Supporting Information File 2

for

Revaluation of biomass-derived furfuryl alcohol derivatives for the synthesis of carbocyclic nucleoside phosphonate analogues

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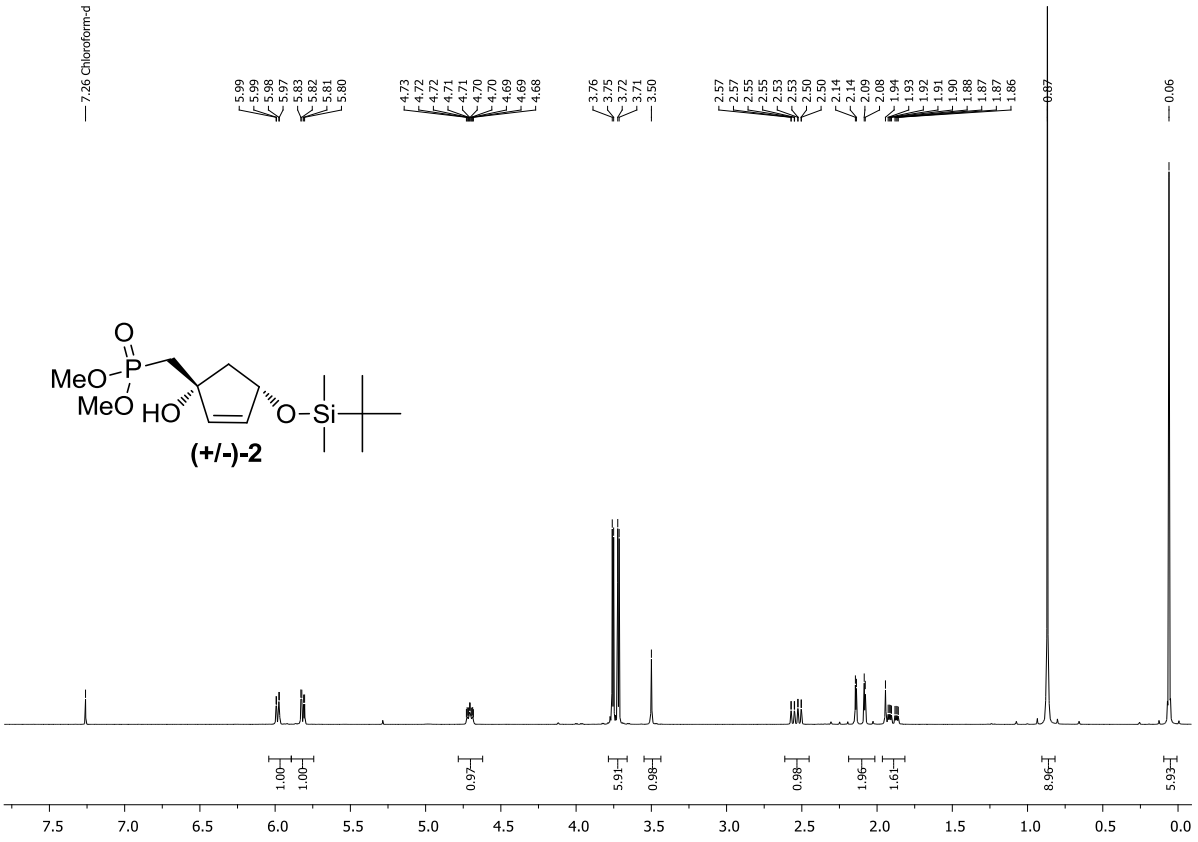
Email: Christophe Mathé - christophe.mathe@umontpellier.fr

*Corresponding author

Copies of NMR spectra for the synthesized compounds


7.26 Chloroform-d
5.99
5.99
5.98
5.97
5.83
5.82
5.81
5.80
4.73
4.72
4.72
4.71
4.71
4.70
4.70
4.69
4.69
4.68
3.76
3.75
3.72
3.71
3.50
2.57
2.57
2.55
2.55
2.53
2.53
2.50
2.50
2.14
2.14
2.09
2.08
1.94
1.93
1.92
1.91
1.90
1.88
1.87
1.87
1.86
0.97
0.06
MeO
P
O
MeO
HO
O
Si
(+/-)-2
1.00
1.00
0.97
5.91
0.98
0.98
1.96
1.61
8.96
5.93
7.5
7.0
6.5
6.0
5.5
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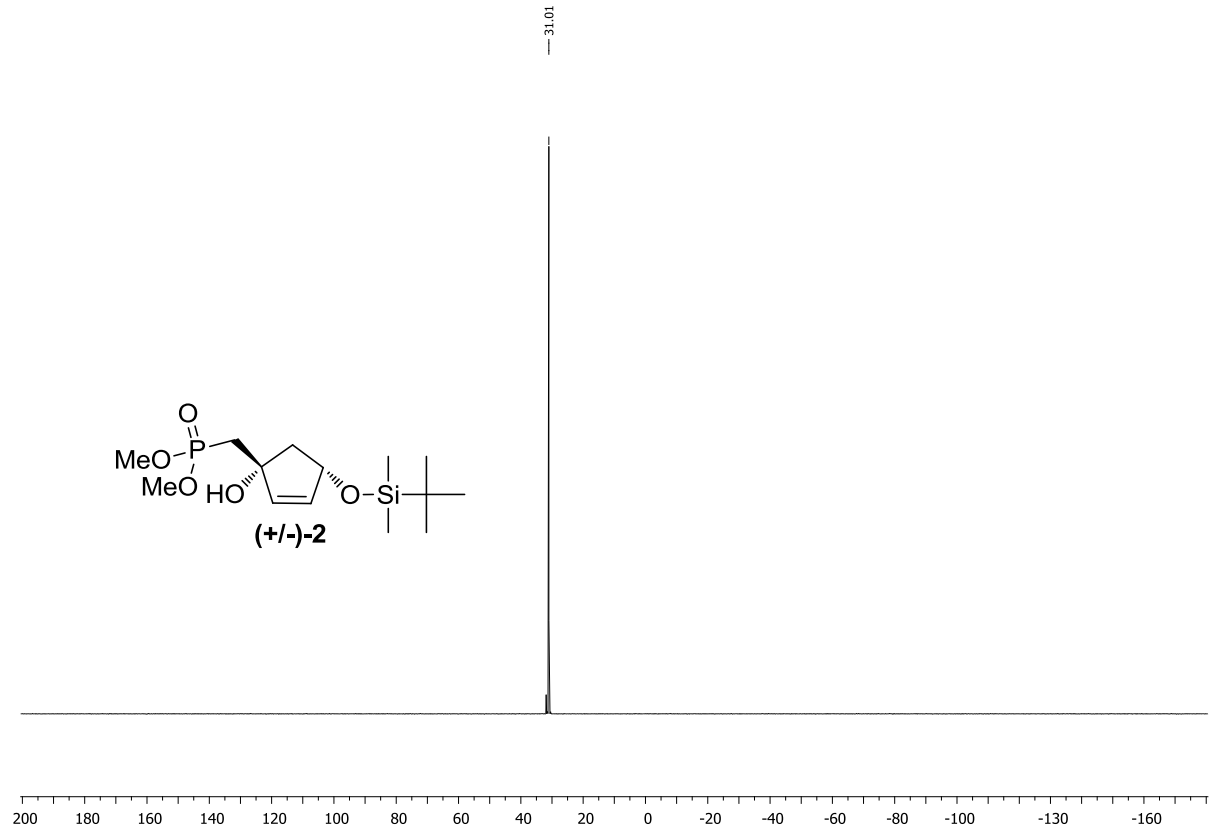
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0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MeO
P
O
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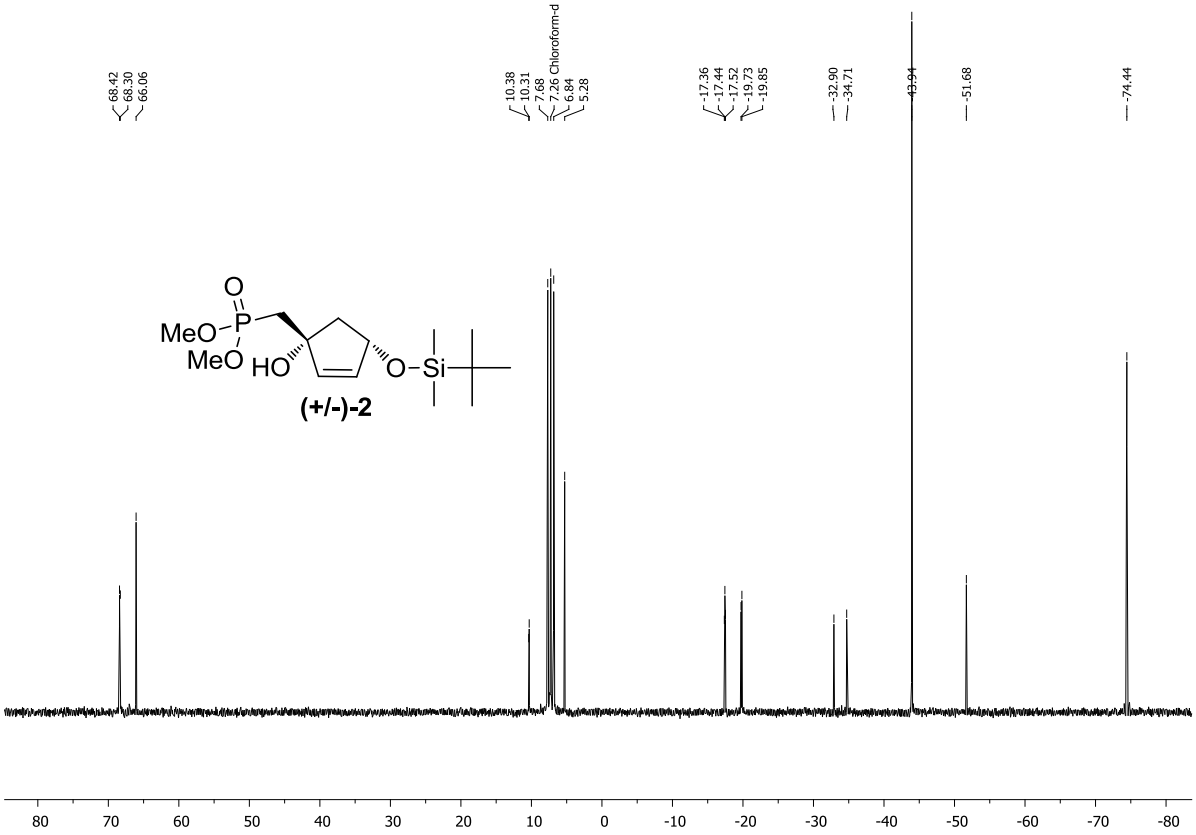
HO
O
Si
(+/-)-2
200
180
160
140
120
100
80
60
40
20
0
-20
-40
-60
-80
-100
-130
-160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66.06
10.38
10.31
7.68
7.26 Chloroform-d
6.84
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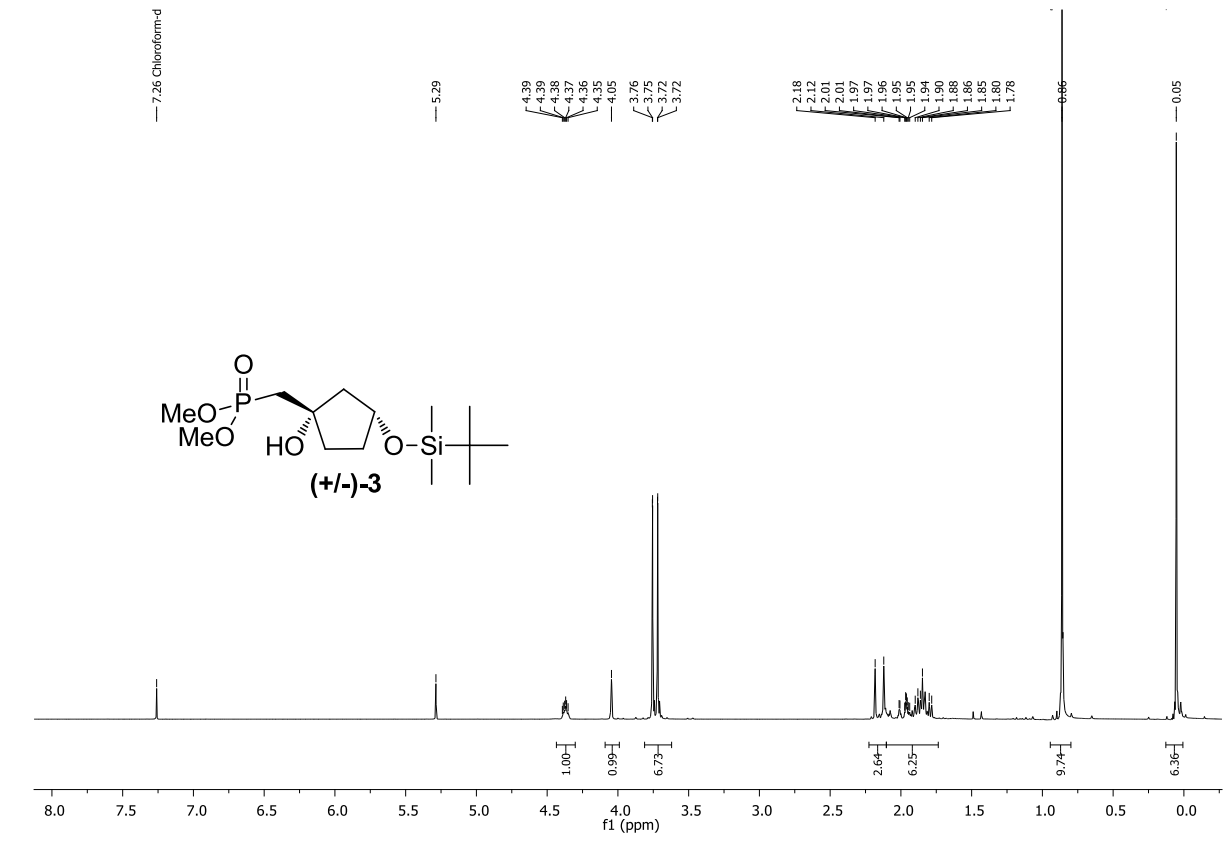
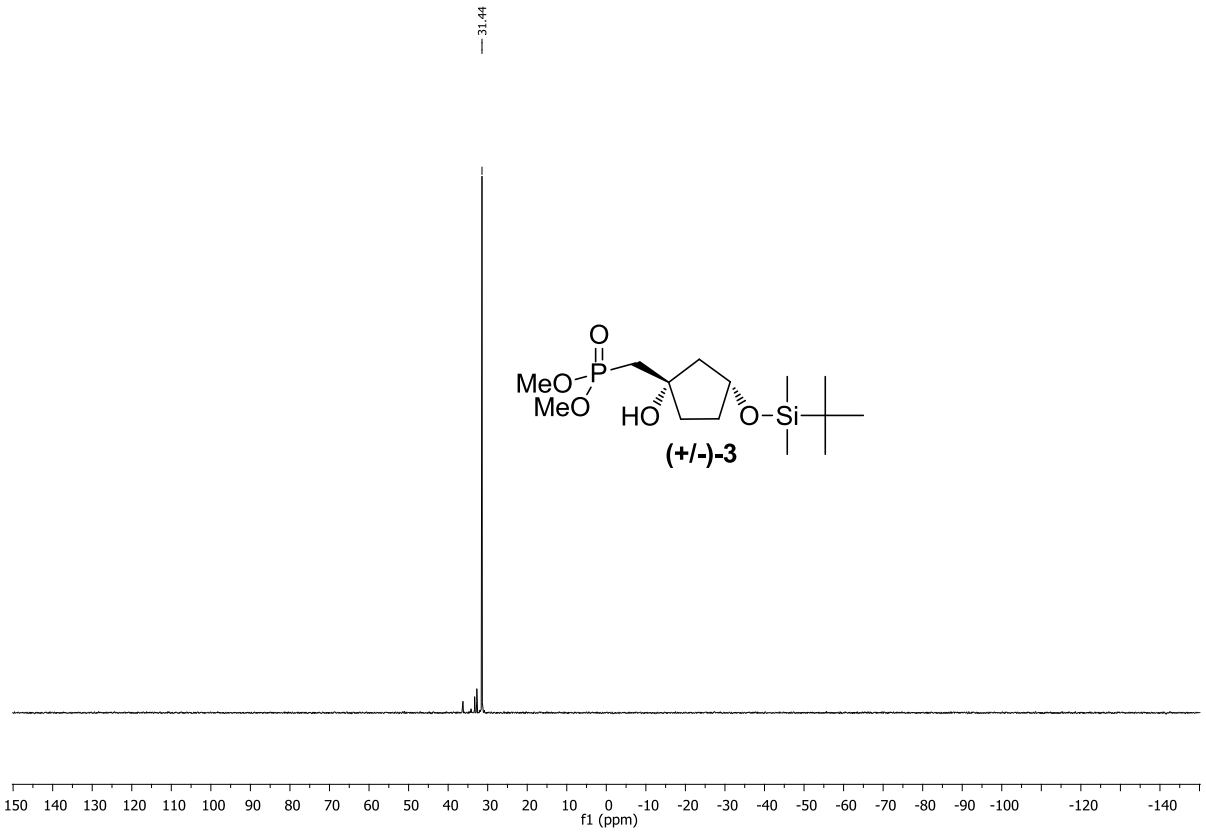
-17.36
-17.44
-17.52
-19.73
-19.85
-32.90
-34.71
43.94
-51.68
-74.44
MeO
MeO
P
O
HO
O-Si
(+/-)-2


7.26 Chloroform-d
5.29
4.39
4.39
4.38
4.37
4.36
4.35
4.05
3.76
3.75
3.72
3.72
2.18
2.12
2.01
2.01
1.97
1.97
1.96
1.95
1.95
1.94
1.90
1.88
1.86
1.85
1.80
1.78
0.86
0.05
MeO
MeO
P
O
HO
O-Si
(+/-)-3
1.00
0.99
6.73
2.64
6.25
9.74
6.36
f1 (ppm)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O
P
HO
O
Si
(+/-)-3
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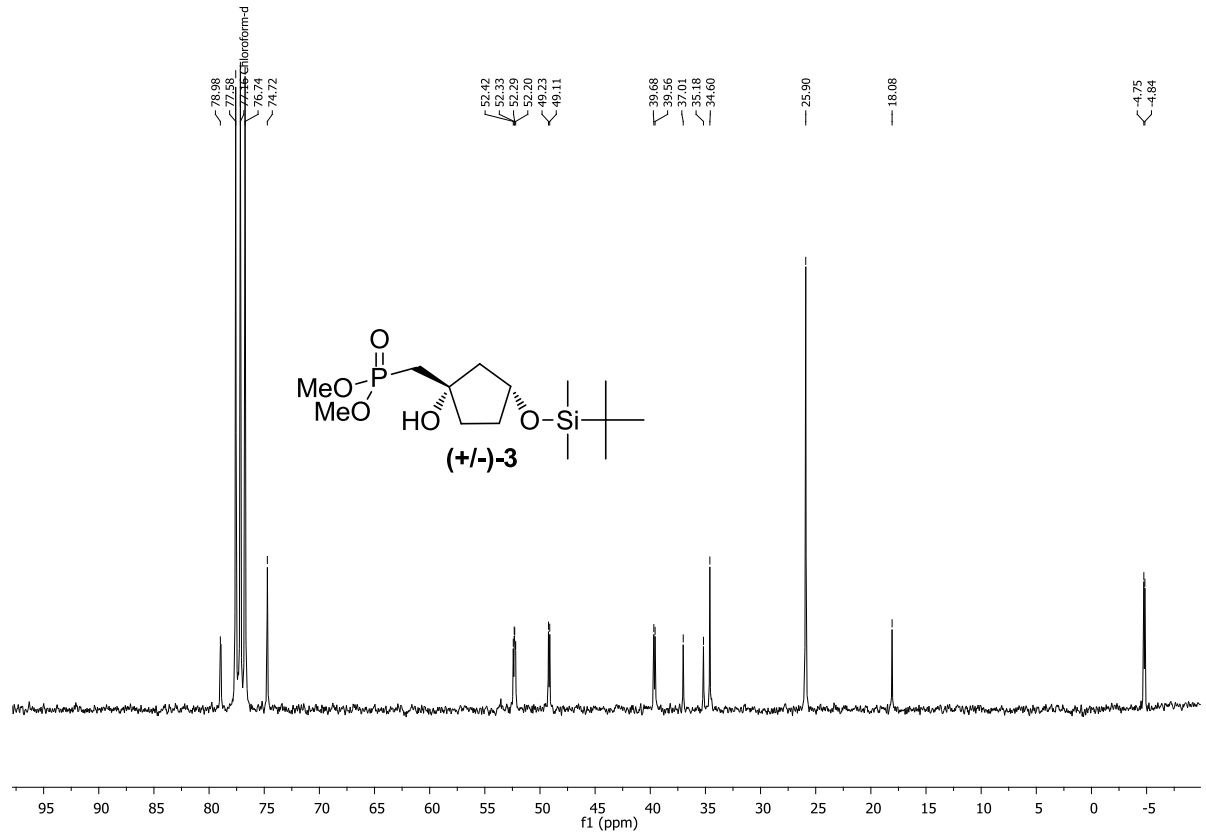
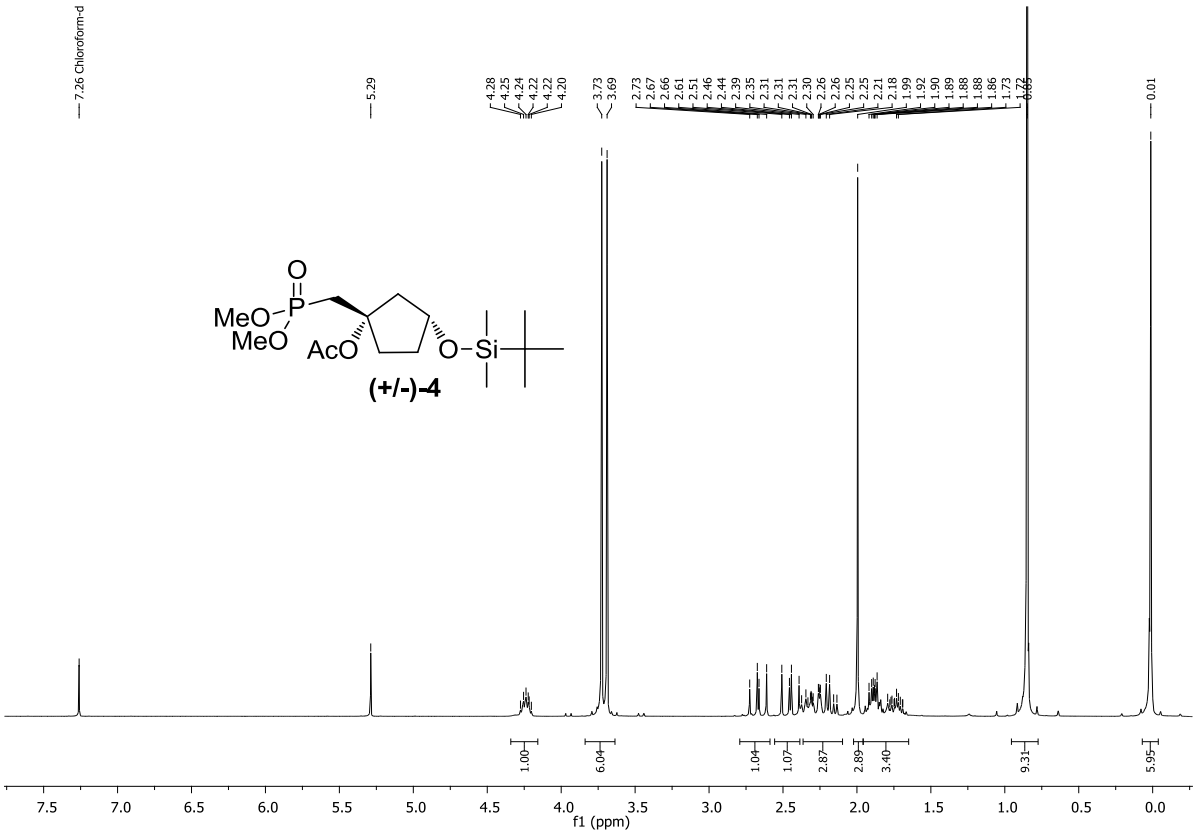
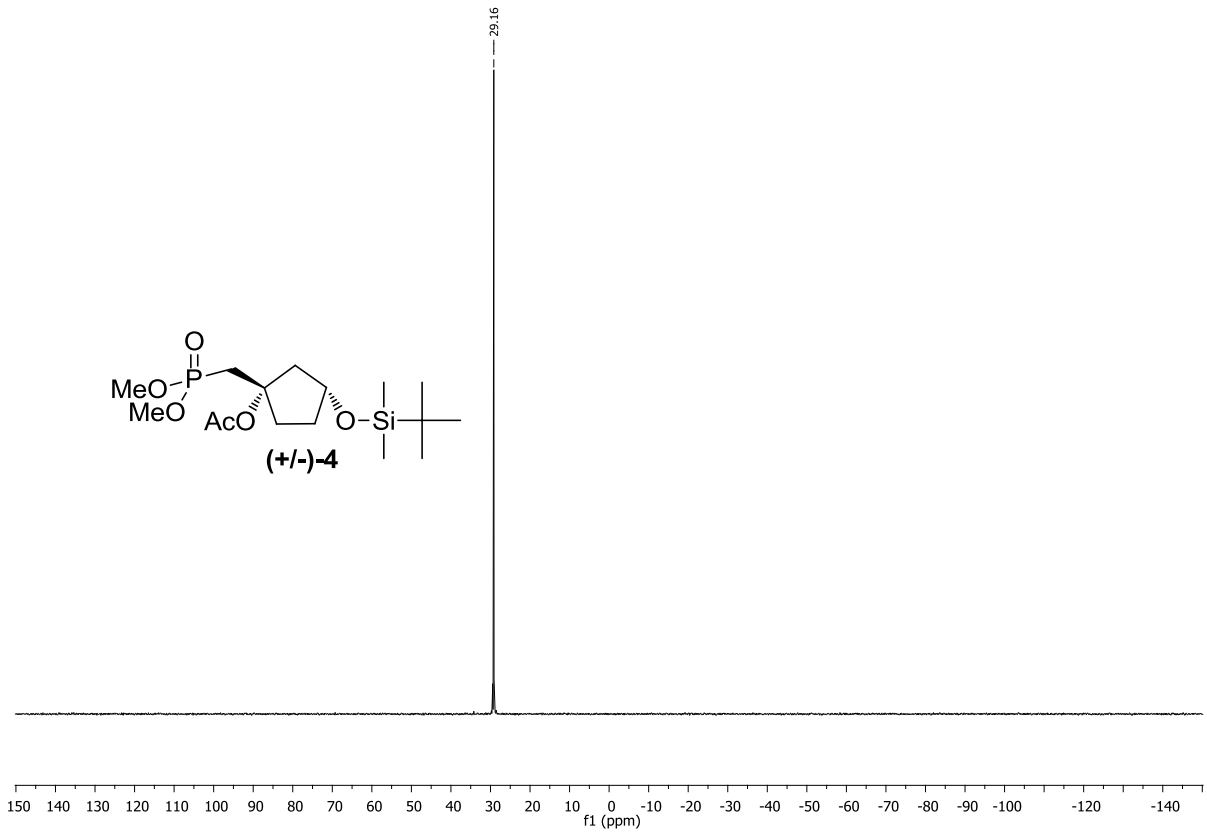
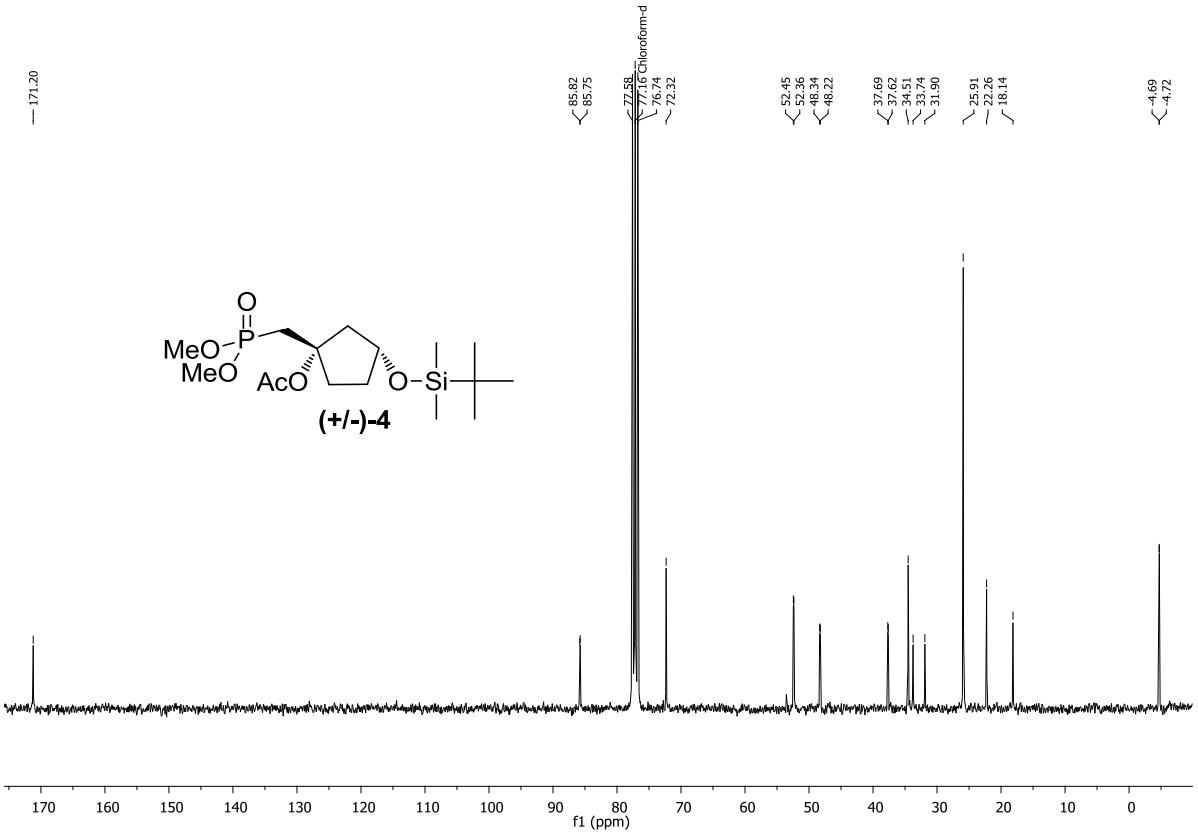
f1 (ppm)

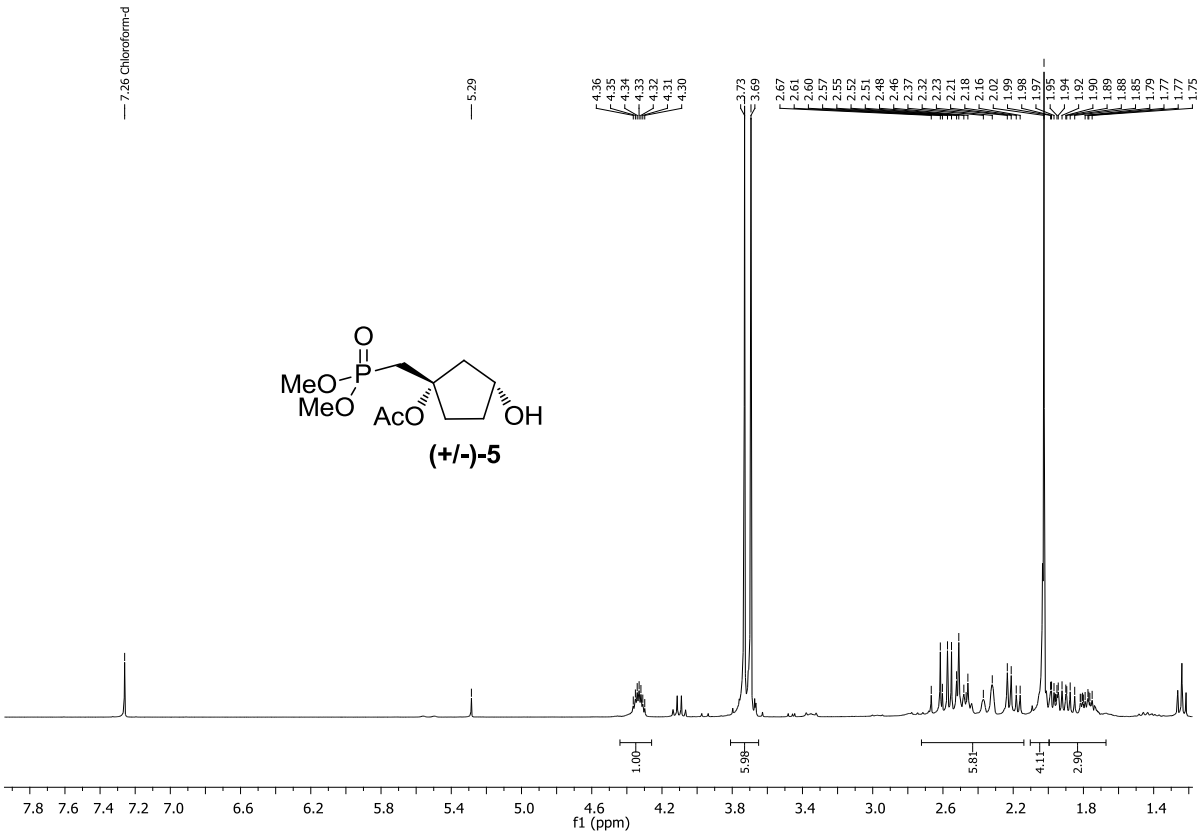

78.98
77.58
77.16 Chloroform-d
76.74
74.72
52.42
52.33
52.29
52.20
49.23
49.11
39.68
39.56
37.01
35.18
34.60
25.90
18.08
-4.75
-4.84
MeO
MeO
O
P
HO
O
Si
(+/-)-3
95 90 85 80 75 70 65 60 55 50 45 40 35 30 25 20 15 10 5 0 -5
f1 (ppm)


7.26 Chloroform-d
5.29
4.28
4.25
4.24
4.22
4.22
4.20
3.73
3.69
2.73
2.67
2.66
2.61
2.51
2.46
2.44
2.39
2.35
2.31
2.31
2.31
2.30
2.26
2.26
2.25
2.25
2.21
2.18
1.99
1.92
1.90
1.89
1.88
1.88
1.86
1.73
1.72
0.85
0.01
MeO
MeO
P
O
AcO
O
Si
(+/-)-4
1.00
6.04
1.04
1.07
2.87
2.89
3.40
9.31
5.95
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)

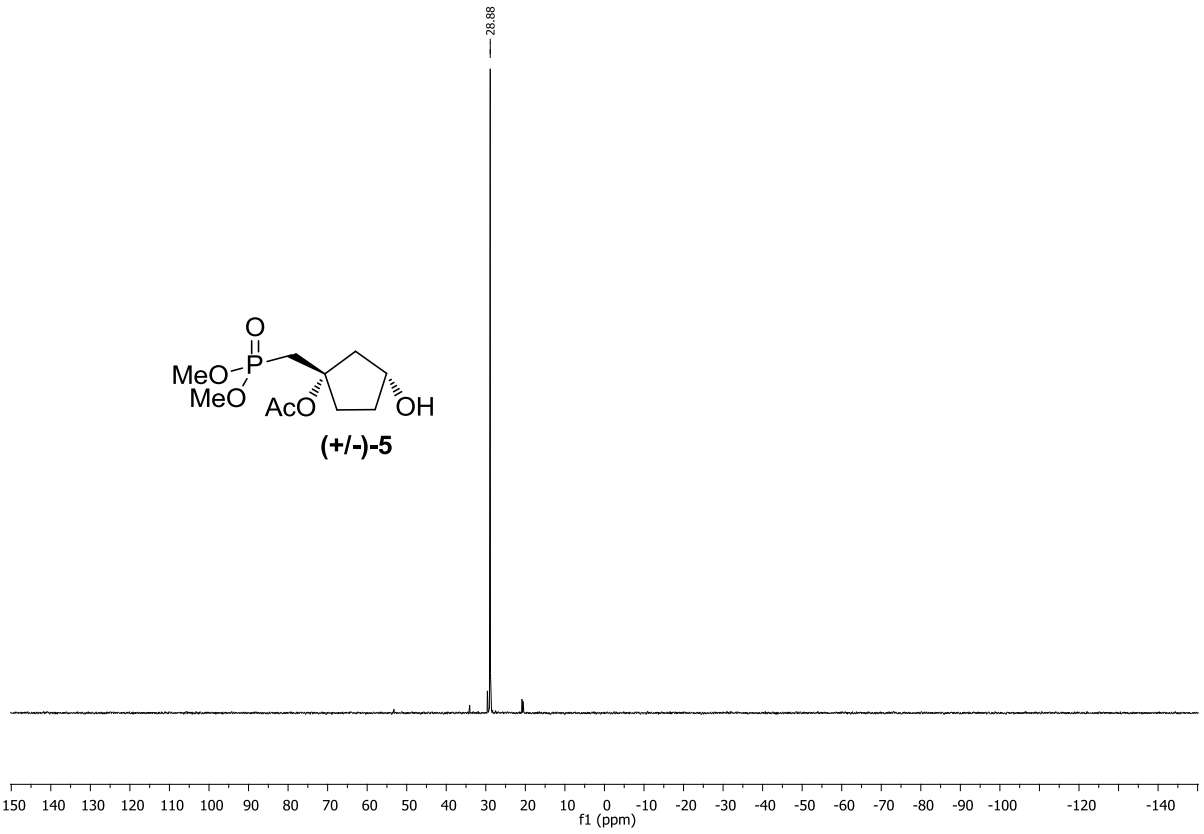

29.16
MeO
MeO
P
O
AcO
O
Si
(+/-)-4
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
-120
-140
f1 (ppm)

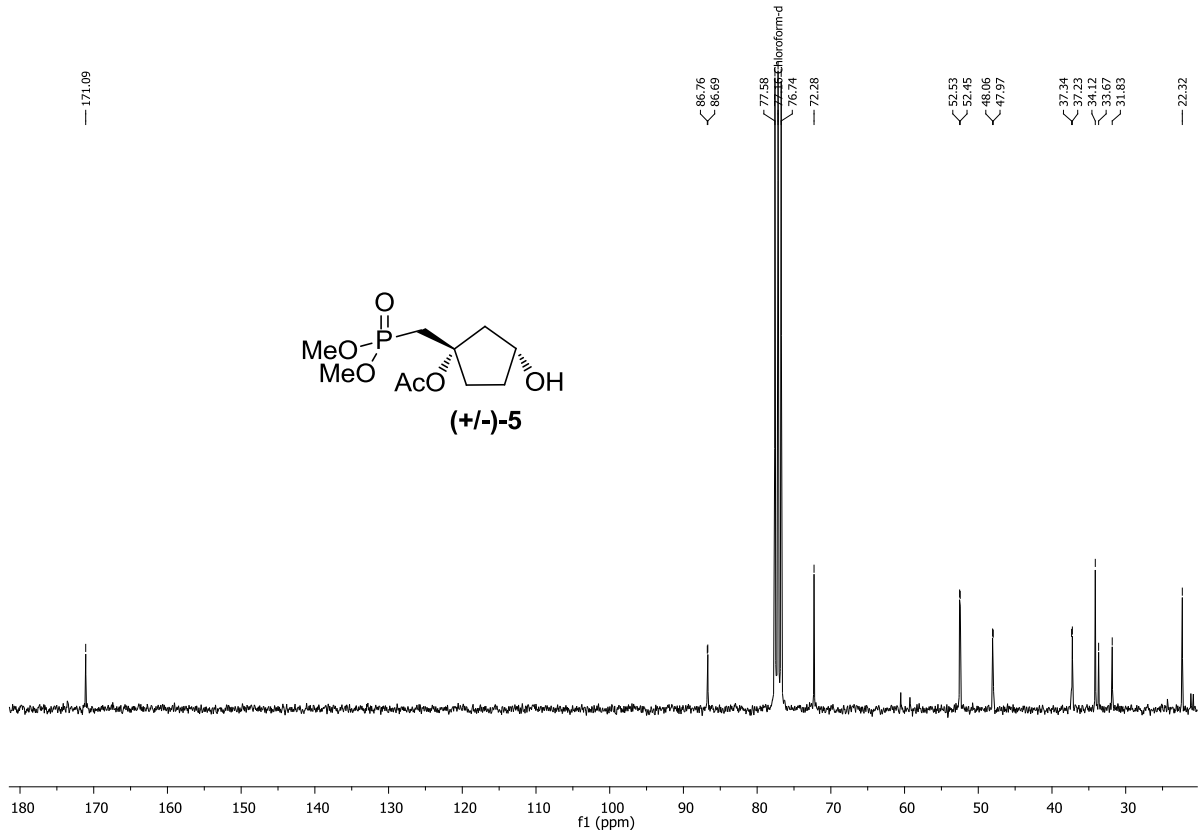

171.20
85.82
85.75
77.58
77.16 Chloroform-d
76.74
72.32
52.45
52.36
48.34
48.22
37.69
37.62
34.51
33.74
31.90
25.91
22.26
18.14
-4.69
-4.72
O
MeO
MeO
AcO
O-Si
f1 (ppm)

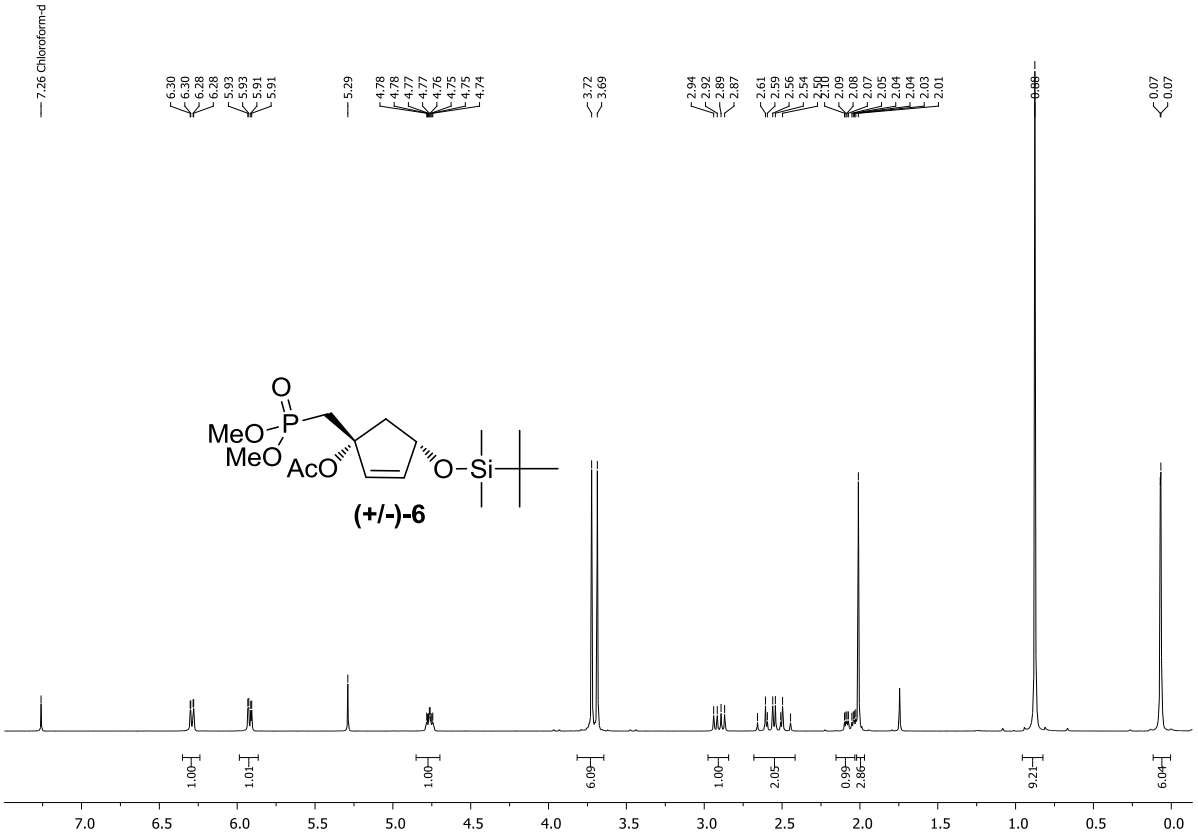
(+/-)-4

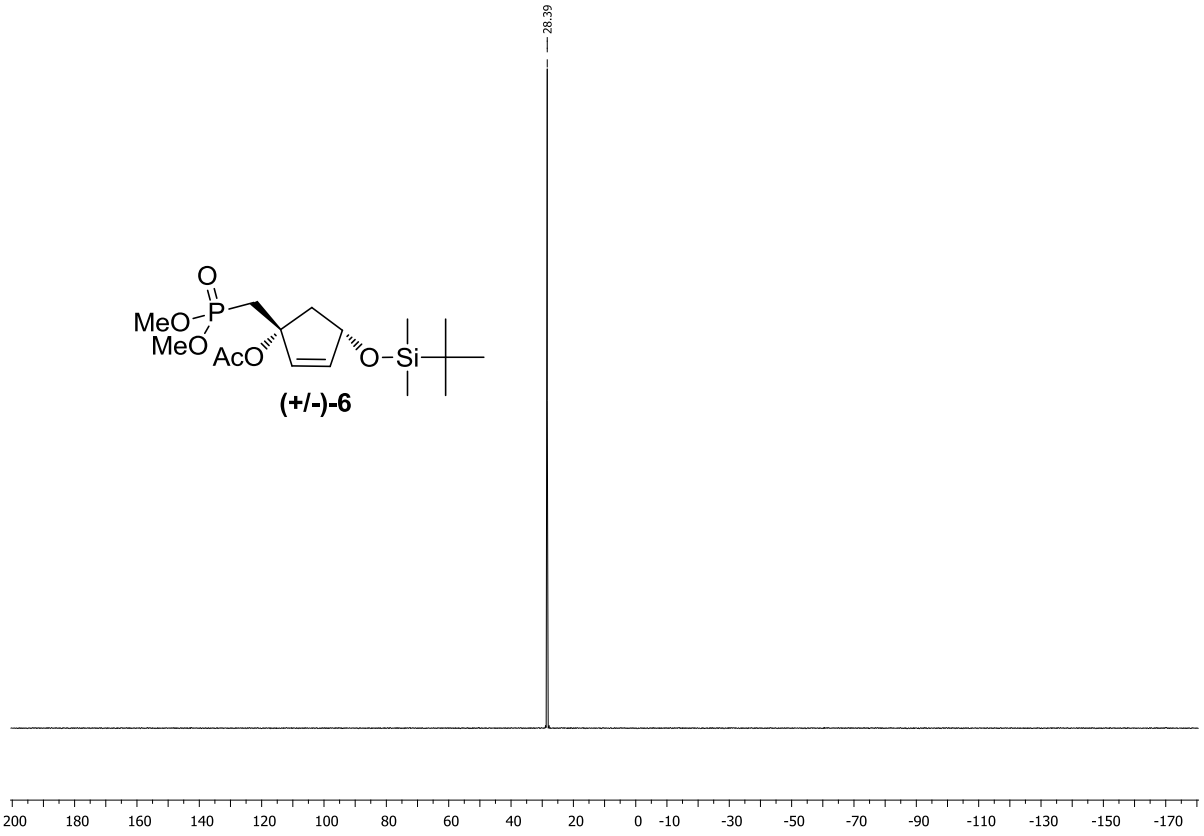

7.26 Chloroform-d
5.29
4.36
4.35
4.34
4.33
4.32
4.31
4.30
3.73
3.69
2.67
2.61
2.60
2.57
2.55
2.52
2.51
2.48
2.46
2.37
2.32
2.23
2.21
2.18
2.16
2.02
1.99
1.98
1.97
1.95
1.94
1.92
1.90
1.89
1.88
1.85
1.79
1.77
1.77
1.75
O
MeO
MeO
AcO
OH
1.00
5.98
5.81
4.11
2.90
f1 (ppm)

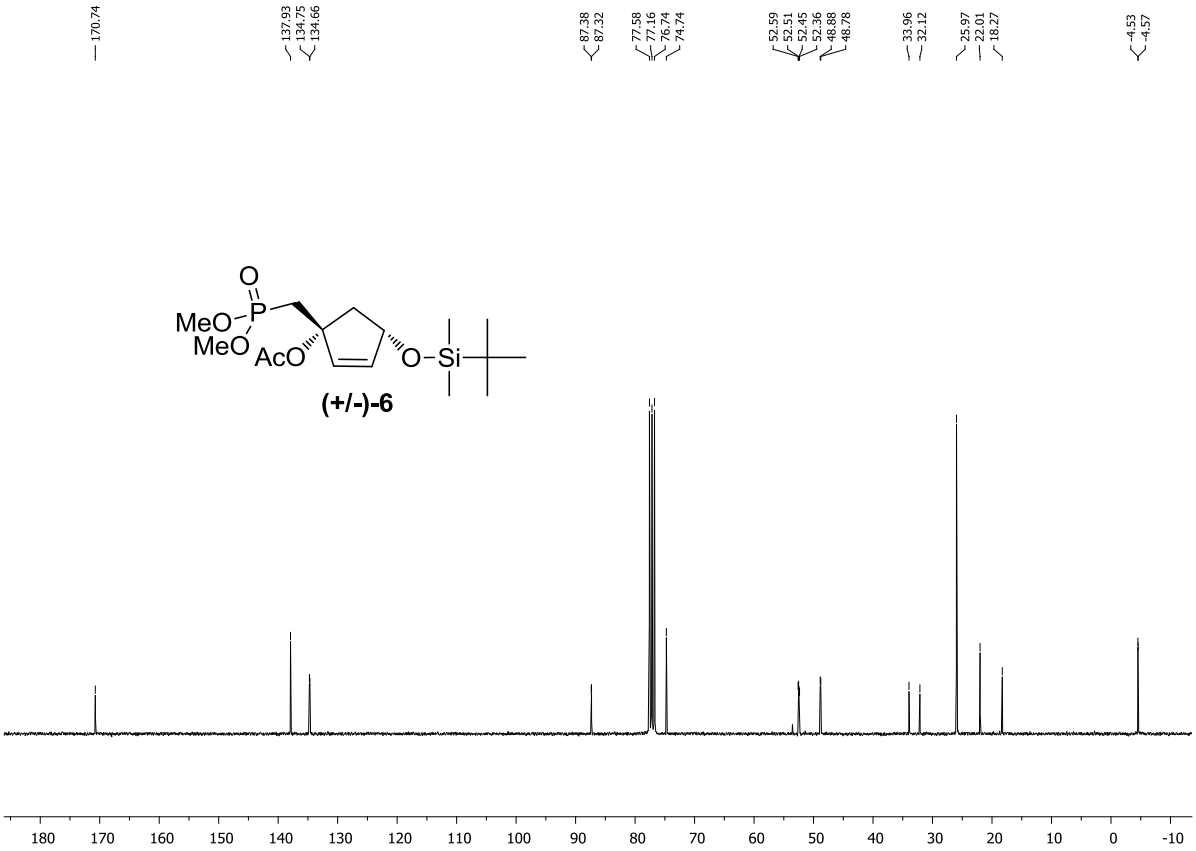
(+/-)-5

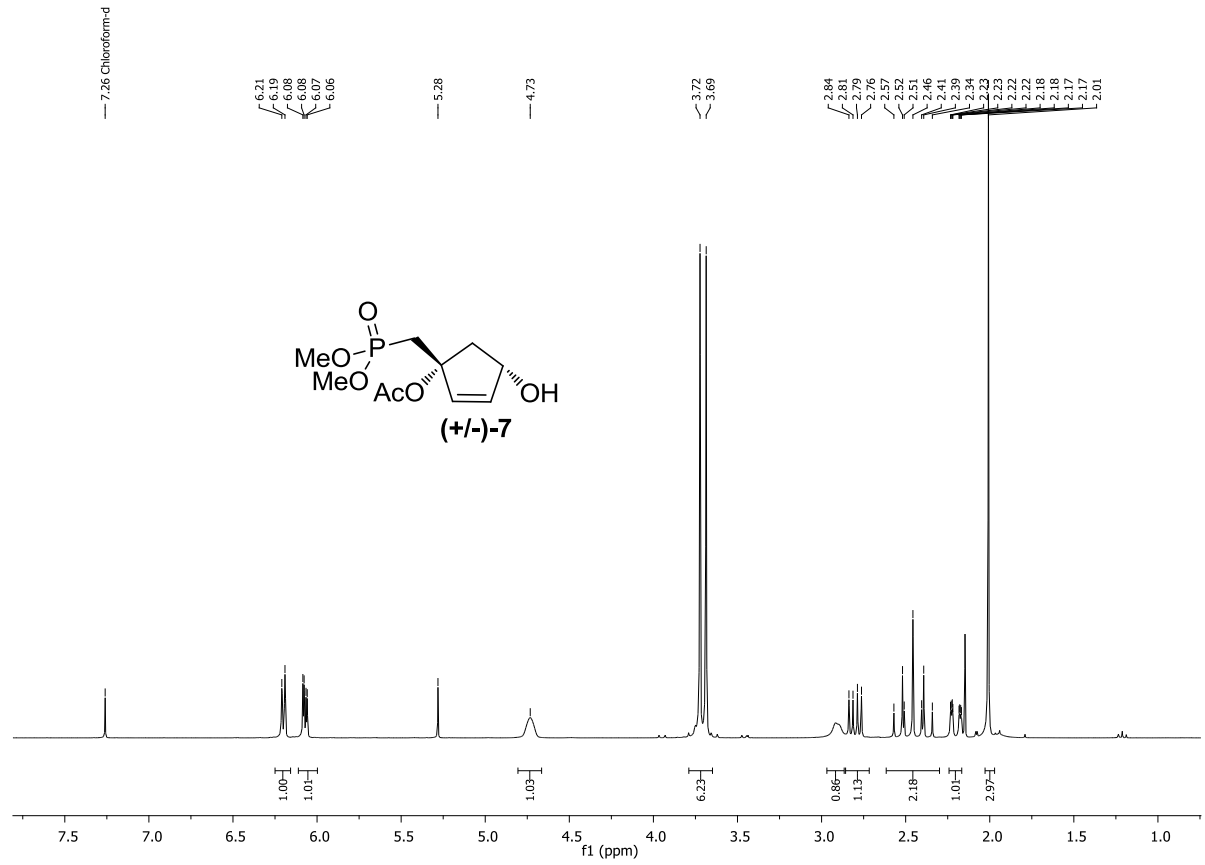

28.88
MeO
MeO
AcO
OH
(+/-)-5
150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10 -20 -30 -40 -50 -60 -70 -80 -90 -100 -120 -140
f1 (ppm)


171.09
86.76
86.69
77.58
77.16 Chloroform-d
76.74
72.28
52.53
52.45
48.06
47.97
37.34
37.23
34.12
33.67
31.83
22.32
MeO
MeO
AcO
OH
(+/-)-5
180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30
f1 (ppm)


7.26 Chloroform-d
6.30
6.30
6.28
6.28
5.93
5.93
5.91
5.91
5.29
4.78
4.78
4.77
4.77
4.76
4.75
4.75
4.74
3.72
3.69
2.94
2.92
2.89
2.87
2.61
2.59
2.56
2.54
2.10
2.09
2.08
2.07
2.05
2.04
2.04
2.03
2.01
0.88
0.07
0.07
MeO
MeO
AcO
O
P
O
Si
(+/-)-6
1.00
1.01
1.00
6.09
1.00
2.05
0.99
2.86
9.21
6.04
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


28.39
MeO
MeO
AcO
O
P
O
Si
(+/-)-6
200
180
160
140
120
100
80
60
40
20
0
-10
-30
-50
-70
-90
-110
-130
-150
-170


170.74
137.93
134.75
134.66
87.38
87.32
77.58
77.16
76.74
74.74
52.59
52.51
52.45
52.36
48.88
48.78
33.96
32.12
25.97
22.01
18.27
-4.53
-4.57
MeO
MeO
AcO
O
Si
(+/-)-6
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
-10


7.26 Chloroform-d
6.21
6.19
6.08
6.08
6.07
6.06
5.28
4.73
3.72
3.69
2.84
2.81
2.79
2.76
2.57
2.52
2.51
2.46
2.41
2.39
2.34
2.23
2.22
2.22
2.18
2.17
2.17
2.01
MeO
MeO
AcO
OH
(+/-)-7
1.00
1.01
1.03
6.23
0.86
1.13
2.18
1.01
2.97
7.5
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3.5
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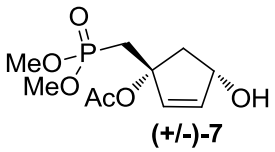
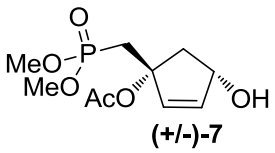
1.5
1.0
f1 (ppm)


O
MeO
P
MeO
AcO
OH

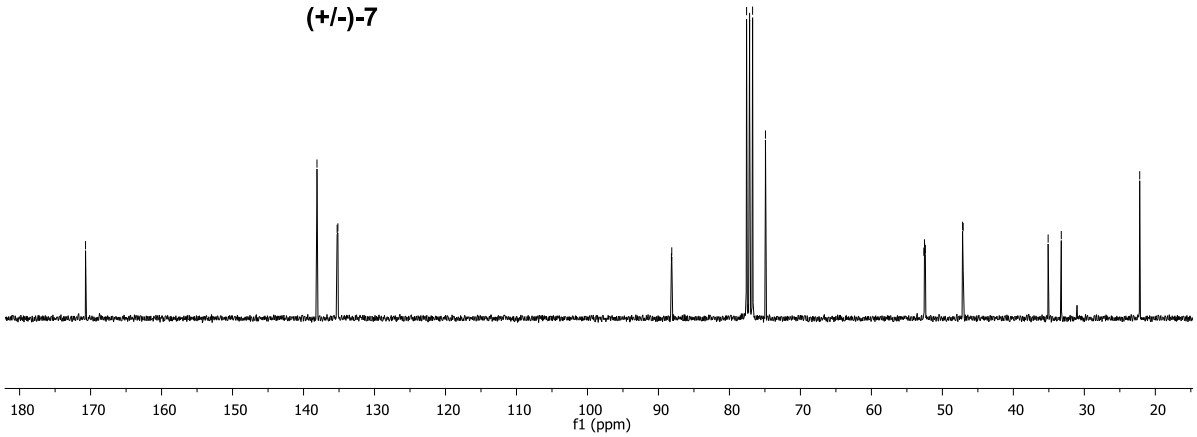
(+/-)-7

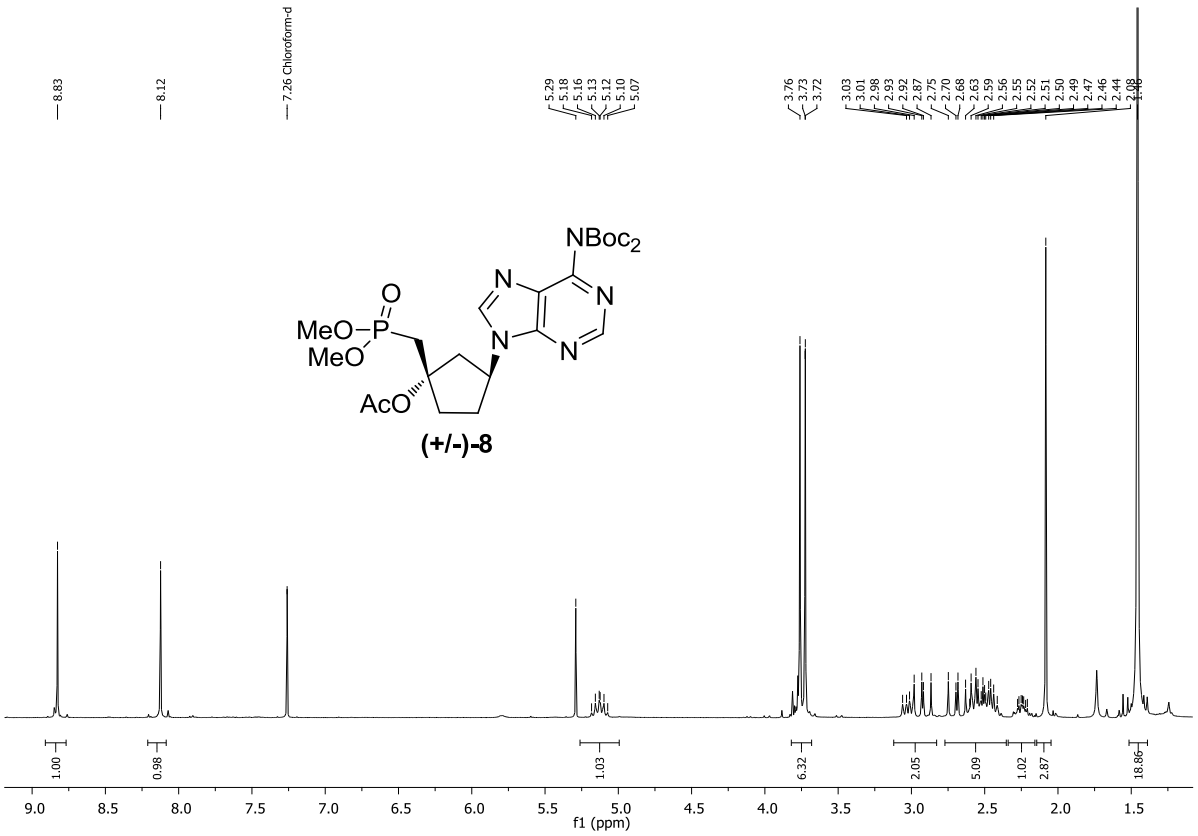
28.10
190 170 150 130 110 90 80 70 60 50 40 30 20 10 0 -10 -30 -50 -70 -90 -110 -130 -150 -170
f1 (ppm)

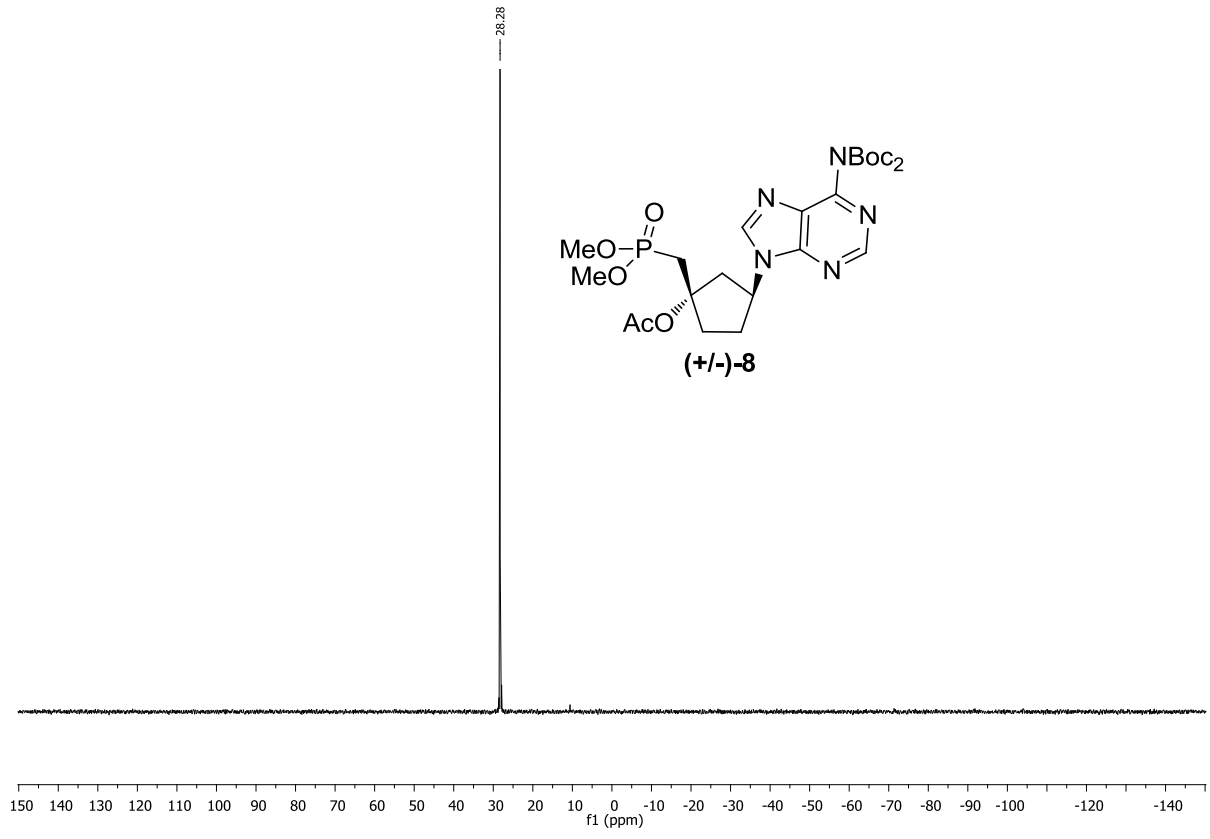

170.71
138.11
135.27
135.16
88.17
88.12
77.58
77.16
76.74
74.92
52.61
52.52
52.49
52.40
47.16
47.08
35.10
33.25
22.20

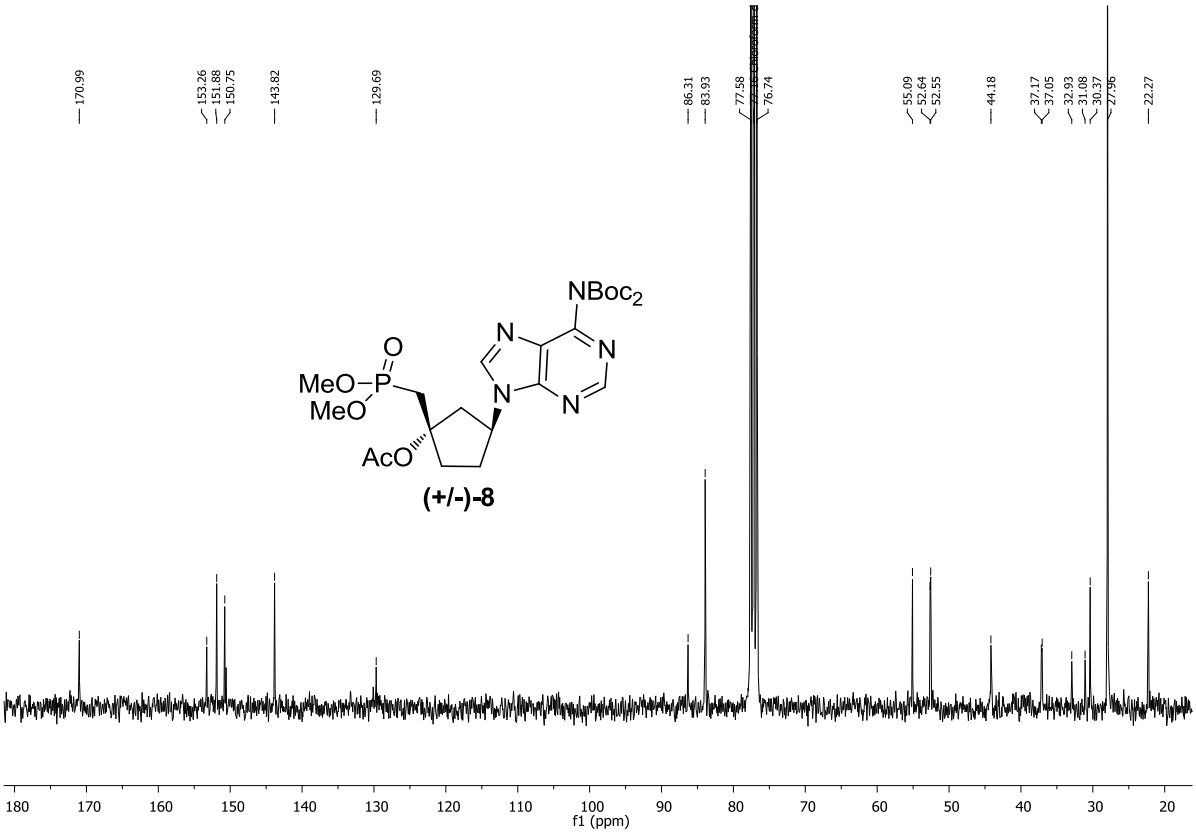

O
MeO
P
MeO
AcO
OH

(+/-)-7

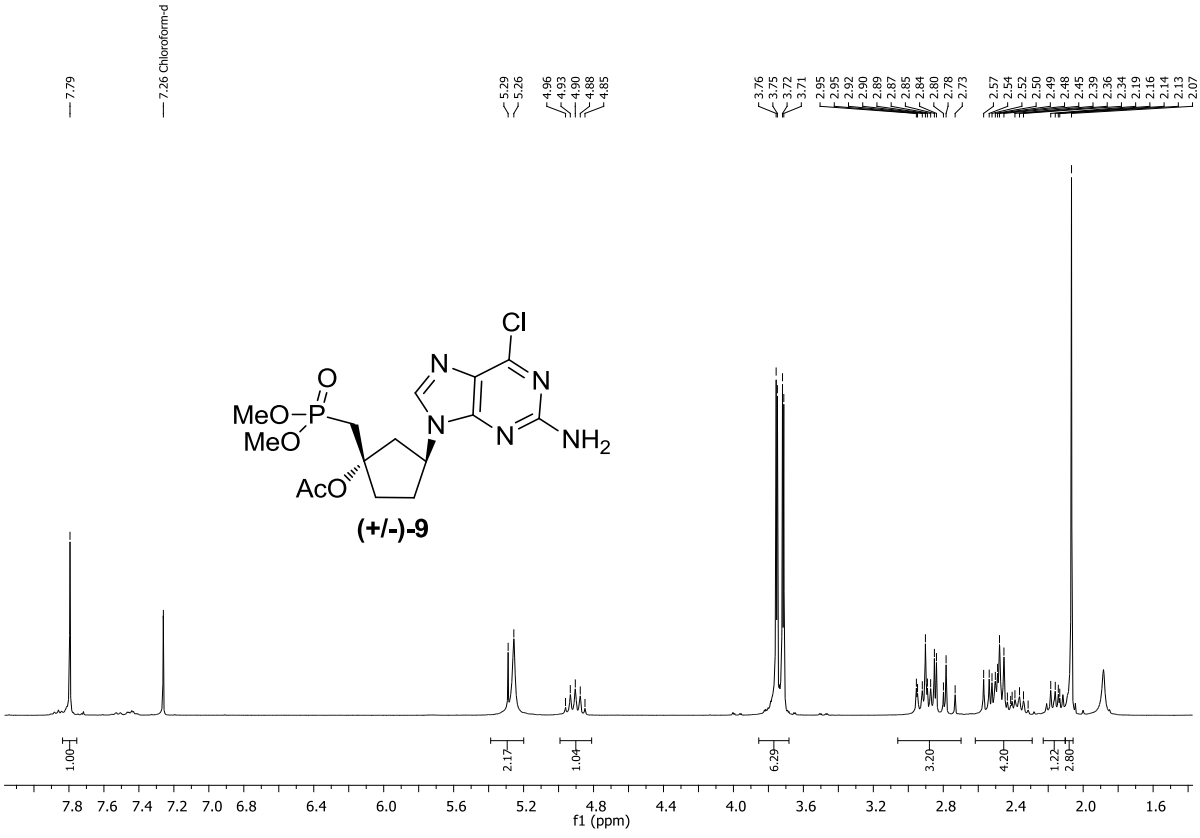

180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20
f1 (ppm)


8.83
8.12
7.26 Chloroform-d
5.29
5.18
5.16
5.13
5.12
5.10
5.07
3.76
3.73
3.72
3.03
3.01
2.98
2.93
2.92
2.87
2.75
2.70
2.68
2.63
2.59
2.56
2.55
2.52
2.51
2.50
2.49
2.47
2.46
2.44
2.08
1.98
NBoc2
N
N
N
N
O
MeO–P
MeO
AcO
(+/-)-8
1.00
0.98
1.03
6.32
2.05
5.09
1.02
2.87
18.86
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
f1 (ppm)

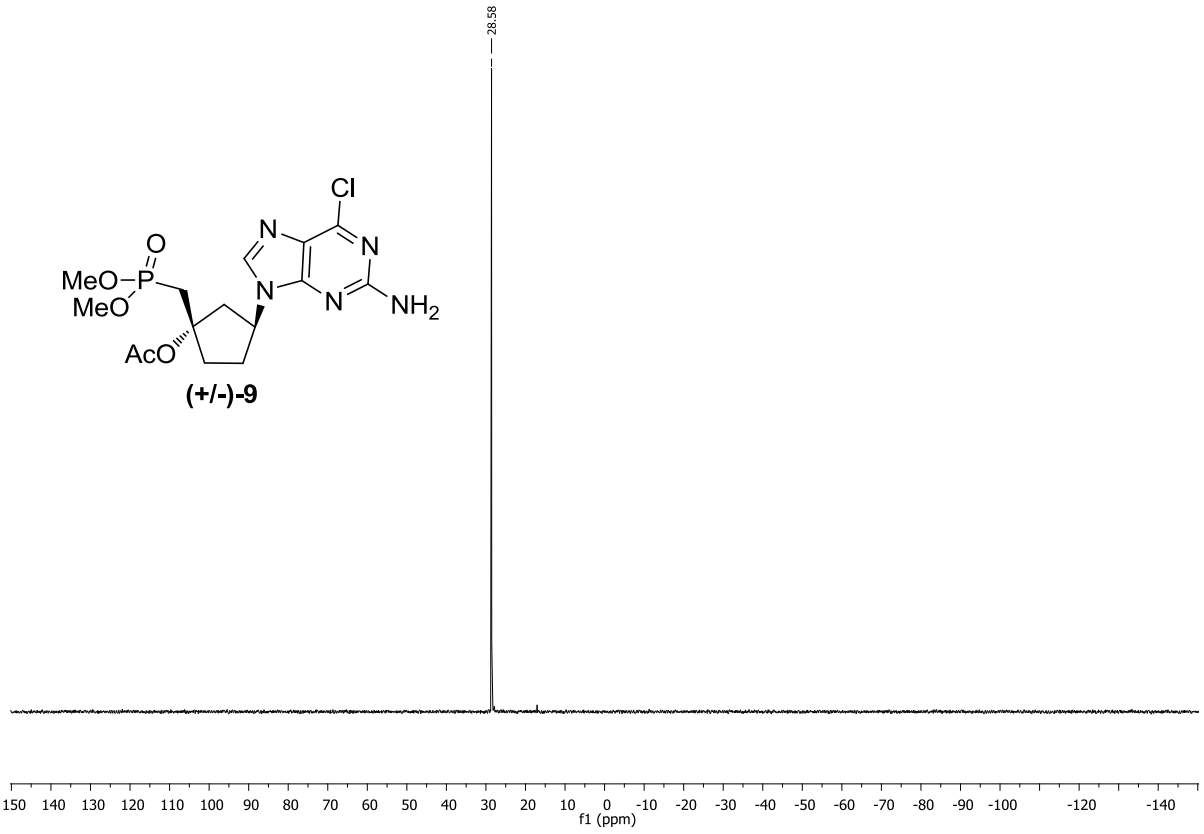

28.28
NBoc2
N
N
N
N
O
MeO–P
MeO
AcO
(+/-)-8
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
-120
-140
f1 (ppm)


170.99
153.26
151.88
150.75
143.82
129.69
86.31
83.93
77.58
76.74
55.09
52.64
52.55
44.18
37.17
37.05
32.93
31.08
30.37
27.96
22.27
NBoc2
MeO–P
MeO
AcO
f1 (ppm)

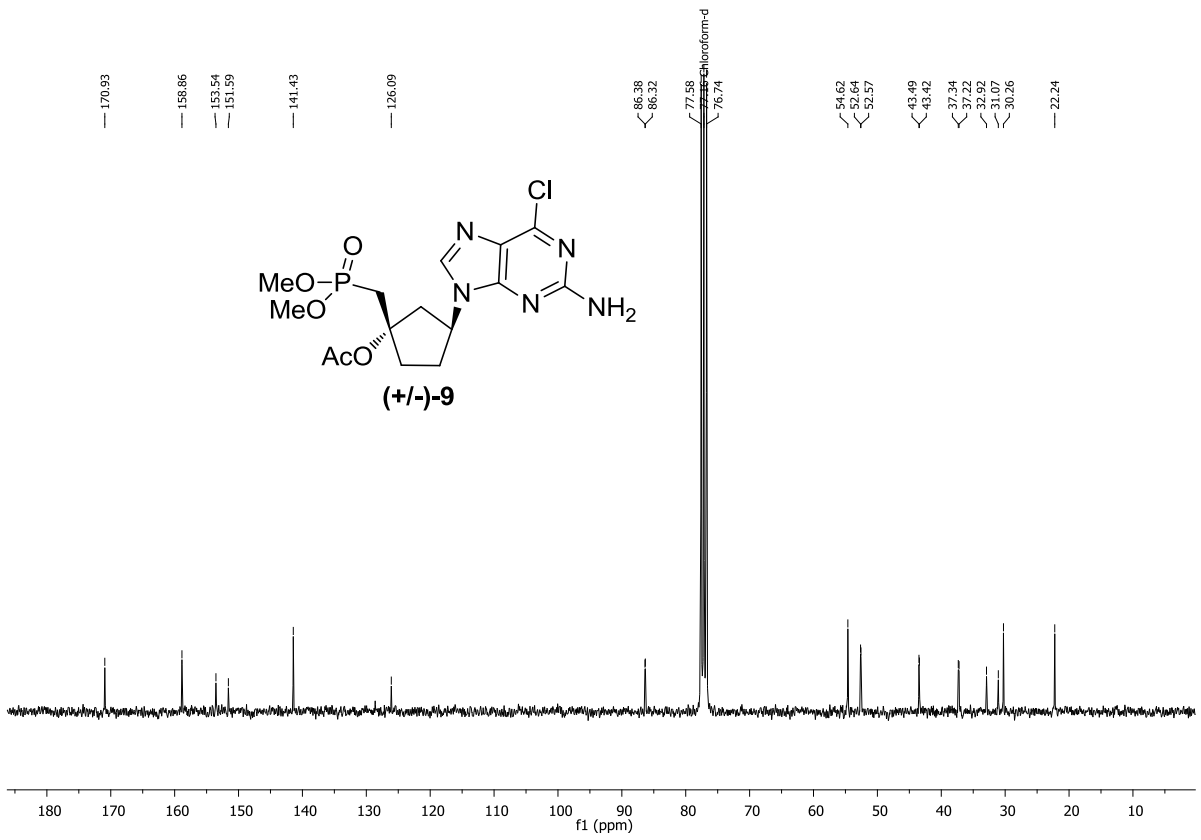
(+/-)-8


7.79
7.26 Chloroform-d
5.29
5.26
4.96
4.93
4.90
4.88
4.85
3.76
3.75
3.72
3.71
2.95
2.92
2.90
2.89
2.87
2.85
2.84
2.80
2.78
2.73
2.57
2.54
2.52
2.50
2.49
2.48
2.45
2.39
2.36
2.34
2.19
2.16
2.14
2.13
2.07
Cl
NH2
MeO–P
MeO
AcO
1.00
2.17
1.04
6.29
3.20
4.20
1.22
2.80
f1 (ppm)

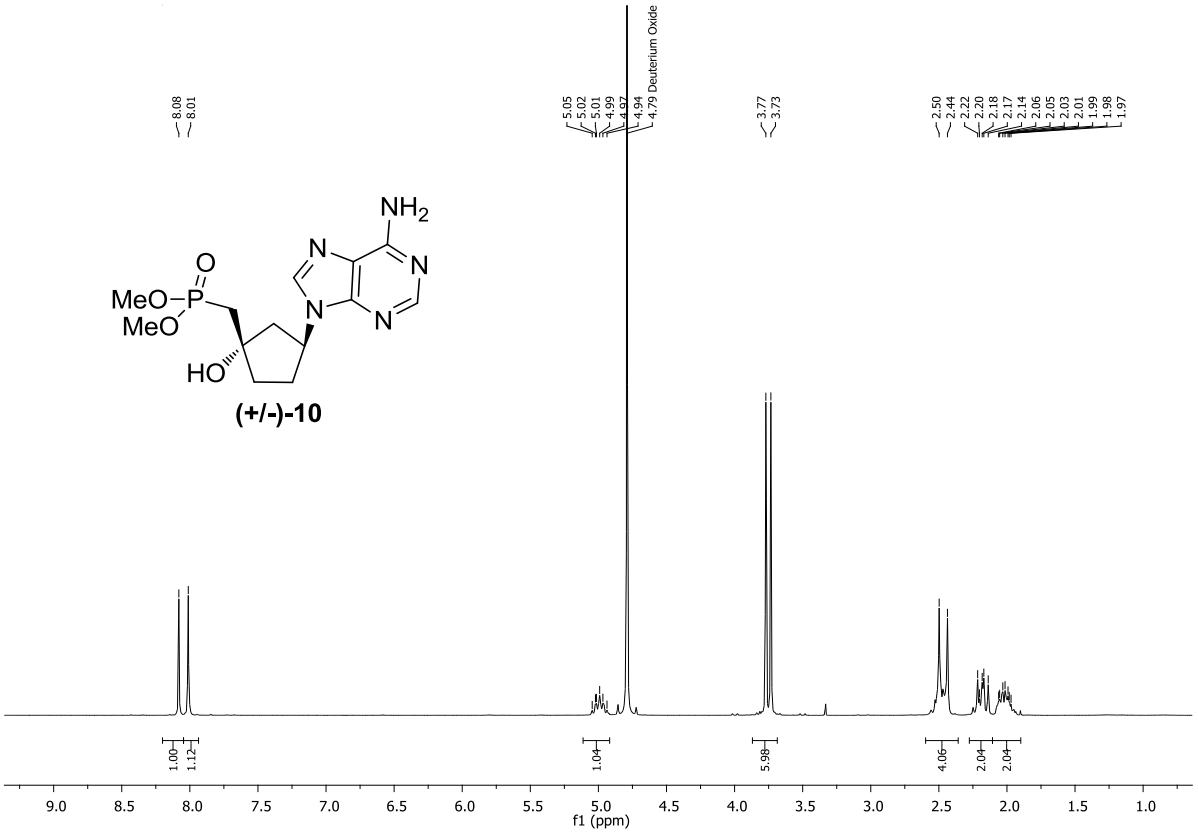
(+/-)-9


28.58
Cl
N
N
N
N
NH2
O
MeO–P
MeO
AcO
150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10 -20 -30 -40 -50 -60 -70 -80 -90 -100 -120 -140
f1 (ppm)

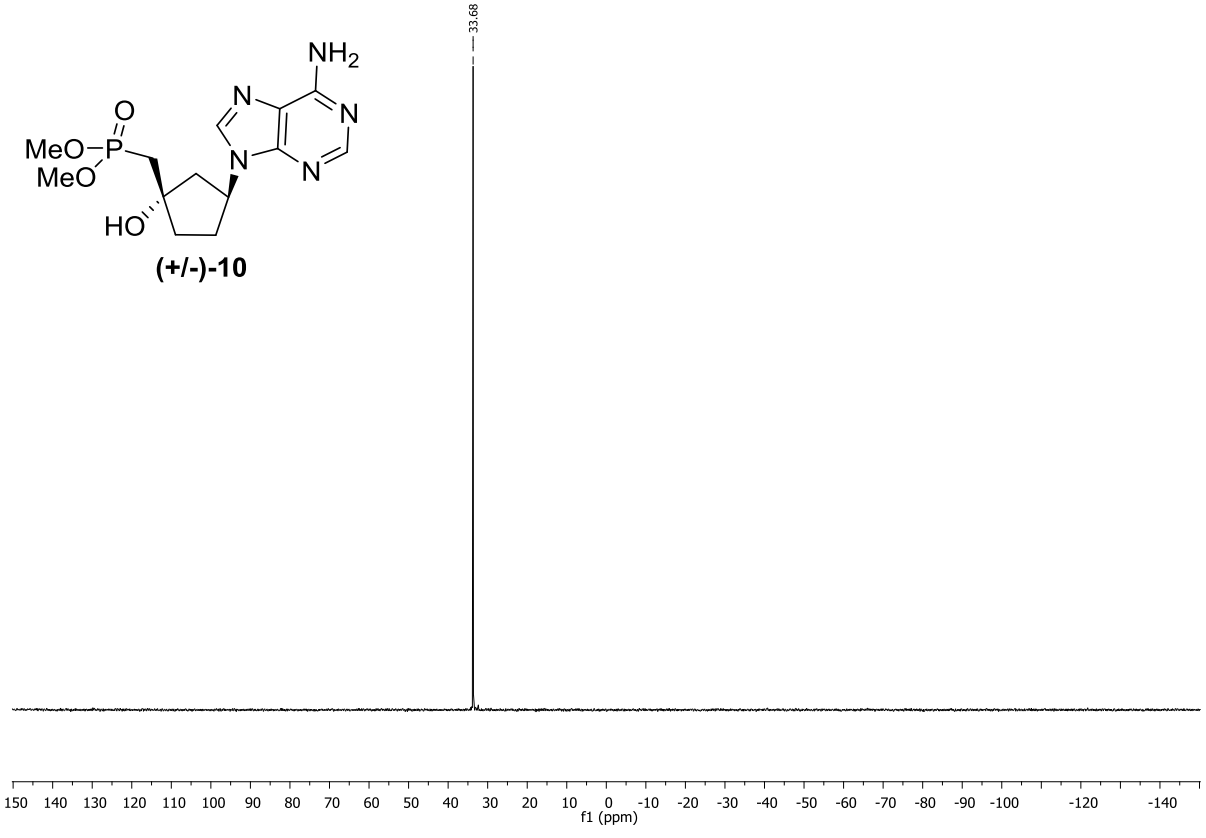
(+/-)-9

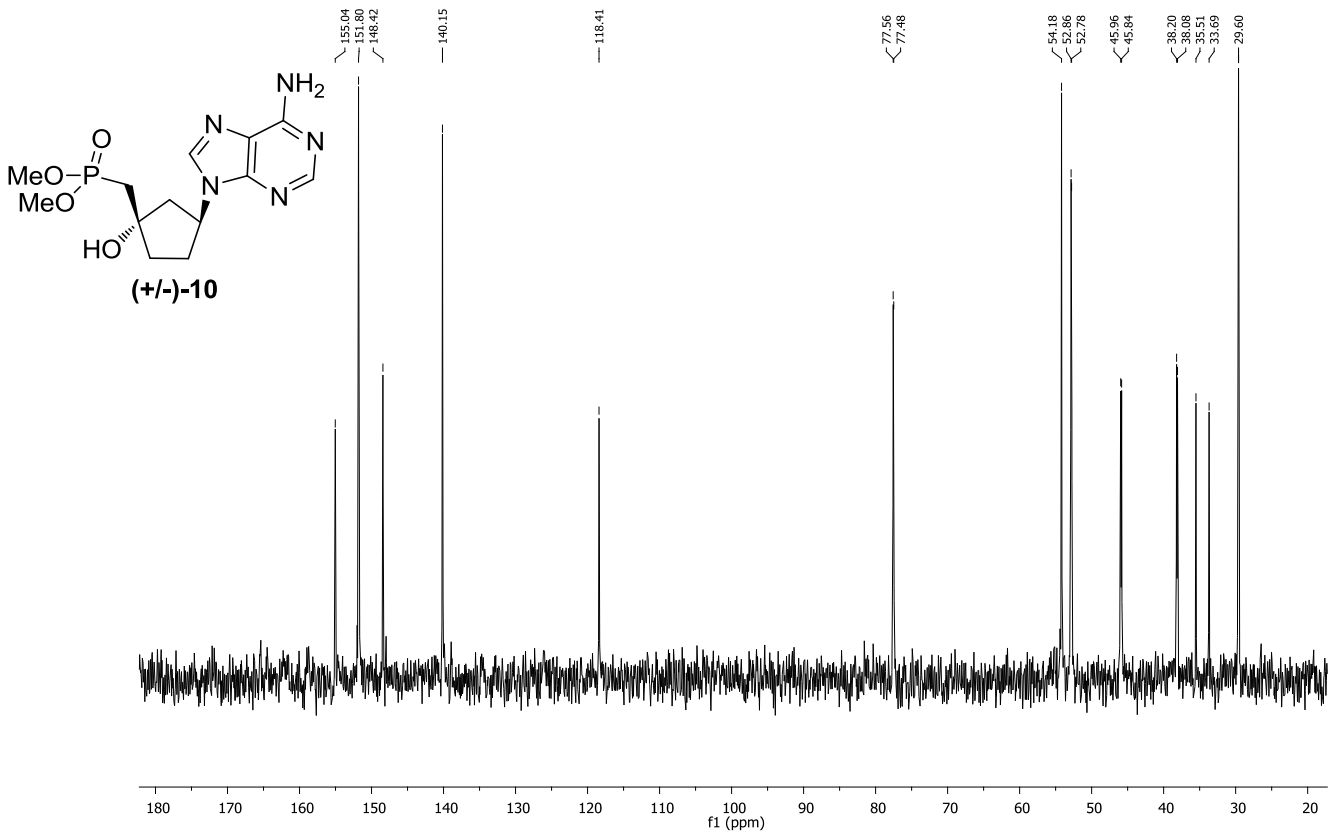

170.93
158.86
153.54
151.59
141.43
126.09
86.38
86.32
77.58
77.16
Chloroform-d
76.74
54.62
52.64
52.57
43.49
43.42
37.34
37.22
32.92
31.07
30.26
22.24
Cl
N
N
N
N
NH2
O
MeO–P
MeO
AcO
180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10
f1 (ppm)

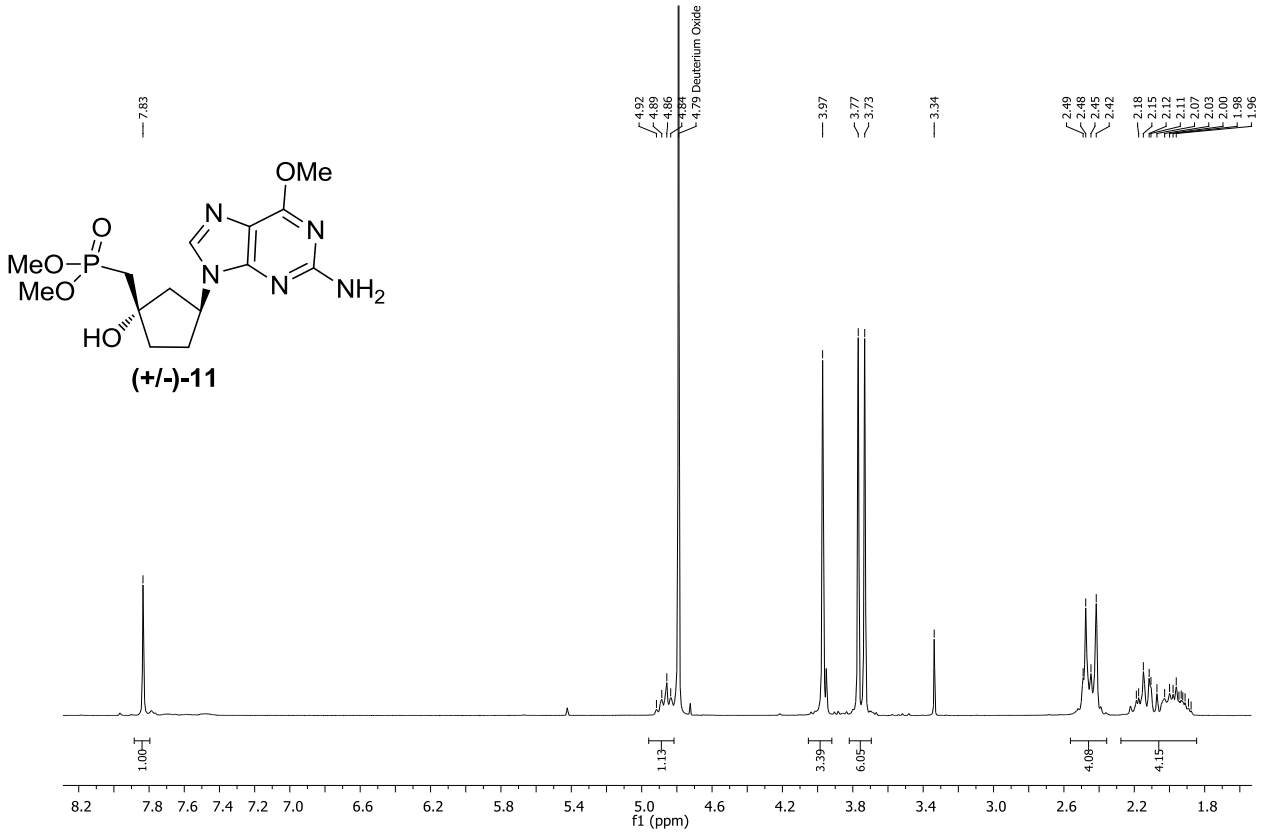
(+/-)-9


8.08
8.01
5.05
5.02
5.01
4.99
4.97
4.94
4.79 Deuterium Oxide
3.77
3.73
2.50
2.44
2.22
2.20
2.18
2.17
2.14
2.06
2.05
2.03
2.01
1.99
1.98
1.97
NH2
N
N
N
N
O
MeO–P
MeO
HO
1.00
1.12
1.04
5.98
4.06
2.04
2.04
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
f1 (ppm)

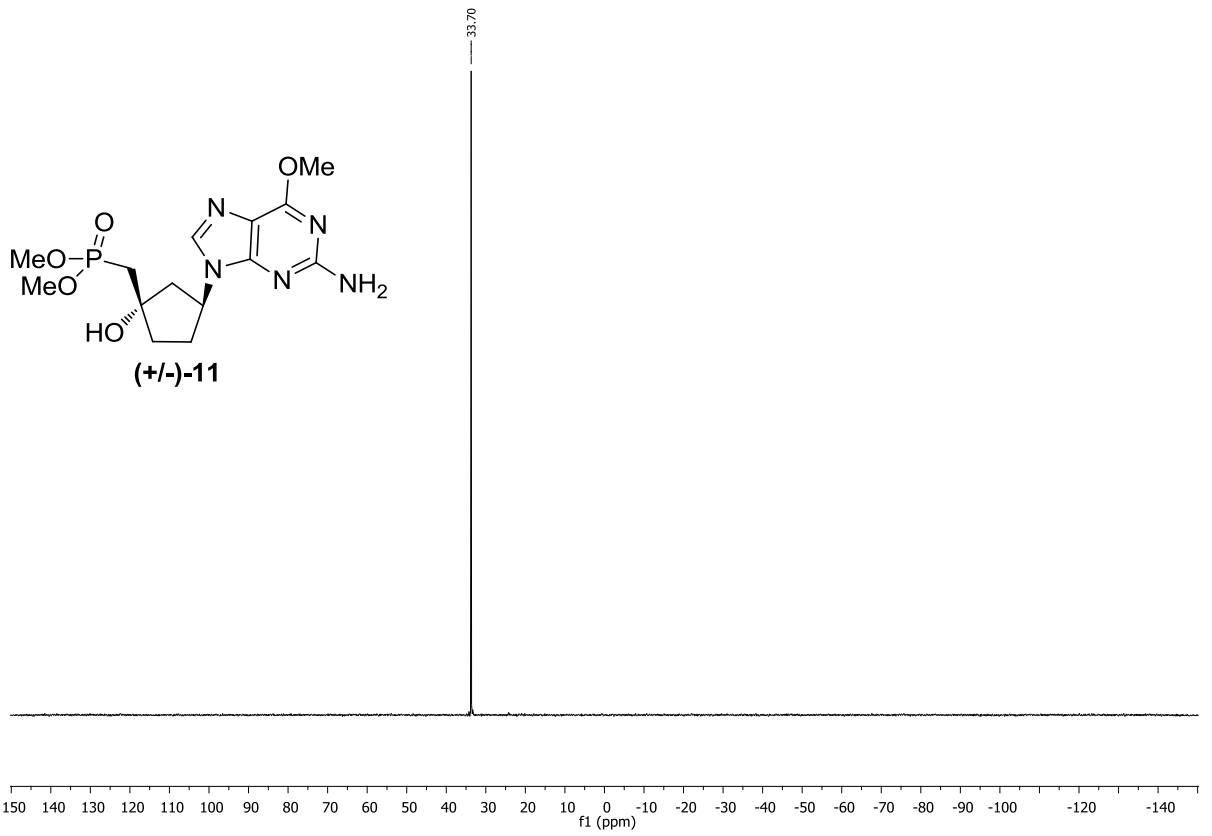
(+/-)-10


33.68
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
-120
-140
f1 (ppm)

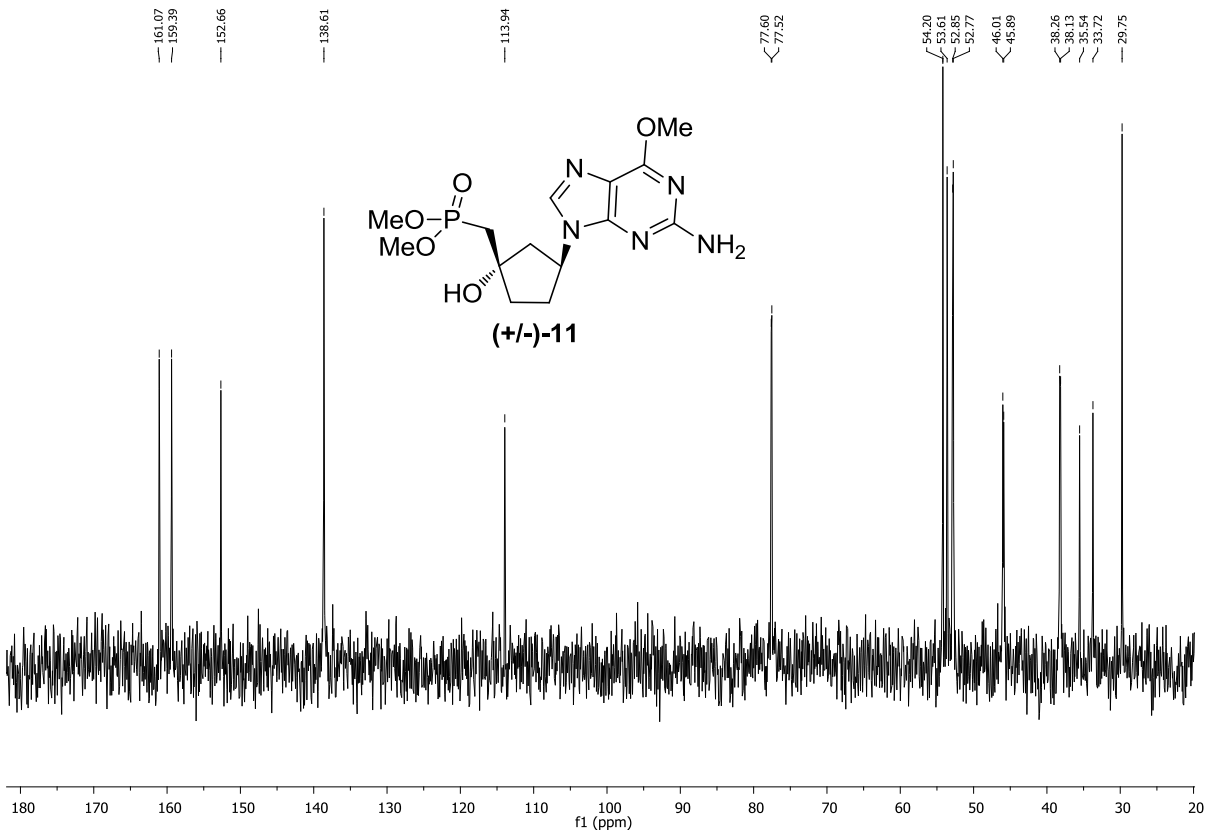

155.04
151.80
148.42
140.15
118.41
77.56
77.48
54.18
52.86
52.78
45.96
45.84
38.20
38.08
35.51
33.69
29.60
NH2
N
N
N
N
O
MeO–P
MeO
HO
(+/-)-10
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
f1 (ppm)

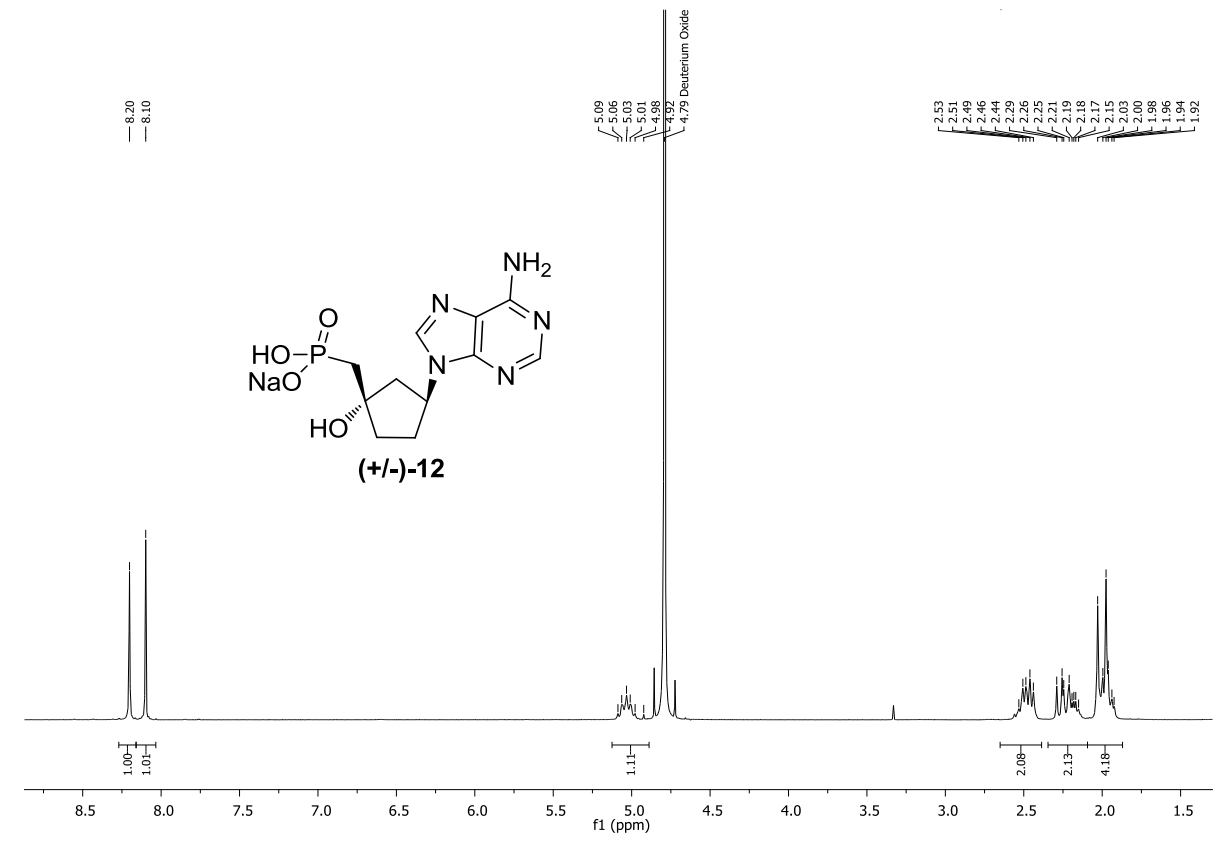

7.83
4.92
4.89
4.86
4.84
4.79 Deuterium Oxide
3.97
3.77
3.73
3.34
2.49
2.48
2.45
2.42
2.18
2.15
2.12
2.11
2.07
2.03
2.00
1.98
1.96
OMe
N
N
N
N
NH2
O
MeO–P
MeO
HO
1.00
1.13
3.39
6.05
4.08
4.15
8.2 7.8 7.6 7.4 7.2 7.0 6.6 6.2 5.8 5.4 5.0 4.6 4.2 3.8 3.4 3.0 2.6 2.2 1.8
f1 (ppm)

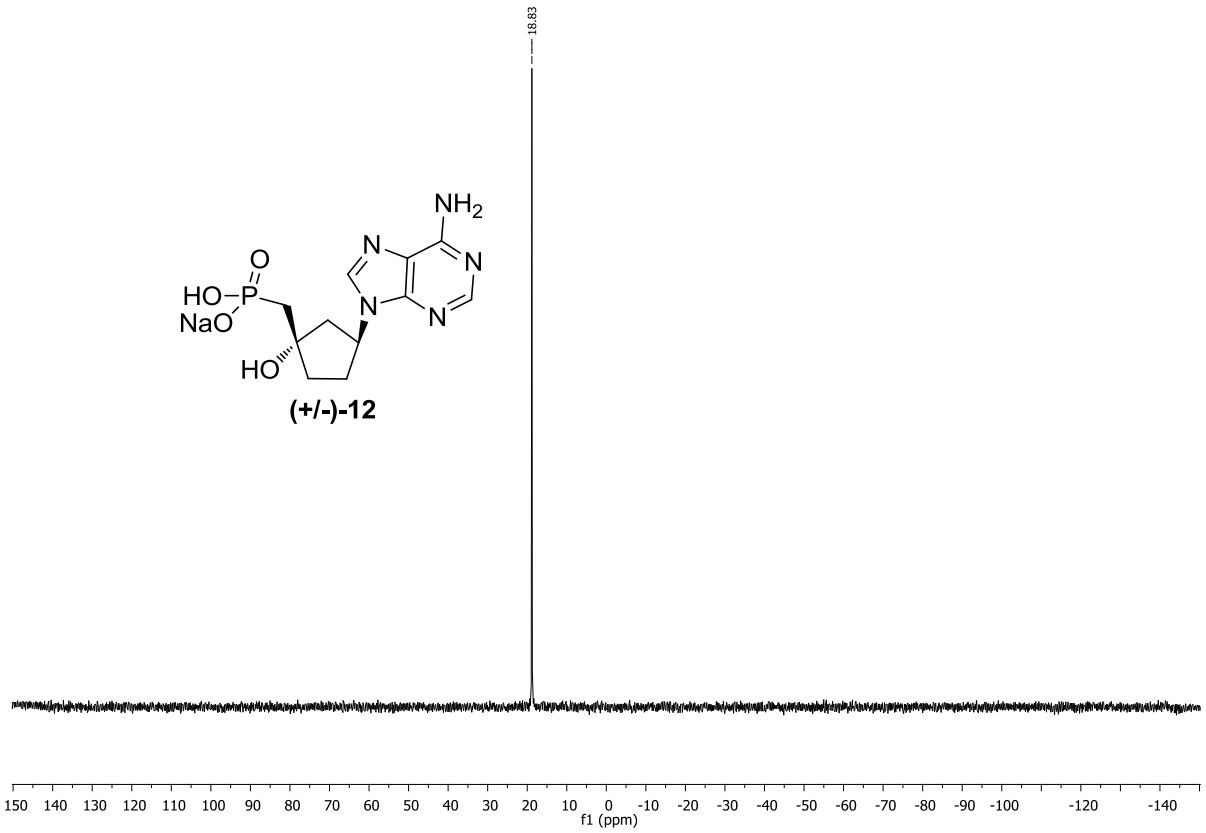
(+/-)-11

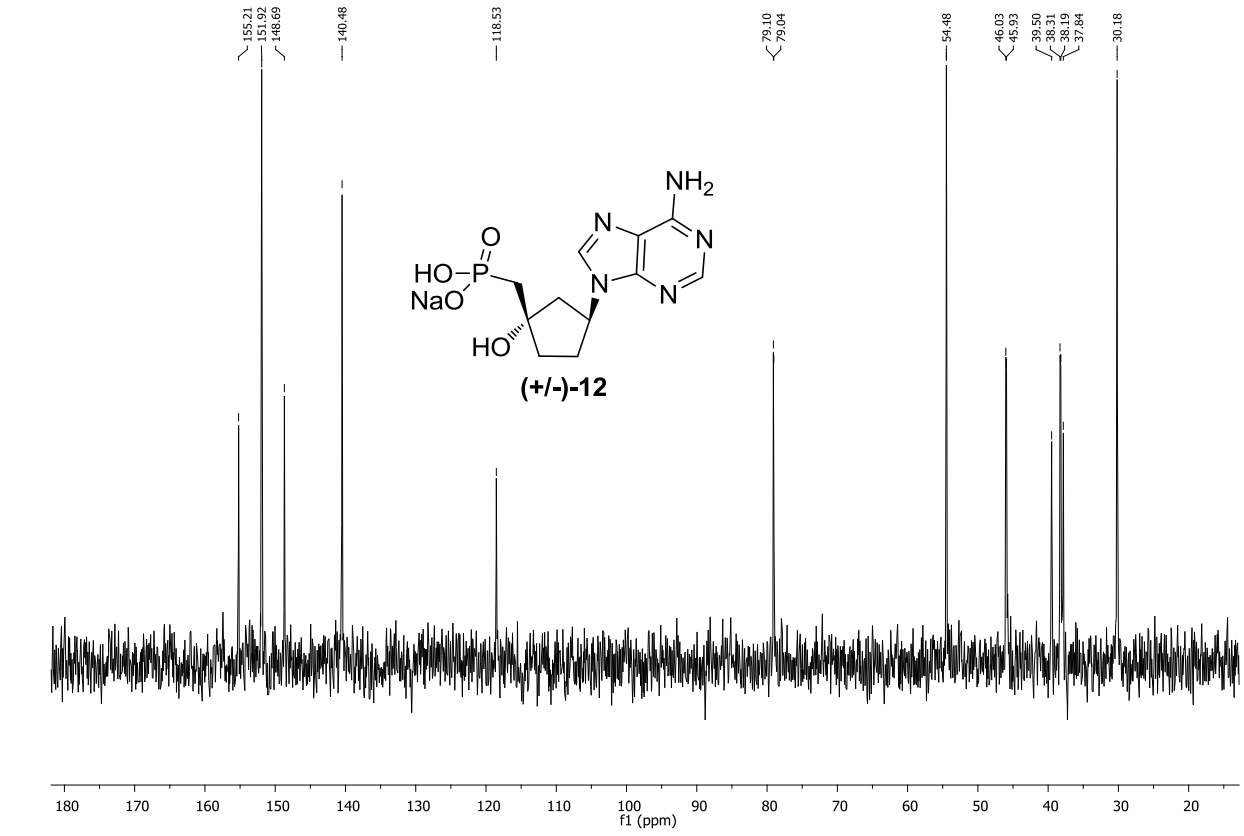

33.70
OMe
N
N
N
N
NH2
O
MeO–P
MeO
HO
150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10 -20 -30 -40 -50 -60 -70 -80 -90 -100 -120 -140
f1 (ppm)

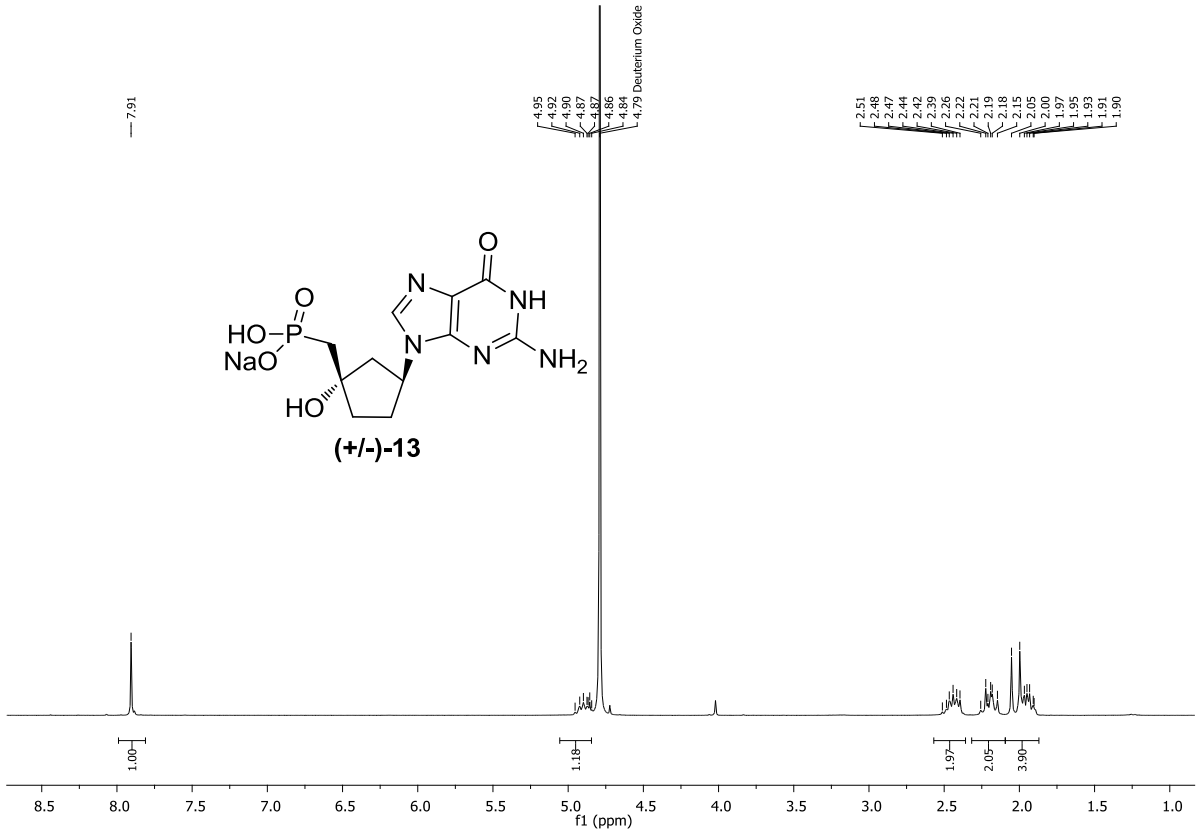
(+/-)-11

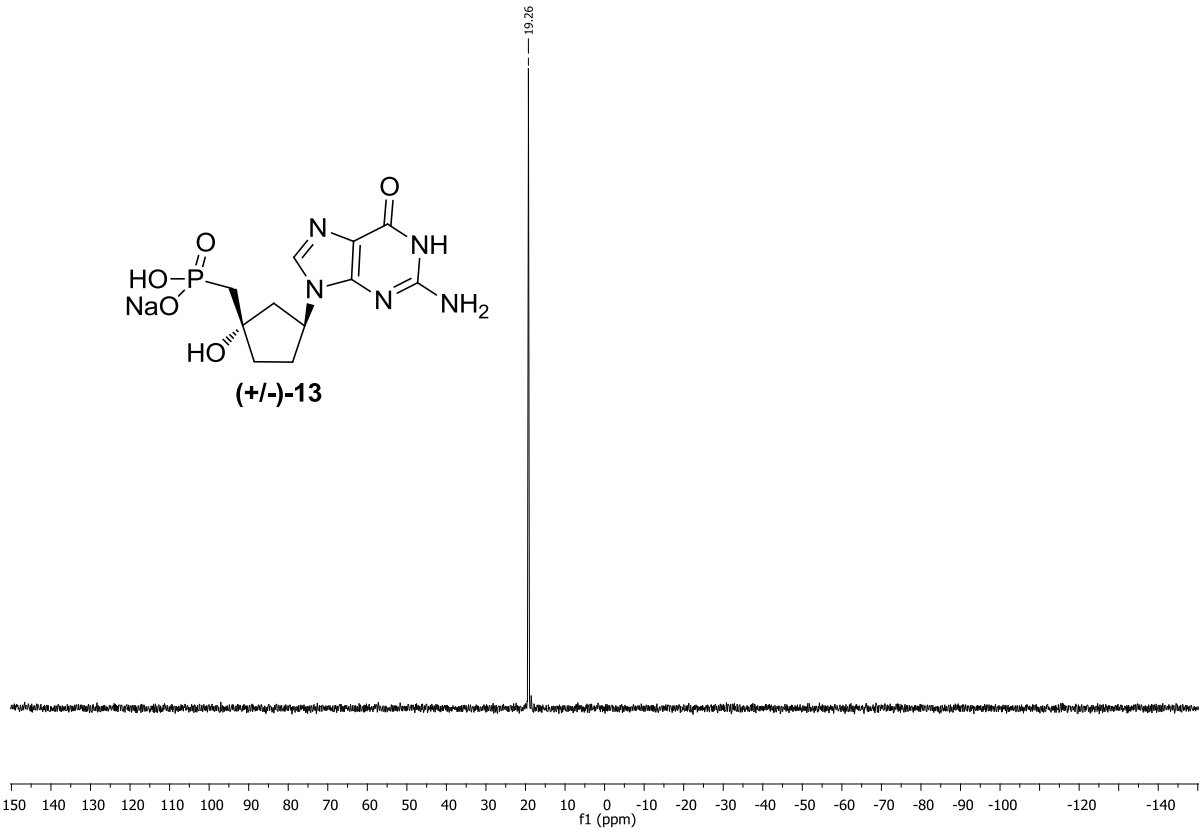

161.07
159.39
152.66
138.61
113.94
77.60
77.52
54.20
53.61
52.85
52.77
46.01
45.89
38.26
38.13
35.54
33.72
29.75
OMe
N
N
N
N
NH2
O
MeO–P
MeO
HO
(+/-)-11
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
f1 (ppm)

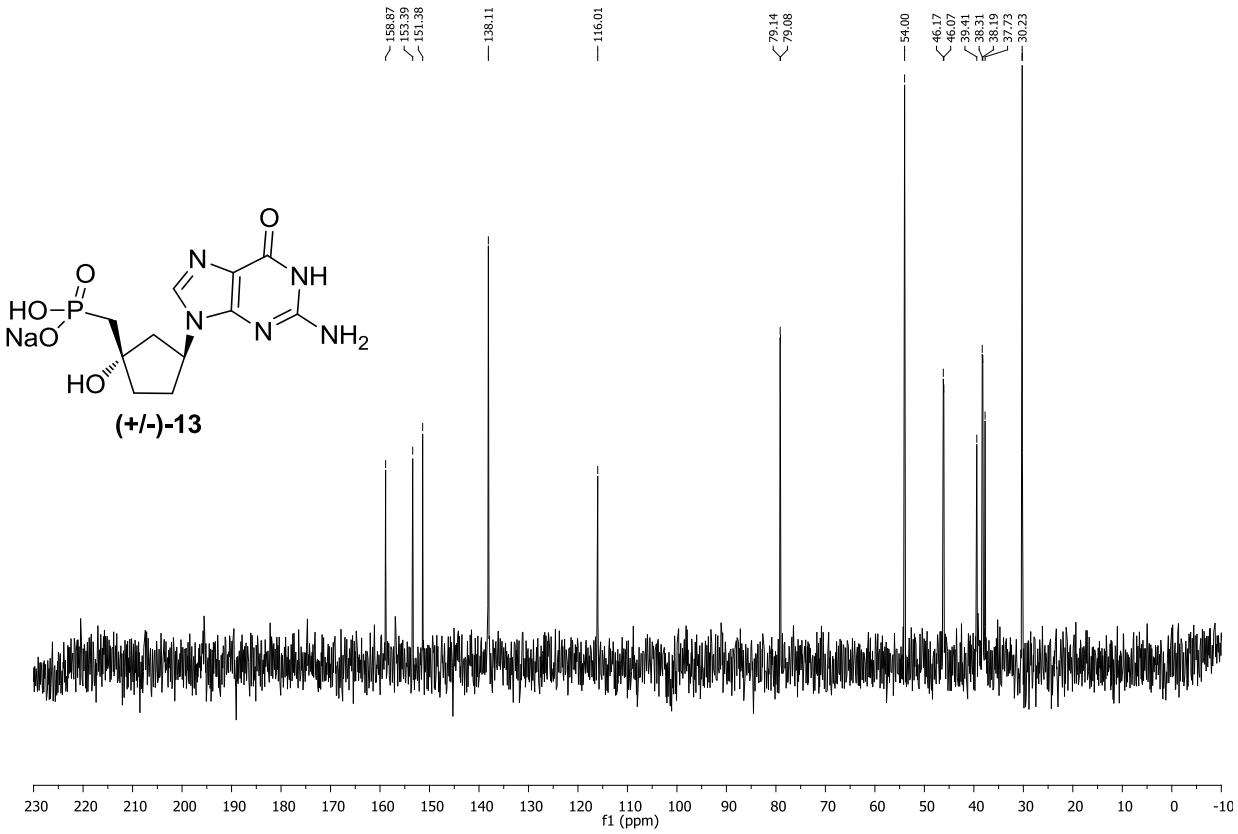

8.20
8.10
5.09
5.06
5.03
5.01
4.98
4.92
4.79 Deuterium Oxide
2.53
2.51
2.49
2.46
2.44
2.29
2.26
2.25
2.21
2.19
2.18
2.17
2.15
2.03
2.00
1.98
1.96
1.94
1.92
NH2
N
N
N
N
O
HO–P
NaO
HO
(+/-)-12
1.00
1.01
1.11
2.08
2.13
4.18
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
f1 (ppm)


18.83
NH2
N
N
N
N
O
HO–P
NaO
HO
(+/-)-12
150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10 -20 -30 -40 -50 -60 -70 -80 -90 -100 -120 -140
f1 (ppm)

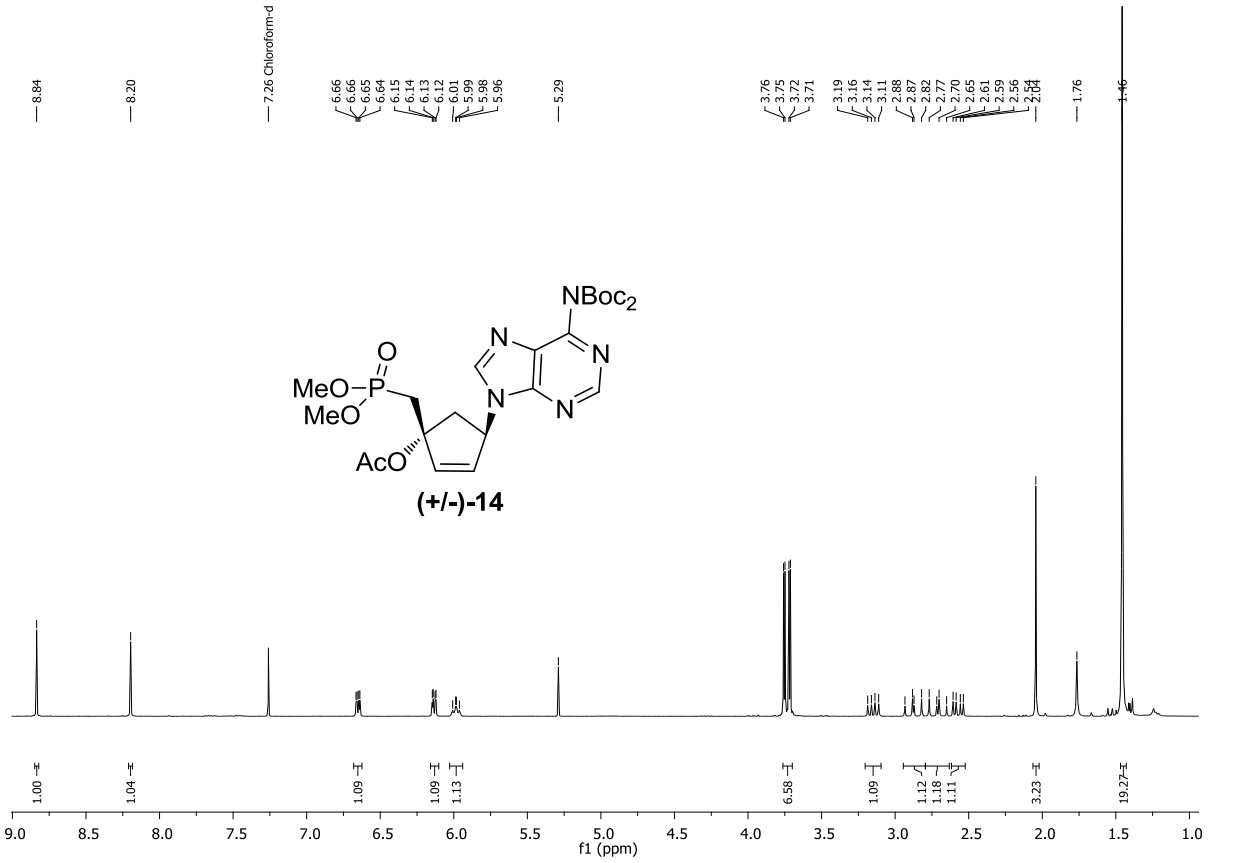

155.21
151.92
148.69
140.48
118.53
79.10
79.04
54.48
46.03
45.93
39.50
38.31
38.19
37.84
30.18
NH2
N
N
N
N
O
HO–P
NaO
HO
(+/-)-12
180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20
f1 (ppm)


7.91
4.95
4.92
4.90
4.87
4.87
4.86
4.84
4.79 Deuterium Oxide
2.51
2.48
2.47
2.44
2.42
2.39
2.26
2.22
2.21
2.19
2.18
2.15
2.05
2.00
1.97
1.95
1.93
1.91
1.90
HO–P
O
NaO
HO
N
NH
N
N
O
NH2
(+/-)-13
1.00
1.18
1.97
2.05
3.90
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
f1 (ppm)

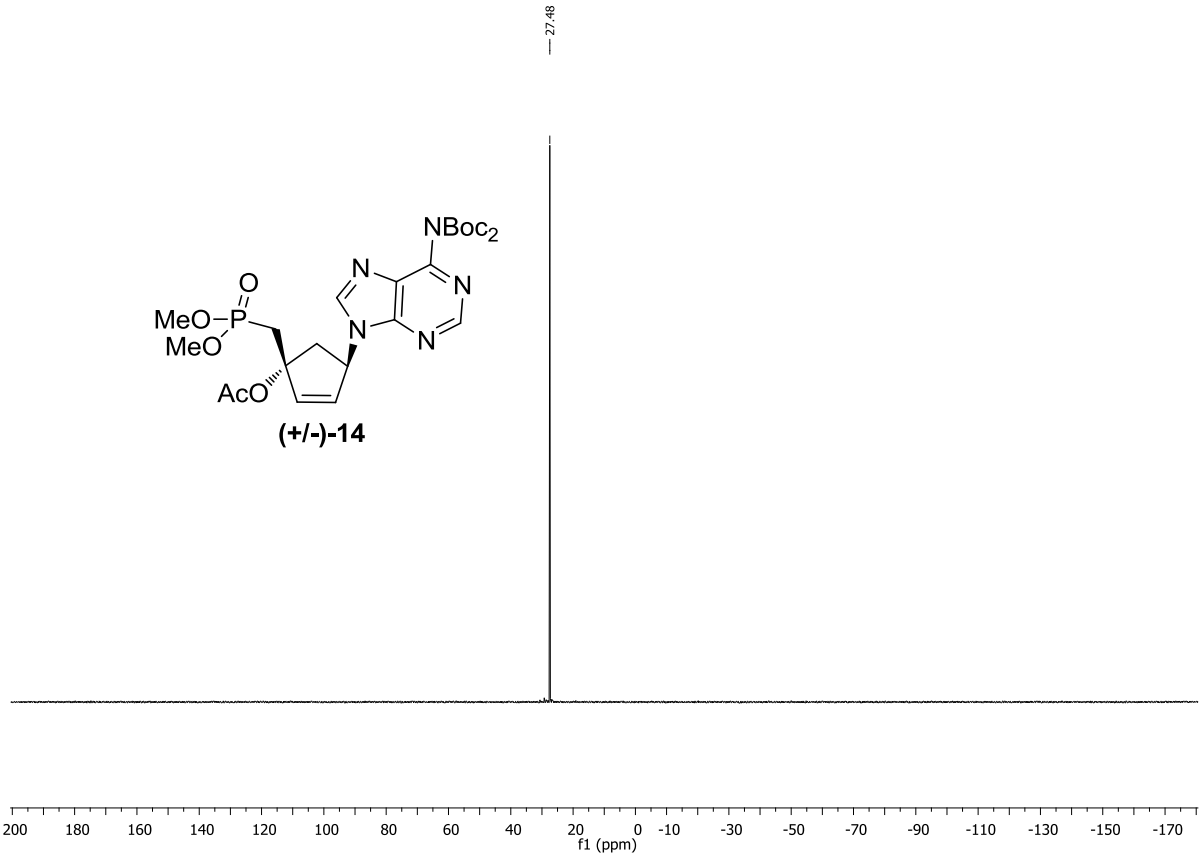

19.26
HO–P
O
NaO
HO
N
NH
N
N
O
NH2
(+/-)-13
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
-120
-140
f1 (ppm)

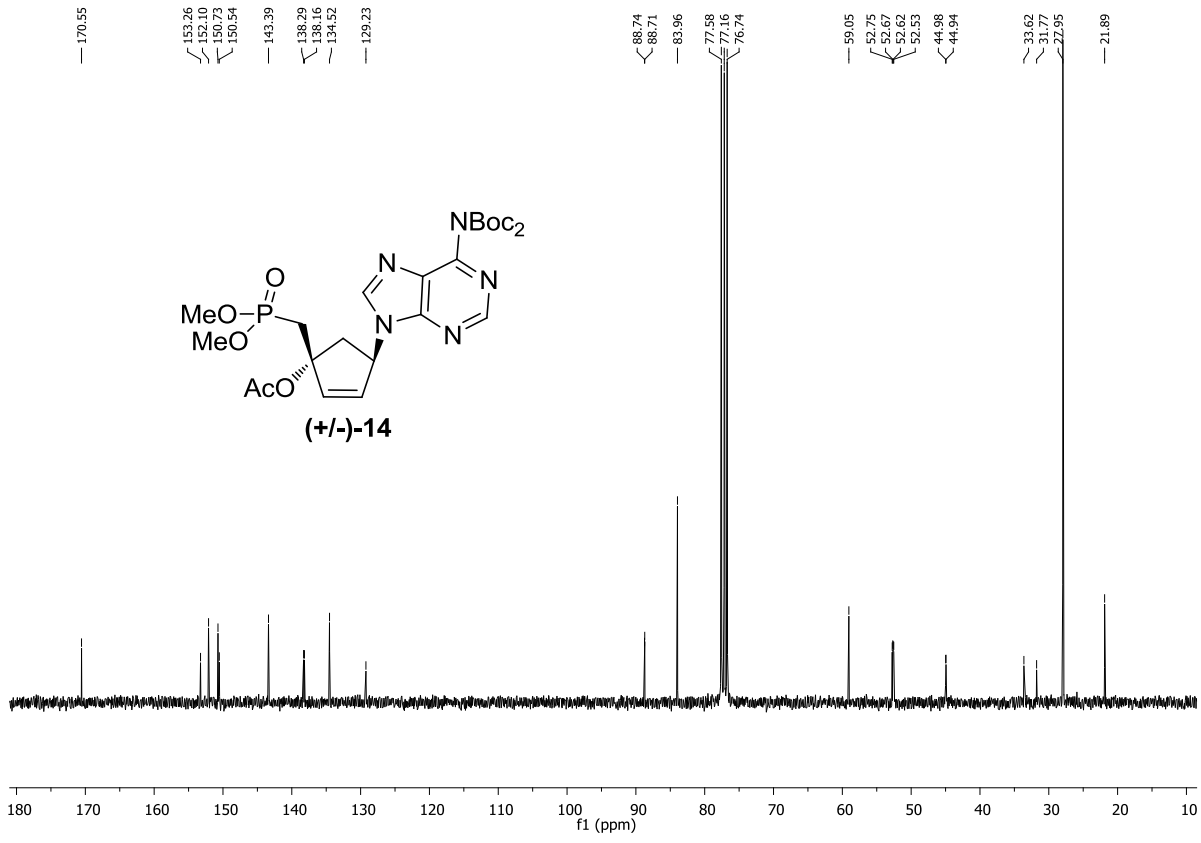

158.87
153.39
151.38
138.11
116.01
79.14
79.08
54.00
46.17
46.07
39.41
38.31
38.19
37.73
30.23
HO–P
NaO
HO
O
N
NH
N
N
NH2
f1 (ppm)

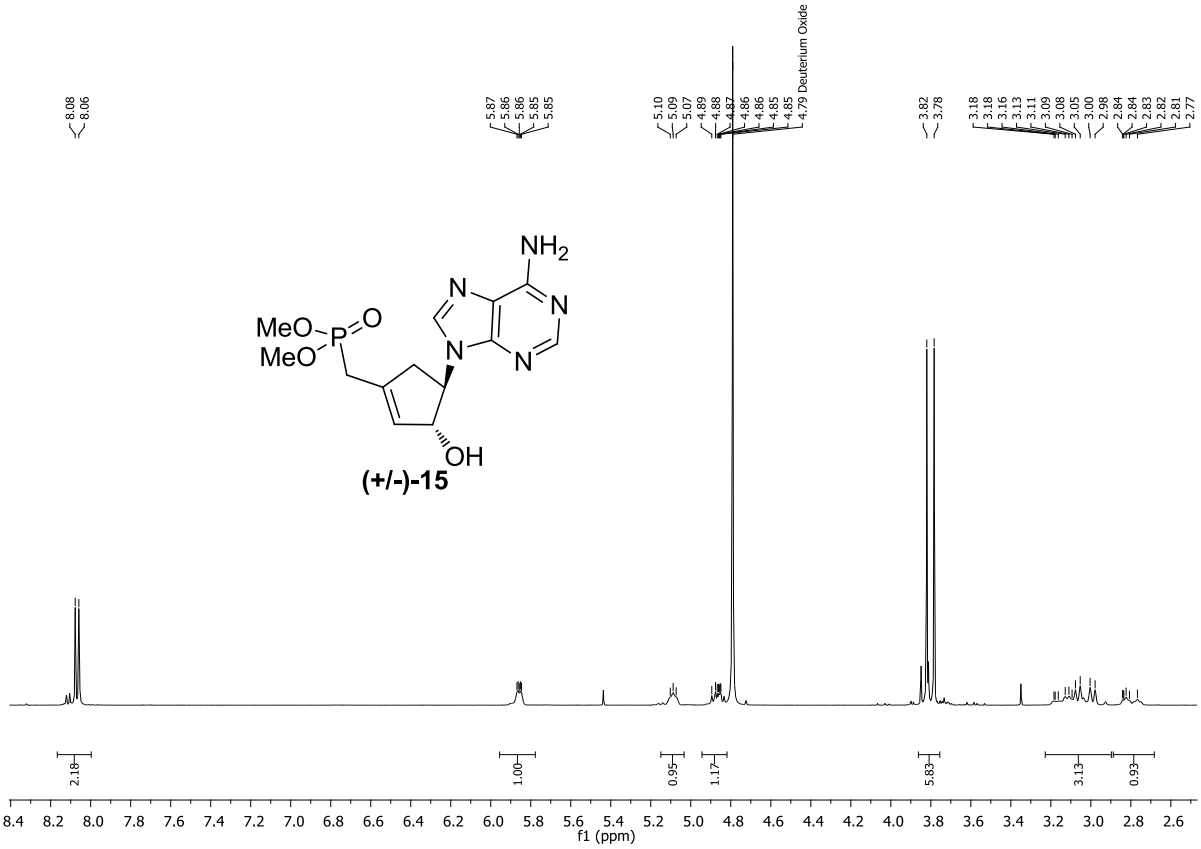
(+/-)-13

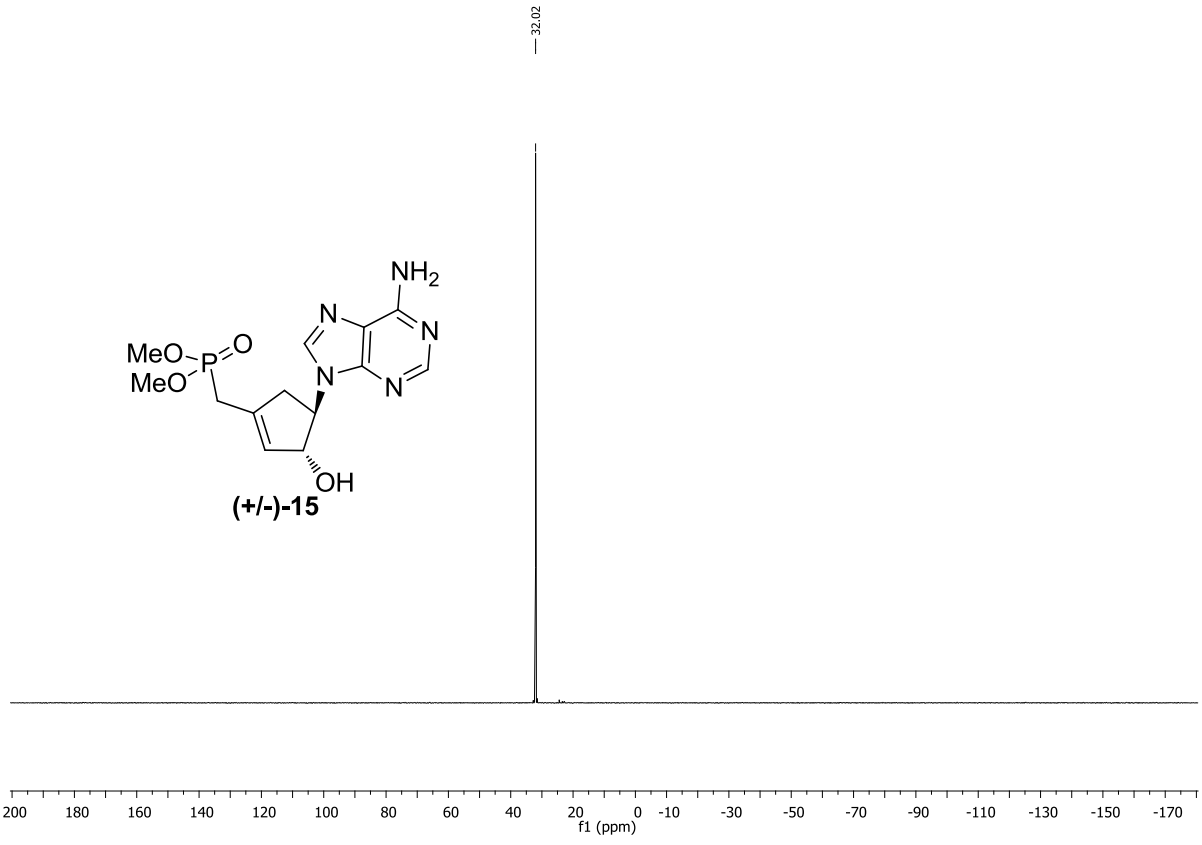

8.84
8.20
7.26 Chloroform-d
6.66
6.66
6.65
6.64
6.15
6.14
6.13
6.12
6.01
5.99
5.98
5.96
5.29
3.76
3.75
3.72
3.71
3.19
3.16
3.14
3.11
2.88
2.87
2.82
2.77
2.70
2.65
2.61
2.59
2.56
2.04
1.76
1.46
NBoc2
MeO–P
MeO
AcO
O
N
N
N
N
1.00
1.04
1.09
1.09
1.13
6.58
1.09
1.12
1.18
1.11
3.23
19.27
f1 (ppm)

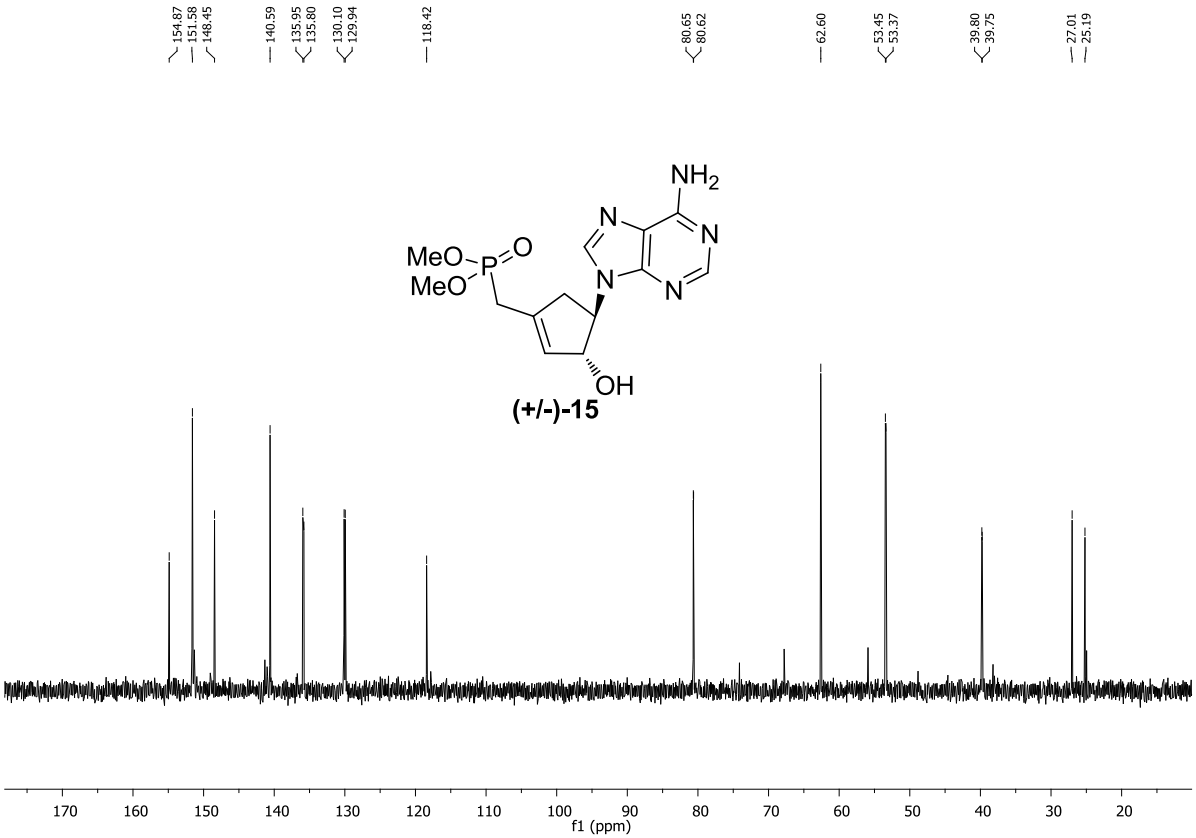
(+/-)-14

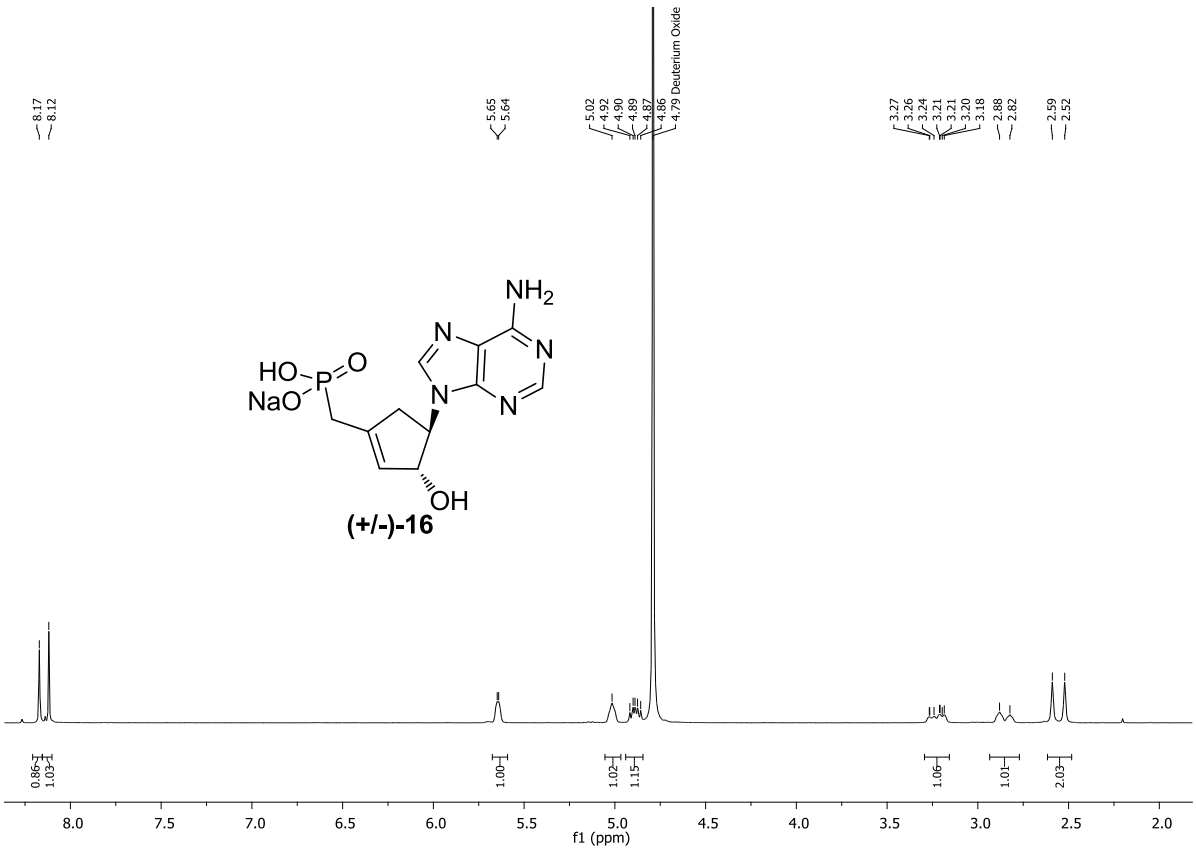

27.48
NBoc2
MeO–P
MeO
AcO
(+/-)-14
200 180 160 140 120 100 80 60 40 20 0 -10 -30 -50 -70 -90 -110 -130 -150 -170
f1 (ppm)

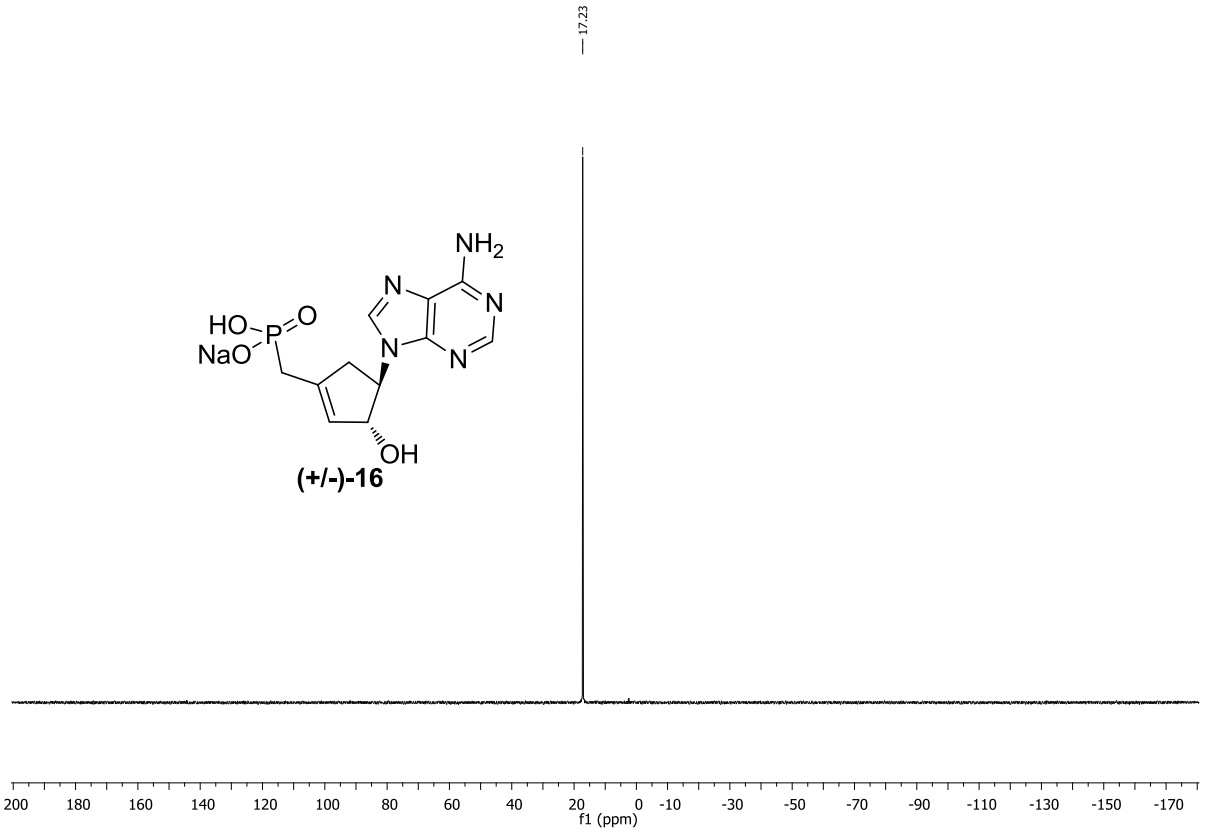

170.55
153.26
152.10
150.73
150.54
143.39
138.29
138.16
134.52
129.23
88.74
88.71
83.96
77.58
77.16
76.74
59.05
52.75
52.67
52.62
52.53
44.98
44.94
33.62
31.77
27.95
21.89
NBoc2
MeO–P
MeO
AcO
(+/-)-14
180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10
f1 (ppm)

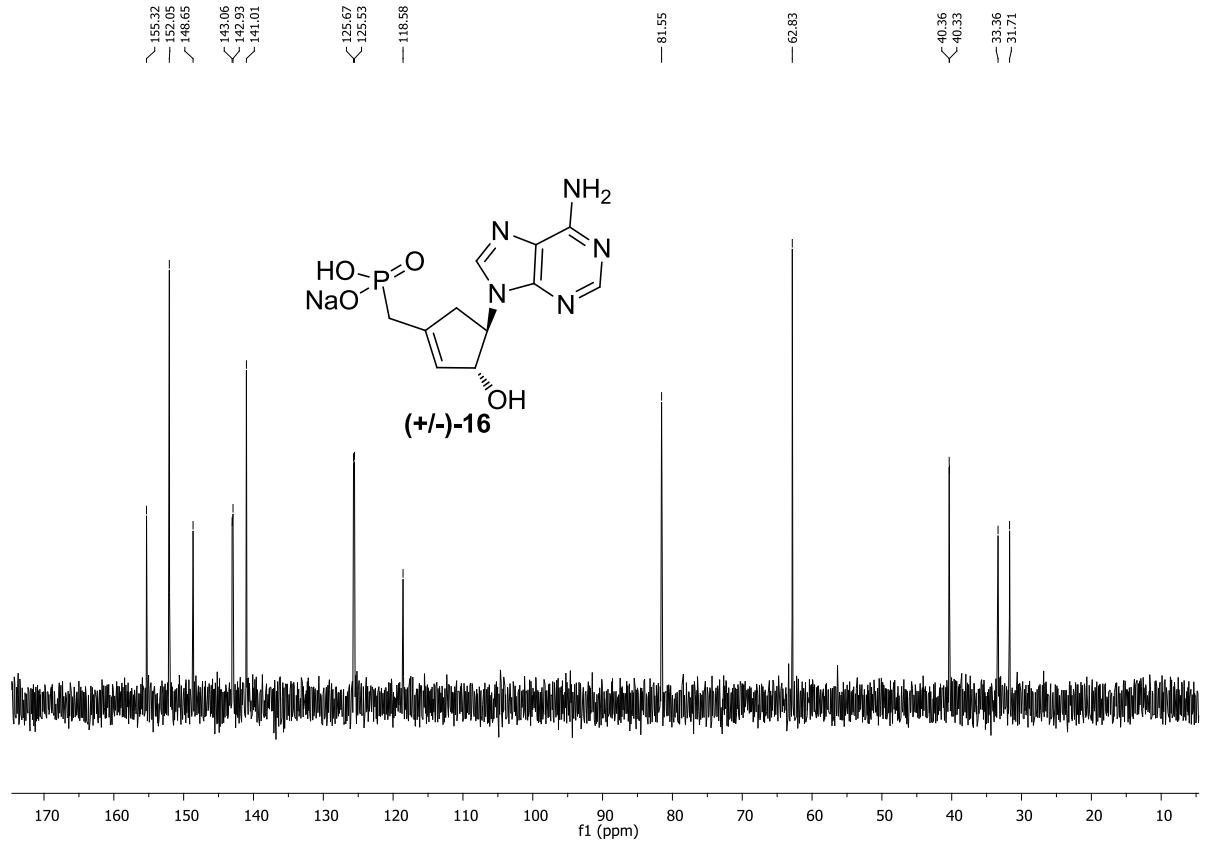

8.08
8.06
5.87
5.86
5.86
5.85
5.85
5.10
5.09
5.07
4.89
4.88
4.87
4.86
4.86
4.85
4.85
4.79 Deuterium Oxide
3.82
3.78
3.18
3.18
3.16
3.13
3.11
3.09
3.08
3.05
3.00
2.98
2.84
2.84
2.83
2.82
2.81
2.77
NH2
N
N
N
N
MeO
MeO
P
O
OH
(+/-)-15
2.18
1.00
0.95
1.17
5.83
3.13
0.93
8.4 8.2 8.0 7.8 7.6 7.4 7.2 7.0 6.8 6.6 6.4 6.2 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 3.0 2.8 2.6
f1 (ppm)

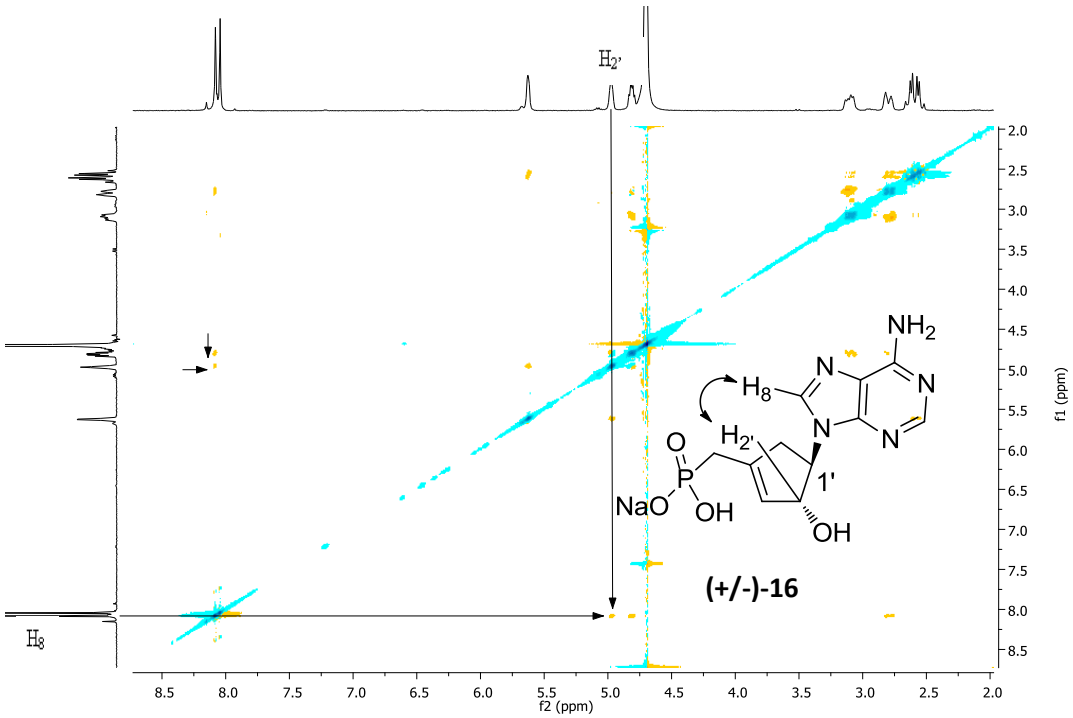

32.02
NH2
N
N
N
N
MeO
MeO
P
O
OH
(+/-)-15
200 180 160 140 120 100 80 60 40 20 0 -10 -30 -50 -70 -90 -110 -130 -150 -170
f1 (ppm)

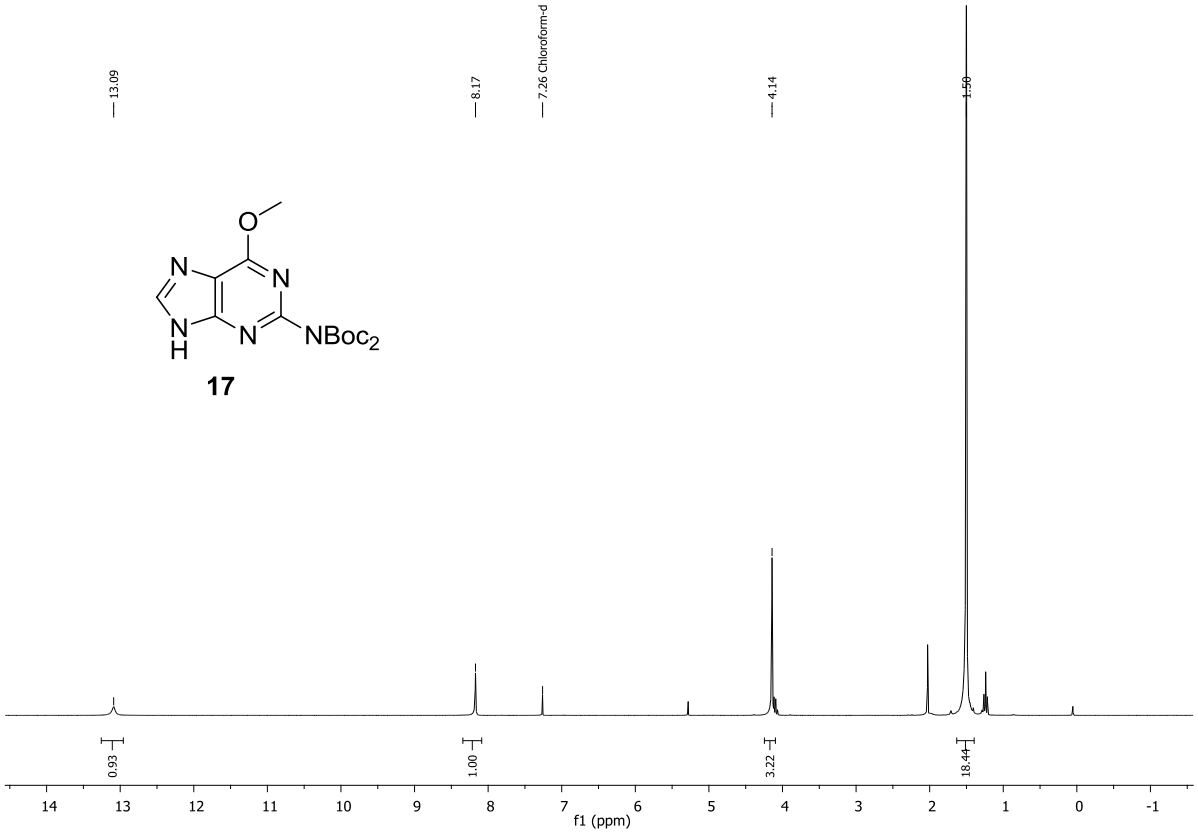

154.87
151.58
148.45
140.59
135.95
135.80
130.10
129.94
118.42
80.65
80.62
62.60
53.45
53.37
39.80
39.75
27.01
25.19
NH2
N
N
N
N
MeO
MeO
P
O
OH
(+/-)-15
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
f1 (ppm)

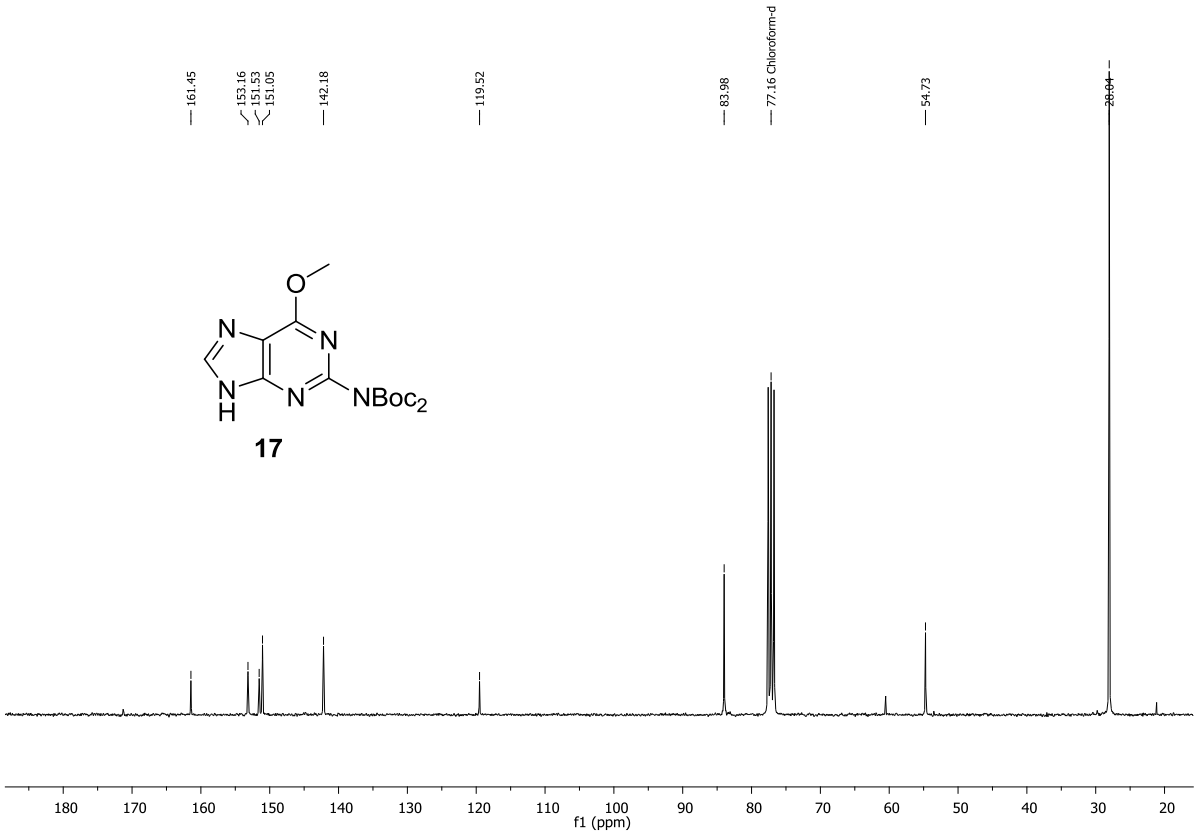

8.17
8.12
5.65
5.64
5.02
4.92
4.90
4.89
4.87
4.86
4.79 Deuterium Oxide
3.27
3.26
3.24
3.21
3.21
3.20
3.18
2.88
2.82
2.59
2.52
NH2
N
N
N
N
HO
NaO
P
O
OH
(+/-)-16
0.86
1.03
1.00
1.02
1.15
1.06
1.01
2.03
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
f1 (ppm)

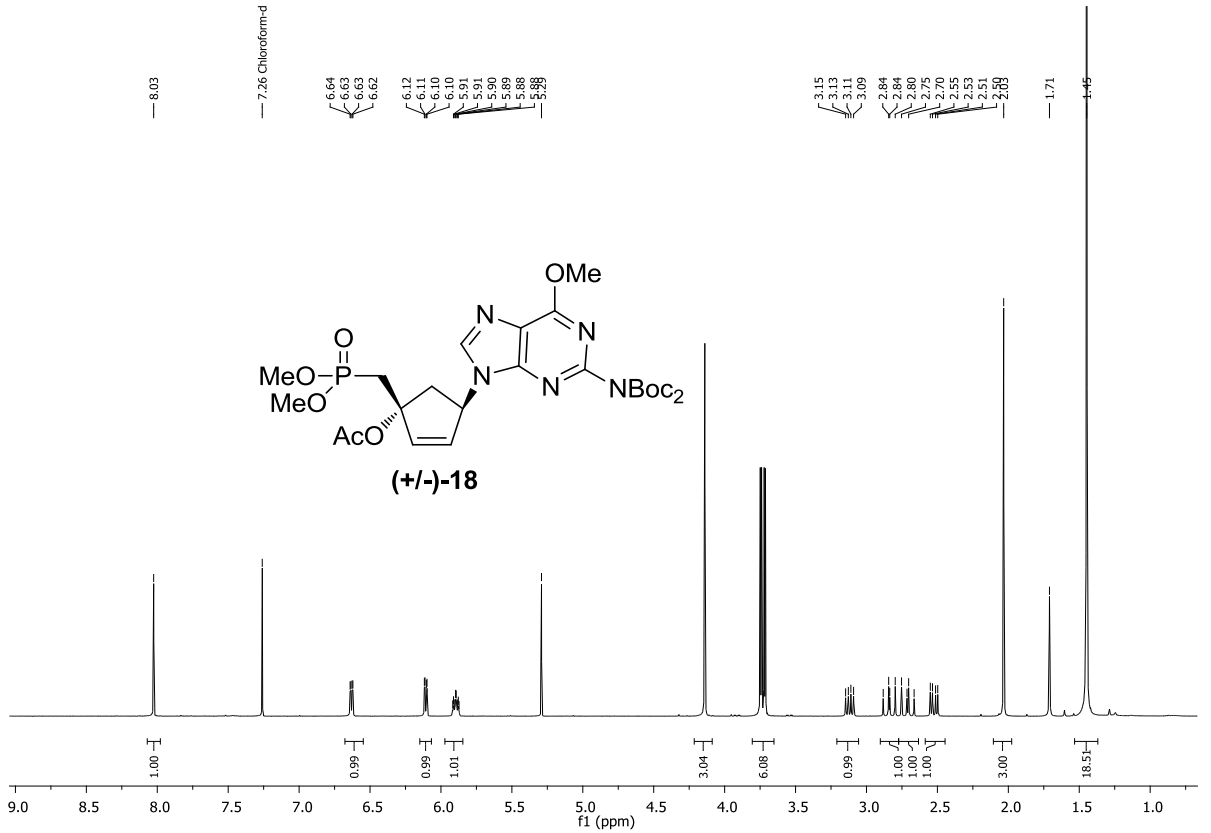

17.23
NH2
N
N
HO
P
O
NaO
N
N
OH
(+/-)-16
200 180 160 140 120 100 80 60 40 20 0 -10 -30 -50 -70 -90 -110 -130 -150 -170
f1 (ppm)


155.32
152.05
148.65
143.06
142.93
141.01
125.67
125.53
118.58
81.55
62.83
40.36
40.33
33.36
31.71
NH2
N
N
HO
P
O
NaO
N
N
OH
(+/-)-16
170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10
f1 (ppm)

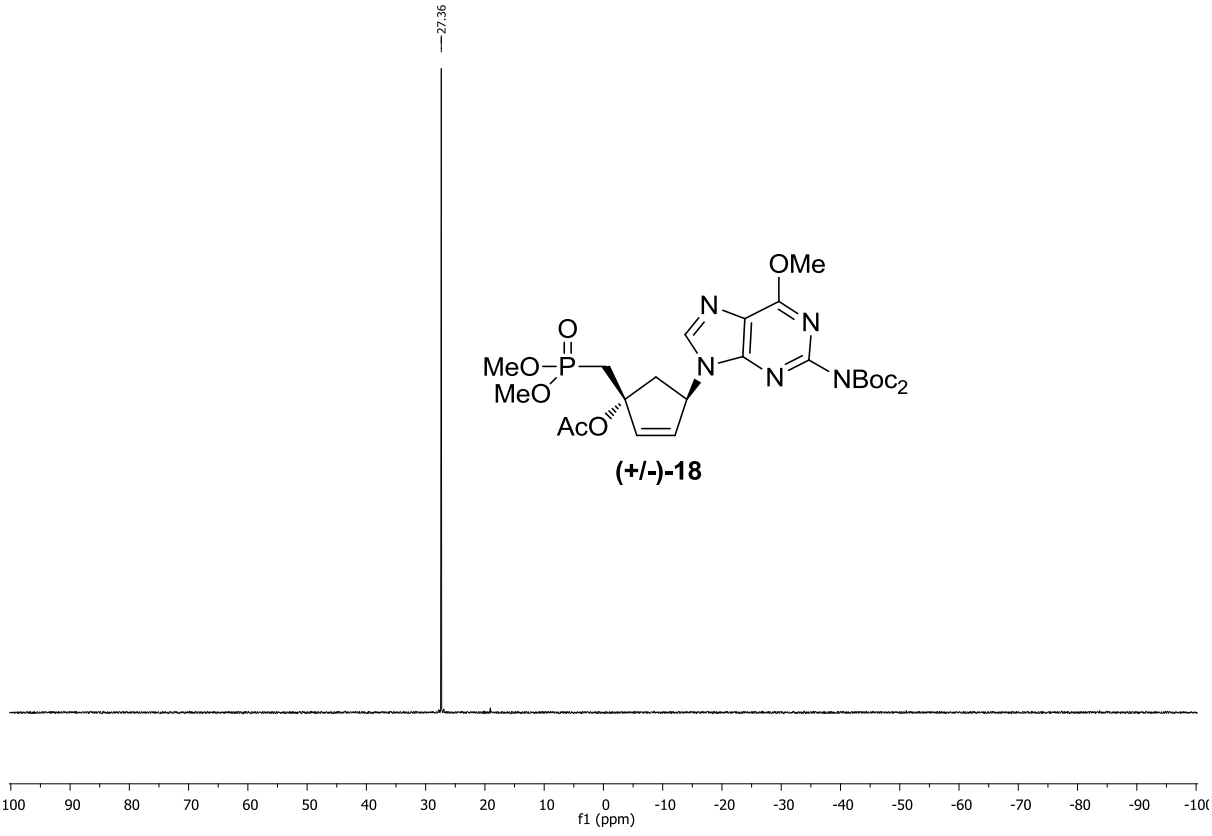

H2'
H8
f2 (ppm)
f1 (ppm)
NH2
N
N
N
N
H8
H2'
O
P
NaO
OH
1'
OH
(+/-)-16


13.09
8.17
7.26 Chloroform-d
4.14
1.50
O
N
N
N
N
H
NBoc2
17
0.93
1.00
3.22
18.44
f1 (ppm)

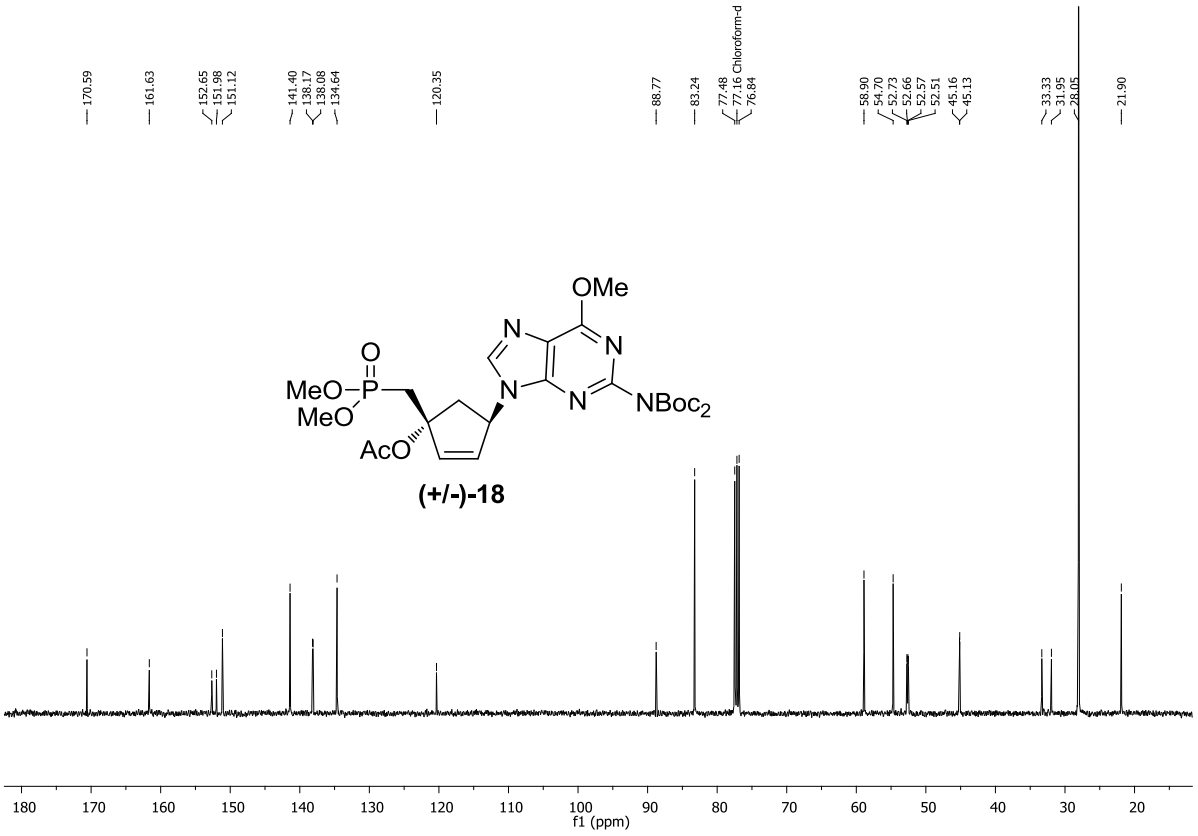

161.45
153.16
151.53
151.05
142.18
119.52
83.98
77.16 Chloroform-d
54.73
28.04
O
N
N
N
N
H
NBoc2
17
f1 (ppm)


8.03
7.26 Chloroform-d
6.64
6.63
6.63
6.62
6.12
6.11
6.10
6.10
5.91
5.91
5.90
5.89
5.88
5.88
5.29
3.15
3.13
3.11
3.09
2.84
2.84
2.80
2.75
2.70
2.55
2.53
2.51
2.50
2.03
1.71
1.45
OMe
N
N
N
N
NBoc2
O
MeO–P
MeO
AcO
1.00
0.99
0.99
1.01
3.04
6.08
0.99
1.00
1.00
1.00
3.00
18.51
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
f1 (ppm)

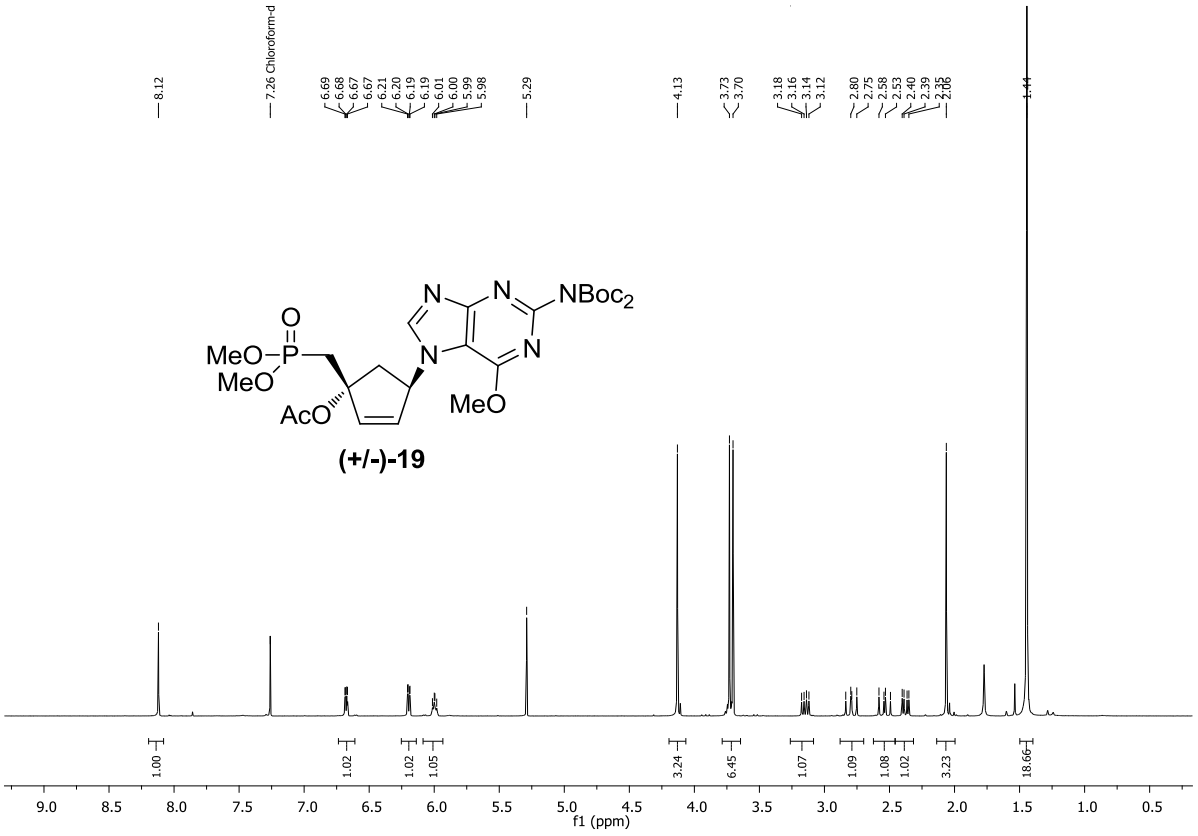
(+/-)-18


27.36
OMe
N
N
N
N
NBoc2
O
MeO–P
MeO
AcO
100
90
80
70
60
50
40
30
20
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
f1 (ppm)

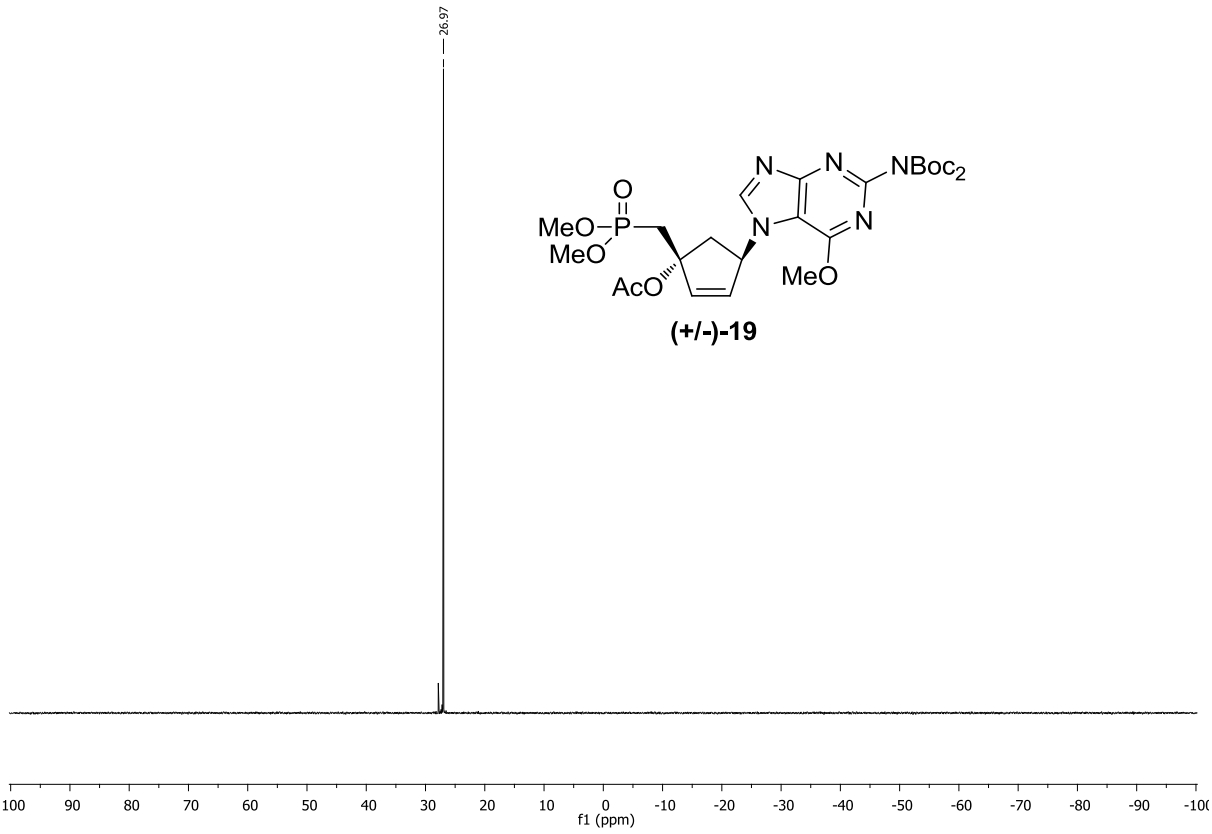
(+/-)-18


170.59
161.63
152.65
151.98
151.12
141.40
138.17
138.08
134.64
120.35
88.77
83.24
77.48
77.16 Chloroform-d
76.84
58.90
54.70
52.73
52.66
52.57
52.51
45.16
45.13
33.33
31.95
28.05
21.90
OMe
N
N
N
N
NBoc2
O
MeO–P
MeO
AcO
f1 (ppm)

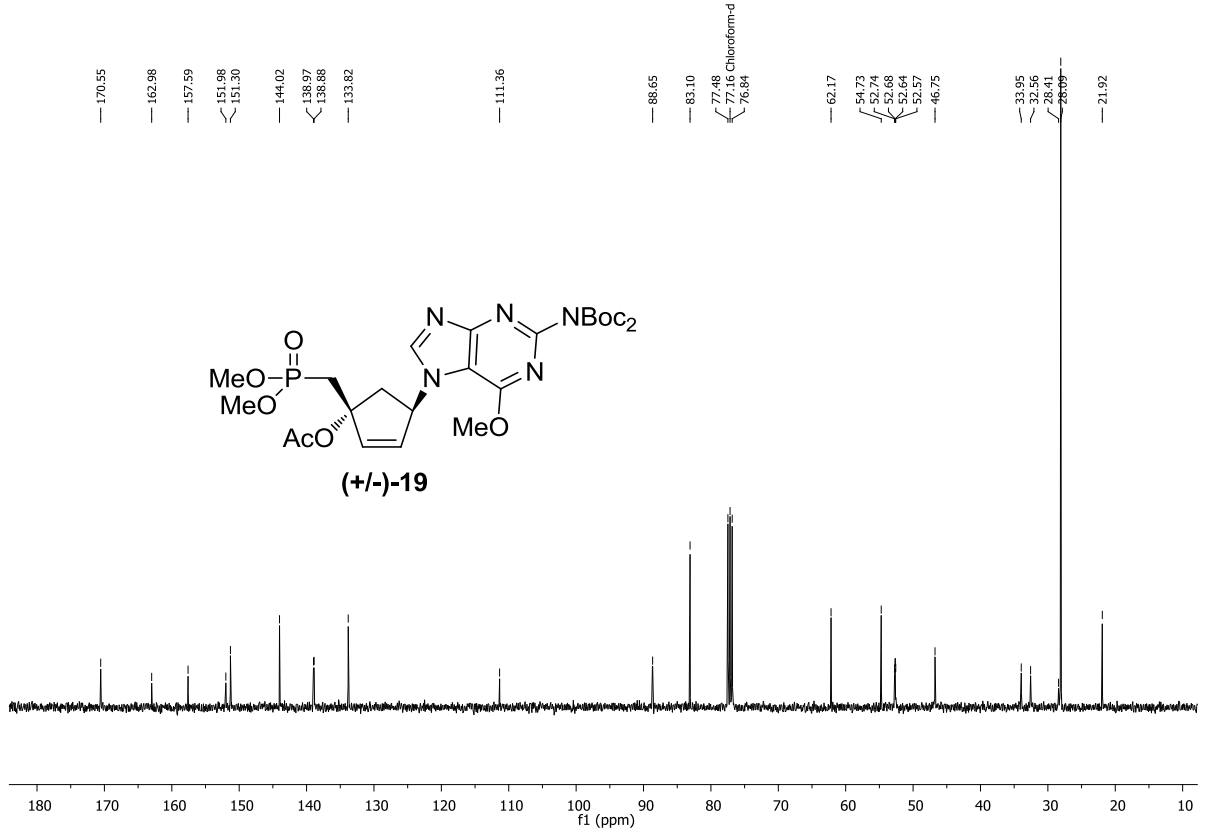
(+/-)-18


8.12
7.26 Chloroform-d
6.69
6.68
6.67
6.67
6.21
6.20
6.19
6.19
6.01
6.00
5.99
5.98
5.29
4.13
3.73
3.70
3.18
3.16
3.14
3.12
2.80
2.75
2.58
2.53
2.40
2.39
2.05
1.44
N
N
NBoc2
N
N
O
MeO–P
MeO
AcO
MeO
1.00
1.02
1.02
1.05
3.24
6.45
1.07
1.09
1.08
1.02
3.23
18.66
f1 (ppm)

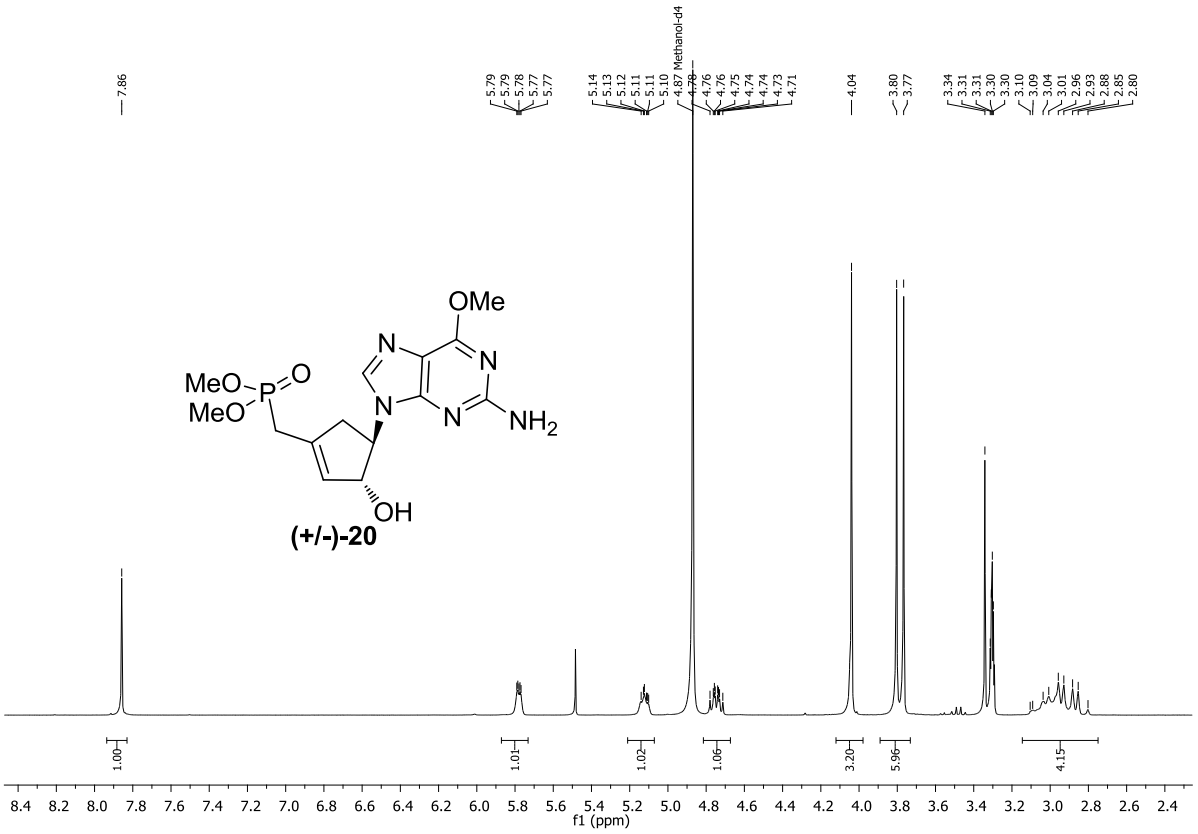
(+/-)-19

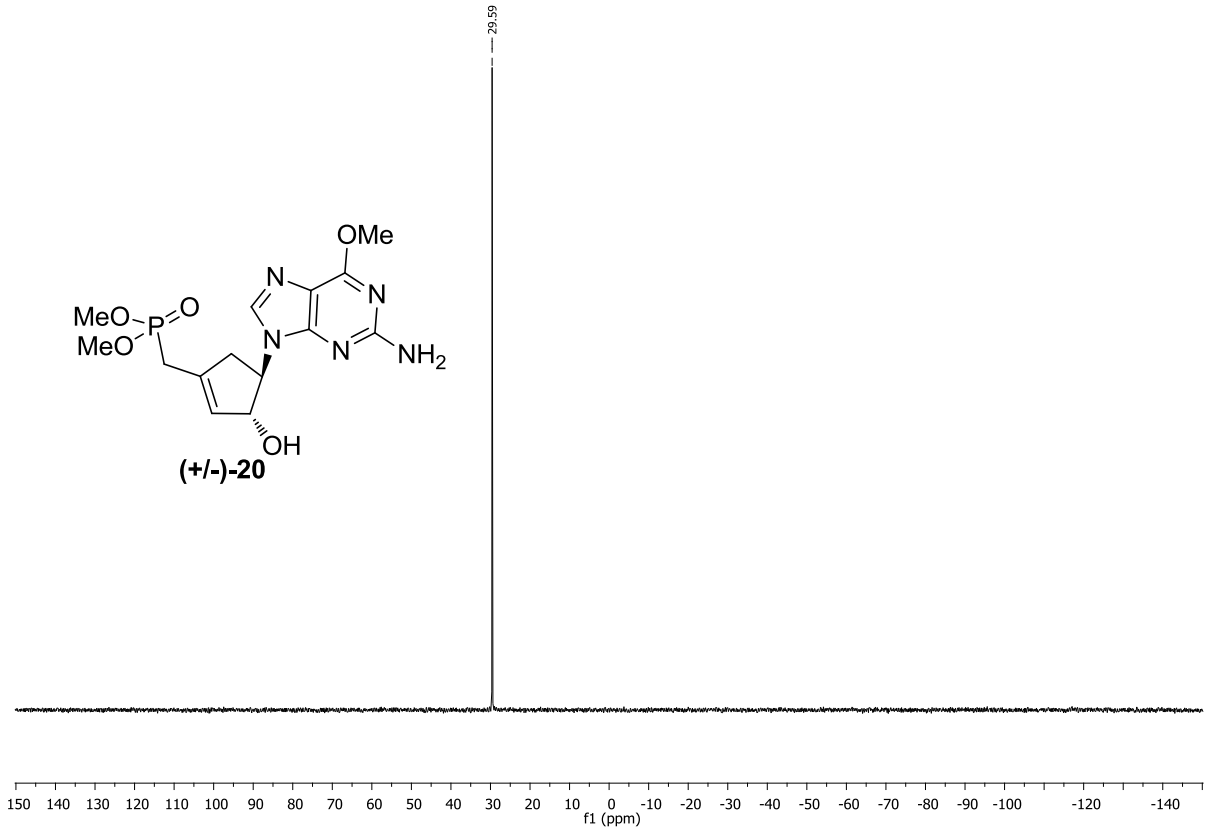

26.97
MeO
MeO
AcO
N
N
N
N
N
NBoc2
MeO
f1 (ppm)

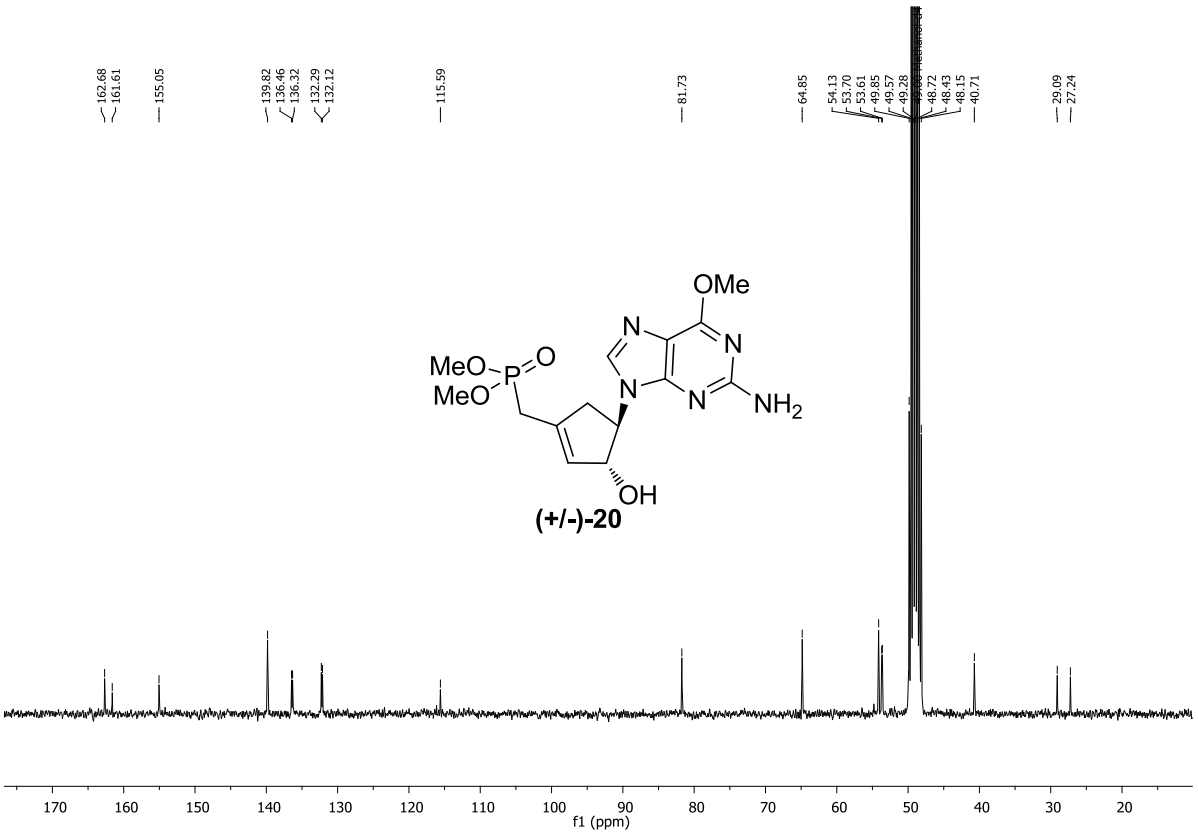
(+/-)-19

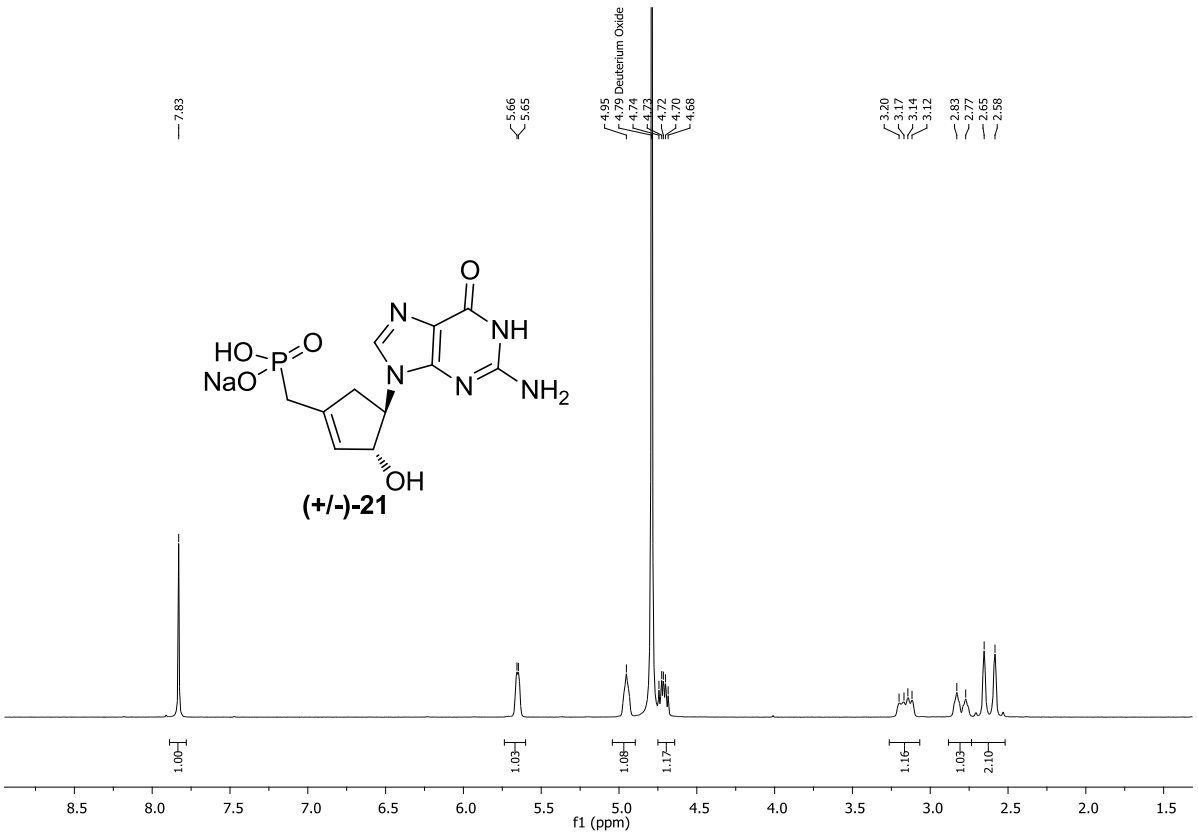

170.55
162.98
157.59
151.98
151.30
144.02
138.97
138.88
133.82
111.36
88.65
83.10
77.48
77.16 Chloroform-d
76.84
62.17
54.73
52.74
52.68
52.64
52.57
46.75
33.95
32.56
28.41
28.09
21.92
MeO
MeO
AcO
N
N
N
N
N
NBoc2
MeO
f1 (ppm)

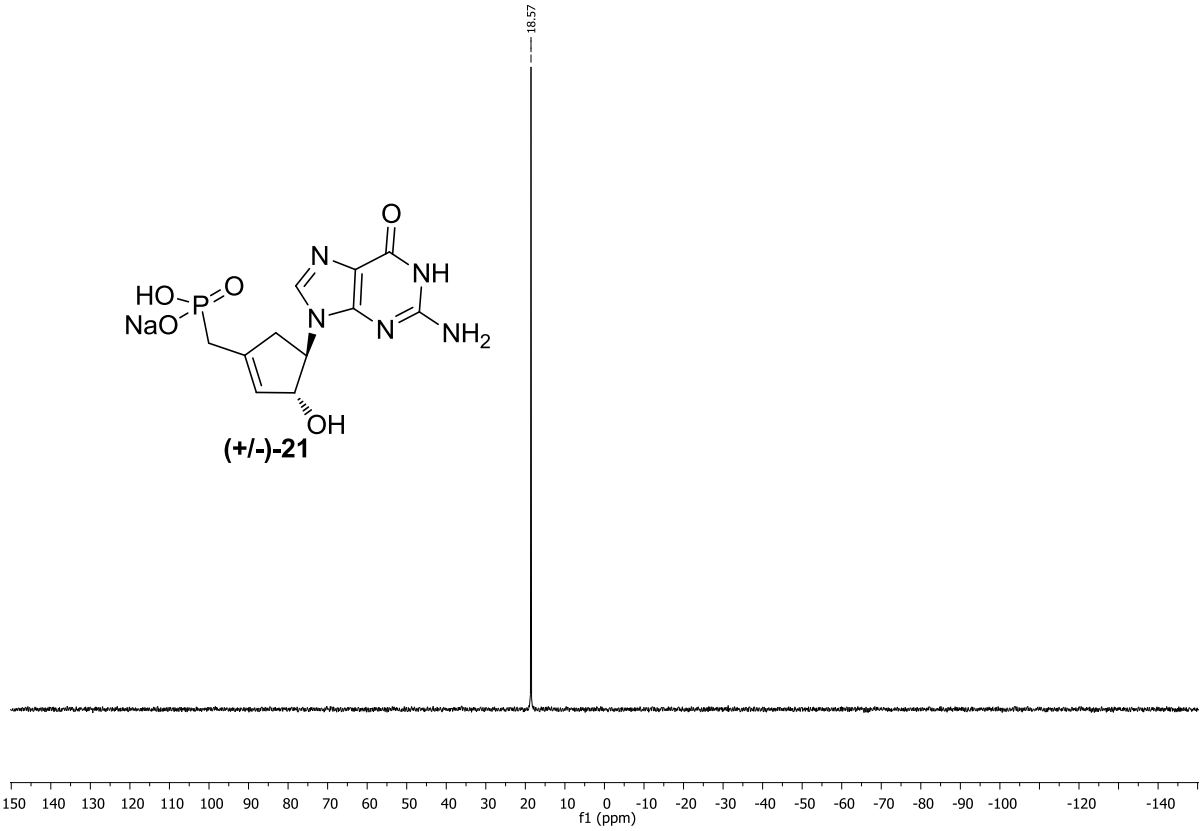
(+/-)-19

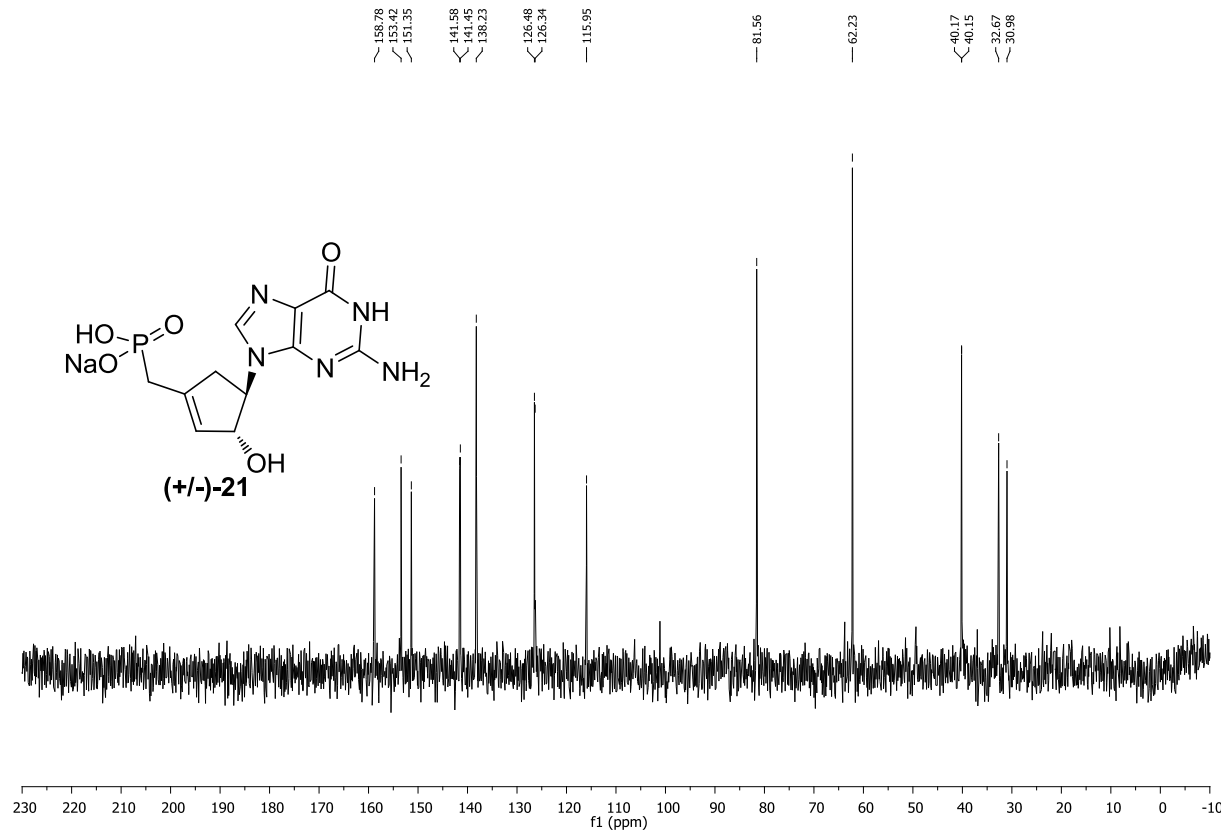

7.86
5.79
5.79
5.78
5.77
5.77
5.14
5.13
5.12
5.11
5.11
5.10
Methanol-d4
4.87
4.78
4.76
4.76
4.75
4.74
4.74
4.73
4.71
4.04
3.80
3.77
3.34
3.31
3.31
3.30
3.30
3.10
3.09
3.04
3.01
2.96
2.93
2.88
2.85
2.80
OMe
N
N
MeO
P
O
MeO
N
N
NH2
OH
(+/-)-20
1.00
1.01
1.02
1.06
3.20
5.96
4.15
8.4 8.2 8.0 7.8 7.6 7.4 7.2 7.0 6.8 6.6 6.4 6.2 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 3.0 2.8 2.6 2.4
f1 (ppm)

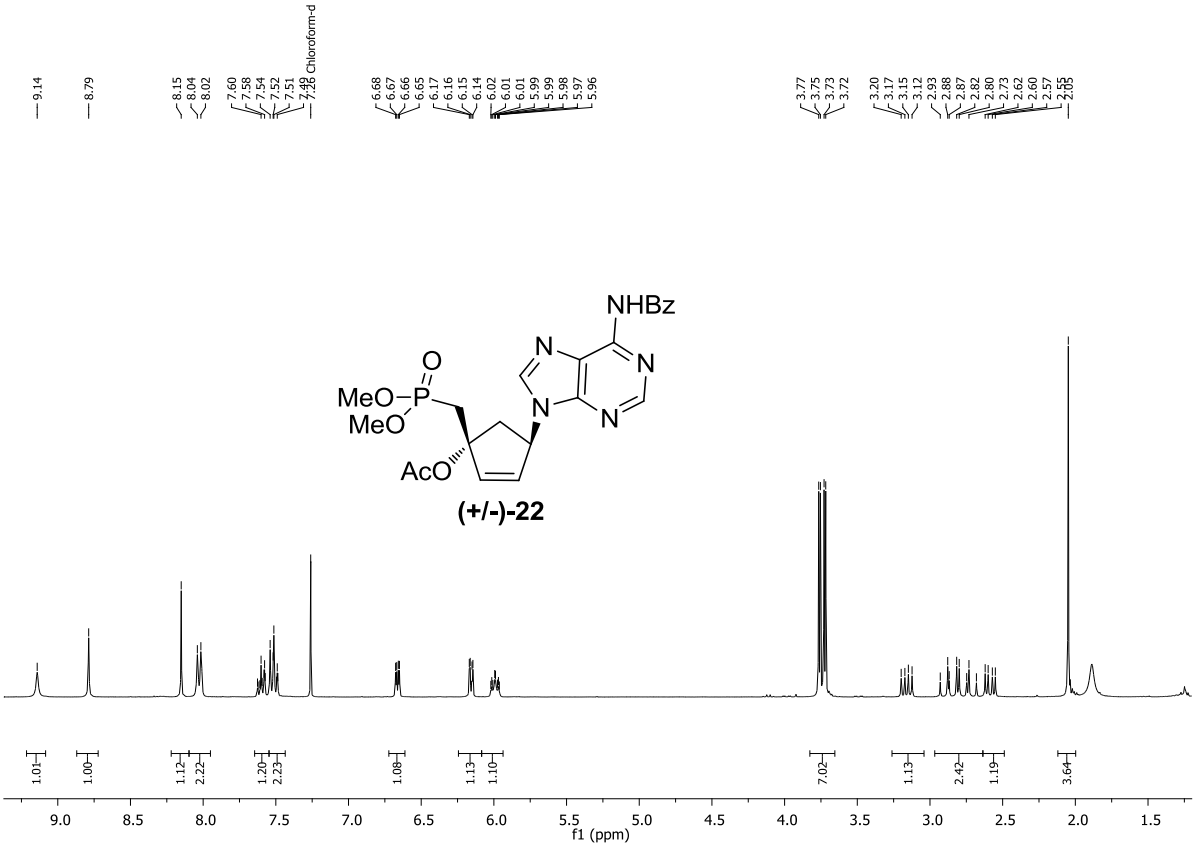

29.59
OMe
N
N
MeO
P
O
MeO
N
N
NH2
OH
(+/-)-20
150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10 -20 -30 -40 -50 -60 -70 -80 -90 -100 -120 -140
f1 (ppm)

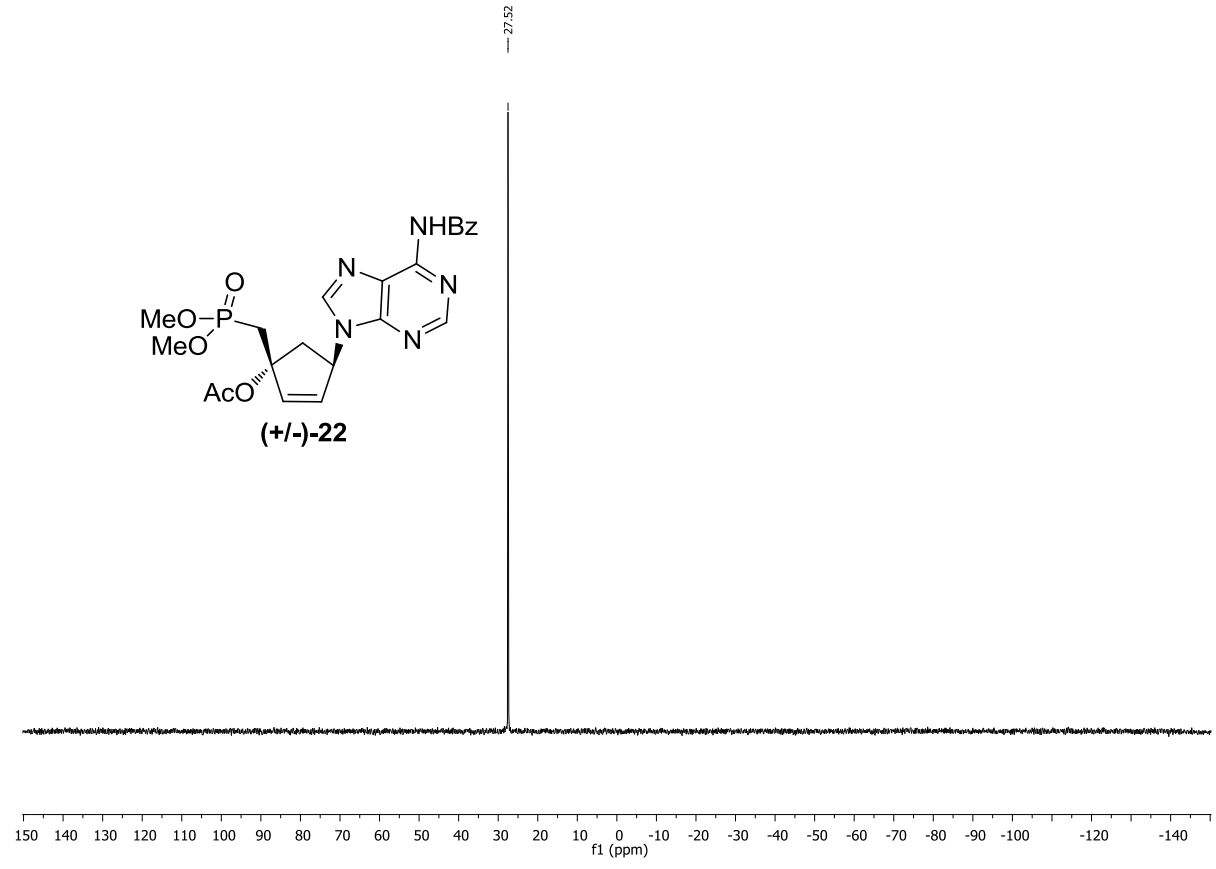

162.68
161.61
155.05
139.82
136.46
136.32
132.29
132.12
115.59
81.73
64.85
54.13
53.70
53.61
49.85
49.57
49.28
48.72
48.43
48.15
40.71
29.09
27.24
OMe
N
N
N
N
NH2
MeO
MeO
P
O
OH
(+/-)-20
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
f1 (ppm)

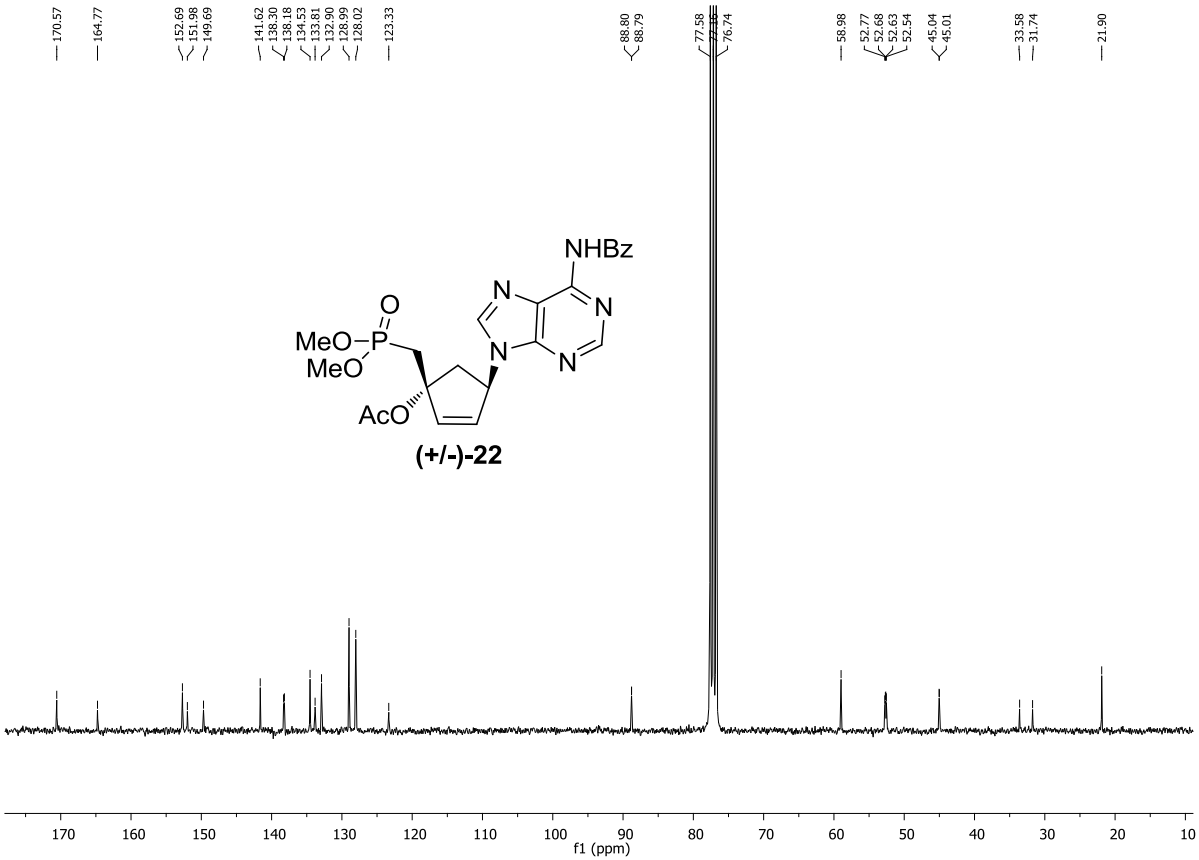

7.83
5.66
5.65
4.95
4.79 Deuterium Oxide
4.74
4.73
4.72
4.70
4.68
3.20
3.17
3.14
3.12
2.83
2.77
2.65
2.58
O
N
NH
N
N
NH2
HO
NaO
P
O
OH
(+/-)-21
1.00
1.03
1.08
1.17
1.16
1.03
2.10
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
f1 (ppm)


18.57
HO
NaO
P
O
N
NH
NH2
OH
(+/-)-21
150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10 -20 -30 -40 -50 -60 -70 -80 -90 -100 -120 -140
f1 (ppm)

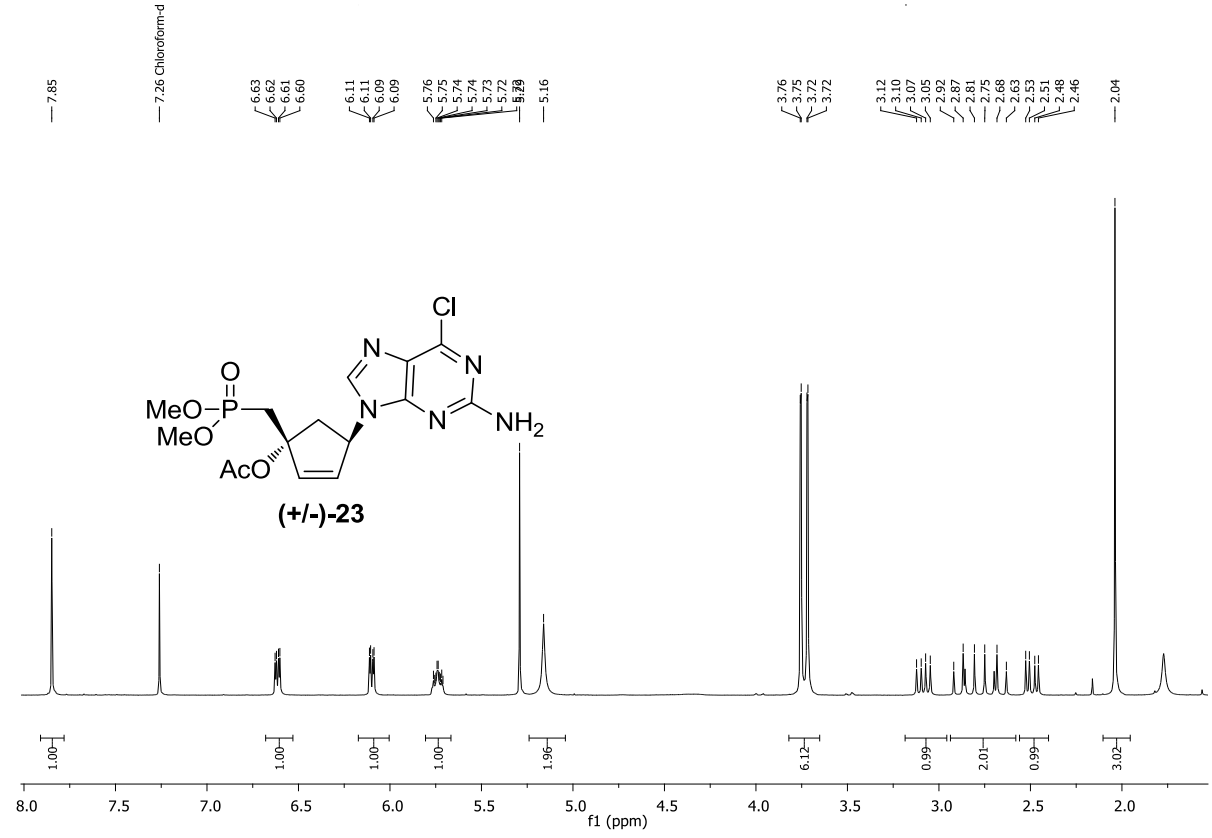

158.78
153.42
151.35
141.58
141.45
138.23
126.48
126.34
115.95
81.56
62.23
40.17
40.15
32.67
30.98
HO
NaO
P
O
N
NH
NH2
OH
(+/-)-21
230 220 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)


9.14
8.79
8.15
8.04
8.02
7.60
7.58
7.54
7.52
7.51
7.26 Chloroform-d
6.68
6.67
6.66
6.65
6.17
6.16
6.15
6.14
6.02
6.01
6.01
5.99
5.99
5.98
5.97
5.96
3.77
3.75
3.73
3.72
3.20
3.17
3.15
3.12
2.93
2.88
2.87
2.82
2.80
2.73
2.62
2.60
2.57
2.55
2.35
NHBz
MeO–P
MeO
AcO
(+/-)-22
1.01
1.00
1.12
2.22
1.20
2.23
1.08
1.13
1.10
7.02
1.13
2.42
1.19
3.64
f1 (ppm)

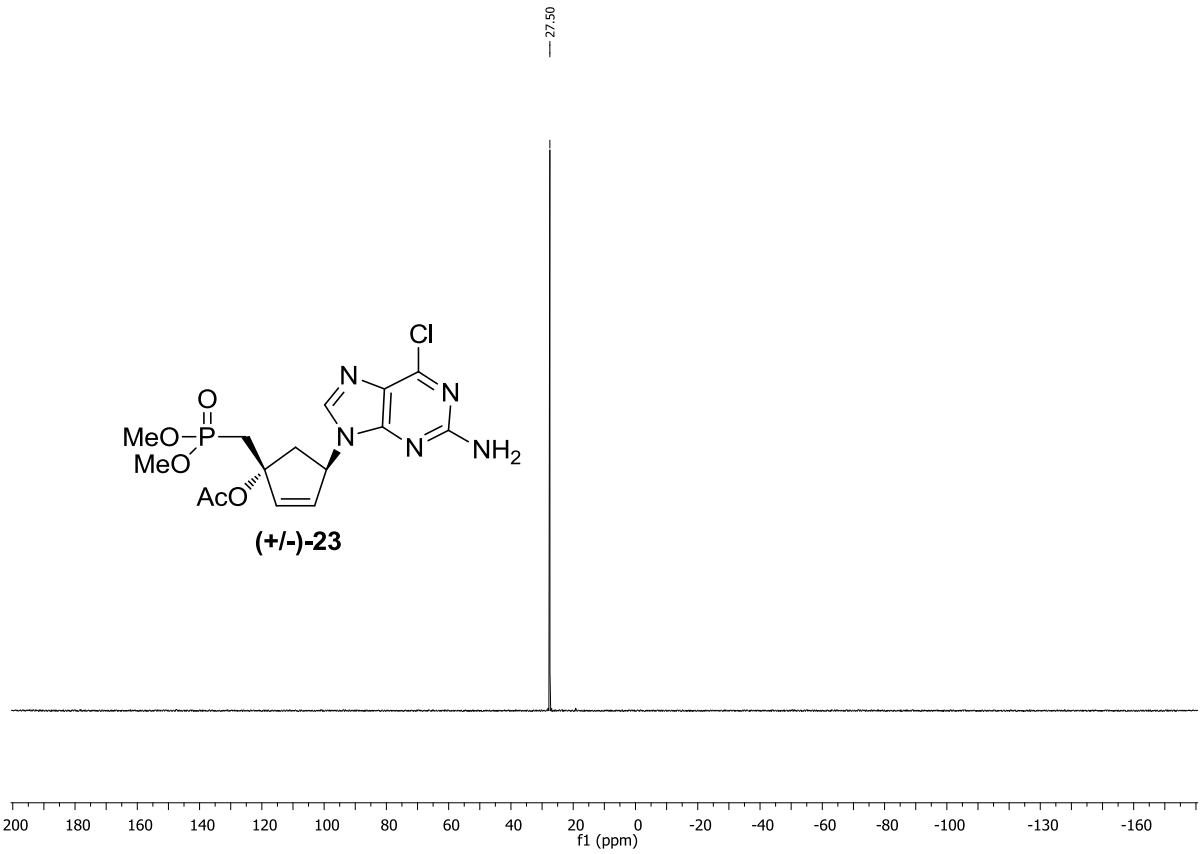

27.52
NHBz
MeO–P
MeO
AcO
(+/-)-22
f1 (ppm)


170.57
164.77
152.69
151.98
149.69
141.62
138.30
138.18
134.53
133.81
132.90
128.99
128.02
123.33
88.80
88.79
77.58
77.16
76.74
58.98
52.77
52.68
52.63
52.54
45.04
45.01
33.58
31.74
21.90
NHBz
N
N
N
N
O
MeO–P
MeO
AcO
f1 (ppm)

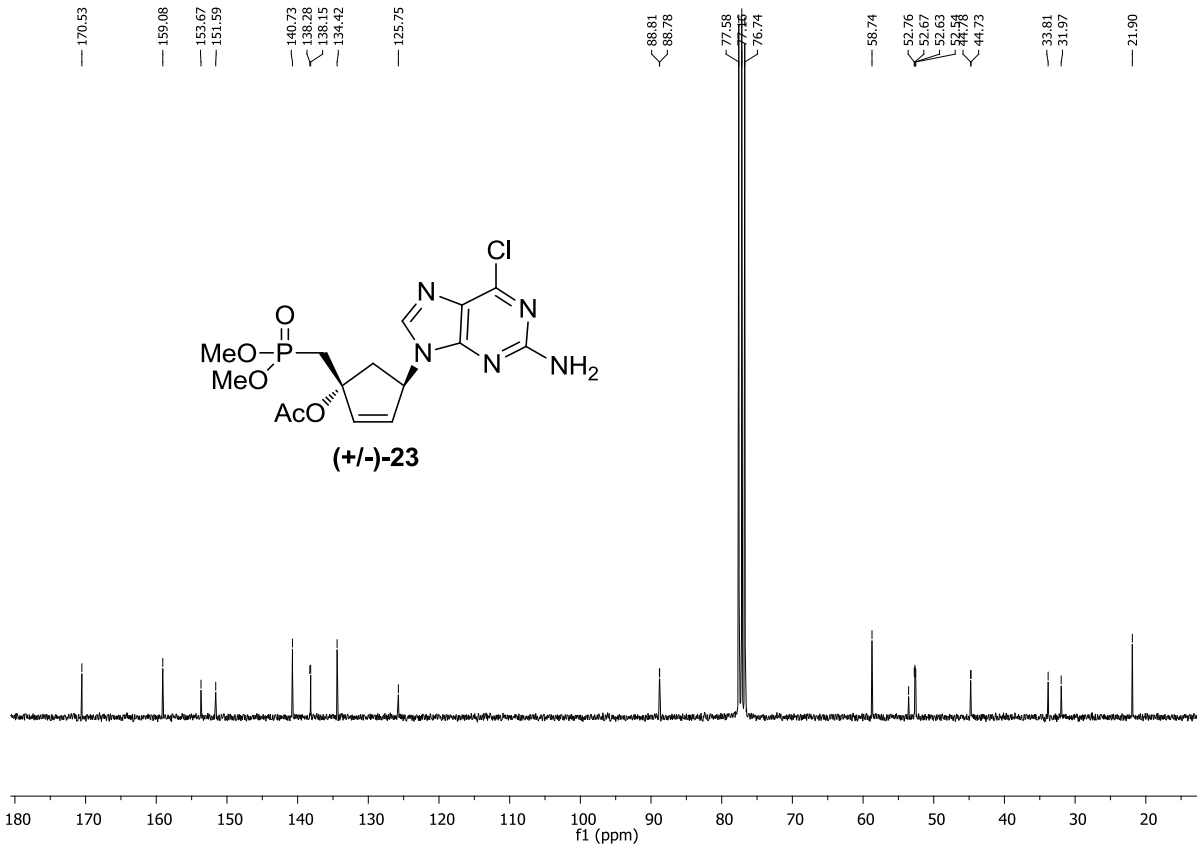
(+/-)-22


7.85
7.26 Chloroform-d
6.63
6.62
6.61
6.60
6.11
6.11
6.09
6.09
5.76
5.75
5.74
5.74
5.73
5.72
5.16
3.76
3.75
3.72
3.72
3.12
3.10
3.07
3.05
2.92
2.87
2.81
2.75
2.68
2.63
2.53
2.51
2.48
2.46
2.04
Cl
N
N
N
N
NH2
O
MeO–P
MeO
AcO
1.00
1.00
1.00
1.00
1.96
6.12
0.99
2.01
0.99
3.02
f1 (ppm)

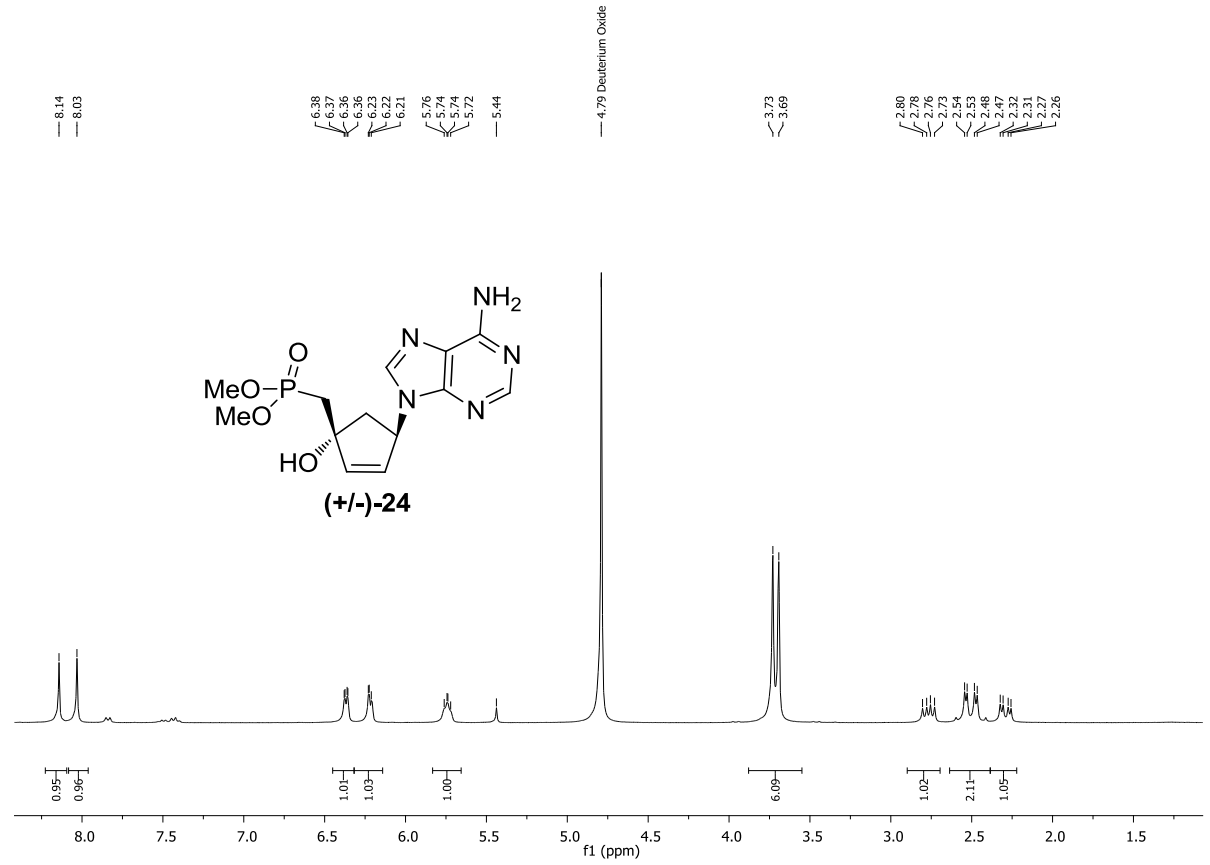
(+/-)-23


27.50
Cl
N
N
O
MeO–P
MeO
N
N
NH2
AcO
200 180 160 140 120 100 80 60 40 20 0 -20 -40 -60 -80 -100 -130 -160
f1 (ppm)

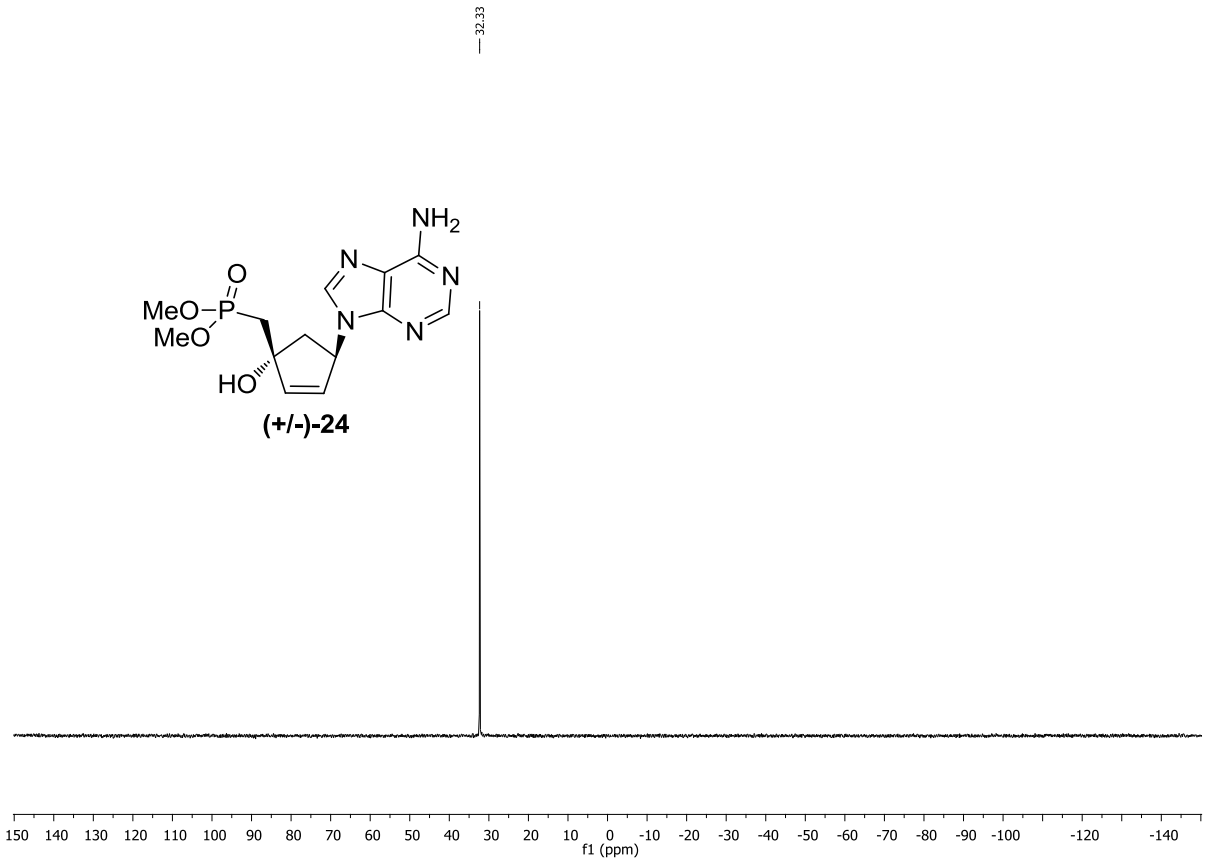
(+/-)-23


170.53
159.08
153.67
151.59
140.73
138.28
138.15
134.42
125.75
88.81
88.78
77.58
77.16
76.74
58.74
52.76
52.67
52.63
44.78
44.73
33.81
31.97
21.90
Cl
N
N
O
MeO–P
MeO
N
N
NH2
AcO
180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20
f1 (ppm)

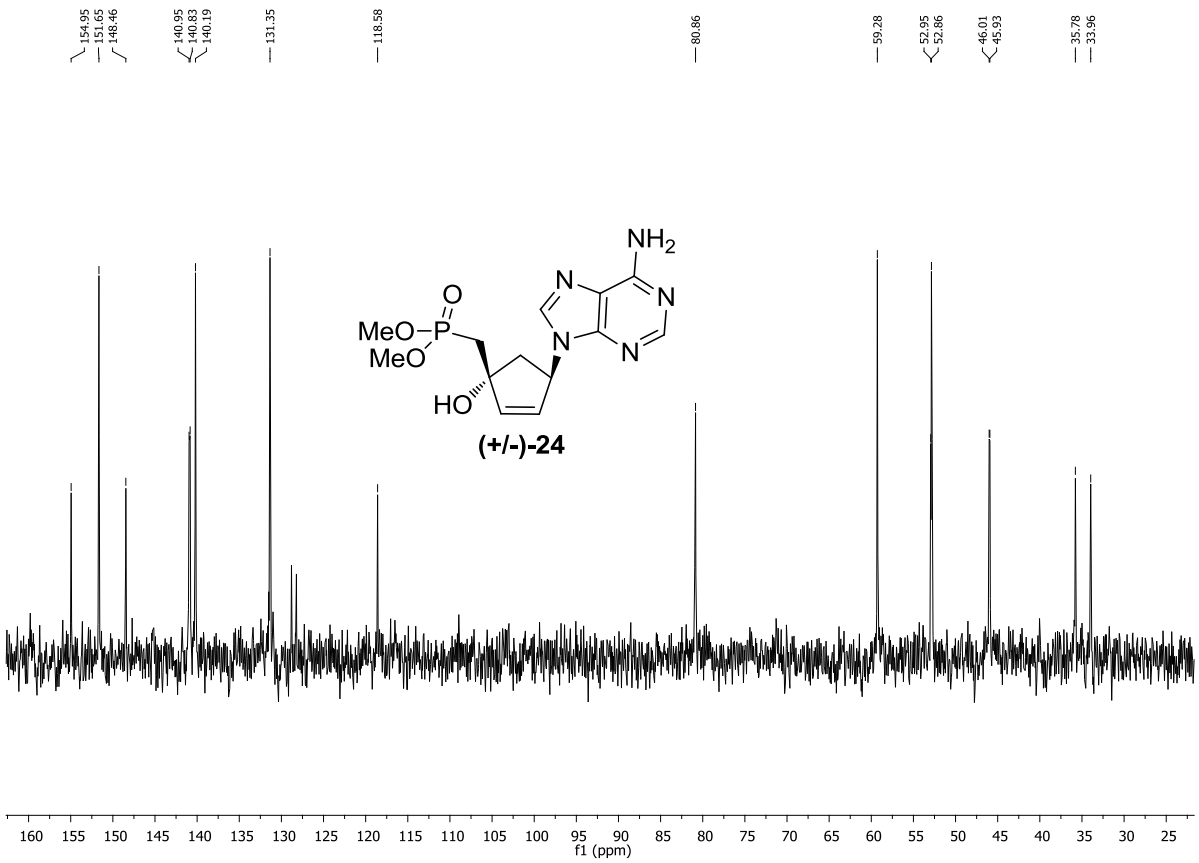
(+/-)-23

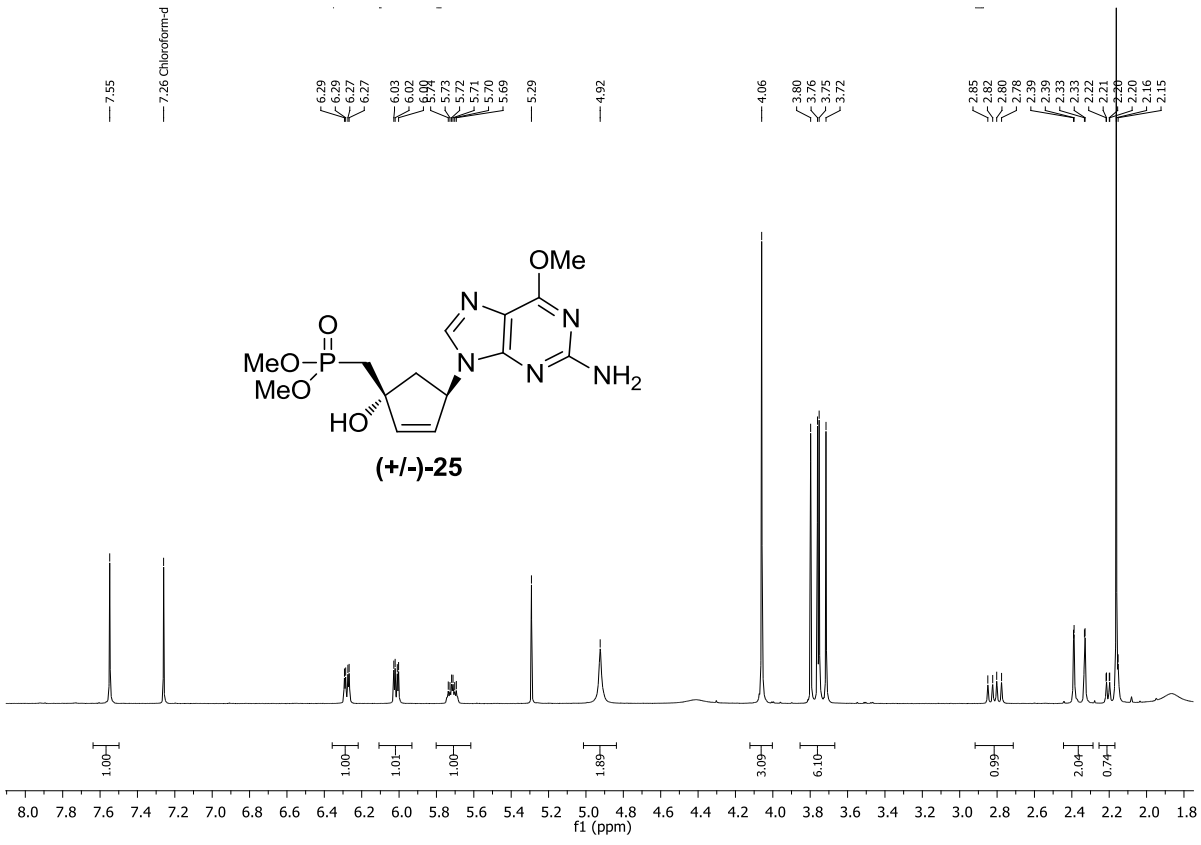

8.14
8.03
6.38
6.37
6.36
6.36
6.23
6.22
6.21
5.76
5.74
5.74
5.72
5.44
4.79 Deuterium Oxide
3.73
3.69
2.80
2.78
2.76
2.73
2.54
2.53
2.48
2.47
2.32
2.31
2.27
2.26
NH2
N
N
N
N
O
MeO–P
MeO
HO
0.95
0.96
1.01
1.03
1.00
6.09
1.02
2.11
1.05
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
f1 (ppm)

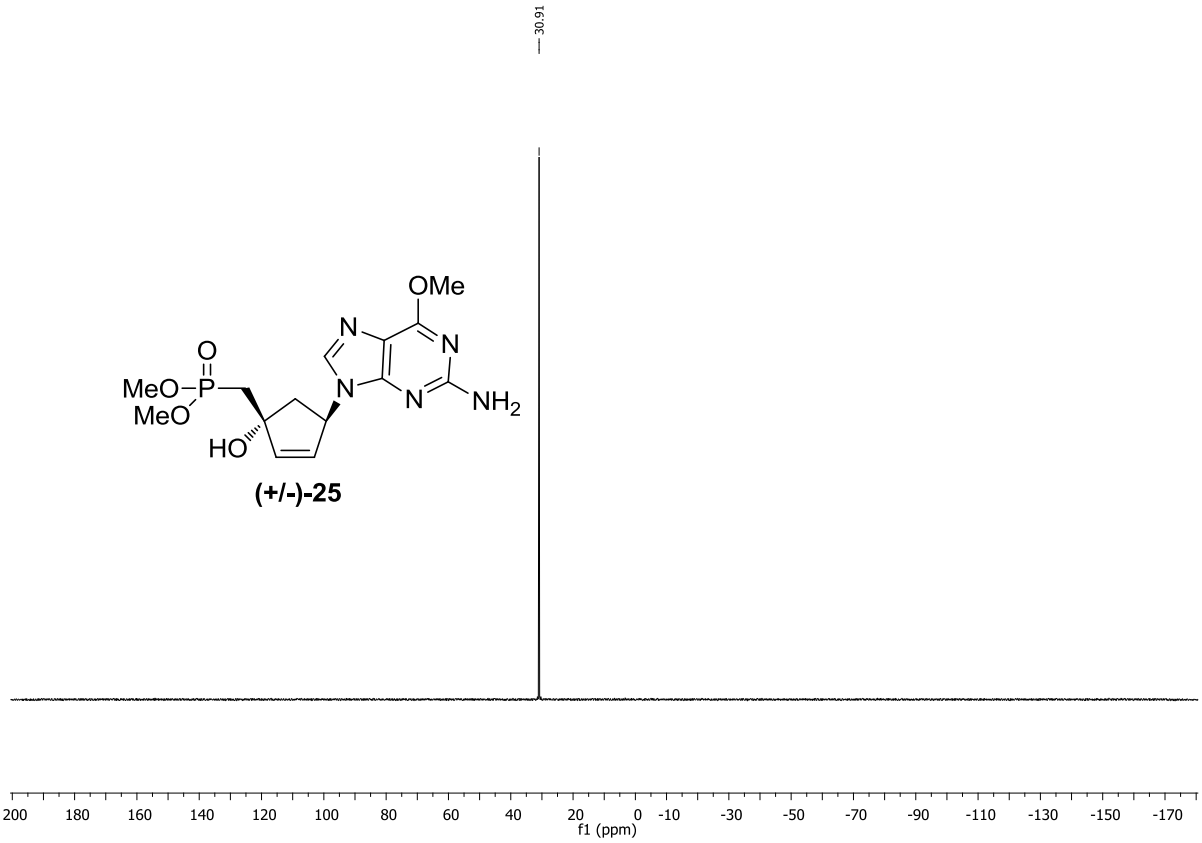
(+/-)-24


32.33
NH2
N
N
N
N
O
MeO–P
MeO
HO
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
-120
-140
f1 (ppm)

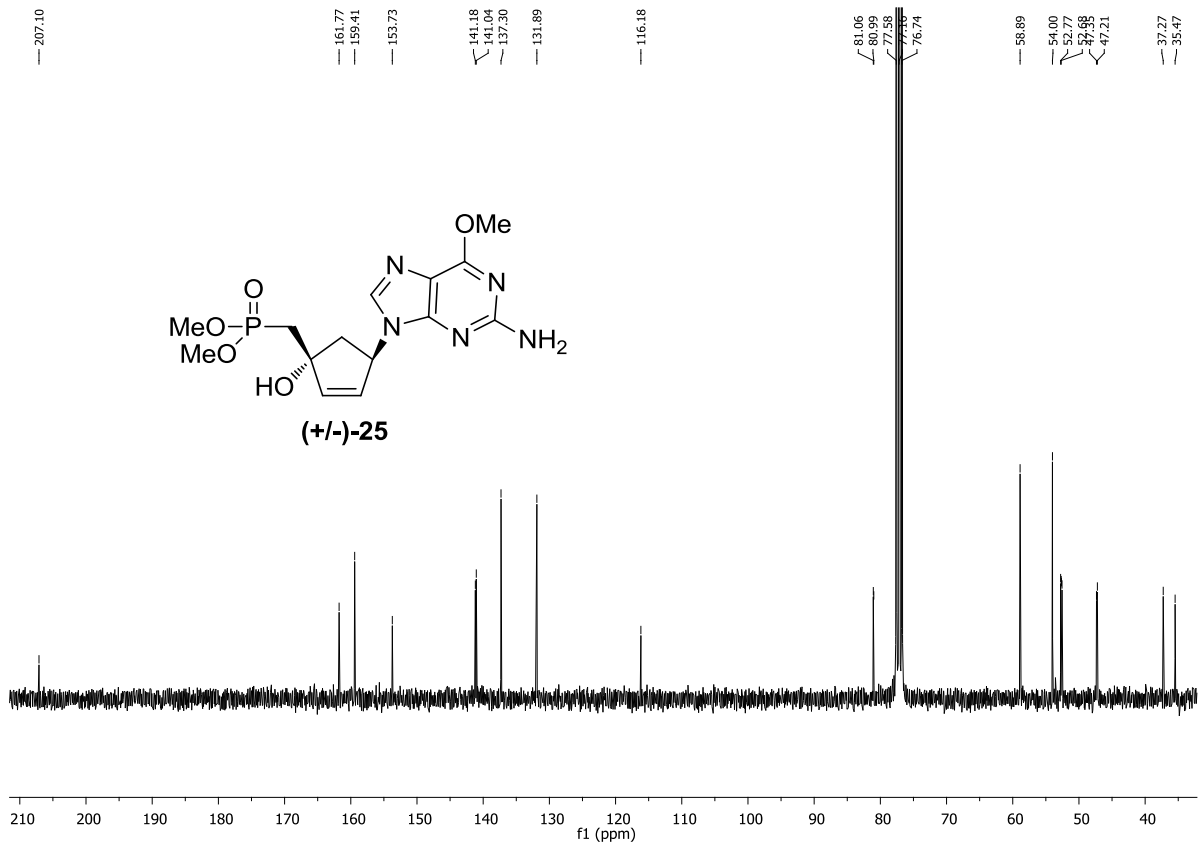
(+/-)-24


154.95
151.65
148.46
140.95
140.83
140.19
131.35
118.58
80.86
59.28
52.95
52.86
46.01
45.93
35.78
33.96
NH2
N
N
N
N
O
MeO–P
MeO
HO
(+/-)-24
160 155 150 145 140 135 130 125 120 115 110 105 100 95 90 85 80 75 70 65 60 55 50 45 40 35 30 25
f1 (ppm)

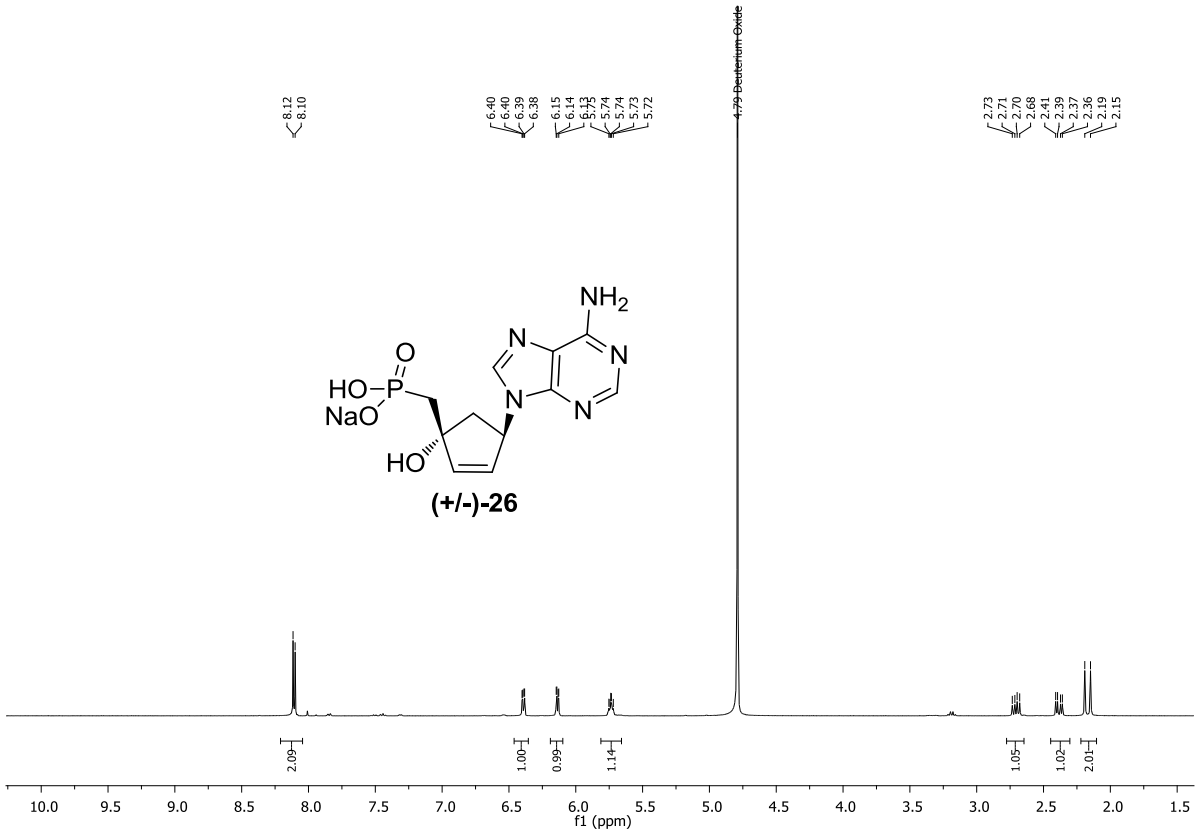

7.55
7.26 Chloroform-d
6.29
6.29
6.27
6.27
6.03
6.02
5.73
5.72
5.71
5.70
5.69
5.29
4.92
4.06
3.80
3.76
3.75
3.72
2.85
2.82
2.80
2.78
2.39
2.39
2.33
2.33
2.22
2.21
2.20
2.16
2.15
OMe
N
N
N
N
NH2
O
MeO–P
MeO
HO
(+/-)-25
1.00
1.00
1.01
1.00
1.89
3.09
6.10
0.99
2.04
0.74
8.0 7.8 7.6 7.4 7.2 7.0 6.8 6.6 6.4 6.2 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 3.0 2.8 2.6 2.4 2.2 2.0 1.8
f1 (ppm)

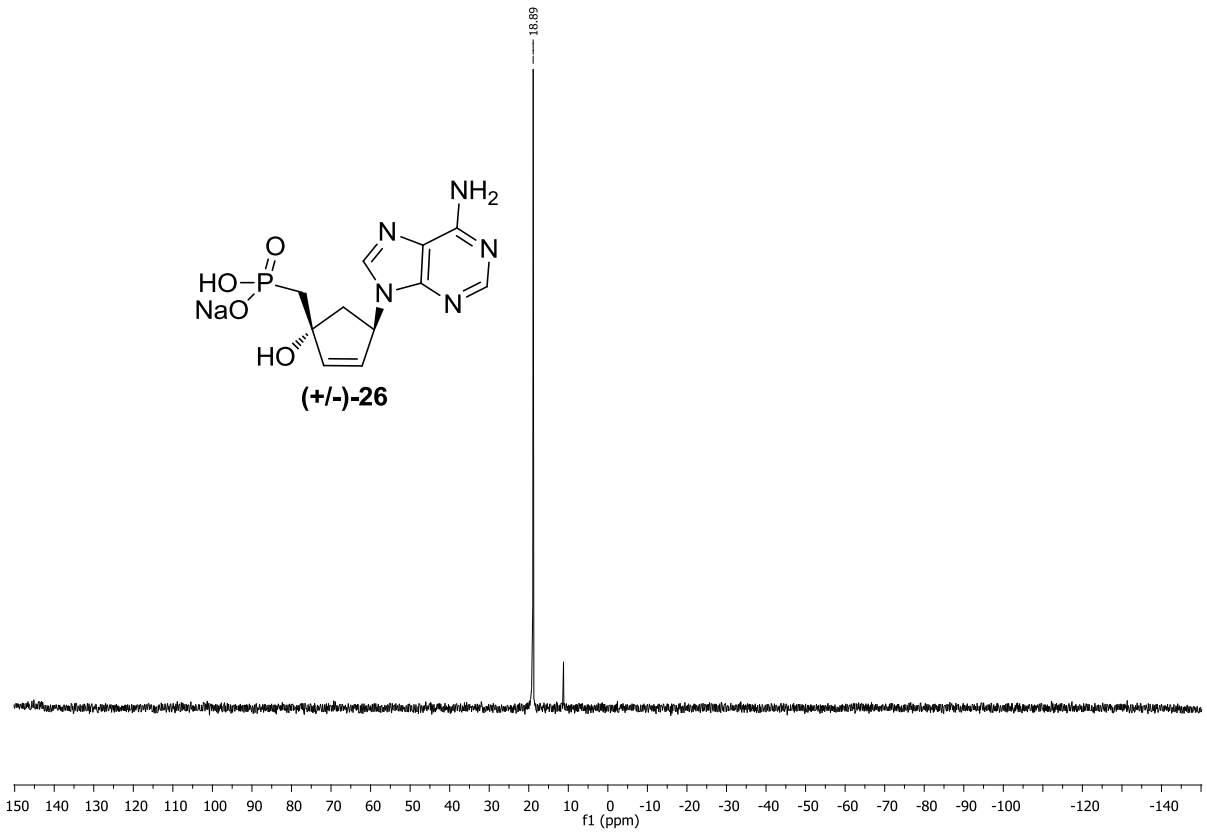

30.91
OMe
N
N
N
N
N
NH2
O
MeO–P
MeO
HO
200 180 160 140 120 100 80 60 40 20 0 -10 -30 -50 -70 -90 -110 -130 -150 -170
f1 (ppm)

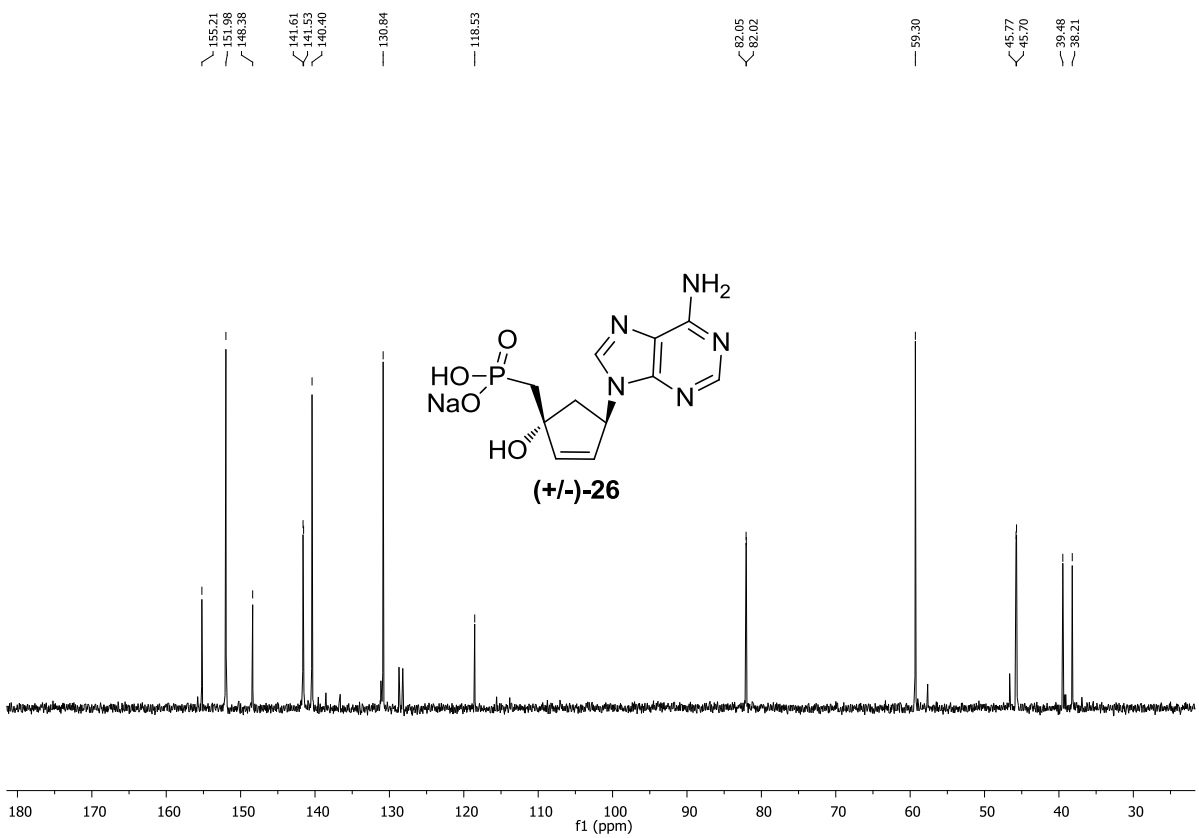
(+/-)-25

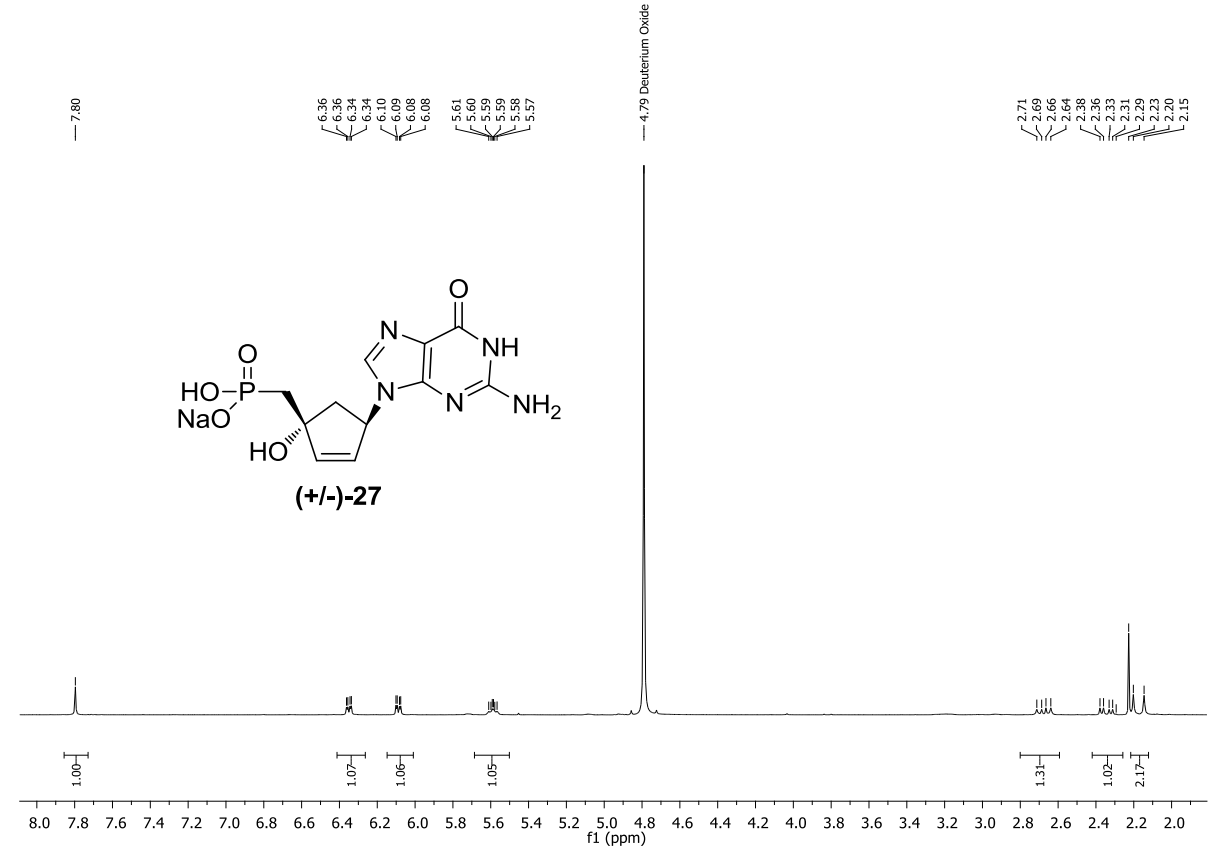

207.10
161.77
159.41
153.73
141.18
141.04
137.30
131.89
116.18
81.06
80.99
77.58
76.74
58.89
54.00
52.77
47.21
37.27
35.47
OMe
N
N
N
N
N
NH2
O
MeO–P
MeO
HO
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40
f1 (ppm)

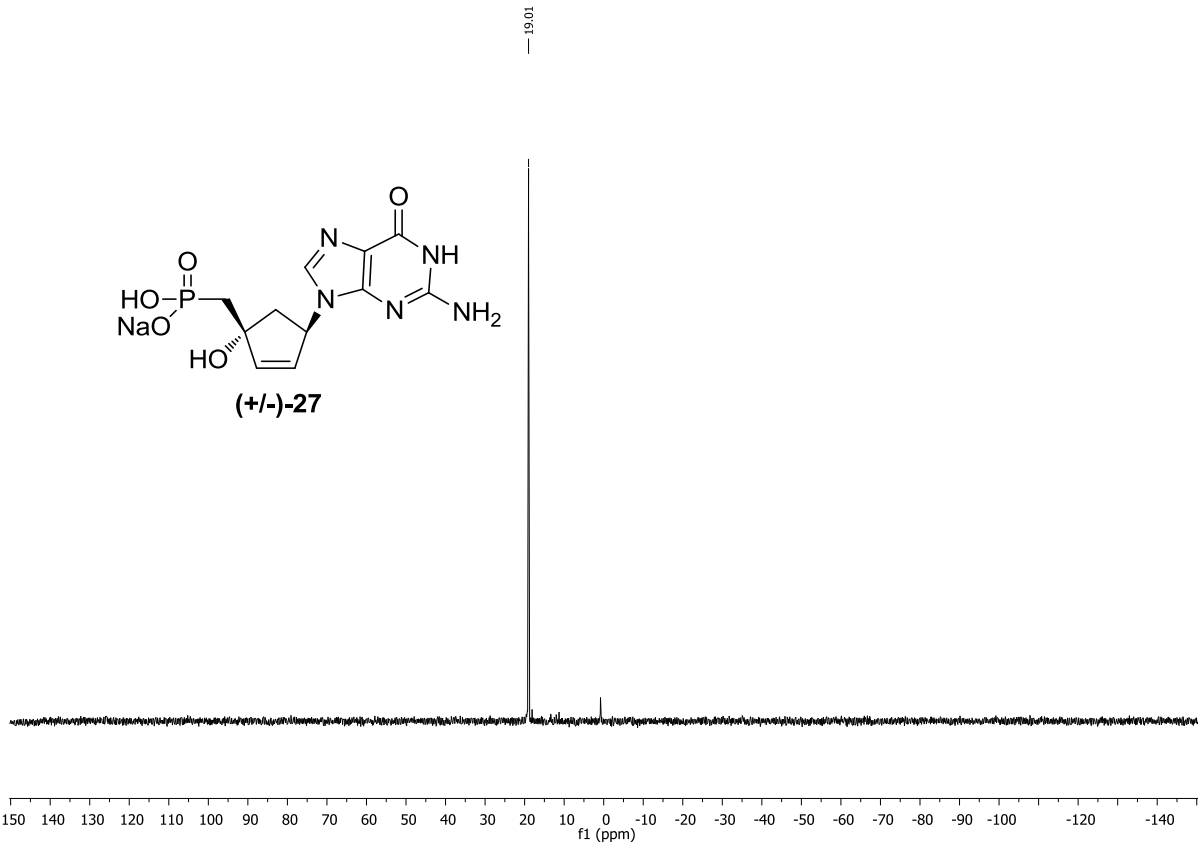
(+/-)-25


8.12
8.10
6.40
6.40
6.39
6.38
6.15
6.14
5.74
5.74
5.73
5.72
4.79 Deuterium Oxide
2.73
2.71
2.70
2.68
2.41
2.39
2.37
2.36
2.19
2.15
NH2
N
N
N
N
HO–P
O
NaO
HO
(+/-)-26
2.09
1.00
0.99
1.14
1.05
1.02
2.01
10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5
f1 (ppm)

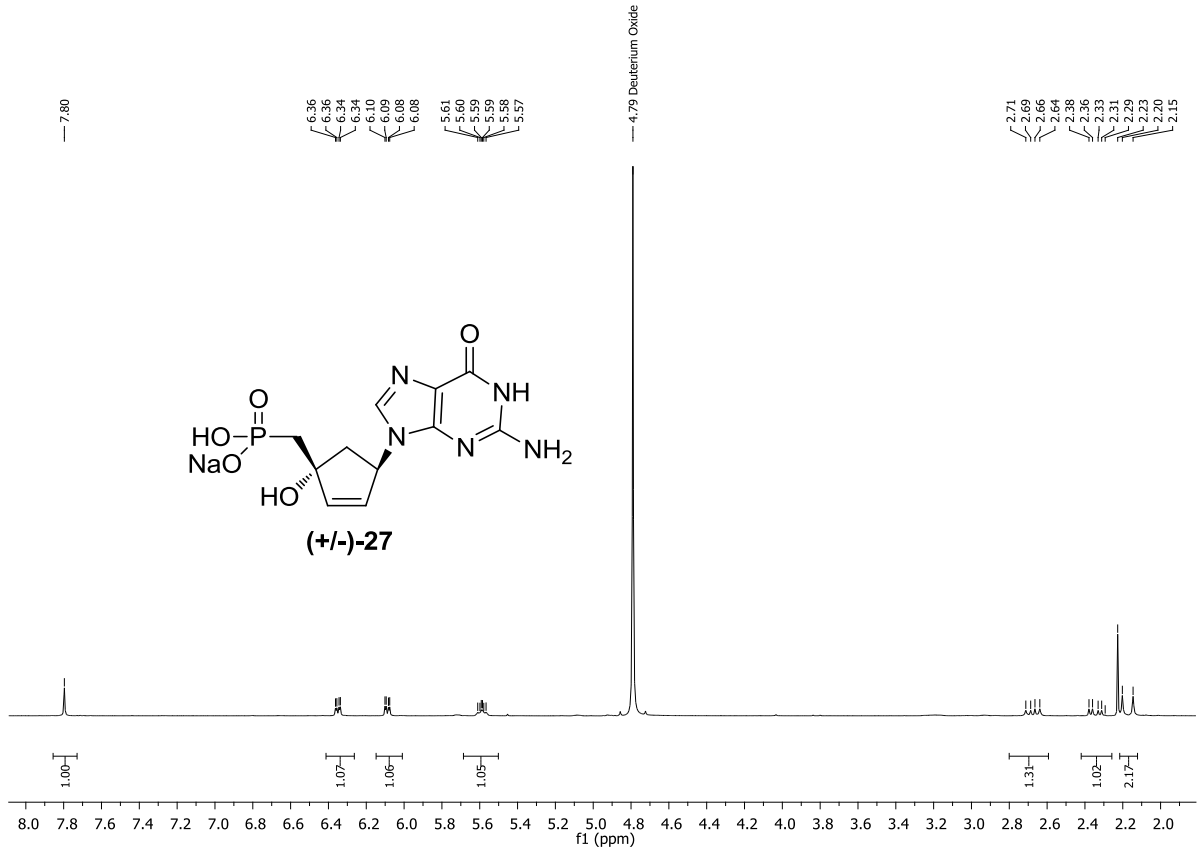

18.89
NH2
N
N
N
N
HO–P
O
NaO
HO
(+/-)-26
150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10 -20 -30 -40 -50 -60 -70 -80 -90 -100 -120 -140
f1 (ppm)


155.21
151.98
148.38
141.61
141.53
140.40
130.84
118.53
82.05
82.02
59.30
45.77
45.70
39.48
38.21
NH2
N
N
N
N
O
HO–P
NaO
HO
(+/-)-26
180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30
f1 (ppm)


7.80
6.36
6.36
6.34
6.34
6.10
6.09
6.08
6.08
5.61
5.60
5.59
5.59
5.58
5.57
4.79 Deuterium Oxide
2.71
2.69
2.66
2.64
2.38
2.36
2.33
2.31
2.29
2.23
2.20
2.15
O
N
NH
N
N
NH2
O
HO–P
NaO
HO
(+/-)-27
1.00
1.07
1.06
1.05
1.31
1.02
2.17
8.0 7.8 7.6 7.4 7.2 7.0 6.8 6.6 6.4 6.2 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 3.0 2.8 2.6 2.4 2.2 2.0
f1 (ppm)


19.01
O
N
NH
HO–P
O
NaO
N
N
NH2
HO
150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10 -20 -30 -40 -50 -60 -70 -80 -90 -100 -120 -140
f1 (ppm)

(+/-)-27


7.80
6.36
6.36
6.34
6.34
6.10
6.09
6.08
6.08
5.61
5.60
5.59
5.59
5.58
5.57
4.79 Deuterium Oxide
2.71
2.69
2.66
2.64
2.38
2.36
2.33
2.31
2.29
2.23
2.20
2.15
O
N
NH
HO–P
O
NaO
N
N
NH2
HO
1.00
1.07
1.06
1.05
1.31
1.02
2.17
8.0 7.8 7.6 7.4 7.2 7.0 6.8 6.6 6.4 6.2 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 3.0 2.8 2.6 2.4 2.2 2.0
f1 (ppm)

(+/-)-27