

Supporting Information

Total Synthesis Provides Strong Evidence: Xestocyclamine A is the Enantiomer of Ingenamine

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Table of Contents

SUPPORTING CRYSTALLOGRAPHIC INFORMATION	S-2
EXPERIMENTAL DETAILS AND CHARACTERIZATION DATA	S-7
NOMINAL XESTOCYCLAMINE A	S-8
Direct Comparison of NMR spectra	
Tabular Comparison of NMR Spectra	
INGENAMINE	S-26
Direct Comparison of NMR spectra	
Tabular Comparison of NMR Spectra	
NMR SPECTRA OF NEW COMPOUNDS	S-43
REFERENCES	S-116

SUPPORTING CRYSTALLOGRAPHIC INFORMATION

Figure S1. Structure of cycloalkyne **16** in the solid state; H-atoms omitted for clarity (except for the H-atom at the bridgehead position C1) (xestocyclamine numbering)

X-Ray Crystal Structure Analysis of Compound 16: C₂₉ H₄₄ N₂ O₄ Si, $M_r = 512.75$ g mol⁻¹, colorless prism, crystal size 0.201 x 0.153 x 0.081 mm³, monoclinic, space group $P2_1$ [4], $a = 13.3614(6)$ Å, $b = 8.4834(4)$ Å, $c = 13.6237(6)$ Å, $\beta = 108.555(2)^\circ$, $V = 1463.98(12)$ Å³, $T = 200(2)$ K, $Z = 2$, $D_{calc} = 1.163$ g·cm⁻³, $\lambda = 0.71073$ Å, $\mu(Mo-K\alpha) = 0.115$ mm⁻¹, analytical absorption correction ($T_{min} = 0.98$, $T_{max} = 0.99$), Bruker-AXS Kappa Mach3 diffractometer with APEX-II detector and I μ S micro focus X-ray source, $2.873 < \theta < 33.476^\circ$, 98946 measured reflections, 11412 independent reflections, 10669 reflections with $I > 2\sigma(I)$, $R_{int} = 0.0359$. The structure was solved by *SHELXT* and refined by full-matrix least-squares (*SHELXL*) against F^2 to $R_I = 0.0333$ [$I > 2\sigma(I)$], $wR_2 = 0.0885$, 339 parameters, absolute structure parameter = 0.063(18). **CCDC 1966915**

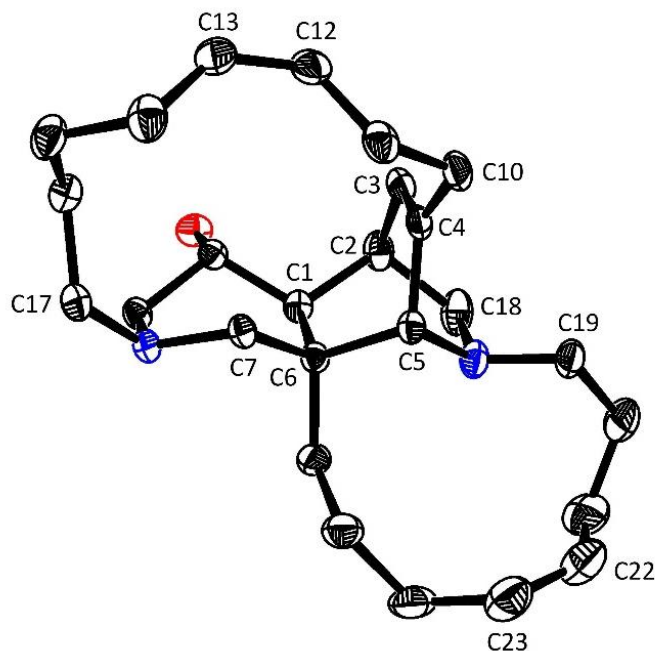


Figure S2. Structure of one of the two independent molecules of nominal xestocyclamine A (–)-**1** in the unit cell (xestocyclamine numbering scheme)

X-ray Crystal Structure Analysis of Nominal Xestocyclamine A (–)-1: $C_{56}H_{80}N_4O_2$, $M_r = 793.20 \text{ g mol}^{-1}$, colorless prism, crystal size $0.106 \times 0.080 \times 0.062 \text{ mm}^3$, monoclinic, space group $P2_1/n$ [14], $a = 9.8330(4) \text{ \AA}$, $b = 24.7971(10) \text{ \AA}$, $c = 18.8369(7) \text{ \AA}$, $\beta = 103.155(2)^\circ$, $V = 4472.5(3) \text{ \AA}^3$, $T = 150(2) \text{ K}$, $Z = 4$, $D_{calc} = 1.178 \text{ g} \cdot \text{cm}^{-3}$, $\lambda = 0.71073 \text{ \AA}$, $\mu(Mo-K\alpha) = 0.071 \text{ mm}^{-1}$, analytical absorption correction ($T_{min} = 0.99$, $T_{max} = 1.00$), Bruker-AXS Kappa Mach3 diffractometer with APEX-II detector and I μ S micro focus X-ray source, $1.381 < \theta < 31.931^\circ$, 112428 measured reflections, 15328 independent reflections, 10518 reflections with $I > 2\sigma(I)$, $R_{int} = 0.0417$. The structure was solved by *SHELXT* and refined by full-matrix least-squares (*SHELXL*) against F^2 to $R_I = 0.0636$ [$I > 2\sigma(I)$], $wR_2 = 0.1696$, 587 parameters, $S = 1.021$, residual electron density $+0.6$ (0.78 \AA from C33B) / -0.5 (0.42 \AA from H44B) $e \cdot \text{\AA}^{-3}$ **CCDC-2001073**.

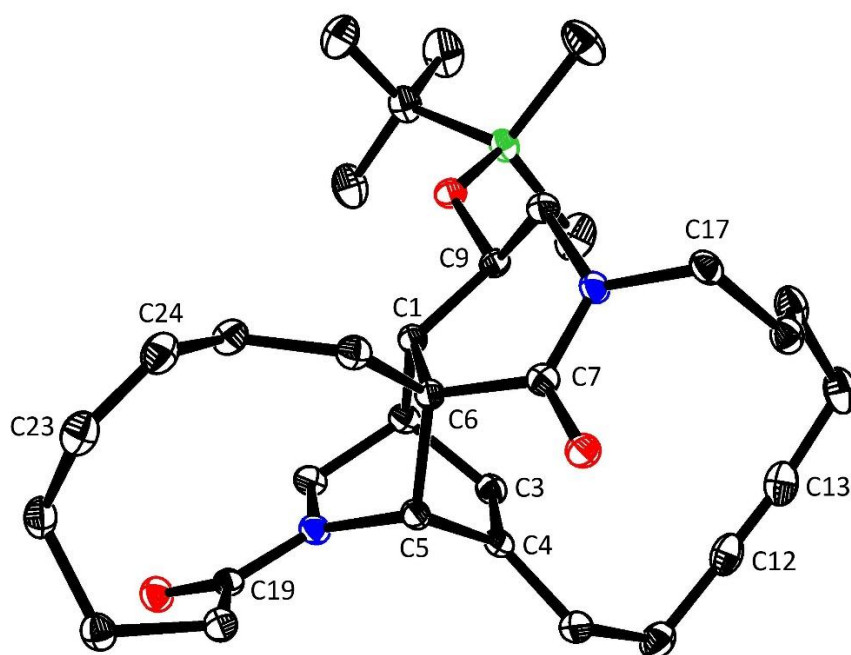


Figure S3. Structure of cycloalkyne **29** in the solid state; H-atoms omitted for clarity (ingenamine numbering)

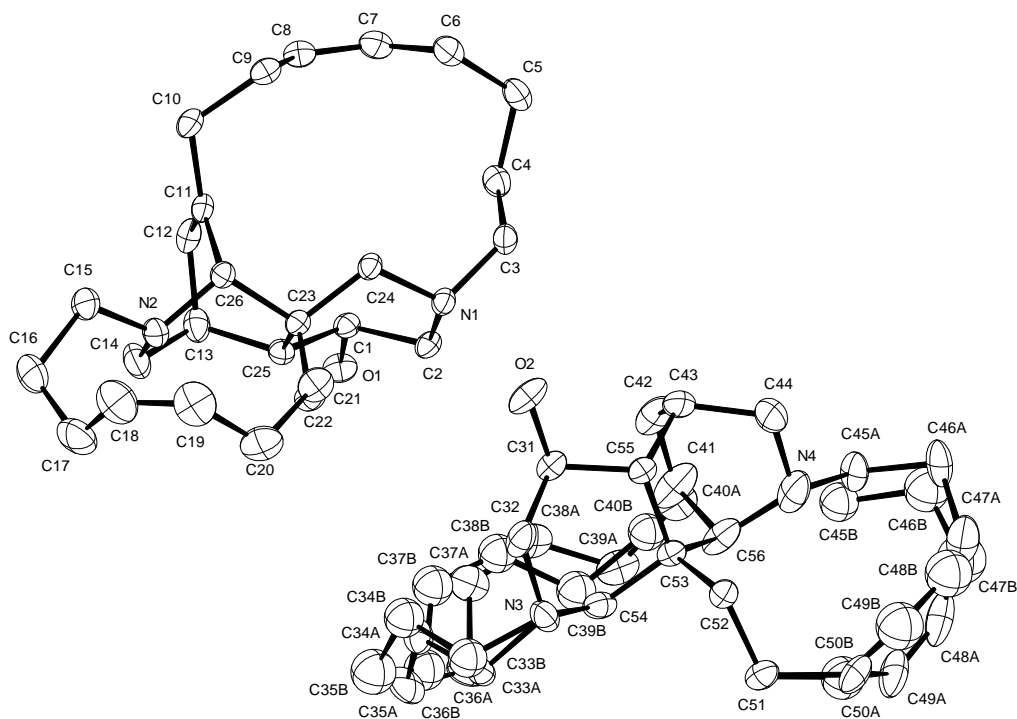


Figure S4. Structure of cycloalkyne **29** in the solid state: the unit cell contains two independent molecules, one of which shows disorder (arbitrary crystallographic numbering scheme)

X-ray Crystal Structure Analysis of Compound 29: C₃₂H₄₈N₂O₃Si, $M_r = 536.81 \text{ g mol}^{-1}$, colorless prism, crystal size 0.175 x 0.162 x 0.132 mm³, monoclinic, space group $P2_1/n$ [14], $a = 12.2517(5) \text{ \AA}$, $b = 12.5232(5) \text{ \AA}$, $c = 19.6866(8) \text{ \AA}$, $\beta = 106.130(2)^\circ$, $V = 2901.6(2) \text{ \AA}^3$, $T = 100(2) \text{ K}$, $Z = 4$, $D_{calc} = 1.229 \text{ g} \cdot \text{cm}^3$, $\lambda = 1.54178 \text{ \AA}$, $\mu(\text{Cu-K}\alpha) = 0.984 \text{ mm}^{-1}$, analytical absorption correction ($T_{min} = 0.82$, $T_{max} = 0.95$), Bruker AXS Enraf-Nonius KappaCCD diffractometer with a FR591 rotating Cu-anode X-ray source, $3.833 < \theta < 71.714^\circ$, 75928 measured reflections, 5177 independent reflections, 4058 reflections with $I > 2\sigma(I)$, $R_{int} = 0.0674$. The structure was solved by *SHELXT* and refined by full-matrix least-squares (*SHELXL*) against F^2 to $R_I = 0.0350$ [$I > 2\sigma(I)$], $wR_2 = 0.1091$, 348 parameters, $S = 1.188$, residual electron density +0.5 (1.37 \AA from H20A) / -1.2 (0.58 \AA from Si1) e $\cdot \text{\AA}^{-3}$ **CCDC-2001072**.

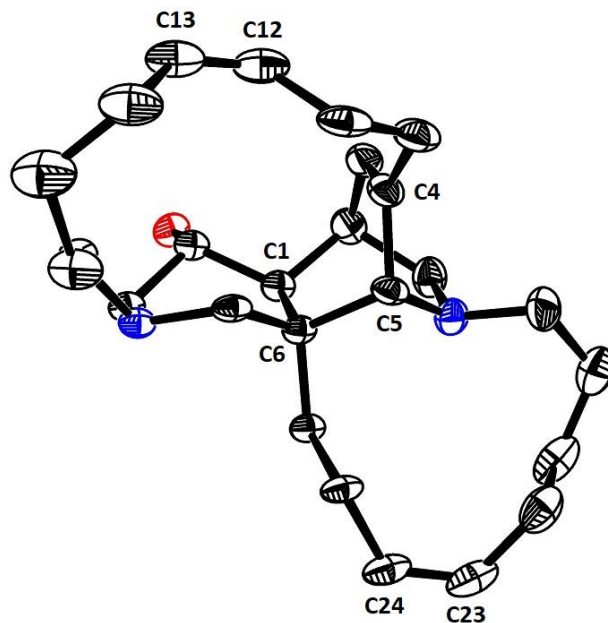


Figure S5. Structure of one of the two independent molecules of *ent*-ingenamine (–)-**3** in the unit cell (ingenamine numbering scheme)

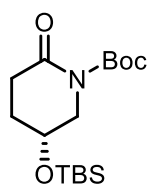
X-ray Crystal Structure Analysis of *ent*-Ingenamine ((–)-3): $C_{26}H_{40}N_2O$, $M_r = 396.60 \text{ g mol}^{-1}$, colorless needle, crystal size $0.054 \times 0.031 \times 0.021 \text{ mm}^3$, orthorhombic, space group $P2_12_12_1$ [19], $a = 13.9193(8) \text{ \AA}$, $b = 14.1971(7) \text{ \AA}$, $c = 23.5673(13) \text{ \AA}$, $V = 4657.2(4) \text{ \AA}^3$, $T = 100(2) \text{ K}$, $Z = 8$, $D_{calc} = 1.131 \text{ g} \cdot \text{cm}^3$, $\lambda = 0.71073 \text{ \AA}$, $\mu(Mo-K\alpha) = 0.068 \text{ mm}^{-1}$, analytical absorption correction ($T_{min} = 0.99$, $T_{max} = 1.00$), Bruker-AXS Kappa Mach3 diffractometer with APEX-II detector and I μ S micro focus X-ray source, $1.675 < \theta < 27.786^\circ$, 105952 measured reflections, 10869 independent reflections, 6850 reflections with $I > 2\sigma(I)$, $R_{int} = 0.1059$. The structure was solved by *SHELXT* and refined by full-matrix least-squares (*SHELXL*) against F^2 to $R_I = 0.0625$ [$I > 2\sigma(I)$], $wR_2 = 0.1693$, 571 parameters, $S = 1.043$, residual electron density $+0.4$ (0.65 \AA from H46B) / -0.2 (0.92 \AA from C32) $e \cdot \text{\AA}^{-3}$, absolute structure parameter = $0.5(6)$. **CCDC- 2004042.**

EXPERIMENTAL DETAILS AND CHARACTERIZATION DATA

General. Unless stated otherwise, all reactions were carried out in flame-dried glassware using anhydrous solvents under argon. The solvents were purified by distillation over the following drying agents and were transferred under argon: THF, Et₂O (Mg/anthracene), MeCN, 2,6-lutidine, CH₂Cl₂ (CaH₂), toluene (Na/K), MeOH (Mg, stored over MS 3 Å); DMSO, DMF, Et₃N, pentane and pyridine were dried by an adsorption solvent purification system based on molecular sieves. Thin layer chromatography (TLC): Macherey-Nagel precoated plates (POLYGRAM®SIL/UV254); Preparative TLC: Macherey-Nagel precoated plates (SIL G-100 UV 254; silica gel layer: 1.0 mm); Flash chromatography: Merck silica gel 60 (40–63 µm) with predistilled or HPLC grade solvents; Celite® was dried at 170°C for 48 h under high vacuum (1×10^{-3} mbar) and stored under argon. NMR: Spectra were recorded on Bruker DPX 300, AV 400, AV 500 or AVIII 600 spectrometers in the solvents indicated; chemical shifts (δ) are given in ppm relative to TMS, coupling constants (J) in Hz. The solvent signals were used as references and the chemical shifts converted to the TMS scale (CDCl₃: $\delta_C = 77.0$ ppm; residual CHCl₃ in CDCl₃: $\delta_H = 7.26$ ppm; CD₃OD: $\delta_C = 49.00$ ppm, residual CD₂HOD in CD₃OD: $\delta_H = 3.31$ ppm; (CD₃)₂SO: $\delta_C = 39.52$ ppm, residual CD₂HSOCD₃ in (CD₃)₂SO: $\delta_H = 2.50$ ppm). IR: Spectrum One (Perkin-Elmer) spectrometer, wavenumbers ($\tilde{\nu}$) in cm⁻¹. MS (EI): Finnigan MAT 8200 (70 eV), ESI-MS: ESQ3000 (Bruker), accurate mass determinations: Bruker APEX III FTMS (7 T magnet) or Mat 95 (Finnigan). Optical rotations ($[\alpha]_D^{20}$) were measured with a Perkin-Elmer Model 343 polarimeter. LC-MS analyses were conducted on a Shimadzu LCMS2020 instrument (pump LC-20AD, autosampler SIL-20AC, column oven CTO-20AC, diode array detector SPD-M20A, controller CBM-20A, ESI detector and software Labsolutions) with an ZORBAX Eclipse Plus C18 (1.8 µm, 3.0 or 4.6 mm ID × 50 mm) (Agilent). A binary gradient of MeCN or MeOH in water or aq. ammonium bicarbonate buffer (20 mmol. pH 9) was used at a flow rate of 0.5 (3.0 mm ID) or 0.8 (4.6 mm ID) mL/min. The oven temperature was kept at 35 °C and the detection wave length at 205 nm. Preparative LC was performed with a Shimadzu LC-20A prominence system (pump LC-20AP, column oven CTO-20AC, diode array detector SPD-M20A, fraction collector FRC-10A, controller CBM-20A and software LC-solution); conditions for each compound are specified below. Unless stated otherwise, all commercially available compounds (Alfa Aesar, Aldrich, TCI, Strem Chemicals, ChemPUR) were used as received.

NOMINAL XESTOCYCLAMINE A

***tert*-Butyl (R)-5-((*tert*-butyldimethylsilyl)oxy)-2-oxopiperidine-1-carboxylate (5).** *tert*-Butyl-

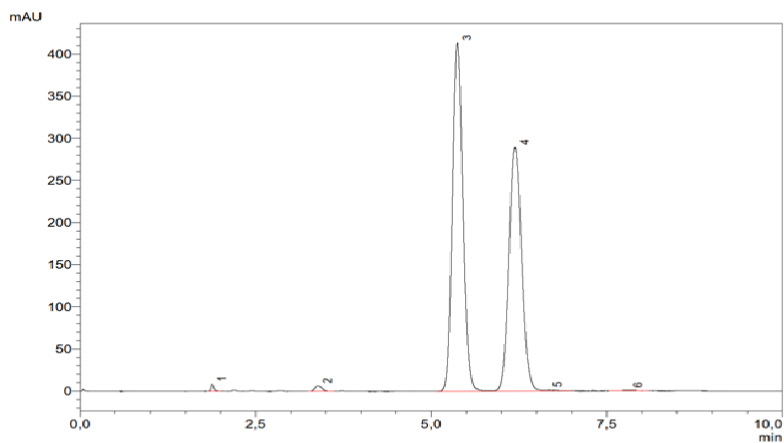


dimethylsilyl chloride (16.4 g, 109 mmol) was added to a solution of (*R*)-1-(*tert*-butoxycarbonyl)-3-hydroxypiperidine (**4**) (20.0 g, 99.4 mmol, ChemPUR) and imidazole (20.8 g, 306 mmol) in DMF (20 ml) at ambient temperature. After 1h, the mixture was poured into ice-water (100 ml). The resulting mixture was extracted with *tert*-butyl methyl ether (100 mL x 3), the combined organic layers were washed with brine (50 mL), dried over anhydrous Na₂SO₄ and filtered. After removing the solvent in vacuum, the crude material was quickly passed through a short pad of silica gel, eluting with hexanes/EtOAc (20 : 1), to provide the desired silyl ether as a colorless oil, which was used in the next step without further purification.

RuO₂·(H₂O)_n (800 mg, 6.01 mmol) was added to a solution of the crude product and NaIO₄ (96.0 g, 449 mmol) in EtOAc/H₂O (1.28 L, 3:1). The mixture was stirred for 4h at ambient temperature before it was filtered through a pad of Celite. The filtrate was washed with brine (100 mL), dried over Na₂SO₄, and evaporated. The residue was purified by flash chromatography on silica gel (hexanes/EtOAc, 20:1) to provide the title compound as a colorless oil (18.1 g, 55 %). $[\alpha]_D^{20} = -6.1$ (c = 1.6, CHCl₃); ¹H NMR (400 MHz, CDCl₃): δ = 4.18–4.02 (m, 1H), 3.76–3.50 (m, 2H), 2.69 (ddd, *J* = 17.2, 9.1, 6.7 Hz, 1H), 2.40 (dt, *J* = 17.2, 6.1, 6.1 Hz, 1H), 1.94 (dddd, *J* = 13.2, 8.9, 6.4, 3.9 Hz, 1H), 1.87–1.78 (m, 1H), 1.50 (s, 9H), 0.86 (s, 9H), 0.06 (s, 6H) ppm; ¹³C NMR (101 MHz, CDCl₃): δ = 170.8, 152.4, 82.8, 64.4, 52.4, 31.0, 28.9, 27.9, 25.6, 17.9, –4.9, –4.9 ppm; IR (film) $\tilde{\nu}$ = 2930, 2857, 1772, 1295, 1249, 1147, 883, 775 cm^{–1}; MS (ESI): *m/z*: 352 [*M*+Na⁺]; HRMS (ESI): *m/z*: calcd. for C₁₆H₃₂NO₄Si [*M*+H⁺]: 330.20951, found: 330.20940.

The optical purity of (*R*)-**5** (>99% ee) was determined by HPLC on a chiral stationary phase (Chiralpak IC-3, 3 μm, 150 mm, Ø 4.6 mm)

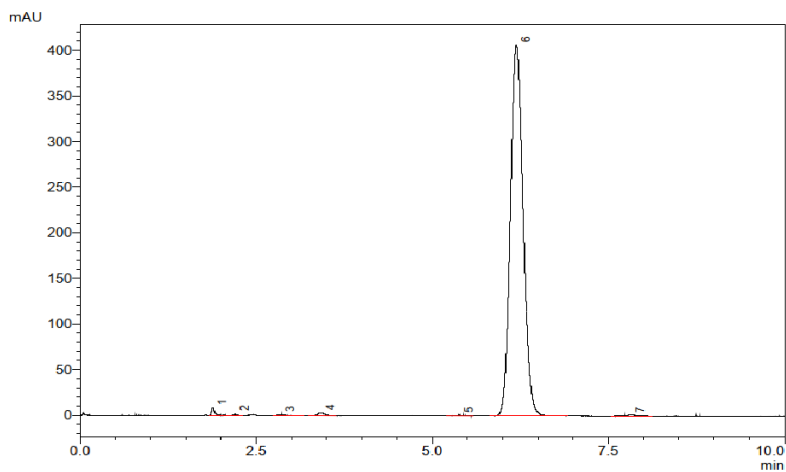
MFA-MB-022 Racemat (2.2 mg/0.5 ml heptane:i-PrOH = 4:1)
 150 mm Chiralpak IC-3, 3 μ m, 4.6 mm i.D.
 heptane/2-Prop = 80:20
 1.0 mL/min/ 298 K / 13.2 MPa



1 210nm,4nm

Peak #	Ret. Time	Area %	Name
1	1.88	0.34	
2	3.39	0.59	
3	5.37	53.67	1. enantiomer
4	6.19	45.04	2. enantiomer
5	6.67	0.21	
6	7.81	0.15	
Total		100.00	

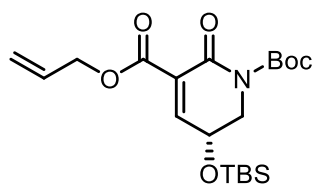
MFA-MB-022 R (2.0 mg/0.5 ml heptane:i-PrOH = 4:1)
 150 mm Chiralpak IC-3, 3 μ m, 4.6 mm i.D.
 heptane/2-Prop = 80:20
 1.0 mL/min/ 298 K / 13.2 MPa



1 210nm,4nm

Peak #	Ret. Time	Area %	Name
1	1.88	0.55	
2	2.20	0.11	
3	2.84	0.19	
4	3.42	0.43	
5	5.38	0.15	
6	6.19	98.24	1. enantiomer
7	7.82	0.34	2. enantiomer 99.7 % ee
Total		100.00	

3-Allyl 1-(*tert*-butyl) (R)-5-((*tert*-butyldimethylsilyl)oxy)-2-oxo-5,6-dihydropyridine-1,3(2*H*)-dicarboxylate (6). LiHMDS (1 M in THF, 38.0 mL, 38.0 mmol) was slowly added to a solution of compound

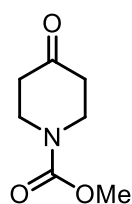


5 (5.0 g, 15.2 mmol) in anhydrous THF (150 mL) at -78°C . The mixture was stirred for 1 h before allyl chloroformate (1.8 mL, 16.9 mmol) was added. After 30 min, PhSeCl (2.61 g, 13.6 mmol) was introduced and stirring continued at -78°C for another 30 min. The mixture was then warmed to ambient temperature

before the reaction was quenched with sat. aq. NH_4Cl (50 mL). The aqueous layer was extracted with EtOAc (3 x 200 mL), the combined organic phases were washed with brine (20 mL), dried over Na_2SO_4 and filtered. After evaporation of the solvent, the crude material was purified by flash chromatography on silica gel (hexanes/EtOAc, 5 :1 to 3:1) to provide the desired selenide product as a yellow oil, which was immediately used in the next step.

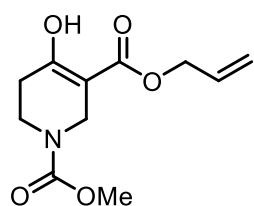
Aq. H_2O_2 (35% w/w, 3.3 mL, 34.0 mmol) was added to a solution of the selenide in CH_2Cl_2 (232 mL) at 0°C . The mixture was stirred at this temperature for 1 h before the reaction was quenched with aq. $\text{Na}_2\text{S}_2\text{O}_3$ (100 mL). The aqueous phase was extracted with CH_2Cl_2 (3 x 150 mL), the combined organic layers were washed with brine (50 mL), dried over Na_2SO_4 and filtered. After removing the solvent, the crude material was purified by flash chromatography on silica gel (hexanes/EtOAc, 10:1 to 5:1) to provide the title compound as a colorless oil (4.71 g, 76 % over 2 steps). $[\alpha]_{\text{D}}^{20} = -10.2$ ($c = 1.8$, CHCl_3); ^1H NMR (400 MHz, CDCl_3): $\delta = 7.26$ (dd, $J = 3.8, 1.1$ Hz, 1H), 5.96 (ddt, $J = 17.1, 10.4, 5.7$ Hz, 1H), 5.39 (dq, $J = 17.2, 1.5$ Hz, 1H), 5.27 (dq, $J = 10.4, 1.2$ Hz, 1H), 4.79–4.70 (m, 2H), 4.59 (ddd, $J = 9.1, 5.1, 2.8$ Hz, 1H), 4.04 (ddd, $J = 12.9, 5.1, 1.5$ Hz, 1H), 3.60 (dd, $J = 12.9, 9.1$ Hz, 1H), 1.54 (s, 9H), 0.90 (s, 9H), 0.13 (s, 3H), 0.13 (s, 3H) ppm; ^{13}C NMR (101 MHz, CDCl_3): $\delta = 163.3, 159.2, 152.3, 151.3, 131.5, 129.1, 118.9, 83.8, 66.2, 64.1, 50.0, 28.0, 25.6, 18.0, -4.8, -4.8$ ppm; IR (film) $\tilde{\nu} = 2931, 2858, 1749, 1368, 1297, 1085, 982, 838, 779$ cm^{-1} ; MS (ESI): m/z : 434 [$M+\text{Na}^+$]; HRMS (ESI): m/z : calcd. for $\text{C}_{20}\text{H}_{34}\text{NO}_5\text{Si}$ [$M+\text{H}^+$]: 412.21499, found: 412.21511.

Methyl 4-oxopiperidine-1-carboxylate (S1). K_2CO_3 (18.1 g, 130.1 mmol) was added to a solution of piperidine-4-one hydrochloride (10.0 g, 65.1 mmol) in THF/ H_2O (95 mL, 2.2:1) at ambient temperature. The mixture was cooled to 0°C before methyl chloroformate (5.5 mL, 71.8 mmol) was added dropwise. The cooling bath was removed and stirring continued at ambient temperature for 2 h before sat. aq. NaHCO_3 (20 mL) was added. The aqueous layer was



extracted with EtOAc (3 x 100 mL). The combined organic layers were dried over anhydrous Na₂SO₄, filtered and concentrated to afford methyl 4-oxopiperidine-1-carboxylate (10.3 g, quant.) as a colorless oil which was pure enough for further use. ¹H NMR (400 MHz, CDCl₃): δ = 3.77–3.62 (m, 7H), 2.39 (td, *J* = 6.6, 6.3, 2.8 Hz, 4H) ppm; ¹³C NMR (101 MHz, CDCl₃): δ = 207.1, 155.6, 52.8, 42.9, 40.9 ppm; IR (film) $\tilde{\nu}$ = 2959, 1448, 1230, 1123, 1000, 769 cm⁻¹; MS (EI): *m/z* (%): 114 (42), 157 (100); HRMS (ESI): *m/z*: calcd. for C₇H₁₁NO₃ [*M*⁺]: 157.07334, found: 157.07362.

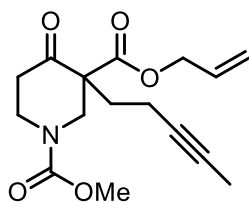
3-Allyl 1-methyl 4-oxopiperidine-1,3-dicarboxylate (S2). LiHMDS (1.0 M in toluene, 134 mL, 134 mmol)



was added to a solution of **S1** (10.0 g, 63.6 mmol) in toluene (212 mL) at -78 °C. After stirring for 1h, allyl chloroformate (7.1 mL, 66.6 mmol) was introduced. The mixture was warmed to 0 °C and stirred for 30 min at this temperature. Sat.aq. NH₄Cl (50 mL) was added, the mixture was stirred for 10 min, the organic phase was separated and

the aqueous layer was extracted with EtOAc (3 x 200 mL). The combined organic phases were washed with brine (20 mL), dried over MgSO₄ and filtered. After removing the solvent, the crude material was purified by flash chromatography on silica gel (hexanes/EtOAc, 4:1 to 2:1) to provide to the title compound as a colorless oil (7.59 g, 50 %). ¹H NMR (400 MHz, CDCl₃): δ = 11.95 (s, 1H), 6.02–5.81 (m, 1H), 5.39–5.17 (m, 2H), 4.68–4.63 (m, 2H), 4.12 (s, 2H), 3.71 (s, 3H), 3.60 (t, *J* = 6.1 Hz, 2H), 2.37 (t, *J* = 6.0 Hz, 2H) ppm; ¹³C NMR (101 MHz, CDCl₃): δ = 201.9, 170.1, 167.4, 155.5, 131.7, 131.4, 118.9, 118.5, 66.1, 65.1, 56.3, 53.1, 52.7, 45.6, 43.5, 40.5 ppm; IR (film) $\tilde{\nu}$ = 2960, 1702, 1588, 1442, 1307, 1121, 962, 766 cm⁻¹; MS (ESI): *m/z*: 242 [*M*+H⁺]; 264 [*M*+Na⁺]; HRMS (ESI): *m/z*: calcd. for C₁₁H₁₆NO₅ [*M*+H⁺]: 242.10230, found: 242.10193.

3-Allyl 1-methyl 4-oxo-3-(pent-3-yn-1-yl)piperidine-1,3-dicarboxylate (8): K₂CO₃ (14.3 g, 103 mmol)

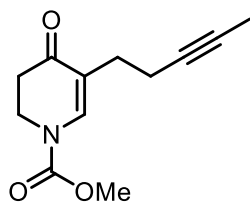


was added to a solution of **S2** (7.58 g, 31.4 mmol) in acetone (120 mL) at ambient temperature. After 15 min, 5-iodo-2-pentyne (11.4 g, 58.8 mmol)^[1] was added dropwise. Once the addition was complete, the mixture was stirred at 70 °C for 7d. After reaching ambient temperature, sat. aq. NH₄Cl (20 mL) was added and stirring

continued for another 30 min. The aqueous layer was extracted with EtOAc (3 x 100 mL), the combined organic phases were washed with brine (20 mL), dried over MgSO₄, filtered and concentrated under reduced pressure. The residue was purified by flash chromatography on silica gel (hexanes/EtOAc, 4:1 to 2:1) to afford the title compound as a colorless oil (3.50 g, 36 %). ¹H NMR (400 MHz, CDCl₃): δ = 5.87 (dddd, *J* =

16.4, 10.3, 6.6, 5.1 Hz, 1H), 5.35–5.16 (m, 2H), 4.62–4.55 (m, 2H), 4.56 (dd, $J = 13.6, 2.1$ Hz, 1H), 4.20–3.97 (m, 1H), 3.74 (s, 3H), 3.39 (s, 1H), 3.23 (d, $J = 13.7$ Hz, 1H), 2.69 (ddd, $J = 14.7, 9.9, 6.4$ Hz, 1H), 2.49 (ddd, $J = 14.7, 5.5, 3.9$ Hz, 1H), 2.29–2.15 (m, 2H), 2.12–2.04 (m, 1H), 1.86 (s, 1H), 1.74 (t, $J = 2.4$ Hz, 3H) ppm; ^{13}C NMR (101 MHz, CDCl_3): $\delta = 203.9, 169.5, 155.7, 131.2, 119.3, 77.8, 76.5, 66.3, 60.7, 53.1, 50.2, 43.7, 39.6, 31.2, 14.4, 3.5$ ppm; IR (film) $\tilde{\nu} = 2956, 1473, 1449, 1273, 1238, 1193, 996\text{ cm}^{-1}$; MS (ESI): m/z : 308 [$M+\text{H}^+$]; 330 [$M+\text{Na}^+$]; HRMS (ESI): m/z : calcd. for $\text{C}_{16}\text{H}_{22}\text{NO}_5\text{Na}$ [$M+\text{H}^+$]: 308.14925, found: 308.14911.

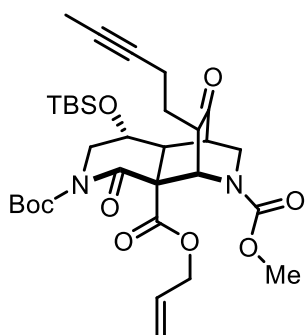
Methyl 4-oxo-5-(pent-3-yn-1-yl)-3,4-dihydropyridine-1(2H)-carboxylate (9): $\text{Pd}_2(\text{dba})_3 \cdot \text{CHCl}_3$ (731 mg,



0.706 mmol) was added to a solution of compound **8** (2.17 g, 7.06 mmol) in CH_3CN (35 mL). The mixture was stirred at $80\text{ }^\circ\text{C}$ for 30 min before it was diluted with H_2O (10 mL). The resulting mixture was extracted with *tert*-butyl methyl ether (3 x 50 mL), the combined organic layers were washed with brine, dried over MgSO_4 and filtered.

The solvent was removed in vacuum and the residue was purified by flash chromatography on silica gel (hexanes/*tert*-butyl methyl ether, 4:1 to 1:1) to afford the title compound as a colorless oil (1.57 g, quant.). ^1H NMR (400 MHz, CDCl_3): $\delta = 7.78$ (s, 1H), 3.99 (t, $J = 7.3, 7.3$ Hz, 2H), 3.86 (s, 3H), 2.57–2.53 (m, 2H), 2.37–2.30 (m, 2H), 2.25 (dddd, $J = 7.8, 6.1, 2.4, 1.5$ Hz, 2H), 1.76 (t, $J = 2.5, 2.5$ Hz, 3H) ppm; ^{13}C NMR (101 MHz, CDCl_3): $\delta = 192.8, 141.1, 135.6, 116.3, 78.5, 76.6, 54.0, 42.6, 35.8, 27.0, 18.8, 3.4$ ppm; IR (film) $\tilde{\nu} = 2959, 1729, 1621, 1443, 1208, 770\text{ cm}^{-1}$; MS (ESI): m/z : 222 [$M+\text{H}^+$], 244 [$M+\text{Na}^+$]; HRMS (ESI): m/z : calcd. for $\text{C}_{12}\text{H}_{16}\text{NO}_3$ [$M+\text{H}^+$]: 222.11247, found: 222.11225.

Compound 11. LiHMDS (1.0 M in THF, 6.7 mL, 6.7 mmol) was added dropwise to a solution of compound



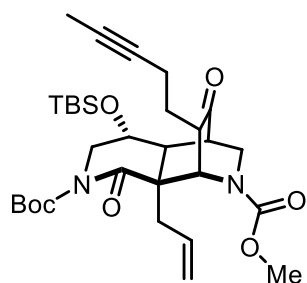
9 (1.13 g, 5.11 mmol) in THF (20 mL) at $-78\text{ }^\circ\text{C}$. After stirring at this temperature for 1h, a solution of compound **6** (1.24 g, 3.01 mmol) in THF (5 mL) was added dropwise over the course of 10 min and stirring was continued for another 20 min.

The reaction was quenched with sat. aq. NH_4Cl (2 mL), the aqueous phase was extracted with EtOAc (3 x 40 mL), the combined organic layers were washed with brine (5 mL), dried over MgSO_4 and filtered. After evaporation of the solvent, the crude material was passed through a plug of on silica gel (hexanes/EtOAc, 8:1 to

4:1) to provide the desired adduct **10** as a mixture of isomers in form of a white solid.

K_2CO_3 (1.25 g, 9.04 mmol) was added to a solution of this compound in CH_3CN (15 mL). The mixture was stirred at $80^\circ C$ for 4 h before sat. aq. NH_4Cl (5 mL) was carefully added. The resulting mixture was extracted with EtOAc (3 x 20 mL), the combined organic phases were washed with brine (5 mL), dried over $MgSO_4$, filtered and evaporated. The residue was purified by flash chromatography on silica gel (hexanes/EtOAc, 8:1 to 5:1) to afford the title compound as a white solid (817 mg, 43%). $[\alpha]_D^{20} = 31.9$ ($c = 1.4$, $CHCl_3$); 1H NMR (600 MHz, $DMSO-d_6$, mixture of rotamers, ca. 1 : 1) $\delta = 5.89$ – 5.76 (m, 1H), 5.32 – 5.11 (m, 2H), 4.93 (d, $J = 1.8$ Hz, 0.5H), 4.88 (d, $J = 1.8$ Hz, 0.5H), 4.71 (dddt, $J = 20.8, 13.8, 5.3, 1.6$ Hz, 1H), 4.58 (dddt, $J = 26.5, 13.7, 5.2, 1.6$ Hz, 1H), 3.99 (dd, $J = 12.5, 3.8$ Hz, 1H), 3.61 (s, 1.5H), 3.60 (s, 1.5H), 3.54 (ddd, $J = 9.6, 5.1, 2.9$ Hz, 1H), 3.45 (ddd, $J = 7.1, 5.1, 2.8$ Hz, 1H), 3.41 – 3.25 (m, 1H), 3.10 (ddd, $J = 12.4, 10.3, 3.8$ Hz, 1H), 3.05 (ddd, $J = 10.8, 6.2, 2.8$ Hz, 1H), 2.70 (dq, $J = 26.0, 2.6$ Hz, 1H), 2.53 – 2.49 (m, 1H), 2.31 – 2.12 (m, 2H), 1.79 – 1.69 (m, 4H), 1.43 – 1.41 (m, 9H), 1.40 – 1.33 (m, 1H), 0.88 – 0.82 (m, 9H), 0.10 – 0.07 (m, 6H) ppm; ^{13}C NMR (151 MHz, $DMSO-d_6$) $\delta = 211.3, 168.5, 168.4, 163.9, 163.8, 155.5, 155.0, 150.2, 150.2, 131.7, 131.6, 118.0, 117.8, 83.1, 83.0, 78.1, 77.9, 76.9, 76.9, 69.8, 68.0, 67.9, 66.8, 66.7, 59.5, 59.4, 54.5, 54.0, 52.7, 52.7, 49.2, 48.8, 48.8, 48.4, 48.4, 46.3, 46.1, 44.9, 44.5, 44.4, 27.5, 27.3, 25.6, 17.5, 15.9, 15.8, 3.2, -4.7, -5.0$ ppm; IR (film) $\tilde{\nu} = 2955, 1727, 1448, 1389, 1298, 1256, 1150, 839$ cm^{-1} ; MS (ESI): m/z : 633 [$M+H^+$], 655 [$M+Na^+$]; HRMS (ESI): m/z : calcd. for $C_{32}H_{47}N_2O_9Si$ [$M-H^+$]: 631.30564, found: 631.30571.

Compound 12. $Pd(PPh_3)_4$ (57.6 mg, 0.0498 mmol) was added to a solution of compound **11** (320 mg, 0.506

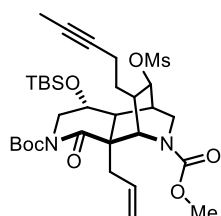


mmol) in toluene (17 mL) at $50^\circ C$. After stirring at this temperature for 4 h, the reaction mixture was adsorbed on silica, which was loaded on top of a flash column filled with silica gel. The product was eluted with hexanes/*tert*-butyl methyl ether (3:1 to 2:1) and the product containing fractions evaporated to afford the title compound as a white solid (296 mg, 99 %). $[\alpha]_D^{20} = 16.6$ ($c = 1.7$, $CHCl_3$);

1H NMR (400 MHz, $CDCl_3$, mixture of rotamers, ca. 1.8:1): $\delta = 5.98$ – 5.66 (m, 1H), 5.24 – 5.04 (m, 2H), 4.76 (d, $J = 1.8$ Hz, 0.36 H, minor), 4.63 (d, $J = 1.7$ Hz, 0.64 H, major), 4.11 – 3.97 (m, 1H), 3.74 (s, 1.17 H, minor), 3.73 (s, 1.83 H, major), 3.62 (ddd, $J = 11.8, 10.7, 2.8$ Hz, 1H), 3.53 – 3.46 (m, 1H), 3.31 – 3.24 (m, 1H), 3.24 – 3.15 (m, 1H), 2.79 – 2.71 (m, 1H), 2.63 – 2.54 (m, 1H), 2.42 – 2.19 (m, 5H), 2.01 (dd, $J = 10.2, 2.9$ Hz, 1H), 1.94 – 1.82 (m, 1H), 1.78 – 1.73 (m, 3H), 1.50 (d, $J = 1.4$ Hz, 9H), 0.89 (d, $J = 1.1$ Hz, 9H), 0.14 – 0.08 (m, 6H) ppm; ^{13}C NMR (101 MHz, $CDCl_3$): $\delta = 212.8, 212.3, 170.3, 170.1, 156.4, 156.3, 151.5, 151.4, 131.5, 131.3, 120.2, 83.8, 83.7, 77.7, 68.7, 68.7, 54.8, 54.3, 53.0, 53.0, 52.8, 52.7, 50.4, 50.2, 49.9, 49.7, 48.6, 48.6, 45.8, 45.6, 45.2, 45.1, 45.1, 28.0, 25.7, 17.8, 16.7, 16.5, 3.6, 3.6, -4.5, -4.5, -4.8$

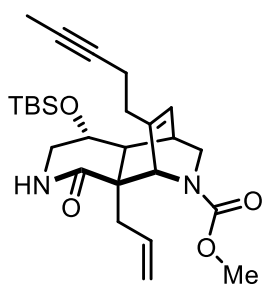
ppm; IR (film) $\tilde{\nu}$ = 2930, 1721, 1449, 1390, 1296, 1257, 840, 780 cm^{-1} ; MS (ESI): m/z : 589 [$M+H^+$], 611 [$M+Na^+$]; HRMS (ESI): m/z : calcd. for $C_{31}H_{49}N_2O_7Si$ [$M+H^+$]: 589.33036, found: 589.33002.

Compound 13. $NaBH_4$ (71.0 mg, 1.88 mmol) was added to a solution of ketone **12** (276 mg, 0.469 mmol) in MeOH (5 mL) at 0 °C. The mixture was stirred at this temperature for 30 min before the reaction was quenched with sat. aq. NH_4Cl (5 mL). The resulting mixture was extracted with EtOAc (3 x 10 mL), the combined organic layers were washed with brine (2 mL), dried over $MgSO_4$, filtered, and evaporated. The crude material was purified by flash chromatography on silica gel (hexanes/EtOAc, 4:1 to 2:1) to afford the corresponding alcohol as a white solid, which was immediately used in the next step.



Et_3N (1.3 mL, 9.33 mmol), 4-dimethylaminopyridine (57.3 mg, 0.469 mmol) and methanesulfonyl chloride (0.22 mL, 2.84 mmol) were successively added to a solution of this compound in CH_2Cl_2 (2.5 mL) at 0°C. The mixture was then stirred at ambient temperature for 4 h before sat. aq. $NaHCO_3$ (2 mL) was added. The aqueous layer was extracted with EtOAc (3 x 5 mL), the combined organic phases were washed with brine (2 mL), dried over $MgSO_4$, filtered, and evaporated. The residue was purified by flash chromatography on silica gel(hexanes/EtOAc, 4:1 to 2:1) to afford the title product as a white solid (253 mg, 81 %). $[\alpha]_D^{20}$ = 13.8 (c = 1.3, $CHCl_3$); 1H NMR (400 MHz, $CDCl_3$, mixture of rotamers, ca. 1.3 :1): δ = 5.94–5.60 (m, 1H), 5.17–4.96 (m, 2H), 4.54–4.27 (m, 2H), 4.25–4.11 (m, 2H), 3.72 (s, 1.3H, minor), 3.70 (s, 1.7H, major), 3.42 (ddd, J = 14.5, 11.8, 2.8 Hz, 1H), 3.29–3.22 (m, 1H), 3.18 (dd, J = 7.6, 1.8 Hz, 1H), 3.06–2.99 (m, 3H), 2.66–2.58 (m, 1H), 2.46–2.14 (m, 4H), 2.14–1.98 (m, 1H), 1.84–1.78 (m, 1H), 1.76–1.72 (m, 3H), 1.71–1.63 (m, 1H), 1.60–1.53 (m, 1H), 1.52–1.50 (m, 9H), 0.90–0.88 (m, 9H), 0.16 (s, 3H), 0.14 (s, 3H) ppm; ^{13}C NMR (101 MHz, $CDCl_3$): δ = 170.8, 170.6, 156.5, 156.5, 151.4, 151.3, 131.7, 131.5, 119.9, 119.8, 84.5, 84.3, 83.6, 83.5, 76.2, 76.2, 67.6, 67.6, 52.9, 52.8, 52.7, 52.5, 51.4, 50.9, 50.4, 50.3, 49.3, 49.2, 48.0, 44.8, 44.8, 43.1, 43.0, 38.8, 38.7, 34.1, 33.9, 31.7, 31.5, 31.5, 28.0, 25.8, 17.9, 16.1, 16.0, 3.5, 3.5, –4.2, –4.2, –4.5, –4.5 ppm; IR (film) $\tilde{\nu}$ = 2931, 2858, 1771, 1450, 1390, 1367, 1343, 1298, 1258, 1157, 780 cm^{-1} ; MS (ESI): m/z : 691 [$M+Na^+$]; HRMS (ESI): m/z : calcd. for $C_{32}H_{52}N_2O_9SSiNa$ [$M+Na^+$]: 691.30550, found: 691.30591.

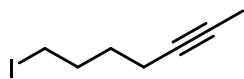
Compound 14. A solution of mesylate **13** (91 mg, 0.136 mmol) in 2,6-lutidine (0.65 mL) was stirred at 170 °C (bath temperature) for 3d. The mixture was then cooled before CH₂Cl₂ (0.2 mL)



and TBSOTf (0.1 mL, 0.435 mmol) were added at 0 °C. The mixture was stirred at ambient temperature for 1h before sat. aq. NaHCO₃ (1 mL) was added at 0 °C. After stirring for another 5 min, HCl (2 M, 10 mL) was added and the resulting mixture vigorously stirred for 10 min. The aqueous layer was extracted with EtOAc (10 mL x 3), the combined organic phases were washed with sat. aq. NaHCO₃ (2 mL), dried

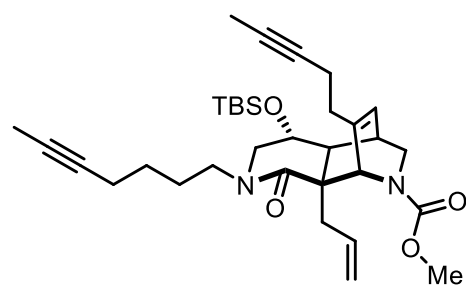
over MgSO₄, filtered and evaporated. The residue was purified by flash chromatography on silica gel (hexanes/Acetone, 8:1 to 4:1) to afford the title product as a white solid (46 mg, 72%). $[\alpha]_D^{20} = 24.0$ (c = 1.1, CHCl₃); ¹H NMR (400 MHz, CDCl₃, mixture of rotamers, ca. 2.0:1): δ = 5.98–5.94 (m, 1H), 5.92–5.81(m, 1H), 5.68–5.62 (d, *J* = 6.4 Hz, 1H), 5.14–5.04 (m, 2H), 4.92 (d, *J* = 1.6 Hz, 0.33H, minor), 4.79 (d, *J* = 1.6 Hz, 0.67H, major), 3.69 (d, *J* = 4.8 Hz, 3H), 3.44–3.35 (m, 1H), 3.19 (td, *J* = 10.3, 10.2, 1.8 Hz, 1H), 3.14–3.07 (m, 1H), 3.06–2.97 (m, 1H), 2.87–2.76 (m, 1H), 2.53–2.37 (m, 2H), 2.35–2.24 (m, 4H), 1.72–1.69 (m, 3H), 1.60–1.55 (m, 2H), 0.90 (s, 9H), 0.11 (s, 3H), 0.07 (s, 3H) ppm; ¹³C NMR (101 MHz, CDCl₃): δ = 172.8, 172.7, 156.2, 146.7, 146.0, 133.0, 132.8, 125.6, 125.1, 118.7, 118.7, 78.5, 76.0, 75.6, 70.8, 70.6, 53.9, 53.5, 52.6, 52.5, 52.4, 52.4, 52.2, 52.0, 47.0, 46.9, 45.6, 45.6, 44.8, 33.8, 33.5, 33.1, 33.1, 29.7, 29.3, 25.7, 17.9, 16.9, 16.8, 3.4, –4.3, –4.3, –4.7, –4.8 ppm; IR (film) $\tilde{\nu}$ = 3208, 2928, 2857, 1448, 1389, 1257, 1109, 1087, 838, 776 cm^{–1}; MS (ESI): *m/z*: 473 [*M*+H⁺]; HRMS (ESI): *m/z*: calcd. for C₂₆H₄₁N₂O₄Si [*M*+H⁺]: 473.28301, found: 478.28347.

7-Iodohept-2-yne (S3). Iodine (7.5 g, 29.5 mmol) was added to a solution of PPh₃ (7.7 g, 29.4 mmol) and imidazole (2.0 g, 29.4 mmol) in CH₂Cl₂ (100 mL) at 0 °C. After stirring at this temperature for 30 min, hept-5-yn-1-ol (3.0 g, 47.6 mmol) was introduced and stirring



was continued for 2 h. The reaction was quenched with aq. sat. Na₂S₂O₃ (40 mL), the organic phase was dried over Na₂SO₄ and evaporated. The residue was purified by flash chromatography on silica gel (pentanes) to afford the title compound as a colorless oil (5.1 g, 86 %). ¹H NMR (400 MHz, CDCl₃): δ = 3.18 (t, *J* = 7.0 Hz, 2H), 2.13 (ddd, *J* = 6.9, 4.4, 2.2 Hz, 2H), 1.94–1.84 (m, 2H), 1.75 (t, *J* = 2.6 Hz, 3H), 1.63–1.49 (m, 2H) ppm; ¹³C NMR (101 MHz, CDCl₃): δ = 78.2, 76.0, 32.4, 29.6, 17.6, 6.3, 3.4 ppm; IR (film) $\tilde{\nu}$ = 2918, 2857, 1432, 1287, 1211, 1165, 909 cm^{–1}; MS (EI): *m/z* (%): 67 (80), 95 (100), 222 (4); HRMS (ESI): *m/z*: calcd. for C₇H₁₁I [*M*⁺]: 221.99990, found: 221.99036.

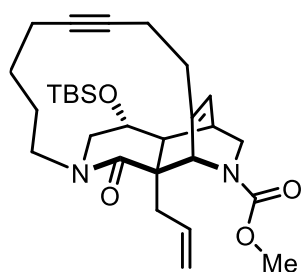
Compound 15. NaH (67.0 mg, 2.79 mmol) was added to a solution of compound **14** (50.6 mg, 0.107 mmol)



and 7-iodohept-2-yne (**S3**) (84.0 mg, 0.378 mmol) in DMF (0.5 mL) at 0 °C. After stirring at this temperature for 1h, the reaction mixture was poured into sat. aq. NH₄Cl (10 mL). The resulting mixture was extracted with EtOAc (3 x 10 mL), the combined organic layers were washed with brine, dried over MgSO₄, filtered and evaporated. The crude product was purified by flash chromatography on silica gel

(hexanes/EtOAc, 8:1 to 4:1) to afford the title compound as a colorless oil (55.3 mg, 91 %). $[\alpha]_D^{20} = 32.3$ ($c = 1.6$, CHCl₃); ¹H NMR (400 MHz, CDCl₃, mixture of rotamers, ca. 1.7:1): $\delta = 5.92$ (t, $J = 6.1$, 6.1 Hz, 1H), 5.89–5.75 (m, 1H), 5.09–4.99 (m, 2H), 4.97 (d, $J = 1.6$ Hz, 0.37H), 4.84 (d, $J = 1.6$ Hz, 0.63H), 3.69–3.67 (m, 3H), 3.37–3.23 (m, 3H), 3.22–3.12 (m, 2H), 3.07–2.97 (m, 1H), 2.96–2.90 (m, 1H), 2.83–2.74 (m, 1H), 2.51–2.33 (m, 2H), 2.33–2.20 (m, 4H), 2.16–2.11 (m, 2H), 1.76 (t, $J = 2.5$, 2.5 Hz, 3H), 1.71 (t, $J = 2.2$, 2.2 Hz, 3H), 1.67 (dd, $J = 8.5$, 2.2 Hz, 1H), 1.56–1.47 (m, 2H), 1.43–1.36 (m, 2H), 0.91 (s, 9H), 0.12 (s, 3H), 0.08 (s, 3H) ppm; ¹³C NMR (101 MHz, CDCl₃): $\delta = 170.1$, 170.0, 156.3, 156.2, 146.9, 146.2, 133.3, 133.1, 125.3, 124.8, 118.3, 118.3, 78.6, 78.3, 75.9, 75.8, 70.5, 70.4, 54.3, 54.1, 52.9, 52.8, 52.5, 52.4, 52.3, 52.3, 51.1, 47.1, 47.1, 46.9, 46.8, 45.0, 33.8, 33.5, 33.1, 33.0, 26.7, 26.6, 26.1, 26.0, 25.7, 18.4, 18.3, 17.9, 16.8, 16.8, 3.4, 3.4, –4.3, –4.3, –4.7, –4.8 ppm; IR (film) $\tilde{\nu} = 2951$, 2857, 1644, 1446, 1389, 1258, 1085, 862, 775 cm^{–1}; MS (ESI): m/z : 567 [$M+H^+$]; HRMS (ESI): m/z : calcd. for C₃₃H₅₁N₂O₄Si [$M+H^+$]: 567.36126, found: 567.36228.

Cycloalkyne 16. A solution of the trisilanol ligand **18** (18.0 mg, 0.0229 mmol)^[2] in toluene (0.5 mL) was

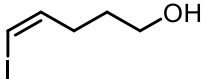


added to complex **17** (13.2 mg, 0.0227 mmol)^[2] and the resulting mixture was stirred for 5 min. This solution was then added to a suspension of diyne **15** (51.3 mg, 0.0905 mmol) and 5 Å MS (1.0 g) in toluene (45.0 mL) at 100 °C. After 10 min, the mixture was cooled to ambient temperature, filtered through a pad of Celite® and the filtrate was concentrated. The crude material was purified by flash chromatography (hexanes/EtOAc, 4/1 to 2:1) to give the title product as a white

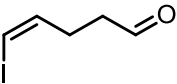
solid material (39.5 mg, 85 %). $[\alpha]_D^{20} = 71.3$ ($c = 1.2$, CHCl₃); Mp = 166.6–167.6 °C; ¹H NMR (400 MHz, CDCl₃, mixture of rotamers, ca.1.7:1): $\delta = 6.00$ –5.91 (m, 1H), 5.90–5.71 (m, 1H), 5.14–5.02 (m, 2H), 4.96 (d, $J = 1.7$ Hz, 0.37H, minor), 4.81 (d, $J = 1.6$ Hz, 0.63H, major), 4.03–3.94 (m, 1H), 3.68–3.67 (m, 3H), 3.70–3.62 (m, 1H), 3.41 (ddd, $J = 12.1$, 10.5, 3.3 Hz, 1H), 3.20 (dd, $J = 10.6$, 1.8 Hz, 1H), 3.02 (ddd, $J =$

22.5, 10.4, 2.9 Hz, 1H), 2.93–2.81 (m, 2H), 2.68–2.42 (m, 2H), 2.41–2.35 (m, 2H), 2.32–2.26 (m, 2H), 2.25–2.18 (m, 2H), 1.99–1.86 (m, 1H), 1.72 (dd, $J = 8.9, 2.4$ Hz, 1H), 1.63–1.53 (m, 1H), 1.41–1.30 (m, 1H), 1.21–1.09 (m, 1H), 0.91 (s, 9H), 0.14 (s, 3H), 0.07 (s, 3H) ppm; ^{13}C NMR (101 MHz, CDCl_3): $\delta = 170.0, 169.9, 156.4, 156.4, 145.9, 145.2, 133.4, 133.3, 123.4, 123.0, 118.4, 81.0, 79.3, 79.3, 70.2, 70.1, 56.5, 56.1, 54.2, 54.2, 52.5, 52.4, 52.4, 50.4, 47.0, 46.9, 45.1, 45.0, 34.0, 33.8, 32.3, 32.2, 26.3, 26.3, 25.7, 18.8, 17.9, 14.1, -4.2, -4.2, -4.6, -4.6$ ppm; IR (film) $\tilde{\nu} = 2929, 2858, 1701, 1642, 1449, 1391, 1083, 837$ cm^{-1} ; MS (ESI): m/z : 513 [$M+\text{H}^+$]; HRMS (ESI): m/z : calcd. for $\text{C}_{29}\text{H}_{45}\text{N}_2\text{O}_4\text{Si}$ [$M+\text{H}^+$]: 513.31431, found: 513.31422.

(Z)-5-Iodopent-4-en-1-ol (S4).^[3] Dibal-H (1.0 M in hexane, 16.0 mL, 16.0 mmol) was added dropwise to a

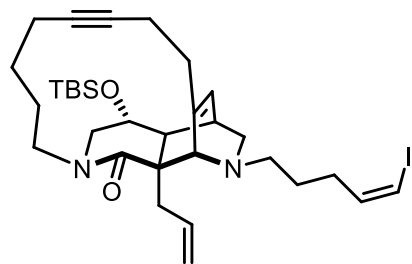
 stirred suspension of anhydrous InCl_3 (3.56 g, 16.1 mmol) in THF (34 mL) at -78 °C. The resulting mixture was stirred at that temperature for 30 min before 4-pentynol (1.1 mL, 11.8 mmol) and Et_3B (1.0 M in hexane, 16.0 mL, 16.0 mmol) were successively added. After another 2.5 h at -78 °C, solid I_2 (18.1 g, 71.3 mmol) was introduced very quickly in one portion. Stirring was continued at -78 °C for 30 min before the reaction mixture was poured into aq. sat. NaHCO_3 (ca. 20 mL). Sat. aq. $\text{Na}_2\text{S}_2\text{O}_3$ was then added, the mixture was extracted with hexane (2 x 200 mL), the combined organic phases were washed with brine and dried over anhydrous Na_2SO_4 . After evaporation of solvent, the residue was purified by chromatography on silica gel (dichloromethane/*tert*-butyl methyl ether; 20:1 to 15:1) to afford the title compound as a yellow oil (1.2 g, 48 %). ^1H NMR (400 MHz, CDCl_3): $\delta = 6.32\text{--}6.05$ (m, 2H), 3.68 (t, $J = 6.4$ Hz, 2H), 2.25 (td, $J = 7.4, 6.0$ Hz, 2H), 1.71 (tt, $J = 7.4, 6.5$ Hz, 2H) ppm; ^{13}C NMR (101 MHz, CDCl_3): $\delta = 140.5, 83.0, 62.1, 31.1, 30.8$ ppm; IR (film) $\nu = 3355, 2934, 1274, 1166, 1115, 729$ cm^{-1} ; MS (EI): m/z (%): 67 (100), 85 (55), 212 (4); HRMS (ESI): m/z : calcd. for $\text{C}_5\text{H}_{10}\text{OI}$ [M^+]: 212.97709, found: 212.97670.

(Z)-5-Iodopent-4-enal (19). DMSO (0.19 mL, 2.67 mmol) was added to a solution of oxalyl chloride (0.1

 mL, 1.16 mmol) in CH_2Cl_2 (0.8 mL) at -78 °C. The mixture was stirred for 30 min before a solution of alcohol **S4** (92 mg, 0.434 mmol) in CH_2Cl_2 (0.7 mL) was introduced. The mixture was stirred at -78 °C for 1h before Et_3N (0.6 mL, 4.30 mmol) was added. The mixture was then warmed to ambient temperature and stirring continued for another 40 min. The mixture was poured into sat. aq. NH_4Cl solution and the aqueous layer was extracted with diethyl ether (3 x 5 mL). The combined organic layers were washed with brine, dried over MgSO_4 , and filtered. After removal of the solvent, the residue was purified by flash chromatography on silica gel (pentanes/diethyl ether, 2:1) to afford the title compound as

a colorless oil (72 mg, 79 %). ^1H NMR (400 MHz, CDCl_3): δ = 9.79 (t, J = 1.3 Hz, 1H), 6.29 (dt, J = 7.4, 1.1 Hz, 1H), 6.25–6.20 (m, 1H), 2.59 (tt, J = 7.1, 1.1 Hz, 2H), 2.50–2.42 (m, 2H) ppm; ^{13}C NMR (101 MHz, CDCl_3): δ = 200.9, 138.9, 84.1, 41.9, 27.5 ppm; IR (film) ν = 2918, 2825, 1282, 1054, 685, 610 cm^{-1} ; MS (ESI): m/z (%): 55 (64), 83 (100), 210 (1); HRMS (ESI): m/z : calcd. for $\text{C}_5\text{H}_8\text{OI}$ [M^+]: 210.96144, found: 210.96166.

Compound 20. L-Selectride (1.0 M in THF, 0.2 mL, 0.2 mol) was added to a solution of compound **16** (18.0

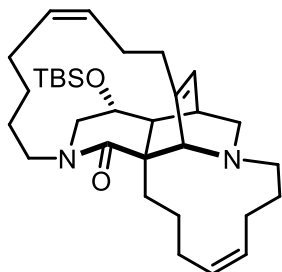


mg, 0.0351 mol) in THF (0.05 mL) at ambient temperature. After stirring for 2 d, the mixture was cooled to 0 °C and the reaction quenched by careful addition of MeOH (0.4 mL). The resulting mixture was loaded onto an amino cartridge (Agilent, Bond Elut-NH₂, 500 mg, 3 mL, 40 μm) pre-equilibrated with three column length volumes of MeOH, H₂O, MeOH successively) and the product eluted with MeOH/H₂O (90:10) to

provide the corresponding free amine as a white solid, which was immediately used in the next step.

$\text{NaBH}(\text{OAc})_3$ (15.3 mg, 0.0722 mmol) was added to a solution of this compound and aldehyde **19** (33.0 mg, 0.157 mmol) in CH_2Cl_2 (0.35 mL). The mixture was stirred for 3 h before it was diluted with CH_2Cl_2 (0.4 mL). The reaction was quenched with sat. aq. NaHCO_3 (0.1 mL). After removing the solvent under argon, the resulting mixture was purified on an amino cartridge (Agilene, Bond Elut-NH₂, 500 mg, 3 mL, 40 μm ; eluting with MeOH) to provide a white solid. This compound was then subjected to preparative HPLC (Kromasil-5-C18, 5 μm , 150 mm \times 30 mm, MeOH: H₂O = 95:5, 35 mL/min, λ = 205 nm, t = 13.5 min) to afford the title compound as a colorless oil (20.2 mg, 89 %). $[\alpha]_{\text{D}}^{20}$ = 18.2 (c = 0.2, CHCl_3); ^1H NMR (400 MHz, CDCl_3): δ = 6.26–6.11 (m, 2H), 5.97–5.94 (m, 1H), 5.86 (ddt, J = 17.5, 10.1, 7.5, 7.5 Hz, 1H), 5.12–5.03 (m, 2H), 3.99 (dd, J = 10.0, 3.4 Hz, 1H), 3.63–3.56 (m, 1H), 3.51 (d, J = 1.7 Hz, 1H), 3.39 (dd, J = 12.0, 10.7 Hz, 1H), 3.01 (dd, J = 9.6, 2.0 Hz, 1H), 2.85 (dd, J = 12.0, 4.6 Hz, 1H), 2.72–2.62 (m, 2H), 2.61–2.50 (m, 2H), 2.48–2.43 (m, 1H), 2.39–2.33 (m, 2H), 2.32–2.23 (m, 3H), 2.23–2.15 (m, 3H), 2.14–2.06 (m, 1H), 1.91 (dddd, J = 15.5, 12.5, 5.7, 2.8 Hz, 1H), 1.81 (dd, J = 9.6, 2.8 Hz, 1H), 1.60–1.57 (m, 2H), 1.53–1.42 (m, 2H), 1.37–1.28 (m, 1H), 1.18 (qd, J = 11.9, 11.7, 11.7, 2.3 Hz, 1H), 0.90 (s, 9H), 0.13 (s, 3H), 0.06 (s, 3H) ppm; ^{13}C NMR (101 MHz, CDCl_3): δ = 171.2, 143.2, 141.3, 135.0, 121.7, 117.4, 82.3, 81.2, 70.6, 63.4, 57.2, 54.3, 53.8, 52.6, 52.3, 50.4, 44.6, 34.4, 34.4, 32.6, 26.9, 26.3, 25.8, 18.8, 17.9, 14.3, –4.2, –4.5 ppm; IR (film) $\tilde{\nu}$ = 2951, 2927, 2855, 1423, 1255, 1111, 1081, 837, 777 cm^{-1} ; MS (ESI): m/z : 649 [$M+\text{H}^+$]; HRMS (ESI): m/z : calcd. for $\text{C}_{32}\text{H}_{50}\text{IN}_2\text{O}_2\text{Si}_2$ [$M+\text{H}^+$]: 649.26808, found: 649.26830.

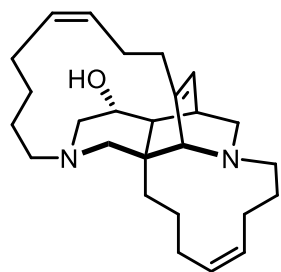
Compound 23. 9-H-9-BBN (0.5 M in THF, 0.085mmol) was added dropwise to neat **20** (9.1 mg, 0.014



mmol) at ambient temperature and the resulting mixture was stirred for 12h at ambient temperature. H₂O (0.05 mL) was added to quench excess 9-H-9-BBN and the resulting mixture was vigorously stirred for 5 min before a stock solution of HOAc (0.35 M in THF, 0.1 mL, 0.35 mmol) was introduced. Stirring was continued for 2.5 h before NaHCO₃ (4.6 mg, 0.0548 mmol) was added. The resulting alkyl borane solution was diluted with THF (1.8 mL), uploaded into a gas-tight syringe

and added over the course of 3 h via syringe pump to a solution of thallium carbonate (20.2 mg, 0.0431 mmol), triphenylarsine (1.8 mg, 0.0059 mmol) and [1,1'-bis(diphenylphosphino)ferrocene] dichloropalladium(II) (2.1 mg, 0.0029 mmol) in THF/DMF/H₂O (4.6 mL, 6:3:1) at ambient temperature. Once the addition was complete, stirring was continued for another 12 h at ambient temperature. The mixture was filtered through an amino cartridge (Agilene, Bond Elut-NH₂, 500 mg, 3 mL, 40 µm), the filtrate was evaporated and the crude product was subjected to preparative HPLC (Kromasil-5-C18, 5 µm, 150 mm × 30 mm, MeOH, 35 mL/min, λ = 205 nm, t = 9.5 min) to afford the title compound as a white solid (3.5 mg, 48 %). [α]_D²² = 19.0 (c = 0.2, CHCl₃); ¹H NMR (600 MHz, CDCl₃): δ = 5.74 (d, *J* = 6.7 Hz, 1H), 5.47 (q, *J* = 8.6 Hz, 1H), 5.40–5.30 (m, 3H), 5.30–5.22 (m, 1H), 4.36 (ddd, *J* = 14.0, 11.2, 4.7 Hz, 1H), 3.66 (d, *J* = 1.7 Hz, 1H), 3.35 (ddd, *J* = 10.2, 9.3, 4.3 Hz, 1H), 2.99 (dd, *J* = 12.0, 10.3 Hz, 1H), 2.93–2.86 (m, 2H), 2.69–2.59 (m, 2H), 2.53–2.45 (m, 2H), 2.43–2.33 (m, 2H), 2.31–2.21 (m, 2H), 2.21–2.12 (m, 5H), 2.08–1.99 (m, 2H), 1.99–1.86 (m, 2H), 1.70 (q, *J* = 6.5, 5.7 Hz, 1H), 1.66 (dd, *J* = 9.7, 3.0 Hz, 1H), 1.63–1.56 (m, 2H), 1.51 (dt, *J* = 10.1, 4.4 Hz, 1H), 1.49–1.38 (m, 2H), 1.31 (dt, *J* = 9.4, 1.5 Hz, 1H), 0.89 (s, 9H), 0.08 (s, 3H), 0.05 (s, 3H).ppm; ¹³C NMR (151 MHz, CDCl₃): δ = 171.8, 144.1, 130.9, 130.8, 130.0, 129.8, 123.8, 70.2, 62.9, 58.8, 55.2, 52.9, 52.1, 48.2, 42.1, 36.4, 34.1, 31.1, 27.2, 27.1, 26.8, 26.2, 25.7, 25.2, 24.8, 24.7, 22.7, 17.9, –4.3, –4.7 ppm; IR (film) $\tilde{\nu}$ = 2928, 2856, 1642, 1434, 1360, 1256, 1082, 836, 775 cm^{–1}; MS (ESI): *m/z*: 525 [*M*+H⁺]; HRMS (ESI): *m/z*: calcd. for C₃₂H₅₃N₂O₂Si [*M*+ H⁺]: 525.38708, found: 525.38739.

Nominal Xestocyclamine A ((-)-1). Dibal-H (1 M in THF, 0.4 mL, 0.4 mmol) was added to a solution of compound **23** (10 mg, 0.0191 mmol) in toluene (0.2 mL) at ambient temperature. After stirring for 2 d, MeOH (0.3 mL) was added dropwise at 0 °C. The resulting mixture was filtered through a short pad of Celite®, rinsing with EtOAc (10 mL). The combined filtrates were evaporated and the residue was purified by preparative HPLC (YMC Triart-5-C18, 5 µm, 150 mm × 30 mm, CH₃CN: 20 mmol NH₄HCO₃ PH 9 = 95:5, 35 mL/min, λ = 205 nm, t = 11.1 min) to afford the title compound as a white solid (4.3 mg, 57 %); according to NMR, the compound is ≈97% pure. M.p. = 136.7-136.9 °C; $[\alpha]_D^{22} = -11.0$ (c = 0.42, MeOH); for the ¹H NMR and ¹³C NMR data, see Tables S1 and S2; IR (film) $\tilde{\nu} = 2921, 2850, 1460, 1260, 1066, 1256, 1031, 800\text{ cm}^{-1}$; MS (ESI): *m/z*: 397 [*M*+*H*⁺]; HRMS (ESI): *m/z*: calcd. for C₂₆H₄₁N₂O [*M*+ *H*⁺]: 397.32134, found: 397.32163.



Nominal Xestocyclamine A Bishydrochloride Salt ((-)-1·2HCl). Excess HCl (1 M in diethyl ether) was added to a solution of (-)-**1** (4.0 mg, 0.010 mmol) in CDCl₃ (ca. 0.5 mL) at 0 °C. After 5 min, the solvent was removed under argon to provide a white solid. $[\alpha]_D^{22} = -11.2$ (c = 0.45, MeOH); for the ¹H NMR and ¹³C NMR data, see Tables S1 and S2.

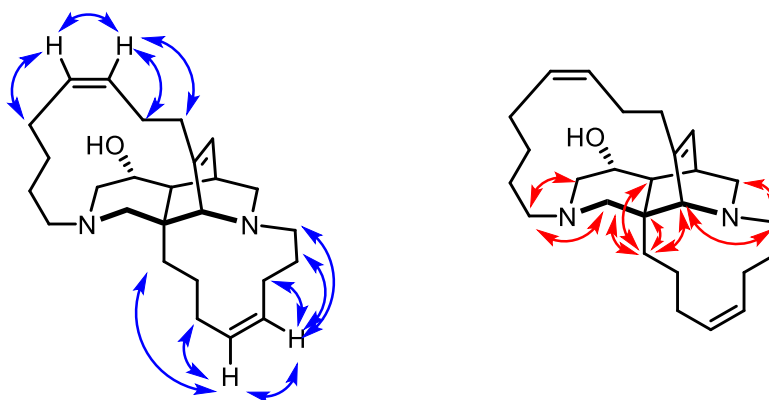
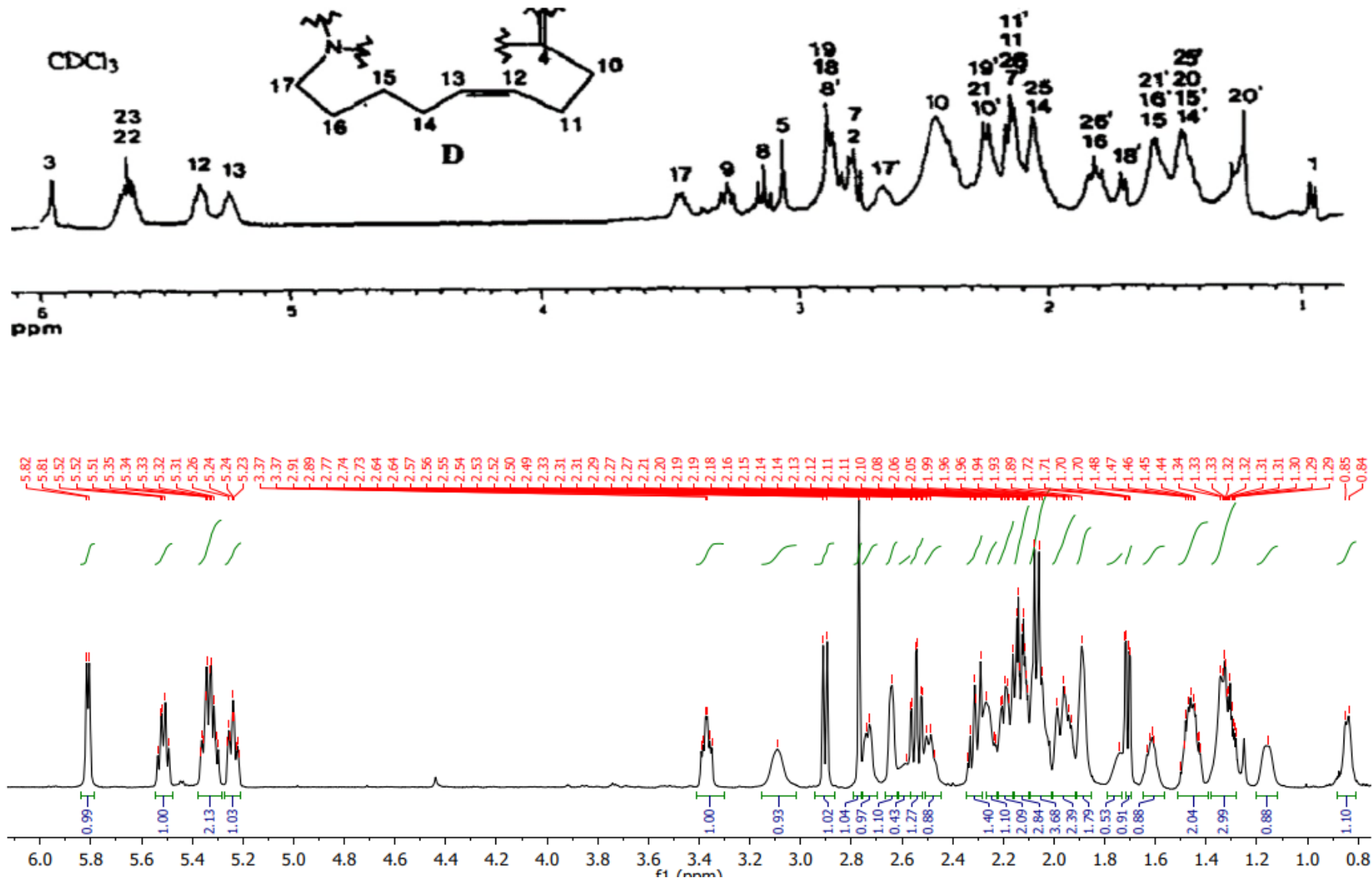
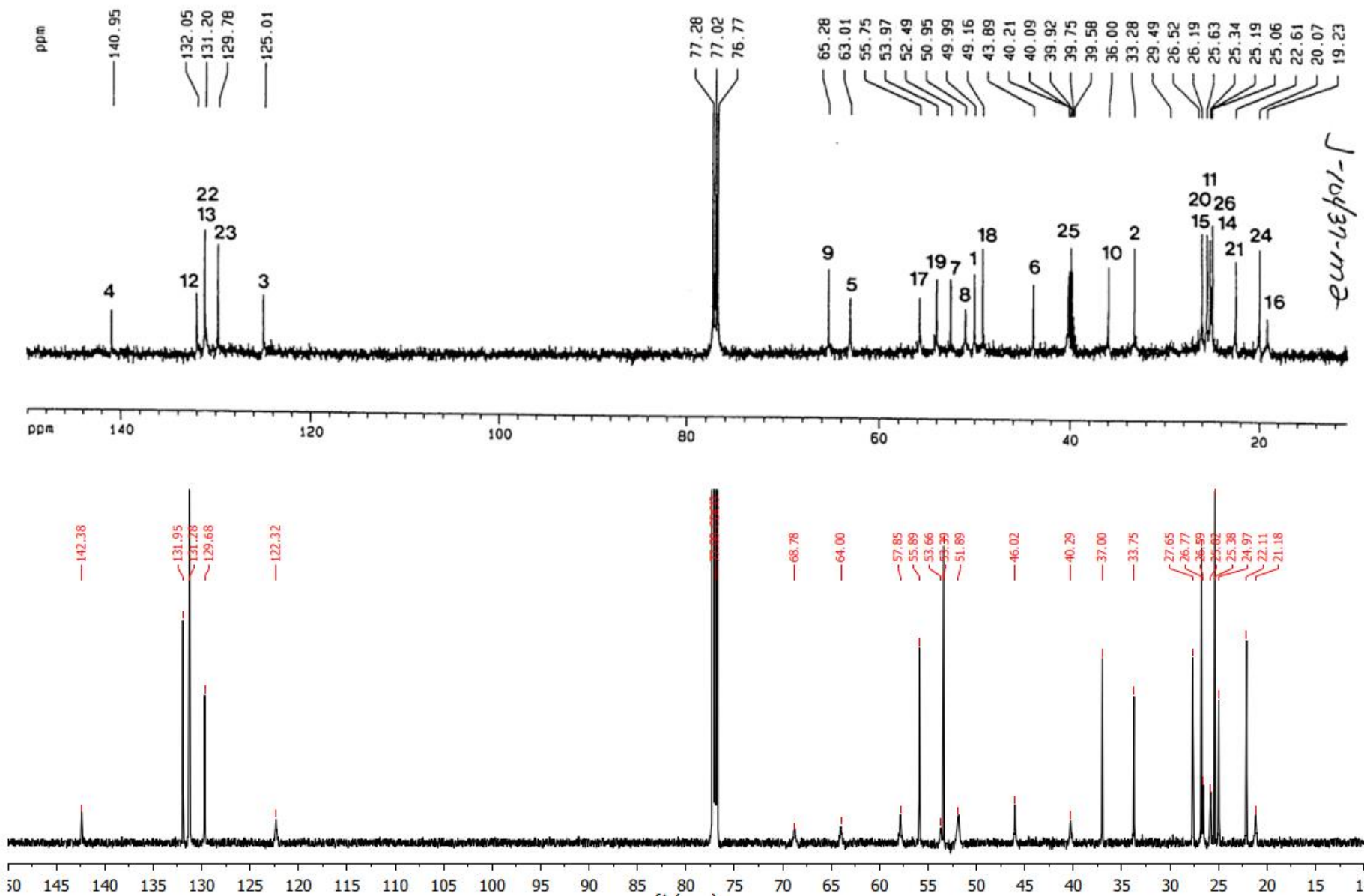


Figure S6. Characteristic NOESY (left) and HMBC connectivities (right) in compound (-)-**1**

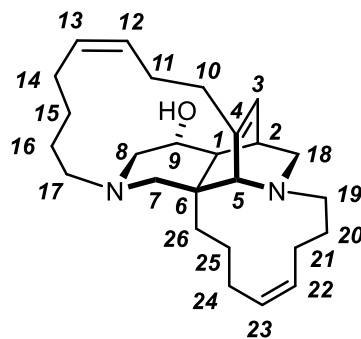


Mismatch between the ^1H NMR spectra of Xestocyclamine A published in the literature (top)^[4,5] and synthetic (-)-1 (CDCl_3 bottom)



Mismatch between the ^{13}C NMR spectra of Xestocyclamine A published in the literature (top)^[4,5] and synthetic (-)-**1** (CDCl_3 bottom)

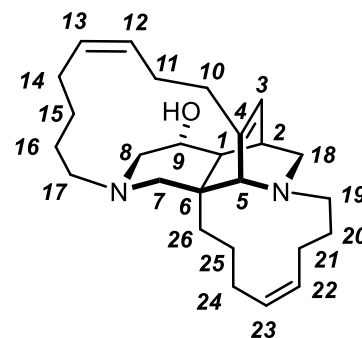
**Table S1: Comparison of ^1H NMR data of Xestocyclamine A;
Numbering Scheme as shown in the Insert**



Position	Literature ^[4,5]		Synthetic Sample (–)-1		Synthetic Sample (–)-1·2HCl	
	δ (ppm)	J (Hz)	δ (ppm)	J (Hz)	δ (ppm)	J (Hz)
1	0.95	(dd, $J = 9.3, 0.8$)	0.78	(dd, $J = 9.2, 2.5$)	1.32	(dd, $J = 10.5, 2.4$)
2	2.80	m	2.59	(dd, $J = 8.7, 2.7$)	3.26	(d, $J = 6.4$)
3	5.95	(d, $J = 7.0$)	5.78	(d, $J = 6.5$)	6.49	(d, $J = 6.8$)
4						
5	3.05	s	2.77	(d, $J = 1.7$)	4.33	s
6						
7a	2.82	m	2.16-2.09		3.55	(dd, $J = 13.0, 6.6$)
7b	2.25	m	2.06	(d, $J = 10.7$)	2.16	(d, $J = 12.8$)
8a	3.10	(d, $J = 11.2$)	2.67	(dd, $J = 11.6, 4.9$)	3.09	(dd, $J = 13.2, 4.9$)
8b	2.85	m	2.41	s	3.06	(d, $J = 12.3$)
9	3.20	(dd, $J = 8.4, 4.1$)	3.38	(ddd, $J = 11.0, 9.2, 4.9$)	3.39	(dt, $J = 11.2, 4.7$)
10a	2.38	m	2.30	(dt, $J = 10.6, 5.6$)	2.65	(dt, $J = 13.3, 2.8$)
10b	2.24	m	2.16-2.09	m	2.61-2.55	m
11a	2.20	m	2.25-2.17	m	2.53-2.46	m
11b			2.16-2.09	m	2.26-2.24	m
12	5.32	m	5.38-5.29	m	5.49	(t, $J = 10.3$)
13	5.23	m	5.24	(ddq, $J = 11.4, 5.9, 3.1$)	5.42	(t, $J = 10.9$)
14a	2.10	m	2.10	(t, $J = 4.7$)	2.35-2.31	m
14b	1.53	m	1.96	(d, $J = 13.9$)	2.12	(d, $J = 15.2$)
15a	1.80	m	1.50-1.41	m	1.57	s
15b	1.67	m	1.34-1.31	m		
16a	1.80	m	1.59-1.54	m	1.57	s
16b	1.65	m	1.30	(ddd, $J = 13.7, 8.4, 3.4$)	1.99-1.92	m

17a	3.42	m	3.05-2.94	m	3.61-3.58	m
17b	2.65	m	2.16	(d, $J = 8.9$)	3.00-2.96	m
18a	2.87	m	2.89	(dd, $J = 9.7, 1.8$)	3.84	(d, $J = 11.7$)
18b	1.67	(d, $J = 9.5$)	1.71	(dd, $J = 9.6, 3.0$)	2.94	(dd, $J = 11.8,$ 2.6)
19a	2.75	m	2.54	(dt, $J = 12.1, 3.0$)	3.75	(t, $J = 12.0$)
19b	2.12	m	2.16-2.09	m	3.33-3.30	m
20a	1.50	m	1.51-1.40	m	1.89-1.87	m
20b	1.28	m	1.31-1.28	m	1.84-1.80	m
21a	1.79	m	2.48	(d, $J = 11.6$)	2.61-2.55	m
21b	1.53	m	1.97-1.94	m	2.42-2.37	m
22	5.55	(dt, $J = 11.0, 5.0$)	5.38-5.29	m	6.09	(q, $J = 8.9$)
23	5.57	m	5.51	(q, $J = 8.2$)	5.75	(t, $J = 11.1$)
24a	2.20	m	2.25-2.17	m	2.61-2.55	m
24b			2.05-1.98	m	2.53-2.46	m
25a	2.10	m	1.66	s	2.16	(d, $J = 12.8$)
25b	1.53	m	1.21	s	1.91-1.90	m
26a	2.17	m	1.84	(t, $J = 6.7$)	2.21-2.19	m
26b	1.80	m			1.50	(dd, $J = 17.0,$ 11.5)

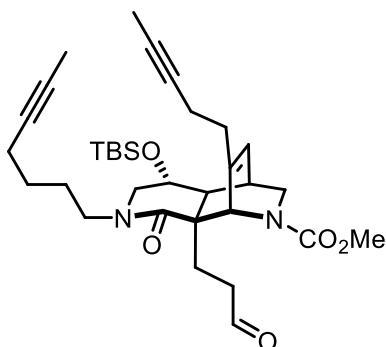
**Table S2: Comparison of ^{13}C NMR data of Xestocyclamine A;
Numbering Scheme as shown in the Insert**



Position	Literature ^[4,5] δ (ppm)	Synthetic Sample (–)-1 δ (ppm)	Synthetic Sample (–)-1·2HCl δ (ppm)
1	49.4	52.6	49.6
2	33.4	34.0	31.6
3	125.3	121.6	132.6
4	141.0	142.9	138.8
5	63.1	64.3	65.4
6	44.0	46.5	43.4
7	49.3	52.6	57.1
8	51.0	54.5	51.9
9	65.6	69.9	64.5
10	36.1	37.2	36.3
11	25.8	25.3	26.0
12	132.2	131.8	132.1
13	131.6	131.3	133.8
14	25.2	24.9	26.5
15	26.3	26.8	25.8
16	19.4	21.8	20.6
17	55.9	55.9	49.4
18	52.6	53.4	53.7
19	54.1	57.9	65.1
20	26.3	27.0	22.4
21	22.8	25.9	27.3
22	131.6	129.7	135.0
23	129.7	131.3	134.0
24	20.2	27.6	26.3
25	25.5	22.2	20.9
26	40.3	40.7	34.2

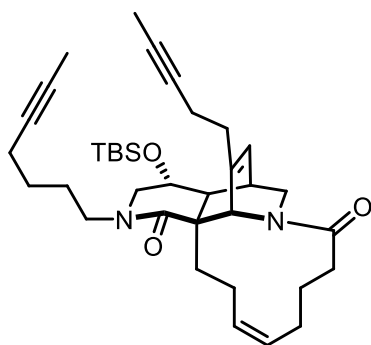
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Compound 24. 9-BBN (0.5 M in THF, 0.78 mL, 0.390 mmol) was added dropwise over 5 min to a solution of **15** (148 mg, 0.261 mmol) in THF (2.6 mL) at 0 °C. After 10 min, the reaction mixture was warmed to ambient temperature and stirring was continued for 1 h before the mixture was diluted with H₂O (0.15 mL). NaBO₃•H₂O (261 mg, 1.31 mmol) was added and the resulting mixture stirred for 1 h at ambient temperature. The mixture was extracted with EtOAc (4 x 10 mL), the combined extracts were dried over Na₂SO₄, filtered and evaporated. The residue was purified by flash chromatography on silica gel (hexanes/acetone, 8:1 to 4:1) to provide the desired alcohol as a colorless oil, which was used without further characterization.



Activated powdered molecular sieves (4 Å ca.200 mg) and PDC (127 mg, 0.338 mmol) were successively added at 0 °C to a solution of this alcohol in CH₂Cl₂ (2.6 mL). After 5 min, the mixture was stirred at room temperature for 1 h before it was filtered through a pad of silica gel, which was carefully rinsed with *tert*-butyl methyl ether (20 mL). The combined filtrates were evaporated and the crude material purified by flash chromatography on silica gel (hexanes/acetone, 8:1 to 4:1) to provide the title compound (112 mg, 74% over 2 steps) as a colorless oil. $[\alpha]_D^{20} = 89.6$ ($c = 1.0$, CHCl₃); ¹H NMR (400 MHz, CDCl₃, mixture of rotamers, ca.1:1): $\delta = 9.74\text{--}9.67$ (m, 1H), 5.94 (t, $J = 6.5$ Hz, 1H), 4.97–4.75 (m, 1H), 3.70 (s, 1.5H), 3.64 (s, 1.5H), 3.33–3.12 (m, 5H), 3.05–2.91 (m, 2H), 2.91–2.51 (m, 3H), 2.44–2.20 (m, 4H), 2.17–2.06 (m, 2H), 2.07–1.96 (m, 1H), 1.84–1.72 (m, 4H), 1.71–1.68 (m, 3H), 1.60 (ddd, $J = 8.4, 5.8, 2.0$ Hz, 1H), 1.48 (tdd, $J = 9.3, 7.3, 4.2$ Hz, 2H), 1.41–1.30 (m, 2H), 0.93–0.78 (m, 9H), 0.11–0.08 (m, 6H) ppm; ¹³C NMR (101 MHz, CDCl₃): $\delta = 202.0, 201.2, 170.1, 170.0, 156.3, 156.1, 146.5, 145.8, 125.6, 125.0, 78.5, 78.5, 78.1, 76.0, 75.9, 70.7, 70.5, 55.1, 54.9, 52.8, 52.5, 52.4, 52.3, 51.3, 51.2, 50.8, 47.2, 47.0, 46.8, 46.8, 39.4, 39.2, 33.6, 33.4, 33.1, 33.0, 31.5, 26.5, 26.4, 25.9, 25.7, 18.3, 17.8, 16.9, 16.8, 3.4, 3.4, -4.3, -4.3, -4.8, -4.8$ ppm; IR (film) $\nu = 2929, 1698, 1448, 1390, 1260, 1214, 1088, 837, 752$ cm⁻¹; MS (ESI): m/z : 583 [$M+H^+$], 605 [$M+Na^+$]; HRMS (ESI): m/z : calcd. for C₃₃H₅₀N₂O₅SiNa [$M+Na^+$]: 605.33812, found: 605.33863.

Compound 28. NaHMDS (1.0 M in THF, 0.72 mL, 0.72 mmol) was added to a solution of (4-carboxybutyl)triphenylphosphonium bromide (**25**) (326 mg, 0.735 mmol) in THF (2.0 mL) at 0 °C. The mixture was stirred at 0 °C for 1 h before the resulting reddish-orange mixture was cooled to ~ -90 °C (hexane/liquid N₂ bath). A solution of aldehyde **24** (60.0 mg, 0.103 mmol) in THF (1.5 mL) was added dropwise. After 1 h, the mixture was warmed to 0 °C over the course of 2 h before it was diluted with saturated NH₄Cl (5 mL). The aqueous phase was extracted with EtOAc (10 mL x 4), the combined organic layers were dried over Na₂SO₄ and concentrated. The crude material was used in the next step without further purification.

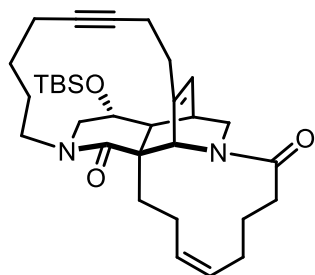


L-Selectride (1 M in THF, 0.8 mL, 0.8 mol) was added to the crude acid at ambient temperature and the resulting mixture was stirred at 40 °C for 2 d. The mixture was cooled to 0 °C and the reaction quenched by careful addition of MeOH (1.0 mL). The resulting mixture was purified by preparative HPLC (Kromasil-5-C18, 5 µm, 150 mm × 30 mm, MeOH:H₂O = 95:5, 35 mL/min, λ = 205 nm, t = 6.5 min) to afford the desired amino acid **26** as a white solid.

A solution of **26** and *N,N*-diisopropylethylamine (130 µL, 0.746 mmol) in CH₂Cl₂/DMF(10 mL, 3:1) was added via syringe pump over the course of 12 h to a solution of Mukaiyama's salt **27** (73.8 mg, 0.289 mmol) in CH₂Cl₂ (70 mL) at ambient temperature. Once the addition was complete, stirring was continued for another 2 d. The reaction was quenched with sat. aq. NH₄Cl (20 mL) and the aqueous layer was extracted with CH₂Cl₂ (2 x 50 mL). The combined organic phases were dried over Na₂SO₄, filtered and concentrated. The crude material was purified by flash chromatography on silica gel (hexanes/acetone, 6:1 to 3:1) to provide the title compound as a yellow oil (23.0 mg, 39% over 3 steps). $[\alpha]_D^{20} = 31.6$ (c = 1.0, CHCl₃); ¹H NMR (400 MHz, Chloroform-*d*) δ = 5.93 (d, *J* = 5.8 Hz, 1H), 5.56 (d, *J* = 9.7 Hz, 1H), 5.34 (td, *J* = 10.4, 5.6 Hz, 1H), 4.95 (s, 1H), 3.41–3.34 (m, 1H), 3.33–3.19 (m, 4H), 3.10 (dd, *J* = 11.8, 2.8 Hz, 1H), 3.00 (dd, *J* = 12.2, 4.0 Hz, 1H), 2.77–2.69 (m, 2H), 2.40–2.34 (m, 2H), 2.29–2.19 (m, 3H), 2.18–2.04 (m, 6H), 2.04–1.83 (m, 3H), 1.76 (t, *J* = 2.5 Hz, 3H), 1.71 (t, *J* = 2.5 Hz, 3H), 1.65–1.59 (m, 2H), 1.59–1.50 (m, 2H), 1.46–1.37 (m, 2H), 0.90 (s, 9H), 0.11 (s, 3H), 0.09 (s, 3H) ppm; ¹³C NMR (101 MHz, CDCl₃): δ = 173.1, 170.6, 146.0, 129.9, 129.8, 125.2, 78.5, 76.2, 75.9, 70.4, 57.2, 57.2, 54.4, 52.1, 51.1, 47.9, 47.1, 38.5, 33.1, 33.0, 30.6, 26.6, 26.2, 26.1, 25.7, 25.2, 22.5, 18.4, 17.9, 16.8, 3.4, 3.4, -4.4, -4.8 ppm; IR (film) ν = 2925, 2855,

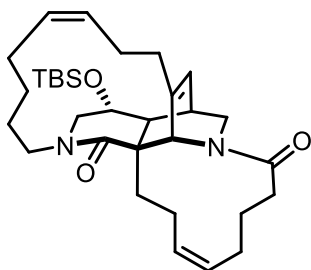
2058, 1952, 1644, 1446, 1258, 1087, 837 cm^{-1} ; MS (ESI): m/z : 591 [$M+H^+$], 613 [$M+Na^+$]; HRMS (ESI): m/z : calcd. for $C_{36}H_{55}N_2O_3Si$ [$M+H^+$]: 591.39765, found: 591.39775.

RCAM Product 29. A solution of ligand **18** (15.6 mg, 0.0198 mmol) in toluene (0.5 mL) was added to complex **17** (11.5 mg, 0.0198 mmol) and the resulting mixture was stirred for 5 min. This mixture was subsequently added to a solution of diyne **28** (39 mg, 0.066 mmol) and MS 5 Å (1.0 g) in toluene (33 mL) at 100 °C. After 10 min, the mixture was allowed to cool to ambient temperature, filtered through a pad of Celite and the filtrate was concentrated. The crude material was purified by flash chromatography (hexanes/acetone, 4:1 to 2:1) to provide the title compound as a



white solid (29.0 mg, 82%). $[\alpha]_D^{20} = 62.0$ ($c = 0.6$, CHCl_3); M. p. = 232.0–233.7 °C; ^1H NMR (600 MHz, CDCl_3): $\delta = 5.95$ (d, $J = 6.6$ Hz, 1H), 5.59 (d, $J = 9.9$ Hz, 1H), 5.31 (td, $J = 10.5, 5.4$ Hz, 1H), 4.08–3.87 (m, 1H), 3.66 (ddd, $J = 10.1, 8.7, 4.3$ Hz, 1H), 3.39 (dd, $J = 12.3, 10.5$ Hz, 1H), 3.22 (dd, $J = 11.5, 1.5$ Hz, 1H), 3.12 (dd, $J = 12.0, 3.0$ Hz, 1H), 2.98 (dd, $J = 12.3, 4.3$ Hz, 1H), 2.83 (dd, $J = 6.7, 2.6$ Hz, 1H), 2.75–2.58 (m, 2H), 2.43–2.32 (m, 4H), 2.31–2.26 (m, 1H), 2.26–2.16 (m, 3H), 2.13–2.00 (m, 4H), 1.98–1.83 (m, 3H), 1.79 (s, 1H), 1.69–1.56 (m, 3H), 1.40–1.33 (m, 1H), 1.22–1.13 (m, 1H), 0.90 (s, 9H), 0.13 (s, 3H), 0.07 (s, 3H) ppm; ^{13}C NMR (151 MHz, CDCl_3): $\delta = 173.3, 170.3, 145.1, 130.0, 129.8, 123.6, 80.7, 79.4, 70.4, 58.2, 55.6, 54.3, 52.3, 50.9, 47.7, 38.3, 33.2, 31.8, 30.6, 26.3, 26.1, 25.9, 25.7, 25.4, 22.8, 18.8, 17.9, 14.2, -4.2, -4.6$ ppm; IR (film) $\nu = 2928, 1636, 1416, 1257, 1085, 872, 837, 754$ cm^{-1} ; MS (ESI): m/z : 537 [$M+H^+$], 559 [$M+Na^+$]; HRMS (ESI): m/z : calcd. for $C_{32}H_{48}N_2O_3SiNa$ [$M+Na^+$]: 559.33264, found: 559.33273.

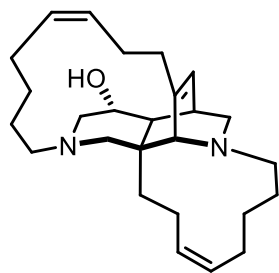
Compound S-5. NaBH_4 (14.8 mg, 0.391 mmol) was added in one portion to a solution of $\text{Ni}(\text{OAc})_2 \cdot 4\text{H}_2\text{O}$ (88.0 mg, 0.354 mmol) in ethanol (4.4 mL). The resulting black suspension was



vigorously stirred for 1 h at ambient temperature before ethylenediamine (95 μL , 1.42 mmol) was introduced. After 30 min, this mixture was transferred into a solution of alkyne **29** (22.0 mg, 0.041 mmol) in ethanol (0.2 mL) at 0 °C. The flask was sealed with a septum and connected to a balloon of H_2 . The mixture was stirred at room temperature for 4 h before it was filtered through a pad of silica gel, which was carefully rinsed with EtOAc. The combined filtrates were evaporated and the residue was purified by flash chromatography on silica gel (hexanes/acetone, 8:1 to 6:1) to afford the title compound as a white solid (19.0 mg, 86%). $[\alpha]_D^{20} = 44.2$ ($c = 0.5$, CHCl_3); ^1H NMR (400 MHz, CDCl_3): $\delta = 5.83$ (d, $J = 6.3$ Hz, 1H), 5.50–5.38 (m, 2H), 5.38–5.28 (m, 2H), 5.00 (s, 1H), 4.36 (ddd, $J = 13.9, 10.9, 4.4$ Hz, 1H),

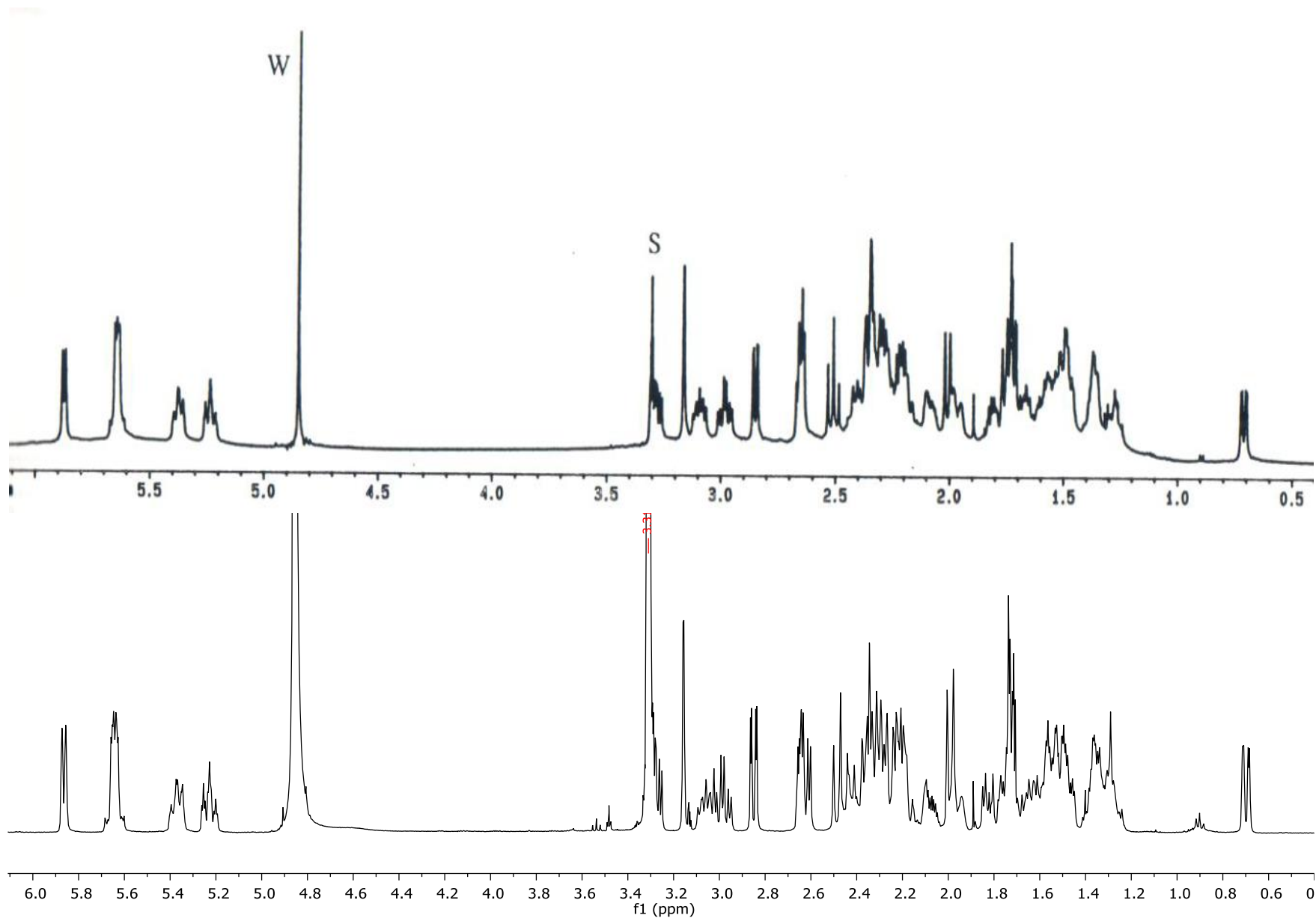
3.51 (td, $J = 8.6, 4.6$ Hz, 1H), 3.20 (dd, $J = 11.9, 1.8$ Hz, 1H), 3.11–2.99 (m, 3H), 2.82–2.73 (m, 2H), 2.60–2.48 (m, 2H), 2.34–2.20 (m, 3H), 2.19–2.07 (m, 4H), 2.04–1.91 (m, 3H), 1.74–1.67 (m, 2H), 1.64 (s, 2H), 1.61 (dd, $J = 8.6, 2.3$ Hz, 1H), 1.58–1.49 (m, 2H), 1.47–1.37 (m, 1H), 1.14–1.04 (m, 1H), 0.90 (s, 9H), 0.10 (s, 3H), 0.08 (s, 3H) ppm; ^{13}C NMR (101 MHz, CDCl_3): $\delta = 173.0, 170.5, 146.0, 130.5, 130.4, 130.1, 128.5, 126.3, 69.7, 58.3, 54.4, 51.3, 48.8, 47.1, 43.6, 40.3, 33.8, 33.4, 31.3, 27.1, 27.0, 25.7, 25.5, 25.3, 24.8, 24.3, 21.7, 17.9, -4.4, -4.7$ ppm; IR (film) $\nu = 2928, 1633, 1415, 1255, 1081, 836, 749, 665$ cm^{-1} ; MS (ESI): m/z : 539 $[M+H^+]$, 561 $[M+Na^+]$; HRMS (ESI): m/z : calcd. for $\text{C}_{32}\text{H}_{50}\text{N}_2\text{O}_3\text{SiNa}$ $[M+H^+]$: 561.34829, found: 561.34839.

(-)-Ingenamine ((-)-3). AlCl_3 (61 mg, 0.458 mmol) was added to a suspension of LiAlH_4 (32 mg, 0.843

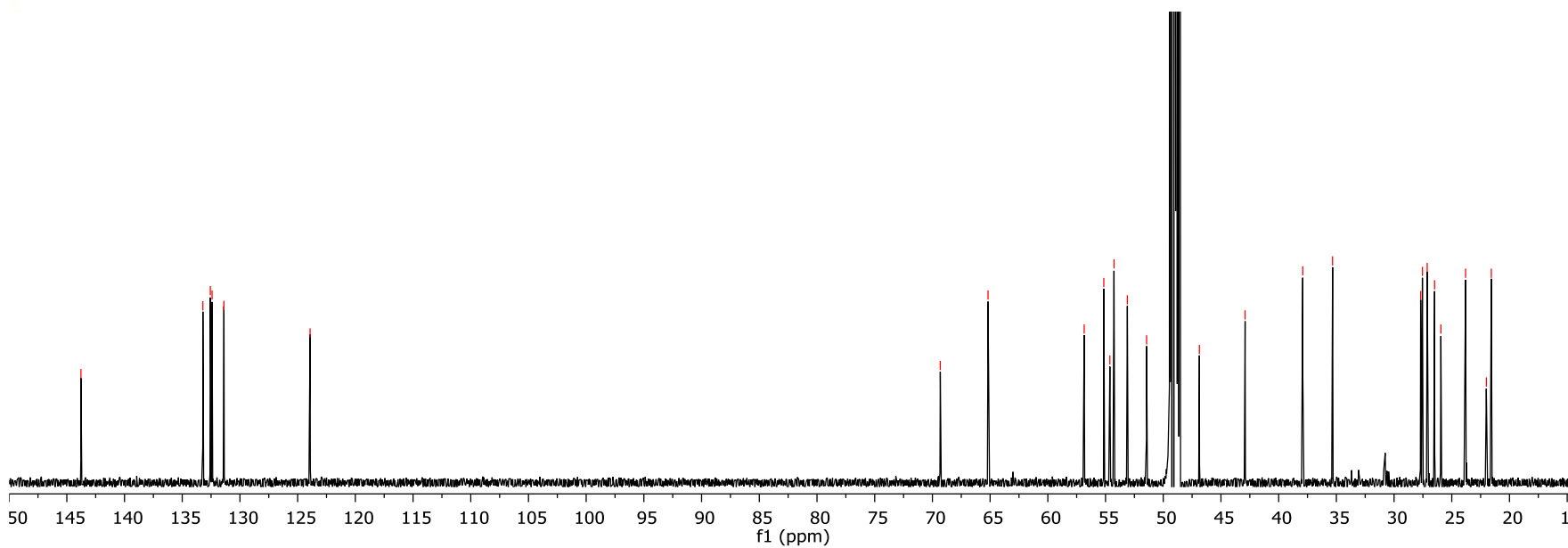
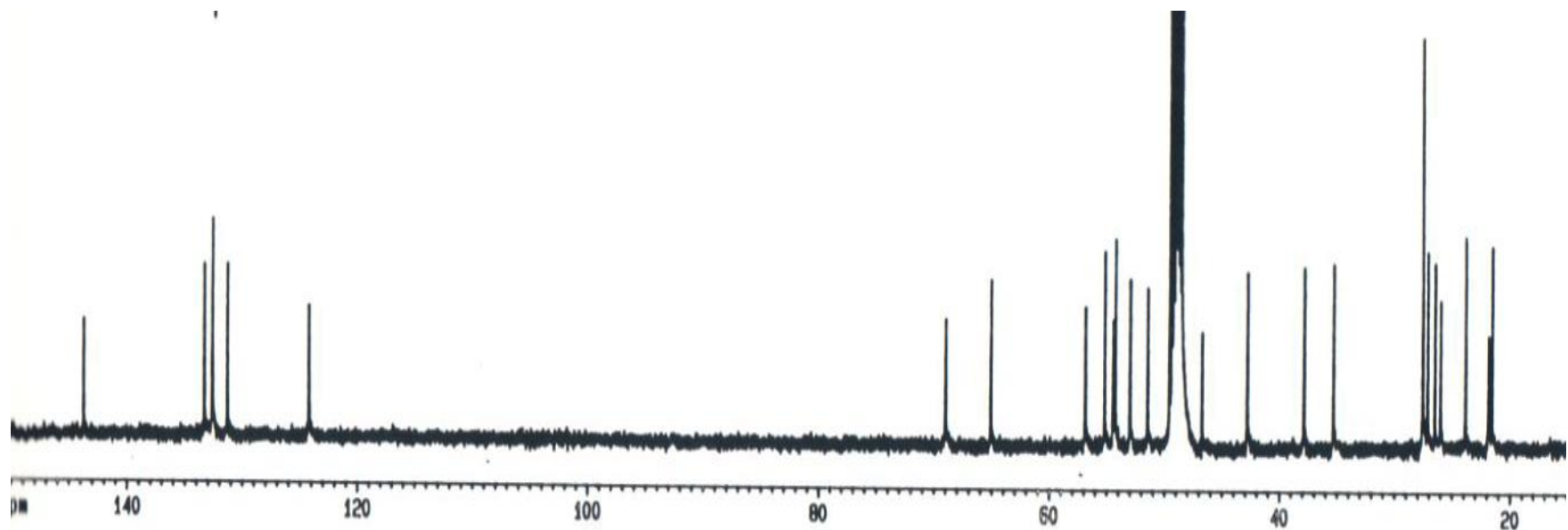


mmol) in THF (3.5 mL) at 0°C . After 5 min, the resulting mixture was warmed to ambient temperature and stirred for 1 h at this temperature. Next, a solution of bislactam **27** (4.0 mg, 0.0074 mmol) in THF (1.0 mL) was added at 0°C . The mixture was allowed to warm to ambient temperature and stirring was continued for 1 d. The solution was cooled to 0°C and carefully quenched by dropwise addition of H_2O (0.5 mL). After 5 min, aq. NaOH (3 M, 1.0 mL) was added to coagulate the

precipitate. The mixture was filtered through a pad of basic alumina, which was carefully rinsed with $\text{MeOH}/\text{CH}_2\text{Cl}_2$ (1:6). After evaporation of the combined filtrates, the residue was purified by preparative HPLC (YMC Triart-5-C18, $5\ \mu\text{m}$, $150\ \text{mm} \times 30\ \text{mm}$, CH_3CN : 20 mmol NH_4HCO_3 pH 9 = 95:5, 35 mL/min, $\lambda = 205\ \text{nm}$, $t = 11.4\ \text{min}$) to afford the title compound as a white solid (1.7 mg, 58 %). M. p. = $142.4\text{--}143.6^\circ\text{C}$; $[\alpha]_{\text{D}}^{20} = -8.5$ ($c = 0.2$, MeOH); for the ^1H NMR and ^{13}C NMR data, see Tables S3 and S4; IR (film) $\nu = 3370, 2923, 2850, 1657, 1460, 1351, 1049, 722\ \text{cm}^{-1}$; MS (ESI): m/z : 397 $[M+H^+]$; HRMS (ESI): m/z : calcd. for $\text{C}_{26}\text{H}_{41}\text{N}_2\text{O}$ $[M+H^+]$: 397.32134, found: 397.32116.

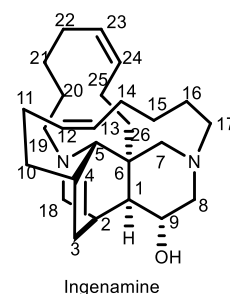


^1H NMR ($[\text{D}_4]\text{-MeOH}$): Top: authentic acid-free Ingenamine (ref. 6); bottom: synthetic Ingenamine (this work)



^{13}C NMR ($[\text{D}_4]$ -MeOH): Top: authentic acid-free Ingenamine (ref. 6); bottom: synthetic Ingenamine (this work)

Table S3. Comparison of ^1H NMR data of (–)-Ingenamine (in $[\text{D}_4\text{-MeOH}]$); Numbering Scheme as shown in the Insert



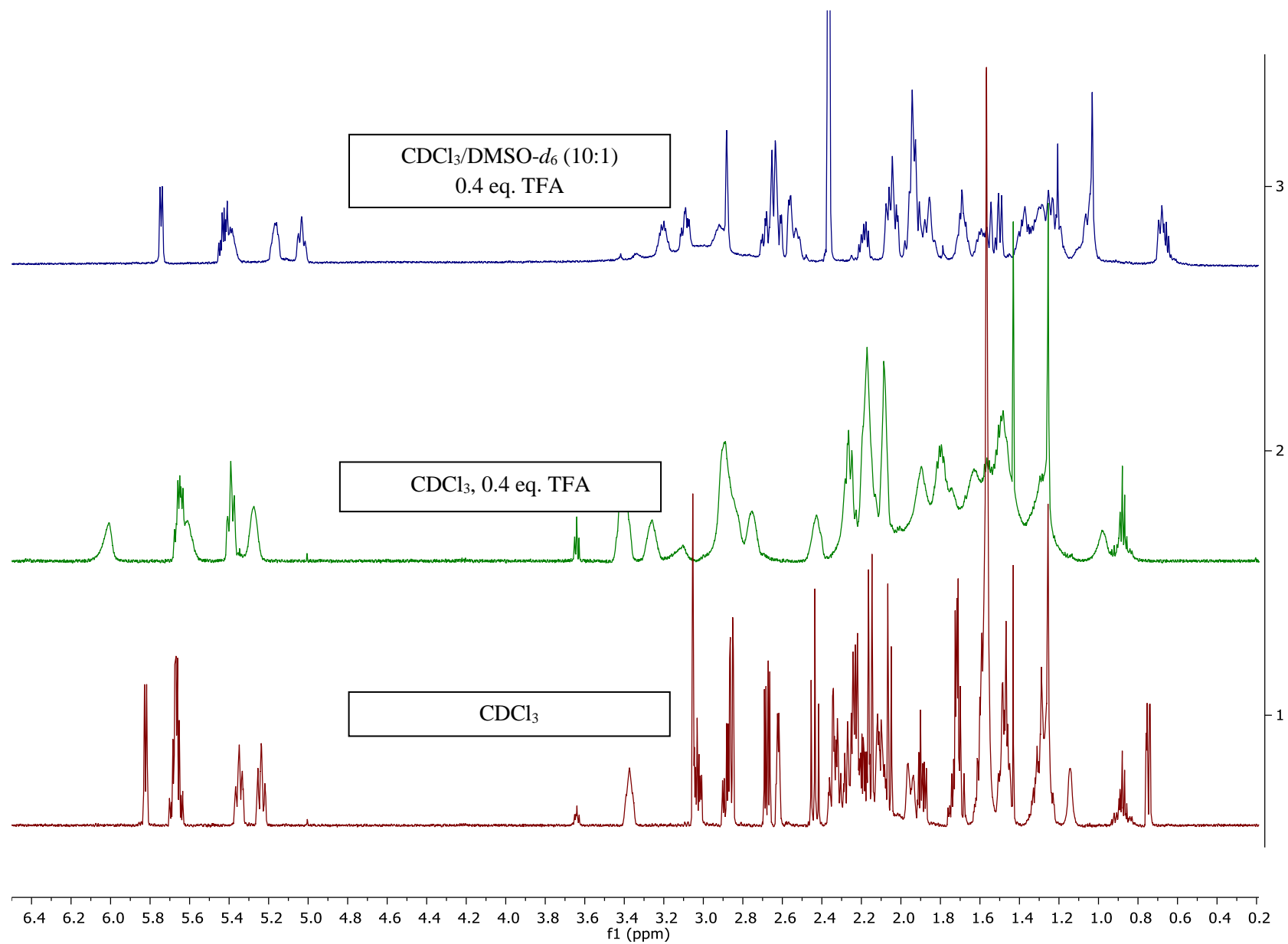
Position	Protonated (+)-Ingenamine ^[7]	Acid-Free (+)-Ingenamine ^[6]	Synthetic (–)-Ingenamine
	δ (ppm), J (Hz)	δ (ppm), J (Hz)	δ (ppm), J (Hz)
1	0.87 (dd, $J = 10.5, 1.8$)	0.69 (dd, $J = 10.1, 2.1$)	0.70, (dd, $J = 10.1, 2.2$)
2	2.75, m	2.64, m	2.66-2.64, m
3	6.01 (d, $J = 6.4$)	5.85 (d, $J = 6.5$)	5.86 (d, $J = 6.5$)
4			
5	3.30 (bs)	3.14 (d, $J = 1.3$)	3.16 (d, $J = 1.1$)
6			
7a	3.10 (d, $J = 12.3$)	2.26 (d, $J = 10.8$)	2.24 (dd, $J = 5.4, 1.2$)
7b	2.22 (bd, $J = 12.3$)	1.98 (d, $J = 10.8$)	1.99-1.95 (m)
8a	3.00 (dd, $J = 12.1, 4.8$)	2.61 (dd, $J = 12.0, 4.8$)	2.63-2.60 (m)
8b	2.92 (t, $J = 12.1$)	2.46 (t, $J = 12.0$)	2.47 (t, $J = 12.0$)
9	3.35 (ddd, $J = 12.1, 10.5, 4.8$)	3.27 (ddd, $J = 11.8, 10.1, 4.8$)	3.31-3.25 (m)
10a	2.41 (m)	2.35 (m)	2.36-2.33 (m)
10b	2.36 (m)	2.28 (m)	2.29-2.27 (m)
11a	2.37 (m)	2.31 (m)	2.35-2.28 (m)
11b	2.15 (m)	2.08 (m)	2.09-2.03 (m)
12	5.45 (bt, $J = 10.5$)	5.36 (m)	5.40-5.36 (m)
13	5.32 (bt, $J = 10.5$)	5.22 (tt, $J = 10.8, 2.9$)	5.26-5.21 (m)
14a	2.31 (m)	2.18 (m)	2.20-2.16 (m)
14b	2.07 (m)	1.95 (m)	1.97-1.94 (m)
15a	1.53 (m)	1.48 (m)	1.52-1.46 (m)
15b		1.34 (m)	1.36-1.33 (m)
16a	1.92 (m)	1.64 (m)	1.65-1.61 (m)
16b	1.54 (m)	1.35 (m)	1.35-1.31 (m)
17a	3.49 (m)	3.04 (ddd, $J = 14.1, 8.2, 6.1$)	3.07-3.03 (m)
17b	2.88 (m)	2.19 (m)	2.20-2.17 (m)
18a	2.89 (dd, $J = 9.3, 1.8$)	2.84 (dd, $J = 9.2, 1.9$)	2.85 (dd, $J = 9.3, 2.0$)
18b	1.76 (dd, $J = 9.3, 1.8$)	1.71 (dd, $J = 9.2, 2.9$)	1.75-1.73 (m)
19a	3.02 (td, $J = 12.7, 4.9$)	2.97 (td, $J = 12.6, 5.2$)	3.00 (dt, $J = 12.7, 5.1$)

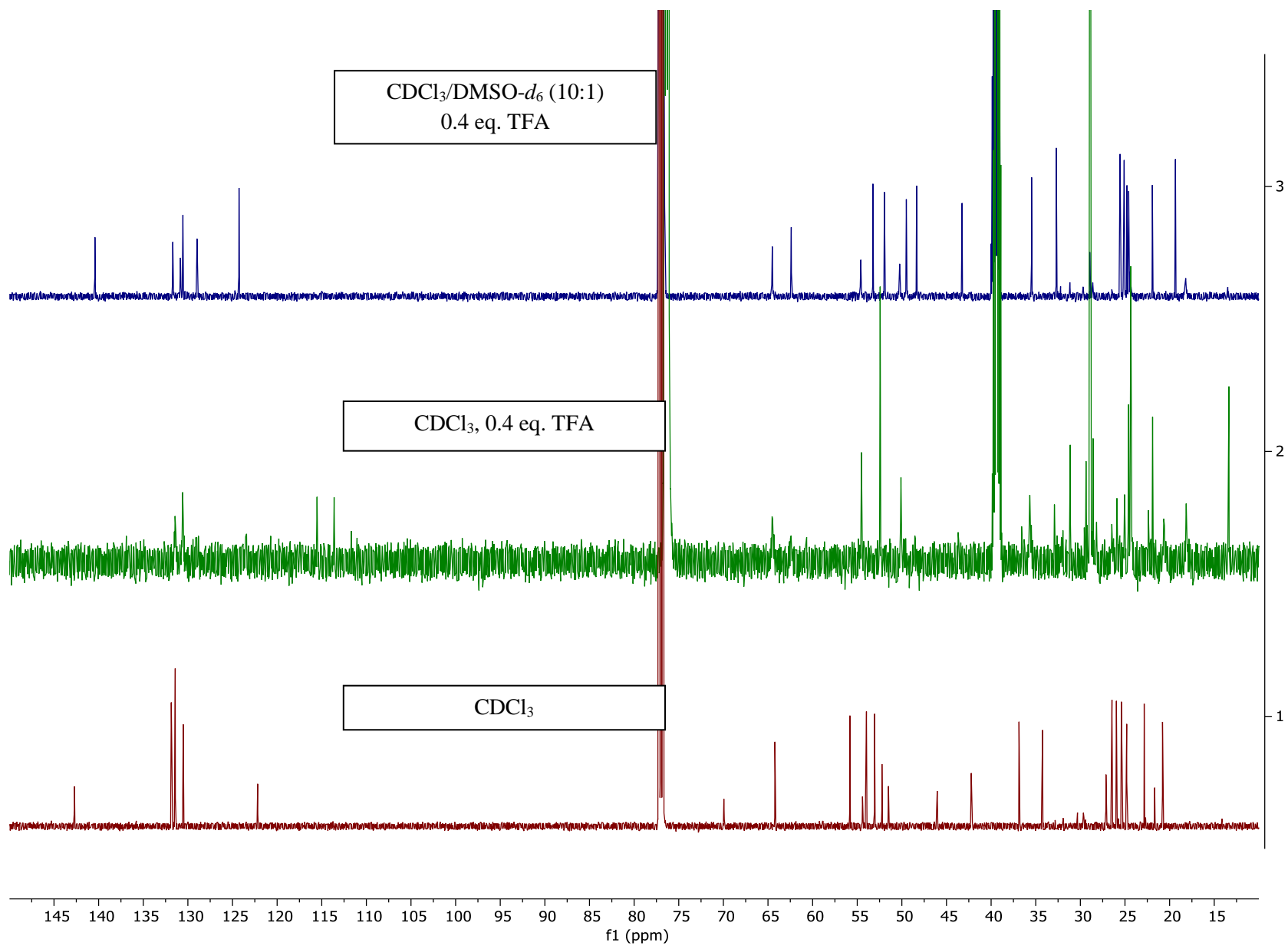
19b	2.24 (m)	2.21 (m)	2.22-2.18 (m)
20a	1.53 (m)	1.48 (m)	1.54-1.46 (m)
20b	1.31 (m)	1.27 (m)	1.28-1.23 (m)
21a	1.62 (m)	1.58 (m)	1.61-1.55 (m)
21b	1.48 (m)	1.50 (m)	1.53-1.51 (m)
22a	2.41 (m)	2.41 (m)	2.43-2.38 (m)
22b	1.62 (m)	1.54 (m)	1.56-1.51 (m)
23	5.70 (dt, $J = 10.3, 5.3$)	5.63 (m)	5.69-5.63 (m)
24	5.65 (dt, $J = 10.3, 5.3$)	5.63 (m)	5.69-5.63 (m)
25a	2.40 (m)	2.34 (m)	2.35-2.34 (m)
25b	1.82 (m)	1.73 (m)	1.74-1.72 (m)
26a	1.93 (m)	1.82 (m)	1.83-1.79 (m)
26b	1.71 (m)	1.71 (m)	1.73-1.70 (m)

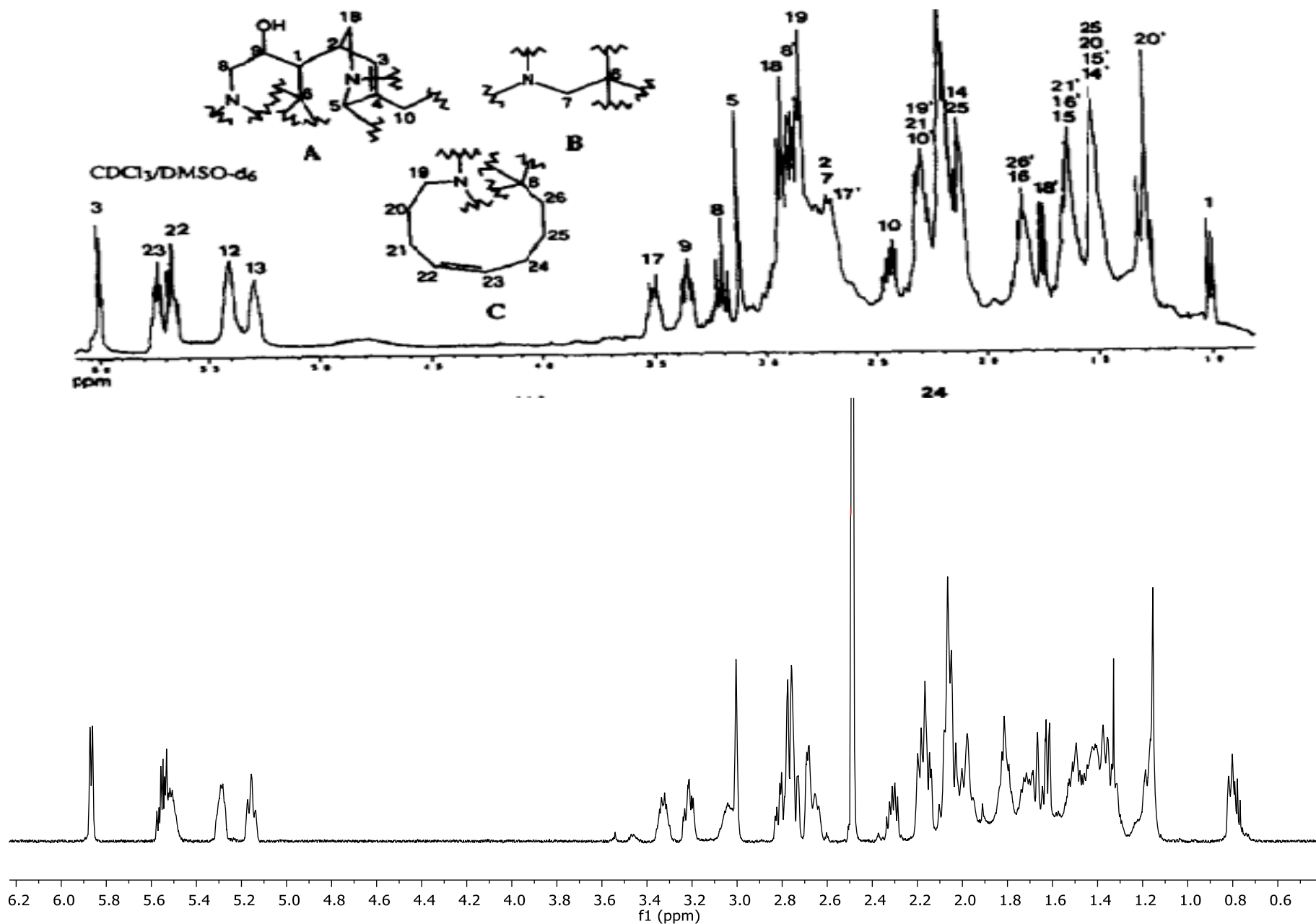
Table S4. Comparison of ^{13}C NMR data of (–)-Ingenamine ($[\text{D}_4\text{-MeOH}]$; Numbering Scheme as shown in the Insert

Position	Protonated (+)-Ingenamine ^[7]	Acid-Free (+)-Ingenamine ^[6]	Synthetic (–)-Ingenamine
	δ (ppm)	δ (ppm)	δ (ppm)
1	51.6	53.1	53.1
2	34.8	35.2	35.3
3	125.8	124.0	123.9
4	143.0	143.8	143.8
5	63.8	65.2	65.2
6	45.2	46.9	46.9
7	50.8	51.5	51.4
8	52.5	54.7	54.3
9	66.1	69.3	69.3
10	37.2	37.9	37.9
11	26.3	26.5	27.1
12	133.7	133.1	133.2
13	132.6	132.6	132.4
14	26.26	26.0	26.5
15	26.0	25.7	25.9
16	20.2	22.1	22.0
17	56.7	56.9	56.9
18	53.8	54.3	54.6
19	55.1	55.2	55.2
20	26.9	27.1	27.6
21	27.4	27.7	27.7
22	23.8	23.8	23.8
23	133.3	132.4	132.6
24	130.2	131.4	131.4
25	21.2	21.6	21.6
26	41.6	42.9	42.9

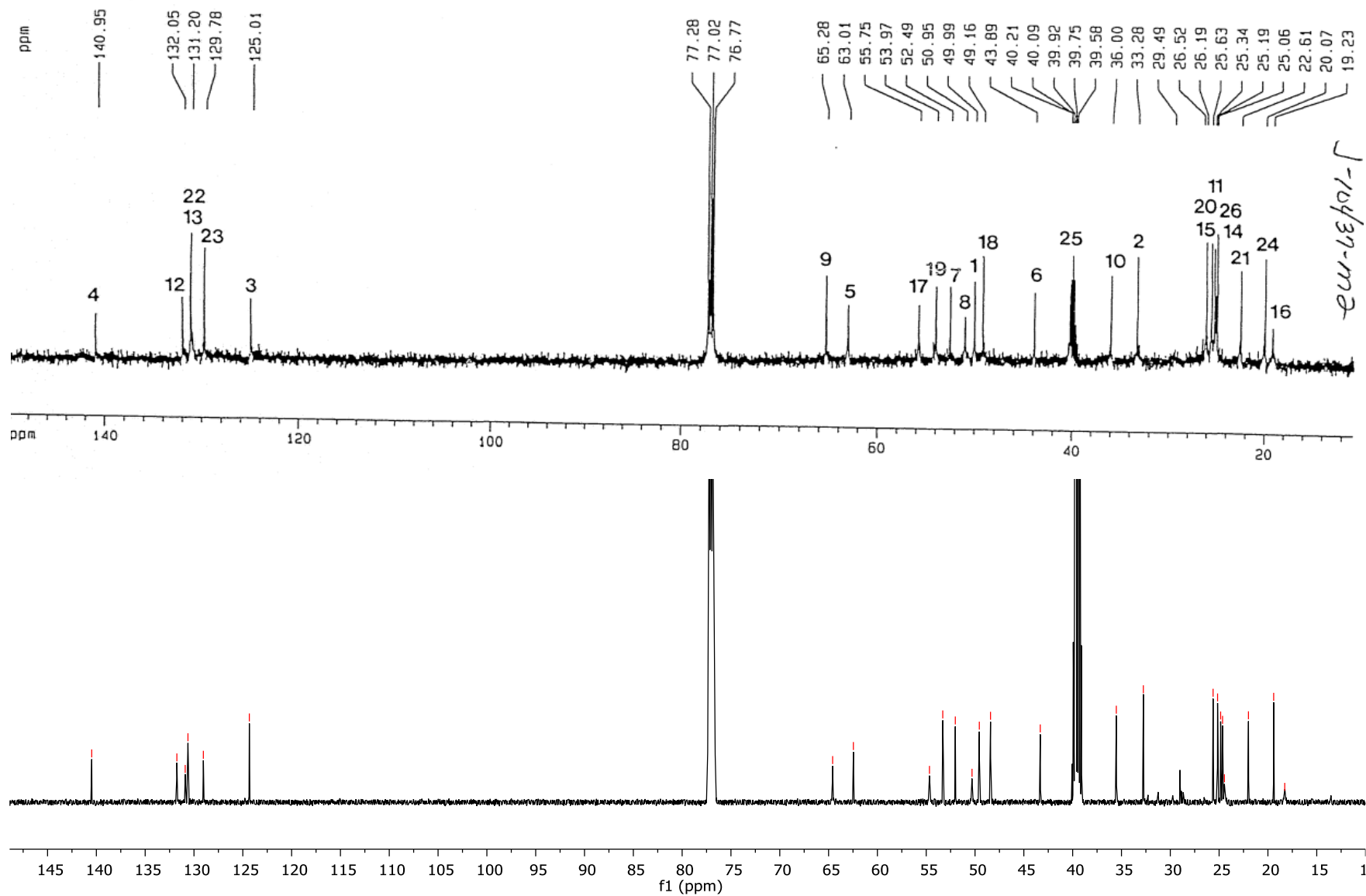
Tritration Experiment of Ingenamine





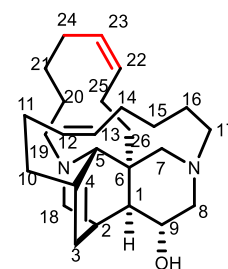


^1H NMR: Top: Xestocyclamine A (ref. 5); bottom: synthetic Ingenamine (*ent*-3) ($\text{CDCl}_3/\text{DMSO}-d_6$, 10:1 + 0.4 eq. TFA)



¹³C NMR: Top : Xestocyclamine A (ref. 5) ; bottom: synthetic Ingenamine (*ent*-3) (CDCl₃/DMSO-d₆, 10:1 + 0.4 eq. TFA)

Table S5. Comparison of ^1H NMR data of Nominal Xestocyclamine A and Protonated (–)-Ingenamine; Numbering Scheme as shown in the Insert



Xestocyclamine A

Position	Xestocyclamine (literature) ^[5]	Protonated (–)-Ingenamine in $\text{CDCl}_3/[\text{D}_6]\text{-DMSO (10:1)}+0.4 \text{ eq. TFA}$
	δ (ppm), J (Hz)	δ (ppm), J (Hz)
1	0.95, (dd, $J = 9.3, 0.8$)	0.85 (d, $J = 10.0$ Hz, 1H)
2	2.80, m	2.70-2.69
3	5.95, (d, $J = 7.0$)	5.88, (d, $J = 6.5$)
4		
5	3.05, s	3.01, s
6		
7a	2.82, m	2.88-2.77, m
7b	2.25, m	2.09-2.04, m
8a	3.10, (d, $J = 11.2$)	3.09-3.03
8b	2.85, m	2.77-2.74
9	3.20, (dd, $J = 8.4, 4.1$)	3.25-3.20, m
10a	2.38, m	2.32 (dt, $J = 14.8, 7.7$ Hz)
10b	2.24, m	2.21-2.18, m
11	2.20, m	2.09-2.06, m
12	5.32, m	5.32-5.28, m
13	5.23, m	5.17 (t, $J = 9.7$ Hz)
14a	2.10, m	2.02-1.96, m
14b	1.53, m	1.45-1.36, m
15a	1.80, m	1.55-1.50, m
15b	1.67, m	1.35-1.32, m
16a	1.80, m	1.76-1.71, m
16b	1.65, m	1.47-1.36, m
17a	3.42, m	3.37-3.31, m
17b	2.65, m	2.69-2.65, m
18a	2.87, m	2.80-2.77, m
18b	1.67, (d, $J = 9.5$)	1.63 (dd, $J = 9.3, 2.3$ Hz, 1H)
19a	2.75, m	2.83-2.77, m
19b	2.12, m	2.19-2.15, m

20a	1.50, m	1.41-1.39, m
20b	1.28, m	1.20-1.17, m
21a	1.79, m	1.54-1.53, m
21b	1.53, m	1.35-1.34, m
22	5.55 (dt, $J = 11.0, 5.0$)	5.56 (dt, $J = 9.9, 5.4$)
23	5.57, m	5.53-5.50, m
24a	2.20, m	2.11-2.06, m
24b		1.83-1.79, m
25a	2.10, m	2.19-2.20, m
25b	1.53, m	1.52-1.49, m
26a	2.17, m	1.85-1.79, m
26b	1.80, m	1.70-1.63, m

Table S6. Comparison of ^{13}C NMR Data of Nominal Xestocyclamine A and Protonated (–)-Ingenamine in $\text{CDCl}_3/\text{DMSO-}d_6$ (10:1) Shows a Systematic Drift ($\Delta\delta \approx 0.5$ ppm); Numbering Scheme as shown in the Insert

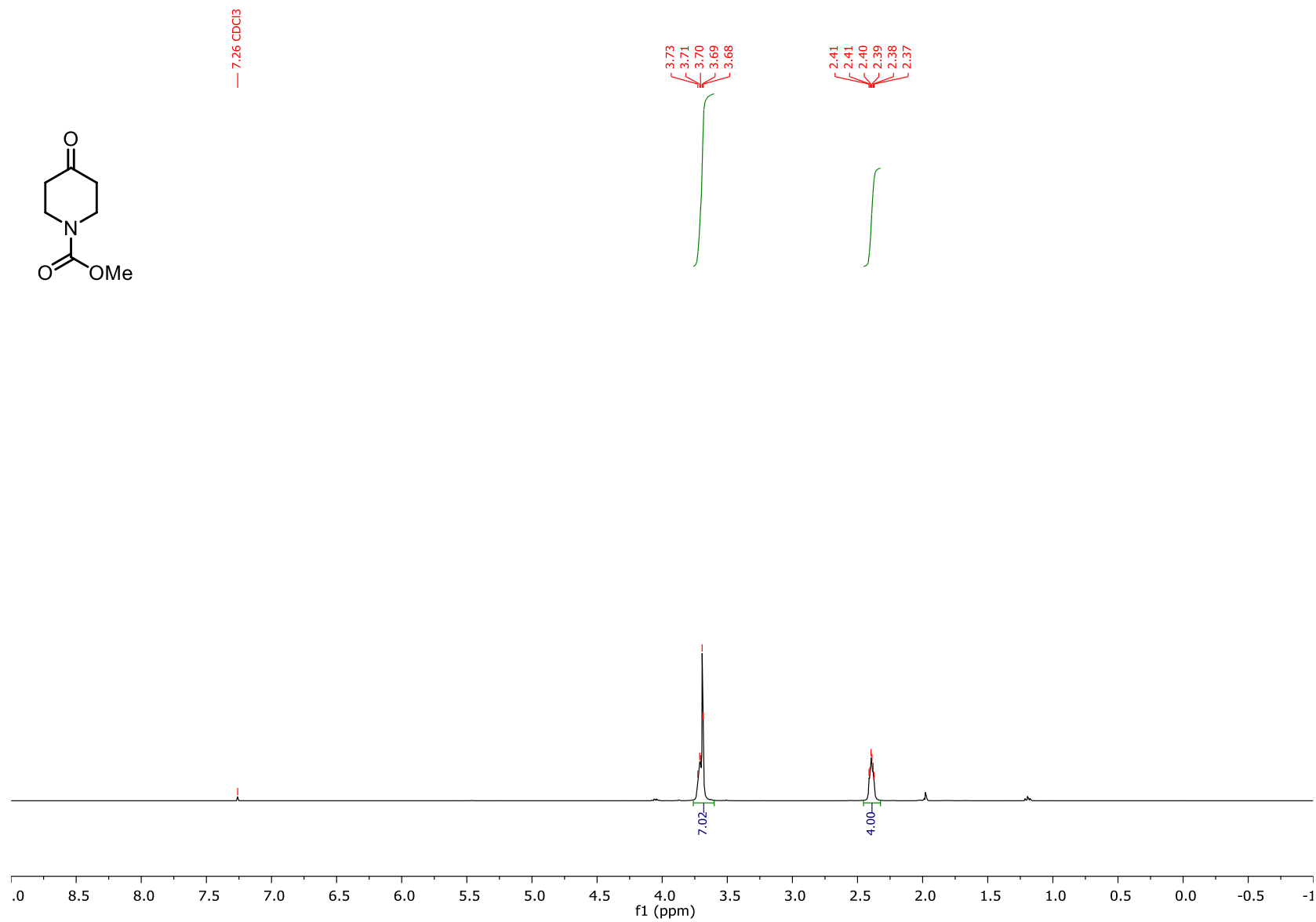
Position	Xestocyclamine (literature) ^[4] in $\text{CDCl}_3/\text{DMSO-}d_6$	Protonated (–)-Ingenamine in $\text{CDCl}_3/\text{DMSO-}d_6$ (10:1) + 0.4 eq. TFA	$\Delta\delta$
	δ (ppm)	δ (ppm)	(ppm)
1	50.0	49.6	0.4
2	33.3	32.8	0.5
3	125.0	124.3	0.7
4	141.0	140.5	0.5
5	63.1	62.5	0.6
6	43.9	43.3	0.6
7	49.2	48.4	0.8
8	51.0	50.3	0.7
9	65.6	64.6	1.0
10	36.0	35.5	0.5
11	25.6	24.8	0.8
12	132.2	131.7	0.5
13	131.2	130.6	0.6
14	25.2	24.4	0.8
15	26.5	25.6	0.6
16	19.4	18.3	1.1
17	55.8	54.7	1.1
18	52.5	52.0	0.5
19	54.0	53.3	0.7
20	26.2	25.2	1.0
21	22.8	22.0	0.8
22	131.2	130.9	0.3
23	129.8	129.0	0.8
24	20.2	19.4	0.8
25	25.3	24.7	0.6
26	40.3	39.8	0.5

Table S7. Comparison of ^{13}C NMR data of Nominal Xestocyclamine A and Protonated (–)-Ingenamine (in pure CDCl_3); Numbering Scheme as shown in the Insert

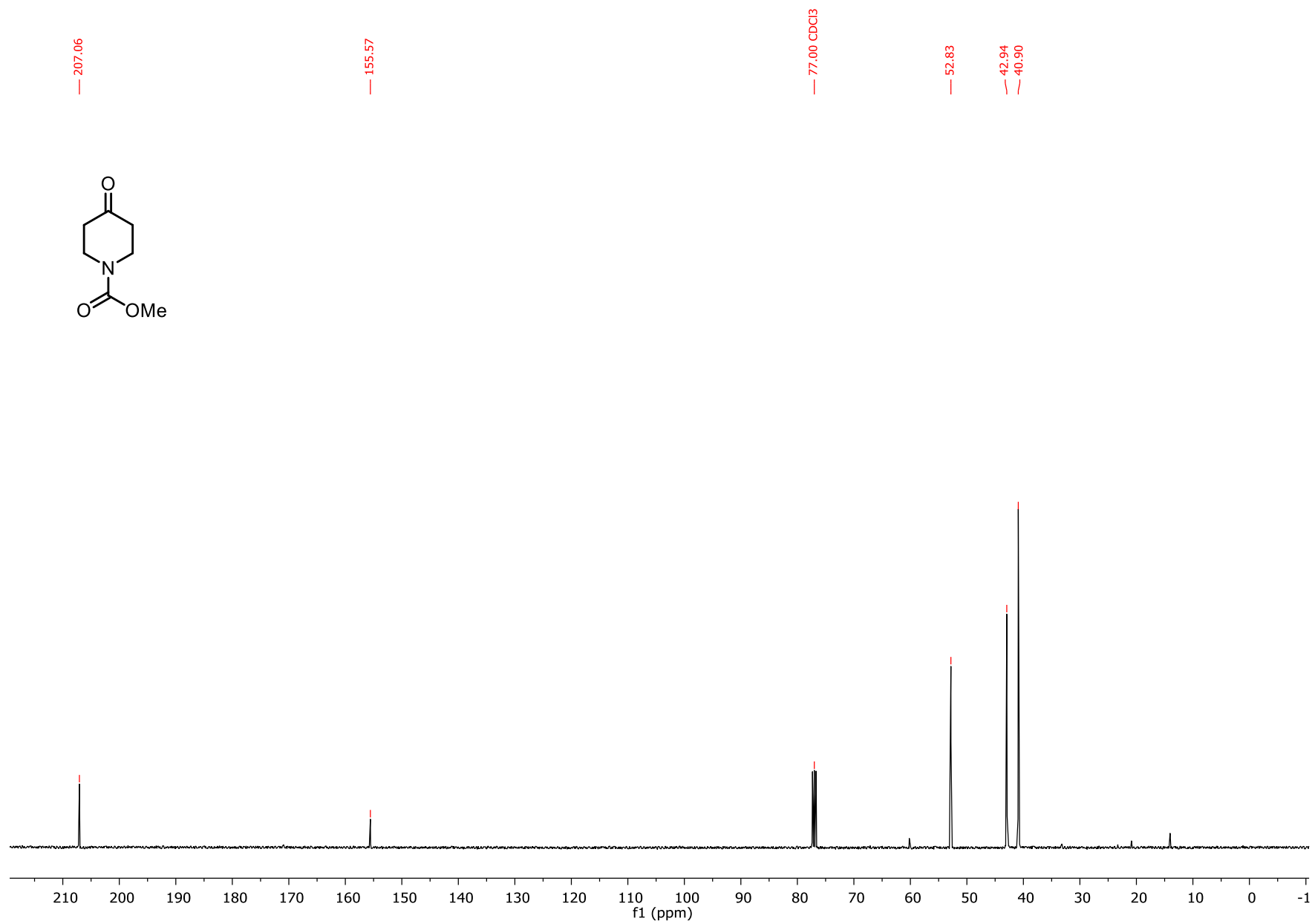
Position	Xestocyclamine (literature) ^[4] in $\text{CDCl}_3/\text{DMSO}-d_6$	Protonated (–)-Ingenamine in $\text{CDCl}_3 + 0.4 \text{ eq. TFA}$	$\Delta\delta$
	δ (ppm)	δ (ppm)	(ppm)
1	50.0	50.3	–0.3
2	33.3	33.3	0
3	125.0	125.3	–0.3
4	141.0	141.0	0
5	63.1	63.0	0.1
6	43.9	44.1	–0.2
7	49.2	49.3	–0.1
8	51.0	51.1	–0.1
9	65.6	65.8	–0.2
10	36.0	36.1	–0.1
11	25.6	25.7	–0.1
12	132.2	132.2	0
13	131.2	131.6	–0.4
14	25.2	25.2	0
15	26.5	26.3	0.2
16	19.4	19.2	0.2
17	55.8	55.6	0.2
18	52.5	52.5	0
19	54.0	54.0	0
20	26.2	26.3	–0.1
21	22.8	22.6	–0.2
22	131.2	131.4	–0.2
23	129.8	129.5	0.3
24	20.2	20.0	0.2
25	25.3	25.4	–0.1
26	40.3	40.2	0.1

NMR SPECTRA OF NEW COMPOUNDS

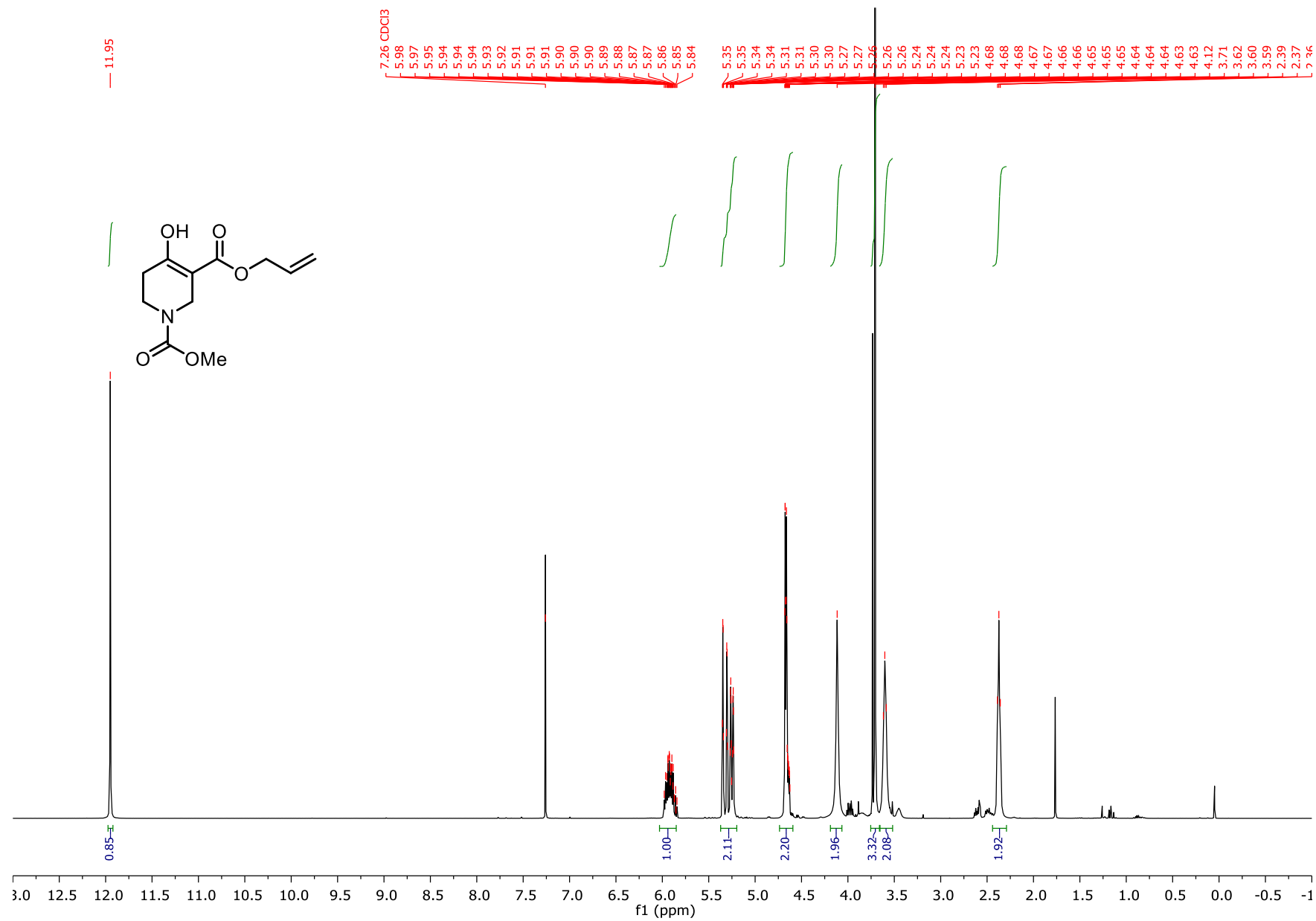
^1H NMR Spectrum of S1 (400 MHz, CDCl_3)



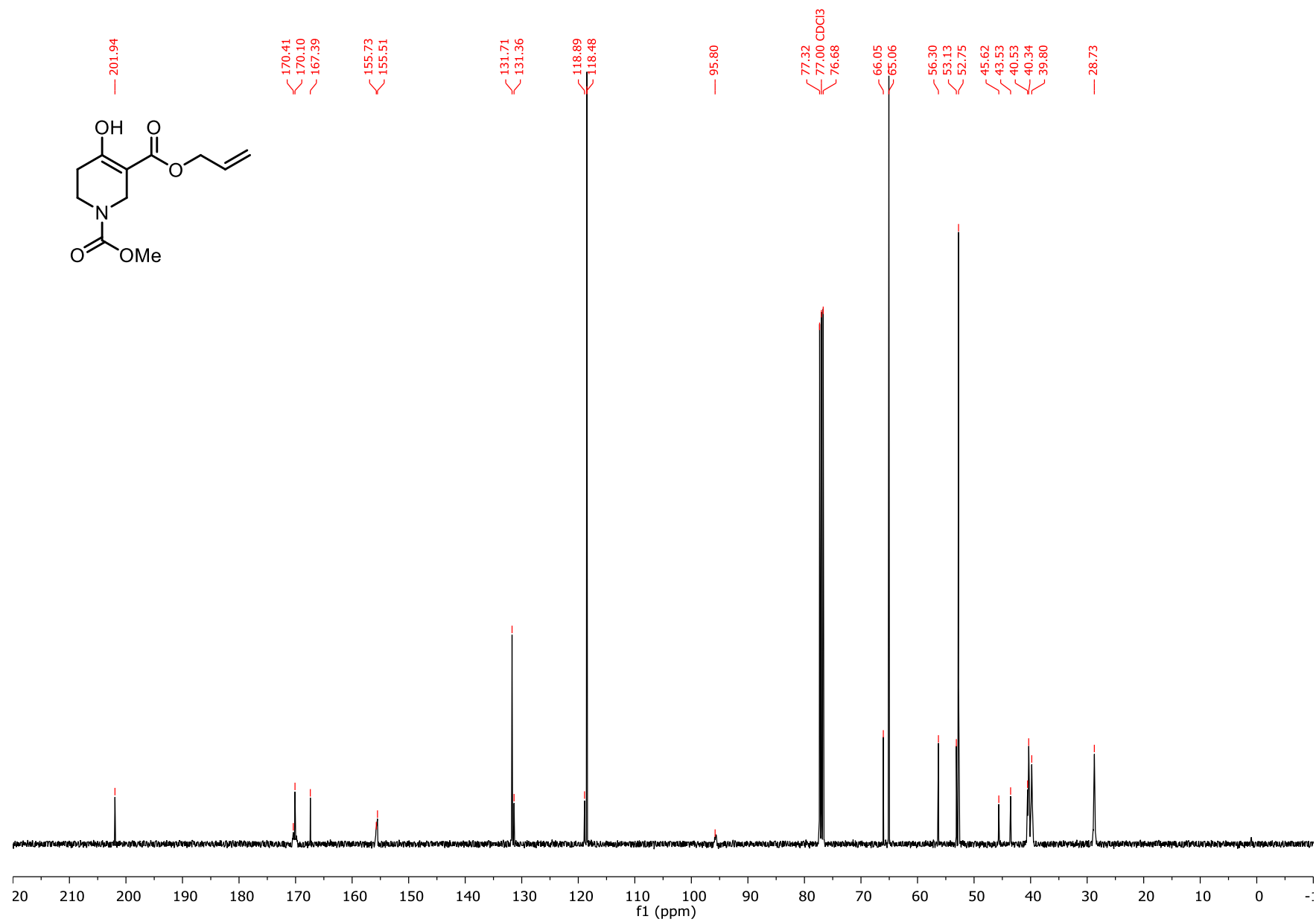
^{13}C NMR Spectrum of S1 (101 MHz, CDCl_3)



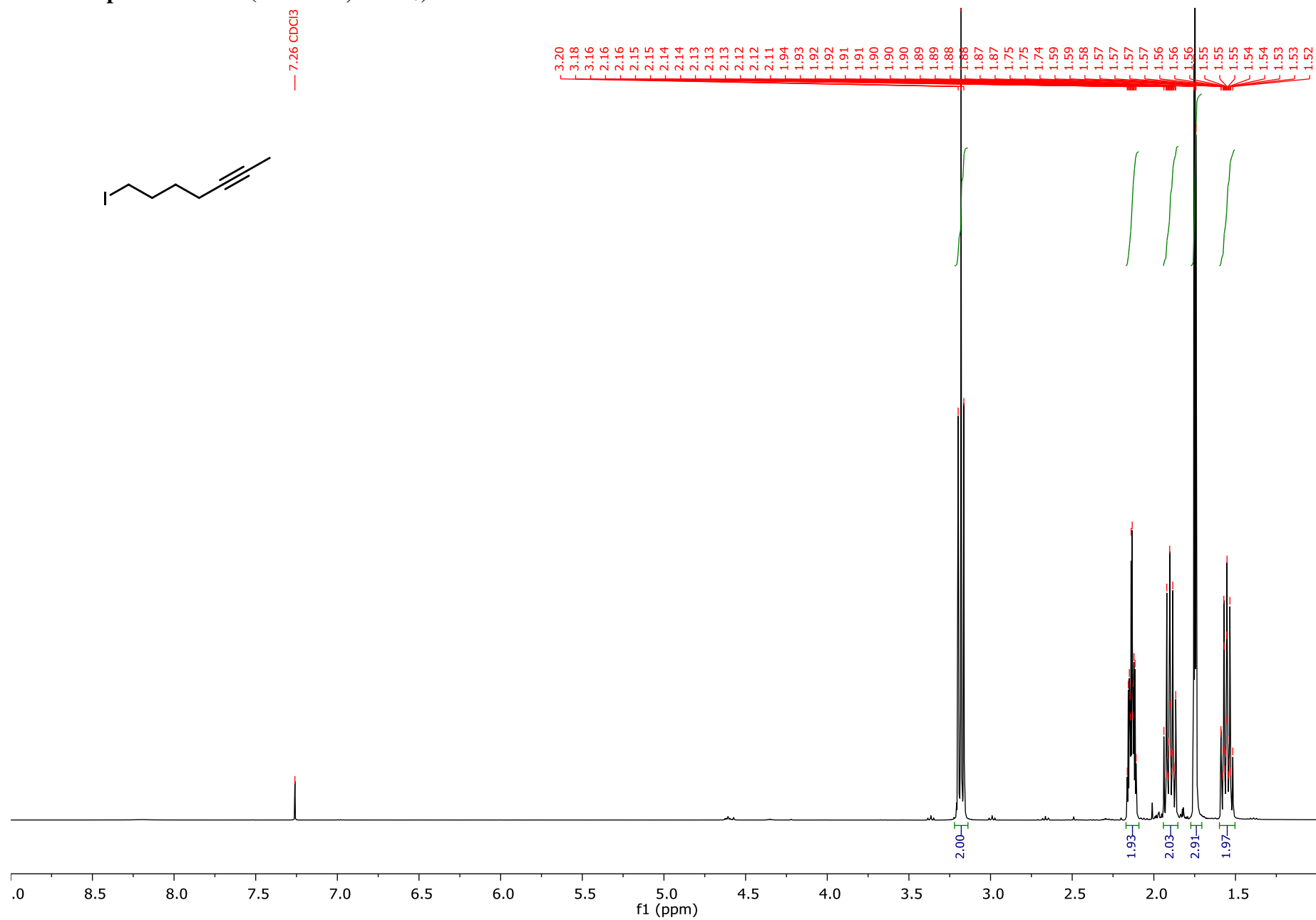
¹H NMR Spectrum of S2 (400 MHz, CDCl₃)



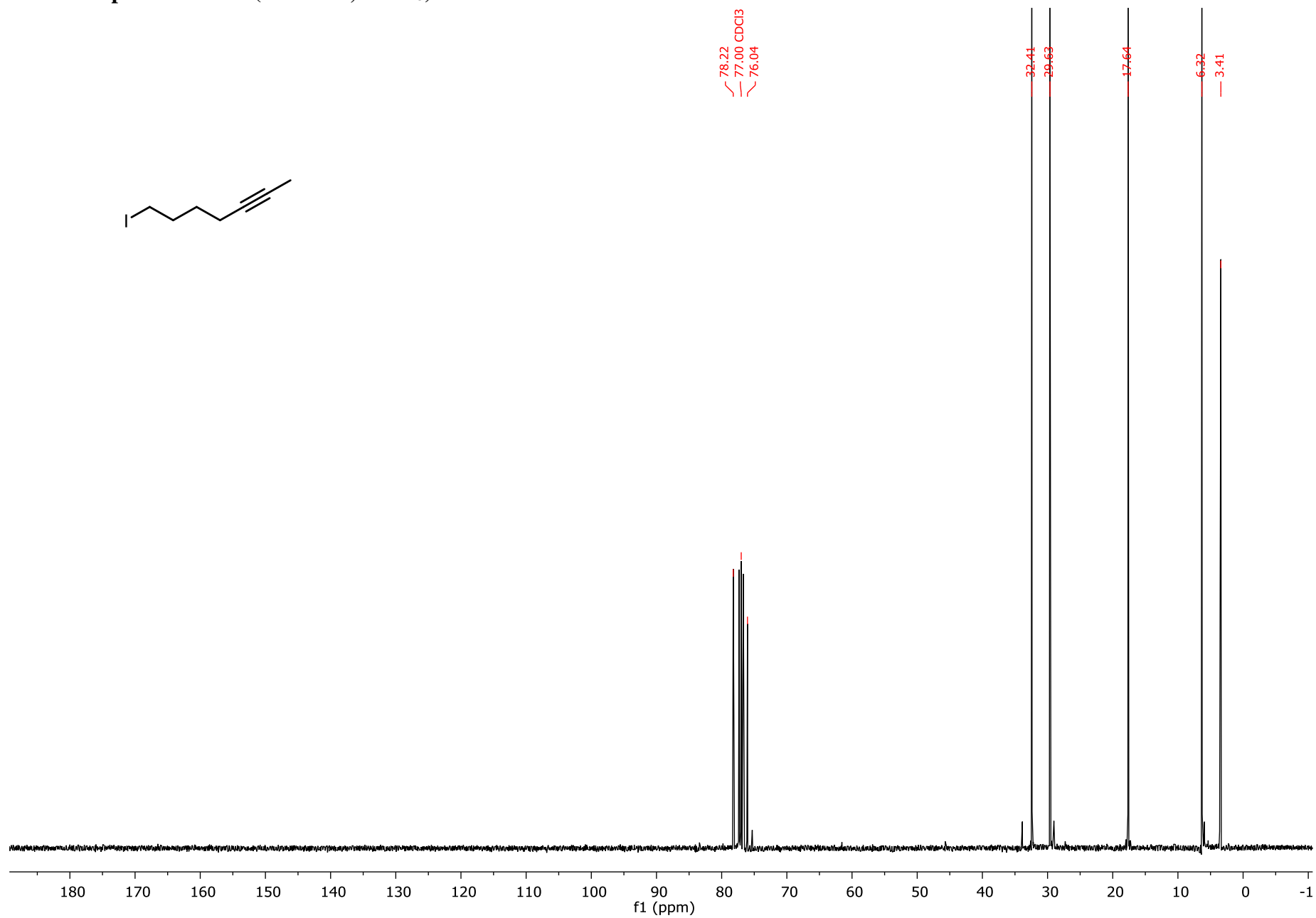
^{13}C NMR Spectrum of S2 (101 MHz, CDCl_3)



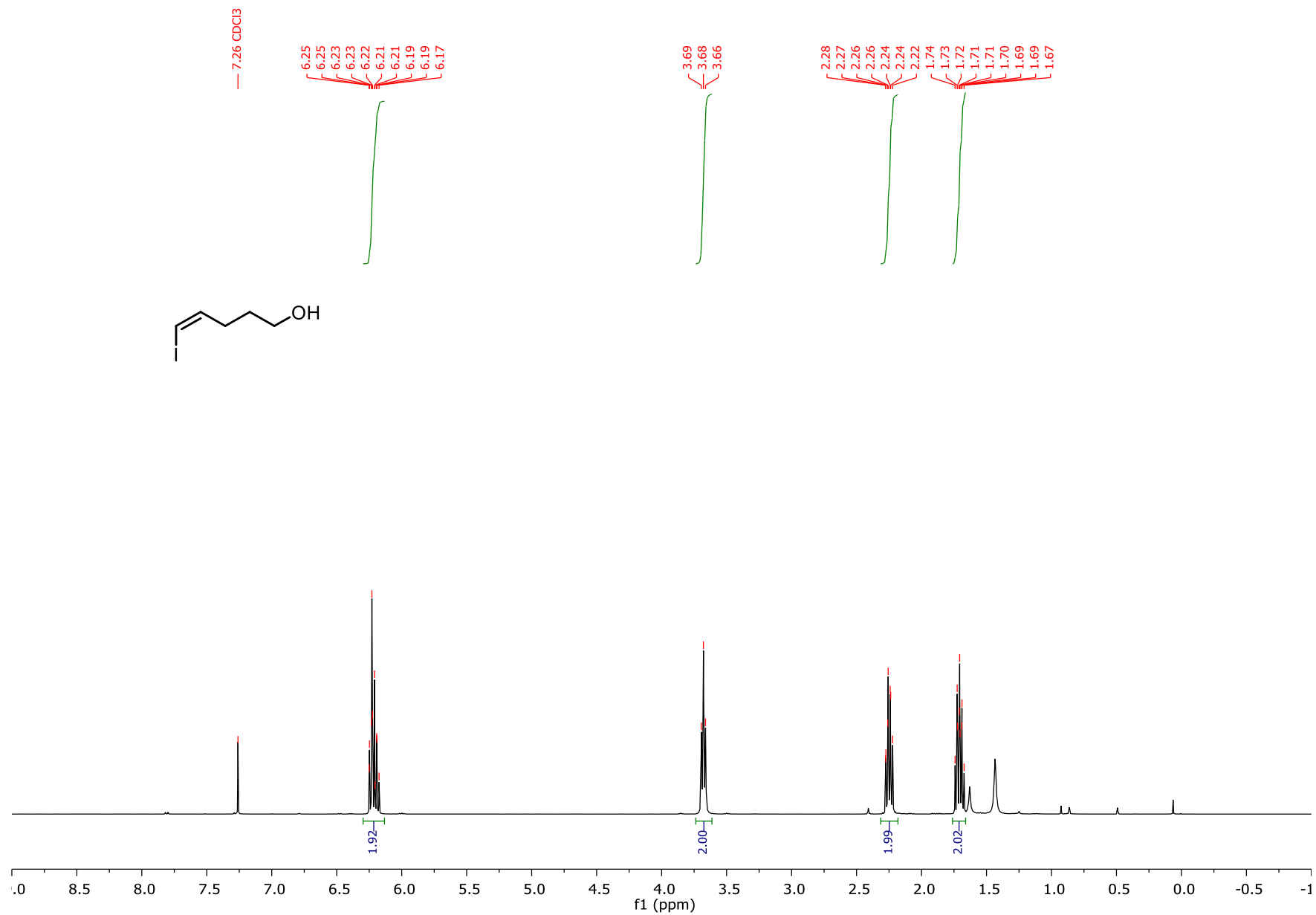
¹H NMR Spectrum of S3 (400 MHz, CDCl₃)



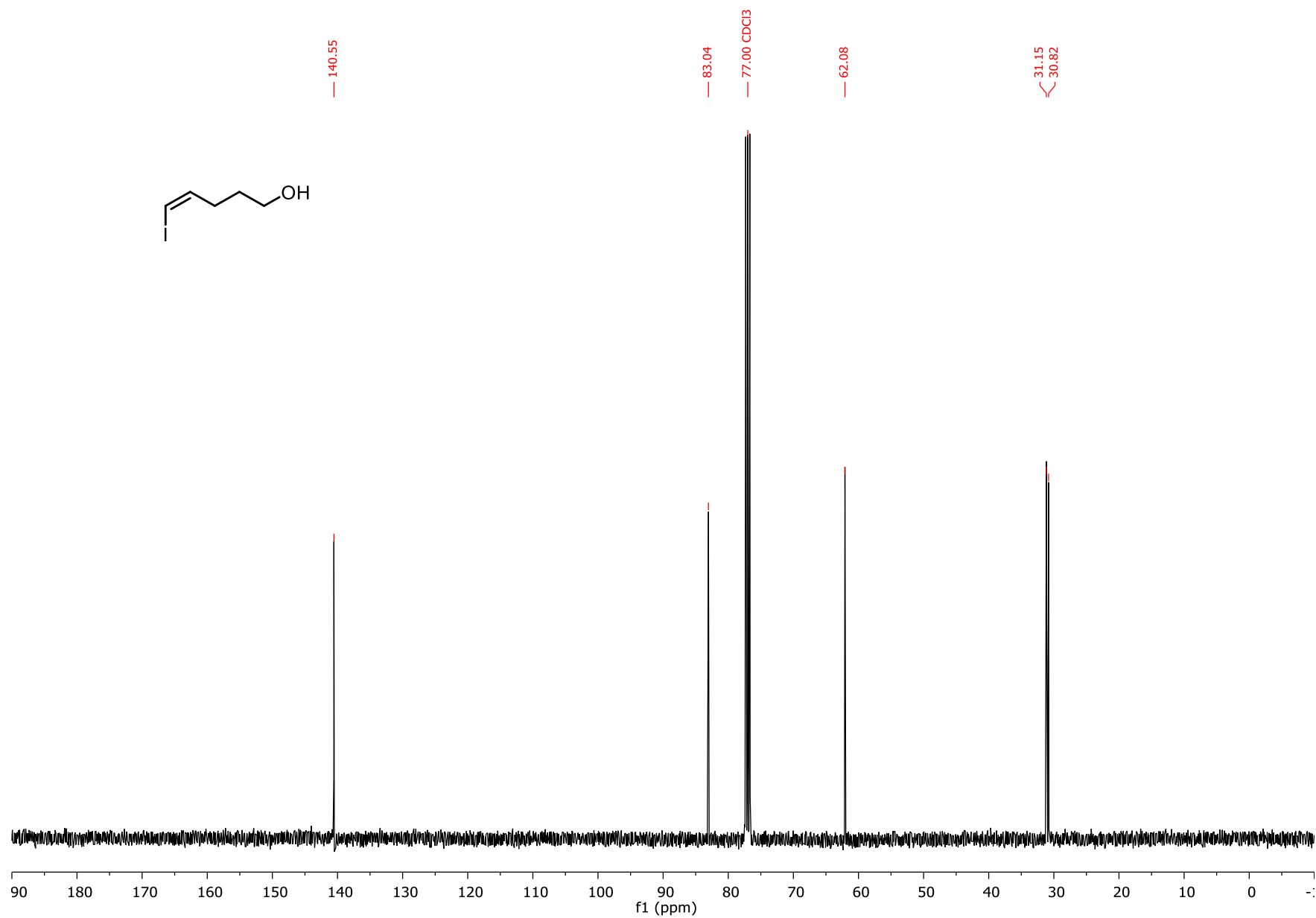
^{13}C NMR Spectrum of S3 (101 MHz, CDCl_3)



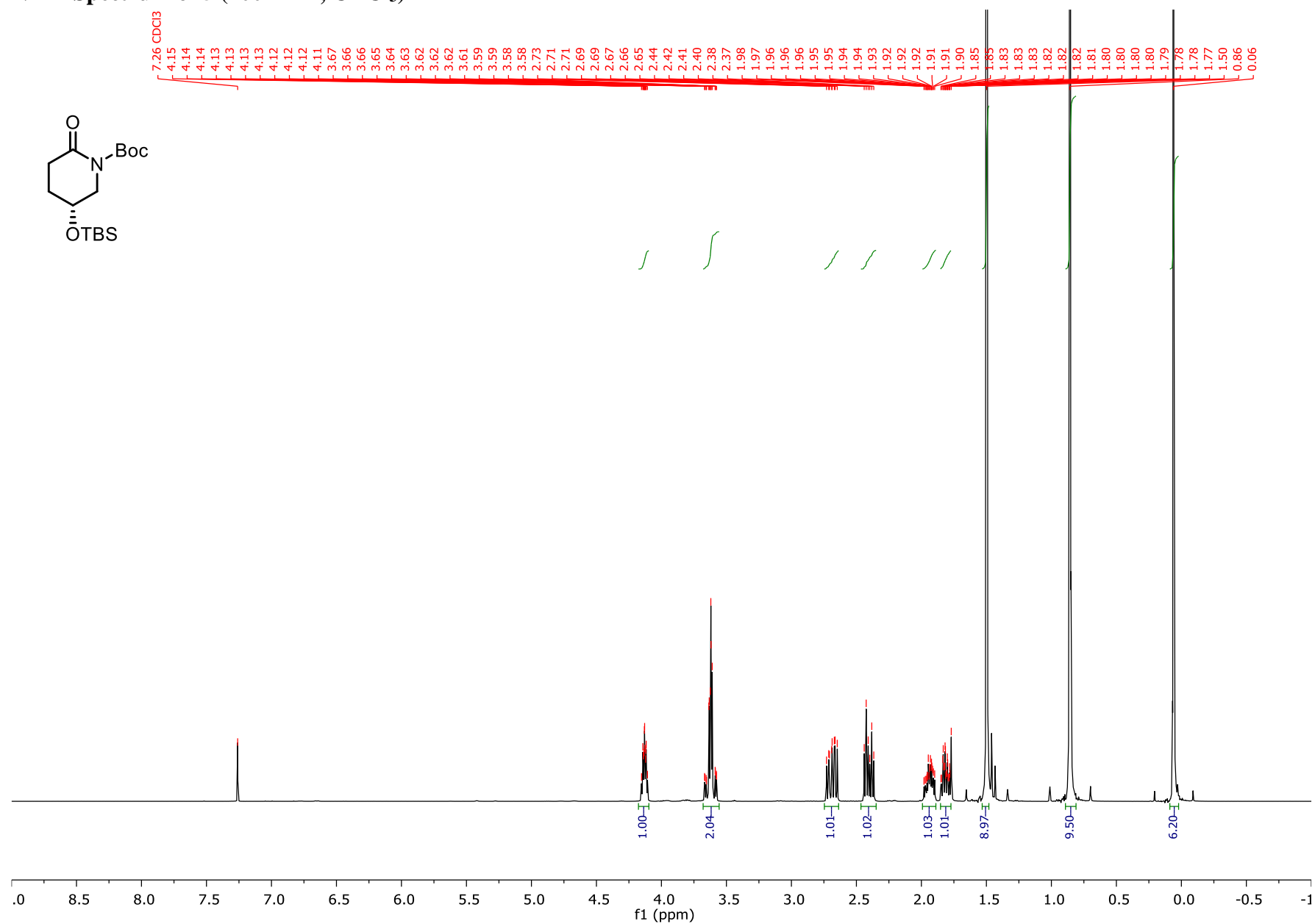
^1H NMR Spectrum of S4 (400 MHz, CDCl_3)



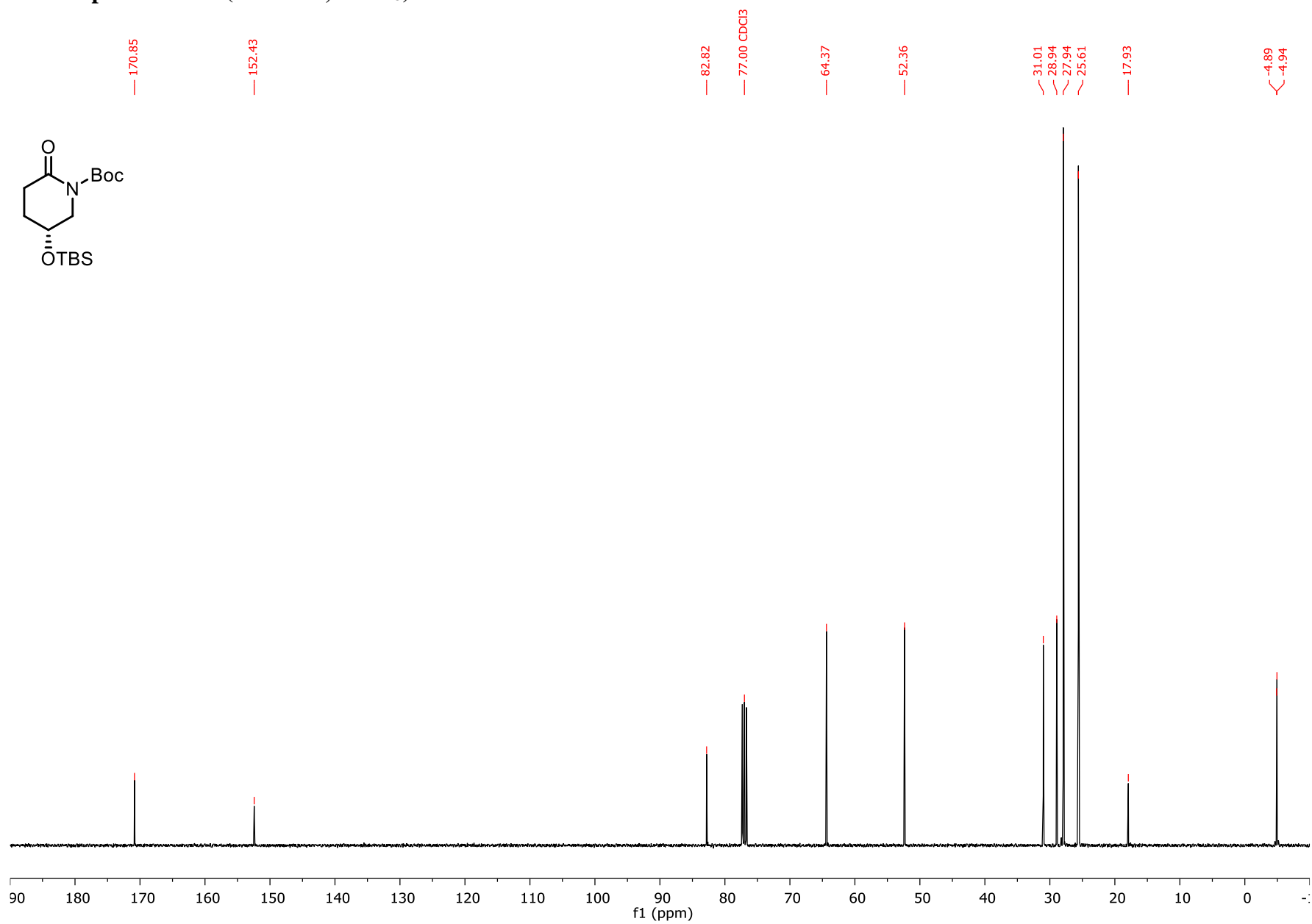
^{13}C NMR Spectrum of S4 (101 MHz, CDCl_3)



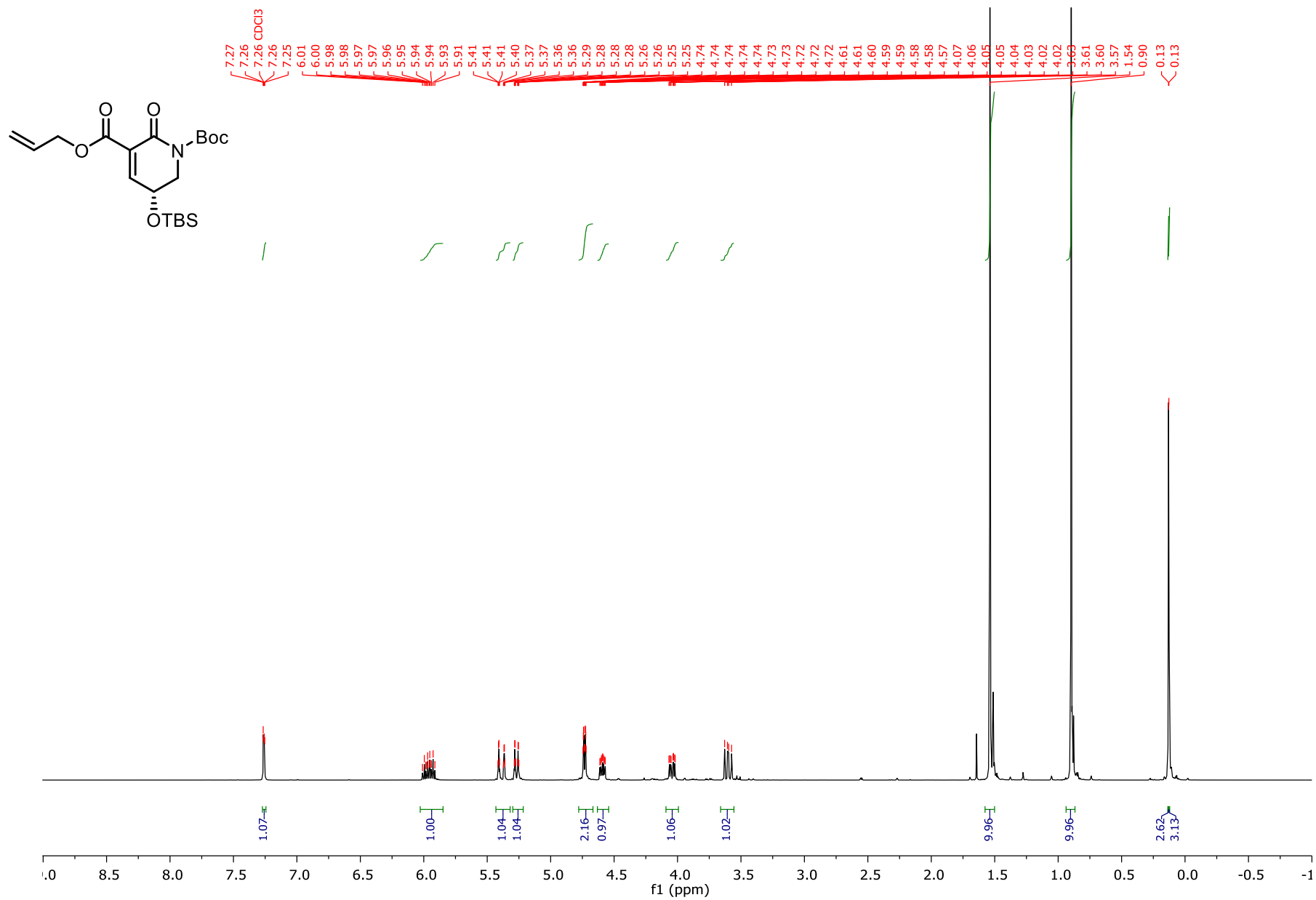
¹H NMR Spectrum of 5 (400 MHz, CDCl₃)



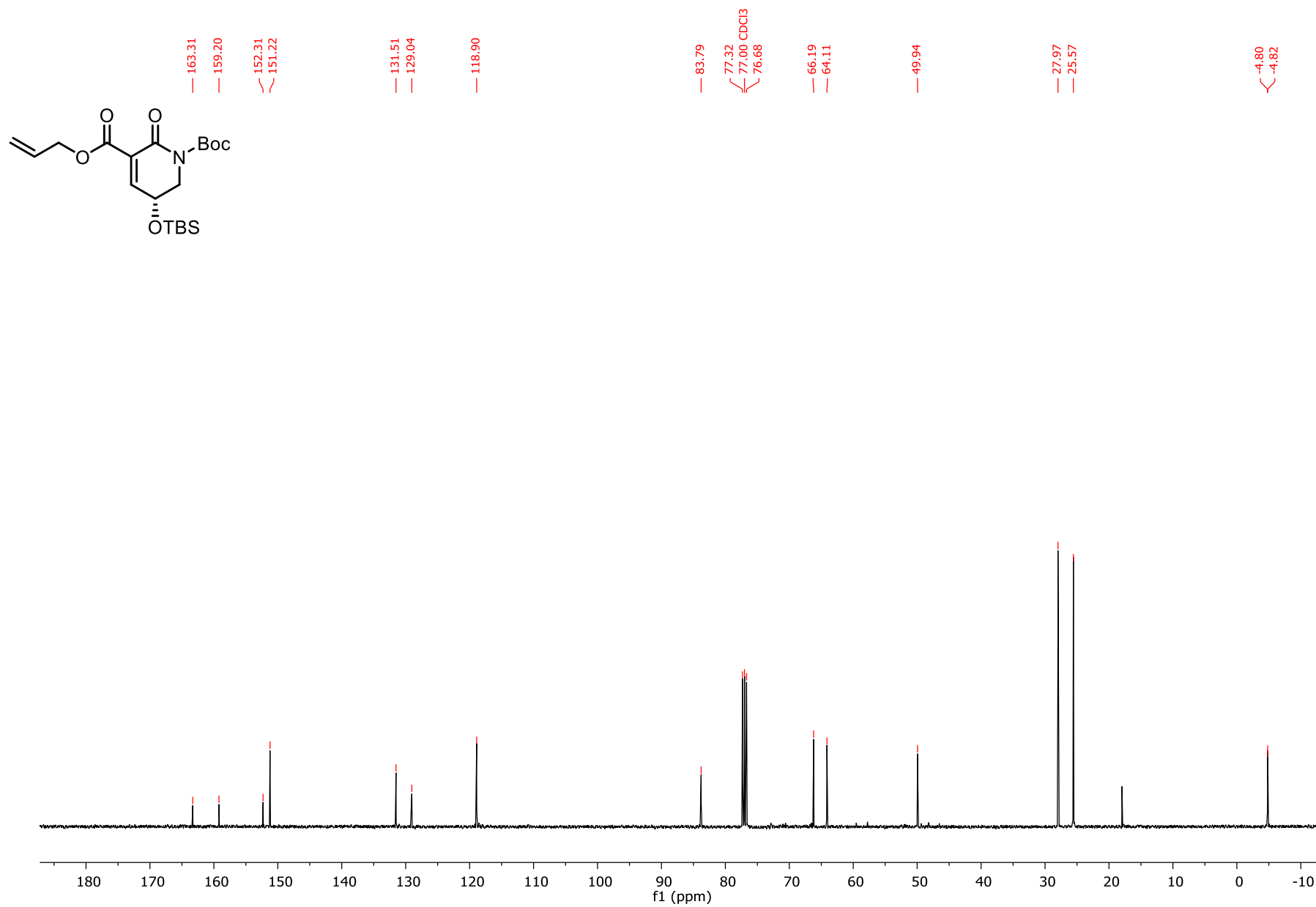
¹³C NMR Spectrum of 5 (101 MHz, CDCl₃)



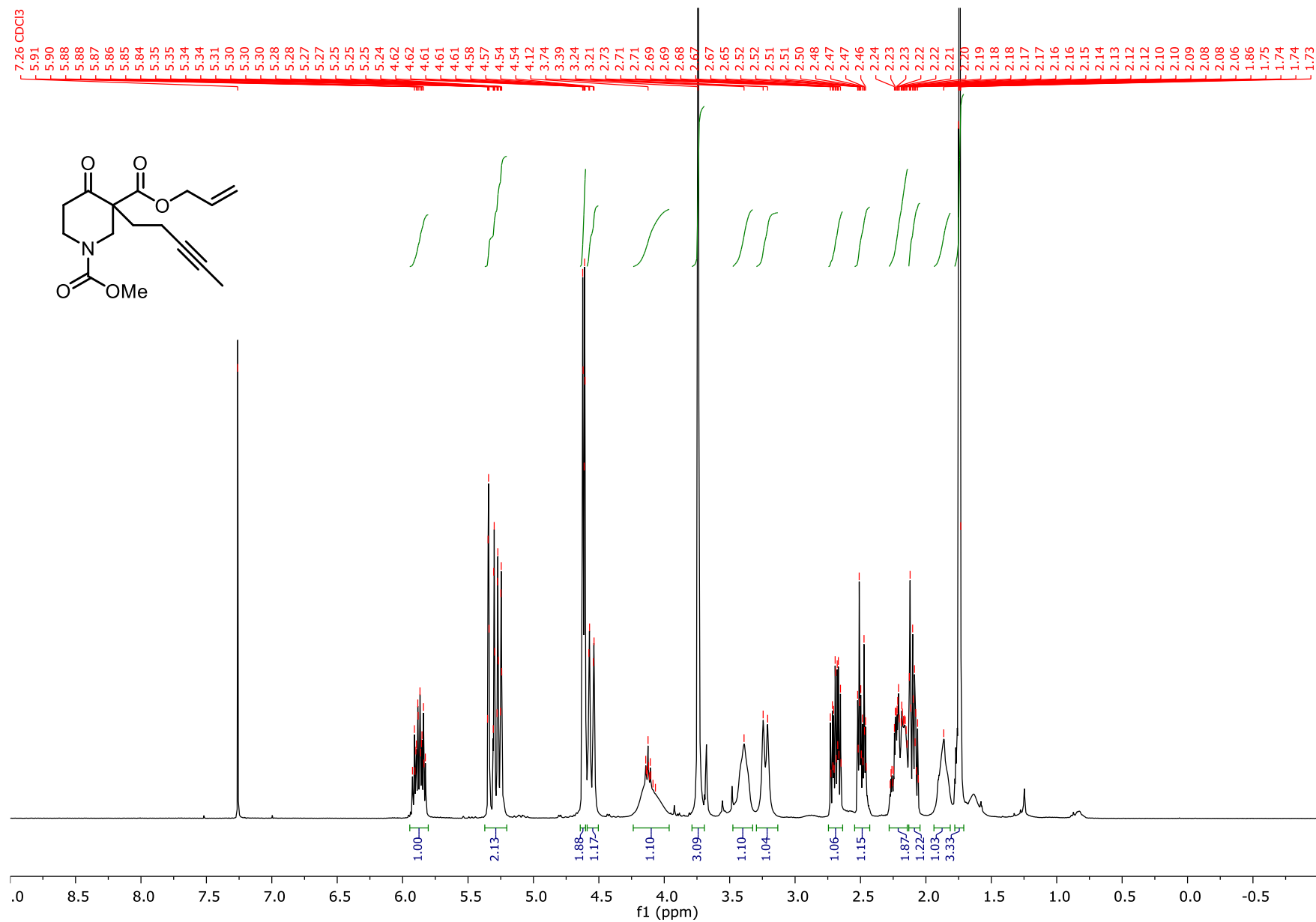
^1H NMR Spectrum of 6 (400 MHz, CDCl_3)



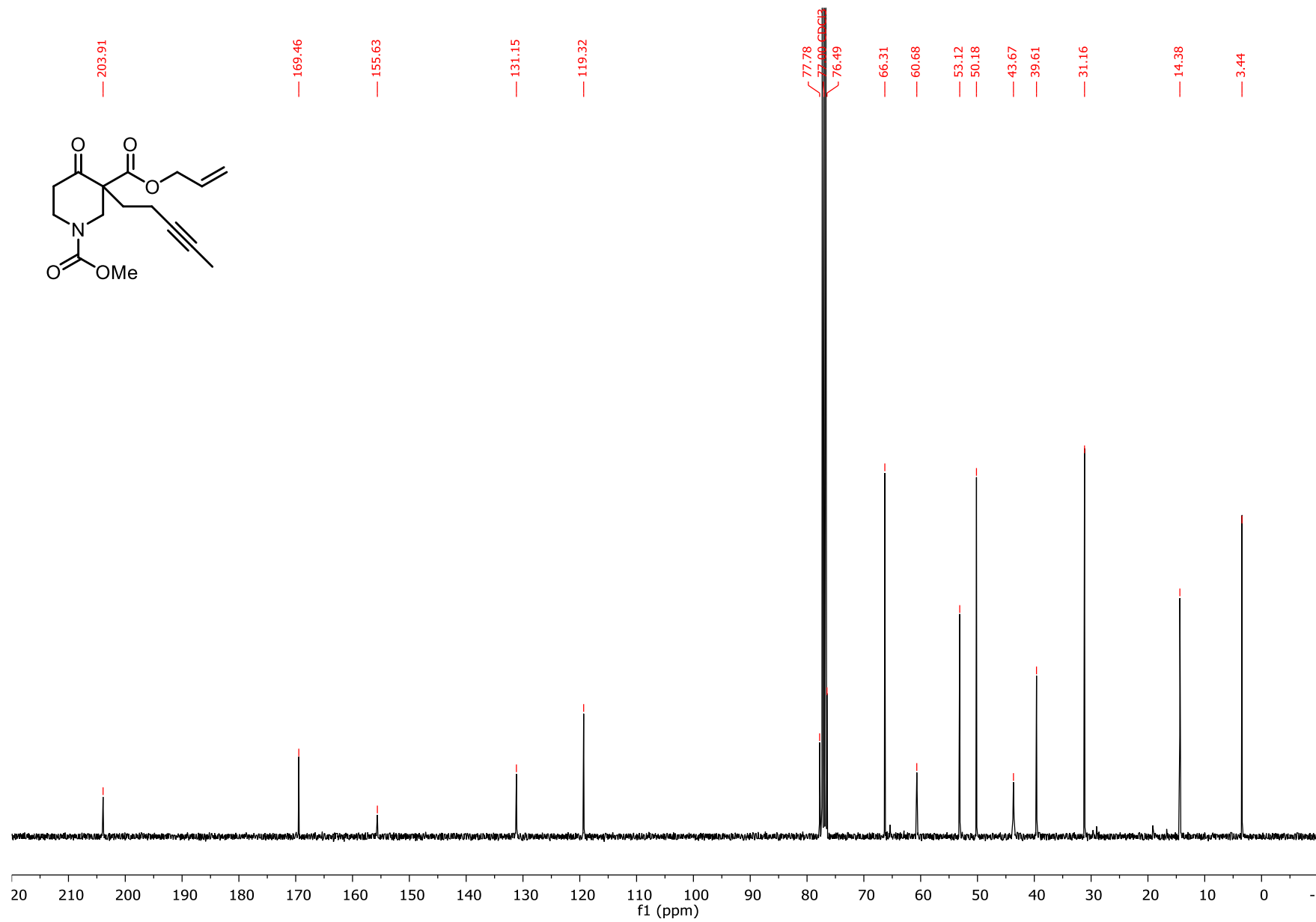
^{13}C NMR Spectrum of 6 (101 MHz, CDCl_3)



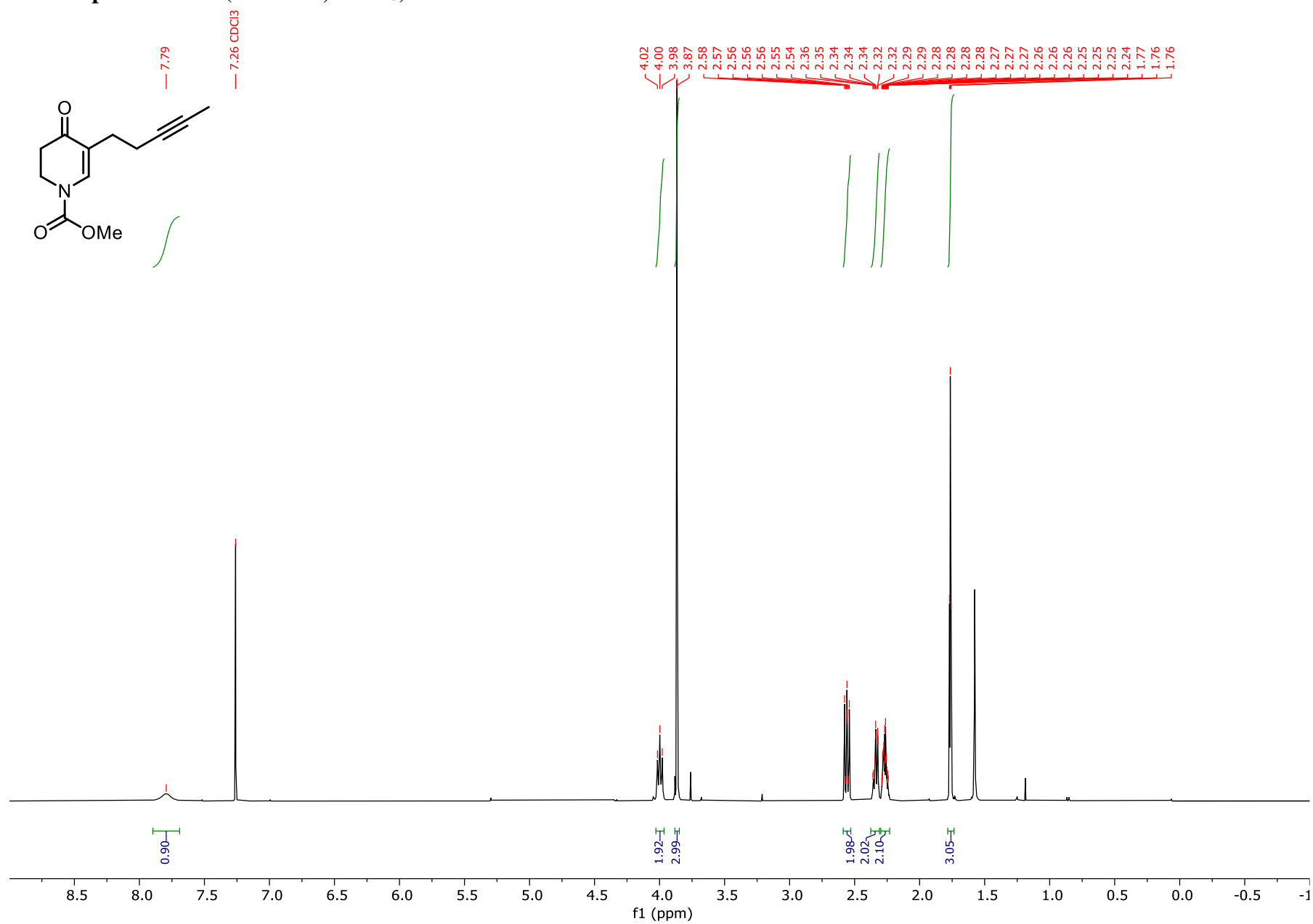
^1H NMR Spectrum of 8 (400 MHz, CDCl_3)



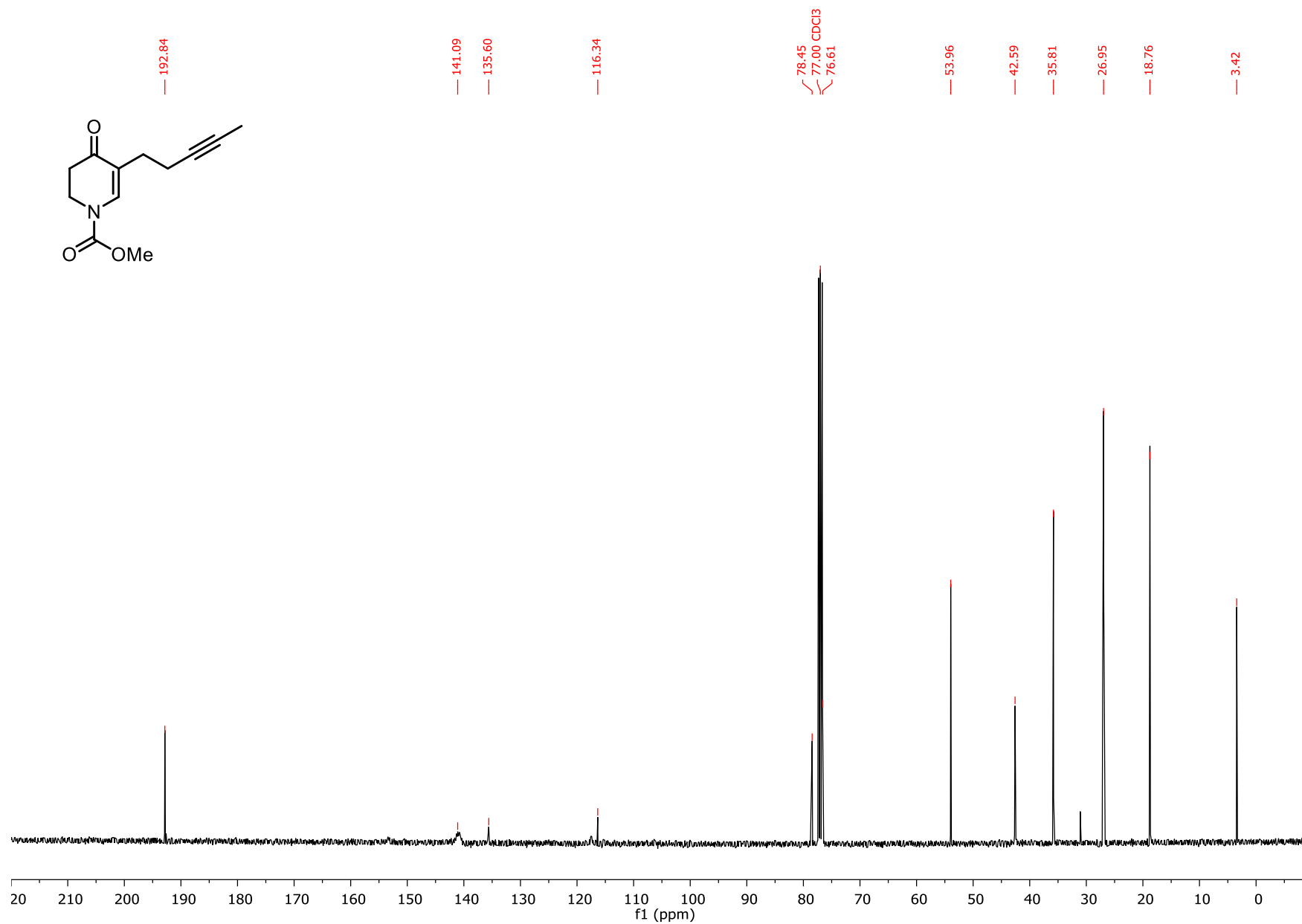
^{13}C NMR Spectrum of 8 (101 MHz, CDCl_3)



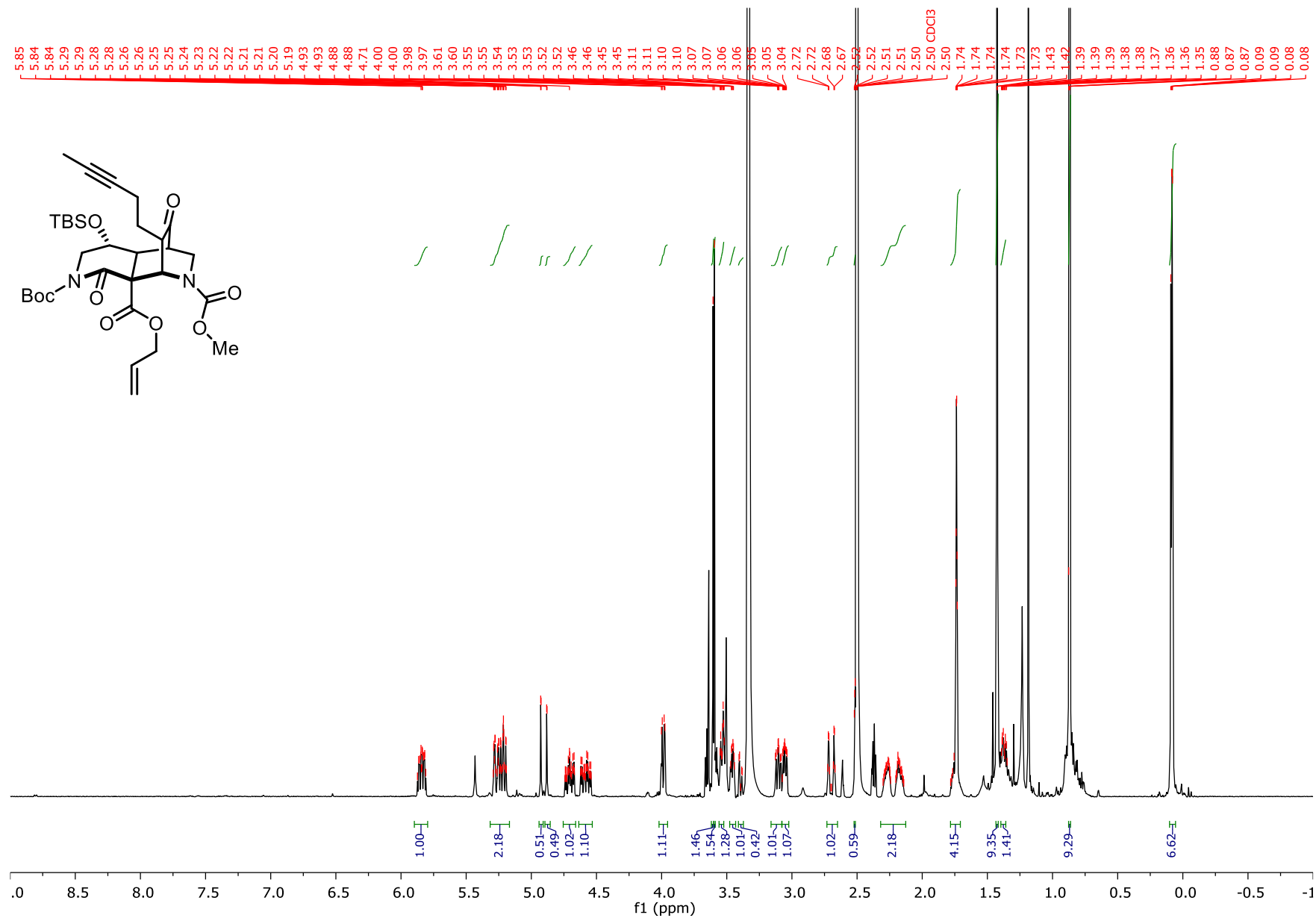
¹H NMR Spectrum of 9 (400 MHz, CDCl₃)



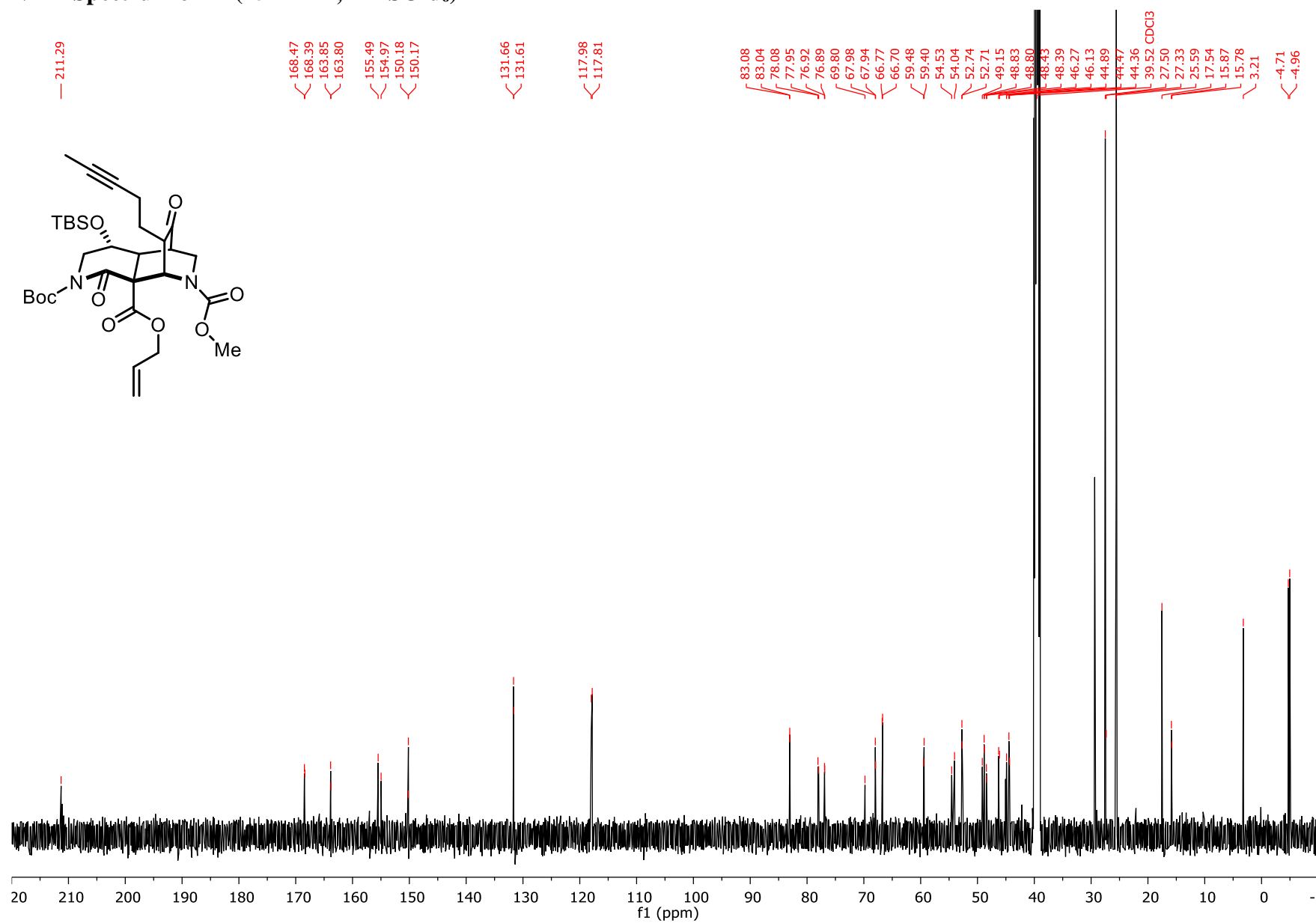
^{13}C NMR Spectrum of 9 (101 MHz, CDCl_3)



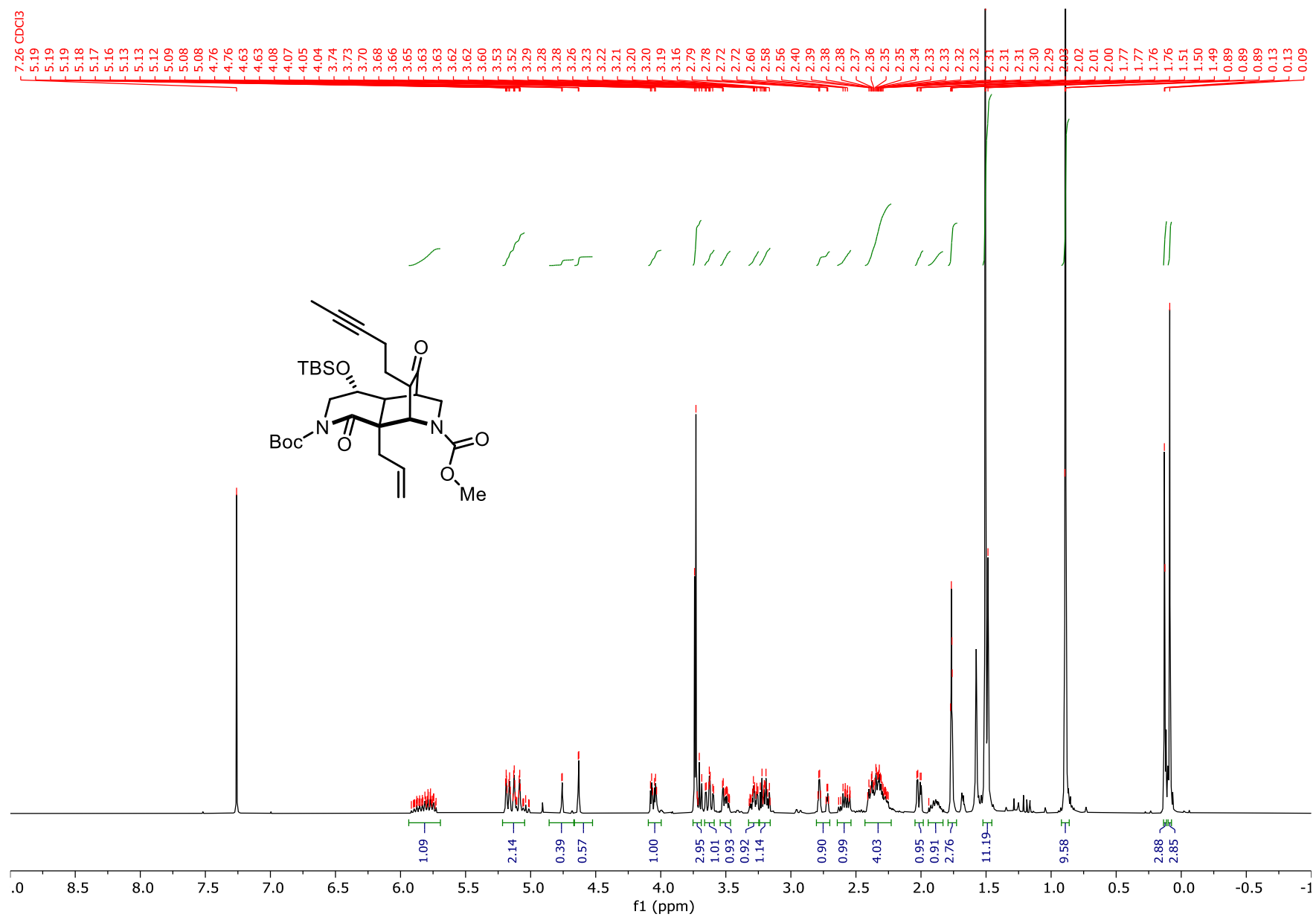
¹H NMR Spectrum of 11 (600 MHz, DMSO-d₆)



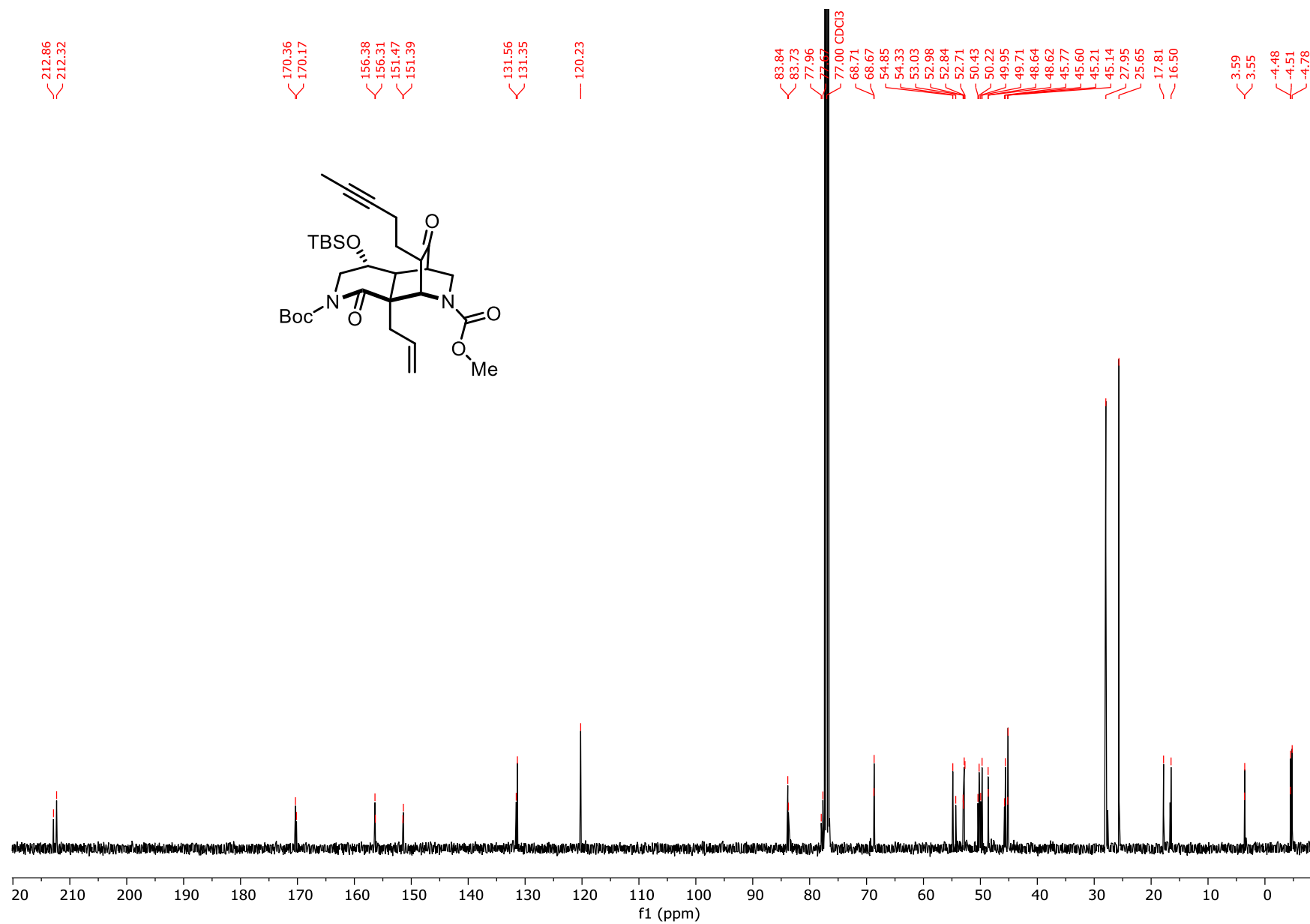
^{13}C NMR Spectrum of 11 (151 MHz, DMSO- d_6)



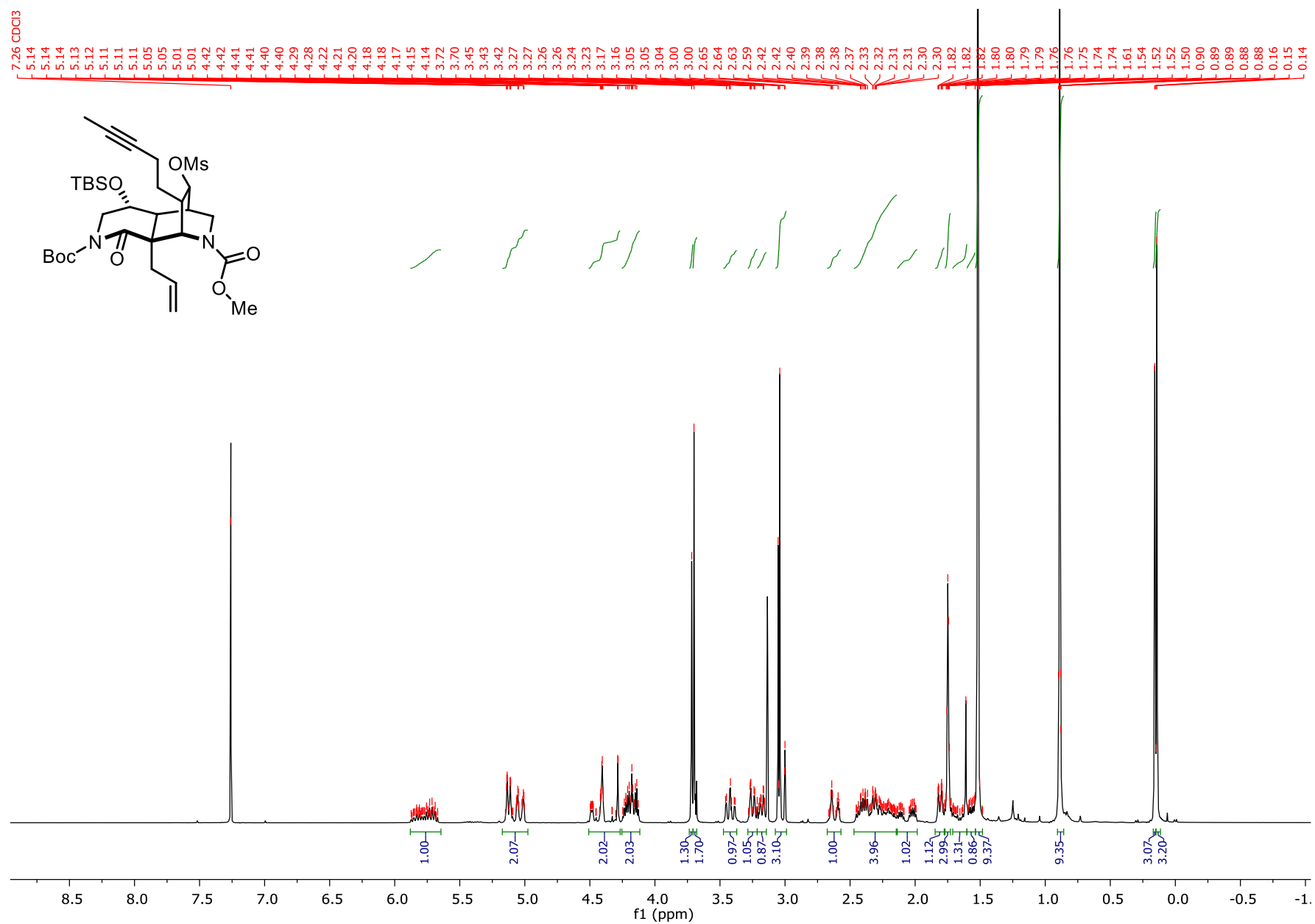
^1H NMR Spectrum of 12 (400 MHz, CDCl_3)



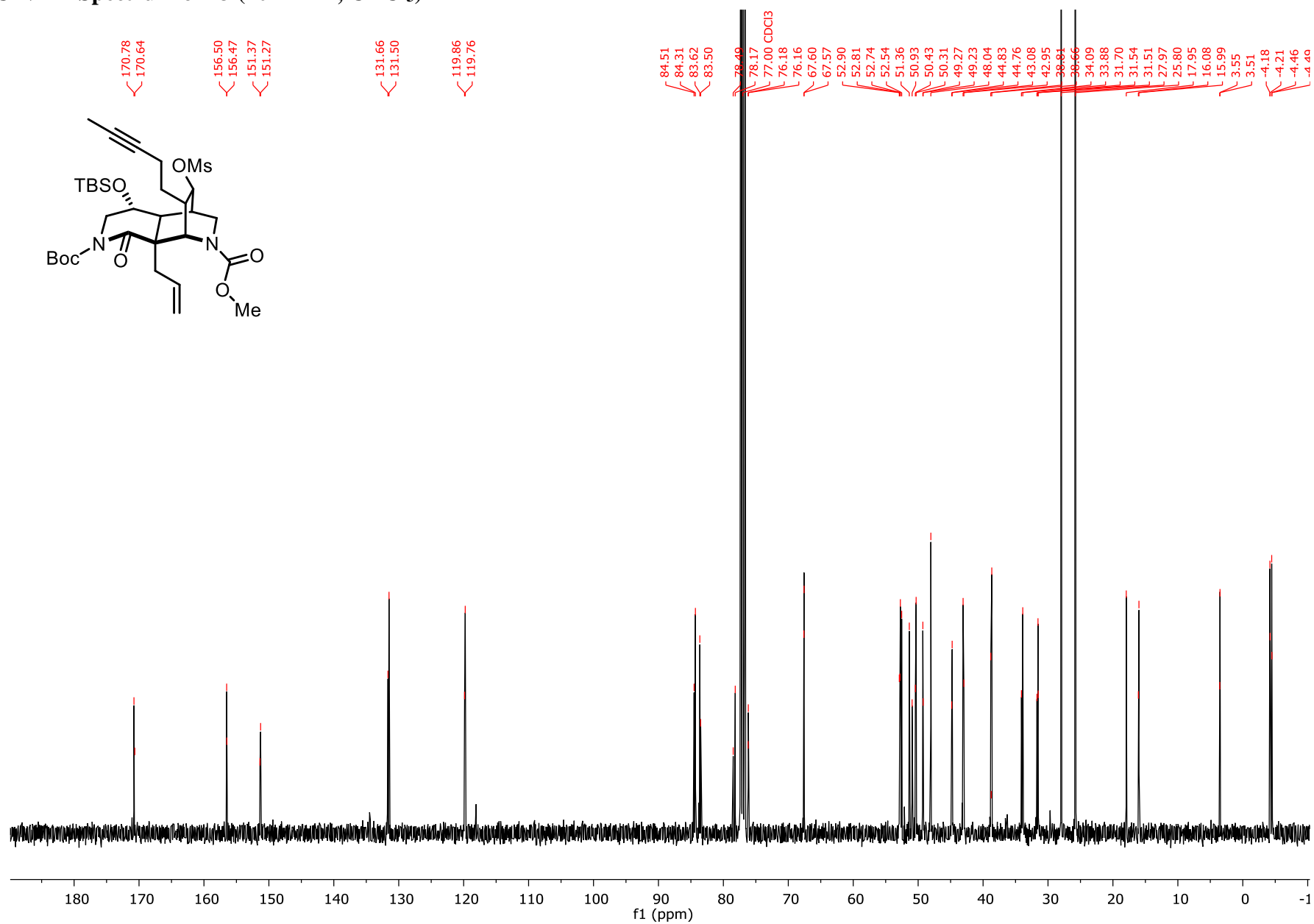
^{13}C NMR Spectrum of 12 (400 MHz, CDCl_3)



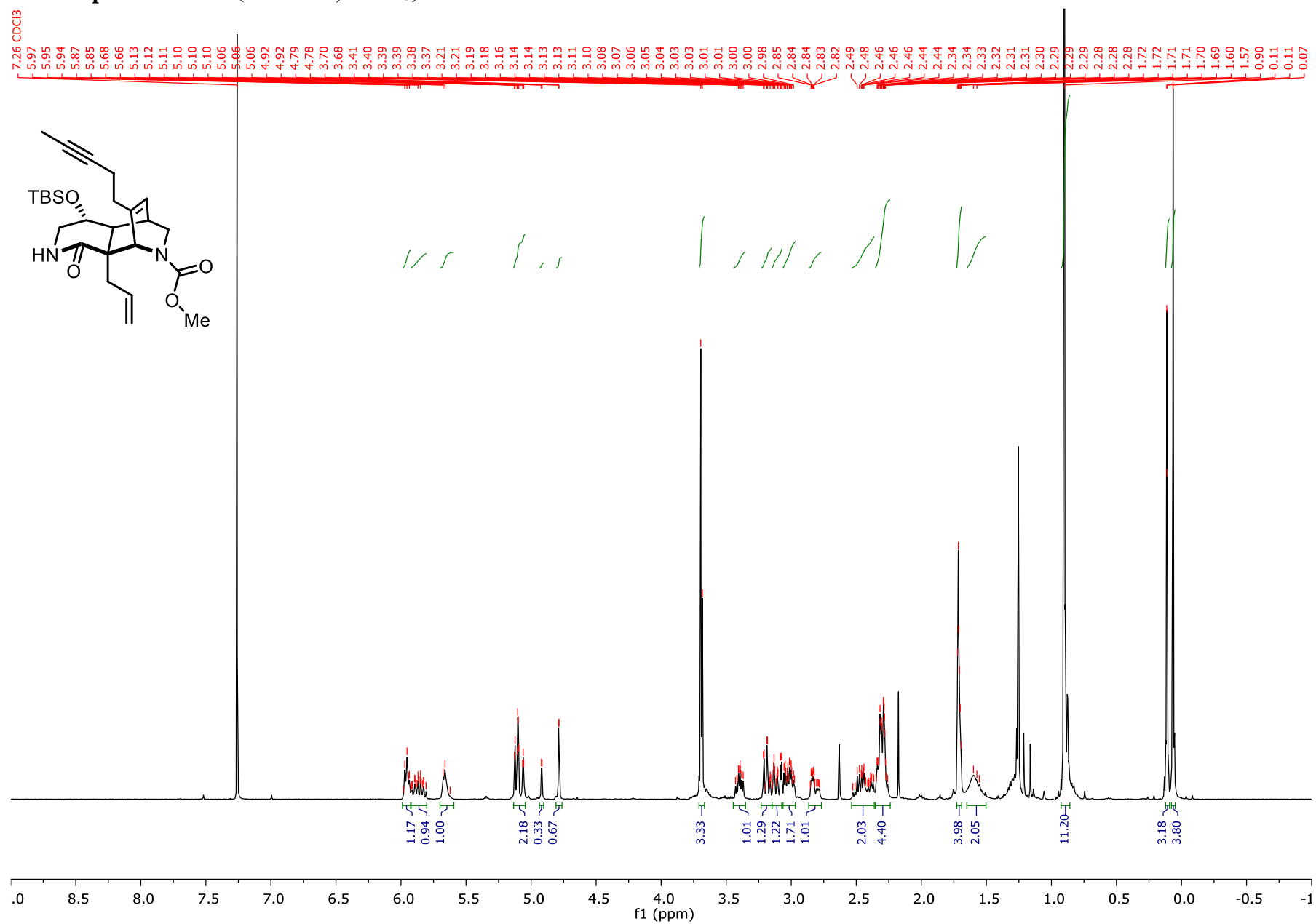
¹H NMR Spectrum of 13 (400 MHz, CDCl₃)



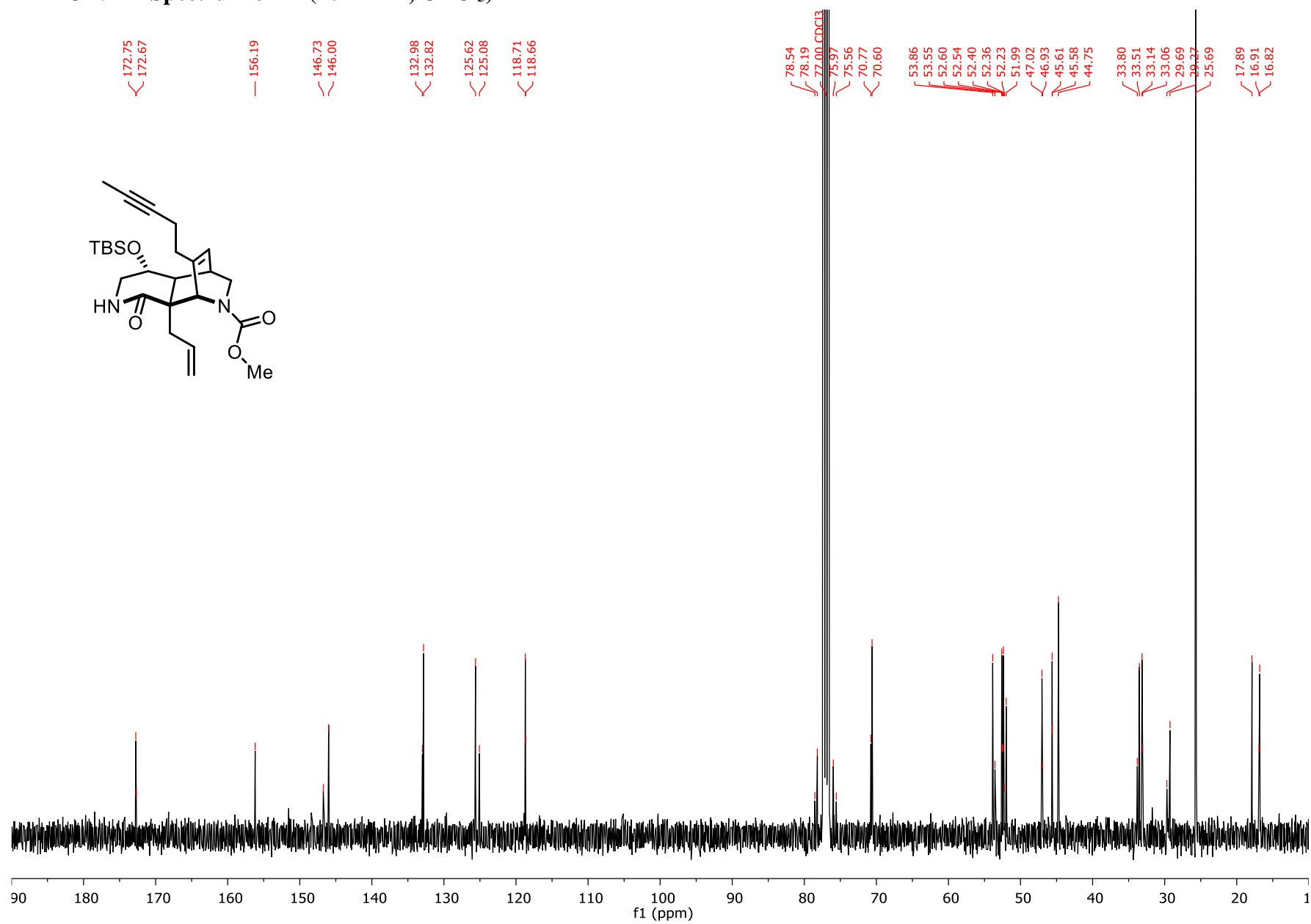
^{13}C NMR Spectrum of 13 (101 MHz, CDCl_3)



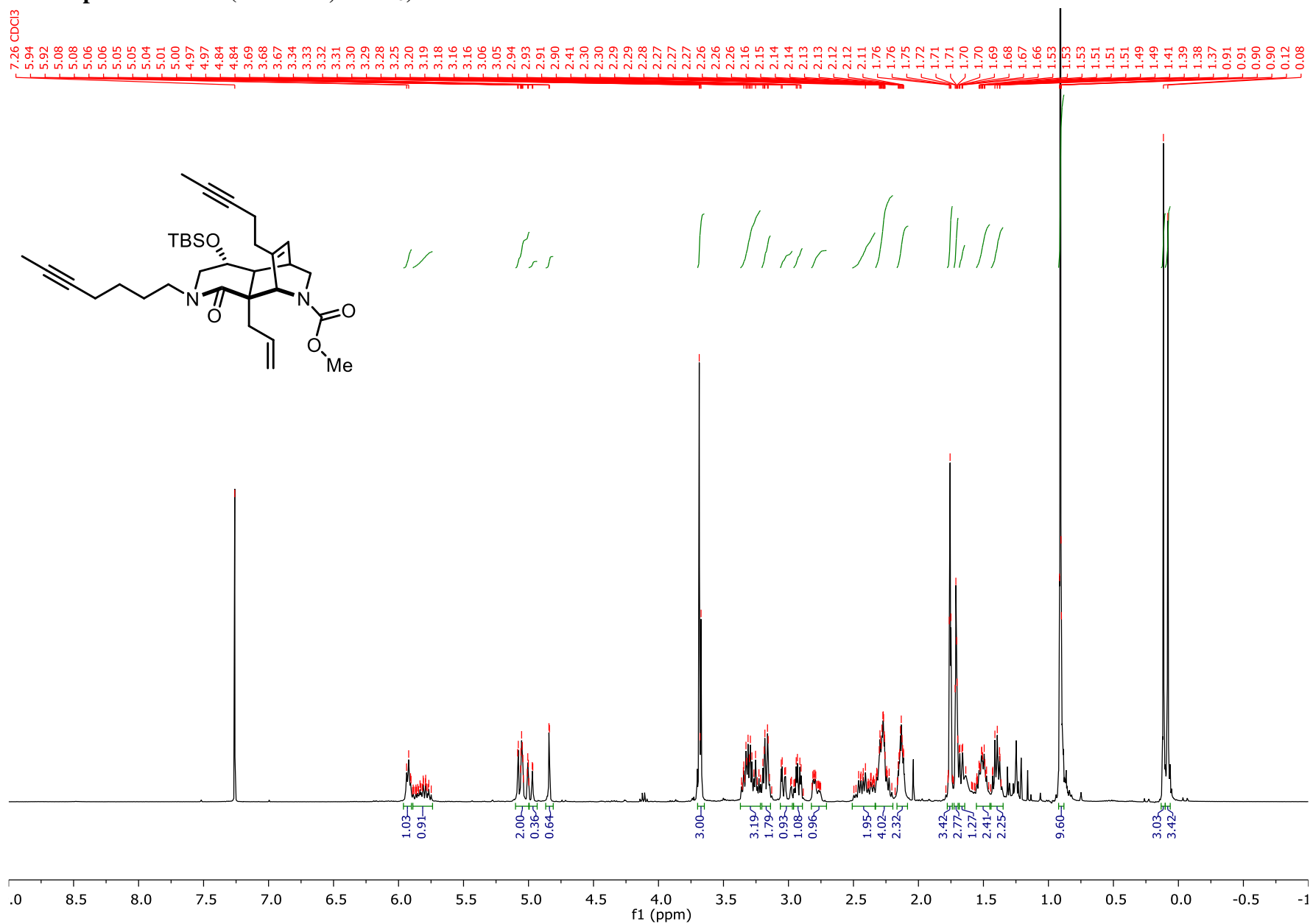
¹H NMR Spectrum of 14 (400 MHz, CDCl₃)



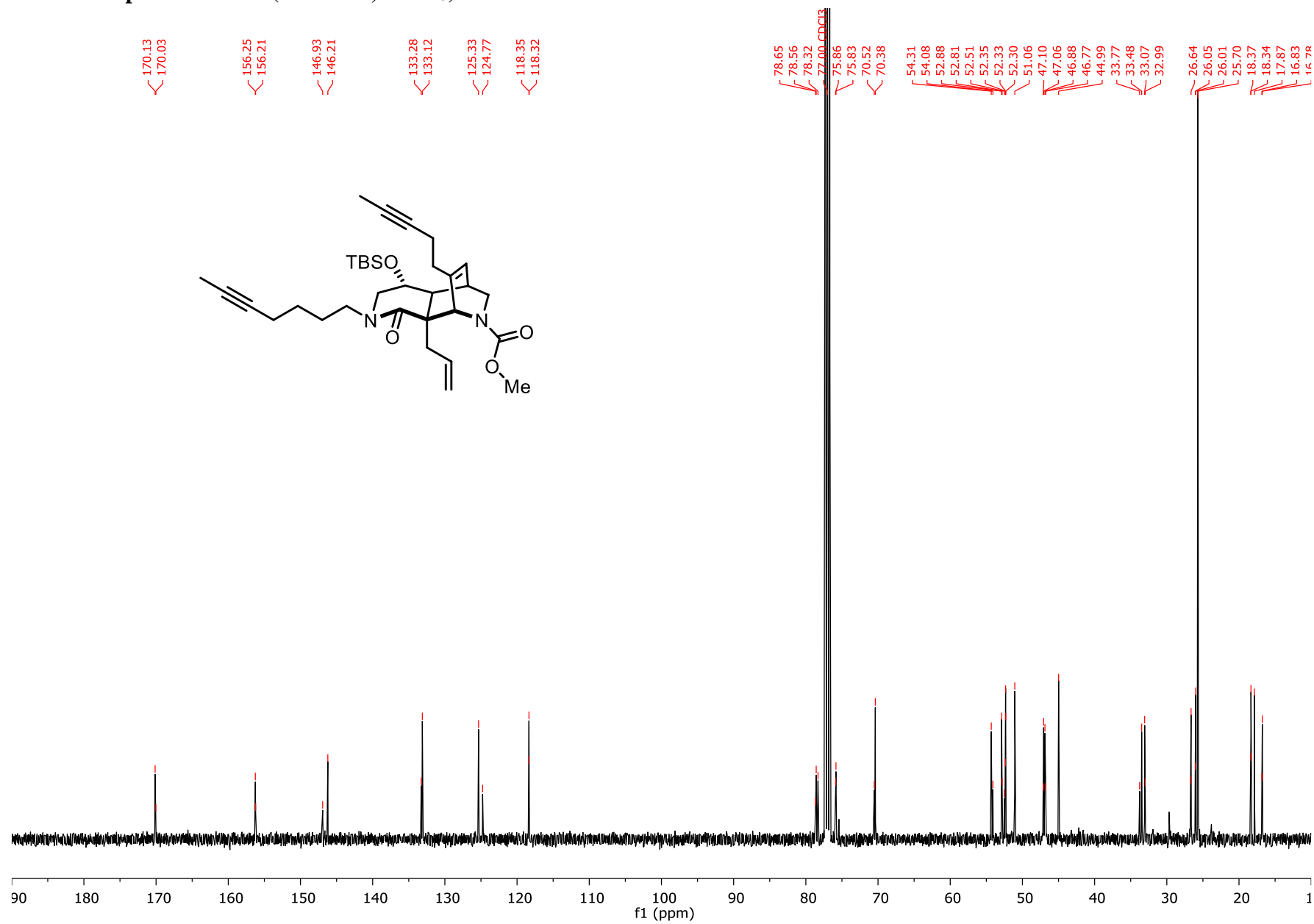
^{13}C NMR Spectrum of 14 (101 MHz, CDCl_3)



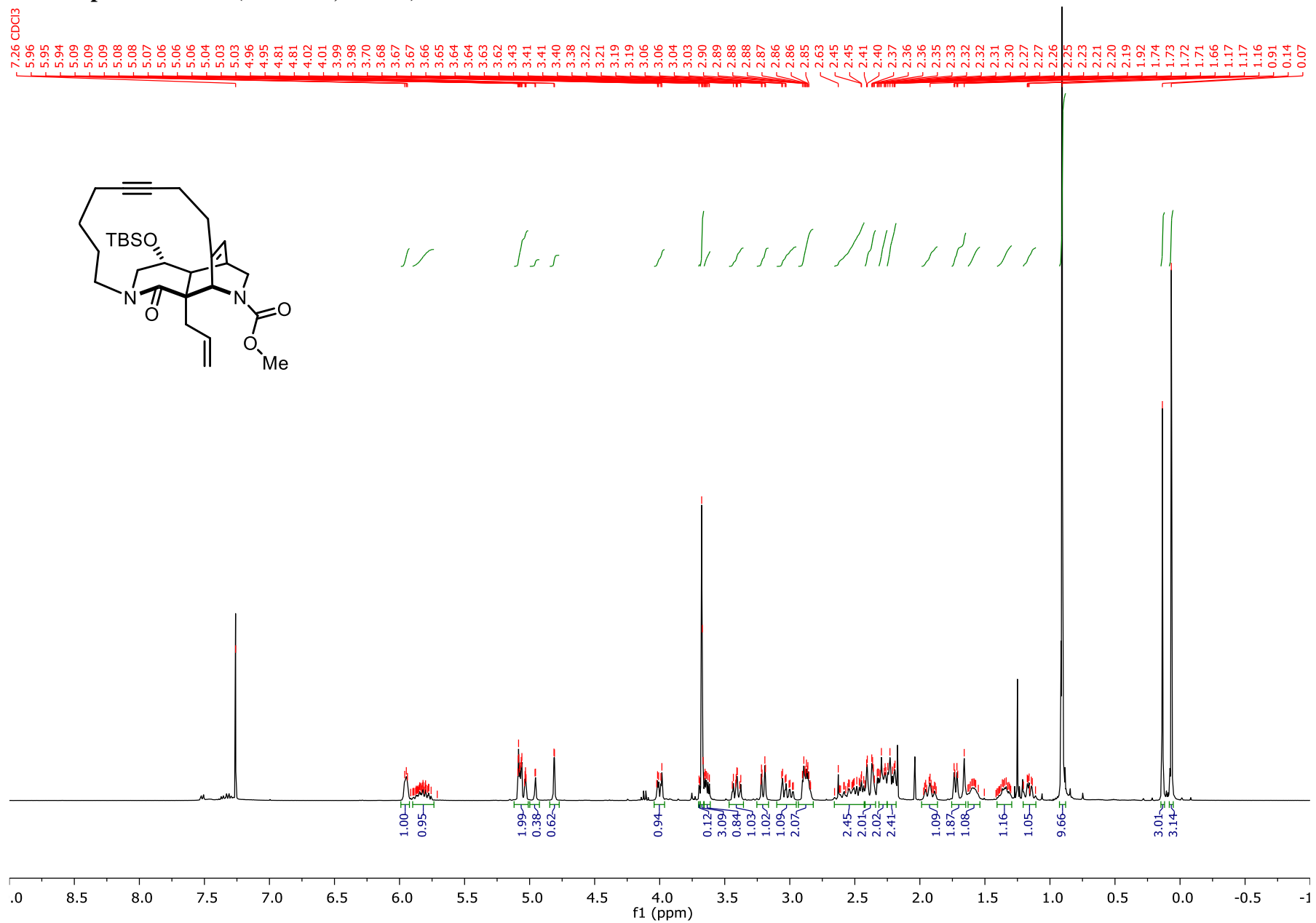
^1H NMR Spectrum of 15 (400 MHz, CDCl_3)



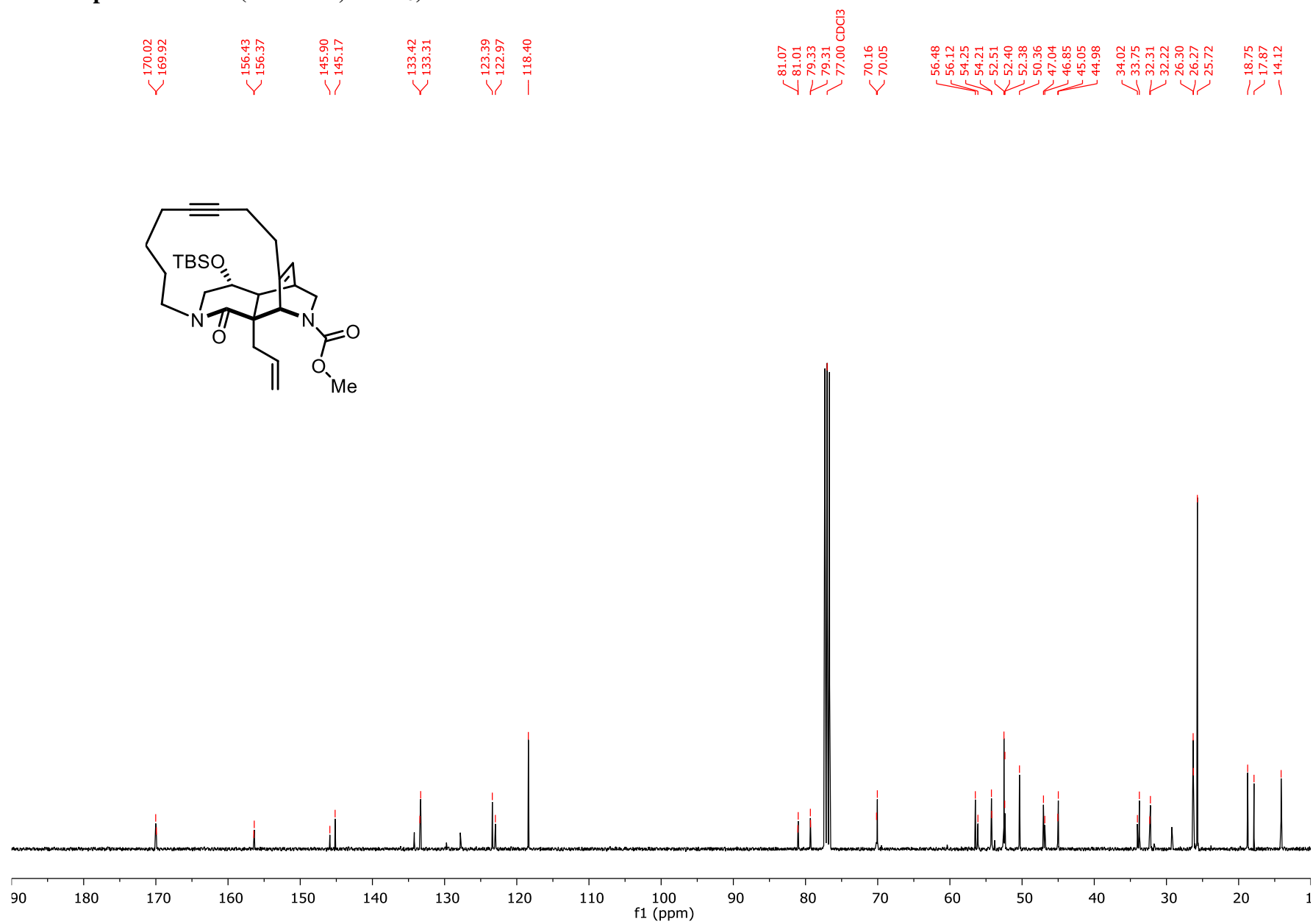
^{13}C NMR Spectrum of 15 (101 MHz, CDCl_3)



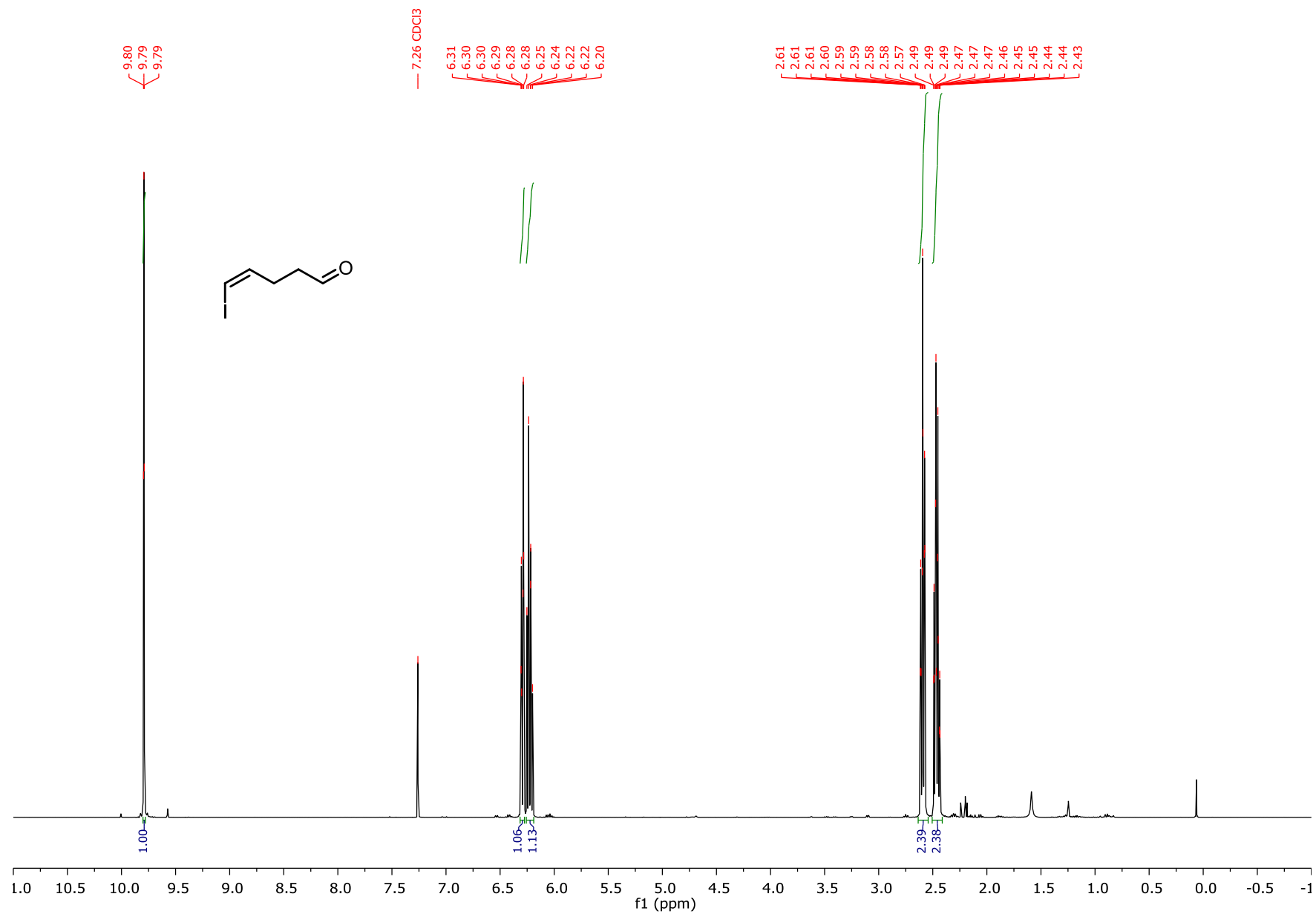
¹H NMR Spectrum of 16 (400 MHz, CDCl₃)



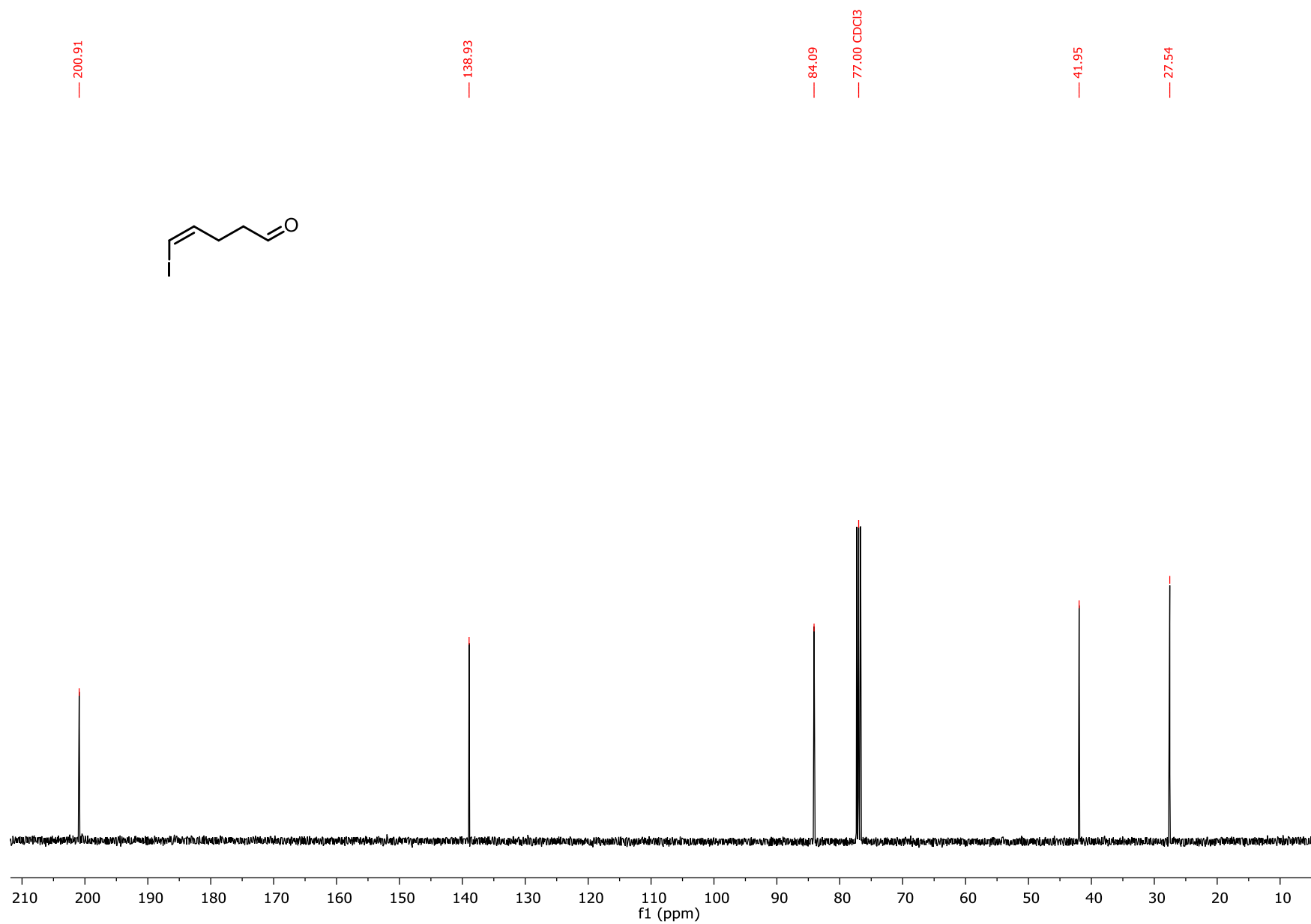
^{13}C NMR Spectrum of 16 (101 MHz, CDCl_3)



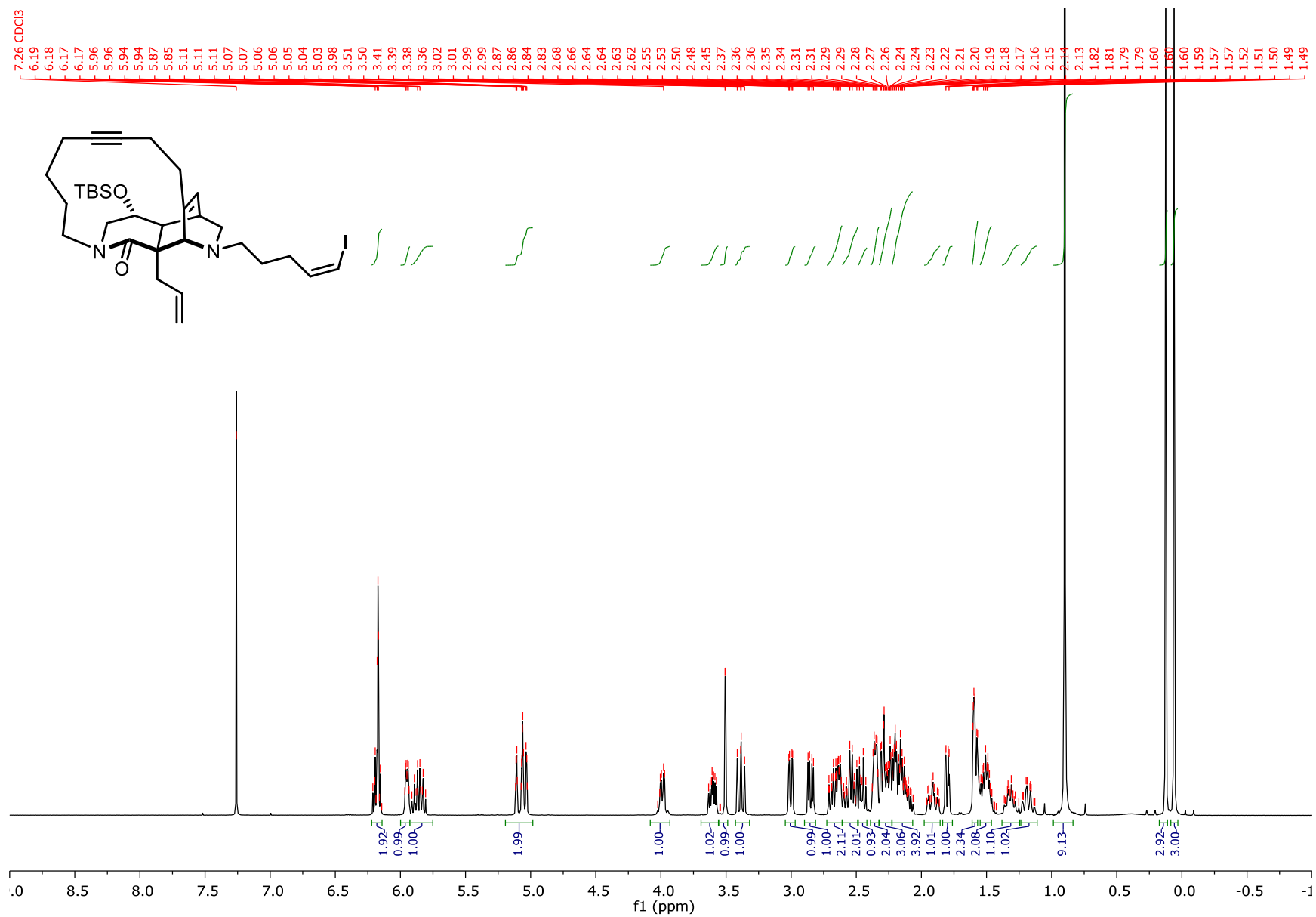
¹H NMR Spectrum of 19 (400 MHz, CDCl₃)



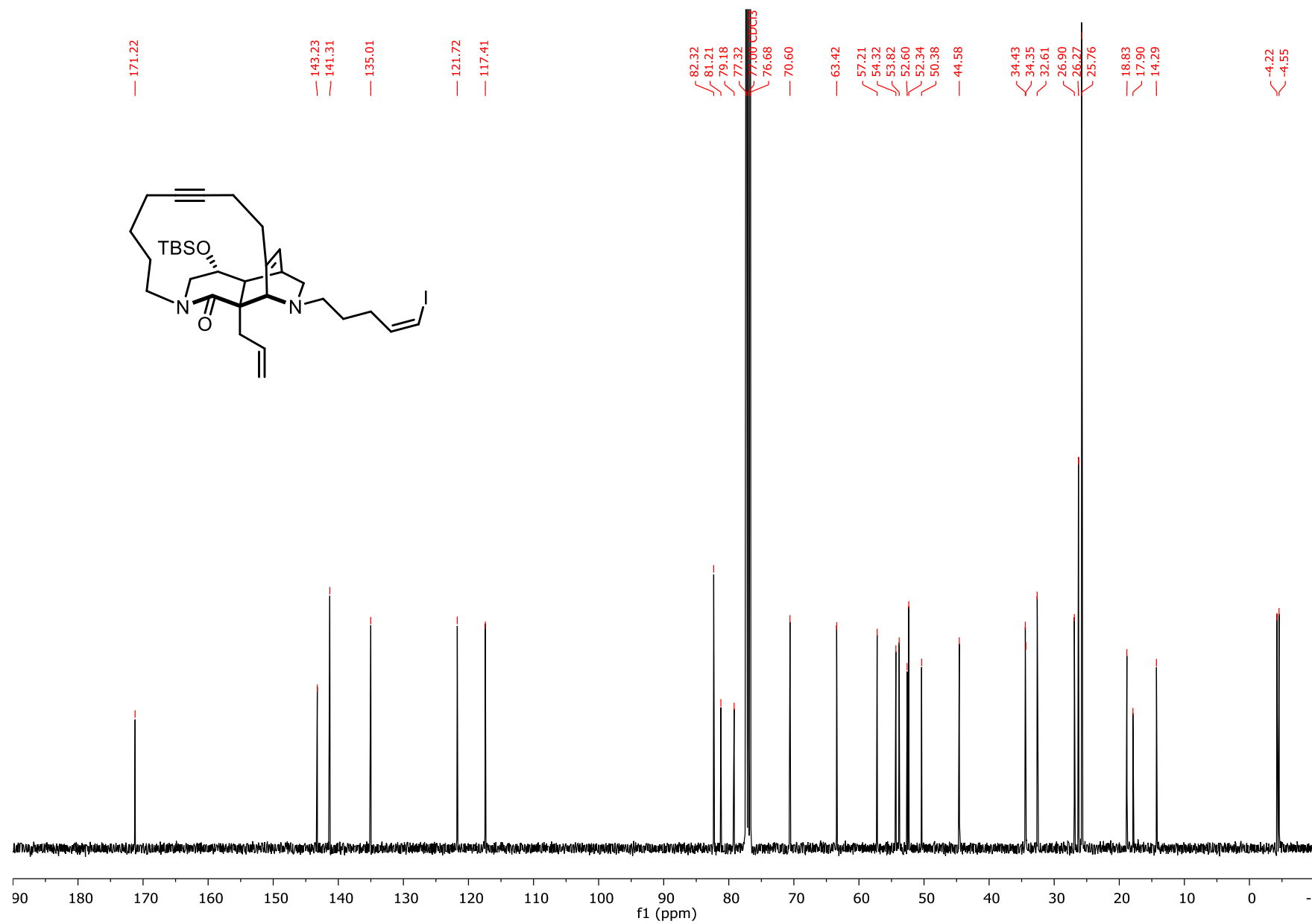
^{13}C NMR Spectrum of 19 (101 MHz, CDCl_3)



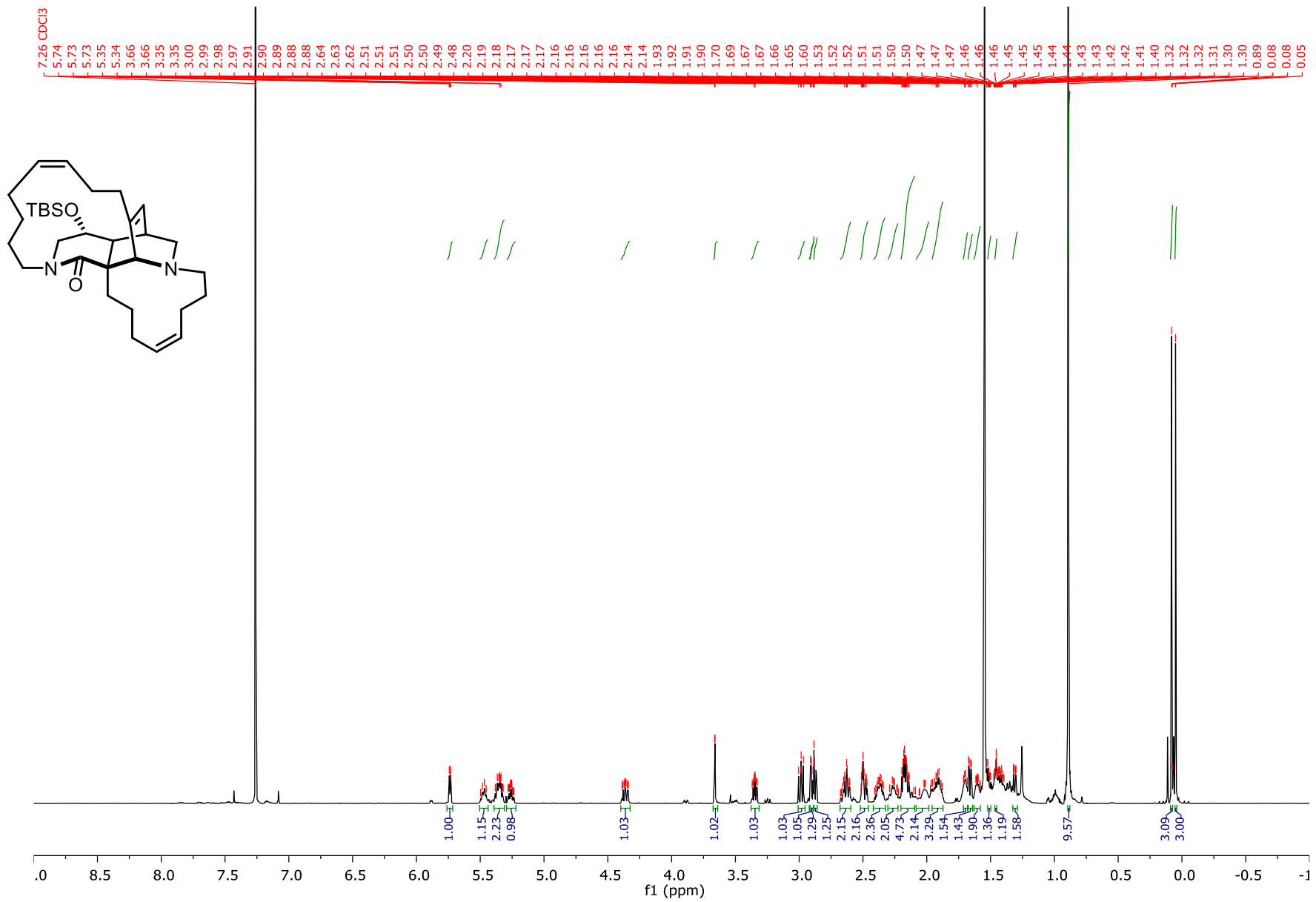
^1H NMR Spectrum of 20 (400 MHz, CDCl_3)



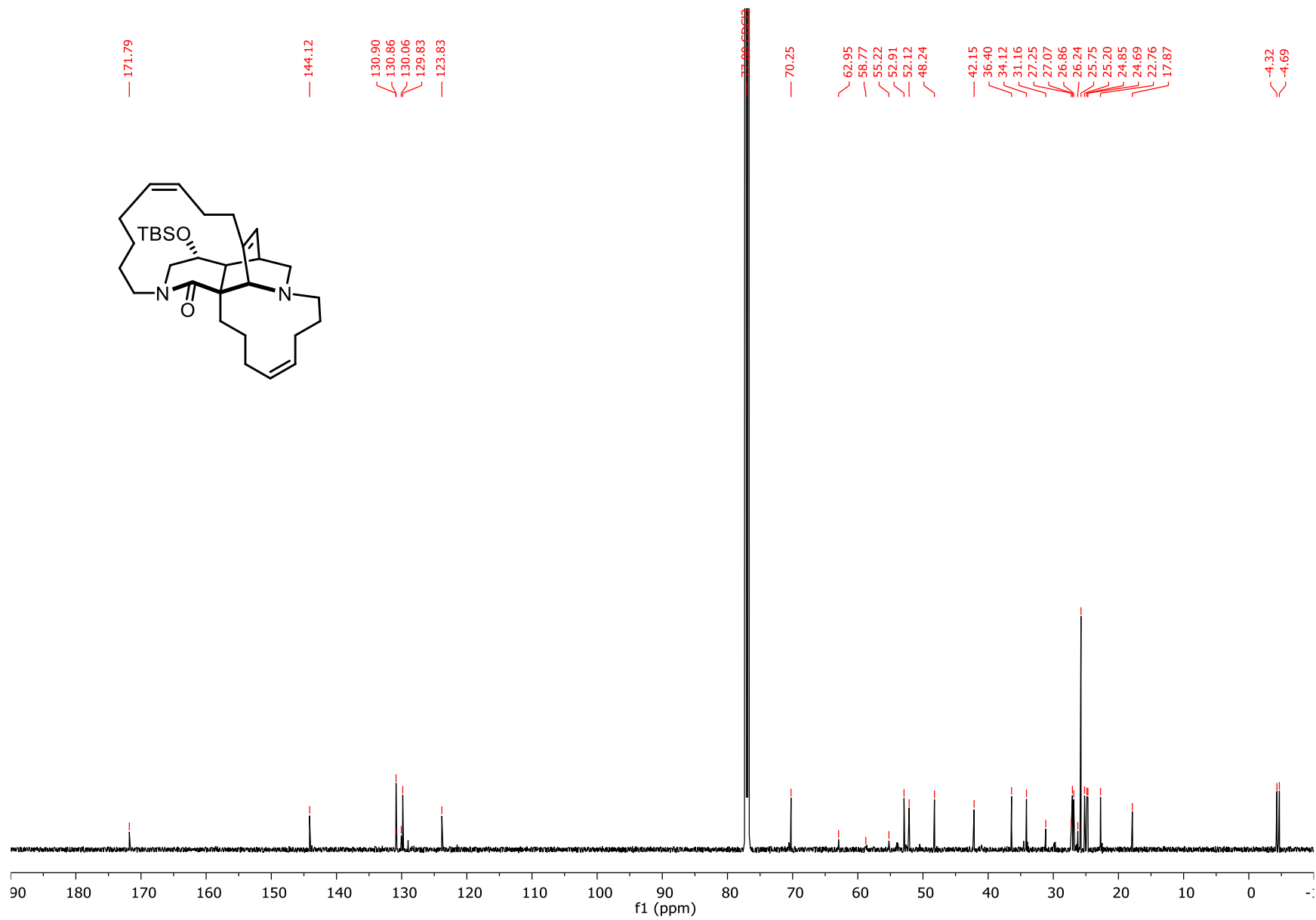
^{13}C NMR Spectrum of 20 (101 MHz, CDCl_3)



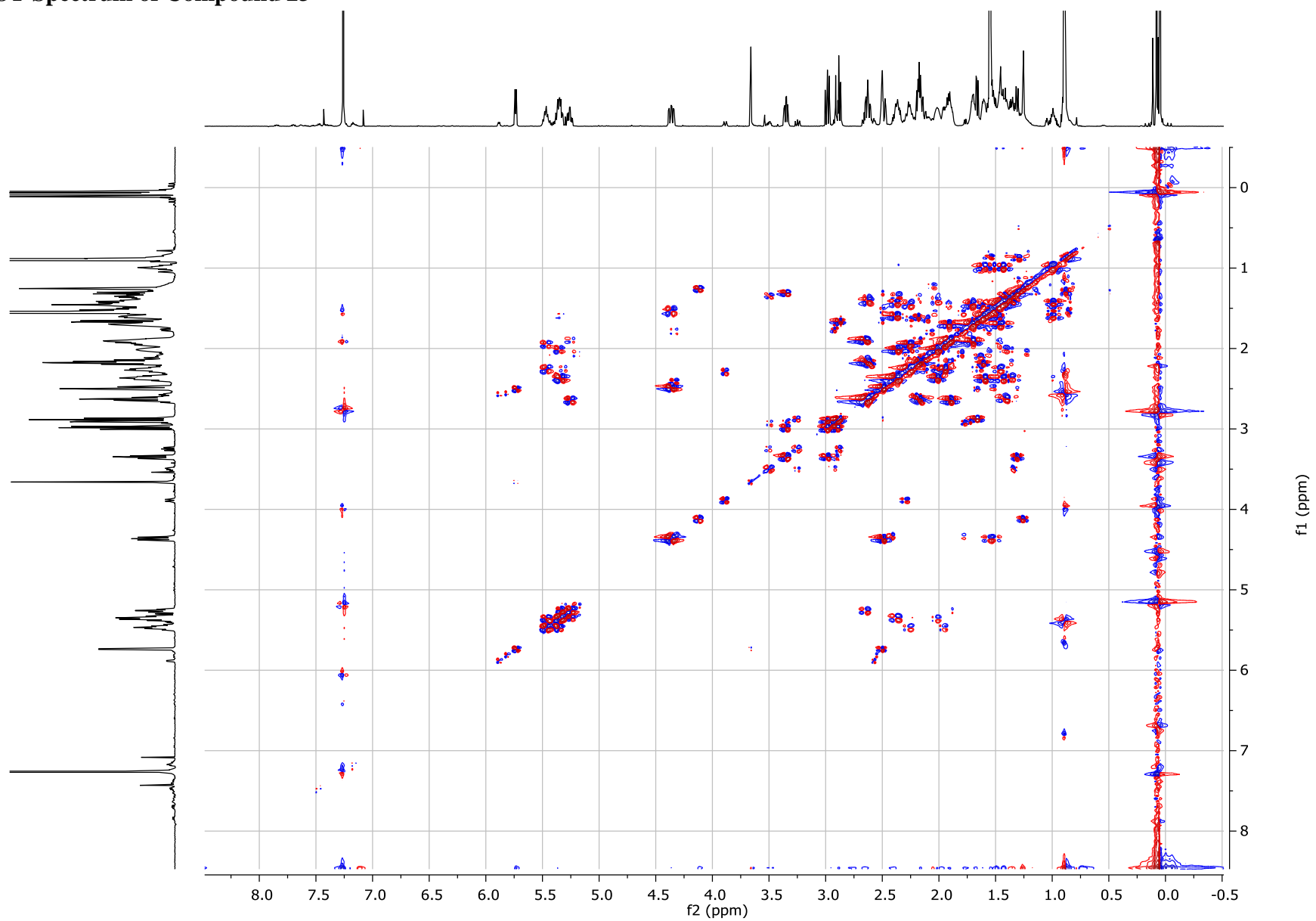
¹H NMR Spectrum of 23 (600 MHz, CDCl₃)



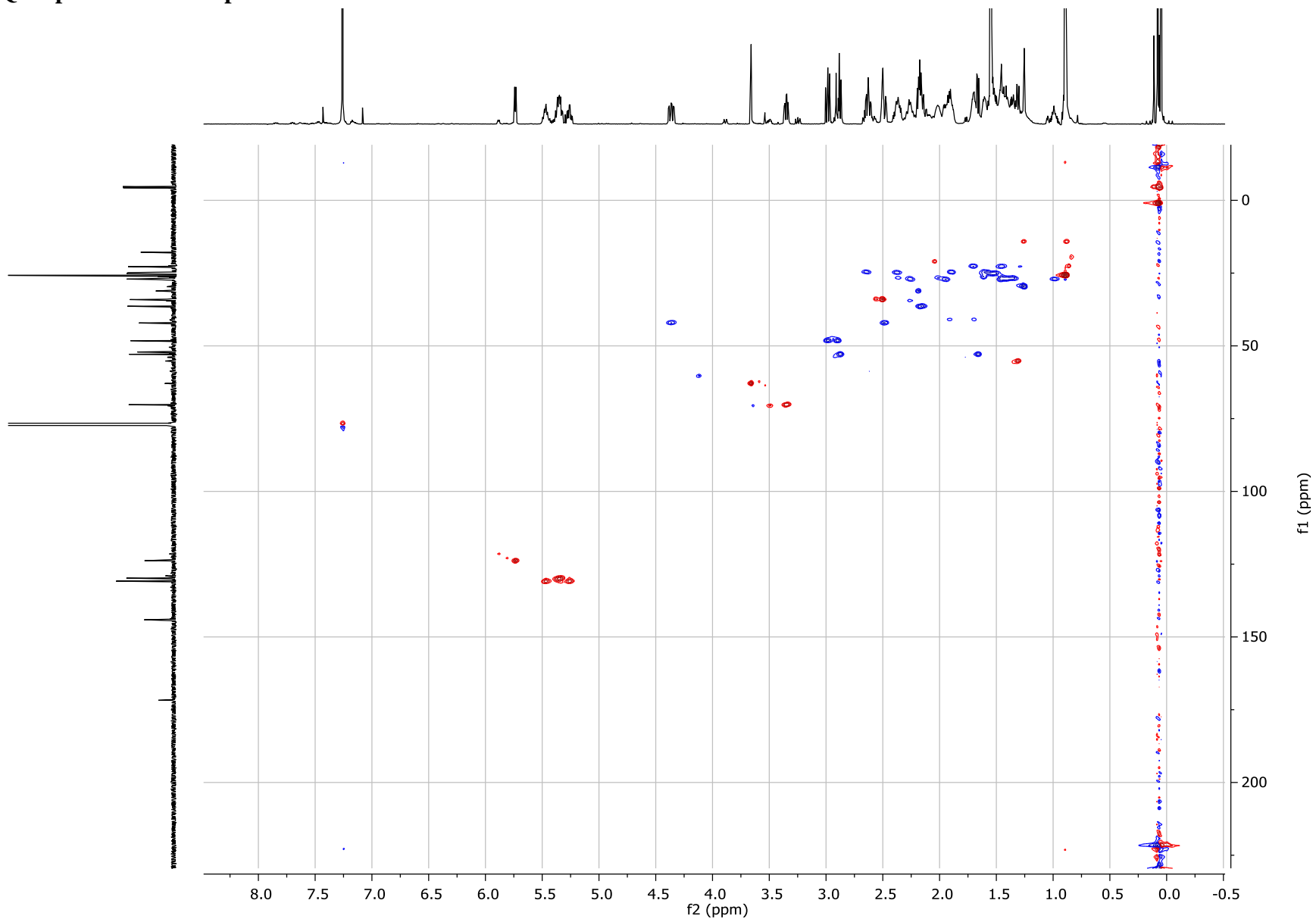
^{13}C NMR Spectrum of 23 (151 MHz, CDCl_3)



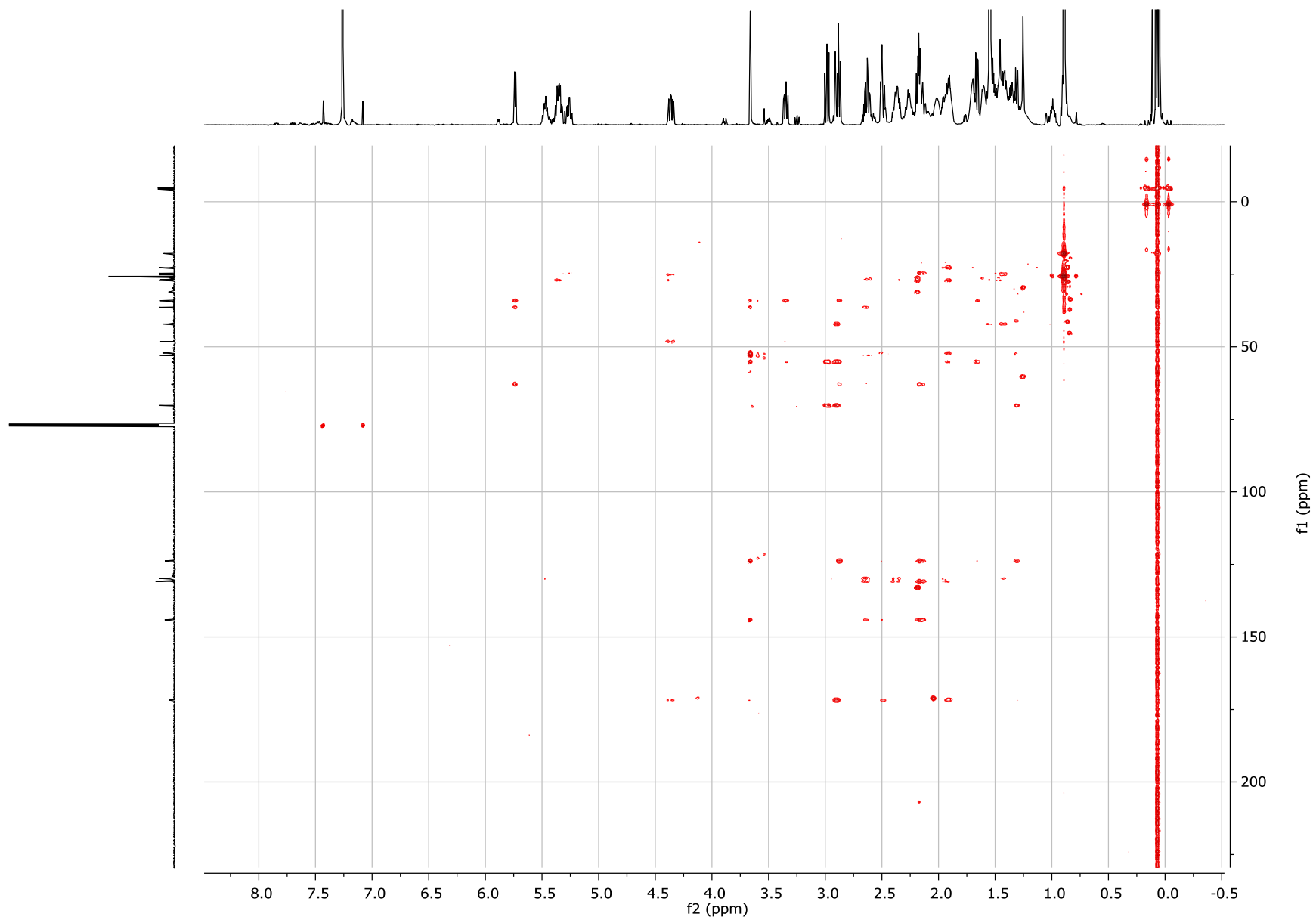
COSY Spectrum of Compound 23



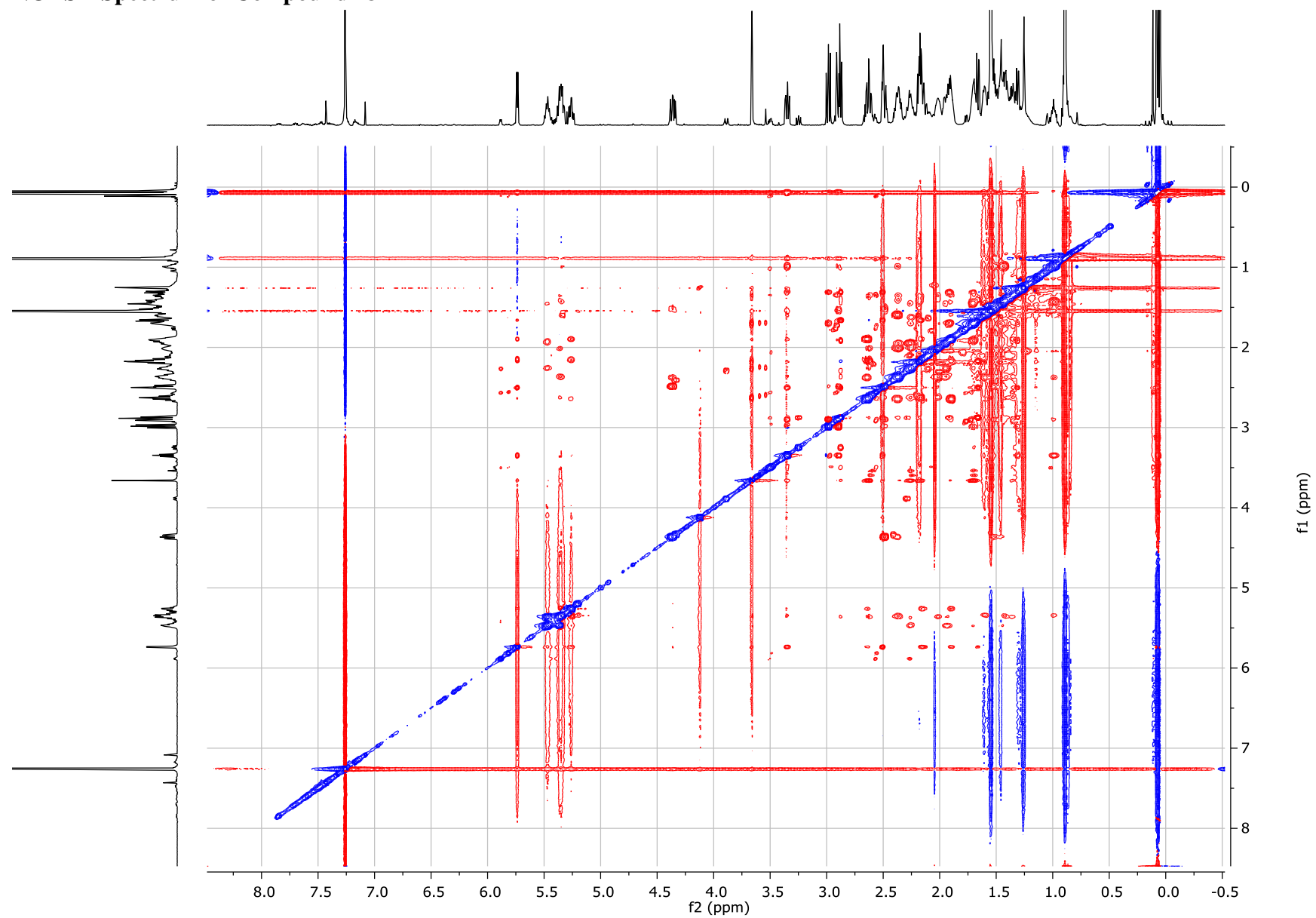
HMQC Spectrum of Compound 23



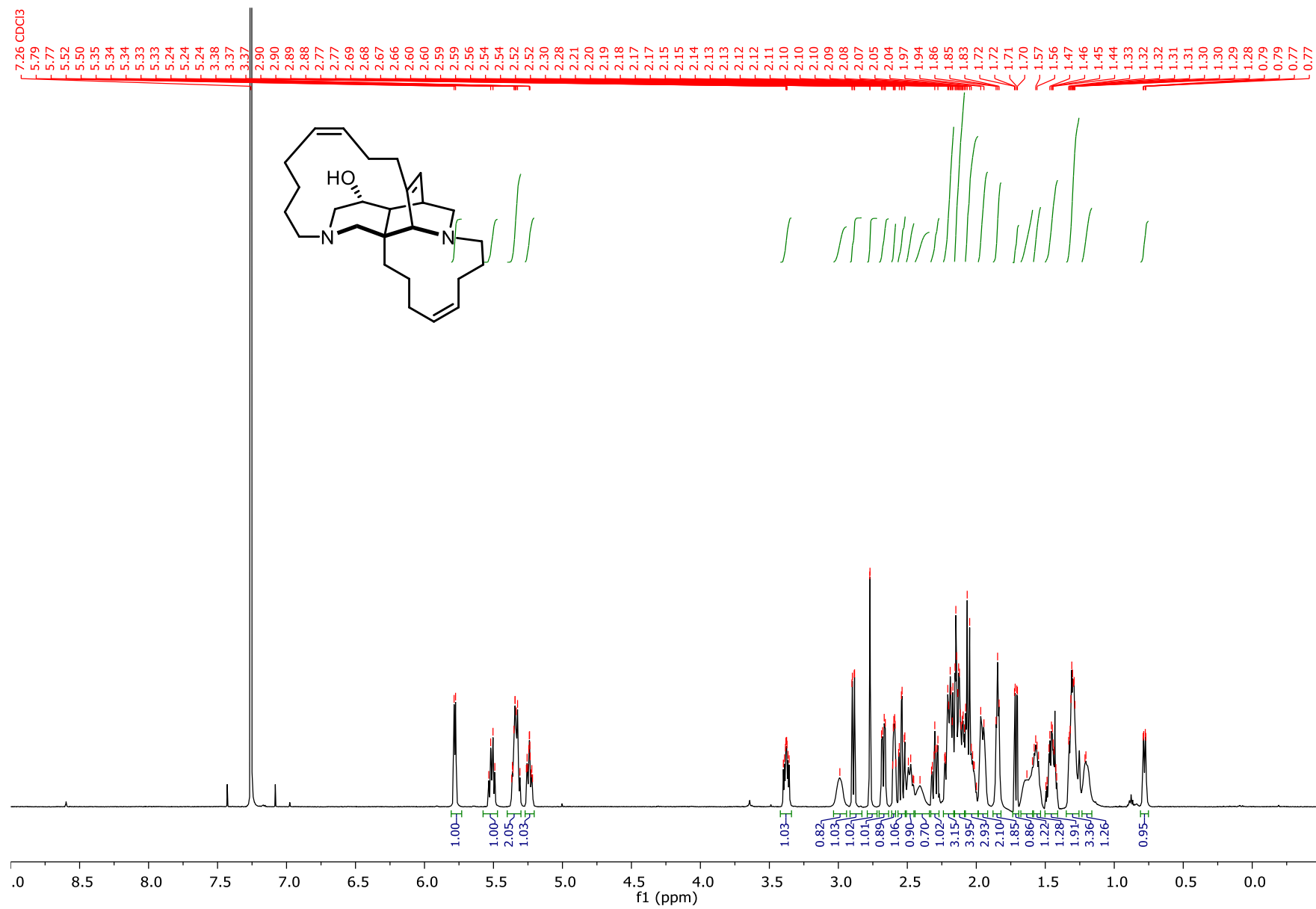
HMBC Spectrum of Compound 23



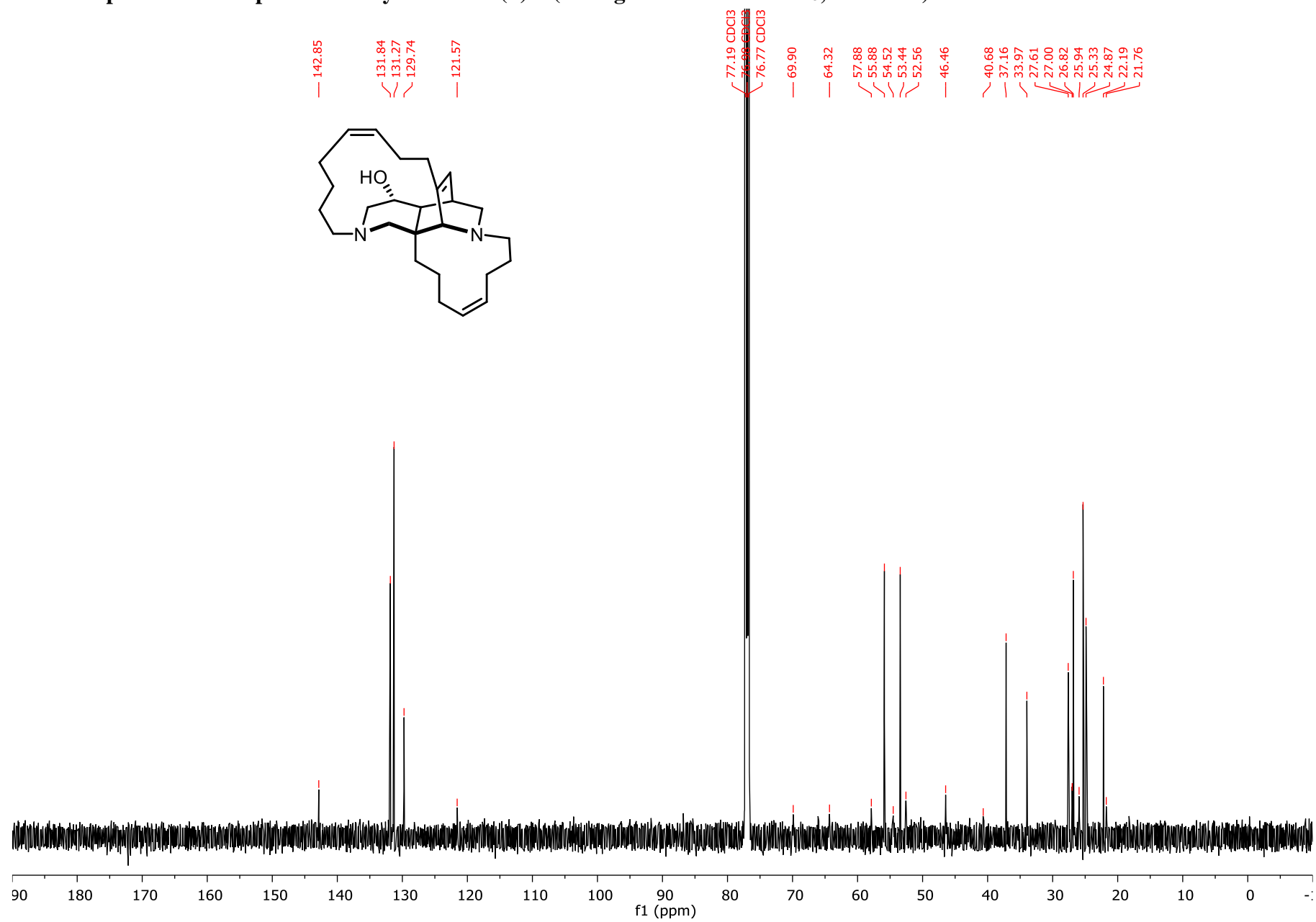
NOESY Spectrum of Compound 23



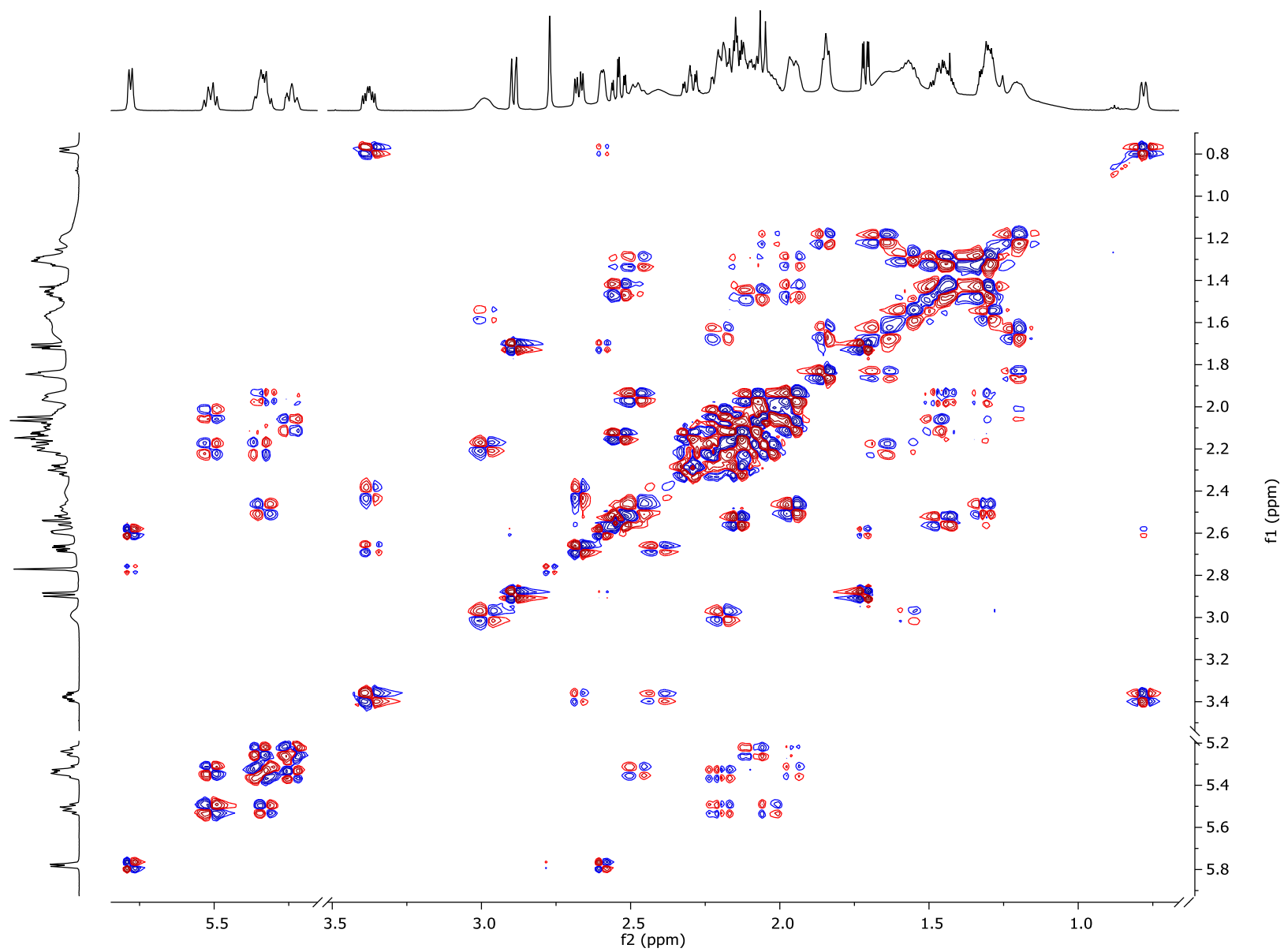
¹H NMR Spectrum of Proposed Xestocyclamine A (–)-1 (0.2 mg in 0.2 mL of CDCl₃, 600 MHz)



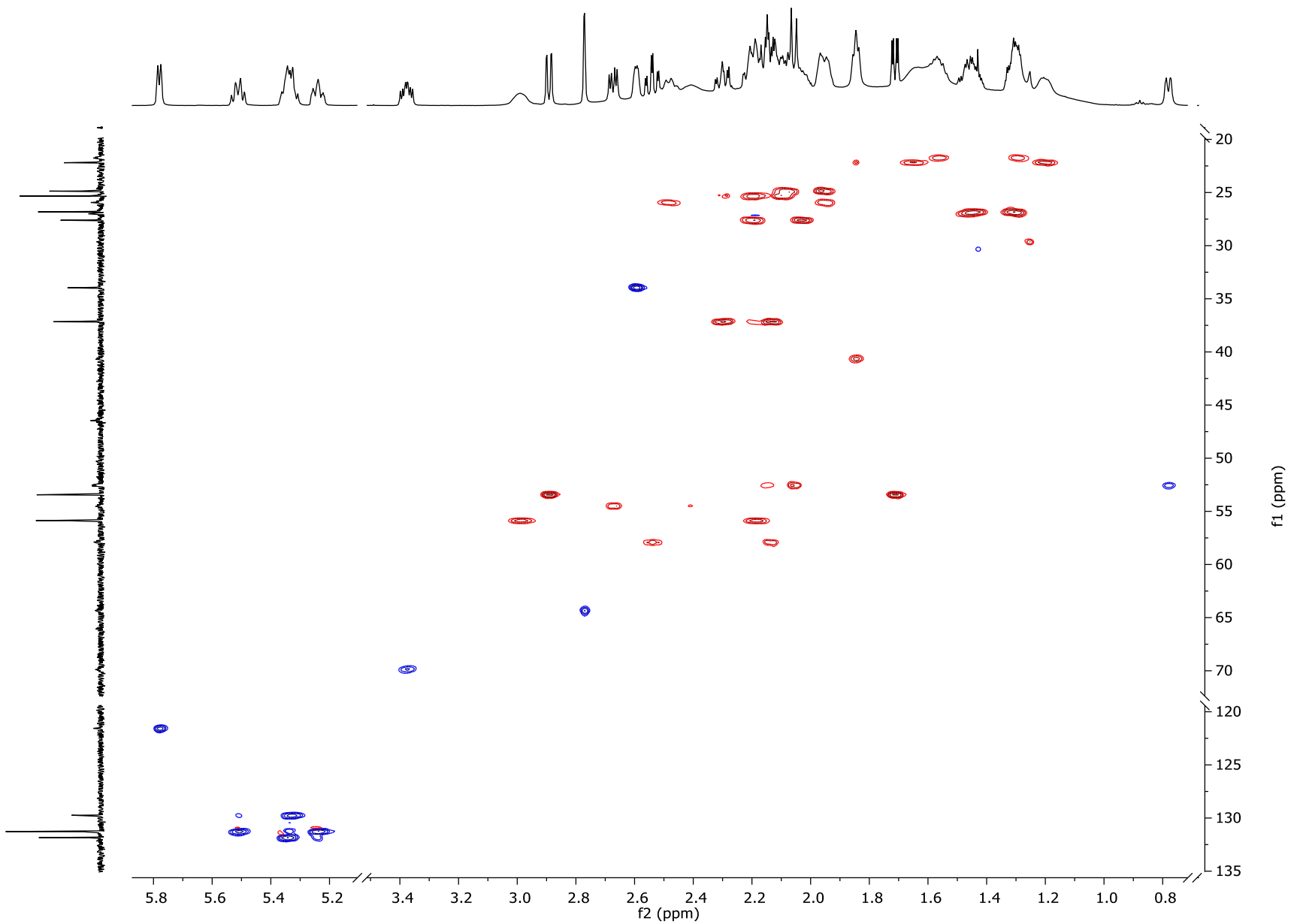
^{13}C NMR Spectrum of Proposed Xestocyclamine A (–)-1 (0.2 mg in 0.2 mL of CDCl_3 , 151 MHz)



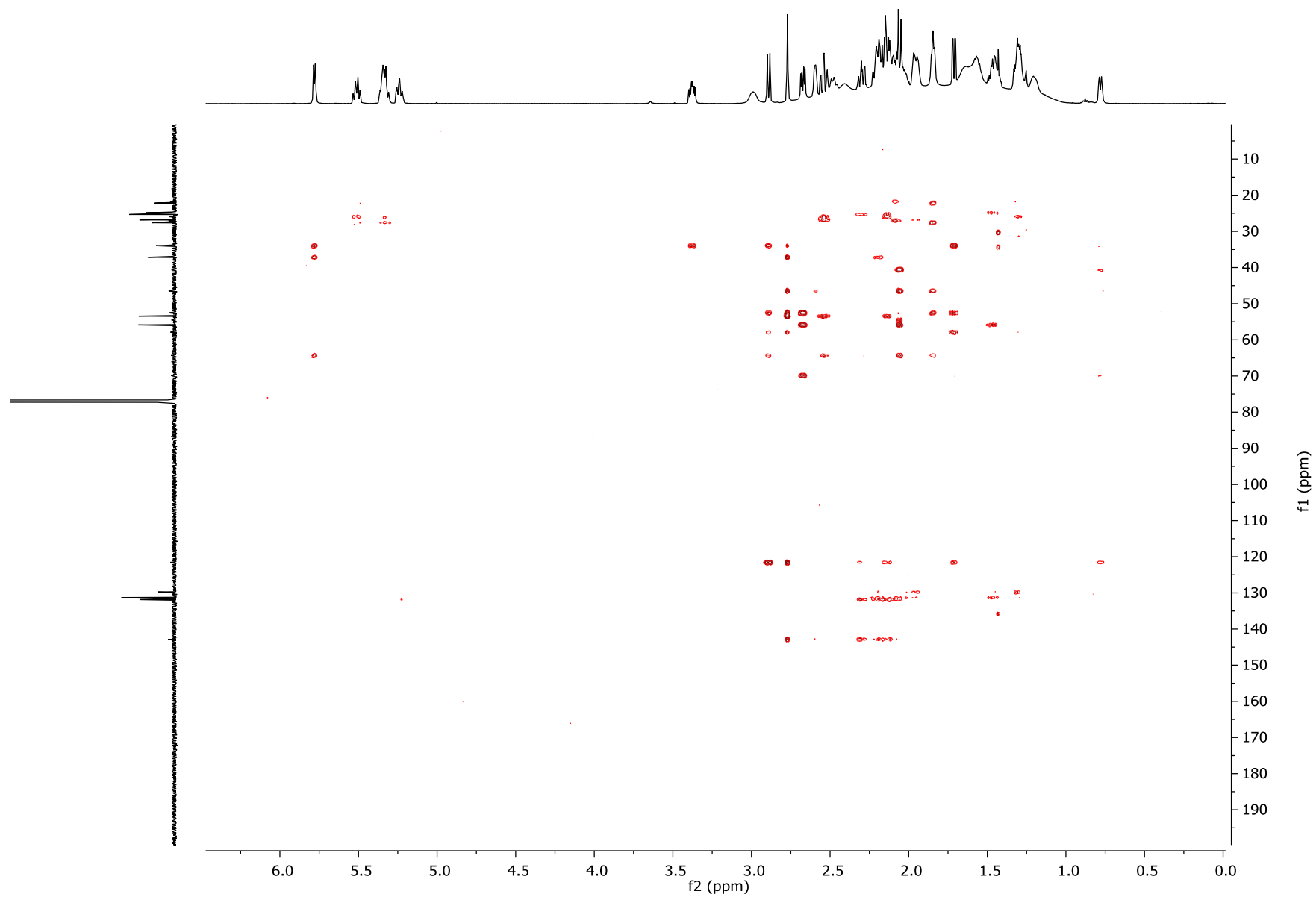
COSY Spectrum of Proposed Xestocyclamine A (-)-1 (in CDCl₃)



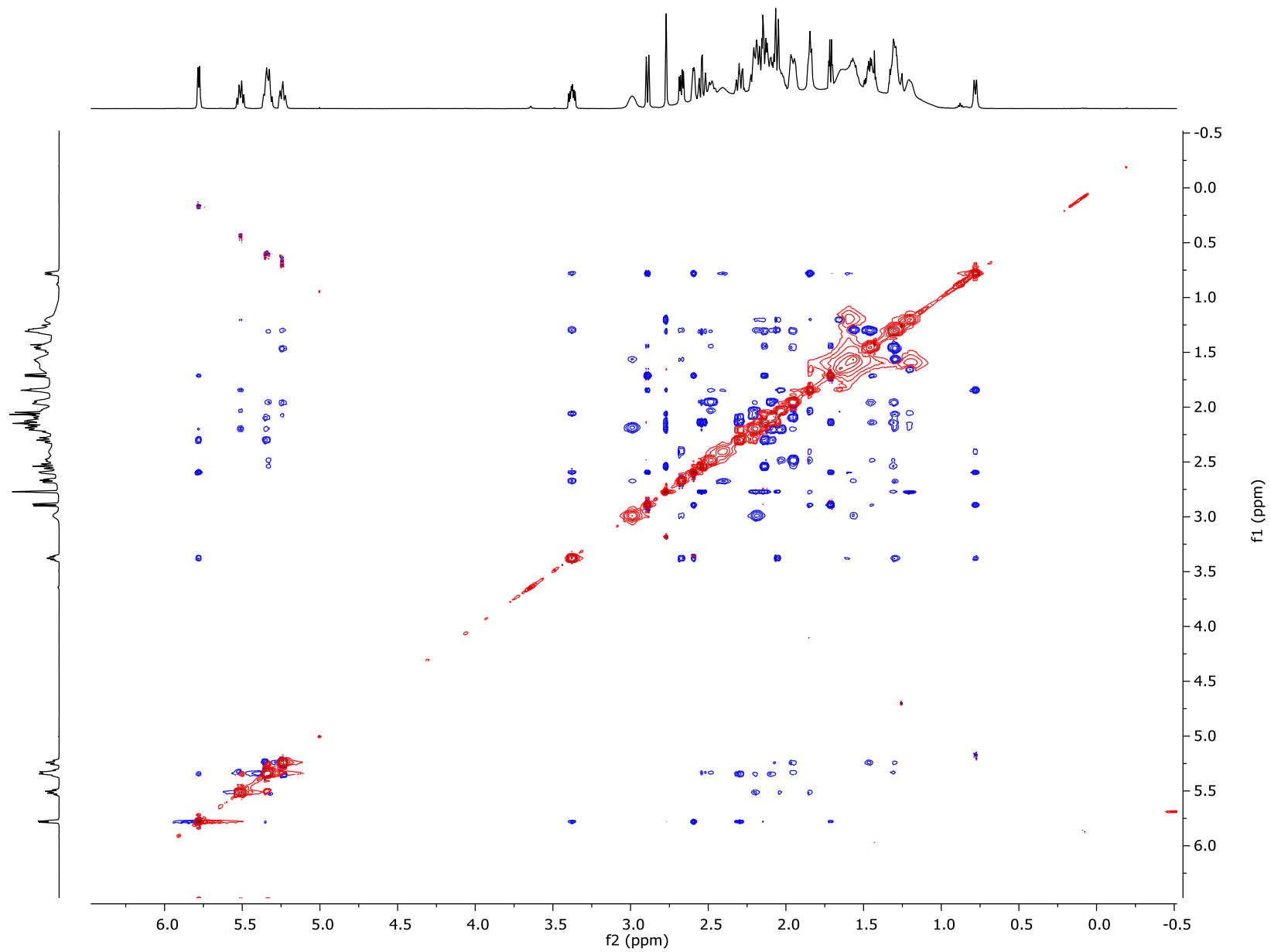
HMQC Spectrum of Proposed Xestocyclamine A (-)-1 (in CDCl₃)



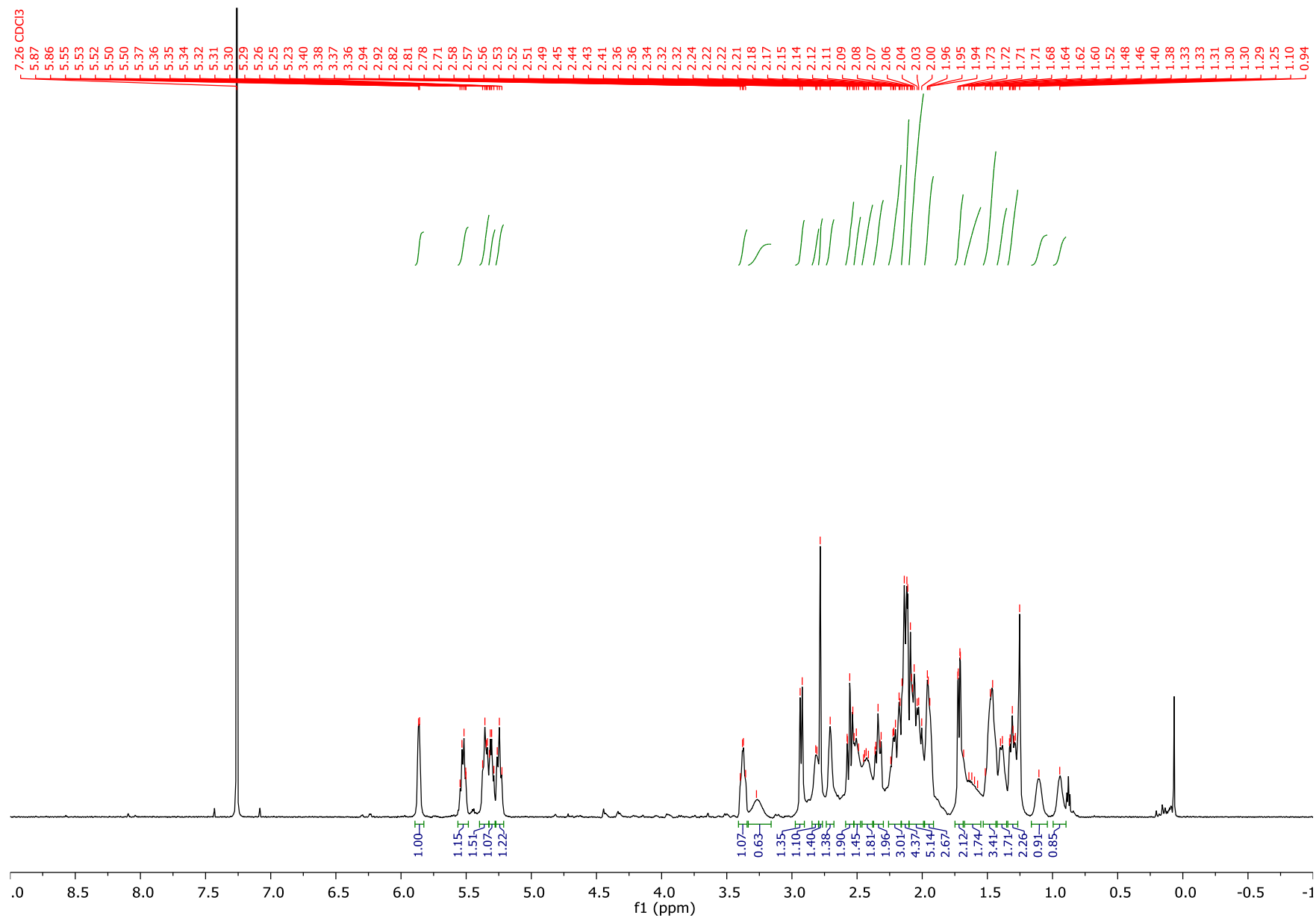
HMBC Spectrum of Proposed Xestocyclamine A (-)-1 (in CDCl₃)



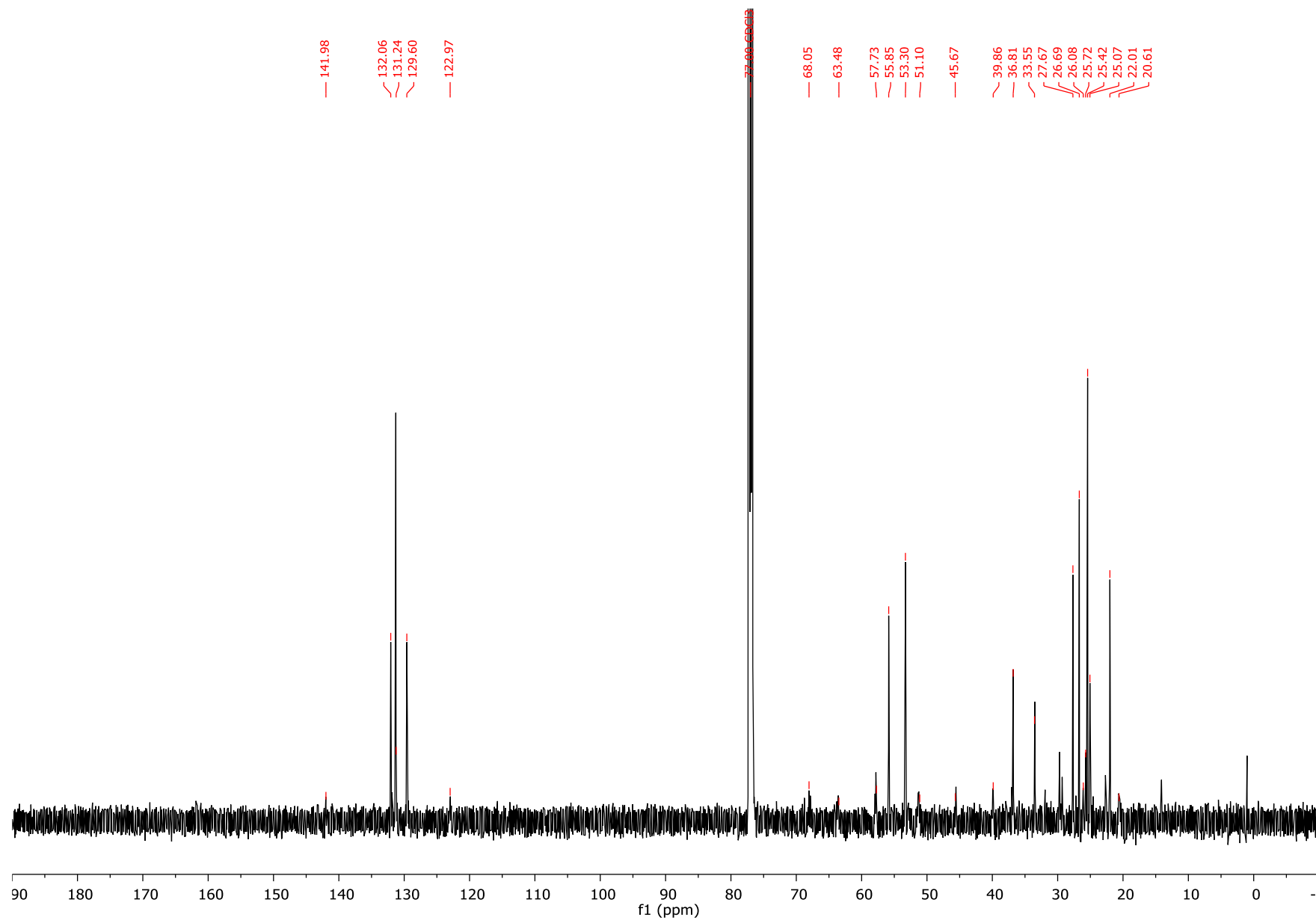
NOESY Spectrum of Proposed Xestocyclamine A (–)-1 (in CDCl₃)



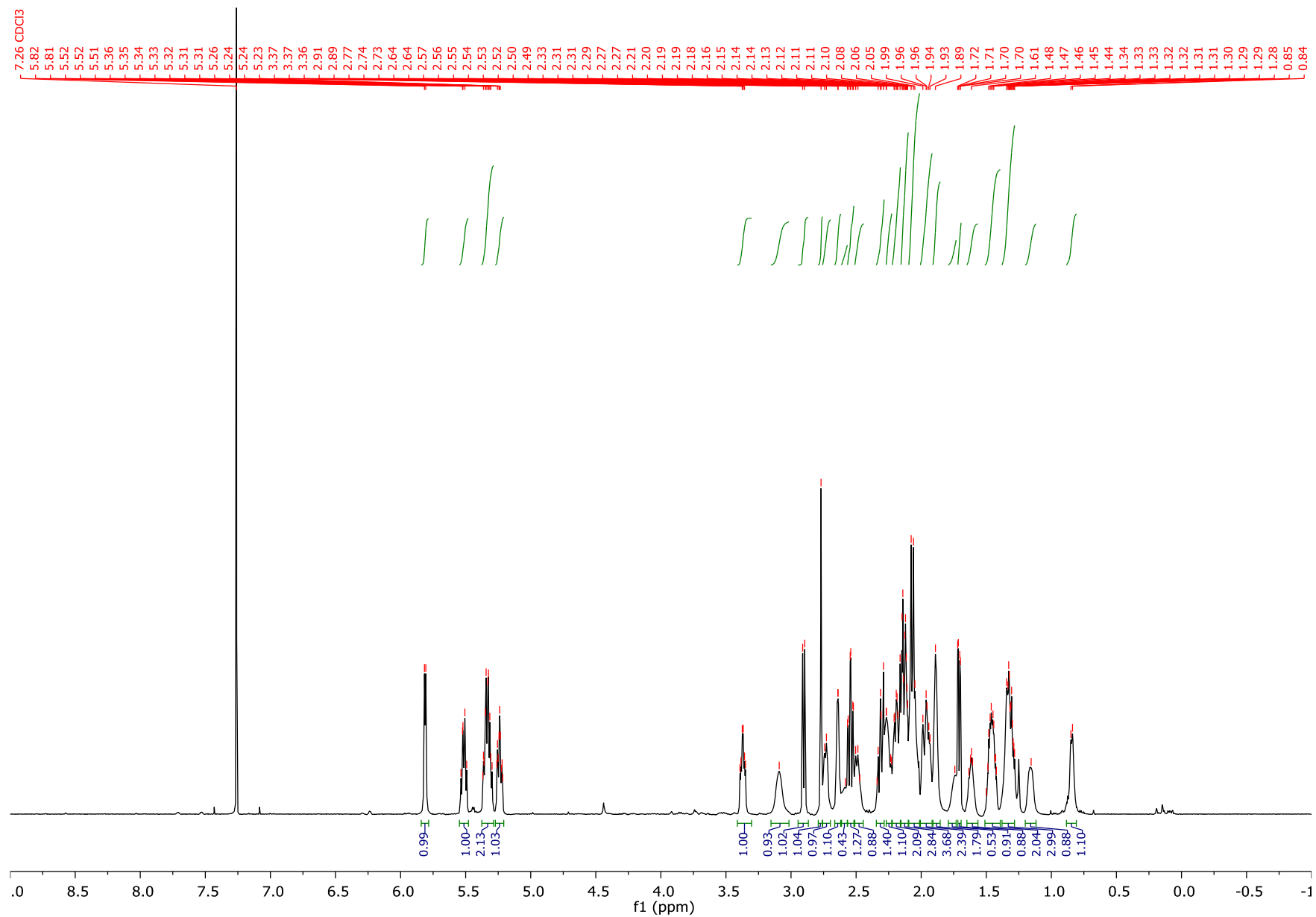
¹H NMR Spectrum of Proposed Xestocyclamine A (–)-1 (1 mg in 0.2 mL of CDCl₃, 600 MHz)



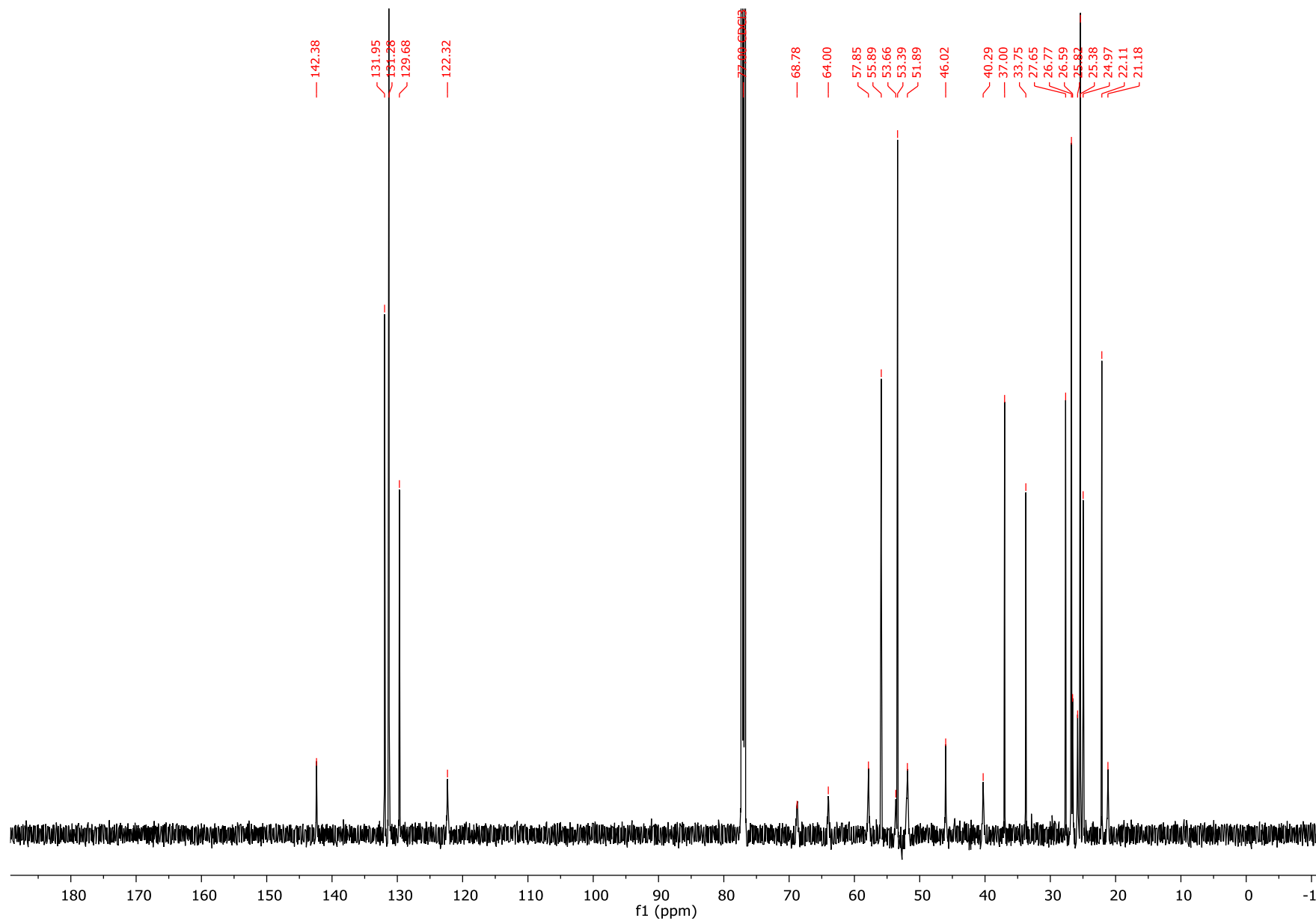
^{13}C NMR Spectrum of Proposed Xestocyclamine A (–)-1 (1 mg in 0.2 mL of CDCl_3 , 151 MHz)



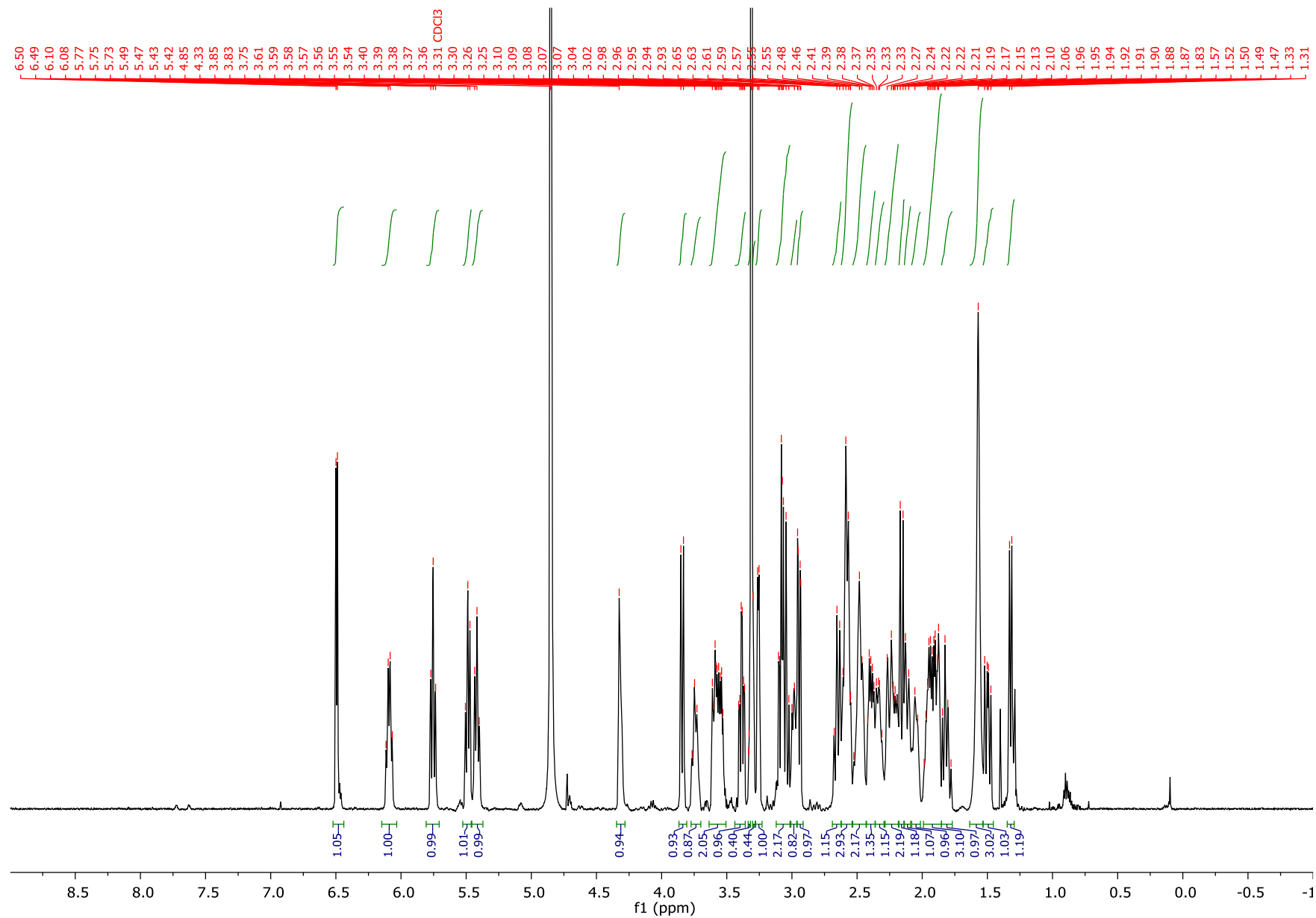
¹H NMR Spectrum of Proposed Xestocyclamine A (–)-1 (4 mg in 0.2 mL of CDCl₃, 600 MHz)



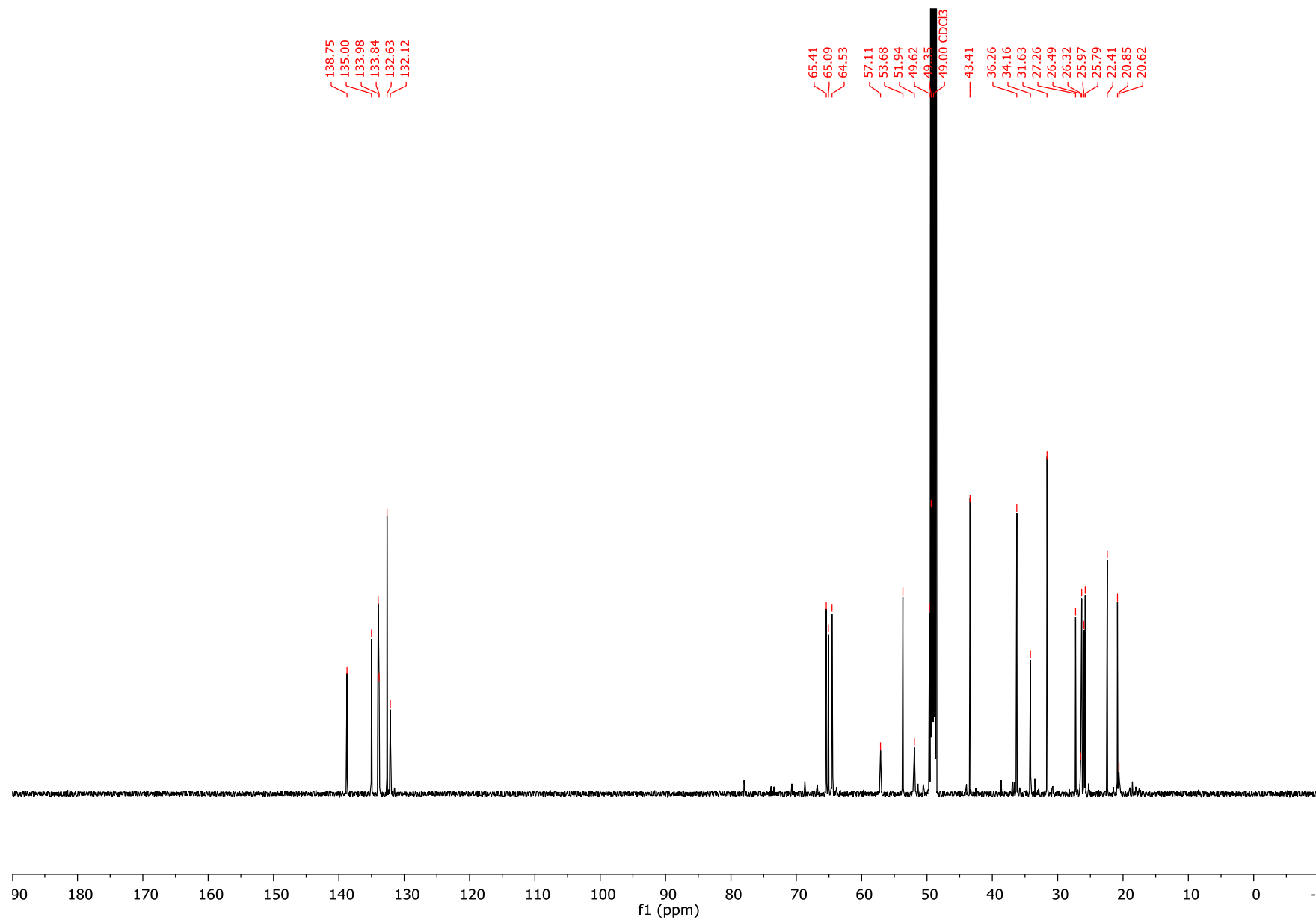
^{13}C NMR Spectrum of Proposed Xestocyclamine A (–)-1 (4 mg in 0.2 mL of CDCl_3 , 151 MHz)



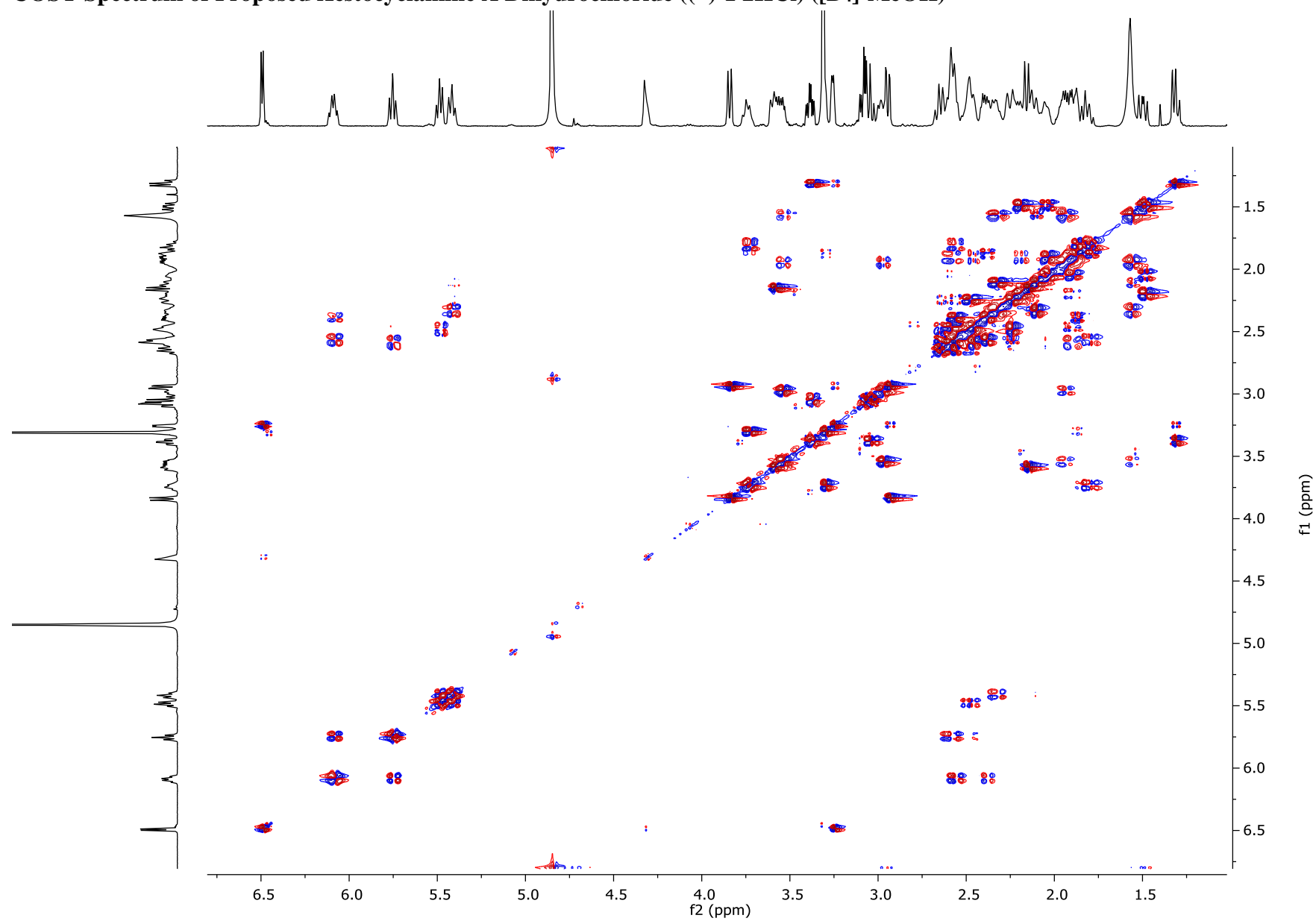
¹H NMR Spectrum of Proposed Xestocyclamine A Dihydrochloride ((-)-1·2HCl) (600 MHz, [D₄]-MeOH)



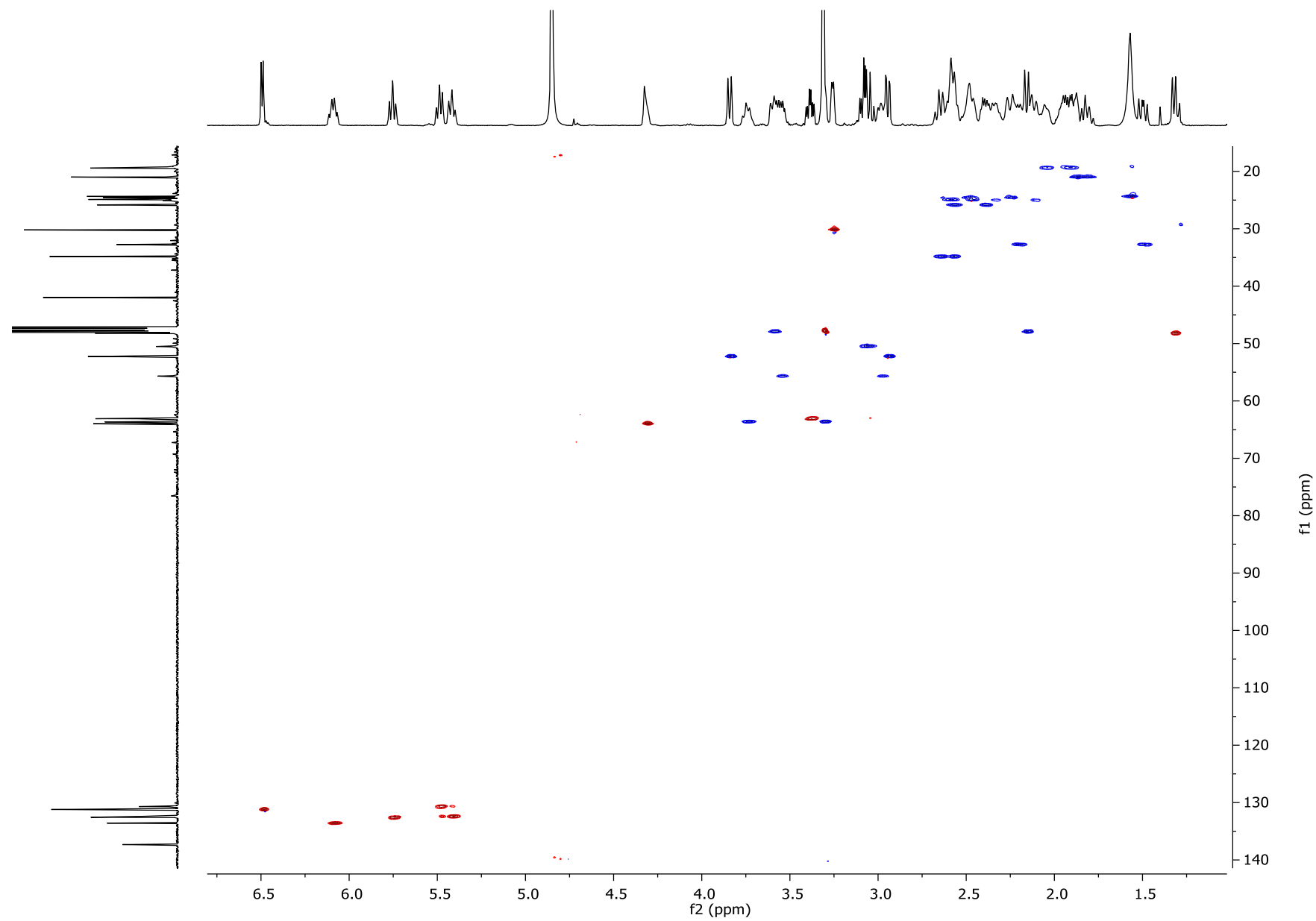
^{13}C NMR Spectrum of Proposed Xestocyclamine A Dihydrochloride ((-)-1·2HCl) (151 MHz, $[\text{D}_4]\text{-MeOH}$)



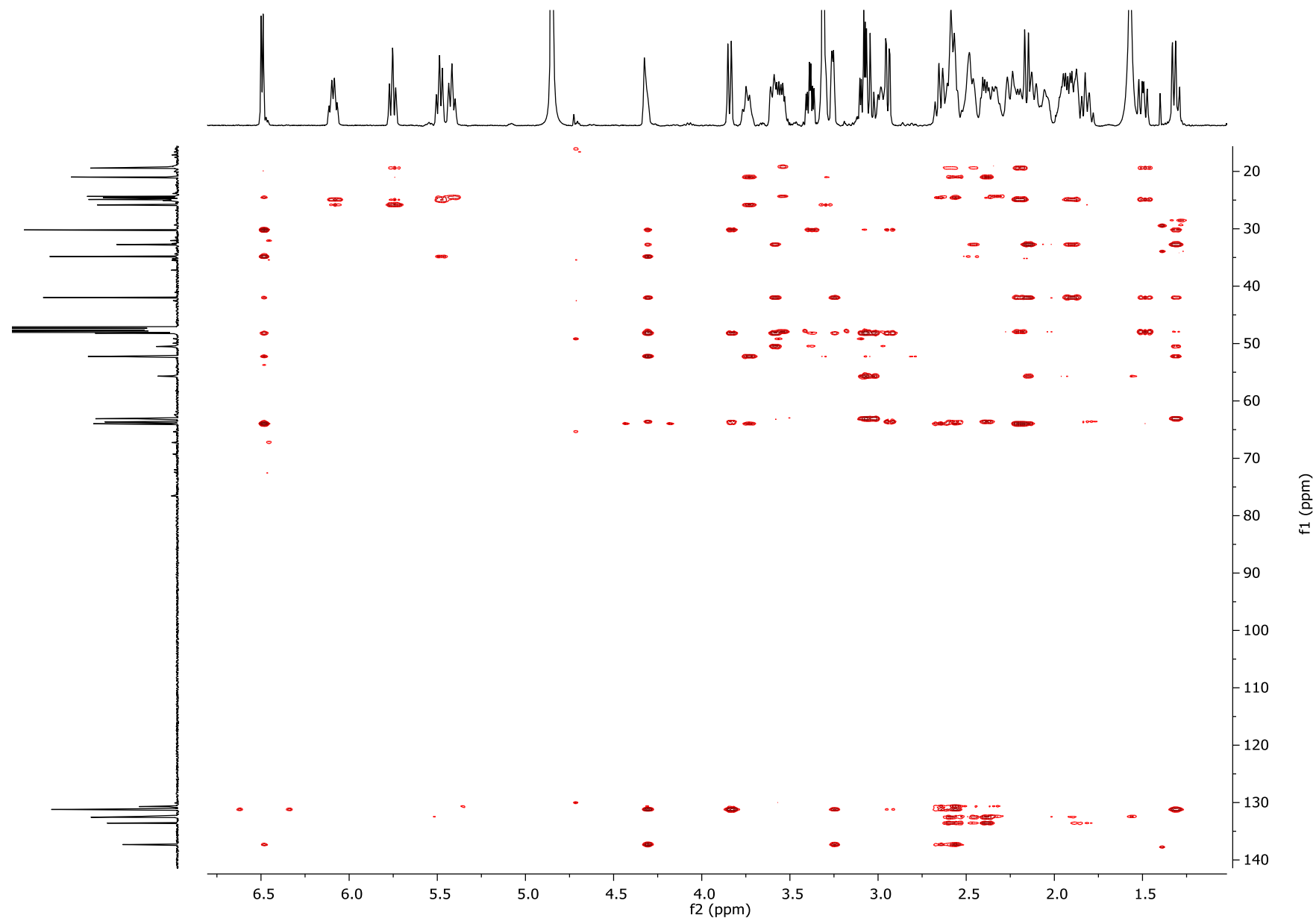
COSY Spectrum of Proposed Xestocyclamine A Dihydrochloride ((-)-1·2HCl) ([D₄]-MeOH)



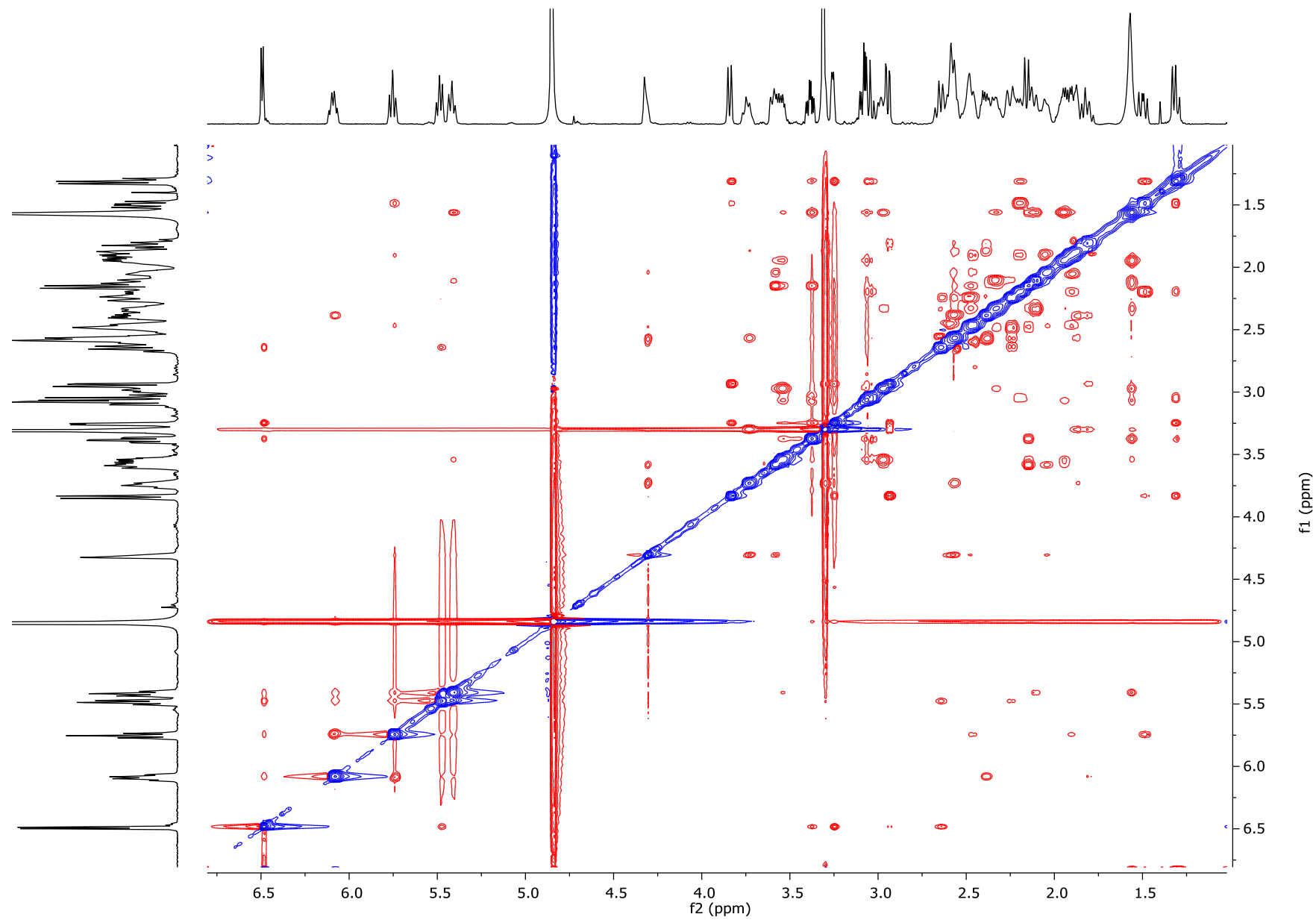
HMQC Spectrum of Proposed Xestocyclamine A Dihydrochloride ((-)-1·2HCl) ([D₄]-MeOH)



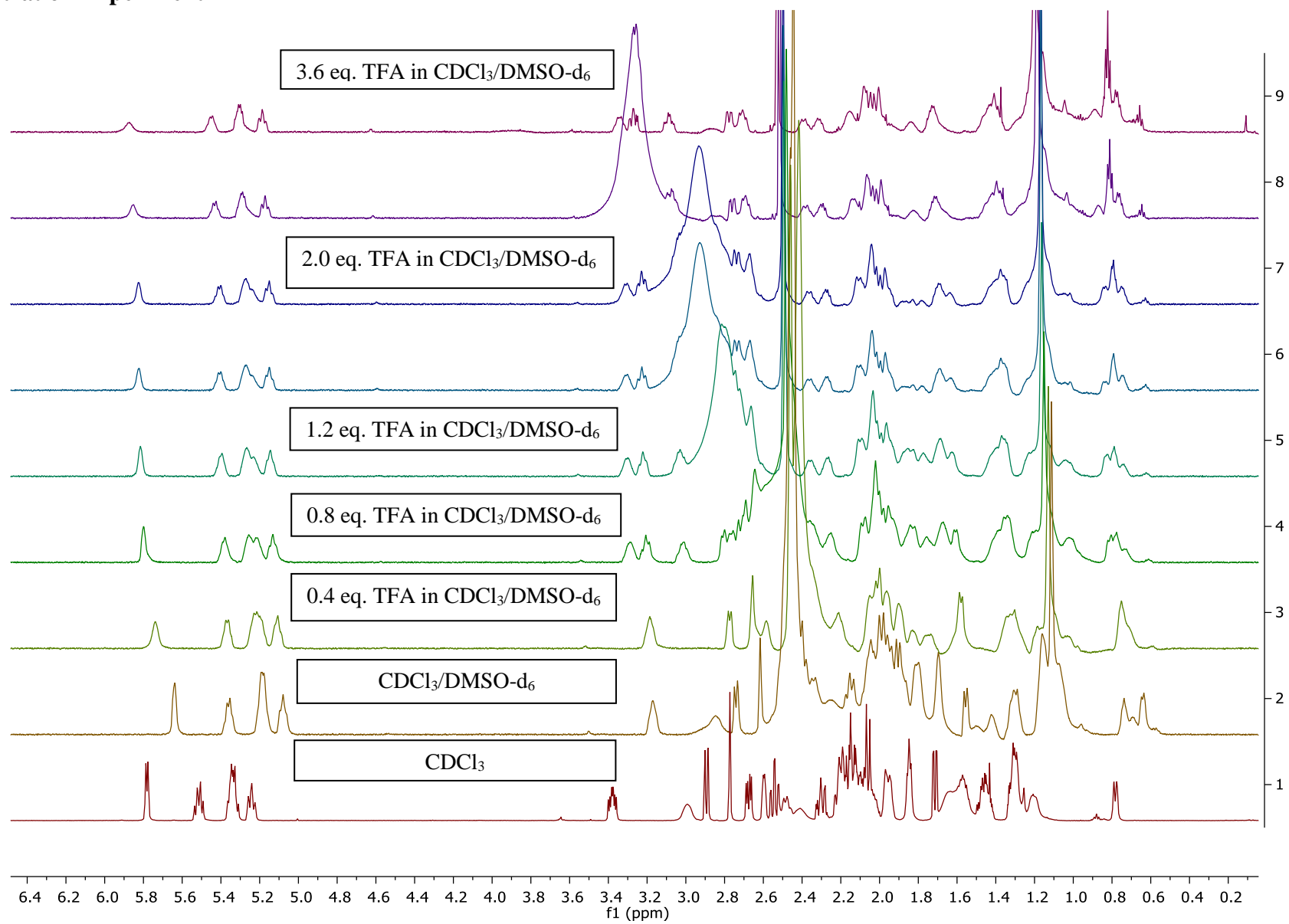
HMBC Spectrum of Proposed Xestocyclamine A Dihydrochloride ((-)-1·2HCl) ([D₄]-MeOH)



NOESY Spectrum of Proposed Xestocyclamine A Dihydrochloride ((-)-1·2HCl) ([D₄]-MeOH)

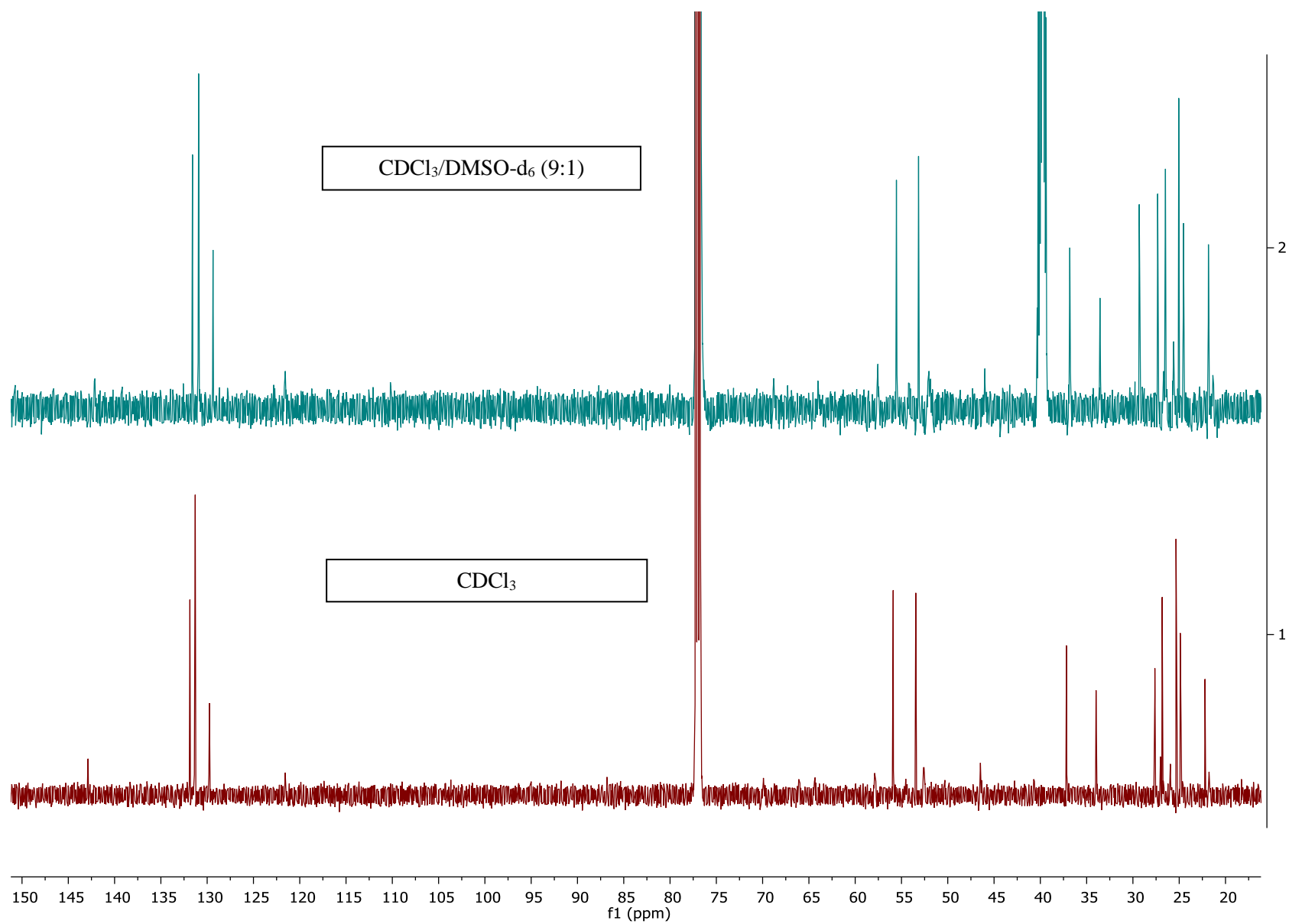


Tritration Experiment

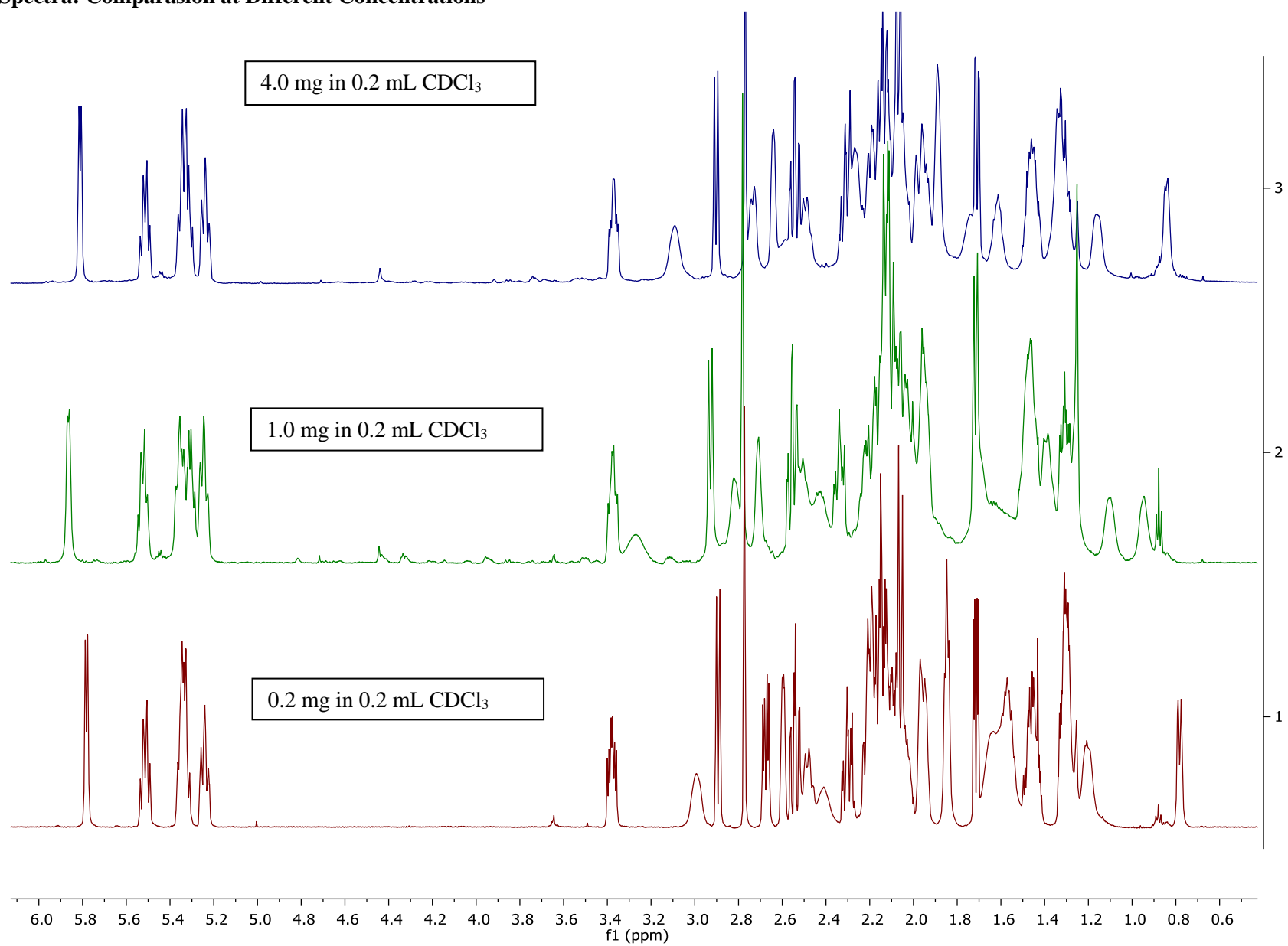


CDCl_3

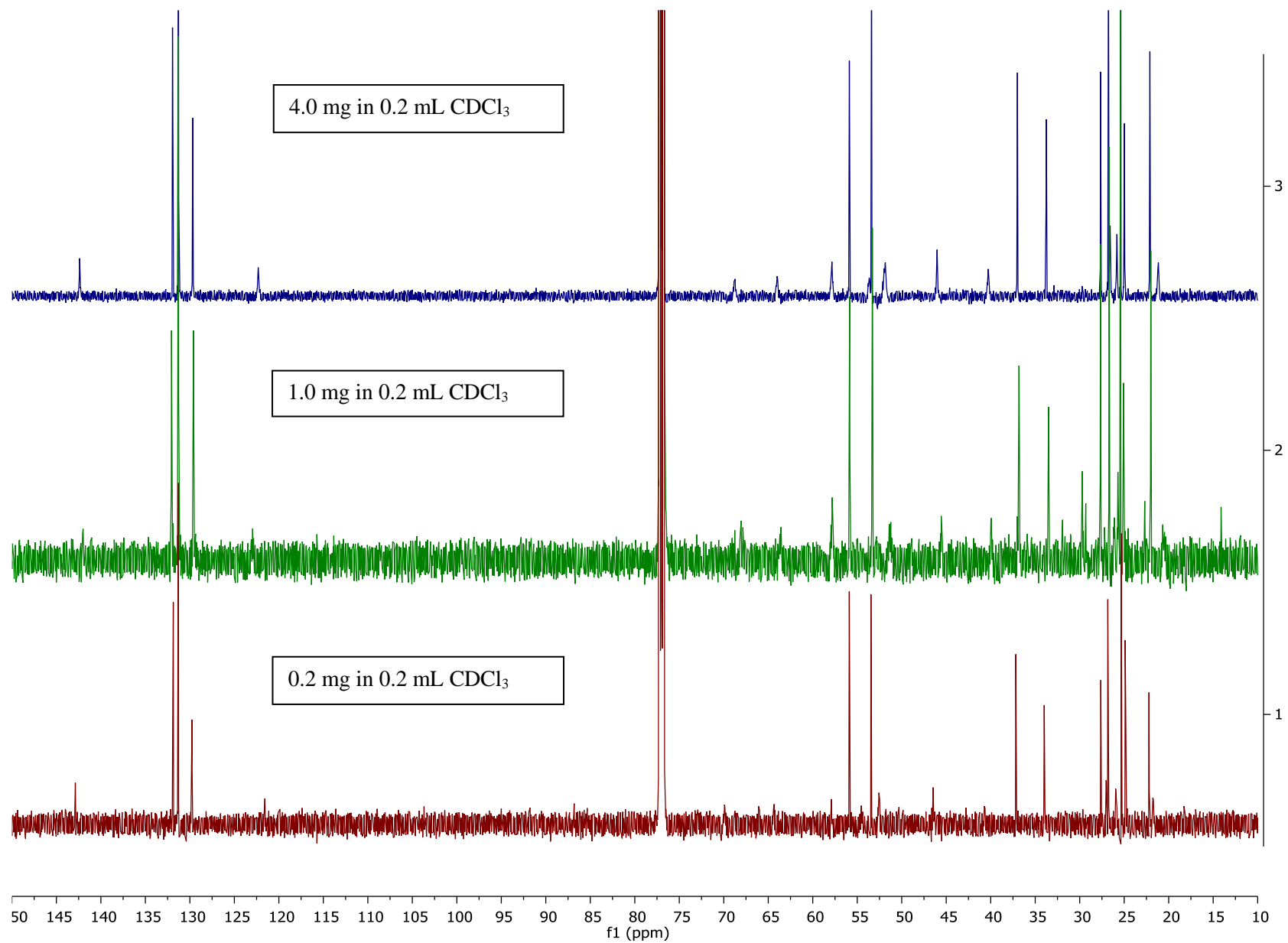
¹³C Spectra: Comparasion in Different Solvent Systems



¹H Spectra: Comparasion at Different Concentrations

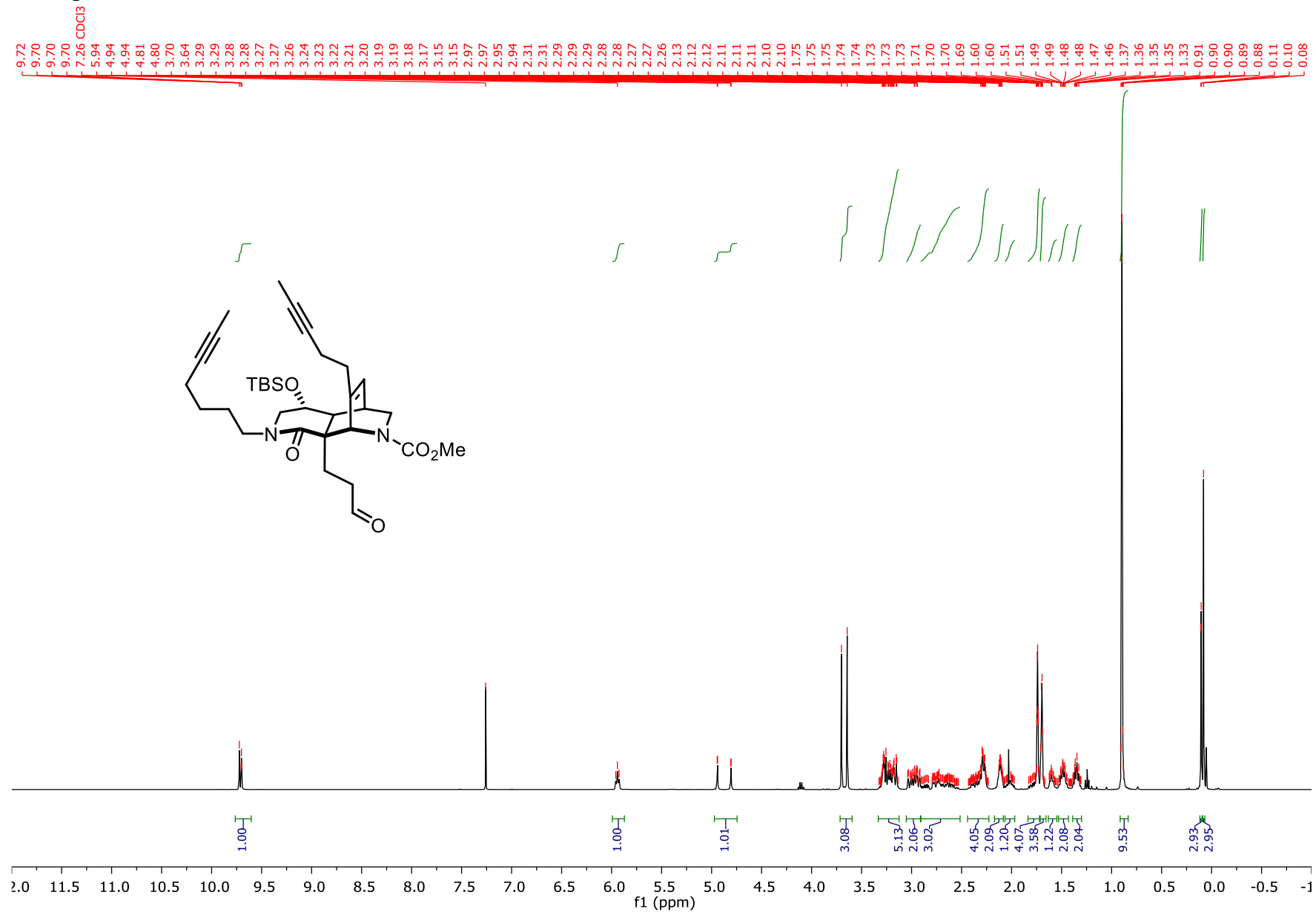


¹³C Spectra: Comparison at Different Concentrations

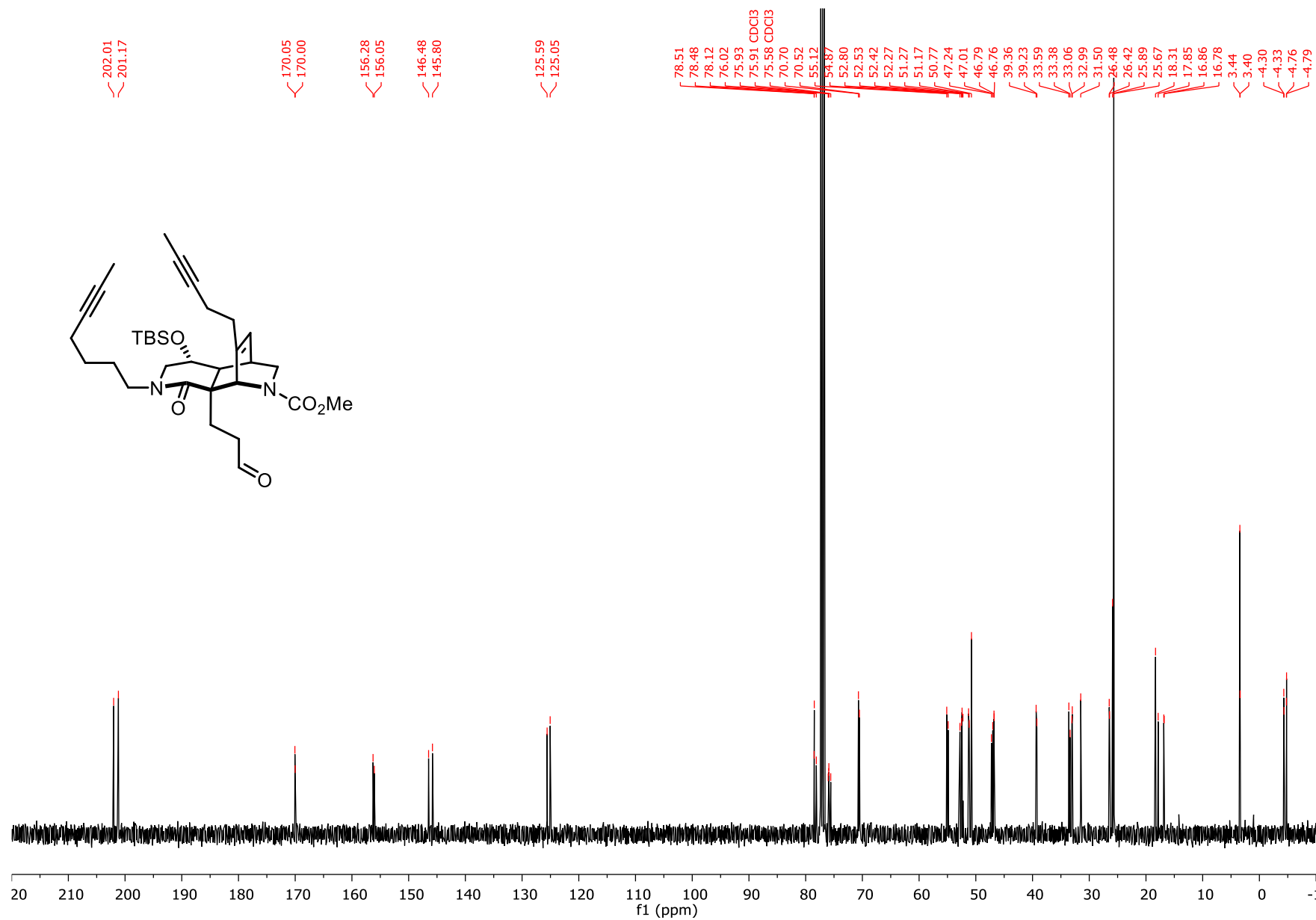


NEW COMPOUNDS TOWARDS INGENAMINE

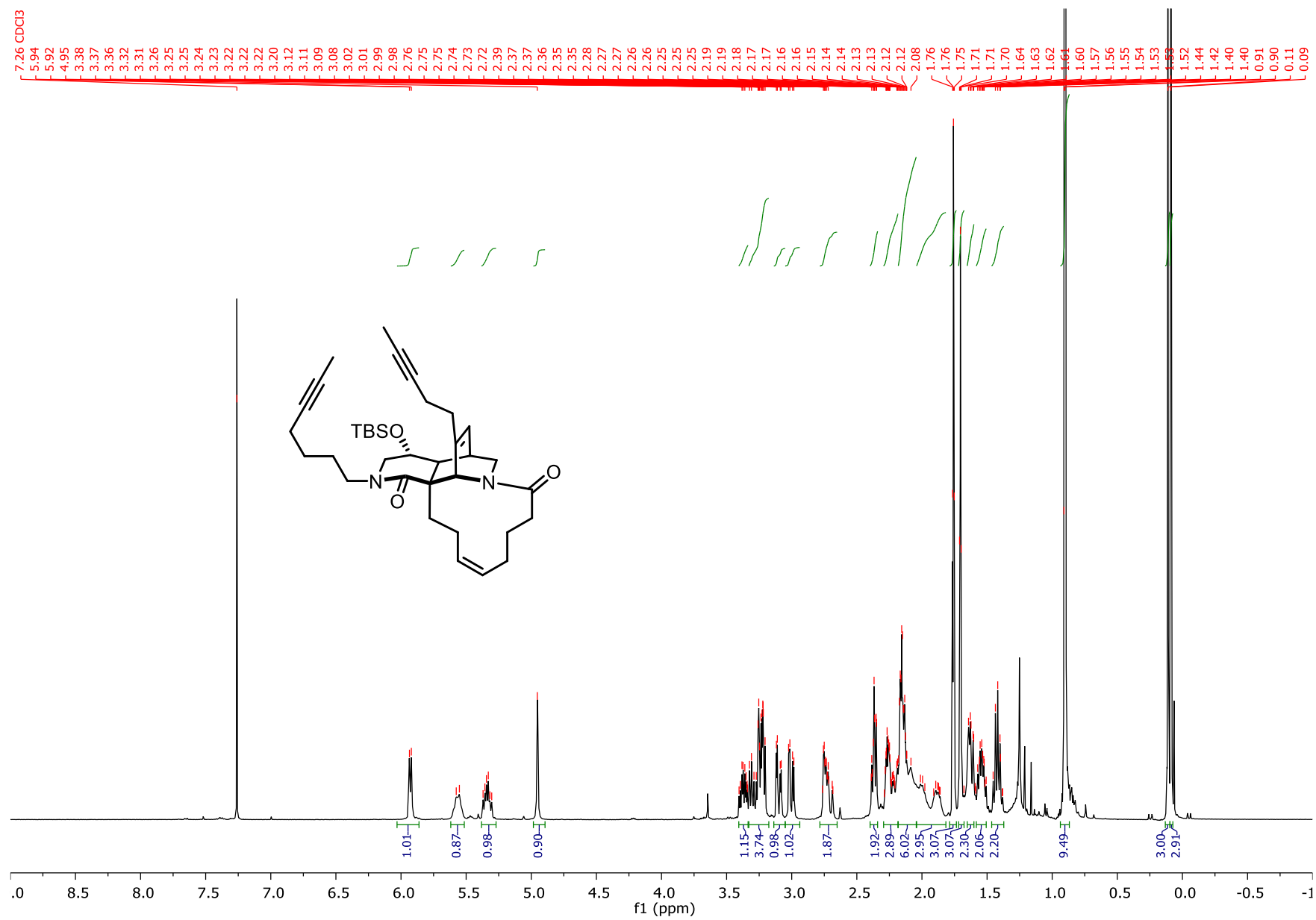
¹H NMR Spectrum of 24 (400 MHz, CDCl₃)



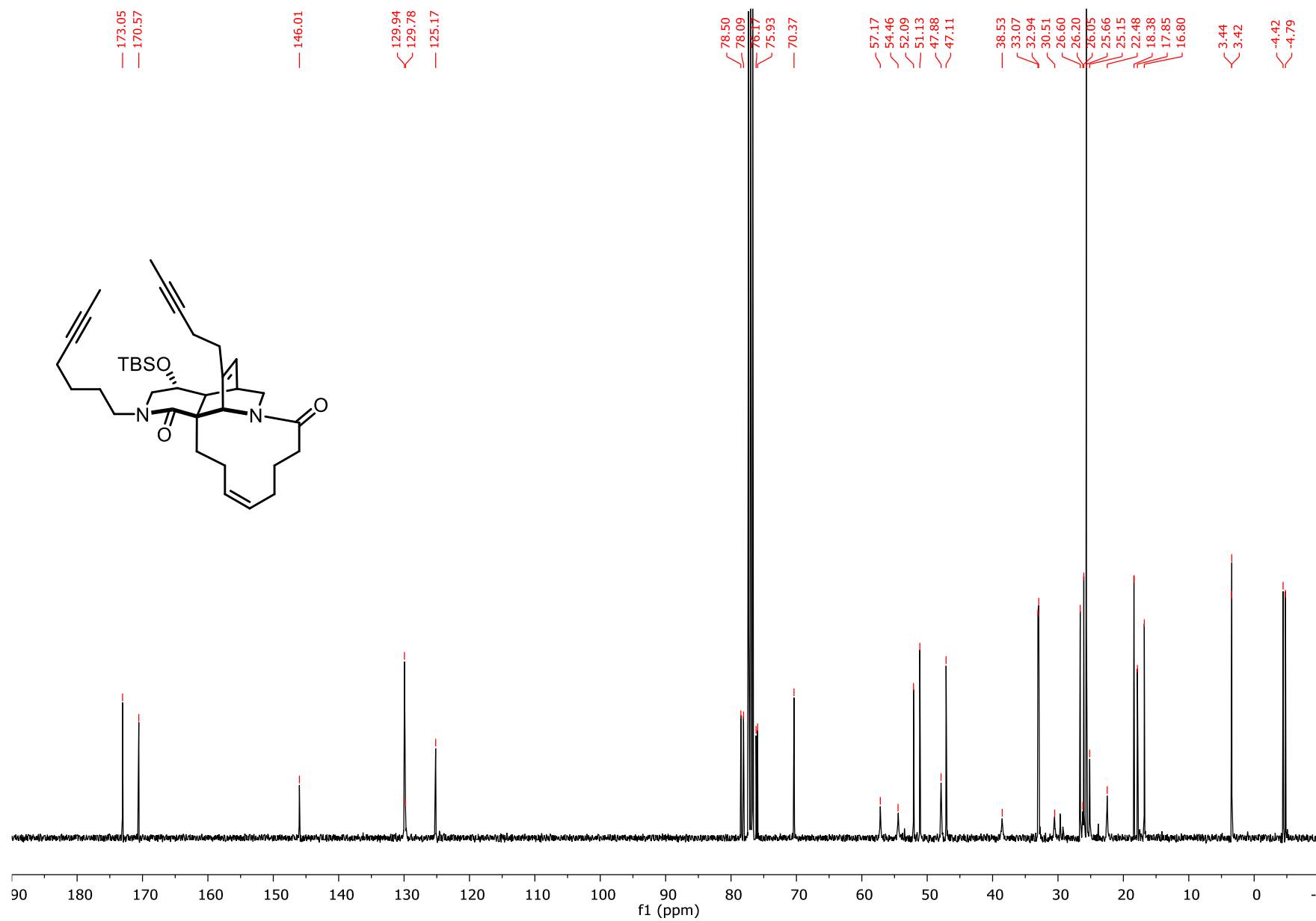
^{13}C NMR Spectrum of 24 (101 MHz, CDCl_3)



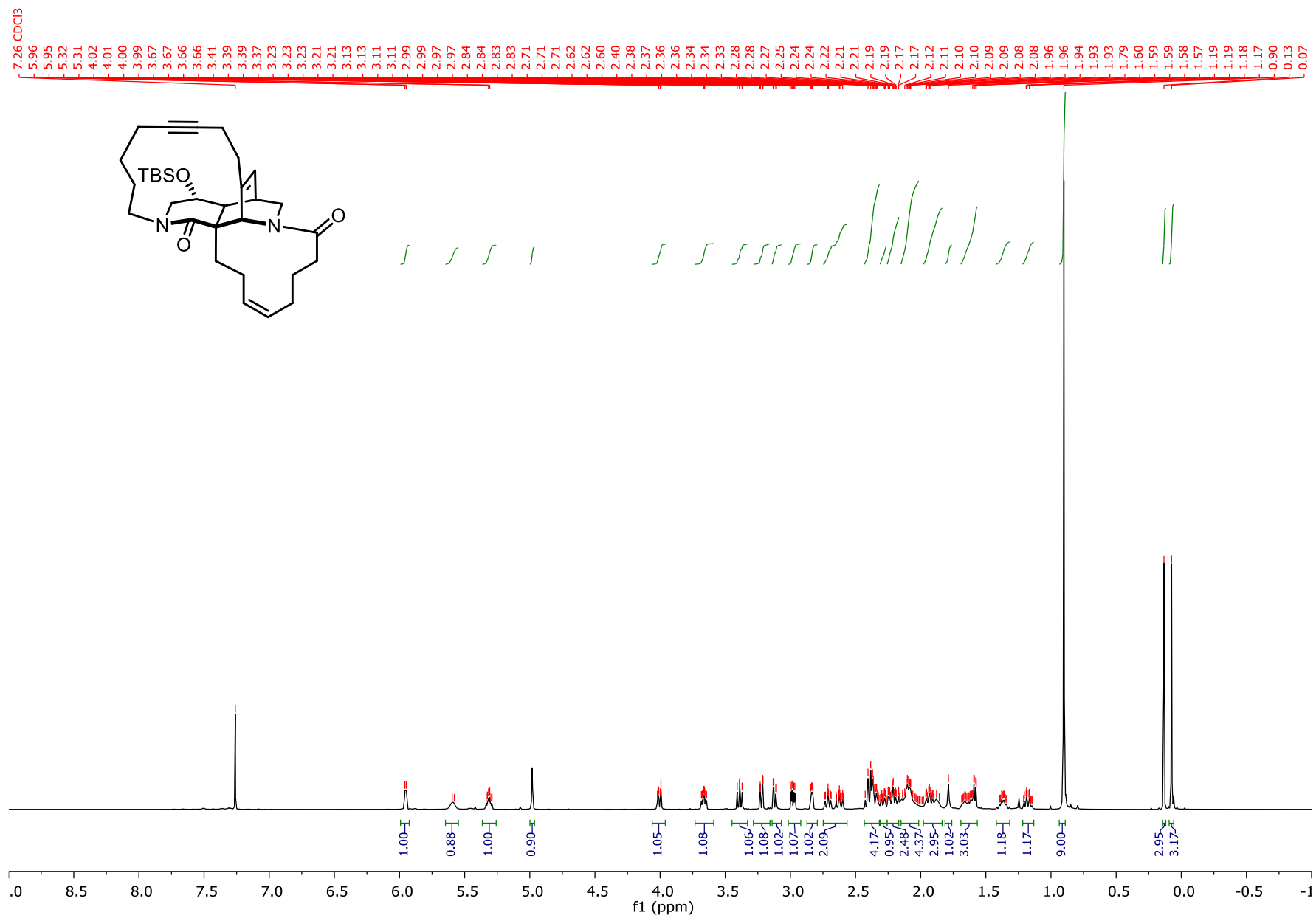
^1H NMR Spectrum of 28 (400 MHz, CDCl_3)



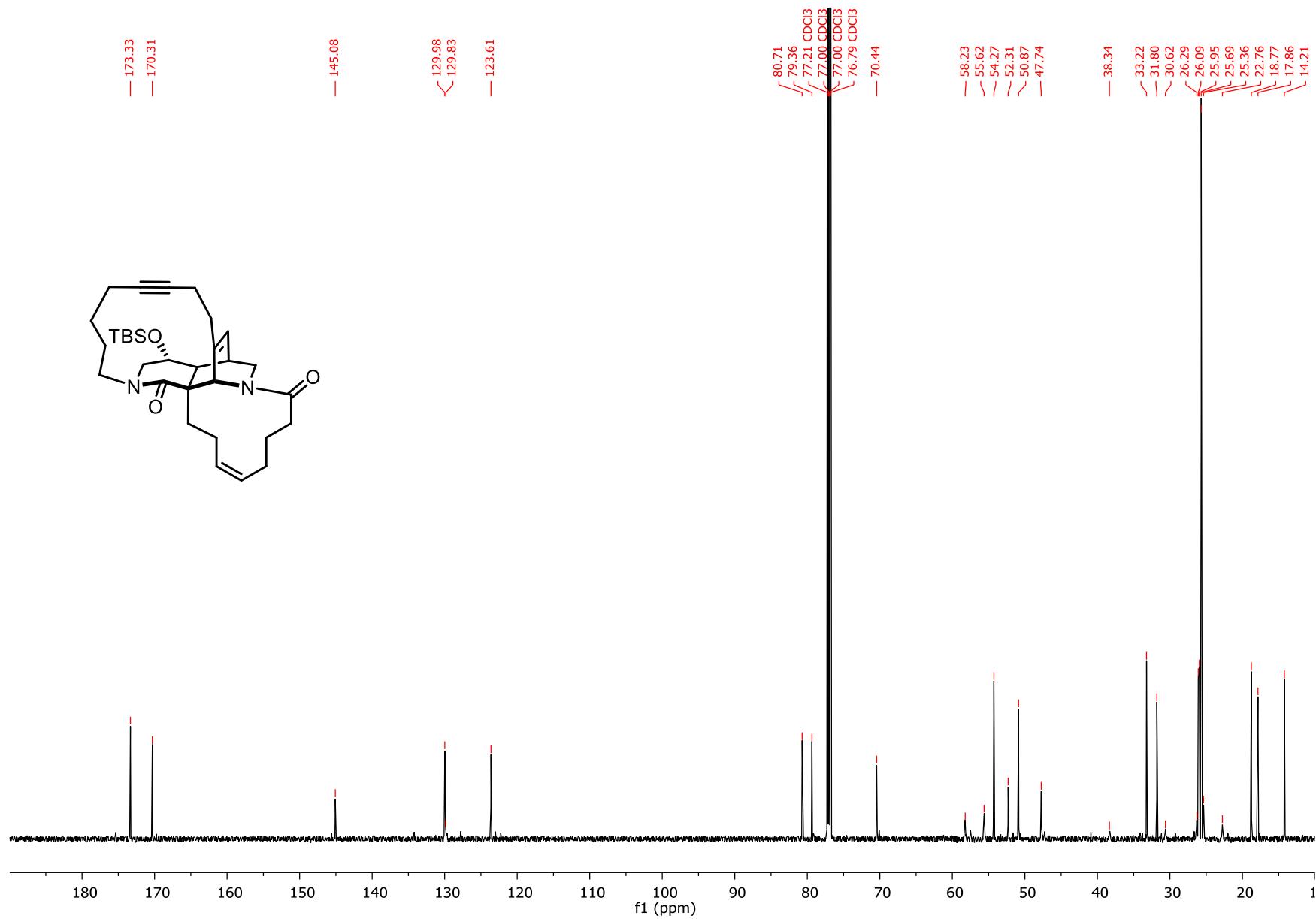
^{13}C NMR Spectrum of 28 (101 MHz, CDCl_3)



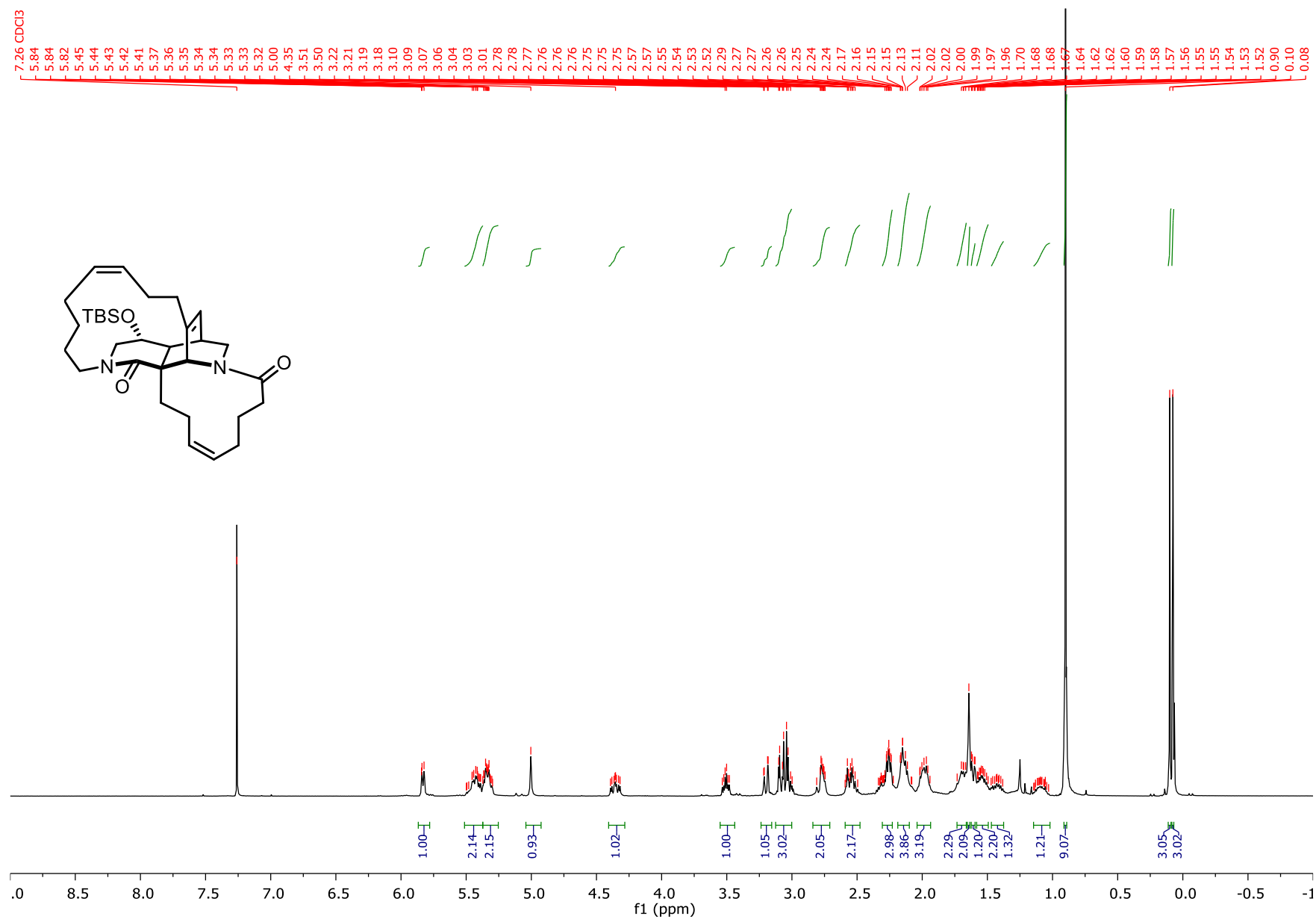
^1H NMR Spectrum of 29 (600 MHz, CDCl_3)



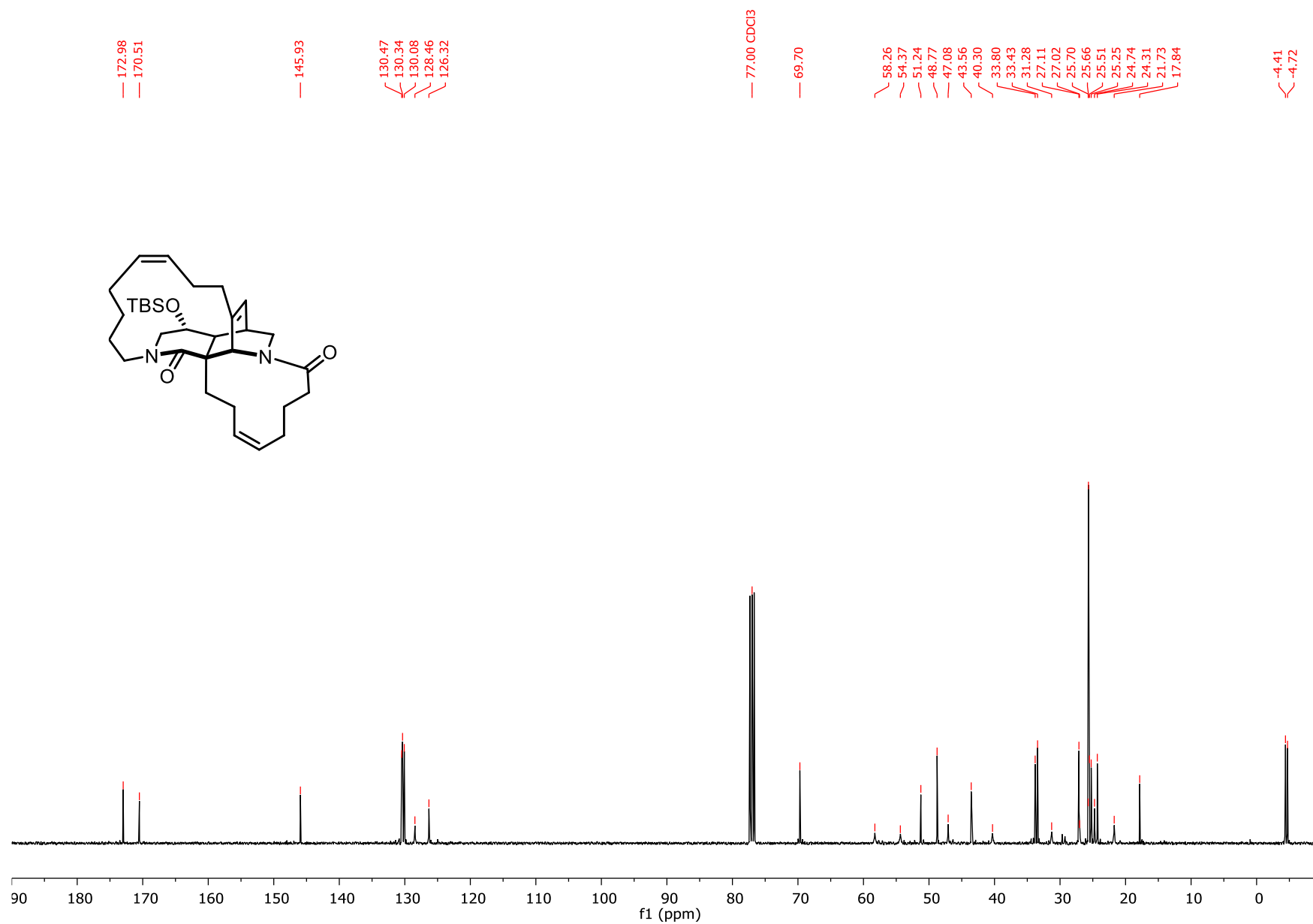
^{13}C NMR Spectrum of 29 (151 MHz, CDCl_3)



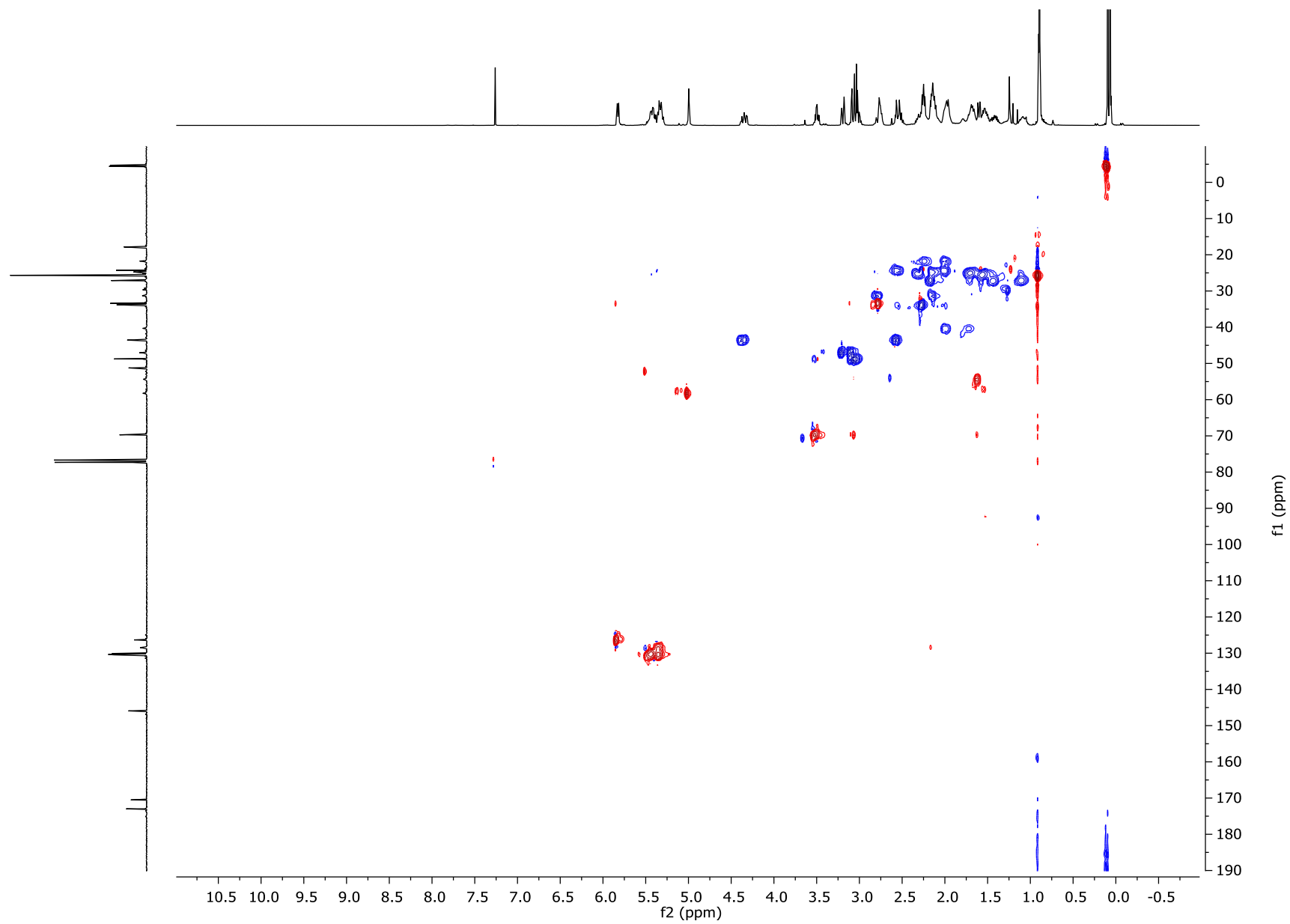
¹H NMR Spectrum of S-5 (400 MHz, CDCl₃)



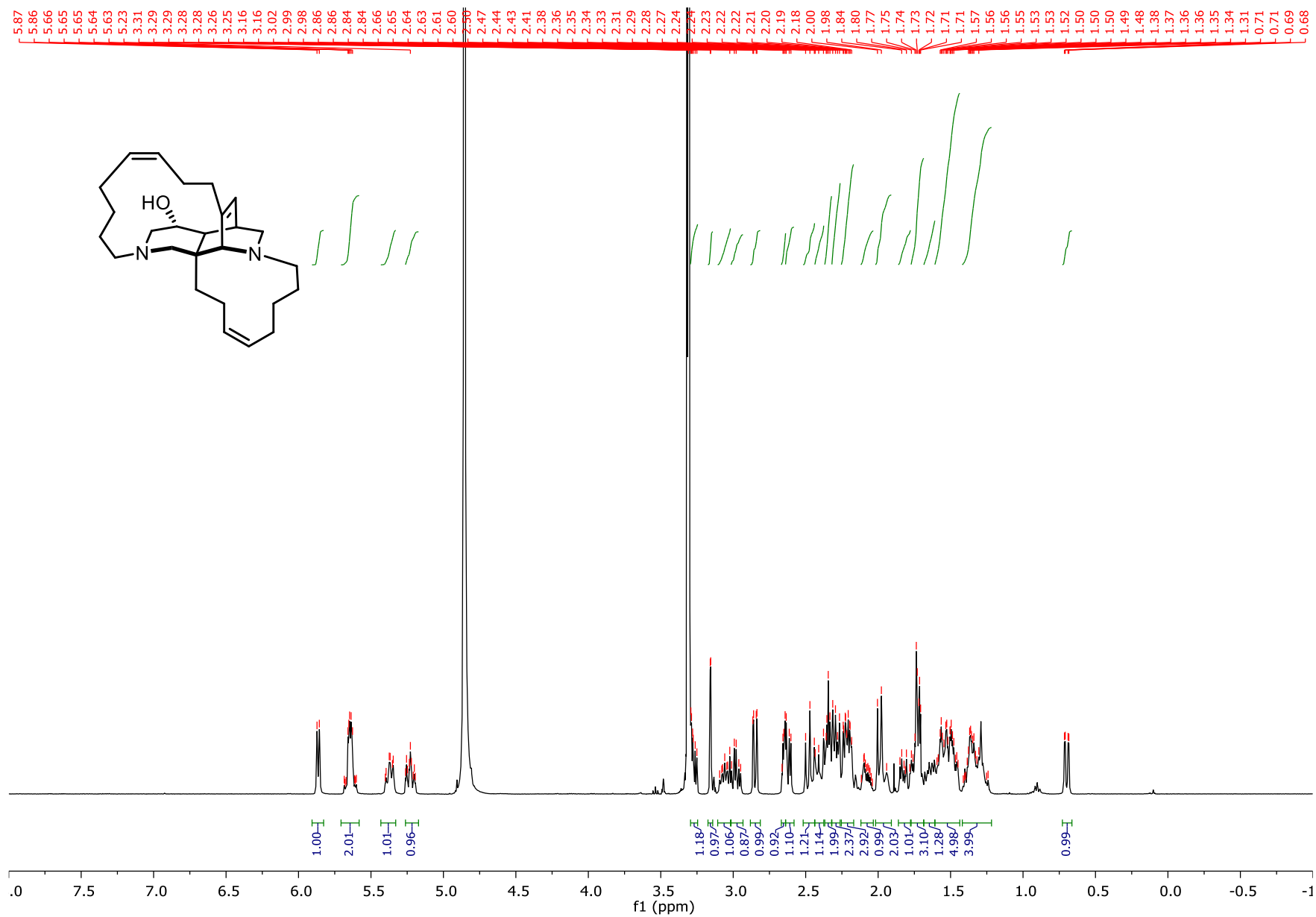
^{13}C NMR Spectrum of S-5 (101 MHz, CDCl_3)



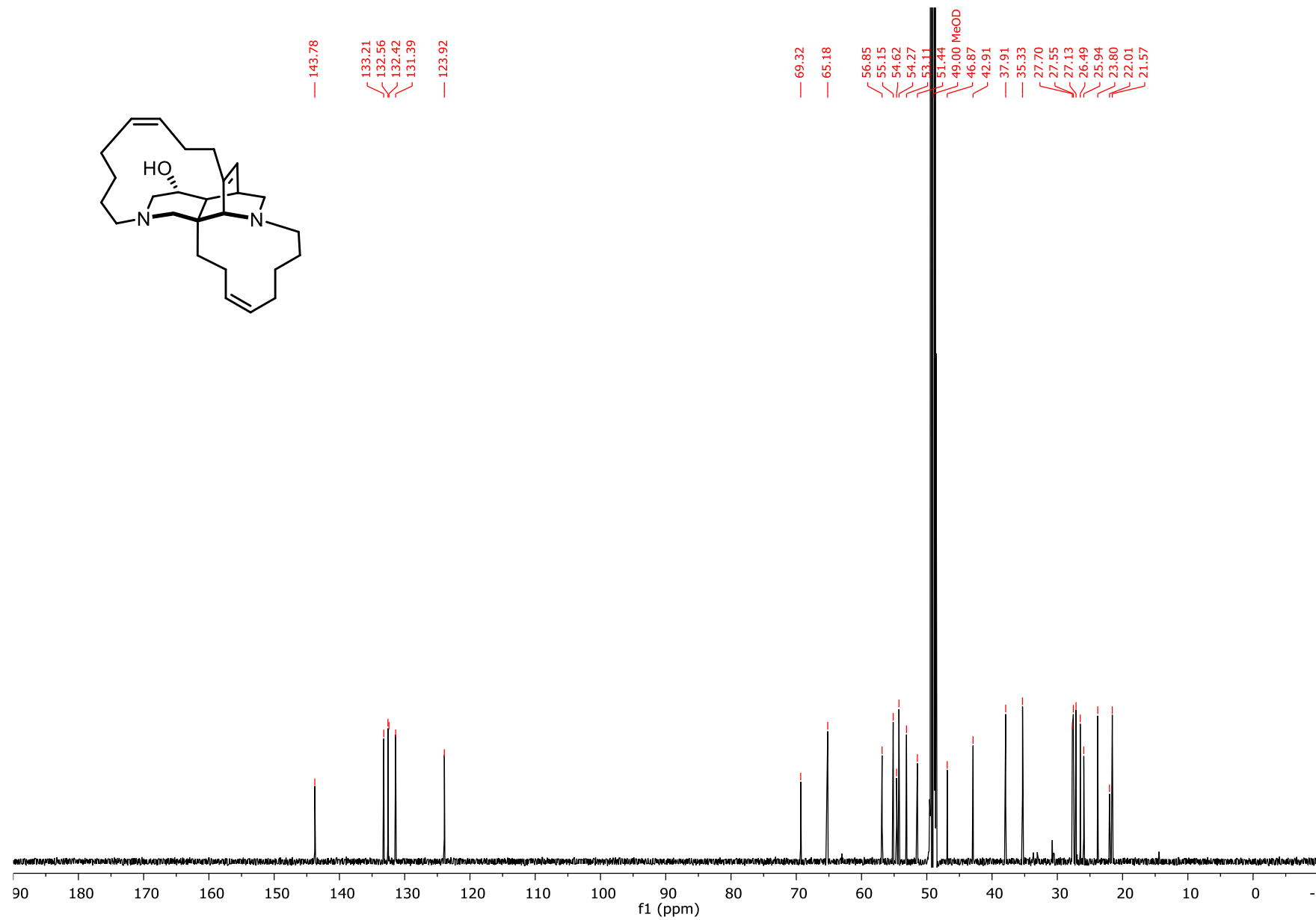
HSQC Spectrum of S-5



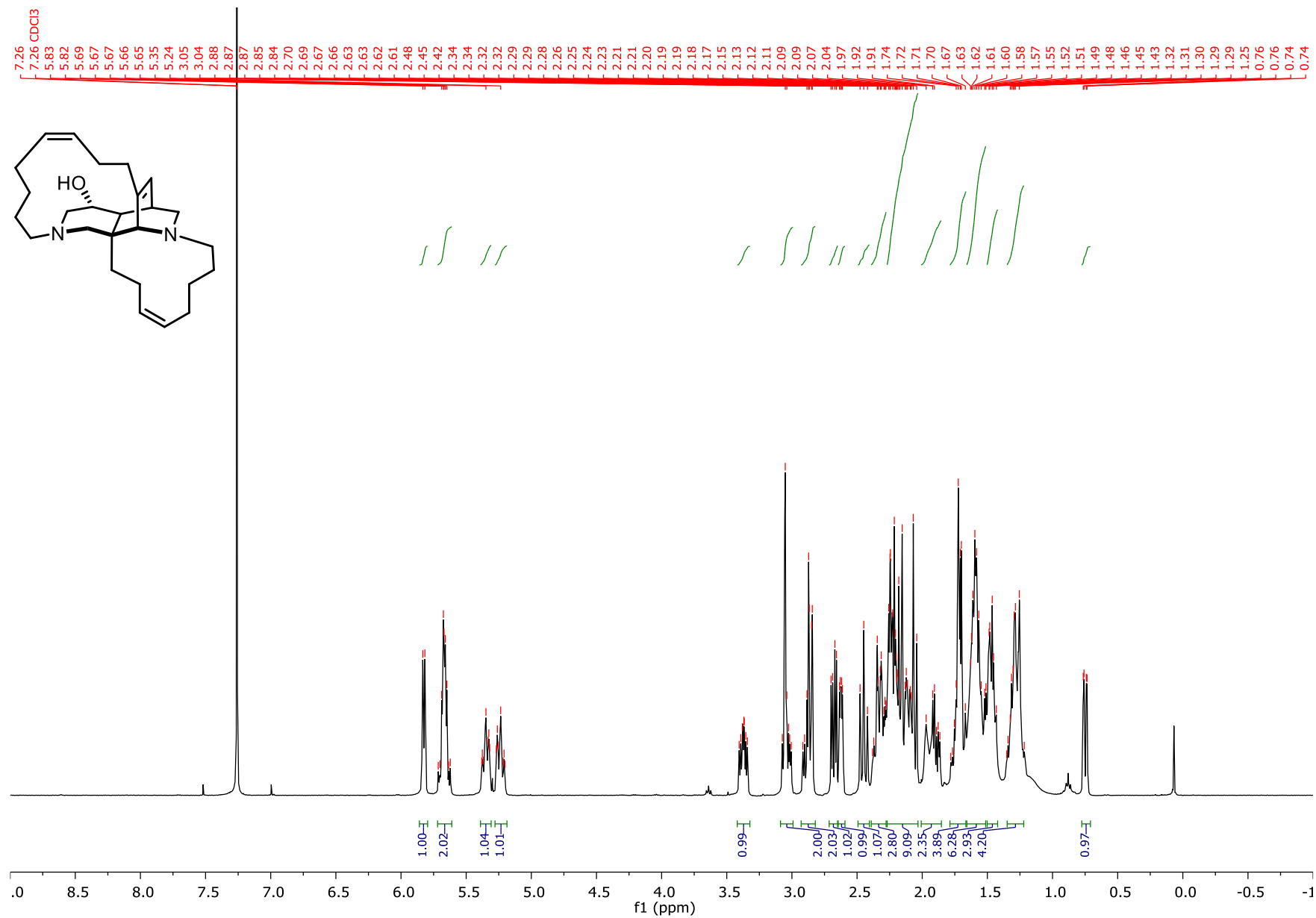
¹H NMR Spectrum of (-)-Ingenamine (-)-3 (400 MHz, methanol-d₄)



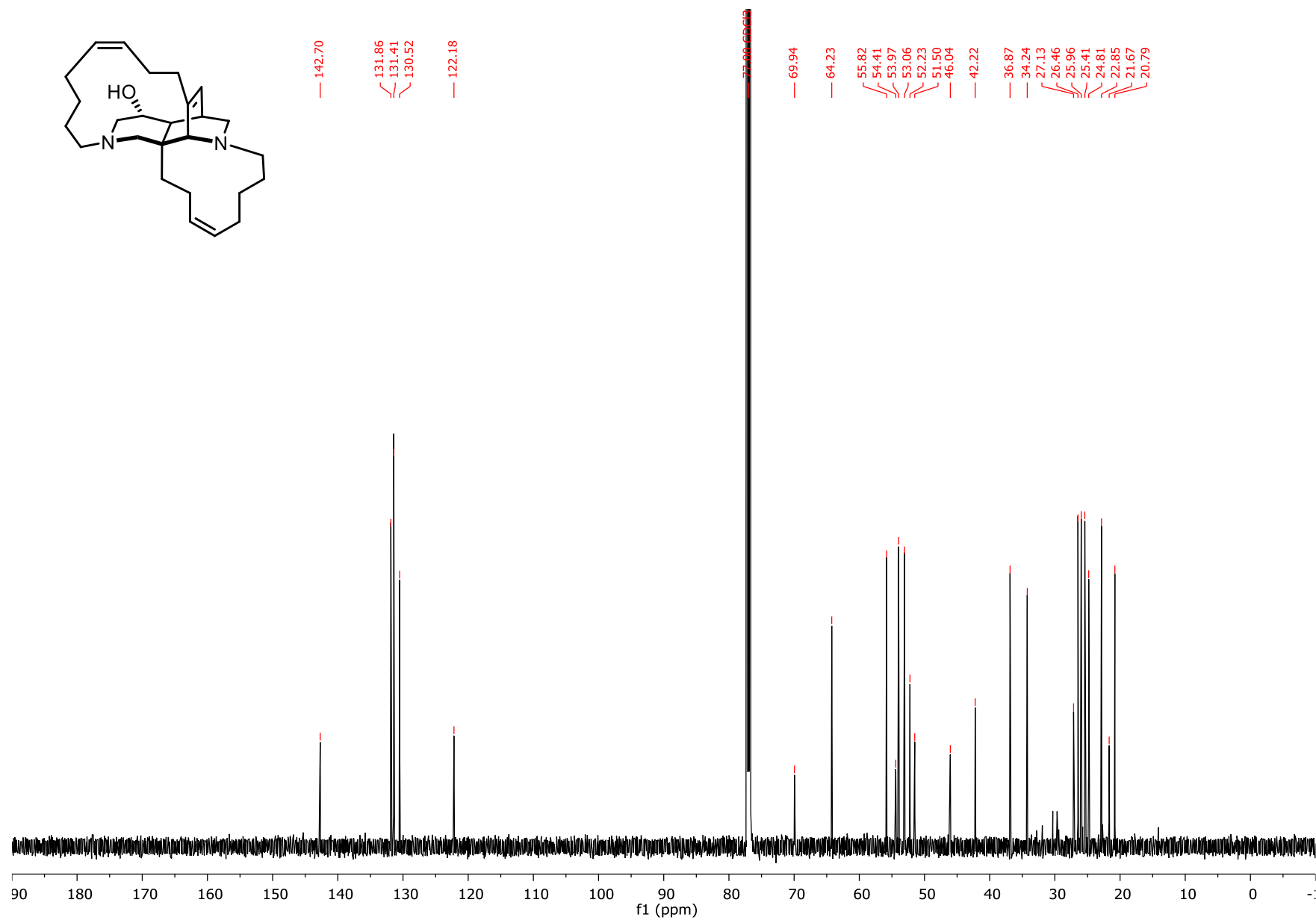
^{13}C NMR Spectrum of (–)-Ingenamine (–)-3 (151 MHz, methanol- d_4)



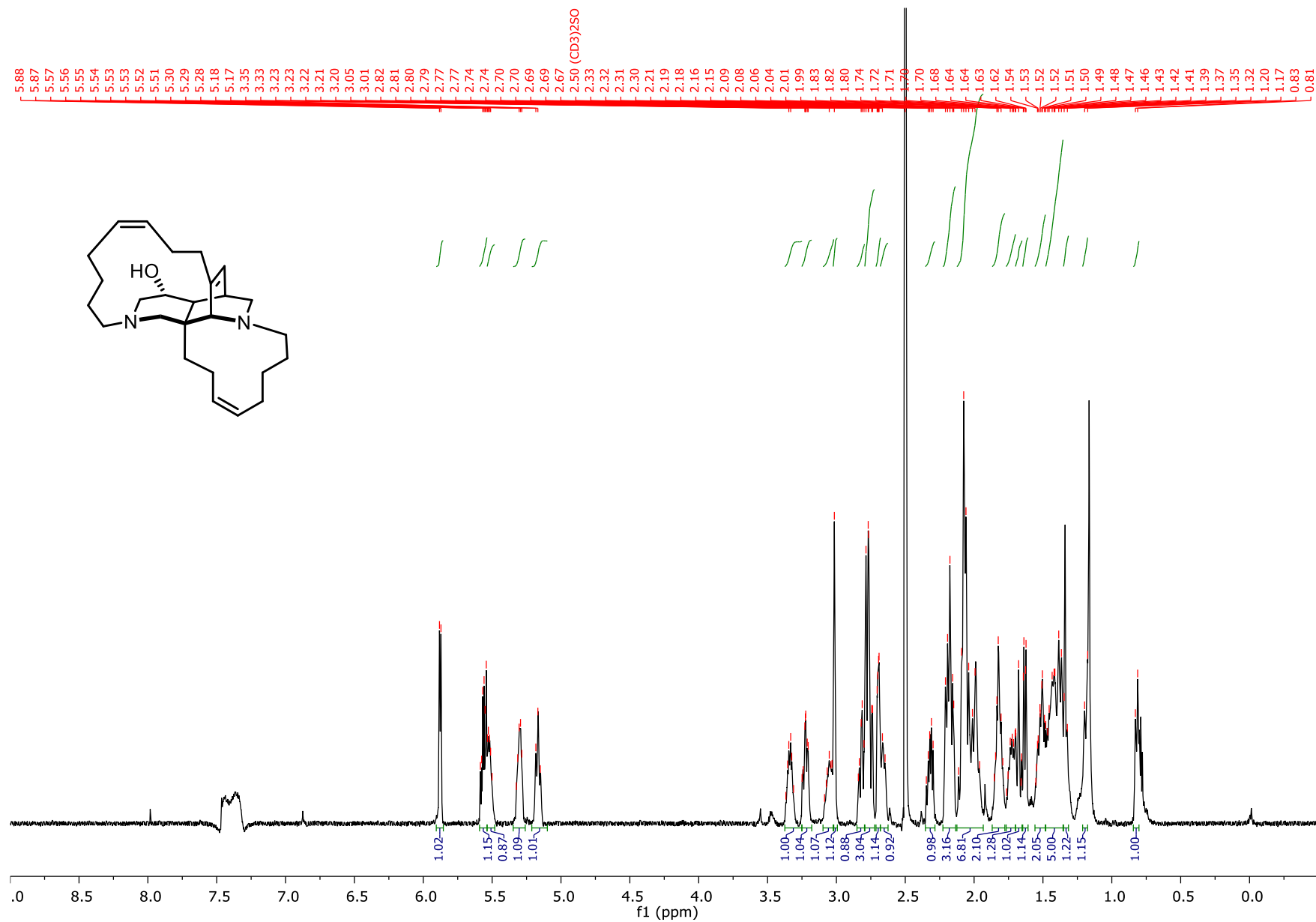
¹H NMR Spectrum of (-)-Ingenamine (-)-3 (400 MHz, CDCl₃)



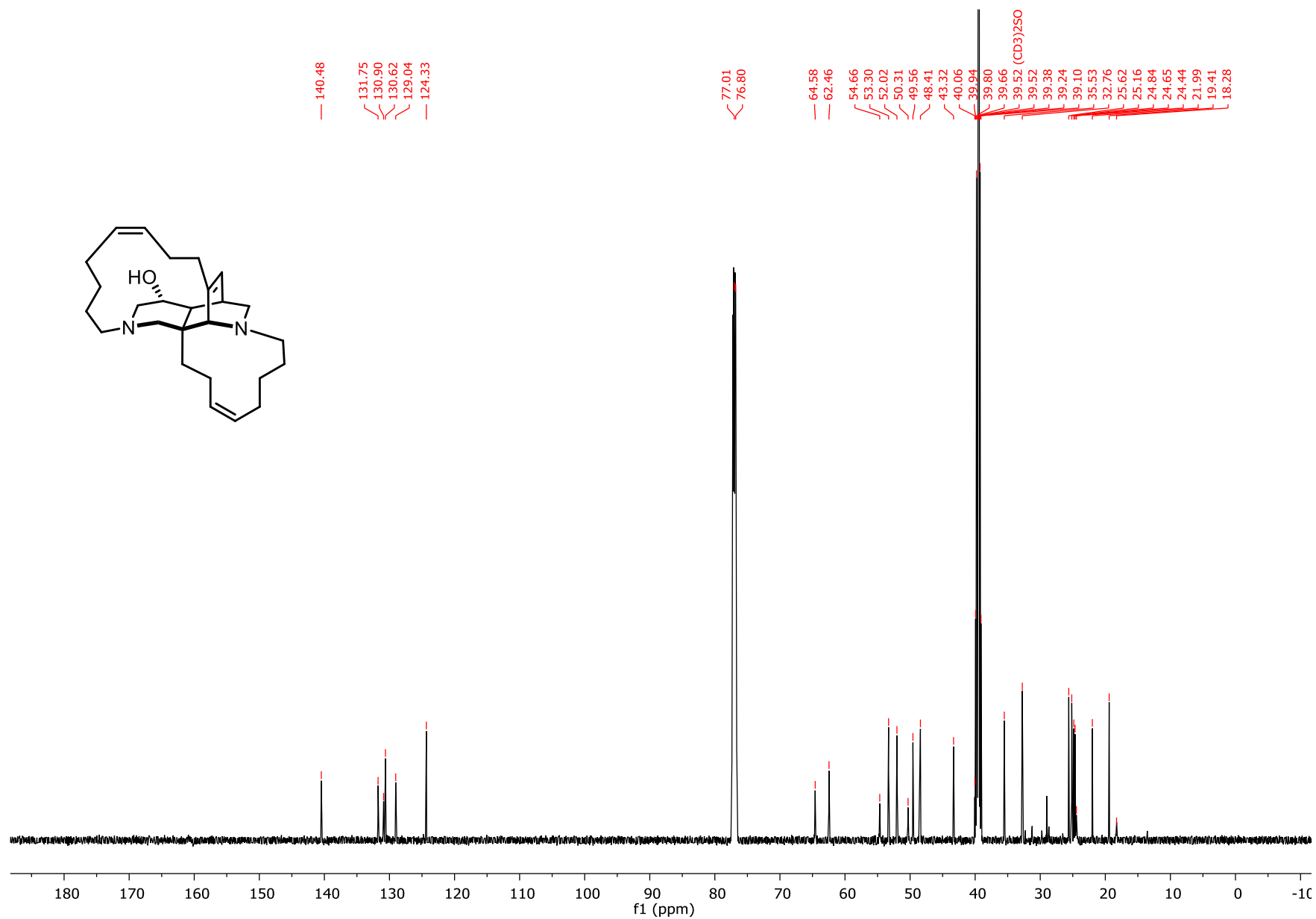
^{13}C NMR Spectrum of (–)-Ingenamine (151 MHz, CDCl_3)



¹H NMR Spectrum of (–)-Ingenamine (–)-3 (600 MHz, CDCl₃/DMSO-*d*₆, 10:1, 0.4 eq. TFA)



^{13}C NMR Spectrum of (–)-Ingenamine (–)-3 (151MHz, $\text{CDCl}_3/\text{DMSO}-d_6$, 10:1, 0.4 eq. TFA)



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