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Linear synthesis of the branched pentasaccharide repeats of O-antigens from *Shigella flexneri* 1b and 1a demonstrating major steric hindrance associated to type-specific glucosylation

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[b] *CNRS UMR3523, Institut Pasteur, 75015 Paris, France*
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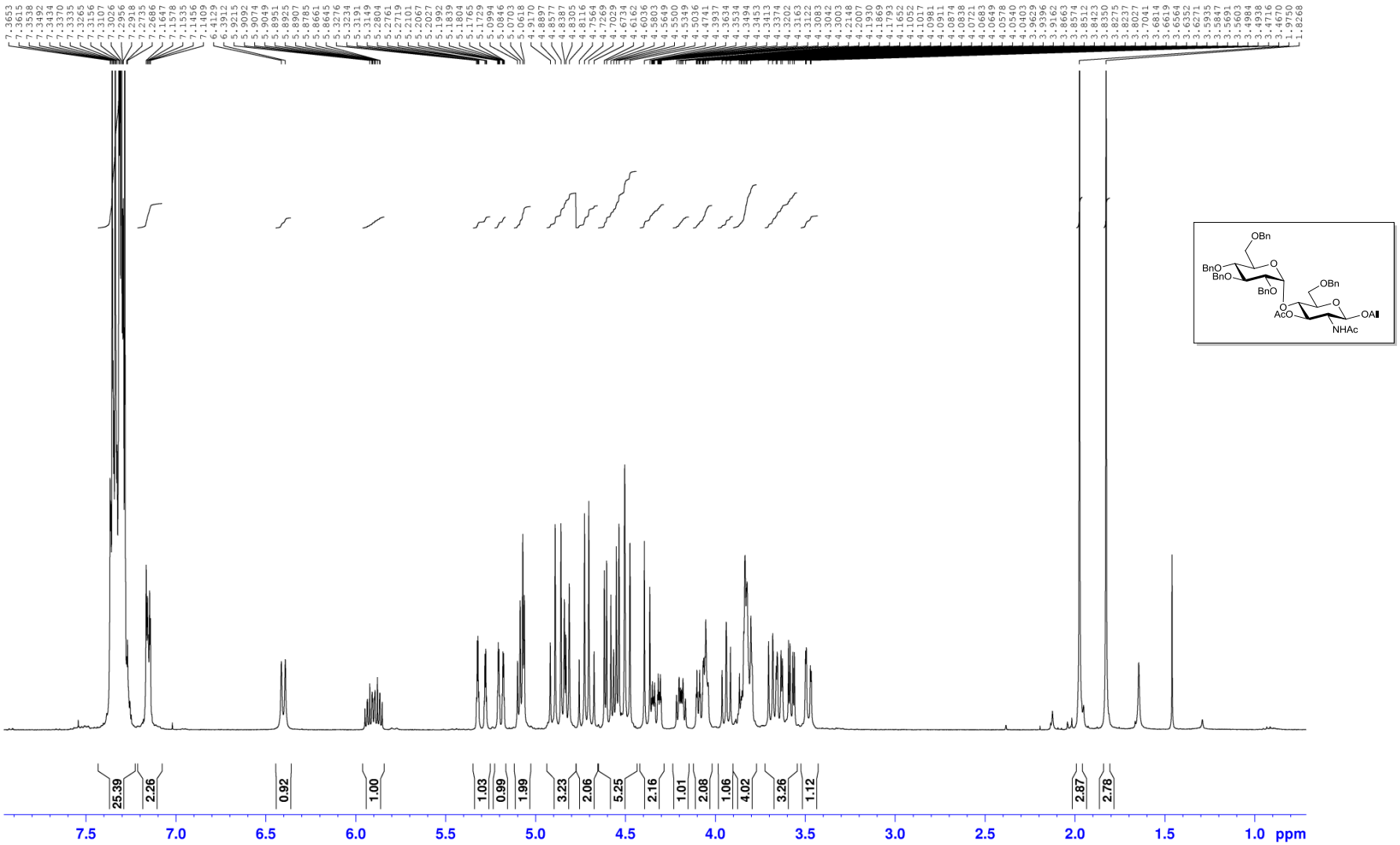
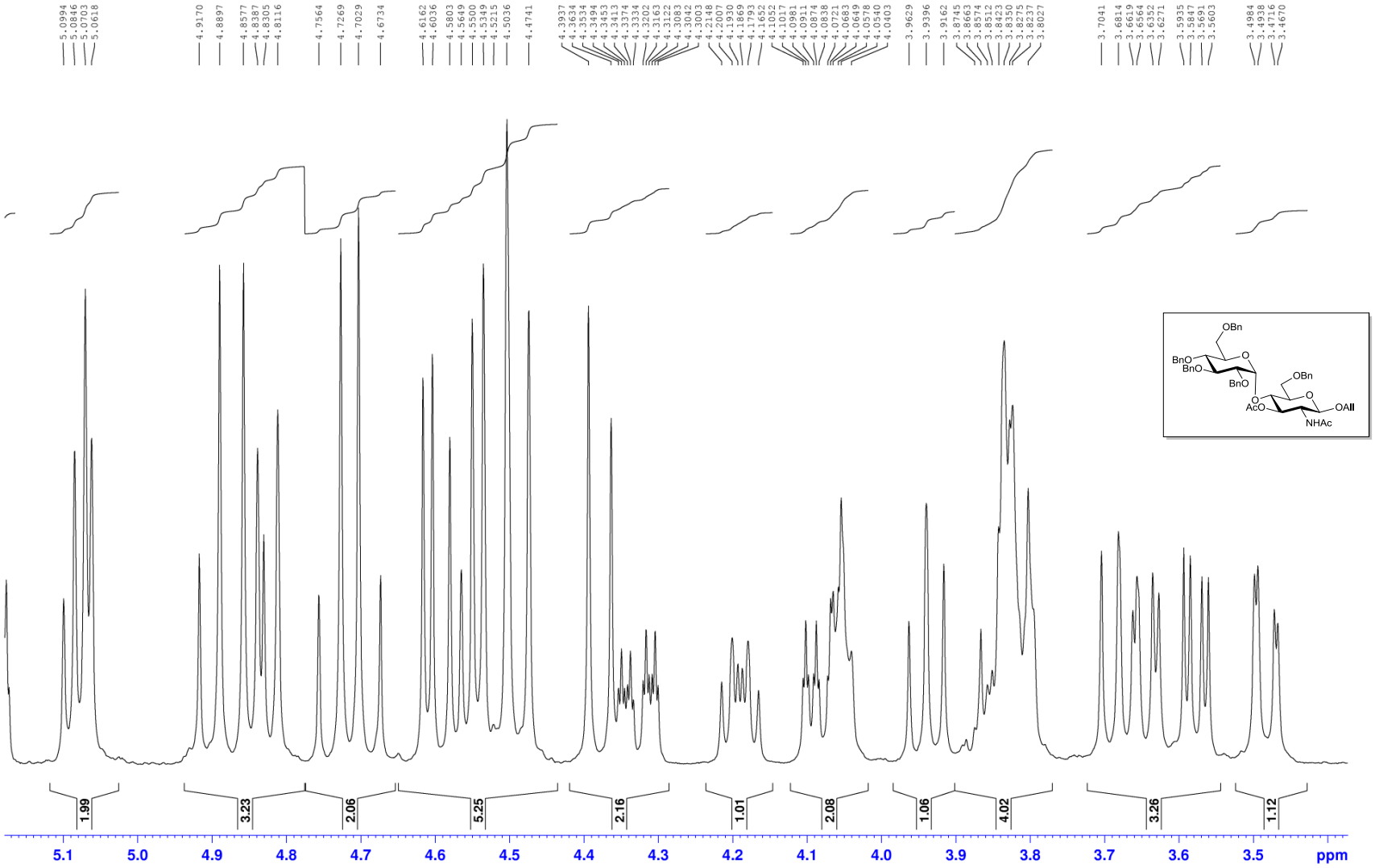
[#]*Present address: Arkema Saint-Auban, 04600 Saint-Auban, France*

Compound 9: **Allyl 2,3,4,6-tetra-*O*-benzyl-α-D-glucopyranosyl-(1→4)-2-acetamido-3-*O*-acetyl-6-*O*-benzyl-2-deoxy-β-D-glucopyranoside**

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BnO
BnO
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BnO
OBn
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O
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OAll
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2.06
5.25
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1.01
2.08
1.06
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1.12
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4.9
4.8
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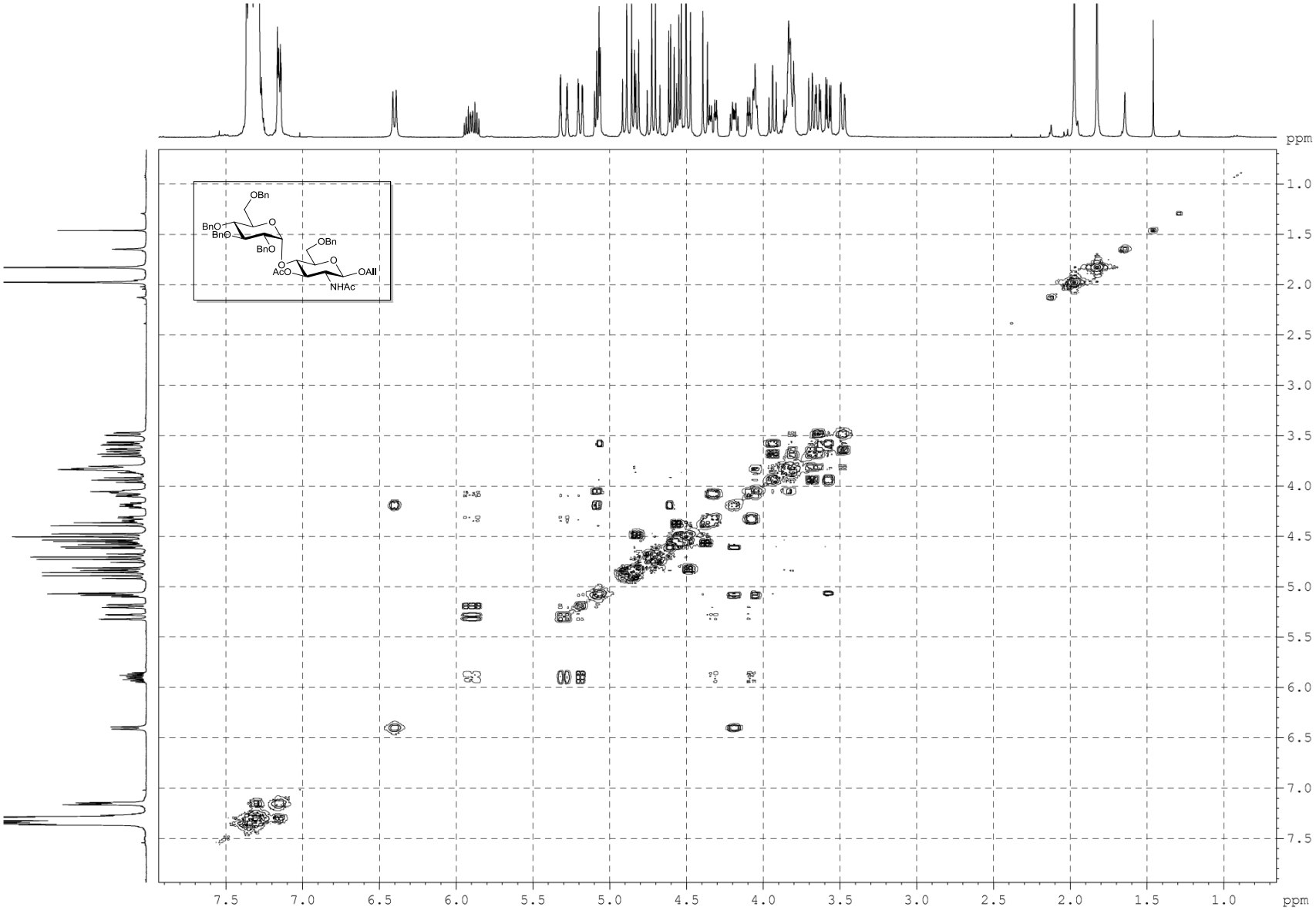
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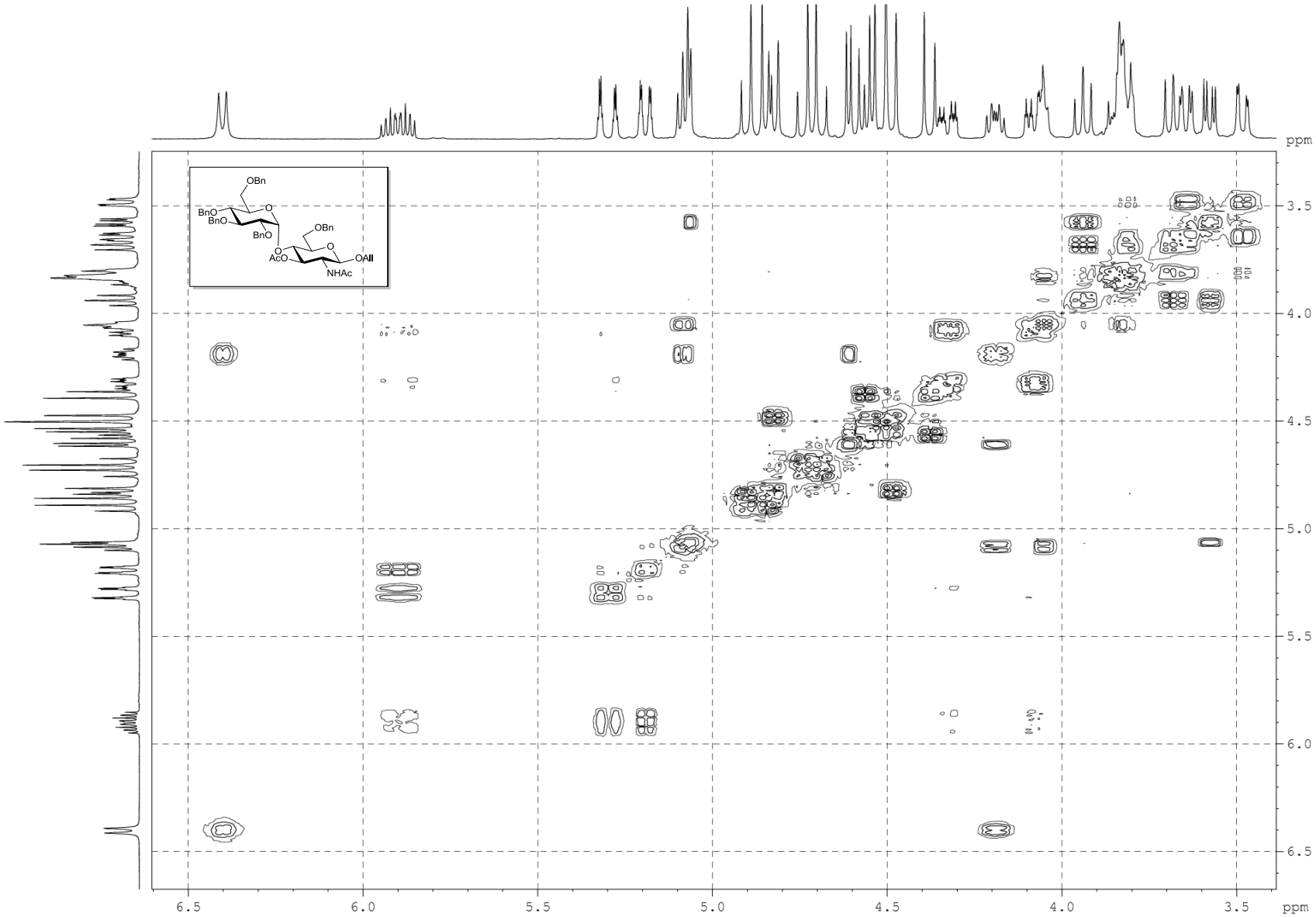
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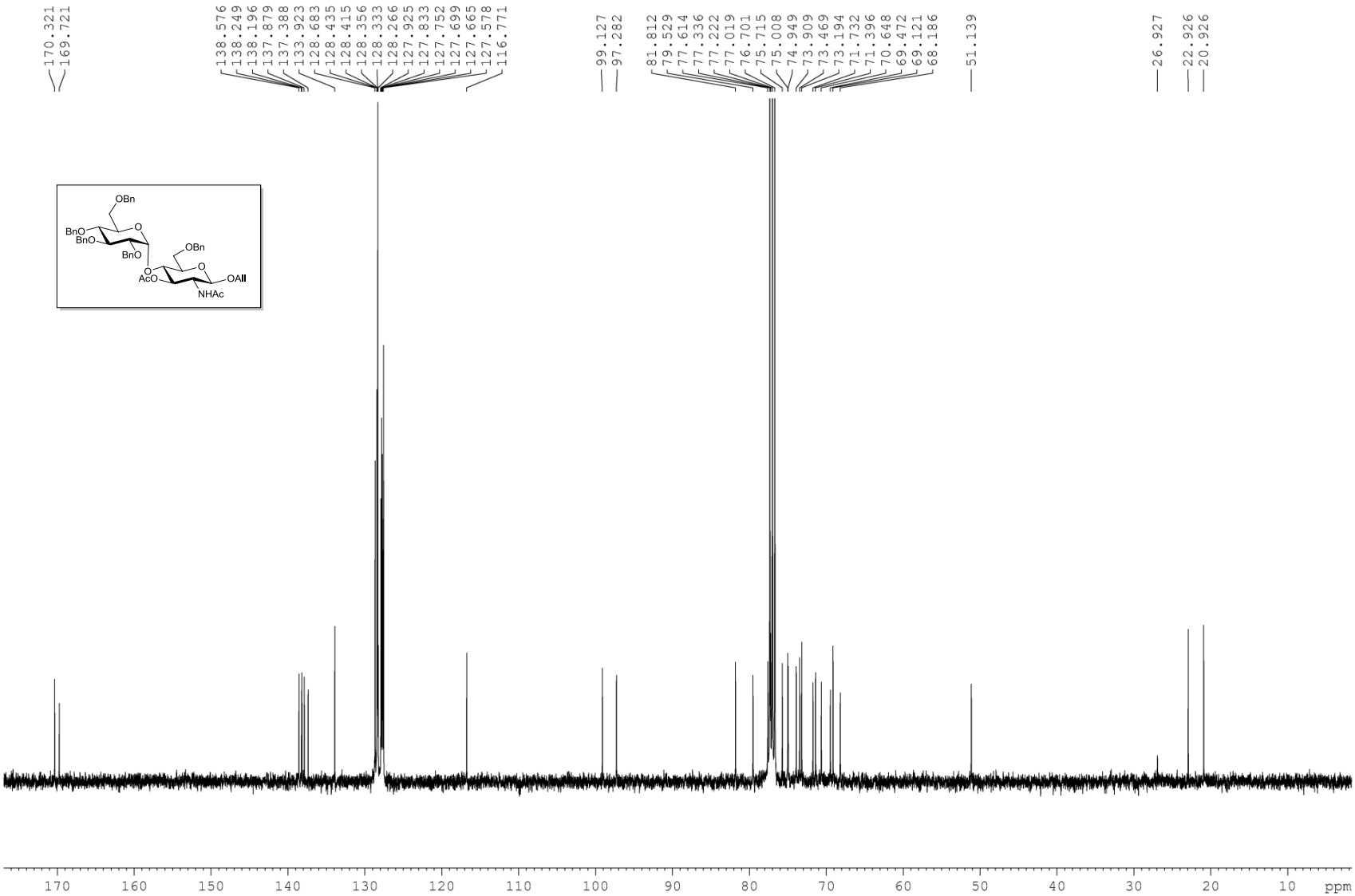
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99.127
97.282
81.812
79.529
77.614
77.336
77.222
77.019
76.701
75.715
75.008
74.949
73.909
73.469
73.194
71.732
71.396
70.648
69.472
69.121
68.186
51.139
26.927
22.926
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BnO
BnO
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BnO
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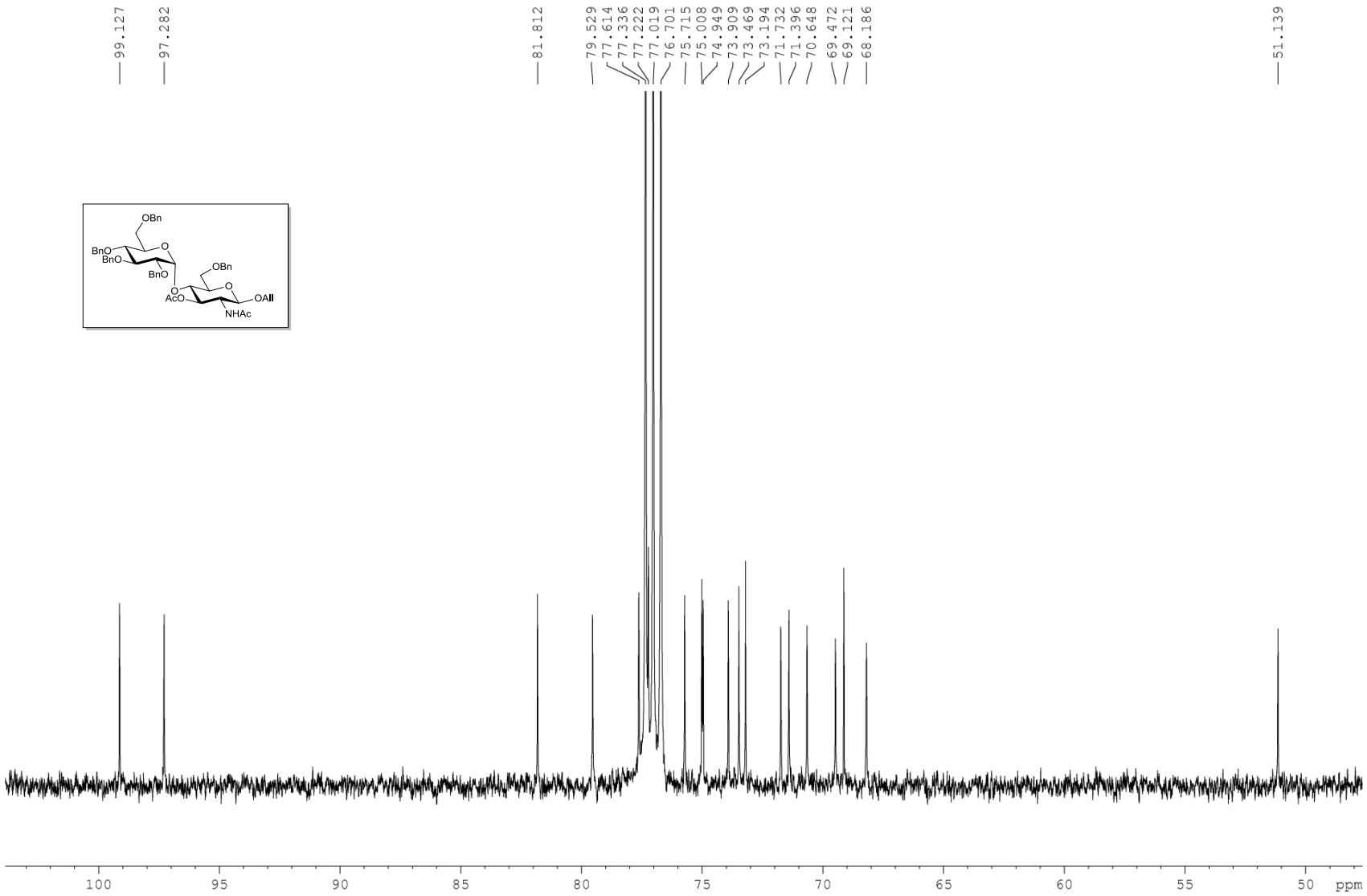
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71.732
71.396
70.648
69.472
69.121
68.186
51.139
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BnO
BnO
O
BnO
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AcO
OAll
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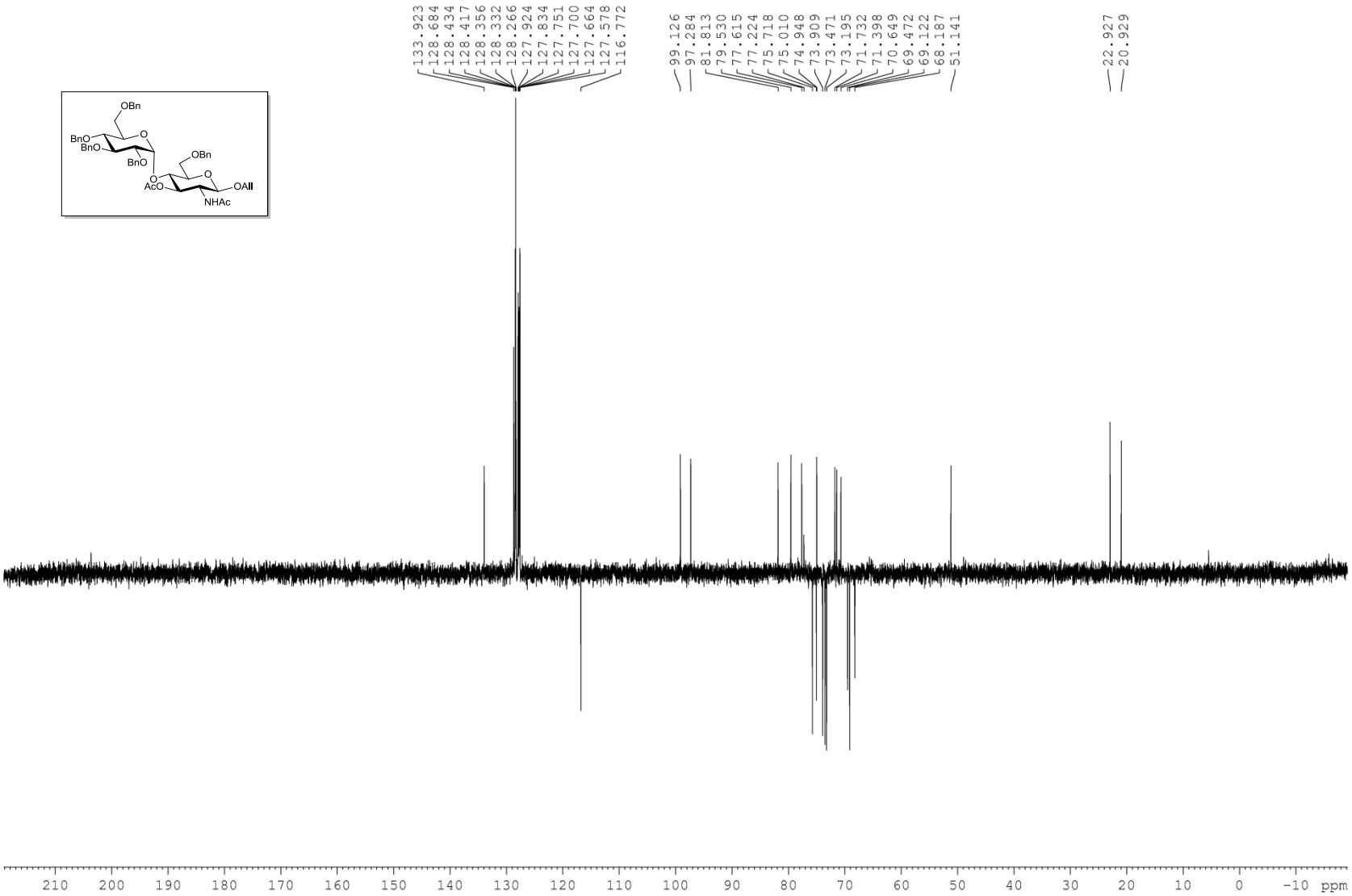
ppm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81.813
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73.471
73.195
71.732
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69.472
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68.187
51.141
22.927
20.929
OBn
BnO
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OBn
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AcO
OAll
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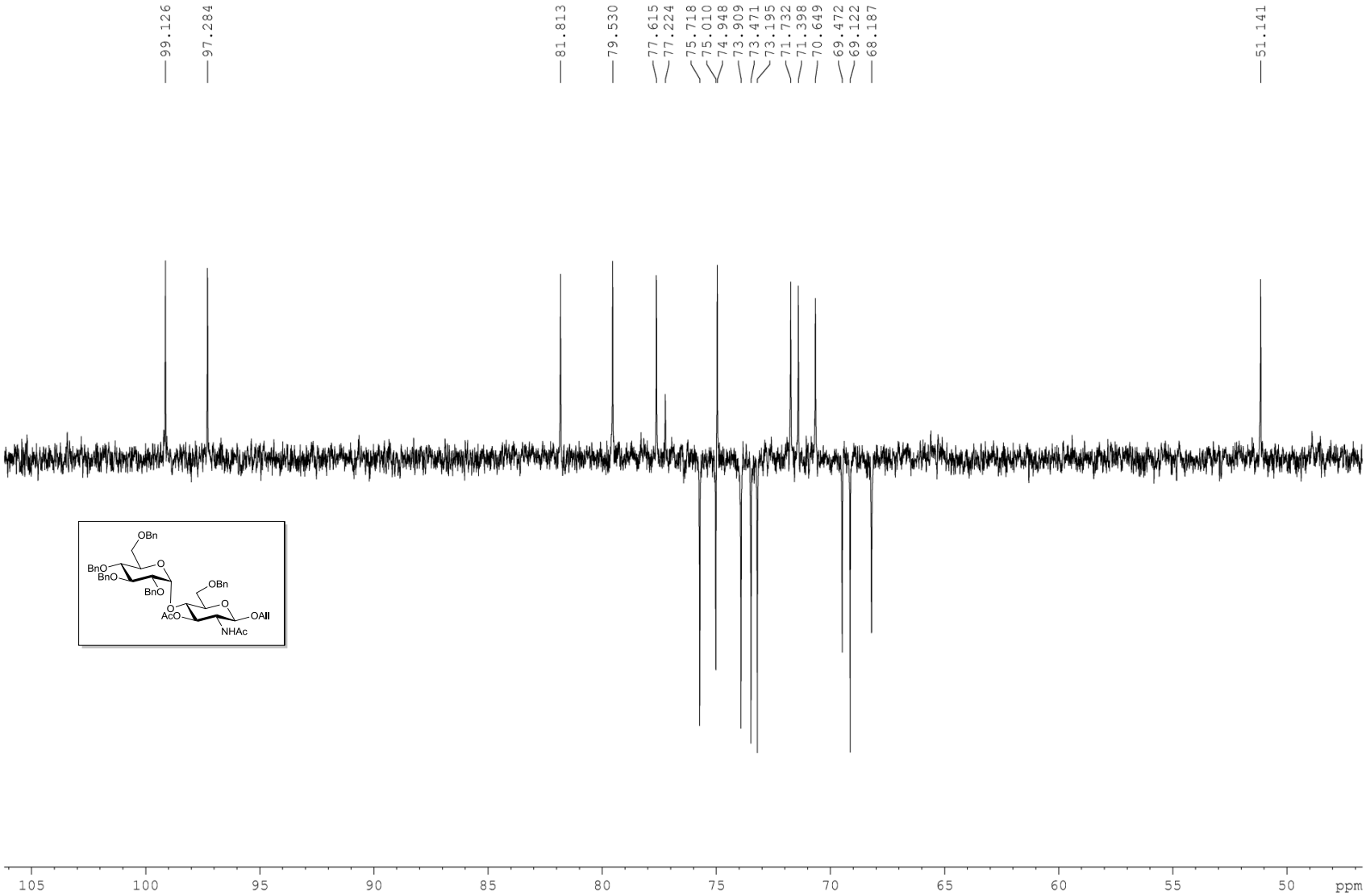
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70.649
69.472
69.122
68.187
51.141
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BnO
BnO
O
BnO
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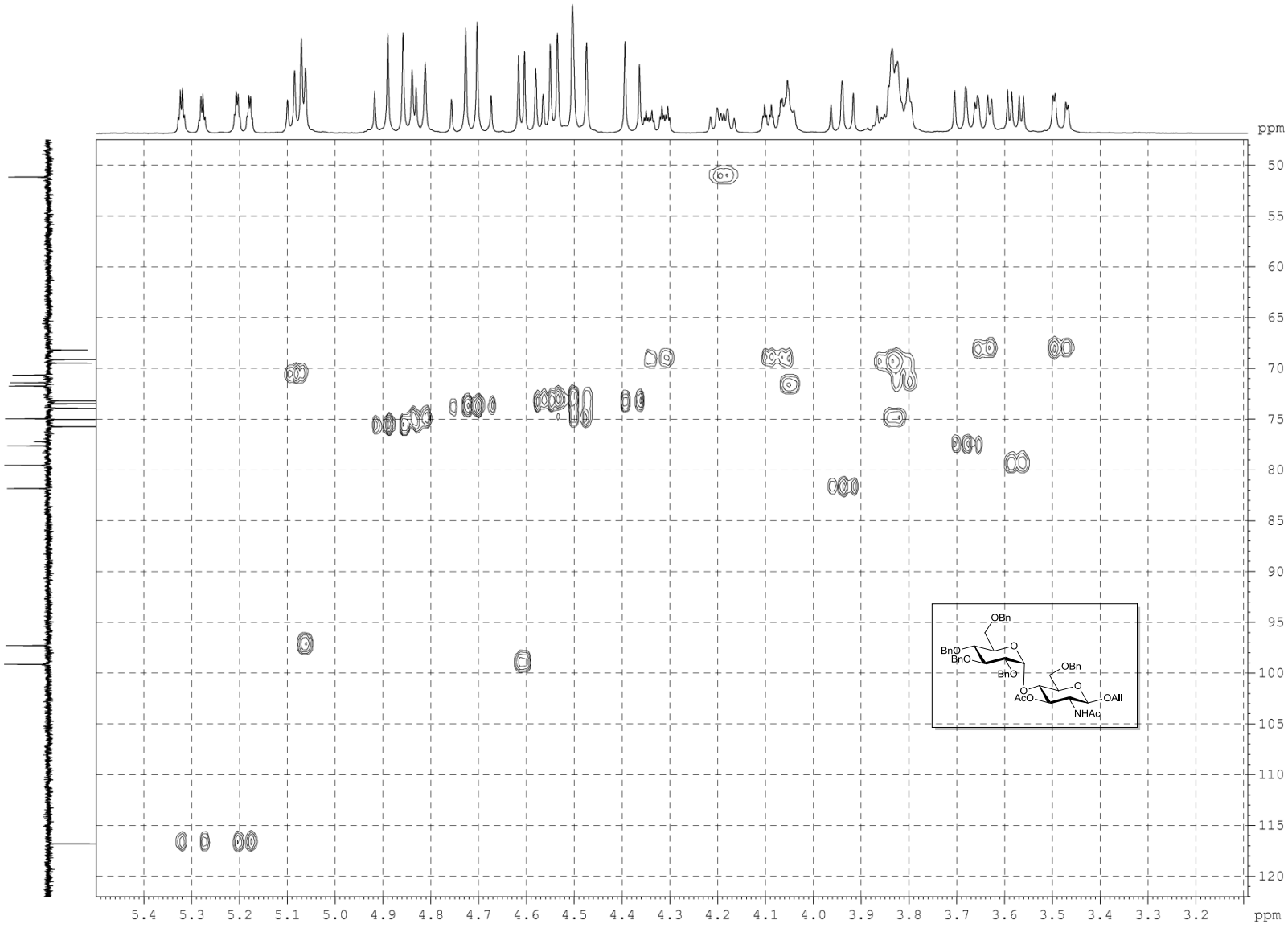
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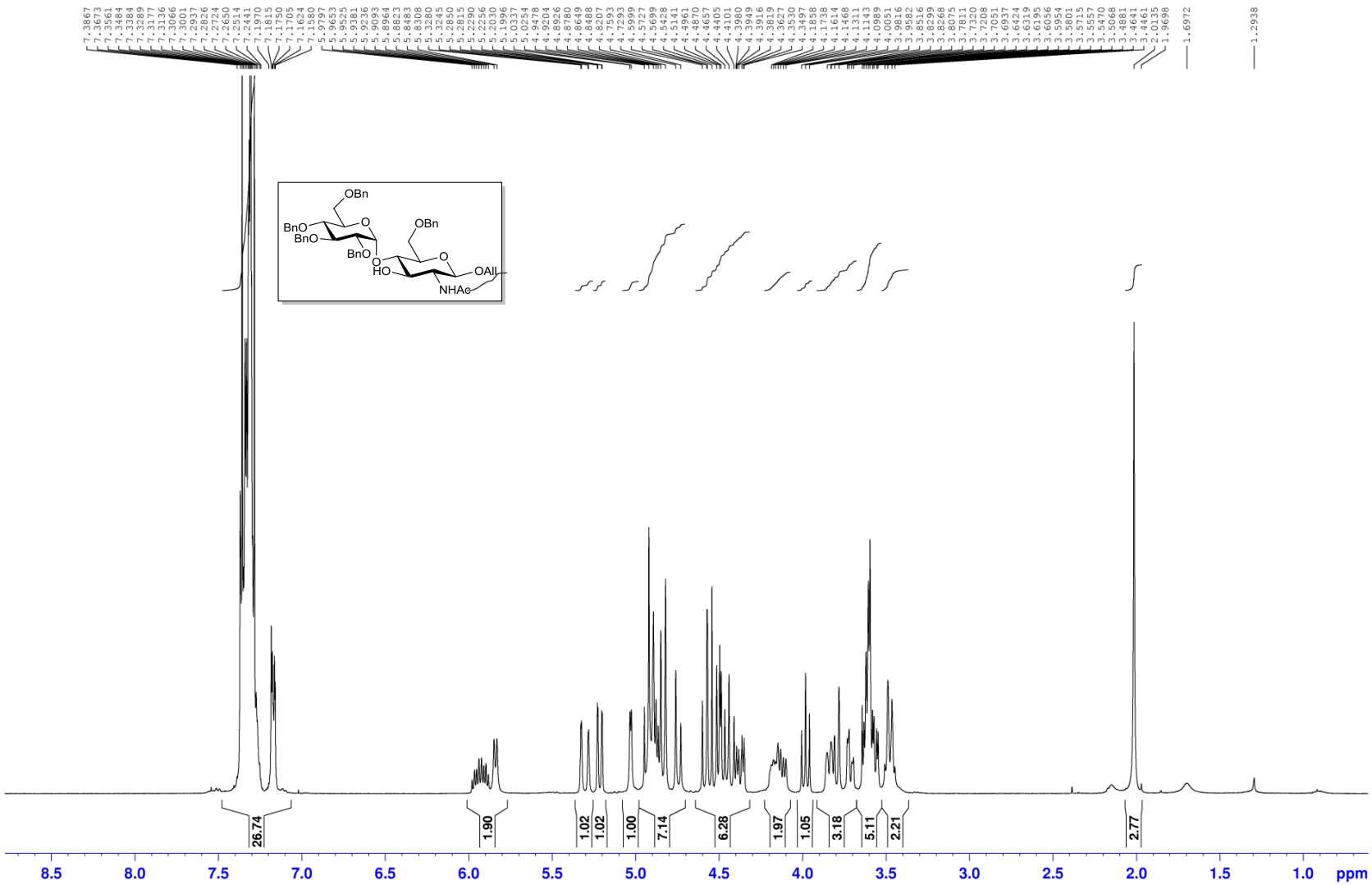
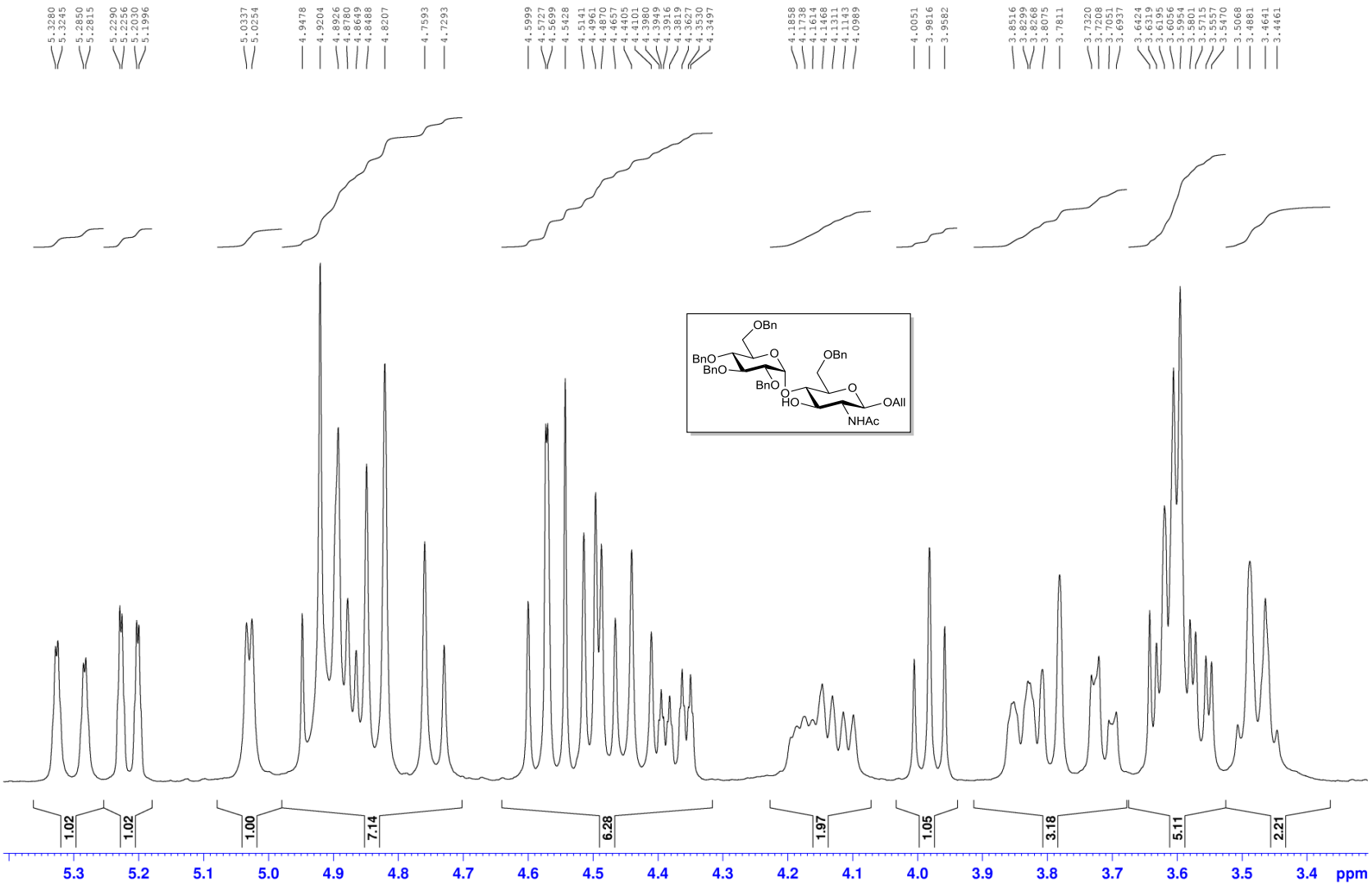
ppm
OBn
BnO
BnO
BnO
O
OBn
O
O
AcO
OAll
NHAc

Compound 10: **Allyl 2,3,4,6-tetra-*O*-benzyl-α-D-glucopyranosyl-(1→4)-2-acetamido-6-*O*-benzyl-2-deoxy-β-D-glucopyranoside**

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3.18
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5.3
5.2
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4.9
4.8
4.7
4.6
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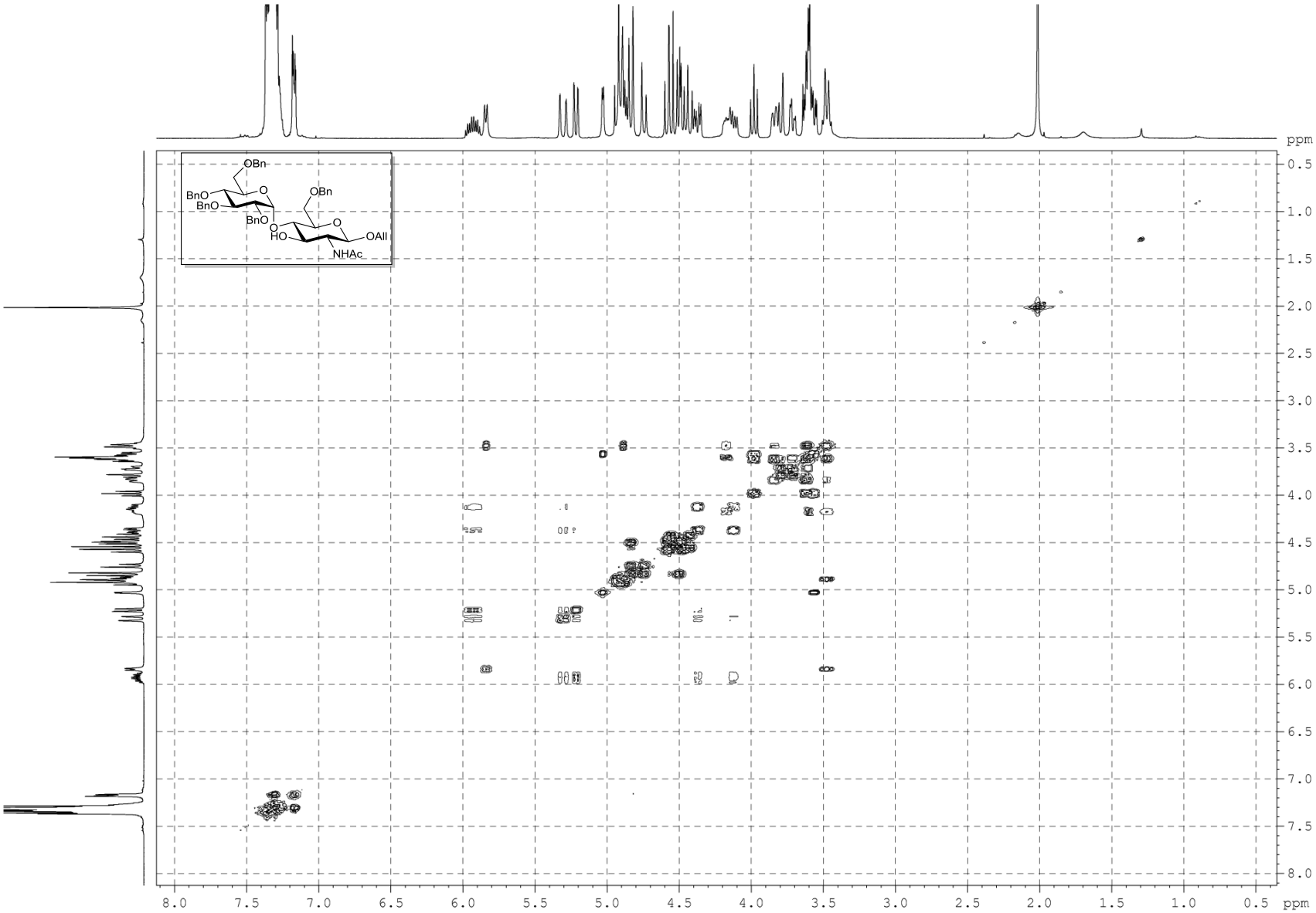
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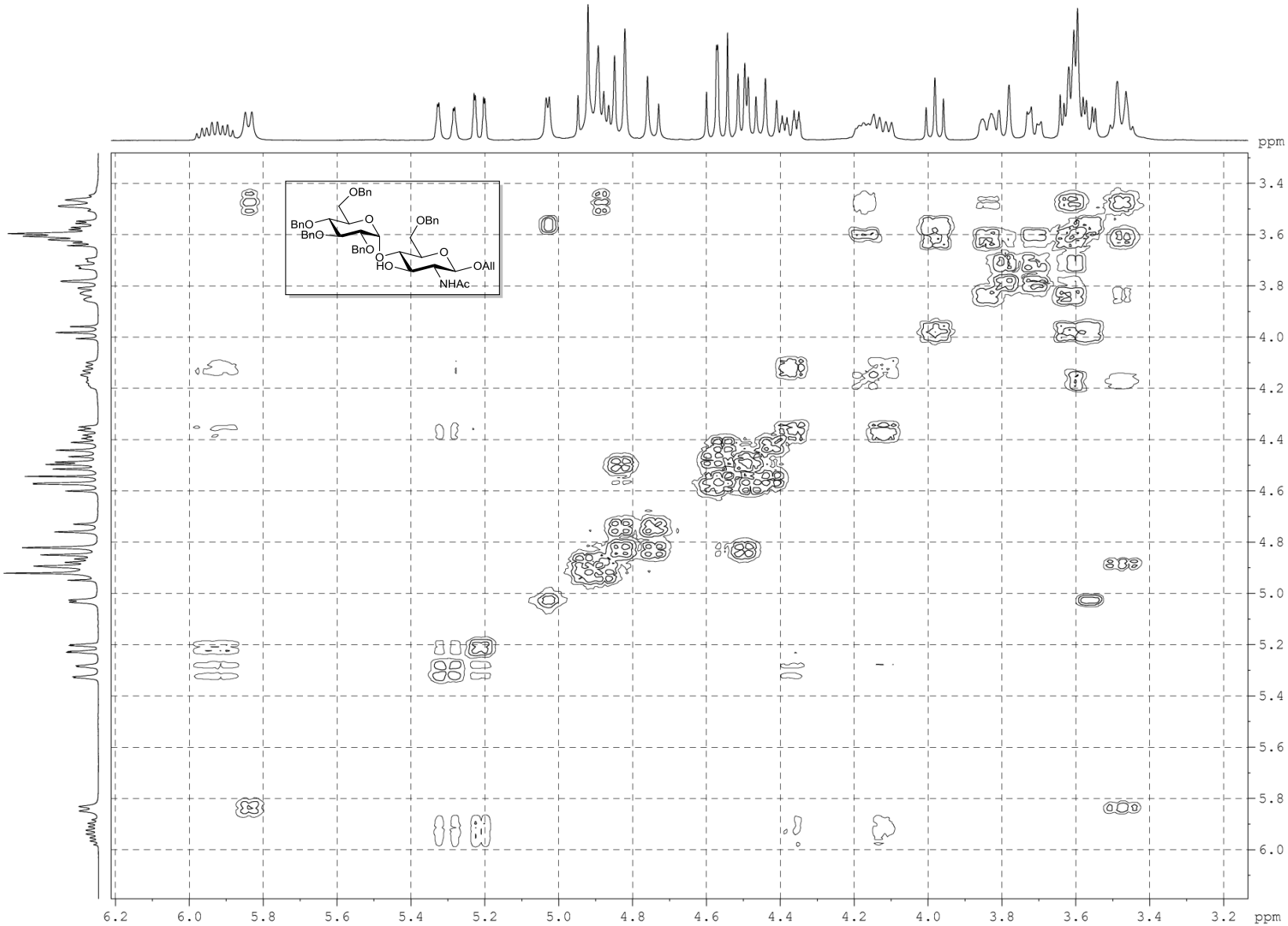
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BnO
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5.6
5.8
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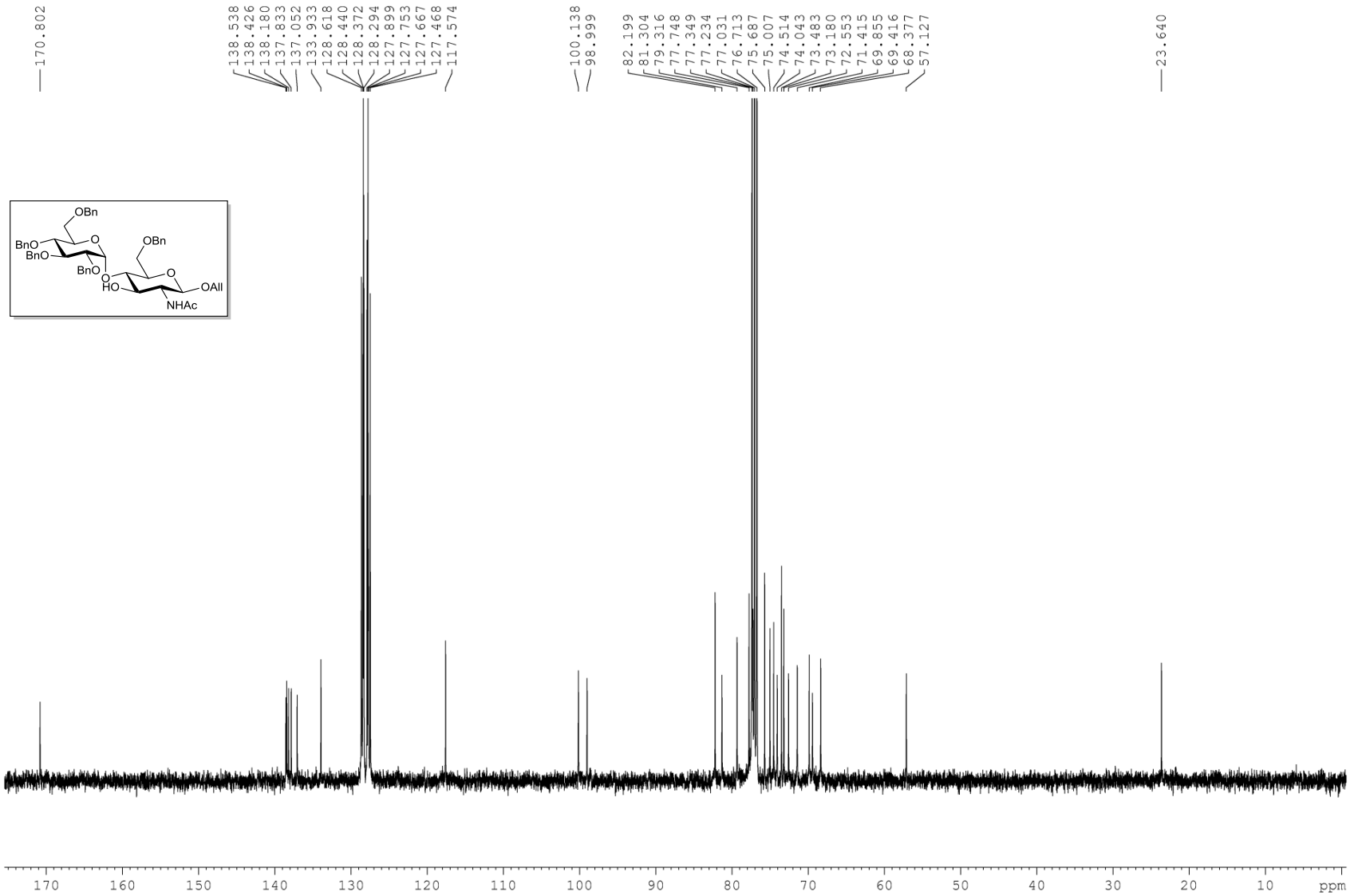
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81.304
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BnO
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HO
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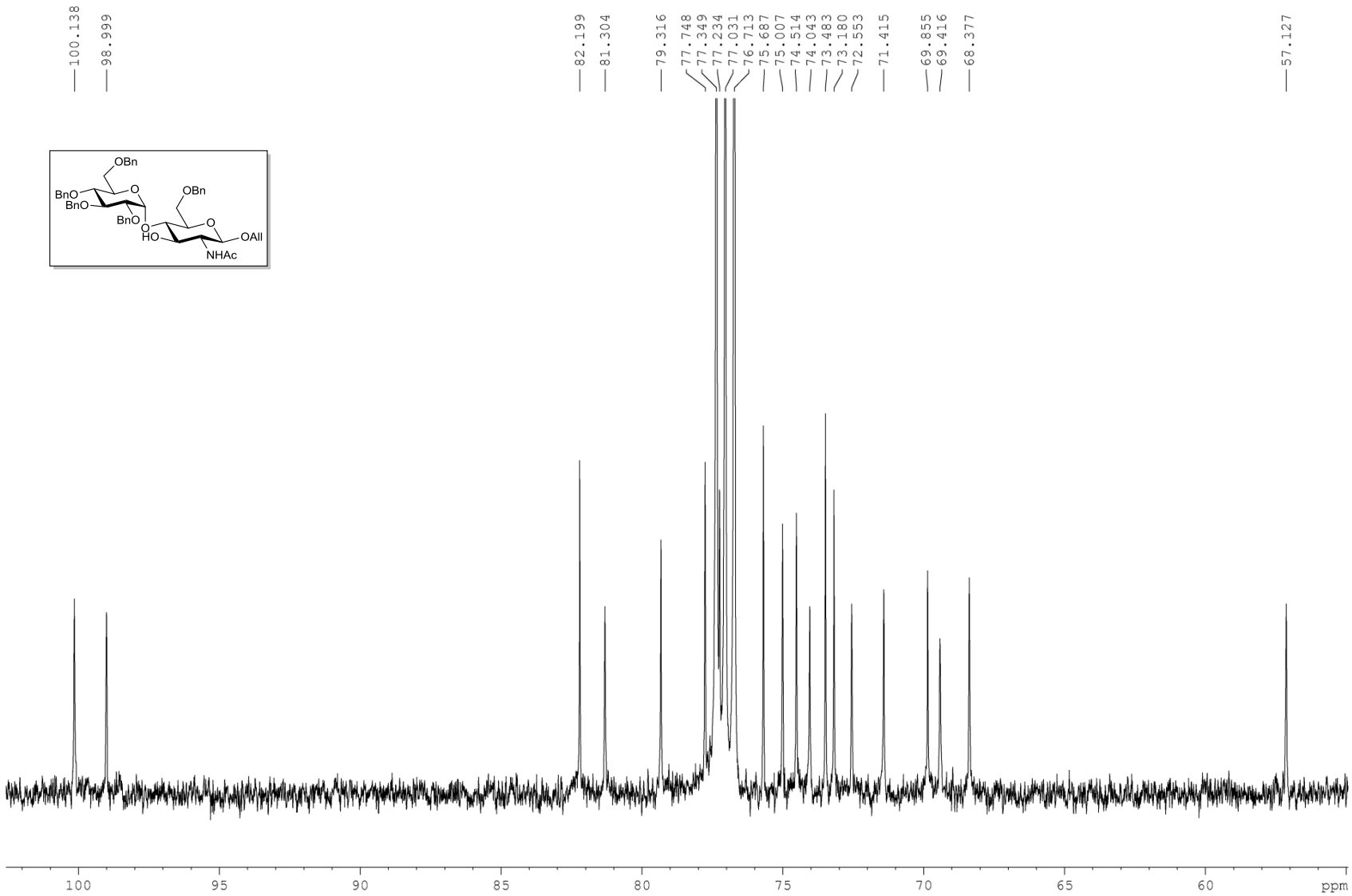
ppm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BnO
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75
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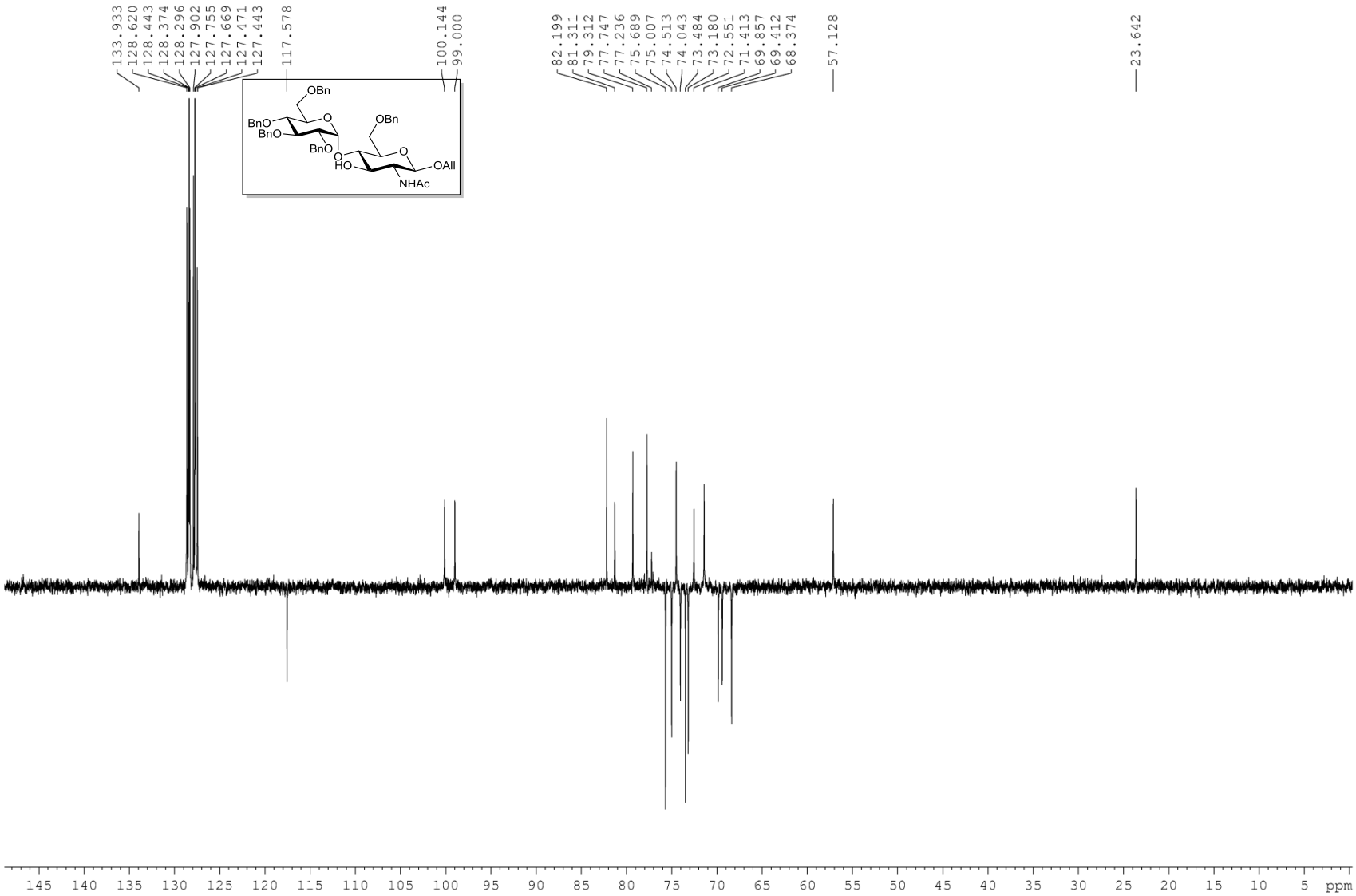
65
60
ppm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BnO
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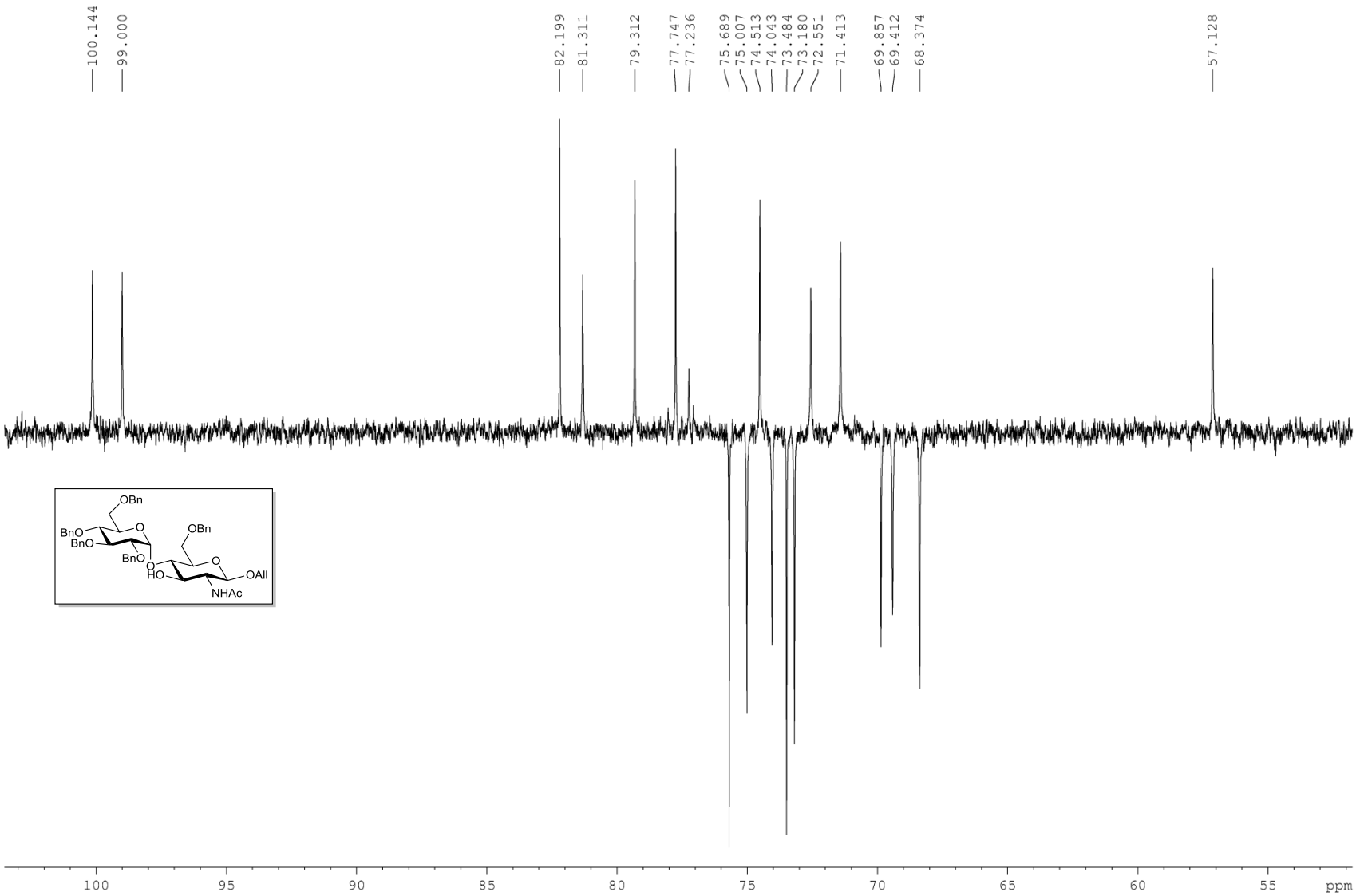
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71.413
69.857
69.412
68.374
57.128
OBn
BnO
BnO
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BnO
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80
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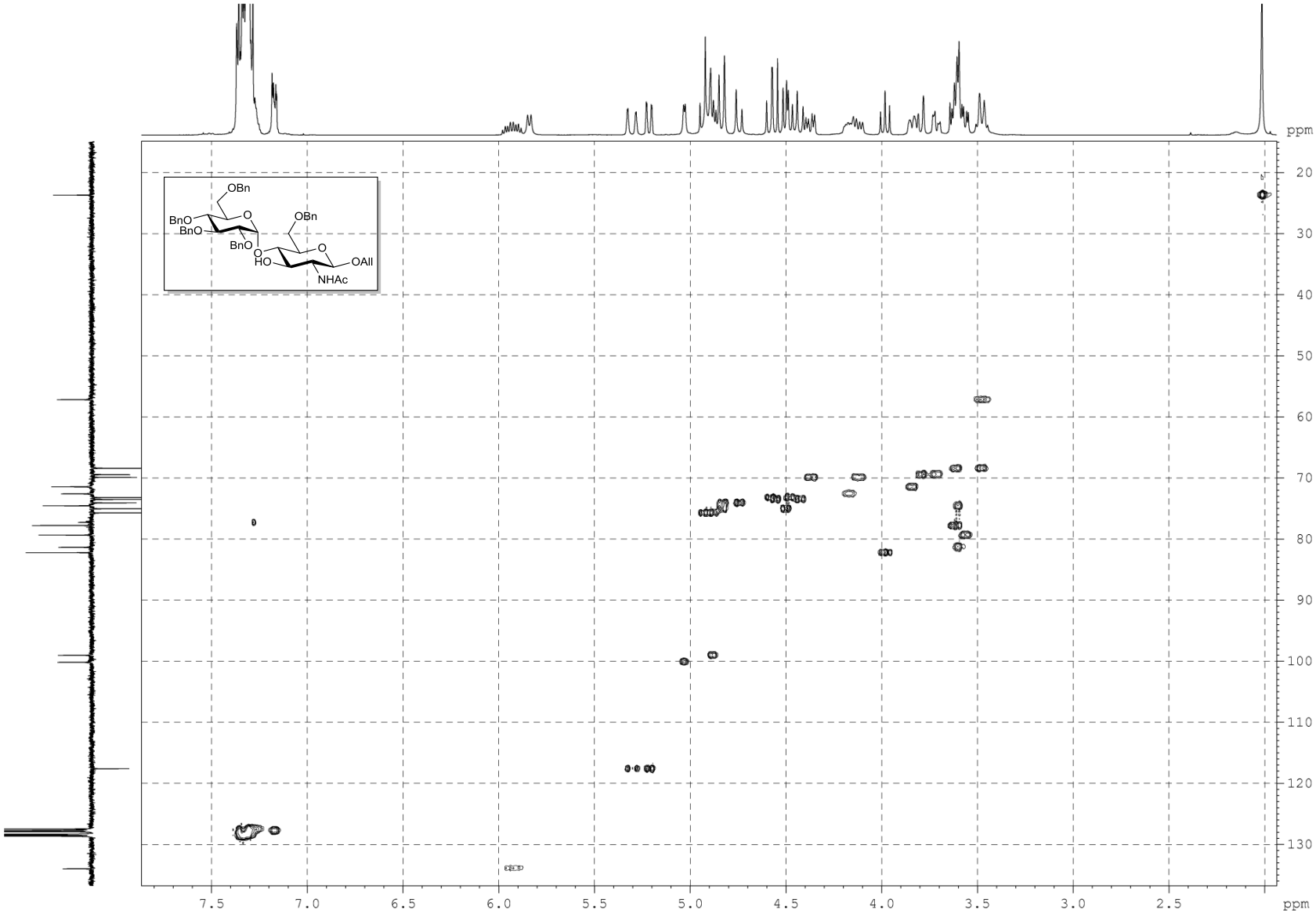
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BnO
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80
90
100
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120
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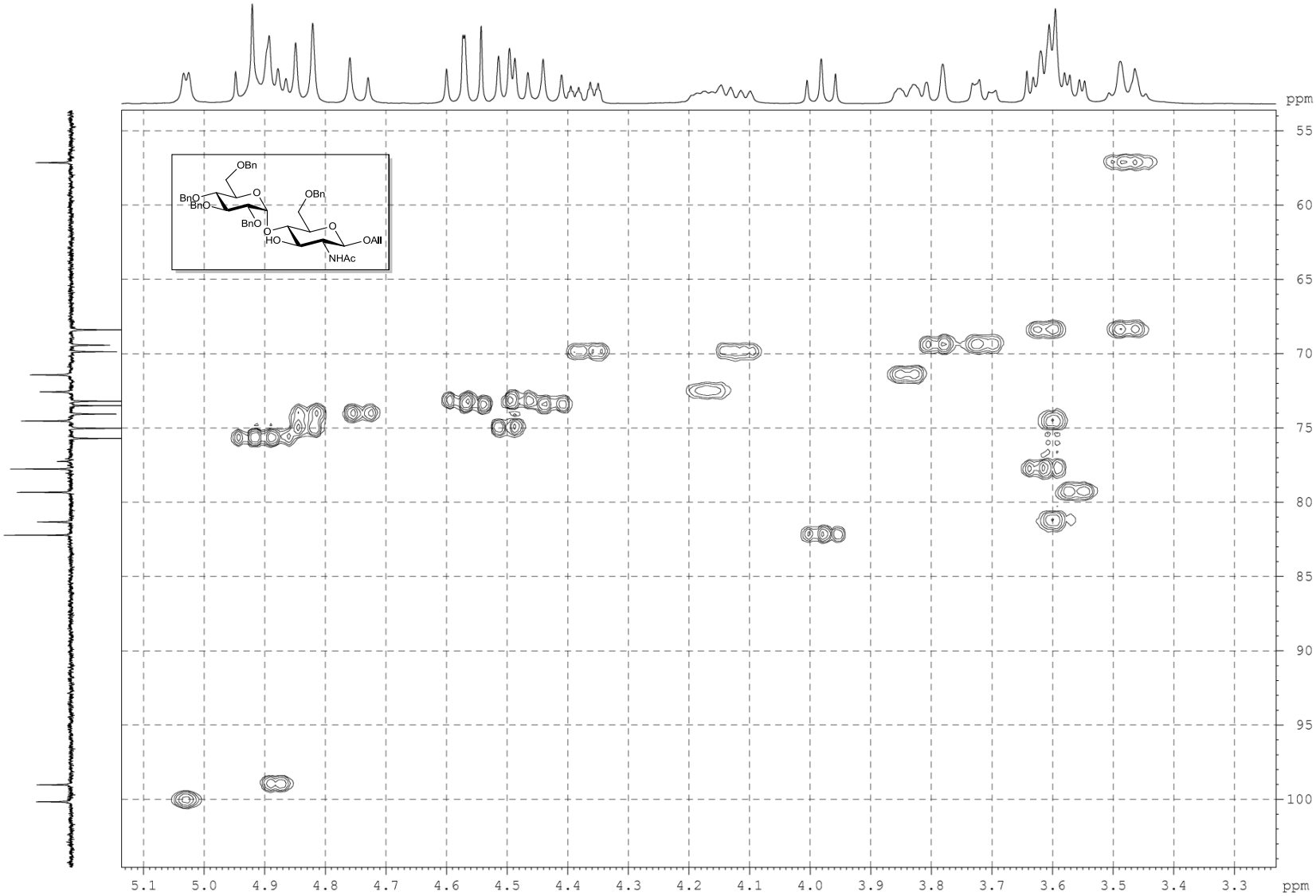
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BnO
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OBn
BnO
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O
HO
OAll
NHAc
ppm
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60
65
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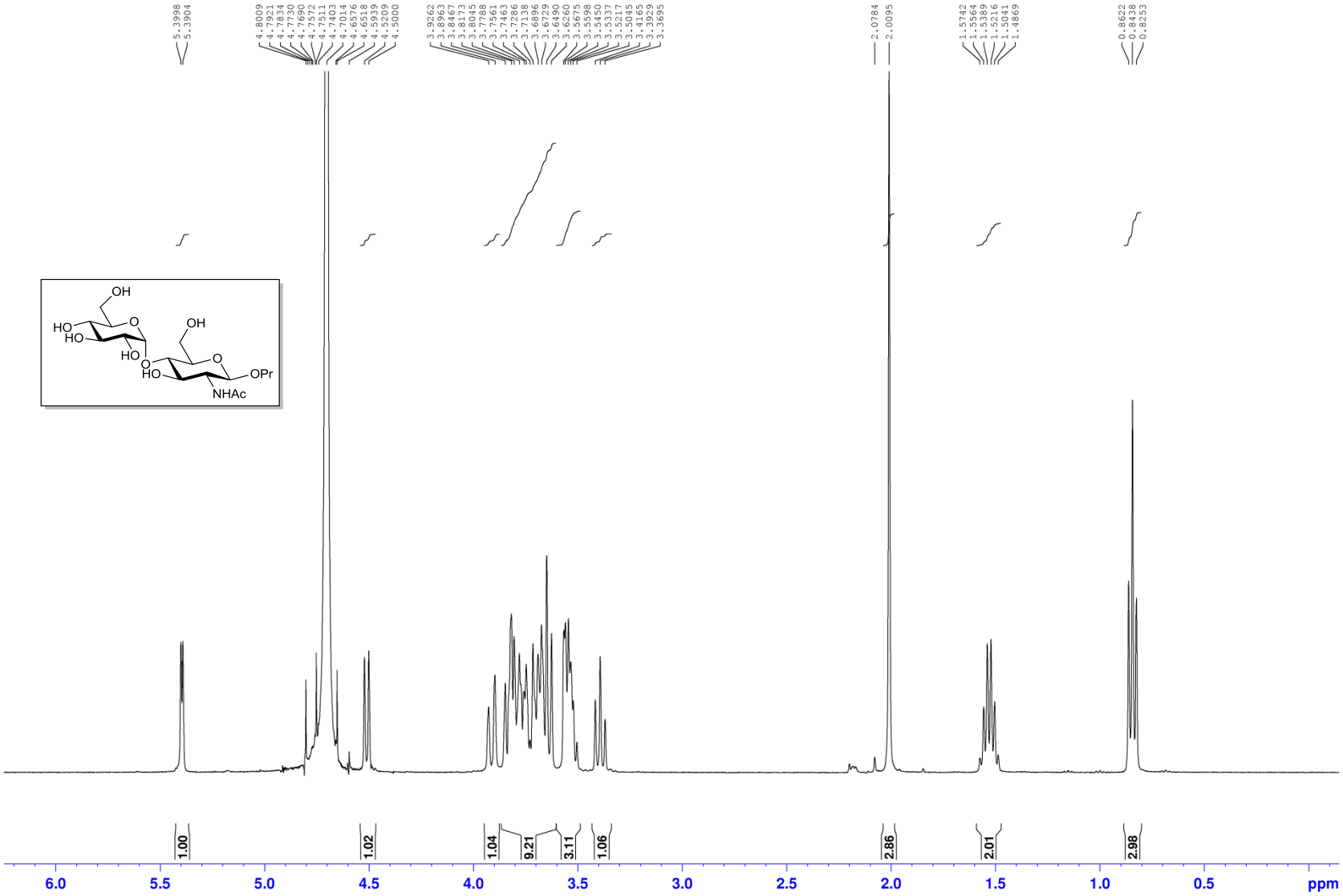
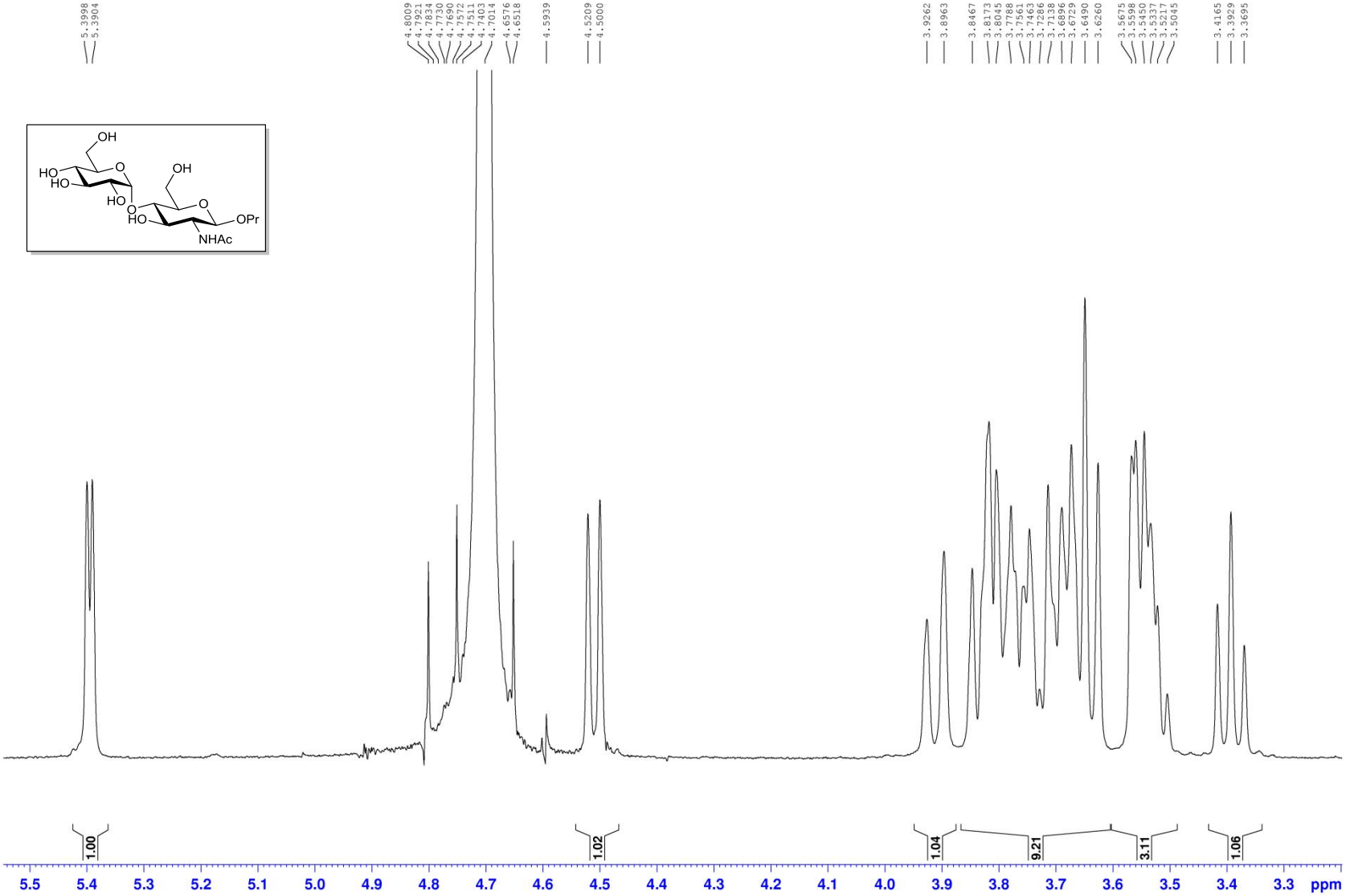
75
80
85
90
95
100
5.1
5.0
4.9
4.8
4.7
4.6
4.5
4.4
4.3
4.2
4.1
4.0
3.9
3.8
3.7
3.6
3.5
3.4
3.3
ppm

Compound 11: **Propyl α-D-glucopyranosyl-(1→4)-2-acetamido-2-deoxy-β-D-glucopyranoside**

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3.3929
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OH
HO
HO
O
HO
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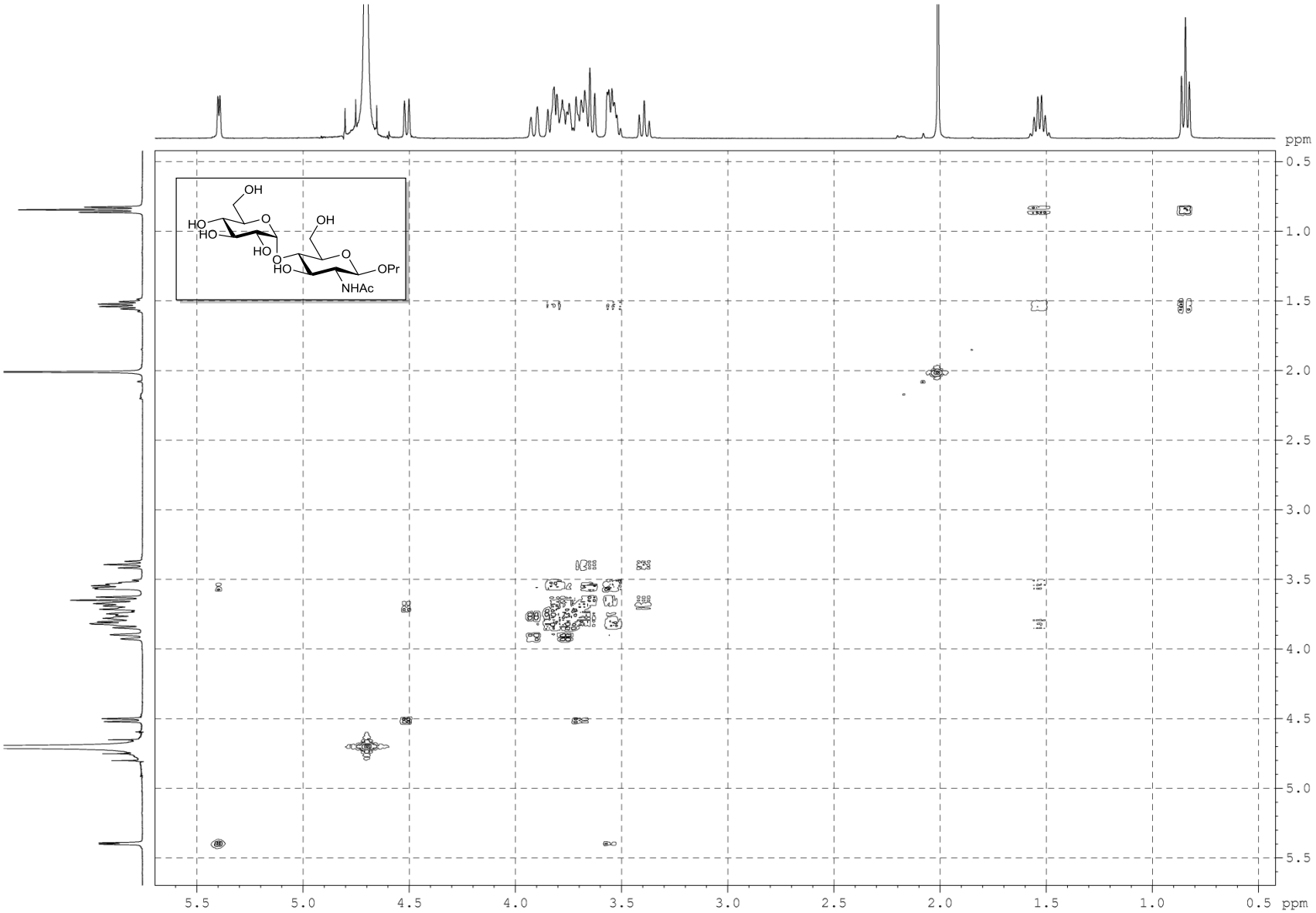
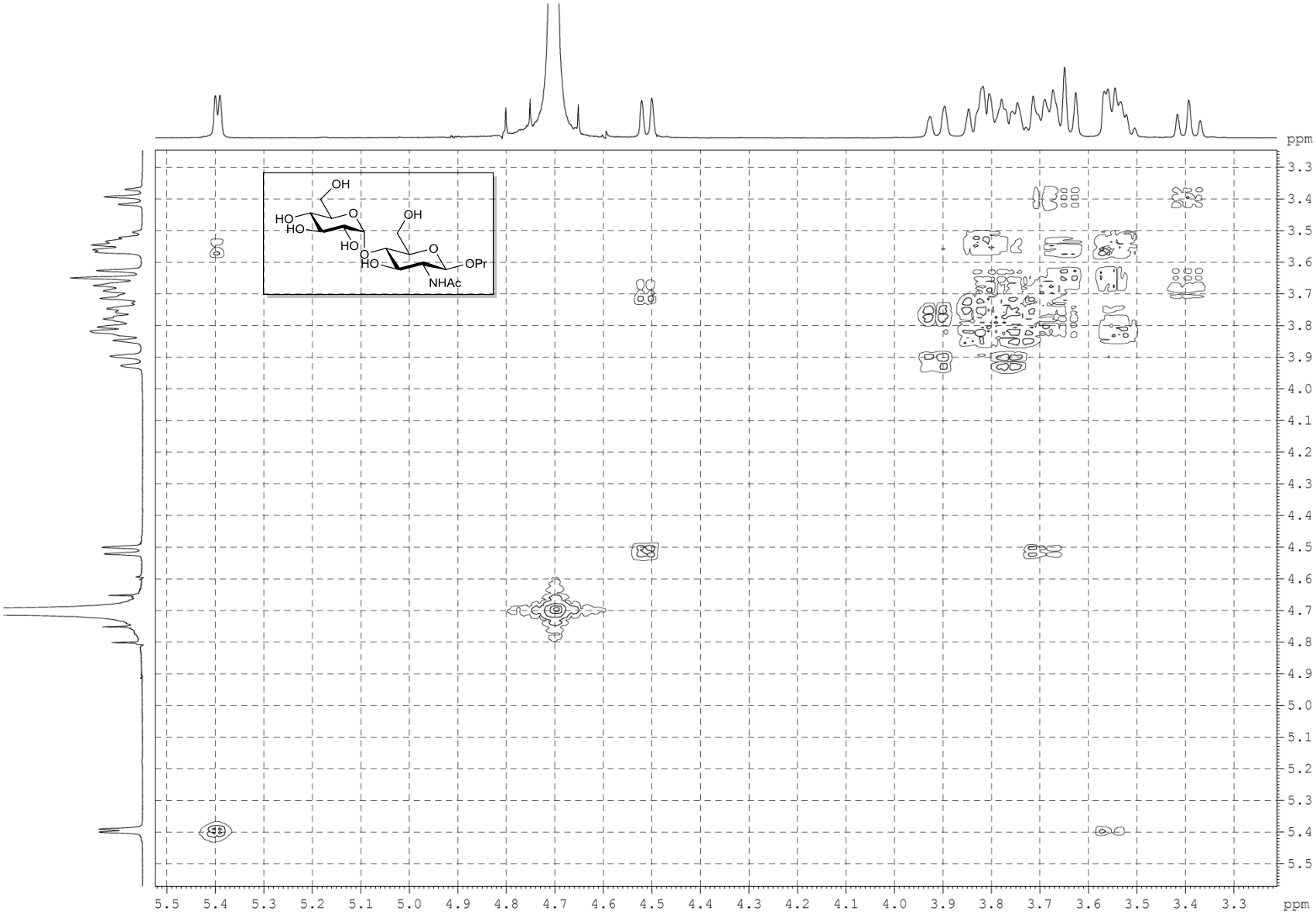
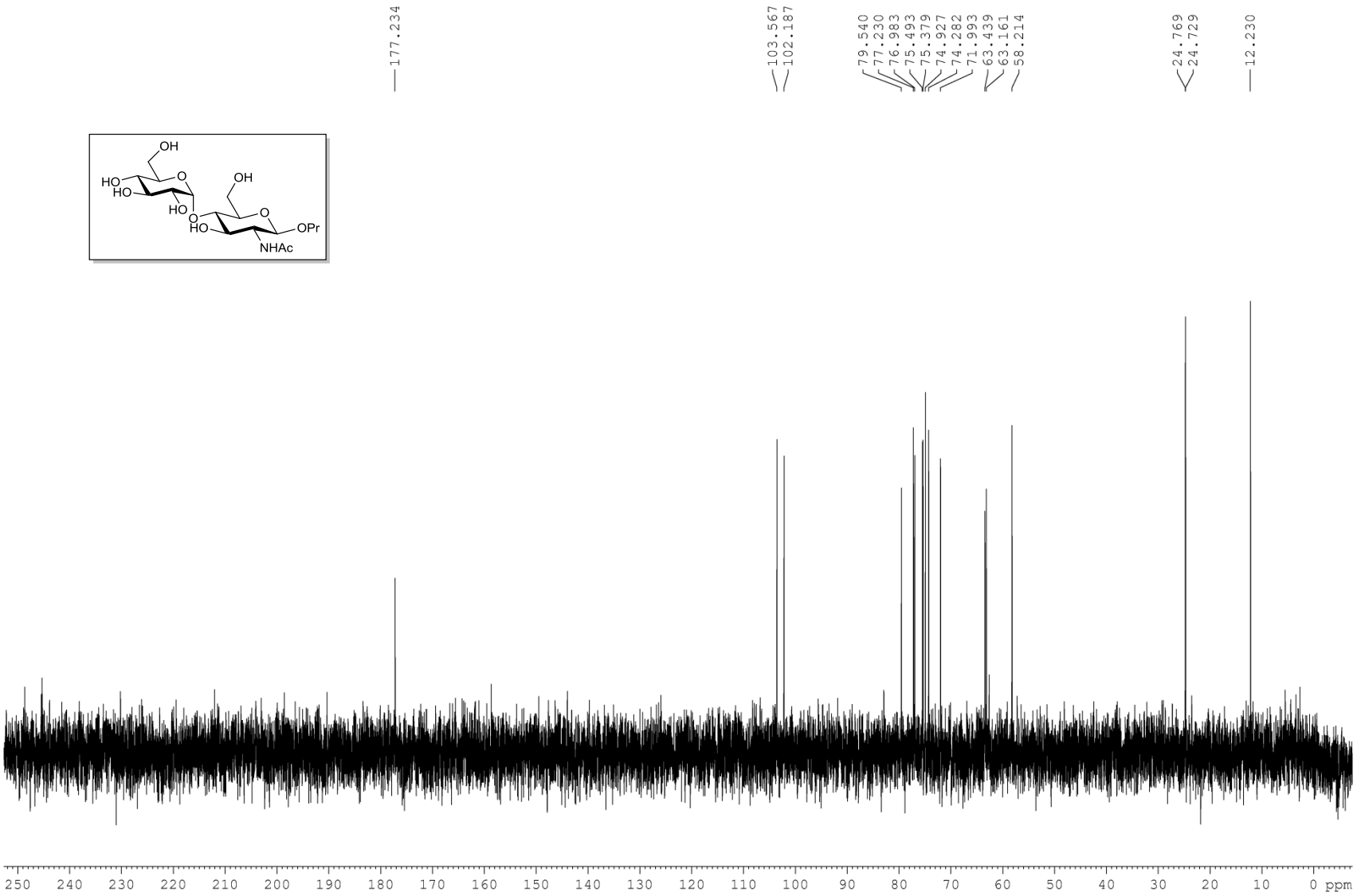
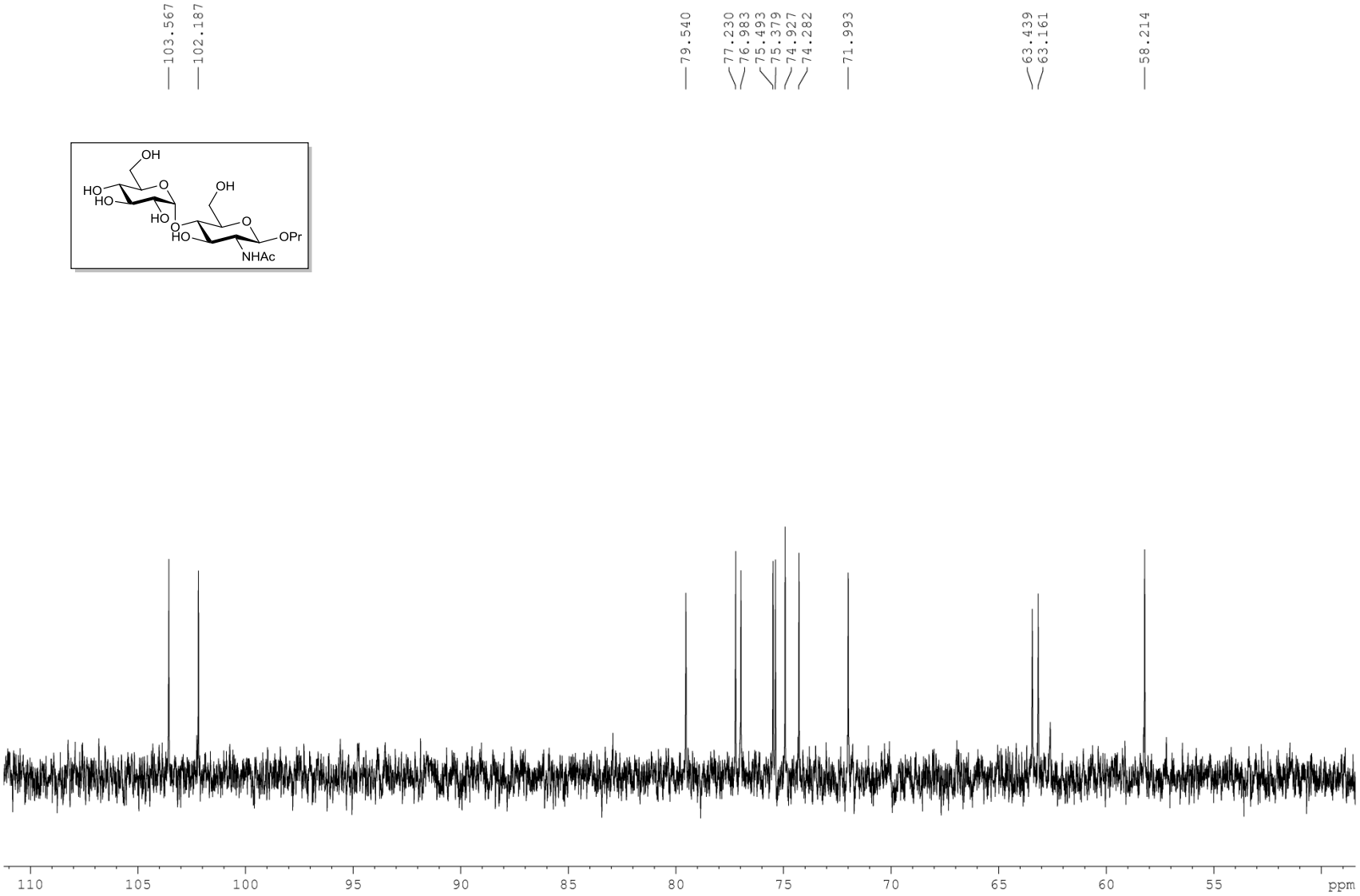
OH
O
HO
OPr
NHAc
1.00
1.02
1.04
9.21
3.11
1.06
5.5
5.4
5.3
5.2
5.1
5.0
4.9
4.8
4.7
4.6
4.5
4.4
4.3
4.2
4.1
4.0
3.9
3.8
3.7
3.6
3.5
3.4
3.3
ppm

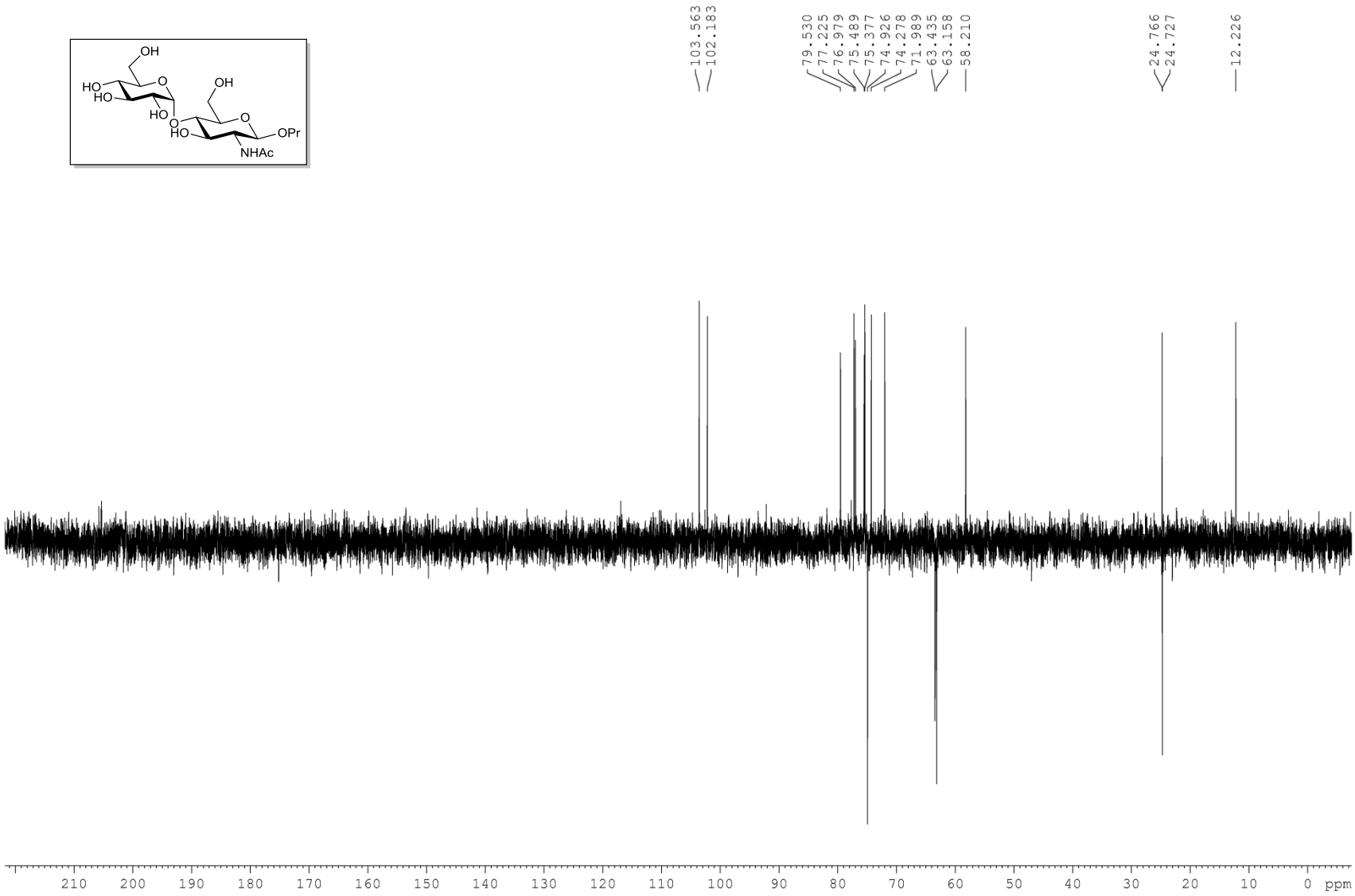

OH
HO
HO
O
HO
O
OH
O
HO
OPr
NHAc
ppm
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
5.5
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
ppm

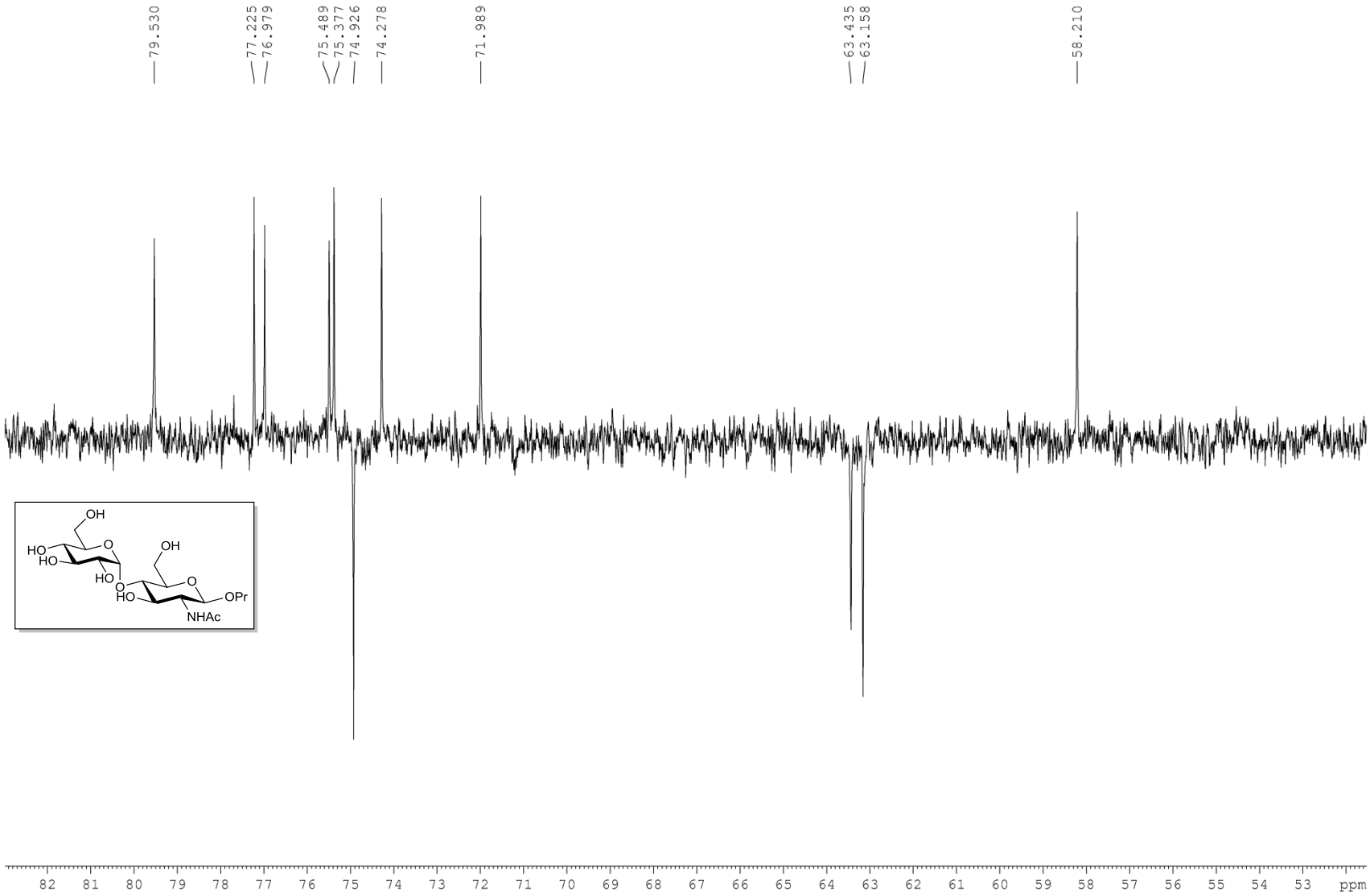

OH
HO
HO
O
OH
HO
O
O
HO
OPr
NHAc
ppm
5.5 5.4 5.3 5.2 5.1 5.0 4.9 4.8 4.7 4.6 4.5 4.4 4.3 4.2 4.1 4.0 3.9 3.8 3.7 3.6 3.5 3.4 3.3
ppm

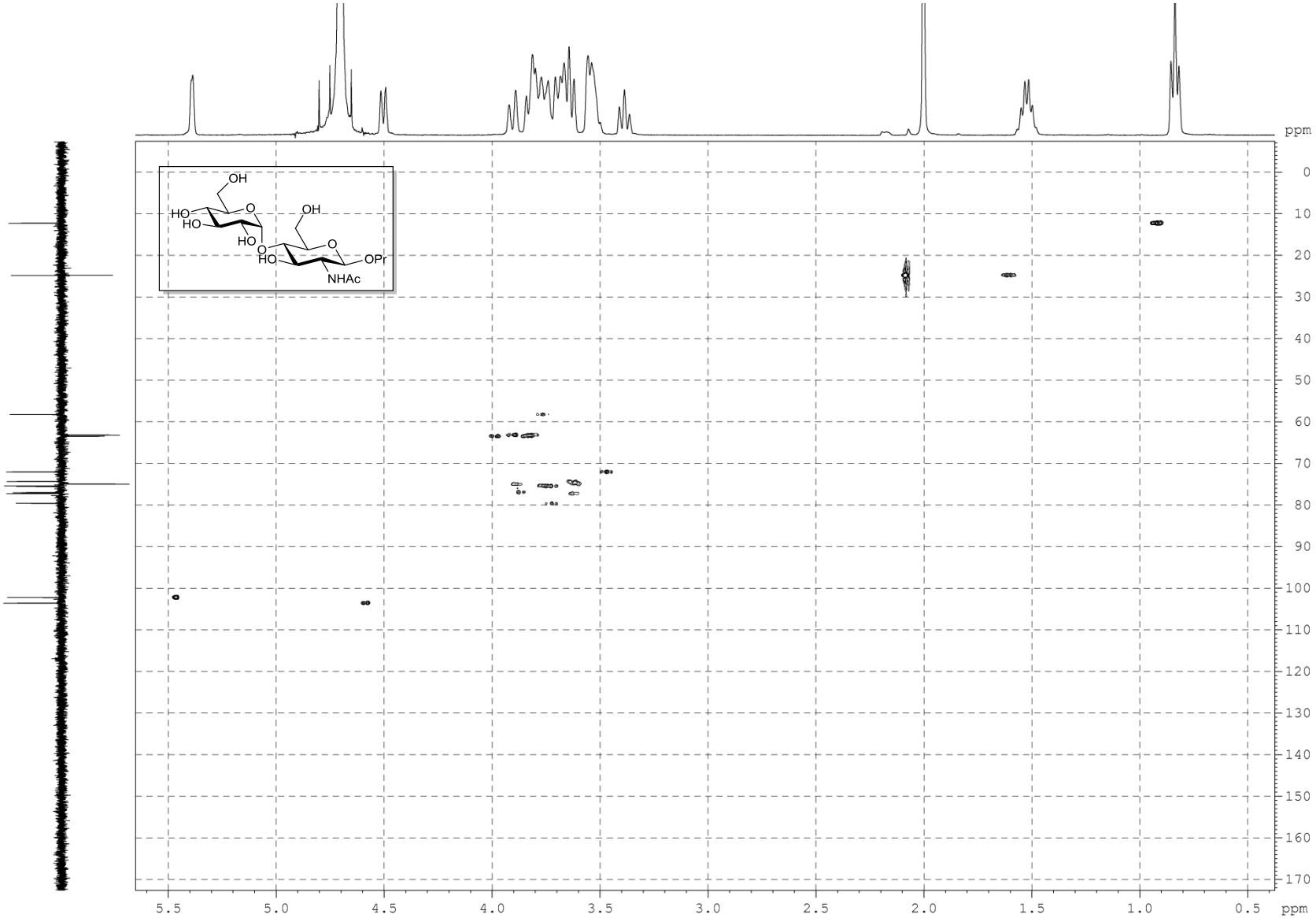

177.234
103.567
102.187
79.540
77.230
76.983
75.493
75.379
74.927
74.282
71.993
63.439
63.161
58.214
24.769
24.729
12.230
OH
HO
HO
O
OH
HO
O
O
HO
OPr
NHAc
250 240 230 220 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 ppm

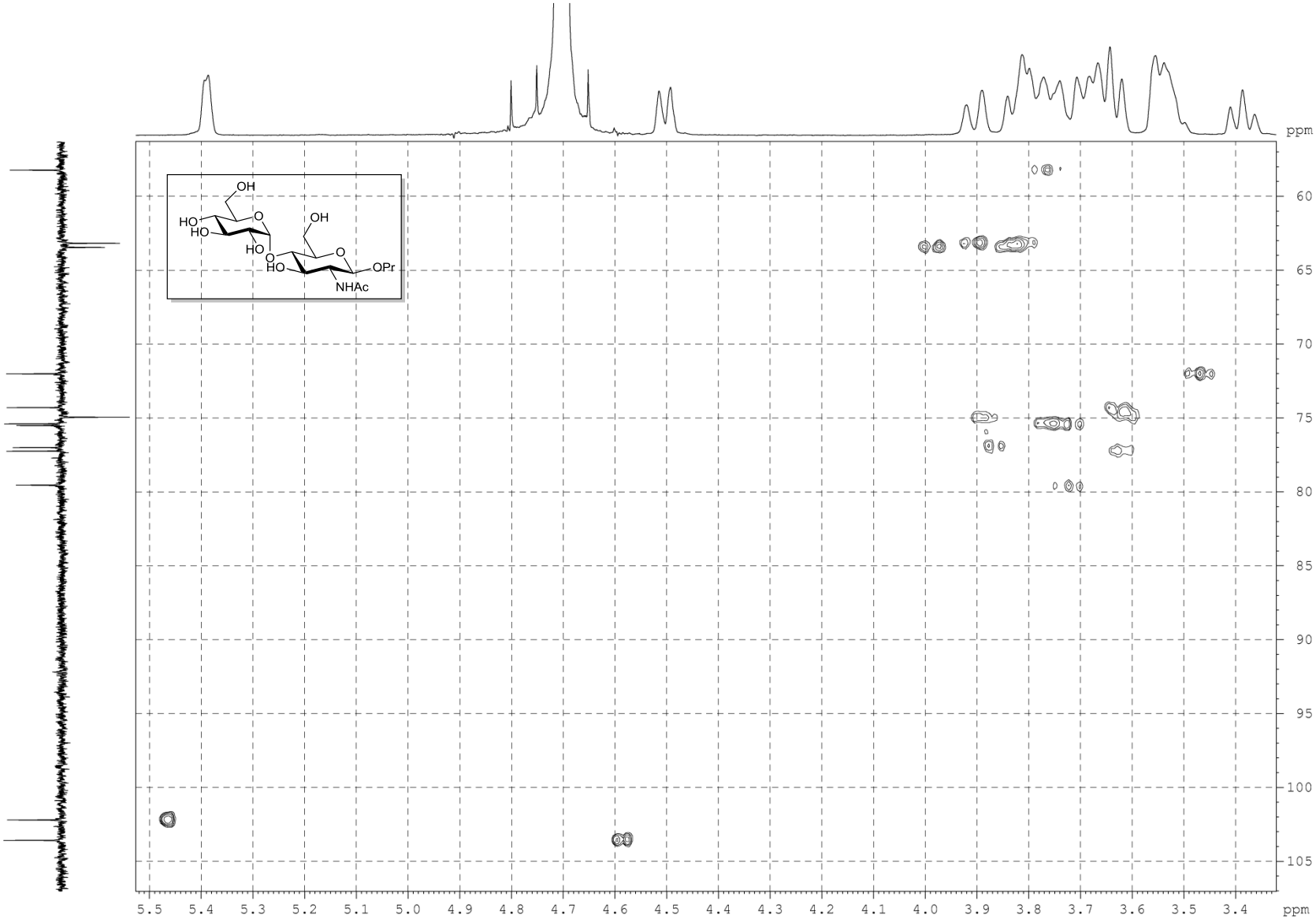

103.567
102.187
79.540
77.230
76.983
75.493
75.379
74.927
74.282
71.993
63.439
63.161
58.214
OH
HO
HO
O
HO
O
OH
O
HO
OPr
NHAc
110
105
100
95
90
85
80
75
70
65
60
55
ppm

OH
HO
HO
O
OH
HO
O
O
HO
OPr
NHAc

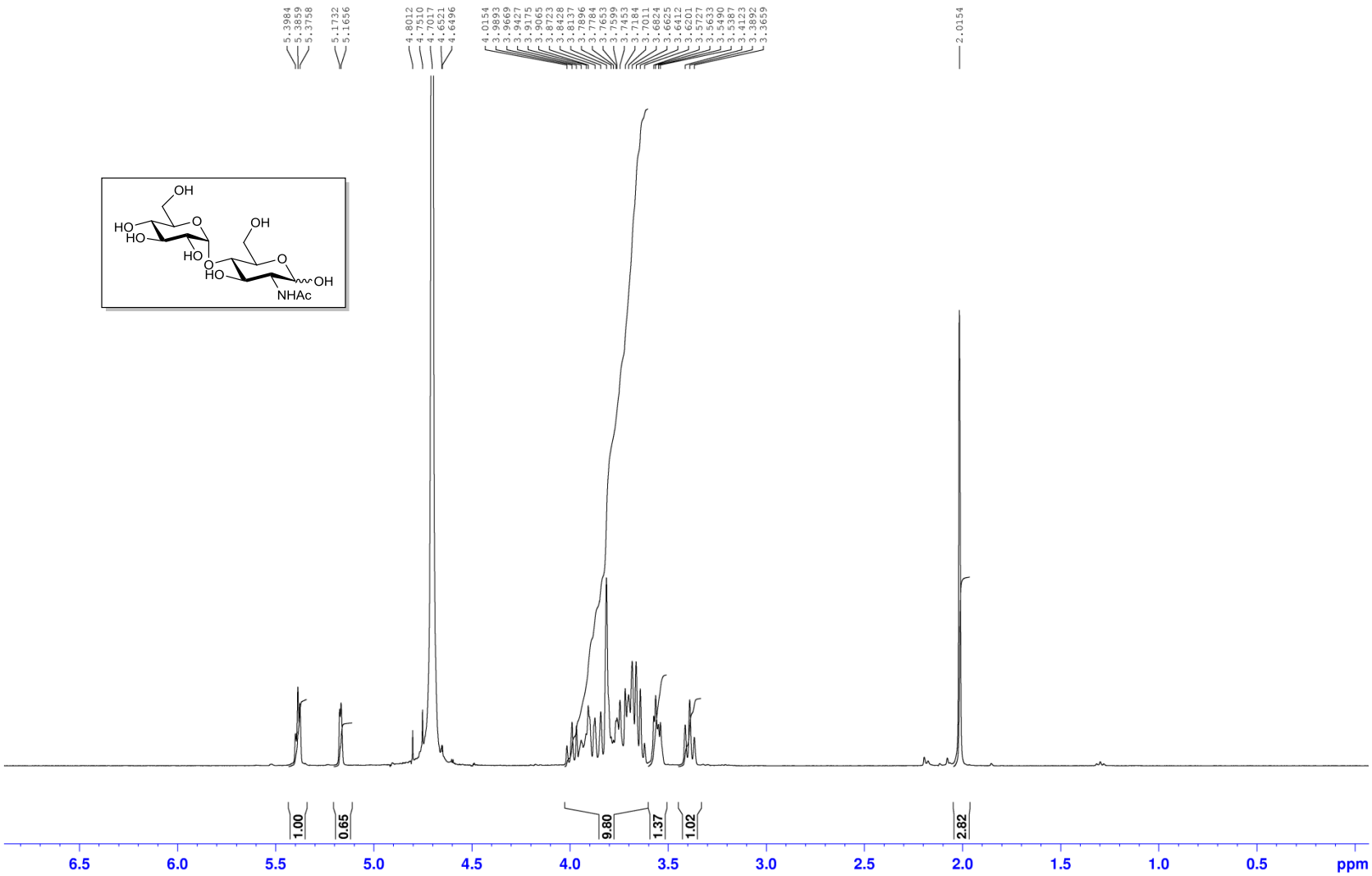

103.563
102.183
79.530
77.225
76.979
75.489
75.377
74.926
74.278
71.989
63.435
63.158
58.210
24.766
24.727
12.226
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 ppm

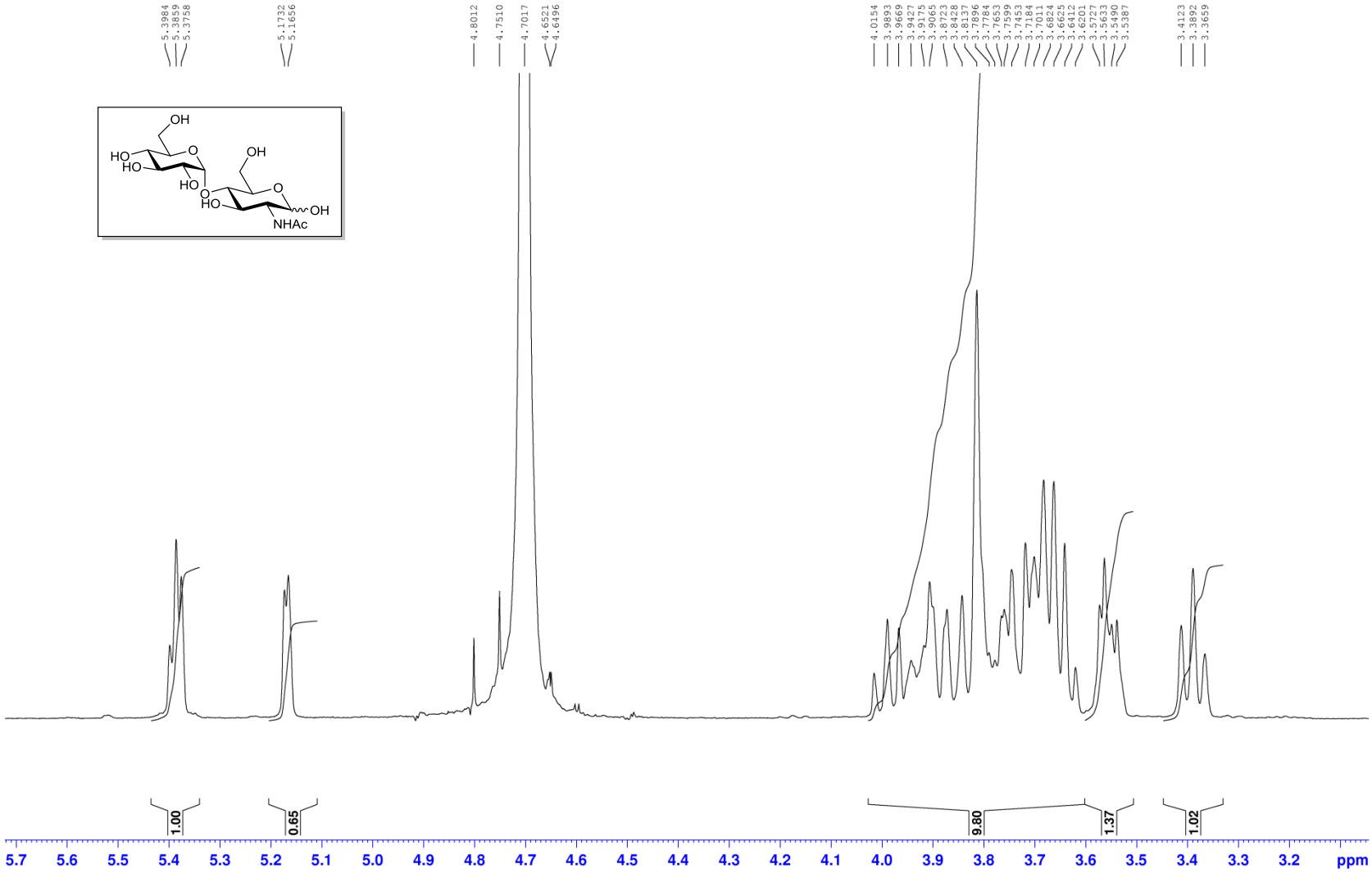

79.530
77.225
76.979
75.489
75.377
74.926
74.278
71.989
63.435
63.158
58.210
OH
HO
HO
O
HO
OH
O
HO
O
OPr
NHAc
82 81 80 79 78 77 76 75 74 73 72 71 70 69 68 67 66 65 64 63 62 61 60 59 58 57 56 55 54 53 ppm

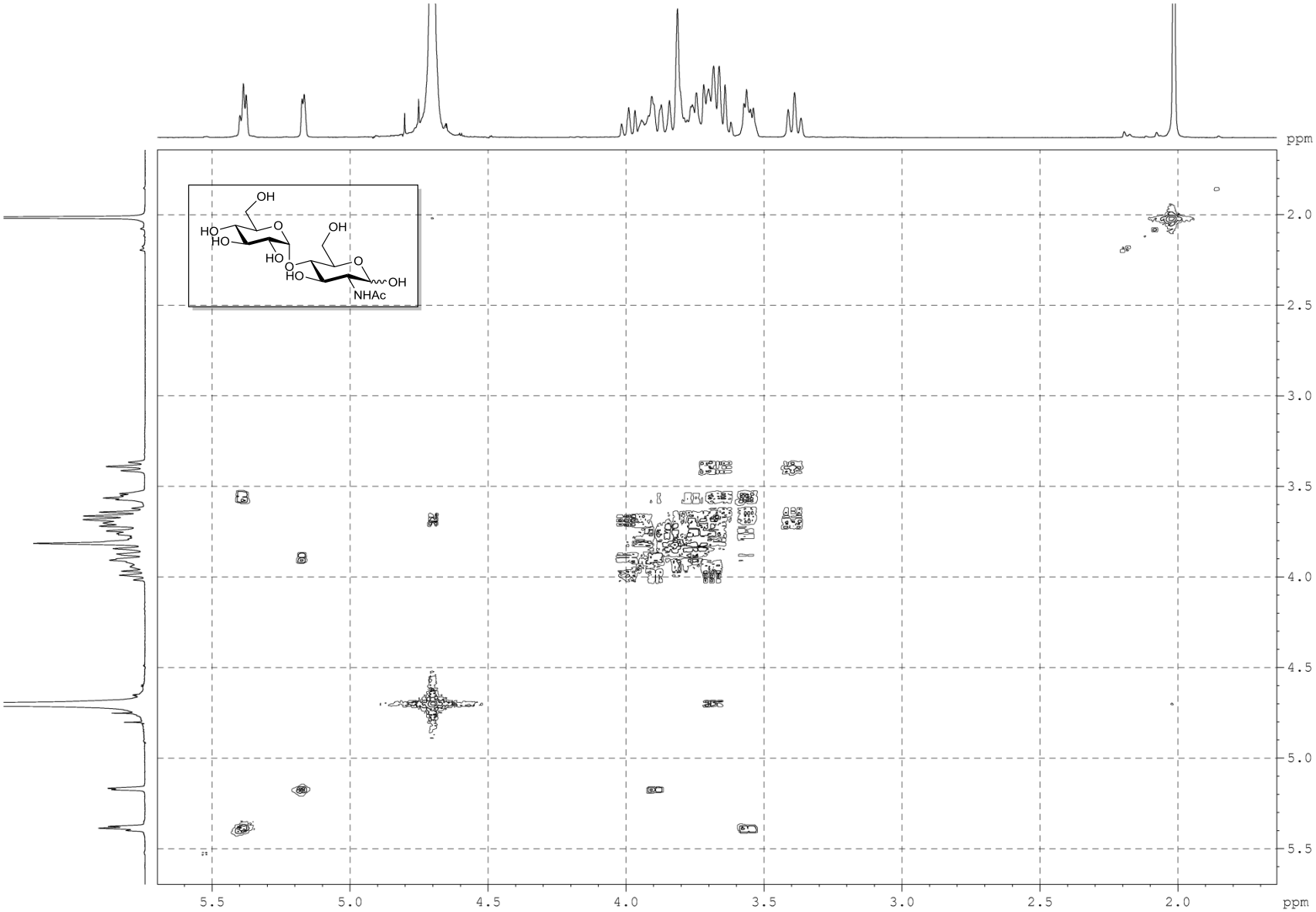

OH
HO
HO
O
HO
O
OH
O
HO
OPr
NHAc
ppm
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
ppm

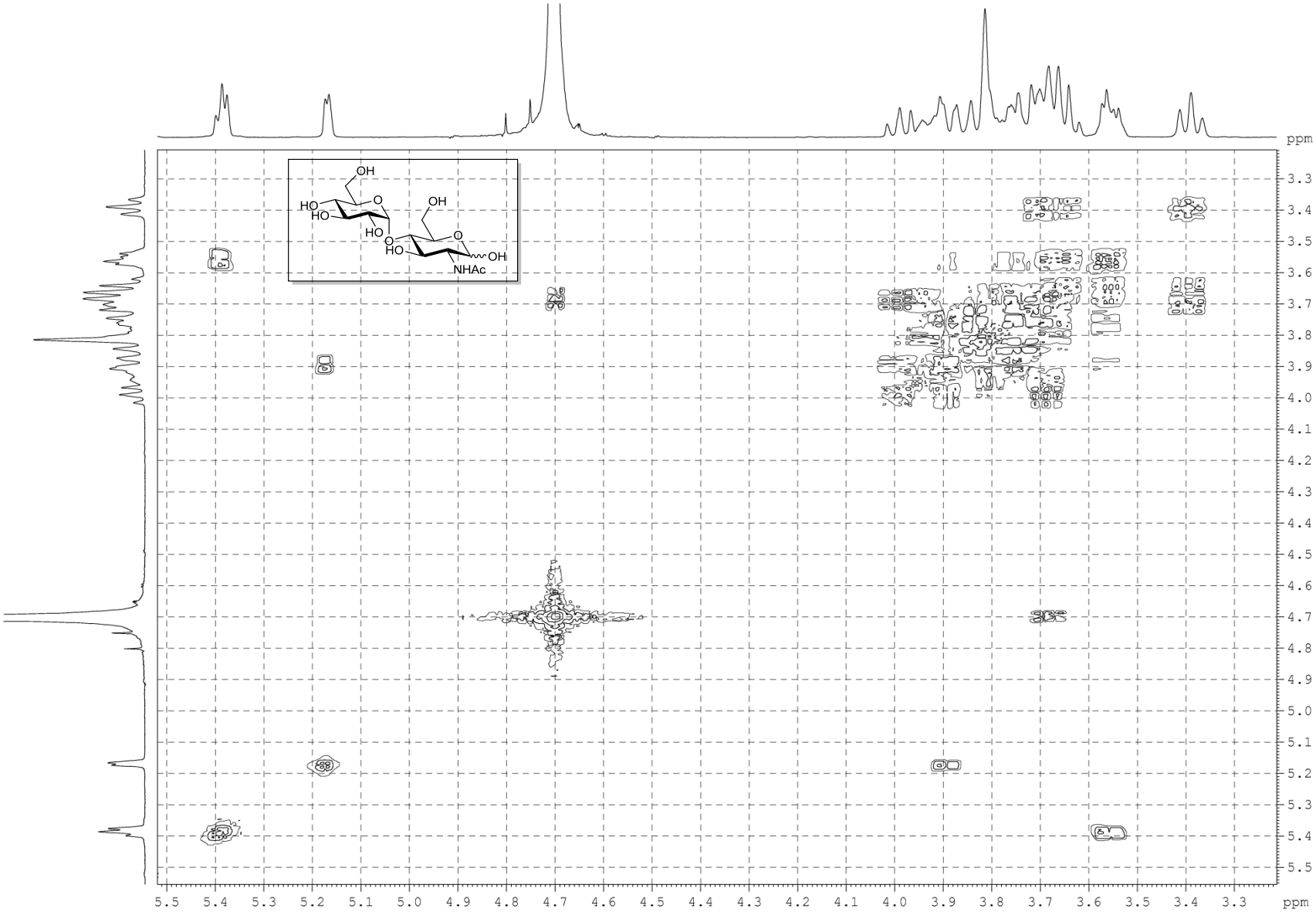

OH
HO
HO
O
HO
O
OH
O
HO
OPr
NHAc
ppm
60
65
70
75
80
85
90
95
100
105
5.5
5.4
5.3
5.2
5.1
5.0
4.9
4.8
4.7
4.6
4.5
4.4
4.3
4.2
4.1
4.0
3.9
3.8
3.7
3.6
3.5
3.4
ppm

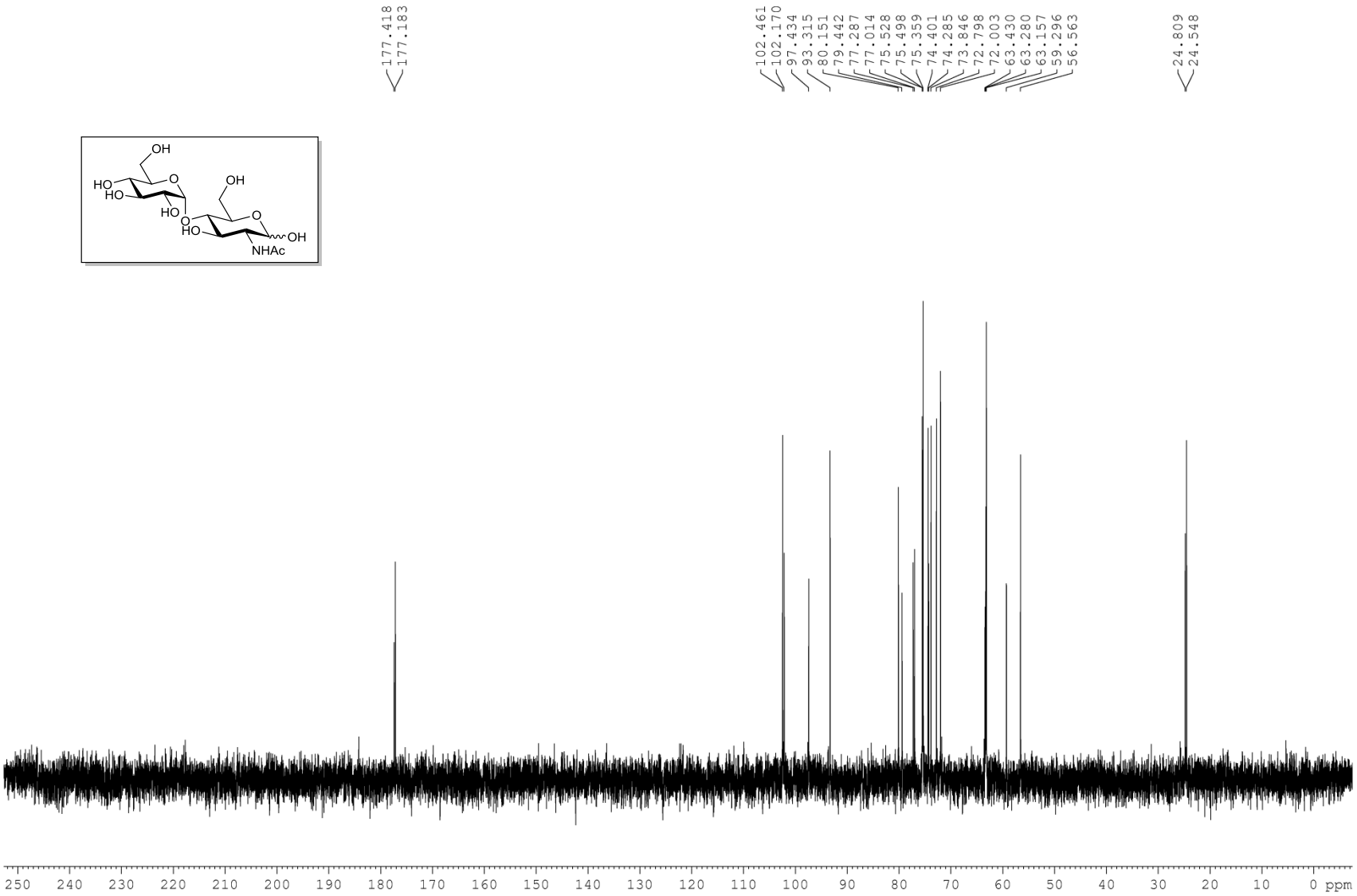
Compound 12: **α-D-glucopyranosyl-(1→4)-2-acetamido-2-deoxy-α/β-D-glucopyranose**

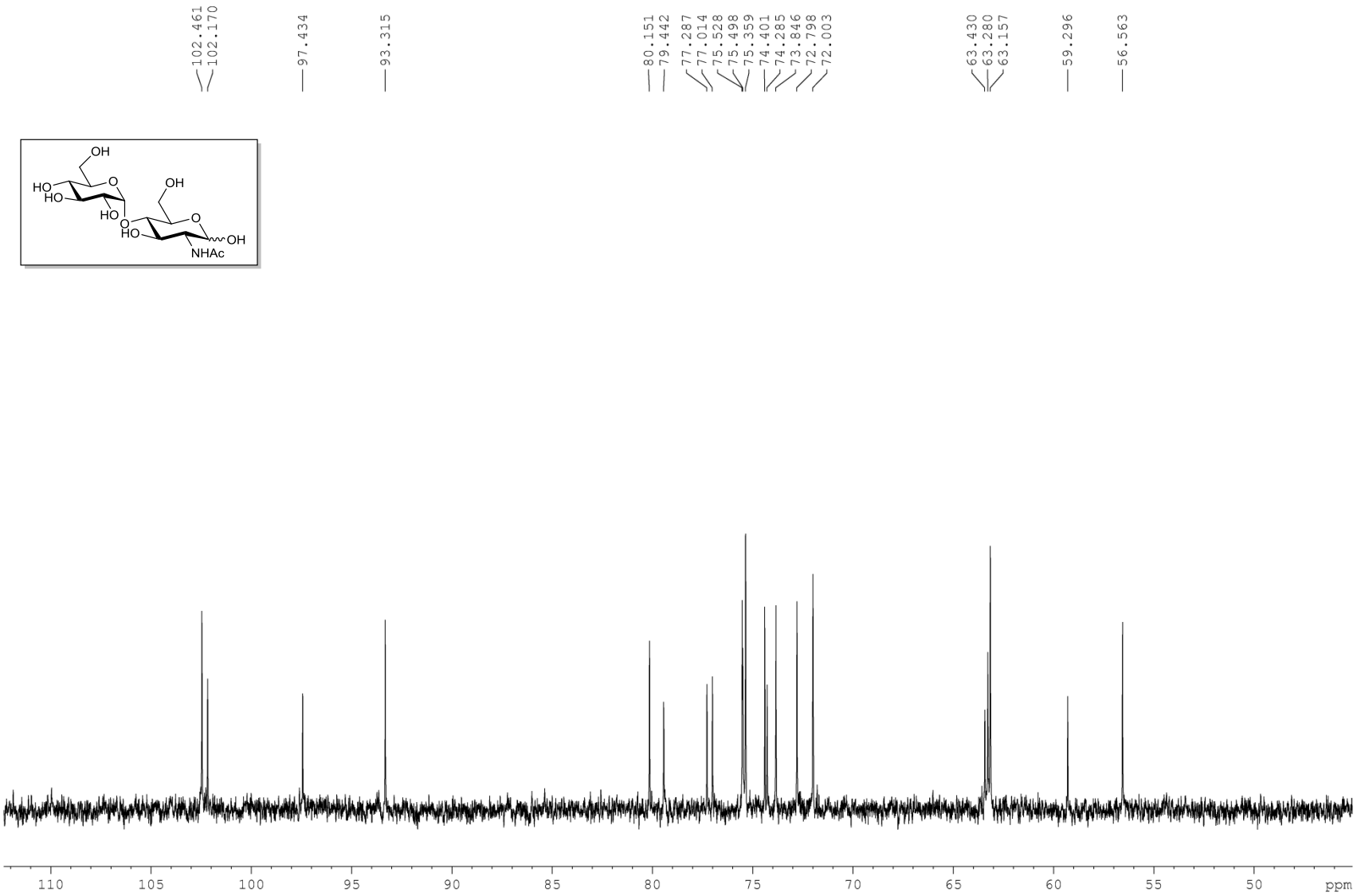


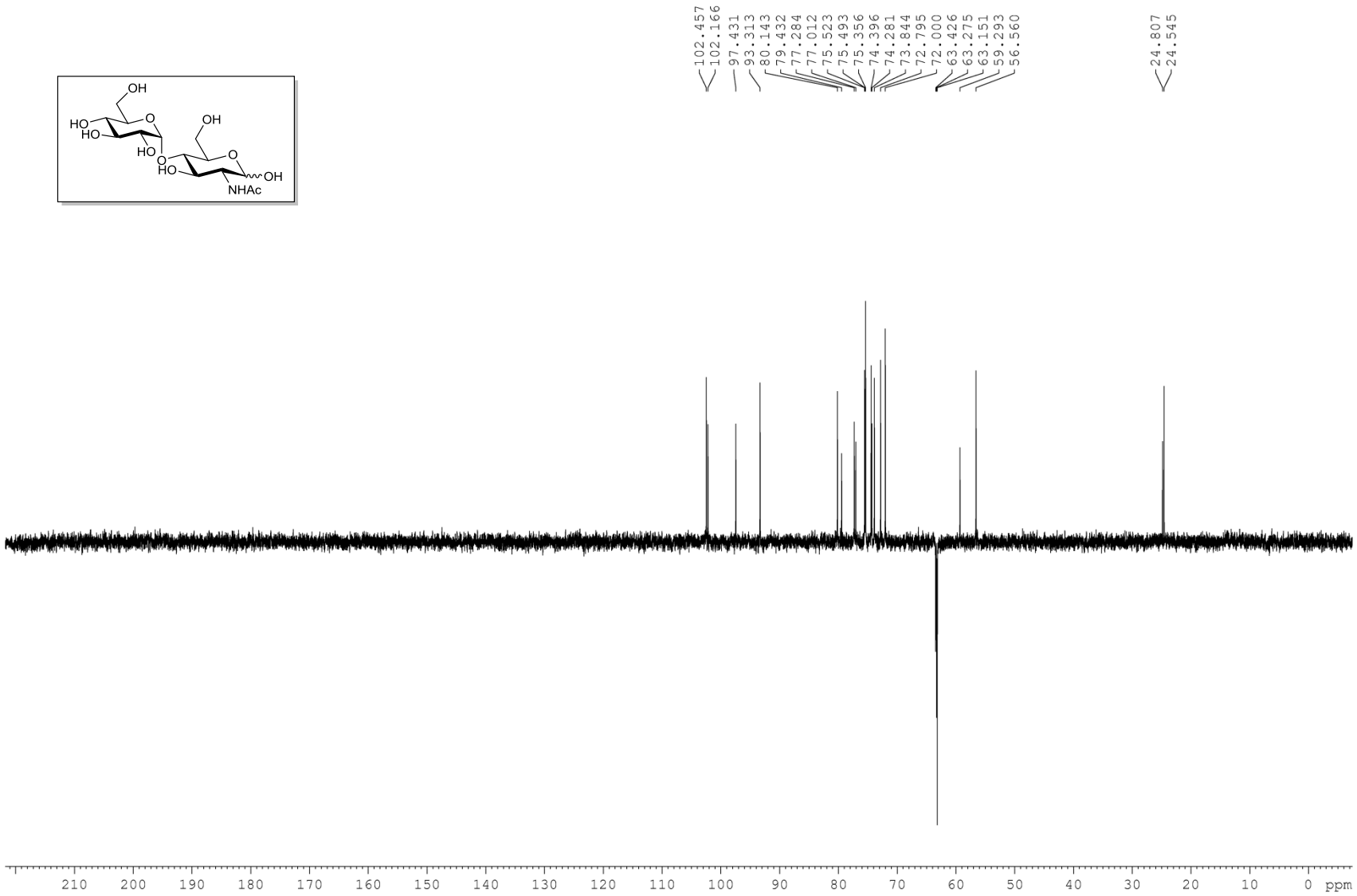

5.3984
5.3859
5.3758
5.1732
5.1656
4.8012
4.7510
4.7017
4.6521
4.6496
4.0154
3.9893
3.9669
3.9427
3.9175
3.9065
3.8723
3.8428
3.8137
3.7896
3.7784
3.7653
3.7599
3.7453
3.7184
3.7011
3.6824
3.6625
3.6412
3.6201
3.5727
3.5633
3.5490
3.5387
3.4123
3.3892
3.3659
OH
HO
HO
O
OH
HO
O
HO
O
OH
NHAc
1.00
0.65
9.80
1.37
1.02
5.7 5.6 5.5 5.4 5.3 5.2 5.1 5.0 4.9 4.8 4.7 4.6 4.5 4.4 4.3 4.2 4.1 4.0 3.9 3.8 3.7 3.6 3.5 3.4 3.3 3.2 ppm

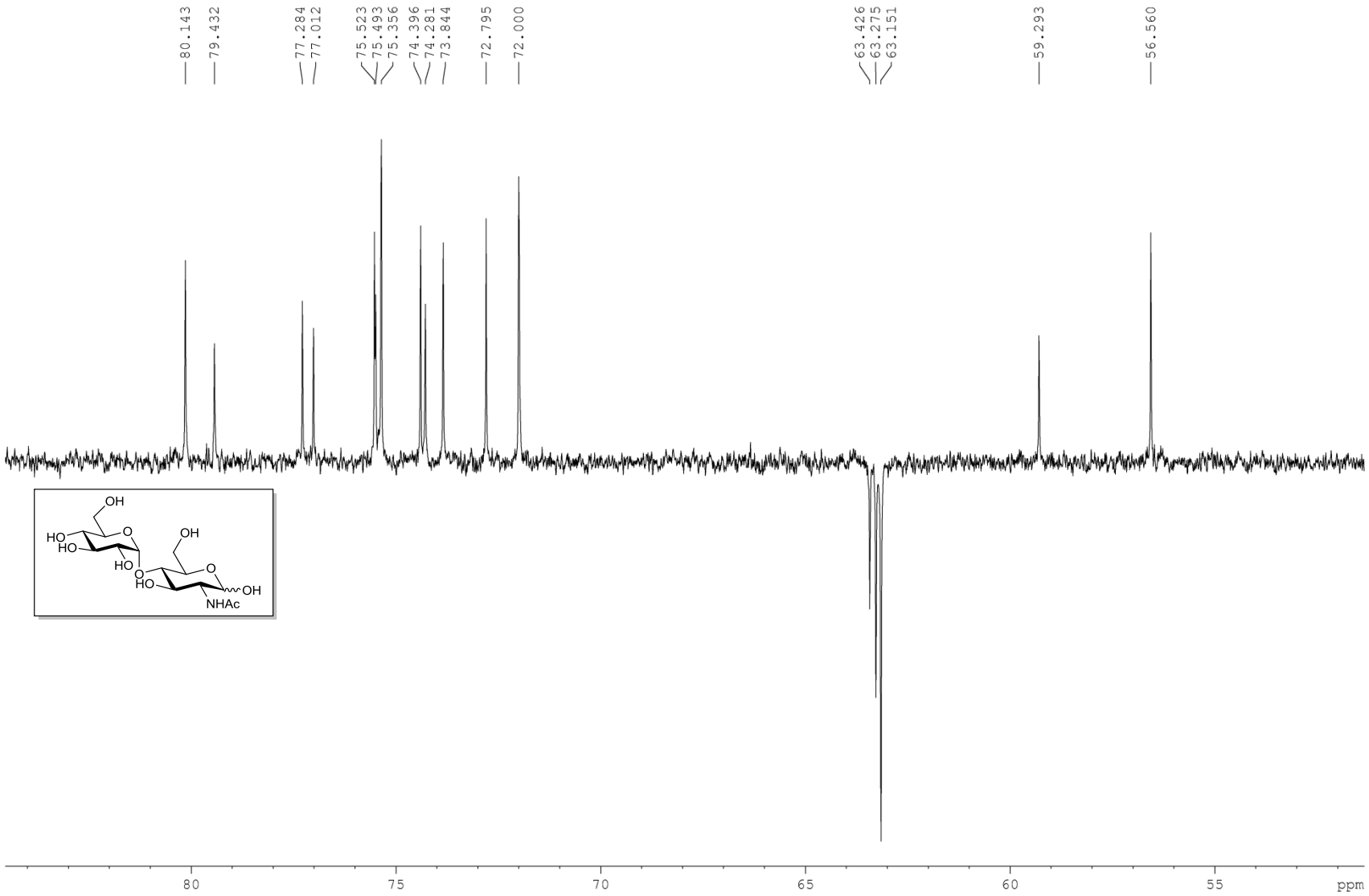

OH
HO
HO
O
HO
O
OH
HO
O
OH
NHAc
ppm
2.0
2.5
3.0
3.5
4.0
4.5
5.0
5.5
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
ppm

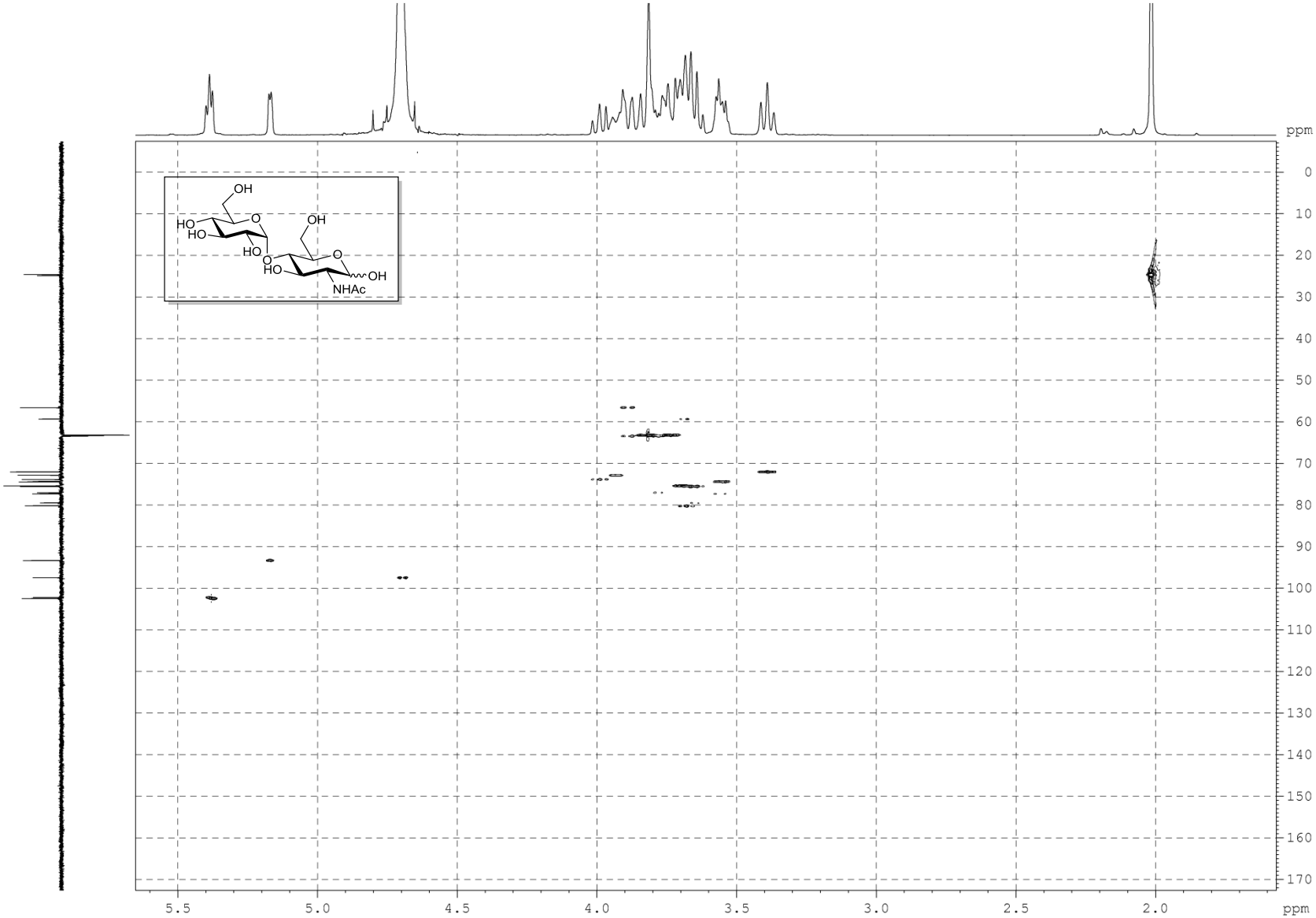

OH
HO
HO
O
OH
HO
O
O
HO
OH
NHAc
ppm
5.5 5.4 5.3 5.2 5.1 5.0 4.9 4.8 4.7 4.6 4.5 4.4 4.3 4.2 4.1 4.0 3.9 3.8 3.7 3.6 3.5 3.4 3.3
ppm
3.3 3.4 3.5 3.6 3.7 3.8 3.9 4.0 4.1 4.2 4.3 4.4 4.5 4.6 4.7 4.8 4.9 5.0 5.1 5.2 5.3 5.4 5.5

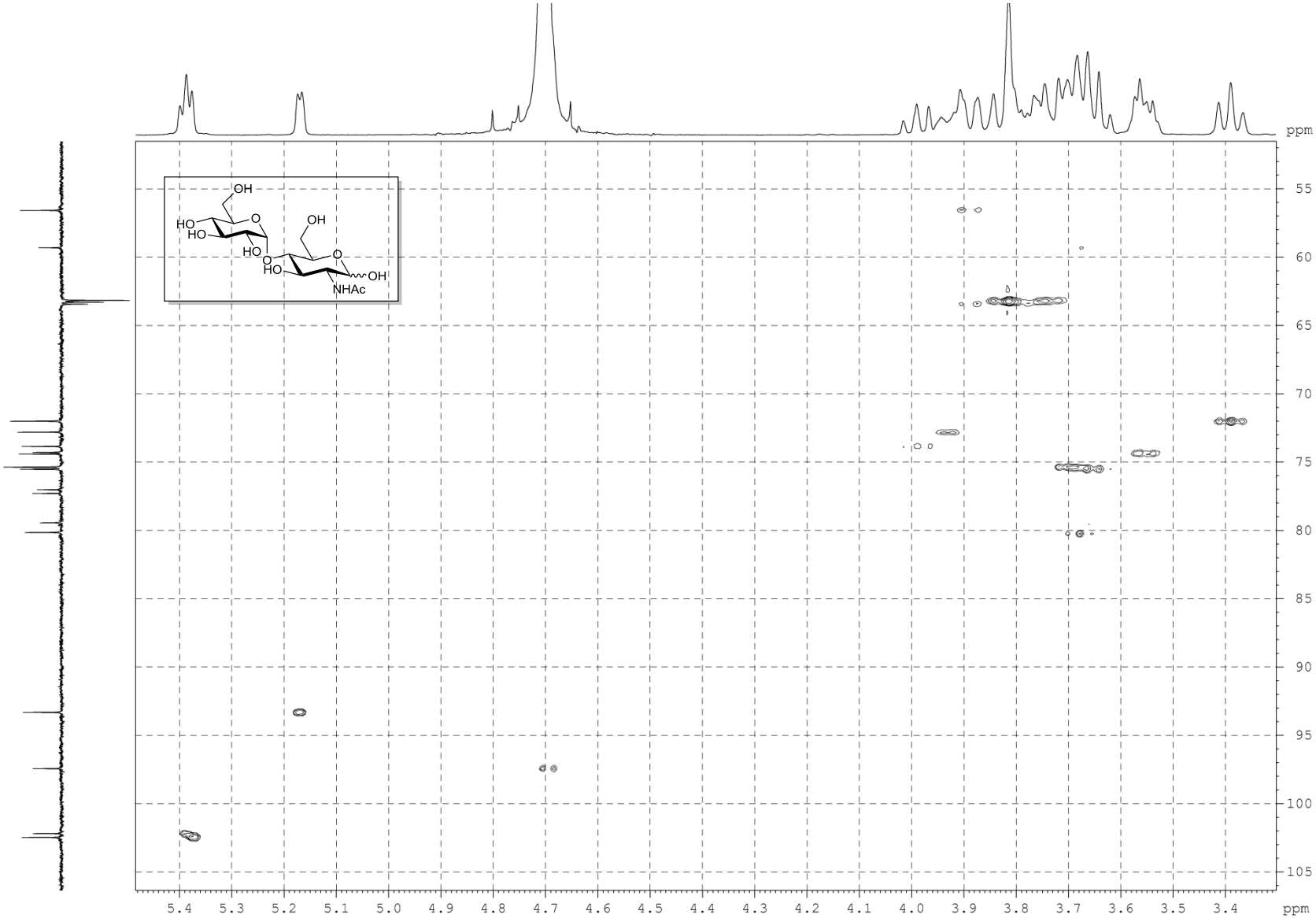

177.418
177.183
102.461
102.170
97.434
93.315
80.151
79.442
77.287
77.014
75.528
75.498
75.359
74.401
74.285
73.846
72.798
72.003
63.430
63.280
63.157
59.296
56.563
24.809
24.548
OH
HO
HO
O
OH
HO
O
O
HO
OH
NHAc
250 240 230 220 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 ppm


102.461
102.170
97.434
93.315
80.151
79.442
77.287
77.014
75.528
75.498
75.359
74.401
74.285
73.846
72.798
72.003
63.430
63.280
63.157
59.296
56.563
OH
HO
HO
O
OH
HO
O
O
HO
OH
NHAc
110
105
100
95
90
85
80
75
70
65
60
55
50
ppm

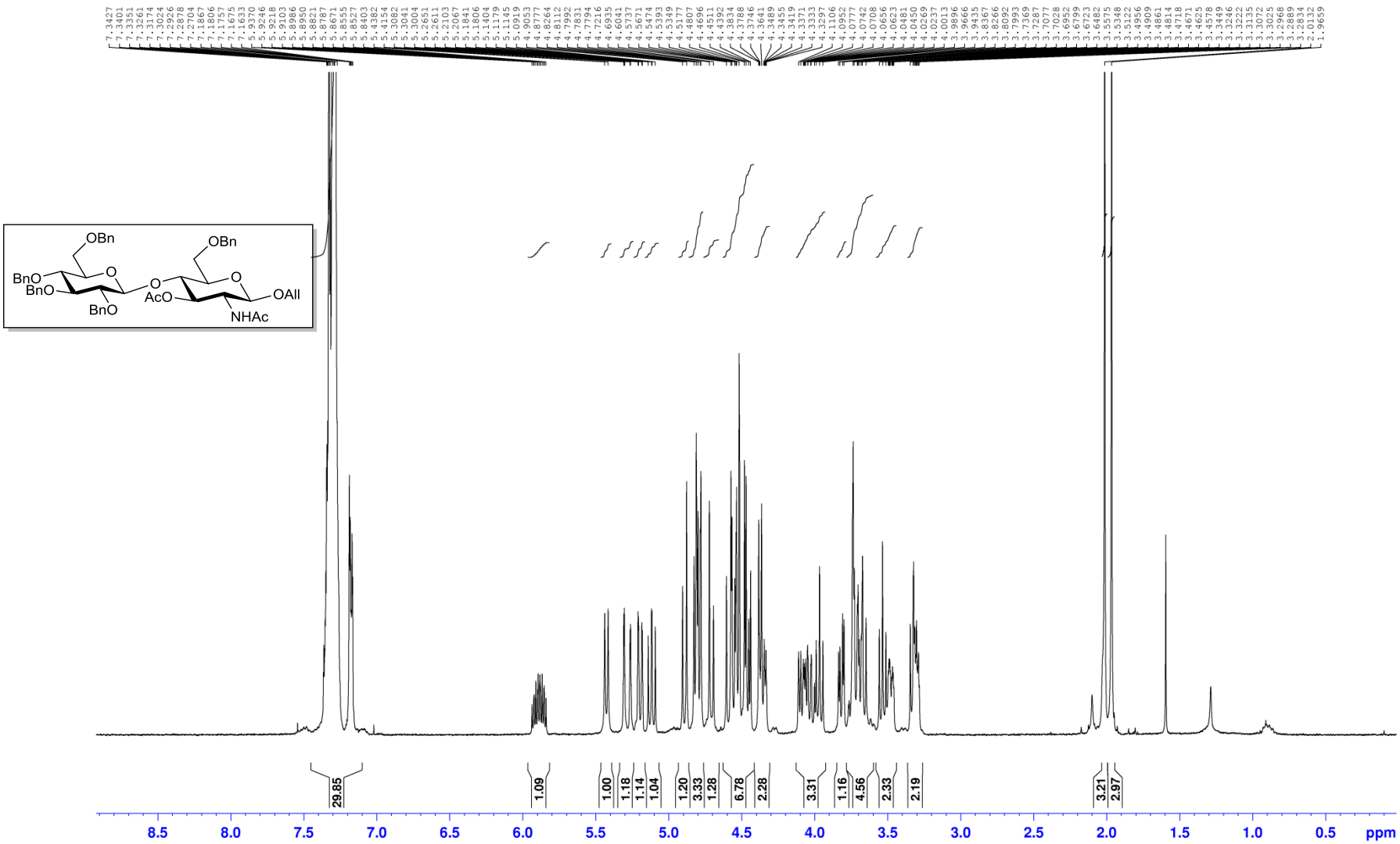

OH
HO
HO
O
HO
O
OH
O
HO
OH
NHAc
102.457
102.166
97.431
93.313
80.143
79.432
77.284
77.012
75.523
75.493
75.356
74.396
74.281
73.844
72.795
72.000
63.426
63.275
63.151
59.293
56.560
24.807
24.545
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 ppm

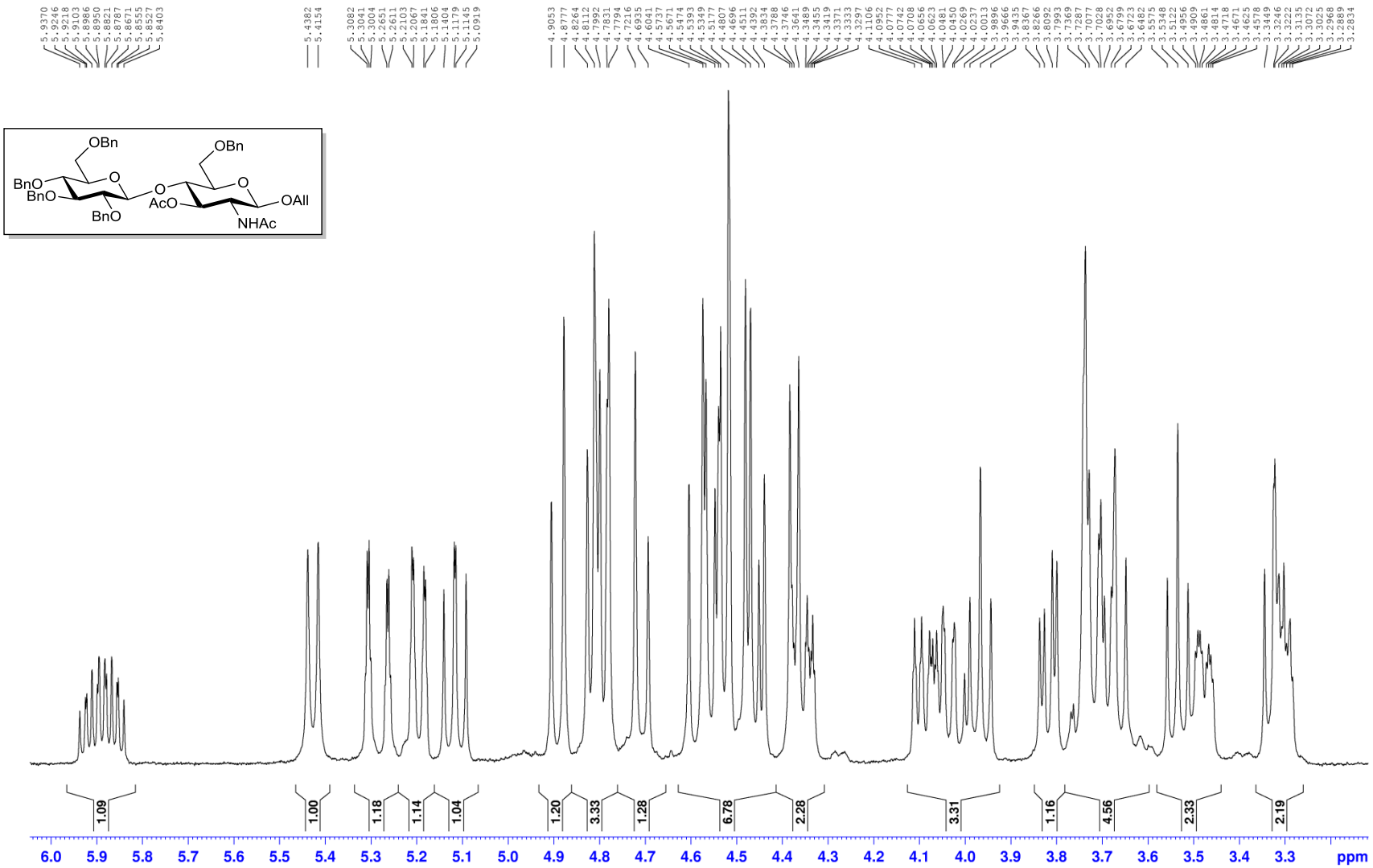

80.143
79.432
77.284
77.012
75.523
75.493
75.356
74.396
74.281
73.844
72.795
72.000
63.426
63.275
63.151
59.293
56.560
OH
HO
HO
HO
O
OH
O
HO
O
OH
NHAc
80
75
70
65
60
55
ppm

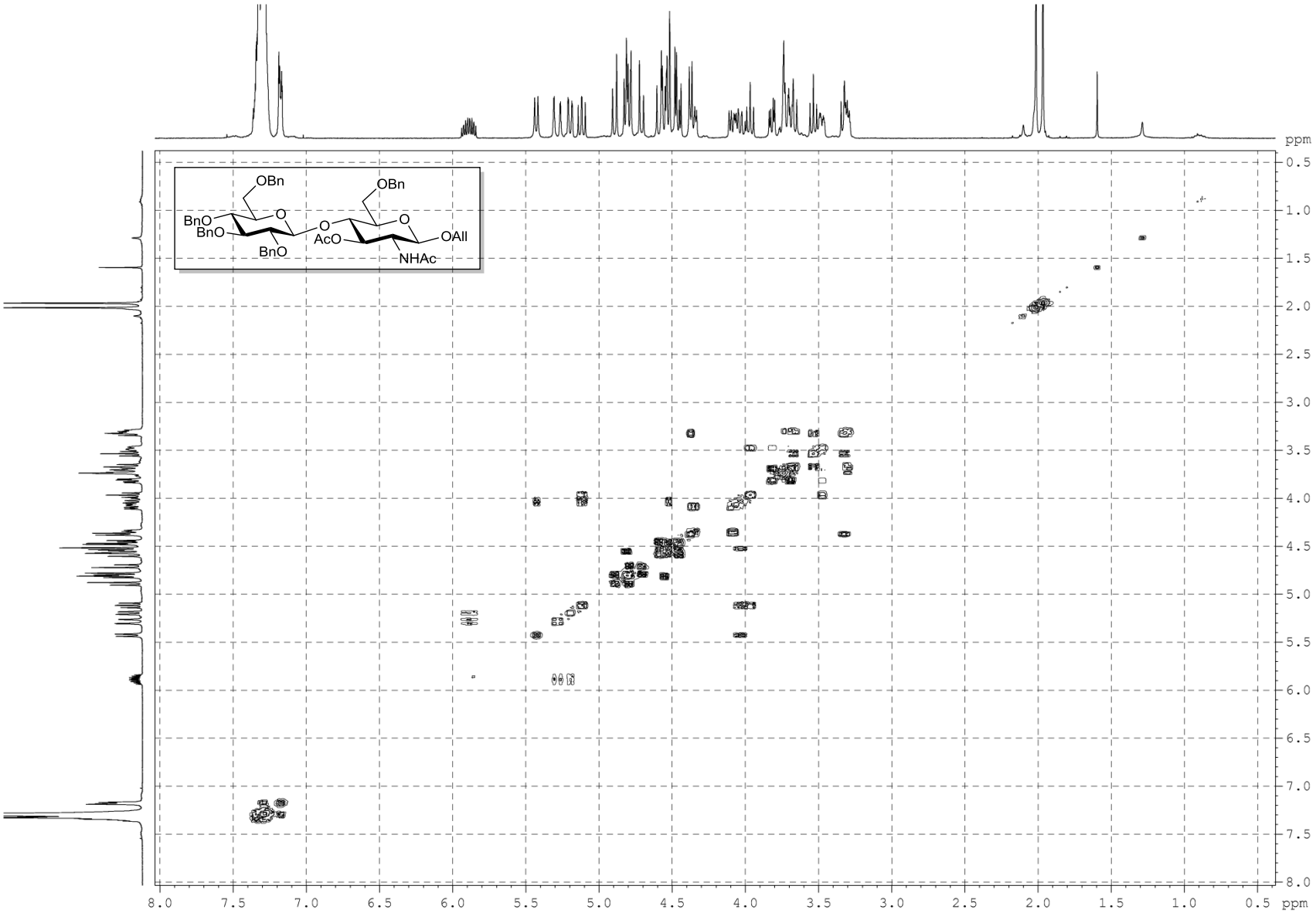

OH
HO
HO
O
OH
HO
O
O
HO
OH
NHAc
ppm
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
ppm

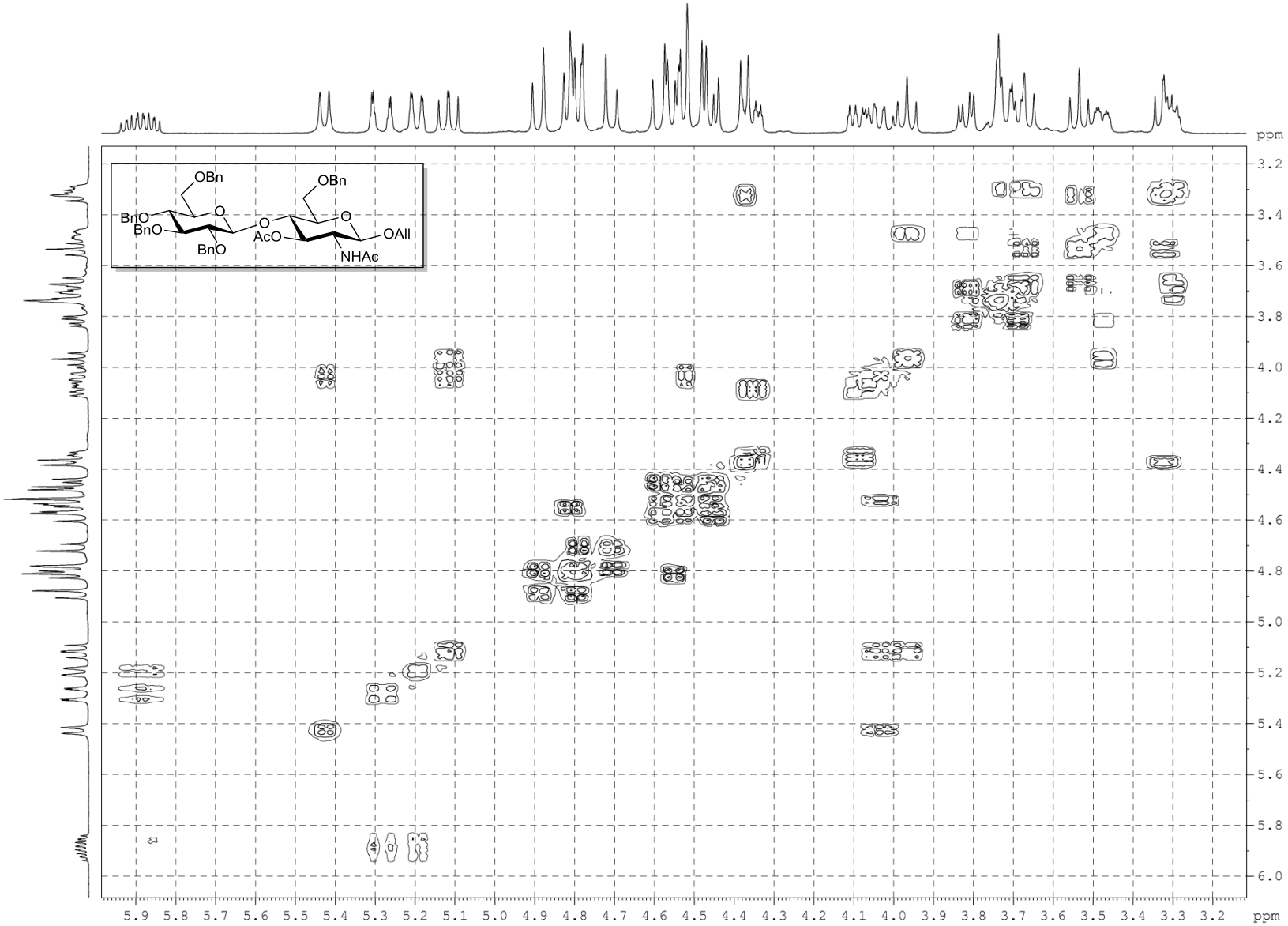

OH
HO
HO
O
HO
OH
O
HO
O
OH
NHAc
ppm
55
60
65
70
75
80
85
90
95
100
105
5.4
5.3
5.2
5.1
5.0
4.9
4.8
4.7
4.6
4.5
4.4
4.3
4.2
4.1
4.0
3.9
3.8
3.7
3.6
3.5
3.4
ppm

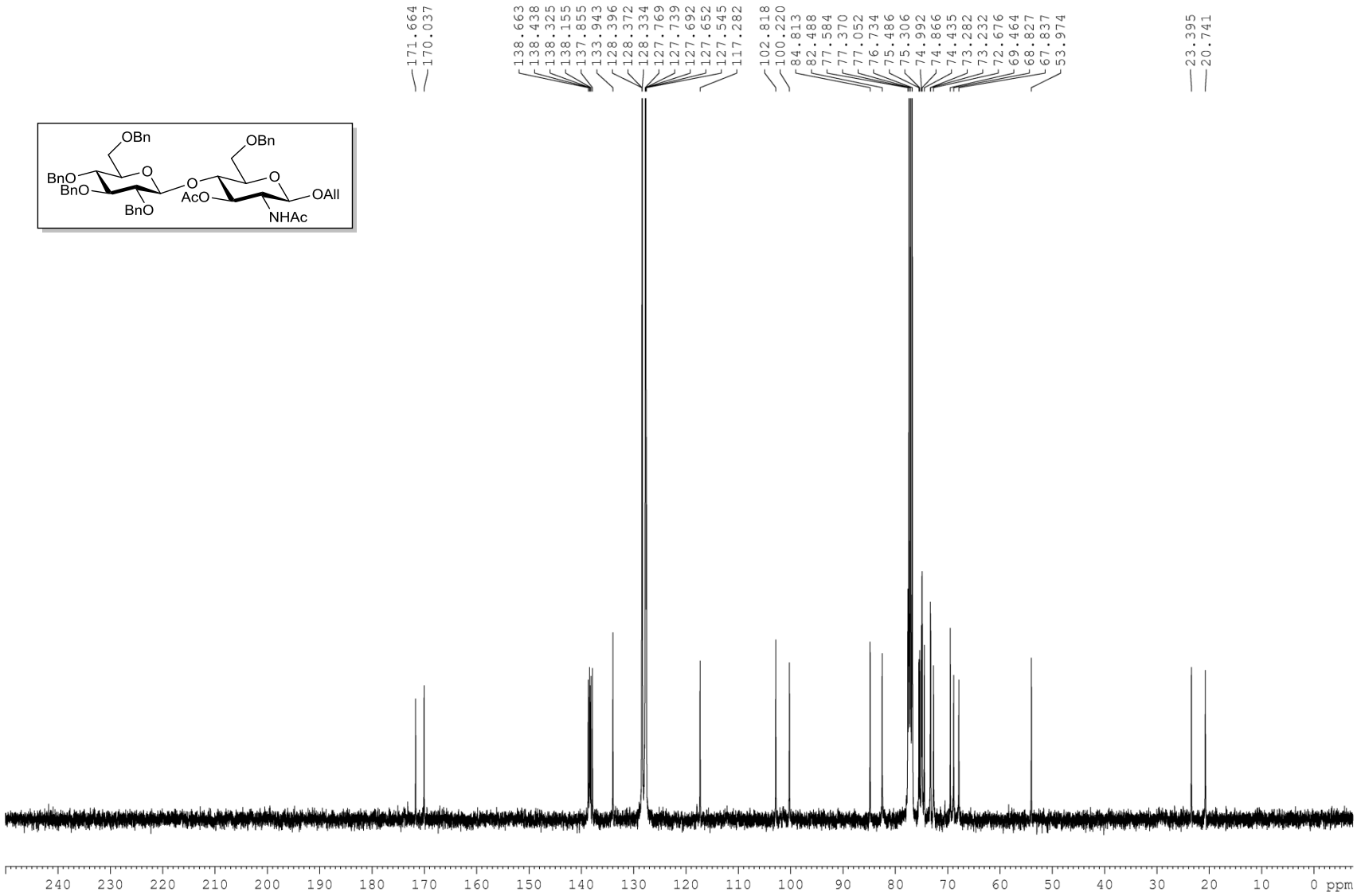
Compound 14: **Allyl 2,3,4,6-tetra-*O*-benzyl-β-D-glucopyranosyl-(1→4)-2-acetamido-3-*O*-acetyl-6-*O*-benzyl-2-deoxy-β-D-glucopyranoside**

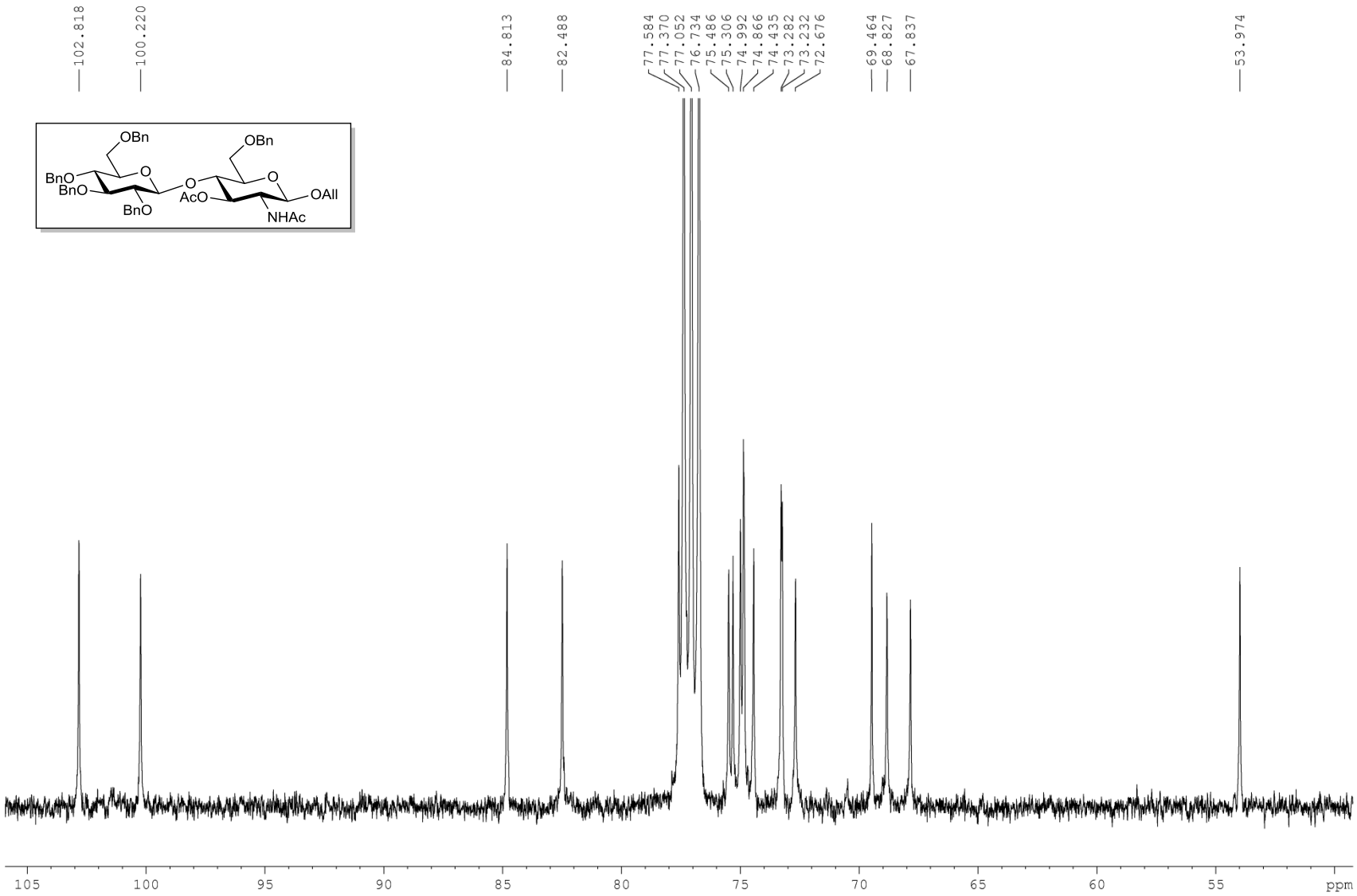


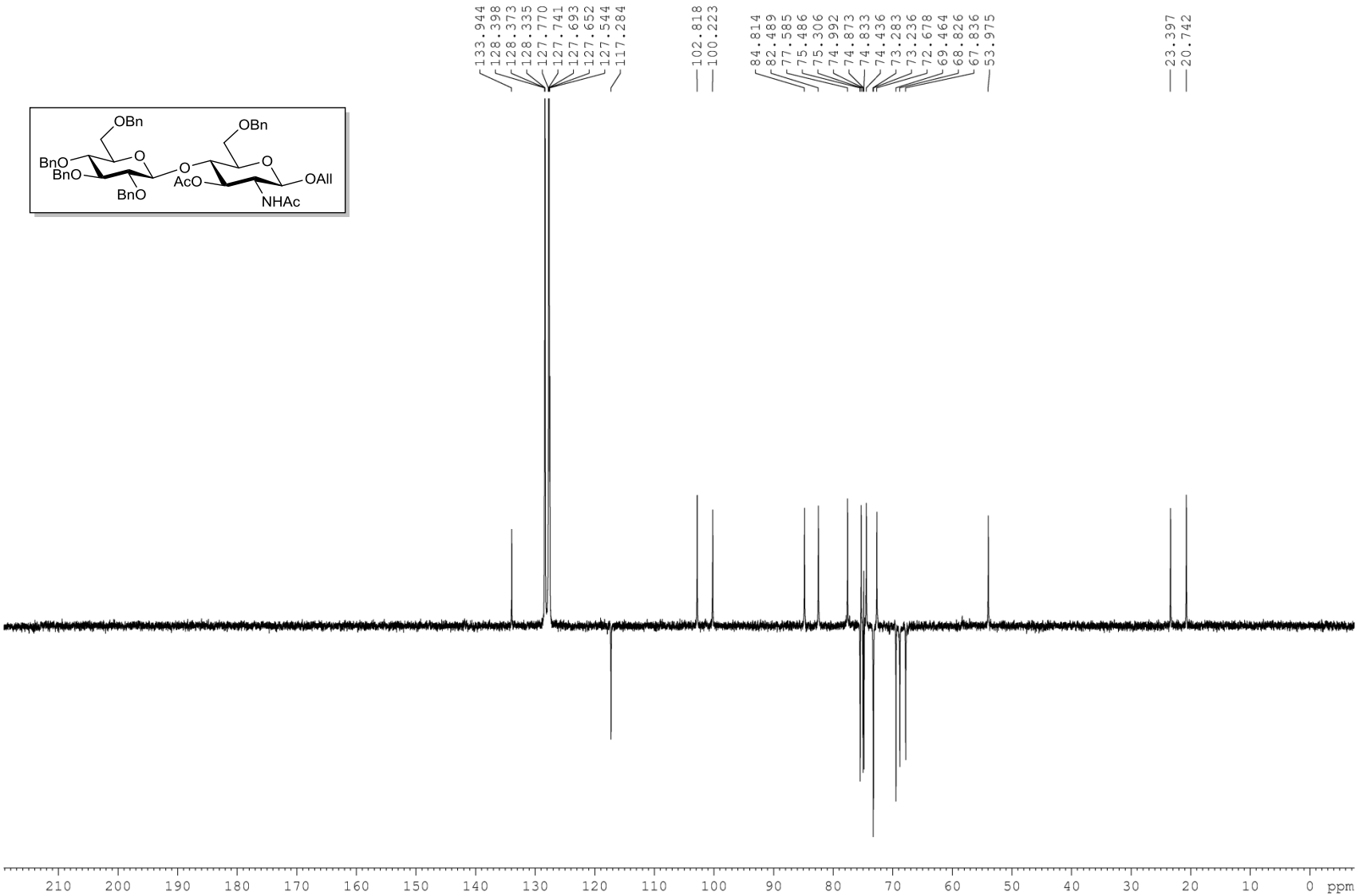

OBn
OBn
BnO
BnO
BnO
O
O
O
AcO
OAll
NHAc
1.09
1.00
1.18
1.14
1.04
1.20
3.33
1.28
6.78
2.28
3.31
1.16
4.56
2.33
2.19
6.0 5.9 5.8 5.7 5.6 5.5 5.4 5.3 5.2 5.1 5.0 4.9 4.8 4.7 4.6 4.5 4.4 4.3 4.2 4.1 4.0 3.9 3.8 3.7 3.6 3.5 3.4 3.3
ppm

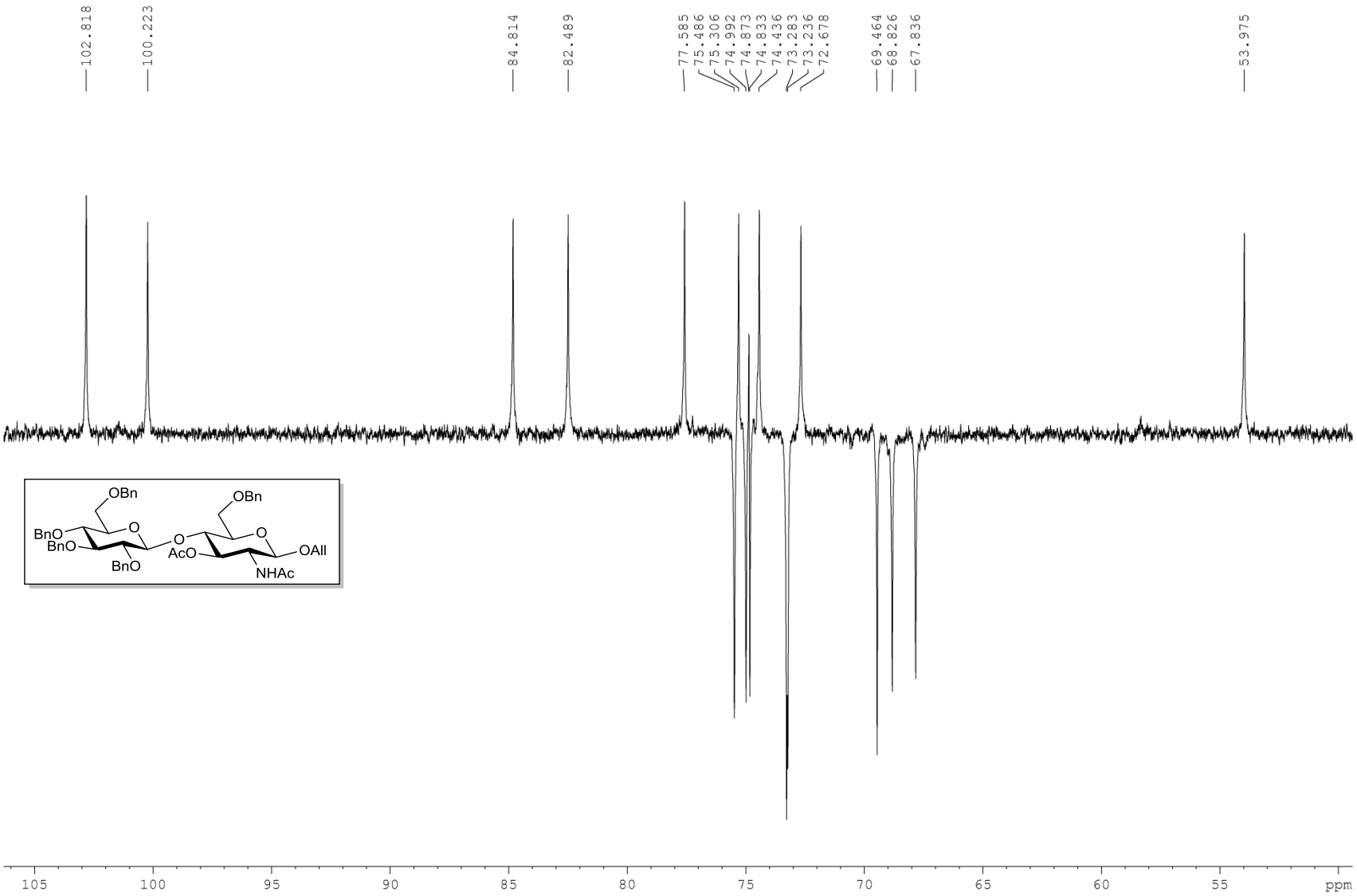

OBn
OBn
BnO
BnO
BnO
O
O
O
AcO
OAll
NHAc
ppm
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
ppm

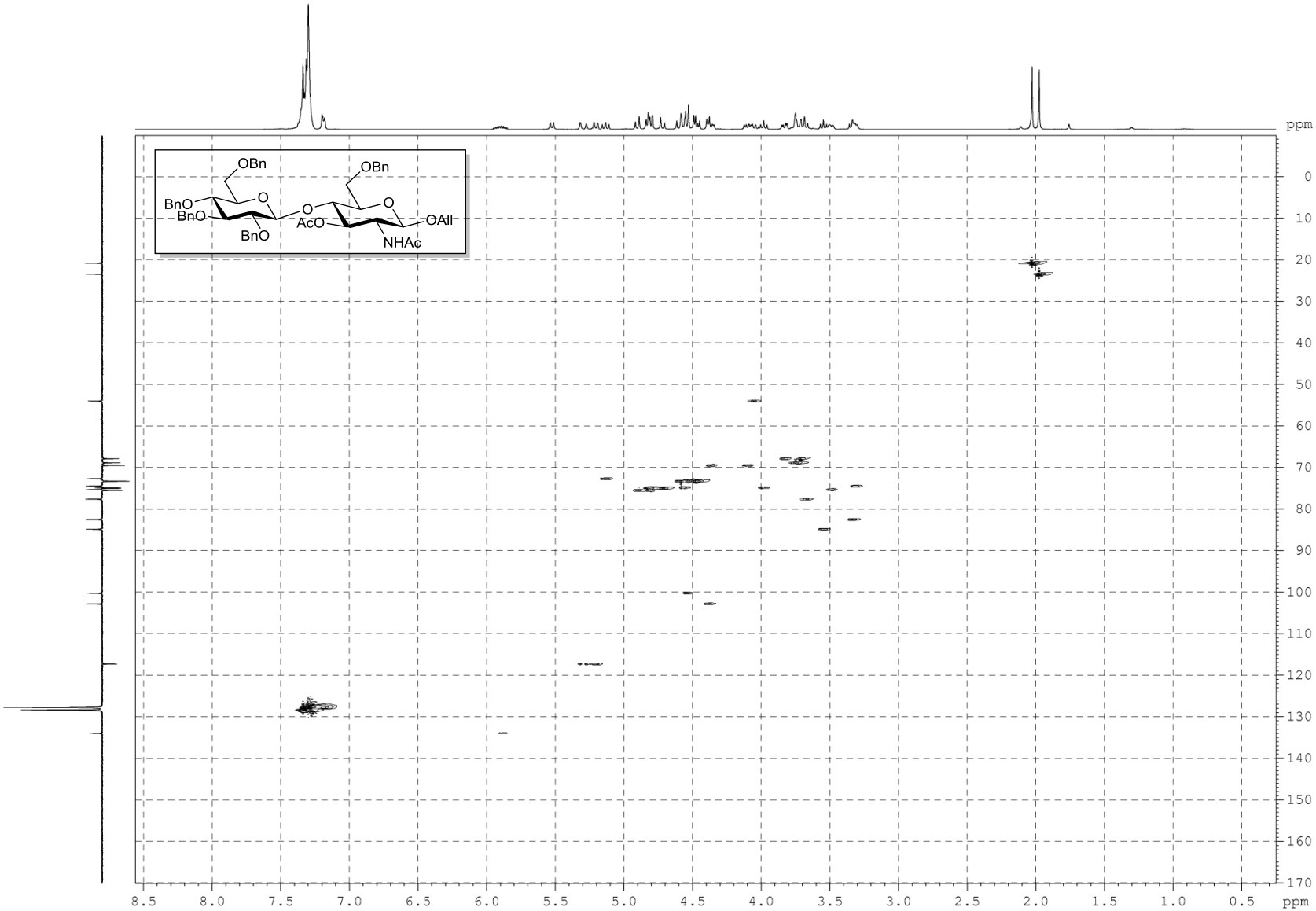

OBn
OBn
BnO
BnO
BnO
O
O
O
AcO
OAll
NHAc
ppm
3.2
3.4
3.6
3.8
4.0
4.2
4.4
4.6
4.8
5.0
5.2
5.4
5.6
5.8
6.0
5.9 5.8 5.7 5.6 5.5 5.4 5.3 5.2 5.1 5.0 4.9 4.8 4.7 4.6 4.5 4.4 4.3 4.2 4.1 4.0 3.9 3.8 3.7 3.6 3.5 3.4 3.3 3.2
ppm

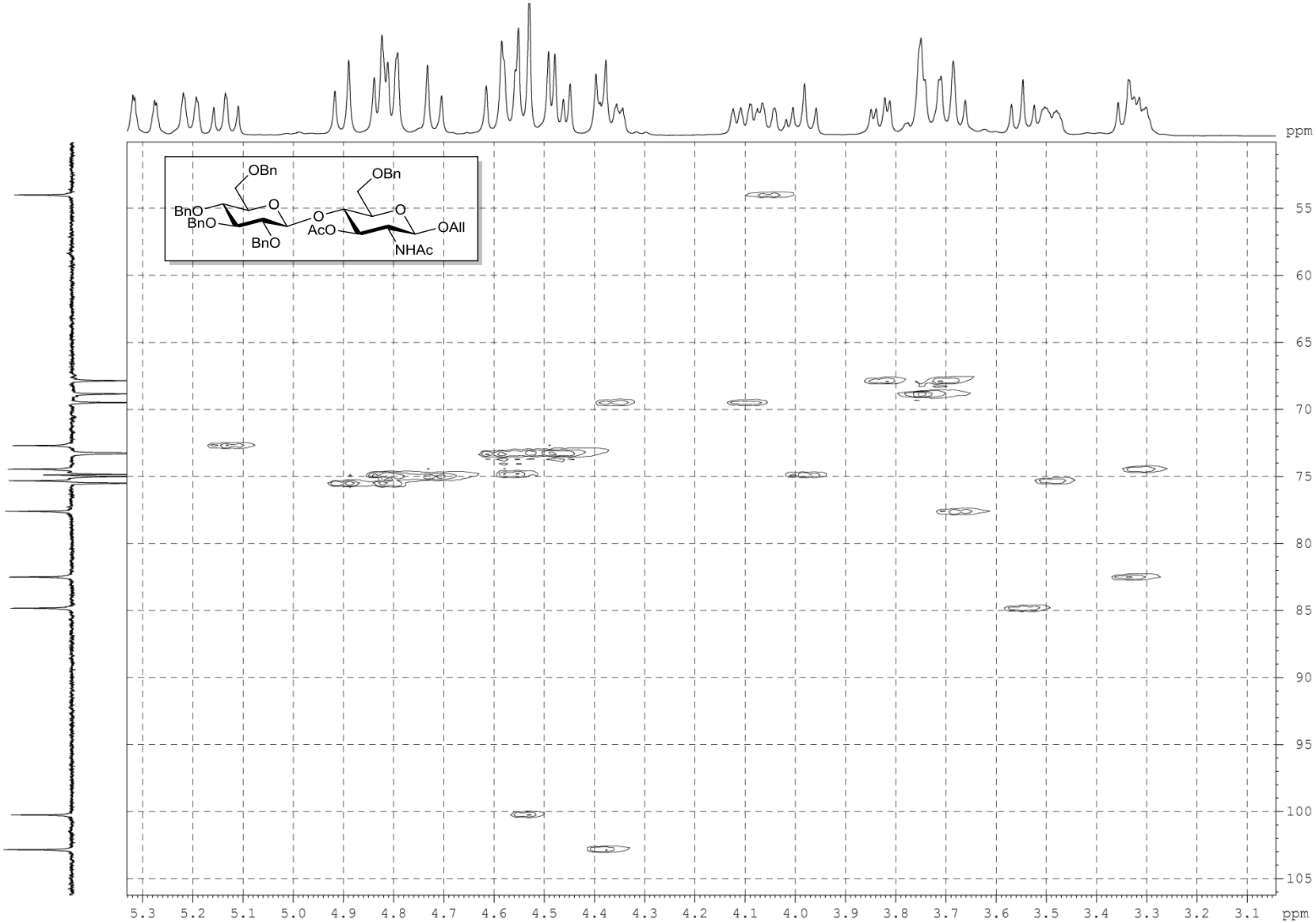

OBn
OBn
BnO
BnO
BnO
O
O
O
AcO
OAll
NHAc
171.664
170.037
138.663
138.438
138.325
138.155
137.855
133.943
128.396
128.372
128.334
127.769
127.739
127.692
127.652
127.545
117.282
102.818
100.220
84.813
82.488
77.584
77.370
77.052
76.734
75.486
75.306
74.992
74.866
74.435
73.282
73.232
72.676
69.464
68.827
67.837
53.974
23.395
20.741
240 230 220 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 ppm


102.818
100.220
84.813
82.488
77.584
77.370
77.052
76.734
75.486
75.306
74.992
74.866
74.435
73.282
73.232
72.676
69.464
68.827
67.837
53.974
OBn
OBn
BnO
BnO
BnO
O
O
O
AcO
OAll
NHAc
105
100
95
90
85
80
75
70
65
60
55
ppm

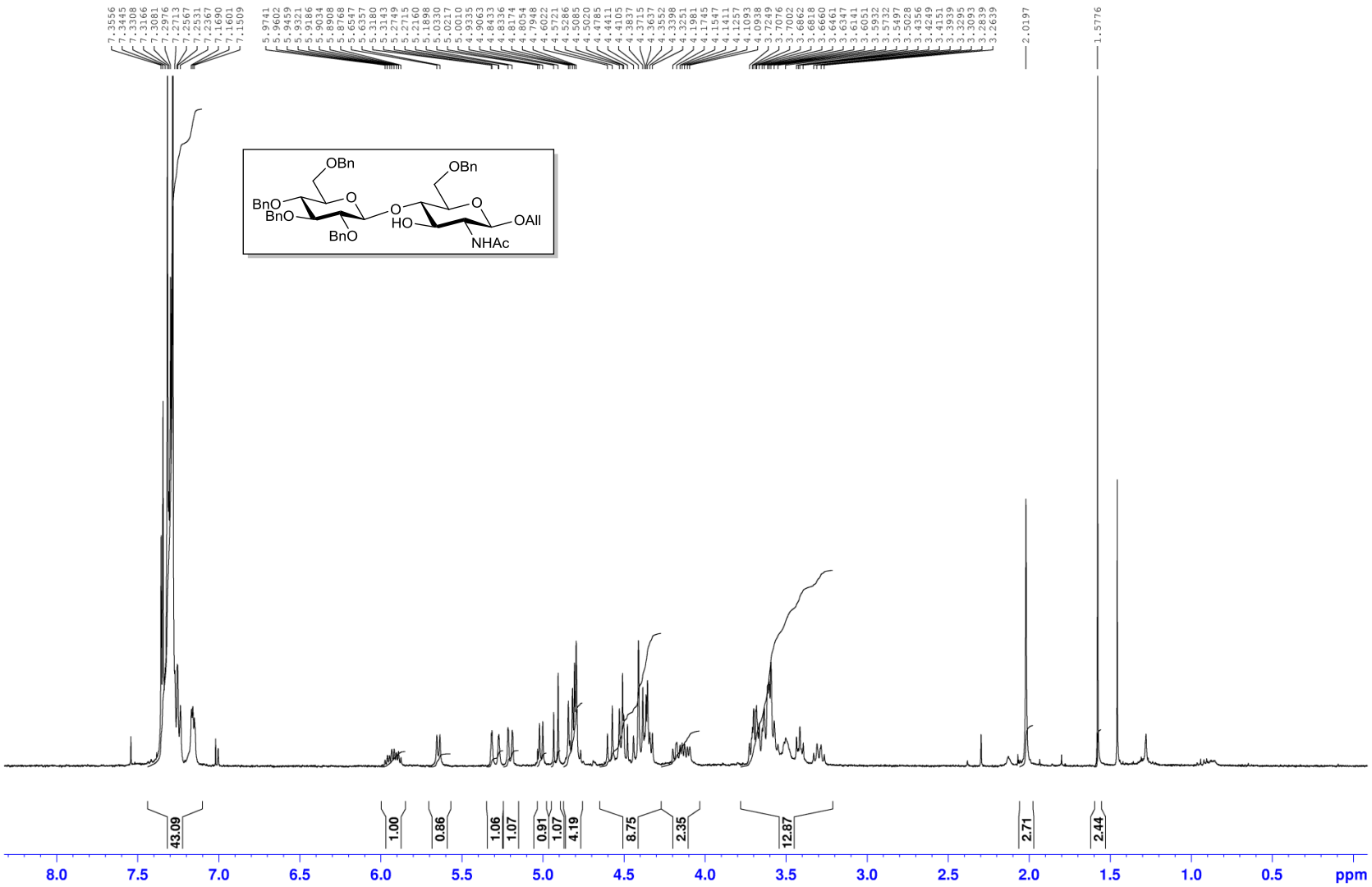

OBn
OBn
BnO
BnO
BnO
O
O
AcO
O
OAll
NHAc
133.944
128.398
128.373
128.335
127.770
127.741
127.693
127.652
127.544
117.284
102.818
100.223
84.814
82.489
77.585
75.486
75.306
74.992
74.873
74.833
74.436
73.283
73.236
72.678
69.464
68.826
67.836
53.975
23.397
20.742
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 ppm

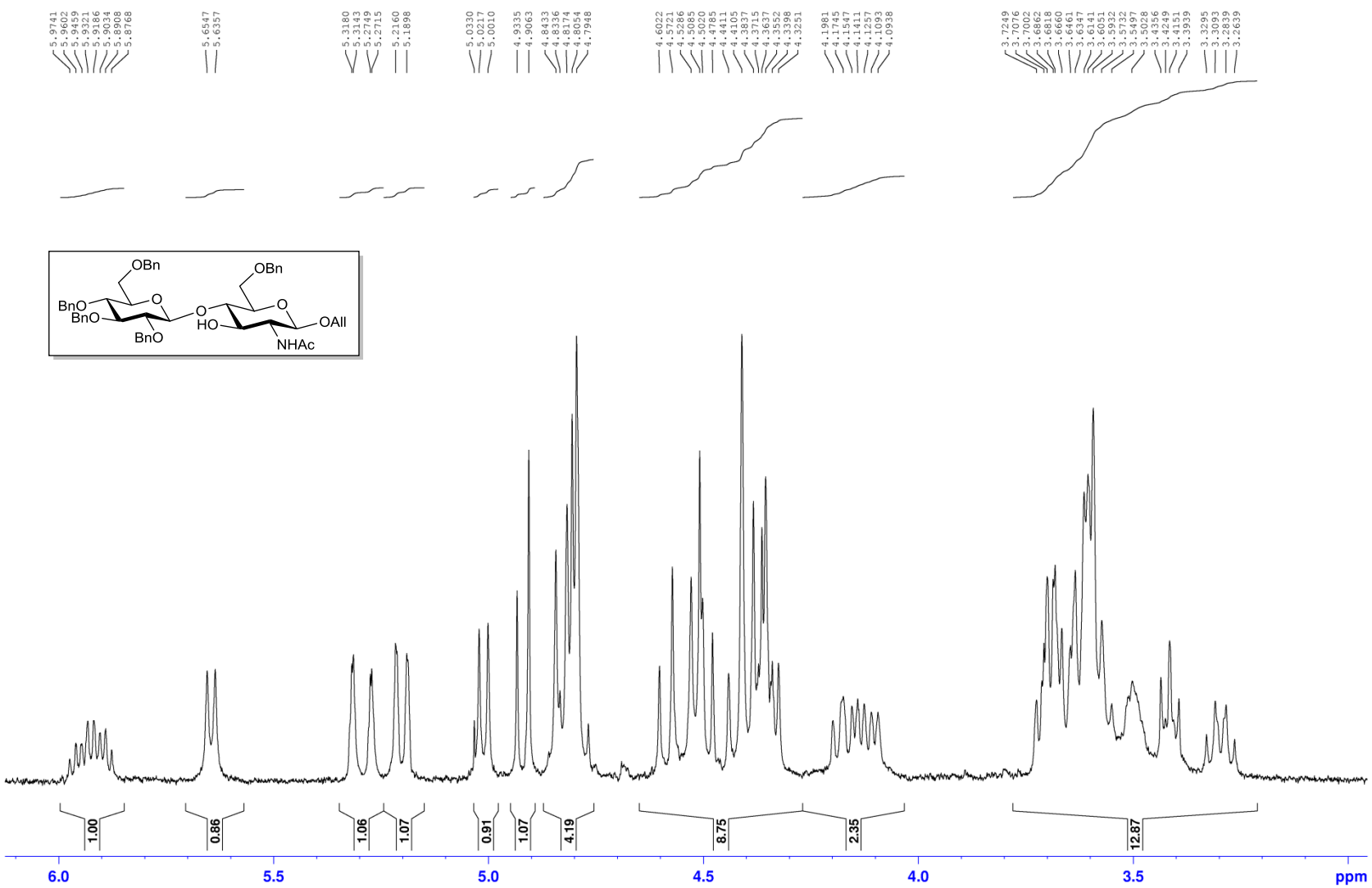

102.818
100.223
84.814
82.489
77.585
75.486
75.306
74.992
74.873
74.833
74.436
73.283
73.236
72.678
69.464
68.826
67.836
53.975
OBn
BnO
BnO
BnO
O
O
OBn
AcO
O
OAll
NHAc
105
100
95
90
85
80
75
70
65
60
55
ppm

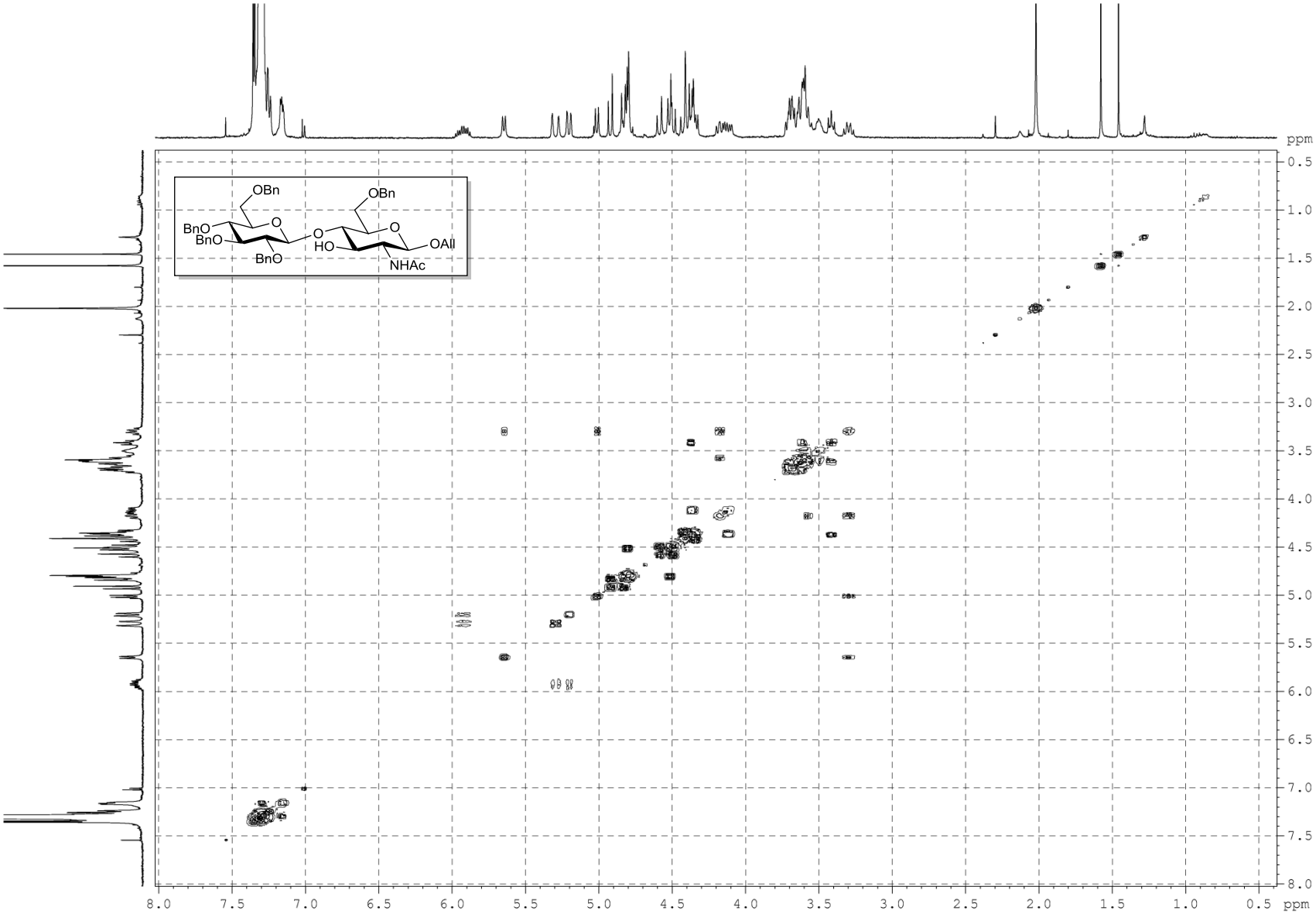

OBn
OBn
BnO
BnO
BnO
O
O
AcO
O
OAll
NHAc
ppm
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
ppm

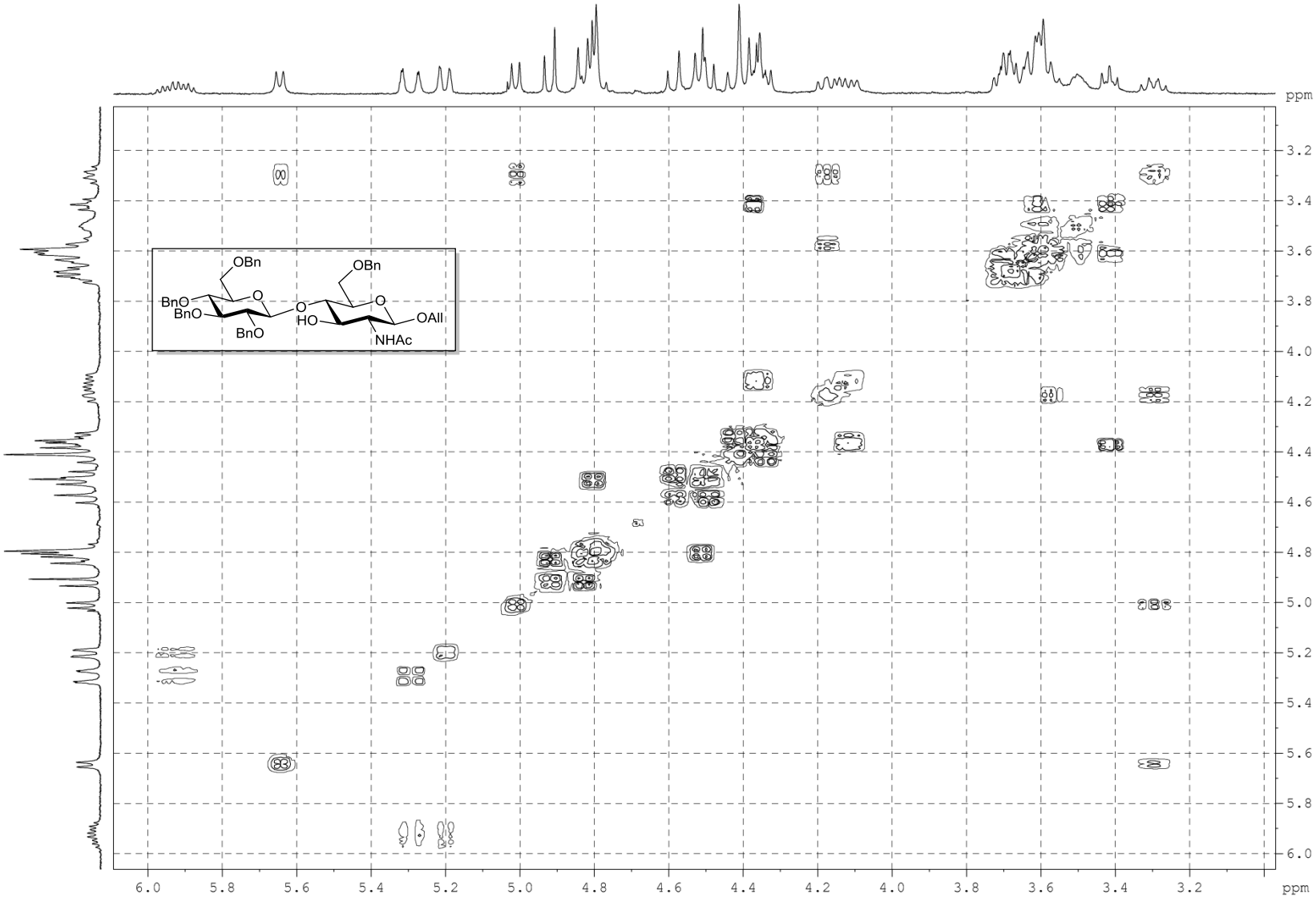

OBn
OBn
BnO
BnO
BnO
O
O
O
AcO
OAll
NHAc
ppm
55
60
65
70
75
80
85
90
95
100
105
5.3 5.2 5.1 5.0 4.9 4.8 4.7 4.6 4.5 4.4 4.3 4.2 4.1 4.0 3.9 3.8 3.7 3.6 3.5 3.4 3.3 3.2 3.1
ppm

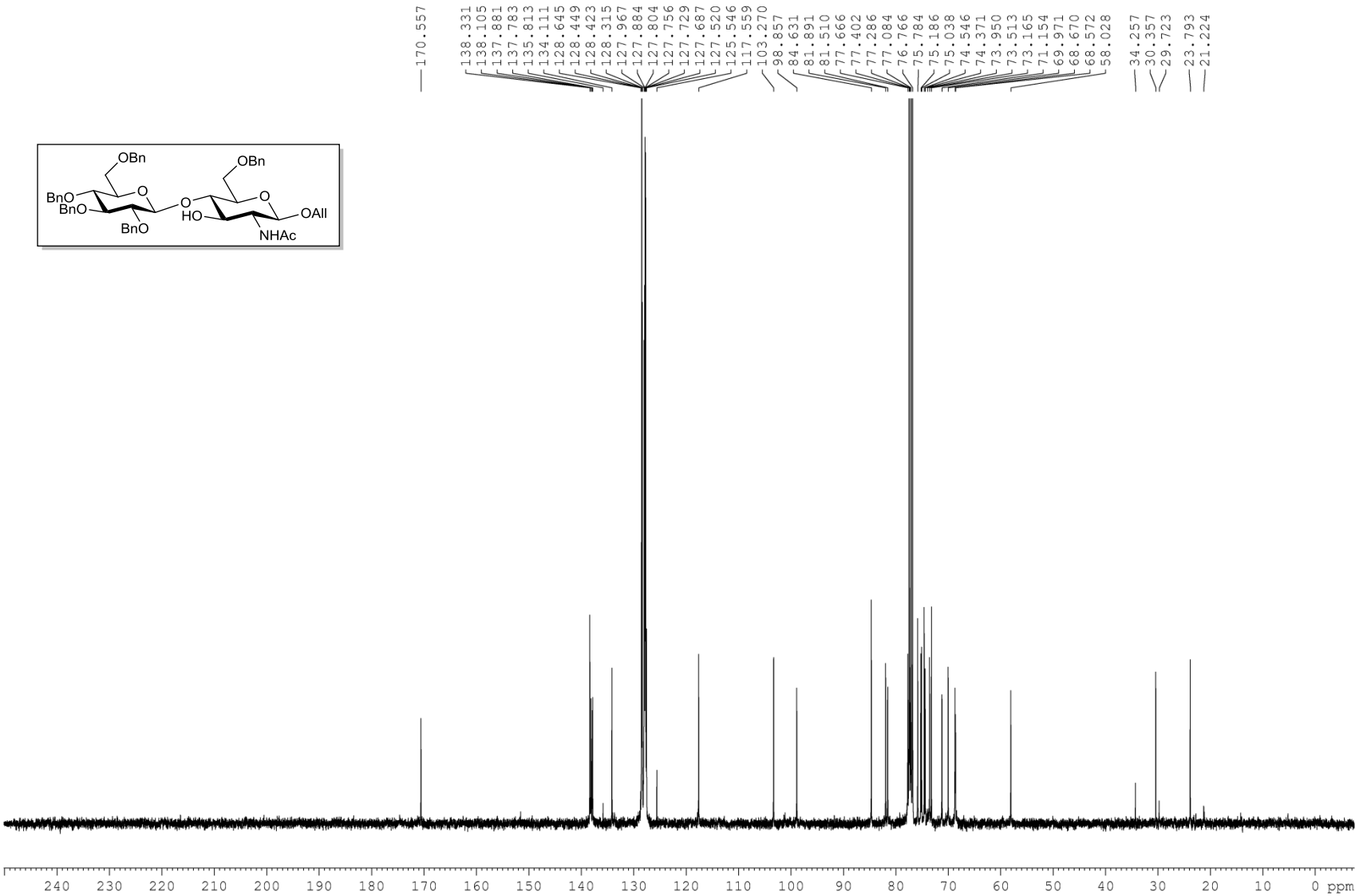
Compound 15: **Allyl 2,3,4,6-tetra-*O*-benzyl-β-D-glucopyranosyl-(1→4)-2-acetamido-6-*O*-benzyl-2-deoxy-β-D-glucopyranoside**

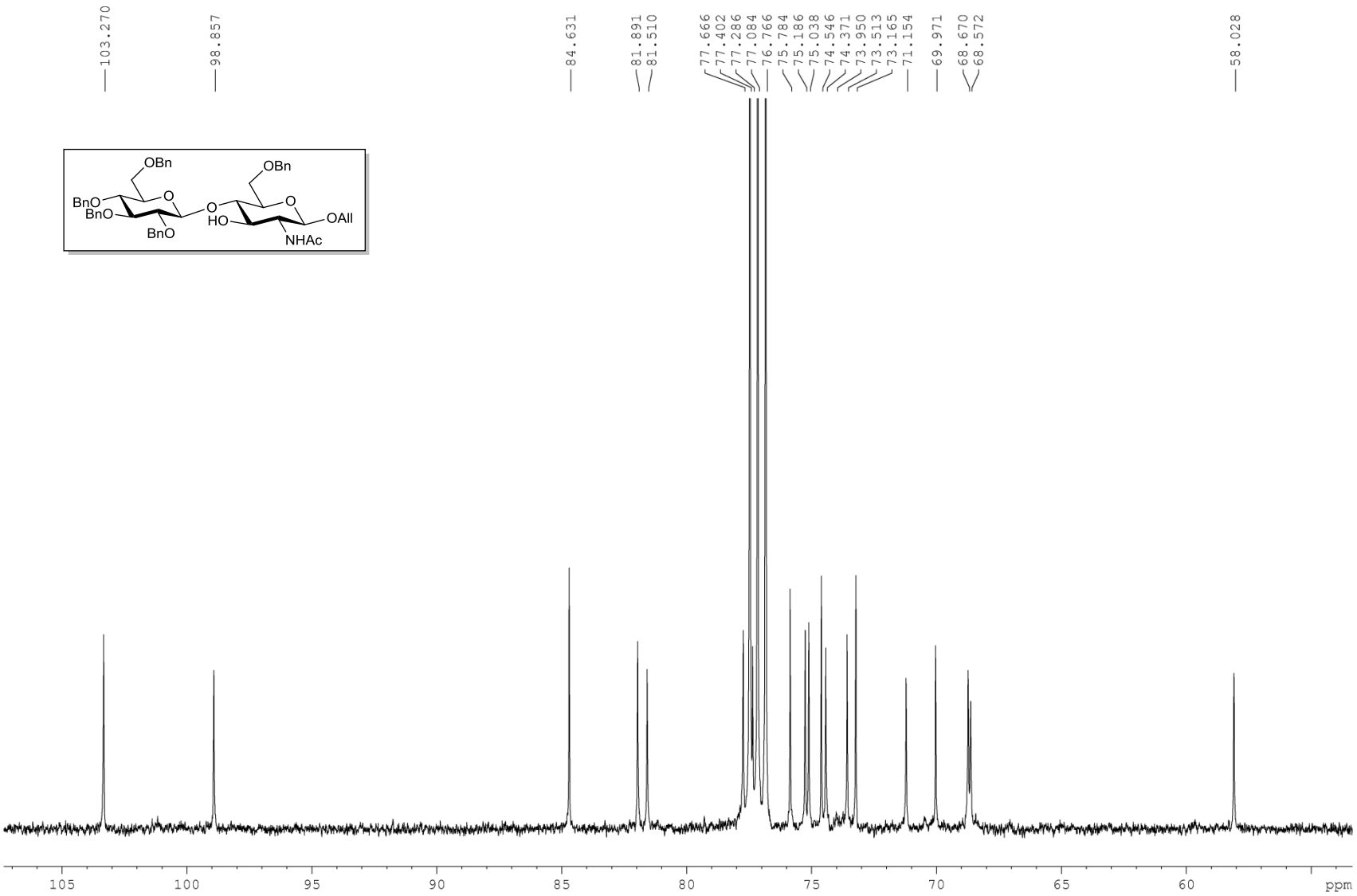


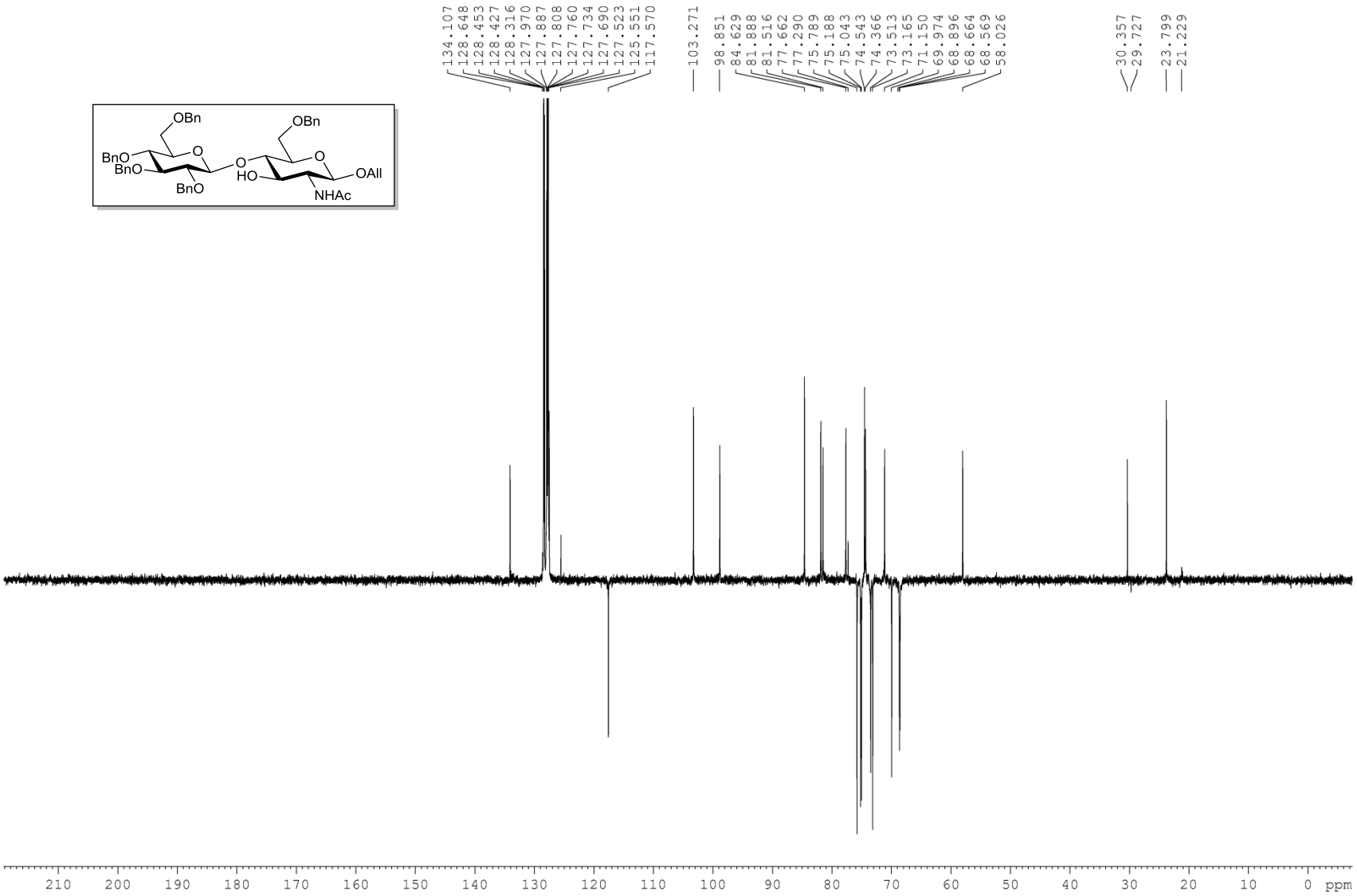

5.9741
5.9602
5.9459
5.9321
5.9186
5.9034
5.8908
5.8768
5.6547
5.6357
5.3180
5.3143
5.2949
5.2715
5.2160
5.1898
5.0330
5.0217
5.0010
4.9335
4.9063
4.8433
4.8336
4.8174
4.8054
4.7948
4.6022
4.5721
4.5286
4.5085
4.5020
4.4785
4.4441
4.4105
4.3837
4.3715
4.3637
4.3552
4.3398
4.3251
4.1981
4.1745
4.1547
4.1411
4.1257
4.1093
4.0938
3.7249
3.7076
3.7002
3.6862
3.6818
3.6660
3.6461
3.6347
3.6241
3.6051
3.5932
3.5732
3.5497
3.5028
3.4356
3.4249
3.4151
3.3939
3.3295
3.3093
3.2839
3.2639
OBn
OBn
BnO
BnO
BnO
O
O
O
HO
OAll
NHAc
1.00
0.86
1.06
1.07
0.91
1.07
4.19
8.75
2.35
12.87
6.0
5.5
5.0
4.5
4.0
3.5
ppm

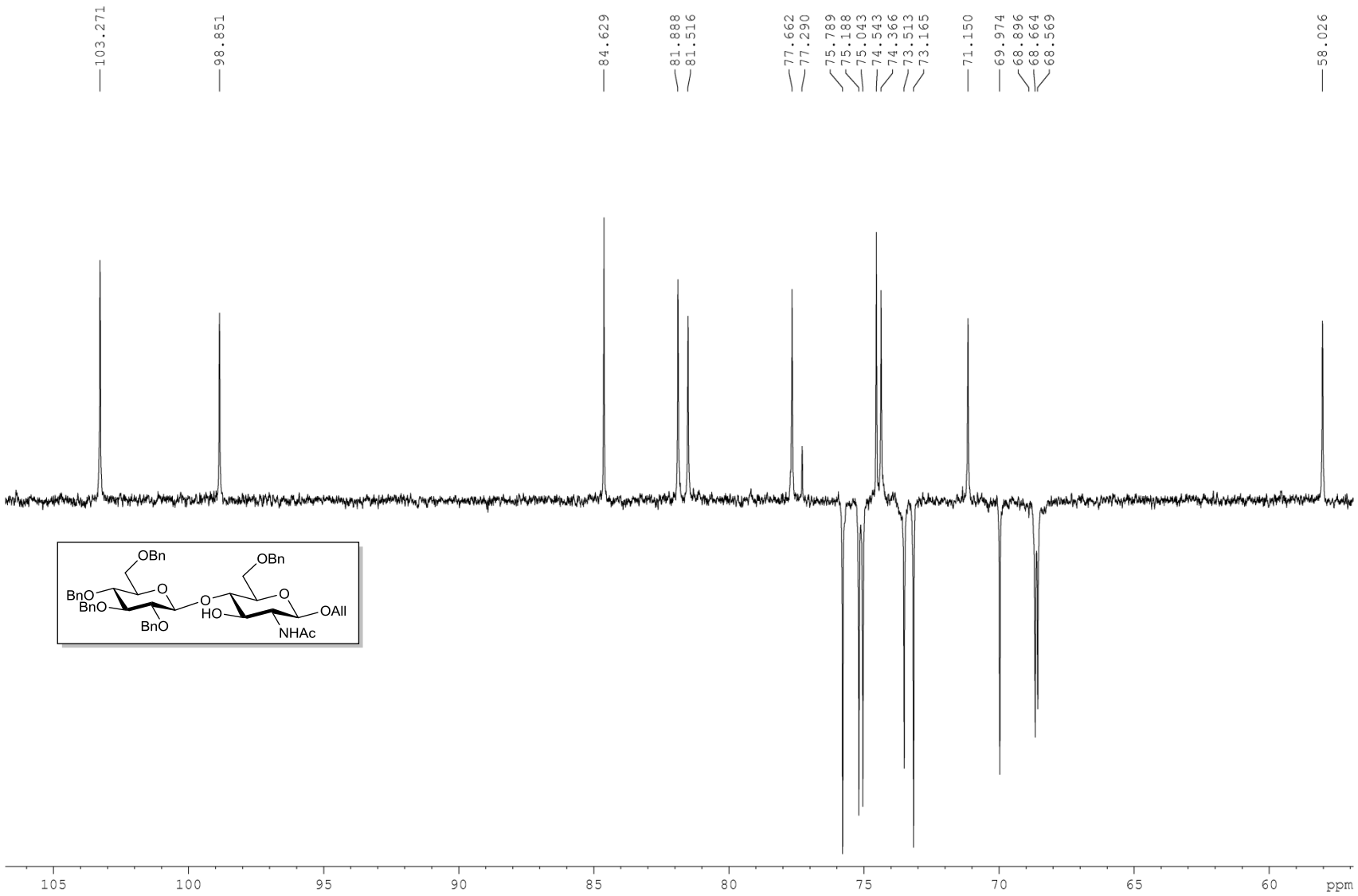

OBn
OBn
BnO
BnO
BnO
O
O
O
HO
NHAc
OAll
ppm
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
ppm

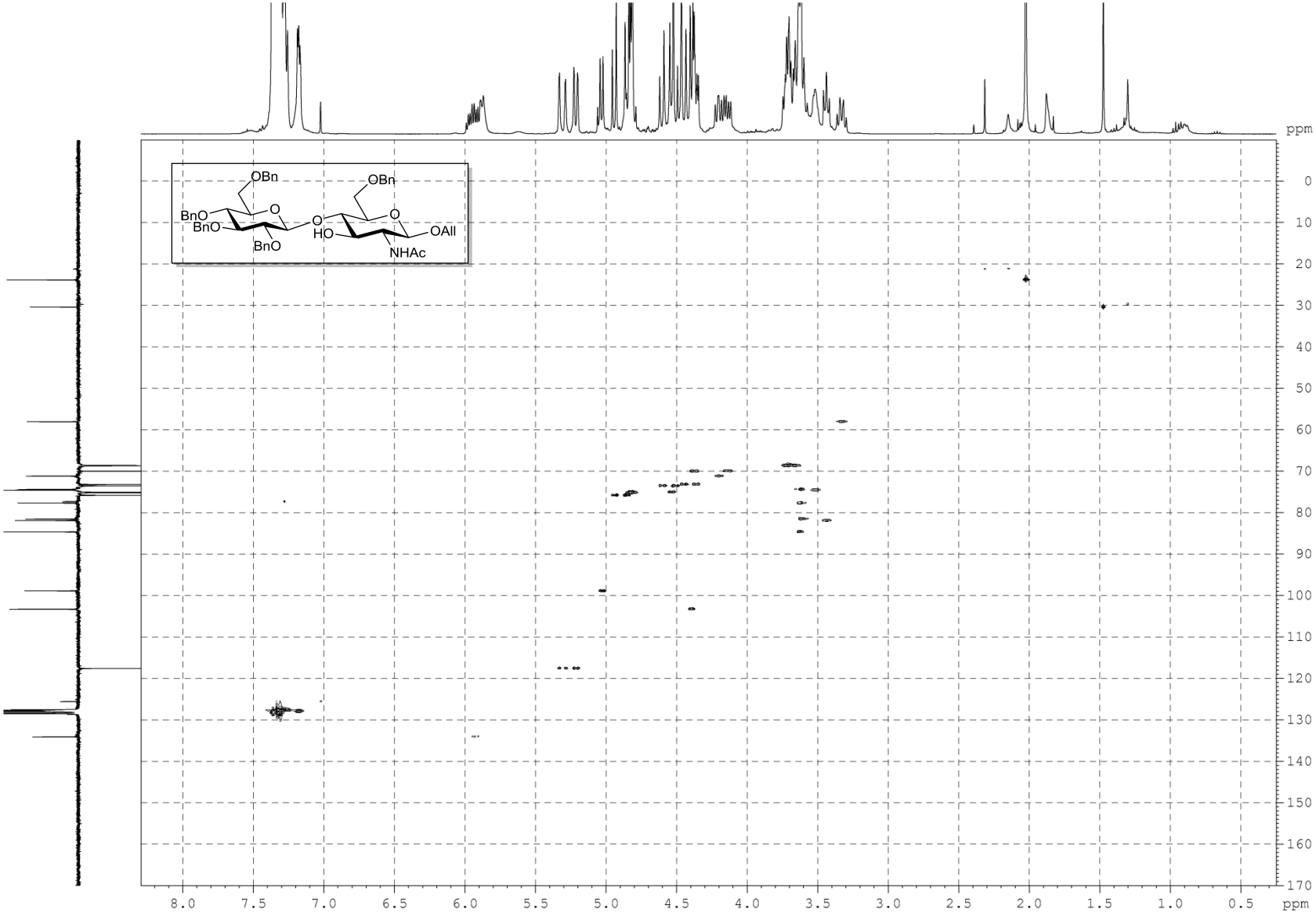

OBn
OBn
BnO
BnO
BnO
O
O
O
HO
OAll
NHAc
ppm
3.2
3.4
3.6
3.8
4.0
4.2
4.4
4.6
4.8
5.0
5.2
5.4
5.6
5.8
6.0
6.0
5.8
5.6
5.4
5.2
5.0
4.8
4.6
4.4
4.2
4.0
3.8
3.6
3.4
3.2
ppm

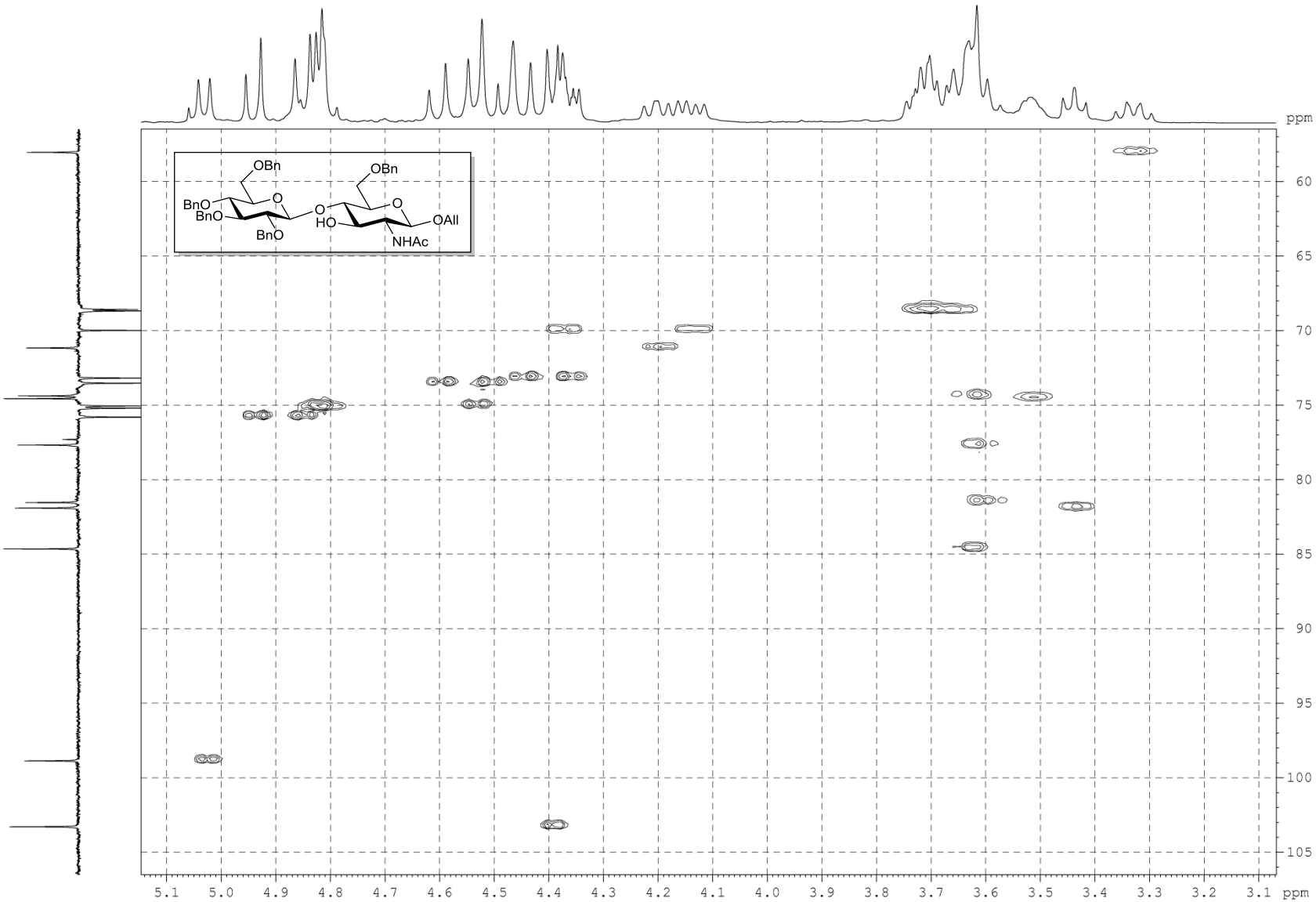

170.557
138.331
138.105
137.881
137.783
135.813
134.111
128.645
128.449
128.423
128.315
127.967
127.884
127.804
127.756
127.729
127.687
127.520
125.546
117.559
103.270
98.857
84.631
81.891
81.510
77.666
77.402
77.286
77.084
76.766
75.784
75.186
75.038
74.546
74.371
73.950
73.513
73.165
71.154
69.971
68.670
68.572
58.028
34.257
30.357
29.723
23.793
21.224
OBn
OBn
BnO
BnO
BnO
O
O
O
HO
OAll
NHAc
240 230 220 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 ppm


103.270
98.857
84.631
81.891
81.510
77.666
77.402
77.286
77.084
76.766
75.784
75.186
75.038
74.546
74.371
73.950
73.513
73.165
71.154
69.971
68.670
68.572
58.028
OBn
OBn
BnO
BnO
BnO
O
O
HO
O
OAll
NHAc
105
100
95
90
85
80
75
70
65
60
ppm

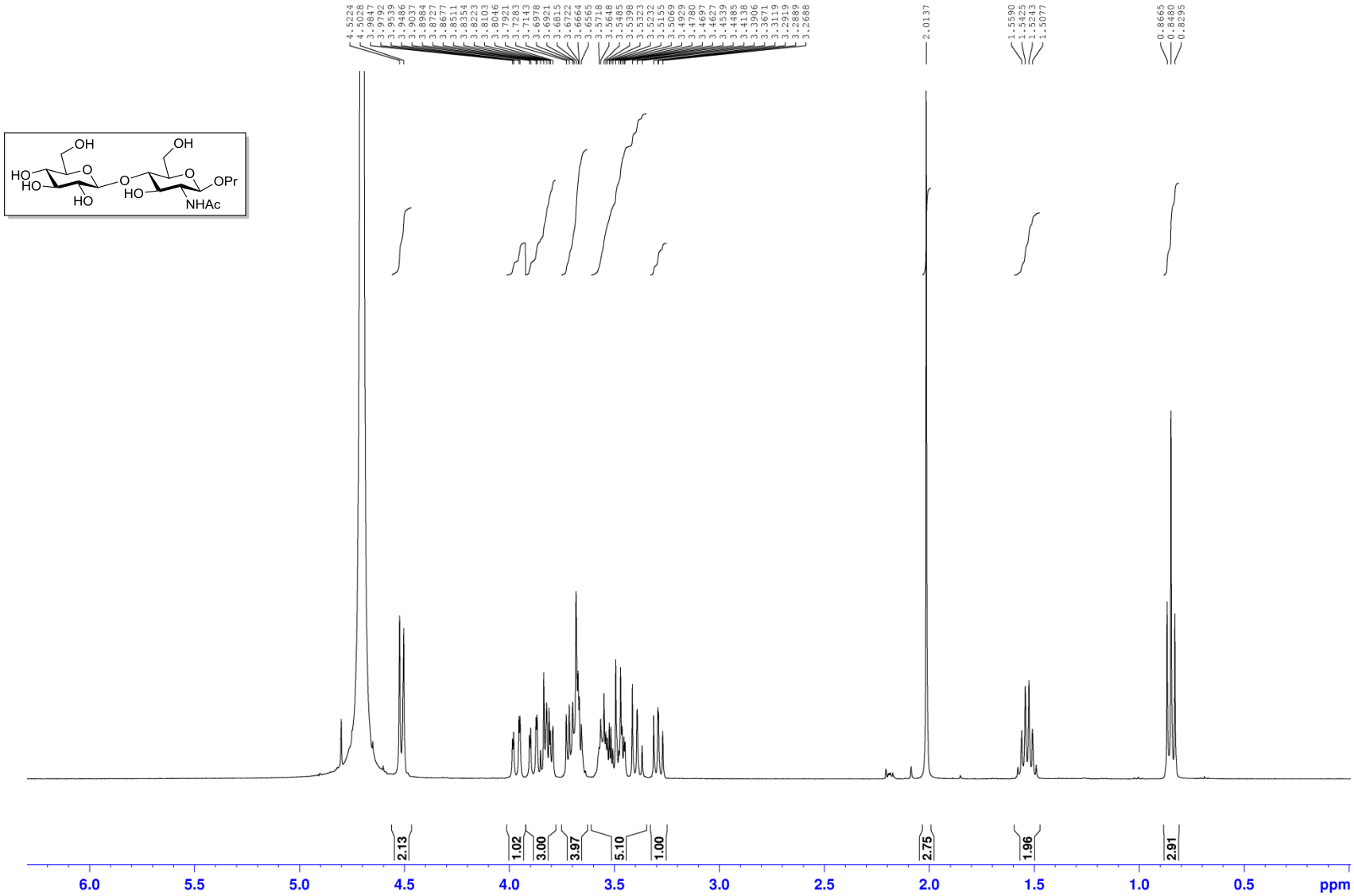

134.107
128.648
128.453
128.427
128.316
127.970
127.887
127.808
127.760
127.734
127.690
127.523
125.551
117.570
103.271
98.851
84.629
81.888
81.516
77.662
77.290
75.789
75.188
75.043
74.543
74.366
73.513
73.165
71.150
69.974
68.896
68.664
68.569
58.026
30.357
29.727
23.799
21.229
OBn
OBn
BnO
BnO
BnO
O
O
O
HO
OAll
NHAc
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 ppm

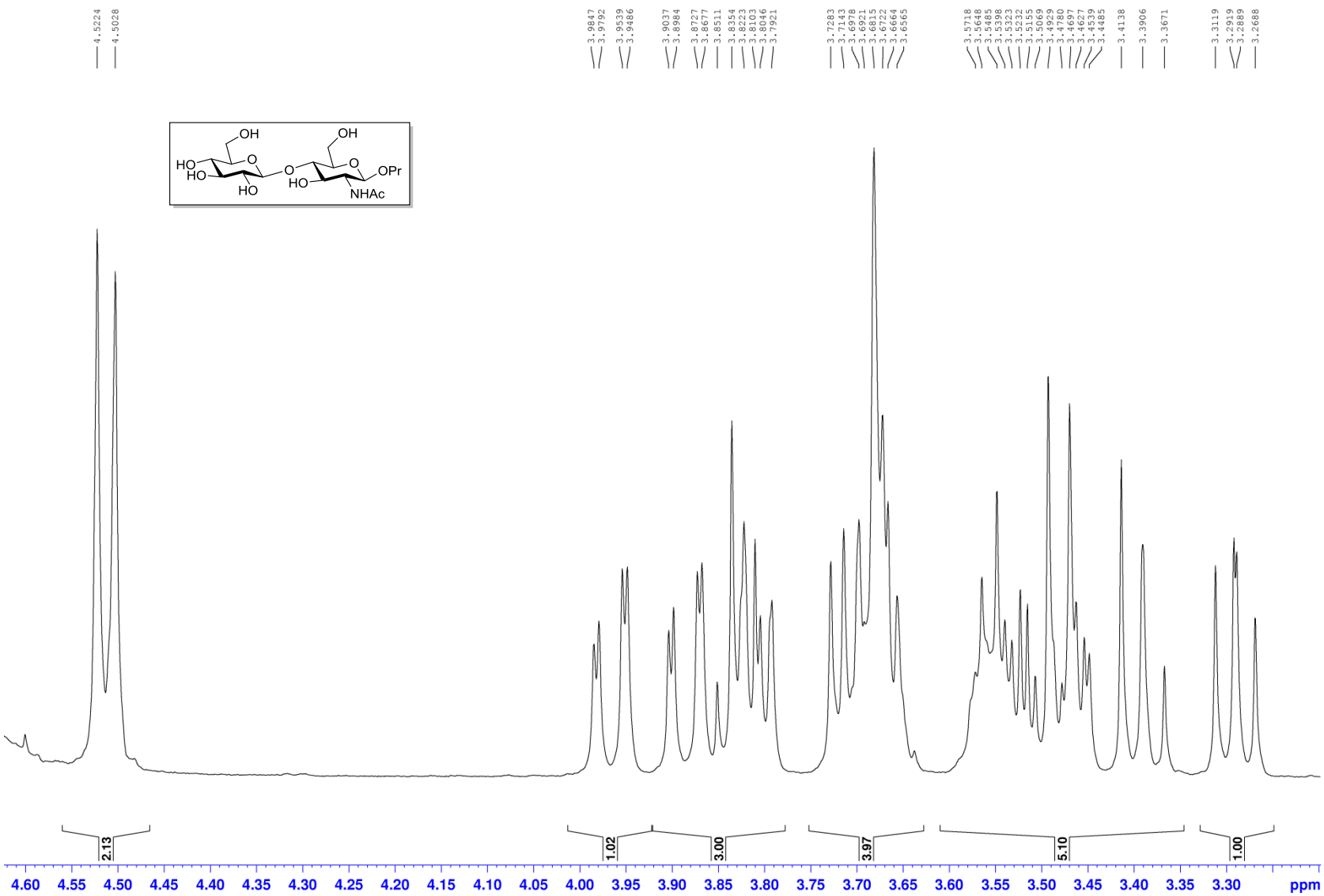

103.271
98.851
84.629
81.888
81.516
77.662
77.290
75.789
75.188
75.043
74.543
74.366
73.513
73.165
71.150
69.974
68.896
68.664
68.569
58.026
OBn
OBn
BnO
BnO
BnO
O
O
O
HO
OAll
NHAc
105
100
95
90
85
80
75
70
65
60
ppm

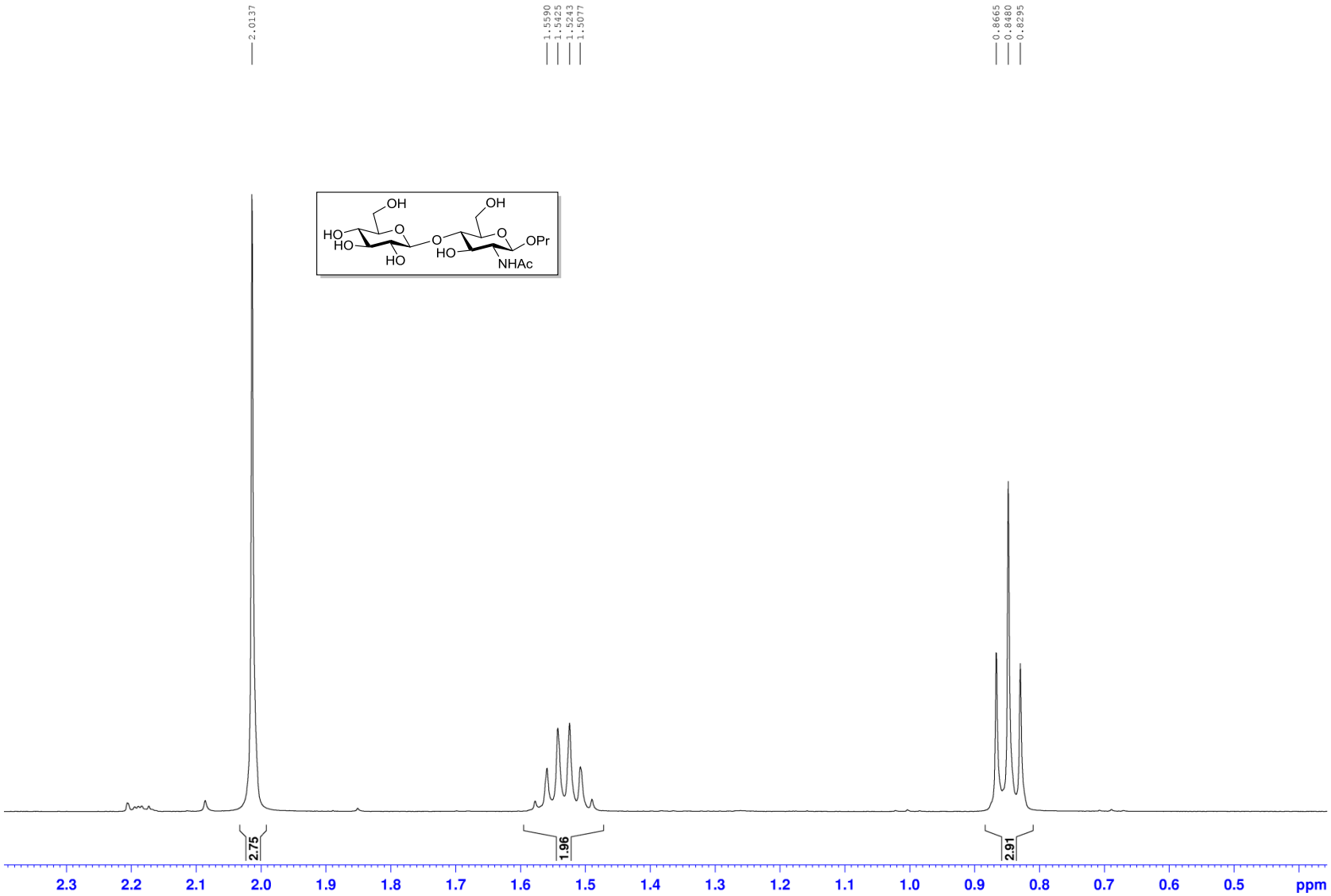

OBn
OBn
BnO
BnO
BnO
O
O
O
HO
NHAc
OAll
ppm
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
ppm

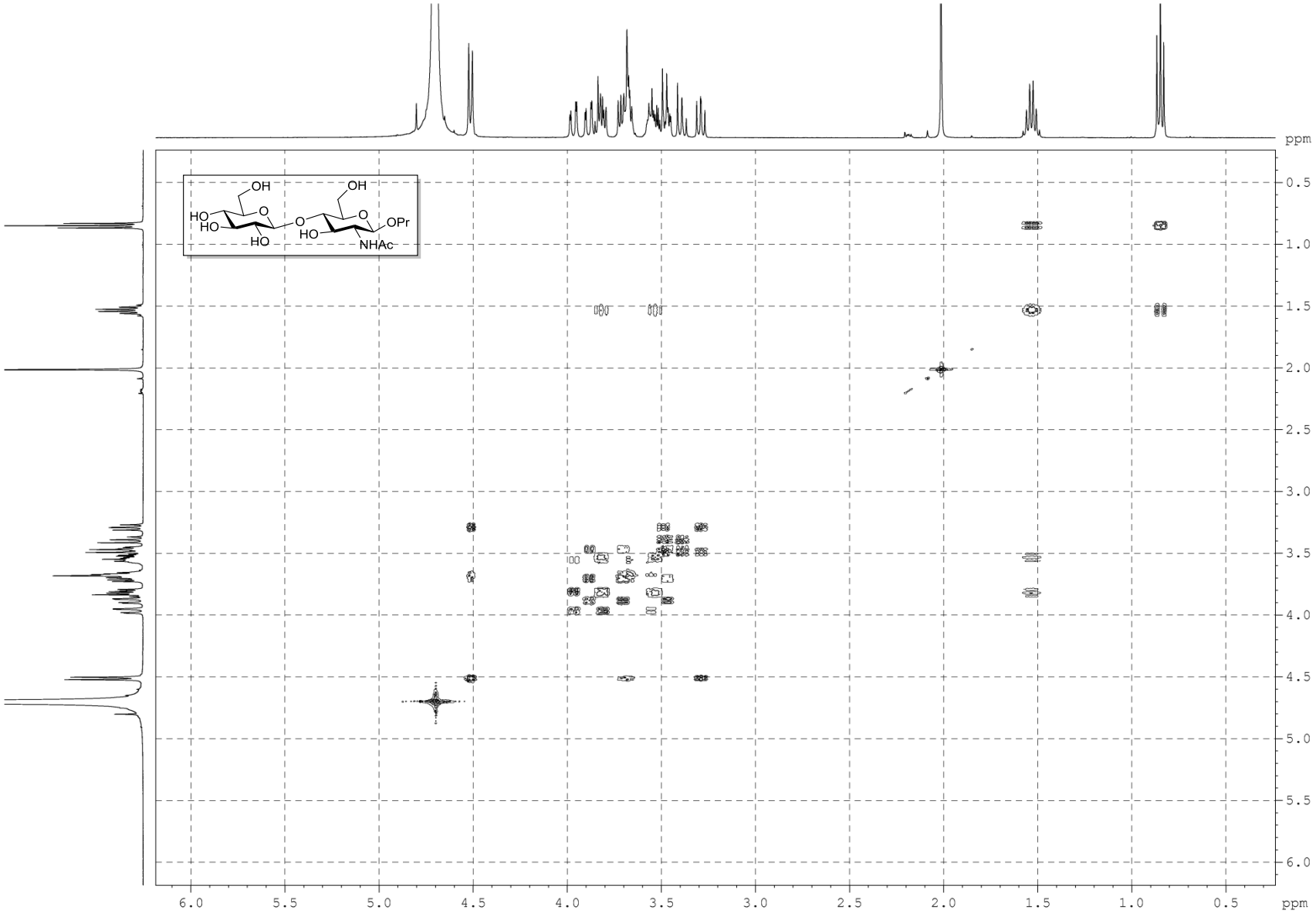

OBn
OBn
BnO
BnO
BnO
O
O
HO
O
OAll
NHAc
ppm
60
65
70
75
80
85
90
95
100
105
5.1
5.0
4.9
4.8
4.7
4.6
4.5
4.4
4.3
4.2
4.1
4.0
3.9
3.8
3.7
3.6
3.5
3.4
3.3
3.2
3.1
ppm

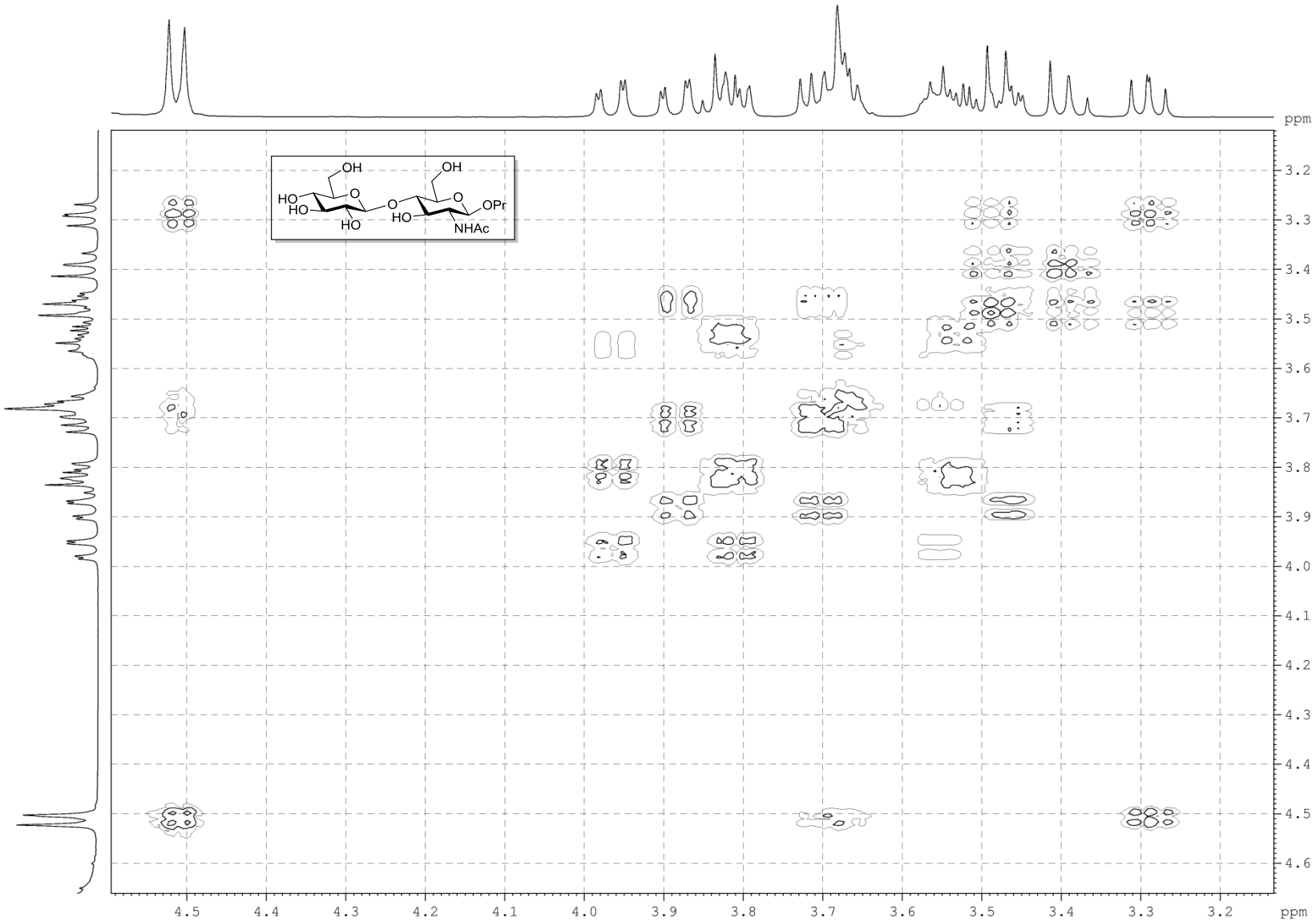
Compound 16: **Propyl β-D-glucopyranosyl-(1→4)-2-acetamido-2-deoxy-β-D-glucopyranoside**

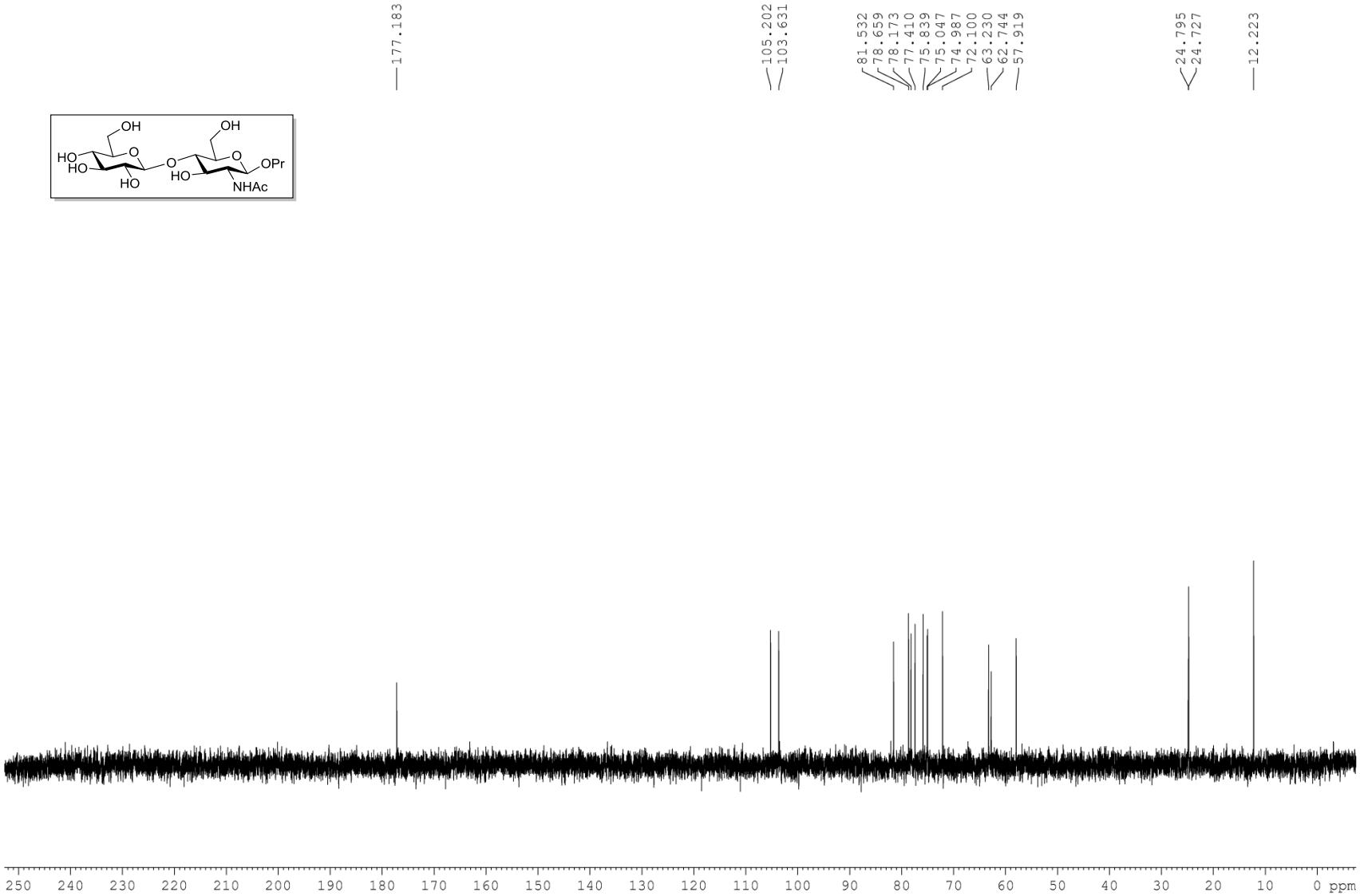


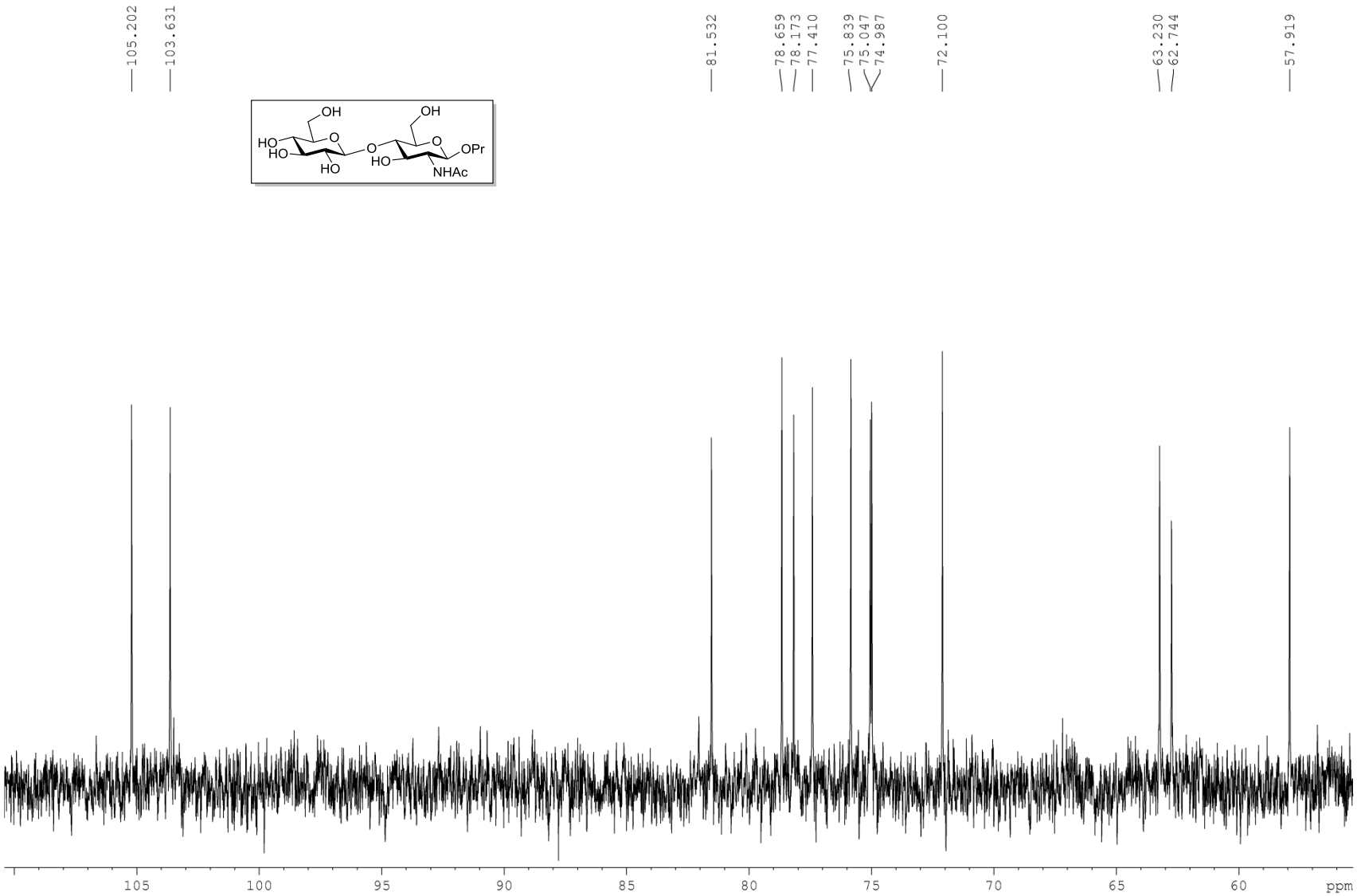

4.5224
4.5028
3.9847
3.9792
3.9539
3.9486
3.9037
3.8984
3.8727
3.8677
3.8511
3.8354
3.8223
3.8103
3.8046
3.7921
3.7283
3.7143
3.6978
3.6921
3.6811
3.6722
3.6664
3.6565
3.5718
3.5648
3.5485
3.5398
3.5323
3.5232
3.5155
3.5069
3.4929
3.4780
3.4697
3.4627
3.4539
3.4485
3.4138
3.3906
3.3671
3.3119
3.2919
3.2889
3.2688
OH
OH
HO
HO
HO
O
O
O
HO
OPr
NHAc
2.13
1.02
3.00
3.97
5.10
1.00
4.60 4.55 4.50 4.45 4.40 4.35 4.30 4.25 4.20 4.15 4.10 4.05 4.00 3.95 3.90 3.85 3.80 3.75 3.70 3.65 3.60 3.55 3.50 3.45 3.40 3.35 3.30 ppm


2.0137
1.5590
1.5425
1.5243
1.5077
0.8665
0.8480
0.8295
OH
OH
HO
HO
HO
O
O
O
HO
OPr
NHAc
2.75
1.96
2.91
2.3
2.2
2.1
2.0
1.9
1.8
1.7
1.6
1.5
1.4
1.3
1.2
1.1
1.0
0.9
0.8
0.7
0.6
0.5
ppm

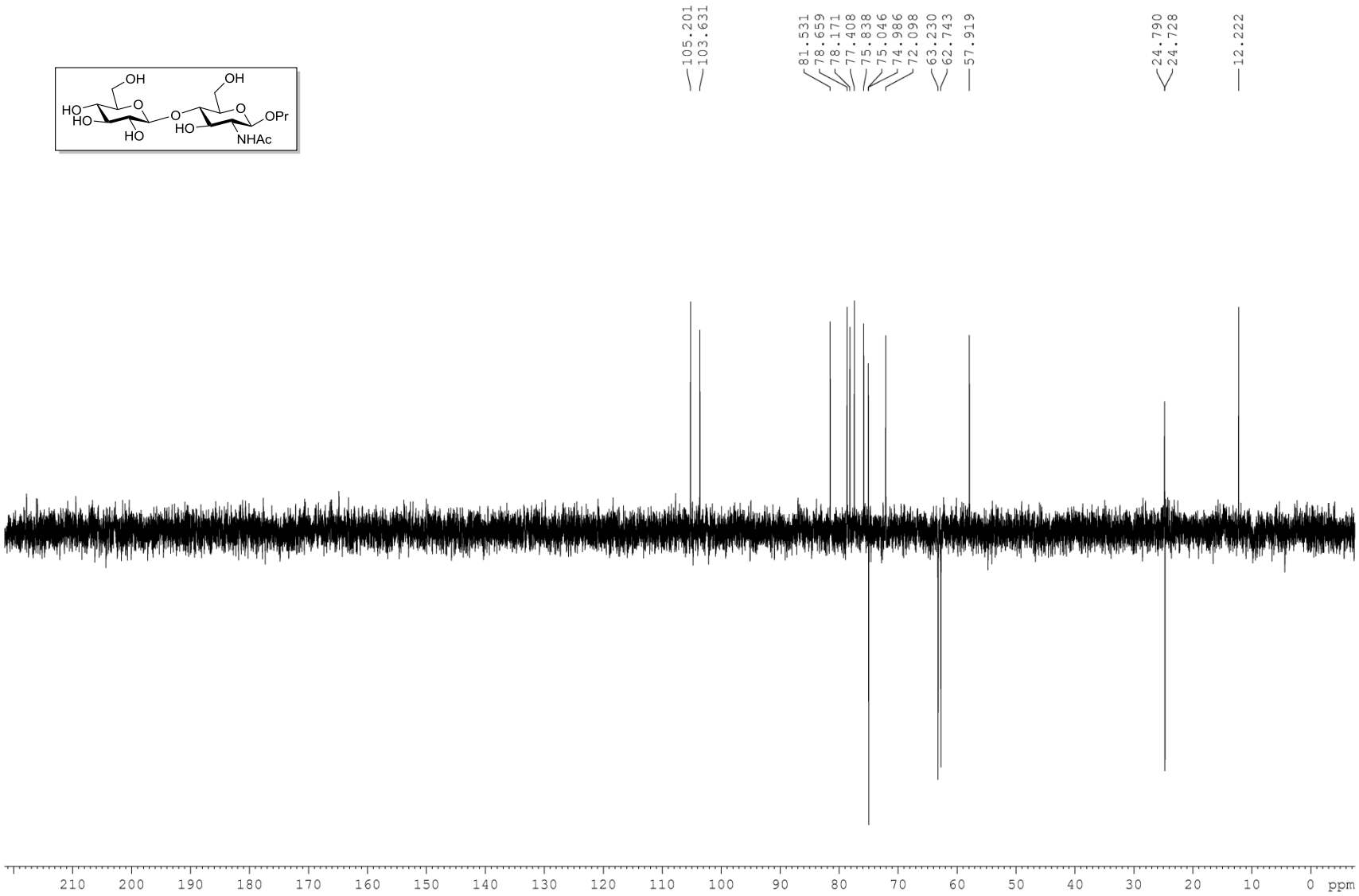

OH
OH
HO
HO
HO
O
O
O
HO
OPr
NHAc
ppm
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
5.5
6.0
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
ppm

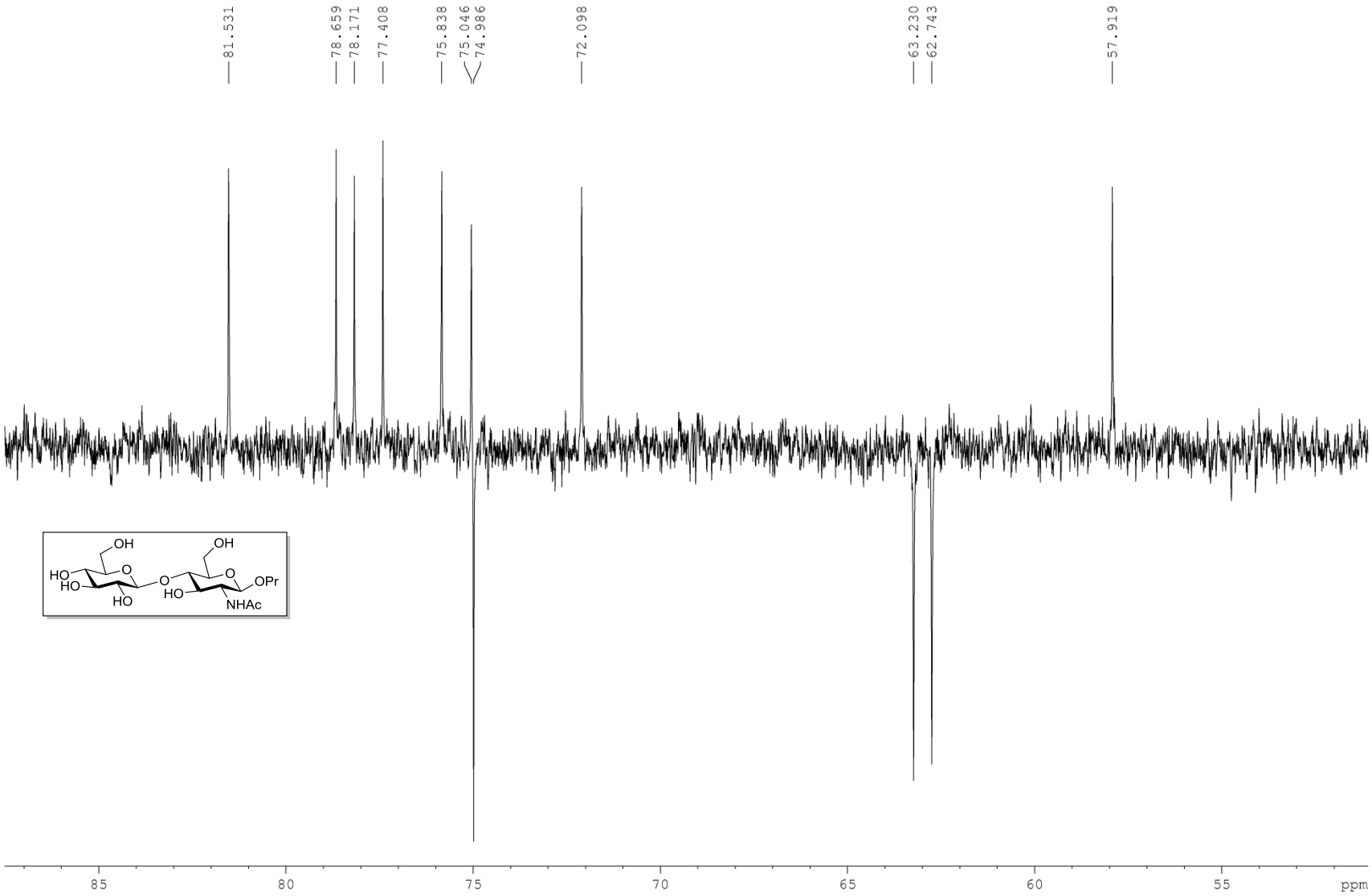

OH
OH
HO
HO
HO
O
O
O
HO
OPr
NHAc
ppm
3.2
3.3
3.4
3.5
3.6
3.7
3.8
3.9
4.0
4.1
4.2
4.3
4.4
4.5
4.6
4.5
4.4
4.3
4.2
4.1
4.0
3.9
3.8
3.7
3.6
3.5
3.4
3.3
3.2
ppm

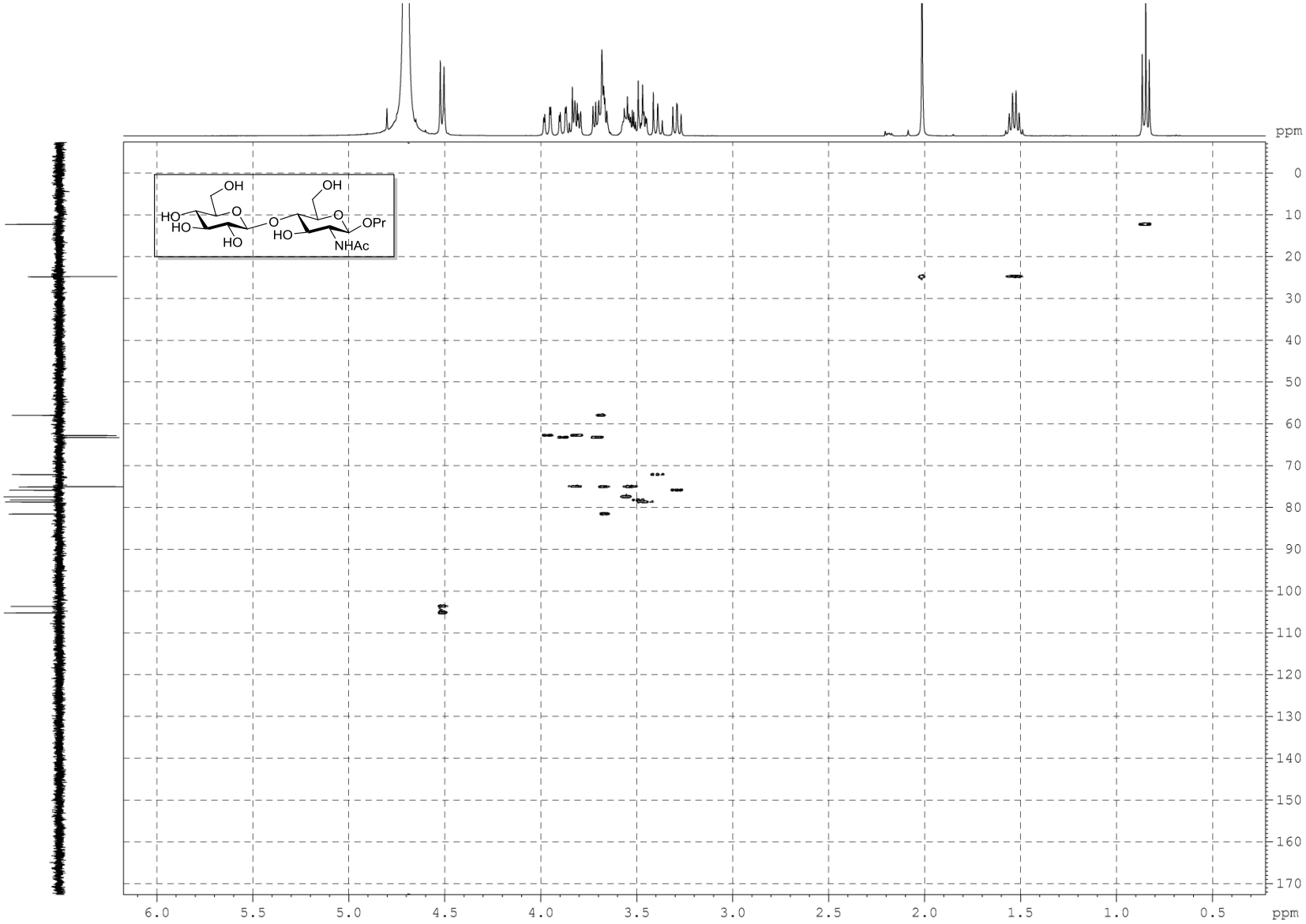

177.183
105.202
103.631
81.532
78.659
78.173
77.410
75.839
75.047
74.987
72.100
63.230
62.744
57.919
24.795
24.727
12.223
OH
OH
HO
HO
HO
O
O
O
HO
OPr
NHAc
250 240 230 220 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 ppm

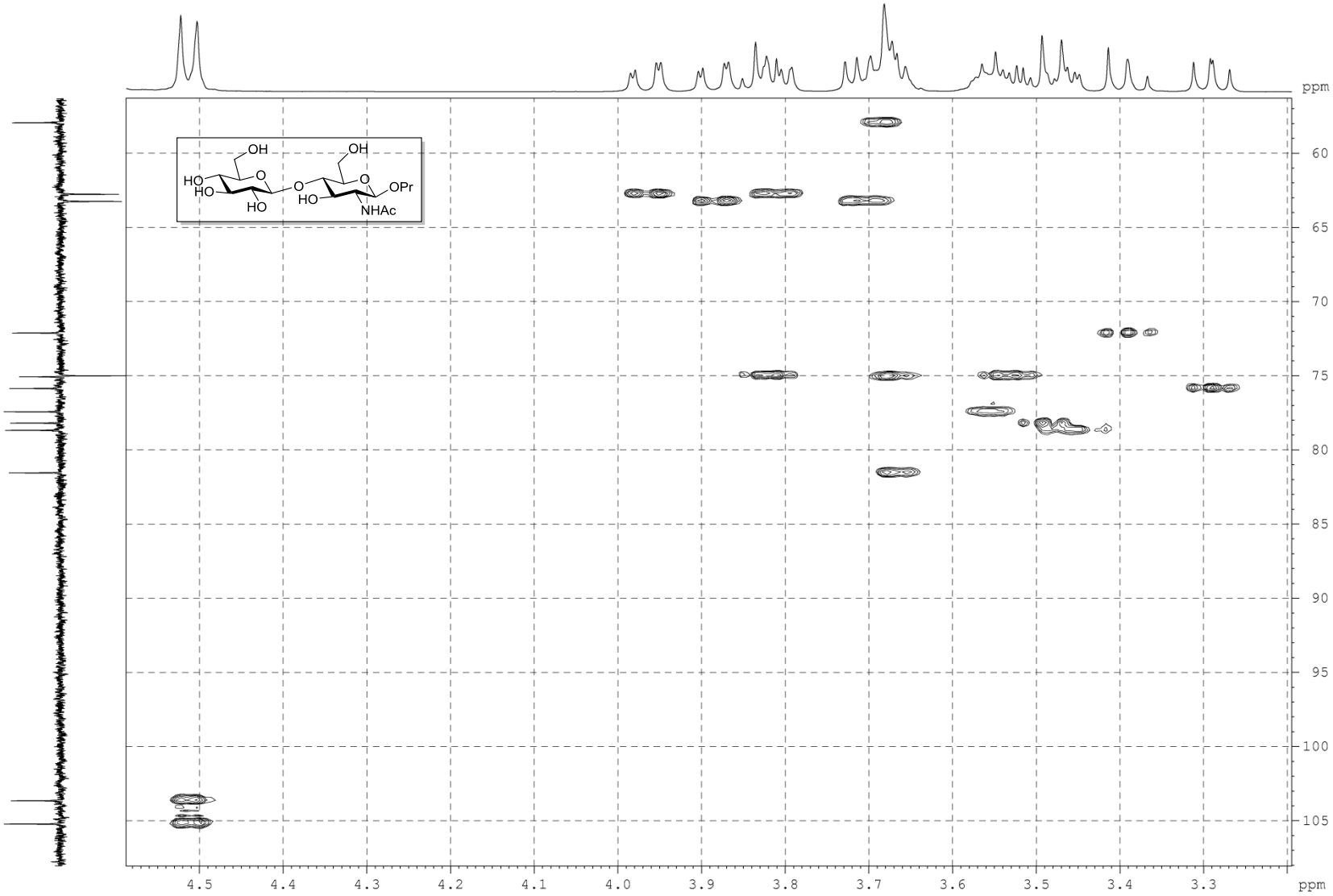

105.202
103.631
81.532
78.659
78.173
77.410
75.839
75.047
74.987
72.100
63.230
62.744
57.919
OH
OH
HO
HO
HO
O
O
O
HO
OPr
NHAc
105
100
95
90
85
80
75
70
65
60
ppm

OH
OH
HO
HO
O
O
O
HO
HO
OPr
HO
NHAc

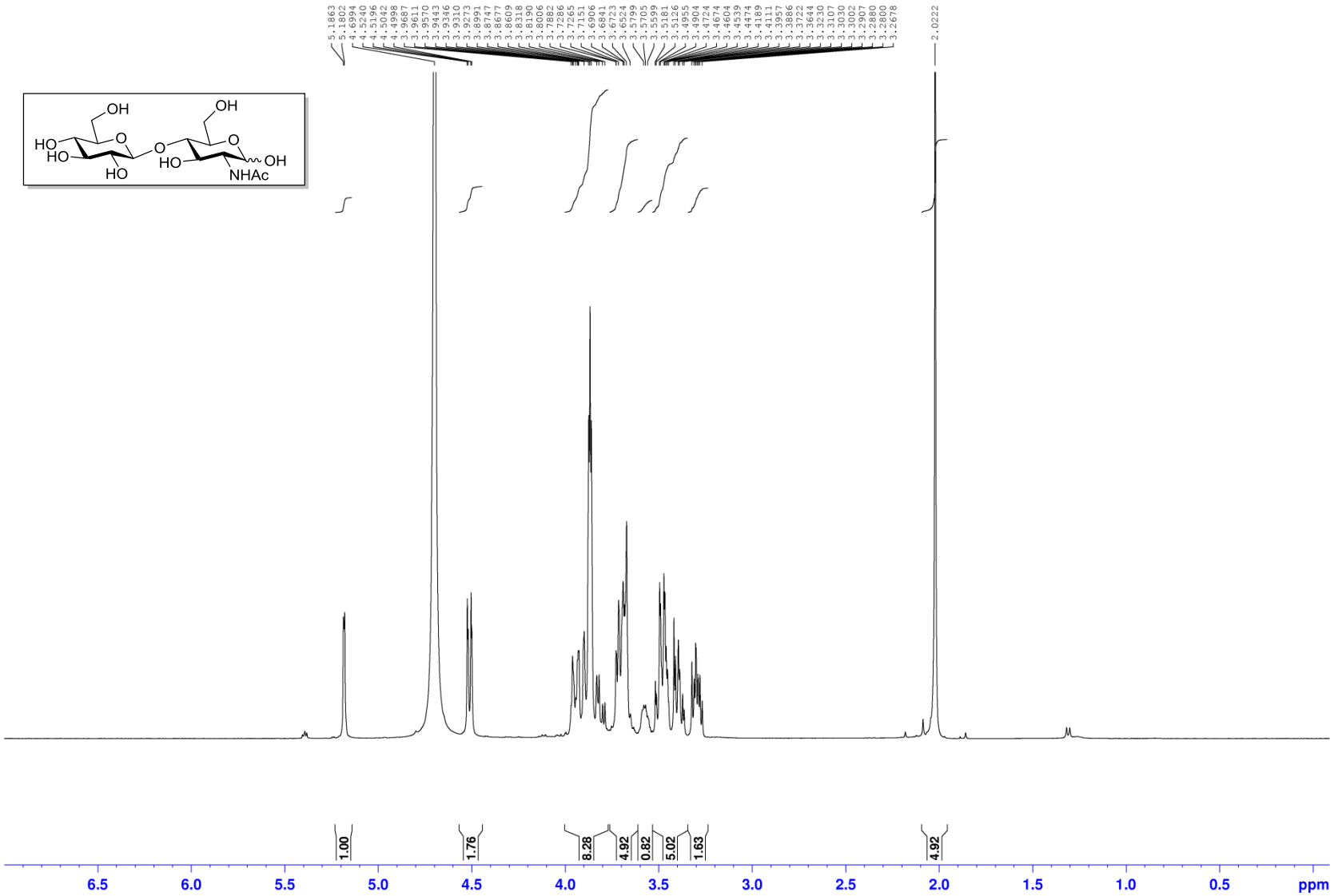

105.201
103.631
81.531
78.659
78.171
77.408
75.838
75.046
74.986
72.098
63.230
62.743
57.919
24.790
24.728
12.222
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 ppm

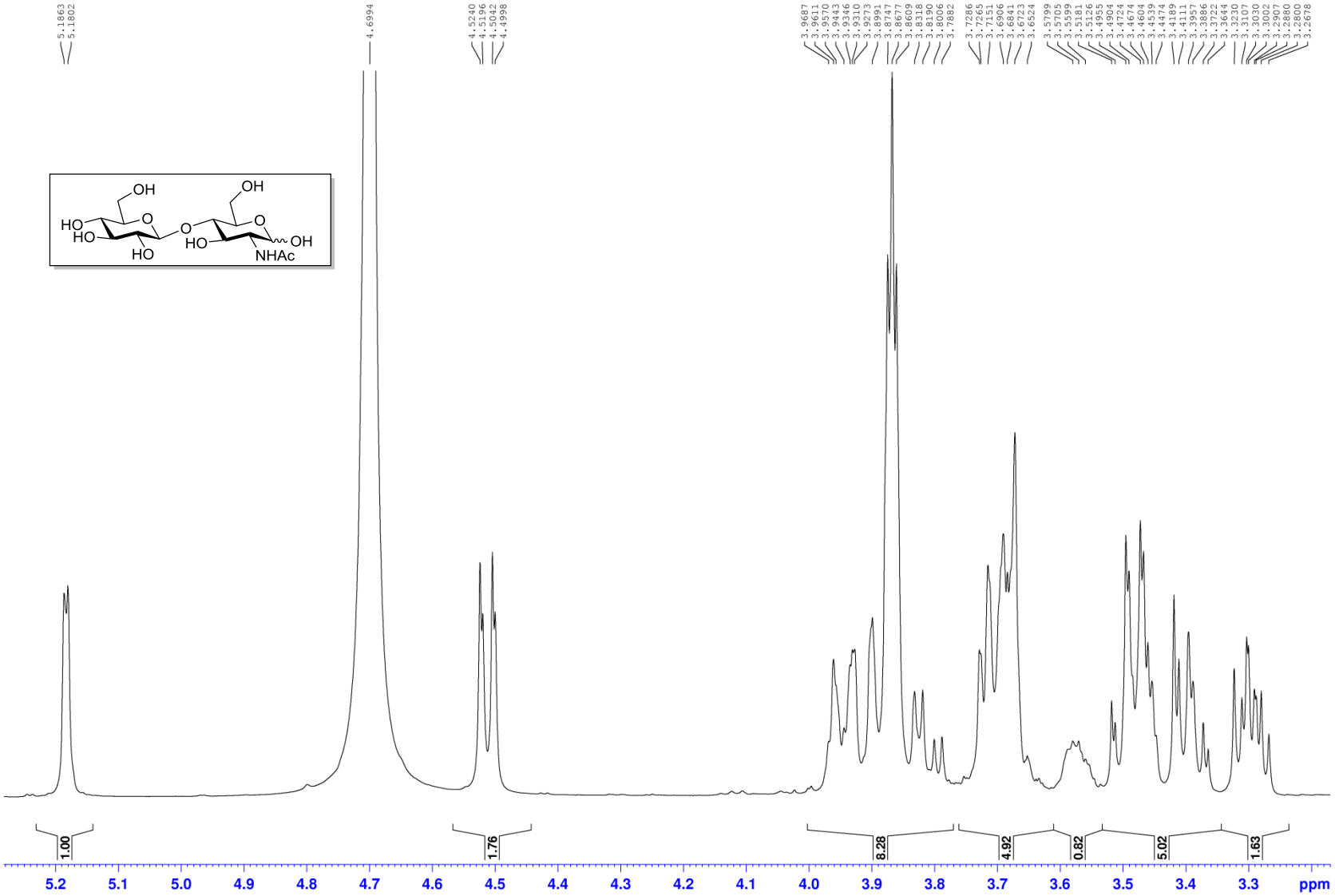

81.531
78.659
78.171
77.408
75.838
75.046
74.986
72.098
63.230
62.743
57.919
OH
HO
HO
HO
O
O
OH
O
HO
OPr
NHAc
85
80
75
70
65
60
55
ppm

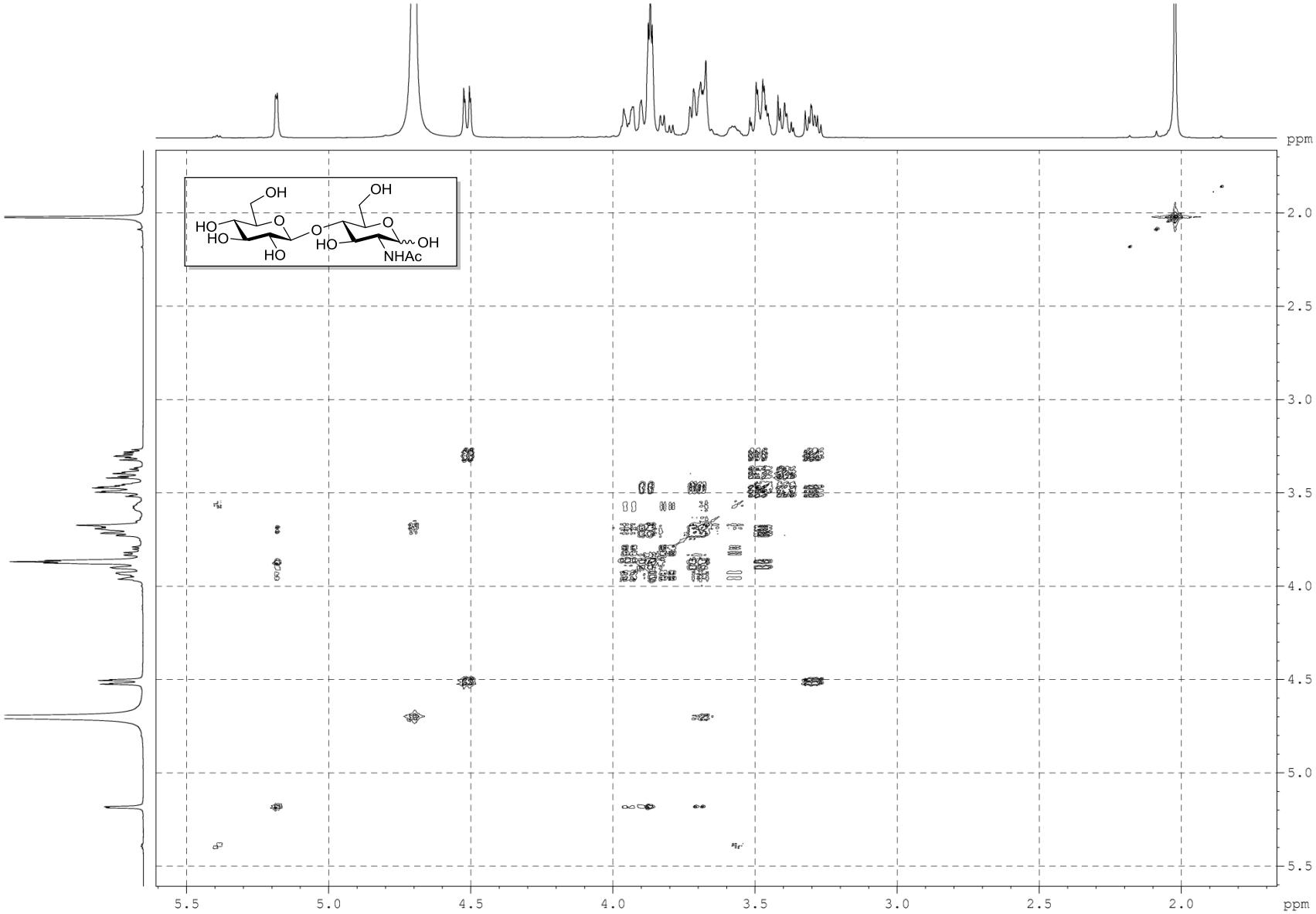

OH
OH
HO
HO
O
O
O
OPr
HO
HO
NHAc
ppm
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
ppm

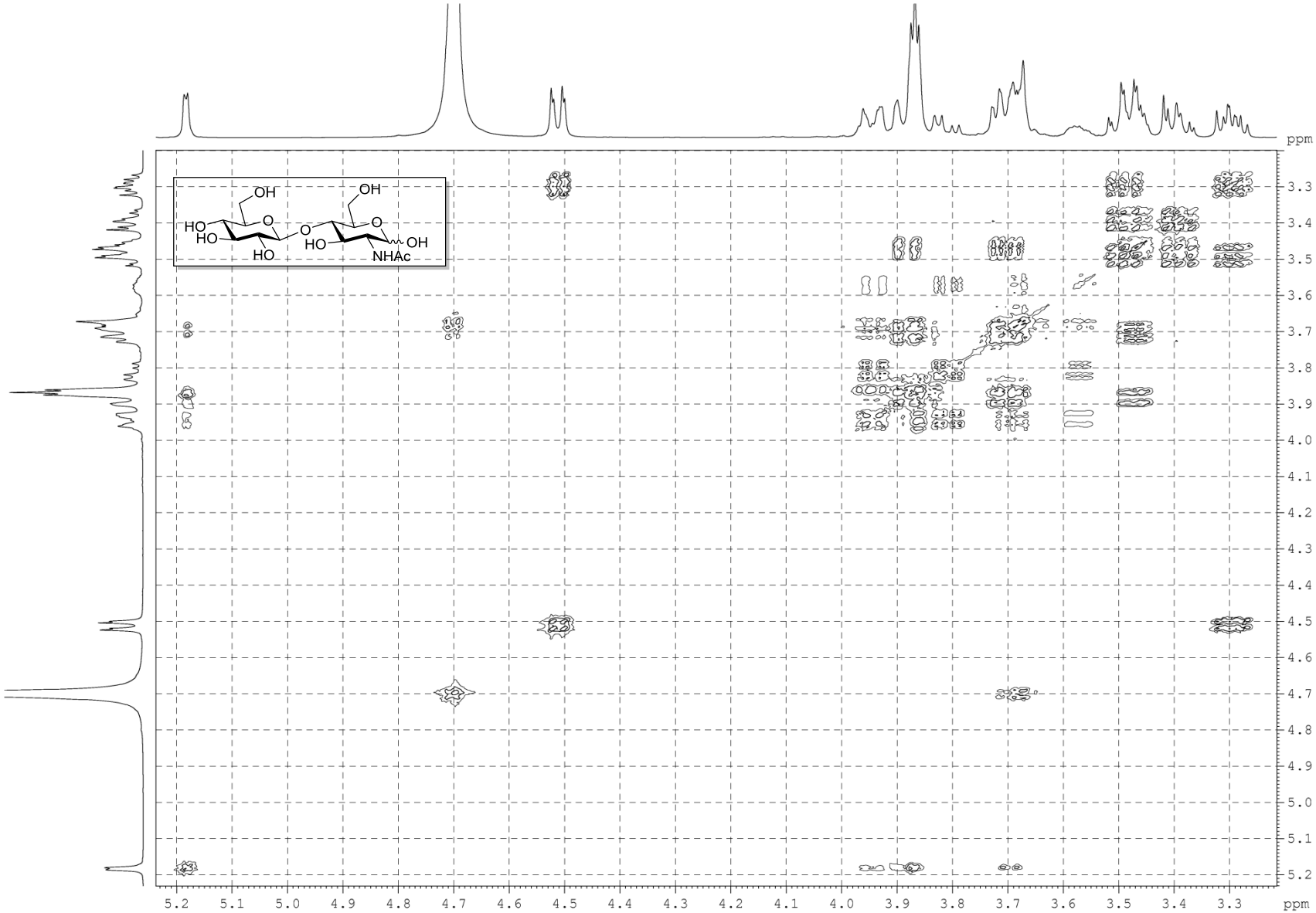

OH
OH
HO
HO
HO
O
O
HO
O
OPr
NHAc
ppm
60
65
70
75
80
85
90
95
100
105
4.5
4.4
4.3
4.2
4.1
4.0
3.9
3.8
3.7
3.6
3.5
3.4
3.3
ppm

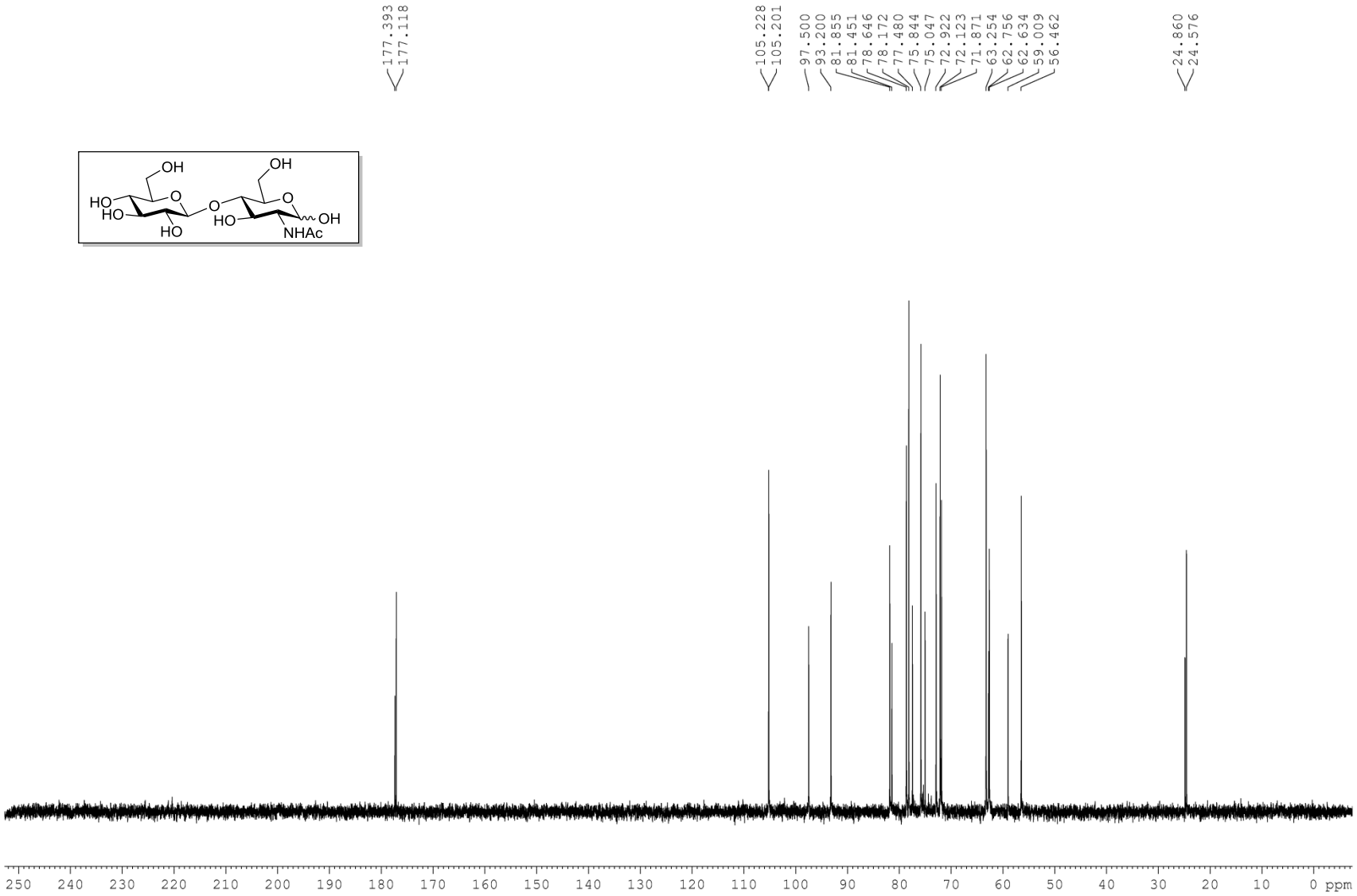
Compound 17: **β-D-glucopyranosyl-(1→4)-2-acetamido-2-deoxy-α/β-D-glucopyranose**

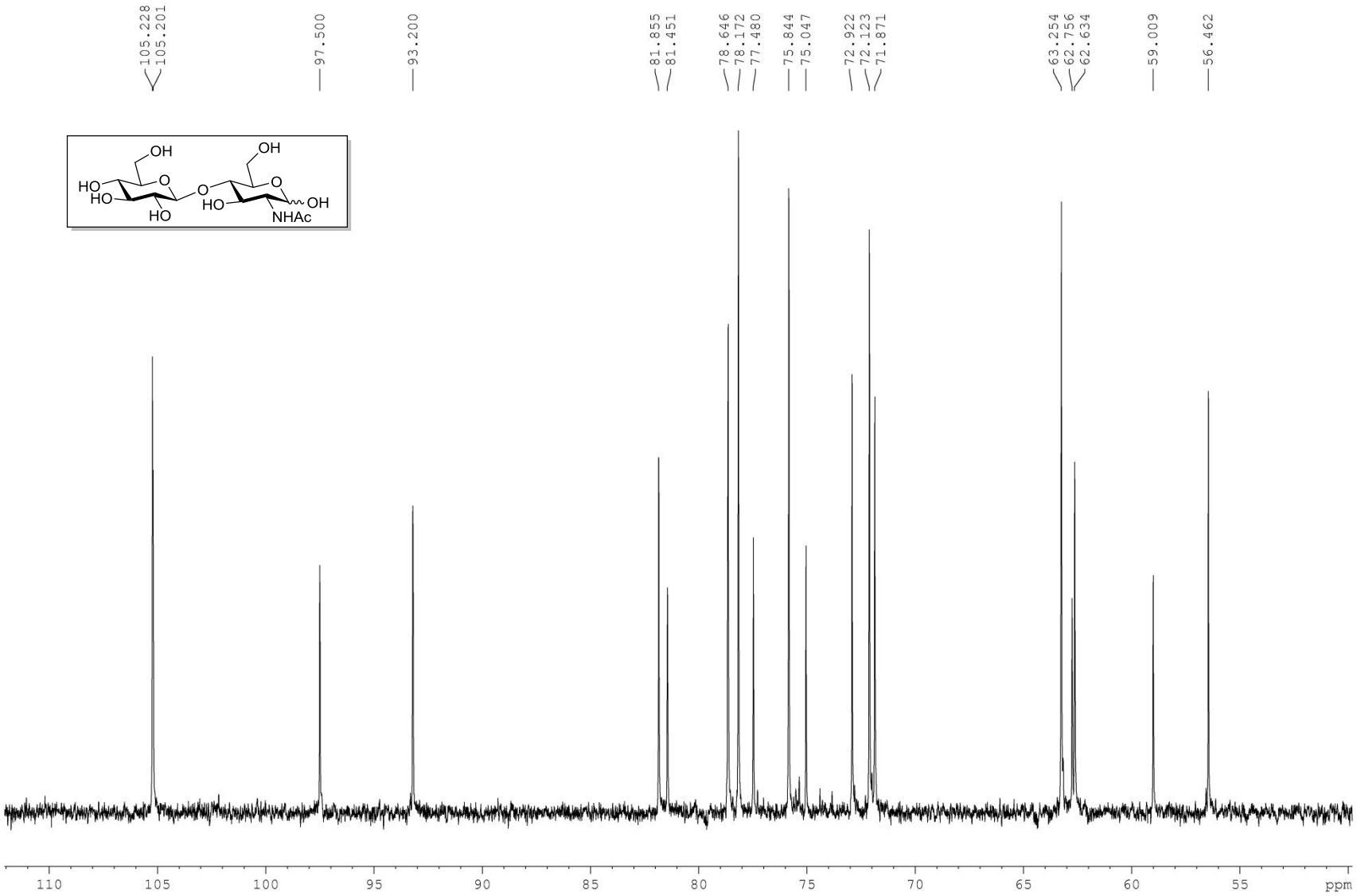


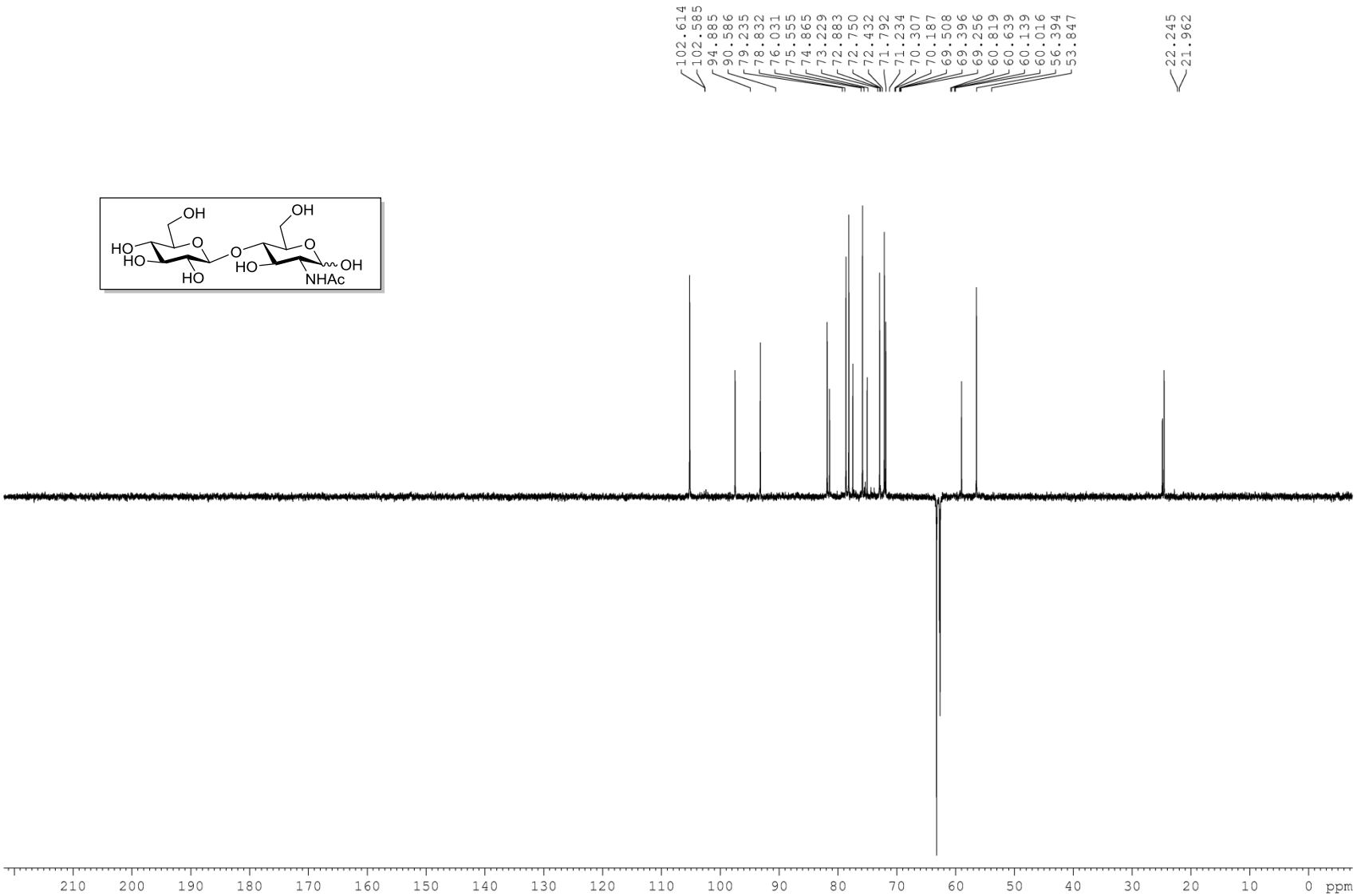

5.1863
5.1802
4.6994
4.5240
4.5196
4.5042
4.4998
3.9687
3.9611
3.9370
3.9343
3.9346
3.9316
3.9273
3.8991
3.8747
3.8677
3.8609
3.8318
3.8190
3.8006
3.7882
3.7286
3.7265
3.7151
3.6906
3.6841
3.6723
3.6524
3.5799
3.5705
3.5599
3.5181
3.5126
3.4955
3.4904
3.4724
3.4674
3.4604
3.4539
3.4474
3.4189
3.4111
3.3957
3.3886
3.3722
3.3644
3.3230
3.3107
3.3030
3.3002
3.2907
3.2880
3.2800
3.2678
OH
HO
HO
HO
O
O
OH
O
HO
NHAc
OH
1.00
1.76
8.28
4.92
0.82
5.02
1.63
5.2
5.1
5.0
4.9
4.8
4.7
4.6
4.5
4.4
4.3
4.2
4.1
4.0
3.9
3.8
3.7
3.6
3.5
3.4
3.3
ppm

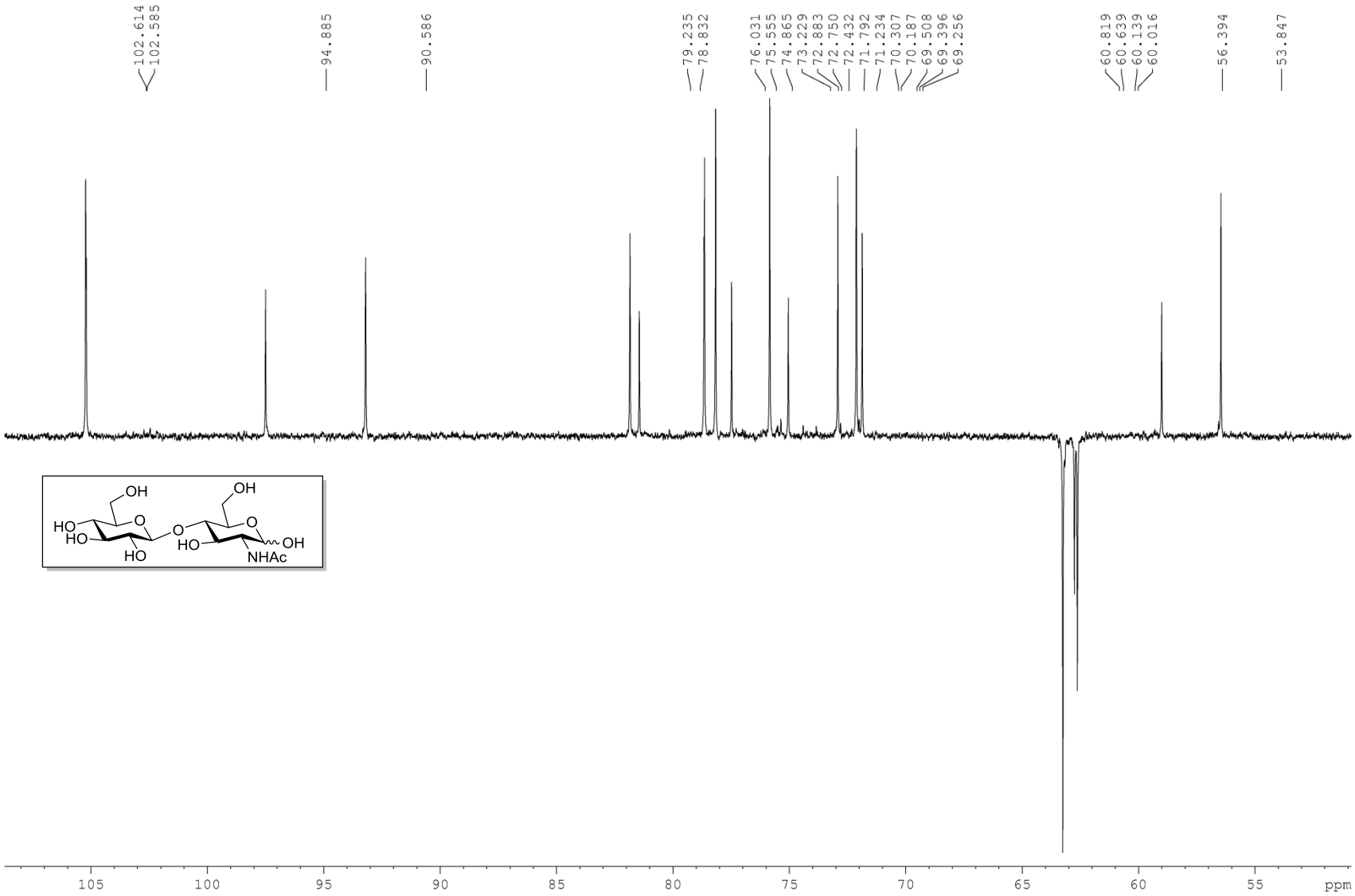

OH
OH
HO
HO
O
O
O
HO
HO
OH
HO
NHAc
ppm
2.0
2.5
3.0
3.5
4.0
4.5
5.0
5.5
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
ppm

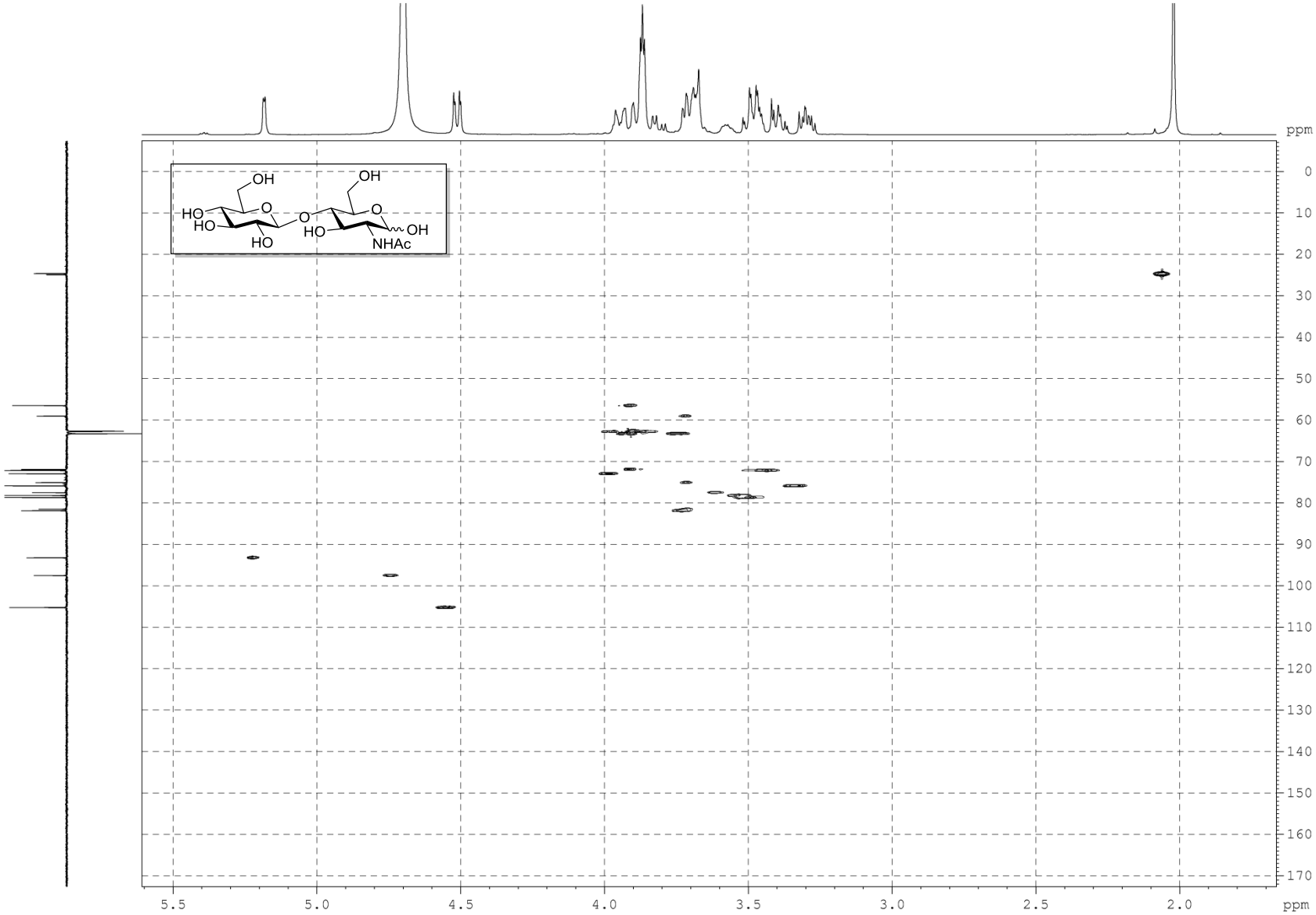

OH
OH
HO
HO
O
O
O
HO
HO
OH
HO
NHAc
ppm
3.3
3.4
3.5
3.6
3.7
3.8
3.9
4.0
4.1
4.2
4.3
4.4
4.5
4.6
4.7
4.8
4.9
5.0
5.1
5.2
5.2 5.1 5.0 4.9 4.8 4.7 4.6 4.5 4.4 4.3 4.2 4.1 4.0 3.9 3.8 3.7 3.6 3.5 3.4 3.3
ppm

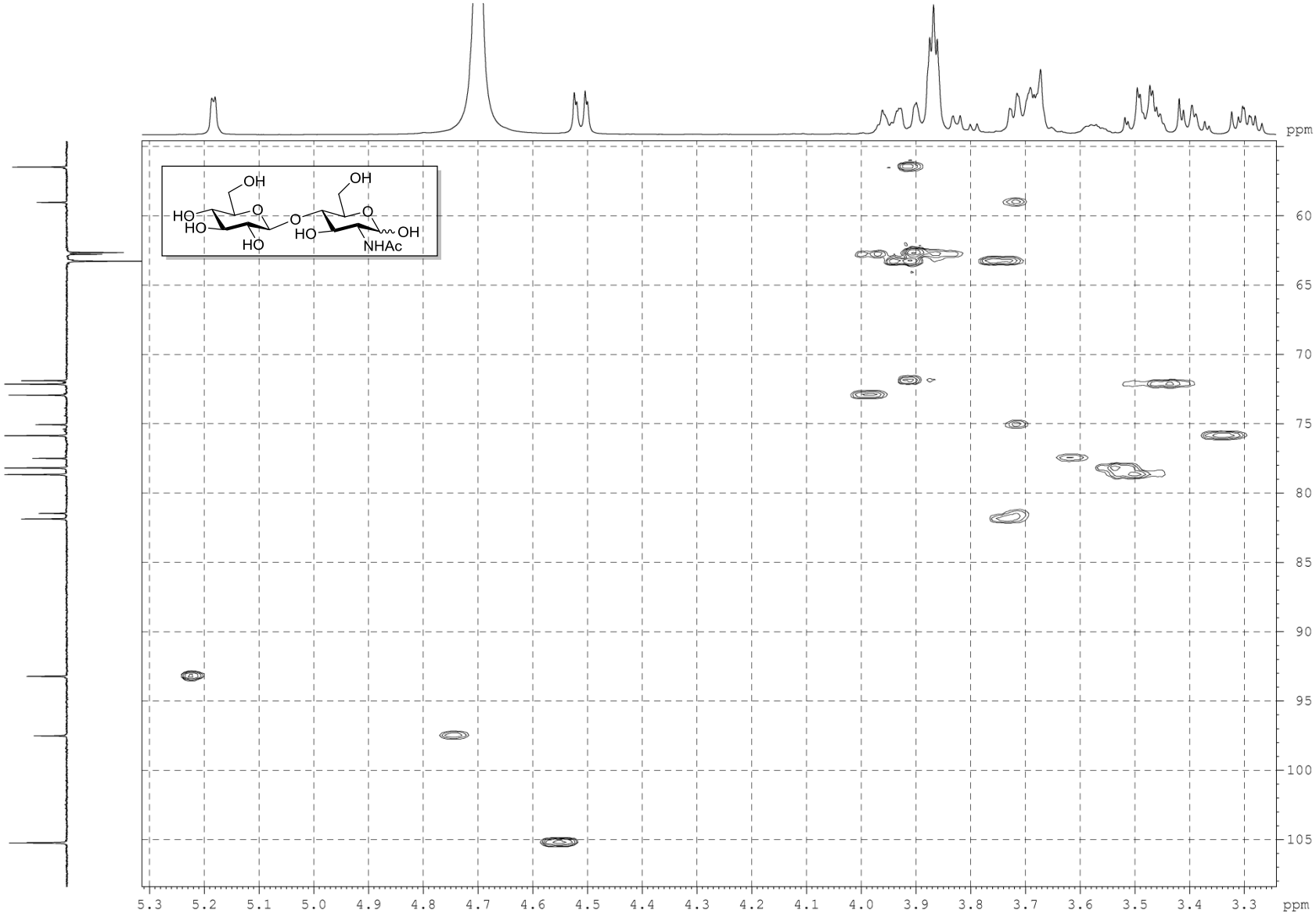

177.393
177.118
105.228
105.201
97.500
93.200
81.855
81.451
78.646
78.172
77.480
75.844
75.047
72.922
72.123
71.871
63.254
62.756
62.634
59.009
56.462
24.860
24.576
OH
HO
HO
HO
O
O
OH
HO
HO
O
OH
NHAc
250 240 230 220 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 ppm


105.228
105.201
97.500
93.200
81.855
81.451
78.646
78.172
77.480
75.844
75.047
72.922
72.123
71.871
63.254
62.756
62.634
59.009
56.462
OH
HO
HO
HO
O
O
OH
O
HO
OH
NHAc
110
105
100
95
90
85
80
75
70
65
60
55
ppm

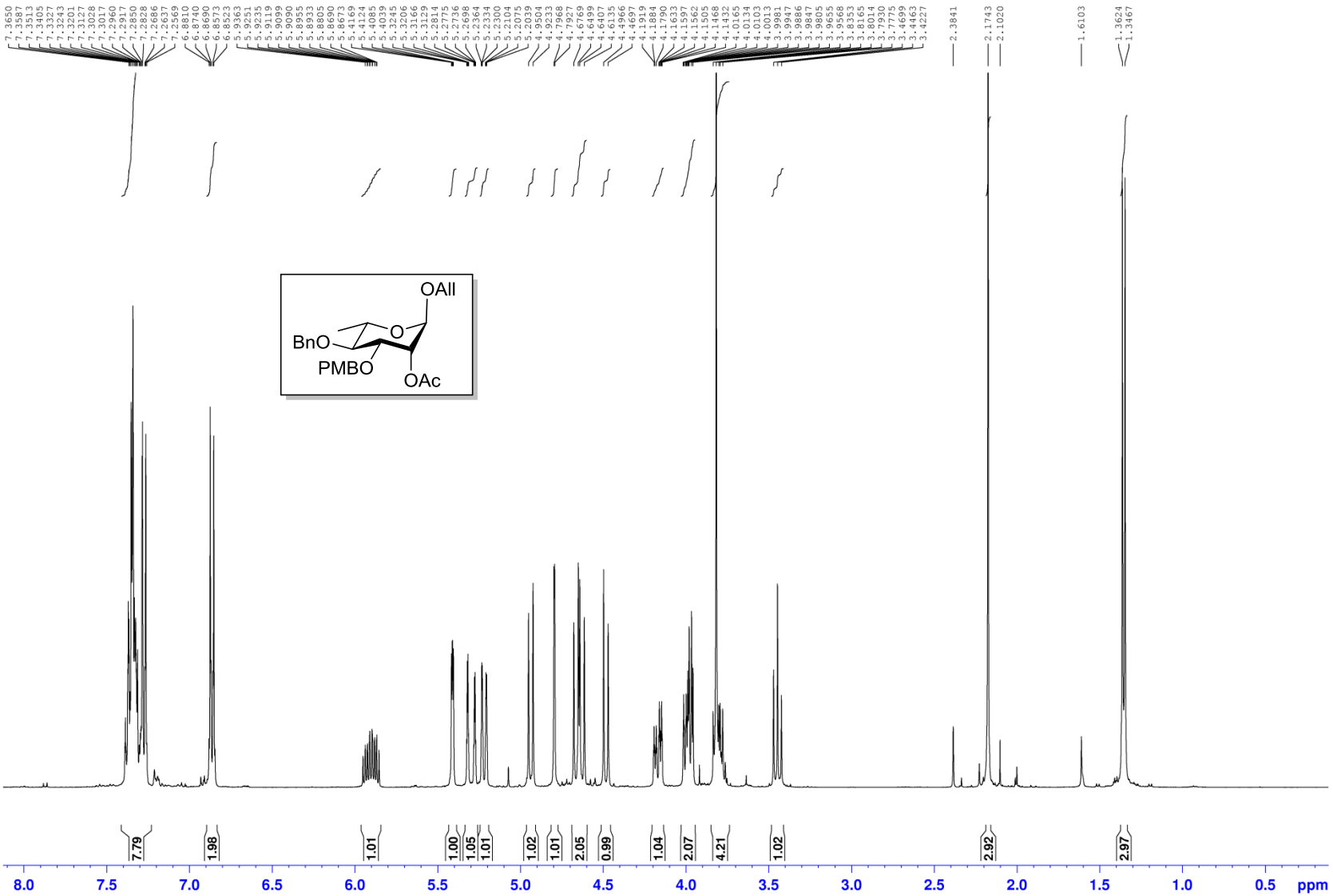

102.614
102.585
94.885
90.586
79.235
78.832
76.031
75.555
74.865
73.229
72.883
72.750
72.432
71.792
71.234
70.307
70.187
69.508
69.396
69.256
60.819
60.639
60.139
60.016
56.394
53.847
22.245
21.962
OH
HO
HO
HO
O
O
OH
HO
NHAc
OH
O
O
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 ppm

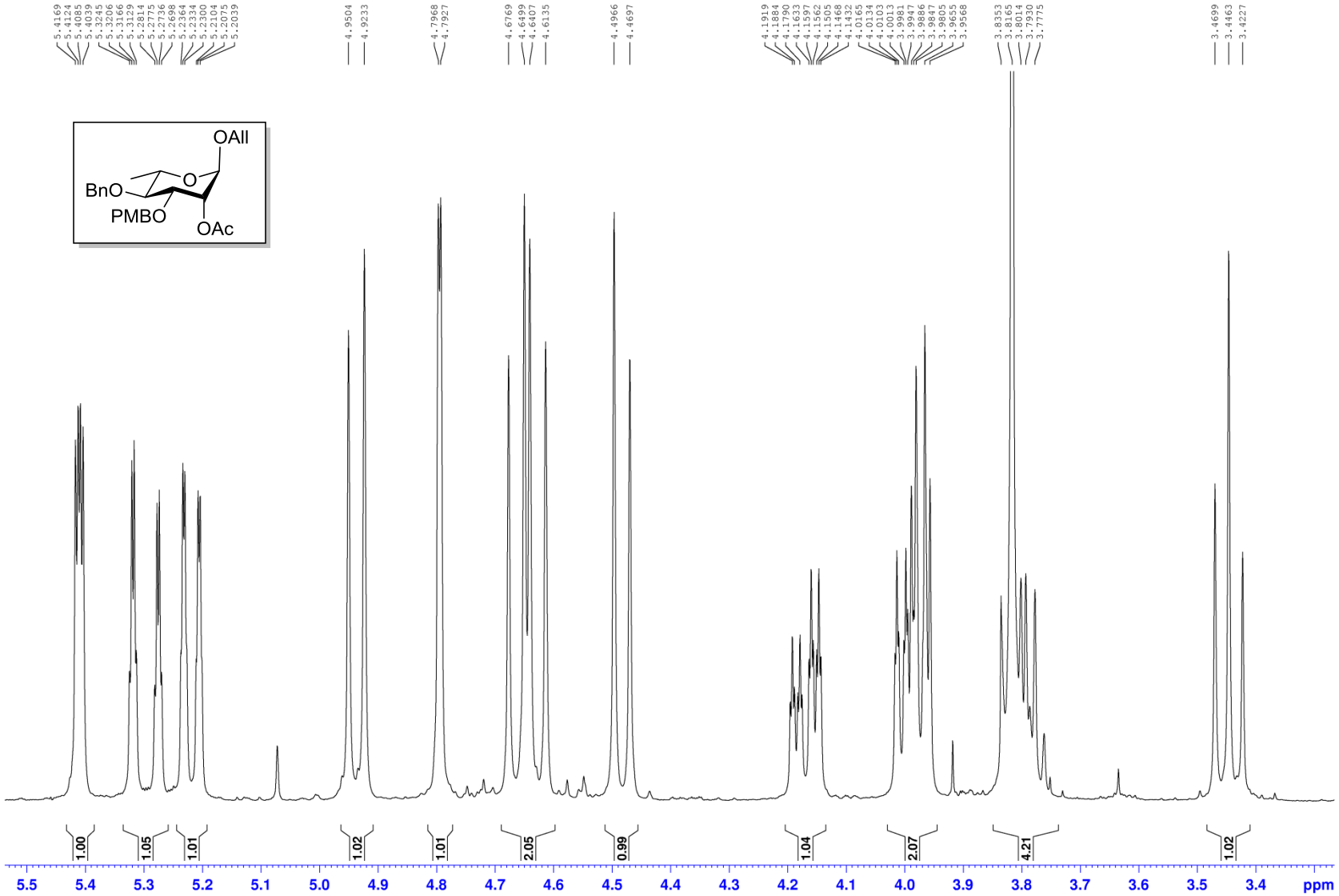

102.614
102.585
94.885
90.586
79.235
78.832
76.031
75.555
74.865
73.229
72.883
72.750
72.432
71.792
71.234
70.307
70.187
69.508
69.396
69.256
60.819
60.639
60.139
60.016
56.394
53.847
OH
HO
HO
HO
O
O
OH
O
HO
OH
NHAc
105
100
95
90
85
80
75
70
65
60
55
ppm

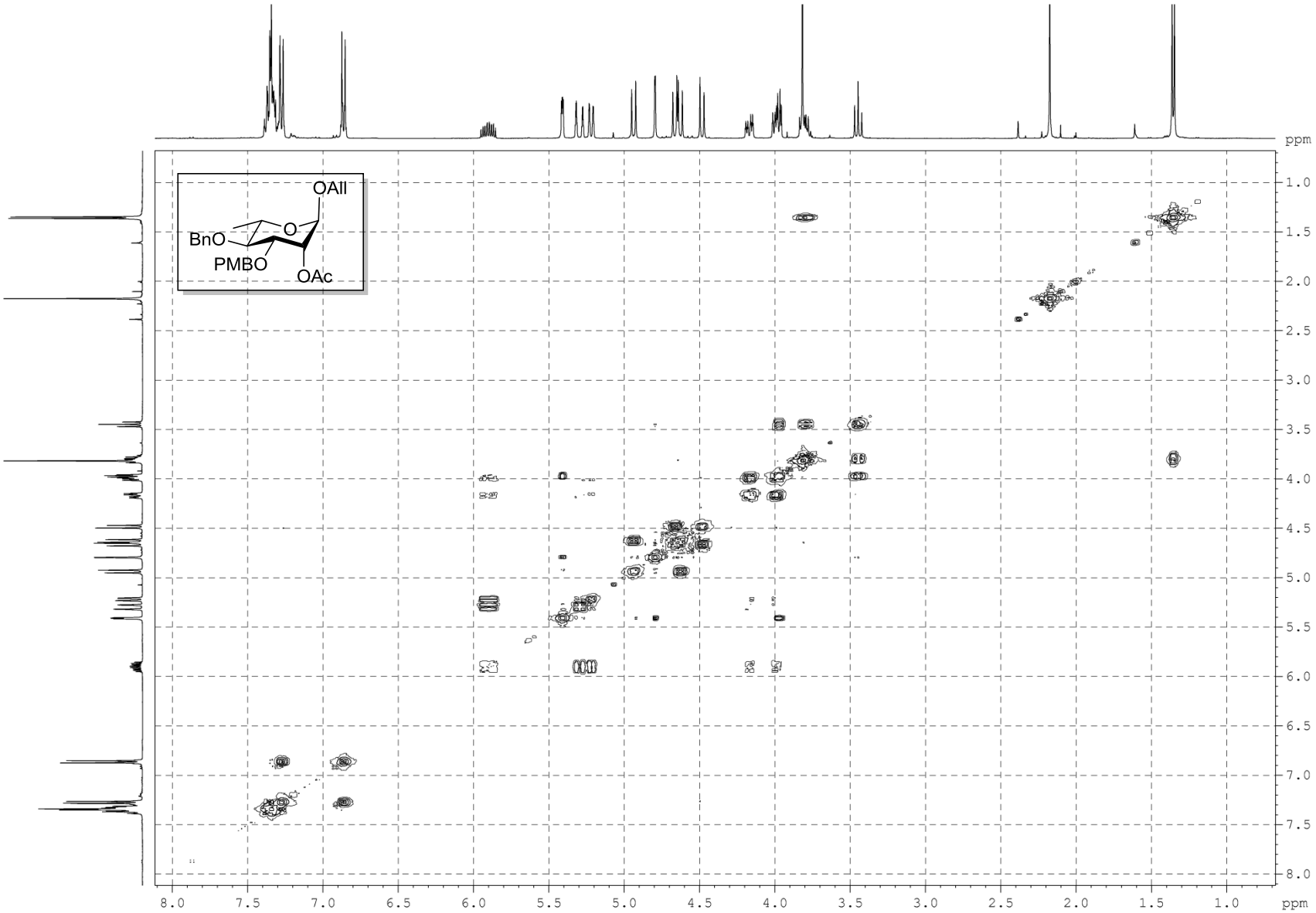

OH
OH
HO
HO
HO
O
O
O
HO
OH
NHAc
ppm
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
ppm

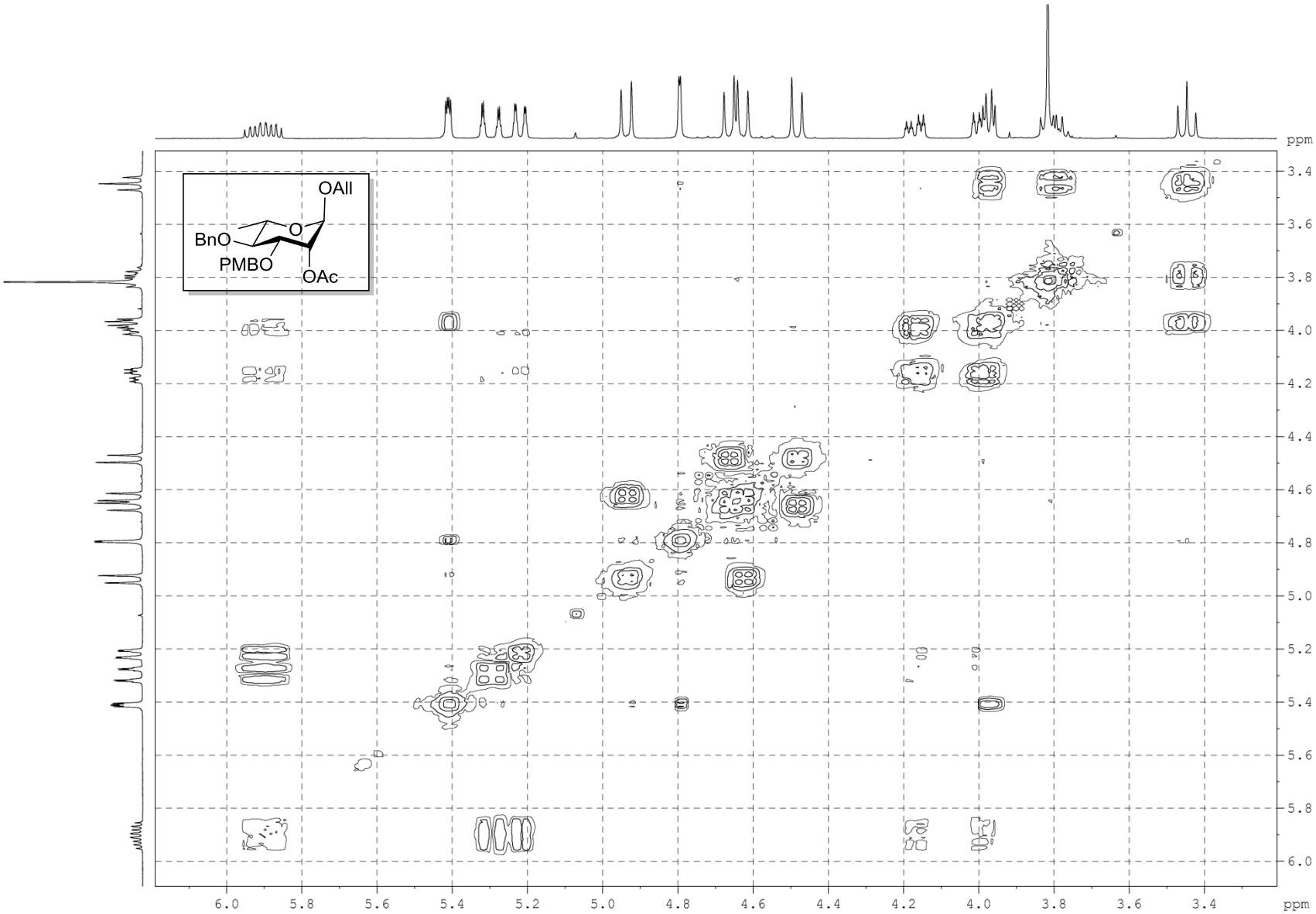

OH
OH
HO
HO
O
O
O
HO
HO
OH
HO
NHAc
ppm
60
65
70
75
80
85
90
95
100
105
5.3
5.2
5.1
5.0
4.9
4.8
4.7
4.6
4.5
4.4
4.3
4.2
4.1
4.0
3.9
3.8
3.7
3.6
3.5
3.4
3.3
ppm

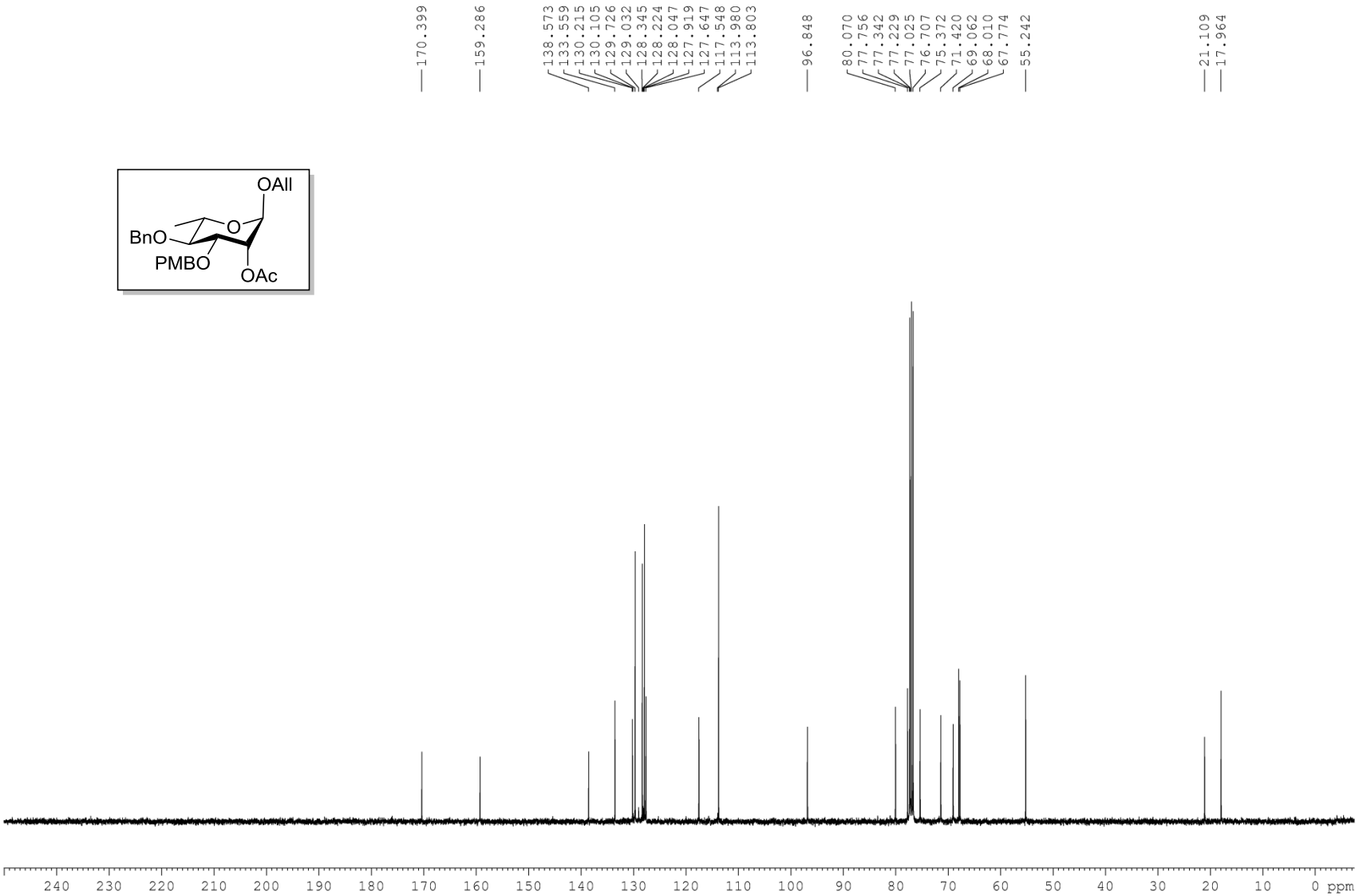
Compound 19: **Allyl 2-*O*-acetyl-4-*O*-benzyl-3-*O*-*para*-methoxybenzyl-α-L-rhamnopyranoside**

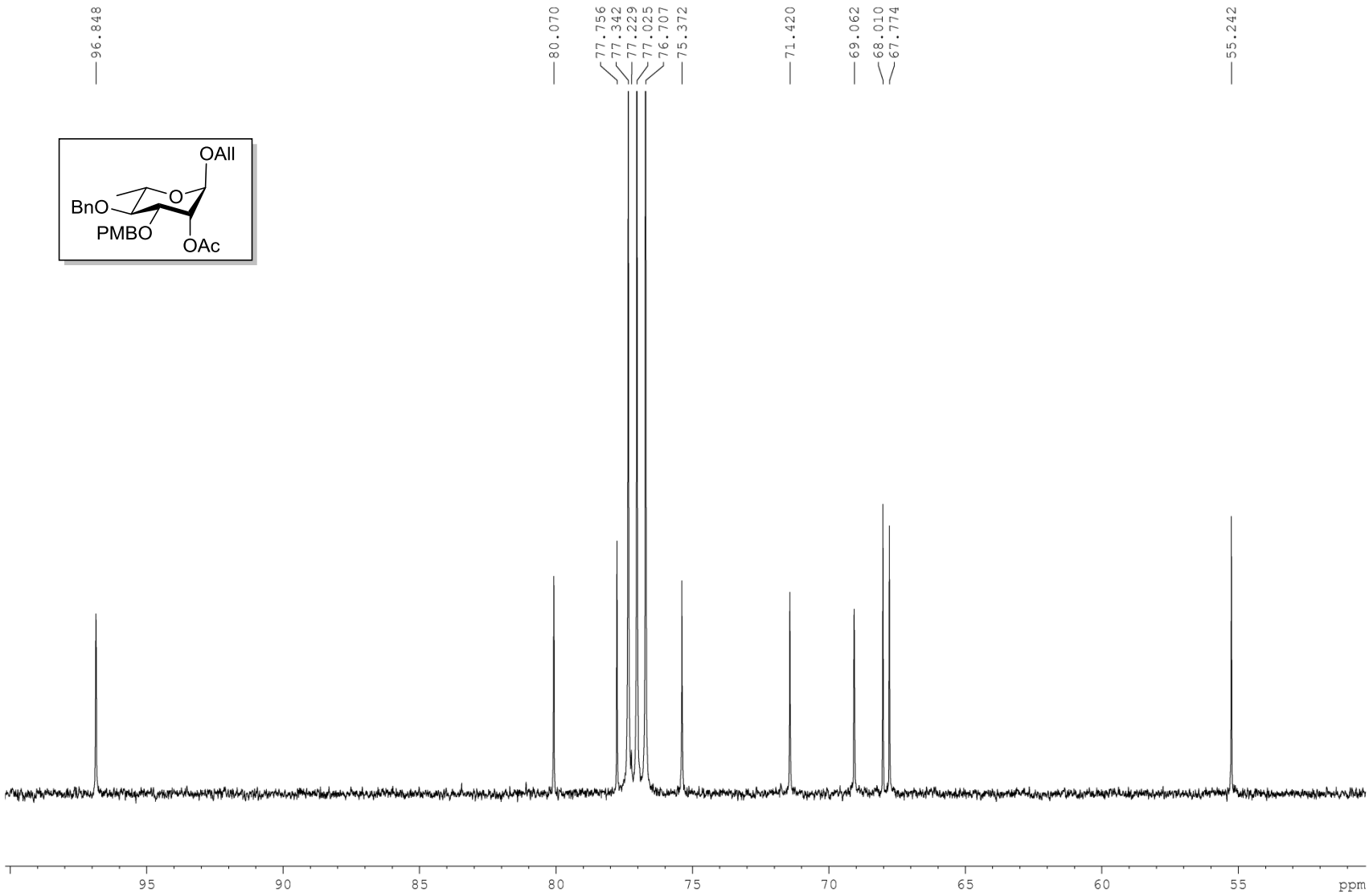


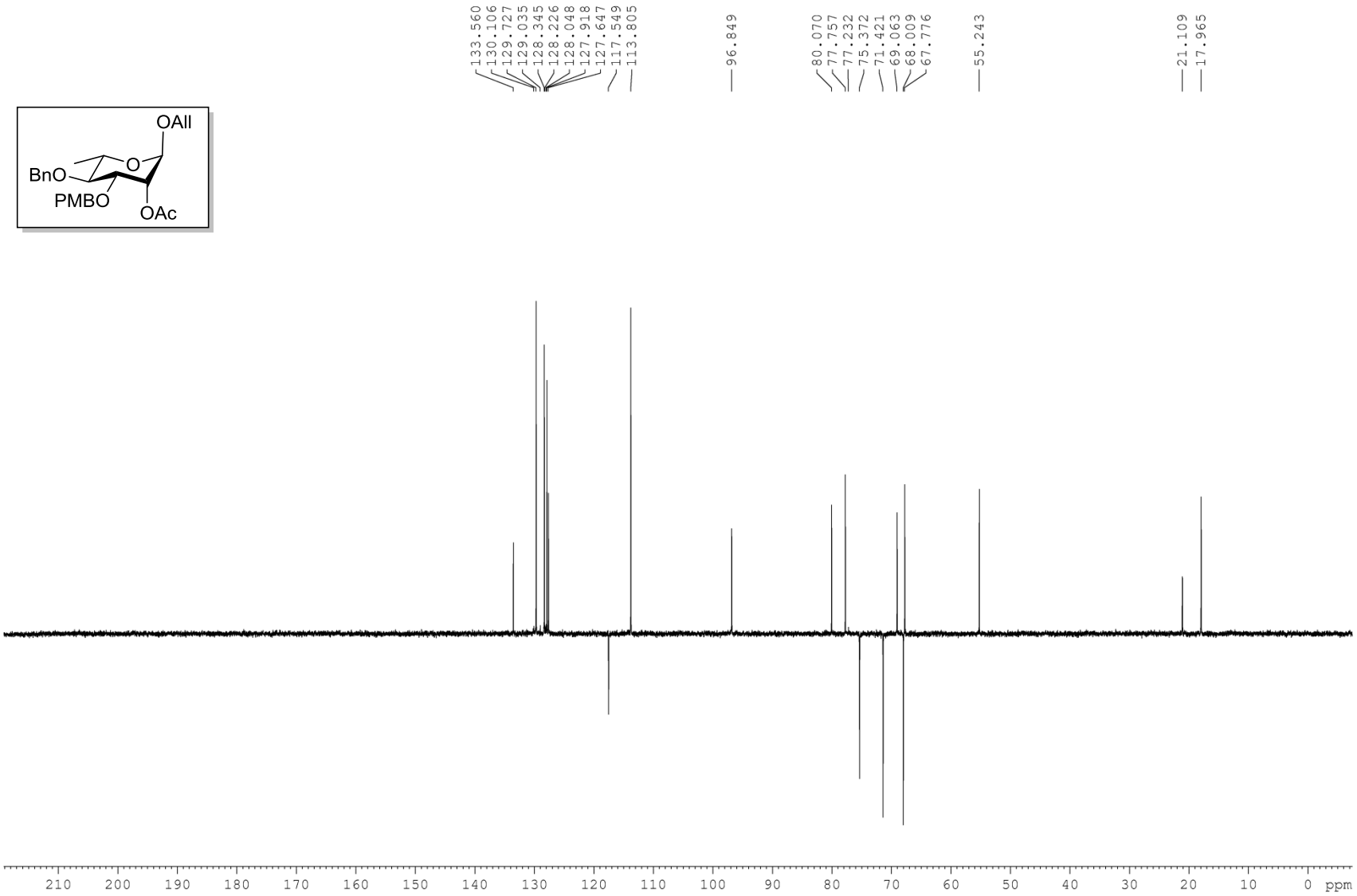

OAll
BnO
O
PMBO
OAc
5.4169
5.4124
5.4085
5.4049
5.3245
5.3206
5.3166
5.3129
5.2814
5.2775
5.2736
5.2698
5.2364
5.2334
5.2300
5.2104
5.2075
5.2039
4.9504
4.9233
4.7968
4.7927
4.6769
4.6499
4.6407
4.6135
4.4966
4.4697
4.1919
4.1884
4.1790
4.1633
4.1597
4.1562
4.1555
4.1468
4.1432
4.0165
4.0134
4.0103
4.0013
3.9981
3.9947
3.9886
3.9847
3.9805
3.9655
3.9568
3.8353
3.8165
3.8014
3.7930
3.7775
3.4699
3.4463
3.4227
1.00
1.05
1.01
1.02
1.01
2.05
0.99
1.04
2.07
4.21
1.02
5.5
5.4
5.3
5.2
5.1
5.0
4.9
4.8
4.7
4.6
4.5
4.4
4.3
4.2
4.1
4.0
3.9
3.8
3.7
3.6
3.5
3.4
ppm

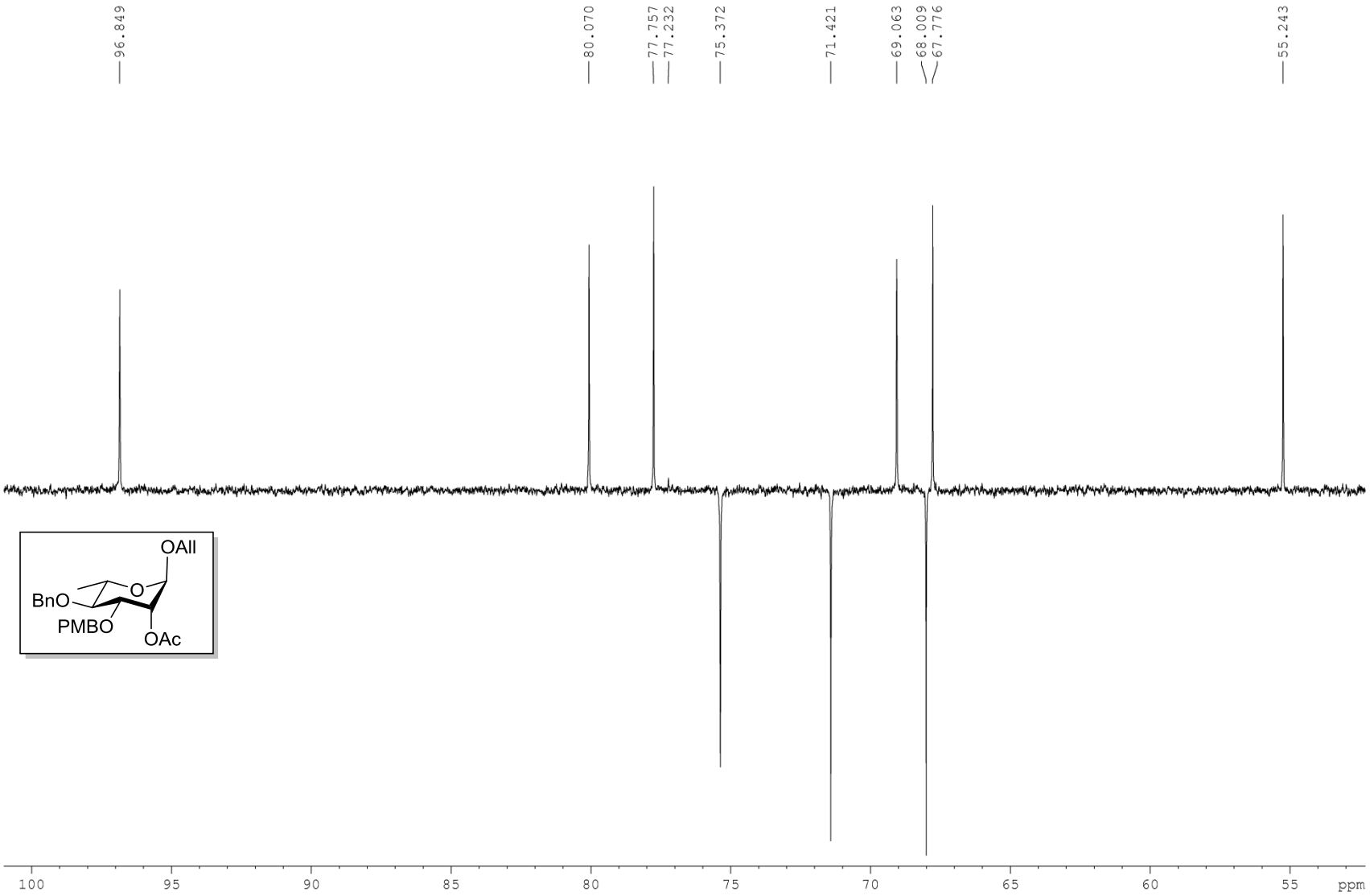

OAll
BnO
O
PMBO
OAc
ppm
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
5.5
6.0
6.5
7.0
7.5
8.0
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
ppm

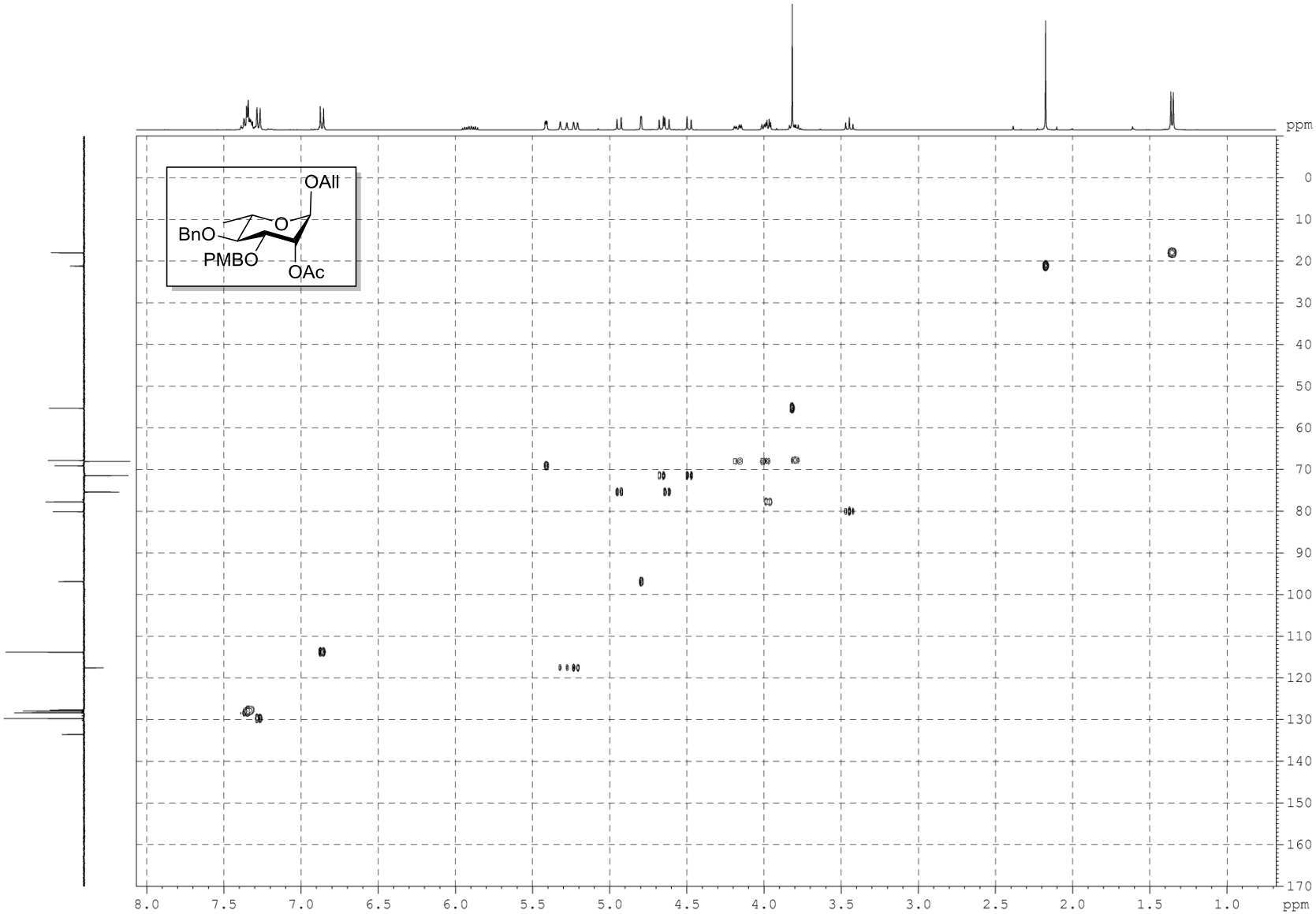

OAll
BnO
O
PMBO
OAc
ppm
6.0
5.8
5.6
5.4
5.2
5.0
4.8
4.6
4.4
4.2
4.0
3.8
3.6
3.4

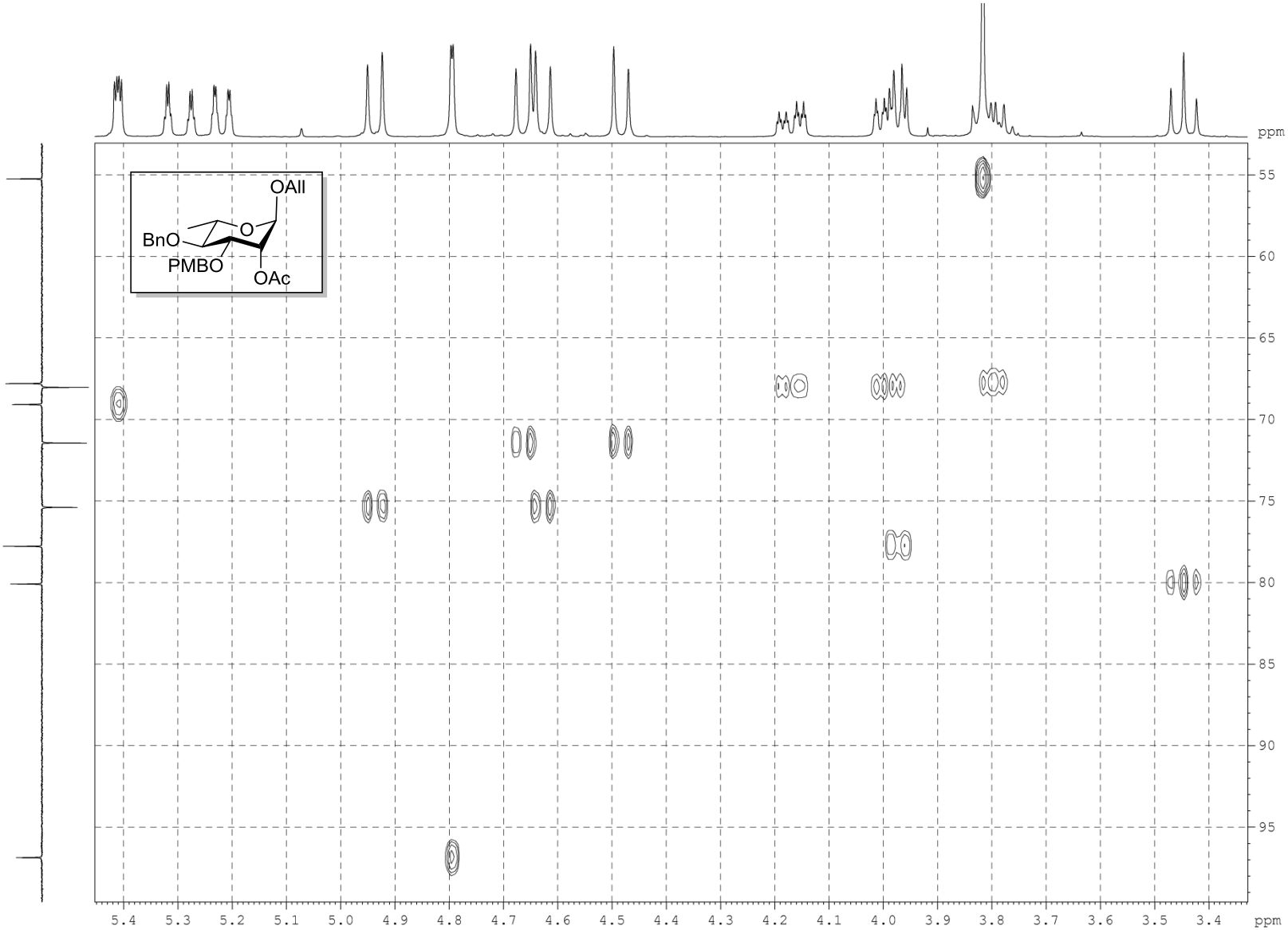

170.399
159.286
138.573
133.559
130.215
130.105
129.726
129.032
128.345
128.224
128.047
127.919
127.647
117.548
113.980
113.803
96.848
80.070
77.756
77.342
77.229
77.025
76.707
75.372
71.420
69.062
68.010
67.774
55.242
21.109
17.964
OAll
BnO
O
PMBO
OAc
240 230 220 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 ppm


96.848
80.070
77.756
77.342
77.229
77.025
76.707
75.372
71.420
69.062
68.010
67.774
55.242
OAll
BnO
O
PMBO
OAc
95
90
85
80
75
70
65
60
55
ppm

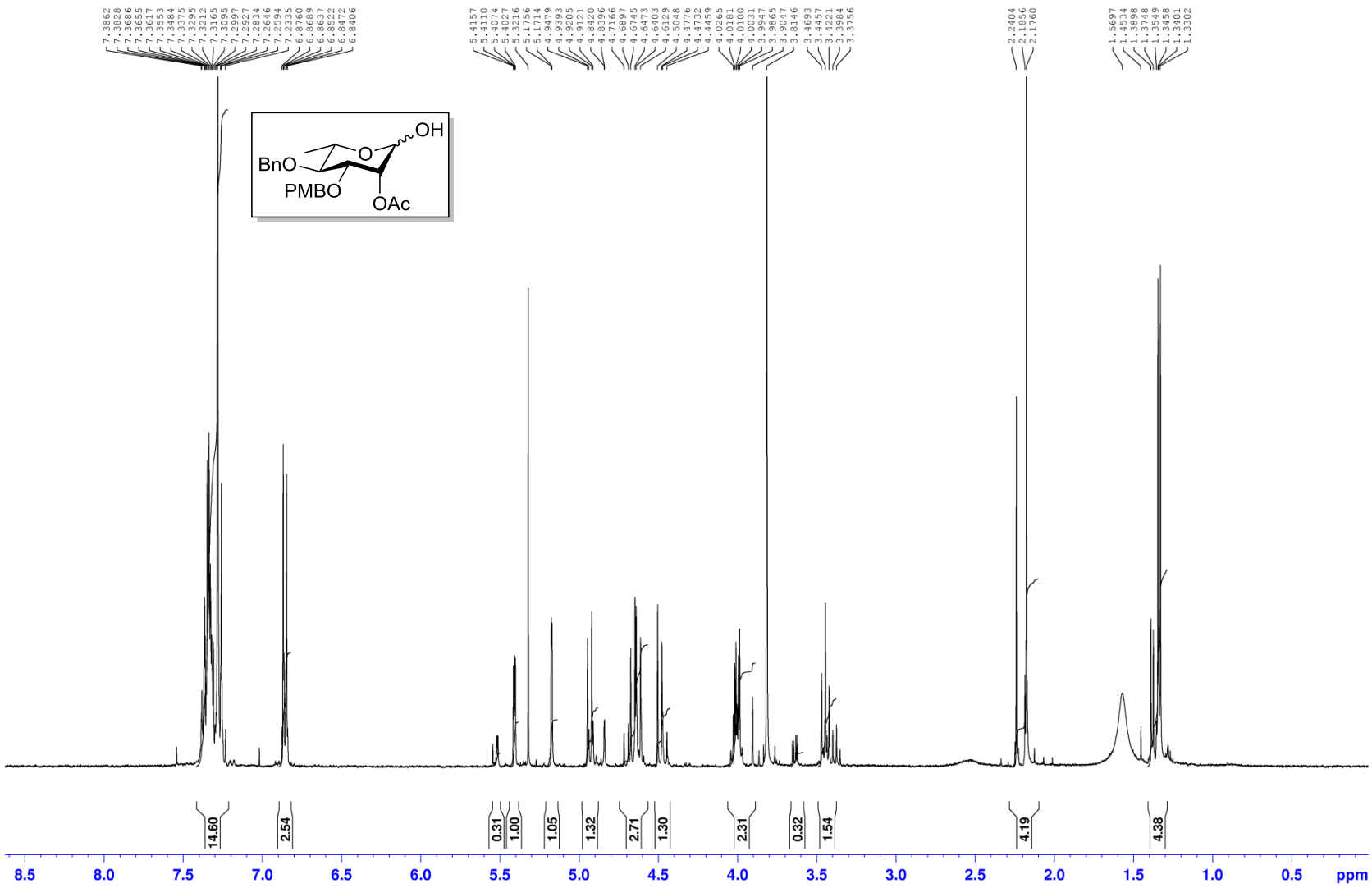

133.560
130.106
129.727
129.035
128.345
128.226
128.048
127.918
127.647
117.549
113.805
96.849
80.070
77.757
77.232
75.372
71.421
69.063
68.009
67.776
55.243
21.109
17.965
OAll
O
BnO
PMBO
OAc
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 ppm

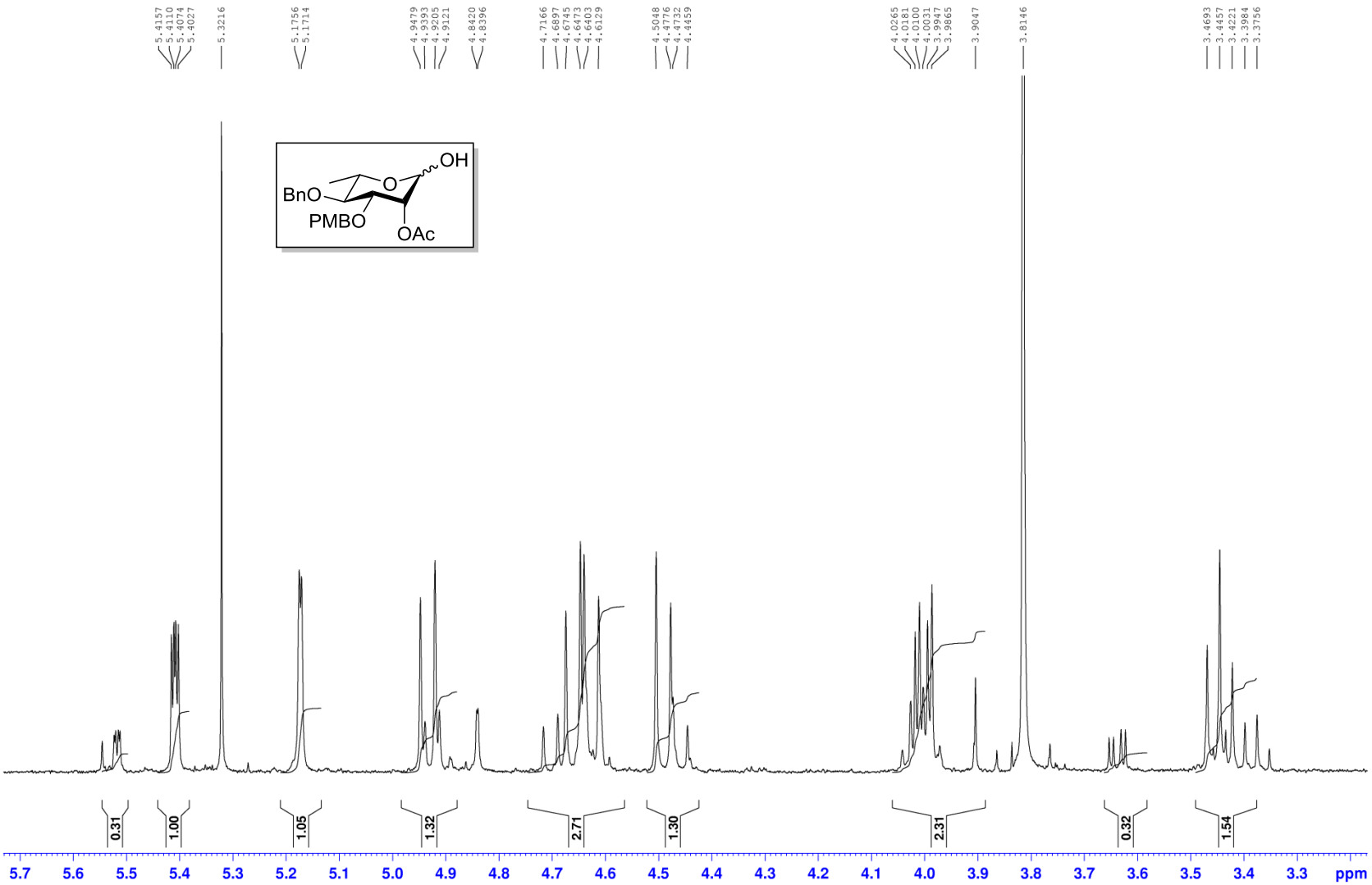

96.849
80.070
77.757
77.232
75.372
71.421
69.063
68.009
67.776
55.243
OAll
O
BnO
PMBO
OAc
100
95
90
85
80
75
70
65
60
55
ppm

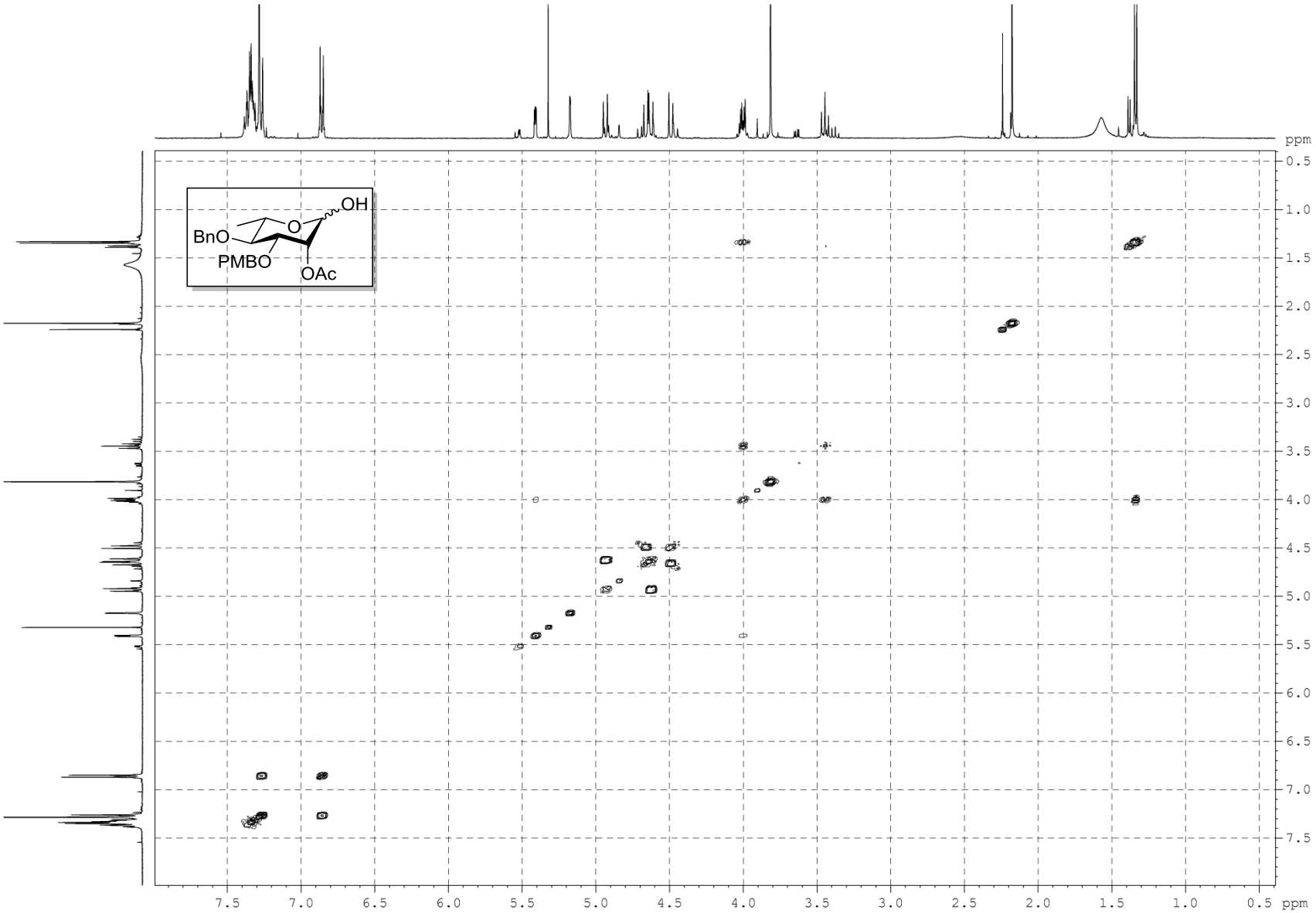

OAll
BnO
O
PMBO
OAc
ppm
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
ppm

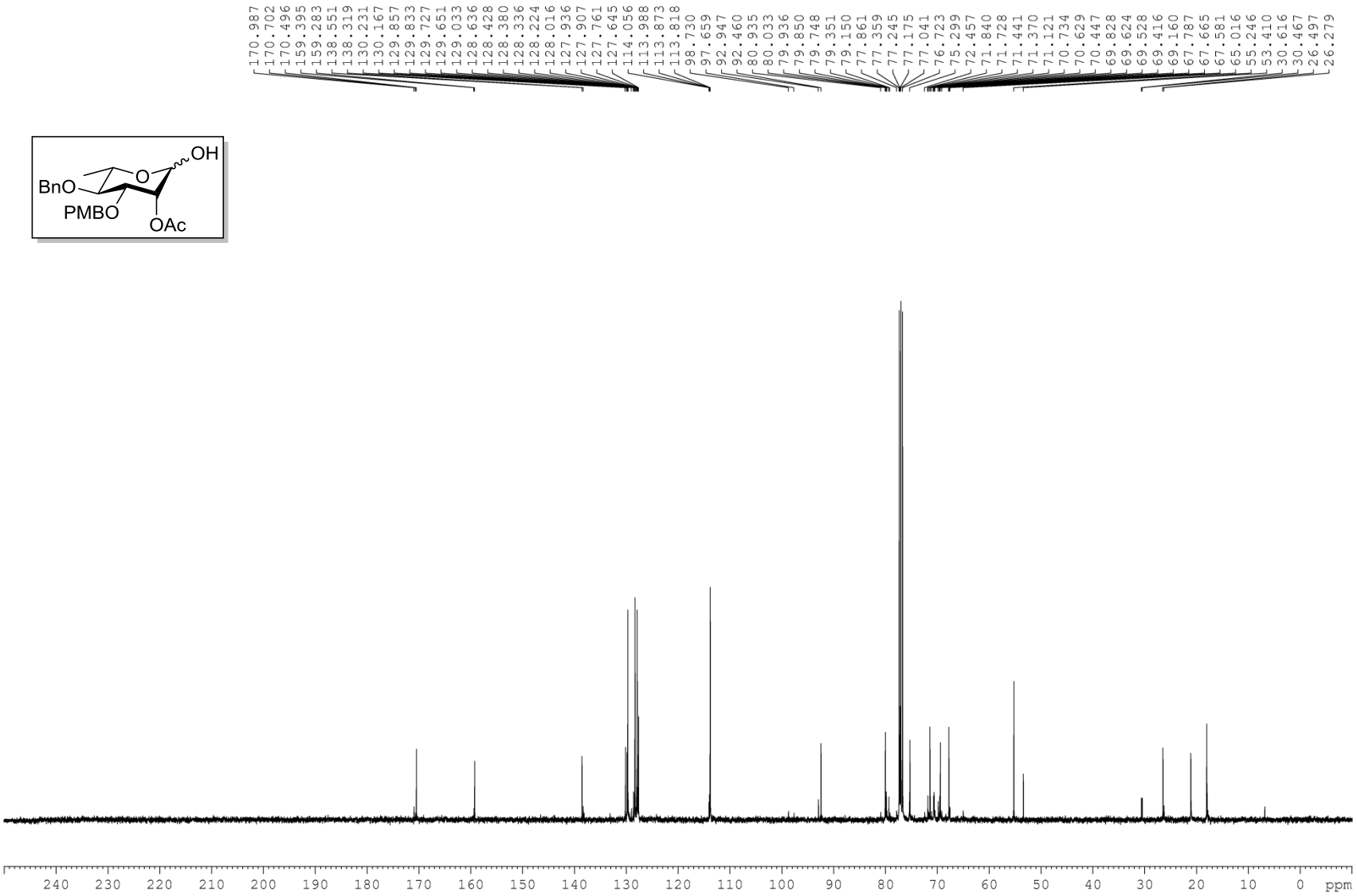

OAll
BnO
O
PMBO
OAc
ppm
55
60
65
70
75
80
85
90
95
5.4
5.3
5.2
5.1
5.0
4.9
4.8
4.7
4.6
4.5
4.4
4.3
4.2
4.1
4.0
3.9
3.8
3.7
3.6
3.5
3.4
ppm

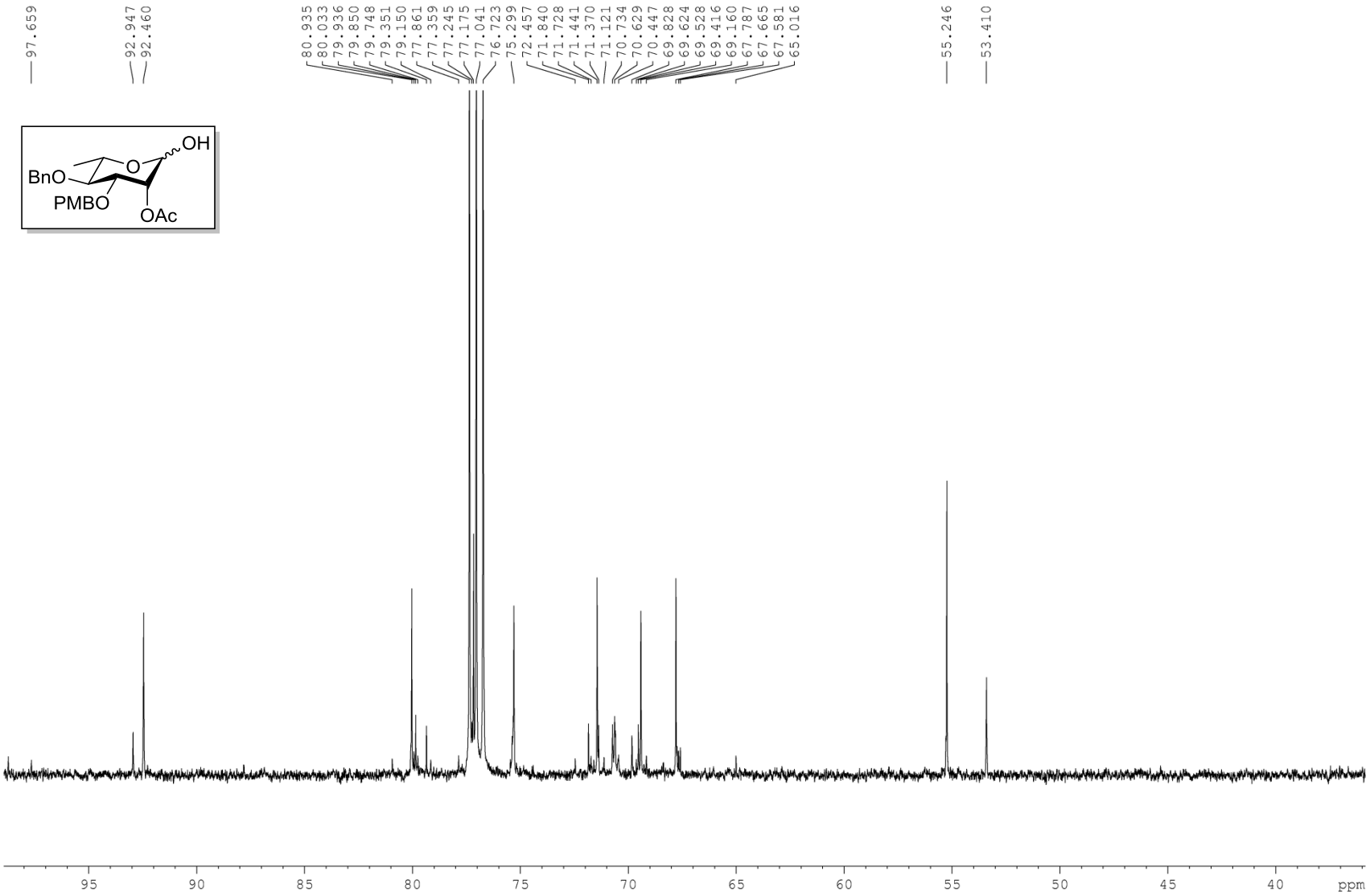
Compound 20: **2-*O*-Acetyl-4-*O*-benzyl-3-*O*-*para*-methoxybenzyl-α/β-L-rhamnopyranose**

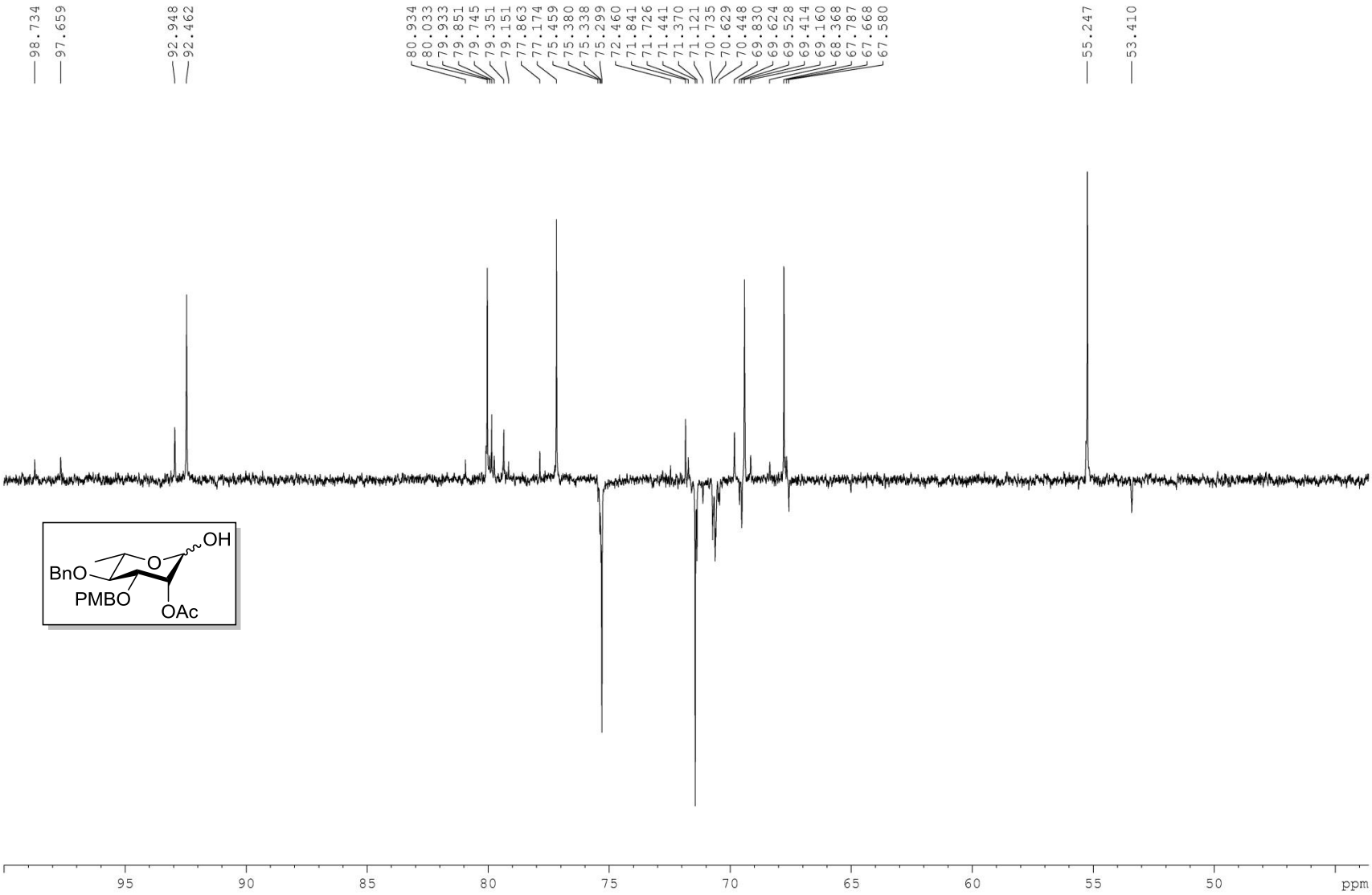


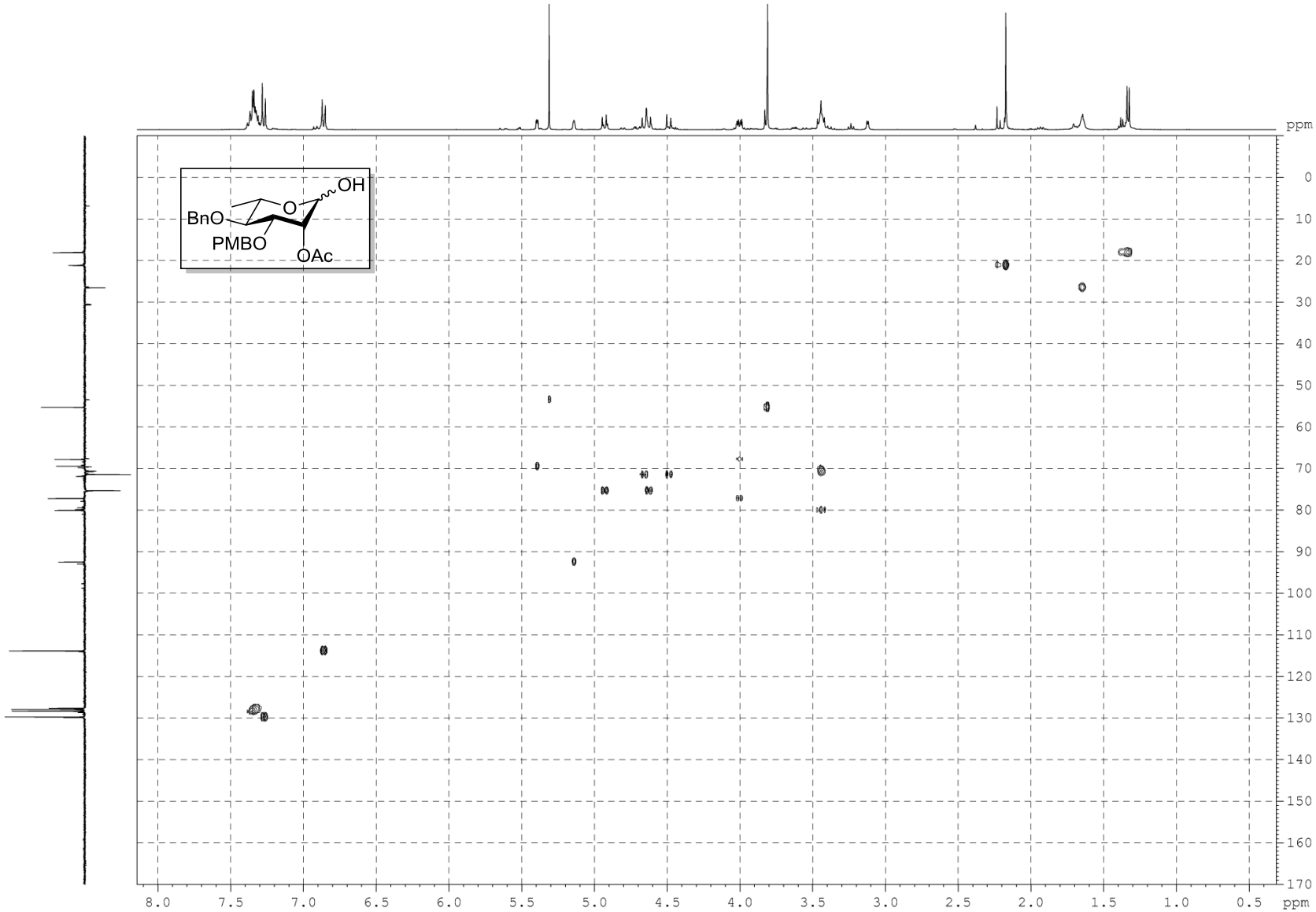

5.4157
5.4110
5.4074
5.4027
5.3216
5.1756
5.1714
4.9479
4.9393
4.9305
4.9121
4.8420
4.8396
4.7166
4.6897
4.6745
4.6473
4.6403
4.6129
4.5048
4.4776
4.4732
4.4459
4.0265
4.0181
4.0100
4.0031
3.9947
3.9865
3.9047
3.8146
3.4693
3.4457
3.4221
3.3984
3.3756
OH
BnO
O
PMBO
OAc
0.31
1.00
1.05
1.32
2.71
1.30
2.31
0.32
1.54
5.7 5.6 5.5 5.4 5.3 5.2 5.1 5.0 4.9 4.8 4.7 4.6 4.5 4.4 4.3 4.2 4.1 4.0 3.9 3.8 3.7 3.6 3.5 3.4 3.3 ppm


OH
BnO
O
PMBO
OAc
ppm
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
5.5
6.0
6.5
7.0
7.5
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

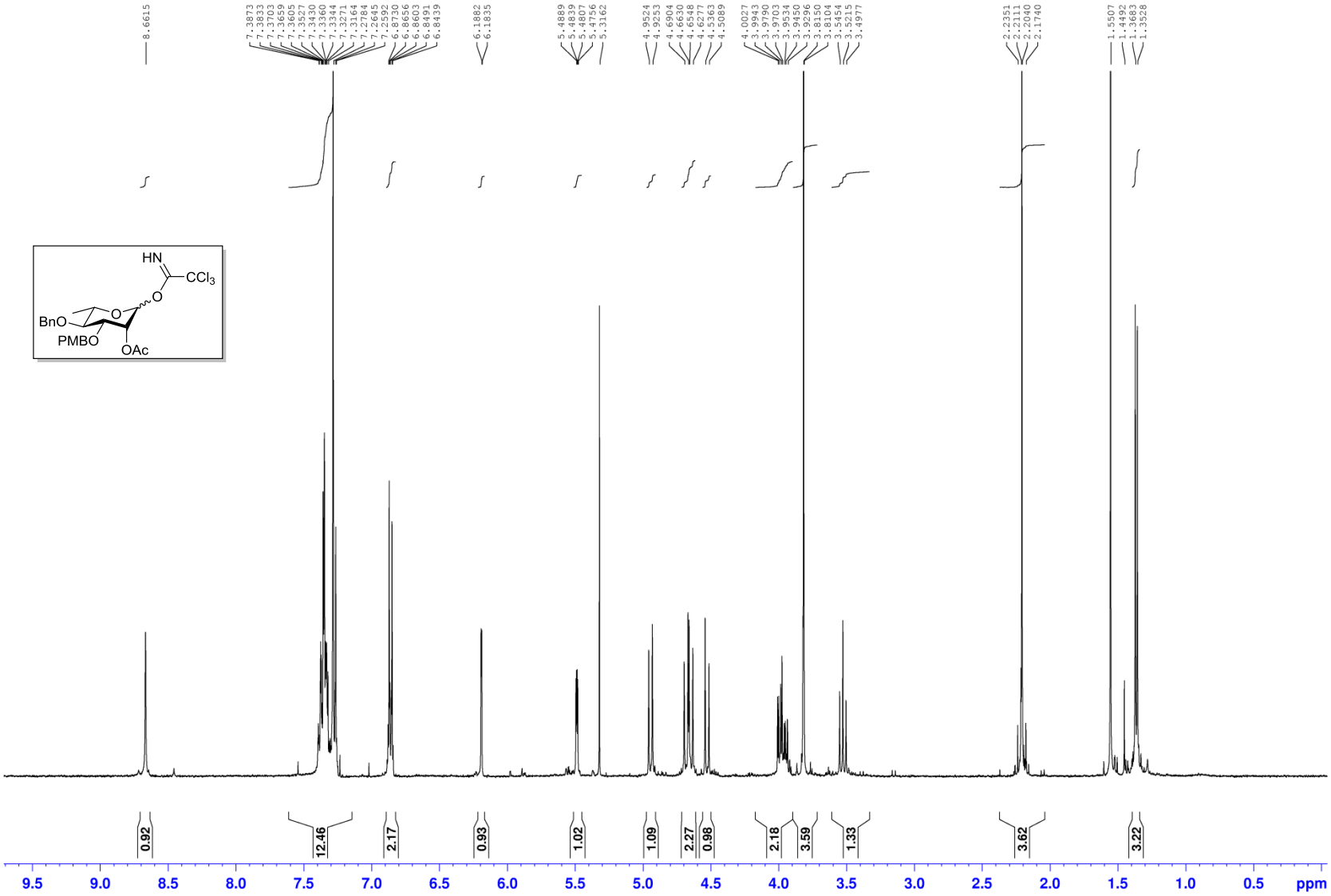

170.987
170.702
170.496
159.395
159.283
138.551
138.319
130.231
130.167
129.857
129.833
129.727
129.651
129.033
128.636
128.428
128.380
128.336
128.224
128.016
127.936
127.907
127.761
127.645
114.056
113.988
113.873
113.818
98.730
97.659
92.947
92.460
80.935
80.033
79.936
79.850
79.748
79.351
79.150
77.861
77.359
77.245
77.175
77.041
76.723
75.299
72.457
71.840
71.728
71.441
71.370
71.121
70.734
70.629
70.447
69.828
69.624
69.528
69.416
69.160
67.787
67.665
67.581
65.016
65.246
53.410
30.616
30.467
26.497
26.279
OH
BnO
O
PMBO
OAc
240 230 220 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 ppm

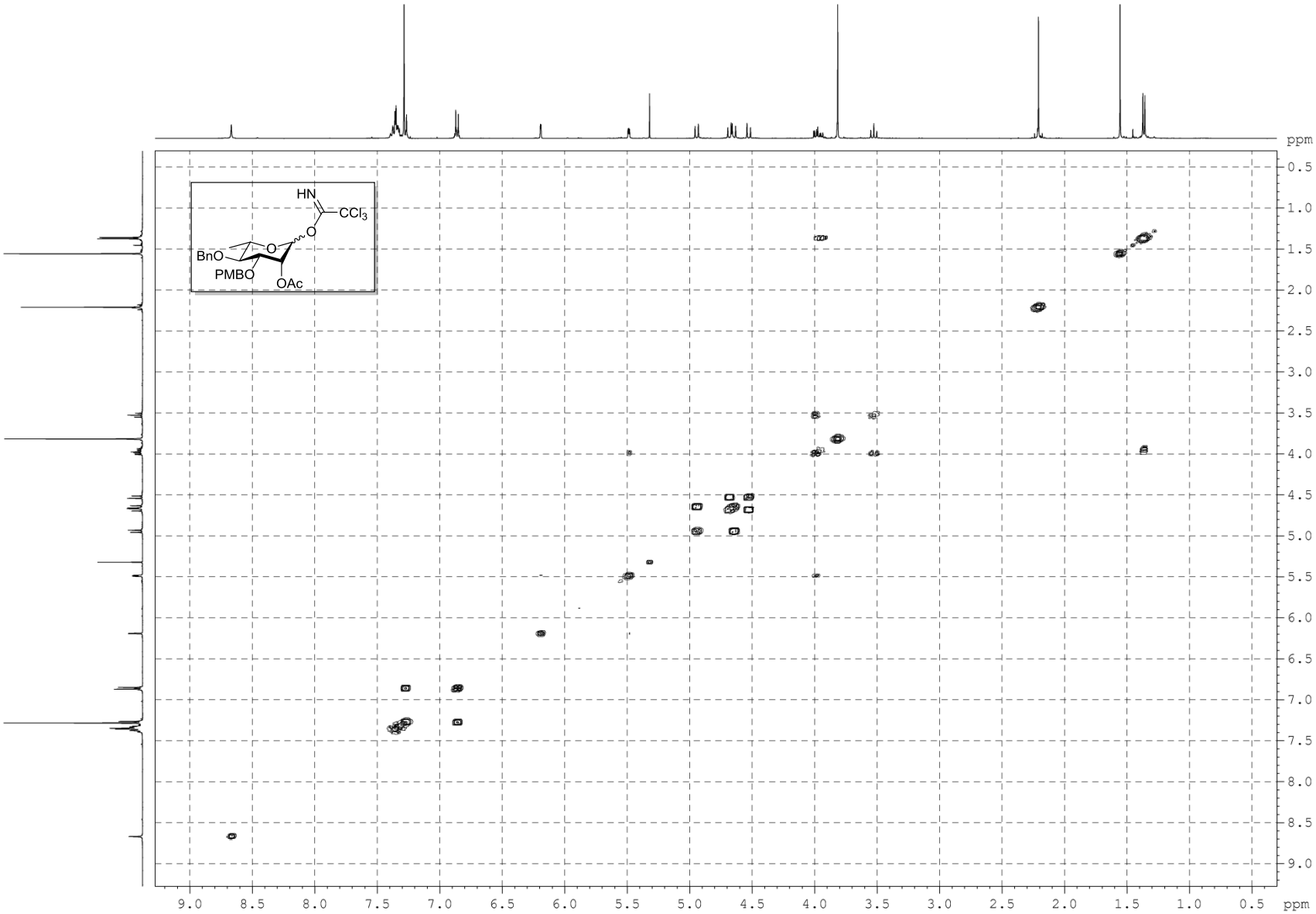

97.659
92.947
92.460
80.935
80.033
79.936
79.850
79.748
79.351
79.150
77.861
77.359
77.245
77.175
77.041
76.723
75.299
72.457
71.840
71.728
71.441
71.370
71.121
70.734
70.629
70.447
69.828
69.624
69.528
69.416
69.160
67.787
67.665
67.581
65.016
55.246
53.410
OH
BnO
O
PMBO
OAc
95
90
85
80
75
70
65
60
55
50
45
40
ppm

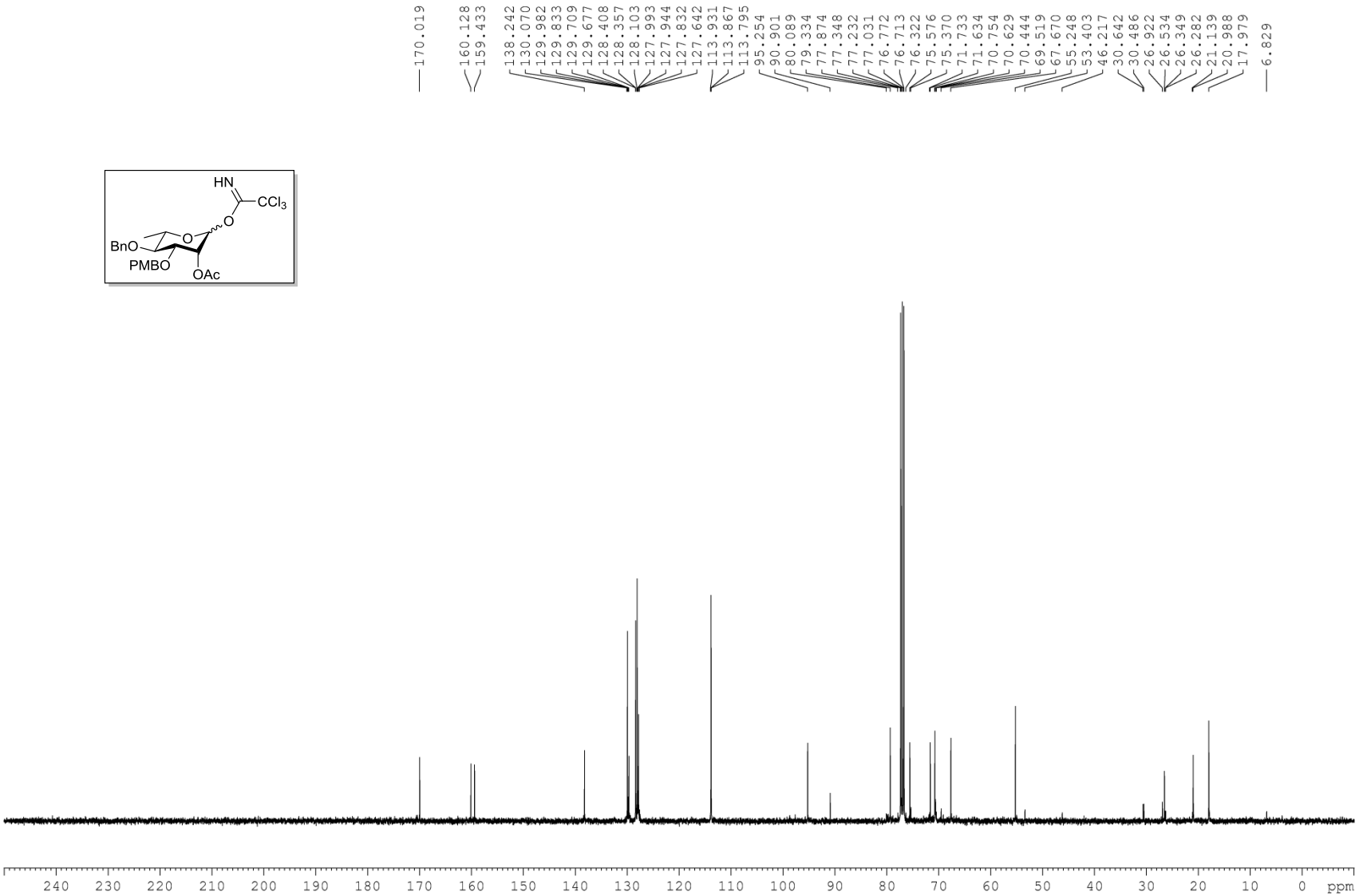

98.734
97.659
92.948
92.462
80.934
80.033
79.933
79.851
79.745
79.351
79.151
77.863
77.174
75.459
75.380
75.338
75.299
72.460
71.841
71.726
71.441
71.370
71.121
70.735
70.629
70.448
69.830
69.624
69.528
69.414
69.160
68.368
67.787
67.668
67.580
55.247
53.410
OH
O
BnO
PMBO
OAc
95
90
85
80
75
70
65
60
55
50
ppm

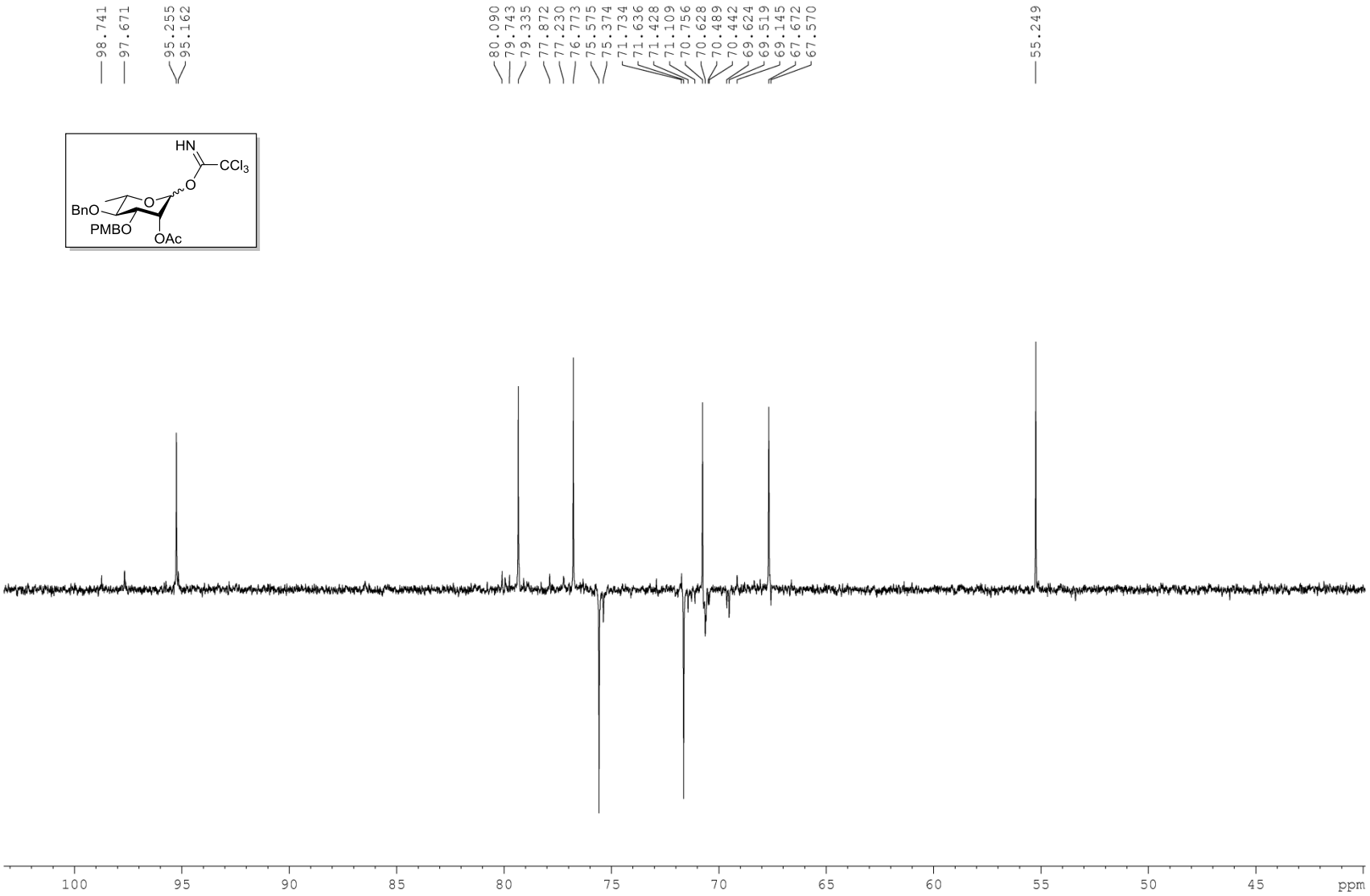

OH
BnO
O
PMBO
OAc
ppm
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
ppm

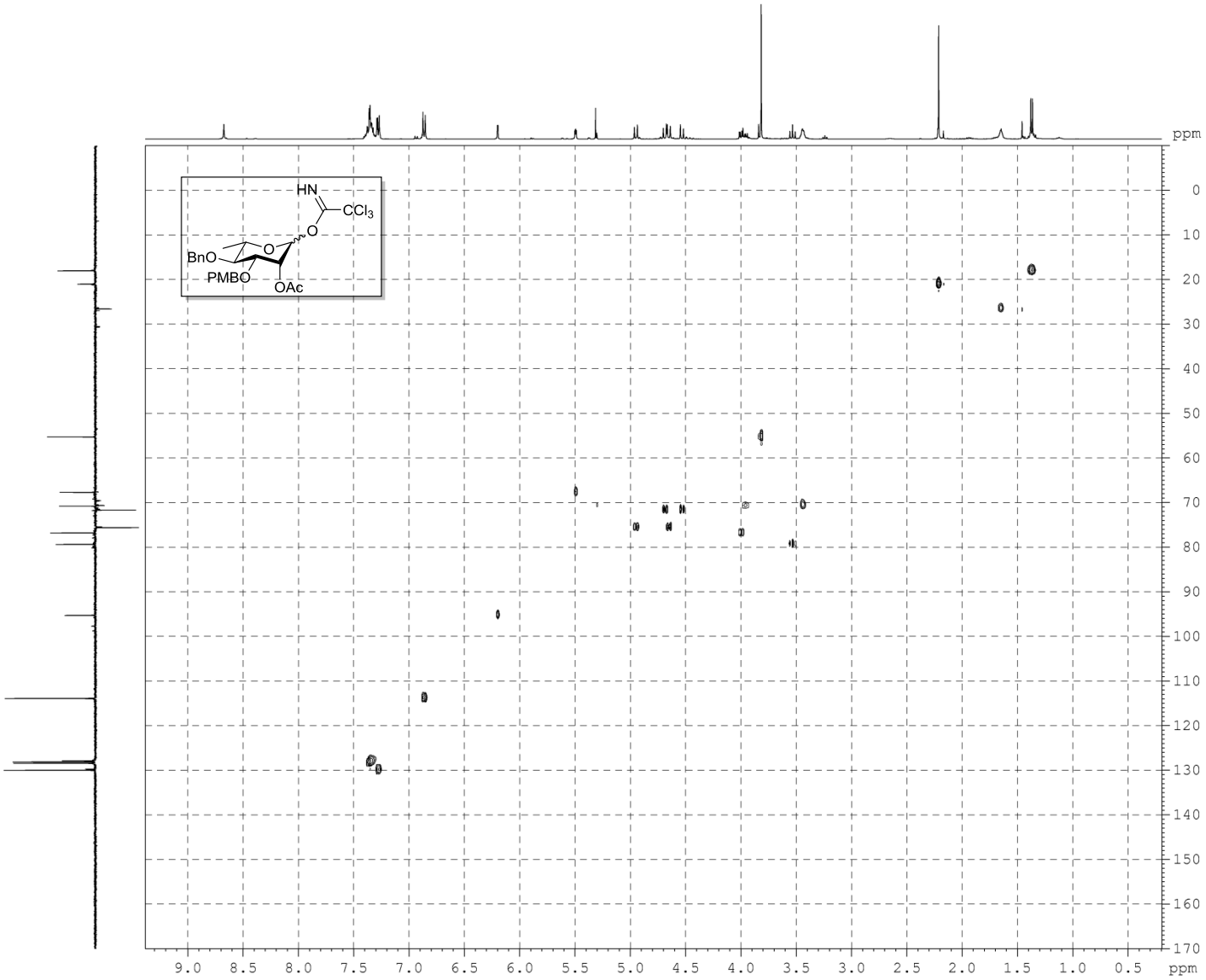
Compound 21: **2-*O*-Acetyl-4-*O*-benzyl-3-*O*-*para*-methoxybenzyl-α/β-L-rhamnopyranosyl trichloroacetimidate**



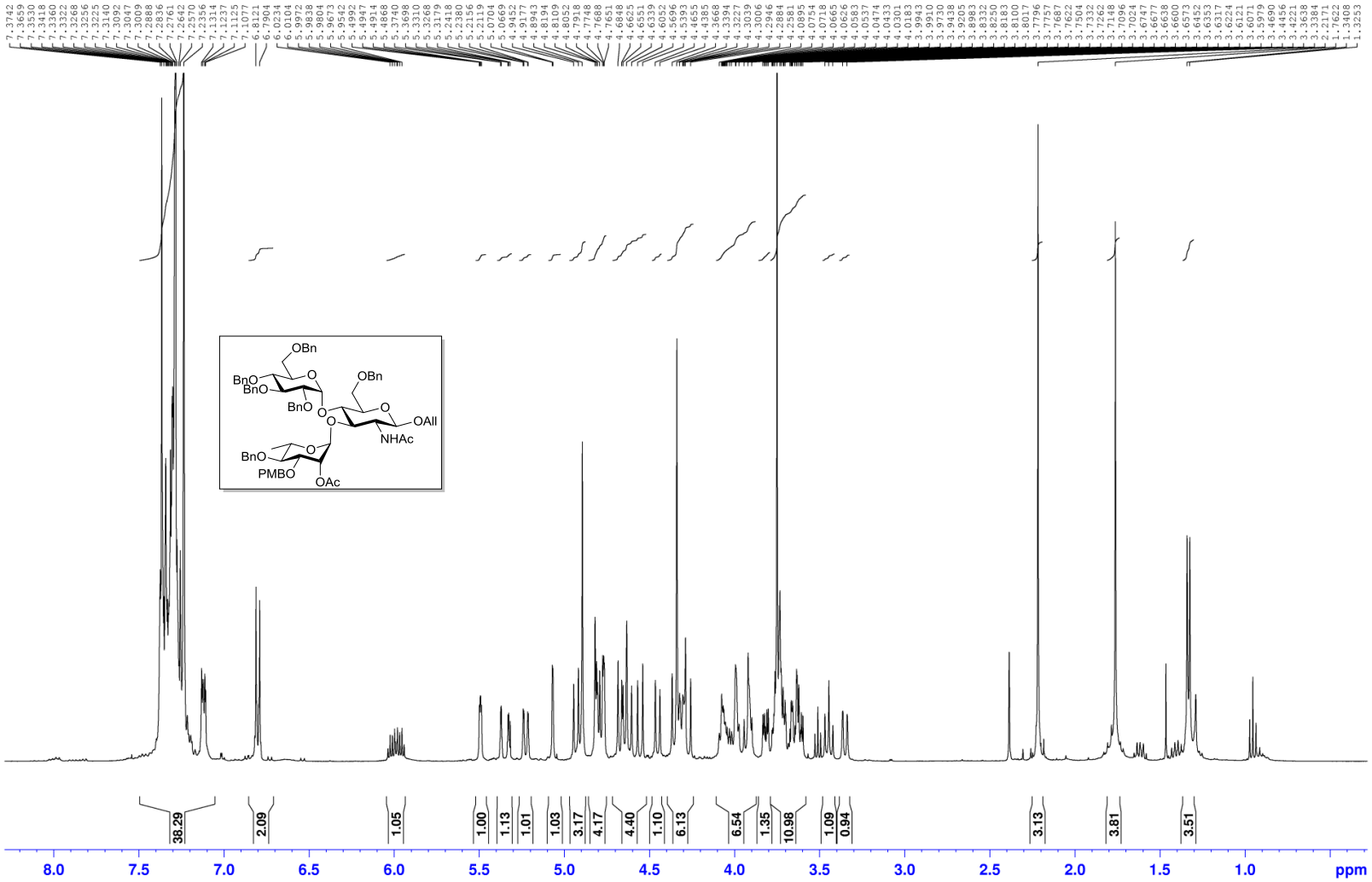

HN
CCl3
O
O
BnO
PMBO
OAc
ppm
9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 ppm

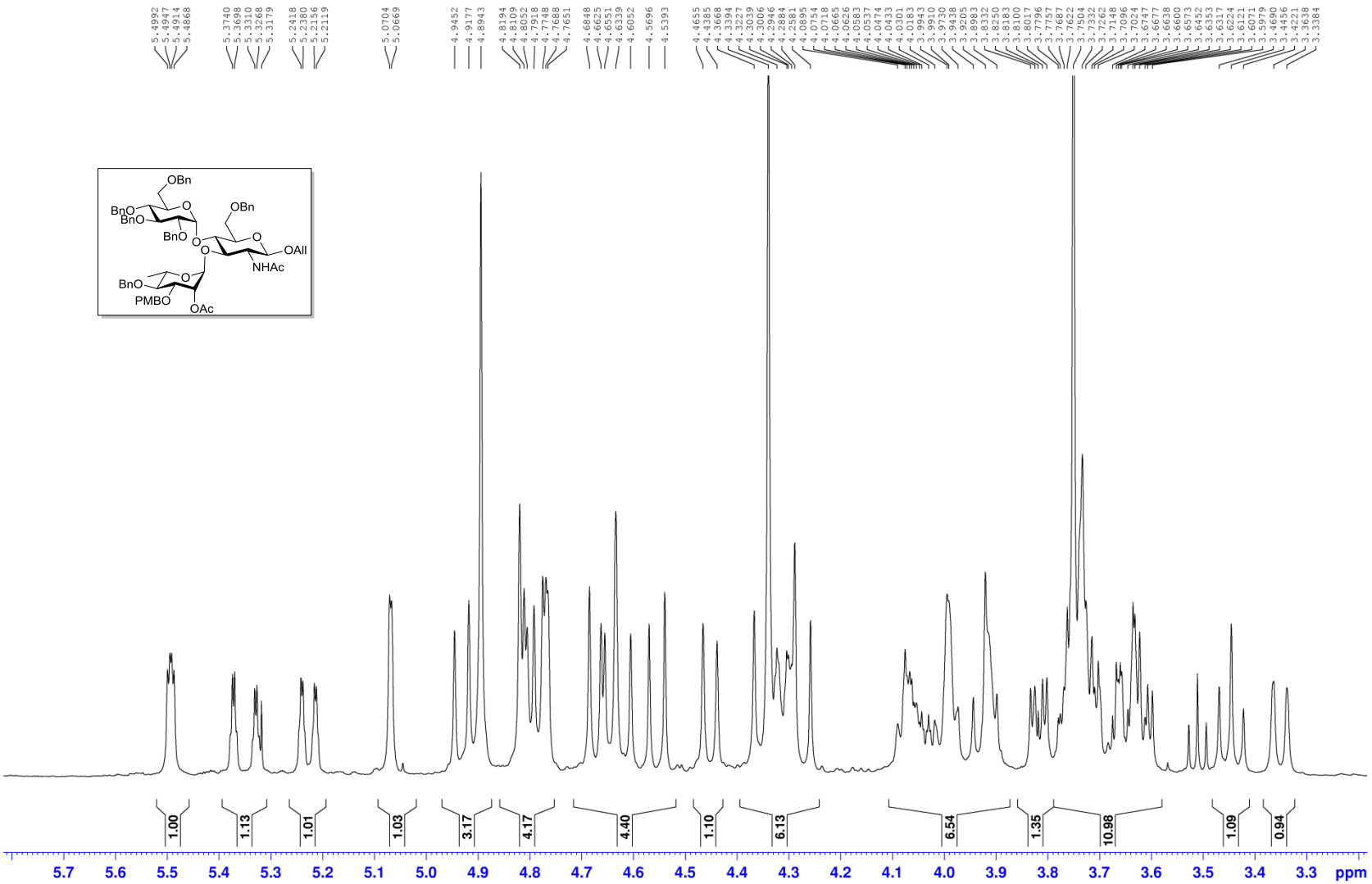

170.019
160.128
159.433
138.242
130.070
129.982
129.833
129.709
129.677
128.408
128.357
128.103
127.993
127.944
127.832
127.642
113.931
113.867
113.795
95.254
90.901
80.089
79.334
77.874
77.348
77.232
77.031
76.772
76.713
76.322
75.576
75.370
71.733
71.634
70.754
70.629
70.444
69.519
67.670
55.248
53.403
46.217
30.642
30.486
26.922
26.534
26.349
26.282
21.139
20.988
17.979
6.829
HN
CCl3
O
O
BnO
PMBO
OAc
240 230 220 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 ppm

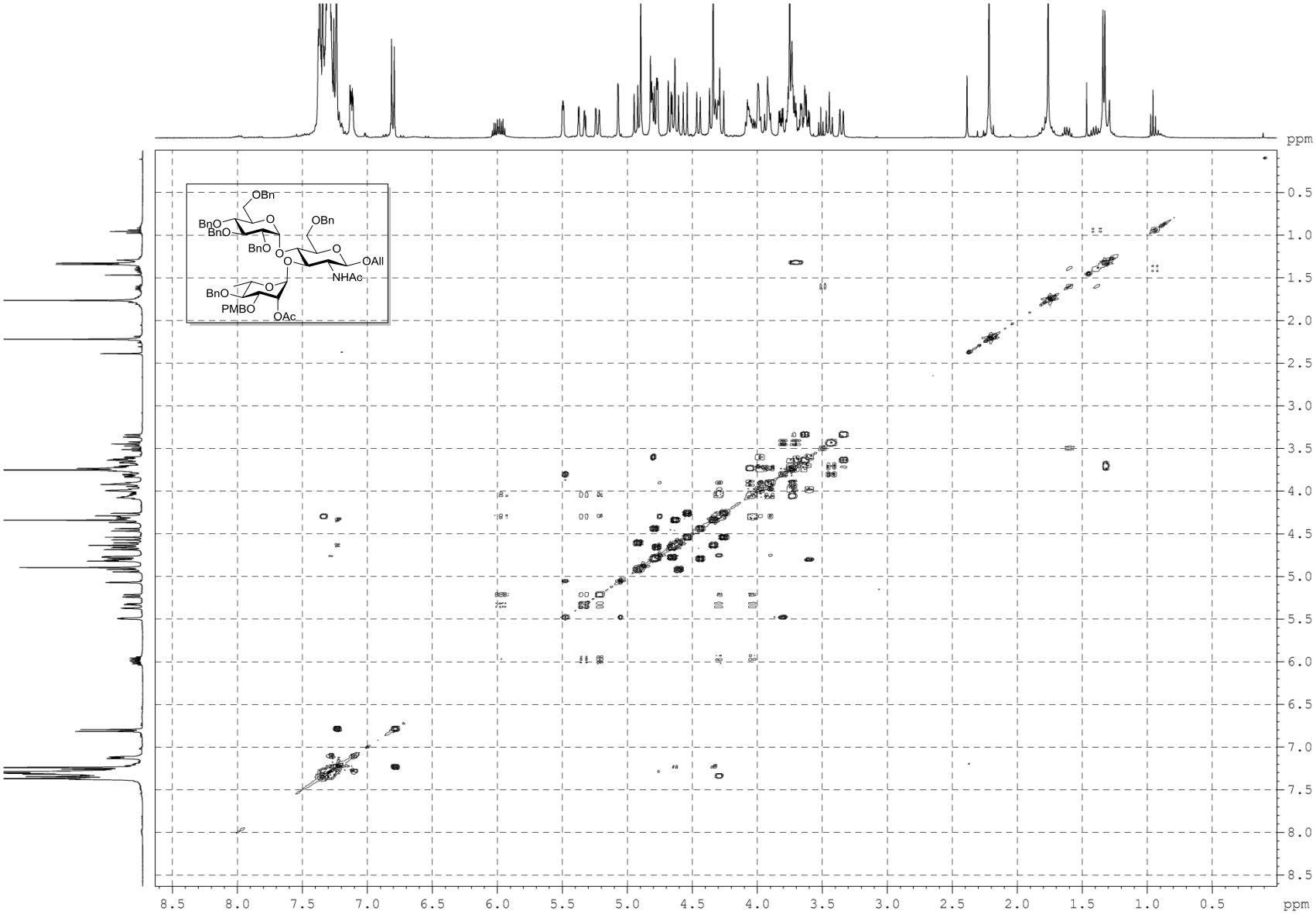

98.741
97.671
95.255
95.162
80.090
79.743
79.335
77.872
77.230
76.773
75.575
75.374
71.734
71.636
71.428
71.109
70.756
70.628
70.489
70.442
69.624
69.519
69.145
67.672
67.570
55.249
HN
CCl3
O
O
BnO
PMBO
OAc
100
95
90
85
80
75
70
65
60
55
50
45
ppm

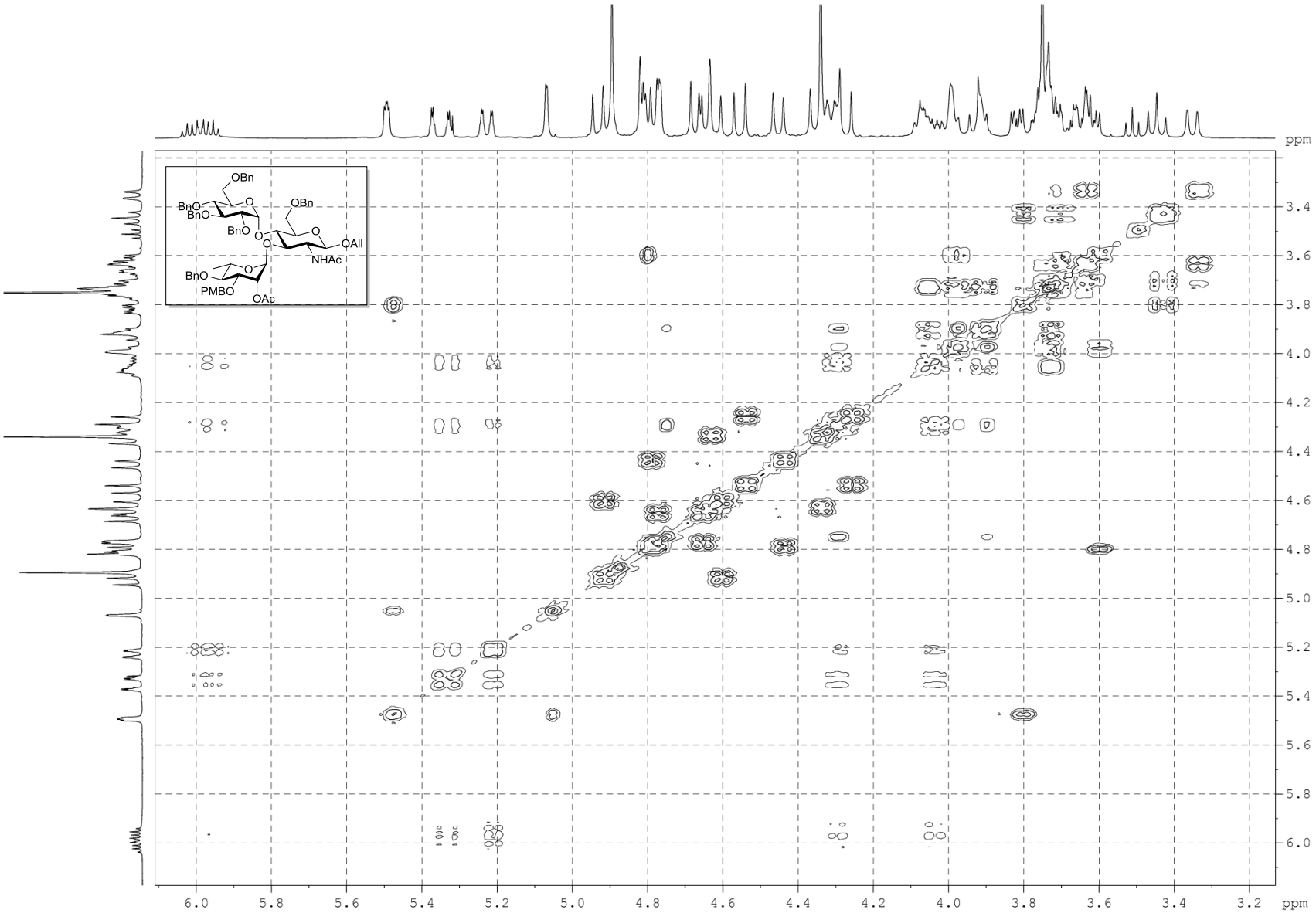

HN
CCl3
O
O
BnO
PMBO
OAc
ppm
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
ppm

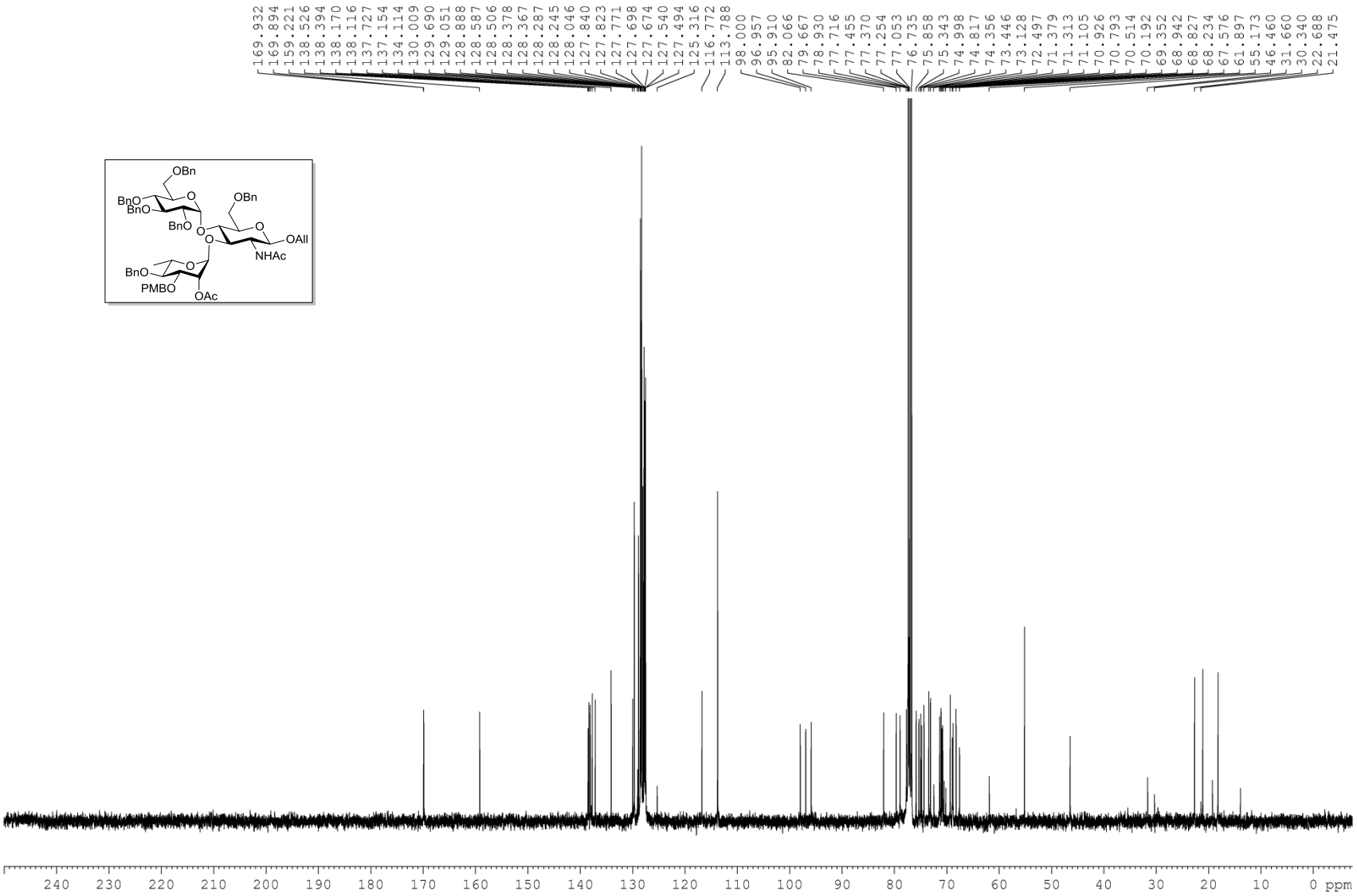
Compound 22: **Allyl (2-*O*-acetyl-4-*O*-benzyl-3-*O*-*para*-methoxybenzyl-α-L-rhamnopyranosyl)-(1→3)-[2,3,4,6-tetra-*O*-benzyl-α-D-glucopyranosyl-(1→4)]-2-acetamido-6-*O*-benzyl-2-deoxy-β-D-glucopyranoside**

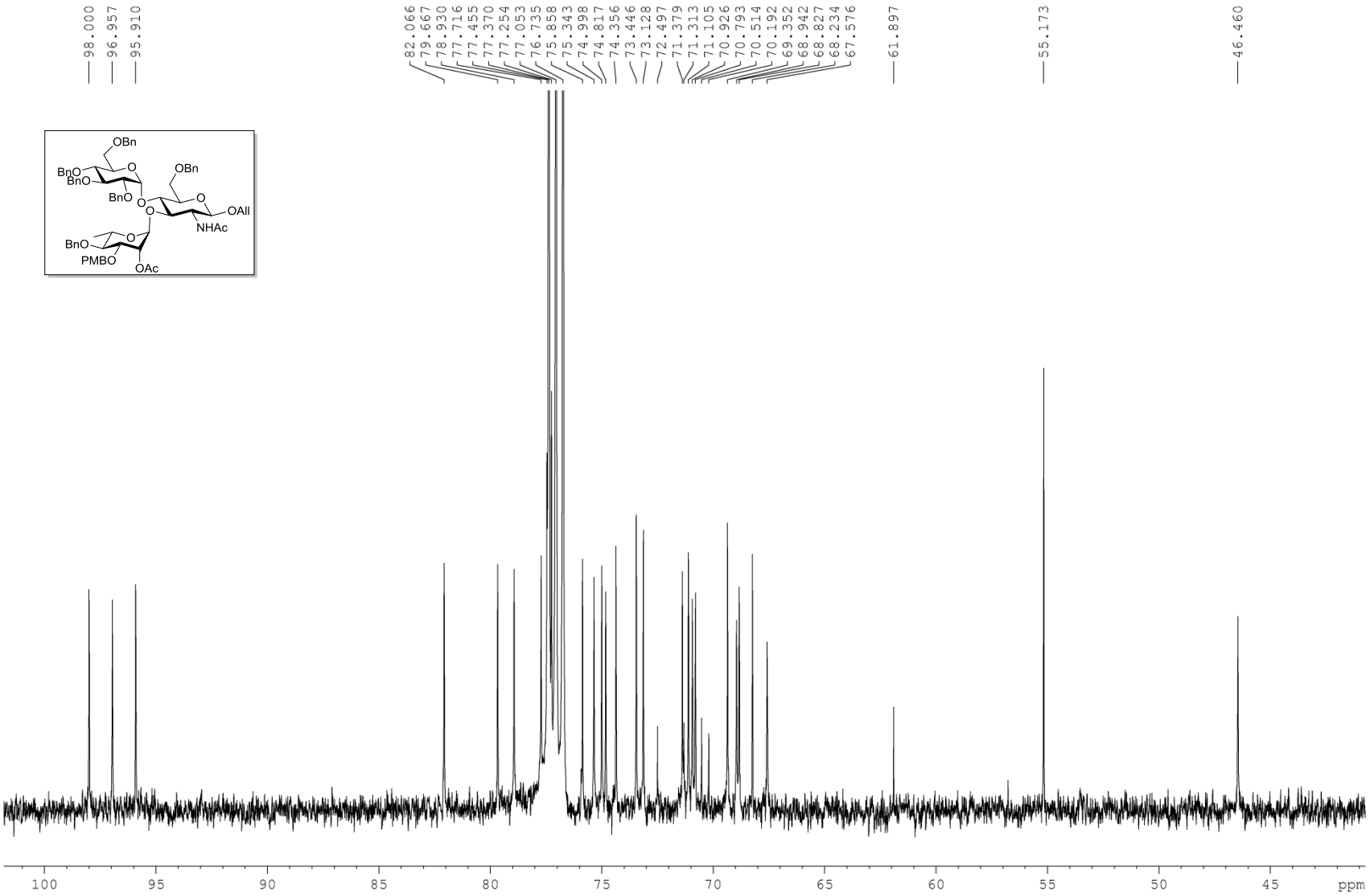


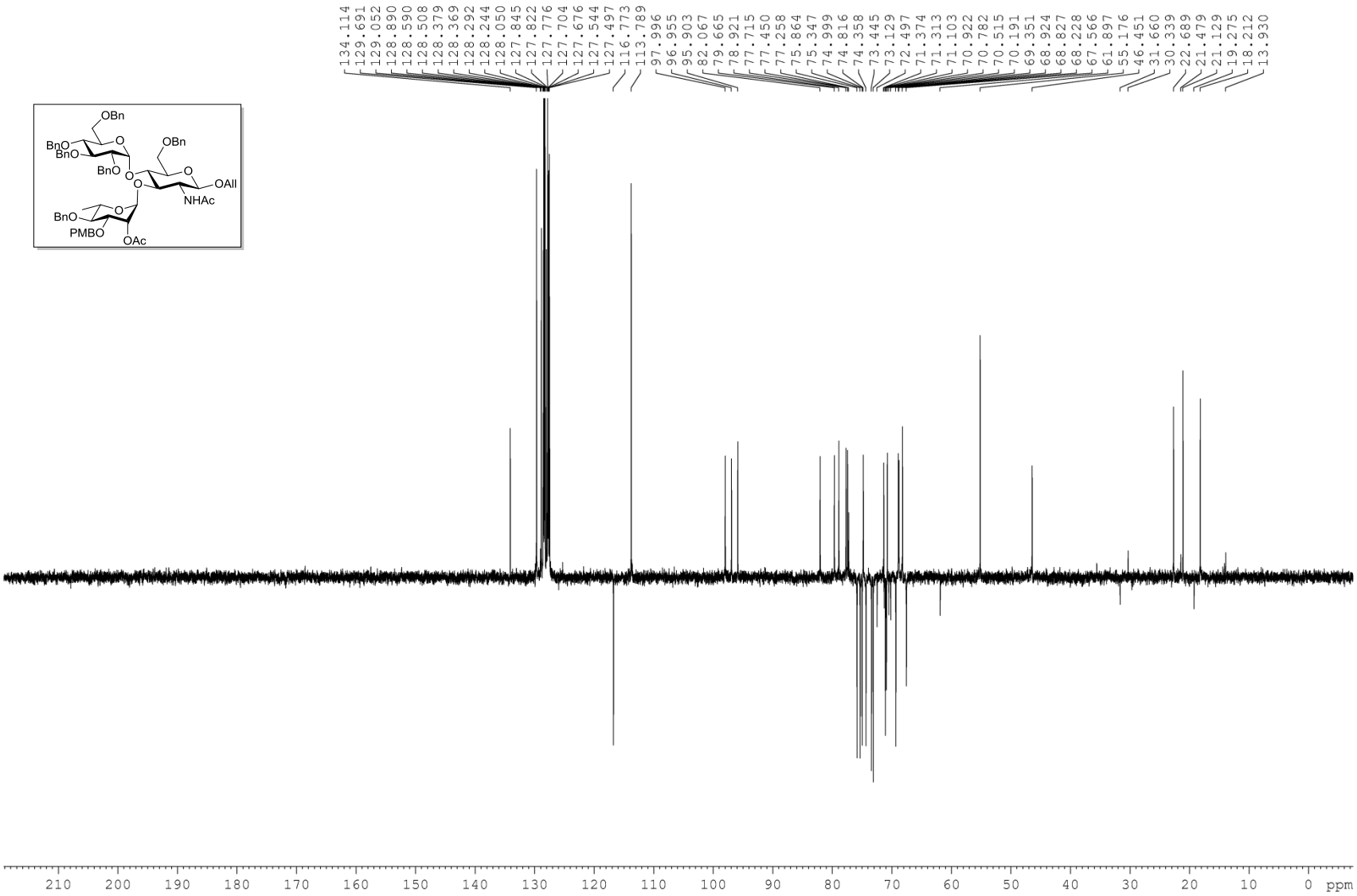

OBn
BnO
BnO
O
OBn
BnO
O
O
O
OAll
NHAc
BnO
O
PMBO
OAc
1.00
1.13
1.01
1.03
3.17
4.17
4.40
1.10
6.13
6.54
1.35
10.98
1.09
0.94
5.7 5.6 5.5 5.4 5.3 5.2 5.1 5.0 4.9 4.8 4.7 4.6 4.5 4.4 4.3 4.2 4.1 4.0 3.9 3.8 3.7 3.6 3.5 3.4 3.3 ppm

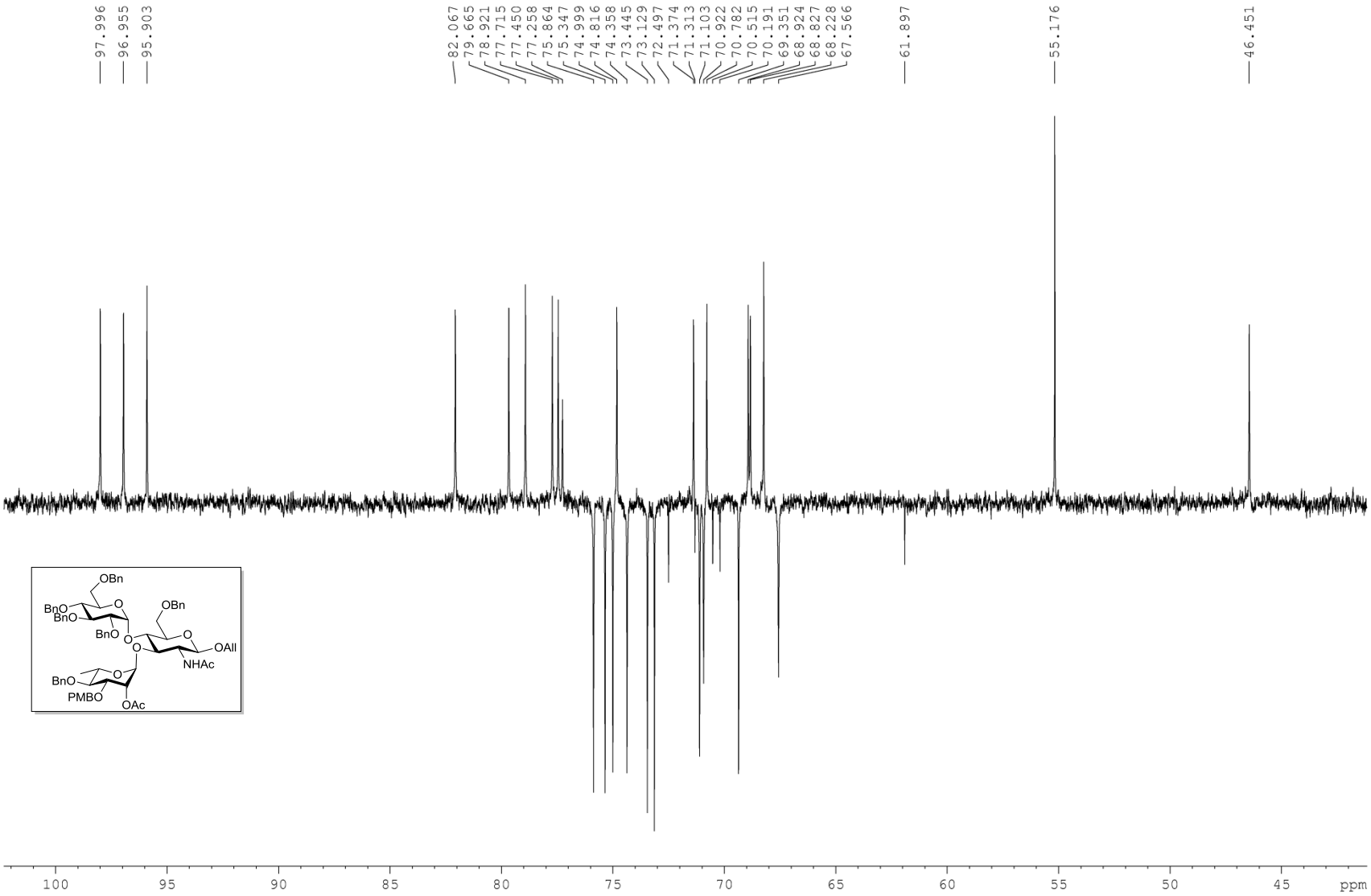

OBn
BnO
BnO
BnO
O
OBn
O
O
O
OAll
NHAc
BnO
O
PMBO
OAc
ppm
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5

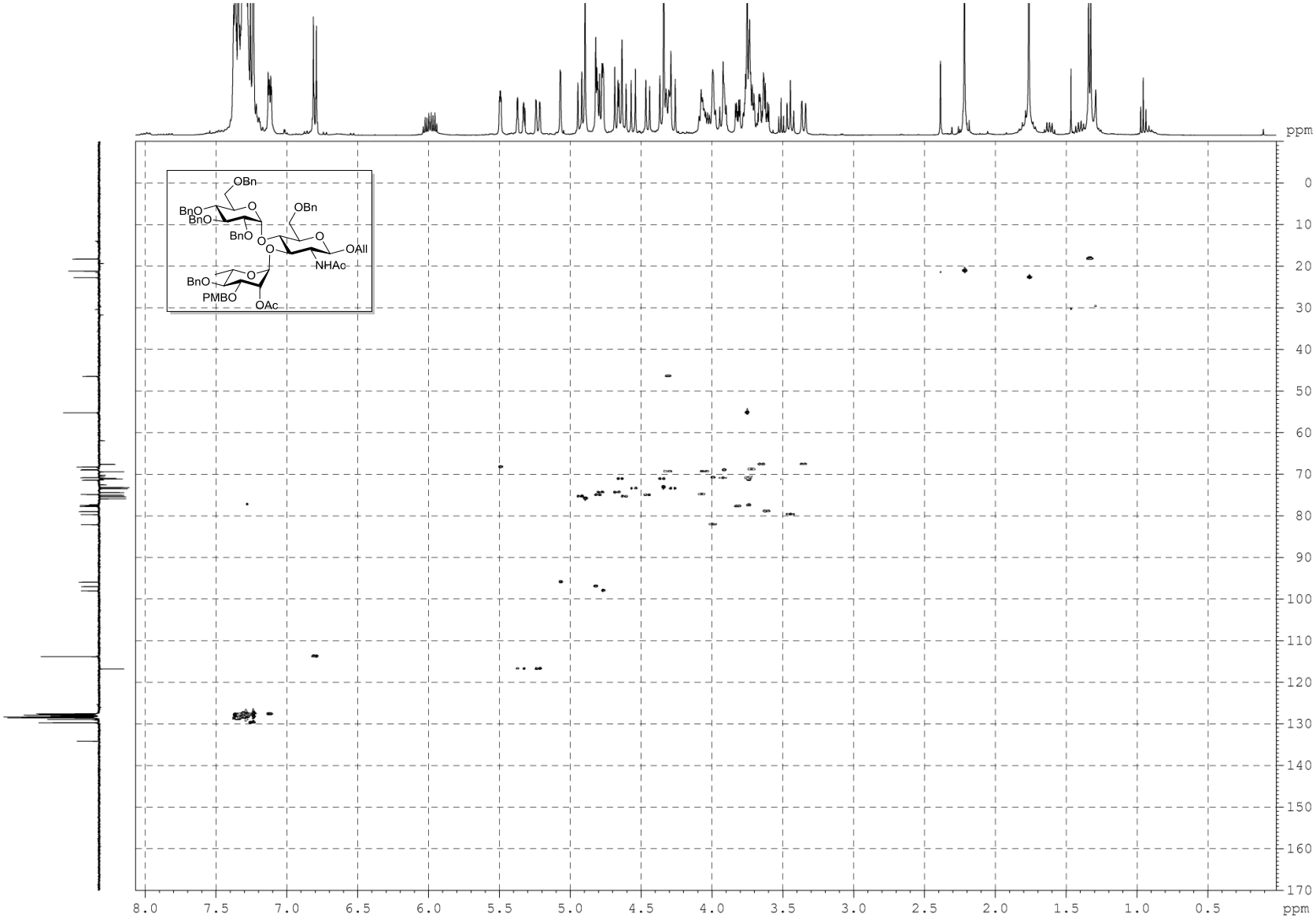

OBn
BnO
BnO
O
OBn
BnO
O
O
O
OAll
NHAc
BnO
O
PMBO
OAc
ppm
3.4
3.6
3.8
4.0
4.2
4.4
4.6
4.8
5.0
5.2
5.4
5.6
5.8
6.0
6.0
5.8
5.6
5.4
5.2
5.0
4.8
4.6
4.4
4.2
4.0
3.8
3.6
3.4
3.2
ppm

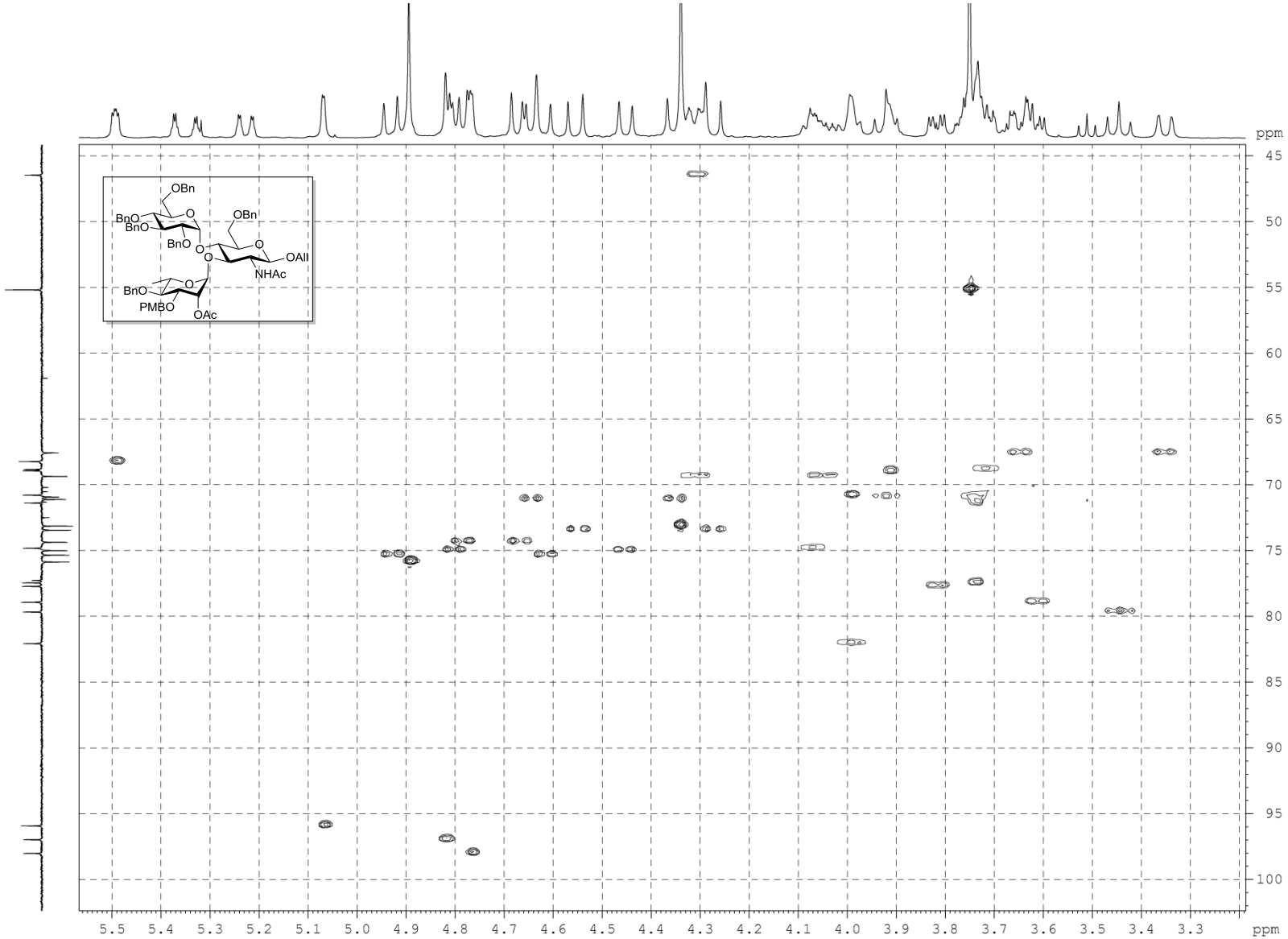

169.932
169.894
159.221
138.526
138.394
138.170
138.116
137.727
137.154
134.114
130.009
129.690
129.051
128.888
128.587
128.506
128.378
128.367
128.287
128.245
128.046
127.840
127.823
127.771
127.698
127.674
127.540
127.494
125.316
116.772
113.788
98.000
96.957
95.910
82.066
79.667
78.930
77.716
77.455
77.370
77.254
77.053
76.735
75.858
75.343
74.998
74.817
74.356
73.446
73.128
72.497
71.379
71.313
71.105
70.926
70.793
70.514
70.192
69.352
68.942
68.827
68.234
67.576
61.897
55.173
46.460
31.660
30.340
22.688
21.475
OBn
BnO
BnO
O
OBn
BnO
O
O
O
OAll
NHAc
BnO
O
PMBO
OAc
240
230
220
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0 ppm


98.000
96.957
95.910
82.066
79.667
78.930
77.716
77.455
77.370
77.254
77.053
76.735
75.858
75.343
74.998
74.817
74.356
73.446
73.128
72.497
71.379
71.313
71.105
70.926
70.793
70.514
70.192
69.352
68.942
68.827
68.234
67.576
61.897
55.173
46.460
OBn
BnO
BnO
O
OBn
BnO
O
O
O
OAll
NHAc
BnO
O
PMBO
OAc
100
95
90
85
80
75
70
65
60
55
50
45
ppm

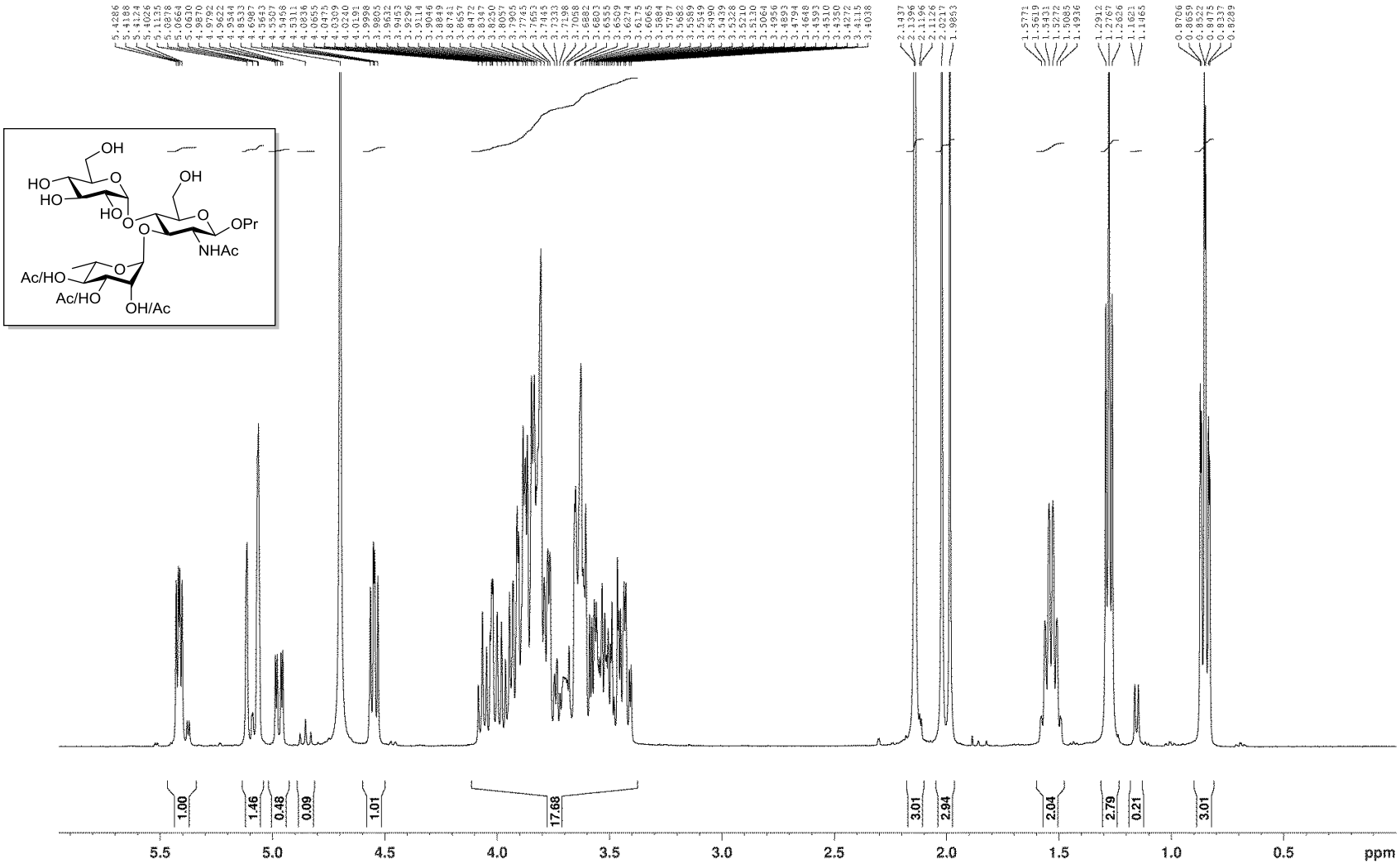

134.114
129.691
129.052
128.890
128.590
128.508
128.379
128.369
128.292
128.244
128.050
127.845
127.822
127.776
127.704
127.676
127.544
127.497
116.773
113.789
97.996
96.955
95.903
82.067
79.665
78.921
77.715
77.450
77.258
75.864
75.347
74.999
74.816
74.358
73.445
73.129
72.497
71.374
71.313
71.103
70.922
70.782
70.515
70.191
69.351
68.924
68.827
68.228
67.566
61.897
55.176
46.451
31.660
30.339
22.689
21.479
21.129
19.275
18.212
13.930
OBn
BnO
BnO
BnO
O
OBn
O
O
O
OAll
NHAc
BnO
O
PMBO
OAc
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
ppm

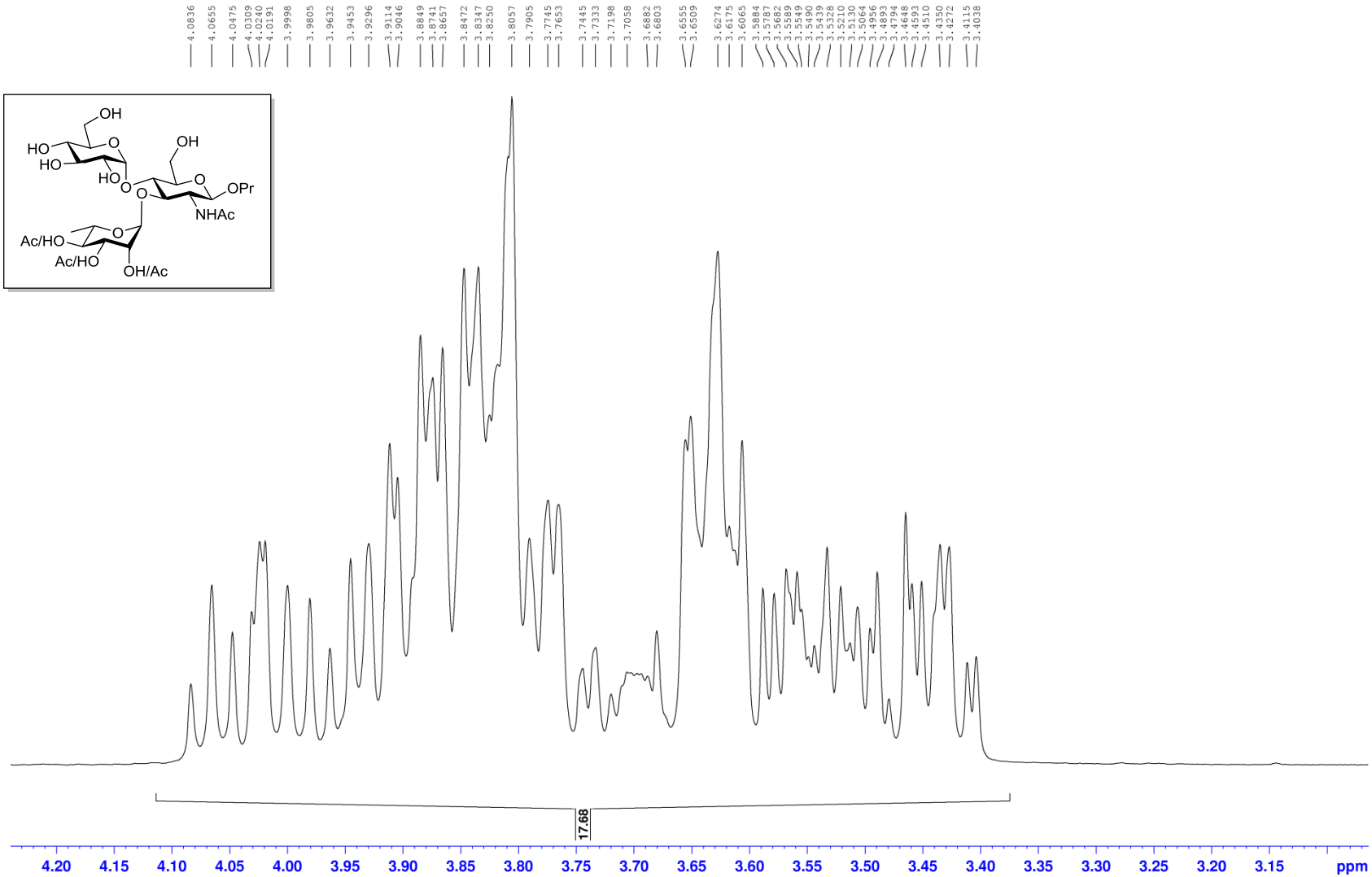

97.996
96.955
95.903
82.067
79.665
78.921
77.715
77.450
77.258
75.864
75.347
74.999
74.816
74.358
73.445
73.129
72.497
71.374
71.313
71.103
70.922
70.782
70.515
70.191
69.351
68.924
68.827
68.228
67.566
61.897
55.176
46.451
OBn
BnO
BnO
O
OBn
BnO
O
O
O
OAll
NHAc
BnO
O
PMBO
OAc
100
95
90
85
80
75
70
65
60
55
50
45
ppm

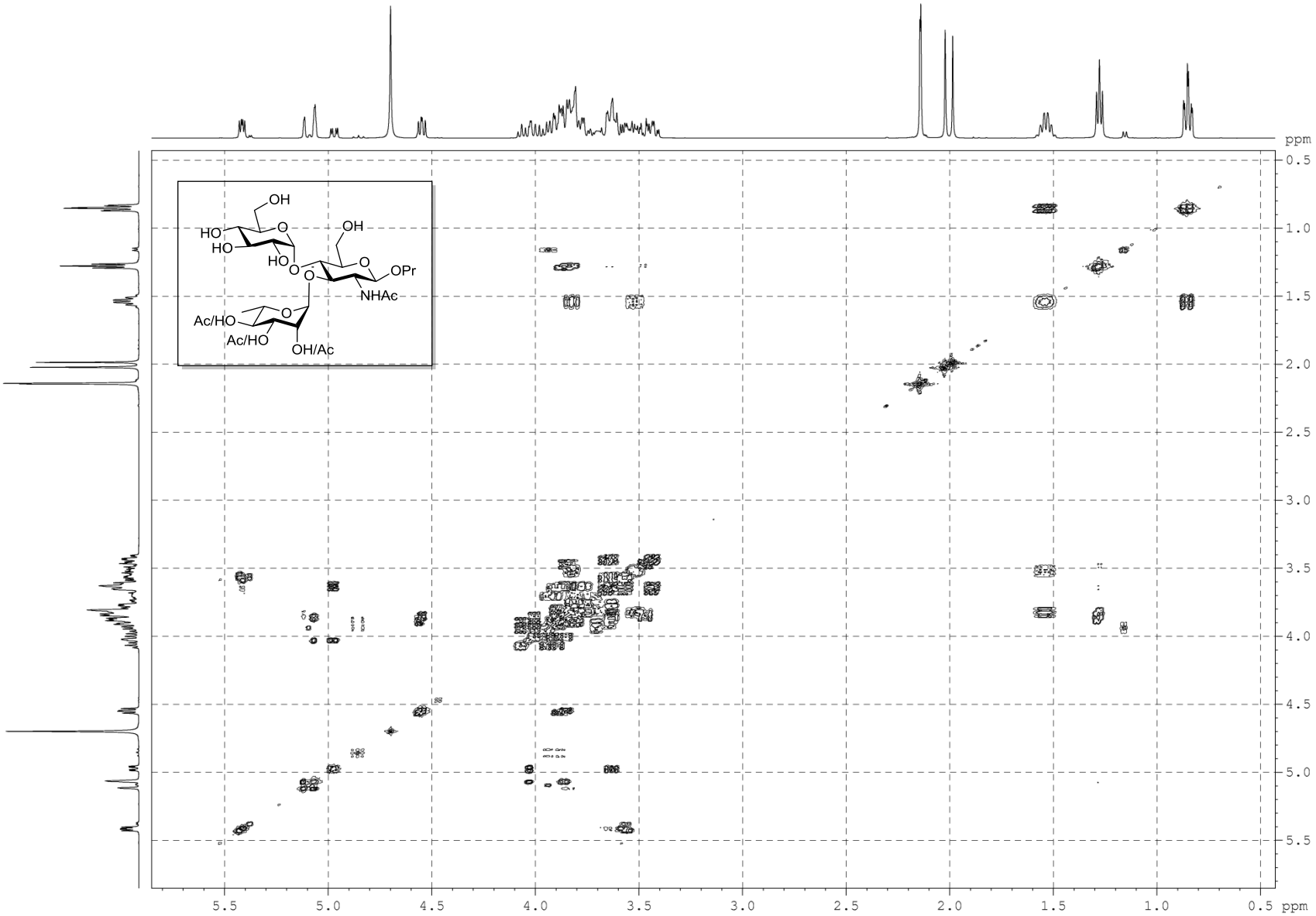

OBn
BnO
BnO
O
BnO
O
O
OBn
O
OAll
NHAc
BnO
O
PMBO
OAc
ppm
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
ppm

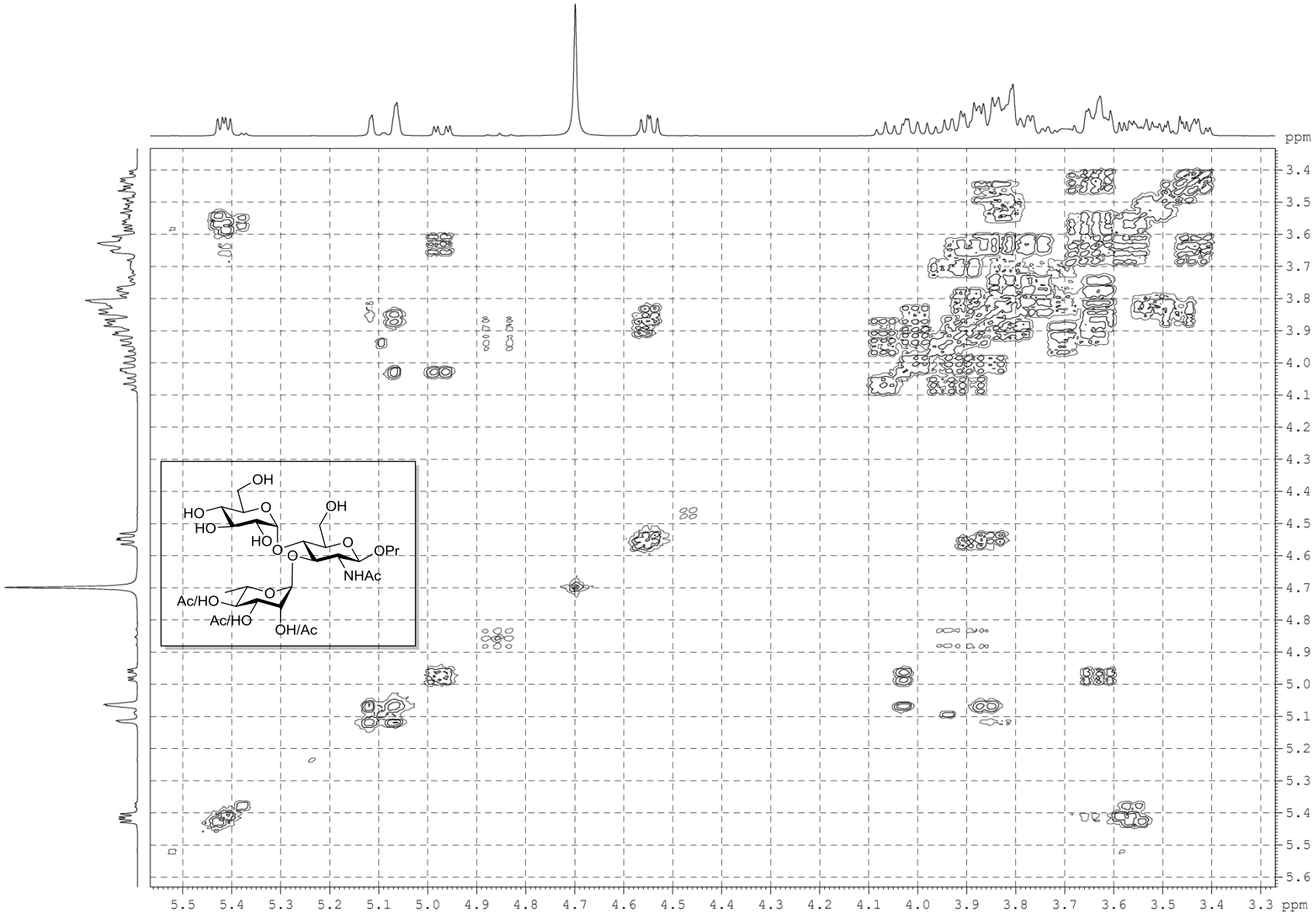

OBn
BnO
BnO
O
OBn
BnO
O
O
O
OAll
NHAc
BnO
O
PMBO
OAc
ppm
45
50
55
60
65
70
75
80
85
90
95
100
5.5 5.4 5.3 5.2 5.1 5.0 4.9 4.8 4.7 4.6 4.5 4.4 4.3 4.2 4.1 4.0 3.9 3.8 3.7 3.6 3.5 3.4 3.3
ppm

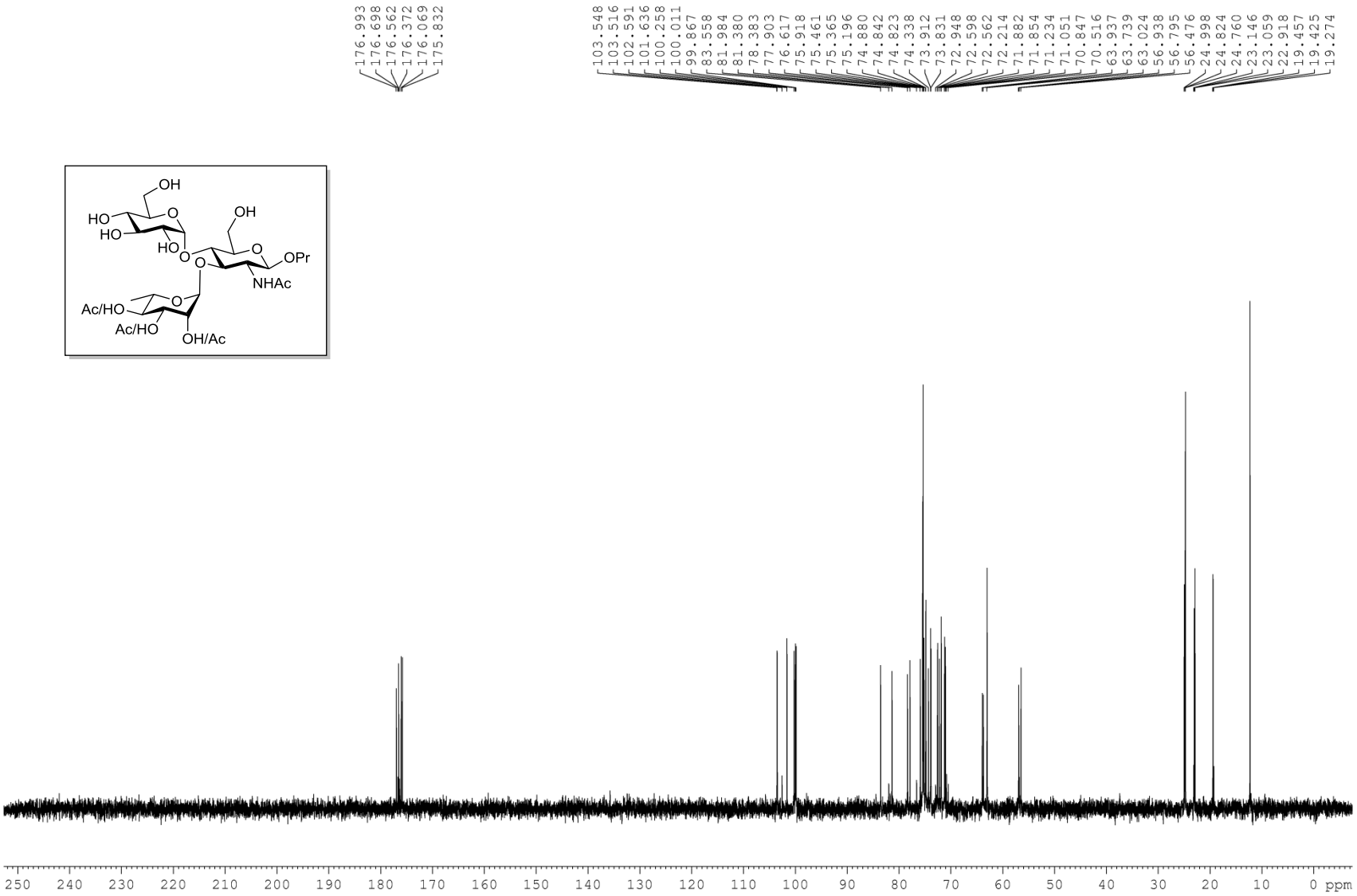
Compound 23, 24 and 25: **Propyl 2-*O*-acetyl-α-L-rhamnopyranosyl-(1→3)-[α-D-glucopyranosyl-(1→4)]-2-acetamido-2-deoxy-β-D-glucopyranoside (23), Propyl 3-*O*-acetyl-α-L-rhamnopyranosyl-(1→3)-[α-D-glucopyranosyl-(1→4)]-2-acetamido-2-deoxy-β-D-glucopyranoside (24), and Propyl 4-*O*-acetyl-α-L-rhamnopyranosyl-(1→3)-[α-D-glucopyranosyl-(1→4)]-2-acetamido-2-deoxy-β-D-glucopyranoside (25)**

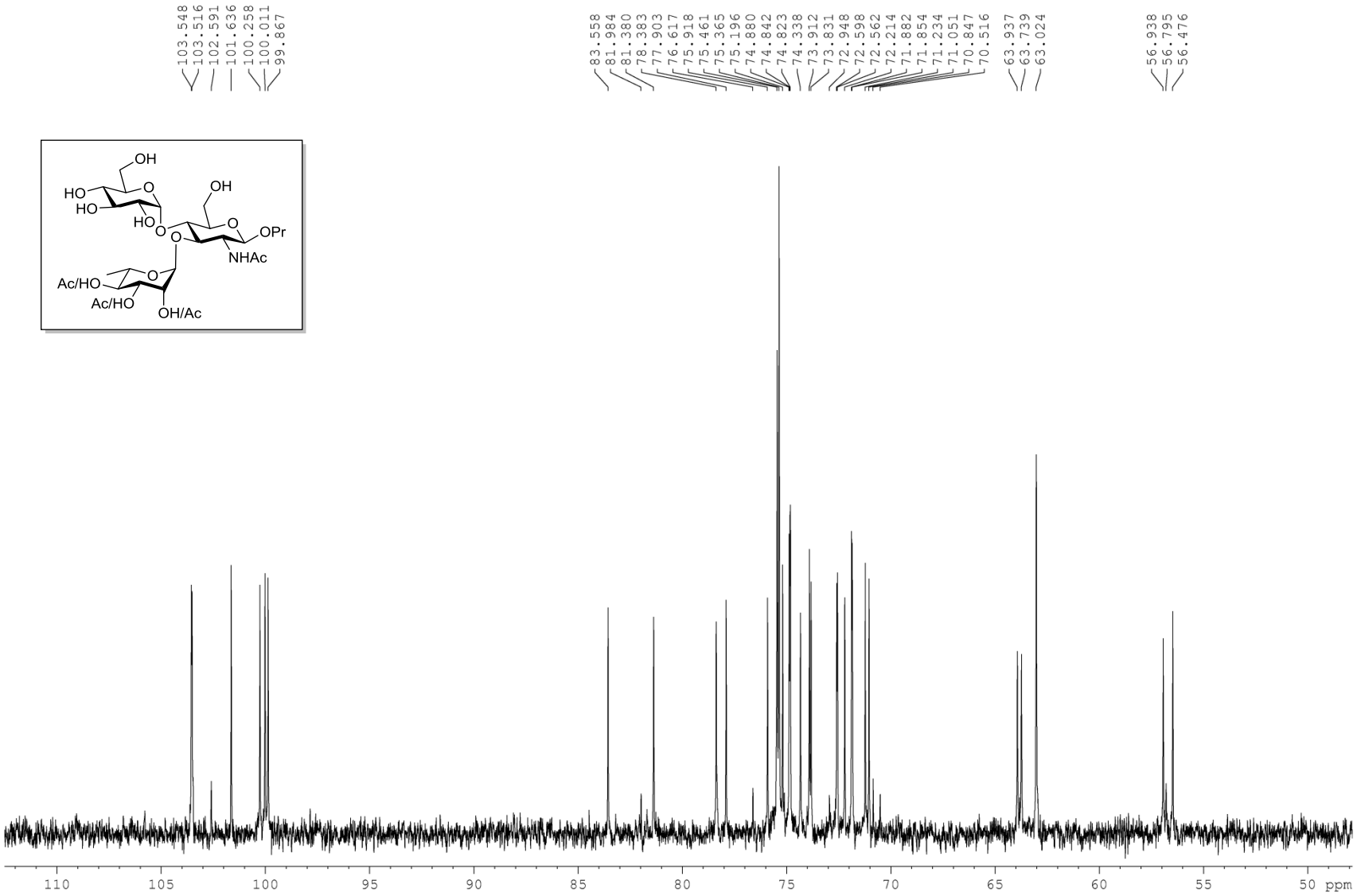


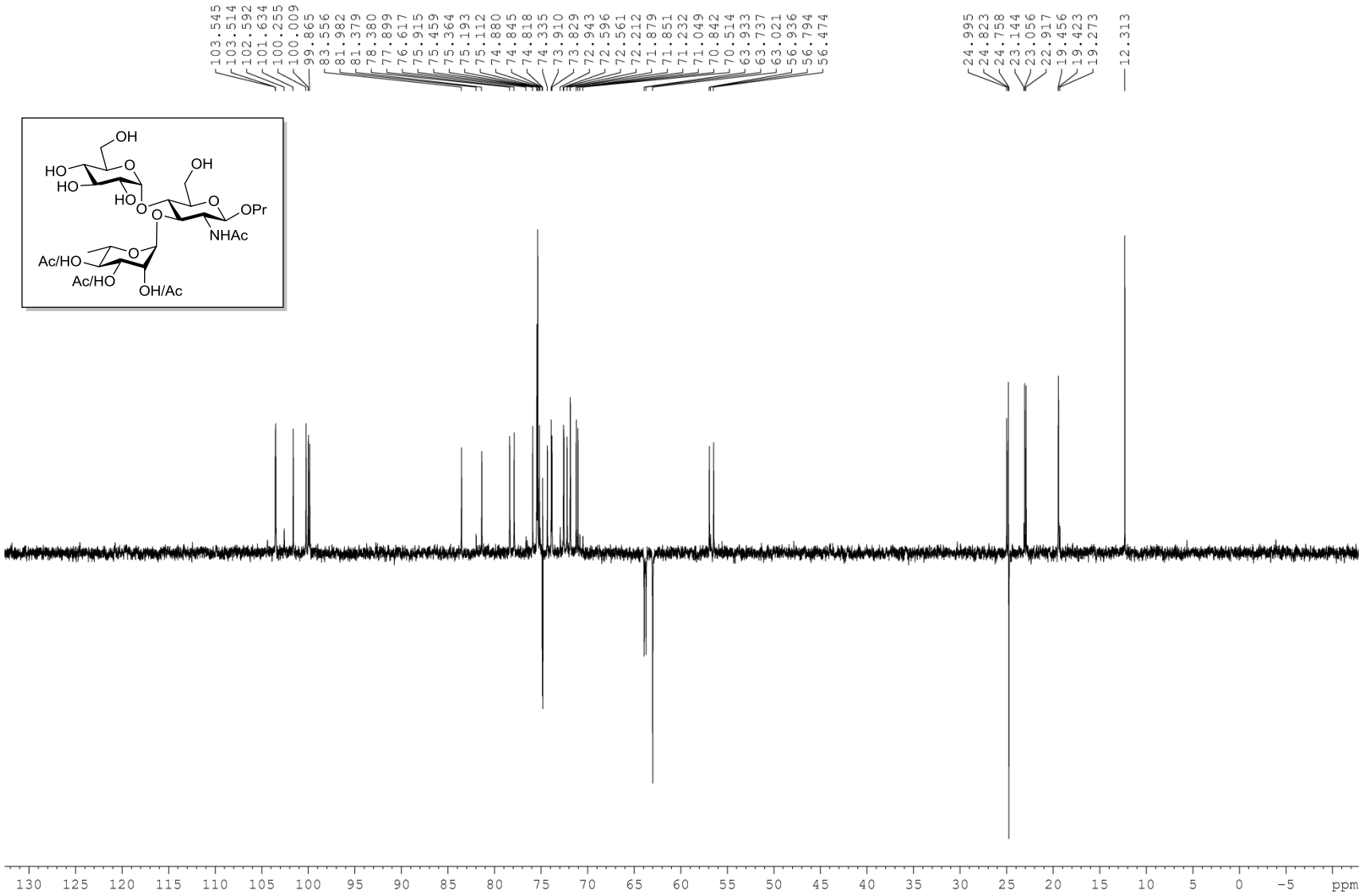

4.0836
4.0655
4.0475
4.0309
4.0240
4.0191
3.9998
3.9805
3.9632
3.9453
3.9296
3.9114
3.9046
3.8849
3.8741
3.8657
3.8472
3.8347
3.8250
3.8057
3.7905
3.7745
3.7653
3.7445
3.7333
3.7198
3.7058
3.6882
3.6803
3.6555
3.6509
3.6274
3.6175
3.6065
3.5884
3.5787
3.5682
3.5589
3.5549
3.5490
3.5439
3.5328
3.5210
3.5130
3.5064
3.4956
3.4893
3.4794
3.4684
3.4593
3.4510
3.4350
3.4272
3.4115
3.4038
OH
HO
HO
HO
O
OH
O
O
OPr
NHAc
Ac/HO
Ac/HO
OH/Ac
17.68
4.20
4.15
4.10
4.05
4.00
3.95
3.90
3.85
3.80
3.75
3.70
3.65
3.60
3.55
3.50
3.45
3.40
3.35
3.30
3.25
3.20
3.15
ppm

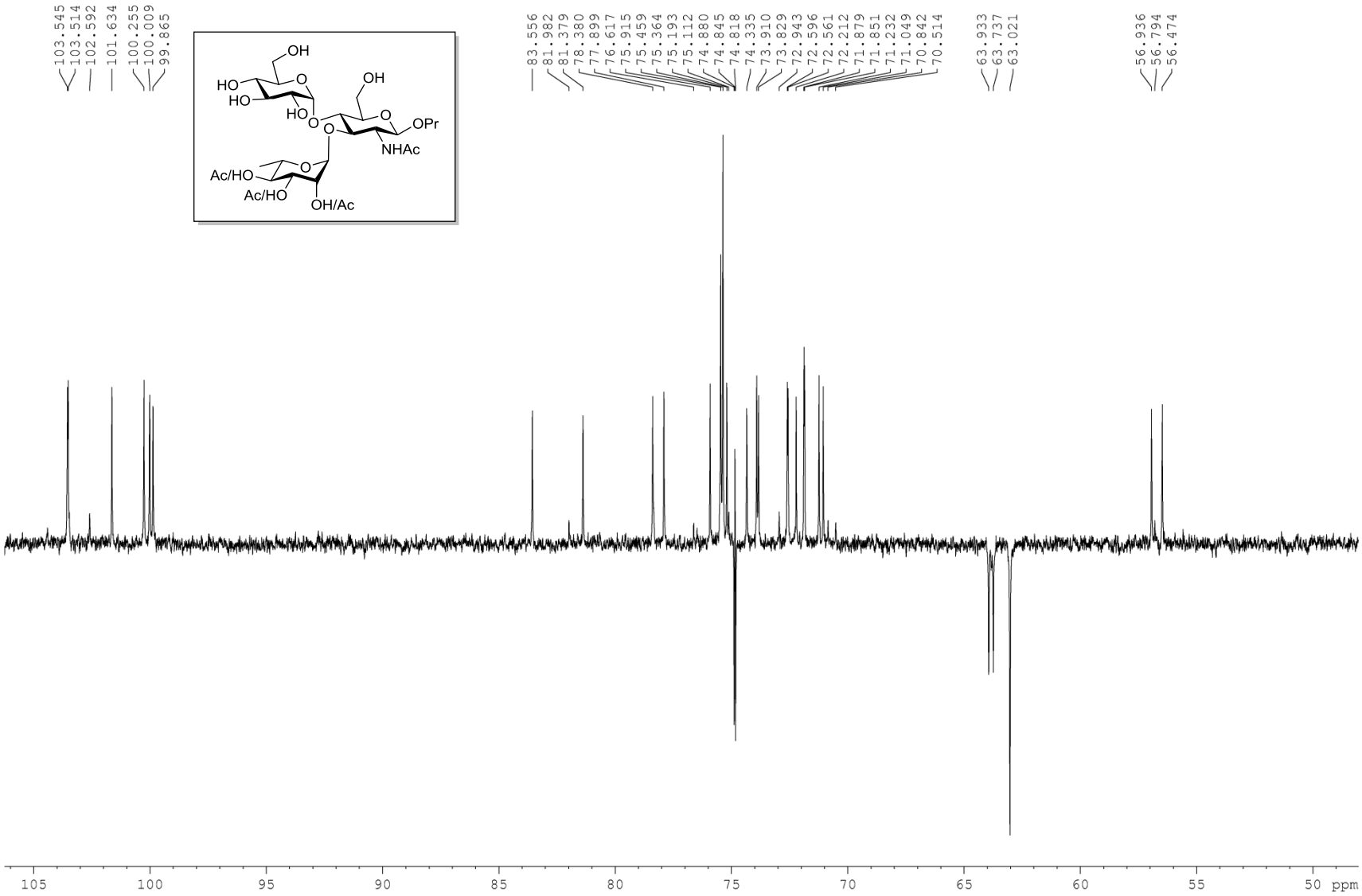

OH
HO
HO
O
HO
O
OH
O
O
OPr
NHAc
Ac/HO
O
Ac/HO
OH/Ac
ppm
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
5.5
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5 ppm

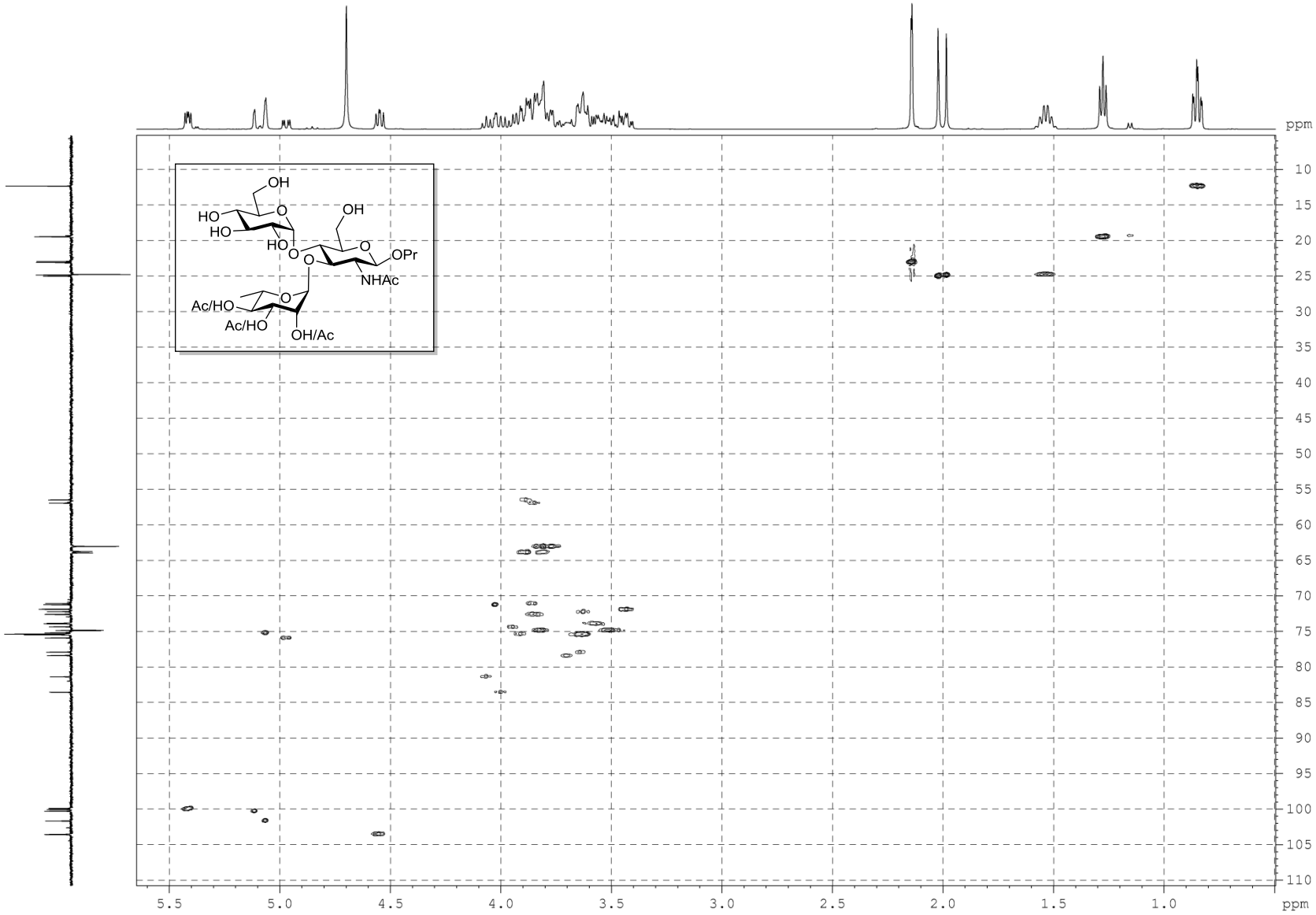

ppm
3.4
3.5
3.6
3.7
3.8
3.9
4.0
4.1
4.2
4.3
4.4
4.5
4.6
4.7
4.8
4.9
5.0
5.1
5.2
5.3
5.4
5.5
5.6
5.5 5.4 5.3 5.2 5.1 5.0 4.9 4.8 4.7 4.6 4.5 4.4 4.3 4.2 4.1 4.0 3.9 3.8 3.7 3.6 3.5 3.4 3.3 ppm
OH
HO
HO
O
HO
O
OH
O
OPr
NHAc
O
Ac/HO
Ac/HO
OH/Ac

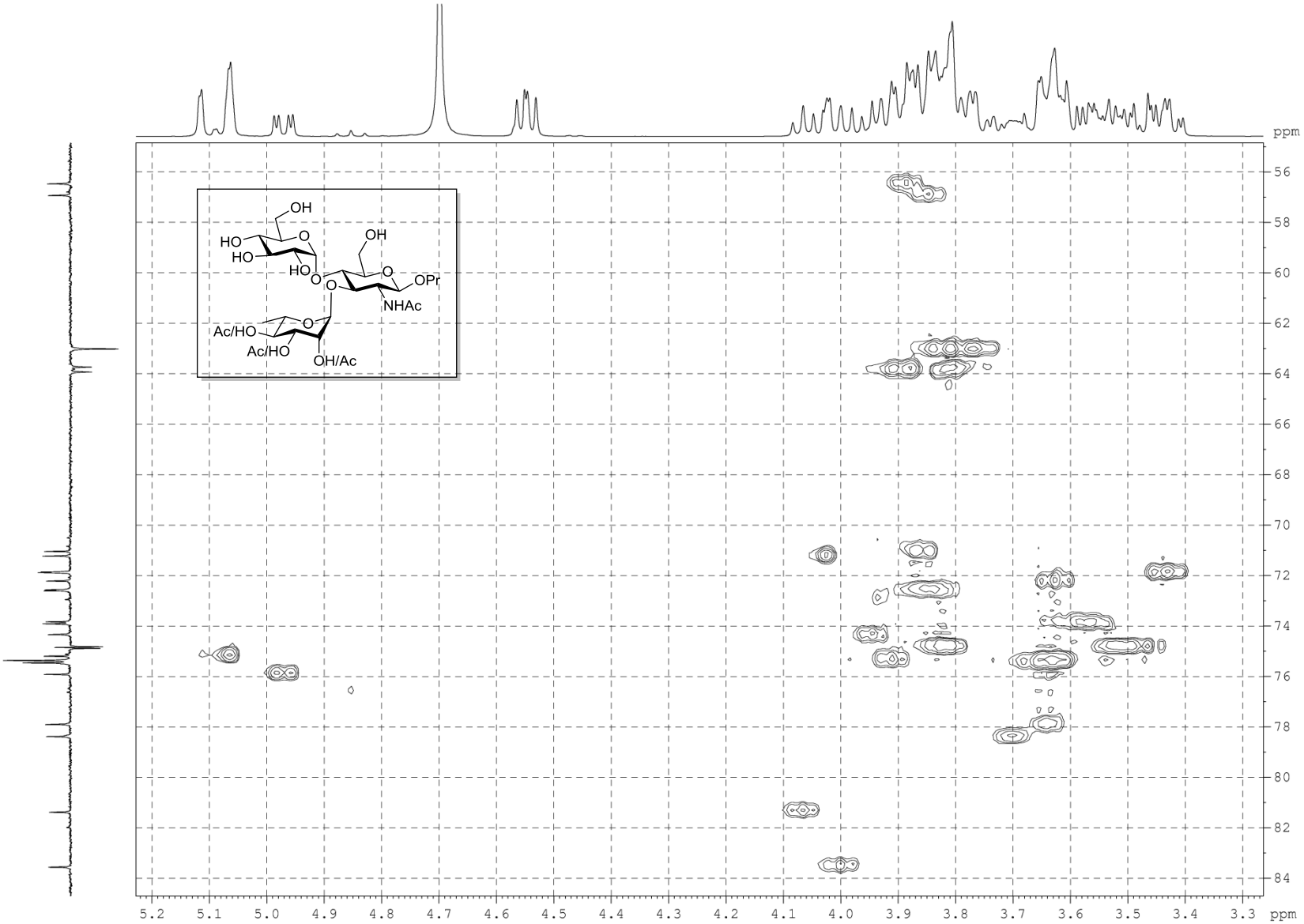

176.993
176.698
176.562
176.372
176.069
175.832
103.548
103.516
102.591
101.636
100.258
100.011
99.867
83.558
81.984
81.380
78.383
77.903
76.617
75.918
75.461
75.365
75.196
74.880
74.842
74.823
74.338
73.912
73.831
72.948
72.598
72.562
72.214
71.882
71.854
71.234
71.051
70.847
70.516
63.937
63.739
63.024
56.938
56.795
56.476
24.998
24.824
24.760
23.146
23.059
22.918
19.457
19.425
19.274
OH
HO
HO
HO
O
OH
O
O
O
OPr
NHAc
O
Ac/HO
Ac/HO
OH/Ac
250 240 230 220 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 ppm


103.548
103.516
102.591
101.636
100.258
100.011
99.867
83.558
81.984
81.380
78.383
77.903
76.617
75.918
75.461
75.365
75.196
74.880
74.842
74.823
74.338
73.912
73.831
72.948
72.598
72.562
72.214
71.882
71.854
71.234
71.051
70.847
70.516
63.937
63.739
63.024
56.938
56.795
56.476
OH
HO
HO
O
HO
O
OH
O
O
OPr
NHAc
O
Ac/HO
Ac/HO
OH/Ac
110
105
100
95
90
85
80
75
70
65
60
55
50 ppm

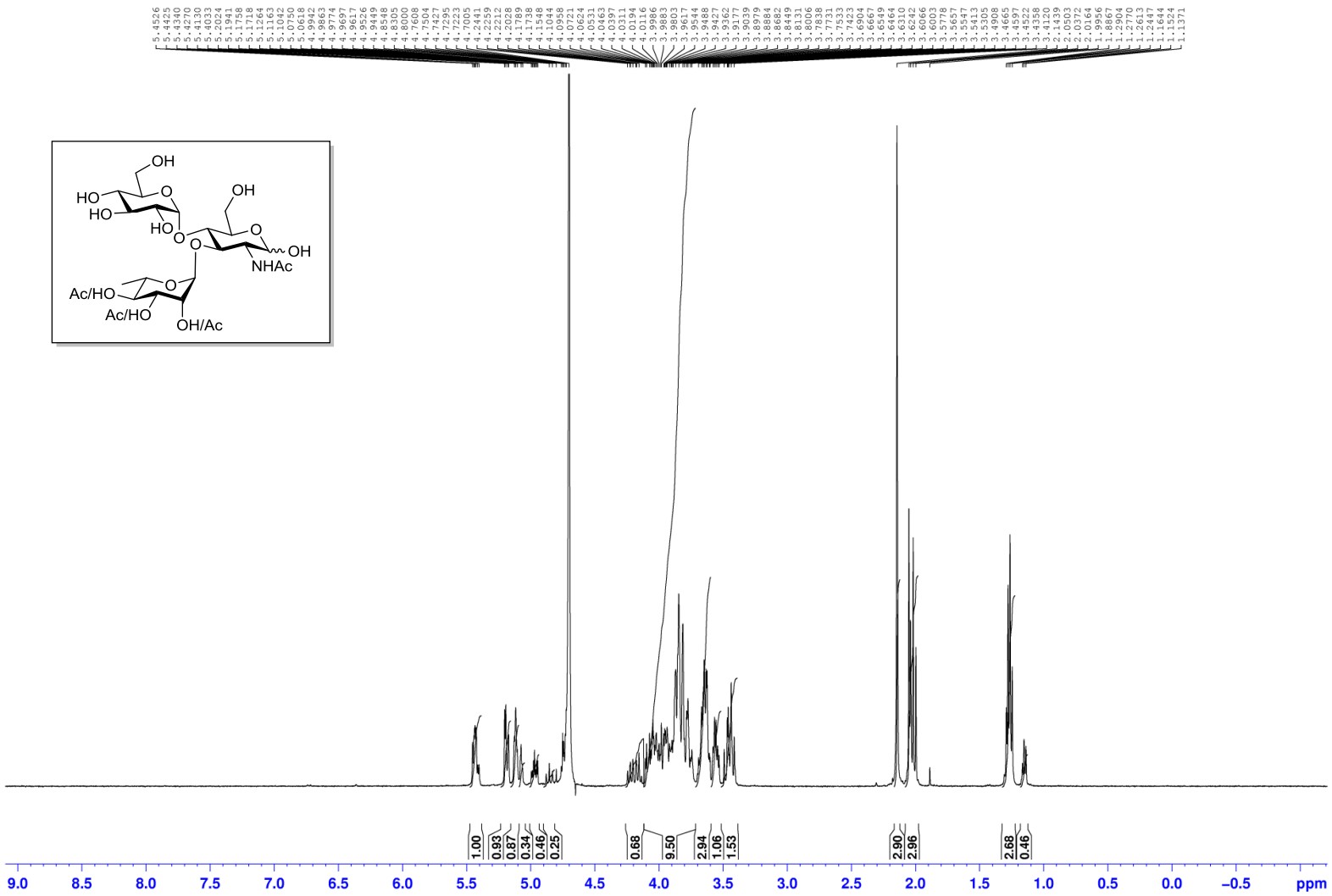

103.545
103.514
102.592
101.634
100.255
100.009
99.865
83.556
81.982
81.379
78.380
77.899
76.617
75.915
75.459
75.364
75.193
75.112
74.880
74.845
74.818
74.335
73.910
73.829
72.943
72.596
72.561
72.212
71.879
71.851
71.232
71.049
70.842
70.514
63.933
63.737
63.021
56.936
56.794
56.474
24.995
24.823
24.758
23.144
23.056
22.917
19.456
19.423
19.273
12.313
OH
HO
HO
O
HO
O
OH
O
OPr
NHAc
O
Ac/HO
Ac/HO
OH/Ac
130 125 120 115 110 105 100 95 90 85 80 75 70 65 60 55 50 45 40 35 30 25 20 15 10 5 0 -5 ppm

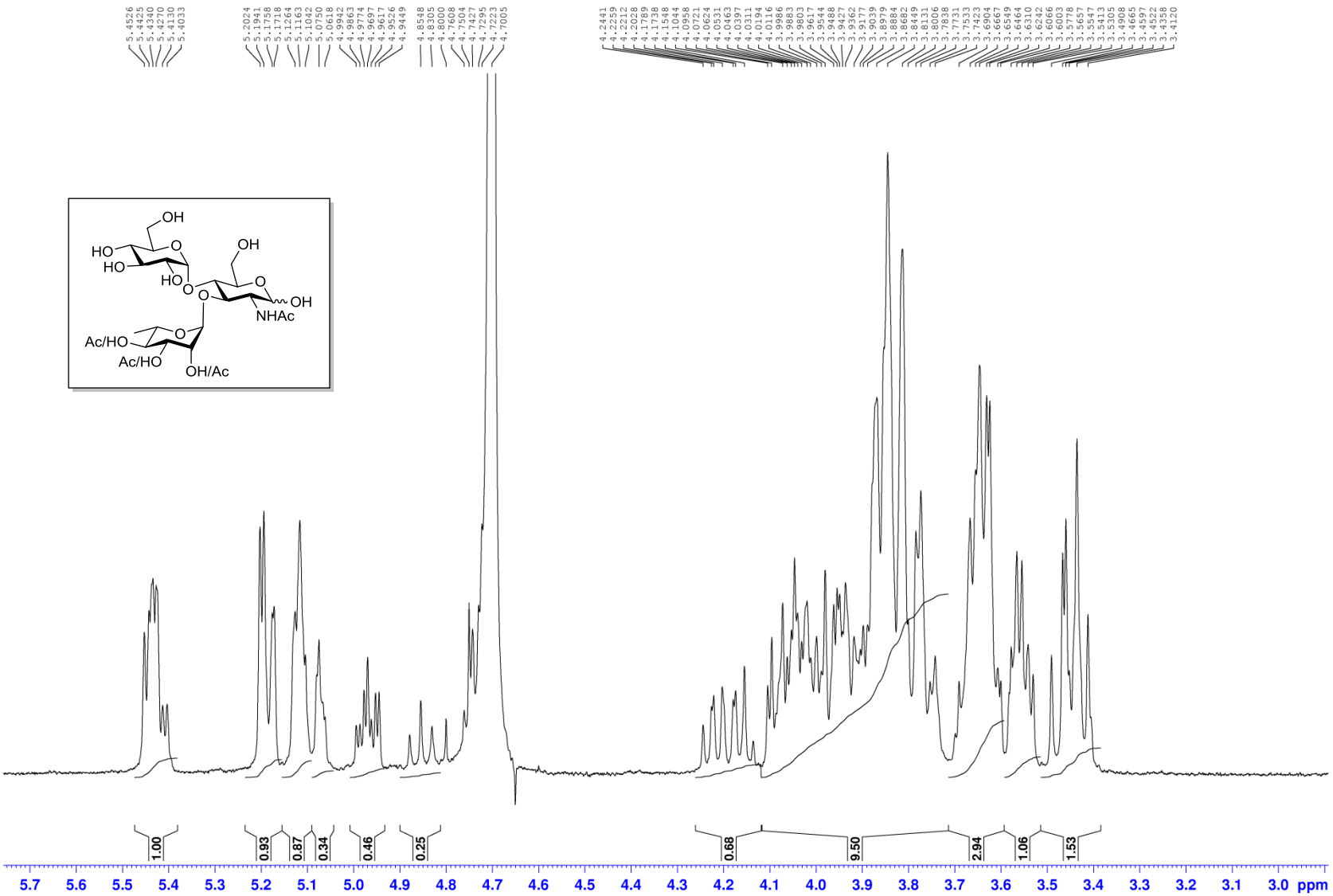

103.545
103.514
102.592
101.634
100.255
100.009
99.865
83.556
81.982
81.379
78.380
77.899
76.617
75.915
75.459
75.364
75.193
75.112
74.880
74.845
74.818
74.335
73.910
73.829
72.943
72.596
72.561
72.212
71.879
71.851
71.232
71.049
70.842
70.514
63.933
63.737
63.021
56.936
56.794
56.474
OH
HO
HO
HO
O
OH
O
OPr
NHAc
O
Ac/HO
Ac/HO
OH/Ac
105
100
95
90
85
80
75
70
65
60
55
50 ppm

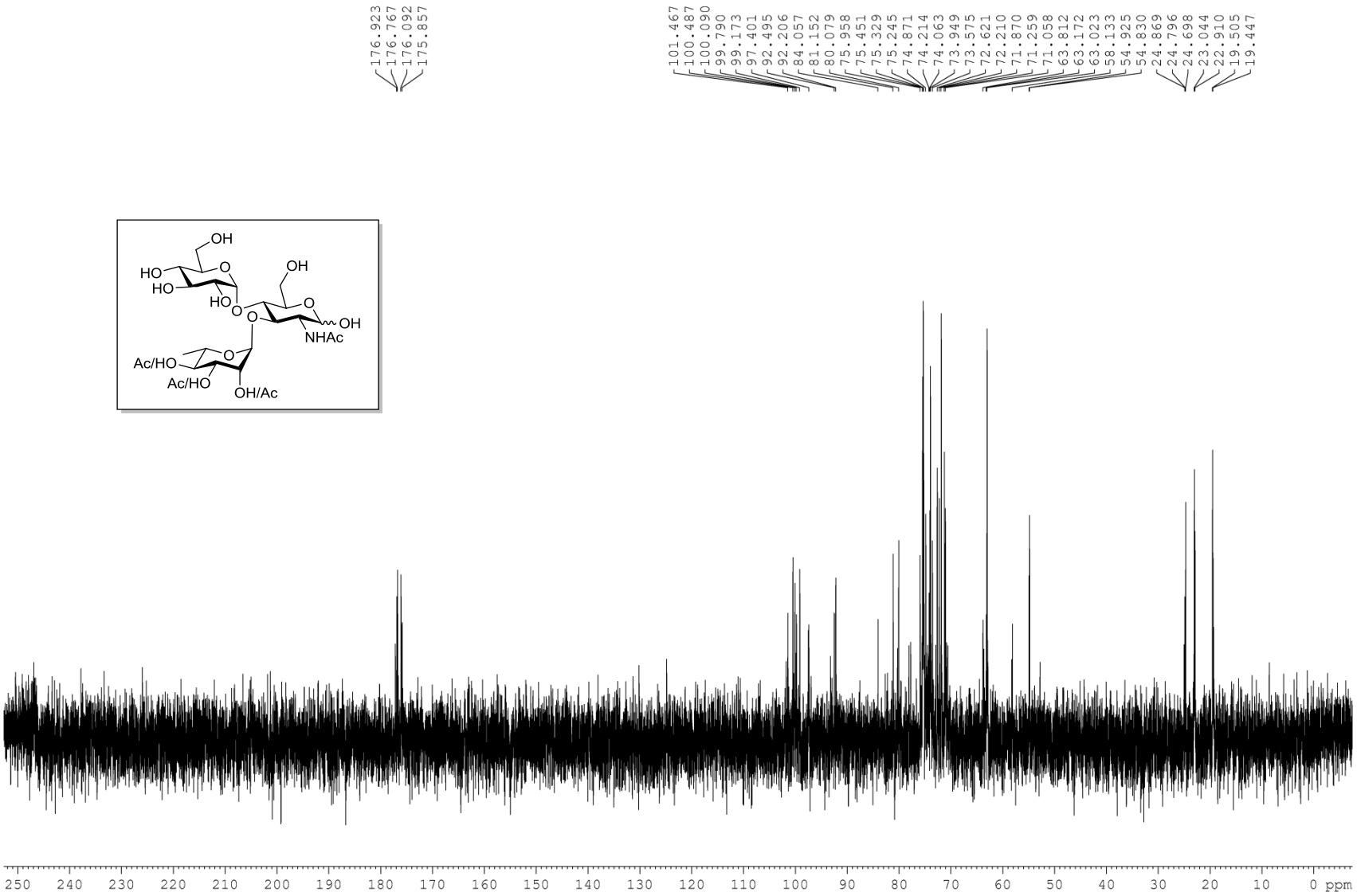

OH
HO
HO
O
HO
O
OH
O
O
OPr
NHAc
O
Ac/HO
Ac/HO
OH/Ac
ppm
10
15
20
25
30
35
40
45
50
55
60
65
70
75
80
85
90
95
100
105
110
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
ppm

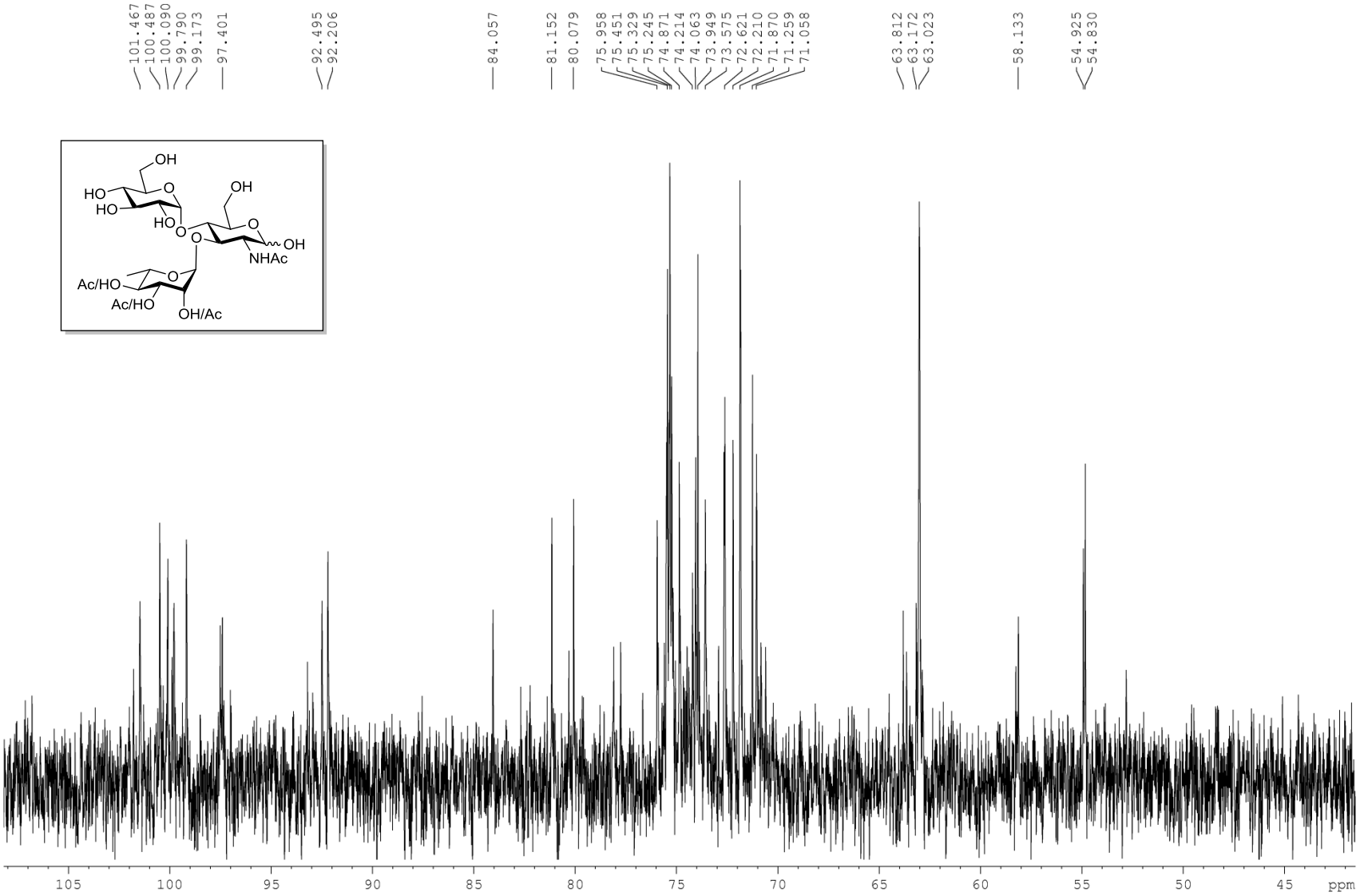

OH
HO
HO
O
HO
O
OH
O
O
OPr
NHAc
Ac/HO
O
Ac/HO
OH/Ac
ppm
56
58
60
62
64
66
68
70
72
74
76
78
80
82
84
5.2
5.1
5.0
4.9
4.8
4.7
4.6
4.5
4.4
4.3
4.2
4.1
4.0
3.9
3.8
3.7
3.6
3.5
3.4
3.3
ppm

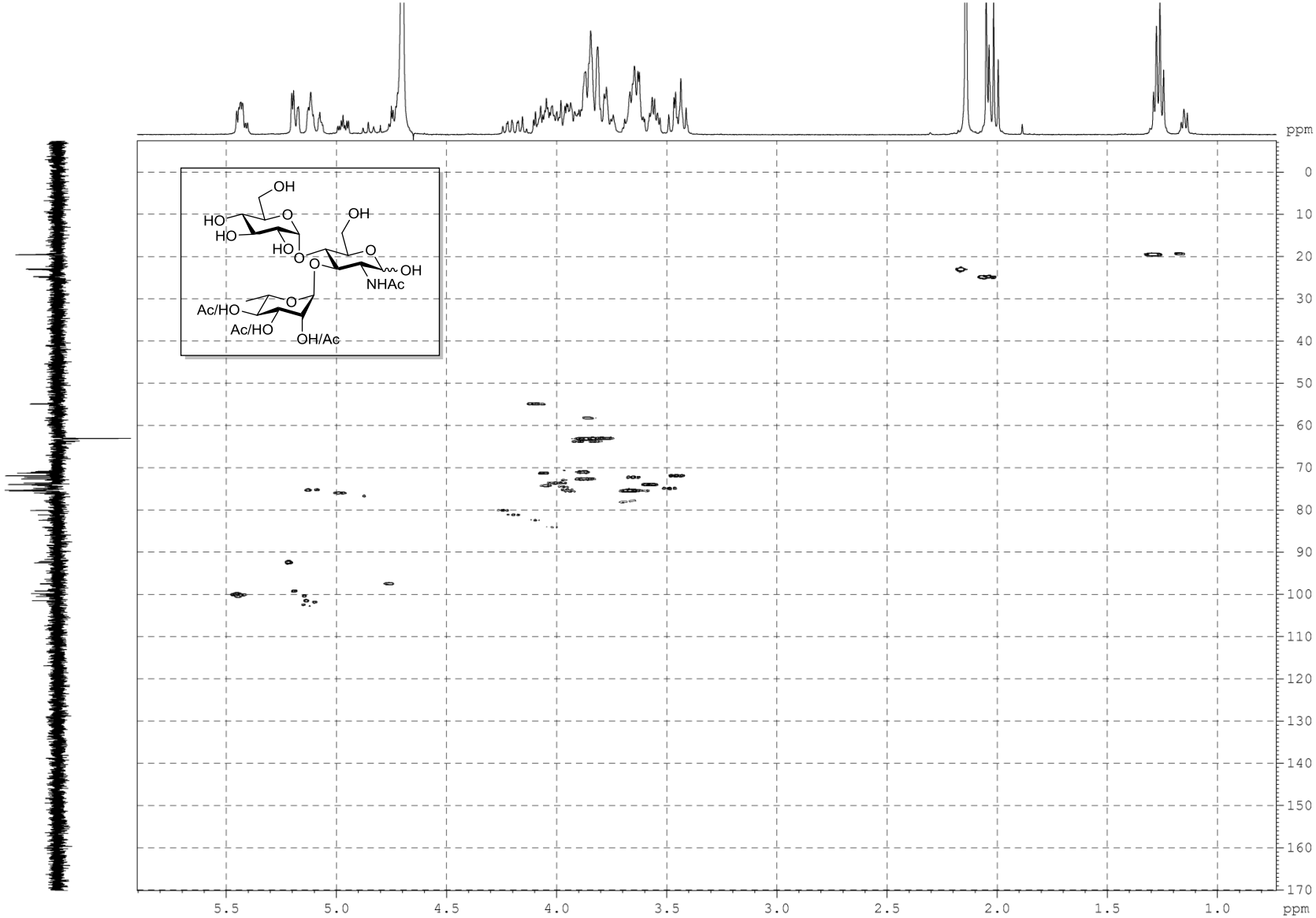
Compound 26, 27 and 28: **2-*O*-acetyl-α-L-rhamnopyranosyl-(1→3)-[α-D-glucopyranosyl-(1→4)]-2-acetamido-2-deoxy-β-D-glucopyranose (26), 3-*O*-acetyl-α-L-rhamnopyranosyl-(1→3)-[α-D-glucopyranosyl-(1→4)]-2-acetamido-2-deoxy-β-D-glucopyranose (27), and 4-*O*-acetyl-α-L-rhamnopyranosyl-(1→3)-[α-D-glucopyranosyl-(1→4)]-2-acetamido-2-deoxy-β-D-glucopyranose (28)**

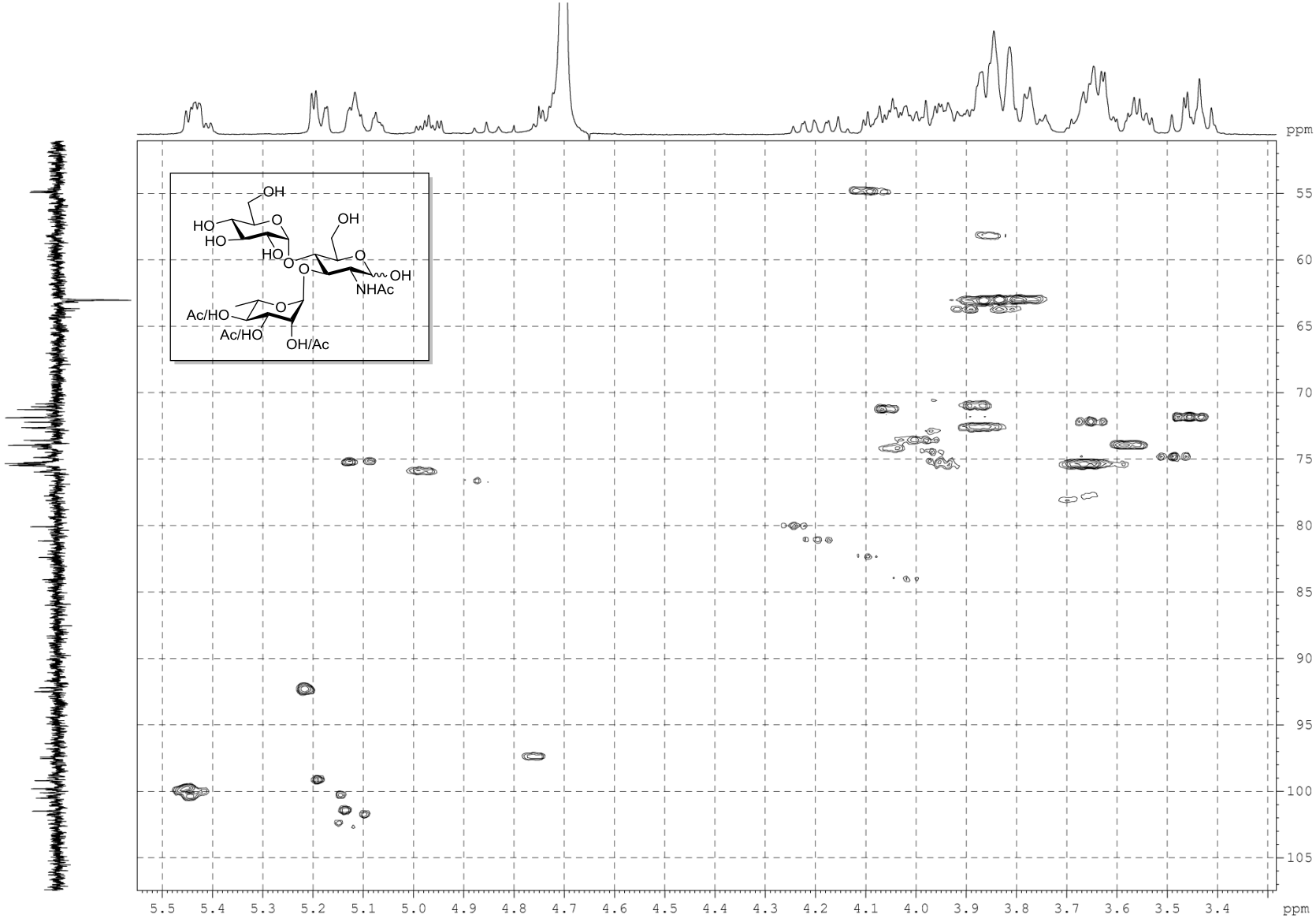



OH
HO
HO
O
OH
HO
O
O
O
OH
NHAc
O
Ac/HO
Ac/HO
OH/Ac
1.00
0.93
0.87
0.34
0.46
0.25
0.68
9.50
2.94
1.06
1.53
5.7 5.6 5.5 5.4 5.3 5.2 5.1 5.0 4.9 4.8 4.7 4.6 4.5 4.4 4.3 4.2 4.1 4.0 3.9 3.8 3.7 3.6 3.5 3.4 3.3 3.2 3.1 3.0 ppm

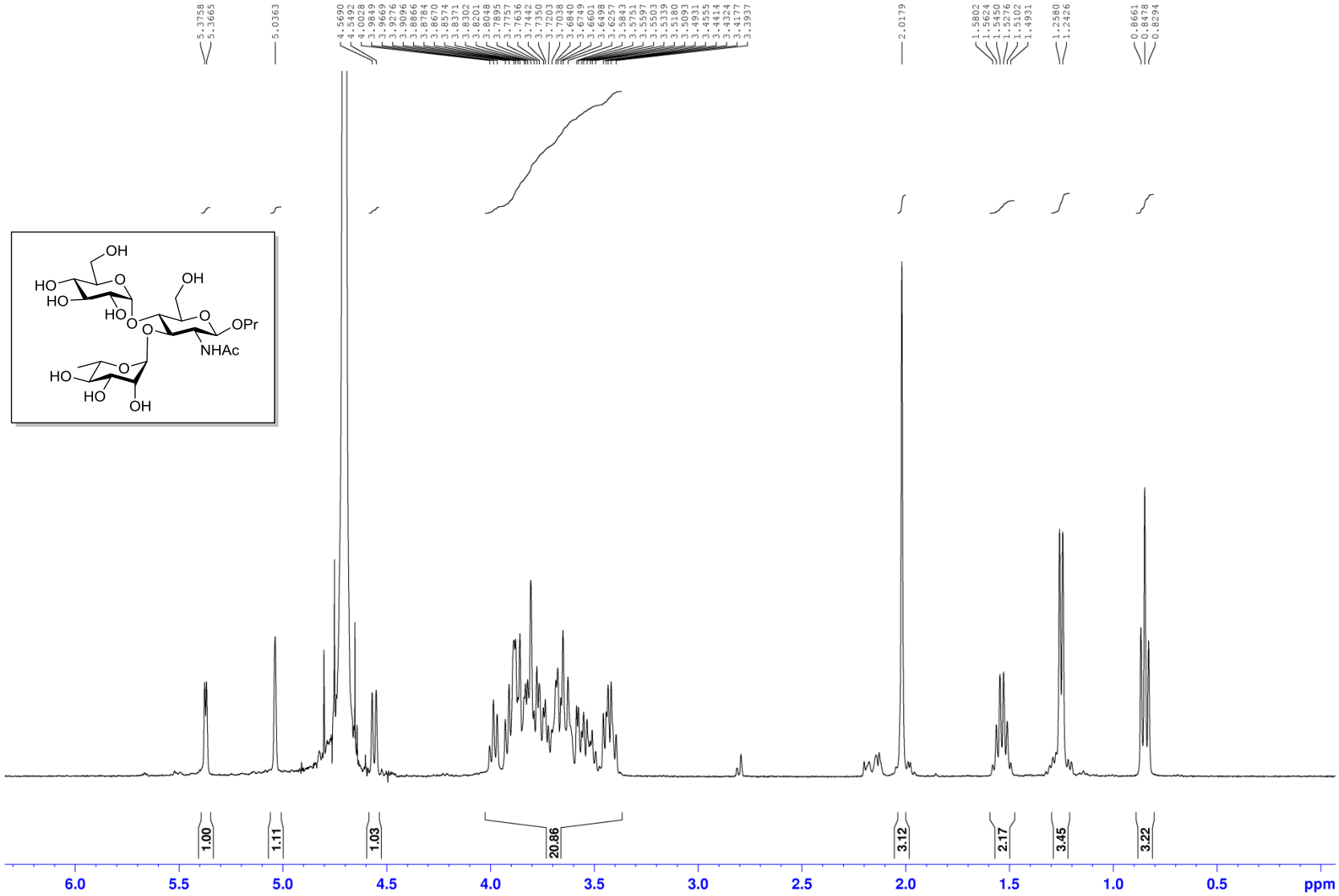

176.923
176.767
176.092
175.857
101.467
100.487
100.090
99.790
99.173
97.401
92.495
92.206
84.057
81.152
80.079
75.958
75.451
75.329
75.245
74.871
74.214
74.063
73.949
73.575
72.621
72.210
71.870
71.259
71.058
63.812
63.172
63.023
58.133
54.925
54.830
24.869
24.796
24.698
23.044
22.910
19.505
19.447
OH
HO
HO
O
HO
O
OH
O
O
OH
NHAc
Ac/HO
O
Ac/HO
OH/Ac
250 240 230 220 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 ppm

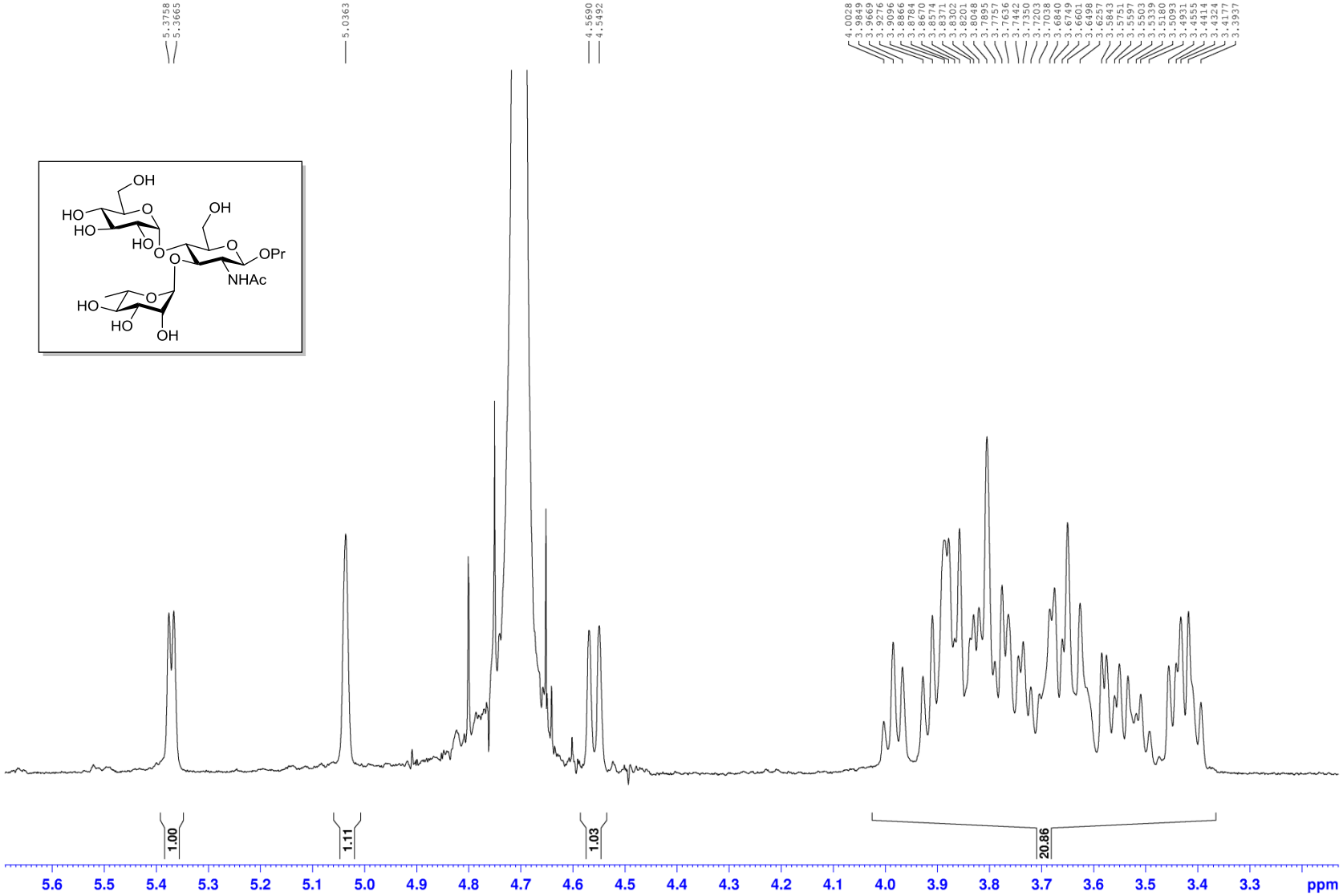

101.467
100.487
100.090
99.790
99.173
97.401
92.495
92.206
84.057
81.152
80.079
75.958
75.451
75.329
75.245
74.871
74.214
74.063
73.949
73.575
72.621
72.210
71.870
71.259
71.058
63.812
63.172
63.023
58.133
54.925
54.830
OH
HO
HO
O
OH
HO
O
O
O
OH
NHAc
O
Ac/HO
Ac/HO
OH/Ac
105
100
95
90
85
80
75
70
65
60
55
50
45
ppm

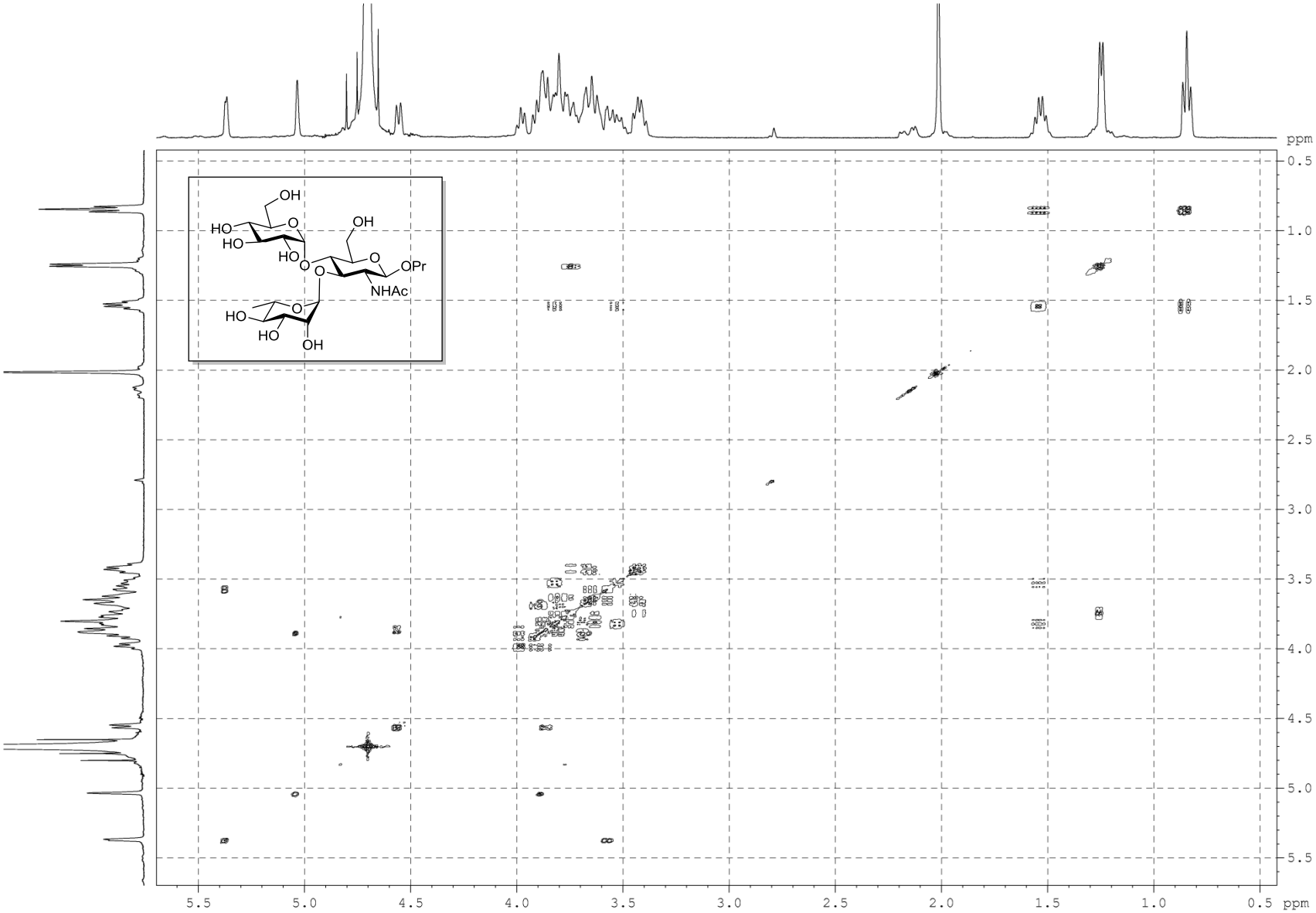

OH
HO
O
HO
HO
OH
O
O
O
OH
NHAc
Ac/HO
O
Ac/HO
OH/Ac
ppm
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
ppm

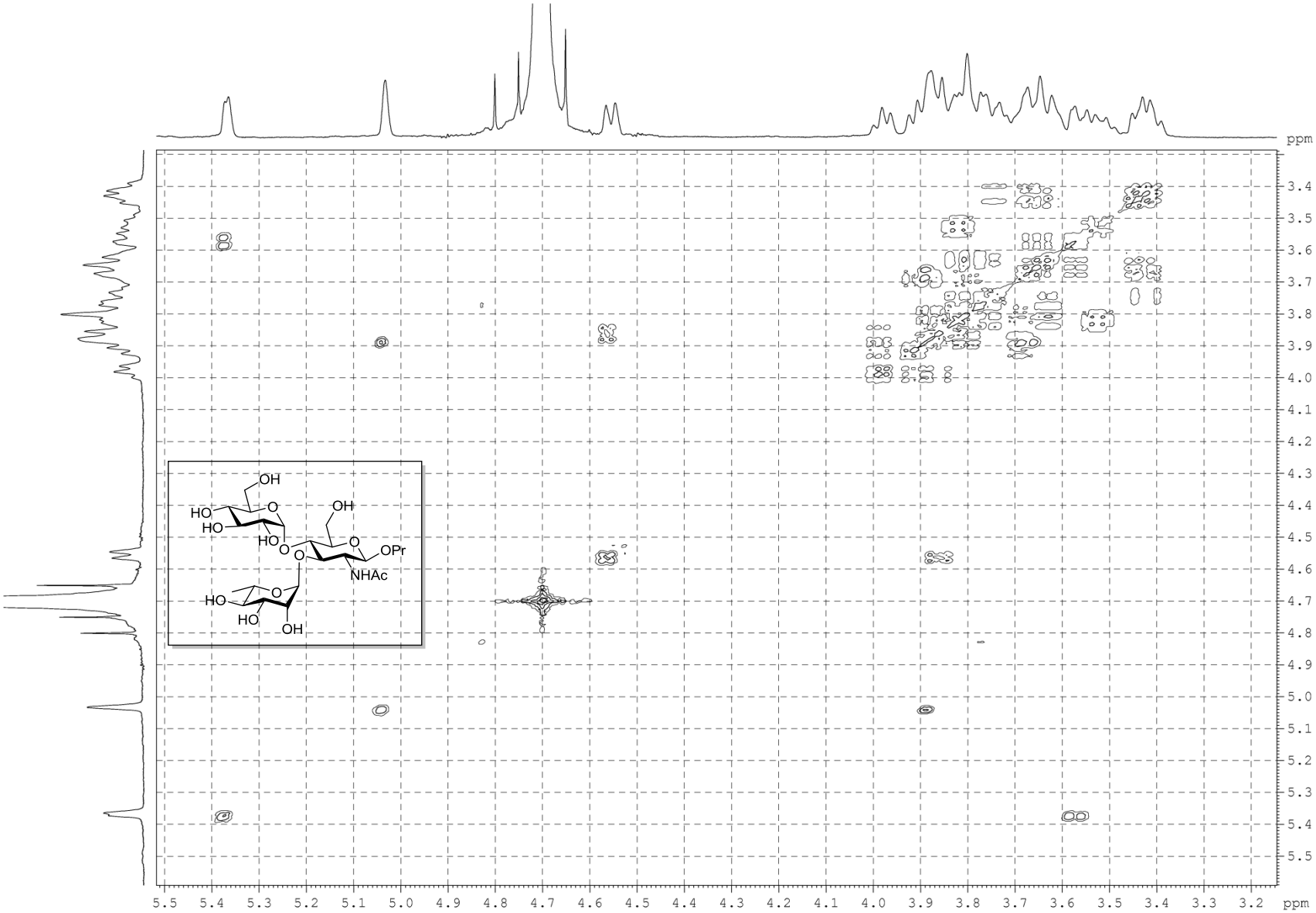

OH
HO
HO
O
HO
O
O
OH
O
OH
NHAc
Ac/HO
Ac/HO
O
OH/Ac
ppm
55
60
65
70
75
80
85
90
95
100
105
5.5 5.4 5.3 5.2 5.1 5.0 4.9 4.8 4.7 4.6 4.5 4.4 4.3 4.2 4.1 4.0 3.9 3.8 3.7 3.6 3.5 3.4
ppm

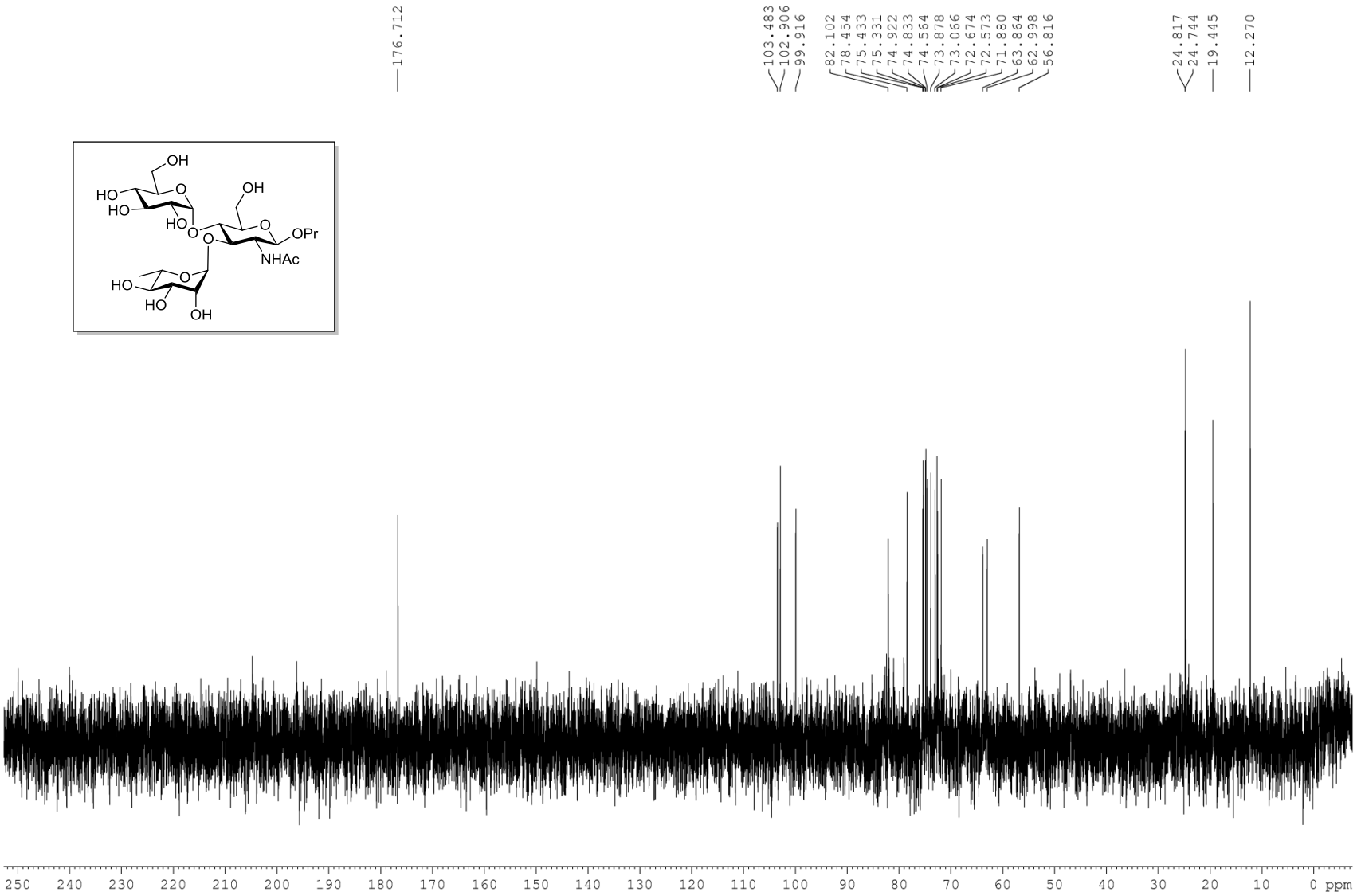
Compound 29: **Propyl α-L-rhamnopyranosyl-(1→3)-[α-D-glucopyranosyl-(1→4)]-2-acetamido-2-deoxy-β-D-glucopyranoside**

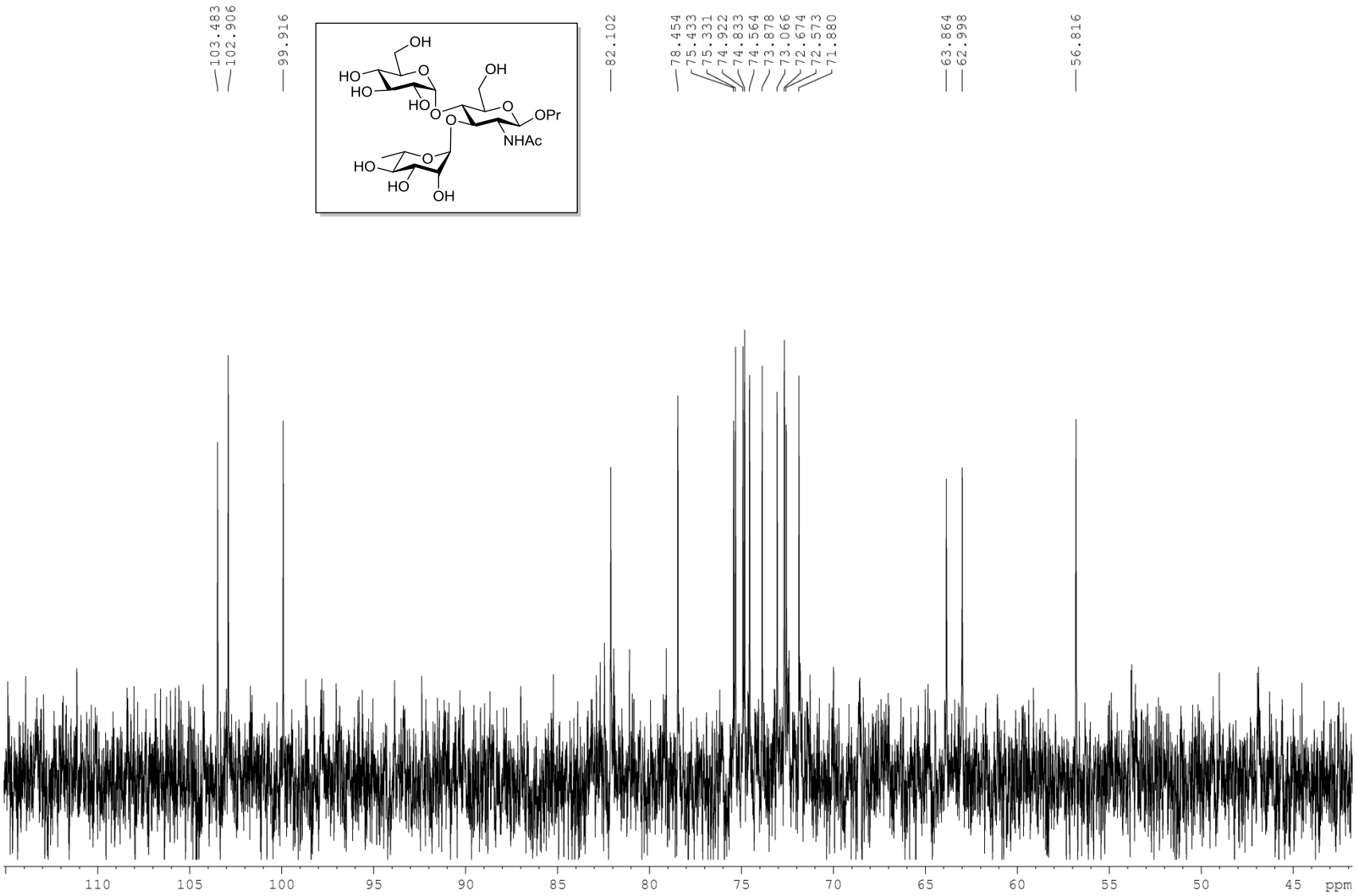


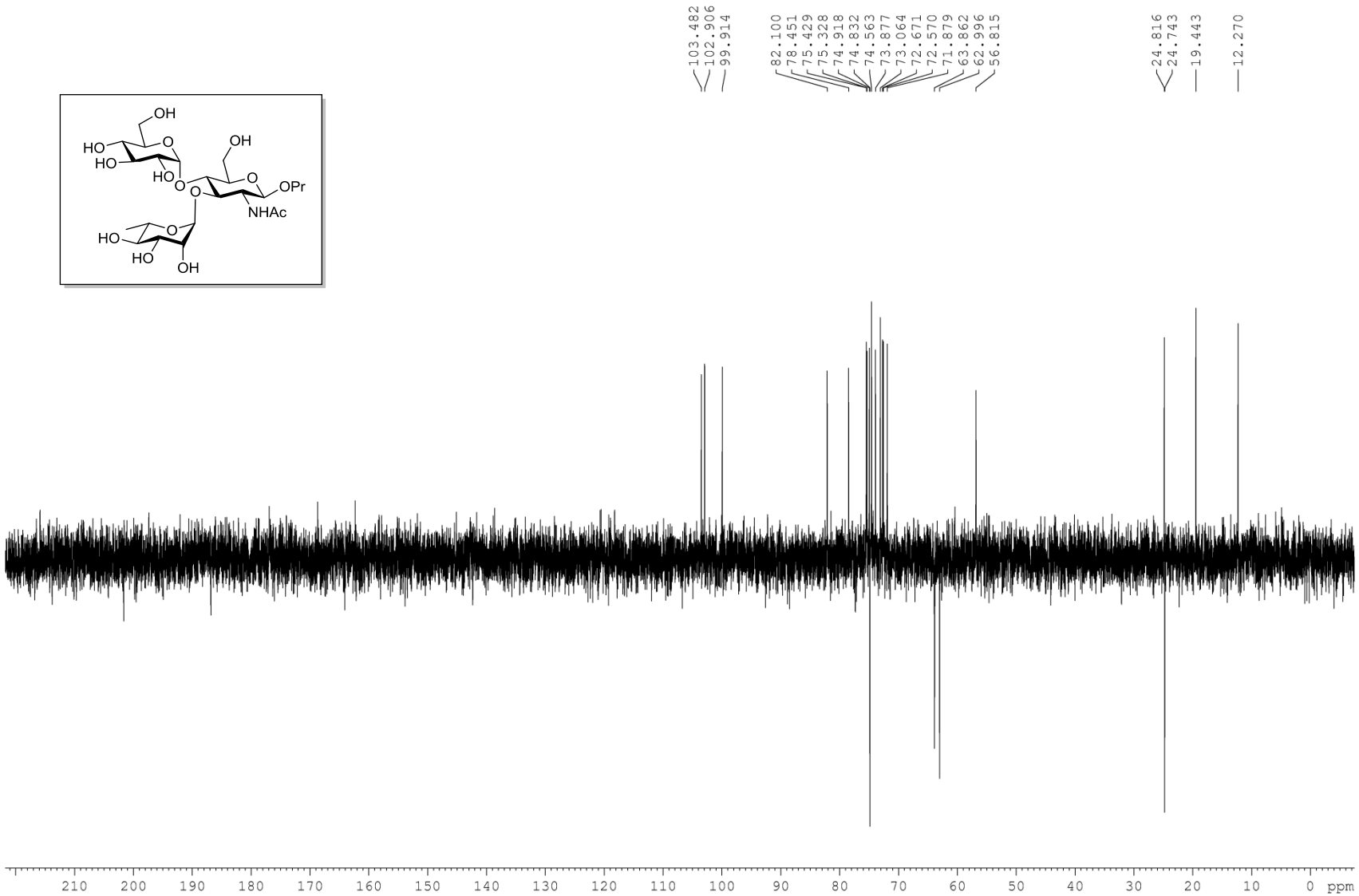

5.3758
5.3665
5.0363
4.5690
4.5492
4.0028
3.9849
3.9669
3.9276
3.9096
3.8866
3.8784
3.8670
3.8574
3.8371
3.8302
3.8201
3.8048
3.7895
3.7757
3.7636
3.7442
3.7350
3.7203
3.7038
3.6840
3.6749
3.6601
3.6498
3.6257
3.5843
3.5751
3.5597
3.5503
3.5339
3.5180
3.5093
3.4931
3.4555
3.4414
3.4324
3.4177
3.3937
OH
HO
HO
O
OH
HO
O
O
O
OPr
NHAc
HO
O
HO
OH
1.00
1.11
1.03
20.86
5.6
5.5
5.4
5.3
5.2
5.1
5.0
4.9
4.8
4.7
4.6
4.5
4.4
4.3
4.2
4.1
4.0
3.9
3.8
3.7
3.6
3.5
3.4
3.3
ppm

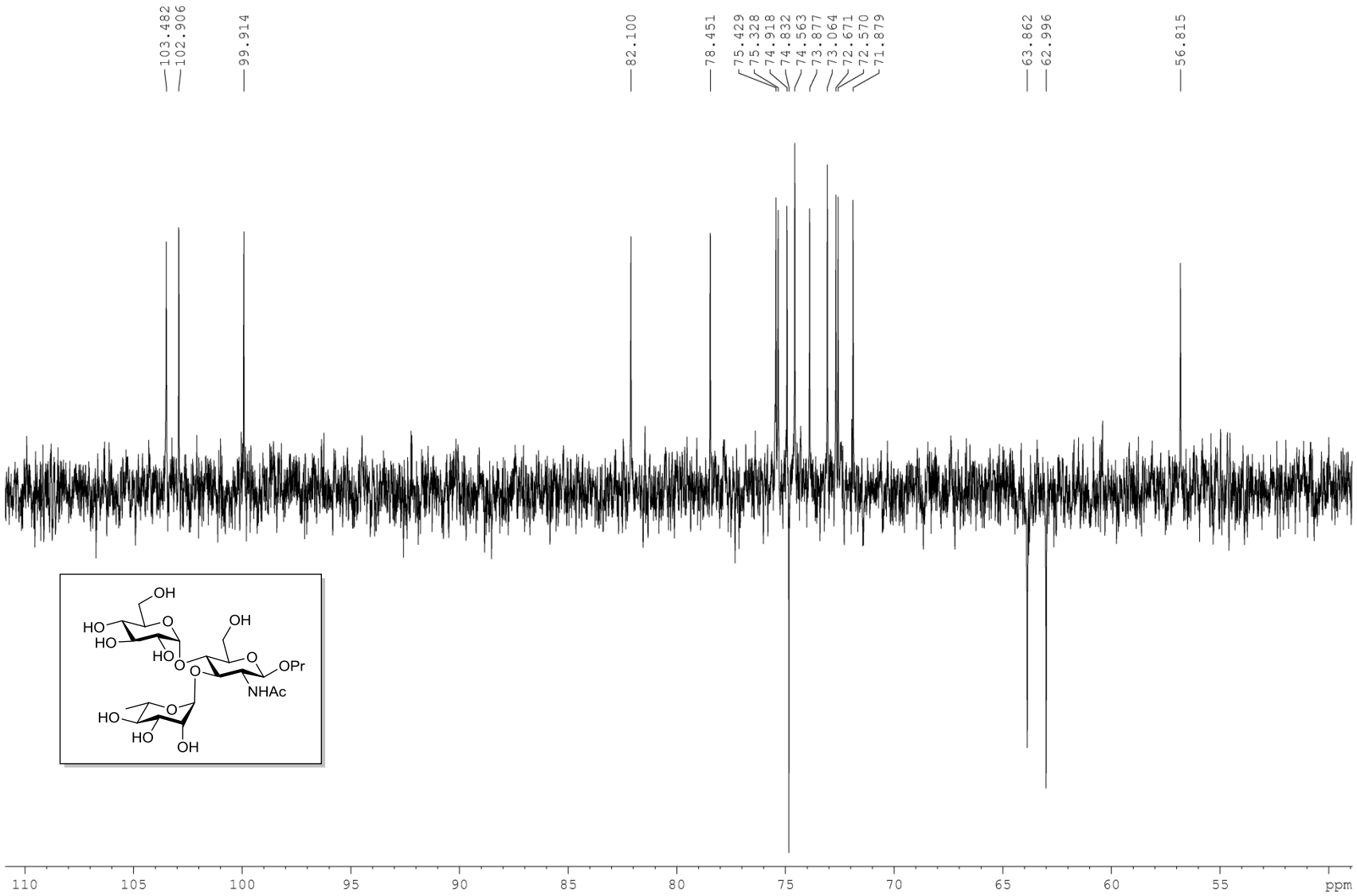

OH
HO
HO
O
OH
HO
O
O
O
OPr
NHAc
HO
O
HO
OH
ppm
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
5.5
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
ppm

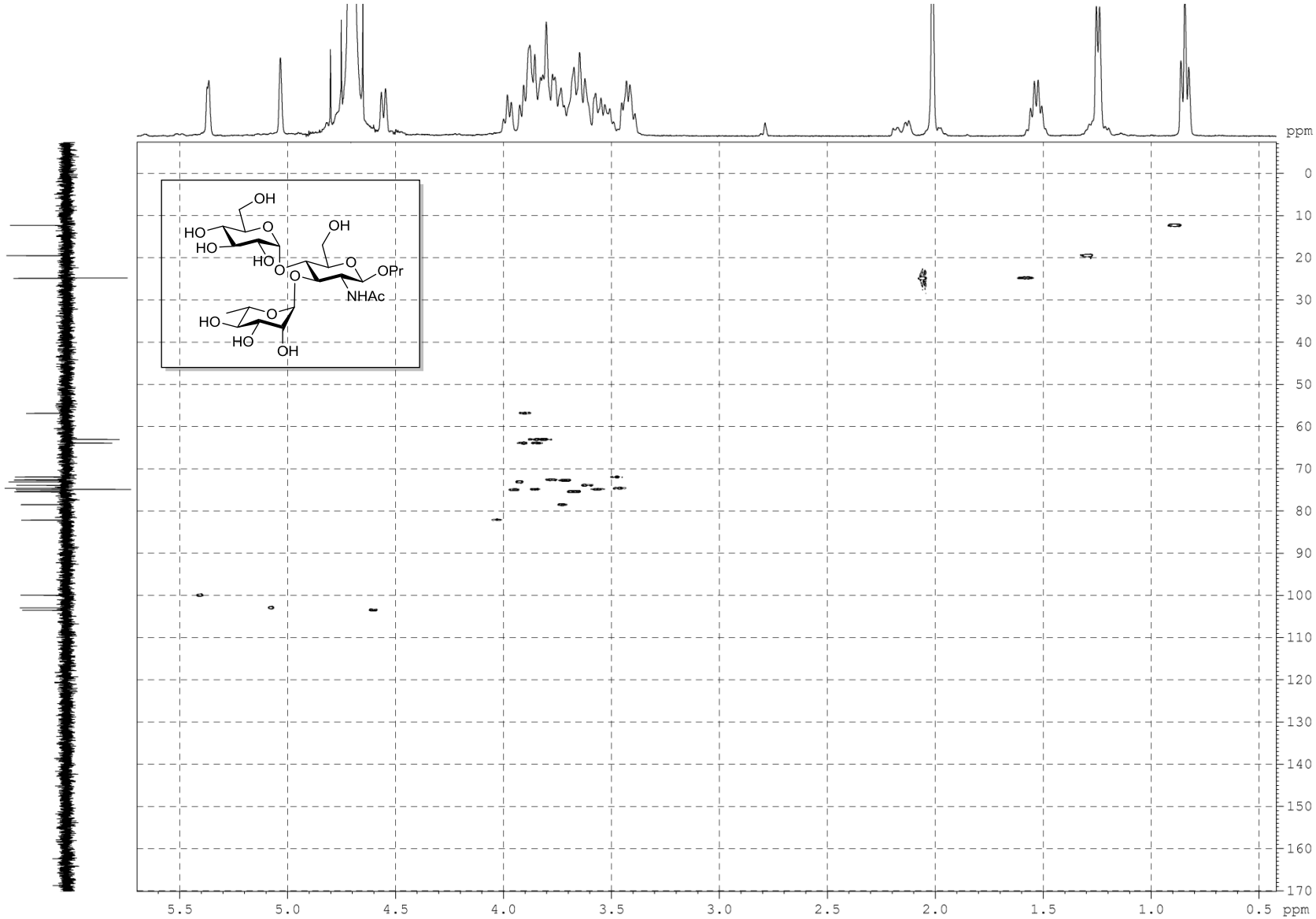

ppm
3.4
3.5
3.6
3.7
3.8
3.9
4.0
4.1
4.2
4.3
4.4
4.5
4.6
4.7
4.8
4.9
5.0
5.1
5.2
5.3
5.4
5.5
5.5 5.4 5.3 5.2 5.1 5.0 4.9 4.8 4.7 4.6 4.5 4.4 4.3 4.2 4.1 4.0 3.9 3.8 3.7 3.6 3.5 3.4 3.3 3.2 ppm
OH
HO
HO
O
HO
O
O
OH
O
OPr
NHAc
HO
O
HO
OH

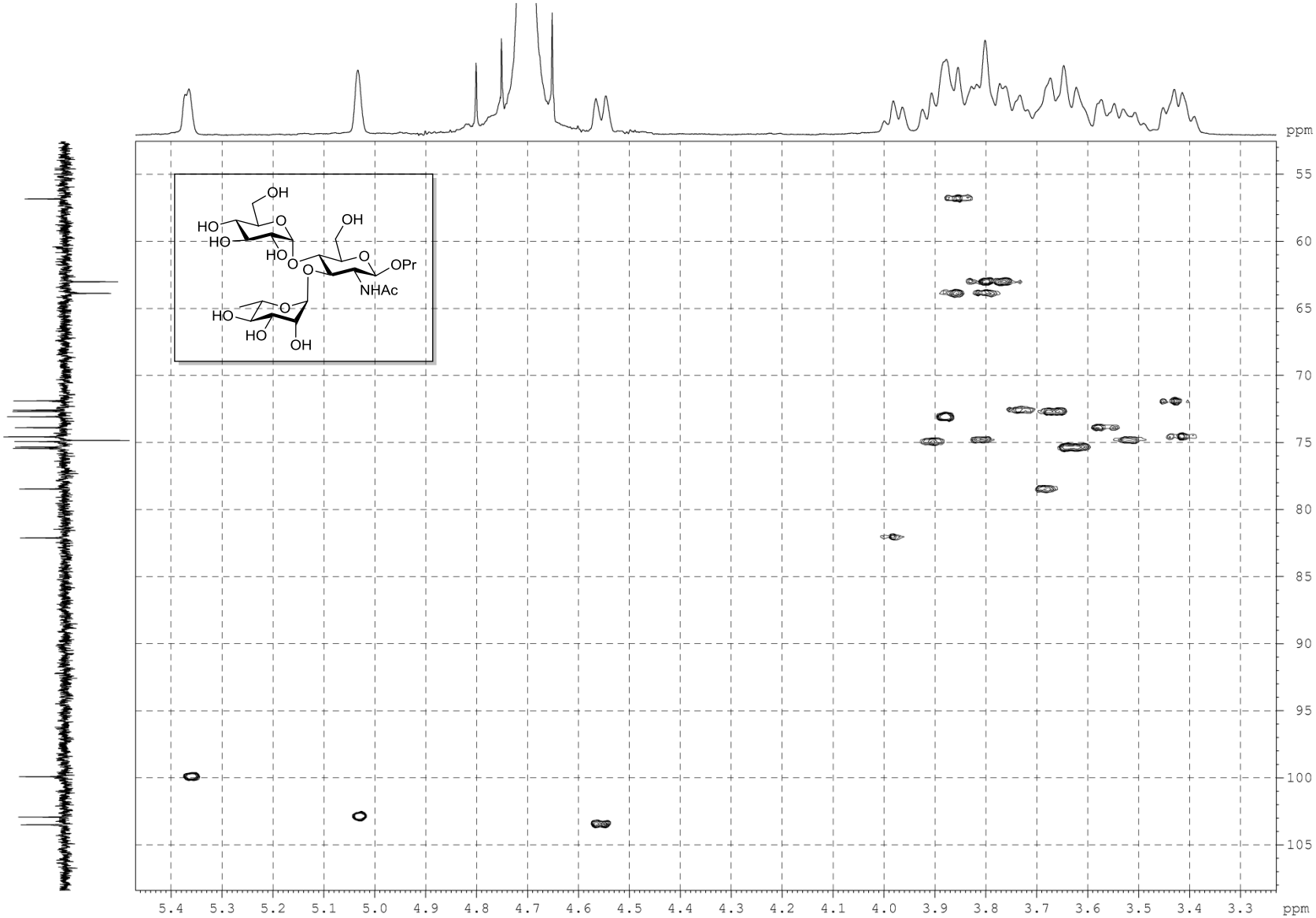

176.712
103.483
102.906
99.916
82.102
78.454
75.433
75.331
74.922
74.833
74.564
73.878
73.066
72.674
72.573
71.880
63.864
62.998
56.816
24.817
24.744
19.445
12.270
OH
HO
HO
HO
O
OH
O
OPr
NHAc
O
HO
HO
OH
250 240 230 220 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 ppm


103.483
102.906
99.916
82.102
78.454
75.433
75.331
74.922
74.833
74.564
73.878
73.066
72.674
72.573
71.880
63.864
62.998
56.816
OH
HO
HO
HO
O
OH
O
O
OPr
NHAc
HO
HO
O
OH
110
105
100
95
90
85
80
75
70
65
60
55
50
45
ppm

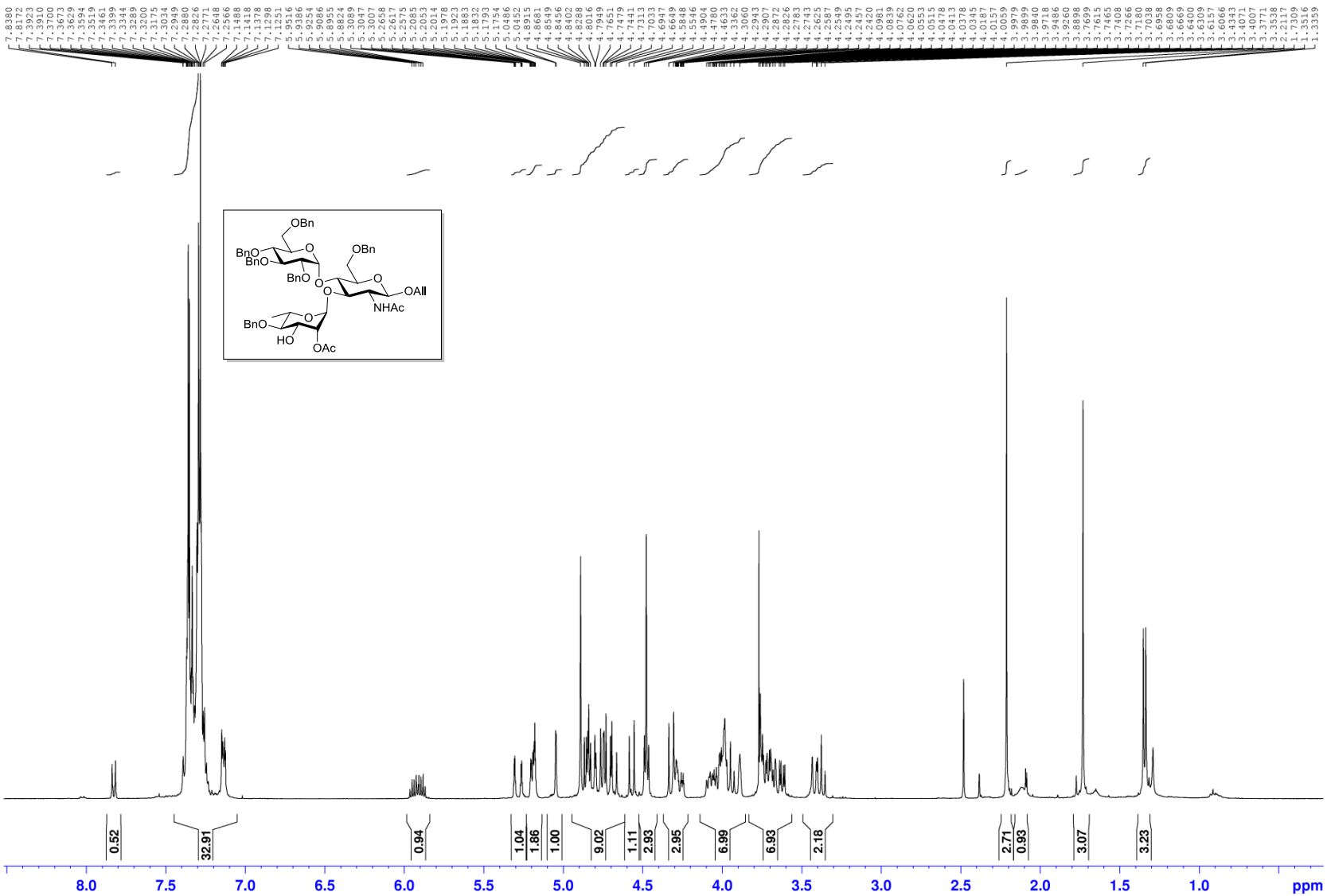

103.482
102.906
99.914
82.100
78.451
75.429
75.328
74.918
74.832
74.563
73.877
73.064
72.671
72.570
71.879
63.862
62.996
56.815
24.816
24.743
19.443
12.270
OH
HO
HO
HO
O
OH
O
O
OPr
NHAc
O
HO
HO
OH
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 ppm

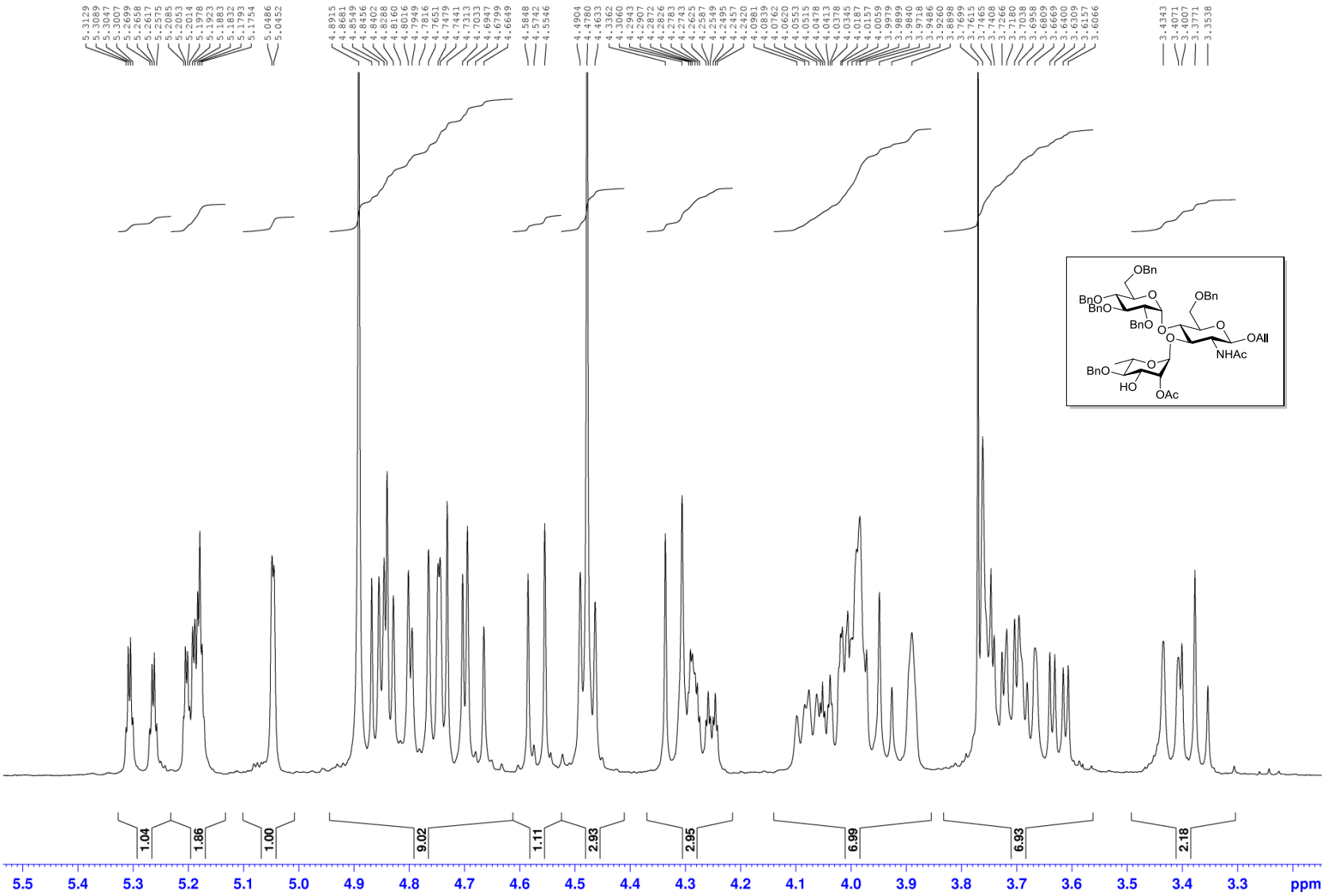

103.482
102.906
99.914
82.100
78.451
75.429
75.328
74.918
74.832
74.563
73.877
73.064
72.671
72.570
71.879
63.862
62.996
56.815
OH
HO
HO
O
HO
O
OH
O
OPr
NHAc
O
HO
HO
OH
110
105
100
95
90
85
80
75
70
65
60
55
ppm

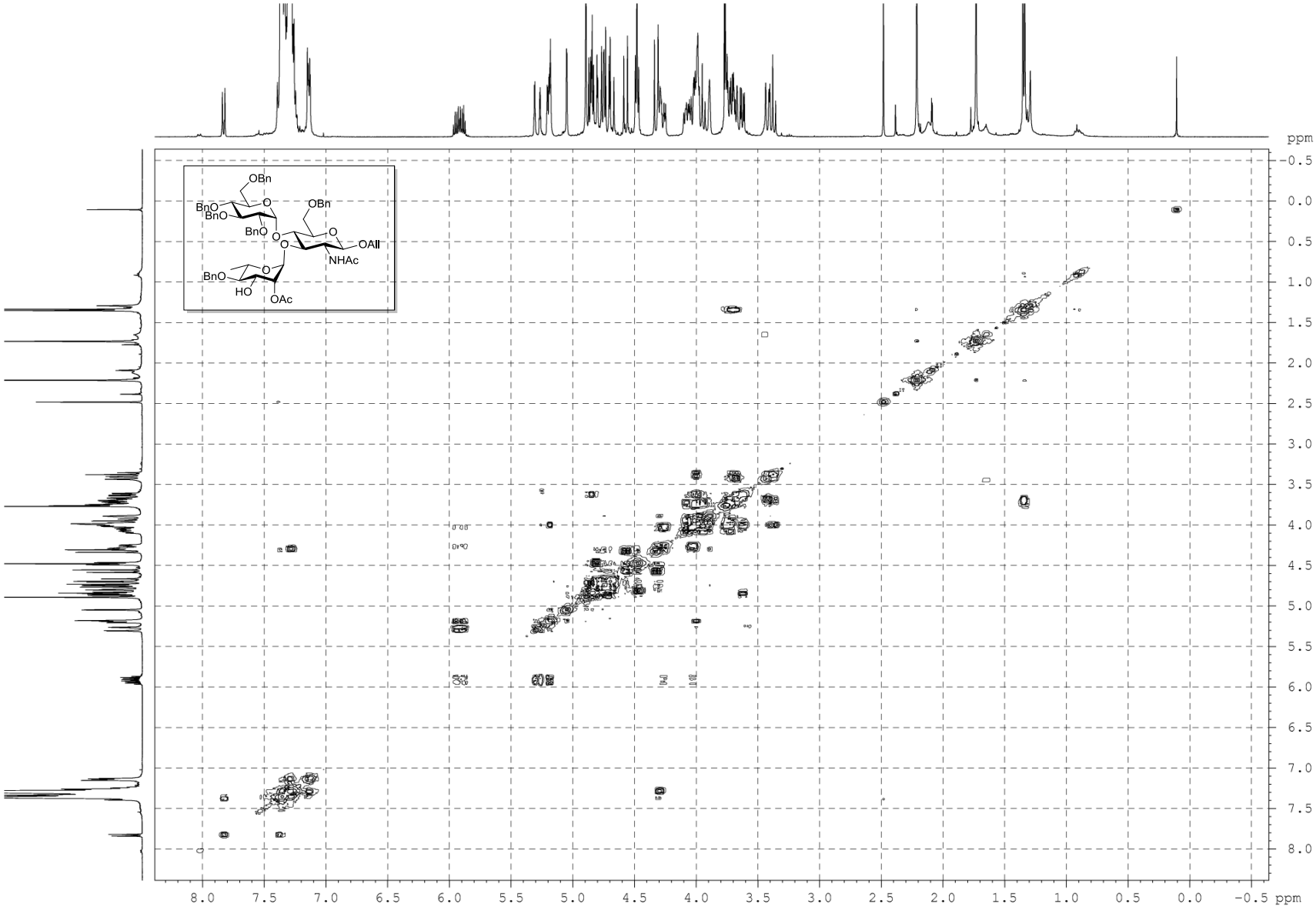

OH
HO
HO
O
HO
O
OH
O
O
OPr
NHAc
HO
O
HO
OH
ppm
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
ppm

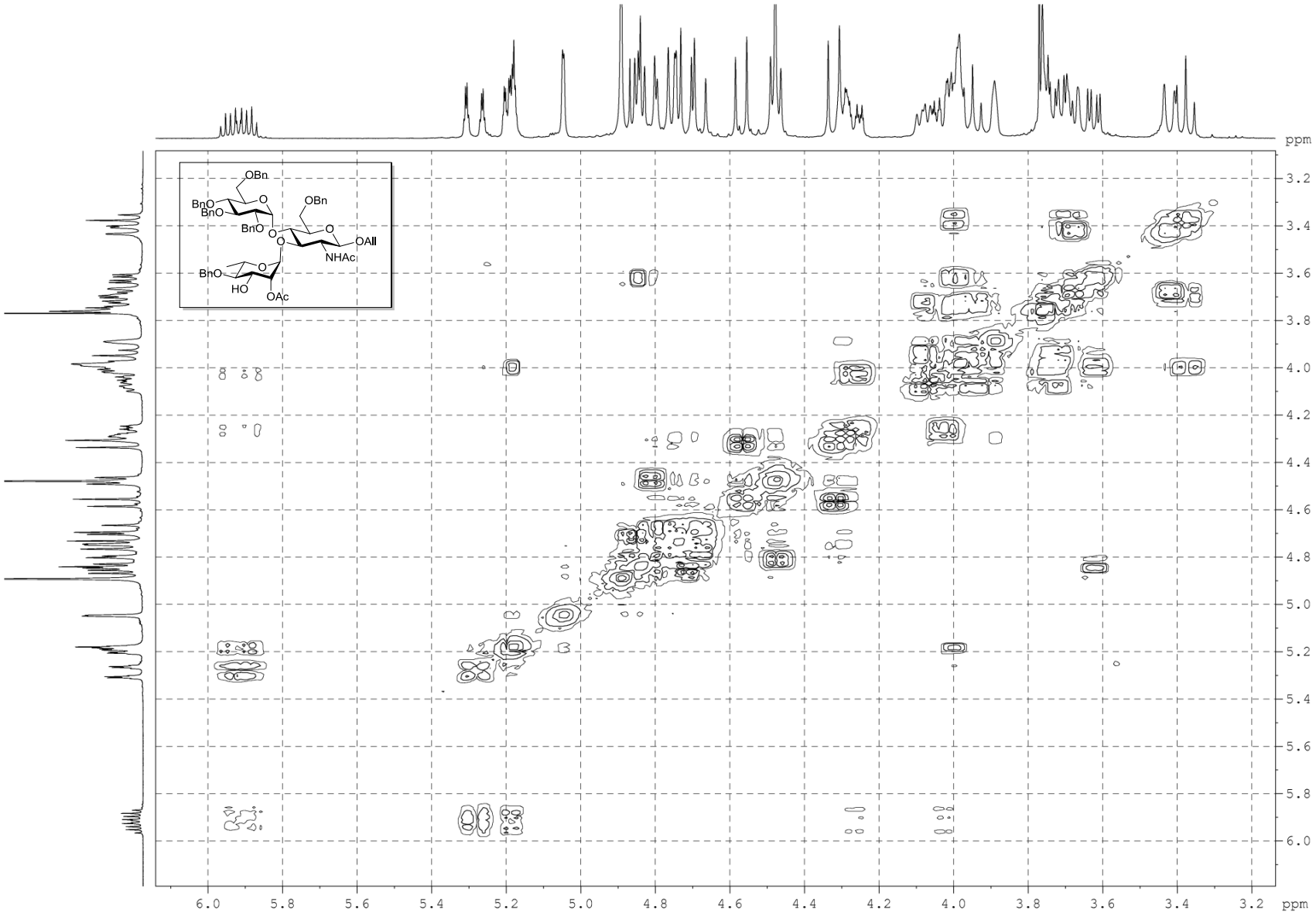

OH
HO
HO
O
HO
O
OH
O
OPr
NHAc
HO
O
HO
OH
ppm
55
60
65
70
75
80
85
90
95
100
105
5.4
5.3
5.2
5.1
5.0
4.9
4.8
4.7
4.6
4.5
4.4
4.3
4.2
4.1
4.0
3.9
3.8
3.7
3.6
3.5
3.4
3.3
ppm

Compound 30: **Allyl (2-*O*-acetyl-4-*O*-benzyl-α-L-rhamnopyranosyl)-(1→3)-[2,3,4,6-tetra-*O*-benzyl-α-D-glucopyranosyl-(1→4)]-2-acetamido-6-*O*-benzyl-2-deoxy-β-D-glucopyranoside**




OBn
BnO
BnO
BnO
O
OBn
O
O
O
OAll
NHAc
BnO
O
HO
OAc
1.04
1.86
1.00
9.02
1.11
2.93
2.95
6.99
6.93
2.18
5.5
5.4
5.3
5.2
5.1
5.0
4.9
4.8
4.7
4.6
4.5
4.4
4.3
4.2
4.1
4.0
3.9
3.8
3.7
3.6
3.5
3.4
3.3
ppm


OBn
BnO
BnO
O
OBn
BnO
O
O
O
OAll
NHAc
BnO
O
HO
OAc
ppm
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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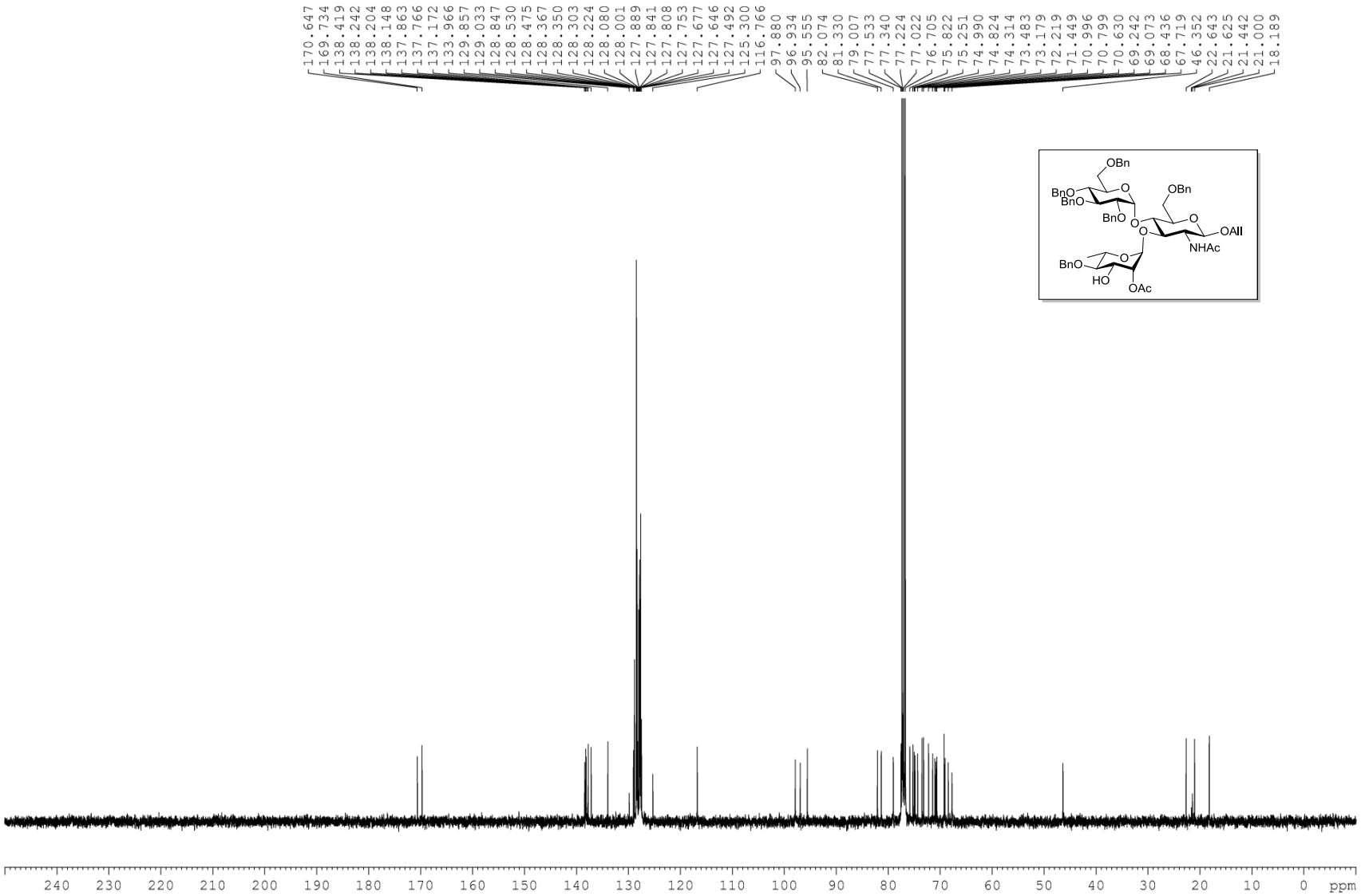
BnO
BnO
O
OBn
BnO
O
O
O
OAll
NHAc
BnO
O
HO
OAc
ppm
3.2
3.4
3.6
3.8
4.0
4.2
4.4
4.6
4.8
5.0
5.2
5.4
5.6
5.8
6.0
6.0
5.8
5.6
5.4
5.2
5.0
4.8
4.6
4.4
4.2
4.0
3.8
3.6
3.4
3.2
ppm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137.172
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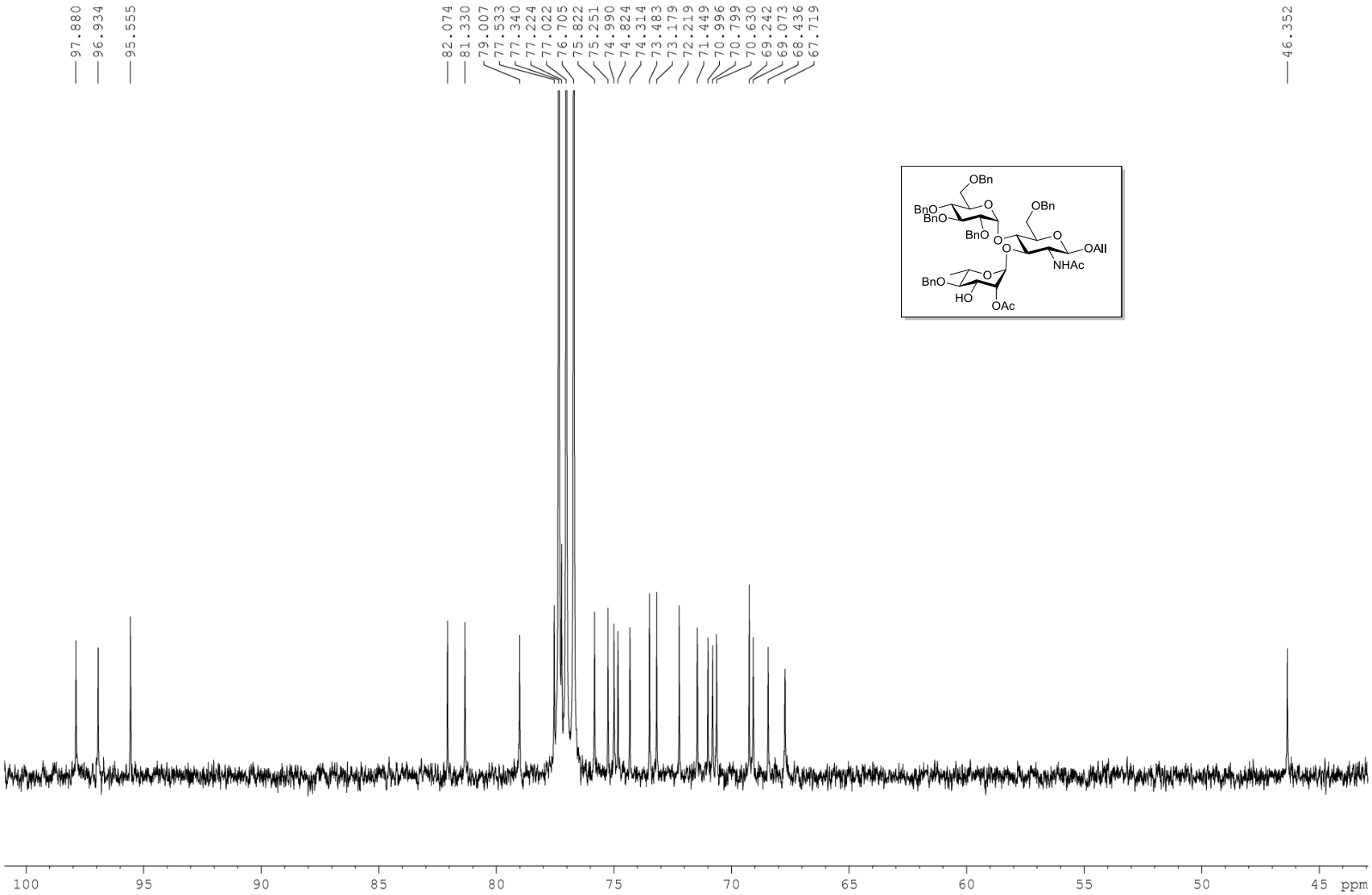
129.033
128.847
128.530
128.475
128.367
128.350
128.303
128.224
128.080
128.001
127.889
127.841
127.808
127.753
127.677
127.646
127.492
125.300
116.766
97.880
96.934
95.555
82.074
81.330
79.007
77.533
77.340
77.224
77.022
76.705
75.822
75.251
74.990
74.824
74.314
73.483
73.179
72.219
71.449
70.996
70.799
70.630
69.242
69.073
68.436
67.719
46.352
22.643
21.625
21.442
21.000
18.189
OBn
BnO
BnO
BnO
OBn
O
OAll
NHAc
BnO
HO
OAc
240 230 220 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 ppm


97.880
96.934
95.555
82.074
81.330
79.007
77.533
77.340
77.224
77.022
76.705
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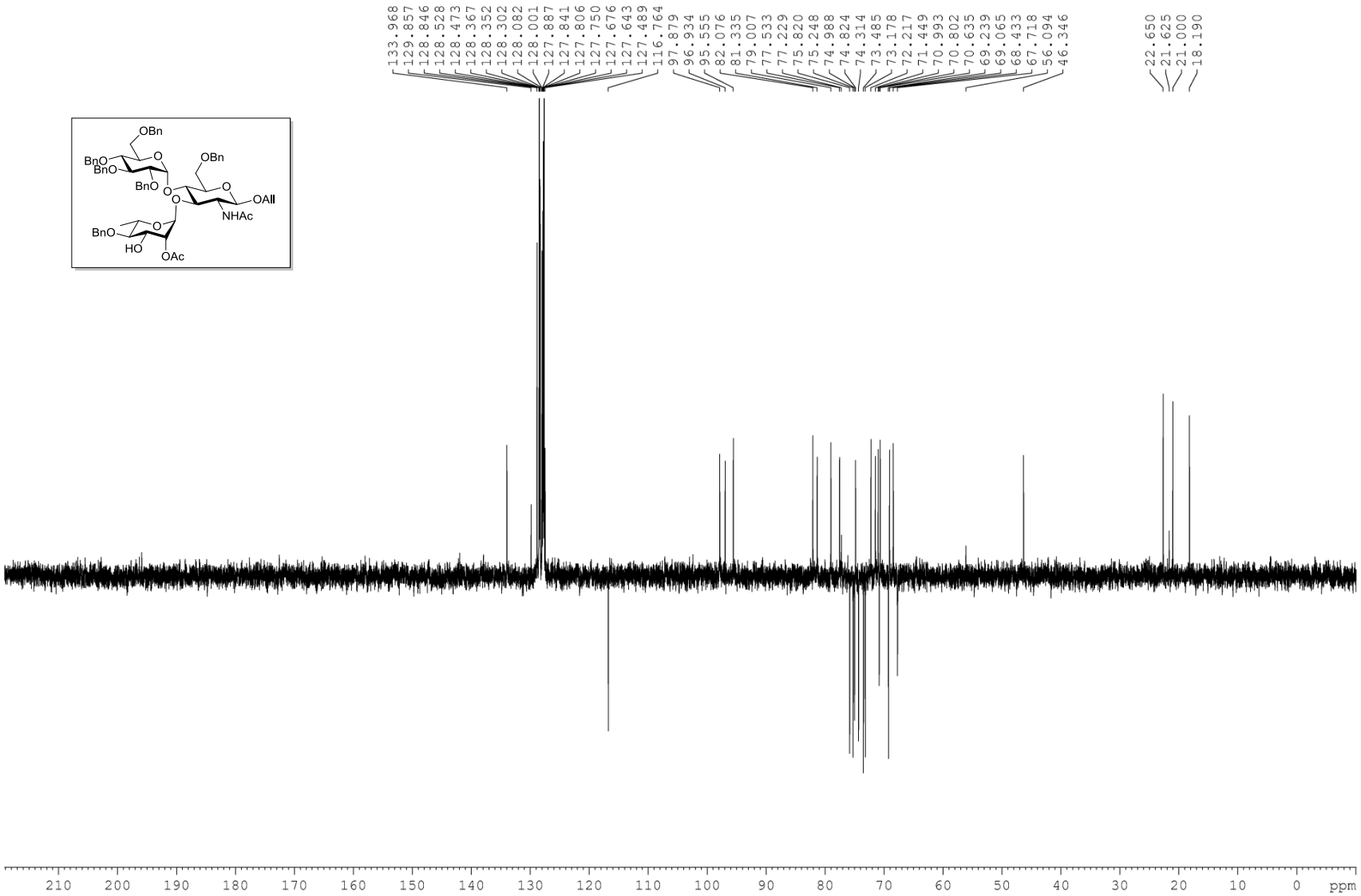
75.251
74.990
74.824
74.314
73.483
73.179
72.219
71.449
70.996
70.799
70.630
69.242
69.073
68.436
67.719
46.352
OBn
BnO
BnO
O
BnO
O
OBn
O
O
OAll
NHAc
BnO
O
HO
OAc
100
95
90
85
80
75
70
65
60
55
50
45
ppm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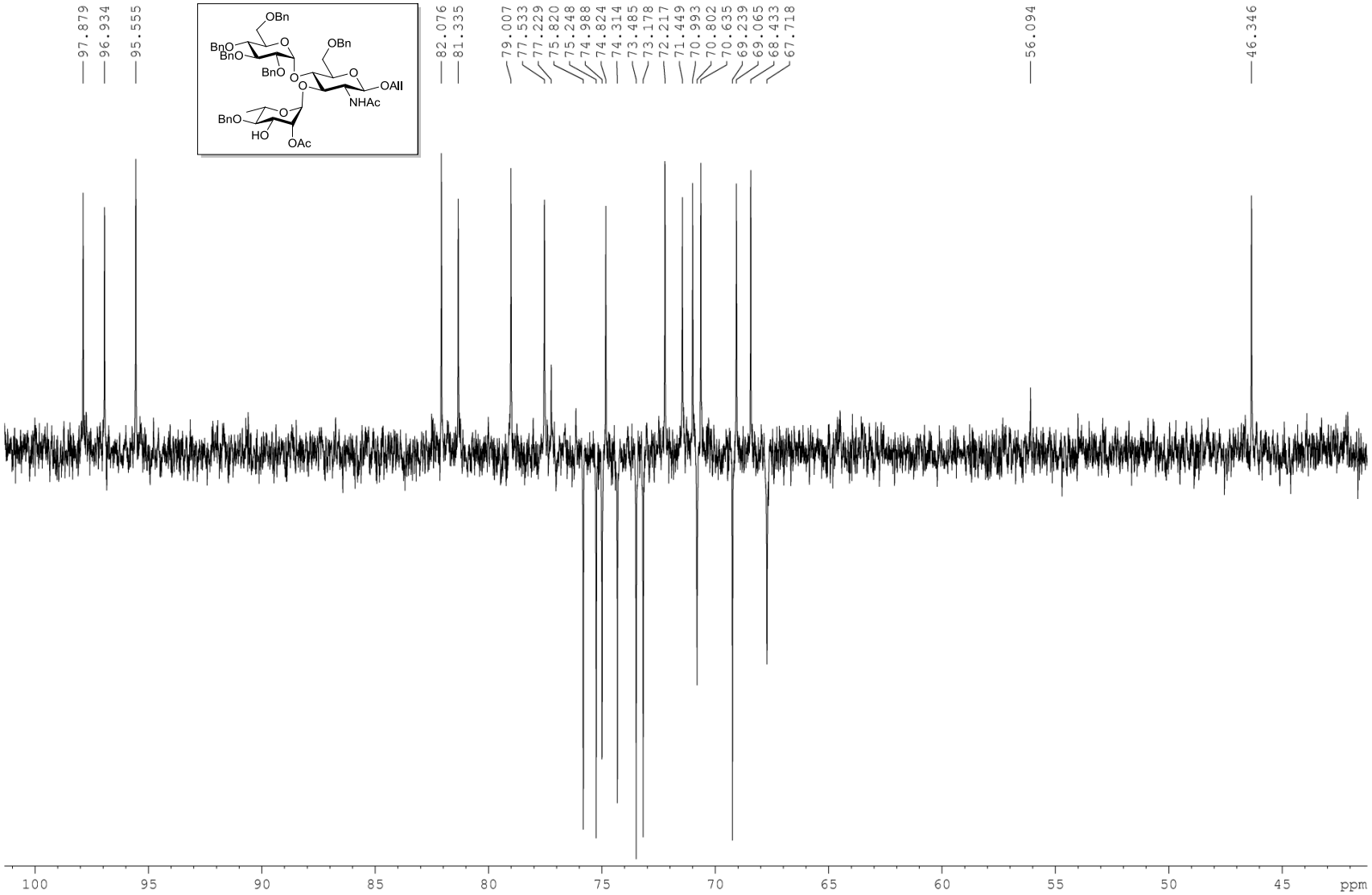
127.841
127.806
127.750
127.676
127.643
127.489
116.764
97.879
96.934
95.555
82.076
81.335
79.007
77.533
77.229
75.820
75.248
74.988
74.824
74.314
73.485
73.178
72.217
71.449
70.993
70.802
70.635
69.239
69.065
68.433
67.718
56.094
46.346
22.650
21.625
21.000
18.190
OBn
BnO
BnO
BnO
O
OBn
O
O
O
OAll
NHAc
BnO
O
HO
OAc
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
ppm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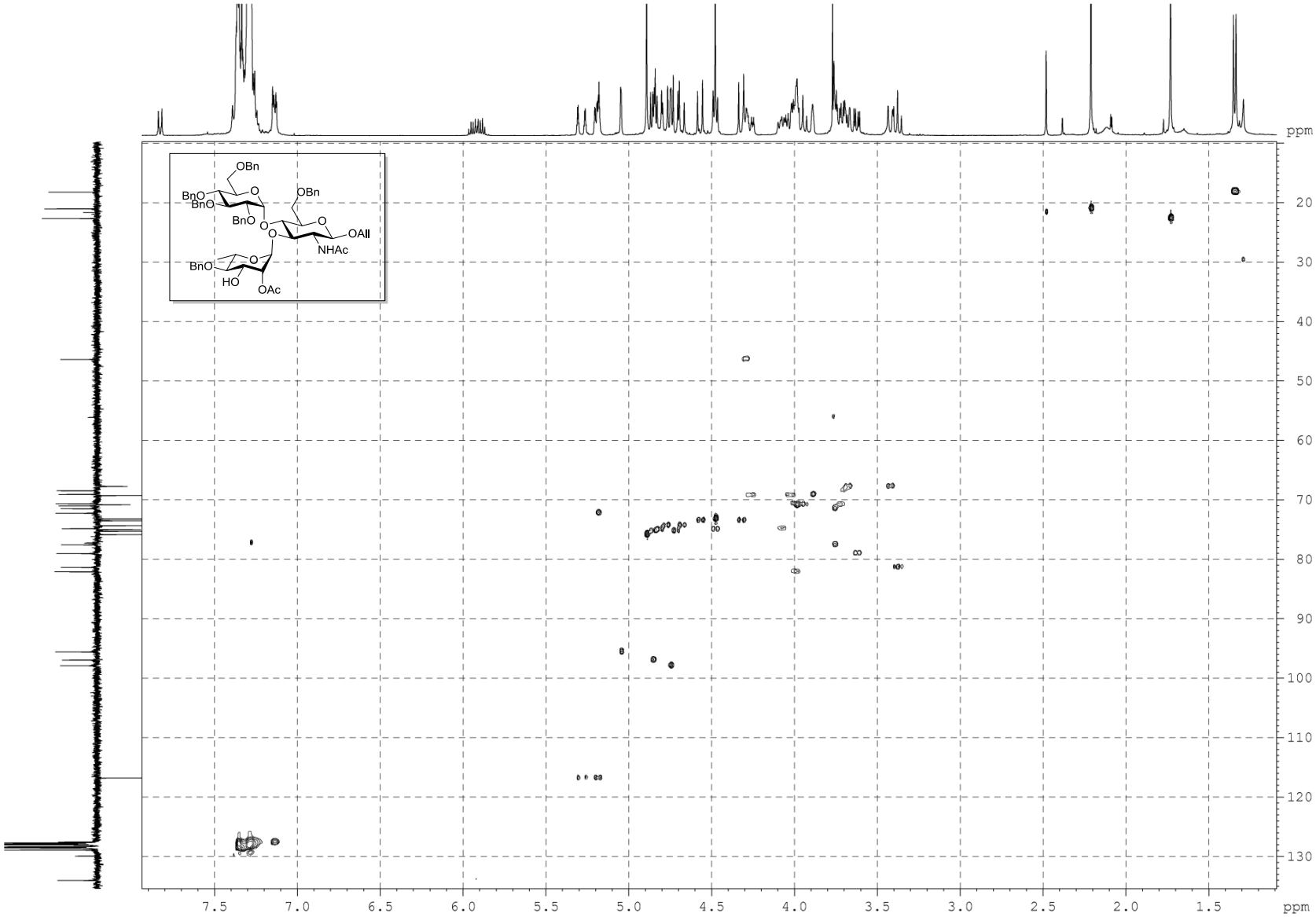
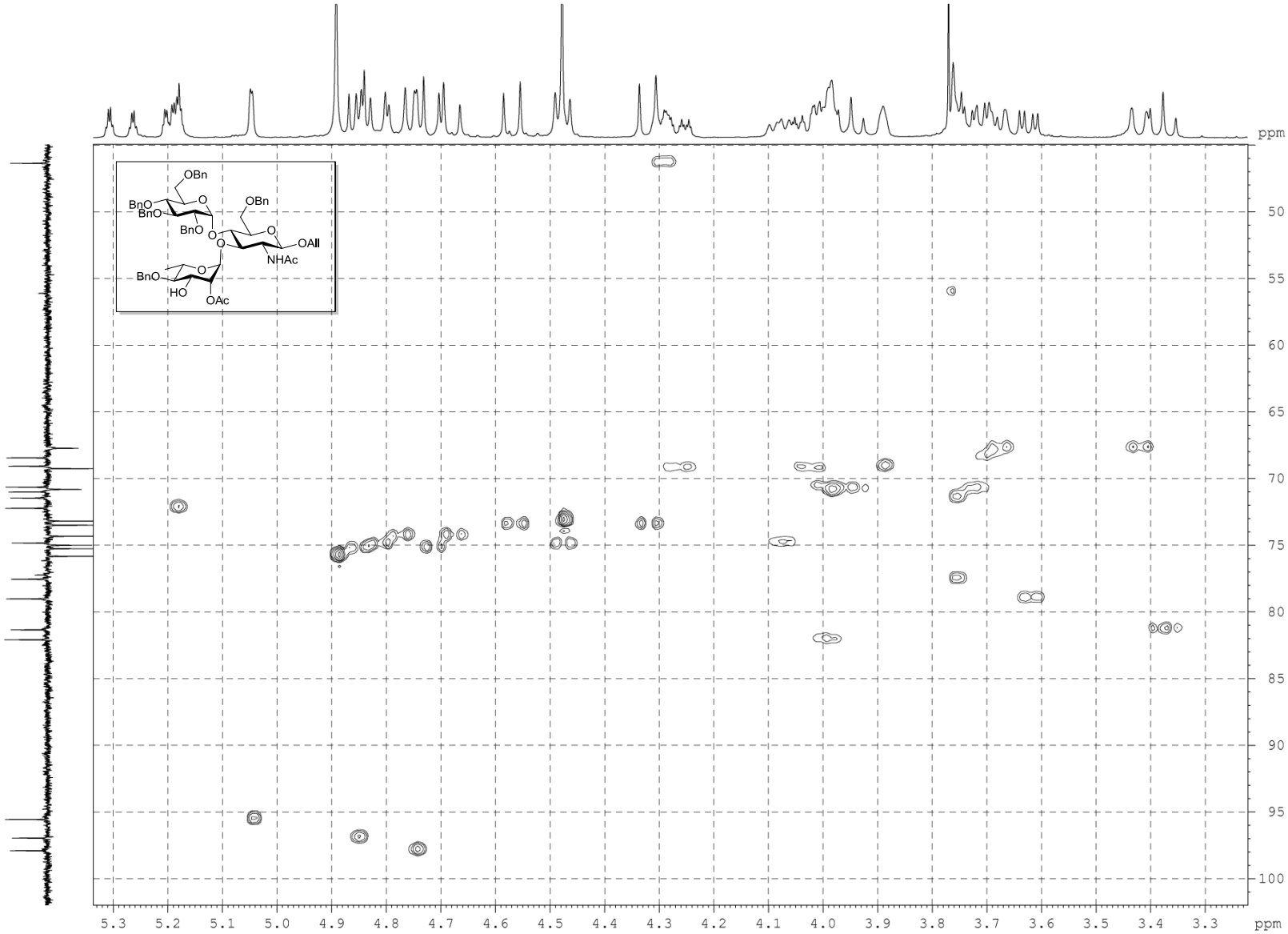
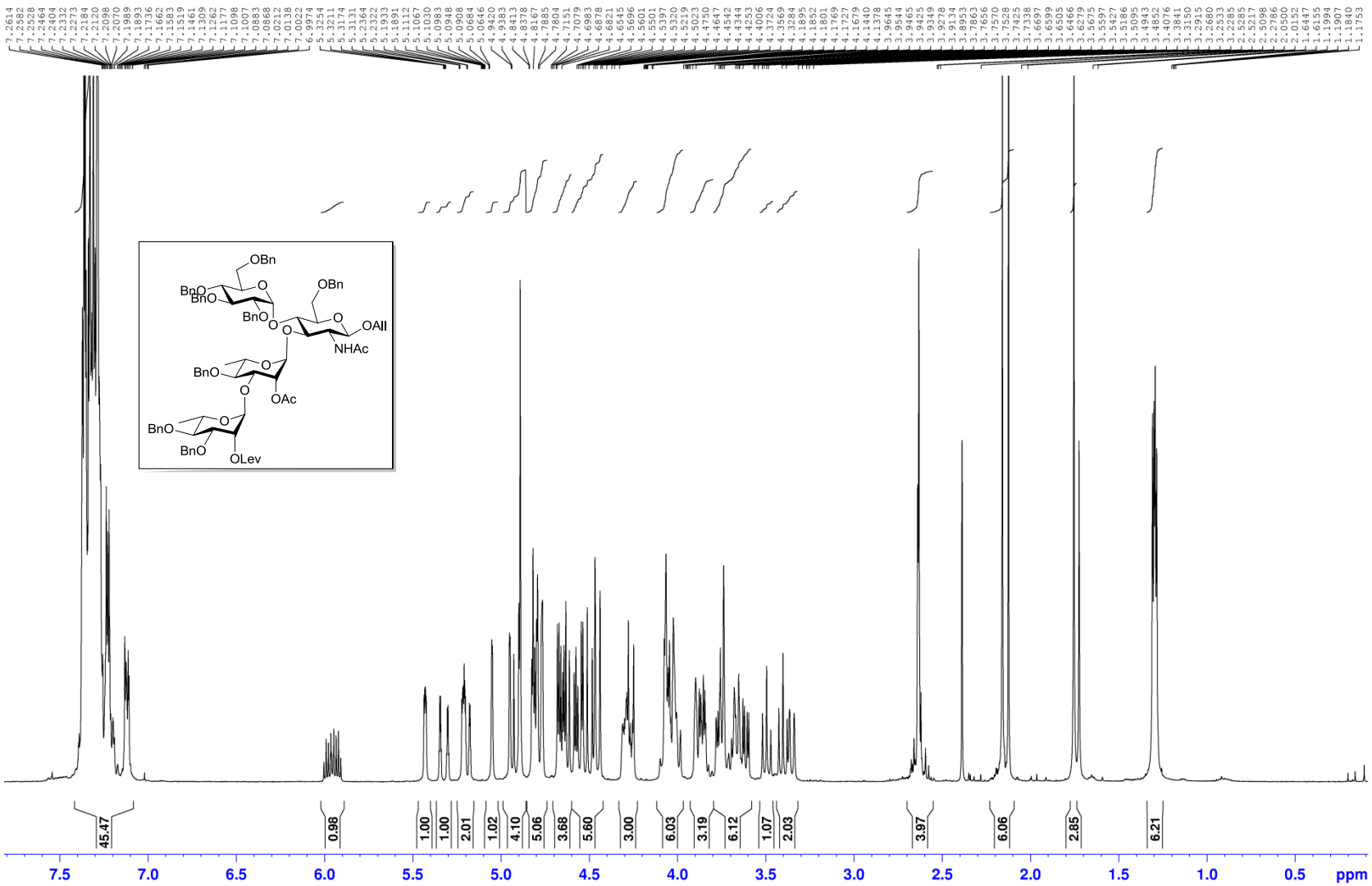
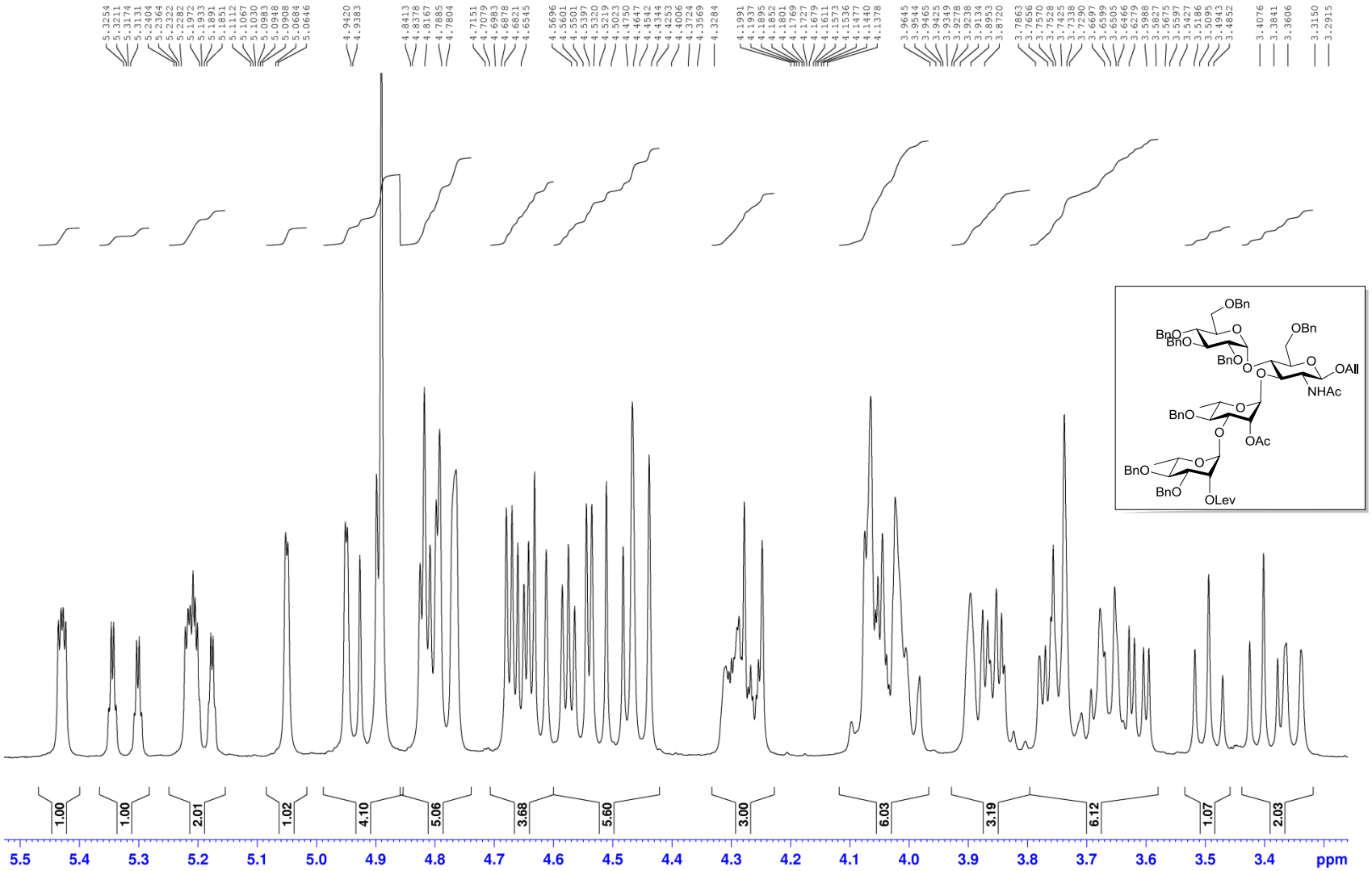
96.934
95.555
82.076
81.335
79.007
77.533
77.229
75.820
75.248
74.988
74.824
74.314
73.485
73.178
72.217
71.449
70.993
70.802
70.635
69.239
69.065
68.433
67.718
56.094
46.346
OBn
BnO
BnO
BnO
OBn
O
O
O
O
O
OAll
NHAc
BnO
HO
OAc
100
95
90
85
80
75
70
65
60
55
50
45
ppm


OBn
BnO
BnO
O
OBn
BnO
O
O
O
OAll
NHAc
BnO
O
HO
OAc
ppm
20
30
40
50
60
70
80
90
100
110
120
130
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
ppm


OBn
BnO
BnO
BnO
O
O
OBn
O
O
OAll
NHAc
BnO
O
HO
OAc
ppm
50
55
60
65
70
75
80
85
90
95
100
5.3
5.2
5.1
5.0
4.9
4.8
4.7
4.6
4.5
4.4
4.3
4.2
4.1
4.0
3.9
3.8
3.7
3.6
3.5
3.4
3.3
ppm

Compound 33: **Allyl (2-*O*-levulinoyl-3,4-di-*O*-benzyl-α-L-rhamnopyranosyl)-(1→3)-(2-*O*-acetyl-4-*O*-benzyl-α-L-rhamnopyranosyl)-(1→3)-[2,3,4,6-tetra-*O*-benzyl-α-D-glucopyranosyl-(1→4)]-2-acetamido-6-*O*-benzyl-2-deoxy-β-D-glucopyranoside**

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5.2322
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5.2272
5.1933
5.1891
5.1851
5.1112
5.1067
5.1030
5.0983
5.0948
5.0908
5.0684
5.0646
4.9420
4.9383
4.8413
4.8378
4.8167
4.7885
4.7804
4.7151
4.7079
4.6983
4.6878
4.6821
4.6545
4.5696
4.5601
4.5501
4.5397
4.5320
4.5219
4.5023
4.4750
4.4647
4.4542
4.4344
4.4253
4.4006
4.3724
4.3569
4.3284
4.1991
4.1937
4.1895
4.1852
4.1801
4.1769
4.1727
4.1679
4.1611
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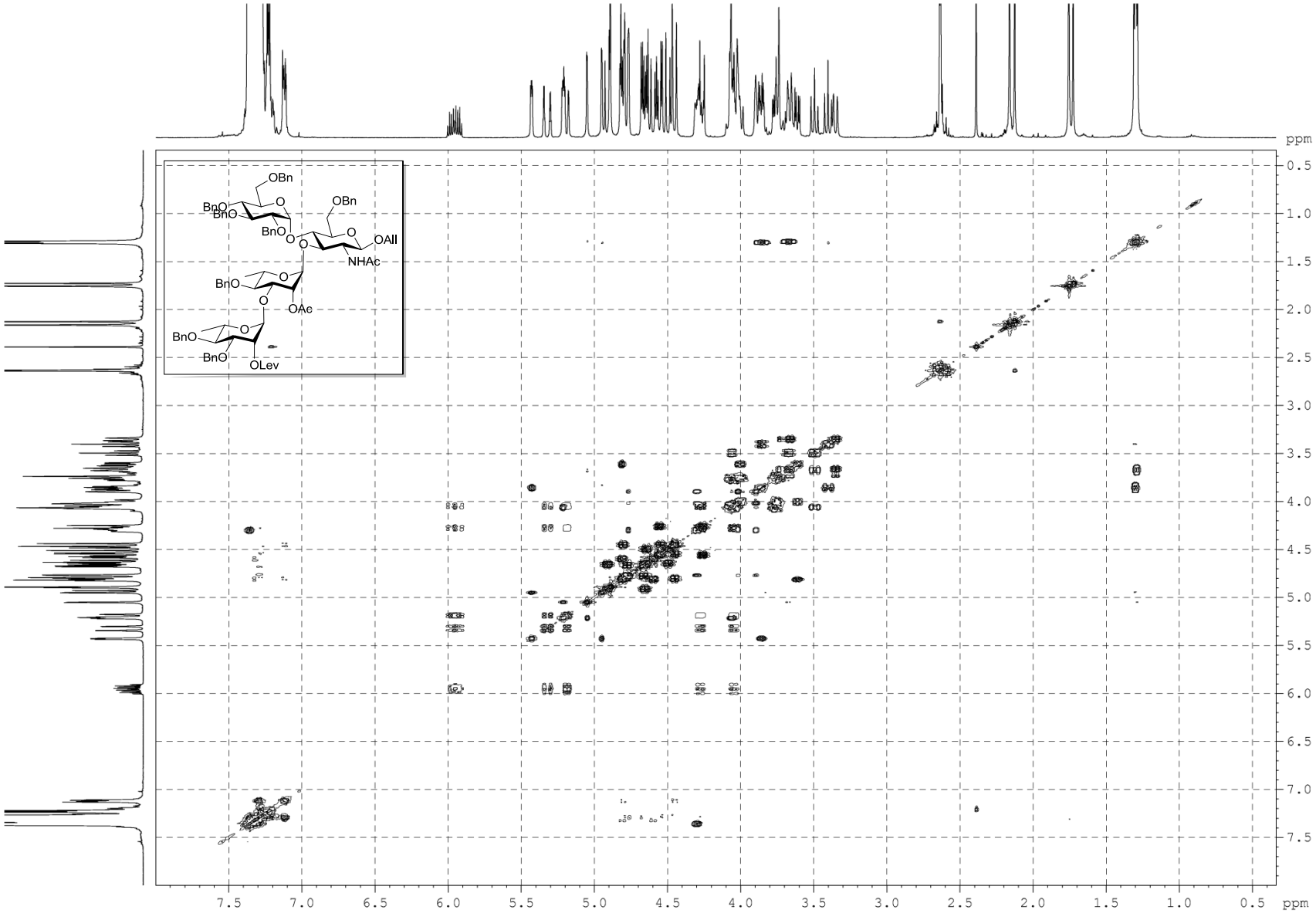
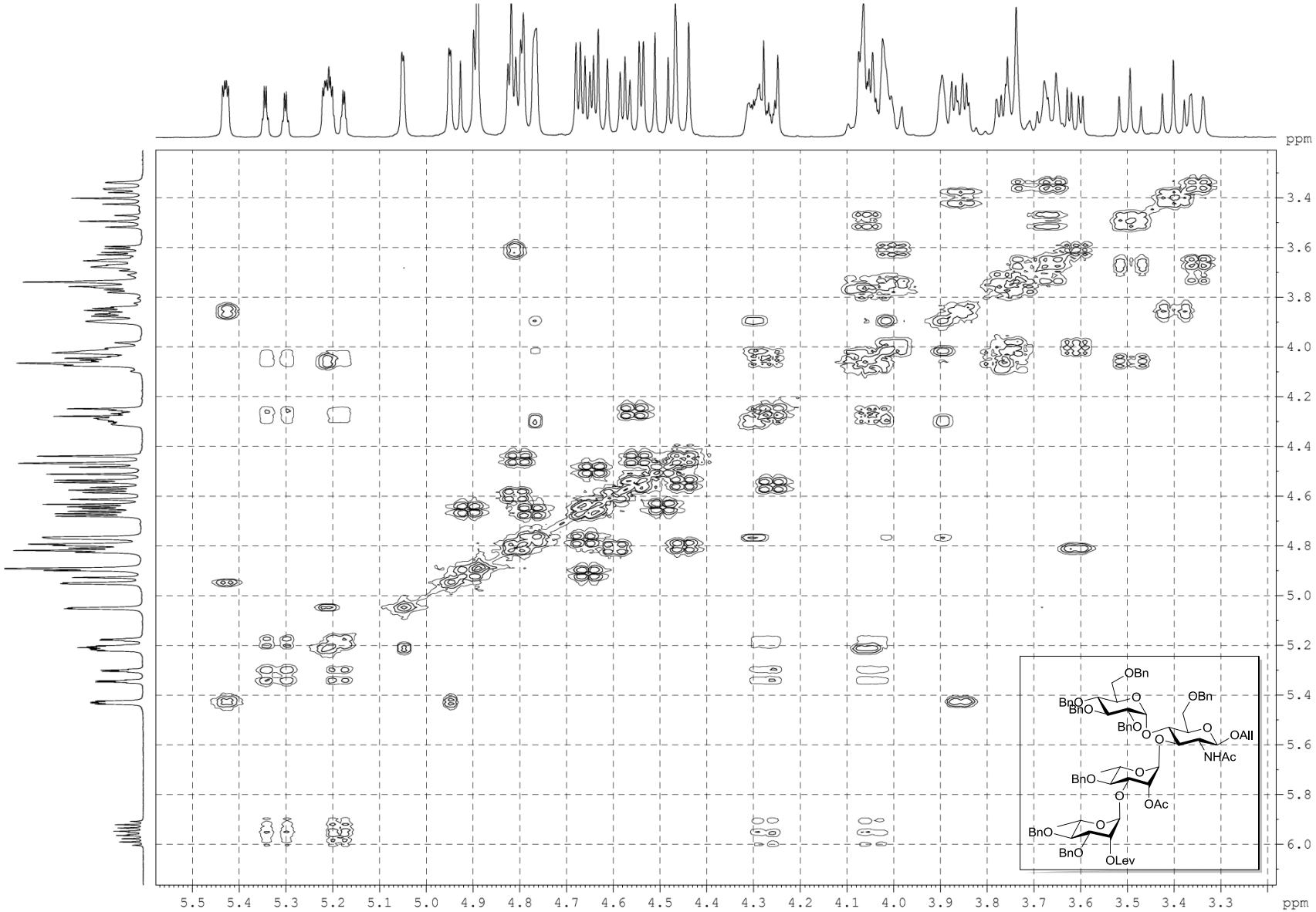
4.1536
4.1477
4.1440
4.1378
3.9645
3.9544
3.9445
3.9425
3.9349
3.9278
3.9238
3.9134
3.8953
3.8720
3.7863
3.7656
3.7570
3.7528
3.7425
3.7338
3.7290
3.6697
3.6599
3.6505
3.6466
3.6279
3.5988
3.5827
3.5675
3.5597
3.5427
3.5286
3.5095
3.4943
3.4852
3.4076
3.3841
3.3606
3.3150
3.2915
1.00
1.00
2.01
1.02
4.10
5.06
3.68
5.60
3.00
6.03
3.19
6.12
1.07
2.03
5.5
5.4
5.3
5.2
5.1
5.0
4.9
4.8
4.7
4.6
4.5
4.4
4.3
4.2
4.1
4.0
3.9
3.8
3.7
3.6
3.5
3.4
ppm
OBn
BnO
BnO
BnO
O
OBn
O
OAll
NHAc
BnO
O
O
OAc
BnO
O
BnO
OLev


OBn
BnO
BnO
BnO
O
O
OBn
O
OAll
NHAc
BnO
O
O
OAc
BnO
O
BnO
OLev
ppm
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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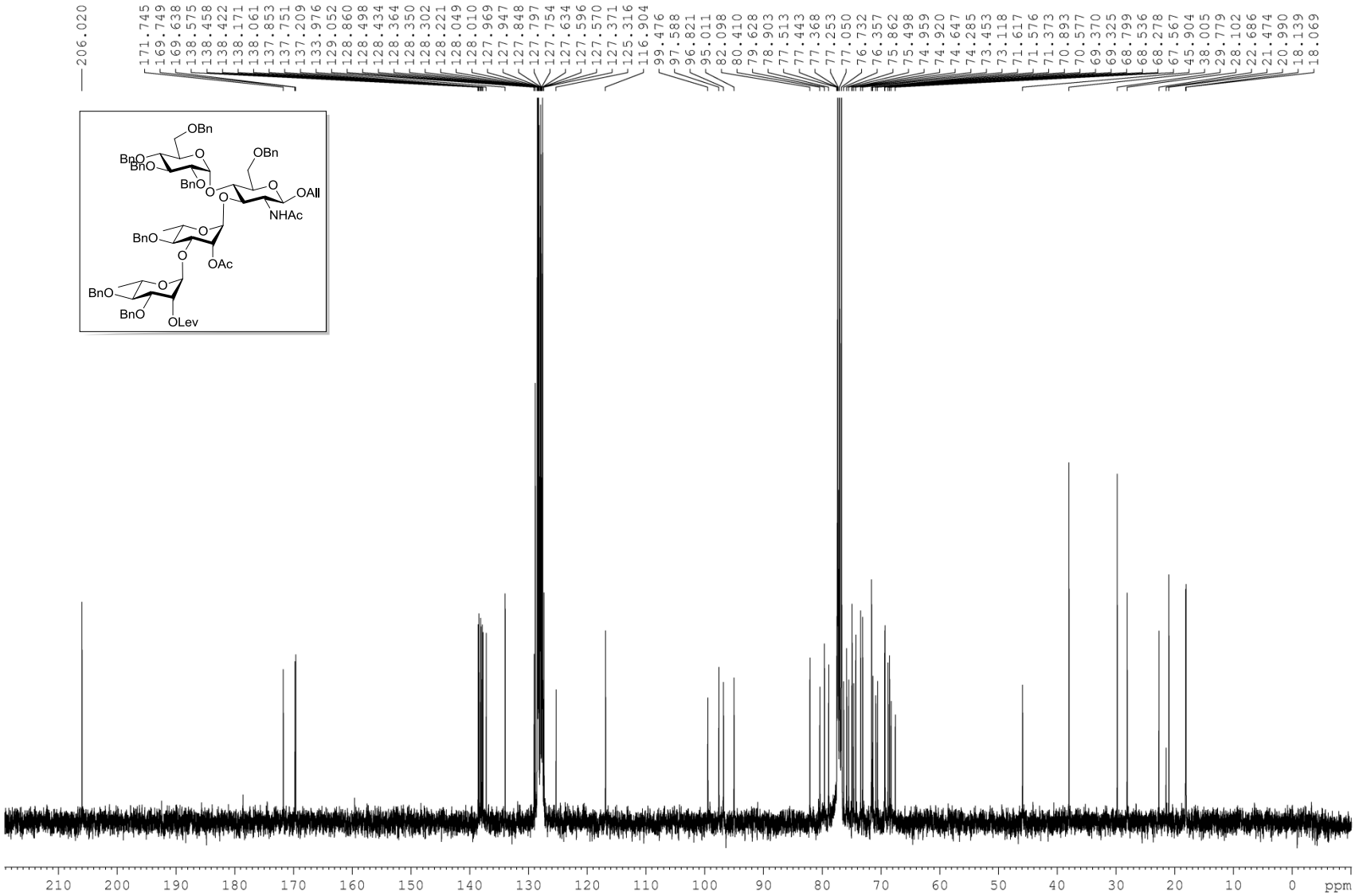
3.6
3.8
4.0
4.2
4.4
4.6
4.8
5.0
5.2
5.4
5.6
5.8
6.0
5.5 5.4 5.3 5.2 5.1 5.0 4.9 4.8 4.7 4.6 4.5 4.4 4.3 4.2 4.1 4.0 3.9 3.8 3.7 3.6 3.5 3.4 3.3
ppm
OBn
BnO
BnO
BnO
O
O
OBn
O
OAll
NHAc
BnO
O
O
OAc
BnO
O
BnO
OLev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138.171
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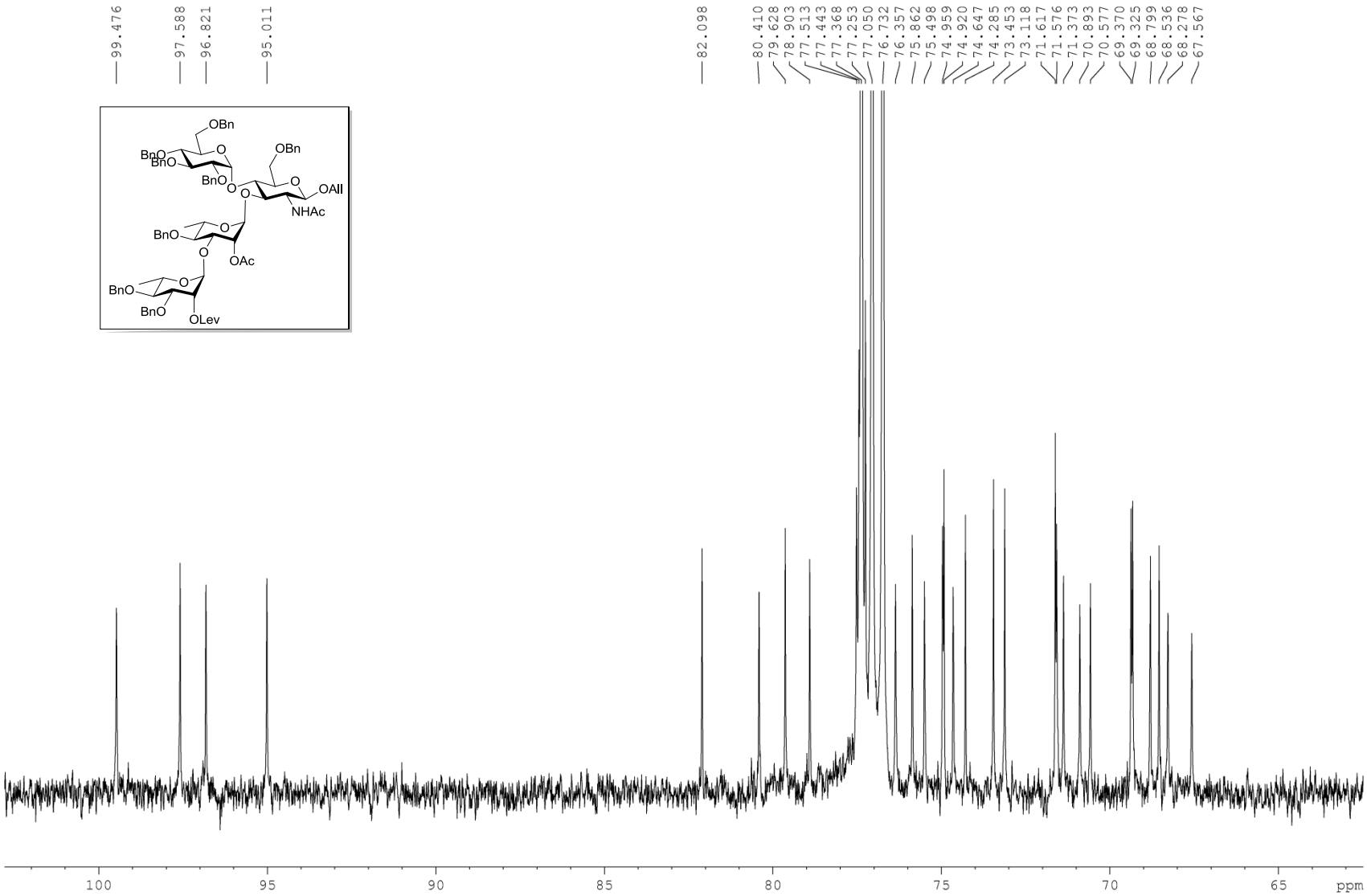
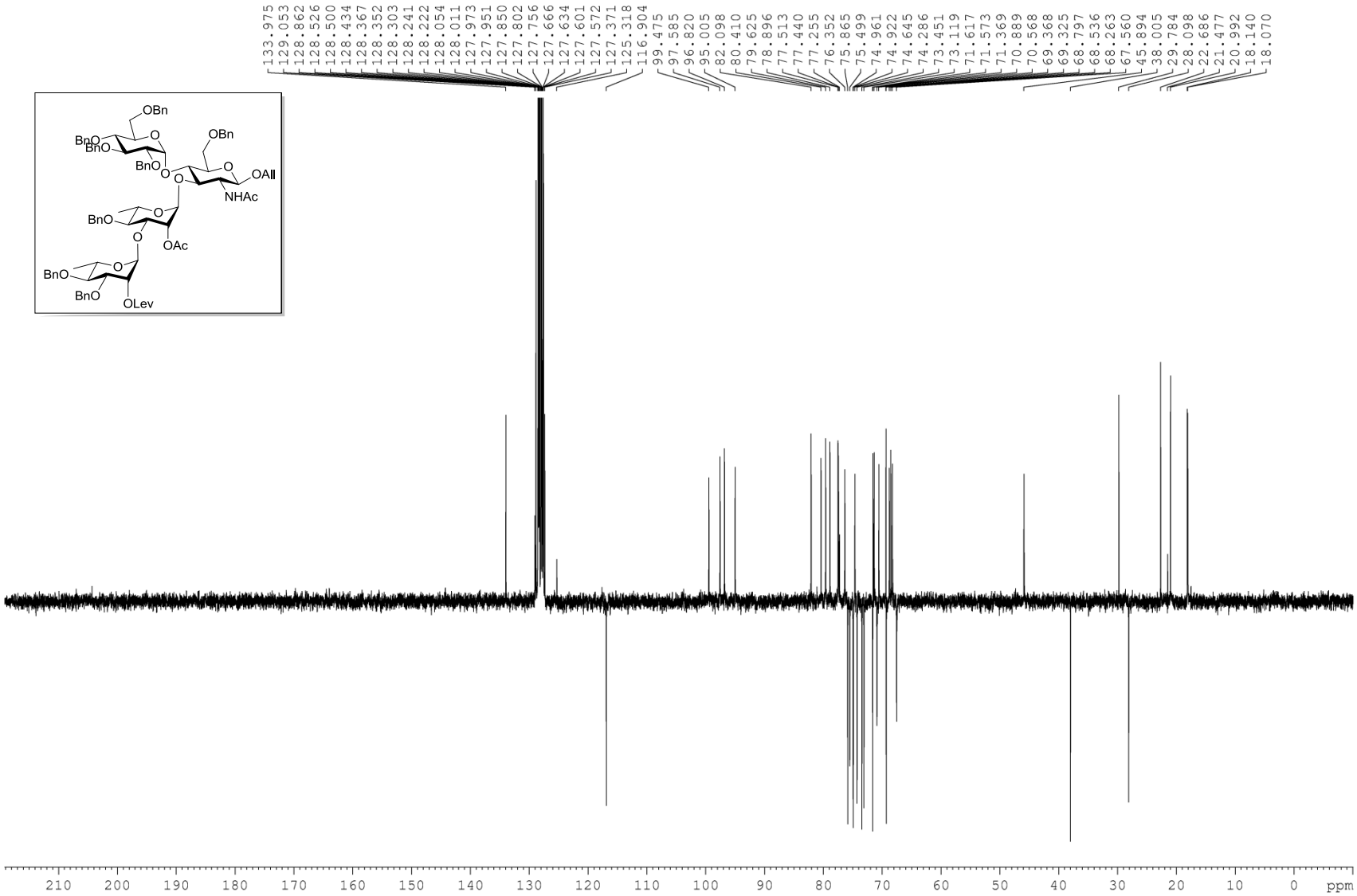
128.860
128.498
128.434
128.364
128.350
128.302
128.221
128.049
128.010
127.969
127.947
127.848
127.797
127.754
127.634
127.596
127.570
127.371
125.316
116.904
99.476
97.588
96.821
95.011
82.098
80.410
79.628
78.903
77.513
77.443
77.368
77.253
77.050
76.732
76.357
75.862
75.498
74.959
74.920
74.647
74.285
73.453
73.118
71.617
71.576
71.373
70.893
70.577
69.370
69.325
68.799
68.536
68.278
67.567
45.904
38.005
29.779
28.102
22.686
21.474
20.990
18.139
18.069
OBn
BnO
BnO
O
BnO
O
OBn
O
OAll
NHAc
BnO
O
O
OAc
BnO
O
BnO
OLev
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
ppm


99.476
97.588
96.821
95.011
82.098
80.410
79.628
78.903
77.513
77.443
77.368
77.253
77.050
76.732
76.357
75.862
75.498
74.959
74.920
74.647
74.285
73.453
73.118
71.617
71.576
71.373
70.893
70.577
69.370
69.325
68.799
68.536
68.278
67.567
OBn
BnO
BnO
O
OBn
BnO
O
O
OAll
NHAc
BnO
O
O
OAc
BnO
O
BnO
OLev
100
95
90
85
80
75
70
65
ppm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128.054
128.011
127.973
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127.850
127.802
127.756
127.666
127.634
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127.572
127.371
125.318
116.904
99.475
97.585
96.820
95.005
82.098
80.410
79.625
78.896
77.513
77.440
77.255
76.352
75.865
75.499
74.961
74.922
74.645
74.286
73.451
73.119
71.617
71.573
71.369
70.889
70.568
69.368
69.325
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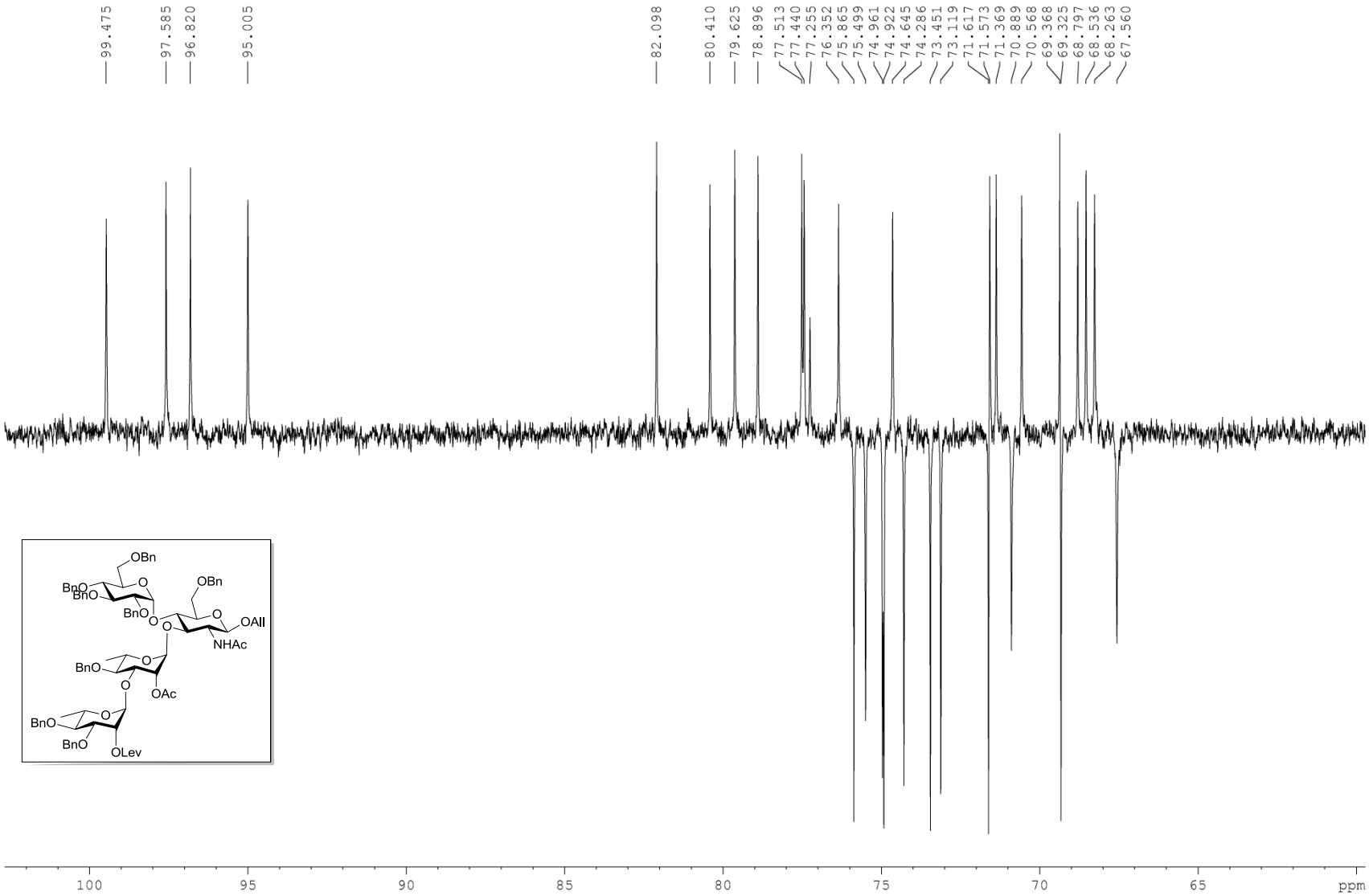
68.536
68.263
67.560
45.894
38.005
29.784
28.098
22.686
21.477
20.992
18.140
18.070
OBn
BnO
BnO
BnO
O
O
OBn
O
OAll
NHAc
BnO
O
O
OAc
BnO
O
BnO
OLev
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
ppm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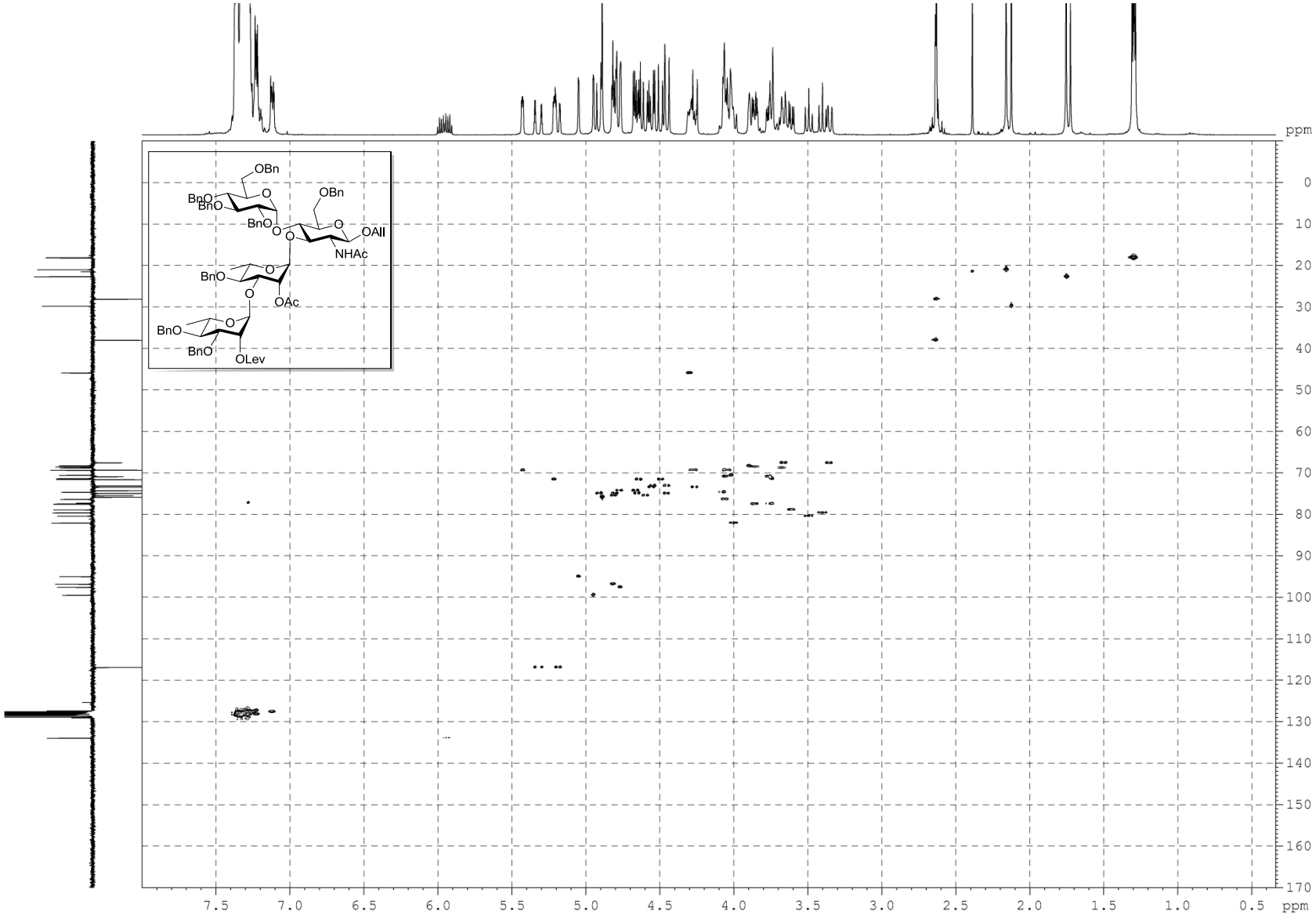
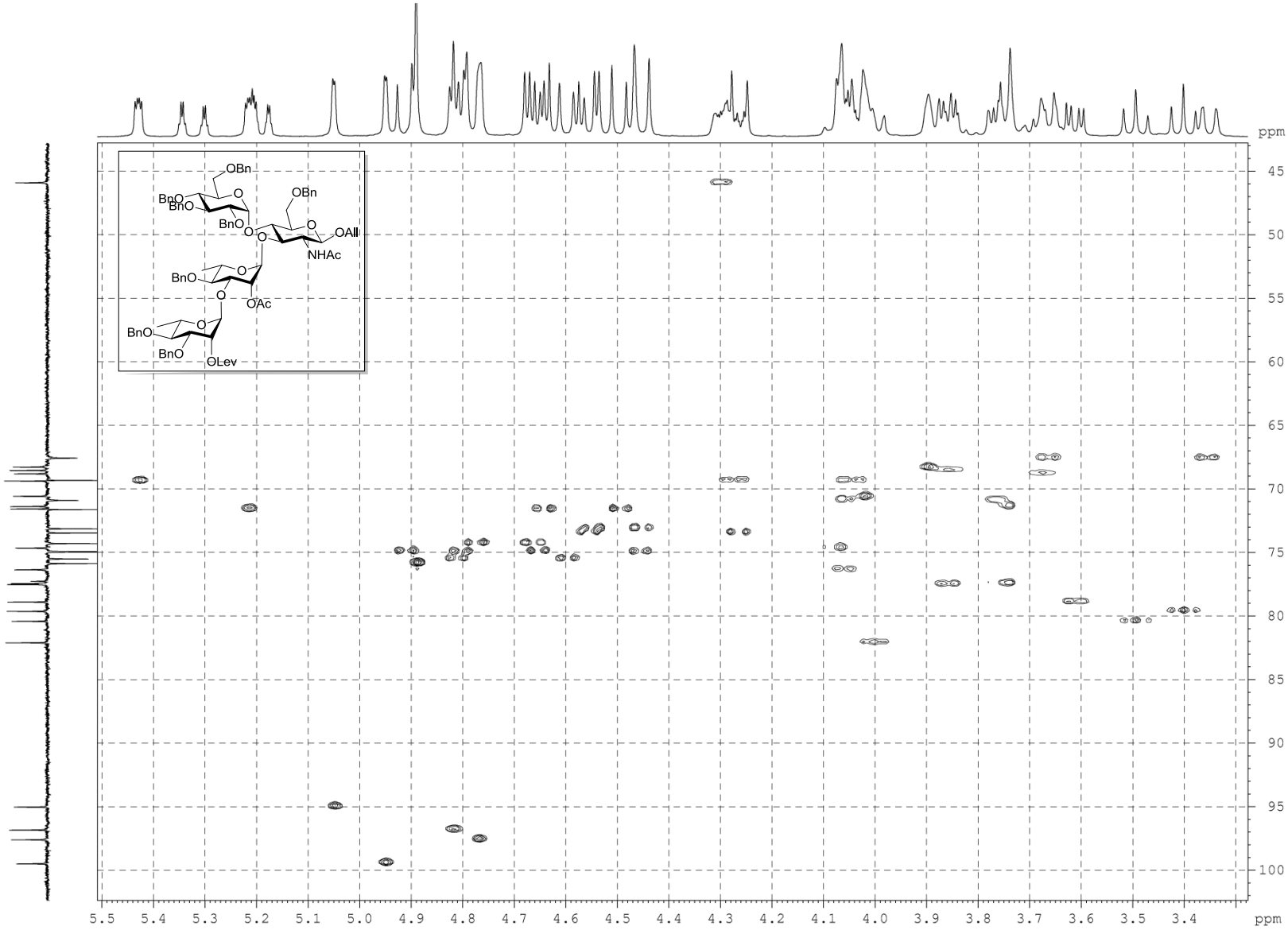
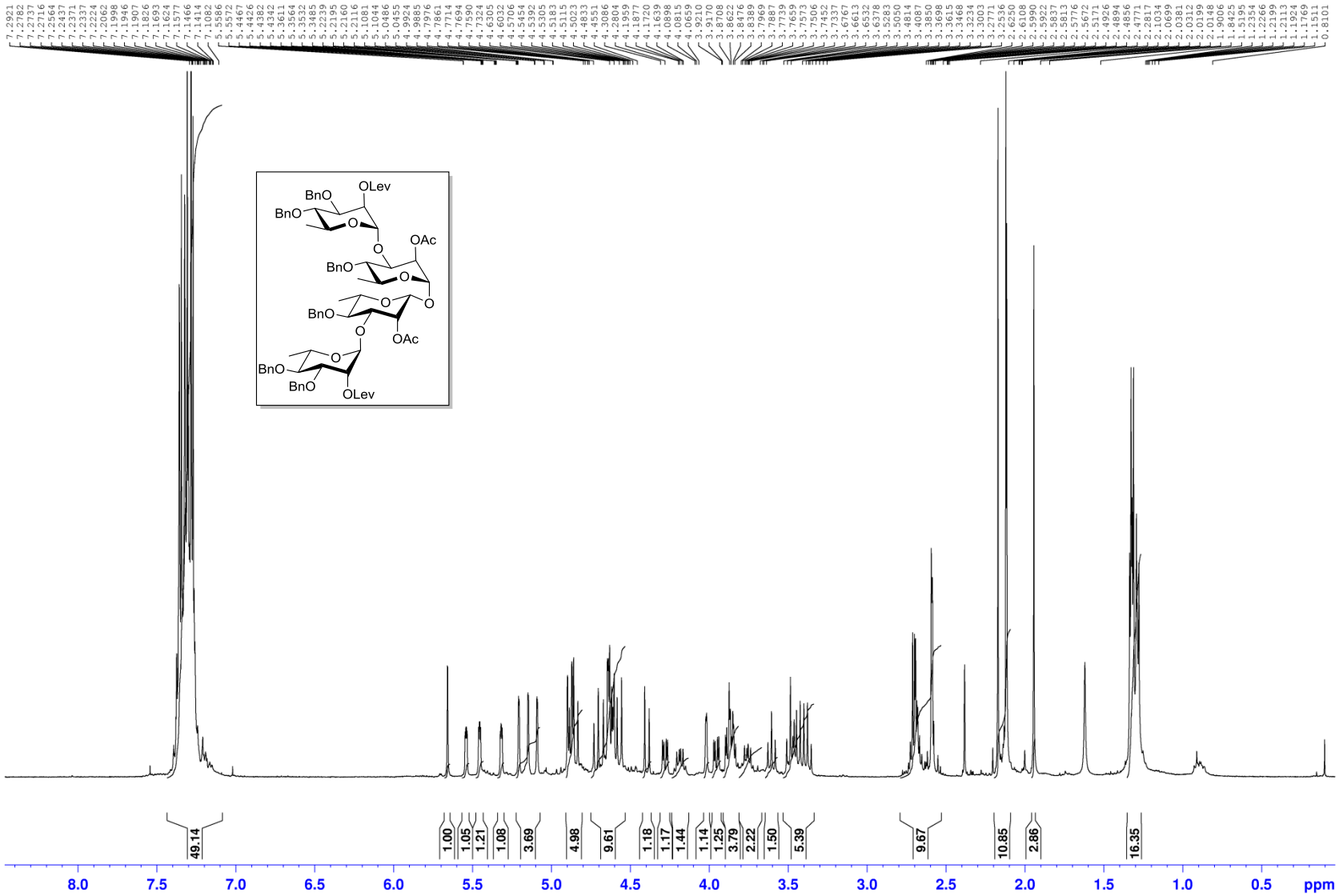
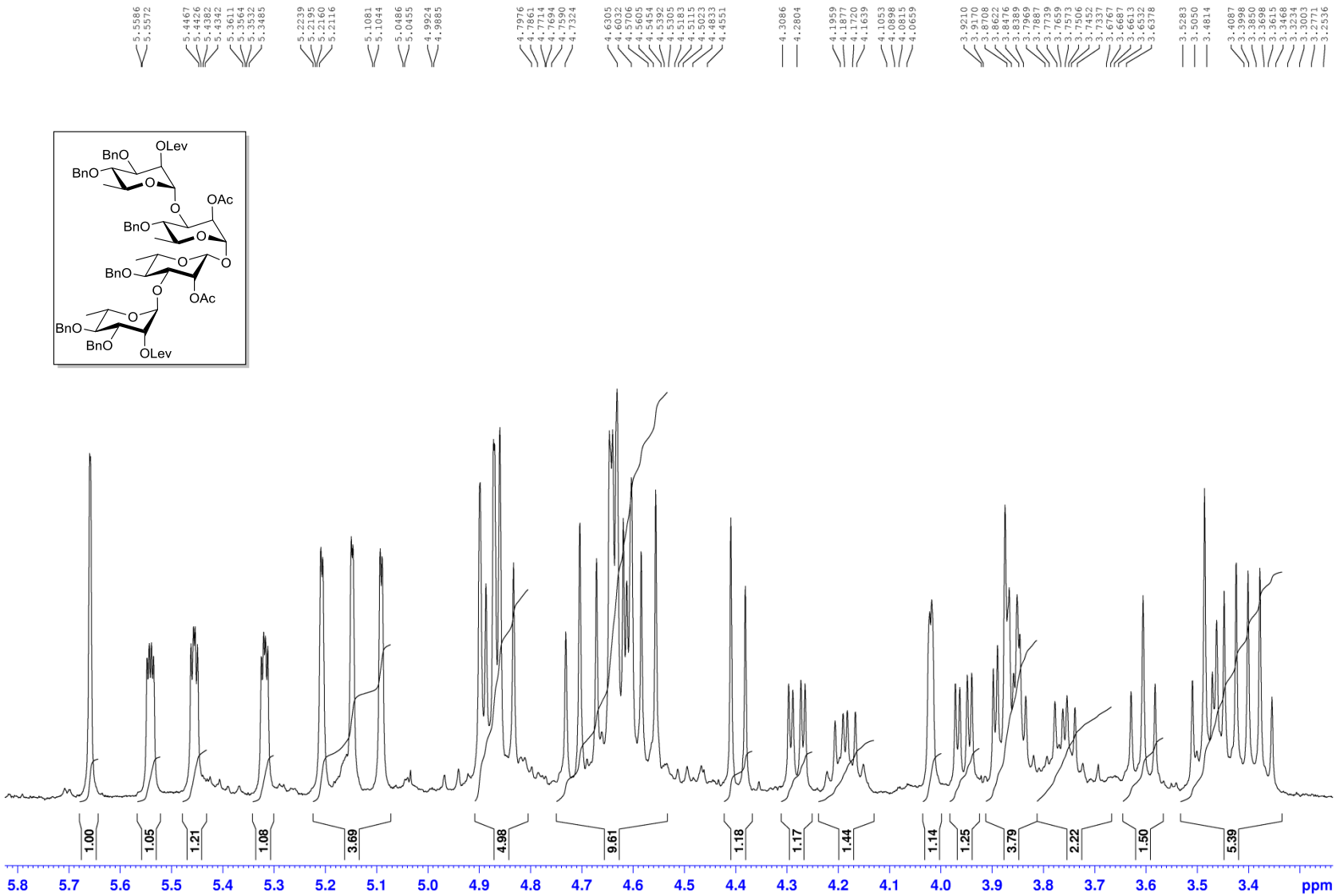
97.585
96.820
95.005
82.098
80.410
79.625
78.896
77.513
77.440
77.255
76.352
75.865
75.499
74.961
74.922
74.645
74.286
73.451
73.119
71.617
71.573
71.369
70.889
70.568
69.368
69.325
68.797
68.536
68.263
67.560
OBn
BnO
BnO
BnO
O
O
OBn
O
OAll
NHAc
BnO
O
O
OAc
BnO
O
BnO
OLev
100
95
90
85
80
75
70
65
ppm


OBn
BnO
BnO
O
OBn
BnO
O
O
O
OAll
NHAc
BnO
O
O
OAc
BnO
O
BnO
OLev
ppm
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
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170


OBn
BnO
BnO
BnO
O
OBn
O
O
O
OAll
NHAc
BnO
O
O
OAc
BnO
O
BnO
OLev
ppm
45
50
55
60
65
70
75
80
85
90
95
100
5.5
5.4
5.3
5.2
5.1
5.0
4.9
4.8
4.7
4.6
4.5
4.4
4.3
4.2
4.1
4.0
3.9
3.8
3.7
3.6
3.5
3.4
ppm

Compound 38: **(2-*O*-Levulinoyl-3,4-di-*O*-benzyl-α-L-rhamnopyranosyl)-(1→3)-(2-*O*-acetyl-4-*O*-benzyl-α-L-rhamnopyranosyl)-(1↔1)-(2-*O*-levulinoyl-3,4-di-*O*-benzyl-α-L-rhamnopyranosyl)-(1→3)-2-*O*-acetyl-4-*O*-benzyl-β-L-rhamnopyranoside**

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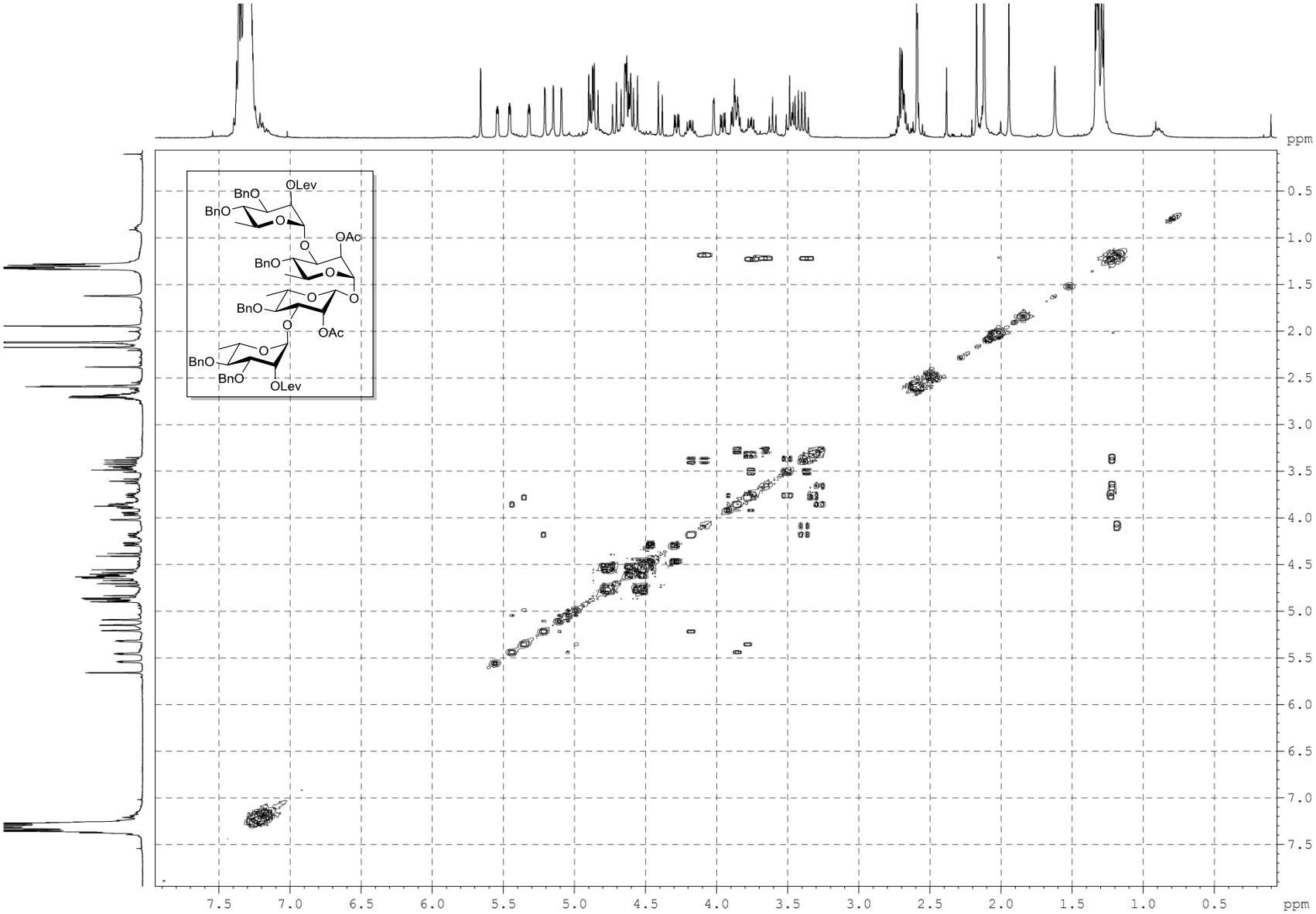
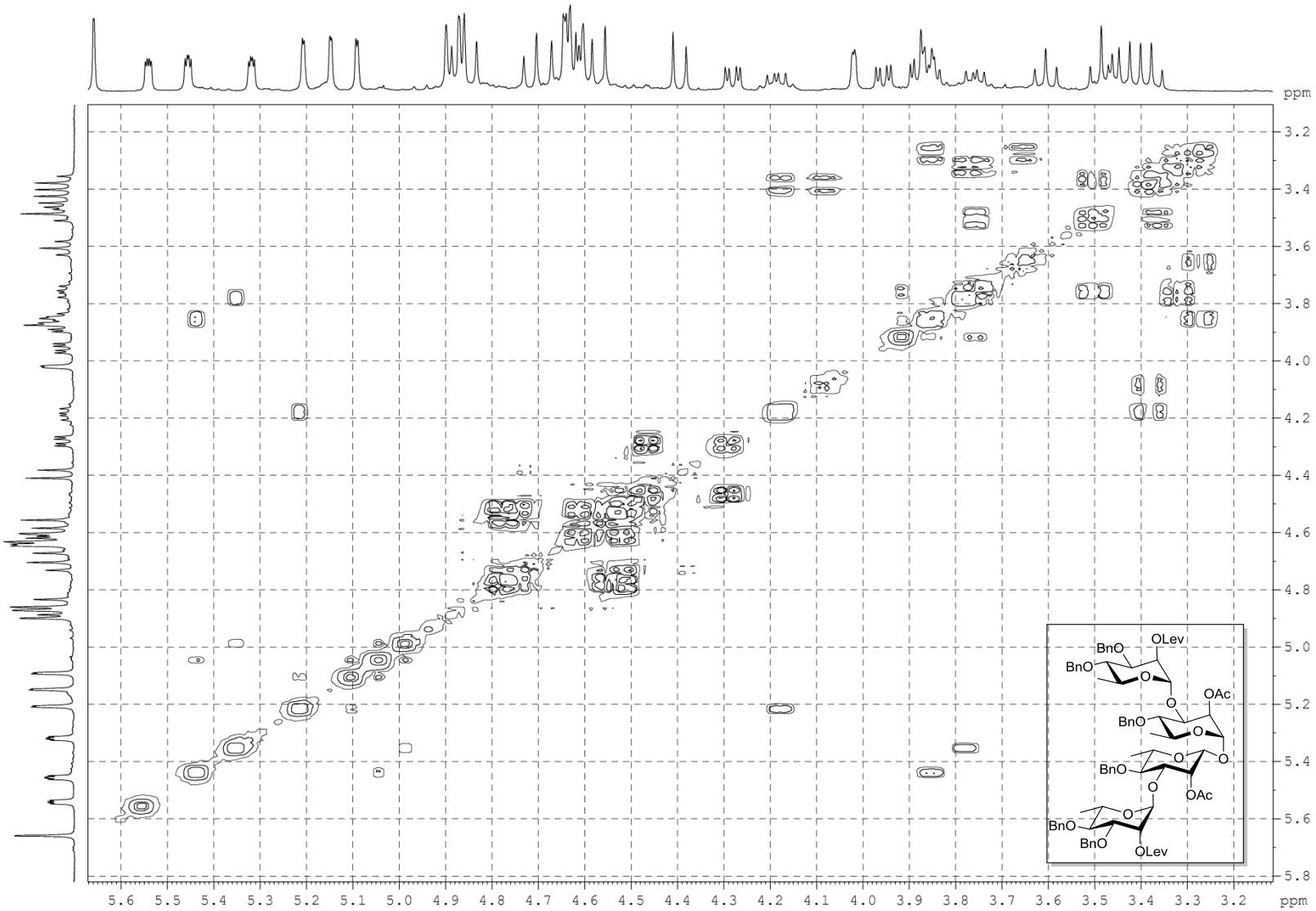
5.4467
5.4426
5.4382
5.4342
5.3611
5.3564
5.3532
5.3485
5.2239
5.2195
5.2160
5.2116
5.1081
5.1044
5.0486
5.0455
4.9924
4.9885
4.7976
4.7861
4.7714
4.7694
4.7590
4.7324
4.6305
4.6032
4.5706
4.5605
4.5454
4.5392
4.5305
4.5183
4.5115
4.5023
4.4833
4.4551
4.3086
4.2804
4.1959
4.1877
4.1720
4.1639
4.1053
4.0898
4.0815
4.0659
3.9210
3.9170
3.8708
3.8622
3.8476
3.8389
3.8369
3.7887
3.7739
3.7659
3.7573
3.7506
3.7452
3.7337
3.6767
3.6687
3.6613
3.6532
3.6378
3.5283
3.5050
3.4814
3.4087
3.3998
3.3850
3.3698
3.3615
3.3465
3.3234
3.3003
3.2771
3.2536
BnO
OLev
BnO
O
O
OAc
BnO
O
BnO
O
O
O
OAc
BnO
O
BnO
OLev
1.00
1.05
1.21
1.08
3.69
4.98
9.61
1.18
1.17
1.44
1.14
1.25
3.79
2.22
1.50
5.39
5.8
5.7
5.6
5.5
5.4
5.3
5.2
5.1
5.0
4.9
4.8
4.7
4.6
4.5
4.4
4.3
4.2
4.1
4.0
3.9
3.8
3.7
3.6
3.5
3.4
ppm


BnO
OLev
BnO
O
O
OAc
BnO
O
O
BnO
O
O
OAc
BnO
O
BnO
OLev
ppm
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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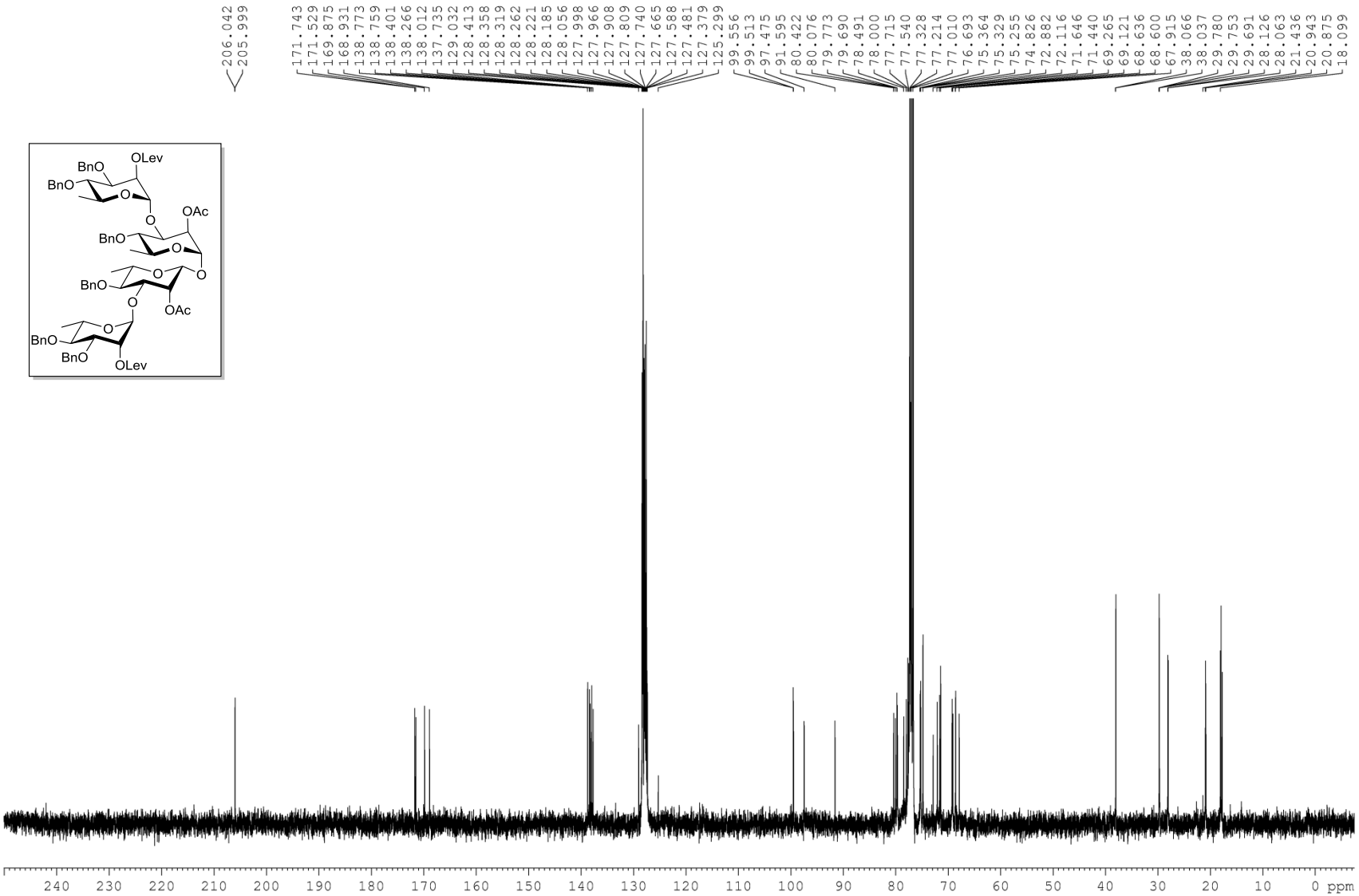
3.4
3.6
3.8
4.0
4.2
4.4
4.6
4.8
5.0
5.2
5.4
5.6
5.8
5.6 5.5 5.4 5.3 5.2 5.1 5.0 4.9 4.8 4.7 4.6 4.5 4.4 4.3 4.2 4.1 4.0 3.9 3.8 3.7 3.6 3.5 3.4 3.3 3.2
ppm
BnO
BnO
OLev
O
O
OAc
BnO
O
O
BnO
O
O
OAc
O
BnO
BnO
OLev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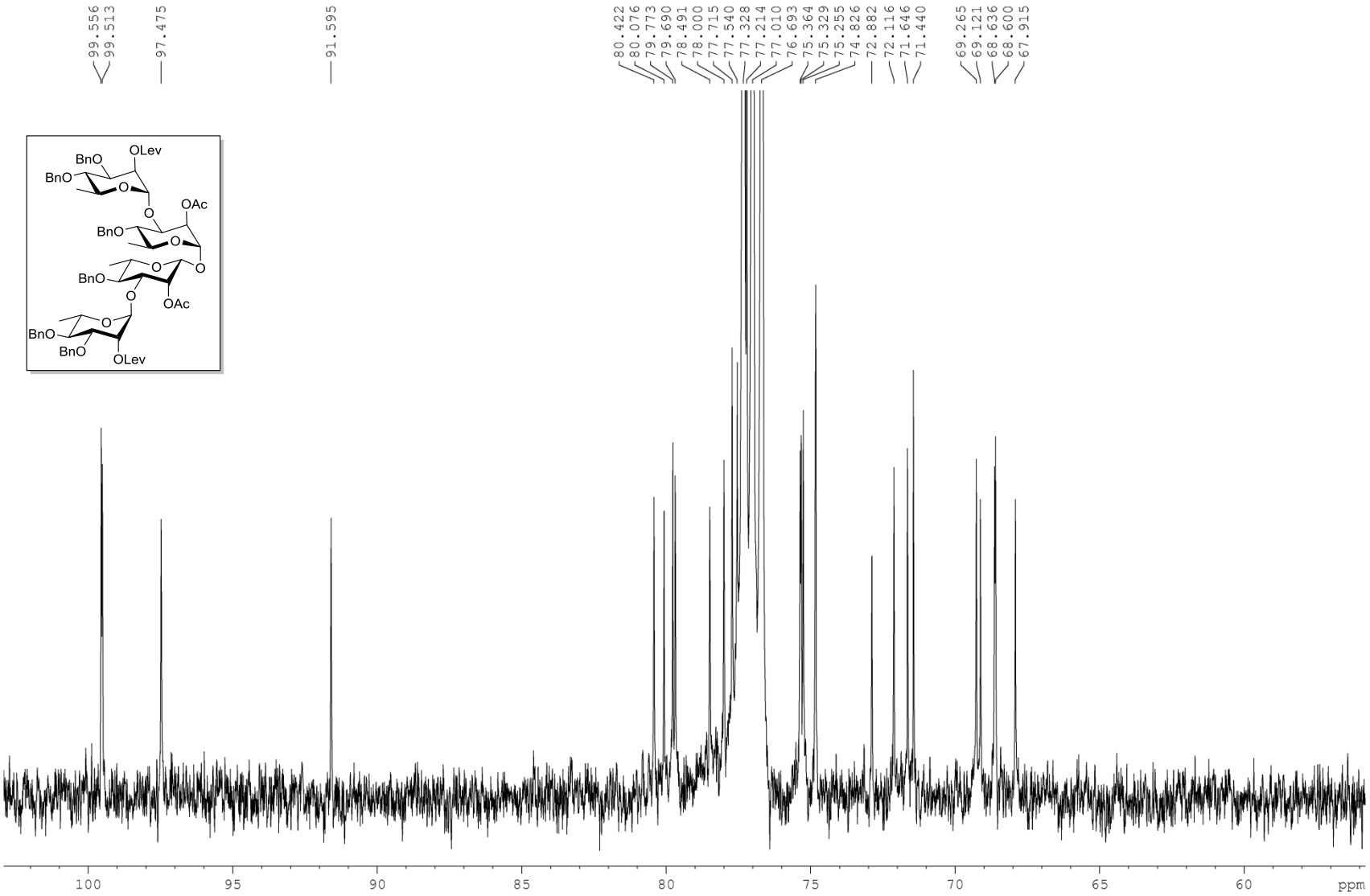
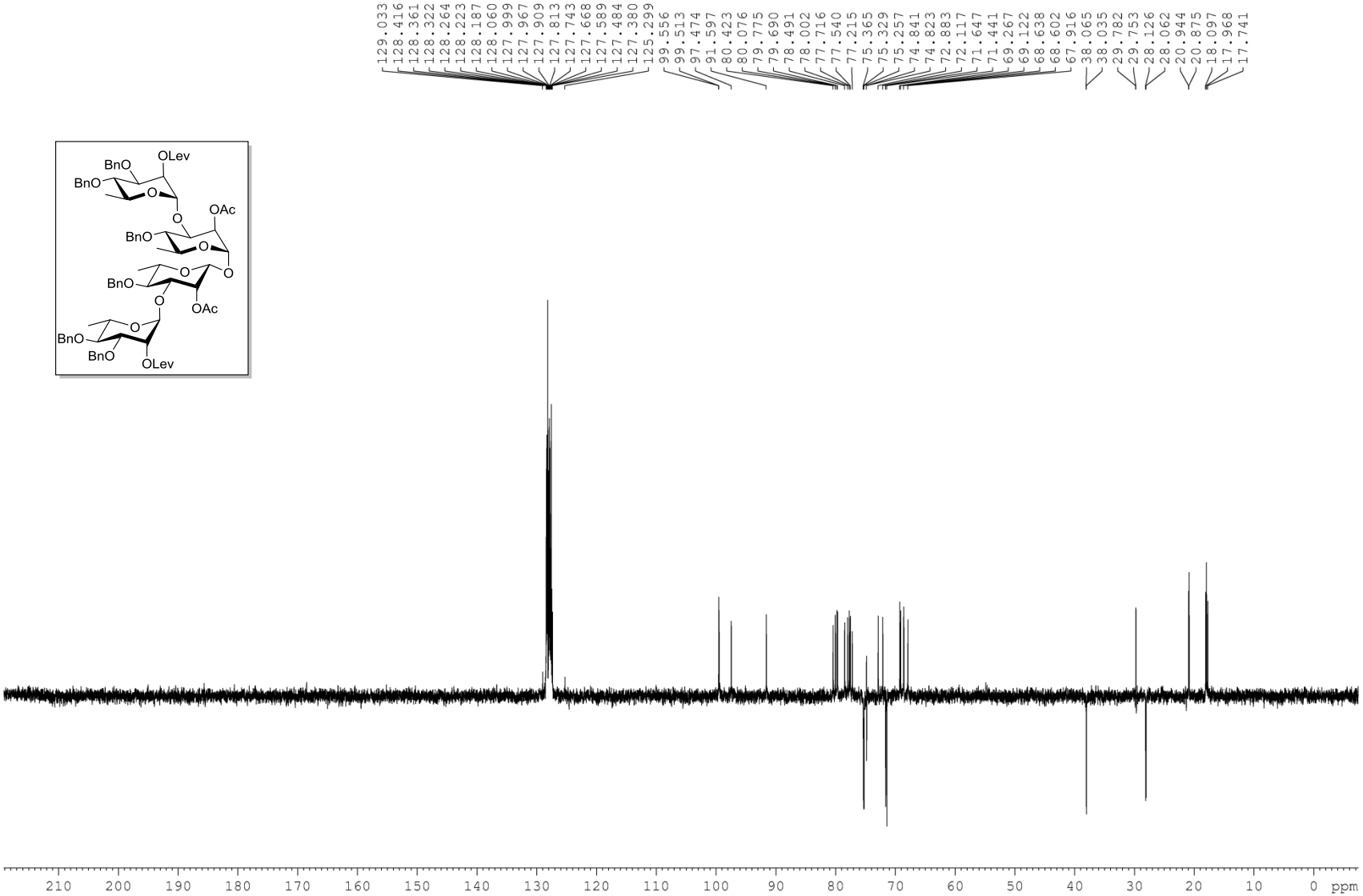
205.999
171.743
171.529
169.875
168.931
138.773
138.759
138.401
138.266
138.012
137.735
129.032
128.413
128.358
128.319
128.262
128.221
128.185
128.056
127.998
127.966
127.908
127.809
127.740
127.665
127.588
127.481
127.379
125.299
99.556
99.513
97.475
91.595
80.422
80.076
79.773
79.690
78.491
78.000
77.715
77.540
77.328
77.214
77.010
76.693
75.364
75.329
75.255
74.826
72.882
72.116
71.646
71.440
69.265
69.121
68.636
68.600
67.915
38.066
38.037
29.780
29.753
29.691
28.126
28.063
21.436
20.943
20.875
18.099
BnO
OLev
BnO
O
O
OAc
BnO
O
BnO
O
O
O
OAc
BnO
BnO
OLev
240 230 220 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 ppm


99.556
99.513
97.475
91.595
80.422
80.076
79.773
79.690
78.491
78.000
77.715
77.540
77.328
77.214
77.010
76.693
75.364
75.329
75.255
74.826
72.882
72.116
71.646
71.440
69.265
69.121
68.636
68.600
67.915
BnO
OLev
BnO
O
O
OAc
BnO
O
O
BnO
O
O
O
OAc
BnO
O
BnO
OLev
100
95
90
85
80
75
70
65
60
ppm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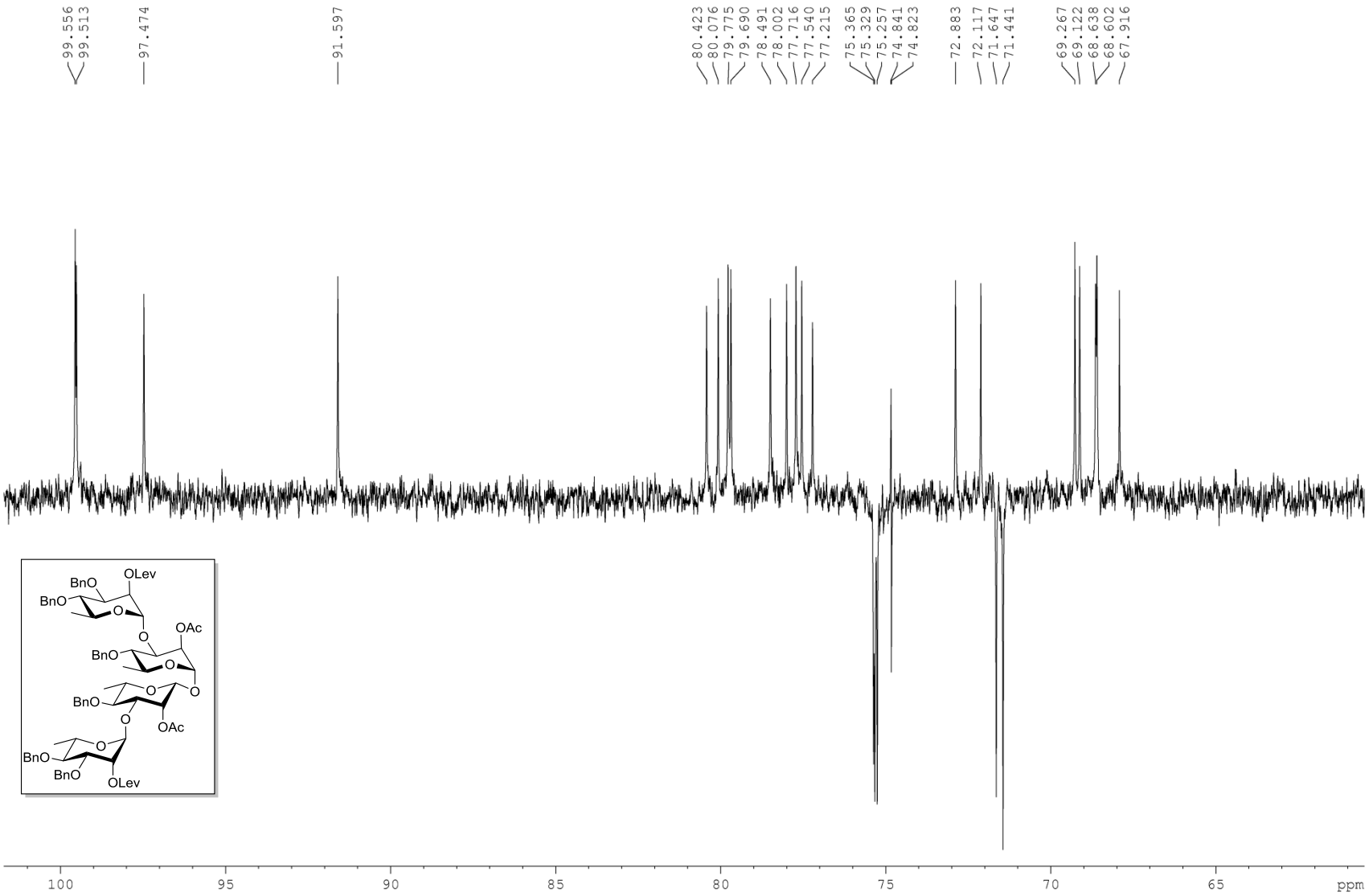
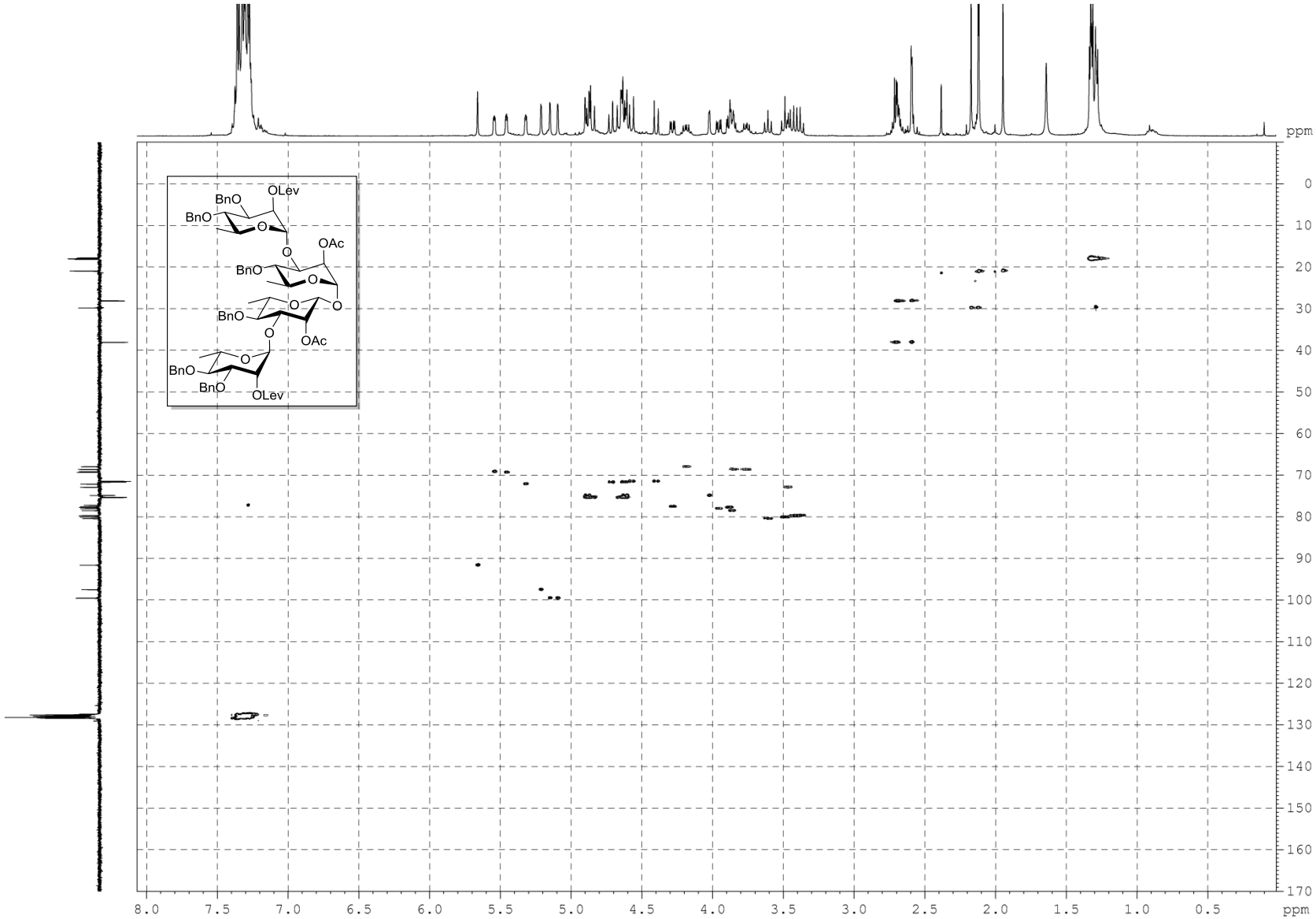
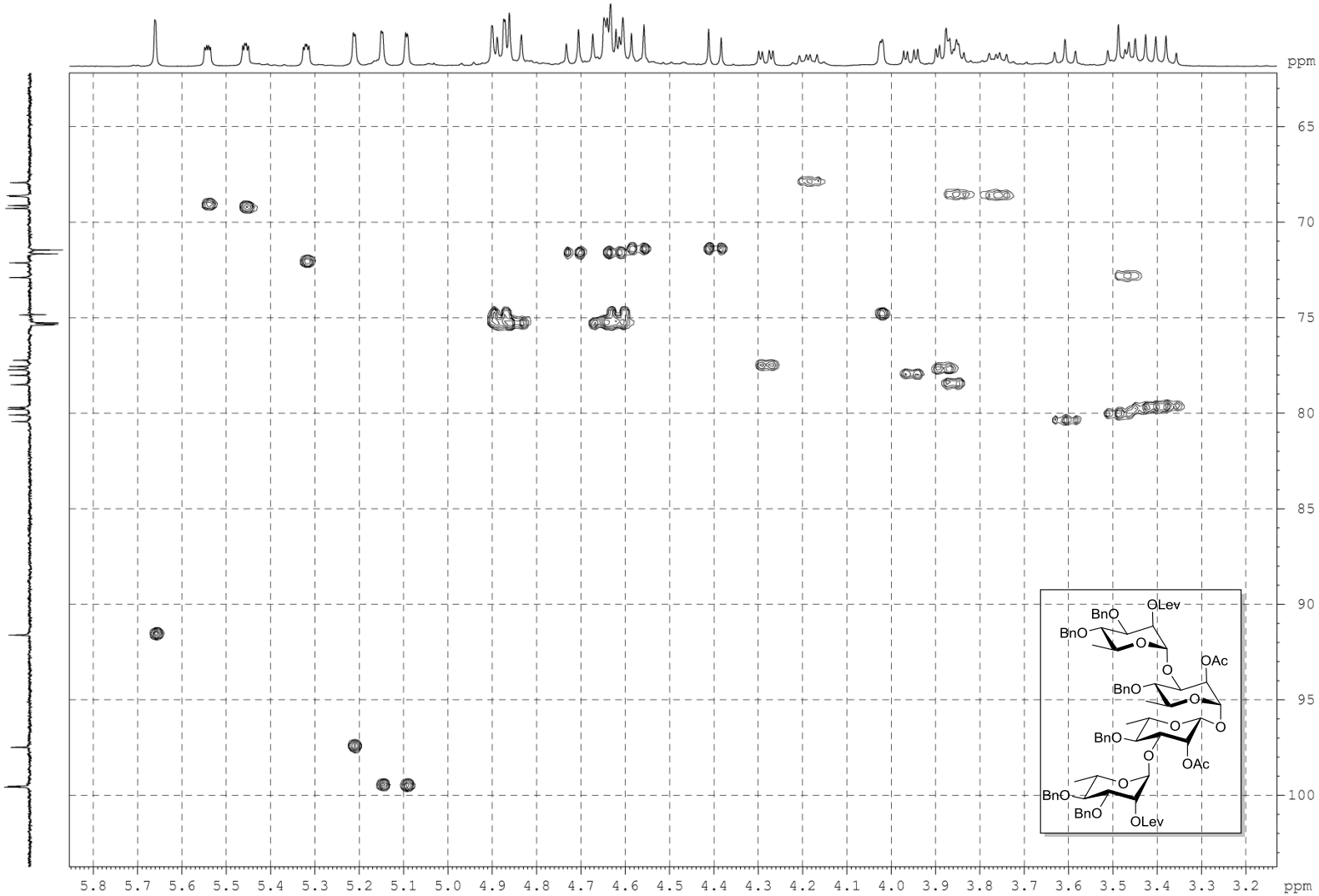
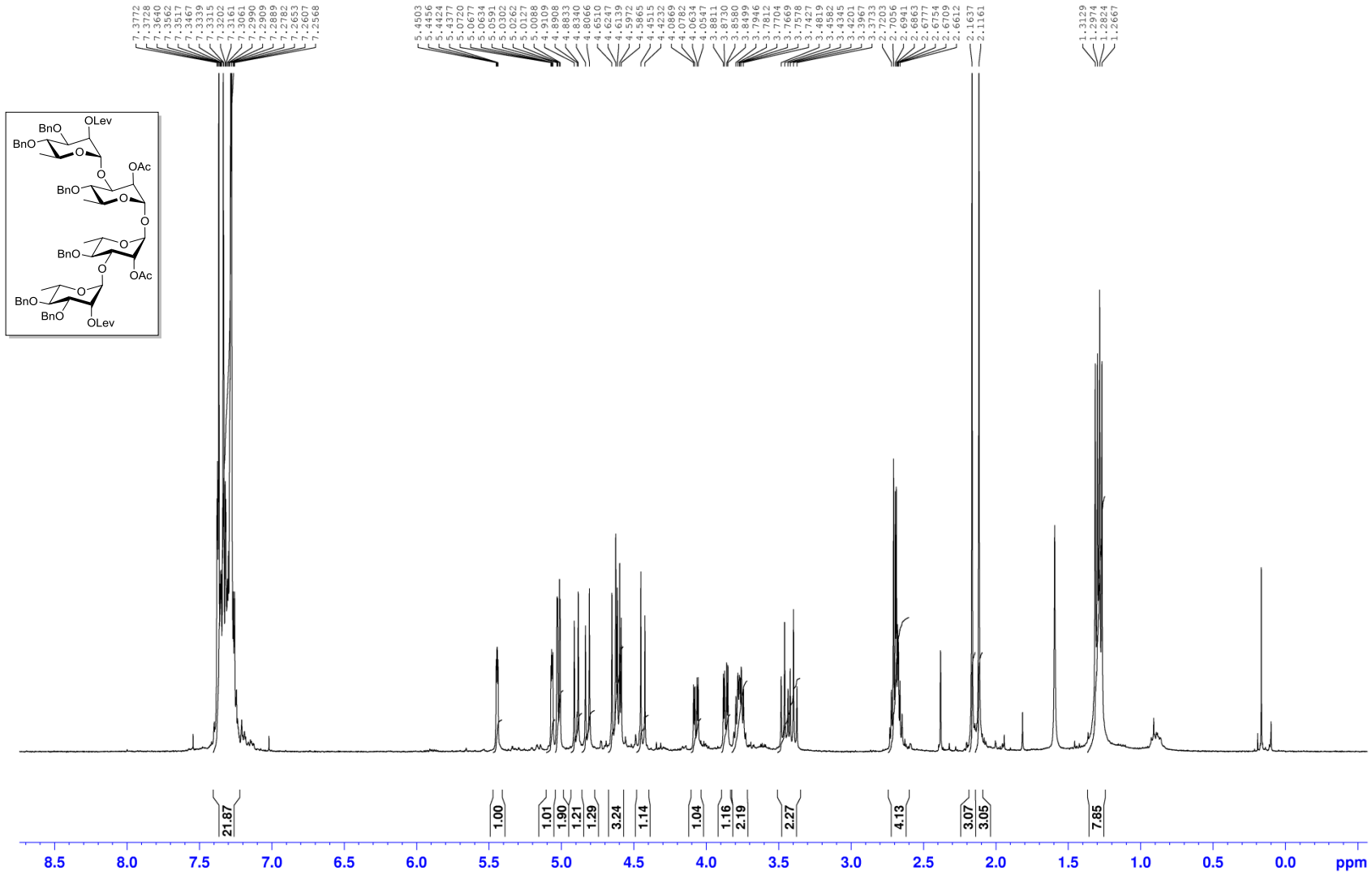
128.416
128.361
128.322
128.264
128.223
128.187
128.060
127.999
127.967
127.909
127.813
127.743
127.668
127.589
127.484
127.380
125.299
99.556
99.513
97.474
91.597
80.423
80.076
79.775
79.690
78.491
78.002
77.716
77.540
77.215
75.365
75.329
75.257
74.841
74.823
72.883
72.117
71.647
71.441
69.267
69.122
68.638
68.602
67.916
38.065
38.035
29.782
29.753
28.126
28.062
20.944
20.875
18.097
17.968
17.741
BnO
OLev
BnO
O
O
OAc
BnO
O
O
BnO
O
O
OAc
BnO
O
BnO
OLev
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
ppm

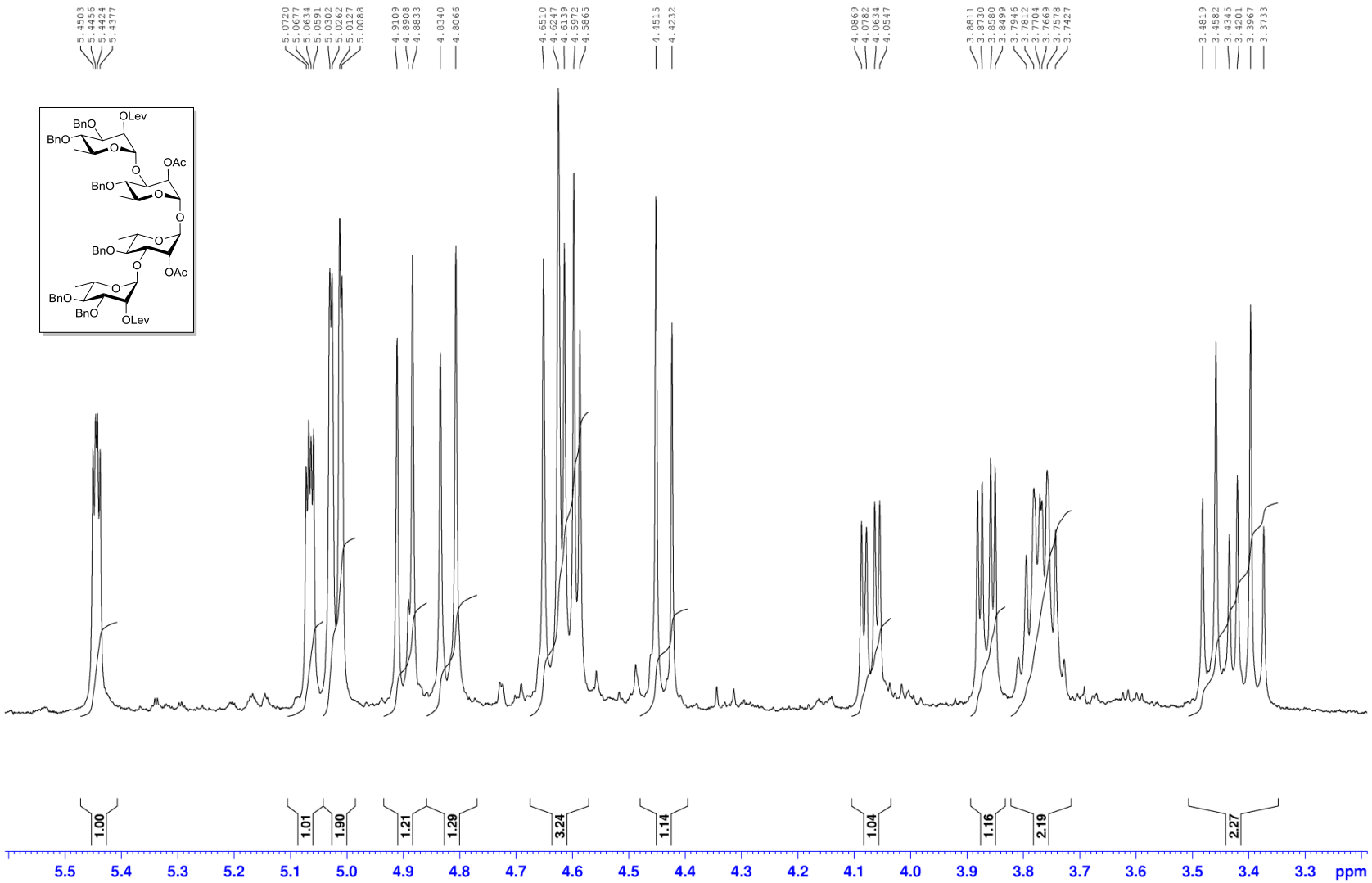

99.556
99.513
97.474
91.597
80.423
80.076
79.775
79.690
78.491
78.002
77.716
77.540
77.215
75.365
75.329
75.257
74.841
74.823
72.883
72.117
71.647
71.441
69.267
69.122
68.638
68.602
67.916
BnO
OLev
OAc
O
100
95
90
85
80
75
70
65
ppm


BnO
OLev
BnO
O
OAc
O
BnO
O
O
BnO
O
OAc
O
BnO
BnO
OLev
ppm
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
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170


ppm
65
70
75
80
85
90
95
100
5.8 5.7 5.6 5.5 5.4 5.3 5.2 5.1 5.0 4.9 4.8 4.7 4.6 4.5 4.4 4.3 4.2 4.1 4.0 3.9 3.8 3.7 3.6 3.5 3.4 3.3 3.2
ppm
BnO
OLev
BnO
O
O
OAc
BnO
O
O
BnO
O
O
O
OAc
BnO
O
BnO
OLev

Compound 39: **(2-*O*-Levulinoyl-3,4-di-*O*-benzyl-α-L-rhamnopyranosyl)-(1→3)-(2-*O*-acetyl-4-*O*-benzyl-α-L-rhamnopyranosyl)-(1↔1)-(2-*O*-levulinoyl-3,4-di-*O*-benzyl-α-L-rhamnopyranosyl)-(1→3)-2-*O*-acetyl-4-*O*-benzyl-α-L-rhamnopyranoside**

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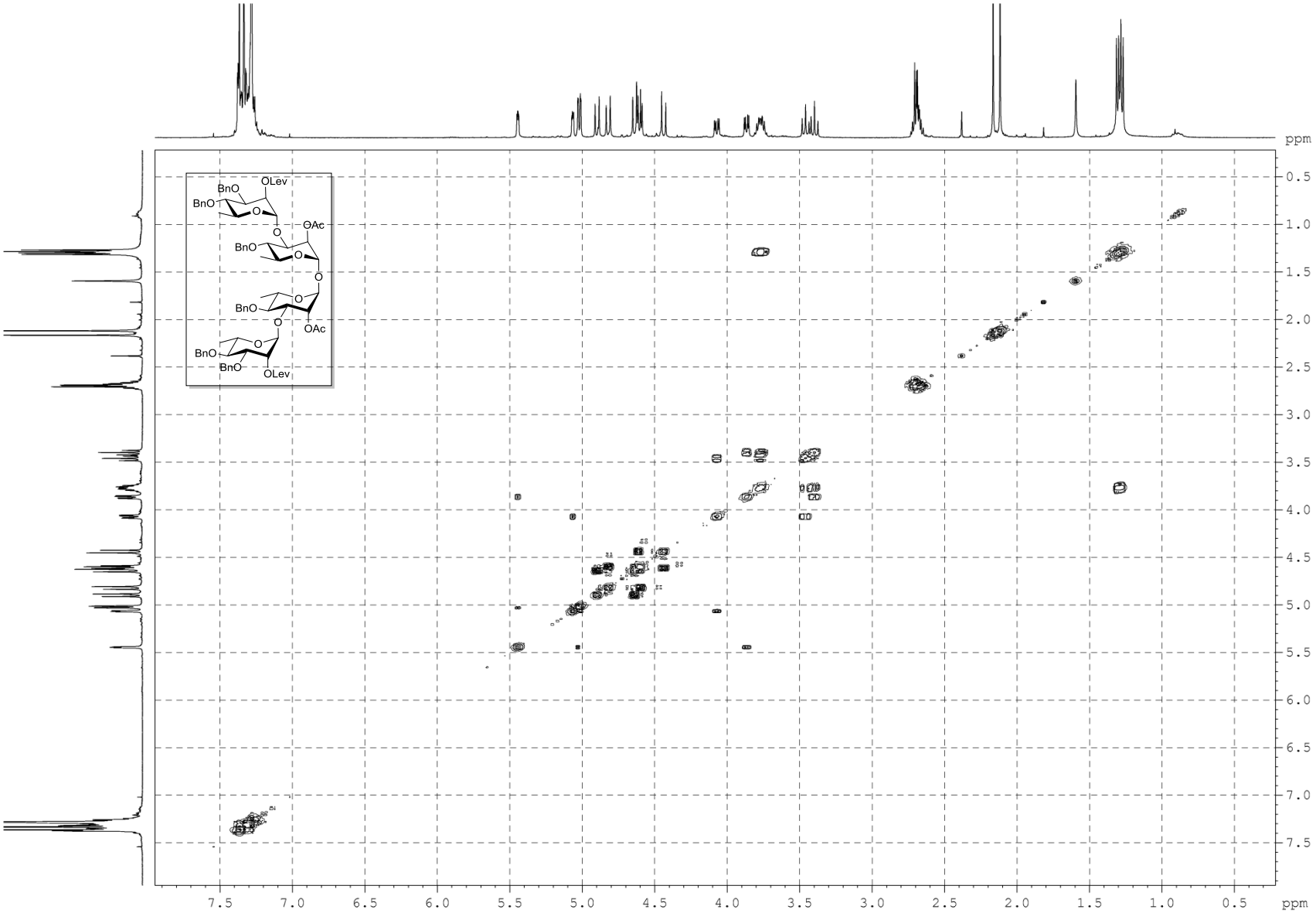
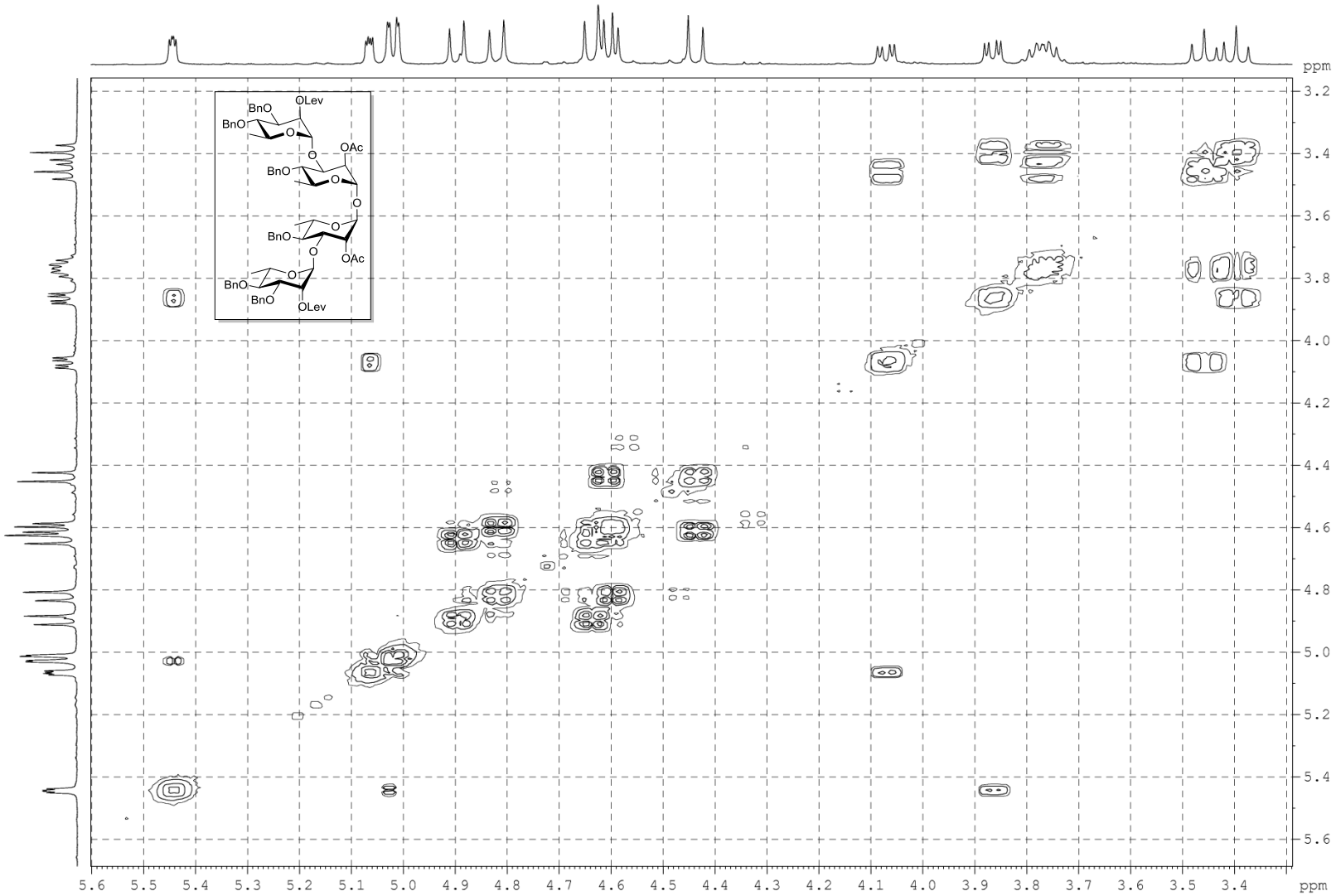
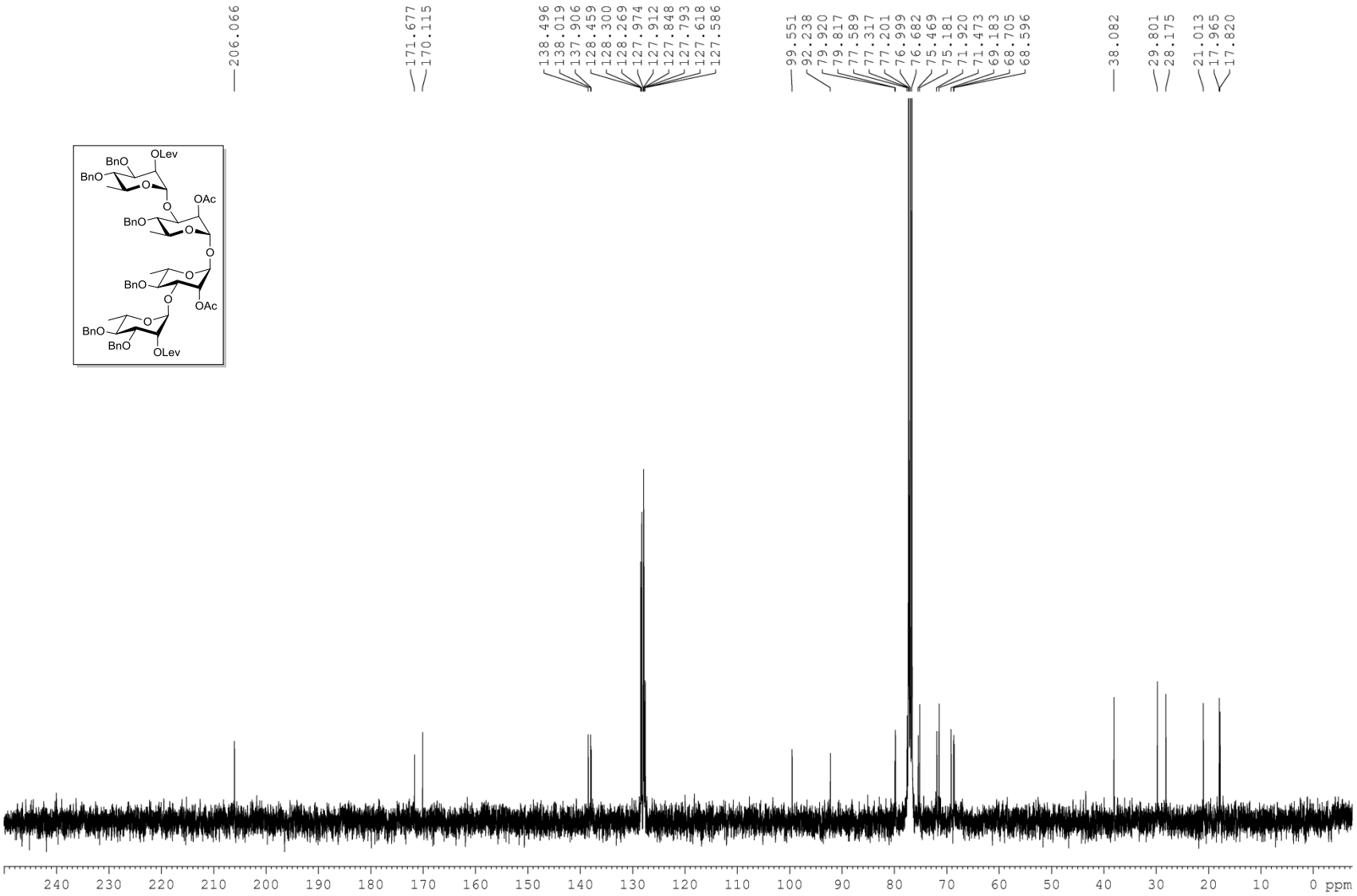
5.4424
5.4377
5.0720
5.0677
5.0634
5.0591
5.0302
5.0262
5.0127
5.0088
4.9109
4.8908
4.8833
4.8340
4.8066
4.6510
4.6247
4.6139
4.5972
4.5865
4.4515
4.4232
4.0869
4.0782
4.0634
4.0547
3.8811
3.8730
3.8580
3.8499
3.7946
3.7812
3.7704
3.7669
3.7578
3.7427
3.4819
3.4582
3.4345
3.4201
3.3967
3.3733
BnO
OLev
OAc
O
1.00
1.01
1.90
1.21
1.29
3.24
1.14
1.04
1.16
2.19
2.27
5.5
5.4
5.3
5.2
5.1
5.0
4.9
4.8
4.7
4.6
4.5
4.4
4.3
4.2
4.1
4.0
3.9
3.8
3.7
3.6
3.5
3.4
3.3
ppm


BnO
OLev
BnO
O
O
OAc
BnO
O
O
BnO
O
OAc
O
BnO
BnO
OLev
ppm
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


BnO
OLev
BnO
O
O
OAc
BnO
O
O
BnO
O
O
OAc
BnO
O
BnO
OLev
ppm
3.2
3.4
3.6
3.8
4.0
4.2
4.4
4.6
4.8
5.0
5.2
5.4
5.6
5.6 5.5 5.4 5.3 5.2 5.1 5.0 4.9 4.8 4.7 4.6 4.5 4.4 4.3 4.2 4.1 4.0 3.9 3.8 3.7 3.6 3.5 3.4
ppm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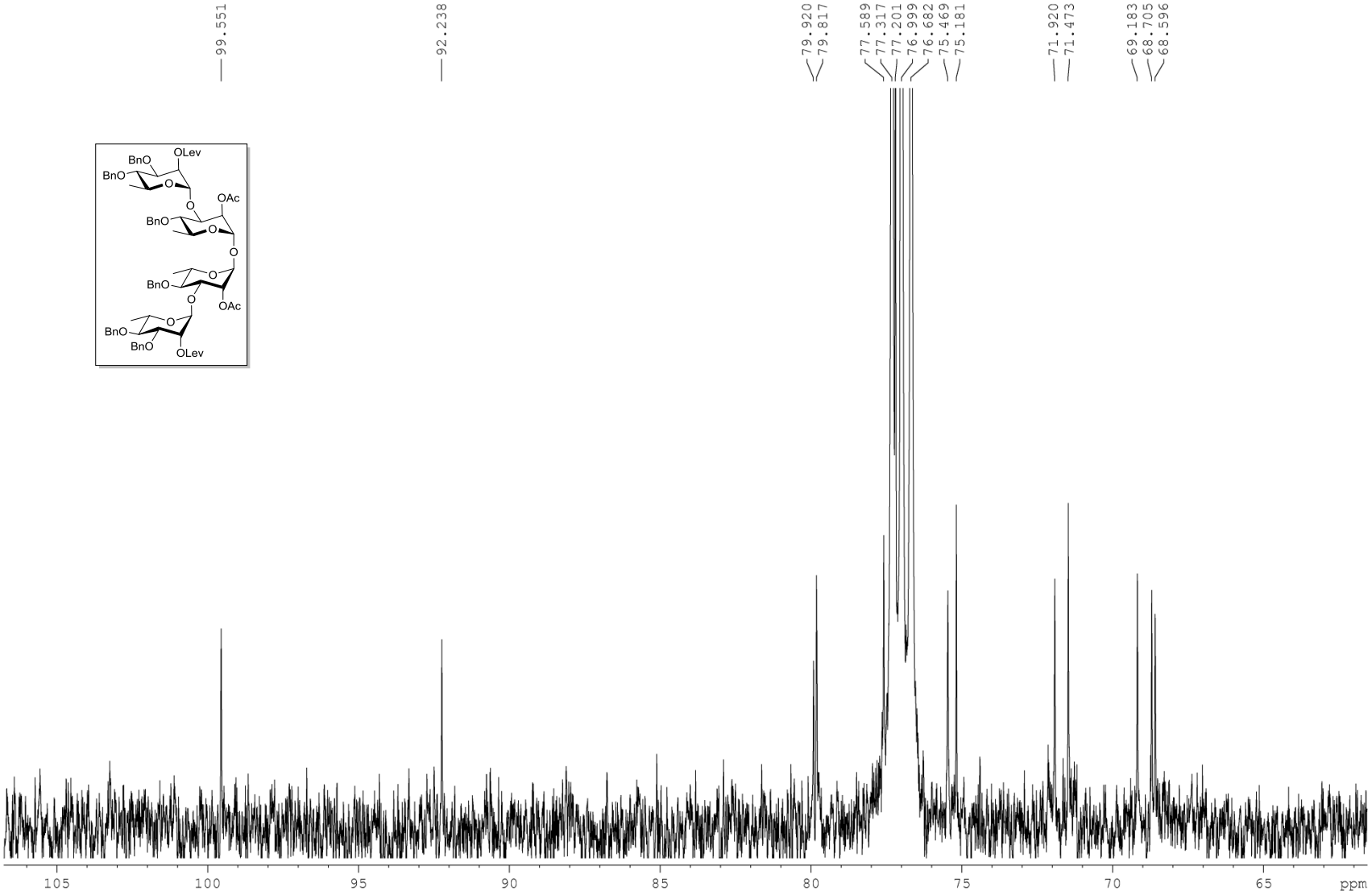
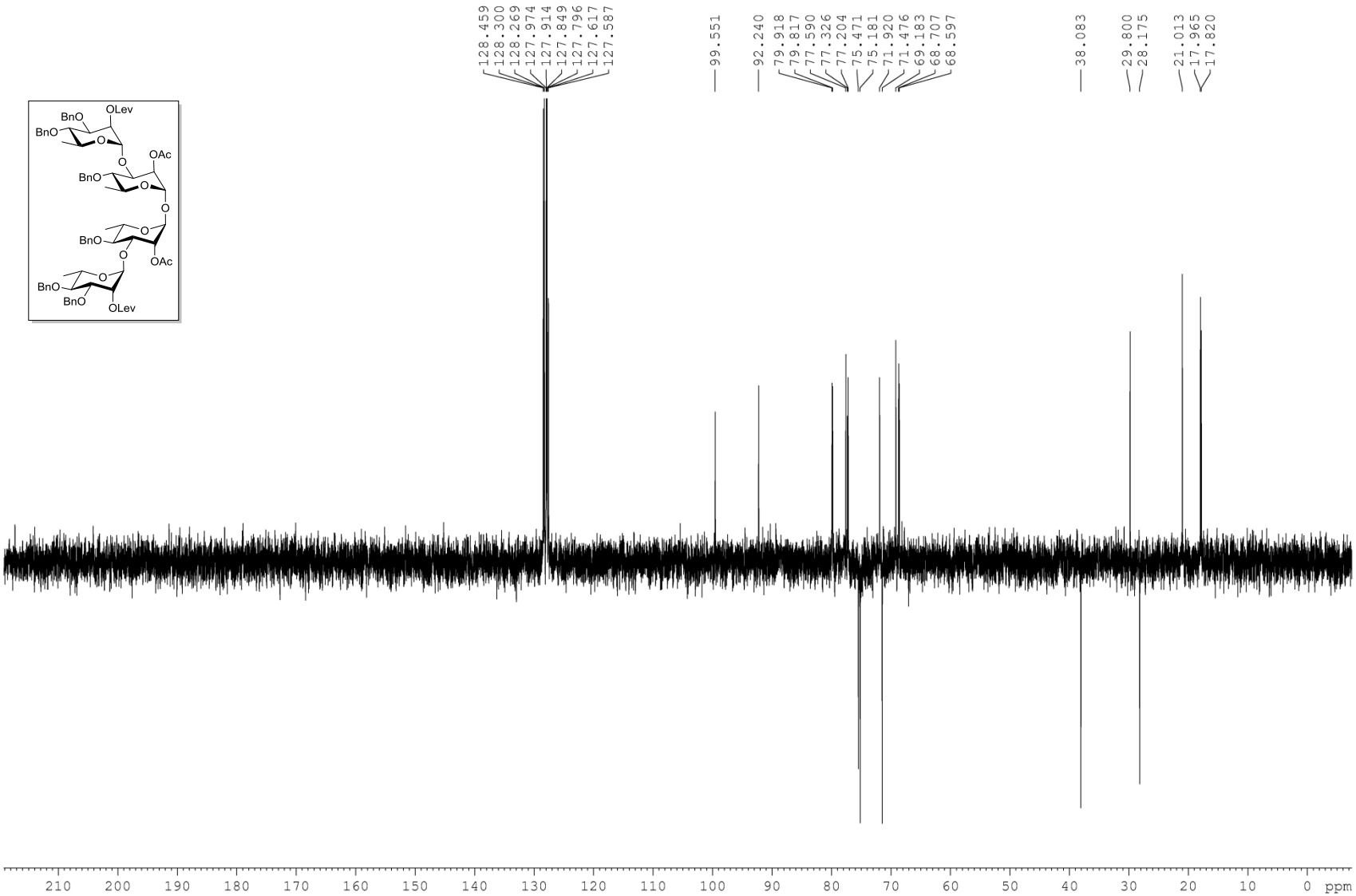
171.677
170.115
138.496
138.019
137.906
128.459
128.300
128.269
127.974
127.912
127.848
127.793
127.618
127.586
99.551
92.238
79.920
79.817
77.589
77.317
77.201
76.999
76.682
75.469
75.181
71.920
71.473
69.183
68.705
68.596
38.082
29.801
28.175
21.013
17.965
17.820
BnO
OLev
OAc
240 230 220 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 ppm


99.551
92.238
79.920
79.817
77.589
77.317
77.201
76.999
76.682
75.469
75.181
71.920
71.473
69.183
68.705
68.596
BnO
OLev
OAc
105
100
95
90
85
80
75
70
65
ppm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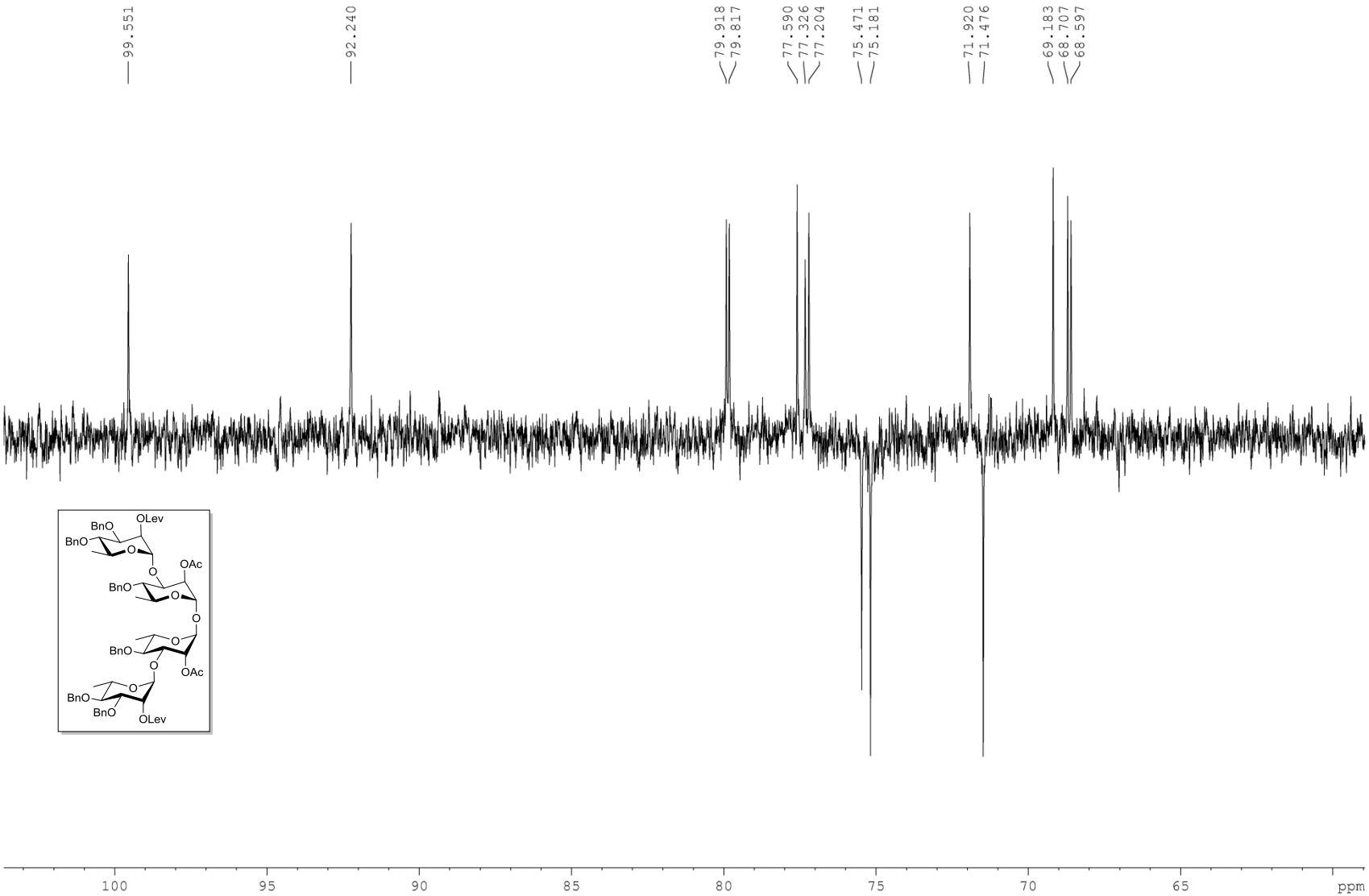
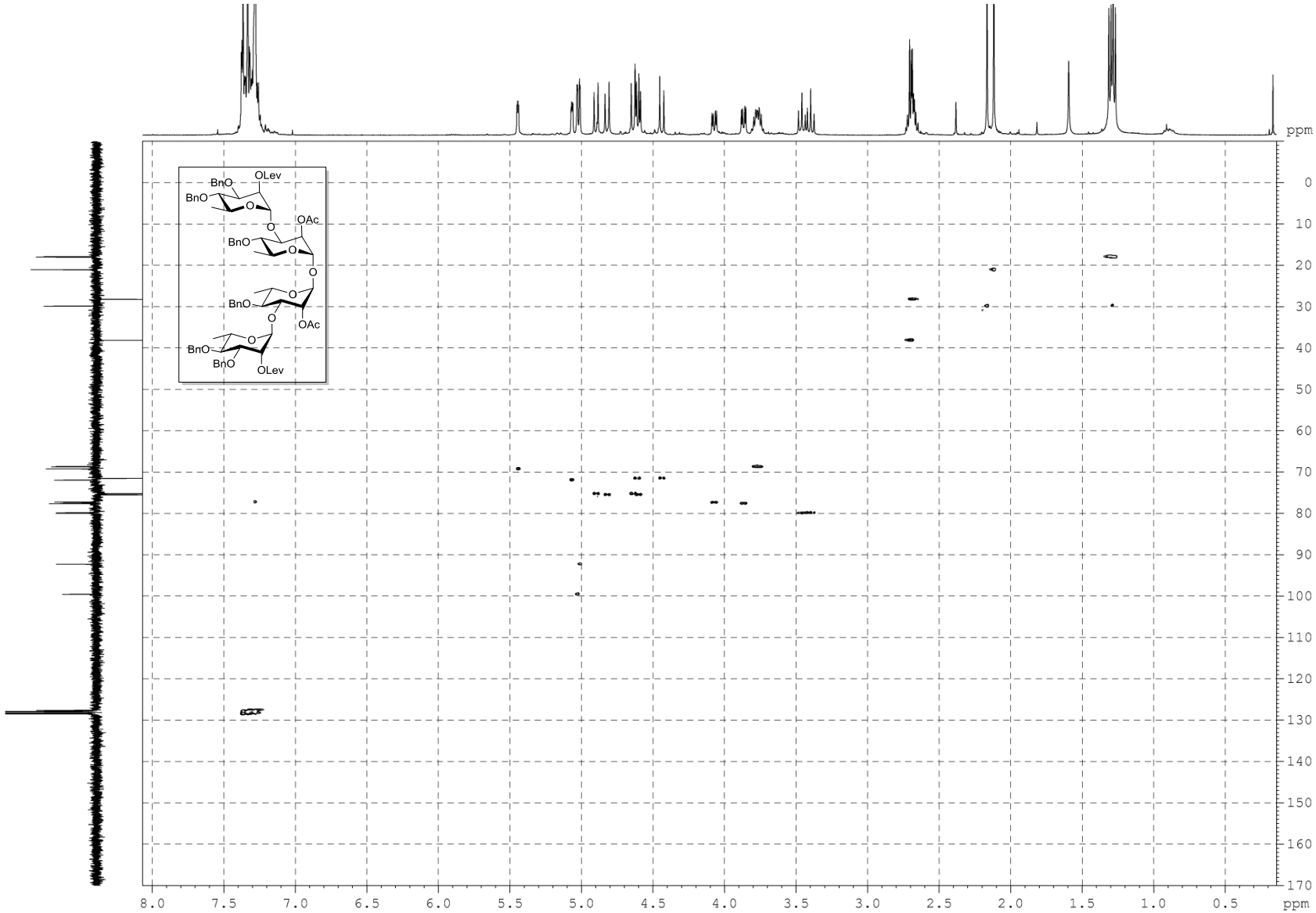
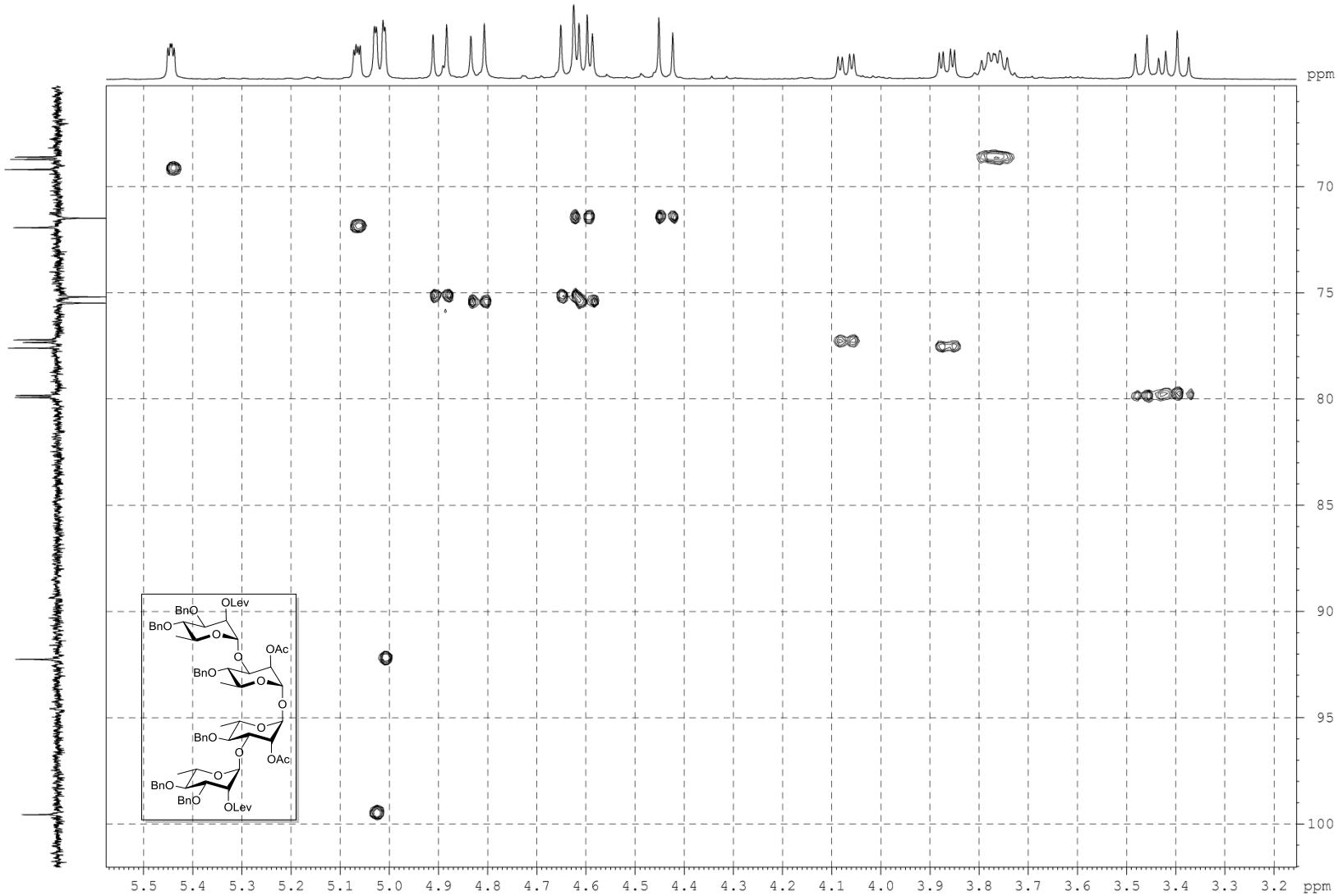
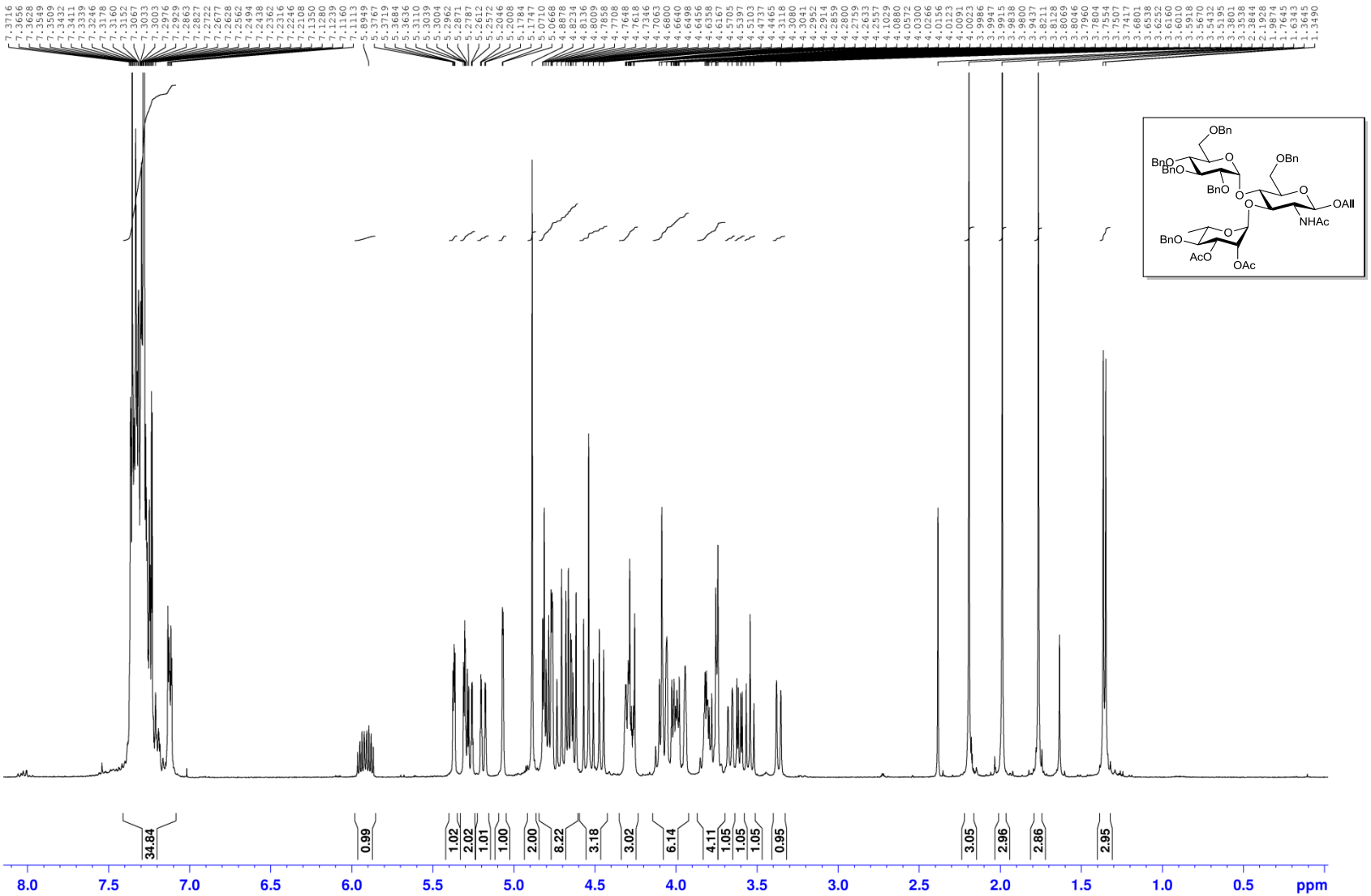
128.300
128.269
127.974
127.914
127.849
127.796
127.617
127.587
99.551
92.240
79.918
79.817
77.590
77.326
77.204
75.471
75.181
71.920
71.476
69.183
68.707
68.597
38.083
29.800
28.175
21.013
17.965
17.820
BnO
OLev
OAc
O
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 ppm

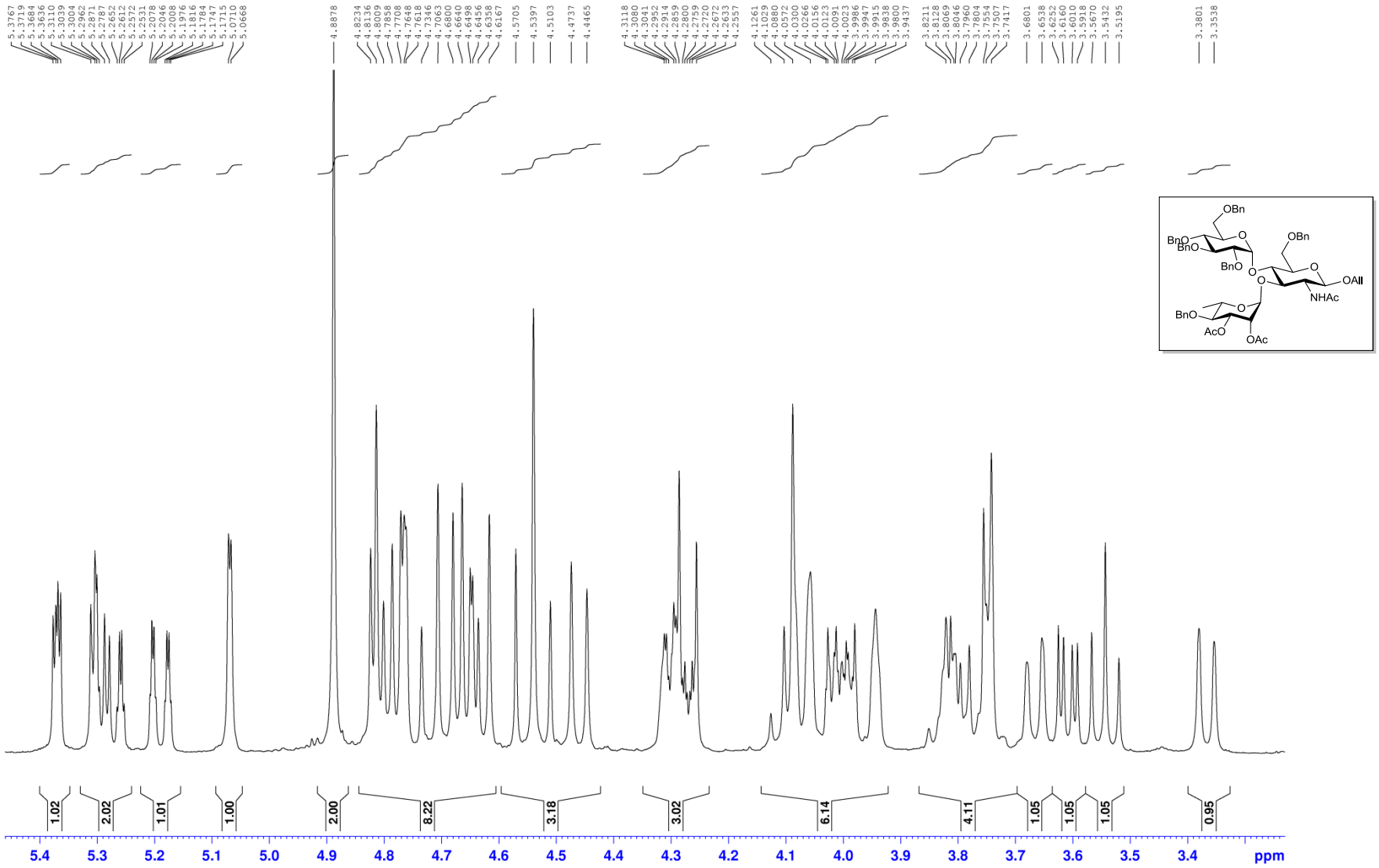

99.551
92.240
79.918
79.817
77.590
77.326
77.204
75.471
75.181
71.920
71.476
69.183
68.707
68.597
BnO
BnO
OLev
O
O
OAc
BnO
O
O
BnO
O
O
OAc
BnO
O
BnO
OLev
100
95
90
85
80
75
70
65
ppm

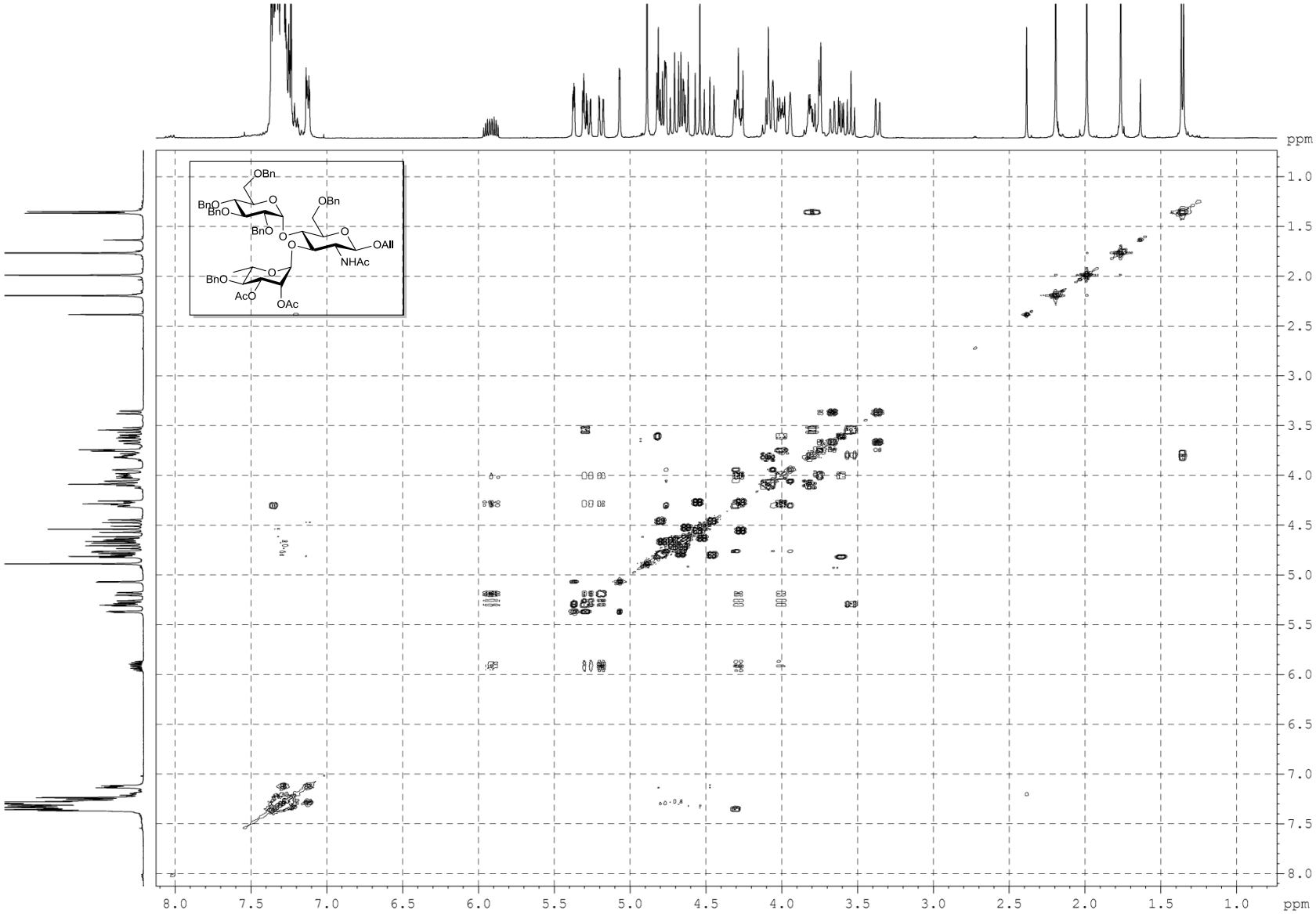

BnO
OLev
BnO
O
O
OAc
BnO
O
O
BnO
O
O
OAc
BnO
O
BnO
OLev
ppm
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
ppm

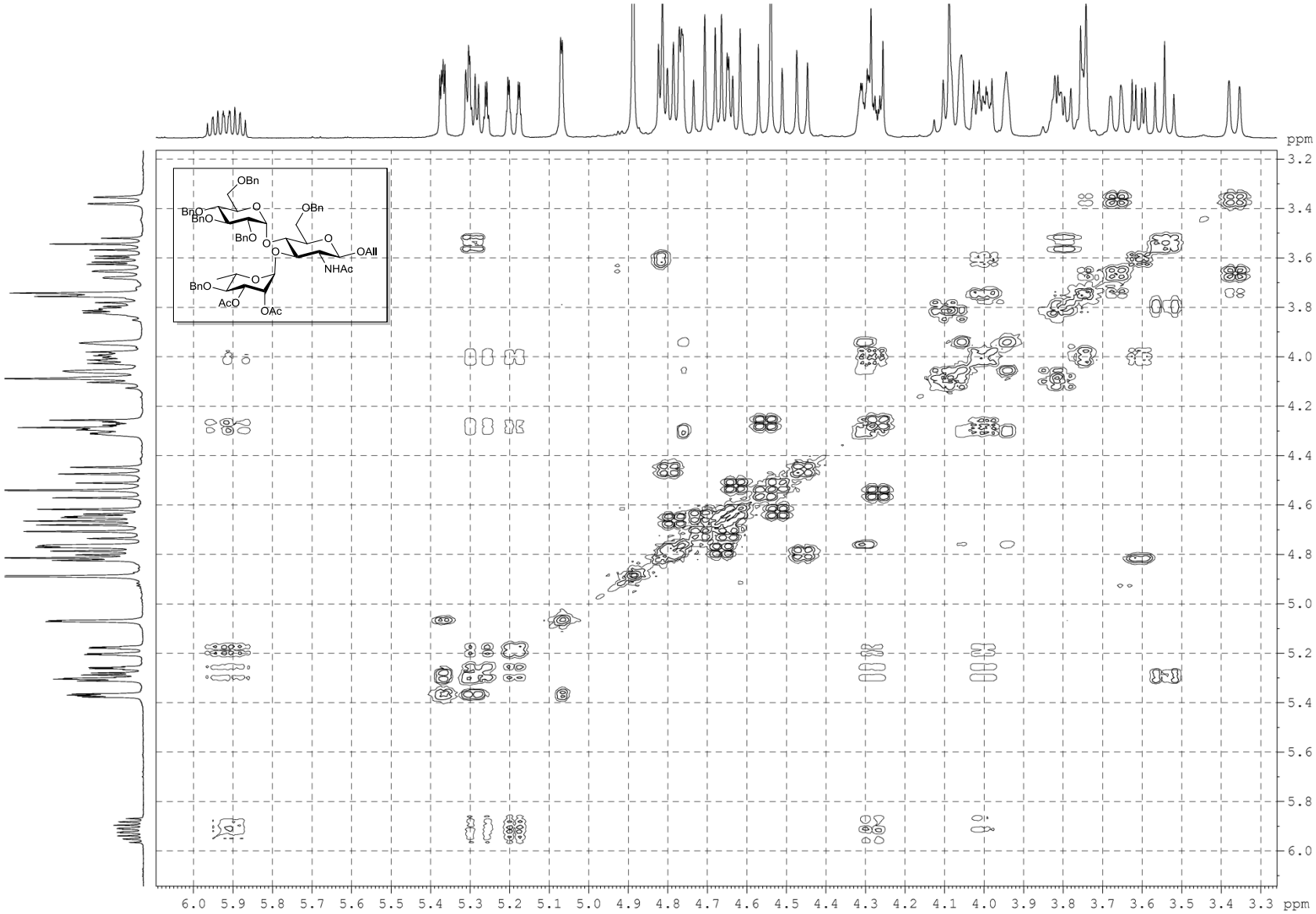

ppm
70
75
80
85
90
95
100
5.5 5.4 5.3 5.2 5.1 5.0 4.9 4.8 4.7 4.6 4.5 4.4 4.3 4.2 4.1 4.0 3.9 3.8 3.7 3.6 3.5 3.4 3.3 3.2
ppm
BnO
OLev
OAc

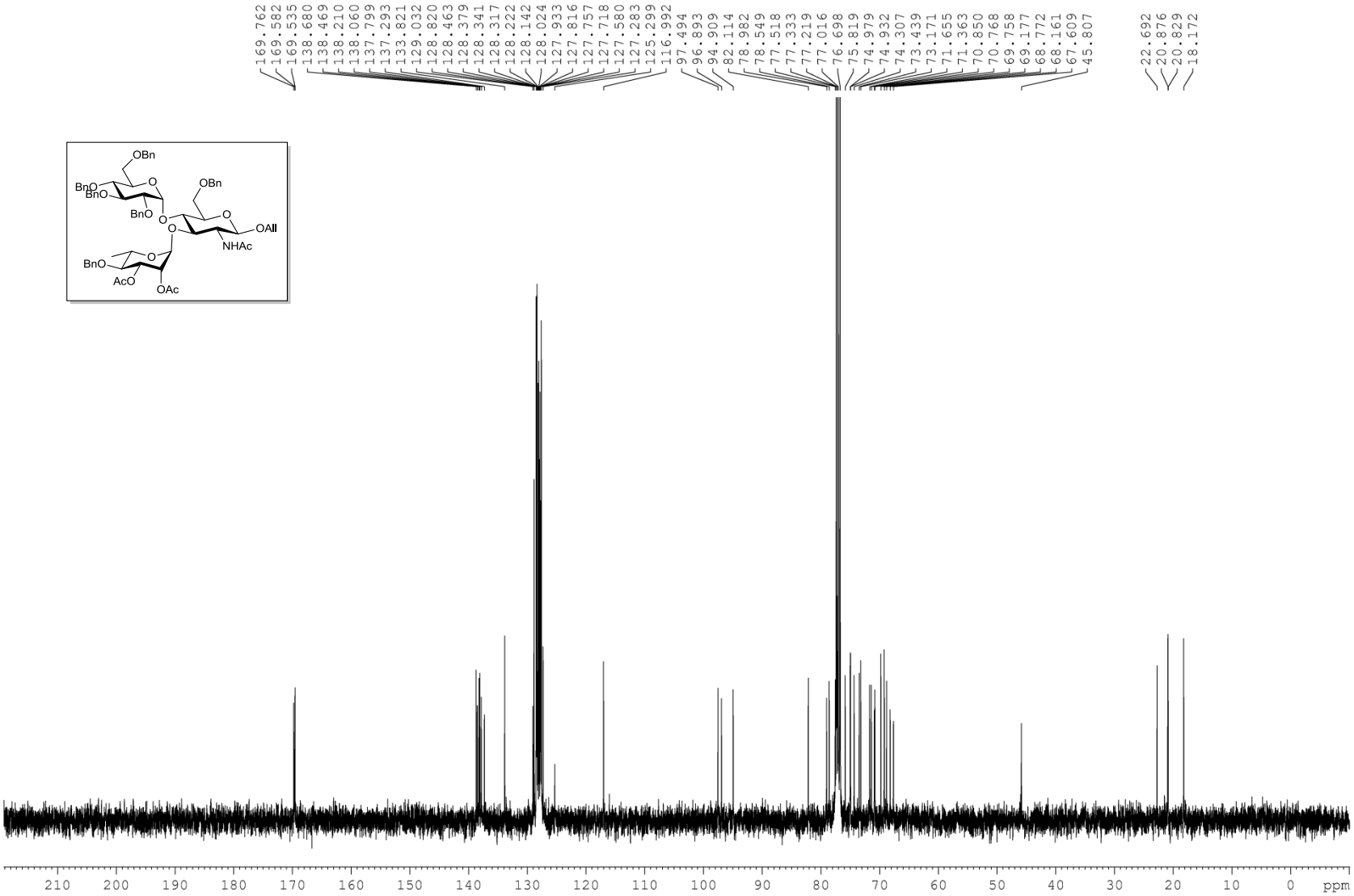
Compound 41: **Allyl (2,3-di-*O*-acetyl-4-*O*-benzyl-α-L-rhamnopyranosyl)-(1→3)-[2,3,4,6-tetra-*O*-benzyl-α-D-glucopyranosyl-(1→4)]-2-acetamido-6-*O*-benzyl-2-deoxy-β-D-glucopyranoside**

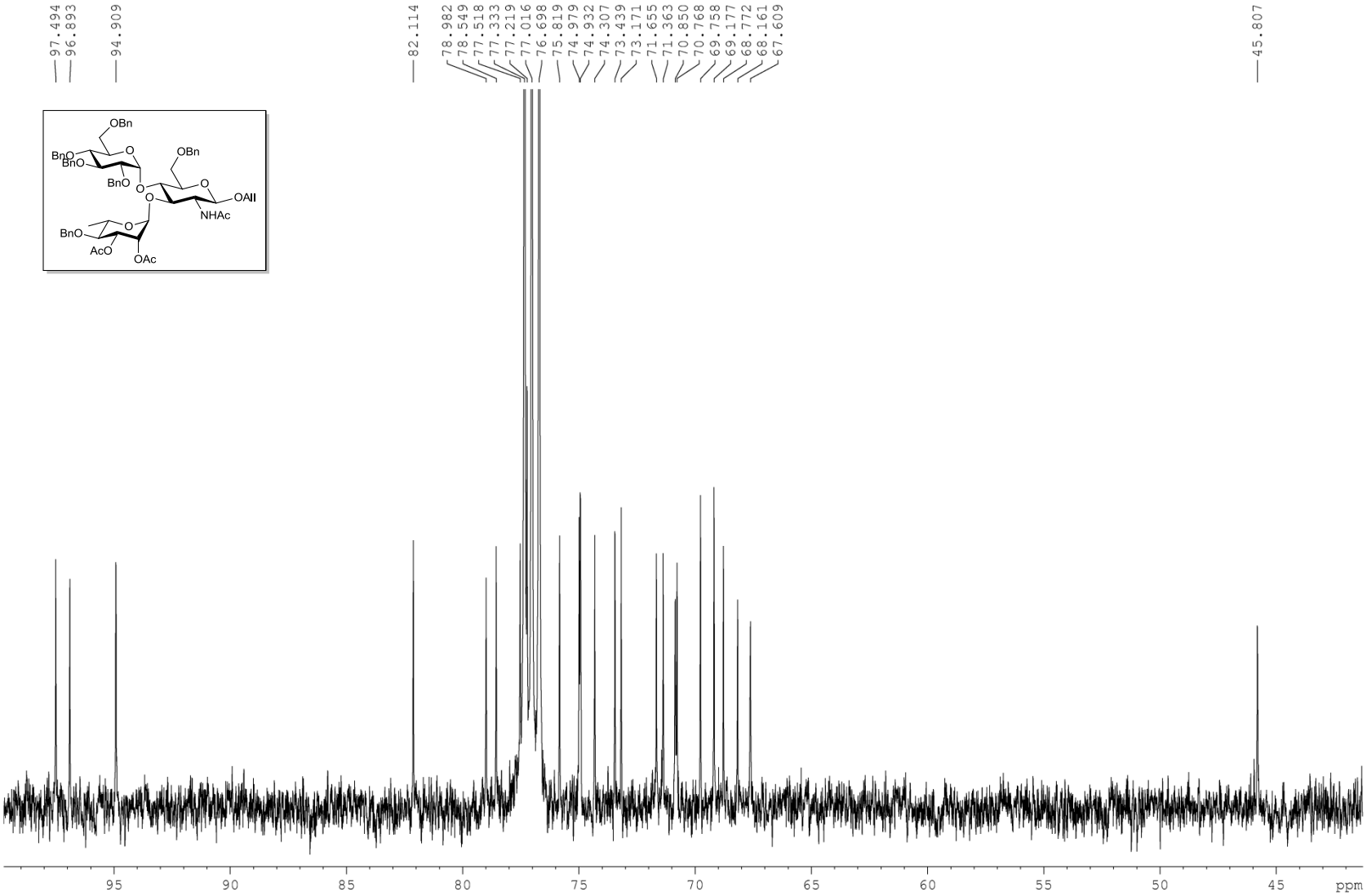


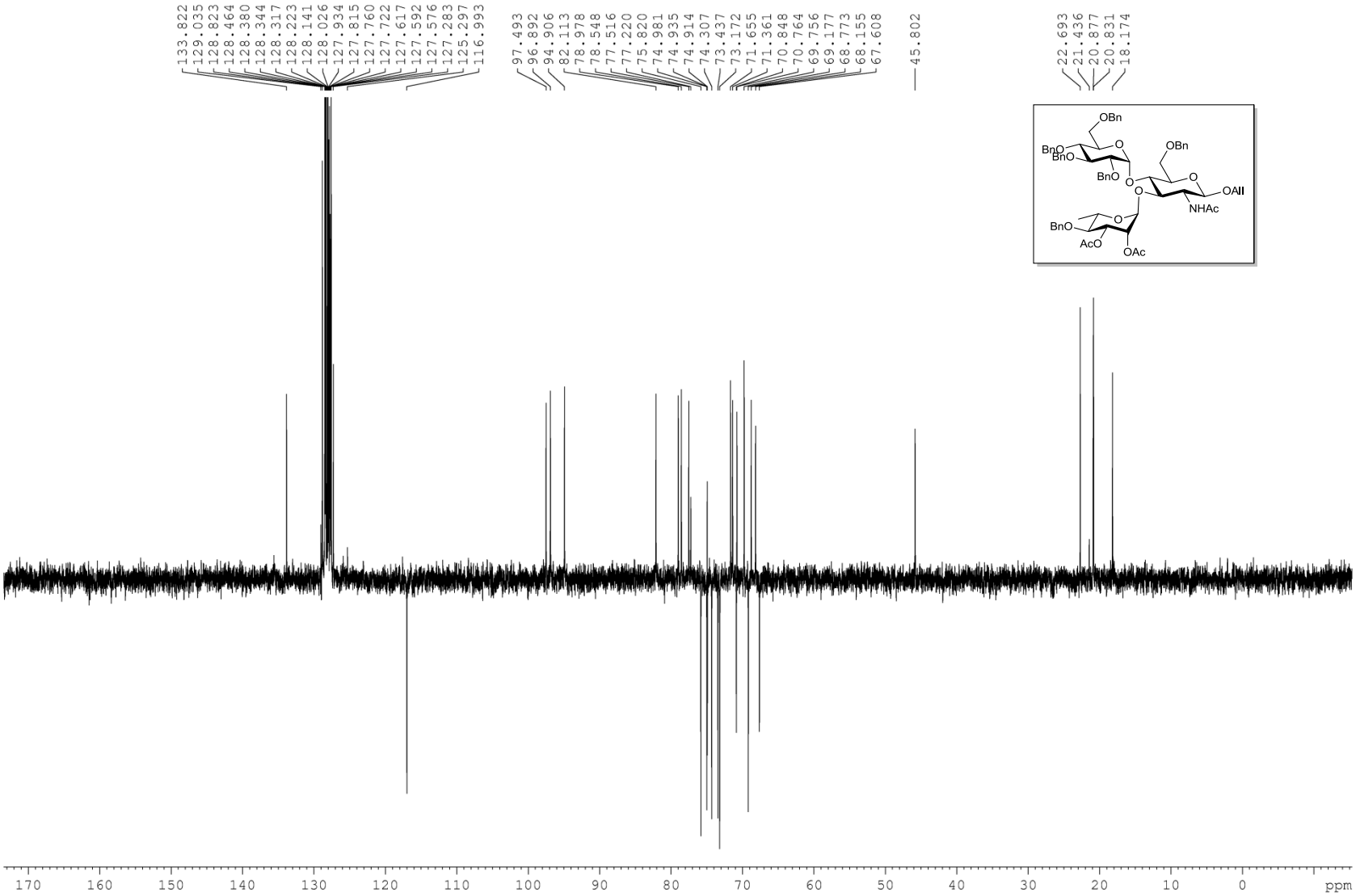

OBn
BnO
BnO
BnO
O
O
OBn
O
O
OAll
NHAc
BnO
O
AcO
OAc
1.02
2.02
1.01
1.00
2.00
8.22
3.18
3.02
6.14
4.11
1.05
1.05
1.05
0.95
5.4
5.3
5.2
5.1
5.0
4.9
4.8
4.7
4.6
4.5
4.4
4.3
4.2
4.1
4.0
3.9
3.8
3.7
3.6
3.5
3.4
ppm

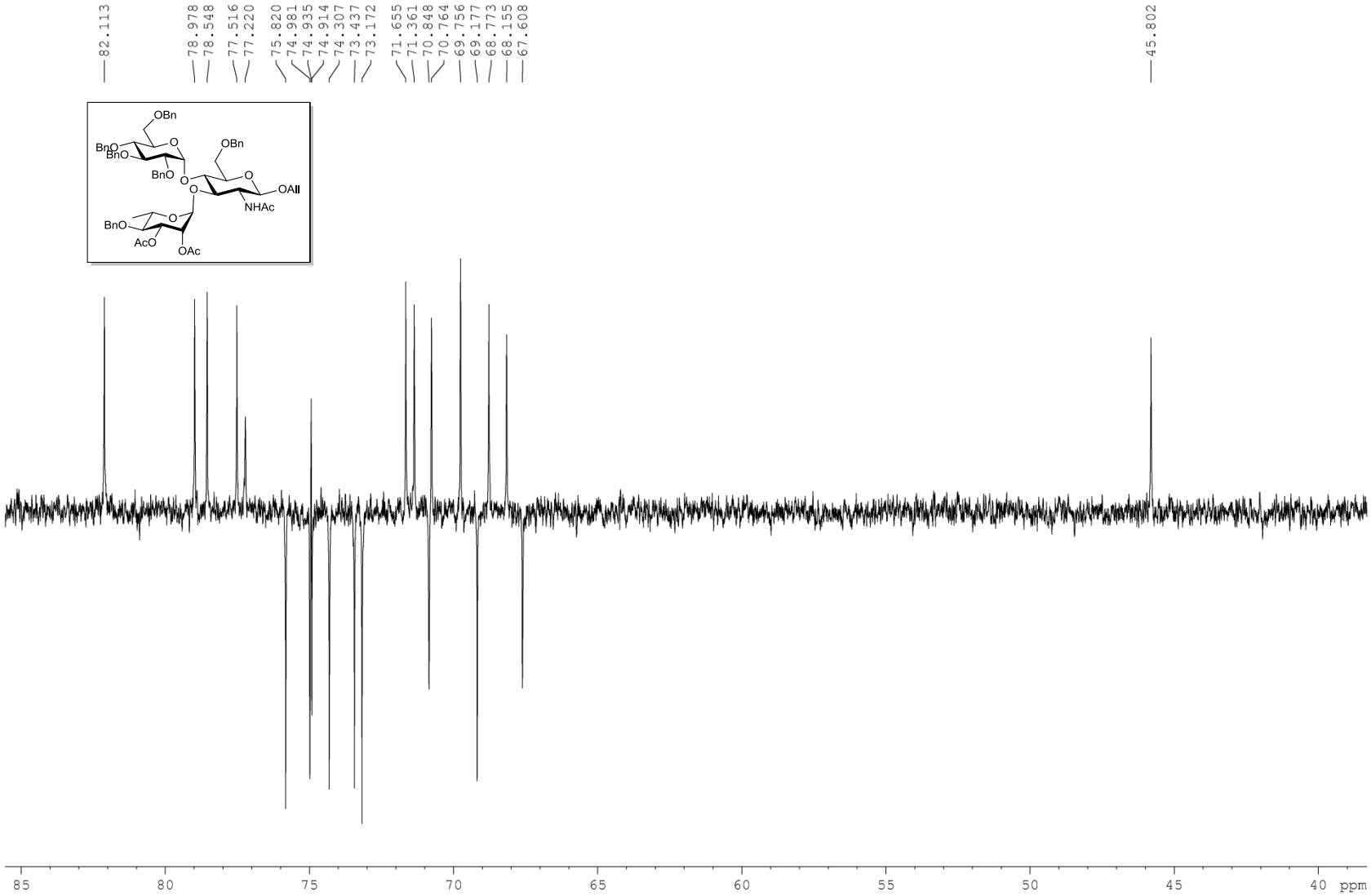

OBn
BnO
BnO
BnO
O
OBn
O
O
O
OAll
NHAc
BnO
O
AcO
OAc
ppm
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
5.5
6.0
6.5
7.0
7.5
8.0
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
ppm

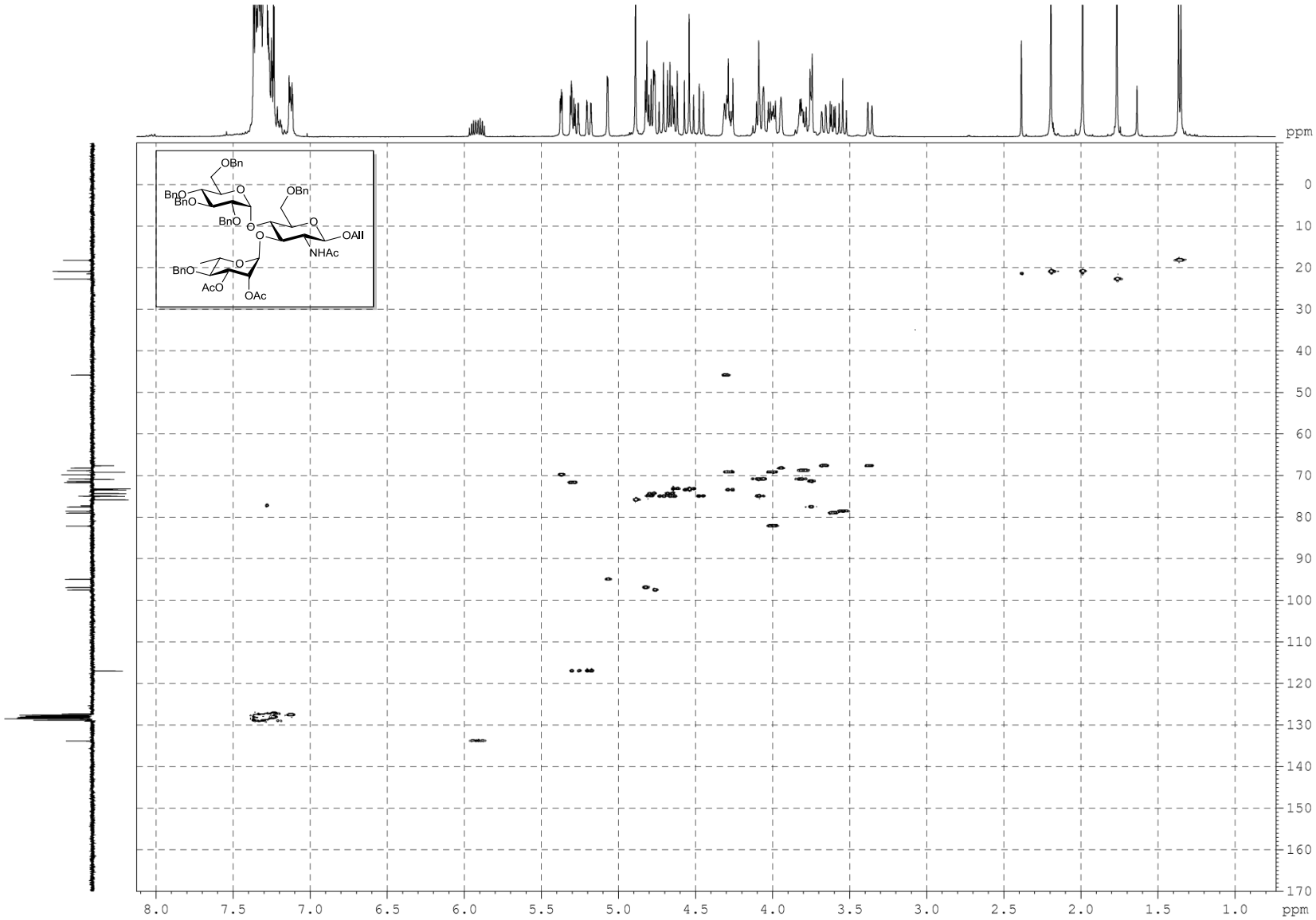

OBn
BnO
BnO
BnO
OBn
O
O
O
O
OAll
NHAc
BnO
AcO
OAc
ppm
3.2
3.4
3.6
3.8
4.0
4.2
4.4
4.6
4.8
5.0
5.2
5.4
5.6
5.8
6.0
6.0 5.9 5.8 5.7 5.6 5.5 5.4 5.3 5.2 5.1 5.0 4.9 4.8 4.7 4.6 4.5 4.4 4.3 4.2 4.1 4.0 3.9 3.8 3.7 3.6 3.5 3.4 3.3 ppm

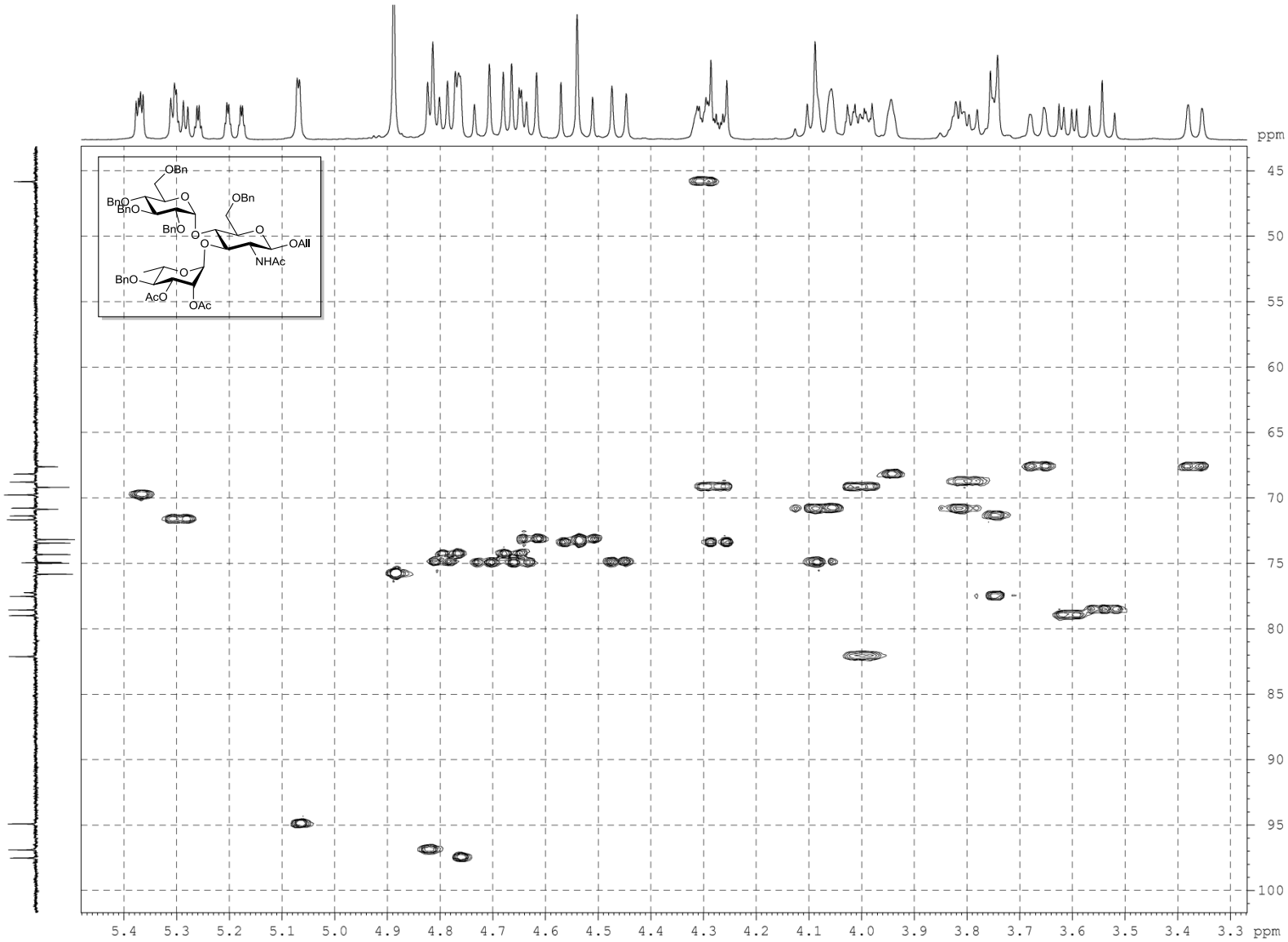

169.762
169.582
169.535
138.680
138.469
138.210
138.060
137.799
137.293
133.821
129.032
128.820
128.463
128.379
128.341
128.317
128.222
128.142
128.024
127.933
127.816
127.757
127.718
127.580
127.283
125.299
116.992
97.494
96.893
94.909
82.114
78.982
78.549
77.518
77.333
77.219
77.016
76.698
75.819
74.979
74.932
74.307
73.439
73.171
71.655
71.363
70.850
70.768
69.758
69.177
68.772
68.161
67.609
45.807
22.692
20.876
20.829
18.172
OBn
BnO
BnO
BnO
OBn
O
O
O
O
O
OAll
NHAc
BnO
AcO
OAc
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
ppm


97.494
96.893
94.909
82.114
78.982
78.549
77.518
77.333
77.219
77.016
76.698
75.819
74.979
74.932
74.307
73.439
73.171
71.655
71.363
70.850
70.768
69.758
69.177
68.772
68.161
67.609
45.807
OBn
BnO
BnO
BnO
O
OBn
O
O
O
OAll
NHAc
BnO
O
AcO
OAc
95
90
85
80
75
70
65
60
55
50
45
ppm

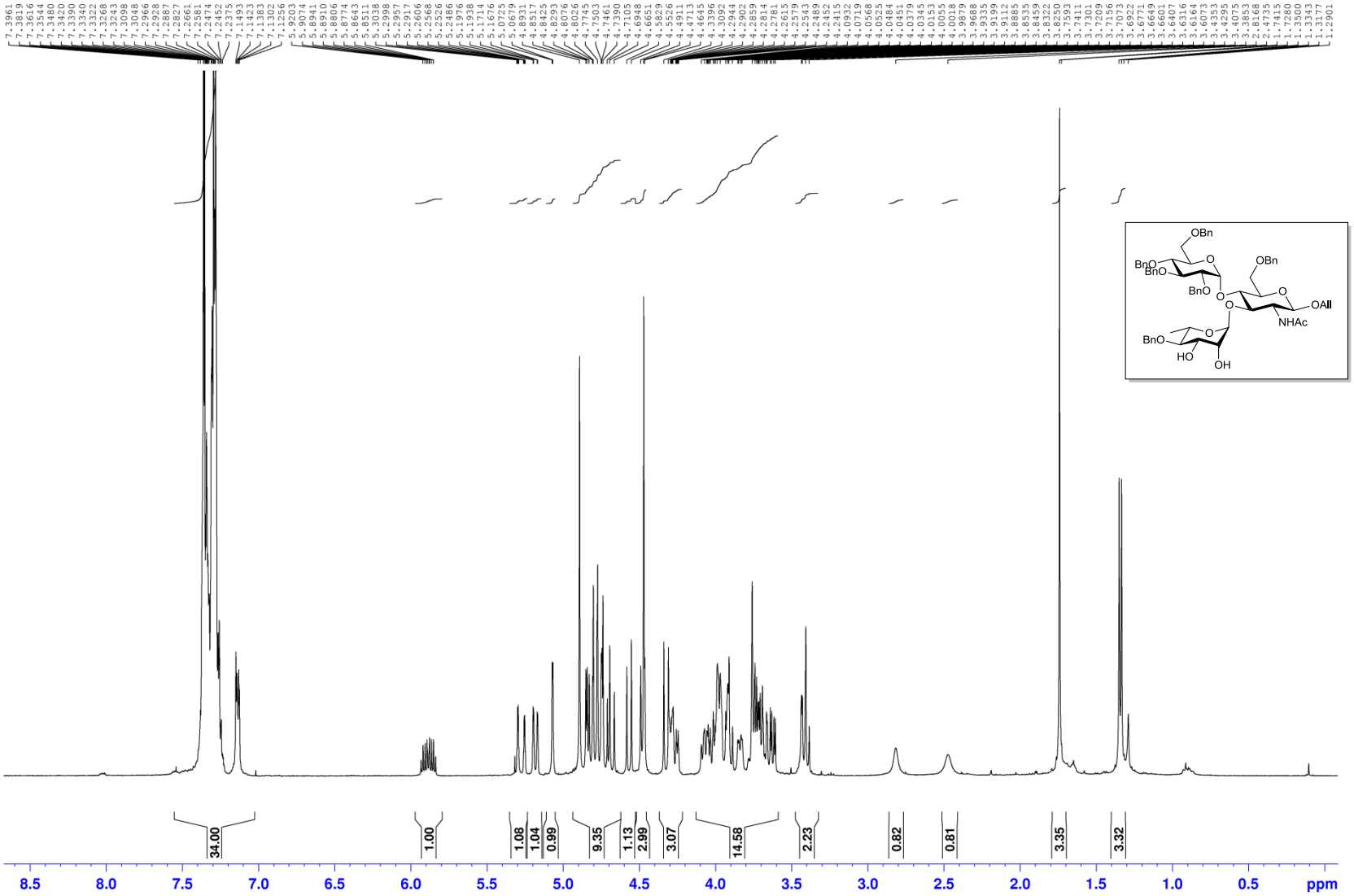

133.822
129.035
128.823
128.464
128.380
128.344
128.317
128.223
128.141
128.026
127.934
127.815
127.760
127.722
127.617
127.592
127.576
127.283
125.297
116.993
97.493
96.892
94.906
82.113
78.978
78.548
77.516
77.220
75.820
74.981
74.935
74.914
74.307
73.437
73.172
71.655
71.361
70.848
70.764
69.756
69.177
68.773
68.155
67.608
45.802
22.693
21.436
20.877
20.831
18.174
OBn
BnO
BnO
BnO
O
OBn
O
OAll
NHAc
BnO
AcO
OAc
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
ppm

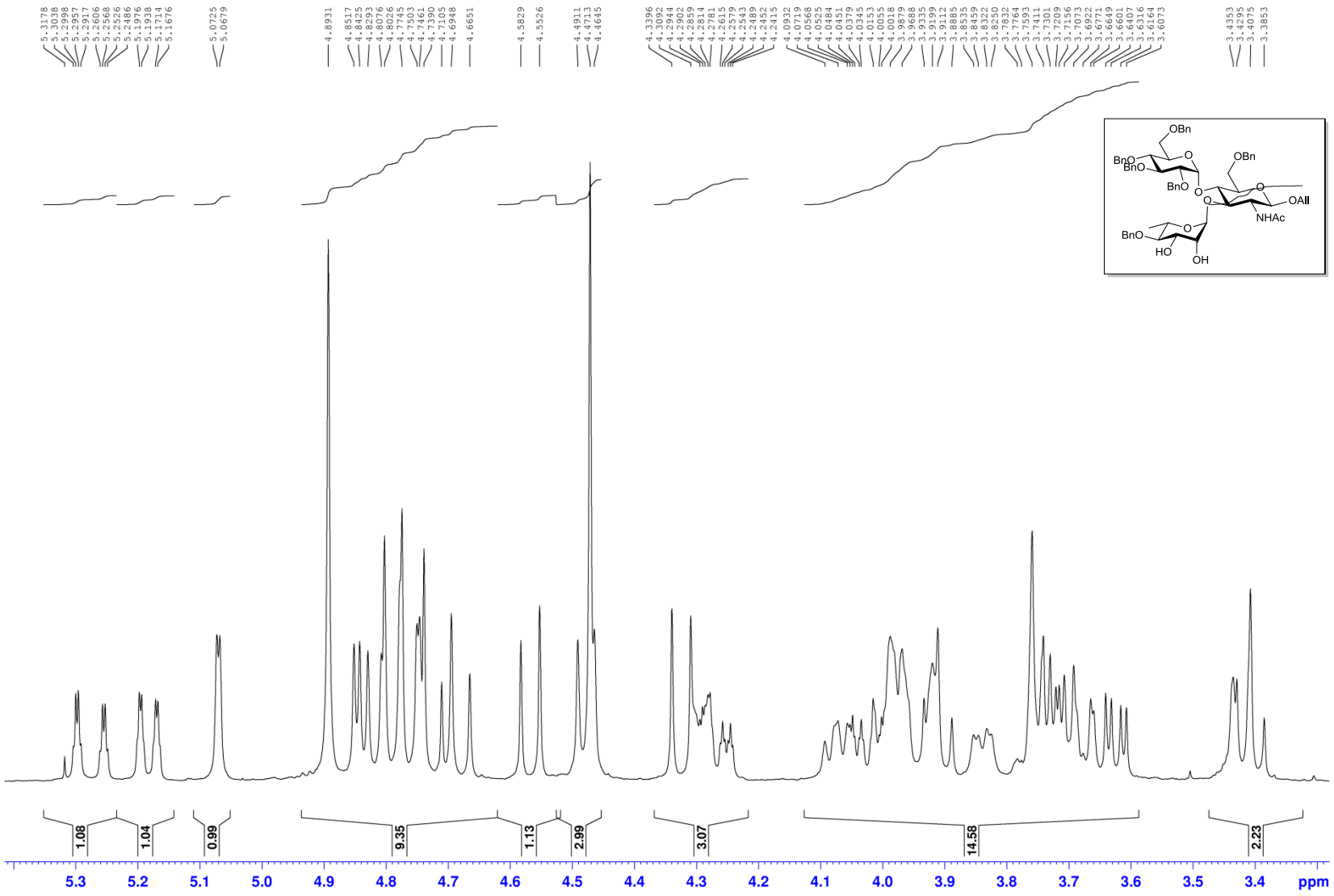

82.113
78.978
78.548
77.516
77.220
75.820
74.981
74.935
74.914
74.307
73.437
73.172
71.655
71.361
70.848
70.764
69.756
69.177
68.773
68.155
67.608
45.802
OBn
BnO
BnO
O
OBn
BnO
O
O
O
OAll
NHAc
BnO
O
AcO
OAc
85
80
75
70
65
60
55
50
45
40
ppm

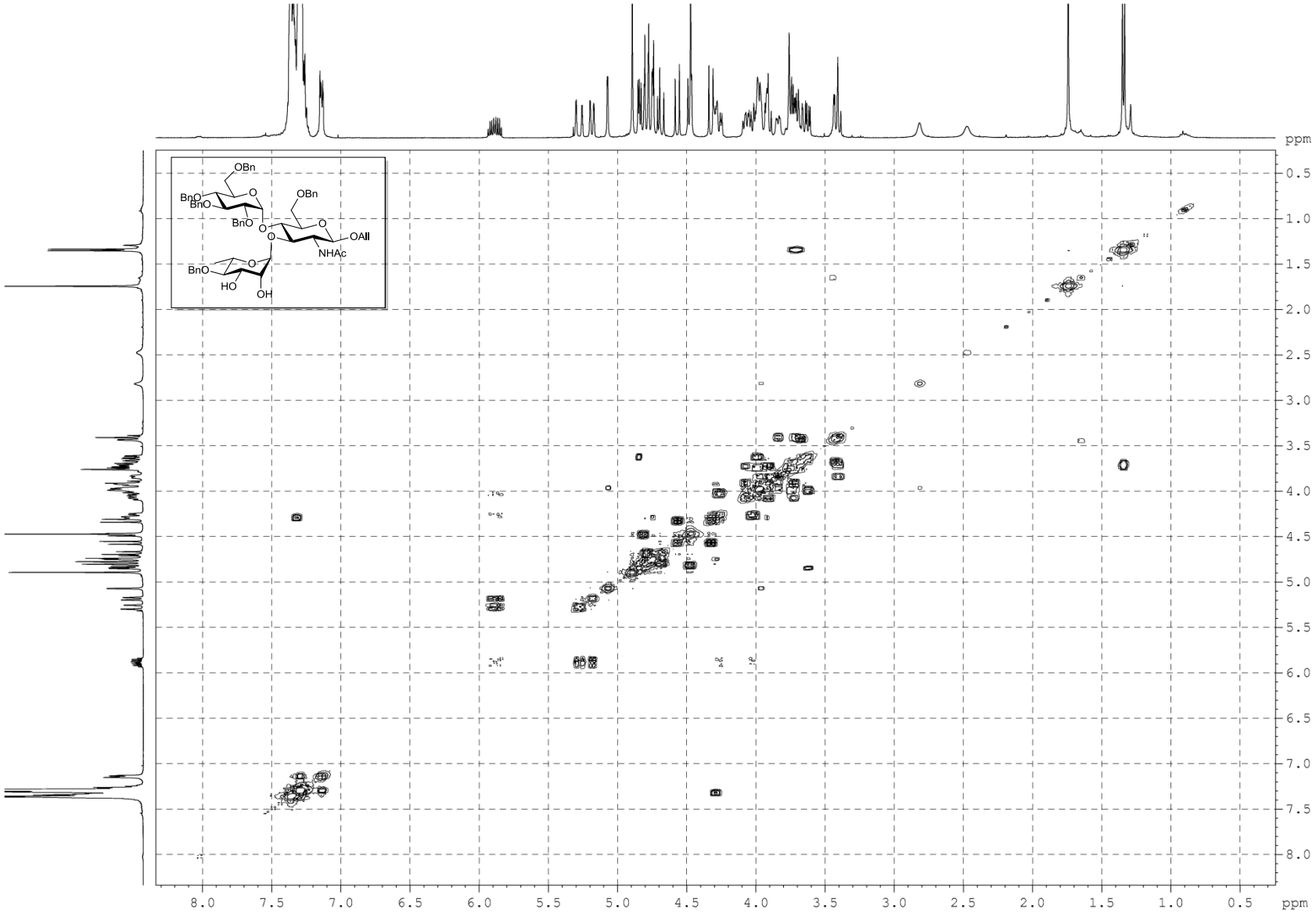

OBn
BnO
BnO
O
OBn
BnO
O
O
O
OAll
NHAc
BnO
O
AcO
OAc
ppm
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
ppm

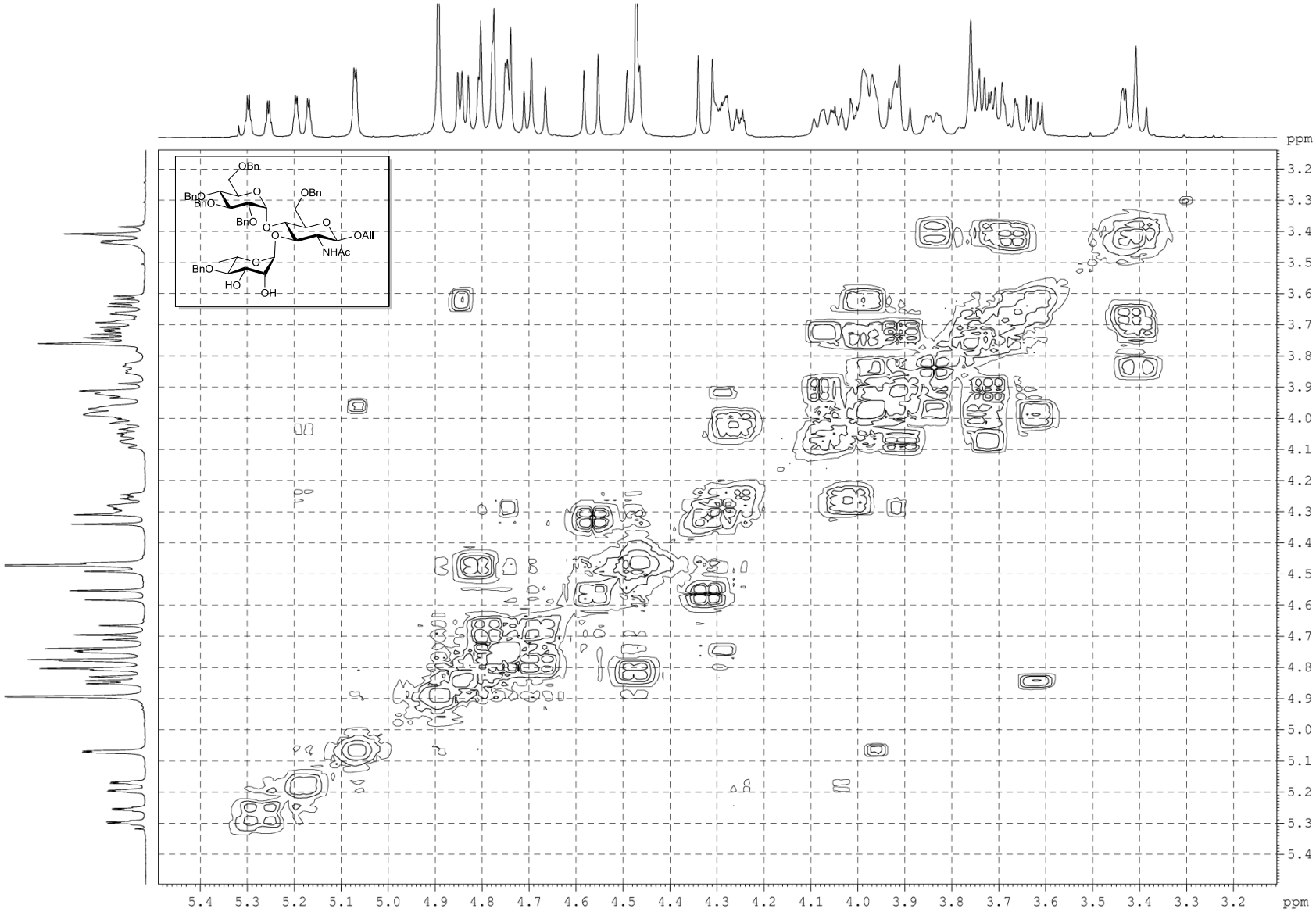

OBn
BnO
BnO
O
OBn
BnO
O
O
O
OAll
NHAc
BnO
O
AcO
OAc
ppm
45
50
55
60
65
70
75
80
85
90
95
100
5.4 5.3 5.2 5.1 5.0 4.9 4.8 4.7 4.6 4.5 4.4 4.3 4.2 4.1 4.0 3.9 3.8 3.7 3.6 3.5 3.4 3.3 ppm

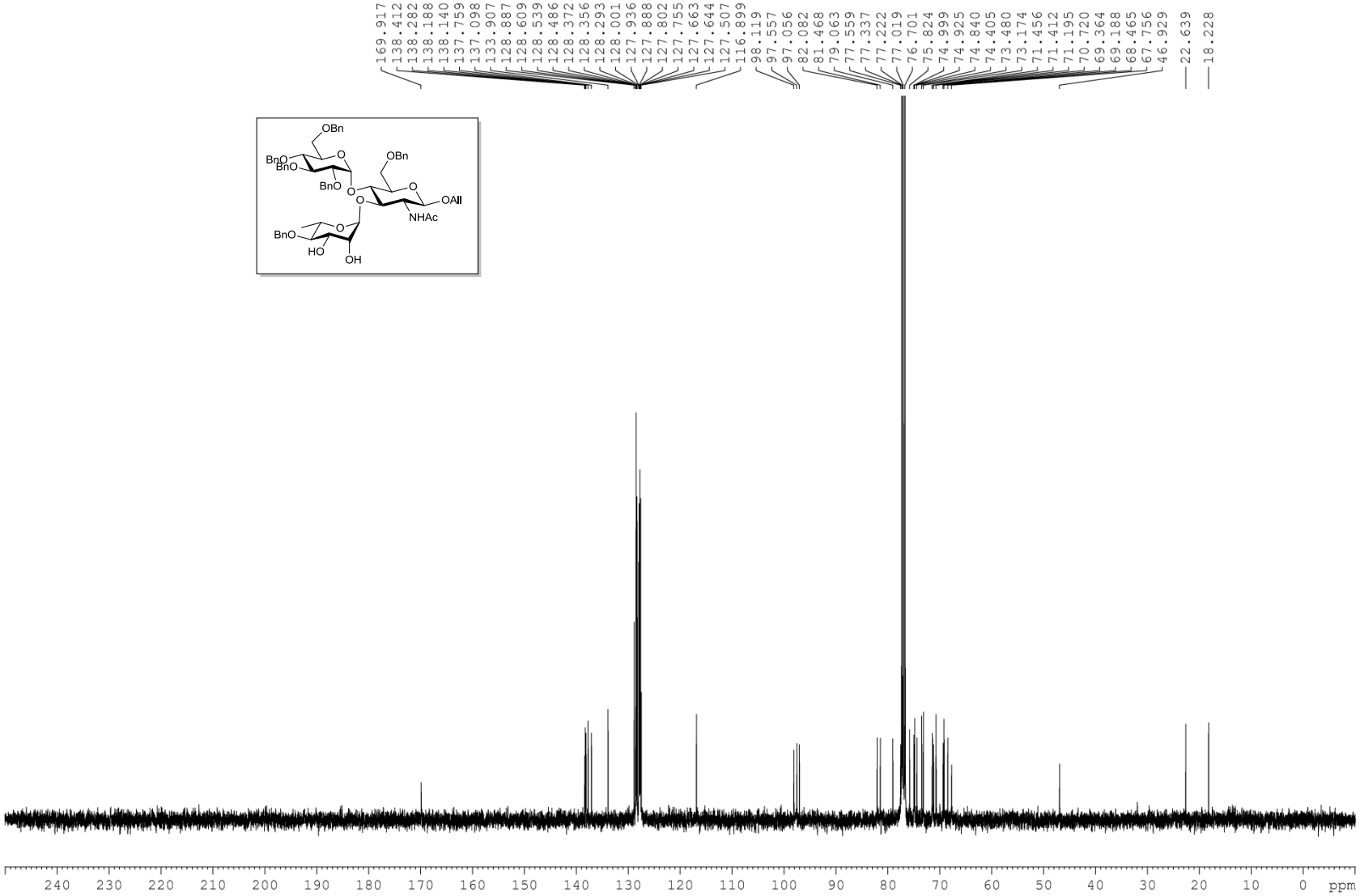
Compound 42: **Allyl (4-*O*-benzyl-α-L-rhamnopyranosyl)-(1→3)-[2,3,4,6-tetra-*O*-benzyl-α-D-glucopyranosyl-(1→4)]-2-acetamido-6-*O*-benzyl-2-deoxy-β-D-glucopyranoside**

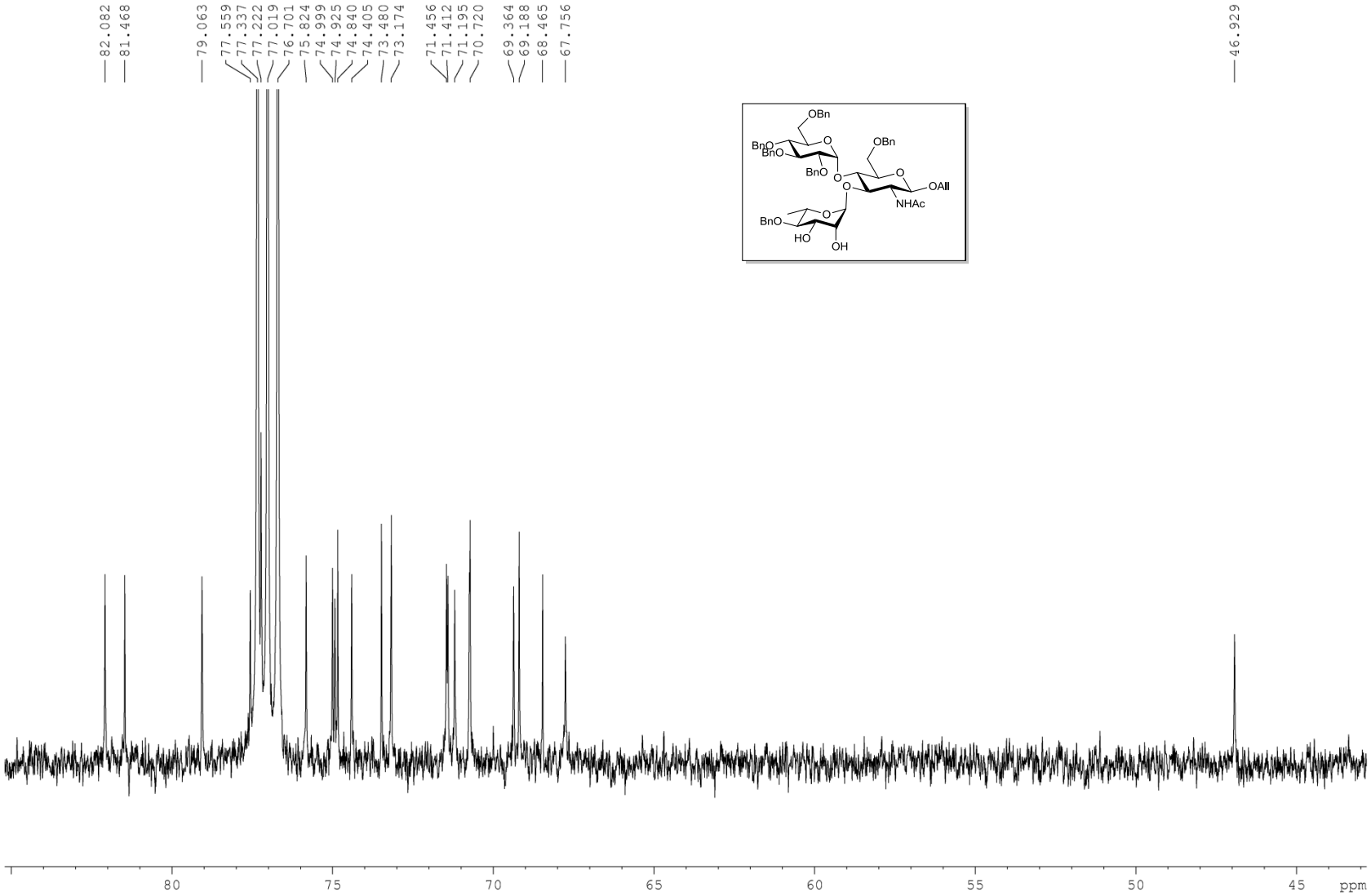


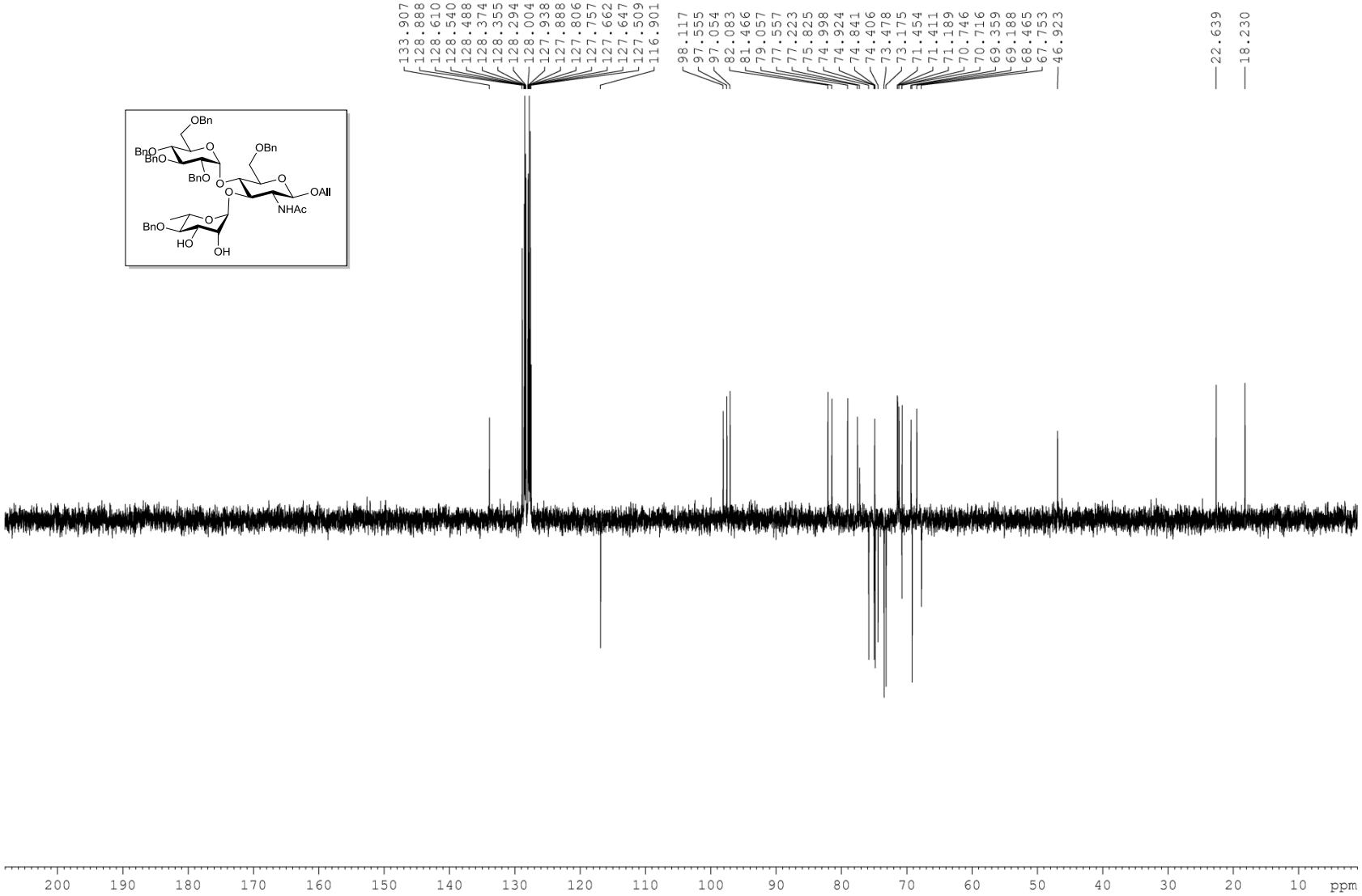

OBn
BnO
BnO
BnO
O
OBn
O
O
O
OAll
NHAc
BnO
O
HO
OH
1.08
1.04
0.99
9.35
1.13
2.99
3.07
14.58
2.23
5.3
5.2
5.1
5.0
4.9
4.8
4.7
4.6
4.5
4.4
4.3
4.2
4.1
4.0
3.9
3.8
3.7
3.6
3.5
3.4
ppm

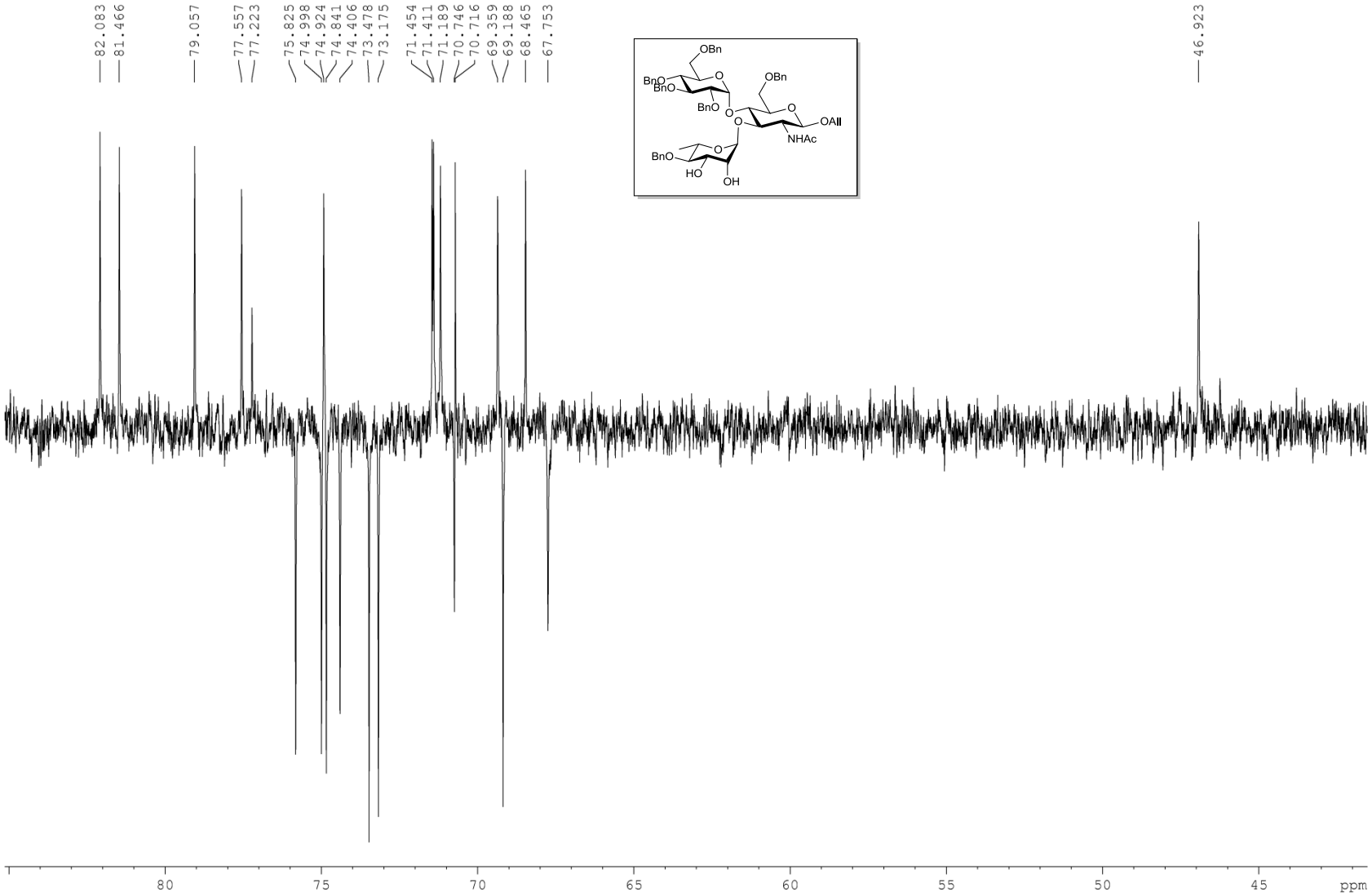

OBn
BnO
BnO
BnO
O
OBn
O
O
O
OAll
NHAc
BnO
O
HO
OH
ppm
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
5.5
6.0
6.5
7.0
7.5
8.0
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
ppm

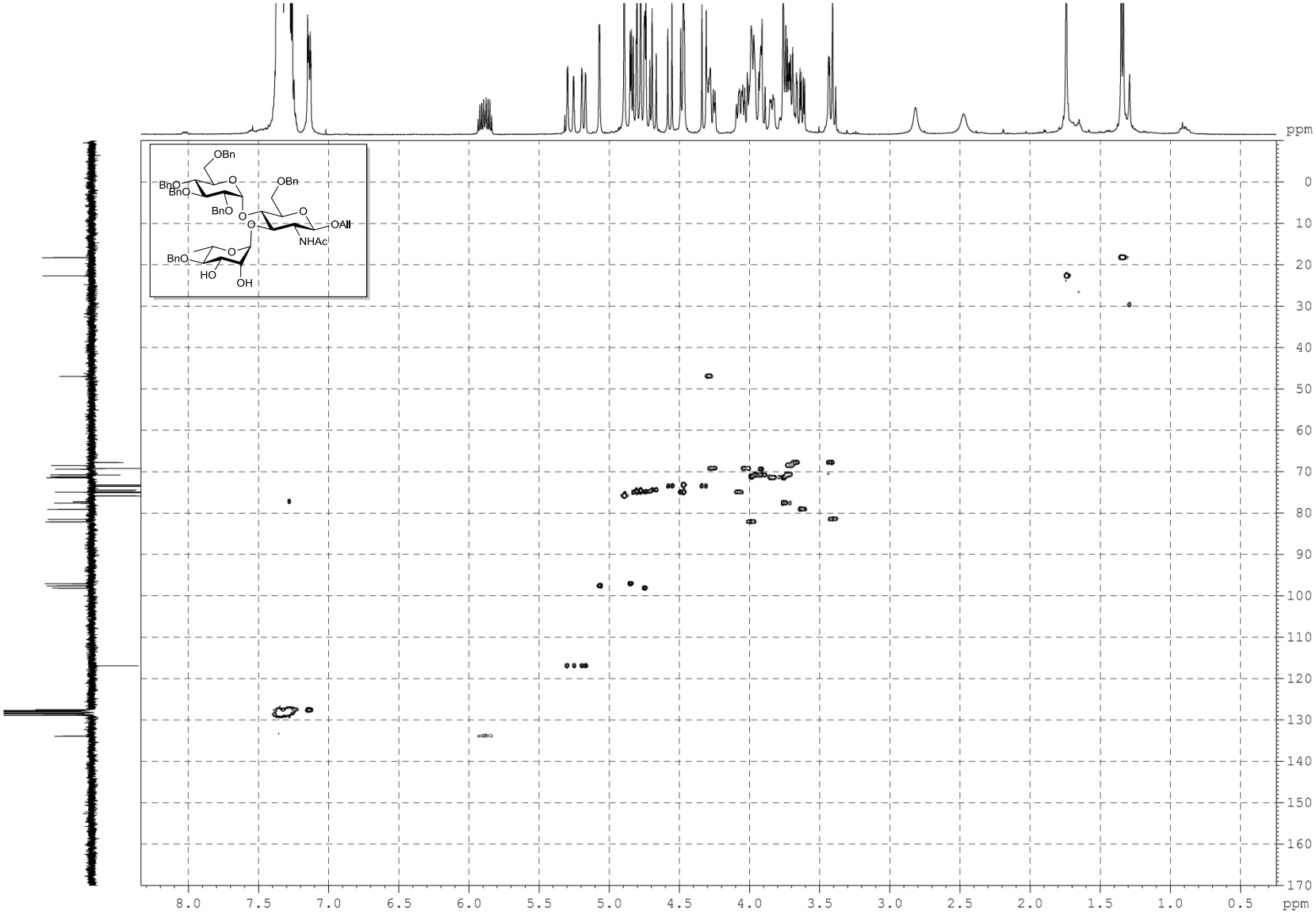

OBn
BnO
BnO
O
OBn
BnO
O
O
O
OAll
NHAc
BnO
O
HO
OH
ppm
5.4 5.3 5.2 5.1 5.0 4.9 4.8 4.7 4.6 4.5 4.4 4.3 4.2 4.1 4.0 3.9 3.8 3.7 3.6 3.5 3.4 3.3 3.2
ppm
3.2 3.3 3.4 3.5 3.6 3.7 3.8 3.9 4.0 4.1 4.2 4.3 4.4 4.5 4.6 4.7 4.8 4.9 5.0 5.1 5.2 5.3 5.4

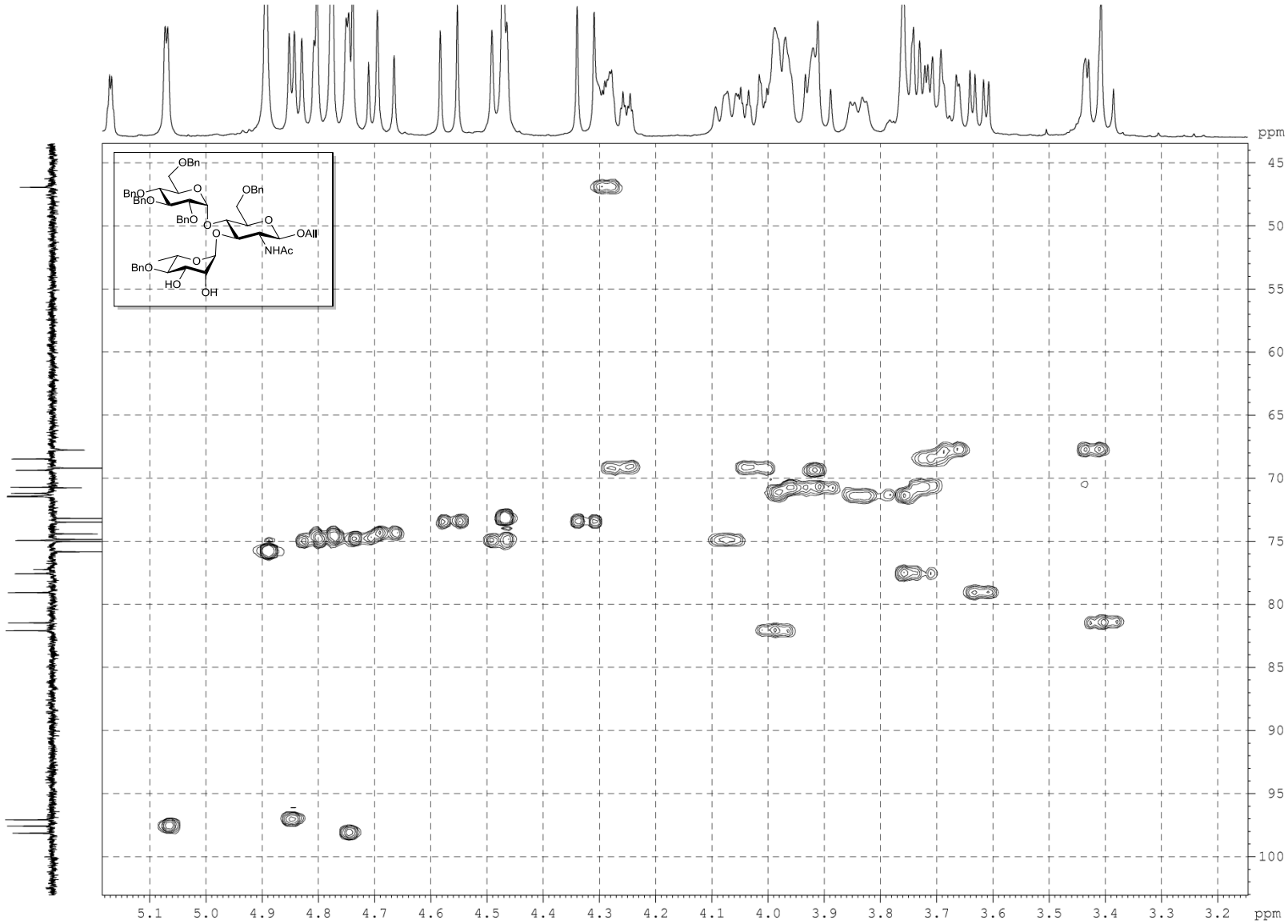

169.917
138.412
138.282
138.188
138.140
137.759
137.098
133.907
128.887
128.609
128.539
128.486
128.372
128.356
128.293
128.001
127.936
127.888
127.802
127.755
127.663
127.644
127.507
116.899
98.119
97.557
97.056
82.082
81.468
79.063
77.559
77.337
77.222
77.019
76.701
75.824
74.999
74.925
74.840
74.405
73.480
73.174
71.456
71.412
71.195
70.720
69.364
69.188
68.465
67.756
46.929
22.639
18.228
OBn
BnO
BnO
BnO
O
OBn
O
O
O
OAll
NHAc
BnO
O
HO
OH
240 230 220 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 ppm


82.082
81.468
79.063
77.559
77.337
77.222
77.019
76.701
75.824
74.999
74.925
74.840
74.405
73.480
73.174
71.456
71.412
71.195
70.720
69.364
69.188
68.465
67.756
46.929
OBn
BnO
BnO
O
BnO
OBn
O
O
O
OAll
NHAc
BnO
O
HO
OH
80
75
70
65
60
55
50
45
ppm

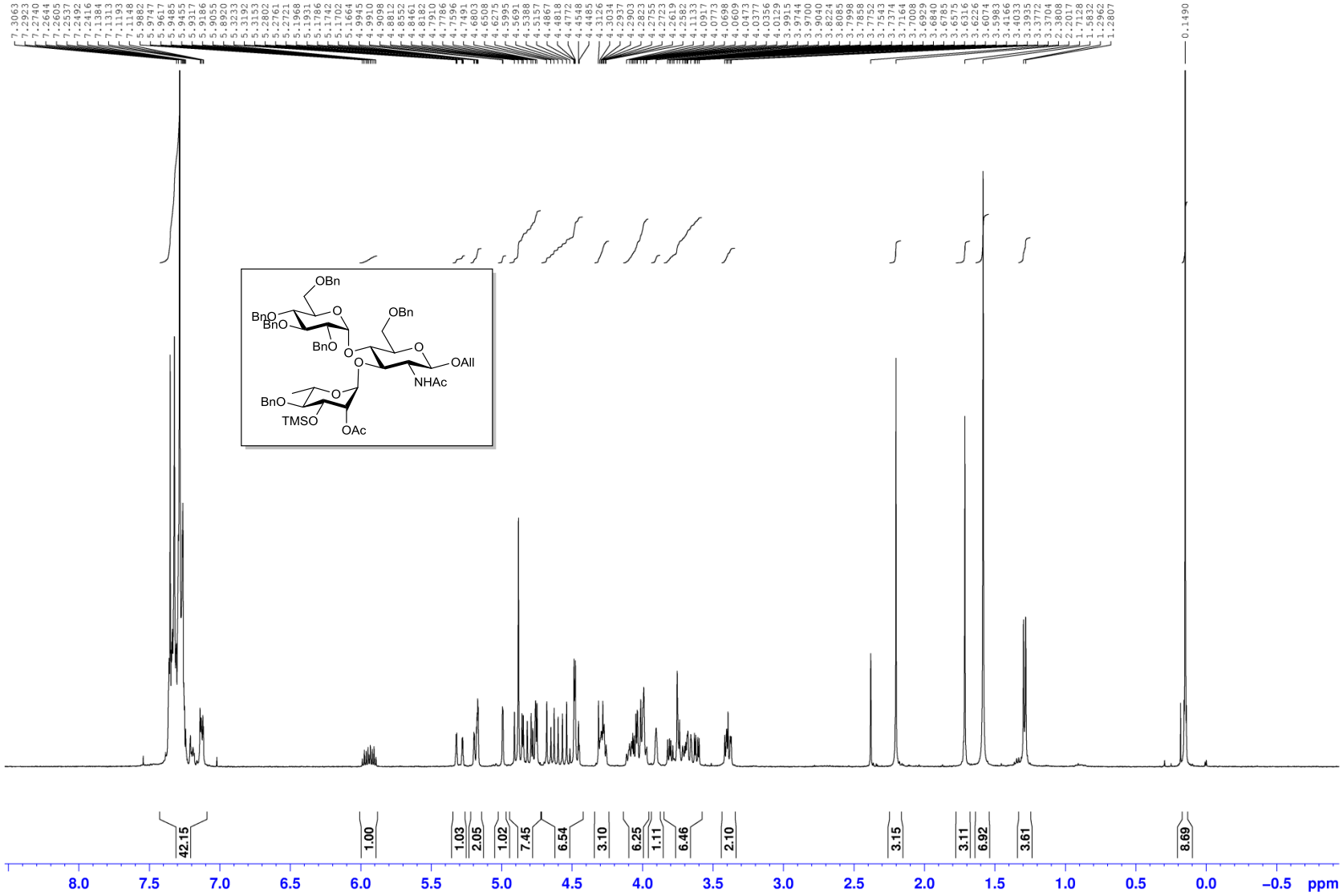

133.907
128.888
128.610
128.540
128.488
128.374
128.355
128.294
128.004
127.938
127.888
127.806
127.757
127.662
127.647
127.509
116.901
98.117
97.555
97.054
82.083
81.466
79.057
77.557
77.223
75.825
74.998
74.924
74.841
74.406
73.478
73.175
71.454
71.411
71.189
70.746
70.716
69.359
69.188
68.465
67.753
46.923
22.639
18.230
OBn
BnO
BnO
O
OBn
BnO
O
O
O
OAll
NHAc
BnO
O
HO
OH
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
ppm

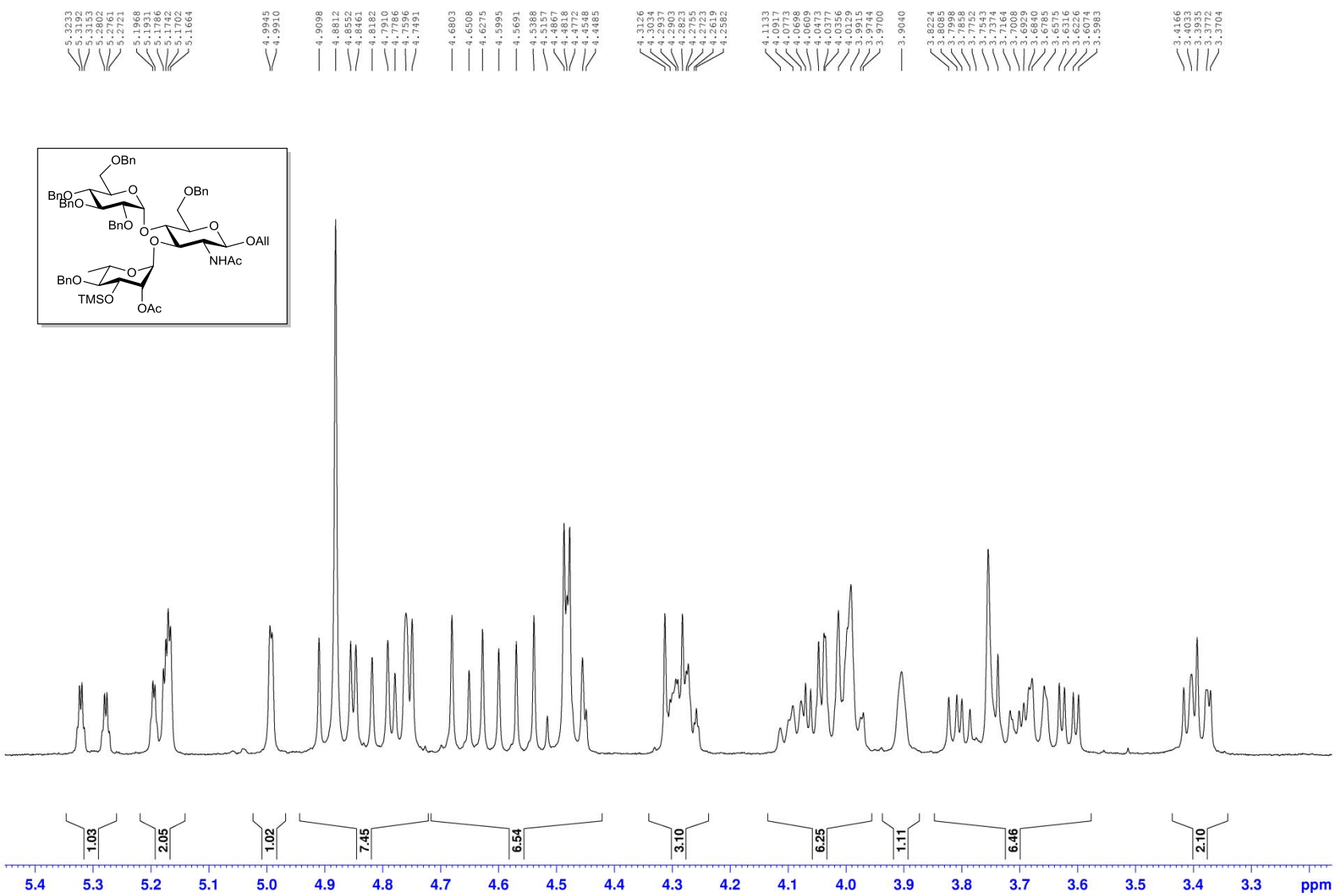

82.083
81.466
79.057
77.557
77.223
75.825
74.998
74.924
74.841
74.406
73.478
73.175
71.454
71.411
71.189
70.746
70.716
69.359
69.188
68.465
67.753
46.923
OBn
BnO
BnO
BnO
O
OBn
O
O
O
OAll
NHAc
BnO
O
HO
OH
80
75
70
65
60
55
50
45
ppm

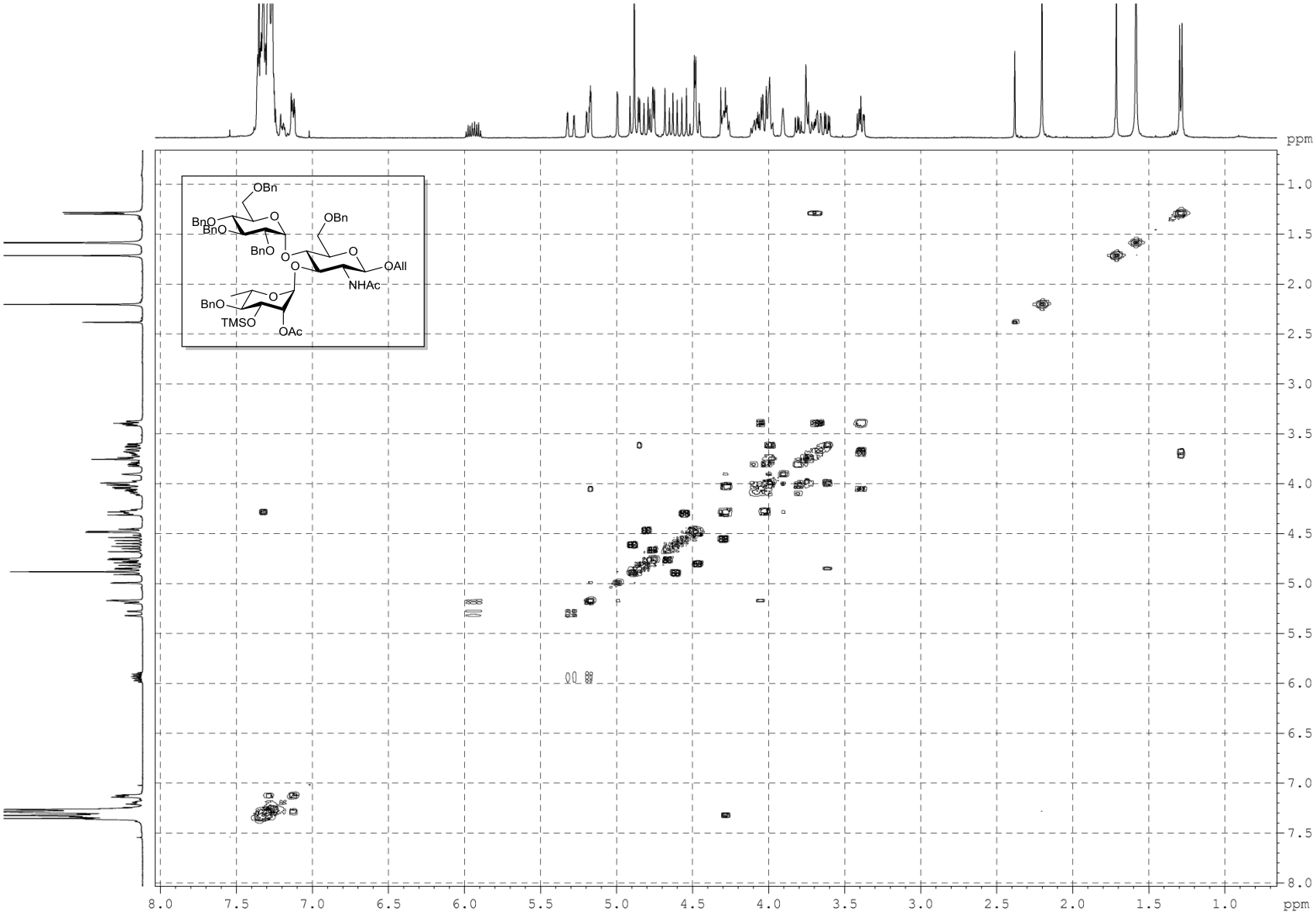

OBn
BnO
BnO
BnO
OBn
O
O
O
O
OAll
NHAc
BnO
HO
OH
ppm
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
ppm

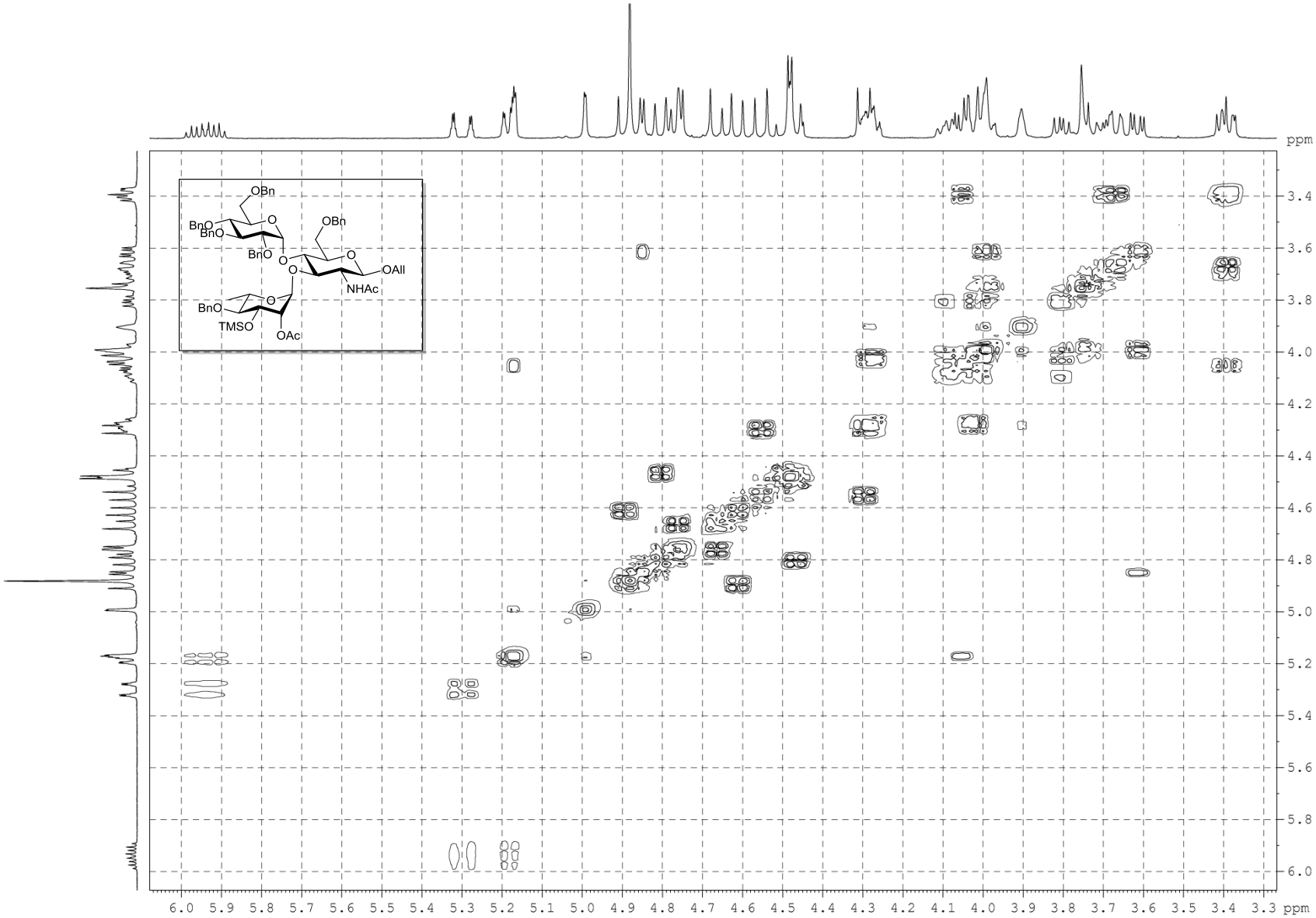

OBn
BnO
BnO
O
OBn
BnO
O
O
O
OAll
NHAc
O
BnO
HO
OH
ppm
45
50
55
60
65
70
75
80
85
90
95
100
5.1
5.0
4.9
4.8
4.7
4.6
4.5
4.4
4.3
4.2
4.1
4.0
3.9
3.8
3.7
3.6
3.5
3.4
3.3
3.2
ppm

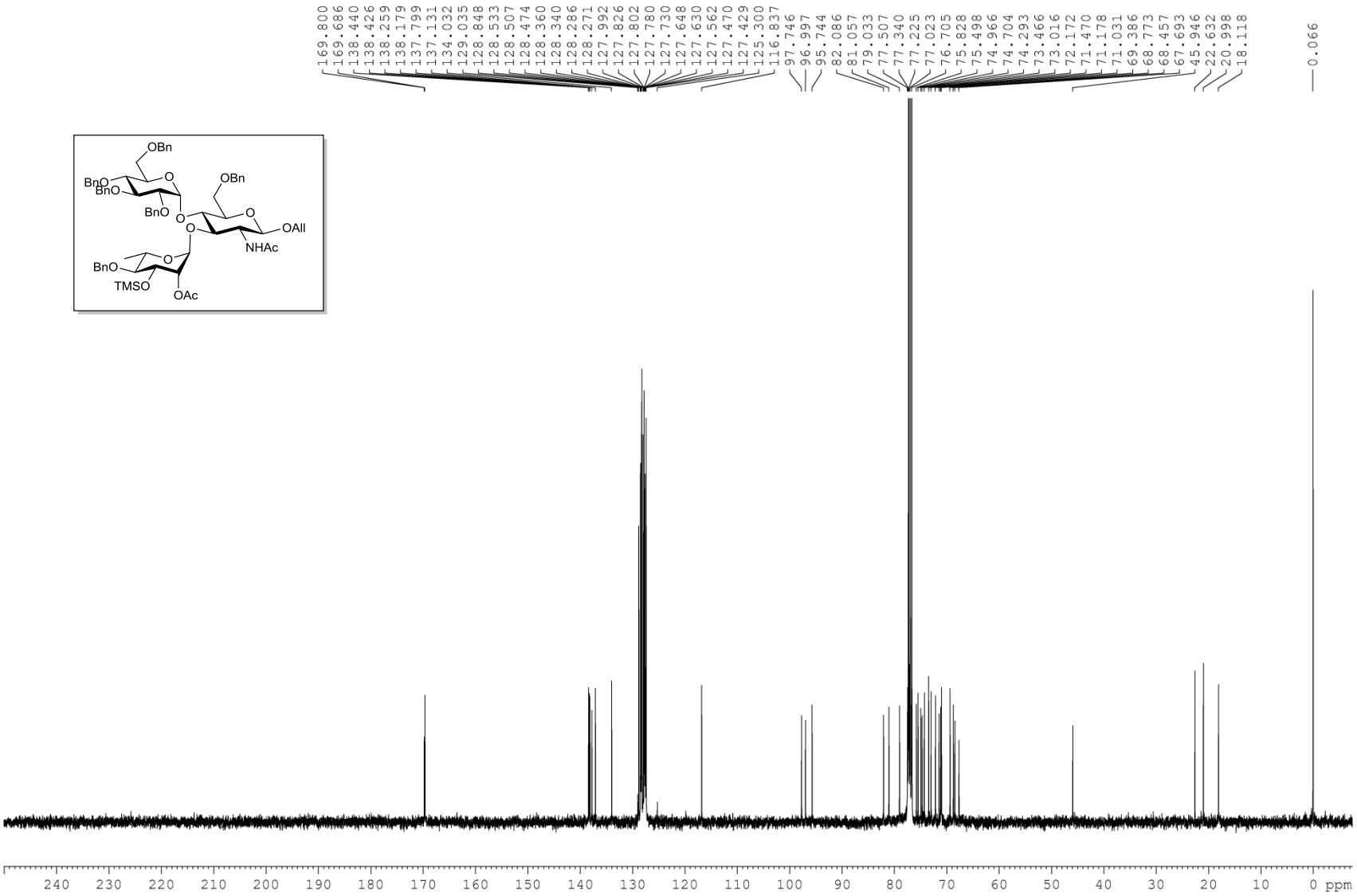
Compound 43: **Allyl (2-*O*-acetyl-4-*O*-benzyl-3-*O*-trimethylsilyl-α-L-rhamnopyranosyl)-(1→3)-[2,3,4,6-tetra-*O*-benzyl-α-D-glucopyranosyl-(1→4)]-2-acetamido-6-*O*-benzyl-2-deoxy-β-D-glucopyranoside**

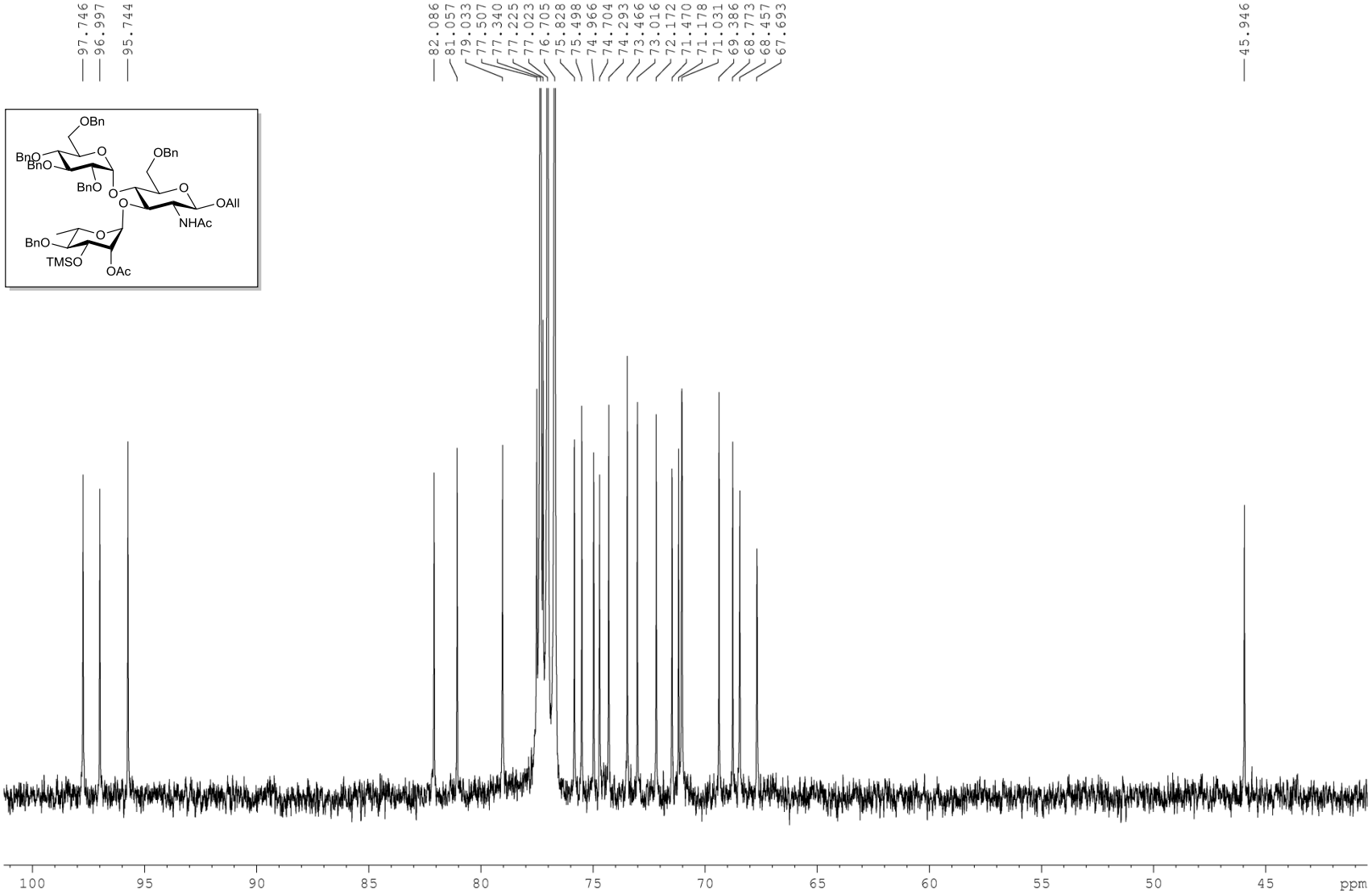


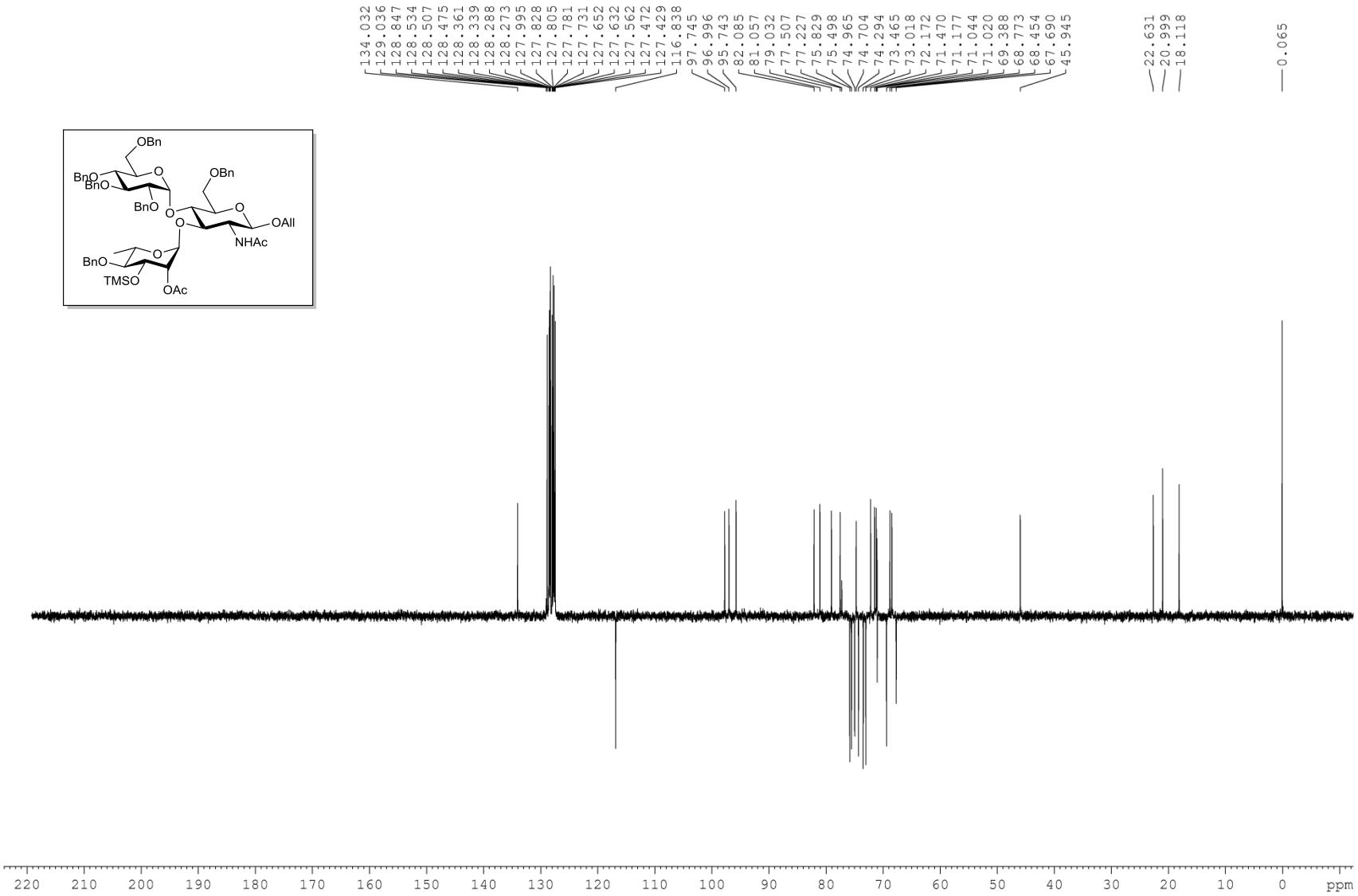

OBn
BnO
BnO
BnO
O
OBn
O
O
O
OAll
NHAc
BnO
O
TMSO
OAc
5.3233
5.3192
5.3153
5.2802
5.2761
5.2721
5.1968
5.1931
5.1786
5.1742
5.1702
5.1664
4.9945
4.9910
4.9098
4.8812
4.8552
4.8461
4.8182
4.7910
4.7786
4.7596
4.7491
4.6803
4.6508
4.6275
4.5995
4.5691
4.5388
4.5157
4.4867
4.4818
4.4772
4.4548
4.4485
4.3126
4.3034
4.2937
4.2903
4.2823
4.2755
4.2723
4.2659
4.2582
4.1133
4.0917
4.0773
4.0698
4.0609
4.0473
4.0377
4.0356
4.0129
3.9915
3.9744
3.9700
3.9040
3.8224
3.8085
3.7998
3.7858
3.7752
3.7543
3.7374
3.7164
3.7068
3.6929
3.6840
3.6785
3.6575
3.6316
3.6226
3.6074
3.5983
3.4166
3.4033
3.3935
3.3772
3.3704
1.03
2.05
1.02
7.45
6.54
3.10
6.25
1.11
6.46
2.10
5.4
5.3
5.2
5.1
5.0
4.9
4.8
4.7
4.6
4.5
4.4
4.3
4.2
4.1
4.0
3.9
3.8
3.7
3.6
3.5
3.4
3.3
ppm

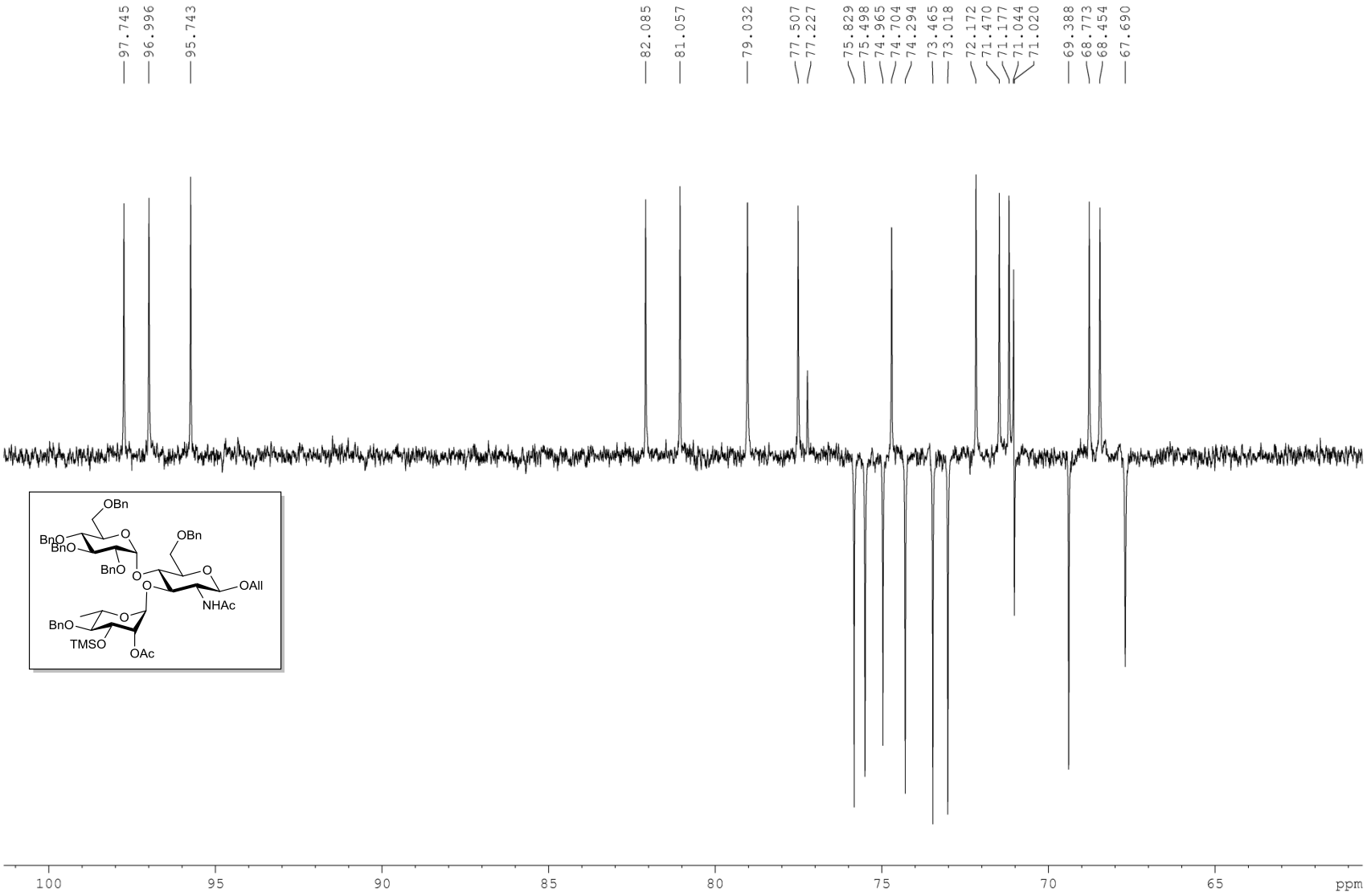

OBn
BnO
BnO
BnO
O
O
OBn
O
O
OAll
NHAc
BnO
O
TMSO
OAc
ppm
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
ppm

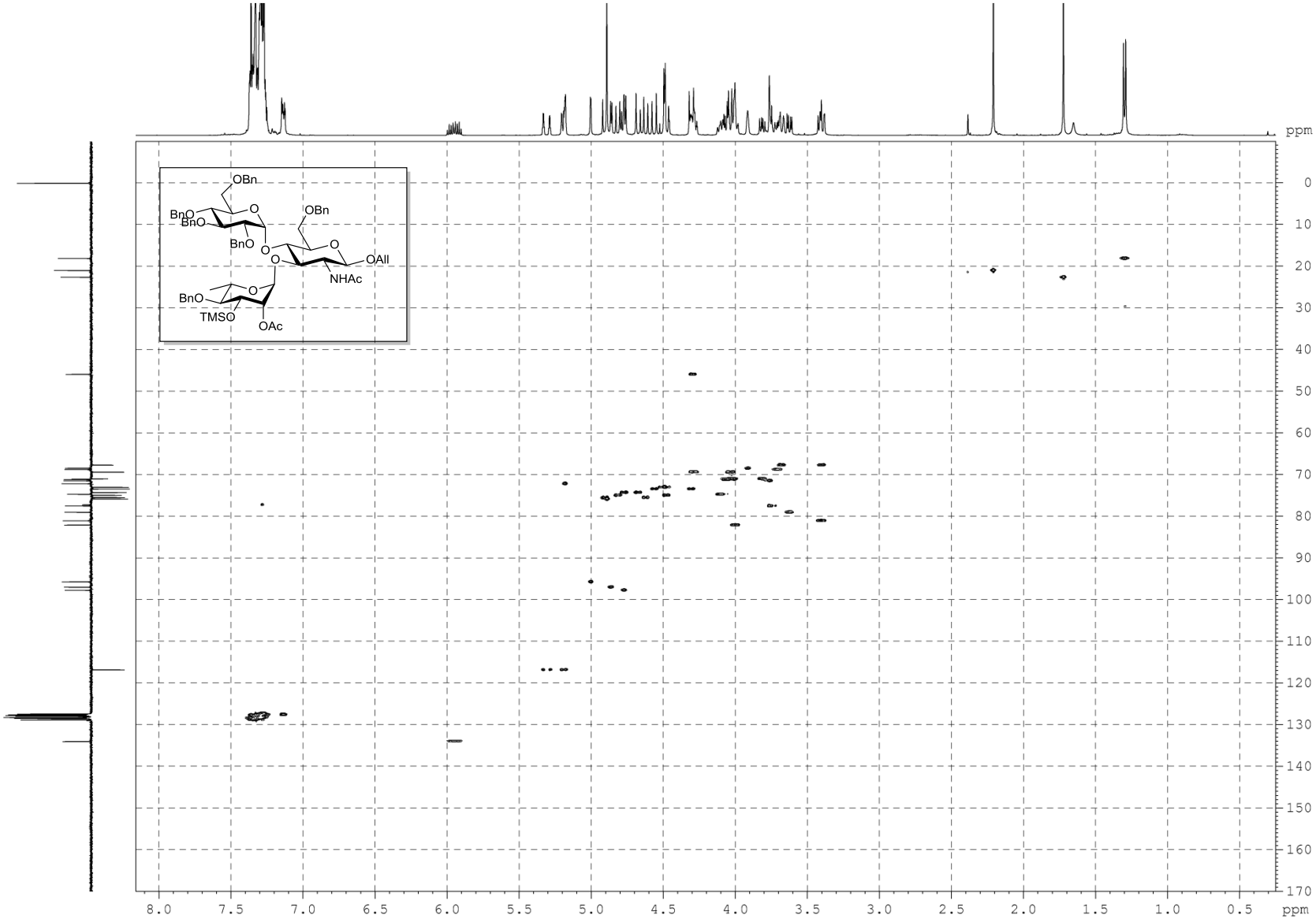

OBn
BnO
BnO
BnO
O
OBn
O
O
O
OAll
NHAc
BnO
O
TMSO
OAc
ppm
3.4
3.6
3.8
4.0
4.2
4.4
4.6
4.8
5.0
5.2
5.4
5.6
5.8
6.0
6.0 5.9 5.8 5.7 5.6 5.5 5.4 5.3 5.2 5.1 5.0 4.9 4.8 4.7 4.6 4.5 4.4 4.3 4.2 4.1 4.0 3.9 3.8 3.7 3.6 3.5 3.4 3.3 ppm

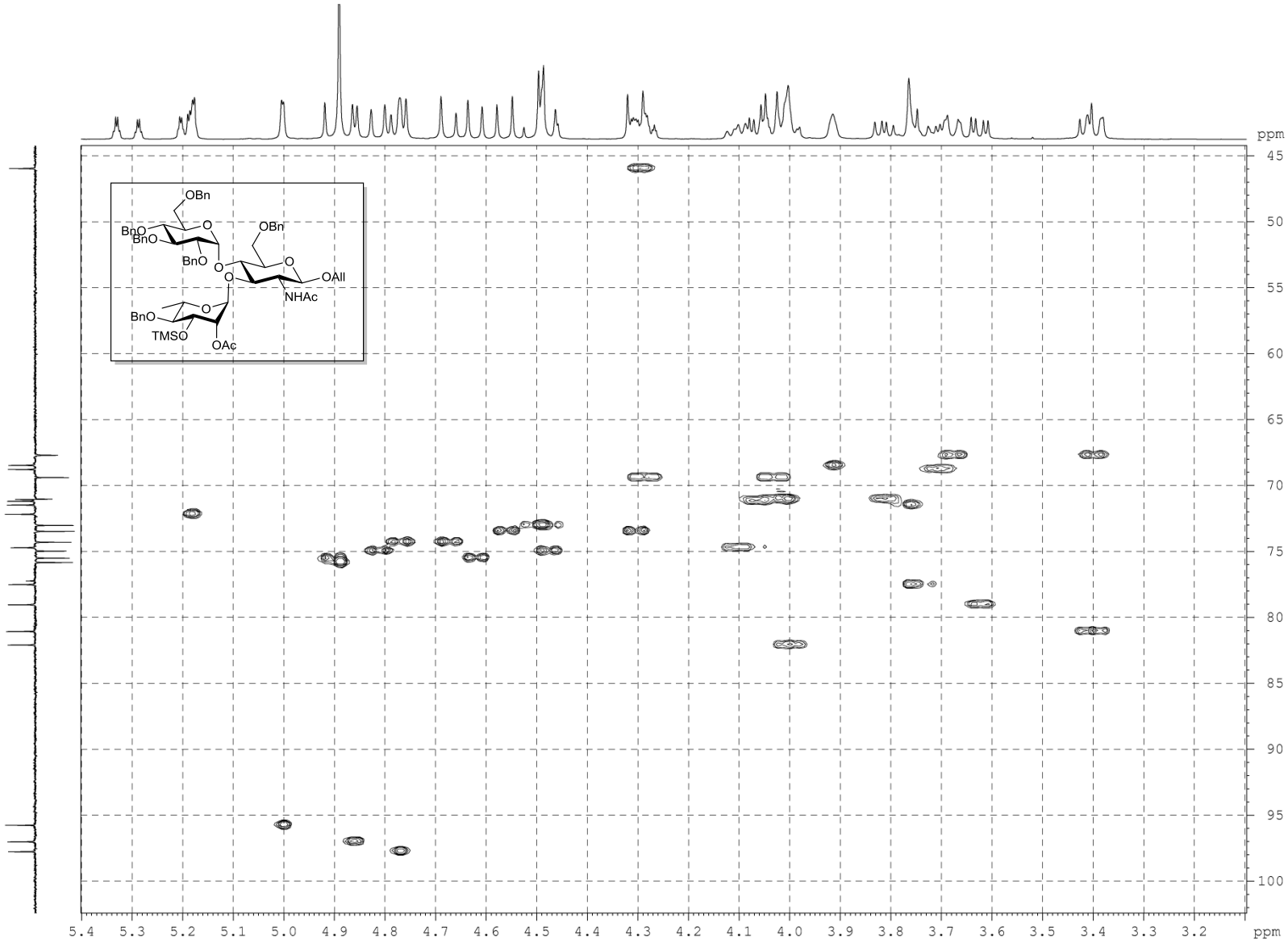

169.800
169.686
138.440
138.426
138.259
138.179
137.799
137.131
134.032
129.035
128.848
128.533
128.507
128.474
128.360
128.340
128.286
128.271
127.992
127.826
127.802
127.780
127.730
127.648
127.630
127.562
127.470
127.429
125.300
116.837
97.746
96.997
95.744
82.086
81.057
79.033
77.507
77.340
77.225
77.023
76.705
75.828
75.498
74.966
74.704
74.293
73.466
73.016
72.172
71.470
71.178
71.031
69.386
68.773
68.457
67.693
45.946
22.632
20.998
18.118
0.066
OBn
BnO
BnO
BnO
OBn
O
O
O
O
OAll
NHAc
BnO
TMSO
OAc
240 230 220 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 ppm


97.746
96.997
95.744
82.086
81.057
79.033
77.507
77.340
77.225
77.023
76.705
75.828
75.498
74.966
74.704
74.293
73.466
73.016
72.172
71.470
71.178
71.031
69.386
68.773
68.457
67.693
45.946
OBn
BnO
BnO
BnO
O
OBn
O
O
O
OAll
NHAc
BnO
O
TMSO
OAc
100
95
90
85
80
75
70
65
60
55
50
45
ppm

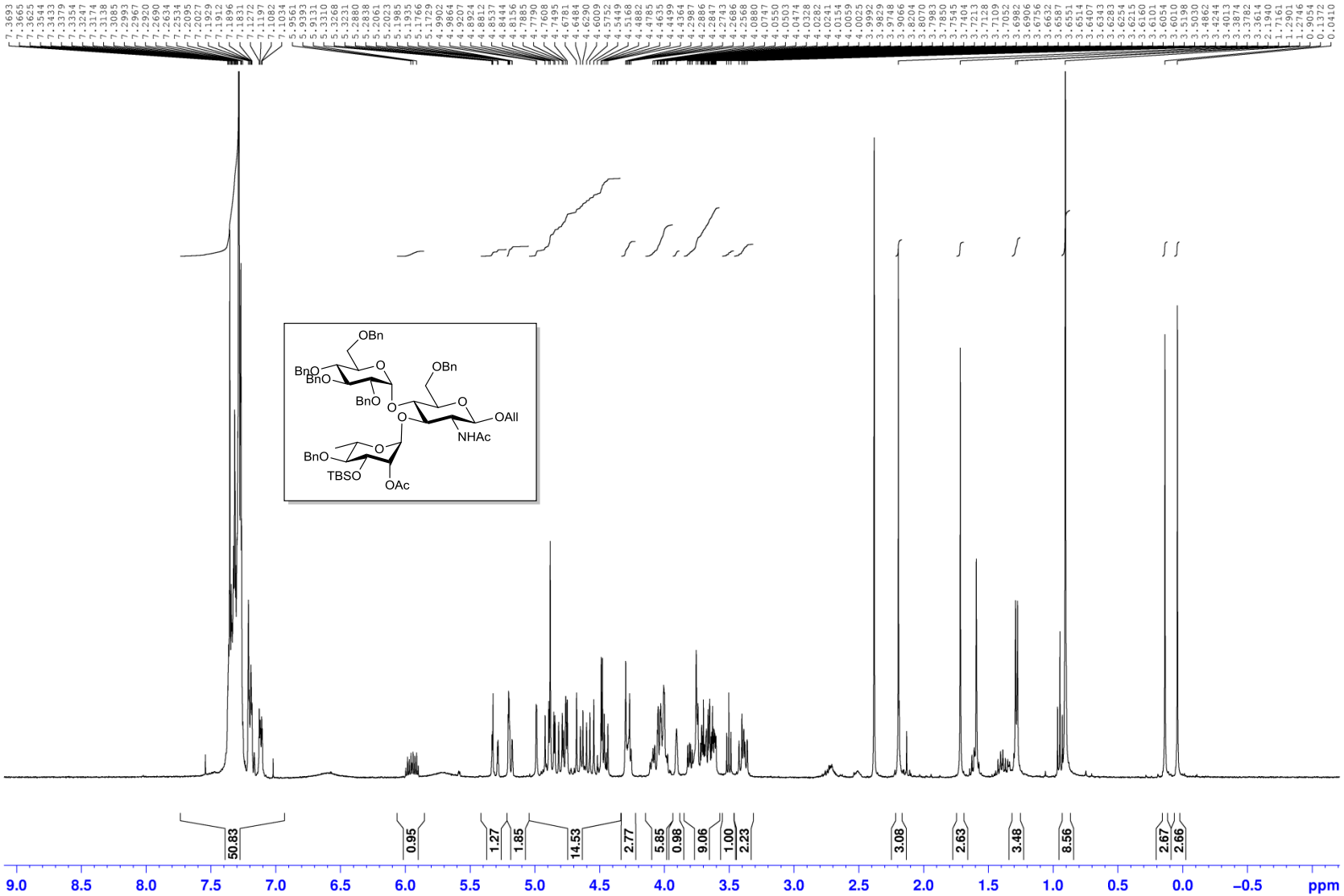

134.032
129.036
128.847
128.534
128.507
128.475
128.361
128.339
128.288
128.273
127.995
127.828
127.805
127.781
127.731
127.652
127.632
127.562
127.472
127.429
116.838
97.745
96.996
95.743
82.085
81.057
79.032
77.507
77.227
75.829
75.498
74.965
74.704
74.294
73.465
73.018
72.172
71.470
71.177
71.044
71.020
69.388
68.773
68.454
67.690
45.945
22.631
20.999
18.118
0.065
OBn
BnO
BnO
O
OBn
BnO
O
O
O
OAll
NHAc
BnO
O
TMSO
OAc
220
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
ppm

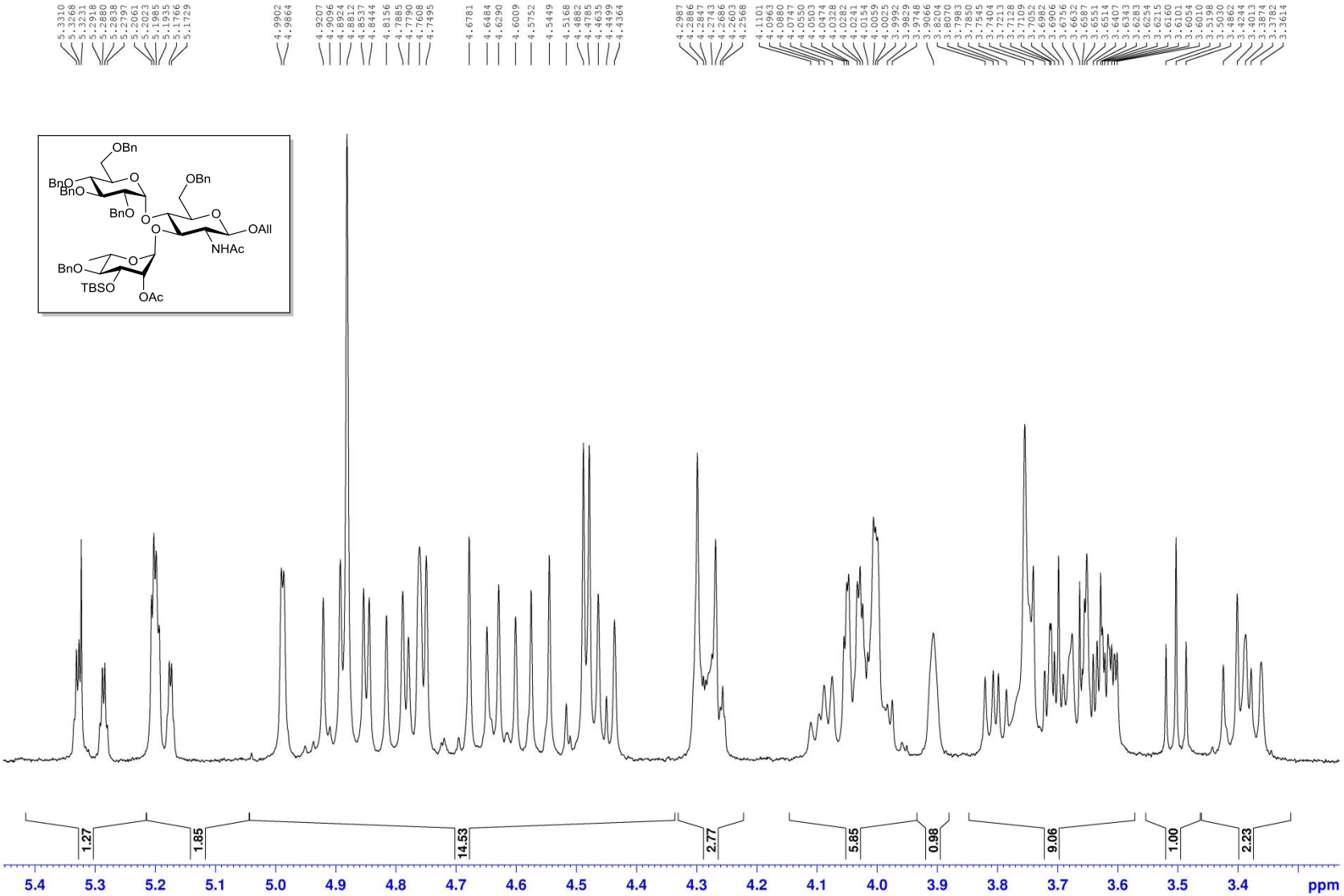

97.745
96.996
95.743
82.085
81.057
79.032
77.507
77.227
75.829
75.498
74.965
74.704
74.294
73.465
73.018
72.172
71.470
71.177
71.044
71.020
69.388
68.773
68.454
67.690
OBn
BnO
BnO
BnO
O
OBn
O
O
O
OAll
NHAc
BnO
O
TMSO
OAc
100
95
90
85
80
75
70
65
ppm

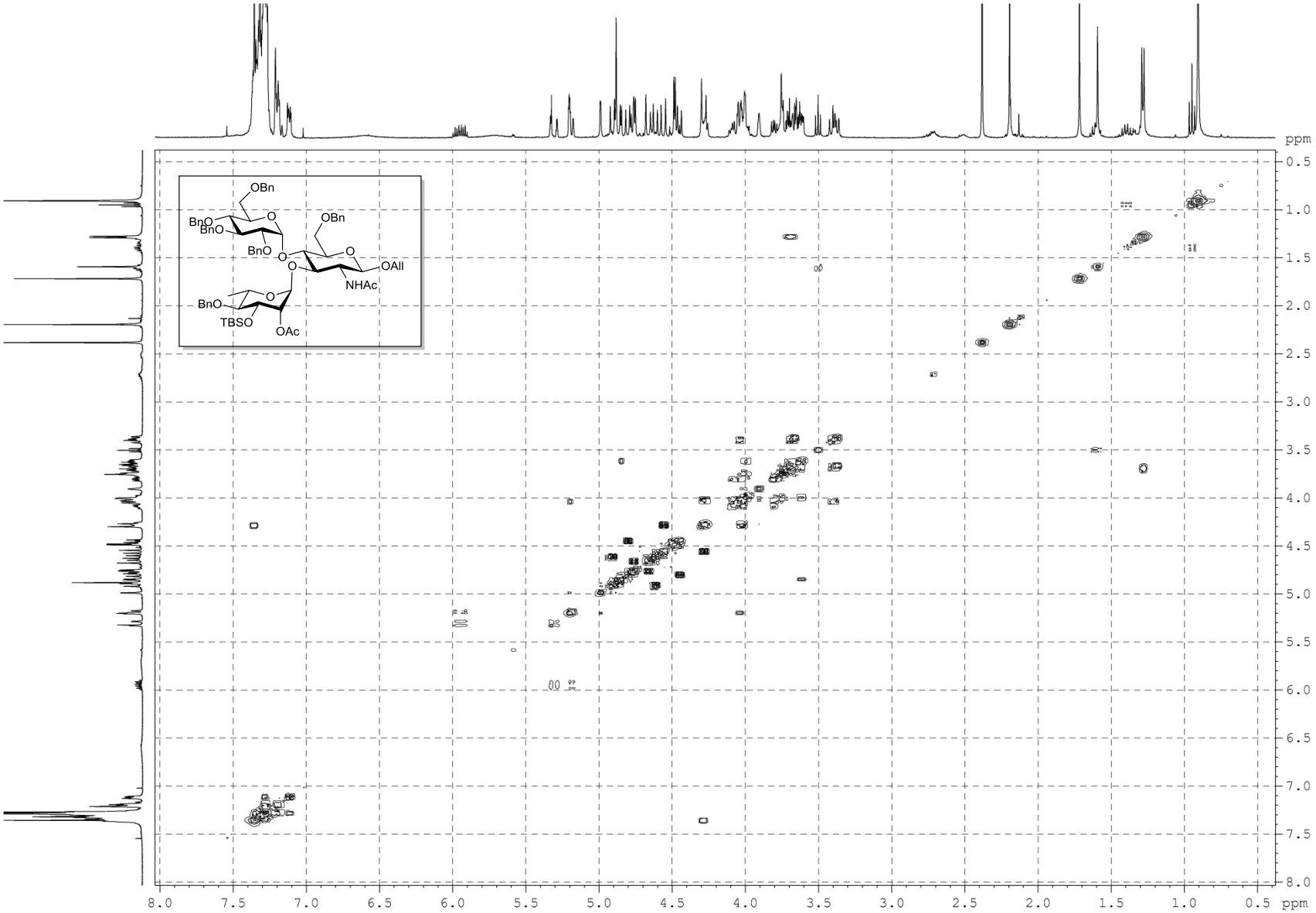

OBn
BnO
BnO
BnO
O
OBn
O
O
O
OAll
NHAc
BnO
O
TMSO
OAc
ppm
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
ppm

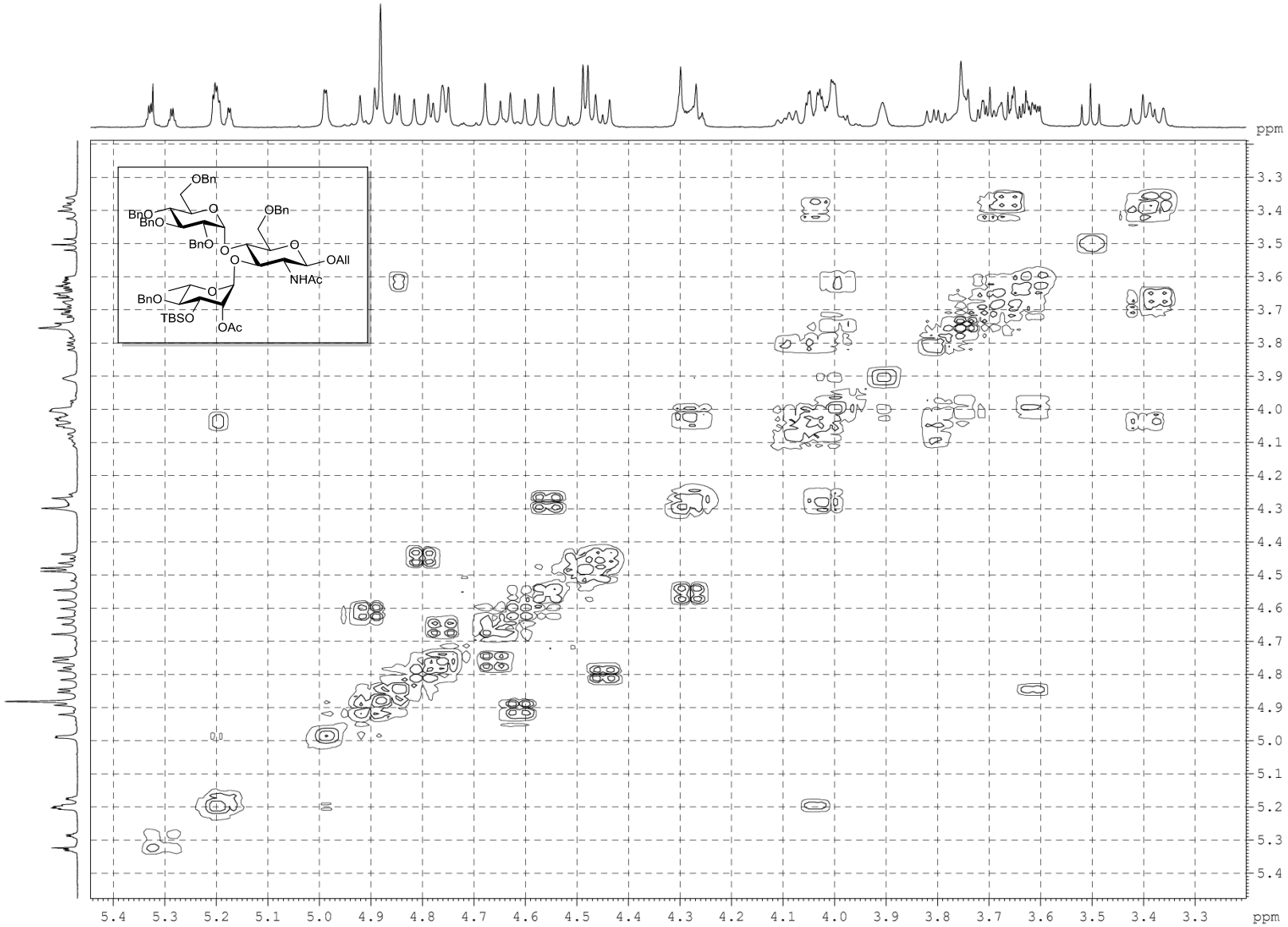

OBn
BnO
BnO
O
BnO
O
OBn
O
O
OAll
NHAc
BnO
O
TMSO
OAc
ppm
45
50
55
60
65
70
75
80
85
90
95
100
5.4
5.3
5.2
5.1
5.0
4.9
4.8
4.7
4.6
4.5
4.4
4.3
4.2
4.1
4.0
3.9
3.8
3.7
3.6
3.5
3.4
3.3
3.2
ppm

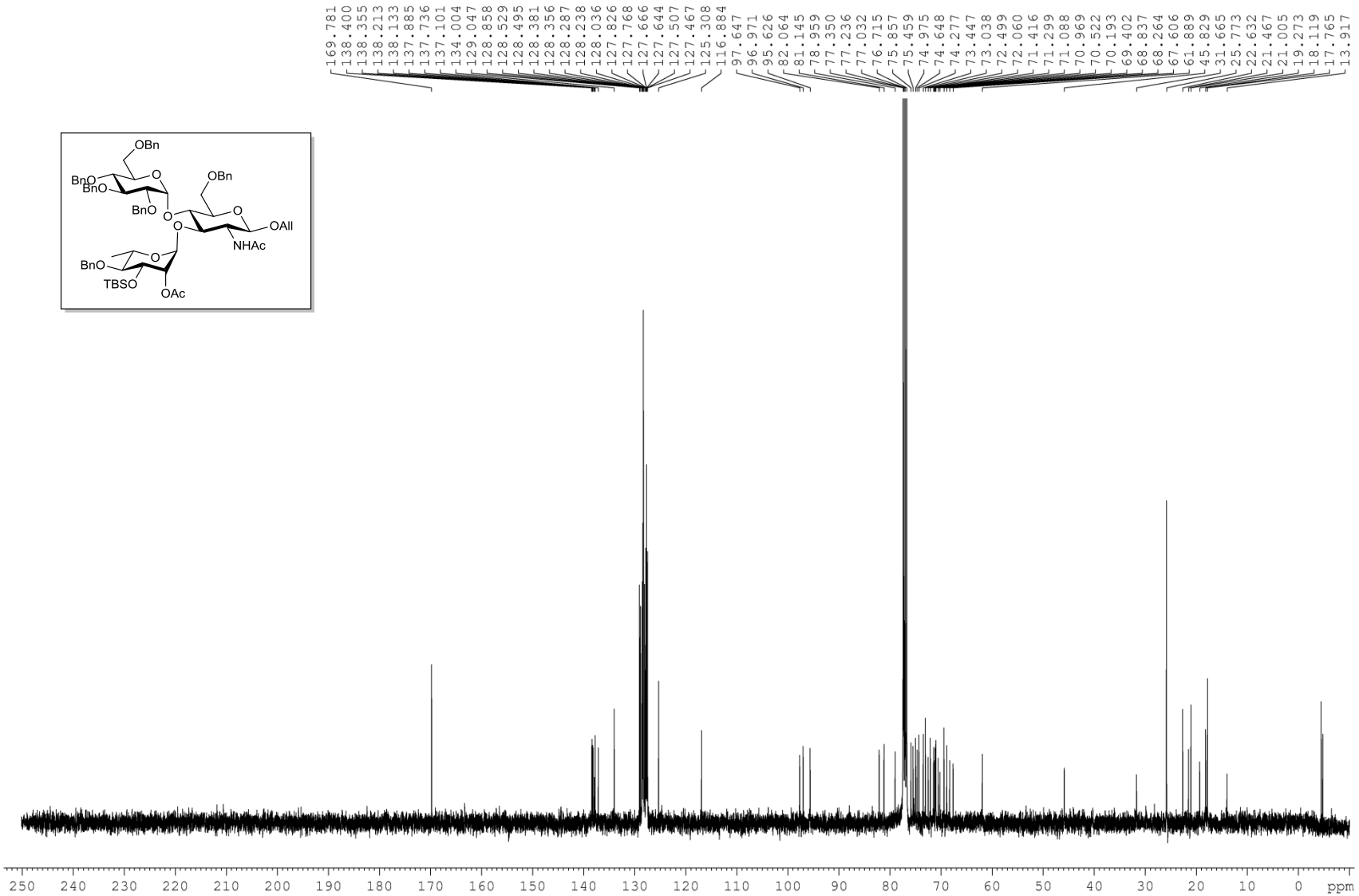
Compound 44: **Allyl (2-*O*-acetyl-4-*O*-benzyl-3-*O*-*tert*-butyldimethylsilyl-α-L-rhamnopyranosyl)-(1→3)-[2,3,4,6-tetra-*O*-benzyl-α-D-glucopyranosyl-(1→4)]-2-acetamido-6-*O*-benzyl-2-deoxy-β-D-glucopyranoside**

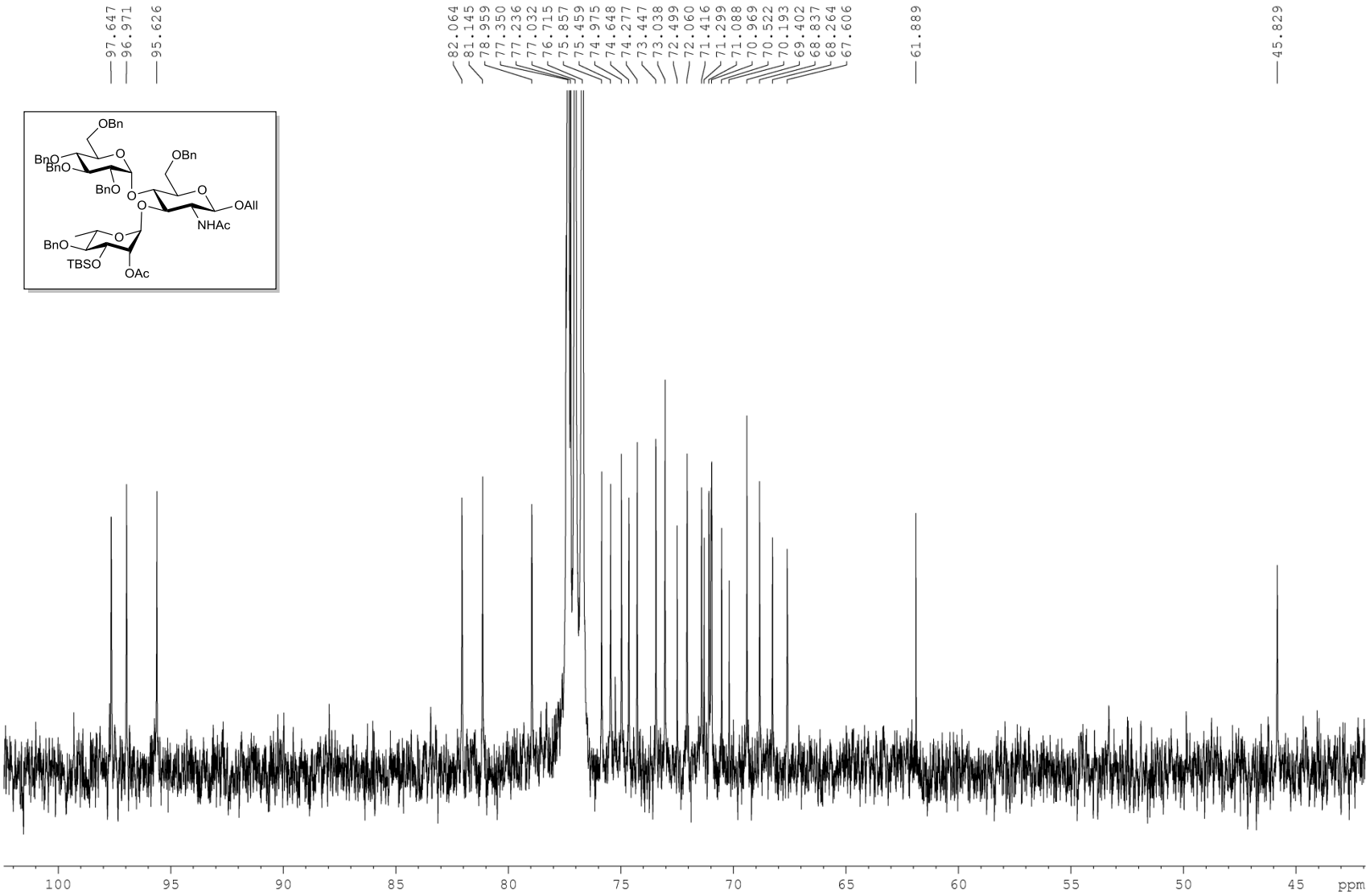


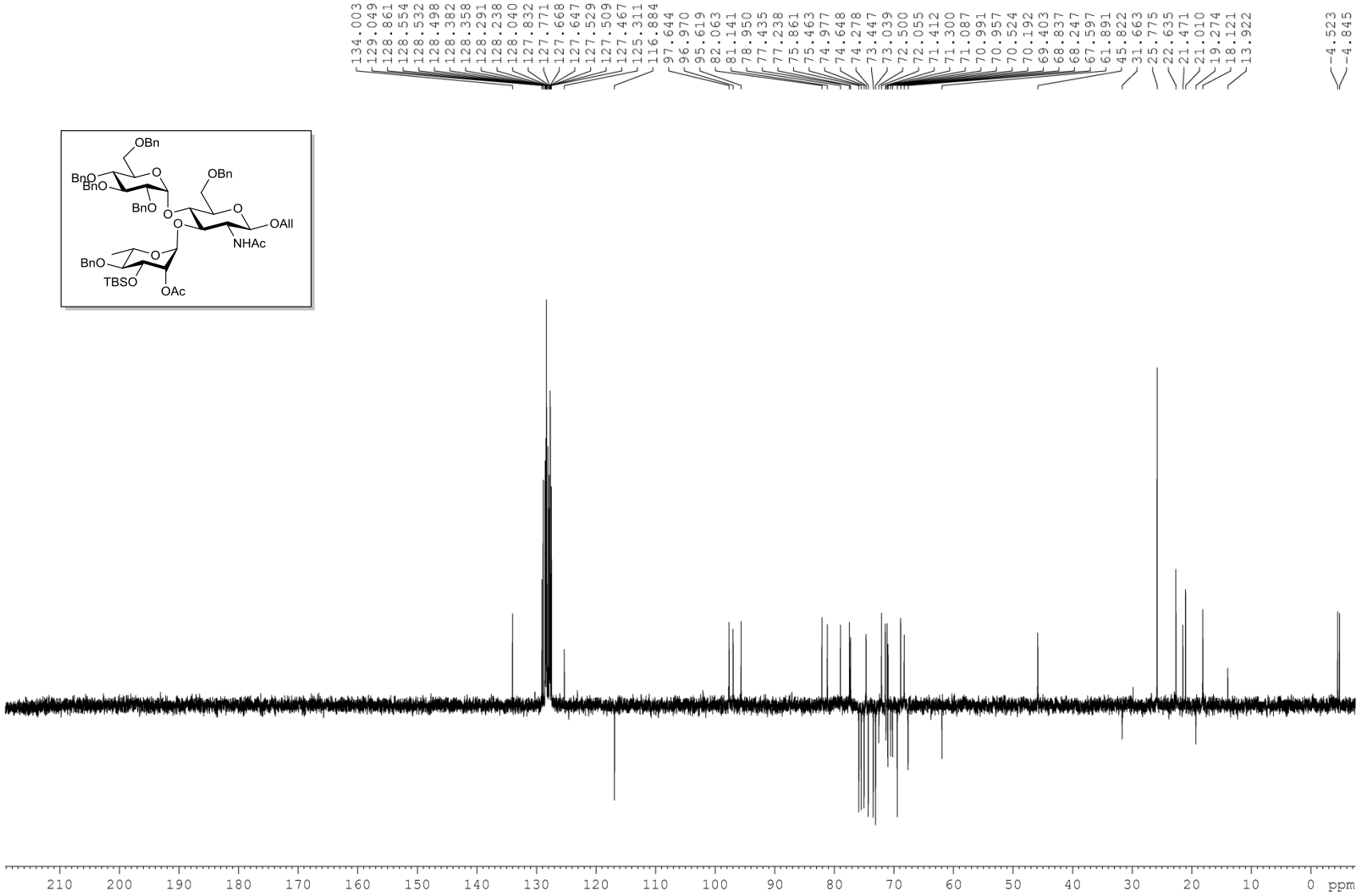

OBn
BnO
BnO
O
OBn
BnO
O
O
O
OAll
NHAc
BnO
O
TBSO
OAc
1.27
1.85
14.53
2.77
5.85
0.98
9.06
1.00
2.23
5.4
5.3
5.2
5.1
5.0
4.9
4.8
4.7
4.6
4.5
4.4
4.3
4.2
4.1
4.0
3.9
3.8
3.7
3.6
3.5
3.4
ppm

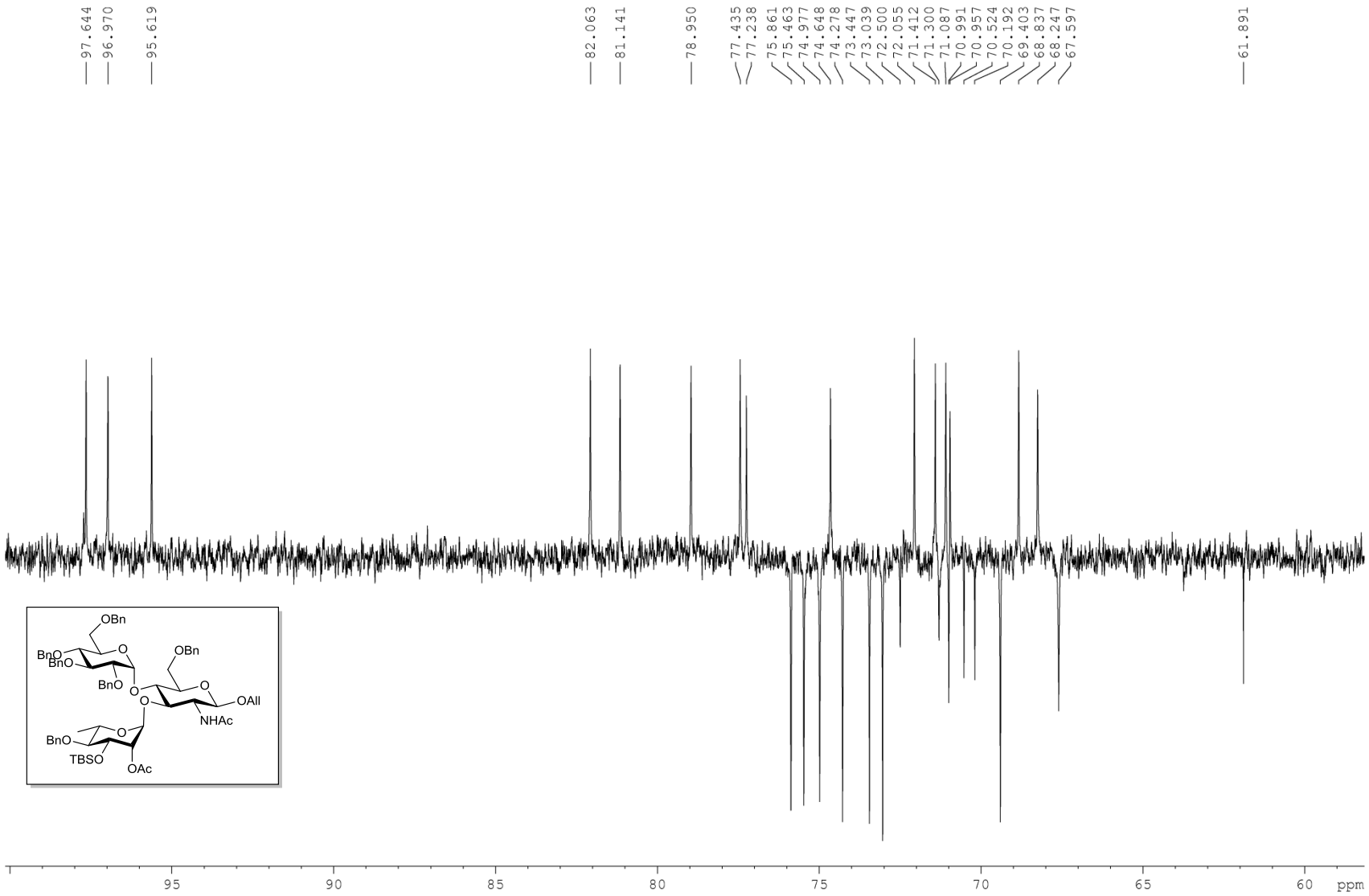

OBn
BnO
BnO
BnO
O
OBn
O
O
O
OAll
NHAc
BnO
O
TBSO
OAc
ppm
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
5.5
6.0
6.5
7.0
7.5
8.0
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
ppm

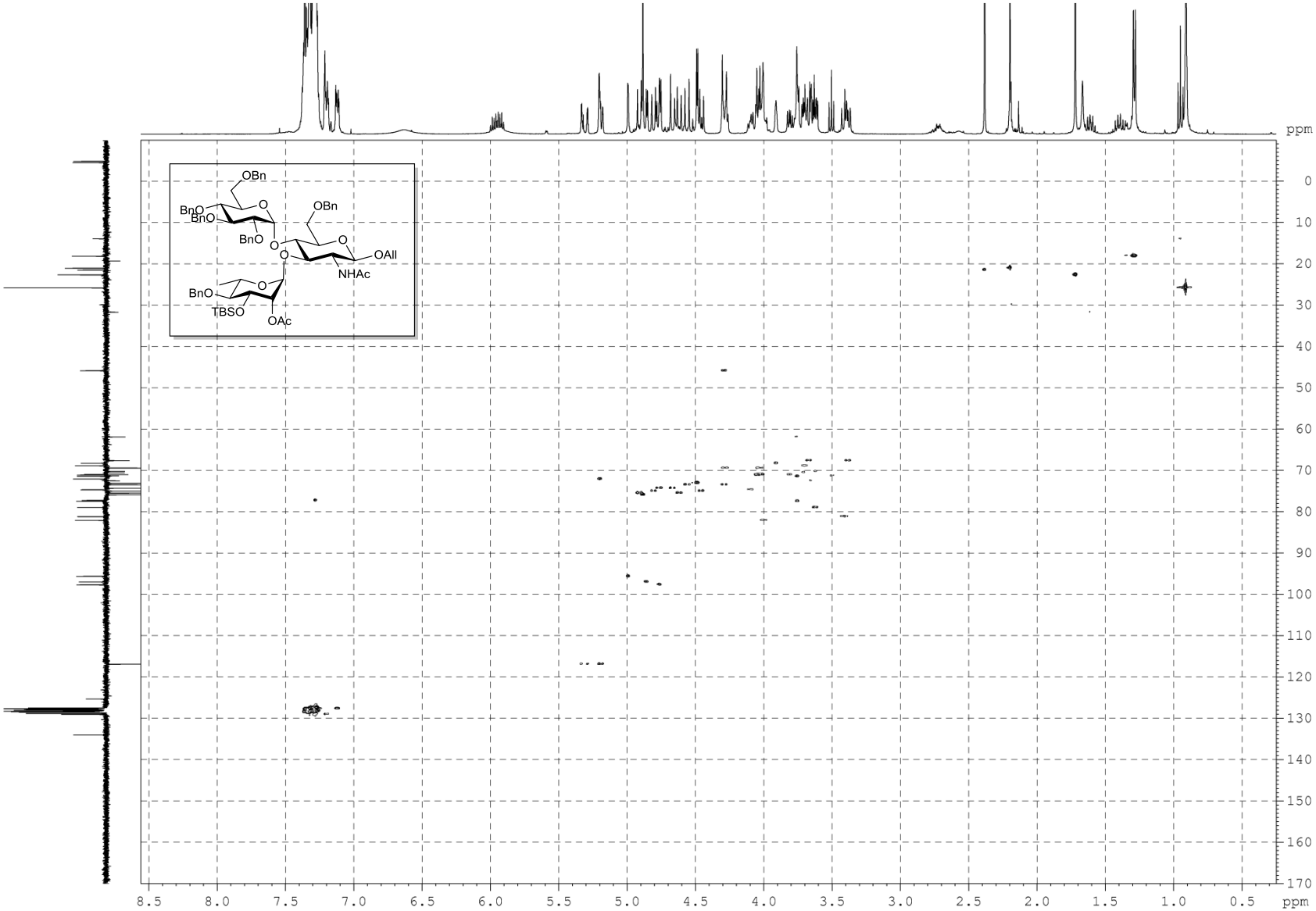

OBn
BnO
BnO
OBn
BnO
O
O
O
O
OAll
NHAc
BnO
O
TBSO
OAc
ppm
5.4 5.3 5.2 5.1 5.0 4.9 4.8 4.7 4.6 4.5 4.4 4.3 4.2 4.1 4.0 3.9 3.8 3.7 3.6 3.5 3.4 3.3
ppm
3.3 3.4 3.5 3.6 3.7 3.8 3.9 4.0 4.1 4.2 4.3 4.4 4.5 4.6 4.7 4.8 4.9 5.0 5.1 5.2 5.3 5.4

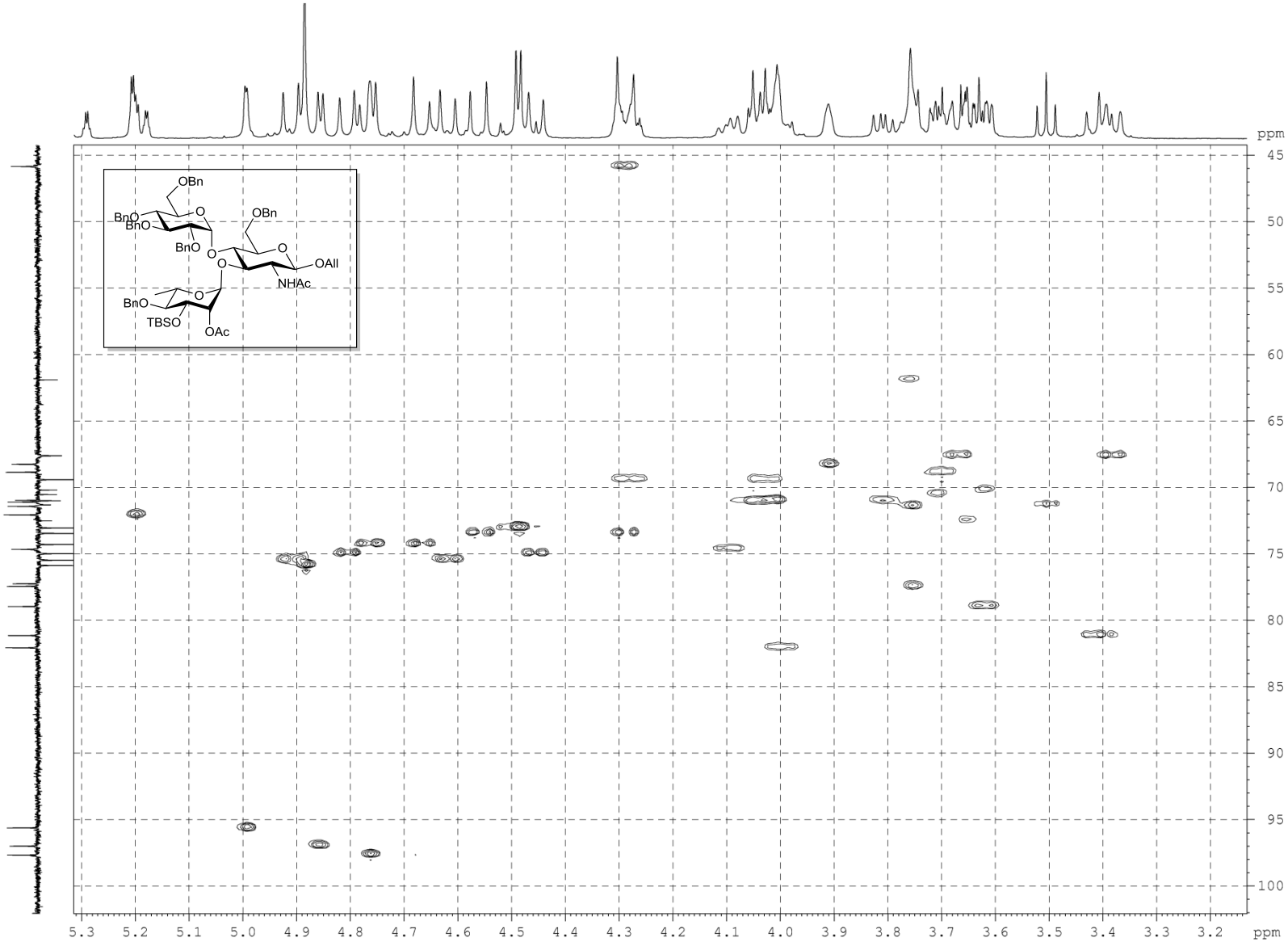

169.781
138.400
138.355
138.213
138.133
137.885
137.736
137.101
134.004
129.047
128.858
128.529
128.495
128.381
128.356
128.287
128.238
128.036
127.826
127.768
127.666
127.644
127.507
127.467
125.308
116.884
97.647
96.971
95.626
82.064
81.145
78.959
77.350
77.236
77.032
76.715
75.857
75.459
74.975
74.648
74.277
73.447
73.038
72.499
72.060
71.416
71.299
71.088
70.969
70.522
70.193
69.402
68.837
68.264
67.606
61.889
45.829
31.665
25.773
22.632
21.467
21.005
19.273
18.119
17.765
13.917
OBn
BnO
BnO
O
OBn
BnO
O
O
O
OAll
NHAc
BnO
O
TBSO
OAc
250 240 230 220 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 ppm


97.647
96.971
95.626
82.064
81.145
78.959
77.350
77.236
77.032
76.715
75.857
75.459
74.975
74.648
74.277
73.447
73.038
72.499
72.060
71.416
71.299
71.088
70.969
70.522
70.193
69.402
68.837
68.264
67.606
61.889
45.829
OBn
BnO
BnO
BnO
O
OBn
O
O
O
OAll
NHAc
O
BnO
TBSO
OAc
100
95
90
85
80
75
70
65
60
55
50
45
ppm

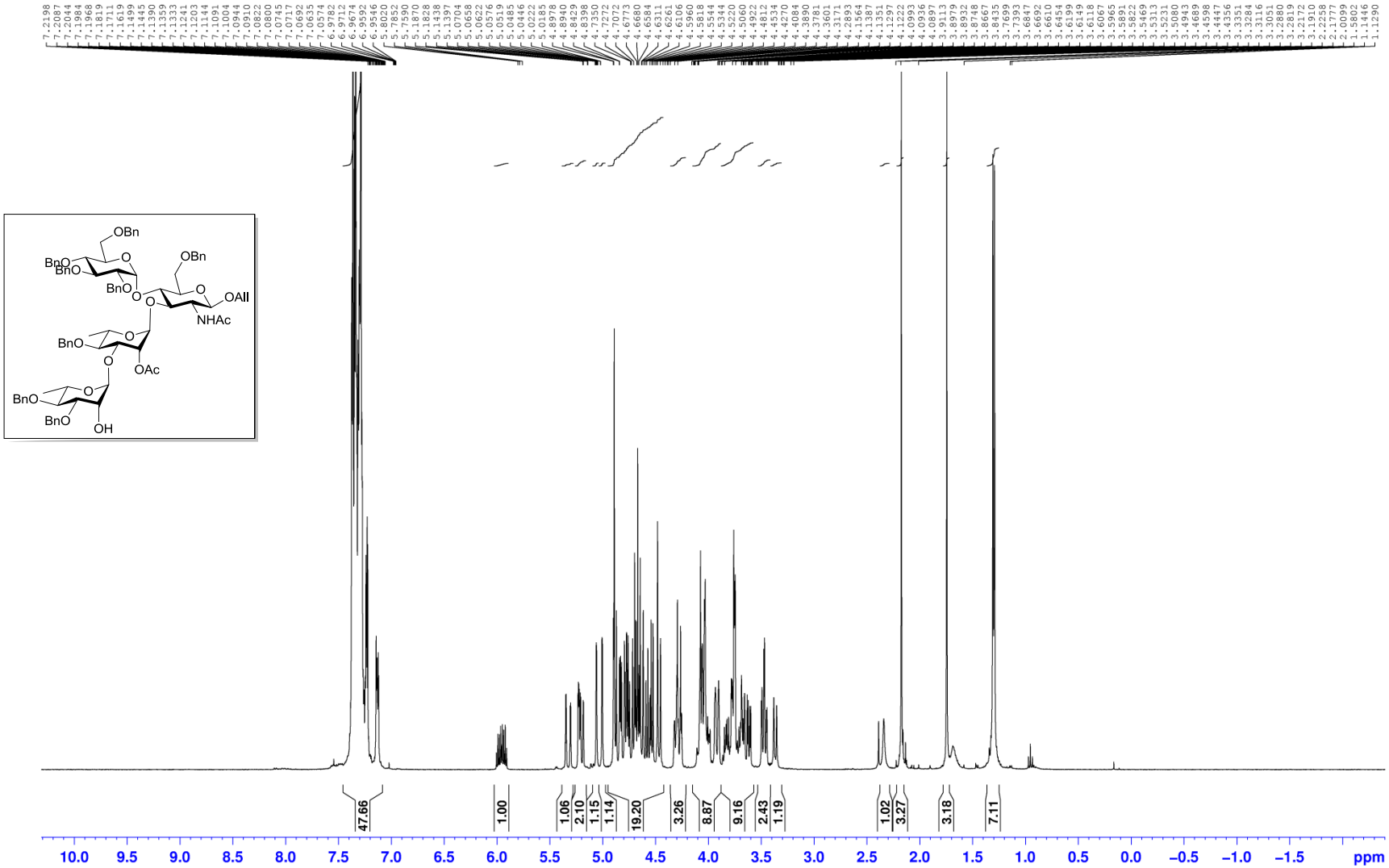

134.003
129.049
128.861
128.554
128.532
128.498
128.382
128.358
128.291
128.238
128.040
127.832
127.771
127.668
127.647
127.529
127.509
127.467
125.311
116.884
97.644
96.970
95.619
82.063
81.141
78.950
77.435
77.238
75.861
75.463
74.977
74.648
74.278
73.447
73.039
72.500
72.055
71.412
71.300
71.087
70.991
70.957
70.524
70.192
69.403
68.837
68.247
67.597
61.891
45.822
31.663
25.775
22.635
21.471
21.010
19.274
18.121
13.922
-4.523
-4.845
OBn
BnO
BnO
O
OBn
BnO
O
O
O
OAll
NHAc
BnO
O
TBSO
OAc
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
ppm

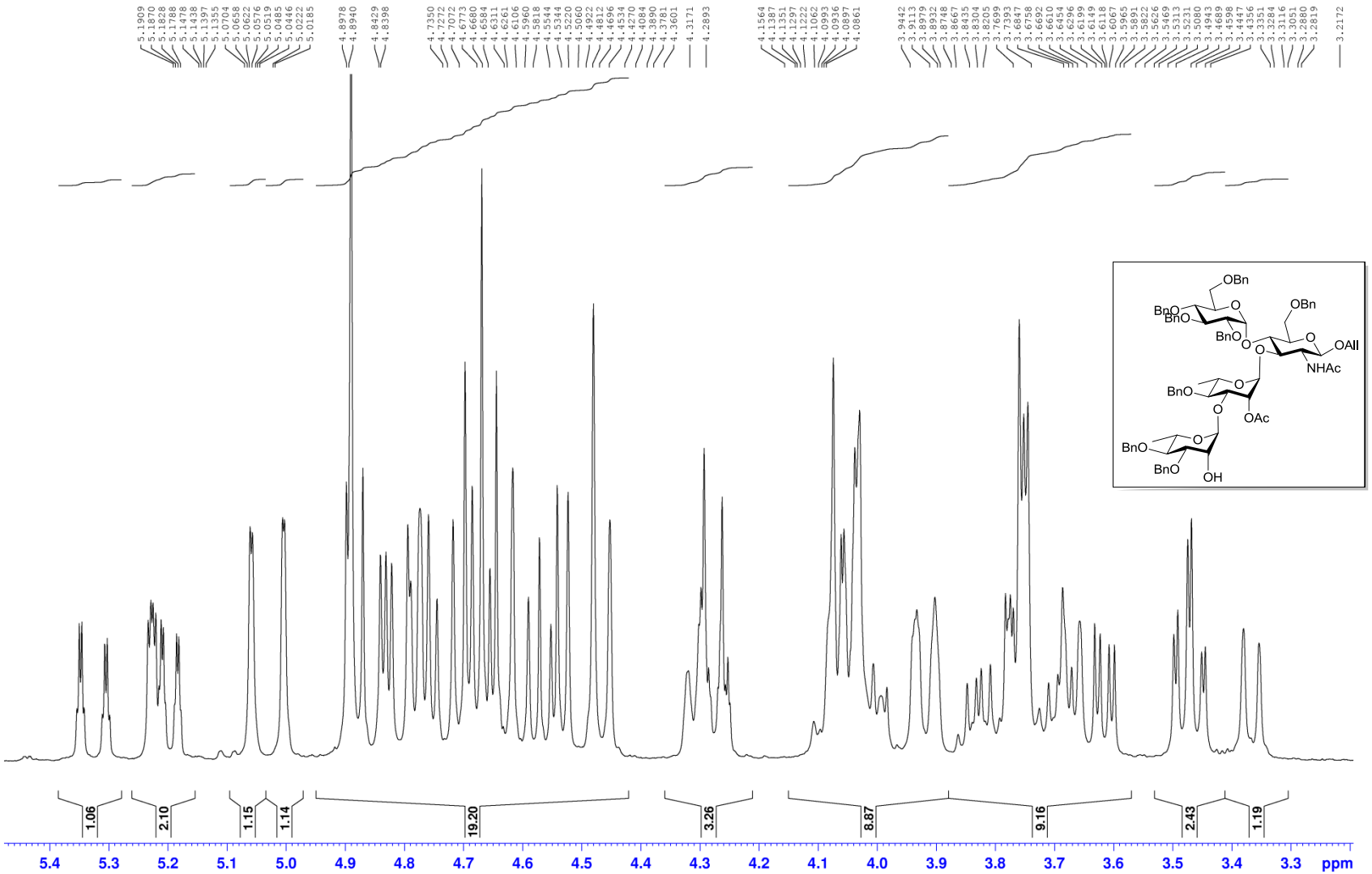

97.644
96.970
95.619
82.063
81.141
78.950
77.435
77.238
75.861
75.463
74.977
74.648
74.278
73.447
73.039
72.500
72.055
71.412
71.300
71.087
70.991
70.957
70.524
70.192
69.403
68.837
68.247
67.597
61.891
OBn
BnO
BnO
BnO
O
OBn
O
O
O
OAll
NHAc
BnO
O
TBSO
OAc
95
90
85
80
75
70
65
60
ppm

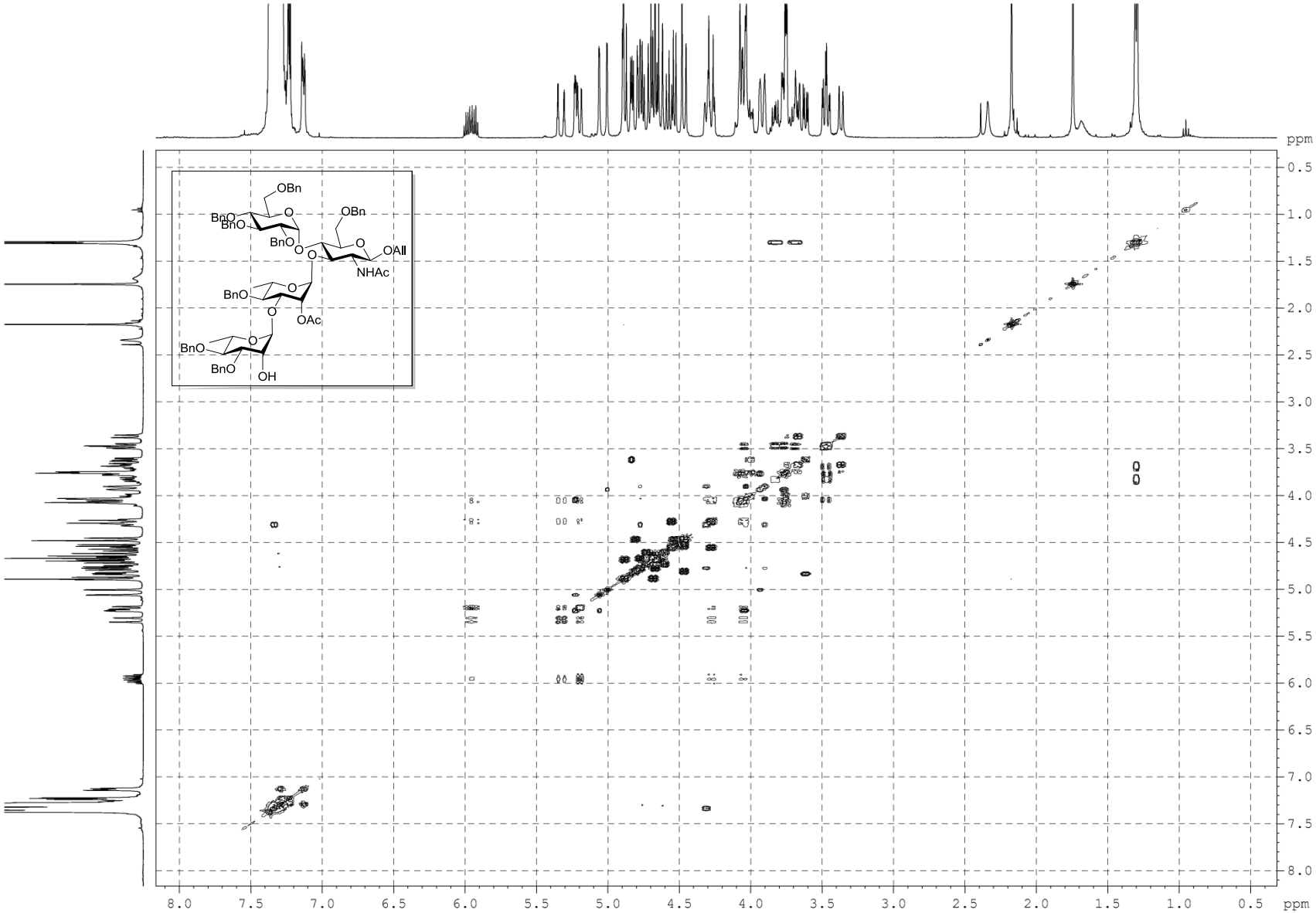

OBn
BnO
BnO
O
OBn
BnO
O
O
O
OAll
NHAc
BnO
O
TBSO
OAc
ppm
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
ppm

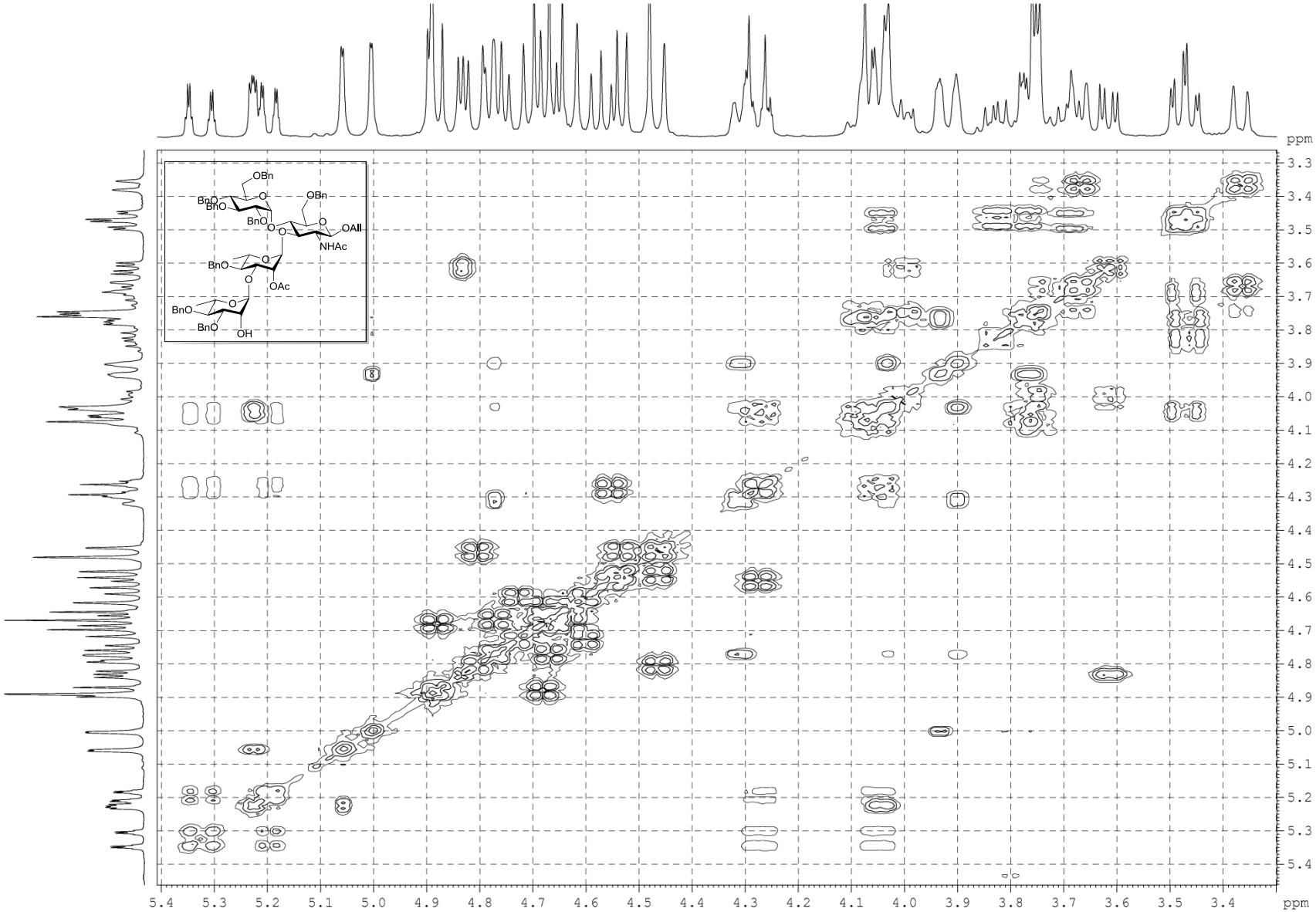

OBn
BnO
BnO
O
BnO
O
OBn
O
OAll
NHAc
O
BnO
TBSO
OAc
ppm
45
50
55
60
65
70
75
80
85
90
95
100
5.3
5.2
5.1
5.0
4.9
4.8
4.7
4.6
4.5
4.4
4.3
4.2
4.1
4.0
3.9
3.8
3.7
3.6
3.5
3.4
3.3
3.2
ppm

Compound 45: **Allyl (3,4-di-*O*-benzyl-α-L-rhamnopyranosyl)-(1→3)-(2-*O*-acetyl-4-*O*-benzyl-α-L-rhamnopyranosyl)-(1→3)-[2,3,4,6-tetra-*O*-benzyl-α-D-glucopyranosyl-(1→4)]-2-acetamido-6-*O*-benzyl-2-deoxy-β-D-glucopyranoside**




OBn
BnO
BnO
O
OBn
BnO
O
O
OAll
NHAc
BnO
O
O
OAc
BnO
O
BnO
OH
1.06
2.10
1.15
1.14
19.20
3.26
8.87
9.16
2.43
1.19
5.4 5.3 5.2 5.1 5.0 4.9 4.8 4.7 4.6 4.5 4.4 4.3 4.2 4.1 4.0 3.9 3.8 3.7 3.6 3.5 3.4 3.3 ppm


OBn
BnO
BnO
O
OBn
BnO
O
O
O
OAll
NHAc
BnO
O
O
OAc
BnO
O
BnO
OH
ppm
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
5.5
6.0
6.5
7.0
7.5
8.0
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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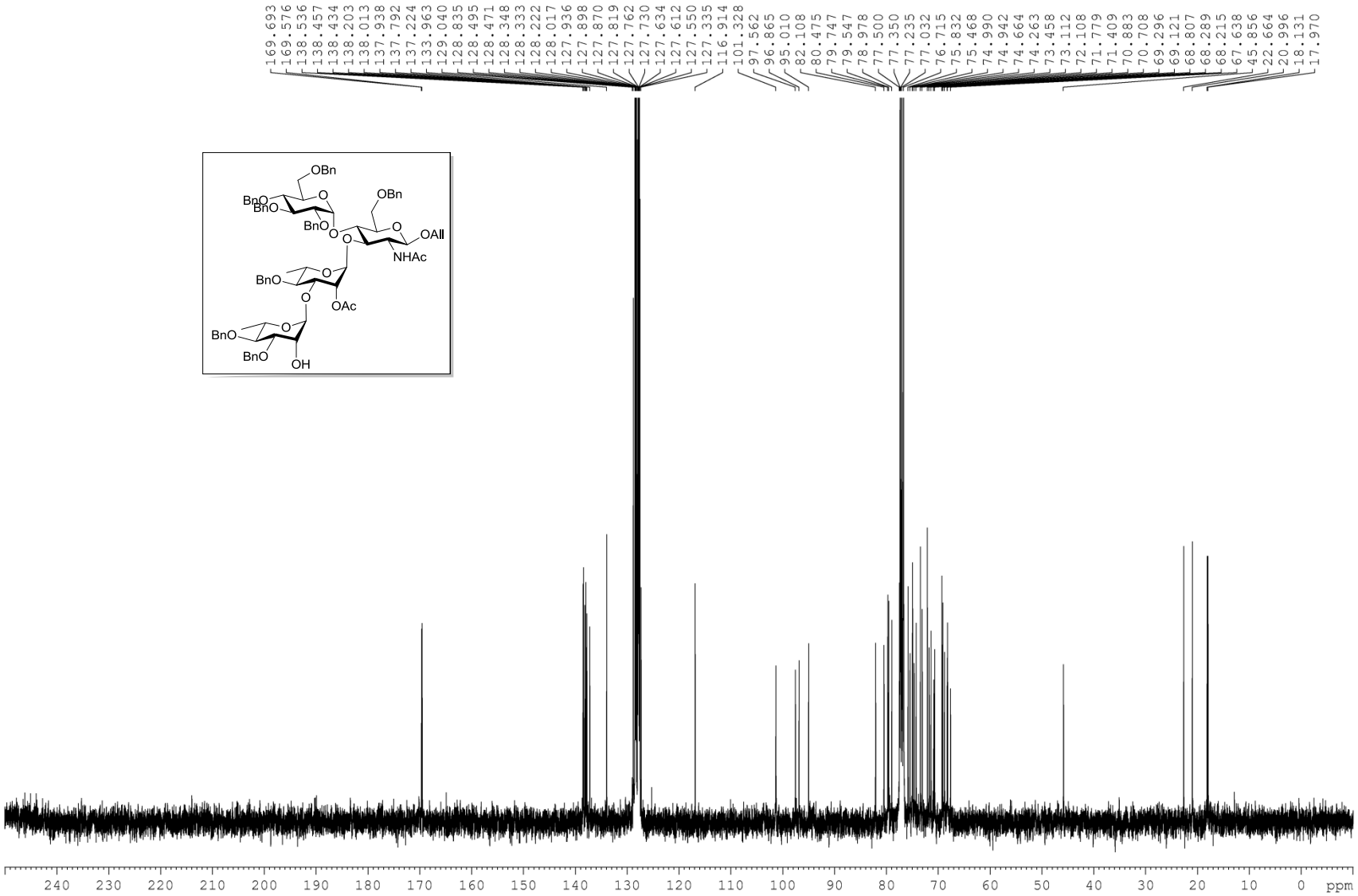
BnO
BnO
O
OBn
BnO
O
O
O
OAll
NHAc
BnO
O
O
OAc
BnO
O
BnO
OH
ppm
3.3
3.4
3.5
3.6
3.7
3.8
3.9
4.0
4.1
4.2
4.3
4.4
4.5
4.6
4.7
4.8
4.9
5.0
5.1
5.2
5.3
5.4
5.4 5.3 5.2 5.1 5.0 4.9 4.8 4.7 4.6 4.5 4.4 4.3 4.2 4.1 4.0 3.9 3.8 3.7 3.6 3.5 3.4
ppm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138.203
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137.938
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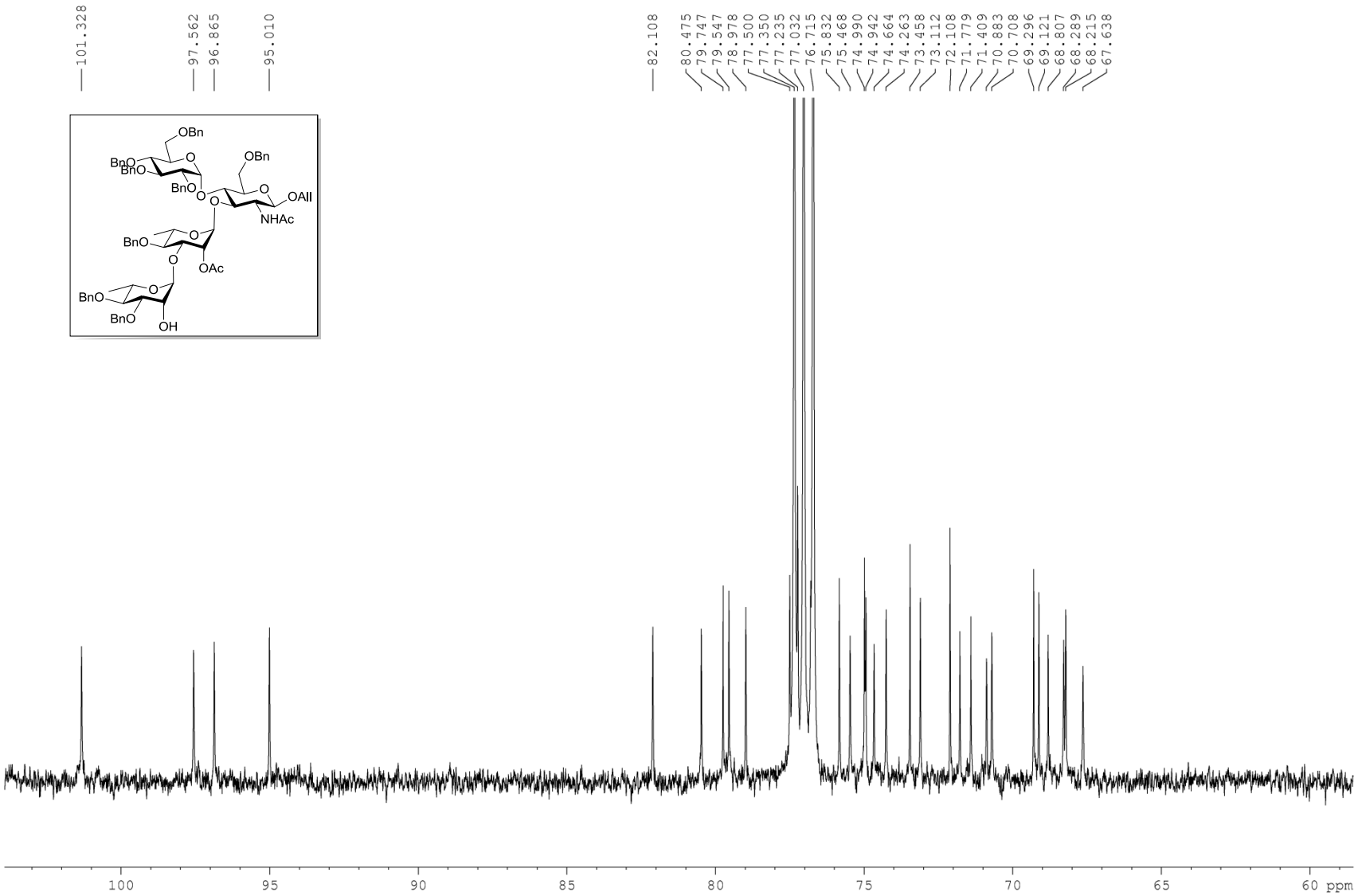
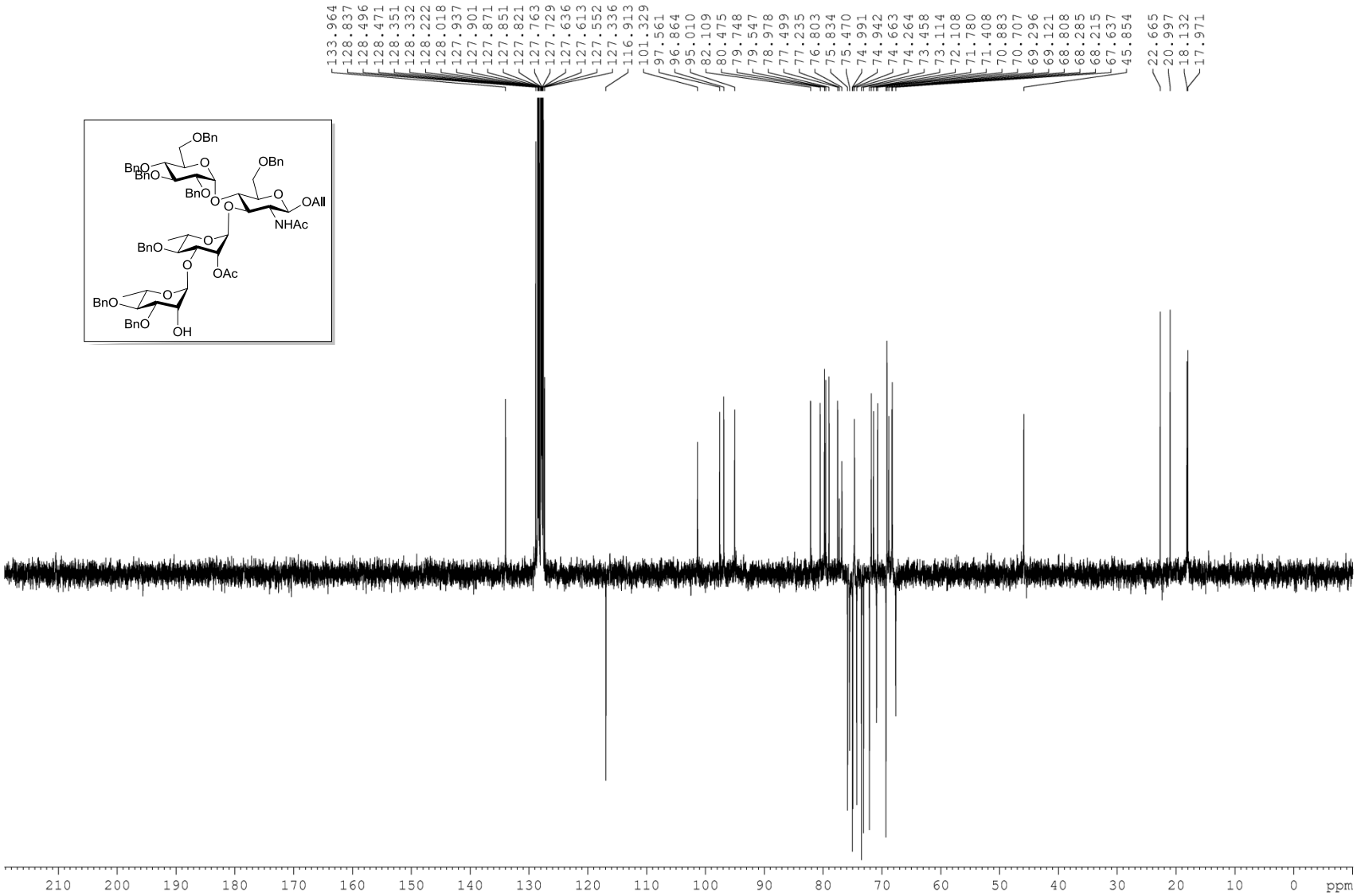
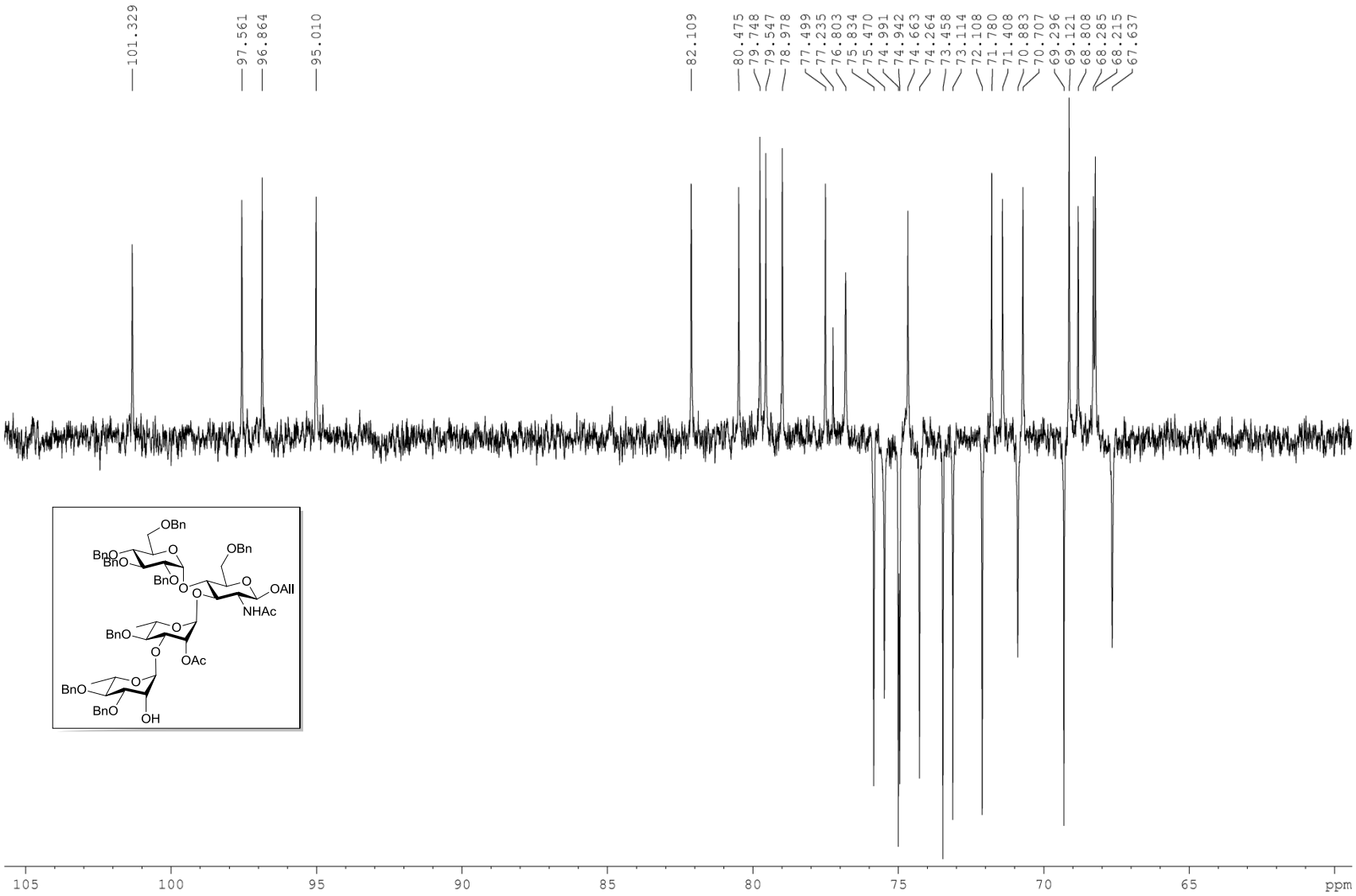
137.224
133.963
129.040
128.835
128.495
128.471
128.348
128.333
128.222
128.017
127.936
127.898
127.870
127.819
127.762
127.730
127.634
127.612
127.550
127.335
116.914
101.328
97.562
96.865
95.010
82.108
80.475
79.747
79.547
78.978
77.500
77.350
77.235
77.032
76.715
75.832
75.468
74.990
74.942
74.664
74.263
73.458
73.112
72.108
71.779
71.409
70.883
70.708
69.296
69.121
68.807
68.289
68.215
67.638
45.856
22.664
20.996
18.131
17.970
OBn
BnO
BnO
O
BnO
O
OBn
O
OAll
NHAc
BnO
O
O
OAc
BnO
O
BnO
OH
240
230
220
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
ppm


101.328
97.562
96.865
95.010
82.108
80.475
79.747
79.547
78.978
77.500
77.350
77.235
77.032
76.715
75.832
75.468
74.990
74.942
74.664
74.263
73.458
73.112
72.108
71.779
71.409
70.883
70.708
69.296
69.121
68.807
68.289
68.215
67.638
OBn
BnO
BnO
BnO
O
OBn
O
O
O
OAll
NHAc
BnO
O
O
OAc
BnO
O
BnO
OH
100
95
90
85
80
75
70
65
60 ppm


133.964
128.837
128.496
128.471
128.351
128.332
128.222
128.018
127.937
127.901
127.871
127.851
127.821
127.763
127.729
127.636
127.613
127.552
127.336
116.913
101.329
97.561
96.864
95.010
82.109
80.475
79.748
79.547
78.978
77.499
77.235
76.803
75.834
75.470
74.991
74.942
74.663
74.264
73.458
73.114
72.108
71.780
71.408
70.883
70.707
69.296
69.121
68.808
68.285
68.215
67.637
45.854
22.665
20.997
18.132
17.971
OBn
BnO
BnO
O
OBn
BnO
O
O
O
OAll
NHAc
BnO
O
O
OAc
BnO
O
BnO
OH
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
ppm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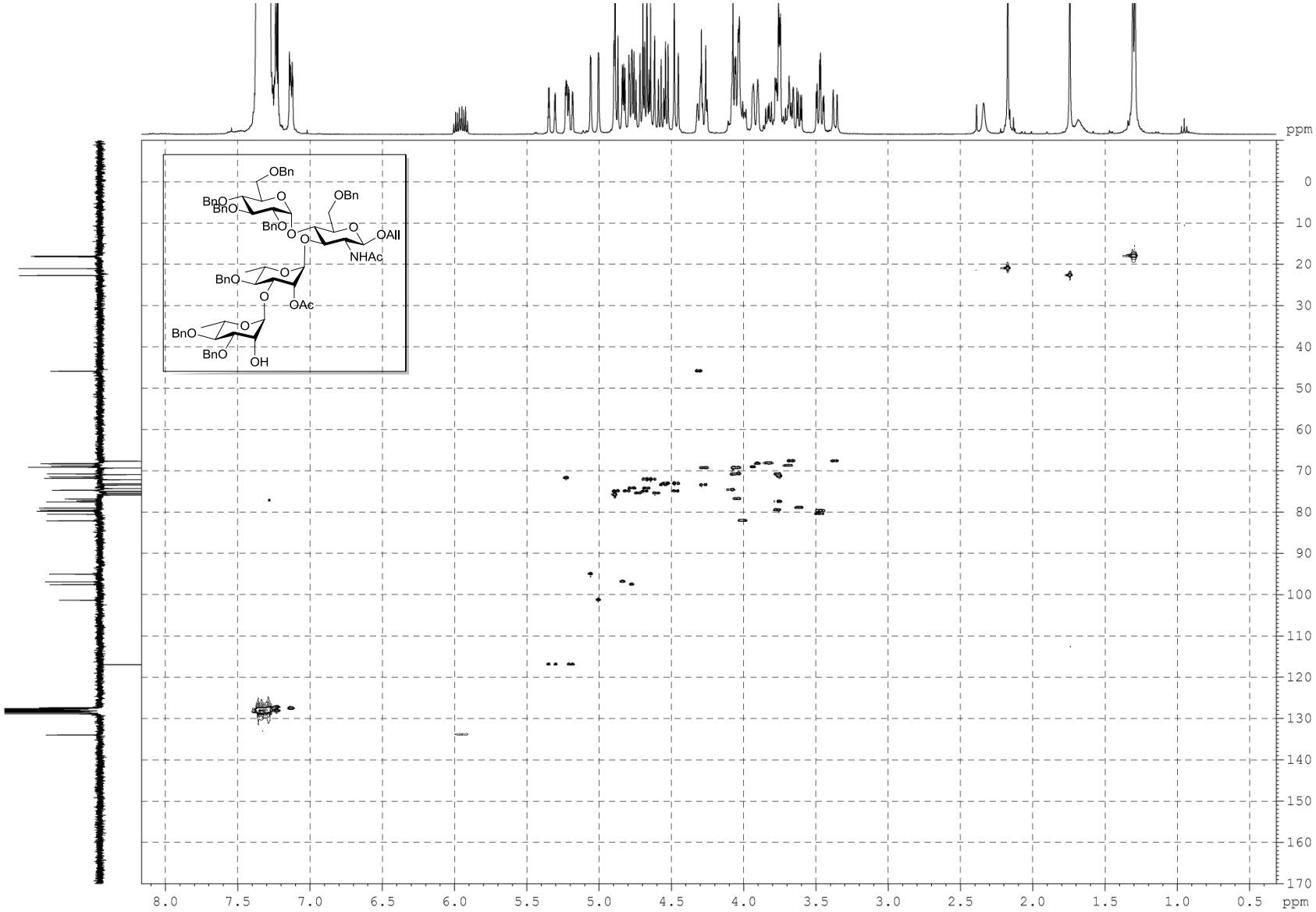
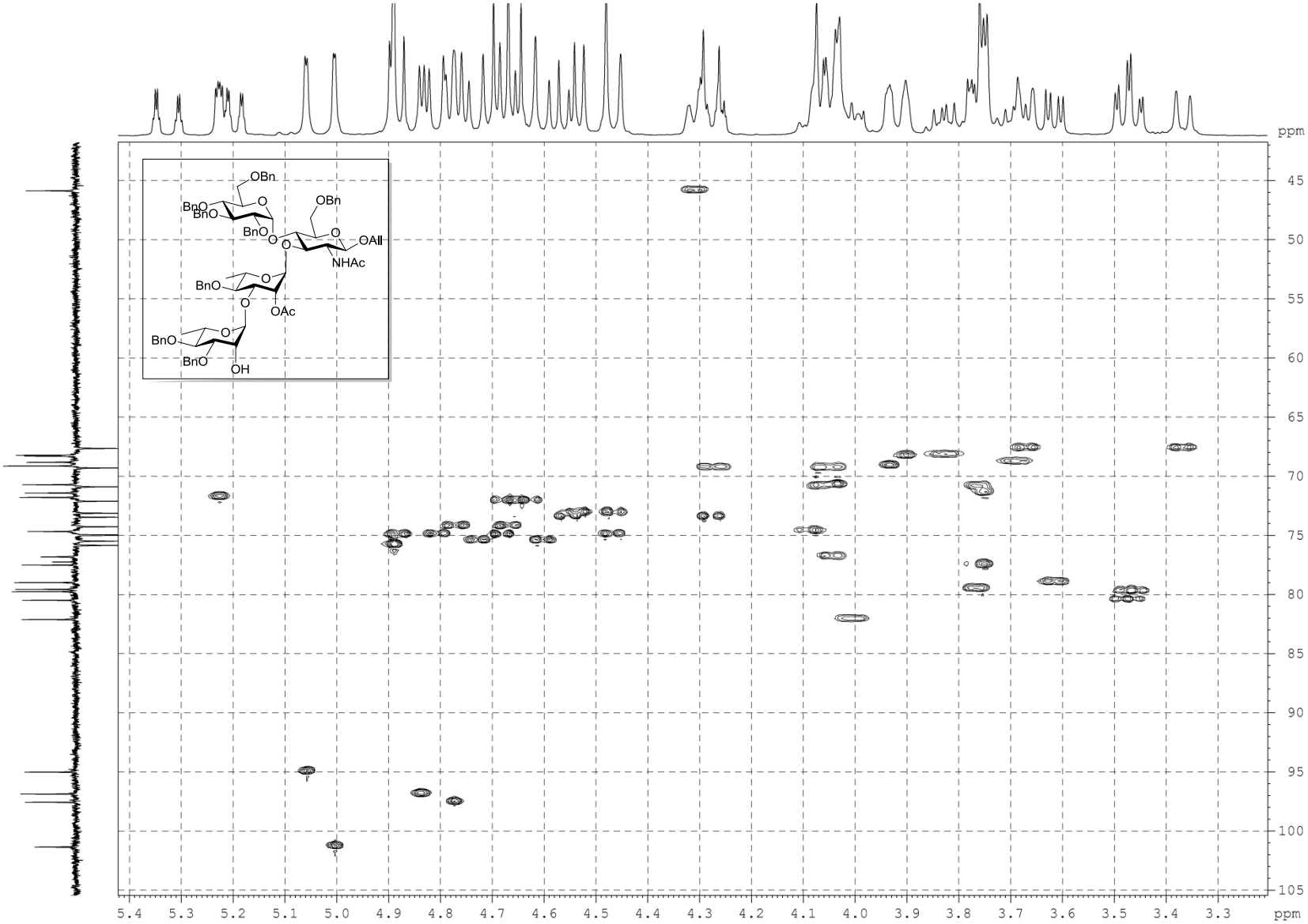
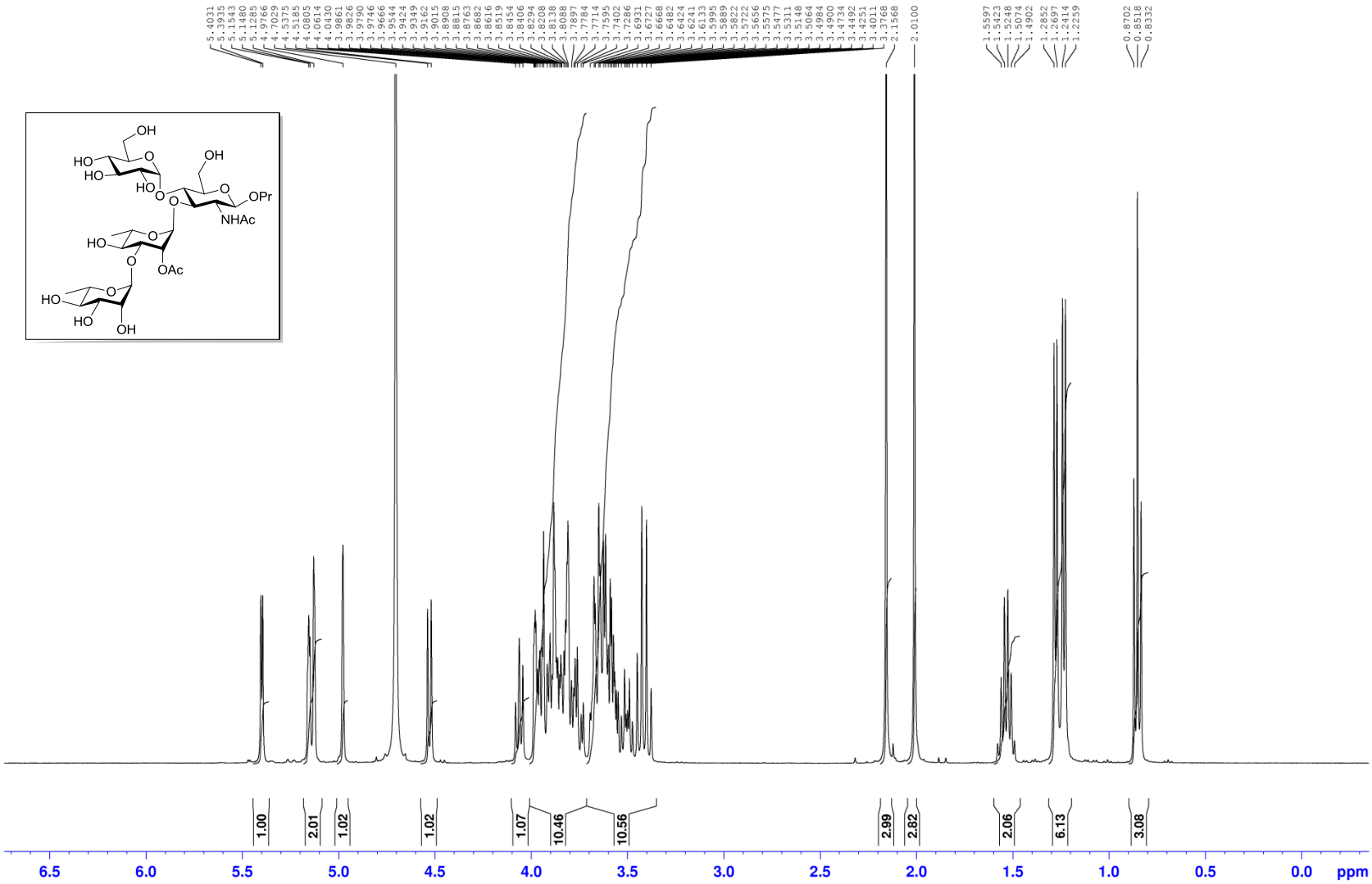
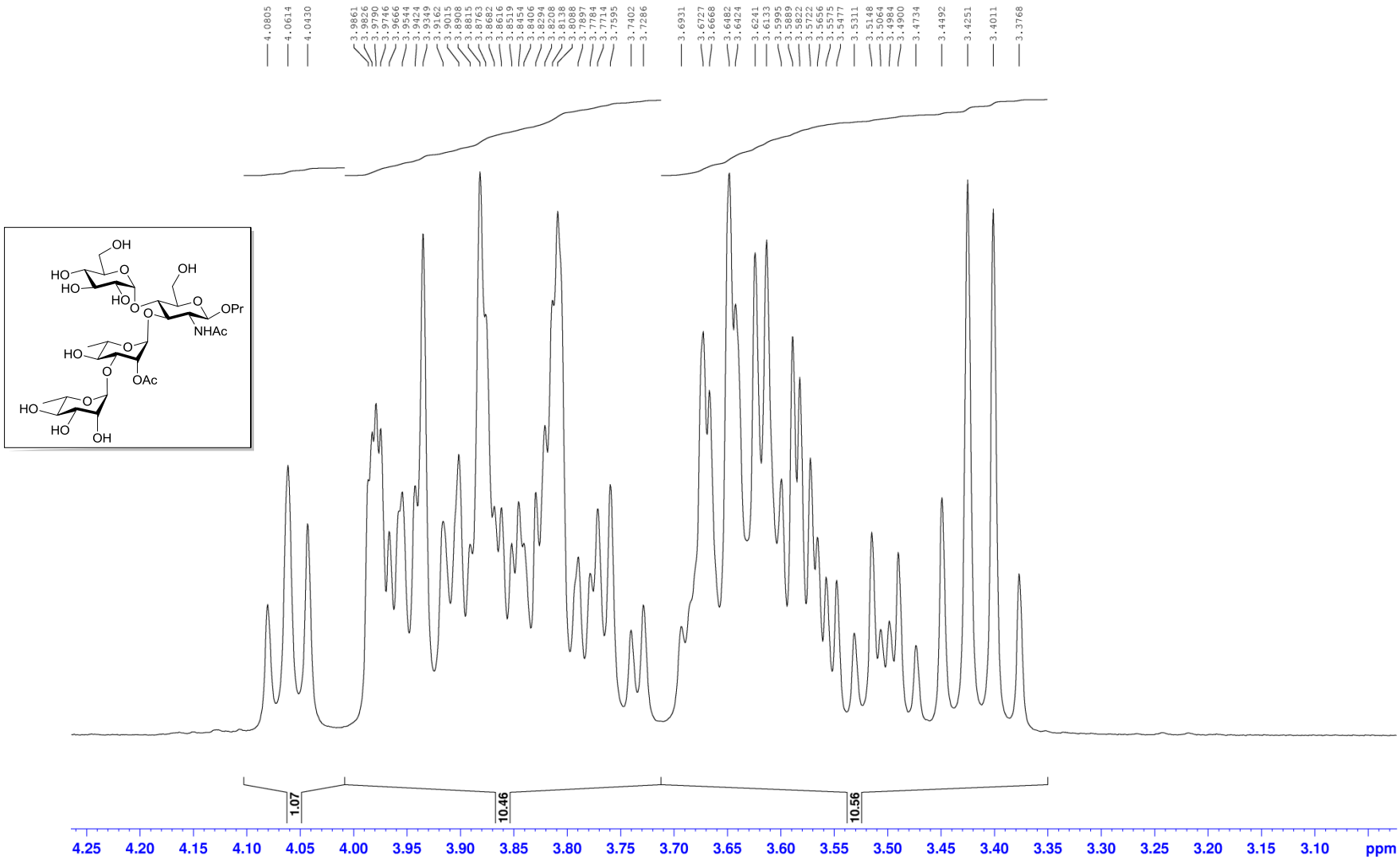
97.561
96.864
95.010
82.109
80.475
79.748
79.547
78.978
77.499
77.235
76.803
75.834
75.470
74.991
74.942
74.663
74.264
73.458
73.114
72.108
71.780
71.408
70.883
70.707
69.296
69.121
68.808
68.285
68.215
67.637
105
100
95
90
85
80
75
70
65
ppm
OBn
BnO
BnO
O
BnO
O
OBn
O
OAll
NHAc
BnO
O
O
OAc
BnO
O
BnO
OH

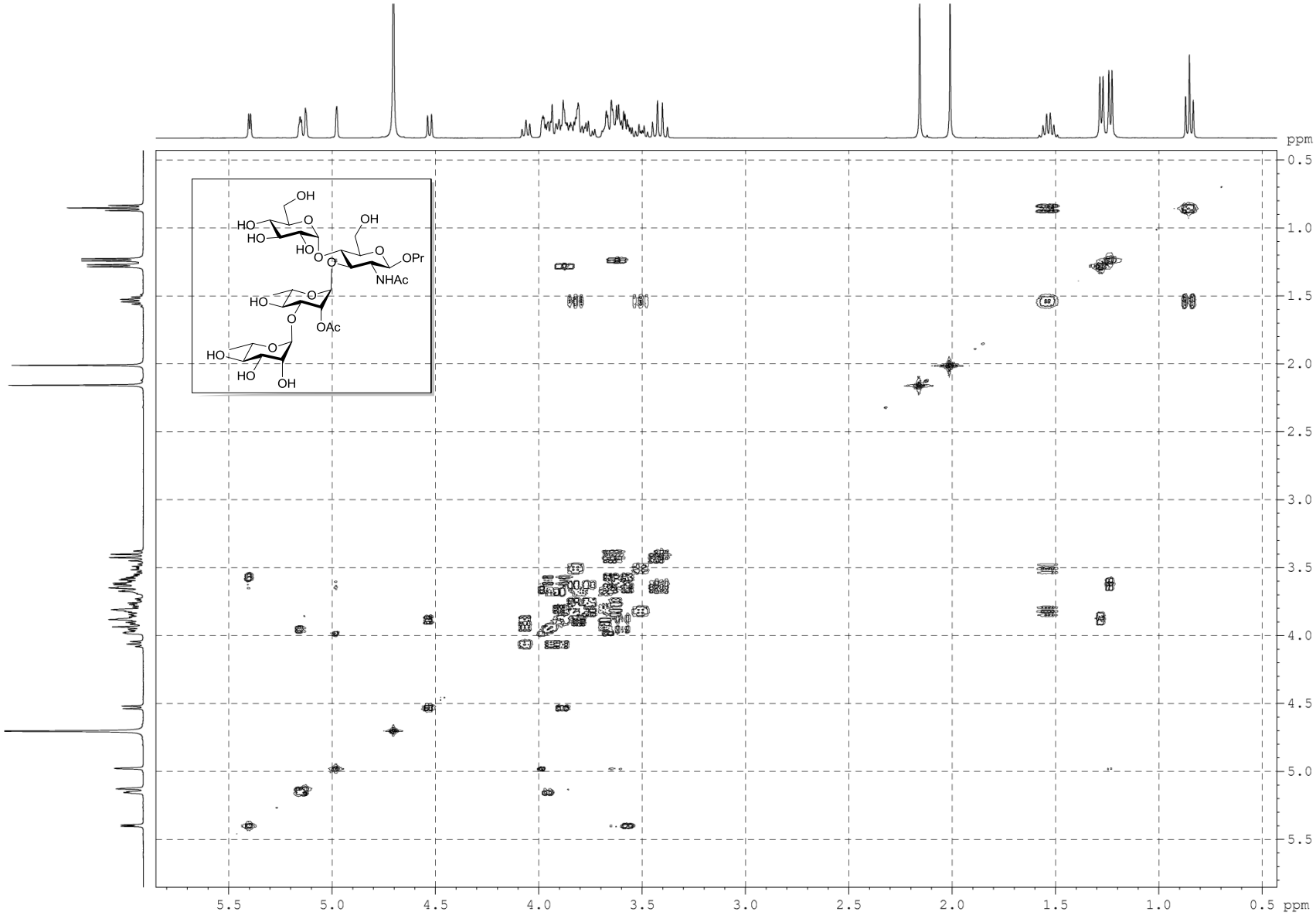

OBn
BnO
BnO
O
BnO
O
O
OBn
O
OAll
NHAc
BnO
O
O
OAc
BnO
O
BnO
OH
ppm
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
ppm

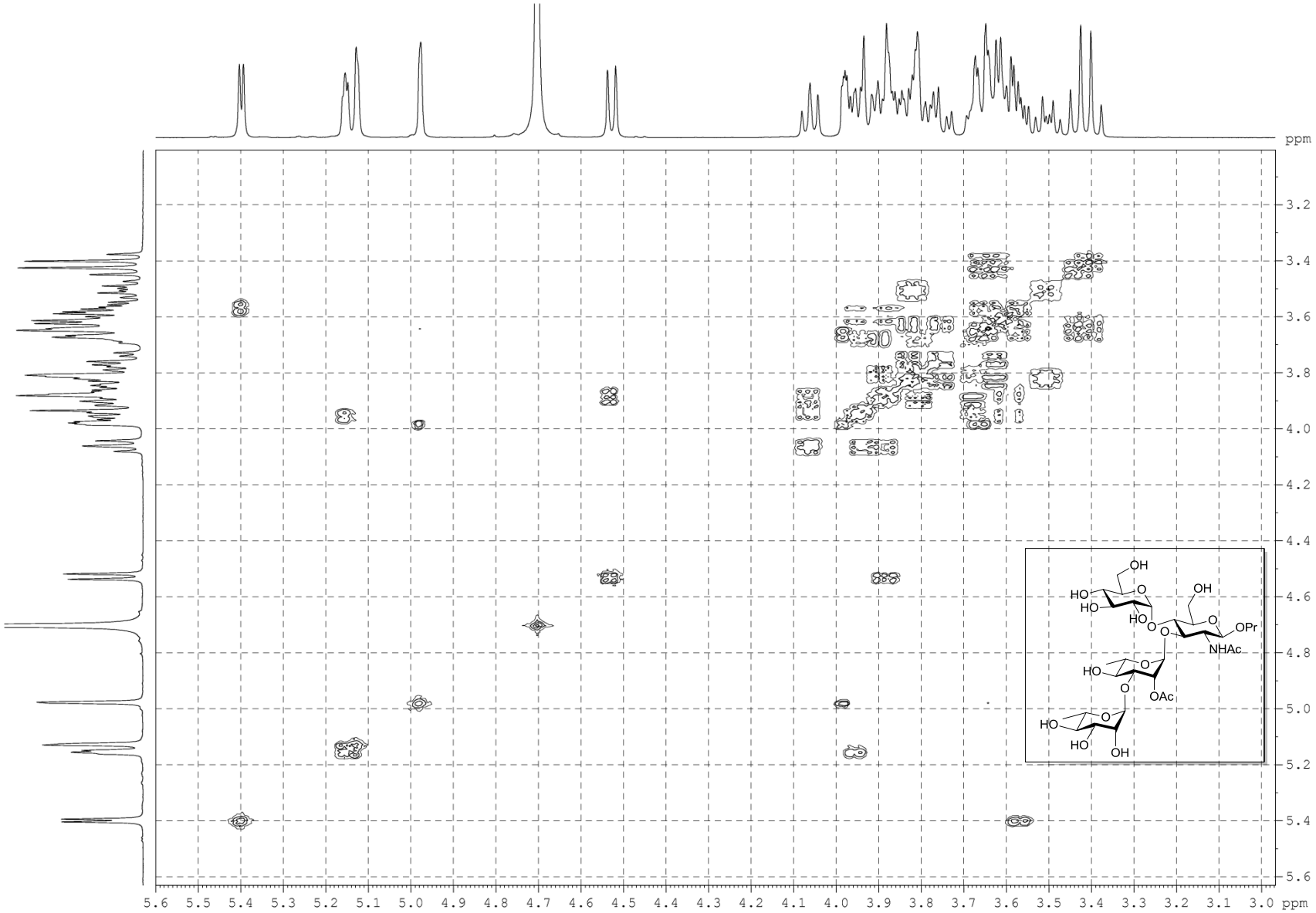

OBn
BnO
BnO
BnO
O
O
OBn
O
O
OAll
NHAc
BnO
O
O
OAc
BnO
O
BnO
OH
ppm
45
50
55
60
65
70
75
80
85
90
95
100
105
5.4
5.3
5.2
5.1
5.0
4.9
4.8
4.7
4.6
4.5
4.4
4.3
4.2
4.1
4.0
3.9
3.8
3.7
3.6
3.5
3.4
3.3
ppm

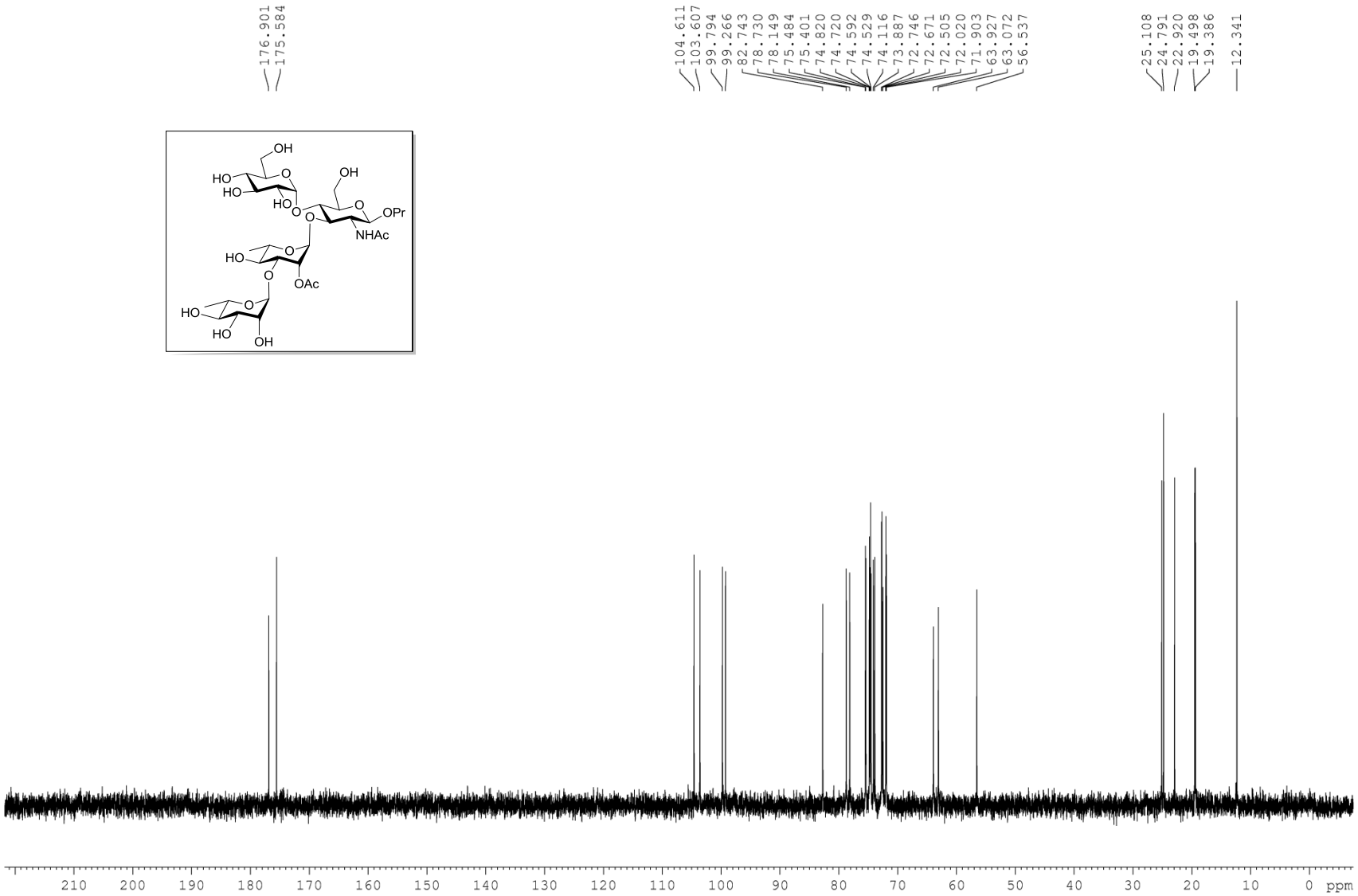
Compound 46: **Propyl α-L-rhamnopyranosyl-(1→3)-(2-*O*-acetyl-α-L-rhamnopyranosyl)-(1→3)-[α-D-glucopyranosyl-(1→4)]-2-acetamido-2-deoxy-β-D-glucopyranoside**

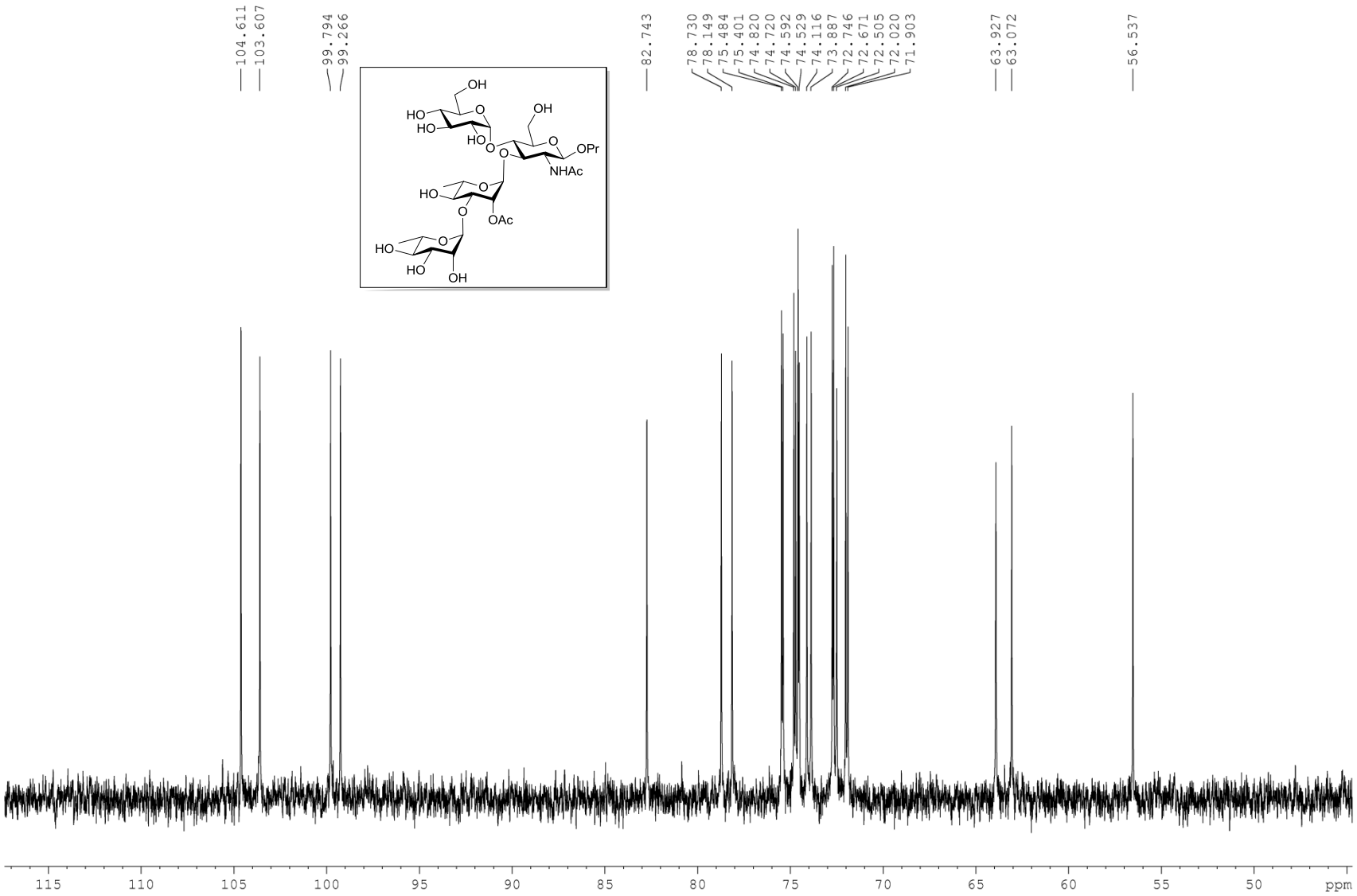


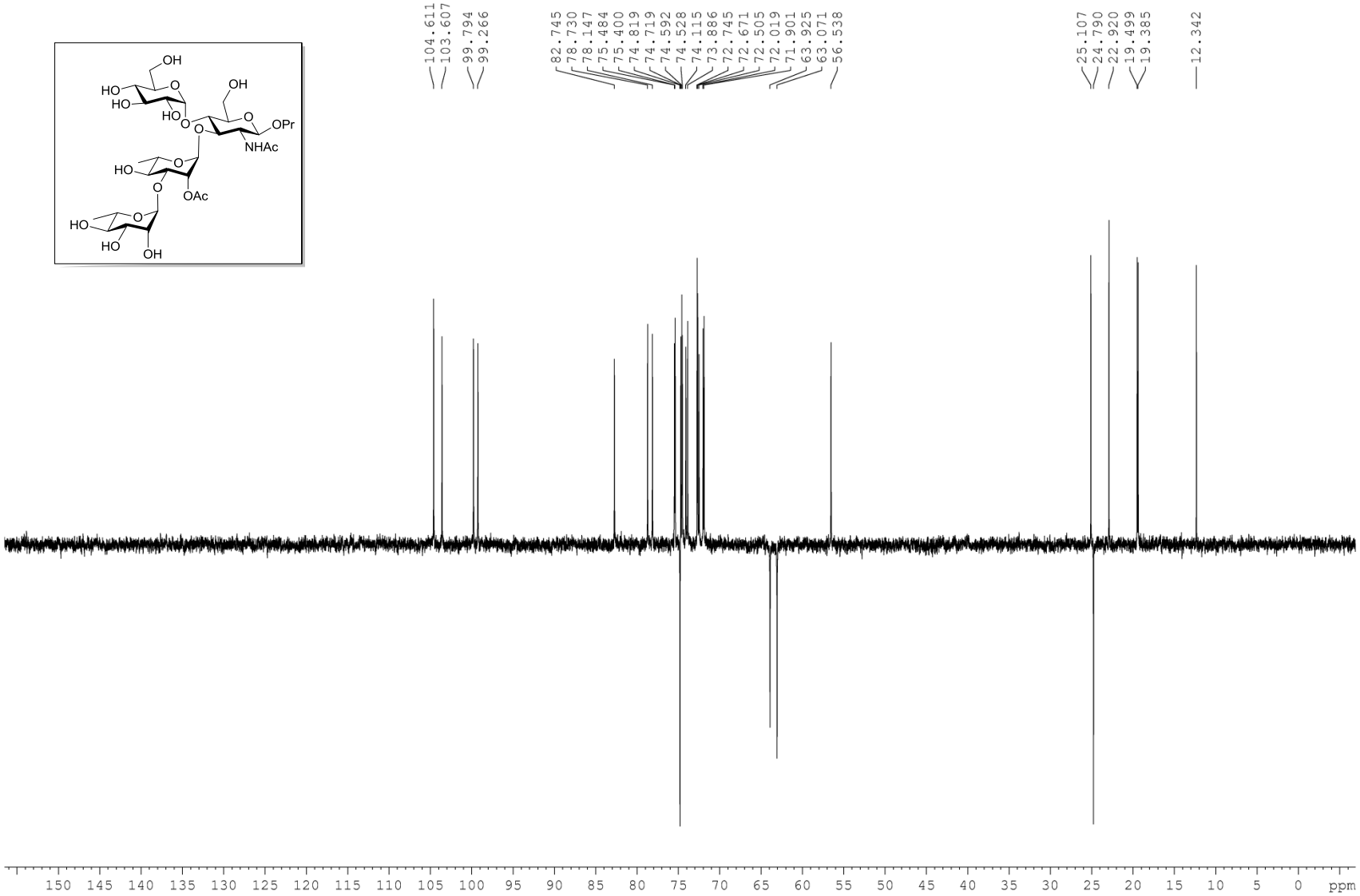

4.0805
4.0614
4.0430
3.9861
3.9826
3.9790
3.9746
3.9666
3.9544
3.9424
3.9349
3.9162
3.9015
3.8908
3.8815
3.8763
3.8662
3.8612
3.8519
3.8454
3.8406
3.8294
3.8208
3.8138
3.8088
3.7897
3.7784
3.7714
3.7595
3.7402
3.7286
3.6931
3.6727
3.6668
3.6482
3.6424
3.6241
3.6133
3.5995
3.5889
3.5822
3.5722
3.5656
3.5575
3.5477
3.5311
3.5148
3.5064
3.4984
3.4900
3.4734
3.4492
3.4251
3.4011
3.3768
OH
HO
HO
HO
O
OH
O
OPr
NHAc
HO
O
OAc
HO
HO
OH
1.07
10.46
10.56
4.25
4.20
4.15
4.10
4.05
4.00
3.95
3.90
3.85
3.80
3.75
3.70
3.65
3.60
3.55
3.50
3.45
3.40
3.35
3.30
3.25
3.20
3.15
3.10
ppm

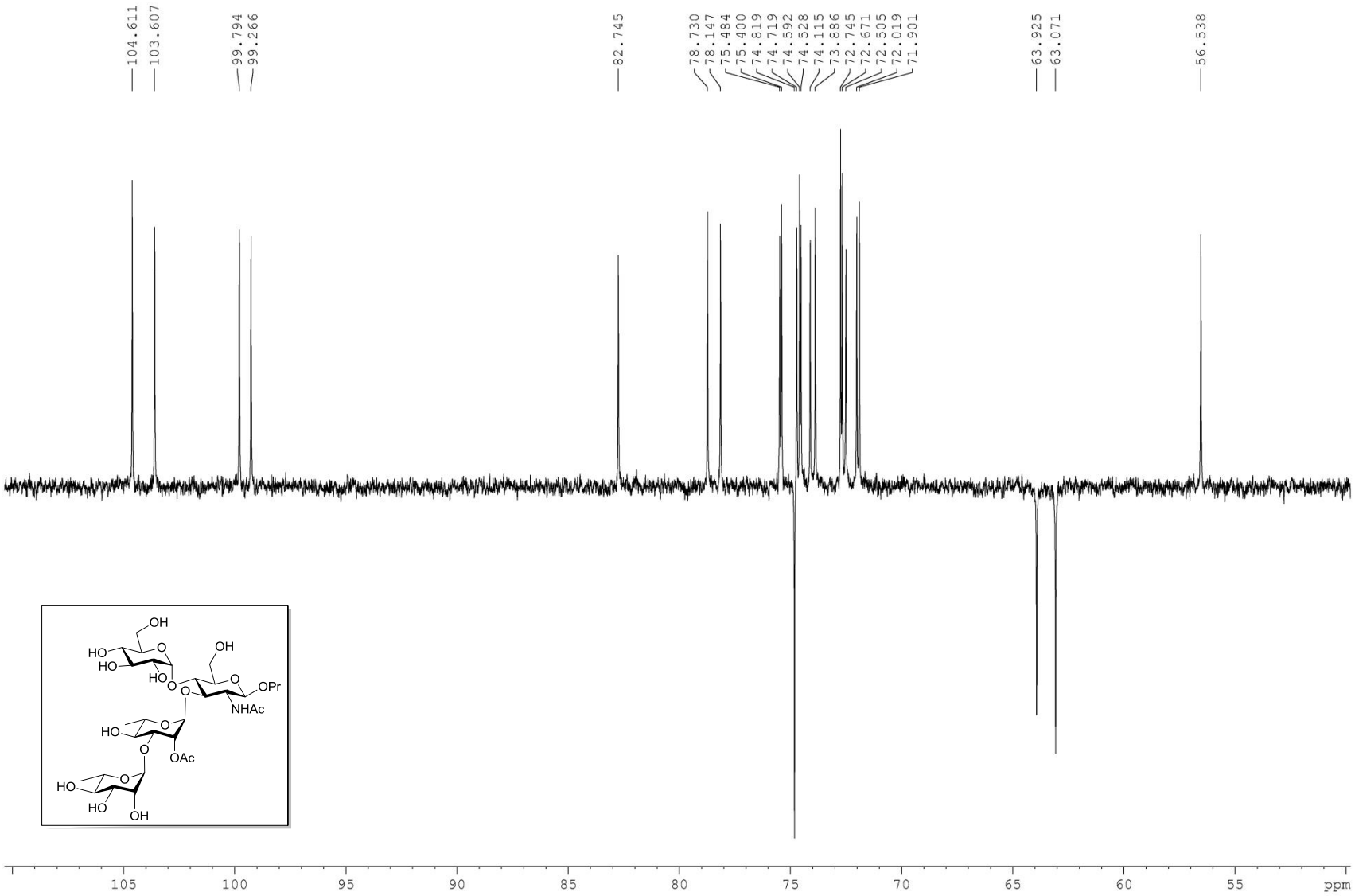

ppm
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
5.5
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5 ppm
OH
HO
HO
HO
O
OH
O
O
OPr
NHAc
HO
O
O
OAc
HO
O
HO
OH

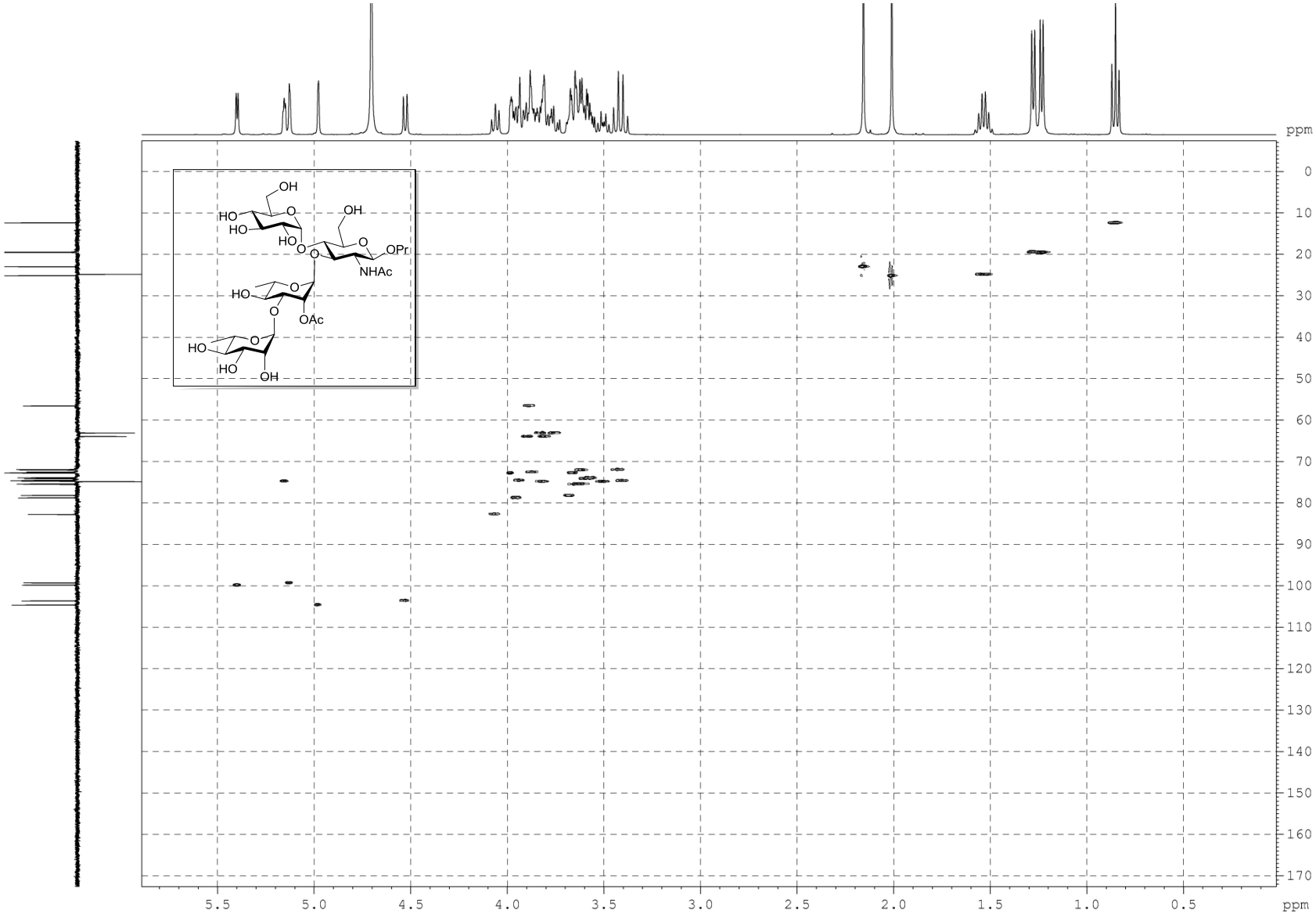

ppm
3.2
3.4
3.6
3.8
4.0
4.2
4.4
4.6
4.8
5.0
5.2
5.4
5.6
5.6 5.5 5.4 5.3 5.2 5.1 5.0 4.9 4.8 4.7 4.6 4.5 4.4 4.3 4.2 4.1 4.0 3.9 3.8 3.7 3.6 3.5 3.4 3.3 3.2 3.1 3.0 ppm
OH
HO
HO
HO
O
O
OH
O
OPr
NHAc
HO
O
O
OAc
HO
O
HO
OH

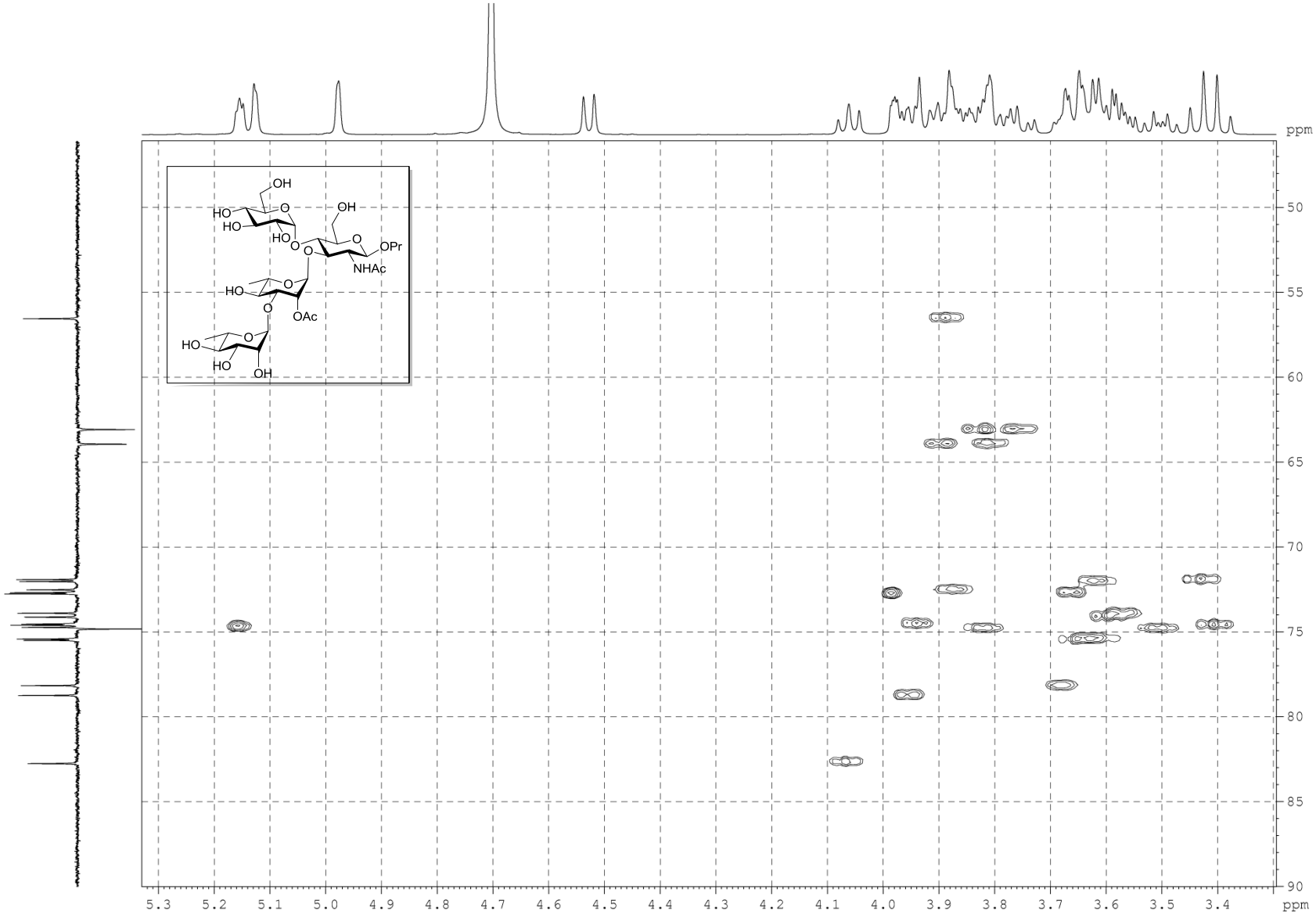

176.901
175.584
104.611
103.607
99.794
99.266
82.743
78.730
78.149
75.484
75.401
74.820
74.720
74.592
74.529
74.116
73.887
72.746
72.671
72.505
72.020
71.903
63.927
63.072
56.537
25.108
24.791
22.920
19.498
19.386
12.341
OH
HO
HO
HO
O
OH
O
OPr
NHAc
HO
O
OAc
HO
O
HO
OH
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 ppm

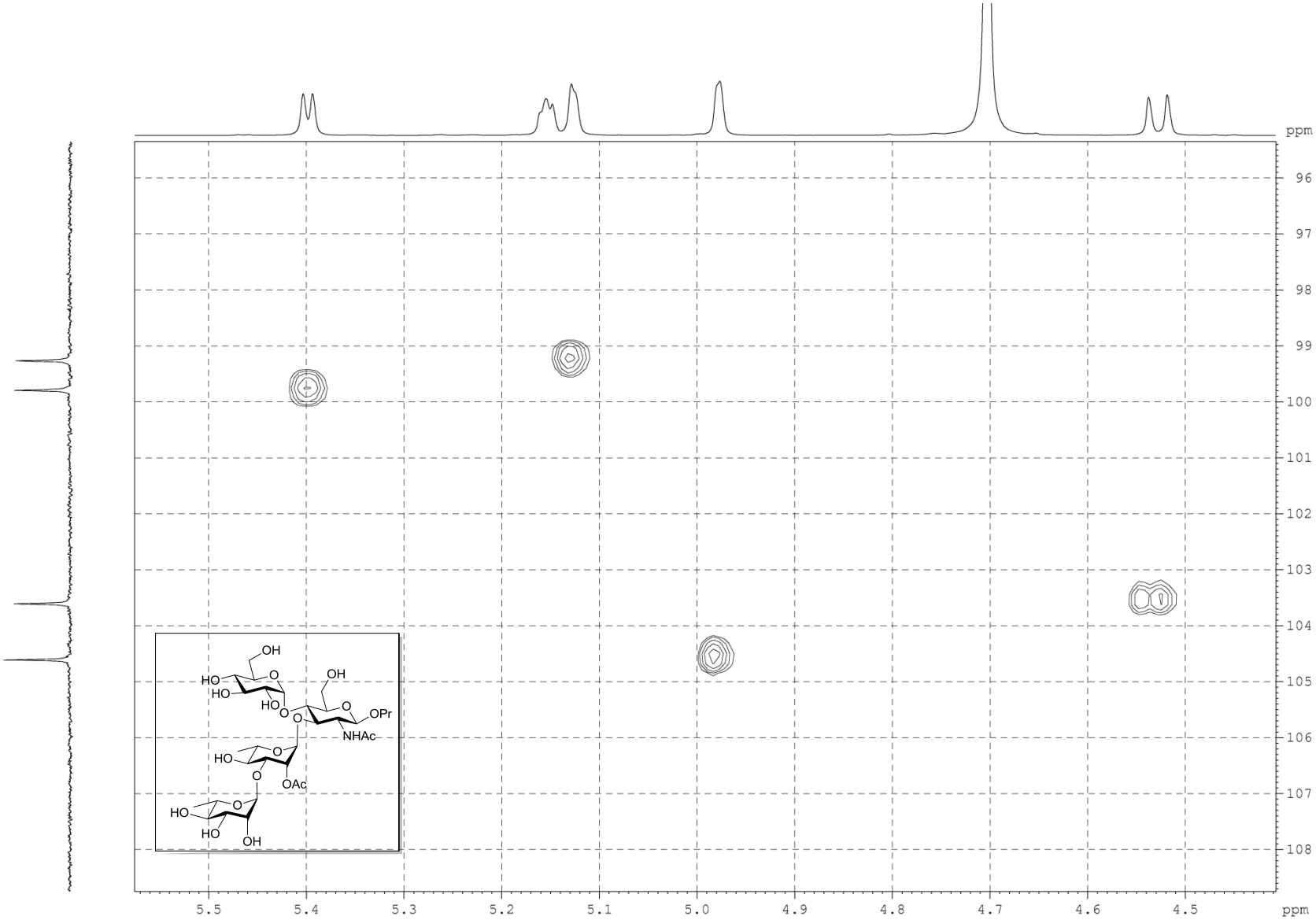

104.611
103.607
99.794
99.266
82.743
78.730
78.149
75.484
75.401
74.820
74.720
74.592
74.529
74.116
73.887
72.746
72.671
72.505
72.020
71.903
63.927
63.072
56.537
OH
HO
HO
HO
O
OH
O
OPr
NHAc
HO
O
O
OAc
HO
O
HO
OH
115
110
105
100
95
90
85
80
75
70
65
60
55
50
ppm


104.611
103.607
99.794
99.266
82.745
78.730
78.147
75.484
75.400
74.819
74.719
74.592
74.528
74.115
73.886
72.745
72.671
72.505
72.019
71.901
63.925
63.071
56.538
25.107
24.790
22.920
19.499
19.385
12.342
OH
HO
HO
HO
O
OH
O
OPr
NHAc
HO
O
OAc
HO
HO
OH
150 145 140 135 130 125 120 115 110 105 100 95 90 85 80 75 70 65 60 55 50 45 40 35 30 25 20 15 10 5 0 ppm

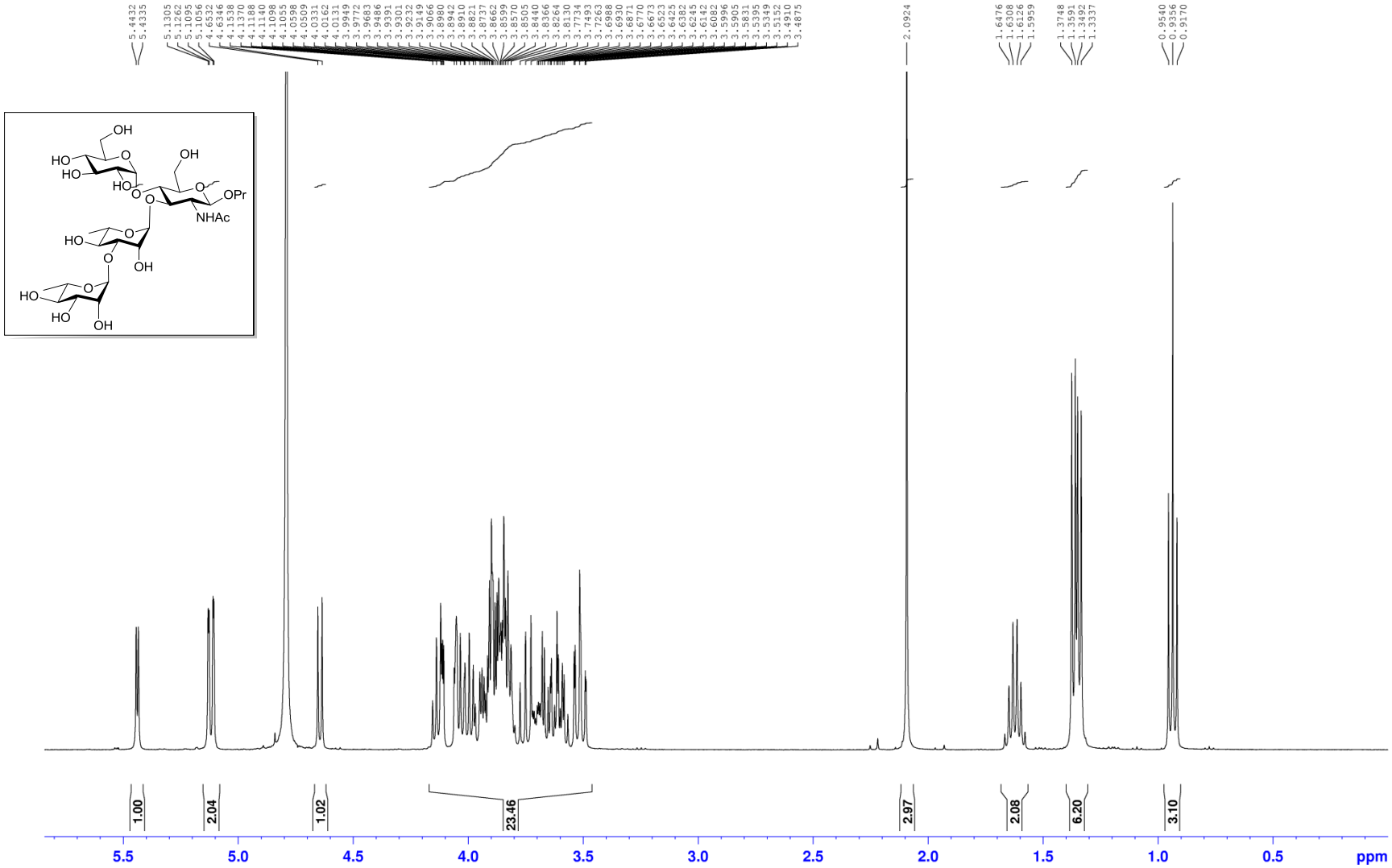

104.611
103.607
99.794
99.266
82.745
78.730
78.147
75.484
75.400
74.819
74.719
74.592
74.528
74.115
73.886
72.745
72.671
72.505
72.019
71.901
63.925
63.071
56.538
OH
HO
HO
HO
O
OH
O
OPr
NHAc
HO
O
OAc
HO
HO
OH
105
100
95
90
85
80
75
70
65
60
55
ppm

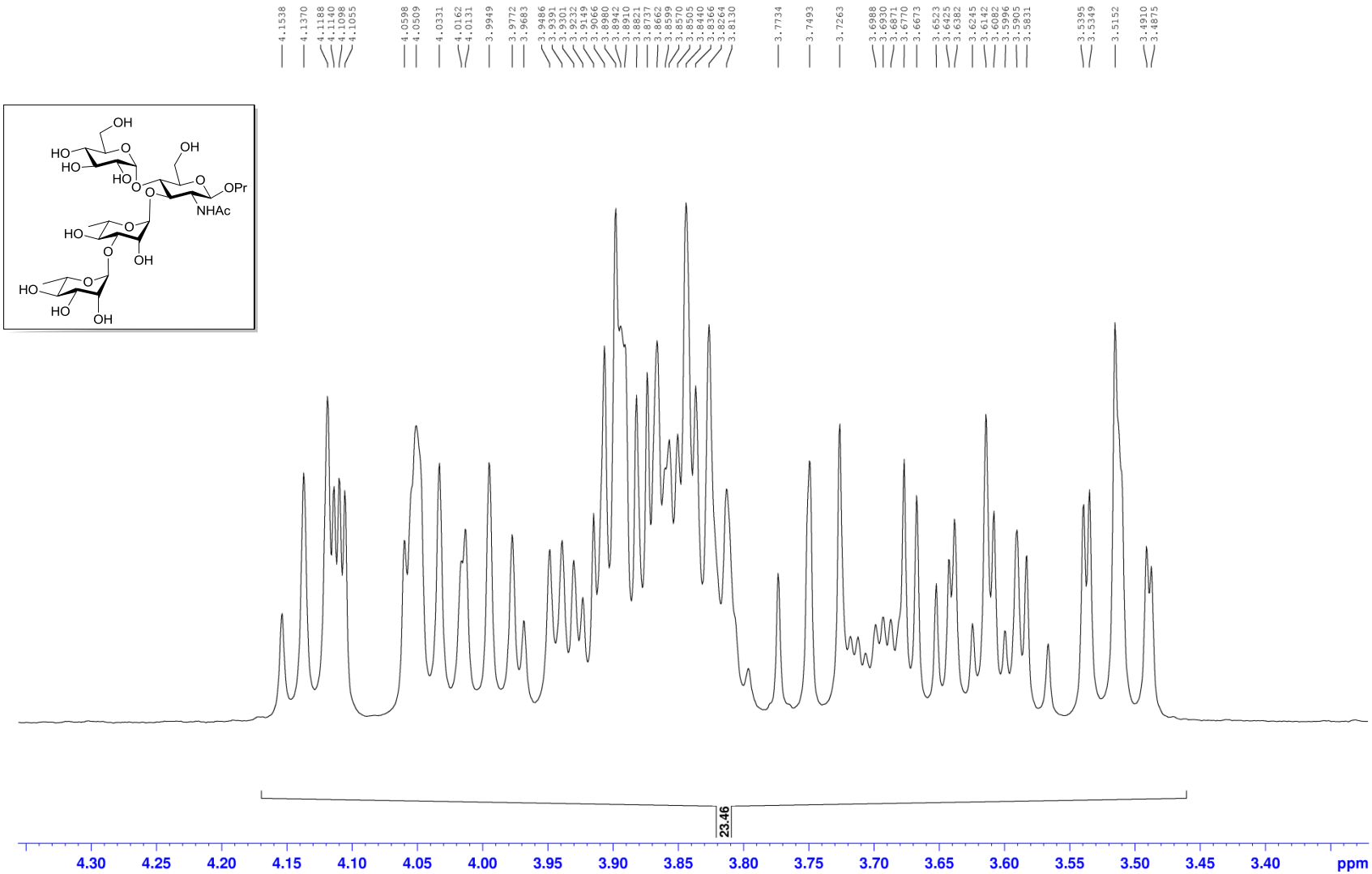

OH
HO
HO
HO
O
OH
O
O
OPr
NHAc
HO
O
O
OAc
HO
O
HO
OH
ppm
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
ppm

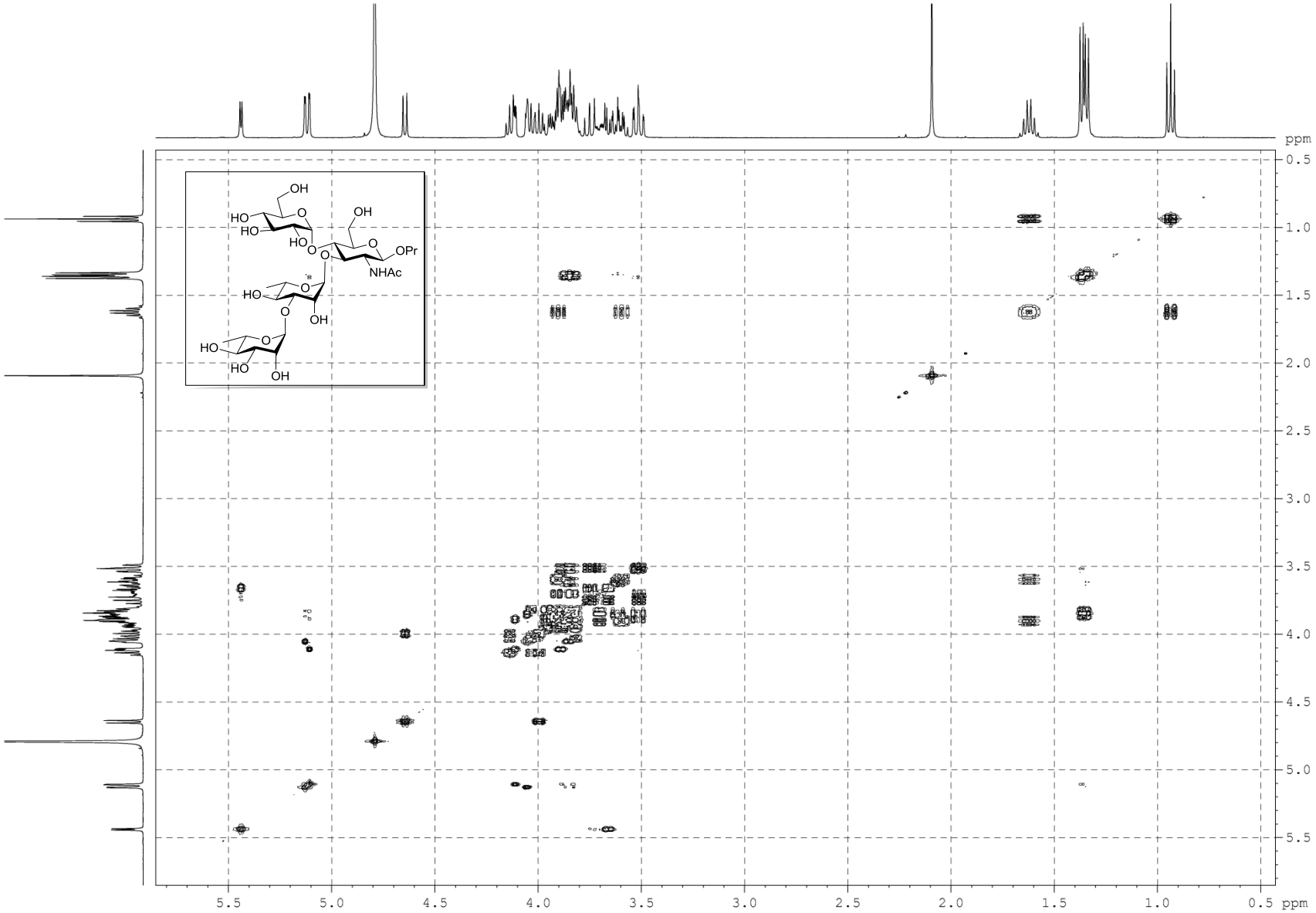

OH
HO
HO
O
HO
O
OH
O
OPr
NHAc
HO
O
O
OAc
HO
O
HO
OH
ppm
50
55
60
65
70
75
80
85
90
5.3
5.2
5.1
5.0
4.9
4.8
4.7
4.6
4.5
4.4
4.3
4.2
4.1
4.0
3.9
3.8
3.7
3.6
3.5
3.4
ppm

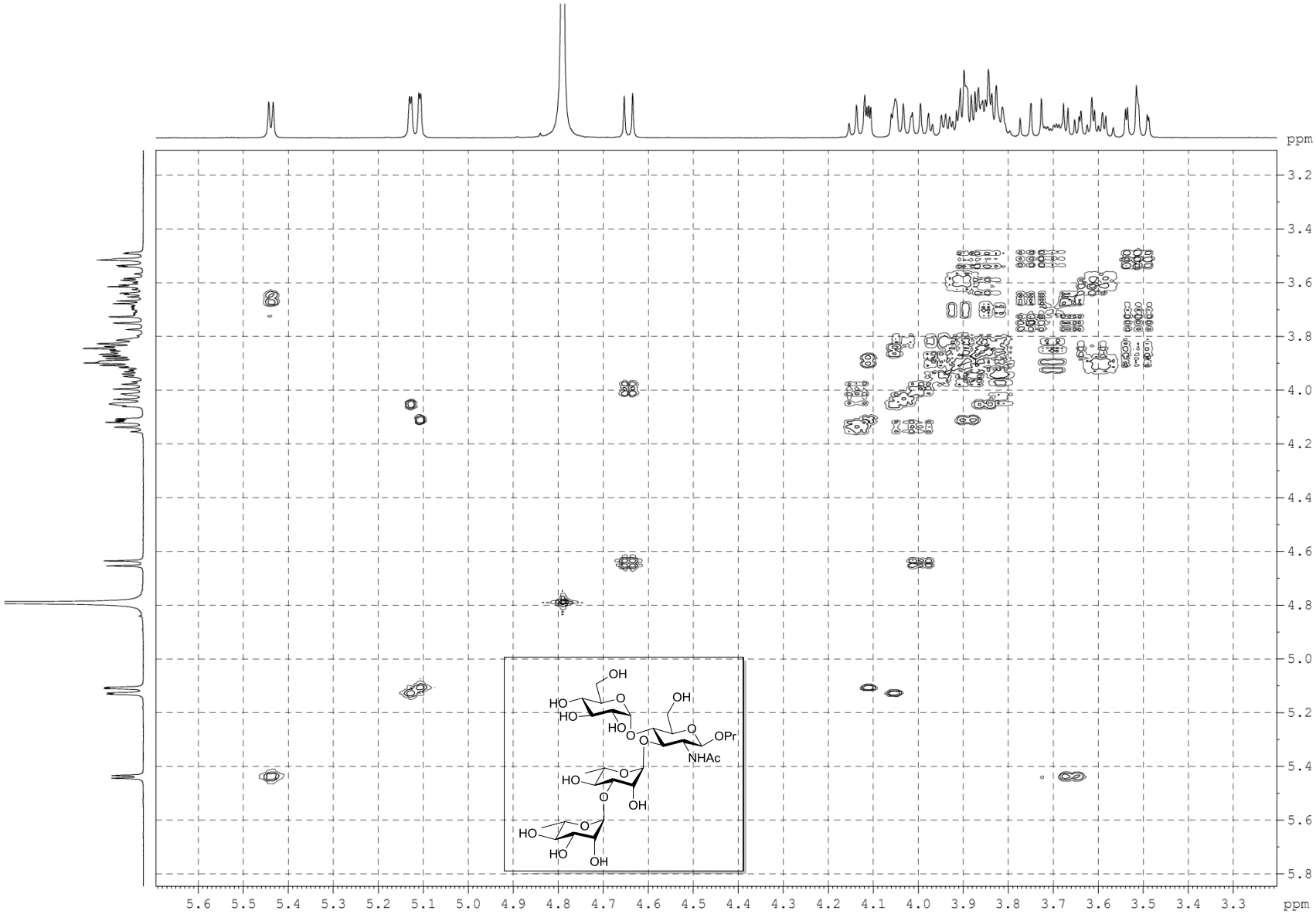

ppm
96
97
98
99
100
101
102
103
104
105
106
107
108
5.5
5.4
5.3
5.2
5.1
5.0
4.9
4.8
4.7
4.6
4.5
ppm
OH
HO
HO
HO
O
O
OH
O
OPr
NHAc
HO
O
O
OAc
O
HO
O
HO
OH

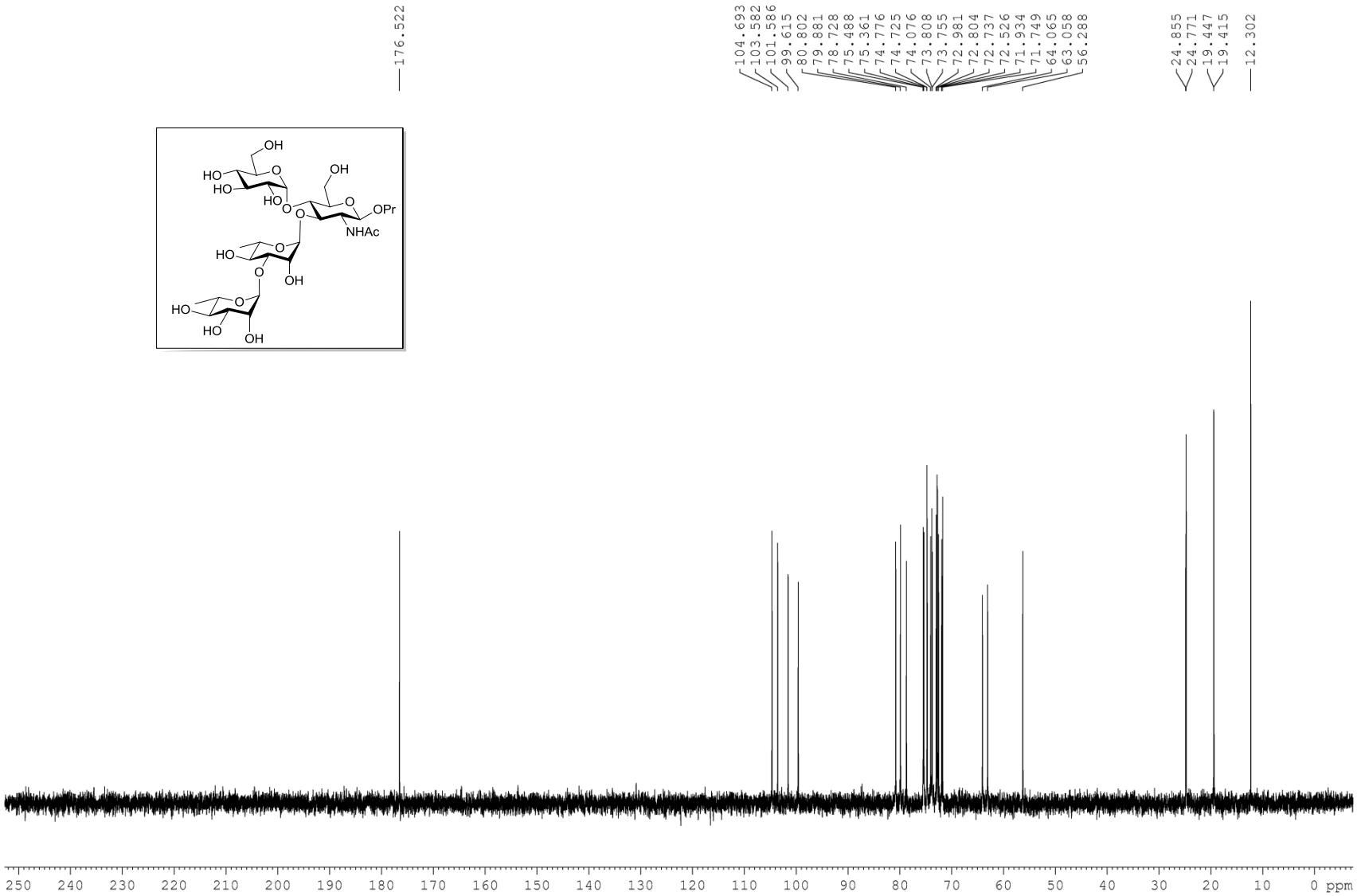
Compound 47: **Propyl α-L-rhamnopyranosyl-(1→3)-α-L-rhamnopyranosyl-(1→3)-[α-D-glucopyranosyl-(1→4)]-2-acetamido-2-deoxy-β-D-glucopyranoside**

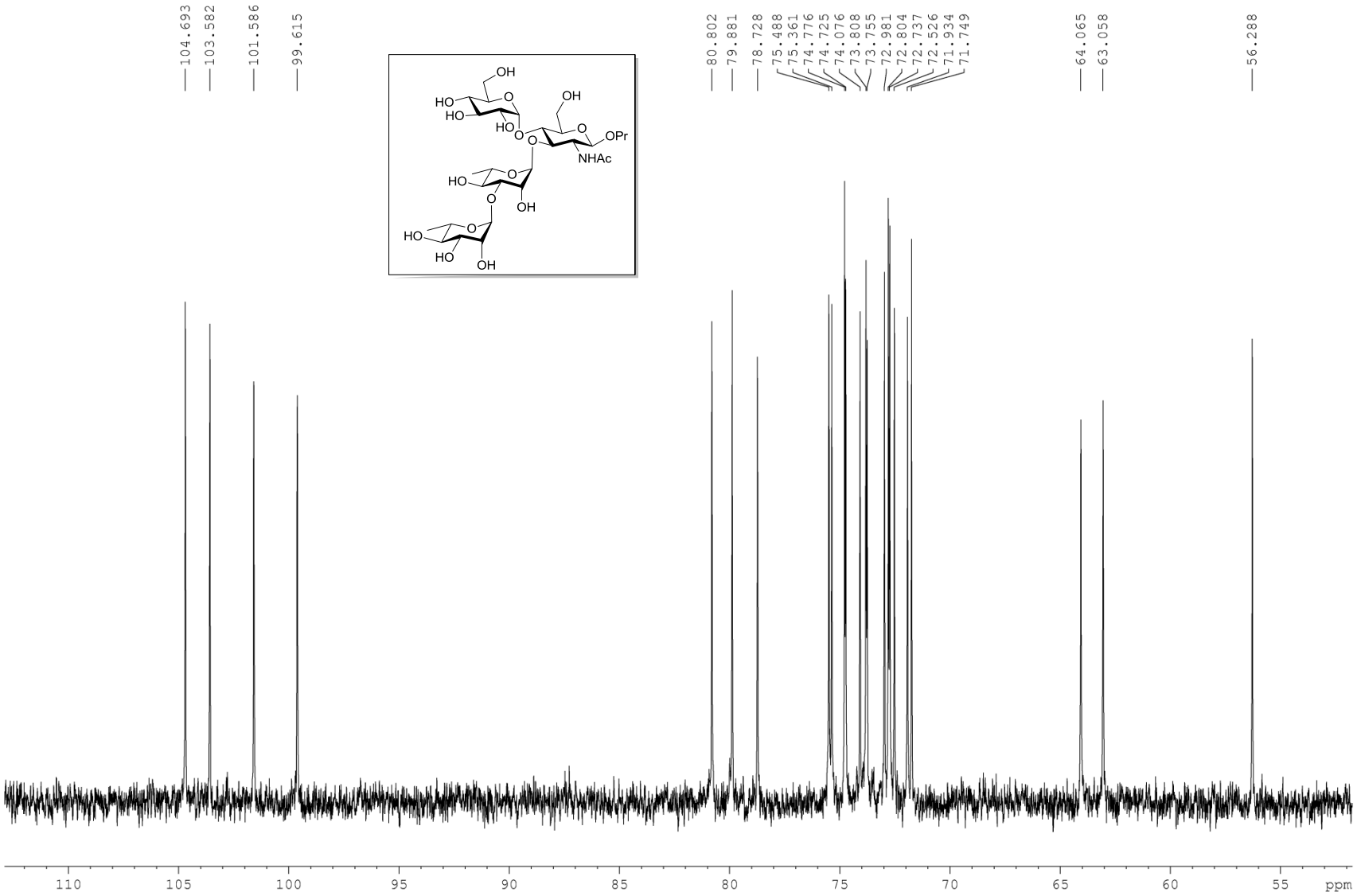



4.1538
4.1370
4.1188
4.1140
4.1098
4.1055
4.0598
4.0509
4.0331
4.0162
4.0131
3.9949
3.9772
3.9683
3.9486
3.9391
3.9301
3.9232
3.9149
3.9066
3.8980
3.8862
3.8810
3.8821
3.8737
3.8662
3.8599
3.8570
3.8505
3.8440
3.8366
3.8264
3.8130
3.7734
3.7493
3.7263
3.6988
3.6930
3.6871
3.6770
3.6673
3.6523
3.6425
3.6382
3.6245
3.6142
3.6082
3.5996
3.5905
3.5831
3.5395
3.5349
3.5152
3.4910
3.4875
OH
HO
HO
HO
O
OH
O
OPr
NHAc
HO
O
O
OH
HO
O
HO
OH
23.46
4.30
4.25
4.20
4.15
4.10
4.05
4.00
3.95
3.90
3.85
3.80
3.75
3.70
3.65
3.60
3.55
3.50
3.45
3.40
ppm


OH
HO
HO
HO
O
OH
O
O
OPr
NHAc
HO
O
OH
O
HO
O
HO
OH
ppm
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
5.5
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5 ppm


ppm
3.2
3.4
3.6
3.8
4.0
4.2
4.4
4.6
4.8
5.0
5.2
5.4
5.6
5.8
5.6 5.5 5.4 5.3 5.2 5.1 5.0 4.9 4.8 4.7 4.6 4.5 4.4 4.3 4.2 4.1 4.0 3.9 3.8 3.7 3.6 3.5 3.4 3.3
ppm
OH
HO
HO
HO
O
O
OH
O
OPr
NHAc
HO
O
O
OH
HO
O
HO
OH


176.522
104.693
103.582
101.586
99.615
80.802
79.881
78.728
75.488
75.361
74.776
74.725
74.076
73.808
73.755
72.981
72.804
72.737
72.526
71.934
71.749
64.065
63.058
56.288
24.855
24.771
19.447
19.415
12.302
OH
HO
HO
HO
O
OH
O
O
OPr
NHAc
HO
O
OH
O
HO
O
HO
OH
250 240 230 220 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 ppm


104.693
103.582
101.586
99.615
80.802
79.881
78.728
75.488
75.361
74.776
74.725
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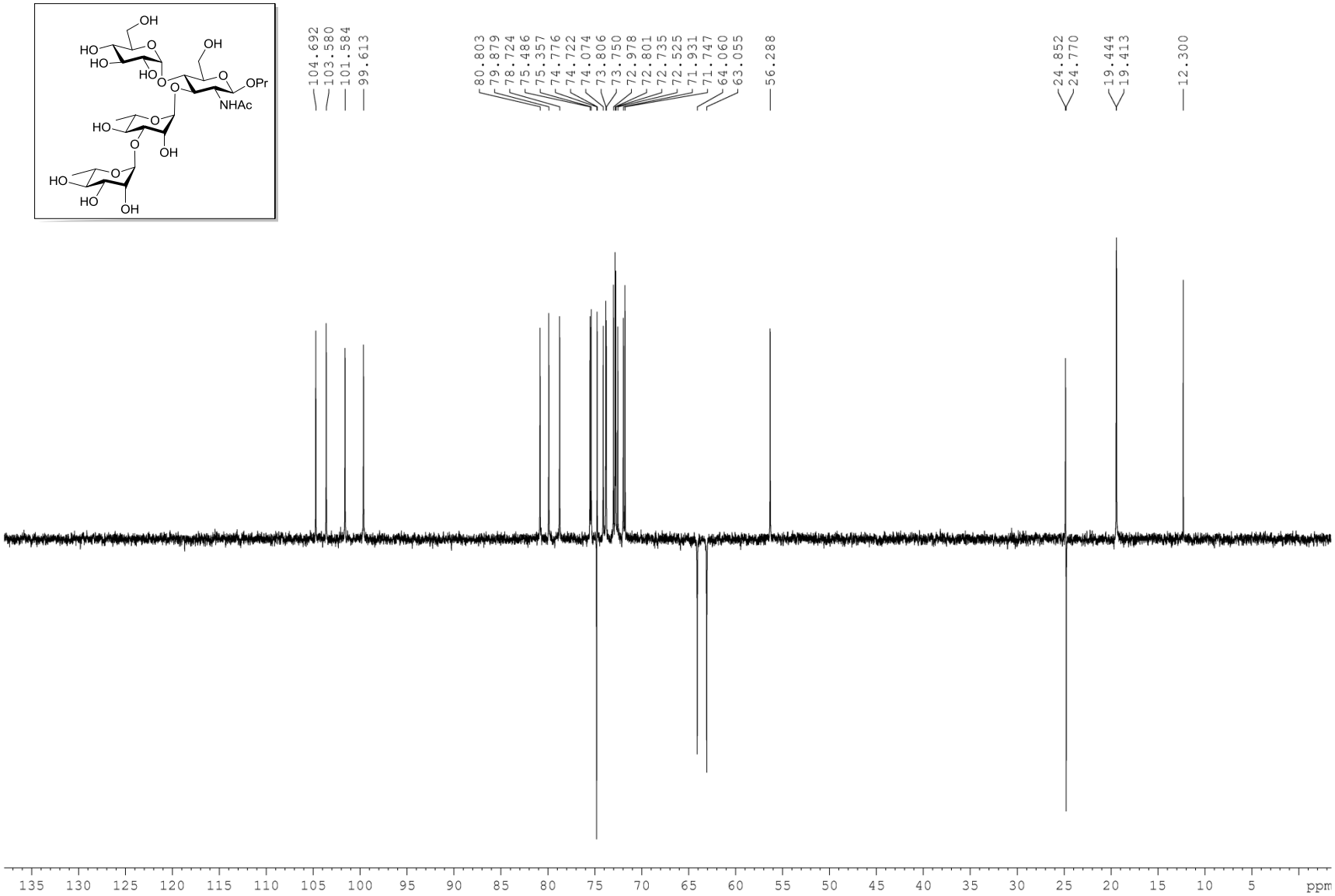
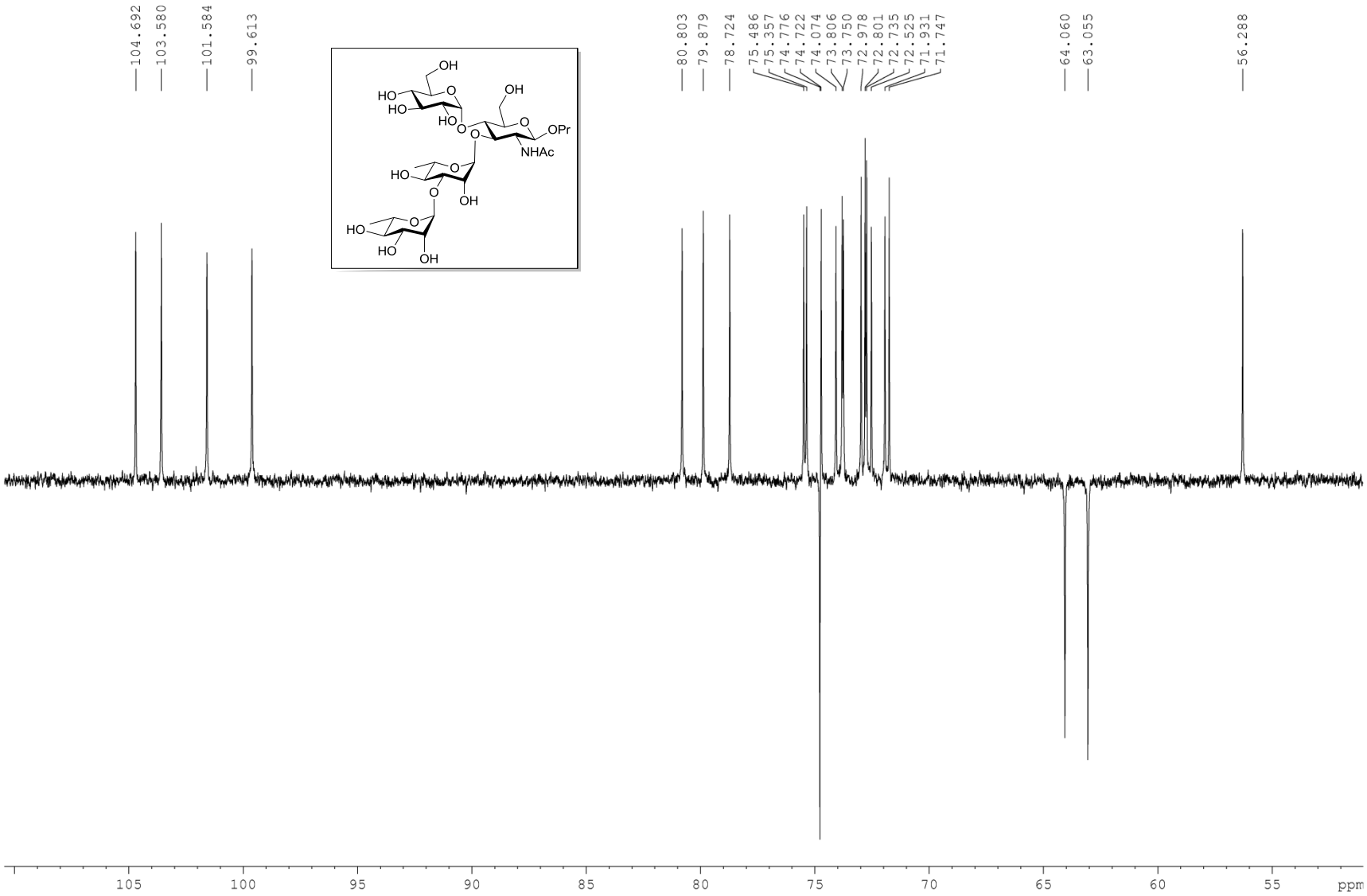
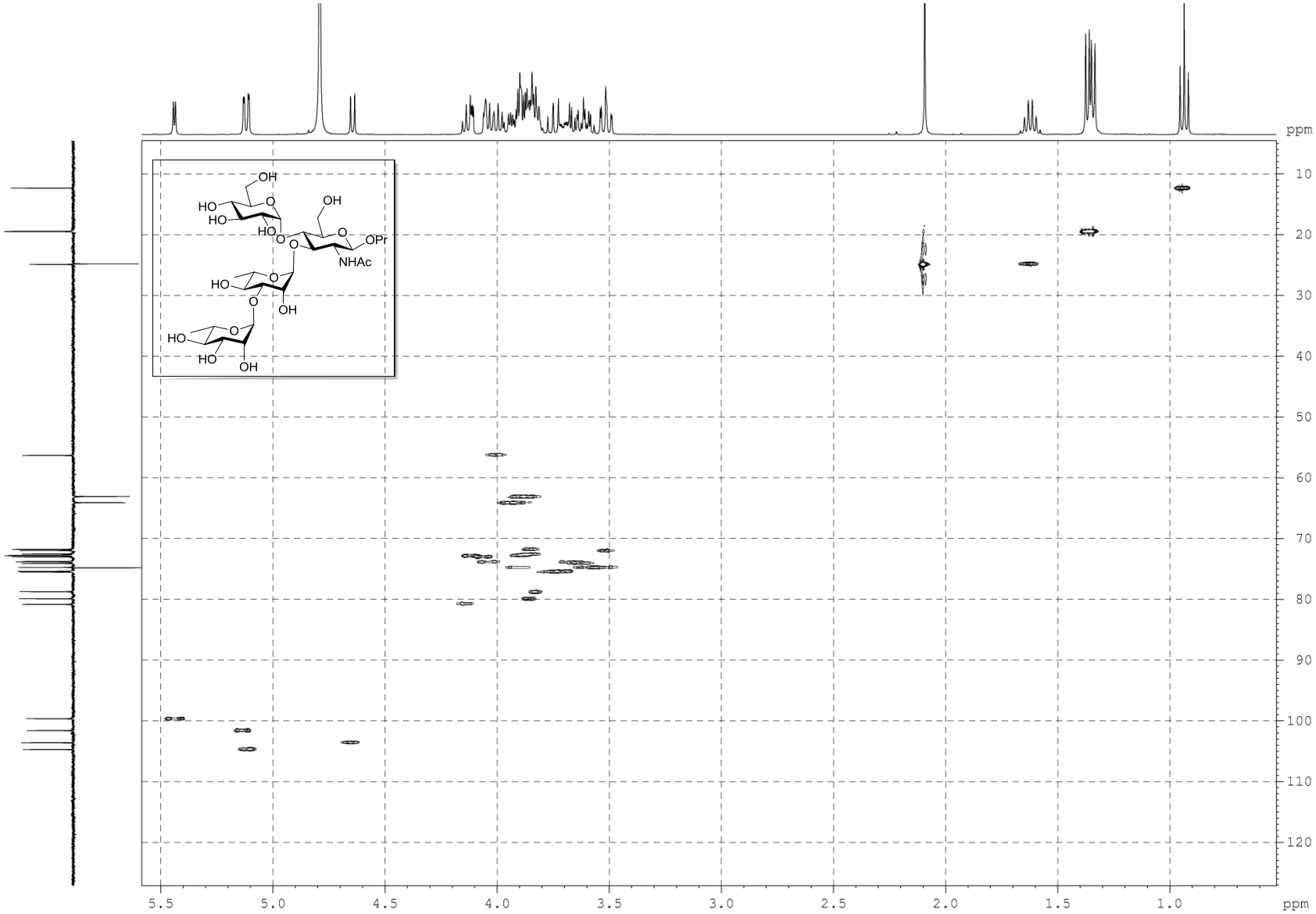
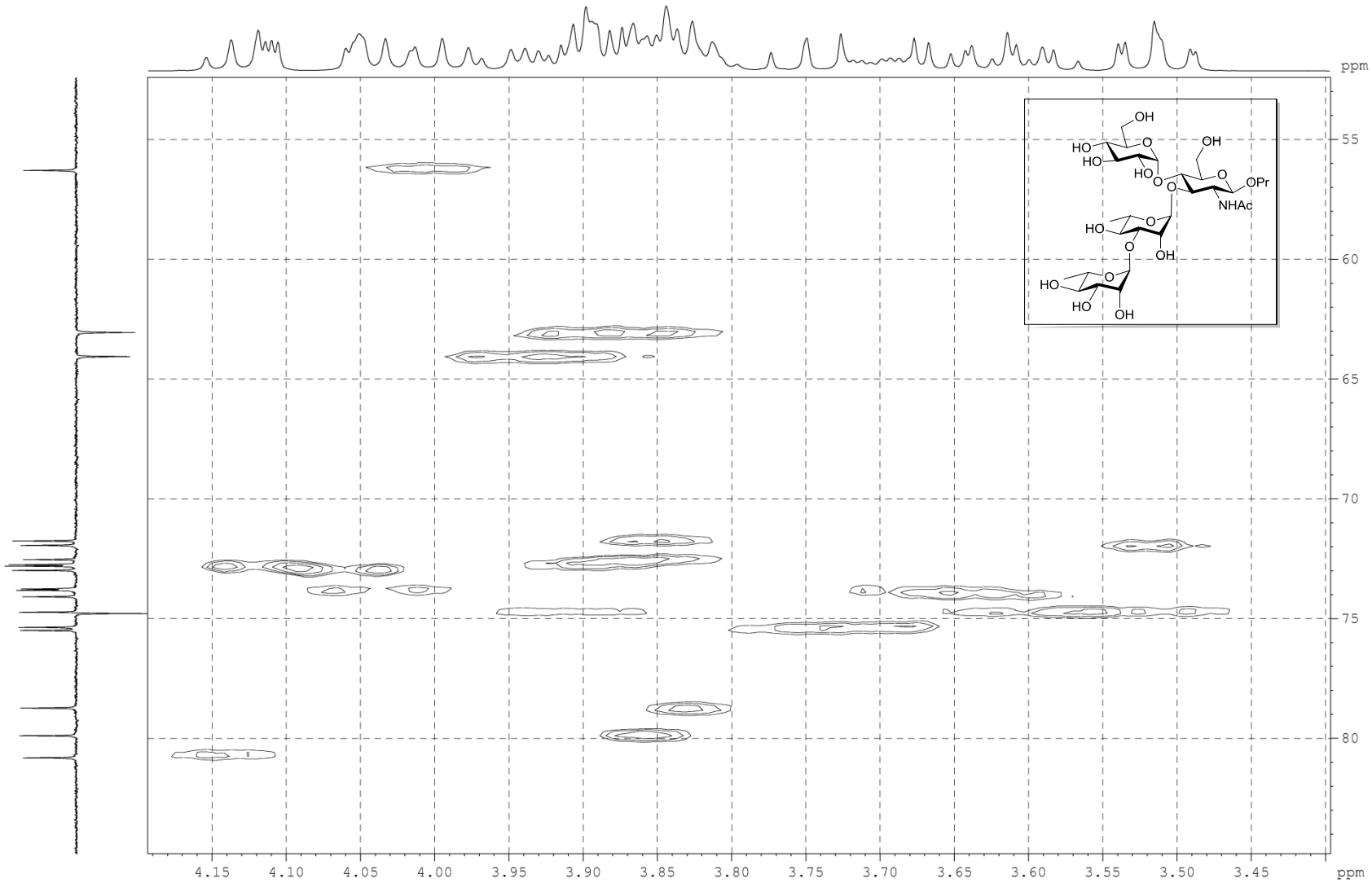
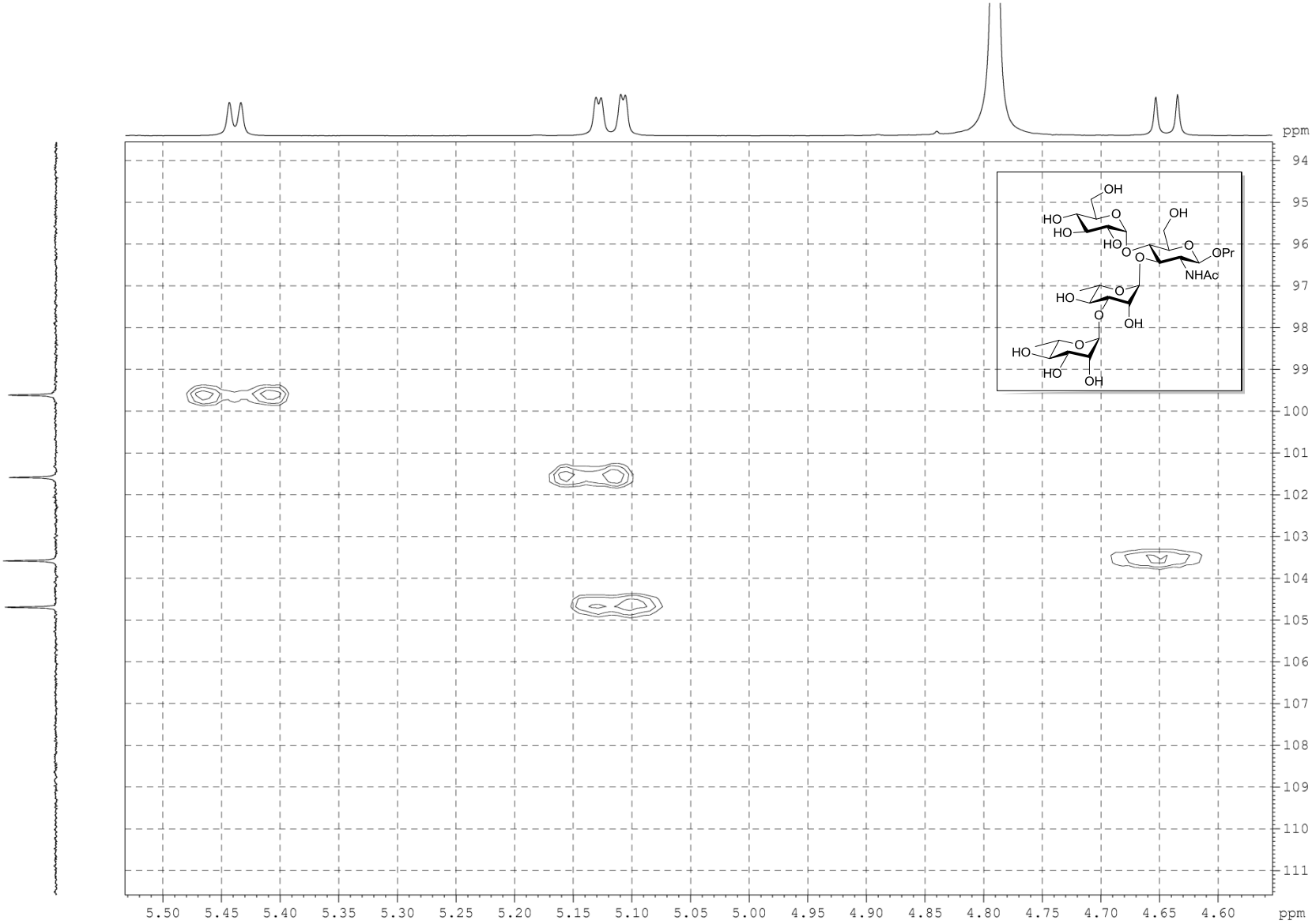
73.808
73.755
72.981
72.804
72.737
72.526
71.934
71.749
64.065
63.058
56.288
OH
HO
HO
HO
O
OH
O
O
OPr
NHAc
HO
O
O
OH
HO
O
HO
OH
110
105
100
95
90
85
80
75
70
65
60
55
ppm


OH
HO
HO
HO
O
OH
O
O
OPr
NHAc
HO
O
O
OH
HO
O
HO
OH
104.692
103.580
101.584
99.613
80.803
79.879
78.724
75.486
75.357
74.776
74.722
74.074
73.806
73.750
72.978
72.801
72.735
72.525
71.931
71.747
64.060
63.055
56.288
24.852
24.770
19.444
19.413
12.300
135 130 125 120 115 110 105 100 95 90 85 80 75 70 65 60 55 50 45 40 35 30 25 20 15 10 5 ppm

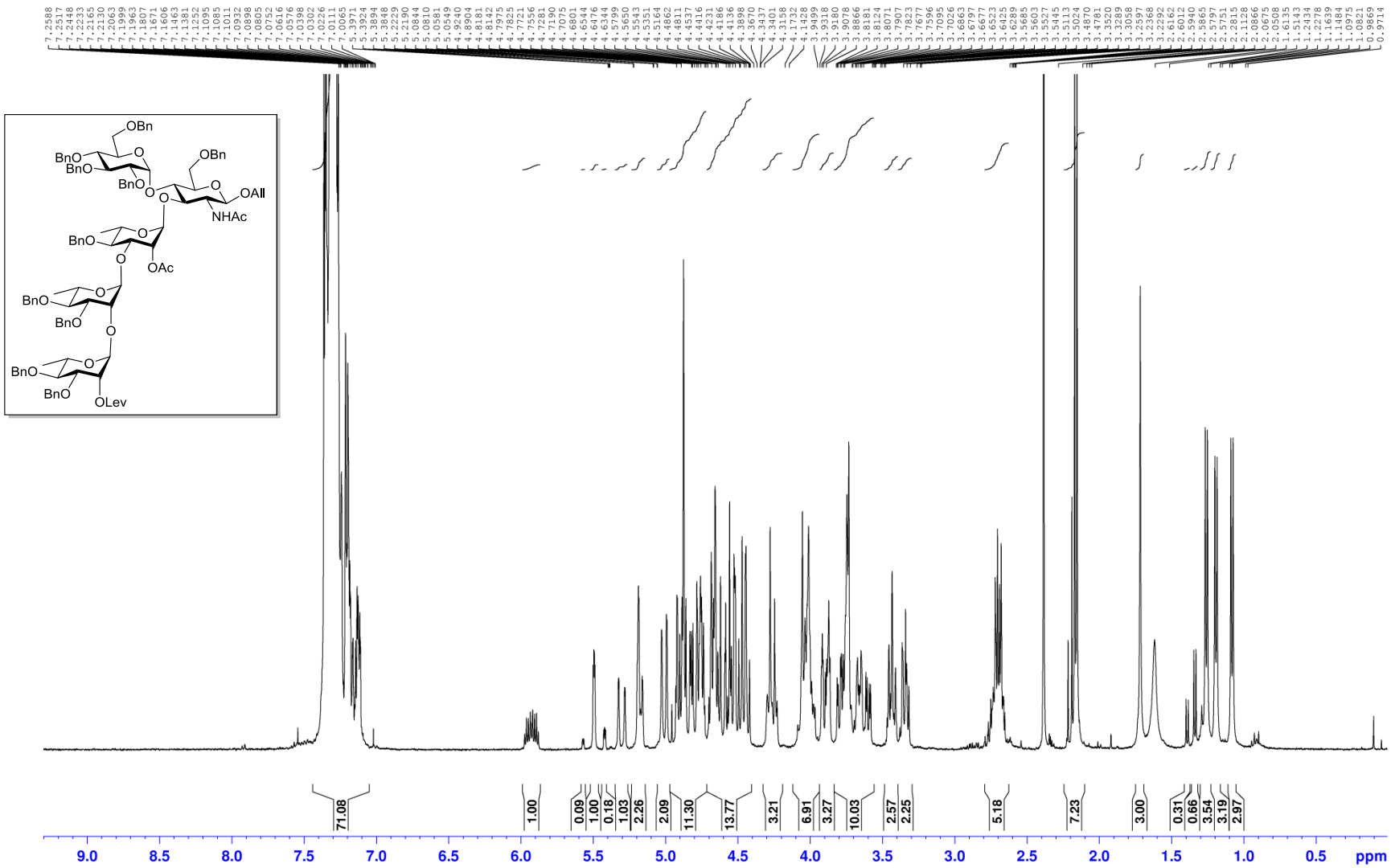

104.692
103.580
101.584
99.613
80.803
79.879
78.724
75.486
75.357
74.776
74.722
74.074
73.806
73.750
72.978
72.801
72.735
72.525
71.931
71.747
64.060
63.055
56.288
OH
HO
HO
HO
O
OH
O
O
OPr
NHAc
HO
O
O
OH
HO
O
HO
OH
105
100
95
90
85
80
75
70
65
60
55
ppm

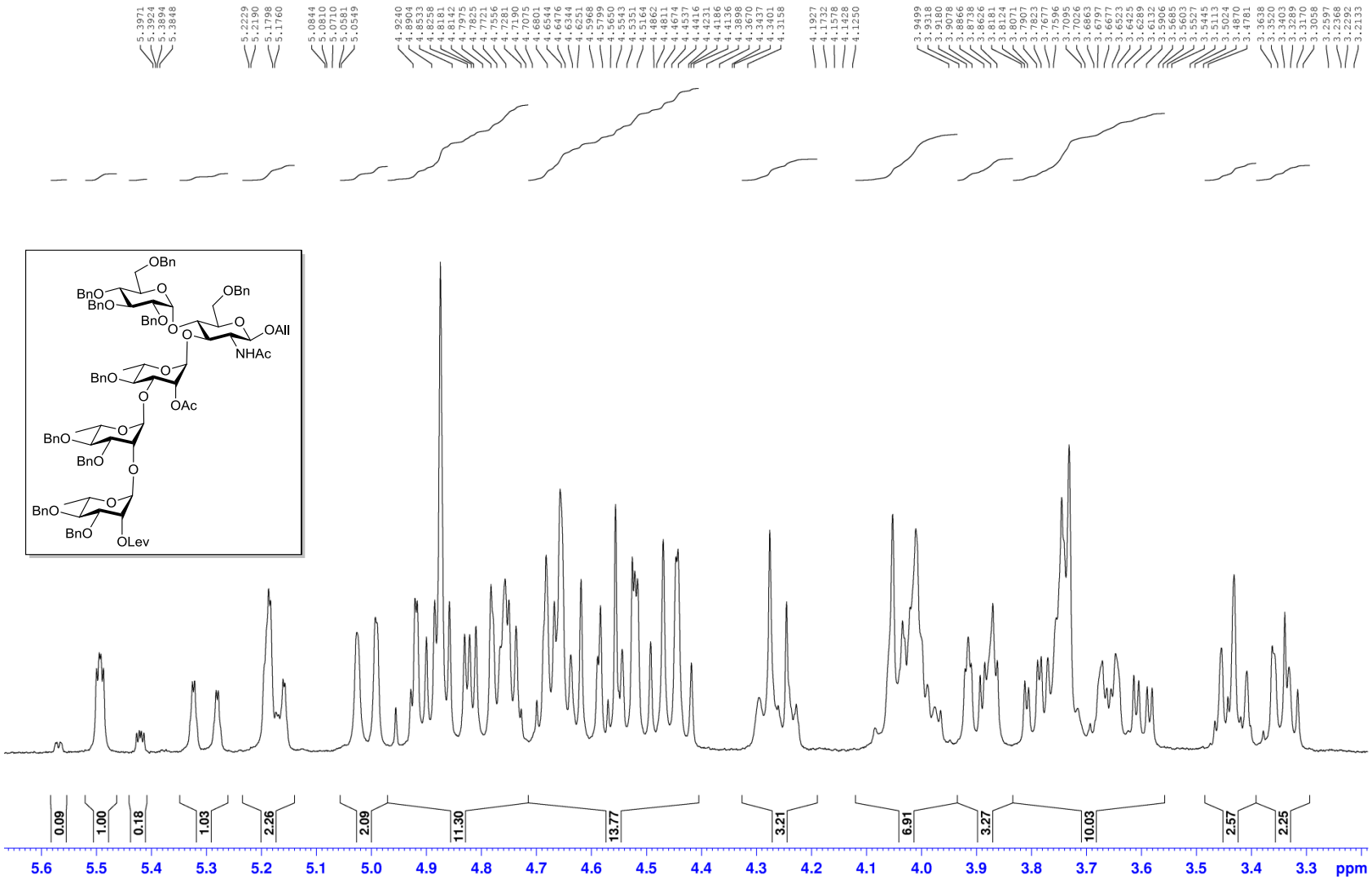

OH
HO
HO
HO
O
OH
O
O
O
OPr
NHAc
HO
O
O
OH
HO
O
HO
OH
ppm
10
20
30
40
50
60
70
80
90
100
110
120
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
ppm

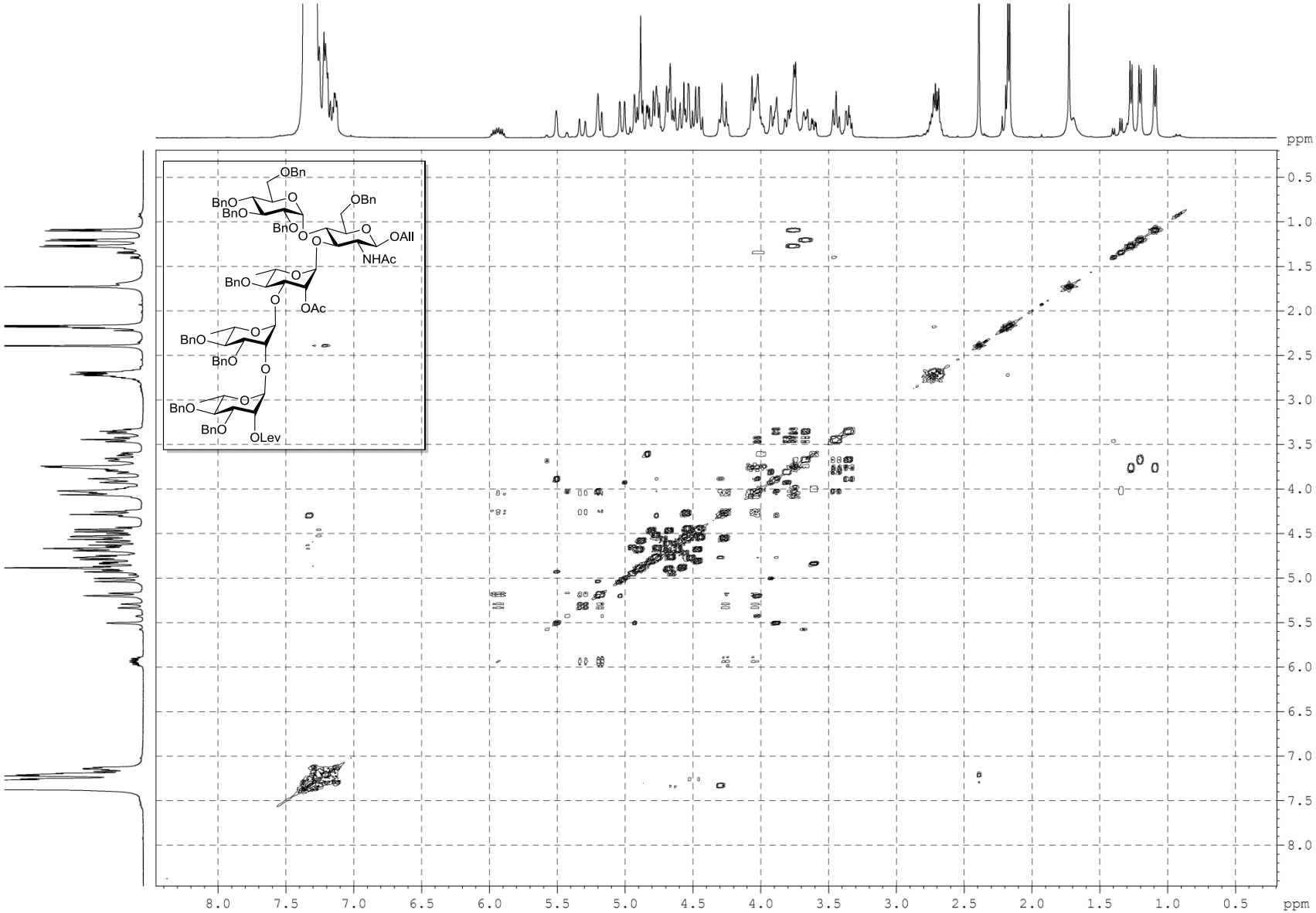

ppm
55
60
65
70
75
80
4.15
4.10
4.05
4.00
3.95
3.90
3.85
3.80
3.75
3.70
3.65
3.60
3.55
3.50
3.45
ppm
OH
HO
HO
HO
O
OH
O
O
OPr
NHAc
HO
O
O
OH
HO
O
HO
OH

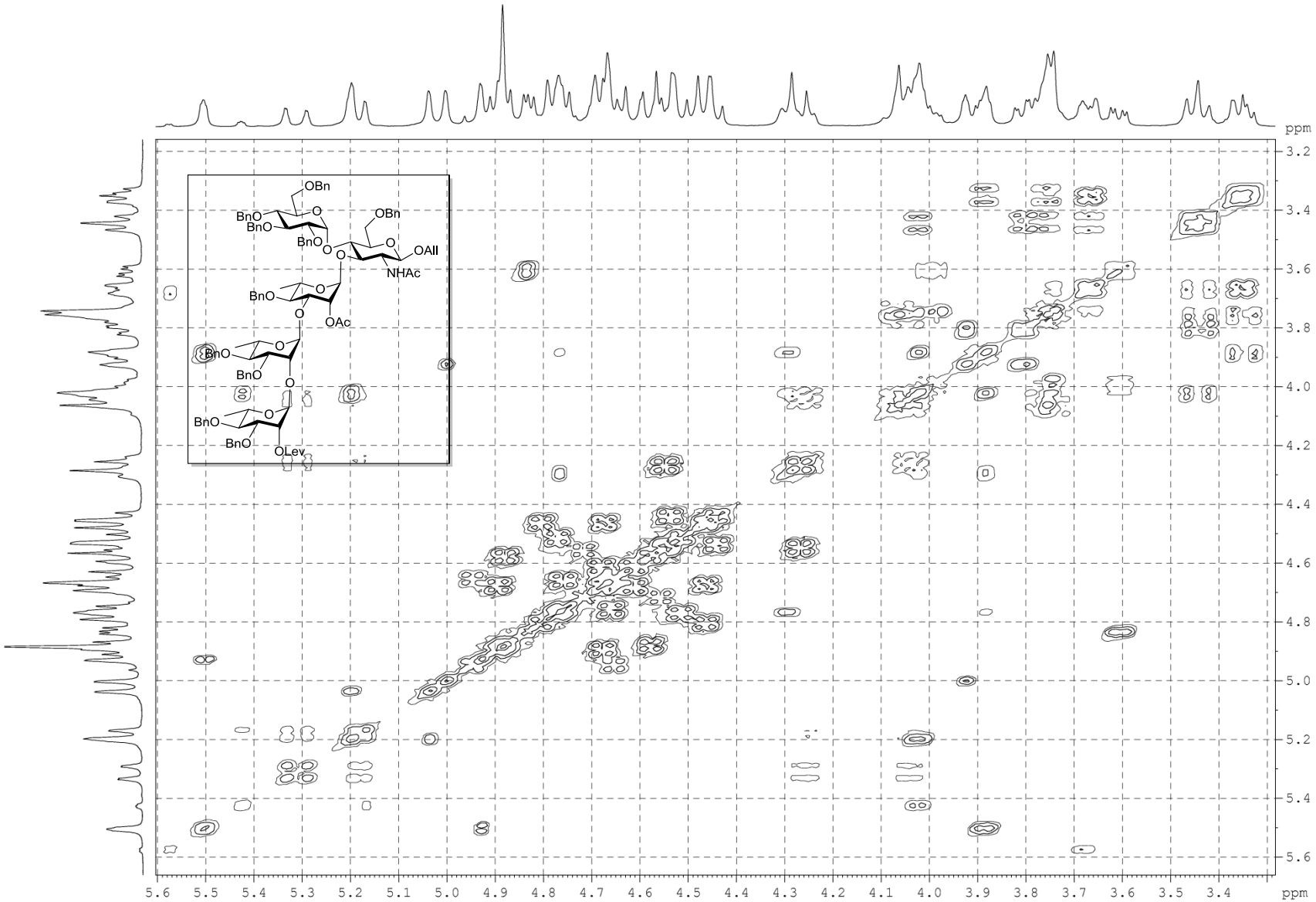

ppm
94
95
96
97
98
99
100
101
102
103
104
105
106
107
108
109
110
111
5.50
5.45
5.40
5.35
5.30
5.25
5.20
5.15
5.10
5.05
5.00
4.95
4.90
4.85
4.80
4.75
4.70
4.65
4.60
ppm
OH
HO
HO
O
HO
O
O
OH
O
OPr
NHAc
HO
O
O
OH
HO
O
HO
OH

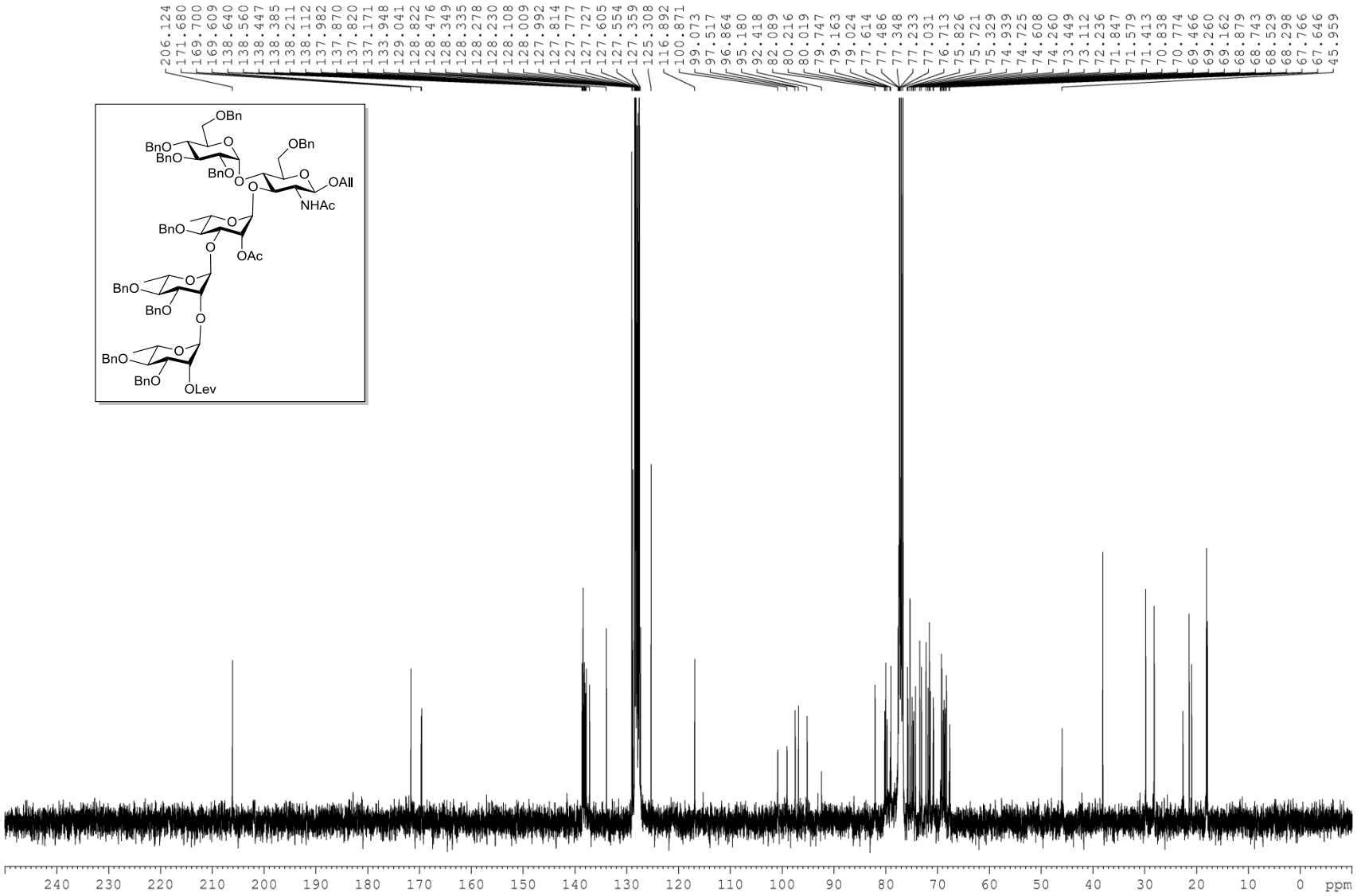
Compound 49: **Allyl (2-*O*-levulinyl-3,4-di-*O*-benzyl-α-L-rhamnopyranosyl)-(1→2)-(3,4-di-*O*-benzyl-α-L-rhamnopyranosyl)-(1→3)-(2-*O*-acetyl-4-*O*-benzyl-α-L-rhamnopyranosyl)-(1→3)-[2,3,4,6-tetra-*O*-benzyl-α-D-glucopyranosyl-(1→4)]-2-acetamido-6-*O*-benzyl-2-deoxy-β-D-glucopyranoside**




OBn
BnO
BnO
BnO
O
OBn
O
O
O
OAll
NHAc
BnO
O
O
OAc
BnO
O
BnO
O
BnO
O
BnO
BnO
OLev
0.09
1.00
0.18
1.03
2.26
2.09
11.30
13.77
3.21
6.91
3.27
10.03
2.57
2.25
5.6 5.5 5.4 5.3 5.2 5.1 5.0 4.9 4.8 4.7 4.6 4.5 4.4 4.3 4.2 4.1 4.0 3.9 3.8 3.7 3.6 3.5 3.4 3.3 ppm


OBn
BnO
BnO
BnO
O
OBn
O
OAll
NHAc
BnO
O
OAc
BnO
BnO
O
BnO
BnO
OLev
ppm
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


OBn
BnO
BnO
BnO
O
OBn
O
OAll
NHAc
BnO
O
O
OAc
BnO
O
BnO
O
BnO
O
BnO
OLev
ppm
3.2
3.4
3.6
3.8
4.0
4.2
4.4
4.6
4.8
5.0
5.2
5.4
5.6
5.6 5.5 5.4 5.3 5.2 5.1 5.0 4.9 4.8 4.7 4.6 4.5 4.4 4.3 4.2 4.1 4.0 3.9 3.8 3.7 3.6 3.5 3.4
ppm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169.609
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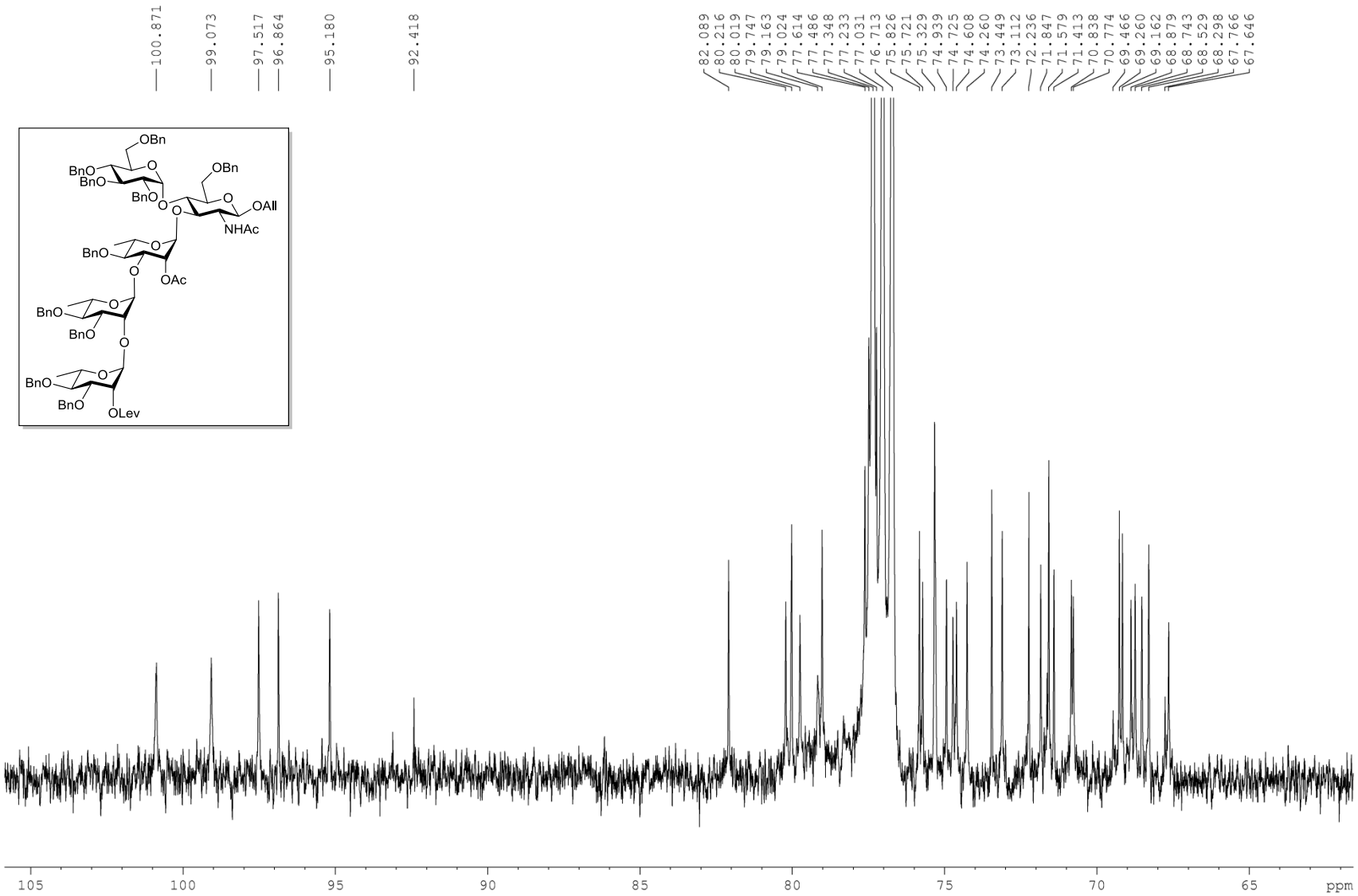
138.560
138.447
138.385
138.211
138.112
137.982
137.870
137.820
137.171
133.948
129.041
128.822
128.476
128.349
128.335
128.278
128.230
128.108
128.009
127.992
127.814
127.777
127.727
127.605
127.554
127.359
125.308
116.892
100.871
99.073
97.517
96.864
95.180
92.418
82.089
80.216
80.019
79.747
79.163
79.024
77.614
77.486
77.348
77.233
77.031
76.713
75.826
75.721
75.329
74.939
74.725
74.608
74.260
73.449
73.112
72.236
71.847
71.579
71.413
70.838
70.774
69.466
69.260
69.162
68.879
68.743
68.529
68.298
67.766
67.646
45.959
OBn
BnO
BnO
BnO
O
OBn
O
O
O
OAll
NHAc
BnO
O
O
OAc
BnO
O
BnO
O
BnO
O
BnO
BnO
OLev
240 230 220 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 ppm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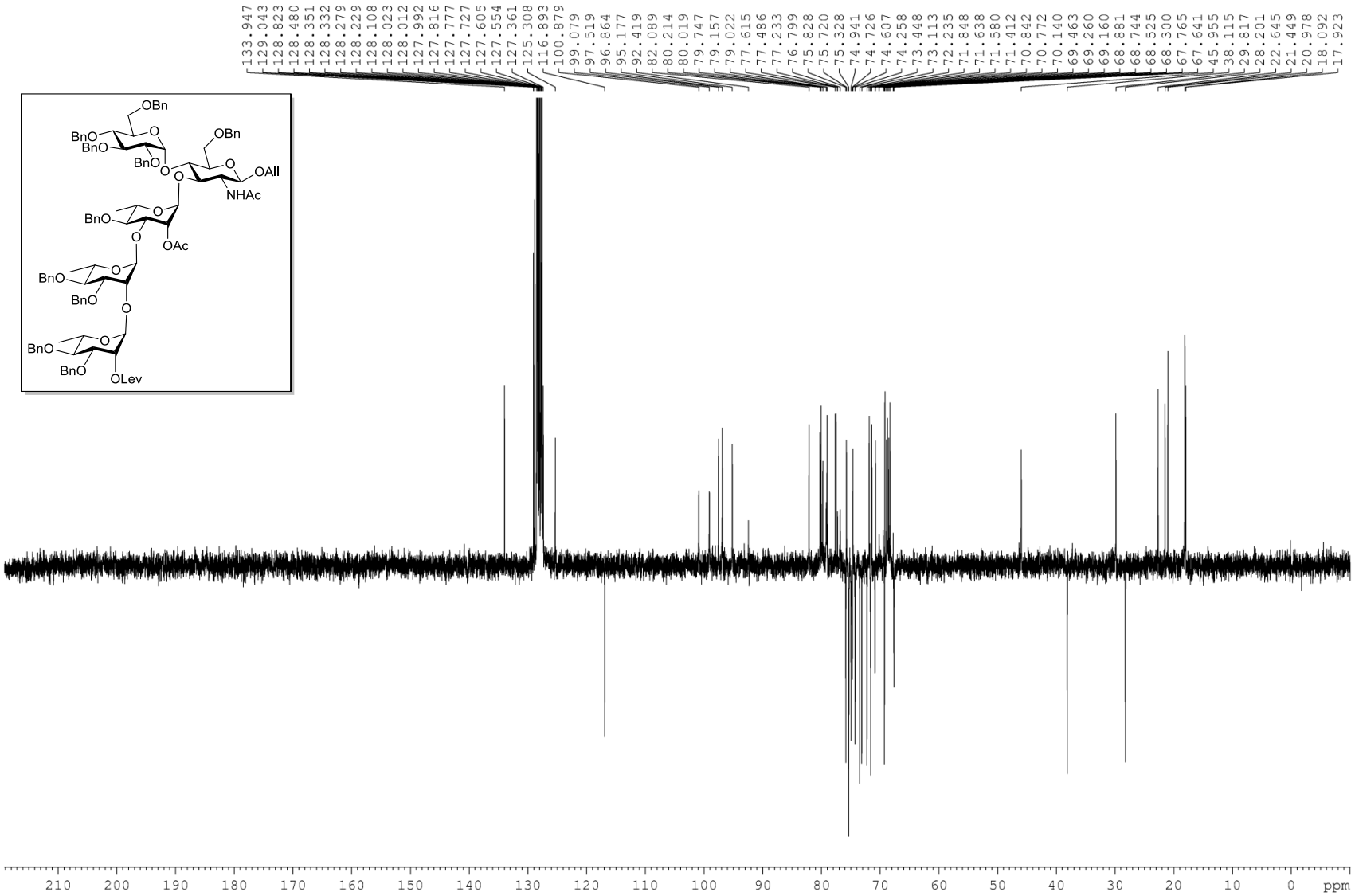
99.073
97.517
96.864
95.180
92.418
82.089
80.216
80.019
79.747
79.163
79.024
77.614
77.486
77.348
77.233
77.031
76.713
75.826
75.721
75.329
74.939
74.725
74.608
74.260
73.449
73.112
72.236
71.847
71.579
71.413
70.838
70.774
69.466
69.260
69.162
68.879
68.743
68.529
68.298
67.766
67.646
OBn
BnO
BnO
BnO
O
OBn
O
O
O
OAll
NHAc
BnO
O
O
OAc
BnO
O
BnO
O
BnO
O
BnO
OLev
105
100
95
90
85
80
75
70
65
ppm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128.279
128.229
128.108
128.023
128.012
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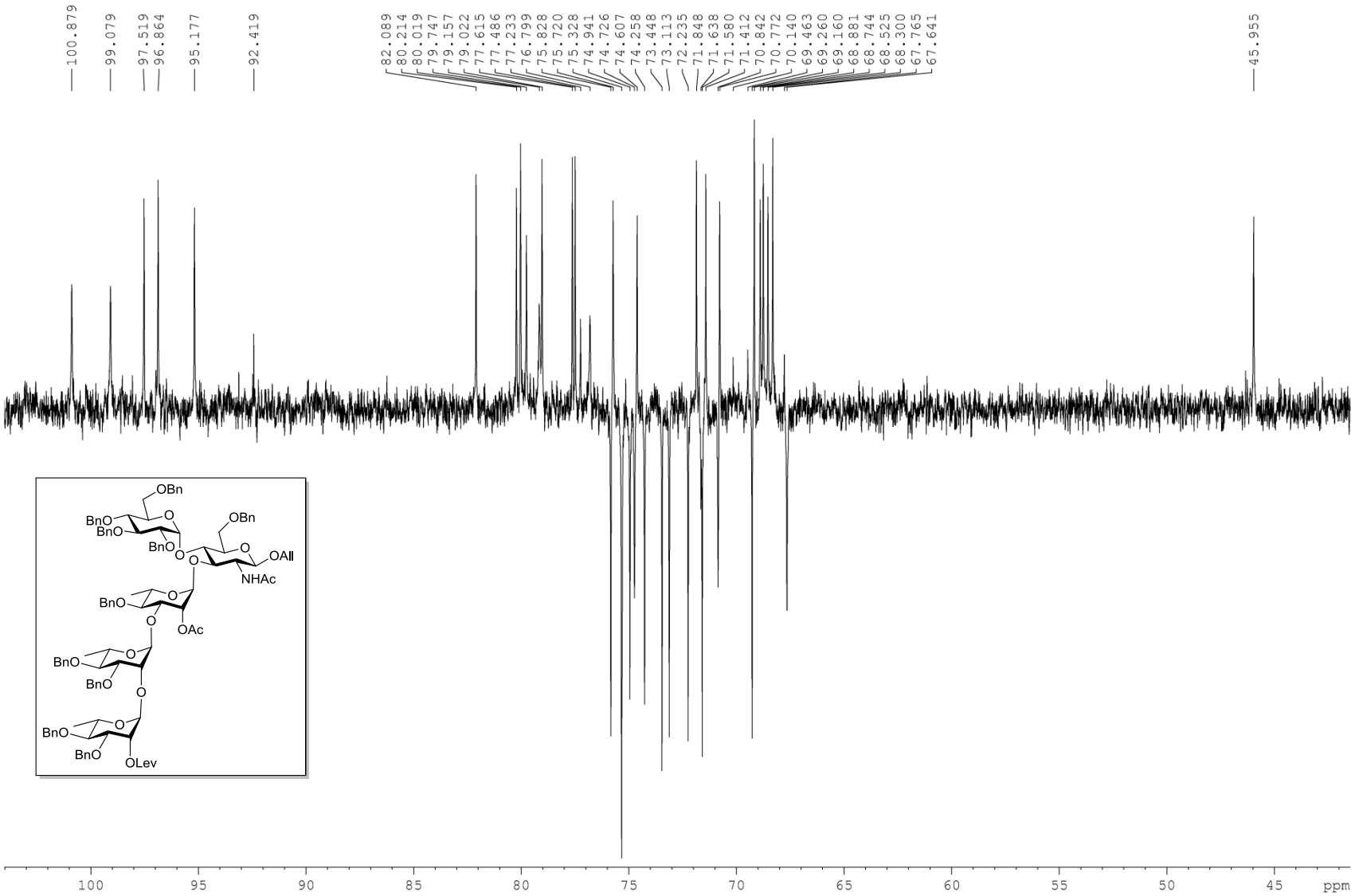
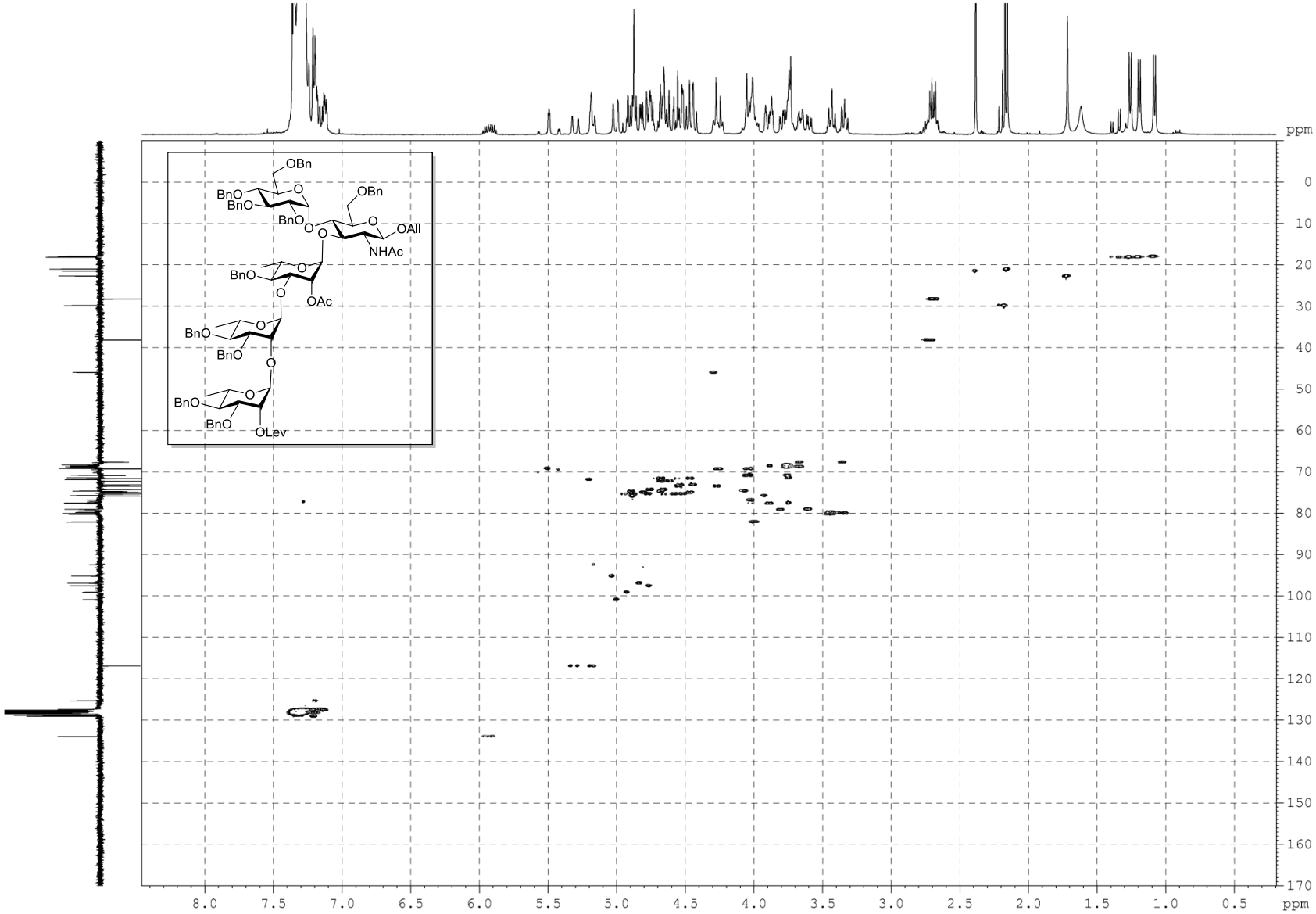
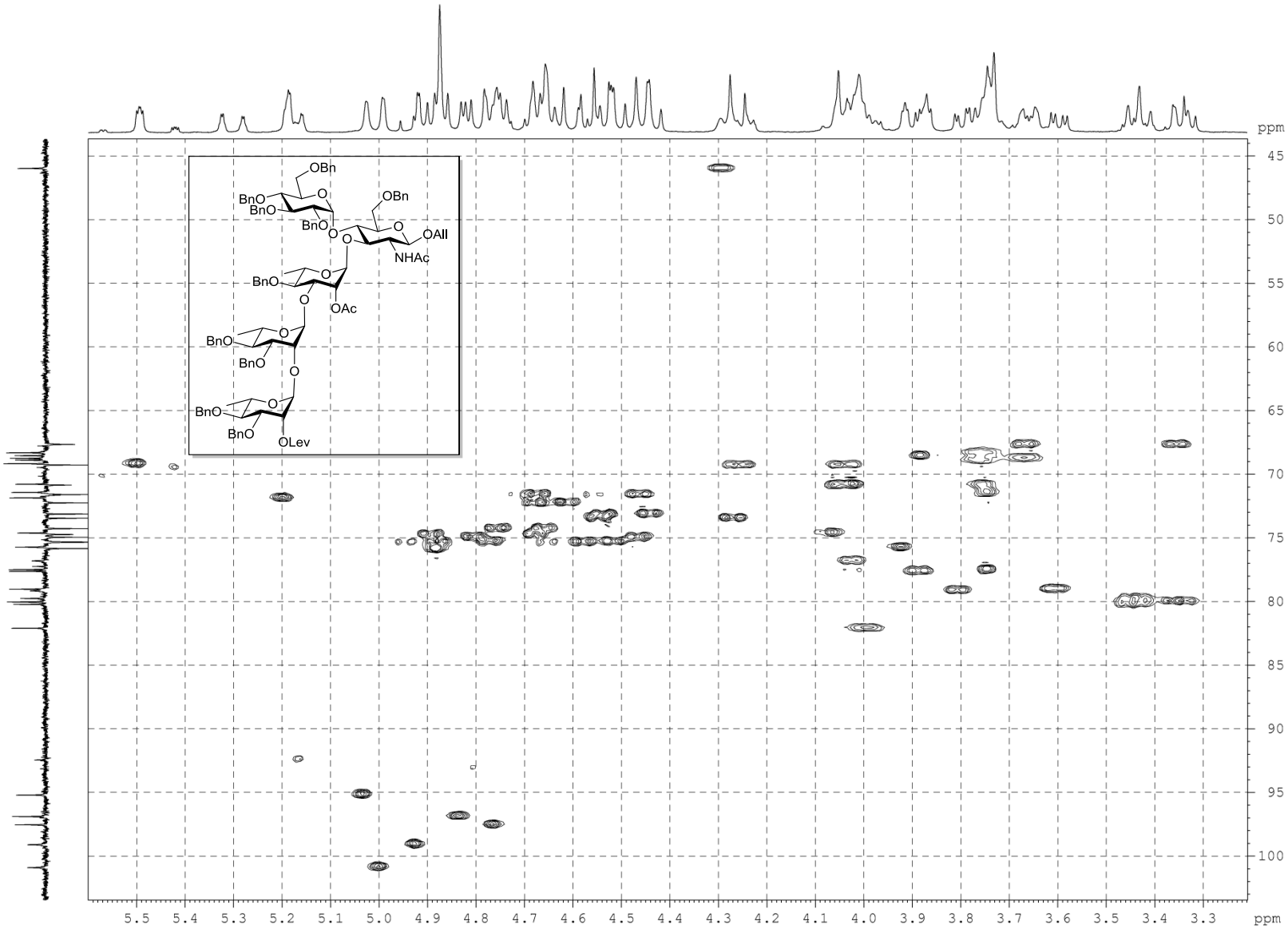
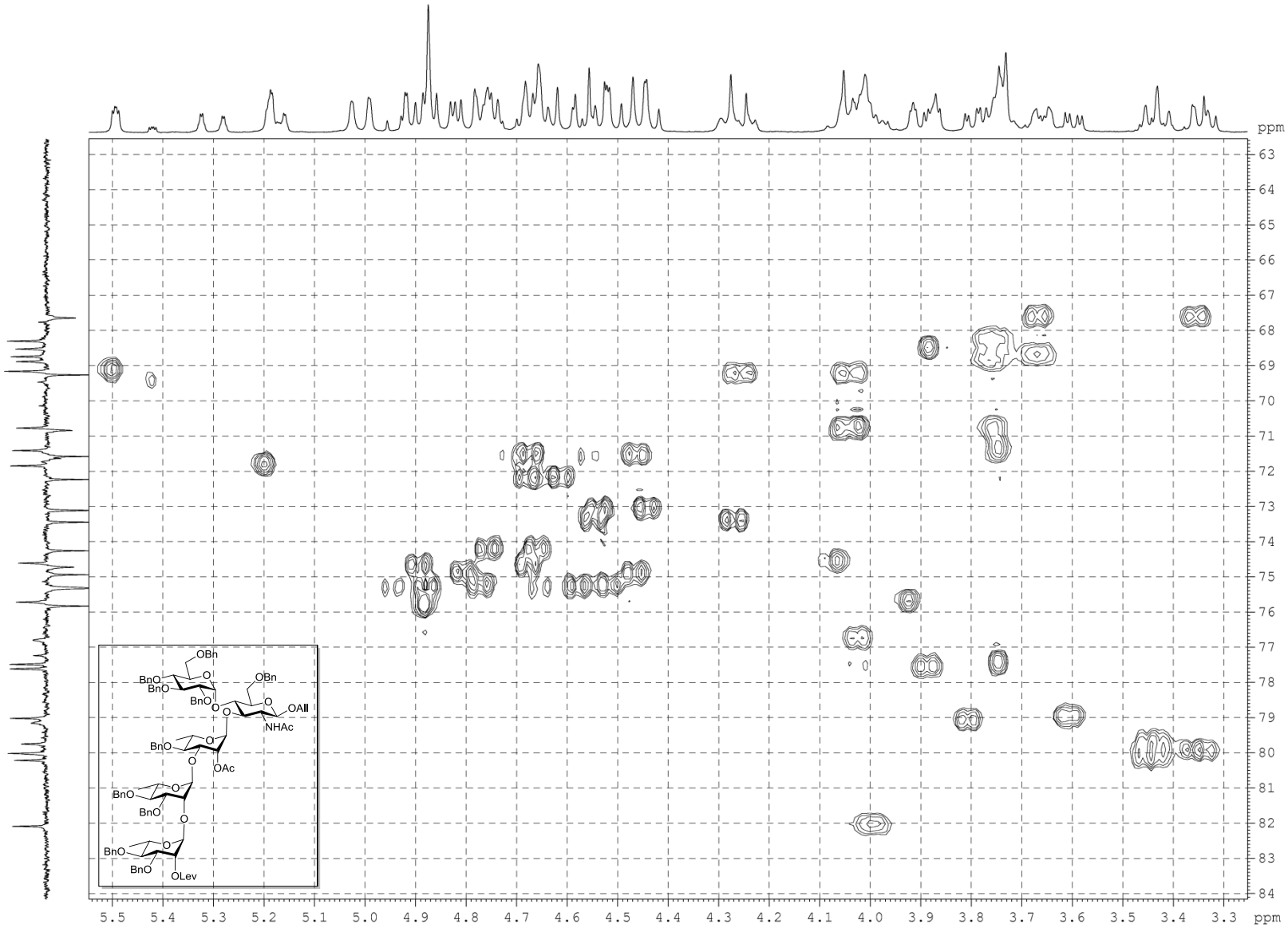
127.777
127.727
127.605
127.554
127.361
125.308
116.893
100.879
99.079
97.519
96.864
95.177
92.419
82.089
80.214
80.019
79.747
79.157
79.022
77.615
77.486
77.233
76.799
75.828
75.720
75.328
74.941
74.726
74.607
74.258
73.448
73.113
72.235
71.848
71.638
71.580
71.412
70.842
70.772
70.140
69.463
69.260
69.160
68.881
68.744
68.525
68.300
67.765
67.641
45.955
38.115
29.817
28.201
22.645
21.449
20.978
18.092
17.923
OBn
BnO
BnO
BnO
O
OBn
O
OAll
NHAc
BnO
O
O
OAc
BnO
O
BnO
O
BnO
O
BnO
OLev
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
ppm

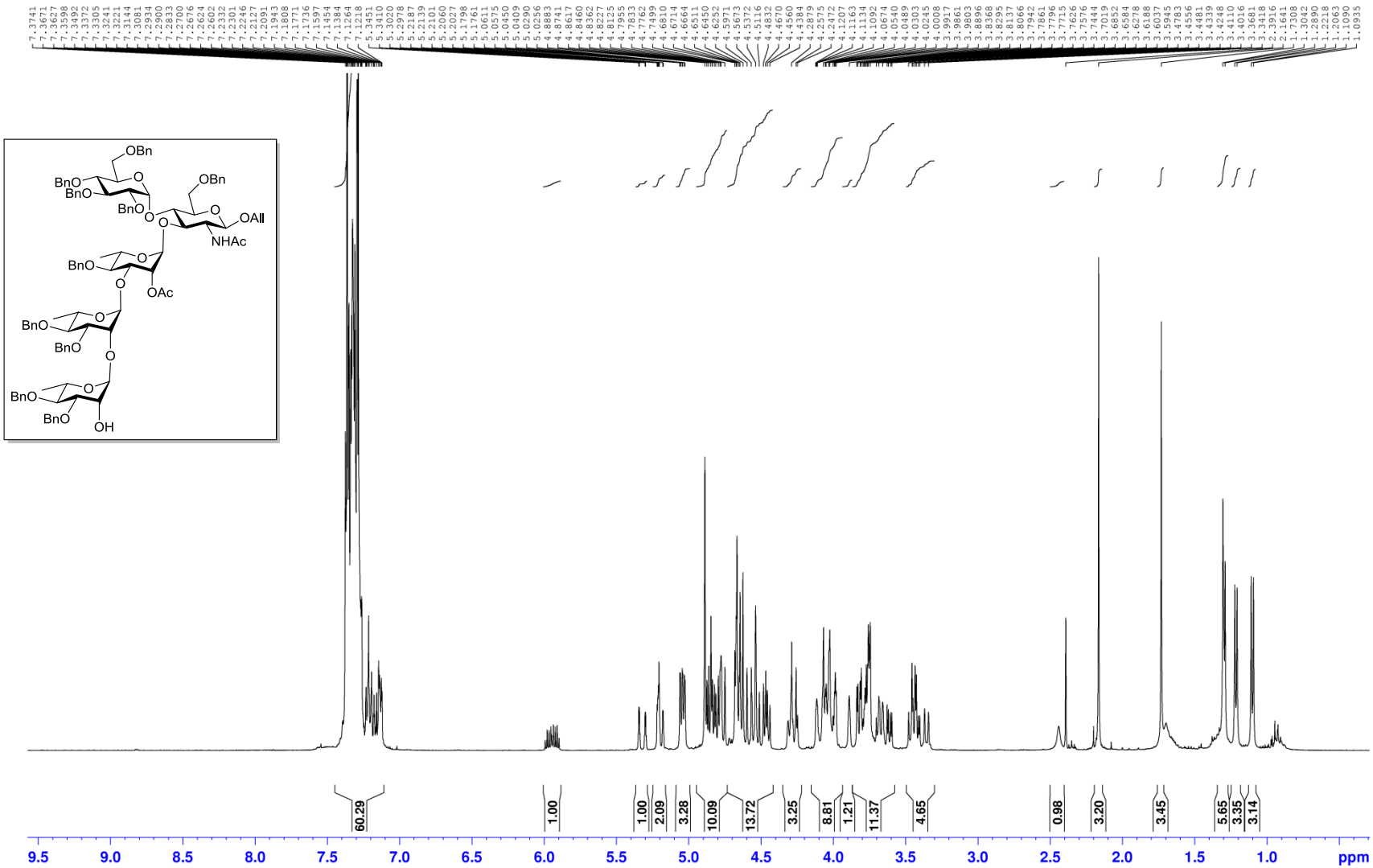

100.879
99.079
97.519
96.864
95.177
92.419
82.089
80.214
80.019
79.747
79.157
79.022
77.615
77.486
77.233
76.799
75.828
75.720
75.328
74.941
74.726
74.607
74.258
73.448
73.113
72.235
71.848
71.638
71.580
71.412
70.842
70.772
70.140
69.463
69.260
69.160
68.881
68.744
68.525
68.300
67.765
67.641
45.955
OBn
BnO
BnO
BnO
O
OBn
O
OAll
NHAc
BnO
O
OAc
BnO
BnO
BnO
O
BnO
BnO
OLev
100
95
90
85
80
75
70
65
60
55
50
45
ppm

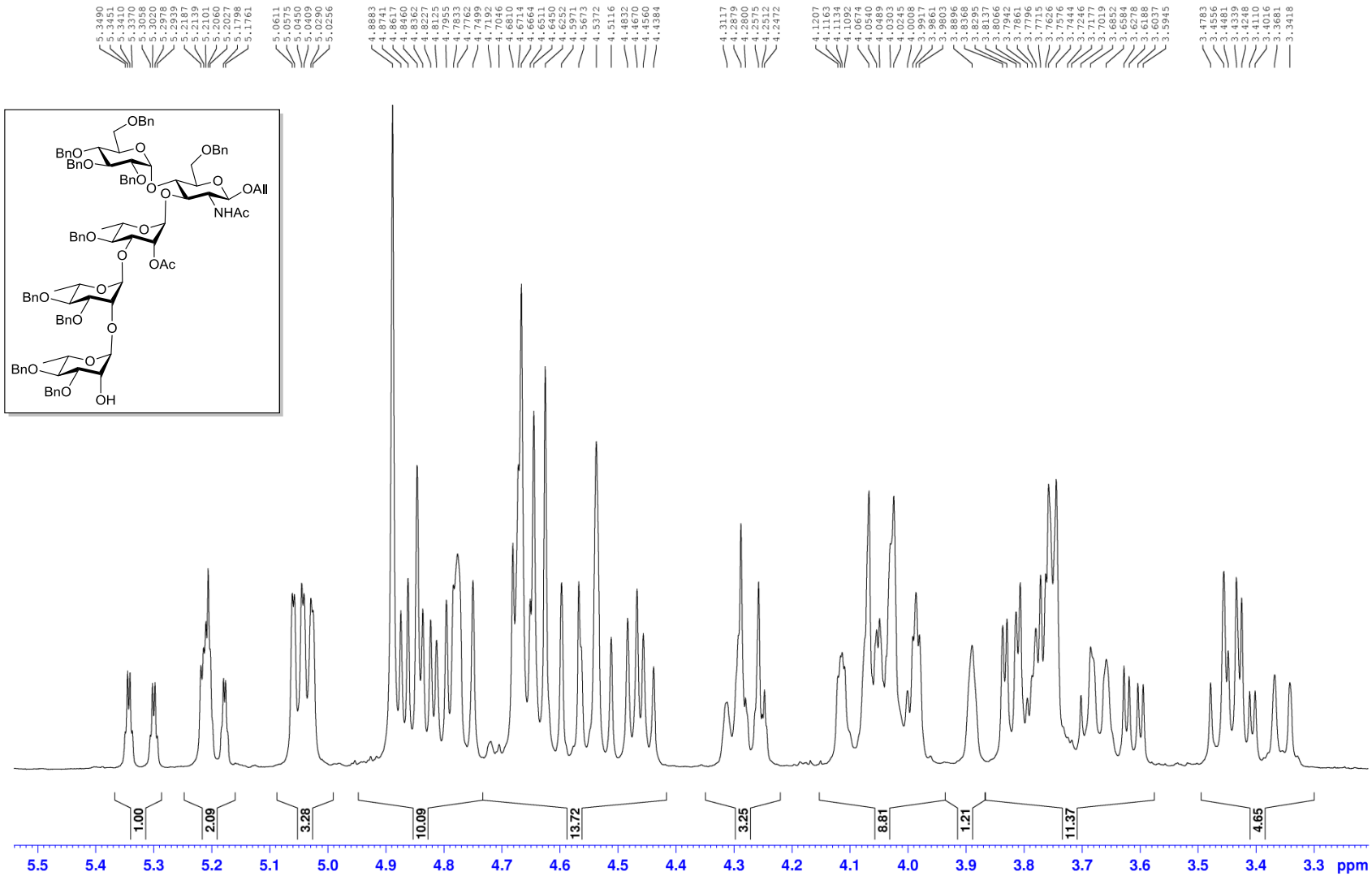

OBn
BnO
BnO
BnO
O
OBn
O
OAll
NHAc
O
BnO
O
OAc
BnO
O
BnO
O
BnO
O
BnO
OLev
ppm
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170


OBn
BnO
BnO
BnO
O
OBn
O
O
O
OAll
NHAc
BnO
O
O
OAc
BnO
O
BnO
O
BnO
O
BnO
BnO
OLev
ppm
45
50
55
60
65
70
75
80
85
90
95
100
5.5
5.4
5.3
5.2
5.1
5.0
4.9
4.8
4.7
4.6
4.5
4.4
4.3
4.2
4.1
4.0
3.9
3.8
3.7
3.6
3.5
3.4
3.3
ppm


ppm
63
64
65
66
67
68
69
70
71
72
73
74
75
76
77
78
79
80
81
82
83
84
5.5 5.4 5.3 5.2 5.1 5.0 4.9 4.8 4.7 4.6 4.5 4.4 4.3 4.2 4.1 4.0 3.9 3.8 3.7 3.6 3.5 3.4 3.3 ppm
OBn
BnO
BnO
O
BnO
O
O
OBn
O
OAll
NHAc
BnO
O
OAc
O
BnO
O
BnO
O
BnO
O
BnO
OLev

Compound 50: **Allyl (3,4-di-*O*-benzyl-α-L-rhamnopyranosyl)-(1→2)-(3,4-di-*O*-benzyl-α-L-rhamnopyranosyl)-(1→3)-(2-*O*-acetyl-4-*O*-benzyl-α-L-rhamnopyranosyl)-(1→3)-[2,3,4,6-tetra-*O*-benzyl-α-D-glucopyranosyl-(1→4)]-2-acetamido-6-*O*-benzyl-2-deoxy-β-D-glucopyranoside**




OBn
BnO
BnO
BnO
O
OBn
O
O
O
OAll
NHAc
BnO
O
O
OAc
BnO
O
BnO
O
BnO
O
BnO
OH
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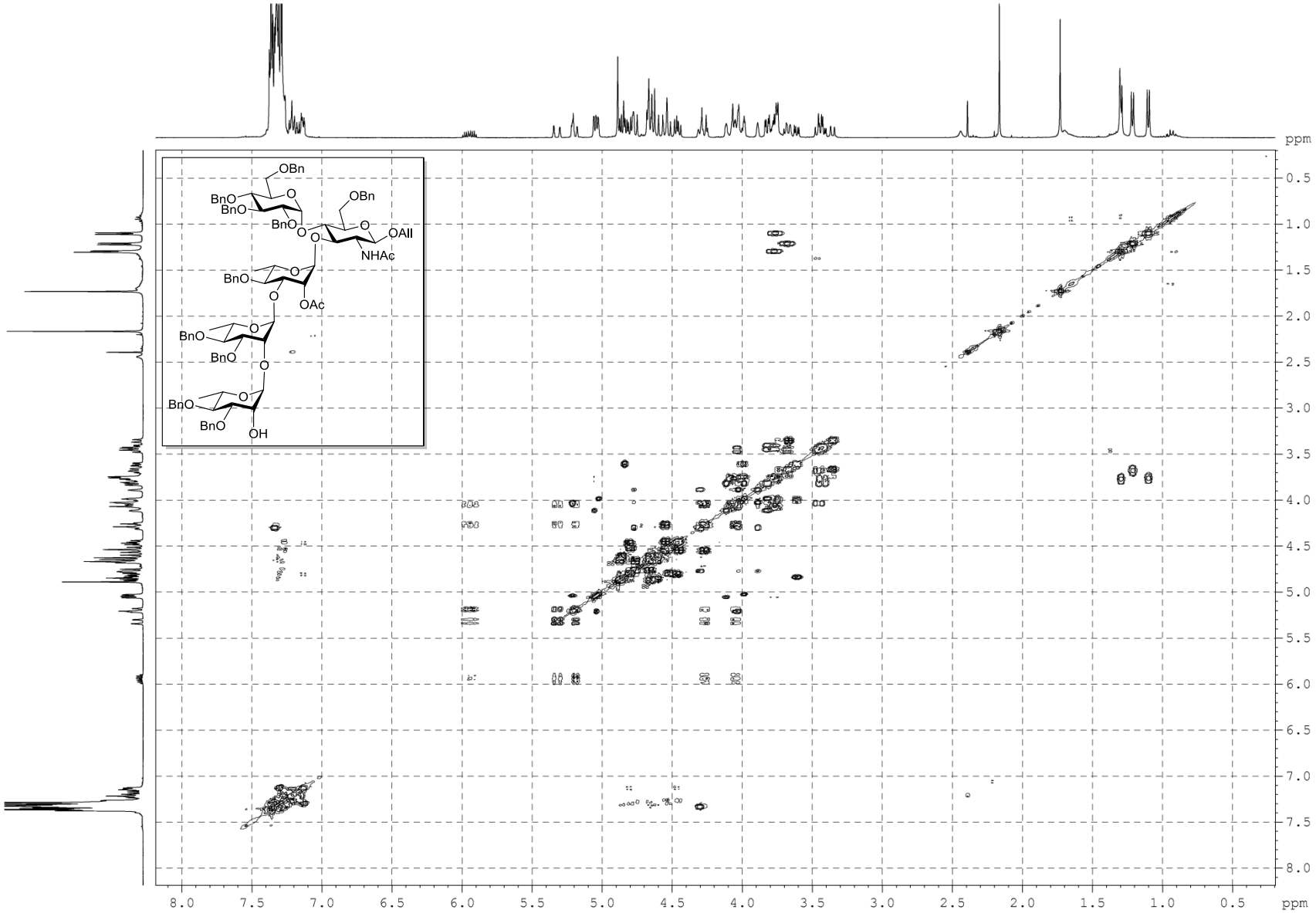
5.0611 5.0575 5.0450 5.0409 5.0290 5.0256
4.8883 4.8741 4.8617 4.8460 4.8362 4.8227 4.8125 4.7955 4.7833 4.7762 4.7499 4.7192 4.7046 4.6810 4.6714 4.6664 4.6511 4.6450 4.6252 4.5971 4.5673 4.5372 4.5116 4.4832 4.4670 4.4560 4.4384
4.3117 4.2879 4.2800 4.2575 4.2512 4.2472
4.1207 4.1163 4.1134 4.1092 4.0674 4.0540 4.0489 4.0303 4.0245 4.0008 3.9917 3.9861 3.9803 3.8896 3.8858 3.8295 3.8137 3.8066 3.7942 3.7861 3.7796 3.7715 3.7626 3.7576 3.7444 3.7246 3.7177 3.7019 3.6852 3.6684 3.6278 3.6188 3.6037 3.5945
3.4783 3.4556 3.4481 3.4339 3.4248 3.4110 3.4016 3.3681 3.3418
1.00
2.09
3.28
10.09
13.72
3.25
8.81
1.21
11.37
4.65
5.5 5.4 5.3 5.2 5.1 5.0 4.9 4.8 4.7 4.6 4.5 4.4 4.3 4.2 4.1 4.0 3.9 3.8 3.7 3.6 3.5 3.4 3.3 ppm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BnO
O
BnO
O
BnO
OH
ppm
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1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
5.5
6.0
6.5
7.0
7.5
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6.5
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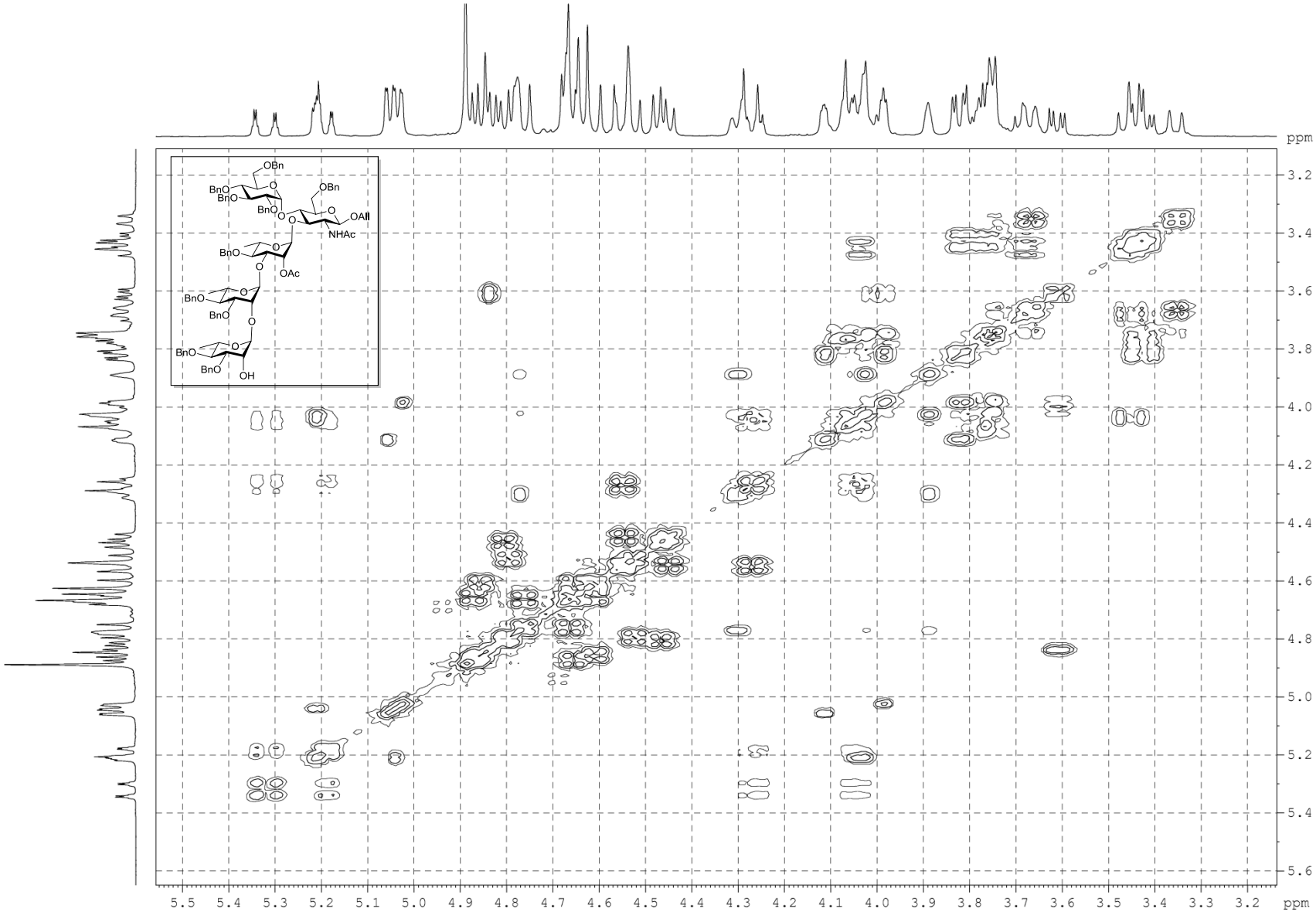
ppm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BnO
BnO
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O
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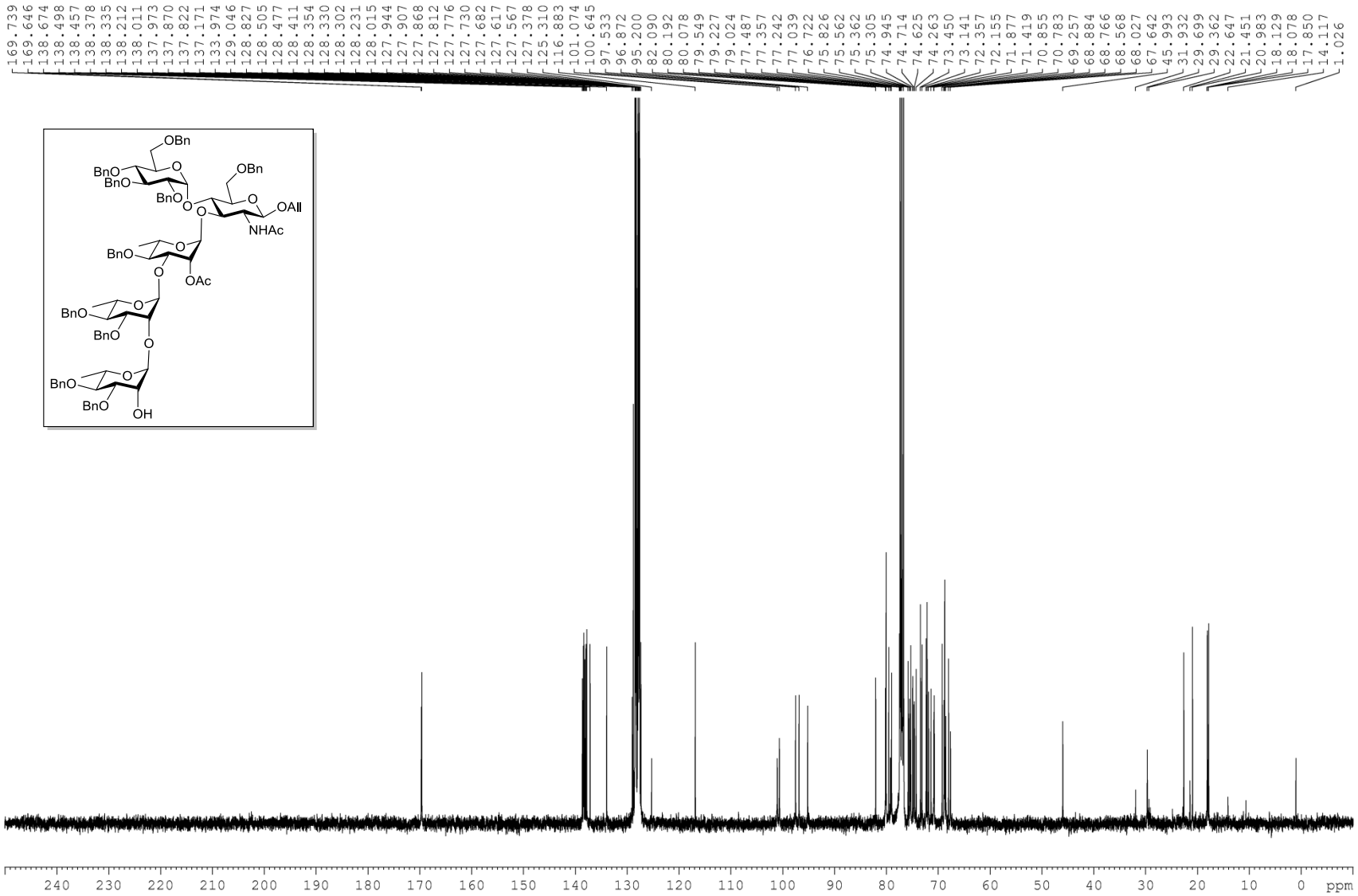
O
O
O
OAll
NHAc
BnO
O
OAc
BnO
BnO
O
BnO
BnO
OH
ppm
3.2
3.4
3.6
3.8
4.0
4.2
4.4
4.6
4.8
5.0
5.2
5.4
5.6
5.5 5.4 5.3 5.2 5.1 5.0 4.9 4.8 4.7 4.6 4.5 4.4 4.3 4.2 4.1 4.0 3.9 3.8 3.7 3.6 3.5 3.4 3.3 3.2
ppm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133.974
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128.505
128.477
128.411
128.354
128.330
128.302
128.231
128.015
127.944
127.907
127.868
127.812
127.776
127.730
127.682
127.617
127.567
127.378
125.310
116.883
101.074
100.645
97.533
96.872
95.200
82.090
80.192
80.078
79.549
79.227
79.024
77.487
77.357
77.242
77.039
76.722
75.826
75.562
75.362
75.305
74.945
74.714
74.625
74.263
73.450
73.141
72.357
72.155
71.877
71.419
70.855
70.783
69.257
68.884
68.766
68.568
68.027
67.642
45.993
31.932
29.699
29.362
22.647
21.451
20.983
18.129
18.078
17.850
14.117
1.026
OBn
BnO
BnO
O
BnO
O
OBn
O
OAll
NHAc
BnO
O
O
OAc
BnO
O
BnO
O
BnO
O
BnO
OH
240
230
220
210
200
190
180
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140
130
120
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100
90
80
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60
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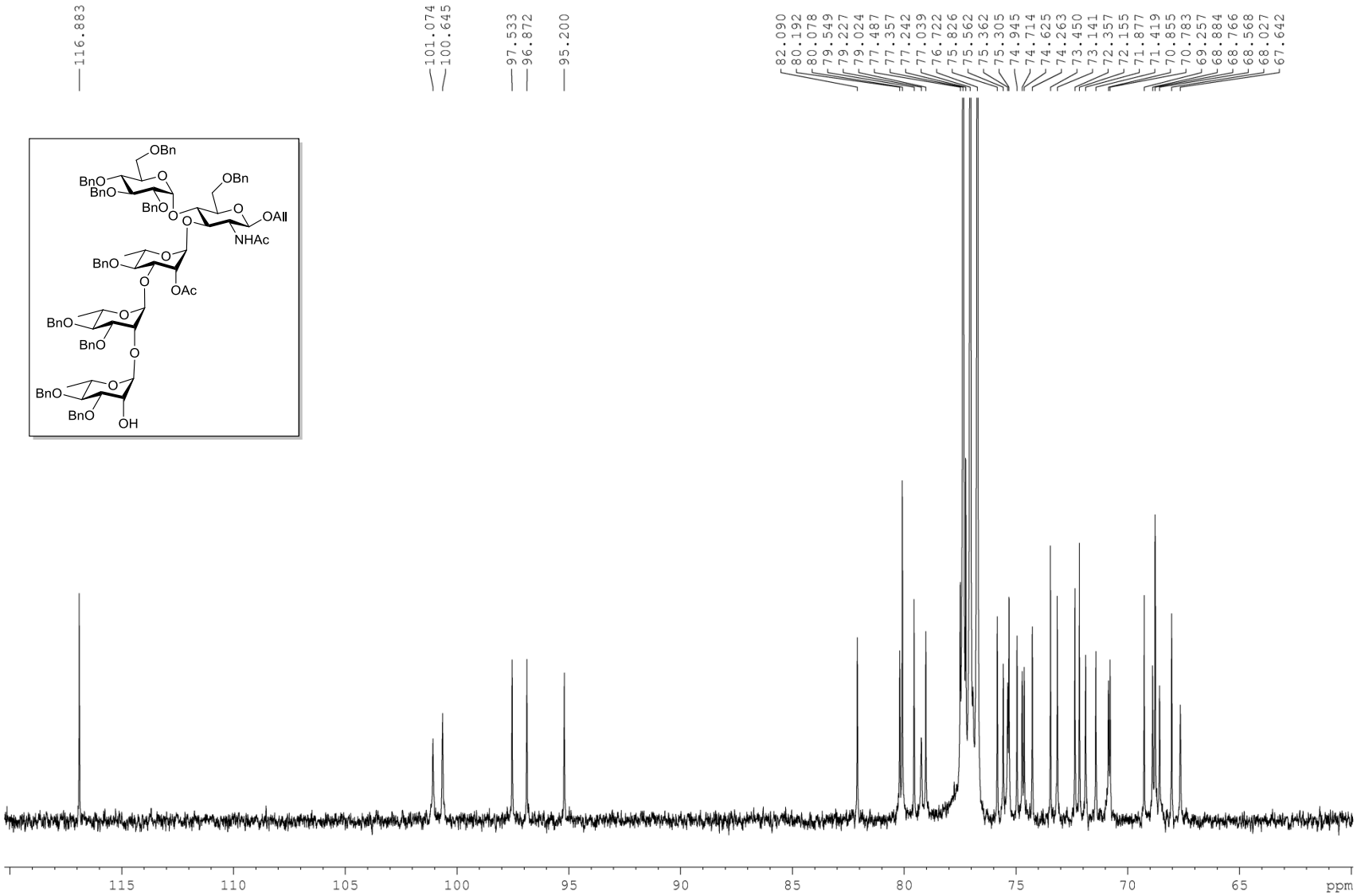
30
20
10
0
ppm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97.533
96.872
95.200
82.090
80.192
80.078
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79.227
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77.487
77.357
77.242
77.039
76.722
75.826
75.562
75.362
75.305
74.945
74.714
74.625
74.263
73.450
73.141
72.357
72.155
71.877
71.419
70.855
70.783
69.257
68.884
68.766
68.568
68.027
67.642
OBn
BnO
BnO
BnO
O
OBn
O
OAll
NHAc
BnO
O
OAc
BnO
BnO
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BnO
BnO
OH
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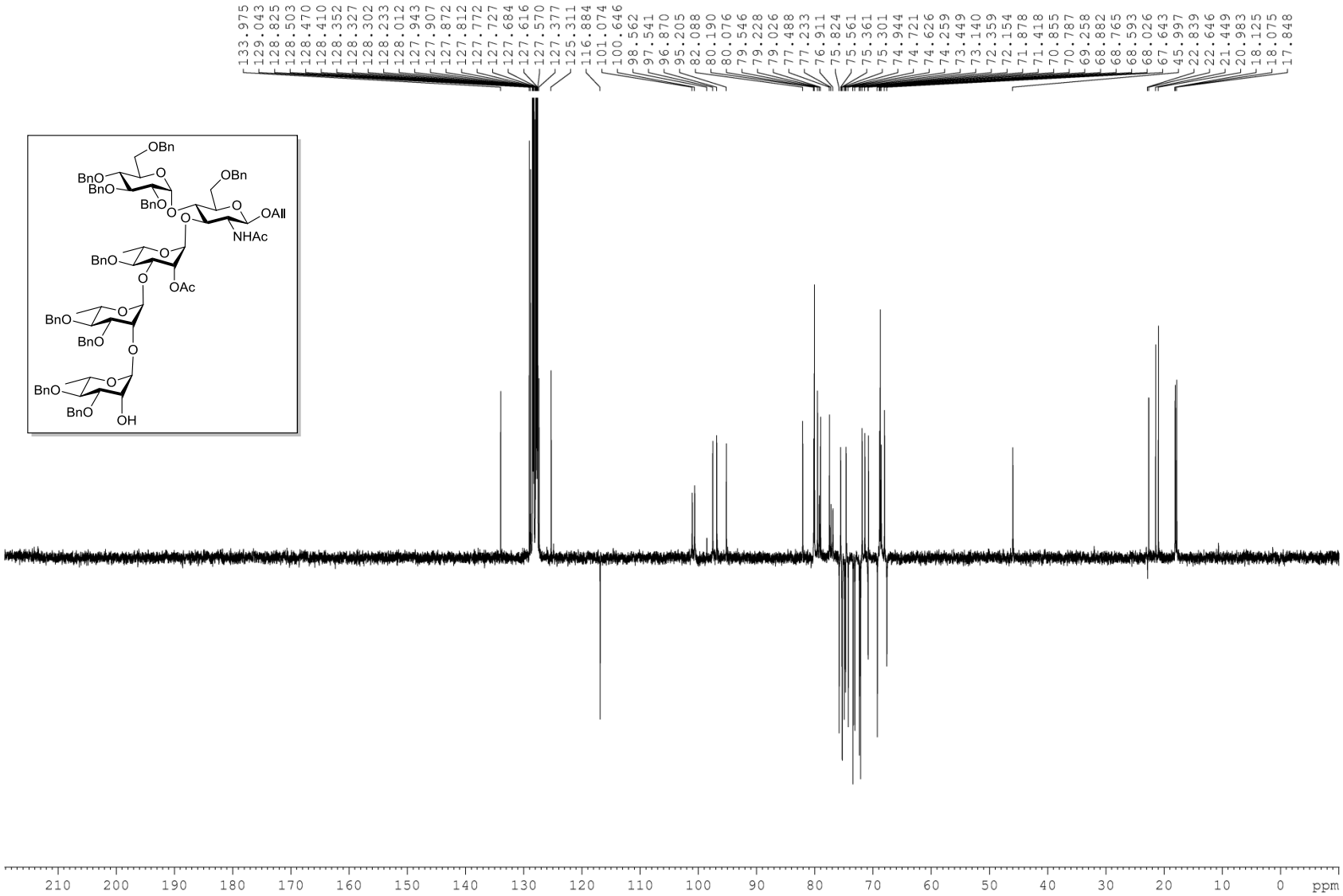
110
105
100
95
90
85
80
75
70
65
ppm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127.872
127.812
127.772
127.727
127.684
127.616
127.570
127.377
125.311
116.884
101.074
100.646
98.562
97.541
96.870
95.205
82.088
80.190
80.076
79.546
79.228
79.026
77.488
77.233
76.911
75.824
75.561
75.361
75.301
74.944
74.721
74.626
74.259
73.449
73.140
72.359
72.154
71.878
71.418
70.855
70.787
69.258
68.882
68.765
68.593
68.026
67.643
45.997
22.839
22.646
21.449
20.983
18.125
18.075
17.848
OBn
BnO
BnO
BnO
O
OBn
O
OAll
NHAc
BnO
O
OAc
BnO
O
BnO
O
BnO
O
BnO
OH
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
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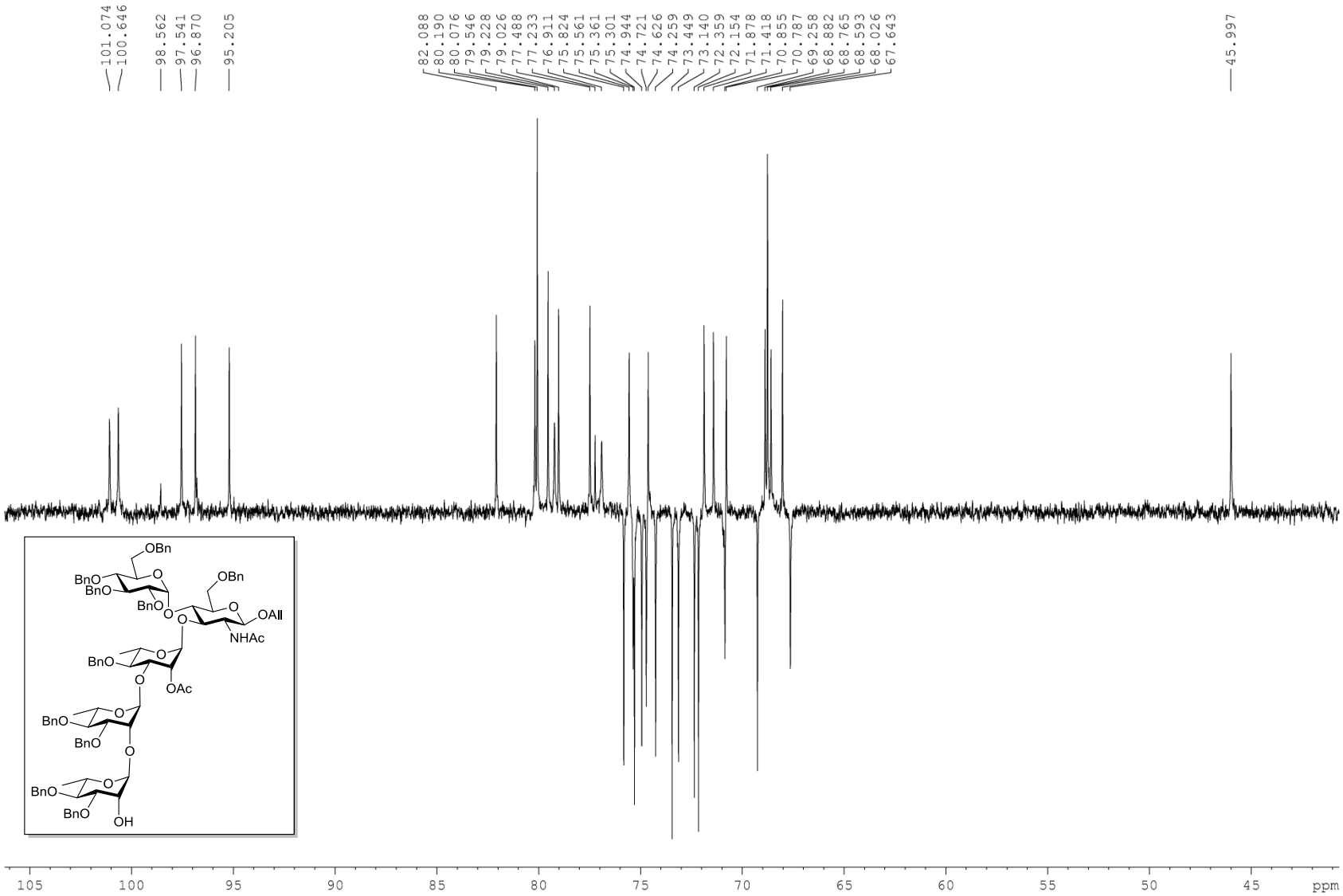
0
ppm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100.646
98.562
97.541
96.870
95.205
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80.076
79.546
79.228
79.026
77.488
77.233
76.911
75.824
75.561
75.361
75.301
74.944
74.721
74.626
74.259
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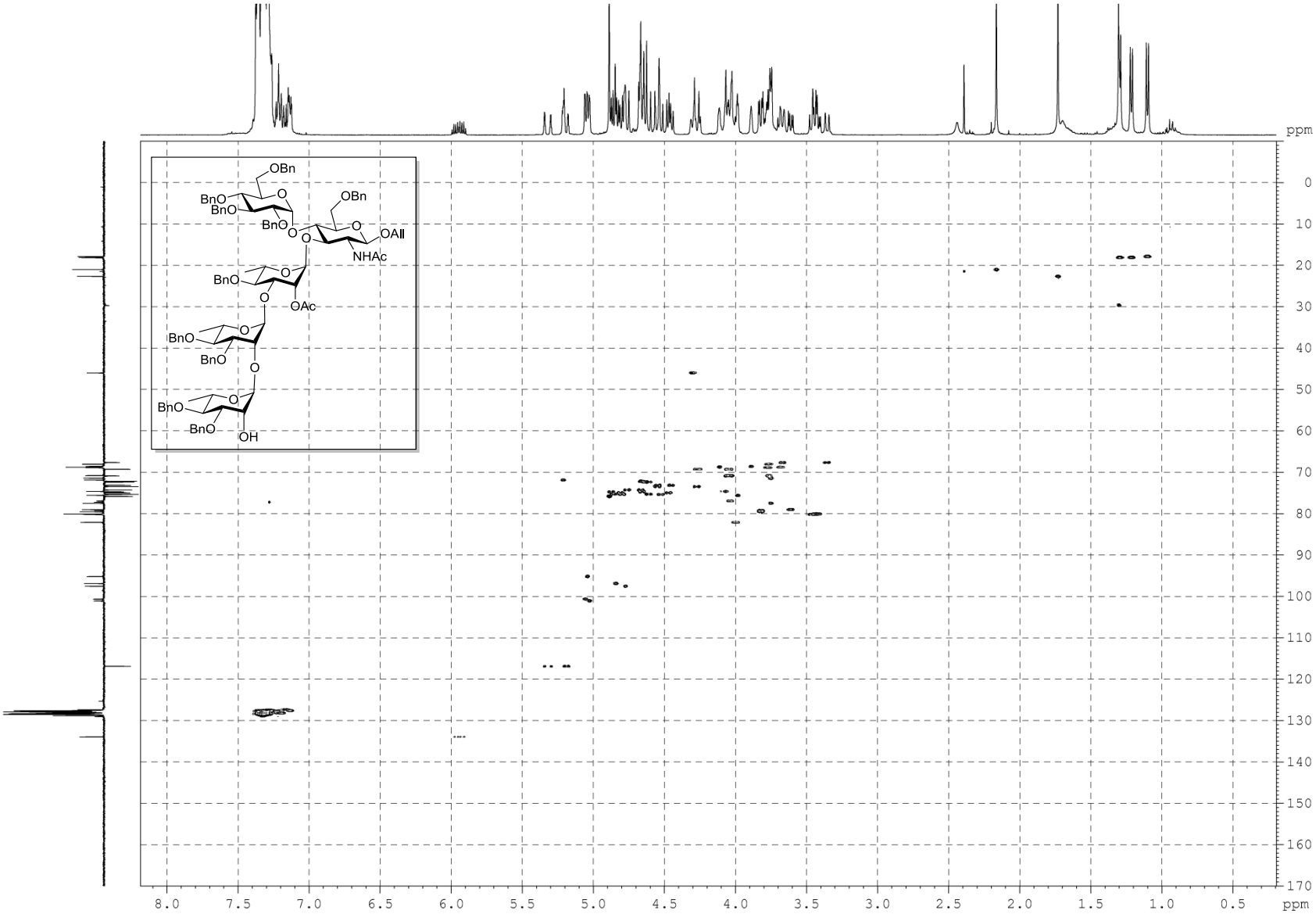
73.140
72.359
72.154
71.878
71.418
70.855
70.787
69.258
68.882
68.765
68.593
68.026
67.643
45.997
OBn
BnO
BnO
O
BnO
O
OBn
O
OAll
NHAc
BnO
O
O
OAc
BnO
O
BnO
O
BnO
O
BnO
OH
105
100
95
90
85
80
75
70
65
60
55
50
45
ppm


OBn
BnO
BnO
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O
OBn
O
OAll
NHAc
O
BnO
O
OAc
BnO
O
BnO
O
BnO
O
BnO
OH
ppm
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170
8.0
7.5
7.0
6.5
6.0
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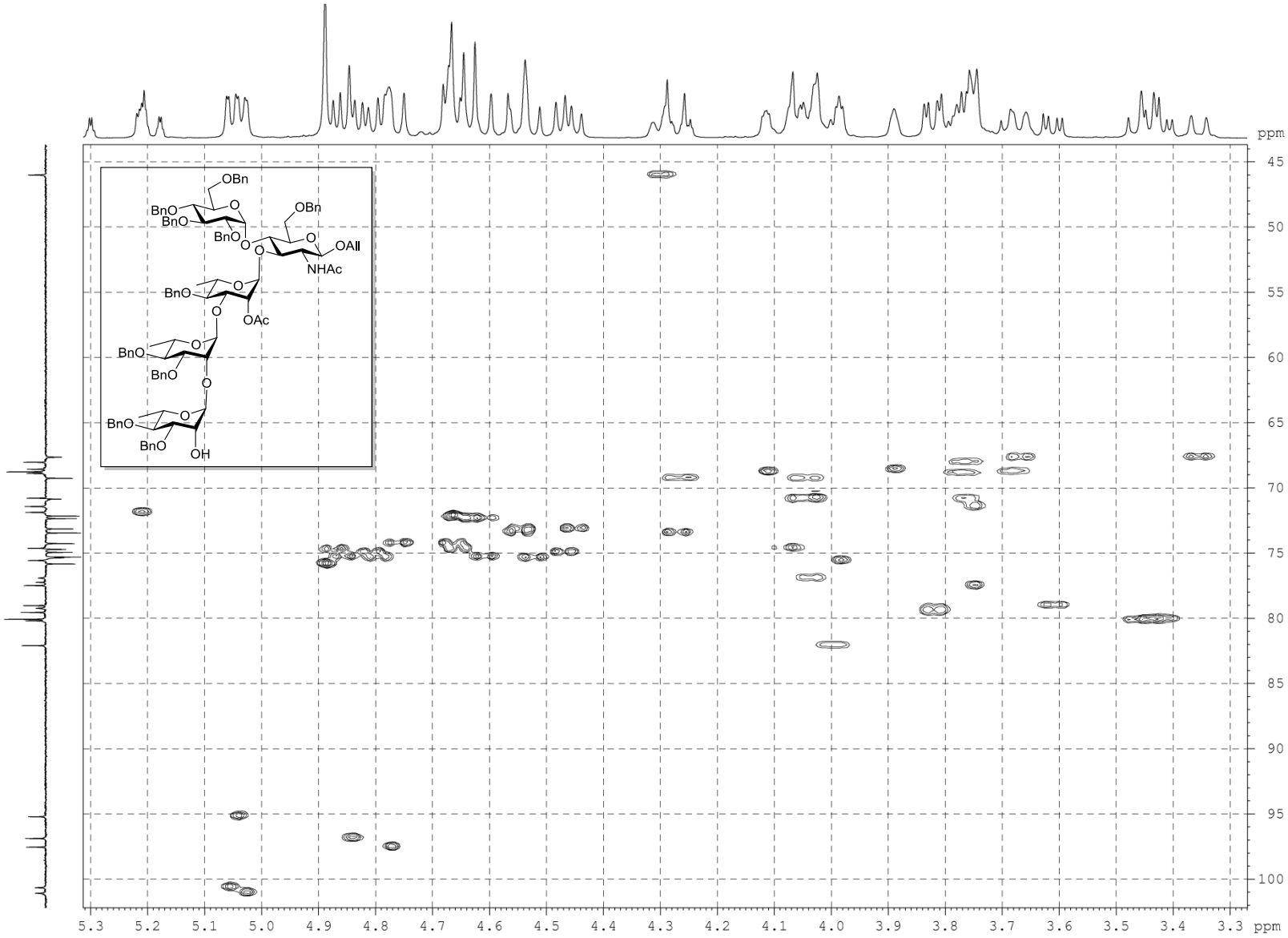
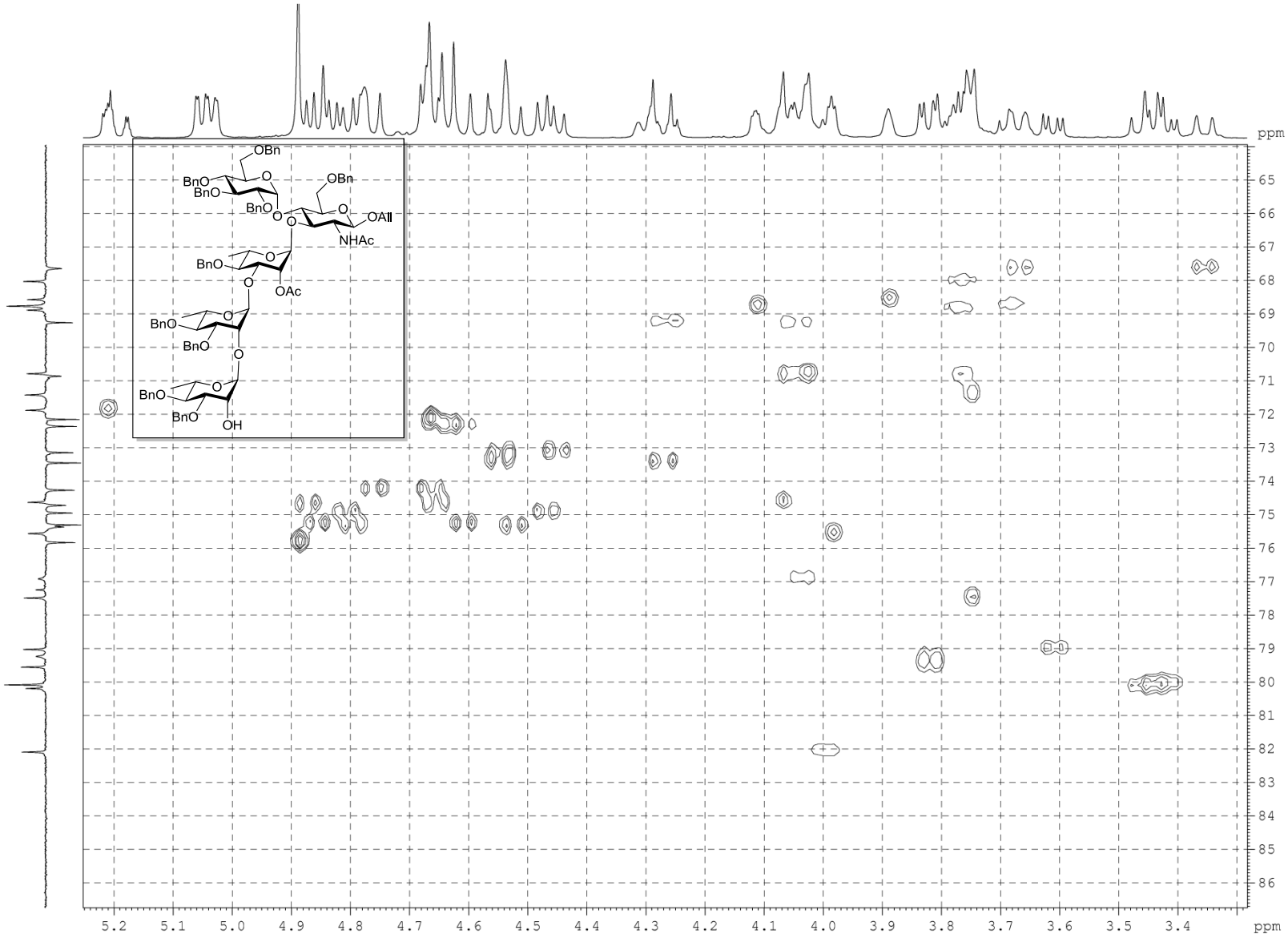
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
ppm


OBn
BnO
BnO
BnO
O
OBn
O
O
OAll
NHAc
BnO
O
O
OAc
BnO
O
BnO
O
BnO
O
BnO
OH
ppm
45
50
55
60
65
70
75
80
85
90
95
100
5.3
5.2
5.1
5.0
4.9
4.8
4.7
4.6
4.5
4.4
4.3
4.2
4.1
4.0
3.9
3.8
3.7
3.6
3.5
3.4
3.3
ppm


OBn
BnO
BnO
BnO
O
OBn
O
OAll
NHAc
BnO
O
OAc
BnO
BnO
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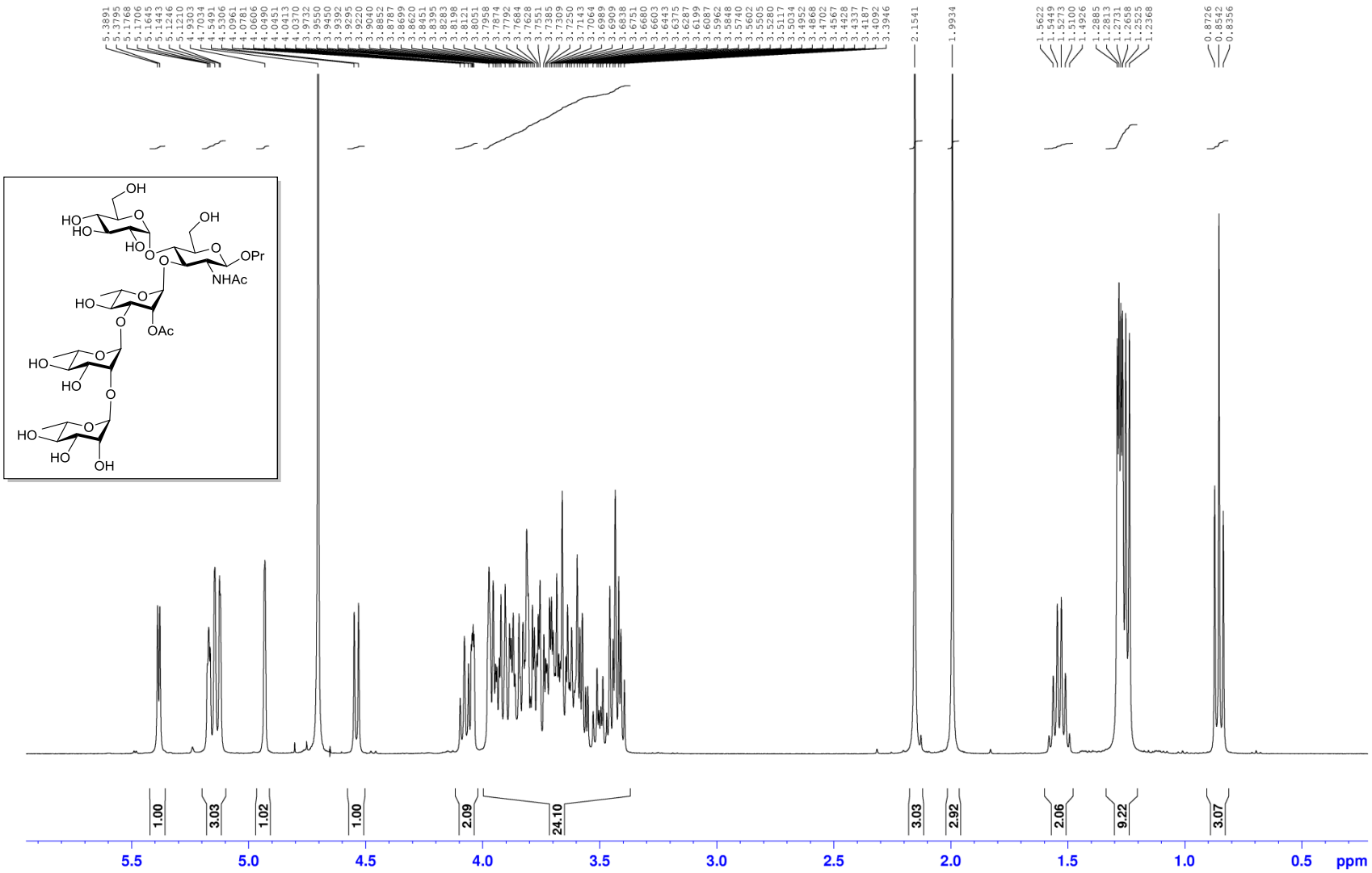
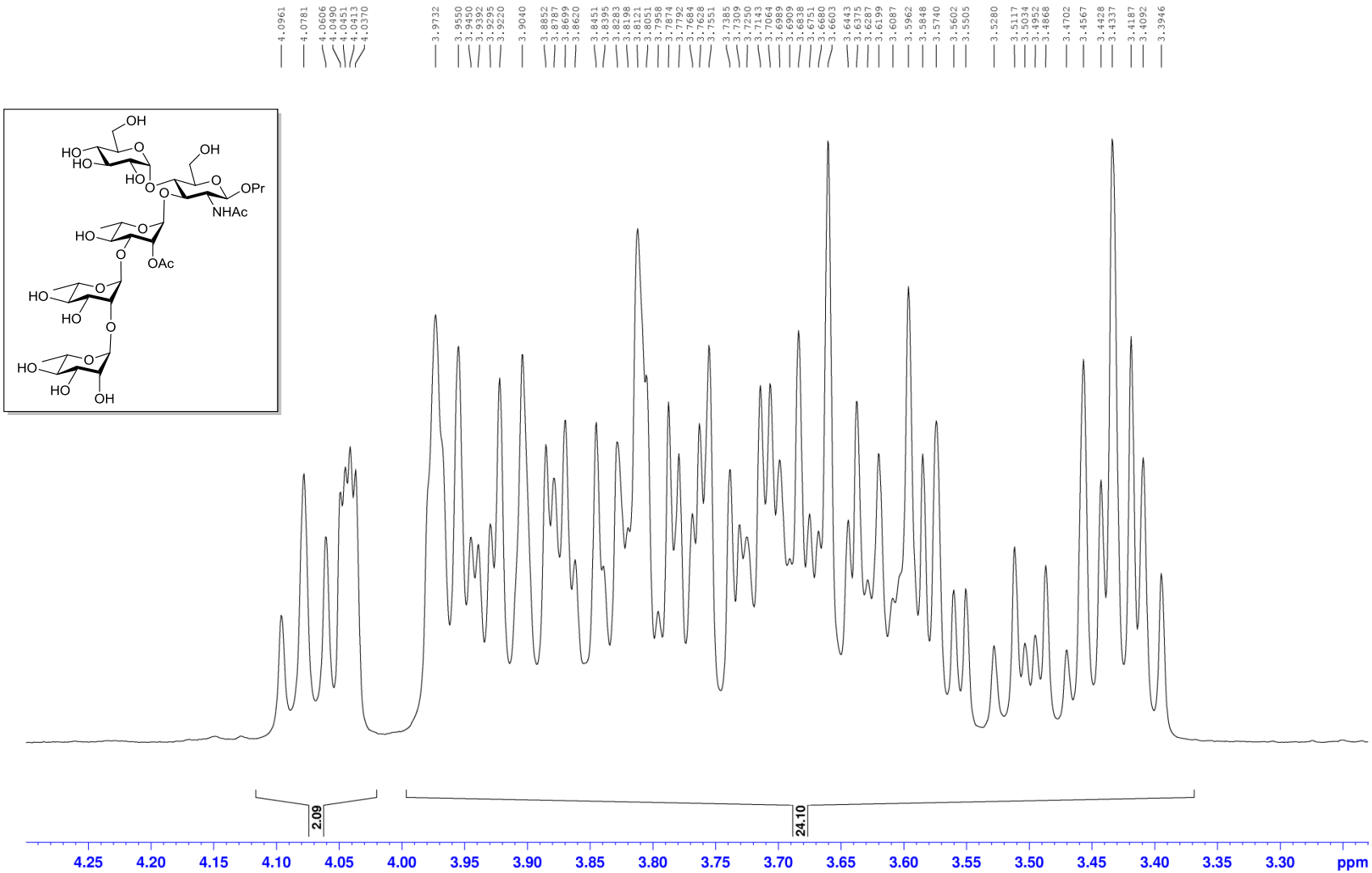
BnO
BnO
OH
ppm
65
66
67
68
69
70
71
72
73
74
75
76
77
78
79
80
81
82
83
84
85
86
5.2
5.1
5.0
4.9
4.8
4.7
4.6
4.5
4.4
4.3
4.2
4.1
4.0
3.9
3.8
3.7
3.6
3.5
3.4
ppm

Compound 51: **Propyl α-L-rhamnopyranosyl-(1→2)-α-L-rhamnopyranosyl-(1→3)-(2-*O*-acetyl-α-L-rhamnopyranosyl)-(1→3)-[α-D-glucopyranosyl-(1→4)]-2-acetamido-2-deoxy-β-D-glucopyranoside**

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4.0370
3.9732
3.9550
3.9450
3.9392
3.9295
3.9220
3.9040
3.8852
3.8827
3.8699
3.8620
3.8451
3.8395
3.8283
3.8198
3.8121
3.8051
3.7958
3.7874
3.7792
3.7764
3.7628
3.7551
3.7385
3.7309
3.7250
3.7143
3.7064
3.6989
3.6909
3.6838
3.6751
3.6680
3.6603
3.6443
3.6375
3.6287
3.6199
3.6087
3.5962
3.5848
3.5740
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3.5280
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3.5034
3.4952
3.4868
3.4702
3.4567
3.4428
3.4337
3.4187
3.4092
3.3946
OH
HO
HO
HO
O
OH
O
OPr
NHAc
HO
O
OAc
HO
HO
O
HO
HO
OH
2.09
24.10
4.25
4.20
4.15
4.10
4.05
4.00
3.95
3.90
3.85
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3.70
3.65
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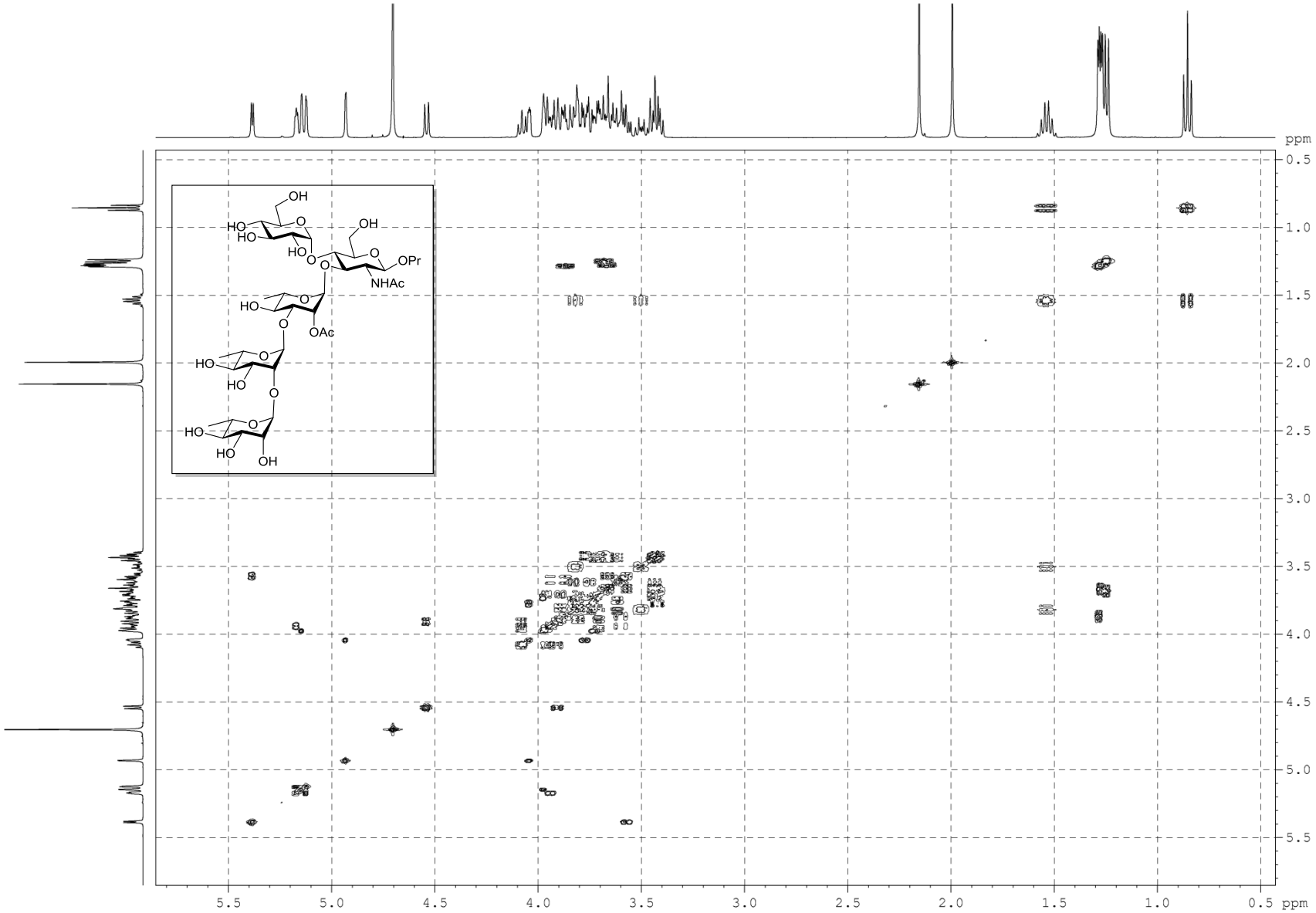
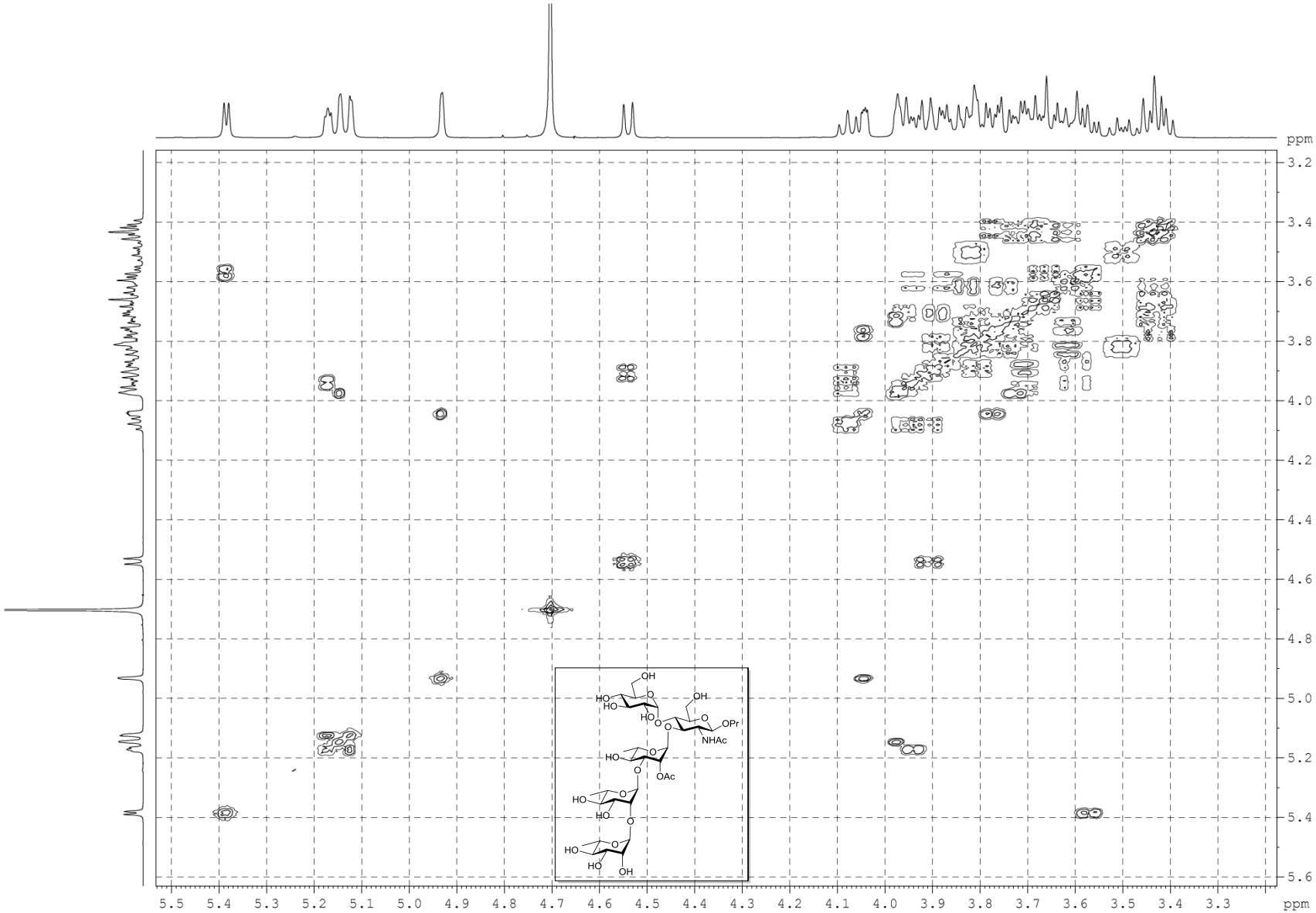
3.45
3.40
3.35
3.30
ppm


OH
HO
HO
O
OH
HO
O
O
OPr
NHAc
HO
O
O
OAc
HO
O
HO
O
HO
O
HO
OH
ppm
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
5.5
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5 ppm


ppm
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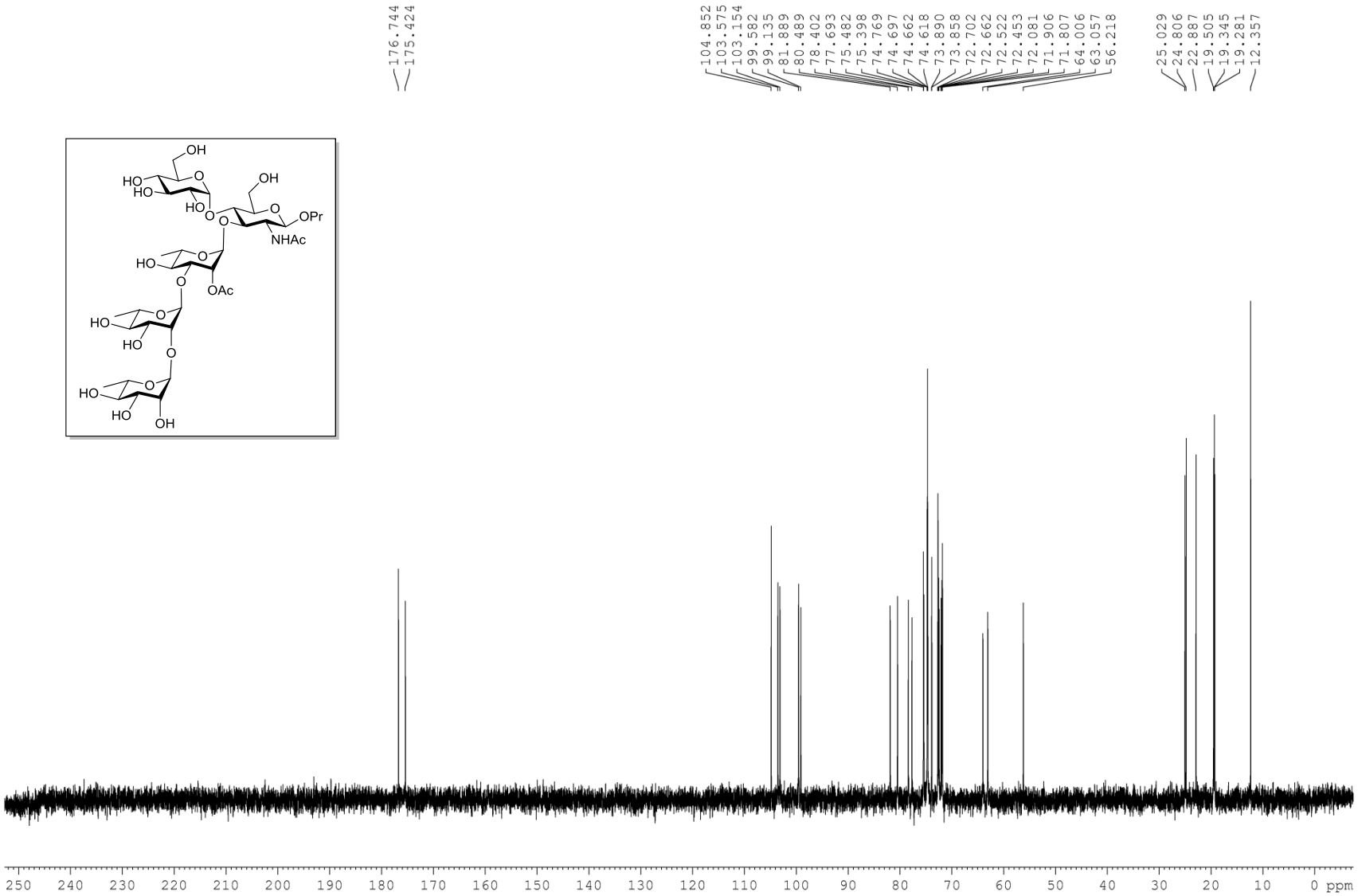
3.4
3.6
3.8
4.0
4.2
4.4
4.6
4.8
5.0
5.2
5.4
5.6
5.5 5.4 5.3 5.2 5.1 5.0 4.9 4.8 4.7 4.6 4.5 4.4 4.3 4.2 4.1 4.0 3.9 3.8 3.7 3.6 3.5 3.4 3.3
ppm
OH
HO
HO
HO
O
OH
O
OPr
NHAc
HO
O
OAc
HO
HO
O
HO
HO
OH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99.135
81.889
80.489
78.402
77.693
75.482
75.398
74.769
74.697
74.662
74.618
73.890
73.858
72.702
72.662
72.522
72.453
72.081
71.906
71.807
64.006
63.057
56.218
25.029
24.806
22.887
19.505
19.345
19.281
12.357
OH
HO
HO
HO
O
OH
O
OPr
NHAc
HO
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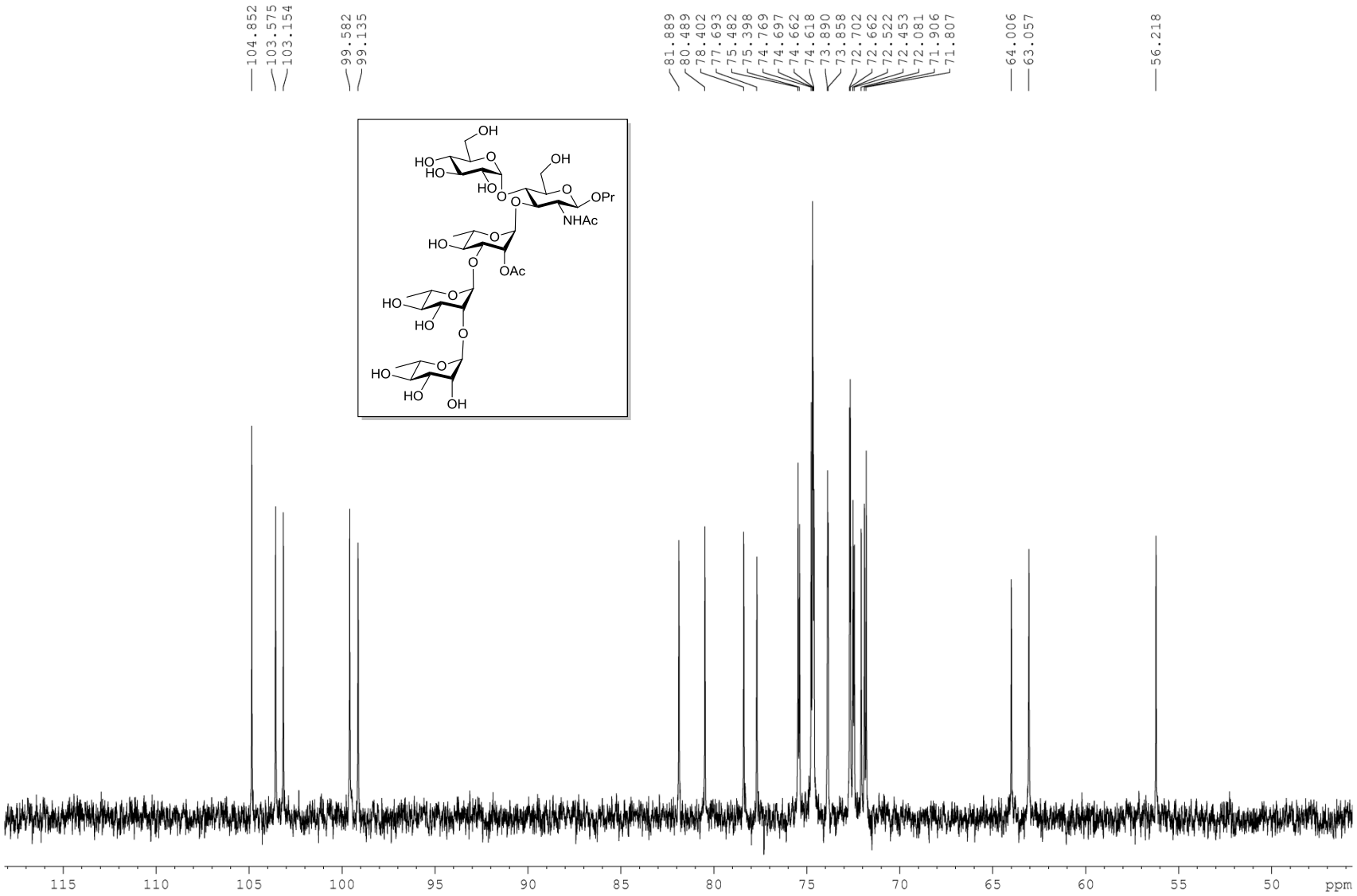
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103.154
99.582
99.135
81.889
80.489
78.402
77.693
75.482
75.398
74.769
74.697
74.662
74.618
73.890
73.858
72.702
72.662
72.522
72.453
72.081
71.906
71.807
64.006
63.057
56.218
OH
HO
HO
HO
O
OH
O
OPr
NHAc
HO
O
O
OAc
HO
O
HO
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OH
115
110
105
100
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80
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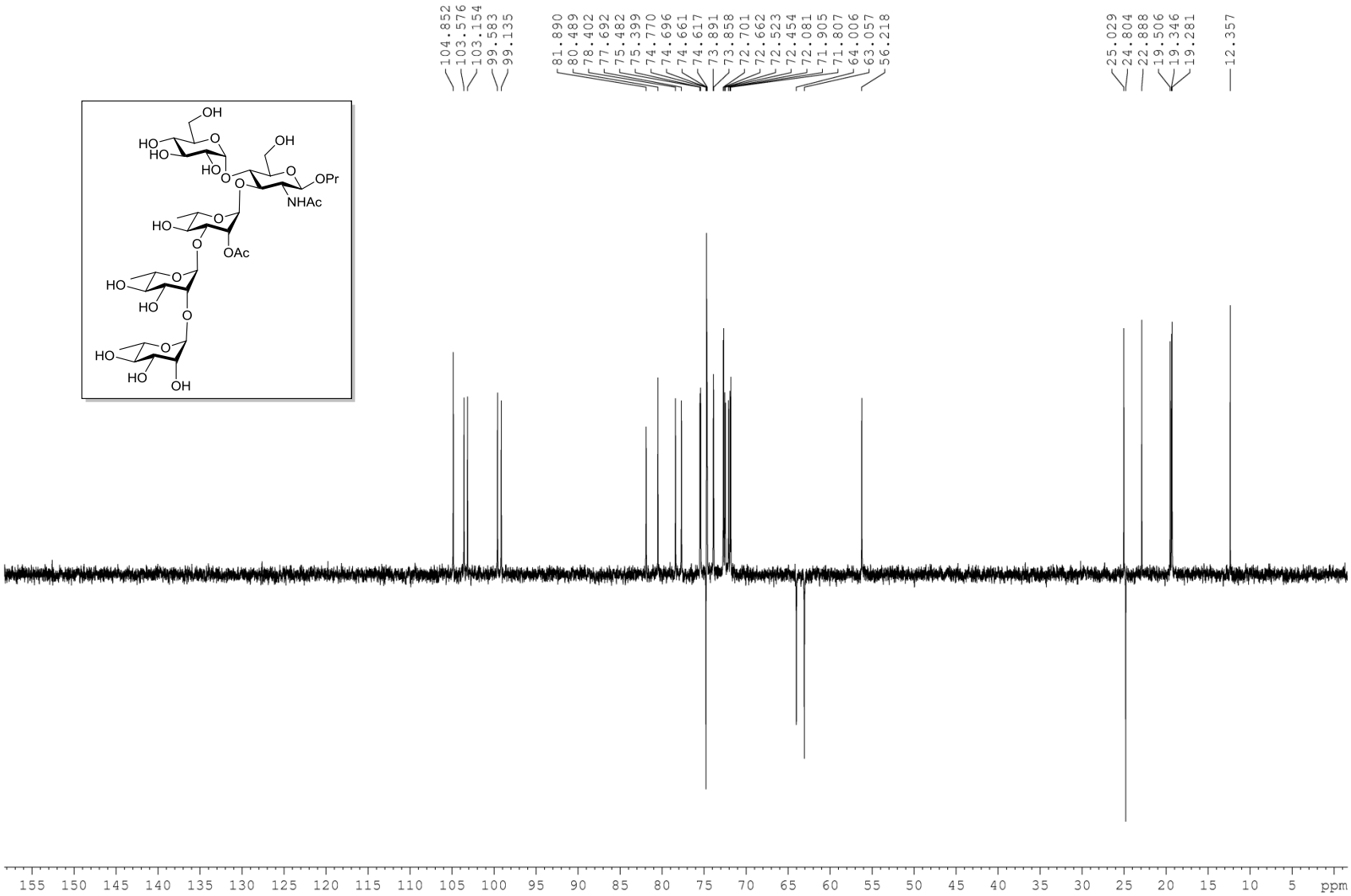
65
60
55
50
ppm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81.890
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78.402
77.692
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75.399
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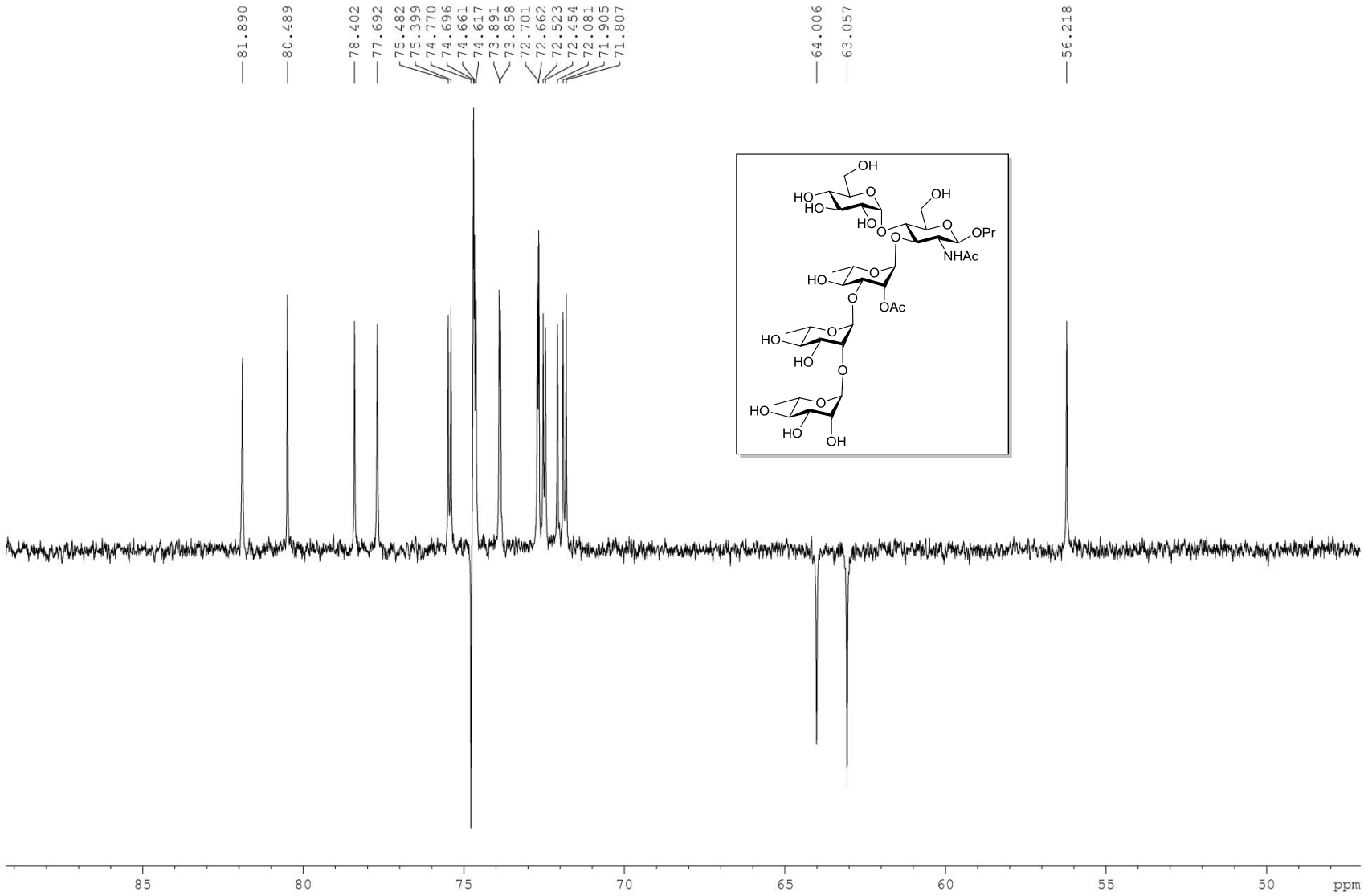
74.696
74.661
74.617
73.891
73.858
72.701
72.662
72.523
72.454
72.081
71.905
71.807
64.006
63.057
56.218
25.029
24.804
22.888
19.506
19.346
19.281
12.357
OH
HO
HO
HO
O
OH
O
OPr
NHAc
HO
O
OAc
HO
HO
O
HO
HO
OH
155 150 145 140 135 130 125 120 115 110 105 100 95 90 85 80 75 70 65 60 55 50 45 40 35 30 25 20 15 10 5 ppm


81.890
80.489
78.402
77.692
75.482
75.399
74.770
74.696
74.661
74.617
73.891
73.858
72.701
72.662
72.523
72.454
72.081
71.905
71.807
64.006
63.057
56.218
OH
HO
HO
HO
O
OH
O
OPr
NHAc
HO
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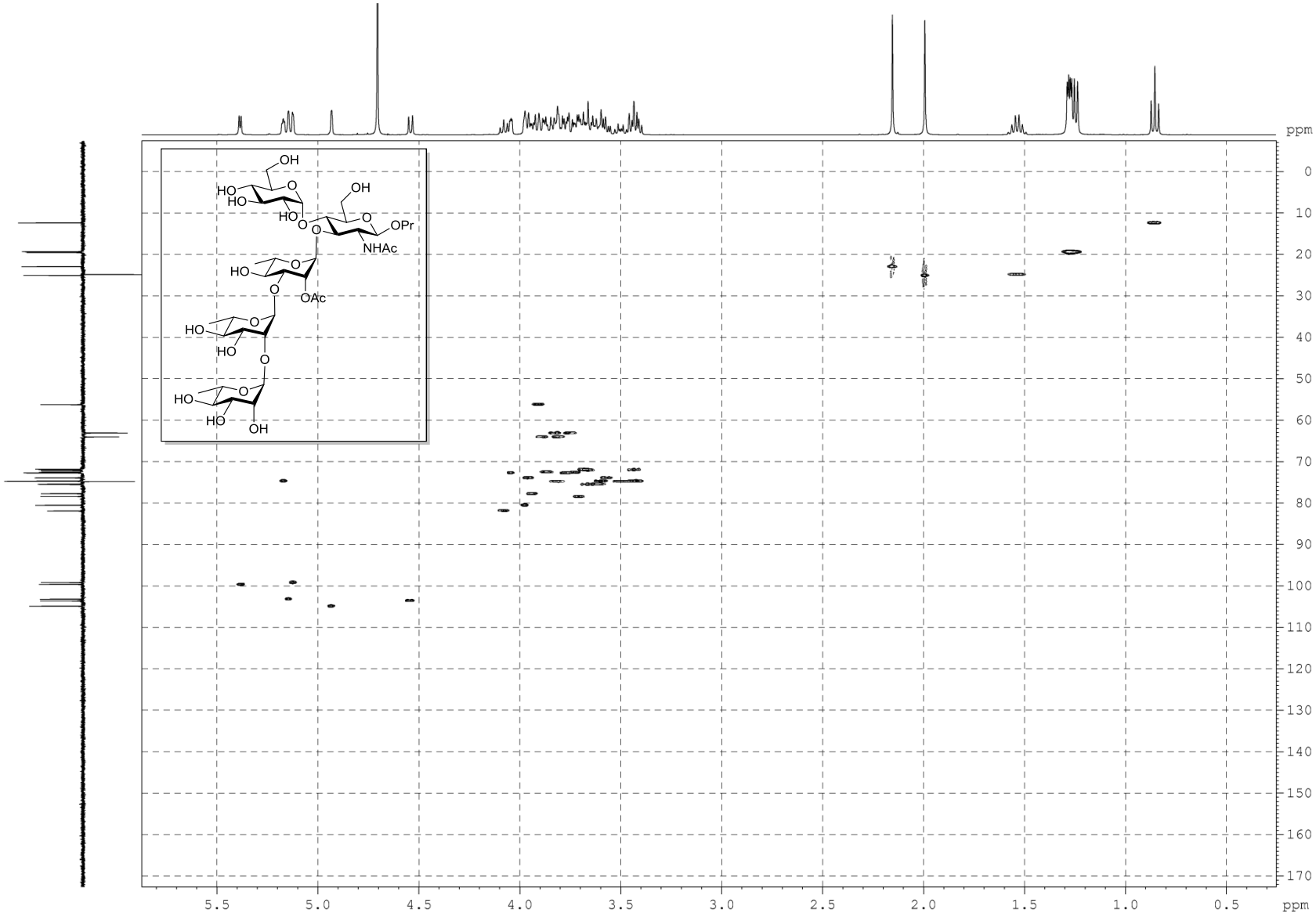
OAc
HO
HO
O
HO
HO
OH
85
80
75
70
65
60
55
50
ppm


OH
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HO
HO
O
OH
O
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OPr
NHAc
HO
O
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OAc
HO
O
HO
O
HO
O
HO
HO
OH
ppm
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170
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4.5
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3.5
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2.0
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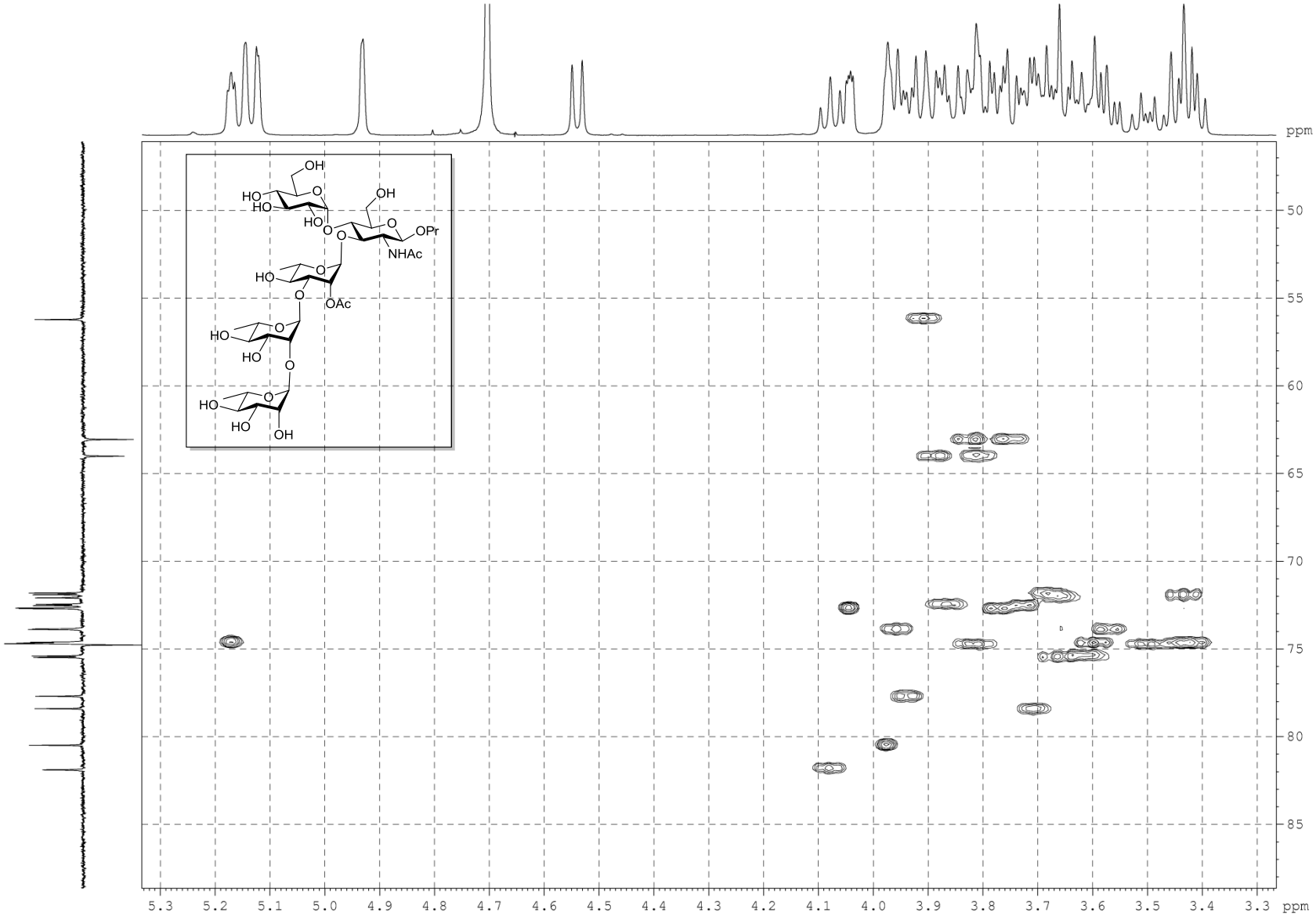
1.0
0.5
ppm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50
55
60
65
70
75
80
85
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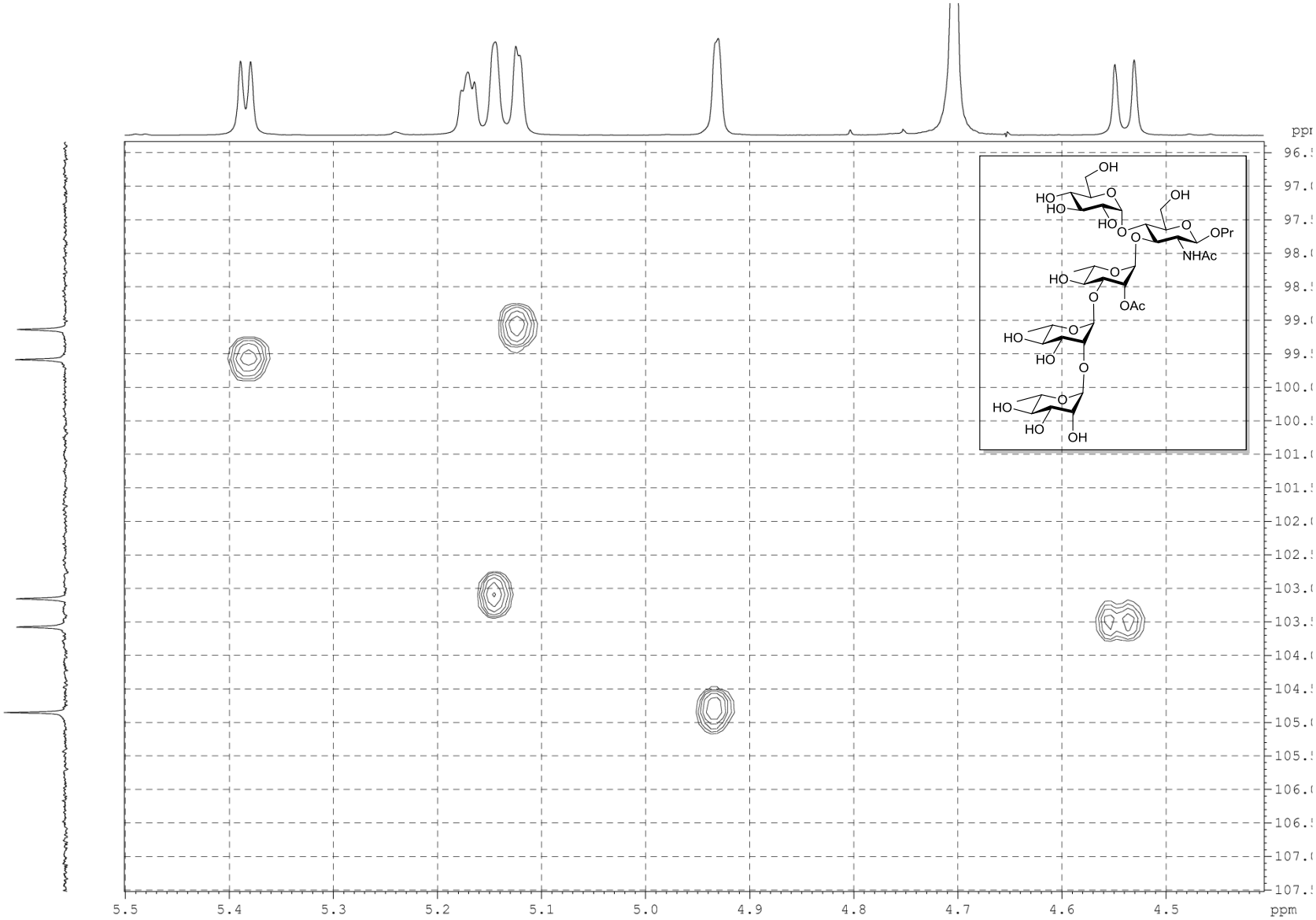
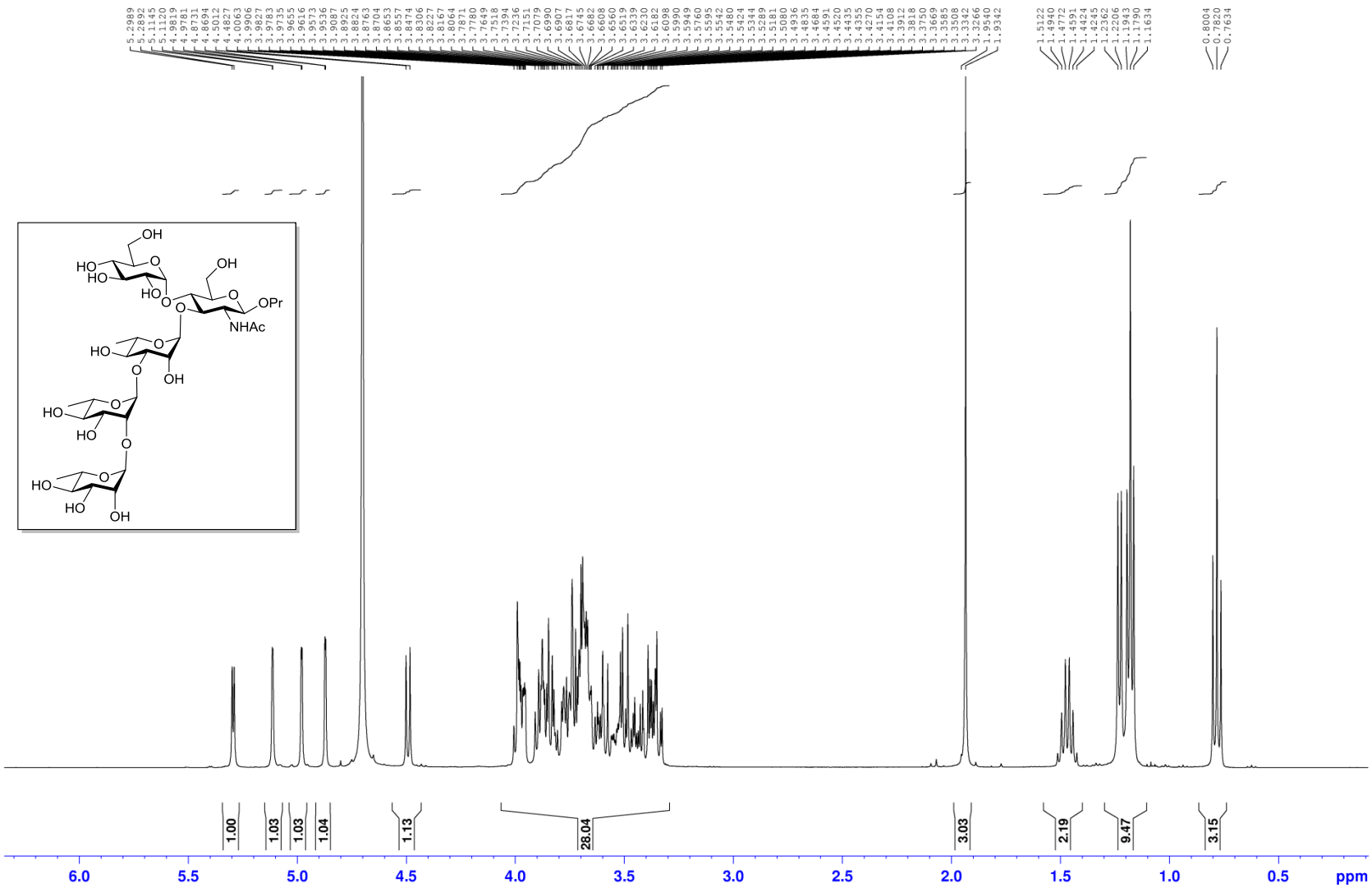
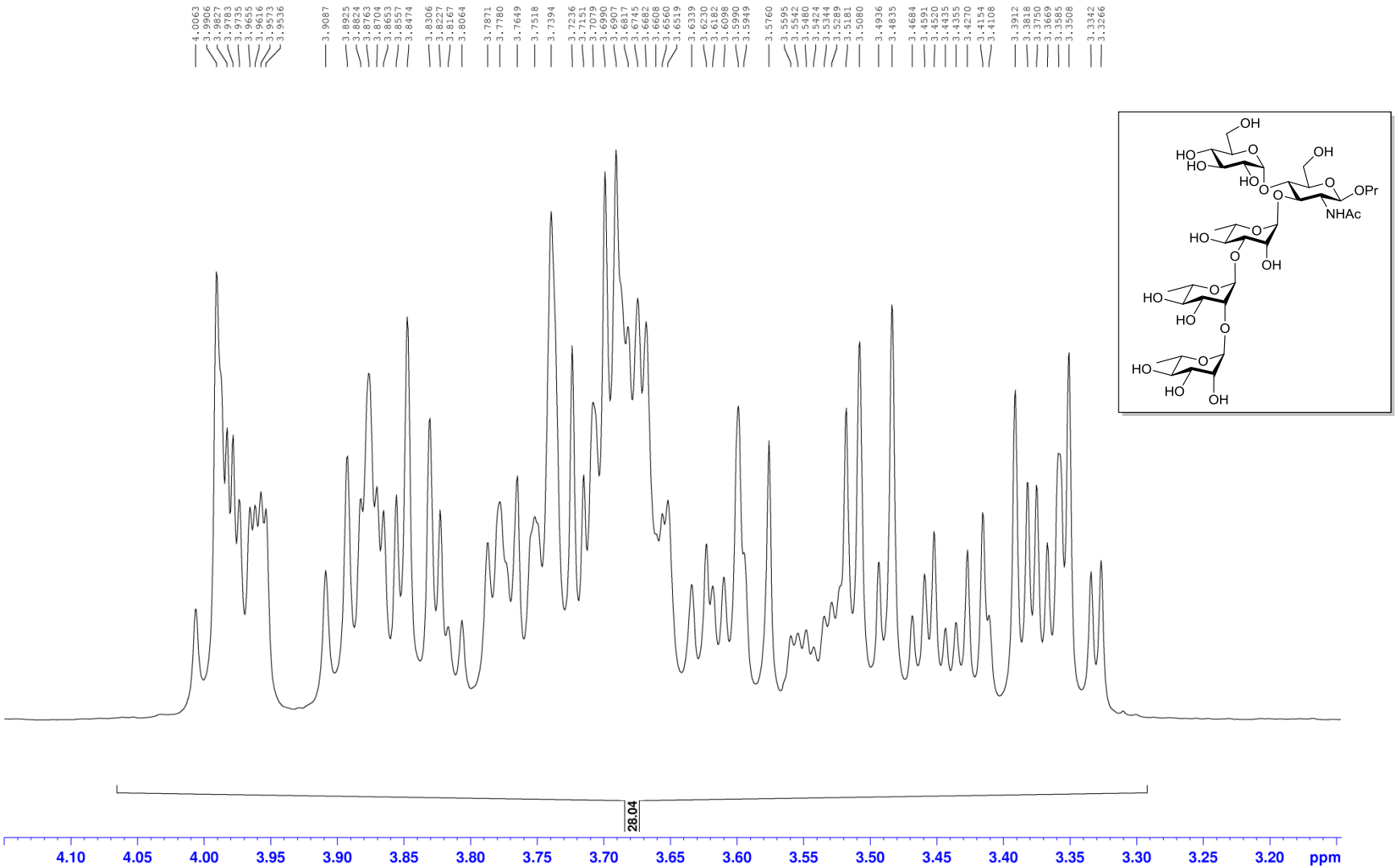
5.2
5.1
5.0
4.9
4.8
4.7
4.6
4.5
4.4
4.3
4.2
4.1
4.0
3.9
3.8
3.7
3.6
3.5
3.4
3.3
ppm
OH
HO
HO
HO
O
OH
O
O
O
OPr
NHAc
HO
O
O
OAc
HO
O
HO
O
HO
O
HO
OH


OH
HO
HO
O
OH
HO
O
O
O
OPr
NHAc
HO
O
O
OAc
HO
O
HO
O
HO
O
HO
OH
5.5
5.4
5.3
5.2
5.1
5.0
4.9
4.8
4.7
4.6
4.5
ppm

Compound 52: **Propyl α-L-rhamnopyranosyl-(1→2)-α-L-rhamnopyranosyl-(1→3)-α-L-rhamnopyranosyl-(1→3)-[α-D-glucopyranosyl-(1→4)]-2-acetamido-2-deoxy-β-D-glucopyranoside**

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3.9655
3.9615
3.9573
3.9536
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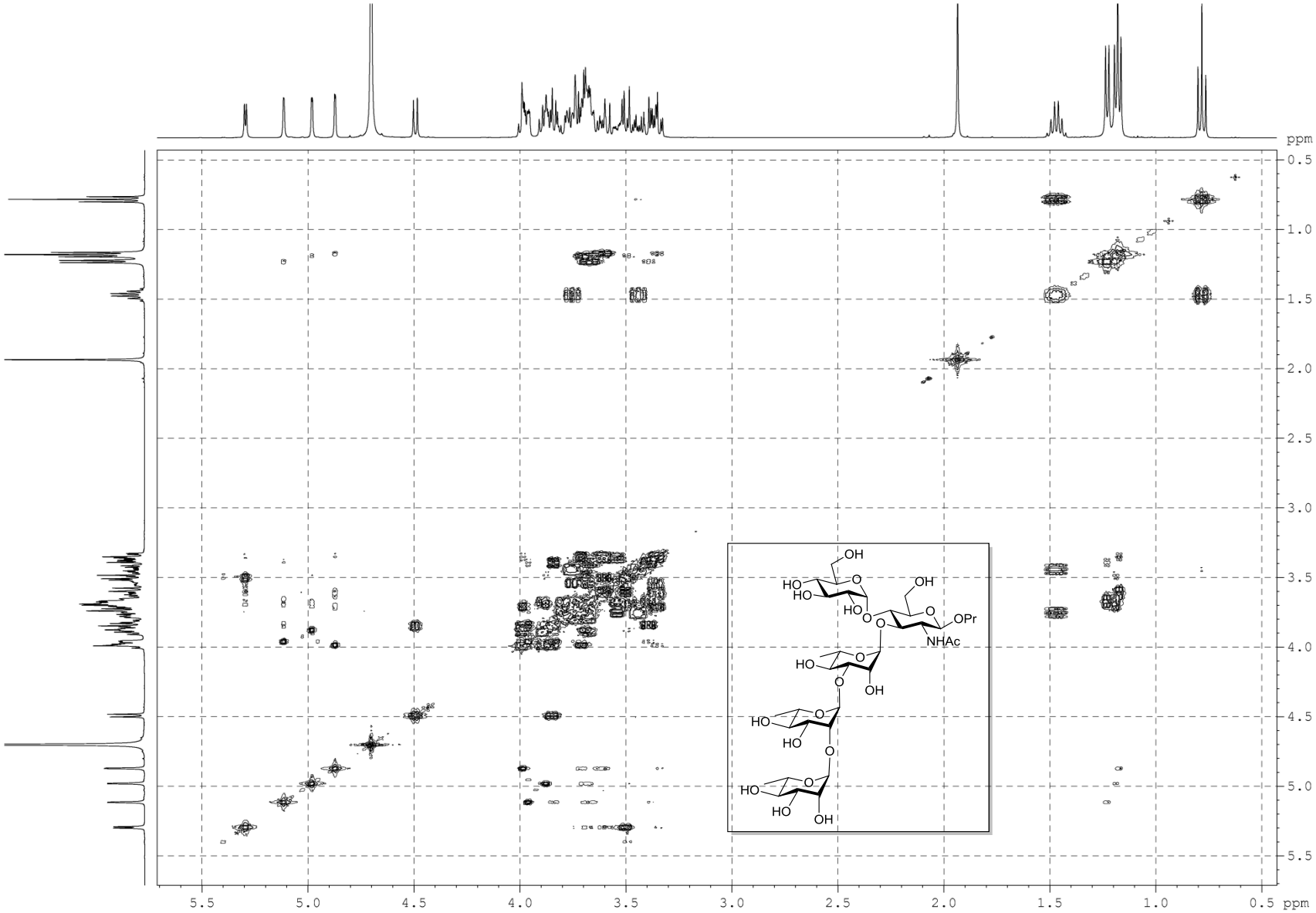
3.8925
3.8824
3.8763
3.8704
3.8653
3.8557
3.8474
3.8306
3.8227
3.8167
3.8064
3.7871
3.7780
3.7649
3.7518
3.7394
3.7236
3.7151
3.7079
3.6990
3.6907
3.6817
3.6745
3.6682
3.6608
3.6560
3.6519
3.6339
3.6230
3.6182
3.6098
3.5990
3.5949
3.5760
3.5595
3.5542
3.5480
3.5424
3.5344
3.5289
3.5181
3.5080
3.4936
3.4835
3.4684
3.4591
3.4521
3.4435
3.4355
3.4270
3.4154
3.4108
3.3912
3.3818
3.3756
3.3669
3.3585
3.3508
3.3342
3.3266
28.04
4.10
4.05
4.00
3.95
3.90
3.85
3.80
3.75
3.70
3.65
3.60
3.55
3.50
3.45
3.40
3.35
3.30
3.25
3.20
ppm
OH
HO
HO
HO
O
OH
O
OPr
NHAc
HO
O
OH
HO
HO
O
HO
HO
OH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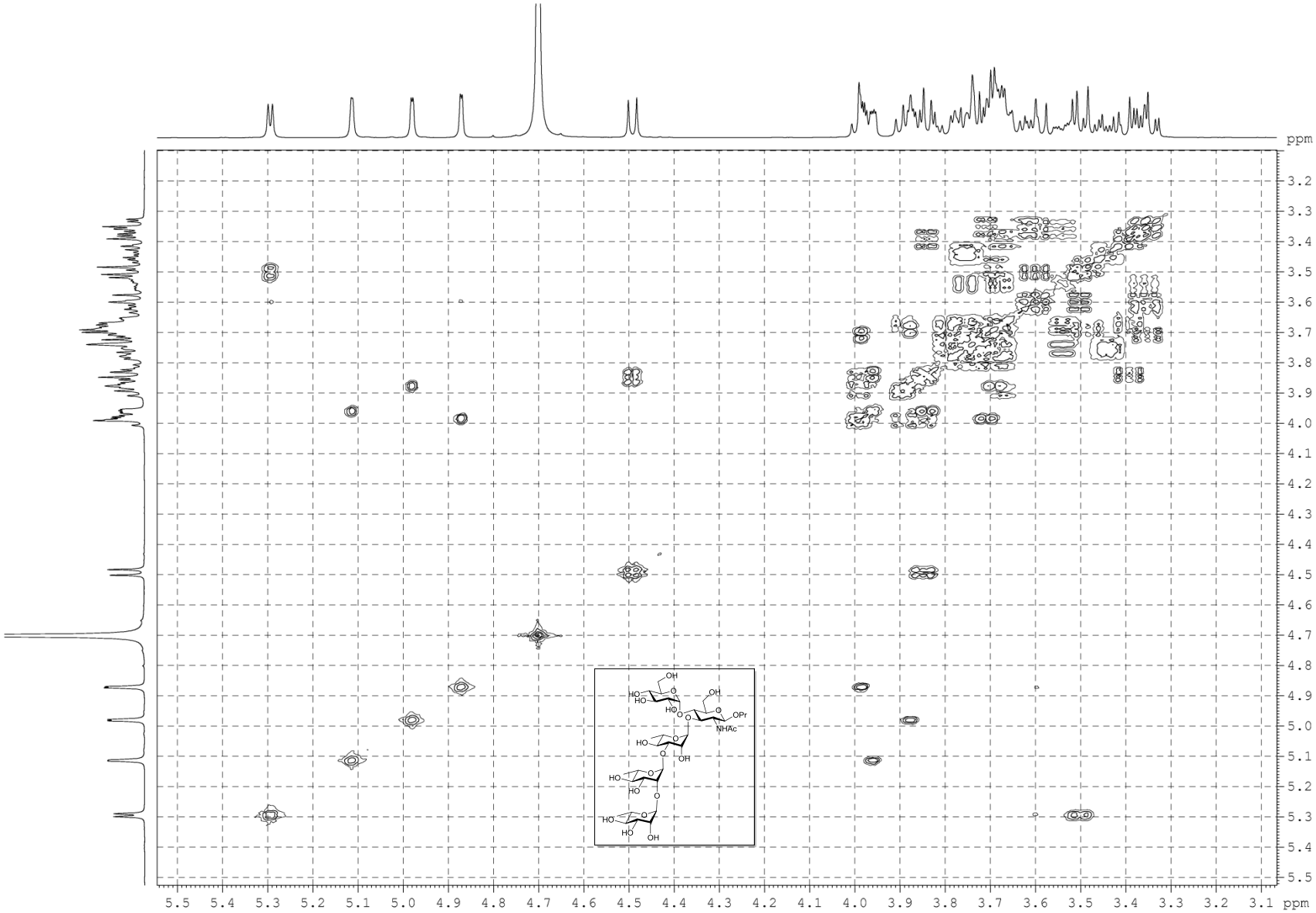
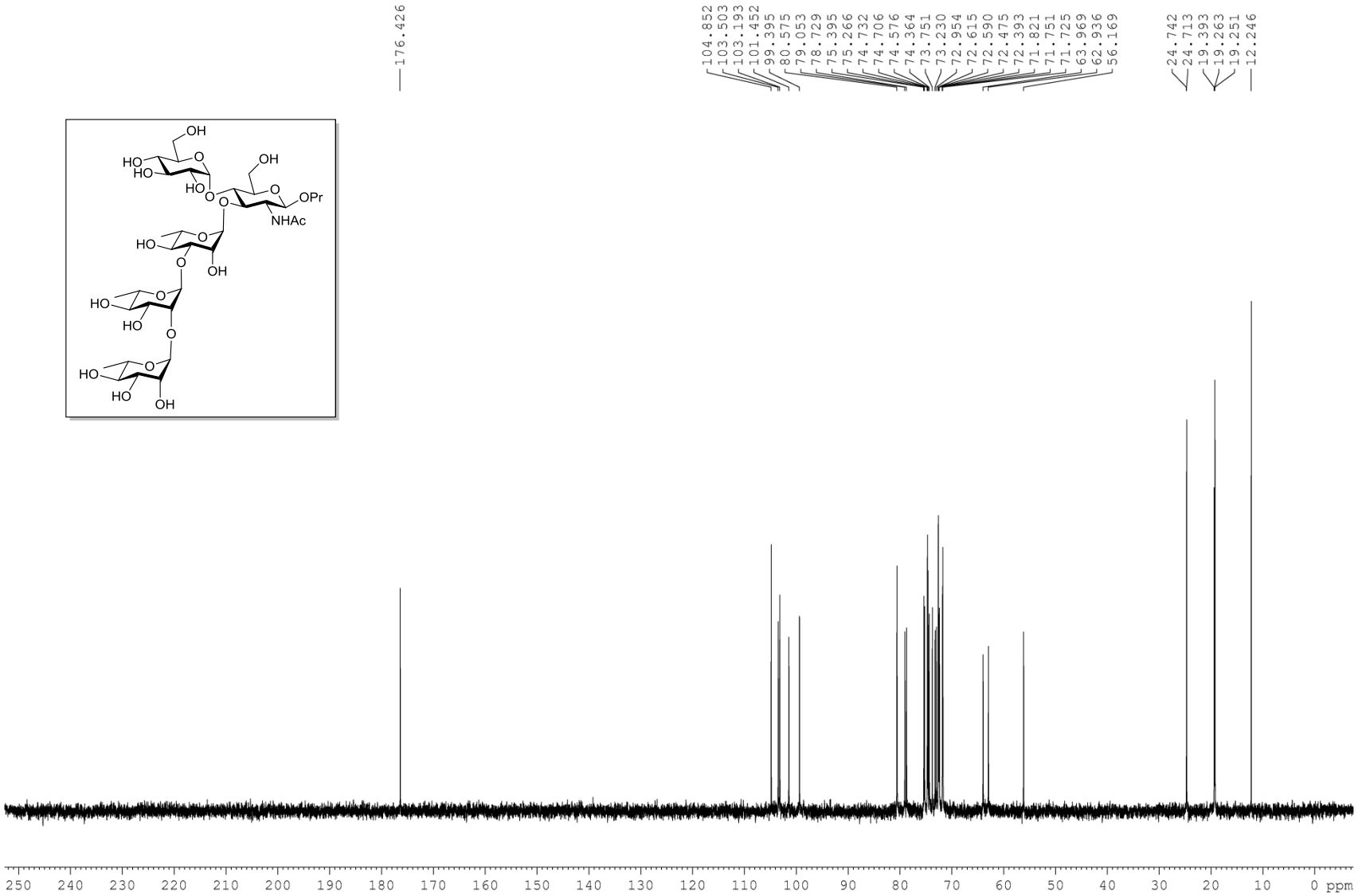
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
5.5
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5 ppm
OH
HO
HO
HO
O
O
OH
O
OPr
NHAc
HO
O
O
OH
HO
O
HO
O
O
HO
O
HO
OH


ppm
3.2
3.3
3.4
3.5
3.6
3.7
3.8
3.9
4.0
4.1
4.2
4.3
4.4
4.5
4.6
4.7
4.8
4.9
5.0
5.1
5.2
5.3
5.4
5.5
5.5 5.4 5.3 5.2 5.1 5.0 4.9 4.8 4.7 4.6 4.5 4.4 4.3 4.2 4.1 4.0 3.9 3.8 3.7 3.6 3.5 3.4 3.3 3.2 3.1 ppm
OH
HO
HO
HO
O
OH
O
OPr
NHAc
HO
O
OH
HO
O
HO
O
HO
O
HO
HO
OH


176.426
104.852
103.503
103.193
101.452
99.395
80.575
79.053
78.729
75.395
75.266
74.732
74.706
74.576
74.364
73.751
73.230
72.954
72.615
72.590
72.475
72.393
71.821
71.751
71.725
63.969
62.936
56.169
24.742
24.713
19.393
19.263
19.251
12.246
OH
HO
HO
HO
O
OH
O
OPr
NHAc
HO
O
OH
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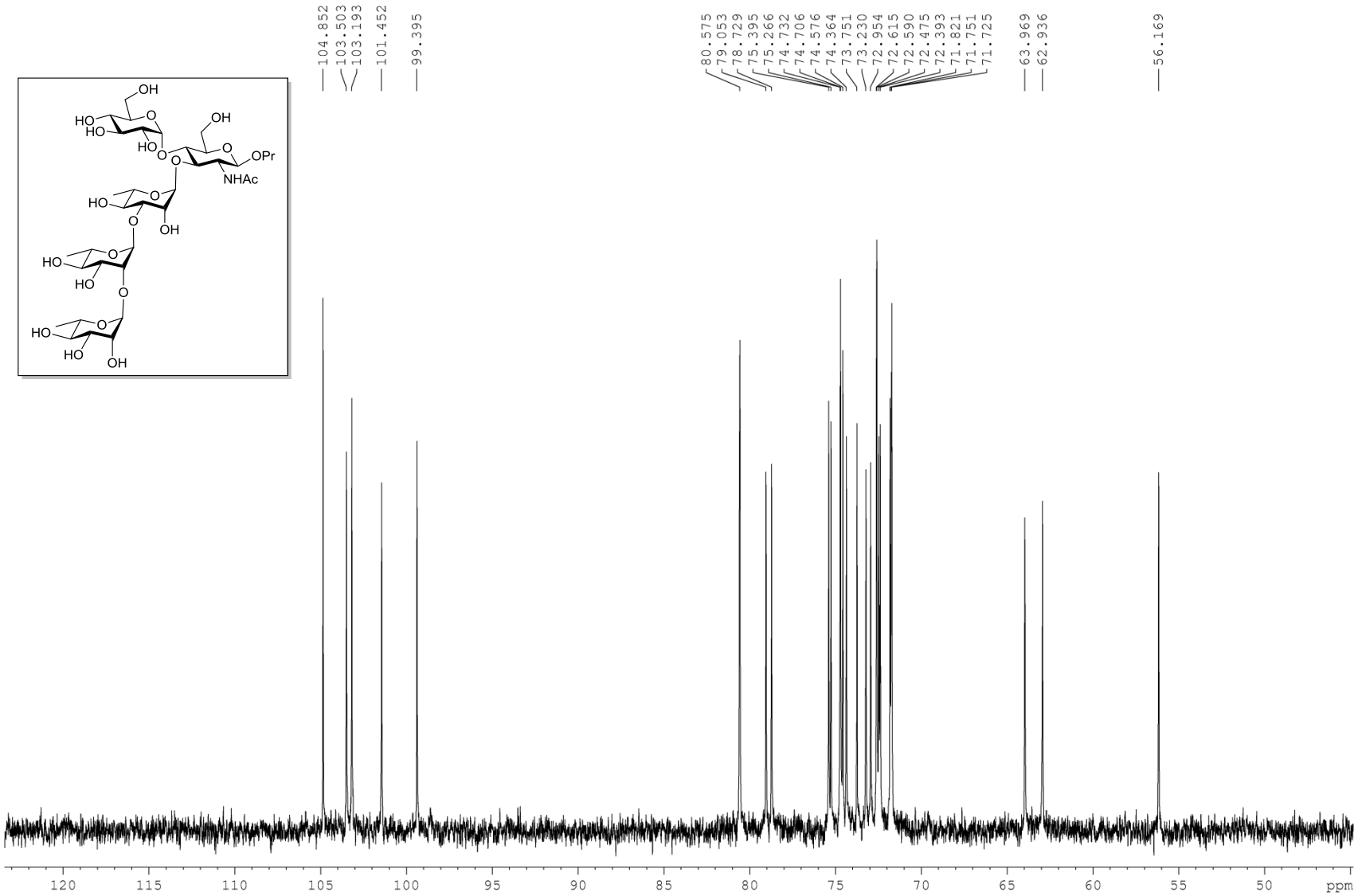
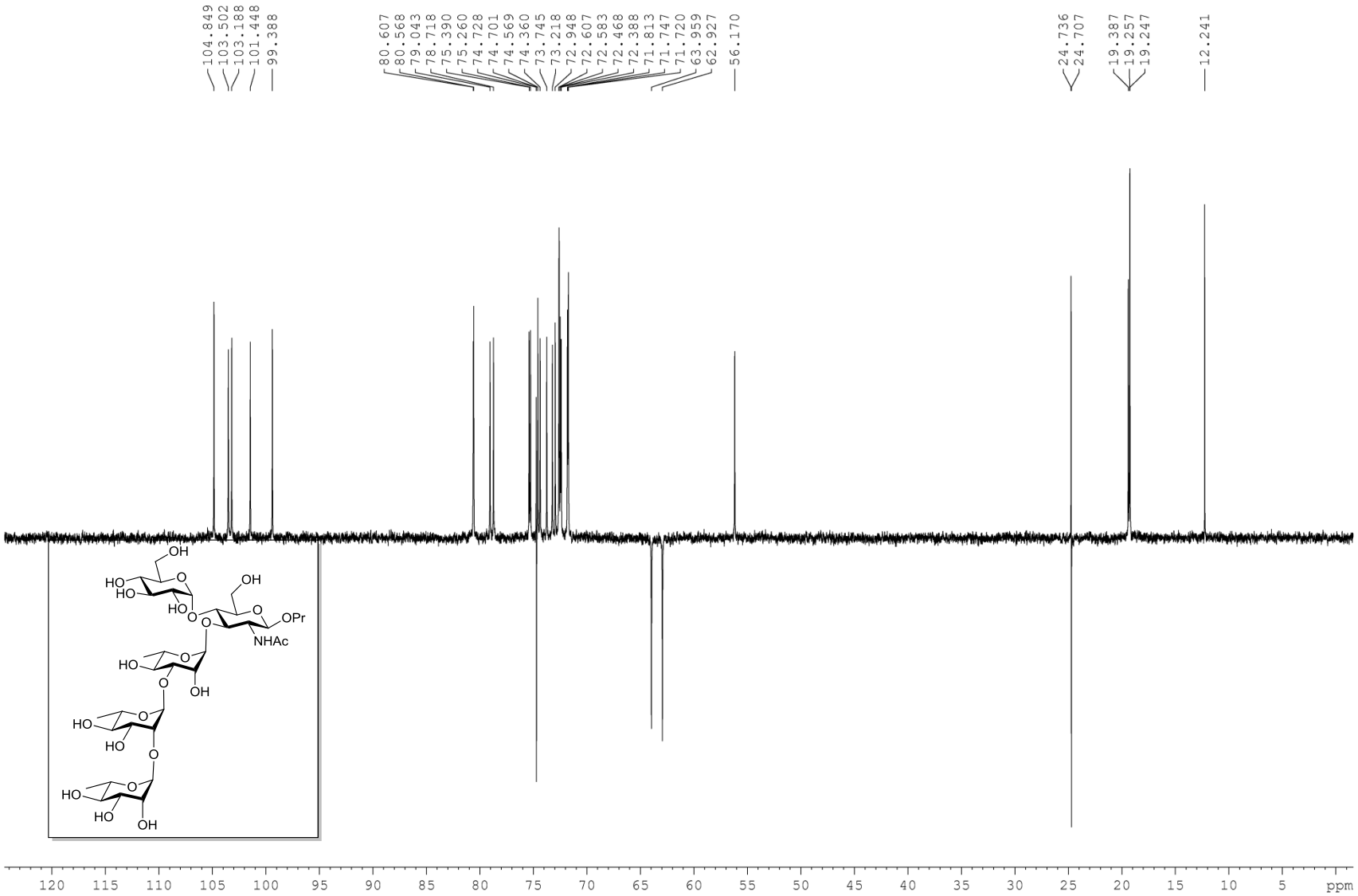
HO
O
HO
O
HO
HO
OH
250 240 230 220 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 ppm


104.852
103.503
103.193
101.452
99.395
80.575
79.053
78.729
75.395
75.266
74.732
74.706
74.576
74.364
73.751
73.230
72.954
72.615
72.590
72.475
72.393
71.821
71.751
71.725
63.969
62.936
56.169
OH
HO
HO
HO
O
OH
O
OPr
NHAc
HO
O
OH
HO
HO
O
HO
HO
OH
120
115
110
105
100
95
90
85
80
75
70
65
60
55
50
ppm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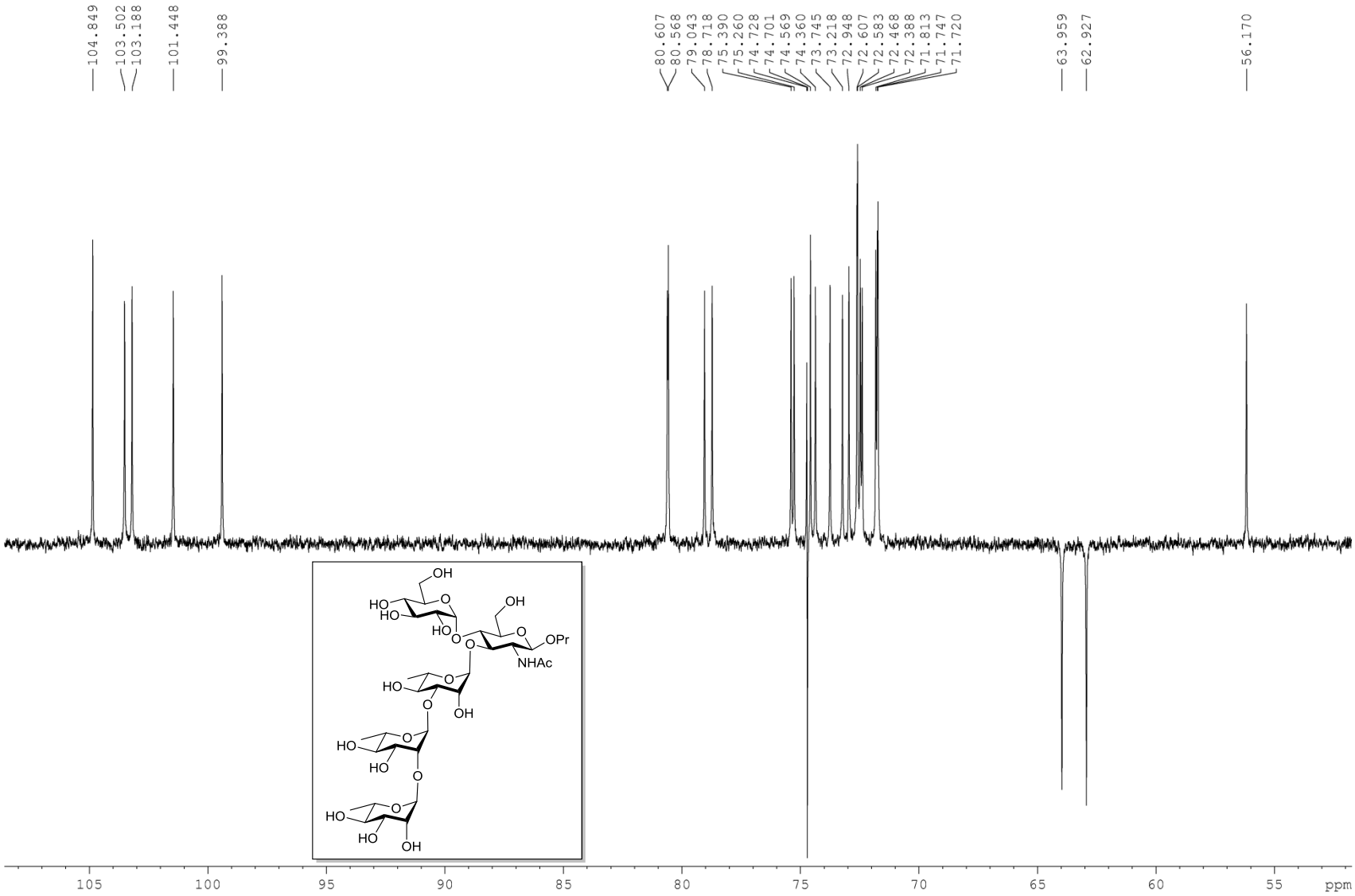
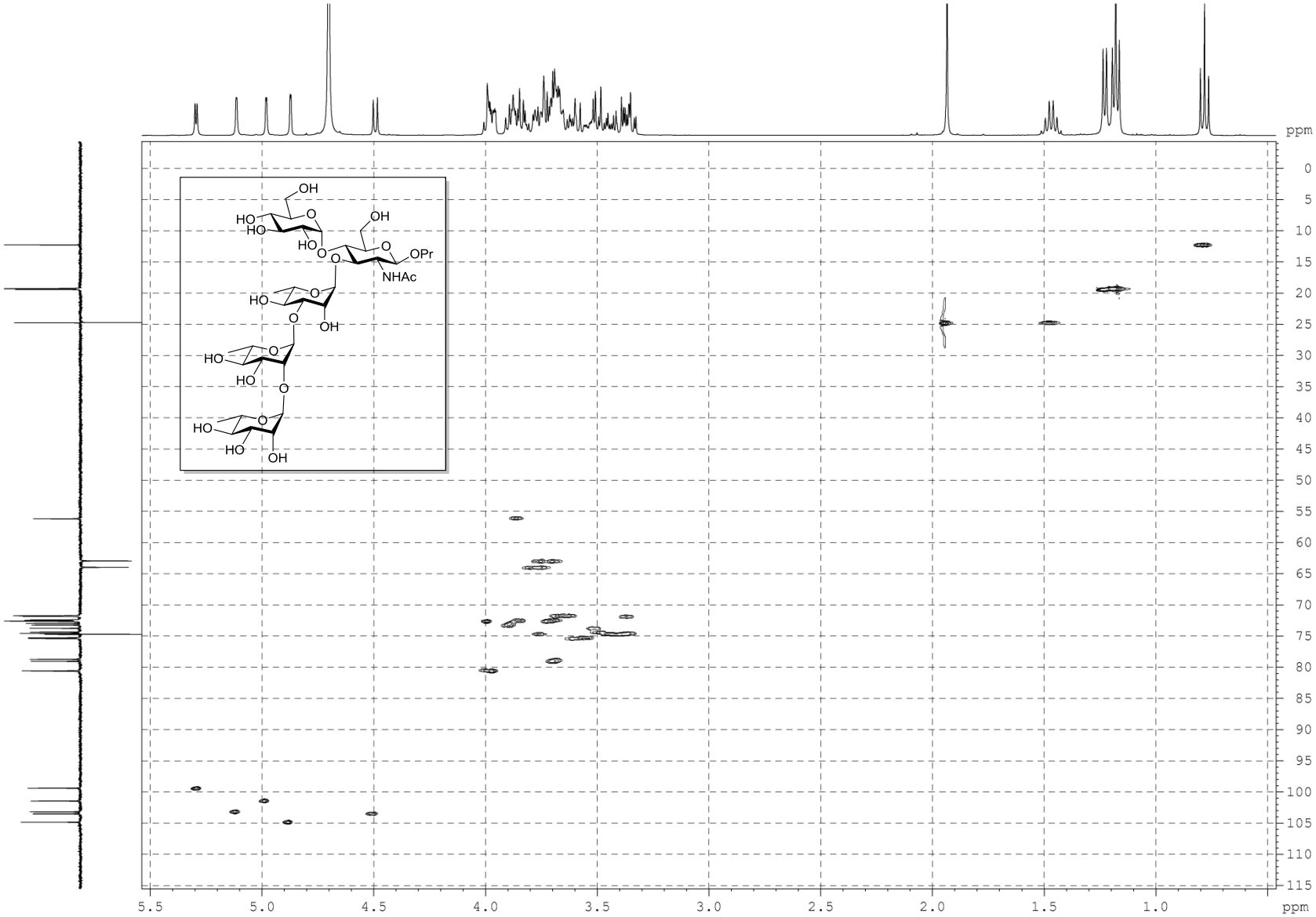
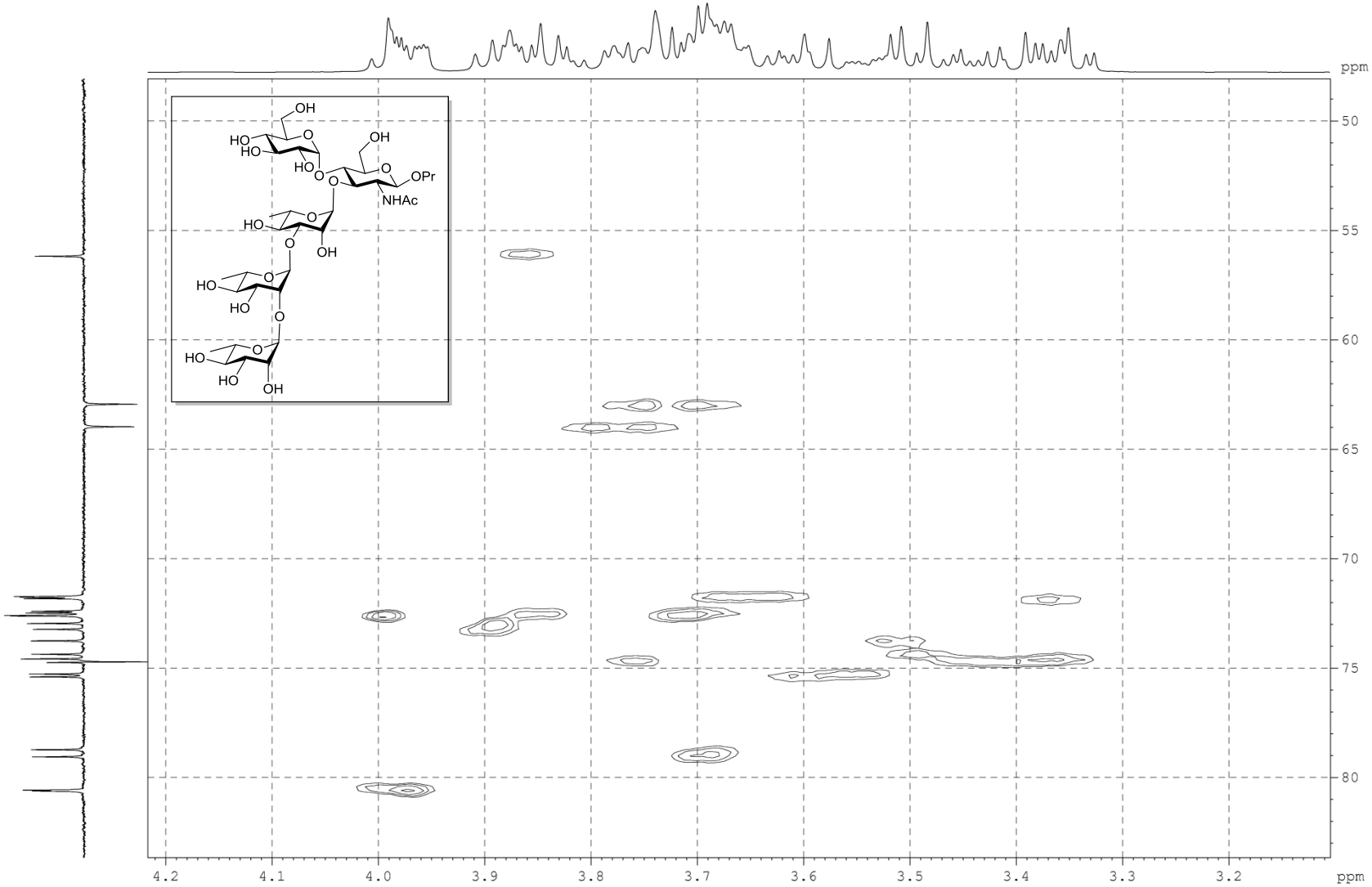
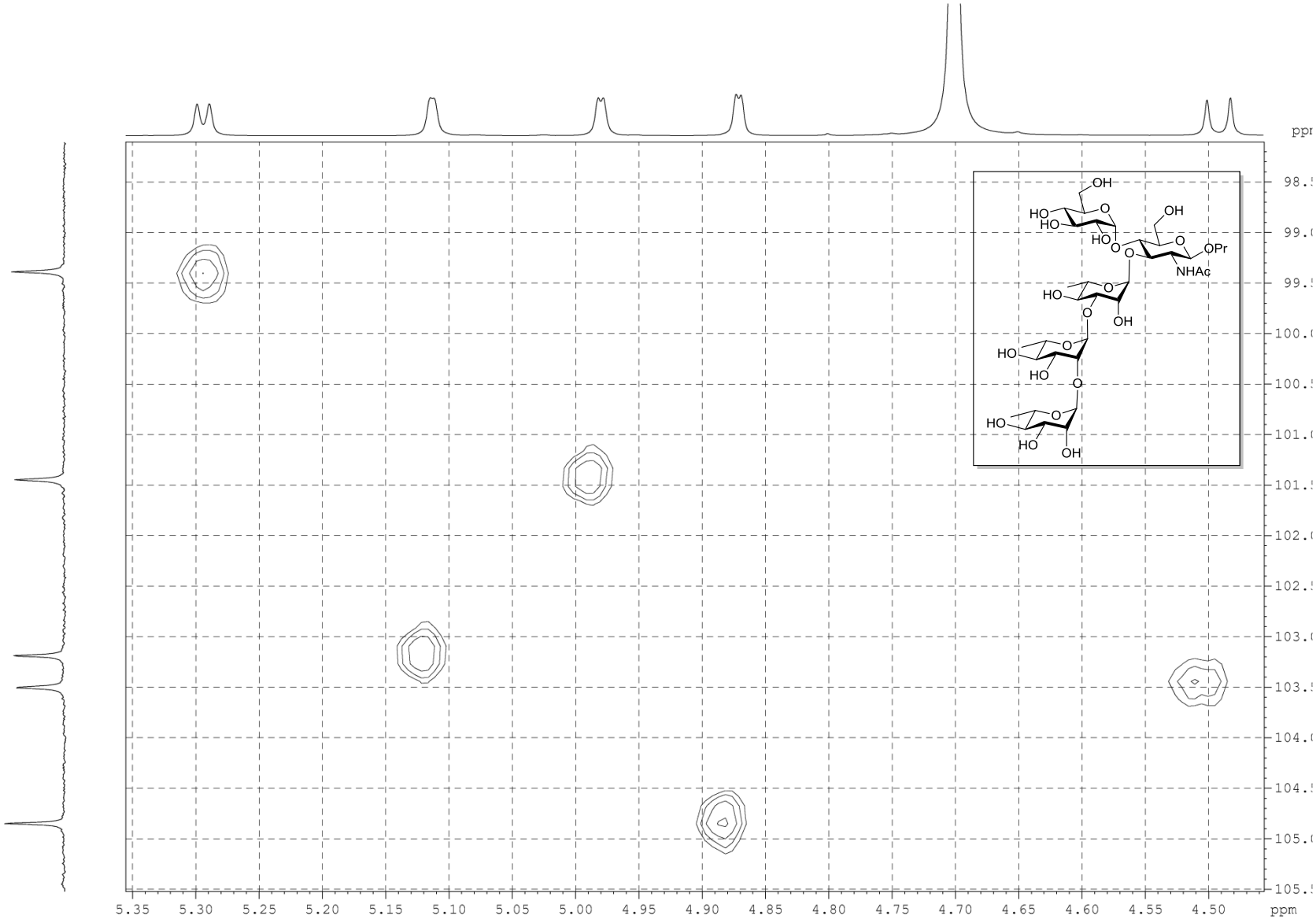
103.502
103.188
101.448
99.388
80.607
80.568
79.043
78.718
75.390
75.260
74.728
74.701
74.569
74.360
73.745
73.218
72.948
72.607
72.583
72.468
72.388
71.813
71.747
71.720
63.959
62.927
56.170
24.736
24.707
19.387
19.257
19.247
12.241
OH
HO
HO
HO
O
OH
O
OPr
NHAc
HO
O
OH
HO
HO
O
HO
HO
OH
120 115 110 105 100 95 90 85 80 75 70 65 60 55 50 45 40 35 30 25 20 15 10 5 ppm


104.849
103.502
103.188
101.448
99.388
80.607
80.568
79.043
78.718
75.390
75.260
74.728
74.701
74.569
74.360
73.745
73.218
72.948
72.607
72.583
72.468
72.388
71.813
71.747
71.720
63.959
62.927
56.170
105
100
95
90
85
80
75
70
65
60
55
ppm
OH
HO
HO
HO
O
OH
O
OPr
NHAc
HO
O
OH
HO
HO
O
HO
O
OH


OH
HO
HO
O
HO
O
OH
O
O
OPr
NHAc
HO
O
O
OH
HO
O
HO
O
HO
O
HO
HO
OH
ppm
0
5
10
15
20
25
30
35
40
45
50
55
60
65
70
75
80
85
90
95
100
105
110
115
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
ppm


ppm
50
55
60
65
70
75
80
4.2
4.1
4.0
3.9
3.8
3.7
3.6
3.5
3.4
3.3
3.2
ppm
OH
HO
HO
HO
O
OH
O
O
OPr
NHAc
HO
O
OH
O
HO
O
HO
O
HO
O
HO
OH


ppm
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5.25
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5.15
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5.05
5.00
4.95
4.90
4.85
4.80
4.75
4.70
4.65
4.60
4.55
4.50
ppm
OH
HO
HO
O
HO
O
OH
O
OPr
NHAc
HO
O
OH
O
HO
O
HO
O
HO
O
HO
HO
OH