Electronic Supplementary Material (ESI) for RSC Advances.

Supplementary Data

NMR fingerprints, an integrated approach to uncover the unique components of the drug-like natural product metabolome of termite gut-associated *Streptomyces* species.

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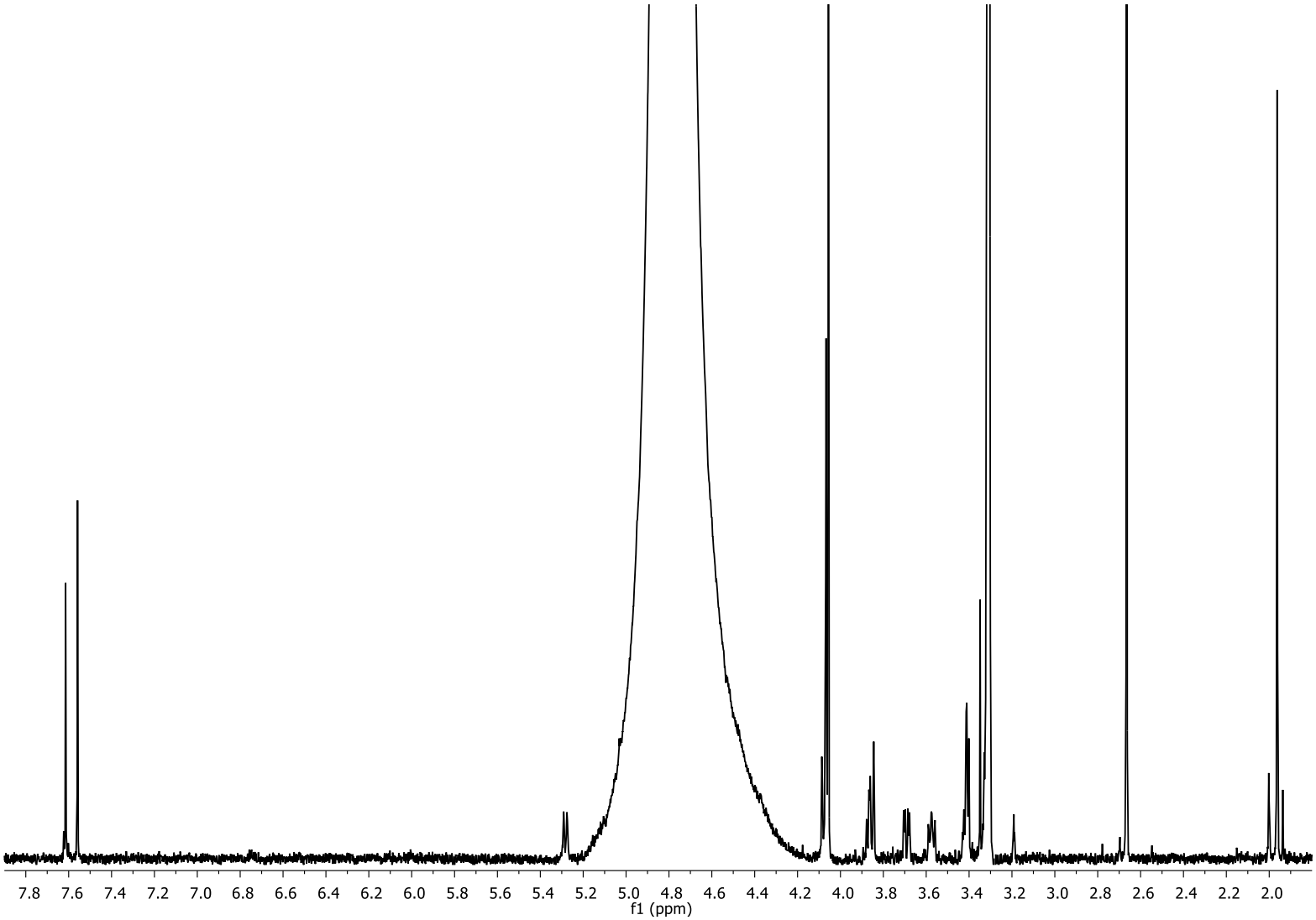
Experimental Methods

General Experimental Procedures

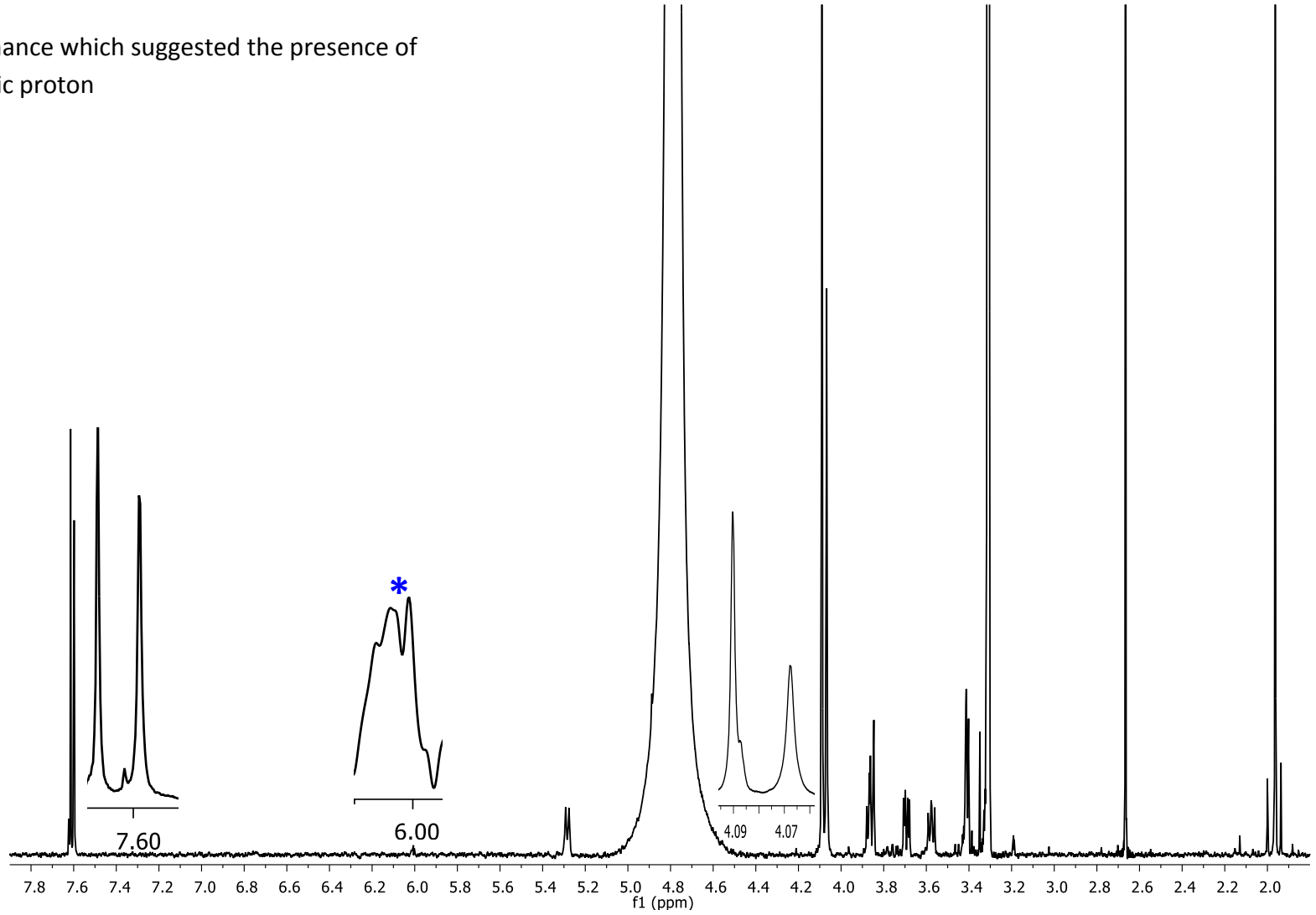
The UV spectra were recorded on a JASCO Varian-650 UV/Vis spectrophotometer. NMR spectra were recorded at 30°C on either a Varian 500 or 600 MHz Unity INOVA spectrometer. The latter spectrometer was equipped with a triple resonance cold probe. The ^{1}H and ^{13}C NMR chemical shifts were referenced to the solvent peak at δ_H 2.50 and δ_C 39.52 for DMSO-d_6. LR-ESIMS were recorded on a Waters Alliance 2790 HPLC system equipped with a 996 PDA detector, and an Alltech ELSD that was attached to a Water ZQ ESI mass spectrometer. All HR-ESIMS were recorded on an Agilent Q-TOF 6520 mass spectrometer. A Waters 600 pump equipped with Waters 996 PDA detector and Gilson 715 liquid handler were used for all HPLC work. Semipreparative HPLC separations were carried out either with a Phenomenex Onyx Monolitic (100 x 10 mm) C_{18} column or a Thermo Scientific BDS Hypersil C_8 column (250 X 10 mm). All solvents used for chromatography, UV, and MS were Lab-Scan HPLC grade (RCI Lab-Scan, Bangkok, Thailand), and the H_2O was Millipore Milli-Q PF filtered.

S1: ^{1}H NMR fingerprint spectrum of *Streptomyces* sp. USC 592, LLE fraction 1 at 600 MHz in MeOD-d_4

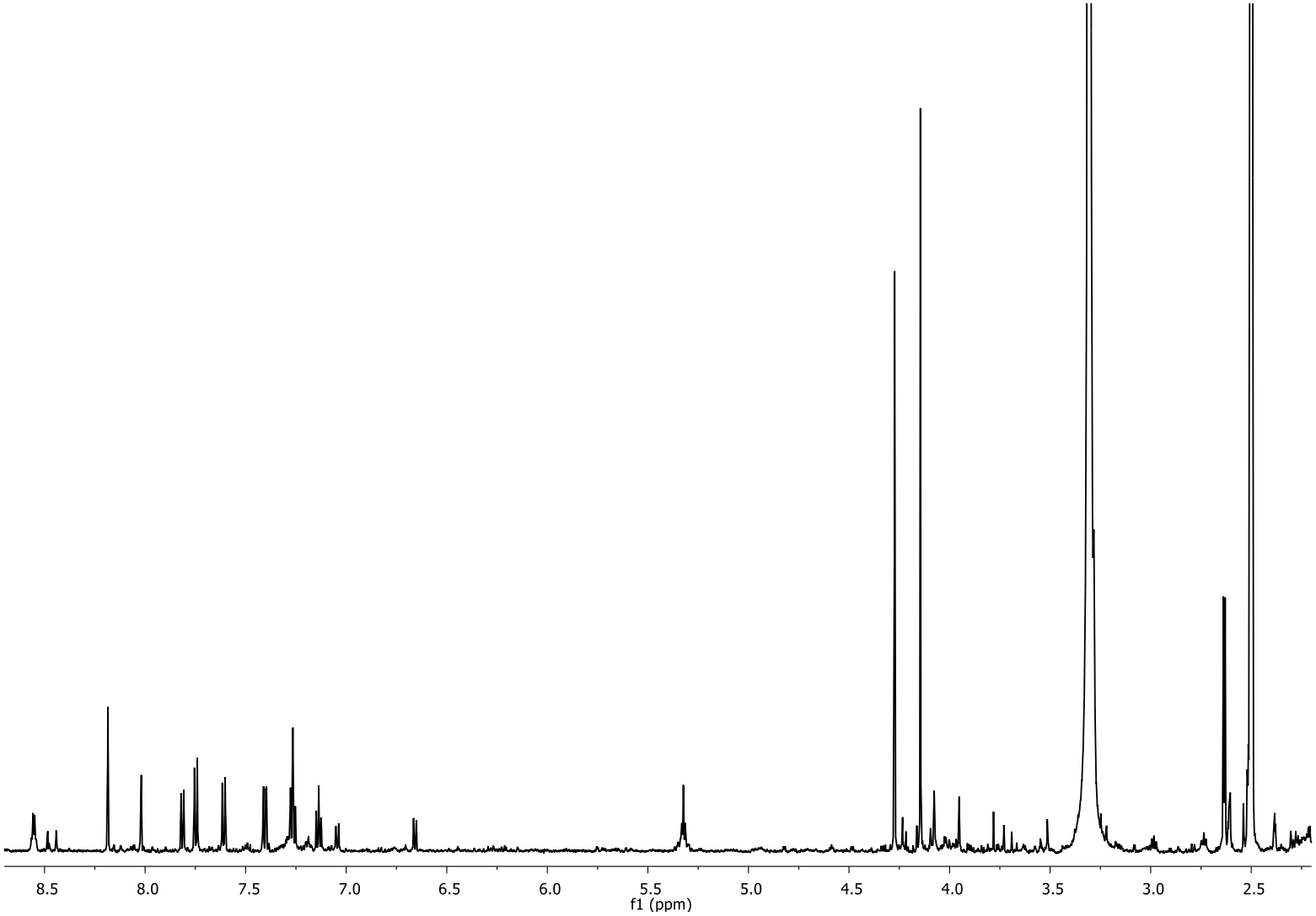


S2: ^{1}H NMR fingerprint spectrum of *Streptomyces* sp. USC 592, LLE fraction 2 at 600 MHz in MeOD-d_4

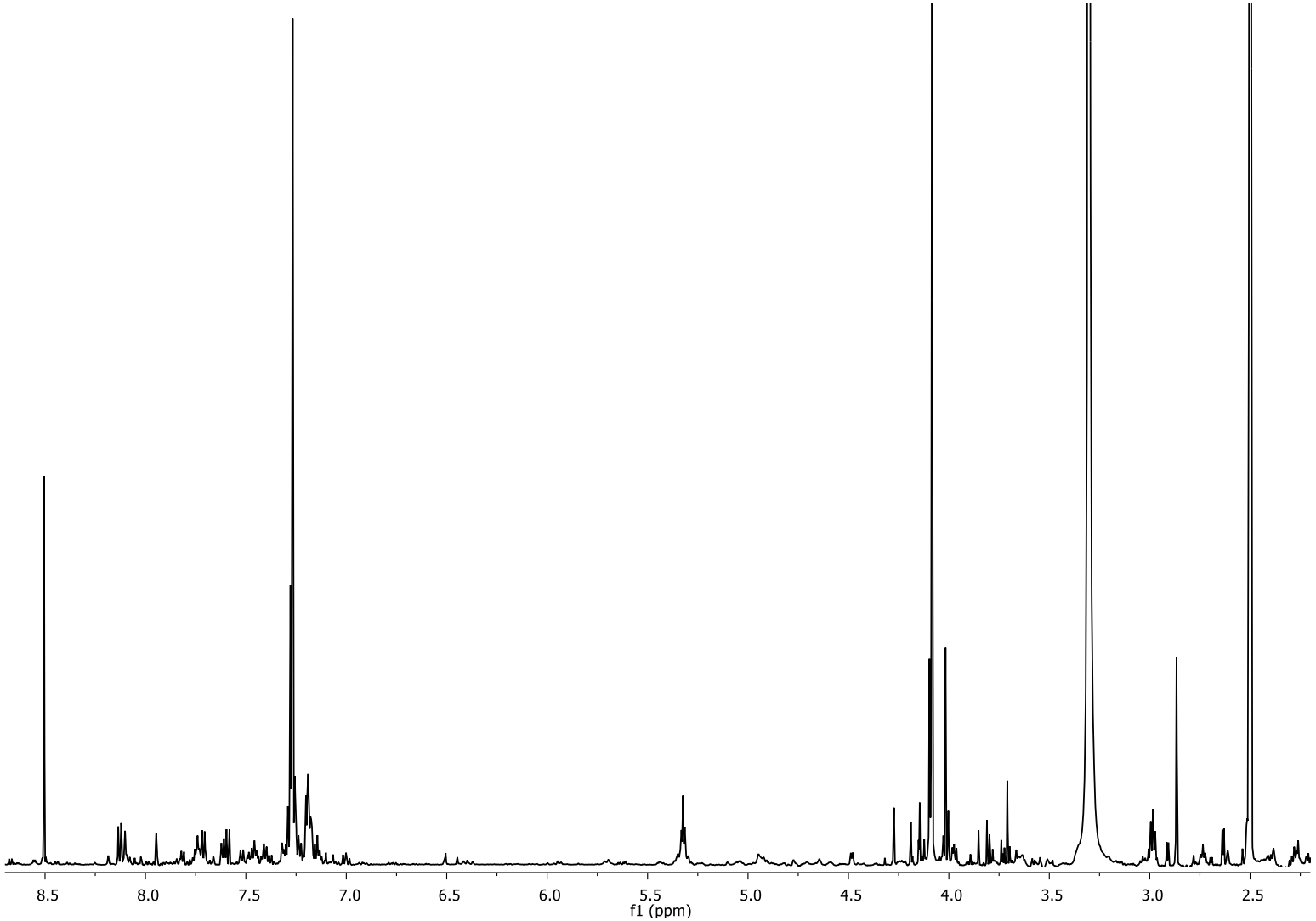
* NMR resonance which suggested the presence of an anomeric proton



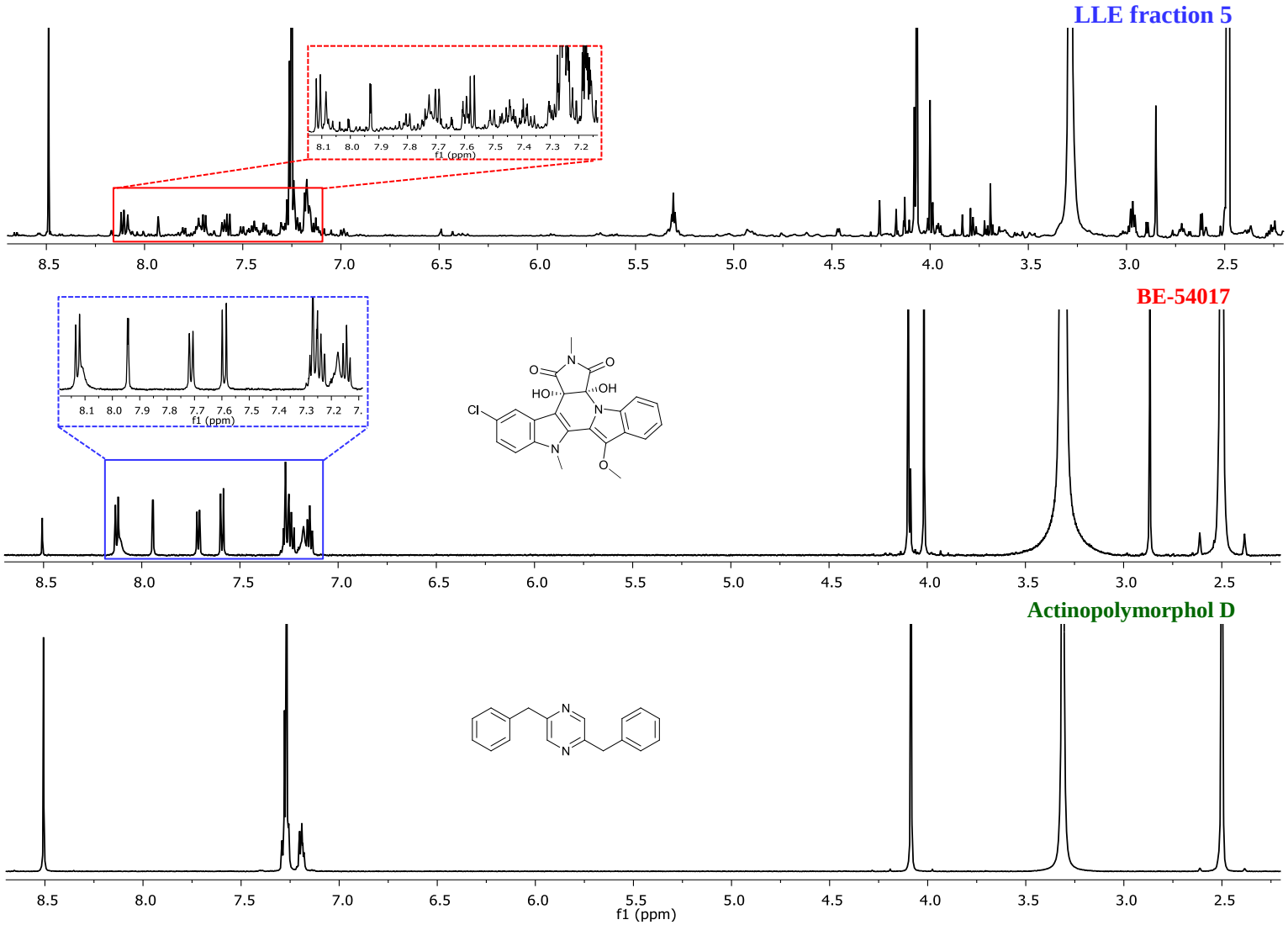
S3: ^{1}H NMR fingerprint spectrum of *Streptomyces* sp. USC 592, LLE fraction 4 at 600 MHz in DMSO-d_6



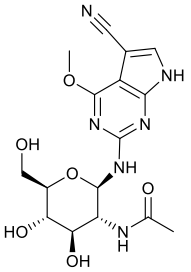
S4: ^{1}H NMR fingerprint spectrum of *Streptomyces* sp. USC 592, LLE fraction 5 at 600 MHz in DMSO-d_6



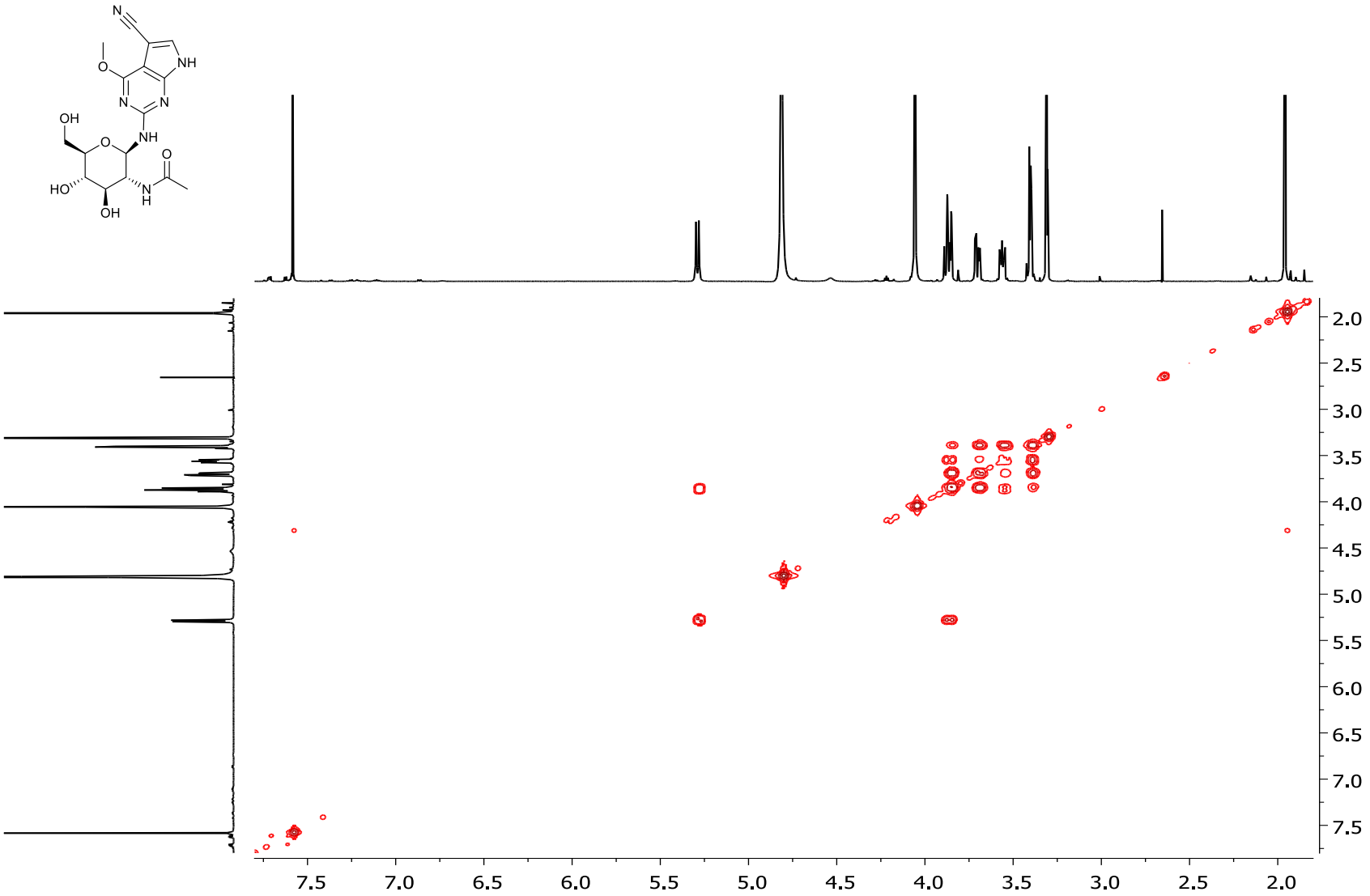
S5: ^{1}H NMR fingerprint of LLE fraction 5 indicating the presence of two components, large-scale NMR guided isolation yield two pure compounds, BE-54017 (middle spectrum) and actinopolymorphol D (spectrum at the bottom).



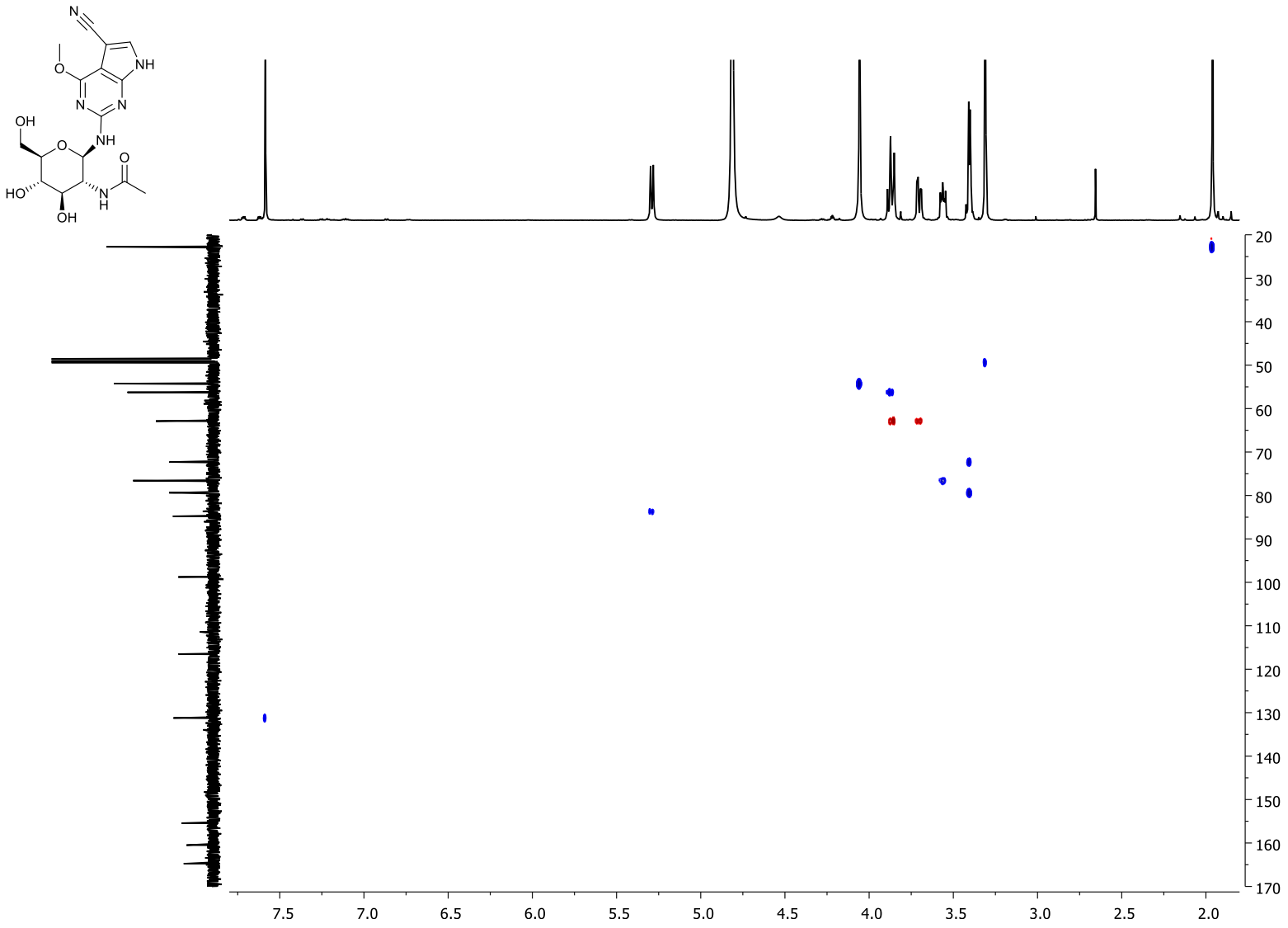
S6: ^{1}H NMR spectrum of actinoglycosidine A at 600 MHz in MeOD-d_4



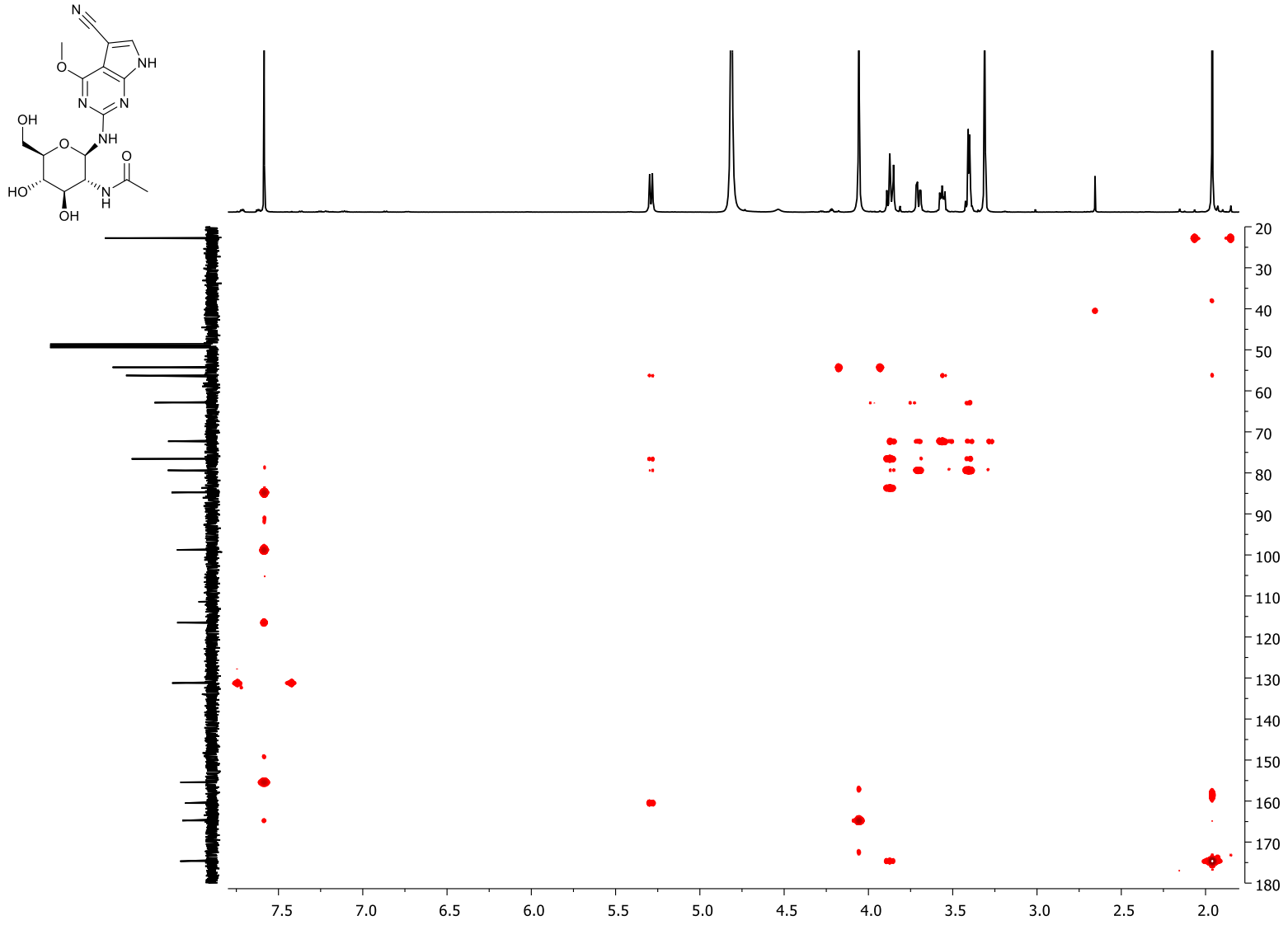
S7: gCOSY spectrum of actinoglycosidine A at 600 MHz in MeOD-d_4



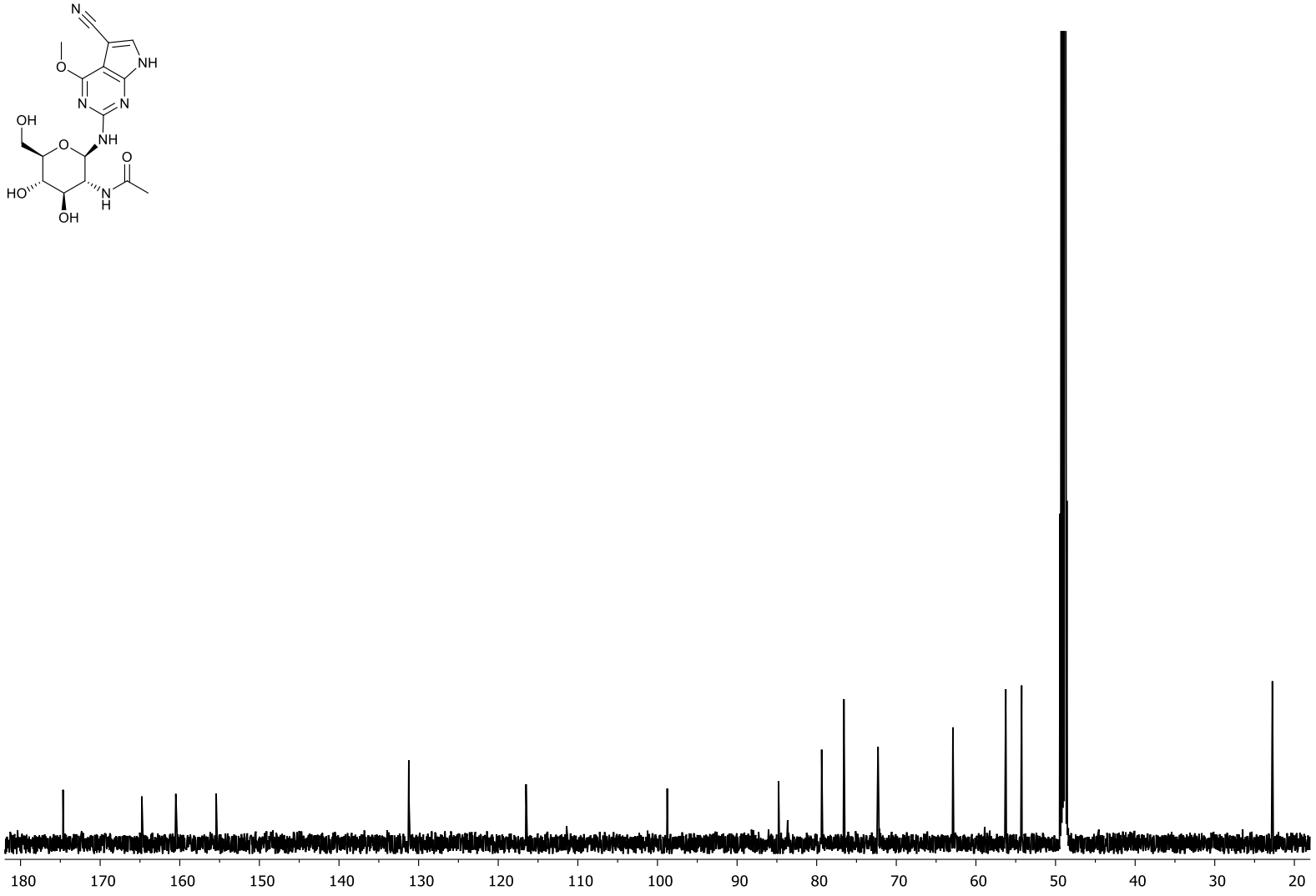
S8: gHSQC spectrum of actinoglycosidine A at 600 MHz in MeOD-d_4



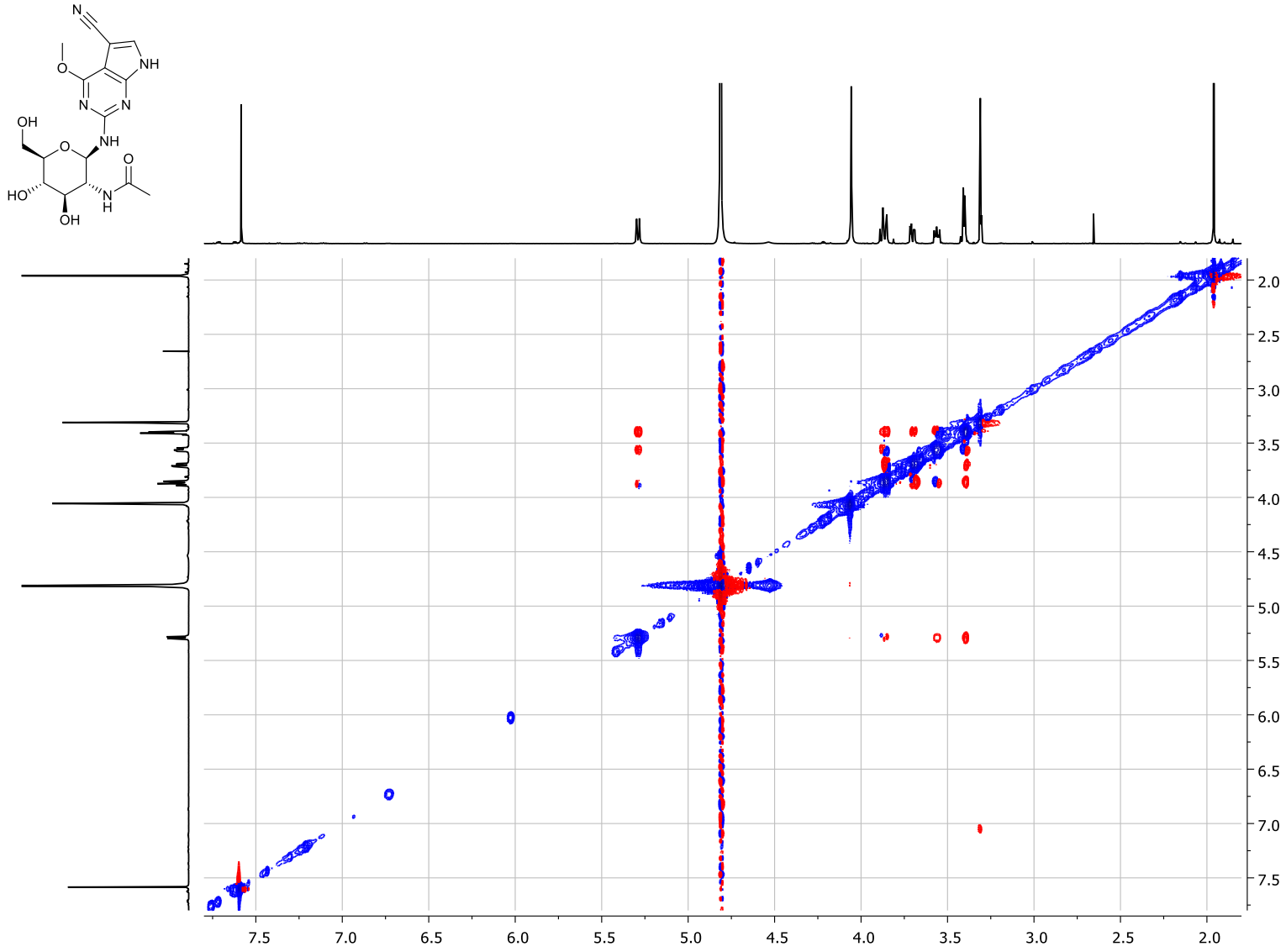
S9: gHMBC spectrum of actinoglycosidine A at 600 MHz in MeOD-d_4



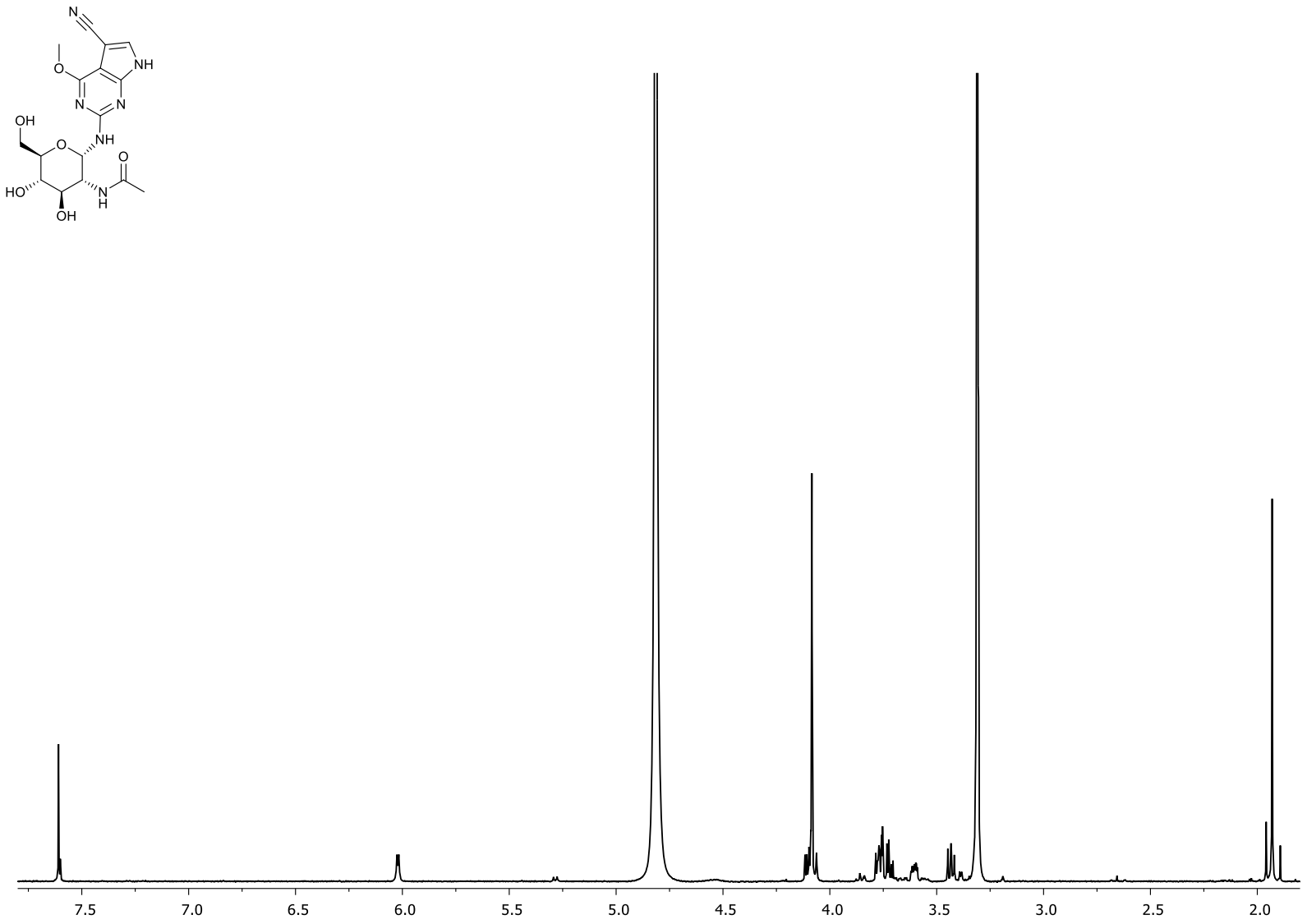
S10: ^{13}C NMR spectrum of actinoglycosidine A at 150 MHz in MeOD-d_4



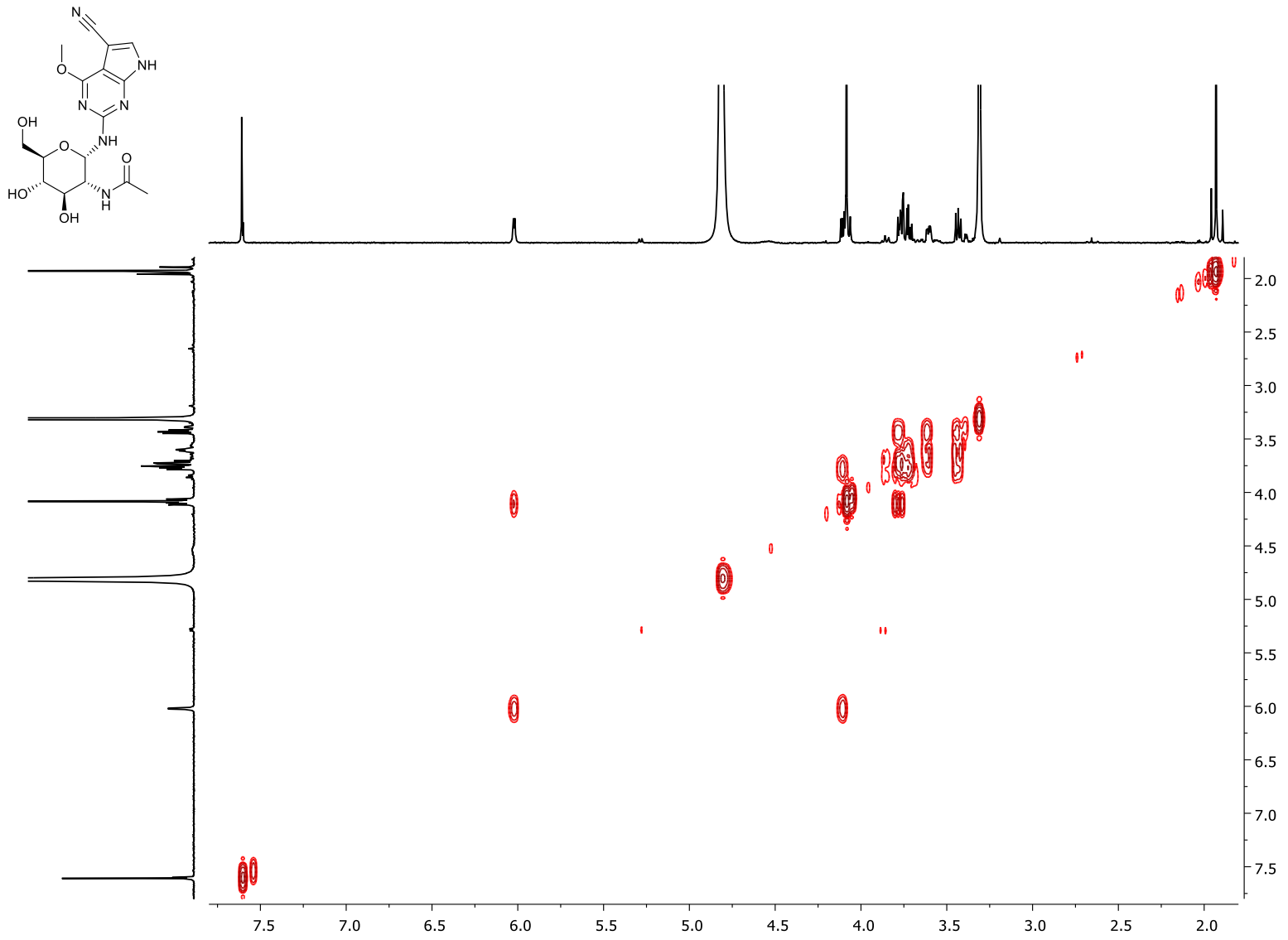
S11: NOESY spectrum of actinoglycosidine A at 600 MHz in MeOD-d_4



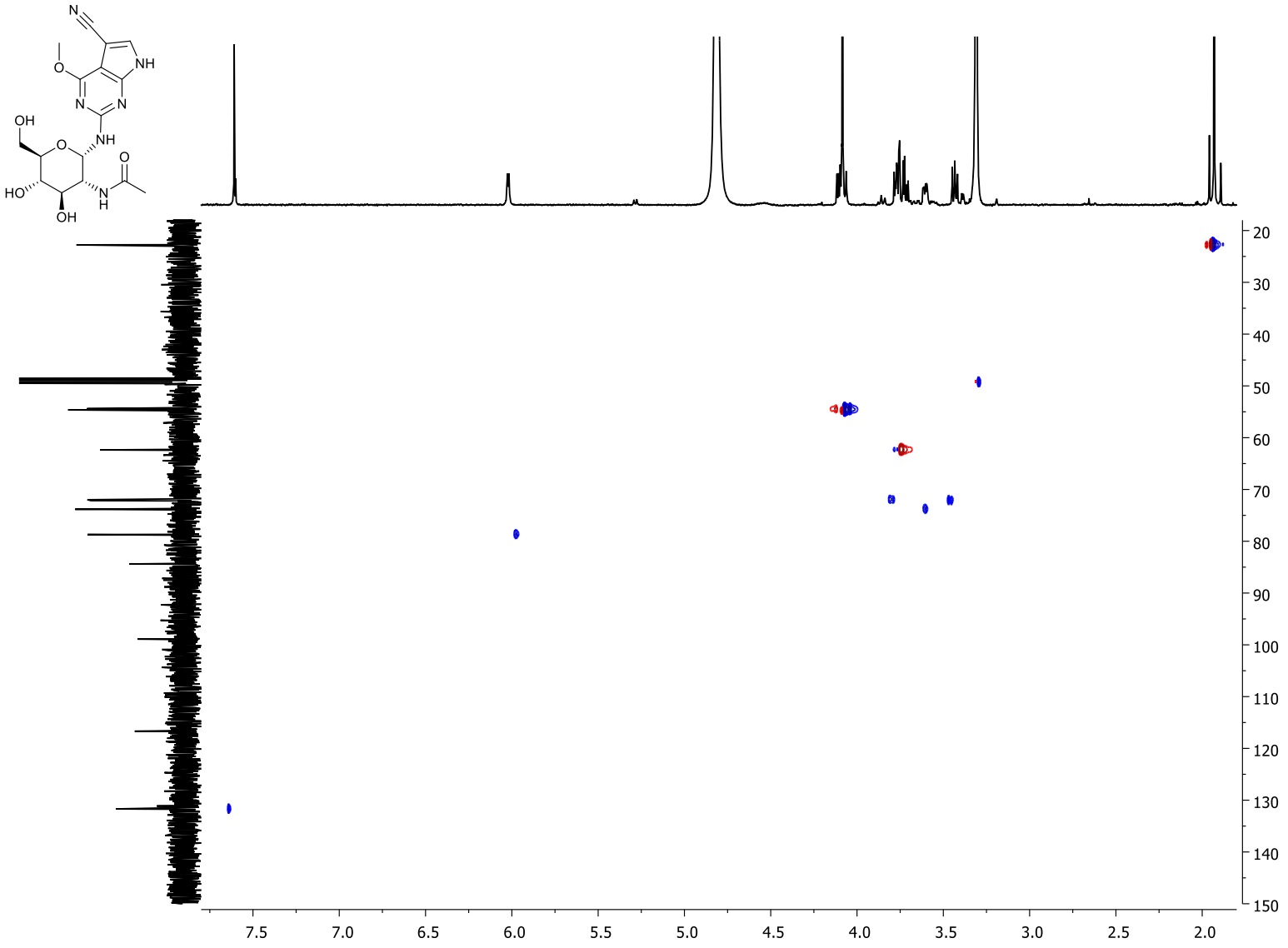
S12: ^{1}H NMR spectrum of actinoglycosidine B at 600 MHz in MeOD-d_4



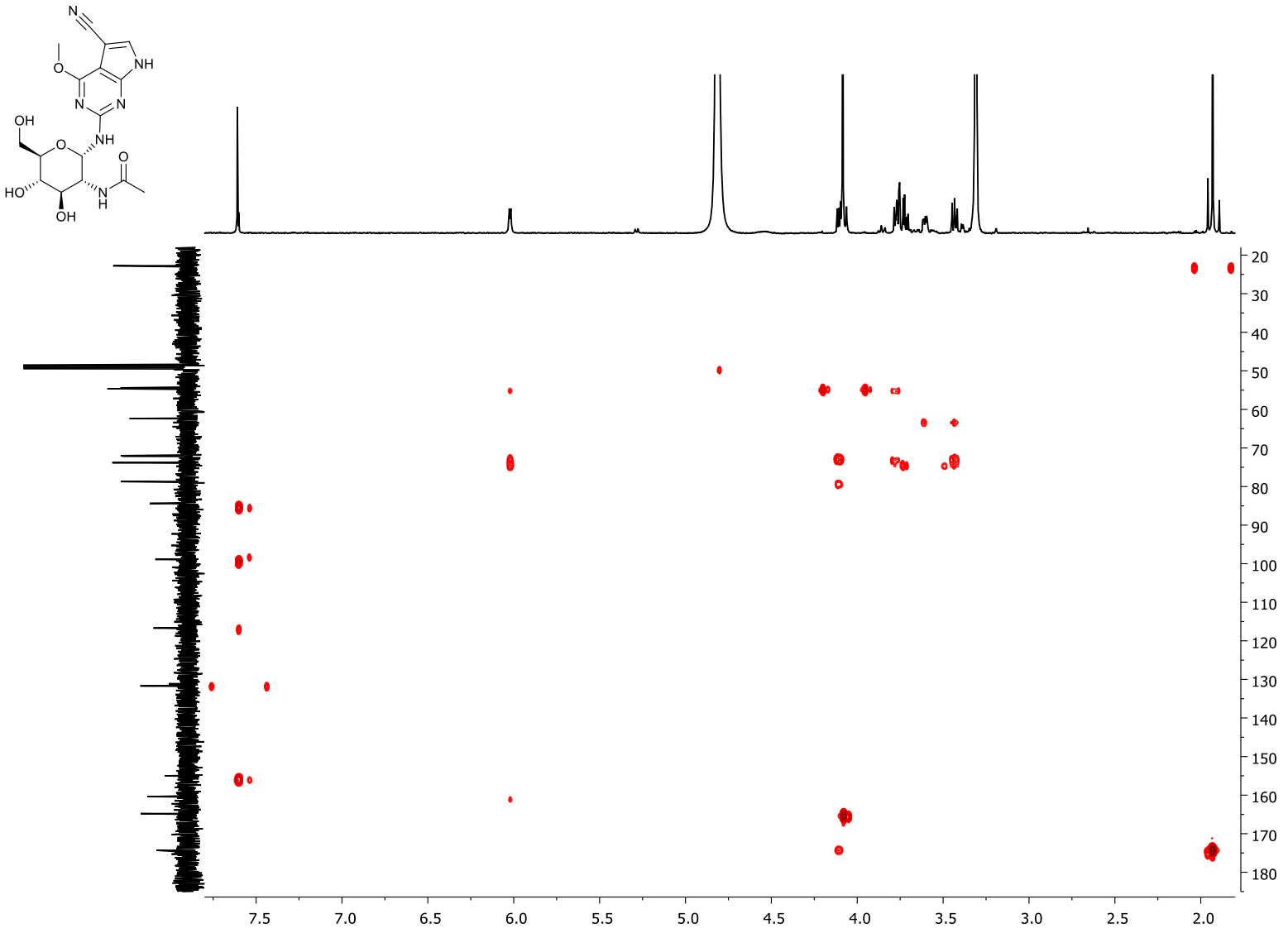
S13: gCOSY spectrum of actinoglycosidine B at 600 MHz in MeOD-d_4



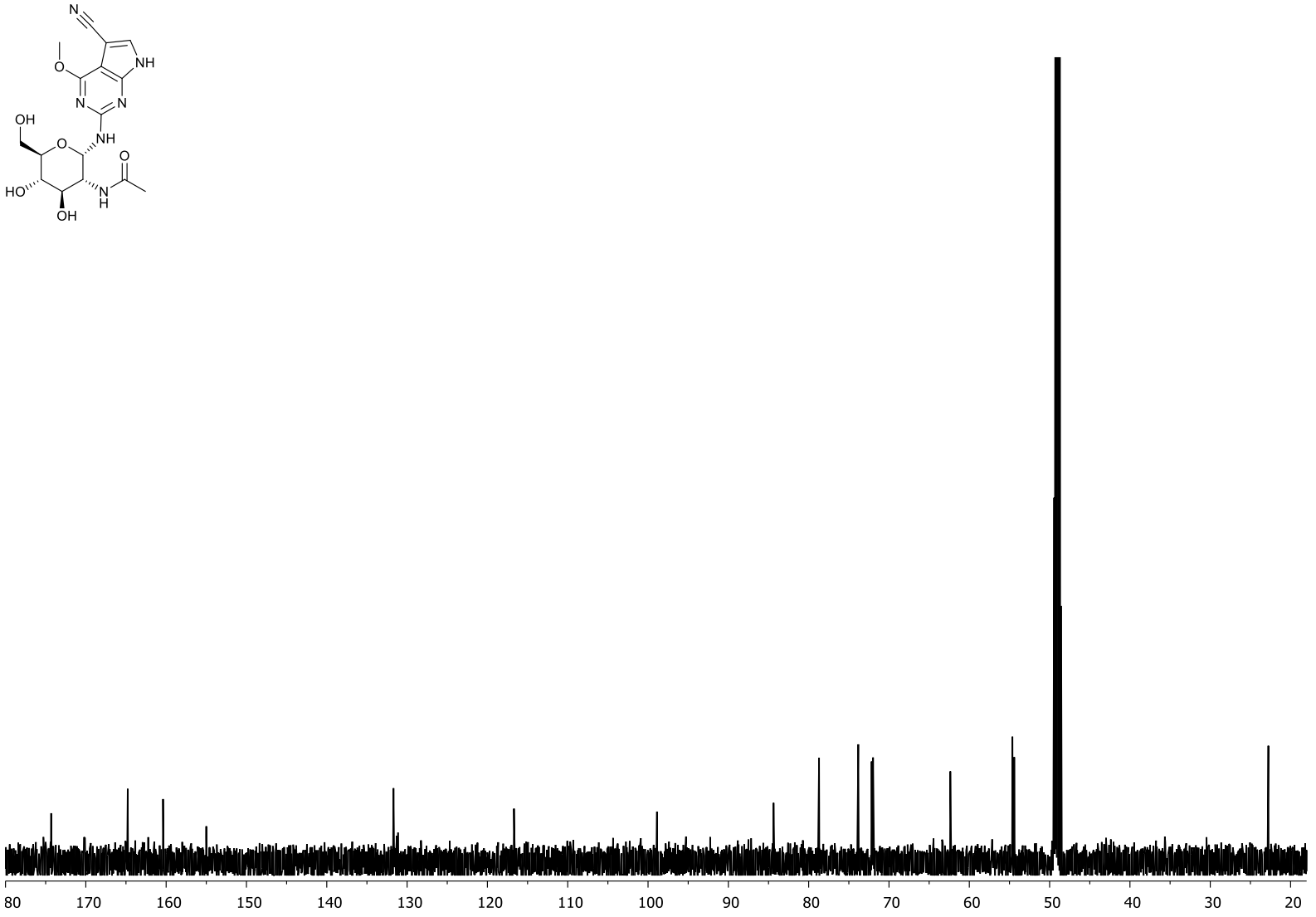
S14: gHSQC spectrum of actinoglycosidine B at 600 MHz in MeOD-d_4



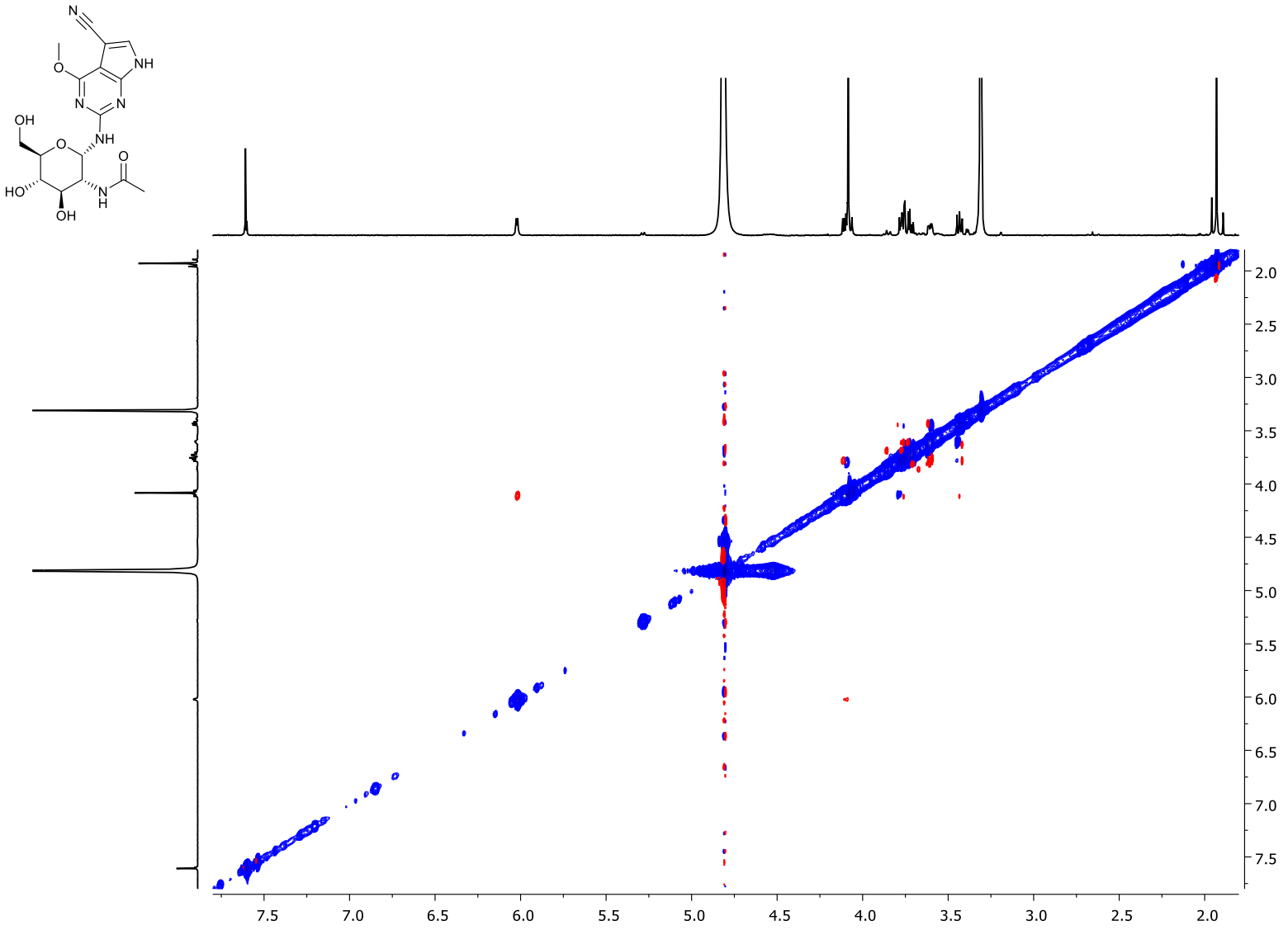
S15: gHMBC spectrum of actinoglycosidine B at 600 MHz in MeOD-d_4



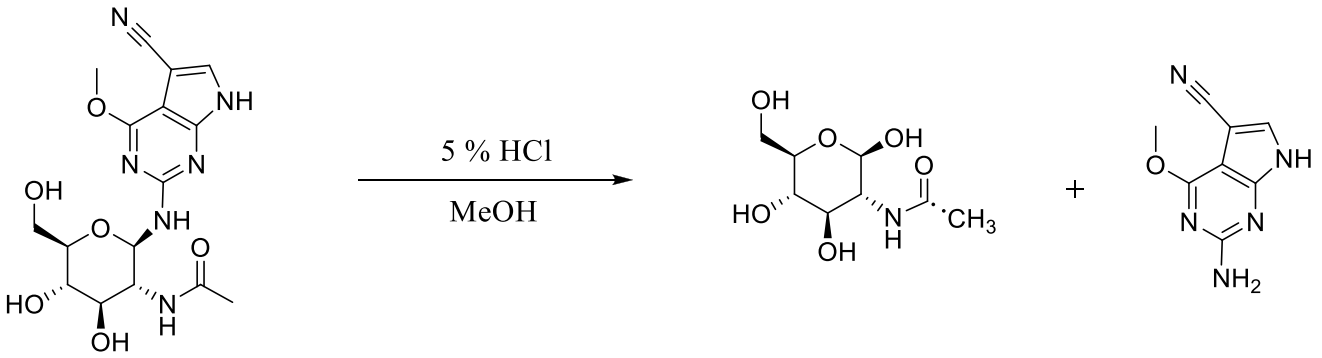
S16: ^{13}C NMR spectrum of actinoglycosidine B at 150 MHz in MeOD-d_4



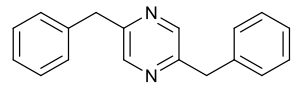
S17: NOESY spectrum of actinoglycosidine B at 600 MHz in MeOD-d_4

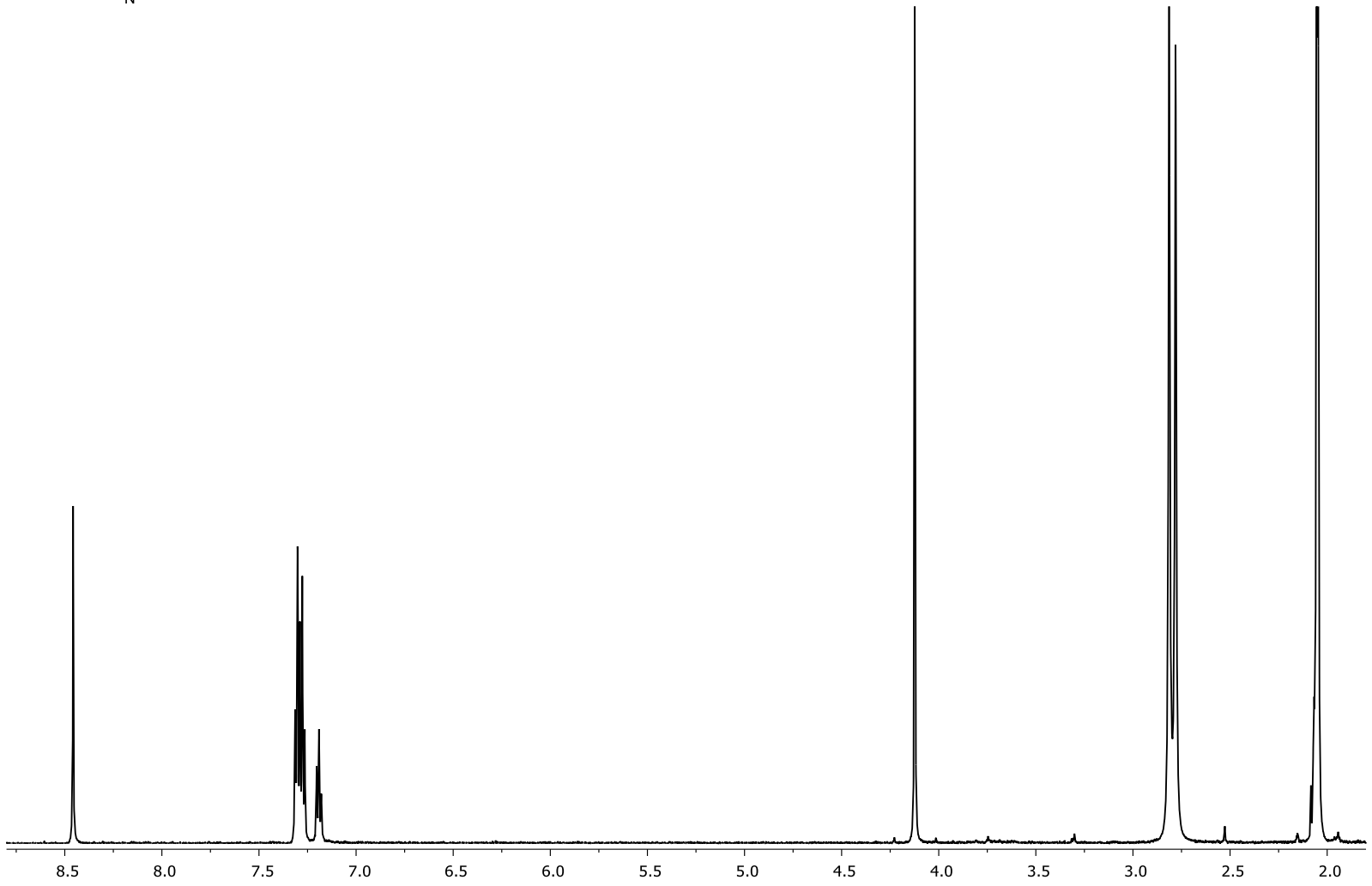


S18: Acid Hydrolysis of actinoglycosidine A

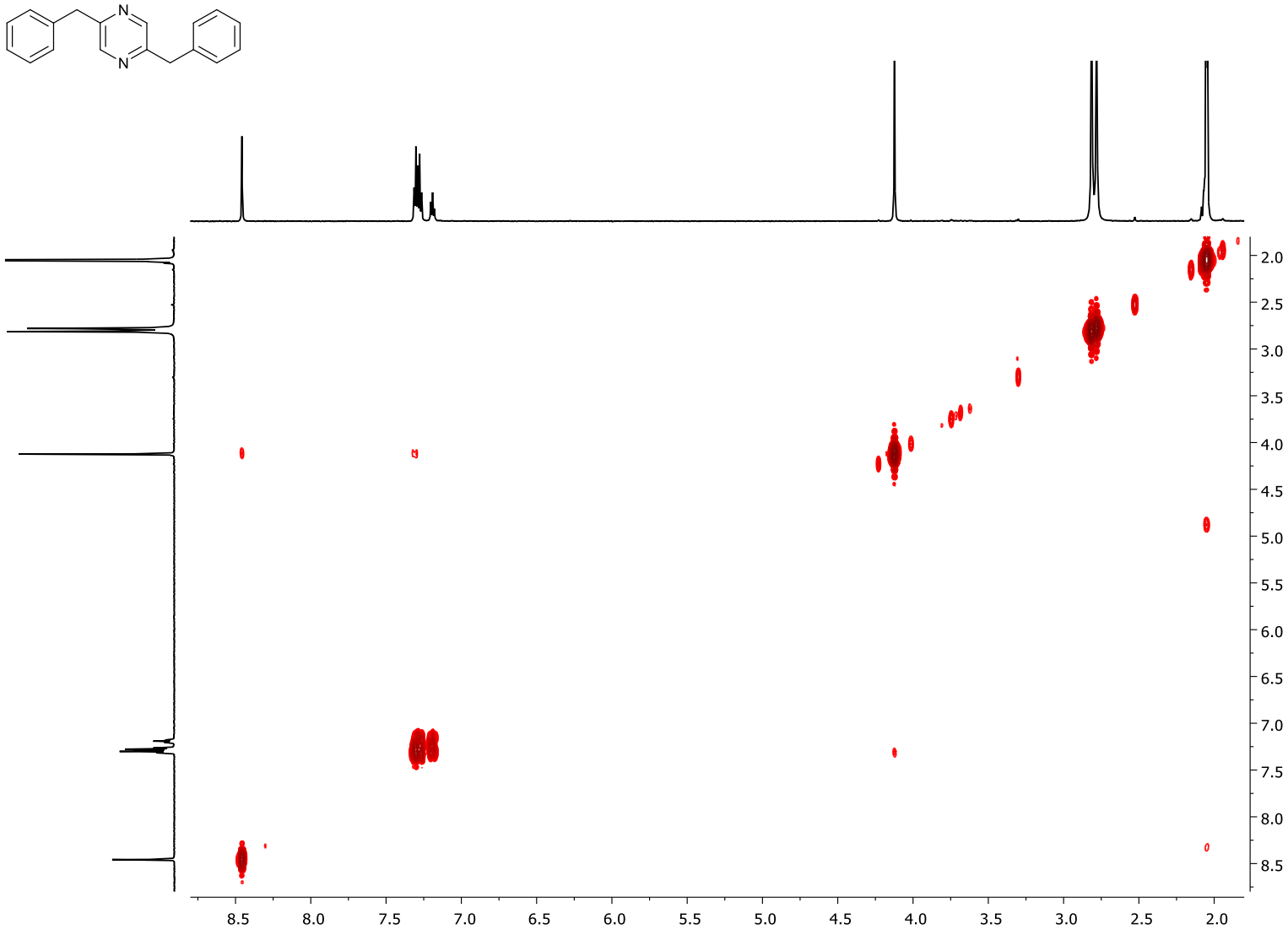


S19: ^{1}H NMR spectrum of actinopolymorphol D at 600 MHz in Acetone-d_6

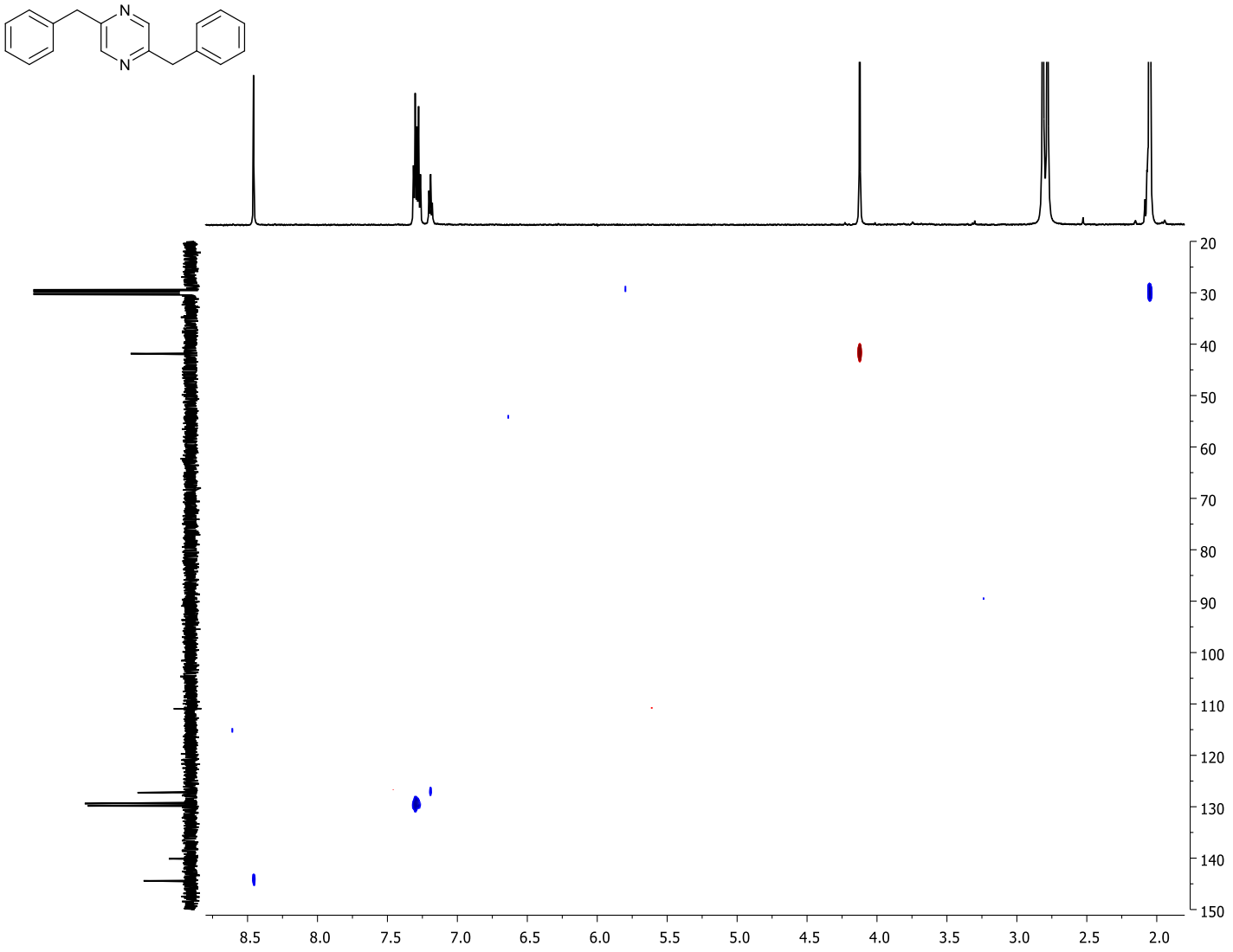




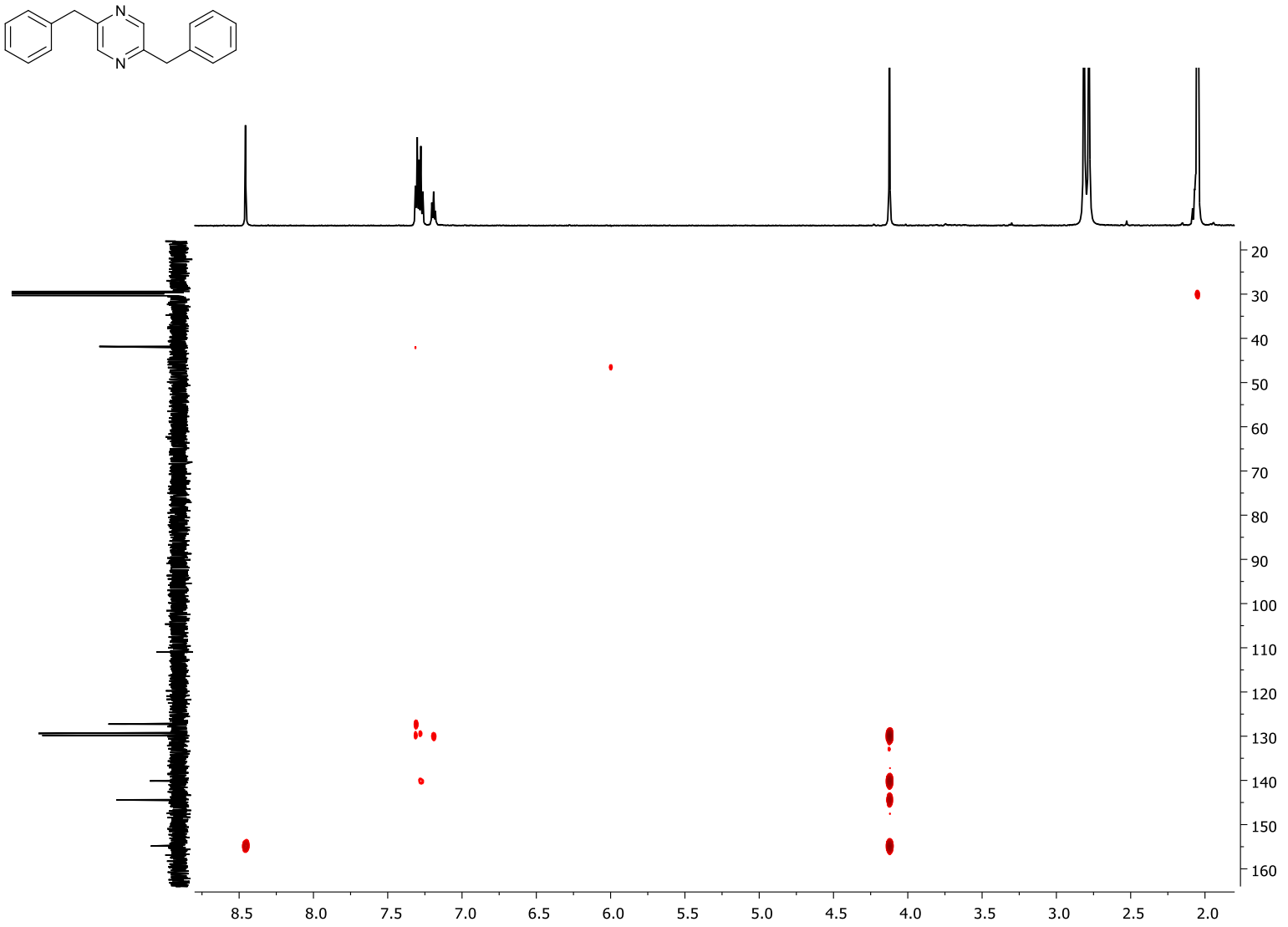
S20: gCOSY spectrum of actinopolymorphol D at 600 MHz in Acetone-d_6



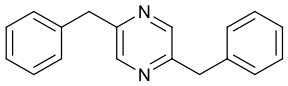
S21: gHSQC spectrum of actinopolymorphol D at 600 MHz in Acetone-d_6

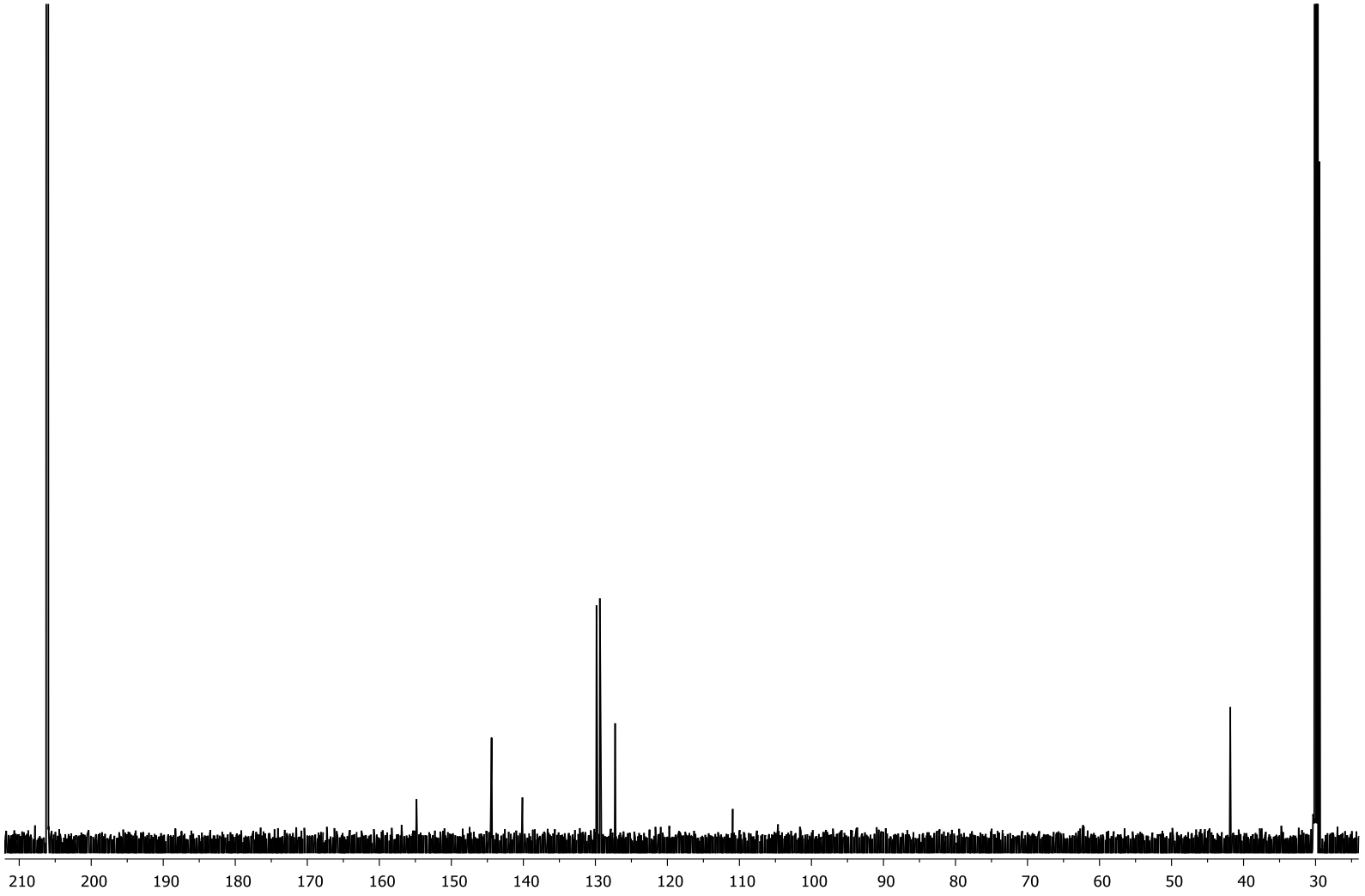


S22: gHMBC spectrum of actinopolymorphol D at 600 MHz in Acetone-d_6

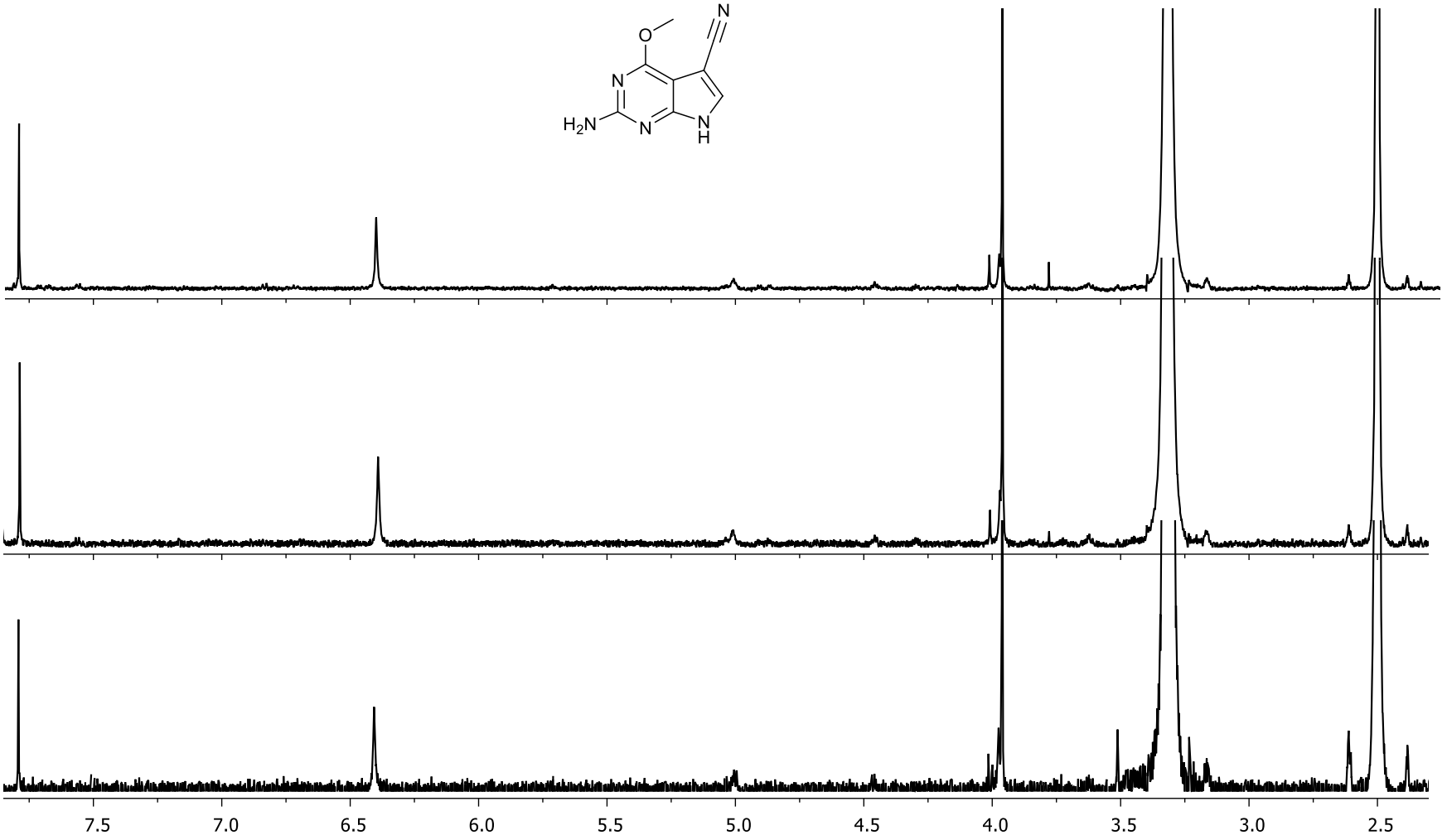


S23: ^{13}C NMR spectrum of actinopolymorphol D at 150 MHz in Acetone-d_6

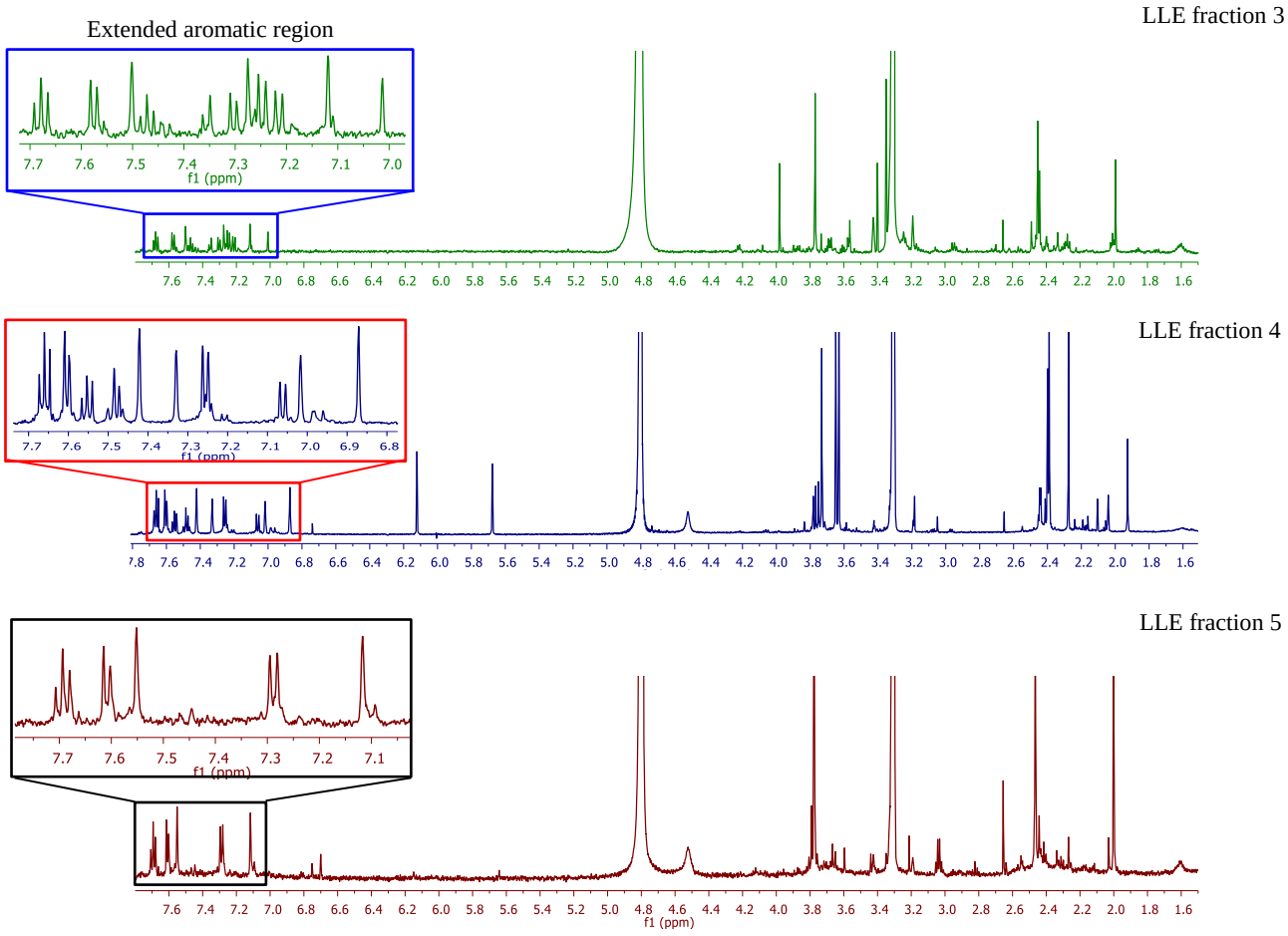




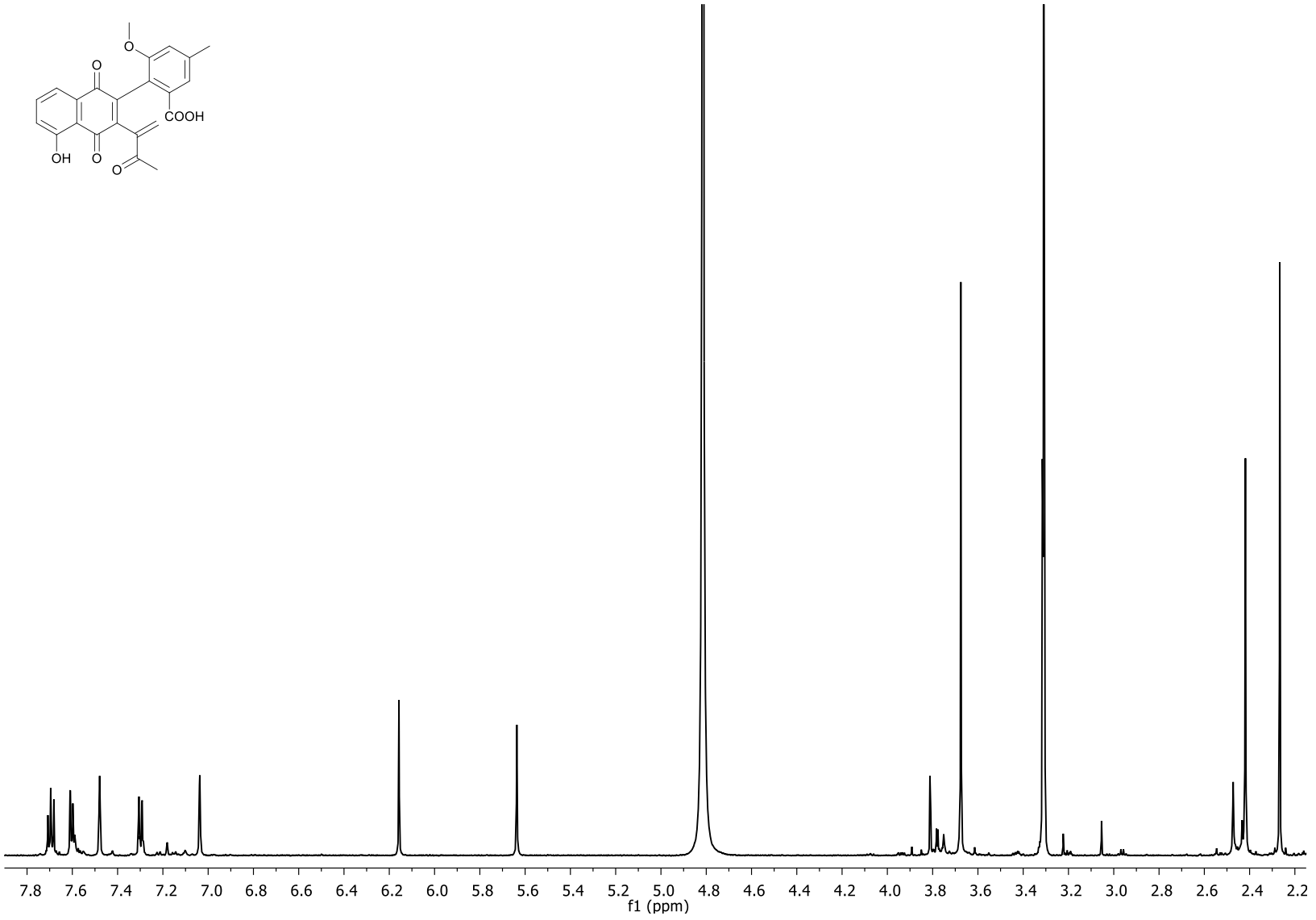
S24: ^{1}H NMR spectrum of fractions 17, 18 and 21 containing the known natural product 2-amino-6-methoxy-9H-pyrrolo[2,3-d]pyrimidine-7-carbonitrile at 600 MHz in DMSO-d_6



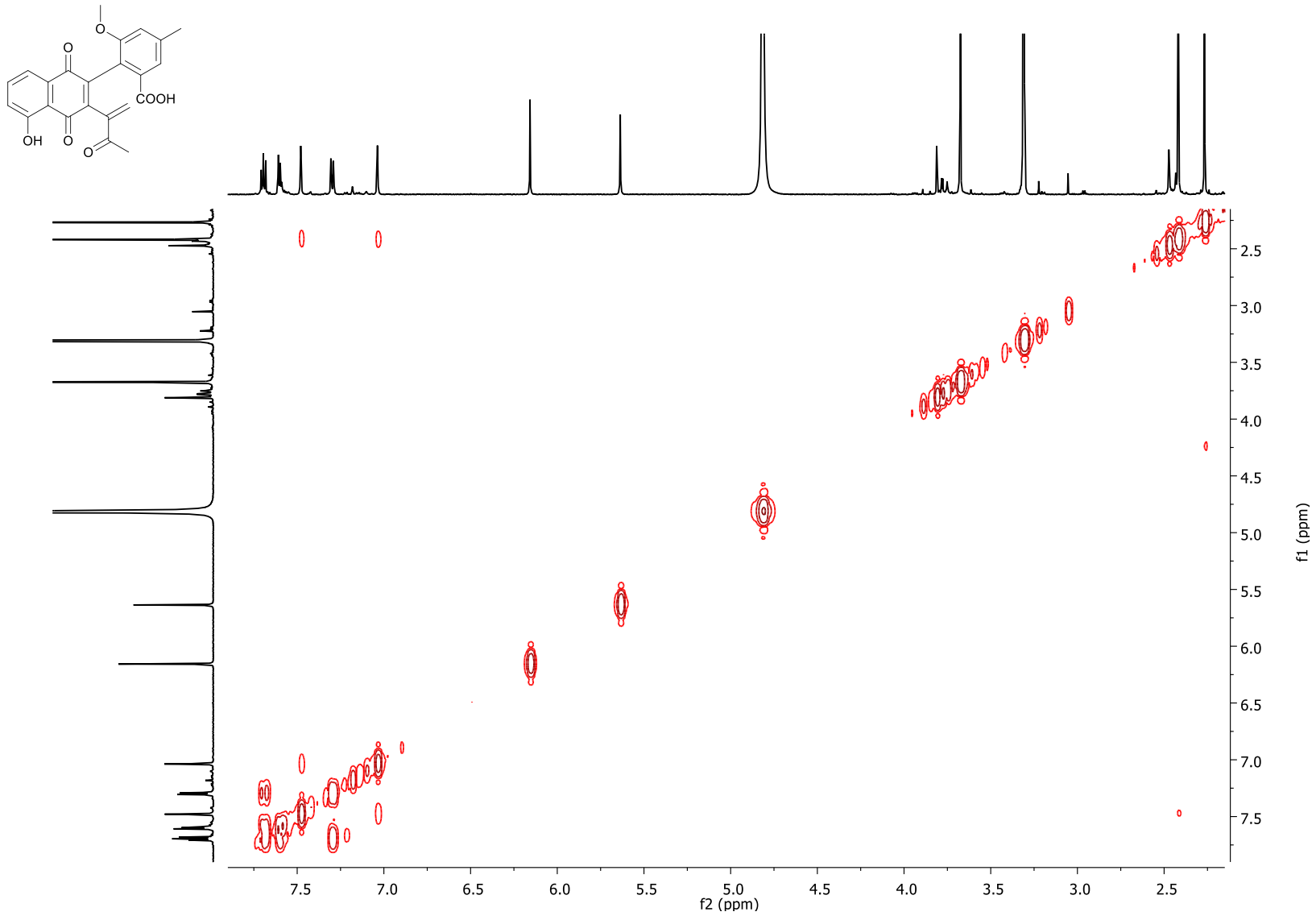
S25: ^{1}H NMR metabolic fingerprints of *Streptomyces* sp. USC 593 in MeOD-d_4



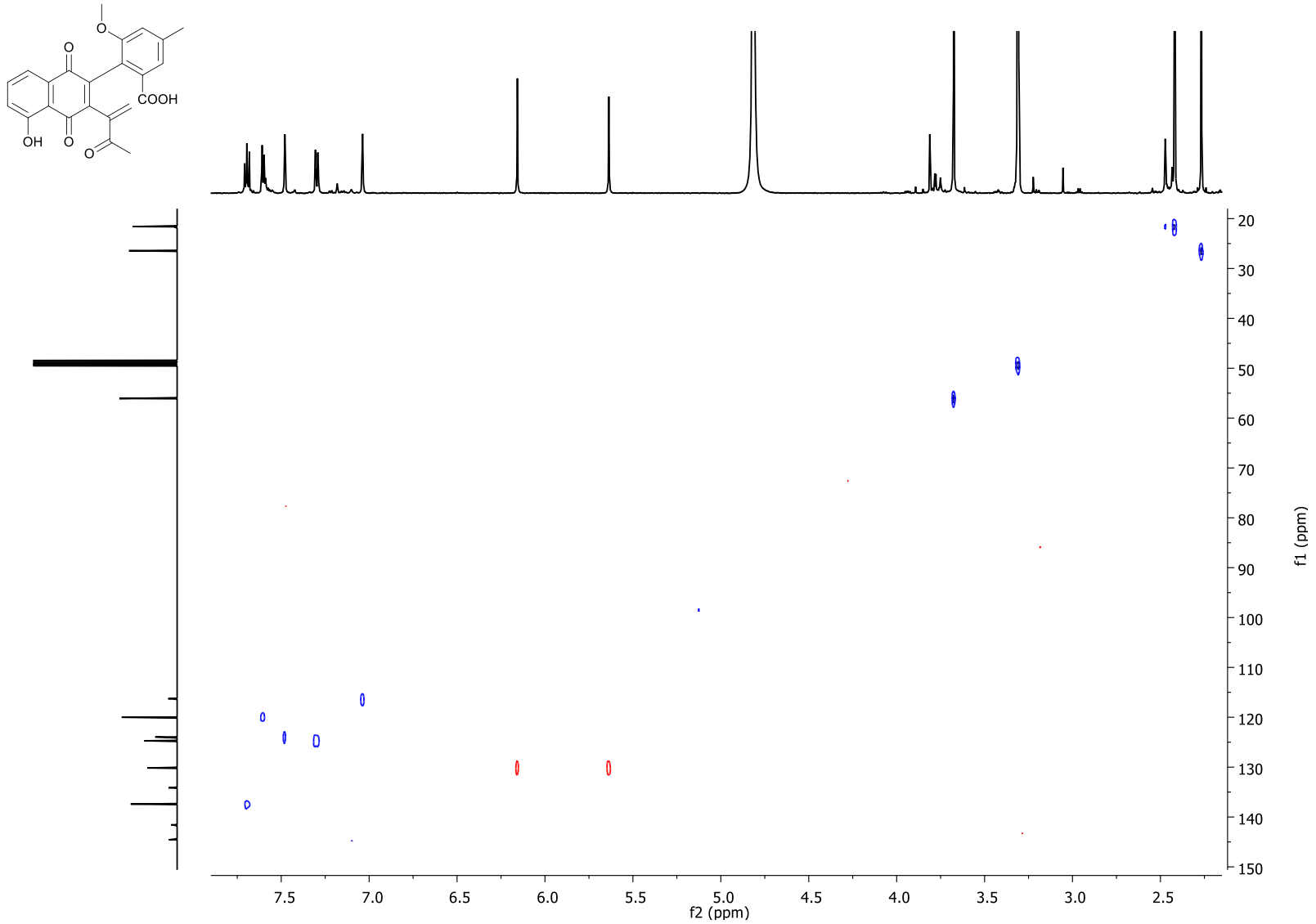
S26: ^{1}H NMR spectrum of niveamycin A at 600 MHz in MeOD-d_4



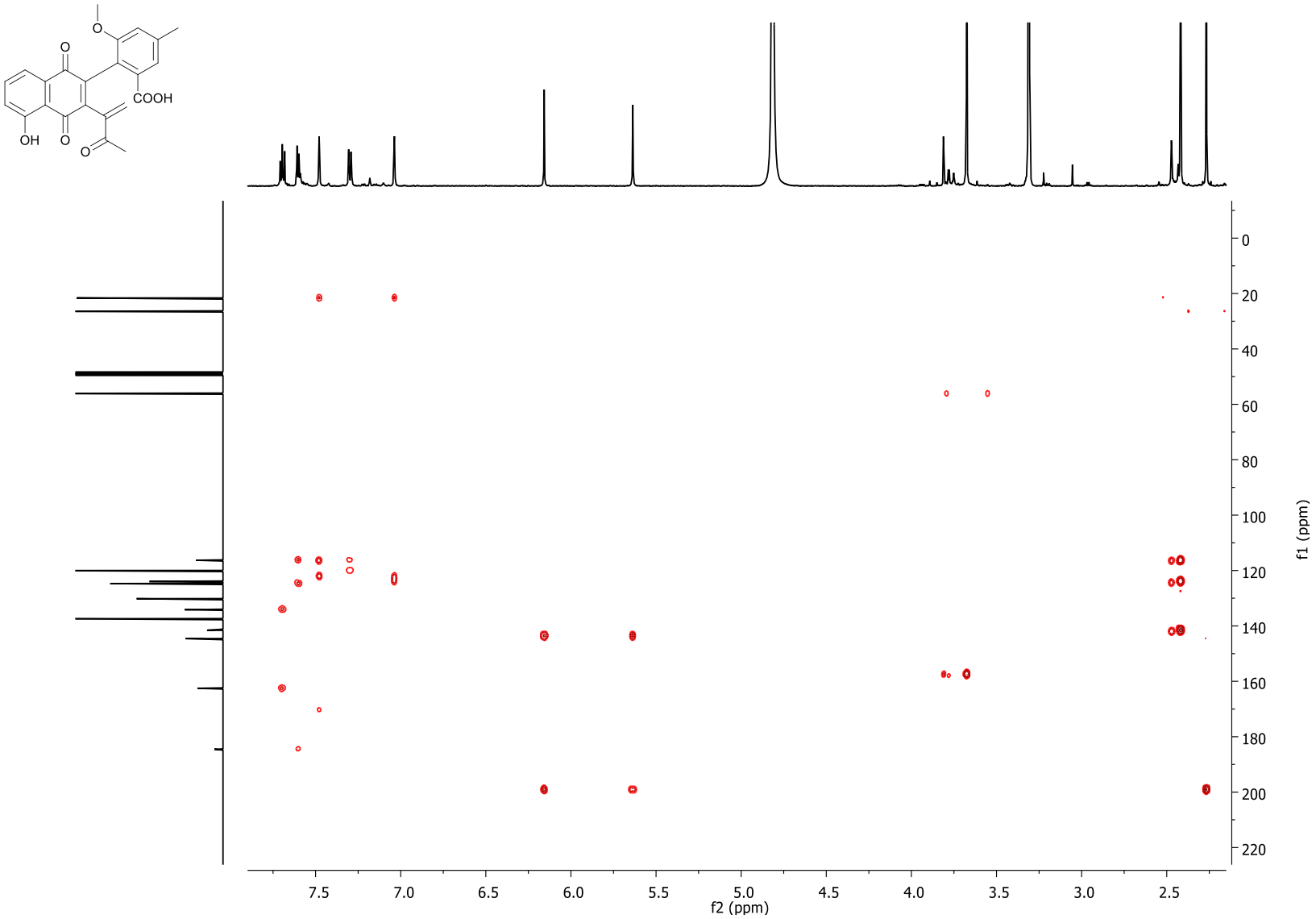
S27: gCOSY NMR spectrum of niveamycin A at 600 MHz in MeOD-d_4



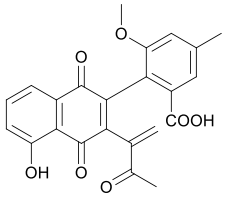
S28: gHSQC NMR spectrum of niveamycin A at 600 MHz in MeOD-d_4



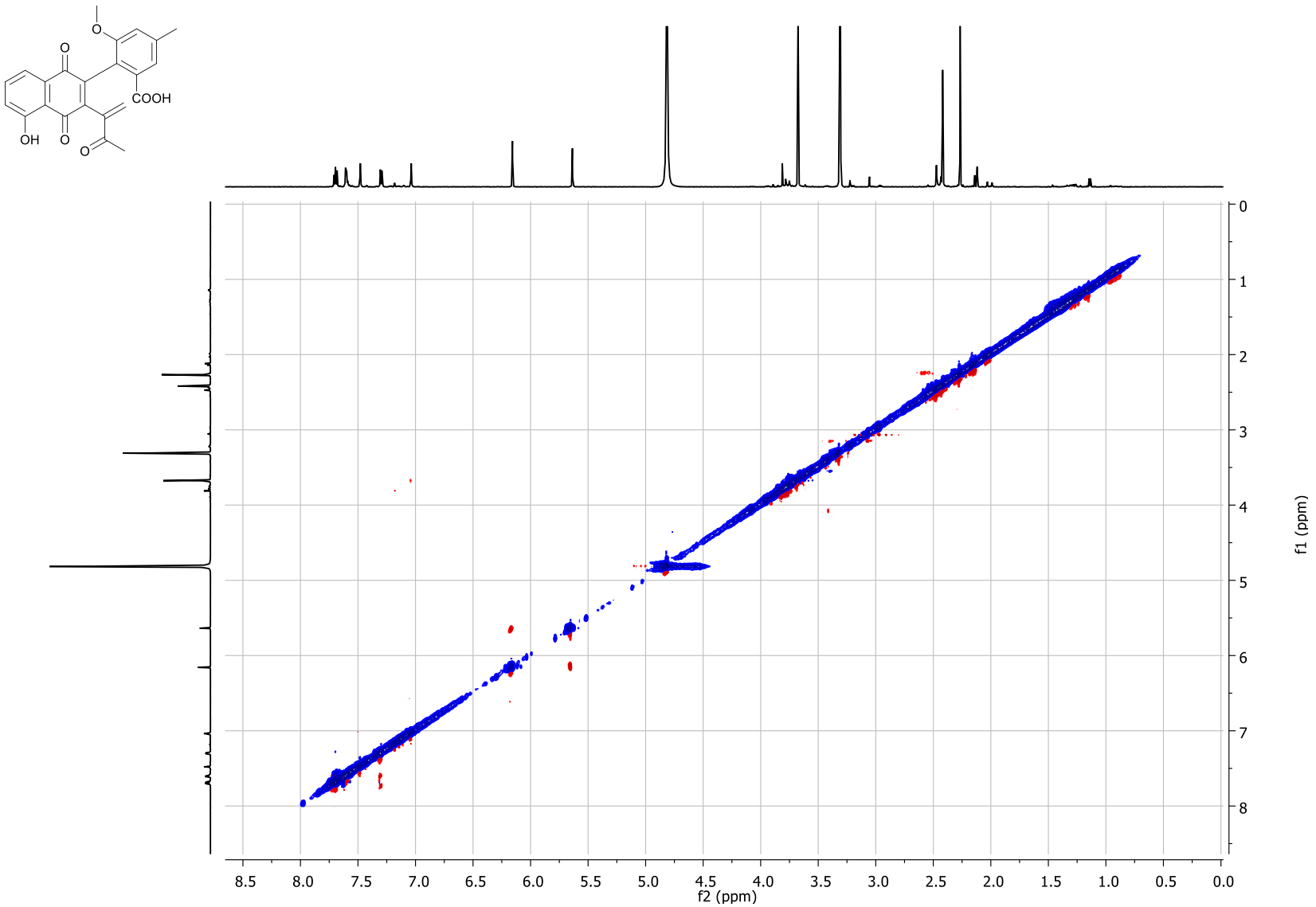
S29: gHMBC NMR spectrum of niveamycin A at 600 MHz in MeOD-d_4



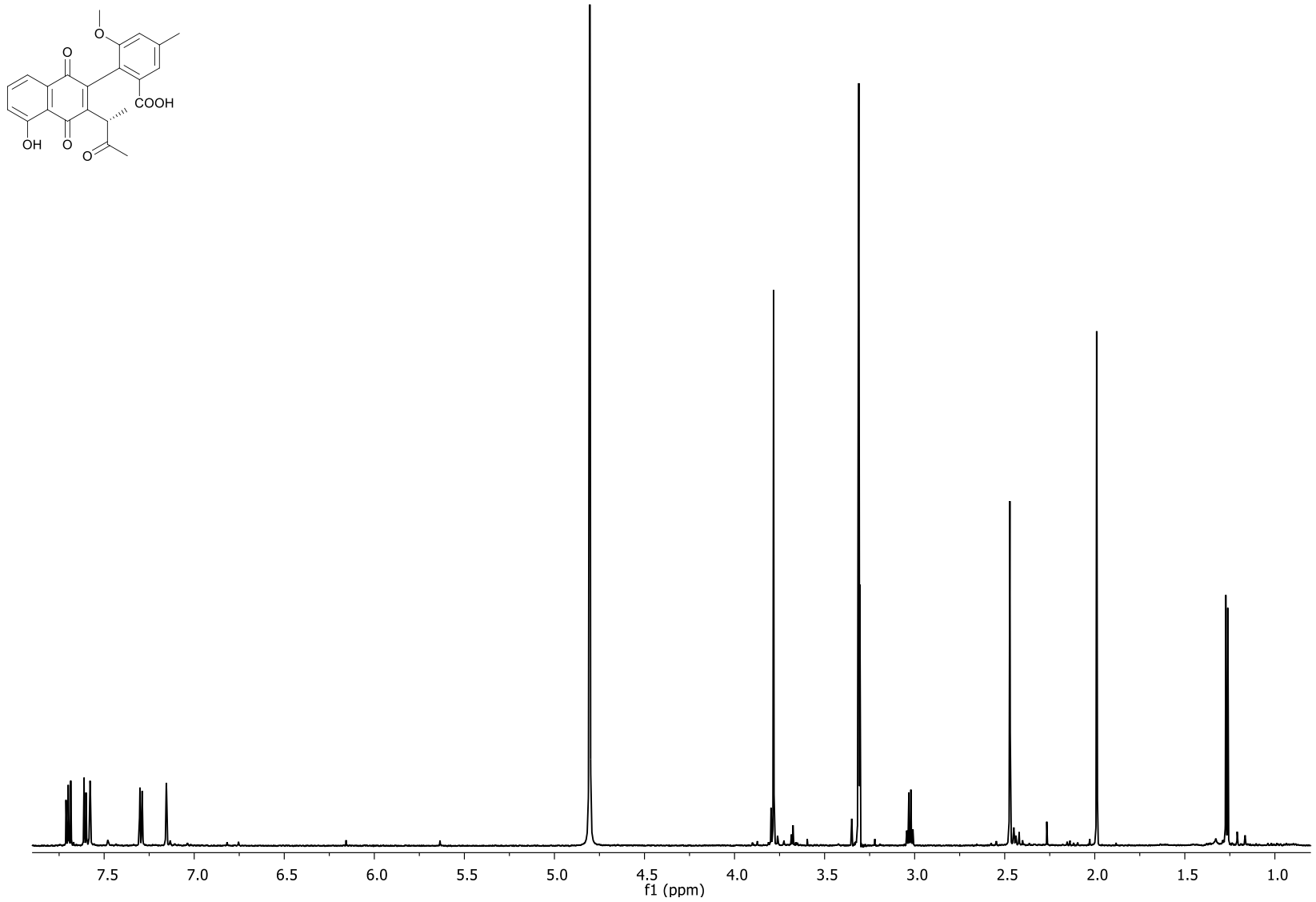
S30: ^{13}C NMR spectrum of niveamycin A at 150 MHz in MeOD-d_4



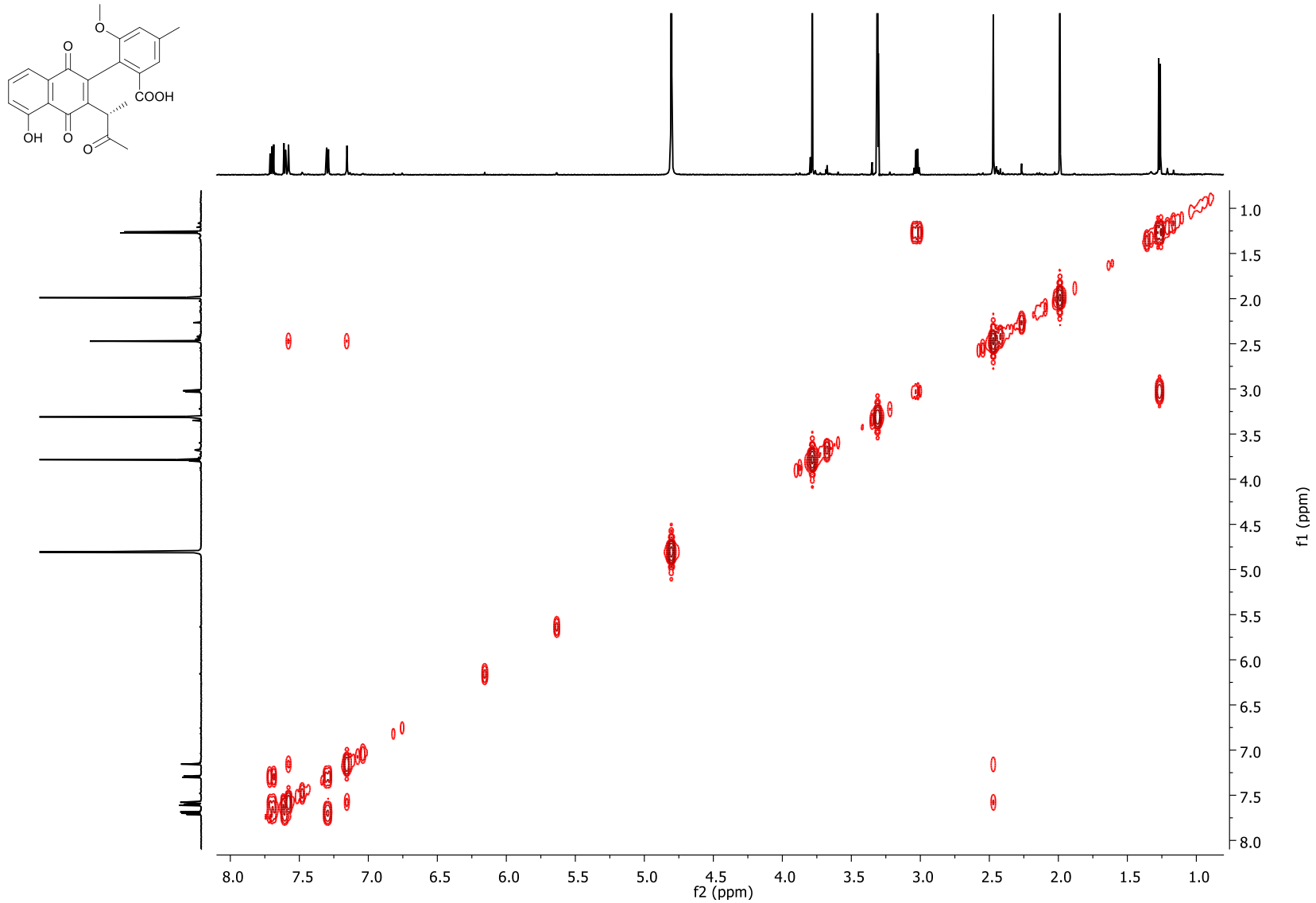
S31: ROSY NMR spectrum of niveamycin A at 600 MHz in MeOD-d_4



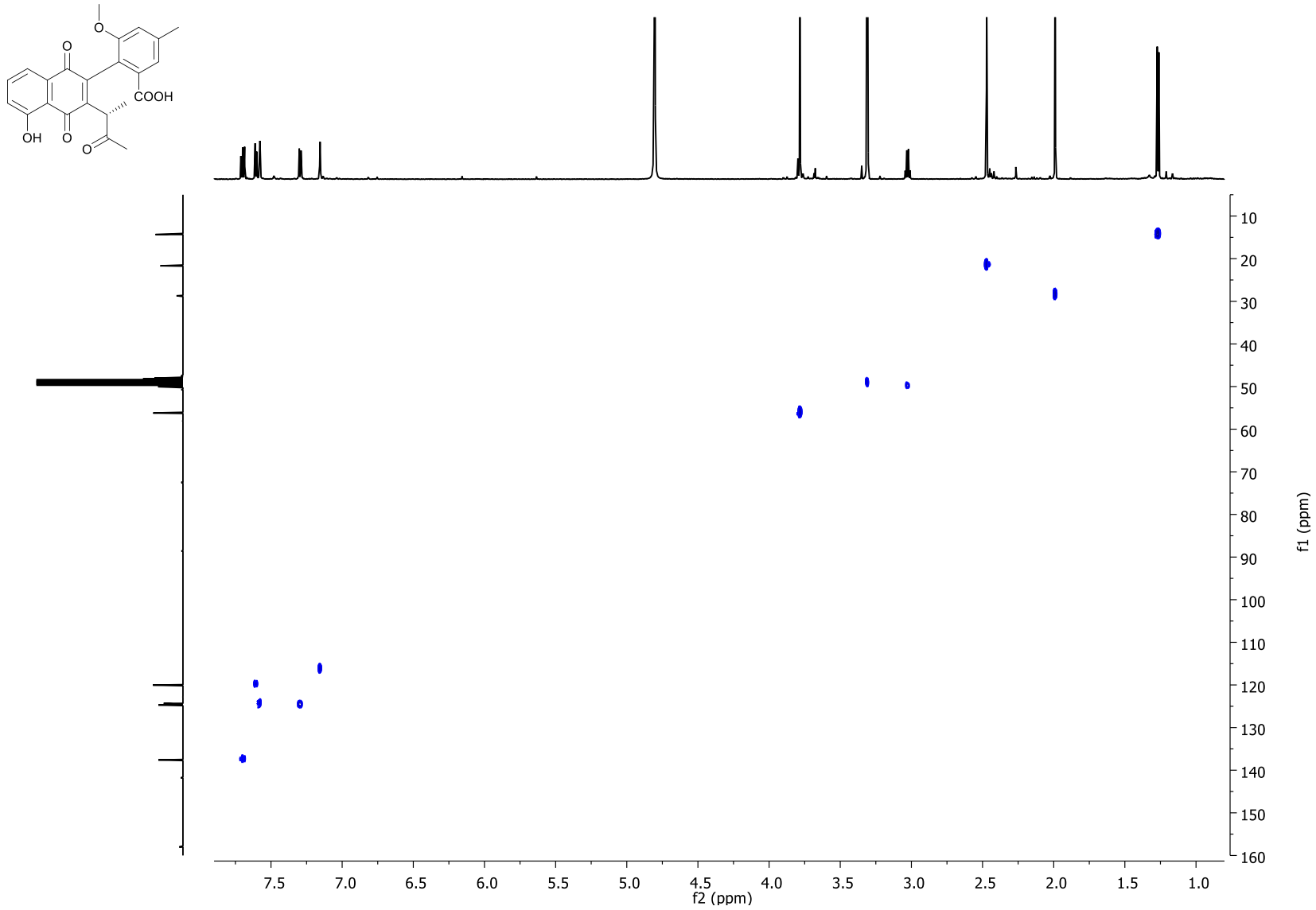
S32: ^{1}H NMR spectrum of niveamycin B at 600 MHz in MeOD-d_4



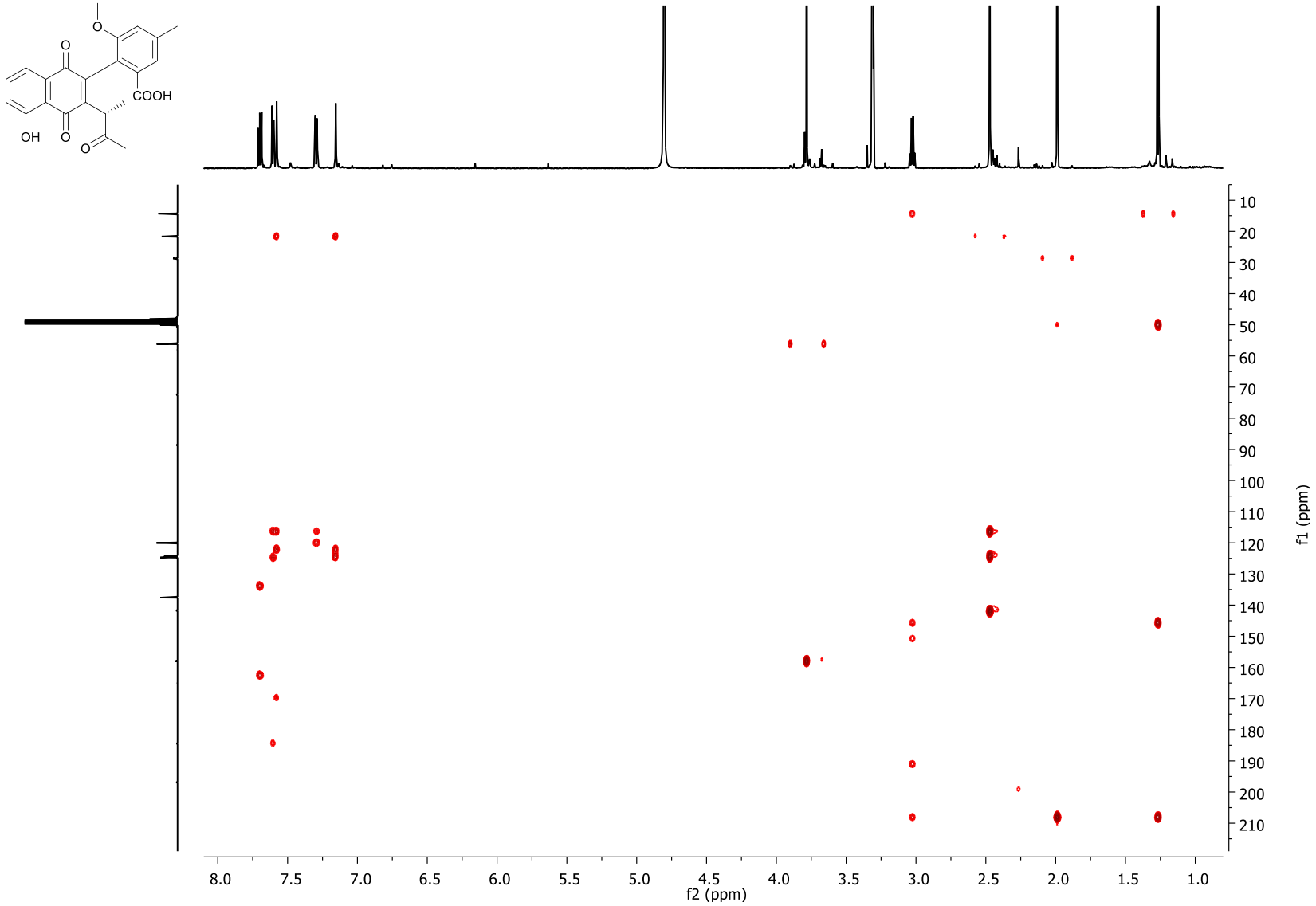
S33: gCOSY NMR spectrum of niveamycin B at 600 MHz in MeOD-d_4



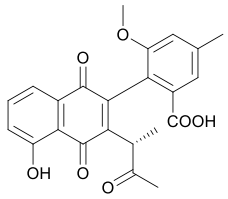
S34: gHSQC NMR spectrum of niveamycin B at 600 MHz in MeOD-d_4

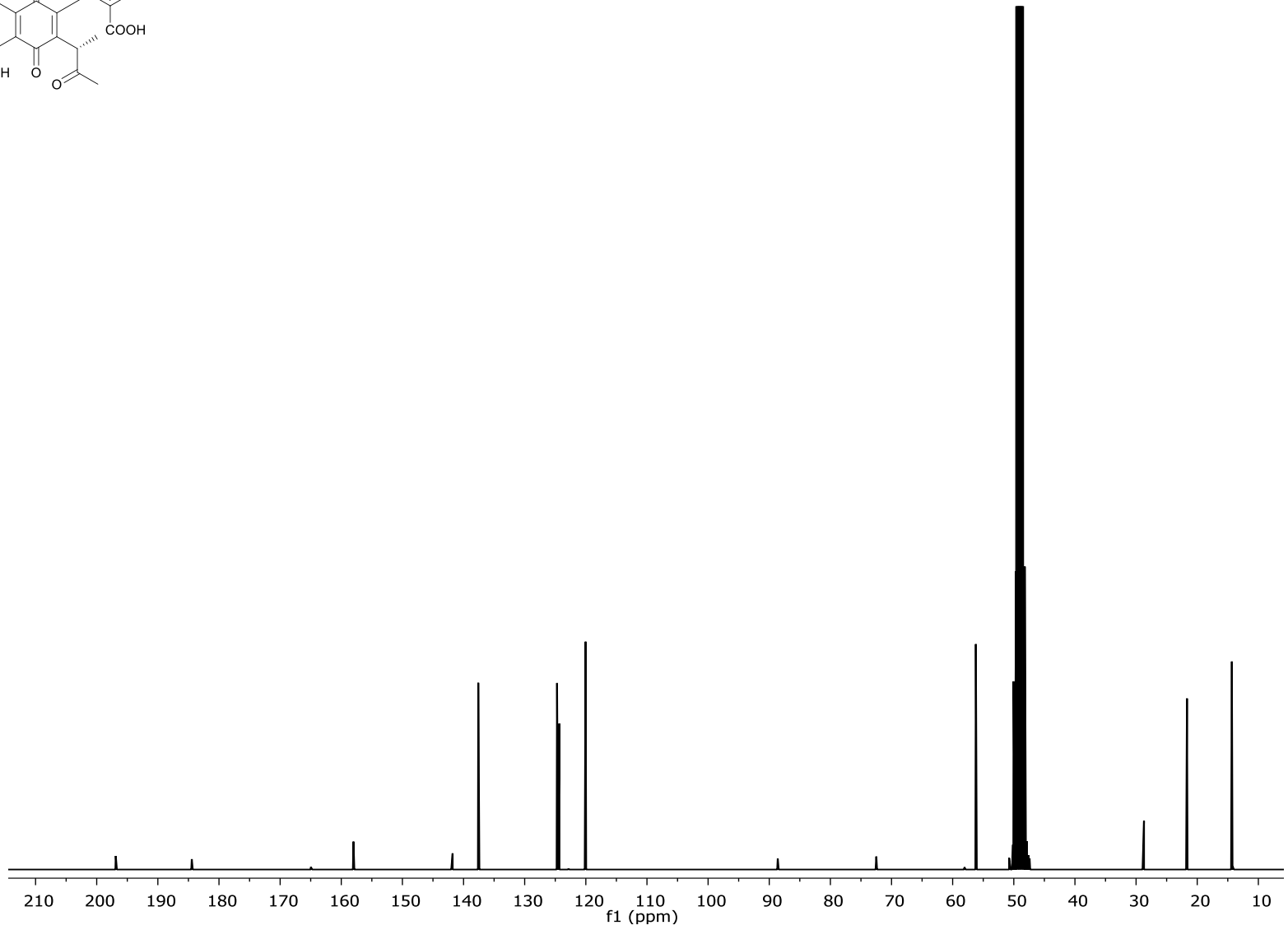


S35: gHMBC NMR spectrum of niveamycin B at 600 MHz in MeOD-d_4

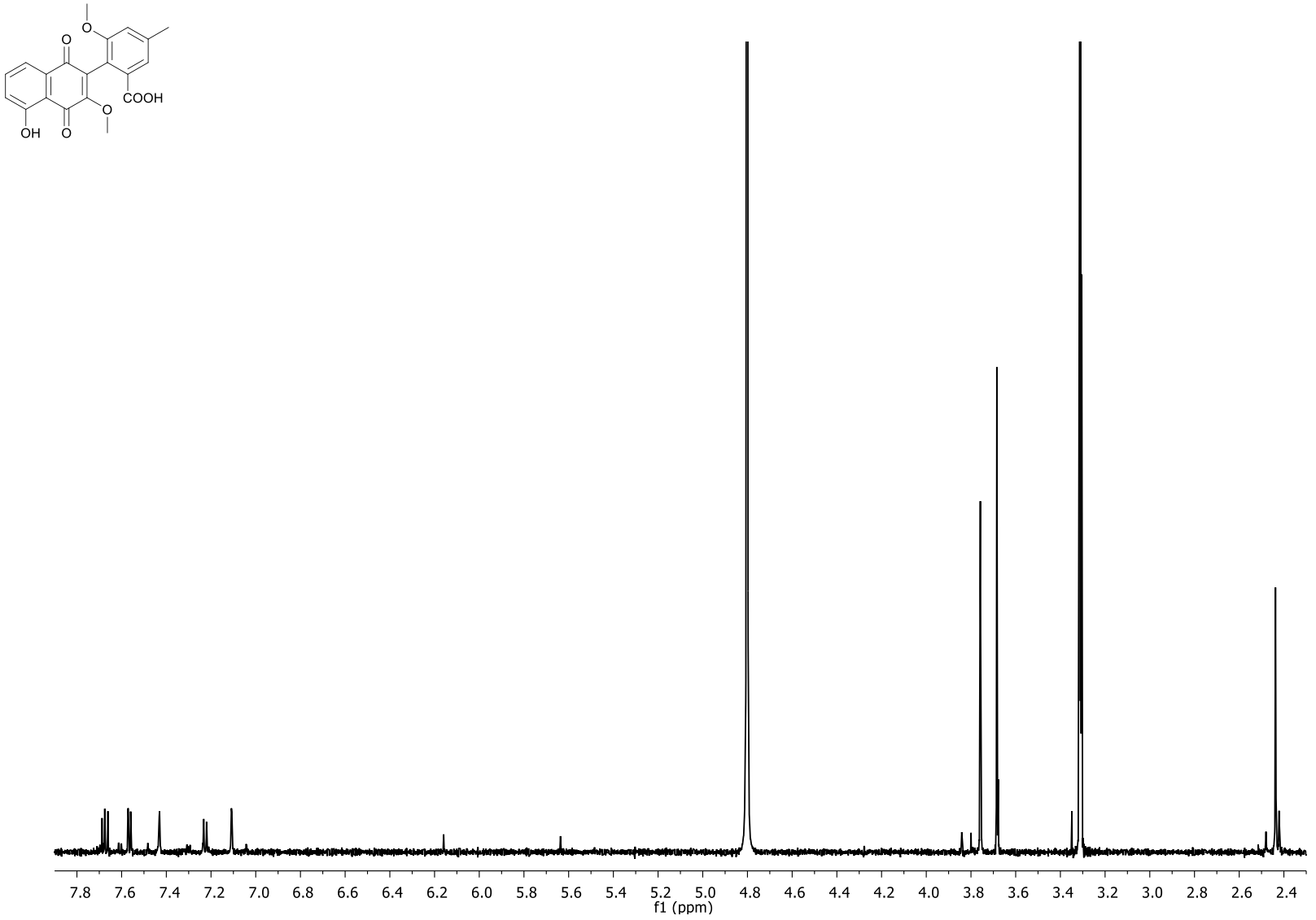


S36: ^{13}C NMR spectrum of niveamycin B at 150 MHz in MeOD-d_4

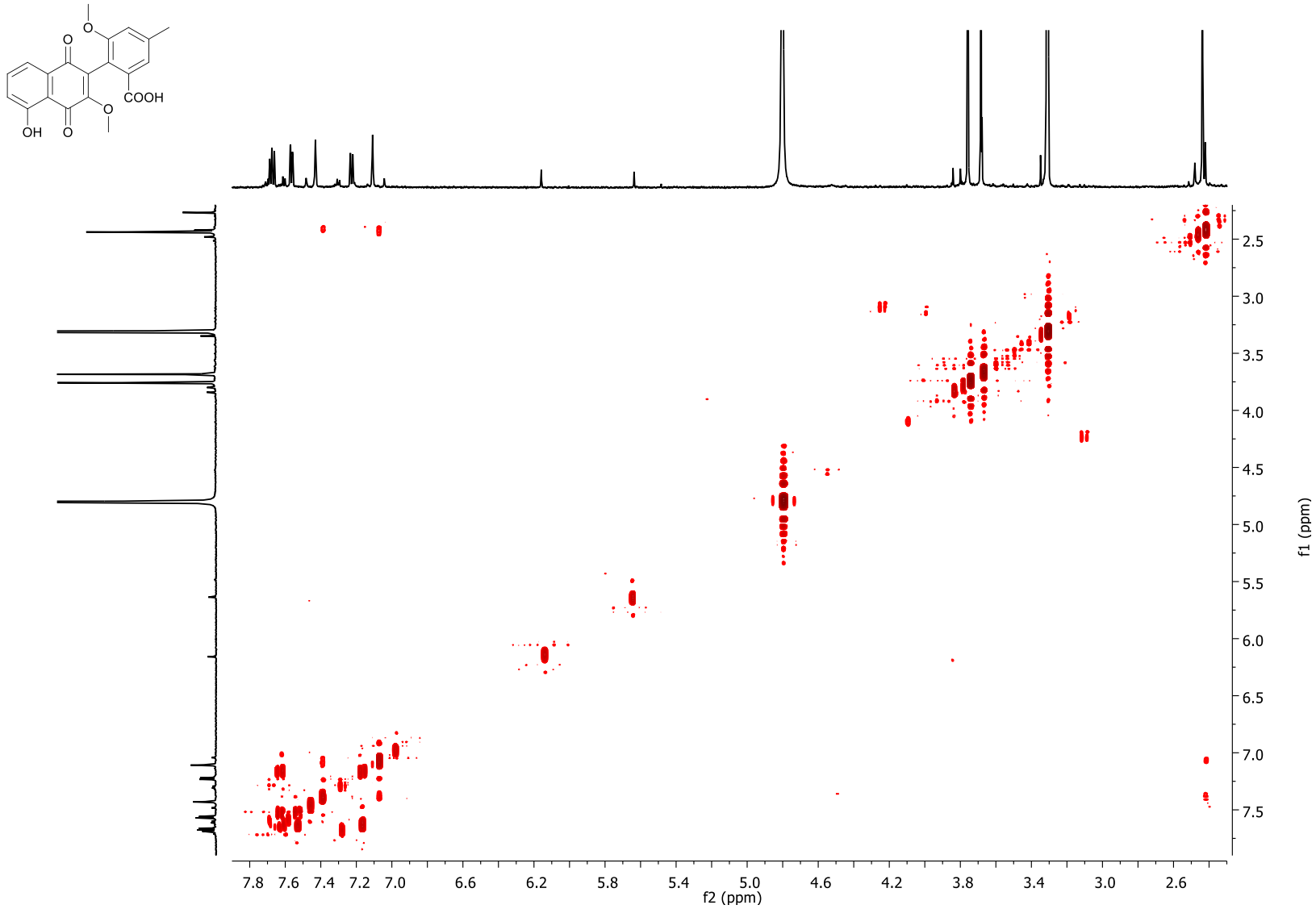




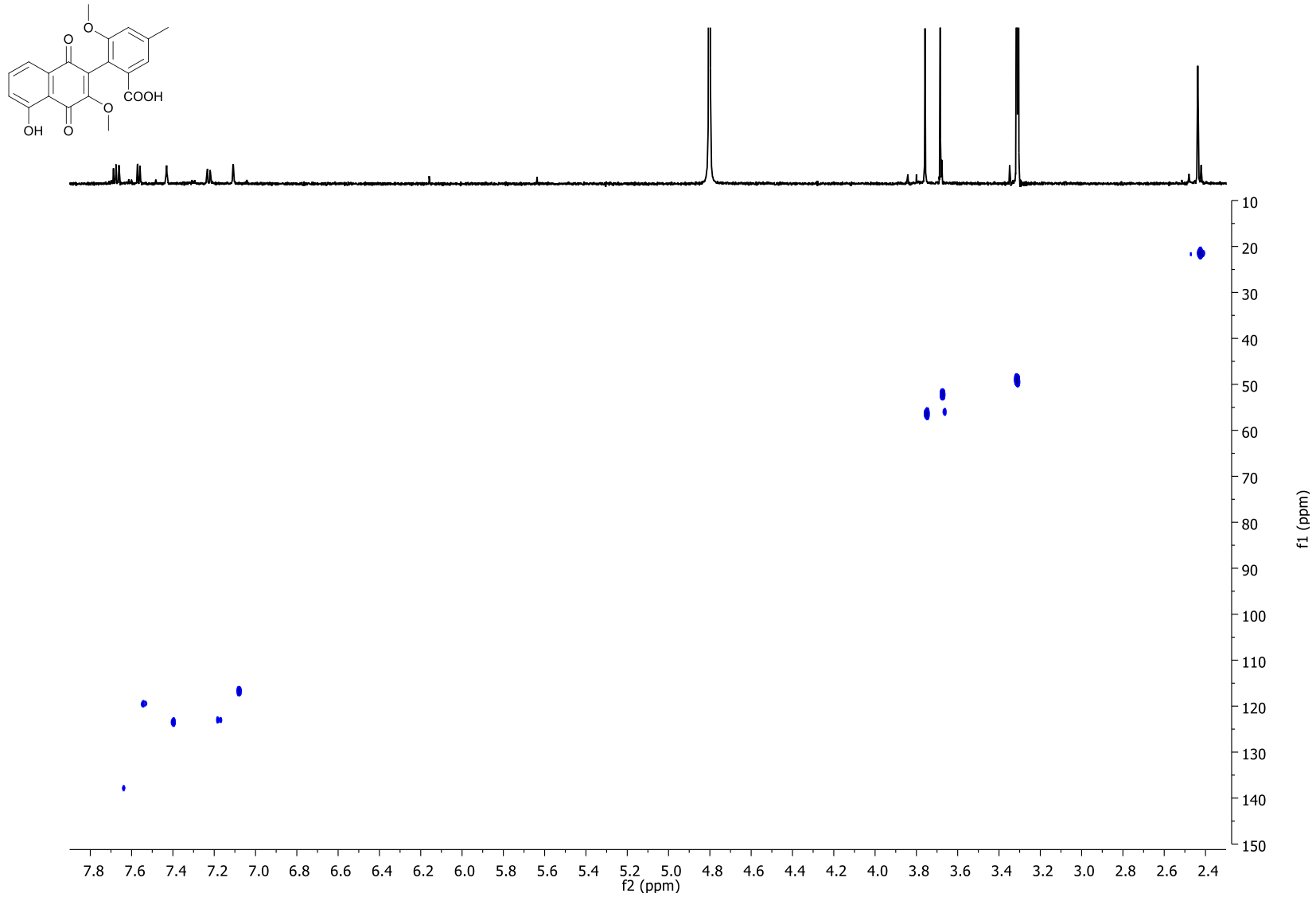
S37: ^{1}H NMR spectrum of niveamycin C at 600 MHz in MeOD-d_4



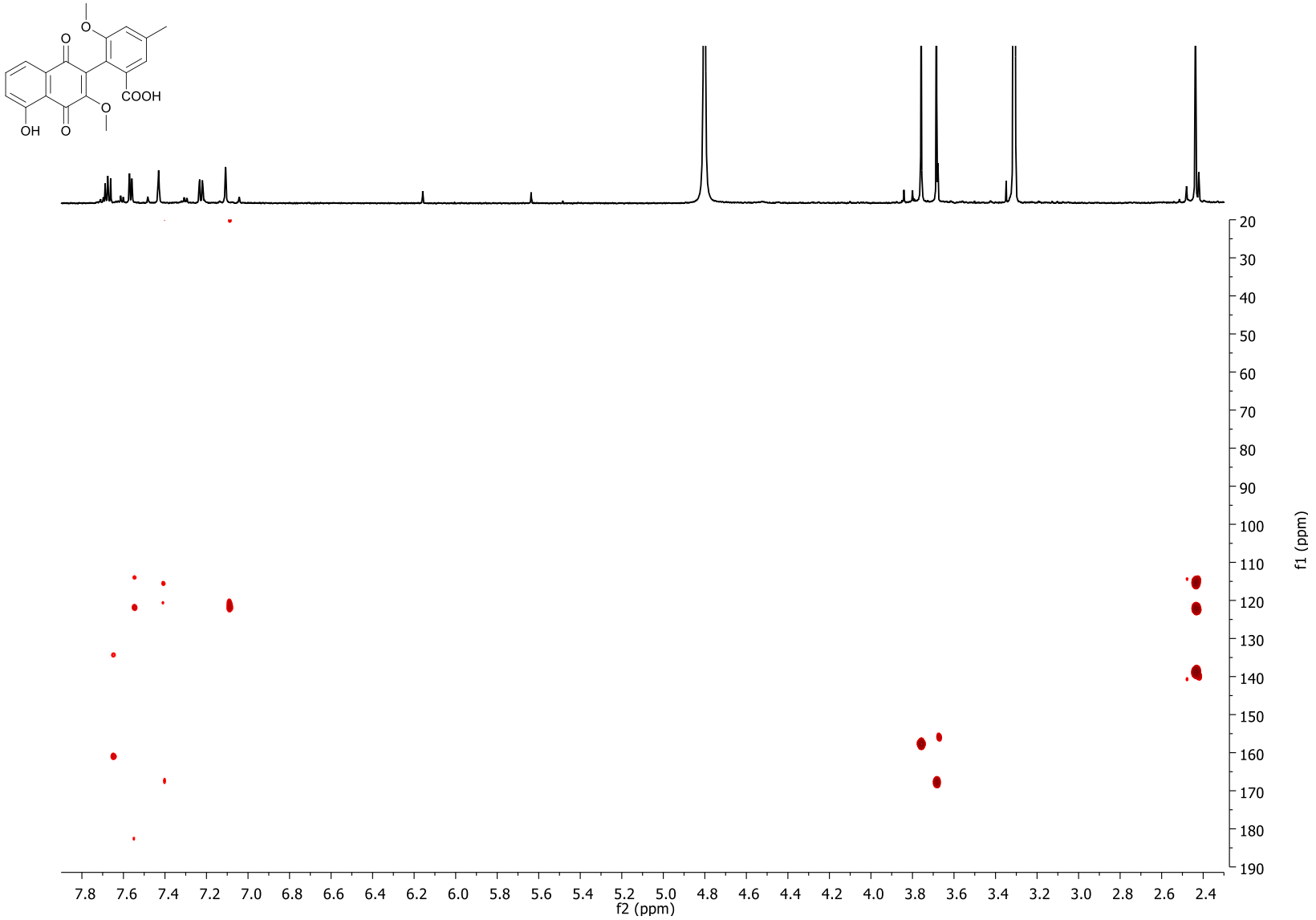
S38: gCOSY NMR spectrum of niveamycin C at 600 MHz in MeOD-d_4



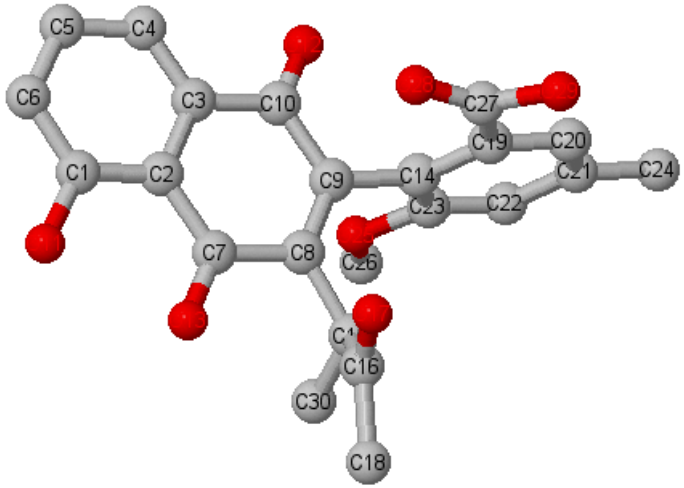
S39: gHSQC NMR spectrum of niveamycin C at 600 MHz in MeOD-d_4



S40: gHMBC NMR spectrum of niveamycin C at 600 MHz in MeOD-d_4



S41: Cartesian coordinates of the most stable conformers for niveamycin B (**8**) at the B3LYP/6-311 + G(d,p)// B3LYP/6-311 + G(2d,p) level of theory in MeOD-d_4



Niveamycin B. Conformer 1

Atom	Angstroms		
	x	y	z
C1	-2.840950	-1.105356	-1.605486
C2	-1.745022	-0.276028	-1.263514
C3	-1.509610	0.030069	0.097543
C4	-2.337181	-0.479783	1.091897
C5	-3.414523	-1.309217	0.738514

C6	-3.668754	-1.620449	-0.590030
C7	-0.867870	0.259793	-2.302116
C8	0.305457	1.093208	-1.927448
C9	0.559056	1.368440	-0.622756
C10	-0.372902	0.918847	0.461069
O11	-3.127970	-1.426639	-2.879431
O12	-0.203830	1.300360	1.618084
O13	-1.081518	0.017930	-3.510020
C14	1.717813	2.198437	-0.173079
C15	1.144127	1.614004	-3.080674
C16	1.677506	0.459488	-3.948784
O17	1.975254	-0.609083	-3.431134
C18	1.912942	0.707297	-5.419914
C19	2.935391	1.647328	0.267155
C20	3.997816	2.478116	0.662305
C21	3.863139	3.866053	0.654532
C22	2.643560	4.421689	0.240286
C23	1.585467	3.604072	-0.166817
C24	4.997559	4.765665	1.085659
O25	0.373062	4.081606	-0.573421
C26	0.142048	5.492753	-0.553692
C27	3.090878	0.166556	0.359399
O28	2.168851	-0.635066	0.332489
O29	4.373069	-0.224400	0.499037
C30	0.418027	2.740476	-3.850026

H31	-2.140314	-0.233290	2.129814
H32	-4.059676	-1.712626	1.514691
H33	-4.501640	-2.258210	-0.872506
H34	-2.451910	-0.981343	-3.453293
H35	2.058980	2.048531	-2.652634
H36	2.364592	-0.177698	-5.870584
H37	0.967980	0.937650	-5.923173
H38	2.572382	1.571114	-5.564775
H39	4.927214	2.026619	0.990737
H40	2.532028	5.500924	0.241779
H41	5.312387	5.422364	0.266547
H42	4.695209	5.409790	1.919037
H43	5.865499	4.183065	1.404712
H44	0.825550	6.015850	-1.232174
H45	-0.884477	5.625405	-0.896013
H46	0.245339	5.895091	0.460301
H47	4.386607	-1.202521	0.585719
H48	-0.465420	2.364064	-4.370428
H49	0.103208	3.515517	-3.147534
H50	1.085016	3.204327	-4.581838

Niveamycin B. Conformer 2

Atom	Angstroms		
	x	Y	Z
C1	-2.906297	-1.130477	-1.497726
C2	-1.802353	-0.298625	-1.189329
C3	-1.543037	0.031128	0.161822
C4	-2.355074	-0.458168	1.179042
C5	-3.440599	-1.290432	0.858919
C6	-3.718217	-1.624657	-0.459315
C7	-0.941346	0.215612	-2.252088
C8	0.240658	1.051738	-1.912342
C9	0.517008	1.349676	-0.617291
C10	-0.397845	0.922764	0.489999
O11	-3.215846	-1.473662	-2.760642
O12	-0.208236	1.324650	1.636893
O13	-1.176135	-0.047196	-3.451653
C14	1.685574	2.184000	-0.202261
C15	1.061300	1.548912	-3.088770
C16	1.576319	0.377238	-3.944858
O17	1.879878	-0.682749	-3.413102
C18	1.787043	0.597605	-5.424071
C19	2.908883	1.637119	0.227159
C20	3.980225	2.471601	0.589154

C21	3.849305	3.859557	0.558652
C22	2.624370	4.411448	0.155274
C23	1.557248	3.589941	-0.219044
C24	4.993384	4.763316	0.954116
O25	0.339385	4.063800	-0.613443
C26	0.112613	5.475789	-0.615094
C27	3.061803	0.157789	0.343577
O28	2.137198	-0.641324	0.346974
O29	4.345069	-0.234538	0.468422
C30	0.325789	2.663922	-3.865834
H31	-2.139961	-0.193677	2.208876
H32	-4.073617	-1.677821	1.653044
H33	-4.557583	-2.264760	-0.716149
H34	-2.548313	-1.040938	-3.353776
H35	1.984611	1.987901	-2.684074
H36	2.228256	-0.296860	-5.866304
H37	0.834185	0.821842	-5.915063
H38	2.446379	1.456530	-5.595957
H39	4.913797	2.023178	0.909876
H40	0.909876	5.490878	0.139351
H41	5.296083	5.404044	0.117958
H42	4.707043	5.423395	1.780634
H43	5.864998	4.183914	1.268960
H44	0.234299	5.895871	0.389619
H45	0.785882	5.984563	-1.314380

H46	-0.919234	5.605417	-0.942234
H47	4.357388	-1.210975	0.572561
H48	-0.567563	2.281303	-4.364345
H49	0.025386	3.452507	-3.172164
H50	0.981687	3.112270	-4.617079

Niveamycin B. Conformer 3

Atom	Angstroms		
	x	Y	Z
C1	-2.906297	-1.130477	-1.497726
C2	-1.802353	-0.298625	-1.189329
C3	-1.543037	0.031128	0.161822
C4	-2.355074	-0.458168	1.179042
C5	-3.440599	-1.290432	0.858919
C6	-3.718217	-1.624657	-0.459315
C7	-0.941346	0.215612	-2.252088
C8	0.240658	1.051738	-1.912342
C9	0.517008	1.349676	-0.617291
C10	-0.397845	0.922764	0.489999
O11	-3.215846	-1.473662	-2.760642
O12	-0.208236	1.324650	1.636893
O13	-1.176135	-0.047196	-3.451653

C14	1.685574	2.184000	-0.202261
C15	2.072935	-0.662519	-1.270182
C16	2.123783	-1.955356	-0.436431
O17	1.447453	-2.069273	0.576635
C18	3.096212	-3.035280	-0.850952
C19	2.453117	3.020225	-1.318000
C20	3.549824	3.804690	-0.919812
C21	3.975737	3.819992	0.407582
C22	3.284032	3.038933	1.345111
C23	2.197520	2.248571	0.958288
C24	5.152188	4.661662	0.843191
O25	1.476580	1.479293	1.821945
C26	1.810434	1.499656	3.212340
C27	1.979421	3.092696	-2.730347
O28	0.908445	2.660936	-3.132241
O29	2.853219	3.706628	-3.552598
C30	2.478010	-0.828379	-2.753532
H31	-3.297685	2.796013	-0.537550
H32	-5.326819	1.461715	-1.131577
H33	-5.092039	-0.893837	-1.898919
H34	-1.917511	-2.420068	-2.182764
H35	2.835660	-0.027486	-0.795744
H36	2.800192	-3.460529	-1.816341
H37	4.104624	-2.624708	-0.977411
H38	3.110432	-3.821758	-0.094933

H39	4.057058	4.416094	-1.657403
H40	3.603640	3.059136	2.381734
H41	4.866202	5.358023	1.639407
H42	5.960415	4.034343	1.236485
H43	5.552148	5.244540	0.009593
H44	1.093759	0.834300	3.693936
H45	2.826893	1.126290	3.380781
H46	1.711473	2.509234	3.627052
H47	2.455152	3.742440	-4.449628
H48	1.814046	-1.523581	-3.271810
H49	2.426284	0.136742	-3.263505
H50	3.505198	-1.192652	-2.838442

Niveamycin B. Conformer 4

Atom	Angstroms		
	x	y	z
C1	-2.807759	-1.041507	-1.658080
C2	-1.704543	-0.228399	-1.300536
C3	-1.553925	0.177259	0.046874
C4	-2.474114	-0.216784	1.011916
C5	-3.560950	-1.027322	0.643387
C6	-3.730920	-1.437232	-0.671526
C7	-0.735630	0.191917	-2.309162
C8	0.435583	1.022810	-1.914406
C9	0.606398	1.393386	-0.620790
C10	-0.400957	1.037168	0.429240
O11	-3.014346	-1.457920	-2.919599
O12	-0.270403	1.458603	1.577321
O13	-0.868567	-0.138735	-3.506886
C14	1.755583	2.231938	-0.159957
C15	1.359045	1.444848	-3.042430
C16	1.919248	0.219798	-3.787248
O17	2.167041	-0.807155	-3.168625
C18	2.242550	0.346993	-5.256527
C19	2.991411	1.711577	0.264351
C20	4.036675	2.570694	0.643789

C21	3.869018	3.954030	0.642723
C22	2.633619	4.480614	0.235180
C23	1.594853	3.636188	-0.164276
C24	4.981849	4.879209	1.075784
O25	0.375314	4.080861	-0.586833
C26	0.112597	5.486374	-0.589191
C27	3.289364	0.248216	0.347748
O28	4.417289	-0.217209	0.282101
O29	2.205041	-0.521900	0.543779
C30	0.710717	2.530323	-3.930685
H31	-2.341770	0.104605	2.039515
H32	-4.279813	-1.337955	1.397134
H33	-4.569283	-2.062349	-0.965804
H34	-2.281697	-1.087228	-3.475994
H35	2.253838	1.891725	-2.586376
H36	2.696447	-0.579369	-5.611635
H37	1.333589	0.557944	-5.829708
H38	2.931119	1.182899	-5.427801
H39	4.980190	2.133002	0.953522
H40	2.497332	5.557003	0.230995
H41	5.207664	5.617077	0.297961
H42	4.701746	5.435078	1.978150
H43	5.897124	4.322760	1.293121
H44	0.196417	5.905074	0.420029
H45	0.791705	6.014927	-1.267857

H46	-0.912841	5.591475	-0.944005
H47	2.491166	-1.461935	0.563177
H48	-0.151107	2.140391	-4.476770
H49	0.376775	3.361938	-3.305000
H50	1.432885	2.924851	-4.650641

Niveamycin B. Conformer 5

Atom	Angstroms		
	x	y	z
C1	-2.944922	-0.849216	-1.828464
C2	-1.800424	-0.105073	-1.450835
C3	-1.957298	1.237695	-1.033267
C4	-3.216366	1.826363	-0.997644
C5	-4.341365	1.079358	-1.385355
C6	-4.214031	-0.240482	-1.794998
C7	-0.474444	-0.716791	-1.480979
C8	0.725473	0.080904	-1.115287
C9	0.589644	1.380815	-0.743888
C10	-0.761373	2.017340	-0.616176
O11	-2.870212	-2.132194	-2.223383
O12	-0.865107	3.156179	-0.163154
O13	-0.326083	-1.913195	-1.813839

C14	1.745559	2.255574	-0.378499
C15	2.071916	-0.604220	-1.279754
C16	2.191097	-1.952870	-0.545346
O17	2.833638	-2.873278	-1.029717
C18	1.582482	-2.065142	0.836215
C19	2.364258	3.136598	-1.285709
C20	3.448220	3.935644	-0.883638
C21	3.922426	3.894081	0.426869
C22	3.293759	3.037679	1.342832
C23	2.221202	2.232163	0.950346
C24	5.085822	4.751304	0.866640
O25	1.562886	1.384700	1.795008
C26	1.925652	1.367419	3.179058
C27	1.841476	3.255757	-2.677106
O28	0.792408	2.767167	-3.072090
O29	2.639858	3.978802	-3.486011
C30	2.489831	-0.711235	-2.758240
H31	-3.316238	2.856591	-0.672938
H32	-5.325891	1.539357	-1.362925
H33	-5.078898	-0.826586	-2.092848
H34	-1.915968	-2.399218	-2.177943
H35	2.810920	0.026948	-0.763951
H36	2.114000	-2.827953	1.408958
H37	1.595644	-1.107089	1.362189
H38	0.535945	-2.376266	0.739348

H39	3.909339	4.601212	-1.604454
H40	3.652455	3.010805	2.366415
H41	4.808497	5.388509	1.713775
H42	5.930391	4.131929	1.189938
H43	5.431299	5.396331	0.054804
H44	1.244790	0.658679	3.650965
H45	2.959146	1.028916	3.313988
H46	1.796247	2.356792	3.631541
H47	2.214157	4.031459	-4.369449
H48	1.799914	-1.350857	-3.313655
H49	2.501814	0.278228	-3.221989
H50	3.489210	-1.146100	-2.830626

Niveamycin B. Conformer 6

Atom	Angstroms		
	x	y	z
C1	-2.908165	-1.034348	-1.489590
C2	-1.792069	-0.183761	-1.297740
C3	-1.836465	0.794381	-0.276621
C4	-2.962510	0.927531	0.528095
C5	-4.064311	0.080159	0.323233
C6	-4.043562	-0.889113	-0.669859
C7	-0.605182	-0.316794	-2.137944
C8	0.561676	0.581221	-1.933593
C9	0.547702	1.494919	-0.927911
C10	-0.664741	1.686787	-0.067752
O11	-2.930030	-1.988716	-2.436327
O12	-0.684398	2.580639	0.777135
O13	-0.539404	-1.198124	-3.022599
C14	1.680351	2.430434	-0.650898
C15	1.715543	0.420084	-2.909468
C16	2.228196	-1.027149	-3.046657
O17	2.547626	-1.478523	-4.136689
C18	2.476827	-1.815690	-1.777785
C19	2.679616	2.178093	0.307685
C20	3.721200	3.098460	0.516565

C21	3.777713	4.292471	-0.201303
C22	2.768734	4.563399	-1.137488
C23	1.733042	3.651126	-1.358330
C24	4.894831	5.285619	0.017090
O25	0.713885	3.860871	-2.240954
C26	0.667201	5.092036	-2.966934
C27	2.614869	0.941333	1.138179
O28	1.663605	0.173926	1.174834
O29	3.721947	0.738705	1.879031
C30	1.396094	1.045556	-4.280449
H31	-2.977135	1.682603	1.306815
H32	-4.945285	0.182559	0.951557
H33	-4.890442	-1.549491	-0.833959
H34	-2.056334	-1.958498	-2.905125
H35	2.571516	0.960156	-2.478195
H36	2.524226	-2.881402	-2.009033
H37	3.449874	-1.507449	-1.372531
H38	1.732726	-1.624566	-1.001740
H39	4.481644	2.876355	1.256528
H40	2.801560	5.497724	-1.688086
H41	5.494004	5.409328	-0.892449
H42	4.499627	6.272790	0.281258
H43	5.562238	4.960607	0.819256
H44	1.545894	5.205090	-3.612086
H45	-0.231550	5.034744	-3.581272

H46	0.593031	5.948084	-2.286932
H47	3.587943	-0.074642	2.412805
H48	0.580408	0.509665	-4.771602
H49	1.110999	2.092280	-4.155494
H50	2.274166	0.990718	-4.928171