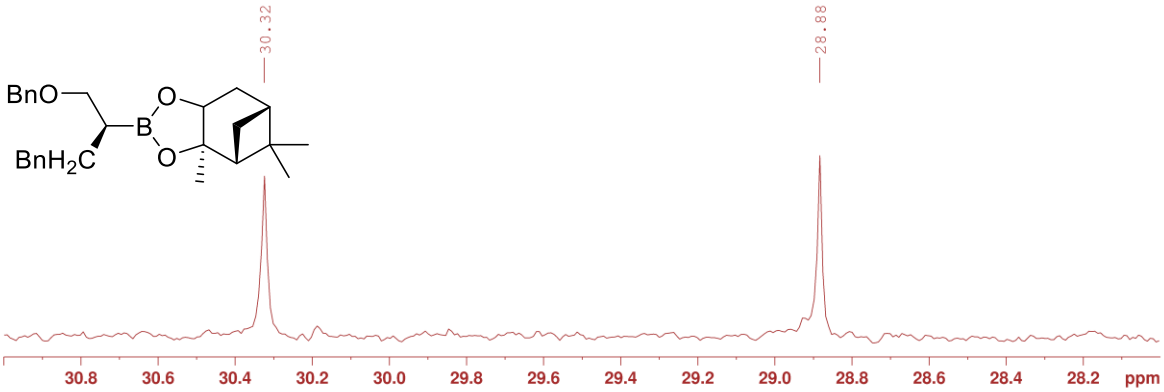

Cy
BnH2C
B
O
O
36.22
35.97
36.9 36.8 36.7 36.6 36.5 36.4 36.3 36.2 36.1 36.0 35.9 35.8 35.7 35.6 35.5 35.4 35.3 35.2 ppm

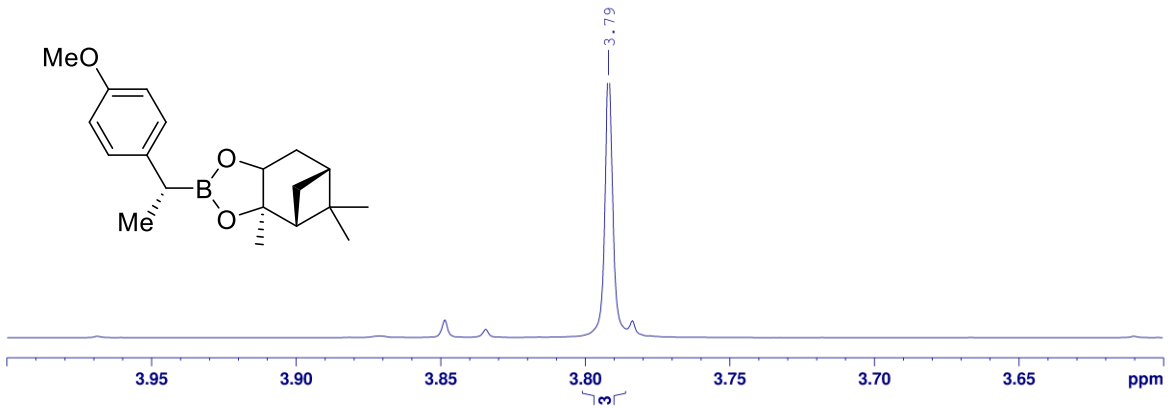

Cy
BnH2C
B
O
O
36.37
36.00
36.9 36.8 36.7 36.6 36.5 36.4 36.3 36.2 36.1 36.0 35.9 35.8 35.7 35.6 35.5 35.4 35.3 35.2 ppm

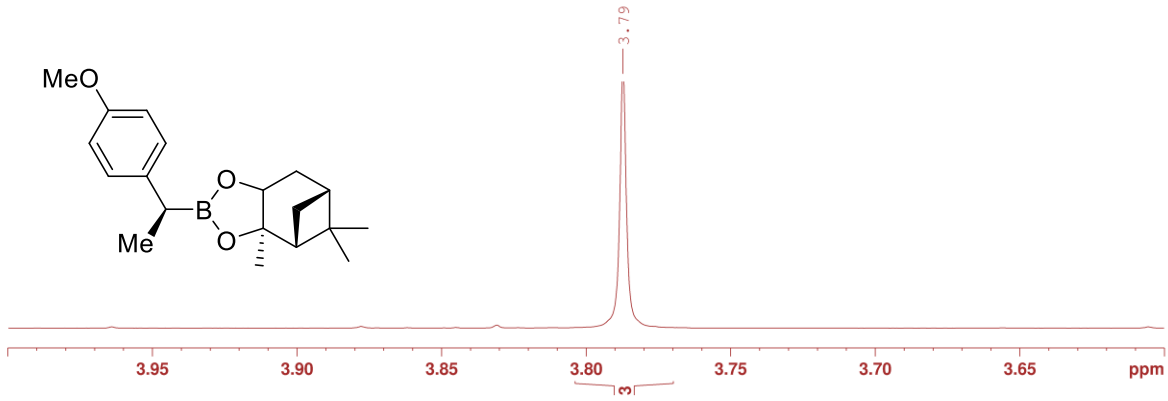

BnO
Me
B
O
O
85.68
85.9
85.8
85.7
85.6
85.5
85.4
85.3
85.2
85.1
ppm

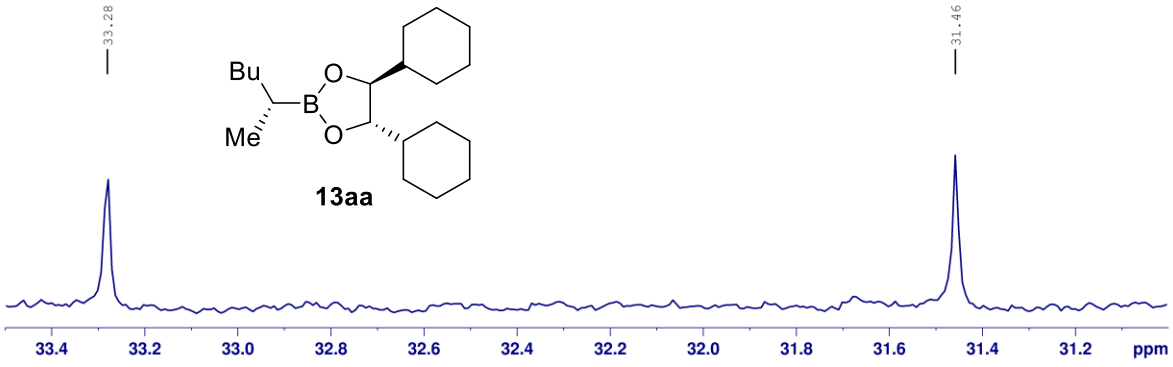

BnO
Me
B
O
O
85.66
85.9
85.8
85.7
85.6
85.5
85.4
85.3
85.2
85.1
ppm

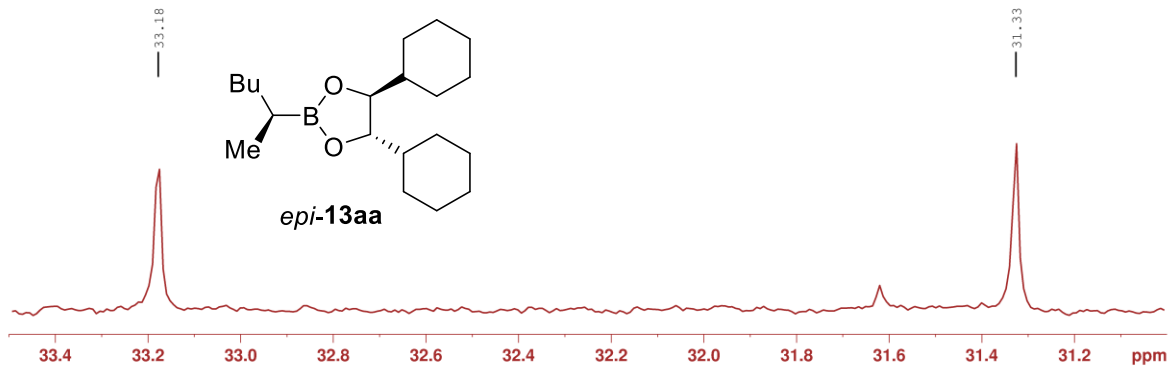

BnO
BnH2C
B
O
O
30.19
28.92
30.8
30.6
30.4
30.2
30.0
29.8
29.6
29.4
29.2
29.0
28.8
28.6
28.4
28.2
ppm

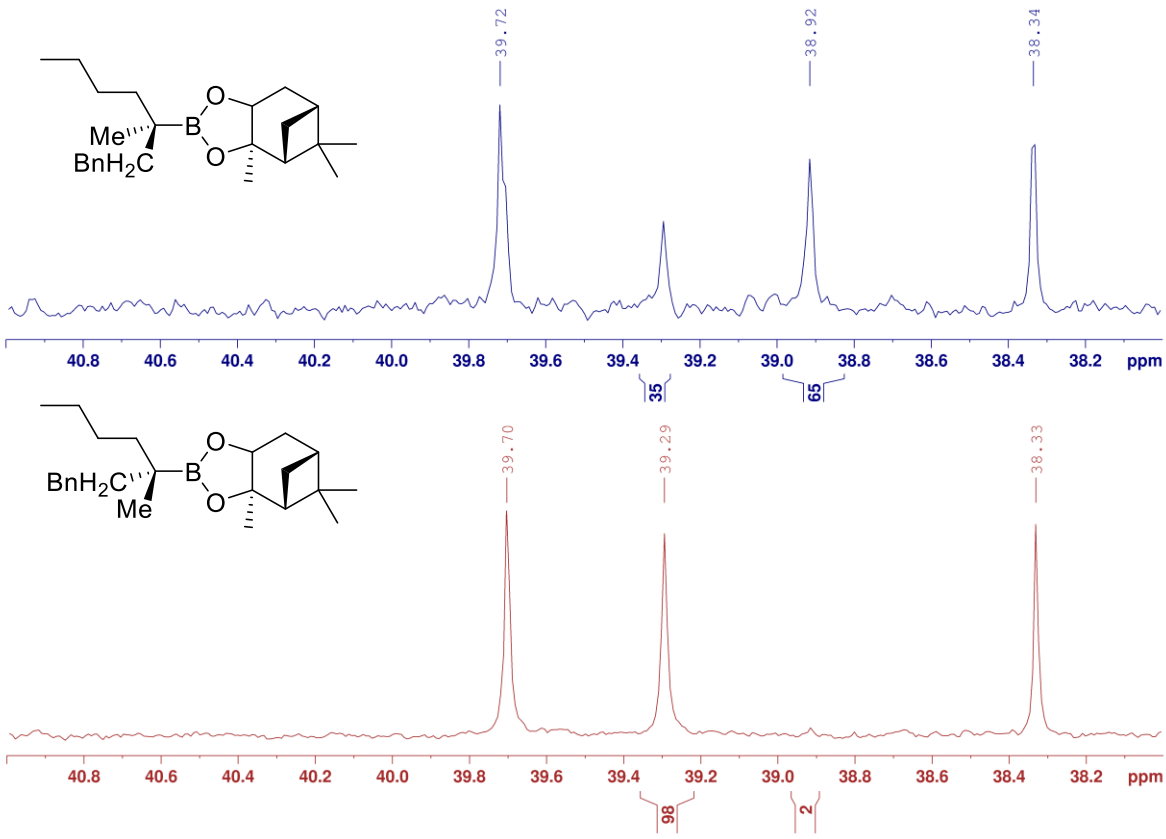

BnO
BnH2C
B
O
O
30.32
28.88
30.8
30.6
30.4
30.2
30.0
29.8
29.6
29.4
29.2
29.0
28.8
28.6
28.4
28.2
ppm


MeO
Me
B
O
O
3.79
3.95
3.90
3.85
3.80
3.75
3.70
3.65
ppm
3


MeO
Me
B
O
O
3.79
3.95
3.90
3.85
3.80
3.75
3.70
3.65
ppm
3


33.28
31.46
Bu
Me
B
O
O
13aa
33.4
33.2
33.0
32.8
32.6
32.4
32.2
32.0
31.8
31.6
31.4
31.2
ppm


33.18
31.33
Bu
Me
B
O
O
epi-13aa
33.4
33.2
33.0
32.8
32.6
32.4
32.2
32.0
31.8
31.6
31.4
31.2
ppm


39.72
38.92
38.34
Me
BnH2C
B
O
O
40.8
40.6
40.4
40.2
40.0
39.8
39.6
39.4
39.2
39.0
38.8
38.6
38.4
38.2
ppm
35
65
39.70
39.29
38.33
BnH2C
Me
98
2

References

1. Love, B. E.; Jones, E. G. The Use of Salicylaldehyde Phenylhydrazone as an Indicator for the Titration of Organometallic Reagents. *J. Org. Chem.* **1999**, *64* (10), 3755–3756. https://doi.org/10.1021/jo982433e.
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3. Chow, W. K.; So, C. M.; Lau, C. P.; Kwong, F. Y. Palladium-Catalyzed Borylation of Aryl Mesylates and Tosylates and Their Applications in One-Pot Sequential Suzuki–Miyaura Biaryl Synthesis. *Chem. – Eur. J.* **2011**, *17* (25), 6913–6917. https://doi.org/10.1002/chem.201100361.
4. Chandrashekar, H. B.; Maji, A.; Halder, G.; Banerjee, S.; Bhattacharyya, S.; Maiti, D. Photocatalyzed Borylation Using Water - Soluble Quantum Dots. *Chem. Commun.* **2019**, *55* (44), 6201–6204. https://doi.org/10.1039/C9CC01737B.