Total Synthesis of Natural Hyacinthacine C_5, and six related Hyacinthacine C_5 Epimers

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Table S1. Comparison of literature ^{1}H NMR data of (+)-hyacinthacine C_5[S1] (500 MHz, D_2O) with synthetic **7** (Syn) (500 MHz, D_2O)

Proton	δ_H Lit. (ppm)	Lit. Mult., *J*(Hz)	δ_H Syn (ppm)	Syn Mult., *J*(Hz)
1	4.01	t (7.6)	4.14	apparent q (7.7)
2	3.80	t (7.6)	3.94	t (7.8)
3	3.01	m	3.14	td (9.1, 4.7, 4.0)
5	2.81	dq (6.9, 7.6)	2.95	dq (6.6, 7.4)
6	3.60	t (7.6)	3.74	t (7.7)
7	3.99	t (7.6)	4.14	apparent q (7.7)
7a	3.24	t (7.6)	3.38	t (7.6)
8α/β	3.55 3.50	dd (4.1, 12.0) dd (5.3, 12.0)	3.66	dd (9.5, 4.7)
9	1.13	d (6.9)	1.27	d (6.7)

Table S2. Comparison of literature ^{13}C NMR data of (+)-hyacinthacine C_5[S1] (500 MHz, D_2O) with synthetic **7** (125 MHz, D_2O)

Carbon	δ_C Lit. (ppm)	Synthetic **7** δ_C (ppm)	$\Delta\ \delta_C$
1	78.2	75.2	3.0
2	81.0	78.1	2.9
3	65.1	62.1	3.0
5	61.4	58.4	3.0
6	81.7	78.8	2.9
7	77.8	74.8	3.0
7a	69.2	66.3	2.9
8	65.7	62.8	2.9
9	15.7	12.8	2.9

Table S3. Comparison of literature ^{1}H NMR data of Yu *et al* Lit. (–)-7-*epi*-hyacinthacine C_5[S2] (600 MHz, D_2O) with synthetic (–)-5,6-di-*epi*-hyacinthacine C_5 **11** (Syn) (500 MHz, D_2O)

Proton	δ_H Lit. (ppm)	Lit. Mult., *J*(Hz)	δ_H Syn (ppm)	Syn Mult., *J*(Hz)
1	4.42	t (7.2)	4.33	t (7.4)
2	3.97	t (7.8)	3.89	t (8.7)
3	2.92-3.12	m	2.78	dt (4.3, 9.1)
5	2.92-3.12	m	2.84	dq (6.4, 12.7)
6	3.85-3.78	m	3.76-3.68	m
7	4.24	t (3.6)	4.13	t (4.1)
7a	3.52-3.45	m	3.26	dt (2.8, 5.7)
8α/β	3.74 3.85-3.78	dd (4.2, 12.6) m	3.65 3.76-3.68	dd (4.7, 11.9) m
9	1.31	d (6.0)	1.20	t (6.2)

Table S4. Comparison of literature ^{13}C NMR data of Yu *et al* Lit. (–)-7-*epi*-hyacinthacine C_5[S2] (75 MHz, D_2O) with synthetic (–)-5,6-di-*epi*-hyacinthacine C_5 **11** (125 MHz, D_2O)

Carbon	δ_C Lit. (ppm)	Synthetic **11** δ_C (ppm)	$\Delta\ \delta_C$
1	73.0	73.8	0.8
2	77.7	78.7	1.0
3	71.0	71.5	0.5
5	63.5	64.0	0.5
6	79.0	79.8	0.8
7	70.0	70.6	0.6
7a	68.2	68.6	0.4
8	60.8	62.2	1.4
9	17.2	18.3	1.1

Table S5. Comparison of literature ^{1}H NMR data of Tamayo *et al* Lit. (+)-hyacinthacine C_5[S3] (500 MHz, D_2O) with synthetic **6** (Syn) (500 MHz, D_2O)

Proton	δ_H Lit. (ppm)	Lit. Mult., *J*(Hz)	δ_H Syn (ppm)	Syn Mult., *J*(Hz)
1	4.19	t (6.9)	4.15	t (7.0)
2	3.99	t (6.9)	3.96	t (7.0)
3	2.97 – 2.93	m	2.96 – 2.87	m
5	2.97 – 2.93	m	2.96 – 2.87	m
6	3.72-3.66	m	3.74 – 3.61	m
7	4.15	t (6.9)	4.11	t (7.1)
7a	3.08	t	3.05	t (6.8)
8α/β	3.72-3.66	m	3.74 – 3.61	m
9	1.24	d (6.3)	1.20	d (6.2)

Table S6. Comparison of literature ^{13}C NMR data of Tamayo *et al* Lit. (+)-hyacinthacine C_5[S3] (125 MHz, D_2O) with synthetic **6** (125 MHz, D_2O)

Carbon	δ_C Lit. (ppm)	Synthetic **6** δ_C (ppm)	$\Delta\ \delta_C$
1	79.6	80.2	0.6
2	78.7	79.3	0.6
3	65.3	66.0	0.7
5	70.4	71.1	0.7
6	82.3	82.9	0.6
7	79.0	79.6	0.6
7a	70.5	71.2	0.7
8	62.2	62.9	0.7
9	17.2	17.8	0.6

Table S7. Comparison of literature ^{1}H NMR data of Tamayo *et al* synthetic 6,7-di-*epi*-hyacinthacine C_5[S3] (400 MHz, D_2O) with synthetic (+)-5-*epi*-hyacinthacine C_5 **12** (Syn) (500 MHz, D_2O)

Proton	δ_H Lit. (ppm)	Lit. Mult., *J*(Hz)	δ_H Syn (ppm)	Syn Mult., *J*(Hz)
1	4.31	t (7.5)	4.28	t (7.5)
2	3.99	t (7.5)	3.96	t (8.4)
3	2.81	m	2.78	dd (4.6, 9.3)
5	3.16	m	3.14	q (4.9, 6.1)
6	4.15	m	4.13	dd (2.4, 4.2)
7	4.24	m	4.21	dd (2.4, 4.7)
7a	3.49	m	3.46	dd (4.6, 7.2)
8α/β	3.71 3.80	dd (4.7) dd (4.0, 11.9)	3.68 3.78	dd (4.6, 12.0) dd (4.0, 12.3)
9	1.19	d (6.7)	1.17	d (6.9)

Table S8. Comparison of literature ^{13}C NMR data of Tamayo *et al* synthetic 6,7-di-*epi*-hyacinthacine C_5[S3] (400 MHz, D_2O) with synthetic (+)-5-*epi*-hyacinthacine C_5 **12** (125 MHz, D_2O)

Carbon	δ_C Lit. (ppm)	Synthetic **6** δ_C (ppm)	$\Delta\ \delta_C$
1	73.1	75.6	2.5
2	78.7	81.2	2.5
3	70.6	73.1	2.5
5	62.7	65.2	2.5
6	79.7	82.2	2.5
7	74.3	76.8	2.5
7a	69.1	71.6	2.5
8	61.6	64.2	2.6
9	14	16.5	2.5

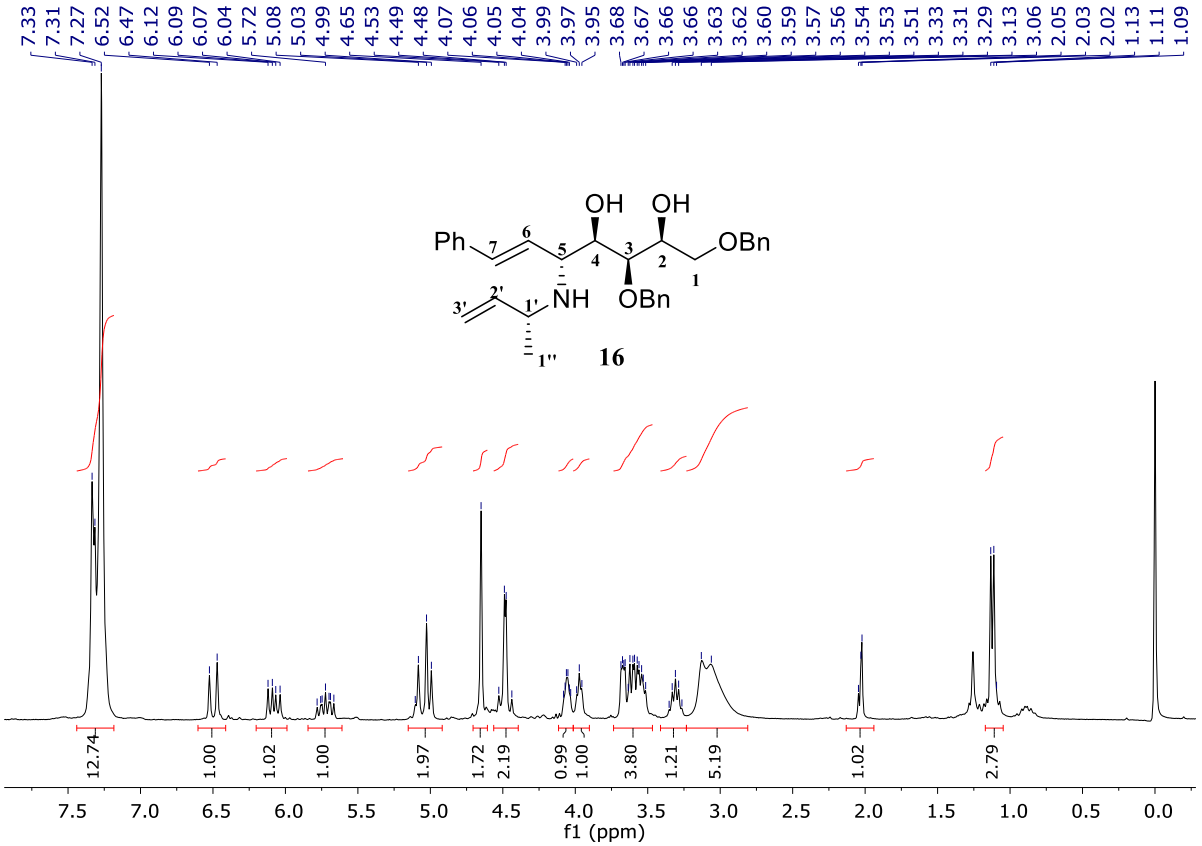


Figure S1: ^{1}H NMR spectrum (500 MHz, $CDCl_3$) of **16**

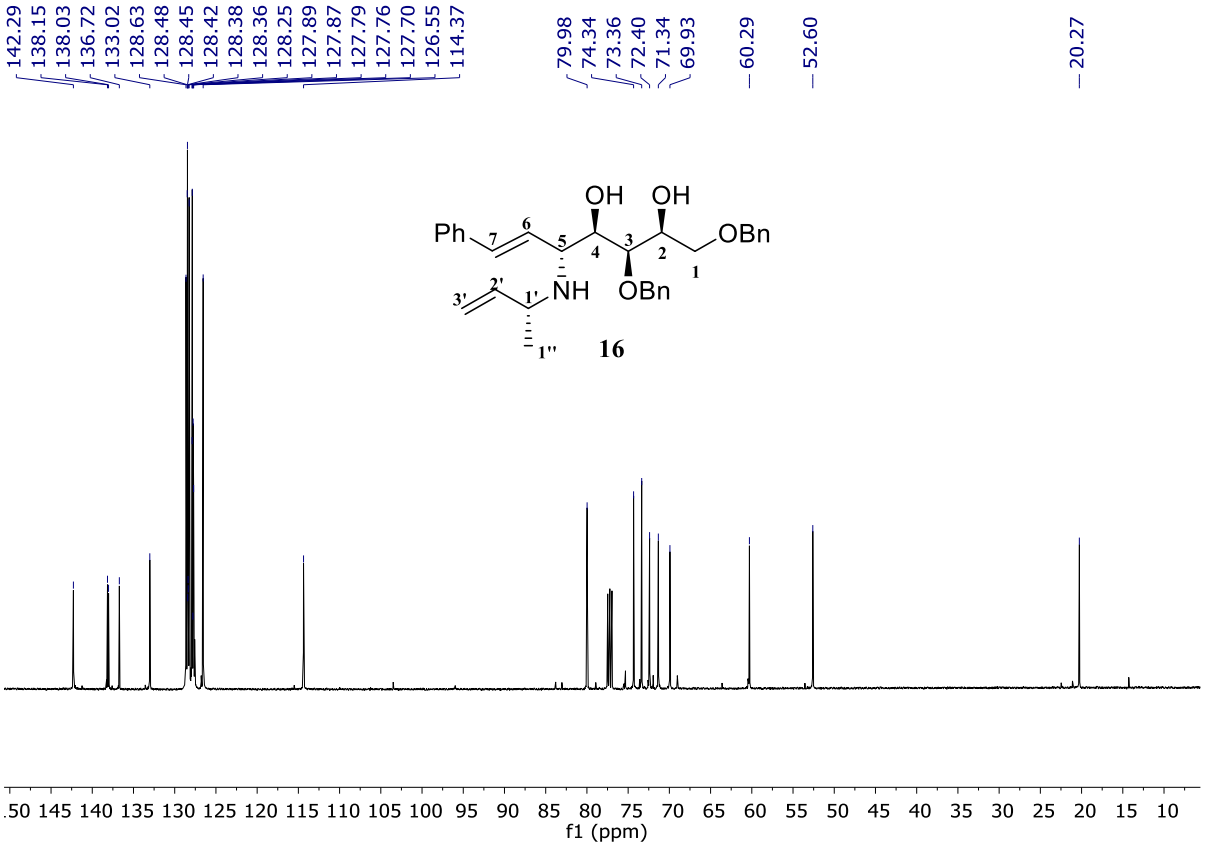


Figure S2: ^{13}C NMR spectrum (125 MHz, $CDCl_3$) of **16**

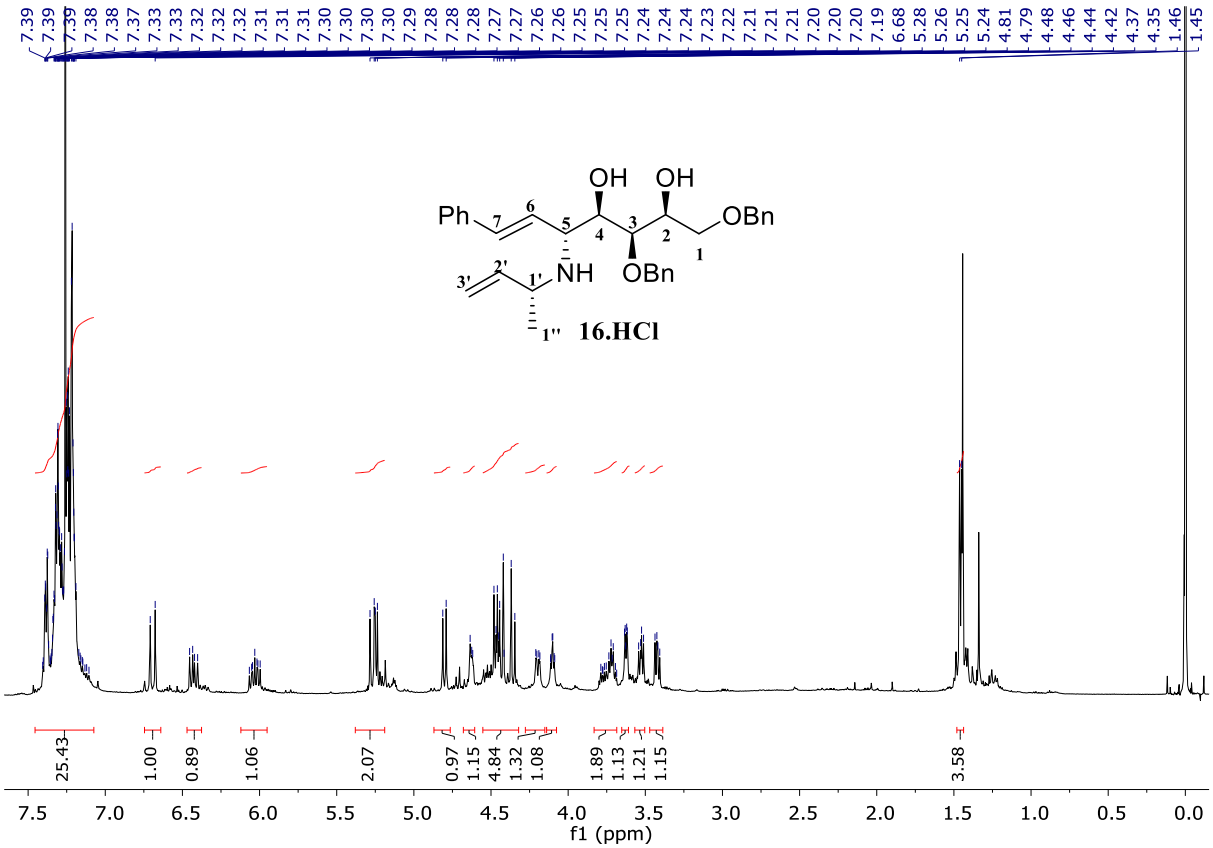


Figure S3: ^{1}H NMR spectrum (500 MHz, $CDCl_3$) of **16.HCl**

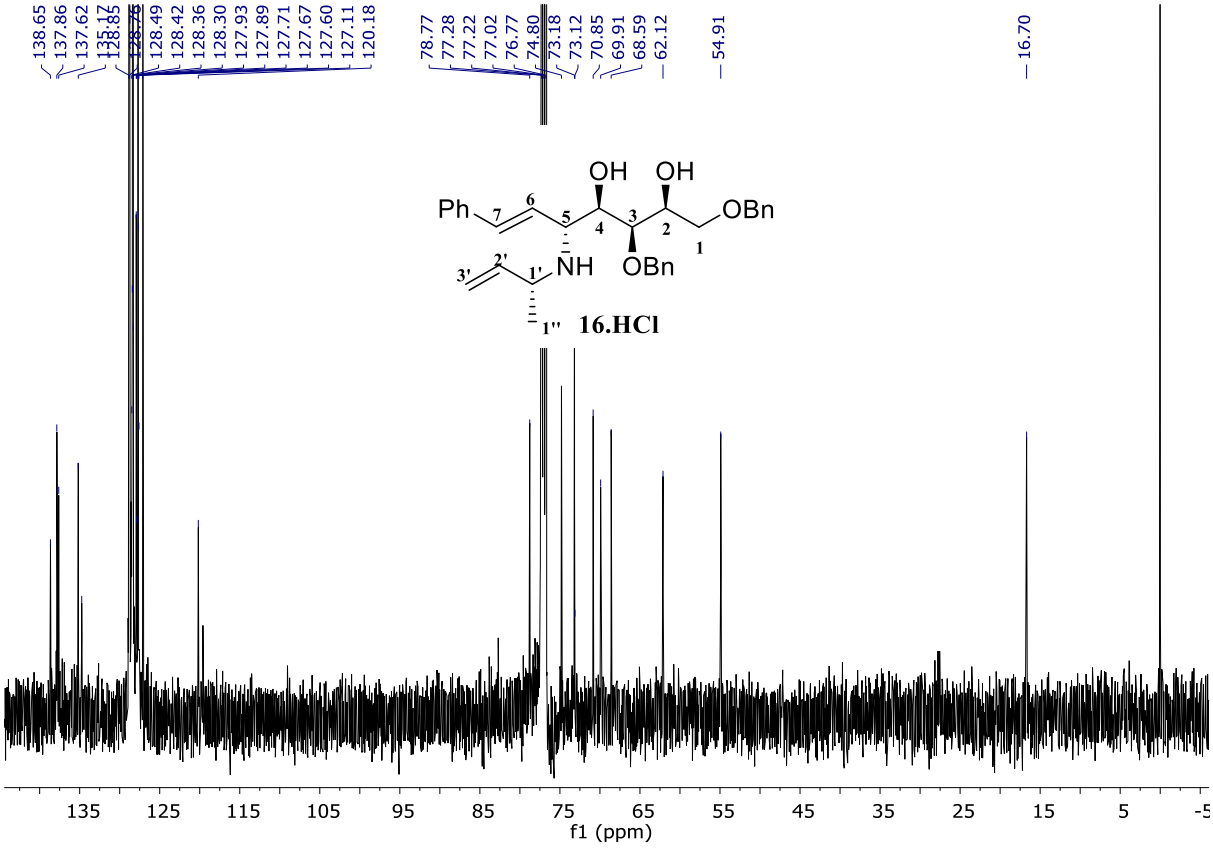


Figure S4: ^{13}C NMR spectrum (125 MHz, $CDCl_3$) of **16.HCl**

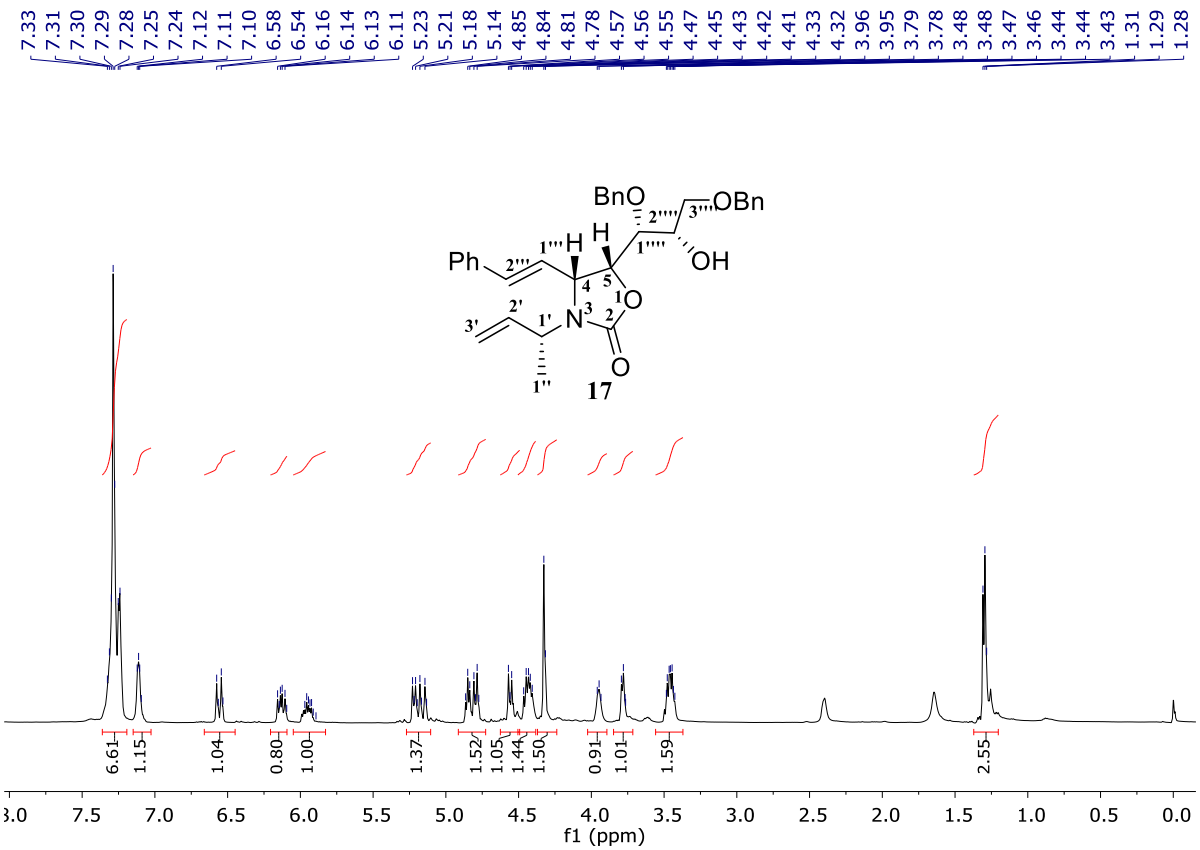


Figure S5: ^{1}H NMR spectrum (500 MHz, $CDCl_3$) of **17** (Experimental: *Procedure A*)

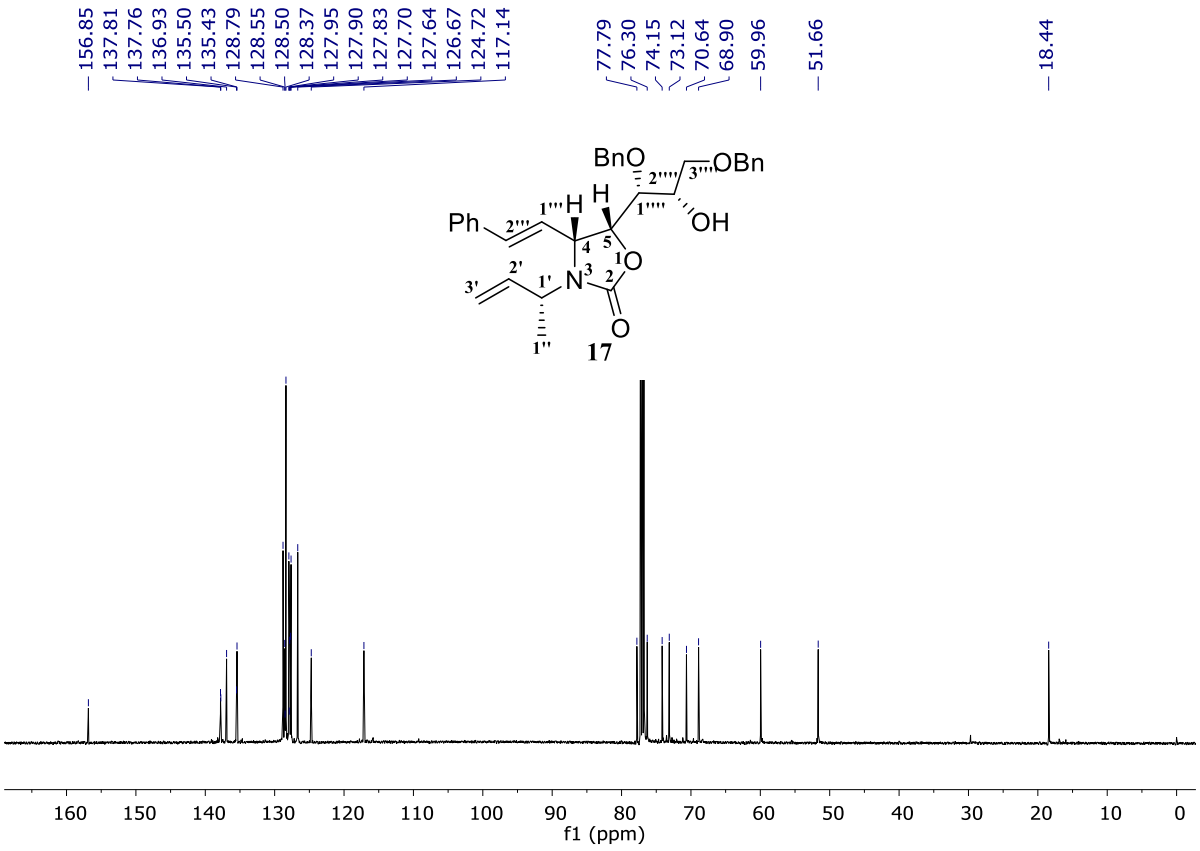


Figure S6: ^{13}C NMR spectrum (125 MHz, $CDCl_3$) of **17**

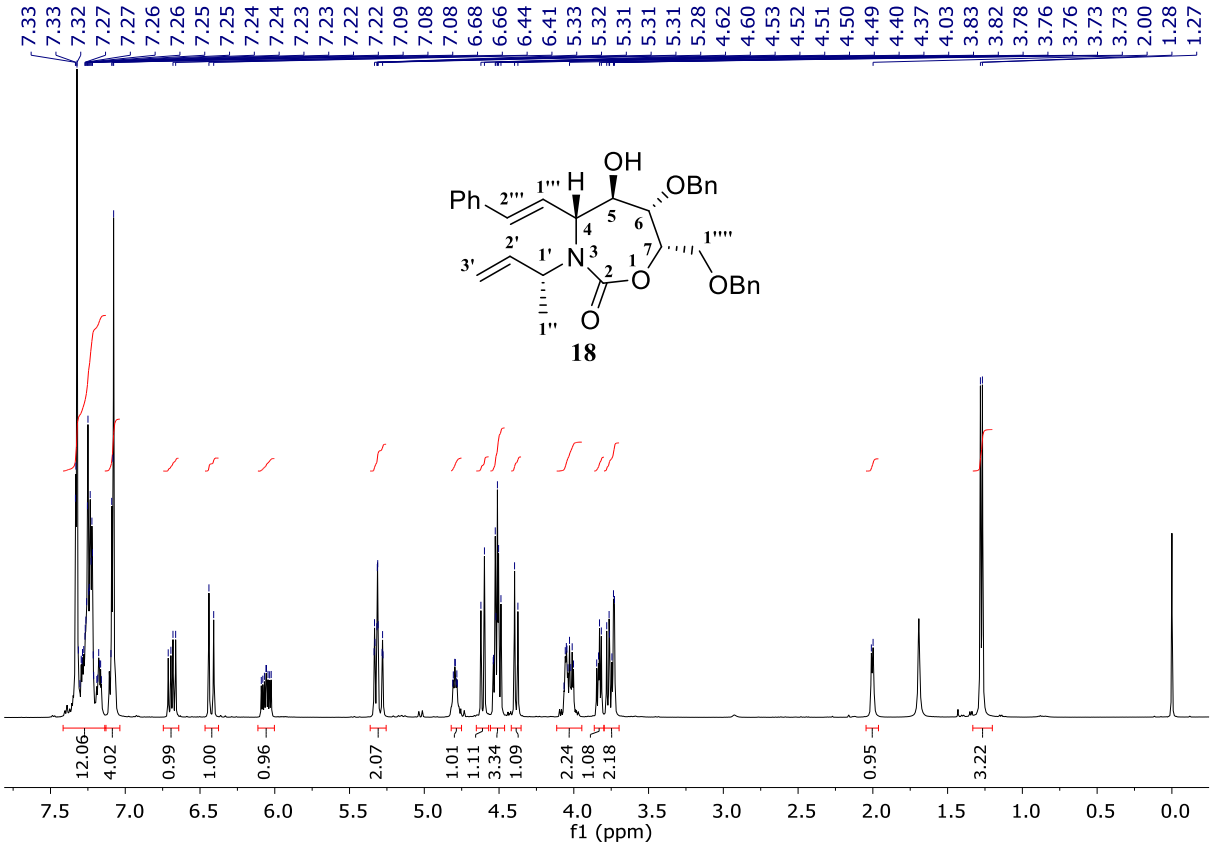


Figure S7: ^{1}H NMR spectrum (500 MHz, $CDCl_3$) of **18**

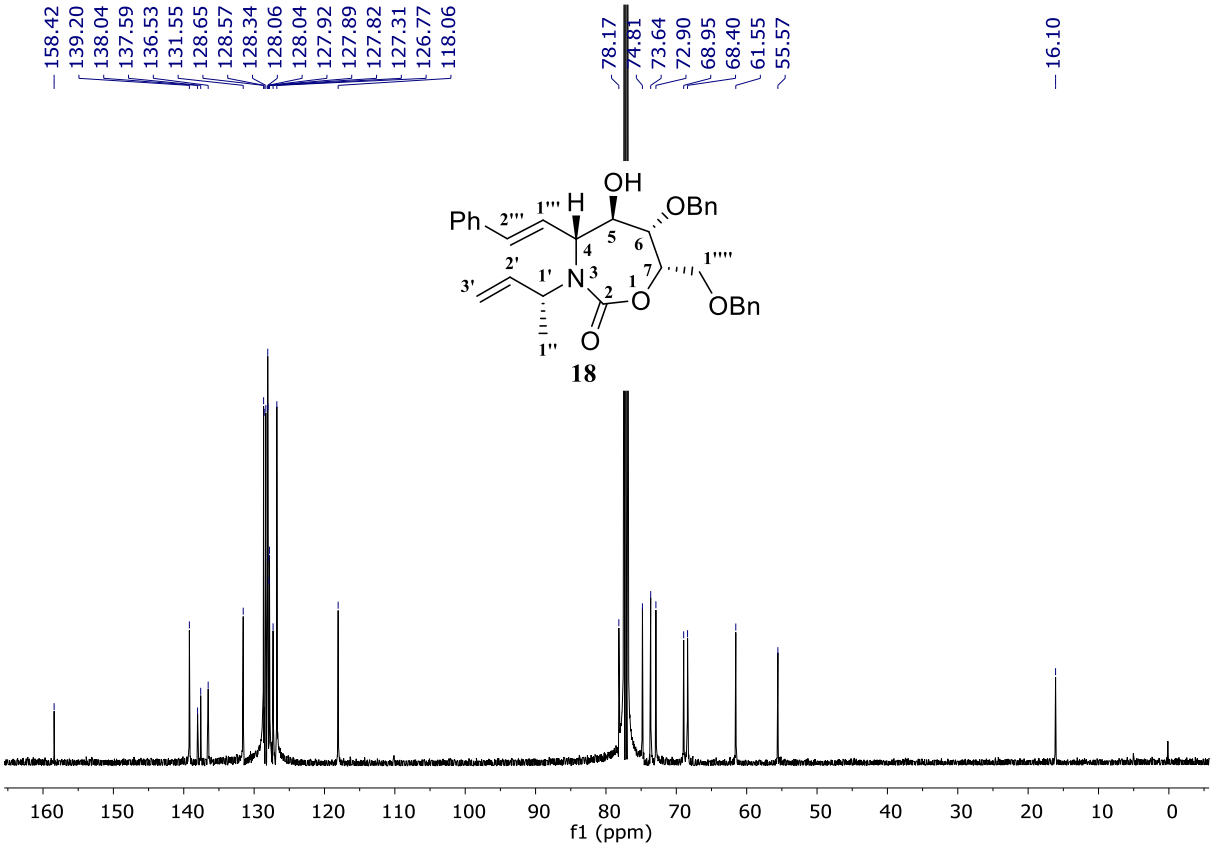


Figure S8: ^{13}C NMR spectrum (125 MHz, $CDCl_3$) of **18**

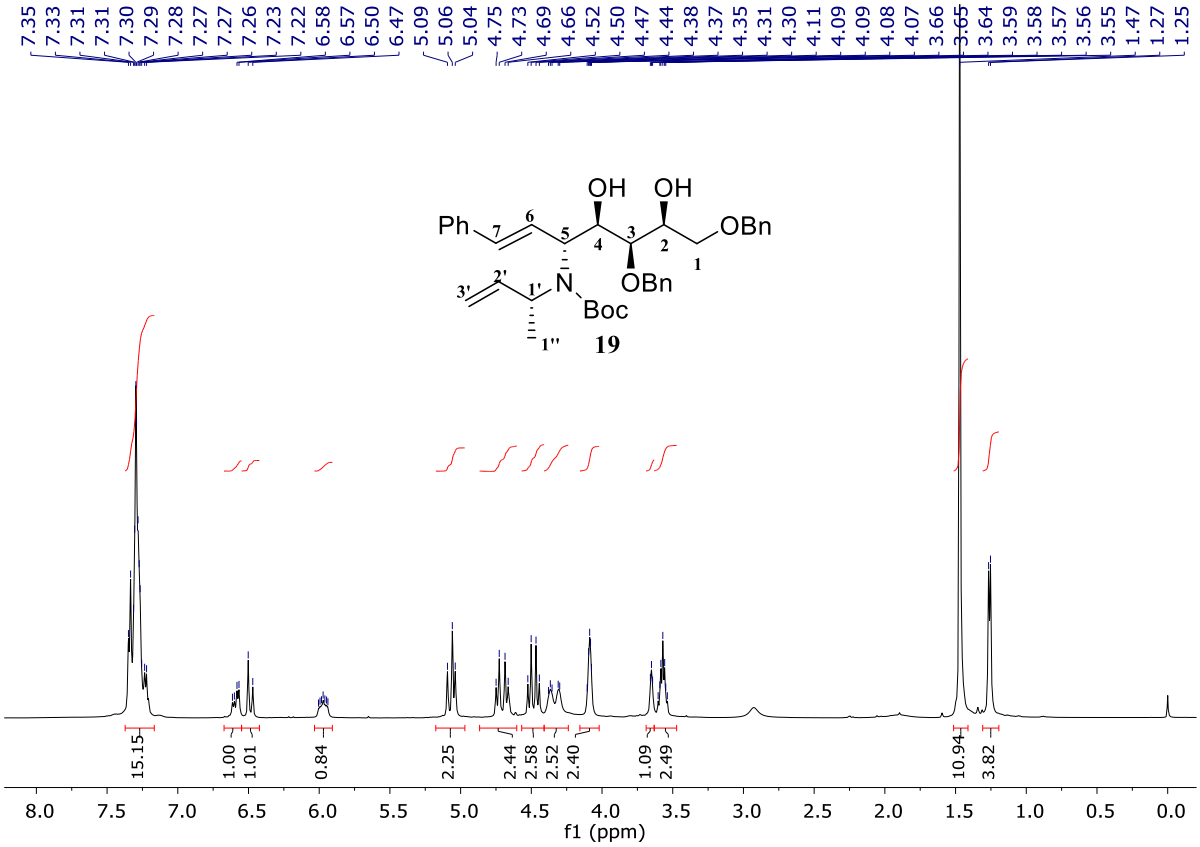


Figure S9: ^{1}H NMR spectrum (500 MHz, CDCl3) of **19**

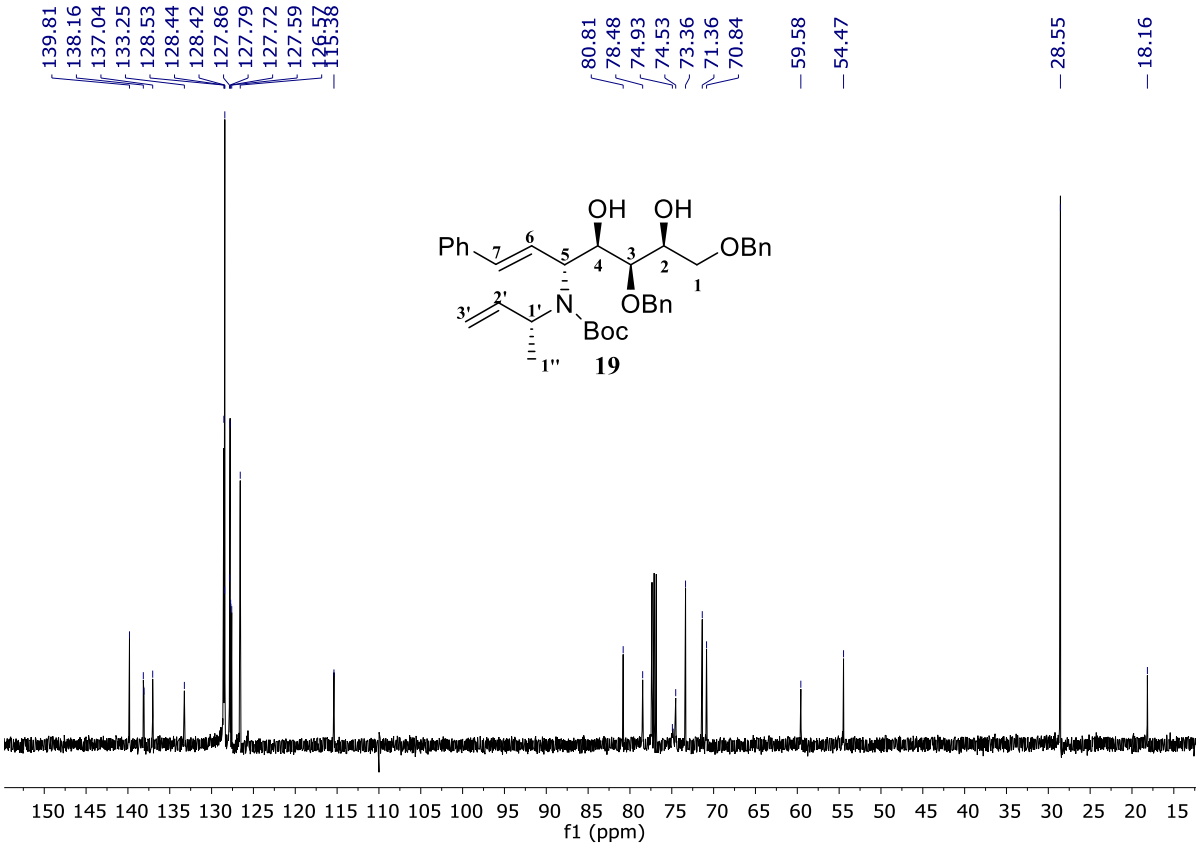


Figure S10: ^{13}C NMR spectrum (125 MHz, $CDCl_3$) of **19**

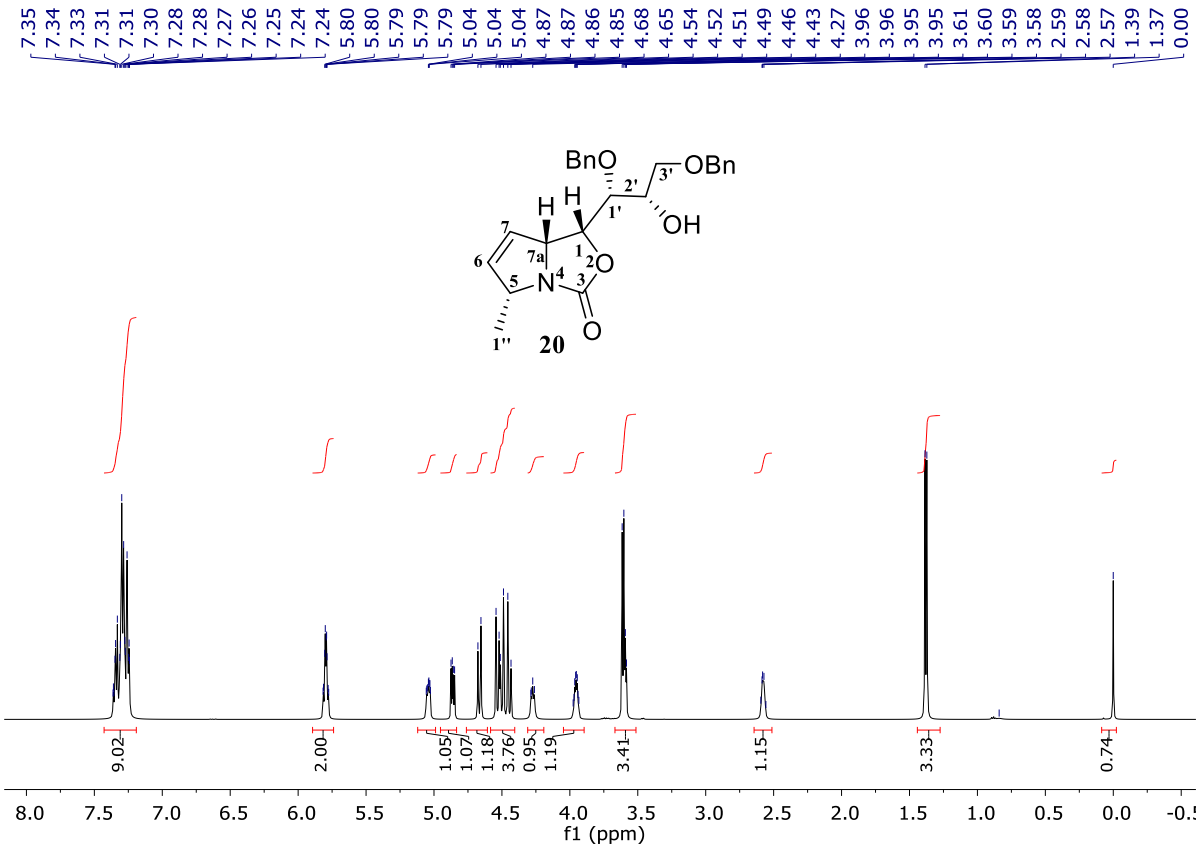


Figure S11: ^{1}H NMR spectrum (500 MHz, $CDCl_3$) of **20**

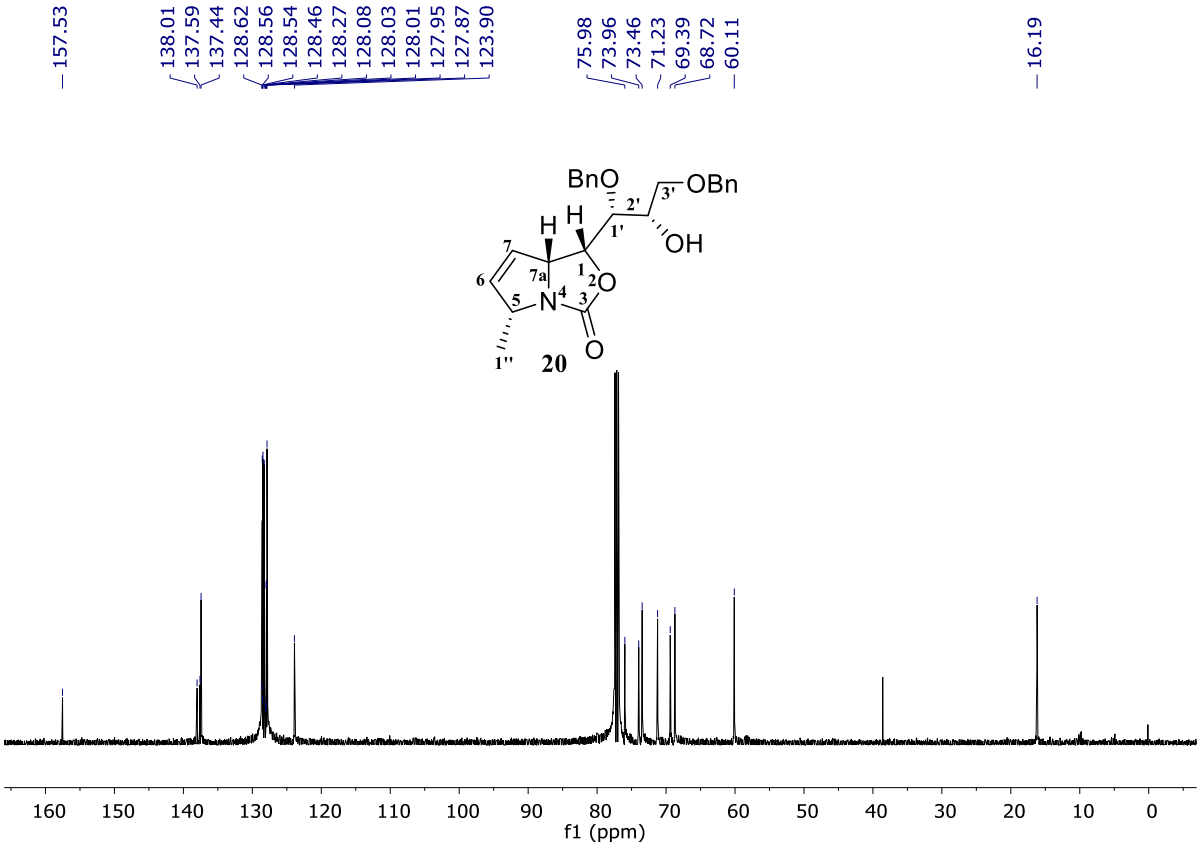


Figure S12: ^{13}C NMR spectrum (125 MHz, $CDCl_3$) of **20**

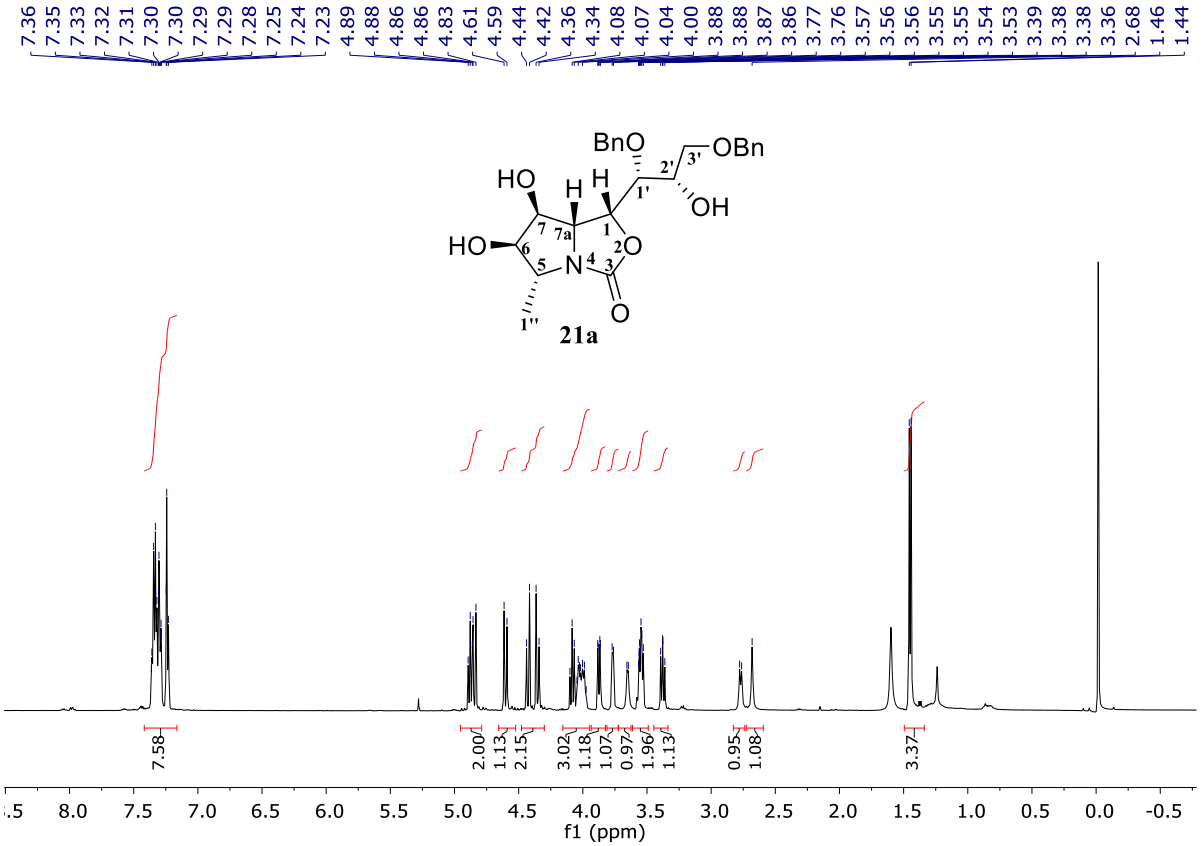


Figure S13: ^{1}H NMR spectrum (500 MHz, $CDCl_3$) of **21a**

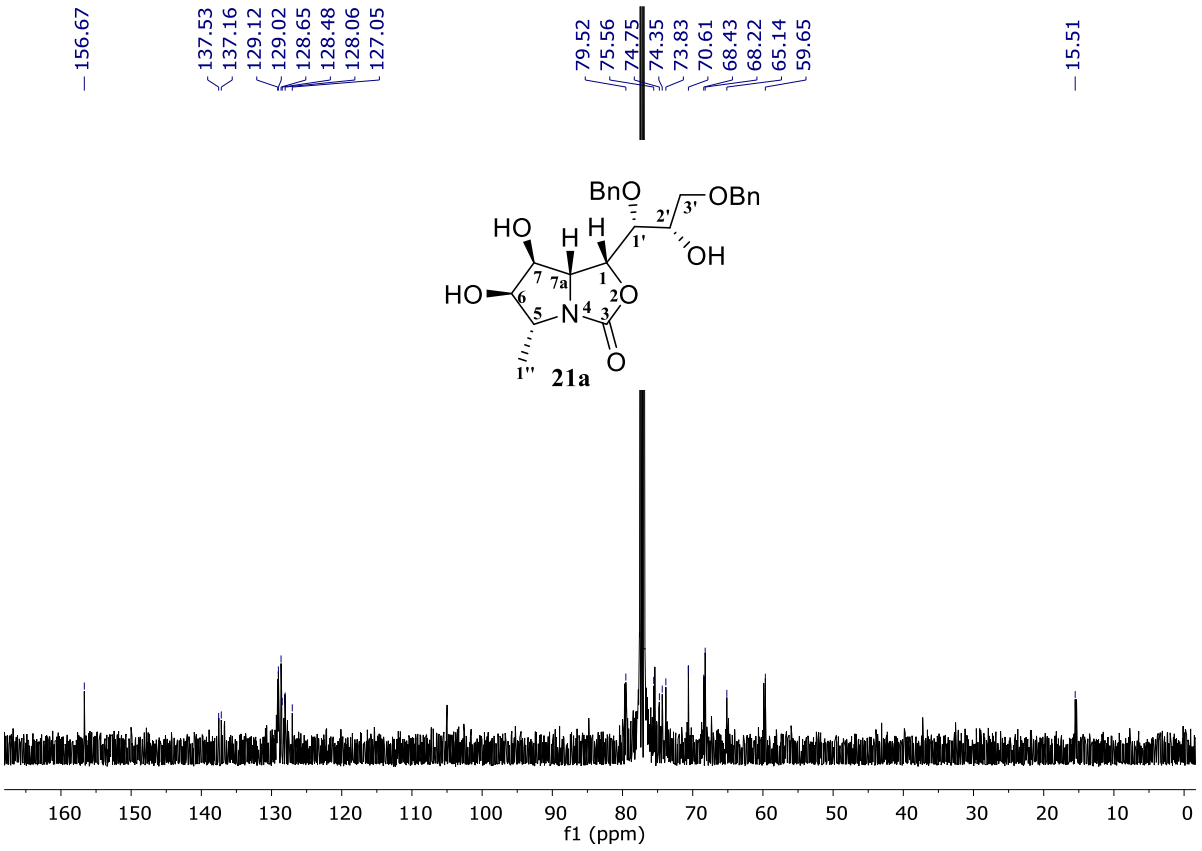


Figure S14: ^{13}C NMR spectrum (125 MHz, $CDCl_3$) of **21a**

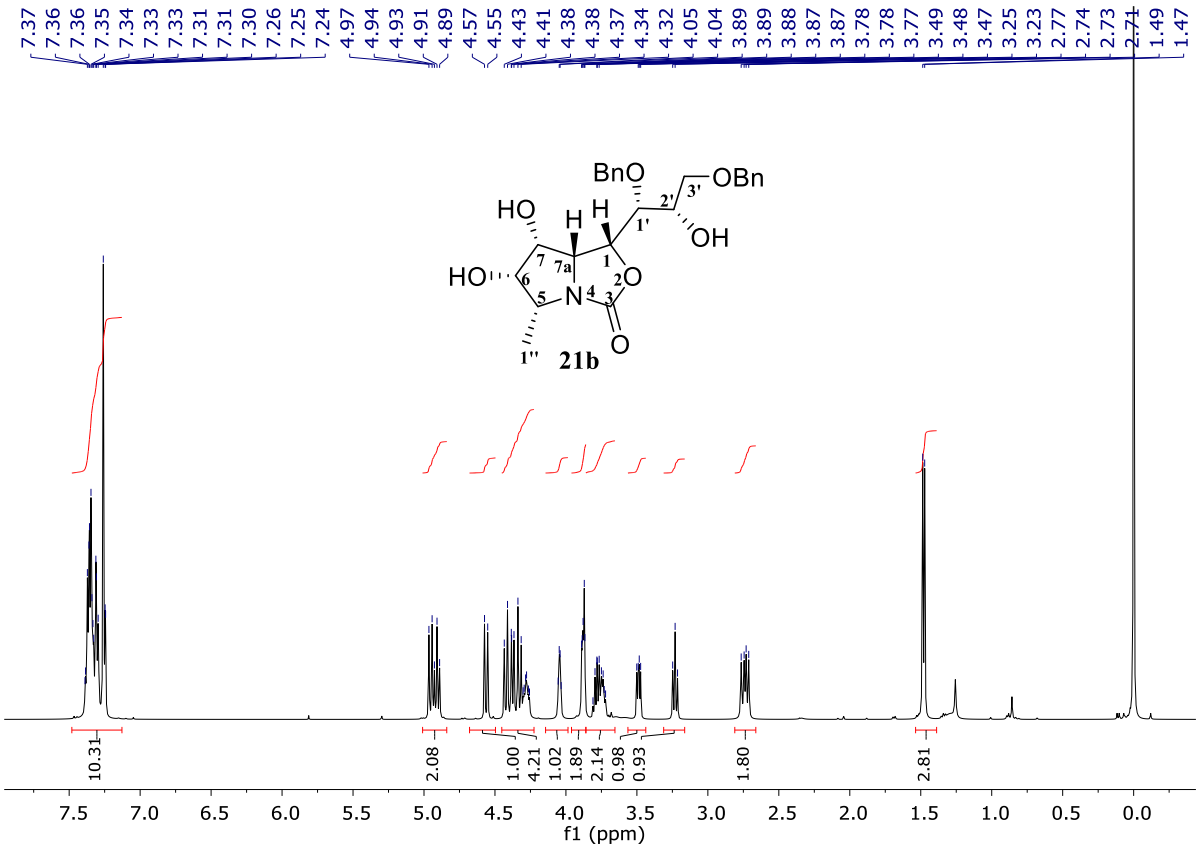


Figure S15: ^{1}H NMR spectrum (500 MHz, $CDCl_3$) of **21b**

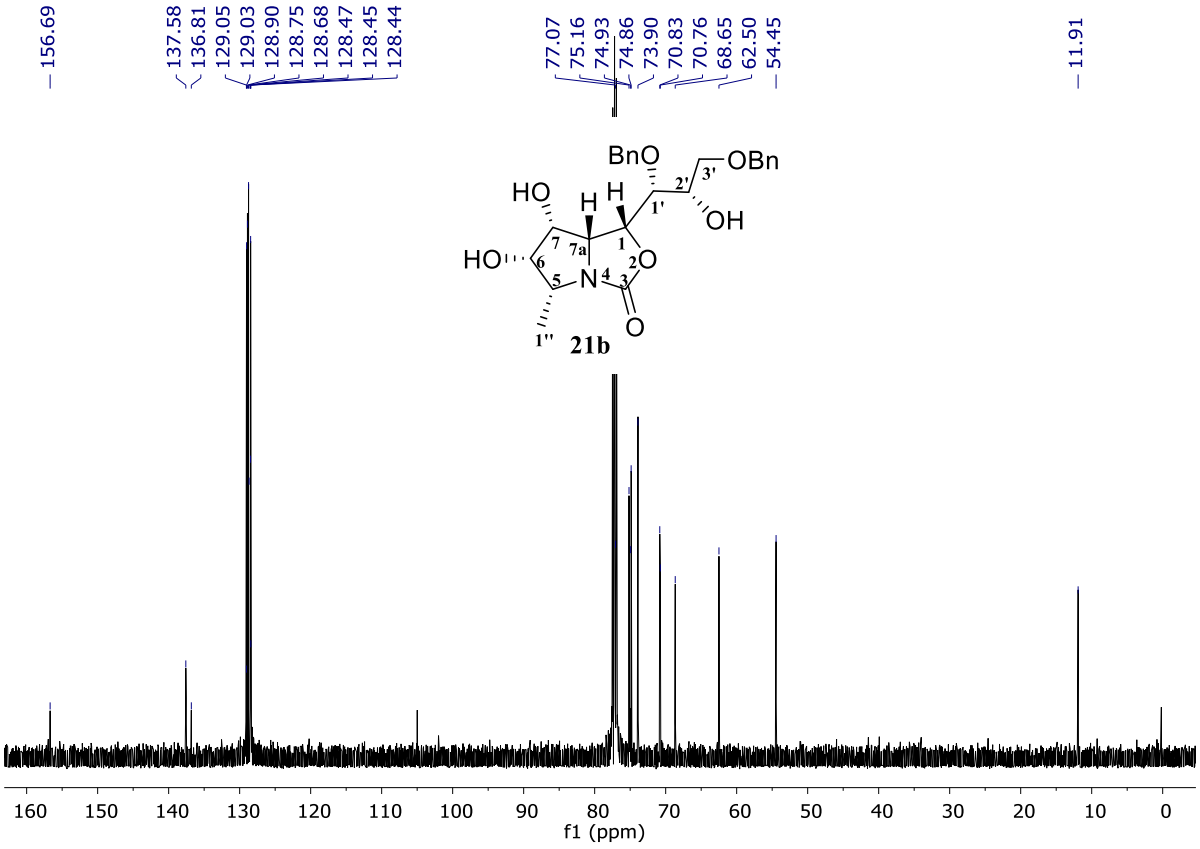


Figure S16: ^{13}C NMR spectrum (125 MHz, $CDCl_3$) of **21b**

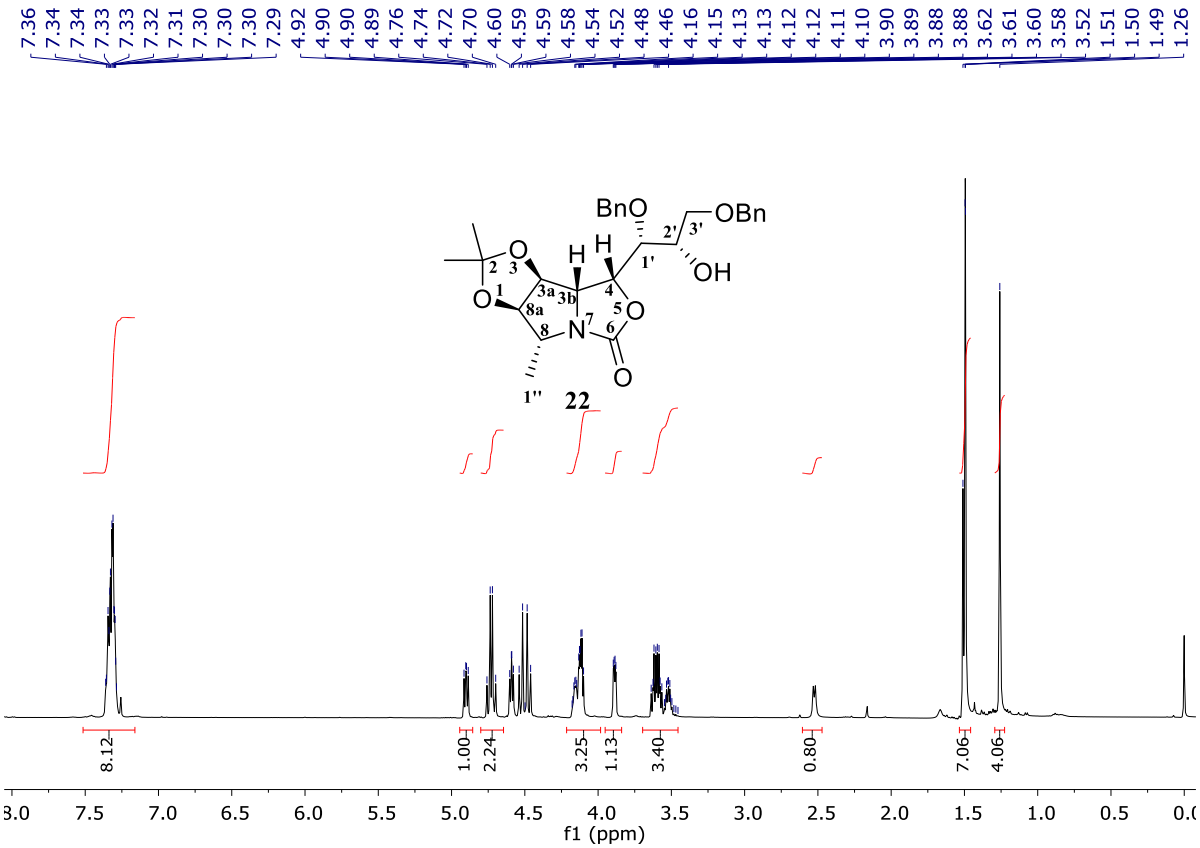


Figure S17: ^{1}H NMR spectrum (500 MHz, $CDCl_3$) of **22**

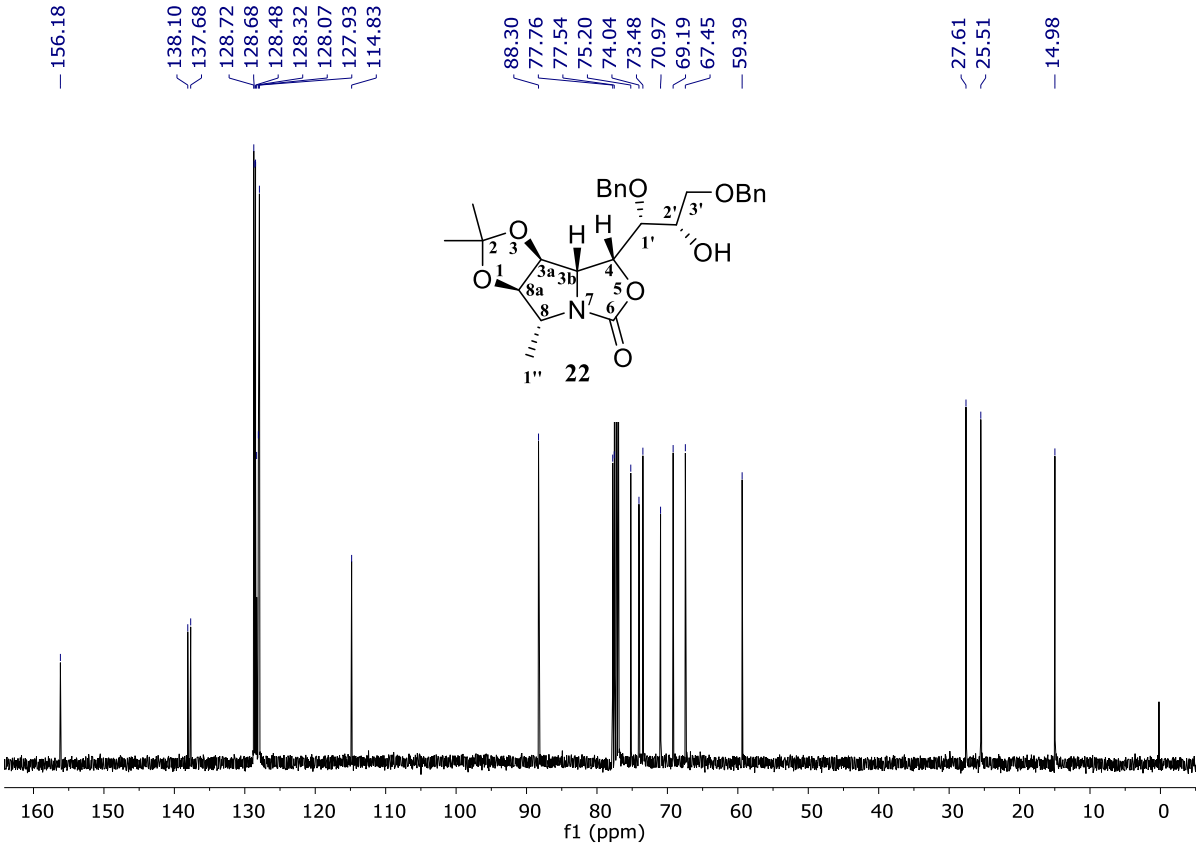


Figure S18: ^{13}C NMR spectrum (125 MHz, $CDCl_3$) of **22**

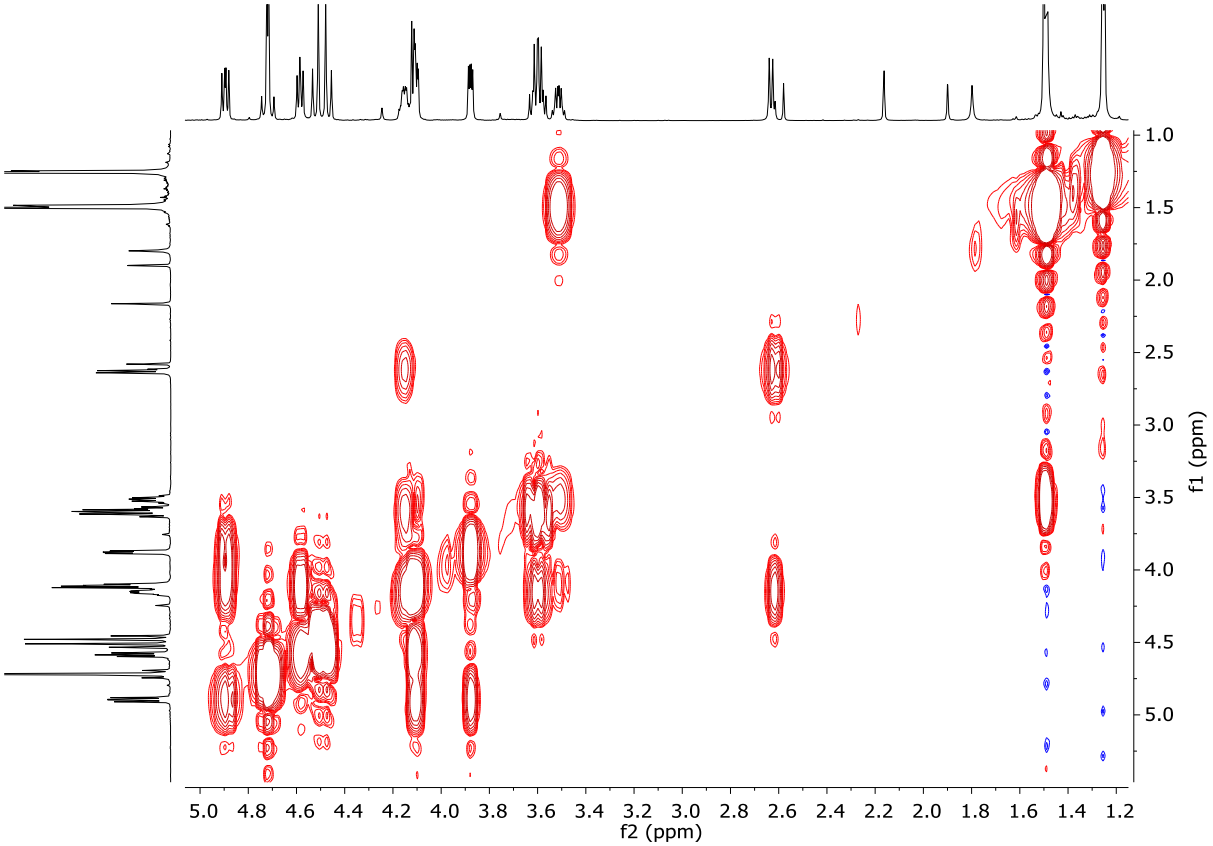


Figure S19: gCOSY spectrum (500 MHz, $CDCl_3$) of **22**

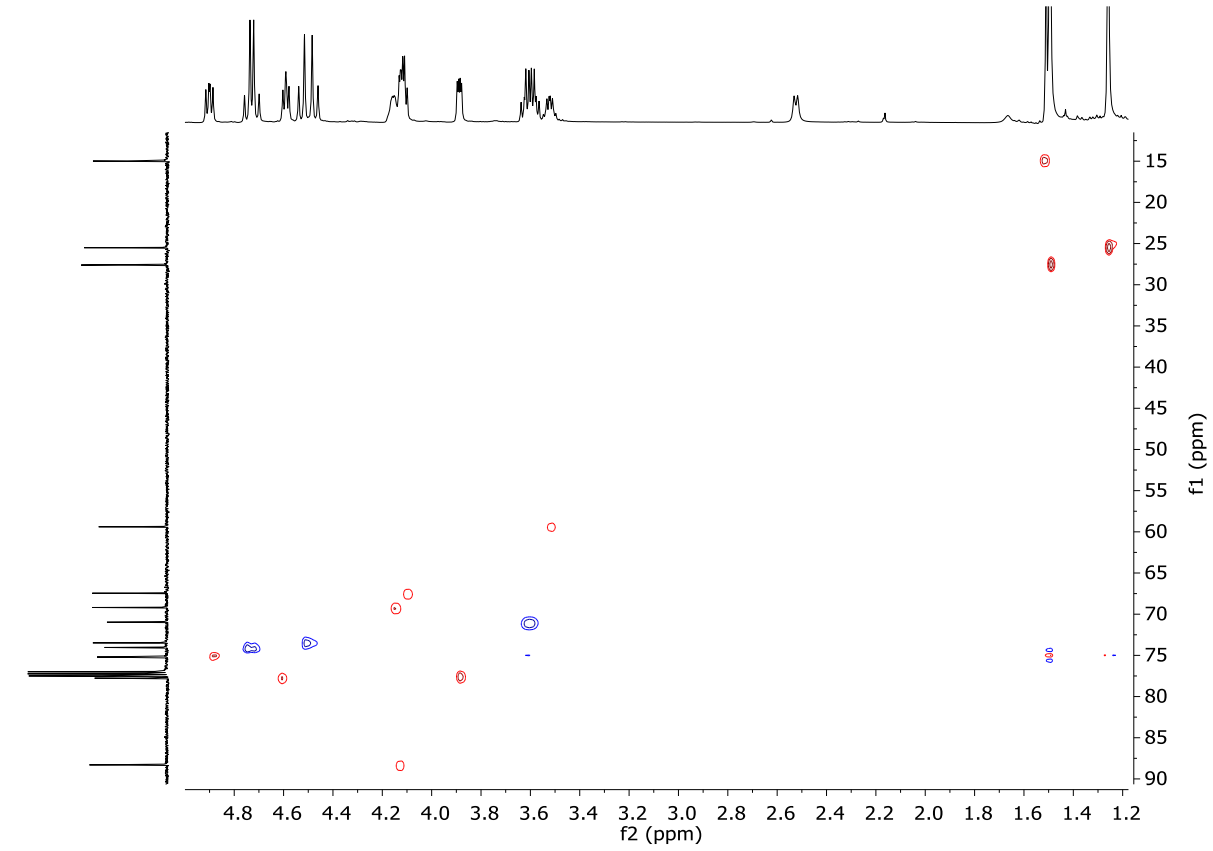


Figure S20: gHSQC spectrum (500 MHz, $CDCl_3$) of **22**

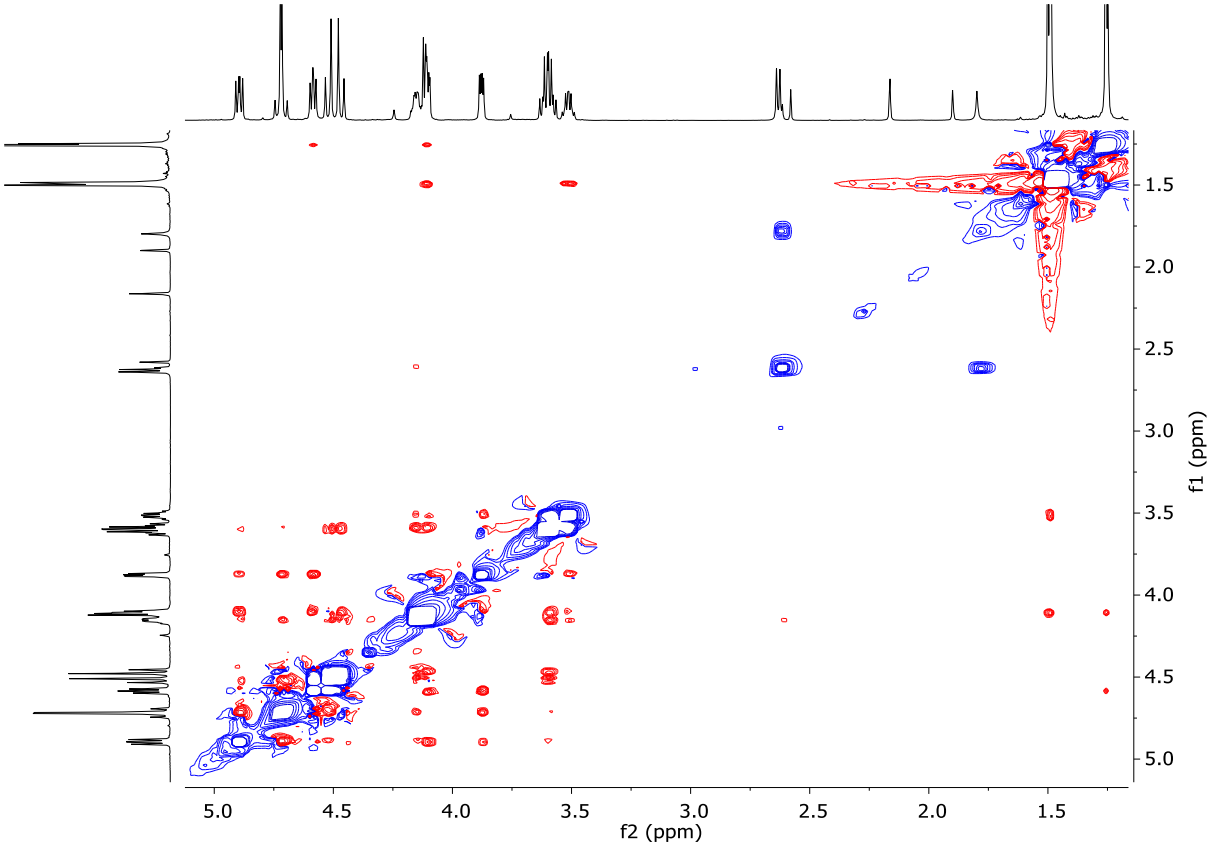


Figure S21: ROESY spectrum (500 MHz, $CDCl_3$) of **22**

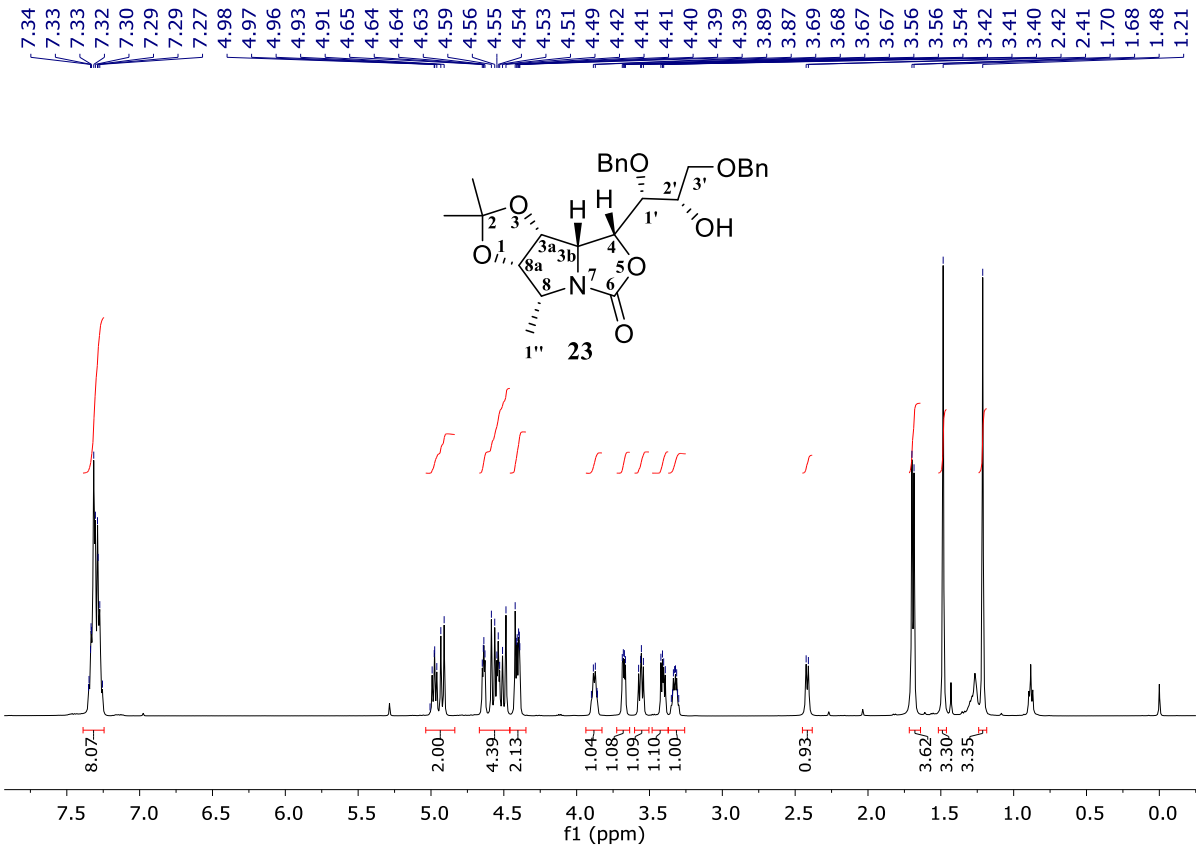


Figure S22: ^1H NMR spectrum (500 MHz, $CDCl_3$) of **23**

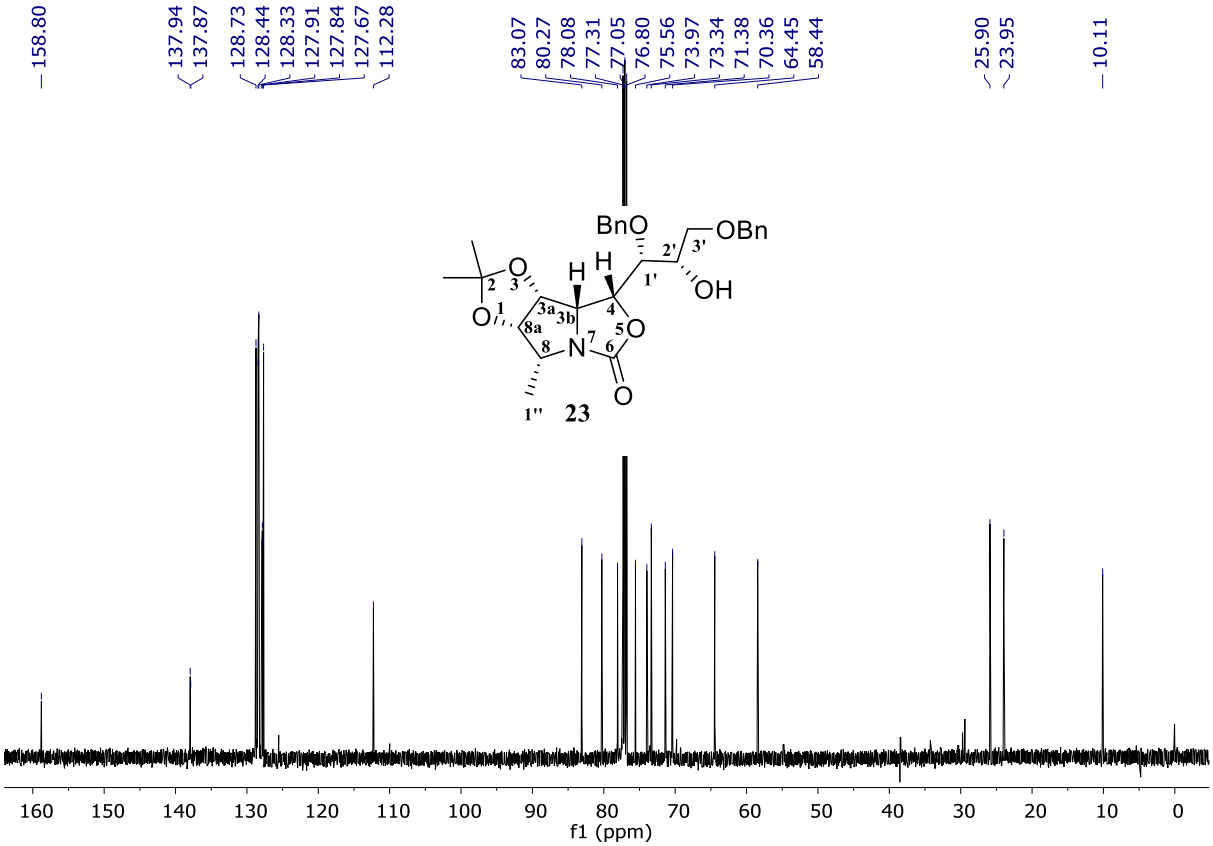


Figure S23: ^{13}C NMR spectrum (125 MHz, $CDCl_3$) of **23**

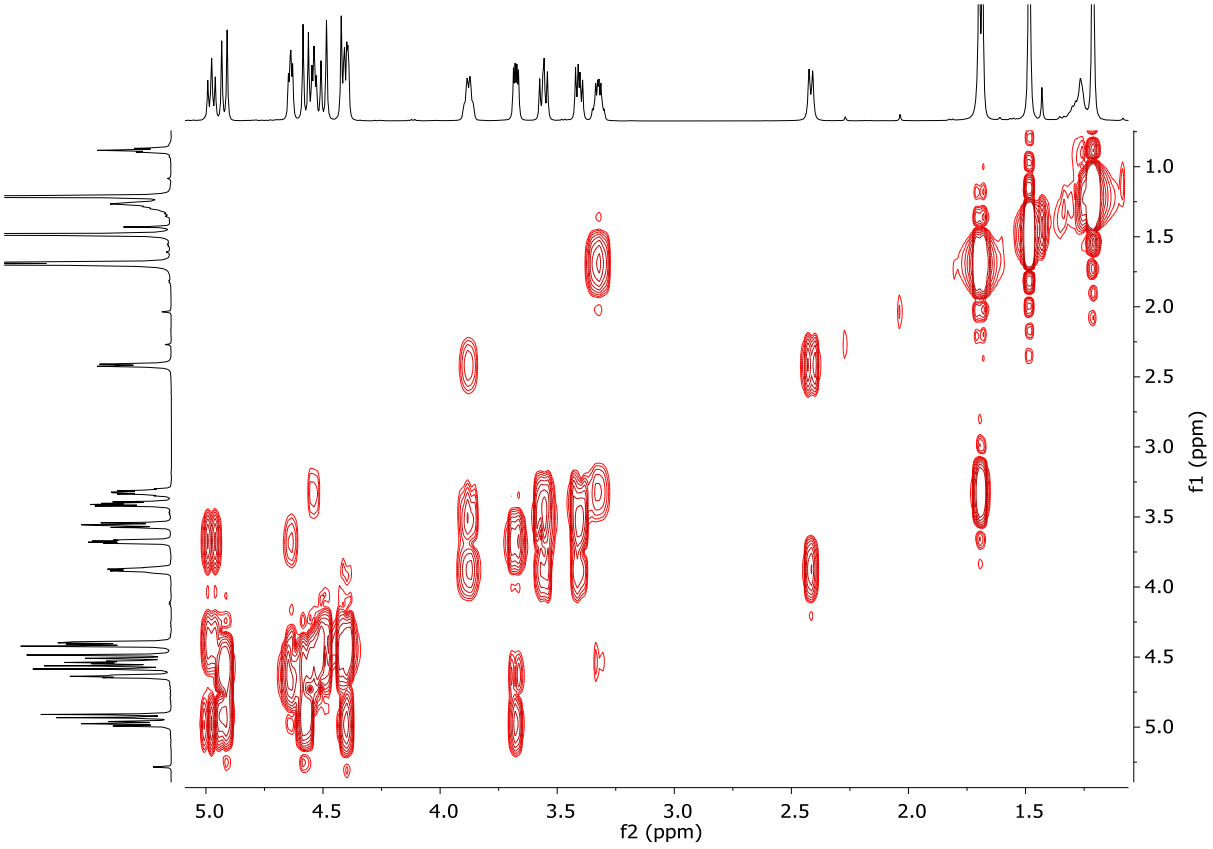


Figure S24: gCOSY spectrum (500 MHz, $CDCl_3$) of **23**

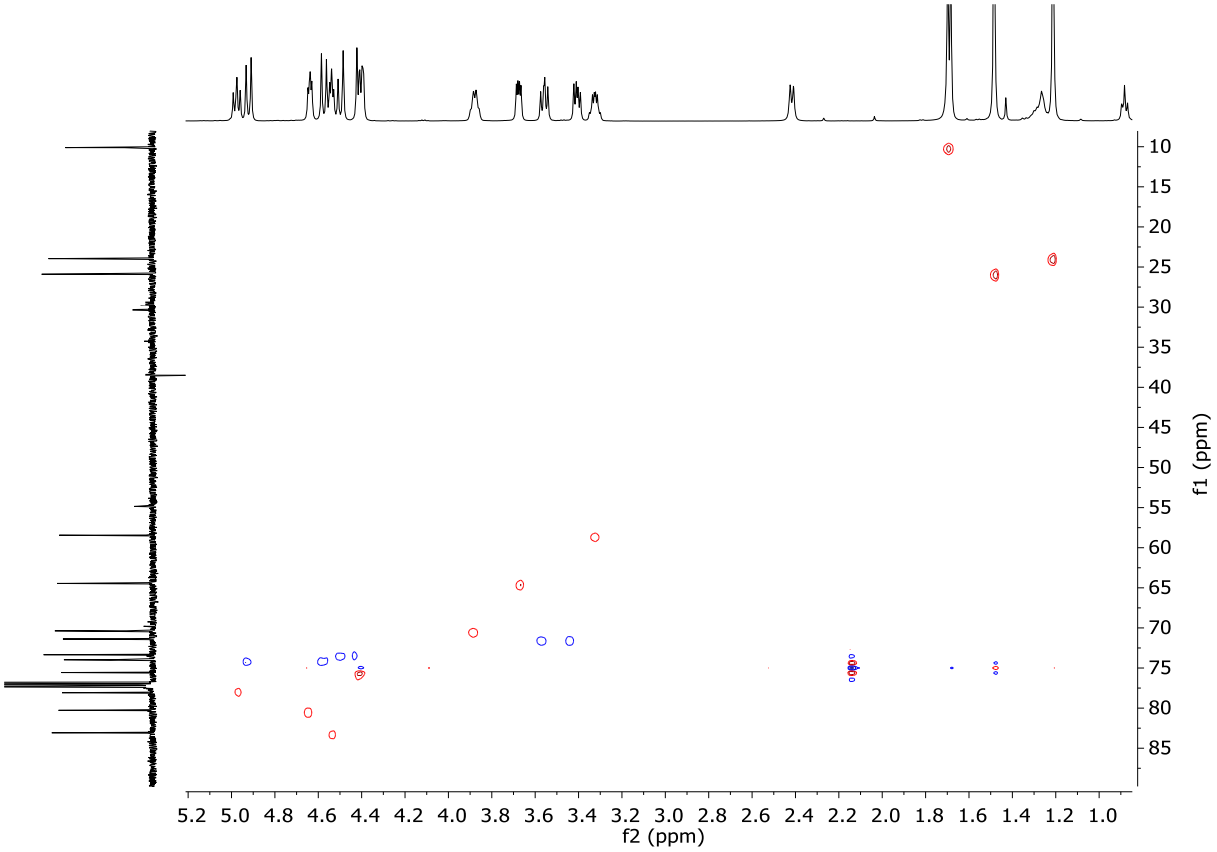
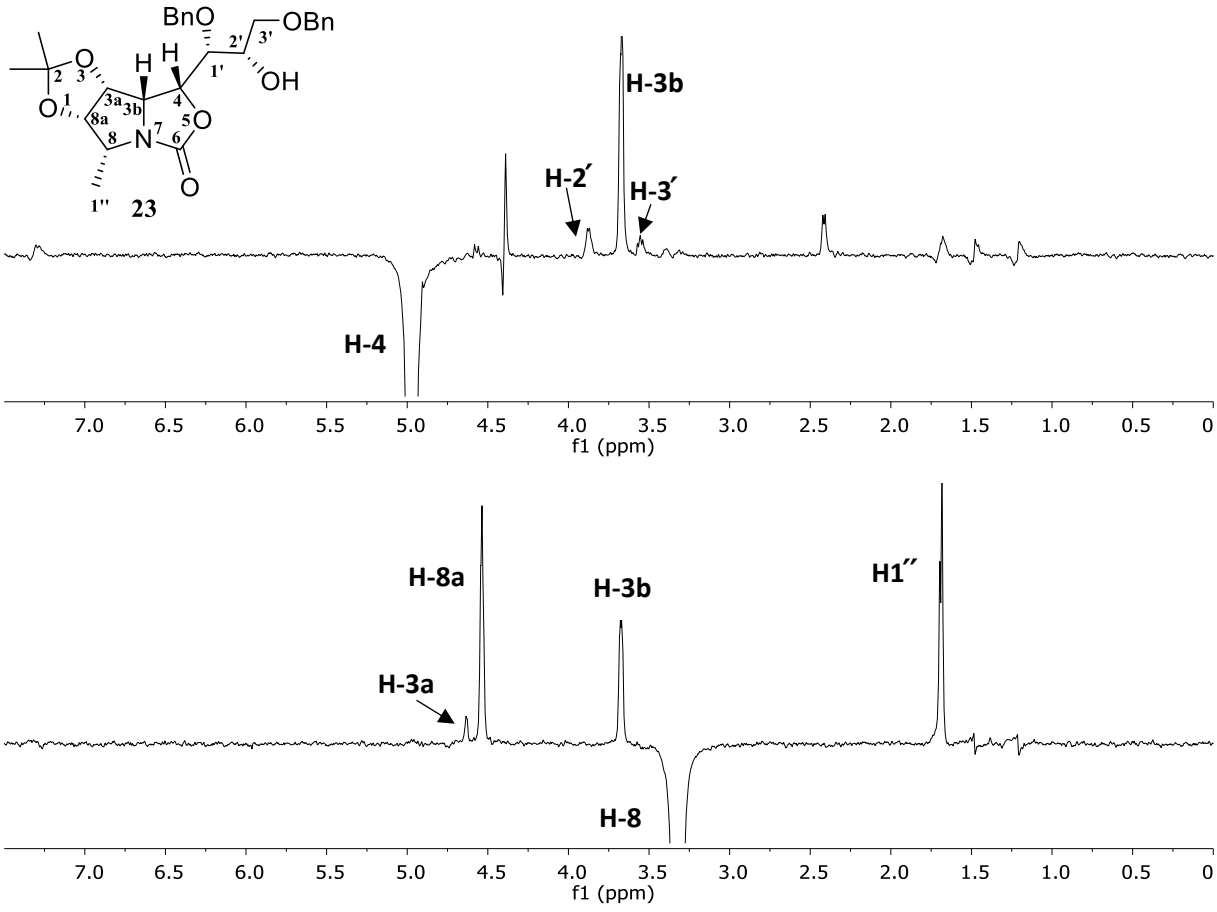


Figure S25: gHSQC spectrum (500 MHz, $CDCl_3$) of **23**



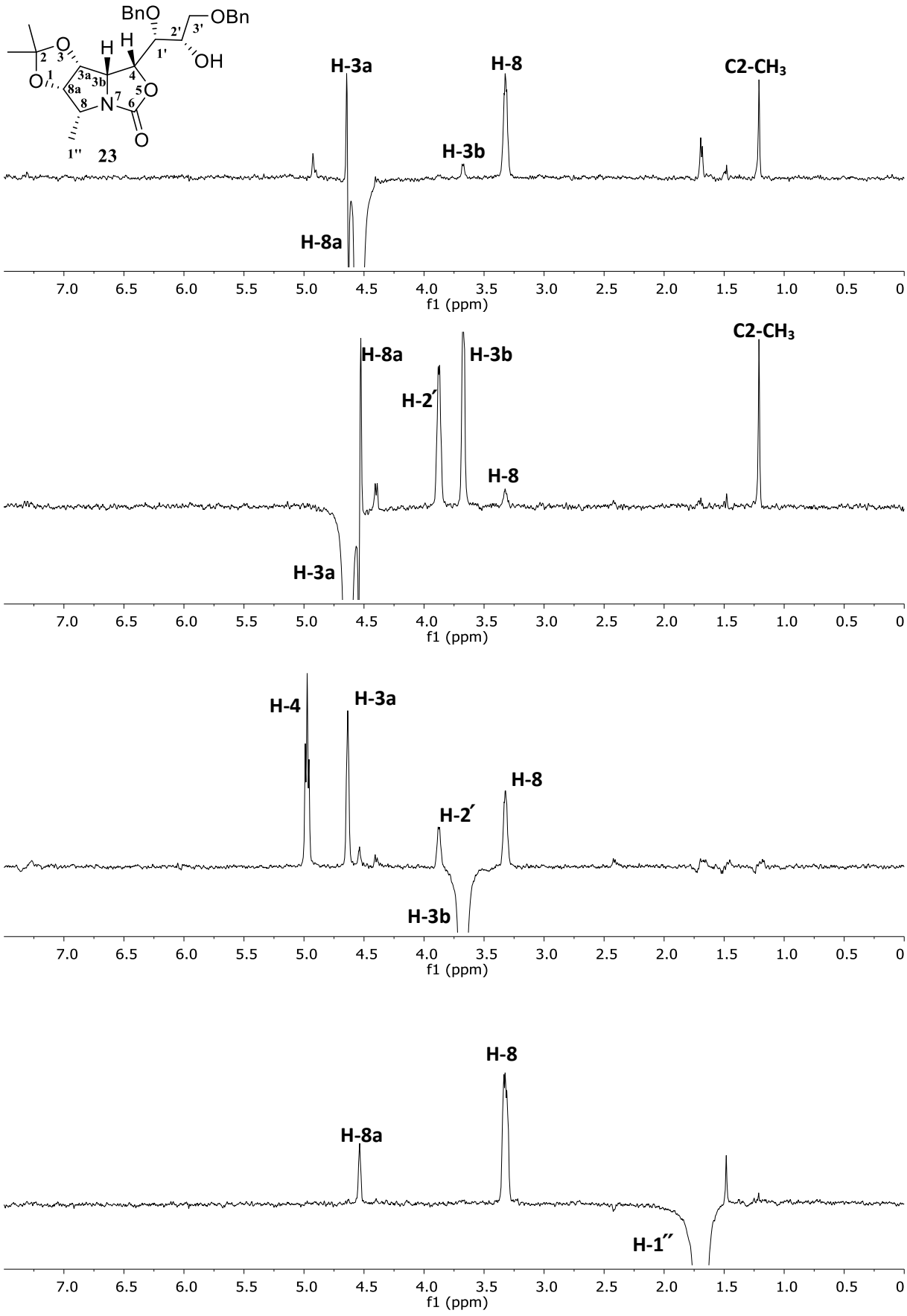


Figure S26: 1D-NOE spectrum (500 MHz, $CDCl_3$) of **23**

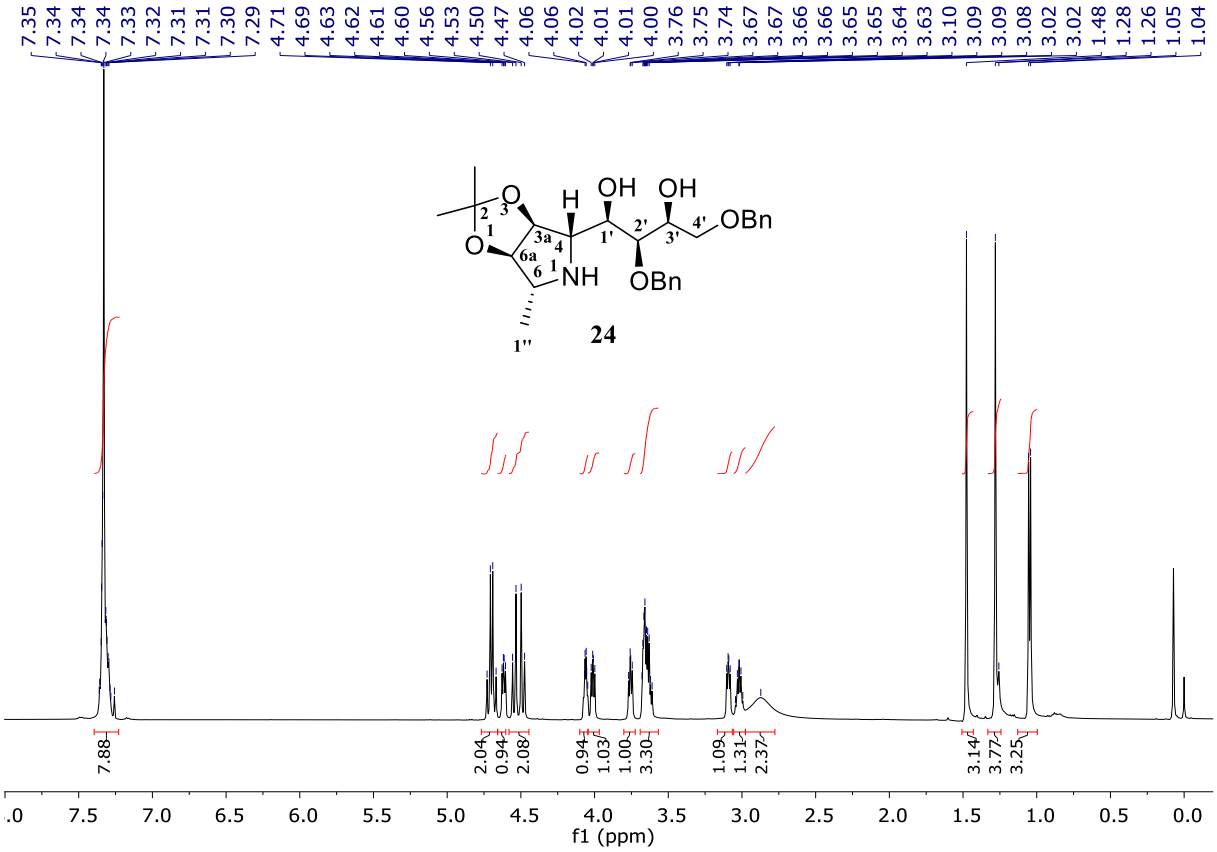


Figure S27: ^{1}H NMR spectrum (500 MHz, $CDCl_3$) of **24**

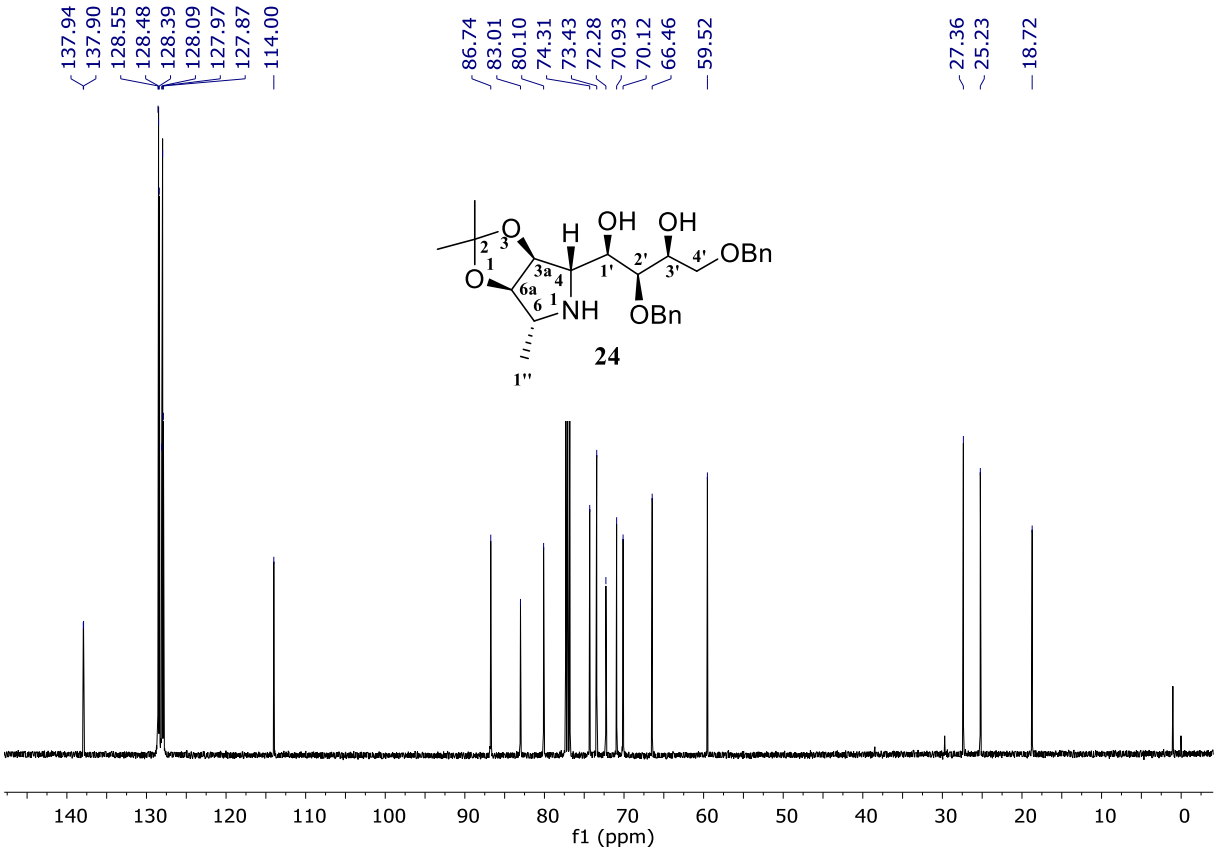


Figure S28: ^{13}C NMR spectrum (125 MHz, $CDCl_3$) of **24**

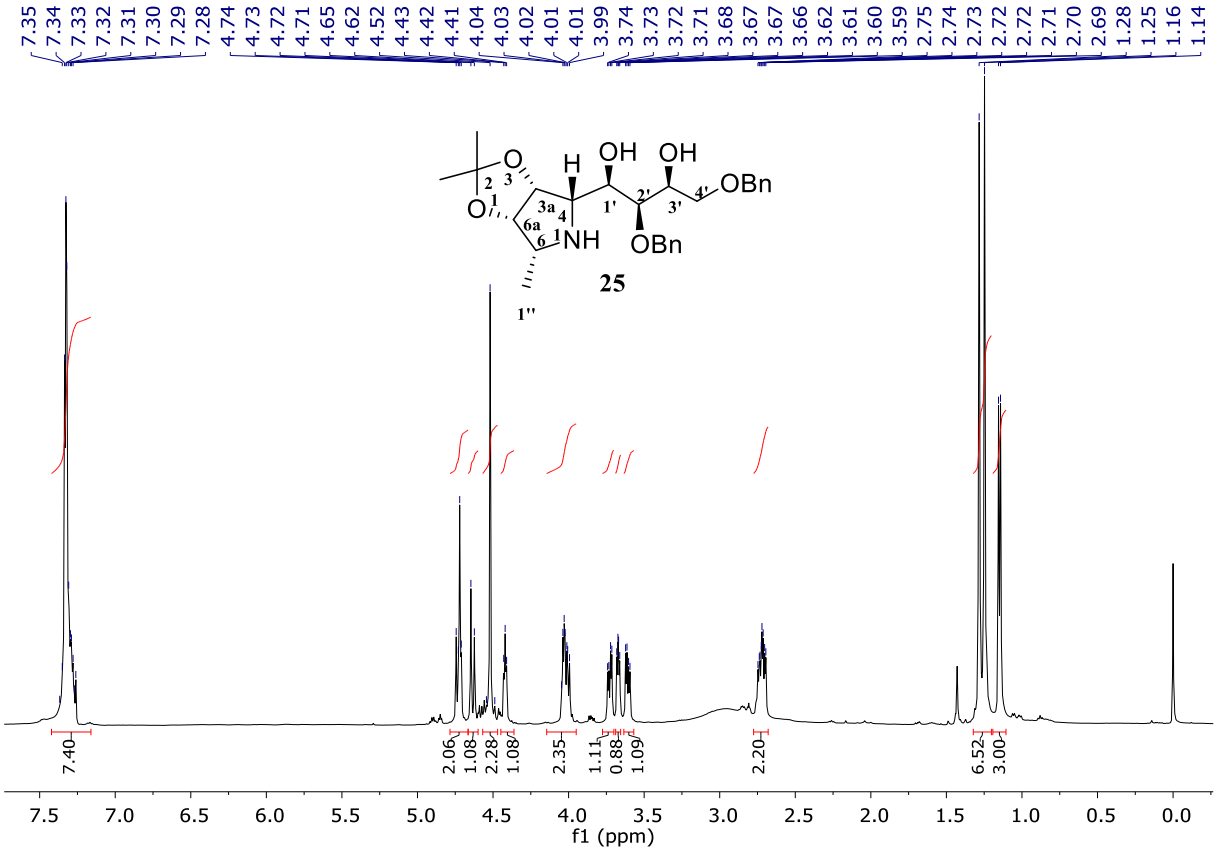


Figure S29: ^{1}H NMR spectrum (500 MHz, $CDCl_3$) of **25**

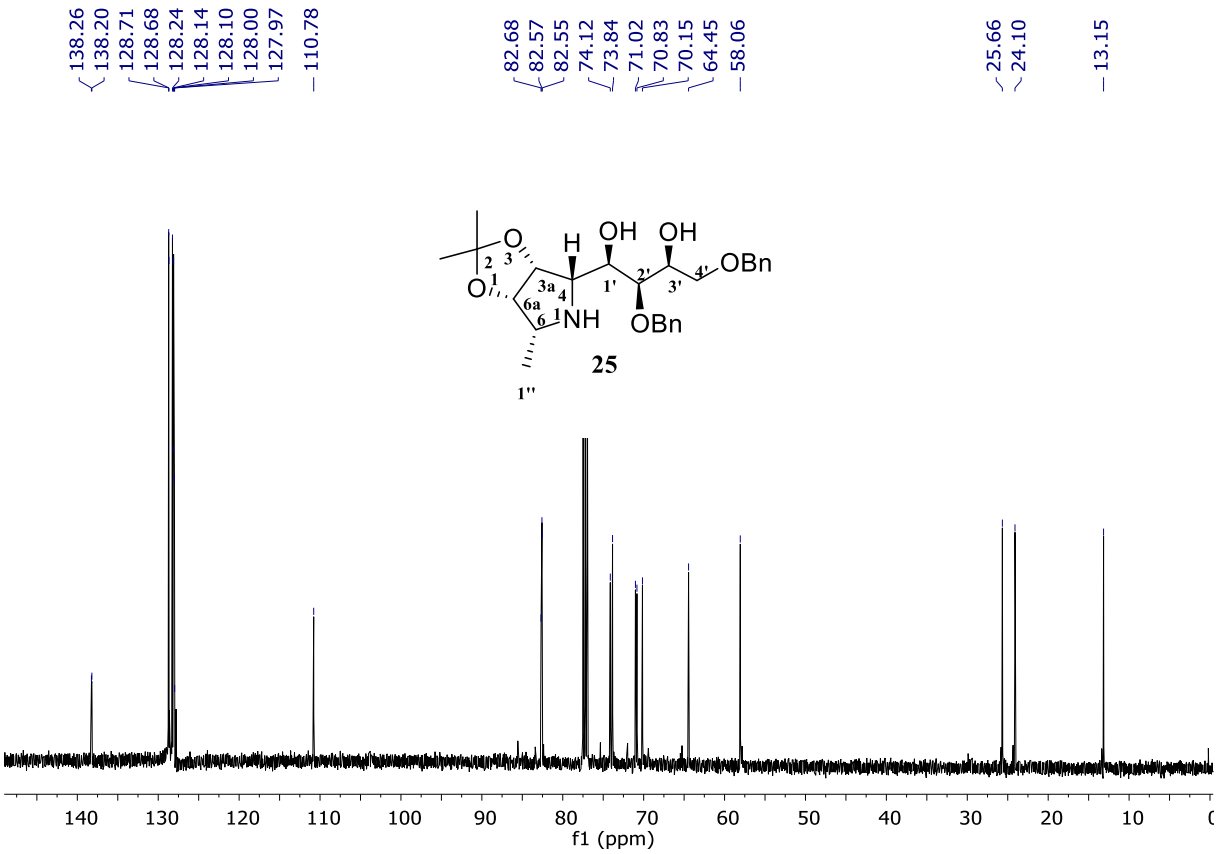


Figure S30: ^{13}C NMR spectrum (125 MHz, $CDCl_3$) of **25**

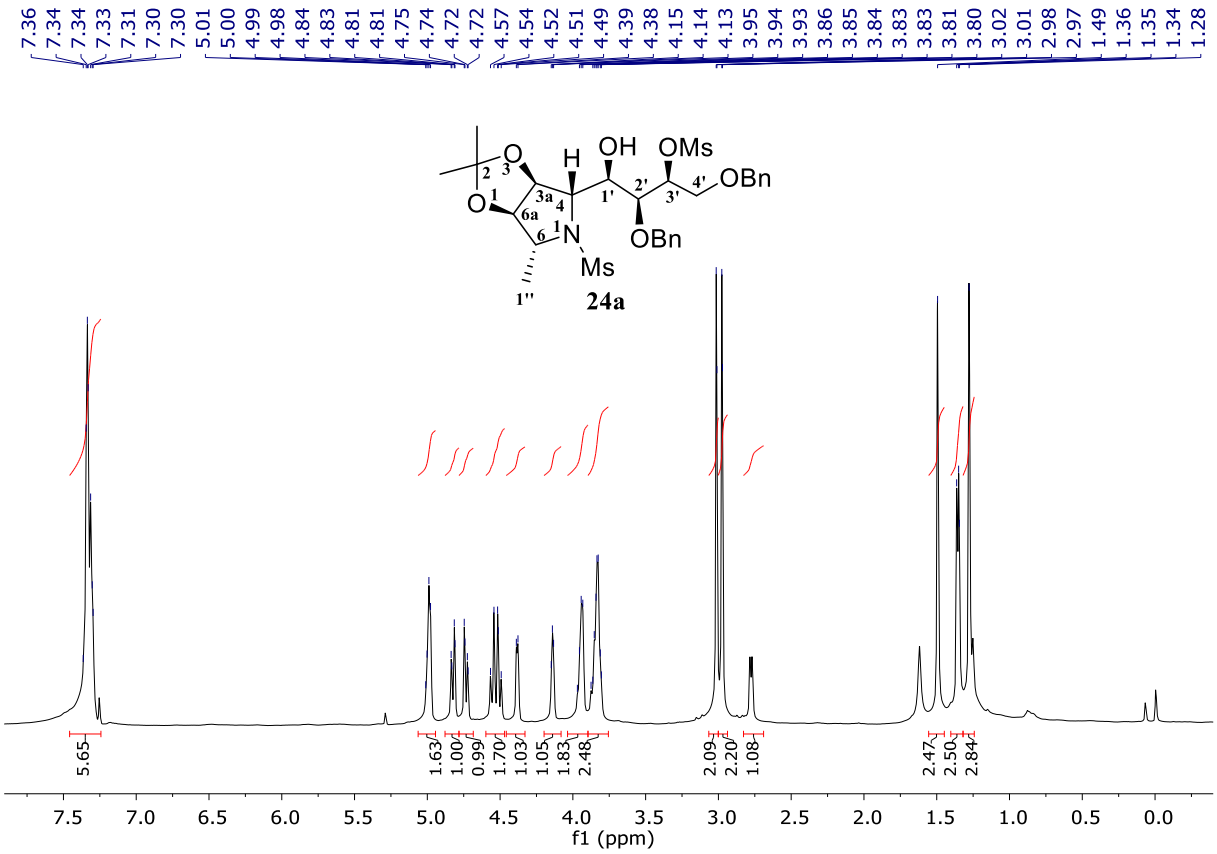


Figure S31: ^{1}H NMR spectrum (500 MHz, $CDCl_3$) of **24a**

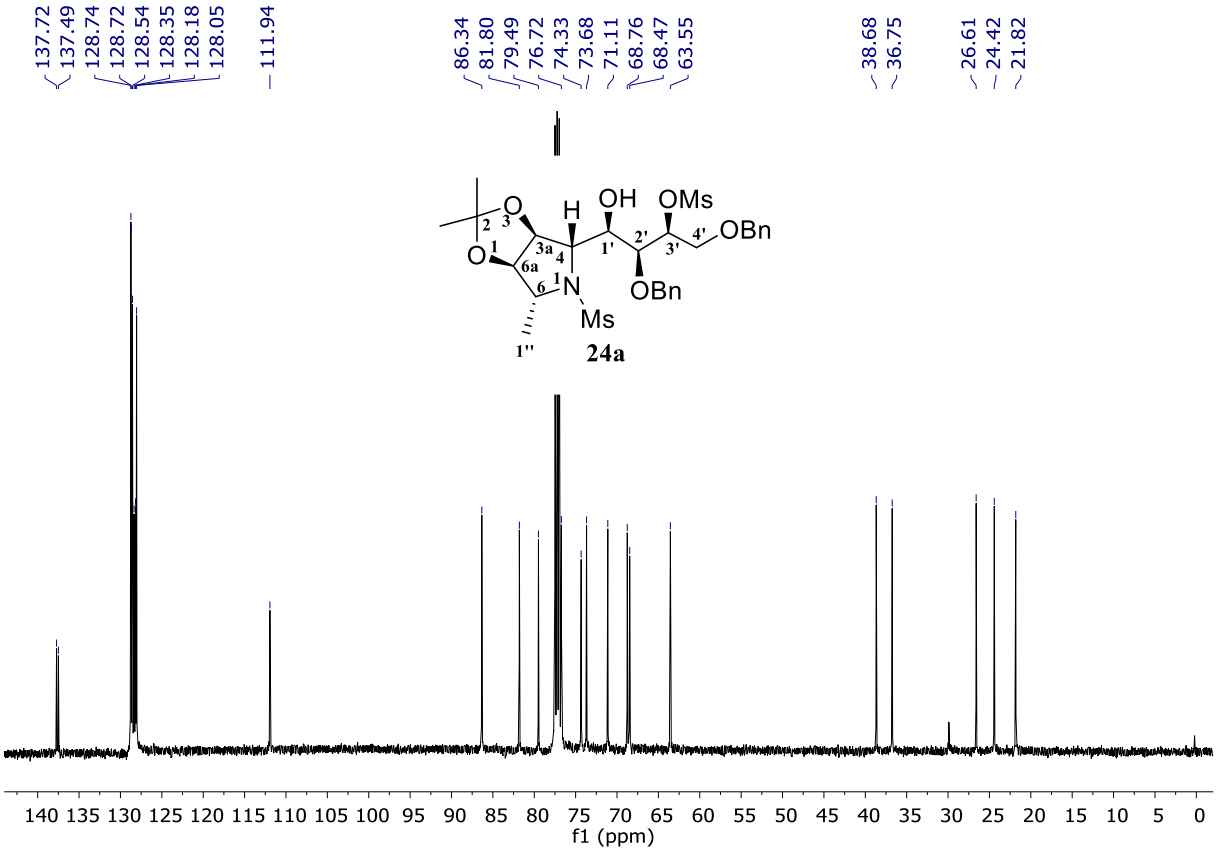


Figure S32: ^{13}C NMR spectrum (125 MHz, $CDCl_3$) of **24a**

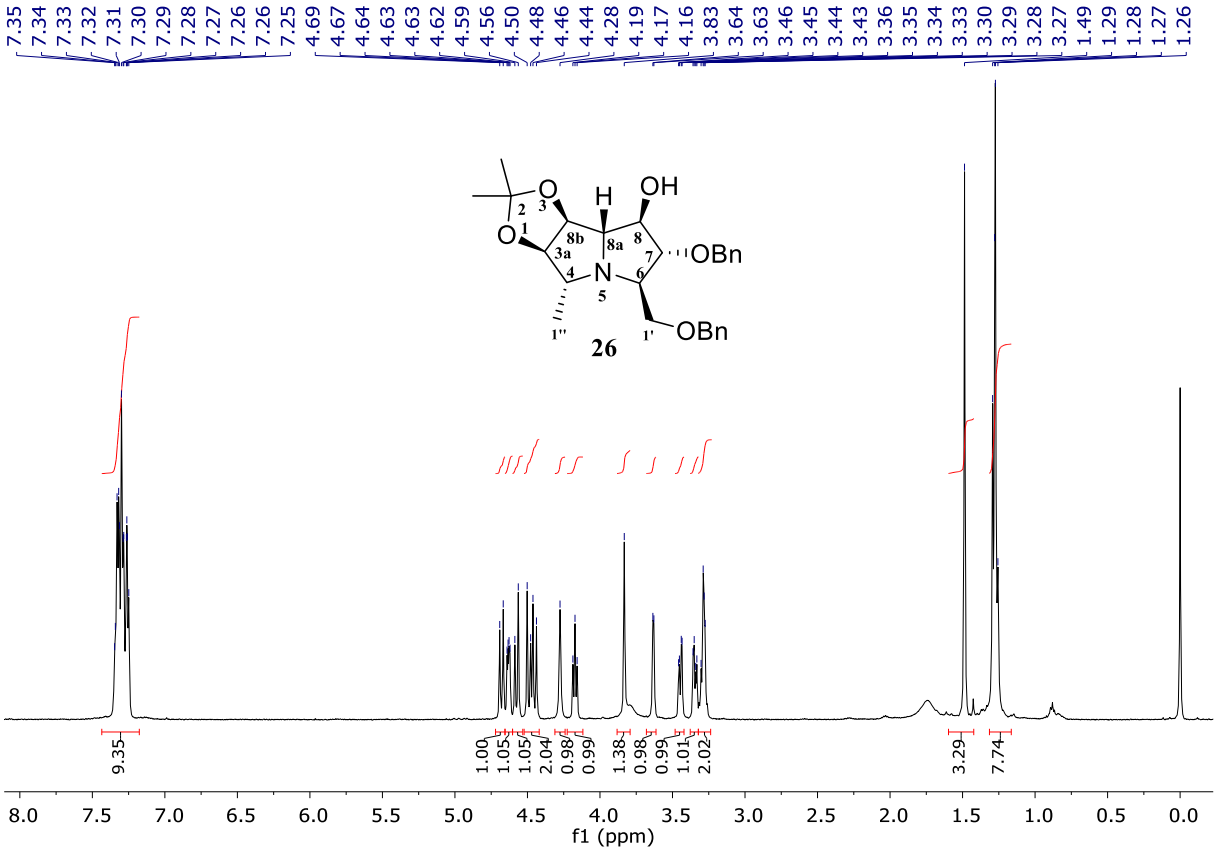


Figure S33: ^{1}H NMR spectrum (500 MHz, $CDCl_3$) of **26** (Experimental: *Procedure A*)

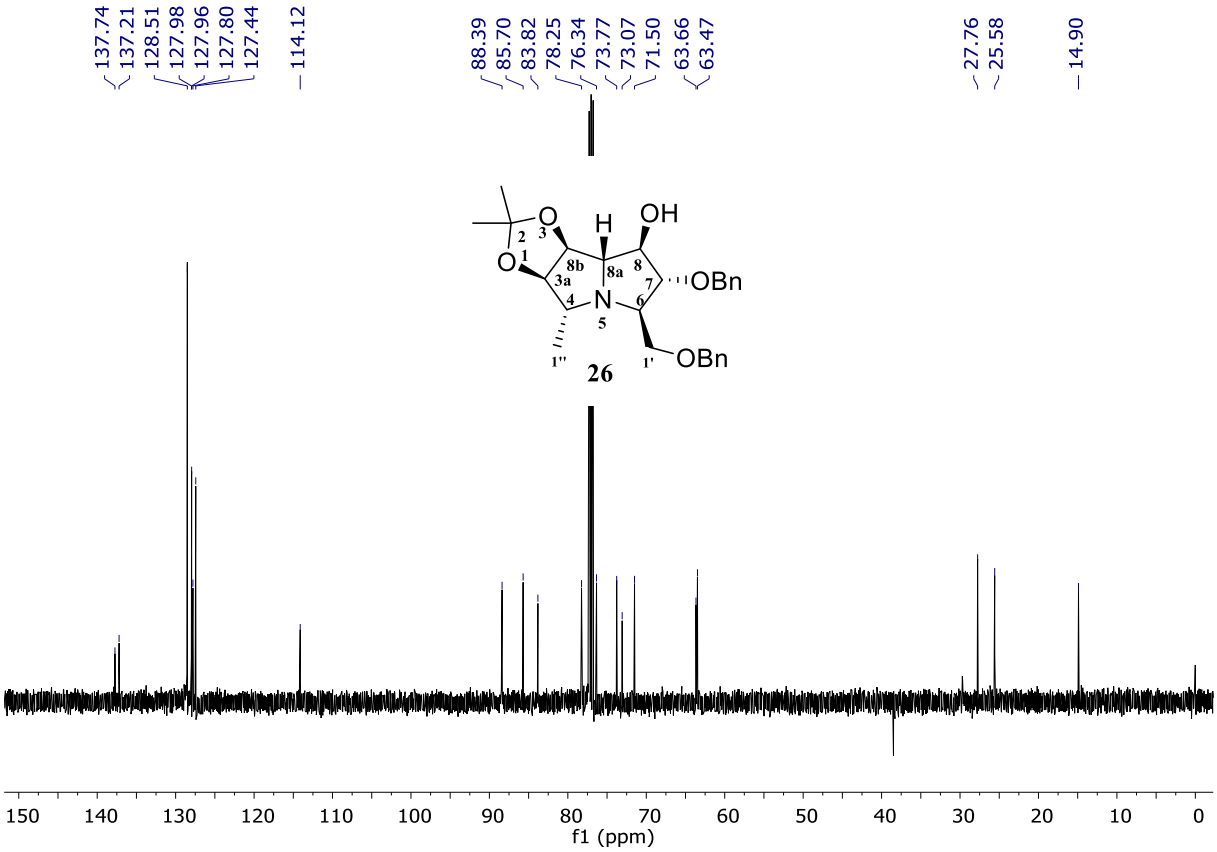


Figure S34: ^{13}C NMR spectrum (125 MHz, $CDCl_3$) of **26**

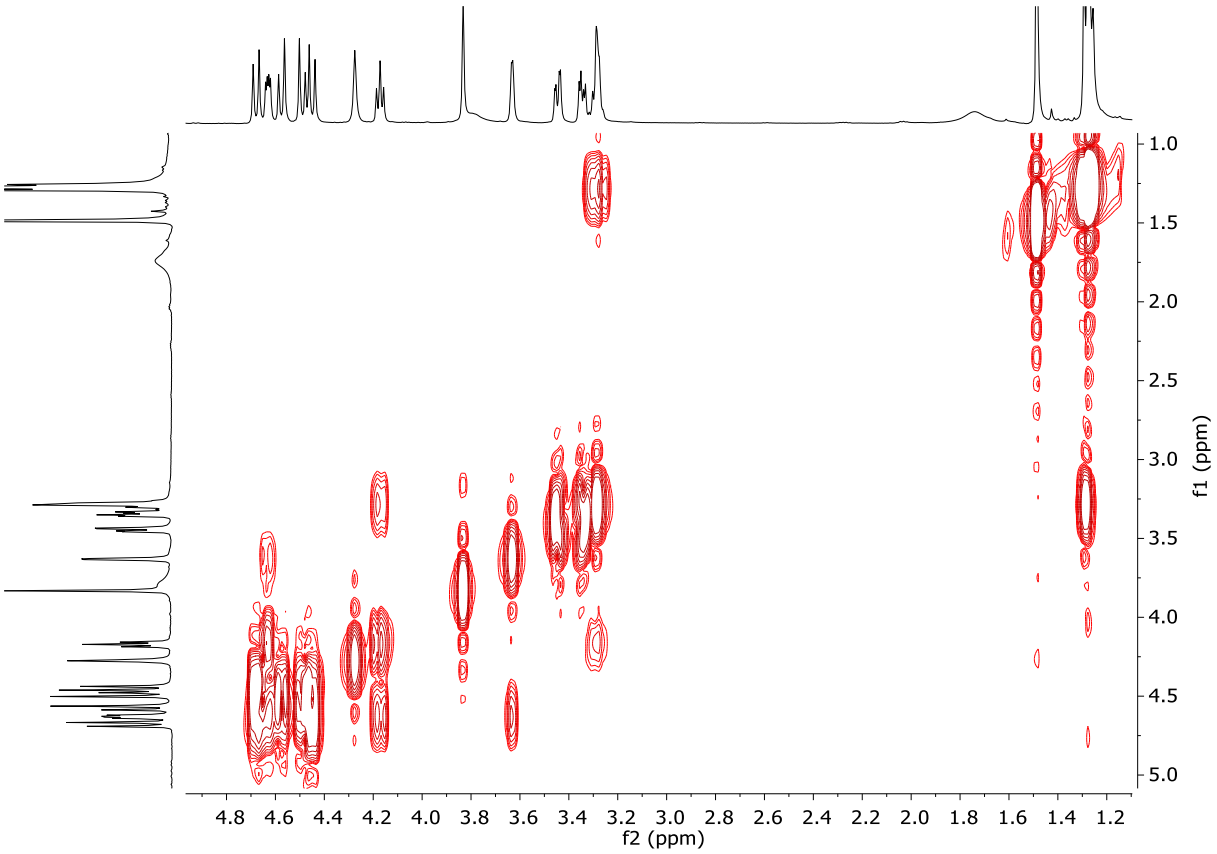


Figure S35: gCOSY spectrum (500 MHz, $CDCl_3$) of **26**

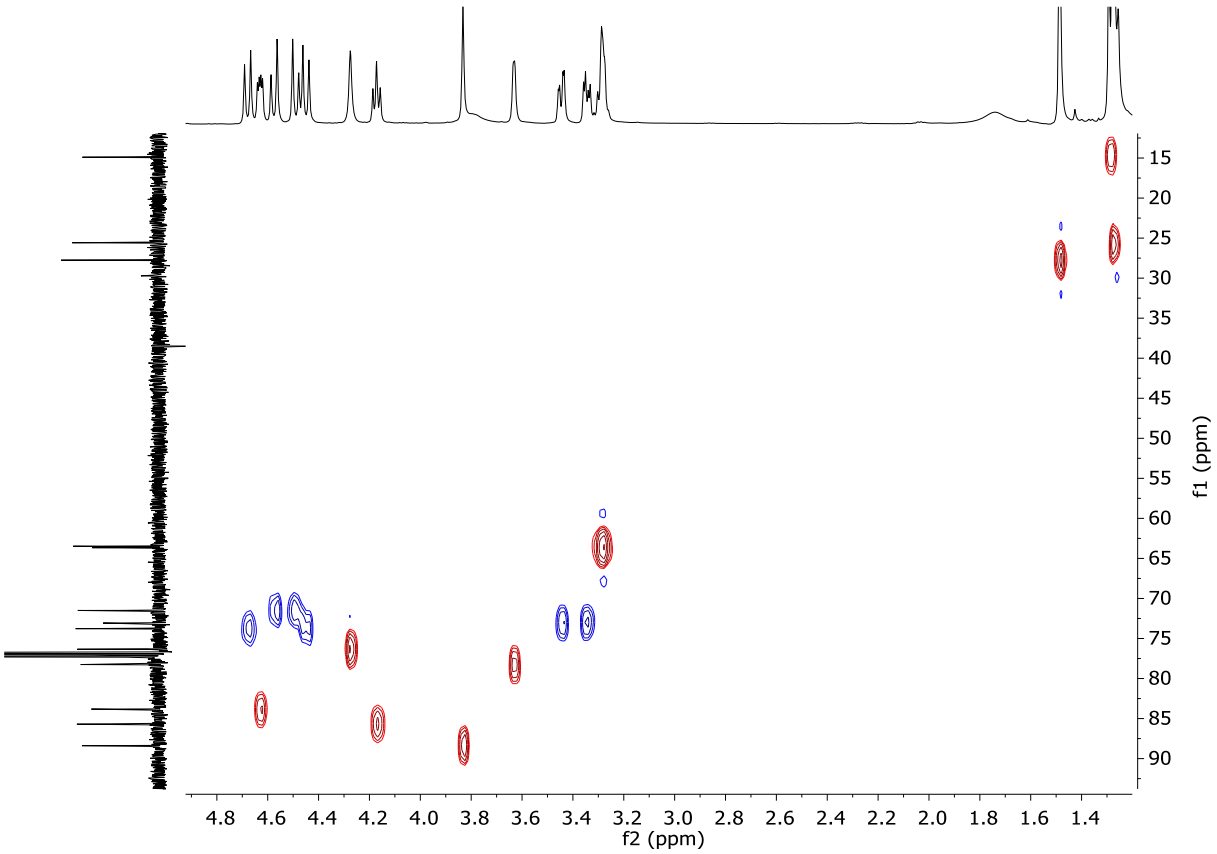


Figure S36: gHSQC spectrum (500 MHz, $CDCl_3$) of **26**

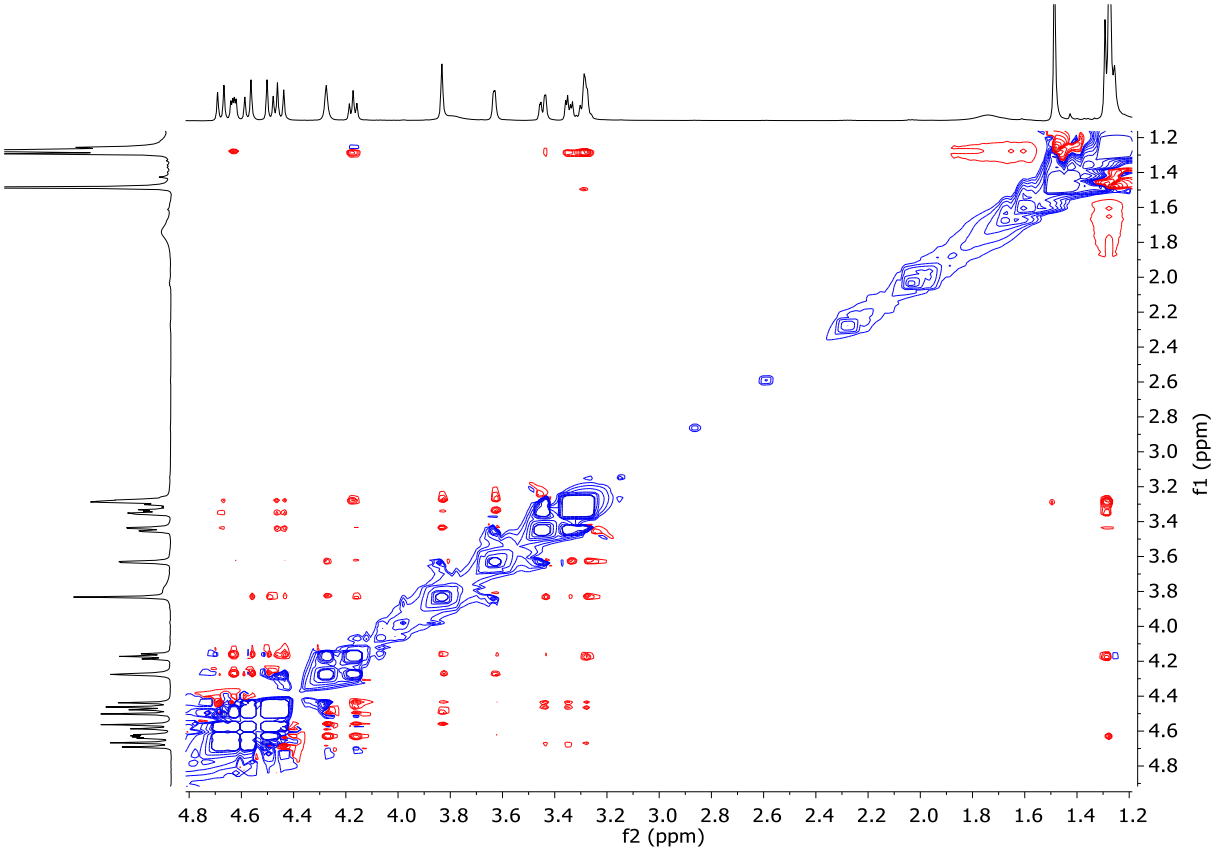


Figure S37: ROESY spectrum (500 MHz, $CDCl_3$) of **26**

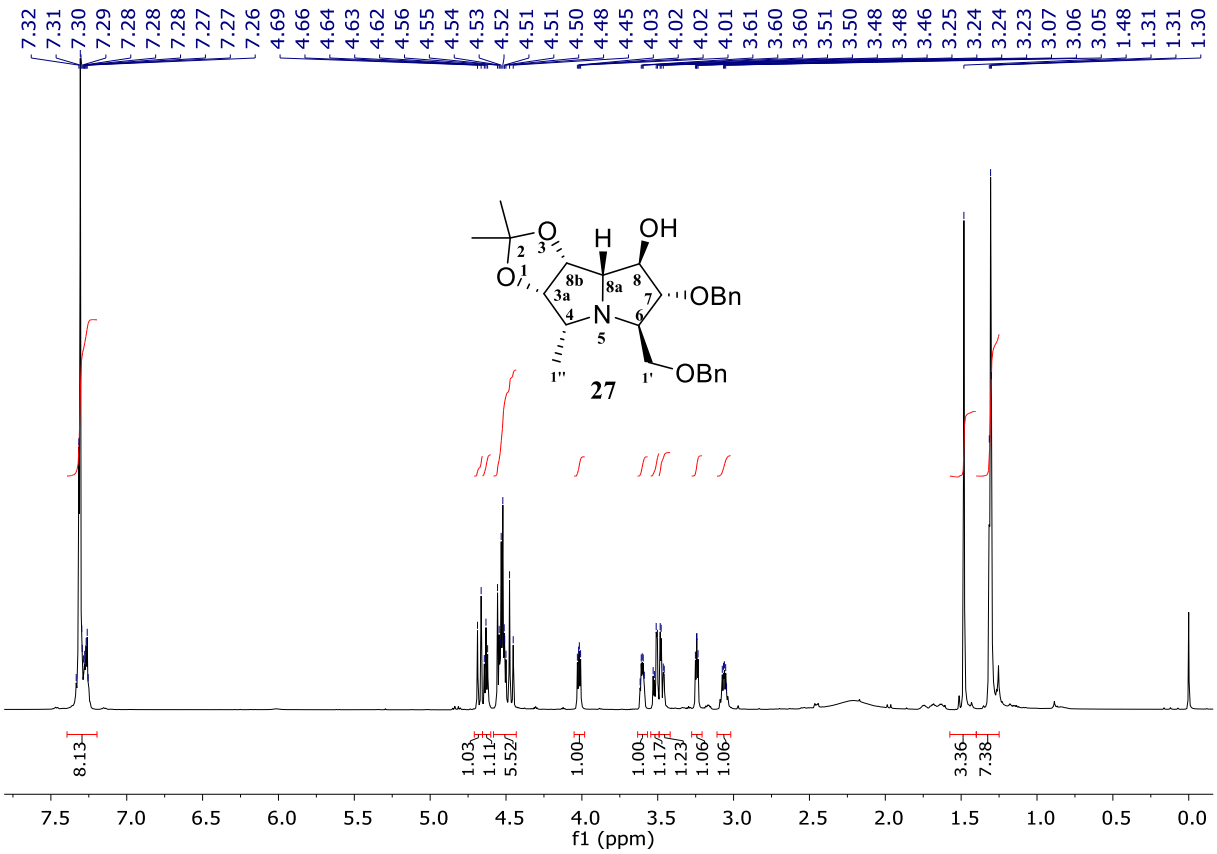


Figure S38: ^1H NMR spectrum (500 MHz, $CDCl_3$) of **27**

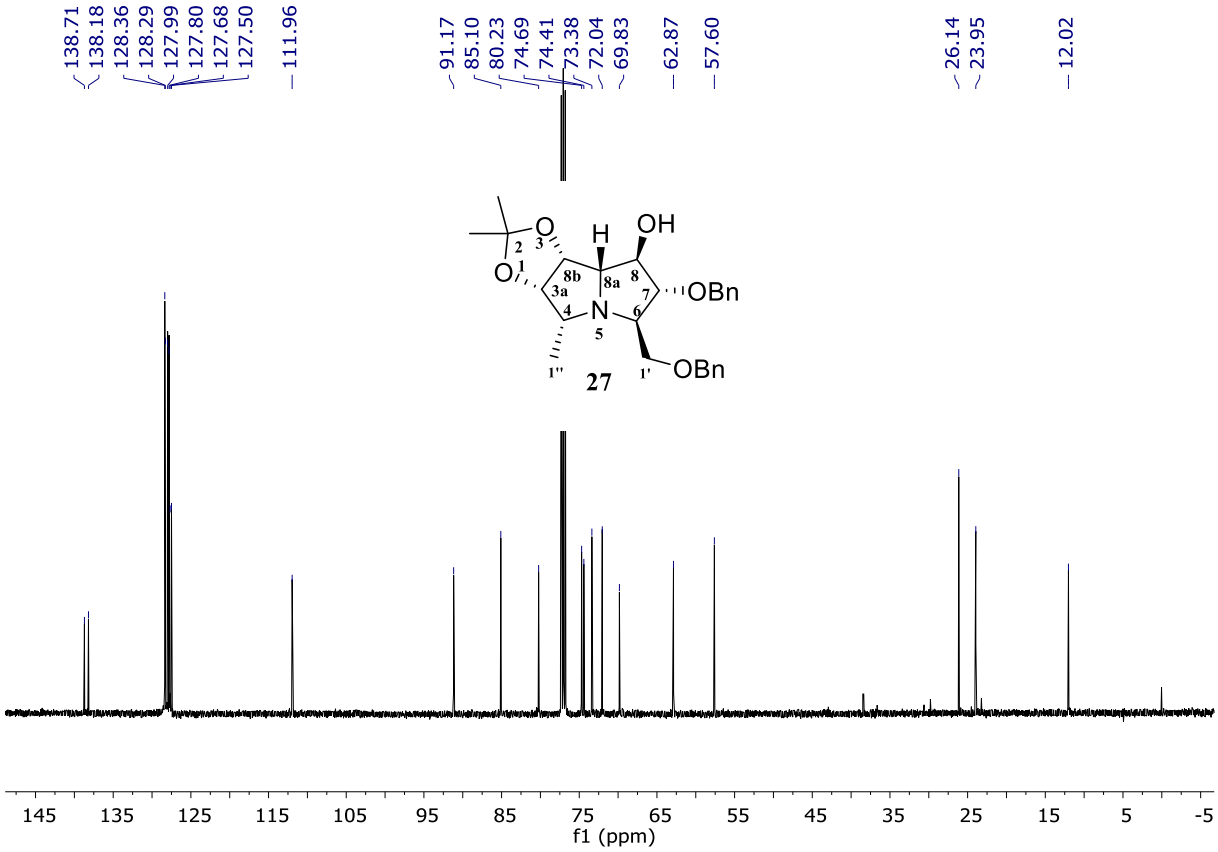


Figure S39: ^{13}C NMR spectrum (125 MHz, $CDCl_3$) of **27**

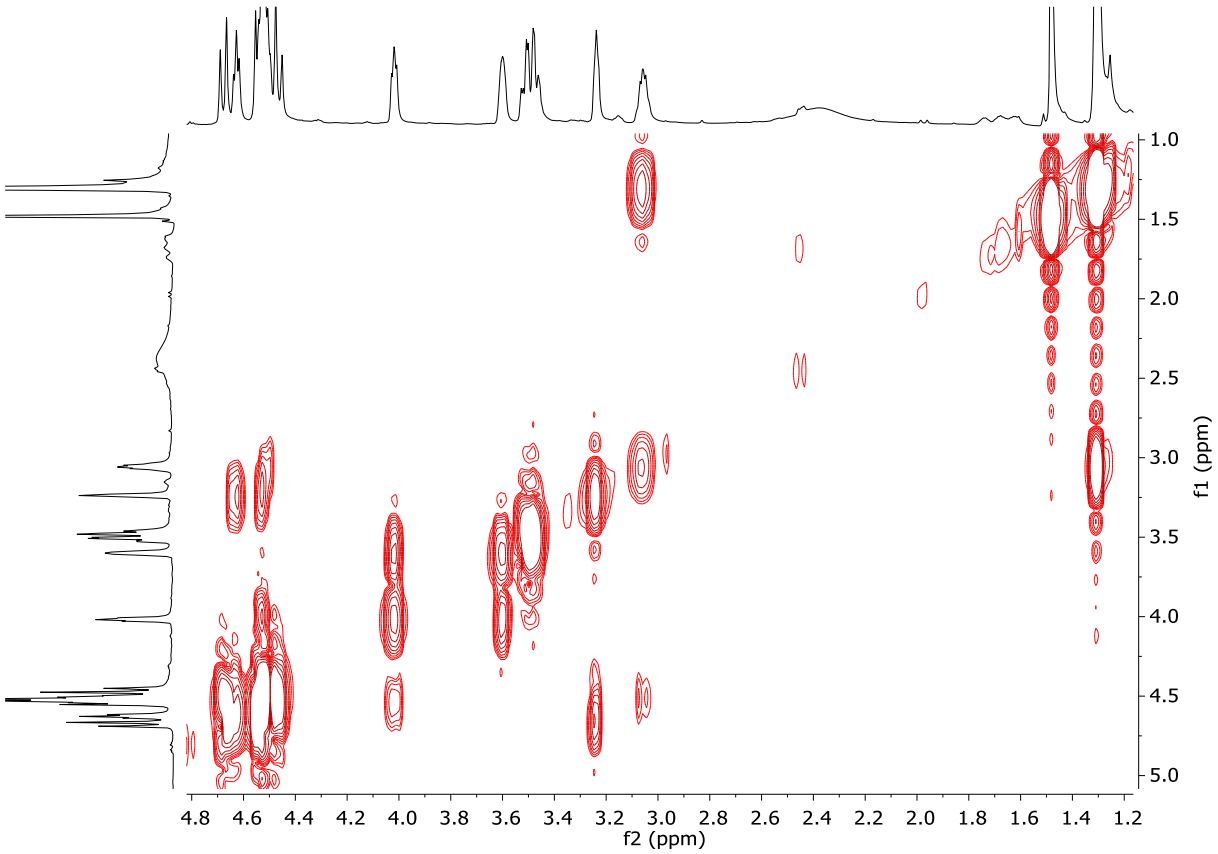


Figure S40: gCOSY spectrum (500 MHz, $CDCl_3$) of **27**

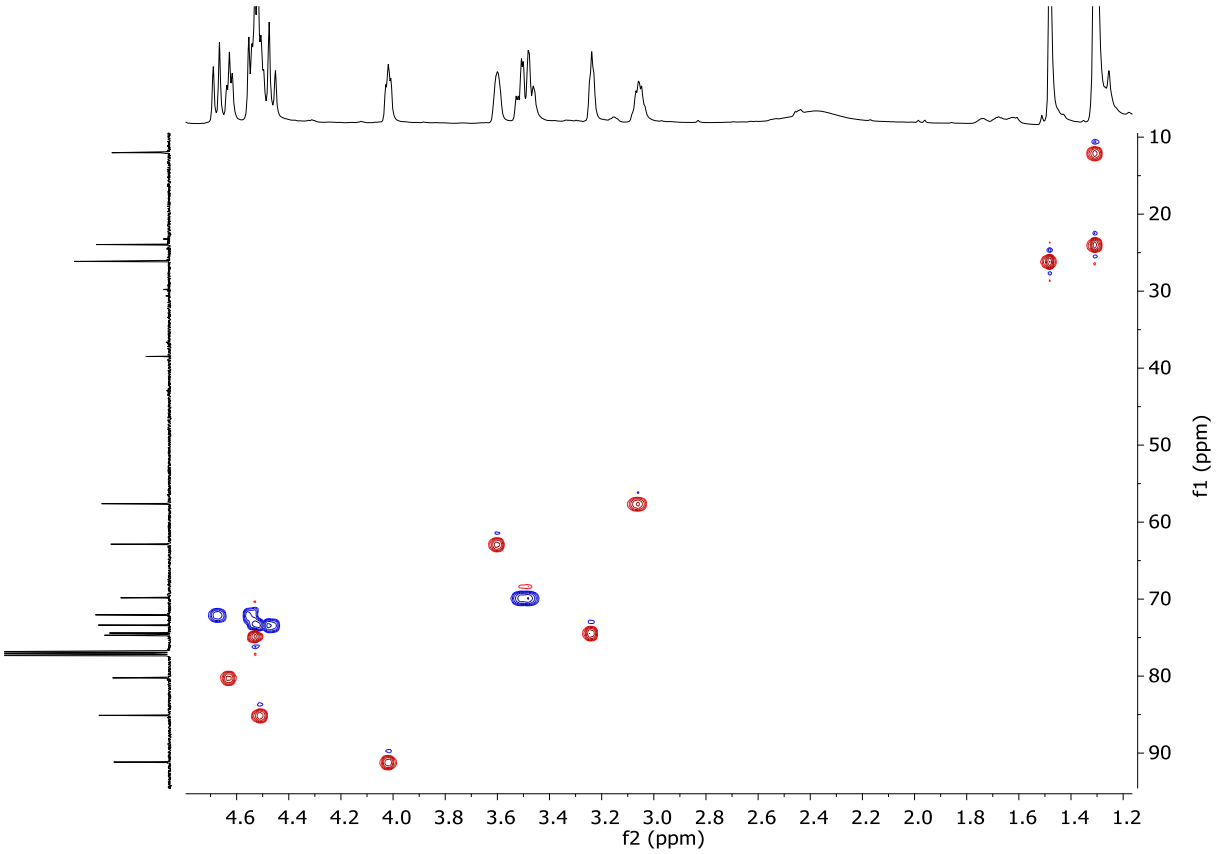
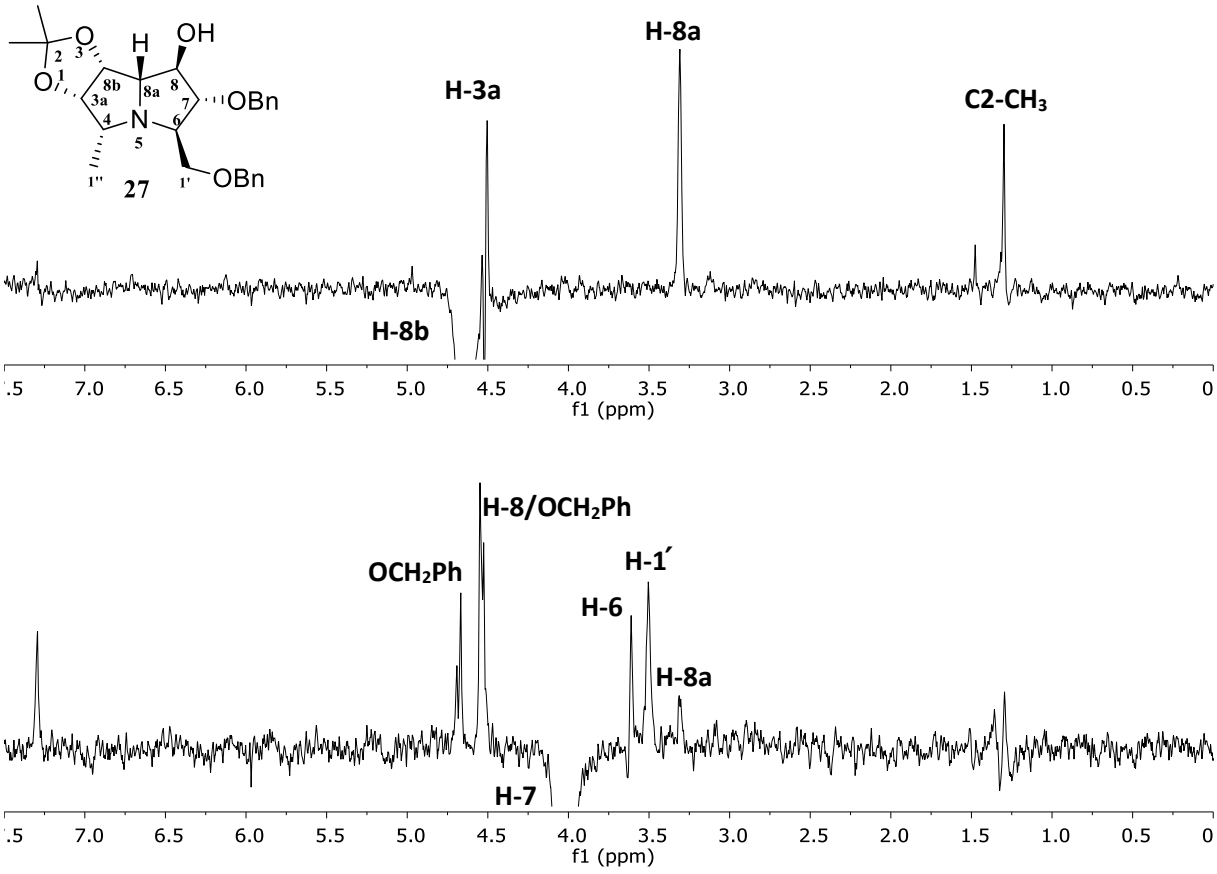
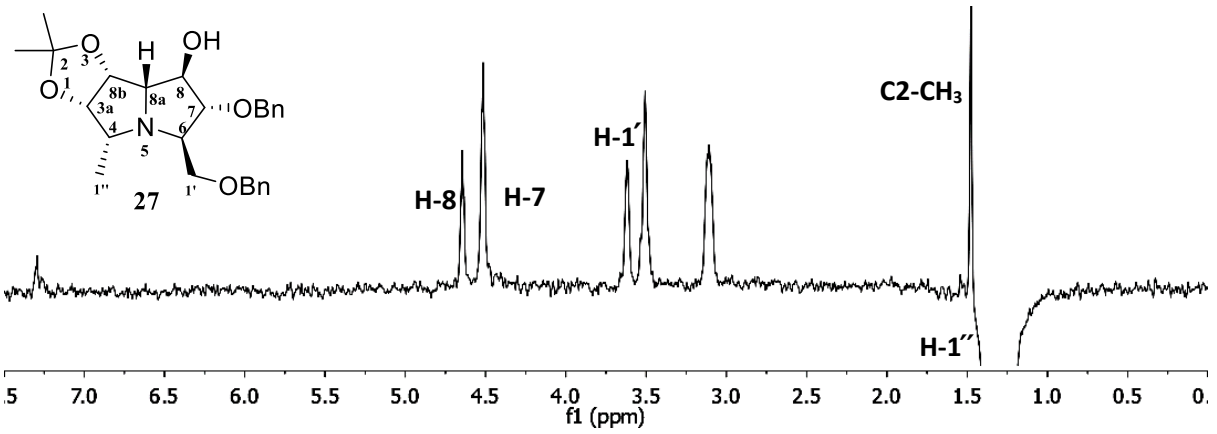
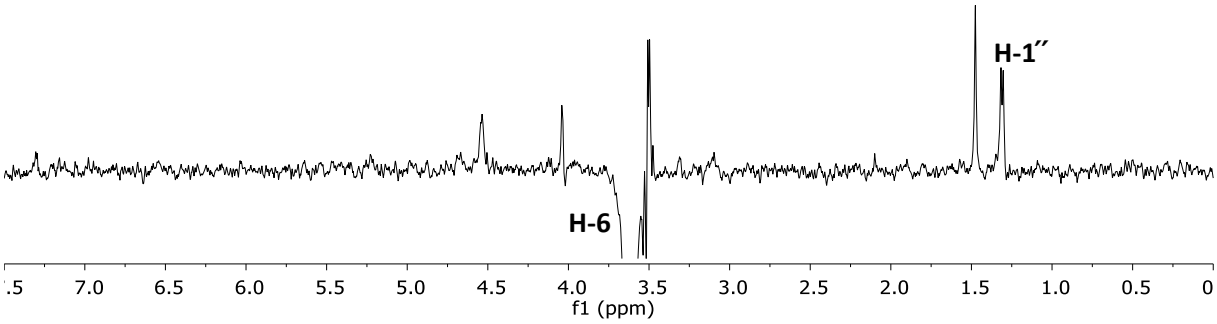
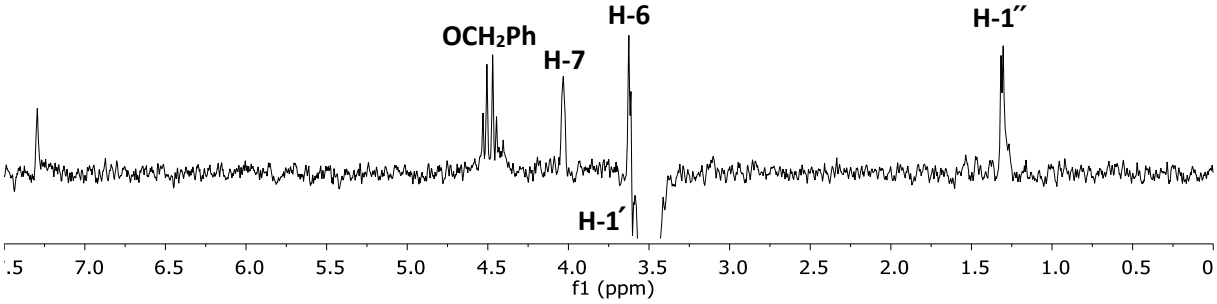


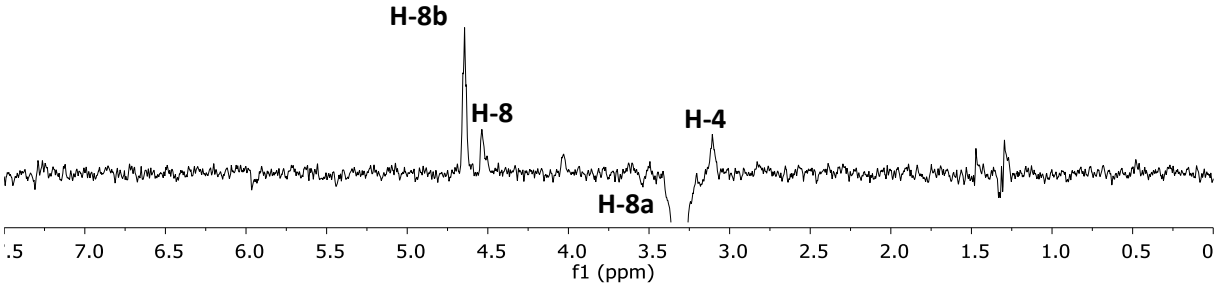
Figure S41: gHSQC spectrum (500 MHz, $CDCl_3$) of **27**




OH
H
OBn
OBn
27
H-8
H-7
H-1´
C2-CH3
H-1´´
f1 (ppm)


H-1´´
H-6
f1 (ppm)


OCH2Ph
H-7
H-6
H-1´´
H-1´
f1 (ppm)


H-8b
H-8
H-4
H-8a
f1 (ppm)

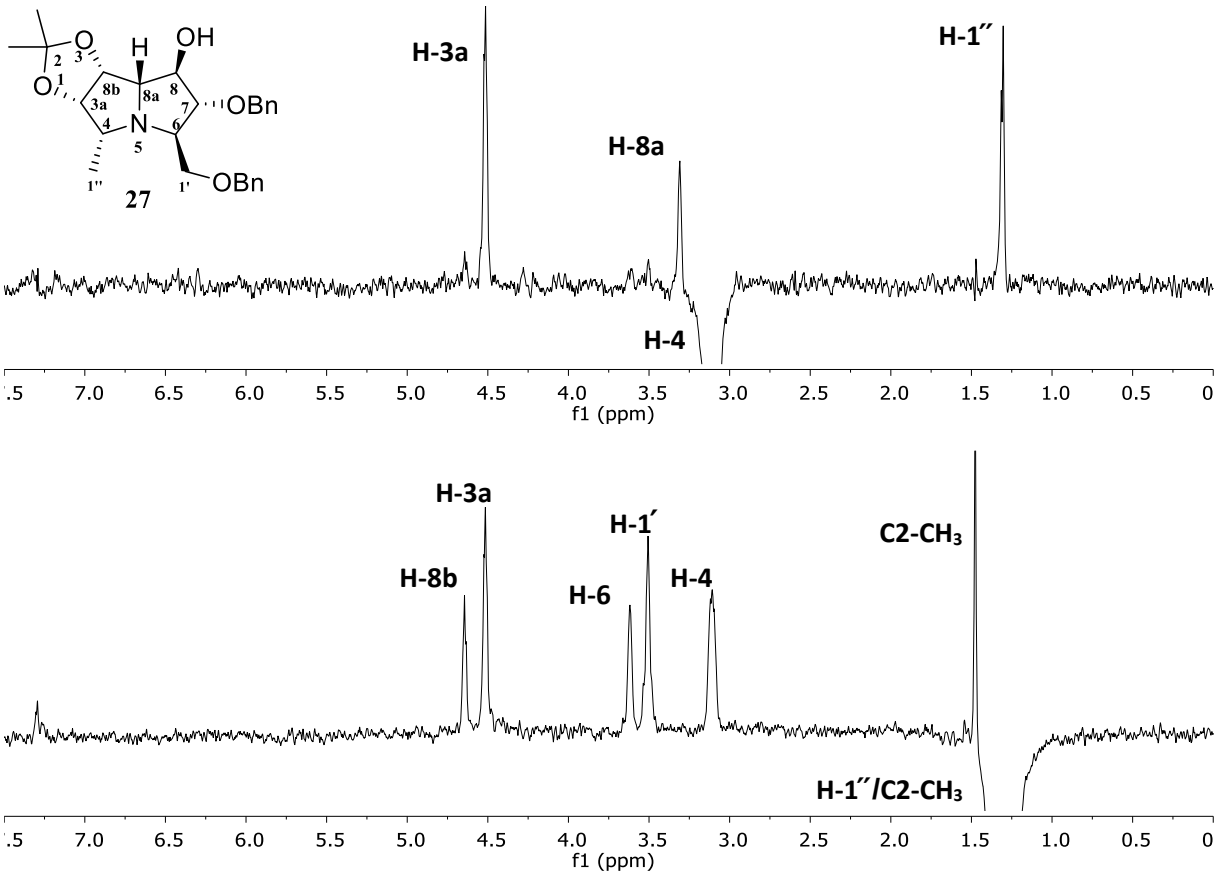


Figure S42: 1D-NOE spectrum (500 MHz, $CDCl_3$) of **27**

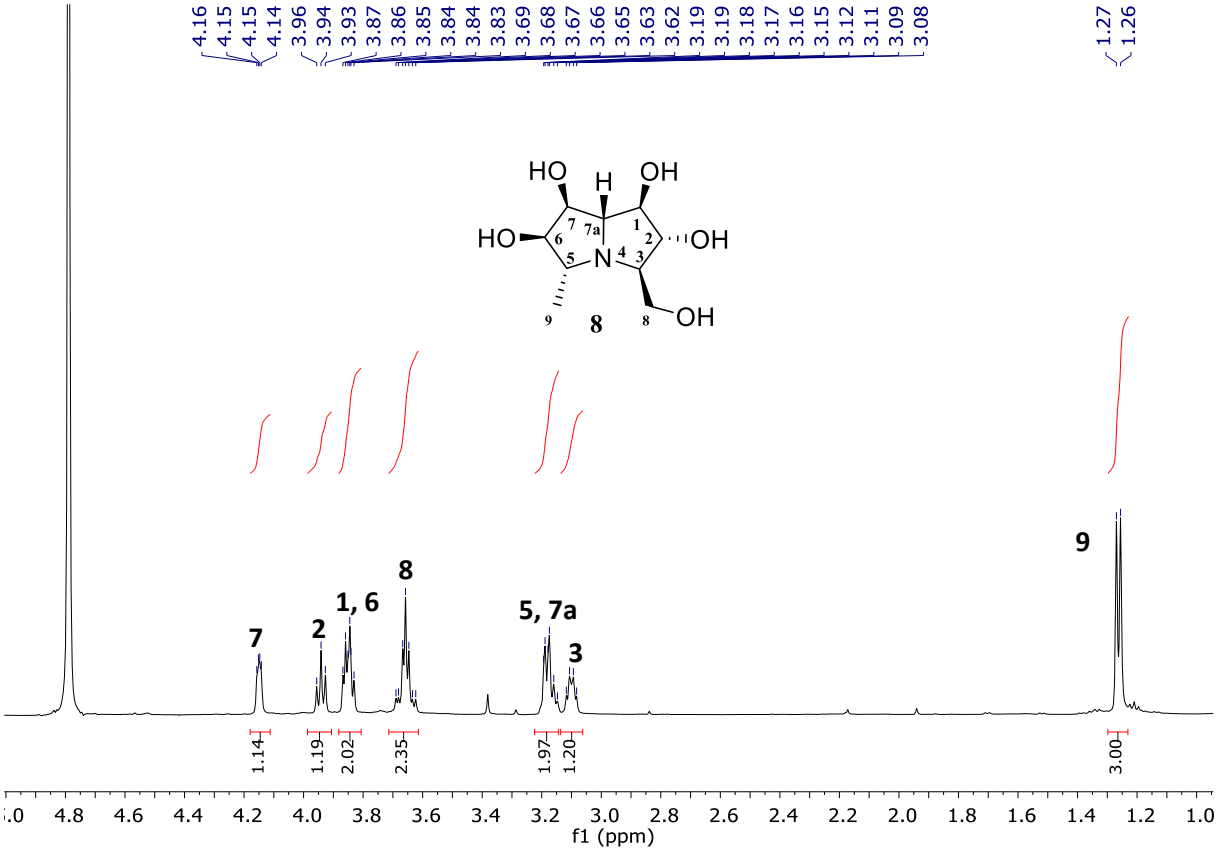


Figure S43: ^{1}H NMR spectrum (500 MHz, D_2O) of **8**

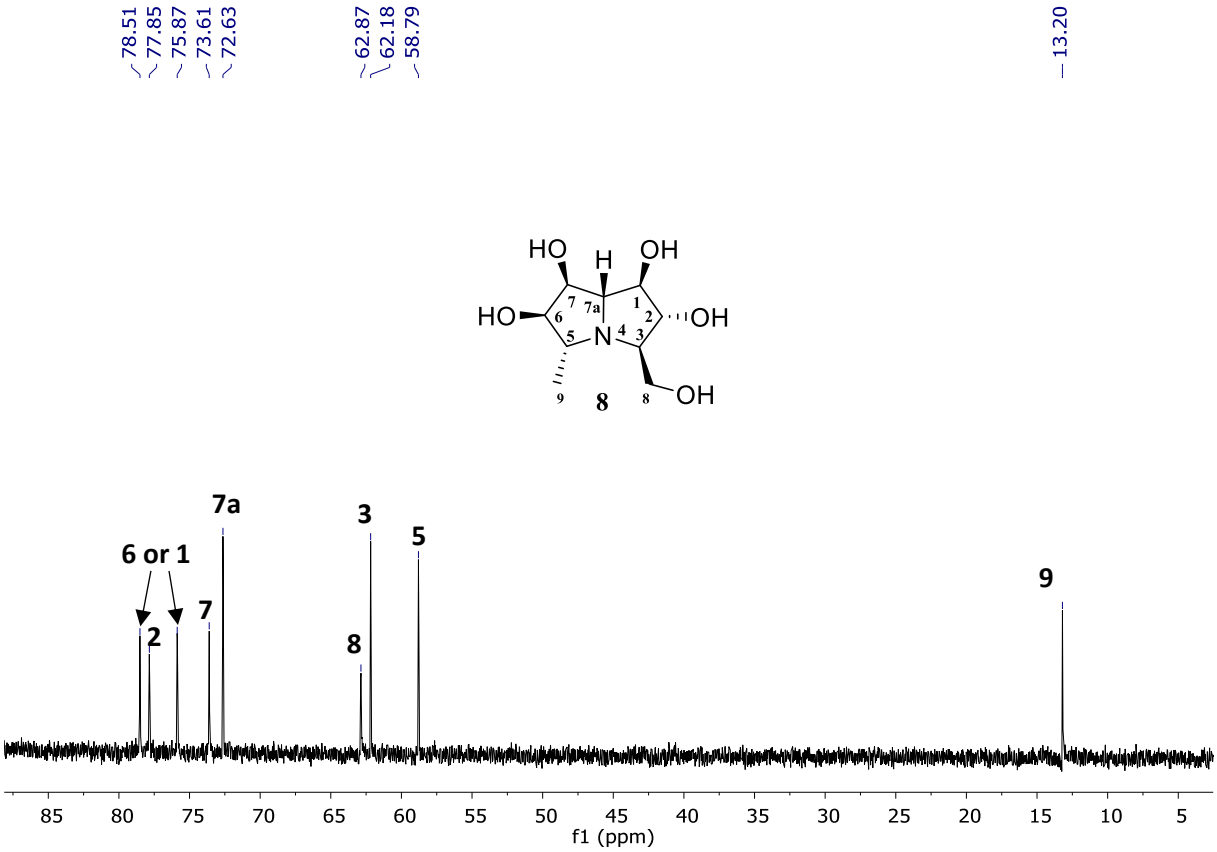


Figure S44: ^{13}C NMR spectrum (125 MHz, D_2O) of **8**

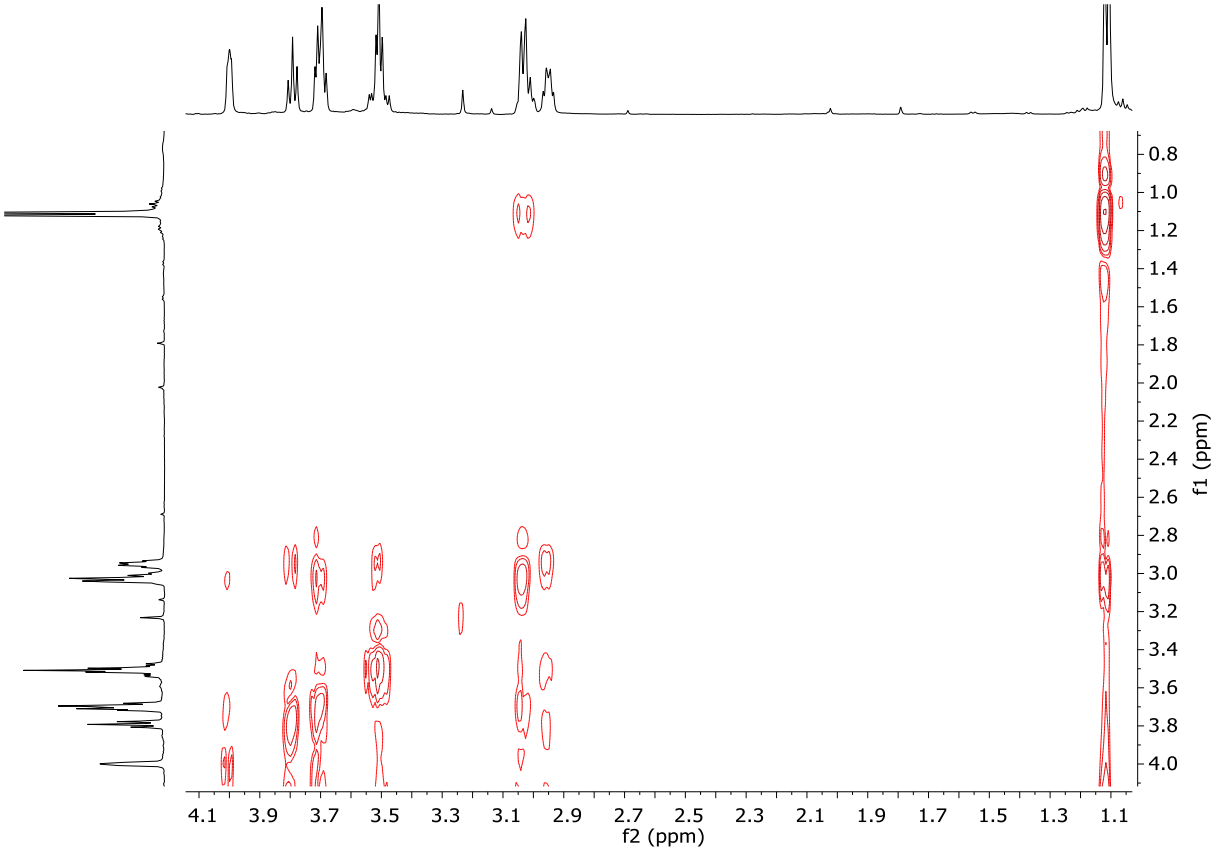


Figure S45: gCOSY spectrum (500 MHz, D_2O) of **8**

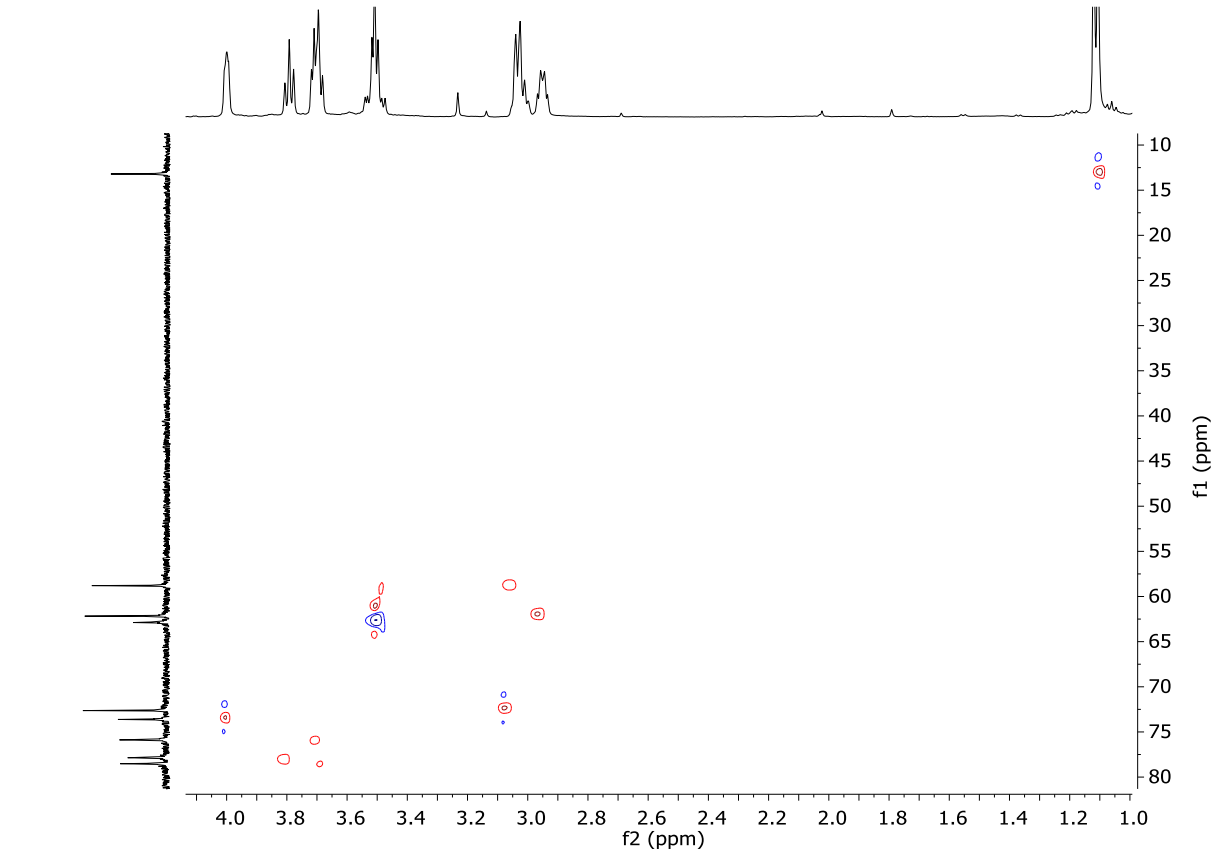


Figure S46: gHSQC spectrum (500 MHz, D_2O) of **8**

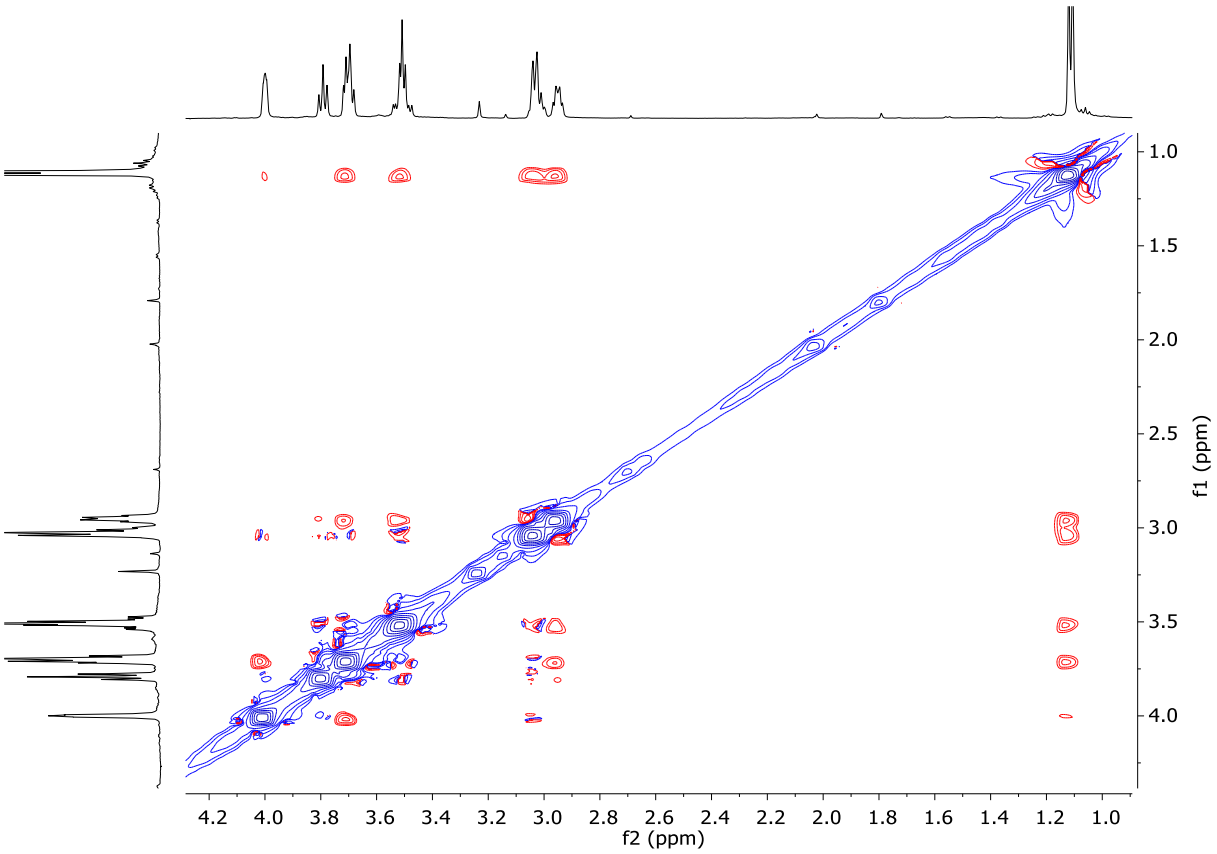


Figure S47: NOESY spectrum (500 MHz, D_2O) of **8**

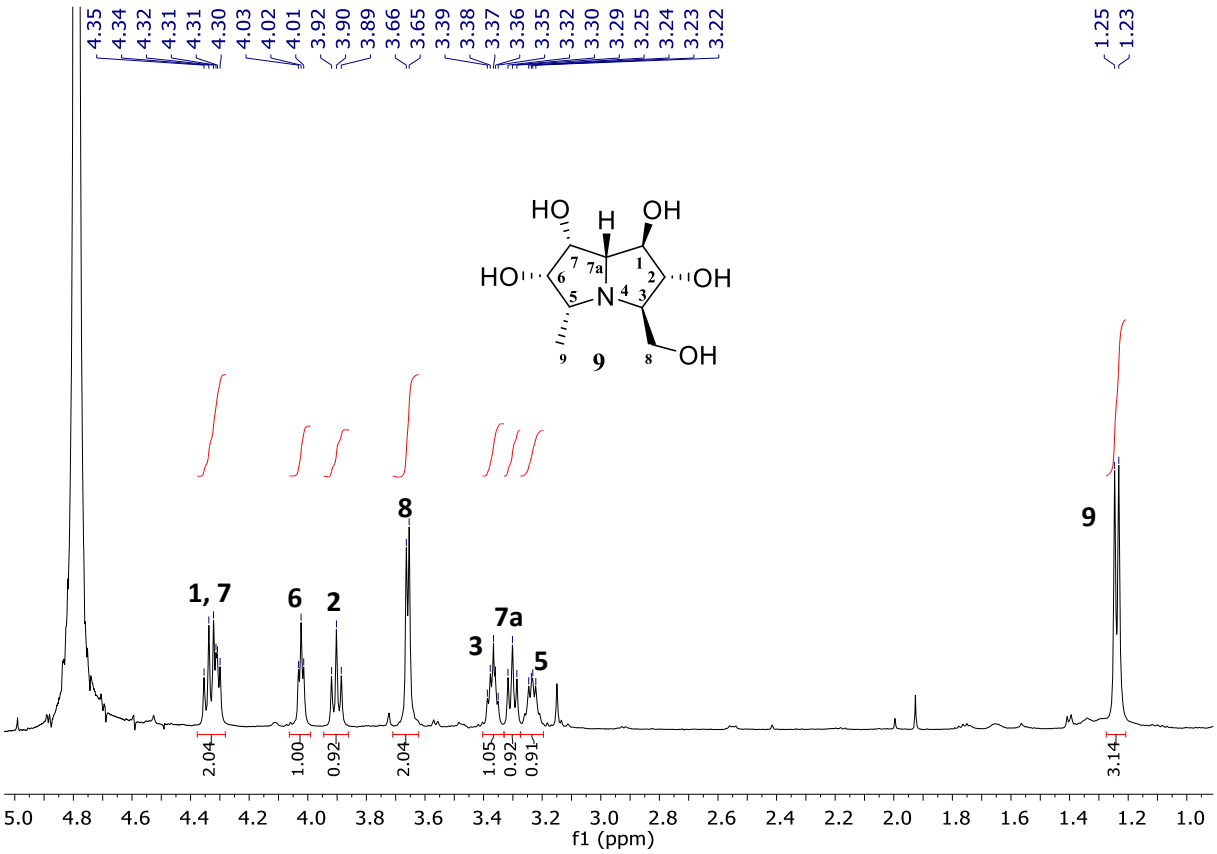


Figure S48: ^1H NMR spectrum (500 MHz, D_2O) of **9**

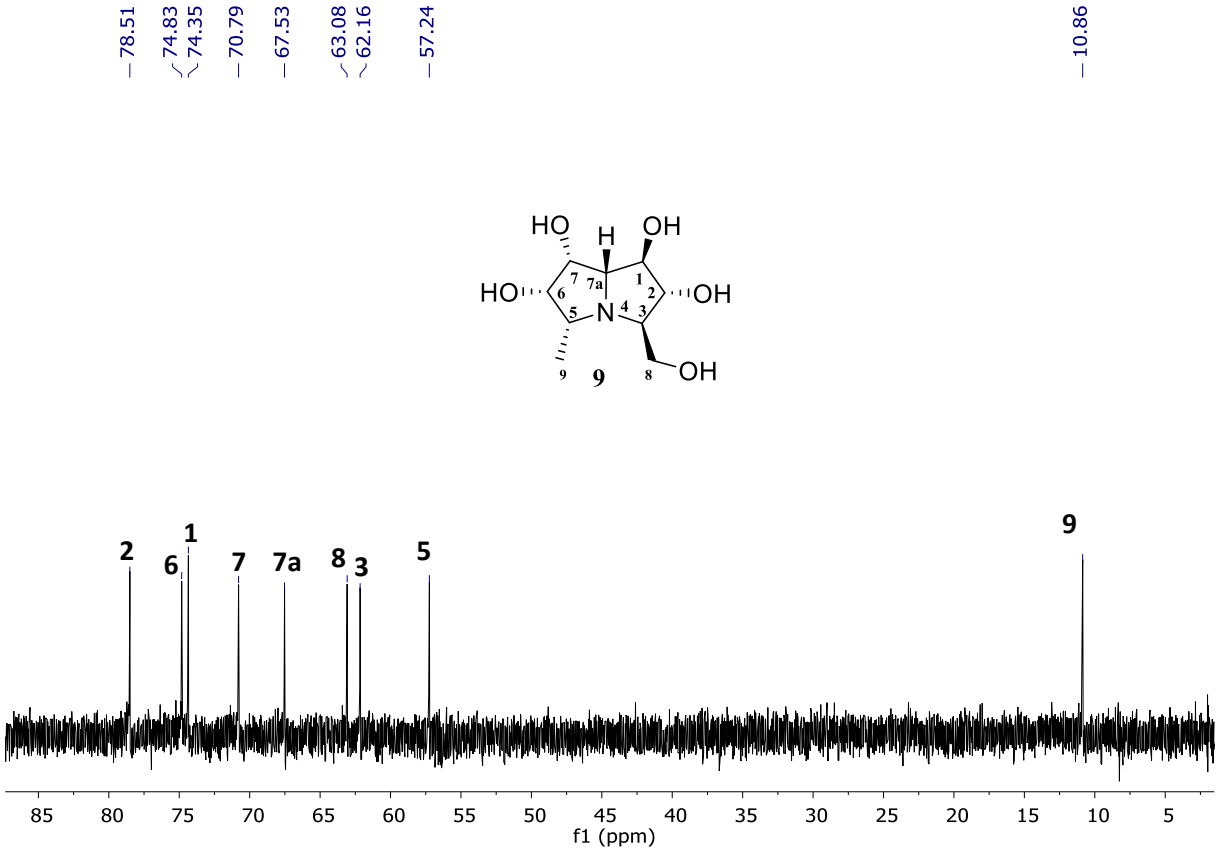


Figure S49: ^{13}C NMR spectrum (125 MHz, D_2O) of **9**

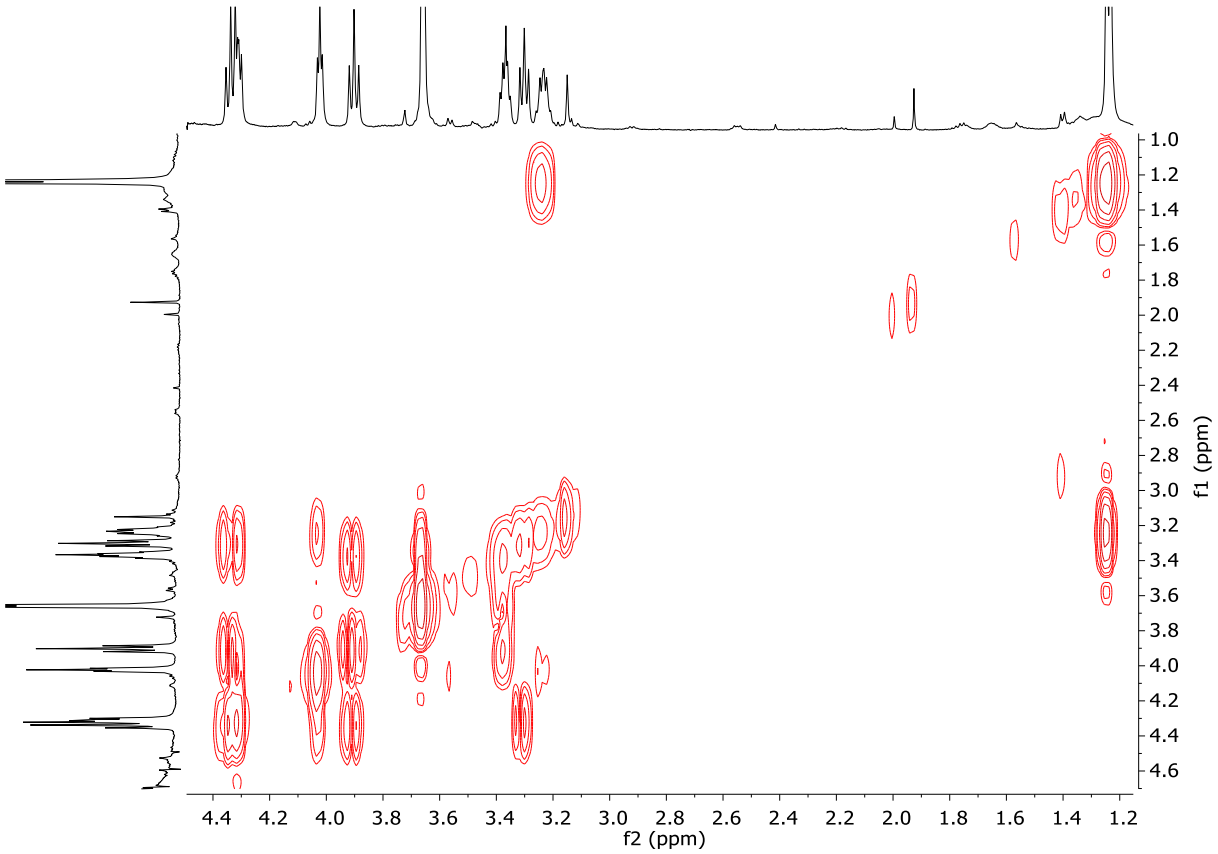


Figure S50: gCOSY spectrum (500 MHz, D_2O) of **9**

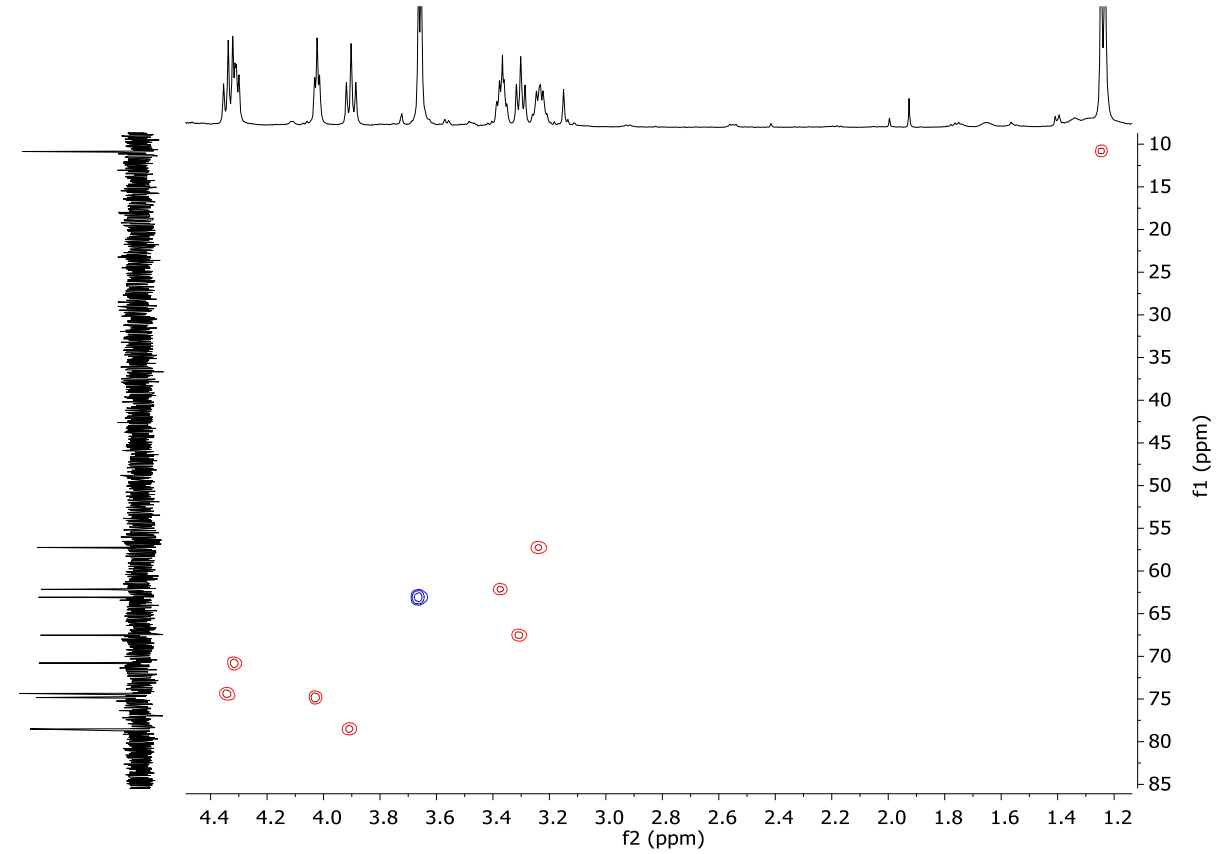


Figure S51: gHSQC spectrum (500 MHz, D_2O) of **9**

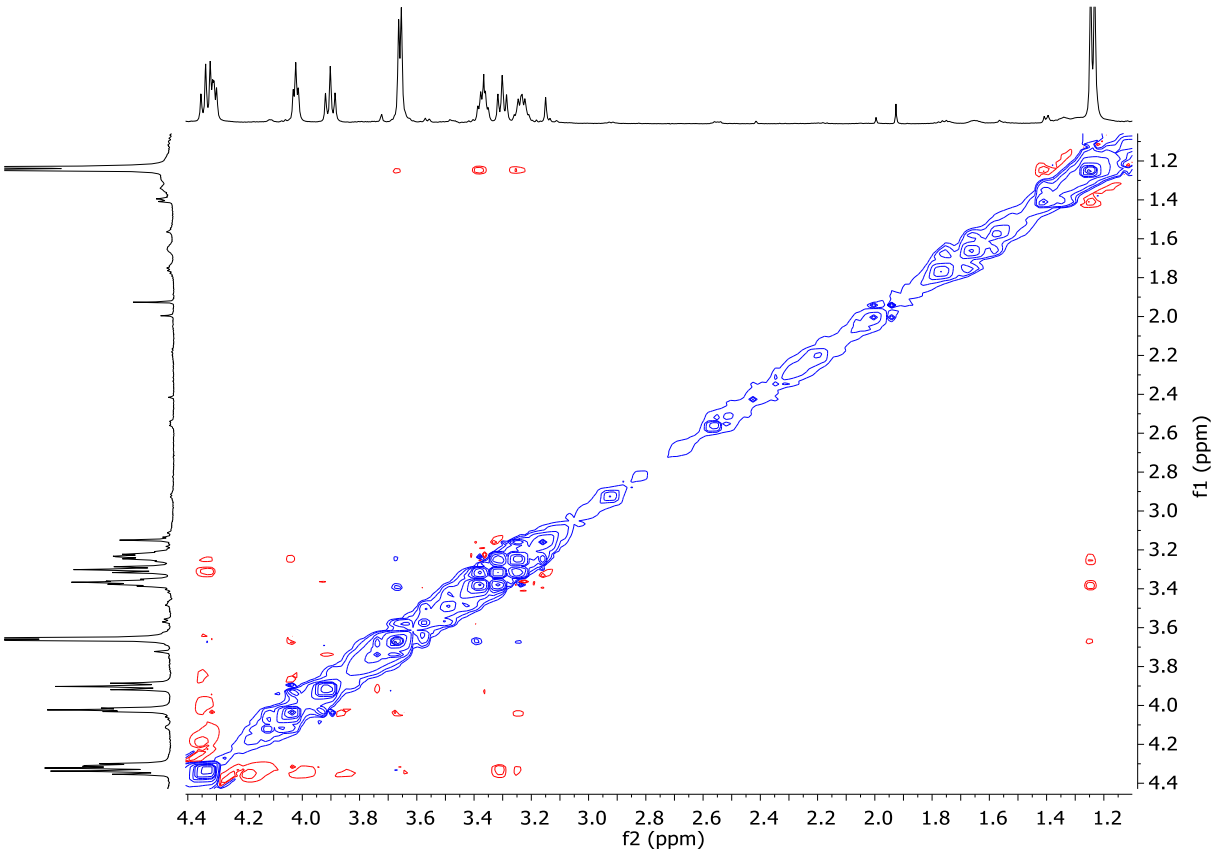


Figure S52: ROESY spectrum (500 MHz, D_2O) of **9**

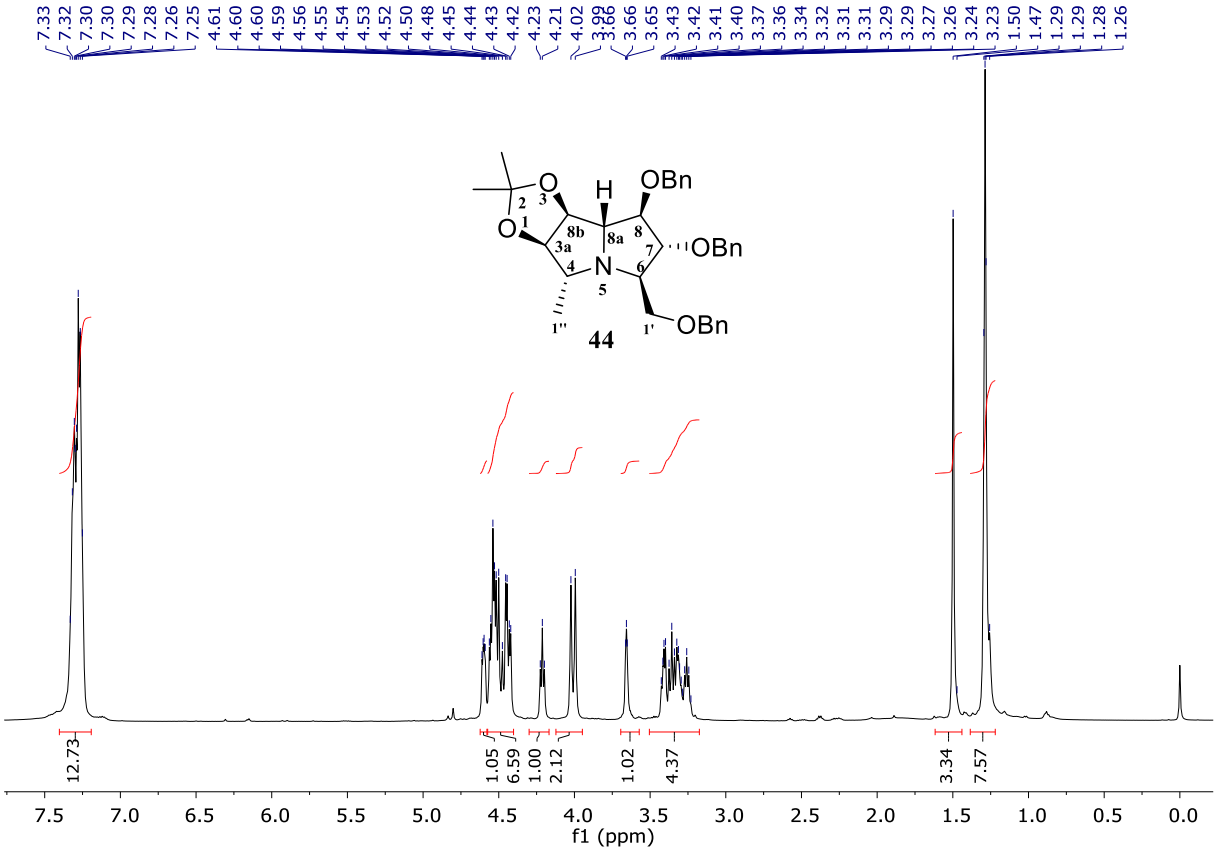


Figure S53: ^{1}H NMR spectrum (500 MHz, $CDCl_3$) of **44**

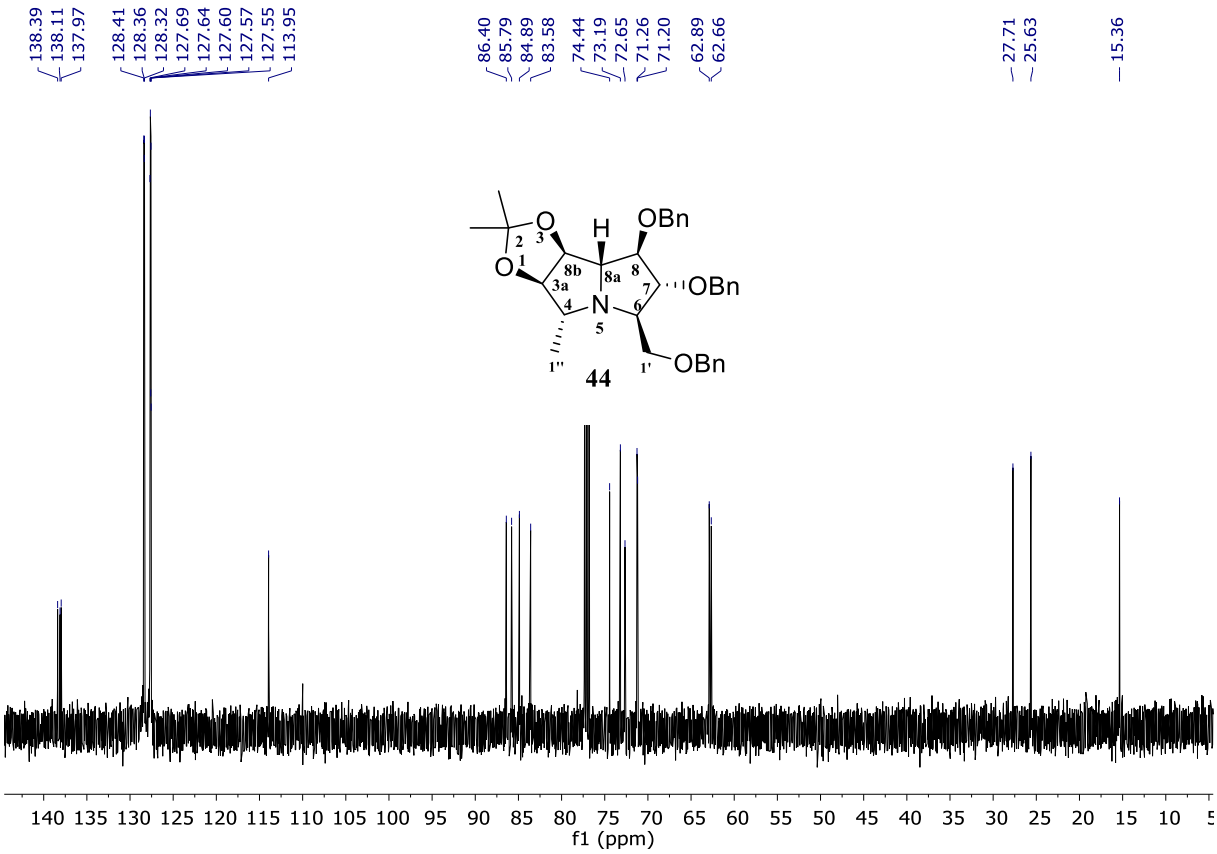


Figure S54: ^{13}C NMR spectrum (125 MHz, $CDCl_3$) of **44**

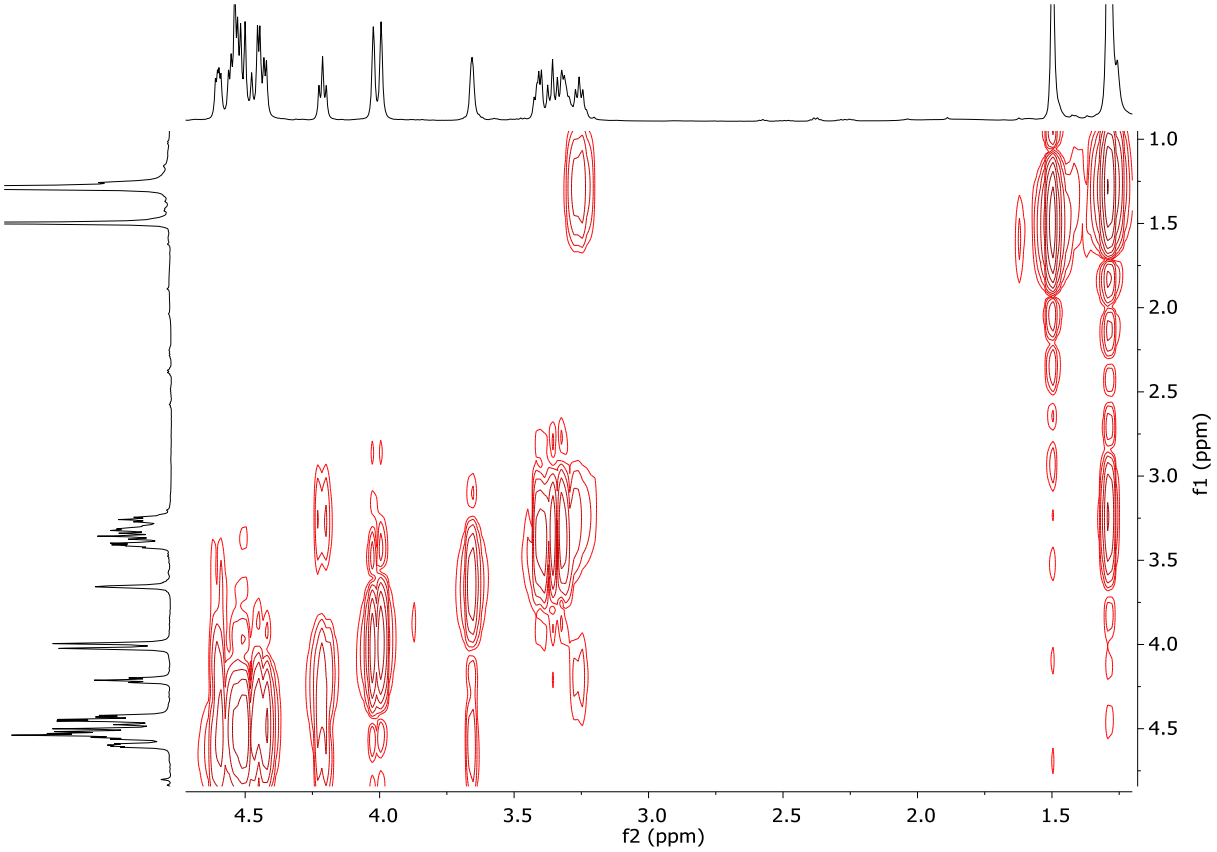


Figure S55: gCOSY spectrum (500 MHz, $CDCl_3$) of **44**

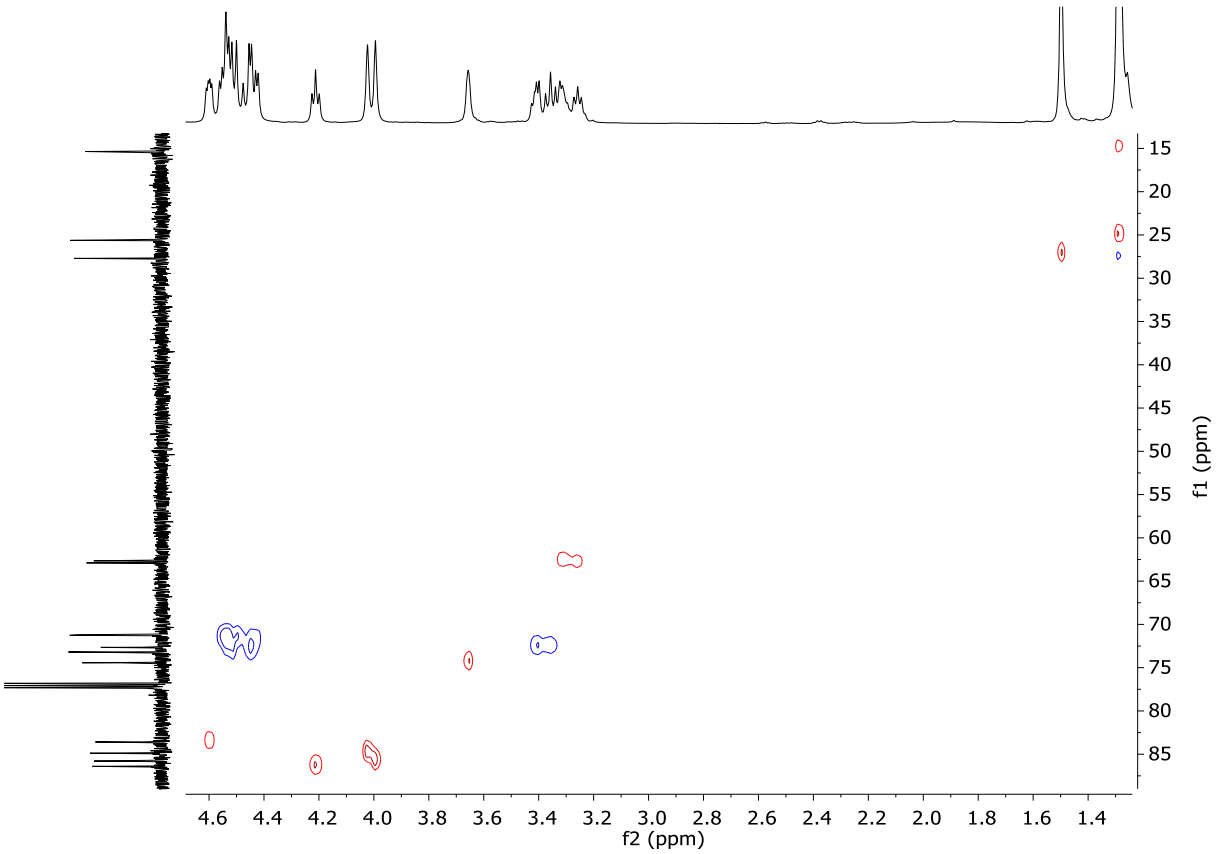


Figure S56: gHSQC spectrum (500 MHz, $CDCl_3$) of **44**

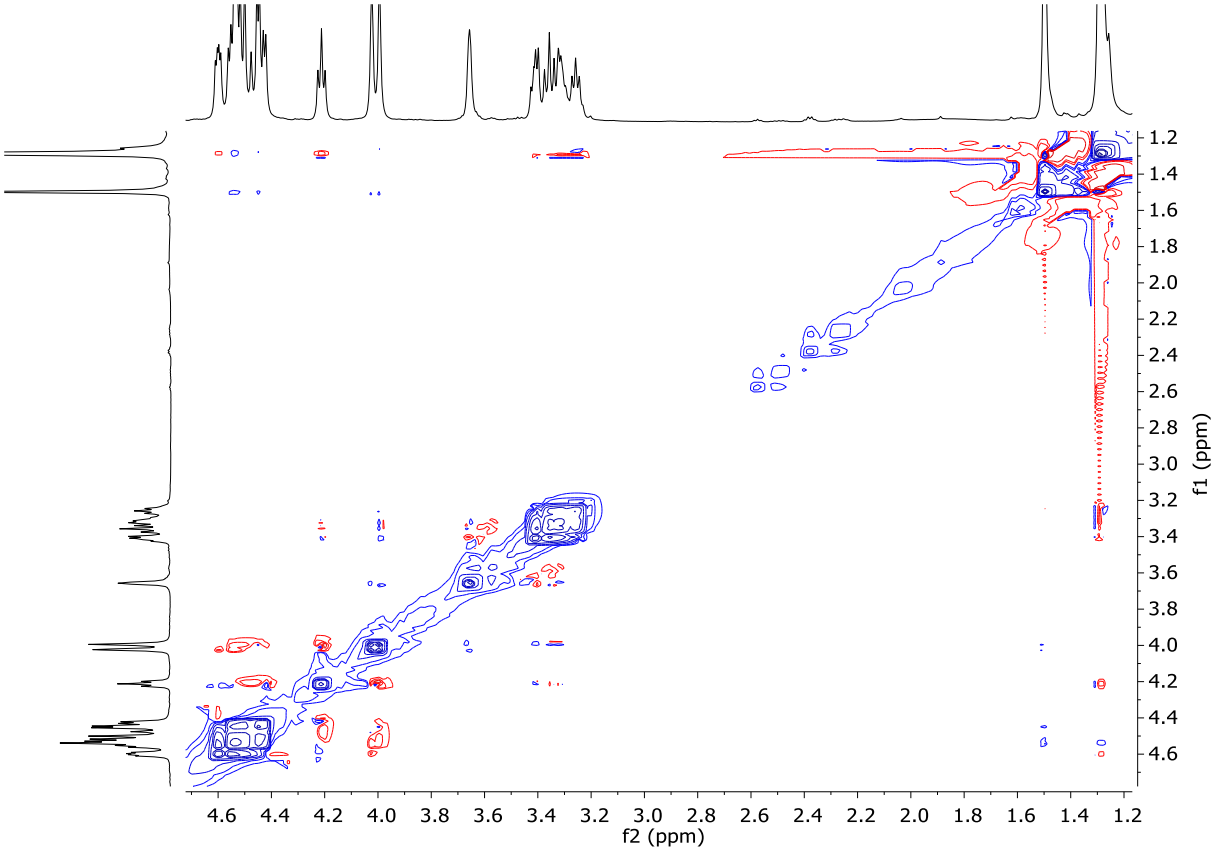


Figure S57: ROESY spectrum (500 MHz, $CDCl_3$) of **44**

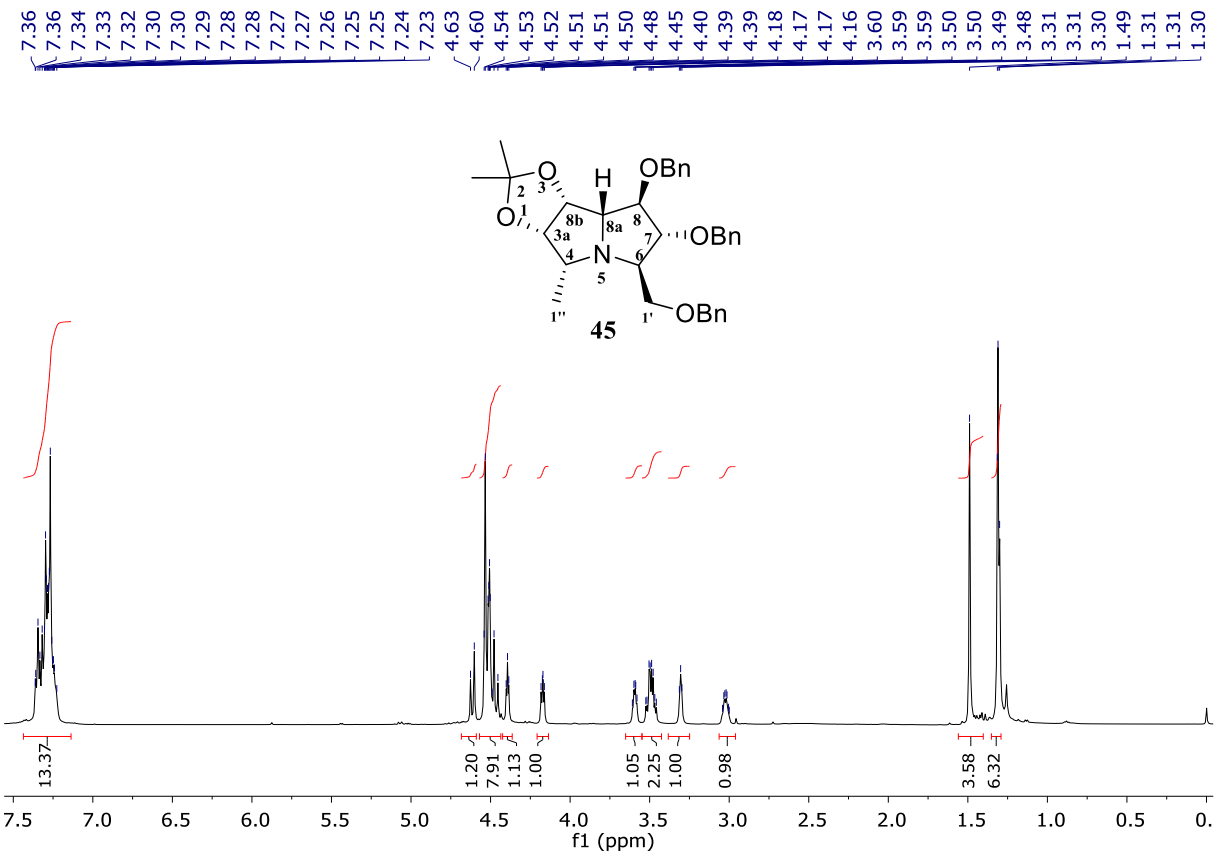


Figure S58: ^1H NMR spectrum (500 MHz, $CDCl_3$) of **45**

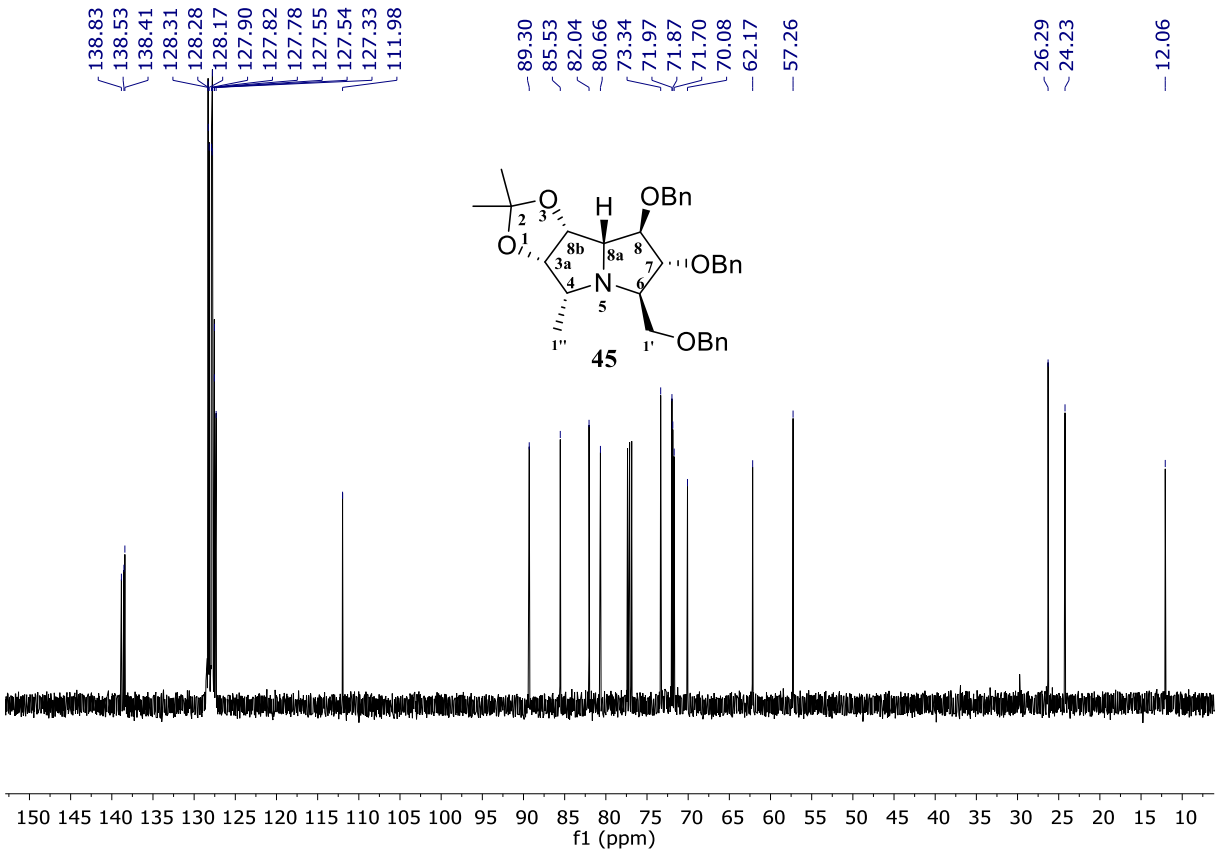


Figure S59: ^{13}C NMR spectrum (125 MHz, $CDCl_3$) of **45**

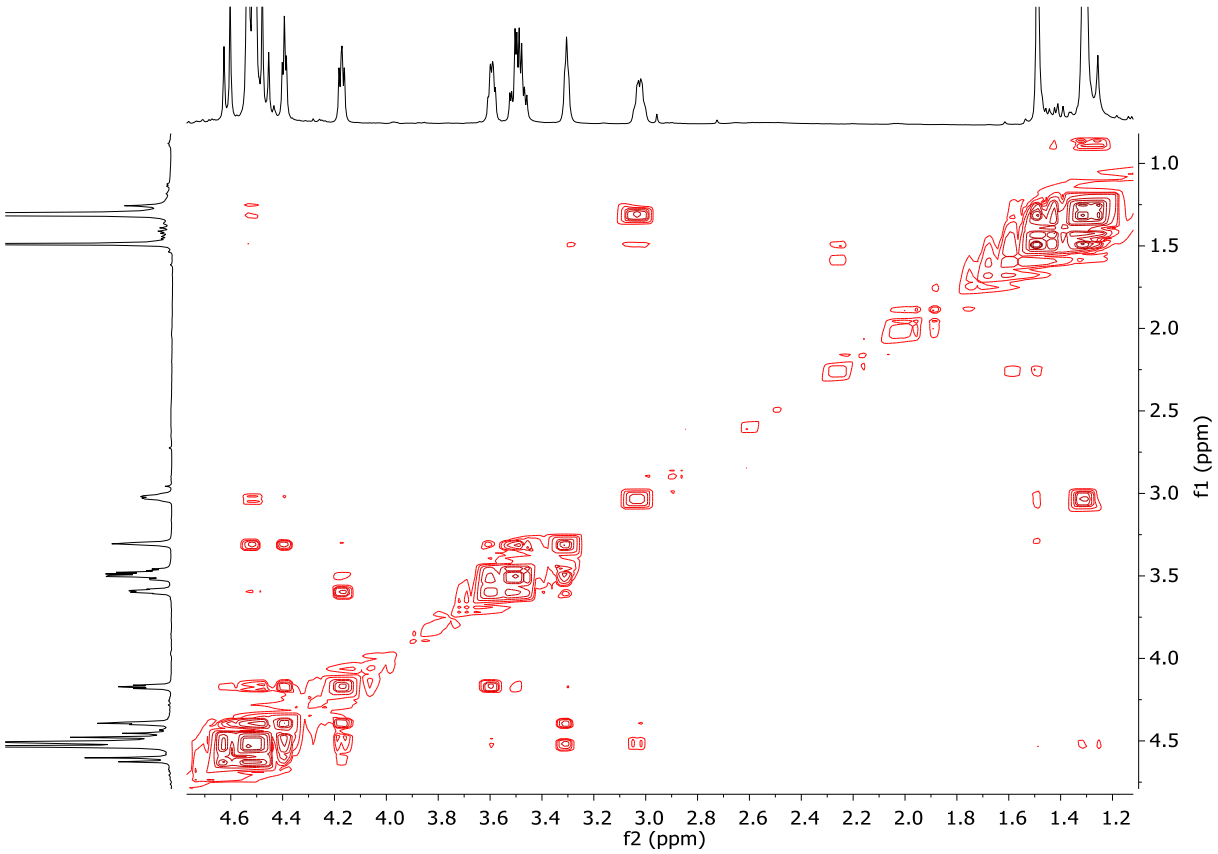


Figure S60: gCOSY spectrum (500 MHz, $CDCl_3$) of **45**

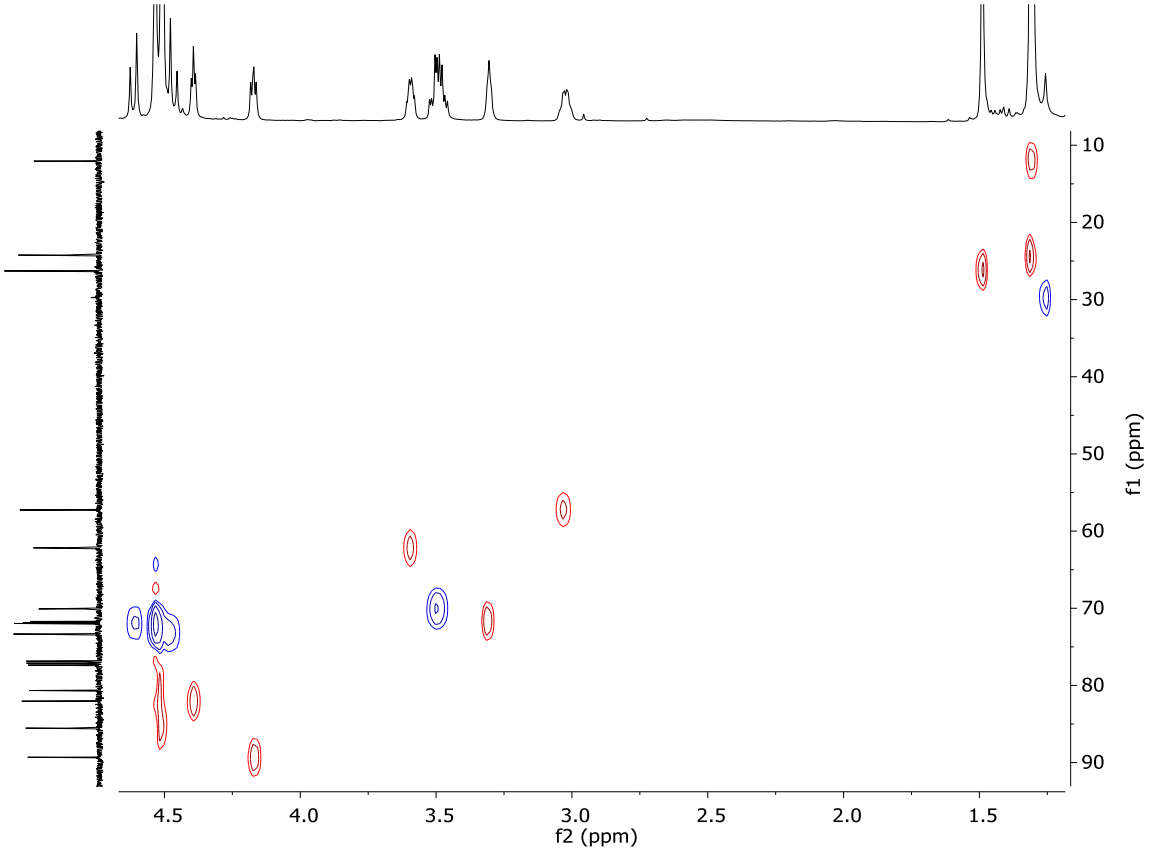
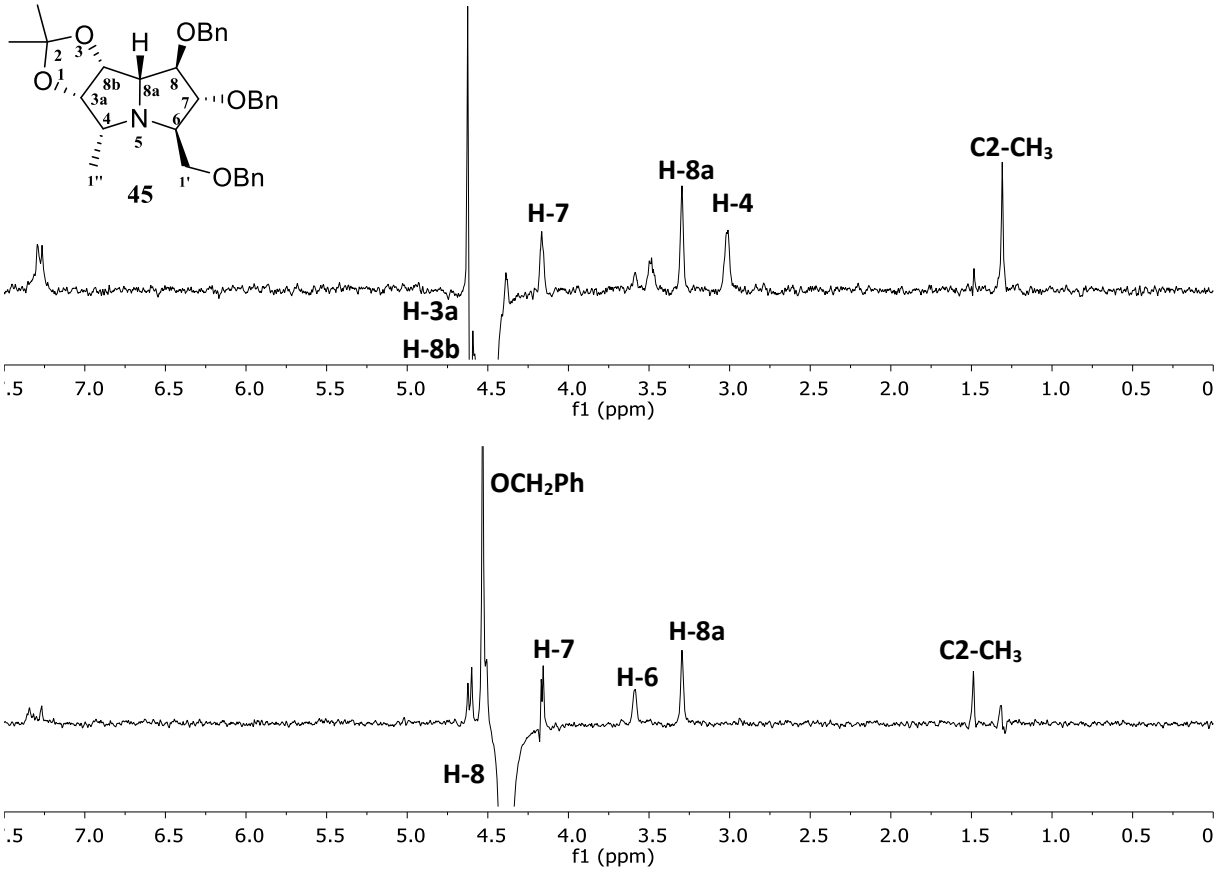
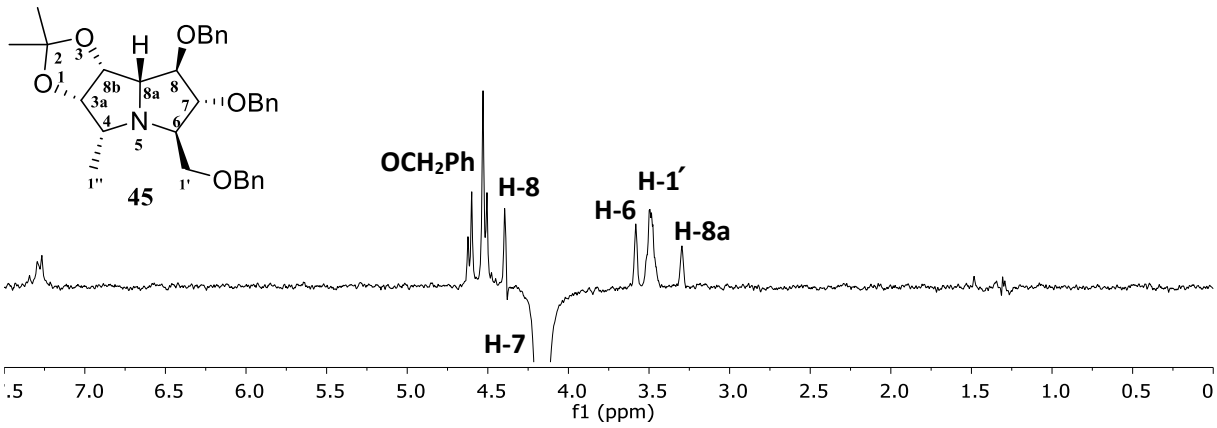
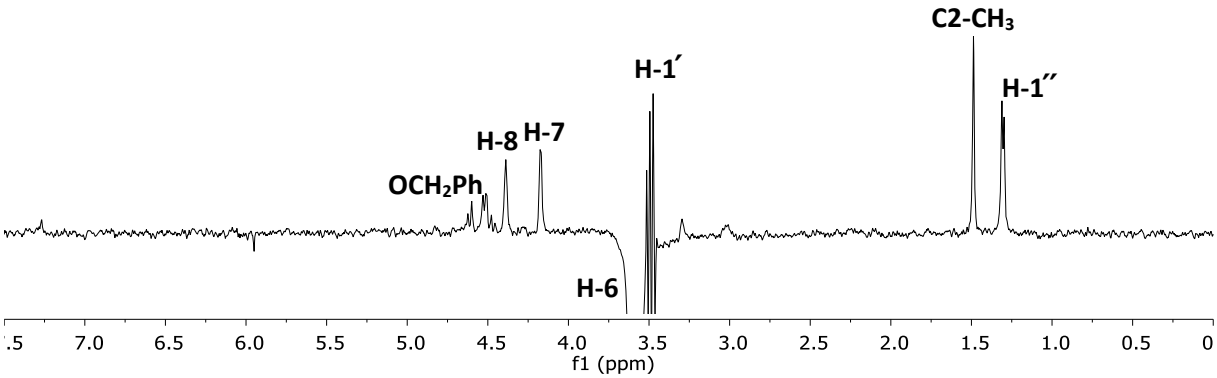
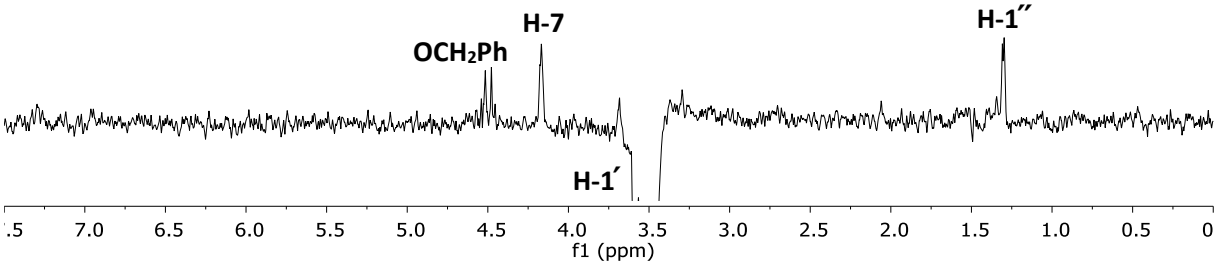


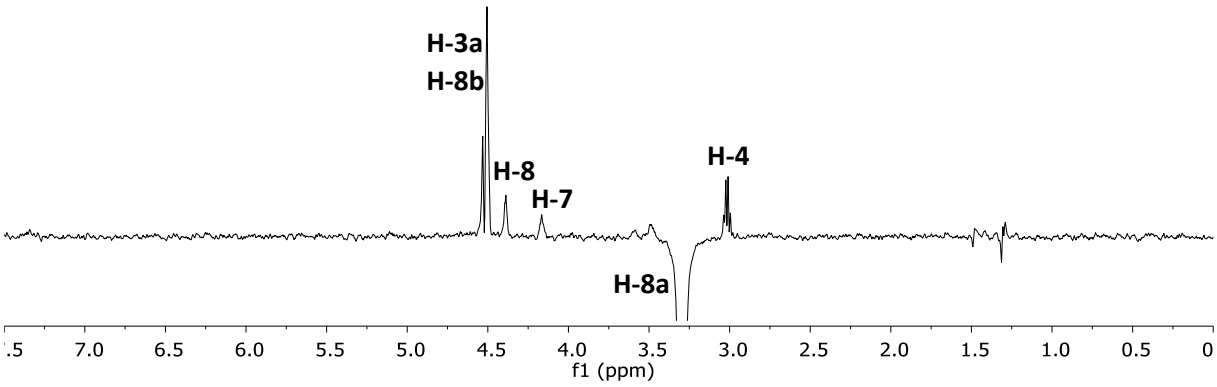
Figure S61: gHSQC spectrum (500 MHz, $CDCl_3$) of **45**




OBn
OBn
OBn
45
OCH2Ph
H-8
H-1´
H-6
H-8a
H-7
f1 (ppm)


C2-CH3
H-1´
H-1´´
H-8
H-7
OCH2Ph
H-6
f1 (ppm)


H-7
OCH2Ph
H-1´´
H-1´
f1 (ppm)


H-3a
H-8b
H-8
H-7
H-4
H-8a
f1 (ppm)

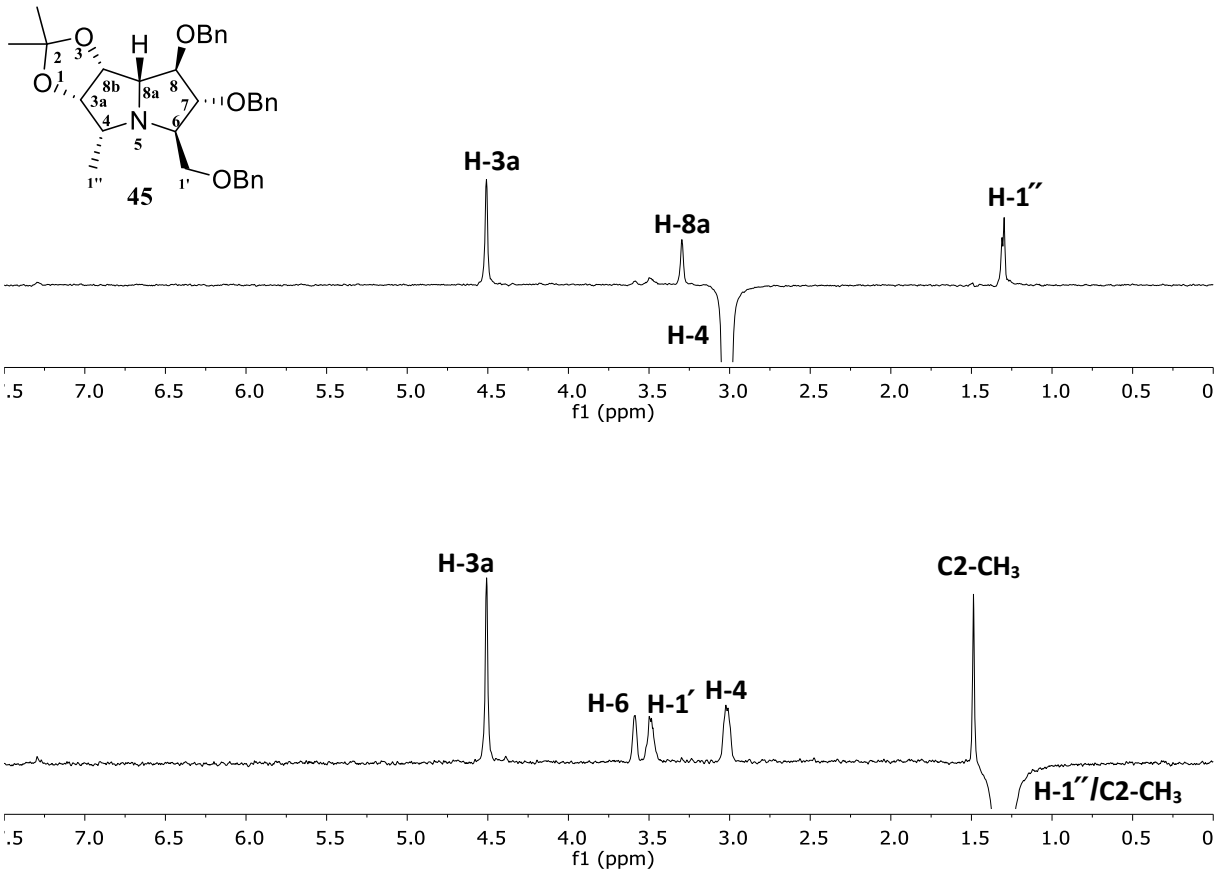


Figure S62: 1D-NOE spectrum (500 MHz, $CDCl_3$) of **45**

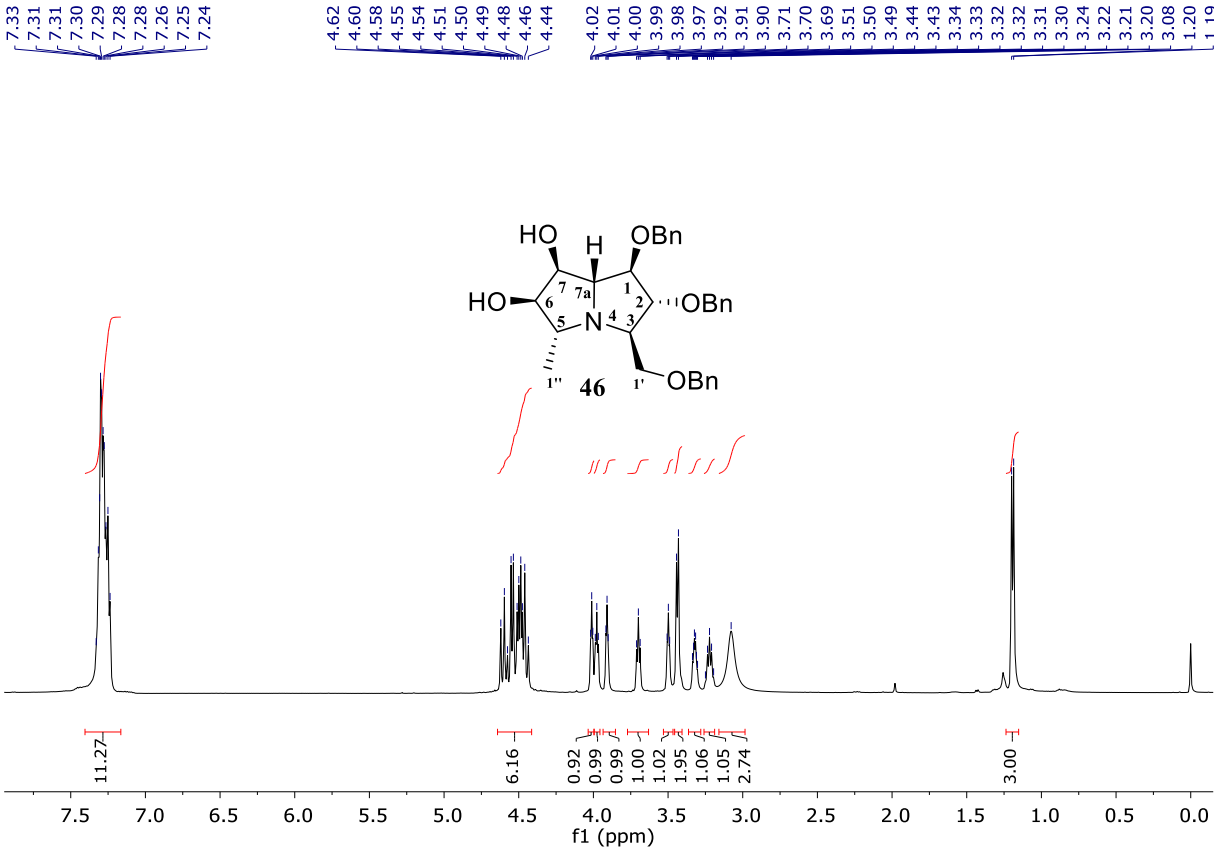


Figure S63: ^{1}H NMR spectrum (500 MHz, $CDCl_3$) of **46**

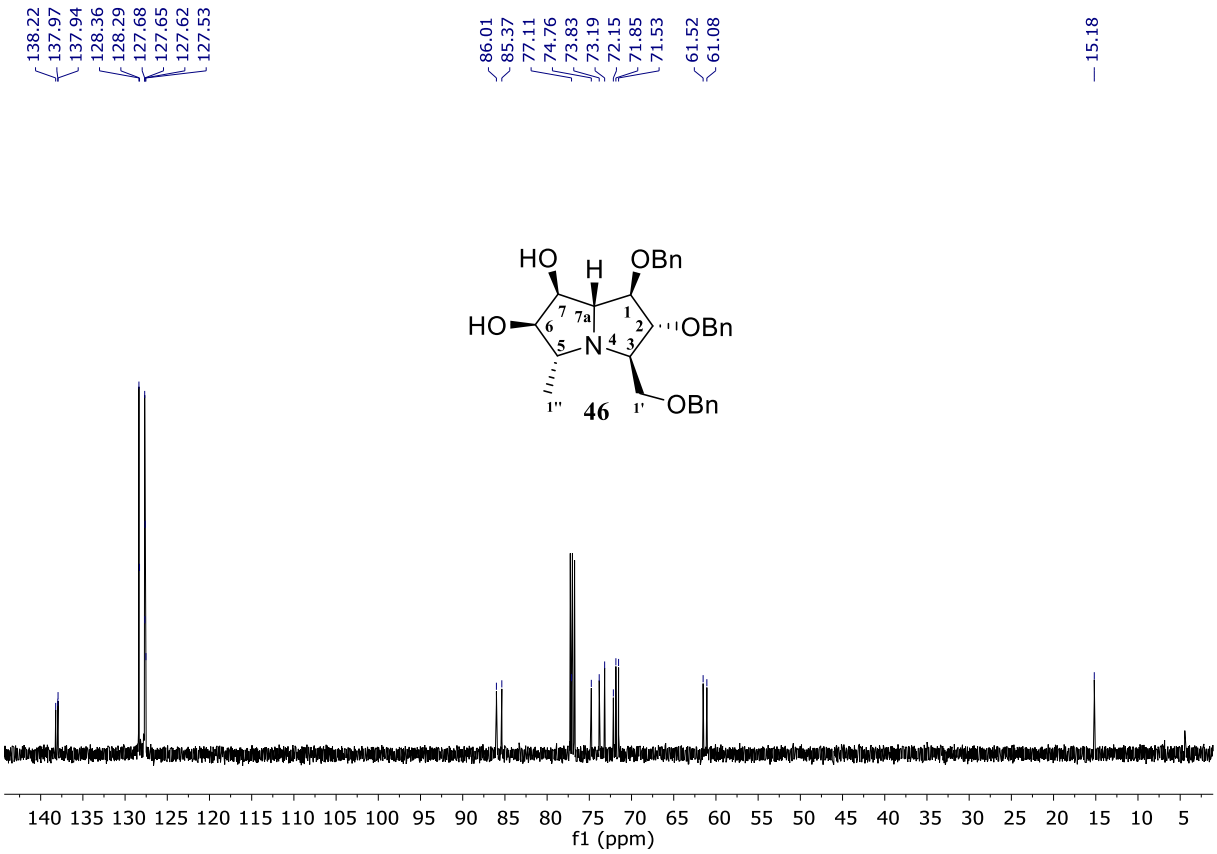


Figure S64: ^{13}C NMR spectrum (125 MHz, $CDCl_3$) of **46**

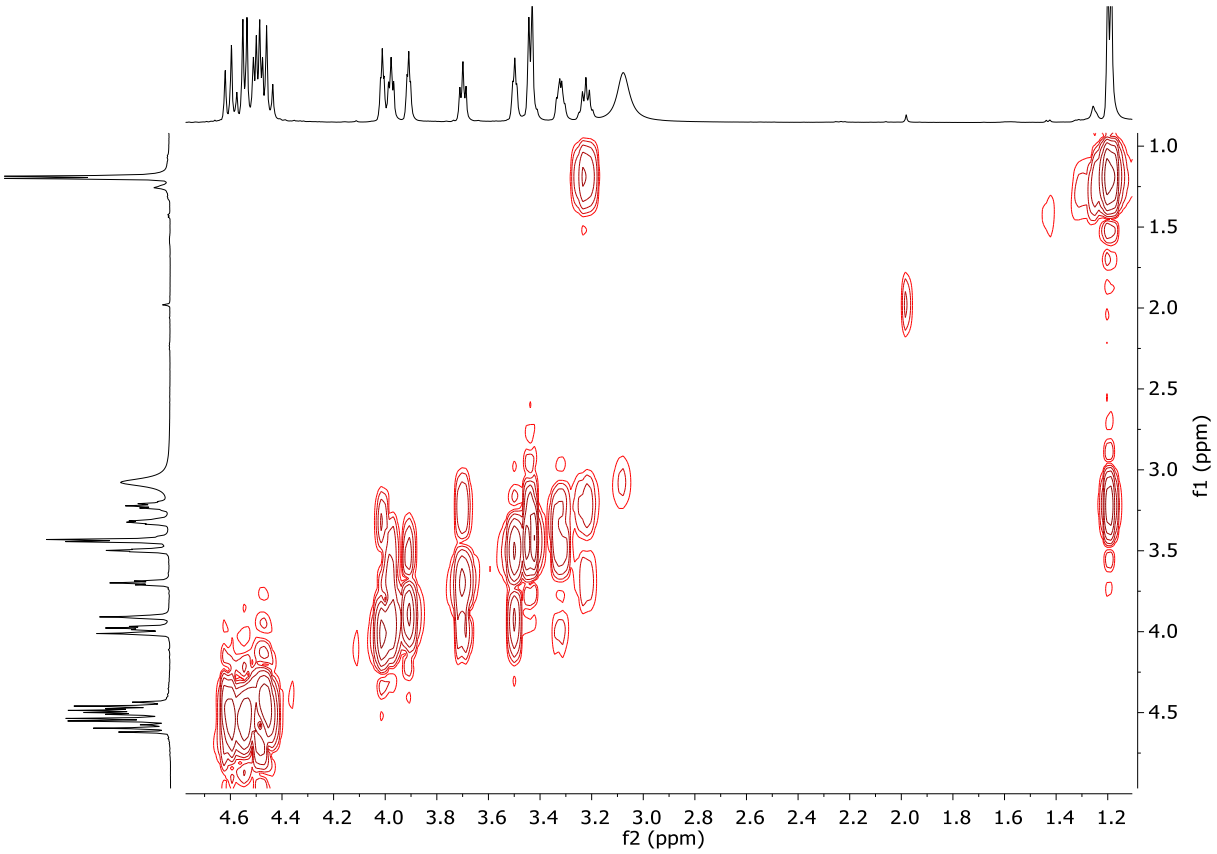


Figure S65: gCOSY spectrum (500 MHz, $CDCl_3$) of **46**

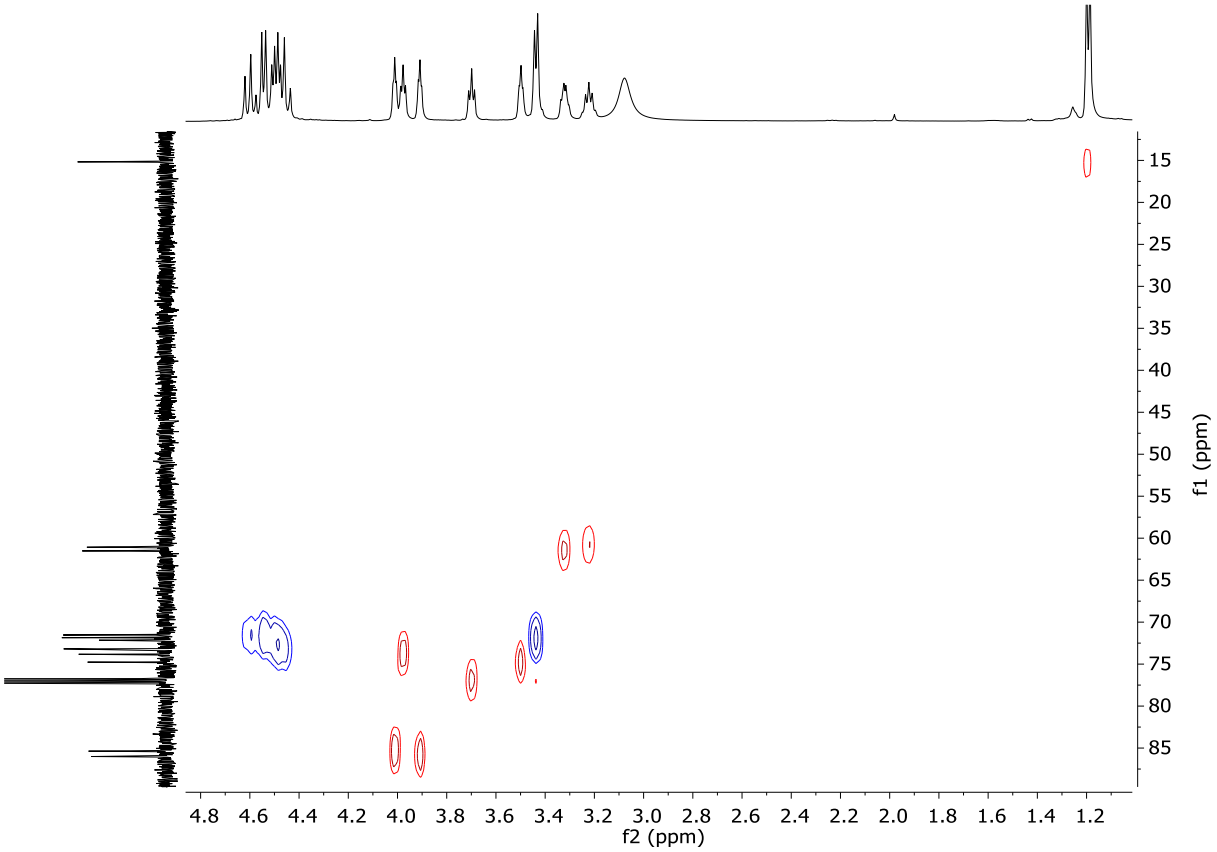
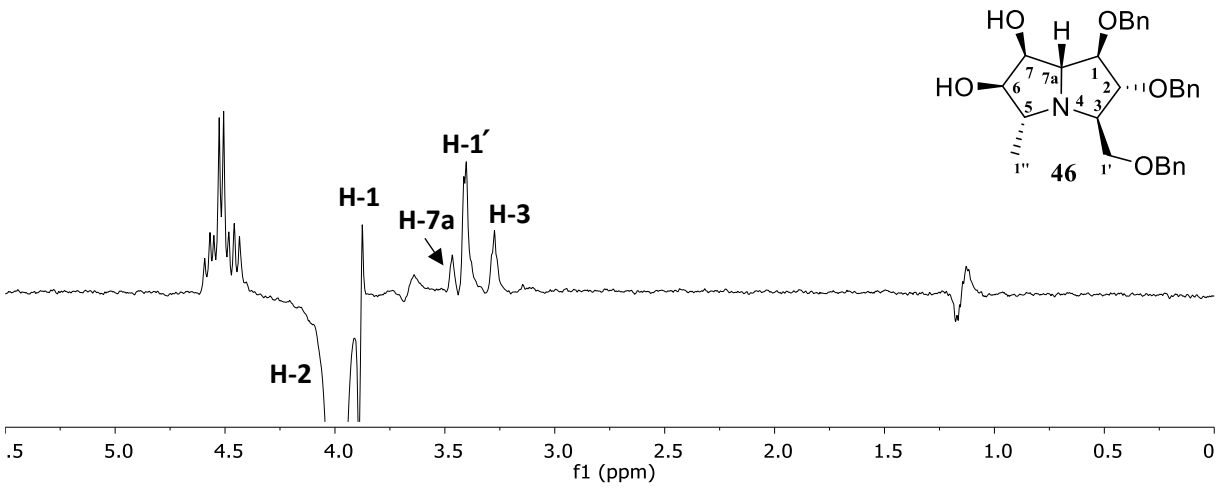
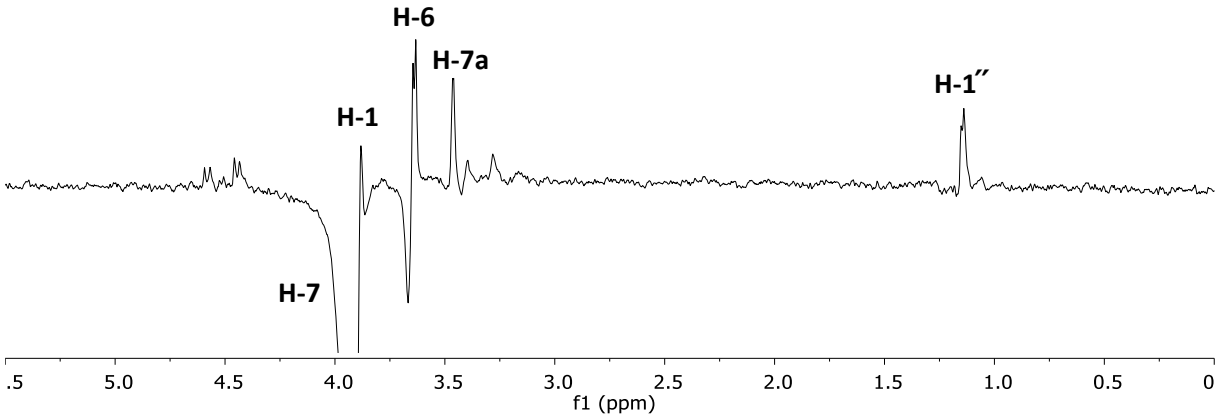
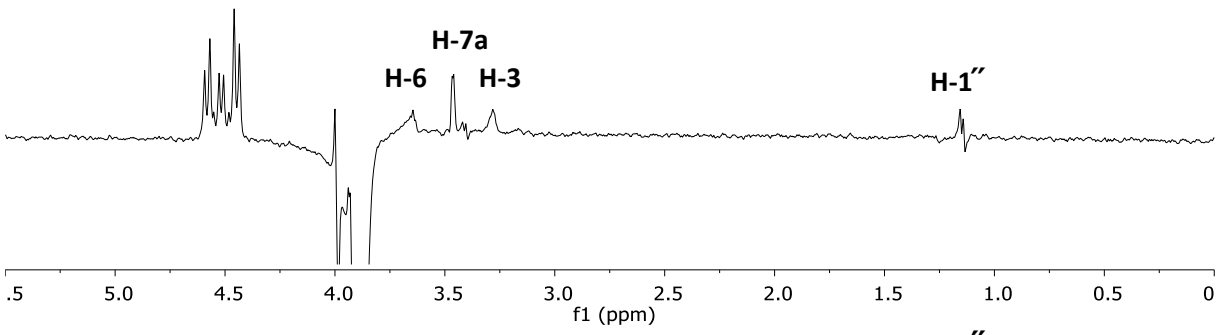
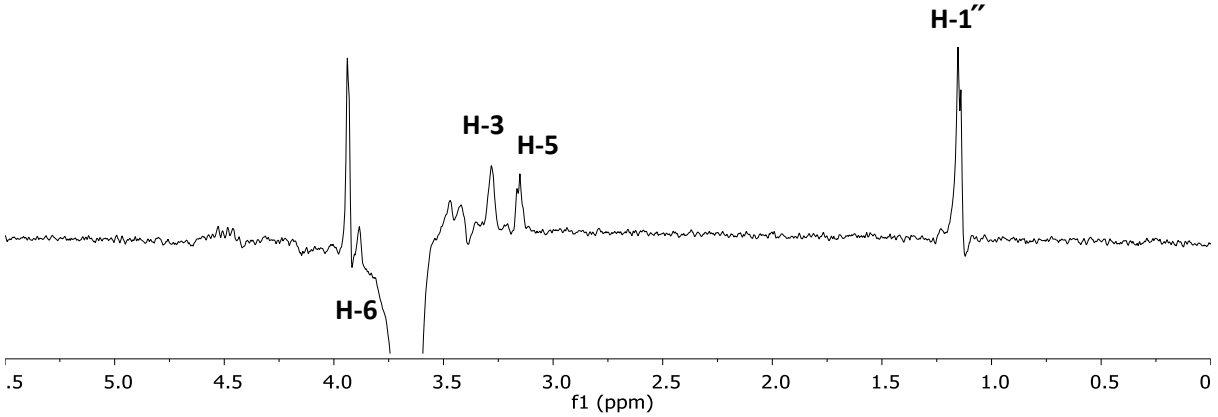


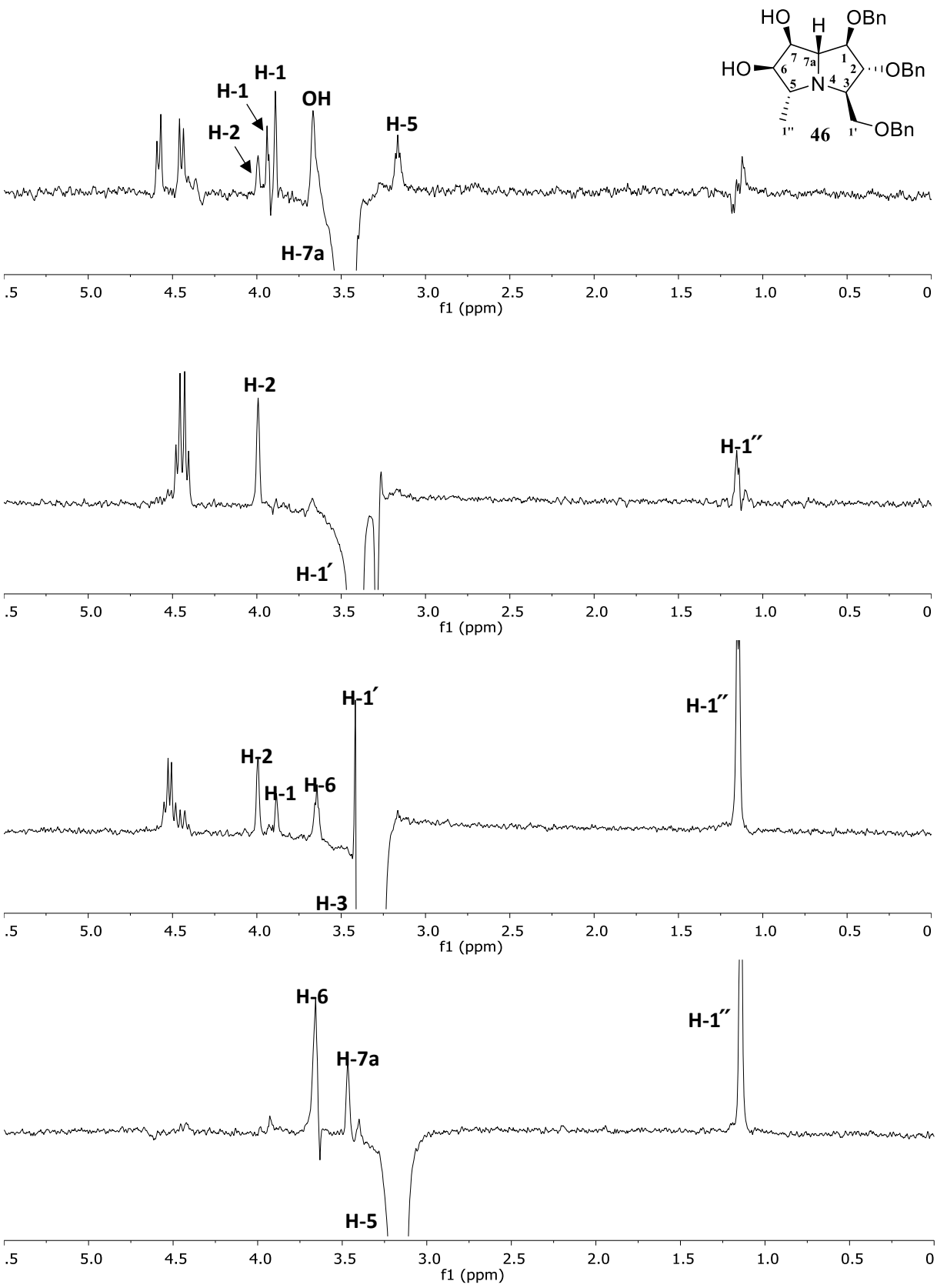
Figure S66: gHSQC spectrum (500 MHz, $CDCl_3$) of **46**


HO
H
OBn
HO
OBn
N
OBn
46
H-1´
H-1
H-7a
H-3
H-2
.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0
f1 (ppm)


H-6
H-7a
H-1″
H-1
H-7
.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0
f1 (ppm)


H-7a
H-6
H-3
H-1″
.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0
f1 (ppm)


H-1″
H-3
H-5
H-6
.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0
f1 (ppm)


HO
H
OBn
HO
OBn
OBn
N
46
H-1
H-1
H-2
OH
H-5
H-7a
f1 (ppm)
H-2
H-1″
H-1′
f1 (ppm)
H-1′
H-1″
H-2
H-1
H-6
H-3
f1 (ppm)
H-6
H-1″
H-7a
H-5
f1 (ppm)

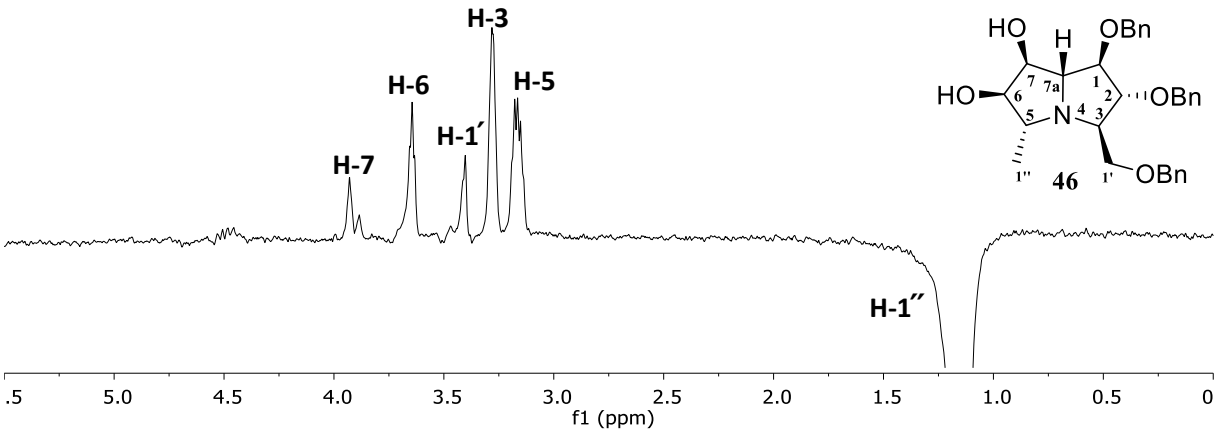


Figure S67: 1D-NOE spectrum (500 MHz, $CDCl_3$) of **46**

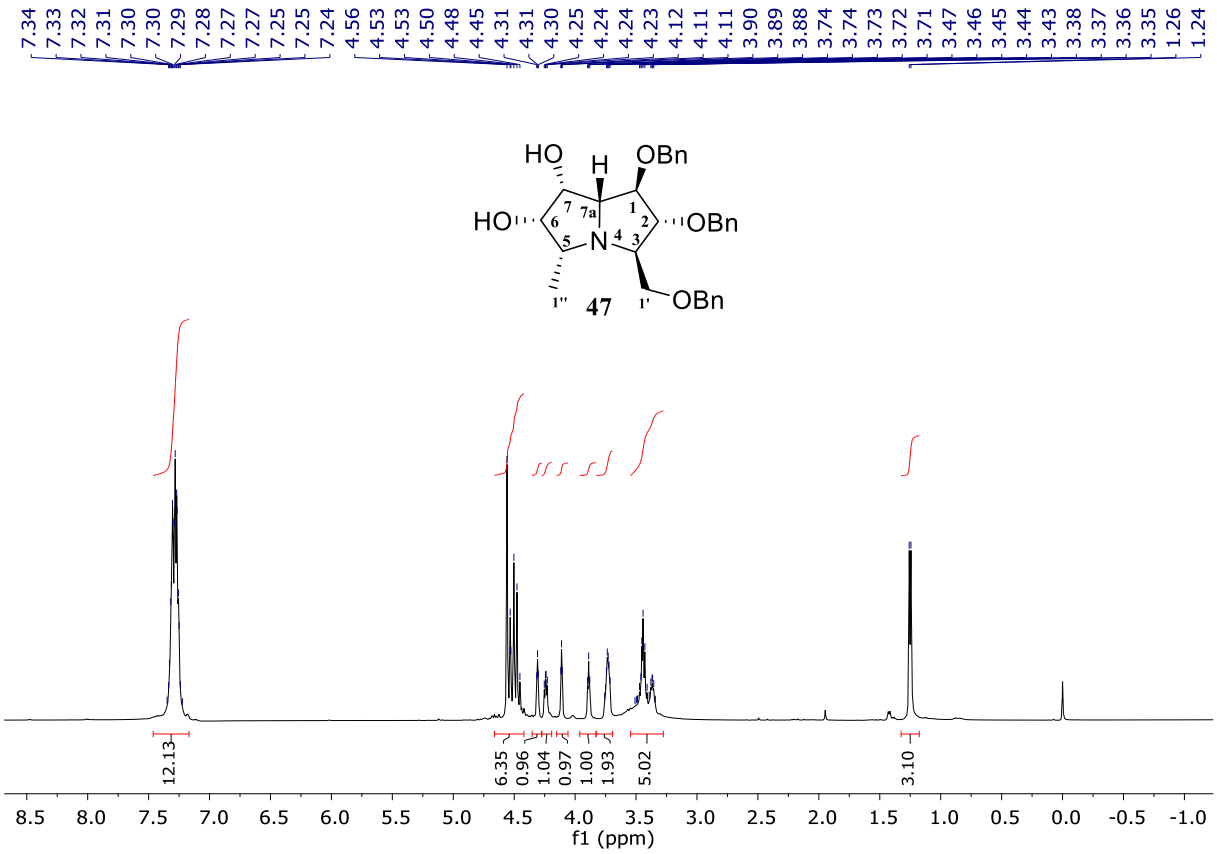


Figure S68: ^{1}H NMR spectrum (500 MHz, $CDCl_3$) of **47**

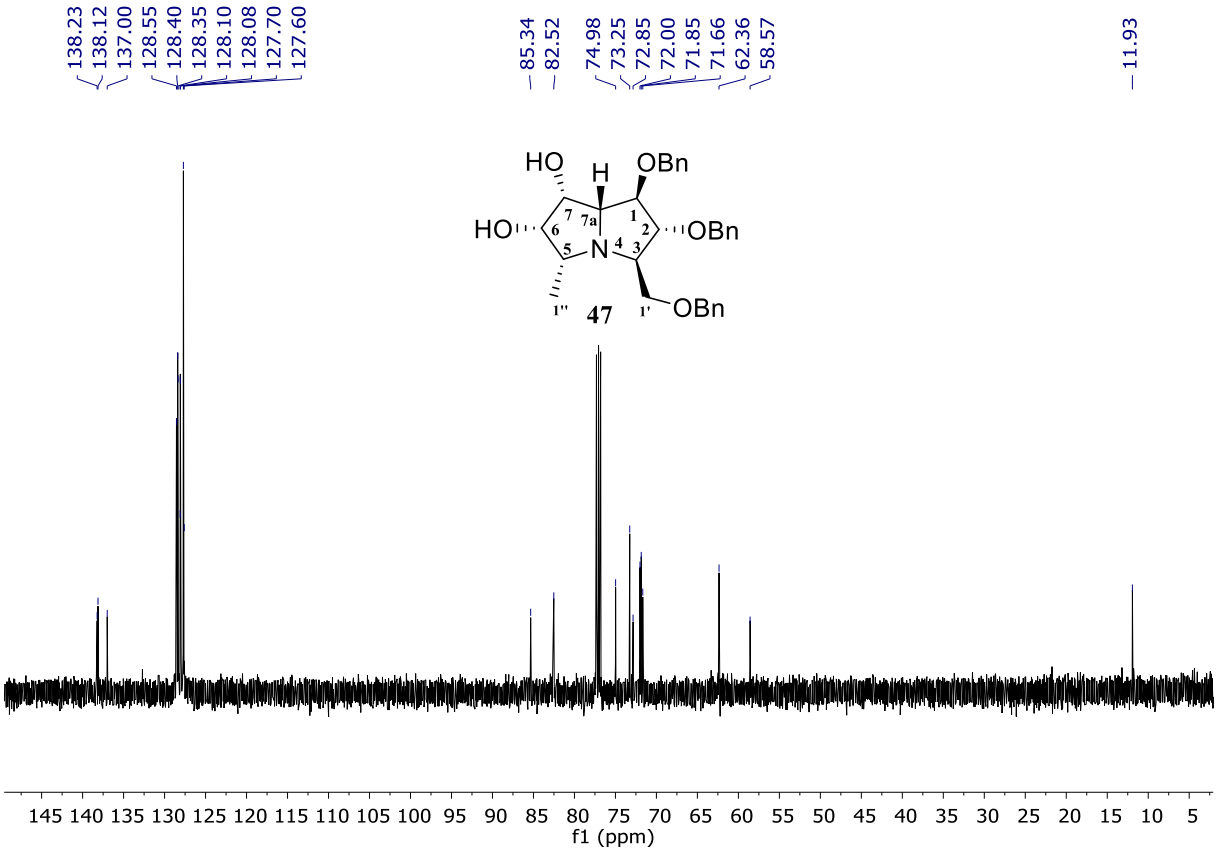


Figure S69: ^{13}C NMR spectrum (125 MHz, $CDCl_3$) of **47**

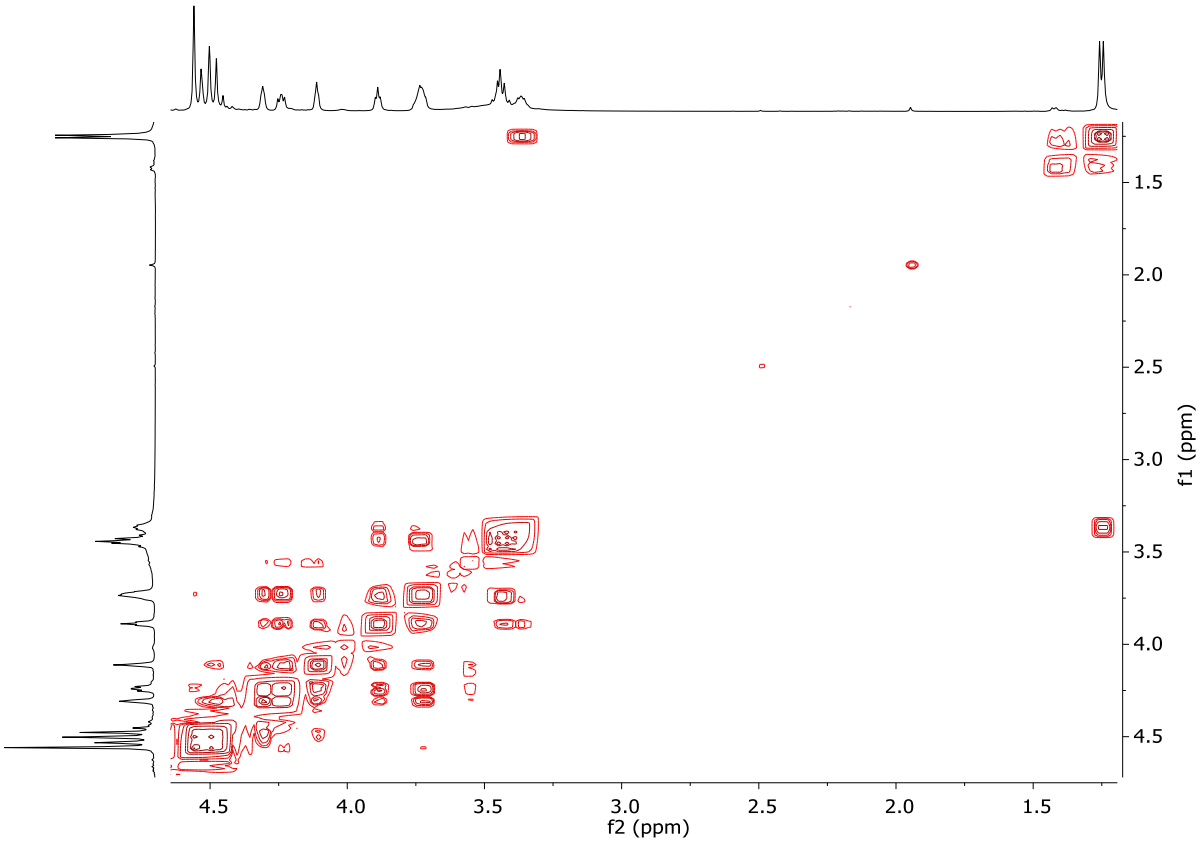


Figure S70: gCOSY spectrum (500 MHz, $CDCl_3$) of **47**

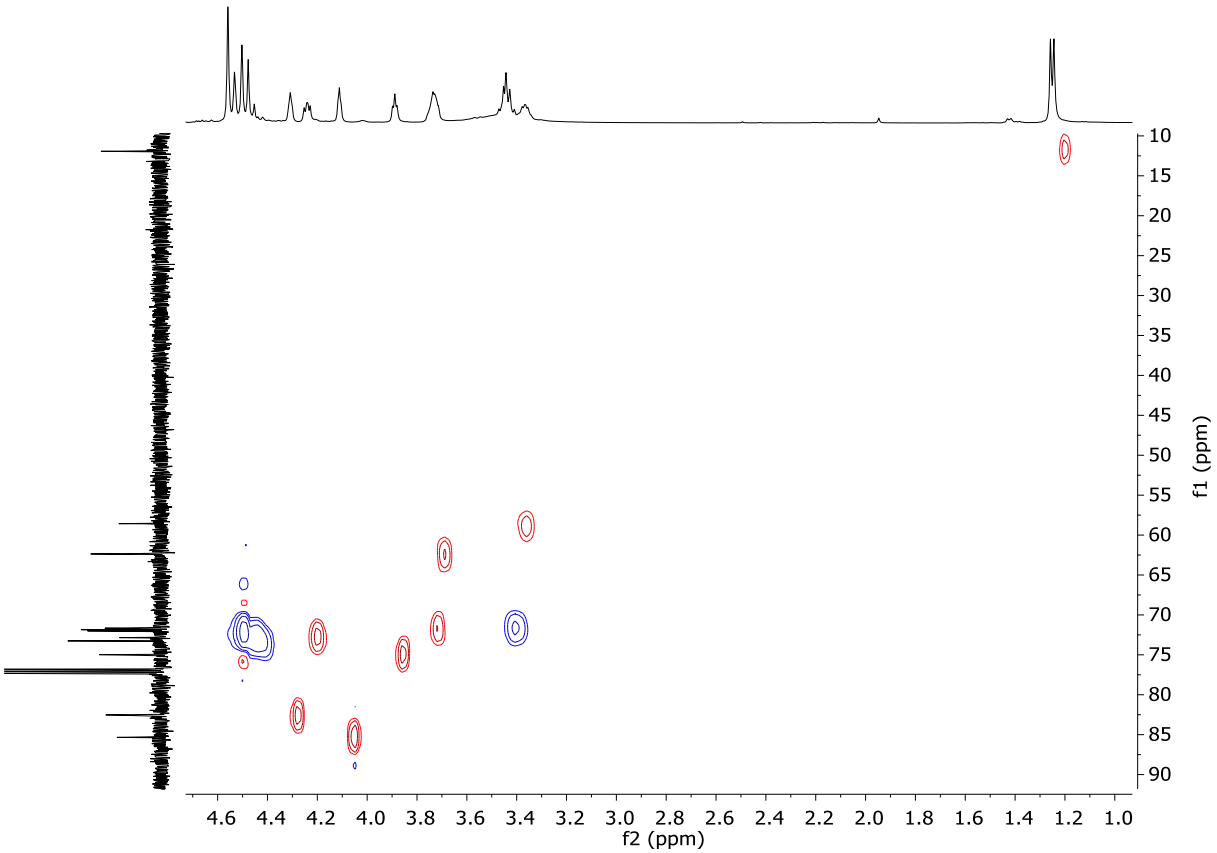
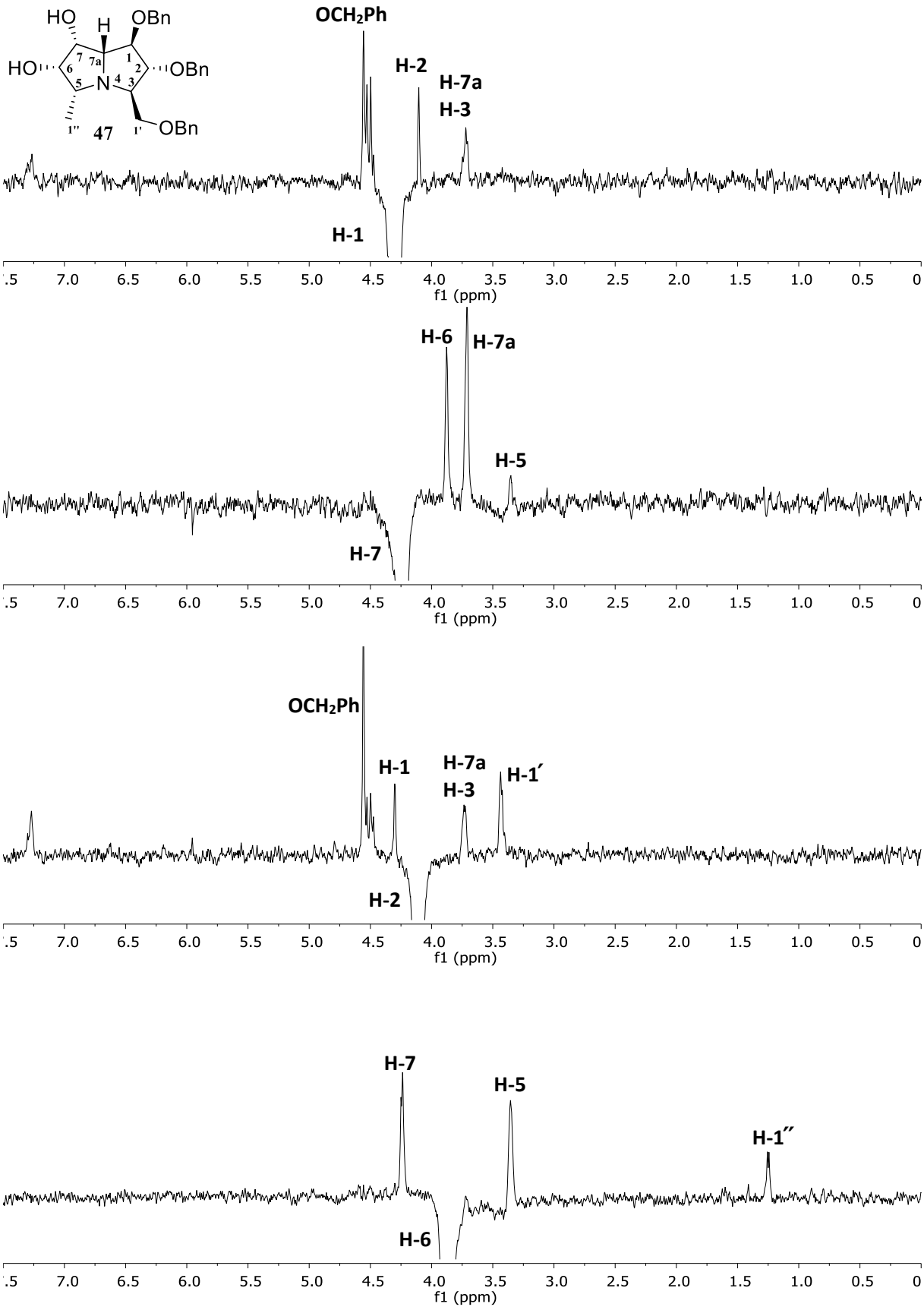


Figure S71: gHSQC spectrum (500 MHz, $CDCl_3$) of **47**


HO
H
OBn
HO
OBn
N
OBn
47
OCH2Ph
H-2
H-7a
H-3
H-1
f1 (ppm)
H-6
H-7a
H-5
H-7
f1 (ppm)
OCH2Ph
H-1
H-7a
H-3
H-1′
H-2
f1 (ppm)
H-7
H-5
H-1″
H-6
f1 (ppm)

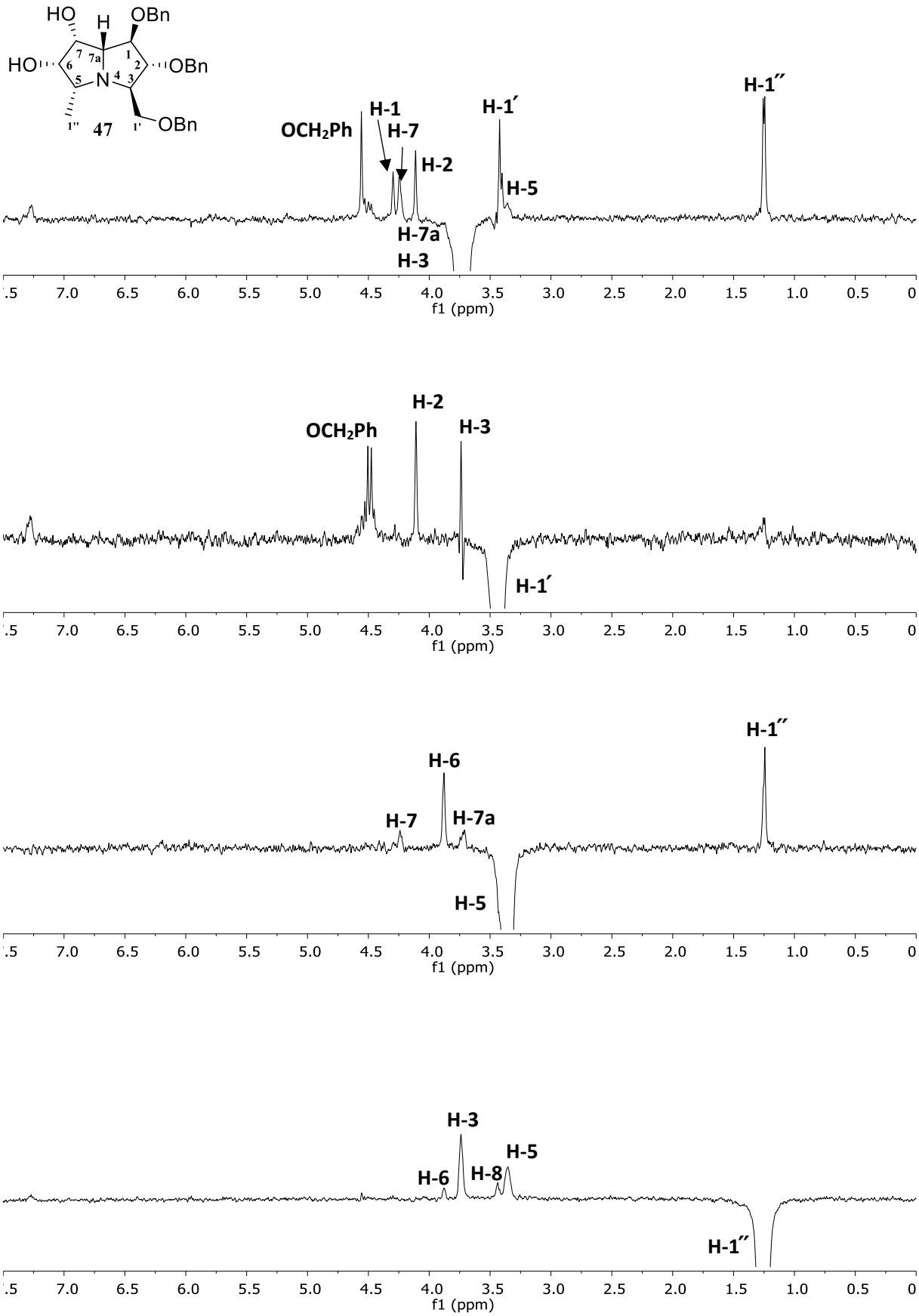


Figure S72: 1D-NOE spectrum (500 MHz, $CDCl_3$) of **47**

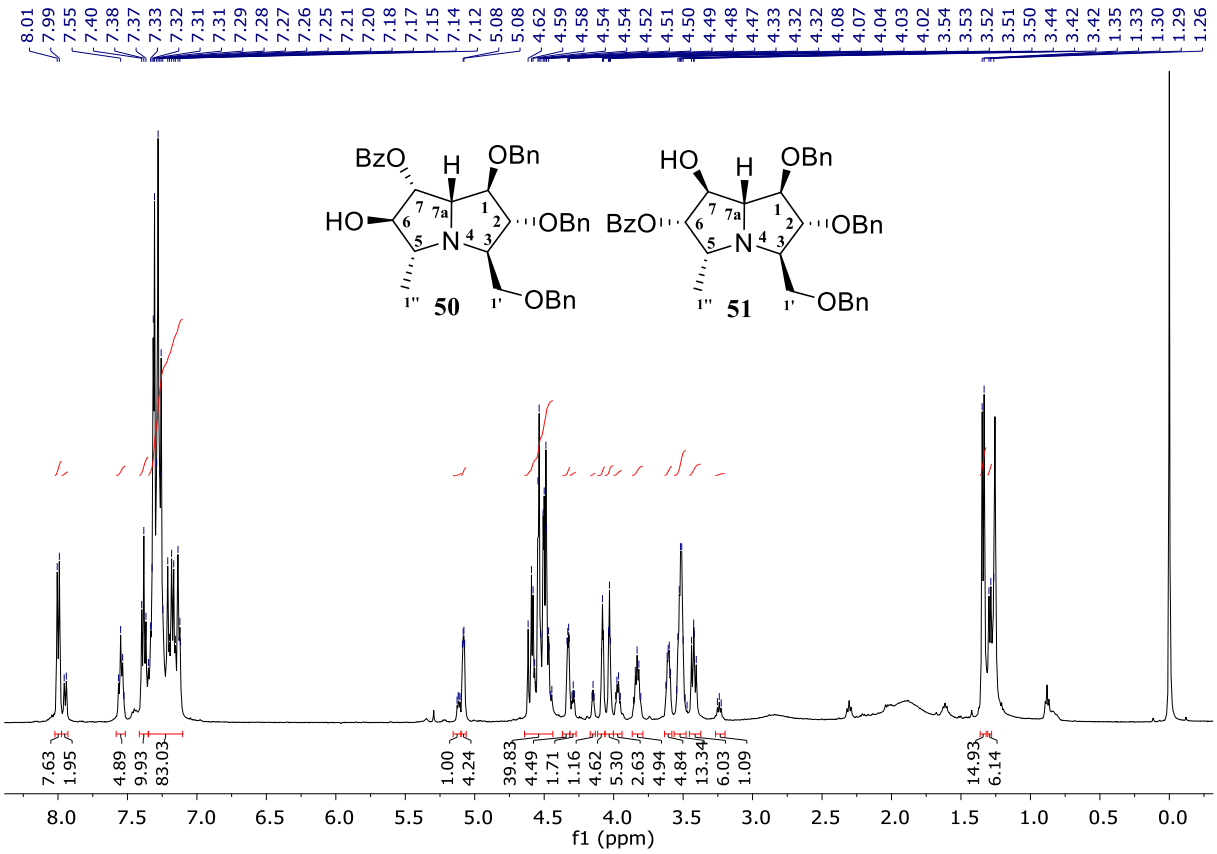


Figure S73: ^{1}H NMR spectrum (500 MHz, $CDCl_3$) of **50** and **51**

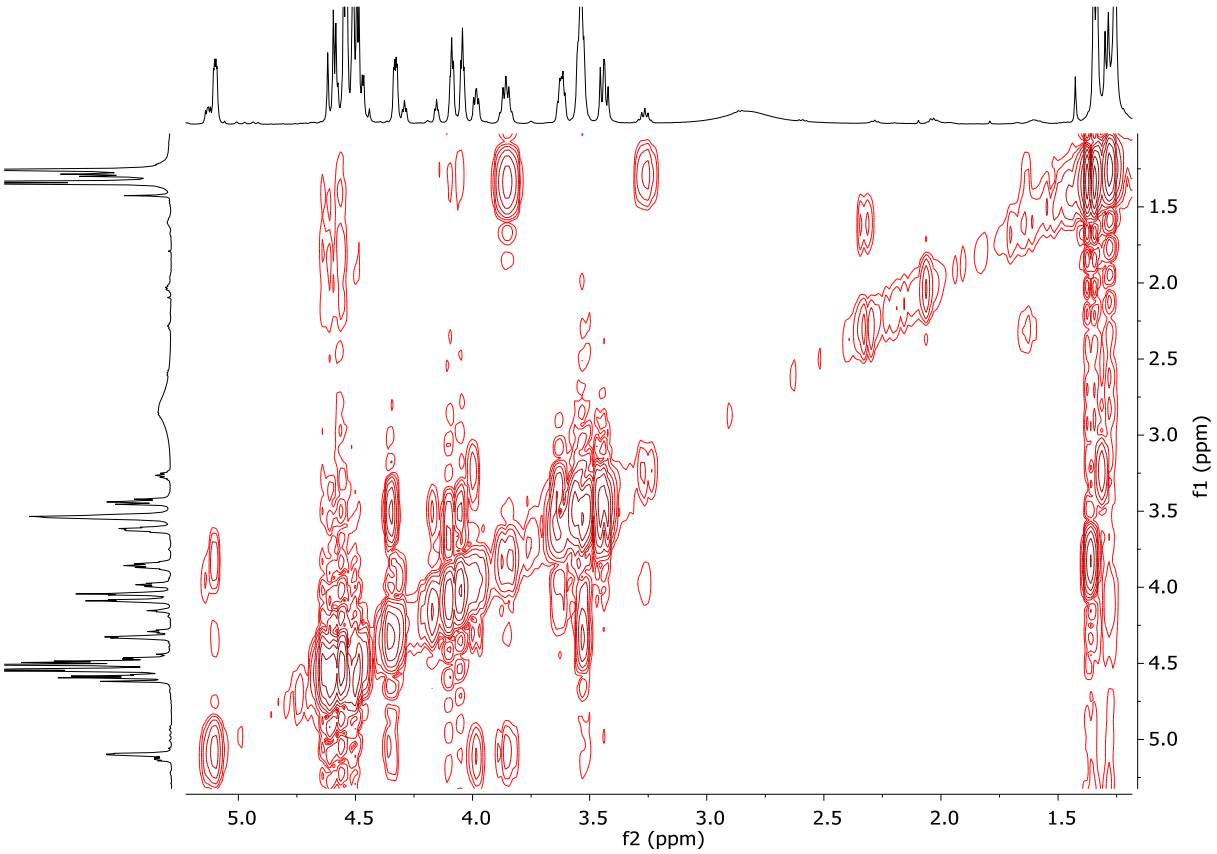


Figure S74: gCOSY spectrum (500 MHz, $CDCl_3$) of **50** and **51**

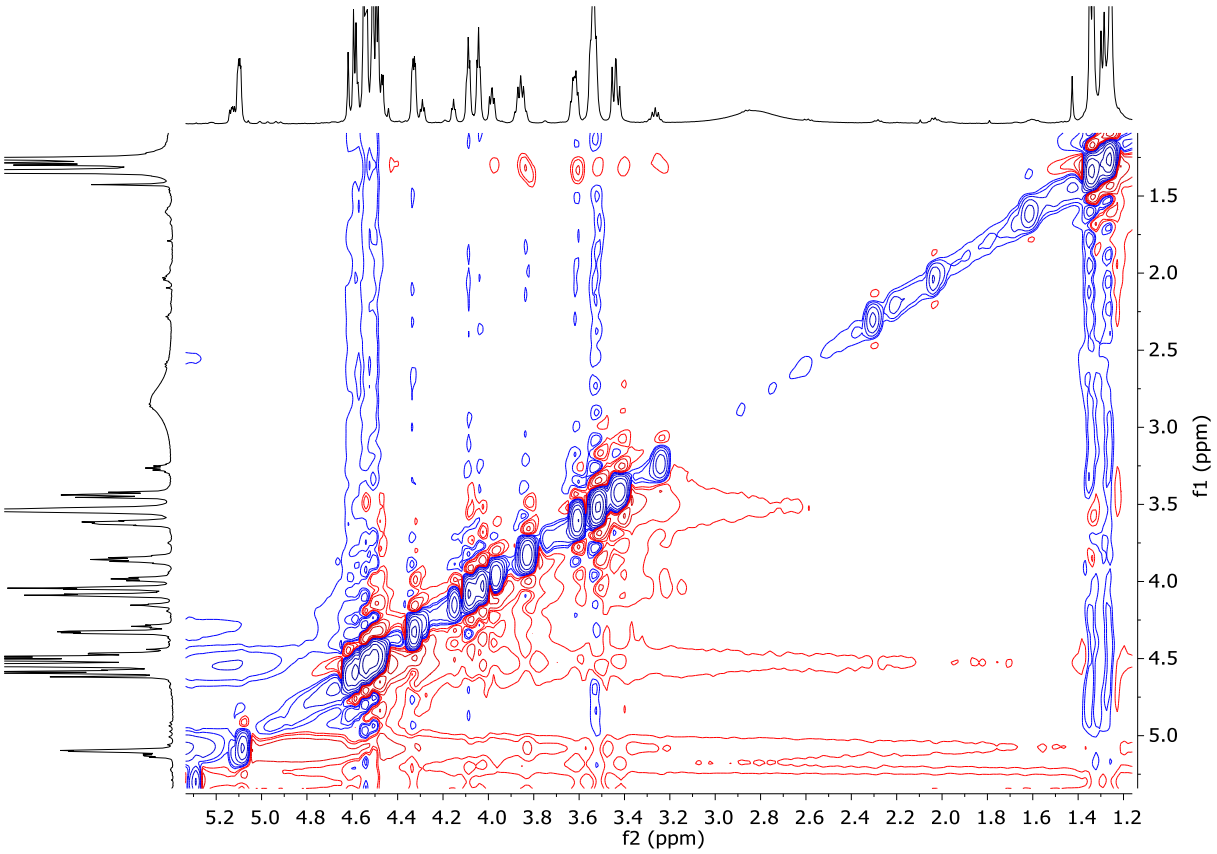


Figure S75: ROSEY spectrum (500 MHz, $CDCl_3$) of **50** and **51**

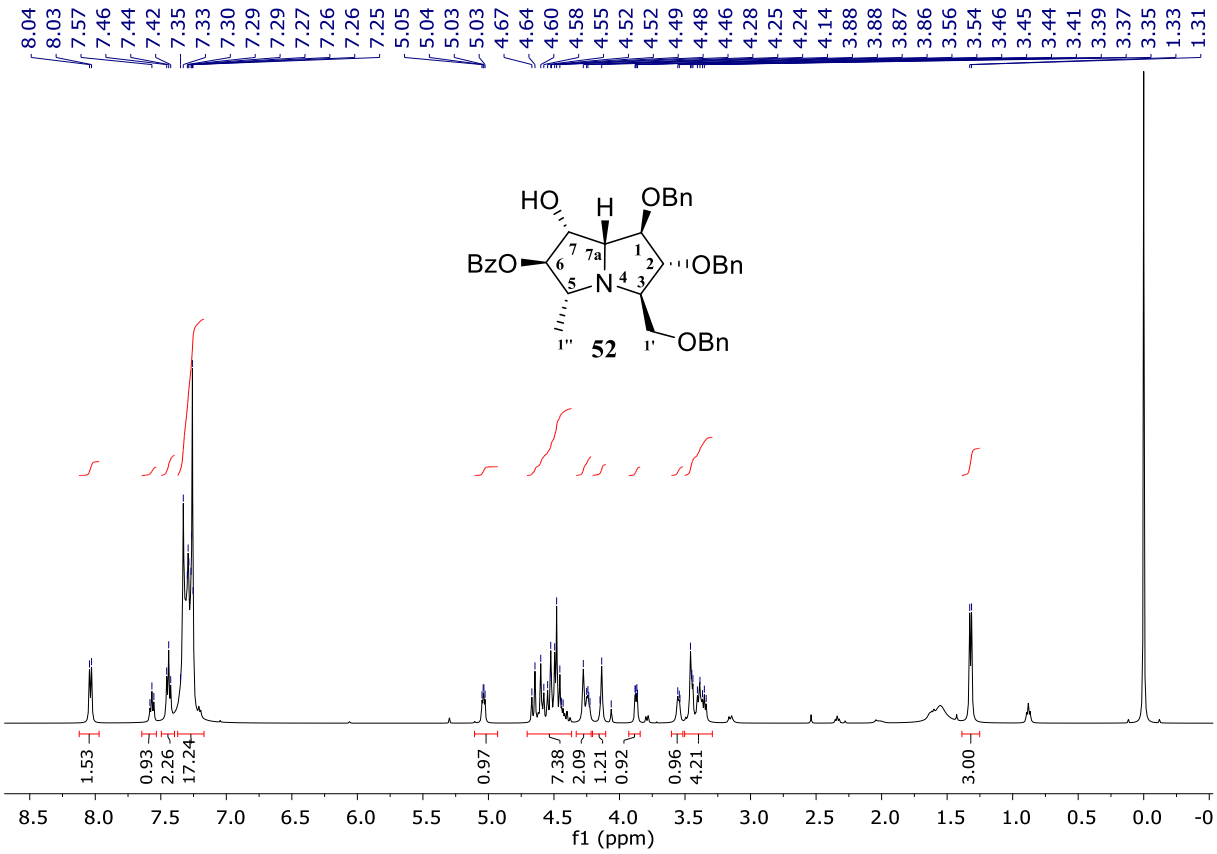


Figure S76: ^1H NMR spectrum (500 MHz, $CDCl_3$) of **52**

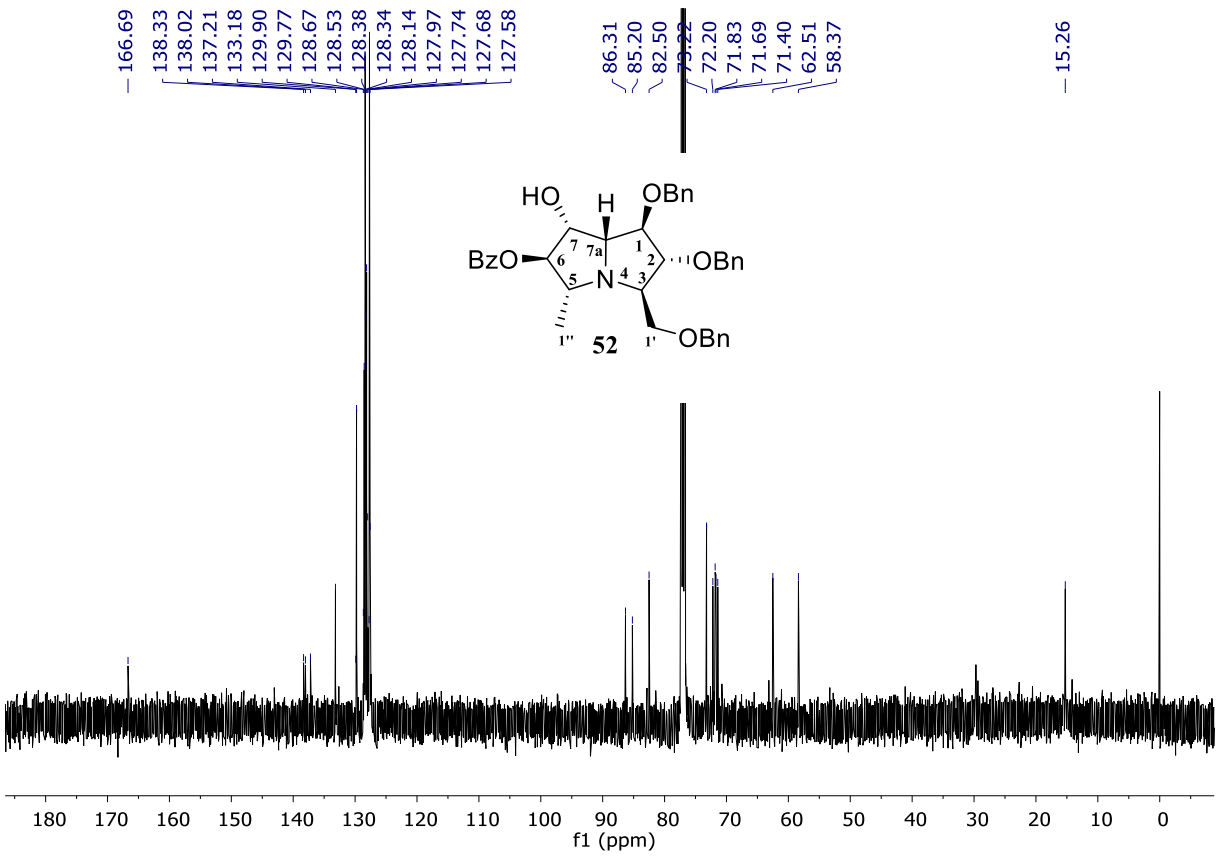


Figure S77: ^{13}C NMR spectrum (125 MHz, $CDCl_3$) of **52**

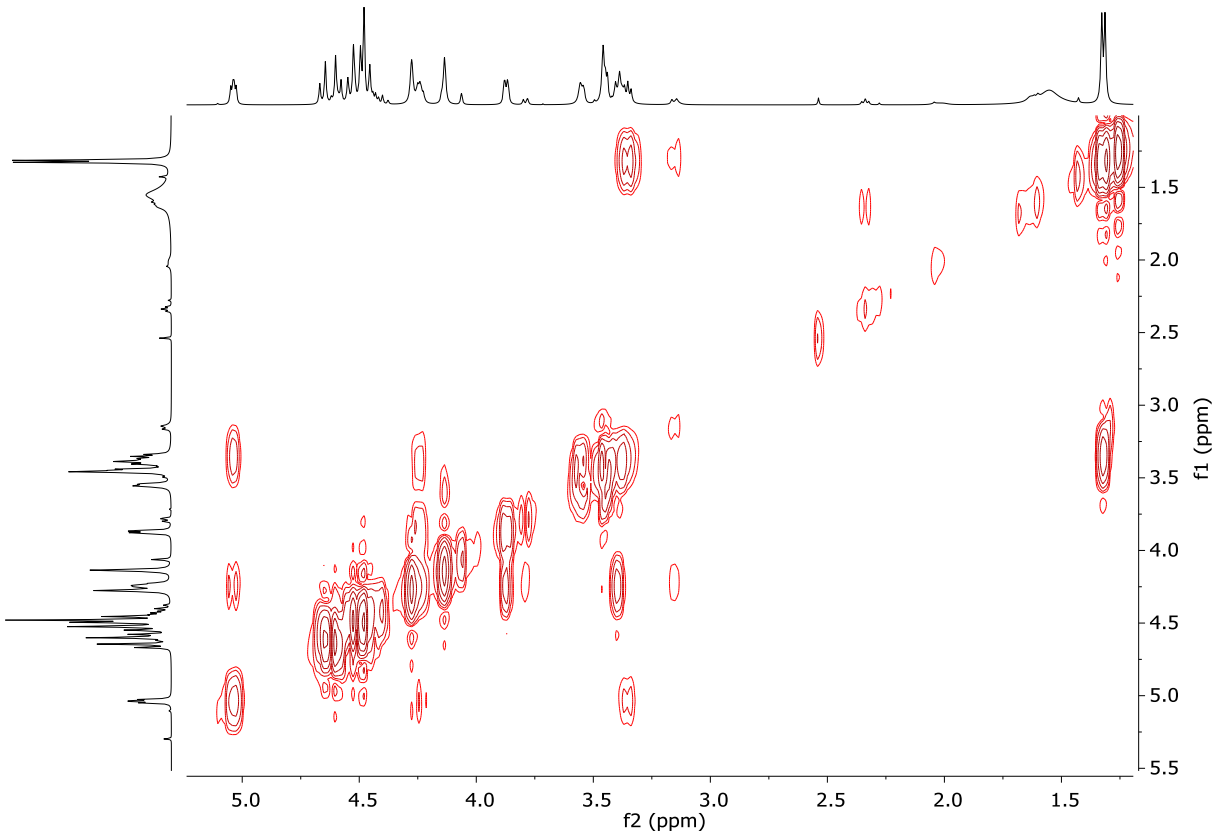


Figure S78: gCOSY spectrum (500 MHz, $CDCl_3$) of **52**

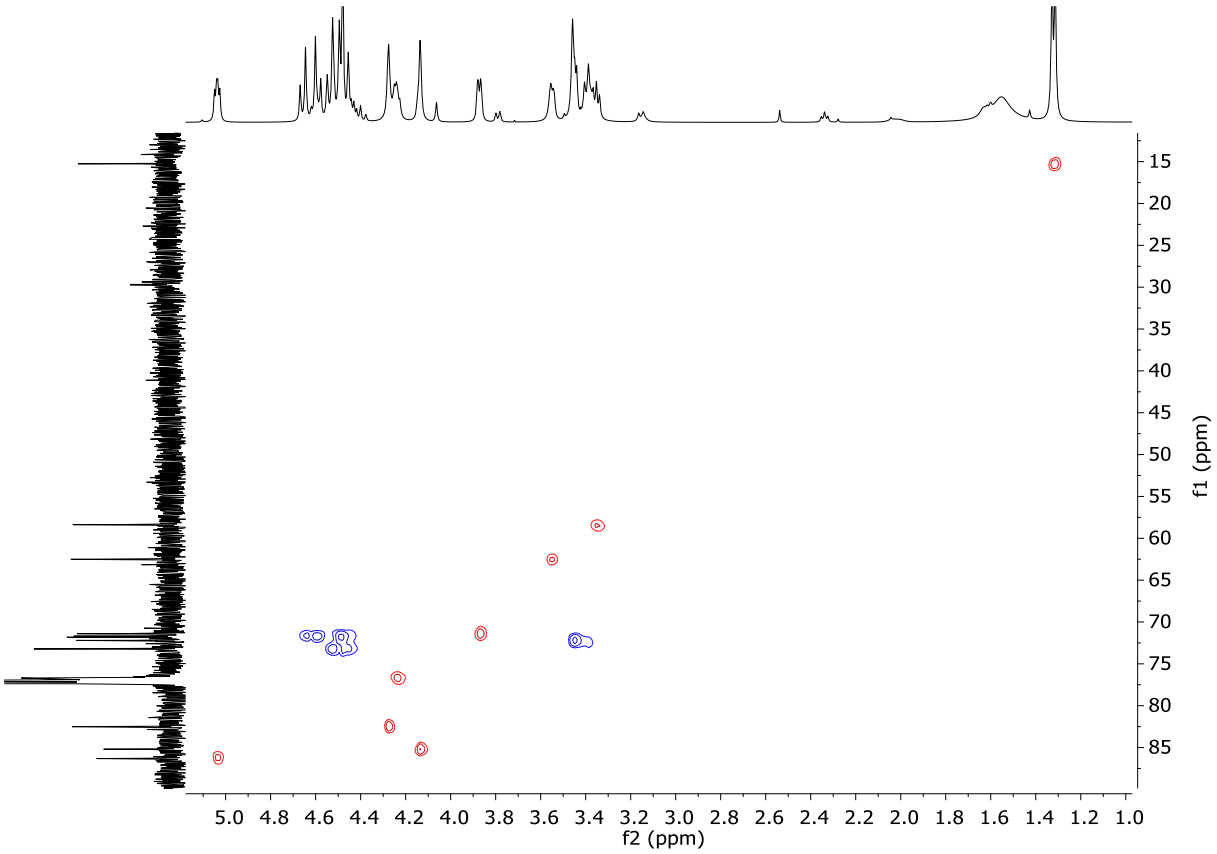
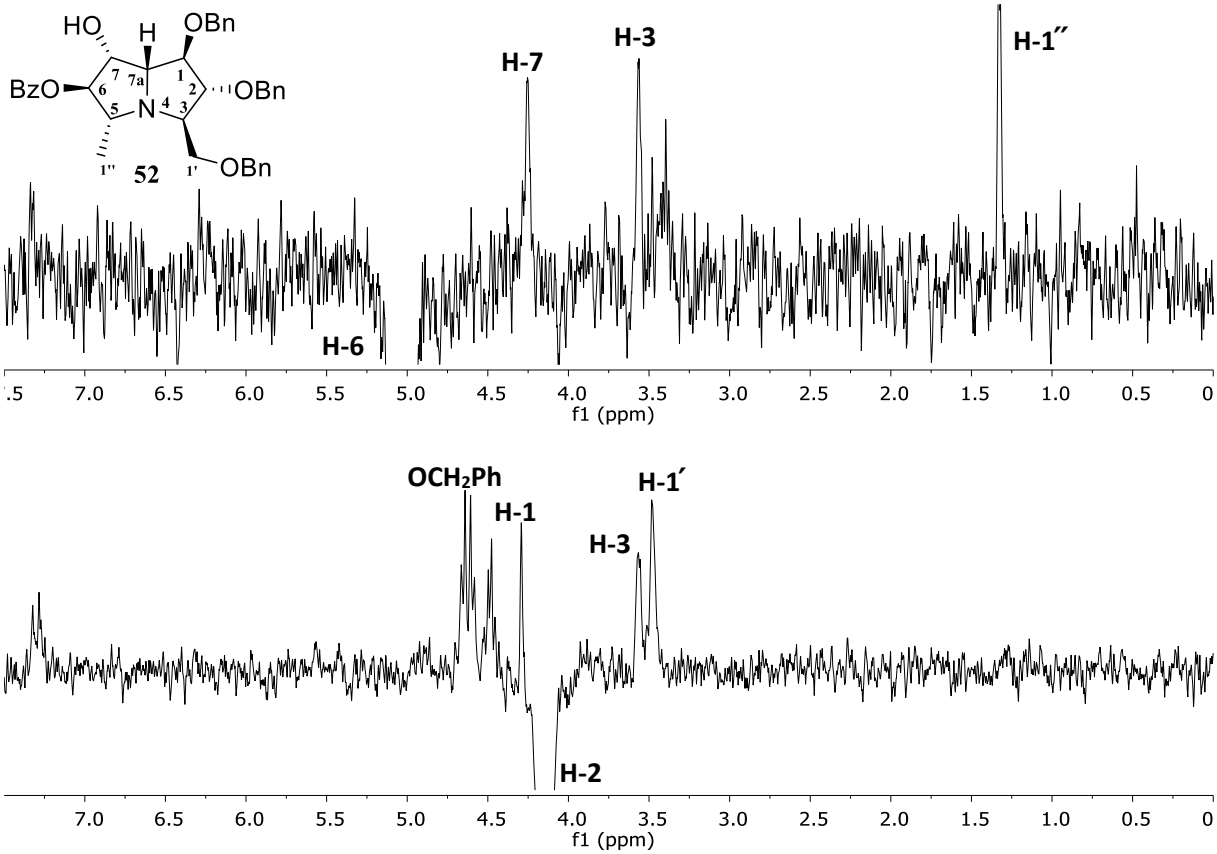


Figure S79: gHSQC spectrum (500 MHz, $CDCl_3$) of **52**



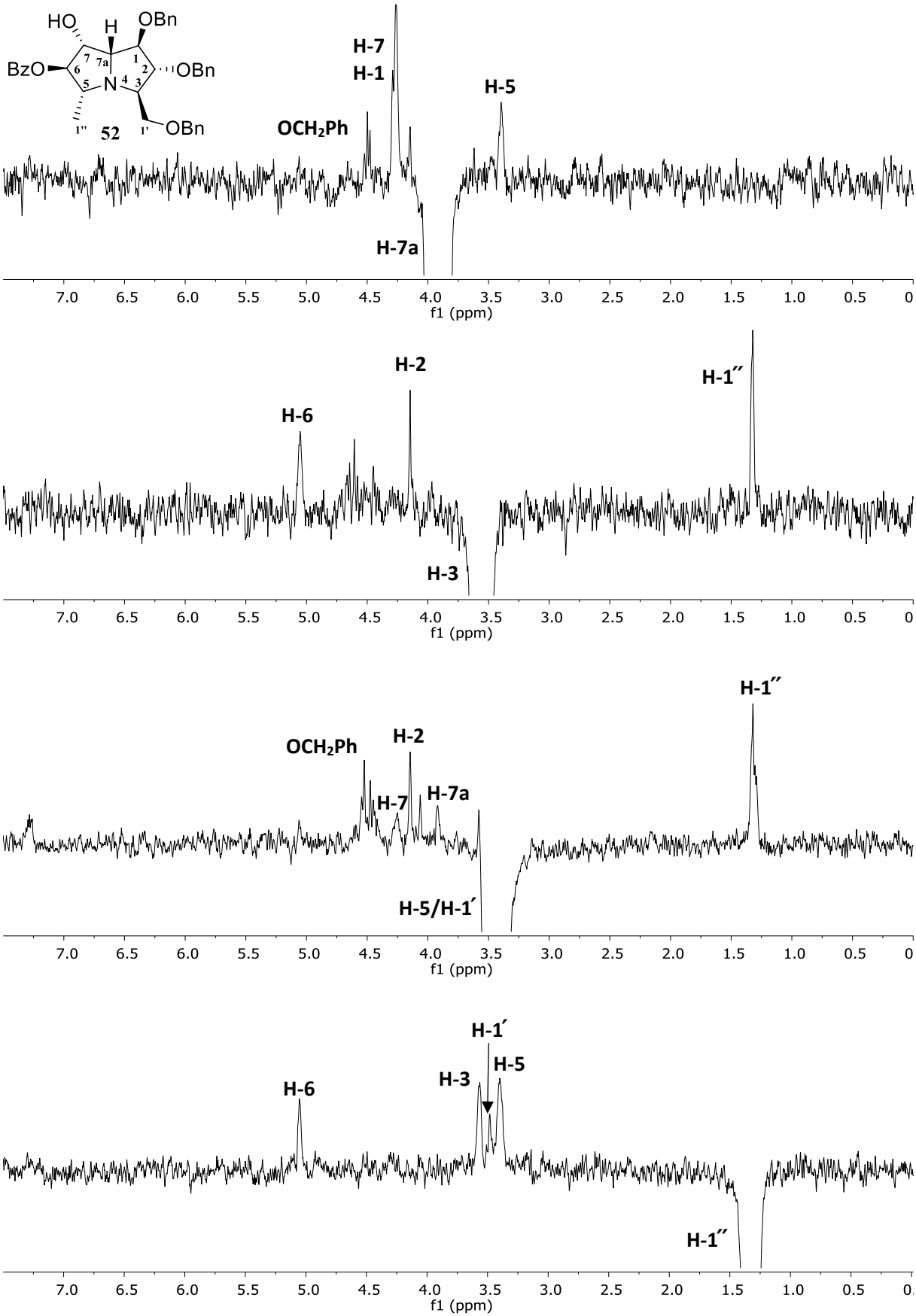


Figure S80: 1D-NOE spectrum (500 MHz, $CDCl_3$) of **52**

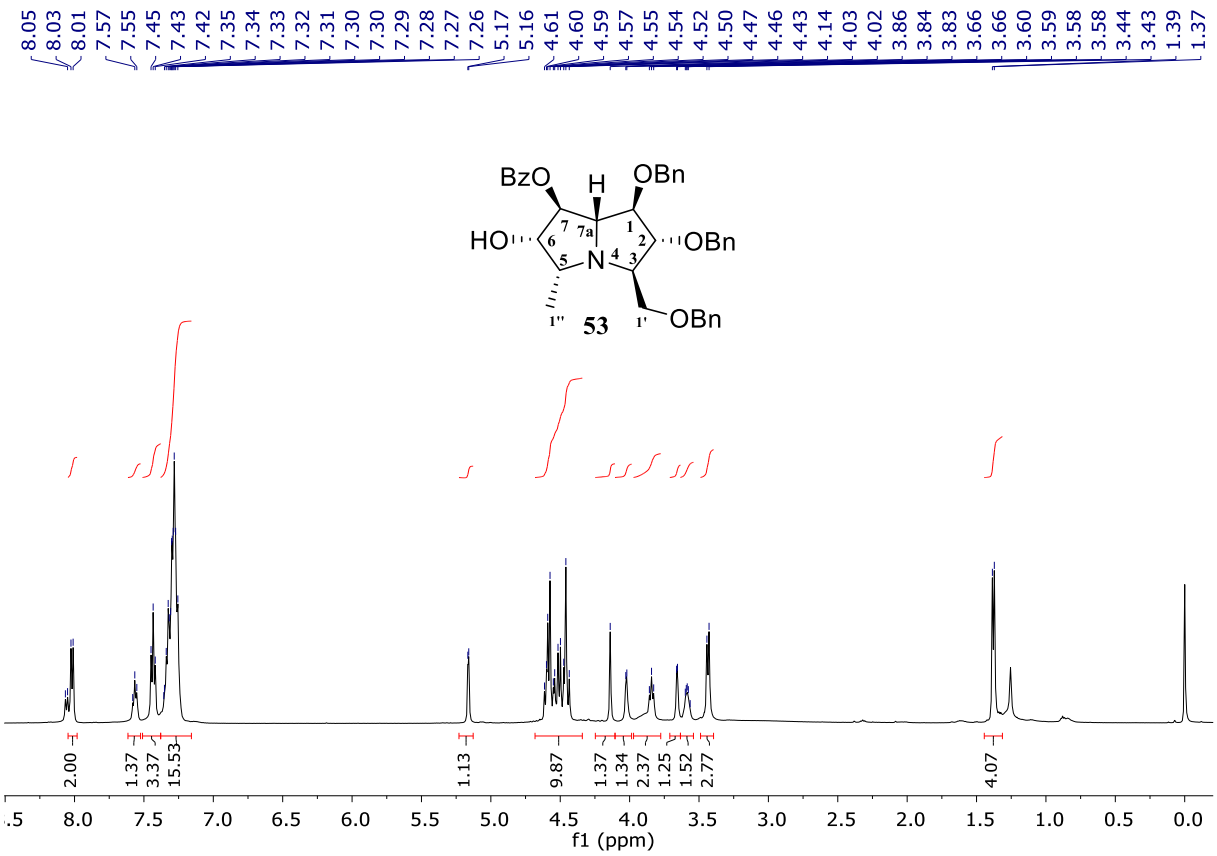


Figure S81: ^{1}H NMR spectrum (500 MHz, $CDCl_3$) of **53**

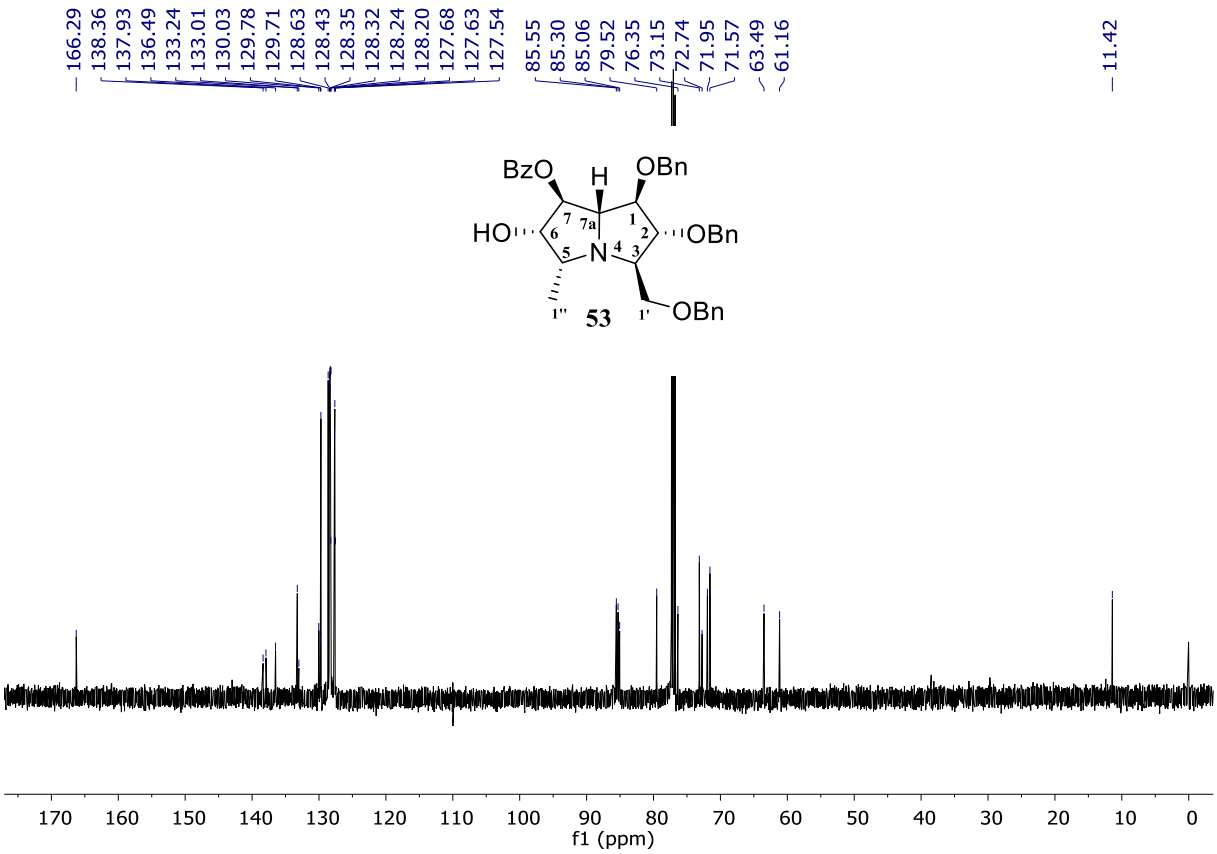


Figure S82: ^{13}C NMR spectrum (125 MHz, $CDCl_3$) of **53**

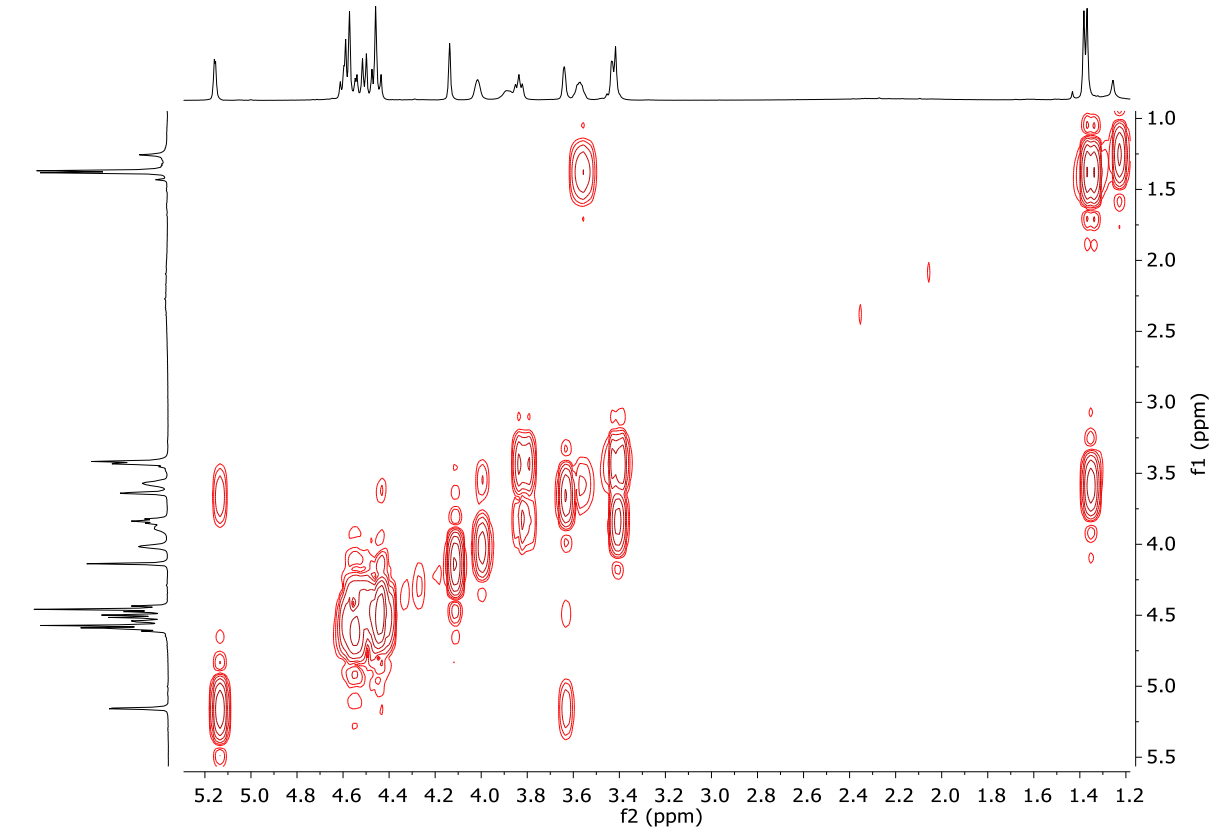


Figure S83: gCOSY spectrum (500 MHz, $CDCl_3$) of **53**

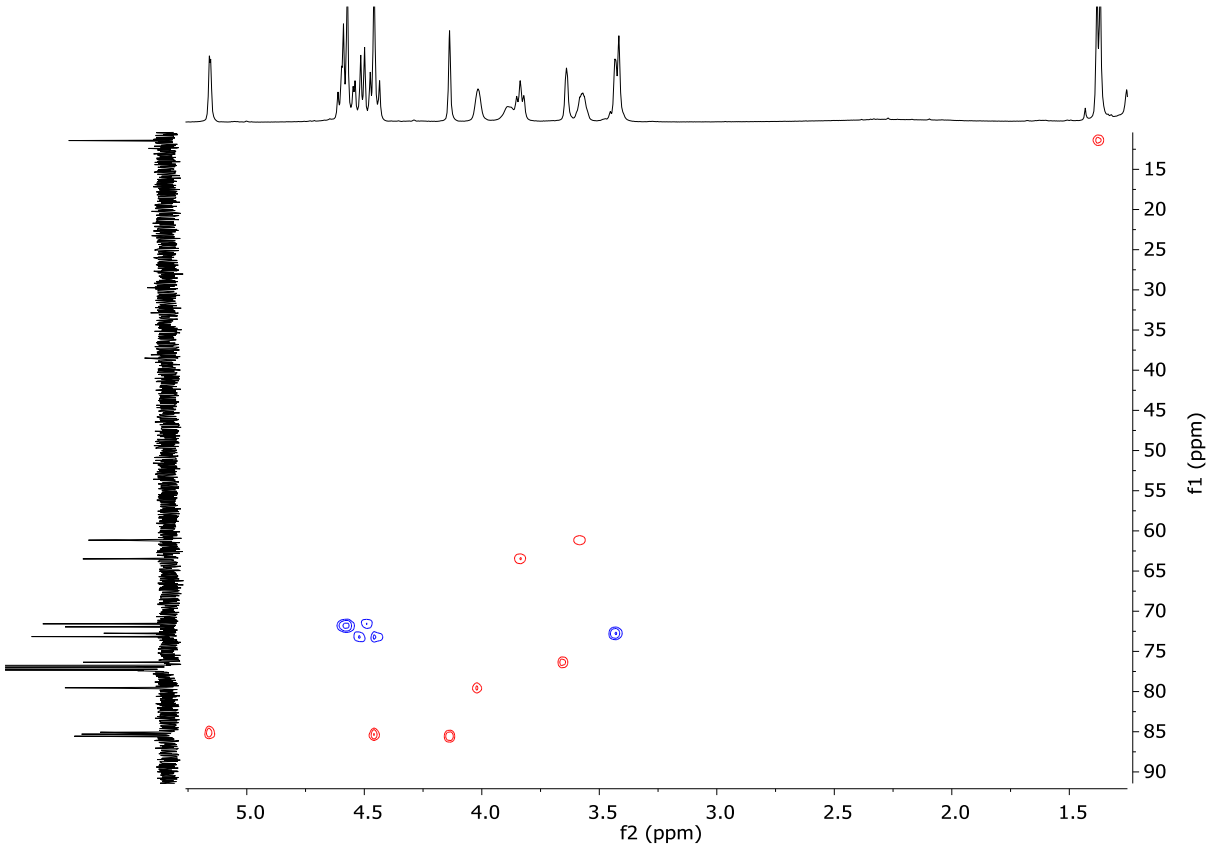
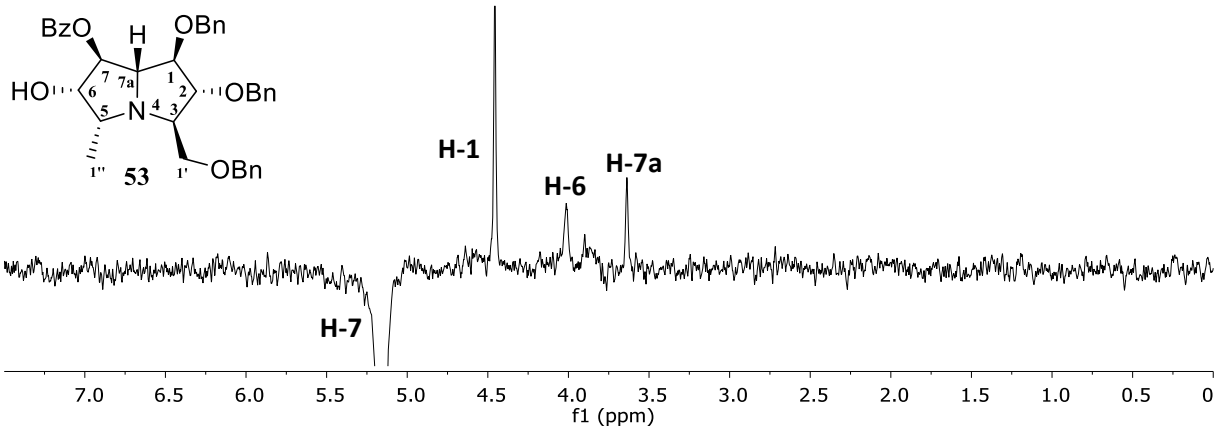
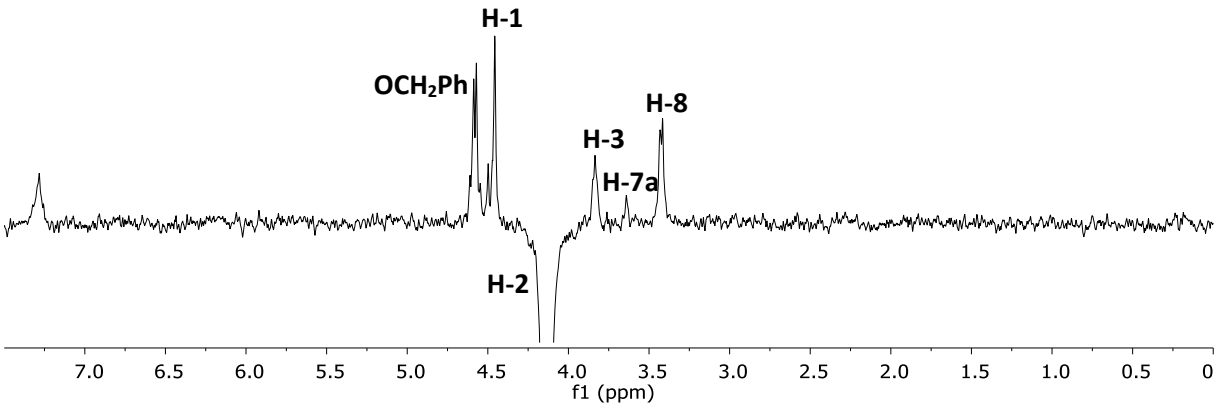
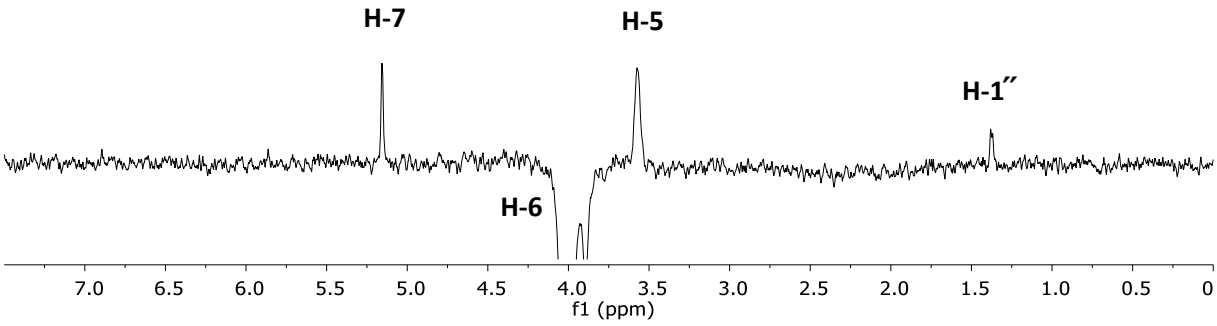
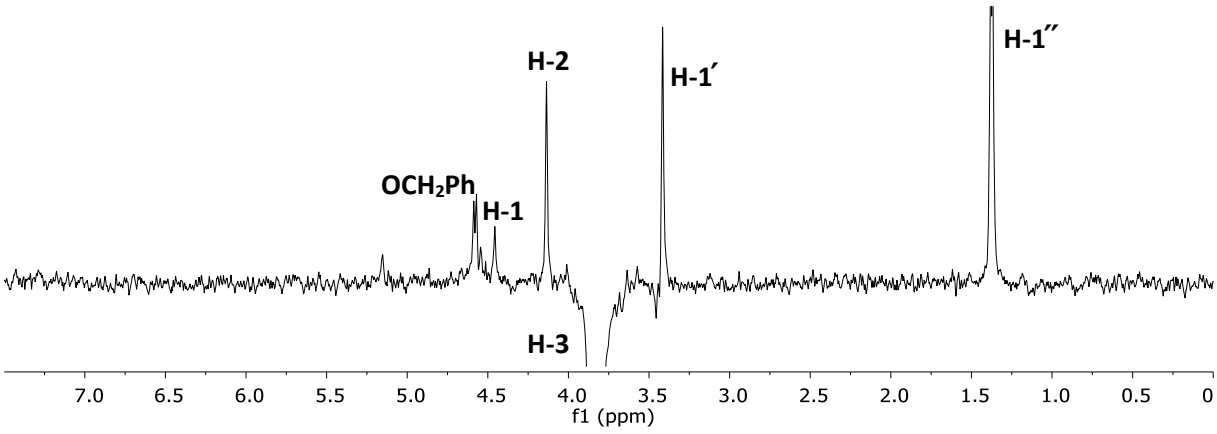


Figure S84: gHSQC spectrum (500 MHz, $CDCl_3$) of **53**


BzO
H
OBn
HO
OBn
OBn
N
53
H-1
H-6
H-7a
H-7
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
f1 (ppm)


H-1
OCH2Ph
H-8
H-3
H-7a
H-2
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
f1 (ppm)


H-7
H-5
H-1″
H-6
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
f1 (ppm)


H-2
H-1′
H-1″
OCH2Ph
H-1
H-3
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
f1 (ppm)

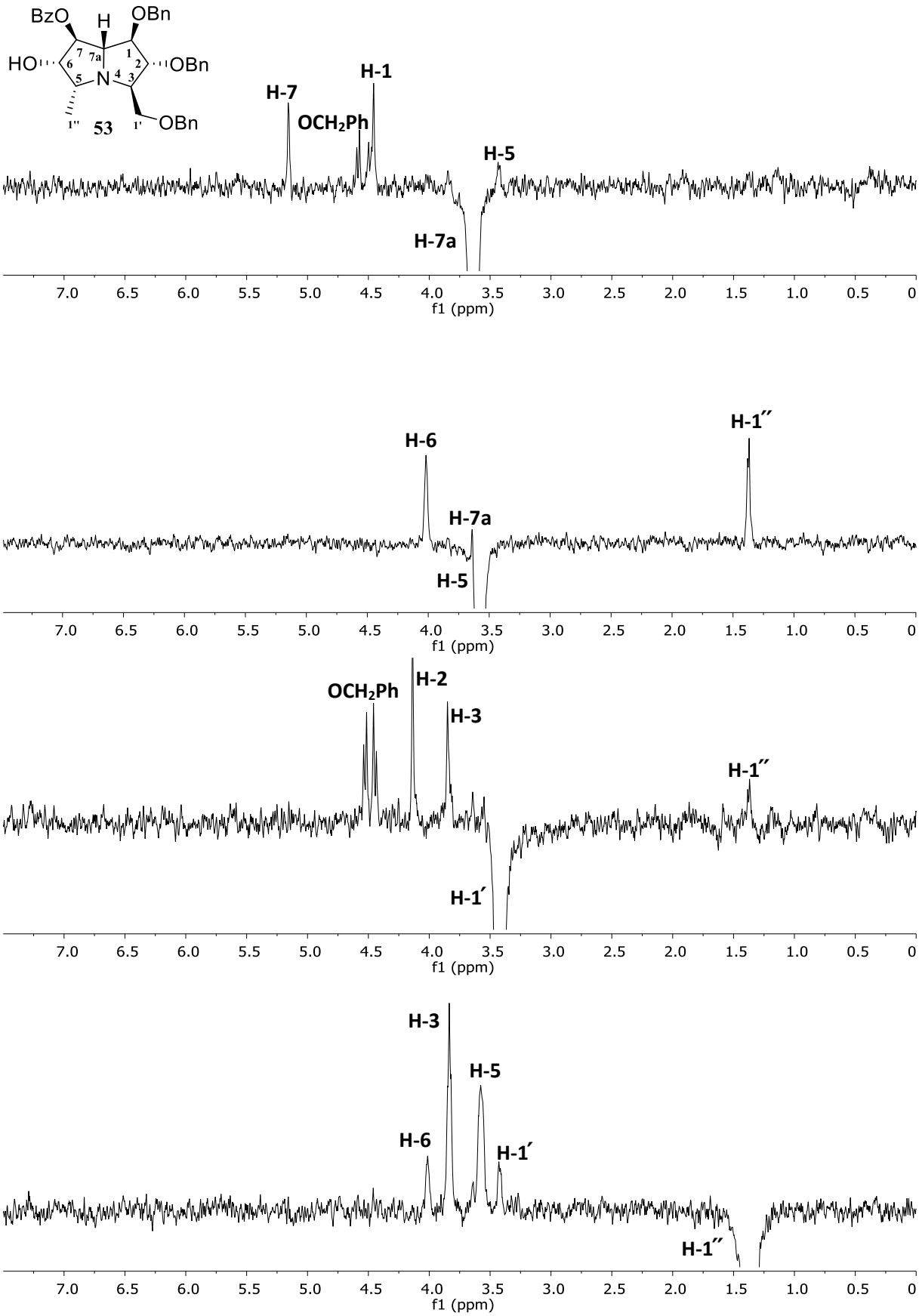


Figure S85: 1D-NOE spectrum (500 MHz, $CDCl_3$) of **53**

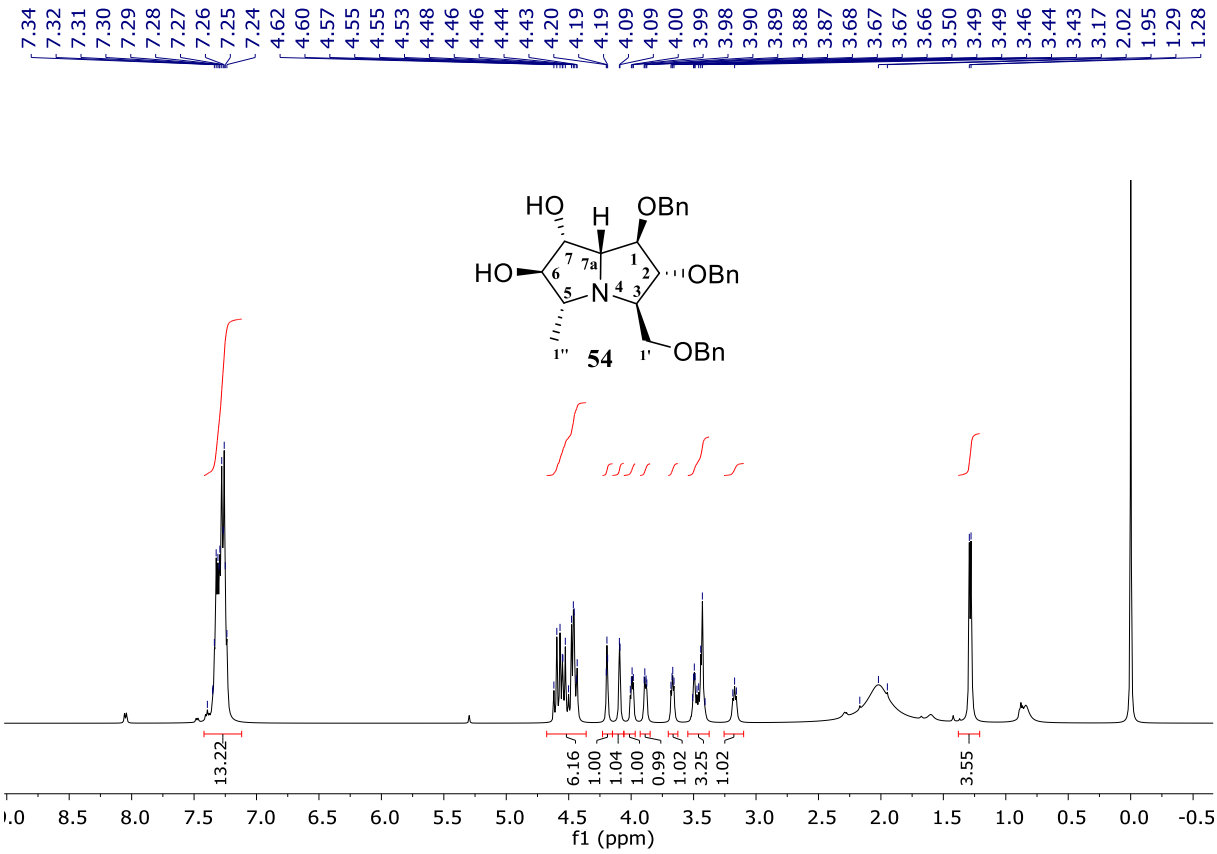


Figure S86: ^{1}H NMR spectrum (500 MHz, $CDCl_3$) of **54**

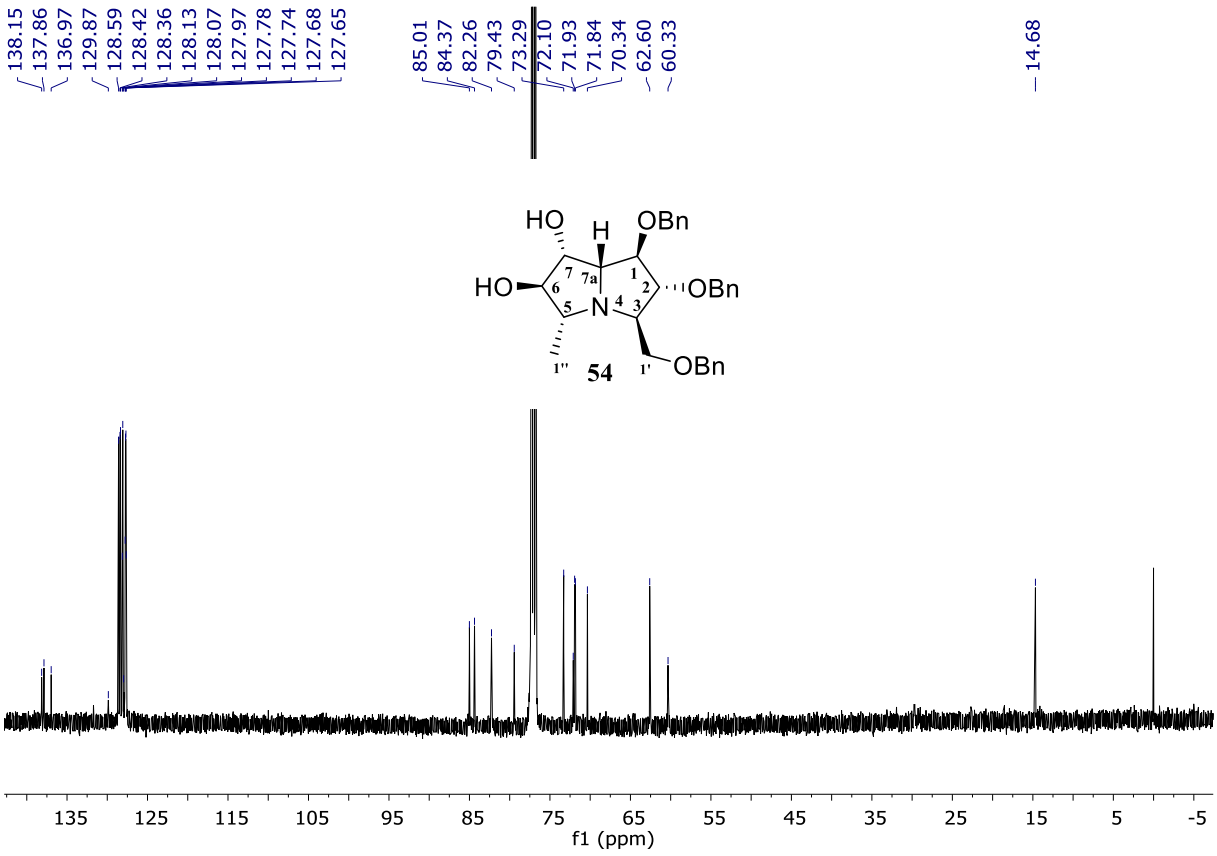


Figure S87: ^{13}C NMR spectrum (125 MHz, $CDCl_3$) of **54**

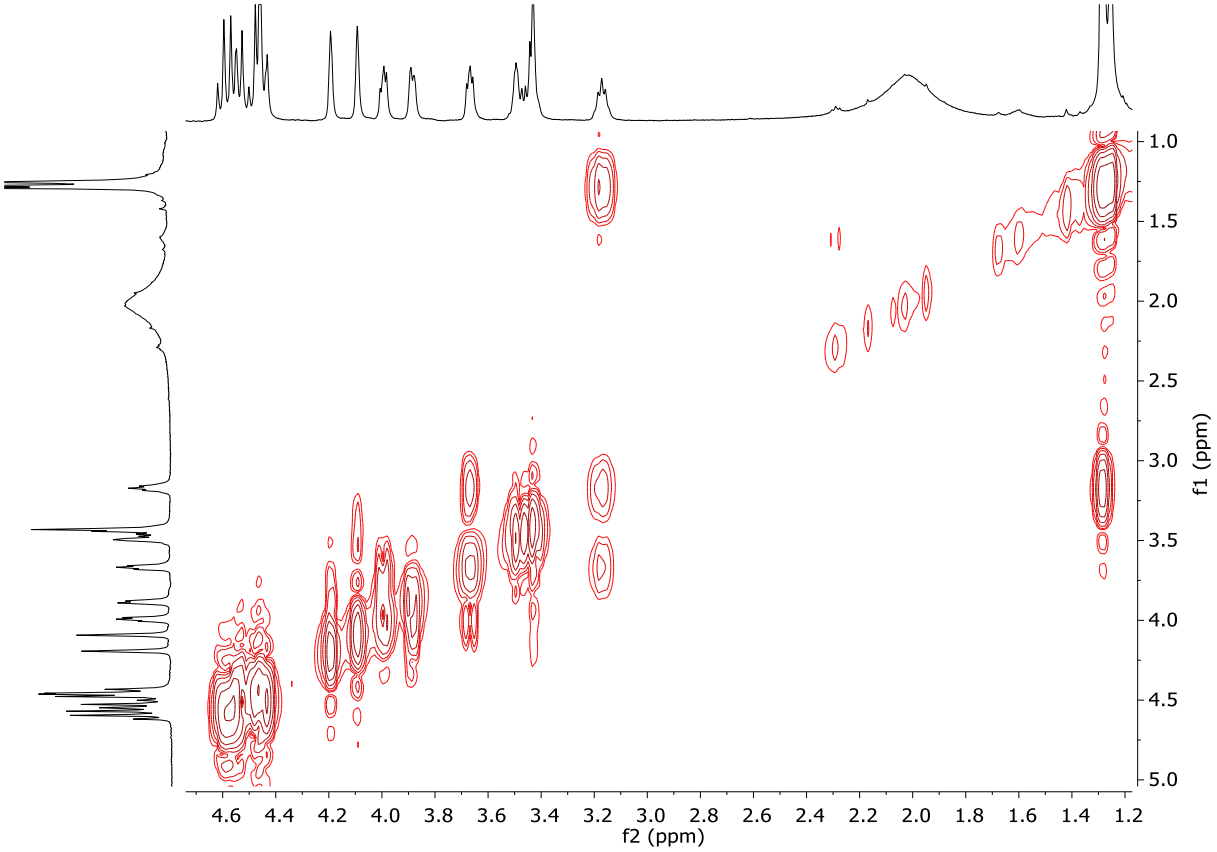


Figure S88: gCOSY spectrum (500 MHz, $CDCl_3$) of **54**

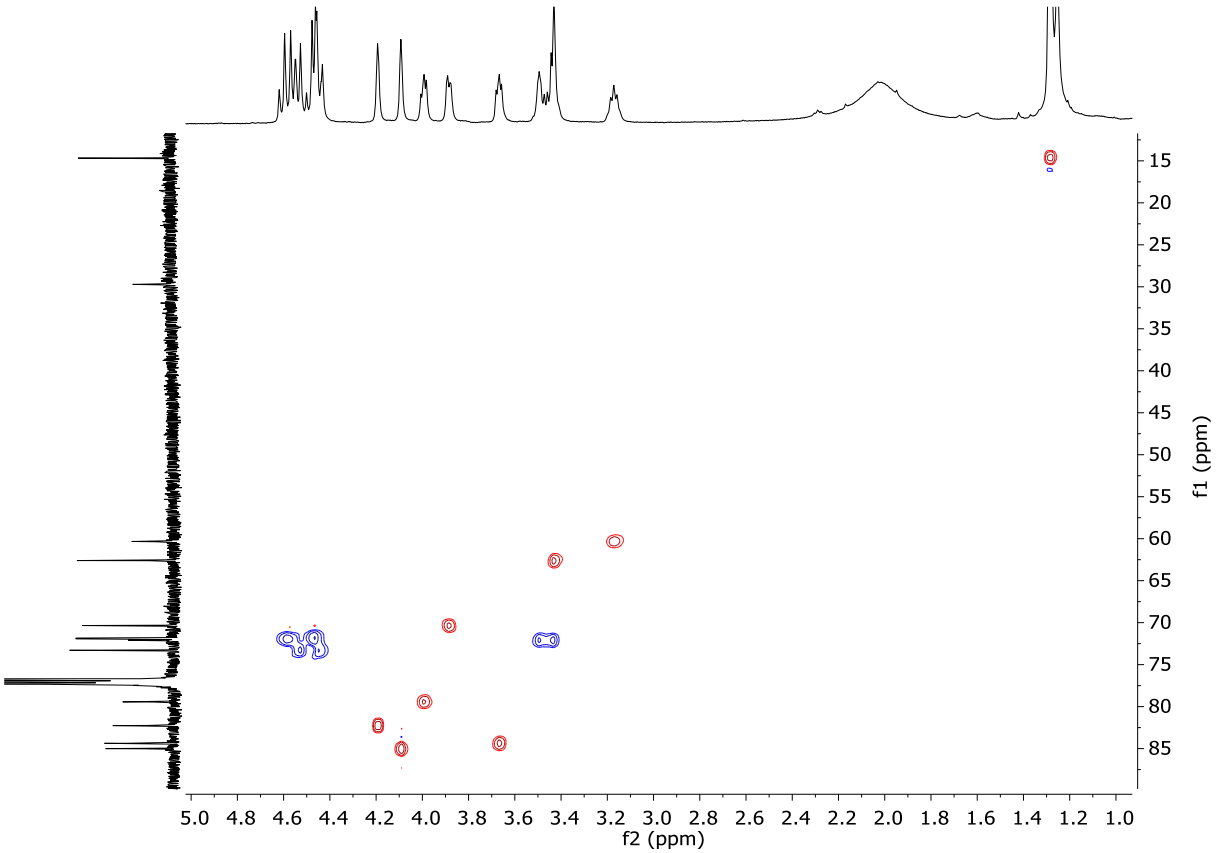


Figure S89: gHSQC spectrum (500 MHz, $CDCl_3$) of **54**

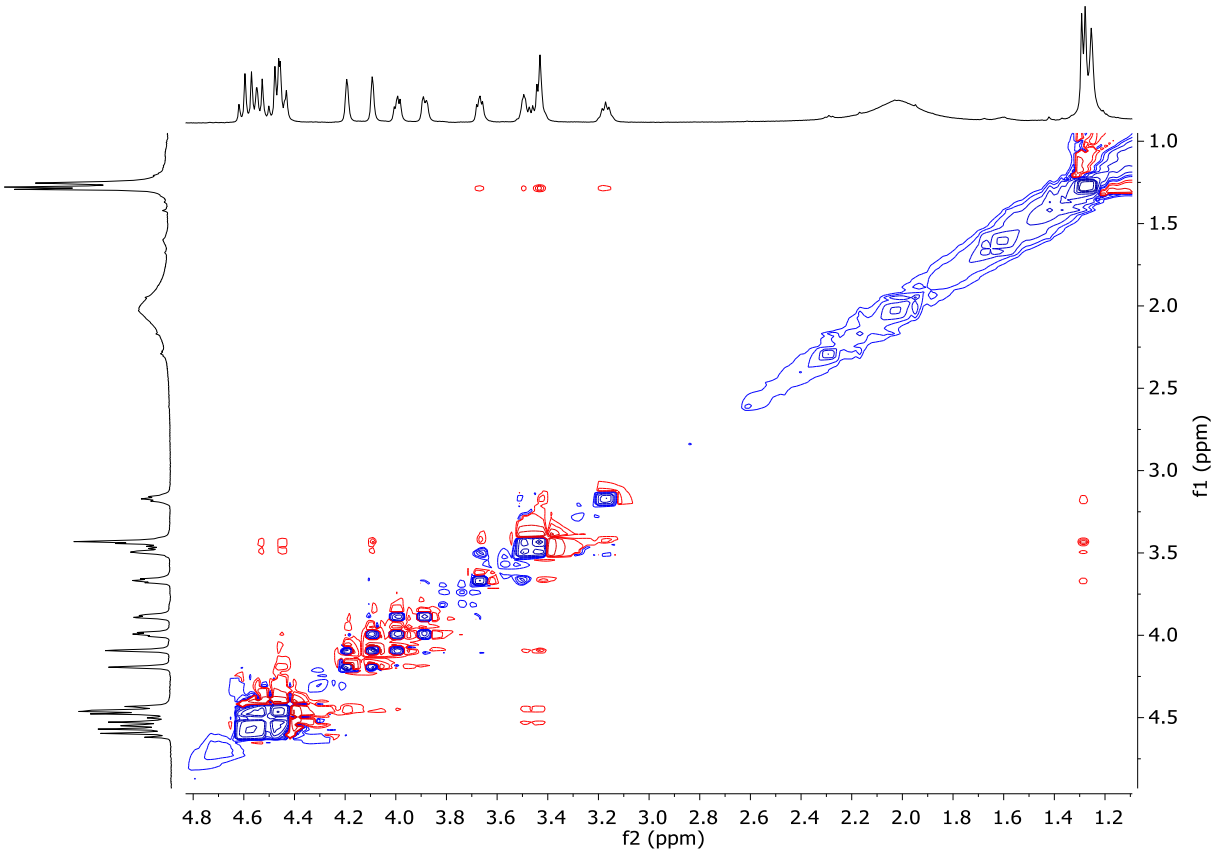


Figure S90: ROSEY spectrum (500 MHz, $CDCl_3$) of **54**

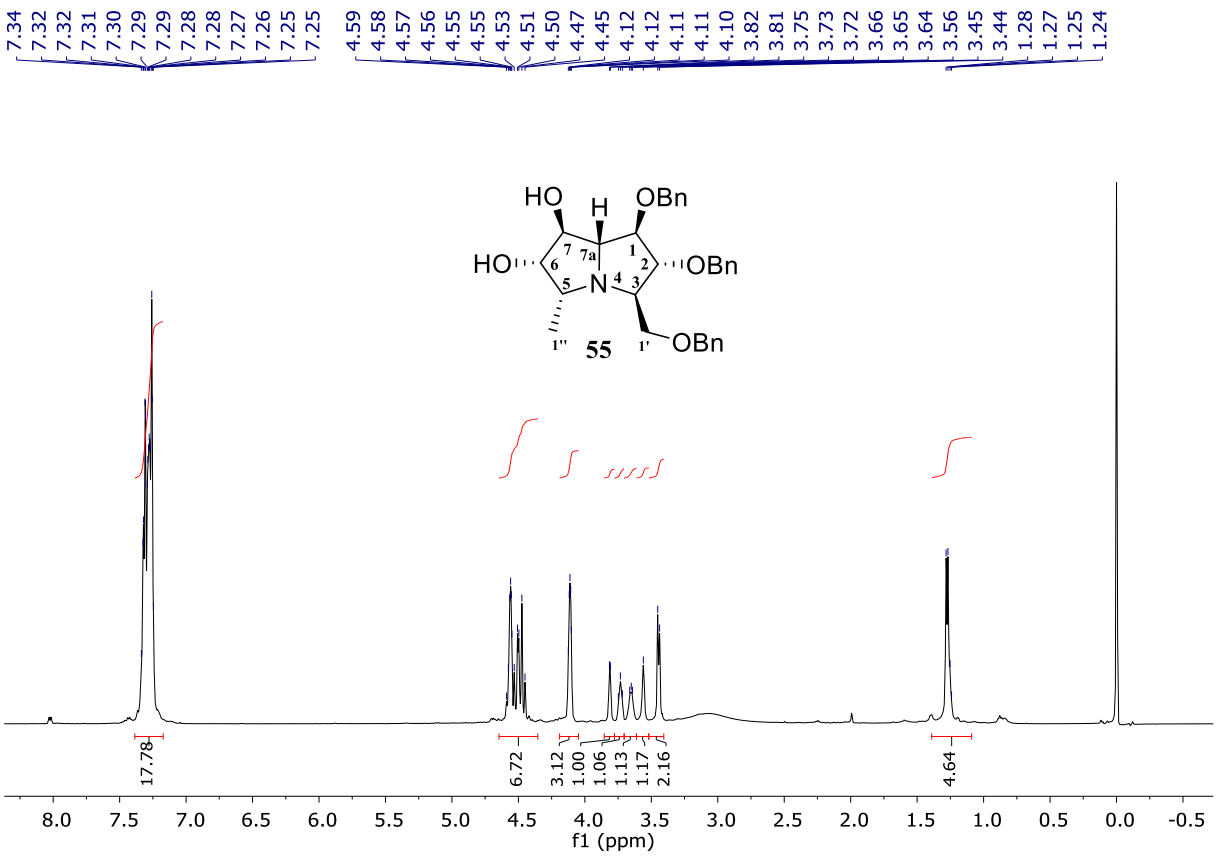


Figure S91: ^1H NMR spectrum (500 MHz, $CDCl_3$) of **55**

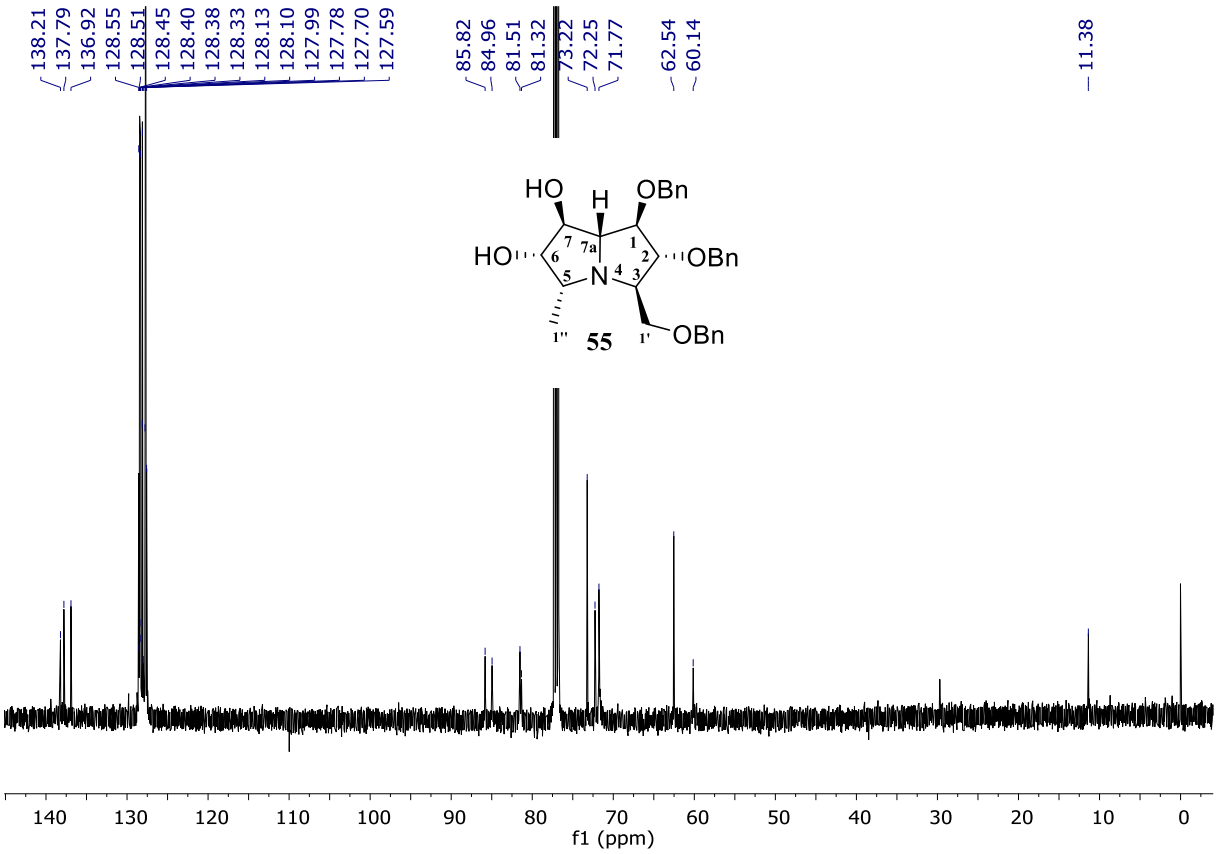


Figure S92: ^{13}C NMR spectrum (125 MHz, $CDCl_3$) of **55**

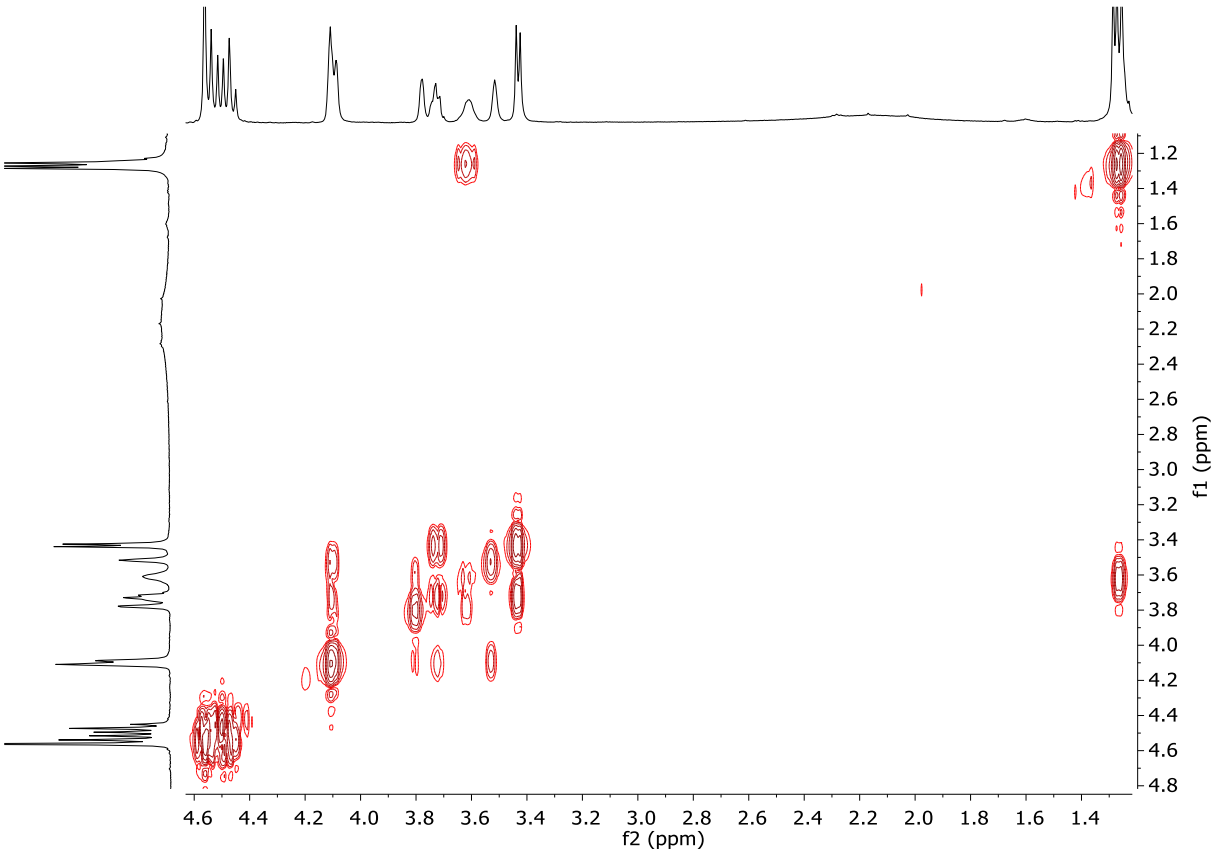


Figure S93: gCOSY spectrum (500 MHz, $CDCl_3$) of **55**

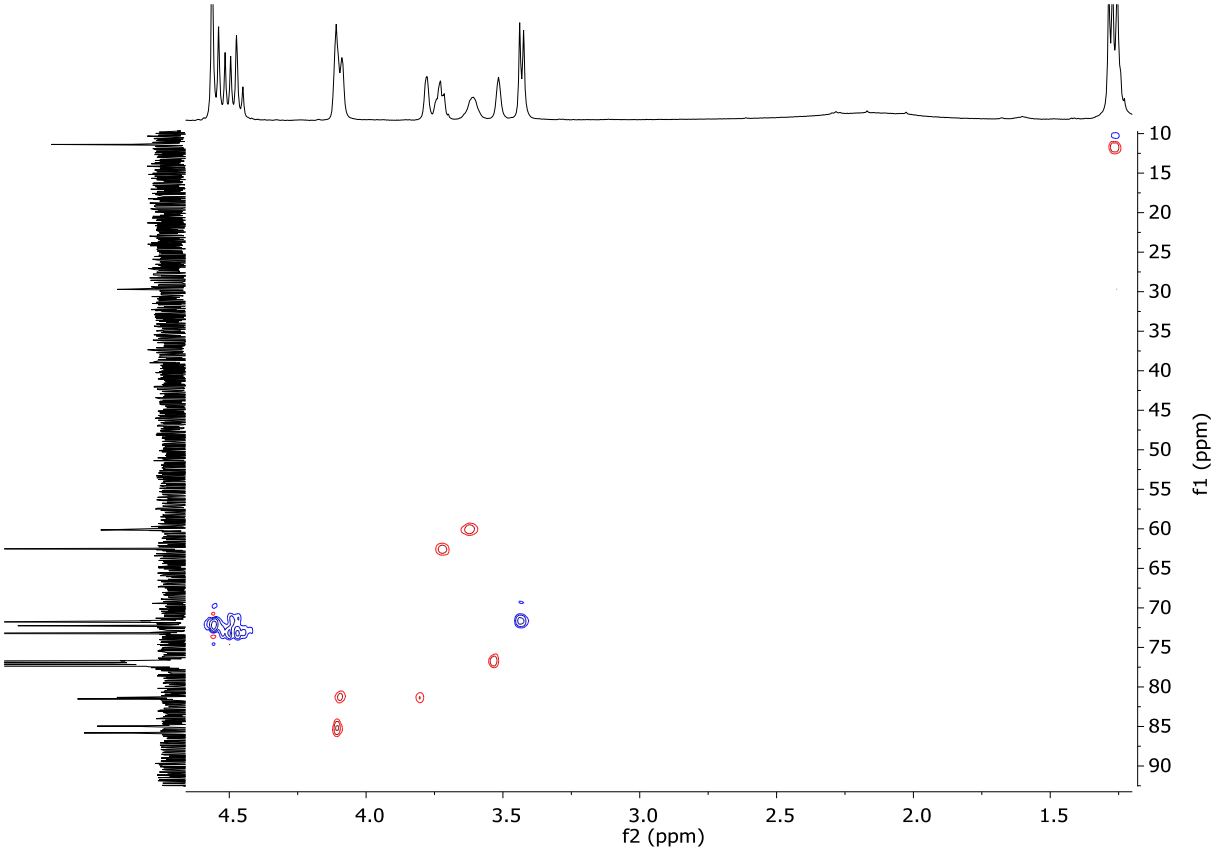


Figure S94: gHSQC spectrum (500 MHz, $CDCl_3$) of **55**

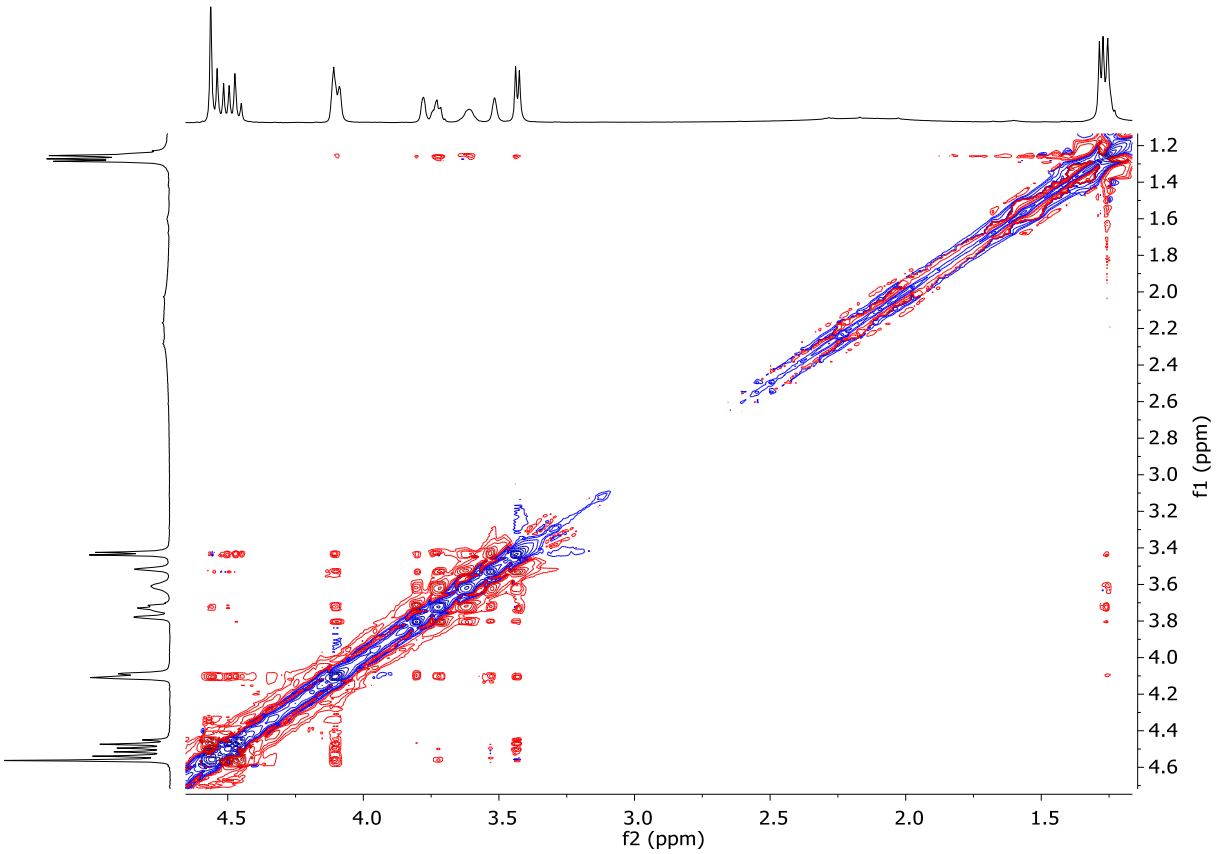


Figure S95: ROSEY spectrum (500 MHz, $CDCl_3$) of **55**

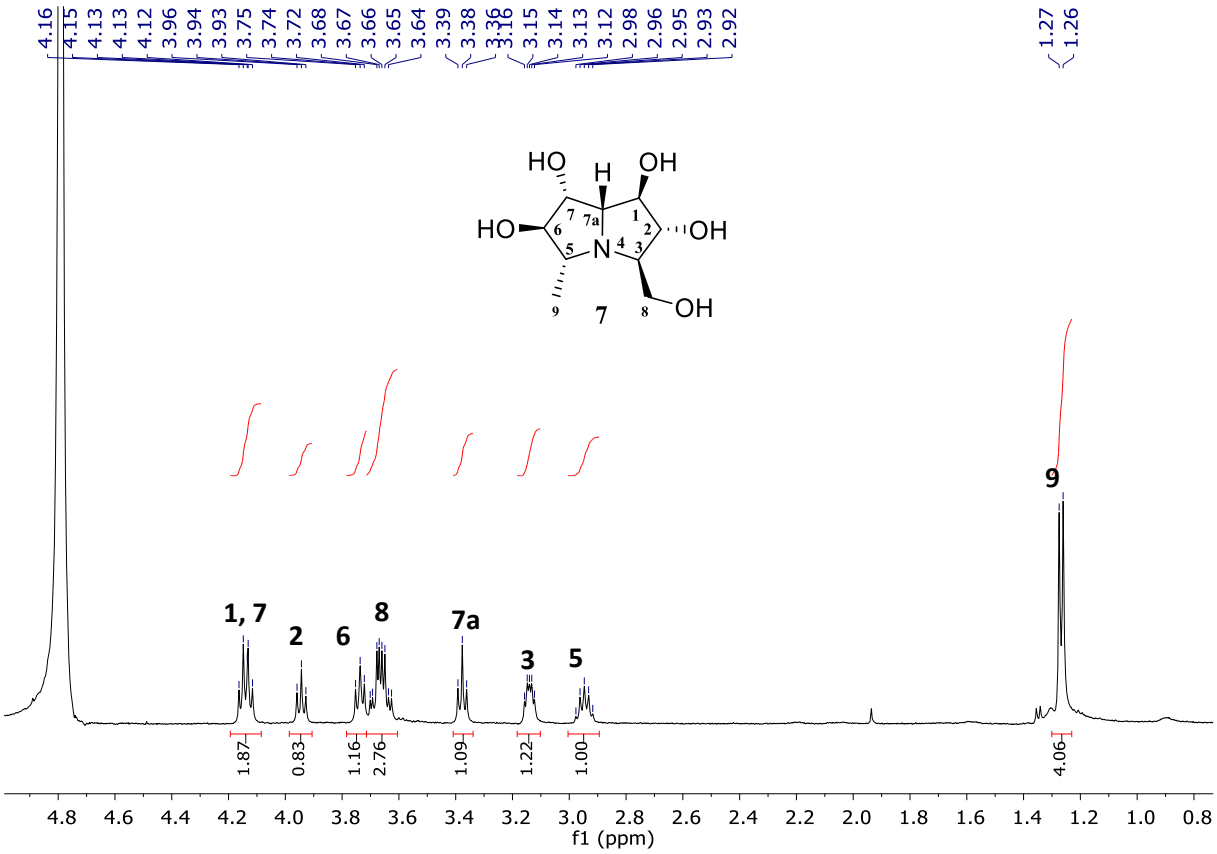


Figure S96: ^{1}H NMR spectrum (500 MHz, D_2O) of **7**

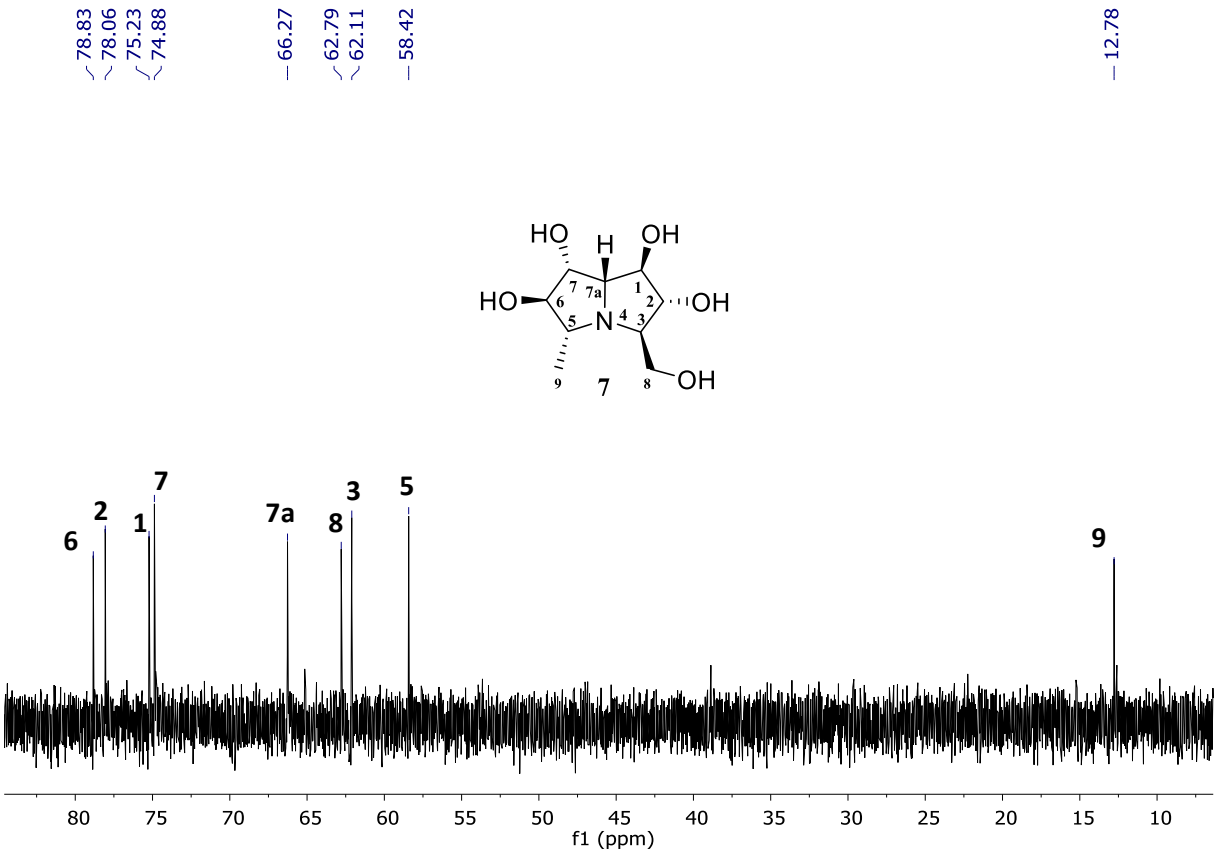


Figure S97: ^{13}C NMR spectrum (125 MHz, D_2O) of **7**

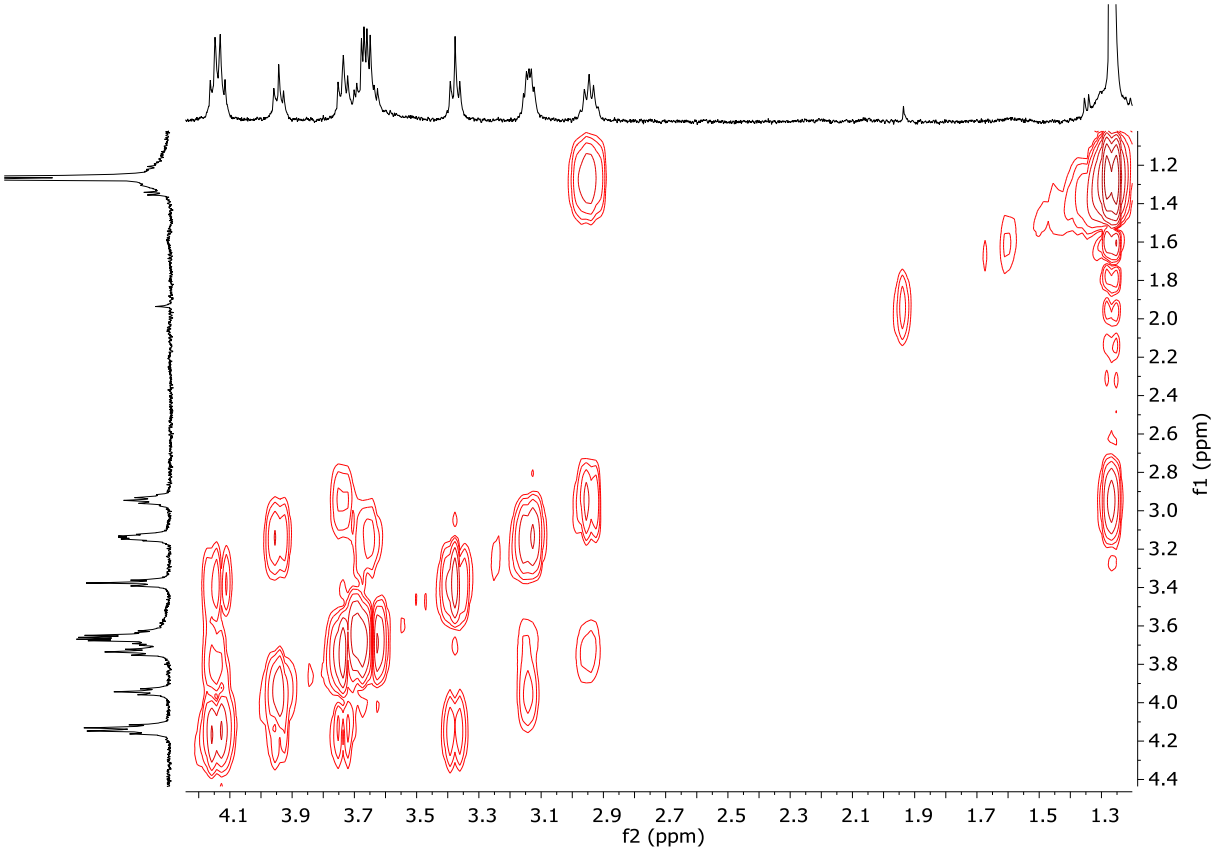


Figure S98: gCOSY spectrum (500 MHz, D_2O) of **7**

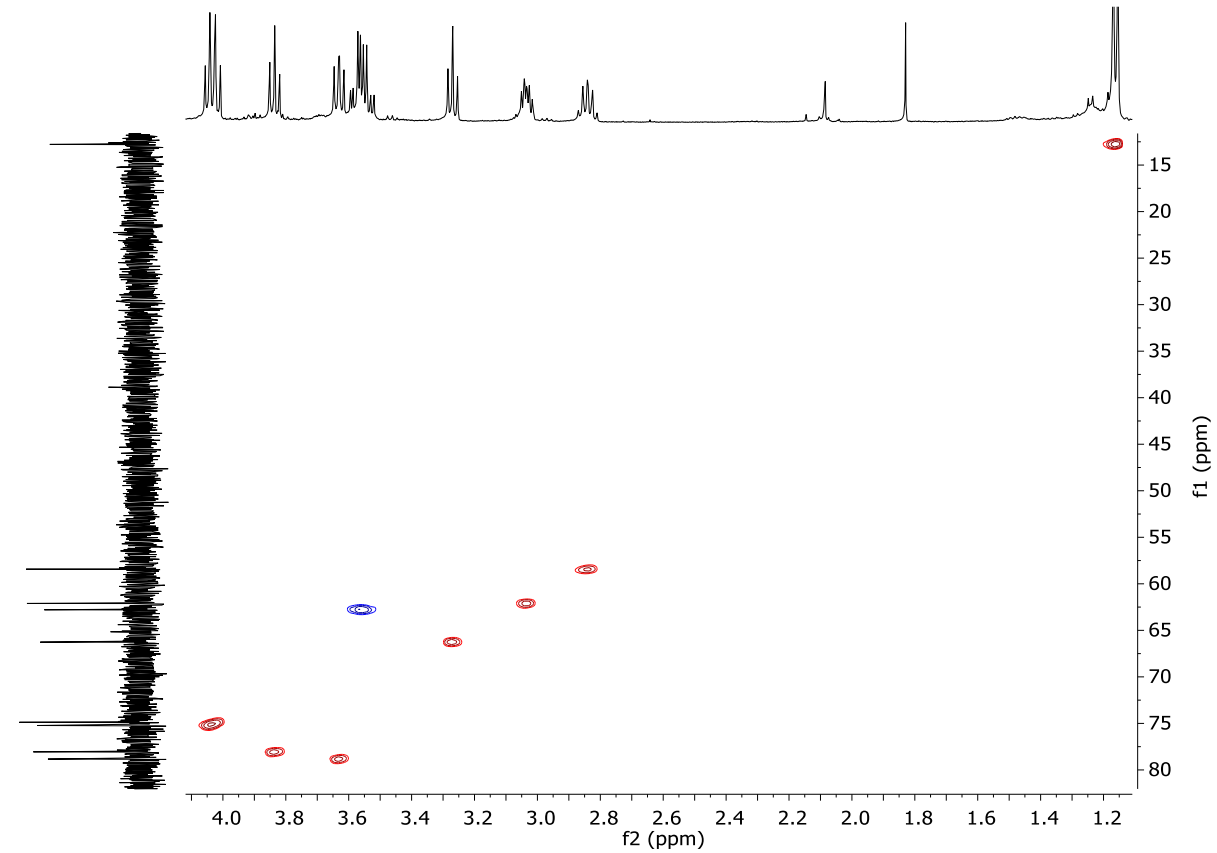


Figure S99: gHSQC spectrum (500 MHz, D_2O) of **7**

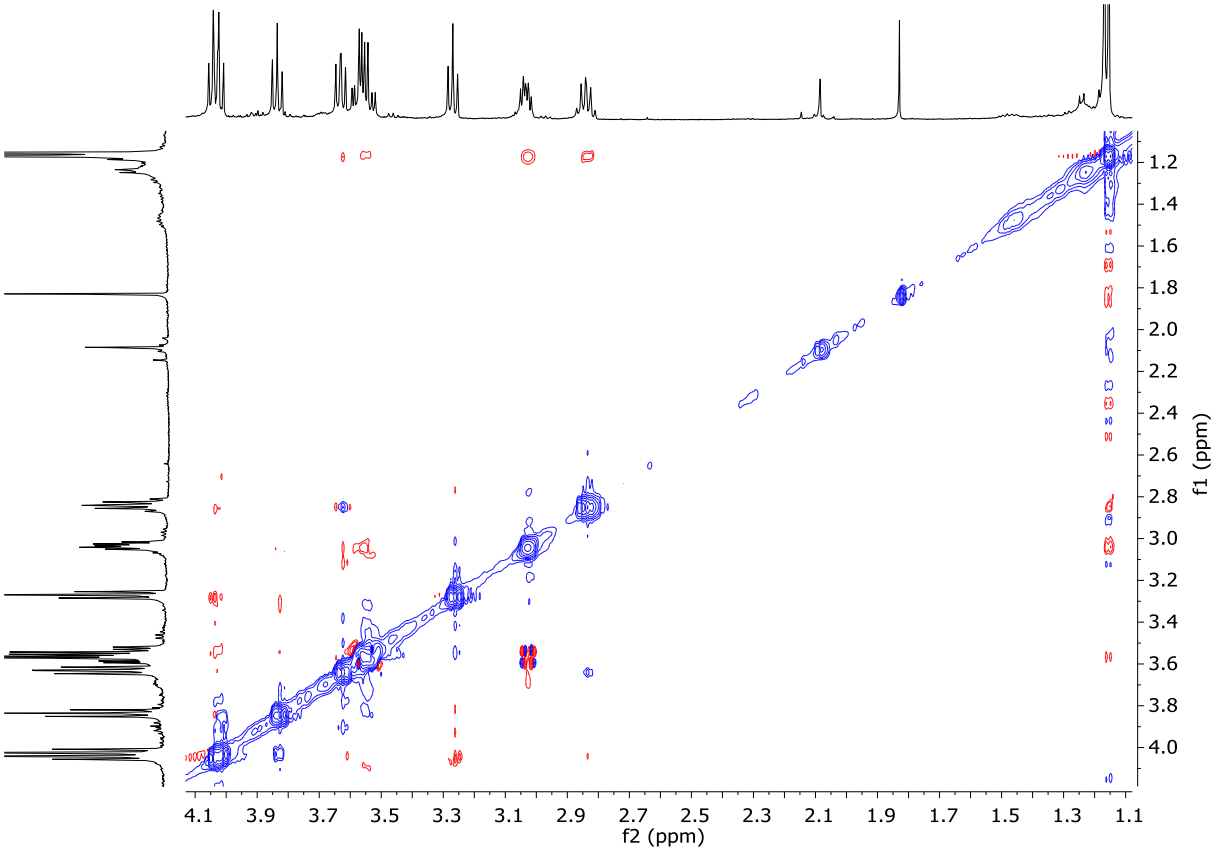


Figure S100: ROSEY spectrum (500 MHz, D_2O) of **7**

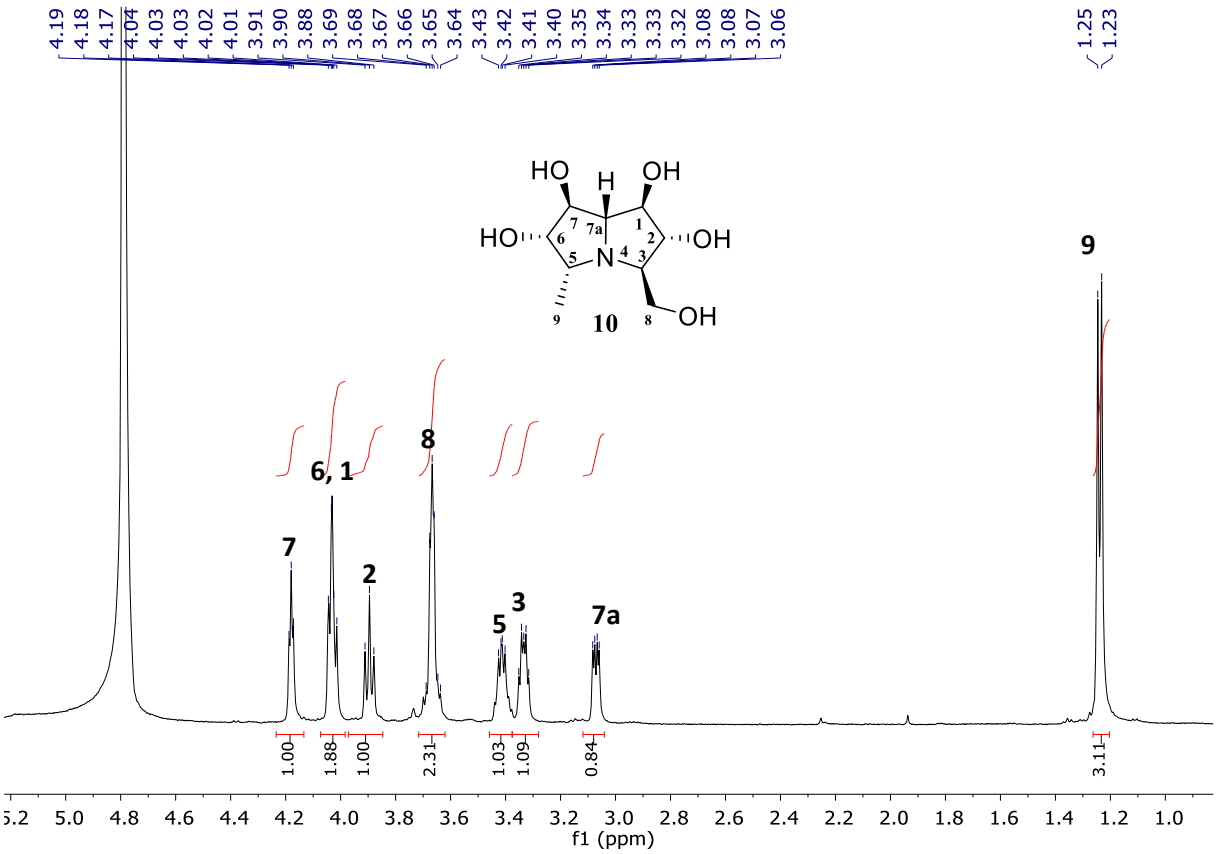


Figure S101: ^1H NMR spectrum (500 MHz, D_2O) of **10**

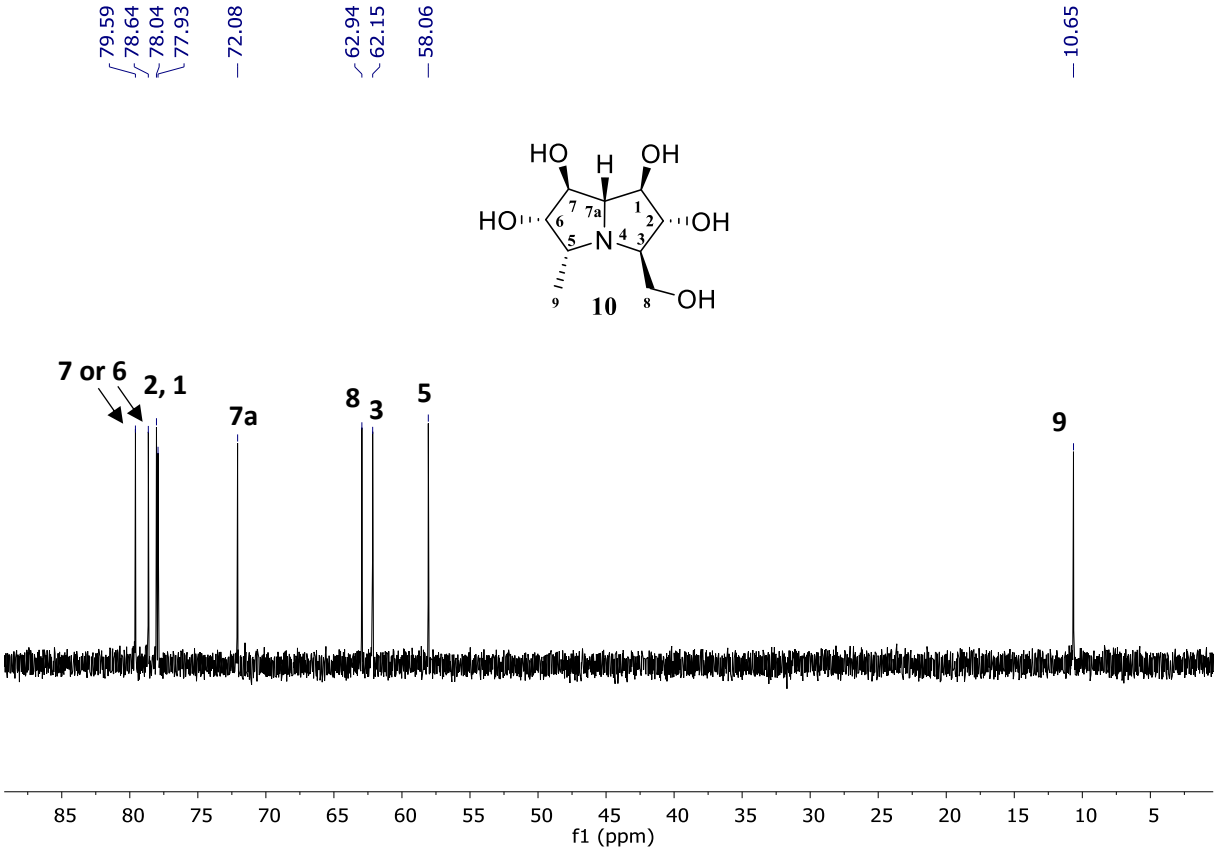


Figure S102: ^{13}C NMR spectrum (125 MHz, D_2O) of **10**

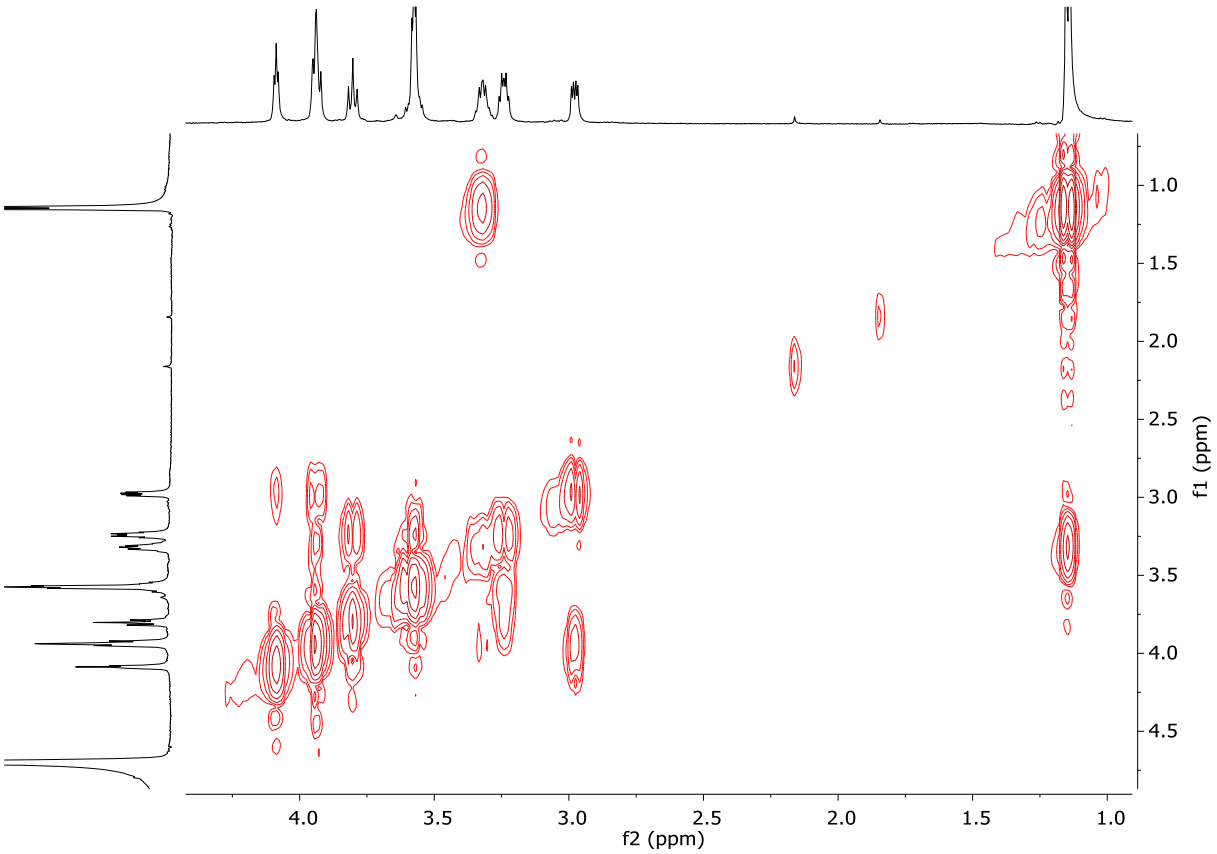


Figure S103: gCOSY spectrum (500 MHz, D_2O) of **10**

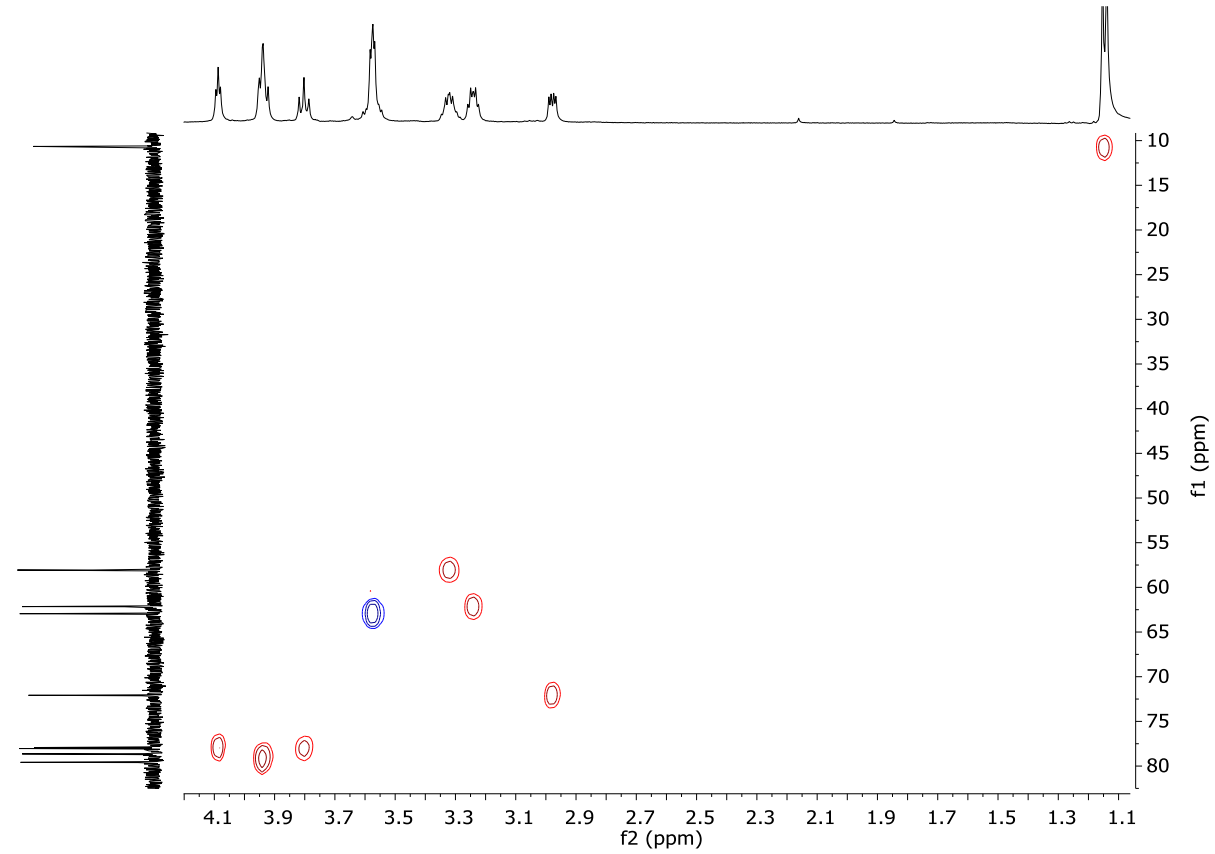
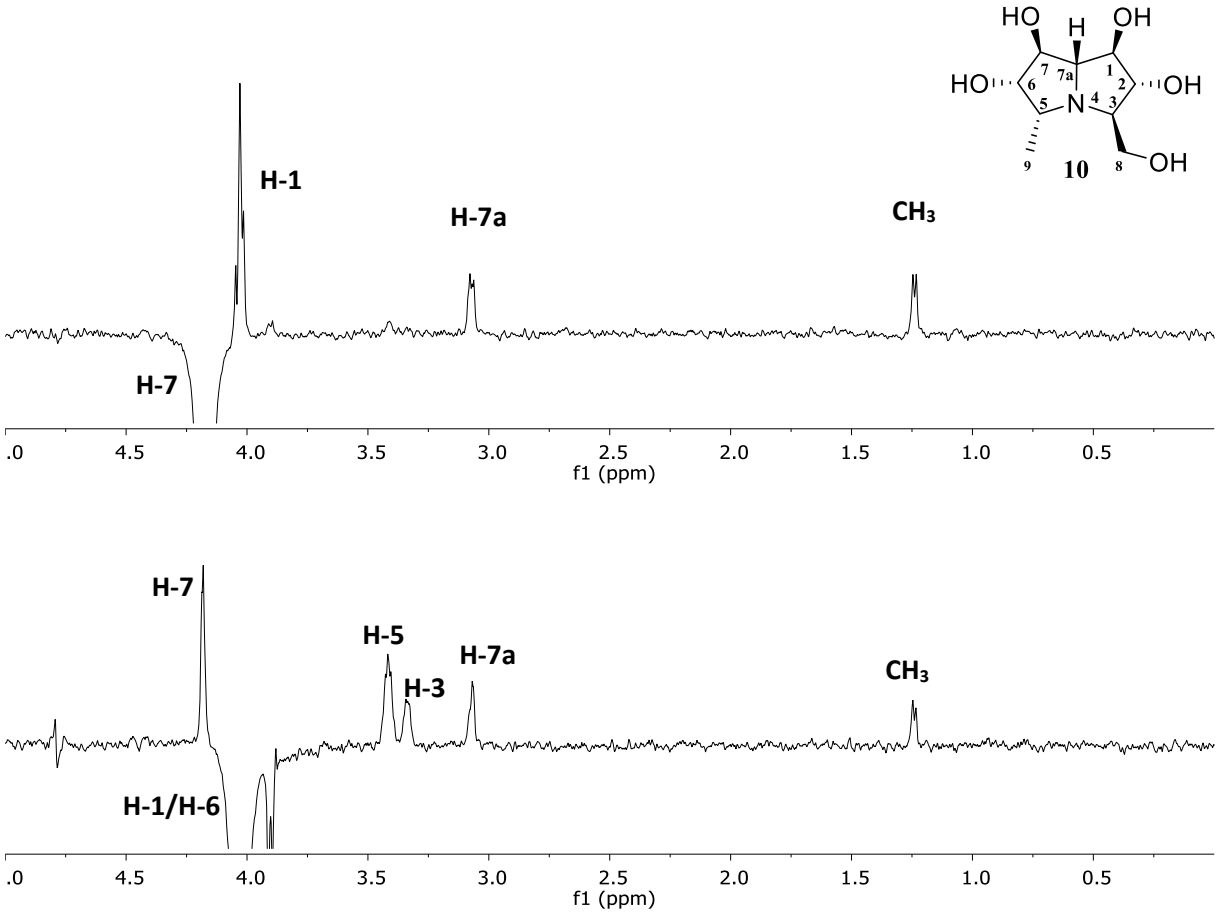
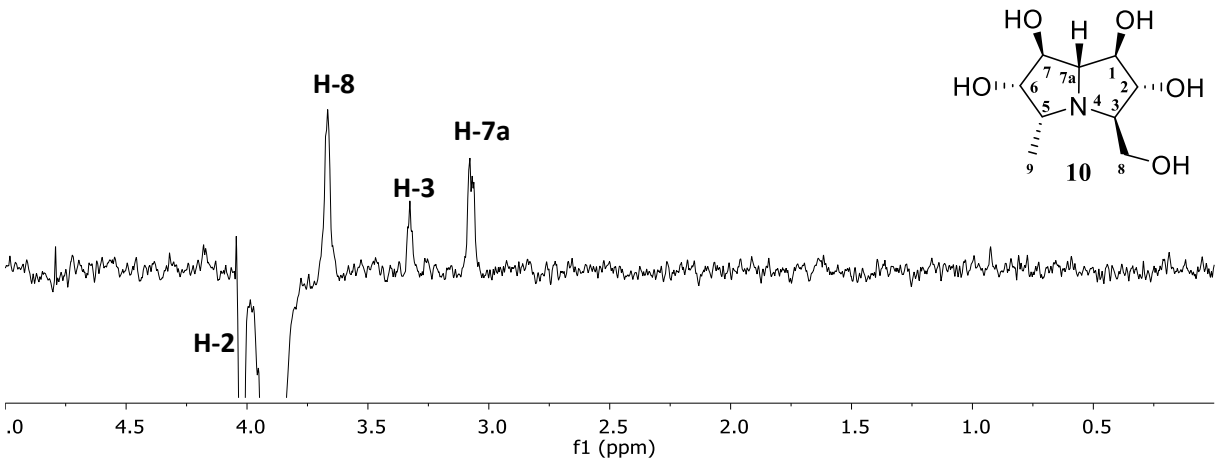
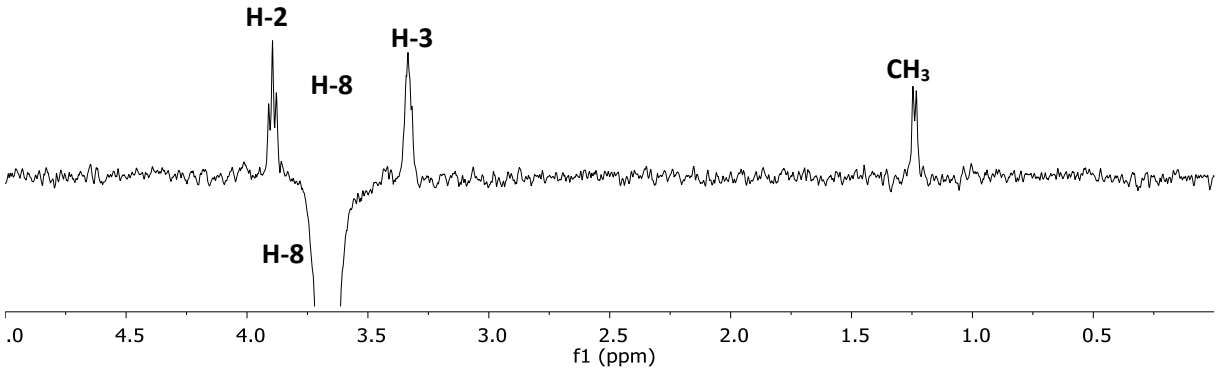
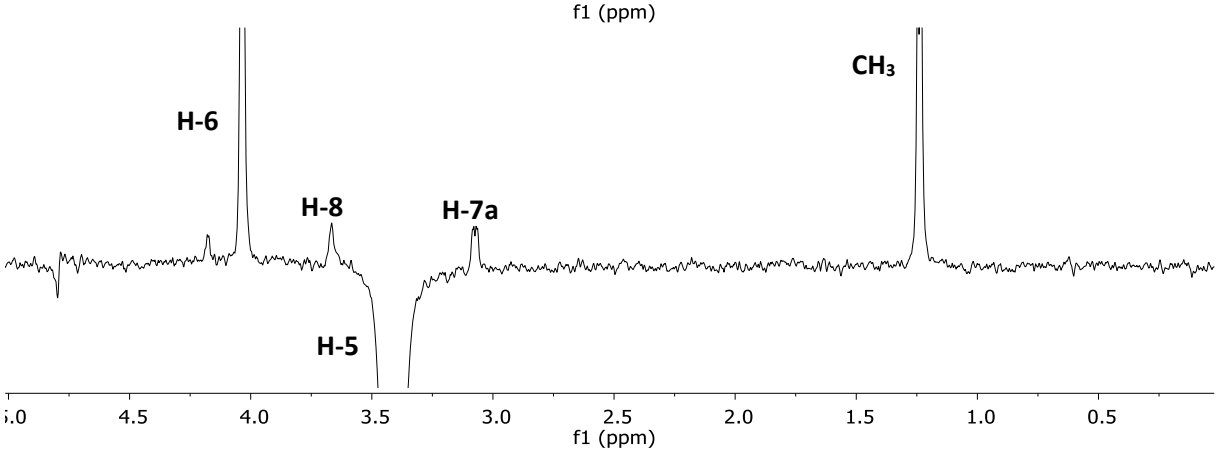


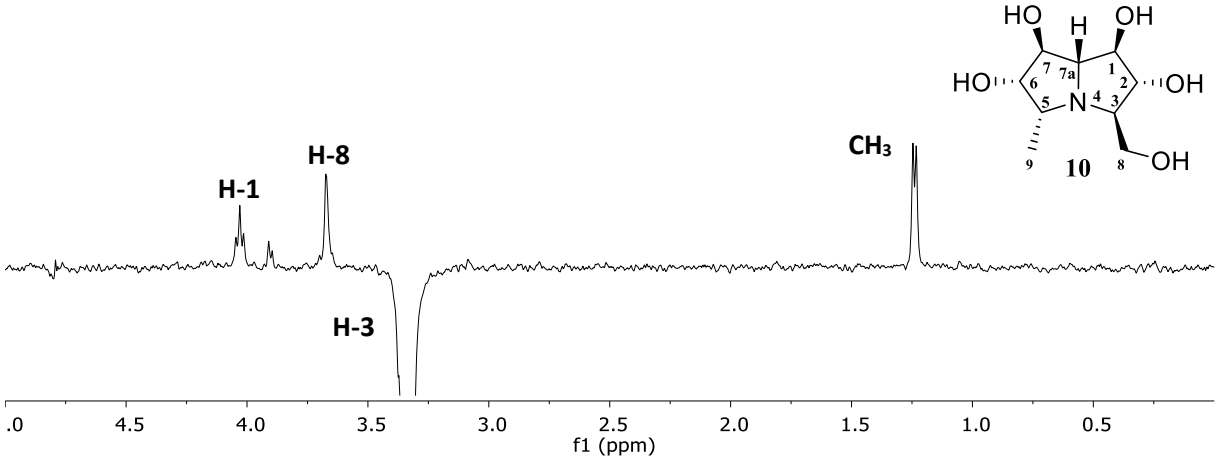
Figure S104: gHSQC spectrum (500 MHz, D_2O) of **10**




HO
H
OH
HO
OH
N
OH
10
H-8
H-7a
H-3
H-2
.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
f1 (ppm)


H-2
H-3
H-8
CH₃
H-8
.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
f1 (ppm)


CH₃
H-6
H-8
H-7a
H-5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
f1 (ppm)


HO
H
OH
HO
OH
N
OH
10
CH₃
H-8
H-1
H-3
.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
f1 (ppm)

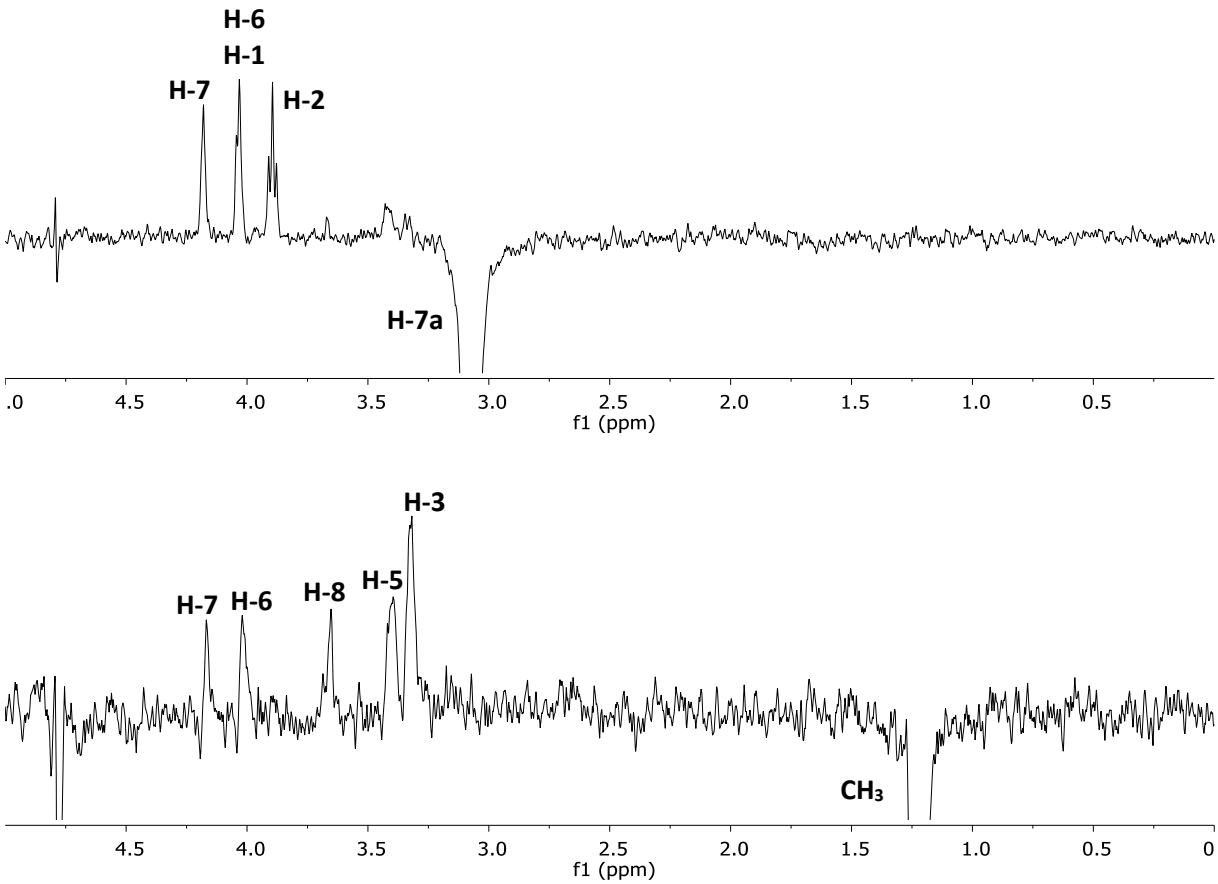


Figure S105: 1D-NOE spectrum (500 MHz, D_2O) of **10**

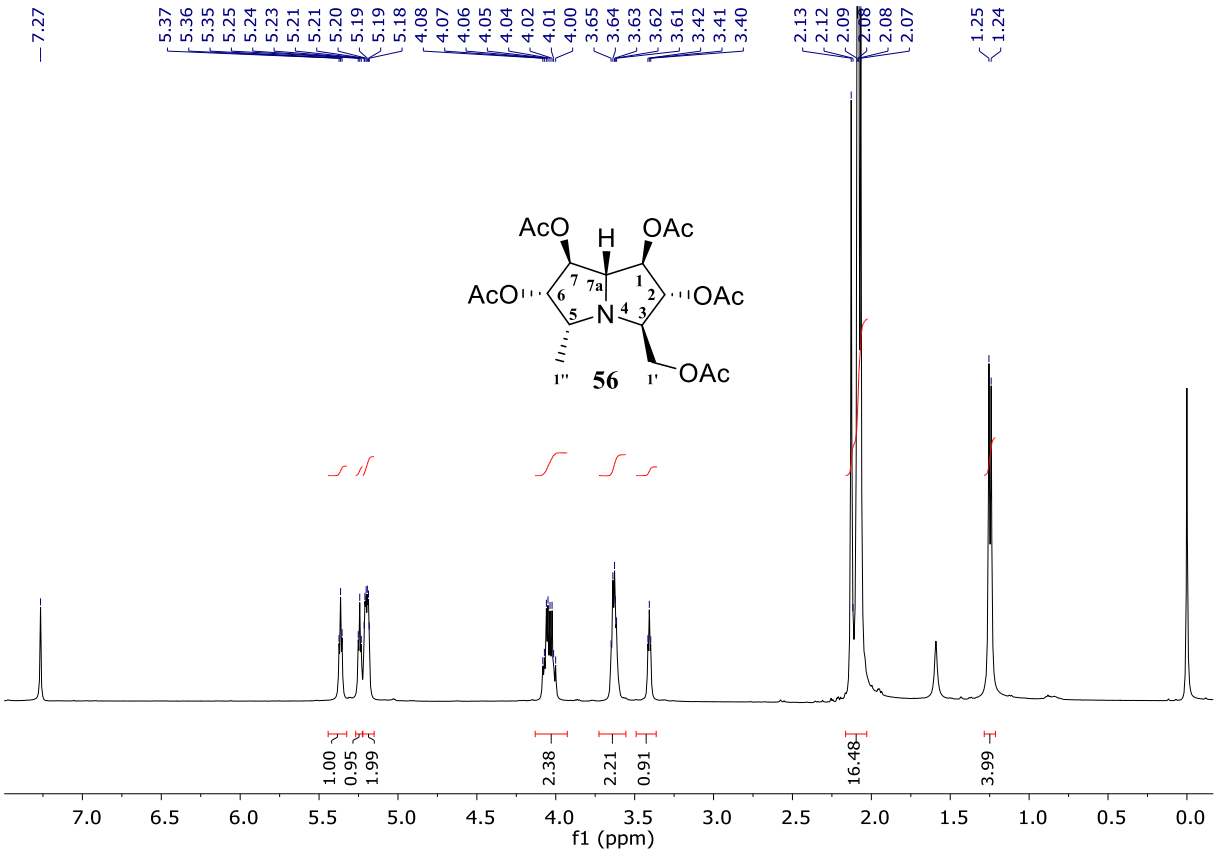


Figure S106: ^{1}H NMR spectrum (500 MHz, $CDCl_3$) of **56**

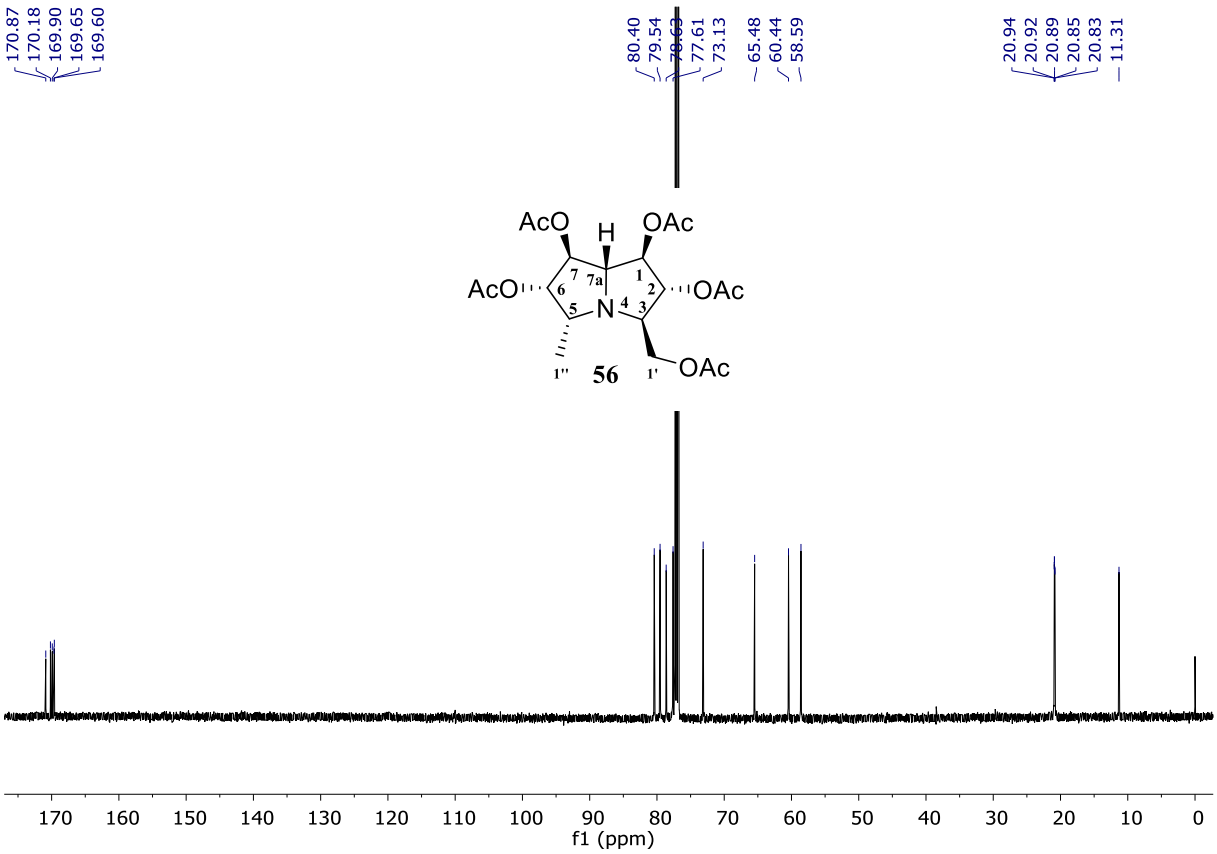


Figure S107: ^{13}C NMR spectrum (125 MHz, $CDCl_3$) of **56**

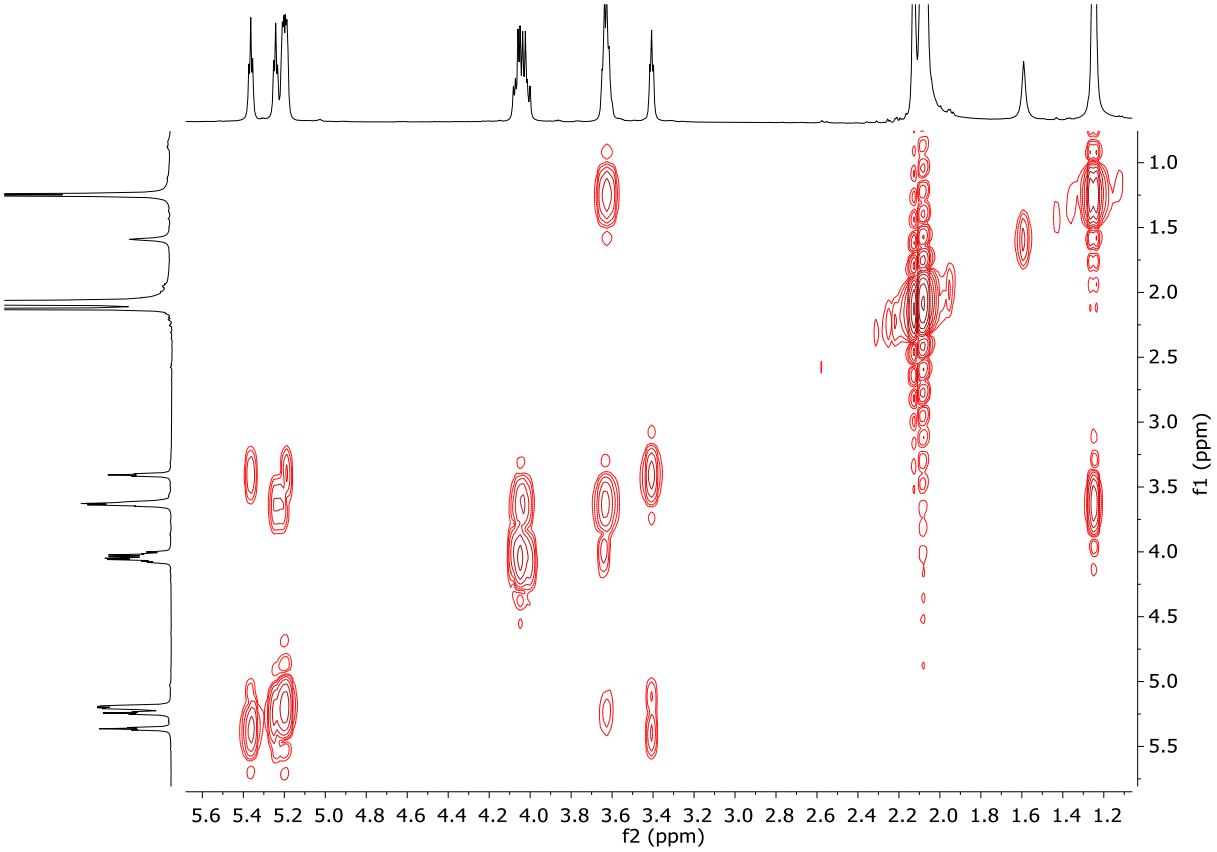


Figure S108: gCOSY spectrum (500 MHz, $CDCl_3$) of **56**

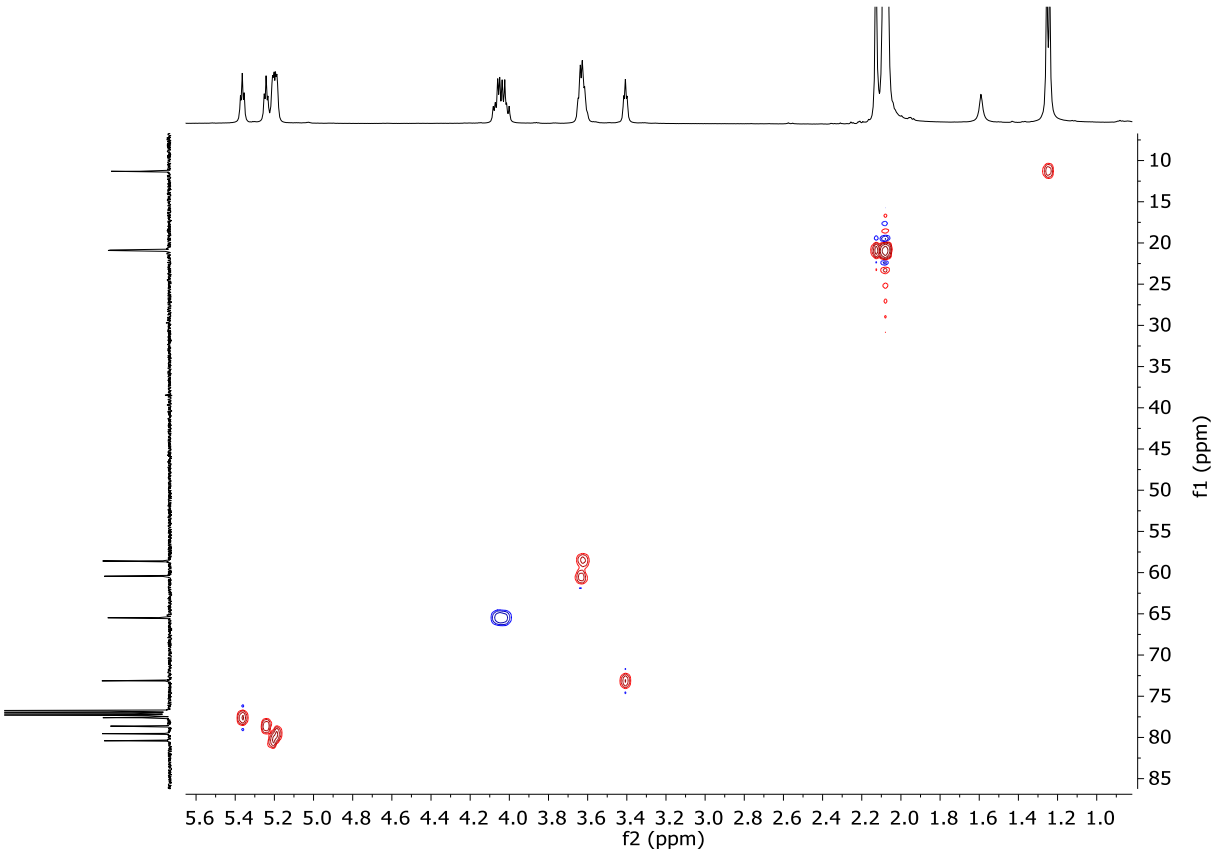
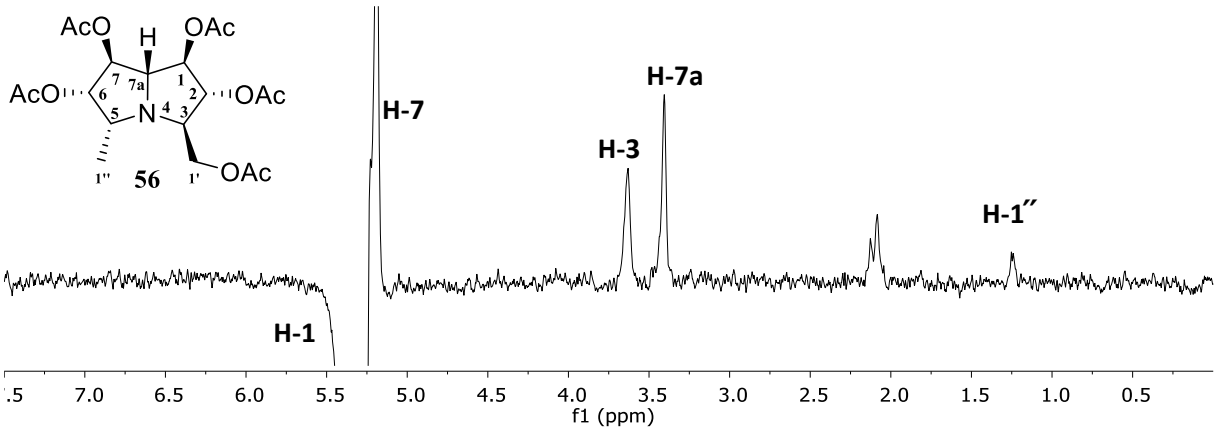
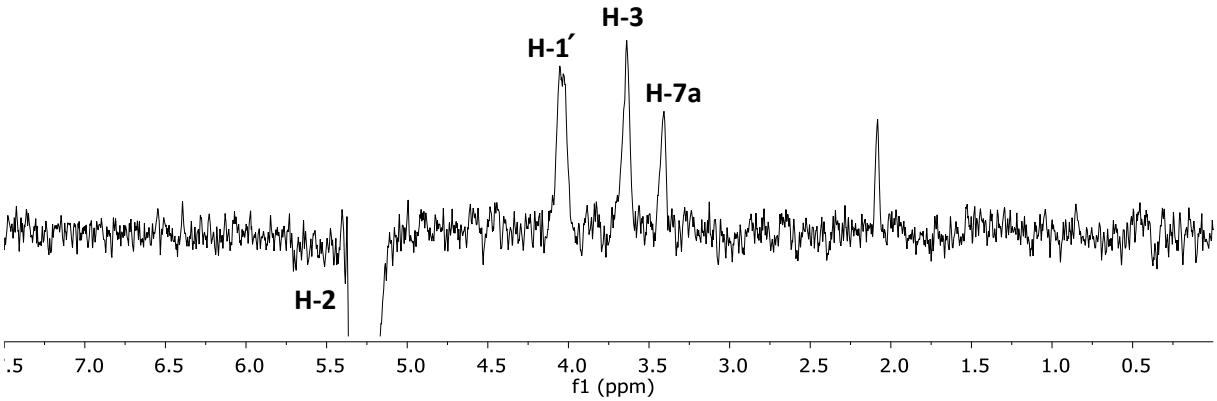
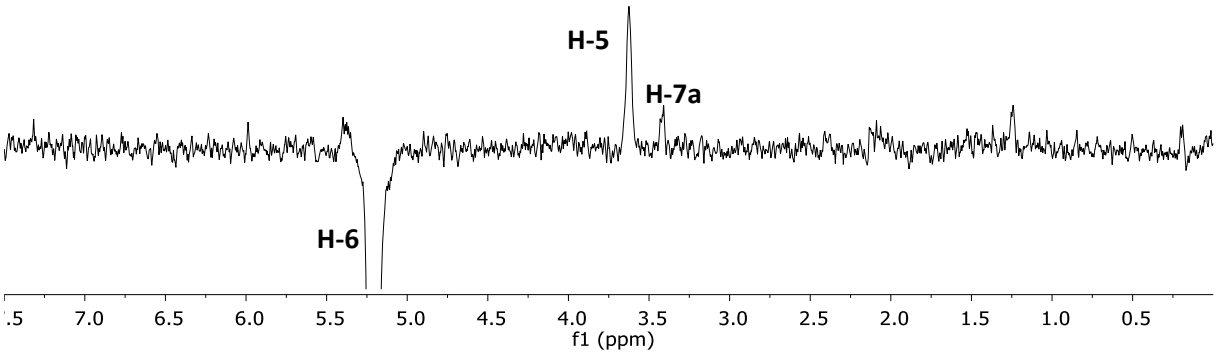
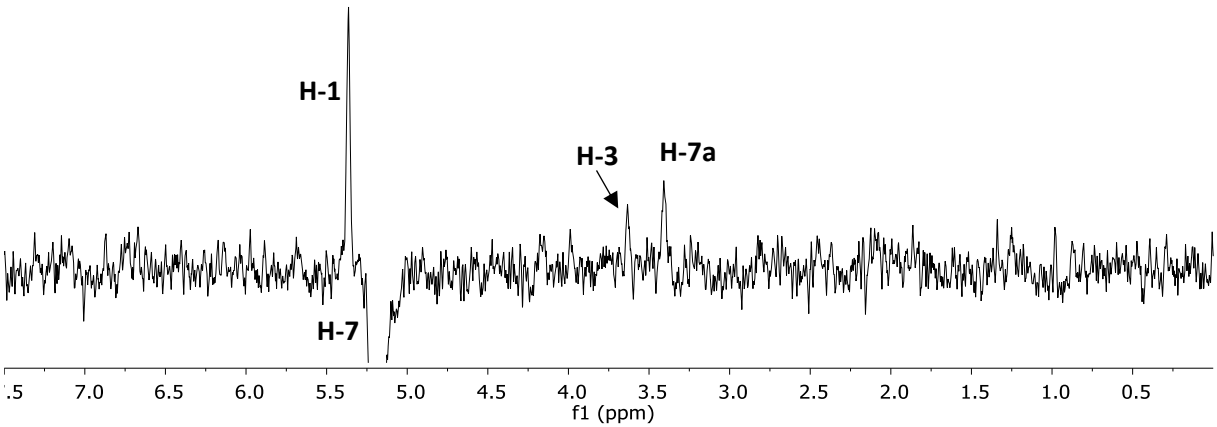


Figure S109: gHSQC spectrum (500 MHz, $CDCl_3$) of **56**


AcO
H
OAc
AcO
OAc
N
OAc
56
H-7
H-7a
H-3
H-1″
H-1
f1 (ppm)


H-3
H-1′
H-7a
H-2
f1 (ppm)


H-5
H-7a
H-6
f1 (ppm)


H-1
H-3
H-7a
H-7
f1 (ppm)

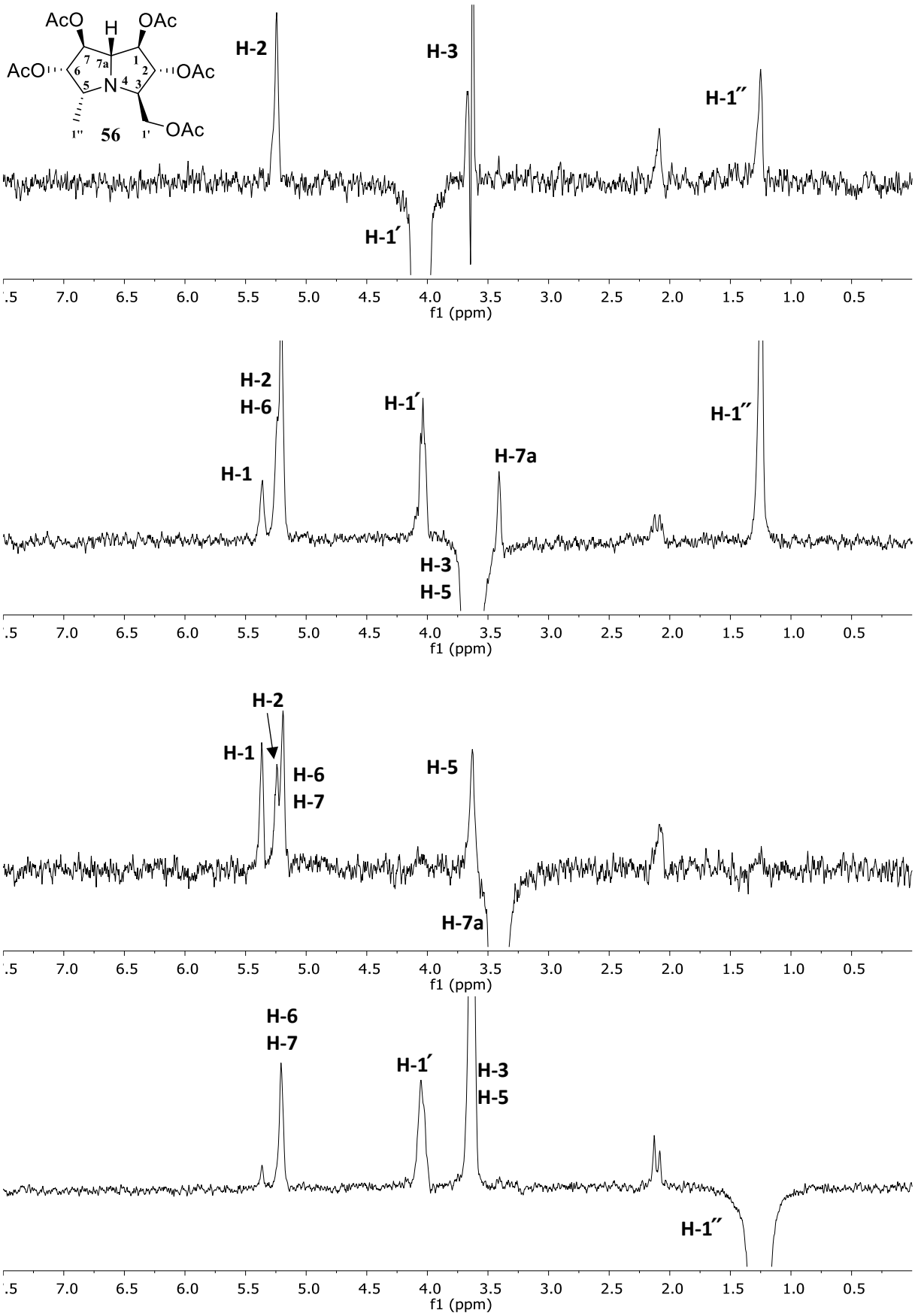


Figure S110: 1D-NOE spectrum (500 MHz, D_2O) of **56**

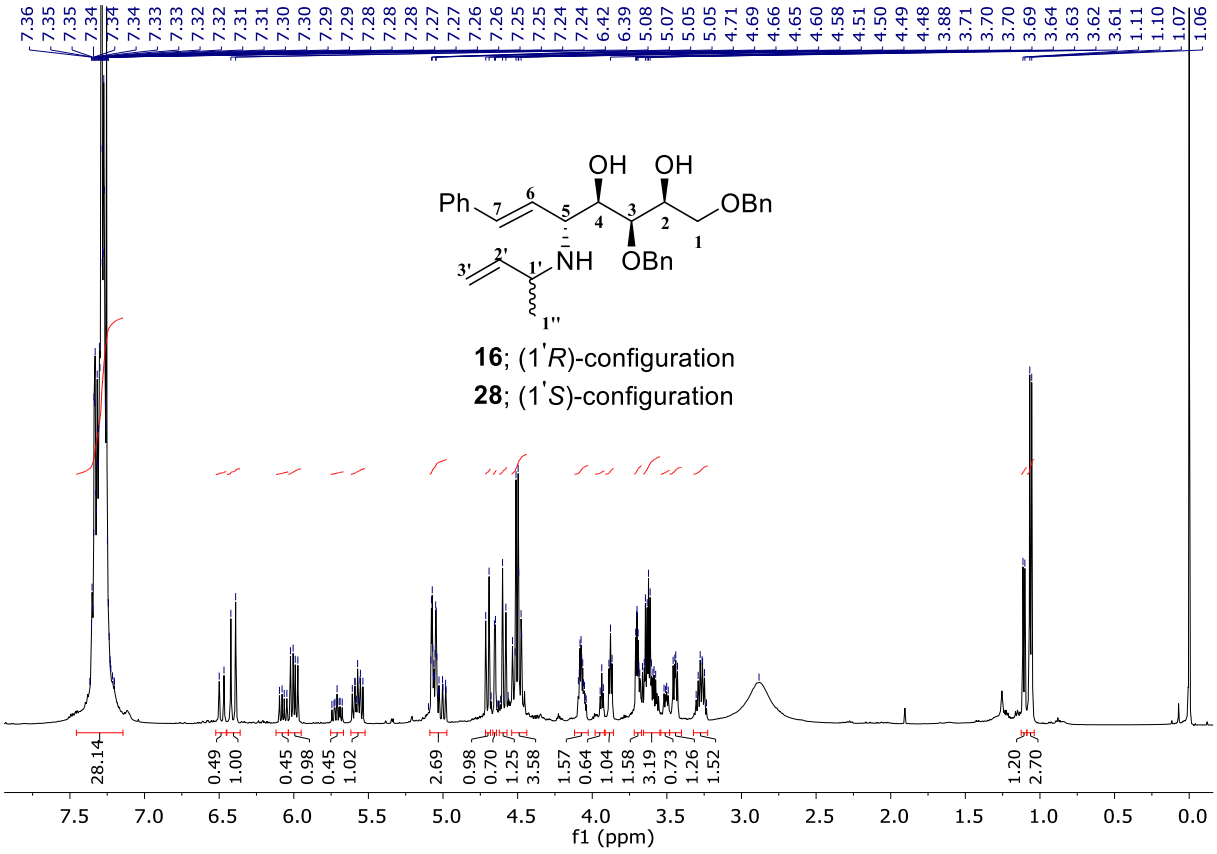


Figure S111: ^{1}H NMR spectrum (500 MHz, $CDCl_3$) of **16** and **28**

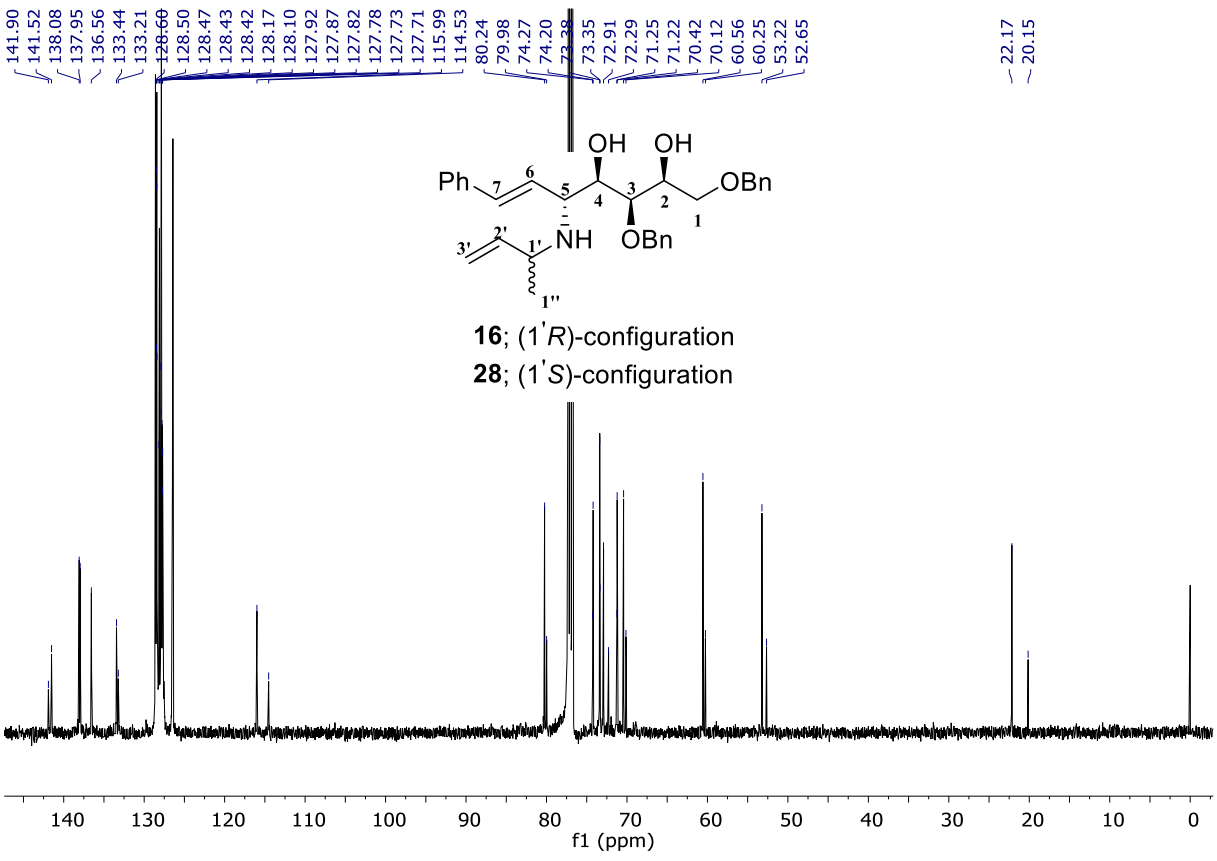


Figure S112: ^{13}C NMR spectrum (125 MHz, $CDCl_3$) of **16** and **28**

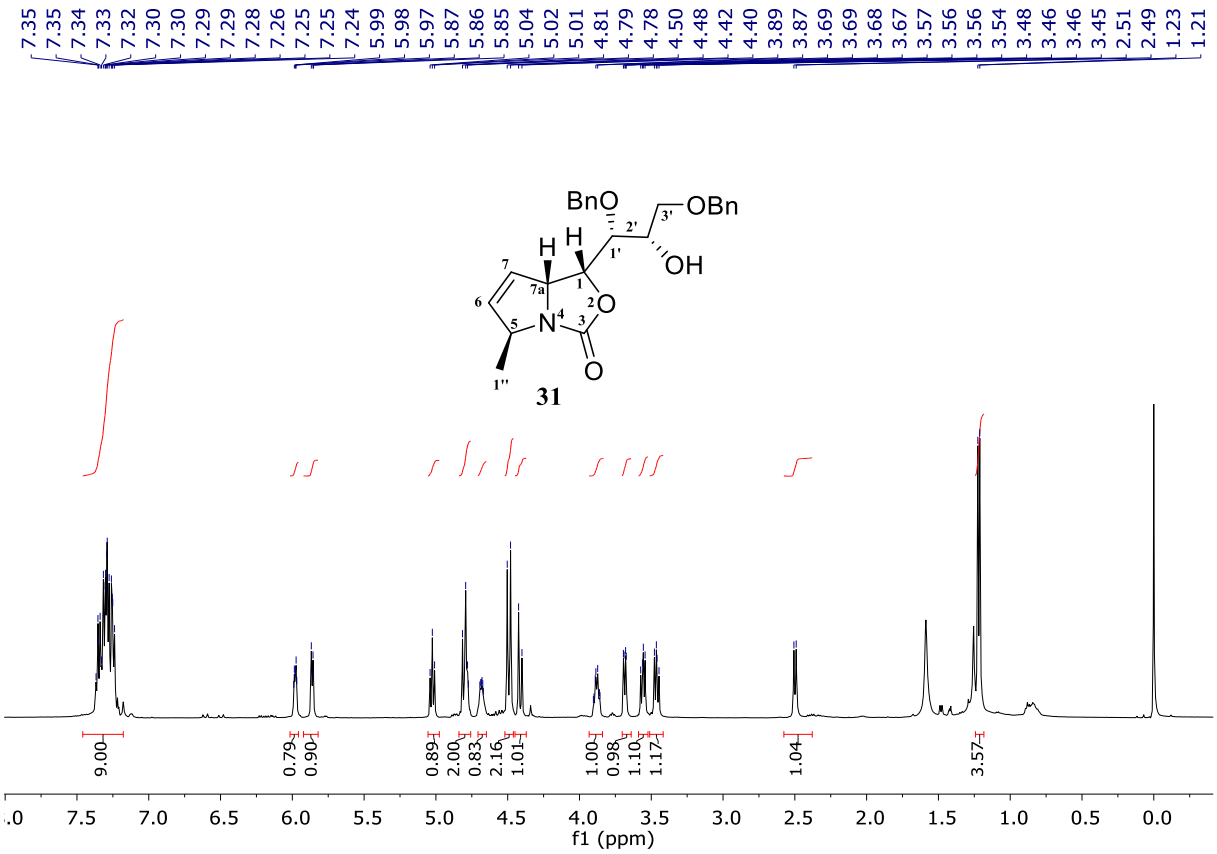


Figure S113: ^{1}H NMR spectrum (500 MHz, $CDCl_3$) of **31**

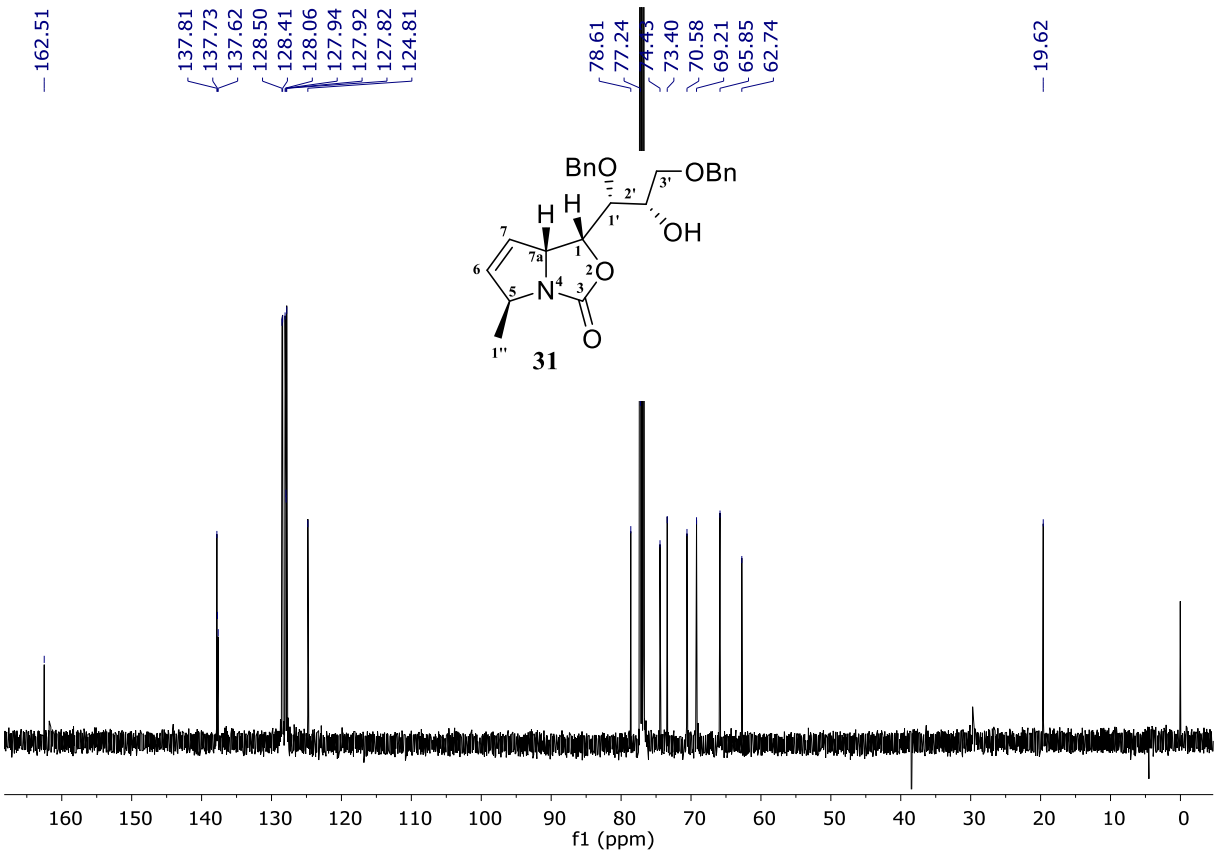


Figure S114: ^{13}C NMR spectrum (125 MHz, $CDCl_3$) of **31**

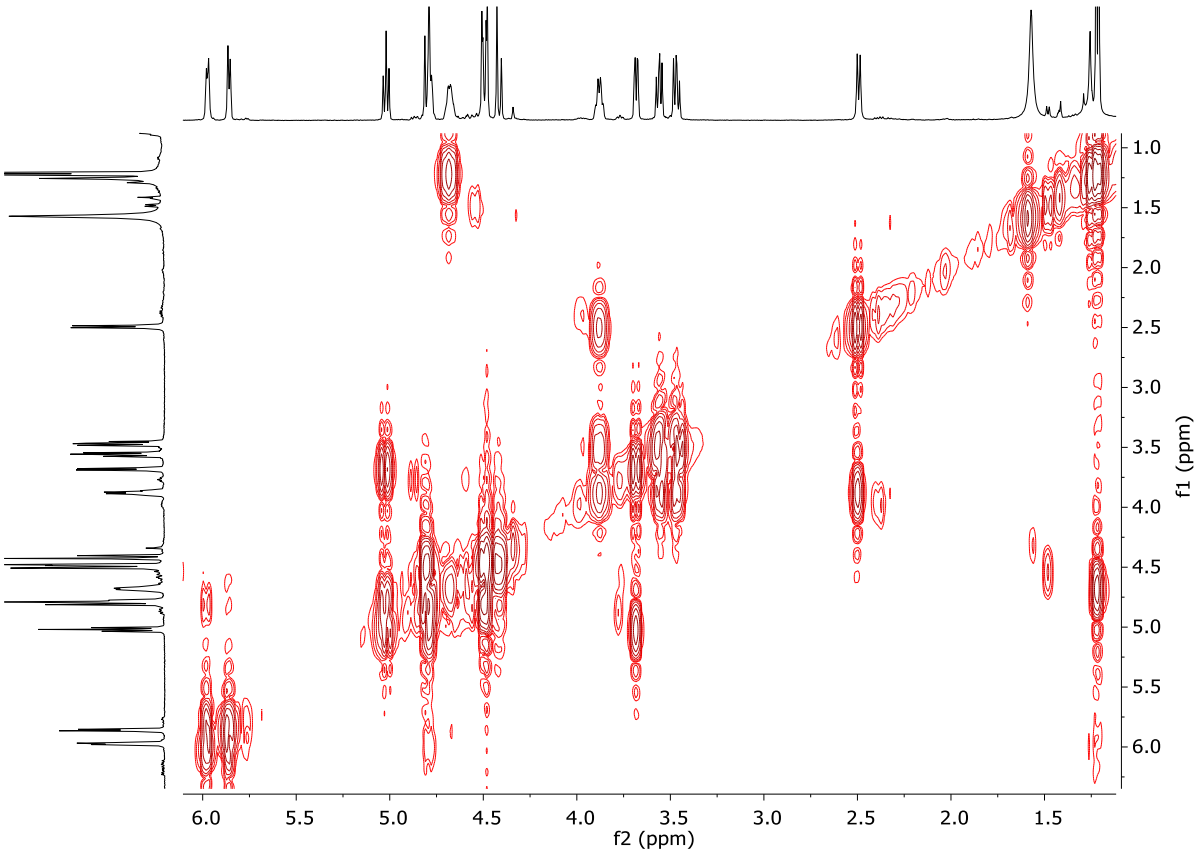


Figure S115: gCOSY spectrum (500 MHz, $CDCl_3$) of **31**

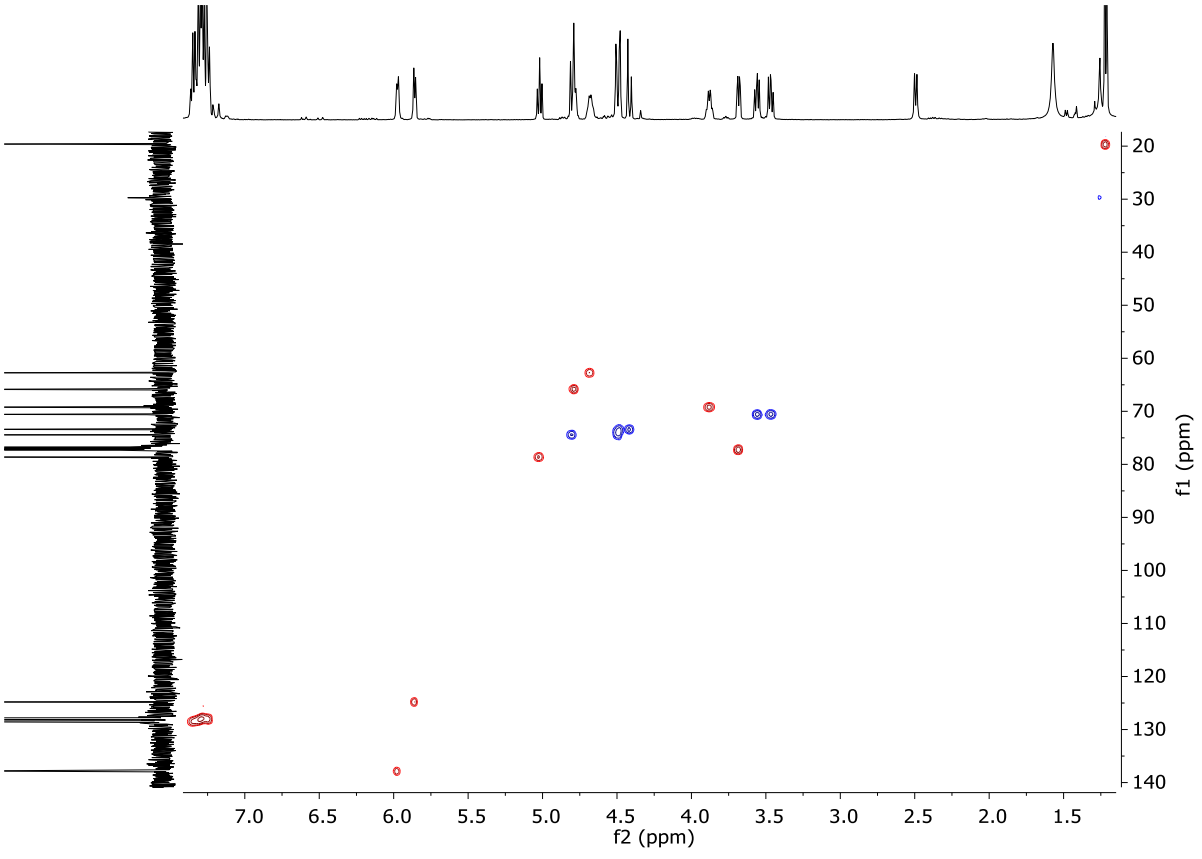


Figure S116: gHSQC spectrum (500 MHz, $CDCl_3$) of **31**

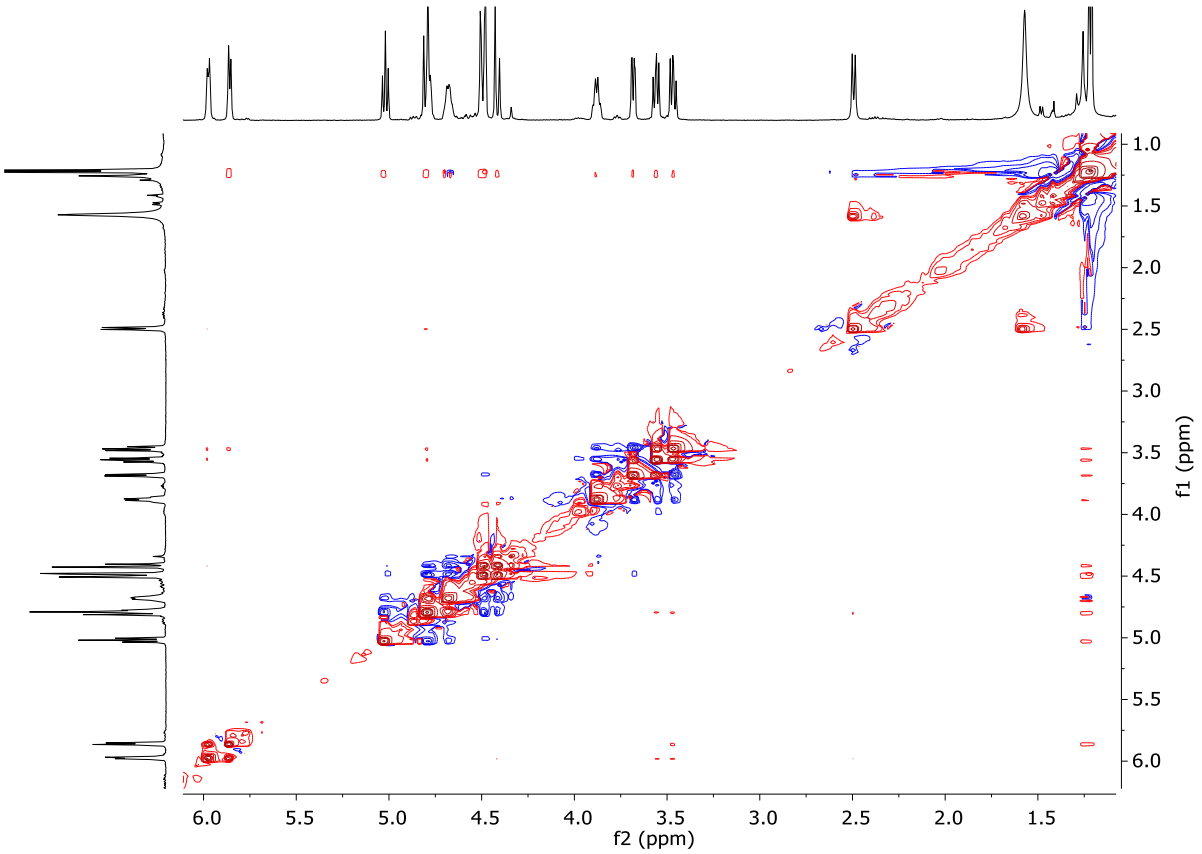


Figure S117: ROSEY spectrum (500 MHz, $CDCl_3$) of **31**

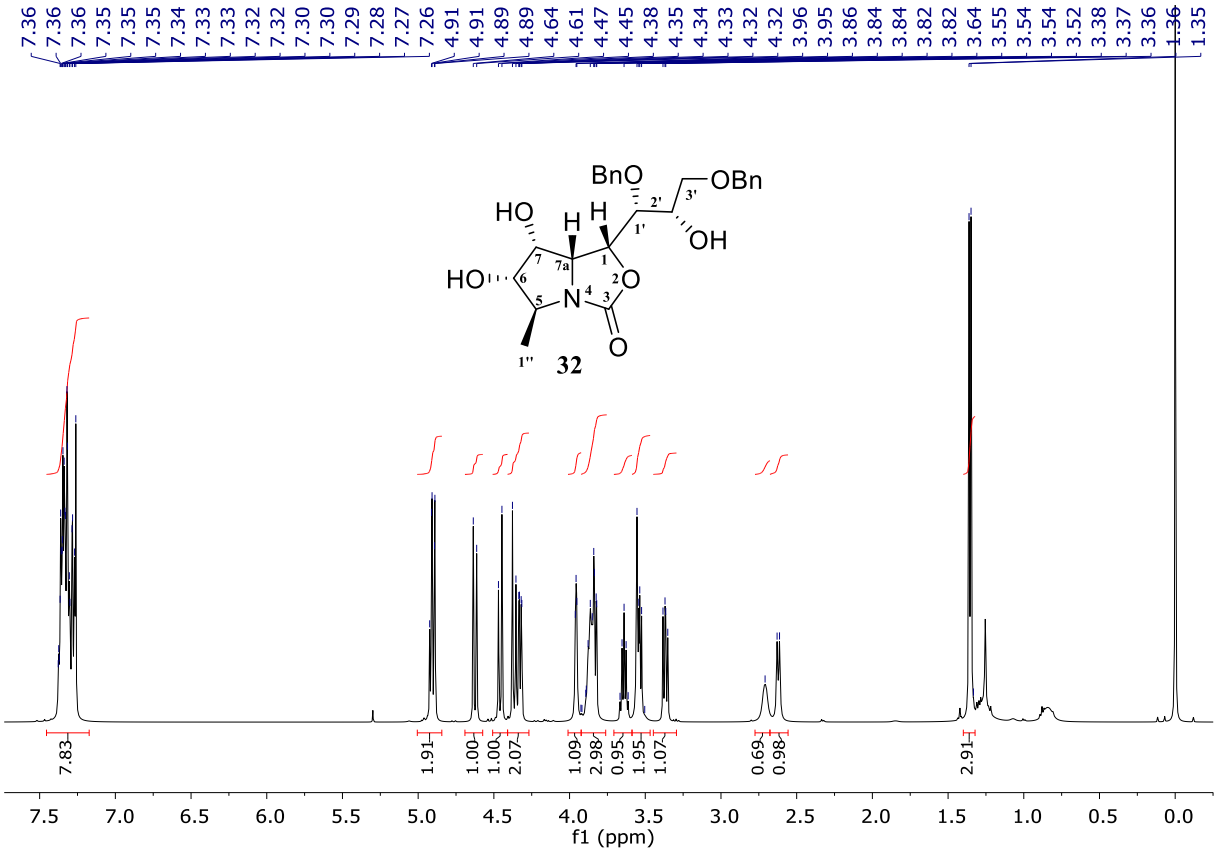


Figure S118: ^{1}H NMR spectrum (500 MHz, $CDCl_3$) of **32**

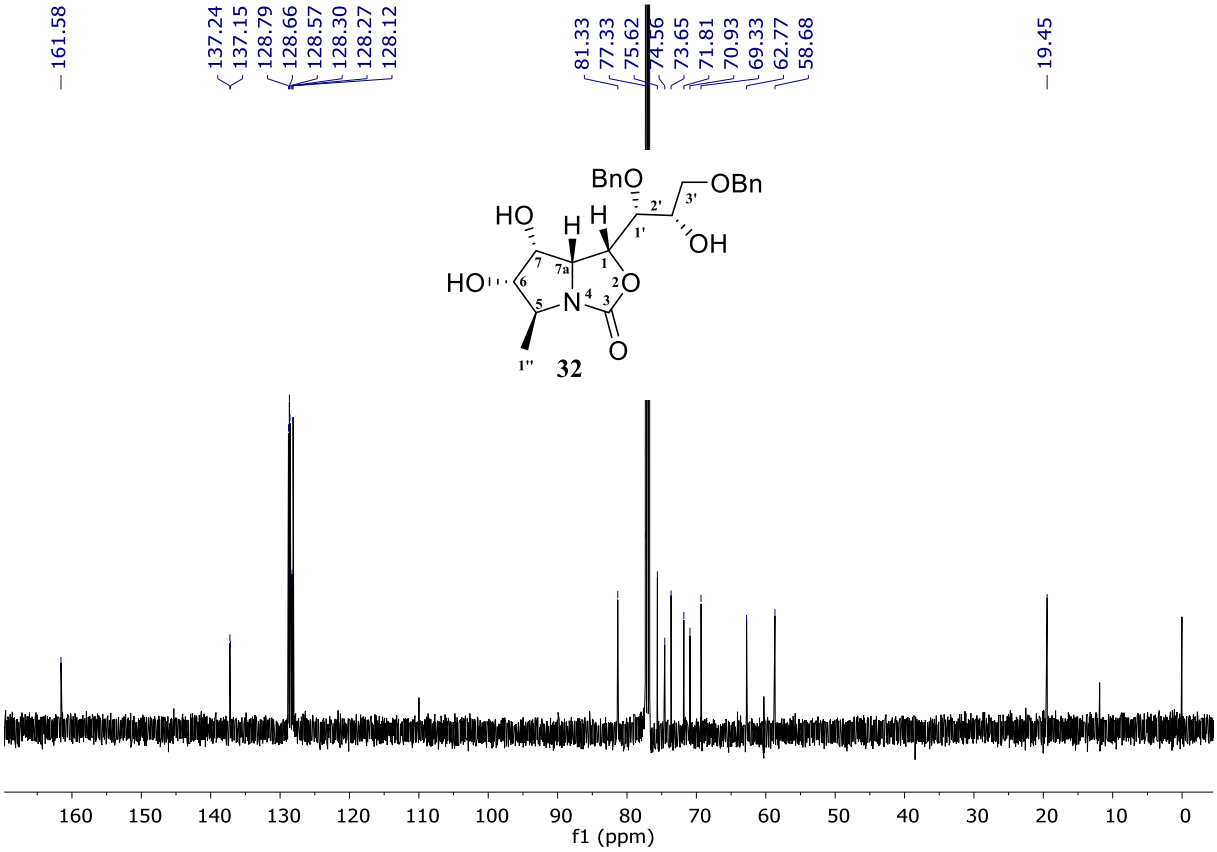


Figure S119: ^{13}C NMR spectrum (500 MHz, $CDCl_3$) of **32**

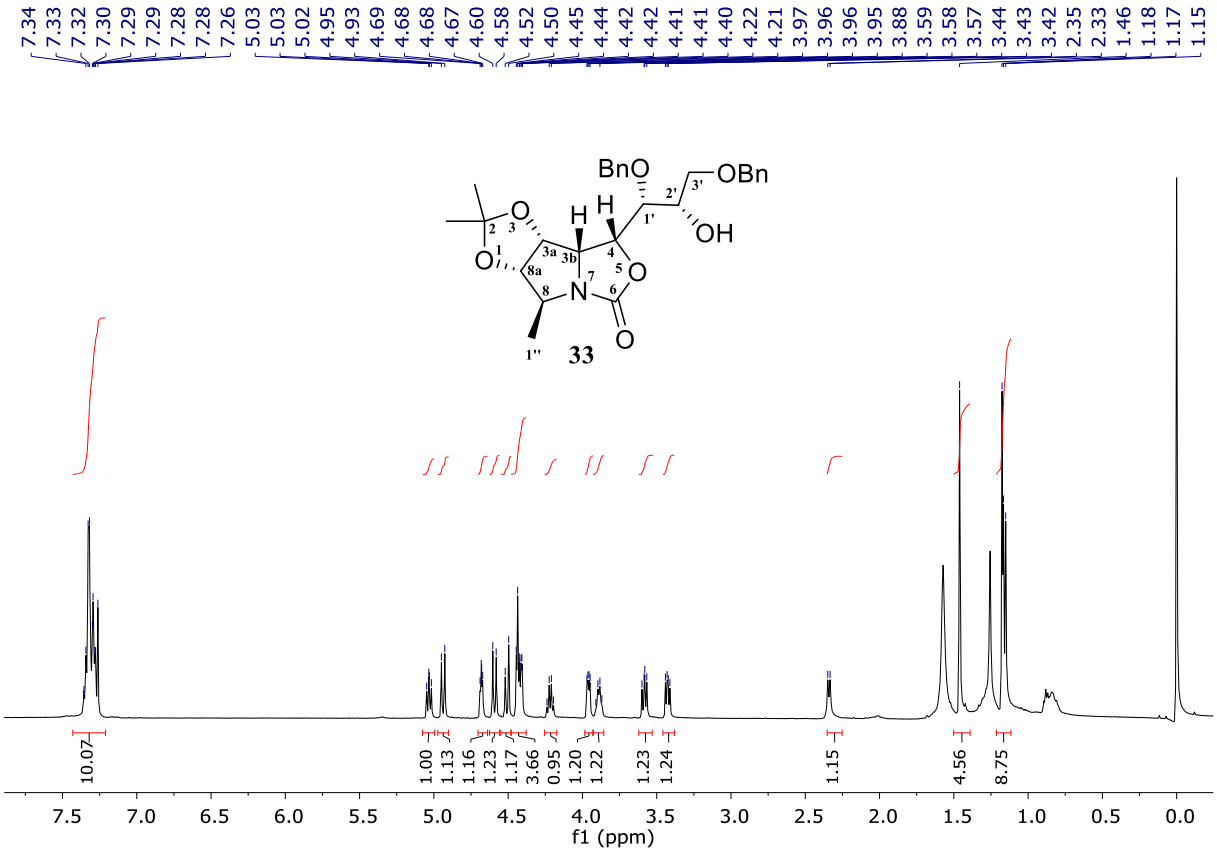


Figure S120: ^{1}H NMR spectrum (500 MHz, $CDCl_3$) of **33**

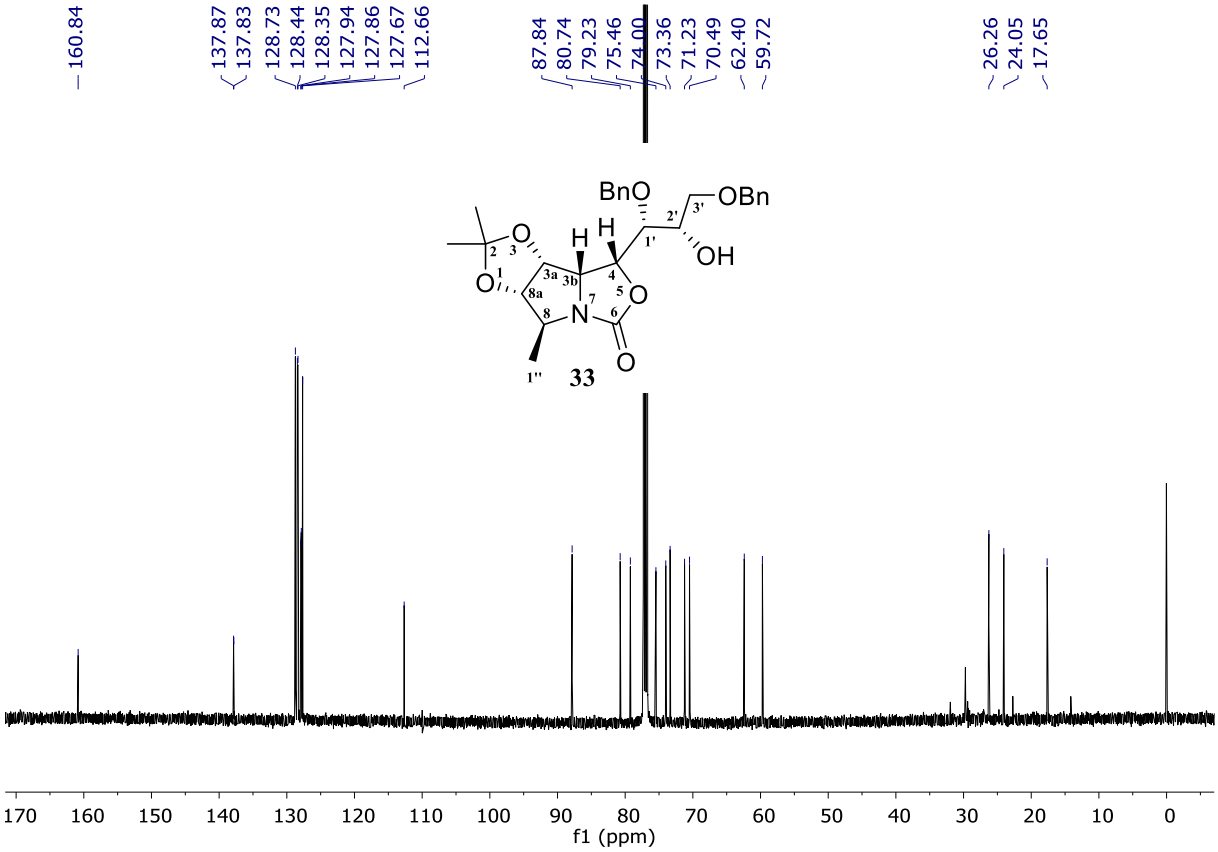


Figure S121: ^{13}C NMR spectrum (500 MHz, $CDCl_3$) of **33**

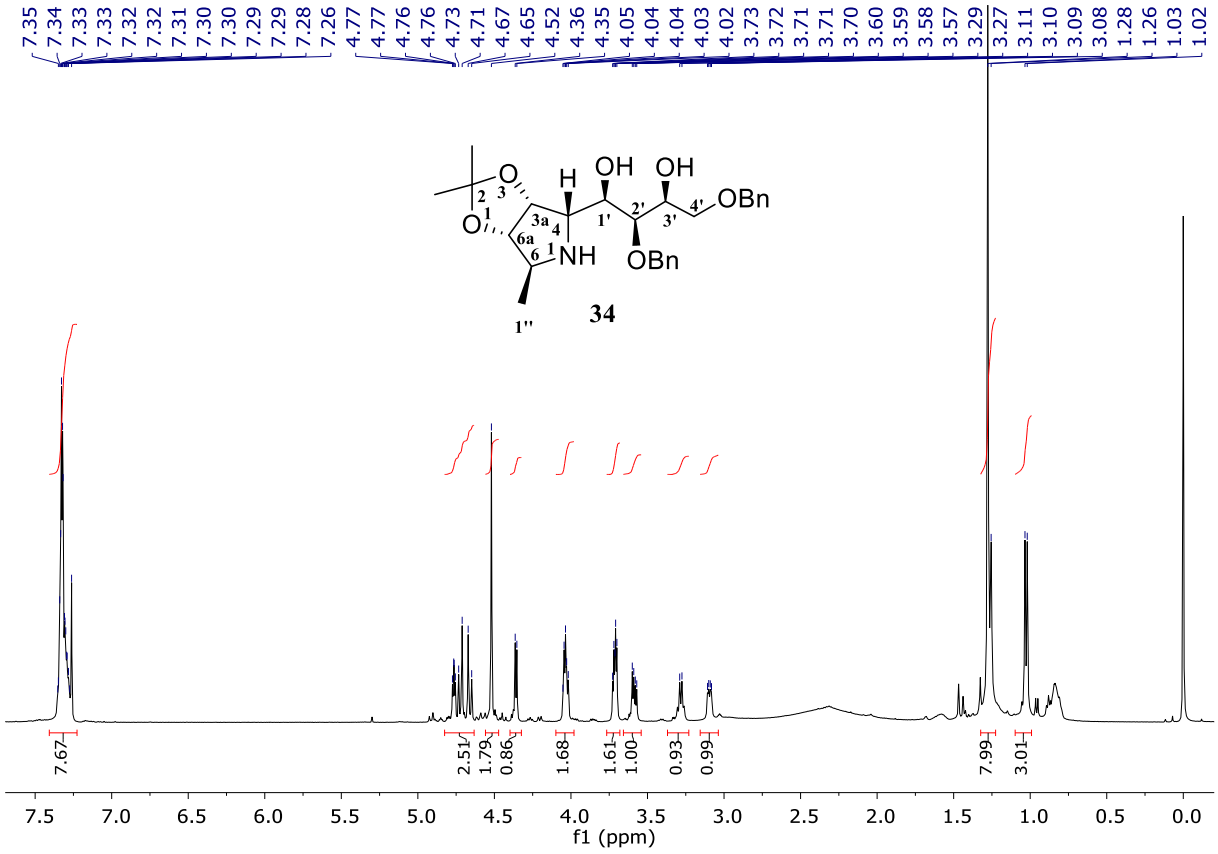


Figure S122: ^{1}H NMR spectrum (500 MHz, $CDCl_3$) of **34**

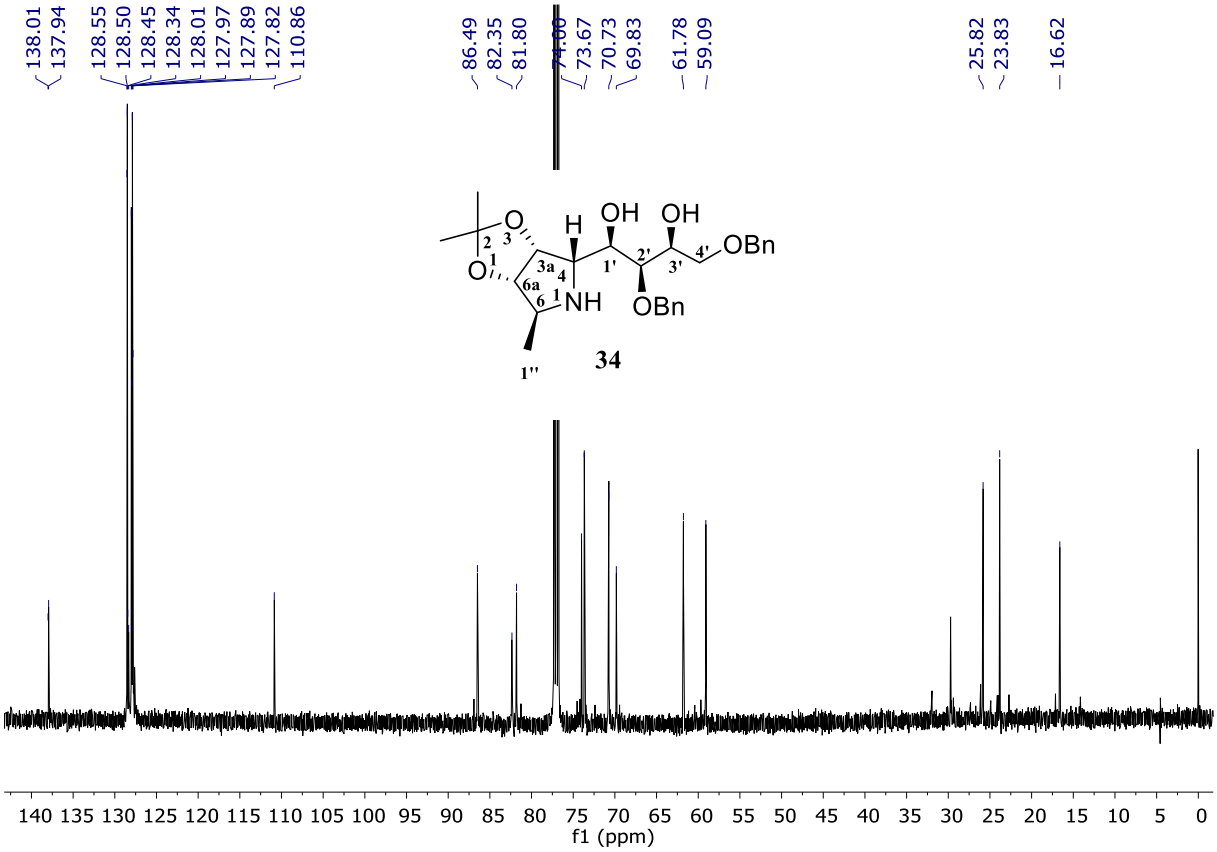


Figure S123: ^{13}C NMR spectrum (500 MHz, $CDCl_3$) of **34**

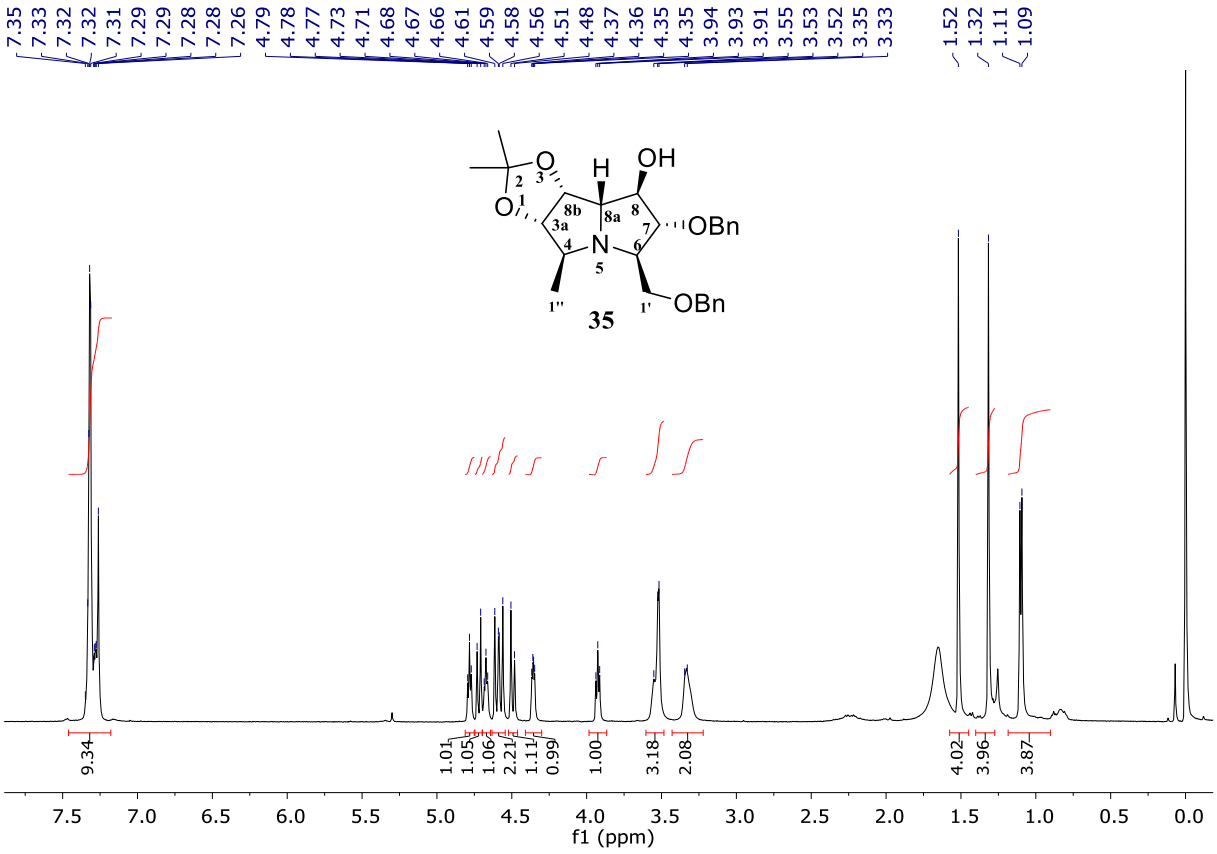


Figure S124: ^{1}H NMR spectrum (500 MHz, $CDCl_3$) of **35**

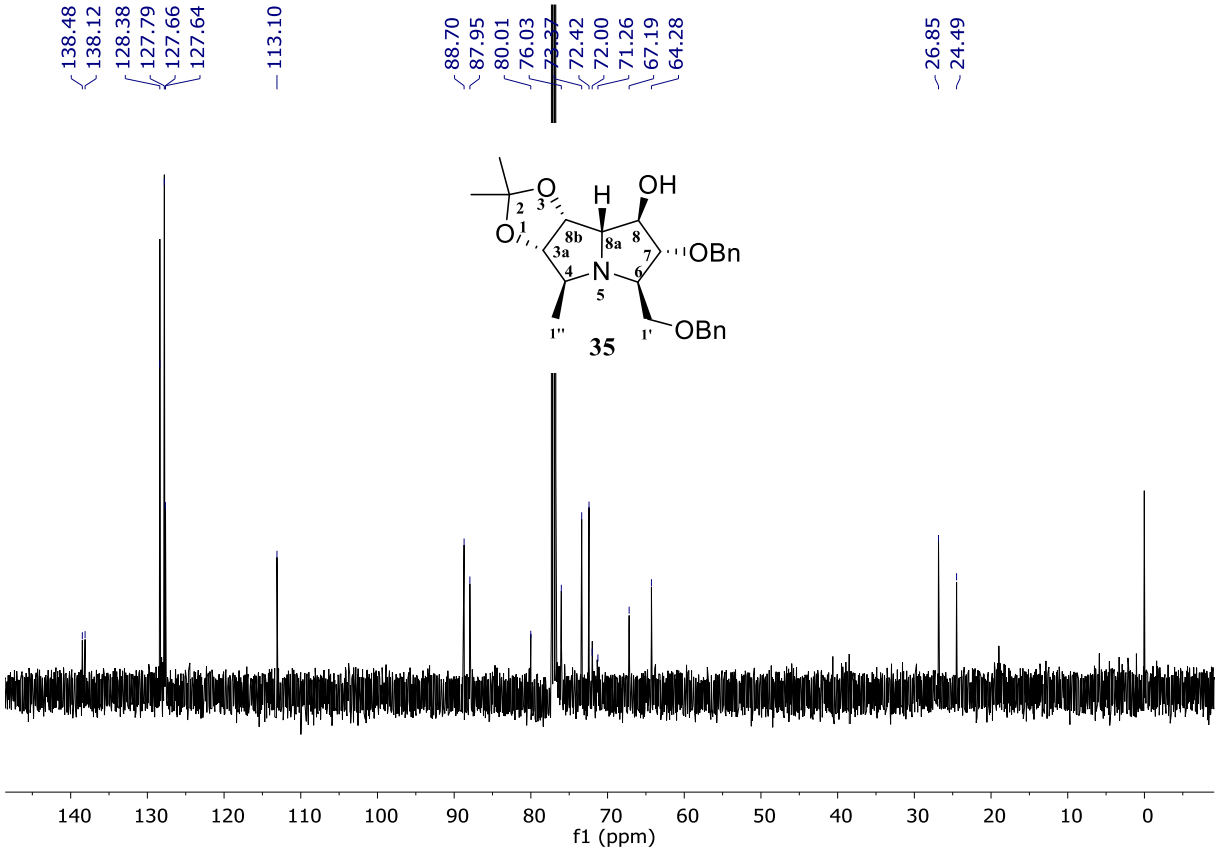


Figure S125: ^{13}C NMR spectrum (500 MHz, $CDCl_3$) of **35**

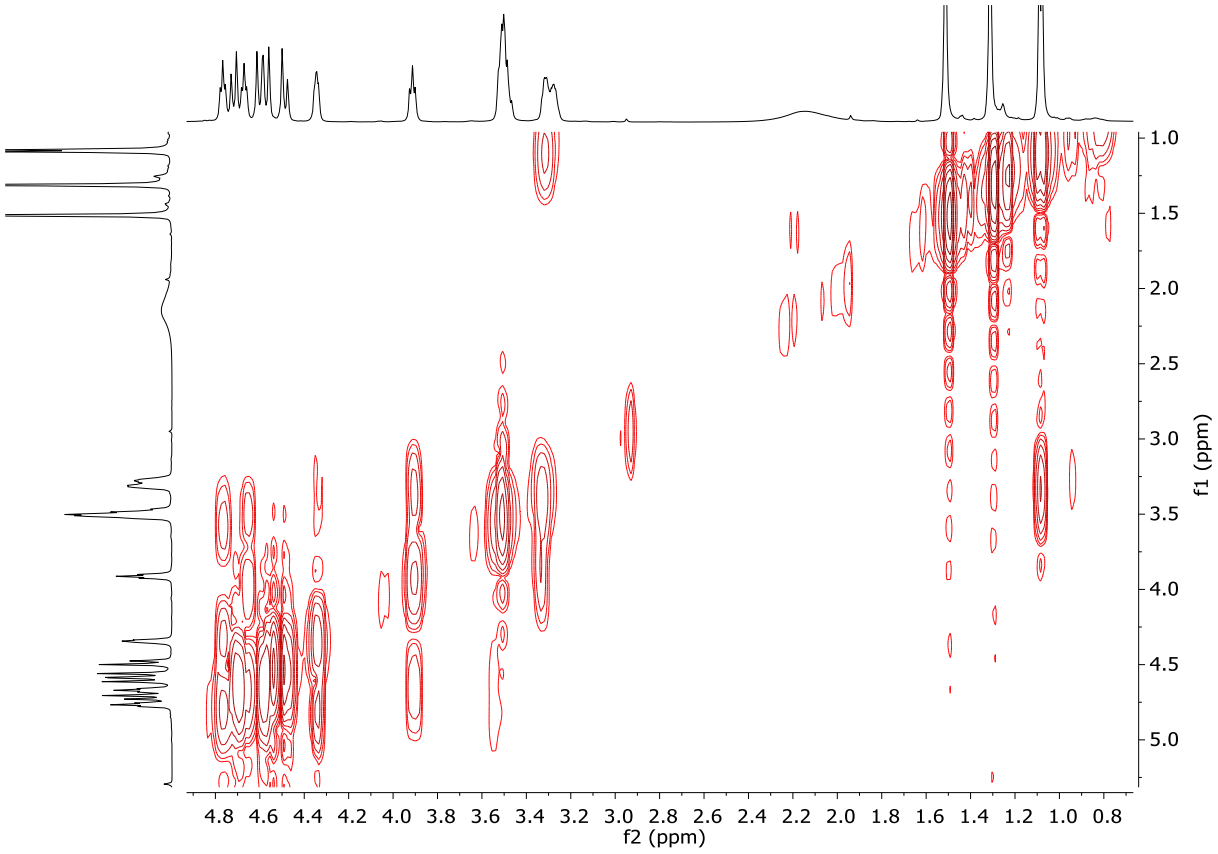


Figure S126: gCOSY spectrum (500 MHz, $CDCl_3$) of **35**

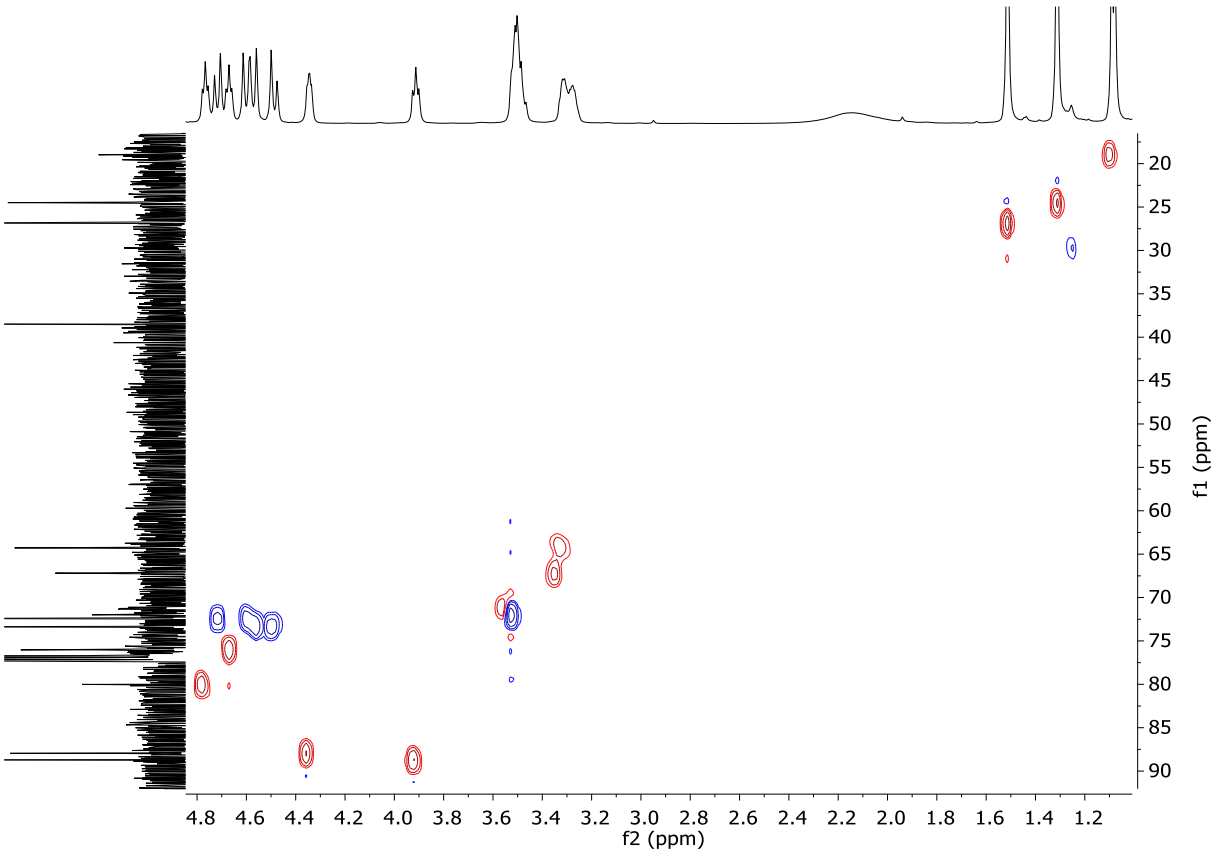


Figure S127: gHSQC spectrum (500 MHz, $CDCl_3$) of **35**

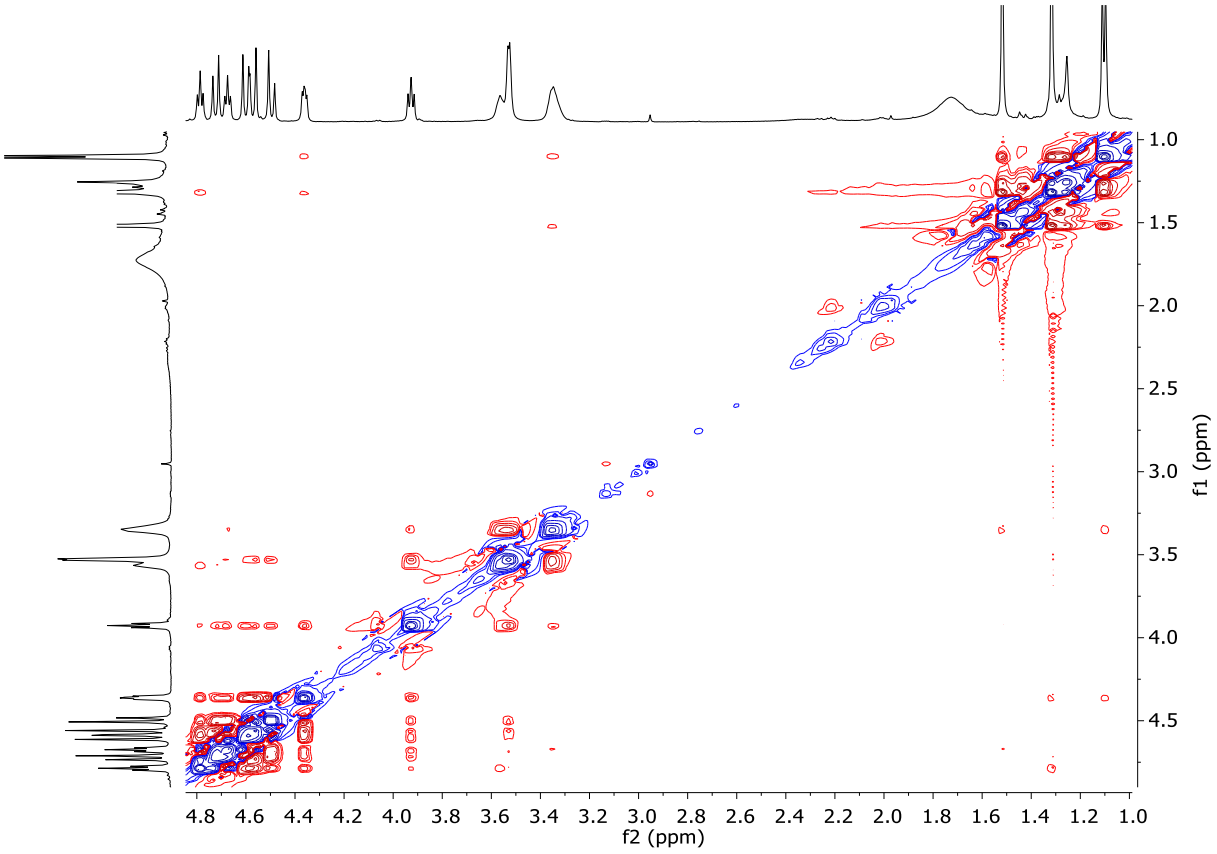


Figure S128: ROSEY spectrum (500 MHz, $CDCl_3$) of **35**

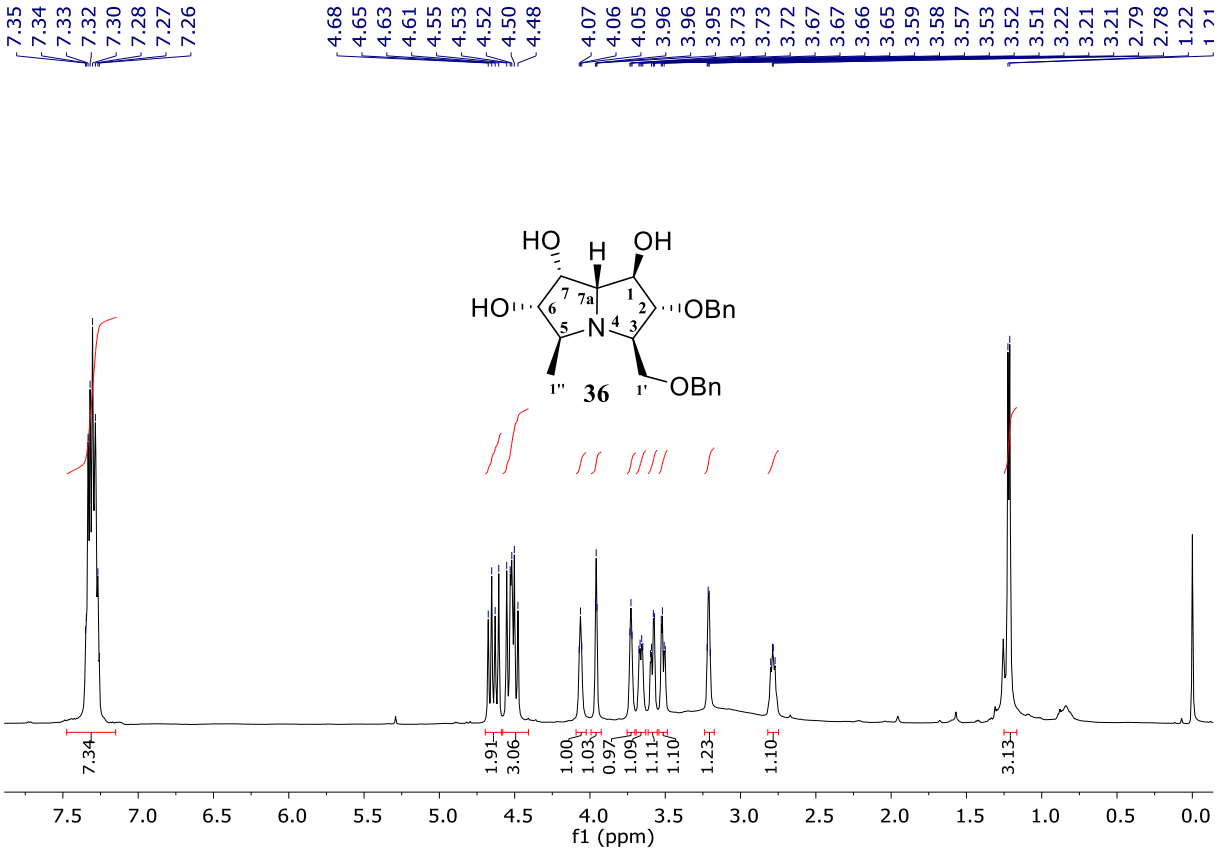


Figure S129: ^1H NMR spectrum (500 MHz, $CDCl_3$) of **36**

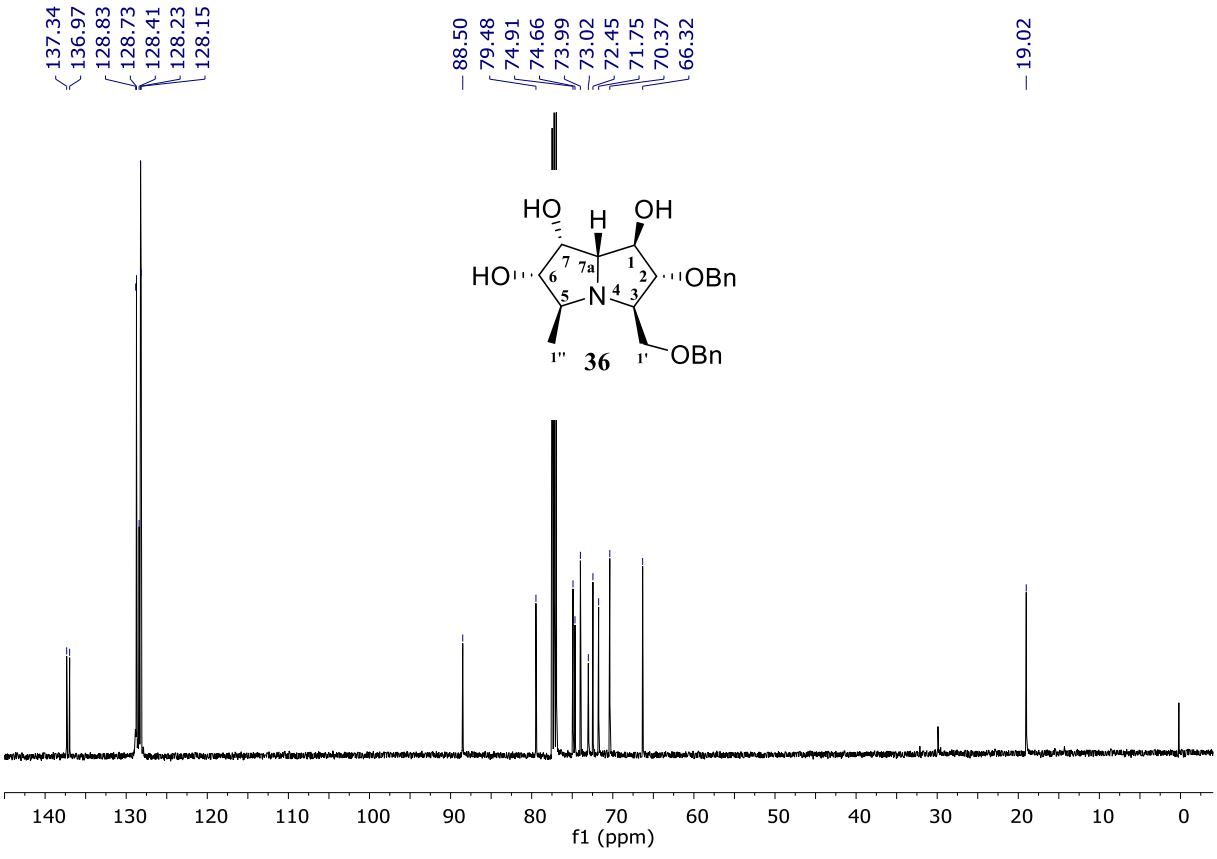


Figure S130: ^{13}C NMR spectrum (500 MHz, $CDCl_3$) of **36**

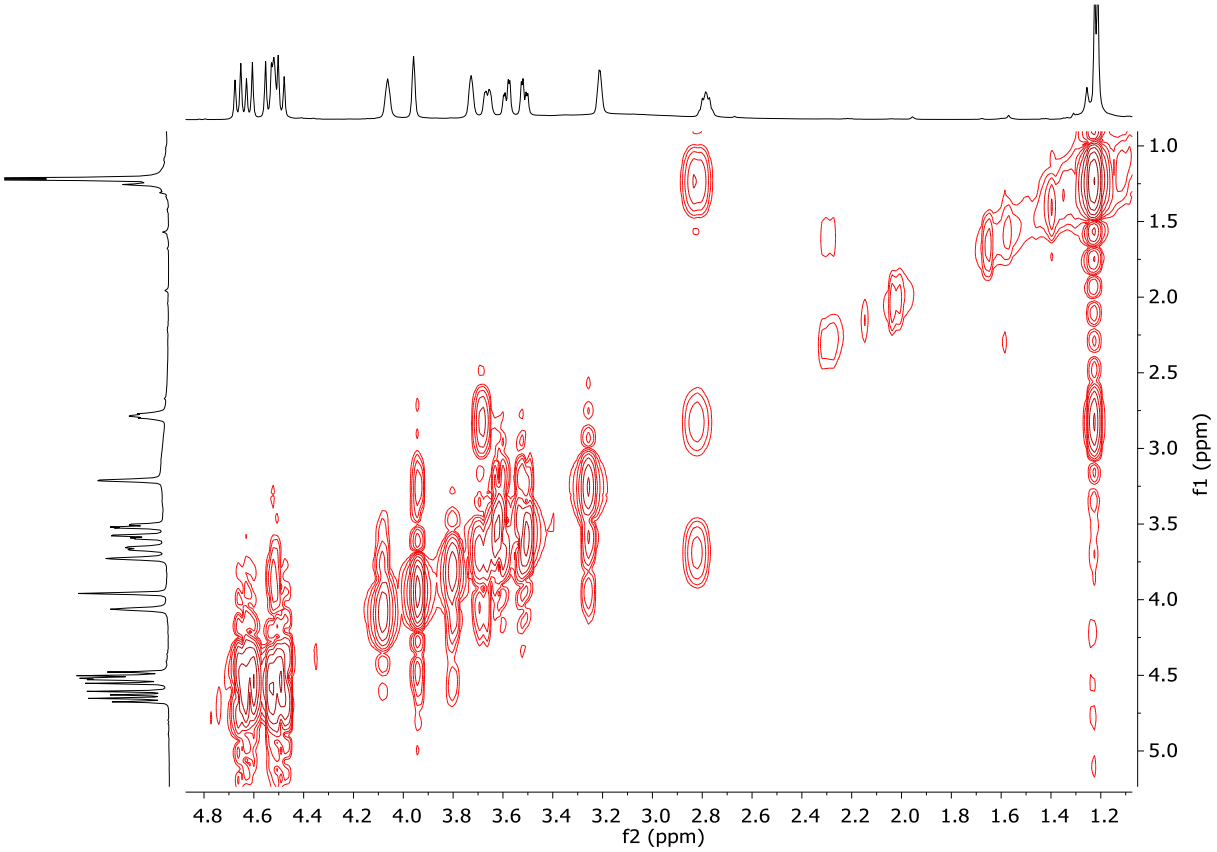


Figure S131: gCOSY spectrum (500 MHz, $CDCl_3$) of **36**

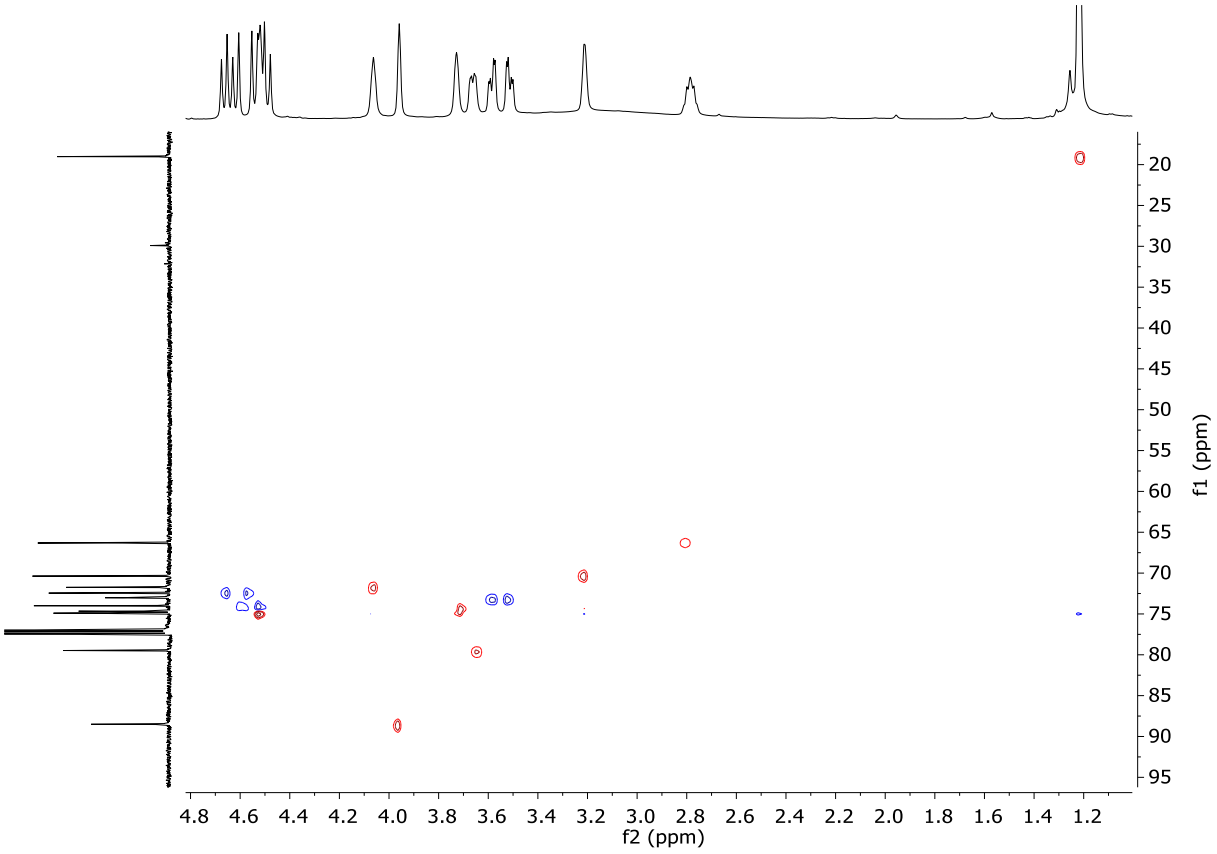


Figure S132: gHSQC spectrum (500 MHz, $CDCl_3$) of **36**

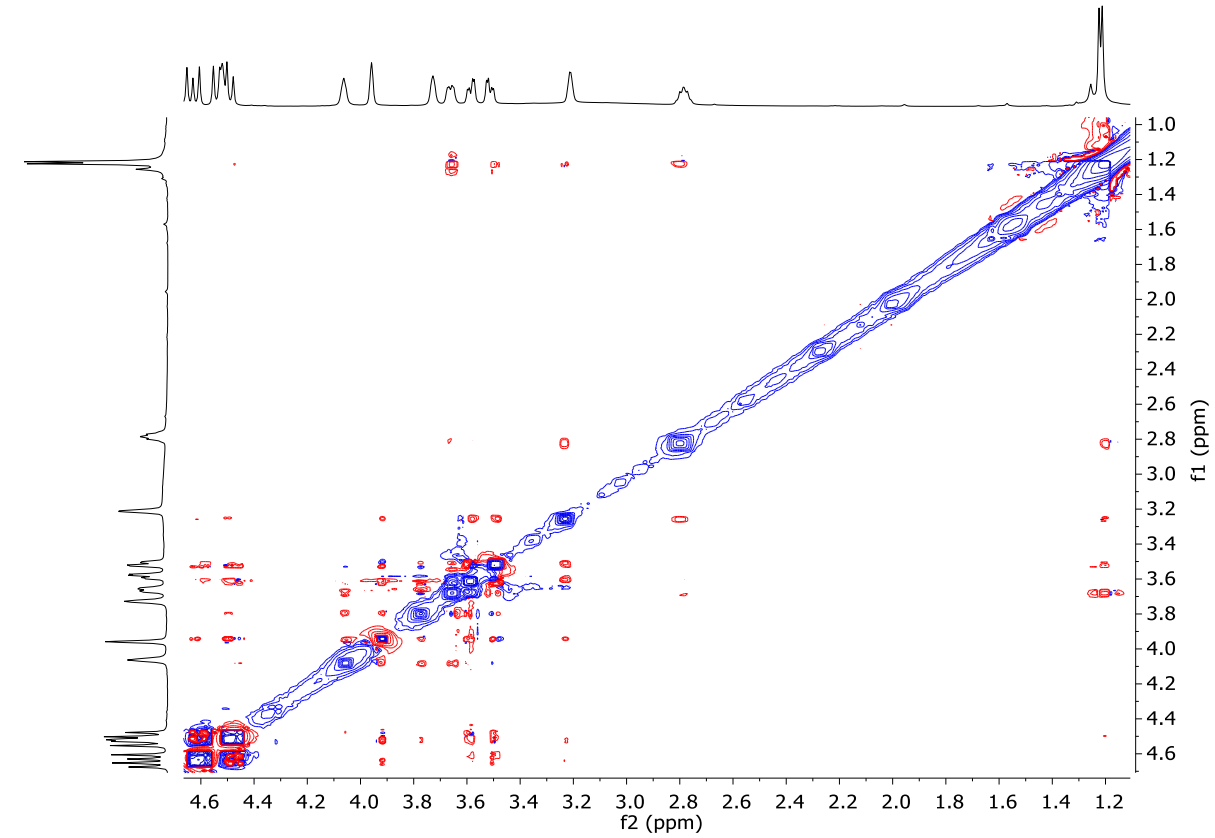


Figure S133: ROSEY spectrum (500 MHz, $CDCl_3$) of **36**

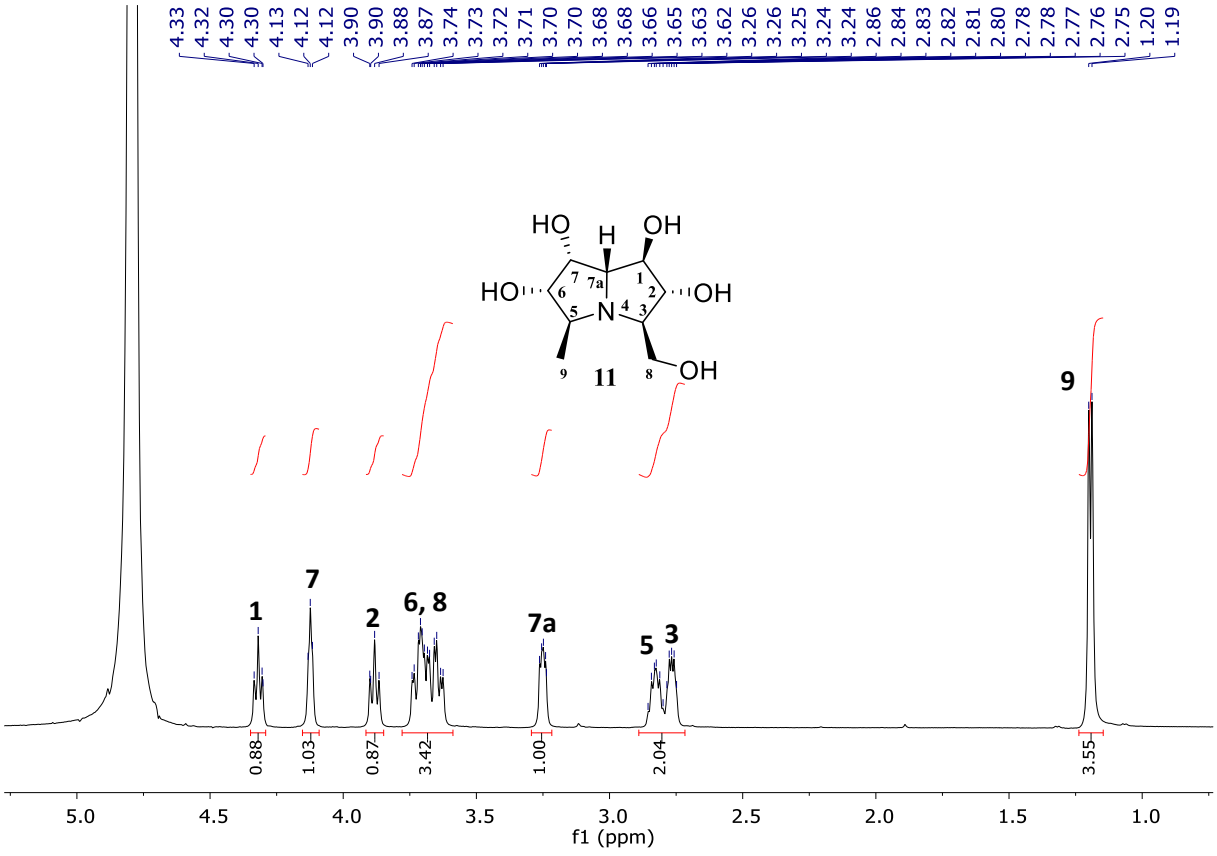


Figure S134: ^{1}H NMR spectrum (500 MHz, D_2O) of **11**

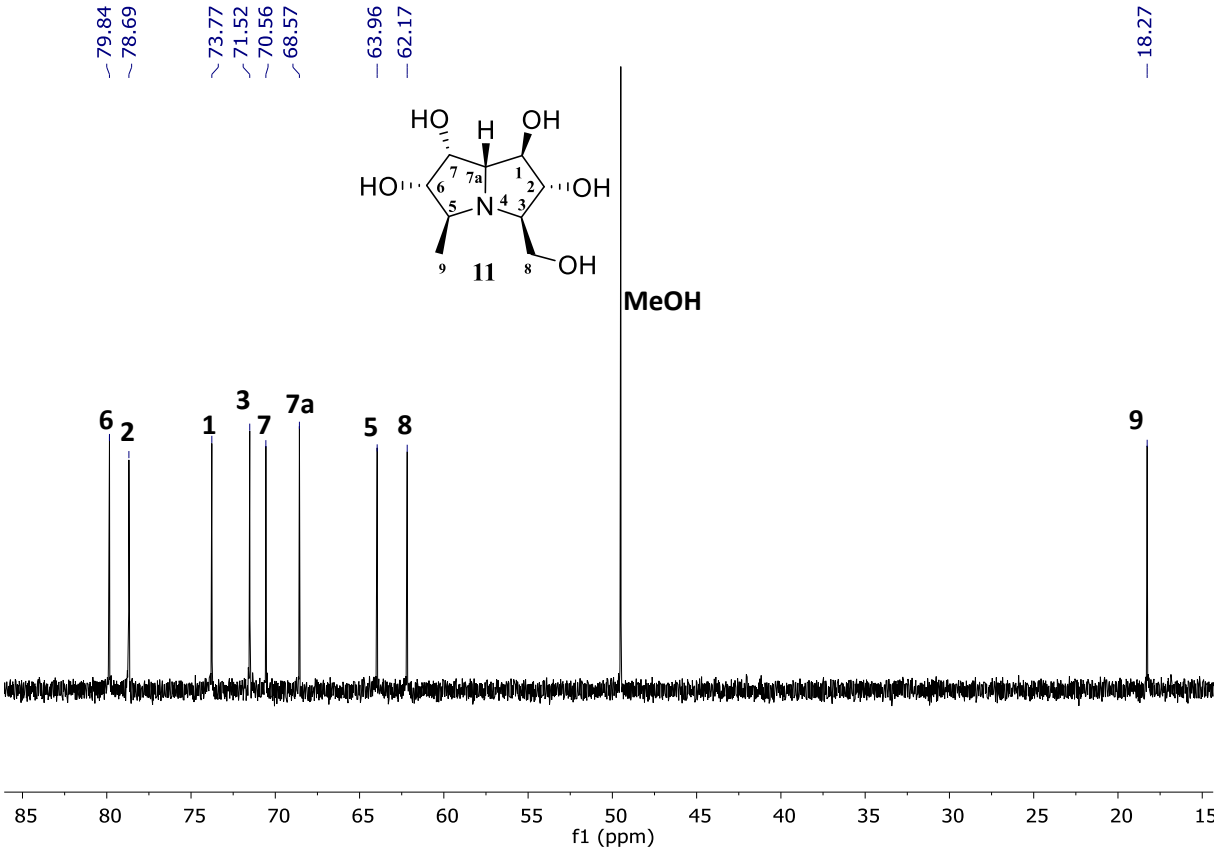


Figure S135: ^{13}C NMR spectrum (125 MHz, D_2O) of **11**

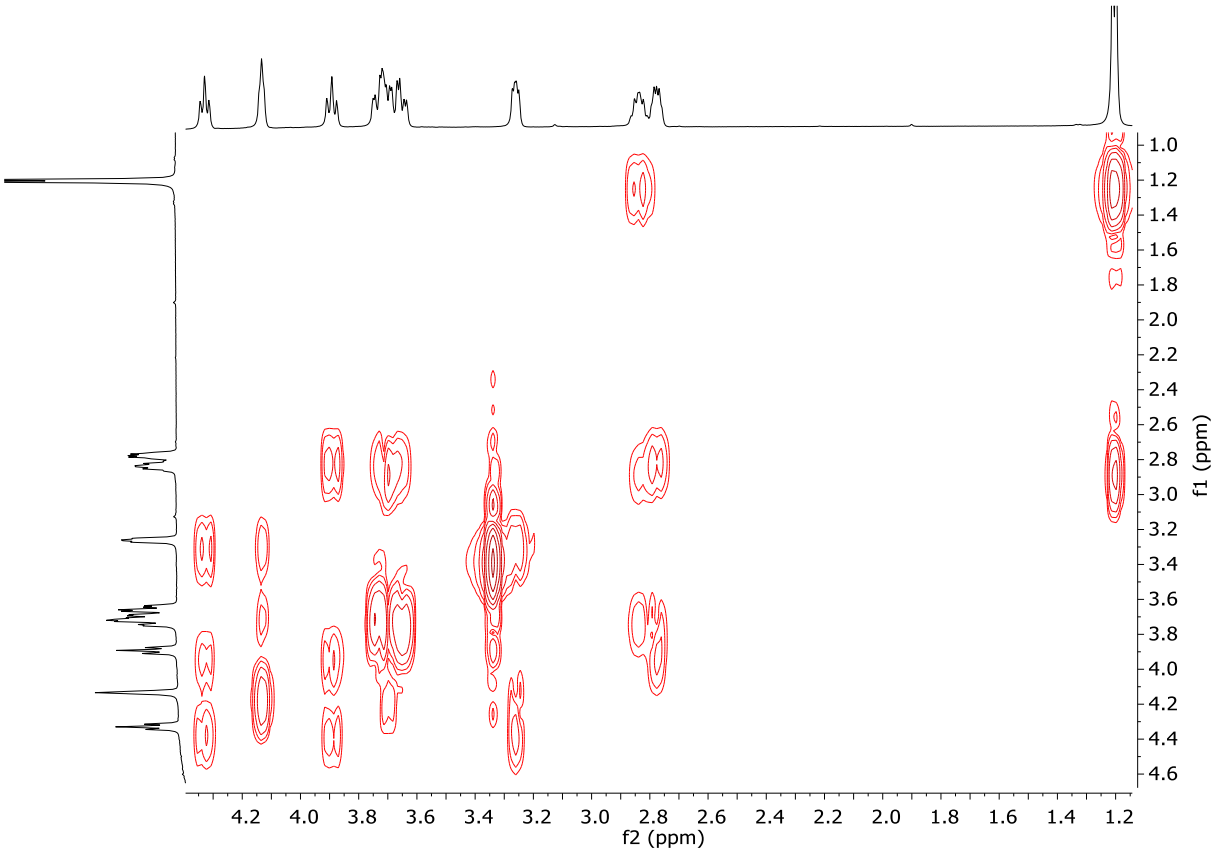


Figure S136: gCOSY spectrum (500 MHz, D_2O) of **11**

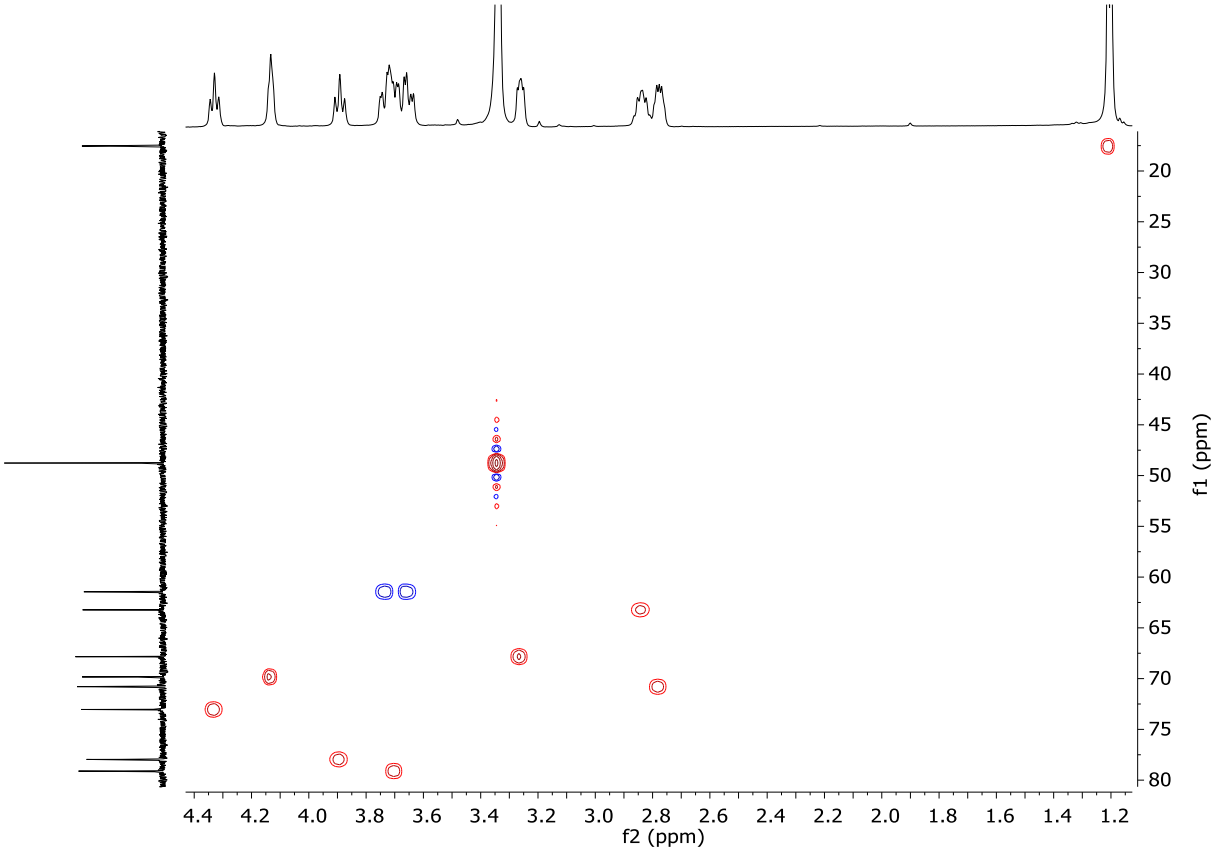


Figure S137: gHSQC spectrum (500 MHz, D_2O) of **11**

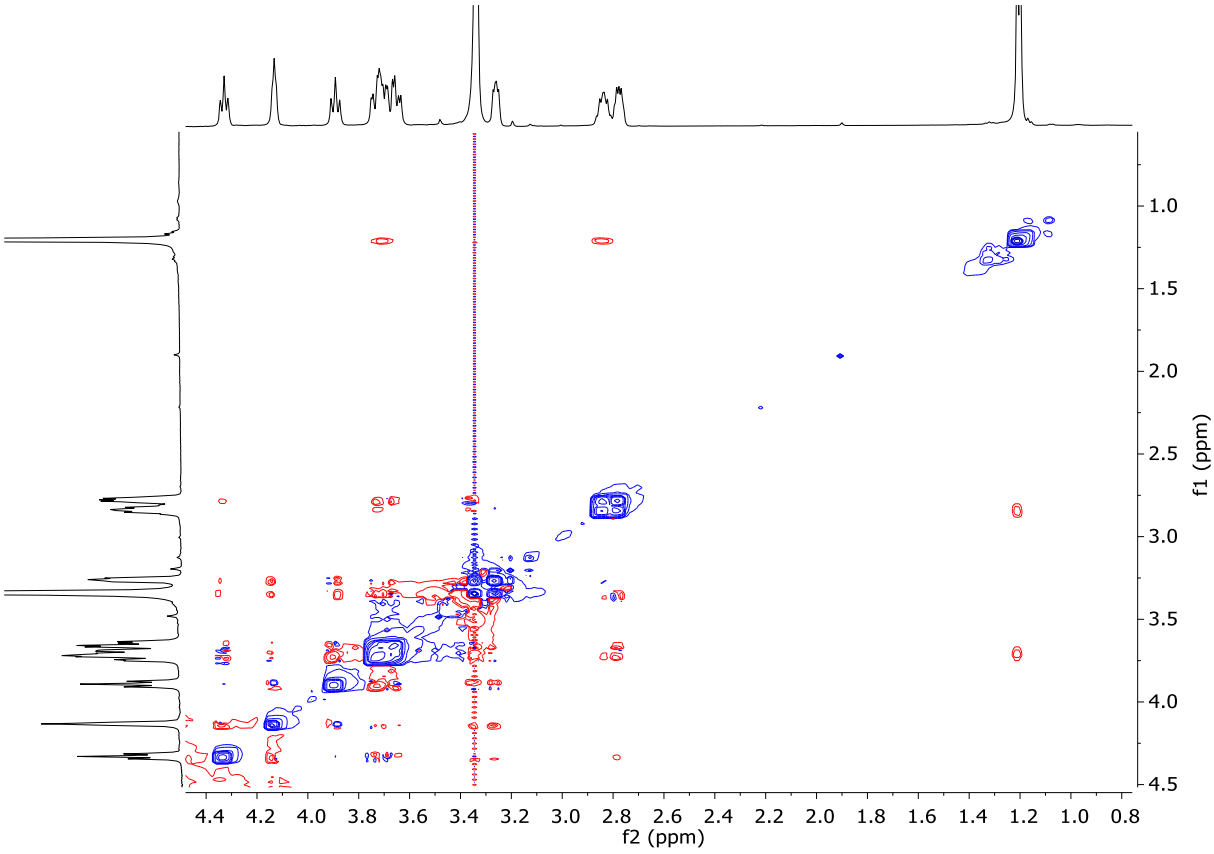


Figure S138*:* ROSEY spectrum (500 MHz, D_2O) of **11**

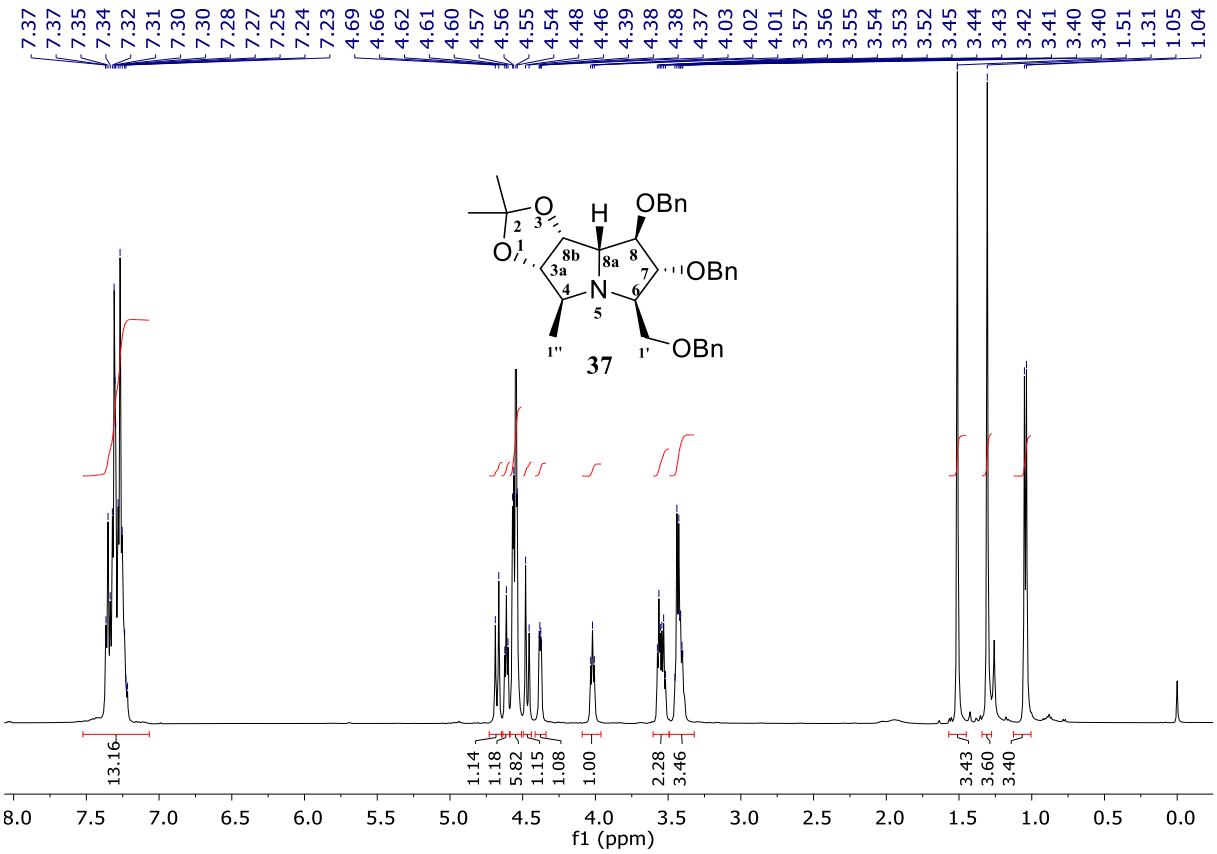


Figure S139: ^1H NMR spectrum (500 MHz, $CDCl_3$) of **37**

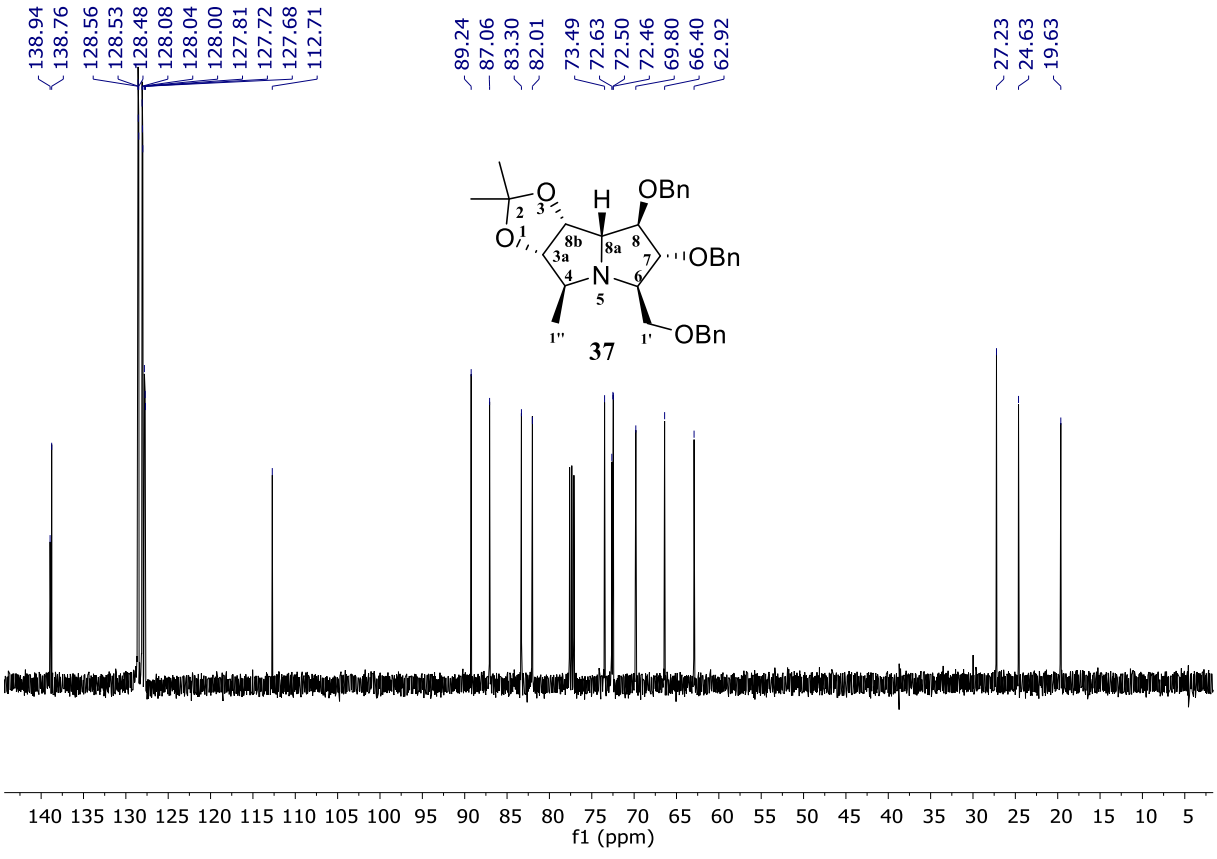


Figure S140: ^{13}C NMR spectrum (125 MHz, $CDCl_3$) of **37**

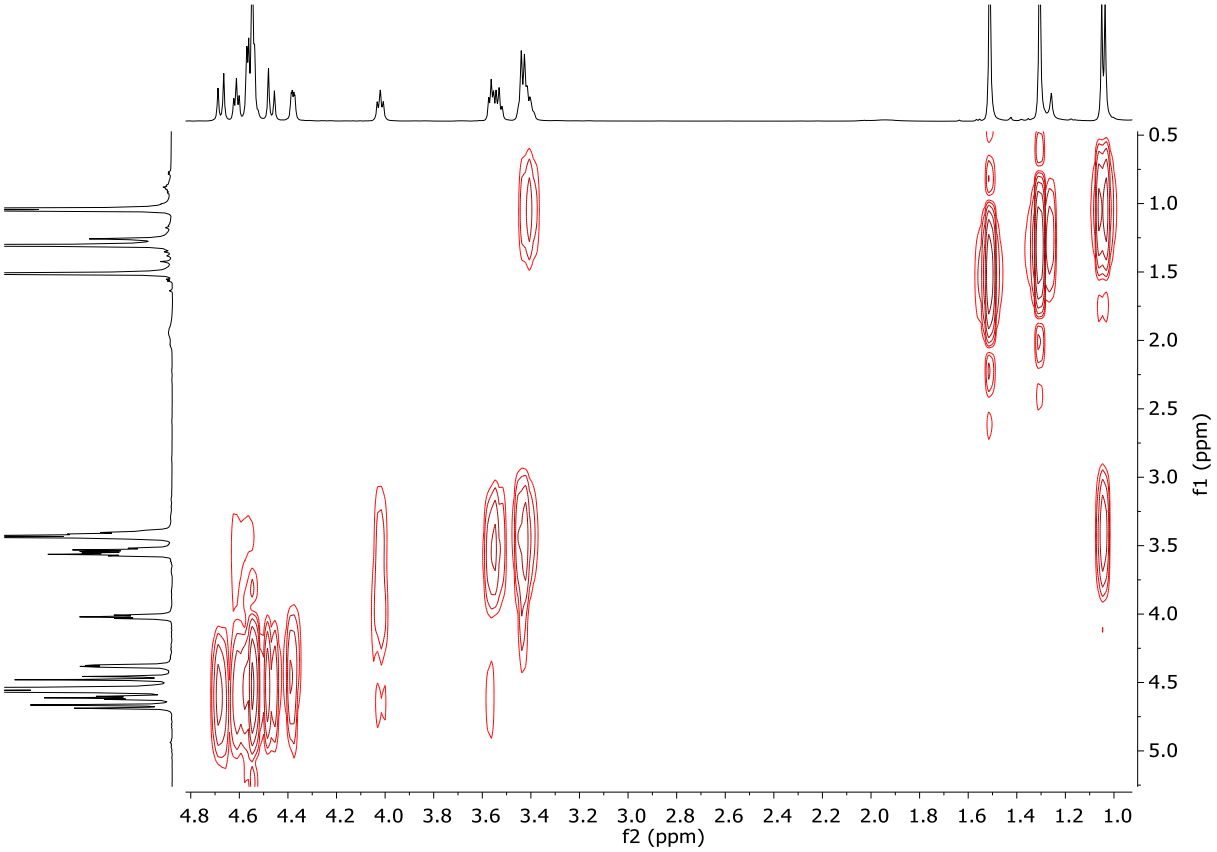


Figure S141: gCOSY spectrum (500 MHz, $CDCl_3$) of **37**

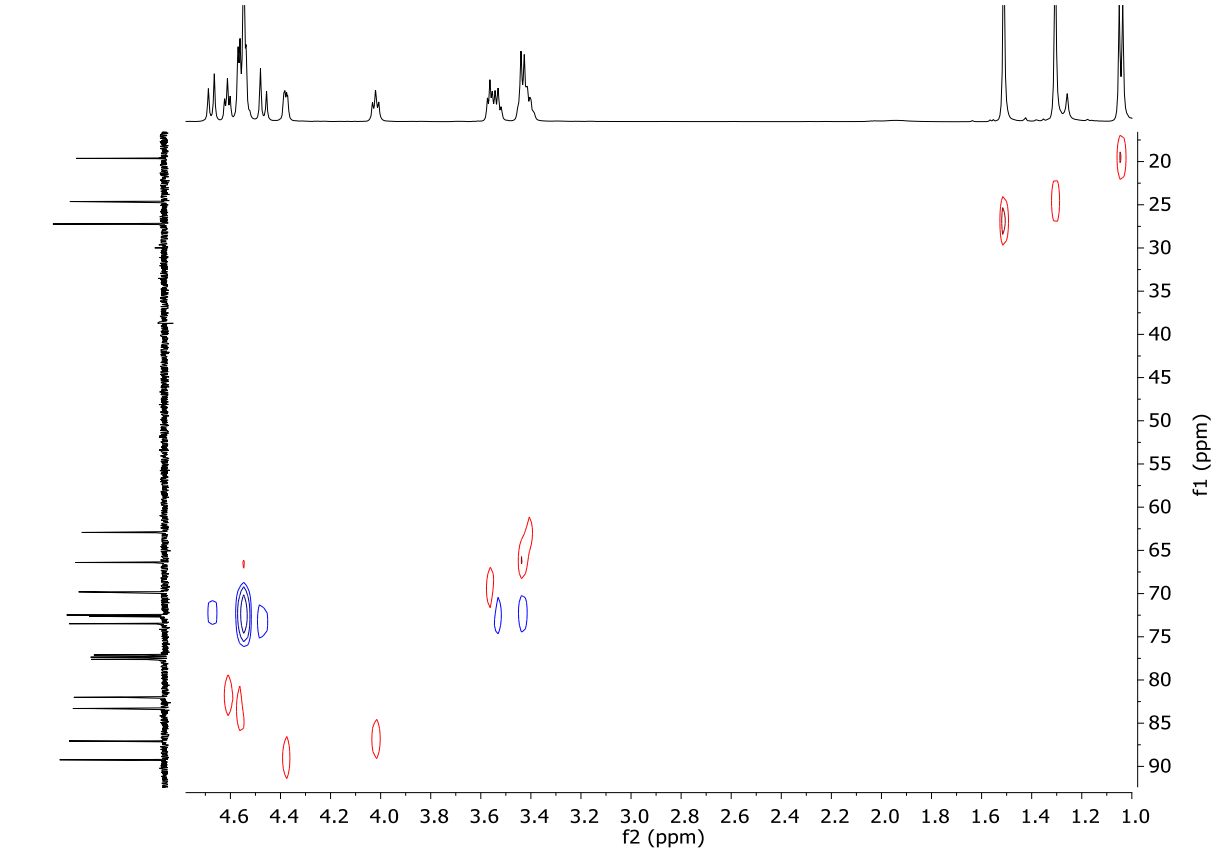


Figure S142: gHSQC spectrum (500 MHz, $CDCl_3$) of **37**

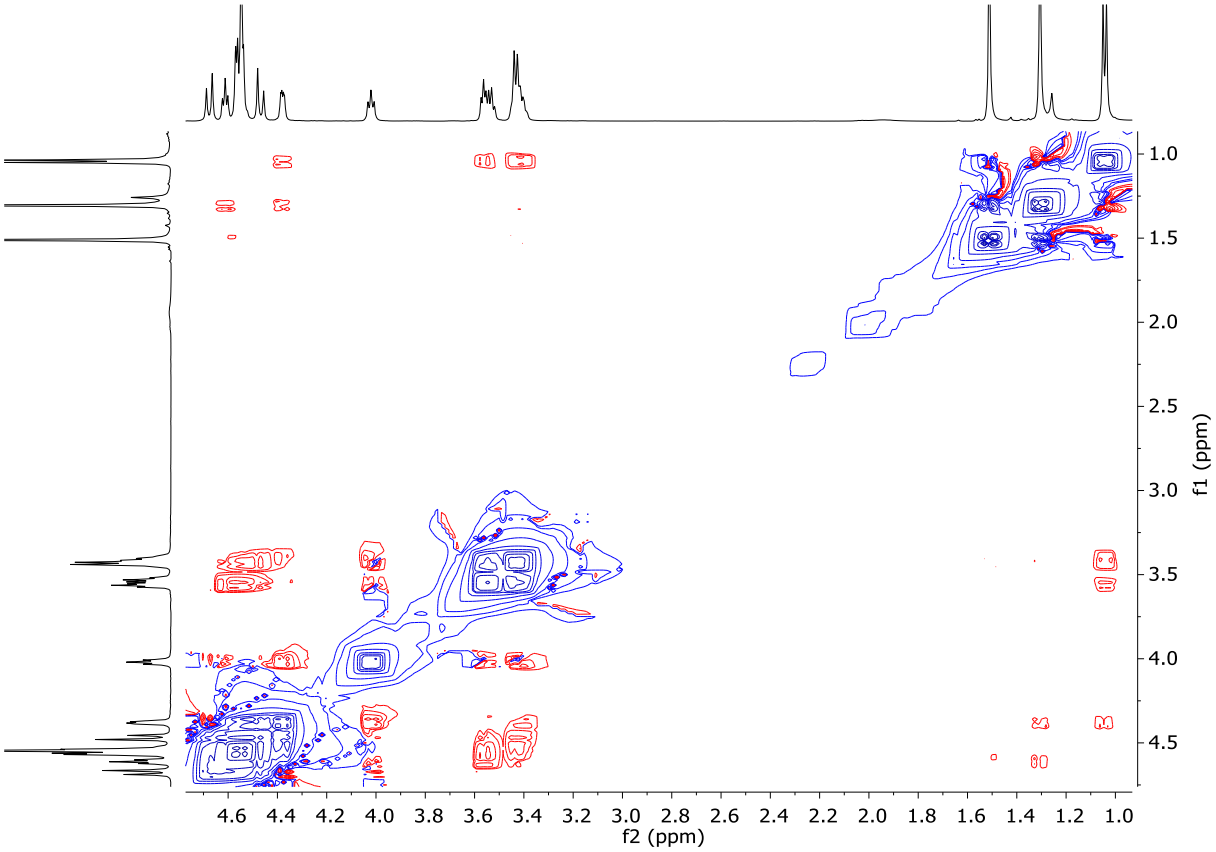


Figure S143: ROSEY spectrum (500 MHz, $CDCl_3$) of **37**

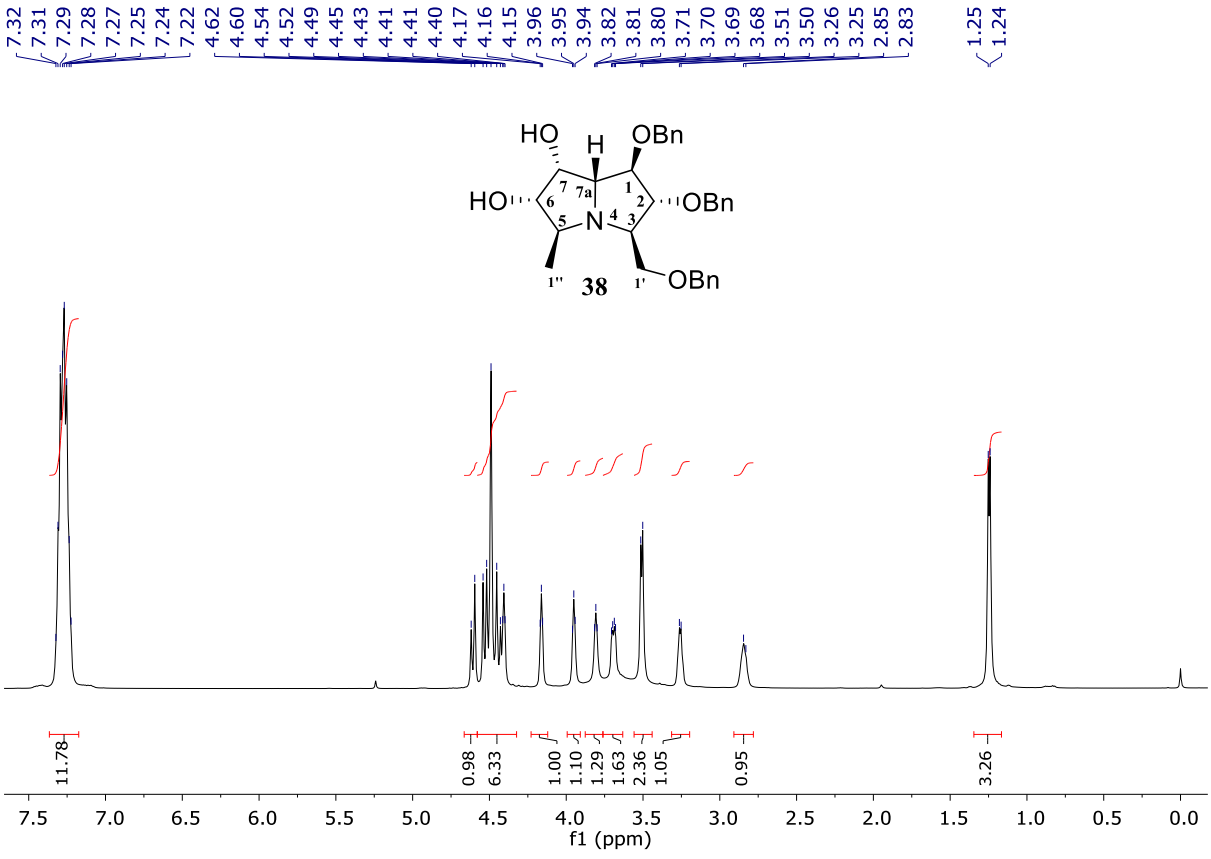


Figure S144: ^{1}H NMR spectrum (500 MHz, $CDCl_3$) of **38**

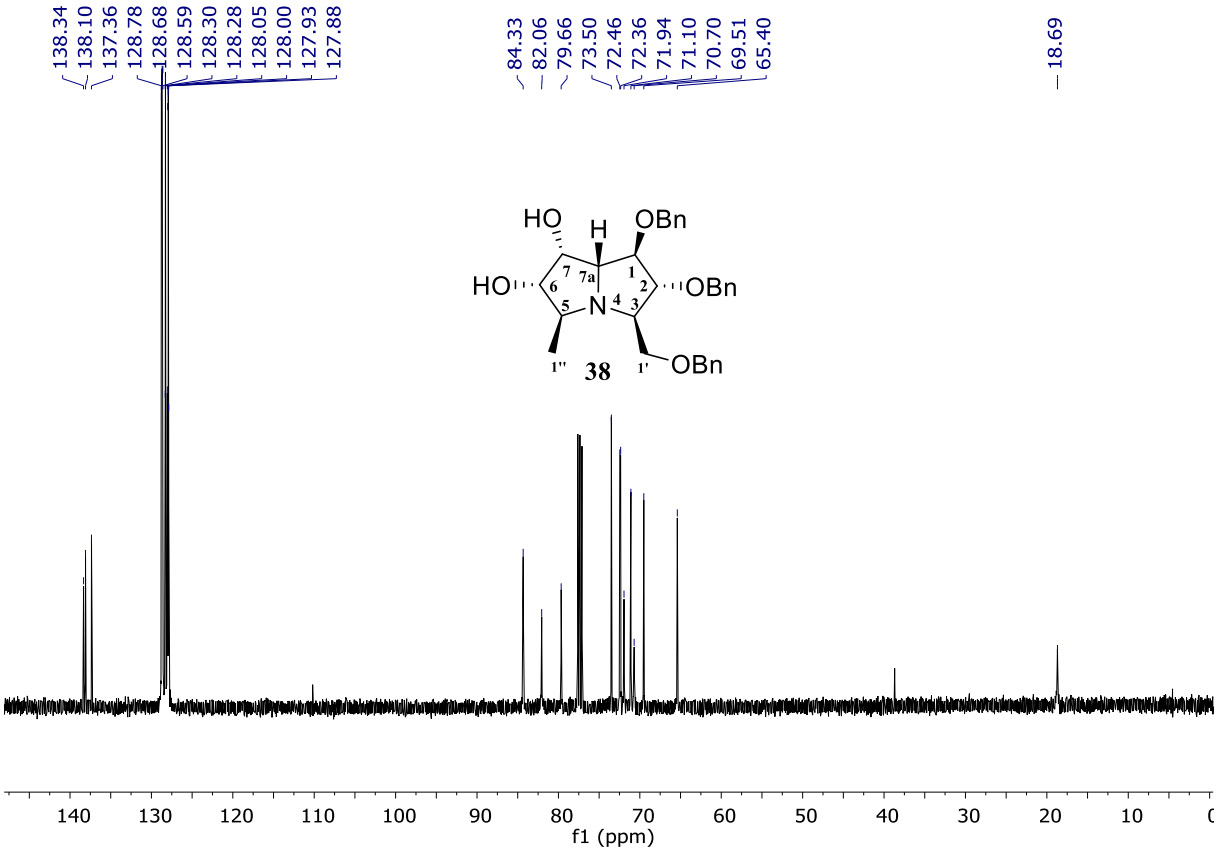


Figure S145: ^{13}C NMR spectrum (125 MHz, $CDCl_3$) of **38**

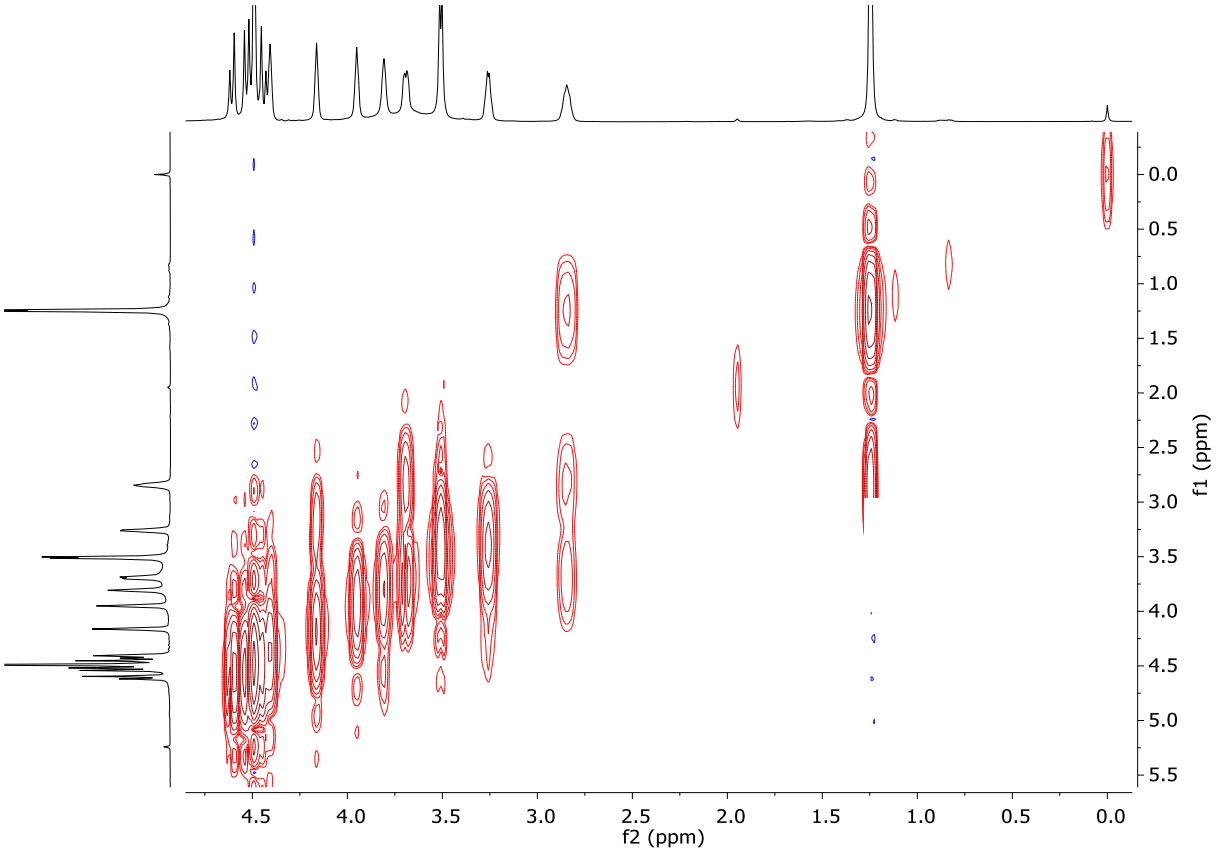


Figure S146: gCOSY spectrum (500 MHz, $CDCl_3$) of **38**

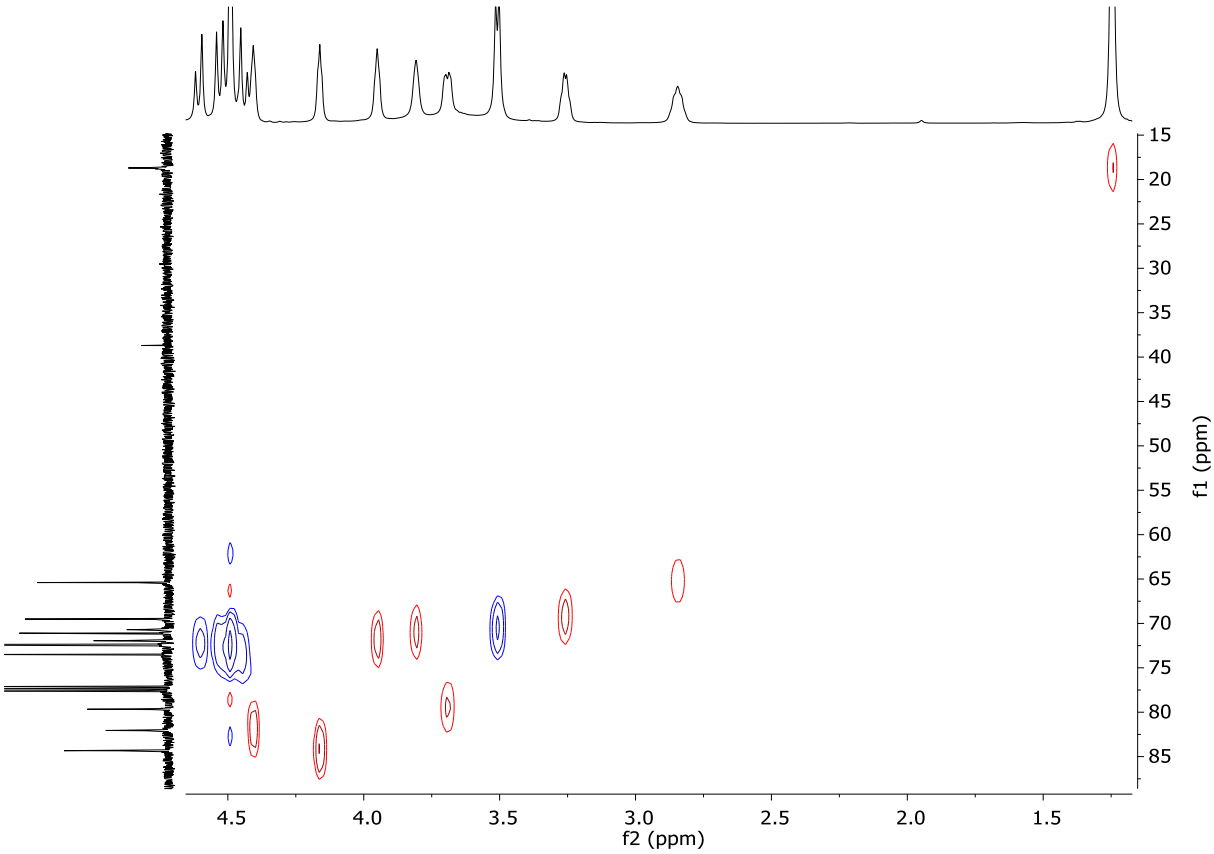


Figure S147: gHSQC spectrum (500 MHz, $CDCl_3$) of **38**

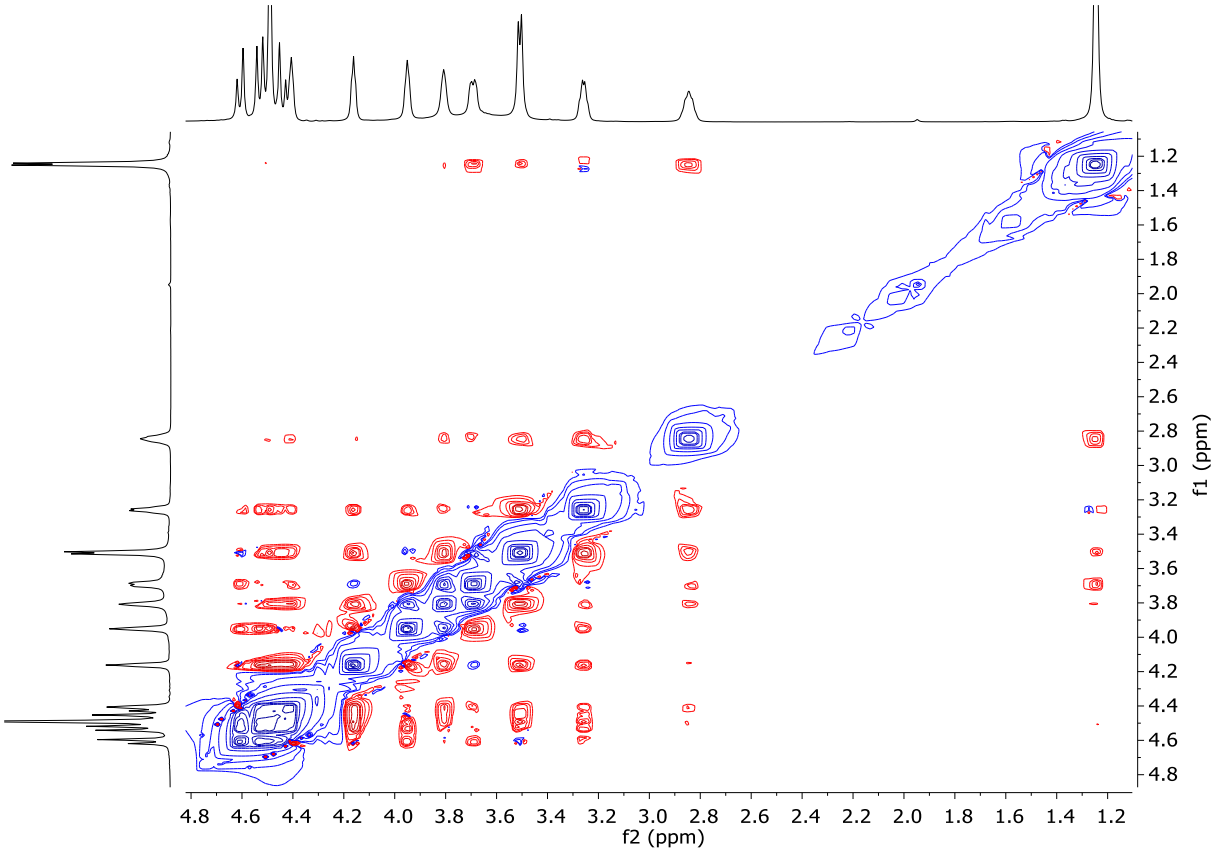


Figure S148: ROSEY spectrum (500 MHz, $CDCl_3$) of **38**

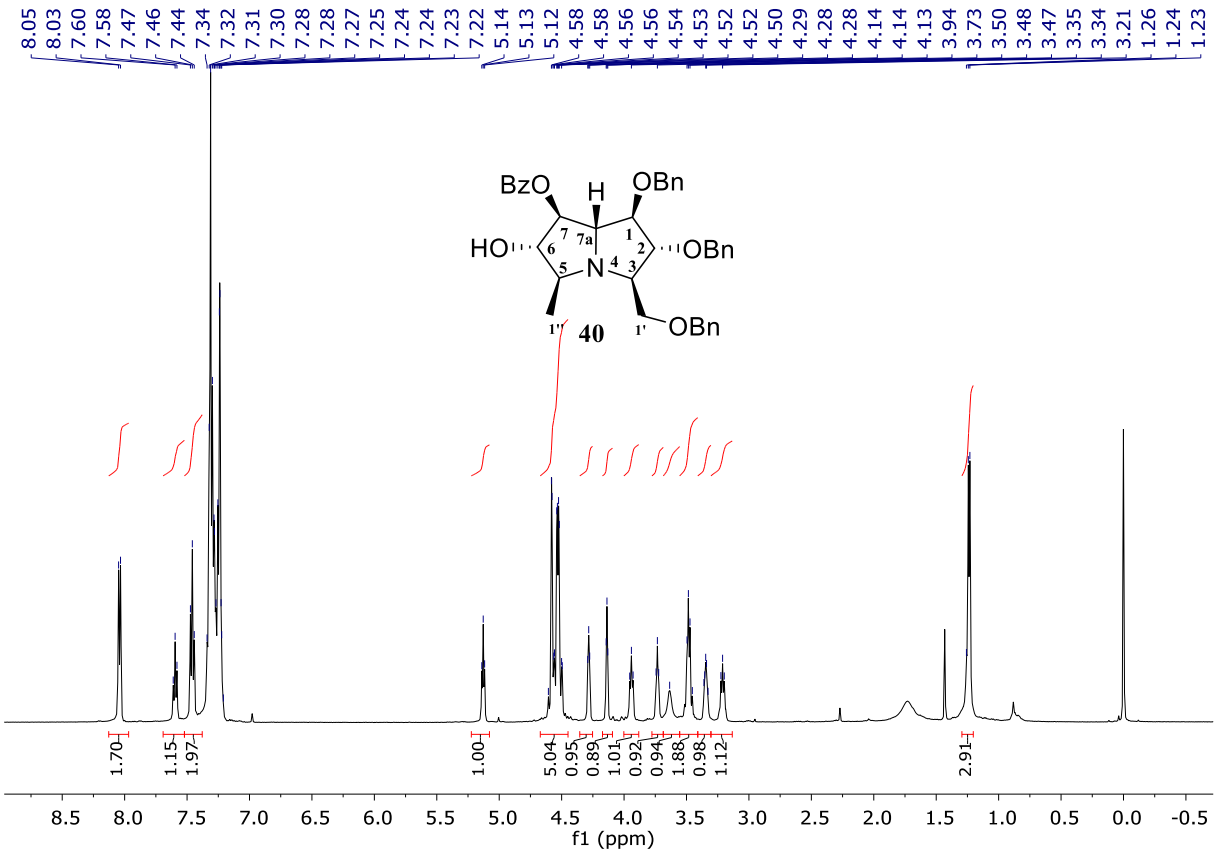


Figure S149: ^1H NMR spectrum (500 MHz, $CDCl_3$) of **40**

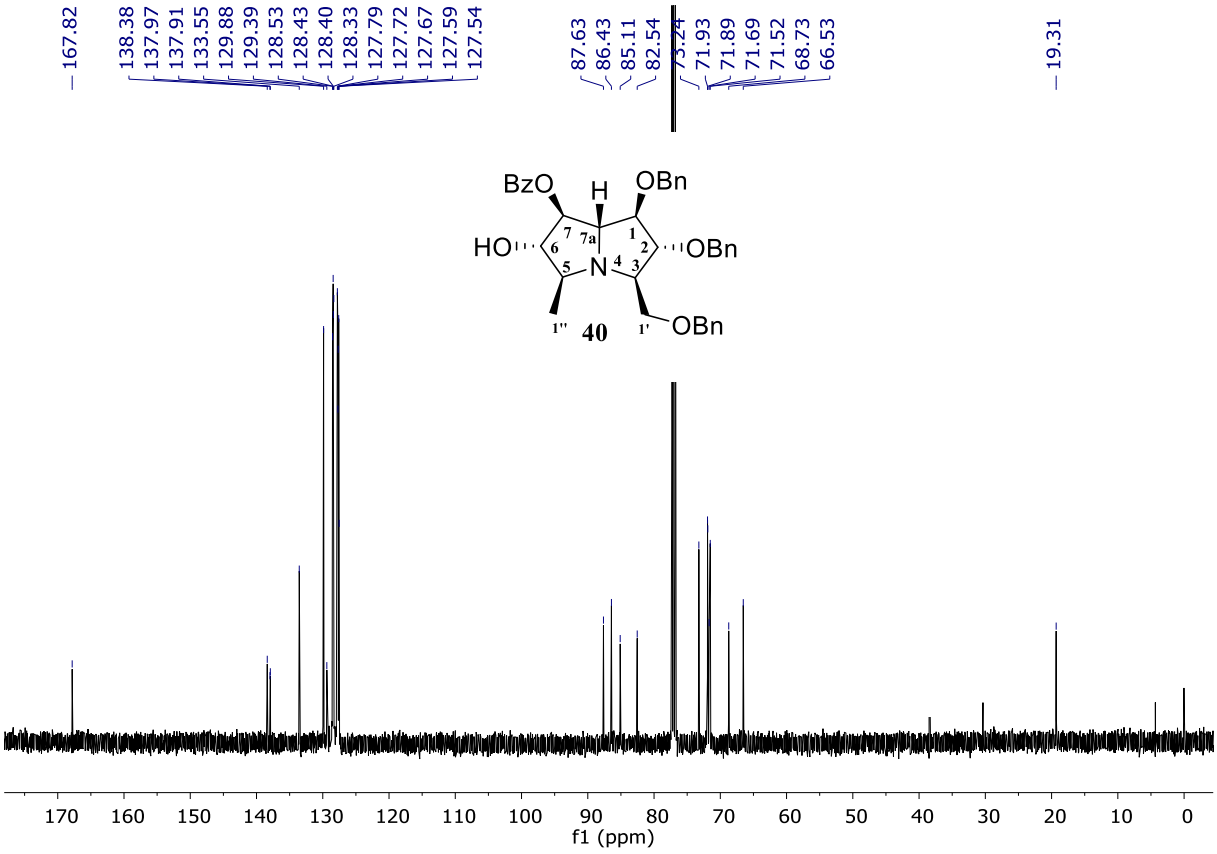


Figure S150: ^{13}C NMR spectrum (125 MHz, $CDCl_3$) of **40**

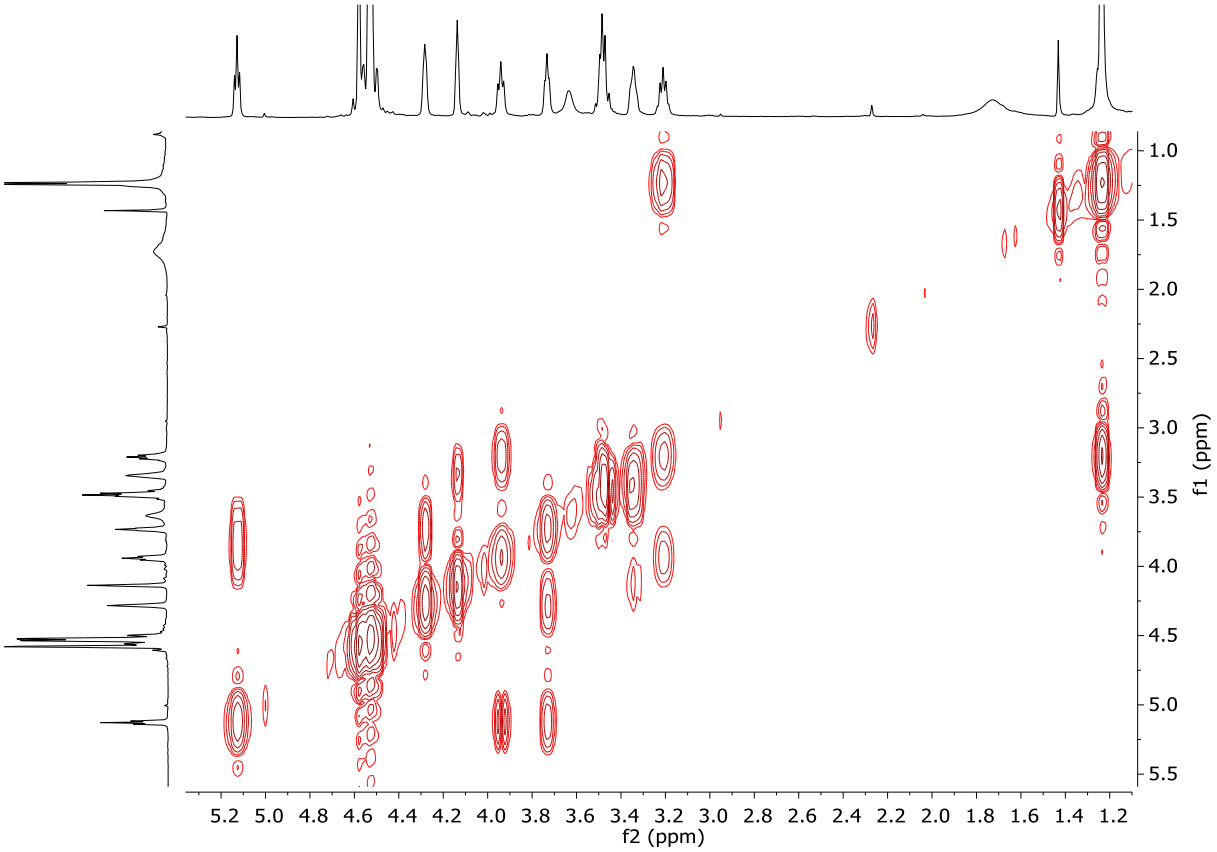


Figure S151: gCOSY spectrum (500 MHz, $CDCl_3$) of **40**

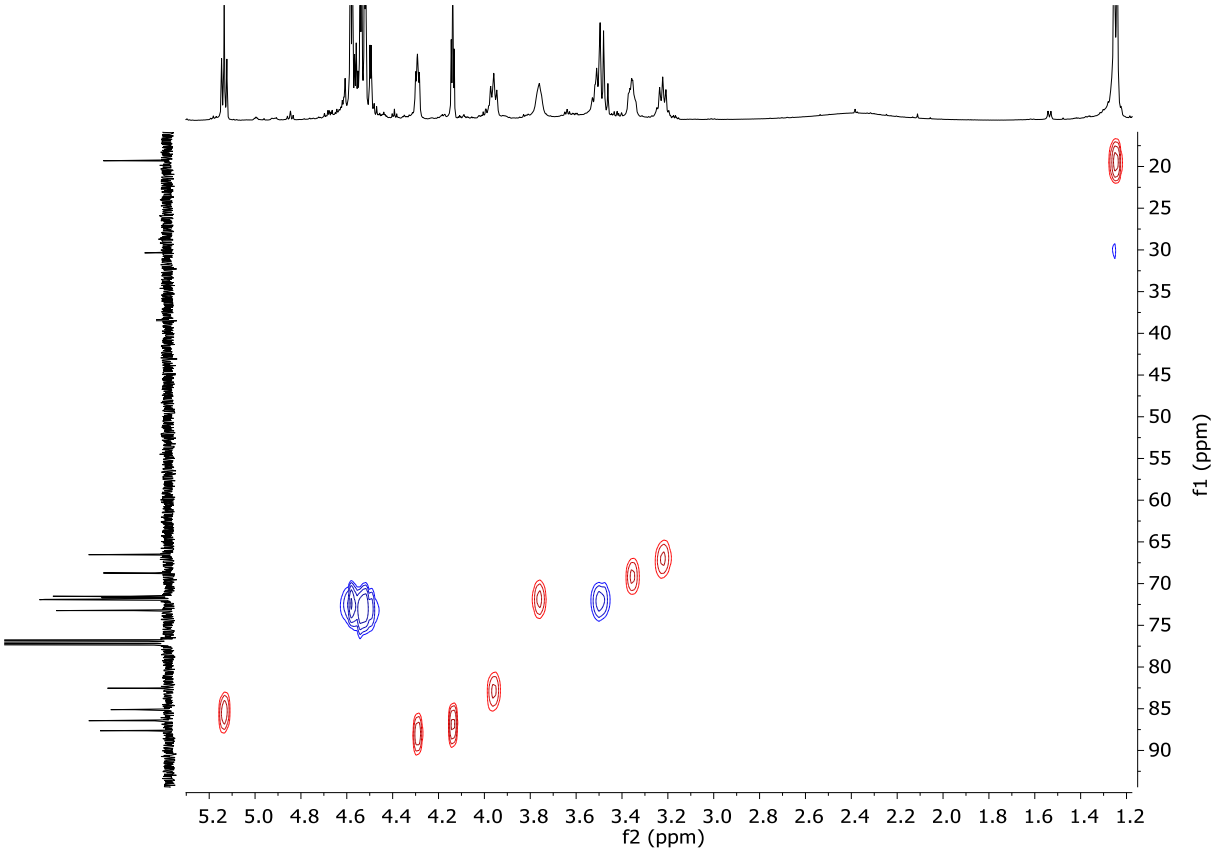


Figure S152: gHSQC spectrum (500 MHz, $CDCl_3$) of **40**

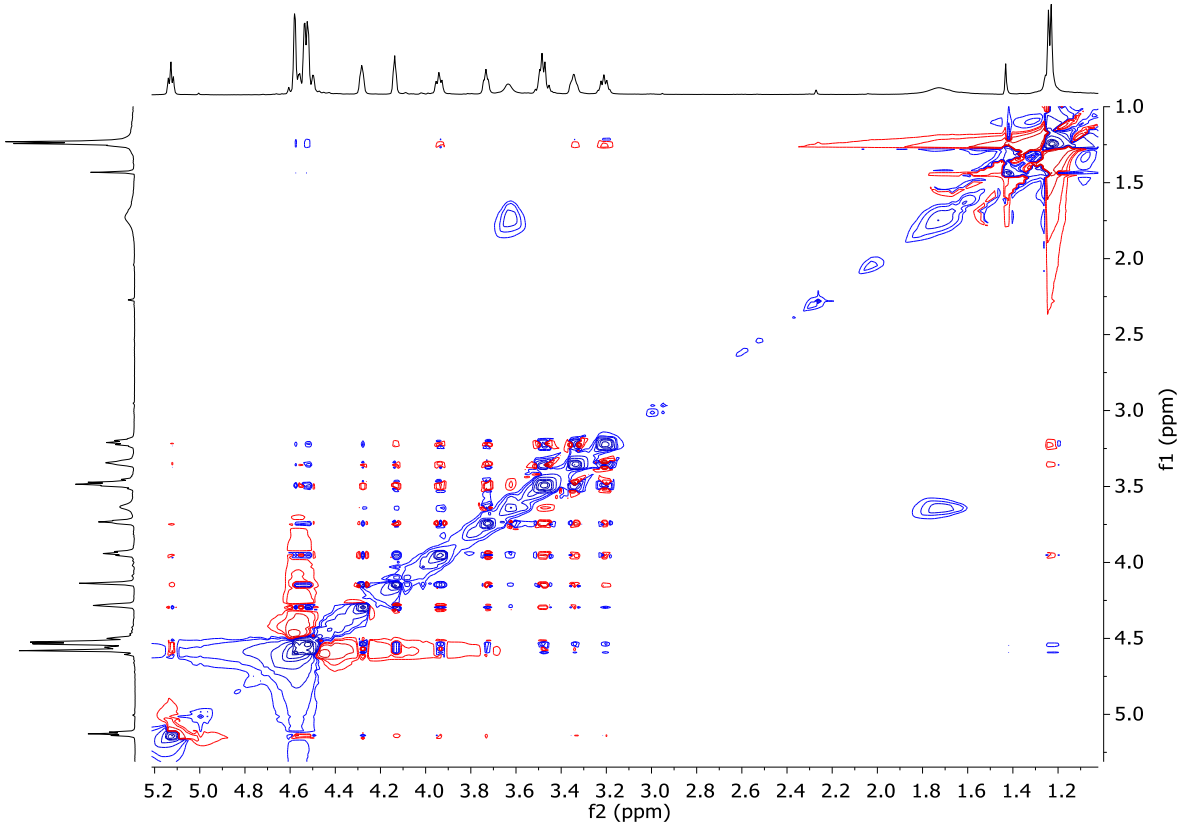


Figure S153: ROSEY spectrum (500 MHz, $CDCl_3$) of **40**

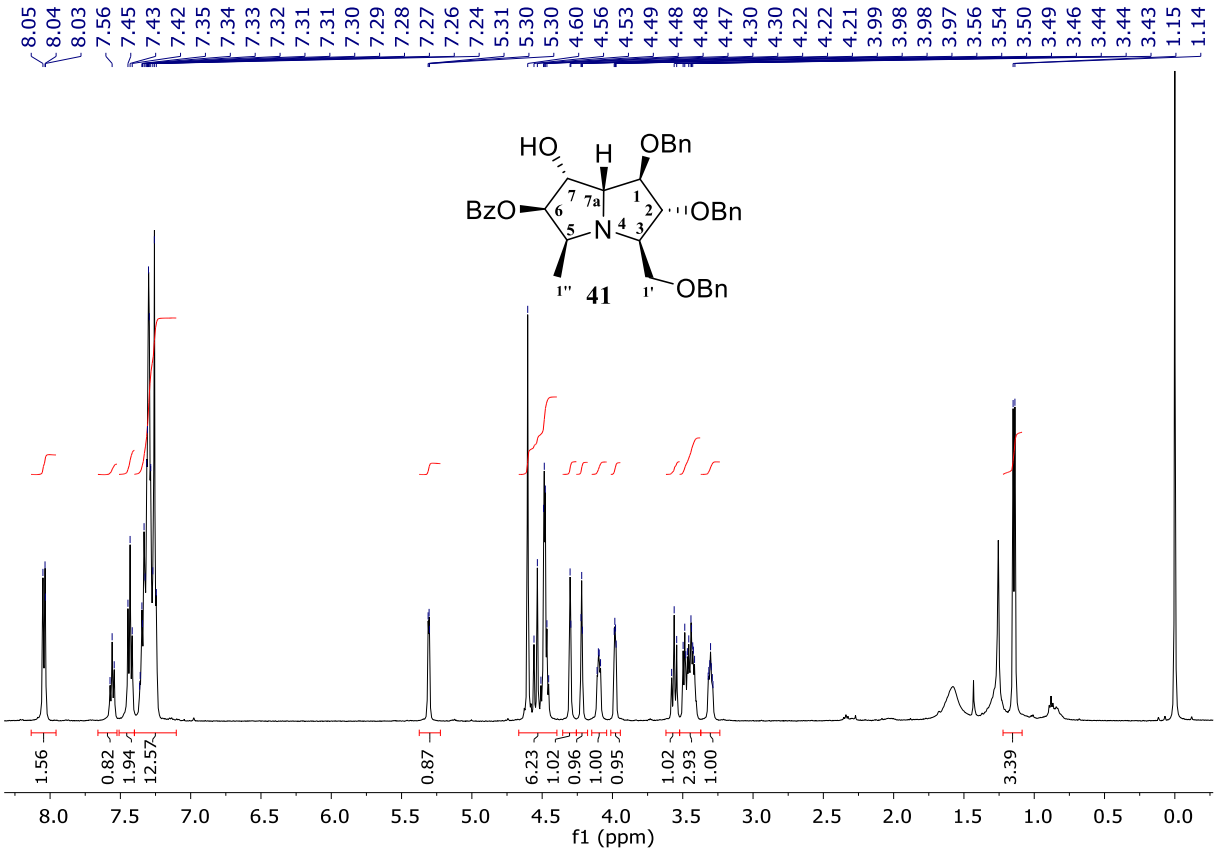


Figure S154: ^{1}H NMR spectrum (500 MHz, $CDCl_3$) of **41**

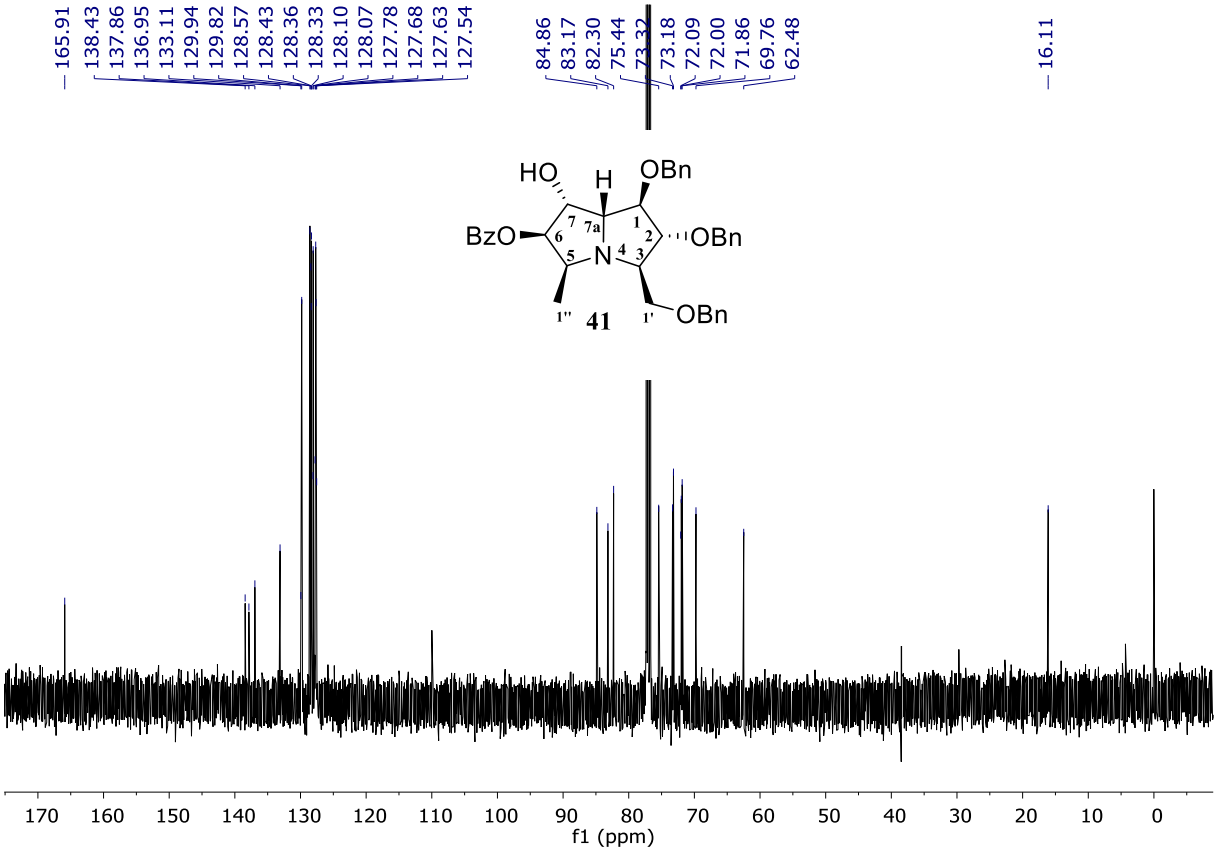


Figure S155: ^{13}C NMR spectrum (125 MHz, $CDCl_3$) of **41**

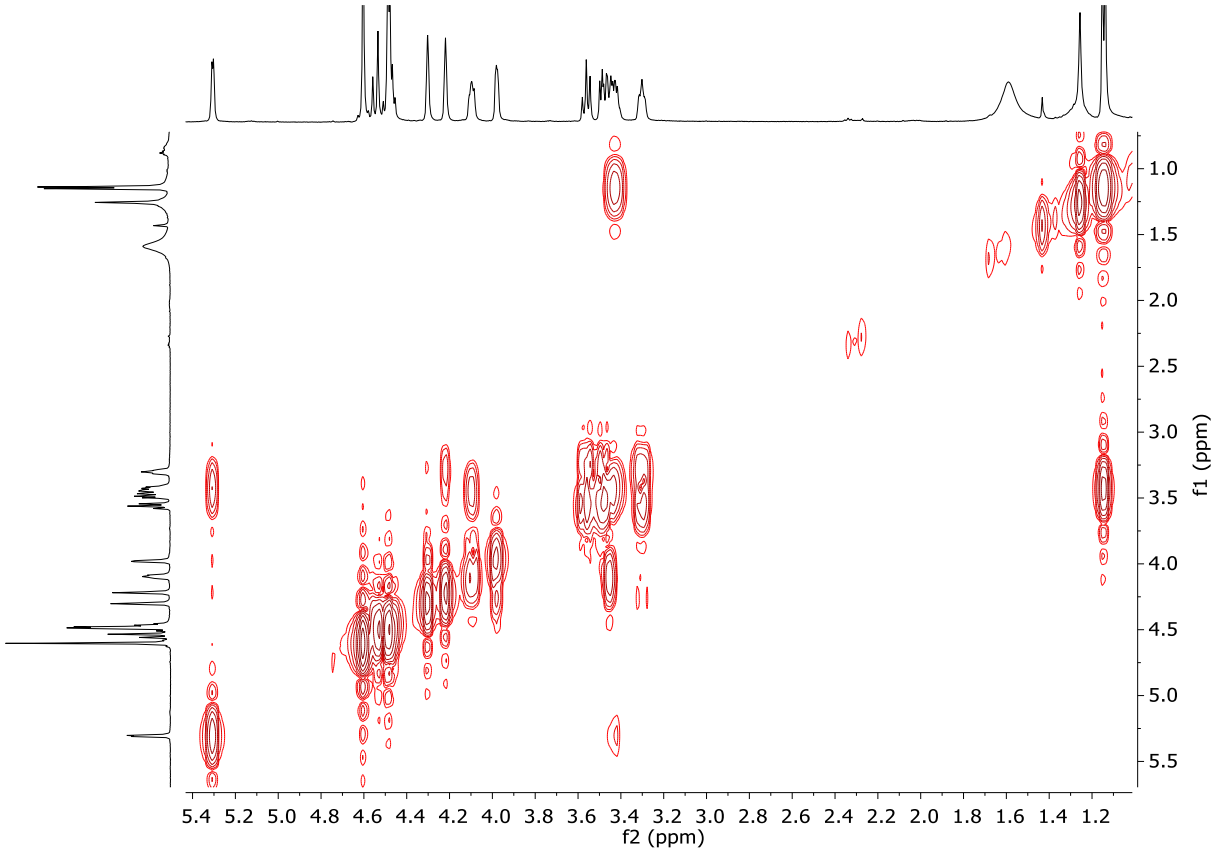


Figure S156: gCOSY spectrum (500 MHz, $CDCl_3$) of **41**

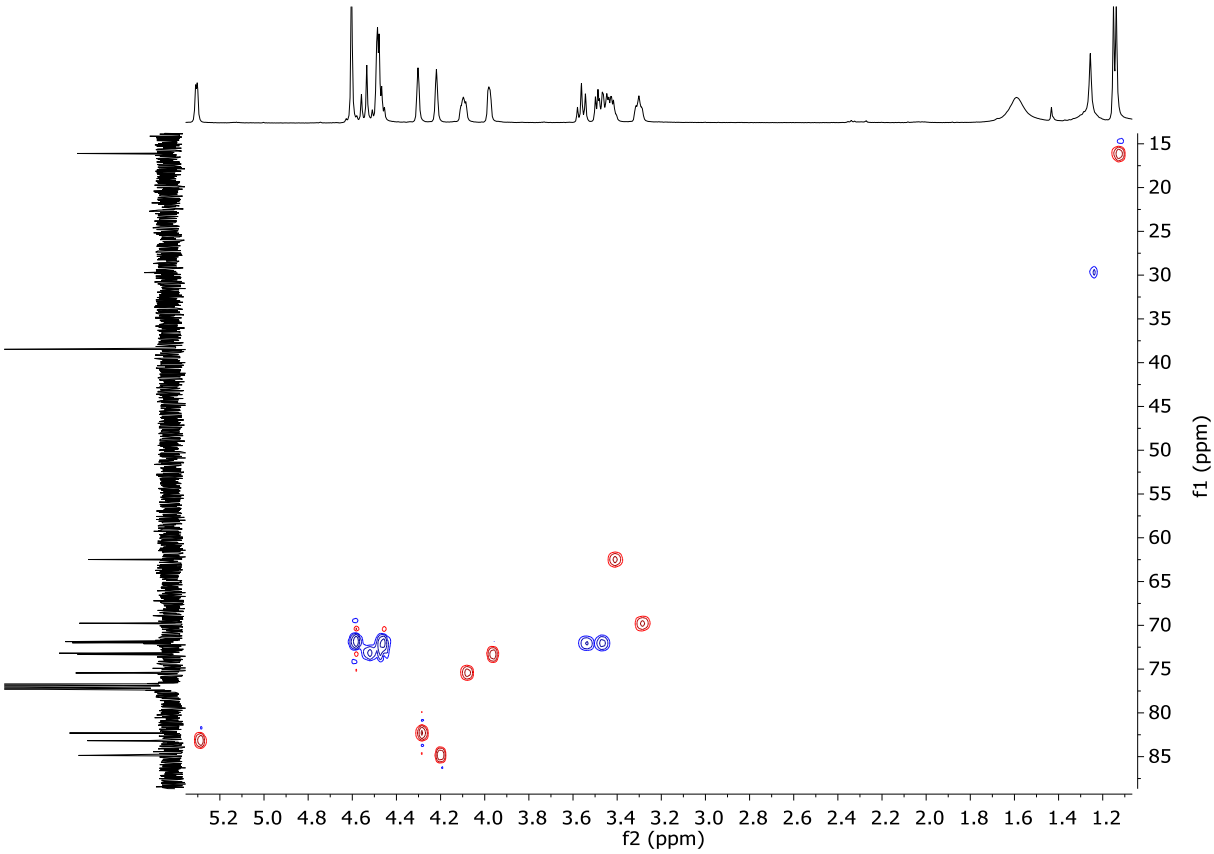


Figure S157: gHSQC spectrum (500 MHz, $CDCl_3$) of **41**

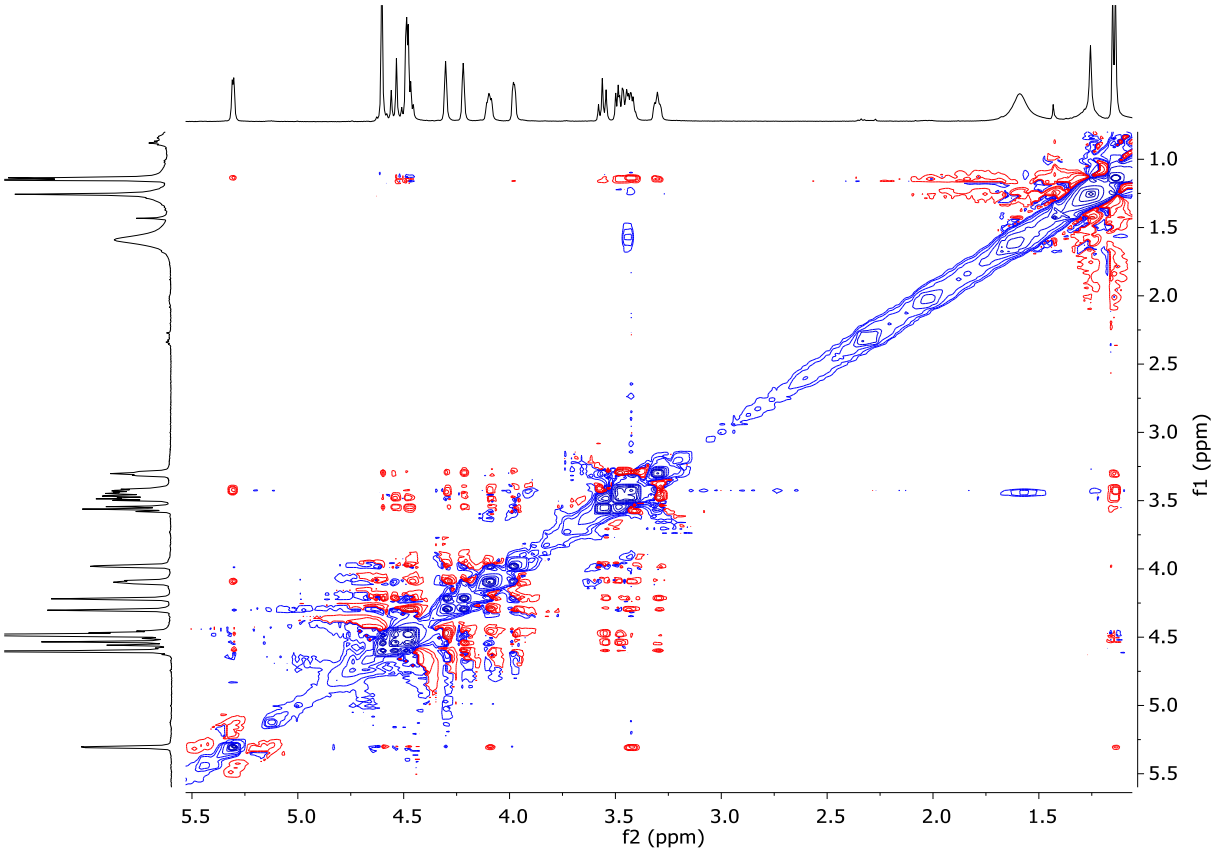


Figure S158: ROSEY spectrum (500 MHz, $CDCl_3$) of **41**

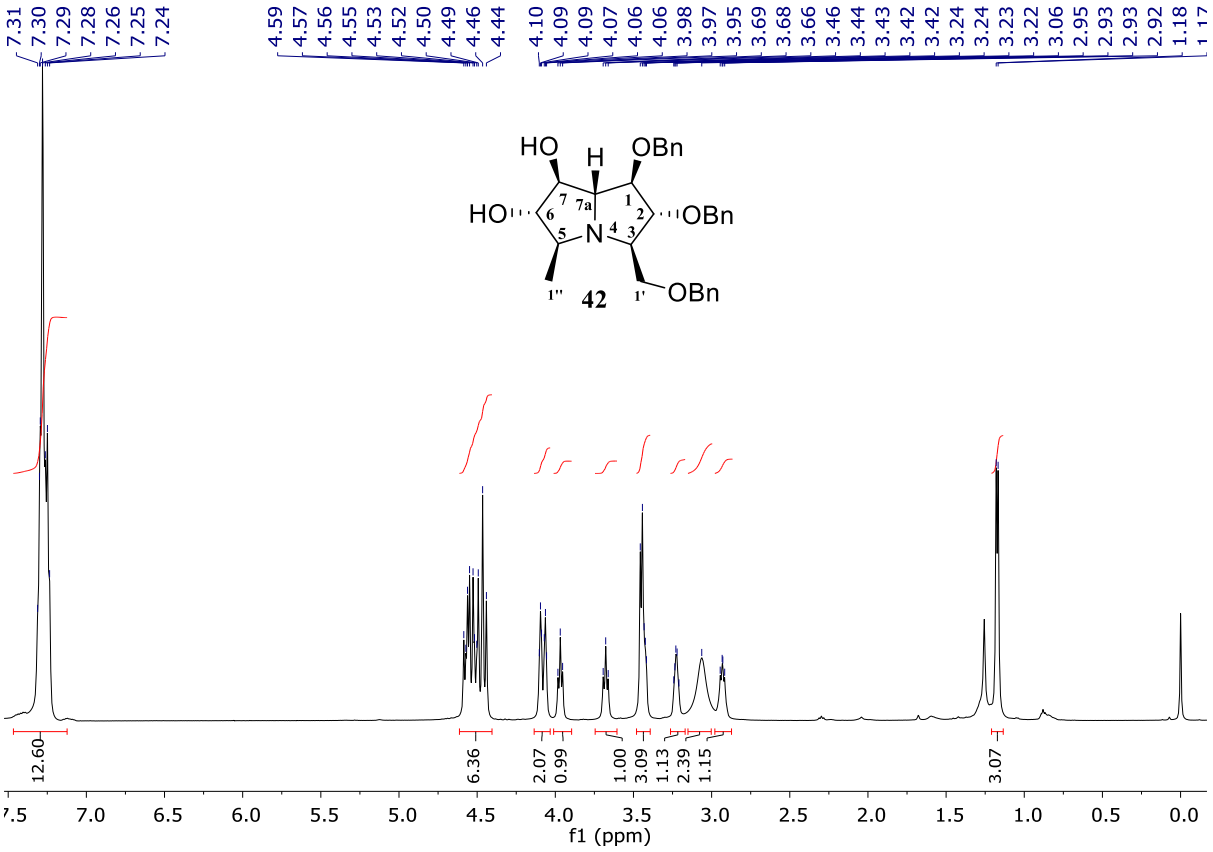


Figure S159: ^1H NMR spectrum (500 MHz, $CDCl_3$) of **42**

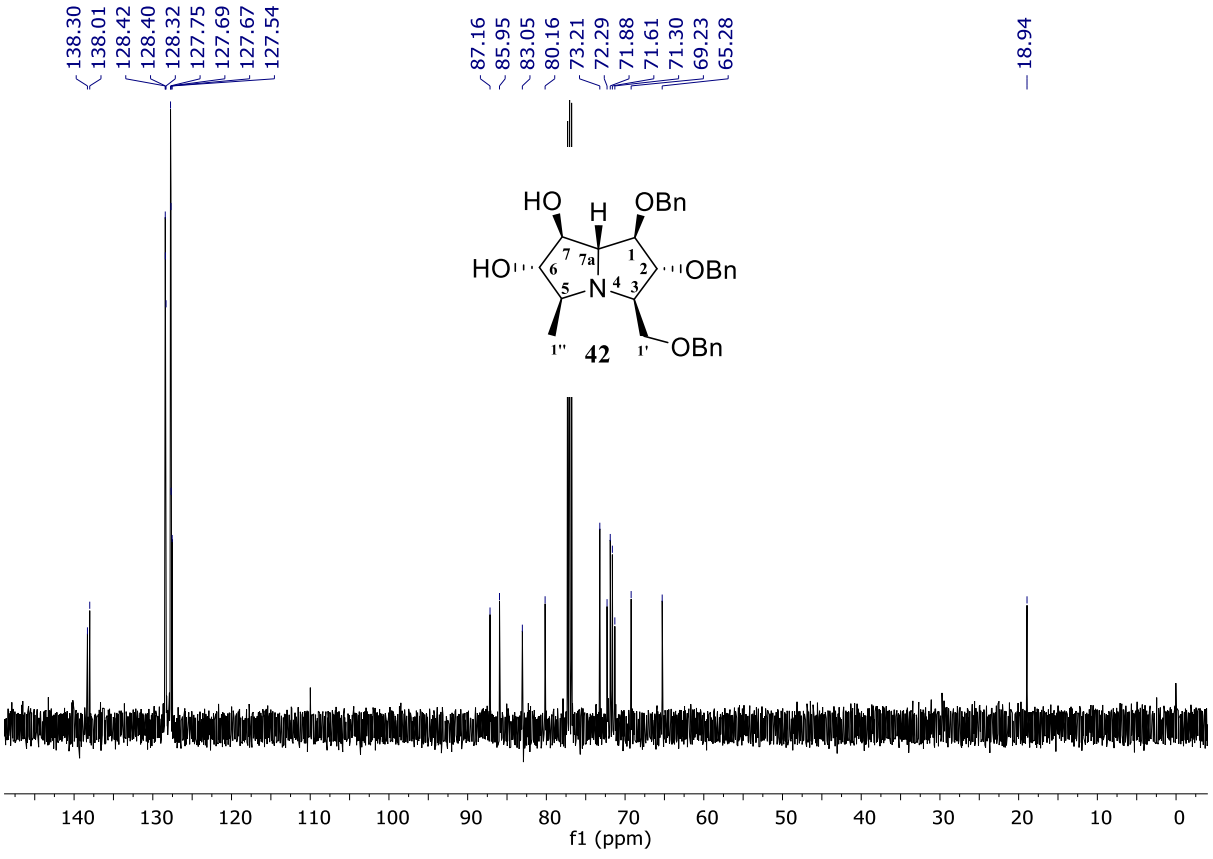


Figure S160: ^{13}C NMR spectrum (125 MHz, $CDCl_3$) of **42**

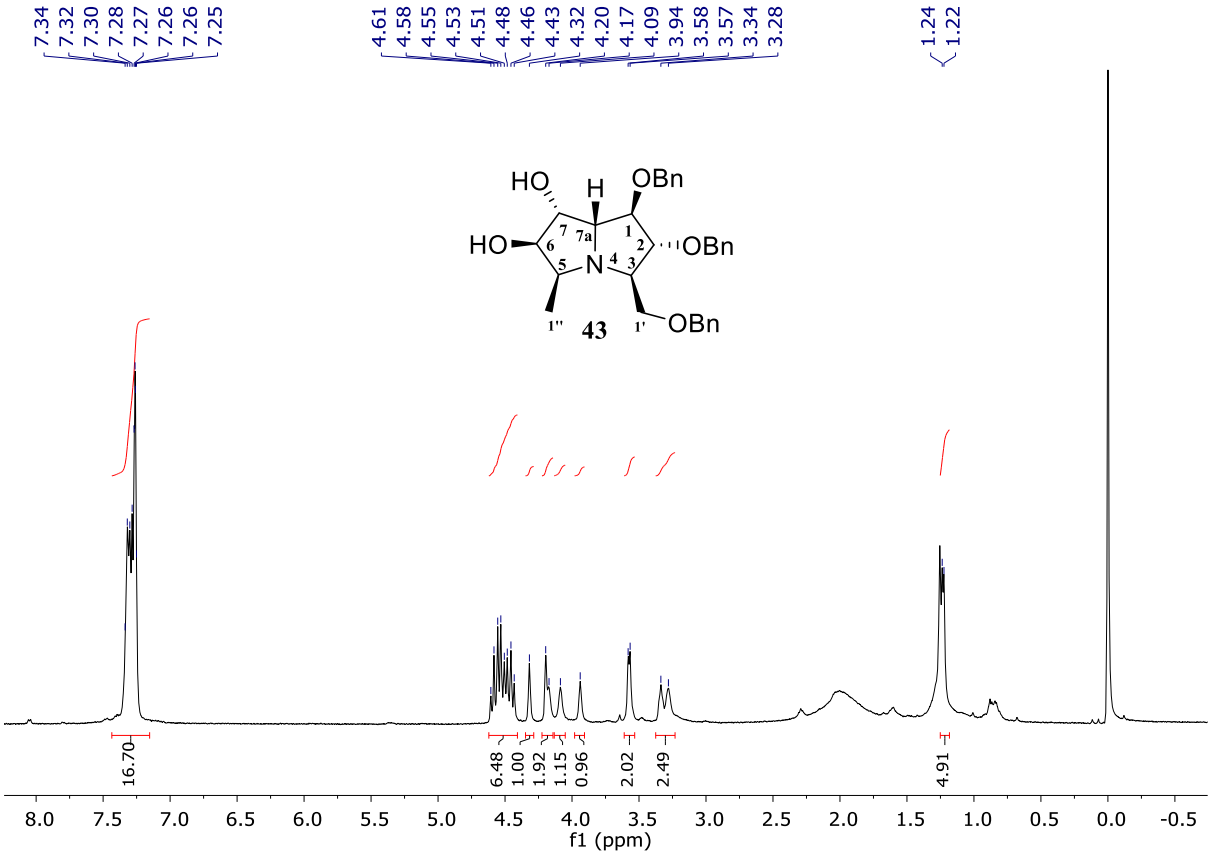


Figure S161: ^{1}H NMR spectrum (500 MHz, $CDCl_3$) of **43**

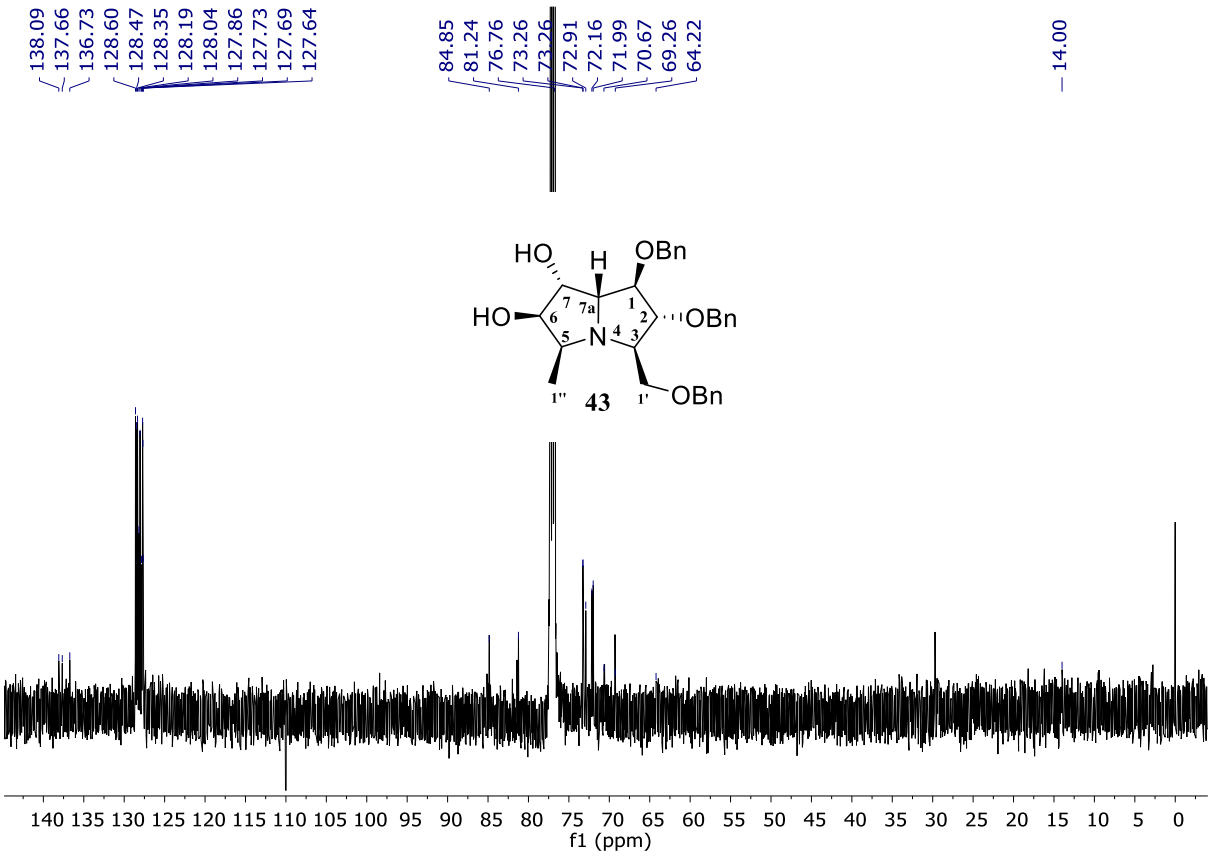


Figure S162: ^{13}C NMR spectrum (125 MHz, $CDCl_3$) of **43**

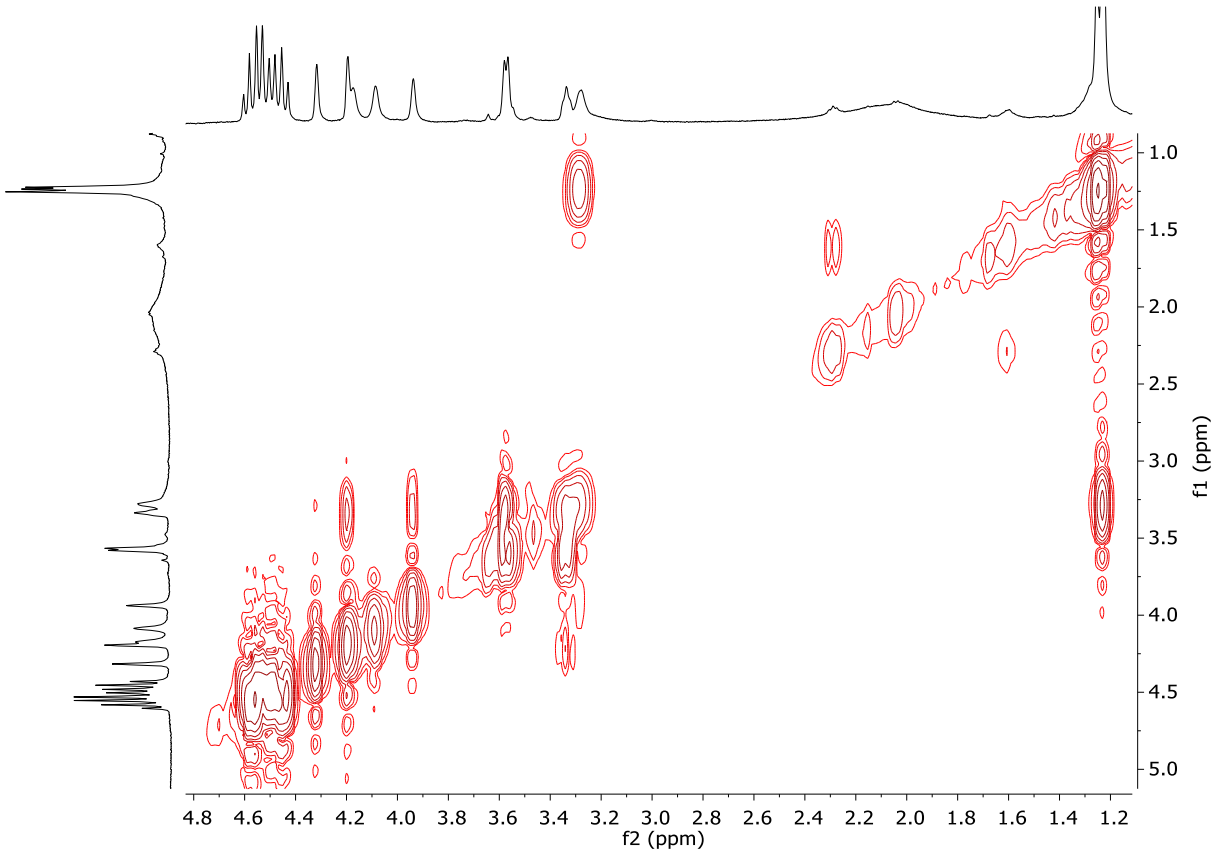


Figure S163: gCOSY spectrum (500 MHz, $CDCl_3$) of **43**

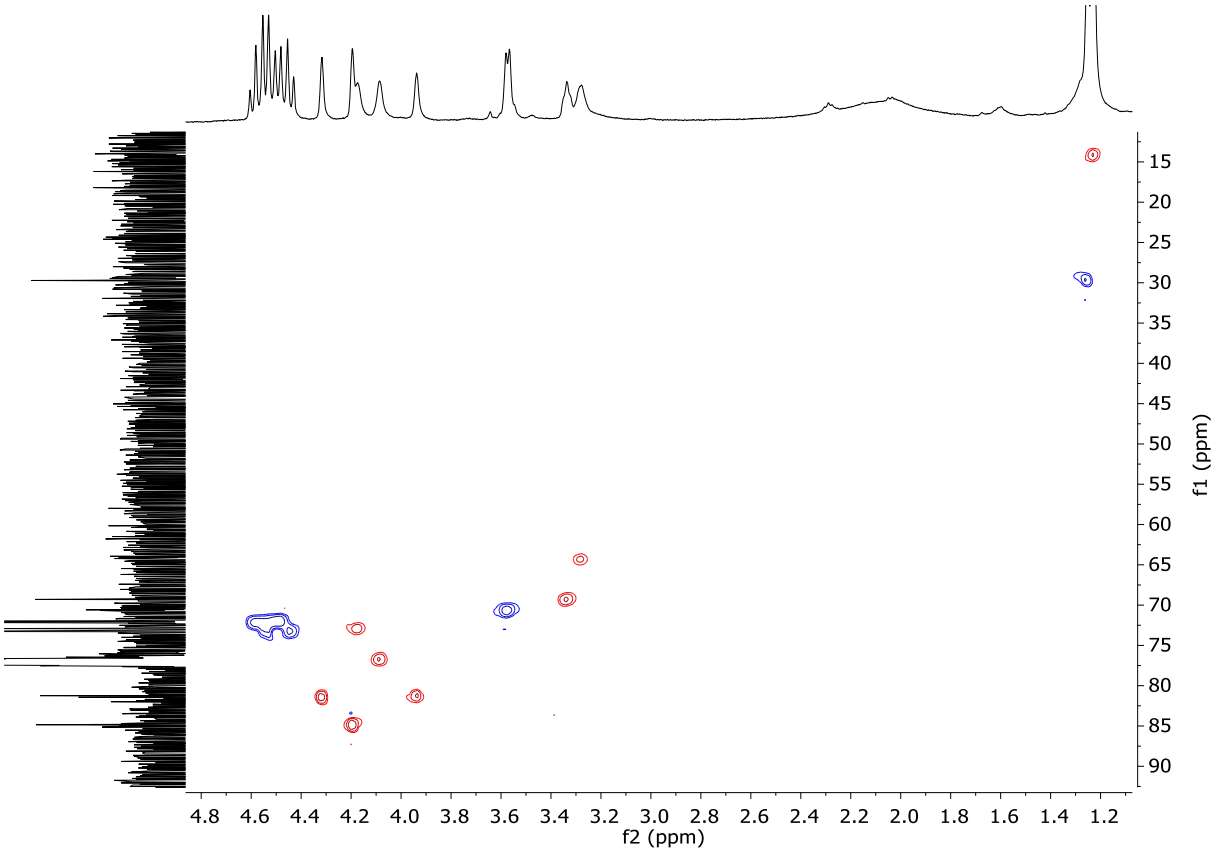


Figure S164: gHSQC spectrum (500 MHz, $CDCl_3$) of **43**

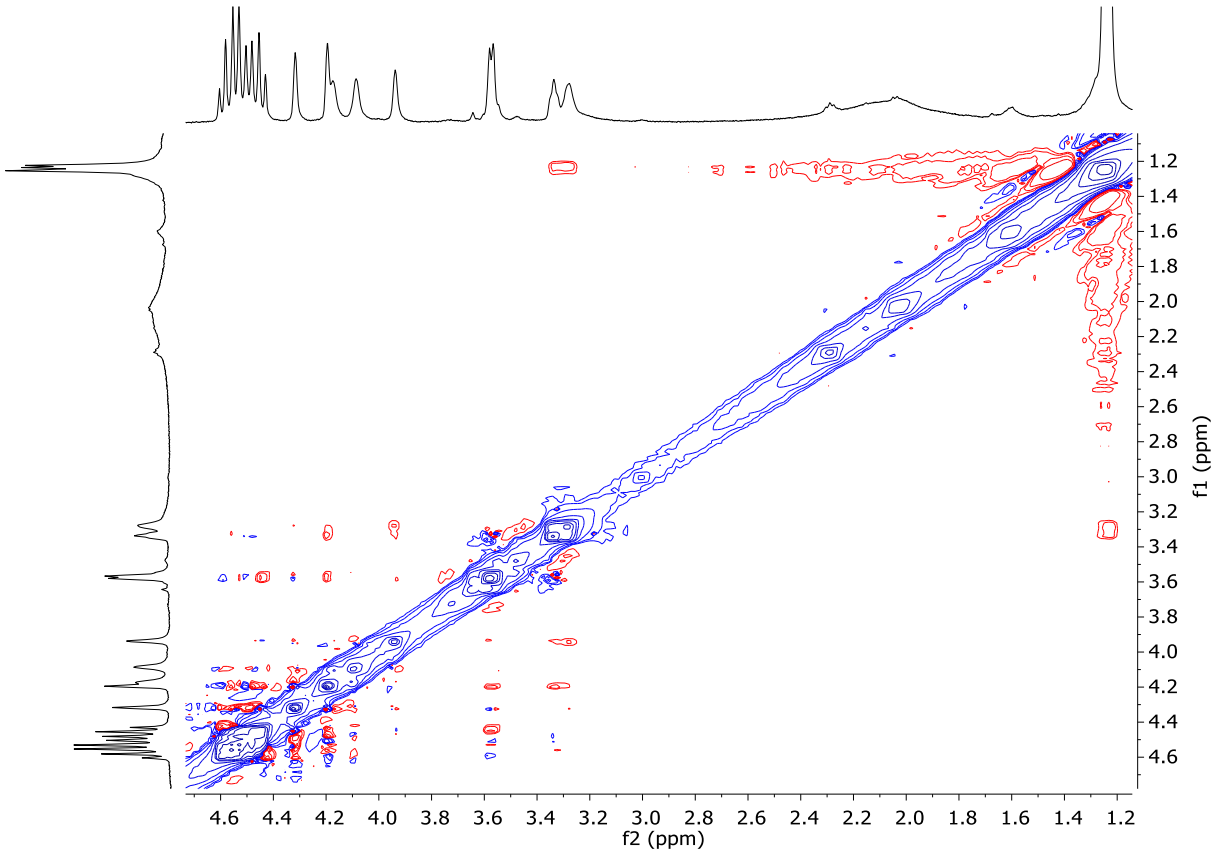


Figure S165: ROSEY spectrum (500 MHz, $CDCl_3$) of **43**

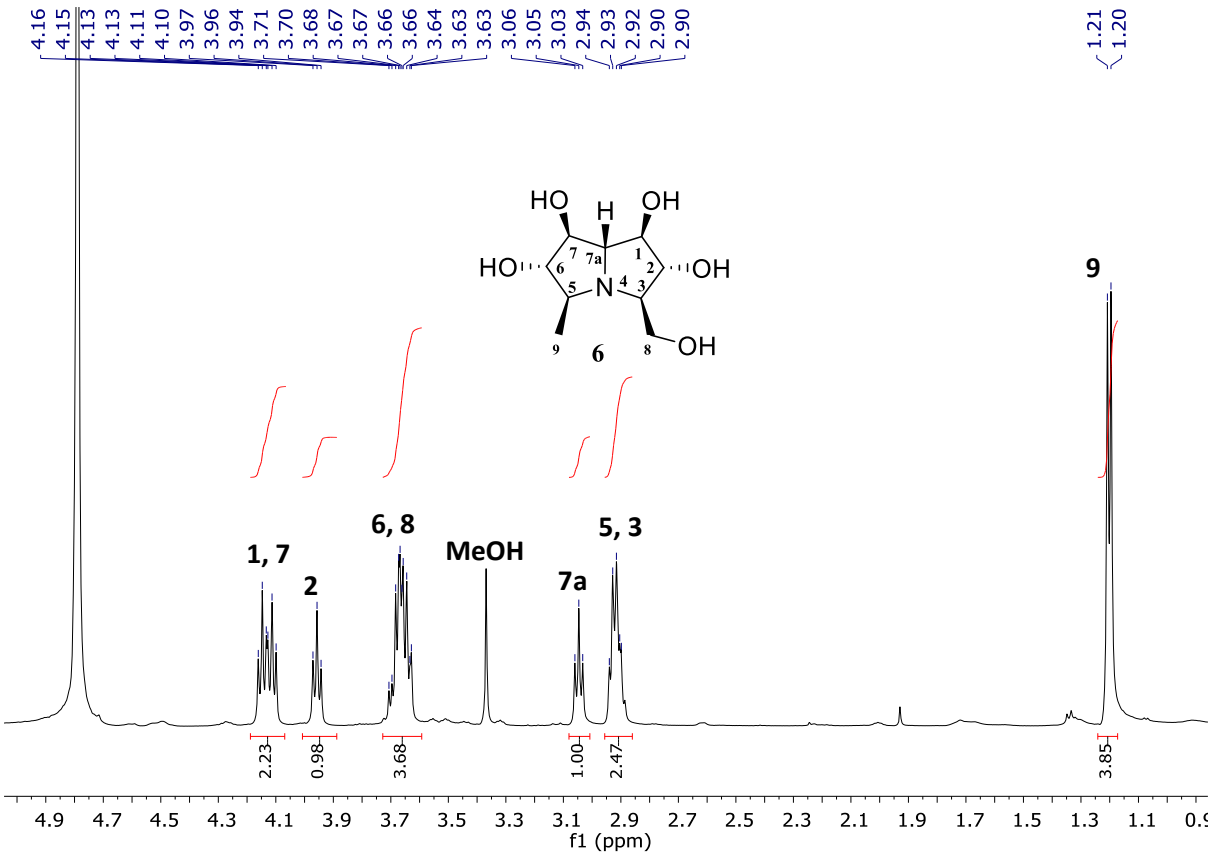


Figure S166: ^{1}H NMR spectrum (500 MHz, D_2O) of **6**

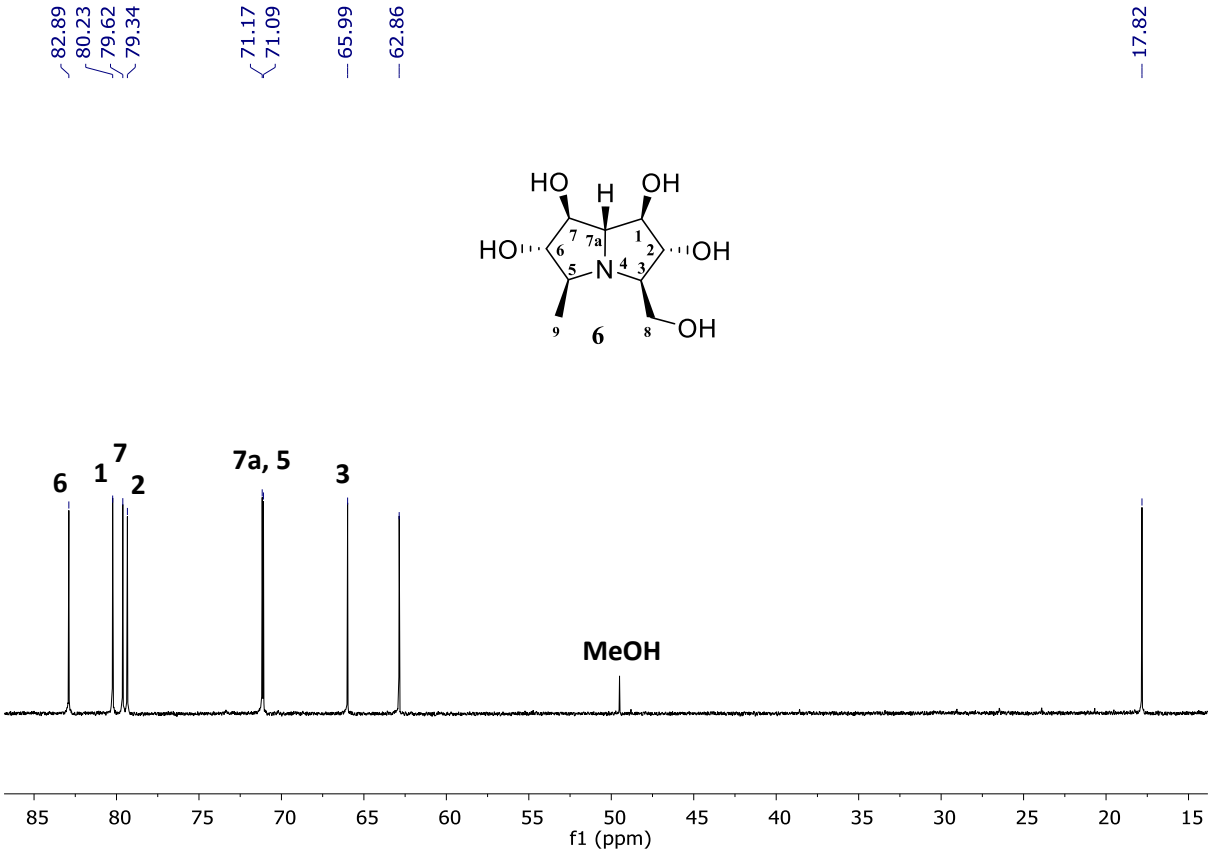


Figure S167: ^{13}C NMR spectrum (125 MHz, D_2O) of **6**

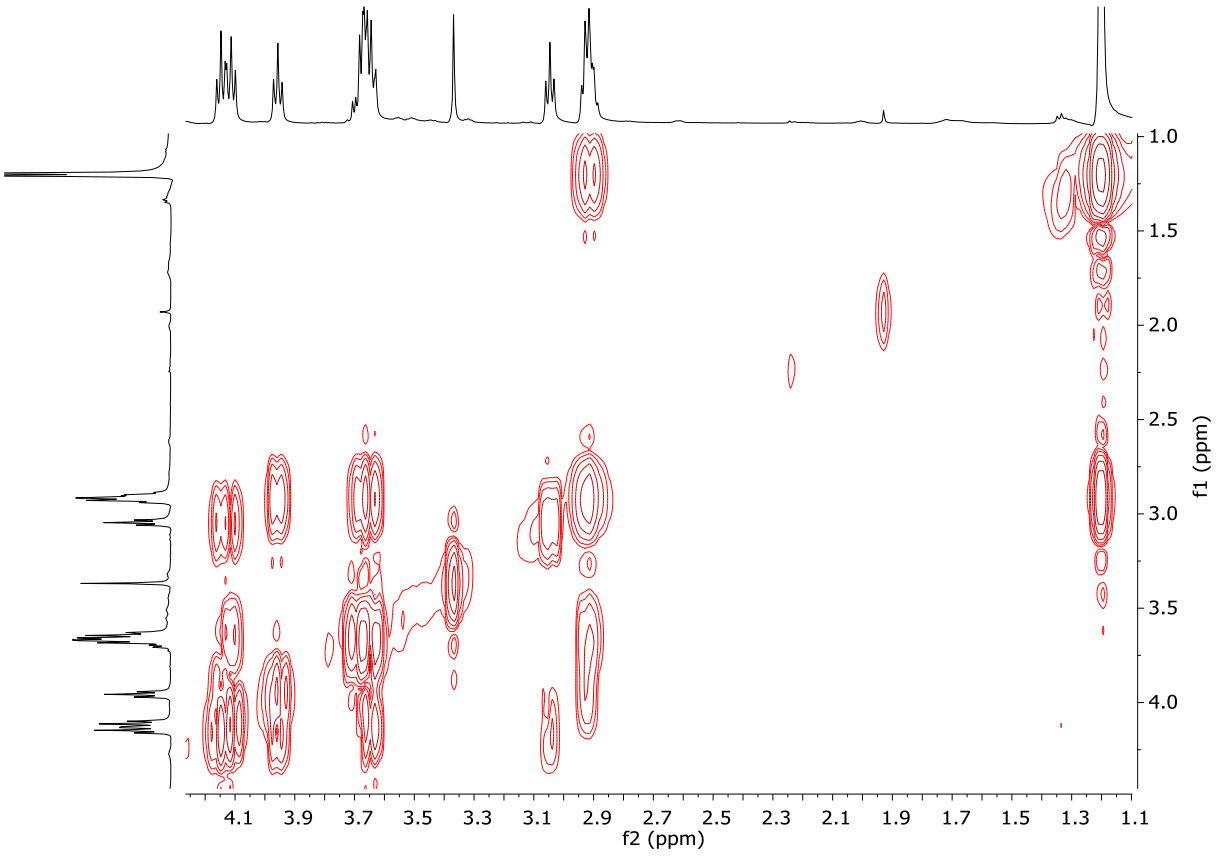


Figure S168: gCOSY spectrum (500 MHz, D_2O) of **6**

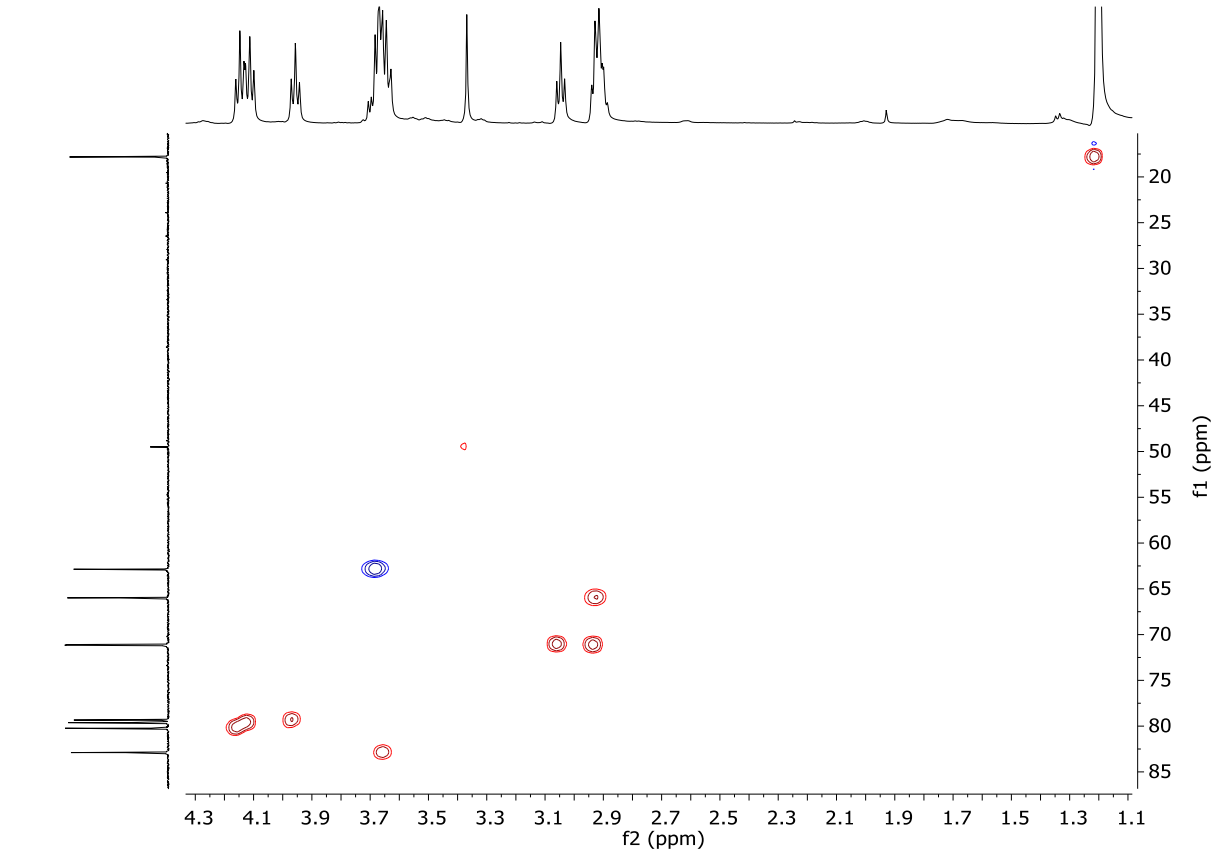


Figure S169: gHSQC spectrum (500 MHz, D_2O) of **6**

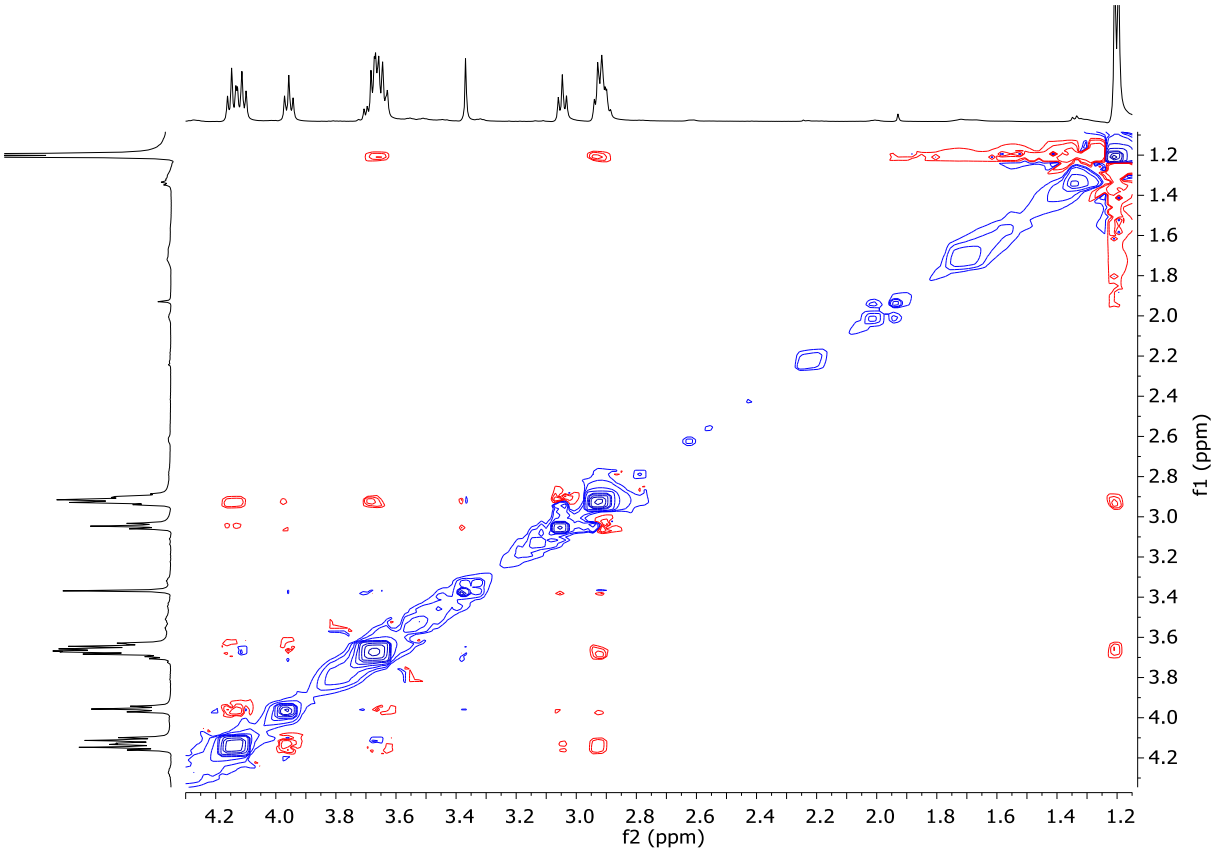


Figure S170: ROSEY spectrum (500 MHz, D_2O) of **6**

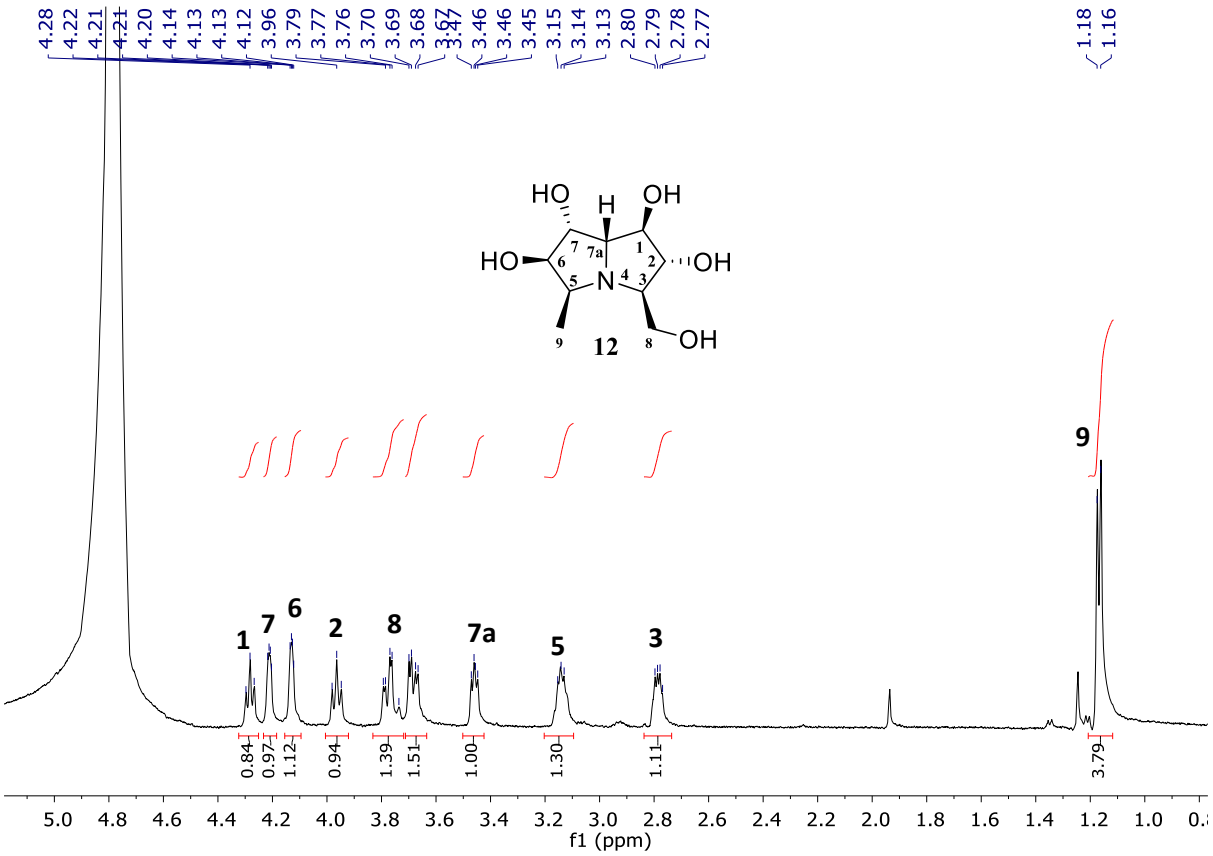


Figure S171: ^1H NMR spectrum (500 MHz, D_2O) of **12**

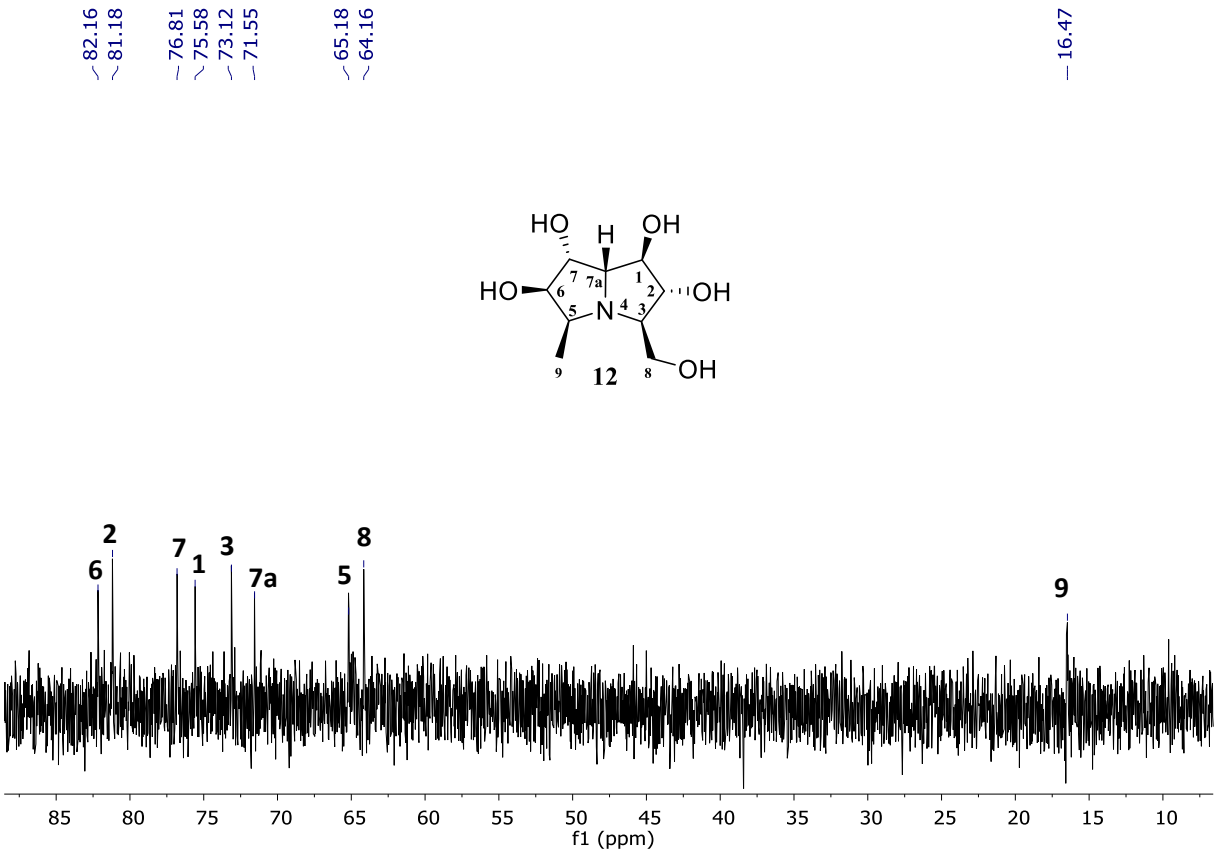


Figure S172: ^{13}C NMR spectrum (125 MHz, D_2O) of **12**

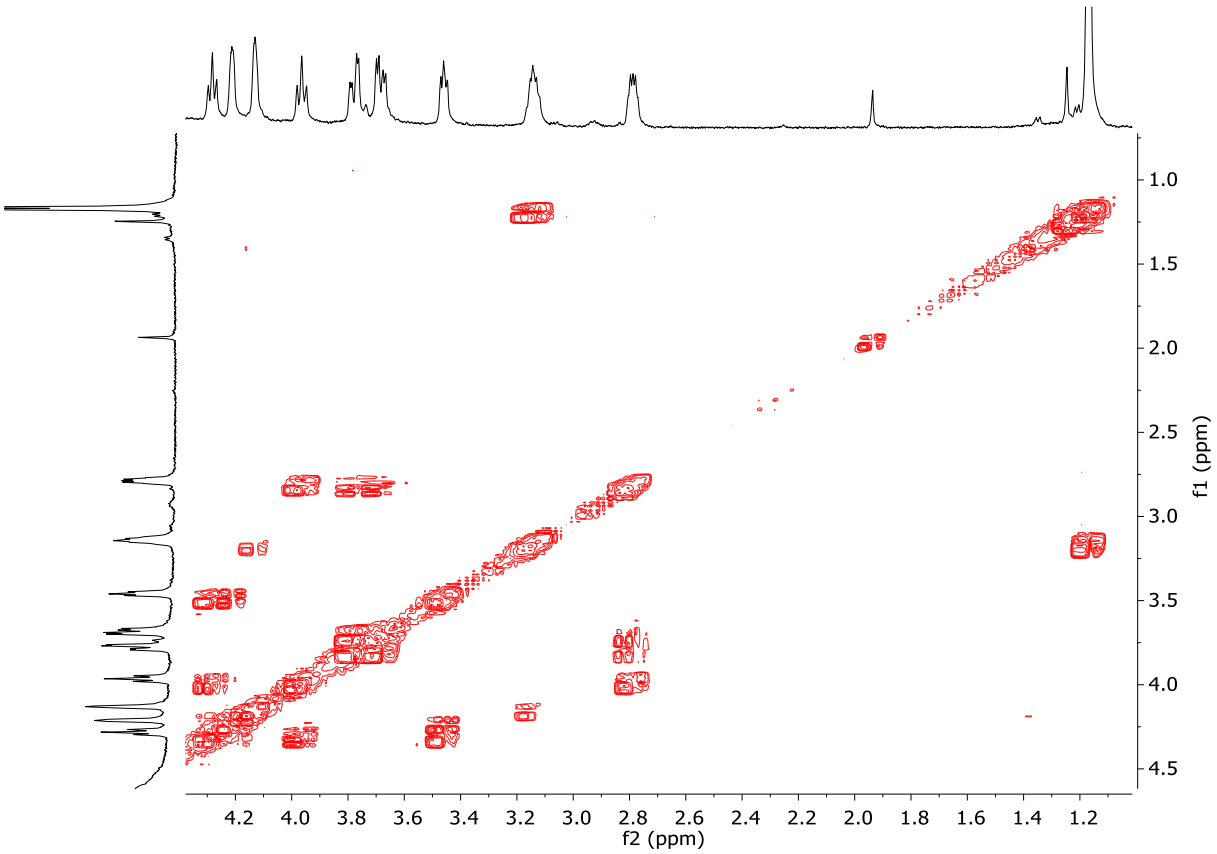


Figure S173: gCOSY spectrum (500 MHz, D_2O) of **12**

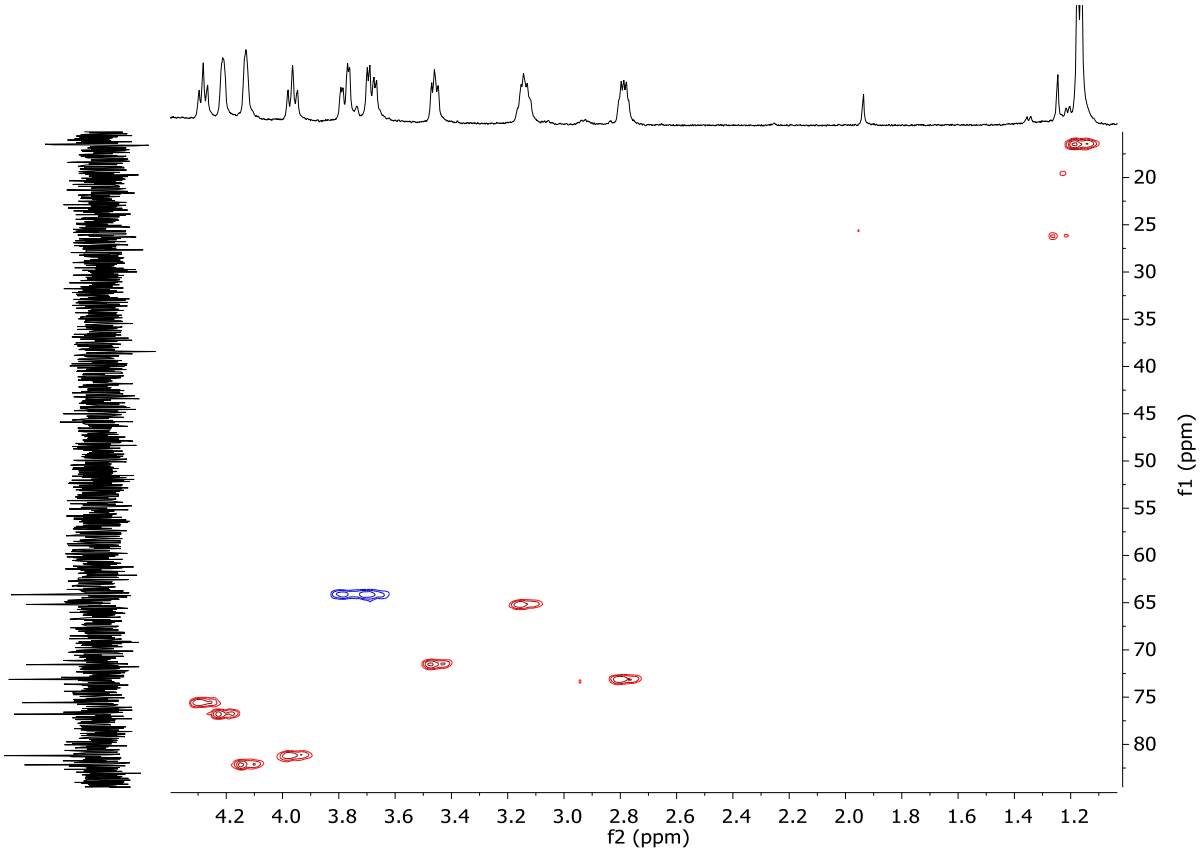


Figure S174: gHSQC spectrum (500 MHz, D_2O) of **12**

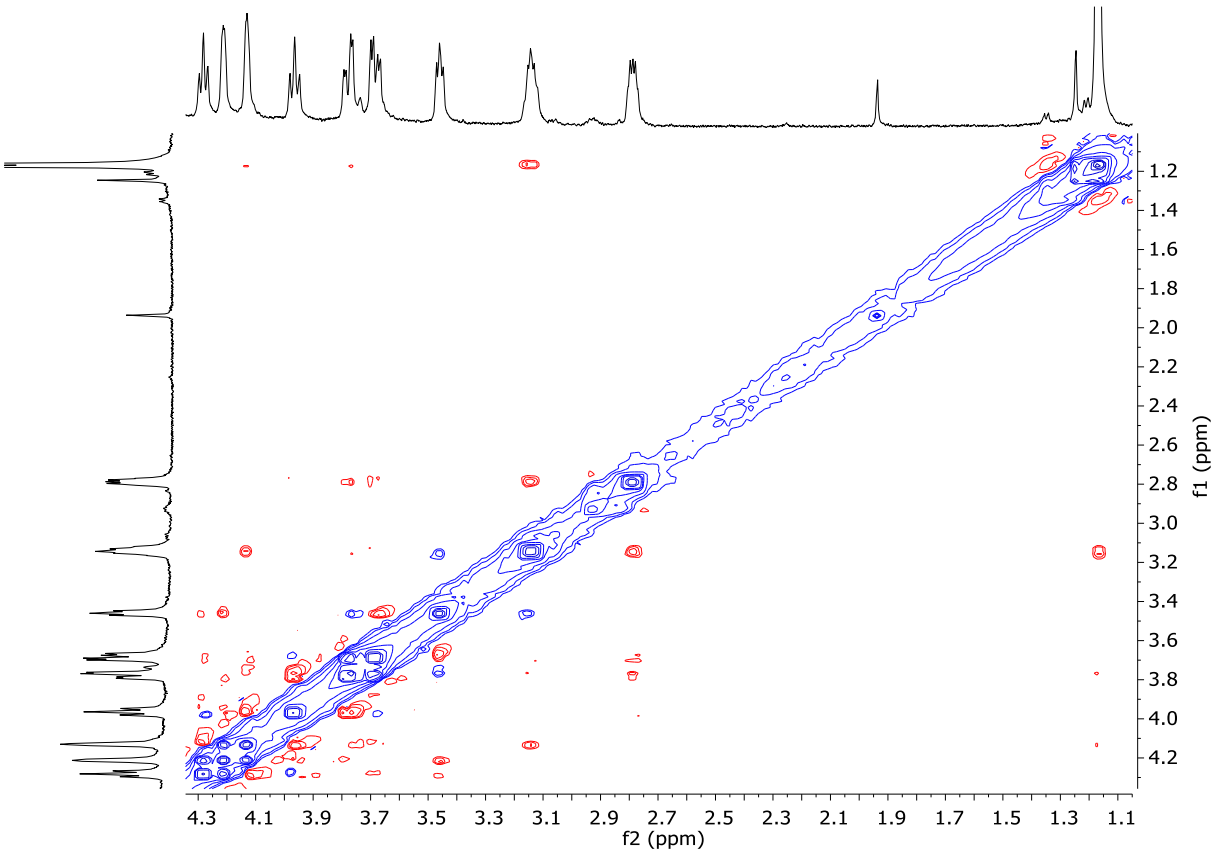
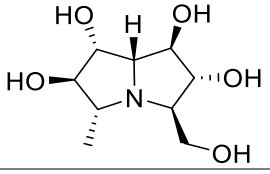
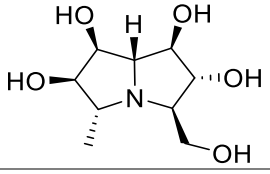
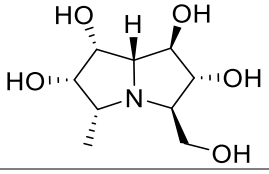
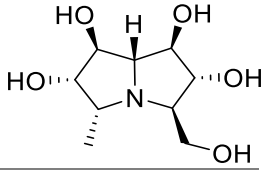


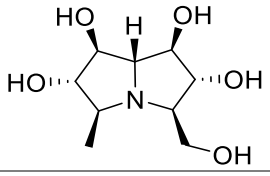
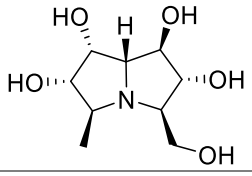
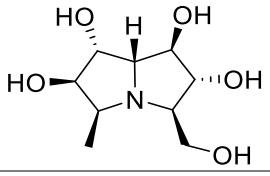
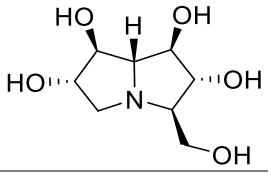
Figure S175: ROSEY spectrum (500 MHz, D_2O) of **12**

Table S9. Concentration of iminosugars giving 50 % inhibition of various glycosidases

	IC_{50} (µM)			
				
enzyme	Corrected structure of natural hyacinthacine C_5 **7**	(+)-7-*epi* hyacinthacine C_5 **8**	(−)-6-*epi* hyacinthacine C_5 **9**	(+)-6,7-di-*epi*-hyacinthacine C_5 **10**
α-glucosidase				
Yeast	195	83	NI (32.6 %)	123
Rice	630	633	504	99
Rat intestinal maltase	108	61	130	21
Rat intestinal isomaltase	[a]NT	20	42	NT
Rat intestinal sucrase	NT	13	9.9	NT
ER-α-glucosidase II	[b]NI [c](5.1 %)	NT	NT	355
Human lysosome	145	NT	NT	15
β-glucosidase				
Almond	NI (5.0 %)	NI (5.42 %)	NI (39.3 %)	NI (17.3 %)
Bovine liver	NI (28.1 %)	NI (27.4 %)	NI (25.0 %)	NI (43.3 %)
Human lysosome	NI (2.6 %)	NT	NT	NI (36.4 %)
α-galactosidase				
Coffee beans	NI (10.6 %)	NI (4.97 %)	NI (0 %)	NI (32.2 %)
β-galactosidase				
Bovine liver	571	NI (27.5 %)	NI (37.3 %)	NI (43.0 %)
α-mannosidase				
Jack bean	NI (3.4 %)	NI (5.04 %)	NI (0.315 %)	NI (0.5 %)
β-mannosidase				
Snail	NI (0 %)	NI (0 %)	NI (0 %)	NI (0 %)
α-L-fucosidase				
Bovine kidney	NI (1.1 %)	NI (0 %)	NI (0 %)	NI (2.1 %)
α,α-trehalase				
Porcine kidney	119	735	NI (45.6 %)	NI (40.5 %)
amyloglucosidase				
Aspergillus niger	370	25	374	41
Rhizopus sp	NT	16	231	NT
α-L-rhamnosidase				
Penicillium decumbens	197	NI (25.8 %)	NI (7.74 %)	NI (23.4 %)
β-glucronidase				
E.coli	NI (9.3 %)	NI (0 %)	NI (5.08 %)	NI (8.2 %)
Bovine liver	NI (16.8 %)	NI (12.4 %)	NI (23.8 %)	NI (16.0 %)

[a]NT : Not tested, [b]NI : No inhibition (less than 50 % inhibition at 1000 µM),
[c]( ) : Inhibition % at 1000 µM

Table S10. Concentration of iminosugars giving 50 % inhibition of various glycosidases

	IC_{50} (μM)			
				
enzyme	Originally proposed structure of (+)-hyacinthacine C_5 **6**	(−)-5,6-di-*epi*-hyacinthacine C_5 **11**	(+)-5-*epi*-hyacinthacine C_5 **12**	Casuarine
α-glucosidase				
Yeast	636	NI (49.2 %)	NI (31.4 %)	67
Rice	[a]NI [b](29.4 %)	NI (41.2 %)	527	18.8
Rat intestinal maltase	NI (31.4 %)	960	NI (38.1 %)	3.5
Rat intestinal isomaltase	[c]NT	NI (48.1 %)	NT	NT
Rat intestinal sucrase	NT	NI (44.6 %)	NT	NT
ER-α-glucosidase II	NI (0 %)	NT	NI (19.6 %)	39.6
Human lysosome	804	NT	823	3.7
β-glucosidase				
Almond	NI (2.6 %)	NI (8.03 %)	NI (0 %)	NI (14.5 %)
Bovine liver	NI (33.4 %)	NI (16.0 %)	NI (37.4 %)	NI (0 %)
Human lysosome	NI (0 %)	NT	NI (35.7 %)	NI (43.0 %)
α-galactosidase				
Coffee beans	NI (13.1 %)	NI (5.59 %)	NI (27.7 %)	NI (8.5 %)
β-galactosidase				
Bovine liver	986	NI (34.2 %)	1070	NI (27.3 %)
α-mannosidase				
Jack bean	NI (1.1 %)	NI (14.2 %)	NI (8.2 %)	NI (1.4 %)
β-mannosidase				
Snail	NI (0 %)	NI (0 %)	NI (0 %)	NI (1.6 %)
α-L-fucosidase				
Bovine kidney	NI (9.7 %)	NI (0 %)	NI (7.5 %)	NI (4.1 %)
α,α-trehalase				
Porcine kidney	NI (6.4 %)	NI (5.47 %)	NI (5.7 %)	168
amyloglucosidase				
Aspergillus niger	423	NI (40.7 %)	NI (9.9 %)	6.0
Rhizopus sp	NT	NI (46.0 %)	NT	NT
α-L-rhamnosidase				
Penicillium decumbens	74	NI (26.8 %)	NI (29.2 %)	NI (18.8 %)
β-glucronidase				
E.coli	NI (8.6 %)	NI (5.08 %)	NI (22.2 %)	NI (0.4 %)
Bovine liver	NI (17.9 %)	NI (18.2 %)	NI (25.7 %)	NI (0 %)

[a]NI : No inhibition (less than 50 % inhibition at 1000 μM), [b]( ) : Inhibition % at 1000 μM,
[c]NT : Not tested

Computational Data

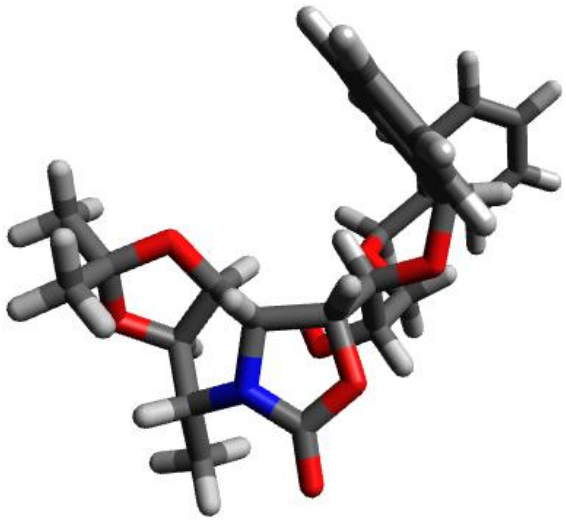


Figure S176: DFT minimized molecular model (B3LYP/6-31G(d)) of acetonide **22**

Cartesian coordinates generated for **22**

```
C1 3.1367540000 -1.5971660000 0.8324680000
C2 2.1505920000 -0.4009730000 0.8998400000
C3 3.8382870000 -1.5633750000 -0.5616180000
N4 3.0452850000 -0.5837730000 -1.3136070000
C5 2.2592790000 0.3085410000 -0.4728650000
C6 2.5210710000 -0.7126920000 -2.5751850000
O7 1.4056790000 0.0914920000 -2.6689000000
C8 1.0259330000 0.6120530000 -1.3783830000
O9 2.9248570000 -1.3653290000 -3.5087430000
C10 3.9312360000 -2.9416150000 -1.2128650000
H11 2.7930970000 1.2506730000 -0.2906060000
C12 -0.3757950000 0.0871460000 -0.9882540000
C13 -0.6042920000 -1.3972050000 -1.3518460000
C14 -1.9829070000 -1.9002510000 -0.9361870000
O15 0.3934130000 -2.2340280000 -0.7654730000
H16 0.9215680000 1.6917710000 -1.4930360000
O17 -1.9663370000 -1.9969630000 0.4910430000
C18 -4.3794280000 -1.8920680000 0.9622150000
C19 -5.4726850000 -2.3710730000 0.2339400000
C20 -6.6594160000 -1.6368750000 0.1630350000
C21 -6.7601970000 -0.4094150000 0.8172440000
C22 -5.6716510000 0.0807140000 1.5451660000
C23 -4.4915230000 -0.6571030000 1.6174380000
C24 -3.0892470000 -2.6803660000 1.0498130000
O25 -1.3634810000 0.8288810000 -1.7107560000
C26 -1.4212350000 3.0105430000 -0.5453550000
C27 -1.2684280000 3.3667080000 0.7981790000
C28 -0.6084110000 4.5462180000 1.1543370000
C29 -0.0889670000 5.3797020000 0.1647510000
C30 -0.2323750000 5.0309600000 -1.1821210000
C31 -0.8951990000 3.8566930000 -1.5333710000
C32 -2.1492180000 1.7408130000 -0.9414180000
H33 4.8519270000 -1.1705420000 -0.4078620000
H34 2.9338260000 -3.3716980000 -1.3467840000
```

```
H35 4.5156500000 -3.5970920000 -0.5571790000
H36 4.4129980000 -2.8920010000 -2.1901440000
H37 -0.5212230000 0.2303140000 0.0902420000
H38 -0.5065800000 -1.4845740000 -2.4372780000
H39 -2.7717390000 -1.2257160000 -1.2847340000
H40 -2.1522510000 -2.8980230000 -1.3692930000
H41 -5.3969170000 -3.3267810000 -0.2802980000
H42 -7.5009790000 -2.0230970000 -0.4057090000
H43 -7.6817700000 0.1637570000 0.7631030000
H44 -5.7470520000 1.0345500000 2.0606320000
H45 -3.6464810000 -0.2790900000 2.1882880000
H46 -3.2098270000 -3.6606680000 0.5636550000
H47 -2.8155380000 -2.8542180000 2.0960960000
H48 -1.6710380000 2.7182700000 1.5736520000
H49 -0.4972980000 4.8083380000 2.2031430000
H50 0.4263830000 6.2965200000 0.4382690000
H51 0.1703500000 5.6774780000 -1.9573850000
H52 -1.0023600000 3.5821260000 -2.5799920000
H53 -2.9982590000 1.9809230000 -1.5911400000
H54 -2.5479040000 1.2390240000 -0.0476060000
O55 2.6121200000 0.3980300000 1.9812770000
H56 1.1324420000 -0.7131050000 1.1298460000
H57 2.6348640000 -2.5589710000 0.9696880000
O58 4.0115650000 -1.4117310000 1.9338010000
C59 3.8879800000 -0.0761900000 2.4300990000
H60 0.0231810000 -2.4974390000 0.0962440000
C61 5.0109630000 0.8162640000 1.8898760000
H62 5.9849600000 0.4332630000 2.2108570000
H63 4.8931850000 1.8380400000 2.2649710000
H64 4.9968620000 0.8481040000 0.7967990000
C65 3.8739050000 -0.1322970000 3.9527510000
H66 3.0578000000 -0.7787400000 4.2858980000
H67 3.7275290000 0.8694980000 4.3681180000
H68 4.8209060000 -0.5334320000 4.3266920000
```

Energies calculated for **22**

Gas: E(RB3LYP) = -1630.03894955 A.U. after 7 cycles
Aqueous: E(RB3LYP) = -1630.03894938 A.U. after 6 cycles

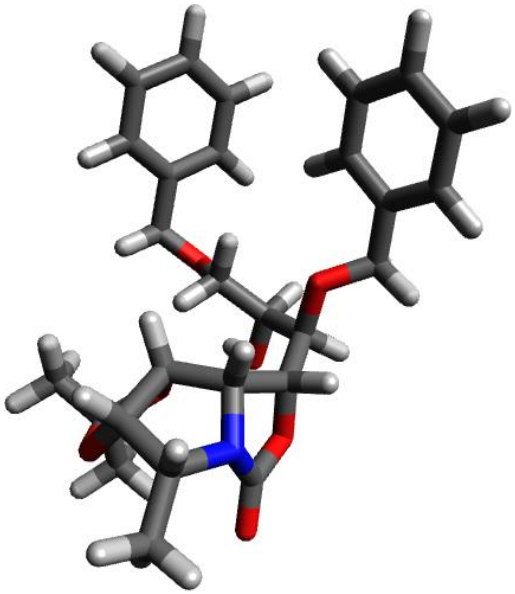


Figure S177: DFT minimized molecular model (B3LYP/6-31G(d)) of acetonide **23**

Cartesian coordinates generated for **23**

```
C1 -3.5086090000 -1.8778230000 -0.3626340000
O2 -4.2220400000 -1.1757720000 -1.3838540000
C3 -3.3835640000 -0.1939640000 -1.9718430000
C4 -2.0716730000 -0.2193510000 -1.1222170000
O5 -2.4239830000 -1.0188780000 -0.0056380000
C6 -3.9609800000 1.2426120000 -1.7992810000
N7 -3.2260080000 1.7786130000 -0.6387910000
C8 -1.8568500000 1.2523260000 -0.7024780000
C9 -3.6569220000 1.7096610000 0.6867810000
O10 -2.5534140000 1.6501790000 1.4972180000
C11 -1.3737520000 1.7317410000 0.6817970000
O12 -4.7853290000 1.7405530000 1.1166770000
C13 -2.9861980000 -3.2061720000 -0.9184730000
C14 -4.4036920000 -2.0430150000 0.8552890000
C15 -5.4799120000 1.3419400000 -1.7464700000
C16 -0.1034060000 1.2892090000 1.4335210000
C17 0.2061710000 -0.1348450000 1.9325240000
C18 0.5922810000 -1.1766900000 0.8879180000
O19 -0.8561030000 -0.5799670000 2.7524780000
H20 -3.2208210000 -0.4331040000 -3.0298990000
H21 -3.6031200000 1.8299810000 -2.6572410000
H22 -1.1778140000 2.8024200000 0.5198870000
H23 -1.2081370000 -0.6346740000 -1.6576910000
H24 -1.2795950000 1.7541330000 -1.4879840000
O25 1.0458210000 -2.3039010000 1.6495540000
C26 2.7940050000 -3.1700190000 0.1526620000
C27 3.8404520000 -2.5204150000 0.8212030000
C28 5.0741630000 -2.3362020000 0.1970070000
C29 5.2800440000 -2.8050960000 -1.1036770000
C30 4.2433000000 -3.4527030000 -1.7762170000
C31 3.0062760000 -3.6276690000 -1.1514310000
C32 1.4677010000 -3.4019740000 0.8557370000
O33 0.9850980000 1.7038910000 0.5998930000
C34 3.0459760000 2.8834530000 0.2779580000
C35 3.3732330000 4.1680070000 -0.1663340000
C36 4.4800000000 4.3757220000 -0.9929710000
C37 5.2645340000 3.2939590000 -1.3922290000
C38 4.9399430000 2.0052390000 -0.9588170000
```

```
C39 3.8411510000 1.8021460000 -0.1264180000
C40 1.8668260000 2.6600660000 1.1928940000
H41 -2.3301810000 -3.0354690000 -1.7790260000
H42 -3.8225460000 -3.8311340000 -1.2463570000
H43 -2.4234320000 -3.7471180000 -0.1507450000
H44 -4.7591970000 -1.0645640000 1.1866120000
H45 -3.8426210000 -2.5100680000 1.6700810000
H46 -5.2619320000 -2.6755050000 0.6082080000
H47 -5.8959640000 0.7307160000 -0.9478350000
H48 -5.8885580000 0.9989800000 -2.7035780000
H49 -5.7882320000 2.3786760000 -1.5876060000
H50 -0.1404800000 1.8989140000 2.3475190000
H51 1.1192660000 -0.0001490000 2.5427610000
H52 -0.2710900000 -1.4765960000 0.2885800000
H53 1.3893150000 -0.7946620000 0.2399380000
H54 -0.6376990000 -1.4988830000 2.9807630000
H55 3.6751700000 -2.1564280000 1.8315520000
H56 5.8781840000 -1.8326310000 0.7277630000
H57 6.2425840000 -2.6657750000 -1.5886790000
H58 4.3930180000 -3.8148220000 -2.7900030000
H59 2.1983230000 -4.1256150000 -1.6839930000
H60 1.5547250000 -4.2414010000 1.5565570000
H61 0.6930020000 -3.6674630000 0.1184390000
H62 2.7583560000 5.0130540000 0.1354870000
H63 4.7229320000 5.3804850000 -1.3284050000
H64 6.1236170000 3.4519700000 -2.0389230000
H65 5.5435530000 1.1560110000 -1.2682240000
H66 3.5948050000 0.7978630000 0.2073010000
H67 1.3368760000 3.6080620000 1.3714570000
H68 2.2063510000 2.2848010000 2.1714080000
```

Energies calculated for **23**

Gas: E(RB3LYP) = -1630.02234875 A.U. after 7 cycles
Aqueous: E(RB3LYP) = -1630.02234881 A.U. after 7 cycles

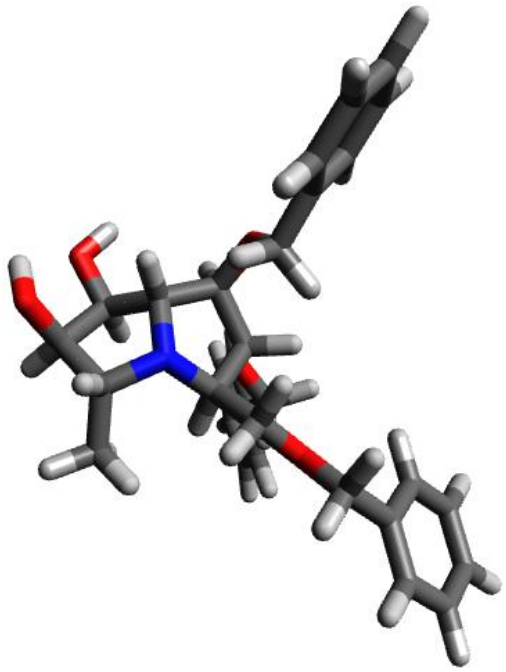


Figure S178: DFT minimized molecular model (B3LYP/6-31G(d)) of **46**

Cartesian coordinates generated for **46**

```
C1 -1.8534410000 -3.1372360000 0.8712670000
C2 -1.9063360000 -3.3003240000 2.3974920000
C3 -1.2741720000 -1.9871840000 2.9373990000
N4 -1.3158300000 -1.0225840000 1.7943010000
C5 -2.1107070000 -1.6270190000 0.7157800000
C6 -0.0788410000 -0.4279150000 1.2588860000
C7 -0.2136190000 -0.4603370000 -0.2892820000
C8 -1.6356430000 -0.9972470000 -0.5989320000
C9 0.1019930000 -2.2199800000 3.5671490000
O10 -3.2569420000 -3.3708790000 2.8304930000
O11 -2.8300640000 -3.9941740000 0.2903850000
C12 0.1252460000 0.9753500000 1.8370190000
H13 -3.1858310000 -1.4577210000 0.8658560000
O14 0.7040750000 -1.3790100000 -0.8770050000
C15 2.9125660000 -1.9121110000 -1.6534610000
C16 2.4147120000 -2.8016960000 -2.6133550000
C17 3.2572380000 -3.7360870000 -3.2156750000
C18 4.6103350000 -3.7879110000 -2.8734870000
C19 5.1143180000 -2.9027140000 -1.9194910000
C20 4.2677840000 -1.9751950000 -1.3101870000
C21 2.0245690000 -0.8643390000 -1.0248560000
O22 -2.5356250000 -0.0544310000 -1.1674890000
C23 -3.9905200000 1.8428570000 -1.0780230000
C24 -4.0142460000 1.9485250000 -2.4740160000
C25 -5.0029130000 2.7008720000 -3.1081870000
C26 -5.9755840000 3.3634230000 -2.3559980000
C27 -5.9575990000 3.2627990000 -0.9643020000
C28 -4.9727530000 2.5024230000 -0.3313930000
C29 -2.8959240000 1.0717360000 -0.3755130000
O30 1.3644100000 1.4752280000 1.3624000000
C31 2.9707370000 3.2534840000 1.2555660000
C32 3.1677960000 3.1792660000 -0.1296980000
C33 4.3437830000 3.6588400000 -0.7041680000
C34 5.3362960000 4.2282290000 0.0982180000
C35 5.1471710000 4.3082880000 1.4778390000
C36 3.9720840000 3.8179040000 2.0517220000
```

```
C37 1.6824130000 2.7630730000 1.8719730000
H38 -0.8480810000 -3.3799210000 0.4951160000
H39 -1.3495830000 -4.1875960000 2.7345420000
H40 -1.9496490000 -1.6218480000 3.7205350000
H41 0.8139250000 -1.0103790000 1.5151530000
H42 -0.0680200000 0.5348400000 -0.7315310000
H43 -1.5338700000 -1.7518480000 -1.3853870000
H44 0.7929110000 -2.7326090000 2.8882290000
H45 -0.0197470000 -2.8518560000 4.4533500000
H46 0.5712180000 -1.2855060000 3.8920330000
H47 -3.7197780000 -3.9017080000 2.1575780000
H48 -2.9721880000 -3.7253620000 -0.6301390000
H49 -0.7036240000 1.6404770000 1.5467120000
H50 0.1243200000 0.9226340000 2.9378020000
H51 1.3618990000 -2.7633990000 -2.8743690000
H52 2.8566130000 -4.4249300000 -3.9551370000
H53 5.2659580000 -4.5156790000 -3.3443730000
H54 6.1644400000 -2.9393420000 -1.6413260000
H55 4.6635870000 -1.2940490000 -0.5598060000
H56 1.9847620000 0.0375020000 -1.6611820000
H57 2.4342470000 -0.5426090000 -0.0576880000
H58 -3.2626740000 1.4257280000 -3.0568780000
H59 -5.0139140000 2.7702630000 -4.1930030000
H60 -6.7448360000 3.9496510000 -2.8517570000
H61 -6.7152110000 3.7671690000 -0.3701440000
H62 -4.9706990000 2.4178810000 0.7534330000
H63 -3.2299860000 0.7648350000 0.6247380000
H64 -2.0190760000 1.7255010000 -0.2338440000
H65 2.3971060000 2.7342800000 -0.7524120000
H66 4.4859940000 3.5914460000 -1.7796430000
H67 6.2518030000 4.6043920000 -0.3505540000
H68 5.9160610000 4.7443060000 2.1102130000
H69 3.8337680000 3.8724930000 3.1293550000
H70 0.8574900000 3.4607610000 1.6426870000
H71 1.7741990000 2.7277640000 2.9697480000
```

Energies calculated for **46**

Gas: E(RB3LYP) = -1595.06221865 A.U. after 7 cycles
Aqueous: E(RB3LYP) = -1595.06221877 A.U. after 7 cycles

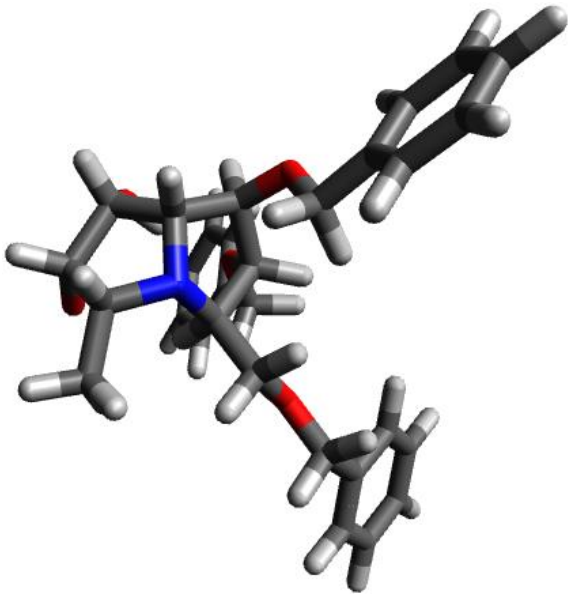


Figure S179: DFT minimized molecular model (B3LYP/6-31G(d)) of **47**

Cartesian coordinates generated for **47**

```
C1 -1.0412030000 -3.4223550000 1.0810210000
C2 -0.4021550000 -3.2665860000 2.5078760000
C3 -1.0284680000 -1.9659280000 3.0582570000
N4 -1.3130860000 -1.1155760000 1.8775590000
C5 -1.8106880000 -2.0661740000 0.8648600000
C6 -0.1851720000 -0.3536530000 1.2805290000
C7 -0.3447650000 -0.5032960000 -0.2597690000
C8 -1.6050510000 -1.3824580000 -0.4902970000
C9 -0.2501120000 -1.3007130000 4.1875100000
O10 1.0054660000 -3.1348680000 2.4066700000
O11 -0.0575110000 -3.7617120000 0.1113270000
C12 -0.2095100000 1.1005740000 1.7530520000
H13 -2.8777600000 -2.2580260000 1.0352170000
O14 0.7421550000 -1.2399110000 -0.8341580000
C15 3.0090730000 -1.4233500000 -1.5829600000
C16 2.7100170000 -2.1788530000 -2.7251610000
C17 3.6769630000 -3.0001320000 -3.3025370000
C18 4.9589090000 -3.0707580000 -2.7508170000
C19 5.2651550000 -2.3206500000 -1.6152780000
C20 4.2920880000 -1.5061860000 -1.0321880000
C21 1.9726080000 -0.5145490000 -0.9711290000
O22 -2.7401490000 -0.6989230000 -0.9993650000
C23 -4.5966020000 0.8095640000 -0.8666900000
C24 -4.8225210000 0.6344050000 -2.2358820000
C25 -5.9852850000 1.1309100000 -2.8281480000
C26 -6.9315100000 1.8134850000 -2.0623910000
C27 -6.7112290000 1.9925030000 -0.6950830000
C28 -5.5530370000 1.4895930000 -0.1026560000
C29 -3.3259360000 0.3222750000 -0.2044110000
O30 0.9078020000 1.7608080000 1.1790040000
C31 2.1882630000 3.7558160000 0.8587200000
C32 2.2041040000 3.8160760000 -0.5415350000
C33 3.2758530000 4.3999010000 -1.2141550000
C34 4.3459340000 4.9383170000 -0.4936970000
C35 4.3382460000 4.8845550000 0.8998600000
C36 3.2654970000 4.2918750000 1.5702330000
C37 1.0210650000 3.1227130000 1.5757410000
H38 -1.7508430000 -4.2545700000 1.0697570000
```

```
H39 -0.6545710000 -4.1250810000 3.1502580000
H40 -2.0183150000 -2.2447980000 3.4517360000
H41 0.7848120000 -0.7835070000 1.5563770000
H42 -0.4288850000 0.4648790000 -0.7685010000
H43 -1.3765600000 -2.1128280000 -1.2686740000
H44 0.7637910000 -1.0324190000 3.8808940000
H45 -0.1622240000 -1.9958880000 5.0294400000
H46 -0.7699260000 -0.4042770000 4.5415680000
H47 1.2458480000 -3.6620890000 1.6196600000
H48 0.3936580000 -2.9496460000 -0.2052390000
H49 -1.1493760000 1.5901400000 1.4513310000
H50 -0.1599820000 1.1425580000 2.8509720000
H51 1.7119690000 -2.1284050000 -3.1511570000
H52 3.4310960000 -3.5853900000 -4.1847570000
H53 5.7126820000 -3.7101750000 -3.2025890000
H54 6.2578130000 -2.3747710000 -1.1761570000
H55 4.5310920000 -0.9305230000 -0.1409900000
H56 1.7822530000 0.3589020000 -1.6139720000
H57 2.3089680000 -0.1294100000 -0.0016860000
H58 -4.0887380000 0.0976160000 -2.8271990000
H59 -6.1513920000 0.9828330000 -3.8922620000
H60 -7.8358640000 2.1993290000 -2.5255060000
H61 -7.4448830000 2.5163390000 -0.0876840000
H62 -5.3917710000 1.6241540000 0.9653960000
H63 -3.5390060000 -0.0362320000 0.8112560000
H64 -2.6239060000 1.1663070000 -0.0981900000
H65 1.3723630000 3.3968440000 -1.1019050000
H66 3.2766590000 4.4390720000 -2.3003080000
H67 5.1804180000 5.3963840000 -1.0179490000
H68 5.1680030000 5.2981630000 1.4669130000
H69 3.2667960000 4.2439700000 2.6568690000
H70 0.0843630000 3.6532350000 1.3322690000
H71 1.1577300000 3.1916640000 2.6668030000
```

Energies calculated for **47**

Gas: E(RB3LYP) = -1595.07213693 A.U. after 7 cycles
Aqueous: E(RB3LYP) = -1595.07213747 A.U. after 6 cycles

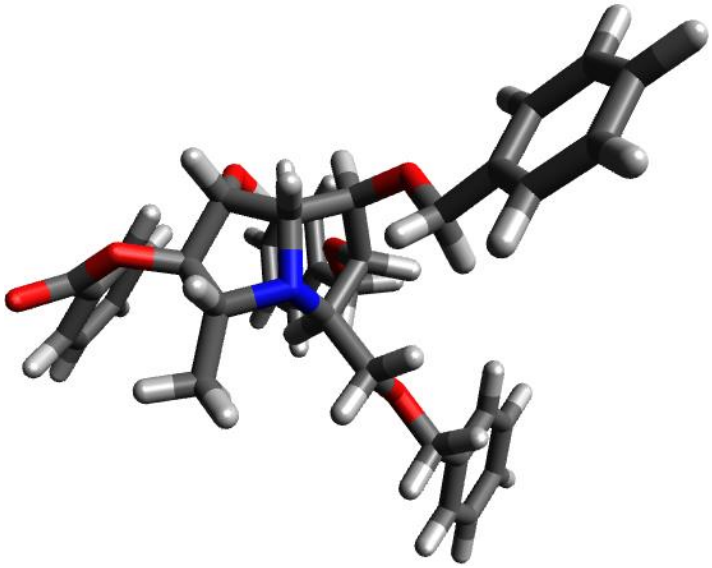


Figure S180: DFT minimized molecular model (B3LYP/6-31G(d)) of **52**

Cartesian coordinates generated for **52**

```
C1 -0.5715750000 -2.8576360000 0.3452420000
C2 -1.3639850000 -2.4606080000 -0.9208040000
C3 -0.2760170000 -2.1965520000 -1.9850960000
N4 0.8204480000 -1.5630180000 -1.2228160000
C5 0.8913100000 -2.3524250000 0.0329810000
C6 0.6548230000 -0.1310120000 -0.8672900000
C7 1.0175660000 -0.0142770000 0.6393630000
C8 1.4977220000 -1.4218910000 1.0863730000
C9 -0.7499100000 -1.4564470000 -3.2292520000
O10 -1.1446260000 -2.3977200000 1.5573940000
C11 1.4989200000 0.7562930000 -1.7835160000
H12 1.5371590000 -3.2247640000 -0.1199930000
O13 -2.2388710000 -3.5184600000 -1.3373400000
C14 -3.5336700000 -3.3252780000 -1.7348300000
C15 -6.1143290000 -0.4653440000 0.1614320000
C16 -6.2869370000 -0.8148370000 -1.1808970000
C17 -5.4280920000 -1.7348380000 -1.7754930000
C18 -4.3746670000 -2.2992080000 -1.0394320000
C19 -4.2138180000 -1.9571080000 0.3119310000
C20 -5.0843510000 -1.0420490000 0.9061550000
O21 -3.9753160000 -4.0328570000 -2.6126310000
O22 -0.1497060000 0.2654980000 1.4228060000
C23 -1.8402380000 1.7629400000 2.2208630000
C24 -1.9769630000 1.1232240000 3.4606150000
C25 -3.1510600000 1.2590740000 4.2007680000
C26 -4.1999220000 2.0457540000 3.7163490000
C27 -4.0693890000 2.6889250000 2.4848140000
C28 -2.8977360000 2.5419040000 1.7397170000
C29 -0.5632460000 1.6376760000 1.4268770000
O30 2.8961300000 -1.5585380000 1.2813900000
C31 5.1492970000 -1.8849000000 0.5295530000
C32 5.5758290000 -1.9446910000 1.8603450000
C33 6.8756890000 -2.3517080000 2.1663880000
C34 7.7656280000 -2.6965420000 1.1480820000
C35 7.3459470000 -2.6378700000 -0.1824390000
C36 6.0449120000 -2.2381430000 -0.4871770000
C37 3.7605530000 -1.4068920000 0.1635850000
O38 1.2403950000 2.1053800000 -1.4293650000
C39 1.6718280000 4.4405240000 -1.7369650000
```

```
C40 1.9763130000 4.7801530000 -0.4115650000
C41 1.7457110000 6.0710380000 0.0599680000
C42 1.2130450000 7.0437890000 -0.7909510000
C43 0.9087760000 6.7153700000 -2.1117920000
C44 1.1335930000 5.4181610000 -2.5787410000
C45 1.9377920000 3.0436380000 -2.2419770000
H46 -0.5771140000 -3.9482710000 0.4251280000
H47 -1.9357090000 -1.5468370000 -0.7315490000
H48 0.0977270000 -3.1807570000 -2.3013310000
H49 -0.3863710000 0.2044040000 -0.9752690000
H50 1.7768160000 0.7528850000 0.8325420000
H51 1.0788220000 -1.6318750000 2.0714130000
H52 -1.1719600000 -0.4722210000 -2.9960940000
H53 -1.5293210000 -2.0446080000 -3.7249180000
H54 0.0719300000 -1.3219780000 -3.9402100000
H55 -1.0945070000 -1.4203140000 1.5730160000
H56 2.5691730000 0.5213660000 -1.6772980000
H57 1.2292180000 0.5718060000 -2.8343540000
H58 -6.7845020000 0.2524750000 0.6271230000
H59 -7.0937550000 -0.3746790000 -1.7606710000
H60 -5.5604000000 -2.0345060000 -2.8100690000
H61 -3.4172910000 -2.4002140000 0.9016430000
H62 -4.9509050000 -0.7751700000 1.9505960000
H63 -1.1628880000 0.5108220000 3.8375280000
H64 -3.2457630000 0.7547970000 5.1588280000
H65 -5.1120720000 2.1564140000 4.2967850000
H66 -4.8811460000 3.2997240000 2.0987210000
H67 -2.8050850000 3.0363300000 0.7754980000
H68 0.2434240000 2.2376040000 1.8777810000
H69 -0.6997450000 2.0073120000 0.4029730000
H70 4.8801770000 -1.6839610000 2.6505630000
H71 7.1928000000 -2.4000220000 3.2050740000
H72 8.7769420000 -3.0135490000 1.3886530000
H73 8.0281550000 -2.9120340000 -0.9830110000
H74 5.7207270000 -2.2048430000 -1.5257630000
H75 3.3864900000 -1.9597430000 -0.7079520000
H76 3.8075970000 -0.3443950000 -0.1305720000
H77 2.3905280000 4.0238650000 0.2500230000
H78 1.9851990000 6.3215150000 1.0901170000
H79 1.0366950000 8.0514180000 -0.4241470000
H80 0.4912690000 7.4649860000 -2.7787290000
H81 0.8870200000 5.1638910000 -3.6071350000
H82 3.0182310000 2.8206850000 -2.2101210000
H83 1.6191330000 2.9478930000 -3.2922360000
```

Energies calculated for **52**

Gas: E(RB3LYP) = -1939.46243871 A.U. after 7 cycles
Aqueous: E(RB3LYP) = -1939.46243872 A.U. after 6 cycles

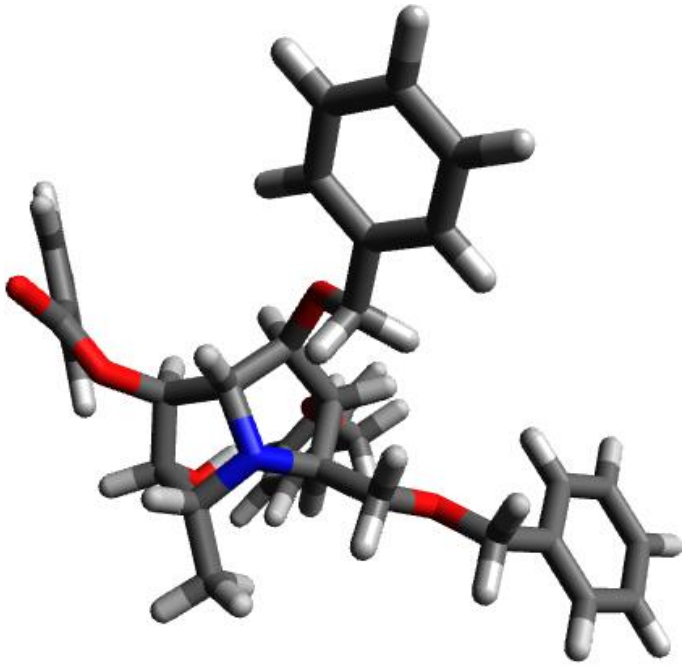


Figure S181: DFT minimized molecular model (B3LYP/6-31G(d)) of **53**

Cartesian coordinates generated for **53**

```
C1 -2.4002220000 0.0903120000 1.1758110000
C2 -1.9095310000 -0.8791570000 2.2690920000
C3 -0.8673520000 -0.0159850000 3.0203120000
N4 -0.1590490000 0.7262610000 1.9493210000
C5 -1.2033150000 1.0818590000 0.9609880000
C6 0.9820900000 0.0612240000 1.2793470000
C7 0.6580960000 0.0567250000 -0.2334760000
C8 -0.5474120000 1.0089530000 -0.4327940000
C9 0.0102940000 -0.7642560000 4.0149800000
O10 -1.3732170000 -2.0738710000 1.7130750000
C11 2.3018990000 0.7431610000 1.6501250000
H12 -1.5949050000 2.0885260000 1.1474780000
O13 -3.5270100000 0.8425640000 1.6651540000
C14 -4.7443260000 0.9022410000 1.0486410000
C15 -6.2836780000 -2.1982120000 -1.5008210000
C16 -6.5818360000 -0.8526410000 -1.7318000000
C17 -6.0547310000 0.1299870000 -0.8987290000
C18 -5.2004070000 -0.2173600000 0.1594840000
C19 -4.9102690000 -1.5705070000 0.3901130000
C20 -5.4559580000 -2.5542090000 -0.4353700000
O21 -5.4455380000 1.8635240000 1.2698650000
O22 0.1953110000 -1.2456770000 -0.6359700000
C23 0.6669480000 -3.5171180000 -1.2579990000
C24 0.5835440000 -3.9361750000 -2.5904670000
C25 0.0301500000 -5.1760560000 -2.9134820000
C26 -0.4520880000 -6.0084810000 -1.9024520000
C27 -0.3795560000 -5.5962500000 -0.5697450000
C28 0.1797280000 -4.3597700000 -0.2494400000
C29 1.2605160000 -2.1761120000 -0.9119560000
O30 -0.2508360000 2.2615610000 -1.0315160000
C31 0.4128810000 4.5605340000 -0.9106740000
C32 -0.8387680000 5.0057230000 -1.3516890000
C33 -0.9945550000 6.3030720000 -1.8396550000
C34 0.0964260000 7.1737020000 -1.8876770000
C35 1.3473930000 6.7362340000 -1.4504580000
C36 1.5032980000 5.4350390000 -0.9703070000
```

```
C37 0.5858850000 3.1740570000 -0.3303130000
O38 3.3482180000 0.0308340000 1.0091290000
C39 5.6870440000 -0.2344180000 0.5497170000
C40 5.5391680000 -0.4040080000 -0.8332400000
C41 6.5165870000 -1.0666560000 -1.5736790000
C42 7.6606480000 -1.5622820000 -0.9424050000
C43 7.8166060000 -1.3961900000 0.4336440000
C44 6.8310810000 -0.7400850000 1.1745420000
C45 4.6425950000 0.5130160000 1.3437700000
H46 -2.6703210000 -0.4412930000 0.2625480000
H47 -2.7327720000 -1.1791410000 2.9249720000
H48 -1.4415850000 0.7405700000 3.5756330000
H49 1.0840310000 -0.9809040000 1.5967770000
H50 1.5112100000 0.3484570000 -0.8563340000
H51 -1.2181680000 0.5441590000 -1.1589100000
H52 0.5109720000 -1.6231970000 3.5612950000
H53 -0.6138870000 -1.1463460000 4.8300910000
H54 0.7624540000 -0.0995900000 4.4525780000
H55 -0.9170690000 -1.8676150000 0.8723200000
H56 2.3077290000 1.8017140000 1.3519010000
H57 2.4247060000 0.7154950000 2.7440680000
H58 -6.6994590000 -2.9669280000 -2.1466710000
H59 -7.2317640000 -0.5710310000 -2.5556450000
H60 -6.2995580000 1.1765170000 -1.0475470000
H61 -4.2708130000 -1.8685050000 1.2138980000
H62 -5.2302570000 -3.5993390000 -0.2438030000
H63 0.9571150000 -3.2874230000 -3.3794520000
H64 -0.0239080000 -5.4907590000 -3.9522670000
H65 -0.8819830000 -6.9752180000 -2.1511470000
H66 -0.7546760000 -6.2397180000 0.2214970000
H67 0.2261430000 -4.0412310000 0.7889540000
H68 1.8560080000 -1.7859630000 -1.7490320000
H69 1.9262040000 -2.2481840000 -0.0415210000
H70 -1.6831440000 4.3247310000 -1.3232510000
H71 -1.9710150000 6.6349840000 -2.1829050000
H72 -0.0267940000 8.1843100000 -2.2679730000
H73 2.2045990000 7.4032720000 -1.4915070000
H74 2.4837030000 5.0954470000 -0.6418930000
H75 0.3351950000 3.1784270000 0.7412740000
H76 1.6408600000 2.8713620000 -0.4148800000
H77 4.6480510000 -0.0216780000 -1.3227960000
H78 6.3881630000 -1.1948830000 -2.6453780000
H79 8.4234340000 -2.0769690000 -1.5205420000
H80 8.7000810000 -1.7837870000 0.9340060000
H81 6.9520030000 -0.6227210000 2.2492390000
H82 4.6972510000 1.5945530000 1.1263320000
H83 4.8268530000 0.3951140000 2.4238310000
```

Energies calculated for **53**

Gas: E(RB3LYP) = -1939.45849755 A.U. after 7 cycles
Aqueous: E(RB3LYP) = -1939.45849745 A.U. after 7 cycles

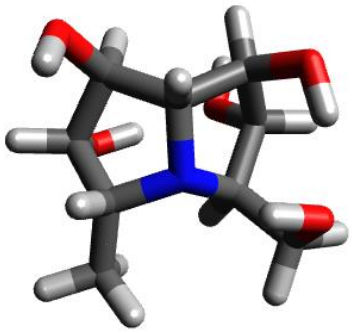


Figure S182: DFT minimized molecular model (B3LYP/6-31G(d)) of **10**

Cartesian coordinates generated for **10**

```
C1 -1.6121620000 -1.1673160000 -0.2928820000
C2 -2.1679350000 0.2465840000 0.0299400000
C3 -1.2041970000 1.1778690000 -0.7481410000
N4 0.1303160000 0.5349820000 -0.6335980000
C5 -0.1187040000 -0.9304130000 -0.7026570000
C6 1.0084810000 0.8351800000 0.5325550000
C7 1.2240950000 -0.5086690000 1.2548590000
C8 0.9776760000 -1.5768830000 0.1694850000
C9 -1.2626700000 2.6498070000 -0.3624840000
O10 -2.2116770000 0.5290700000 1.4176290000
O11 -2.3401820000 -1.8511200000 -1.3063220000
O12 0.2396160000 -0.5680370000 2.3025910000
C13 2.3088420000 1.4704500000 -0.0079920000
O14 2.1582190000 -1.8829090000 -0.5413030000
H15 0.0027770000 -1.2967300000 -1.7306770000
O16 2.7379350000 0.8016530000 -1.1917650000
H17 2.1312230000 2.5336740000 -0.2241160000
H18 3.1236570000 1.4034260000 0.7189610000
H19 -1.7069050000 -1.8053220000 0.5898660000
H20 -3.1972350000 0.3313280000 -0.3336220000
H21 -1.4710170000 1.0969380000 -1.8155420000
H22 0.5461060000 1.5330420000 1.2367360000
H23 2.2289330000 -0.6081070000 1.6832590000
H24 0.6337350000 -2.5224920000 0.6041270000
H25 -1.1885340000 2.7832530000 0.7192340000
H26 -2.2258420000 3.0684640000 -0.6730230000
H27 -0.4706910000 3.2226930000 -0.8571370000
H28 -1.4035700000 0.1702630000 1.8347450000
H29 -2.2441680000 -1.3513350000 -2.1331550000
H30 0.2667790000 -1.4519910000 2.7026340000
H31 2.5563780000 -1.0369500000 -0.8438510000
H32 1.9143050000 0.7760610000 -1.7259950000
```

Energies calculated for **10**

Gas: E(RB3LYP) = -784.001004001 A.U. after 7 cycles
Aqueous: E(RB3LYP) = -784.121949141 A.U. after 13 cycles

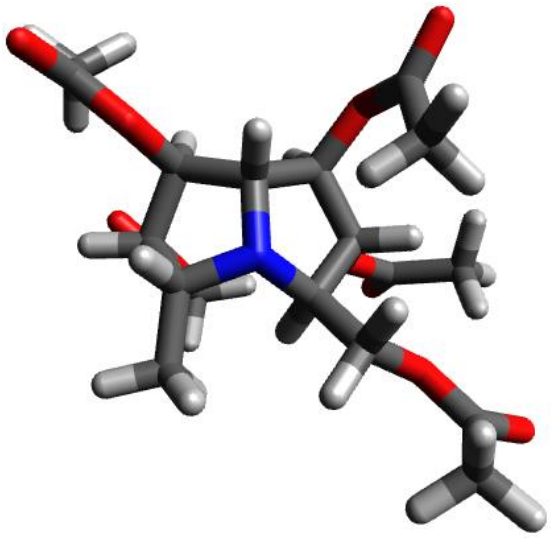


Figure S183: DFT minimized molecular model (B3LYP/6-31G(d)) of **56**

Cartesian coordinates generated for **56**

```
C1 -2.3828390000 0.2781820000 0.1840150000
C2 -2.1298990000 -0.9449110000 1.0825660000
C3 -1.1509980000 -0.3648420000 2.1179610000
N4 -0.2127020000 0.4577390000 1.3088710000
C5 -1.0231970000 1.0454780000 0.2118110000
C6 1.0015120000 -0.1965250000 0.7765380000
C7 1.1138140000 0.1825440000 -0.7207880000
C8 -0.1940460000 0.9240620000 -1.0835310000
C9 -0.5176750000 -1.3635960000 3.0797970000
C10 2.2234450000 0.2314090000 1.5994890000
H11 -1.2682430000 2.0928190000 0.4163110000
O12 -1.4213850000 -1.9676190000 0.3528470000
O13 -3.3321680000 -2.6344400000 -0.6604630000
C14 -2.1379290000 -2.7596970000 -0.4954370000
C15 -1.2471450000 -3.7744280000 -1.1620910000
O16 -3.3559950000 1.1199380000 0.8132120000
O17 -5.4400390000 1.7394610000 1.1946020000
C18 -4.6987740000 1.0903420000 0.5026810000
C19 -5.1412940000 0.2811640000 -0.6961090000
O20 1.1548580000 -1.0289830000 -1.4907880000
O21 2.0377670000 -2.4771200000 -2.8844360000
C22 2.1609910000 -1.4054770000 -2.3428060000
C23 3.3392500000 -0.4816380000 -2.5460650000
O24 -0.0448650000 2.1349020000 -1.8397590000
O25 0.4039060000 4.2685080000 -2.1484900000
C26 0.4909490000 3.3212330000 -1.4091880000
C27 1.2213470000 3.3913140000 -0.0813090000
O28 3.3786370000 -0.2688630000 0.9085230000
O29 5.5648770000 -0.4502850000 0.6806650000
C30 4.6451580000 -0.1685190000 1.4090210000
C31 4.8034730000 0.2690050000 2.8492850000
H32 -2.6894440000 0.0048090000 -0.8254620000
H33 -3.0527140000 -1.3515670000 1.5021920000
H34 -1.7434470000 0.3444260000 2.7103810000
H35 0.9346240000 -1.2862500000 0.8086640000
H36 1.9904280000 0.7948820000 -0.9274750000
H37 -0.7147490000 0.2830160000 -1.7964060000
H38 0.0308540000 -2.1570290000 2.5662190000
H39 -1.3046940000 -1.8388440000 3.6746880000
H40 0.1577800000 -0.8547970000 3.7751110000
H41 2.2716090000 1.3226460000 1.6785270000
```

```
H42 2.1595470000 -0.1850390000 2.6098620000
H43 -1.8321340000 -4.3519980000 -1.8784900000
H44 -0.8250000000 -4.4474000000 -0.4074090000
H45 -0.4062580000 -3.2820510000 -1.6629350000
H46 -6.2278690000 0.3476270000 -0.7556360000
H47 -4.8352980000 -0.7673910000 -0.6261720000
H48 -4.7130580000 0.6919880000 -1.6186600000
H49 3.9622710000 -0.9124000000 -3.3301530000
H50 3.9290270000 -0.3976680000 -1.6264710000
H51 3.0230380000 0.5214640000 -2.8523970000
H52 1.2674030000 4.4409270000 0.2129290000
H53 2.2507850000 3.0381350000 -0.2192420000
H54 0.7621750000 2.8056470000 0.7175420000
H55 5.8682340000 0.3067180000 3.0793040000
H56 4.3124200000 -0.4371610000 3.5284340000
H57 4.3600060000 1.2557200000 3.0222890000
```

Energies calculated for **56**

Gas: E(RB3LYP) = -1547.28194323 A.U. after 6 cycles
Aqueous: E(RB3LYP) = -1547.28194336 A.U. after 6 cycles

ORTEP Single Crystal X-ray Diffraction Data

General Method: ORTEP representations shown for the following crystal structures were generated in accordance with CrysAlis PRO 1.171.38.46; cell refinement: CrysAlis PRO 1.171.38.46; data reduction: CrysAlis PRO 1.171.38.46, CrysAlis PRO 1.171.38.43; cell refinement: CrysAlis PRO 1.171.38.43; data reduction: CrysAlis PRO 1.171.38.43.[S4] Program(s) used to solve structure: SIR92[S5]; program(s) used to refine structure: CRYSTALS[S6]; molecular graphics: PLATON[S6]; software used to prepare material for publication: CRYSTALS[S6].

16.HCl was recrystalized from absolute ethanol over 72 h. Colourless needle-like crystals were obtained and the crystallographic asymmetric unit was determined to consist of one $C_{31}H_{38}NO_4^+$ cation and one Cl^- anion. Shown in Figure S184, the ORTEP representation of **16.HCl**.[S4-S10]

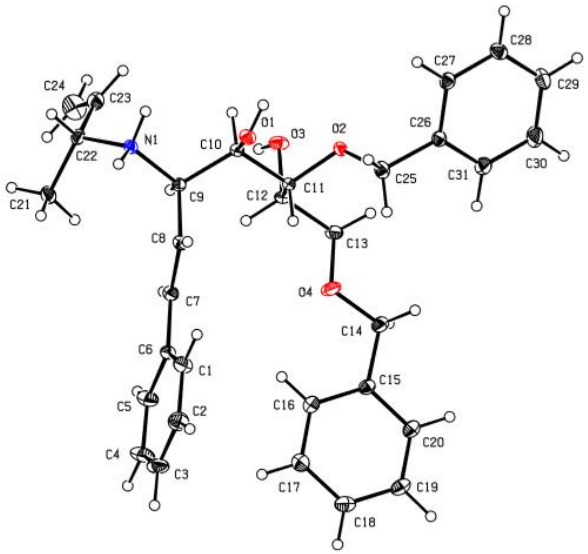


Figure S184: Crystal structure of the $C_{31}H_{38}NO_4^+$ cation of **16.HCl** with labelling of selected atoms. Anisotropic displacement ellipsoids display 30% probability levels. Hydrogen atoms are drawn as circles with small radii.

Crystal data

$C_{31}H_{38}NO_4^+ \cdot Cl^-$
$M_r = 524.10$
Monoclinic, $P2_1$
Hall symbol: P 2yb
$a = 10.8287$ (1) Å
$b = 8.7361$ (1) Å
$c = 14.9004$ (1) Å
$\beta = 91.5711$ (7)°
$V = 1409.06$ (2) Å^3
$Z = 2$
$F(000) = 560$
$D_x = 1.235$ Mg m^{-3}
Cu $K\alpha$ radiation, $\lambda = 1.54184$ Å
Cell parameters from 19672 reflections
$\theta = 3$–74°
$\mu = 1.48$ mm^{-1}
$T = 150$ K
Block, pale yellow
0.36 × 0.17 × 0.10 mm

Data collection

SuperNova, Dual, Cu at zero, EosS2 diffractometer
Radiation source: micro-focus sealed X-ray tube, SuperNova (Cu) X-ray Source
Mirror monochromator
ω scans
Absorption correction: multi-scan *CrysAlis PRO* version 1.171.38.43 (Rigaku Oxford Diffraction, 2016) (Release 29 April 2016; compiled 27 May 2016,16:53) Empirical absorption correction using spherical harmonics, implemented in SCALE3 ABSPACK scaling algorithm.
$T_{min} = 0.74$, $T_{max} = 0.86$
28942 measured reflections
4664 independent reflections
4603 reflections with $I > 2.0\sigma(I)$
$R_{int} = 0.033$
$\theta_{max} = 73.9°$, $\theta_{min} = 3.0°$
$h = -13 \rightarrow 13$
$k = -7 \rightarrow 10$
$l = -18 \rightarrow 18$

Refinement

Refinement on F^2
Least-squares matrix: full
$R[F^2 > 2\sigma(F^2)] = 0.024$
$wR(F^2) = 0.062$
$S = 1.00$
4664 reflections
348 parameters
1 restraint
Primary atom site location: structure-invariant direct methods
Hydrogen site location: difference Fourier map
H atoms treated by a mixture of independent and constrained refinement
Method = Modified Sheldrick $w = 1/[\sigma^2(F^2) + (0.03P)^2 + 0.26P]$, where $P = (\max(F_o^2,0) + 2F_c^2)/3$
$(\Delta/\sigma)_{max} = 0.002$
$\Delta\rho_{max} = 0.55$ e Å^{-3}
$\Delta\rho_{min} = -0.53$ e Å^{-3}
Extinction correction: Larson (1970), Equation 22
Extinction coefficient: 27 (3)
Absolute structure: Flack (1983), 1610 Friedel-pairs
Absolute structure parameter: −0.001 (9)

24a was recrystalized from absolute ethanol over 72 h. Colourless needle-like crystals were obtained and the the crystallographic asymmetric unit consists of four independent $C_{28}H_{39}NO_{10}S_2$ molecule. The data suggests twinned crystals for **24a** (Figure S185).[S4, S6-S9, S11]

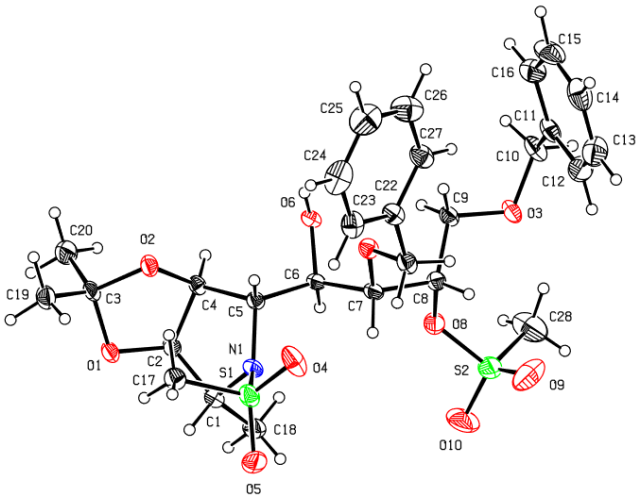


Figure S185: Crystal structure of $C_{28}H_{39}NO_{10}S_2$ molecule of **24a** one with labelling of selected atoms, Anisotropic displacement ellipsoids display 30% probability levels. Hydrogen atoms are drawn as circles with small radii.

Crystal data

$C_{28}H_{38}NO_{10}S_2$
$M_r = 613.75$
Triclinic, $P\overline{1}$
Hall symbol: P -1
$a = 12.1681\ (2)$ Å
$b = 13.7635\ (4)$ Å
$c = 19.2104\ (6)$ Å
$\alpha = 100.542\ (2)°$
$\beta = 90.699\ (2)°$
$\gamma = 90.063\ (2)°$
$V = 3162.72\ (15)$ Å^3
$Z = 4$
$F(000) = 1304$
$D_x = 1.289$ Mg m^{-3}
Cu $K\alpha$ radiation, $\lambda = 1.54184$ Å
Cell parameters from 15904 reflections
$\theta = 3–73°$
$\mu = 1.99$ mm^{-1}
$T = 150$ K
Plate, colourless
0.15 × 0.15 × 0.04 mm

Data collection

SuperNova, Dual, Cu at zero, EosS2 diffractometer
Radiation source: micro-focus sealed X-ray tube, SuperNova (Cu) X-ray Source
Mirror monochromator
ω scans
Absorption correction: multi-scan *CrysAlis PRO* version 1.171.38.46 (Rigaku Oxford Diffraction, 2017) Empirical absorption correction using spherical harmonics, implemented in SCALE3 ABSPACK scaling algorithm.
$T_{min} = 0.87$, $T_{max} = 0.93$
91259 measured reflections
22786 independent reflections
20333 reflections with $I > 2.0\sigma(I)$
$R_{int} = 0.064$
$\theta_{max} = 74.0°$, $\theta_{min} = 2.3°$
$h = -15\rightarrow15$
$k = -16\rightarrow16$
$l = -23\rightarrow23$

Refinement

Refinement on F^2
Least-squares matrix: full
$R[F^2 > 2\sigma(F^2)] = 0.060$
$wR(F^2) = 0.160$
$S = 0.98$
22777 reflections
1478 parameters
3 restraints
Primary atom site location: Other
Hydrogen site location: difference Fourier map
H-atom parameters constrained
Method = Modified Sheldrick $w = 1/[\sigma^2(F^2) + (0.09P)^2 + 1.6P]$, where $P = (\max(F_o^2,0) + 2F_c^2)/3$
$(\Delta/\sigma)_{max} = 0.012$
$\Delta\rho_{max} = 0.99$ e Å^{-3}
$\Delta\rho_{min} = -0.64$ e Å^{-3}

32 was recrystalized from absolute ethanol over 72 h. Colourless needle-like crystals were obtained and the crystallographic asymmetric unit consists of one molecule of C24H29NO7 and one site of water of crystallization which has an occupancy of 0.553. There is some disorder in the packing of one of the benzyl groups. Shown in Figure S186 is the ORTEP representation of **32**.[S4-S9, S12]

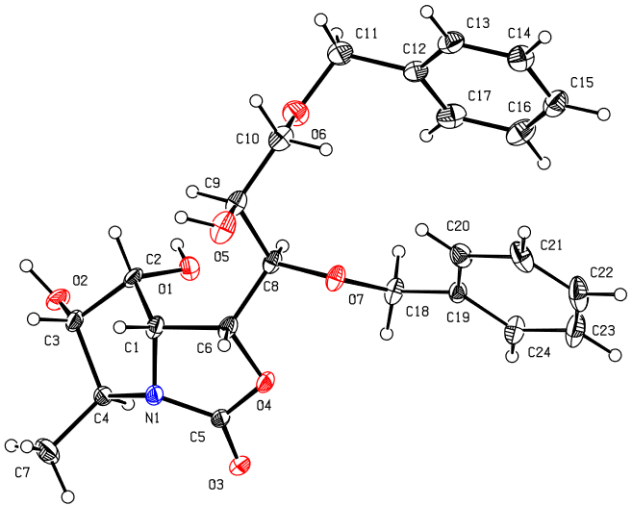


Figure S186: Crystal structure of the $C_{24}H_{29}NO_7$ cation of **32** with labelling of selected atoms. Anisotropic displacement ellipsoids display 30% probability levels. Hydrogen atoms are drawn as circles with small radii.

Crystal data

$C_{24}H_{29}NO_7 \cdot 0.553(H_2O)$
$M_r = 453.46$

$a = 5.8947$ (1) Å
$b = 11.9409$ (1) Å
$c = 32.5277$ (4) Å
$V = 2289.56$ (5) Å^3
$Z = 4$
$F(000) = 966.109$
$D_x = 1.315$ Mg m^{-3}

Orthorhombic, $P2_12_12_1$
Hall symbol: P 2ac 2ab

Cu $K\alpha$ radiation, $\lambda = 1.54184$ Å
Cell parameters from 15624 reflections
$\theta = 5$–$72°$
$\mu = 0.81$ mm^{-1}
$T = 150$ K
Block, colourless
0.34 × 0.09 × 0.07 mm

Data collection

SuperNova, Dual, Cu at zero, EosS2 diffractometer
Radiation source: Supernova (Cu) X-ray Source
Mirror monochromator
ω scans

Absorption correction: multi-scan *CrysAlis PRO*, Agilent Technologies, Version 1.171.37.35h (release 09-02-2015 CrysAlis171 .NET) (compiled Feb 9 2015,16:26:32) Empirical absorption correction using spherical harmonics, implemented in SCALE3 ABSPACK scaling algorithm.
$T_{min} = 0.81$, $T_{max} = 0.94$
36015 measured reflections
4539 independent reflections
4398 reflections with $I > 2.0\sigma(I)$
$R_{int} = 0.055$
$\theta_{max} = 72.5°$, $\theta_{min} = 3.9°$
$h = -7 \rightarrow 6$
$k = -14 \rightarrow 13$
$l = -39 \rightarrow 40$

Refinement

Refinement on F^2
Least-squares matrix: full
$R[F^2 > 2\sigma(F^2)] = 0.029$
$wR(F^2) = 0.073$
$S = 1.00$
4539 reflections
364 parameters
88 restraints
Primary atom site location: structure-invariant direct methods
Hydrogen site location: difference Fourier map

H atoms treated by a mixture of independent and constrained refinement
Method = Modified Sheldrick $w = 1/[\sigma^2(F^2) + (0.04P)^2 + 0.33P]$, where $P = (\max(F_o^2,0) + 2F_c^2)/3$
$(\Delta/\sigma)_{max} = 0.006$
$\Delta\rho_{max} = 0.14$ e Å^{-3}
$\Delta\rho_{min} = -0.15$ e Å^{-3}
Absolute structure: Flack (1983), 1893 Friedel-pairs
Absolute structure parameter: 0.01 (11)

33 was recrystalized from absolute ethanol over 72 h. Colourless needle-like crystals were obtained and the crystallographic asymmetric unit consists of two molecules of $C_{27}H_{33}NO_7$ and two molecules of ethanol (Figure S187).[S4-S9,S12-S14]

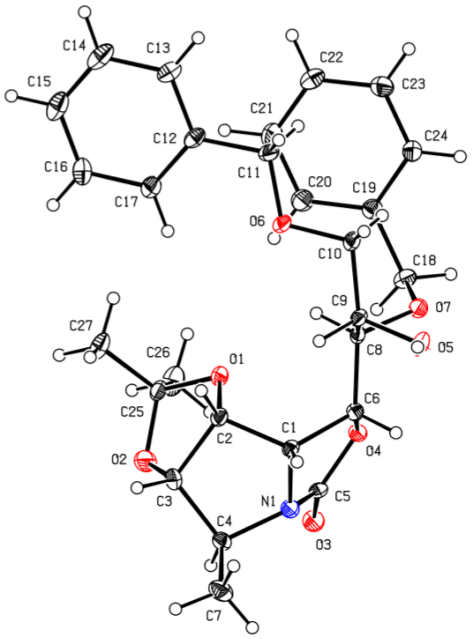


Figure S187: Crystal structure of the $C_{27}H_{33}NO_7$ molecule **33** with labelling of selected atoms. Anisotropic displacement ellipsoids display 30% probability levels. Hydrogen atoms are drawn as circles with small radii.

Crystal data

$C_{27}H_{33}NO_7 \cdot C_2H_6O$
$M_r = 529.63$
Triclinic, $P\overline{1}$
Hall symbol: P -1
$a = 10.6785\ (4)$ Å
$b = 10.7888\ (7)$ Å
$c = 12.4332\ (8)$ Å
$\alpha = 98.711\ (6)°$
$\beta = 101.123\ (4)°$
$\gamma = 92.413\ (4)°$
$V = 1385.53\ (14)$ Å^3
$Z = 2$
$F(000) = 568$
$D_x = 1.269$ Mg m^{-3}
Cu $K\alpha$ radiation, $\lambda = 1.54184$ Å
Cell parameters from 3928 reflections
$\theta = 4–72°$
$\mu = 0.76$ mm^{-1}
$T = 150$ K
Lath, colourless
0.31 × 0.10 × 0.04 mm

Data collection

SuperNova, Dual, Cu at zero, EosS2 diffractometer
Radiation source: Supernova (Cu) X-ray Source
Mirror monochromator
ω scans
Absorption correction: multi-scan *CrysAlis PRO*, Agilent Technologies, Version 1.171.37.35h (release 09-02-2015 CrysAlis171 .NET) (compiled Feb 9 2015,16:26:32) Empirical absorption correction using spherical harmonics, implemented in SCALE3 ABSPACK scaling algorithm.
$T_{min} = 0.77$, $T_{max} = 0.97$
16238 measured reflections
7065 independent reflections
6118 reflections with $I > 2.0\sigma(I)$
$R_{int} = 0.061$
$\theta_{max} = 72.4°$, $\theta_{min} = 3.7°$
$h = -13 \rightarrow 8$
$k = -13 \rightarrow 12$
$l = -15 \rightarrow 15$

Refinement

Refinement on F^2
Least-squares matrix: full
$R[F^2 > 2\sigma(F^2)] = 0.054$
$wR(F^2) = 0.134$
$S = 0.99$
7063 reflections
686 parameters
3 restraints
Primary atom site location: structure-invariant direct methods
Hydrogen site location: difference Fourier map
H-atom parameters constrained
Method = Modified Sheldrick $w = 1/[\sigma^2(F^2) + (0.06P)^2 + 0.51P]$, where $P = (\max(F_o^2,0) + 2F_c^2)/3$
$(\Delta/\sigma)_{max} = 0.001$
$\Delta\rho_{max} = 0.32$ e Å^{-3}
$\Delta\rho_{min} = -0.31$ e Å^{-3}
Absolute structure: Flack (1983), 1601 Friedel-pairs
Absolute structure parameter: 0.2 (3)

42 was recrystalized from diethylether over 72 h. Colourless needle-like crystals were obtained and the crystallographic asymmetric unit consists of one $C_{30}H_{35}NO_5$ molecule. There is some disorder in the packing of one of the benzyl groups. Shown in Figure S188 is the ORTEP representation of **42**.[S4-S8]

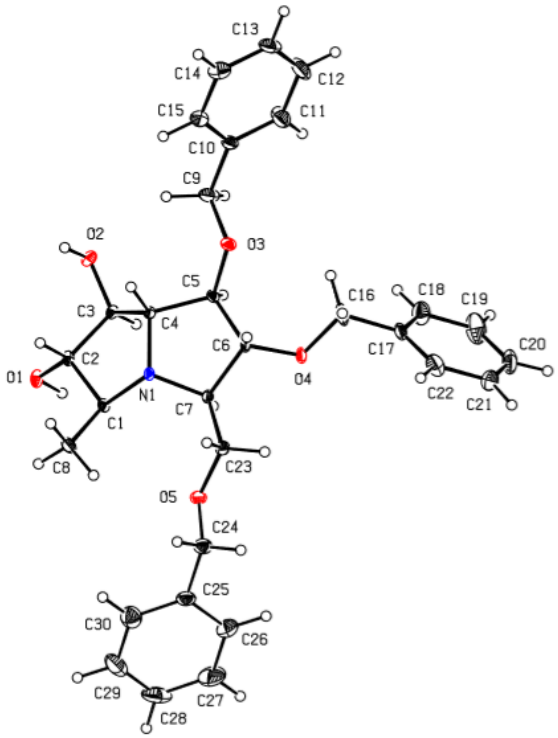


Figure S188: Crystal structure of the $C_{30}H_{35}NO_5$ molecule of **42** with labelling of selected atoms, showing only one set of sites for the disorder in the benzyl groups. Anisotropic displacement ellipsoids display 30% probability levels. Hydrogen atoms are drawn as circles with small radii.

Crystal data

$C_{30}H_{35}NO_5$
$M_r = 489.61$
Monoclinic, $P2_1$
Hall symbol: P 2yb
$a = 13.3461\ (2)$ Å
$b = 5.1418\ (1)$ Å
$c = 19.3686\ (2)$ Å
$\beta = 97.7303\ (12)°$
$V = 1317.05\ (4)$ Å^3
$Z = 2$
$F(000) = 524$
$D_x = 1.235$ Mg m^{-3}
Cu $K\alpha$ radiation, $\lambda = 1.54184$ Å
Cell parameters from 13283 reflections
$\theta = 2–74°$
$\mu = 0.67$ mm^{-1}
$T = 150$ K
Prism, colourless
0.36 × 0.10 × 0.06 mm

Data collection

SuperNova, Dual, Cu at zero, EosS2 diffractometer
Radiation source: micro-focus sealed X-ray tube, SuperNova (Cu) X-ray Source
Mirror monochromator
ω scans
Absorption correction: multi-scan *CrysAlis PRO* version 1.171.38.46 (Rigaku Oxford Diffraction, 2017) Empirical absorption correction using spherical harmonics, implemented in SCALE3 ABSPACK scaling algorithm.
$T_{min} = 0.67$, $T_{max} = 0.96$
20574 measured reflections
4647 independent reflections
4524 reflections with $I > 2.0\sigma(I)$
$R_{int} = 0.034$
$\theta_{max} = 73.9°$, $\theta_{min} = 2.3°$
$h = -16 \rightarrow 16$
$k = -5 \rightarrow 6$
$l = -24 \rightarrow 23$

Refinement

Refinement on F^2
Least-squares matrix: full
$R[F^2 > 2\sigma(F^2)] = 0.038$
$wR(F^2) = 0.104$
$S = 1.01$
4647 reflections
386 parameters
77 restraints
Primary atom site location: structure-invariant direct methods
Hydrogen site location: difference Fourier map
H atoms treated by a mixture of independent and constrained refinement
Method = Modified Sheldrick $w = 1/[\sigma^2(F^2) + (0.07P)^2 + 0.24P]$, where $P = (\max(F_o^2,0) + 2F_c^2)/3$
$(\Delta/\sigma)_{max} = 0.001$
$\Delta\rho_{max} = 0.19$ e Å^{-3}
$\Delta\rho_{min} = -0.16$ e Å^{-3}
Absolute structure: Flack (1983), 1663 Friedel-pairs
Absolute structure parameter: −0.06 (15)

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