Supportive Information

Endophytic *Akanthomyces* sp. LN303 from Edelweiss produces emestrin and two new 2-hydroxy-4 pyridone alkaloids

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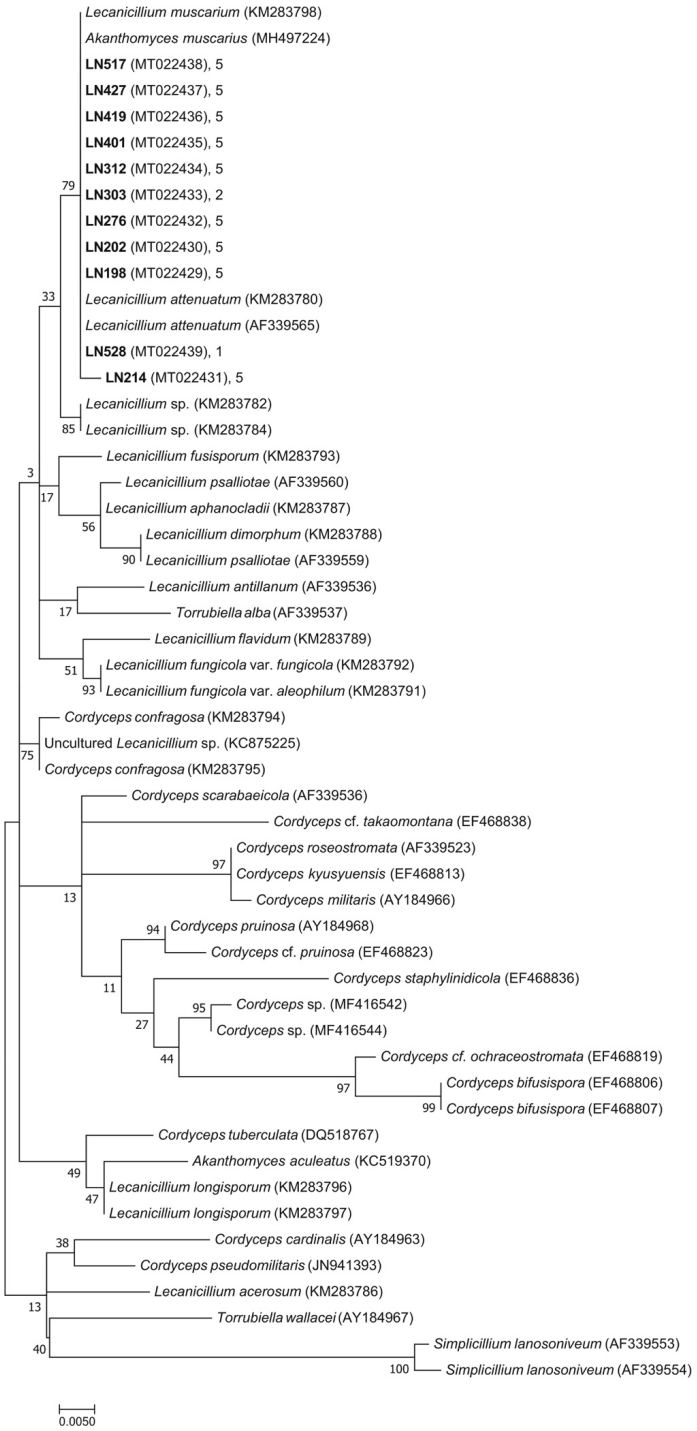
Supplementary Information


Lecanicillium muscarium (KM283798)
Akanthomyces muscarius (MH497224)
LN517 (MT022438), 5
LN427 (MT022437), 5
LN419 (MT022436), 5
LN401 (MT022435), 5
LN312 (MT022434), 5
LN303 (MT022433), 2
LN276 (MT022432), 5
LN202 (MT022430), 5
LN198 (MT022429), 5
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Lecanicillium attenuatum (AF339565)
LN528 (MT022439), 1
LN214 (MT022431), 5
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Lecanicillium psalliotae (AF339560)
Lecanicillium aphanocladii (KM283787)
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Lecanicillium psalliotae (AF339559)
Lecanicillium antillanum (AF339536)
Torrubiella alba (AF339537)
Lecanicillium flavidum (KM283789)
Lecanicillium fungicola var. *fungicola* (KM283792)
Lecanicillium fungicola var. *aleophilum* (KM283791)
Cordyceps confragosa (KM283794)
Uncultured *Lecanicillium* sp. (KC875225)
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Cordyceps scarabaeicola (AF339536)
Cordyceps cf. *takaomontana* (EF468838)
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Cordyceps kyusyuensis (EF468813)
Cordyceps militaris (AY184966)
Cordyceps pruinosa (AY184968)
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Cordyceps staphylinidicola (EF468836)
Cordyceps sp. (MF416542)
Cordyceps sp. (MF416544)
Cordyceps cf. ochraceostromata (EF468819)
Cordyceps bifusispora (EF468806)
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Cordyceps tuberculata (DQ518767)
Akanthomyces aculeatus (KC519370)
Lecanicillium longisporum (KM283796)
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Torrubiella wallacei (AY184967)
Simplicillium lanosoniveum (AF339553)
Simplicillium lanosoniveum (AF339554)
0.0050

Figure S1. Phylogenetic relationship of endophytic *Akanthomyces* isolates from *Leontopodium nivale* subsp. *alpinum* with closely related members of Cordycipitaceae. Maximum likelihood analysis of the LSU region of endophytic *Akanthomyces* sp. strains with Genbank accession numbers in brackets and the plant number, from which they were isolated, referenced to closely related fungi from Cordycipitaceae [9]. Best fitting model was K2+G+I and bootstrap support was estimated with 1000 replicates. The tree is drawn to scale, with branch lengths measured in the number of substitutions per site. The analysis involved 53 nucleotide sequences. Codon positions included were 1st+2nd+3rd+Noncoding. All positions containing gaps and missing data were eliminated. A total of 392 positions were in the final dataset. Evolutionary analyses were conducted in MEGA7 [31].

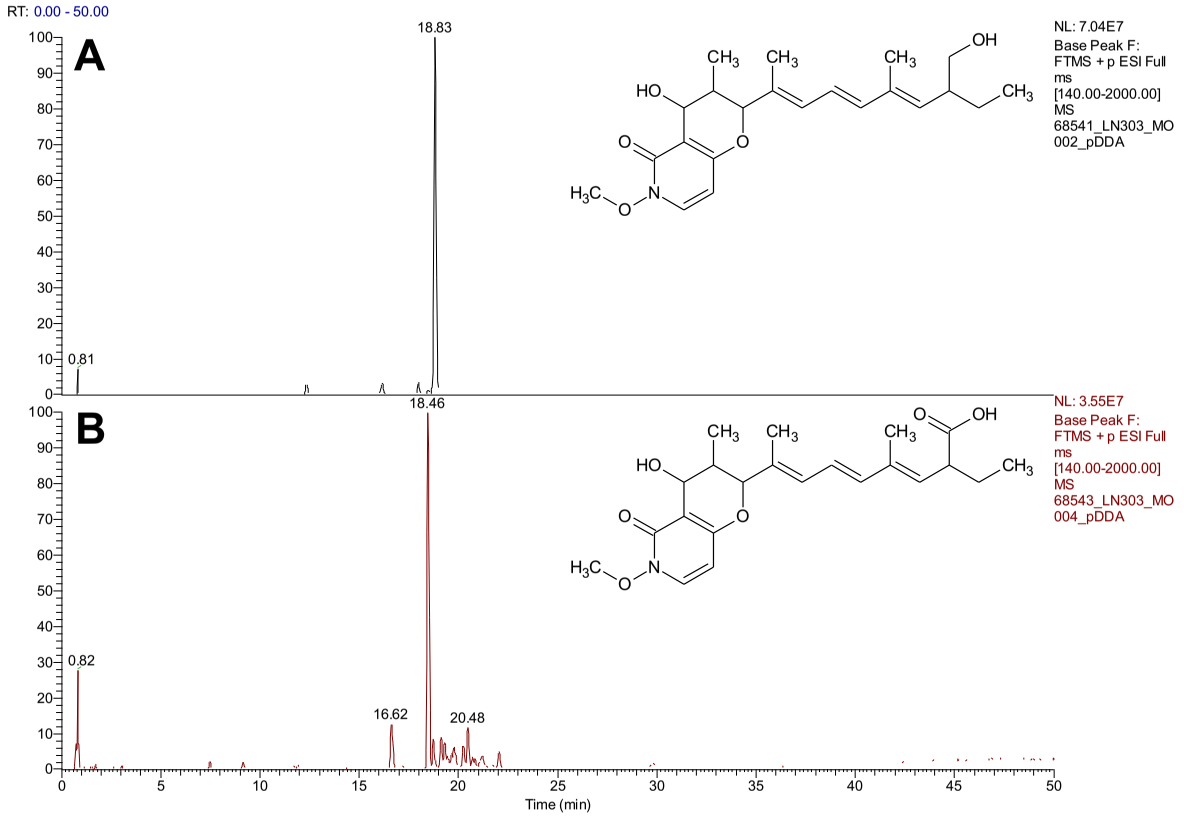


Figure S2. LC-MS data of purified compounds **1** (A) and **2** (B) shown as base peak chromatogram in the range *m/z* 140-2000.

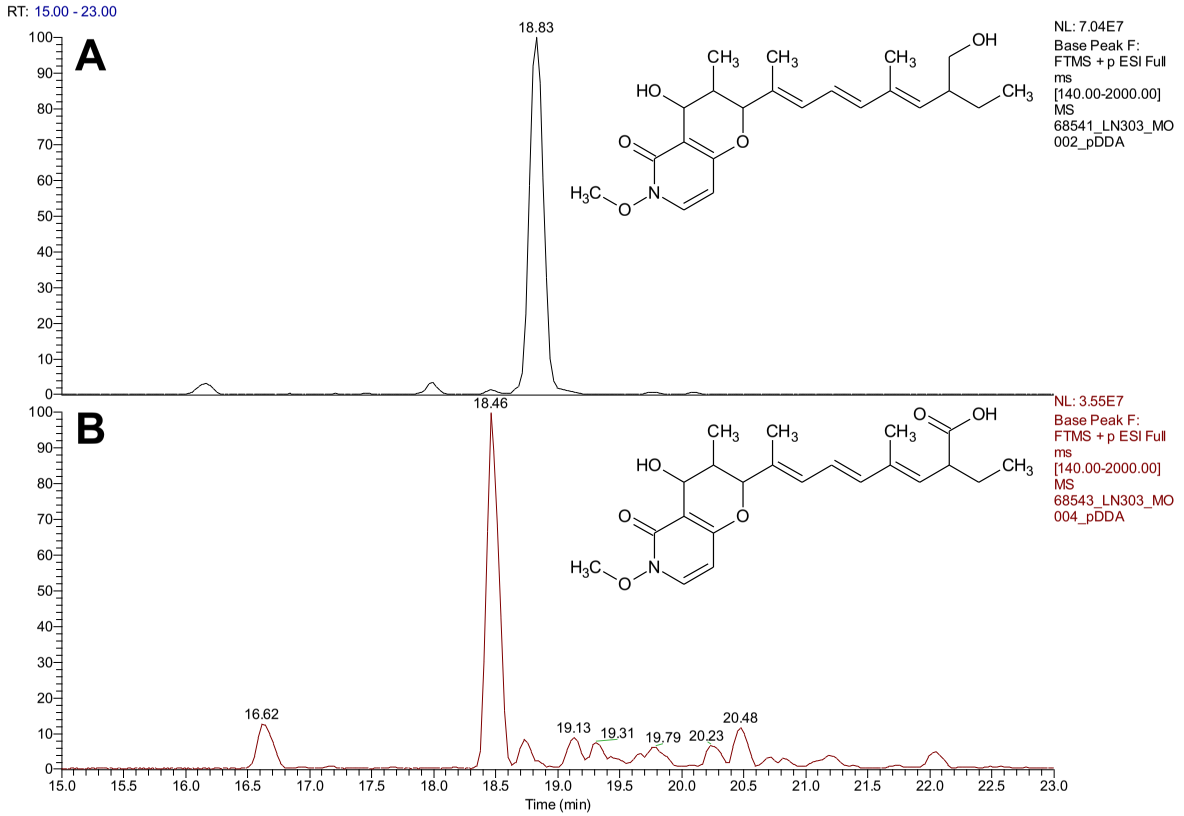


Figure S3. LC-MS data (zoom) of purified compounds **1** (A) and **2** (B) shown as base peak chromatogram in the range *m/z* 140-2000.

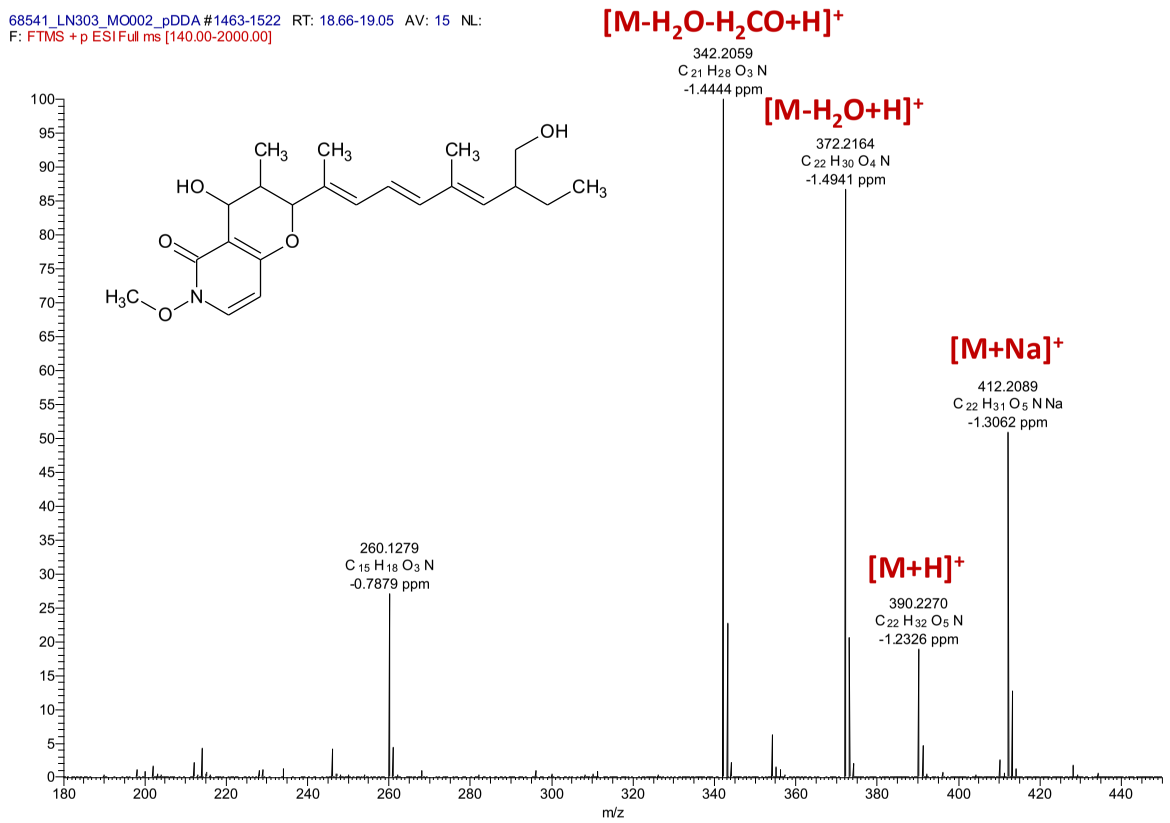


Figure S4. HRESIMS spectrum of the purified compound **1** obtained by LC-MS in positive ion mode.

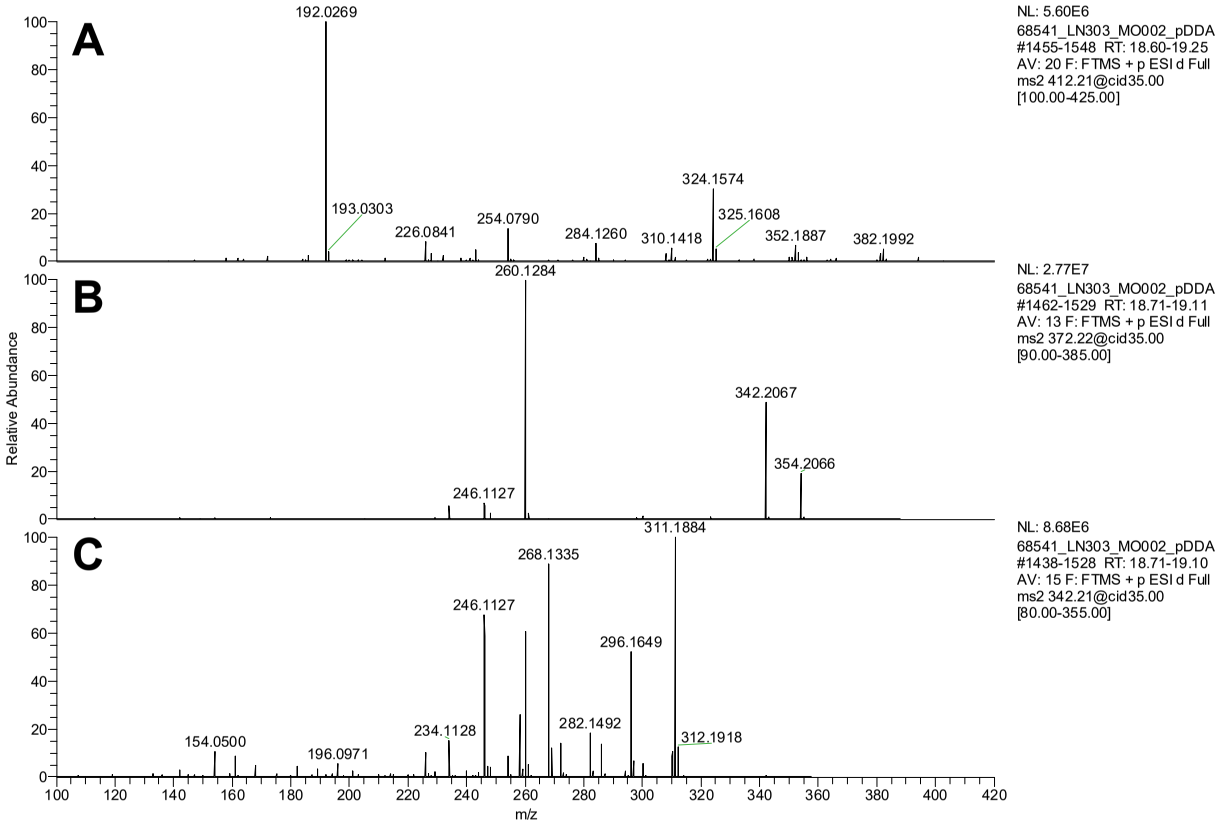
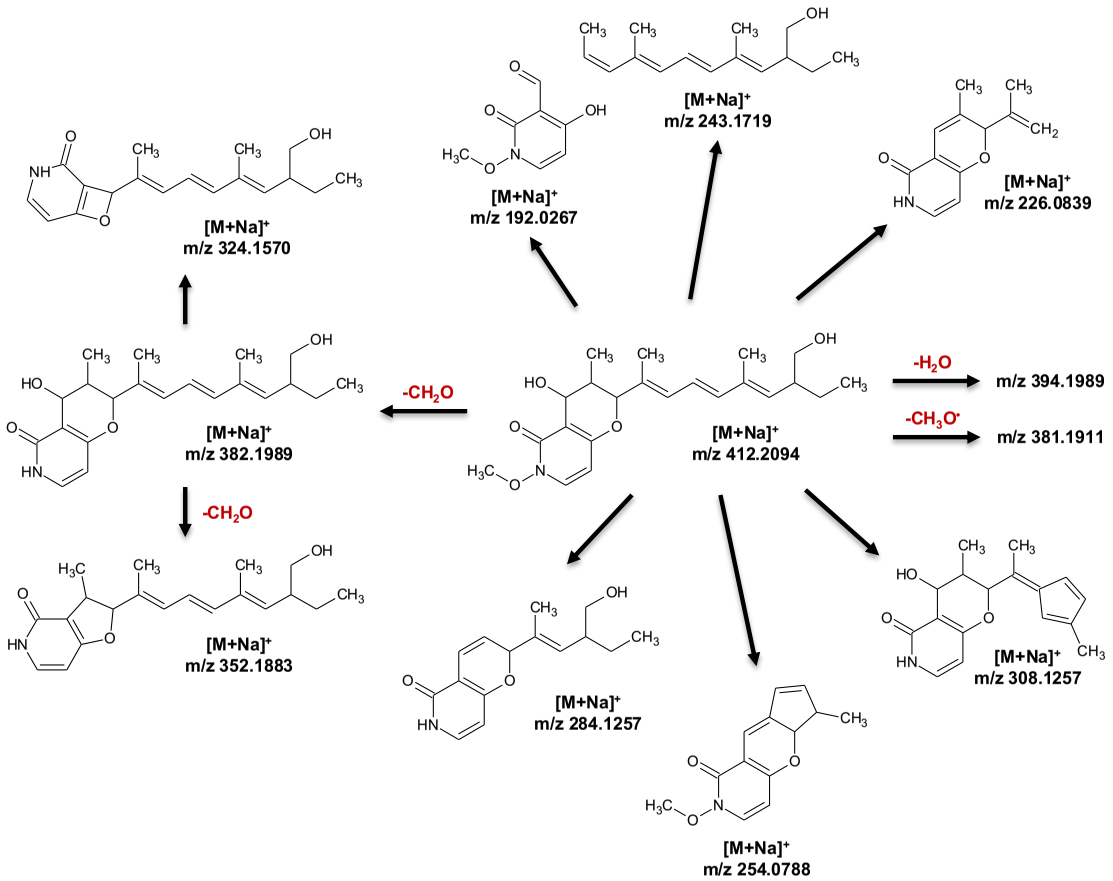
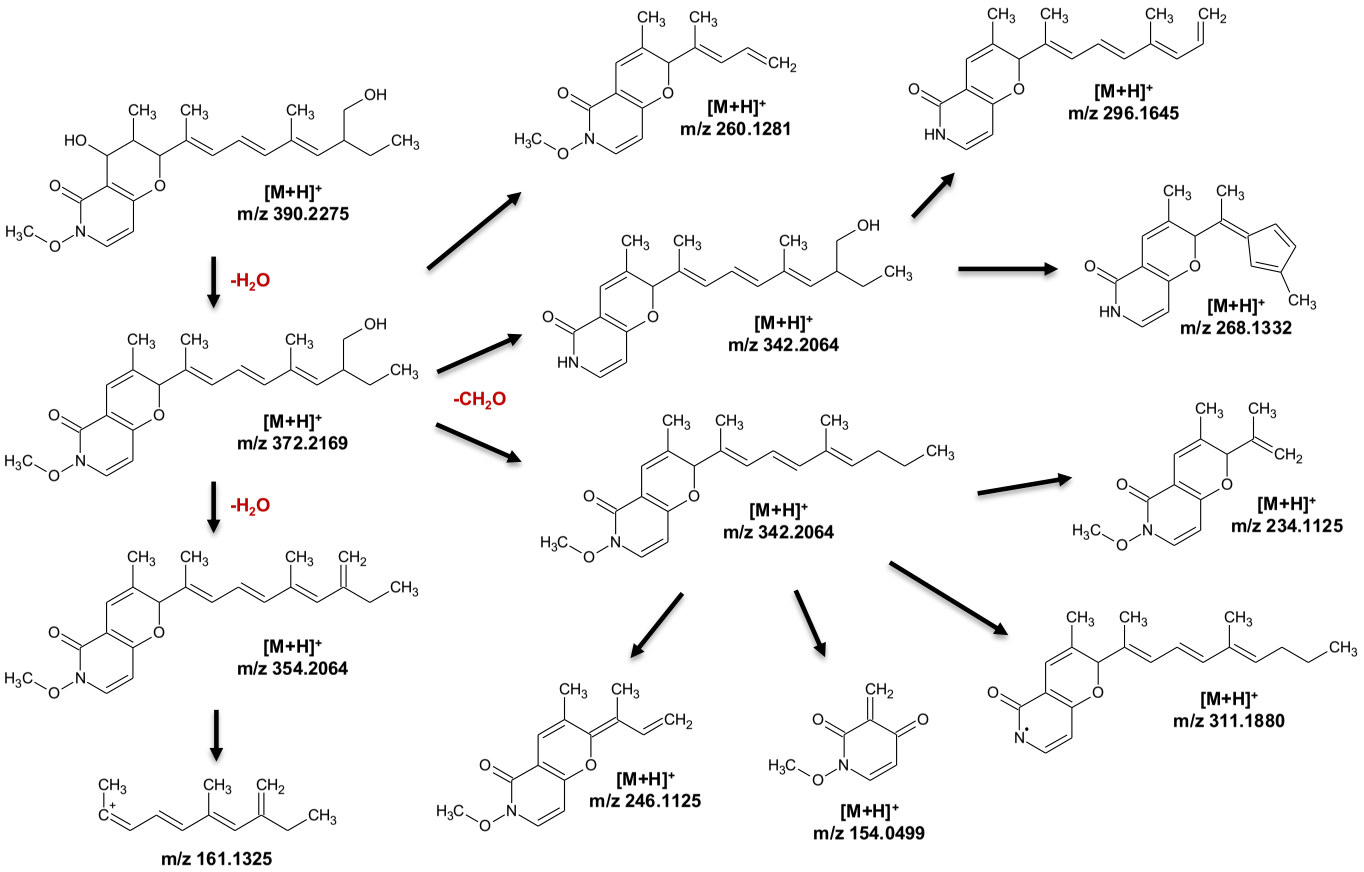


Figure S5. HRESIMS/MS spectra of the $[M+Na]^+$ ion (A), the $[M-H_2O+H]^+$ ion (B), and the $[M-H_2O-H_2CO+H]^+$ ion (C) of the purified compound **1** obtained by LC-MS in positive ion mode.



Scheme S1. Proposed fragmentation pathway of the $[M+Na]^+$ ion of the purified compound **1** showing selected key fragment ions.



Scheme S2. Proposed fragmentation pathway of the $[M+H]^+$ ion of the purified compound **1** showing selected key fragment ions.

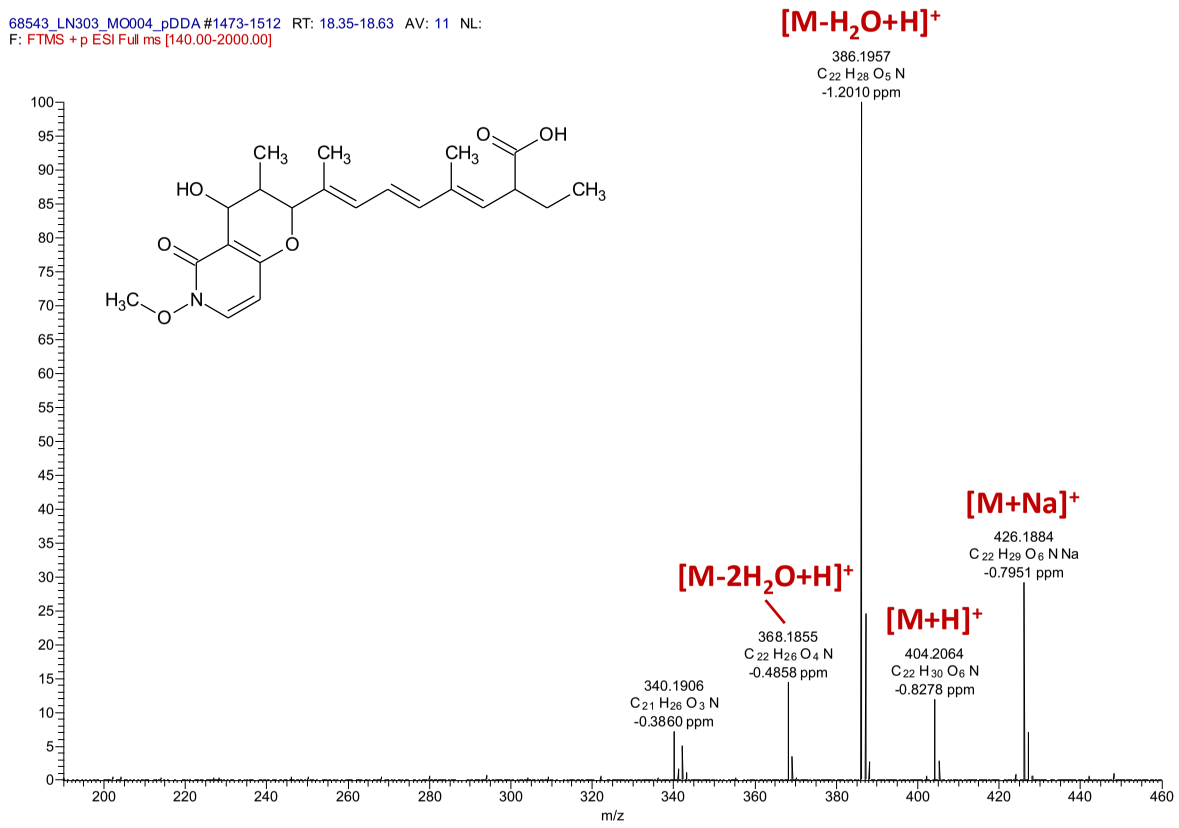


Figure S6. HRESIMS spectrum of the purified compound **2** obtained by LC-MS in positive ion mode.

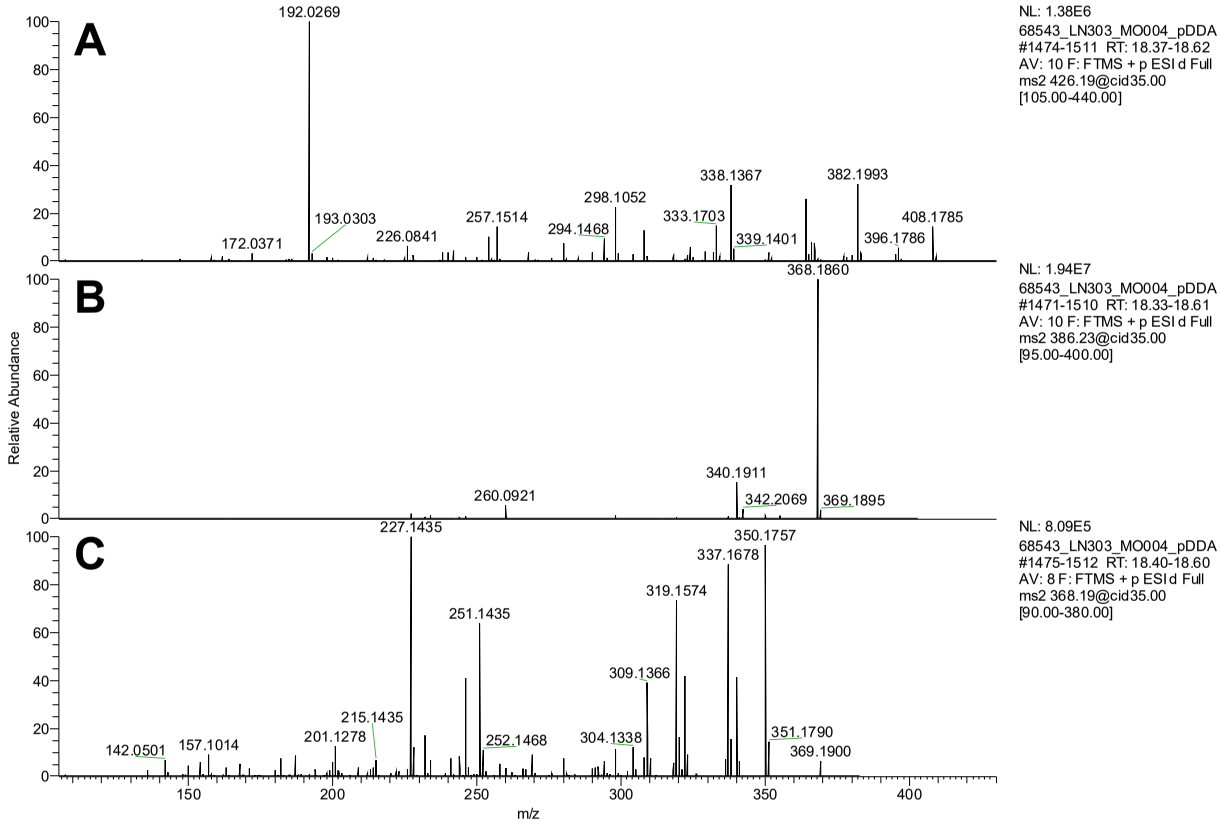
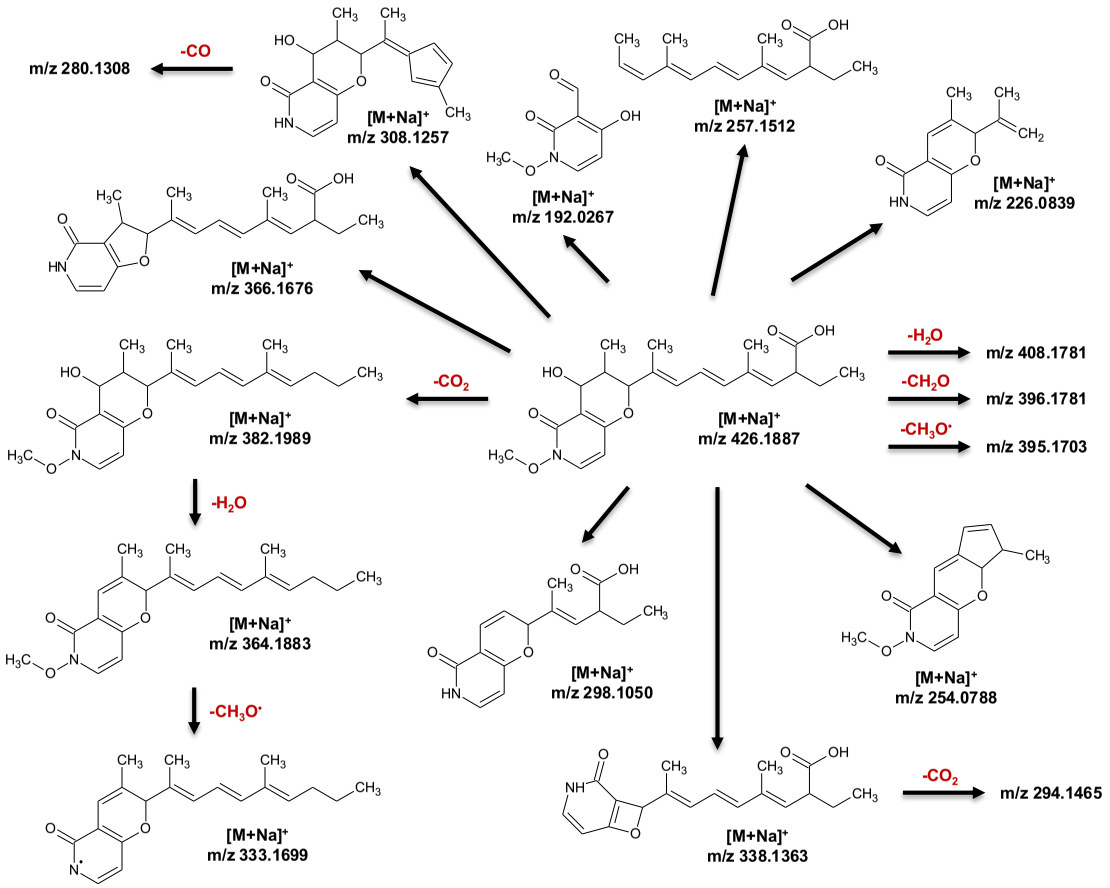
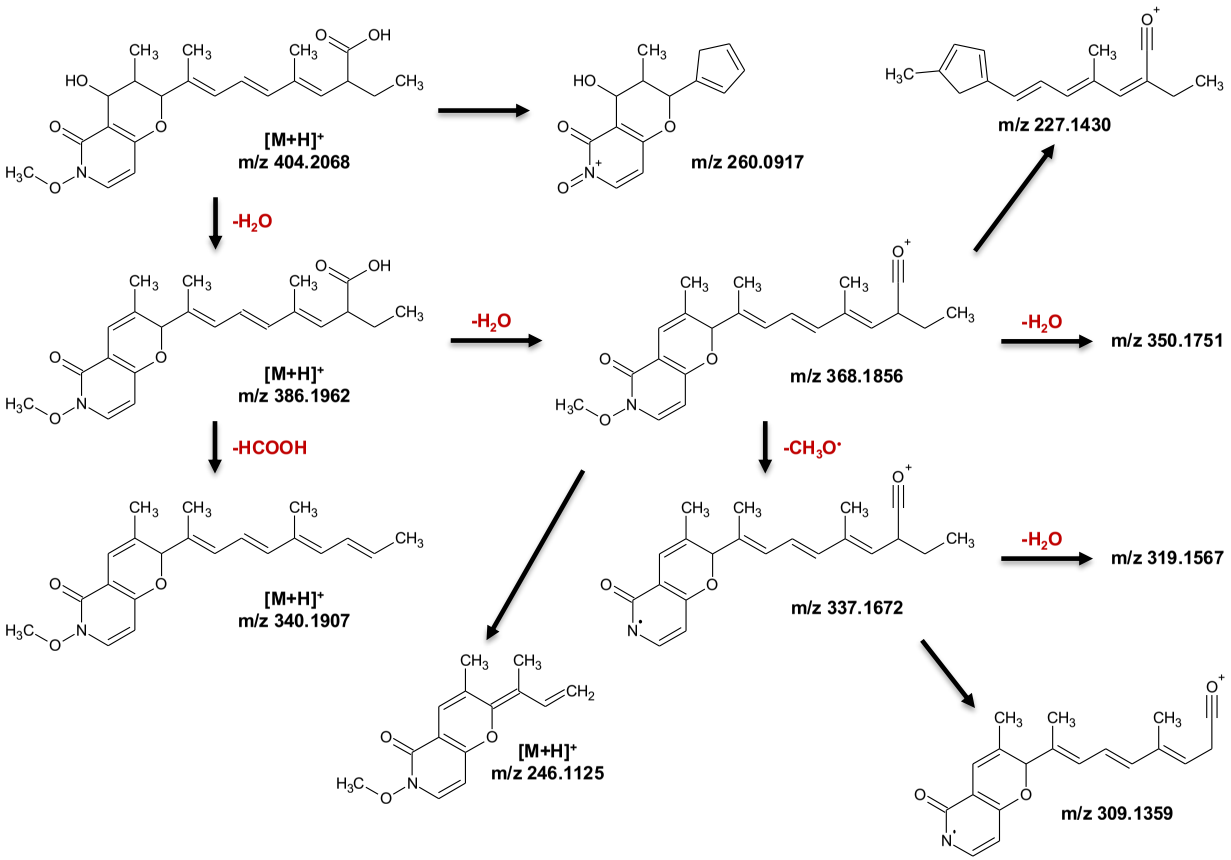


Figure S7. HRESIMS/MS spectra of the $[M+Na]^+$ ion (A), the $[M-H_2O+H]^+$ ion (B), and the $[M-2H_2O+H]^+$ ion (C) of the purified compound **2** obtained by LC-MS in positive ion mode.



Scheme S3. Proposed fragmentation pathway of the $[M+Na]^+$ ion of the purified compound **2** showing selected key fragment ions.



Scheme S4. Proposed fragmentation pathway of the $[M+H]^+$ ion of the purified compound **2** showing selected key fragment ions.

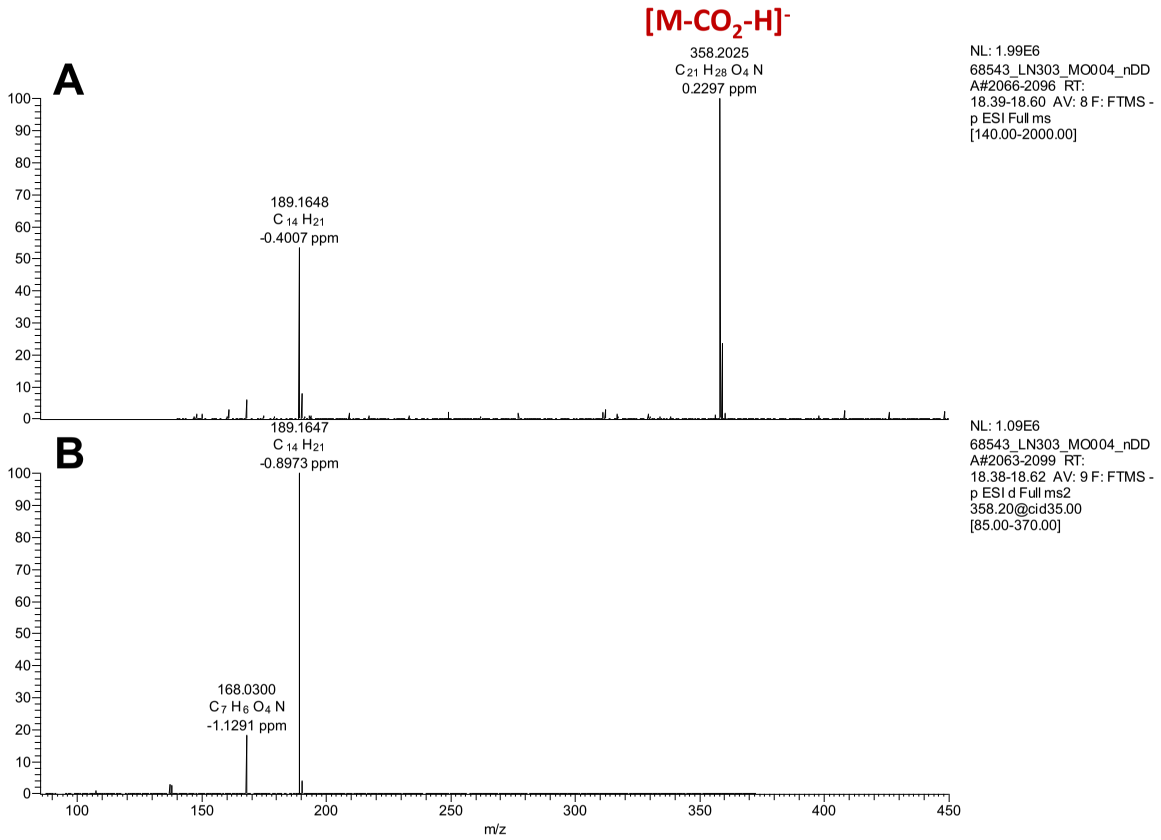
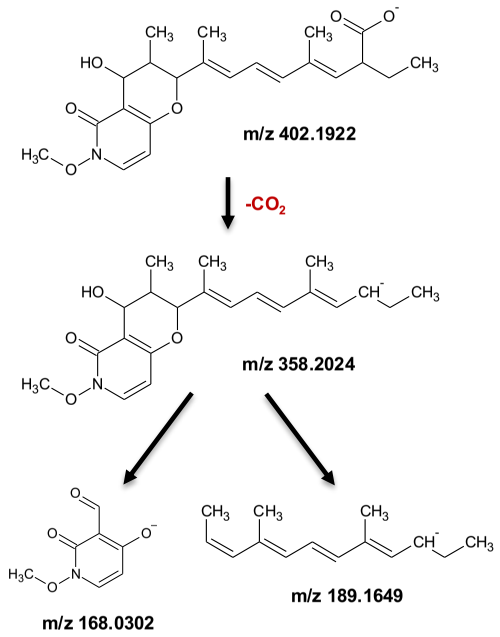


Figure S8. HRESIMS spectrum (A) and HRESIMS/MS spectrum of the $[M\text{-}CO_2\text{-}H]^-$ ion (B) of the purified compound **2** obtained by LC-MS in negative ion mode.



Scheme S5. Proposed fragmentation pathway of the $[M-H]^-$ ion of the purified compound **2** showing selected key fragment ions.

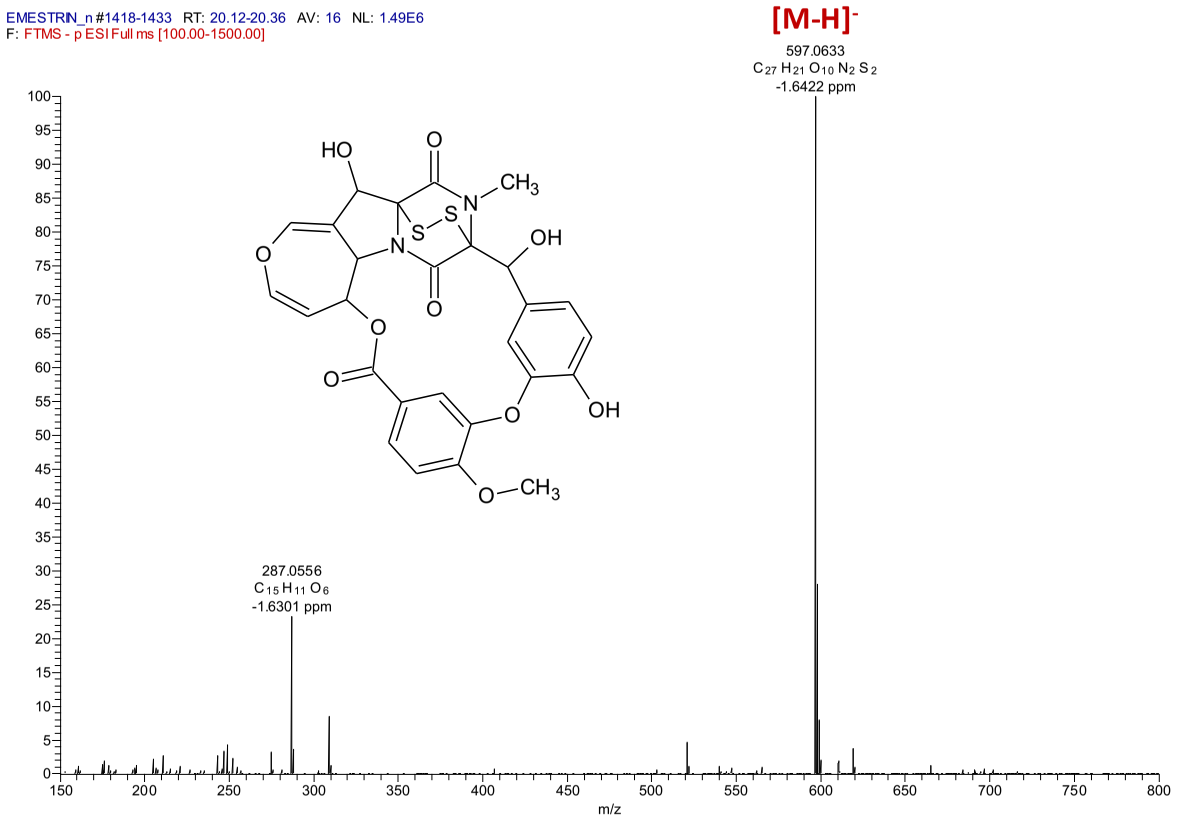


Figure S9. HRESIMS spectrum of the purified compound **3** obtained by LC-MS in negative ion mode.

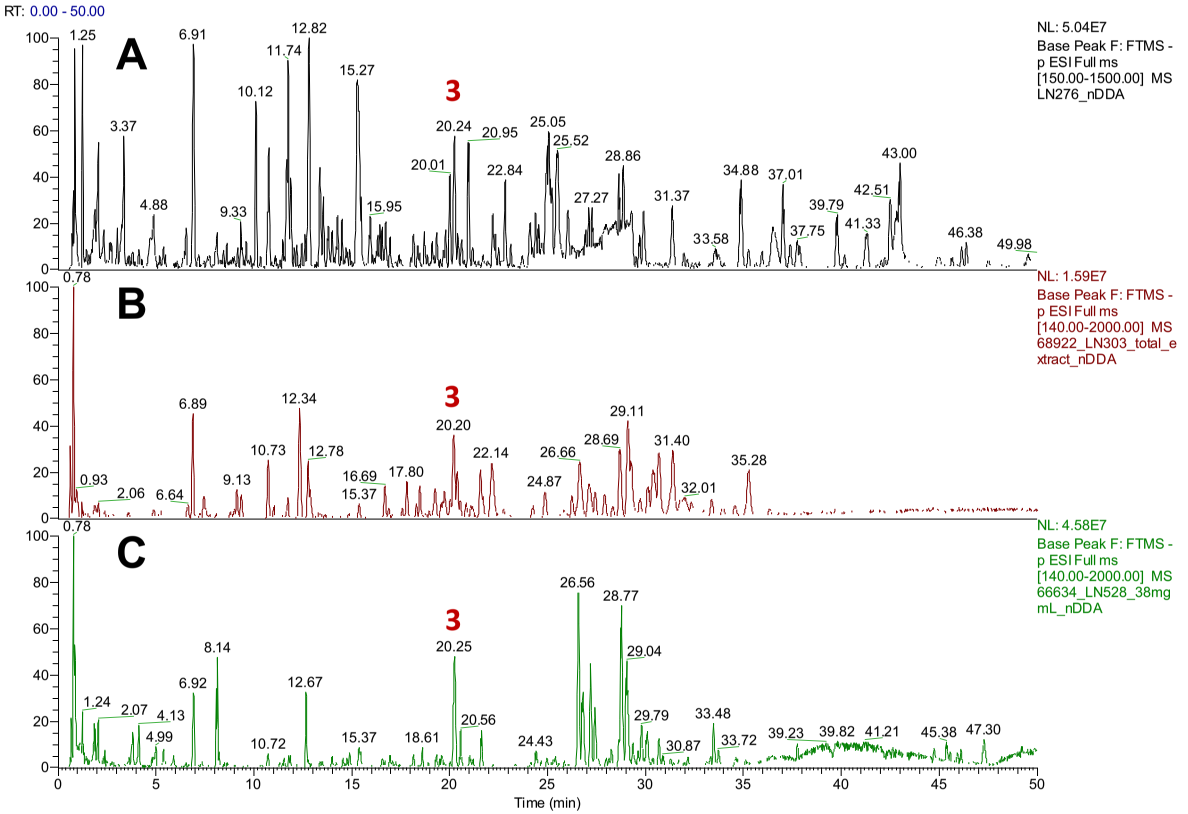


Figure S10. Base peak chromatograms obtained by LC-MS in negative ion mode of the extracts from isolates LN276 (A), LN303 (B), and LN528 (C). The peak corresponding to emestrin is marked with **3**.

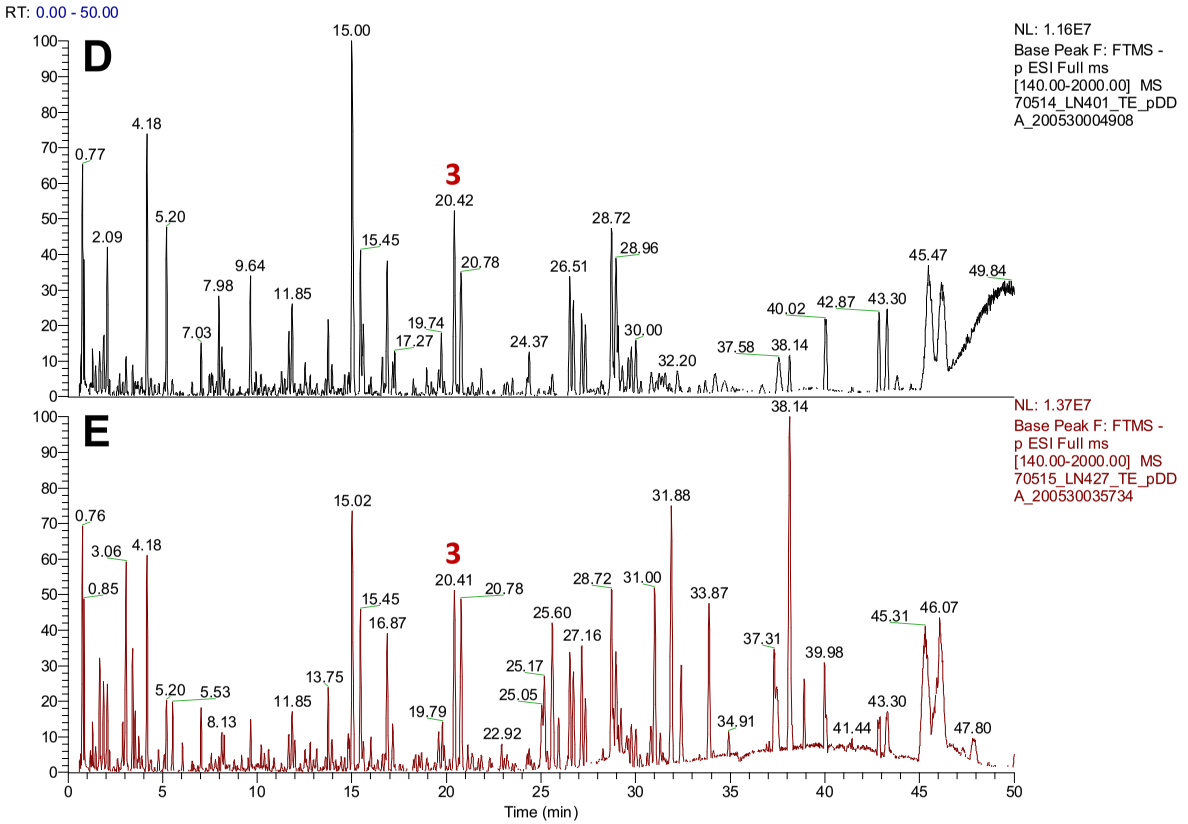


Figure S10 (cont.). Base peak chromatograms obtained by LC-MS in negative ion mode of the extracts from isolates LN401 (D) and LN427 (E). The peak corresponding to emestrin is marked with **3**.

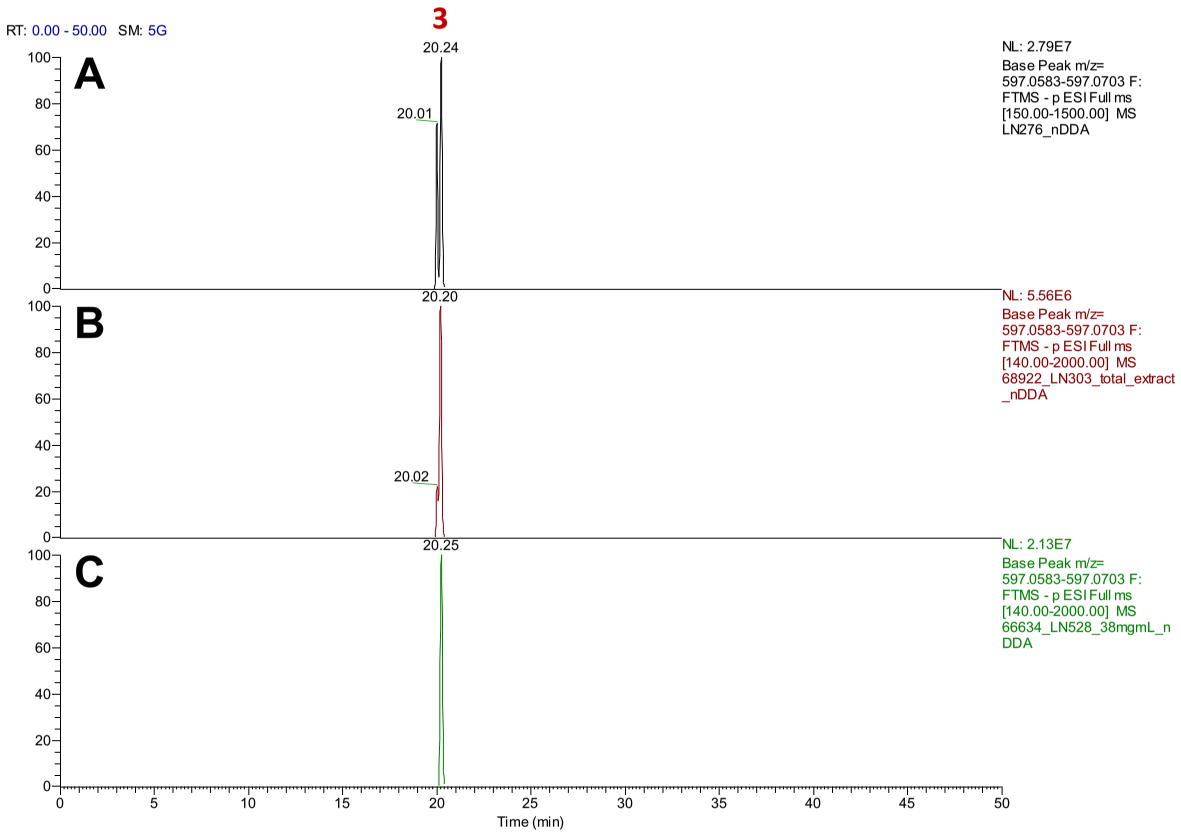


Figure S11. Extracted ion chromatograms (*m/z* 597.0643±0.0060) obtained by LC-MS in negative ion mode of the extracts from isolates LN276 (A), LN303 (B), and LN528 (C). The peak corresponding to emestrin is marked with **3**.

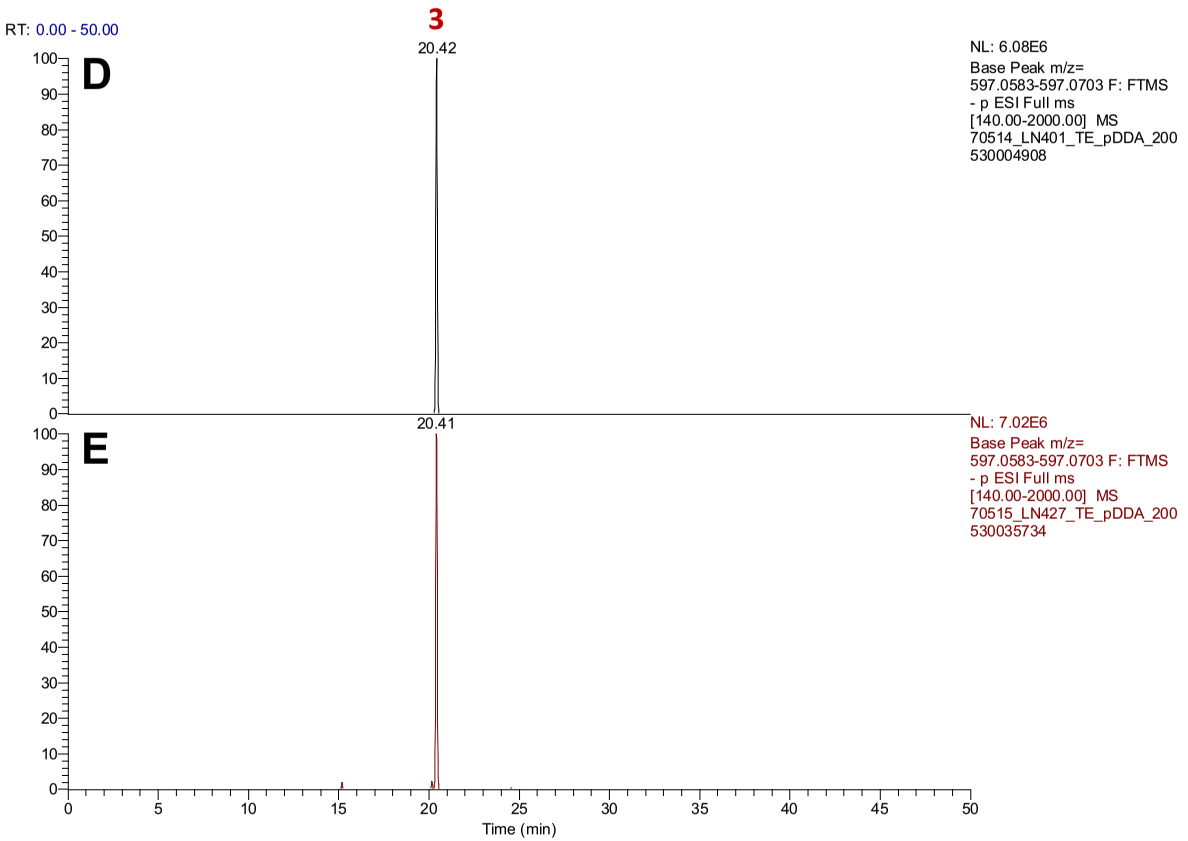


Figure S11 (cont.). Extracted ion chromatograms (*m/z* 597.0643±0.0060) obtained by LC-MS in negative ion mode of the extracts from isolates LN401 (D) and LN427 (E). The peak corresponding to emestrin is marked with **3**.

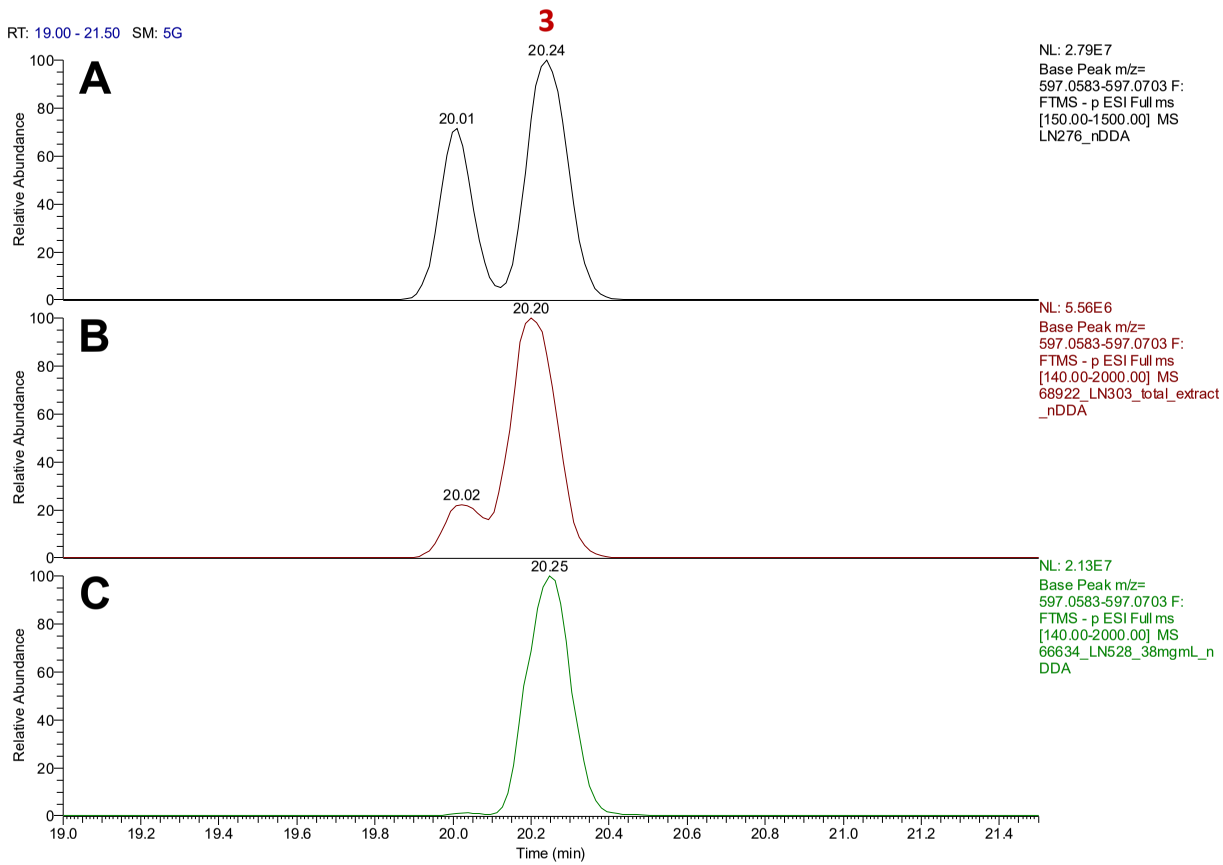


Figure S12. Extracted ion chromatograms (*m/z* 597.0643±0.0060) obtained by LC-MS in negative ion mode of the extracts from isolates LN276 (A), LN303 (B), and LN528 (C). The zoom shows the peak corresponding to emestrin (**3**) eluting at 20.2 min and the peak of an isomer eluting shortly earlier at 20.0 min.

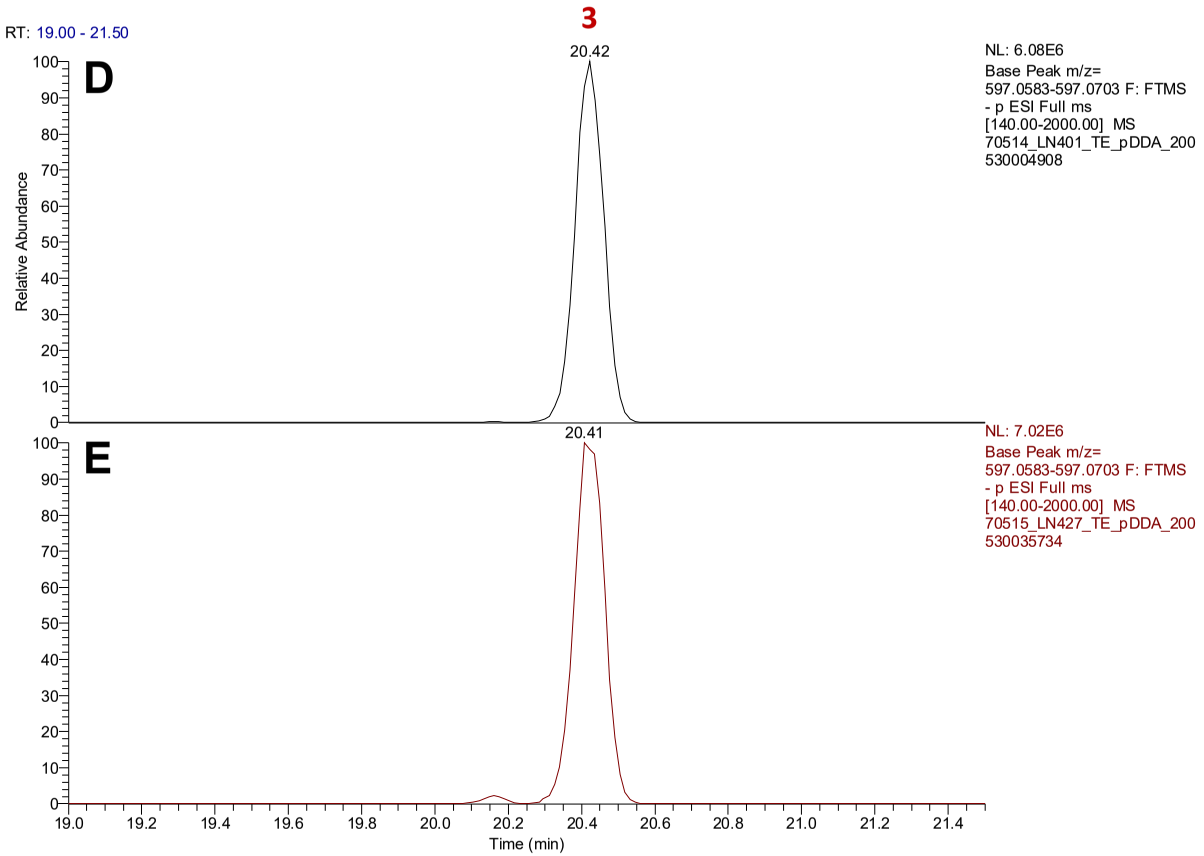


Figure S12 (cont.). Extracted ion chromatograms (*m/z* 597.0643±0.0060) obtained by LC-MS in negative ion mode of the extracts from isolates LN401 (D) and LN427 (E). The zoom shows the peak corresponding to emestrin (**3**) eluting at 20.4 min and the peak of an isomer eluting shortly earlier at 20.2 min.

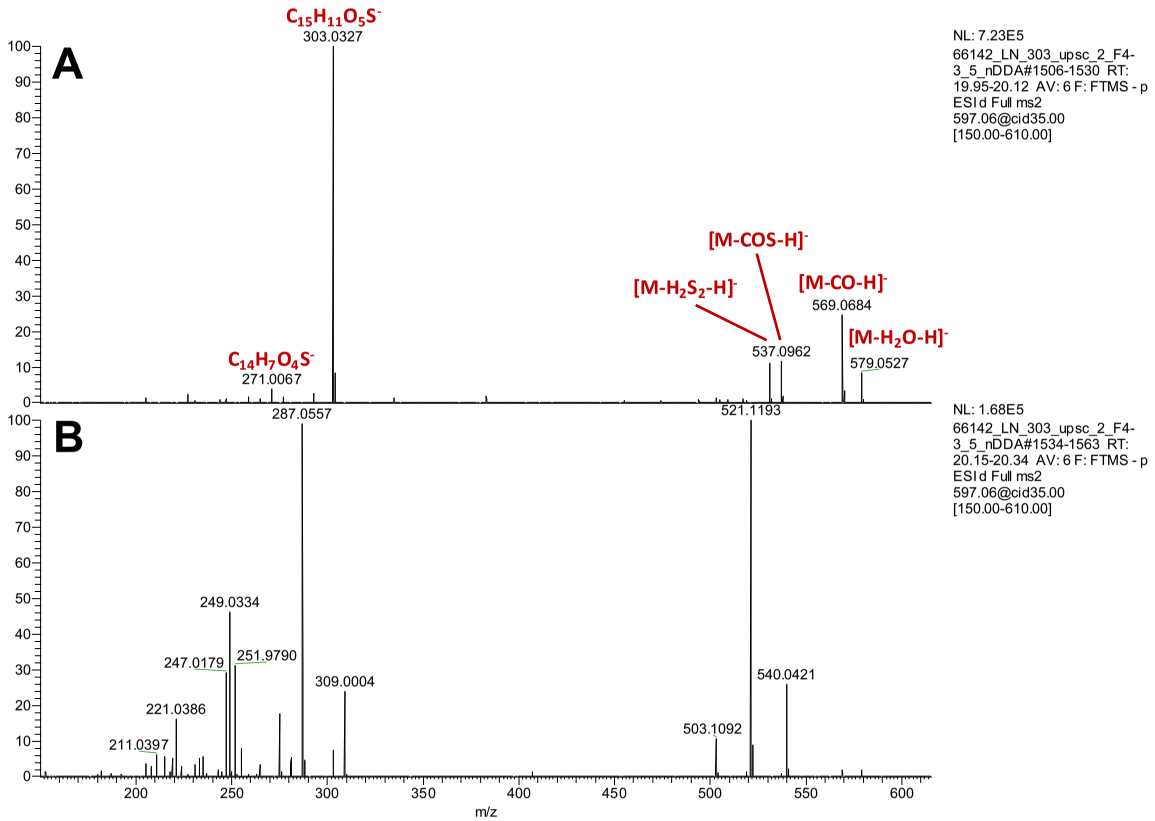
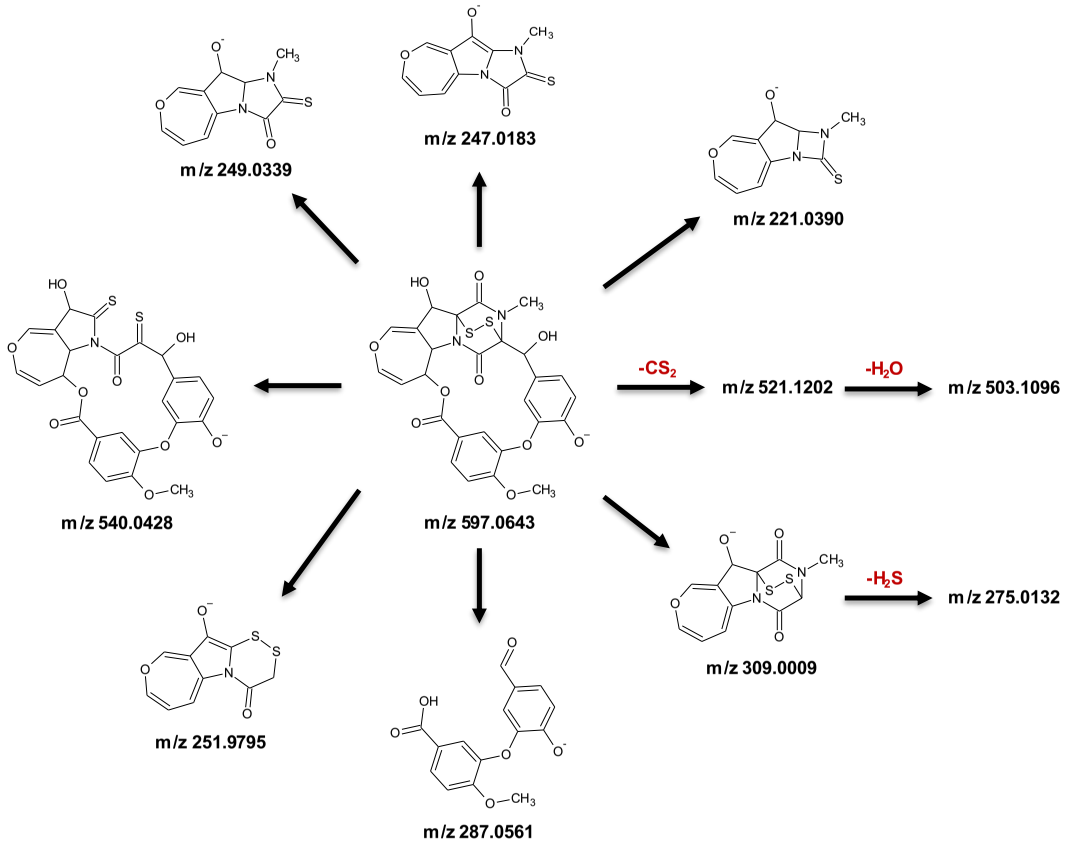


Figure S13. HRESIMS/MS spectrum of the $[M-H]^-$ ion of the non-isolated emestrin isomer eluting at 20.0. min (A) and emestrin (**3**) eluting at 20.2 min (B) obtained by LC-MS in negative ion mode.



Scheme S6. Proposed fragmentation pathway of the $[M-H]^-$ ion of emestrin (**3**) showing selected key fragment ions.

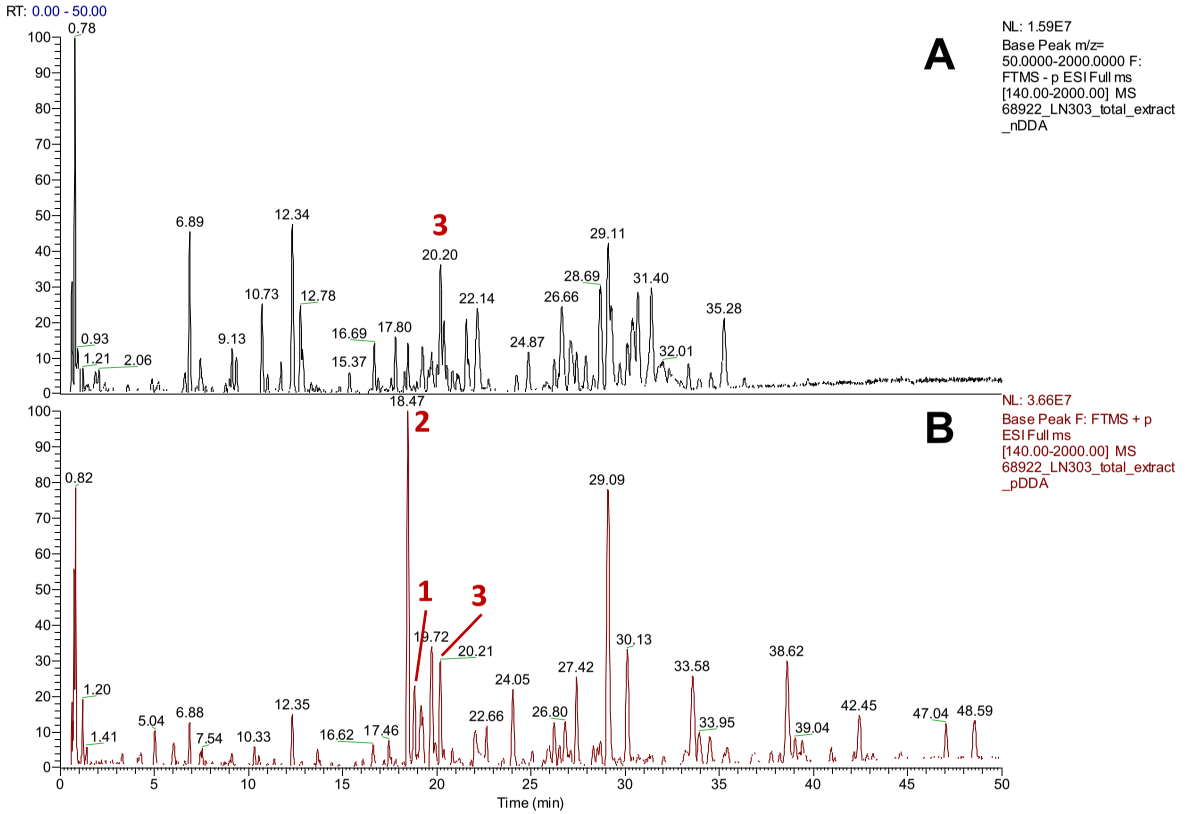


Figure S14. Base peak chromatograms obtained by LC-MS in negative ion mode (A) and positive ion mode (B) of the total extract from isolate LN303. The peaks corresponding to akanthenin A, akanthenin B, and emestrin are marked with **1**, **2**, and **3**, respectively.

Table S1. Experimental parameters and CCDC-Code of emestrin.

Sample	Machine	Source	Temp.	Detector Distance	Time/ Frame	#Frames	Frame width	CCDC
	Bruker		[K]	[mm]	[s]		[°]	
Emestrin	D8	Mo	100	40	60	4309	0.300	2040245

Table S2. Sample and crystal data.

Radiation [Å]	MoKα (λ = 0.71073)	Z	2	Measurement method	\f and \w scans
Crystal habit	clear colorless block	a [Å]	12.0970(12)		
Crystal size [mm^3]	0.08 × 0.02 × 0.01	b [Å]	7.7388(8)	Abs. correction type	multiscan
Empirical formula	C29H30N2O12S2	c [Å]	15.2512(15)	Abs. correction Tmin	0.6477
Formula weight [g/mol]	662.67	α [°]	90	Abs. correction Tmax	0.5913
Temperature [K]	100.0	β [°]	98.357(4)	Density (calculated) [g/cm^3]	1.378
Crystal system	monoclinic	γ [°]	90	Absorption coefficient [mm^{-1}]	0.095
Space group	$P2_1$	Volume [$Å^3$]	1412.6(2)	F (000) [e^-]	784.0

Table S3. Data collection and structure refinement.

2Θ range for data collection [°]	4.642 to 60.228	Index ranges		Goodness-of-fit on F^2	1031
Reflections collected	73456	h	$-17 \le h \le 17$	Diff. peak and hole [$e^- Å^{-3}$]	0.36/-0.47
Data / restraints / parameters	8218/1/415	k	$-10 \le k \le 10$		
Refinement method	Least squares	l	$-21 \le l \le 21$	Function minimized	$\Sigma\, w(F_o^2 - F_c^2)^2$
		all data	R1 = 0.0609, wR2 = 0.1169	Weighting scheme	where
		I>2σ(I)	R1 = 0.1094, wR2 = 0.1403	$W = 1/[\sigma^2(Fo^2) + (0.0457P)^2 + 1.4439P]$	$P=(F_o^2+2F_c^2)/3$

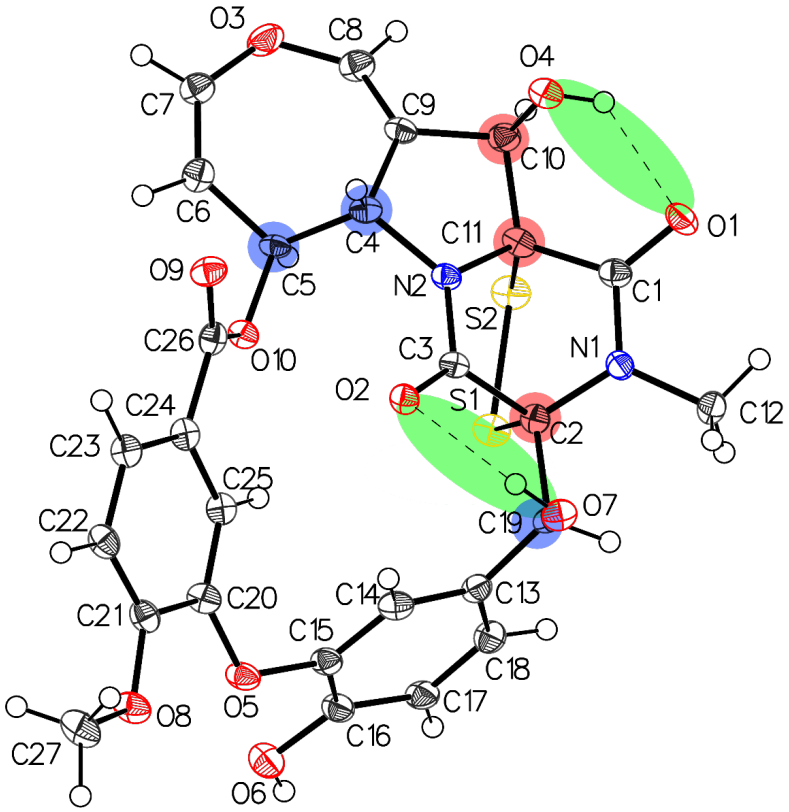


Figure S15. Asymmetric Unit of [emestrin]. C-C- Bond precision: 0.0070Å. Chiral centres can be determined with the proof of Flack of -0.07(6). Red dotted are "R", blue are "S". Additional to the chiral information we can detect two intramolecular hydrogen bonds of moderate character (green highlighted). The structure is already at the CCDC at 1133525 & 1133526 but at RT. Both results are as well published and from good quality.

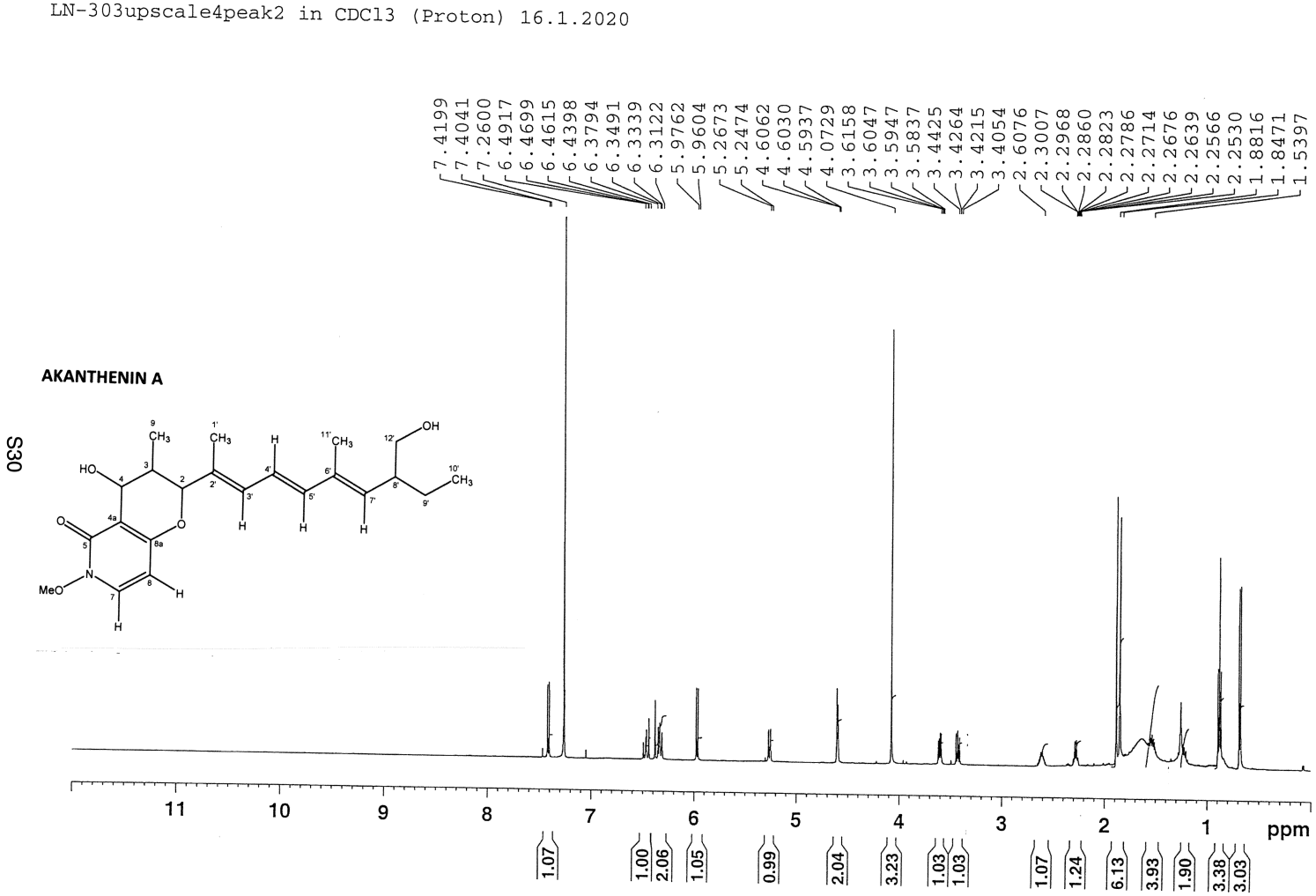
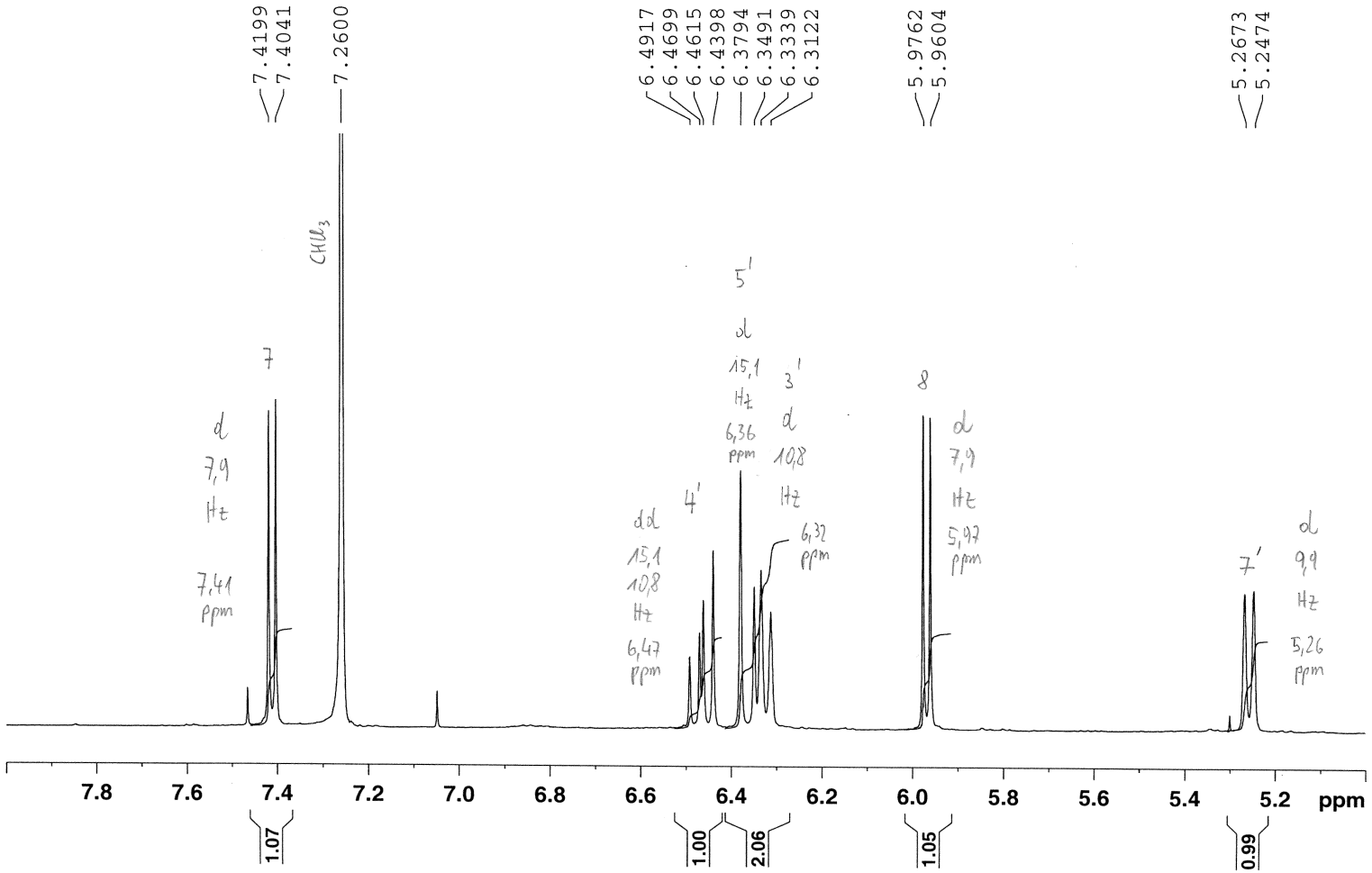
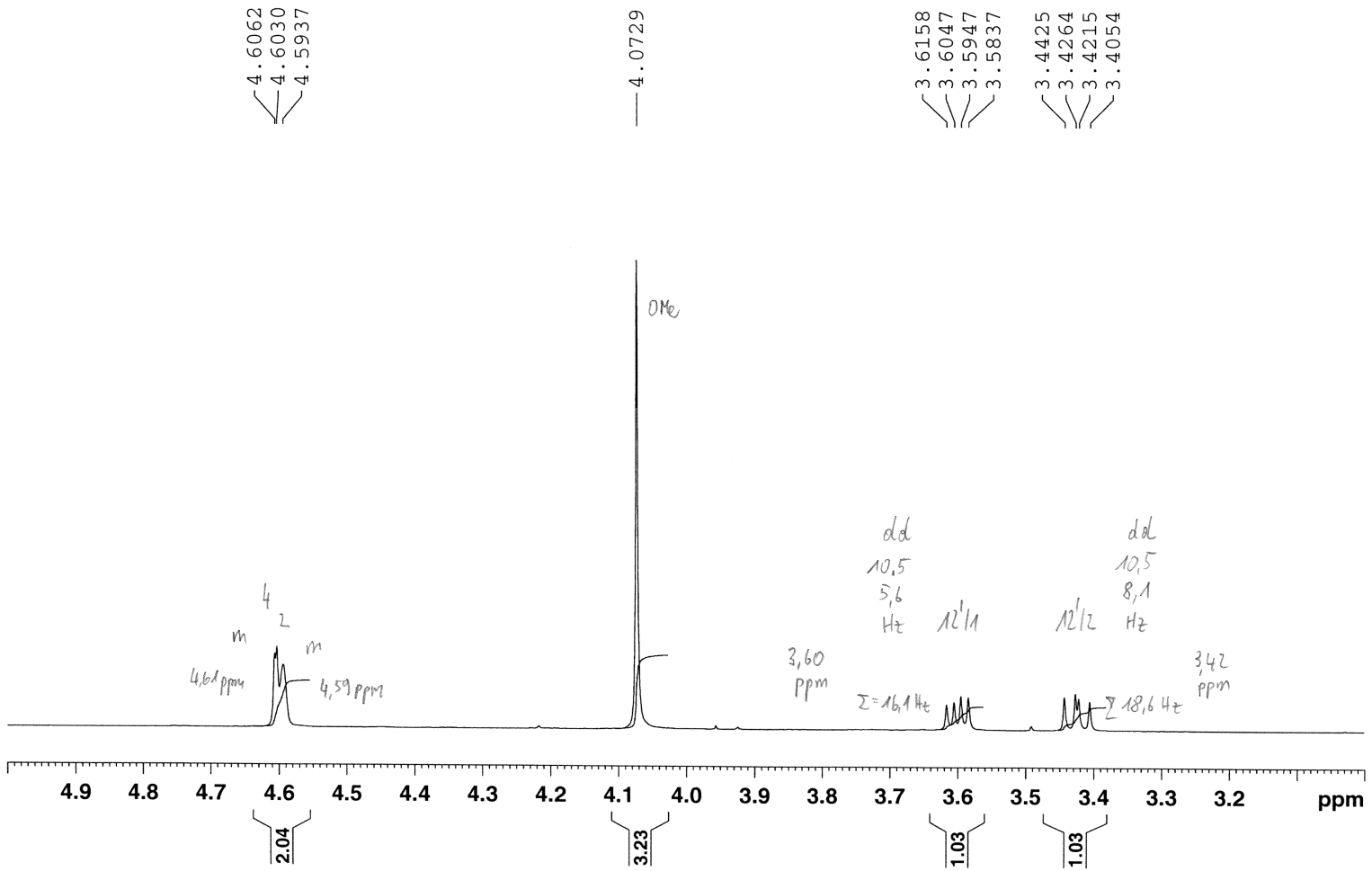


Figure S16 (pages S30-S33). ^{1}H NMR spectrum of **1** in $CDCl_3$ (δ in ppm).

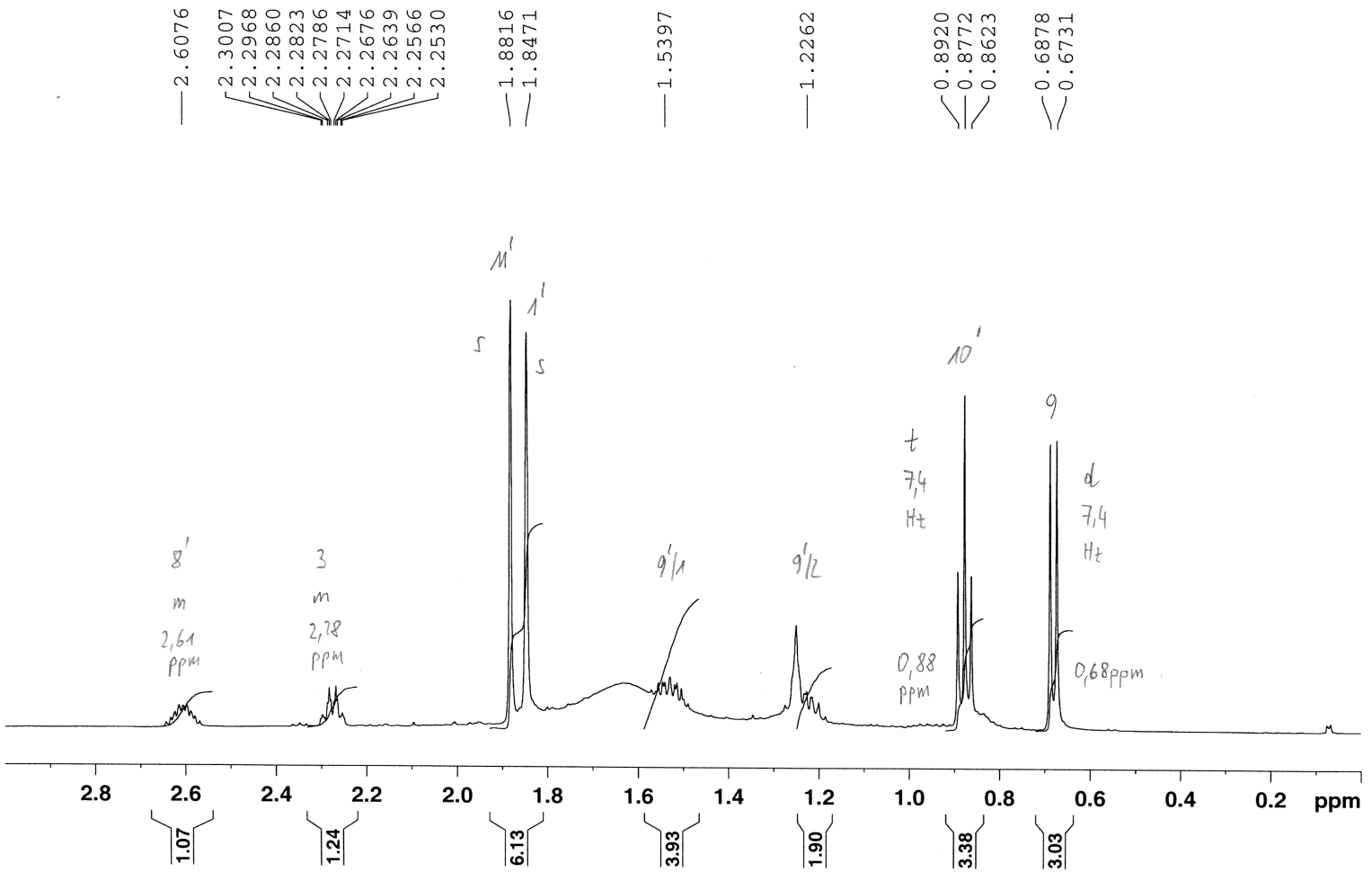
LN-303upscale4peak2 in CDCl3 (Proton) 16.1.2020



LN-303upscale4peak2 in CDCl3 (Proton) 16.1.2020



LN-303upscale4peak2 in CDCl3 (Proton) 16.1.2020



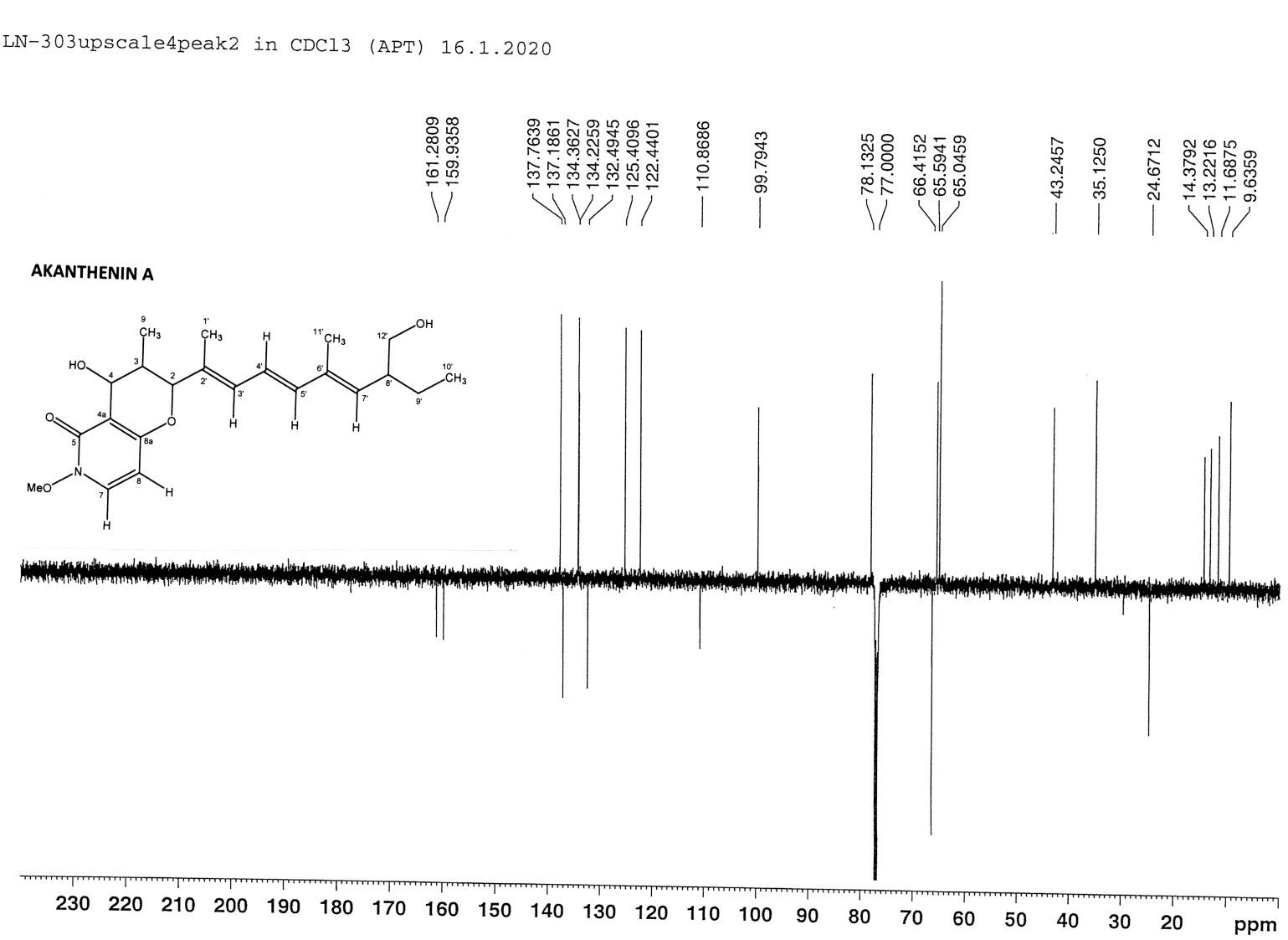
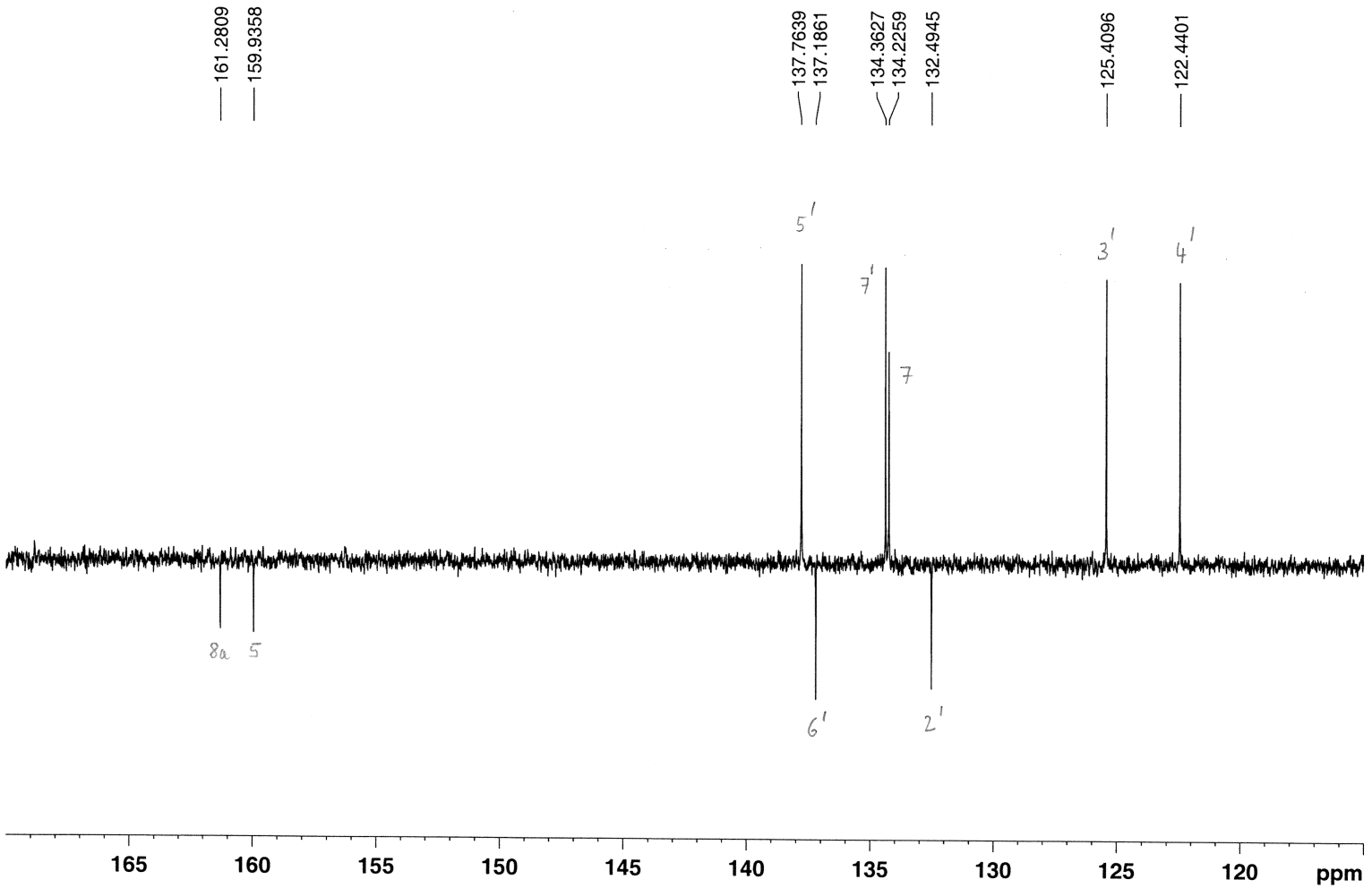
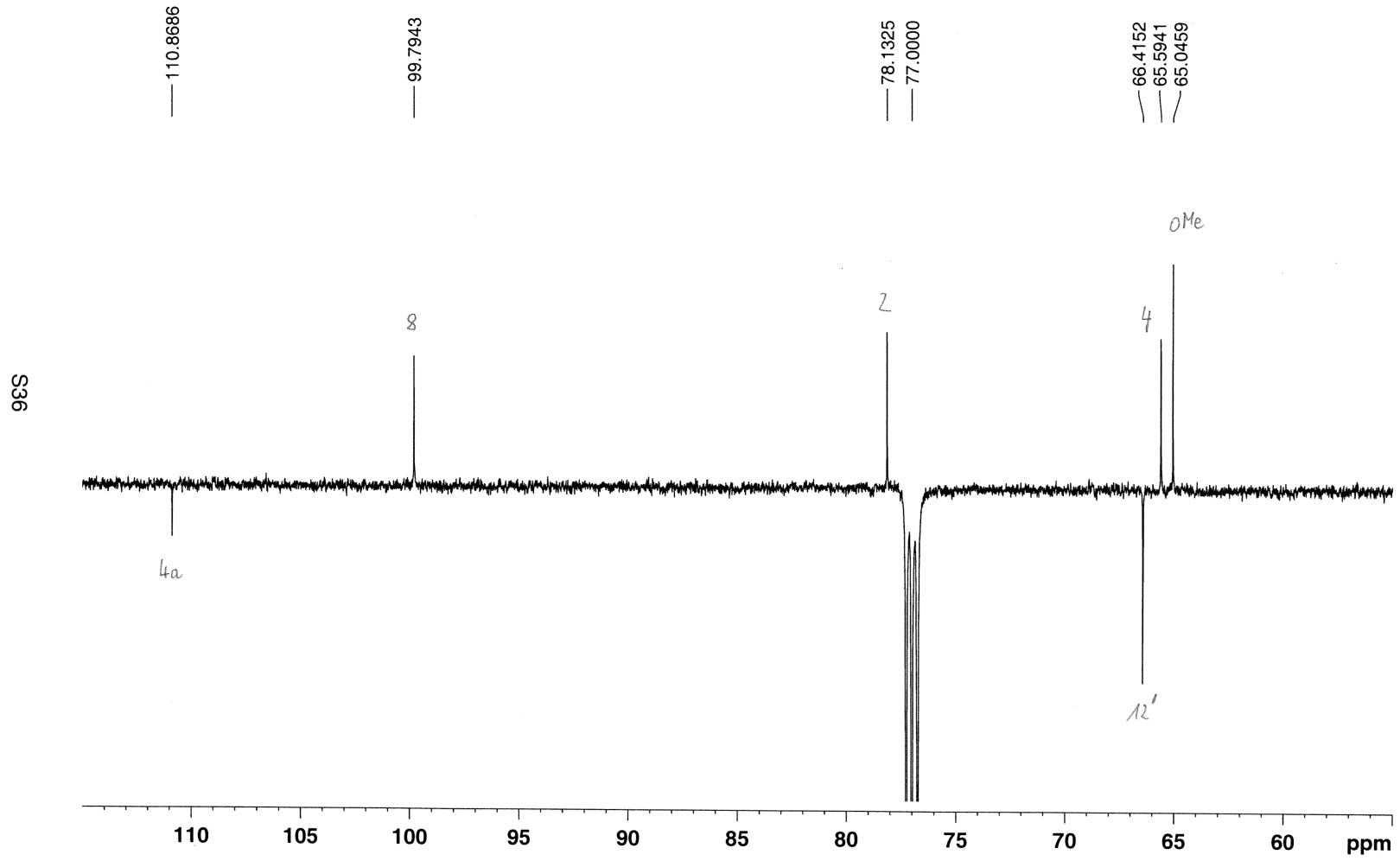


Figure S16 (pages S34-S37). ^{13}C NMR spectrum of **1** in $CDCl_3$ (δ in ppm).

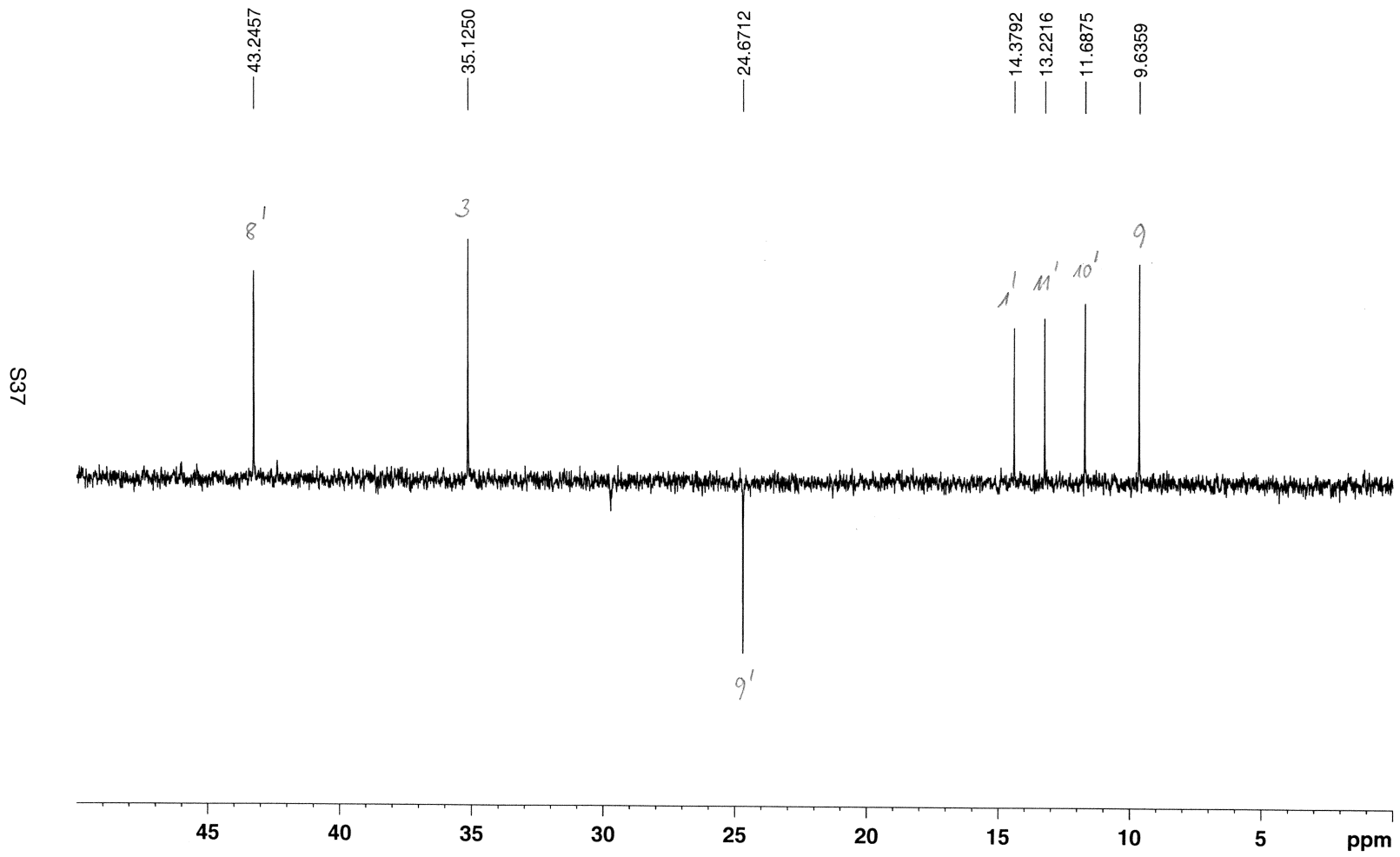
LN-303upscale4peak2 in CDCl3 (APT) 16.1.2020



LN-303upscale4peak2 in CDCl3 (APT) 16.1.2020



LN-303upscale4peak2 in CDCl3 (APT) 16.1.2020



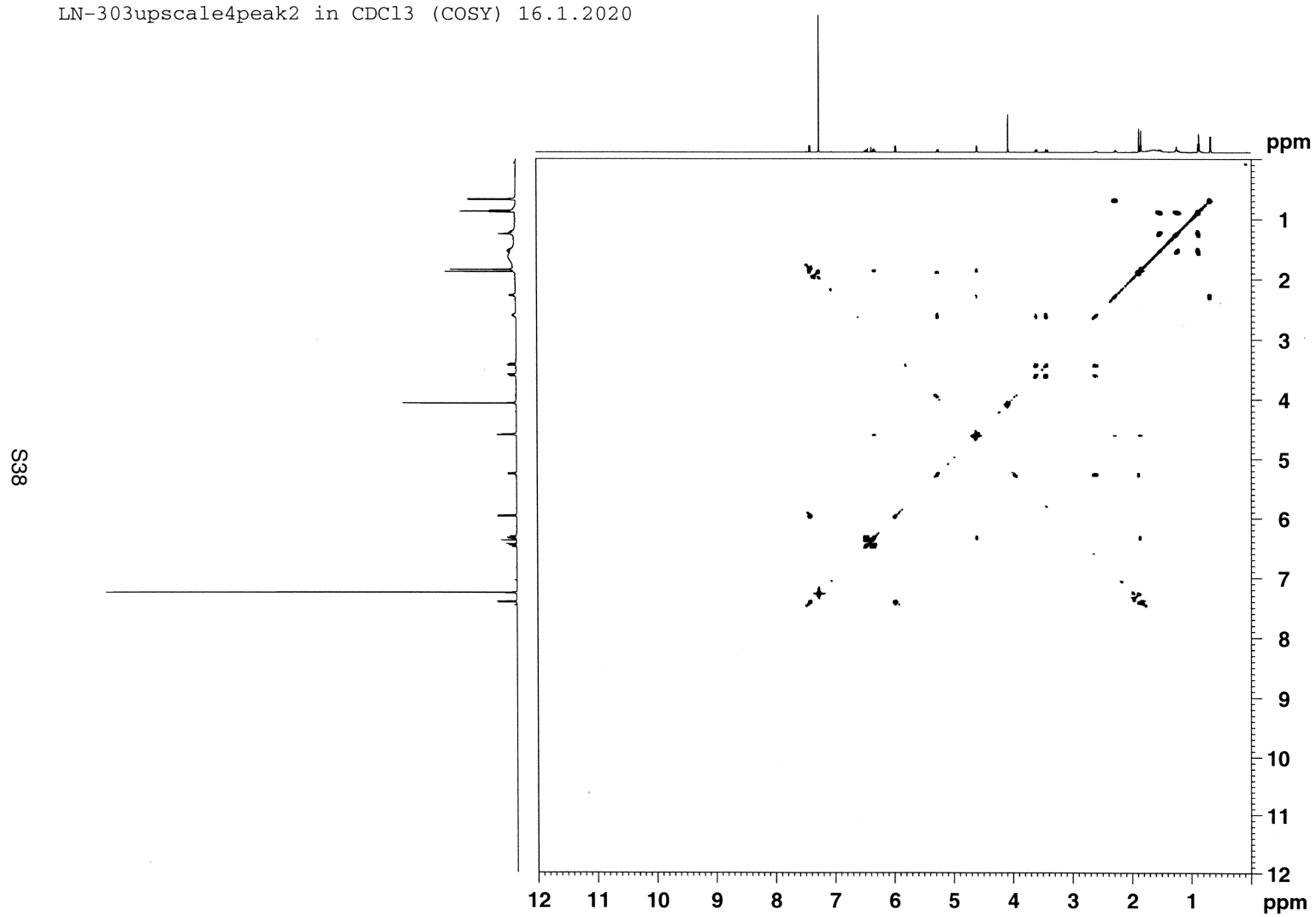
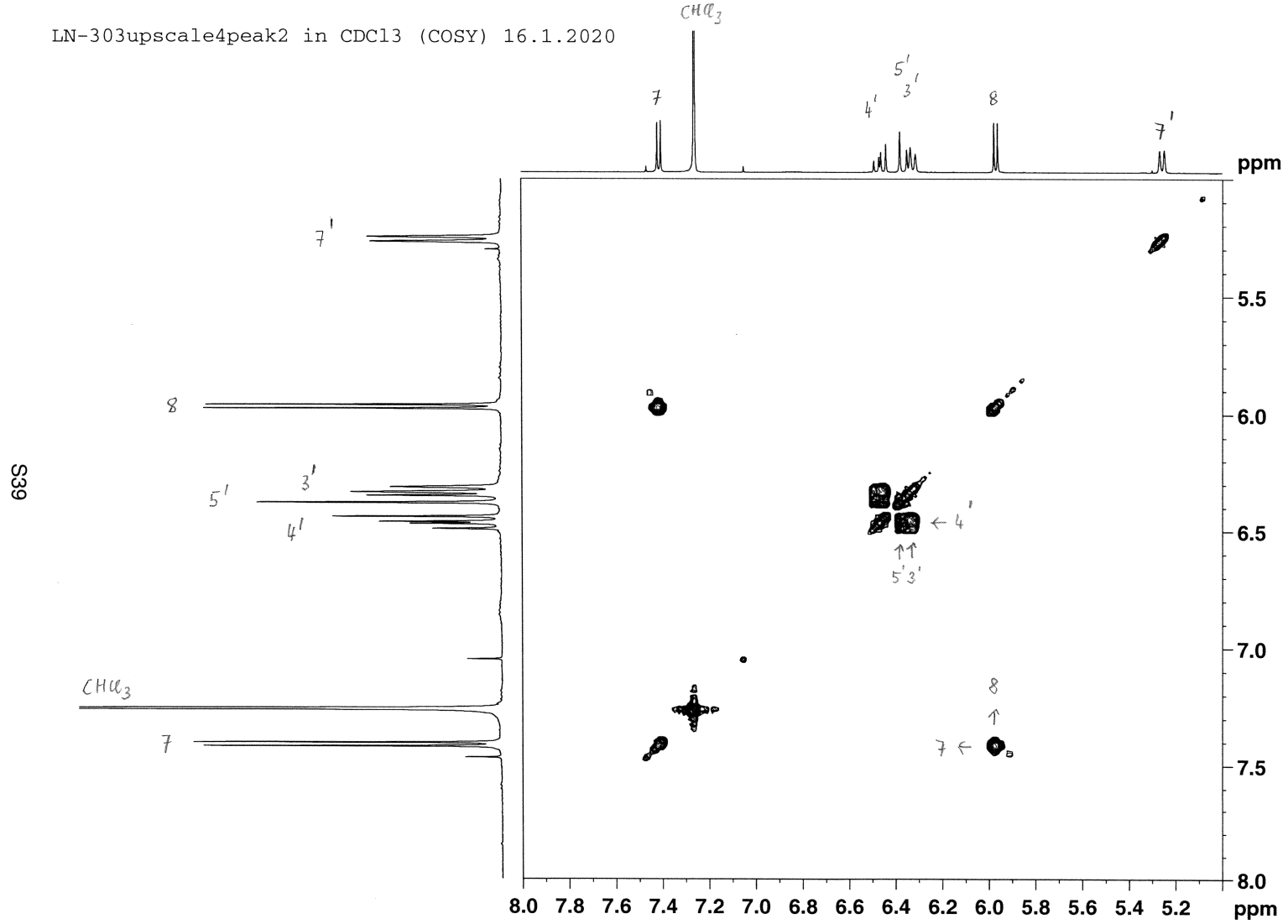
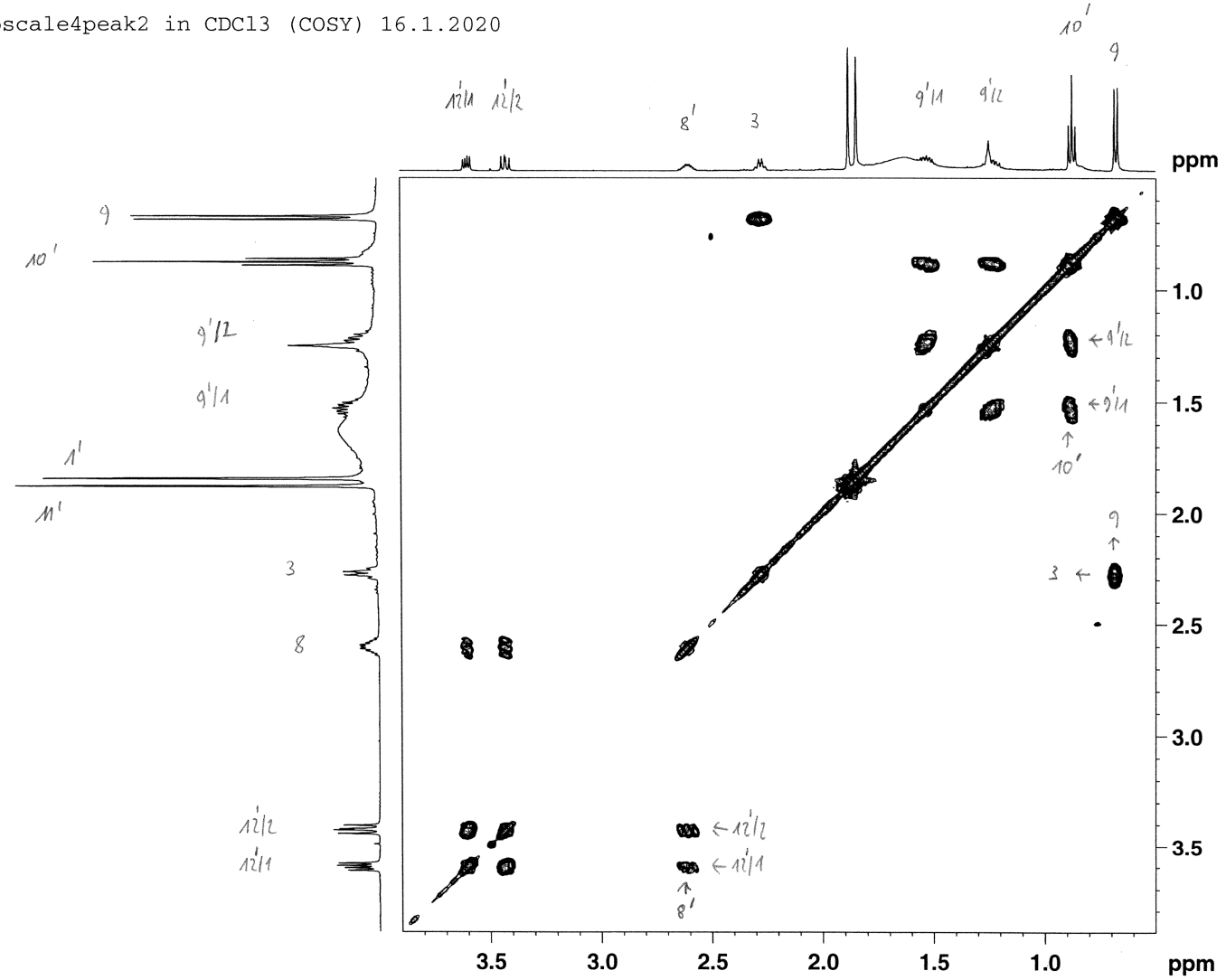


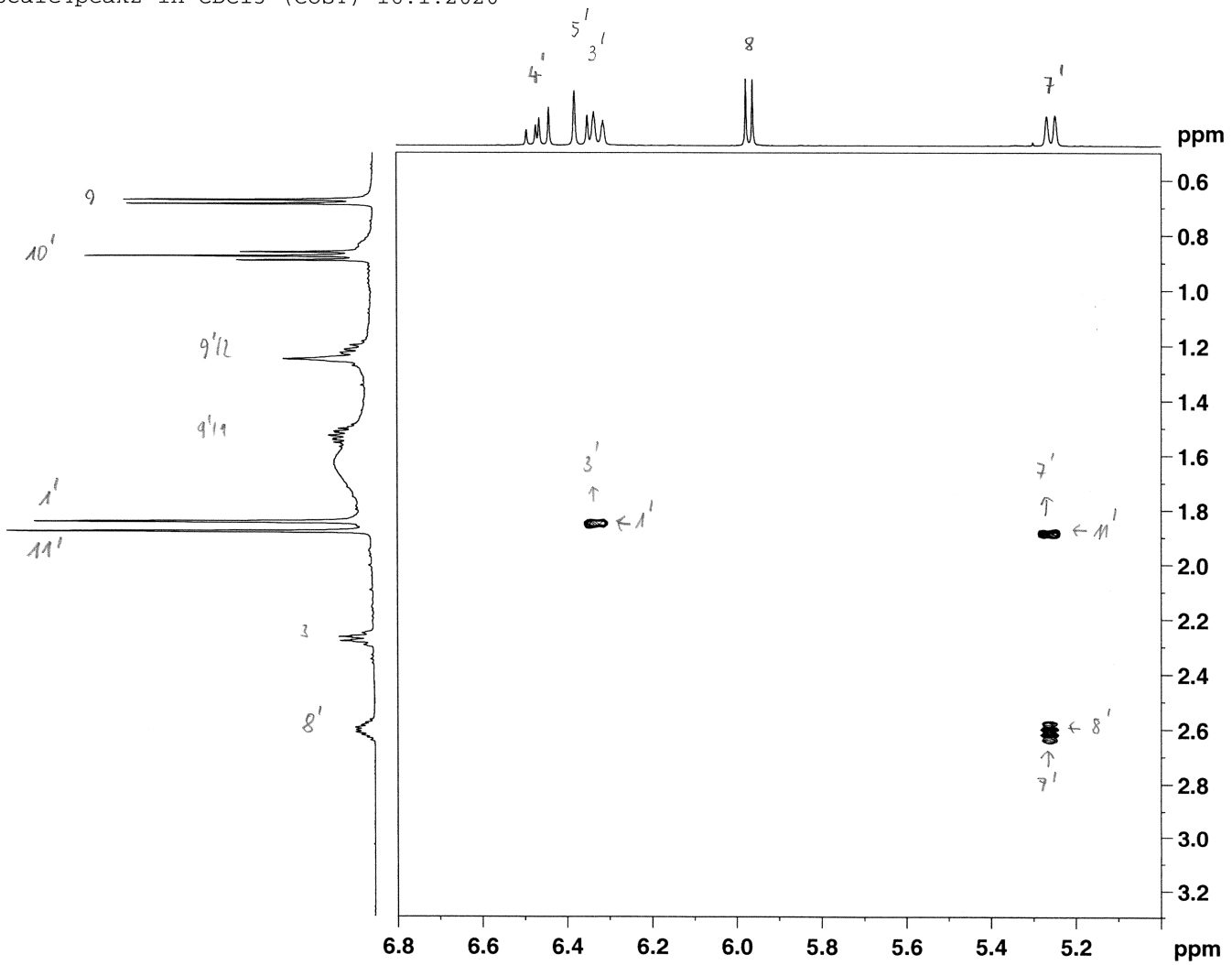
Figure S16 (pages S38-S41). COSY spectrum of **1** in $CDCl_3$ (δ in ppm).


LN-303upscale4peak2 in CDCl3 (COSY) 16.1.2020
CHCl3
7
5'
3'
4'
8
7'
ppm
5.5
6.0
6.5
7.0
7.5
8.0
8.0 7.8 7.6 7.4 7.2 7.0 6.8 6.6 6.4 6.2 6.0 5.8 5.6 5.4 5.2
ppm

LN-303upscale4peak2 in CDCl3 (COSY) 16.1.2020



LN-303upscale4peak2 in CDCl3 (COSY) 16.1.2020



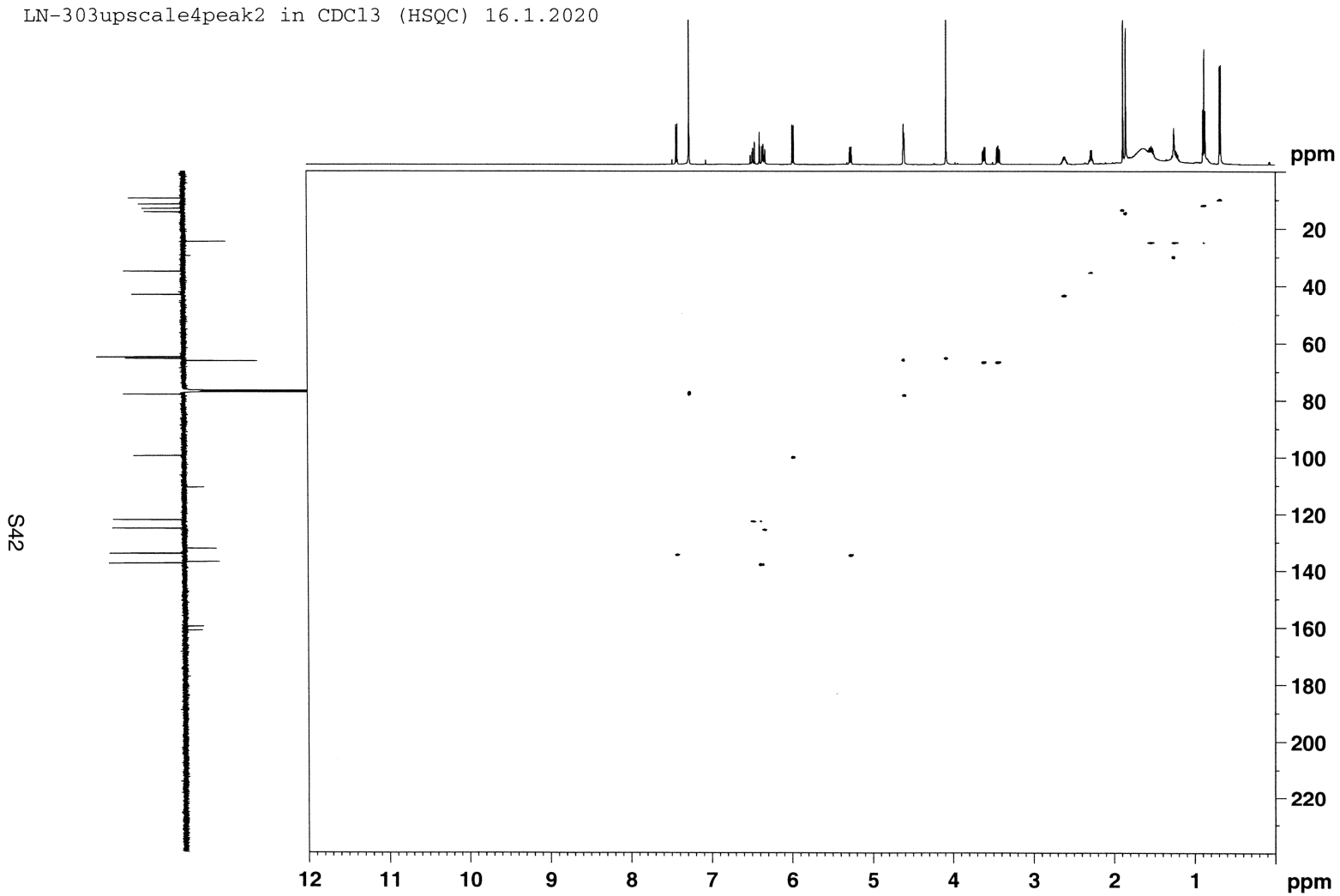
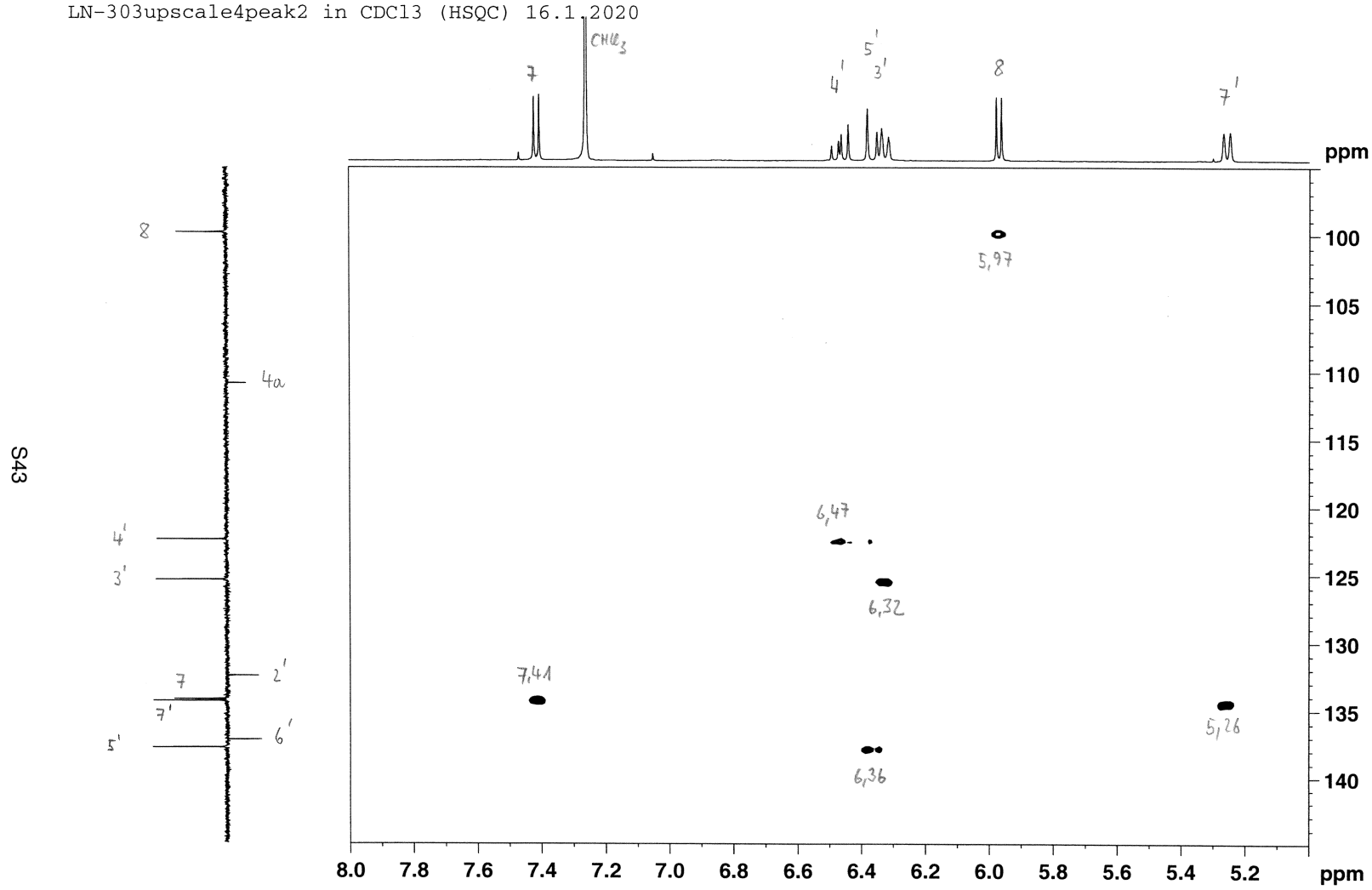
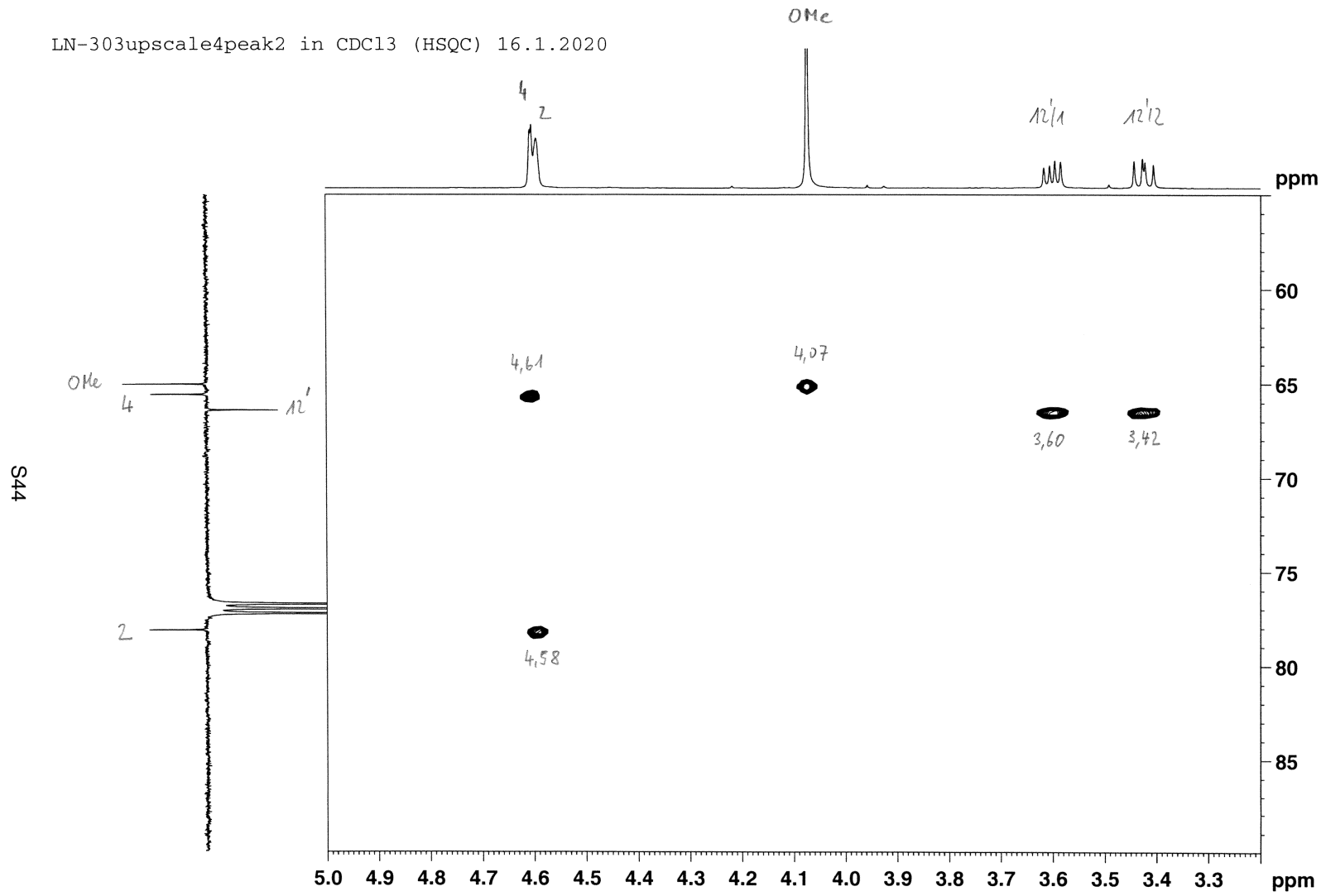
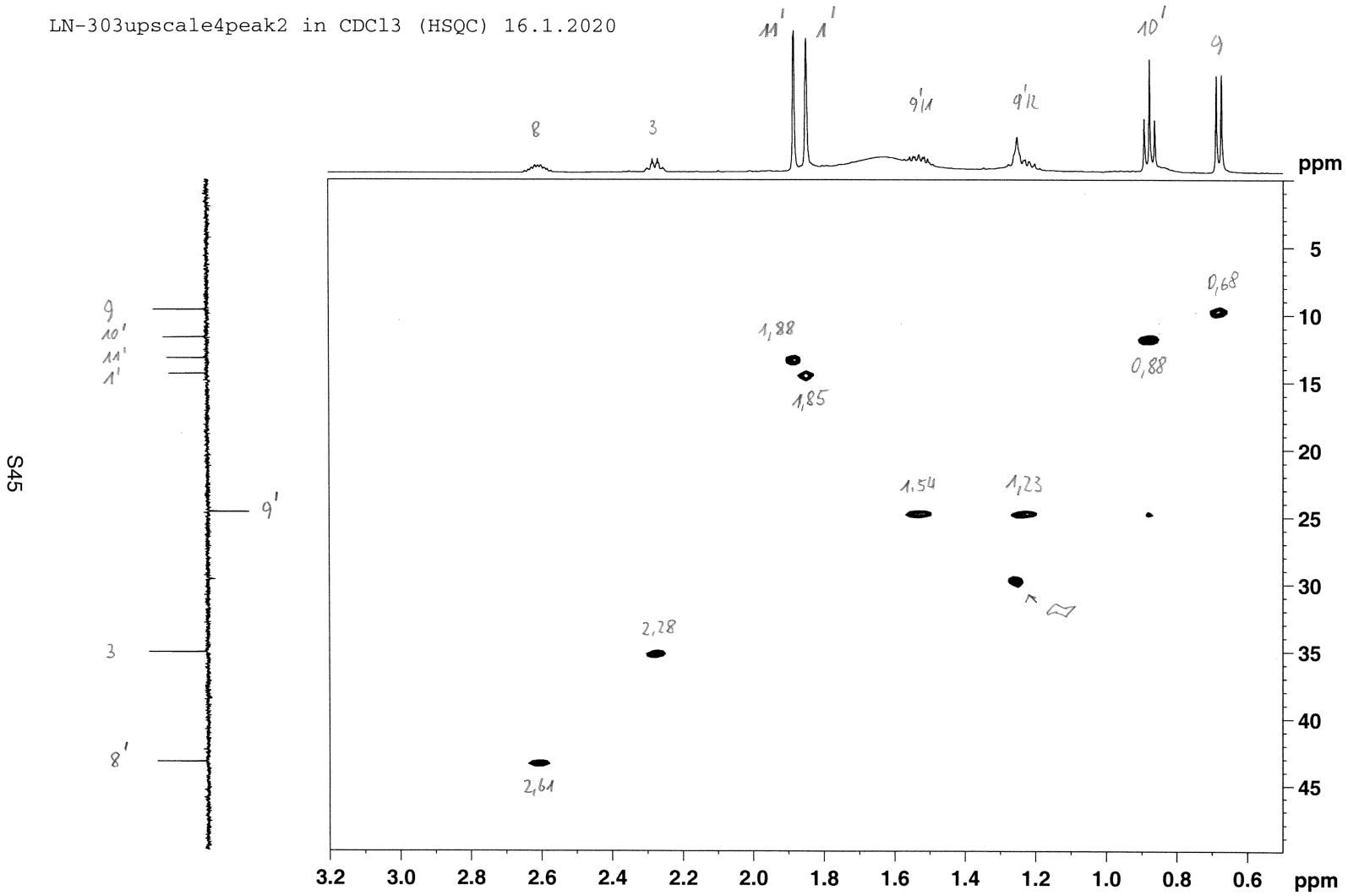


Figure S16 (pages S42-S45). HSQC spectrum of **1** in $CDCl_3$ (δ in ppm).


LN-303upscale4peak2 in CDCl3 (HSQC) 16.1.2020
CHCl3
7
4'
5'
3'
8
7'
ppm
8
4a
4'
3'
7
2'
7'
6'
5'
5,97
6,47
6,32
7,41
5,26
6,36
100
105
110
115
120
125
130
135
140
8.0
7.8
7.6
7.4
7.2
7.0
6.8
6.6
6.4
6.2
6.0
5.8
5.6
5.4
5.2
ppm


LN-303upscale4peak2 in CDCl3 (HSQC) 16.1.2020
OMe
4
2
12'1
12'2
ppm
OMe
4
12'
2
4,61
4,07
3,60
3,42
4,58
60
65
70
75
80
85
5.0 4.9 4.8 4.7 4.6 4.5 4.4 4.3 4.2 4.1 4.0 3.9 3.8 3.7 3.6 3.5 3.4 3.3
ppm


LN-303upscale4peak2 in CDCl3 (HSQC) 16.1.2020
11'
1'
10'
9
8
3
9'11
9'12
ppm
9
10'
11'
1'
9'
3
8'
0,68
1,88
0,88
1,85
1,54
1,23
2,28
2,61
3.2
3.0
2.8
2.6
2.4
2.2
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
ppm

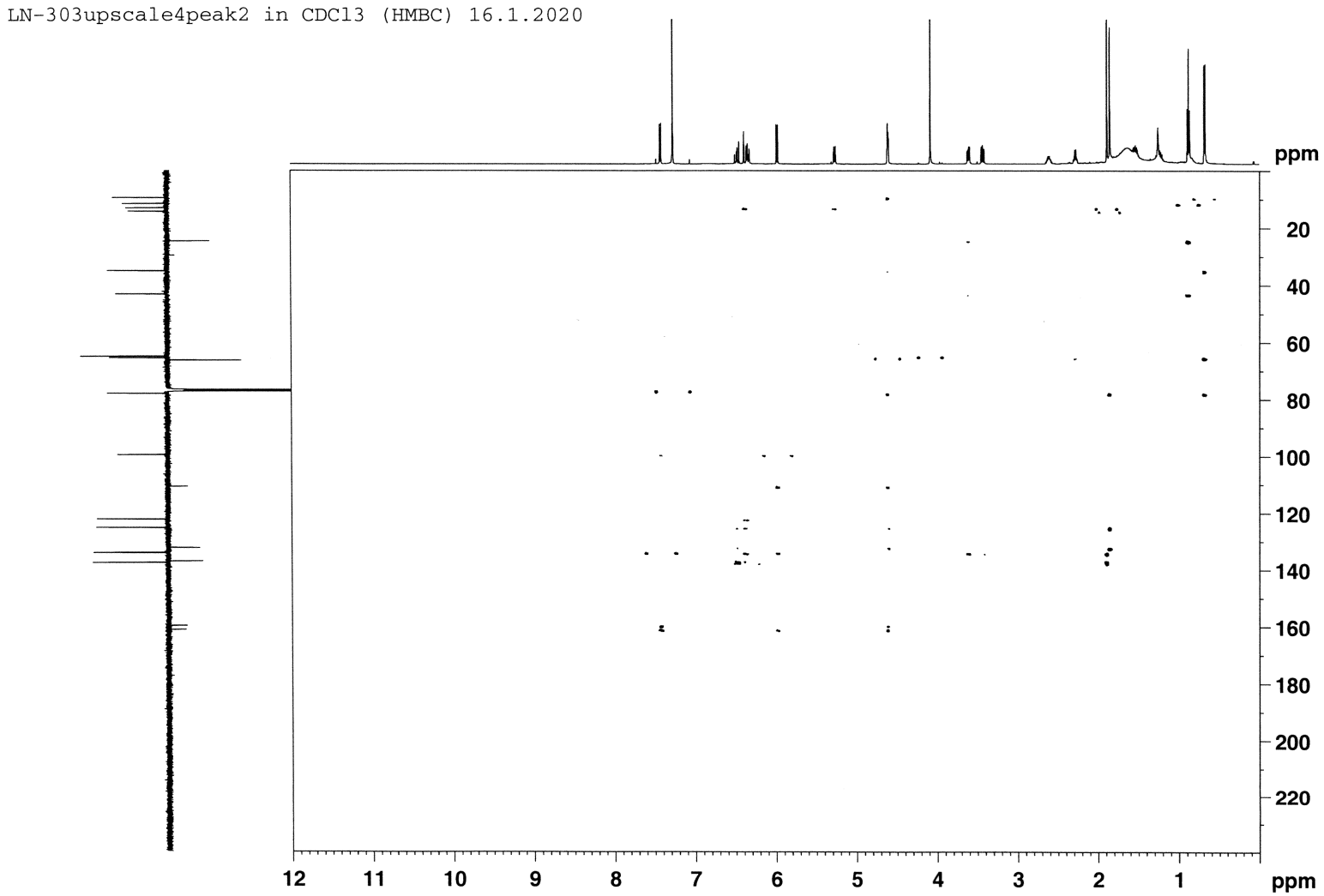
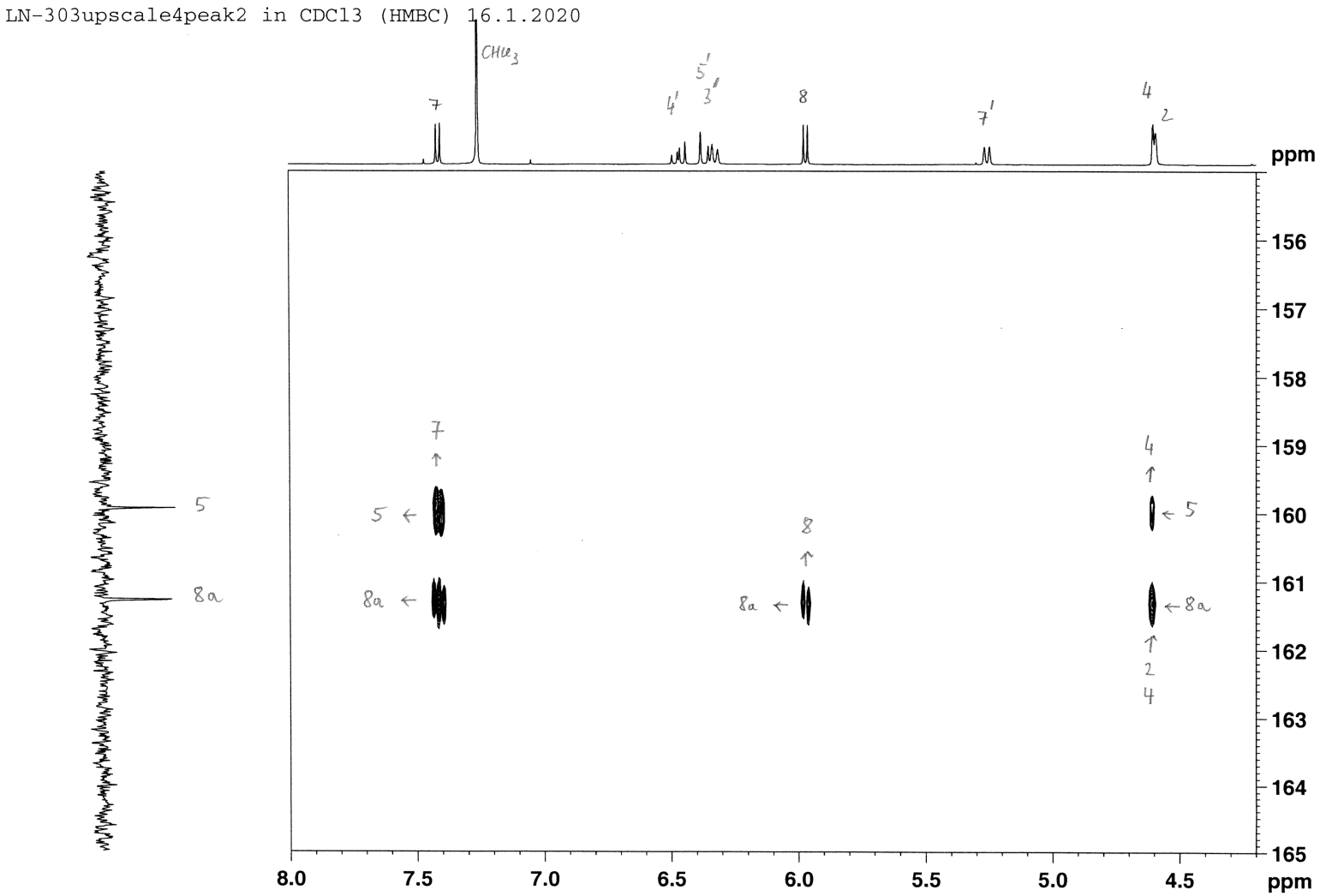
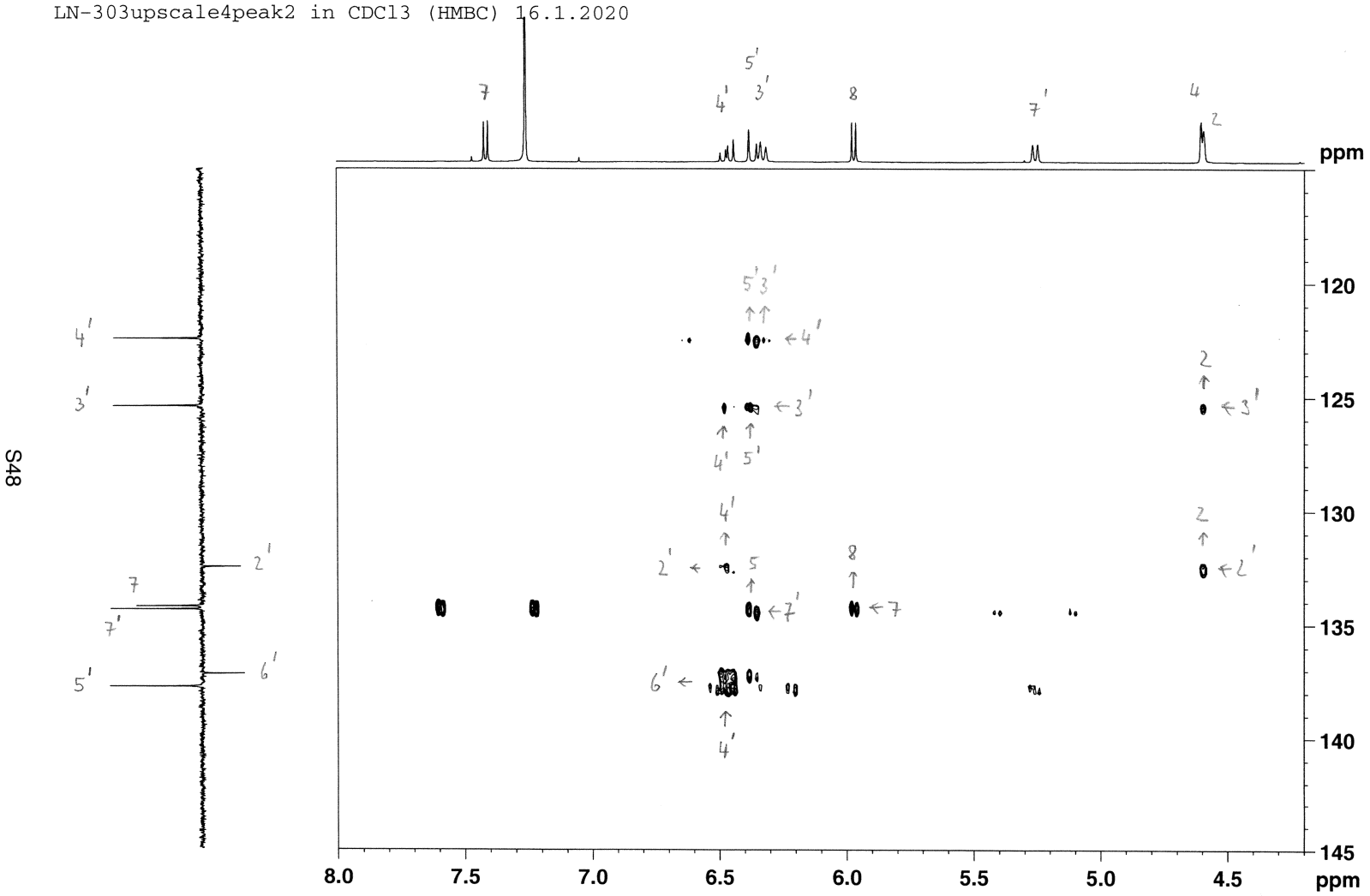
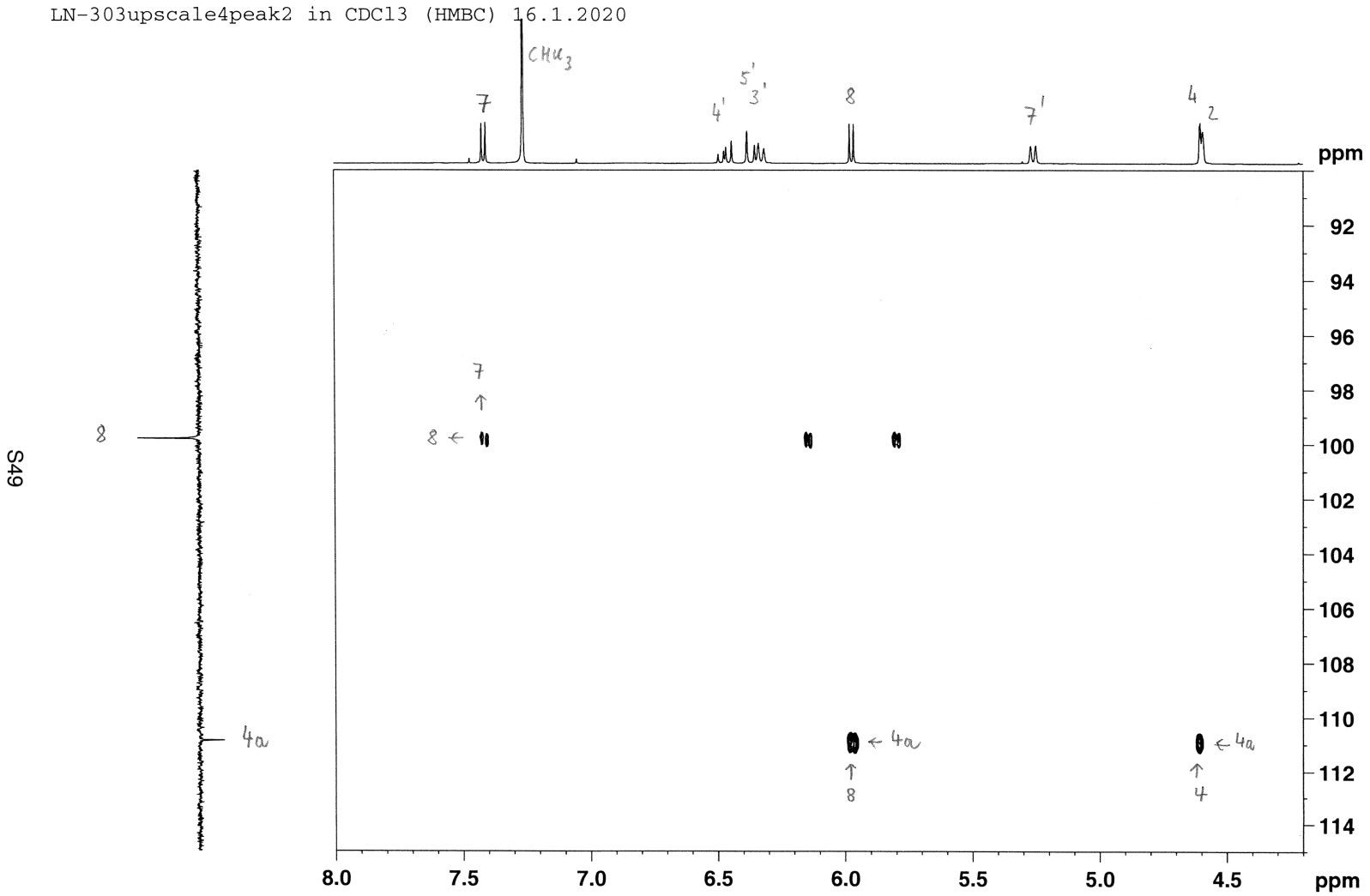
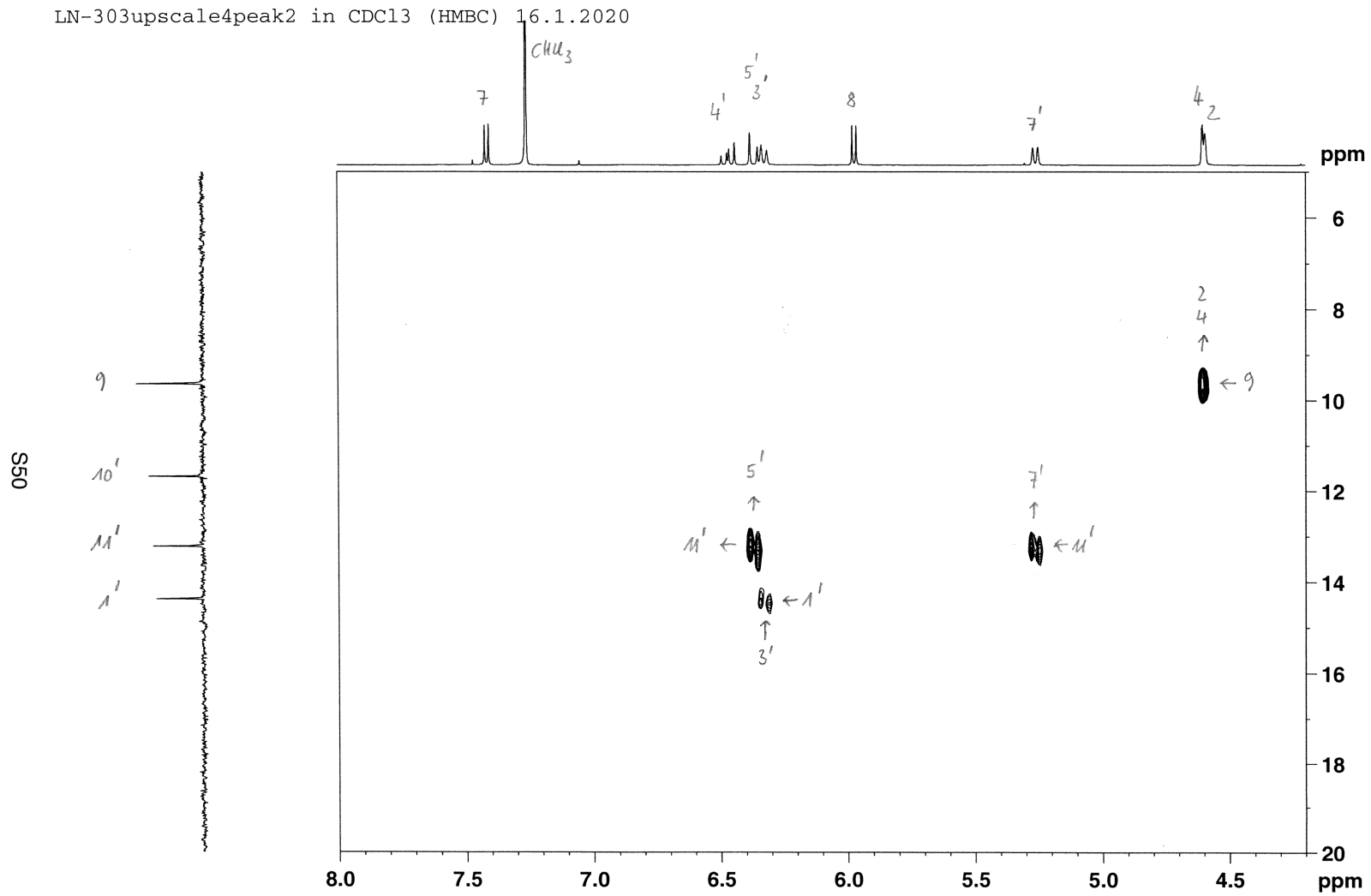


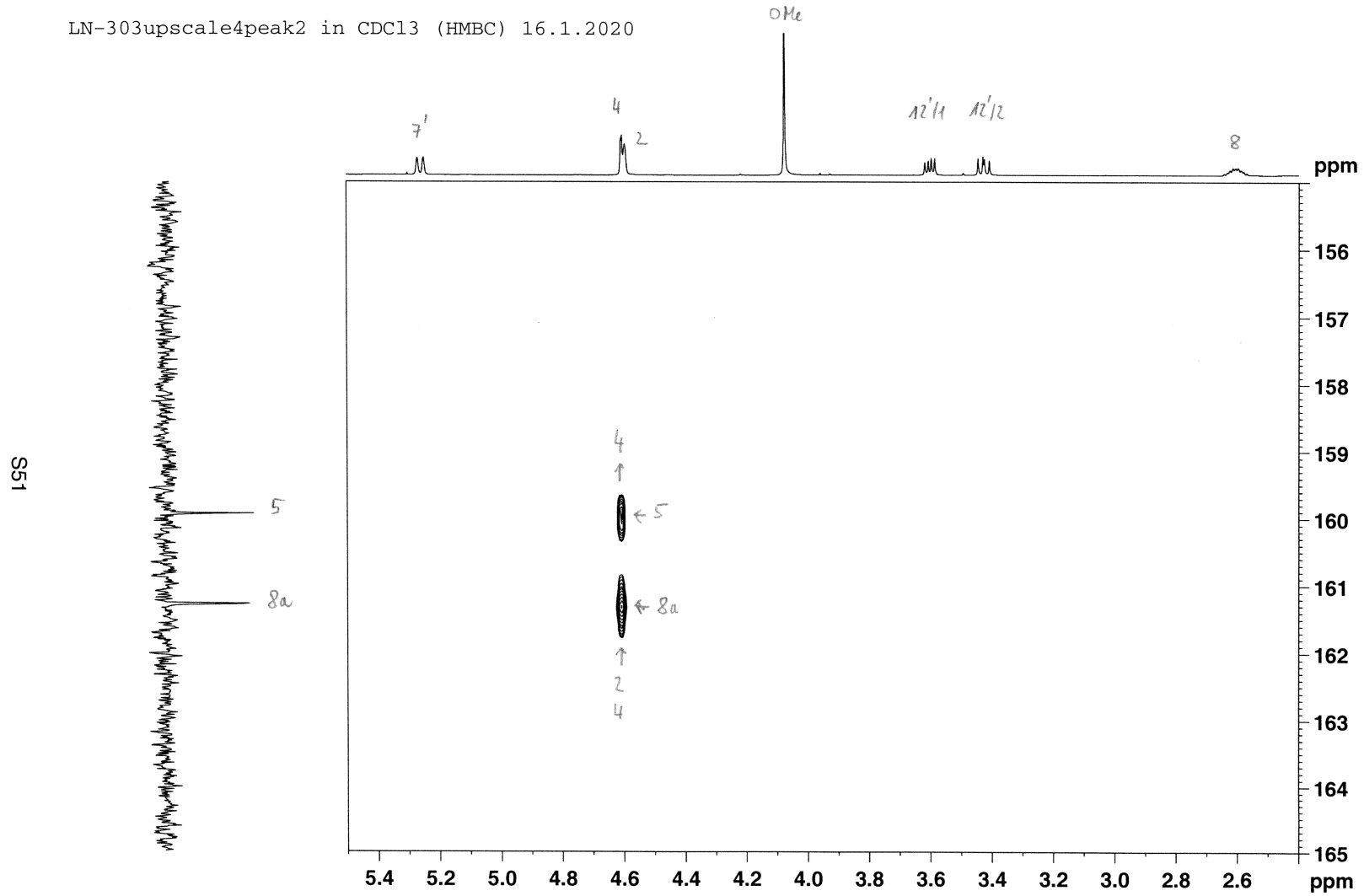
Figure S16 (pages S46-S59). HMBC spectrum of **1** in $CDCl_3$ (δ in ppm).

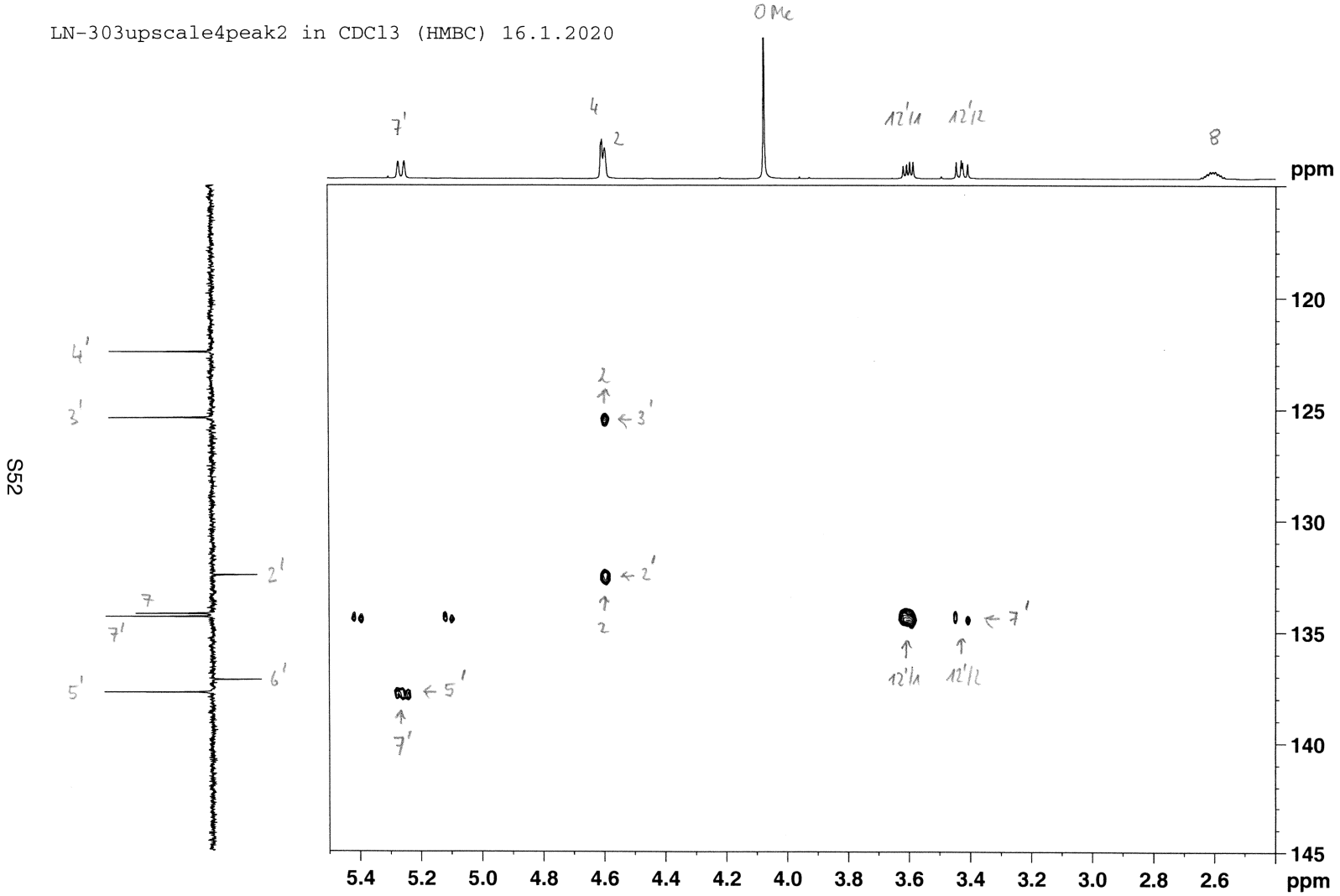

LN-303upscale4peak2 in CDCl3 (HMBC) 16.1.2020
CHCl3
7
4'
5'
3'
8
7'
4
2
ppm
156
157
158
159
160
161
162
163
164
165
5
8a
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
ppm

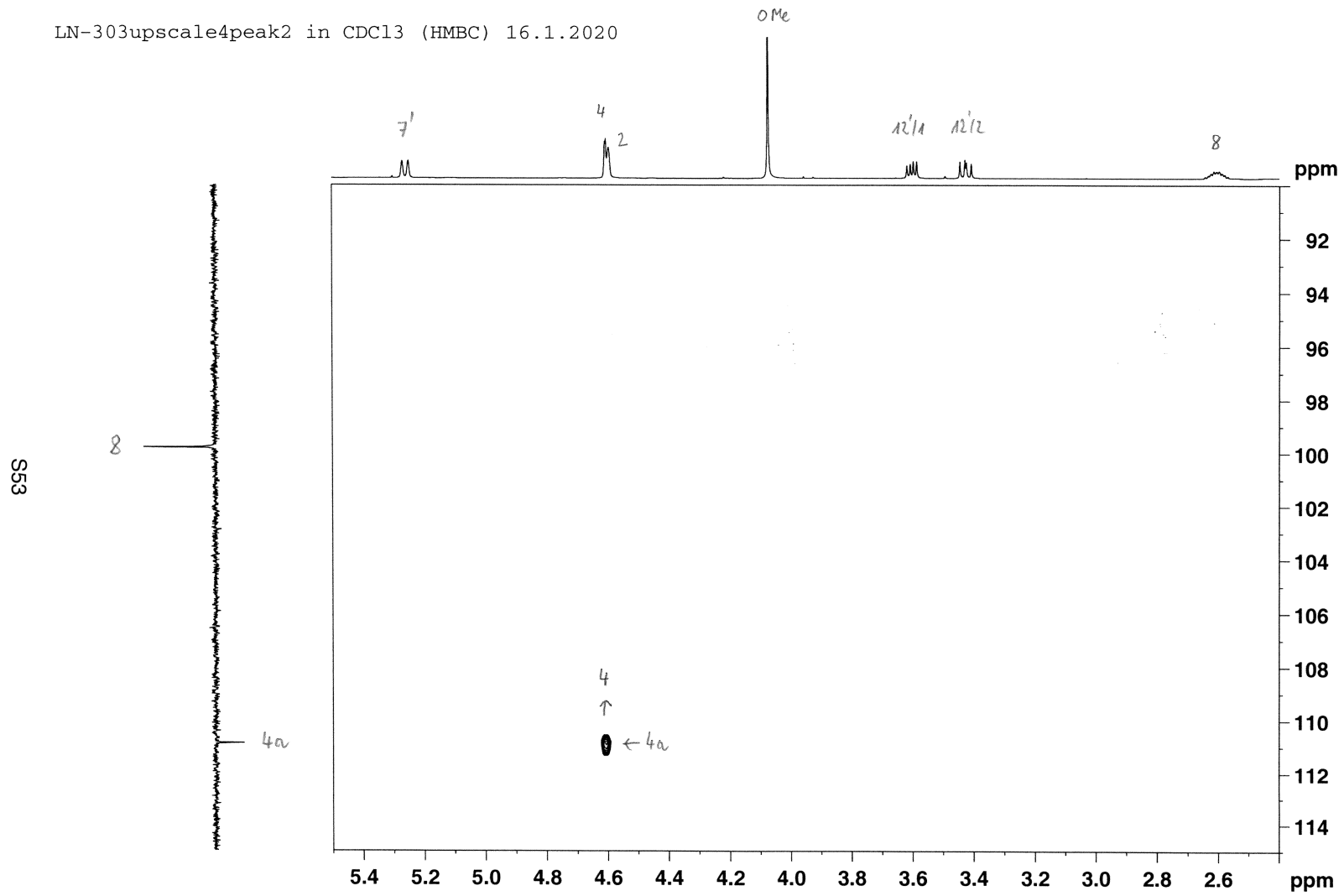

LN-303upscale4peak2 in CDCl3 (HMBC) 16.1.2020
ppm
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
ppm
120
125
130
135
140
145

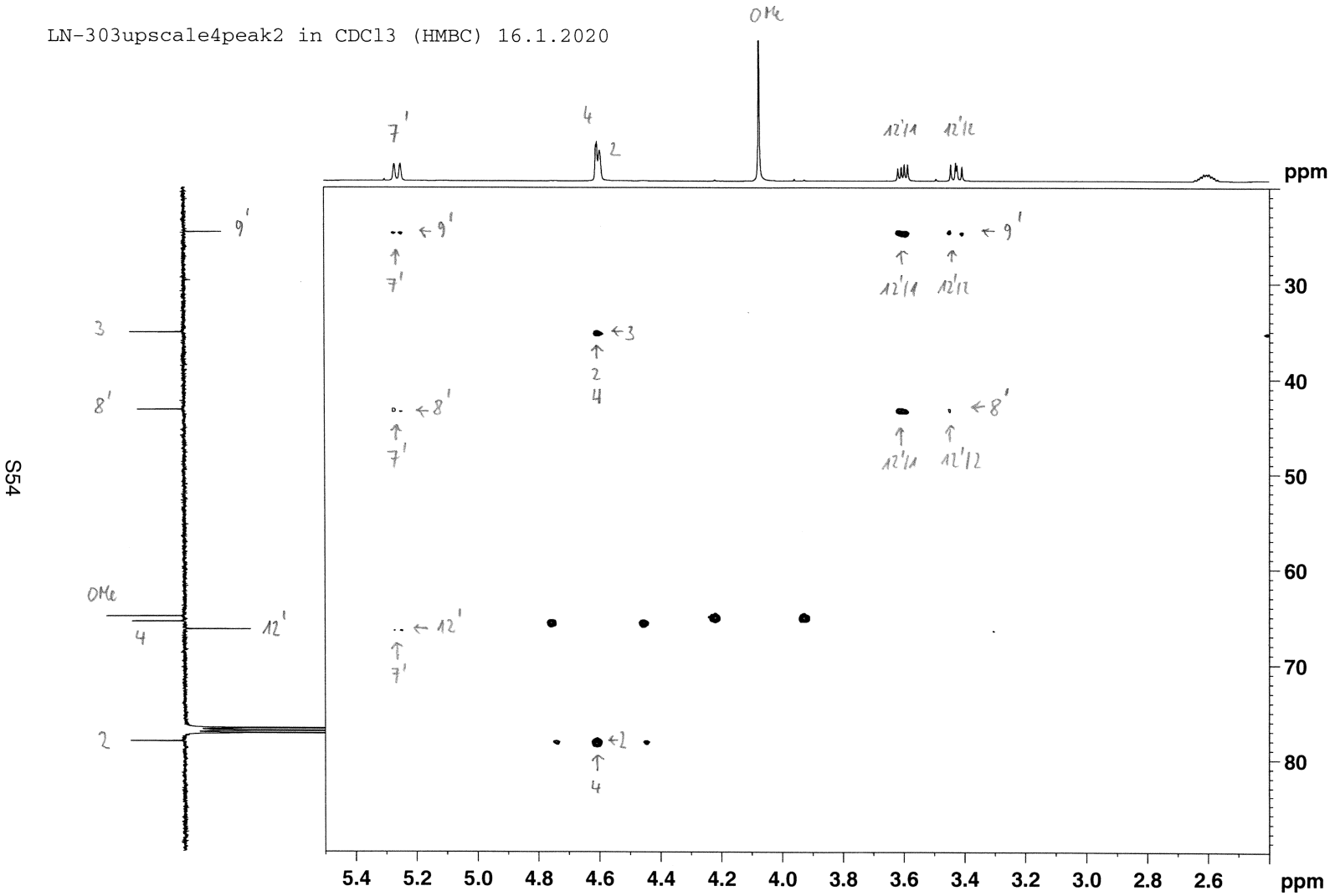

LN-303upscale4peak2 in CDCl3 (HMBC) 16.1.2020
CHu3
7
5'
4'
3'
8
7'
4
2
ppm
92
94
96
98
100
102
104
106
108
110
112
114
8
4a
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
ppm

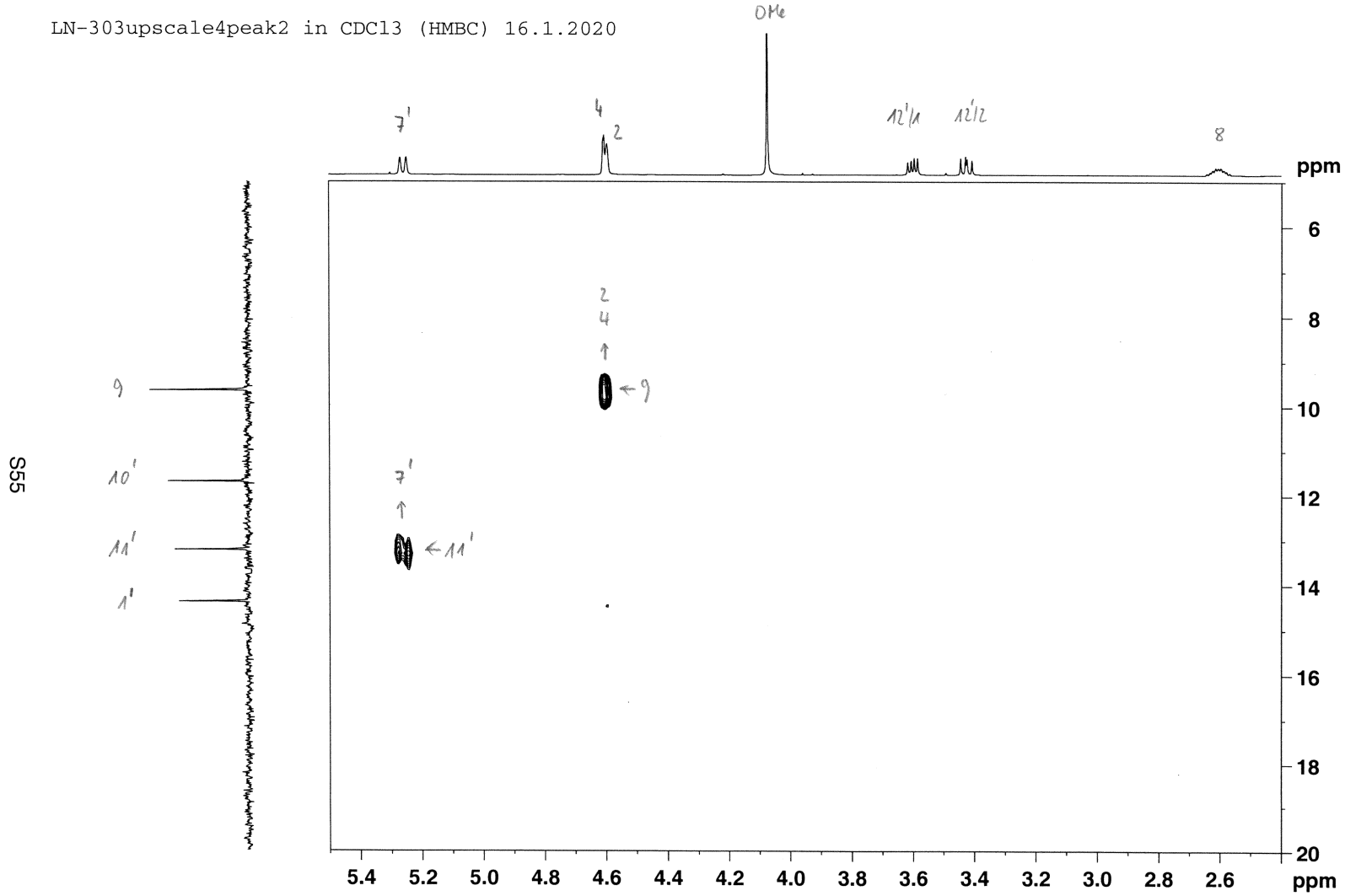

LN-303upscale4peak2 in CDCl3 (HMBC) 16.1.2020
CHD3
7
5'
3'
4'
8
7'
4
2
ppm
6
8
10
12
14
16
18
20
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
ppm
9
10'
11'
1'
S50

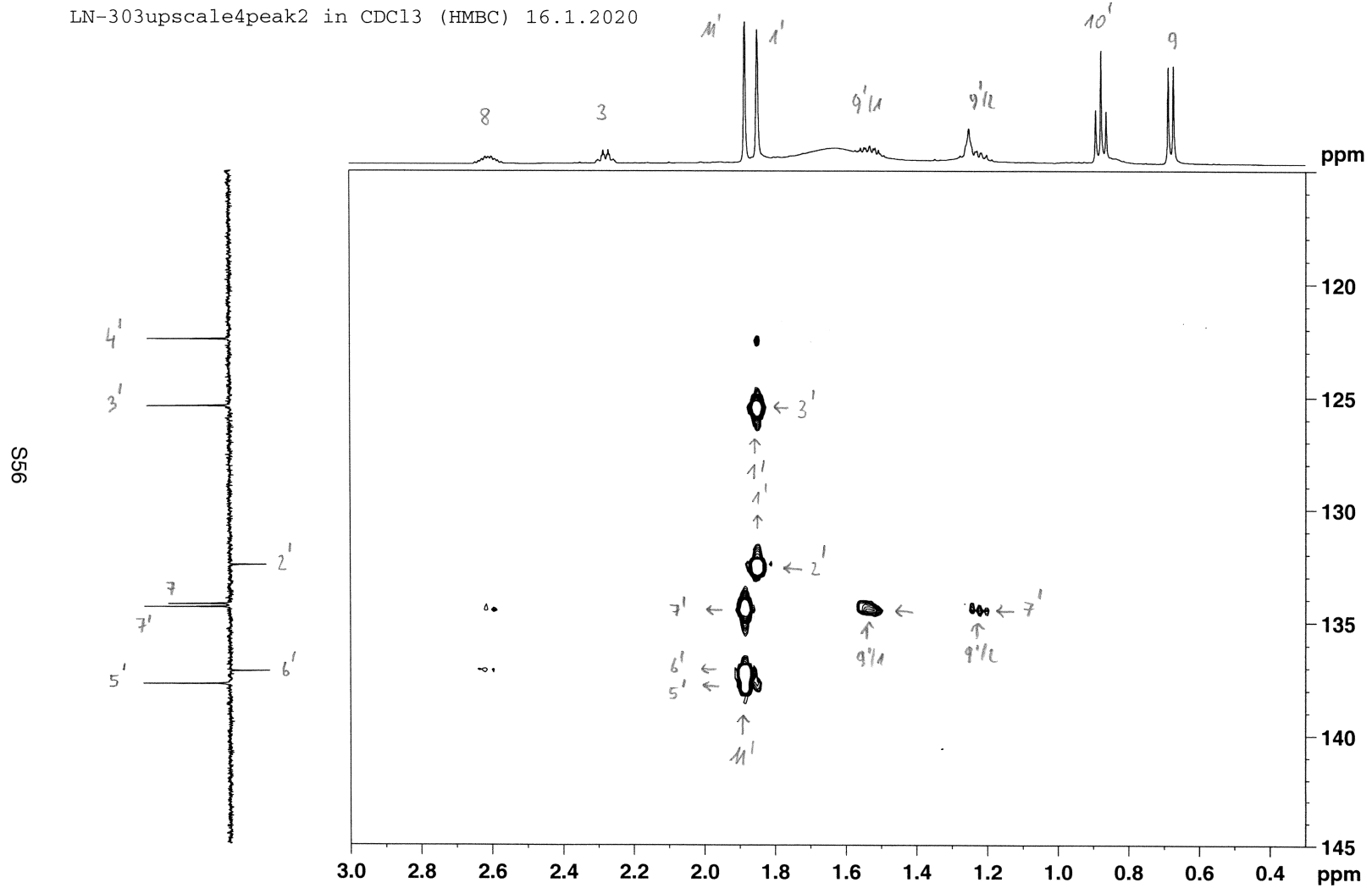

LN-303upscale4peak2 in CDCl3 (HMBC) 16.1.2020
OMe
7'
4
2
12'/11
12'/12
8
ppm
5
8a
4
5
8a
2
4
156
157
158
159
160
161
162
163
164
165
5.4
5.2
5.0
4.8
4.6
4.4
4.2
4.0
3.8
3.6
3.4
3.2
3.0
2.8
2.6
ppm

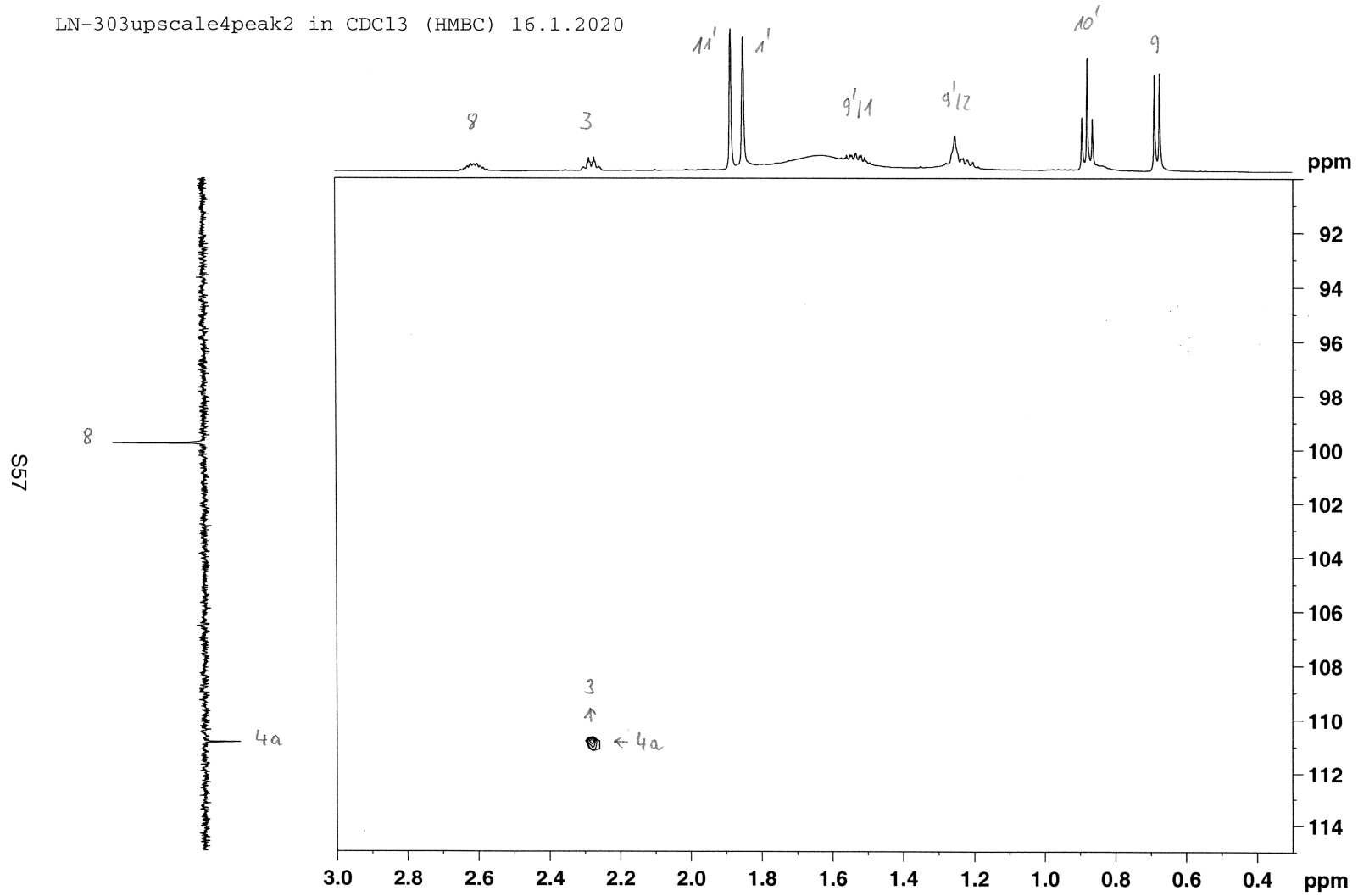

LN-303upscale4peak2 in CDCl3 (HMBC) 16.1.2020
OMe
7'
4
2
12'/1
12'/2
8
ppm
4'
3'
2'
7
7'
6'
5'
2
↑
← 3'
← 2'
← 5'
← 7'
12'/1
12'/2
120
125
130
135
140
145
5.4
5.2
5.0
4.8
4.6
4.4
4.2
4.0
3.8
3.6
3.4
3.2
3.0
2.8
2.6
ppm

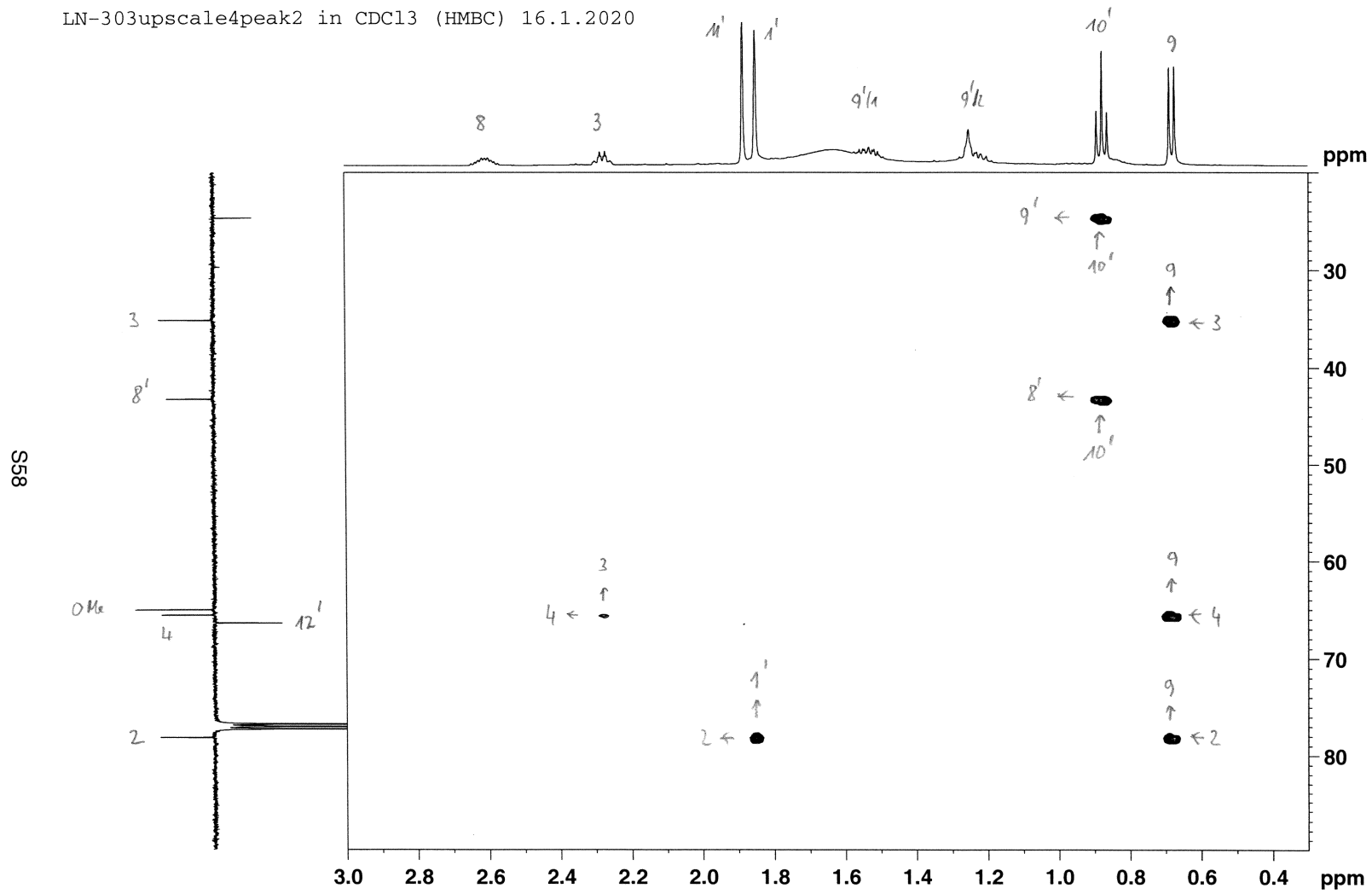

LN-303upscale4peak2 in CDCl3 (HMBC) 16.1.2020
OMe
7'
4
2
12'1
12'2
8
ppm
92
94
96
98
100
102
104
106
108
110
112
114
8
4a
4
4a
5.4
5.2
5.0
4.8
4.6
4.4
4.2
4.0
3.8
3.6
3.4
3.2
3.0
2.8
2.6
ppm

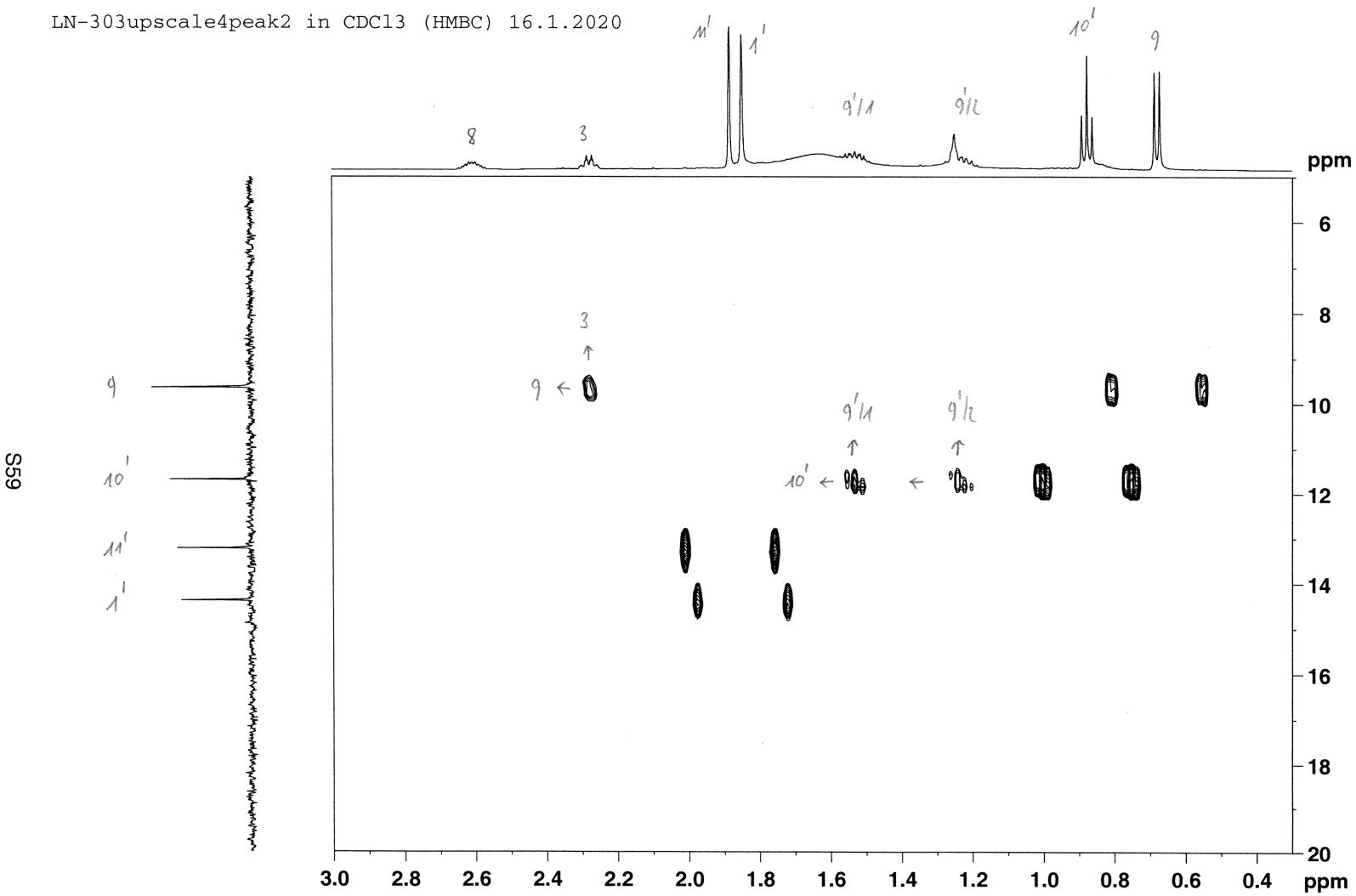

LN-303upscale4peak2 in CDCl3 (HMBC) 16.1.2020
OMe
7'
4
2
12'1
12'2
ppm
9'
3
8'
OMe
4
12'
2
←9'
7'
←3
2
4
←8'
7'
←12'
7'
←2
4
12'1
12'2
30
40
50
60
70
80
5.4
5.2
5.0
4.8
4.6
4.4
4.2
4.0
3.8
3.6
3.4
3.2
3.0
2.8
2.6
ppm


LN-303upscale4peak2 in CDCl3 (HMBC) 16.1.2020
OMe
7'
4
2
12'/1
12'/2
8
9
10'
11'
1'
ppm
6
8
10
12
14
16
18
20
5.4
5.2
5.0
4.8
4.6
4.4
4.2
4.0
3.8
3.6
3.4
3.2
3.0
2.8
2.6
ppm


LN-303upscale4peak2 in CDCl3 (HMBC) 16.1.2020
M'
1'
10'
9
8
3
9'/1
9'/2
ppm
4'
3'
2'
7
7'
5'
6'
120
125
130
135
140
145
3.0
2.8
2.6
2.4
2.2
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
ppm


LN-303upscale4peak2 in CDCl3 (HMBC) 16.1.2020
11'
1'
10'
9
8
3
9'/11
9'/12
ppm
92
94
96
98
100
102
104
106
108
110
112
114
3.0
2.8
2.6
2.4
2.2
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
ppm
8
4a
3
← 4a


LN-303upscale4peak2 in CDCl3 (HMBC) 16.1.2020
11'
1'
10'
9
8
3
9'/1
9'/2
ppm
9'
10'
9
3
8'
10'
3
OMe
4
12'
4
9
4
1'
2
9
2
2
3.0
2.8
2.6
2.4
2.2
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
ppm
30
40
50
60
70
80


LN-303upscale4peak2 in CDCl3 (HMBC) 16.1.2020
11'
1'
10'
9
8
3
9'/11
9'/12
ppm
6
8
10
12
14
16
18
20
3.0
2.8
2.6
2.4
2.2
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
ppm

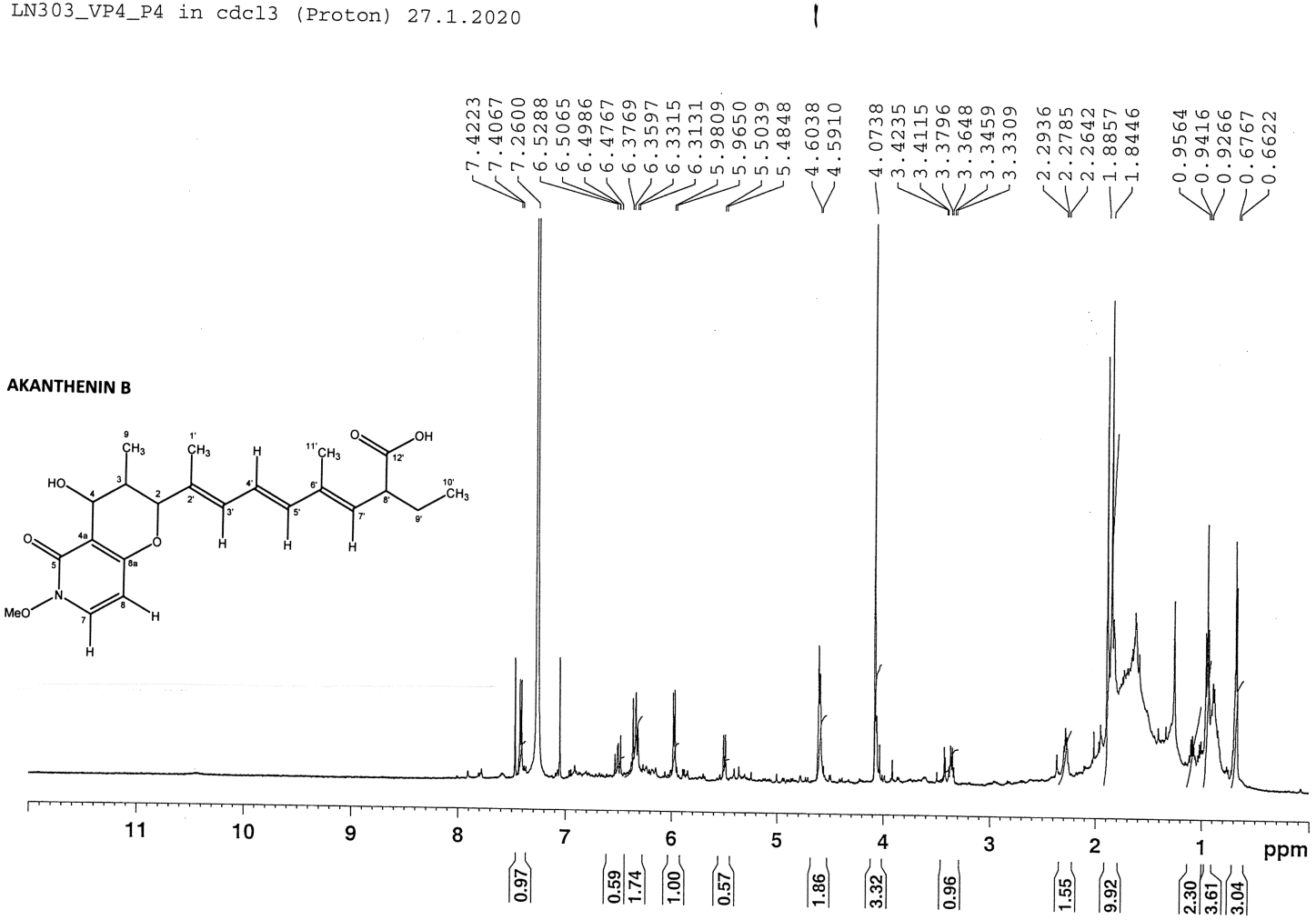
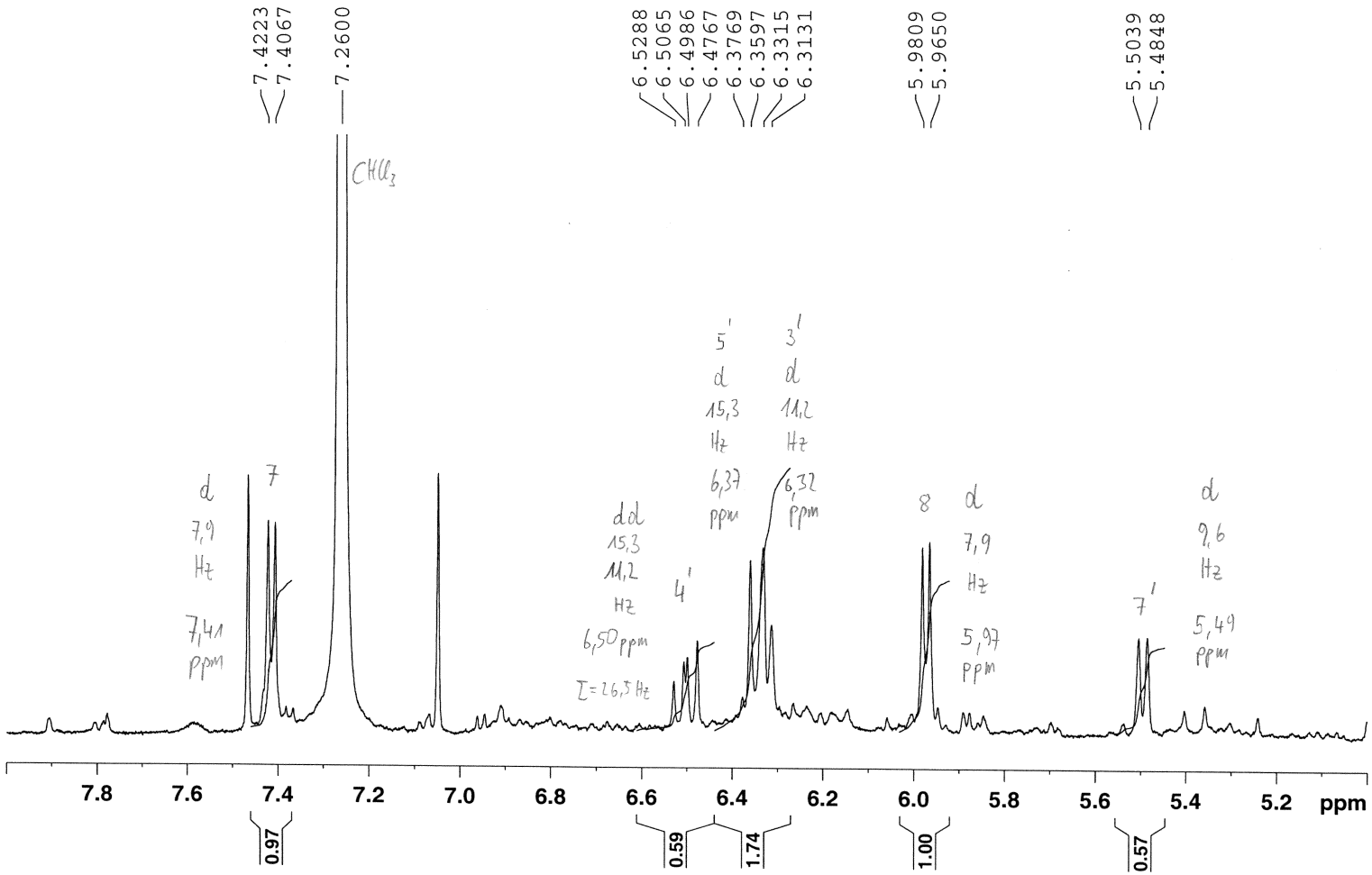
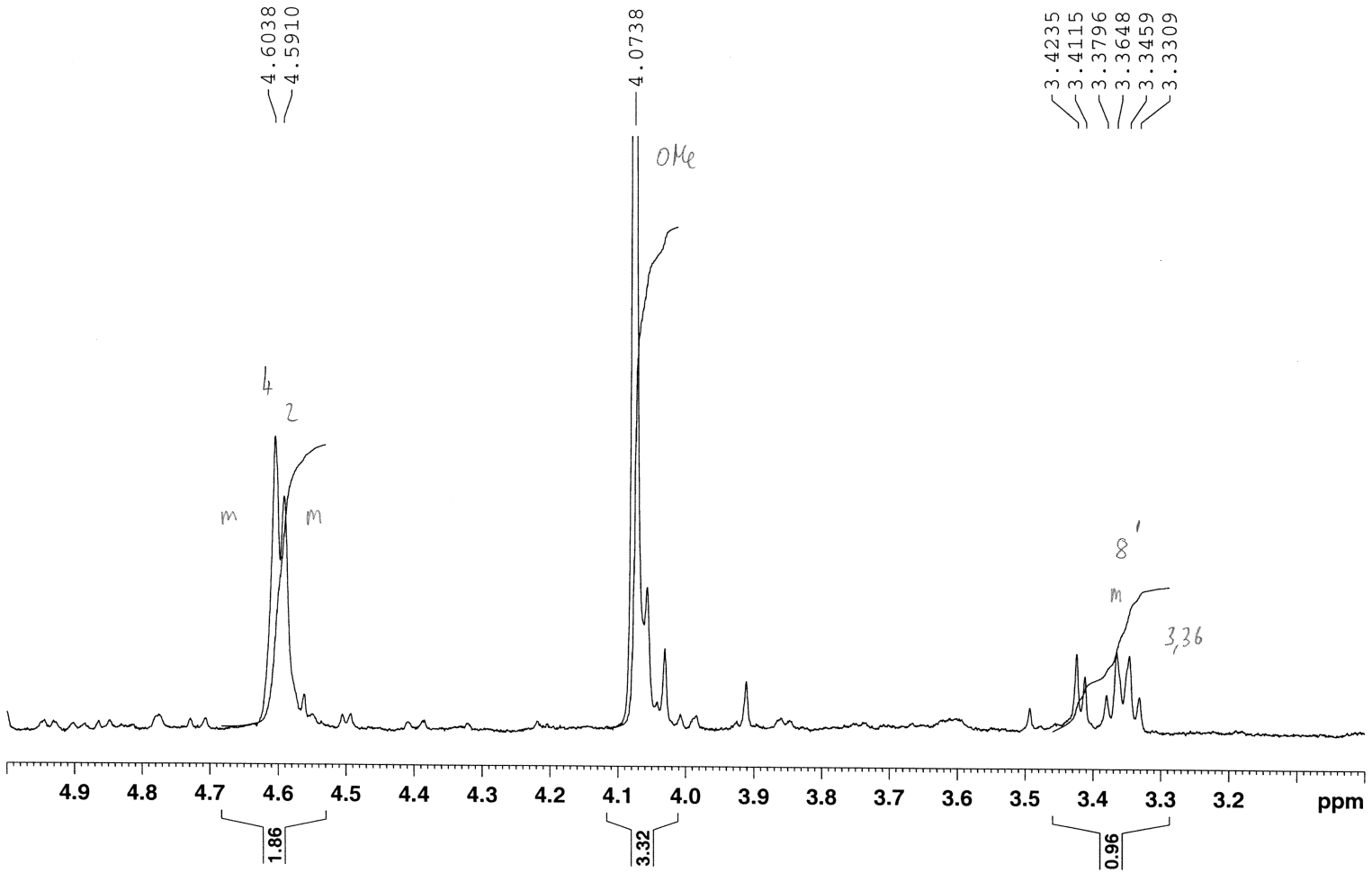


Figure S17 (pages S60-S63). ^{1}H NMR spectrum of **2** in $CDCl_3$ (δ in ppm).

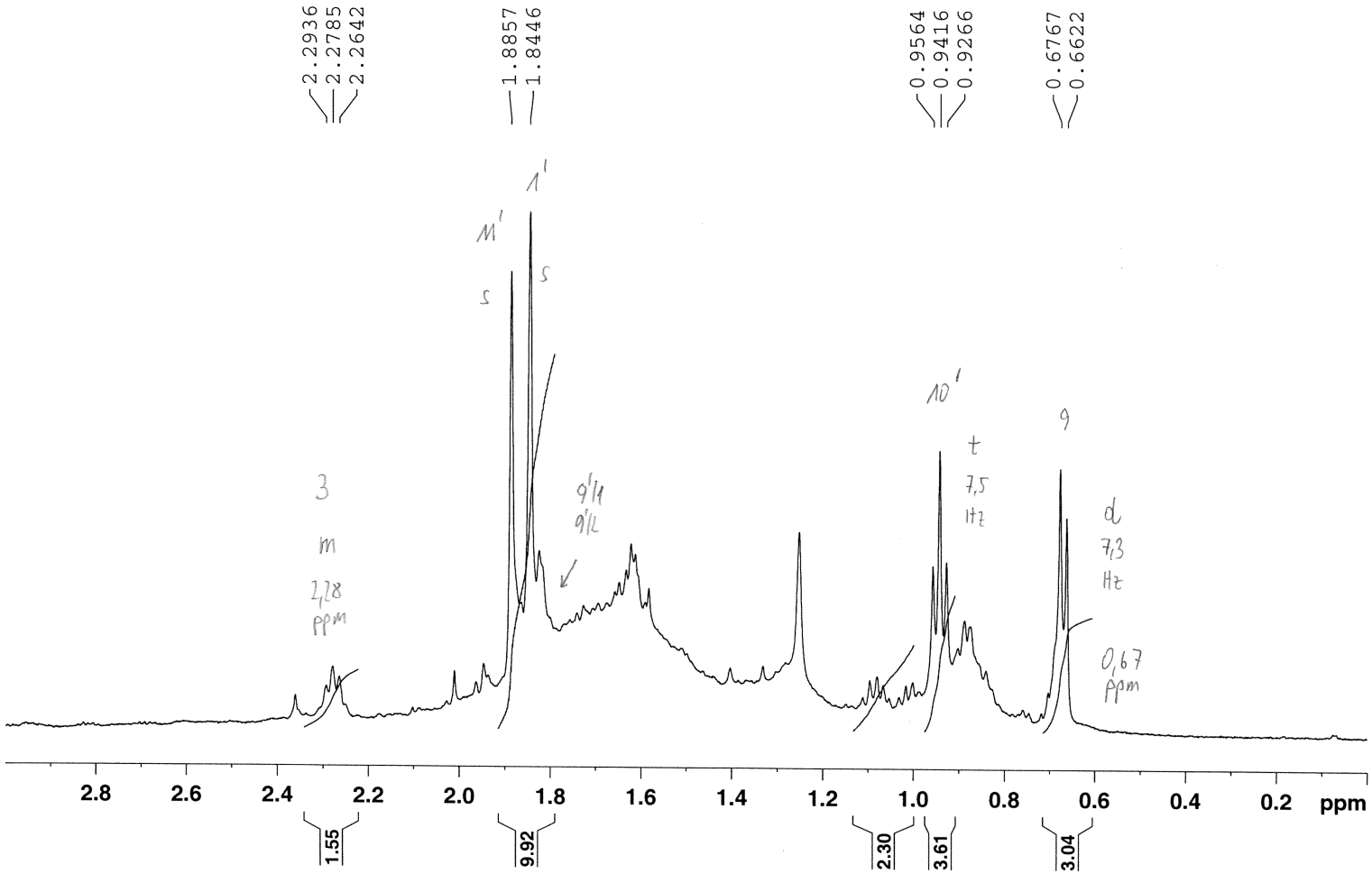
LN303_VP4_P4 in cdcl3 (Proton) 27.1.2020



LN303_VP4_P4 in cdcl3 (Proton) 27.1.2020



LN303_VP4_P4 in cdcl3 (Proton) 27.1.2020



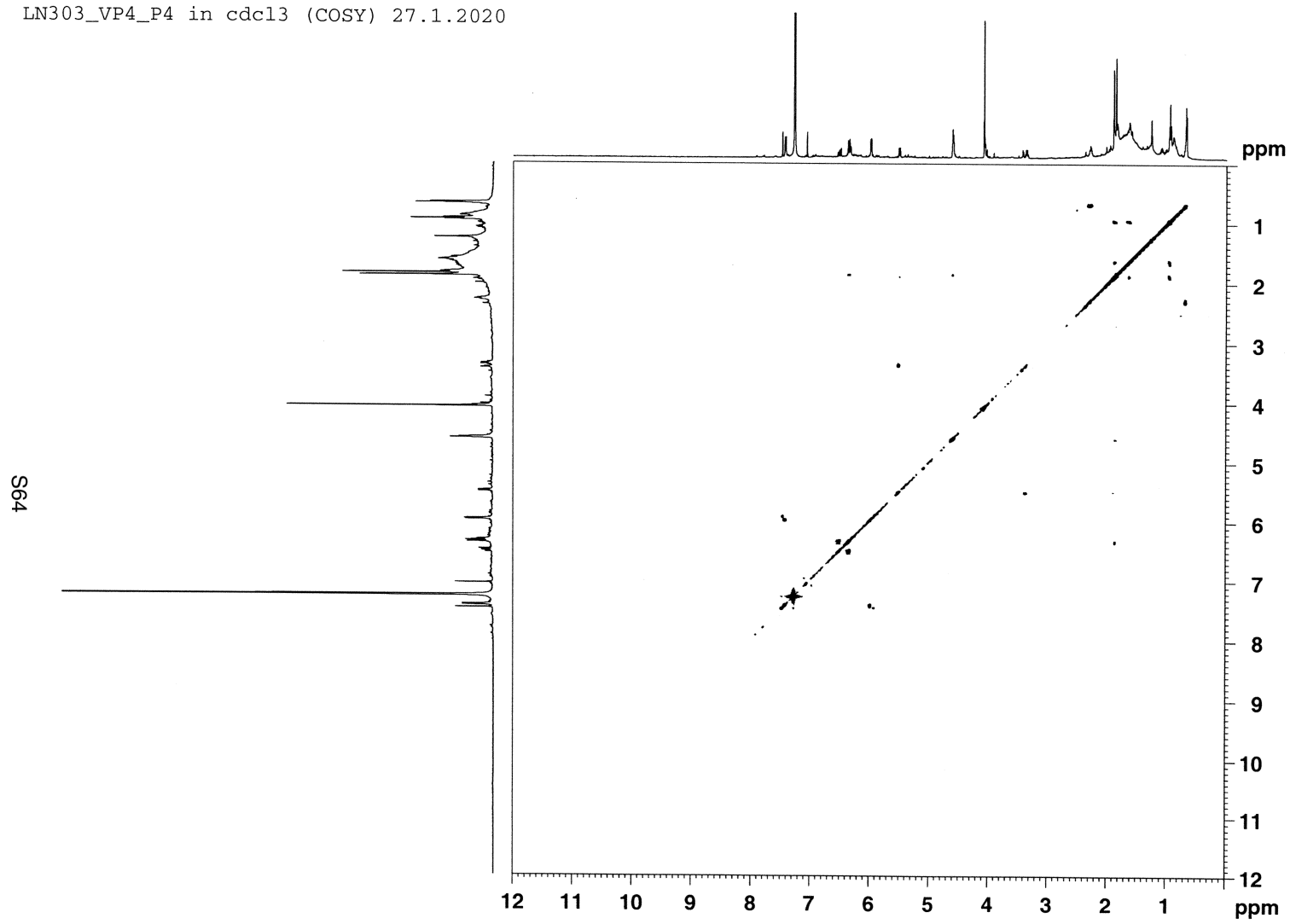
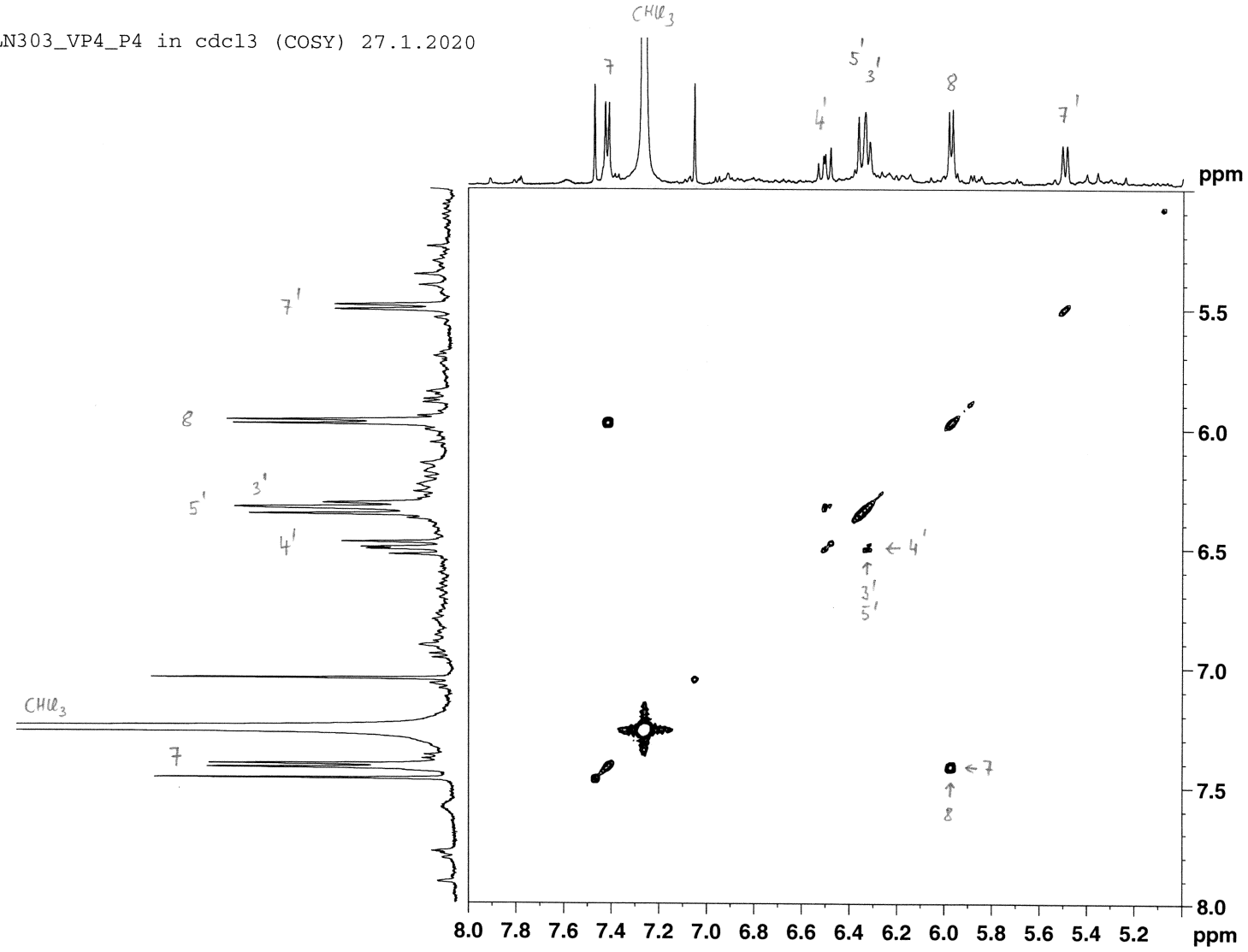
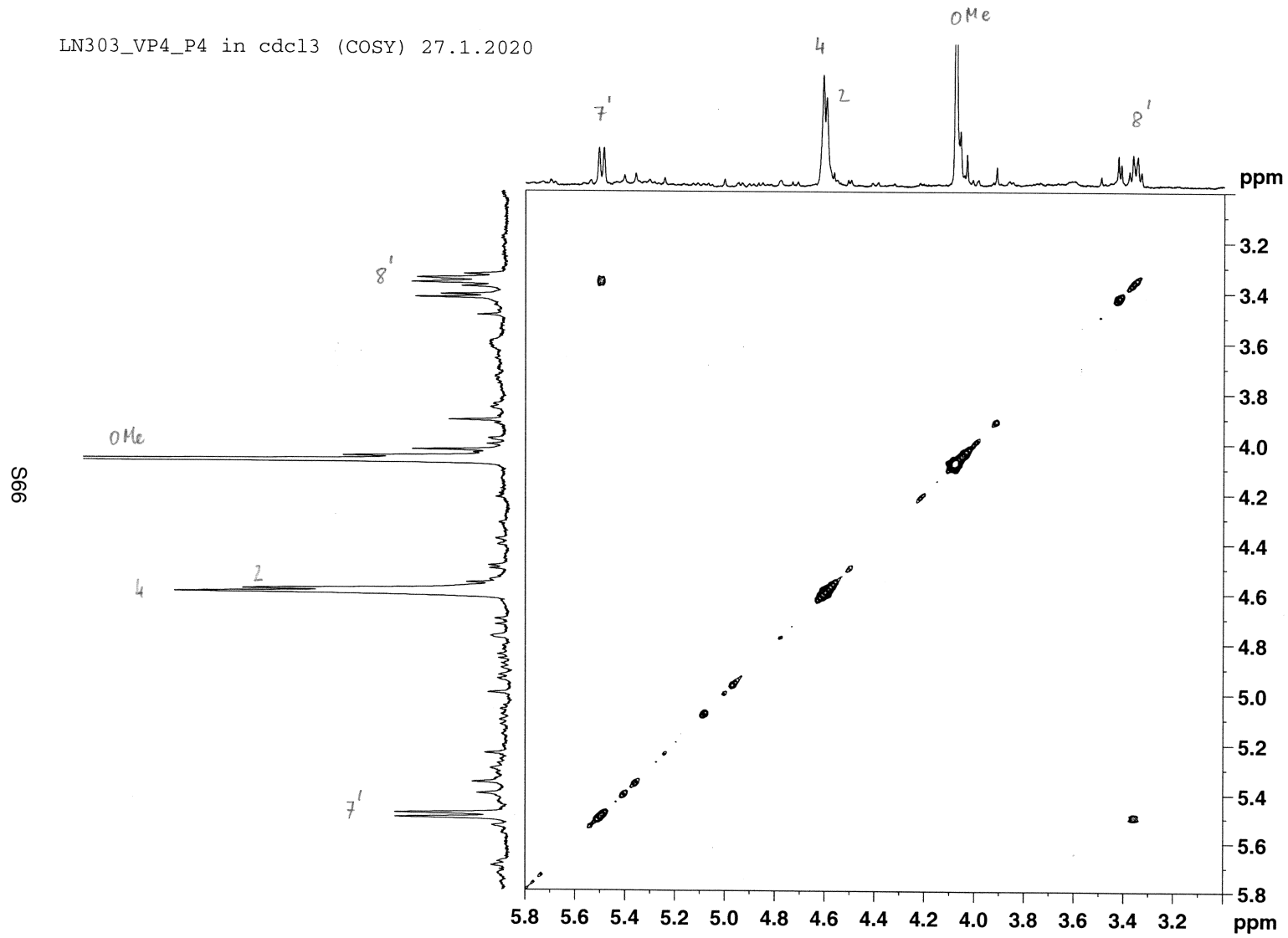


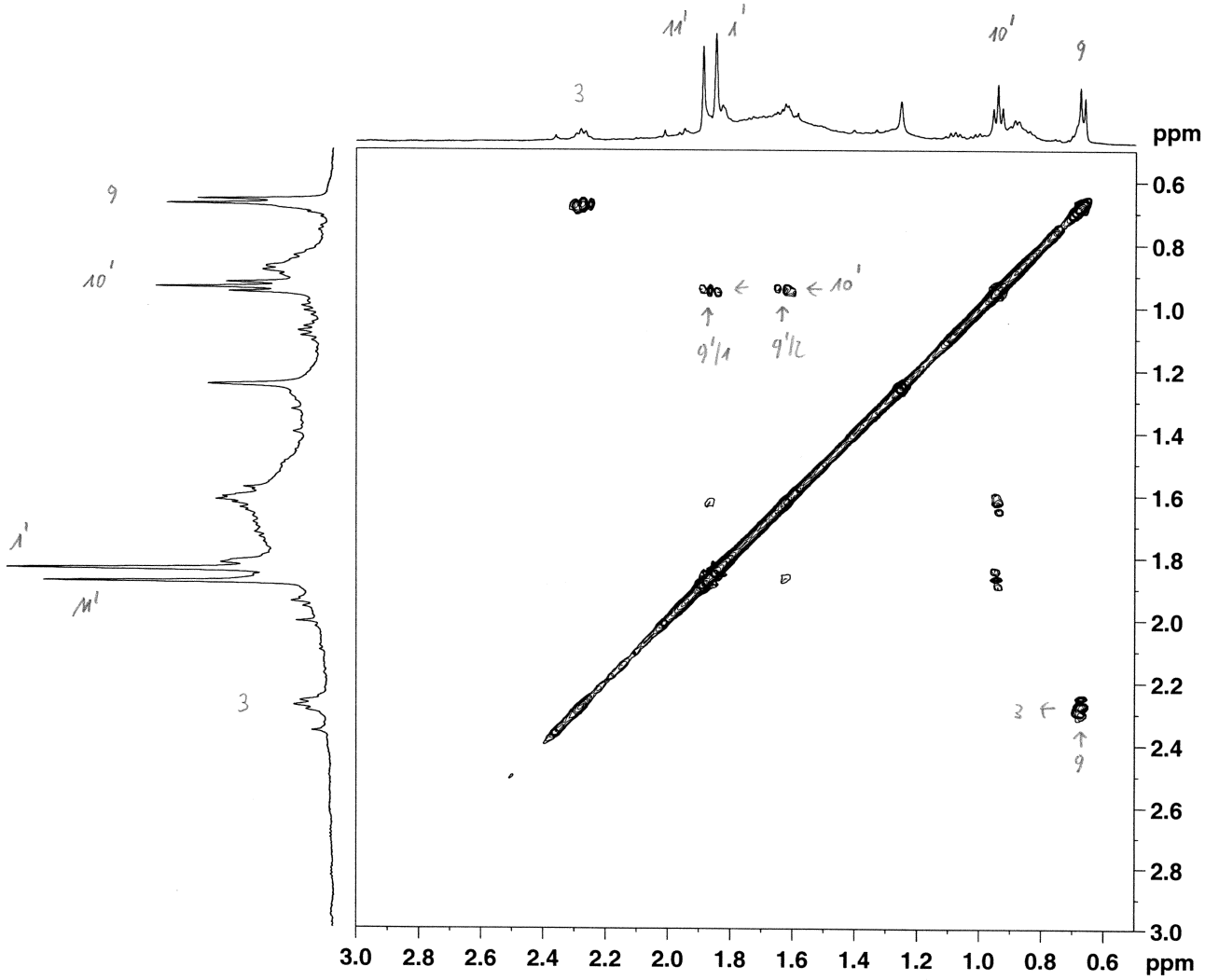
Figure S17 (pages S64-S67). COSY spectrum of **2** in $CDCl_3$ (δ in ppm).

LN303_VP4_P4 in cdcl3 (COSY) 27.1.2020




LN303_VP4_P4 in cdcl3 (COSY) 27.1.2020
OMe
4
2
7'
8'
ppm
5.8 5.6 5.4 5.2 5.0 4.8 4.6 4.4 4.2 4.0 3.8 3.6 3.4 3.2 ppm

LN303_VP4_P4 in cdcl3 (COSY) 27.1.2020



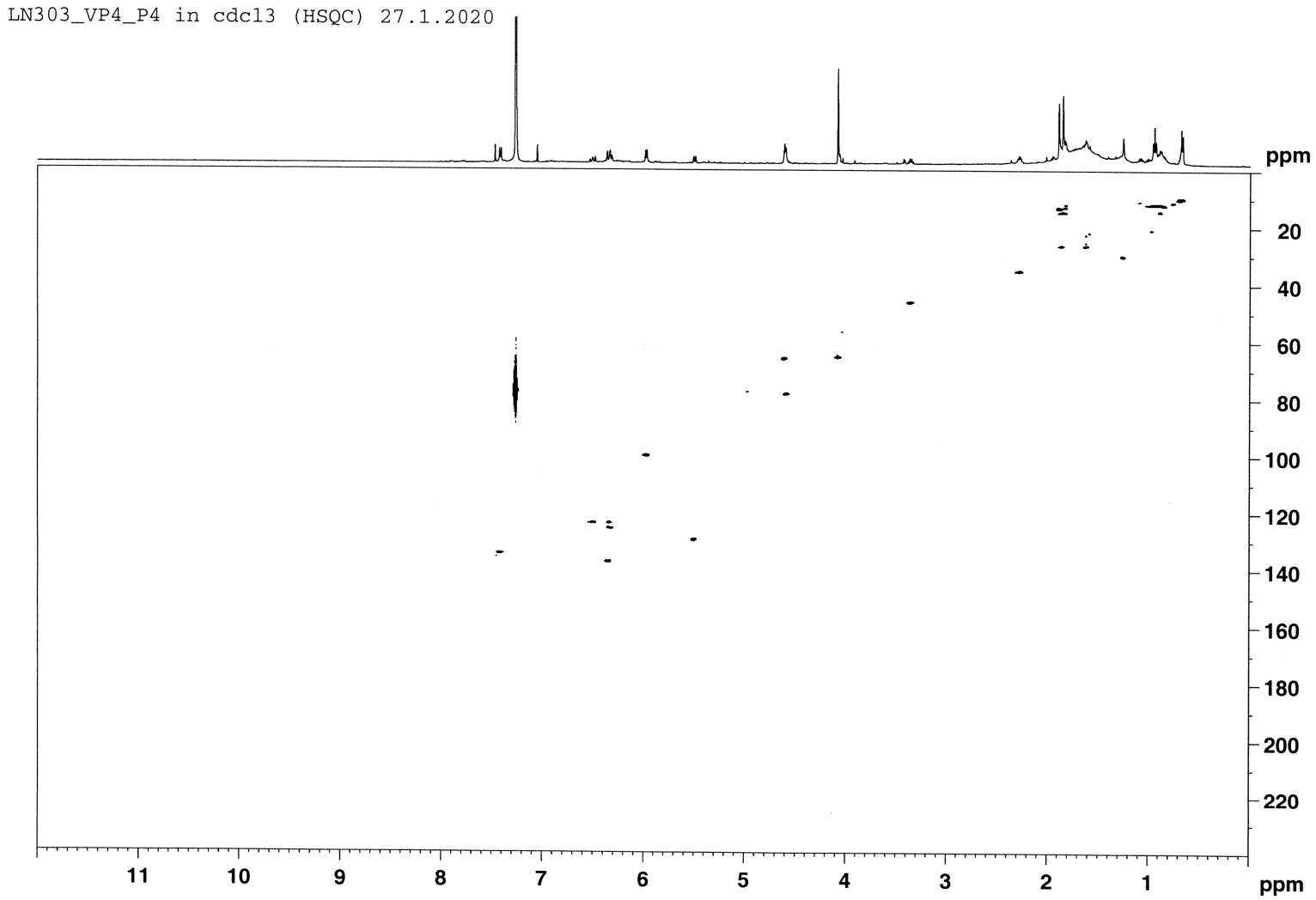
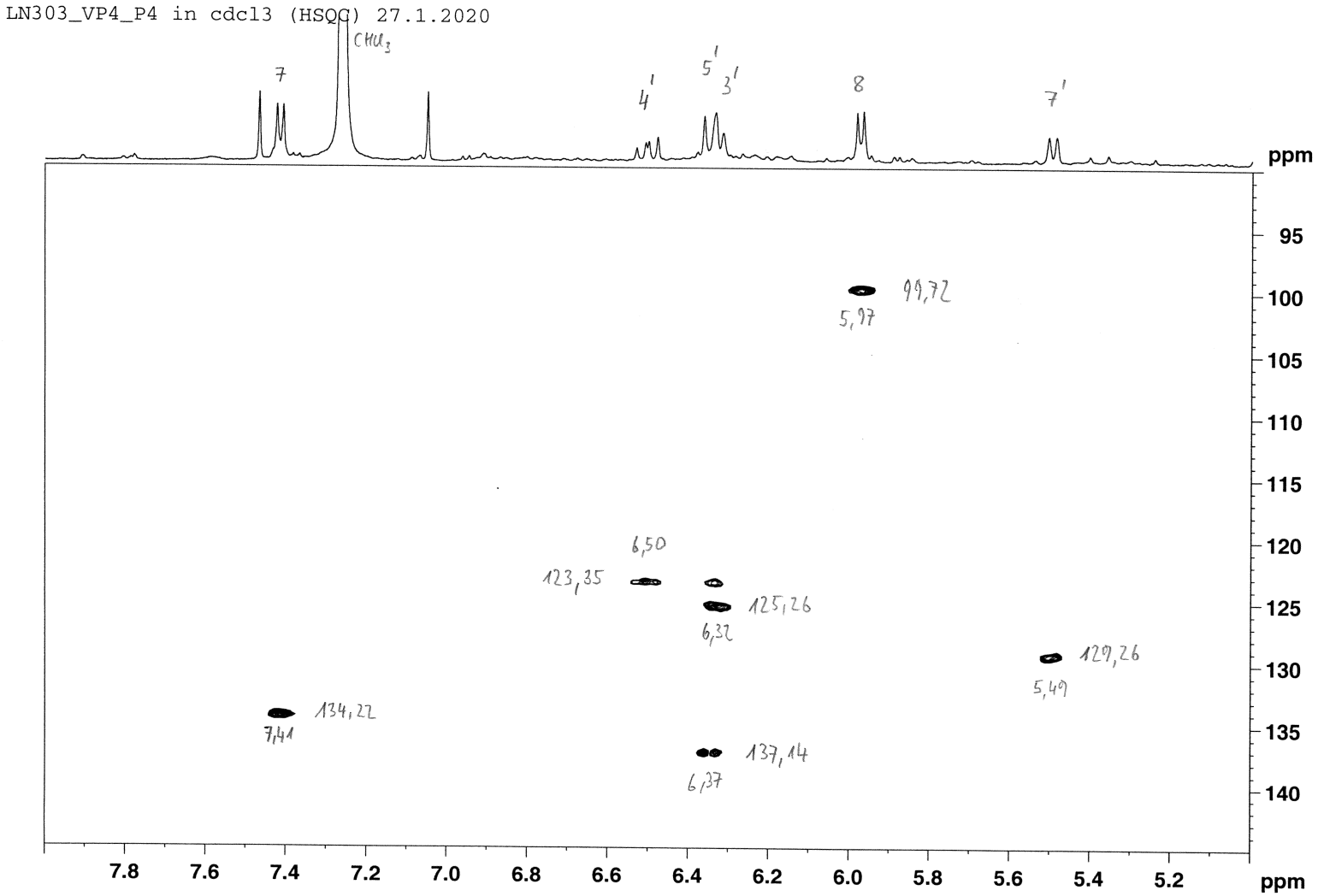
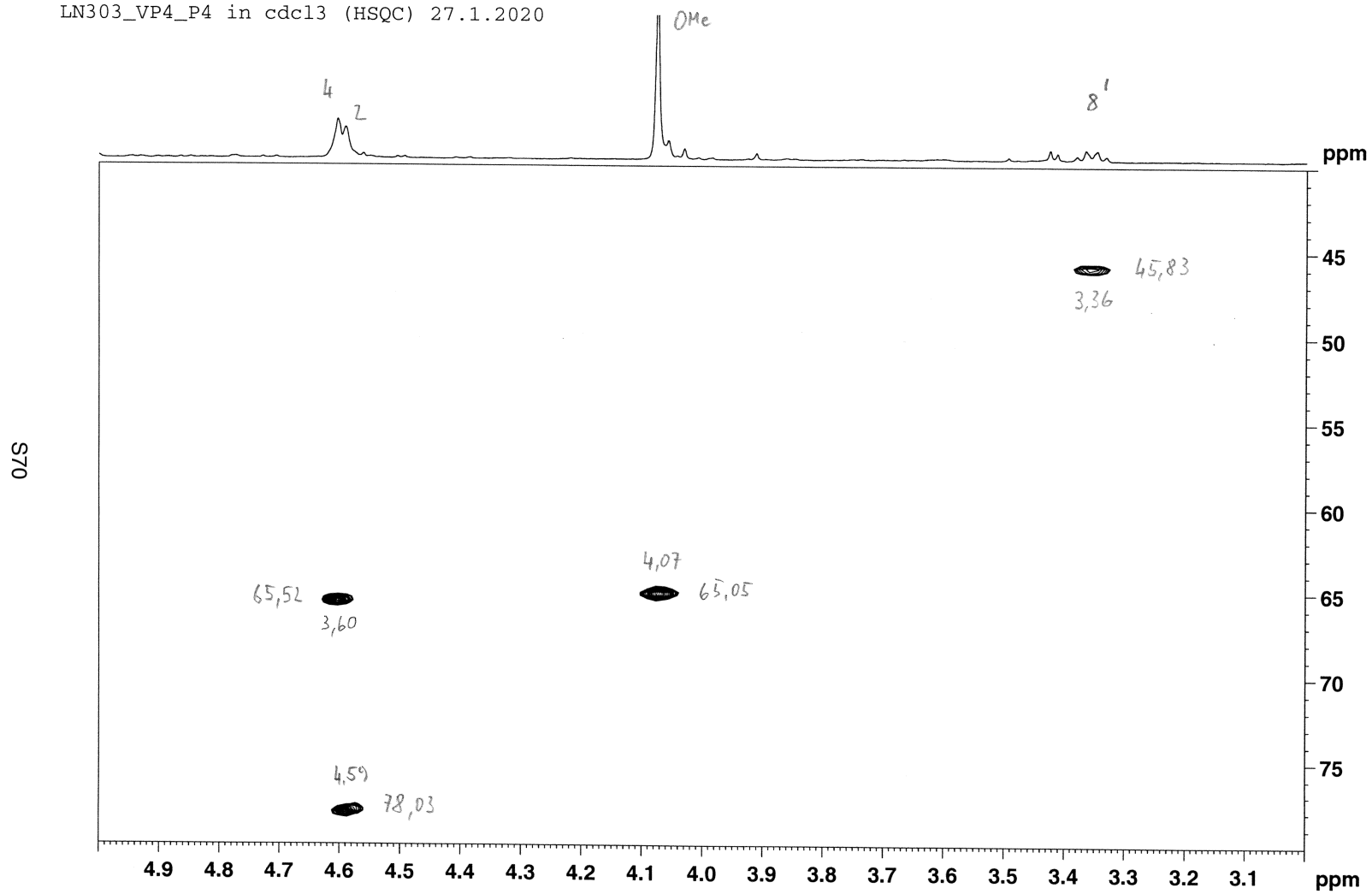
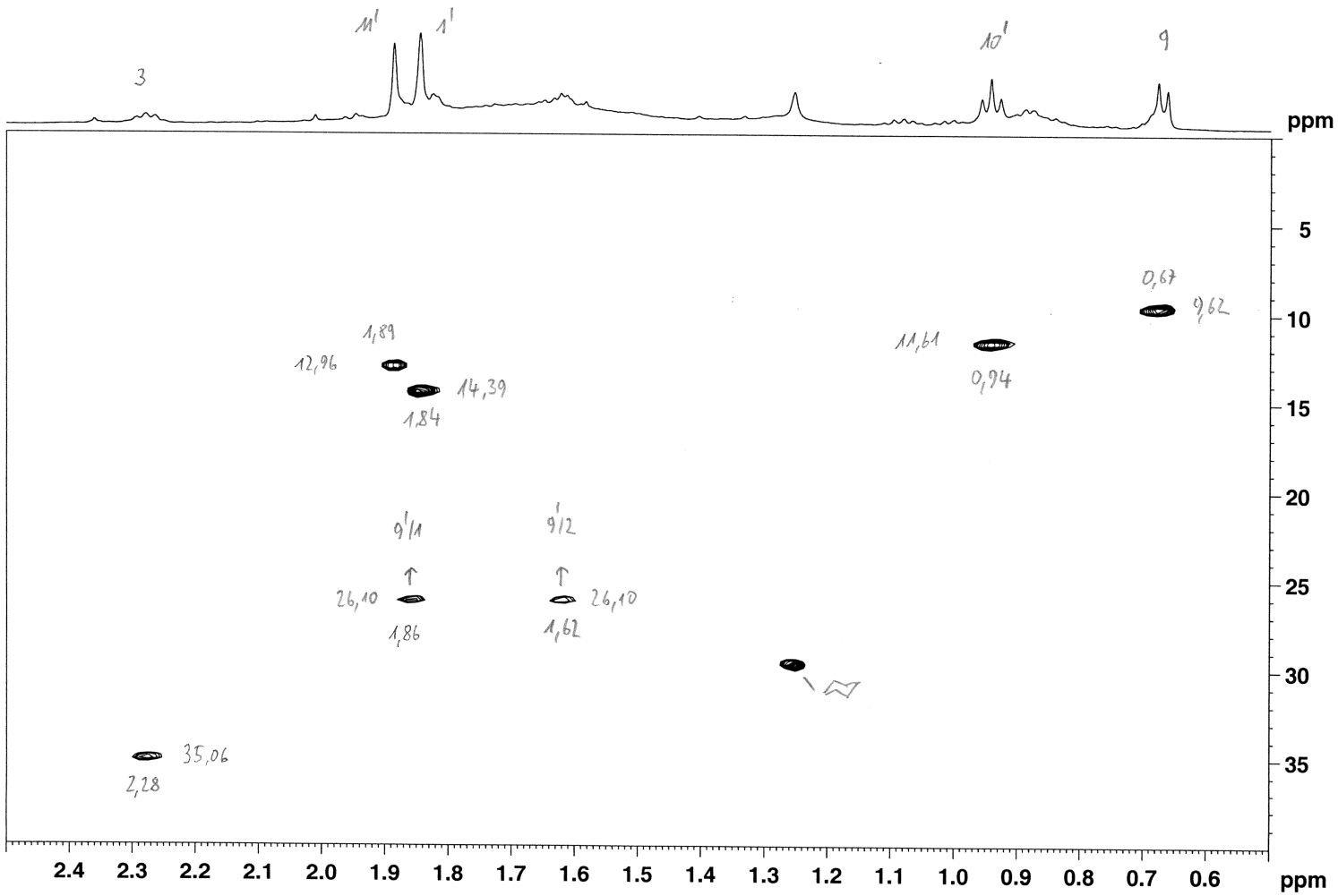


Figure S17 (pages S68-71). HSQC spectrum of **2** in $CDCl_3$ (δ in ppm).


LN303_VP4_P4 in cdcl3 (HSQC) 27.1.2020
CHCl3
7
4'
5'
3'
8
7'
ppm
95
100
105
110
115
120
125
130
135
140
99,72
5,97
6,50
123,35
125,26
6,32
129,26
5,49
134,22
7,41
137,14
6,37
7.8
7.6
7.4
7.2
7.0
6.8
6.6
6.4
6.2
6.0
5.8
5.6
5.4
5.2
ppm


LN303_VP4_P4 in cdcl3 (HSQC) 27.1.2020
OMe
4
2
8'
ppm
45,83
3,36
4,07
65,05
65,52
3,60
4,59
78,03
S70
4.9 4.8 4.7 4.6 4.5 4.4 4.3 4.2 4.1 4.0 3.9 3.8 3.7 3.6 3.5 3.4 3.3 3.2 3.1
ppm
45 50 55 60 65 70 75

LN303_VP4_P4 in cdcl3 (HSQC) 27.1.2020



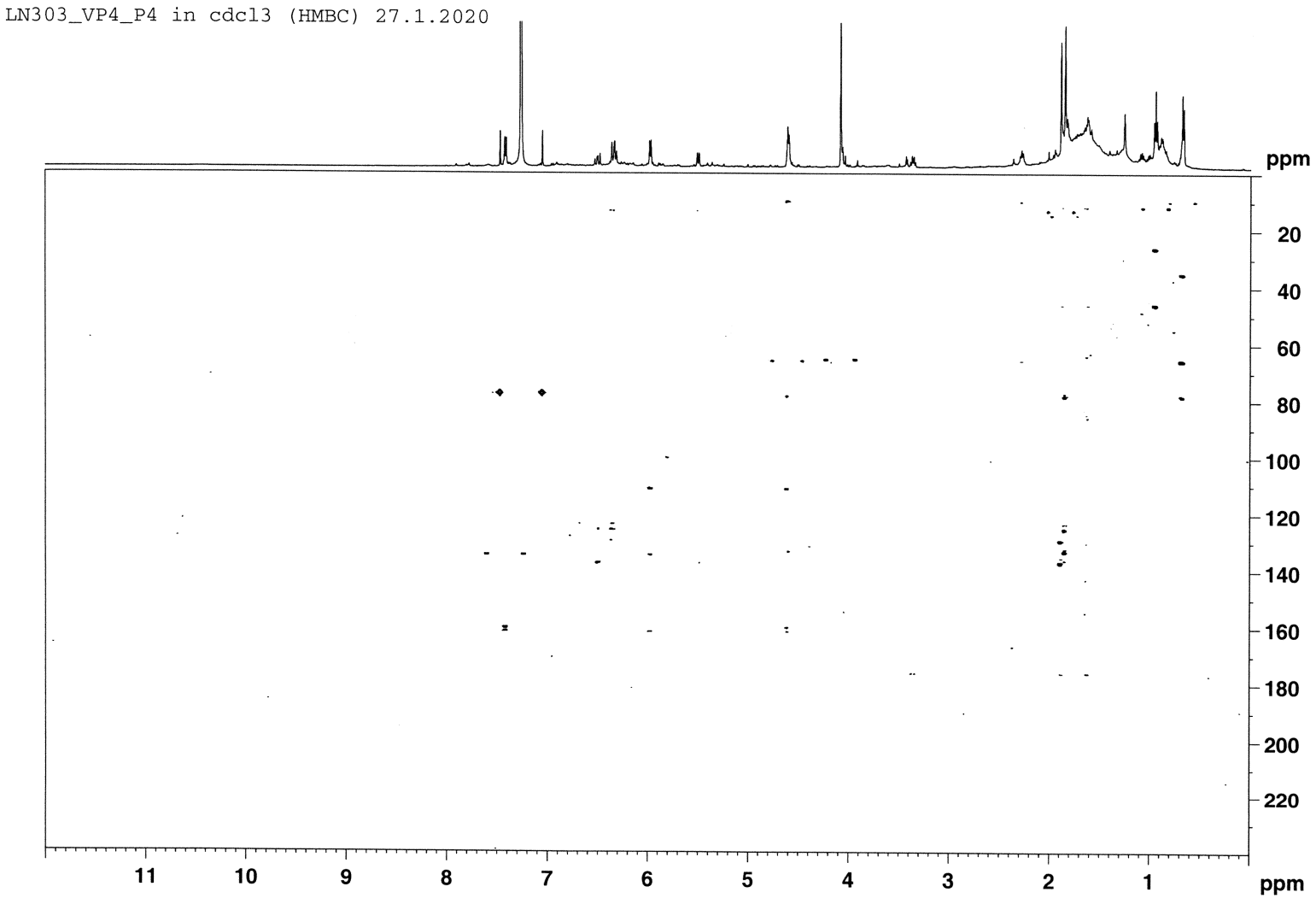
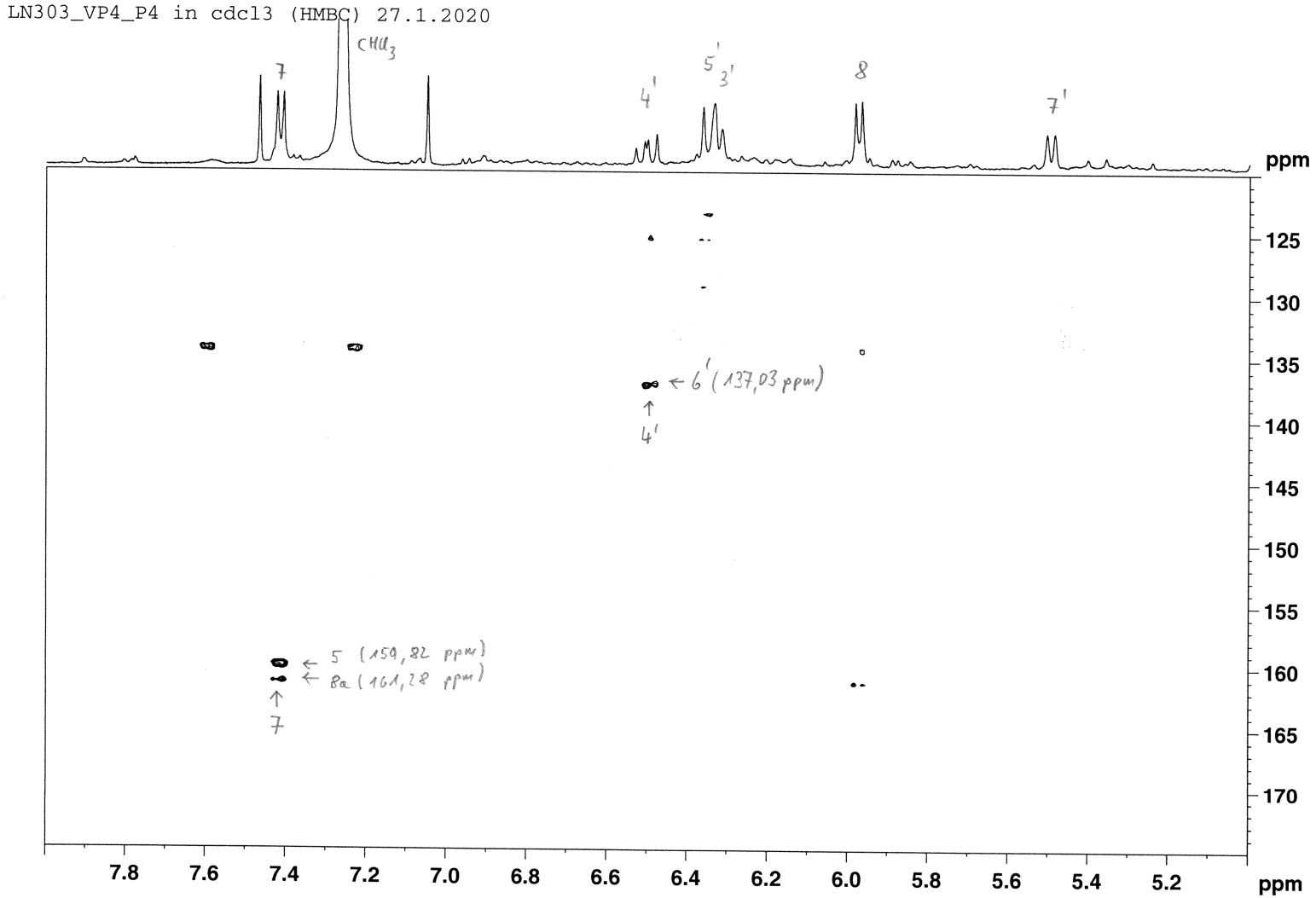
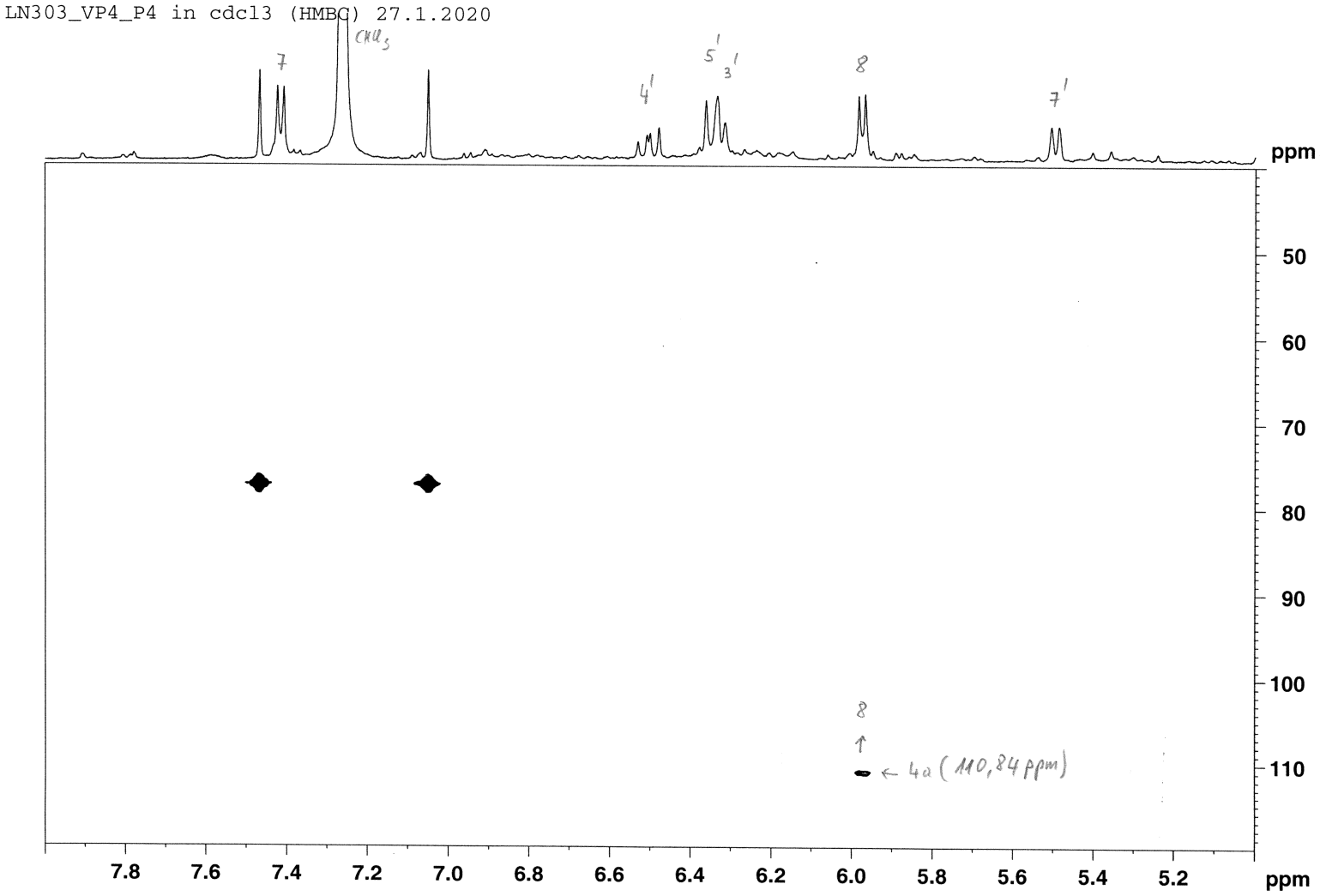
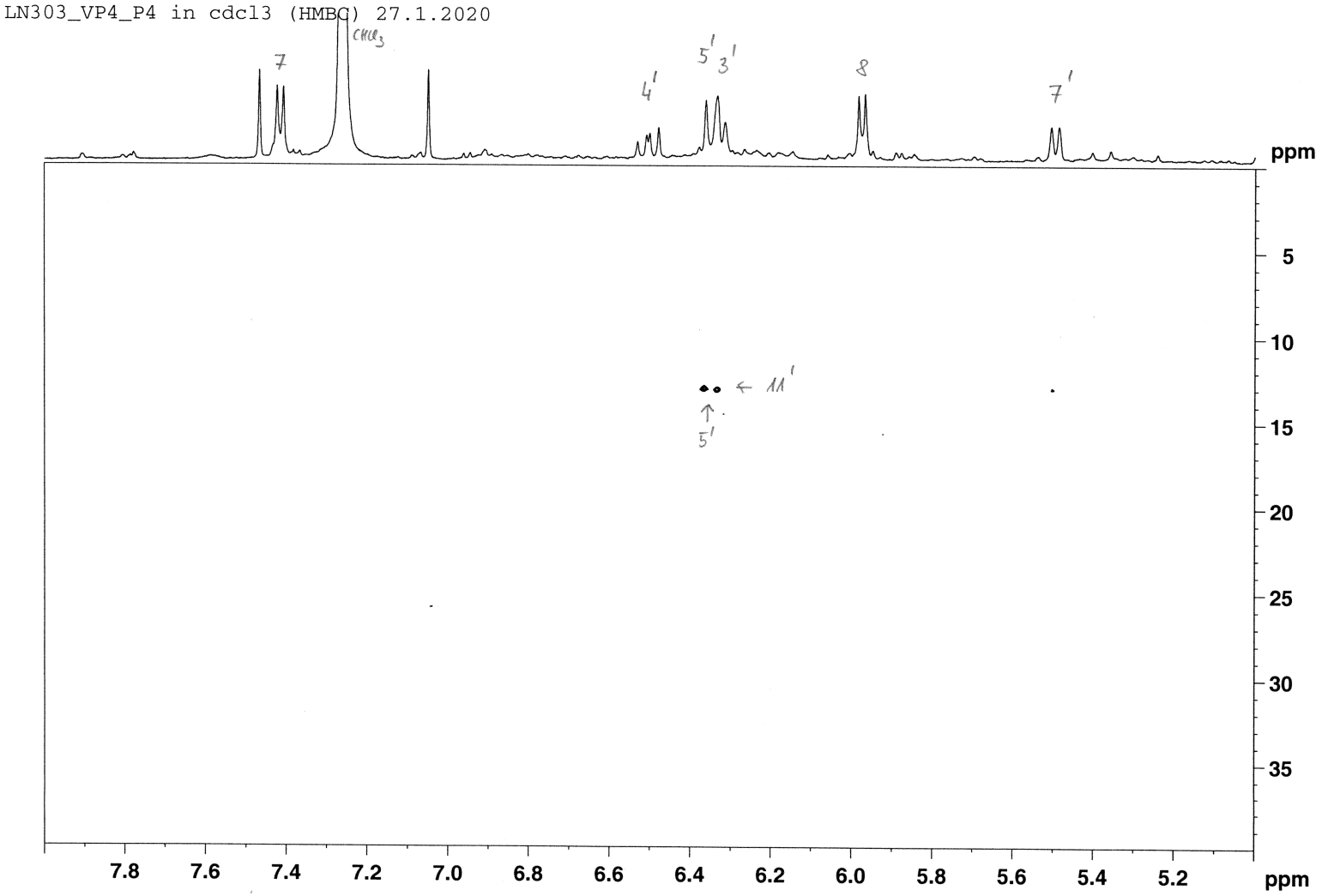
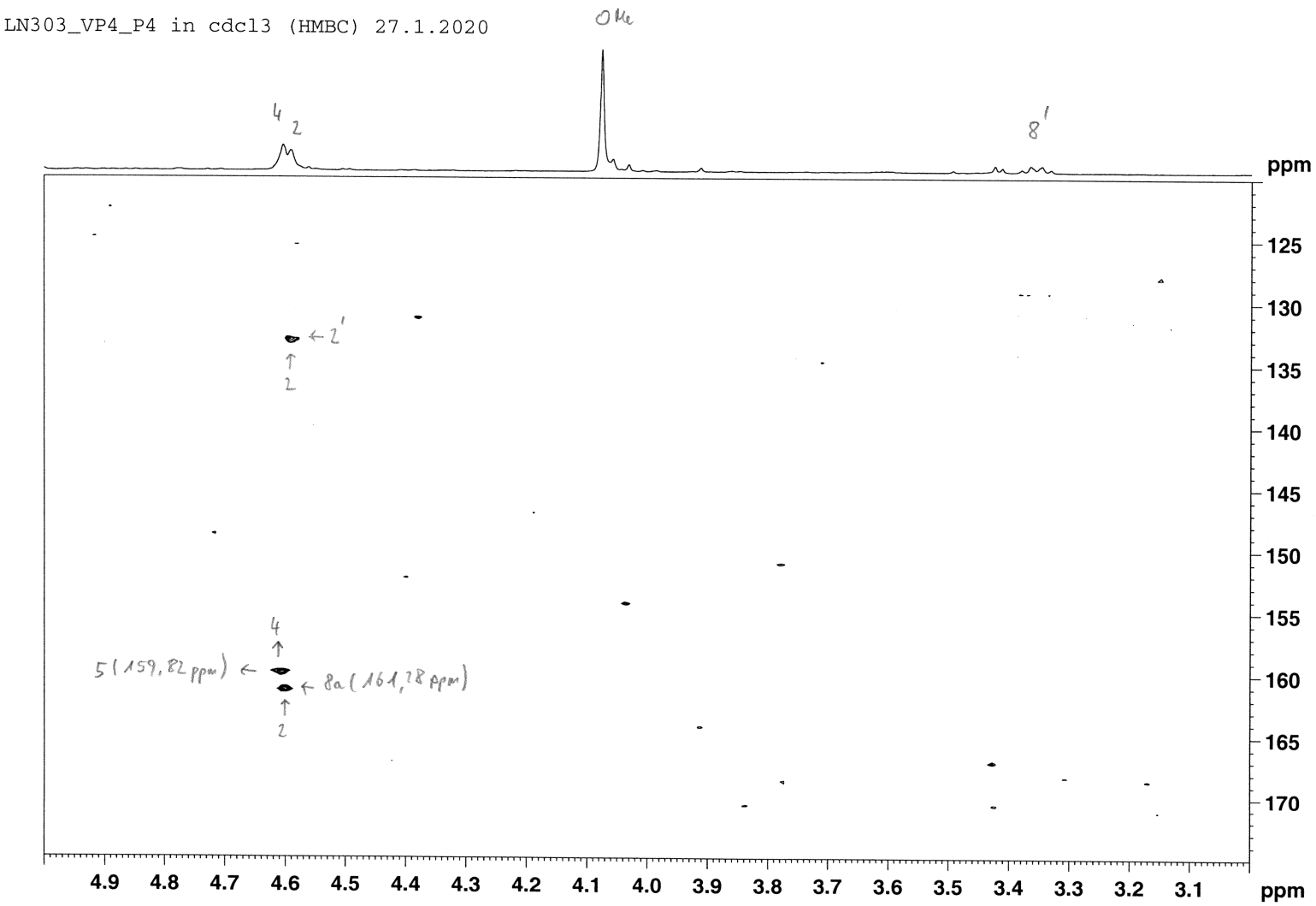


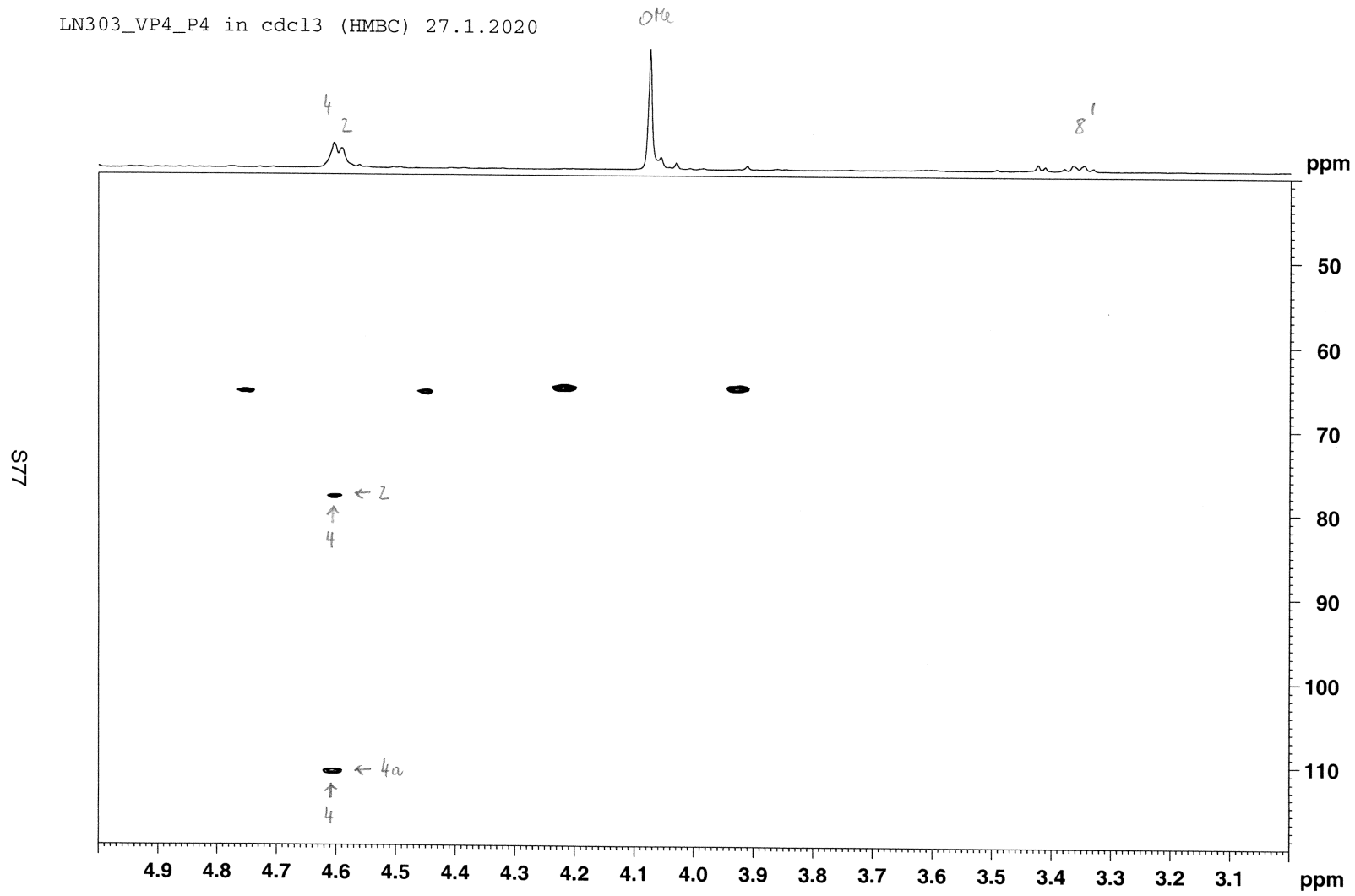
Figure S17 (pages S72-S82). HMBC spectrum of **2** in $CDCl_3$ (δ in ppm).

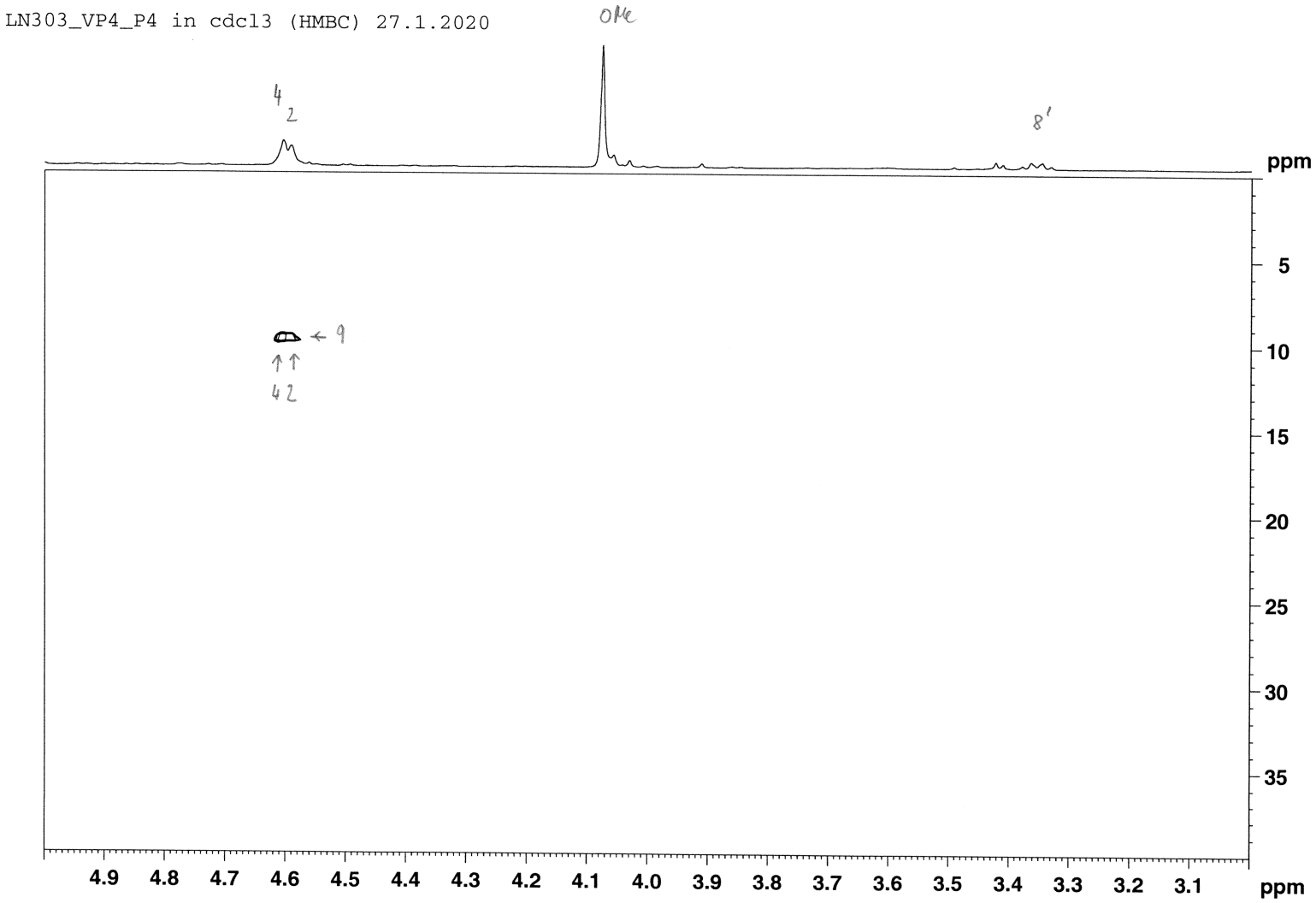

LN303_VP4_P4 in cdcl3 (HMBC) 27.1.2020
CHCl3
7
4'
5'
3'
8
7'
ppm
125
130
135
140
145
150
155
160
165
170
← 6' (137,03 ppm)
4'
← 5 (159,82 ppm)
← 8a (161,28 ppm)
7
7.8
7.6
7.4
7.2
7.0
6.8
6.6
6.4
6.2
6.0
5.8
5.6
5.4
5.2
ppm

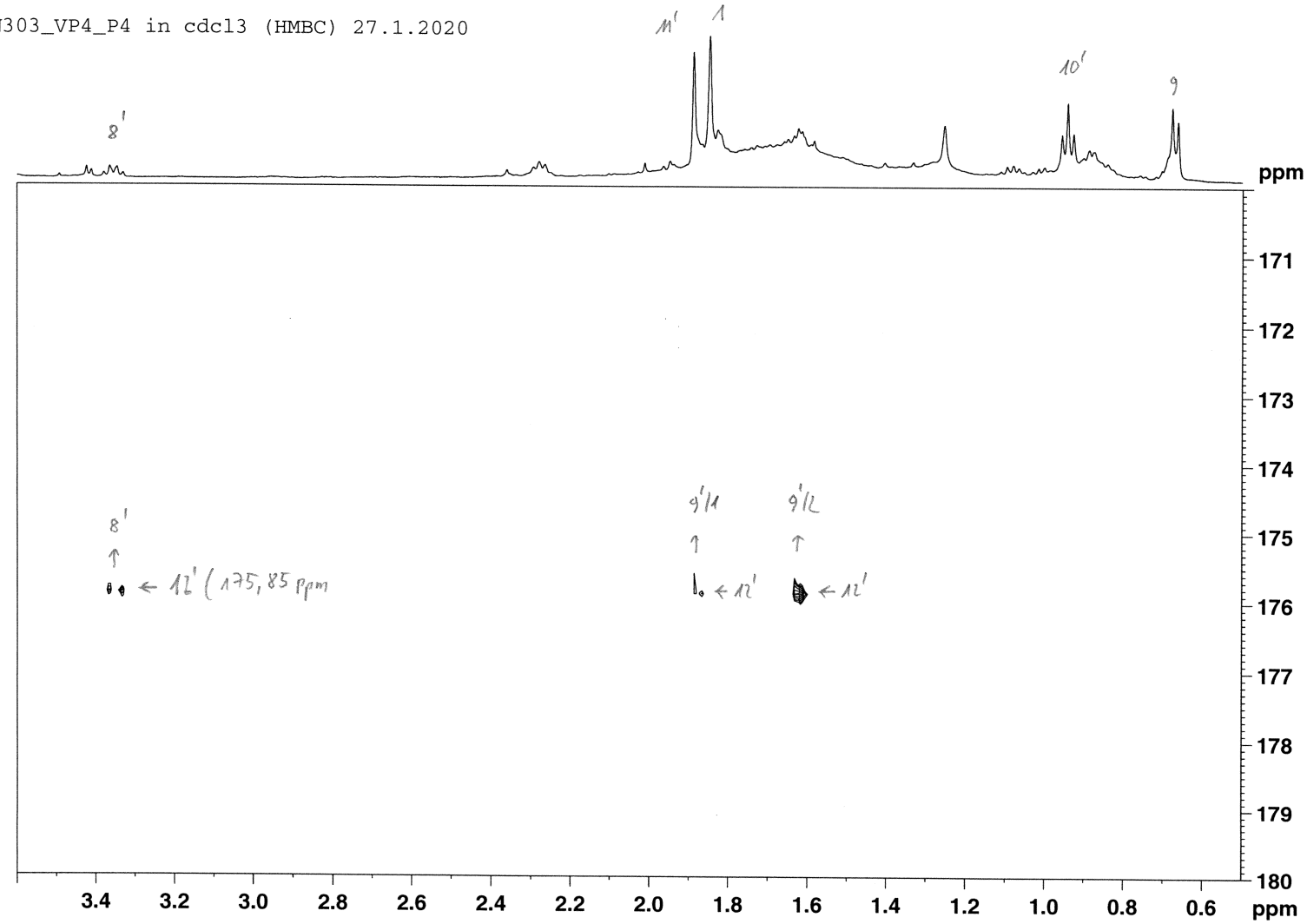

LN303_VP4_P4 in cdcl3 (HMBC) 27.1.2020
7
CHCl3
4'
5'
3'
8
7'
ppm
50
60
70
80
90
100
110
8
← 4a (110,84 ppm)
7.8
7.6
7.4
7.2
7.0
6.8
6.6
6.4
6.2
6.0
5.8
5.6
5.4
5.2
ppm

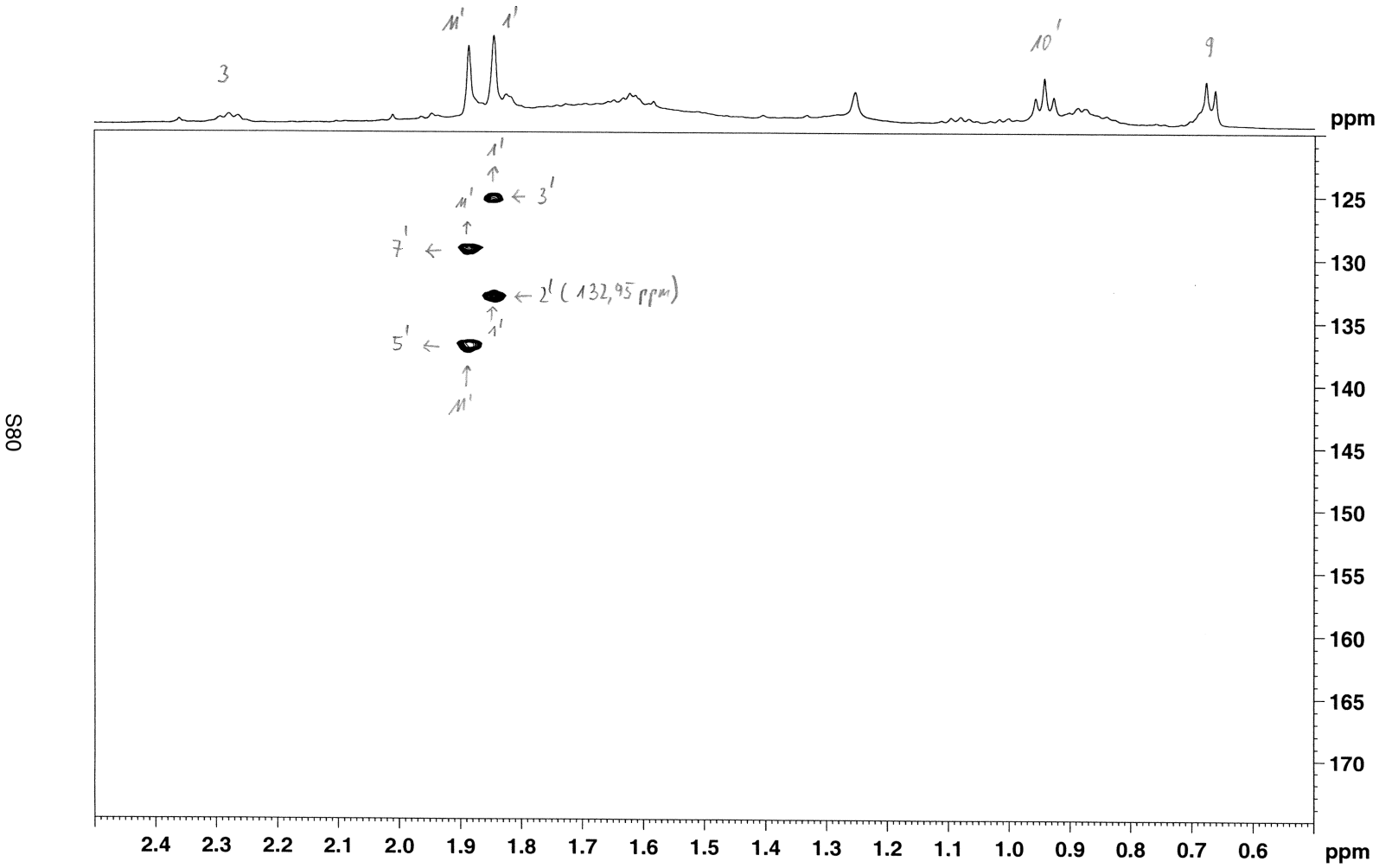

LN303_VP4_P4 in cdcl3 (HMBC) 27.1.2020
CHCl3
7
4'
5'
3'
8
7'
11'
5'
ppm
5
10
15
20
25
30
35
7.8
7.6
7.4
7.2
7.0
6.8
6.6
6.4
6.2
6.0
5.8
5.6
5.4
5.2
ppm

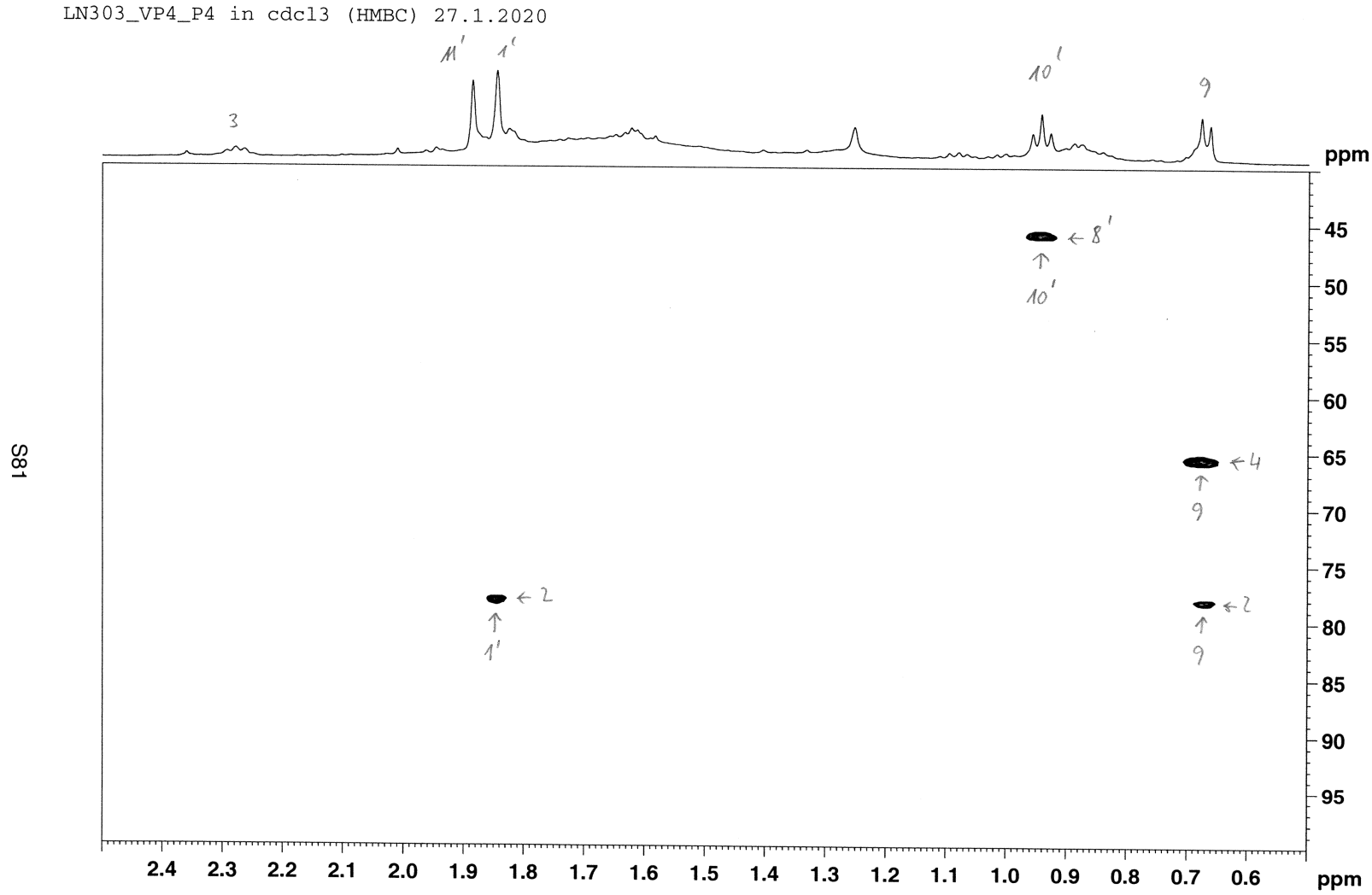

LN303_VP4_P4 in cdcl3 (HMBC) 27.1.2020
OMe
4
2
8'
ppm
125
130
135
140
145
150
155
160
165
170
← 2'
2
4
5 (159,82 ppm) ←
← 8a (161,78 ppm)
2
4.9
4.8
4.7
4.6
4.5
4.4
4.3
4.2
4.1
4.0
3.9
3.8
3.7
3.6
3.5
3.4
3.3
3.2
3.1
ppm

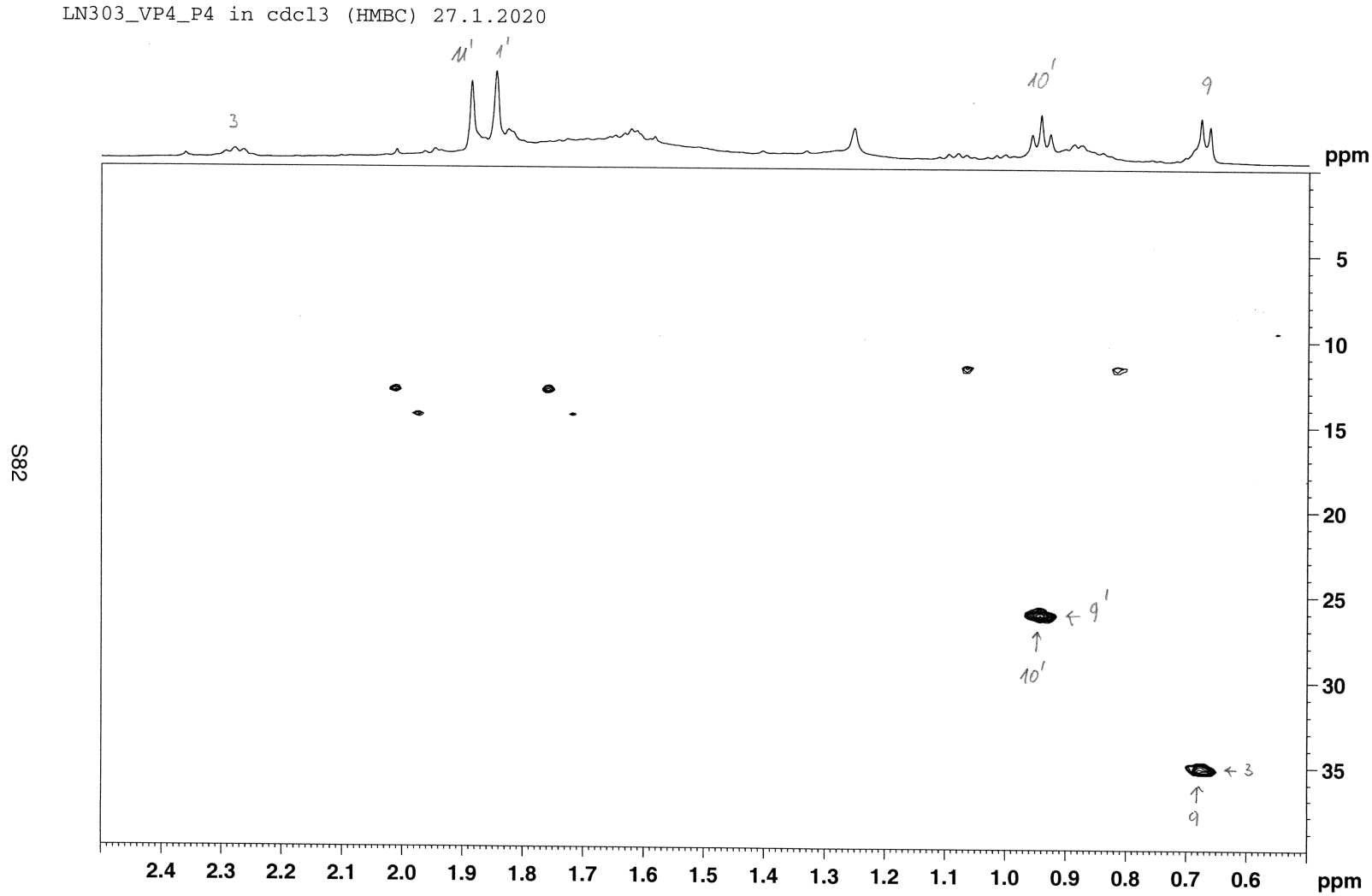

LN303_VP4_P4 in cdcl3 (HMBC) 27.1.2020
OMe
4
2
8
1
ppm
50
60
70
80
90
100
110
S77
← 2
4
← 4a
4
4.9
4.8
4.7
4.6
4.5
4.4
4.3
4.2
4.1
4.0
3.9
3.8
3.7
3.6
3.5
3.4
3.3
3.2
3.1
ppm


LN303_VP4_P4 in cdcl3 (HMBC) 27.1.2020
OMe
4
2
8'
ppm
5
10
15
20
25
30
35
9
4 2
4.9
4.8
4.7
4.6
4.5
4.4
4.3
4.2
4.1
4.0
3.9
3.8
3.7
3.6
3.5
3.4
3.3
3.2
3.1
ppm


LN303_VP4_P4 in cdcl3 (HMBC) 27.1.2020
11'
1
10'
9
8'
ppm
171
172
173
174
175
176
177
178
179
180
8'
12' (175,85 ppm
9'/11
9'/12
11'
11'
3.4
3.2
3.0
2.8
2.6
2.4
2.2
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
ppm


LN303_VP4_P4 in cdcl3 (HMBC) 27.1.2020
3
M'
1'
10'
9
ppm
1'
M'
3'
7'
2' (132,95 ppm)
1'
5'
M'
125
130
135
140
145
150
155
160
165
170
2.4
2.3
2.2
2.1
2.0
1.9
1.8
1.7
1.6
1.5
1.4
1.3
1.2
1.1
1.0
0.9
0.8
0.7
0.6
ppm


LN303_VP4_P4 in cdcl3 (HMBC) 27.1.2020
11'
1'
10'
9
3
ppm
← 8'
10'
← 4
9
← 2
1'
← 2
9
45
50
55
60
65
70
75
80
85
90
95
2.4
2.3
2.2
2.1
2.0
1.9
1.8
1.7
1.6
1.5
1.4
1.3
1.2
1.1
1.0
0.9
0.8
0.7
0.6
ppm


LN303_VP4_P4 in cdcl3 (HMBC) 27.1.2020
11'
1'
10'
9
3
ppm
5
10
15
20
25
30
35
← 9'
10'
← 3
9
2.4
2.3
2.2
2.1
2.0
1.9
1.8
1.7
1.6
1.5
1.4
1.3
1.2
1.1
1.0
0.9
0.8
0.7
0.6
ppm

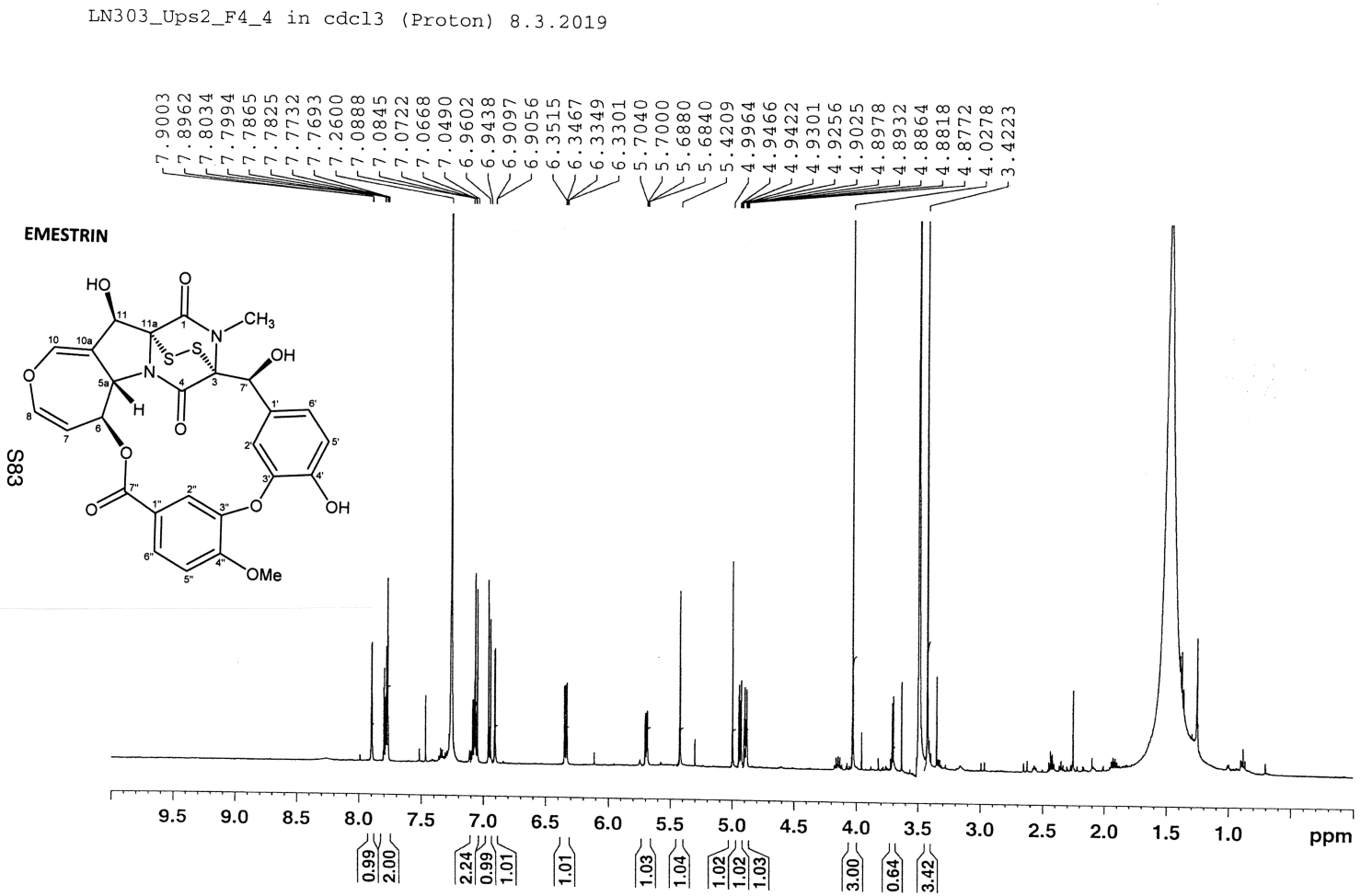


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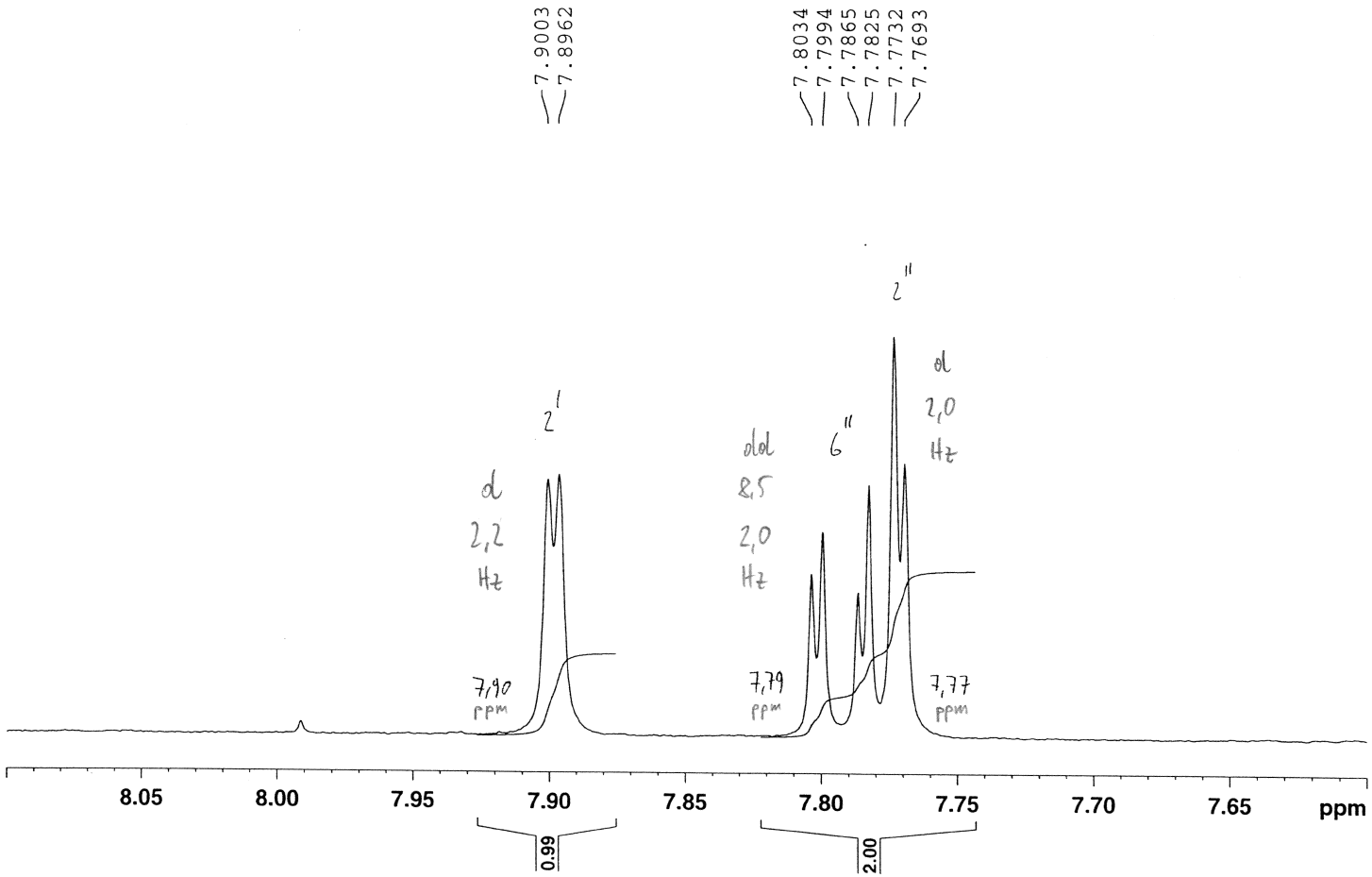
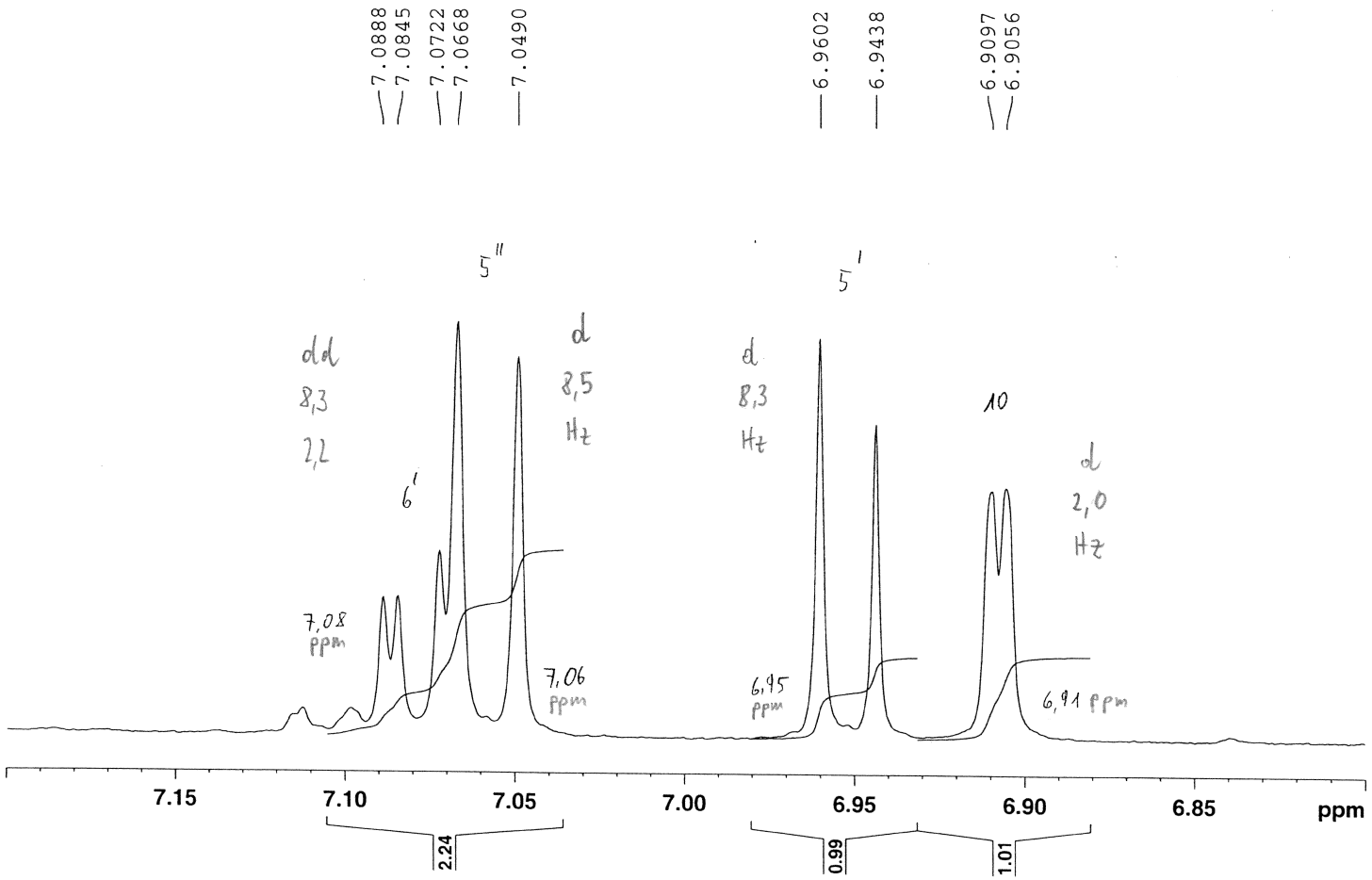
Figure S18. NMR data on compound 3.

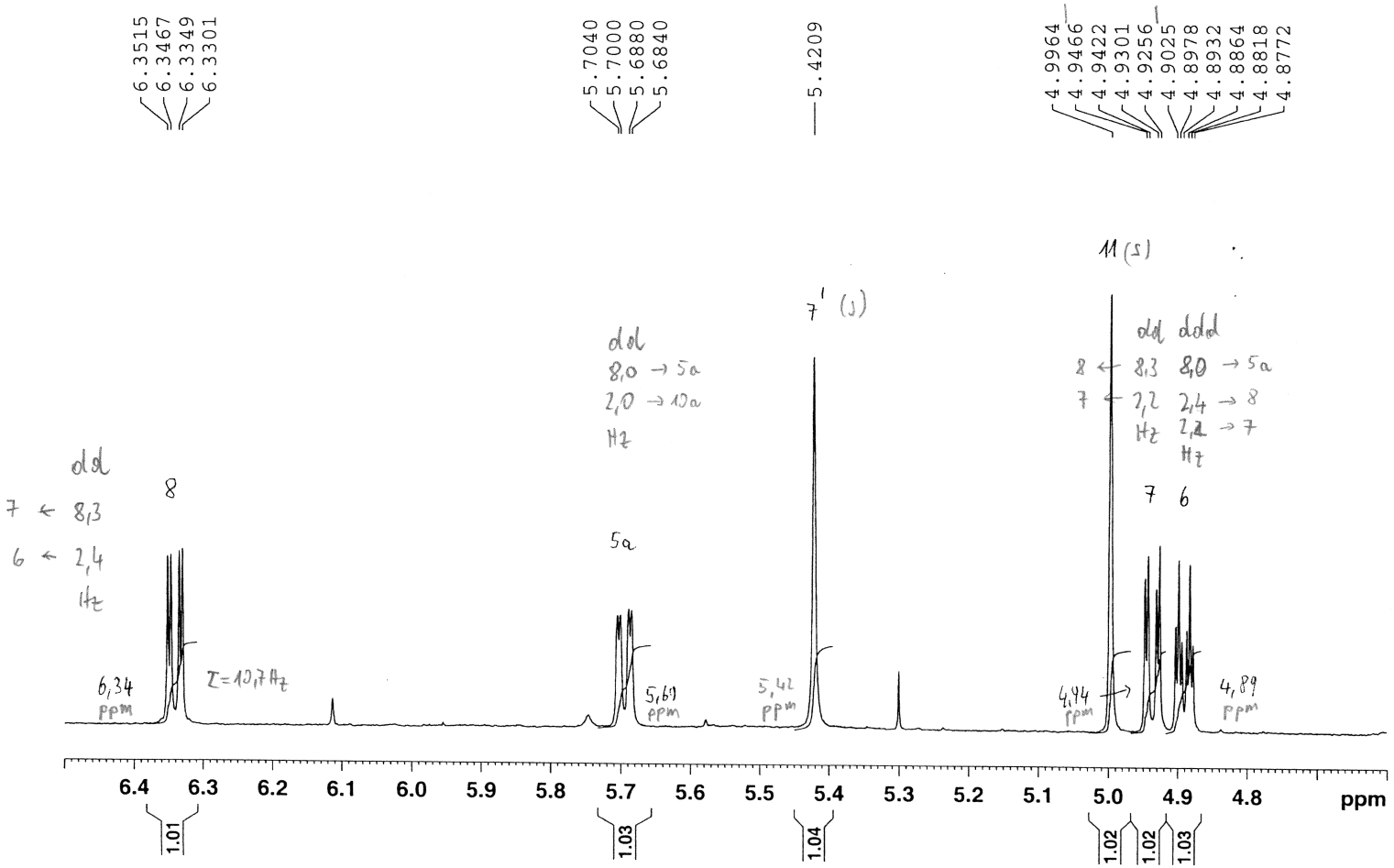
LN303_Ups2_F4_4 in cdcl3 (Proton) 8.3.2019



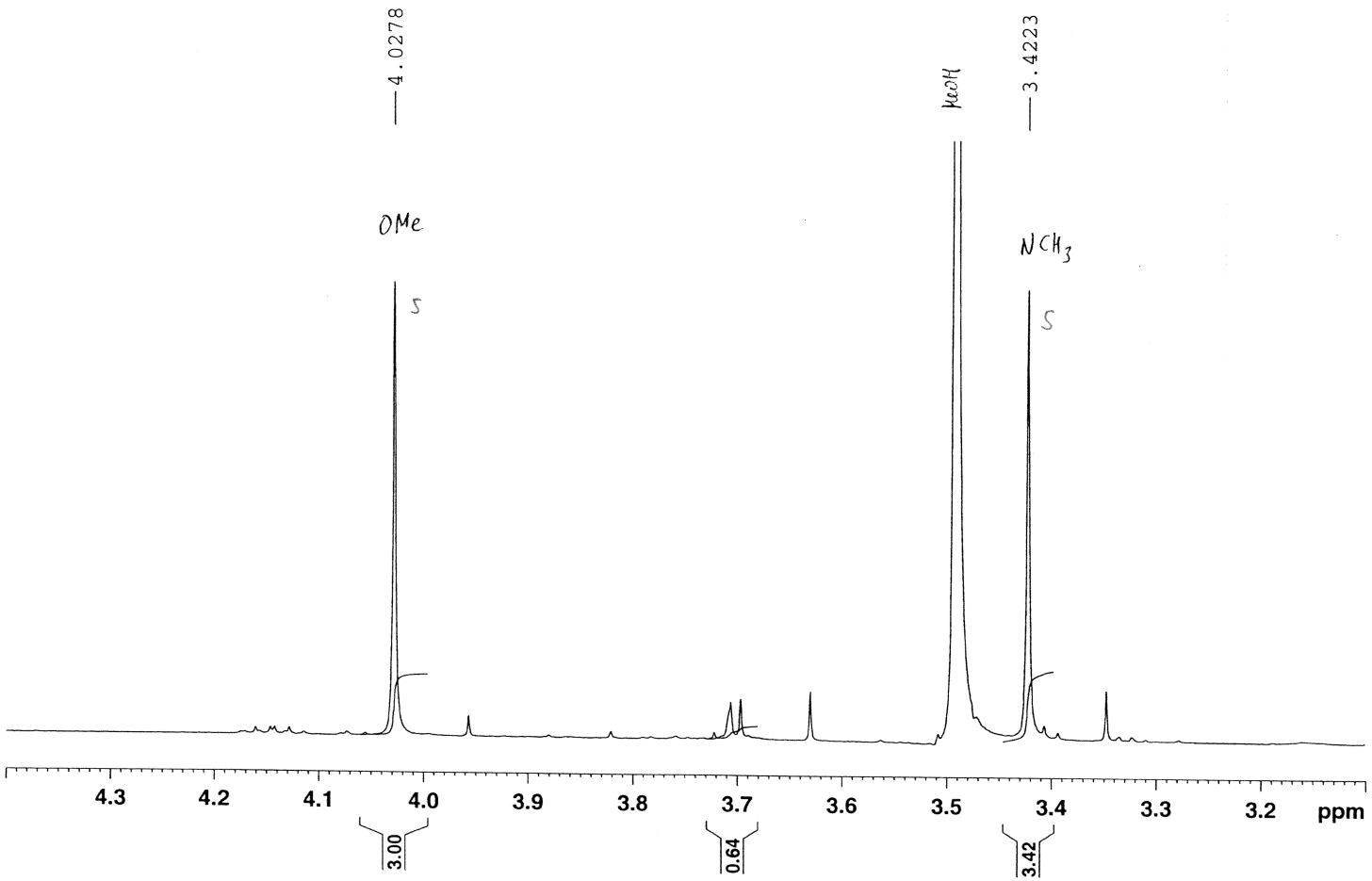
LN303_Ups2_F4_4 in cdcl3 (Proton) 8.3.2019



LN303_Ups2_F4_4 in cdcl3 (Proton) 8.3.2019



LN303_Ups2_F4_4 in cdcl3 (Proton) 8.3.2019



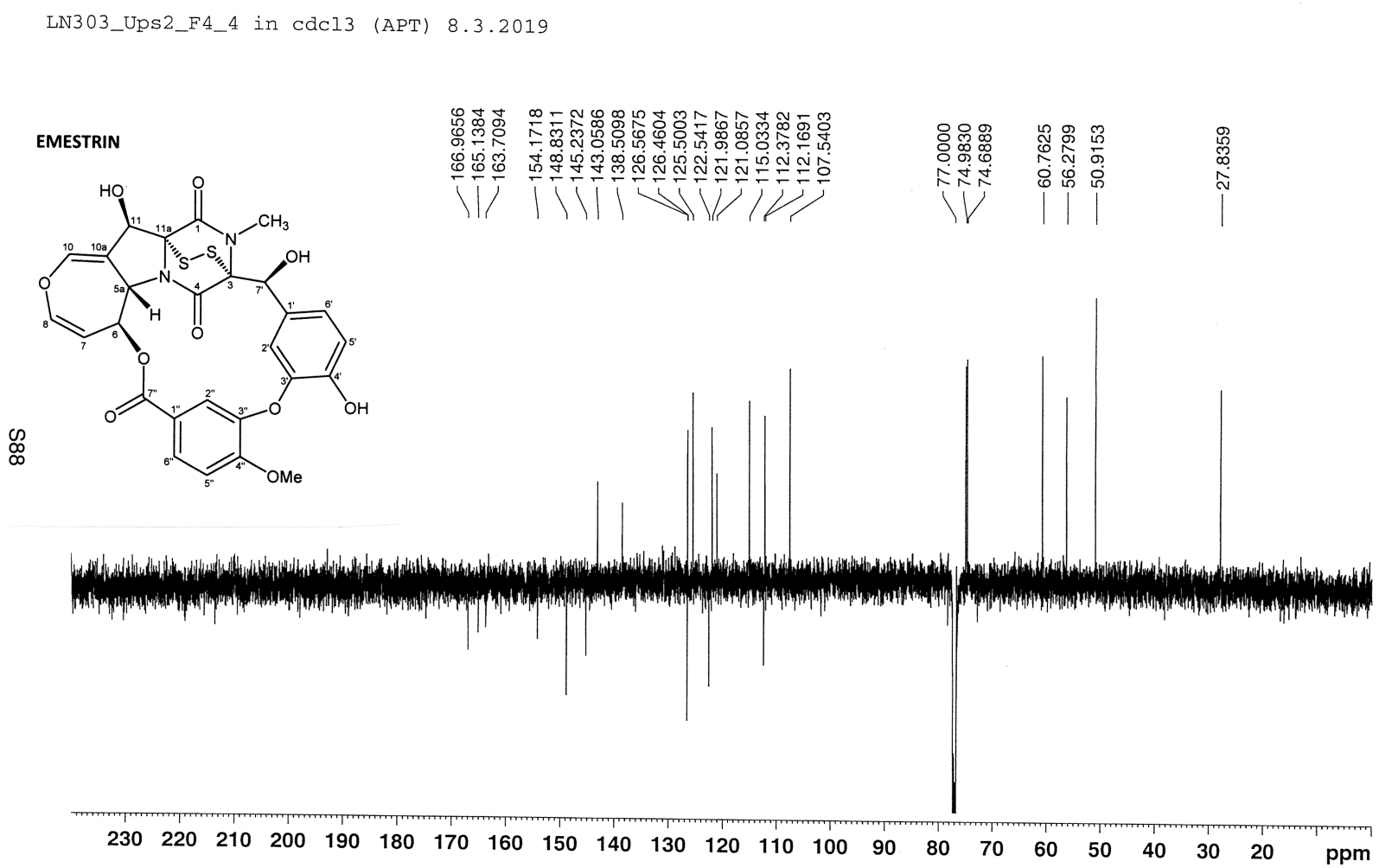
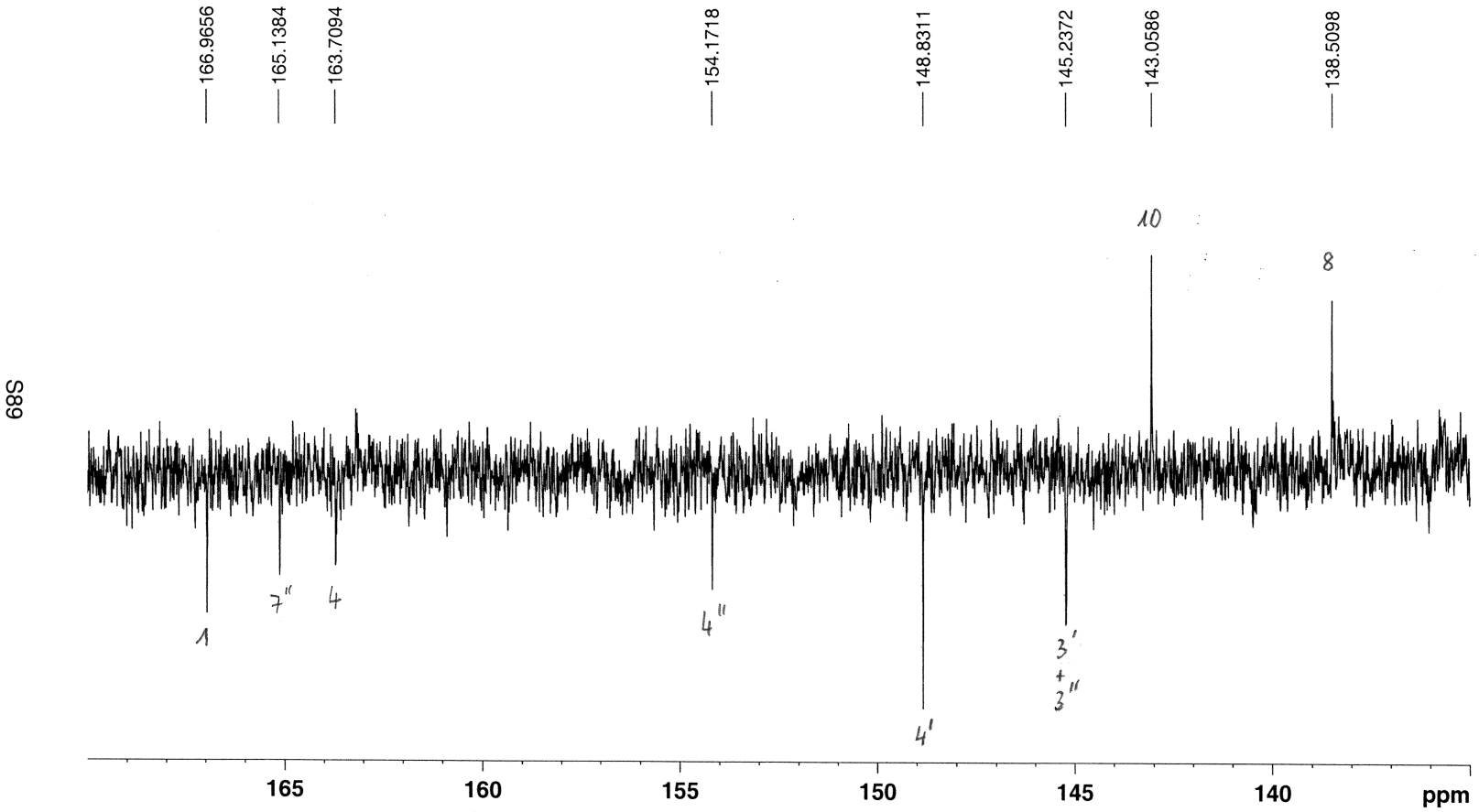
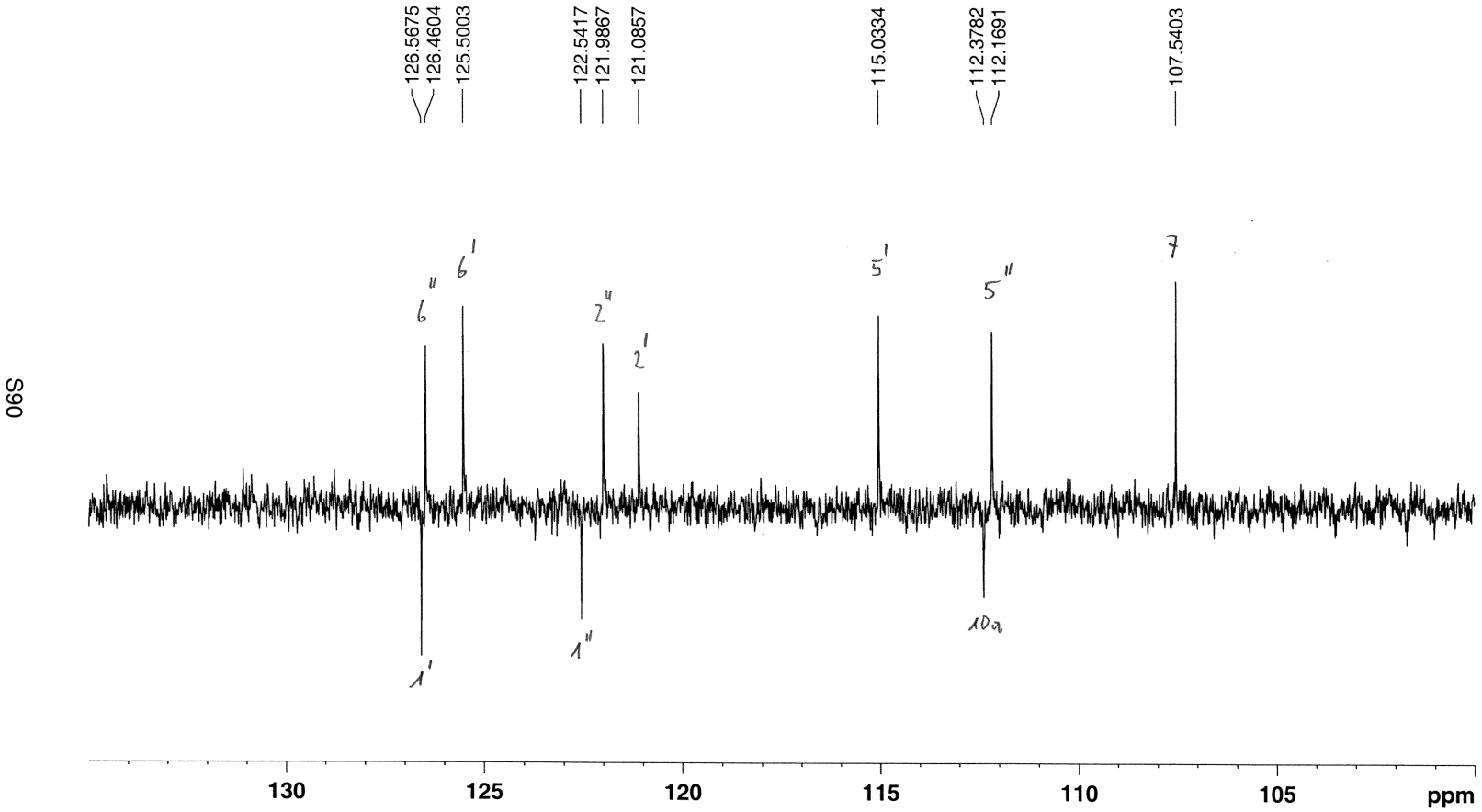


Figure S18 (pages S88-S91). ^{1}H NMR spectrum of **3** in $CDCl_3$ (δ in ppm).

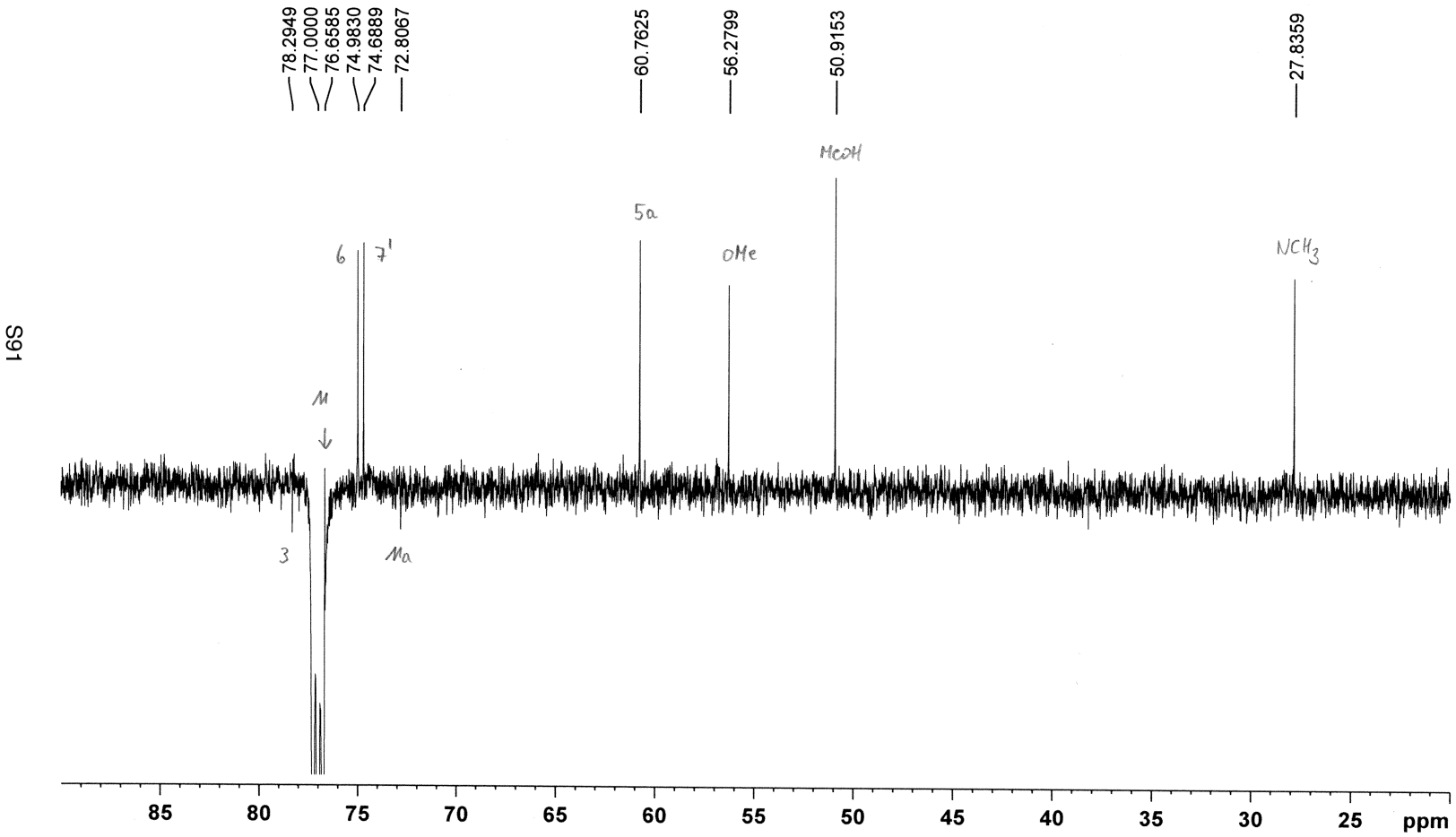
LN303_Ups2_F4_4 in cdcl3 (APT) 8.3.2019



LN303_Ups2_F4_4 in cdcl3 (APT) 8.3.2019



LN303_Ups2_F4_4 in cdcl3 (APT) 8.3.2019



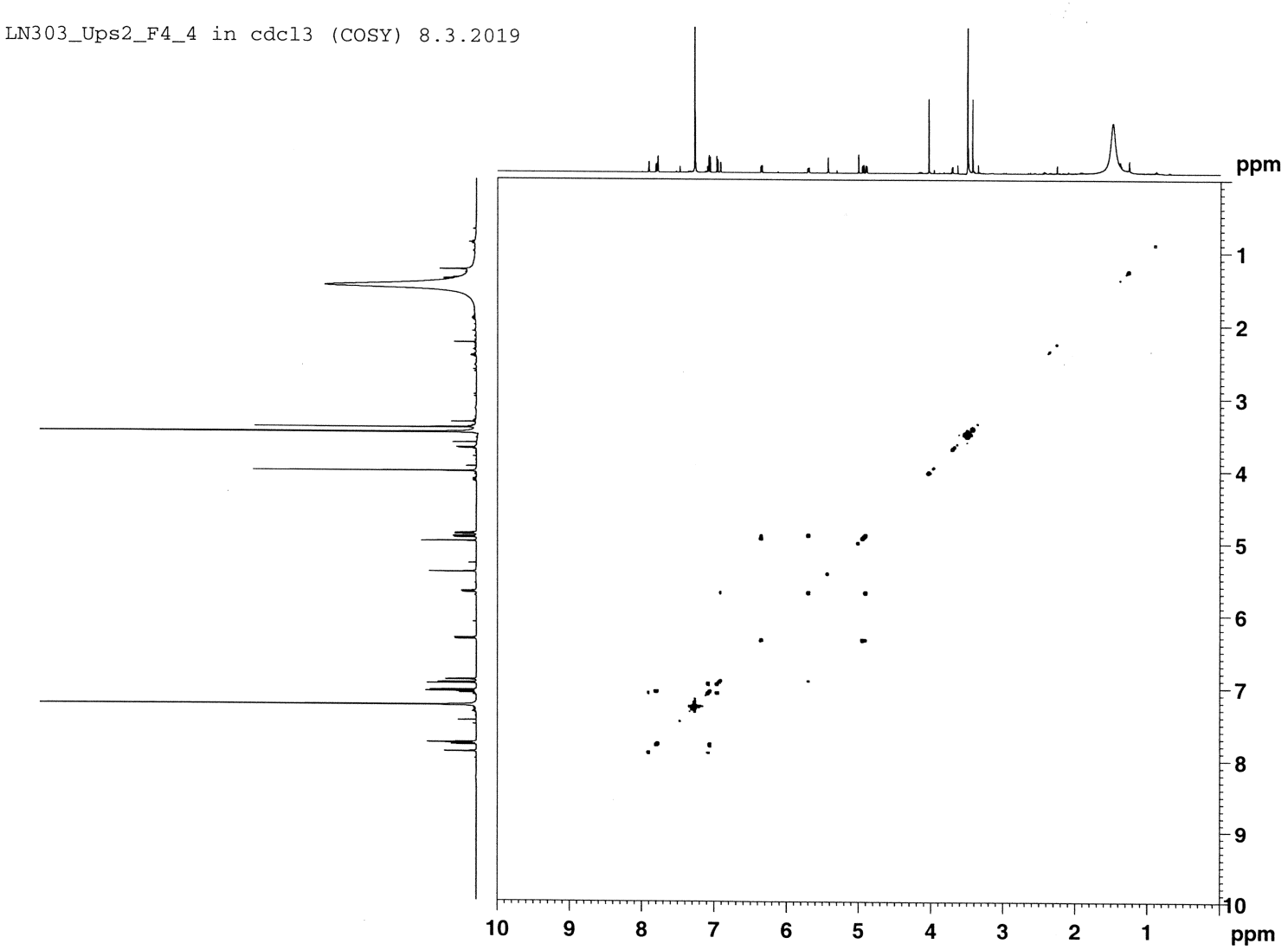
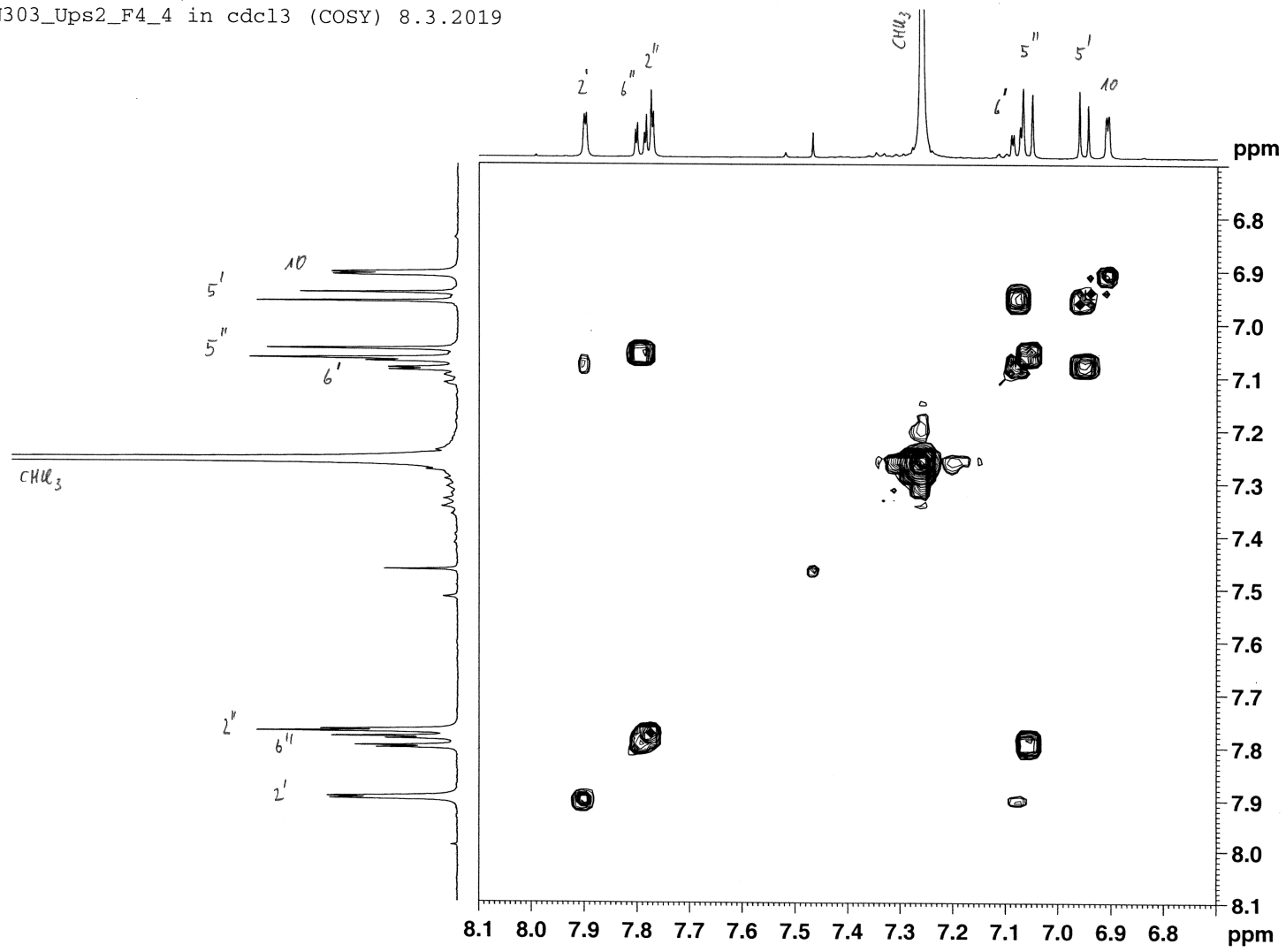
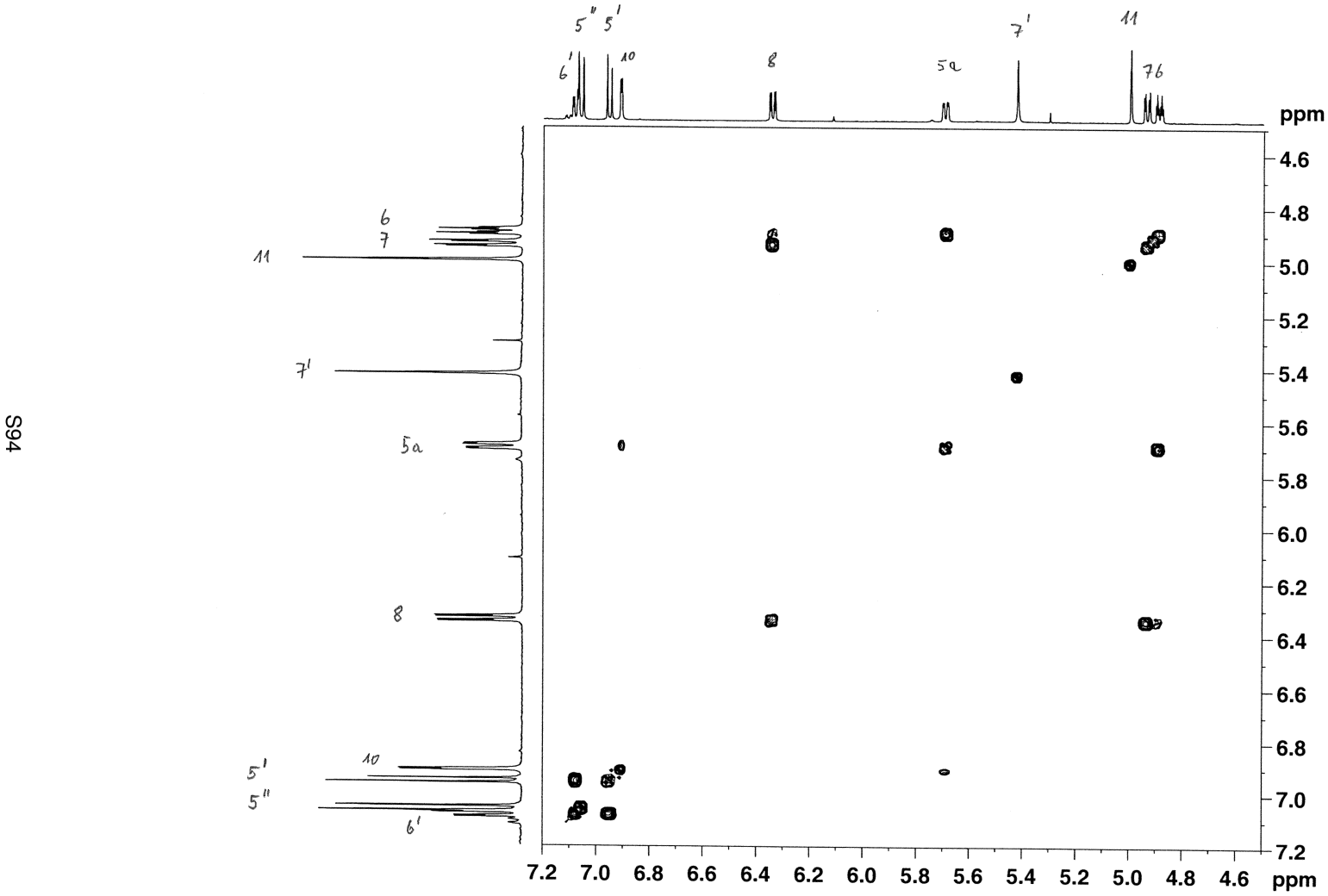


Figure S18 (pages S92-S94). COSY spectrum of **3** in $CDCl_3$ (δ in ppm).

LN303_Ups2_F4_4 in cdcl3 (COSY) 8.3.2019



LN303_Ups2_F4_4 in cdcl3 (COSY) 8.3.2019



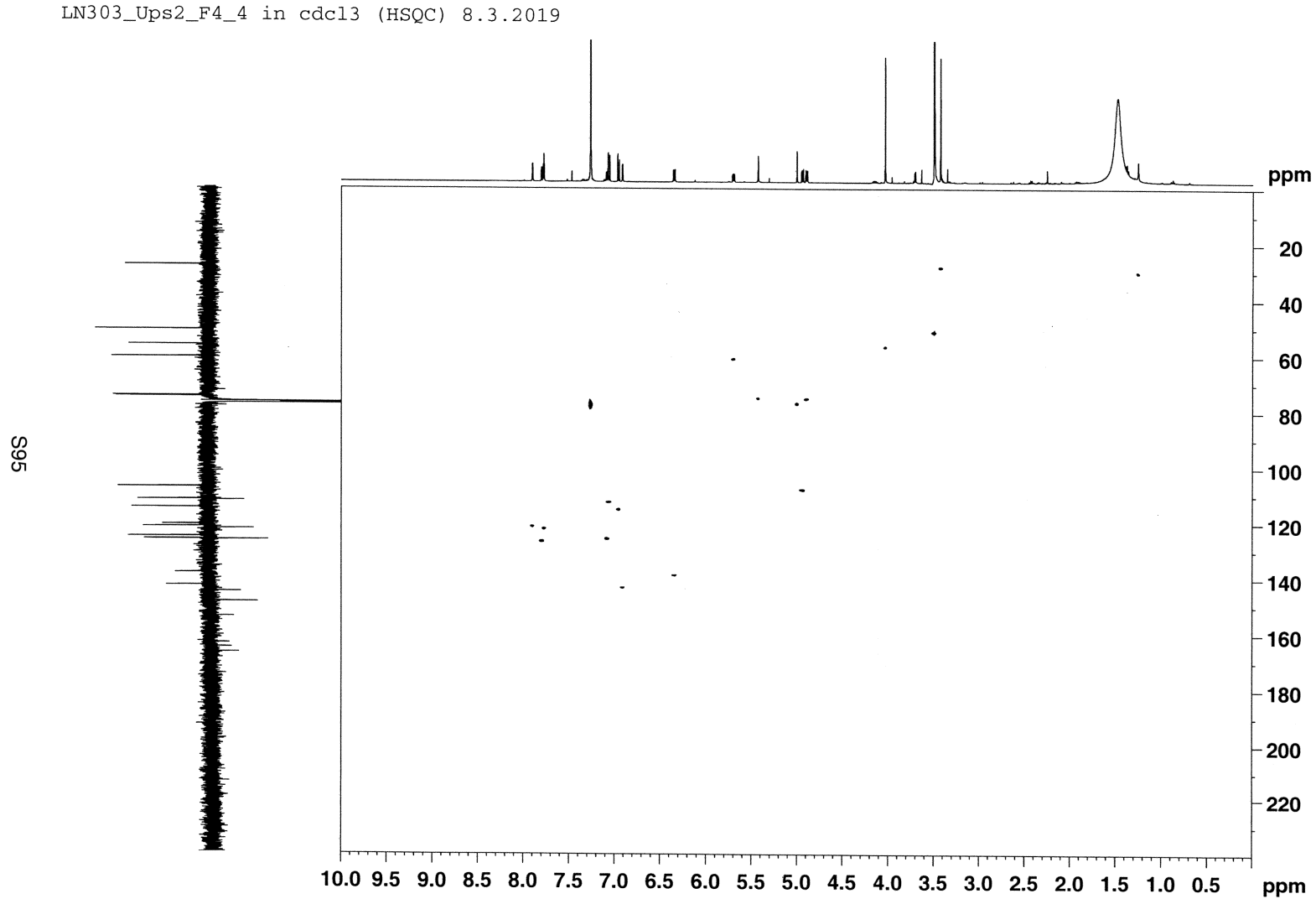
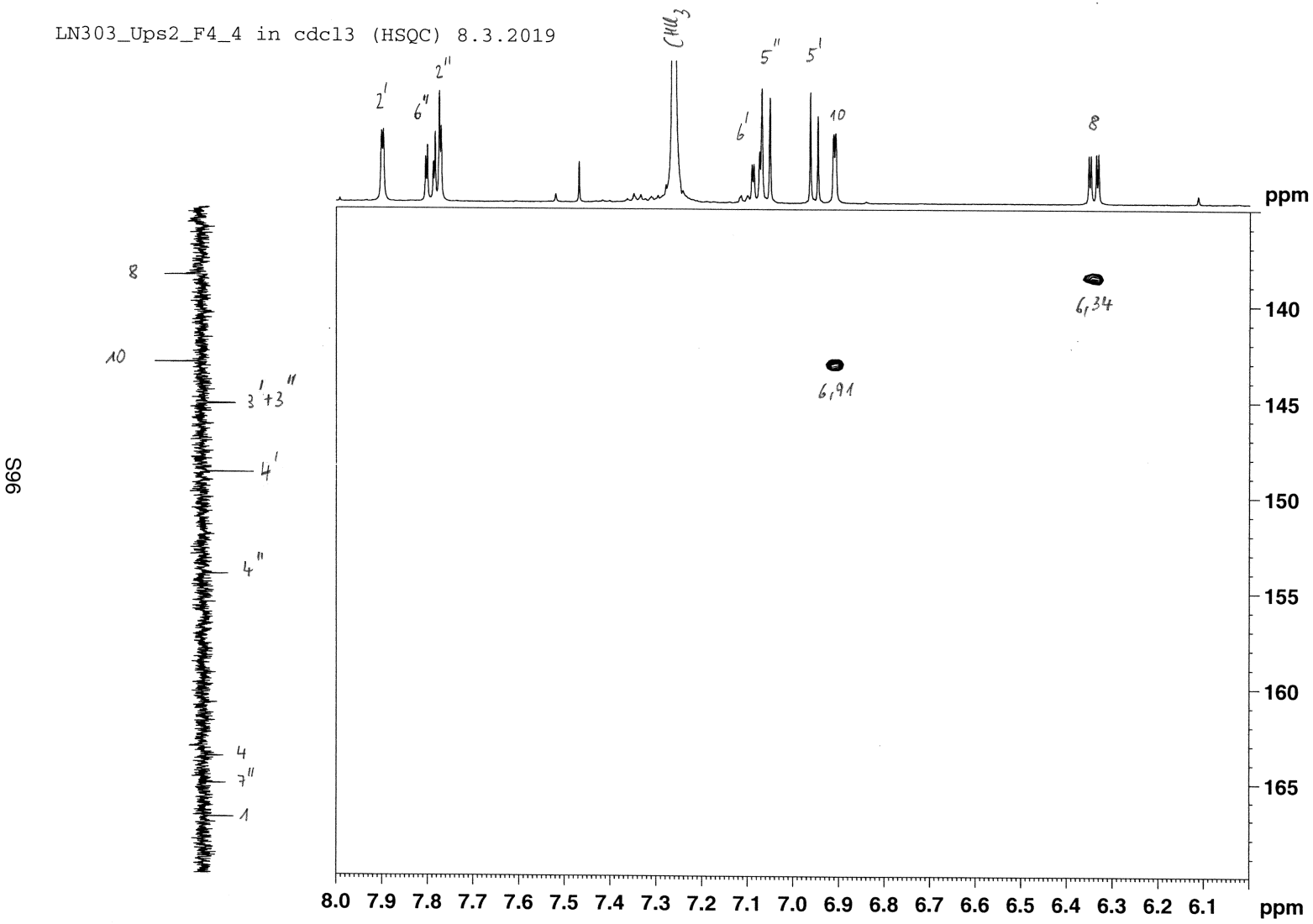
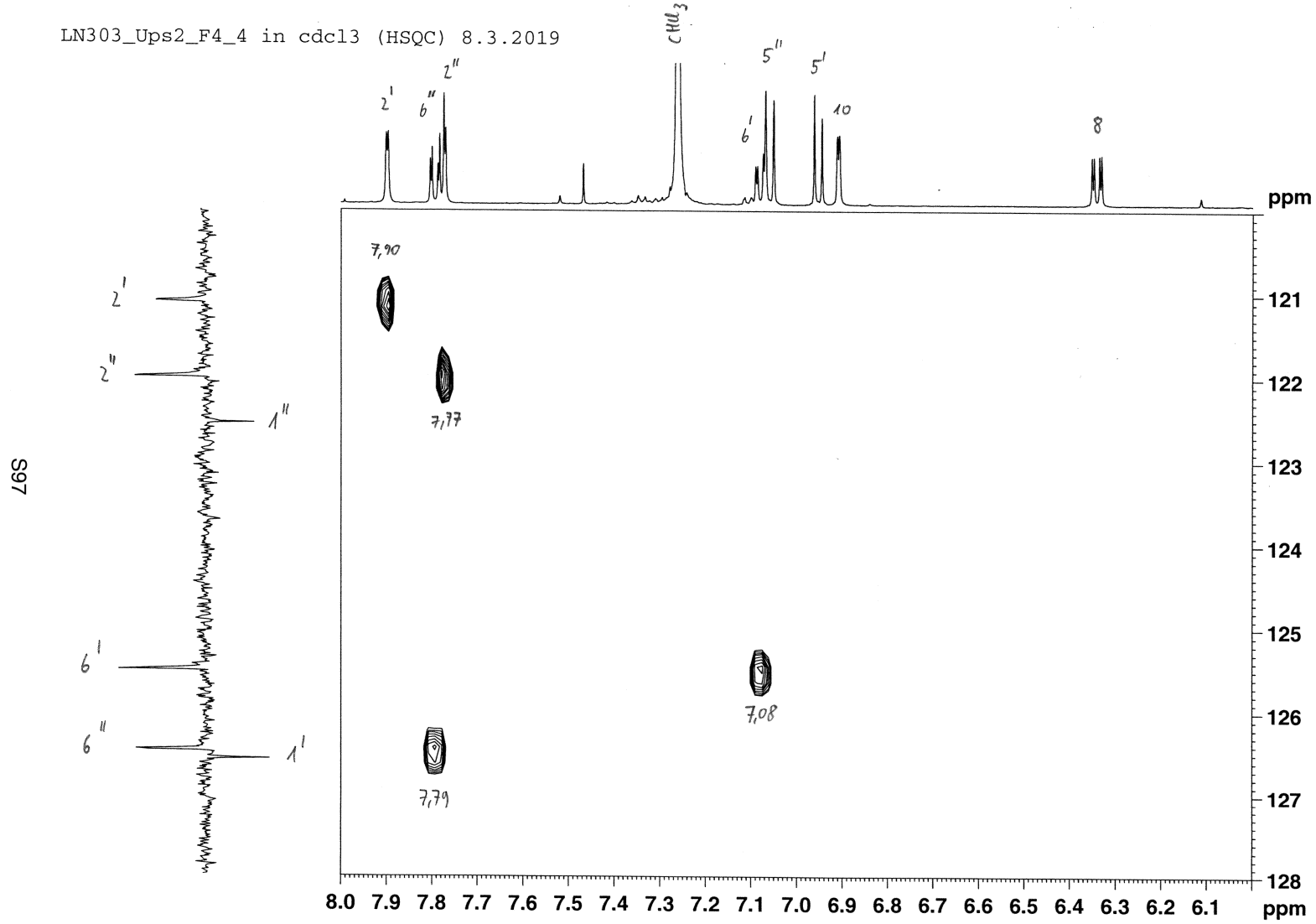
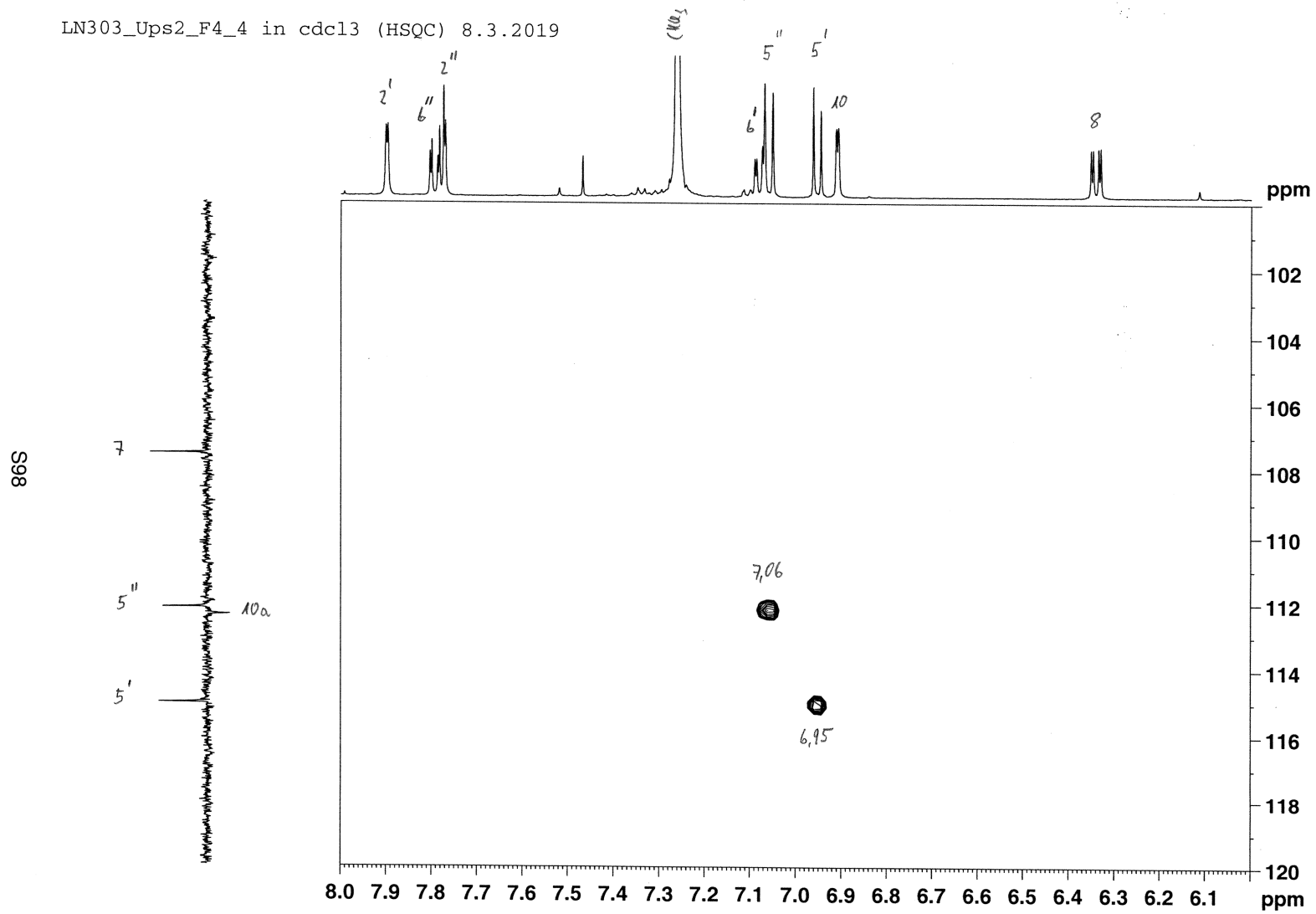


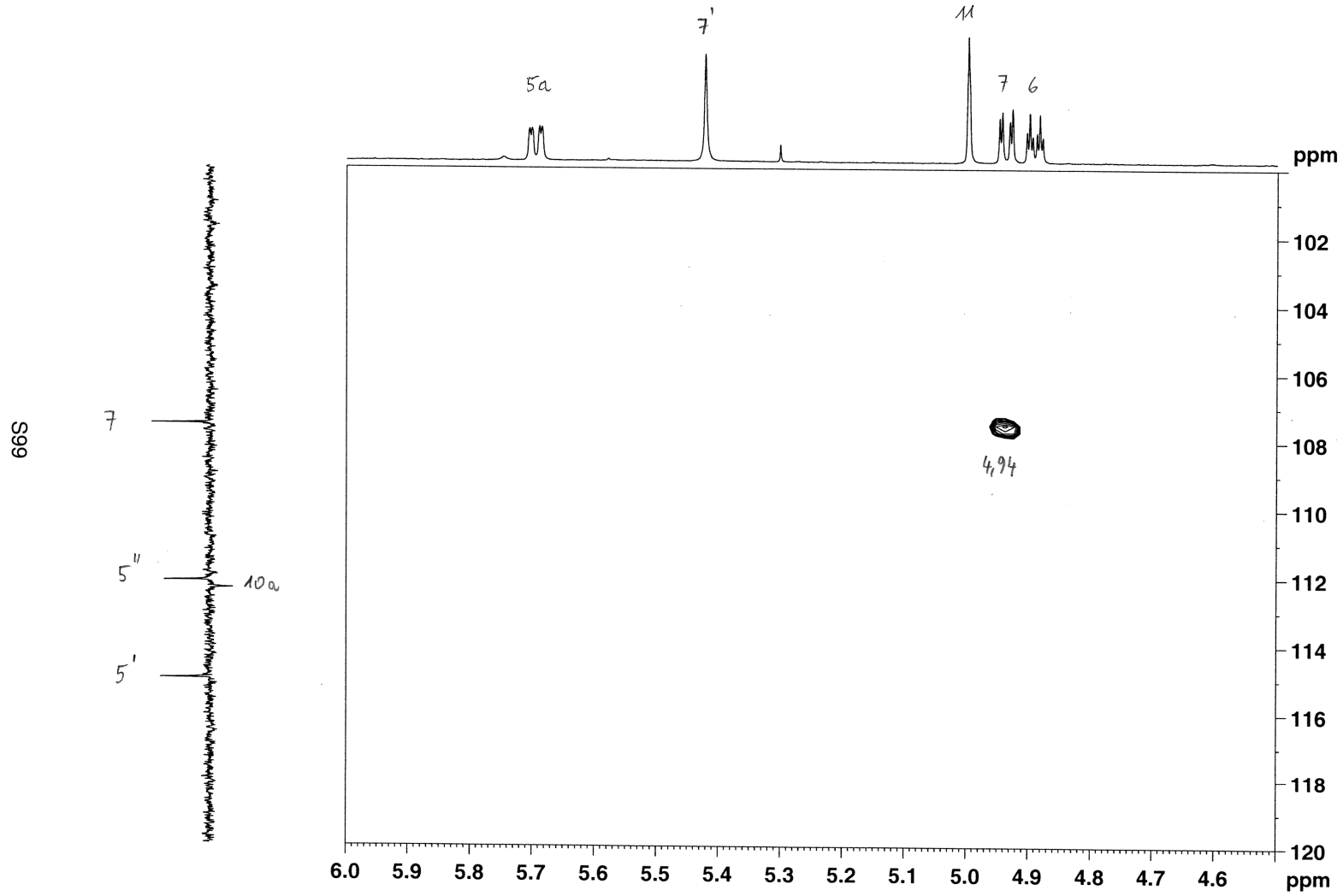
Figure S18 (pages S95-S101). HSQC spectrum of **3** in $CDCl_3$ (δ in ppm).


LN303_Ups2_F4_4 in cdcl3 (HSQC) 8.3.2019
2'
6''
2''
CHCl3
5''
5'
6'
10
8
ppm
8
10
3'+3''
4'
4''
4
7''
1
6,34
6,91
140
145
150
155
160
165
8.0 7.9 7.8 7.7 7.6 7.5 7.4 7.3 7.2 7.1 7.0 6.9 6.8 6.7 6.6 6.5 6.4 6.3 6.2 6.1
ppm

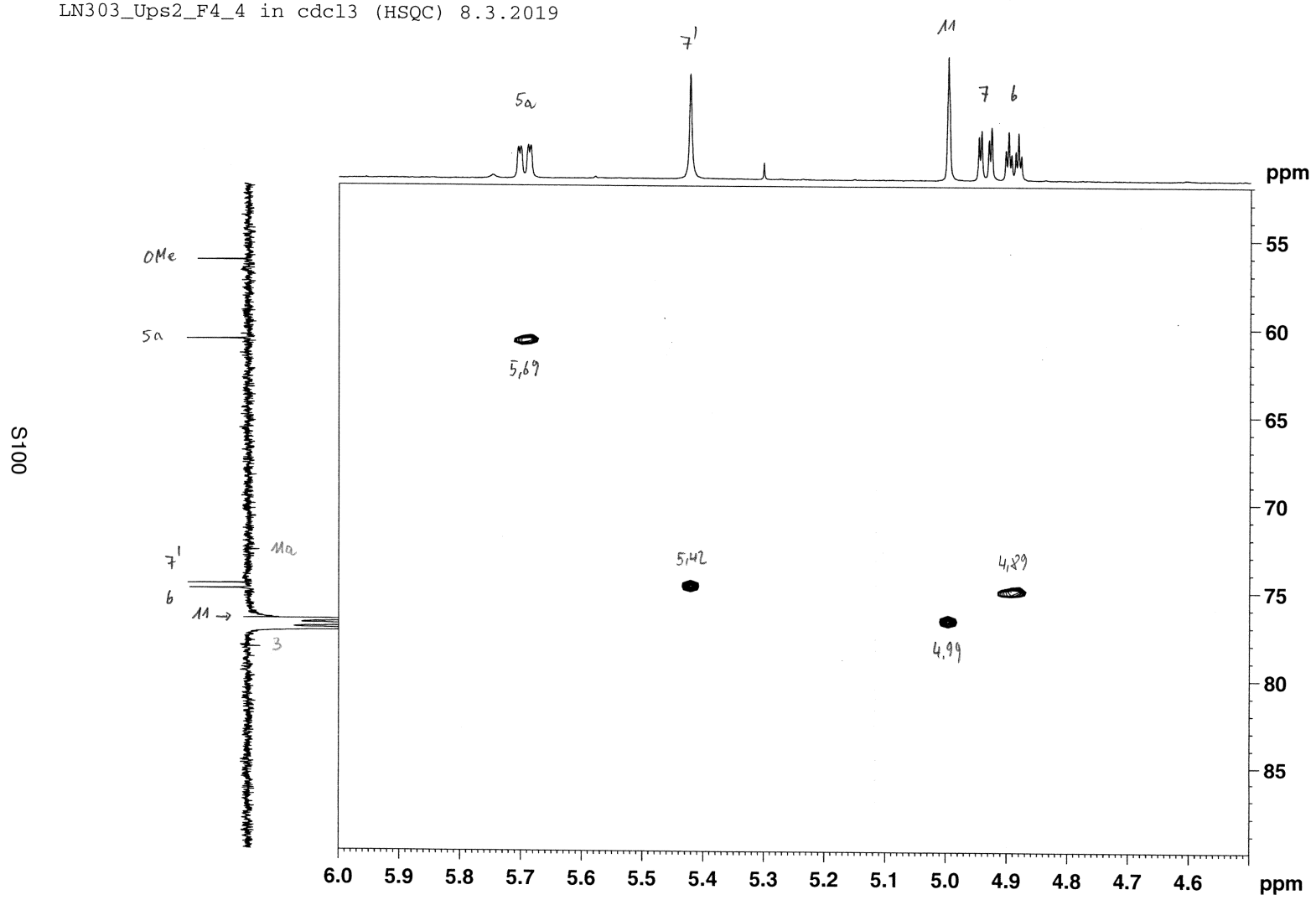

LN303_Ups2_F4_4 in cdcl3 (HSQC) 8.3.2019
CHCl3
2'
6''
2''
6'
5''
5'
10
8
ppm
7,90
7,77
7,08
7,79
2'
2''
1''
6'
6''
1'
121
122
123
124
125
126
127
128
8.0 7.9 7.8 7.7 7.6 7.5 7.4 7.3 7.2 7.1 7.0 6.9 6.8 6.7 6.6 6.5 6.4 6.3 6.2 6.1
ppm

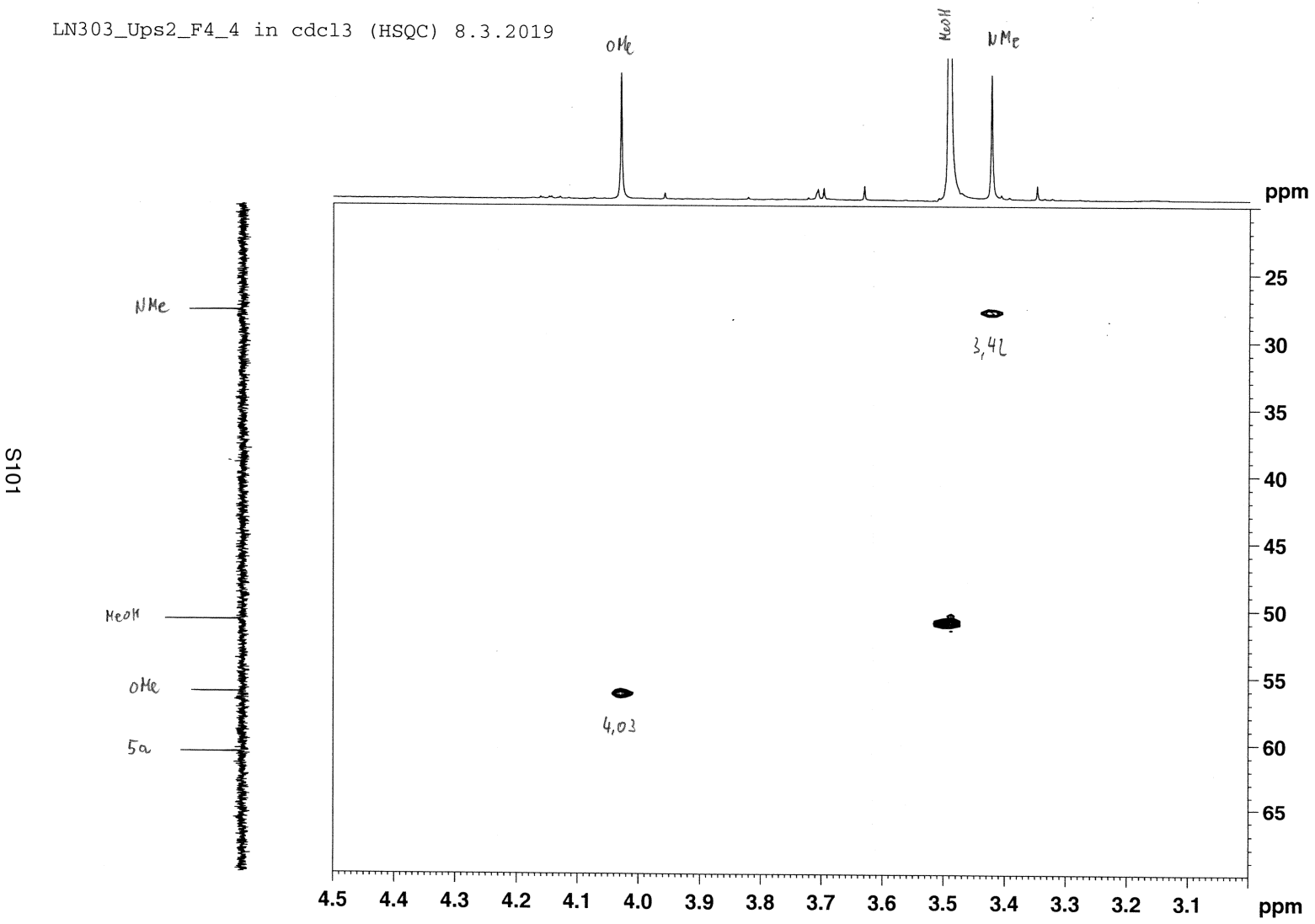

LN303_Ups2_F4_4 in cdcl3 (HSQC) 8.3.2019
2'
6''
2''
5''
5'
10
6'
8
ppm
7
5''
10a
5'
7,06
6,95
102
104
106
108
110
112
114
116
118
120
8.0 7.9 7.8 7.7 7.6 7.5 7.4 7.3 7.2 7.1 7.0 6.9 6.8 6.7 6.6 6.5 6.4 6.3 6.2 6.1
ppm

LN303_Ups2_F4_4 in cdcl3 (HSQC) 8.3.2019



LN303_Ups2_F4_4 in cdcl3 (HSQC) 8.3.2019




LN303_Ups2_F4_4 in cdcl3 (HSQC) 8.3.2019
OMe
MeOH
NMe
ppm
NMe
MeOH
OMe
5a
3,41
4,03
25
30
35
40
45
50
55
60
65
4.5
4.4
4.3
4.2
4.1
4.0
3.9
3.8
3.7
3.6
3.5
3.4
3.3
3.2
3.1
ppm

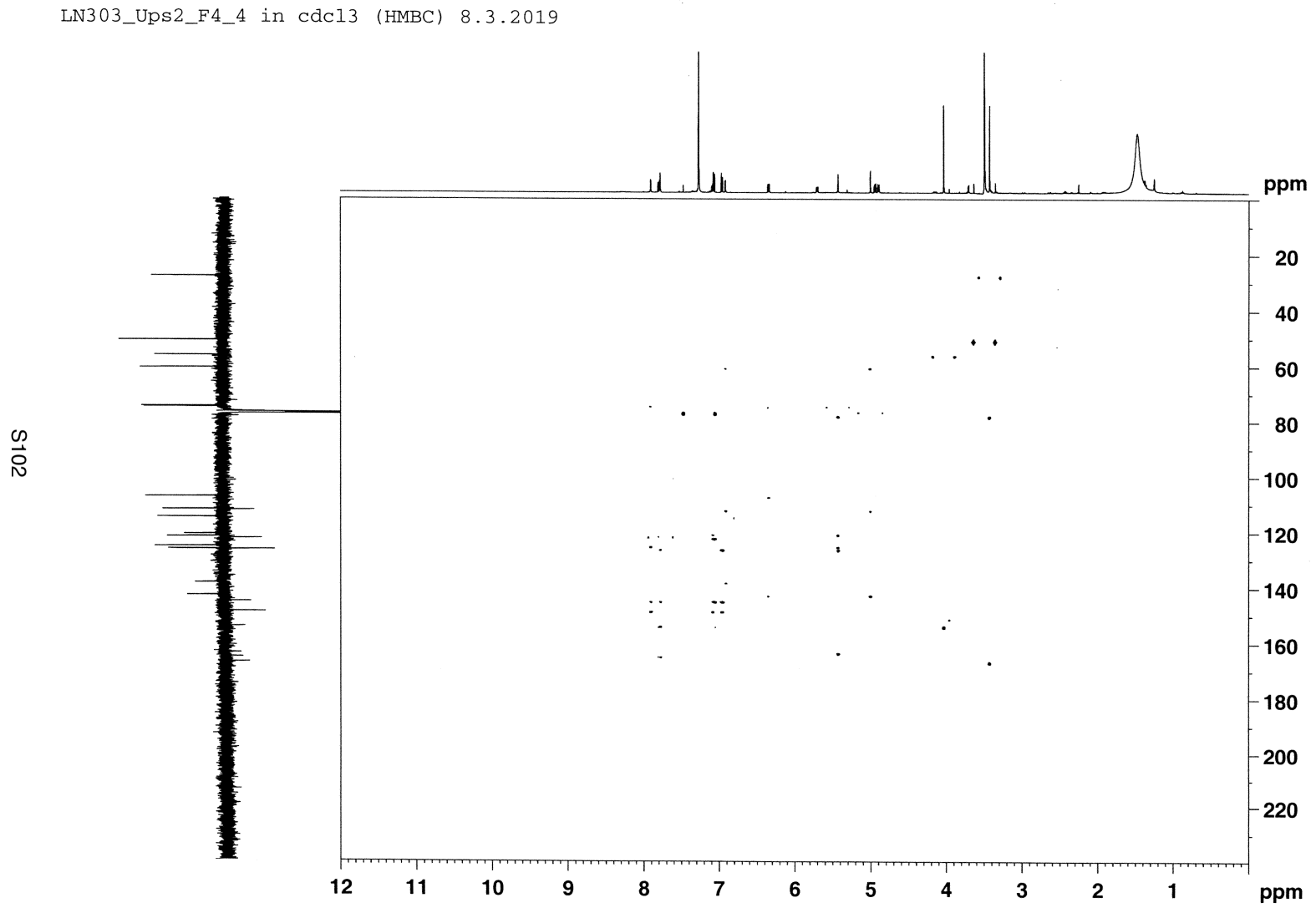
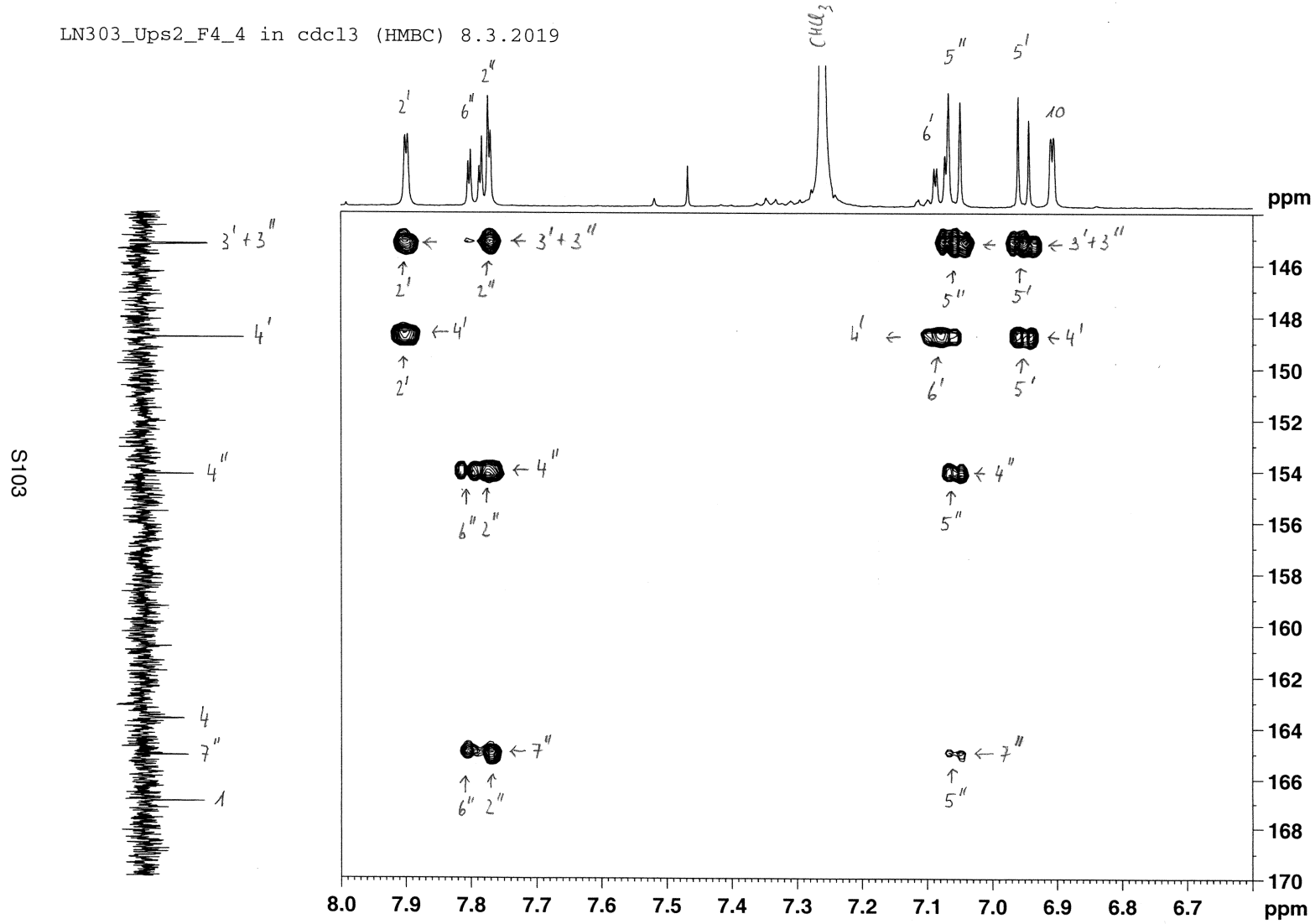
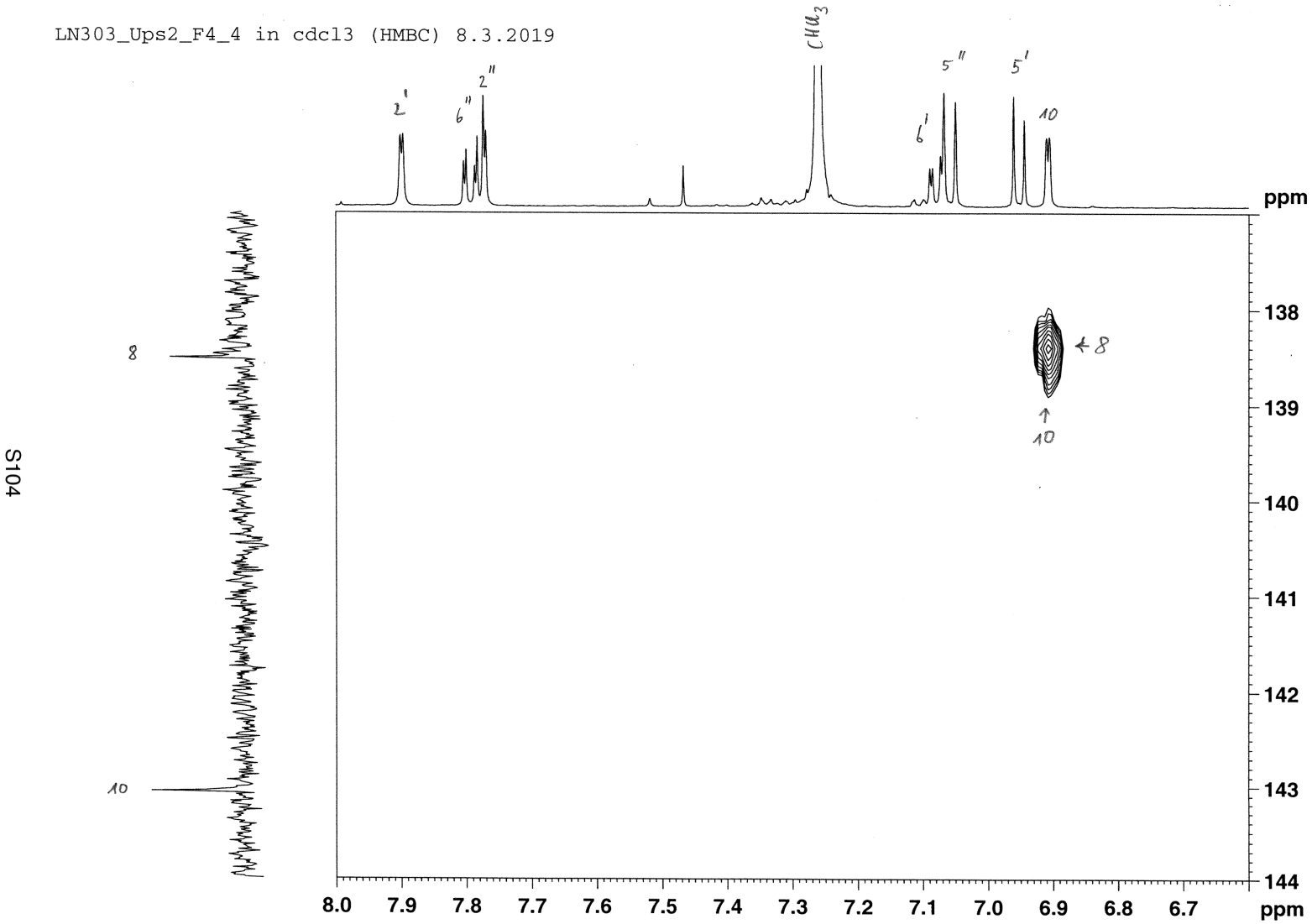
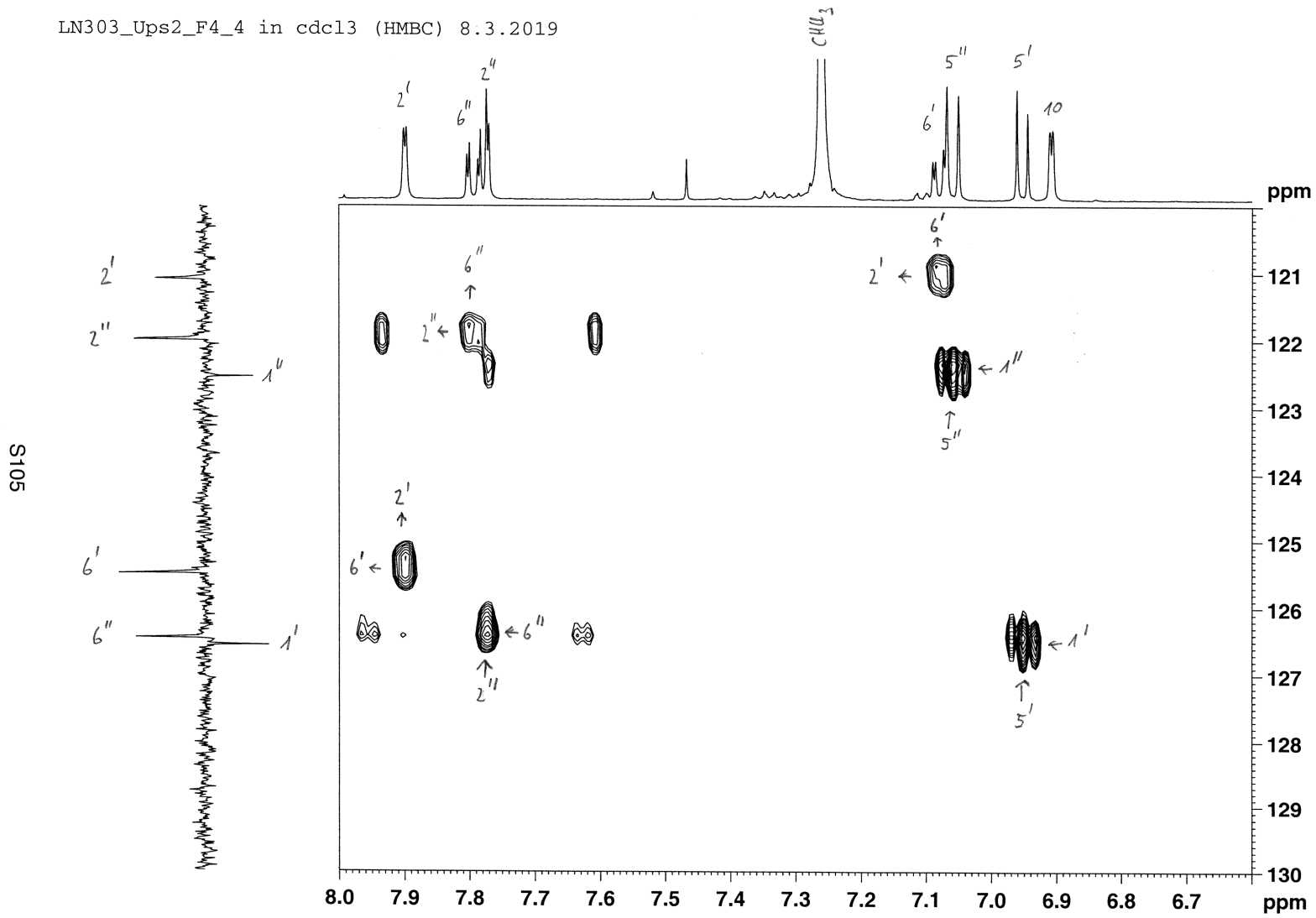
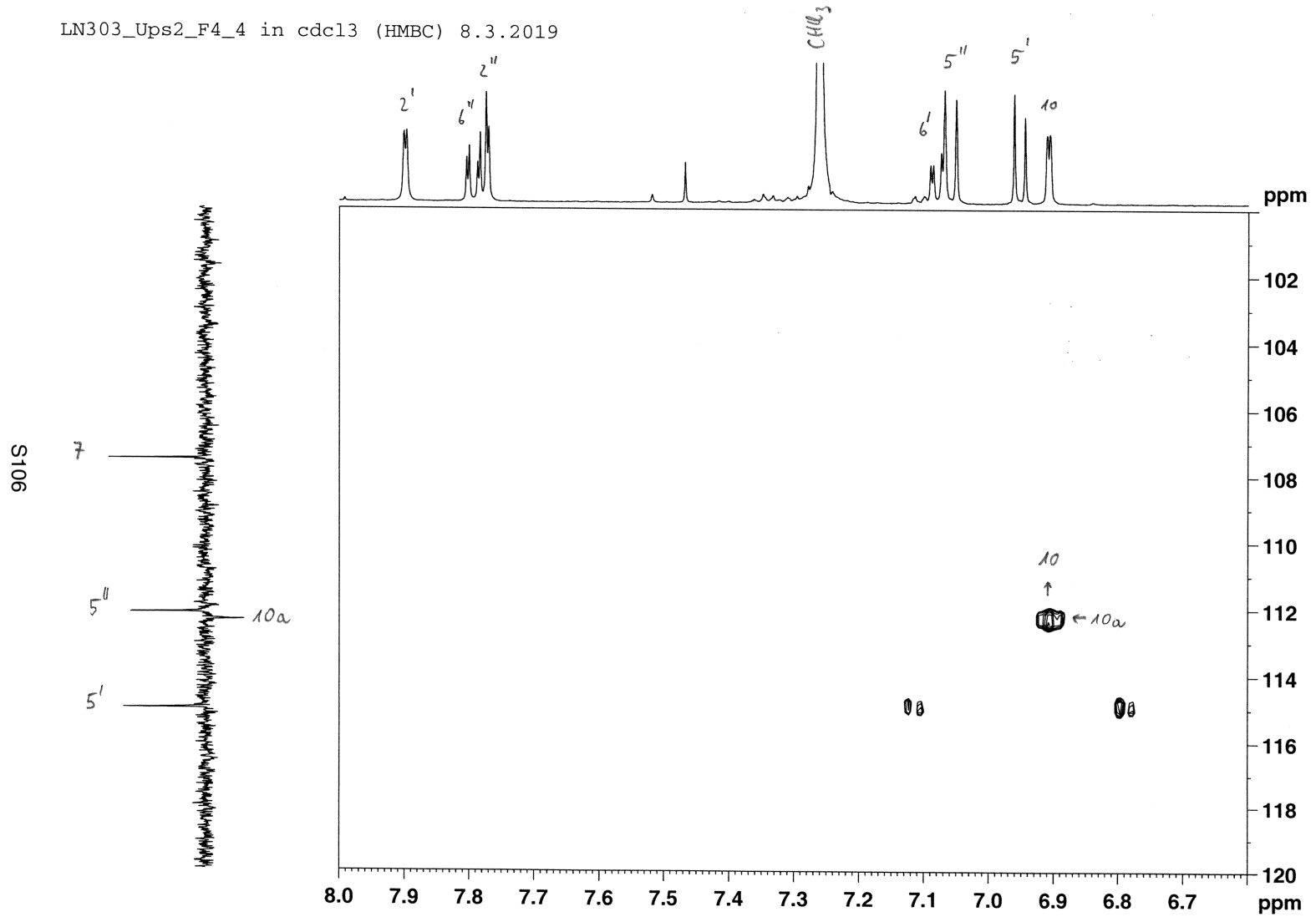


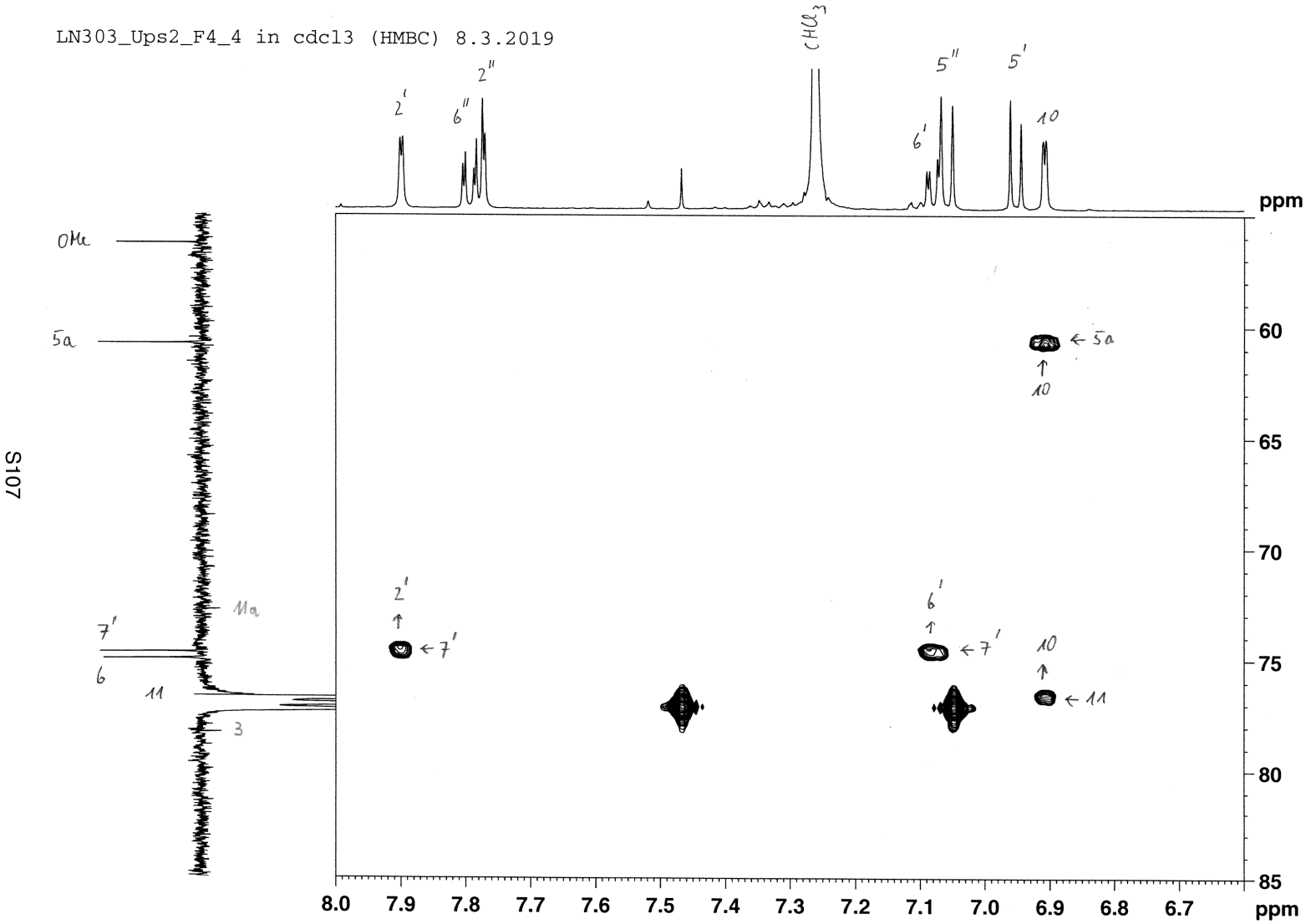
Figure S18 (pages S102-S112). HMBC spectrum of **3** in $CDCl_3$ (δ in ppm).


LN303_Ups2_F4_4 in cdcl3 (HMBC) 8.3.2019
CHCl3
2'
6''
2''
6'
5''
5'
10
ppm
3'+3''
4'
4''
4
7''
1
8.0
7.9
7.8
7.7
7.6
7.5
7.4
7.3
7.2
7.1
7.0
6.9
6.8
6.7
146
148
150
152
154
156
158
160
162
164
166
168
170

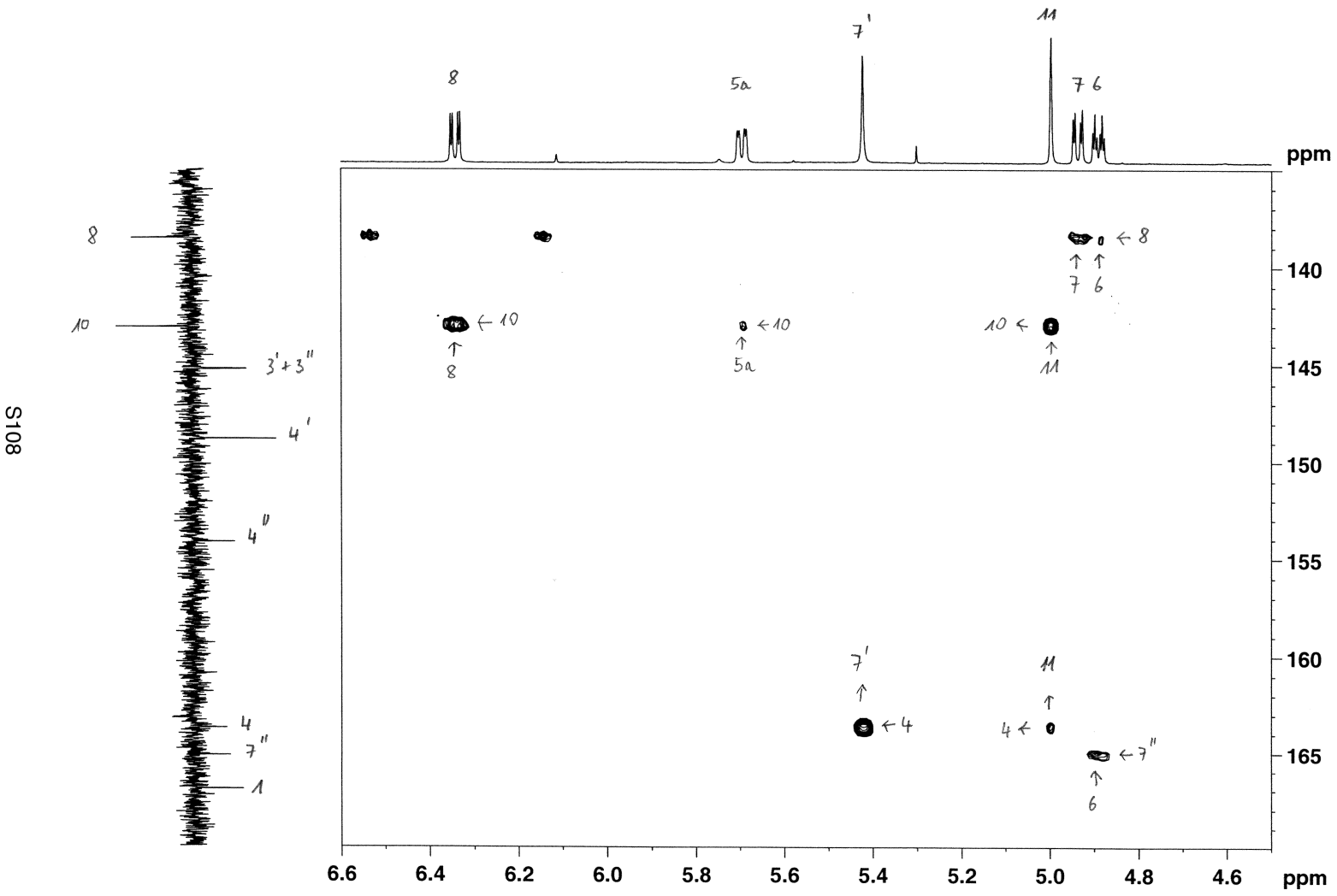

LN303_Ups2_F4_4 in cdcl3 (HMBC) 8.3.2019
CHCl3
2'
6''
2''
6'
5''
5'
10
8
10
ppm
138
139
140
141
142
143
144
8.0
7.9
7.8
7.7
7.6
7.5
7.4
7.3
7.2
7.1
7.0
6.9
6.8
6.7
ppm


LN303_Ups2_F4_4 in cdcl3 (HMBC) 8.3.2019
CHCl3
2'
6''
2''
6'
5''
5'
10
ppm
2'
2''
1''
6'
6''
1'
6''
2''
2'
6'
1''
5''
1'
5'
121
122
123
124
125
126
127
128
129
130
8.0
7.9
7.8
7.7
7.6
7.5
7.4
7.3
7.2
7.1
7.0
6.9
6.8
6.7
ppm

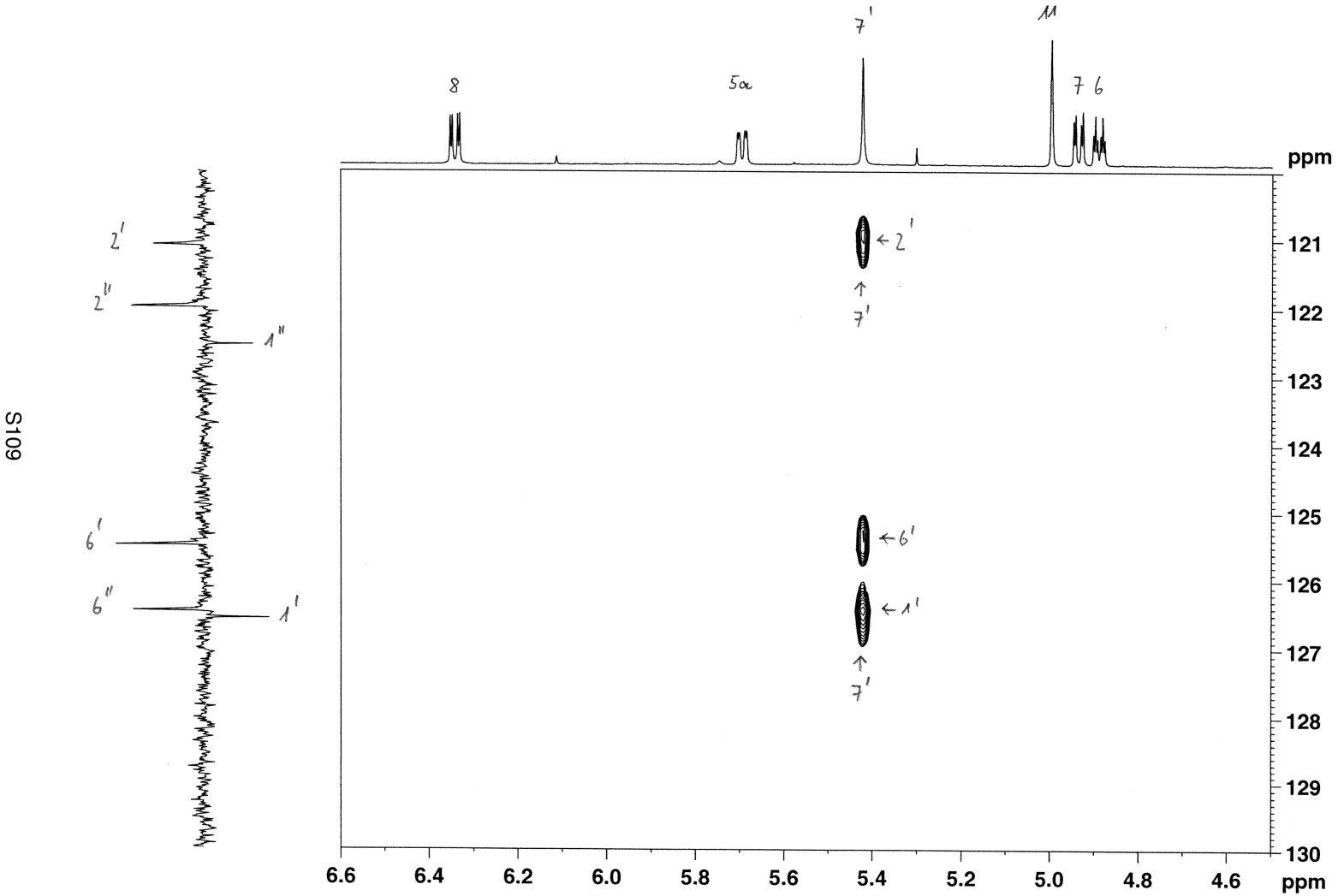

LN303_Ups2_F4_4 in cdcl3 (HMBC) 8.3.2019
2'
6''
2''
CHCl3
6'
5''
5'
10
ppm
102
104
106
108
110
112
114
116
118
120
8.0
7.9
7.8
7.7
7.6
7.5
7.4
7.3
7.2
7.1
7.0
6.9
6.8
6.7
ppm
7
5''
10a
5'
10
10a


LN303_Ups2_F4_4 in cdcl3 (HMBC) 8.3.2019
CHCl3
2'
6''
2''
5''
5'
6'
10
OMe
5a
11a
7'
6
11
3
ppm
60
65
70
75
80
85
8.0
7.9
7.8
7.7
7.6
7.5
7.4
7.3
7.2
7.1
7.0
6.9
6.8
6.7
ppm

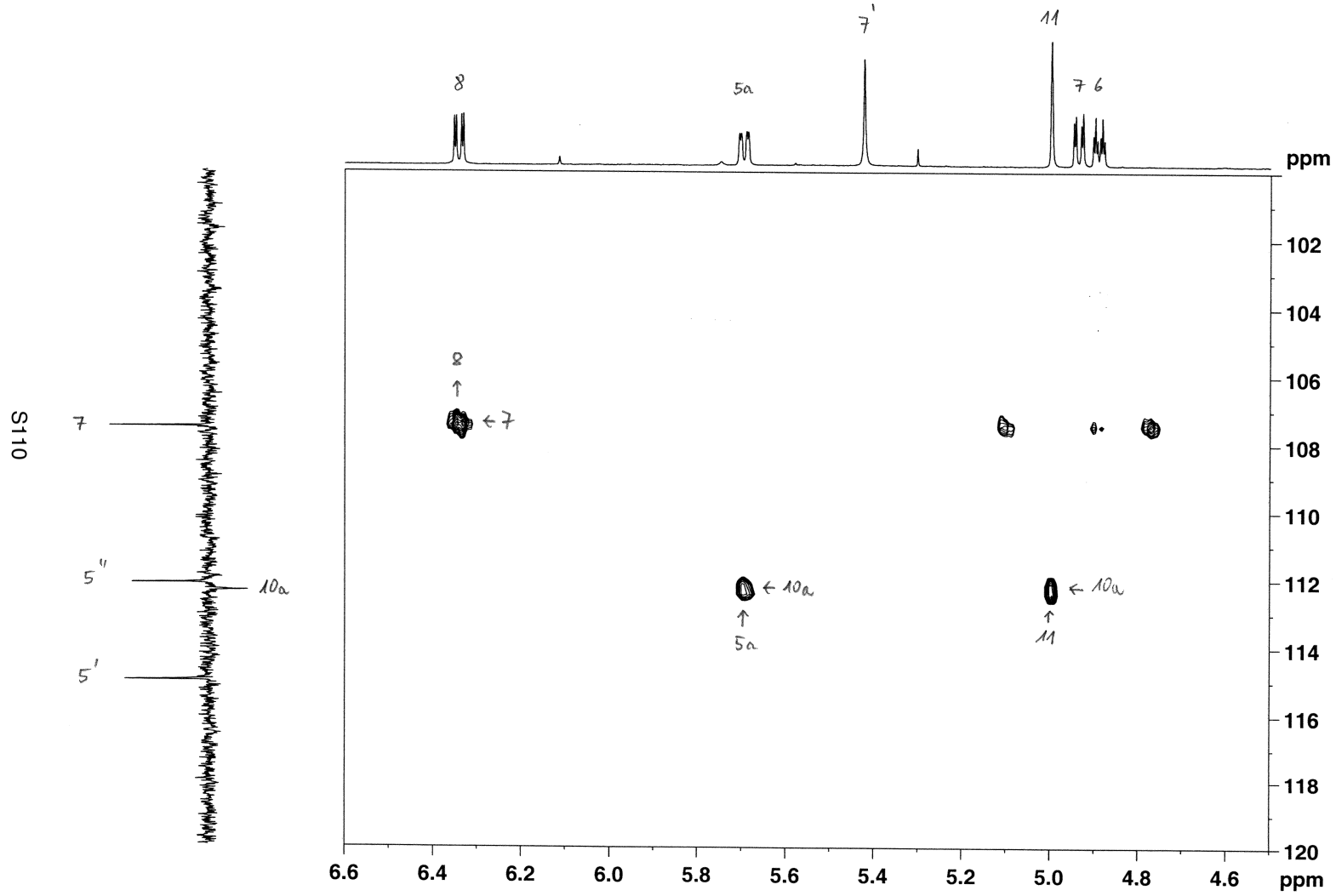
LN303_Ups2_F4_4 in cdcl3 (HMBC) 8.3.2019



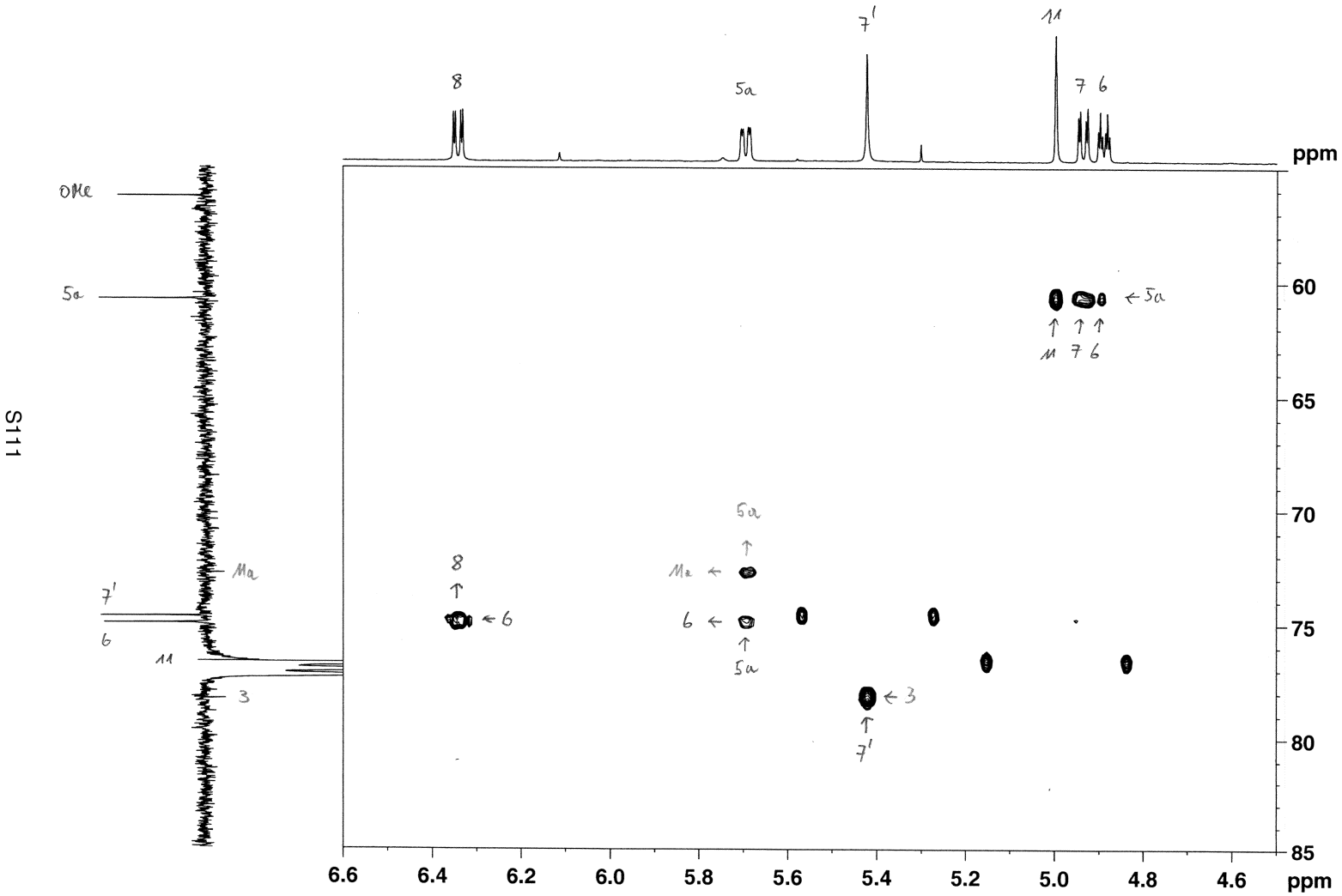
LN303_Ups2_F4_4 in cdcl3 (HMBC) 8.3.2019

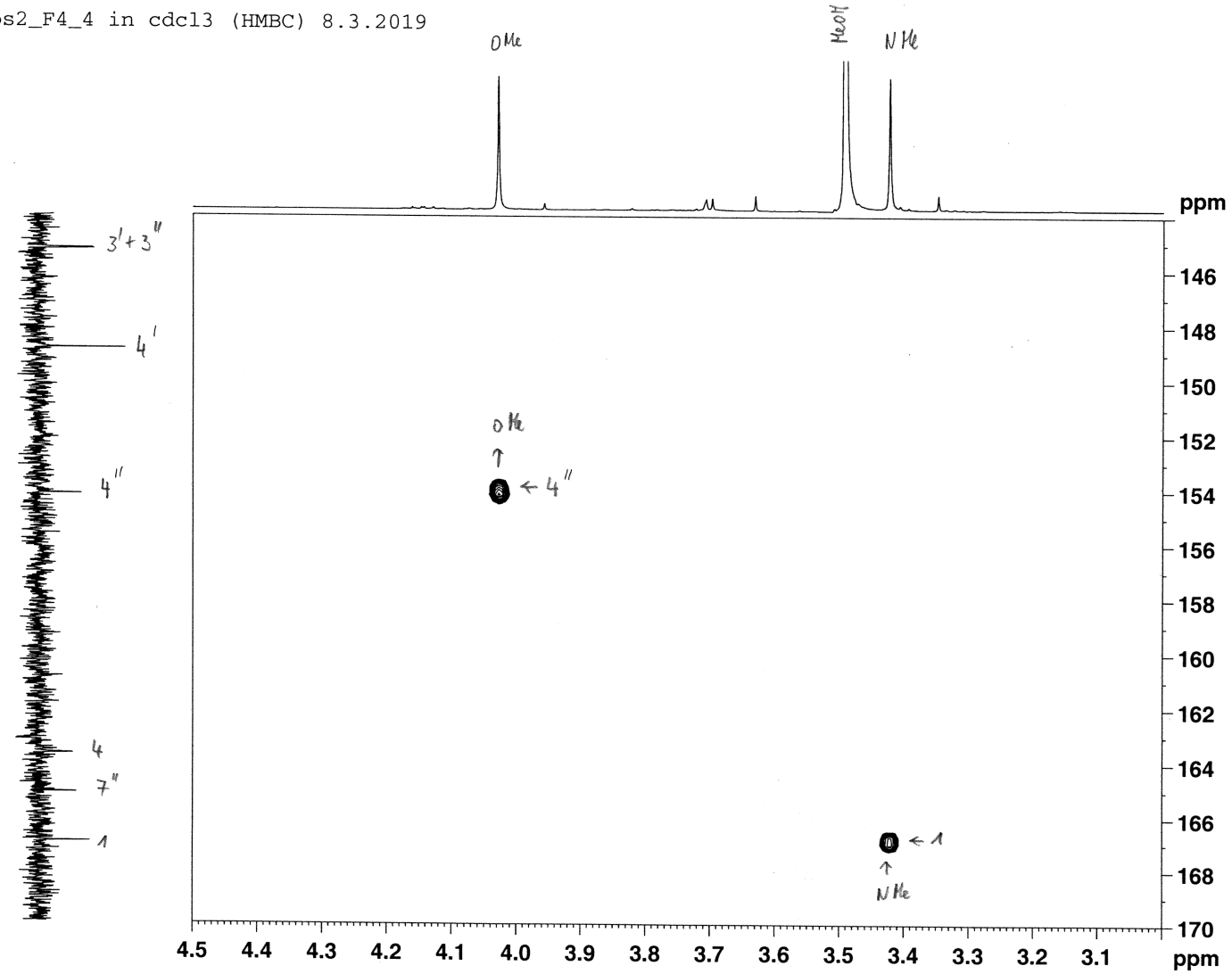


LN303_Ups2_F4_4 in cdcl3 (HMBC) 8.3.2019



LN303_Ups2_F4_4 in cdcl3 (HMBC) 8.3.2019




LN303_Ups2_F4_4 in cdcl3 (HMBC) 8.3.2019
OMe
MeOH
NMe
ppm
3'+3''
4'
4''
4
7''
1
OMe
← 4''
← 1
NMe
146
148
150
152
154
156
158
160
162
164
166
168
170
4.5
4.4
4.3
4.2
4.1
4.0
3.9
3.8
3.7
3.6
3.5
3.4
3.3
3.2
3.1
ppm