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Supporting Information

β-C(sp2)–H Alkylation of Enamides using Xanthate Chemistry

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TABLE OF CONTENT.

CRYSTALLOGRAPHIC DATA COLLECTION, STRUCTURE DETERMINATION AND REFINEMENT.

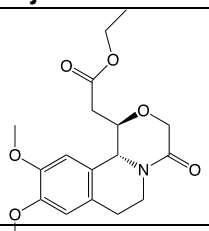
X-ray diffraction data for *trans*-**5j** were measured using a RIGAKU diffractometer constituted by a MM007 HF rotating-anode generator, delivering copper radiation through Osmic CMF confocal optics, and a Rapid II curved Image Plate detector. *Fs_process*[1] software under the *CrystalClear 2.0*[1] suite was used to integrate and scale the data, applying multi-scan *REQAB*[2] for the absorption correction. The structure was solved by intrinsic phasing methods (*SHELXT* program),[2] then refined by full-matrix least-squares methods on F^2 using *SHELX-L*.[3] All non-hydrogen atoms of the molecules of interest improved by anisotropic refinement. Most of the H atoms were identified in difference maps nevertheless methyl H atoms were idealized and included as rigid groups allowed to rotate but not tip, and refined with U_{iso} set to $1.5U_{eq}$(C) of the parent carbon atom. All other H atoms bound to carbon atoms were positioned geometrically and refined with U_{iso} set to $1.2U_{eq}$(C) of the parent carbon atom. The asymmetric unit of the racemic unit cell is made of one molecule (Fig. 1), whose heterobicycle conformations of the oxazinoisoquinoline platform significantly differ from the almost flat overall parent structure[4] (CSD[5] refcode ROTSOK) due to the di-substitution of the morpholinic moiety (Fig. 2) : the piperidine moiety adopts a boat-conformation *versus* an half-chair in the unsubstituted platform and the morpholinic one features an envelope conformation *versus* a chair conformation respectively.

Crystal data, data collection and structure refinement details are summarized in Table 1 (see below).

CCDC 1917239 contains the supplementary crystallographic data for this paper. These data can be obtained free of charge from the Cambridge Crystallographic Data Centre via www.ccdc.cam.ac.uk/data_request/cif.

1. Rigaku. (2009) *CrystalClear-SM Expert 2.0 r4* Rigaku Corporation, Tokyo, Japan.
2. G. M. Sheldrick, *Acta Crystallogr.,* 2015, **C71**, 3.
3. G. M. Sheldrick, *Acta Crystallogr.,* 2015, **A71**, 3.
4. A. Saidov, E. Y. Mazur, K. K. Turgunov, B. Tashkhodzhaev, M. G. Levkovich and V. I. Vinogradova, *Chem. Nat. Compd.,* 2014, **50**, 503.
5. C. R. Groom and F. H. Allen, *Angew. Chem. Int. Ed.* 2014, **53**, 662.

Table 1 Crystal data, data collection and refinement details for the structure of *rac*-Ethyl 2-((1*R*,11b*R*)-9,10-dimethoxy-4-oxo-1,3,4,6,7,11b-hexahydro-[1,4]oxazino[3,4-a]isoquinolin-1-yl)acetate **5j**.

Compound		**5j**
		Rac- 
Empirical formula		$C_{18}H_{23}NO_6$
Formula weight		349.37
Temperature (K)		293(2)
Wavelength (Å)		1.54187
Crystal system, space group		Monoclinic, $P\,2_1/n$
Unit cell dimensions | (Å) | (°)		15.1265(16) 7.2749(7) 16.0388(16) 90 103.411(7) 90
Volume ($Å^3$)		1716.8(3)
Z, Calculated density (Mg/m^3)		4, 1.352
Absorption coefficient (mm^{-1})		0.846
F(000)		744
Crystal size (mm)		0.600 x 0.040 x 0.015
θ range for data collection (°)		3.620 to 66.592
Limiting indices		-18 ≤ h ≤ 18, -8 ≤ k ≤ 7, -19 ≤ l ≤ 17
Reflections collected / unique [R(int)		18707 / 3019 0.071
Completeness to θ_{full} (%)		99.3
Absorption correction		Semi-empirical from equivalents
Max. and min. transmission		1.000 and 0.835
Refinement method		Full-matrix least-squares on F^2
Data / restraints / parameters		3005 / 0 / 229
Goodness-of-fit on F^2		0.817
Final R indices [$I>2\sigma(I)$]	R1 wR2	0.042, 0.069
R indices (all data)	R1 wR2	0.121, 0.089
Largest Δ peak and hole ($e.Å^{-3}$)		0.214 and -0.268
CCDC Refcode		NUKBAZ

GENERAL REMARKS.

Unless otherwise stated, all reagents and starting materials were purchased from commercial sources and used as received. Compounds **1c**,[6] and **1j** were prepare following reported procedures. Toluene (puriss. p.a., ACS reagent, ≥ 99.7% (GC)) and THF (99.9% GC) with 2,6-di-*tert*-butyl-4-methylphenol (250 mg/L) as stabilizer were purified by passage through a column containing activated alumina under nitrogen pressure (Dry Solvent Station GT S100, GlassTechnology, Geneva, CH). Dichloromethane (99.99% GC) was distilled from calcium hydride (CaH_2) and used as solvent in reactions under anhydrous conditions. NMR spectra were recorded at 298 K with a Bruker Avance III HD nanobay 400 MHz spectrometer equipped with a BBO probe. The structures of the new compounds were assigned with the aid of 1 D [^{1}H NMR, ^{13}C NMR, Distortionless Enhancement by Polarization Transfer (DEPT)] and 2 D Correlation Spectroscopy [(^{1}H–^{1}H COSY, ^{1}H–^{13}C Heteronuclear Single Quantum Coherence (HSQC), ^{1}H–^{13}C Heteronuclear Multiple-bond Correlation (HMBC) and Nuclear Overhauser Effect Spectroscopy (NOESY)] experiments. ^{1}H NMR (400 MHz) chemical shift values are listed in parts per million (ppm). Tetramethylsilane (TMS) was used as an internal standard, or alternatively, spectra were calibrated using the signals of the corresponding non-deuterated solvent. Data are reported as follows: chemical shift (ppm on the δ scale), multiplicity (s = singlet, d = doublet, t = triplet, q = quartet, m = multiplet and po = partially overlapped), coupling constant *J* (Hz), and integration. ^{13}C NMR (101 MHz) chemical shifts are given in ppm. Spectra were calibrated using the corresponding non-deuterated solvent. High-resolution mass spectra were recorded with a Brucker maXis ESI qTOF ultrahigh-resolution mass spectrometer coupled to a Dionex Ultimate 3000 RSLC system (FR2708, Orléans). MS data were acquired in positive mode and were processed using Data Analysis 4.4 software (Bruker). Infrared spectra were recorded with a Thermo Scientific Nicolet IS10 FTIR spectrometer using diamond ATR golden gate sampling and are reported in wave numbers (cm^{-1}). Analytical thin-layer chromatography (TLC) was performed with Merck Silica Gel 60 F254 precoated plates. Visualization of the developed chromatogram was performed under ultraviolet light (254 nm) and on staining by immersion in aqueous, acidic ceric ammonium molybdate followed by charring at 150 °C. Flash chromatography was performed in air on Silica Gel 60 (230–400 mesh) with petroleum ether (PE, bp 40–65 °C) and ethyl acetate as eluents, unless otherwise stated. Organic solutions were concentrated under reduced pressure with a Buchi rotary evaporator. The IUPAC name of the new compounds was generated automatically using the included structure-to-name generator from BIOVIA Draw 201

6. S. Pal, A.-C. Gaumont, S. Lakhdar and I. Gillaizeau, *Org. Lett.,* 2019, **21**, 5621.

EXPERIMENTAL PROCEDURES AND CHARACTERIZATION DATA.

General Procedure for the Synthesis of Enamides 1d–i, 1k, 1l and 1o–1q (G.P. A).

An oven-dried single-necked round-bottomed flask under argon atmosphere was charged with dry toluene, the related imide **1** (1.0 equiv., 0.49 M) and a magnetic stir bar. The reaction vessel was cooled to −78 °C (dry ice/acetone bath) and a 1 M solution of $LiEt_3BH$ in THF (1.1 equiv.) was then added dropwise. The mixture was stirred further at −78 °C for 1 h. Next, *N,N*-Diisopropylethylamine (DIPEA, 5.7 equiv.) and a catalytic amount of 4-Dimethylaminopyridine (DMAP, 0.03 equiv.) were added, followed by the dropwise addition of Trifluoroacetic anhydride (TFAA, 1.2 equiv.) and the reaction mixture was allowed to warm up to room temperature (ca. 20 °C). The mixture was stirred for 3 h at the same temperature and it was quenched by the addition of water. The aqueous phase was then extracted twice with EtOAc, combined organic phases were washed (sat. aq. NaCl), dried over $MgSO_4$ and filtered through a cotton plug. The solvents were evaporated under reduced pressure and the resulting crude enamide derivative was purified by column chromatography (SiO_2).

General Procedure for the Direct Oxidative Radical β-C(sp2)–H Monoalkylation of Enamides (G.P. B).

An oven-dried 2–5 mL microwave vial under argon atmosphere was charged with the enamide substrate (1.0 equiv., 0.33 M), ethyl acetate, corresponding xanthate (2.0 equiv., 0.66 M) and a magnetic stir bar. The solution was degassed 3 times (vacuum/argon cycles), the reaction vessel was capped and it was placed in a pre-heated oil bath for 5 min at 90 °C. Next, the vial was uncapped and dilauroyl peroxide (DLP, 1.2 equiv.) was added. The vessel was sealed and the reaction mixture was heated at 78 °C for 4.5 h under argon atmosphere. After cooling to rt (ca. 20 °C), the solvent was concentrated under reduced pressure. The residue was taken up in dichloromethane and dry silica was added (approximately 10 times the mass of the sample). The solvents were evaporated *in vacuo* until the silica is dry and free-flowing and the coated support was packed on top of a silica gel column. The crude product was purified (SiO_2) to give the desired monoalkylated enamide derivative in moderate to good yield.

General Procedure for the Radical Difunctionalisation of Enamides With Xanthates in Presence of a Nucleophile (G.P. C).

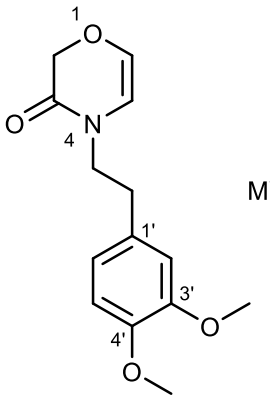
An oven-dried 2–5 mL microwave vial under argon atmosphere was charged with the enamide substrate (1.0 equiv., 0.33 M), related xanthate derivative (2.0 equiv., 0.66 M), ethyl acetate and a magnetic stir bar. The solution was degassed 3 times (vacuum/argon cycles), the reaction vessel was capped and it was placed in a pre-heated oil bath for 5 min at 90 °C. Next, the vial was uncapped and DLP (1.2 equiv.) followed by corresponding nucleophile (10 equiv.) were added. The vessel was sealed and the reaction mixture was heated at 78 °C for 4.5 h under argon atmosphere. After cooling to rt (ca. 20 °C), the solvent was concentrated under reduced pressure. The residue was taken up in dichloromethane and dry silica was added (approximately 10 times the mass of the sample). The solvents were evaporated *in vacuo* until

the silica is dry and free-flowing and the coated support was packed on top of a silica gel column. The crude product was purified (SiO_2) to give the desired dialkylated enamide compound in moderate to good yield.

General procedure D (G.P. D):

Alternatively, after solvent concentration in **G.P. B** and **G.P. C**, addition of cold acetonitrile could be performed at 0 °C, leaving decomposition products from DLP undissolved. The precipitate was filtered through a sintered glass Büchner funnel and the mother liquor was recovered. Then, the acetonitrile was removed by rotary evaporation and the product residue was purified further by flash SiO_2–column chromatography.

Synthesis of Starting Enamide 1q:

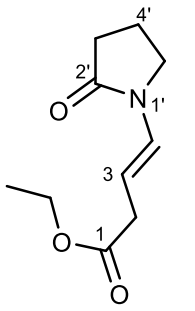


$C_{14}H_{17}NO_4$
MW = 263,12 g/mol

4-(3,4-Dimethoxyphenethyl)-1,4-oxazin-3-one (1q).

The titled compound was obtained following **G.P. A**. Purification by flash chromatography using petroleum ether/EtOAc (8:2, v/v) gave **1q** as a yellow oil (632.0 mg, 48%). R_f 0.1 (SiO_2, petroleum ether/EtOAc 8:2, v/v). M.p. < 40 °C. ^{1}H NMR (400 MHz, $CDCl_3$): δ 6.80 (d, J = 8.0 Hz, 1 H, H_{Ar}), 6.77–6.70 (po, 2 H, H_{Ar}), 6.11 (d, J = 4.3 Hz, 1 H, H-6), 5.46 (d, J = 4.3 Hz, 1 H, H-5), 4.39 (s, 2 H, H-2), 3.87 (s, 3 H, OCH_3), 3.86 (s, 3 H, OCH_3), 3.68 (t, J = 7.4 Hz, 2 H, NCH_2), 2.83 (t, J = 7.4 Hz, 2 H, NCH_2CH_2) ppm. ^{13}C NMR (101 MHz, $CDCl_3$): δ 162.5 (C, C-3), 149.1 (C, C_{Ar}), 147.9 (C, C_{Ar}), 130.7 (C, C_{Ar}), 130.5 (CH, C-6), 120.9 (CH, CH_{Ar}), 112.2 (CH, CH_{Ar}), 111.5 (CH, CH_{Ar}), 111.0 (CH, C-5), 67.7 (CH_2, C-2), 56.0 (CH_3, OCH_3), 56.0 (CH_3, OCH_3), 47.3 (CH_2, NCH_2), 34.1 (CH_2, NCH_2CH_2) ppm. HRMS (ESI): m/z calcd. for $C_{14}H_{18}NO_4$ $[M + H]^+$ 264.123034, found 264.123098.

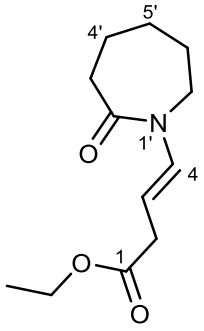
β-C(sp2)–H Monoalkylation of Diverse Enamides through G.P. B.



$C_{10}H_{15}NO_3$
MW = 197,11 g/mol

Ethyl (*E*)-4-(2-oxopyrrolidin-1-yl)but-3-enoate (3a).

According to **G.P. B**, the reaction was performed with enamide **1a** (56 mg, 0.50 mmol), ethyl 2-ethoxycarbothioylsulfanylacetate (210 mg, 1.0 mmol), DLP (239 mg, 0.60 mmol) and EtOAc (1.5 mL). The crude product was purified by column chromatography (SiO_2, petroleum ether/EtOAc 75:25 to 70:30, v/v) to afford **3a** as a colourless oil (61 mg, 62%). R_f 0.2 (SiO_2, petroleum ether/EtOAc 5:5, v/v). ^{1}H NMR (400 MHz, $CDCl_3$/TMS): δ 6.97 (d, J = 14.6 Hz, 1 H, H-4), 5.03 (dt, J = 14.6, 7.3 Hz, 1 H, H-3), 4.15 (q, J = 7.1 Hz, 2 H, OCH_2CH$_3$), 3.54 (t, J = 7.2 Hz, 2 H, H-5'), 3.10 (d, J = 7.3 Hz, 2 H, H-2), 2.48 (t, J = 8.1 Hz, 2 H, H-3'), 2.18–2.04 (m, 2 H, H-4'), 1.27 (t, J = 7.1 Hz, 3 H, OCH$_2$CH_3) ppm. ^{13}C NMR (101 MHz, $CDCl_3$): δ 173.2 (C, *C*O), 172.1 (C, *C*O), 126.6 (CH, C-4), 103.6 (CH, C-3), 60.9 (CH$_2$, O*C*H$_2$CH$_3$), 45.3 (CH$_2$, C-5'), 35.7 (CH$_2$, C-2), 31.3 (CH$_2$, C-3'), 17.6 (CH$_2$, C-4'), 14.3 (OCH$_2$*C*H$_3$) ppm. IR (neat): $\tilde{\nu}$ = 1728 (C=O), 1653 (C=O) cm^{-1}. HRMS (ESI): m/z calcd. for $C_{10}H_{16}NO_3$ $[M + H]^+$ 198.112470, found 198.112227.

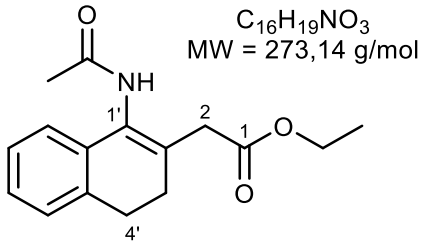


$C_{12}H_{19}NO_3$
MW = 225,14 g/mol

Ethyl (*E*)-4-(2-oxoazepan-1-yl)but-3-enoate (3b).

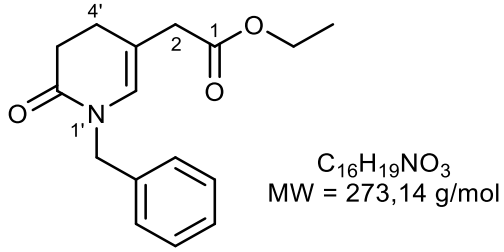
According to **G.P. B**, the reaction was performed with enamide **1b** (70 mg, 0.50 mmol), ethyl 2-ethoxycarbothioylsulfanylacetate (210 mg, 1.0 mmol), DLP (239 mg, 0.60 mmol) and EtOAc (1.5 mL). The crude product was purified by column chromatography (SiO_2, petroleum ether/EtOAc 85:15 to 75:25, v/v) to afford **3b** as a colourless oil (80 mg, 71%). R_f 0.14 (SiO_2, petroleum ether/EtOAc 75:25, v/v). ^{1}H NMR (400 MHz, $CDCl_3$/TMS): δ 7.24 (d, J = 14.6 Hz, 1 H, H-4), 5.13 (dt, J = 14.6, 7.2 Hz, 1 H, H-3), 4.14 (q, J = 7.1 Hz, 2 H, OCH_2CH$_3$), 3.63–3.56 (m, 2 H, H-7'), 3.10 (dd, J = 7.2, 1.2 Hz, 2 H, H-2), 2.65–2.58 (m, 2 H, H-3'), 1.79–1.60 (po, 6 H, H-6' + H-5' + H-4'), 1.26 (t, J = 7.1 Hz, 3 H, OCH$_2$CH_3) ppm. ^{13}C NMR (101 MHz, $CDCl_3$): δ 174.3 (C, *C*O), 172.4 (C, *C*O), 129.6 (CH, C-4), 102.4 (CH, C-3), 60.8 (CH$_2$, O*C*H$_2$CH$_3$), 45.5 (CH$_2$, C-7'), 37.2 (CH$_2$,

C-3'), 35.8 (CH_2, C-2), 29.5 (CH_2, C-6'), 27.4 (CH_2, C-5'), 23.5 (CH_2, C-4'), 14.3 (CH_3, OCH_2CH_3) ppm. IR (neat): ṽ = 1690 (C=O), 1652 (C=O) cm^{-1}. HRMS (ESI): m/z calcd. for $C_{12}H_{20}NO_3$ $[M + H]^+$ 226.143770 found, 226.143888.



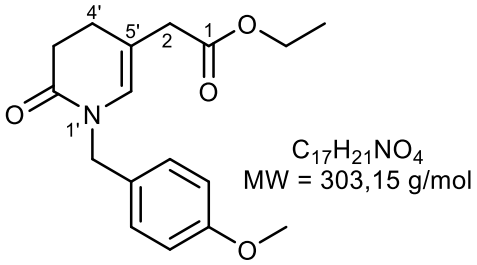
Ethyl 2-(1-acetamido-3,4-dihydronaphthalen-2-yl)acetate (3c).

Compound **3c** was prepared according to **G.P. B**, using enamide **1c** (94 mg, 0.50 mmol), ethyl 2-ethoxycarbothioylsulfanylacetate (210 mg, 1.0 mmol), DLP (239 mg, 0.60 mmol) and EtOAc (1.5 mL). The crude product was purified by passage though SiO_2–column chromatography (petroleum ether/EtOAc 70/30 to 50/50 v/v) and was obtained in moderate yield (87 mg, 64%) as a mixture of rotamers (ca. 65:35). R_f 0.16 (SiO_2, petroleum ether/EtOAc 5:5, v/v). M.p. 107–109 °C. ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.25–7.06 (po, 4 H, H_{Ar} *maj. +* H_{Ar} *min.*), 6.71 (s, 0.35 H, N*H min*.), 4.16 (po, 2 H, OCH_2CH_3 *min.* + OCH_2CH_3 *maj*.), 3.36 (s, 0.75 H, H-2 *min.*), 3.27 (s, 1.25 H, H-2 *maj.*), 2.85 (t, *J* = 8.0 Hz, 2 H, H-3' *maj. +* H-3' *min.* or H-4' *maj. +* H-4' *min.*), 2.46 (t, *J* = 8.0 Hz, 2 H, H-4' *maj.* + H-4' *min.* or H-3' *maj. +* H-3' *min.*), 2.20 (s, 1.87 H, CH_3CO *maj.*), 1.83 (s, 1.13 H, CH_3CO *min.*), 1.27 (t, J = 7.1 Hz, 3 H, OCH_2CH_3 *maj*. + OCH_2CH_3 *min.*) ppm. ^{13}C NMR (101 MHz, $CDCl_3$): δ 174.0 (C, *C*O *min.*), 171.5 (C, *C*O *maj.*), 170.4 (C, *C*O *min.*), 169.3 (C, *C*O *maj.*), 135.8 (C, C_{Ar} *min.*), 135.7 (C, C_{Ar} *maj.*), 133.1 (C, C^{IV} *min.*), 132.2 (C, C^{IV} *maj.*), 131.7 (C, C^{IV} *min.*), 131.0 (C, C^{IV} *min.*), 130.2 (C, C^{IV} *maj.*), 129.2 (C, C^{IV} *min.*), 128.0 (CH, CH_{Ar} *min.*), 127.7 (CH, CH_{Ar} *min.*), 127.6 (CH, CH_{Ar} *maj.*), 127.5 (CH, CH_{Ar} *maj.*), 127.0 (CH, CH_{Ar} *min.*), 126.6 (CH, CH_{Ar} *maj.*), 122.7 (CH, CH_{Ar} *min.*), 122.6 (CH, CH_{Ar} *maj.*), 61.3 (CH_2, OCH_2CH_3 *min.*), 61.2 (CH_2, OCH_2CH_3 *maj.*), 39.3 (CH_2, C-2 *maj.*), 38.5 (CH_2, C-2 *min.*), 28.6 (CH_2, C-3' *maj.*), 28.2 (CH_2, C-3' *min.*), 27.7 (CH_2, C-4' *maj.*), 27.5 (CH_2, C-4' *min.*), 23.4 (CH_3, CH_3CO *maj.*), 20.3 (CH_3, CH_3CO *min.*), 14.3 (CH_3, OCH_2CH_3 *maj.* + OCH_2CH_3 *min.*) ppm. IR (neat): ṽ = 3244 (N–H), 1725 (C=O), 1641 (C=O) cm^{-1}. HRMS (ESI): m/z calcd. for $C_{16}H_{20}NO_3$ $[M + H]^+$ 274.143770 found, 274.143607.



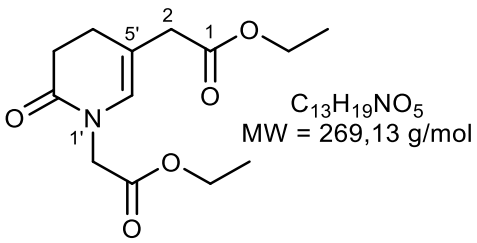
Ethyl 2-(1-benzyl-2-oxo-3,4-dihydropyridin-3-yl)acetate (3d).

According to **G.P. B**, the reaction was performed with enamide **1d** (94 mg, 0.50 mmol), ethyl 2-ethoxycarbothioylsulfanylacetate (210 mg, 1.0 mmol), DLP (239 mg, 0.60 mmol) and EtOAc (1.5 mL). The crude product was purified by column chromatography (SiO_2, petroleum ether/EtOAc 85:15 to 80:20, v/v) to give **3d** as a colourless oil (98 mg, 72%). R_f 0.1 (SiO_2, petroleum ether/EtOAc 75:25, v/v). ^{1}H NMR (400 MHz, $CDCl_3$/TMS): δ 7.37–7.09 (po, 5 H, H_{Ar}), 5.97–5.88 (m, 1 H, H-6'), 4.67 (s, 2 H, CH_2Ph), 4.13 (q, J = 7.1 Hz, 2 H, OCH_2), 2.99 (s, 2 H, H-2), 2.62 (dd, J = 8.8, 7.2 Hz, 2 H, H-3'), 2.38 (t, J = 8.1 Hz, 2 H, H-4'), 1.24 (t, J = 7.1 Hz, 3 H, OCH_2CH_3) ppm. ^{13}C NMR (101 MHz, $CDCl_3$/TMS): δ 171.0 (C, C-1), 168.9 (CH_2, C-2'), 137.0 (C, C_{Ar}), 128.6 (CH, CH_{Ar}), 127.5 (CH, CH_{Ar}), 127.4 (CH, CH_{Ar}), 127.2 (CH, C-6'), 112.9 (C, C-5'), 60.7 (CH_2, OCH_2), 48.8 (CH_2, NCH_2Ph), 39.0 (CH_2, C-2), 31.0 (CH_2, C-3'), 24.2 (CH_2, C-4'), 14.1 (CH_3, OCH_2CH_3) ppm. IR (neat): $\tilde{\nu}$ = 2926 (C-H), 1732 (C=O), 1643 (C=O), 1563 (C=C) cm^{-1}. HRMS (ESI): m/z calcd. for $C_{16}H_{20}NO_3$ $[M + H]^+$ 274.143770, found 274.143849.



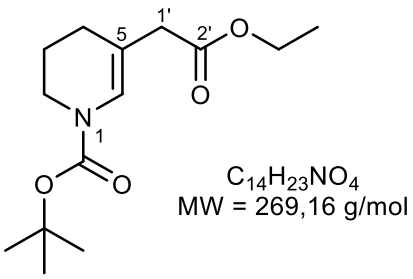
Ethyl 2-[1-[(4-methoxyphenyl)methyl]-2-oxo-3,4-dihydropyridin-5-yl]acetate (3e).

According to **G.P. B**, the reaction was performed with enamide **1e** (109 mg, 0.50 mmol), ethyl 2-ethoxycarbothioylsulfanylacetate (210 mg, 1.0 mmol), DLP (239 mg, 0.60 mmol) and EtOAc (1.5 mL). The crude product was purified by column chromatography (SiO_2, petroleum ether/EtOAc 85:15 to 75:25, v/v) to afford **3e** as a colourless oil (77 mg, 51%). R_f 0.14 (SiO_2, petroleum ether/EtOAc 75:25, v/v). ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.17 (d, J = 8.7 Hz, 2 H, H_{Ar}), 6.85 (d, J = 8.7 Hz, 2 H, H_{Ar}), 5.92 (s, 1 H, H-6'), 4.60 (s, 2 H, NCH_2Ph), 4.13 (q, J = 7.1 Hz, 2 H, OCH_2CH$_3$), 3.79 (s, 3 H, OCH_3), 2.98 (s, 2 H, H-2), 2.60 (t, J = 8.0 Hz, 2 H, H-3'), 2.36 (t, J = 8.1 Hz, 2 H, H-4'), 1.24 (t, J = 7.1 Hz, 3 H, OCH_2CH_3) ppm. ^{13}C NMR (101 MHz, $CDCl_3$/TMS): δ 171.1 (C, *C*O), 168.8 (C, *C*O), 159.0 (C, C_{Ar}), 129.2 (C, C_{Ar}), 129.1 (CH, CH_{Ar}), 127.1 (CH, C-6'), 114.0 (CH, CH_{Ar}), 112.7 (C, C-5'), 60.8 (CH_2, OCH_2CH$_3$), 55.2 (CH_3, OCH_3), 48.3 (CH_2, NCH_2), 39.1 (CH_2, C-2), 31.1 (CH_2, C-3'), 24.3 (CH_2, C-4'), 14.2 (CH_3, OCH_2CH_3) ppm. IR (neat): $\tilde{\nu}$ = 1724 (C=O), 1659 (C=O) cm^{-1}. HRMS (ESI): m/z calcd. for $C_{17}H_{22}NO_4$ $[M + H]^+$ 304.154335, found 304.154465.



Ethyl 2-[1-(2-ethoxy-2-oxoethyl)-2-oxo-3,4-dihydropyridin-5-yl]acetate (3f).

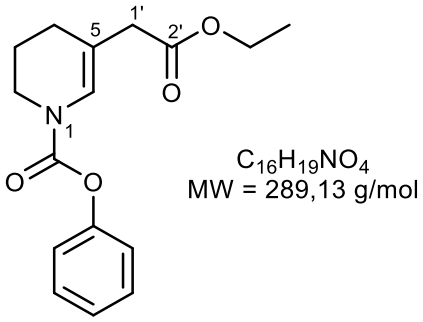
The titled compound was synthesized according to **G.P. B**, using enamide **1f** (92 mg, 0.50 mmol), ethyl 2-ethoxycarbothioylsulfanylacetate (210 mg, 1.0 mmol), DLP (239 mg, 0.60 mmol) and EtOAc (1.5 mL). The crude product was purified by column chromatography (SiO_2, petroleum ether/EtOAc 80:20 to 70:30 v/v) to provide **3f** as a colourless oil (82 mg, 61%). R_f 0.07 (SiO_2, petroleum ether/EtOAc 75:25, v/v). ^{1}H NMR (400 MHz, $CDCl_3$): δ 5.91 (s, 1 H, H-6'), 4.25–4.10 (po, 6 H, CH_2N + 2 × OCH_2CH$_3$), 3.03 (s, 2 H, H-2), 2.65–2.55 (m, 2 H, H-3'), 2.39 (t, J = 7.9 Hz, 2 H, H-4'), 1.26 (t, J = 7.2 Hz, 3 H, OCH$_2$CH_3), 1.25 (t, J = 7.2 Hz, 3 H, OCH$_2$CH_3) ppm. ^{13}C NMR (101 MHz, $CDCl_3$): δ 171.1 (C, *C*O), 169.3 (C, *C*O), 168.8 (C, *C*O), 127.9 (CH, C-6'), 113.0 (C, C-5'), 61.5 (CH$_2$, O*C*H$_2$CH$_3$), 61.0 (CH$_2$, O*C*H$_2$CH$_3$), 47.4 (CH$_2$, N*C*H$_2$), 39.2 (CH$_2$, C-2), 30.8 (CH$_2$, C-3'), 24.3 (CH$_2$, C-4'), 14.3 (CH$_3$, OCH$_2$*C*H$_3$), 14.2 (CH$_3$, OCH$_2$*C*H$_3$) ppm. IR (neat): $\tilde{\nu}$ = 1732 (C=O), 1672 (C=O) cm^{-1}. HRMS (ESI): m/z calcd. for $C_{13}H_{20}NO_5$ $[M + H]^+$ 270.133599 found, 270.133791.



***tert*-Butyl 5-(2-ethoxy-2-oxoethyl)-3,4-dihydro-2*H*-pyridine-1-carboxylate (3g)**.

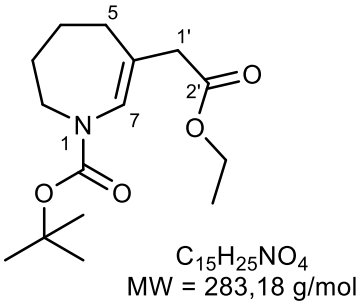
According to **G.P. B**, the reaction was performed with enamide **1g** (93 mg, 0.51 mmol), ethyl 2-ethoxycarbothioylsulfanylacetate (210 mg, 1.0 mmol), DLP (239 mg, 0.60 mmol) and EtOAc (1.5 mL). The crude product was purified by column chromatography (SiO_2, petroleum ether/EtOAc 98:2 to 97:3, v/v) to afford **3g** as a colourless oil (88 mg, 64%). Mixture of rotamers ca. 6:4. R_f 0.6 (SiO_2, petroleum ether/EtOAc 75:25, v/v). ^{1}H NMR (400 MHz, $CDCl_3$/TMS): δ 6.80 (br s, 0.4 H, H-6 *min.*), 6.65 (br s, 0.6 H, H-6 *maj.*) 4.23–4.06 (m, 2 H, CH$_2$, OCH_2CH$_3$ *maj. +* OCH_2CH$_3$ *min.*), 3.58–3.43 (m, 2 H, H-2 *maj. +* H-2 *min.*), 2.95 (s, 2 H, H-1' *maj.* + H-1' *min.*), 2.04 (t, J = 6.1 Hz, 2 H, H-4 *maj.* + H-4 *min.*), 1.88–1.77 (m, 2 H, H-3 *maj.* + H-3 *min.*), 1.46 (s, 9 H, C(CH_3)$_3$ *maj.* + C(CH_3)$_3$ *min.*), 1.33–1.21 (m, 3 H, OCH$_2$CH_3 *maj.* + OCH$_2$CH_3 *min.*) ppm. ^{13}C NMR (101 MHz, $CDCl_3$): δ 172.0 (C, C-2' *maj. +* C-2' *min.*), 152.8 (C, N*C*O *min.*), 152.3 (C, N*C*O *maj.*), 124.1 (CH, C-6 *maj.*), 123.8 (CH, C-6 *min.*), 111.1 (C, C-5 *min.*), 110.5 (C,

C-5 *maj.*), 80.8 (C, *C*$(CH_3)_3$ *maj.*), 80.6(C, *C*$(CH_3)_3$ *min.*), 60.7 (CH_2, O*C*H_2CH_3 *maj.*), 60.6 (CH_2, O*C*H_2CH_3 *min.*), 42.1 (CH_2, C-2 *min.*), 41.1 (CH_2, C-1' *min.*), 41.0 (CH_2, C-2 *maj.*), 41.0 (CH_2, C-1' *maj.*), 28.4 (CH_3, C(*C*$H_3)_3$ *maj. +* C(*C*$H_3)_3$ *min.*), 25.4 (CH_2, C-4 *maj.*), 25.2 (CH_2, C-4 *min.*), 21.8 (CH_2, C-3 *min.*), 21.6 (CH_2, C-3 *maj.*), 14.3 (CH_3, OCH_2*C*H_3 *maj.* + OCH_2*C*H_3 *min.*) ppm. HRMS (ESI): m/z calcd. for $C_{14}H_{24}NO_4$ $[M + H]^+$ 270.169985 found, 270.170411.



Phenyl 5-(2-ethoxy-2-oxoethyl)-3,4-dihydro-2*H*-pyridine-1-carboxylate (3h).

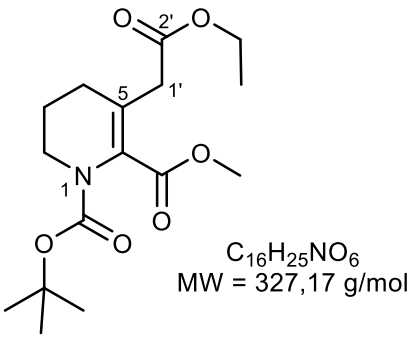
The reaction was performed according to **G.P. B**, using enamide **1h** (102 mg, 0.50 mmol), ethyl 2-ethoxycarbothioylsulfanylacetate (210 mg, 1.0 mmol), DLP (239 mg, 0.60 mmol) and EtOAc (1.5 mL). The crude titled product was purified by column chromatography (SiO_2, petroleum ether/EtOAc 95:5 to 90:10 v/v) to afford **3h** as a colourless oil (82 mg, 57%). Mixture of rotamers ca. 6:4. R_f 0.2 (SiO_2, petroleum ether/EtOAc 85:15, v/v). ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.36 (br t, *J* = 7.7 Hz, 2 H, H_{Ar}), 7.21 (t, *J* = 7.4 Hz, 1 H, H_{Ar}), 7.12 (d, *J* = 7.7 Hz, 2 H, H_{Ar}), 6.94 (br s, 0.6 H, H-6 *maj.*), 6.87 (br s, 0.4 H, H-6 *min.*), 4.17 (m, 2 H, O*C*H_2CH_3 *maj. +* O*C*H_2CH_3 *min.*), 3.81–3.74 (m, 0.8 H, H-2 *min.*), 3.71–3.64 (m, 1.2 H, H-2 *maj.*), 3.03 (s, 2 H, H-1' *maj.* + H-1' *min.*), 2.15 (t, *J* = 6.1 Hz, 2 H, H-4 *maj.* + H-4 *min.*), 1.99–1.88 (m, 2 H, H-3 *maj.* + H-3 *min.*), 1.30–1.21 (m, 3 H, OCH_2C*H*$_3$ *maj.* + OCH_2C*H*$_3$ *min.*) ppm. ^{13}C NMR (101 MHz, $CDCl_3$): δ 171.5 (C, C-2' *maj.*), 171.6 (C, C-2' *min.*), 152.0 (C, N*C*O *min.*), 151.5 (C, N*C*O *maj.*), 151.1 (C, C_{Ar} *maj.*), 151.0 (C, C_{Ar} *min.*), 129.3 (CH, CH_{Ar} *maj.* + CH_{Ar} *min.*), 125.5 (CH, CH_{Ar} *maj.* + CH_{Ar} *min.*), 123.5 (CH, C-6 *min.*), 123.2 (CH, C-6 *maj.*), 121.7 (CH, CH_{Ar} *maj.*), 121.6 (CH, CH_{Ar} *min.*), 113.4 (C, C-5 *min.*), 112.8 (C, C-5 *maj.*), 60.7 (CH_2, O*C*H_2CH_3 *maj.*), 60.6 (CH_2, O*C*H_2CH_3 *min.*), 42.4 (CH_2, C-2 *min.*), 41.9 (**(**CH_2, C-2 *maj.*), 40.8 (CH_2, C-1' *maj.*), 40.7 (CH_2, C-1' *min.*), 25.3 (CH_2, C-4 *maj.*), 25.0 (**(**CH_2, C-4 *min.*), 21.6 (CH_2, C-3 *min.*), 21.4 (**(**CH_2, C-3 *maj.*), 14.2 (CH_3, OCH_2*C*H_3 *maj.* + OCH_2*C*H_3 *min.*) ppm. IR (neat): $\tilde{\nu}$ = 1716 (C=O), 1674 (C=O) cm^{-1}. HRMS (ESI): m/z calcd. for $C_{16}H_{20}NO_4$ $[M + H]^+$ 290.138685 found, 290.138613.



$C_{15}H_{25}NO_4$
MW = 283,18 g/mol

***tert*-Butyl 6-(2-ethoxy-2-oxoethyl)-2,3,4,5-tetrahydroazepine-1-carboxylate (3i)**.

The titled compound was synthesized according to **G.P. B**, using enamide **1i** (198 mg, 1.0 mmol), ethyl 2-ethoxycarbothioylsulfanylacetate (420 mg, 2.0 mmol), DLP (478 mg, 1.2 mmol) and EtOAc (3.0 mL). The crude product was purified by column chromatography (SiO_2, petroleum ether/EtOAc 97:3 to 95:5 v/v) to give **3i** as a colourless oil (173 mg, 61%). Mixture of rotamers ca. 6:4. R_f 0.3 (SiO_2, petroleum ether/EtOAc 85:15, v/v). ^{1}H NMR (400 MHz, $CDCl_3$): δ 6.50 (br s, 0.4 H, H-7 *min.*), 6.37 (br s, 0.6 H, H-7 *maj.*), 4.14 (q, *J* = 7.1 Hz, 2 H, OC*H*$_2$CH$_3$ *maj.* + OC*H*$_2$CH$_3$ *min.*), 3.68–3.59 (br m, 2 H, H-2 *maj.* + H-2 *min.*), 2.97 (br s, 2 H, H-1' *maj.* + H-1' *min.*), 2.31–2.18 (br m, 2 H, H-5 *maj.* + H-5 *min.*), 1.84–1.67 (po, 4 H, H-3 *maj.* + H-4 *maj.* + H-3 *min.* + H-4 *min.*), 1.47 (s, 9 H, C(*C*H$_3$)$_3$ *maj.* + C(*C*H$_3$)$_3$ *min.*), 1.26 (t, *J* = 7.1 Hz, 3 H, OCH$_2$C*H*$_3$ *maj.* + OCH$_2$C*H*$_3$ *min.*) ppm. ^{13}C NMR (101 MHz, $CDCl_3$): δ 172.1 (C, C-2' *maj.* + C-2' *min.*), 153.8 (C, N*C*O *maj.* + N*C*O *min.*), 129.9 (CH, C-7 *maj.* + C-7 *min.*), 121.0 (C, C-6 *maj.* + C-6 *min.*), 80.5 (C, *C*(CH$_3$)$_3$ *maj.* + *C*(CH$_3$)$_3$ *min.*), 60.7 (CH$_2$, O*C*H$_2$CH$_3$ *maj.* + CH$_2$, O*C*H$_2$CH$_3$ *min.*), 47.9 (CH$_2$, C-2 *min.*), 47.0 (CH$_2$, C-2 *maj.*), 42.9 (C, C-1' *maj.* + C-1' *min.*), 31.0 (CH$_2$, C-5 *maj.*), 30.7 (CH$_2$, C-5 *min.*), 28.2 (CH$_3$, C(*C*H$_3$)$_3$ *maj.* + C(*C*H$_3$)$_3$ *min.*), 28.1 (CH$_2$, C-3 *maj.* + C-3 *min.*), 24.3 (CH$_2$, C-4 *maj.* + C-4 *min.*), 14.4 (CH$_3$, OCH$_2$*C*H$_3$ *maj.* + OCH$_2$*C*H$_3$ *min.*) ppm. IR (neat): $\tilde{\nu}$ = 1762 (C=O), 1682 (C=O) cm^{-1}. HRMS (ESI): m/z calcd. for $C_{15}H_{26}NO_4$ $[M + H]^+$ 284.185635 found, 284.185824.

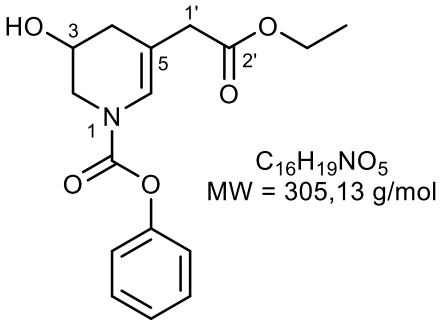


$C_{16}H_{25}NO_6$
MW = 327,17 g/mol

1-*O*-*tert*-Butyl 6-*O*-methyl 5-(2-ethoxy-2-oxoethyl)-3,4-dihydro-2*H*-pyridine-1,6-dicarboxylate (3j).

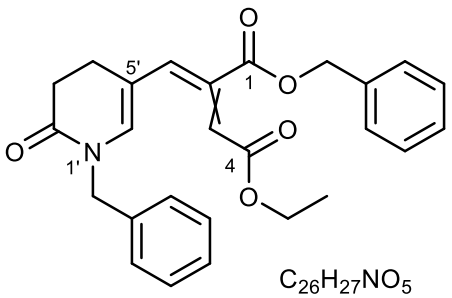
The titled compound was synthesized according to **G.P. B**, using enamide **1j** (121 mg, 0.50 mmol), ethyl 2-ethoxycarbothioylsulfanylacetate (210 mg, 1.0 mmol), DLP (239 mg, 0.60

mmol) and EtOAc (1.5 mL). The crude product was purified by column chromatography (SiO_2, petroleum ether/EtOAc 93:7 to 95:5 v/v) to give **3j** as a colourless oil (41 mg, 25%). R_f 0.17 (SiO_2, petroleum ether/EtOAc 85:15, v/v). ^{1}H NMR (400 MHz, $CDCl_3$): δ 4.14 (q, J = 7.1 Hz, 2 H, OCH_2CH$_3$), 3.75 (s, 3 H, OCH_3), 3.60–3.50 (m, 2 H, H-2), 3.32 (s, 2 H, H-1'), 2.23 (t, J = 6.7 Hz, 2 H, H-4), 1.86–1.79 (m, 2 H, H-3), 1.43 (s, 9 H, C(CH_3)$_3$), 1.24 (t, J = 7.1 Hz, 3 H, OCH$_2$CH_3) ppm. IR (neat): ṽ = 1731 (C=O), 1702 (C=O) cm^{-1}. HRMS (ESI): m/z calcd. for $C_{16}H_{26}NO_6$ $[M + H]^+$ 328.175464 found, 328.176091.



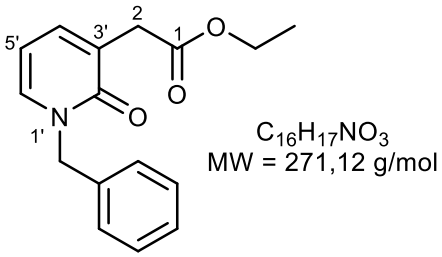
(*rac*)-Phenyl 5-(2-ethoxy-2-oxoethyl)-3-hydroxy-3,4-dihydro-2*H*-pyridine-1-carboxylate (3k).

Compound **3k** was prepared according to **G.P. B**, using enamide **1k** (110 mg, 0.50 mmol), ethyl 2-ethoxycarbothioylsulfanylacetate (210 mg, 1.0 mmol), DLP (239 mg, 0.60 mmol) and EtOAc (1.5 mL). The crude product was purified by column chromatography (SiO_2, petroleum ether/EtOAc 85/15 to 75/25 v/v) to provide **3k** as a colourless oil (63 mg, 41%) and a mixture of rotamers (ca. 55:45). R_f 0.2 (SiO_2, petroleum ether/EtOAc 6:4, v/v). ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.41–7.33 (m, 2 H, H$_{Ar}$ *maj.* + H$_{Ar}$ *min.*), 7.25–7.20 (m, 1 H, H$_{Ar}$ *maj.* + H$_{Ar}$ *min.*), 7.16–7.10 (m, 2 H, H$_{Ar}$ *maj.* + H$_{Ar}$ *min.*), 6.99 (br s, 0.55 H, H-6 *maj.*), 6.93 (br s, 0.45 H, H-6 *min.*), 4.27 (br s, 1 H, H-3 *maj.* + H-3 *min.*), 4.21–4.11 (m, 2 H, OCH_2CH$_3$ *maj.* + OCH_2CH$_3$ *min.*), 3.95 (dd, J = 12.7, 4.1 Hz, 0.45 H, H-2a *min.*), 3.81 (dd, J = 12.7, 4.8 Hz, 0.55 H, H-2a *maj.*), 3.63 (br d, J = 12.5 Hz, 0.45 H, H-2b *min.*), 3.56 (br d, J = 12.7 Hz, 0.55 H, H-2b *maj.*), 3.06 (s, 2 H, H-1' *maj.* + H-1' *min.*), 2.48 (br dd, J = 17.0, 4.0 Hz, 1 H, H-4a *maj.* + H-4a *min.*), 2.41 (br s, 0.45 H, OH *min.*), 2.30 (br s, 0.55 H, OH *maj.*), 2.22–2.13 (m, 1 H, H-4b *maj.* + H-4b *min.*), 1.28 (td, J = 7.2, 2.4 Hz, 3 H OCH$_2$CH_3 *maj.* + OCH$_2$CH_3 *min.*) ppm. ^{13}C NMR (101 MHz, $CDCl_3$): δ 171.9 (C, C-2' *maj.*), 171.8 (C, C-2' *min.*), 152.7 (C, N*C*O *maj.*), 152.1 (C, N*C*O *min.*), 151.1 (C, C$_{Ar}$ *maj.*), 151.0 (C, C$_{Ar}$ *min.*), 129.5 (CH, CH$_{Ar}$ *maj.* + CH$_{Ar}$ *min.*), 125.8 (CH, CH$_{Ar}$ *maj.* + CH$_{Ar}$ *min.*), 123.9 (CH, C-6 *min.*), 123.4 (CH, C-6 *maj.*), 121.8 (CH, CH$_{Ar}$ *maj.*), 121.5 (CH, CH$_{Ar}$ *min.*), 109.2 (C, C-5 *maj.* + C-5 *min.*), 63.0 (CH, C-3 *maj.* + C-3 *min.*), 61.1 (CH$_2$, O*C*H$_2$CH$_3$ *maj.* + O*C*H$_2$CH$_3$ *min.*), 48.4 (CH$_2$, C-2 *min.*), 47.8 (CH$_2$, C-2 *maj.*), 40.3 (CH$_2$, C-1' *maj.*), 40.1 (CH$_2$, C-1' *min.*), 33.9 (CH$_2$, C-4 *maj.*), 33.7 (CH$_2$, C-4 *min.*), 14.3 (CH$_3$, OCH$_2$*C*H$_3$ *maj.* + OCH$_2$*C*H$_3$ *min.*) ppm. IR (neat): ṽ = 1716 (C=O), 1070 (C–OH), 1563 cm^{-1}. HRMS (ESI): m/z calcd. for $C_{16}H_{20}NO_5$ $[M + H]^+$ 306.133599 found, 306.133786.



1-*O*-Benzyl 4-*O*-ethyl (2*E*)-2-[(1-benzyl-2-oxo-3,4-dihydropyridin-5-yl)methylene]butanedioate (3l).

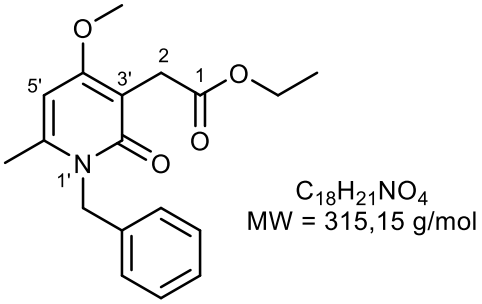
Compound **3l** was synthesized according to **G.P. B**, using enamide **1l** (348 mg, 1.0 mmol), ethyl 2-ethoxycarbothioylsulfanylacetate (420 mg, 2.0 mmol), DLP (478 mg, 1.2 mmol) and EtOAc (3.0 mL). The crude product was obtained as a single diastereomer. It was purified by column chromatography (SiO_2, petroleum ether/EtOAc 85/15 to 75/25 v/v) to give **3l** as a colourless oil (152 mg, 35%). R_f 0.5 (SiO_2, petroleum ether/EtOAc 6:4, v/v). ^{1}H NMR (400 MHz, $CDCl_3$/TMS): δ 7.41–7.11 (po, 11 H, H_{Ar} + H-6'), 6.50 (s, 1 H, C-5'–C*H*), 5.18 (s, 2 H, OCH_2Ph), 4.71 (s, 2 H, NCH_2Ph), 4.08 (q, *J* = 7.1 Hz, 2 H, OCH_2CH$_3$), 3.46 (s, 2 H, H-3), 2.64 (s, 4 H, H-3' + H-4'), 1.18 (t, *J* = 7.1 Hz, 3 H, OCH$_2$CH_3) ppm. ^{13}C NMR (101 MHz, $CDCl_3$): δ 171.3 (C, C-4), 168.8 (C, C-2'), 167.6 (C, C-1), 140.6 (CH, C-6'), 136.6 (C, C_{Ar}), 136.3 (CH, C-5'–*C*H), 136.2 (C, C_{Ar}), 129.0 (CH, CH_{Ar}), 128.6 (CH, CH_{Ar}), 128.3 (CH, CH_{Ar}), 128.2 (CH, CH_{Ar}), 128.0 (CH, CH_{Ar}), 127.9 (CH, CH_{Ar}), 120.6 (C, C-2), 115.9 (C, C-5'), 66.9 (CH_2, O*C*H$_2$Ph), 61.1 (CH_2, O*C*H$_2$CH$_3$), 49.6 (CH_2, N*C*H$_2$Ph), 33.8 (CH_2, C-3), 31.0 (CH_2, C-3'), 23.4 (CH_2, C-4'), 14.2 (CH_3, OCH$_2$*C*H$_3$) ppm. IR (neat): $\tilde{\nu}$ = 1732 (C=O), 1682 (C=O), 1619 (C=O) cm^{-1}. HRMS (ESI): m/z calcd. for $C_{26}H_{28}NO_5$ $[M + H]^+$ 434.196199 found, 434.196219.



Ethyl 2-(1-benzyl-2-oxo-3-pyridyl)acetate (3m).

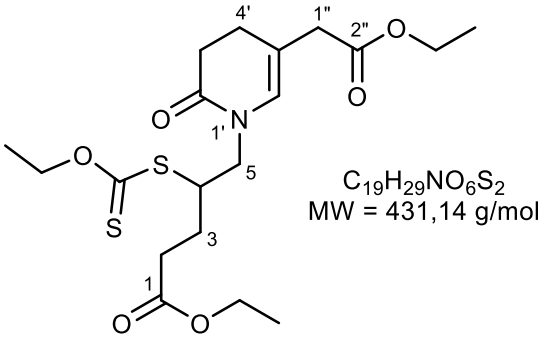
Compound **3m** was synthesized according to **G.P. B**, using pyridone **1n** (93 mg, 0.50 mmol), ethyl 2-ethoxycarbothioylsulfanylacetate (210 mg, 1.0 mmol), DLP (239 mg, 0.60 mmol) and EtOAc (1.5 mL). The crude product was purified by column chromatography (SiO_2, petroleum ether/EtOAc 75/25 to 40/60 v/v) to give **3m** as a colourless oil (83 mg, 61%, (88% brsm)). R_f 0.4 (SiO_2, petroleum ether/EtOAc 5:5, v/v). ^{1}H NMR (400 MHz, $CDCl_3$/TMS): δ 7.36–7.26 (po, 6 H, H_{Ar} + H-6'), 7.22 (dd, *J* = 6.8, 2.0 Hz, 1 H, H-4'), 6.13 (t, *J* = 6.8 Hz, 1 H, H-5'), 5.15 (s, 2 H,

NC*H*$_2$Ph), 4.18 (q, *J* = 7.1 Hz, 2 H, OC*H*$_2$CH$_3$), 3.56 (s, 2 H, H-2), 1.26 (t, *J* = 7.1 Hz, 3 H, OCH$_2$C*H*$_3$) ppm. ^{13}C NMR (101 MHz, $CDCl_3$): *δ* 171.3 (C, C-1), 162.3 (C, C-2'), 138.4 (CH, C-6'), 136.5 (C, C_{Ar}), 136.2 (CH, C-4'), 129.0 (CH, CH_{Ar}), 128.3 (CH, CH_{Ar}), 128.1 (CH, CH_{Ar}), 126.9 (C, C-3'), 105.9 (CH, C-5'), 61.0 (CH_2, O*C*H$_2$CH$_3$), 52.4 (CH_2, N*C*H$_2$Ph), 36.5 (CH_2, C-2), 14.3 (CH_3, OCH$_2$*C*H$_3$) ppm. IR (neat): ṽ = 1730 (C=O), 1651 (C=O) cm^{-1}. HRMS (ESI): m/z calcd. for $C_{16}H_{18}NO_3$ $[M + H]^+$ 272.128120 found, 272.128007.



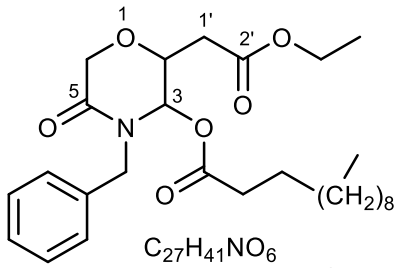
Ethyl 2-(1-benzyl-4-methoxy-6-methyl-2-oxo-3-pyridyl)acetate (3n).

Compound **3n** was prepared according to **G.P. B**, using pyridone **1n** (150 mg, 0.654 mmol), ethyl 2-ethoxycarbothioylsulfanylacetate (271 mg, 1.30 mmol), DLP (311 mg, 0.78 mmol) and EtOAc (2.2 mL). The crude product was purified by column chromatography (SiO_2, petroleum ether/EtOAc 75/25 to 40/60 v/v) to give **3n** as a colourless oil (80 mg, 39% (49% brsm)). R_f 0.25 (SiO_2, petroleum ether/EtOAc 5:5, v/v). M.p. 94–95 °C. ^{1}H NMR (400 MHz, $CDCl_3$/TMS): *δ* 7.32–7.22 (po, 3 H, H_{Ar}), 7.13 (d, *J* = 7.1 Hz, 2 H, H_{Ar}), 5.94 (s, 1 H, H-5'), 5.34 (s, 2 H, NC*H*$_2$Ph), 4.15 (q, *J* = 7.1 Hz, 2 H, OC*H*$_2$CH$_3$), 3.83 (s, 3 H, OC*H*$_3$), 3.61 (s, 2 H, H-2), 2.28 (s, 3 H, C*H*$_3$), 1.24 (d, *J* = 7.1 Hz, 3 H, OCH$_2$C*H*$_3$) ppm. ^{13}C NMR (101 MHz, $CDCl_3$): *δ* 171.9 (C, C-1), 164.1 (C, C-2' or C-4'), 163.9 (C, C-4' or C-2'), 146.0 (C, C-6')), 136.7 (C, C_{Ar}), 128.7 (CH, CH_{Ar}), 127.2 (CH, CH_{Ar}), 126.4 (CH, CH_{Ar}), 105.1 (C, C-3'), 95.5 (C, C-5'), 60.4 (CH_2, O*C*H$_2$CH$_3$), 55.7 (CH_3, O*C*H$_3$), 47.2 (CH_2, N*C*H$_2$Ph), 29.6 (CH_2, C-2), 21.0 (CH_3, *C*H$_3$), 14.2 (CH_3, OCH$_2$*C*H$_3$) ppm. IR (neat): ṽ = 2930 (C–H), 1732 (C=O), 1672 (C=O), 1644 (C=C), 1563 cm^{-1}. HRMS (ESI): m/z calcd. for $C_{18}H_{22}NO_4$ $[M + H]^+$ 316.154335 found, 316.154606.



Ethyl 4-ethoxycarbothioylsulfanyl-5-[5-(2-ethoxy-2-oxoethyl)-2-oxo-3,4-dihydropyridin-1-yl]pentanoate (3o).

Compound **3o** was prepared according to **G.P. B**, using *N*-allyl enamide **1o** (69 mg, 0.50 mmol), ethyl 2-ethoxycarbothioylsulfanylacetate (210 mg, 1.0 mmol), DLP (239 mg, 0.60 mmol) and EtOAc (1.5 mL). The crude product was purified by passage though SiO_2–column chromatography (petroleum ether/EtOAc 85/15 to 75/25 v/v) and was obtained in moderate yield (86 mg, 40%). R_f 0.44 (SiO_2, petroleum ether/EtOAc 5:5, v/v). ^{1}H NMR (400 MHz, $CDCl_3$): δ 6.10 (s, 1 H, H-6'), 4.64 (d, J = 7.0 Hz, 2 H, SCOCH_2CH$_3$), 4.20–4.07 (po, 4 H, 2 × OCH_2CH$_3$), 4.02–3.93 (po, 2 H, H-4 + H-5a), 3.50–3.41 (m, 1 H, H-5b), 3.05 (s, 2 H, H-1"), 2.60–2.50 (po, 3 H, H-3' + H-2a), 2.48–2.40 (m, 1 H, H-2b), 2.40–2.30 (m, 2 H, H-4'), 2.15–2.04 (m, 1 H, H-3a), 1.89–1.76 (m, 1 H, H-3b), 1.43 (t, J = 7.1 Hz, 3 H, SCOCH$_2$CH_3), 1.26 (t, J = 7.1 Hz, 3 H, OCH$_2$CH_3), 1.26 (t, J = 7.1 Hz, 3 H, OCH$_2$CH_3) ppm. ^{13}C NMR (101 MHz, $CDCl_3$): δ 213.4 (C, *C*S), 172.7 (C, C-1), 171.2 (C, C-2"), 169.3 (C, C-2'), 127.7 (CH, C-6'), 112.9 (C, C-5'), 70.4 (CH$_2$, SCO*C*H$_2$CH$_3$), 61.0 (CH$_2$, O*C*H$_2$CH$_3$), 60.7 (CH$_2$, O*C*H$_2$CH$_3$), 49.6 (CH, C-4), 48.9 (CH$_2$, C-5), 39.3 (CH$_2$, C-1"), 31.6 (CH$_2$, C-2), 31.2 (CH$_2$, C-3'), 26.2 (CH$_2$, C-3), 24.2 (CH$_2$, C-4'), 14.3 (CH$_3$, OCH$_2$*C*H$_3$), 14.3 (CH$_3$, OCH$_2$*C*H$_3$), 13.9 (CH$_3$, SCOCH$_2$*C*H$_3$) ppm. IR (neat): $\tilde{\nu}$ = 2923 (C–H), 1763 (C=O), 1683 (C=O), 1663 (C=O) cm^{-1}. HRMS (ESI): m/z calcd. for $C_{19}H_{30}NO_6S_2$ $[M + H]^+$ 432.150906 found, 432.151189.



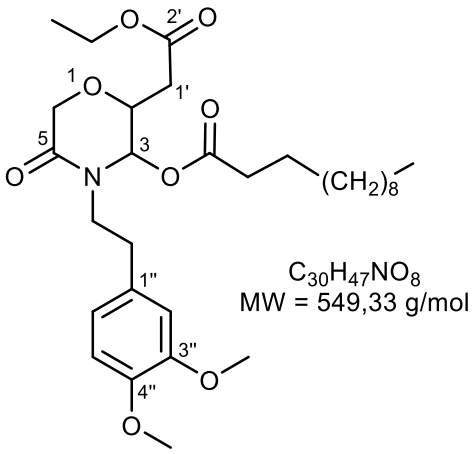
***Cis*- and *trans*-[4-benzyl-2-(2-ethoxy-2-oxoethyl)-5-oxo-morpholin-3-yl] dodecanoate (4p)**.

Prepared following **G.P. B**, using enamide **1p** (189 mg, 1.0 mmol), ethyl 2-ethoxycarbothioylsulfanylacetate (420 mg, 2.0 mmol), DLP (478 mg, 1.2 mmol) and EtOAc (3.0 mL). The crude product was obtained as a mixture of diastereomers (*trans*:*cis* 55:45). It was purified by SiO_2–column chromatography (petroleum ether/EtOAc 90:10 to 85:15 v/v) to give 2,3-*cis*-**4p** (105 mg, 22%) and 2,3-*trans*-**4p** (124 mg, 26%).

2,3-*cis*-**4p**. Colourless oil. R_f 0.3 (SiO_2, petroleum ether/EtOAc 8:2, v/v). ^{1}H NMR (400 MHz, $CDCl_3$/TMS): δ 7.35–7.25 (po, 5 H, H$_{Ar}$), 6.05 (d, J = 1.2 Hz, 1 H, H-3), 4.94 (d, J = 14.8 Hz, 1 H, 0.5 × NCH_2Ph), 4.44 (d, J = 16.9 Hz, 1 H, H-6a), 4.30 (d, J = 16.9 Hz, 1 H, H-6b), 4.28–4.21 (po, 2 H, H-2 + 0.5 × NCH_2Ph), 4.13 (q, J = 7.1 Hz, 2 H, OCH_2CH$_3$), 2.51 (dd, J = 16.4, 8.2 Hz, 1 H, H-1'a), 2.40 (dd, J = 16.4, 5.0 Hz, 1 H, H-1'b), 2.30–2.10 (m, 2 H, CH_2(CO)O), 1.60–1.49 (m, 2 H, CH_2CH$_2$(CO)O), 1.27 (s, 16 H, (CH_2)$_8$), 1.22 (t, J = 7.1 Hz, 3 H, OCH$_2$CH_3), 0.88 (t, J = 6.8 Hz, 3 H, (CH$_2$)$_8$CH_3) ppm. ^{13}C NMR (101 MHz, $CDCl_3$): δ 173.4 (C, *C*O), 169.5 (C, *C*O), 167.0 (C, *C*O), 136.3 (C, C$_{Ar}$), 128.8 (CH, CH$_{Ar}$), 128.5 (CH, CH$_{Ar}$), 128.0 (CH, CH$_{Ar}$), 77.7 (CH, C-3), 72.6 (CH, C-2), 68.2 (CH$_2$, C-6), 61.3 (CH$_2$, O*C*H$_2$CH$_3$), 47.8 (CH$_2$, N*C*H$_2$Ph), 35.8 (CH$_2$, C-1'), 33.9 (CH$_2$, *C*H$_2$(CO)O), 32.0 (CH$_2$, (*C*H$_2$)$_8$), 29.7 (CH$_2$, (*C*H$_2$)$_8$), 29.7 (CH$_2$, (*C*H$_2$)$_8$), 29.6 (CH$_2$, (*C*H$_2$)$_8$), 29.4 (CH$_2$, (*C*H$_2$)$_8$),

29.3 (CH_2, (CH_2)$_8$), 29.2 (CH_2, (CH_2)$_8$), 24.7 (CH_2, CH_2CH_2(CO)O), 22.8 (CH_2, (CH_2)$_8$), 14.2 (CH_3, (CH_2)$_8CH_3$), 14.2 (CH_3, OCH_2CH_3) ppm. IR (neat): ṽ = 2922 (C–H), 2852 (C–H), 1735 (C=O), 1672 (C=O) cm^{-1}. HRMS (ESI): m/z calcd. for $C_{27}H_{41}NNaO_6$ [M + Na]$^+$ 498.282609 found, 498.282760.

2,3-*trans*-**4p**. Colourless oil. R_f 0.4 (SiO_2, petroleum ether/EtOAc 8:2, v/v). ^{1}H NMR (400 MHz, $CDCl_3$/TMS): δ 7.38–7.21 (po, 5 H, H_{Ar}), 5.93 (d, J = 3.7 Hz, 1 H, H-3), 4.99 (d, J = 14.8 Hz, 1 H, 0.5 × NCH_2Ph), 4.36–4.27 (po, 2 H, H-6a + H-6b), 4.26–4.20 (po, 2 H, H-2 + 0.5 × NCH_2Ph), 4.15–4.07 (m, 2 H, OCH_2CH$_3$), 2.57 (dd, J = 15.7, 8.6 Hz, 1 H, H-1'a), 2.38 (dd, J = 15.7, 5.1 Hz, 1 H, H-1'b), 2.27–2.08 (m, 2 H, CH_2(CO)O), 1.59–1.49 (m, 2 H, CH_2CH$_2$(CO)O), 1.26 (br s, 16 H, (CH_2)$_8$), 1.22 (t, J = 7.1 Hz, 3 H, OCH$_2$CH_3), 0.88 (t, J = 6.8 Hz, 3 H, (CH$_2$)$_8$CH_3) ppm. ^{13}C NMR (101 MHz, $CDCl_3$): δ 173.1 (C, *C*O), 169.4 (C, *C*O), 167.7 (C, *C*O), 136.2 (C, C_{Ar}), 128.9 (CH, CH_{Ar}), 128.5 (CH, CH_{Ar}), 128.0 (CH, CH_{Ar}), 79.2 (CH, C-3), 72.5 (CH, C-2), 65.0 (CH_2, C-6), 61.3 (CH_2, OCH_2CH_3), 47.2 (CH_2, NCH_2Ph), 35.4 (CH_2, C-1'), 34.1 (CH_2, CH_2(CO)O), 32.0 (CH_2, (CH_2)$_8$), 29.7 (CH_2, (CH_2)$_8$), 29.7 (CH_2, (CH_2)$_8$), 29.6 (CH_2, (CH_2)$_8$), 29.5 (CH_2, (CH_2)$_8$), 29.3 (CH_2, (CH_2)$_8$), 29.2 (CH_2, (CH_2)$_8$), 24.7 (CH_2, CH_2CH_2(CO)O), 22.8 (CH_2, (CH_2)$_8$), 14.2 (CH_3, (CH$_2$)$_8CH_3$), 14.2 (CH_3, OCH_2CH_3). IR (neat): ṽ = 2922 (C–H), 2852 (C–H), 1735 (C=O), 1672 (C=O) cm^{-1}. HRMS (ESI): m/z calcd. for $C_{27}H_{41}NNaO_6$ [M + Na]$^+$ 498.282609 found, 498.282760.



$C_{30}H_{47}NO_8$
MW = 549,33 g/mol

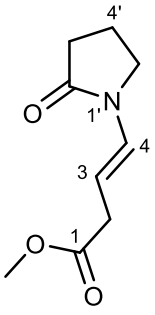
***Cis*- and *trans* [4-(3,4-dimethoxyphenethyl)-2-(2-ethoxy-2-oxoethyl)-5-oxo-morpholin-3-yl] dodecanoate (4q)**.

Prepared following **G.P. B**, using enamide **1q** (158 mg, 0.60 mmol), ethyl 2-ethoxycarbothioylsulfanylacetate (253 mg, 1.2 mmol), DLP (287 mg, 0.72 mmol) and EtOAc (2.0 mL). The crude product was purified by passage though SiO_2–column chromatography (petroleum ether/EtOAc 85:15 to 75:25 v/v) and was obtained in moderate yield (184 mg, 56%) as a mixture of diastereomers (*trans*:*cis* 55:45).

2,3-*cis*-**4q**. R_f 0.27 (SiO_2, petroleum ether/EtOAc 5:5, v/v). ^{1}H NMR (400 MHz, $CDCl_3$): δ 6.84–6.71 (po, 3 H, H_{Ar}), 5.88 (d, J = 1.5 Hz, 1 H, H-3), 4.37–4.11 (po, 5 H, H-2 + H-6 + OCH_2CH$_3$), 4.02–3.93 (m, 1 H, 0.5 × NCH_2), 3.89 (s, 3 H, OCH_3), 3.86 (s, 3 H, OCH_3), 3.25–3.14 (m, 1 H, 0.5 × NCH_2), 2.97–2.86 (m, 1 H, 0.5 × CH_2Ph), 2.85–2.72 (m, 1 H, 0.5 × CH_2Ph), 2.52 (dd, J = 16.3,

7.8 Hz, 1 H, H-1'a), 2.41–2.35 (po, 3 H, H-1'b + CH_2(CO)O), 1.75–1.53 (m, 2 H, CH_2CH$_2$(CO)O), 1.37–1.15 (po, 19 H, OCH$_2$CH_3 + (CH_2)$_8$), 0.88 (t, *J* = 6.7 Hz, 3 H, (CH$_2$)$_8$CH_3) ppm. ^{13}C NMR (101 MHz, CDCl$_3$): *δ* 173.6 (C, *C*O), 169.5 (C, *C*O), 167.0 (C, *C*O), 149.2 (C, C$_{Ar}$), 147.9 (C, C$_{Ar}$), 130.7 (C, C$_{Ar}$), 121.0 (CH, CH$_{Ar}$), 112.1 (CH, CH$_{Ar}$), 111.4 (CH, CH$_{Ar}$), 78.3 (CH, C-3), 72.4 (CH, C-2), 68.2 (CH, C-6), 61.3 (CH$_2$, O*C*H$_2$CH$_3$), 56.0 (CH$_3$, O*C*H$_3$), 56.0 (CH$_3$, O*C*H$_3$), 46.9 (CH$_2$, N*C*H$_2$), 35.9 (CH$_2$, C-1'), 34.4 (CH$_2$, *C*H$_2$(CO)O), 33.6 (CH$_2$, *C*H$_2$Ph), 32.0 (CH$_2$, (*C*H$_2$)$_8$), 29.7 (CH$_2$, (*C*H$_2$)$_8$), 29.7 (CH$_2$, (*C*H$_2$)$_8$), 29.6 (CH$_2$, (*C*H$_2$)$_8$), 29.5 (CH$_2$, (*C*H$_2$)$_8$), 29.3 (CH$_2$, (*C*H$_2$)$_8$), 29.3 (CH$_2$, (*C*H$_2$)$_8$), 25.0 (CH$_2$, *C*H$_2$CH$_2$(CO)O), 22.8 (CH$_2$, (*C*H$_2$)$_8$), 14.2 (CH$_3$, (CH$_2$)$_8$*C*H$_3$), 14.2 (CH$_3$, OCH$_2$*C*H$_3$) ppm. IR (neat): ṽ = 2924 (C–H), 2864 (C–H), 1736 (C=O), 1680 (C=O) cm^{-1}. HRMS (ESI): m/z calcd. for C$_{30}$H$_{47}$NNaO$_8$ [M + Na]$^+$ 572.319388 found, 572.318643.

2,3-*trans*-**4q**. R$_f$ 0.34 (SiO$_2$, petroleum ether/EtOAc 5:5, v/v). ^{1}H NMR (400 MHz, CDCl$_3$): *δ* 6.85–6.69 (po, 3 H, H$_{Ar}$), 5.90 (d, *J* = 3.7 Hz, 1 H, H-3), 4.25–4.11 (po, 5 H, H-2 + H-6 + OCH_2CH$_3$), 4.08–3.95 (m, 1 H, 0.5 × NCH_2), 3.88 (s, 3 H, OCH_3), 3.86 (s, 3 H, OCH_3), 3.23–3.12 (m, 1 H, 0.5 × NCH_2), 2.95–2.87 (m, 1 H, 0.5 × CH_2Ph), 2.83–2.73 (m, 1 H, 0.5 × CH_2Ph), 2.53 (dd, *J* = 15.7, 8.6 Hz, 1 H, H-1'a), 2.41–2.29 (po, 3 H, H-1'b + CH_2(CO)O), 1.68–1.59 (m, 2 H, CH_2CH$_2$(CO)O), 1.36–1.20 (po, 19 H, OCH$_2$CH_3 + (CH_2)$_8$), 0.88 (t, *J* = 6.7 Hz, 3 H, (CH$_2$)$_8$CH_3) ppm. ^{13}C NMR (101 MHz, CDCl$_3$): *δ* 173.4 (C, *C*O), 169.5 (C, *C*O), 167.8 (C, *C*O), 149.2 (C, C$_{Ar}$), 147.9 (C, C$_{Ar}$), 130.6 (C, C$_{Ar}$), 121.0 (CH, CH$_{Ar}$), 112.0 (CH, CH$_{Ar}$), 111.4 (CH, CH$_{Ar}$), 80.1 (CH, C-3), 72.4 (CH, C-2), 64.9 (CH$_2$, C-6), 61.3 (CH$_2$, O*C*H$_2$CH$_3$), 56.0 (CH$_3$, O*C*H$_3$), 56.0 (CH$_3$, O*C*H$_3$), 45.6 (CH$_2$, N*C*H$_2$), 35.5 (CH$_2$, C-1'), 34.3 (CH$_2$, *C*H$_2$(CO)O), 33.4 (CH$_2$, *C*H$_2$Ph), 32.0 (CH$_2$, (*C*H$_2$)$_8$), 29.7 (CH$_2$, (*C*H$_2$)$_8$), 29.7 (CH$_2$, (*C*H$_2$)$_8$), 29.6 (CH$_2$, (*C*H$_2$)$_8$), 29.4 (CH$_2$, (*C*H$_2$)$_8$), 29.3 (CH$_2$, (*C*H$_2$)$_8$), 29.2 (CH$_2$, (*C*H$_2$)$_8$), 24.9 (CH$_2$, *C*H$_2$CH$_2$(CO)O), 22.8 (CH$_2$, (*C*H$_2$)$_8$), 14.2 (CH$_3$, (CH$_2$)$_8$*C*H$_3$), 14.2 (CH$_3$, OCH$_2$*C*H$_3$) ppm. IR (neat): ṽ = 2924 (C–H), 2864 (C–H), 1736 (C=O), 1680 (C=O) cm^{-1}. HRMS (ESI): m/z calcd. for C$_{30}$H$_{47}$NNaO$_8$ [M + Na]$^+$ 572.319388 found, 572.318643.

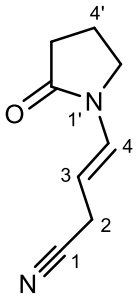


C$_9$H$_{13}$NO$_3$
MW = 183,09 g/mol

Methyl (*E*)-4-(2-oxopyrrolidinyl)but-3-enoate (3ab).

Compound **3ab** was prepared according to **G.P. B**, using enamide **1a** (56 mg, 0.50 mmol), methyl 2-ethoxycarbothioylsulfanylacetate **2b** (198 mg, 1.0 mmol), DLP (239 mg, 0.60 mmol) and EtOAc (1.5 mL). The crude product was purified by passage though SiO$_2$–column chromatography (petroleum ether/EtOAc 75/25 to 60/40 v/v) and was obtained as colourless oil (41 mg, 45%). R$_f$ 0.1 (SiO$_2$, petroleum ether/EtOAc 6:4, v/v). M.p. < 40 °C. ^{1}H NMR (400 MHz, CDCl$_3$): *δ* 6.98 (d, *J* = 14.5 Hz, 1 H, H-4), 5.02 (dt, *J* = 14.5, 7.3 Hz, 1 H, H-3), 3.69 (s, 3 H,

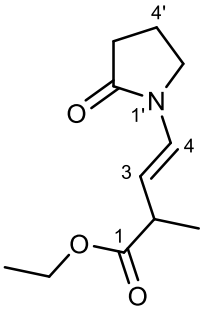
OC*H*$_3$), 3.54 (d, *J* = 7.2 Hz, 2 H, H-5'), 3.11 (dd, *J* = 7.3, 1.1 Hz, 2 H, H-2), 2.48 (t, *J* = 8.1 Hz, 2H, H-3'), 2.18–2.06 (m, 2 H, H-4') ppm. ^{13}C NMR (101 MHz, $CDCl_3$): *δ* 173.3 (C, *C*O), 172.5 (C, *C*O), 126.8 (CH, C-4), 103.4 (CH, C-3), 52.1 (CH_3, O*C*H$_3$), 45.3 (CH_2, C-5'), 35.4 (CH_2, C-2), 31.3 (CH_2, C-3'), 17.6 (CH_2, C-4') ppm. IR (neat): ṽ = 2952 (C–H), 1724 (C=O), 1686 (C=O), 1661 (C=C) cm^{-1}. HRMS (ESI): m/z calcd. for $C_9H_{14}NO_3$ $[M + H]^+$ 184.096820 found, 184.096651.



$C_8H_{10}N_2O$
MW = 150,08 g/mol

(*E*)-4-(2-oxopyrrolidinyl)but-3-enenitrile (3ac).

According to **G.P. B**, the reaction was performed, using *N*-vinylpyrrolidone **1a** (56 mg, 0.50 mmol), *O*-ethyl cyanomethylsulfanylmethanethioate **2c** (162 mg, 1.0 mmol), DLP (239 mg, 0.60 mmol) and EtOAc (1.5 mL). The crude product was purified by passage though SiO_2–column chromatography (petroleum ether/EtOAc 60/40 to 40/60 v/v) and was isolated as a beige solid (45 mg, 60%). R_f 0.03 (SiO_2, petroleum ether/EtOAc 6:4, v/v). M.p. 75–78 °C. ^{1}H NMR (400 MHz, $CDCl_3$): *δ* 7.13 (br d, *J* = 14.2 Hz, 1 H, H-4), 4.83 (dt, *J* = 14.2, 6.6 Hz, 1 H, H-3), 3.51 (t, *J* = 7.2 Hz, 2 H, H-5'), 3.15 (dd, *J* = 6.6, 1.2 Hz, 2 H, H-2), 2.50 (t, *J* = 8.2 Hz, 2 H, H-3'), 2.19–2.07 (m, 2 H, H-4') ppm. ^{13}C NMR (101 MHz, $CDCl_3$): *δ* 173.5 (C, C-2'), 128.3 (CH, C-4), 117.9 (C, C-1), 98.9 (CH, C-3), 45.2 (CH_2, C-5'), 31.1 (CH_2, C-3'), 18.6 (CH_2, C-2 or C-4'), 17.6 (CH_2, C-4' or C-2) ppm. IR (neat): ṽ = 2954 (C–H), 2240 (C≡N), 1690 (C=O), 1652 (C=C) cm^{-1}. HRMS (ESI): m/z calcd. for $C_8H_{11}N_2O$ $[M + H]^+$ 151.086589 found, 151.086535.

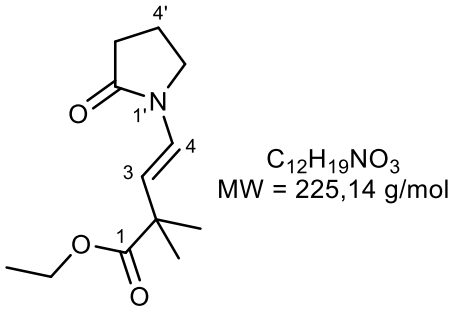


$C_{11}H_{17}NO_3$
MW = 211,12 g/mol

Ethyl (*E*)-2-methyl-4-(2-oxopyrrolidinyl)but-3-enoate (3ad).

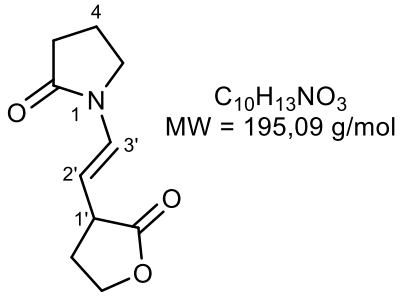
Following **G.P. B**, the reaction was performed with enamide **1a** (56 mg, 0.50 mmol), ethyl 2-ethoxycarbothioylsulfanylpropanoate **2d** (222 mg, 1.0 mmol), DLP (239 mg, 0.60 mmol) and EtOAc (1.5 mL). The crude product was purified by passage though SiO_2–column chromatography (petroleum ether/EtOAc 75/25 to 65/35 v/v) and was obtained as a

colourless oil (79 mg, 72%). R_f 0.24 (SiO_2, petroleum ether/EtOAc 5:5, v/v). ^{1}H NMR (400 MHz, $CDCl_3$/TMS): δ 6.99 (d, J = 14.5 Hz, 1 H, H-4), 5.02 (dd, J = 14.5, 8.4 Hz, 1 H , H-3), 4.13 (qd, J = 7.1, 1.5 Hz, 2 H, OCH_2CH$_3$), 3.52 (t, J = 7.2 Hz, 2 H, H-5'), 3.22–3.11 (m, 1 H, H-2), 2.48 (t, J = 8.1 Hz, 2 H, H-3'), 2.14–2.05 (m, 2 H, H-4'), 1.30 (d, J = 7.1 Hz, 3 H, CH_3), 1.26 (t, J = 7.1 Hz, 3 H, OCH$_2$CH_3) ppm. ^{13}C NMR (101 MHz, $CDCl_3$): δ 175.0 (C, *C*O), 173.3 (C, *C*O), 125.0 (CH, C-4), 111.0 (CH, C-3), 60.8 (CH_2, O*C*H$_2$CH$_3$), 45.3 (CH_2, C-5'), 41.0 (CH, C-2), 31.3 (CH_2, C-3'), 18.3 (CH_3), 17.6 (CH_2, C-4'), 14.3 (CH_3, OCH$_2$*C*H$_3$) ppm. HRMS (ESI): m/z calcd. for $C_{11}H_{18}NO_3$ [M + H]$^+$ 212.128120 found, 212.128116.



Ethyl (*E*)-2,2-dimethyl-4-(2-oxopyrrolidinyl)but-3-enoate (3ae).

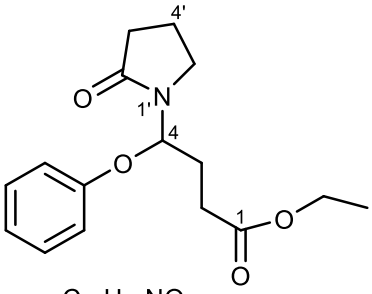
Following **G.P. B**, the reaction was performed with enamide **1a** (56 mg, 0.50 mmol), ethyl 2-ethoxycarbothioylsulfanyl-2-methyl-propanoate **2e** (236 mg, 1.0 mmol), DLP (239 mg, 0.60 mmol) and EtOAc (1.5 mL). The crude residue was purified though SiO_2–column chromatography (petroleum ether/EtOAc 75/25 to 65/35 v/v) to afford compound **3ae** (42 mg, 39%). R_f 0.14 (SiO_2, petroleum ether/EtOAc 5:5, v/v). ^{1}H NMR (400 MHz, $CDCl_3$/TMS): δ 6.97 (d, J = 14.8 Hz, 1 H, H-4), 5.17 (d, J = 14.8 Hz, 1 H, H-3), 4.12 (q, J = 7.1 Hz, 2 H, OCH_2CH$_3$), 3.52 (t, J = 7.2 Hz, 2 H, H-5'), 2.49 (t, J = 8.1 Hz, 2 H, H-3'), 2.17–2.01 (m, 2 H, H-4'), 1.35 (s, 6 H, 2 × CH_3), 1.25 (t, J = 7.1 Hz, 3 H, OCH$_2$CH_3) ppm. ^{13}C NMR (101 MHz, $CDCl_3$): δ 176.6 (C, *C*O), 173.3 (C, *C*O), 123.1 (CH, C-4), 116.9 (CH, C-3), 60.9 (CH_2, O*C*H$_2$CH$_3$), 45.3 (CH_2, C-5'), 43.0 (C, C-2), 31.4 (CH_2, C-3'), 25.6 (CH_3), 25.6 (CH_3), 17.5 (CH_2, C-4'), 14.2 (CH_3, OCH$_2$*C*H$_3$) ppm. IR (neat): $\tilde{\nu}$ = 2926 (C–H), 1731 (C=O), 1683 (C=O), 1515 (C=C) cm^{-1}. HRMS (ESI): m/z calcd. for $C_{12}H_{20}NO_3$ [M + H]$^+$ 226.143770 found, 226.143487.



1-[(*E*)-2-(2-oxotetrahydrofuran-3-yl)vinyl]pyrrolidin-2-one (3af).

The reaction was performed according to **G.P. B**, using *N*-vinylpyrrolidone **1a** (56 mg, 0.50 mmol), *O*-ethyl (2-oxotetrahydrofuran-3-yl)sulfanylmethanethioate **2f** (207 mg, 1.0 mmol), DLP (239 mg, 0.60 mmol) and EtOAc (1.5 mL). The crude product was purified by passage though SiO_2–column chromatography (petroleum ether/EtOAc 50/50 to 25/75 v/v) and was isolated as a colourless oil (70 mg, 71%). R_f 0.1 (SiO_2, petroleum ether/EtOAc 1:3, v/v). ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.04 (d, J = 14.5 Hz, 1 H, H-3'), 5.01 (dd, J = 14.5, 6.9 Hz, 1 H, H-2'), 4.41 (td, J = 8.7, 2.4 Hz, 1 H, 0.5 × OCH_2), 4.24 (ddd, J = 10.3, 9.1, 6.3 Hz, 1 H, 0.5 × OCH_2), 3.59–3.46 (m, 2 H, H-5), 3.36–3.23 (m, 1 H, H-1'), 2.56–2.45 (po, 3 H, H-3 + 0.5 × OCH_2CH_2), 2.27–2.14 (m, 1 H, 0.5 × OCH_2CH_2), 2.16–2.08 (m, 2 H, H-4) ppm. ^{13}C NMR (101 MHz, $CDCl_3$): δ 177.8 (C, *C*O(O)), 173.4 (C, C-2), 127.0 (CH, C-3'), 105.9 (CH, C-2'), 66.7 (CH_2, O*C*H_2), 45.2 (CH_2, C-5), 40.9 (CH, C-1'), 31.2 (CH_2, C-3), 29.7 (CH_2, OCH_2CH_2), 17.6 (CH_2, C-4) ppm. IR (neat): ṽ = 2919 (C–H), 1762 (C=O), 1683 (C=O), 1661 (C=C) cm^{-1}. HRMS (ESI): m/z calcd. for $C_{10}H_{14}NO_3$ [M + H]$^+$ 196.096820 found: 196.096790.

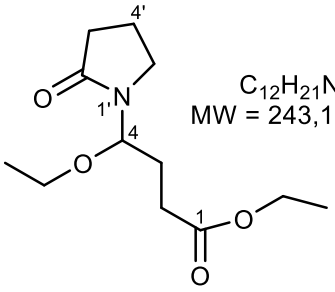
Difunctionalisation of Enamides 1a or 1b with Xanthates 2a or 2b in Presence of Nucleophile (G.P. C).



$C_{16}H_{21}NO_4$
MW = 291,15 g/mol

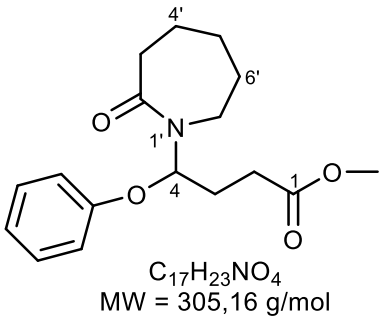
Ethyl 4-(2-oxopyrrolidinyl)-4-phenoxy-butanoate (5a).

According to **G.P. C**, the reaction was performed with enamide **1a** (56 mg, 0.5 mmol), ethyl 2-ethoxycarbothioylsulfanylacetate (210 mg, 1 mmol), DLP (239 mg, 0.6 mmol), phenol (470 mg, 5 mmol) and EtOAc (1.5 mL). The crude product was purified by column chromatography (SiO_2, petroleum ether/EtOAc 80:20 to 70:30, v/v) to give **5a** as a yellow oil (60 mg, 40%). R_f 0.27 (SiO_2, petroleum ether/EtOAc 8:2, v/v). ^{1}H NMR (400 MHz, $CDCl_3$/TMS): δ 7.26 (t, J = 7.8 Hz, 2 H, H_{Ar}), 6.99–6.94 (po, 3 H, H_{Ar}), 6.04 (t, J = 6.5 Hz, 1 H, H-4), 4.14 (q, J = 7.1 Hz, 2 H, O*C*H_2CH_3), 3.45–3.39 (m, 1H, H-5'a), 3.32–3.27 (m, 1 H, H-5'b), 2.55–2.25 (po, 5 H, H-3' + H-3a + H-2), 2.15–1.80 (po, 3 H, H-4' + H-3b), 1.26 (t, J = 6.5 Hz, 3 H, OCH_2CH_3) ppm. ^{13}C NMR (101 MHz, $CDCl_3$): δ 175.6 (C, *C*O), 172.7 (C, *C*O), 155.9 (C, C_{Ar}), 129.8 (CH, CH_{Ar}), 121.9 (CH, CH_{Ar}), 115.7 (CH, CH_{Ar}), 78.3 (CH, C-4), 60.8 (CH_2, O*C*H_2CH_3), 41.3 (CH_2, C-5'), 31.3 (CH_2, C-2), 29.9 (CH_2, C-3'), 28.0 (CH_2, C-3), 18.1 (CH_2, C-4'), 14.2 (CH_3, OCH_2CH_3) ppm. IR (neat): ṽ = 1740 (C=O), 1603 (C=O) cm^{-1}. HRMS (ESI): m/z calcd. for $C_{16}H_{21}NNaO_4$ [M + Na]$^+$ 314.135680 found, 314.136279.



Ethyl 4-ethoxy-4-(2-oxopyrrolidinyl)butanoate (5b).

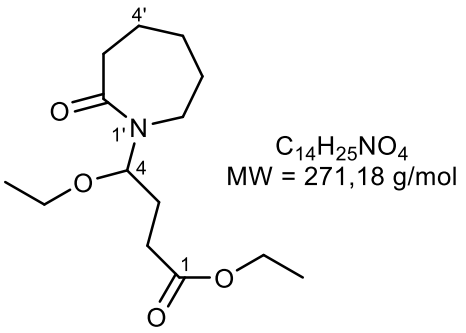
According to **G.P. C**, the reaction was performed with enamide **1a** (56 mg, 0.5 mmol), ethyl 2-ethoxycarbothioylsulfanylacetate (210 mg, 1 mmol), DLP (239 mg, 0.6 mmol), EtOH (300 µl, 5 mmol) and EtOAc (1.5 mL). The crude product was purified by column chromatography (SiO_2, petroleum ether/EtOAc 70:30 to 60:40, v/v) to provide **5b** as a yellow oil (26 mg, 51%). R_f 0.2 (SiO_2, petroleum ether/EtOAc 5:5, v/v). ^{1}H NMR (400 MHz, $CDCl_3$): δ 5.30–5.21 (br t, J = 6.8 Hz, 1 H, H-4), 4.13 (q, J = 7.1 Hz, 2 H, (OC)OCH_2CH$_3$), 3.46–3.27 (po, 4 H, OCH_2CH$_3$ + H-5'), 2.48–2.37 (po, 3 H, H-2a + H-3'), 2.33–2.22 (m, 1 H, H-2b), 2.12–1.94 (po, 3 H, H-4' + H-3a), 1.88–1.77 (m, 1 H, H-3b), 1.24 (t, J = 7.1 Hz, 3 H, (OC)OCH$_2$CH_3), 1.17 (t, J = 7.0 Hz, 3 H, OCH$_2$CH_3) ppm. ^{13}C NMR (101 MHz, $CDCl_3$): δ 176.0 (C, C-2'), 172.9 (C, C-1), 80.4 (CH, C-4), 63.6 (CH$_2$, OCH$_2$CH$_3$), 60.6 (CH$_2$, (OC)OCH$_2$CH$_3$) 41.2(CH$_2$, C-5'), 31.7 (CH$_2$, C-3'), 30.3 (CH$_2$, C-2), 28.1 (CH$_2$, C-3),18.4 (CH$_2$, C-4'), 15.0 (CH$_3$, (OC)OCH$_2$$CH_3$), 14.3 (CH$_3$, OCH$_2$$CH_3$) ppm. HRMS (ESI): m/z calcd. for $C_{12}H_{21}NNaO_4$ $[M + Na]^+$ 266.136279 found, 266.136185.



Methyl 4-(2-oxoazepanyl)-4-phenoxy-butanoate (5c).

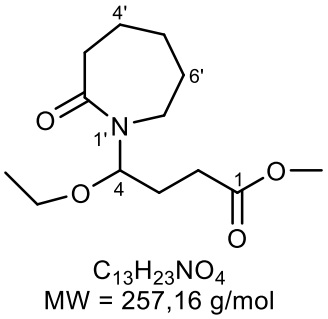
According to **G.P. C**, the reaction was performed with enamide **1b** (100 mg, 0.71 mmol), methyl 2-ethoxycarbothioylsulfanylacetate (277 mg, 1.42 mmol), DLP (342 mg, 0.86 mmol), phenol (671 mg, 7.2 mmol) and EtOAc (1.5 mL). The crude product was purified by column chromatography (SiO_2, petroleum ether/EtOAc 80:20 to 70:30, v/v) to provide **5c** as a yellow oil (120 mg, 55%). R_f 0.25 (SiO_2, petroleum ether/EtOAc 8:2, v/v). ^{1}H NMR (400 MHz, $CDCl_3$/TMS): δ 7.26 (t, J = 7.4 Hz, 2 H, H_{Ar}), 6.96 (t, J = 7.4 Hz, 1 H, H_{Ar}), 6.91 (br d, J = 8.1 Hz, 2 H, H_{Ar}), 6.46 (t, J = 6.7 Hz, 1 H, H-4), 3.68 (s, 3 H, OCH_3), 3.40–3.20 (m, 2 H, H-7'), 2.58–2.45 (po, 3 H, H-2a + H-3'), 2.45–2.35 (m, 1 H, H-2b), 2.30–2.20 (m, 1 H, H-3a), 2.06–1.97 (m, 1 H,

H-3b), 1.70–1.50 (po, 5 H, H-4’ + H-5’ + H-6’a), 1.31–1.21 (m, 1 H, H-6’b) ppm. ^{13}C NMR (101 MHz, $CDCl_3$): δ 176.4 (C, *C*O), 173.3 (C, *C*O), 156.3 (C, C_{Ar}), 129.7 (CH, CH_{Ar}), 121.7 (CH, CH_{Ar}), 115.3 (CH, CH_{Ar}), 79.6 (CH, C-4), 51.9 (CH_3, O*C*H_3), 41.9 (CH_2, C-7’), 37.8 (CH_2, C-3’), 30.1 (CH_2, C-5’), 29.9 (CH_2, C-2), 28.9 (CH_2, C-6’), 28.6 (CH_2, C-3), 23.4 (CH_2, C-4’) ppm. IR (neat): $\tilde{\nu}$ = 1739 (C=O), 1645 (C=O) cm^{-1}. HRMS (ESI): m/z calcd. for $C_{17}H_{24}NO_4$ $[M + H]^+$ 306.169896 found, 306.169985; m/z calcd. for $C_{17}H_{23}NNaO_4$ $[M + Na]^+$ 328.151955 found 328.151929.



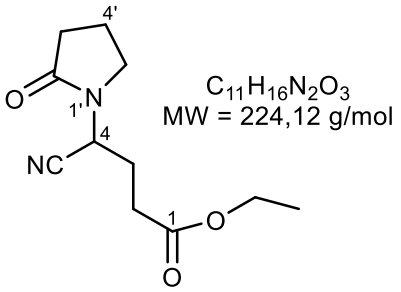
Ethyl 4-ethoxy-4-(2-oxoazepanyl)butanoate (5d).

According to **G.P. C**, the reaction was performed with enamide **1b** (100 mg, 0.71 mmol)), ethyl 2-ethoxycarbothioylsulfanylacetate (300 mg, 1.44 mmol), DLP (342 mg, 0.86 mmol), EtOH (41 µl, 7.2 mmol) and EtOAc (1.5 mL). The crude product was purified by column chromatography (SiO_2, petroleum ether/EtOAc 80:20 to 70:30, v/v) to afford **5d** as a yellow oil (121 mg, 63%). R_f 0.25 (SiO_2, petroleum ether/EtOAc 8:2, v/v). ^{1}H NMR (400 MHz, $CDCl_3$): δ 5.70–5.65 (dd, *J* = 7.5, 6.0 Hz, 1 H, H-4), 4.13 (q, *J* = 7.1 Hz, 2 H, OC*H*$_2$CH$_3$), 3.55–3.15 (po, 4 H, OC*H*$_2$CH$_3$ + H-7’), 2.63–2.20 (po, 4 H, H-3’ + H-2), 2.05–1.90 (m, 1 H, H-3a), 1.90–1.50 (po, 7 H, H-4’ + H-5’ + H-6’+H-3b), 1.25 (t, *J* = 7.1 Hz, 3 H, OC*H*$_2$CH$_3$), 1.15 (t, *J* = 7.0 Hz, 3 H, OC*H*$_2$CH$_3$) ppm. ^{13}C NMR (101 MHz, $CDCl_3$): δ 177.0 (C, *C*O), 173.1 (C, *C*O), 81.4 (CH, C-4), 63.7 (CH_2, O*C*H$_2$CH$_3$), 60.6 (CH_2, O*C*H$_2$CH$_3$), 41.5 (CH_2, C-7’), 38.0 (CH_2, C-3’), 30.5 (CH_2, C-2), 30.3 (CH_2, C-5’ or C-6’), 29.4 (CH_2, C-6’ or C-5’), 28.6 (CH_2, C-3), 23.8 (CH_2, C-4’), 15.1 (CH_3, OCH$_2$*C*H$_3$), 14.3 (CH_3, OCH$_2$*C*H$_3$) ppm. IR (neat): $\tilde{\nu}$ = 1735 (C=O), 1645 (C=O) cm^{-1}. HRMS (ESI): m/z calcd. for $C_{14}H_{26}NO_4$ $[M + H]^+$ 272.185396 found, 272.185635; m/z calcd. for $C_{14}H_{25}NNaO_4$ $[M + Na]^+$ 294.167609 found, 294.167579.



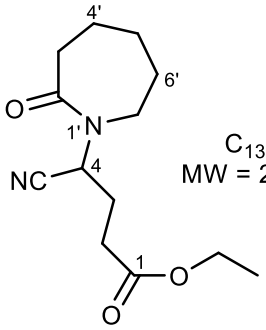
Methyl 4-ethoxy-4-(2-oxoazepanyl)butanoate (5e).

According to **G.P. C**, the reaction was performed with enamide **1b** (100 mg, 0.71 mmol), methyl 2-ethoxycarbothioylsulfanylacetate (277 mg, 1.42 mmol), DLP (342 mg, 0.86 mmol), EtOH (400 µL, 7.2 mmol) and EtOAc (1.5 mL). The crude product was purified by column chromatography (SiO_2, petroleum ether/EtOAc 80:20 to 70:30, v/v) to provide **5e** as a yellow oil (100 mg, 54%). R_f 0.3 (SiO_2, petroleum ether/EtOAc 8:2, v/v). ^{1}H NMR (400 MHz, $CDCl_3$): δ 5.69–5.65 (m, 1 H, H-4), 3.66 (s, 3 H, OCH_3), 3.48–3.16 (po, 4 H, H-7' + OCH_2CH$_3$), 2.62–2.36 (m, 3 H, H-3' + H-2a), 2.36–2.21 (m, 1 H, H-2b), 2.04–1.90 (m, 1 H, H-3a), 1.99–1.48 (m, 7 H, H-4' + H-5' + H-6' + H-3b), 1.15 (t, J = 7.0, 1.1 Hz, 3 H, OCH$_2$CH_3) ppm. ^{13}C NMR (101 MHz, $CDCl_3$): δ 177.0 (C, *C*O), 173.6 (C, *C*O), 82.4 (CH, C-4), 63.7 (CH_2, O*C*H$_2$CH$_3$), 51.8 (CH_3, O*C*H$_3$), 41.4 (CH_2, C-7'), 37.9 (CH_2, C-3'), 30.3 (CH_2, C-2), 30.3 (CH_2, C-6' or C-5') 29.4 (CH_2, C-5' or C-6'), 28.7 (CH_2, C-3), 23.8 (CH_2, C-4'), 15.1 (CH_3, OCH$_2$*C*H$_3$) ppm. IR (neat): $\tilde{\nu}$ = 1727 (C=O), 1688 (C=O) cm^{-1}. HRMS (ESI): m/z calcd. for $C_{13}H_{24}NO_4$ $[M + H]^+$ 258.169826 found, 258.169985; m/z calcd. for $C_{13}H_{23}NaNO_4$ $[M + Na]^+$ 280.151725 found 280.151929.



Ethyl 4-cyano-4-(2-oxopyrrolidinyl)butanoate (5f).

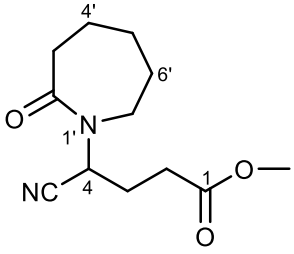
According to **G.P. C**, the reaction was performed with enamide **1a** (56 mg, 0.5 mmol), ethyl 2-ethoxycarbothioylsulfanylacetate (210 mg, 1 mmol), DLP (239 mg, 0.6 mmol), TMSCN (625 µl, 5 mmol) and EtOAc (1.5 mL). The crude product was purified by column chromatography (SiO_2, petroleum ether/EtOAc 80:20 to 70:30, v/v) to provide **5f** as a yellow oil (50 mg, 40%). R_f 0.3 (SiO_2, petroleum ether/EtOAc 8:2, v/v). ^{1}H NMR (400 MHz, $CDCl_3$): δ 5.18 (t, J = 8.0 Hz, 1 H, H-4), 4.16 (q, J = 7.1 Hz, 2 H, OCH_2CH$_3$), 3.54–3.37 (m, 2 H, H-5'), 2.46–2.25 (po, 4 H, H-2 + H-3'), 2.25–1.90 (po, 4 H, H-4' + H-3), 1.27 (t, J = 7.1 Hz, 3 H, OCH$_2$CH_3) ppm. ^{13}C NMR (101 MHz, $CDCl_3$): δ 174.8 (C, *C*O), 171.3 (C, *C*O), 116.4 (C, *C*N), 61.9 (CH_2, OCH$_2$*C*H$_3$), 43.4 (CH, C-4), 42.1 (CH_2, C-5'), 30.2 (CH_2 C-3' or C-2), 29.9 (CH_2, C-2 or C-3'), 26.3 (CH_2, C-3), 17.7 (CH_2, C-4'), 14.1 (CH_3, OCH$_2$*C*H$_3$) ppm. IR (neat): $\tilde{\nu}$ = 1750 (C=O), 1640 (C=O) cm^{-1}. HRMS (ESI): m/z calcd. for $C_{11}H_{17}N_2O_3$ $[M + H]^+$ 225.123214 found, 225.123369; m/z calcd. for $C_{11}H_{16}N_2NaO_3$ $[M + Na]^+$ 247.12105210 found, 247.12105313.



$C_{13}H_{20}N_2O_3$
MW = 252,15 g/mol

Ethyl 4-cyano-4-(2-oxoazepan-1-yl)butanoate (5g).

According to **G.P. C**, the reaction was performed with enamide **1b** (100 mg, 0.71 mmol)), ethyl 2-ethoxycarbothioylsulfanylacetate (300 mg, 1.44 mmol), DLP (342 mg, 0.86 mmol), TMSCN (900 µL, 7.2 mmol) and EtOAc (1.5 mL). The crude product was purified by column chromatography (SiO_2, petroleum ether/EtOAc 80:20 to 70:30, v/v) to give **5g** as a yellow oil (100 mg, 55%). R_f 0.2 (SiO_2, petroleum ether/EtOAc 8:2, v/v). ^{1}H NMR (400 MHz, $CDCl_3$): δ 5.66 (t, J = 8.0 Hz, 1 H, H-4), 4.16 (q, J = 7.1 Hz, 2 H, OCH_2CH$_3$), 3.47 (t, J = 9.1 Hz, 2 H, H-7'), 2.65–2.49 (m, 2 H, H-3'), 2.49–2.31 (m, 2 H, H-2), 2.23–2.11 (m, 1 H, H-3a), 2.10–1.98 (m, 1 H, H-3b), 1.90–1.62 (po, 6 H, H-4' + H-5'+ H-6'), 1.27 (t, J = 7.1 Hz, 3 H, OCH$_2$CH_3) ppm. ^{13}C NMR (101 MHz, $CDCl_3$): δ 175.6 (C, *C*O), 171.7 (C, *C*O), 117.7 (C, *C*N), 61.1 (CH_2, O*C*H$_2$CH$_3$), 46.1 (CH_2, C-7'), 45.0 (CH, C-4), 36.9 (CH_2, C-3'), 30.3 (CH_2, C-2), 29.9 (CH_2, C-6' or C-5'), 28.8 (CH_2, C-5' or C-6'), 27.0 (CH_2, C-3), 23.2 (CH_2, C-4'), 14.3 (CH_3, OCH$_2$*C*H$_3$) ppm. IR (neat): $\tilde{\nu}$ = 1739 (C=O), 1654 (C=O) cm^{-1}. HRMS (ESI): m/z calcd. for $C_{13}H_{21}N_2O_3$ $[M + H]^+$ 253.154708 found, 253.154669; m/z calcd. for $C_{13}H_{20}N_2NaO_3$ $[M + Na]^+$ 275.136713 found, 275.1376613.

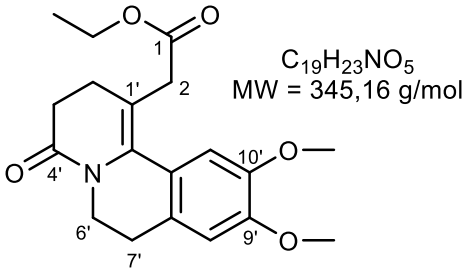


$C_{12}H_{18}N_2O_3$
MW = 238,13 g/mol

Methyl 4-cyano-4-(2-oxoazepanyl)butanoate (5h).

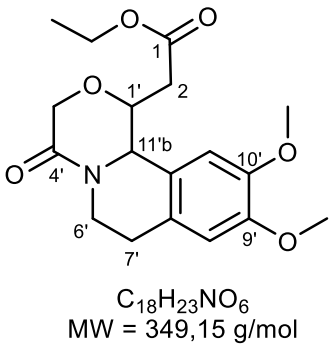
According to **G.P. C**, the reaction was performed with enamide **1b** (100 mg, 0.71 mmol), methyl 2-ethoxycarbothioylsulfanylacetate (277 mg, 1.42 mmol), DLP (342 mg, 0.86 mmol), TMSCN (900 µL, 7.2 mmol) and EtOAc (1.5 mL). The crude product was purified by column chromatography (SiO_2, petroleum ether/EtOAc 80:20 to 70:30, v/v) to provide **5h** as a yellow oil (90 mg, 52%). R_f 0.25 (SiO_2, petroleum ether/EtOAc 8:2, v/v). ^{1}H NMR (400 MHz, $CDCl_3$): δ 5.63 (t, J = 7.9 Hz, 1 H, H-4), 3.70 (s, 3 H, OCH_3), 3.48 (m, 2 H, H-7'), 2.62–2.47 (m, 2 H, H-3'), 2.46–2.28 (m, 2 H, H-2), 2.21–2.10 (m, 1 H, H-3a), 2.09–1.97 (m, 1 H, H-3b), 1.81 (po, 6 H, H-4'

+ H-5’ + H-6’) ppm. ^{13}C NMR (101 MHz, $CDCl_3$): δ 175.6 (C, *C*O), 172.1 (C, *C*O), 117.6 (C, *C*N), 52.1 (CH_3, O*C*H$_3$), 46.0 (CH_2, C-7’), 44.9 (CH, C-4), 36.8(CH_2, C-3’), 29.9 (CH_2, C-5’ or C-2), 29.8 (CH_2, C-2 or C-5’), 28.7 (CH_2, C-6’), 27.0 (CH_2, C-3), 23.2 (CH_2, C-4’) ppm. IR (neat): $\tilde{\nu}$ = 1735 (C=O), 1652 (C=O) cm^{-1}. HRMS (ESI): m/z calcd. for $C_{12}H_{19}N_2O_3$ $[M + H]^+$ 239.138817 found, 239.139019; m/z calcd. for $C_{12}H_{18}N_2NaO_3$ $[M + Na]^+$ 261.120838 found, 261.120963.



Ethyl 2-(9,10-dimethoxy-4-oxo-2,3,6,7-tetrahydrobenzo[*a*]quinolizinyl)acetate (5i).

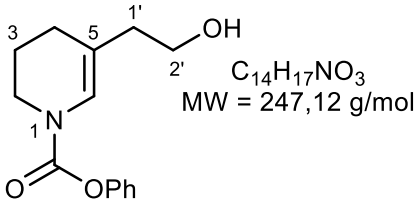
The titled compound was prepared according to **G.P. C**, using enamide **1r** (500 mg, 1.8 mmol), ethyl 2-ethoxycarbothioylsulfanylacetate (749mg, 3.6 mmol), DLP (861 mg, 2.16 mmol), EtOH (1.04 mL, 18.0 mmol) and EtOAc (3.6 mL). The crude product was purified by column chromatography (SiO_2, petroleum ether/EtOAc 80:20 to 70:30, v/v) to provide **5i** as a yellow oil (186 mg, 30%). R_f 0.6 (SiO_2, petroleum ether/EtOAc 8:2, v/v). ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.62 (s, 1 H, H_{Ar}), 6.68 (s, 1 H, H_{Ar}), 4.15 (q, *J* = 7.1, 2 H, OC*H*$_2$CH$_3$), 3.90–3.85 (t, 2 H, *J* = 6.2 Hz, H-6’), 3.95 (s, 3 H, OC*H*$_3$), 3.93 (s, 3 H, OC*H*$_3$), 3.37 (t, *J* = 6.4 Hz, 2 H, H-3’), 2.93 (t, *J* = 6.2 Hz, 2 H, H-7’), 2.75–2.66 (t, *J* = 6.4 Hz, 2 H, H-2’), 1.28–1.23 (m, 5 H, H-2 + OCH$_2$C*H*$_3$) ppm. ^{13}C NMR (101 MHz, $CDCl_3$): δ 175.6 (C, *C*O), 173.0 (C, *C*O), 165.7 (C, C=C), 153.6 (C, C^{IV}), 148.6 (C, C^{IV}), 134.9 (C, C^{IV}), 121.4 (C, C_{Ar}), 111.2 (CH, CH_{Ar}), 109.4 (CH, CH_{Ar}), 60.7 (CH_2, O*C*H$_2$CH$_3$), 56.3 (CH_3, O*C*H$_3$), 56.3 (CH_3, O*C*H$_3$), 42.4 (CH_2, C-6’), 34.7 (CH_2, C-3’), 29.7 (CH_2, C-2’), 29.7 (CH_2, C-2), 28.0 (CH_2, C-7’), 14.4 (CH_3, OCH$_2$*C*H$_3$) ppm. IR (neat): $\tilde{\nu}$ = 1726 (C=O), 1688 (C=O) cm^{-1}. HRMS (ESI): m/z calcd. for $C_{17}H_{22}NO_6$ $[M - C_2H_5 + H_3O^+ + H]^+$ 336.144391 found, 336.1444164; m/z calcd. for $C_{17}H_{21}NNaO_6$ $[M - C_2H_5 + H_3O^+ + Na]^+$ 358.126130 found, 358.126108.



***Trans*- Ethyl 2-(9,10-dimethoxy-4-oxo-1,6,7,11b-tetrahydro-[1,4]oxazino[3,4-*a*]isoquinolinyl)acetate (5j).**

An oven-dried round-bottomed flask under argon atmosphere was charged with compound **4q** (33 mg, 0.060 mmol, *cis*:*trans* 45:55), dry CH_2Cl_2 (1.0 mL) and a magnetic stir bar. Trifluoroacetic acid (10 µL, 0.14 mmol) was then added and the solution mixture was stirred at rt for 18 h. Next, the solution was diluted (CH_2Cl_2) and the organic phase was washed with aqueous $NaHCO_3$ and brine. The organic phase was dried ($MgSO_4$), filtered through a cotton plug and evaporated under reduced pressure. The crude product was obtained as a single diastereomer; purification of which (SiO_2, petroleum ether/EtOAc 85/15 to 75/25) afforded *trans*-**5j** as a white solid (11 mg, 52%). R_f 0.2 (SiO_2, petroleum ether/EtOAc 3:7, v/v). M.p. 110–112 °C. ^{1}H NMR (400 MHz, $CDCl_3$): δ 6.75 (s, 1 H, H_{Ar}), 6.70 (s, 1 H, H_{Ar}), 4.66 (d, J = 8.4 Hz, 1 H, H-11'b), 4.48–4.42 (m, 1 H, H-6'a), 4.38 (d, J = 16.7 Hz, 1 H, H-3'a), 4.25–4.16 (po, 4 H, H-1' + H-3'b+ OCH_2CH$_3$), 3.88 (s, 3 H, OCH_3), 3.86 (s, 3 H, OCH_3), 3.09–2.99 (m, 1 H, H-6'b), 2.95–2.87 (po, 2 H, H-7'a + H-2a), 2.79 (dd, J = 15.6, 7.9 Hz, 1 H, H-2b), 2.76–2.67 (dt, J = 15.8, 4.8 Hz, 1 H, H-7'b), 1.28 (t, J = 7.1 Hz, 3 H, OCH$_2$CH_3) ppm. ^{13}C NMR (101 MHz, $CDCl_3$): δ 170.5 (C, *C*O), 166.7 (C, *C*O), 148.7 (C, C_{Ar}), 147.7 (C, C_{Ar}), 130.1 (C, C_{Ar}), 124.2 (C, C_{Ar}), 112.0 (CH, CH_{Ar}), 109.6 (CH, CH_{Ar}), 75.1 (CH, C-1'), 67.5 (CH_2, C-3'), 61.3 (CH_2, O*C*H$_2$CH$_3$), 58.2 (CH, C-11'b), 56.3 (CH_3, O*C*H$_3$), 56.1 (CH_3, O*C*H$_3$), 40.5 (CH_2, C-6'), 38.8 (CH_2, C-2), 28.9 (CH_2, C-7'), 14.3 (CH_3, OCH$_2$*C*H$_3$) ppm. IR (neat): $\tilde{\nu}$ = 2979 (C–H), 2939 (C–H), 1717 (C=O), 1636 (C=O), 1522 (C=C) cm^{-1}. HRMS (ESI): m/z calcd. for $C_{18}H_{24}NO_6$ $[M + H]^+$ 350.159814 found, 350.160181.

Synthesis of Alcool 6.



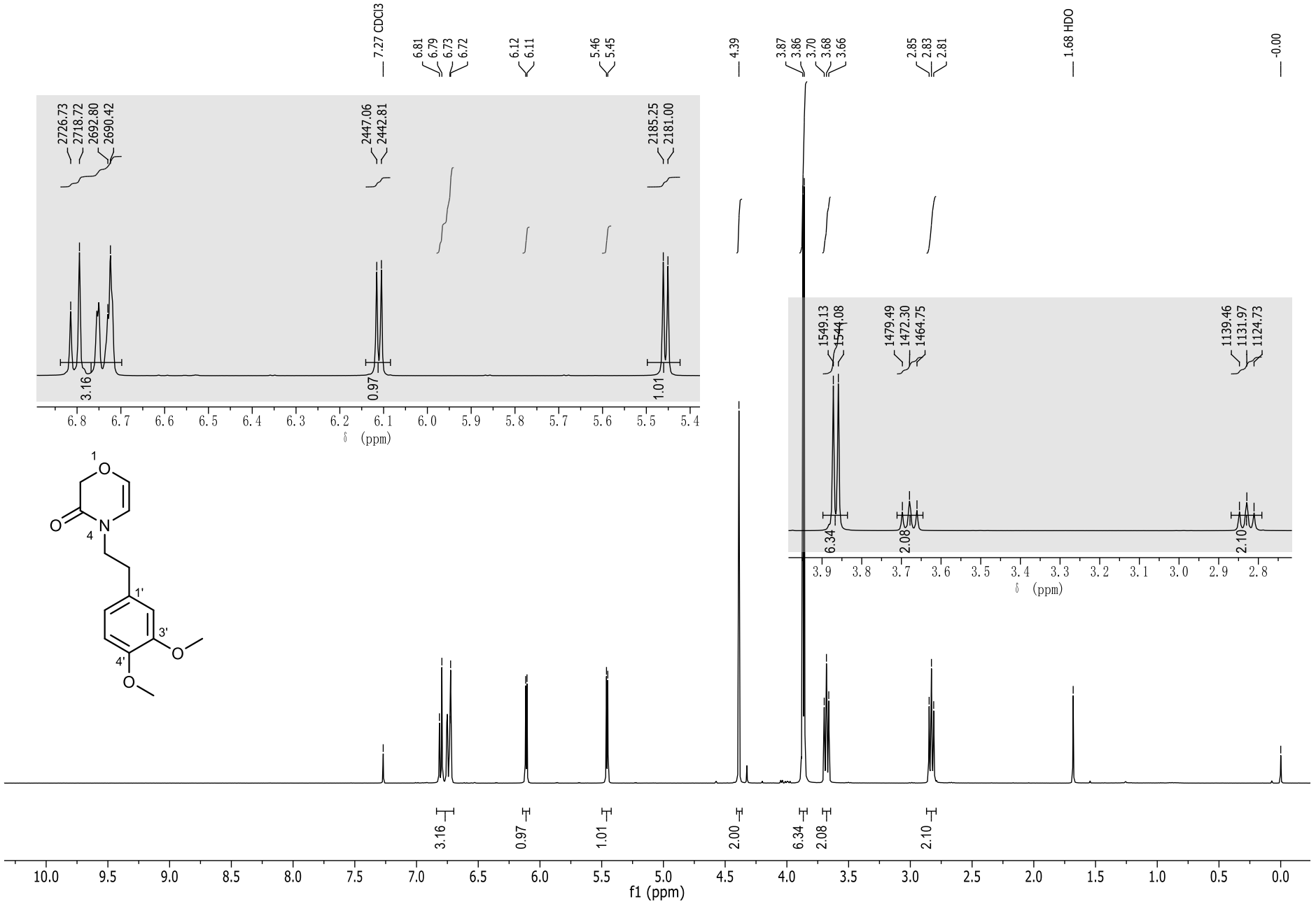
Phenyl 5-(2-hydroxyethyl)-3,4-dihydro-2*H*-pyridine-1-carboxylate (6).

An oven-dried round-bottomed flask under argon atmosphere was charged with ester **3h** (55 mg, 0.19 mmol), anhydrous THF (1.5 mL) and a magnetic stir bar. The solution was cooled to 0 °C (ice-water bath) and $LiAlH_4$ (80 mg, 11 equiv) was added portionwise. The mixture was stirred at rt for 16 h and then heated under reflux for 3 h (reaction monitored by TLC using EP/EtOAc 5/5 as eluent). After cooling at 0 °C (ice-water bath), the mixture was then hydrolysed (H_2O, 0.5 mL), the suspension was filtered through a pad of celite® and the cake rinsed with CH_2Cl_2. Next, the aqueous phase was discarded, the organic layer was dried ($MgSO_4$), filtered through a cotton plug and evaporated under reduced pressure. The crude product was purified by column chromatography over silica gel (petroleum ether/EtOAc: 50/50) to give **6** as a 6:4 mixture of rotamers (colourless oil, 31 mg, 66%). R_f 0.36 (SiO_2, petroleum ether/EtOAc 6:4, v/v). ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.37 (t, J = 7.9 Hz, 2 H, H_{Ar} *maj.* + H_{Ar} *min.*), 7.21 (t, J = 7.4 Hz, 1 H, H_{Ar} *maj.* + H_{Ar} *min.*), 7.13 (br s, 0.56 H, H_{Ar} *maj.* + H_{Ar} *min.*), 6.89 (br s, 0.6 H, H-6 *maj.*), 6.82 (br s, 0.4 H, H-6 *min.*), 3.85–3.60 (m, 4 H, H-2 *maj.* + H-2 *min.*

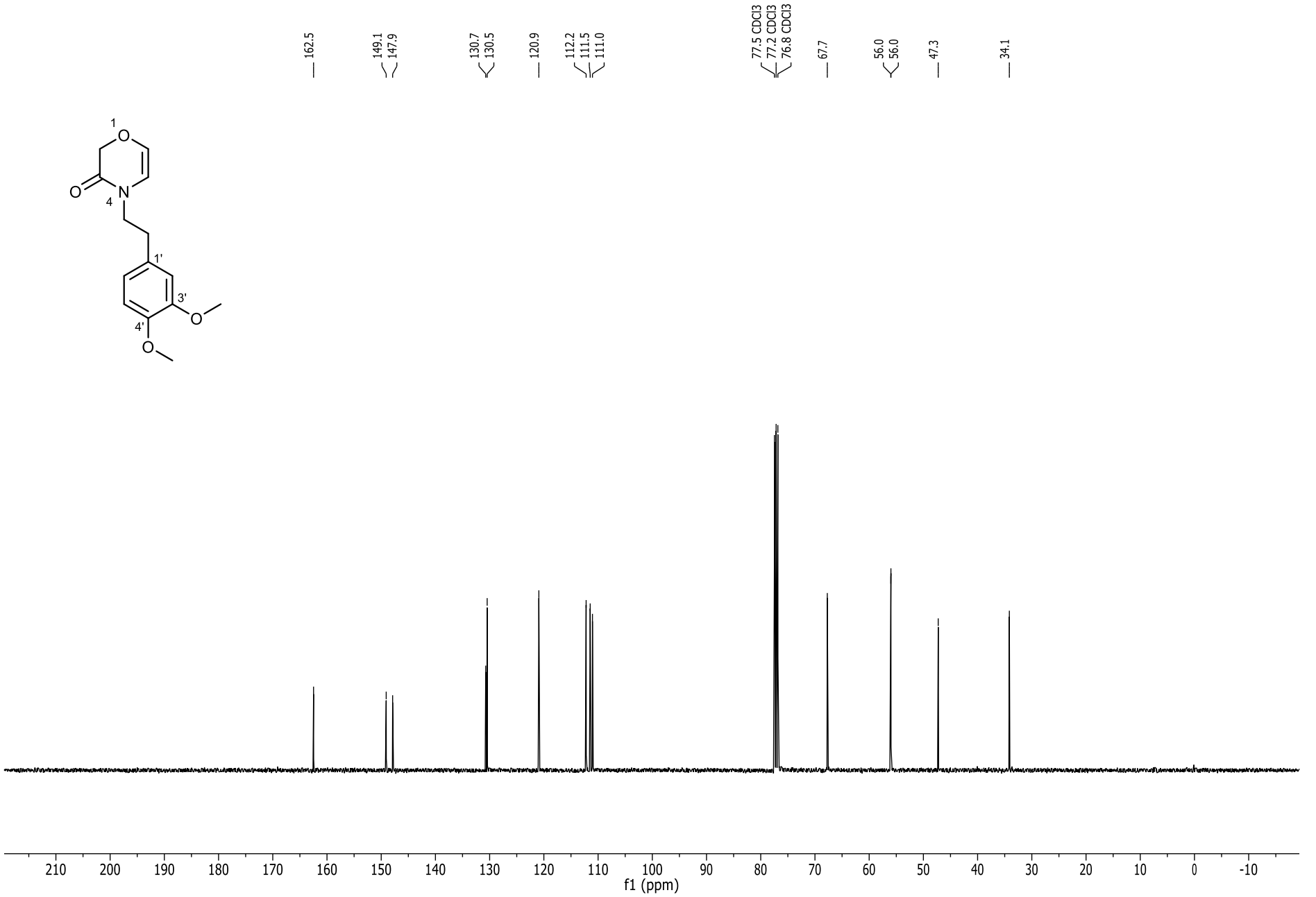
+ H-2' *maj.* + H-2' *min.*), 2.30 (t, *J* = 6.2 Hz, 2 H, H-1' *maj.* + H-1' *min.*), 2.09 (t, *J* = 6.0 Hz, 2 H, H-4 *maj.* + H-4 *min.*), 1.93 (p, *J* = 6.0 Hz, 2 H, H-3 *maj.* + H-3 *min.*), 1.55 (br s, 1 H, O*H maj.* + O*H min.*) ppm. ^{13}C NMR (101 MHz, $CDCl_3$): *δ* 152.2 (C, *C*O *min.*), 151.7 (C, *C*O *maj.*), 151.3 (C, C_{Ar} *maj.*), 151.2 (C, C_{Ar} *min.*), 129.5 (CH, CH_{Ar} *maj.* + CH_{Ar} *min.*), 125.6 (CH, CH_{Ar} *maj.* + CH_{Ar} *min.*), 122.3 (CH, C-6 *min.*), 122.0 (CH, C-6 *maj.*), 121.8 (CH, CH_{Ar} *maj.*) 121.8 (CH, CH_{Ar} *min.*), 116.7 (C, C-5 *min.*), 116.1 (C, C-5 *maj.*), 60.7 (CH_2, C-2' *min.*), 60.6 (CH_2, C-2' *maj.*), 42.7 (CH_2, C-2 *min.*), 42.2 (CH_2, C-2 *maj.*), 38.7 (CH_2, C-1' *maj.*), 38.6 (**(**CH_2, C-1' *min.*), 25.0 (CH_2, C-4 *maj.*), 24.9 (CH_2, C-4 *min.*), 21.9 (CH_2, C-3 *min.*), 21.7 (CH_2, C-3 *maj.*) ppm. IR (neat): ṽ = 3112 (br, O–H), 2933 (C–H), 1715 (C=O), 1260 (O–H), 1043 (C–OH) cm^{-1}. HRMS (ESI): m/z calcd. for $C_{14}H_{18}NO_3$ $[M + H]^+$ 248.128120 found, 248.127933.

COPIES OF ^{1}H AND ^{13}C NMR SPECTRA OF NEW COMPOUNDS.

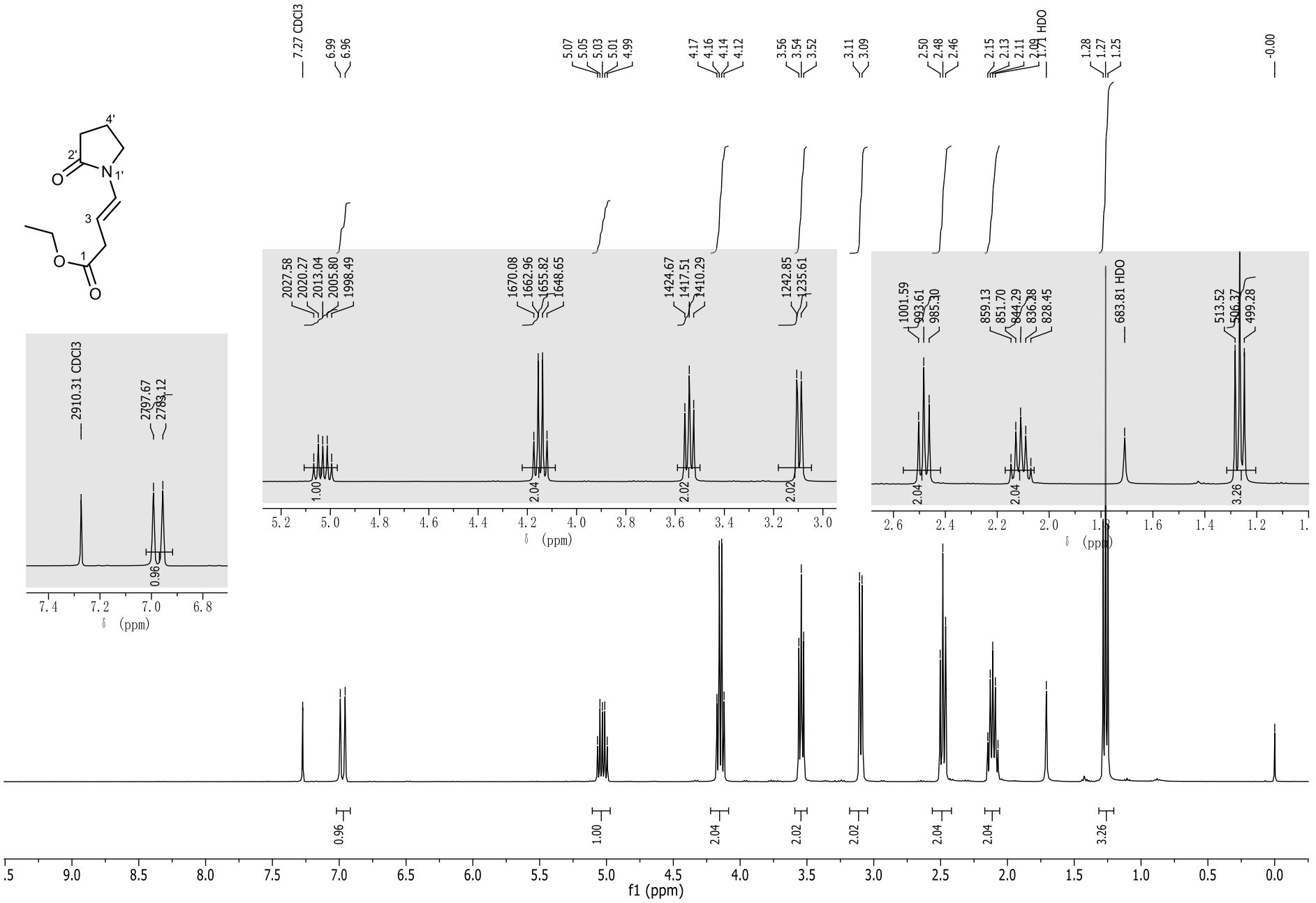
^{1}H NMR (400 MHz) Analysis of Compound 1q.



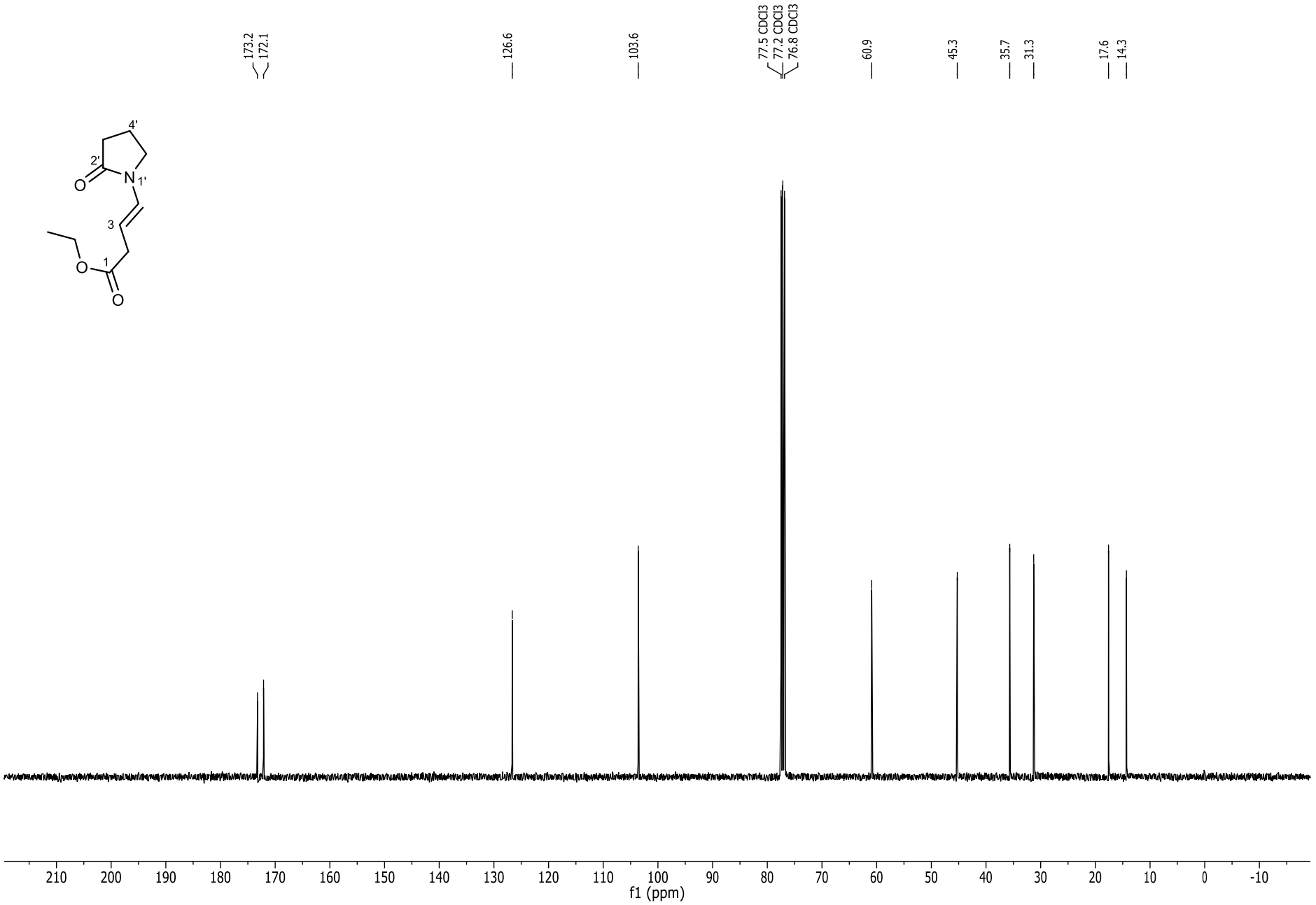
^{13}C NMR (101 MHz) Analysis of Compound 1q.



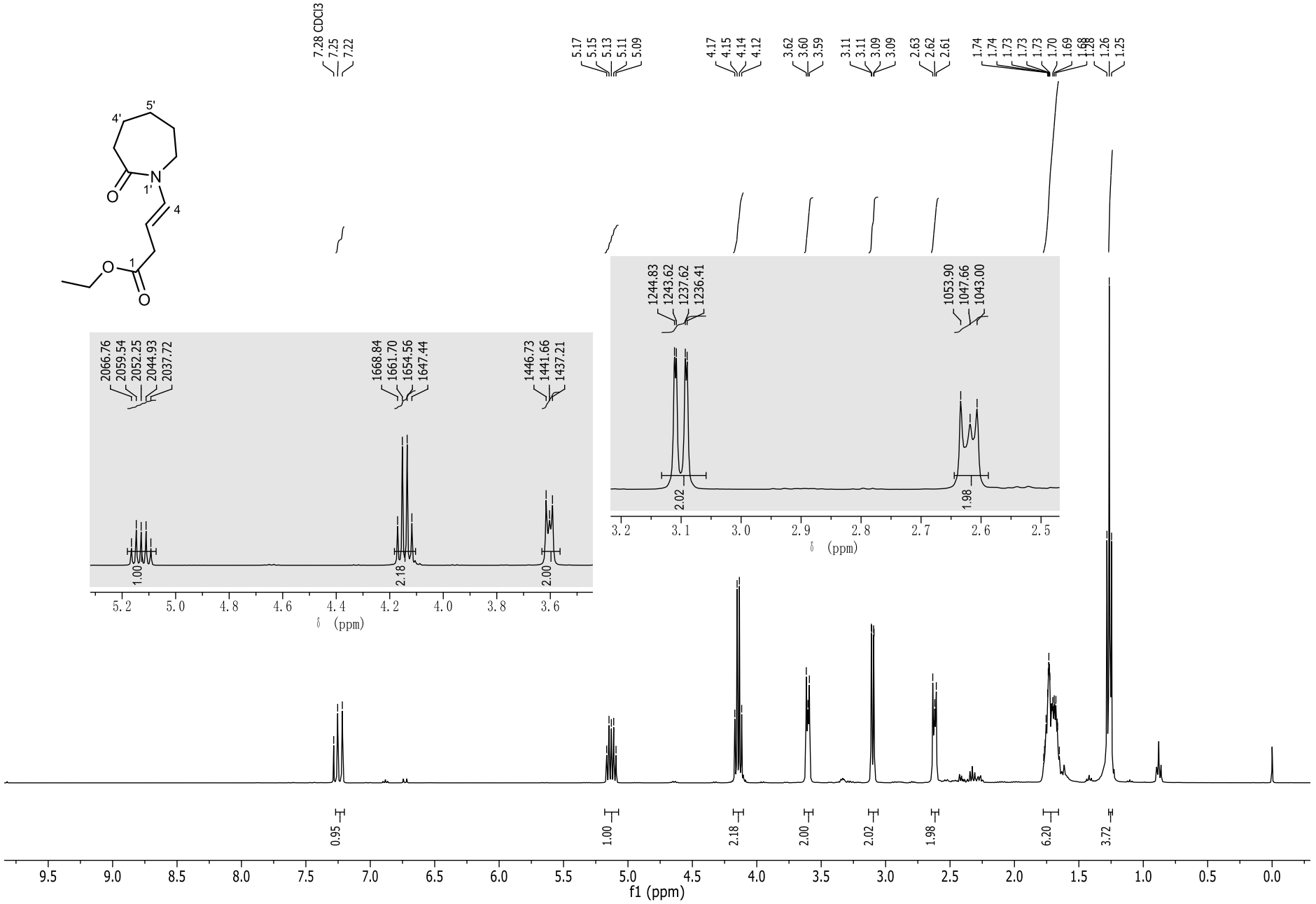
^{1}H NMR (400 MHz) Analysis of Compound 3a.



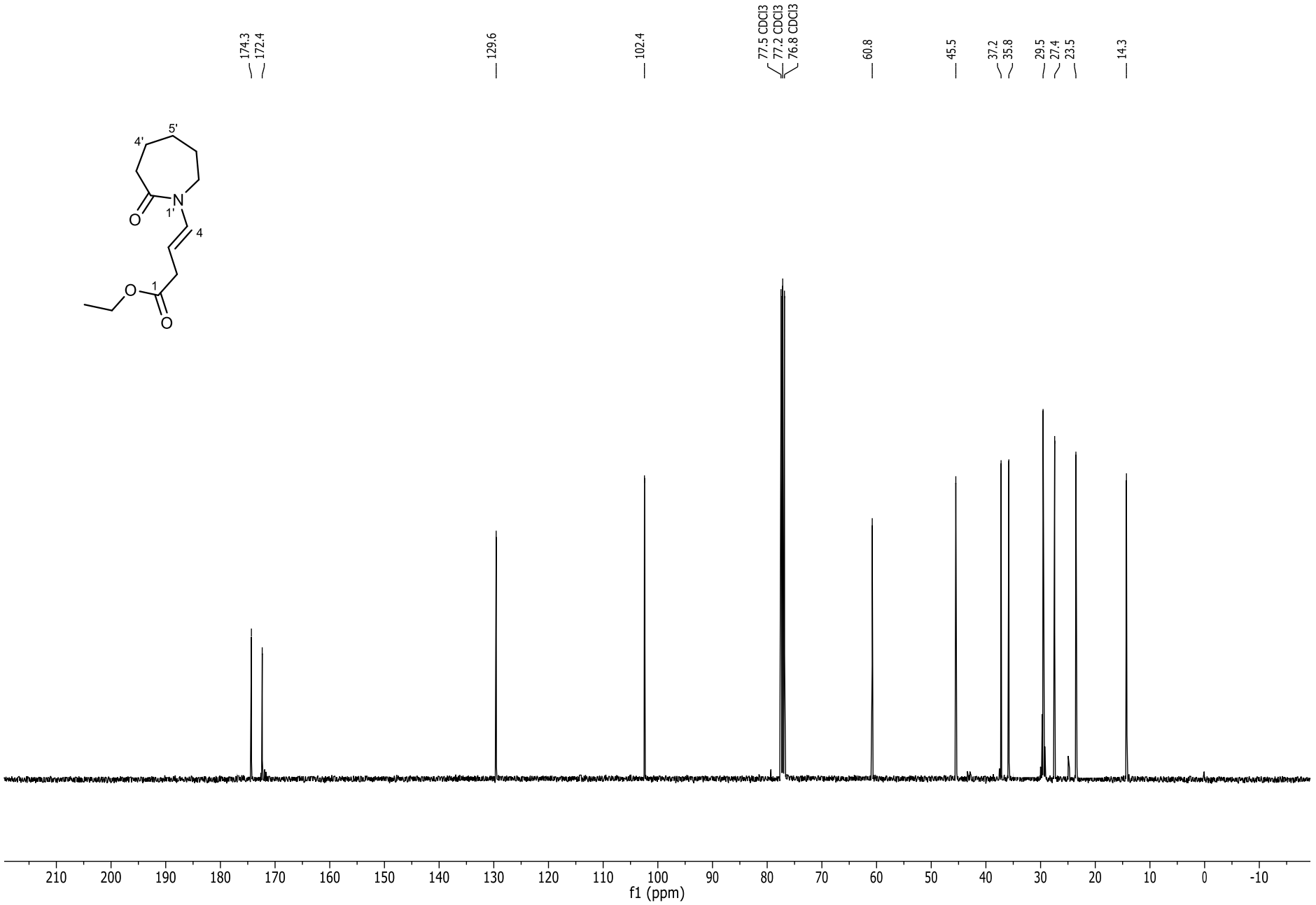
^{13}C NMR (101 MHz) Analysis of Compound 3a.



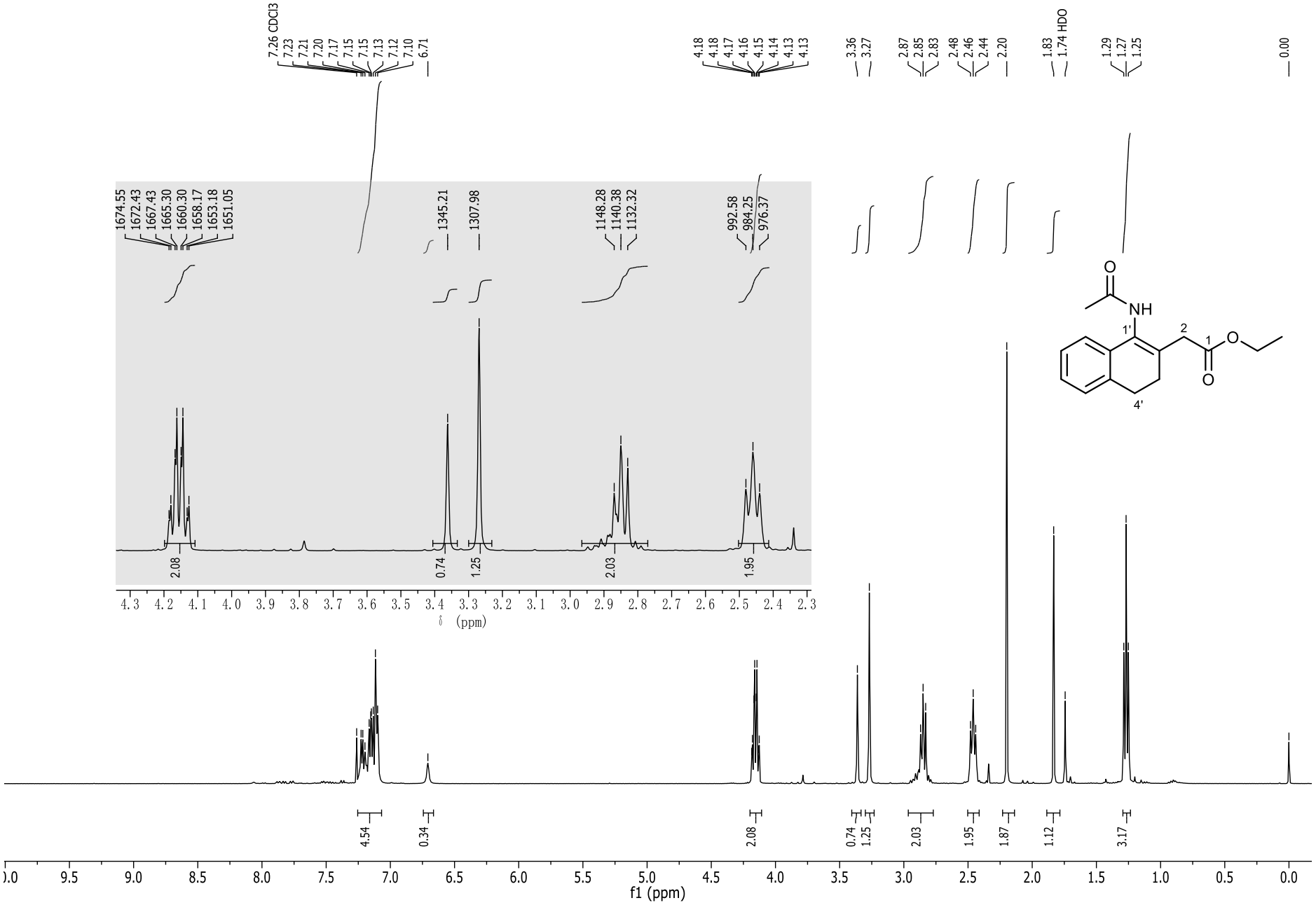
^{1}H NMR (400 MHz) Analysis of Compound 3b.



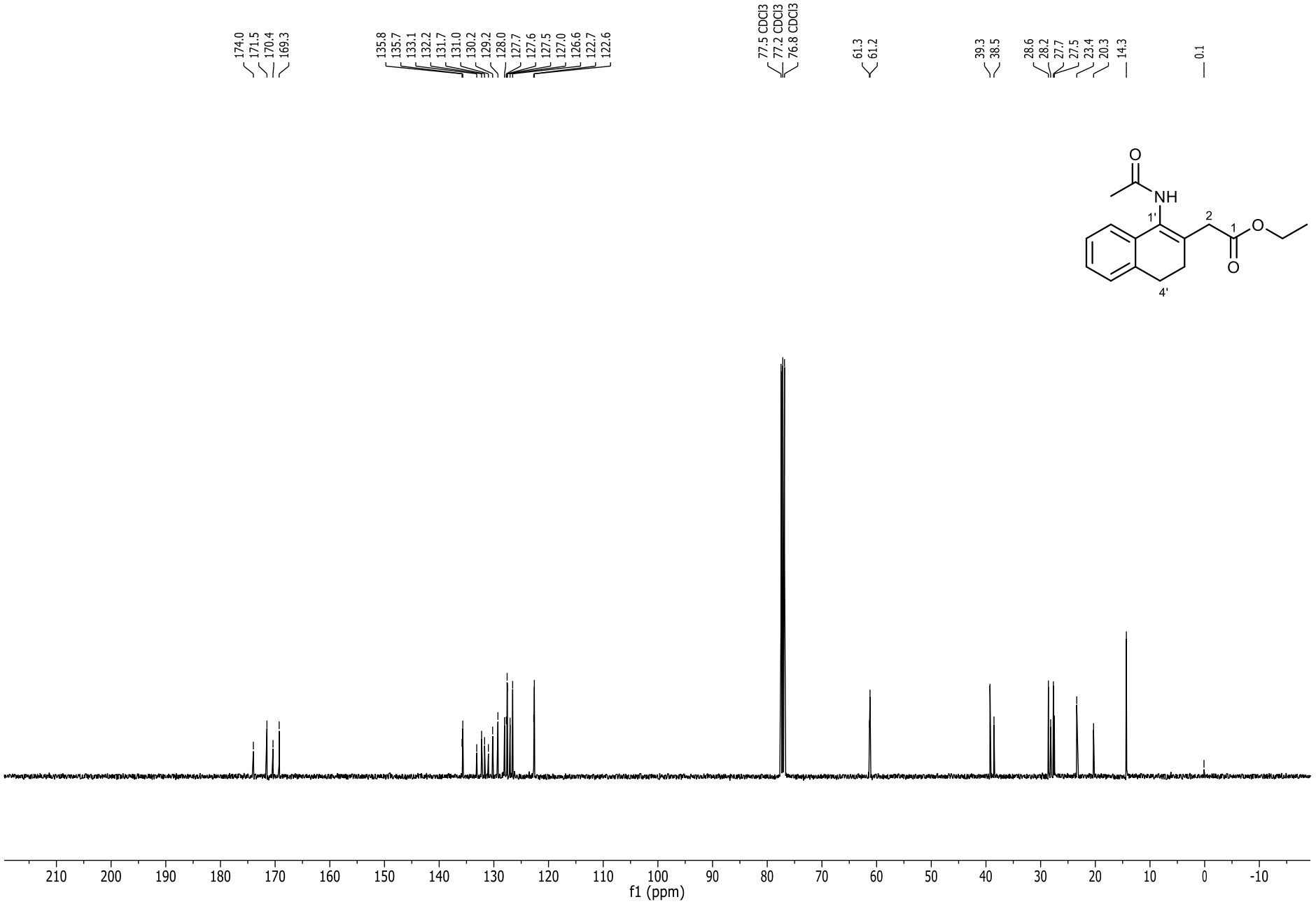
^{13}C NMR (101 MHz) Analysis of Compound 3b.



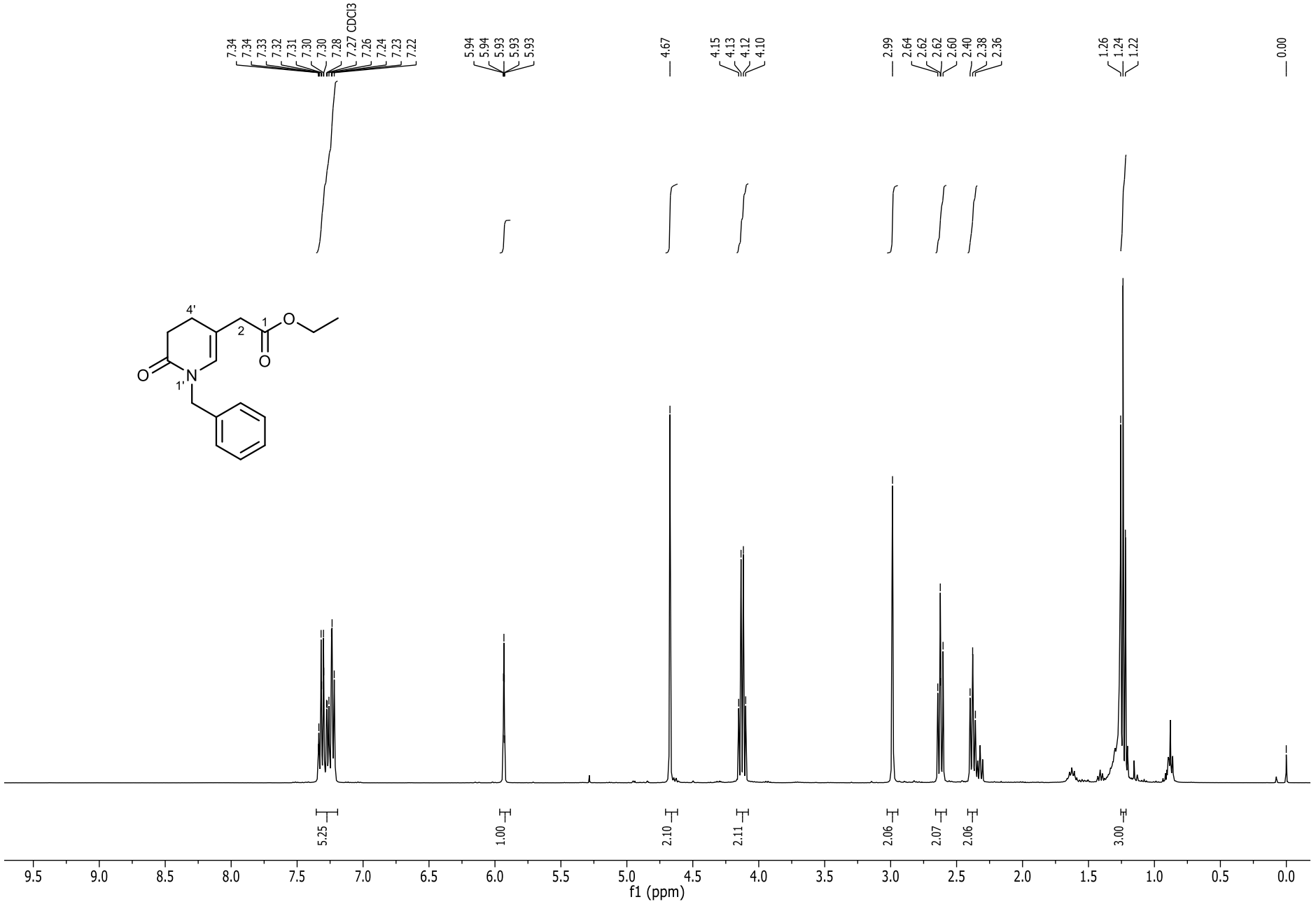
^{1}H NMR (400 MHz) Analysis of Compound 3c.



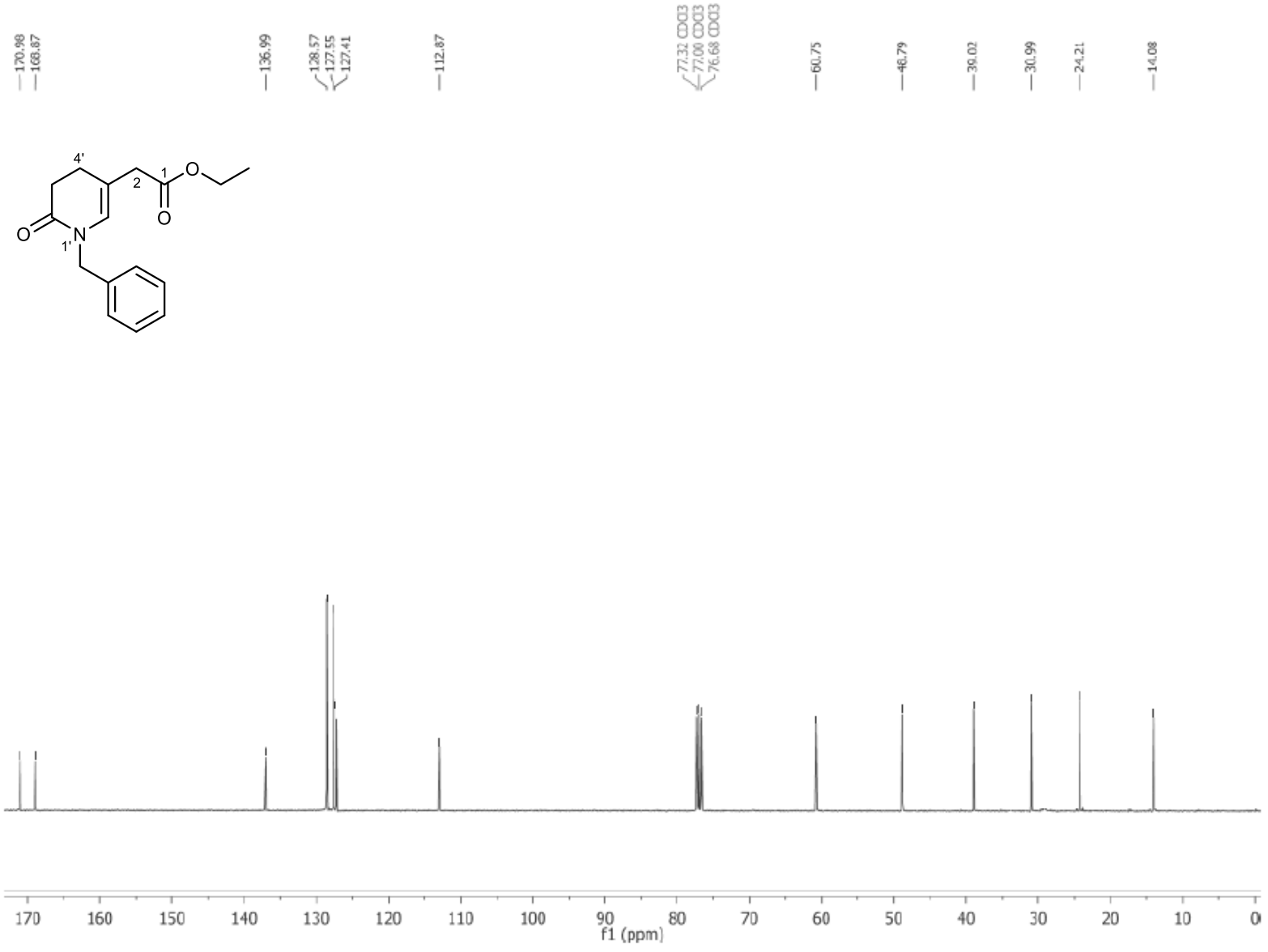
^{13}C NMR (101 MHz) Analysis of Compound 3c.



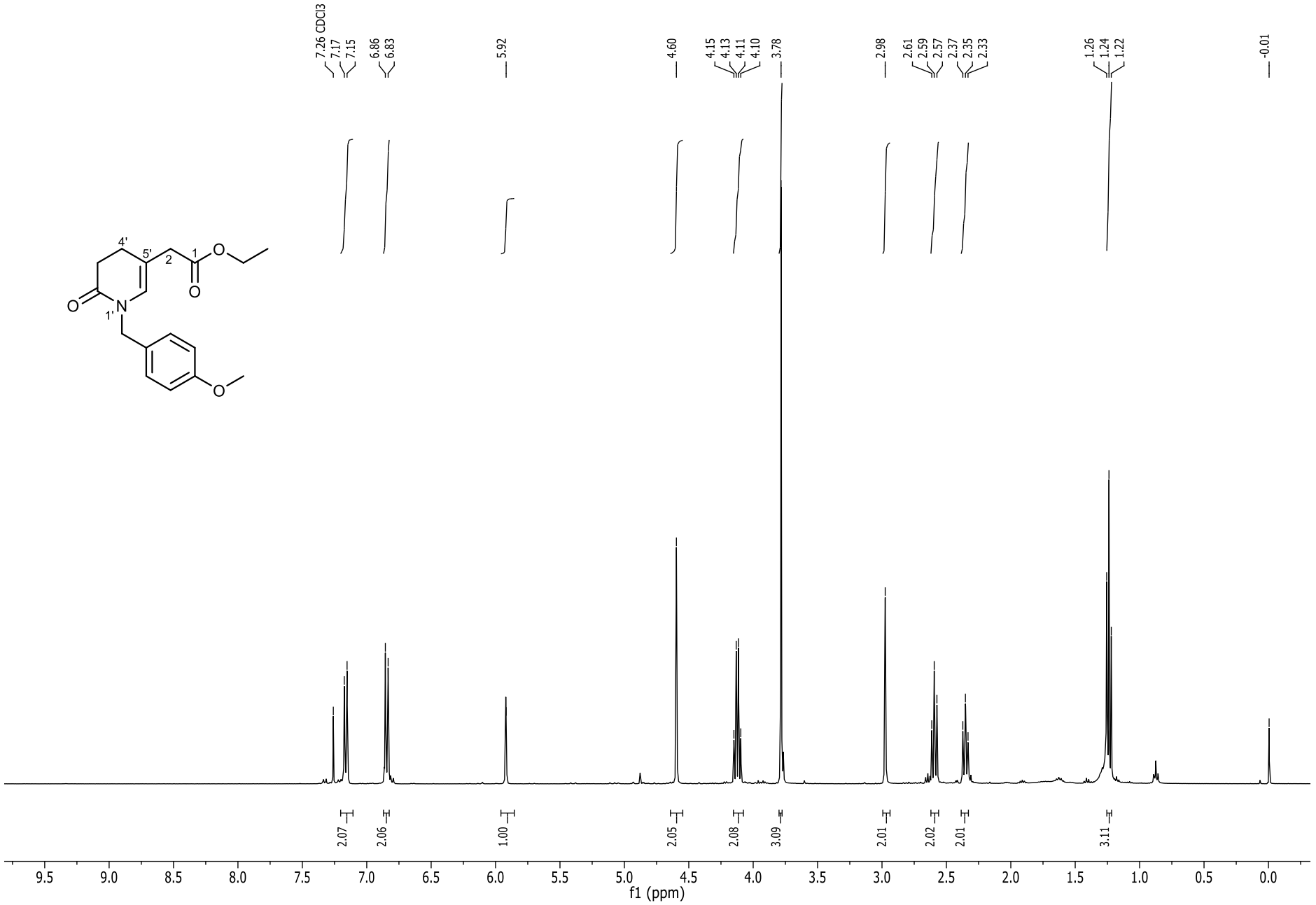
^{1}H NMR (400 MHz) Analysis of Compound 3d.



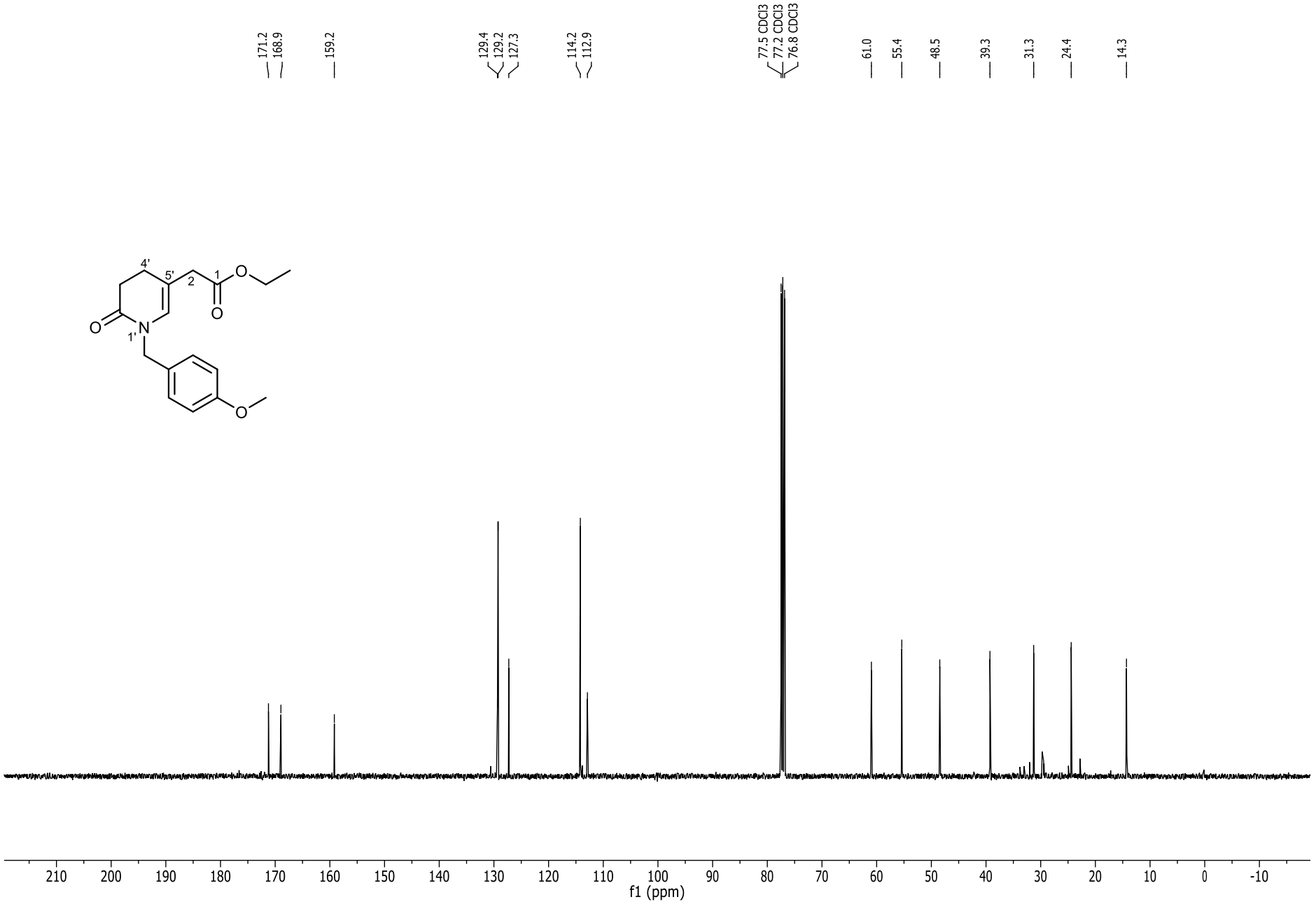
^{13}C NMR (101 MHz) Analysis of Compound 3d.



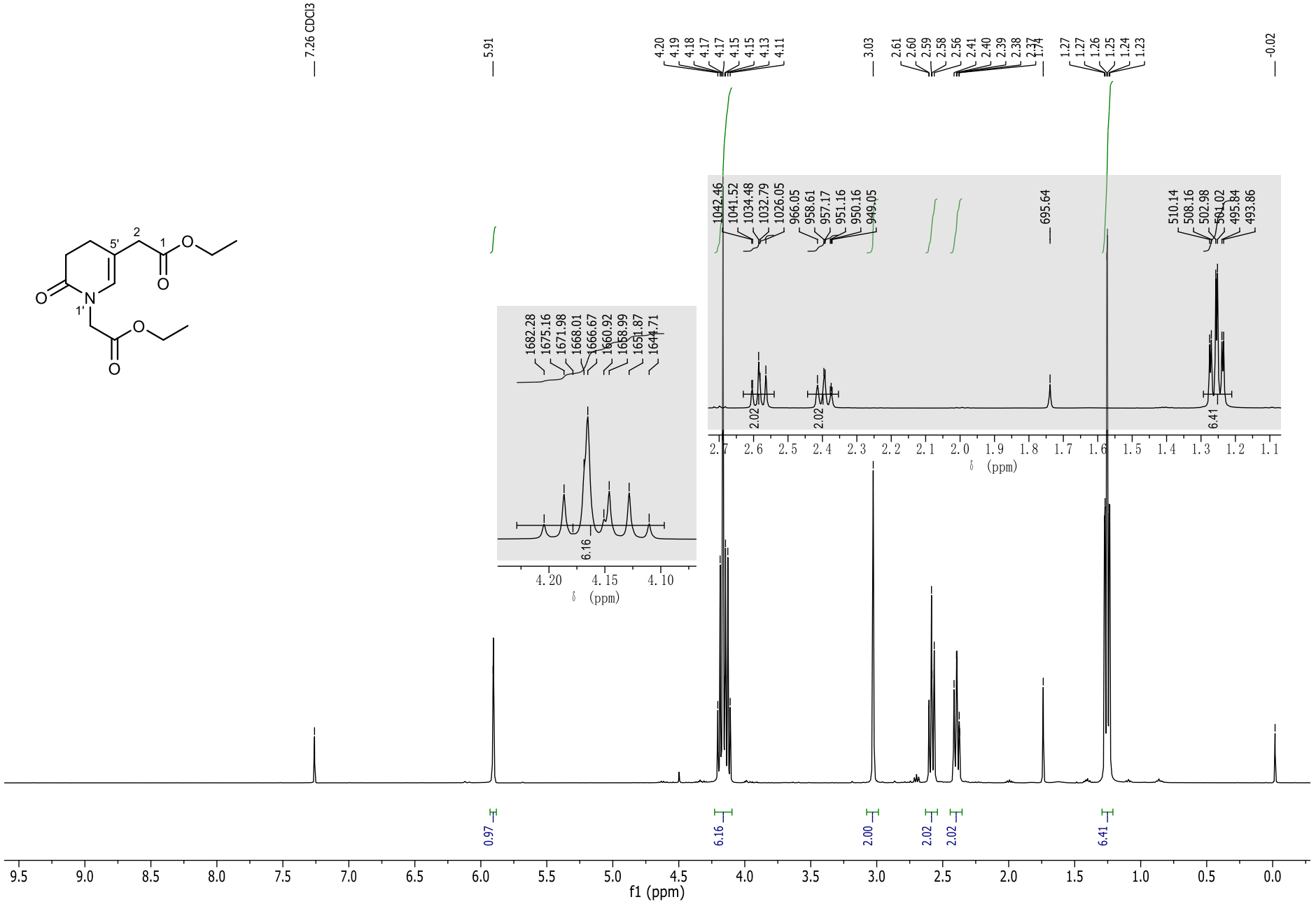
^{1}H NMR (400 MHz) Analysis of Compound 3e.



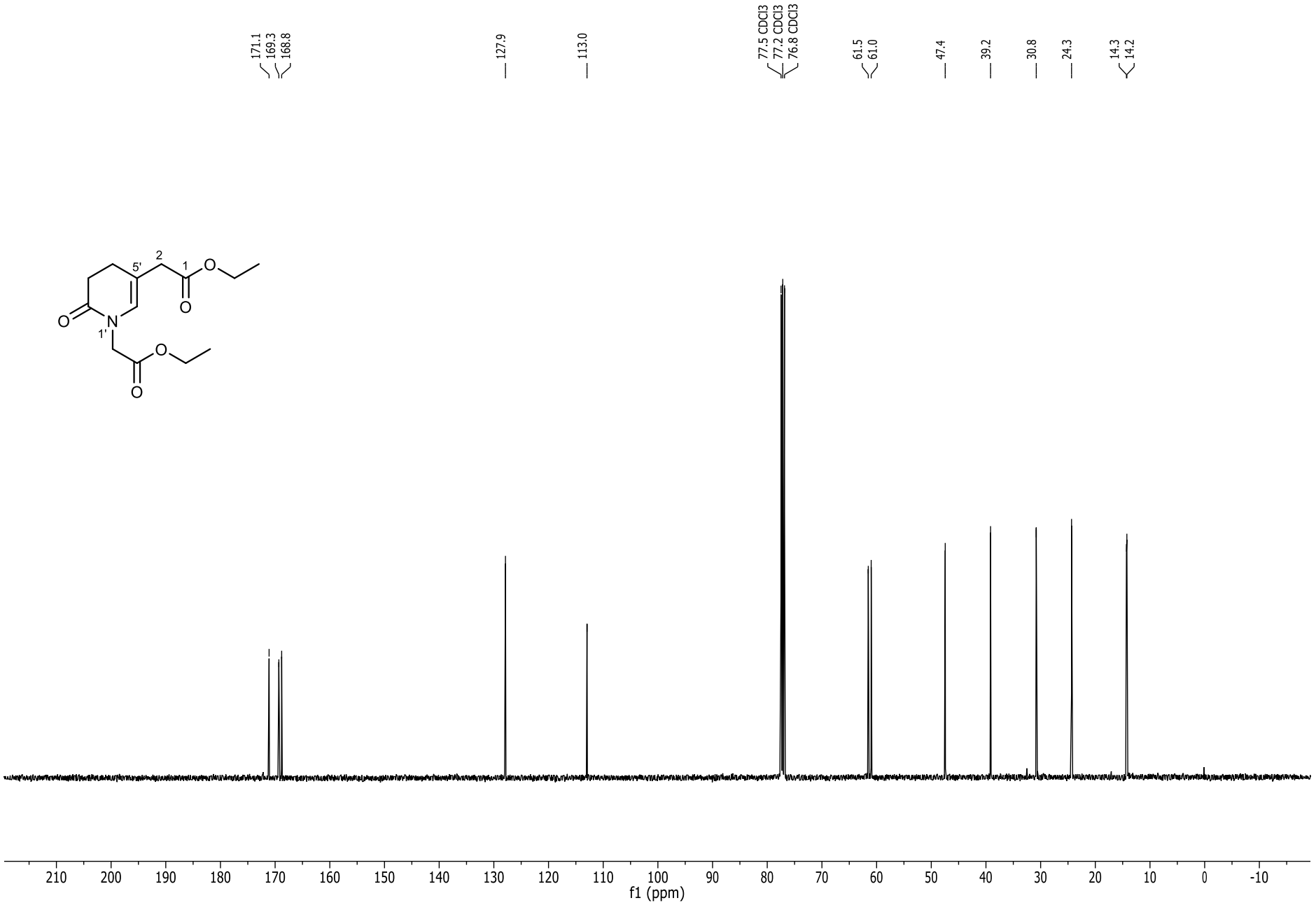
^{13}C NMR (101 MHz) Analysis of Compound 3e.



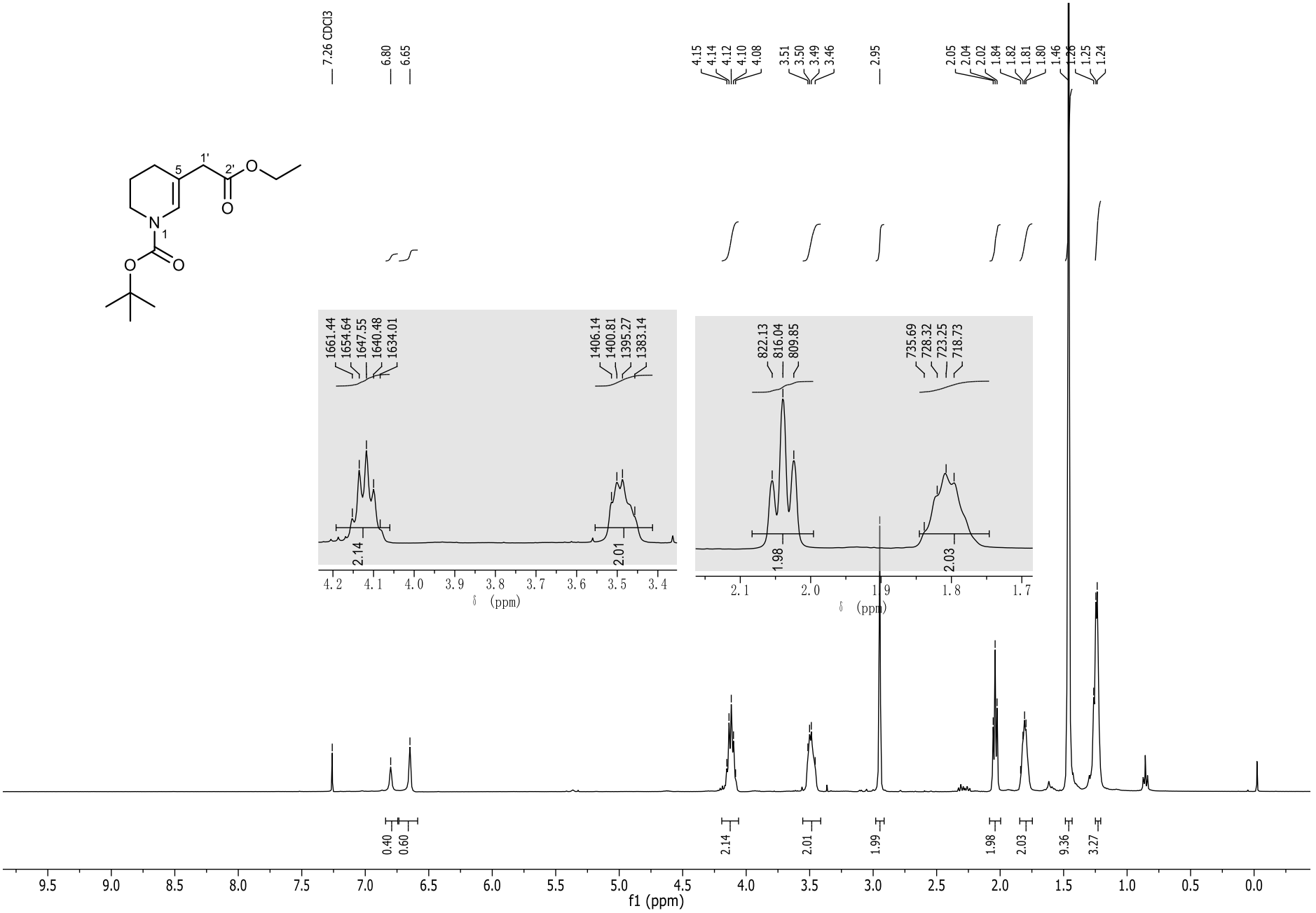
^{1}H NMR (400 MHz) Analysis of Compound 3f.



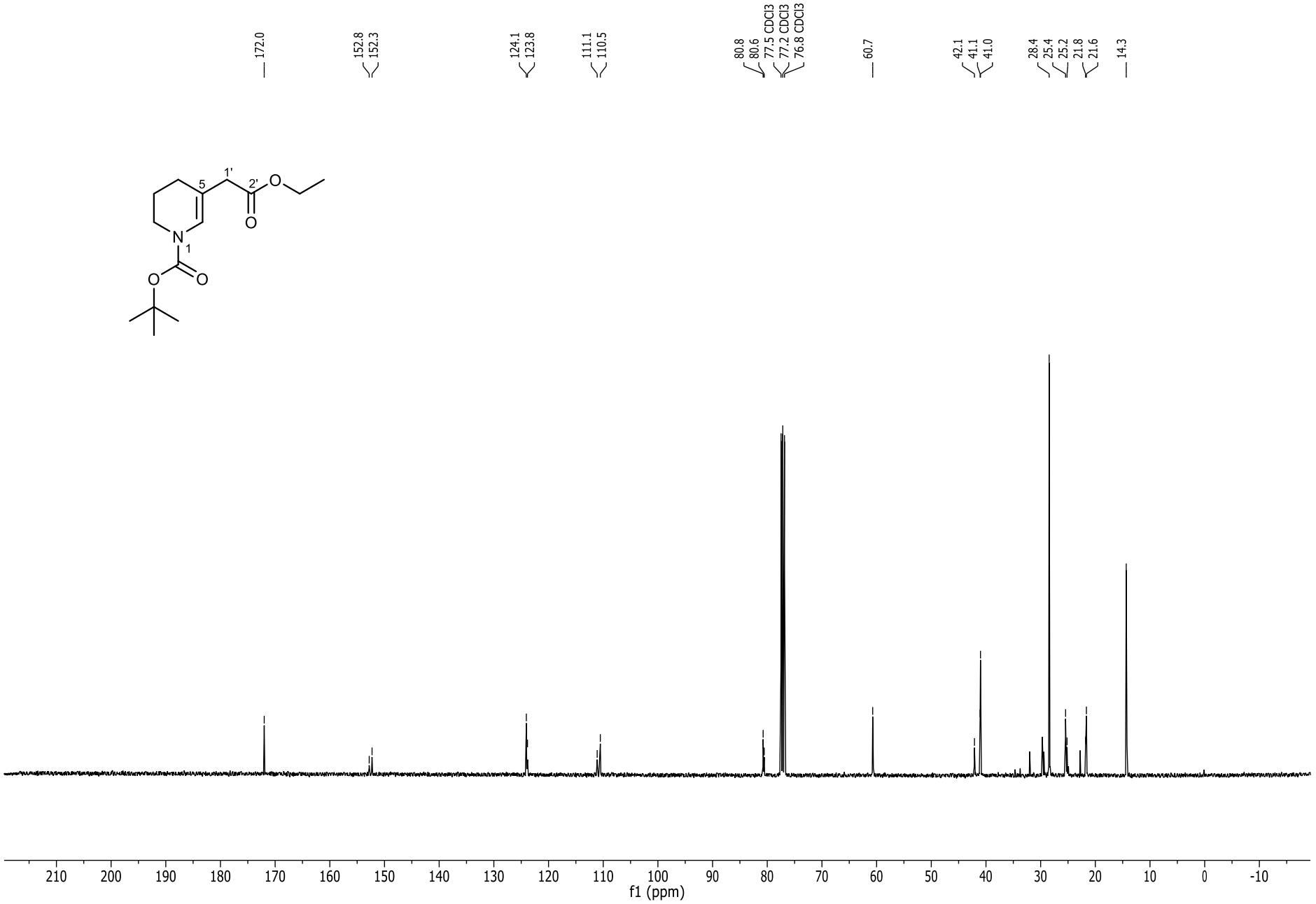
^{13}C NMR (101 MHz) Analysis of Compound 3f.



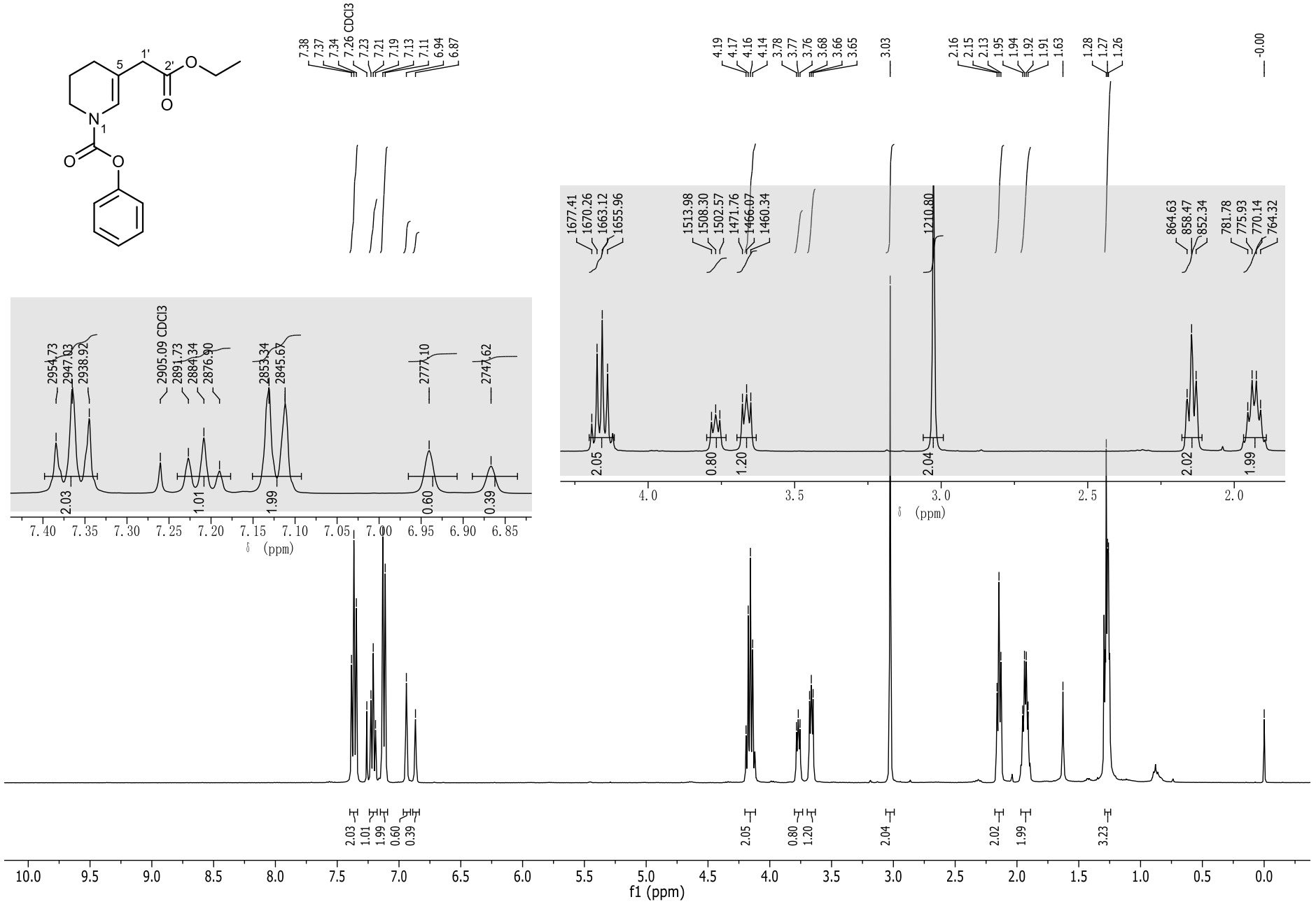
^{1}H NMR (400 MHz) Analysis of Compound 3g.



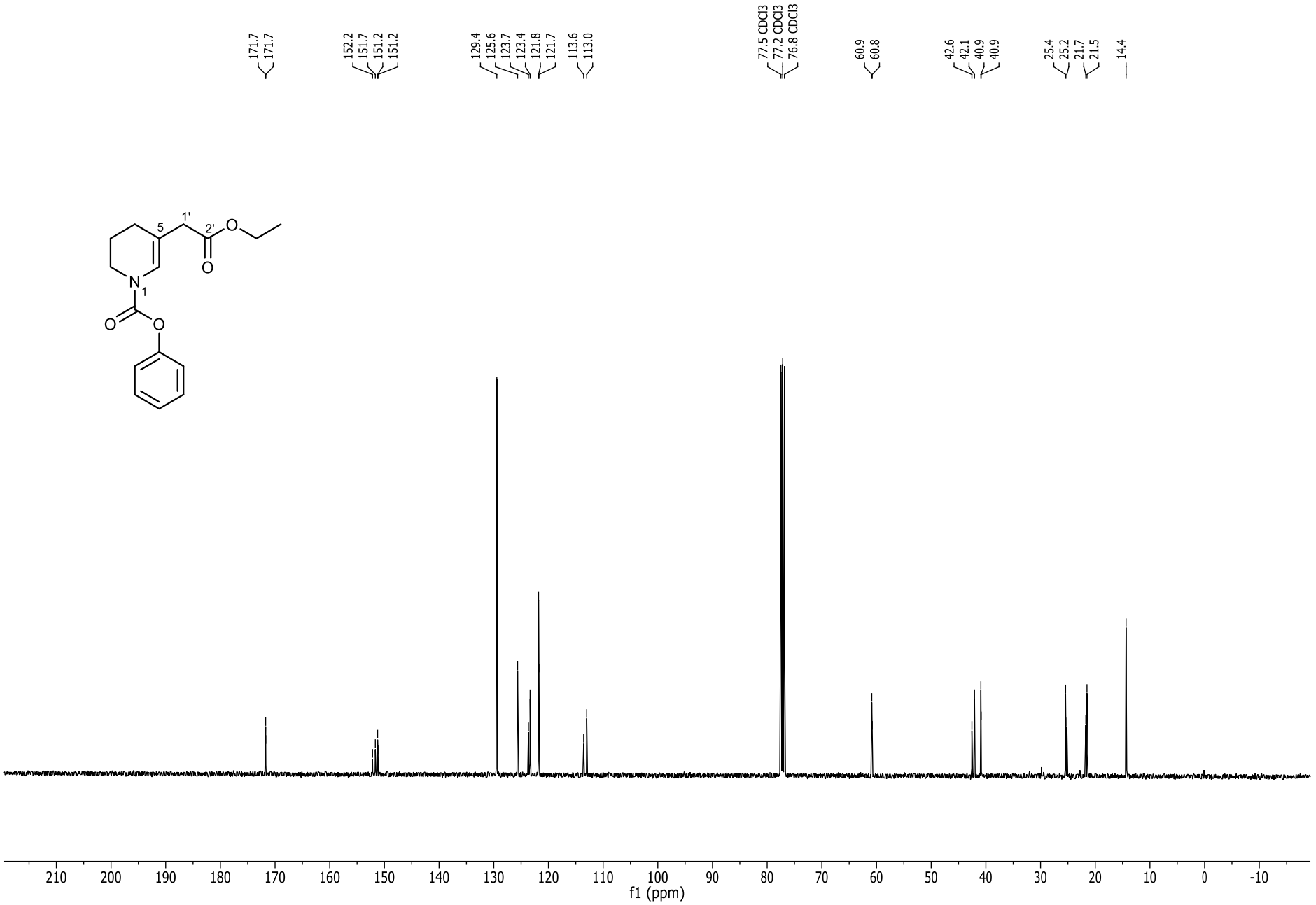
^{13}C NMR (101 MHz) Analysis of Compound 3g.



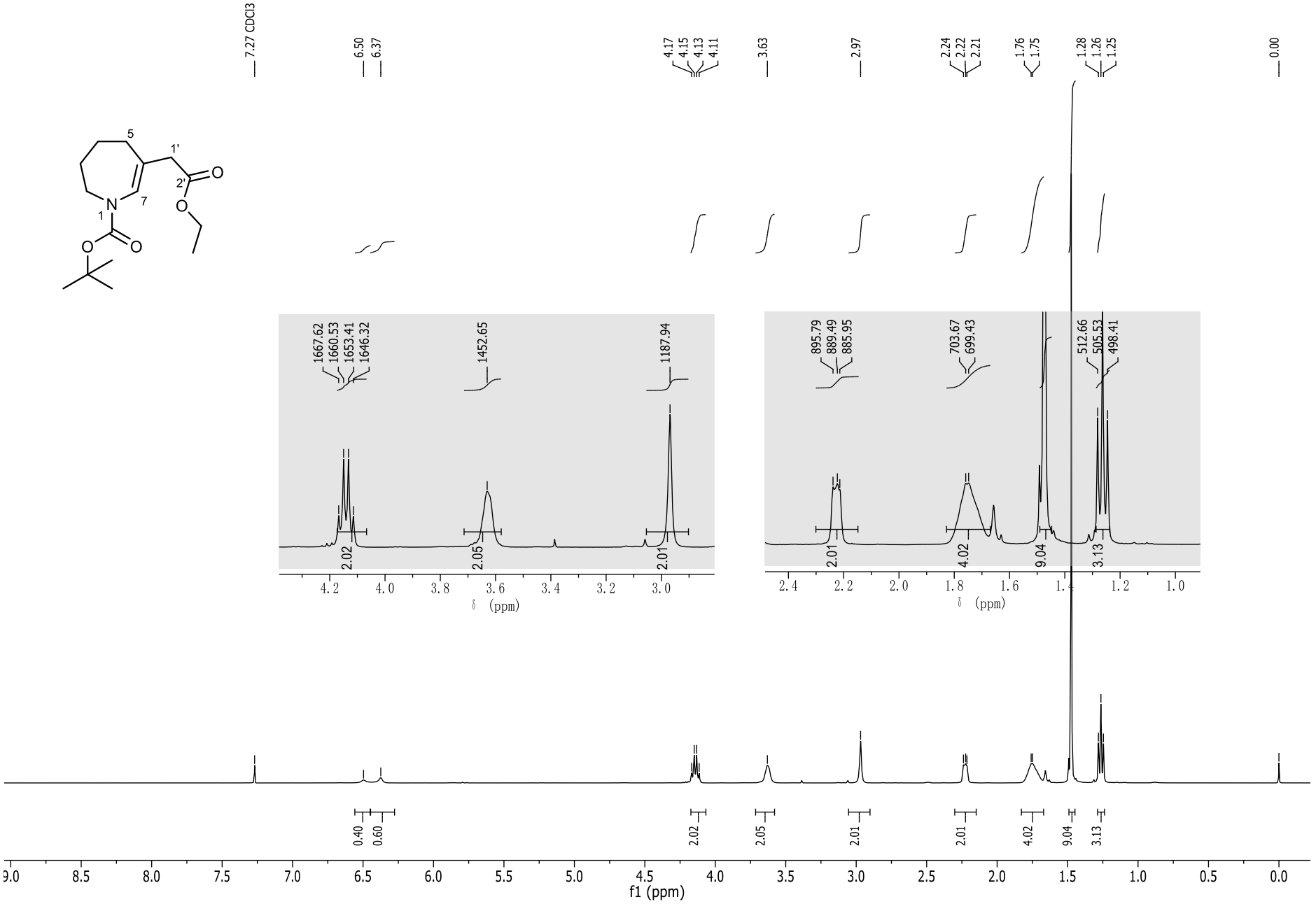
^{1}H NMR (400 MHz) Analysis of Compound 3h.



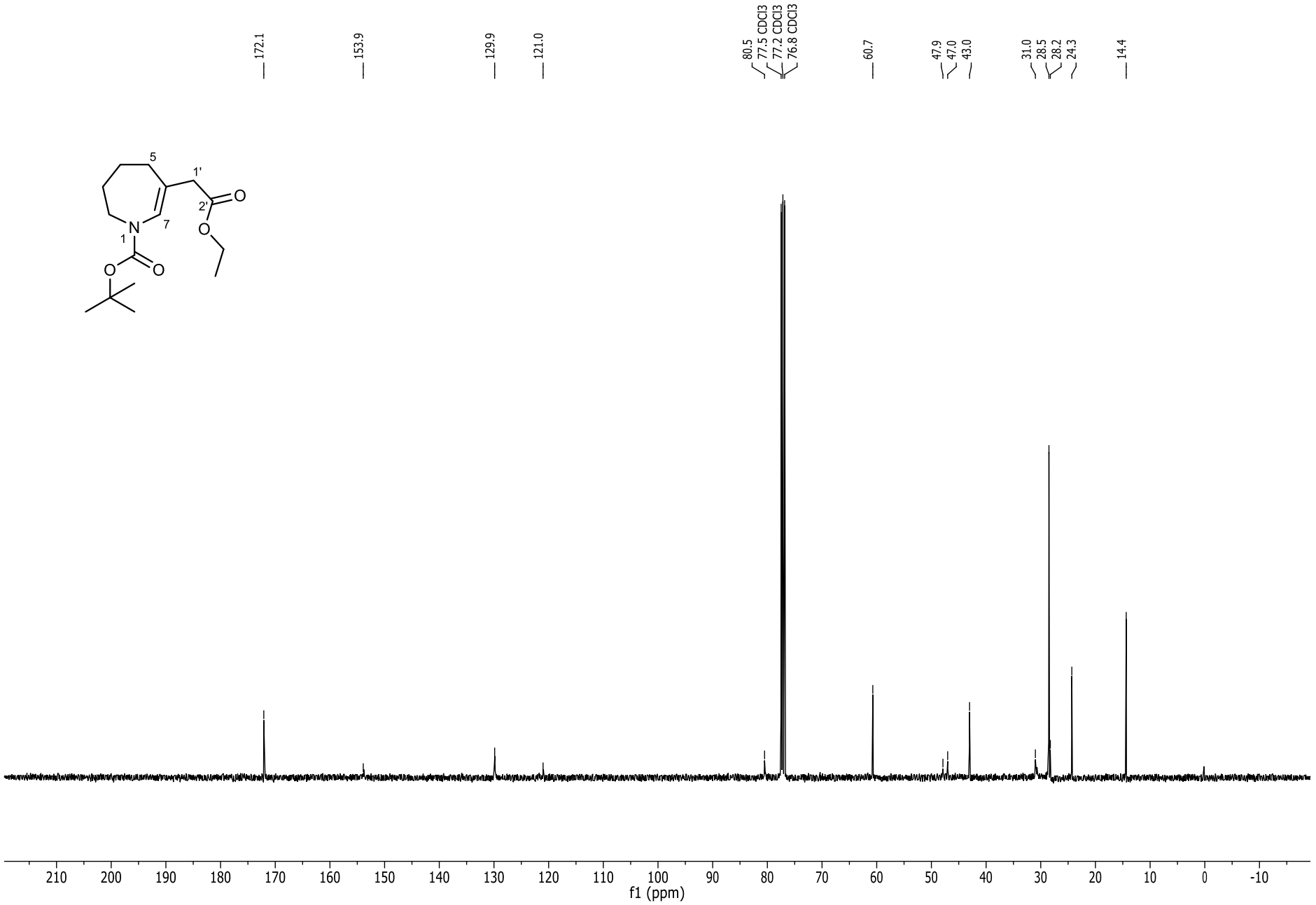
^{13}C NMR (101 MHz) Analysis of Compound 3h.



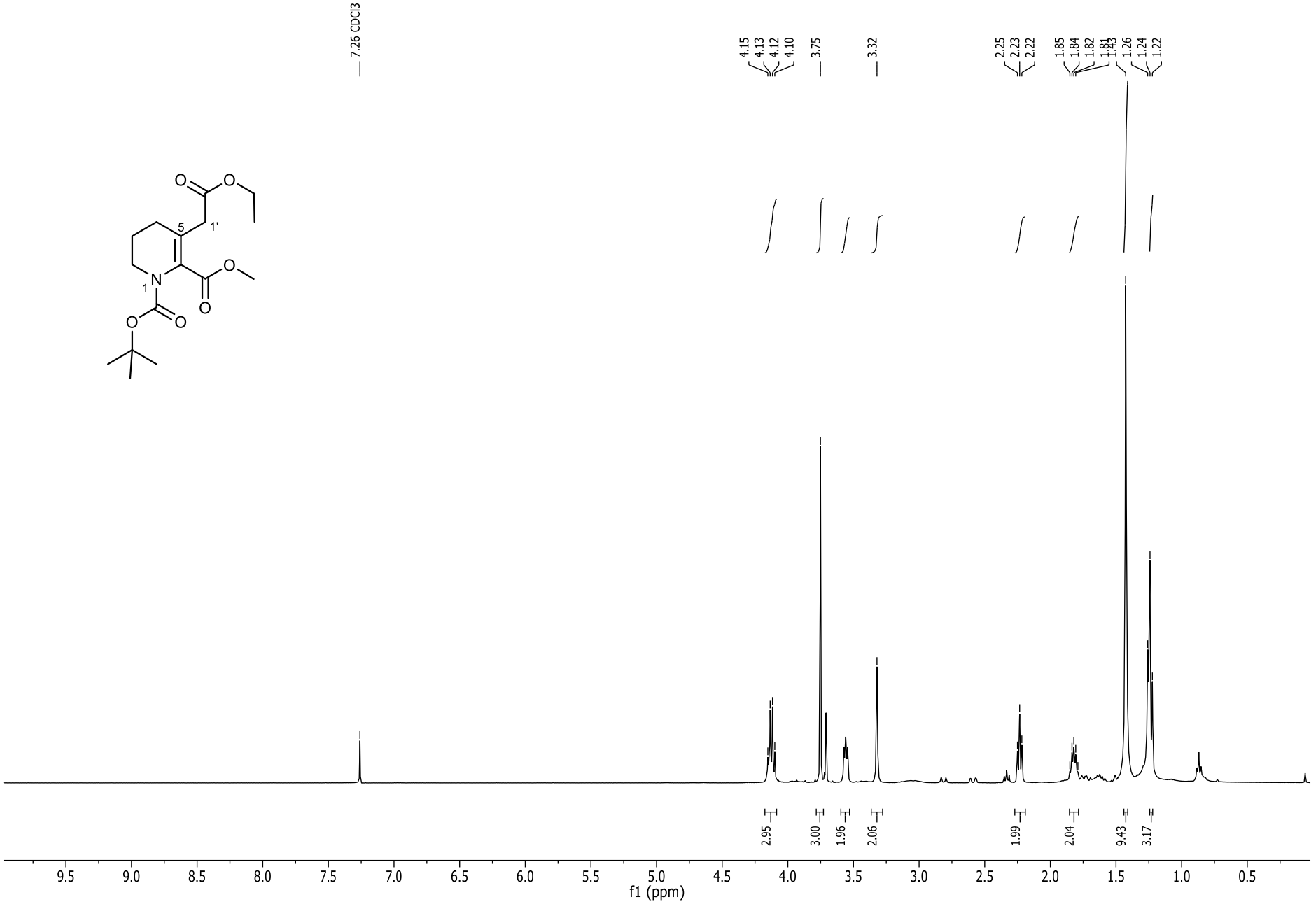
^{1}H NMR (400 MHz) Analysis of Compound 3i.



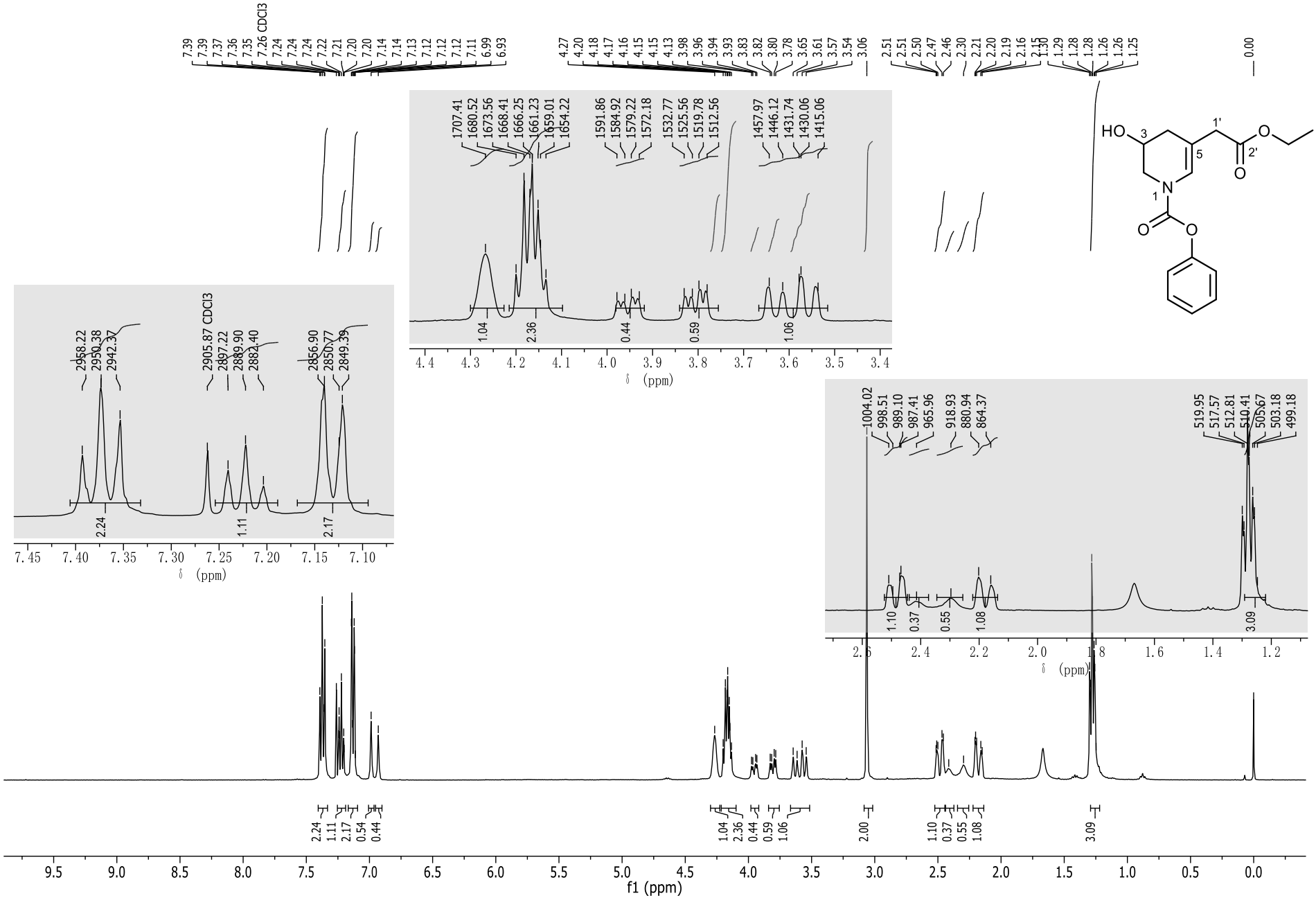
^{13}C NMR (101 MHz) Analysis of Compound 3i.



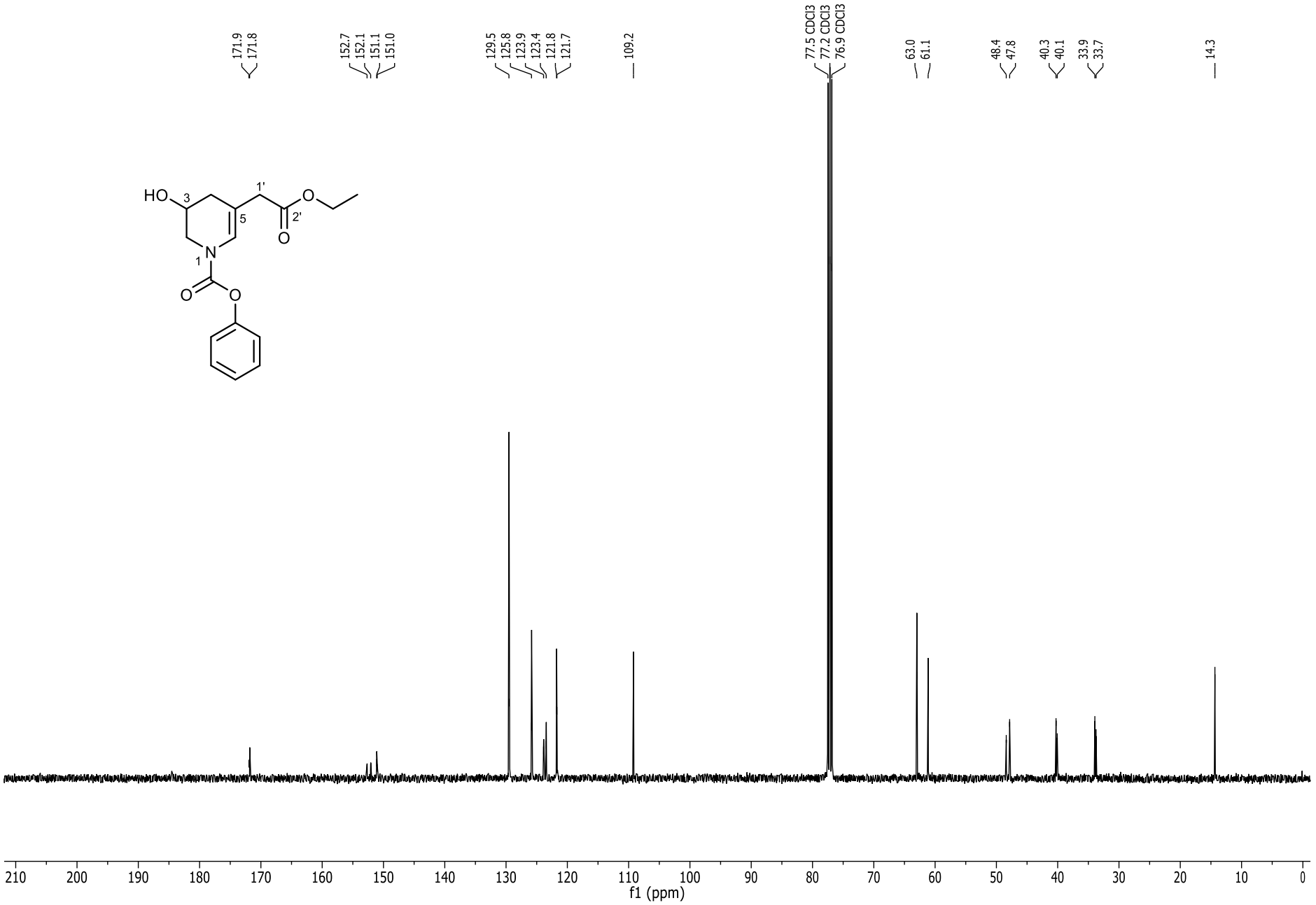
^{1}H NMR (400 MHz) Analysis of Compound 3j.



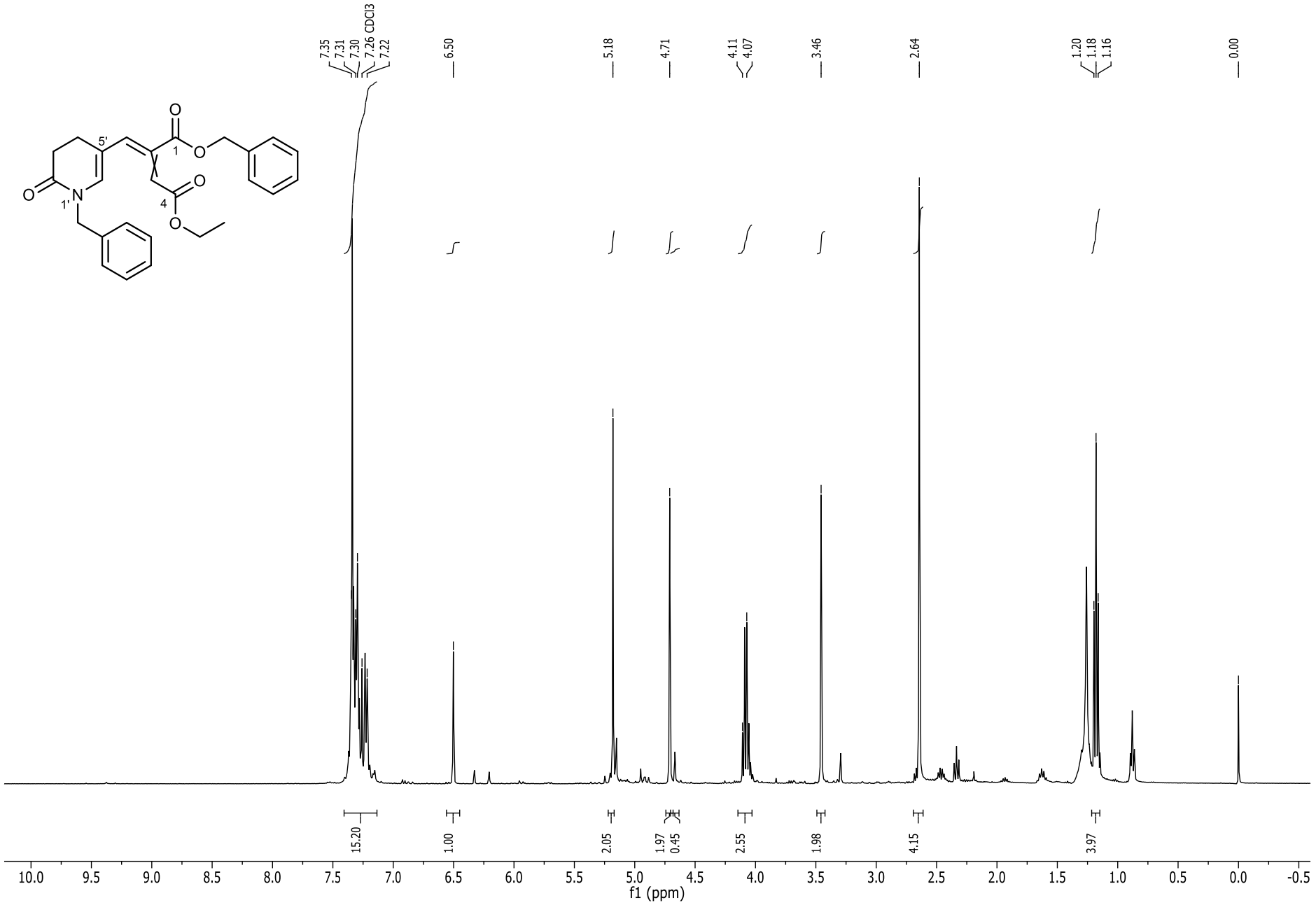
^{1}H NMR (400 MHz) Analysis of Compound 3k.



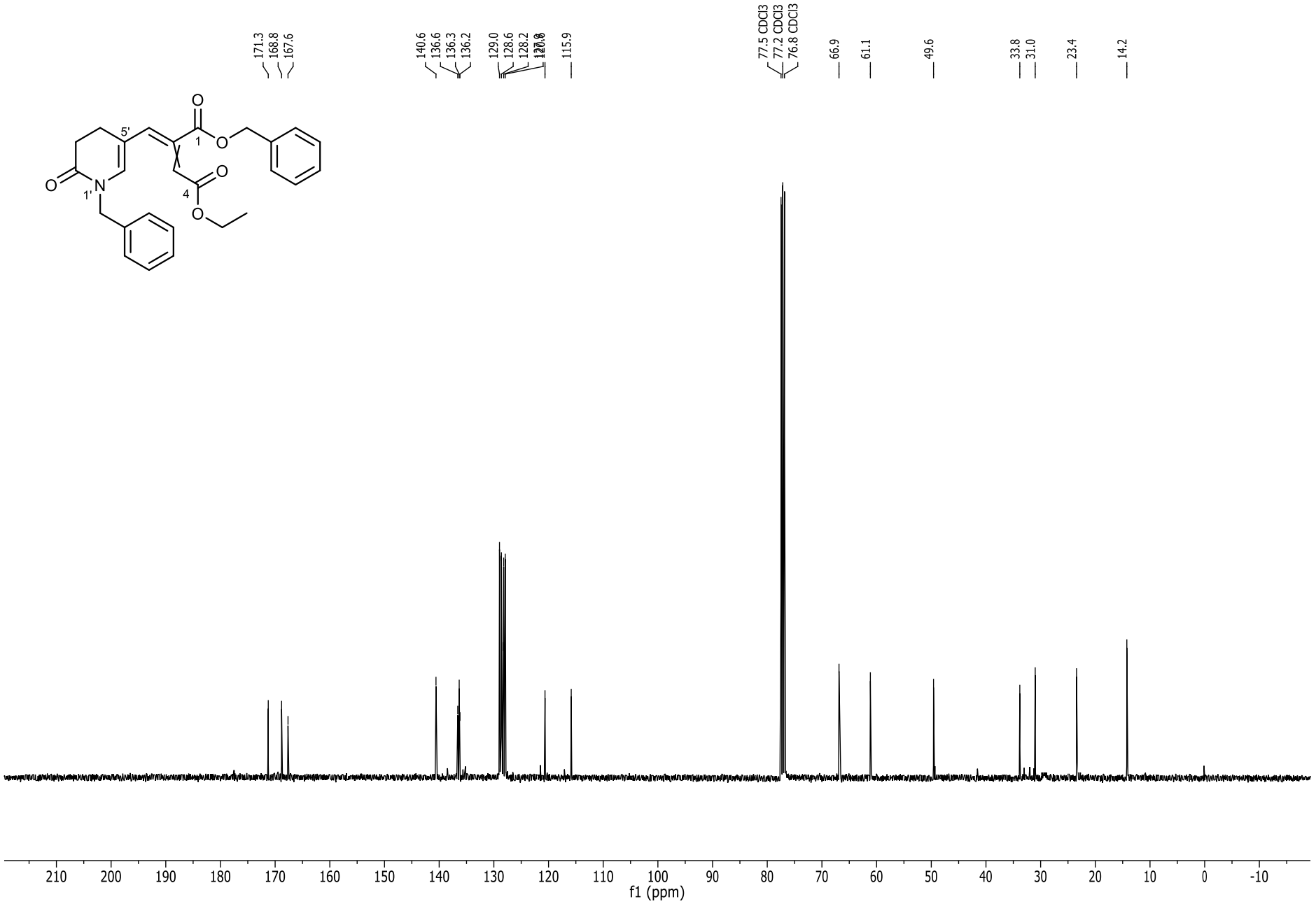
^{13}C NMR (101 MHz) Analysis of Compound 3k.



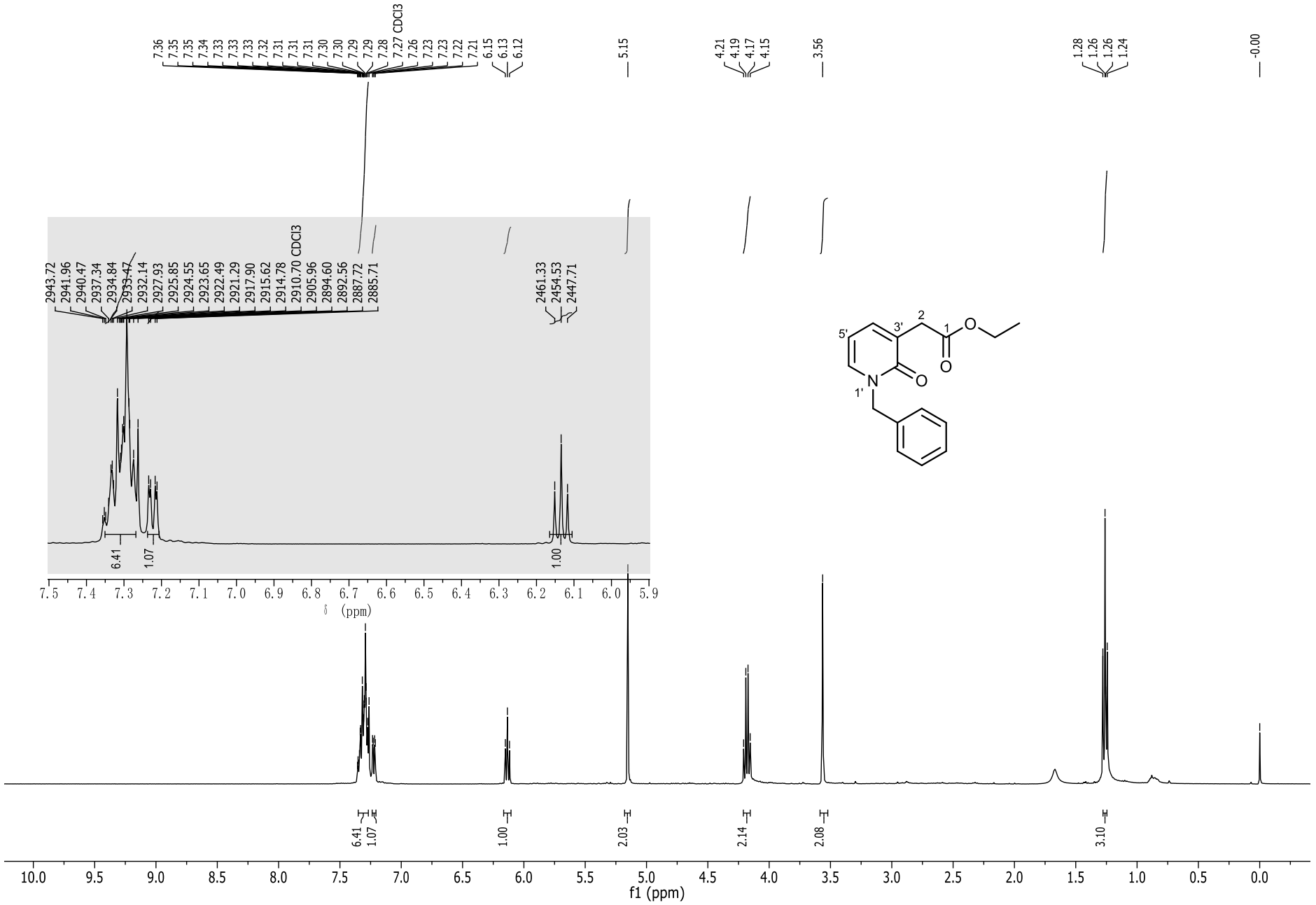
^{1}H NMR (400 MHz) Analysis of Compound 3l.



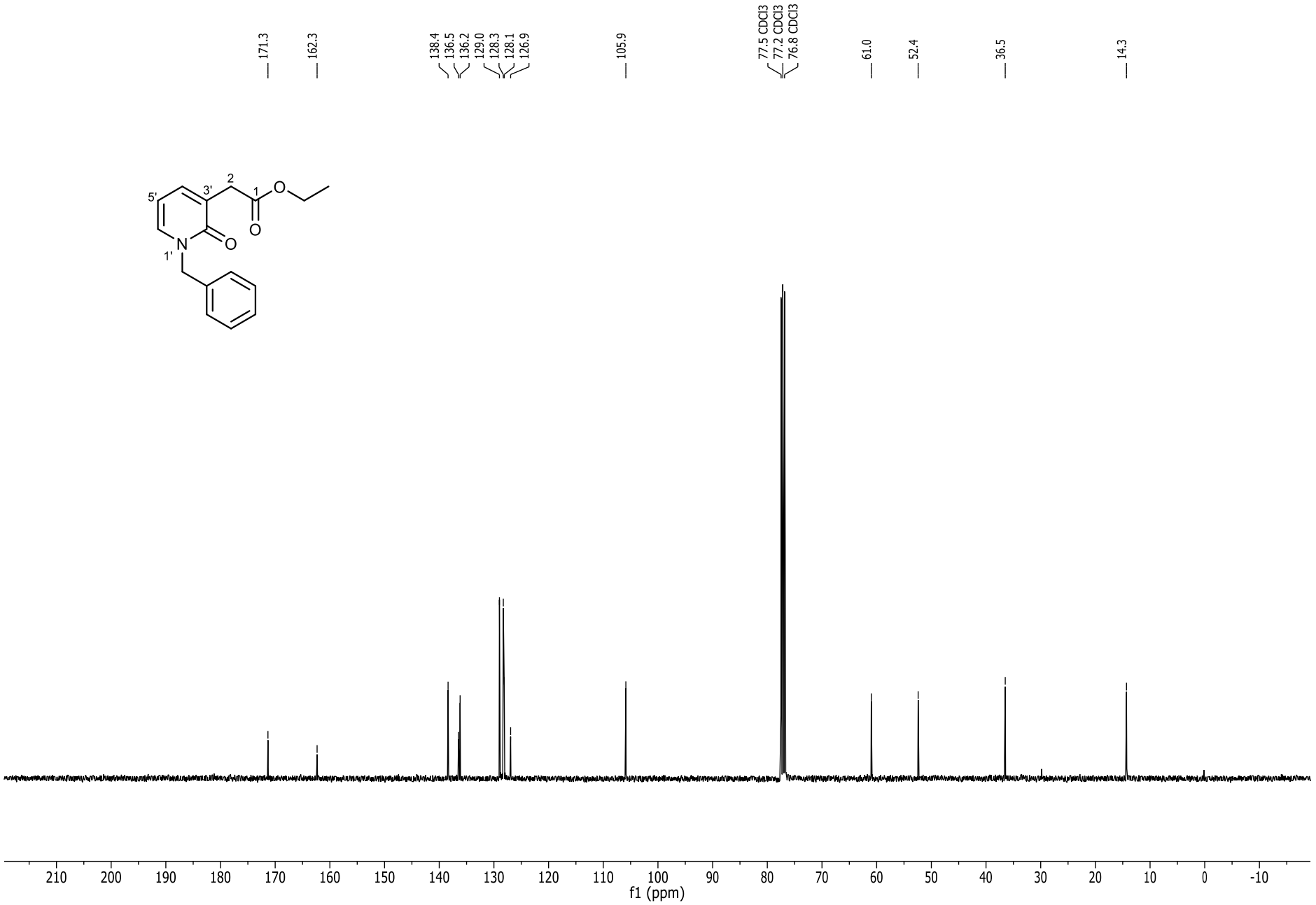
^{13}C NMR (101 MHz) Analysis of Compound 3l.



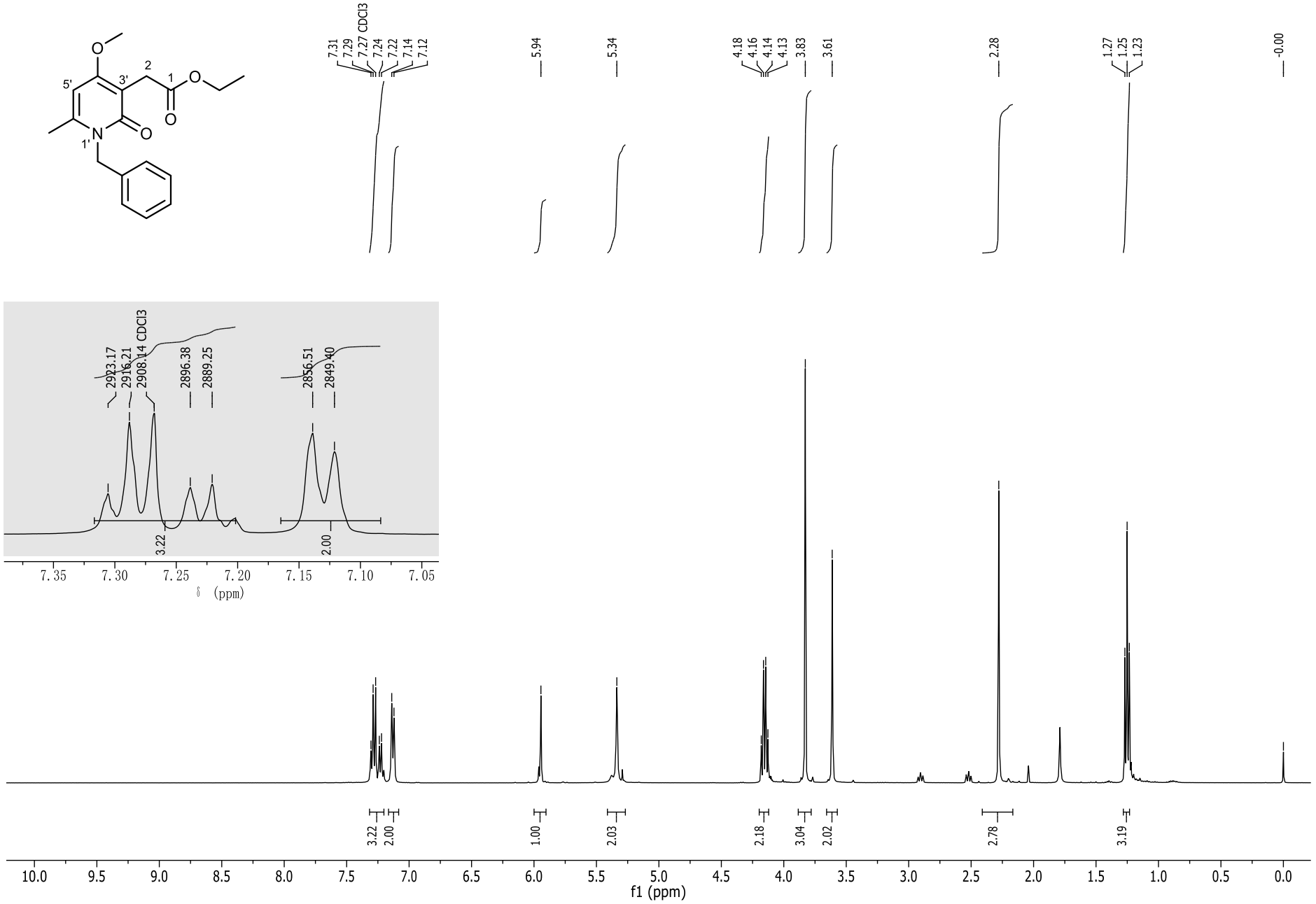
^{1}H NMR (400 MHz) Analysis of Compound 3m.



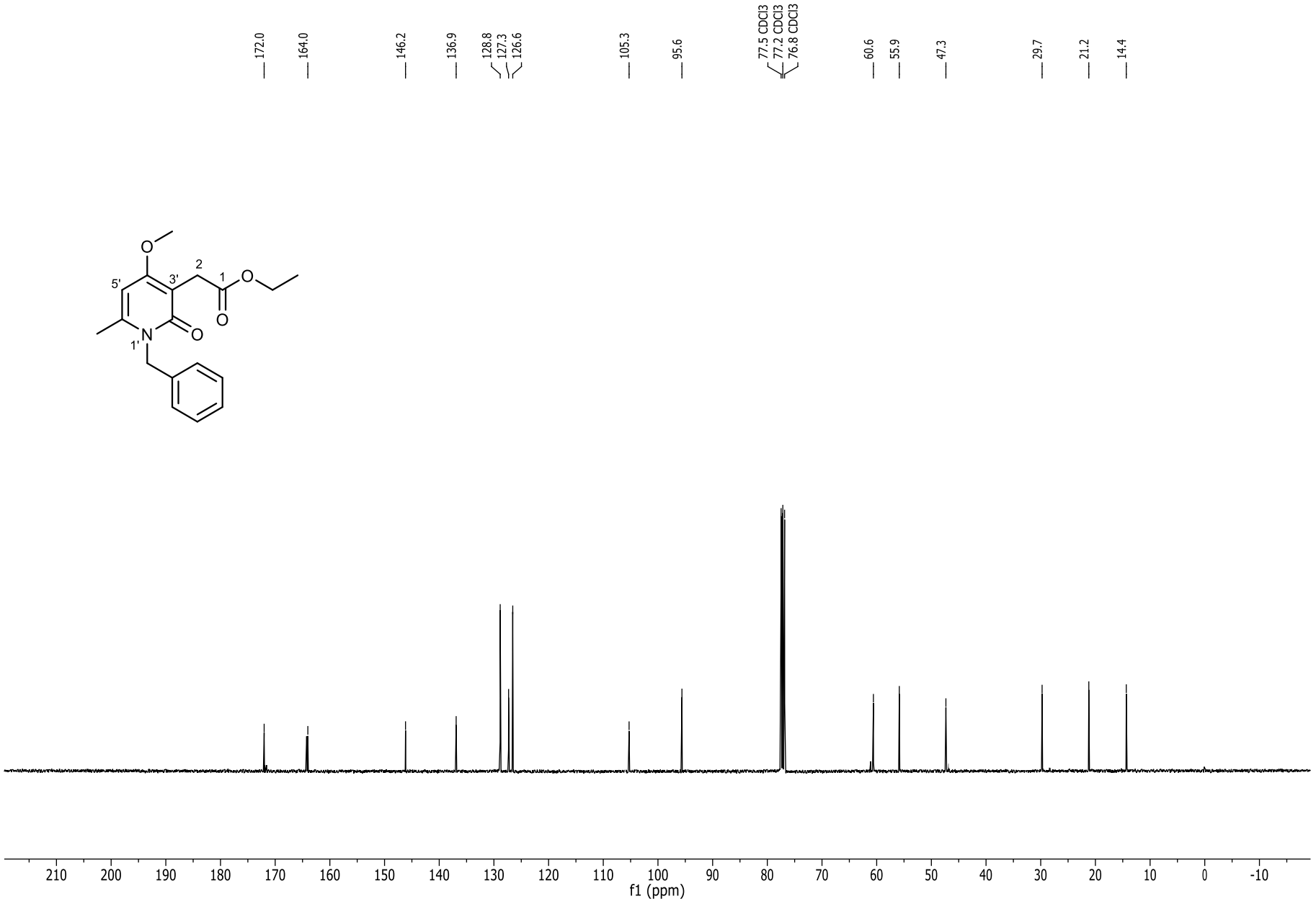
^{13}C NMR (101 MHz) Analysis of Compound 3m.



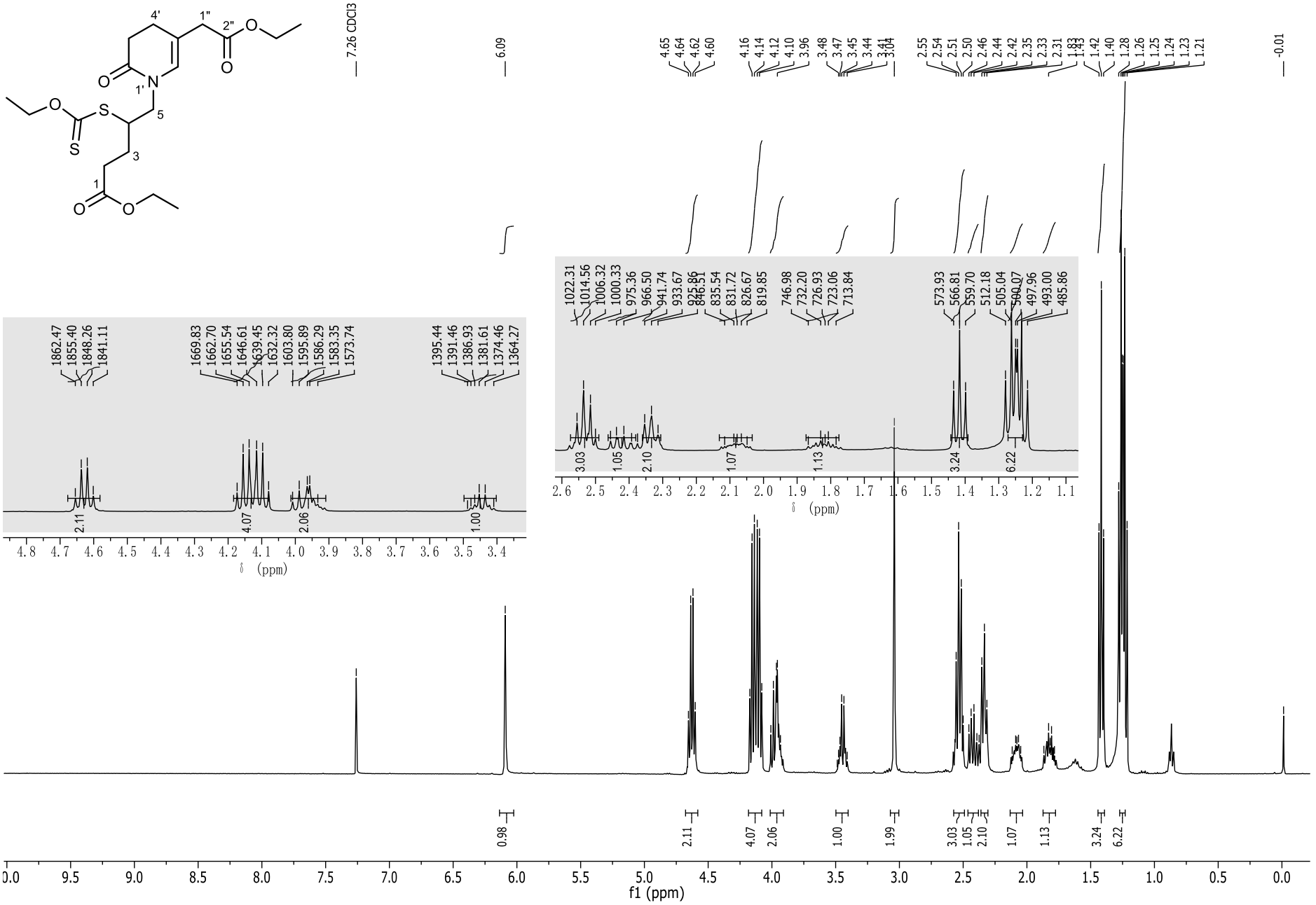
^{1}H NMR (400 MHz) Analysis of Compound 3n.



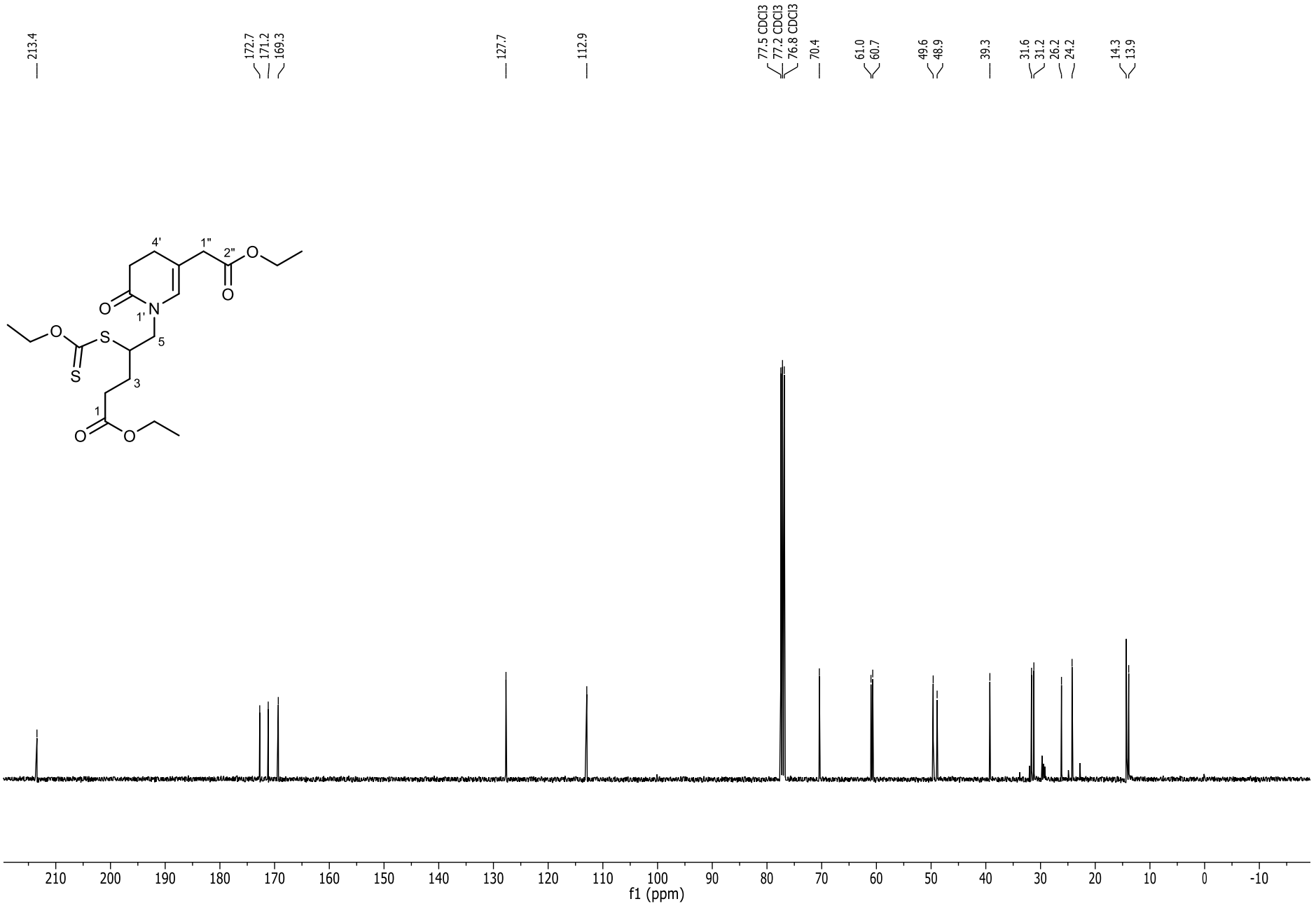
^{13}C NMR (101 MHz) Analysis of Compound 3n.



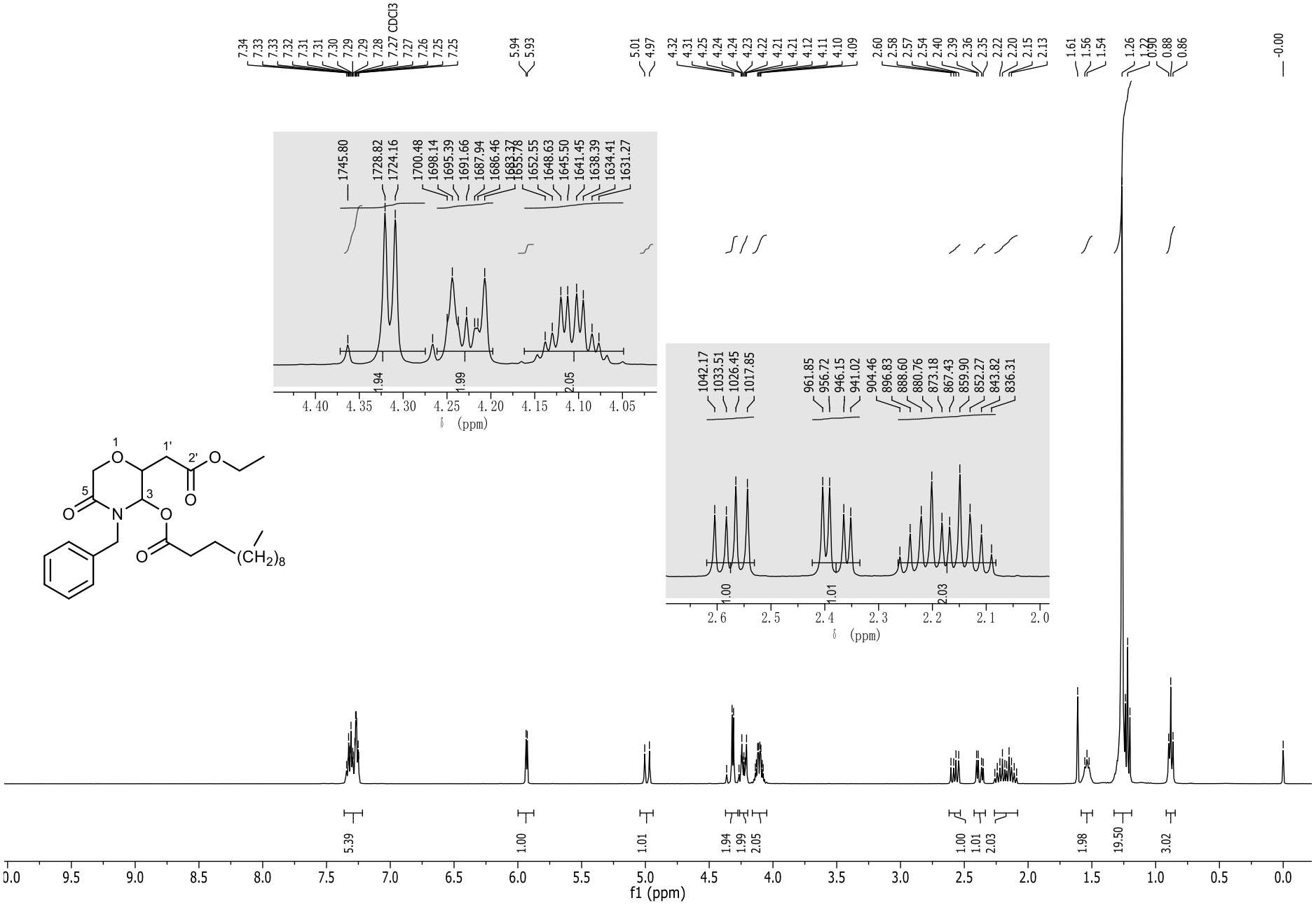
^{1}H NMR (400 MHz) Analysis of Compound 3o.



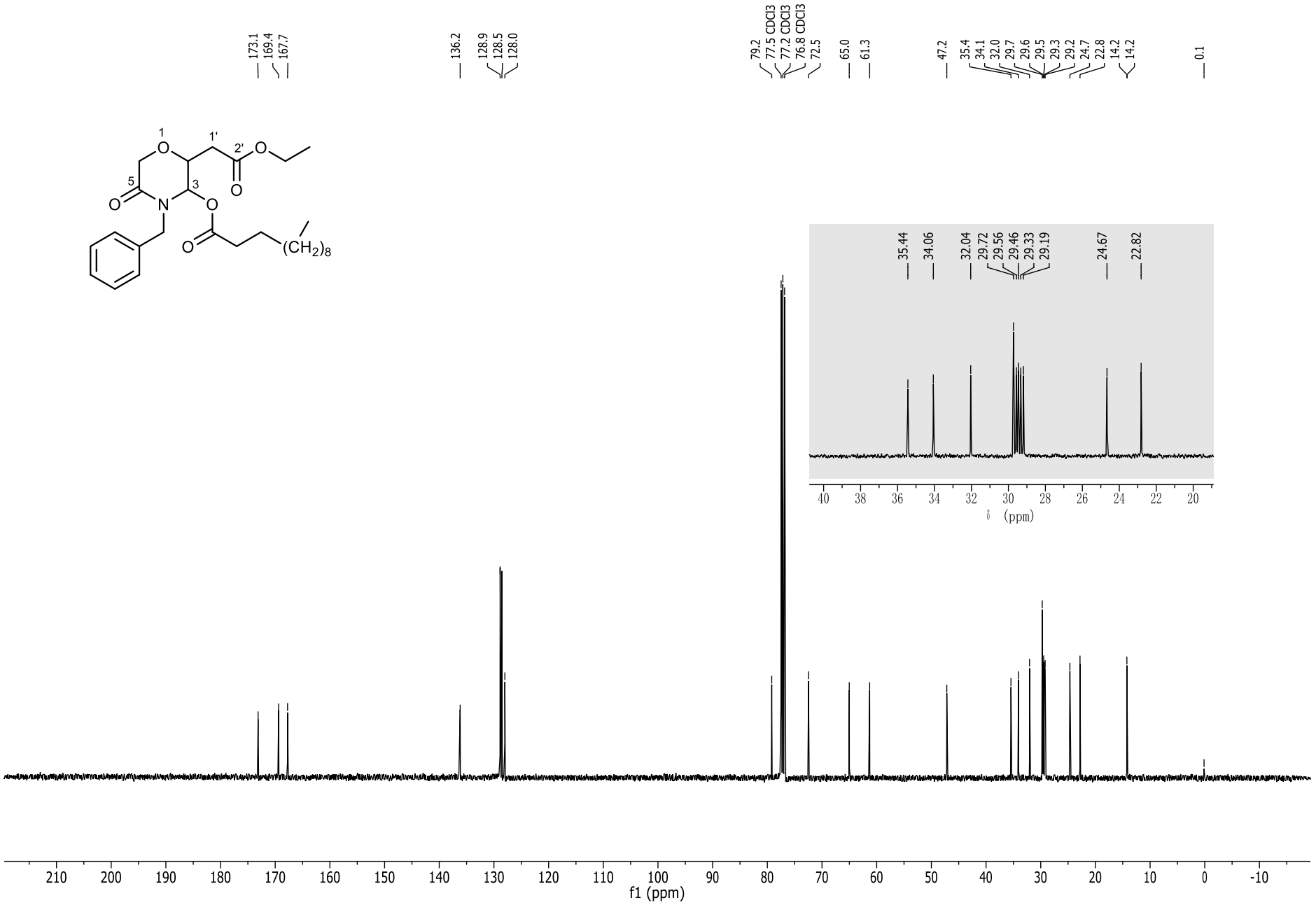
^{13}C NMR (101 MHz) Analysis of Compound 3o.



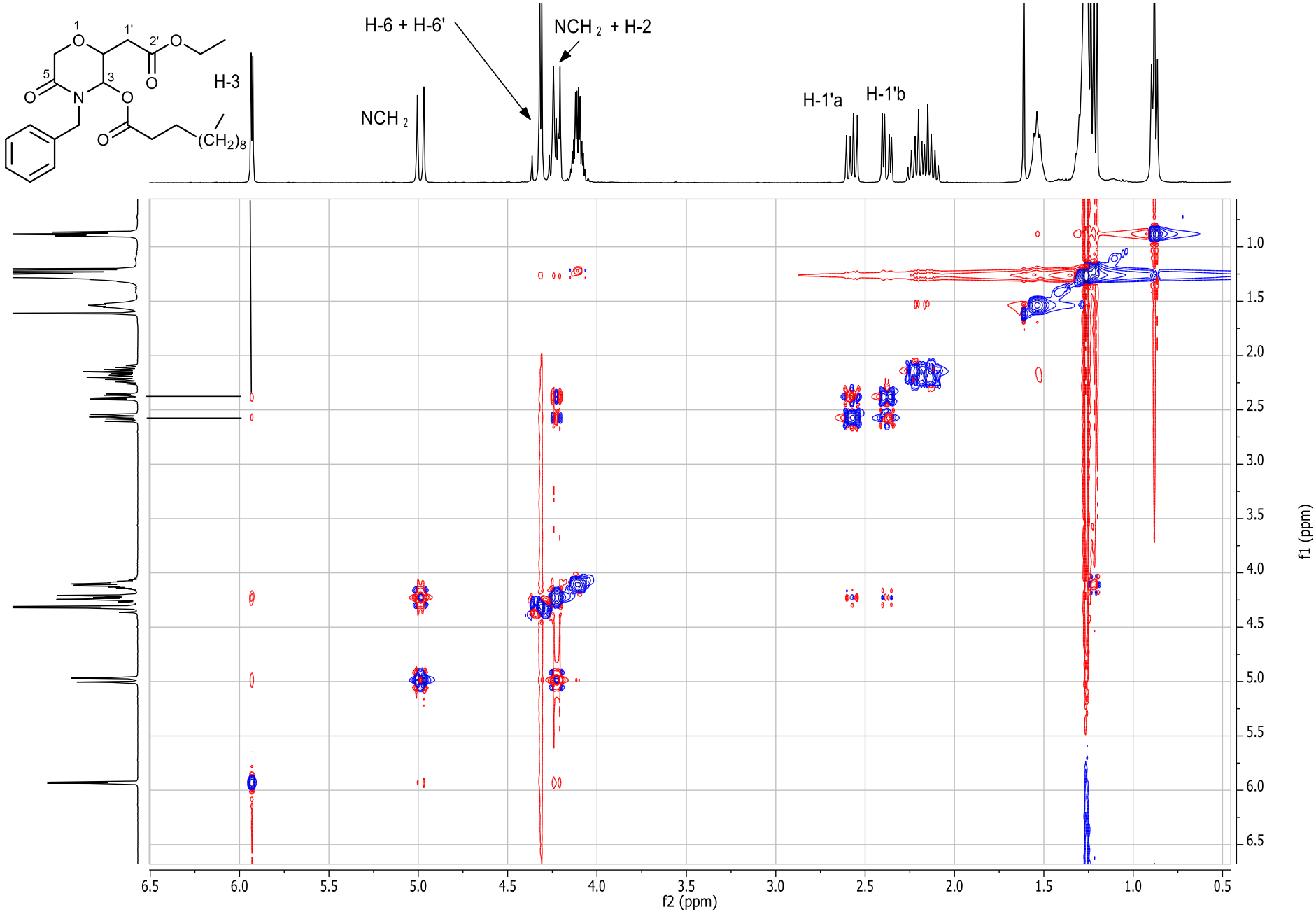
^{1}H NMR (400 MHz) Analysis of Compound 2,3-*trans*-4p.



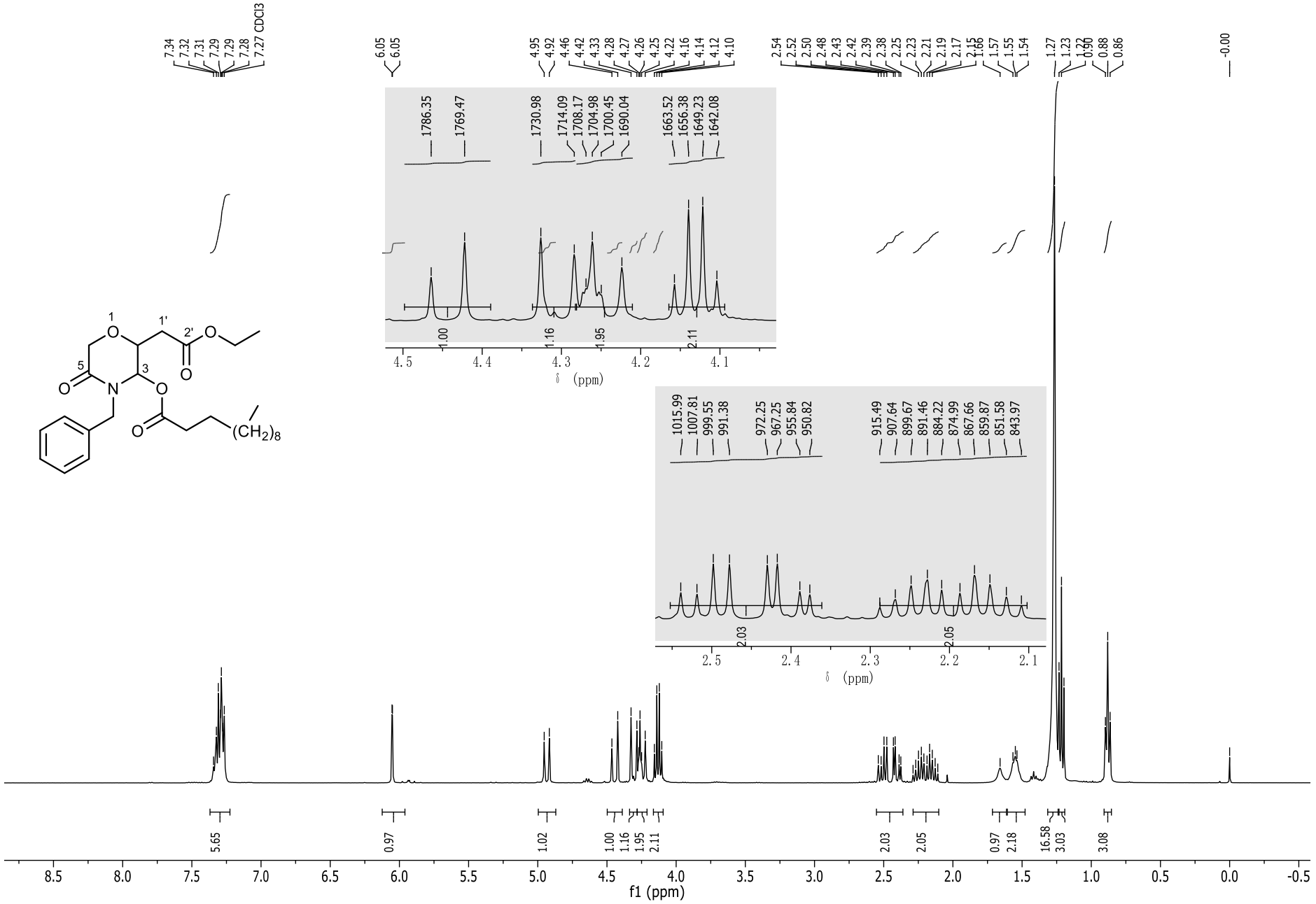
^{13}C NMR (101 MHz) Analysis of Compound 2,3-*trans*-4p.



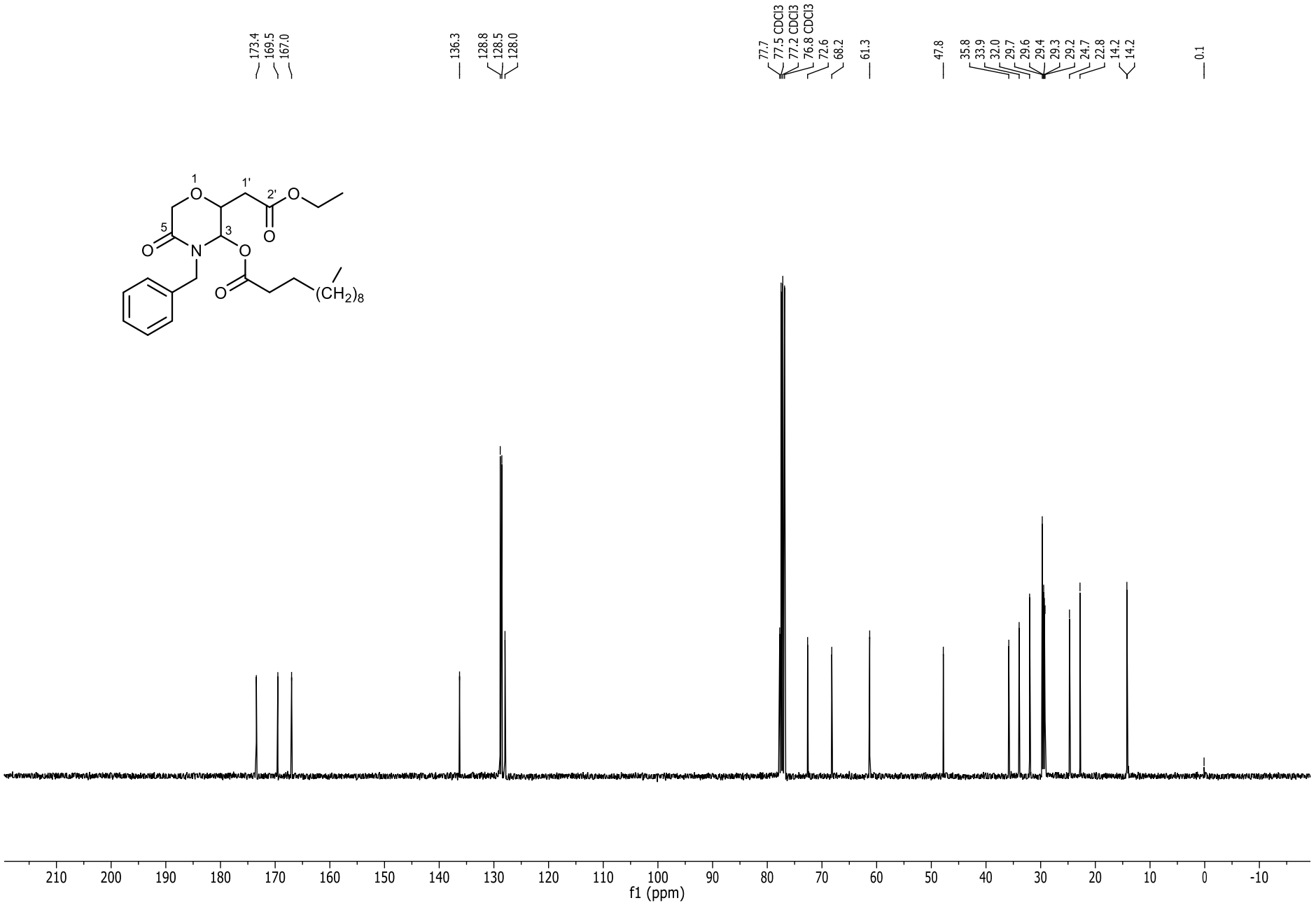
^{1}H–^{1}H NOESY (400 MHz) Analysis of Compound 2,3-*trans*-4p.



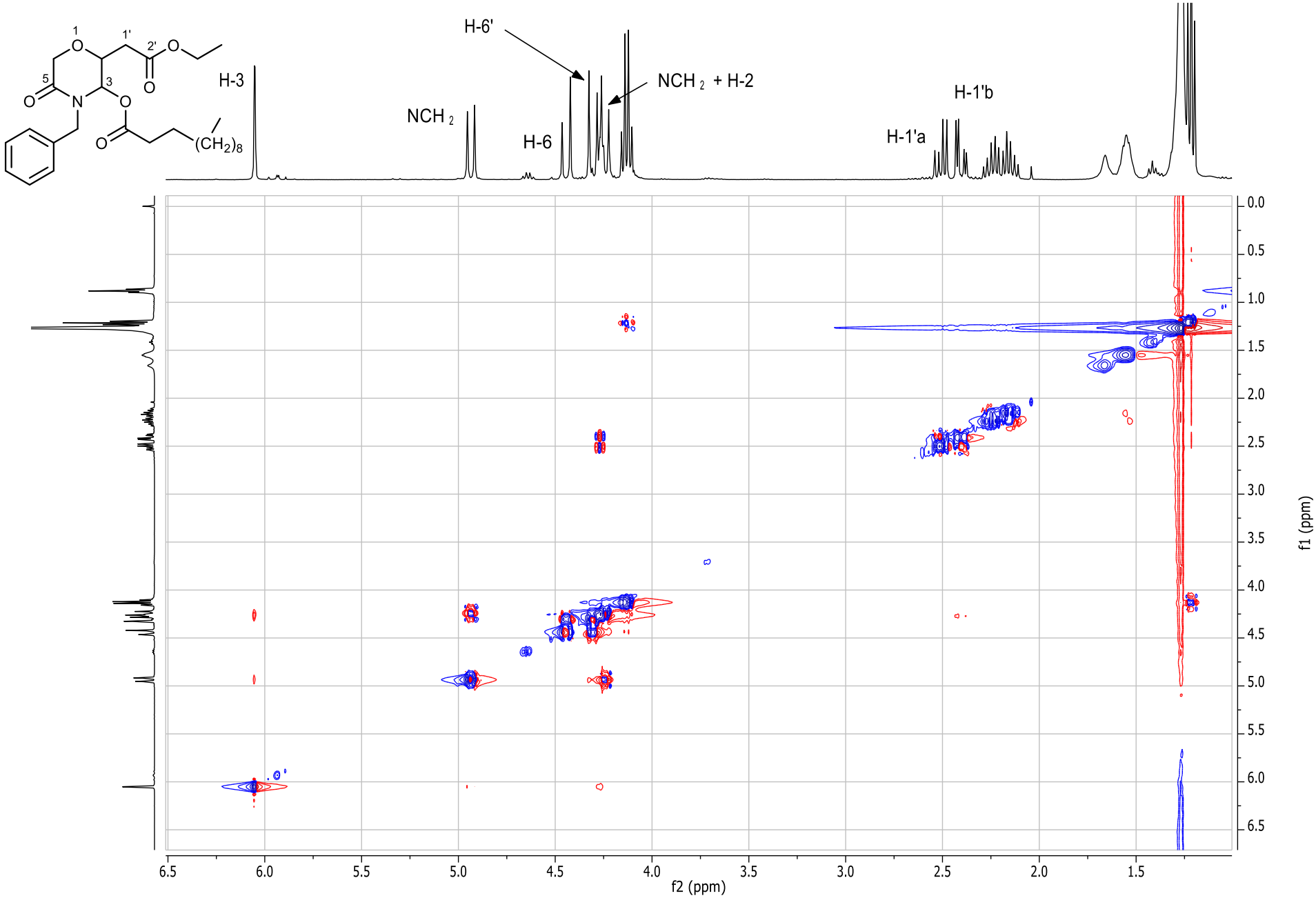
^{1}H NMR (400 MHz) Analysis of Compound 2,3-*cis*-4p.



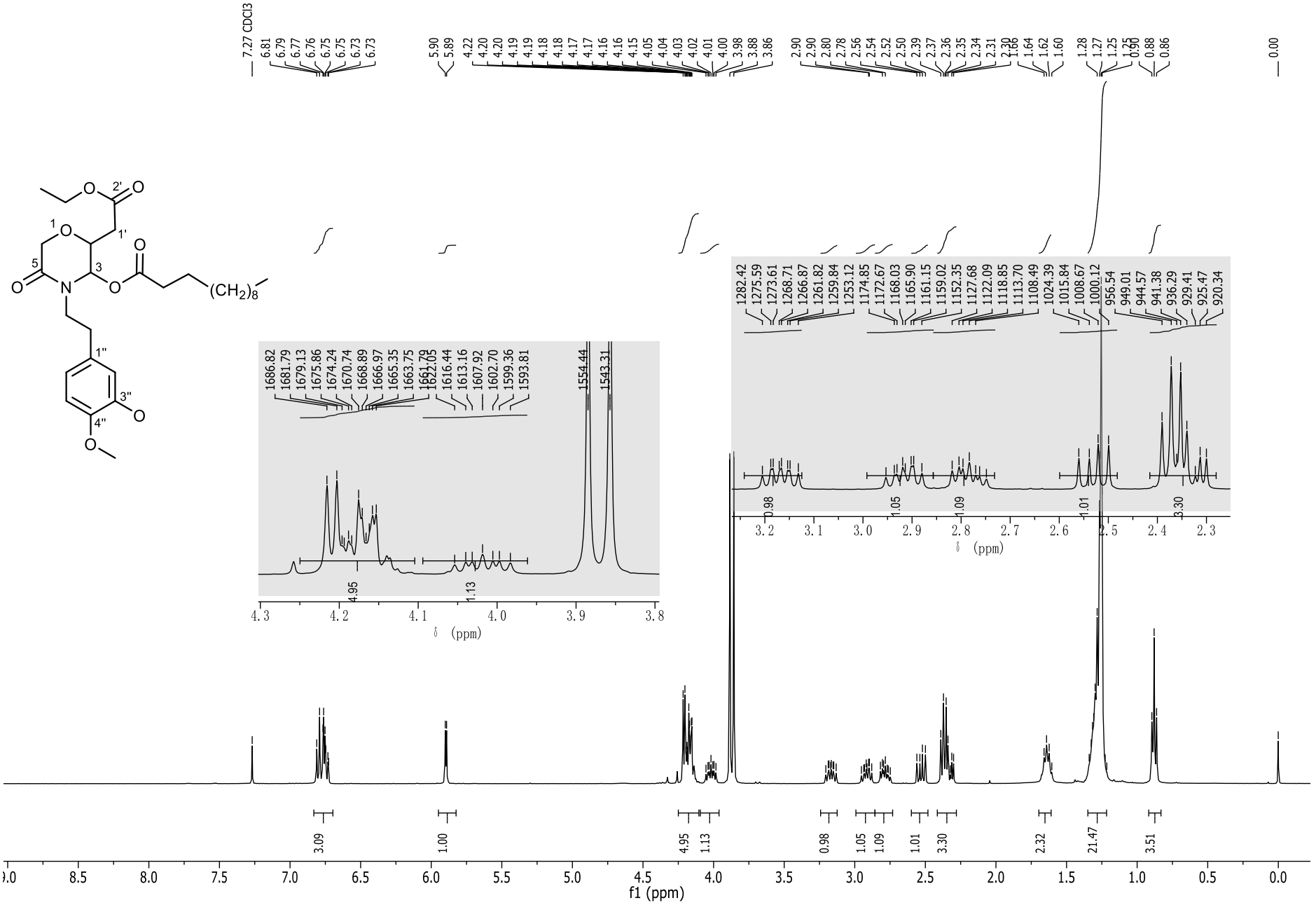
^{13}C NMR (101 MHz) Analysis of Compound 2,3-*cis*-4p.



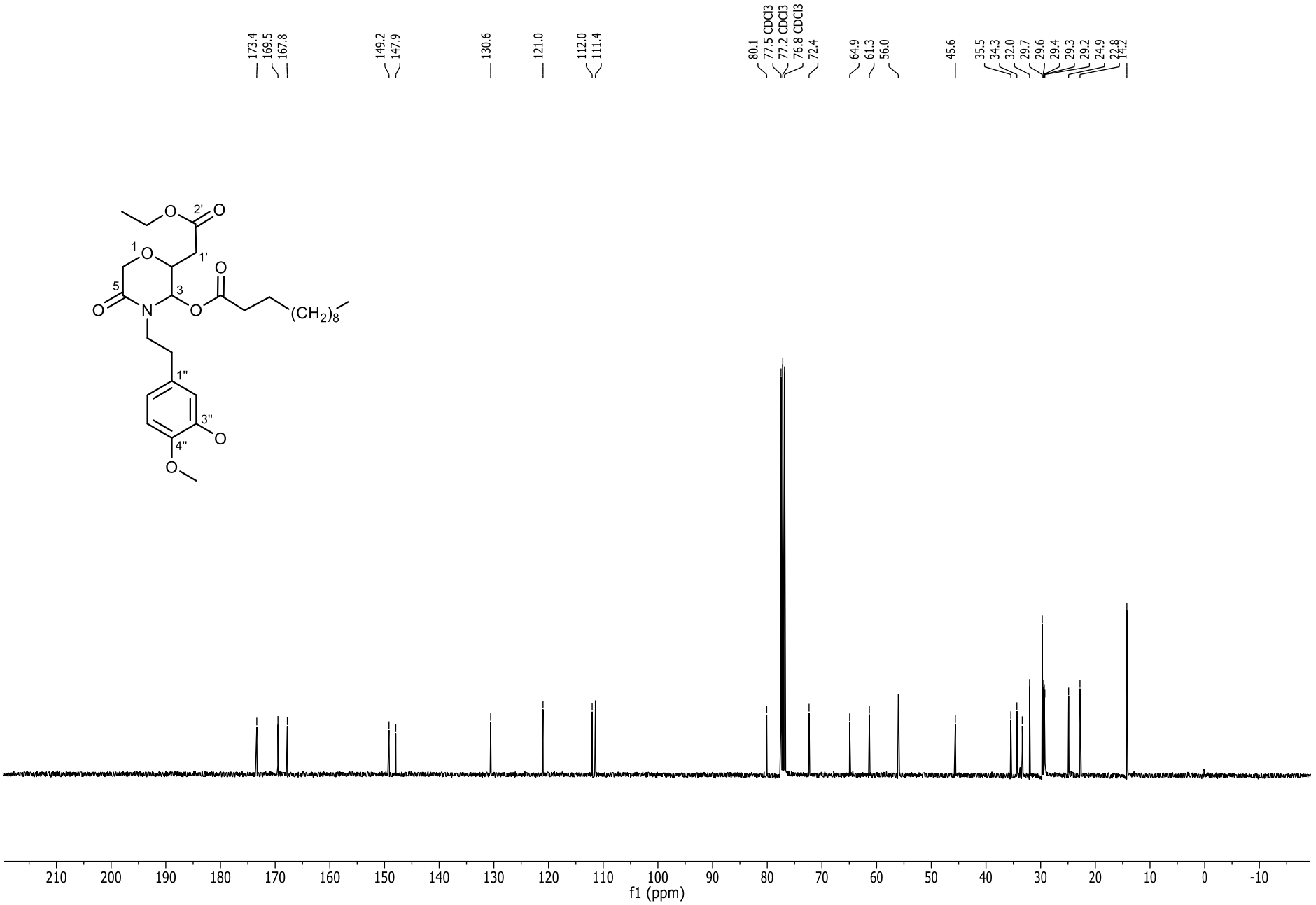
^{1}H–^{1}H NOESY (400 MHz) Analysis of Compound 2,3-*cis*-4p.



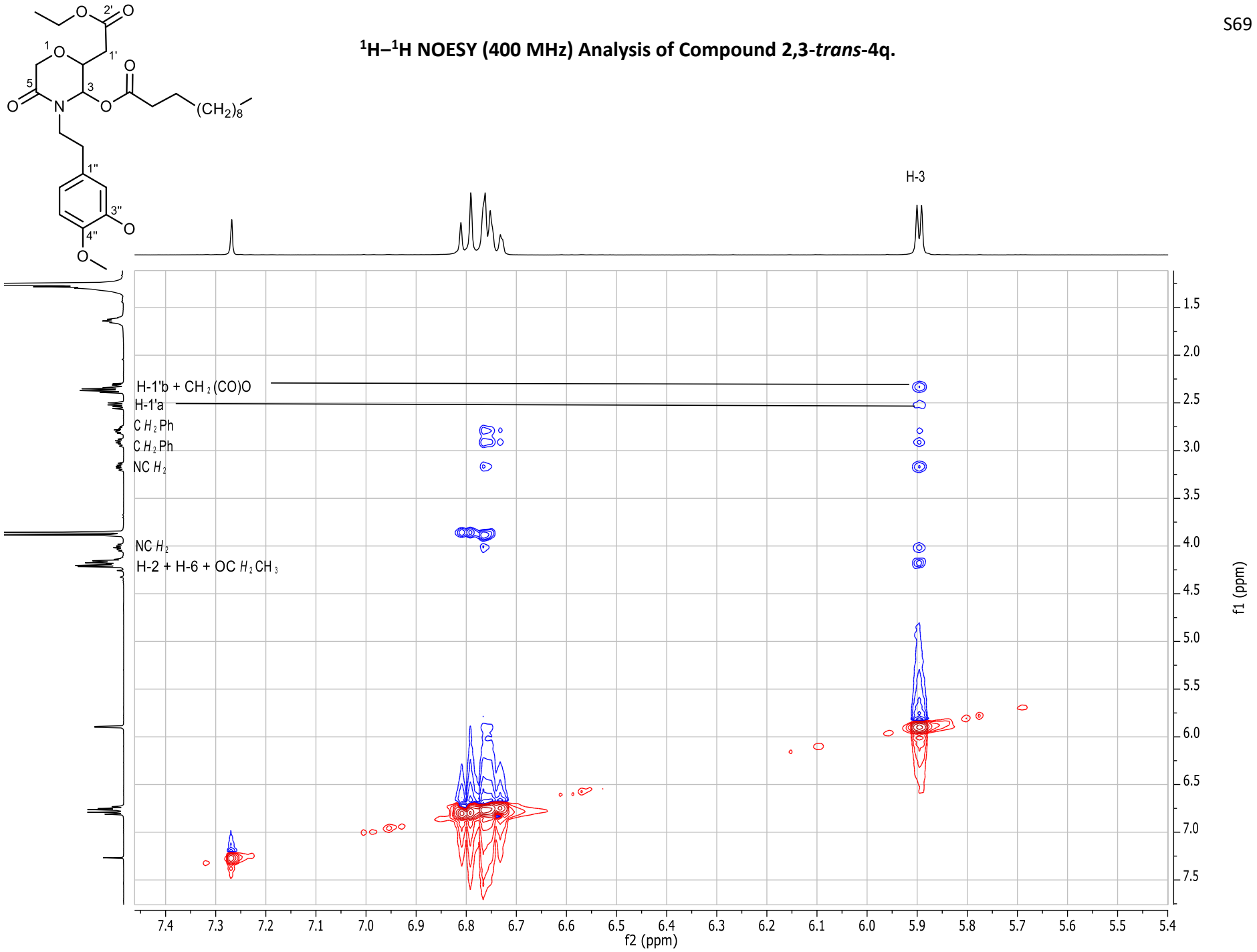
^{1}H NMR (400 MHz) Analysis of Compound 2,3-*trans*-4q.



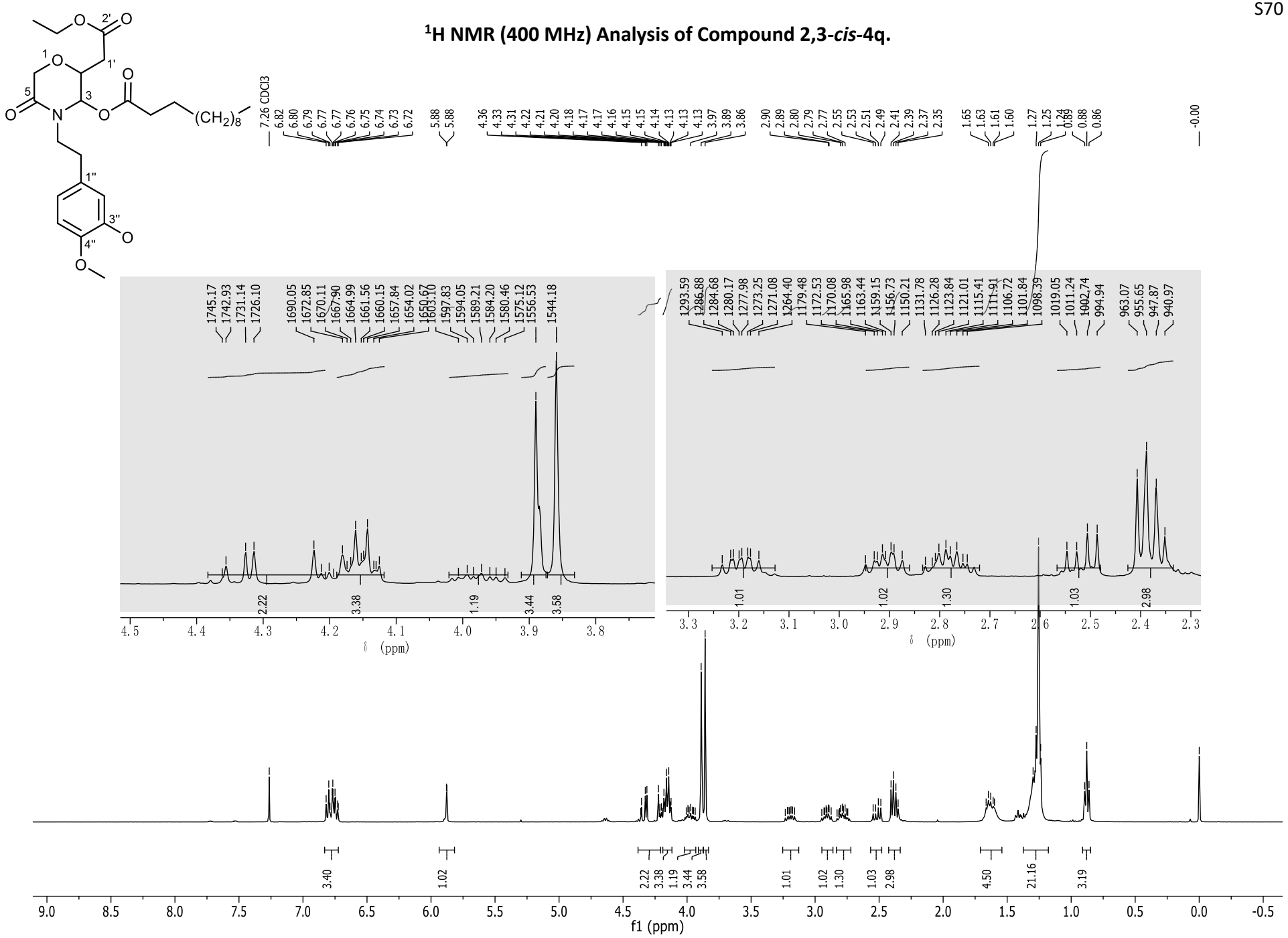
^{13}C NMR (101 MHz) Analysis of Compound 2,3-*trans*-4q.



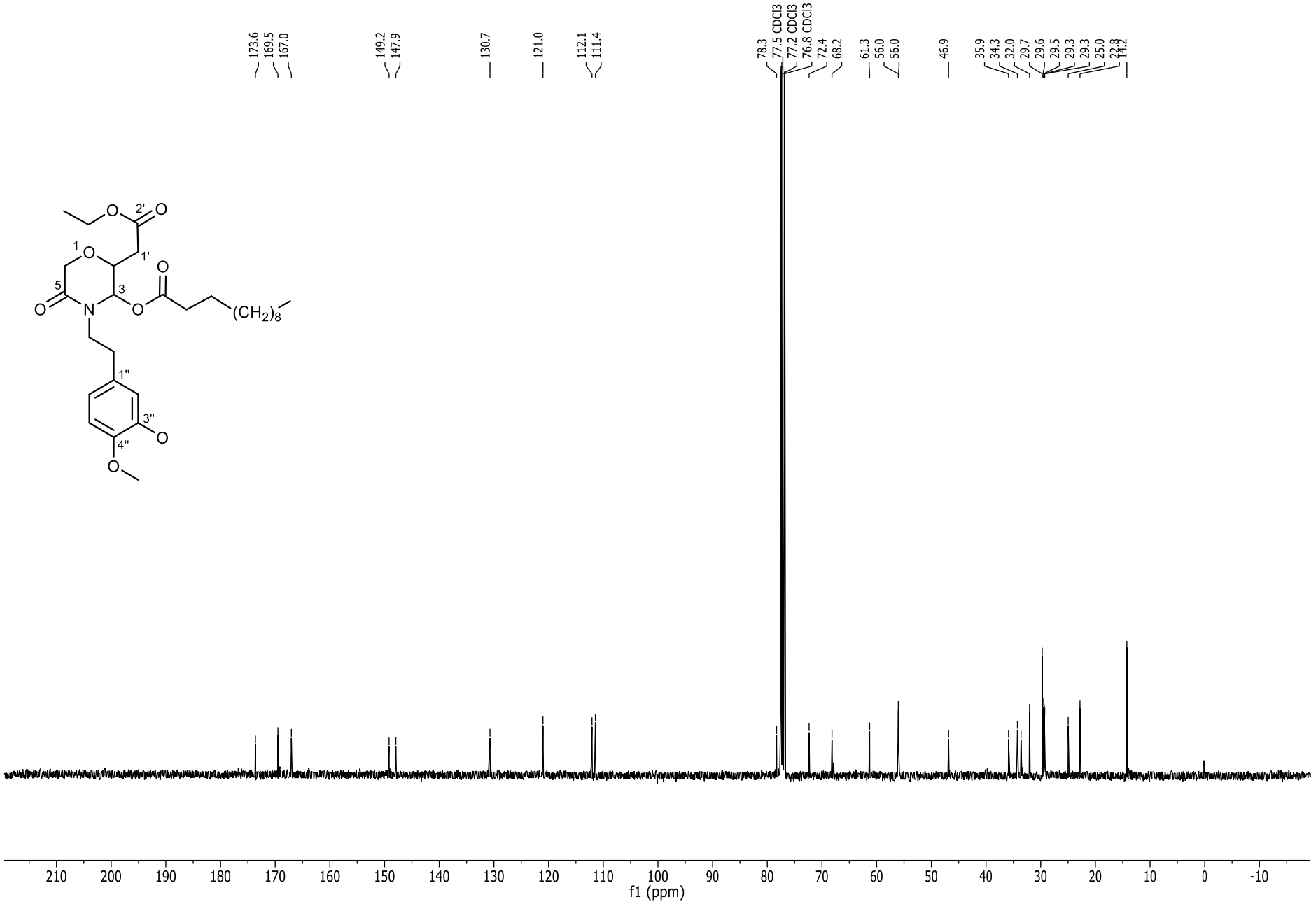
^{1}H–^{1}H NOESY (400 MHz) Analysis of Compound 2,3-*trans*-4q.



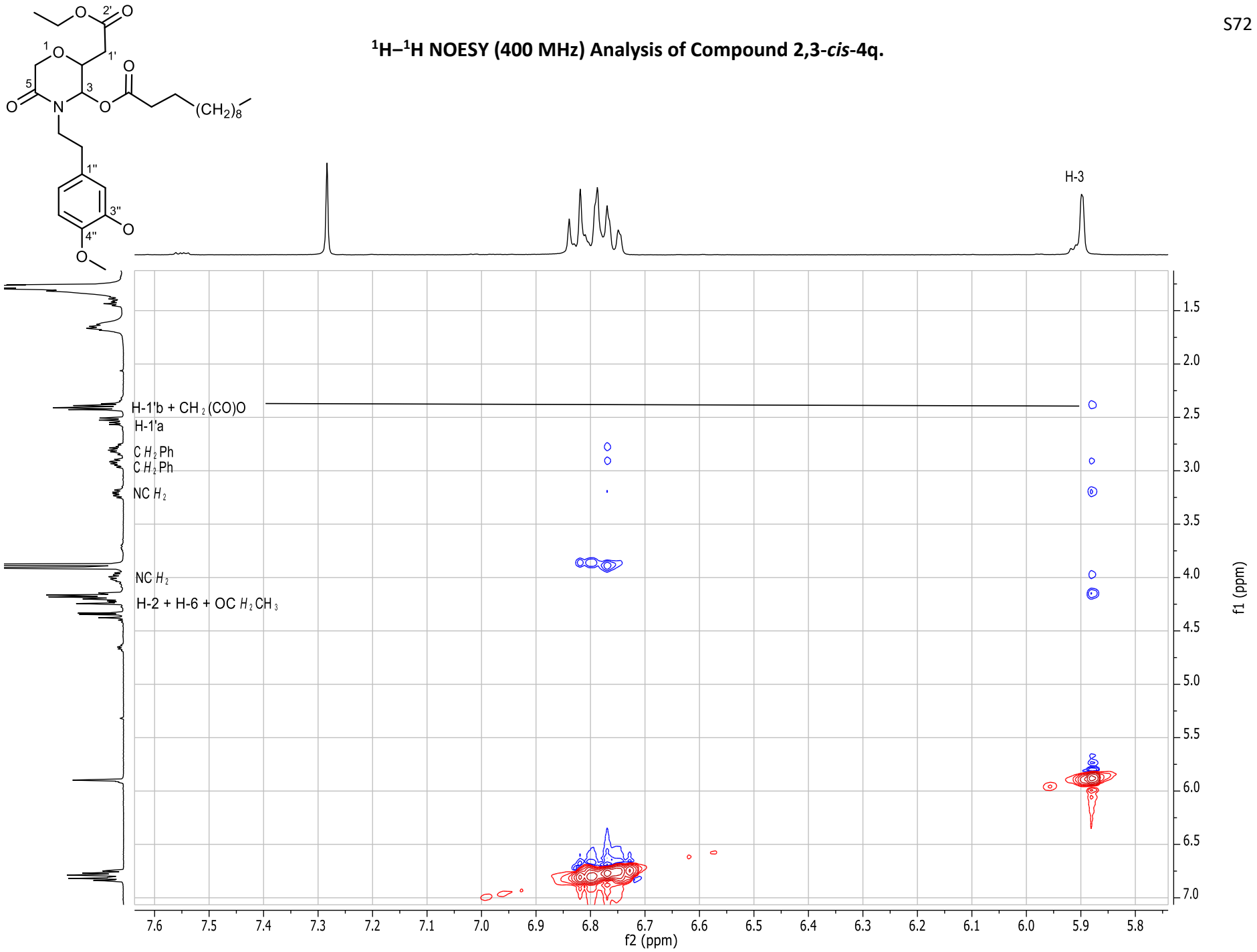
^{1}H NMR (400 MHz) Analysis of Compound 2,3-*cis*-4q.



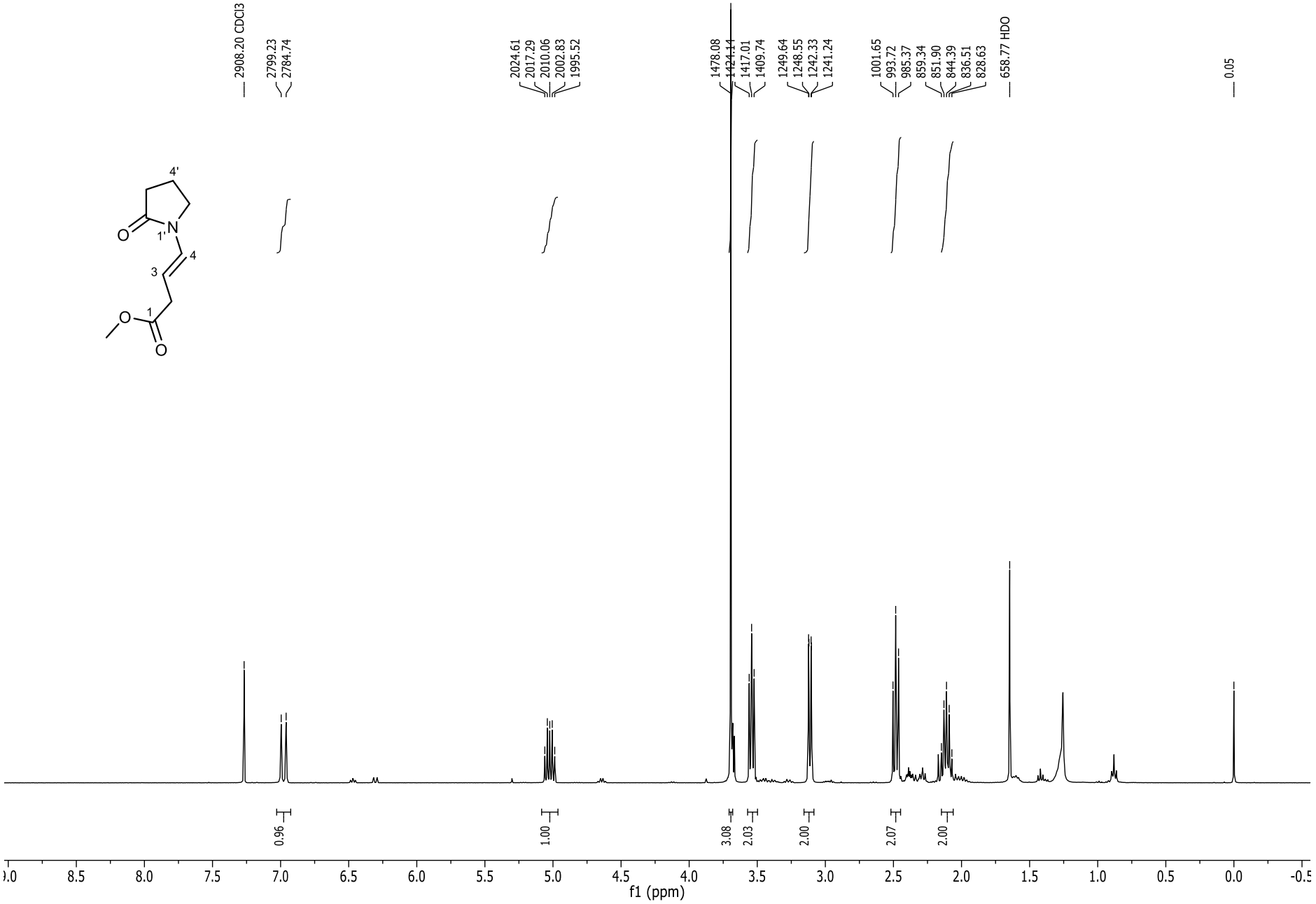
^{13}C NMR (101 MHz) Analysis of Compound 2,3-*cis*-4q.



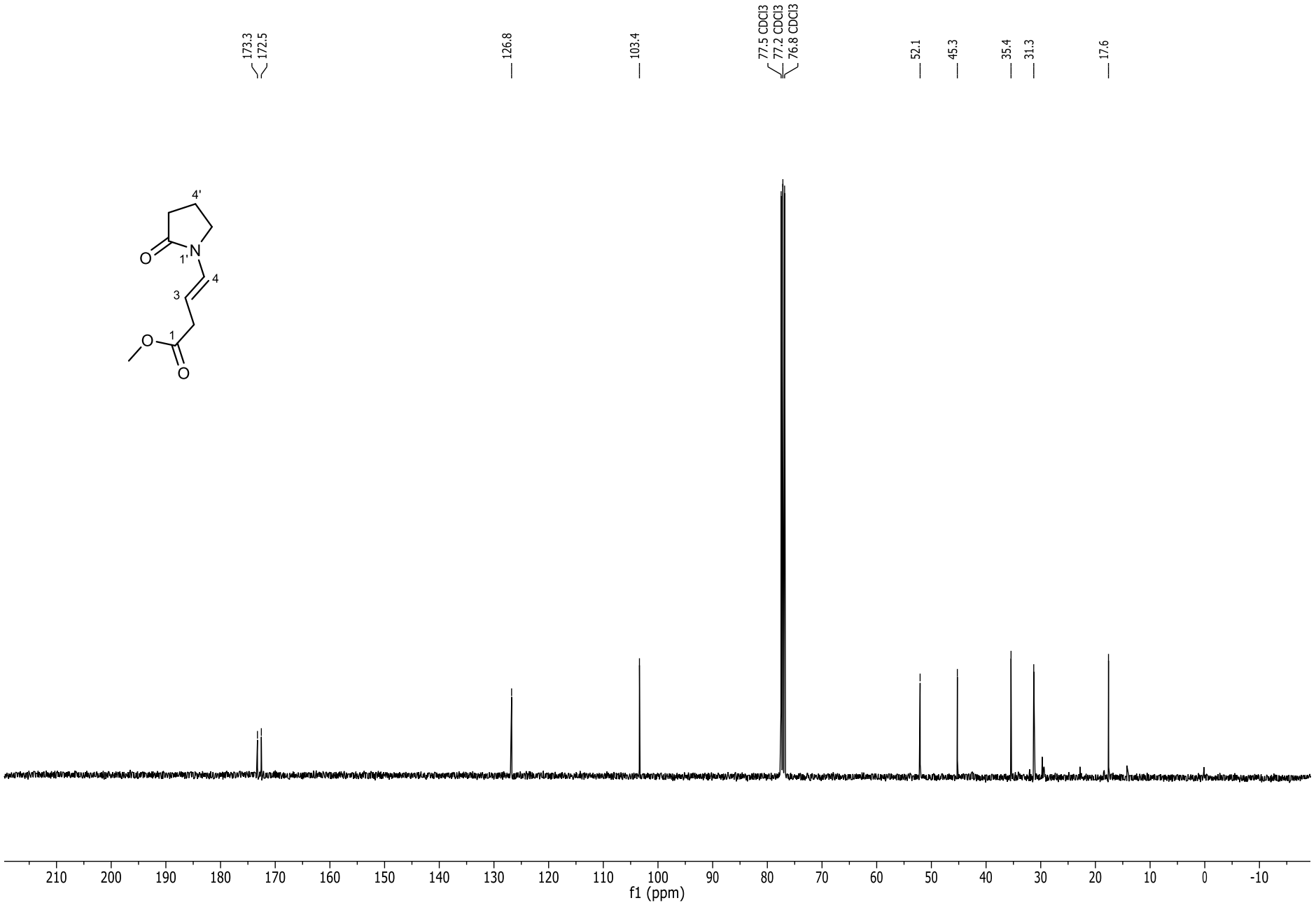
^{1}H–^{1}H NOESY (400 MHz) Analysis of Compound 2,3-*cis*-4q.



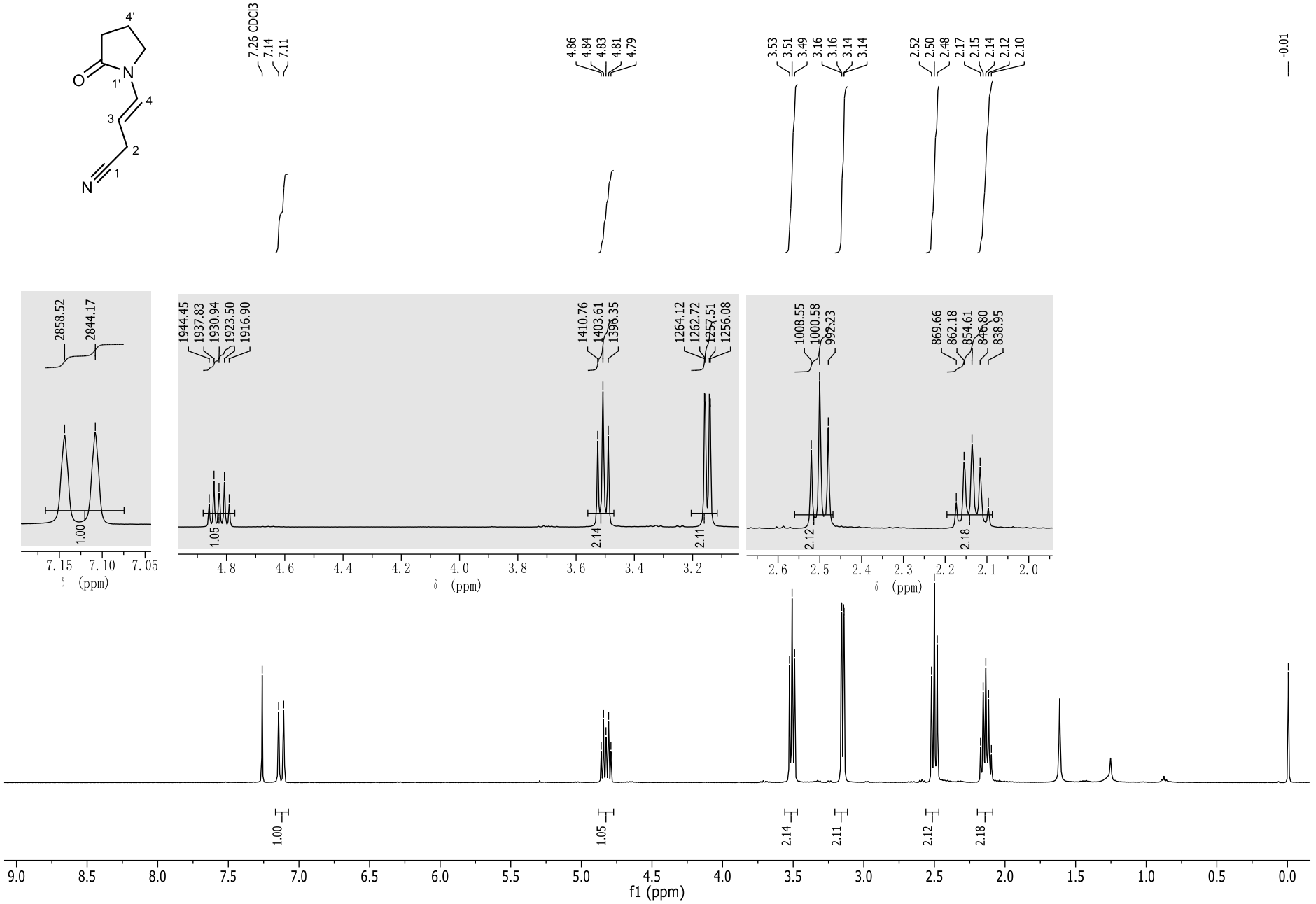
^{1}H NMR (400 MHz) Analysis of Compound 3ab.



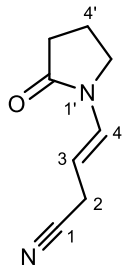
^{13}C NMR (101 MHz) Analysis of Compound 3ab.



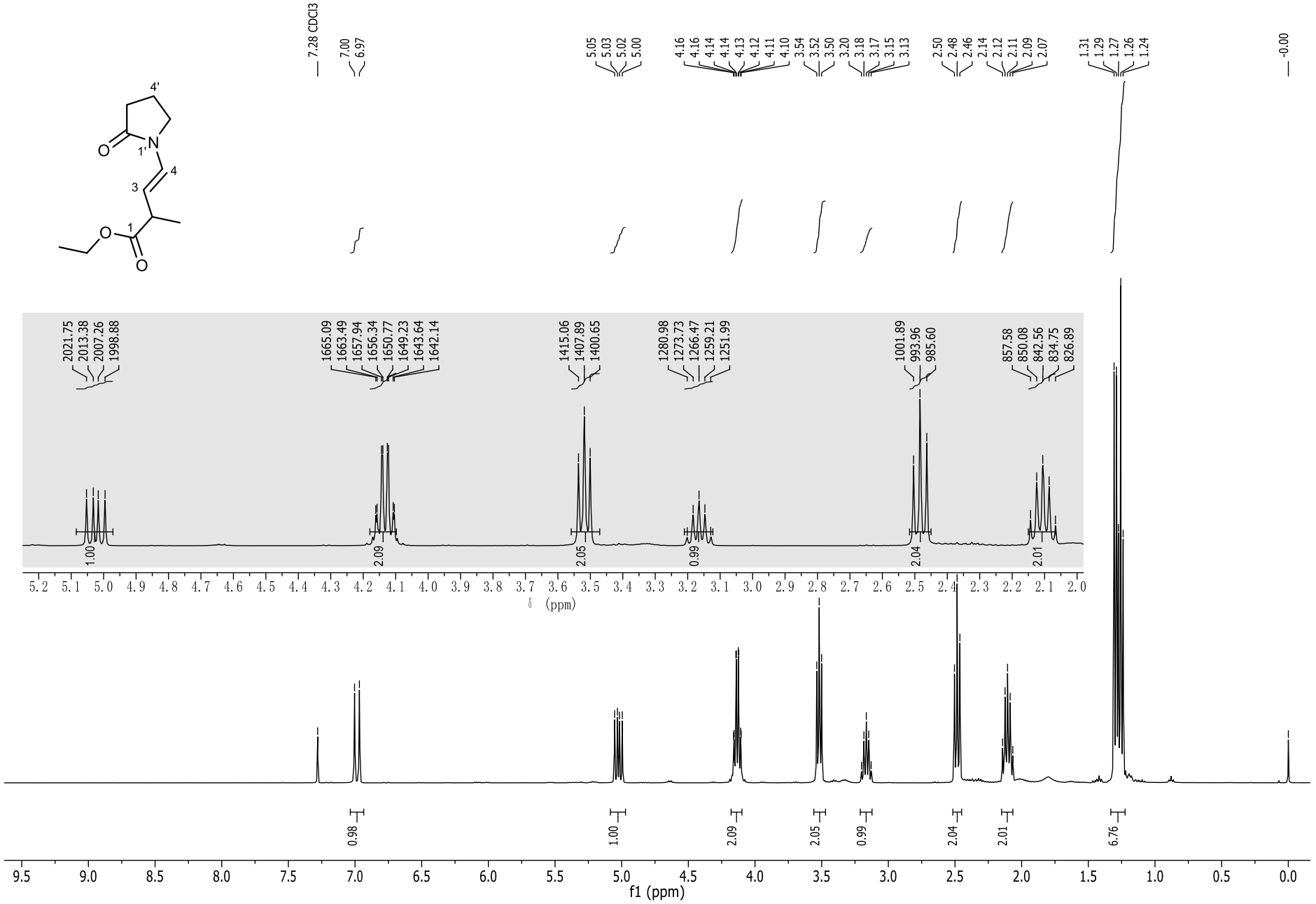
^{1}H NMR (400 MHz) Analysis of Compound 3ac.



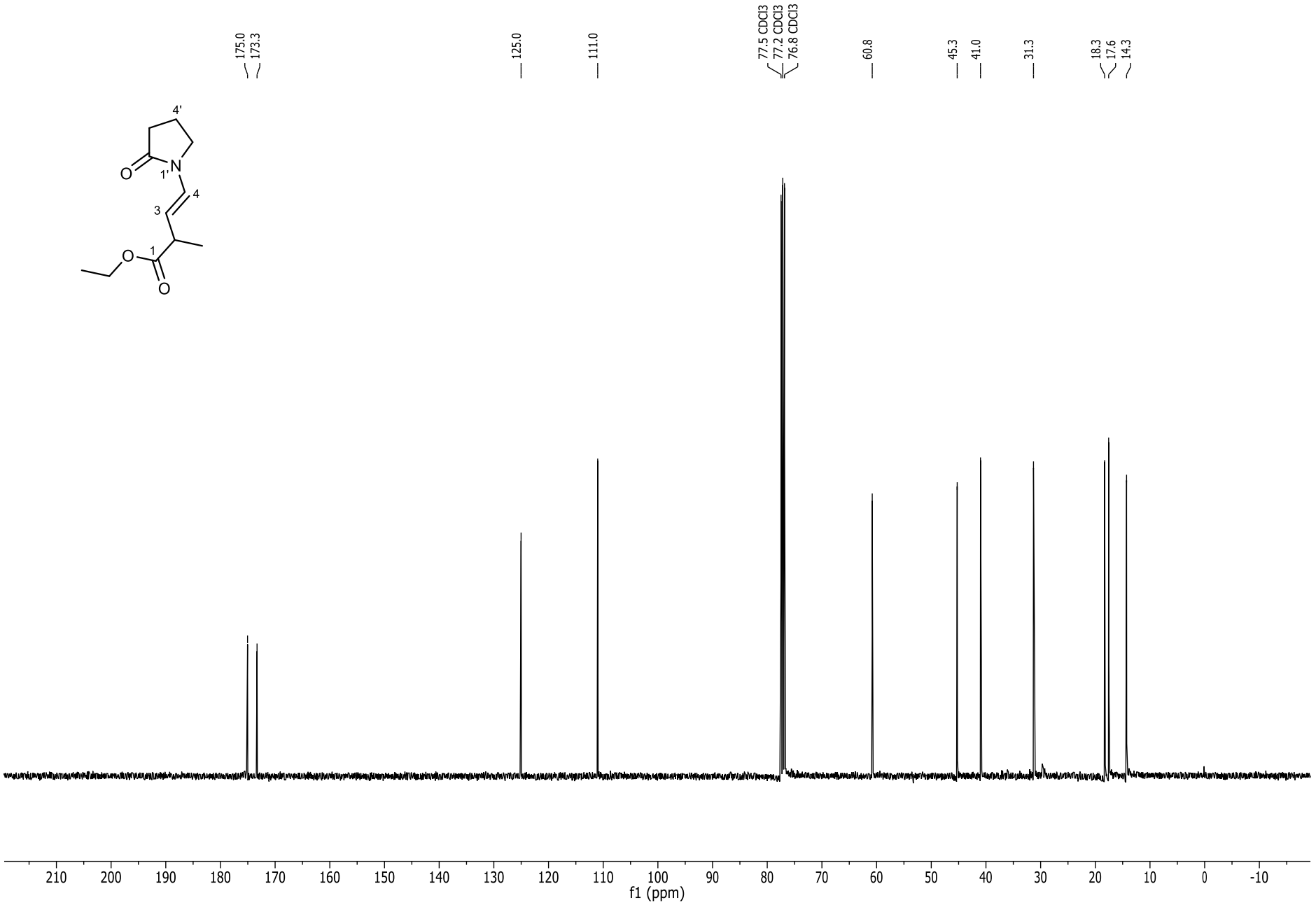
^{13}C NMR (101 MHz) Analysis of Compound 3ac.



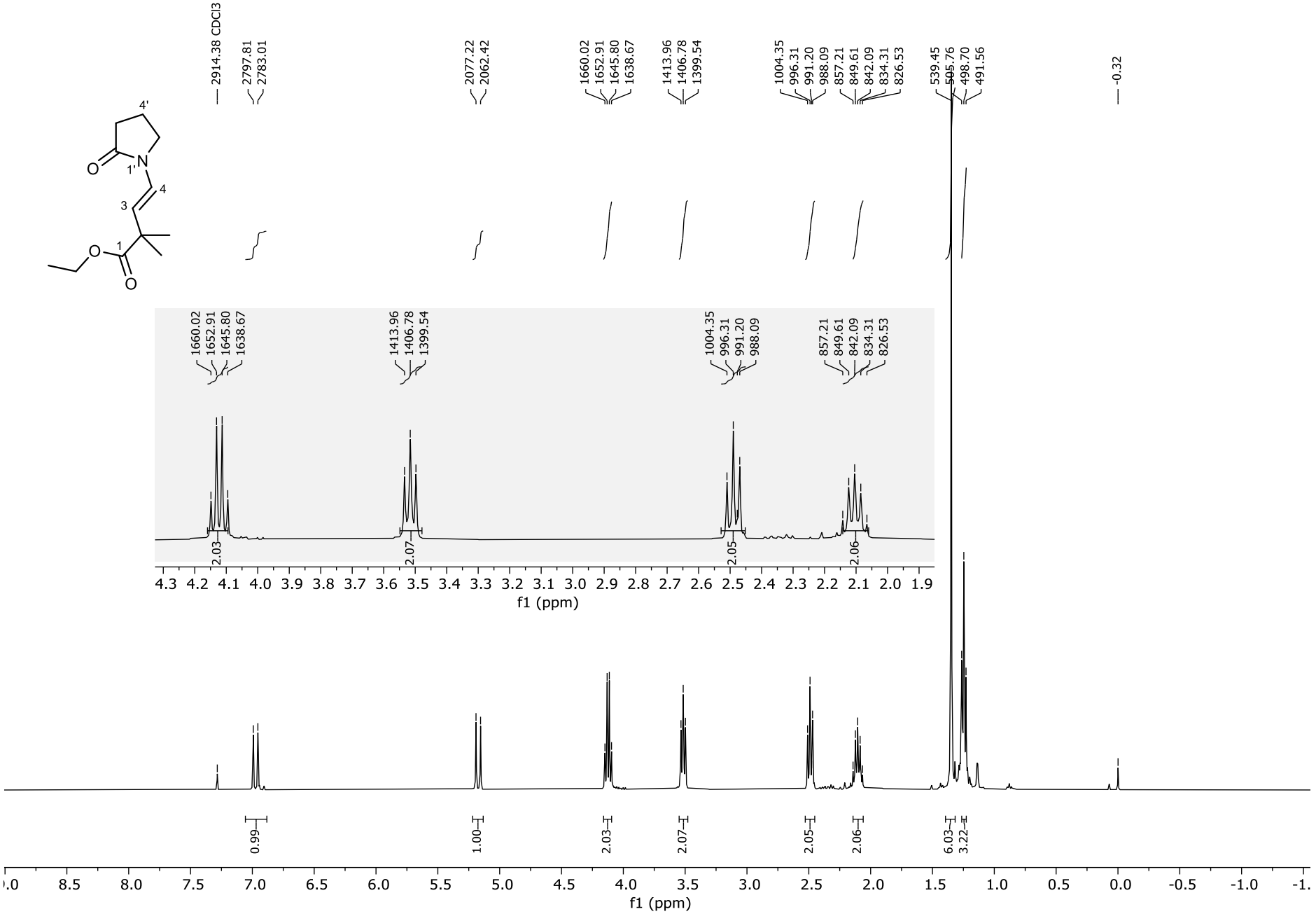
^{1}H NMR (400 MHz) Analysis of Compound 3ad.



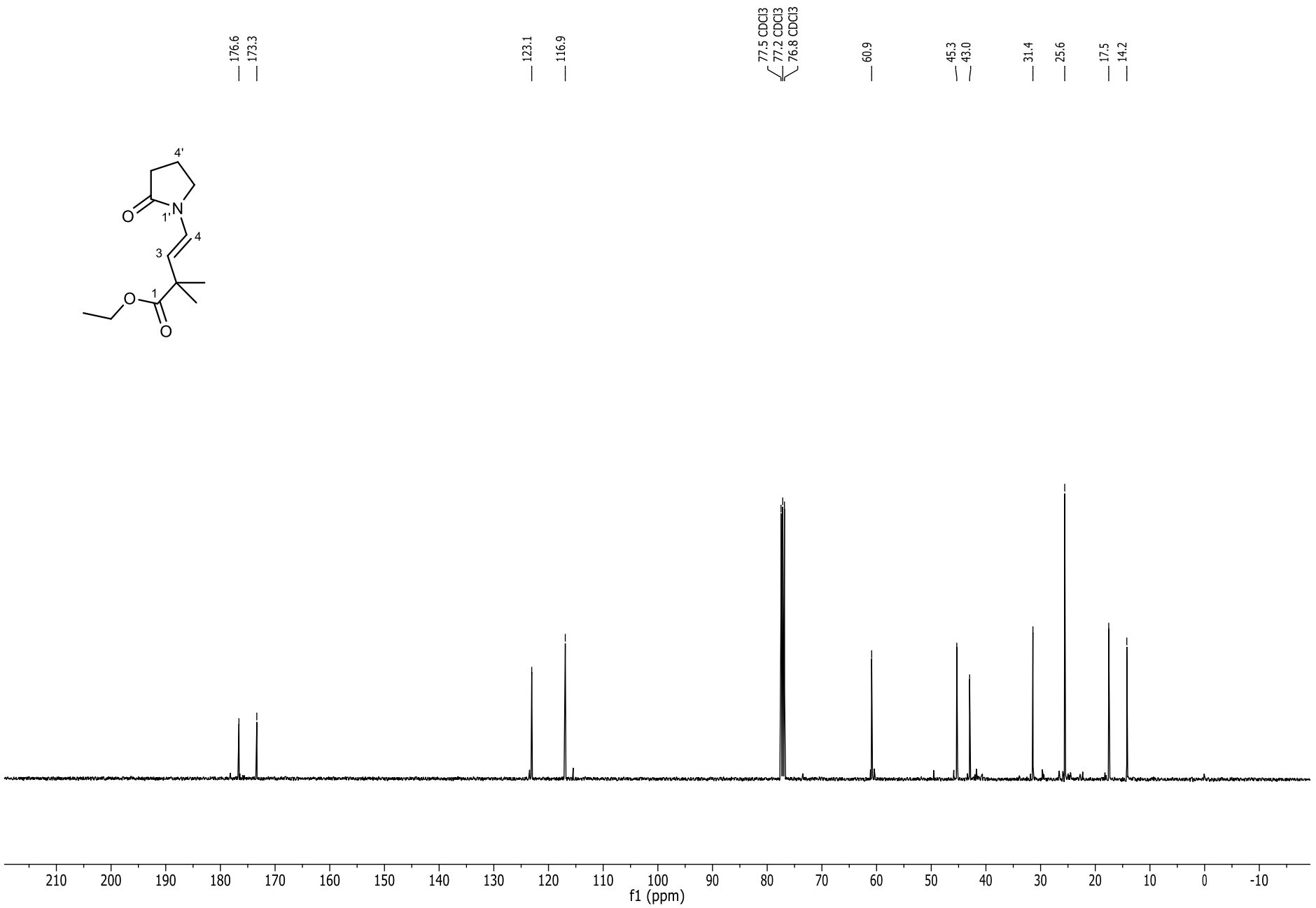
^{13}C NMR (101 MHz) Analysis of Compound 3ad.



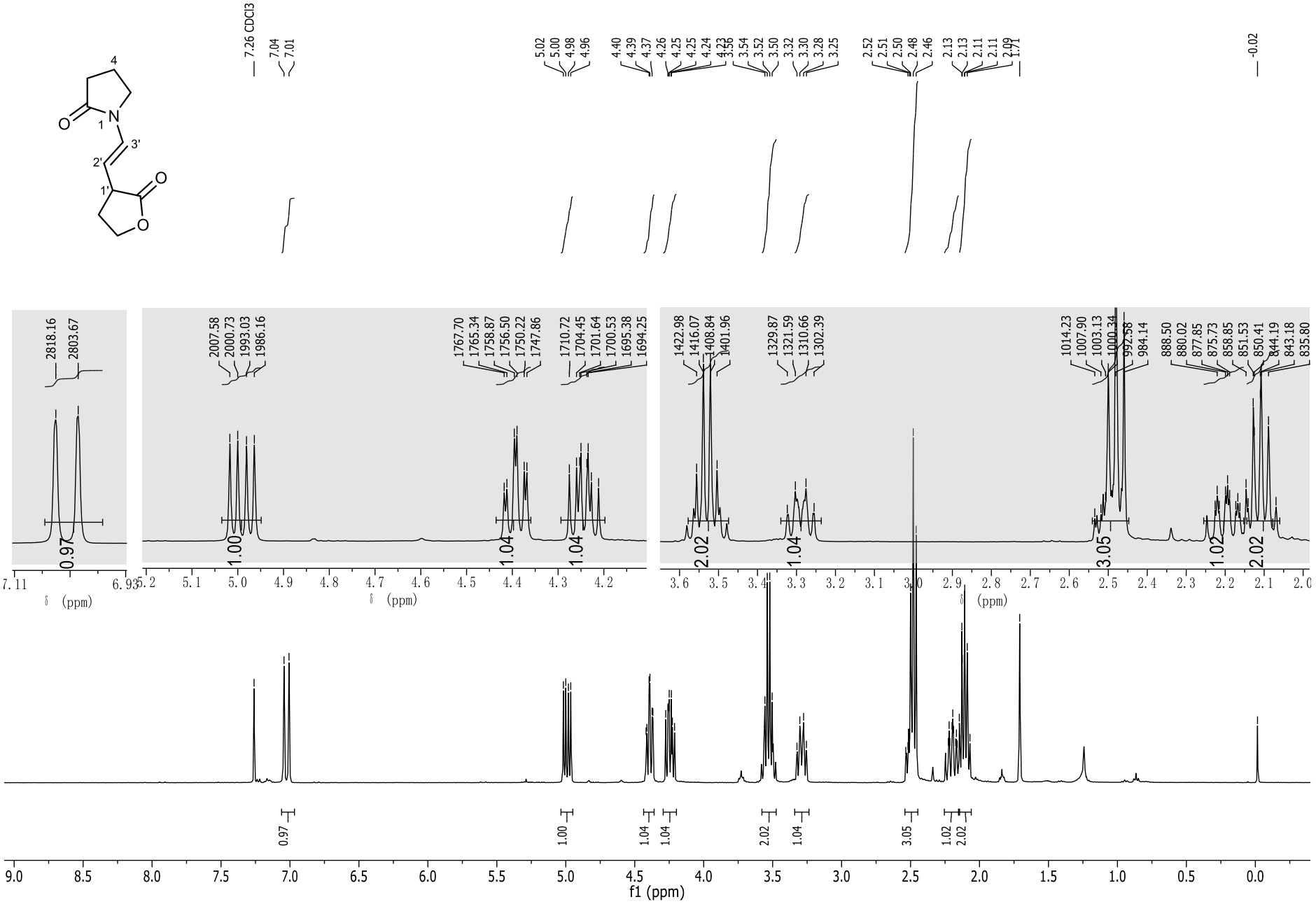
^{1}H NMR (400 MHz) Analysis of Compound 3ae.



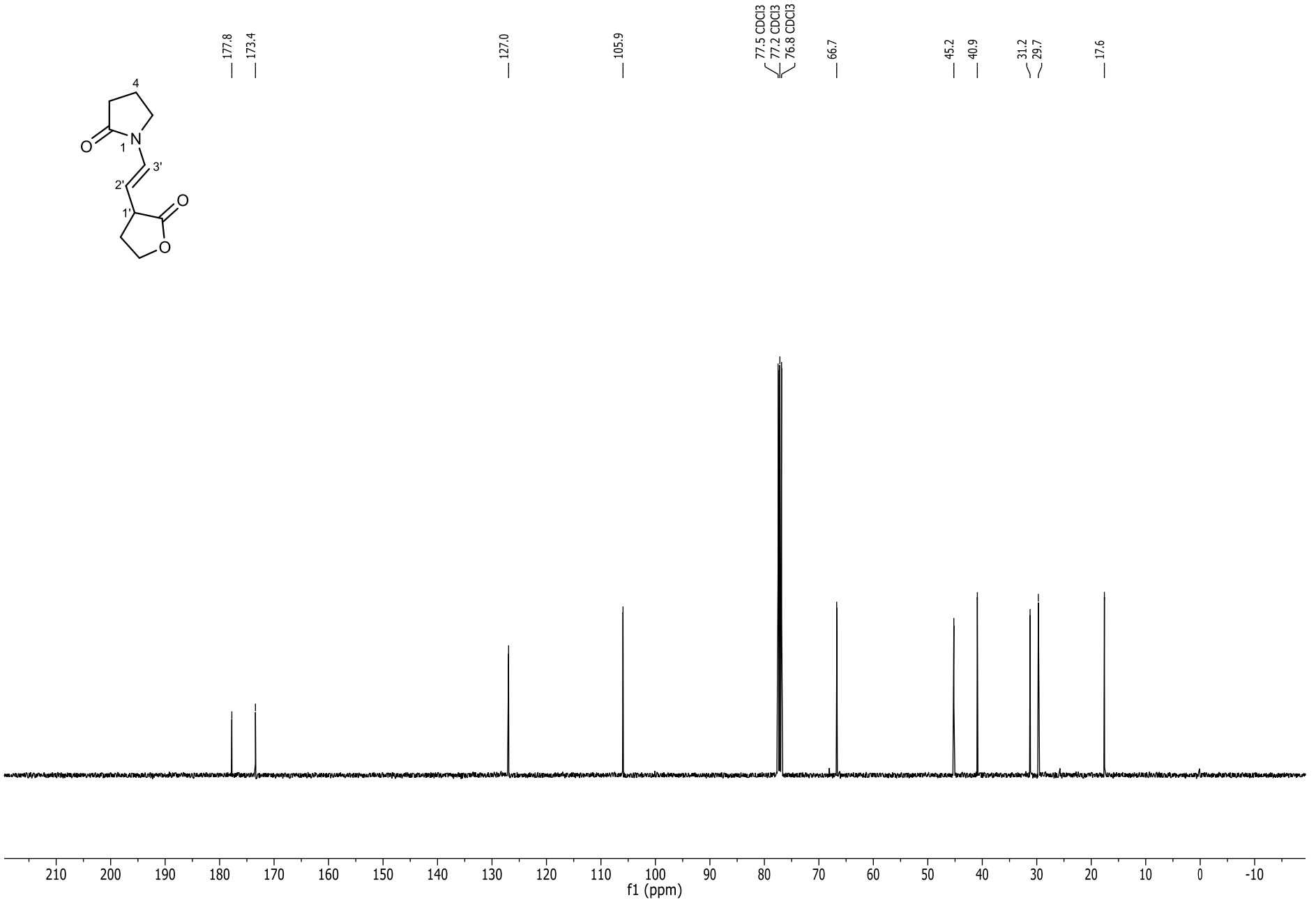
^{13}C NMR (101 MHz) Analysis of Compound 3ae.



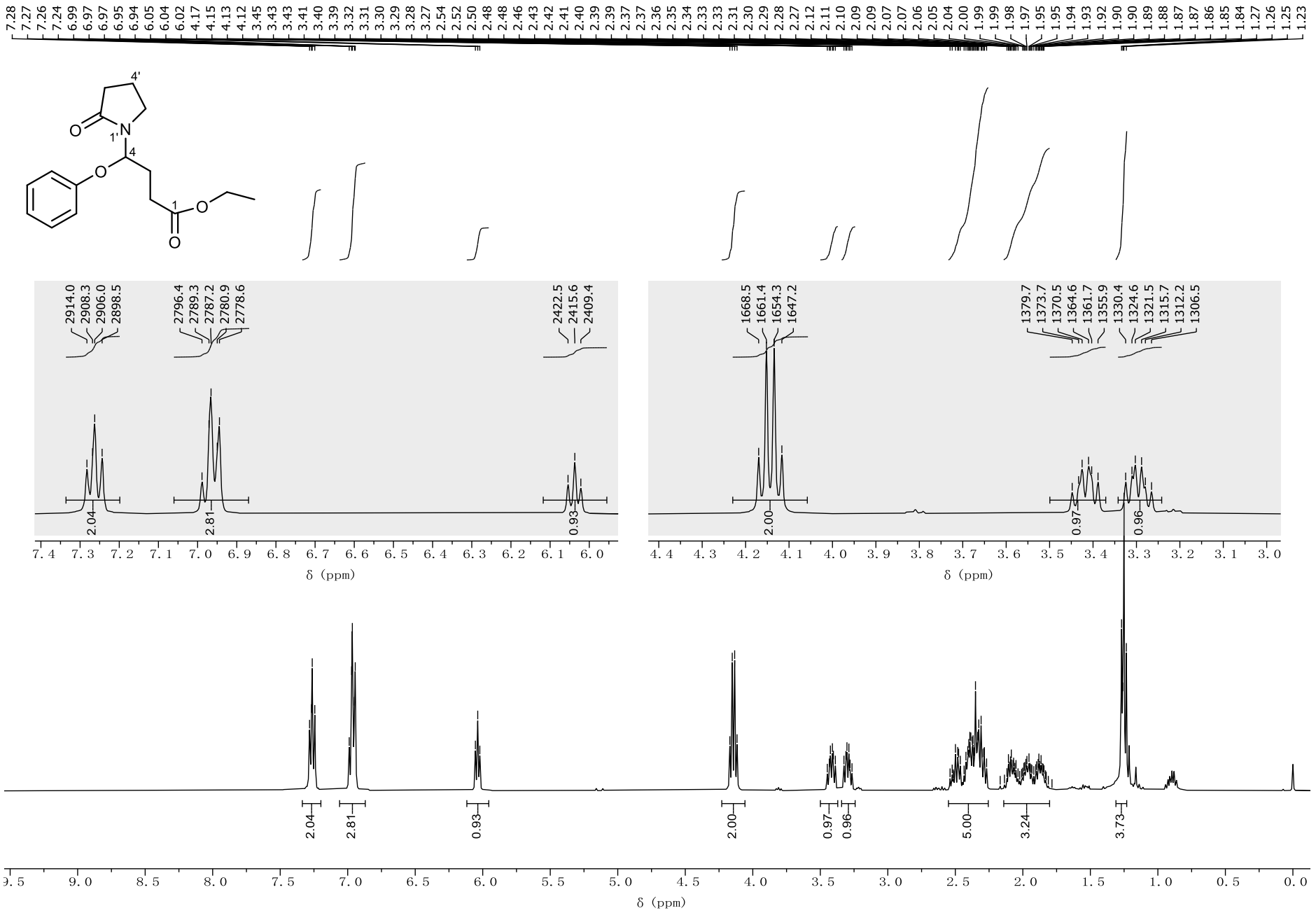
^{1}H NMR (400 MHz) Analysis of Compound 3af.



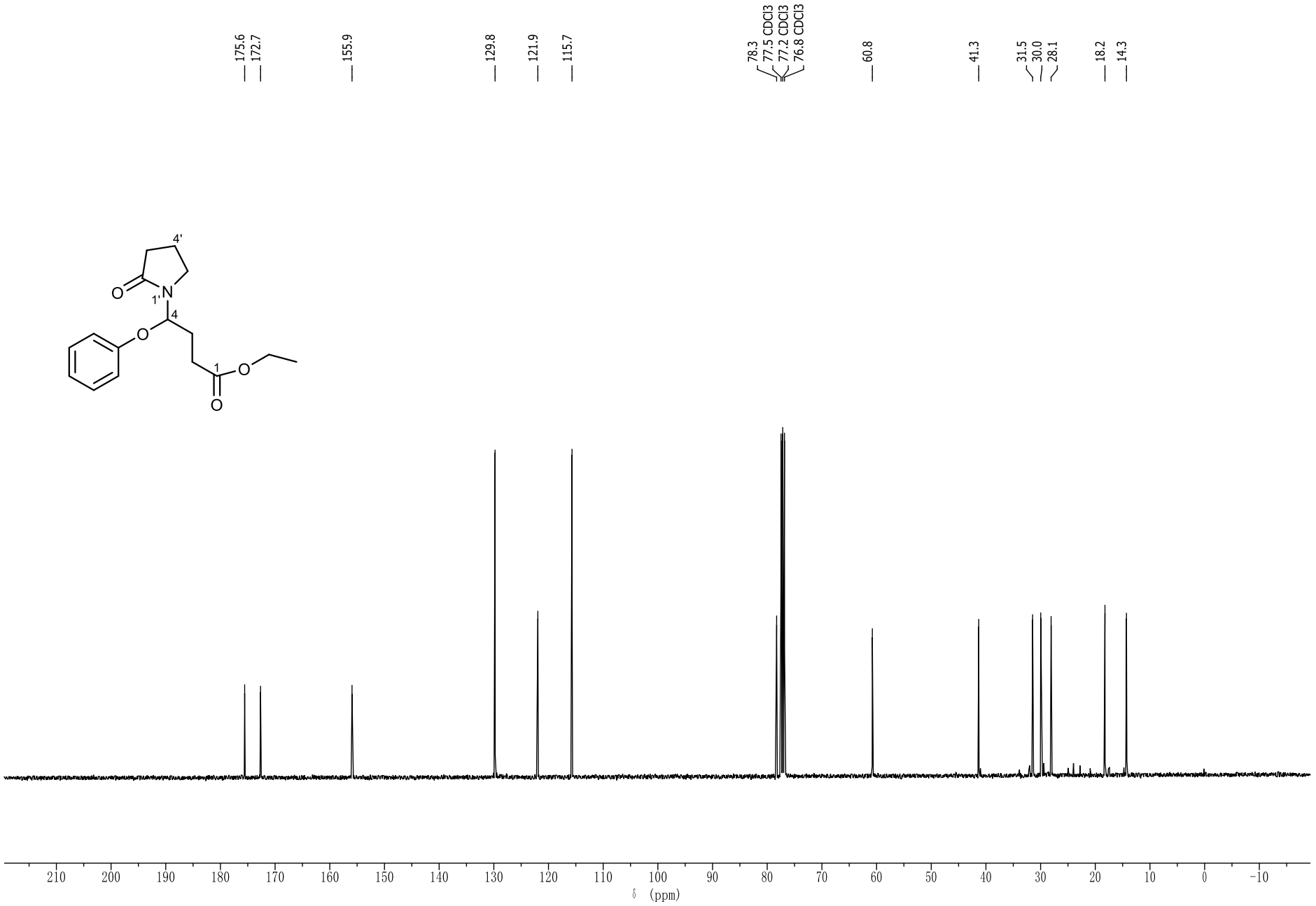
^{13}C NMR (101 MHz) Analysis of Compound 3af.



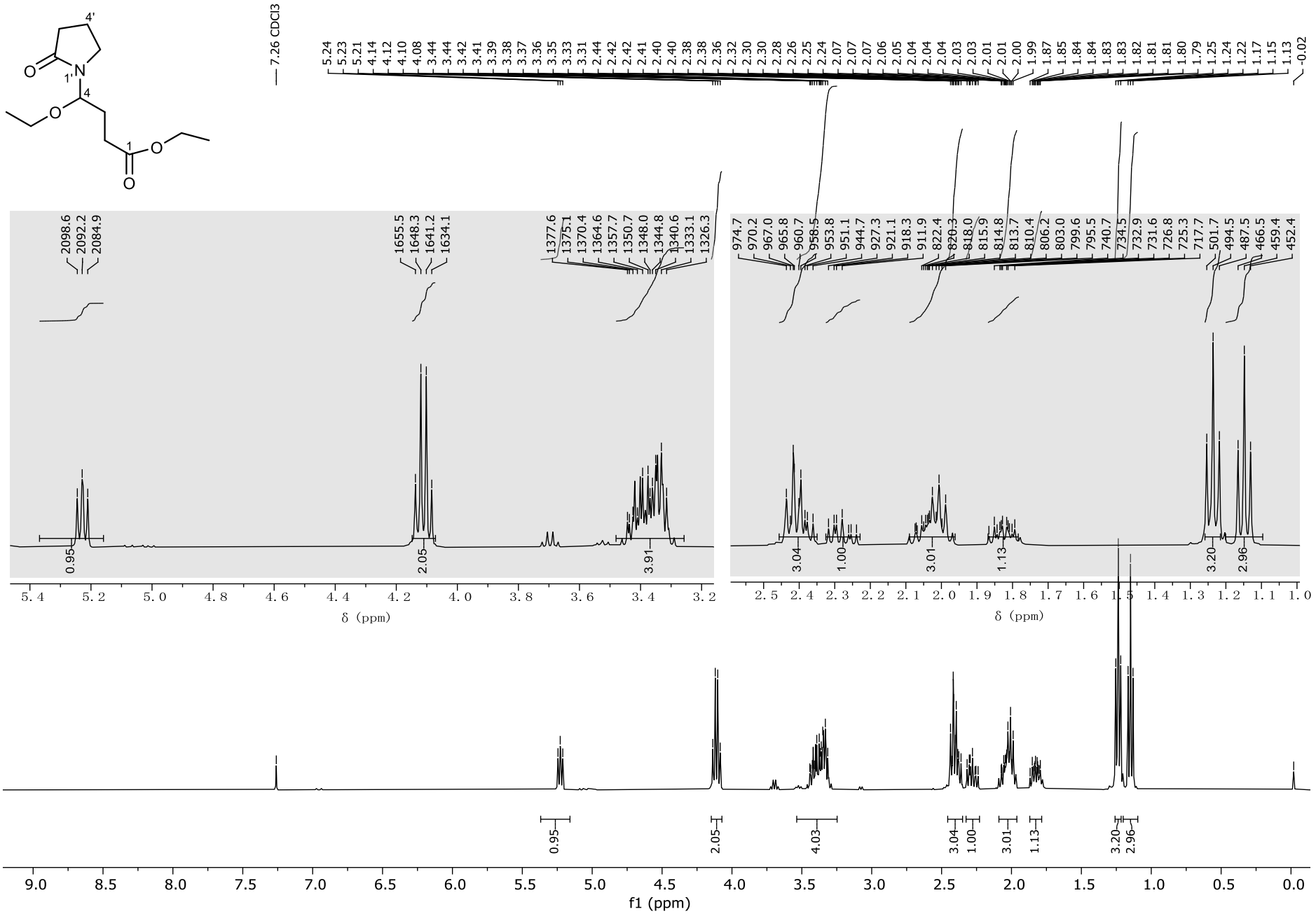
^{1}H NMR (400 MHz) Analysis of Compound 5a.



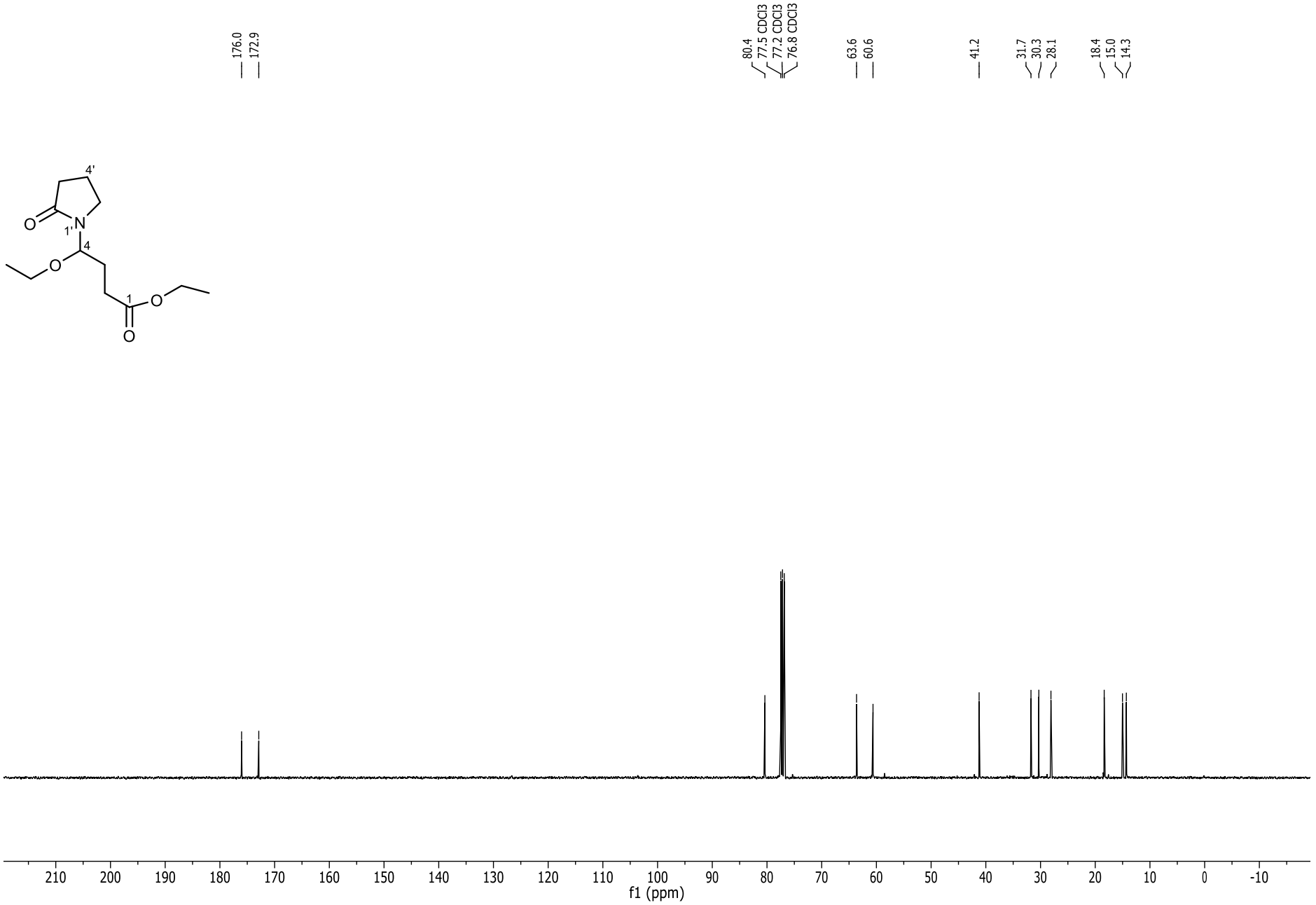
^{13}C NMR (101 MHz) Analysis of Compound 5a.



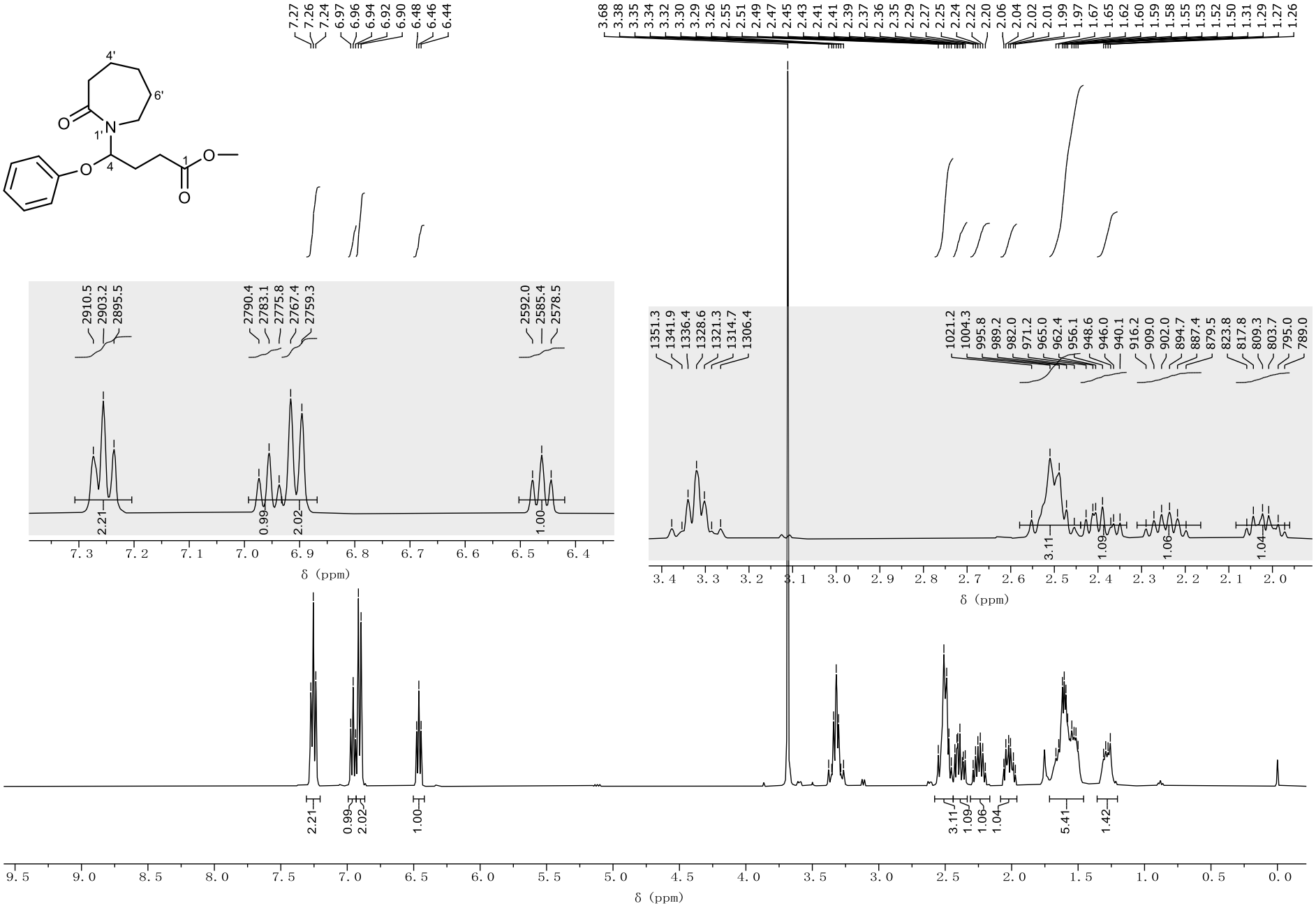
^{1}H NMR (400 MHz) Analysis of Compound 5b.



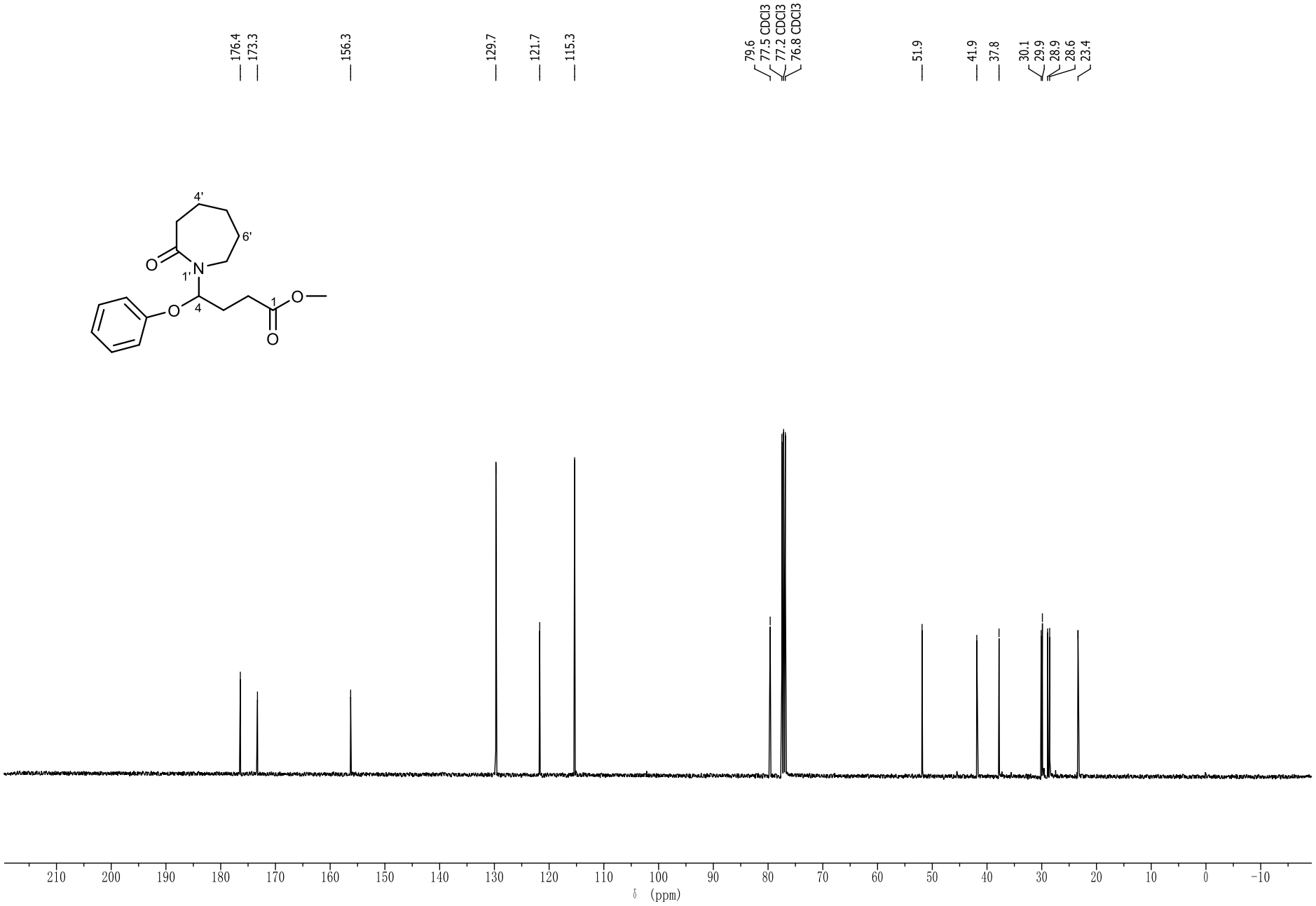
^{13}C NMR (101 MHz) Analysis of Compound 5b.



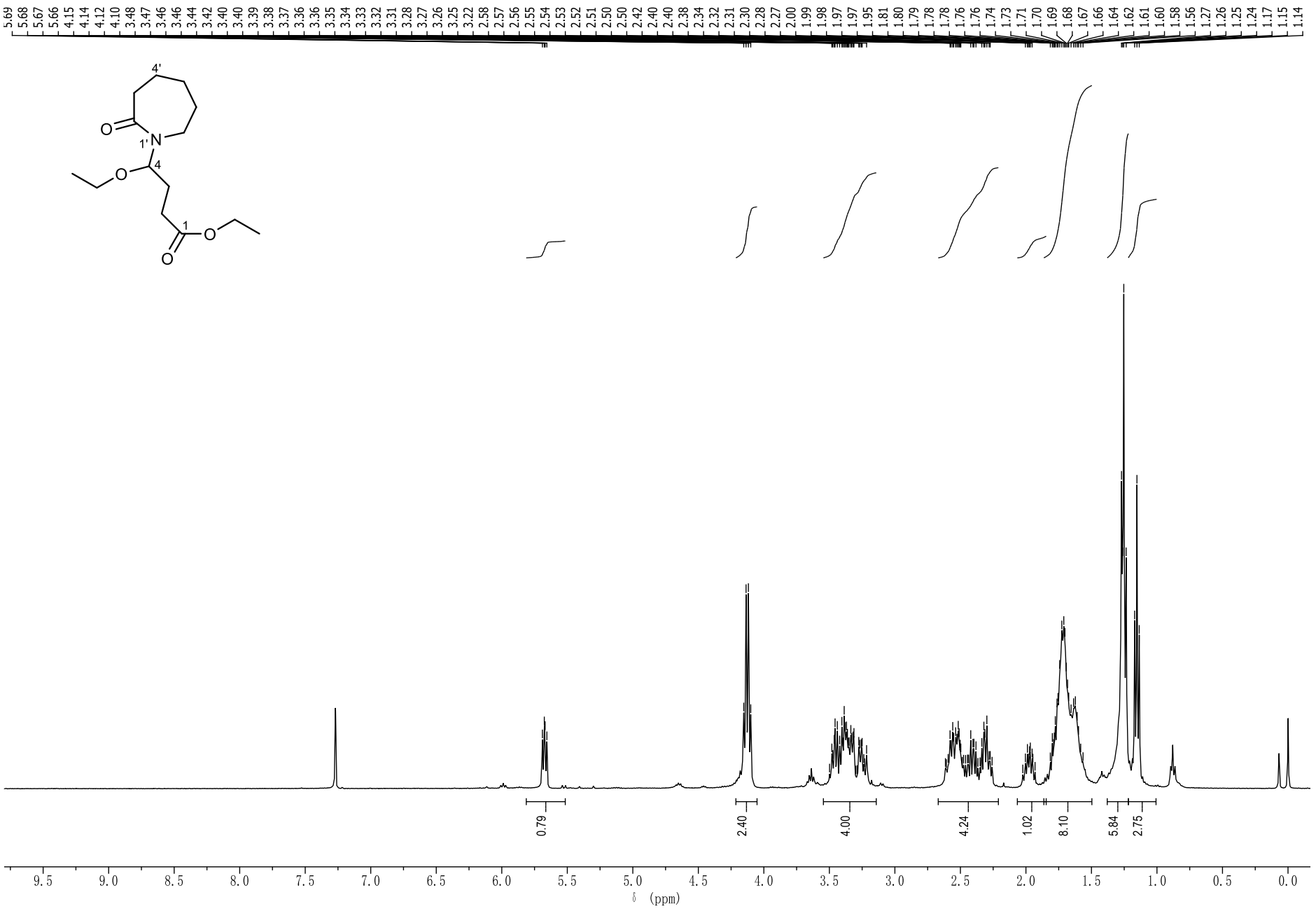
^{1}H NMR (400 MHz) Analysis of Compound 5c.



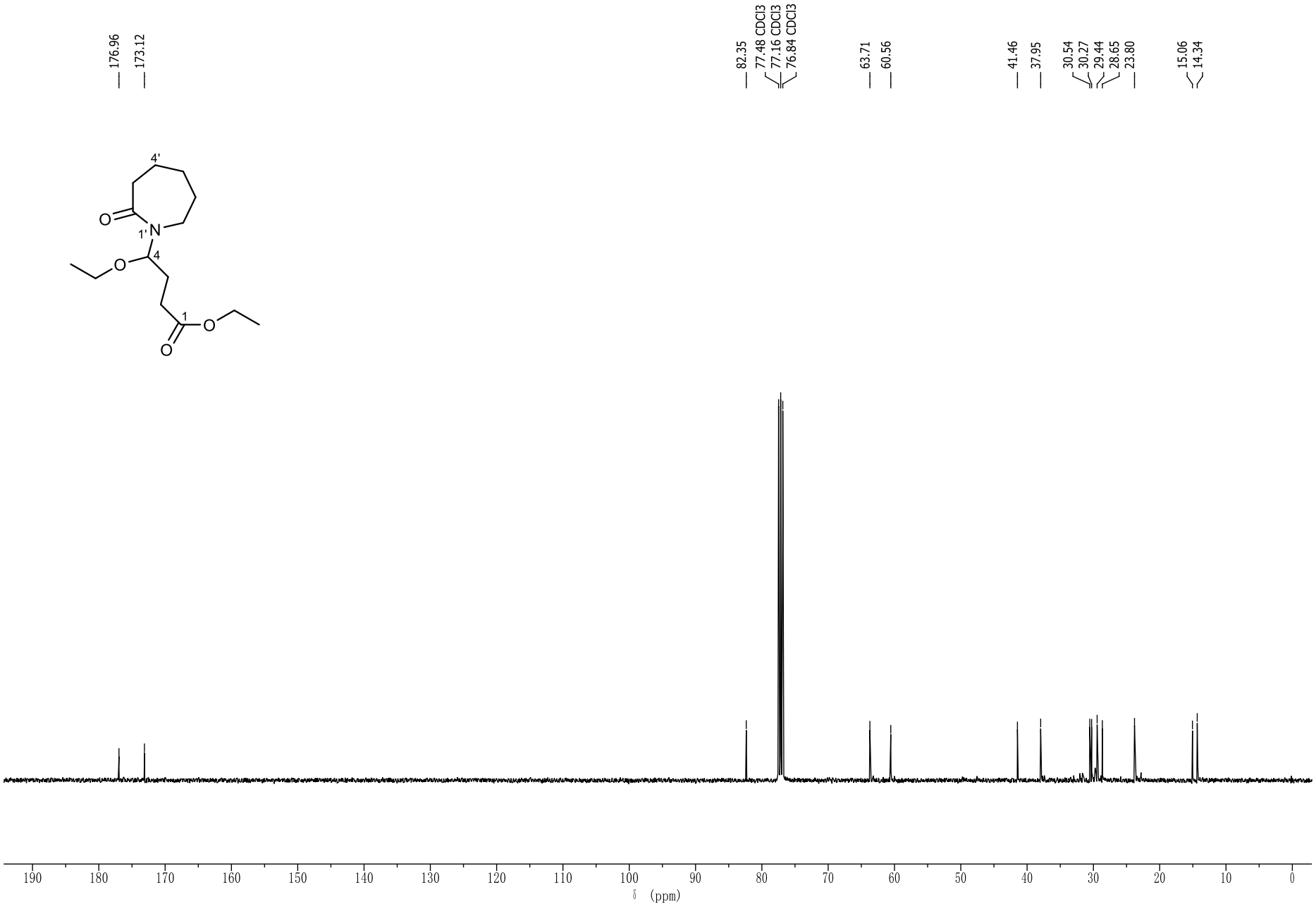
^{13}C NMR (101 MHz) Analysis of Compound 5c.



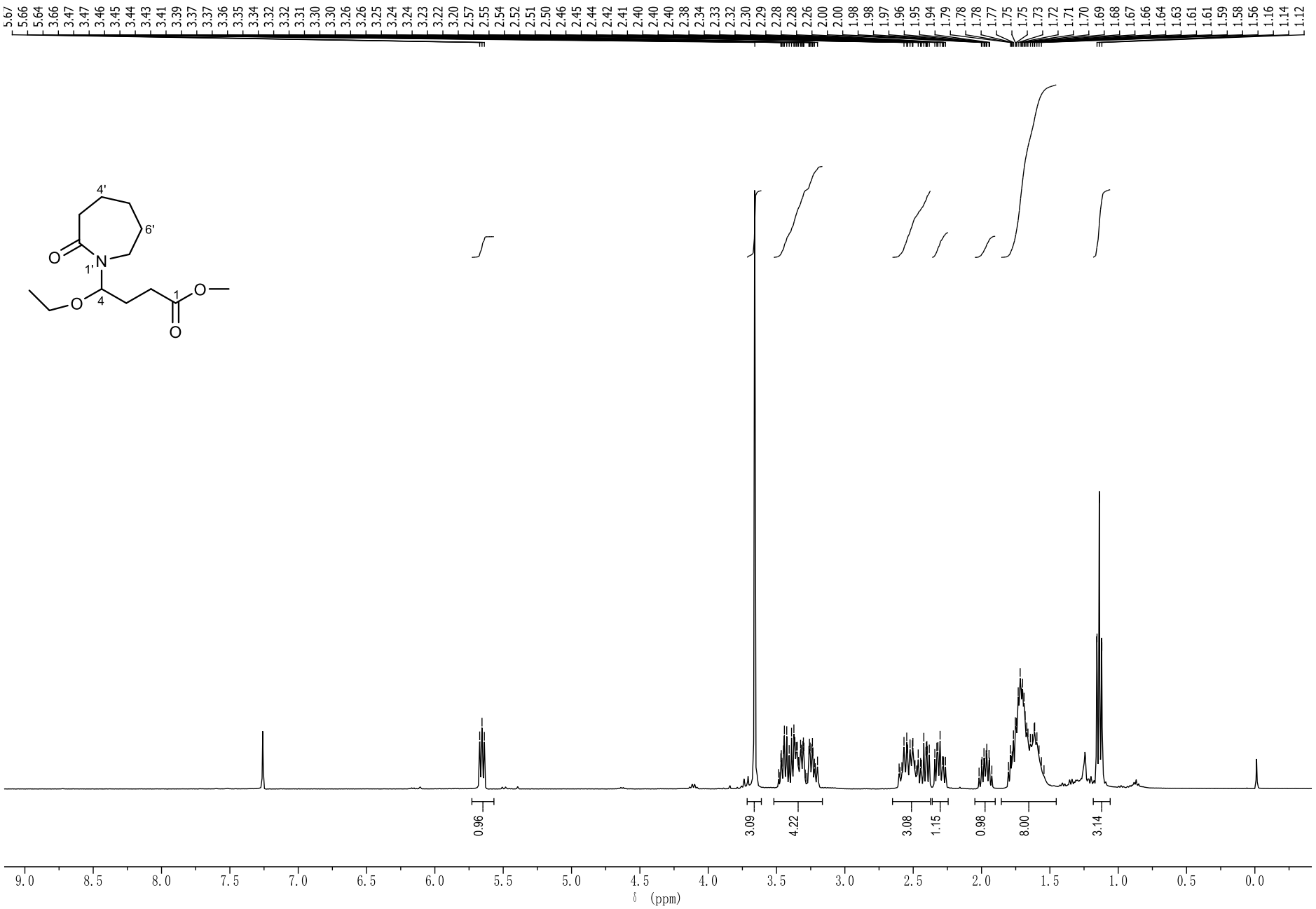
^{1}H NMR (400 MHz) Analysis of Compound 5d.



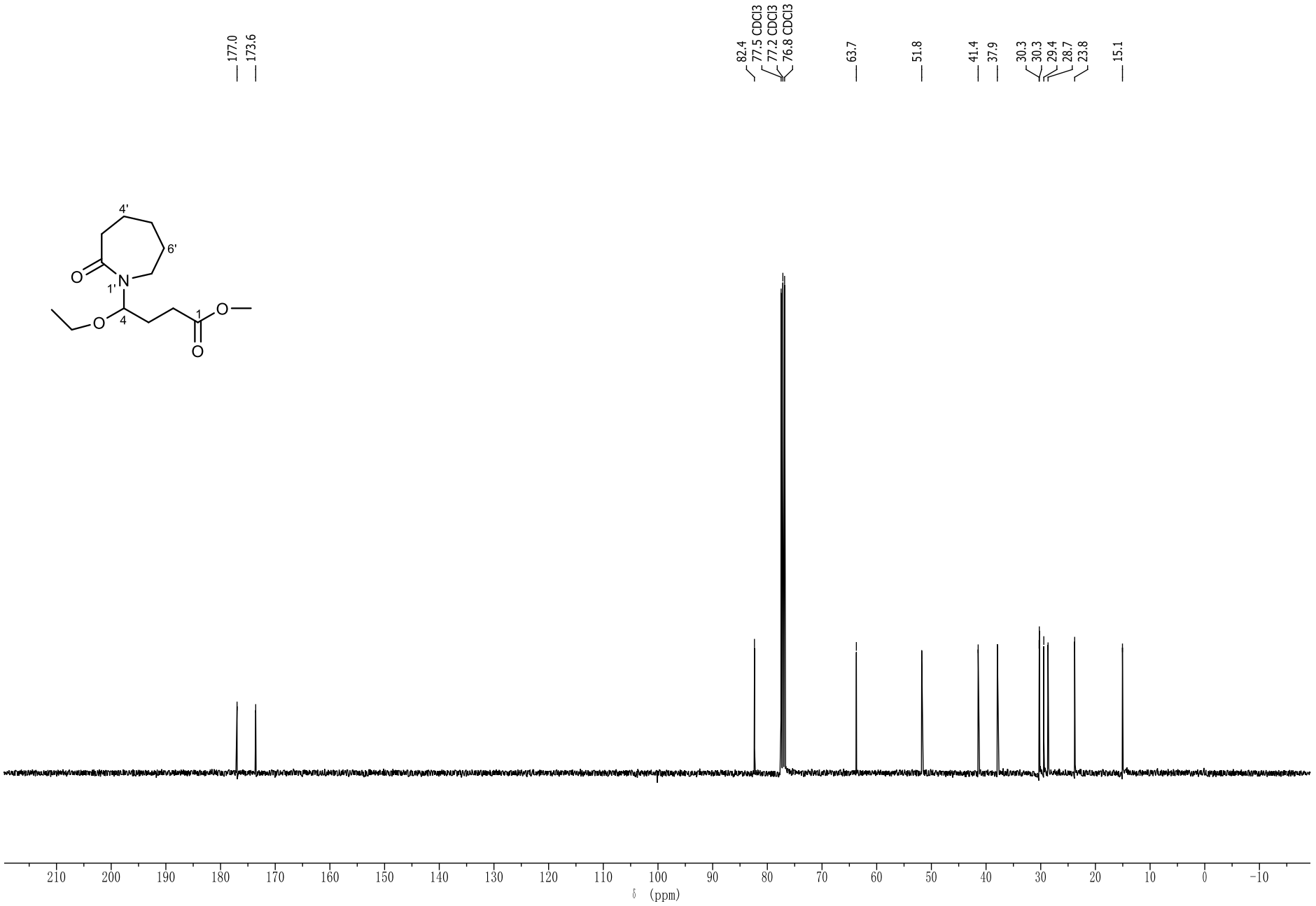
^{13}C NMR (101 MHz) Analysis of Compound 5d.



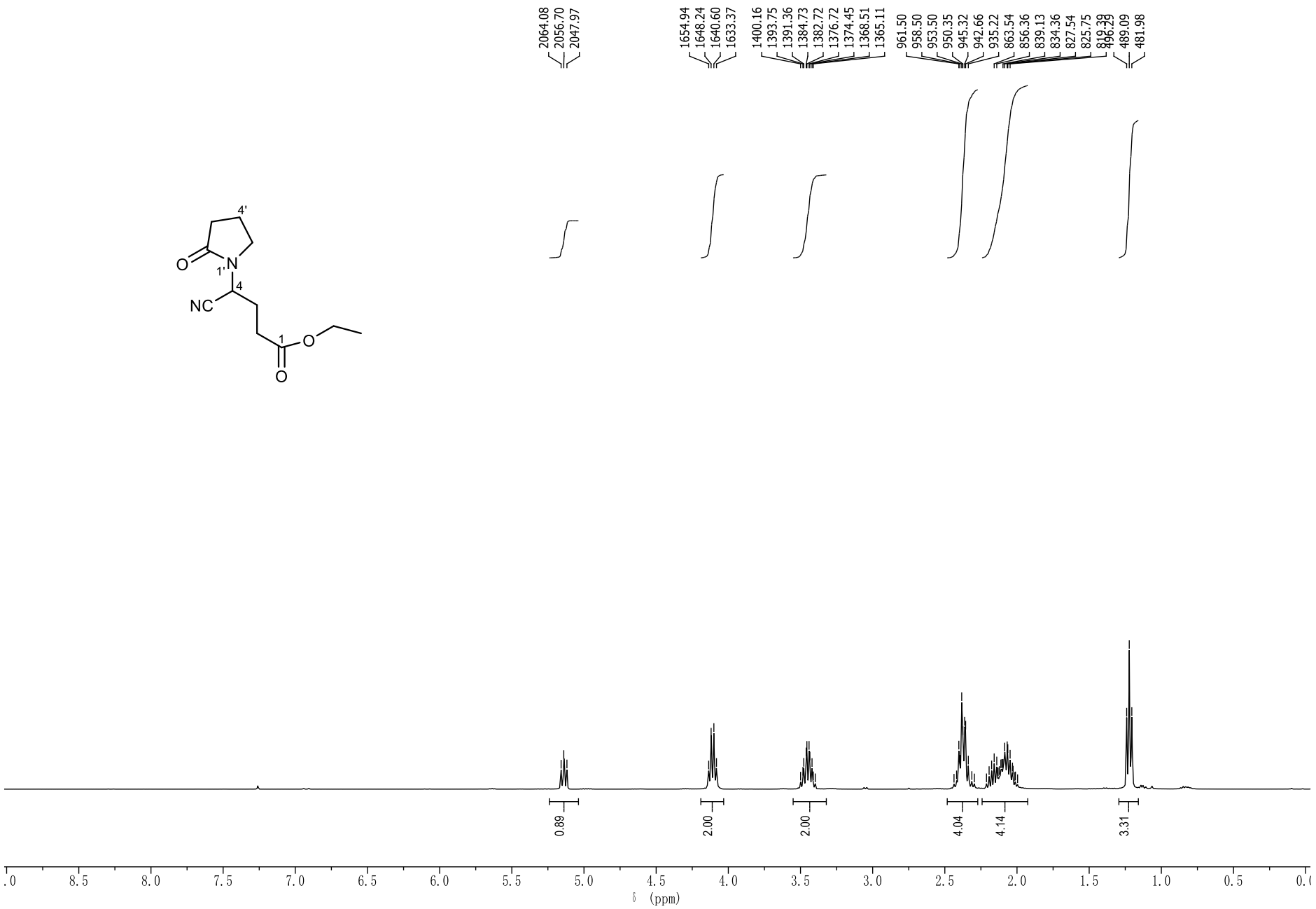
^{1}H NMR (400 MHz) Analysis of Compound 5e.



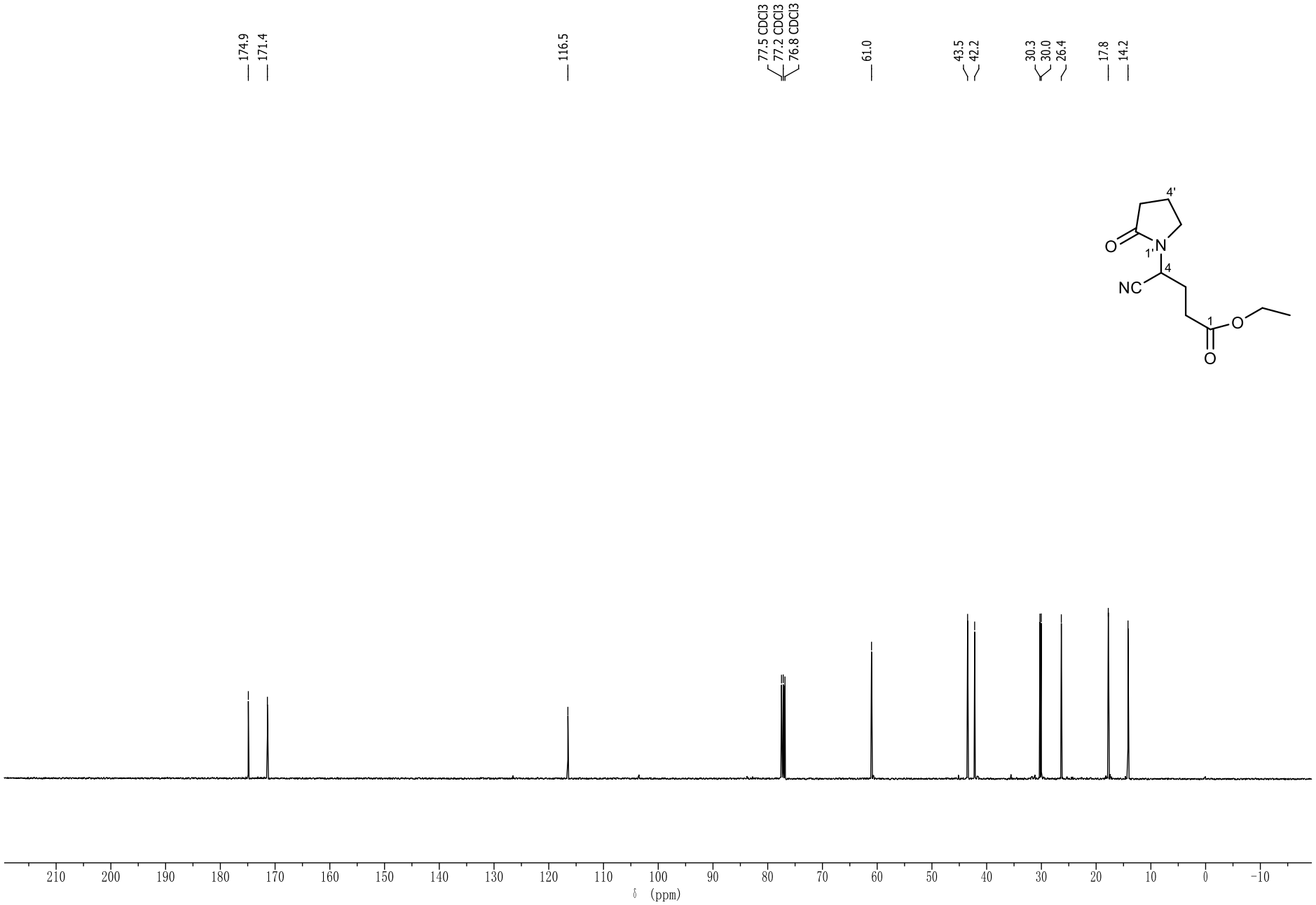
^{13}C NMR (101 MHz) Analysis of Compound 5e.



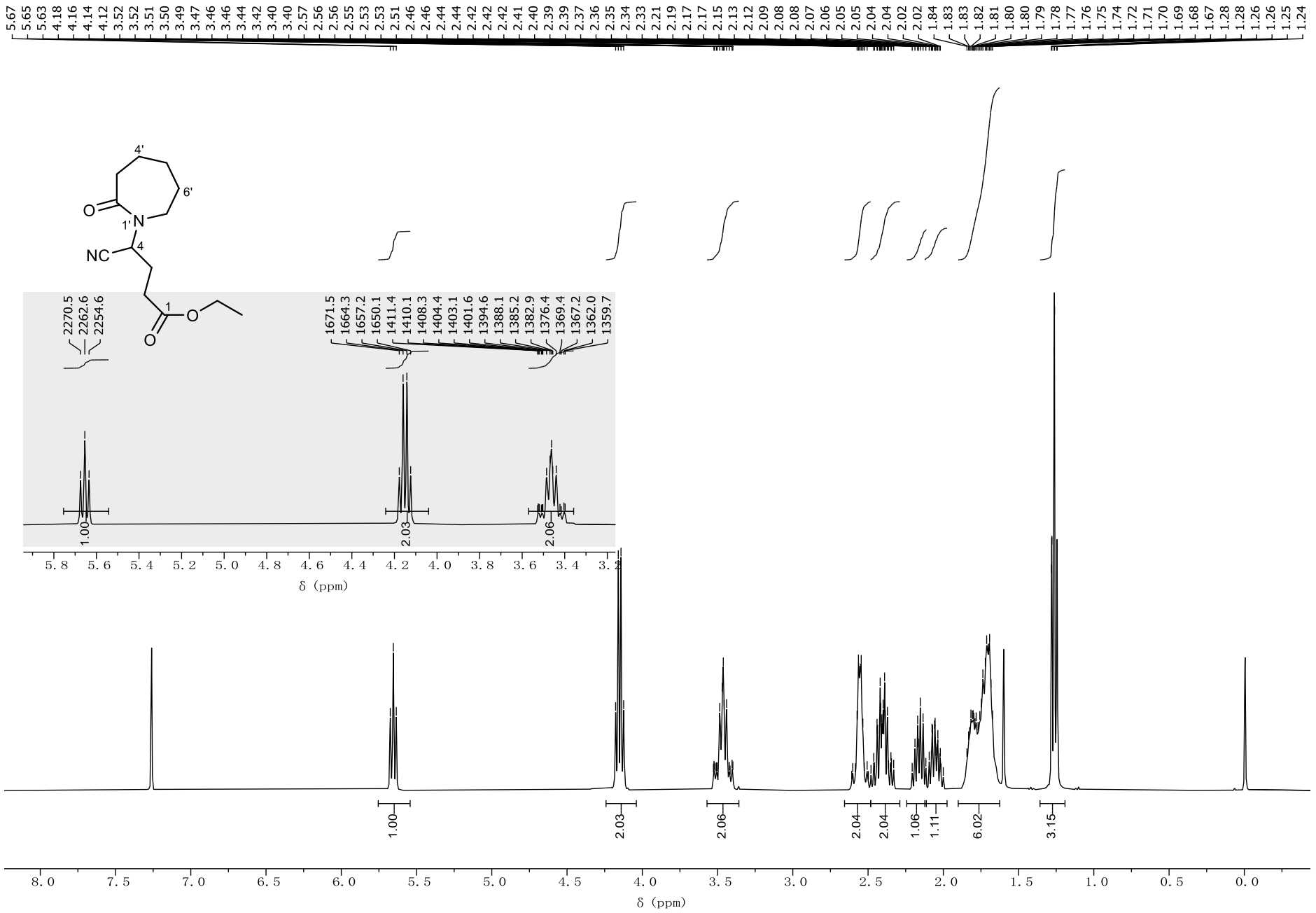
^{1}H NMR (400 MHz) Analysis of Compound 5f.



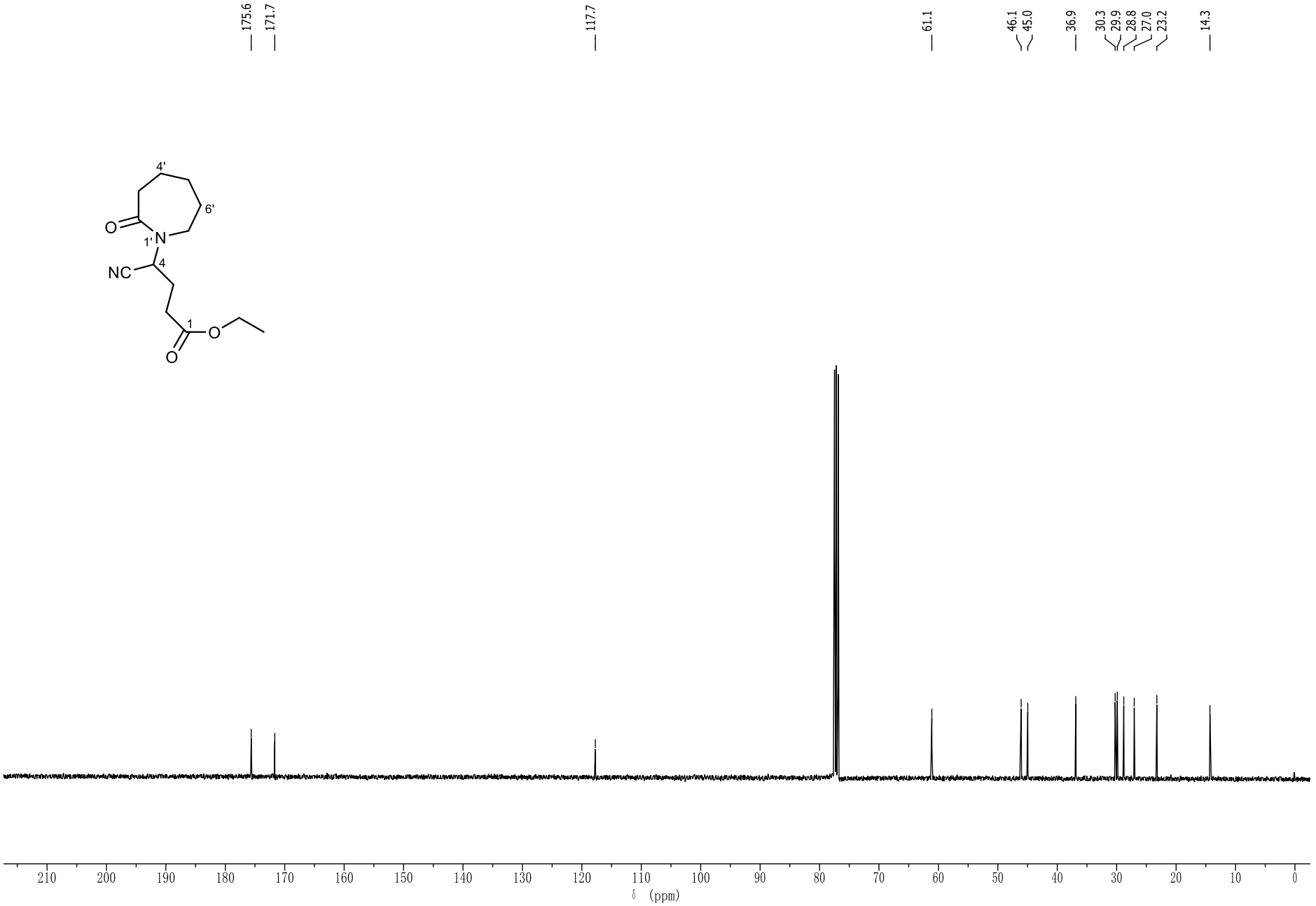
^{13}C NMR (101 MHz) Analysis of Compound 5f.



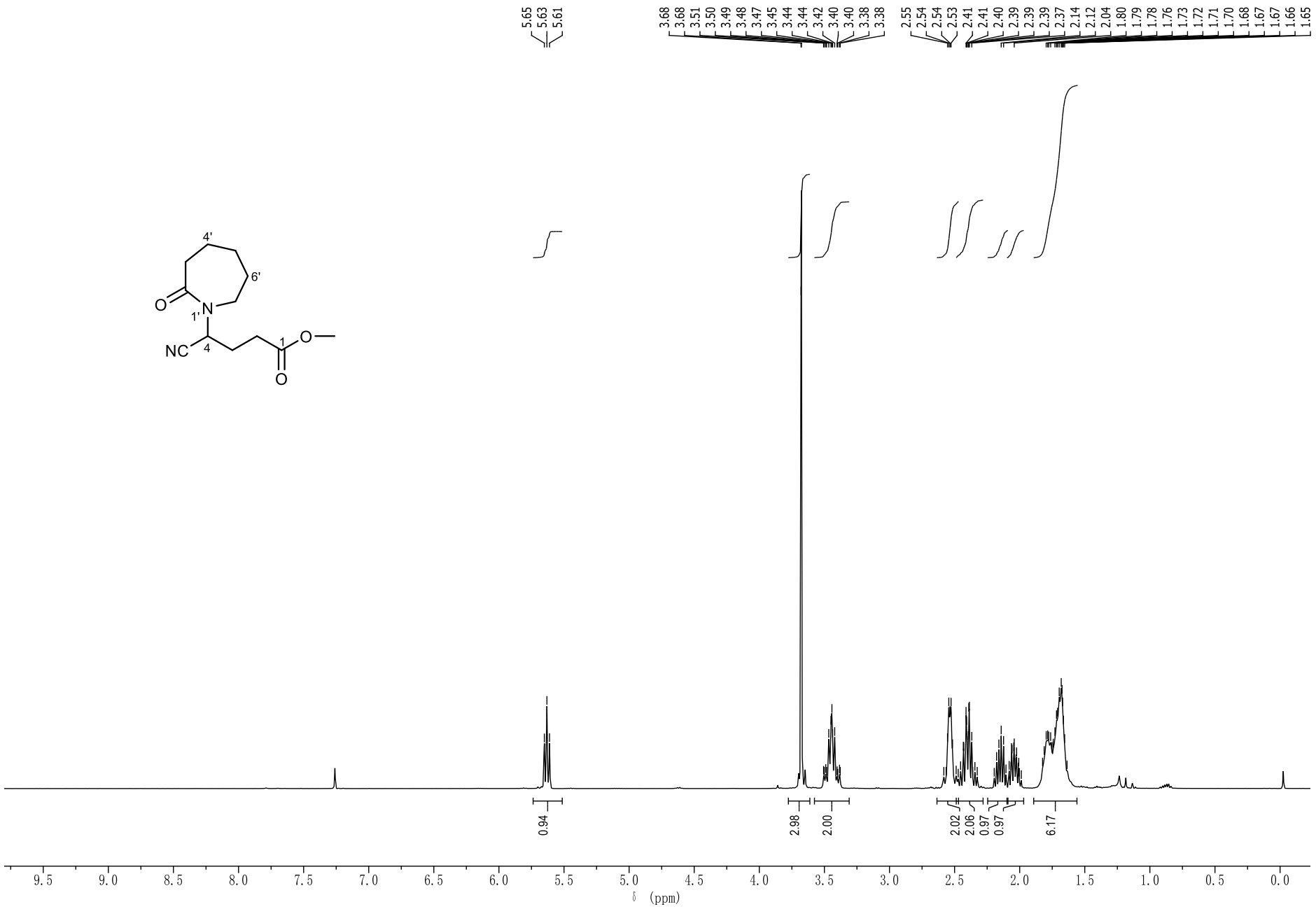
^{1}H NMR (400 MHz) Analysis of Compound 5g.



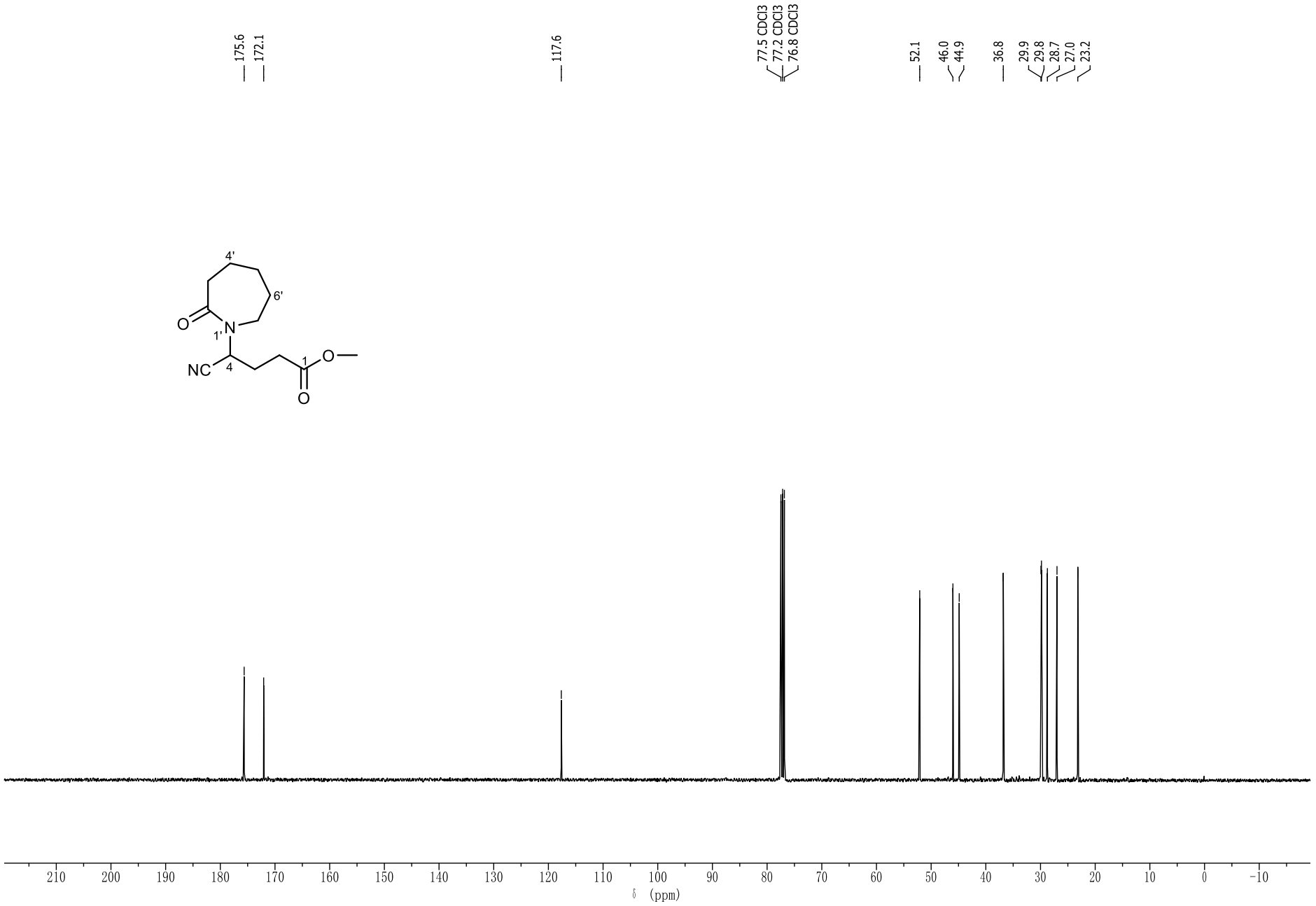
^{13}C NMR (101 MHz) Analysis of Compound 5g.



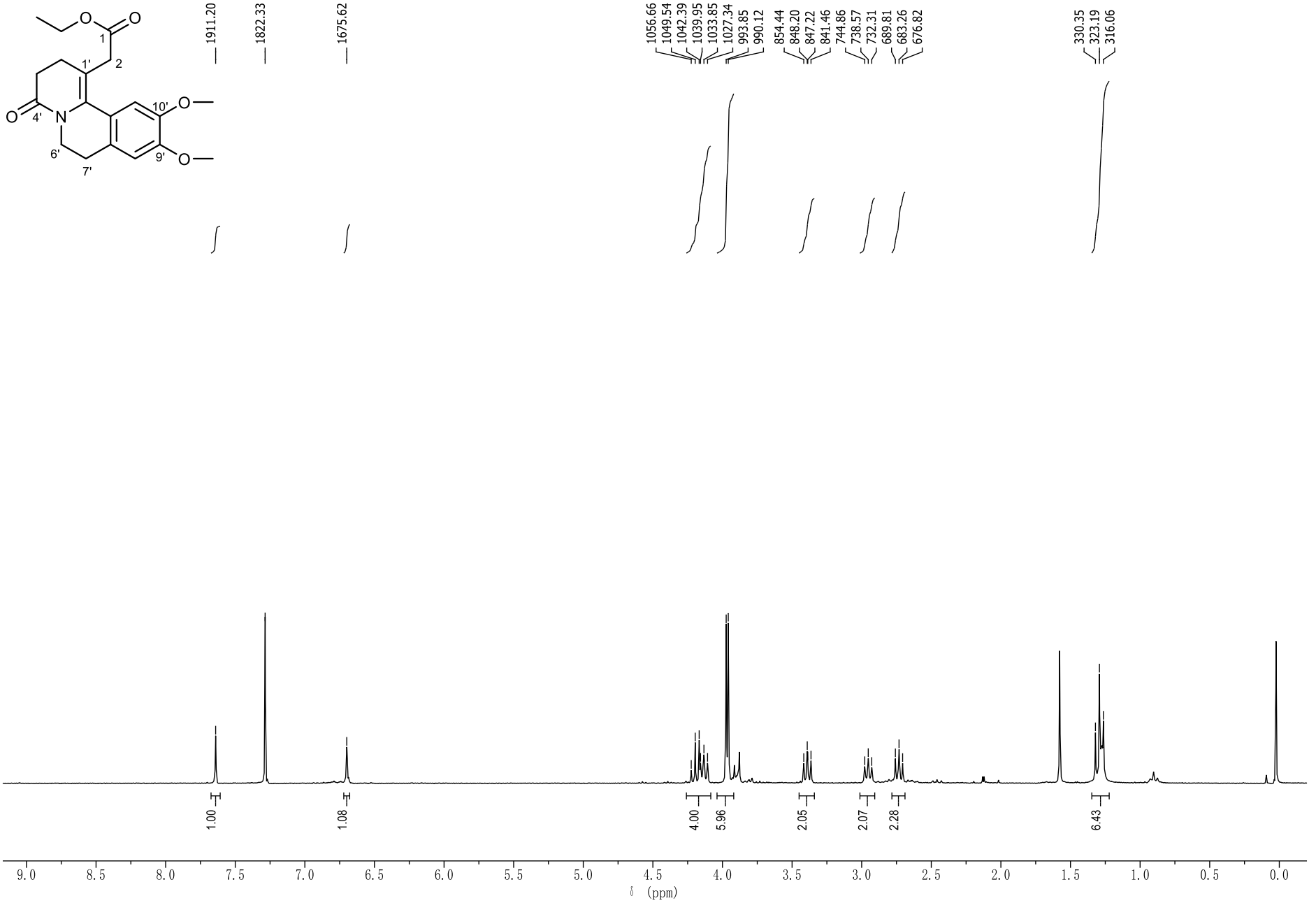
^{1}H NMR (400 MHz) Analysis of Compound 5h.



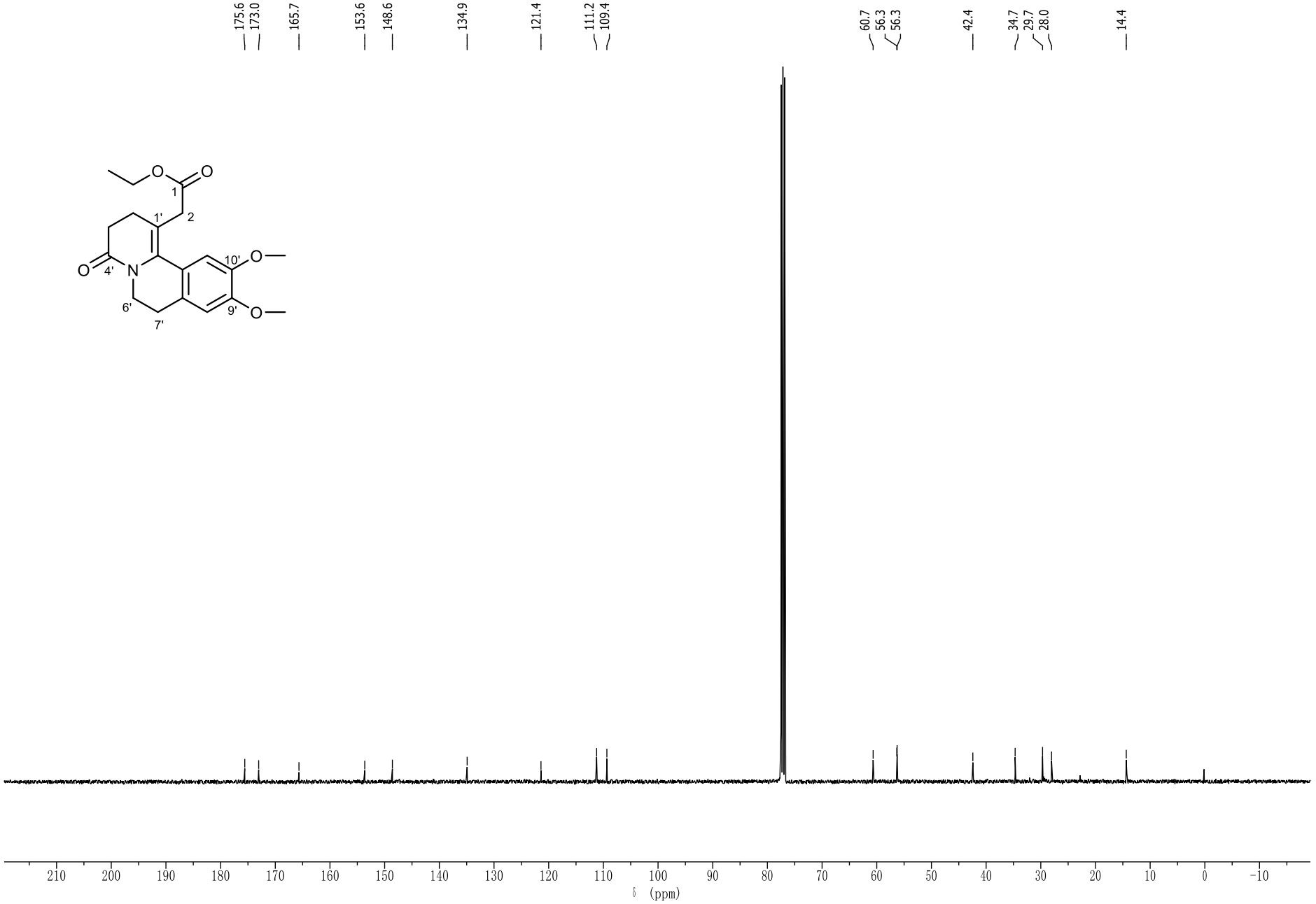
^{13}C NMR (101 MHz) Analysis of Compound 5h.



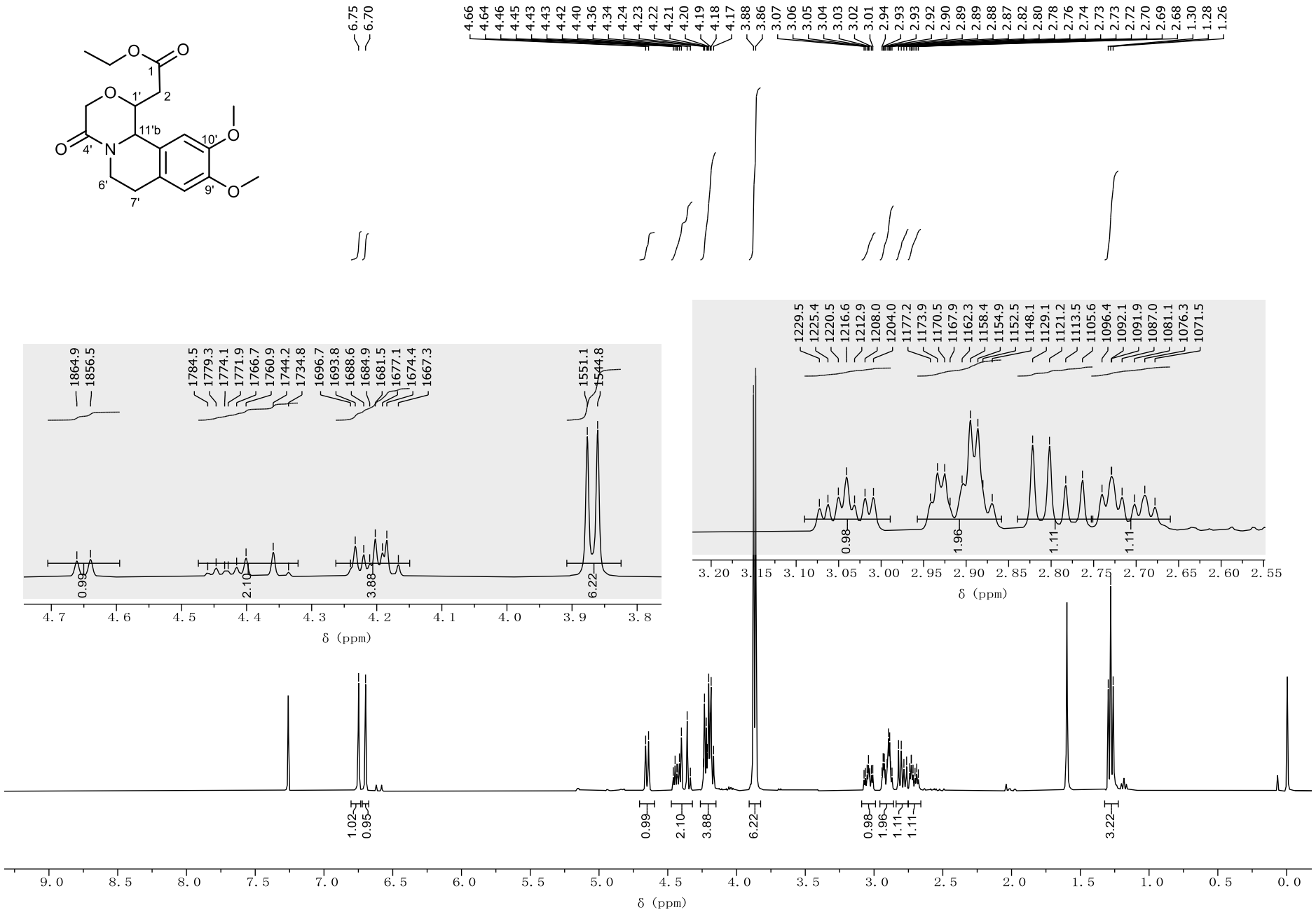
^{1}H NMR (400 MHz) Analysis of Compound 5i.



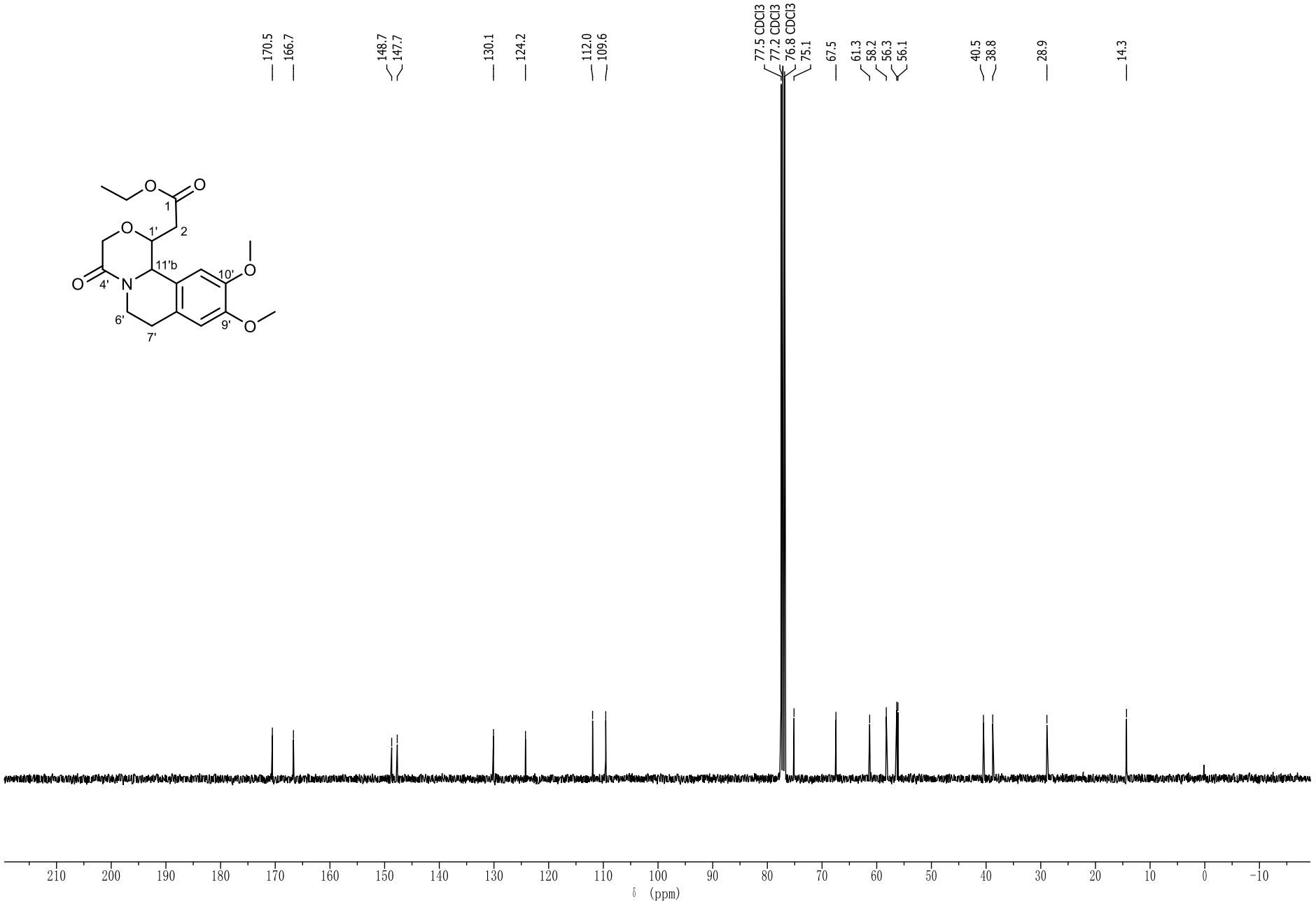
^{13}C NMR (101 MHz) Analysis of Compound 5i.



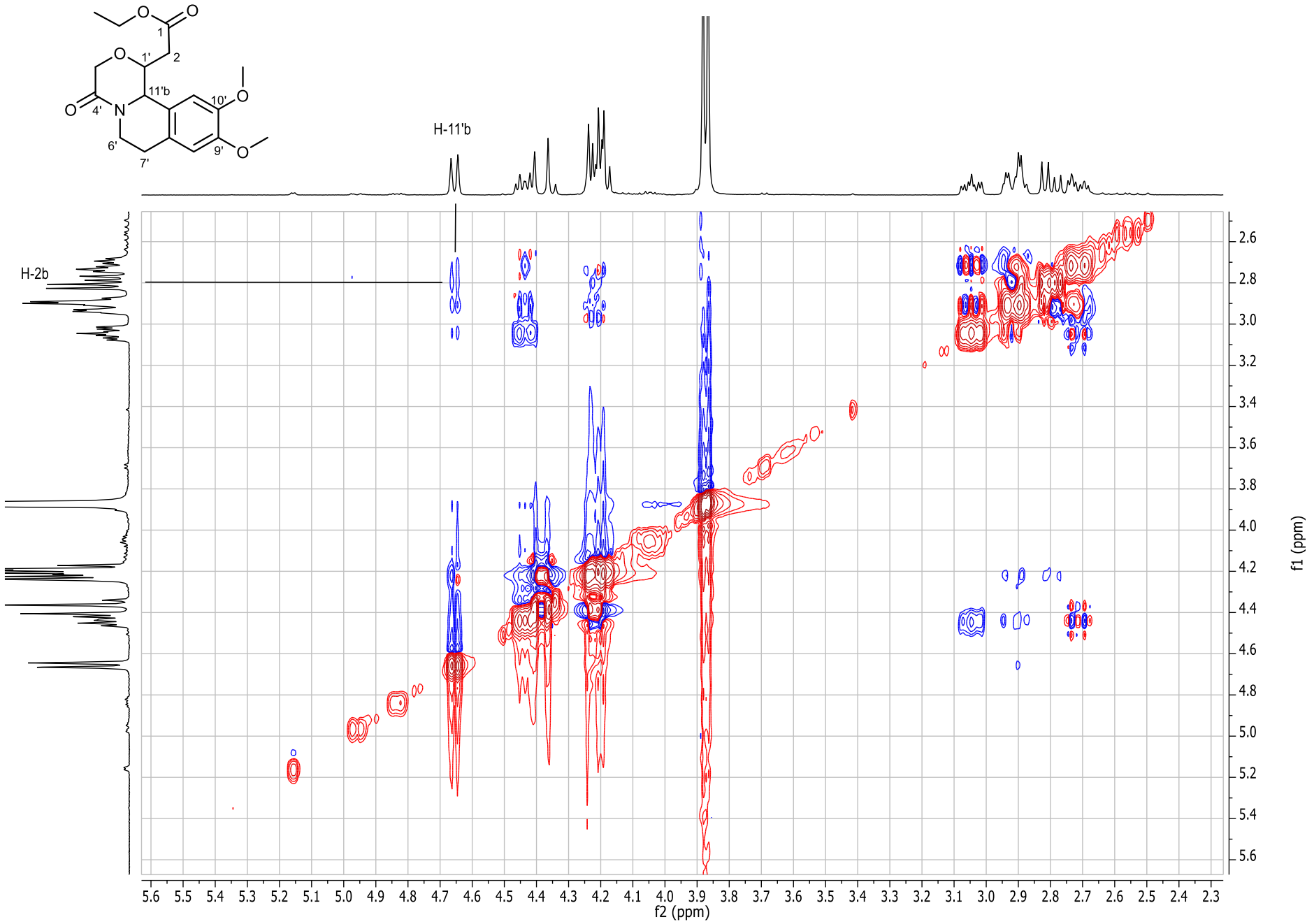
^{1}H NMR (400 MHz) Analysis of Compound *trans*-5j.



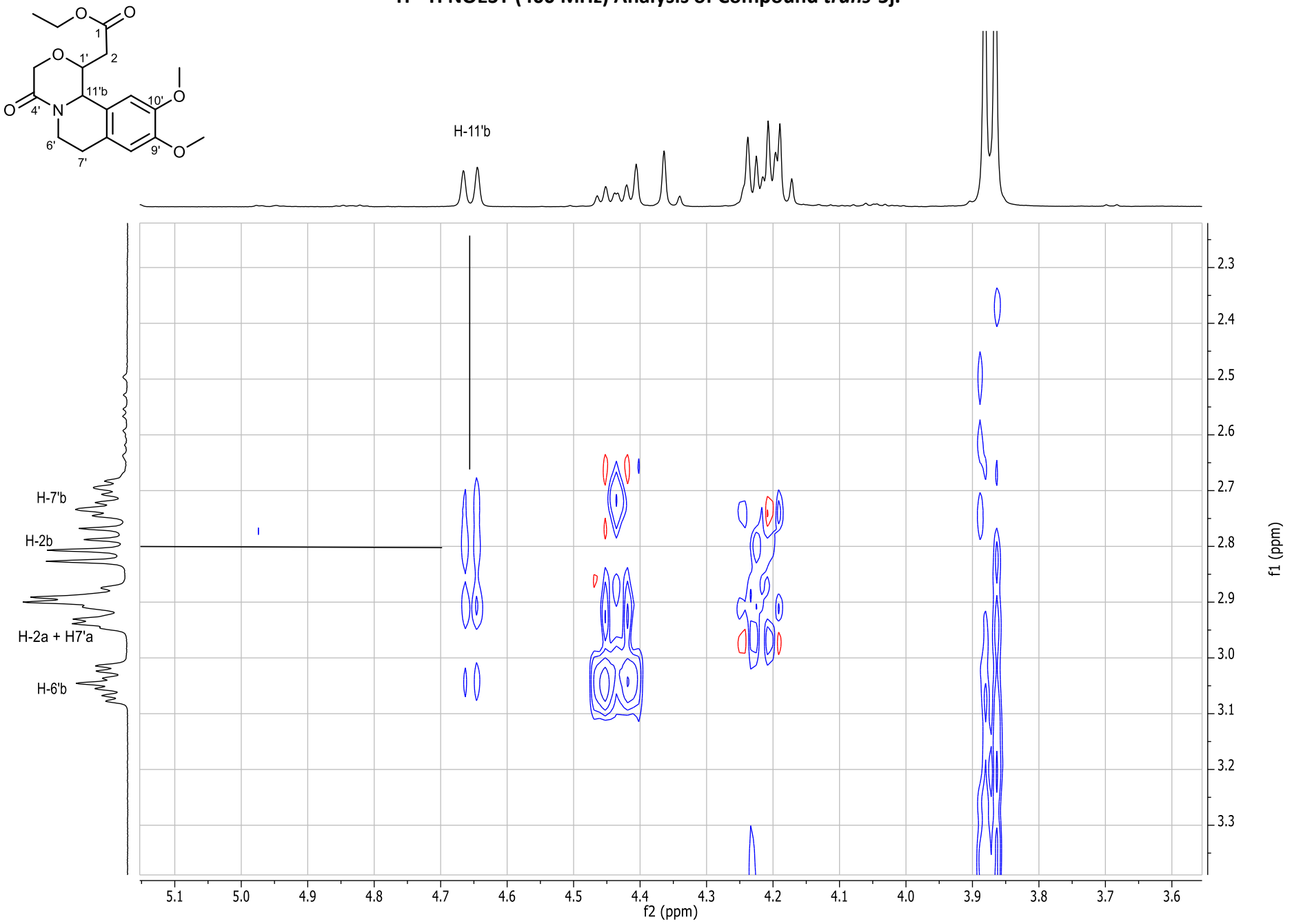
^{13}C NMR (101 MHz) Analysis of Compound *trans*-5j.



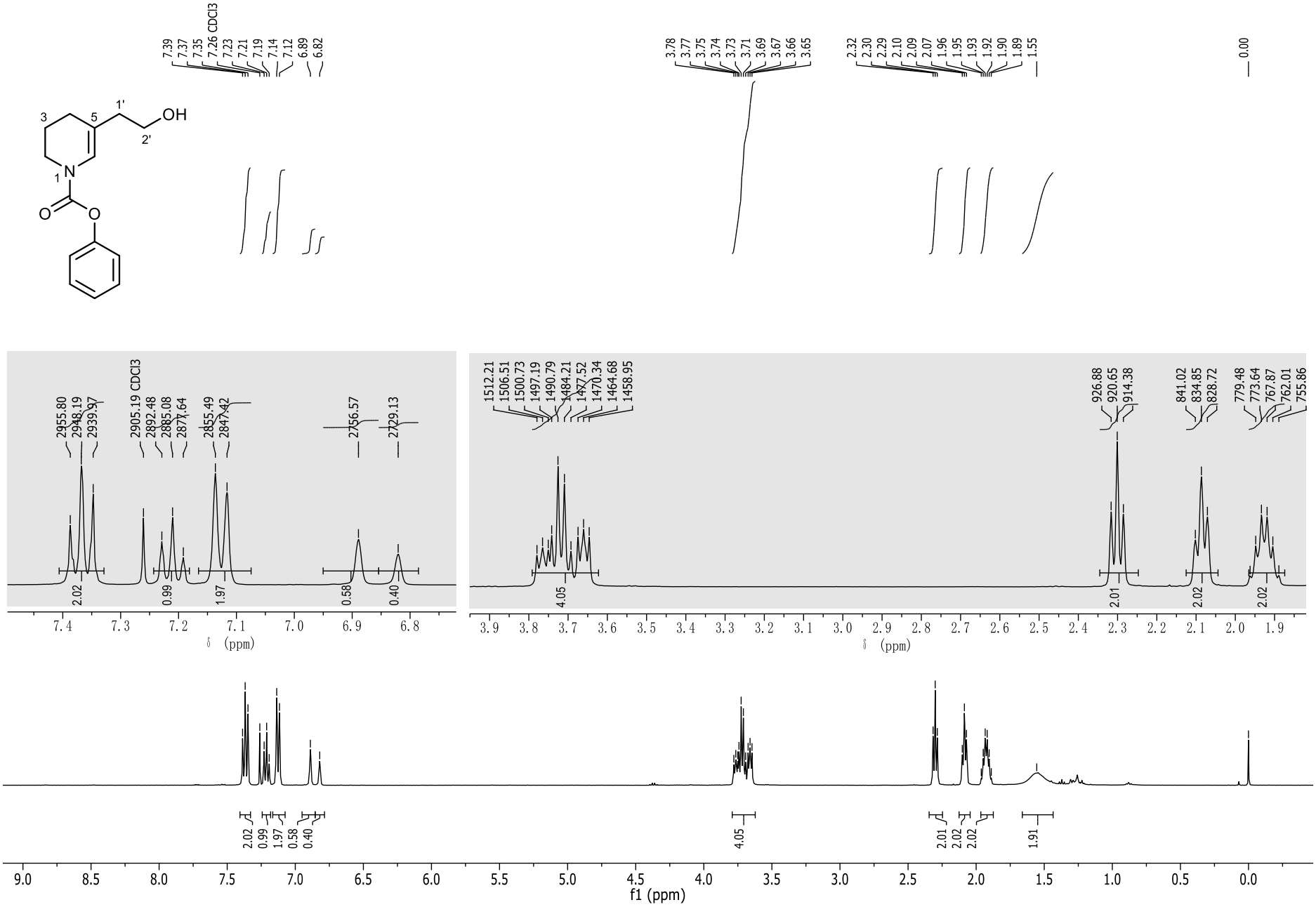
^{1}H–^{1}H NOESY (400 MHz) Analysis of Compound *trans*-5j.



^{1}H–^{1}H NOESY (400 MHz) Analysis of Compound *trans*-5j.



^{1}H NMR (400 MHz) Analysis of Compound 6.



^{13}C NMR (101 MHz) Analysis of Compound 6.