Supplementary Material (ESI) for Organic & Biomolecular Chemistry

Evaluation of the pharmacophoric motif of the Caged *Garcinia* Xanthones

Oraphin Chantarasriwong,[a,b] Woo Cheal Cho,[a] Ayse Batova,[c*] Warinthorn Chavasiri,[b] Curtis Moore,[a] Arnold L. Rheingold[a] and Emmanuel A. Theodorakis[a*]

Supplementary Information

Table 1. Crystal data and structure refinement for Compound 7.

Identification code	CCDC-737621	
Empirical formula	C23 H24 O4	
Formula weight	364.42	
Temperature	100(2) K	
Wavelength	1.54178 Å	
Crystal system	Monoclinic	
Space group	P2(1)/c	
Unit cell dimensions	a = 10.2829(5) Å	α= 90°.
	b = 13.7839(7) Å	β= 109.118(2)°.
	c = 13.8591(8) Å	γ = 90°.
Volume	1856.02(17) $Å^3$	
Z	4	
Density (calculated)	1.304 Mg/m^3	
Absorption coefficient	0.711 mm^{-1}	
F(000)	776	
Crystal size	0.33 x 0.22 x 0.08 mm^3	
Crystal color, habit	Colorless Plate	
Theta range for data collection	4.55 to 68.30°.	
Index ranges	-12<=h<=12, -16<=k<=16, -15<=l<=16	
Reflections collected	10317	
Independent reflections	3330 [R(int) = 0.0251]	
Completeness to theta = 65.00°	98.4 %	
Absorption correction	Semi-empirical from equivalents	
Max. and min. transmission	0.914 and 0.789	
Refinement method	Full-matrix least-squares on F^2	
Data / restraints / parameters	3330 / 0 / 249	
Goodness-of-fit on F^2	1.087	
Final R indices [I>2sigma(I)]	R1 = 0.0380, wR2 = 0.1066	
R indices (all data)	R1 = 0.0414, wR2 = 0.1092	
Extinction coefficient	0.0019(3)	
Largest diff. peak and hole	0.314 and -0.219 $e.Å^{-3}$	

Table 2. Crystal data and structure refinement for Compound 15.

Identification code	CCDC-737622	
Empirical formula	C20 H26 O5	
Formula weight	346.41	
Temperature	100(2) K	
Wavelength	1.54178 Å	
Crystal system	Monoclinic	
Space group	P2(1)/n	
Unit cell dimensions	a = 10.9193(4) Å	α= 90°.
	b = 12.8300(5) Å	β= 105.650(2)°.
	c = 13.3814(5) Å	γ = 90°.
Volume	1805.16(12) $Å^3$	
Z	4	
Density (calculated)	1.275 Mg/m^3	
Absorption coefficient	0.739 mm^{-1}	
F(000)	744	
Crystal size	0.30 x 0.20 x 0.08 mm^3	
Crystal color, habit	Colorless Rod	
Theta range for data collection	4.66 to 68.40°.	
Index ranges	-13<=h<=13, -15<=k<=15, -15<=l<=11	
Reflections collected	11208	
Independent reflections	3199 [R(int) = 0.0345]	
Completeness to theta = 60.00°	98.2 %	
Absorption correction	Semi-empirical from equivalents	
Max. and min. transmission	0.9432 and 0.8087	
Refinement method	Full-matrix least-squares on F^2	
Data / restraints / parameters	3199 / 0 / 233	
Goodness-of-fit on F^2	1.003	
Final R indices [I>2sigma(I)]	R1 = 0.0343, wR2 = 0.0864	
R indices (all data)	R1 = 0.0422, wR2 = 0.0916	
Extinction coefficient	0.00144(19)	
Largest diff. peak and hole	0.267 and -0.173 $e.Å^{-3}$	

Table 3. Crystal data and structure refinement for Compound 16.

Identification code	CCDC-737623	
Empirical formula	C20 H26 O5	
Formula weight	346.41	
Temperature	100(2) K	
Wavelength	1.54178 Å	
Crystal system	Monoclinic	
Space group	P2(1)/n	
Unit cell dimensions	a = 8.0045(2) Å	α= 90°.
	b = 13.2751(4) Å	β= 92.4170(10)°.
	c = 16.4708(5) Å	γ = 90°.
Volume	1748.64(9) $Å^3$	
Z	4	
Density (calculated)	1.316 Mg/m^3	
Absorption coefficient	0.763 mm^{-1}	
F(000)	744	
Crystal size	0.33 x 0.30 x 0.27 mm^3	
Crystal color, habit	Colorless Block	
Theta range for data collection	4.28 to 68.15°.	
Index ranges	-9<=h<=9, -15<=k<=15, -19<=l<=15	
Reflections collected	13879	
Independent reflections	3087 [R(int) = 0.0209]	
Completeness to theta = 60.00°	97.3 %	
Absorption correction	Semi-empirical from equivalents	
Max. and min. transmission	0.919 and 0.791	
Refinement method	Full-matrix least-squares on F^2	
Data / restraints / parameters	3087 / 0 / 233	
Goodness-of-fit on F^2	1.043	
Final R indices [I>2sigma(I)]	R1 = 0.0315, wR2 = 0.0739	
R indices (all data)	R1 = 0.0322, wR2 = 0.0744	
Extinction coefficient	0.0044(2)	
Largest diff. peak and hole	0.293 and -0.185 $e.Å^{-3}$	

Table 4. Crystal data and structure refinement for Compound 26.

Identification code	737624	
Empirical formula	C19 H24 O4	
Formula weight	316.38	
Temperature	100(2) K	
Wavelength	1.54178 Å	
Crystal system	Orthorhombic	
Space group	Pbca	
Unit cell dimensions	a = 7.6777(4) Å	α= 90°.
	b = 12.8146(8) Å	β= 90°.
	c = 33.0175(18) Å	γ = 90°.
Volume	3248.5(3) $Å^3$	
Z	8	
Density (calculated)	1.294 Mg/m^3	
Absorption coefficient	0.724 mm^{-1}	
F(000)	1360	
Crystal size	0.42 x 0.38 x 0.08 mm^3	
Crystal color, habit	Colorlesss Plate	
Theta range for data collection	6.36 to 68.23°.	
Index ranges	-9<=h<=7, -15<=k<=13, -39<=l<=39	
Reflections collected	14719	
Independent reflections	2918 [R(int) = 0.0579]	
Completeness to theta = 55.00°	98.9 %	
Absorption correction	Semi-empirical from equivalents	
Max. and min. transmission	0.9444 and 0.7508	
Refinement method	Full-matrix least-squares on F^2	
Data / restraints / parameters	2918 / 0 / 213	
Goodness-of-fit on F^2	1.014	
Final R indices [I>2sigma(I)]	R1 = 0.0396, wR2 = 0.0951	
R indices (all data)	R1 = 0.0593, wR2 = 0.1051	
Extinction coefficient	0.00068(13)	
Largest diff. peak and hole	0.303 and -0.164 $e.Å^{-3}$	

Table 5. Crystal data and structure refinement for Compound 36.

Identification code	CCDC-737625	
Empirical formula	C23 H22 O6	
Formula weight	394.41	
Temperature	100(2) K	
Wavelength	1.54178 Å	
Crystal system	Triclinic	
Space group	P-1	
Unit cell dimensions	a = 9.8298(5) Å	α= 89.130(3)°.
	b = 9.8418(4) Å	β= 89.002(4)°.
	c = 20.5815(9) Å	γ = 67.618(3)°.
Volume	1840.76(14) $Å^3$	
Z	4	
Density (calculated)	1.423 Mg/m^3	
Absorption coefficient	0.849 mm^{-1}	
F(000)	832	
Crystal size	0.25 x 0.18 x 0.12 mm^3	
Crystal color, habit	Colorless Block	
Theta range for data collection	4.30 to 65.15°.	
Index ranges	-10<=h<=11, -10<=k<=10, -16<=l<=21	
Reflections collected	13913	
Independent reflections	4995 [R(int) = 0.0559]	
Completeness to theta = 60.00°	95.9 %	
Absorption correction	Semi-empirical from equivalents	
Max. and min. transmission	0.9050 and 0.8158	
Refinement method	Full-matrix least-squares on F^2	
Data / restraints / parameters	4995 / 0 / 530	
Goodness-of-fit on F^2	1.083	
Final R indices [I>2sigma(I)]	R1 = 0.0640, wR2 = 0.1547	
R indices (all data)	R1 = 0.0783, wR2 = 0.1654	
Largest diff. peak and hole	0.619 and -0.309 e.$Å^{-3}$	

Table 6. Crystal data and structure refinement for Compound 42.

Identification code	CCDC-737626	
Empirical formula	C28 H35 N O4	
Formula weight	449.57	
Temperature	100(2) K	
Wavelength	0.71073 Å	
Crystal system	Triclinic	
Space group	P-1	
Unit cell dimensions	a = 9.8106(7) Å	α= 106.4770(10)°.
	b = 10.1395(8) Å	β= 93.9620(10)°.
	c = 12.1918(9) Å	γ = 92.8280(10)°.
Volume	1157.17(15) $Å^3$	
Z	2	
Density (calculated)	1.290 Mg/m^3	
Absorption coefficient	0.085 mm^{-1}	
F(000)	484	
Crystal size	0.40 x 0.40 x 0.30 mm^3	
Crystal color, habit	Colorless Plate	
Theta range for data collection	1.75 to 27.50°.	
Index ranges	-12<=h<=12, -13<=k<=13, -15<=l<=15	
Reflections collected	9915	
Independent reflections	5073 [R(int) = 0.0157]	
Completeness to theta = 27.50°	95.2 %	
Absorption correction	Semi-empirical from equivalents	
Max. and min. transmission	0.9749 and 0.9667	
Refinement method	Full-matrix least-squares on F^2	
Data / restraints / parameters	5073 / 0 / 298	
Goodness-of-fit on F^2	1.095	
Final R indices [I>2sigma(I)]	R1 = 0.0468, wR2 = 0.1261	
R indices (all data)	R1 = 0.0530, wR2 = 0.1308	
Largest diff. peak and hole	0.422 and -0.351 $e.Å^{-3}$	

Table 7. Crystal data and structure refinement for Compound 43.

Identification code	CCDC-614936	
Empirical formula	C24 H28 O5	
Formula weight	396.46	
Temperature	100(2) K	
Wavelength	0.71073 Å	
Crystal system	Triclinic	
Space group	P-1	
Unit cell dimensions	a = 10.5010(10) Å	α= 112.0840(10)°.
	b = 14.3480(14) Å	β= 90.4770(10)°.
	c = 14.6990(14) Å	γ = 104.1960(10)°.
Volume	1977.0(3) $Å^3$	
Z	4	
Density (calculated)	1.332 Mg/m^3	
Absorption coefficient	0.092 mm^{-1}	
F(000)	848	
Crystal size	0.20 x 0.20 x 0.10 mm^3	
Crystal color, habit	Colorless Block	
Theta range for data collection	2.21 to 28.22°.	
Index ranges	-13<=h<=13, -18<=k<=18, -19<=l<=19	
Reflections collected	20632	
Independent reflections	8823 [R(int) = 0.0209]	
Completeness to theta = 25.00°	99.3 %	
Absorption correction	Semi-empirical from equivalents	
Max. and min. transmission	0.9908 and 0.9818	
Refinement method	Full-matrix least-squares on F^2	
Data / restraints / parameters	8823 / 0 / 533	
Goodness-of-fit on F^2	1.021	
Final R indices [I>2sigma(I)]	R1 = 0.0502, wR2 = 0.1287	
R indices (all data)	R1 = 0.0583, wR2 = 0.1345	
Largest diff. peak and hole	0.749 and -0.301 $e.Å^{-3}$	

Procedures and spectroscopic/analytical data for compounds **9, 10a, 10b, 10c, 18, 19, 20, 22, 23, 34, 35, 36, 38, 39, 42, 43, 44, 45, 46.**

7,8-Dihydroxy-2,2-dimethyl-4*H*-benzo[d][1,3]dioxin-4-one 9. To a suspension of 2, 3, 4-trihydroxybenzoic acid **8** (0.99 g, 6.4 mmol) in TFA (9.5 mL) was added TFAA (10.0 mL, 64.0 mmol) followed by dry acetone (2.8 mL, 38 mmol) at 0 ºC. After 19 h, the homogeneous reaction mixture was concentrated under reduced pressure to half its volume and subsequently stirred with EtOAc (50 mL) and aqueous saturated $NaHCO_3$ (50 mL) in a 500 mL Erlenmeyer flask. The aqueous and ethyl acetate layers were then separated and the aqueous layer was back-extracted with EtOAc (2 x 25 mL). The combined ethyl acetate layers were dried over $MgSO_4$, filtered and concentrated by rotary evapor ation. The crude material was purified through flash column chromatography (silica, 50% EtOAc-hexane) to give the acetonide **9** (0.38 g, 31%). **9:** white solid; R_f = 0.14 (50% EtOAc-hexane); ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.50 (d, J = 8.6 Hz, 1H), 6.72 (d, J = 8.6 Hz, 1H), 6.01 (s, 1H), 5.30 (s, 1H), 1.76 (s, 6H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 161.9, 151.4, 144.4, 131.5, 122.4, 110.7, 107.5, 106.3, 26.0; HRMS calc. for $C_{10}H_{10}O_5$ $(M + H)^+$ 210.0523, found 210.0524.

Isobutyl 2-methylbut-3-en-2-yl carbonate 10a. 2-Methyl-3-buten-2-ol (7.3 mL, 70 mmol) was dissolved in dry THF (125 mL) and stirred under argon at 0 ºC. To the clear solution was added 1.6 M *n*-BuLi in hexane (48.1 mL, 77.0 mmol) dropwise via syringe. After 30 min of continued stirring at 0 ºC, isobutyl chloroformate (13.7 mL, 105 mmol) was added dropwise to the reaction mixture. The reaction vessel was then allowed to gradually warm to room temperature and stirred for another 4 hours at room temperature. The reaction mixture was acidified by addition of 1M HCl, extracted with diethyl ether (3 x 50 mL) and washed with water (20 mL). The combined organic layers were dried over $MgSO_4$, filtered, and concentrated by rotary evaporation to give isobutyl 2-methylbut-3-en-2-yl carbonate **10a** (13.9 mL, 100%). Further purification was not necessary. **10a**: colorless liquid; R_f = 0.60 (25% EtOAc-hexane); ^{1}H NMR (400 MHz, $CDCl_3$): δ 6.10 (dd, J = 17.5, 10.9 Hz, 1H), 5.22 (d, J = 17.5 Hz, 1H), 5.13 (d, J = 11.0 Hz, 1H), 3.85 (d, J = 6.7 Hz, 1H), 1.99-1.92 (m, 1H), 1.55 (s, 6H), 0.94 (s, 3H), 0.93 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 153.8, 142.0, 113.7, 82.1, 73.5, 28.0, 26.4, 19.2.

***tert*-Butyl 2-methylbut-3-en-2-yl carbonate 10b.** To a solution of 2-methyl-3-buten-2-ol (4.0 mL, 38 mmol) in dry THF (80 mL) under argon at -78 ^{o}C was added 1.6 M *n*-BuLi in hexane (26.3 mL, 42.1 mmol) dropwise via syringe. After stirring for 30 min, a solution of Boc_2O (8.35 g, 38.3 mmol) in THF (5 mL) was added to the reaction mixture. The reaction mixture was allowed to warm to room temperature and stirred for another 3 hours. The reaction mixture was then quenched with saturated aqueous NH_4Cl (20 mL) and extracted with diethyl ether (2 x 25 mL). The combined organic layers were washed with water and brine, dried over $MgSO_4$, filtered, and concentrated in vacuo. Purification by flash column chromatography (silica, 100% hexane) gave *tert*-butyl 2-methylbut-3-en-2-yl carbonate **10b** (7.1 g, 100%). **10b**: colorless liquid; R_f = 0.60 (25% EtOAc-hexane); ^{1}H NMR (400 MHz, $CDCl_3$): δ 6.11 (dd, J = 17.5, 10.9 Hz, 1H), 5.17 (d, J = 17.5 Hz, 1H), 5.09 (d, J = 10.9 Hz, 1H), 1.51 (s, 6H), 1.45 (s, 6H); ^{13}C NMR (100 MHz,

$CDCl_3$) δ 152.1, 142.5, 113.2, 81.6, 81.6, 28.1, 26.6; HRMS calc. for $C_{10}H_{18}O_3$ $(M + Na)^+$ 209.1150, found 209.1148.

Bis(2-methylbut-3-en-2-yl) carbonate 10c: Carbonate **10c** was prepared in two steps: 2-methyl-3-buten-2-ol (2.1 mL, 25 mmol) was dissolved in dry DCM (20 mL) in a 200 mL round-bottomed flask. To the stirring solution was added carbonyl diimidazole (5.0 g, 31.3 mmol) at room temperature. After 1 hour, the reaction mixture was washed with water (2 x 15 mL) and extracted with DCM (20 mL). The organic layer was dried over $MgSO_4$, filtered, and concentrated by rotary evaporation to yield 2-methylbut-3-en-2-yl 1*H*-imidazole-1-carboxylate (3.8 g, 84%) which was used in the next step without further purification: colorless liquid; R_f = 0.48 (25% EtOAc-hexane); ^{1}H NMR (400 MHz, $CDCl_3$): δ 8.03 (s, 1H), 7.33 (s, 1H), 6.98 (s, 1H), 6.11 (dd, *J* = 17.4, 10.9 Hz, 1H), 5.27 (d, *J* = 17.4 Hz, 1H), 5.18 (d, *J* = 10.9 Hz, 1H), 1.64 (s, 6H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 147.0, 140.6, 137.2, 130.5, 117.3, 115.0, 85.7, 64.4, 26.4. To a solution of 2-methyl-3-buten-2-ol (4.1 mL, 39 mmol) in dry THF (80 mL) under argon at -78 ^{o}C was added 1.6 M *n*-BuLi in hexane (26.7 mL, 42.7 mmol) dropwise via syringe. After stirring for 30 min at -78 ^{o}C, 2-methylbut-3-en-2-yl 1*H*-imidazole-1-carboxylate (6.7 mL, 38.8 mmol) was added. The reaction mixture was allowed to warm to room temperature and stirred for another 3 hours. The reaction mixture was then quenched with saturated aqueous NH_4Cl (20 mL) and extracted with diethyl ether (2 x 25 mL). The combined organic layers were washed with water (2 x 20 mL) and brine (20 mL), dried over $MgSO_4$, and concentrated in vacuo. Purification by flash column chromatography (silica, 100% hexane) gave bis(2-methylbut-3-en-2-yl) carbonate **10c** (7.7 g, 100%). **10c:** colorless liquid; R_f = 0.60 (25% EtOAc-hexane); ^{1}H NMR (400 MHz, $CDCl_3$): δ 6.08 (dd, *J* = 17.5, 10.9 Hz, 2H), 5.15 (d, *J* = 17.5 Hz, 2H), 5.07 (d, *J* = 10.9 Hz, 2H), 1.46 (s, 12H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 151.8, 142.2, 113.4, 81.9, 26.5.

Biotin conjugate 18. To a solution containing acid **17** (5.4 mg, 17.6 µmol) and biotin ethylenediamine hydrobromide (7.1 mg, 19.4 µmol) in DCM (0.37 mL) was added DIPEA (6.13 µL, 35.2 µmol). Upon adding solid HATU (7.4 mg, 19.4 µmol) portionwise to the reaction mixture, the reaction mixture turned to pale yellow in color within 5 min. After 24 hours, the reaction mixture was partitioned between ethyl acetate (5 mL) and water (2 mL). The organic layer was washed with water (2 x 1 mL) and brine (2 mL). The combined organic layers were then dried over $MgSO_4$, filtered, and concentrated by rotary evaporation. The crude material was purified by preparative TLC (silica, 9% MeOH-EtOAc) to obtain the amide **18** (5.5 mg, 9.53 µmol, 54%). **18**: yellow solid; R_f = 0.28 (20% MeOH-EtOAc); ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.84 (br s, 1H), 7.70 (br s, 1H), 7.08 (br s, 1H), 7.01 (br s, 1H), 6.89 (dd, *J* = 22.7, 7.0 Hz, 1H), 6.64 (d, *J* = 21.9 Hz, 1H), 6.60 (d, *J* = 8.4 Hz, 1H), 5.49 (d, *J* = 17.2 Hz, 1H), 4.72 (m, 1H), 4.54 (m, 1H), 4.33 (m, 1H), 3.50-3.33 (m, 4H), 3.23-3.14 (m, 2H), 2.94 (dd, *J* = 12.9, 4.9 Hz, 1H), 2.74 (d, *J* = 12.9 Hz, 1H), 2.67-2.18 (m, 5H), 2.80-2.30 (m, 16H), 1.20 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 205.8, 174.5, 167.4, 156.1, 145.0, 135.4, 134.6, 131.9, 128.2, 124.2, 121.1, 118.8, 117.2, 85.3, 84.3, 83.2, 49.7, 46.3, 42.1, 39.4, 35.9, 30.3, 29.3, 28.6, 27.5, 26.2, 25.1, 18.0, 15.3, 11.6; HRMS calc. for $C_{29}H_{42}N_4O_6S$ $(M + Na)^+$ 597.2717, found 597.2728.

Coumarin conjugate 19. To a solution containing acid **17** (5.40 mg, 17.6 µmol) and coumarin diethyleneamine (5.58 mg, 19.4 µmol) in DCM (0.37 mL) was added DIPEA (6.13 µL, 35.2 µmol). Upon adding solid HATU (7.36 mg, 19.4 µmol) portionwise to the reaction mixture, the reaction mixture turned to pale yellow in color within 5 min. After 24 hours, the reaction mixture

was partitioned between ethyl acetate (5 mL) and water (2 mL). The organic layer was washed with water (2 x 1 mL) and brine (2 mL). The combined organic layers were then dried over $MgSO_4$, filtered, and concentrated by rotary evaporation. The crude material was purified by preparative TLC (silica, 100% EtOAc) to obtain the amide **19** (6.0 mg, 59%). **19**: yellow solid; R_f = 0.17 (100% EtOAc); ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.48 (br s, 1H), 7.45 (br s, 1H), 6.90 (br s, 1H), 6.68 (d, *J* = 7.0 Hz, 1H), 6.60 (dd, *J* = 9.1, 2.5 Hz, 1H), 6.46 (d, *J* = 2.5 Hz, 1H), 6.30 (br s, 1H), 6.00 (br s, 1H), 4.69 (t, *J* = 7.6 Hz, 1H), 3.64 (s, 2H), 3.52-3.13 (m, 5H), 3.06 (s, 6H), 2.60 (dd, *J* = 14.0, 9.0 Hz, 1H), 2.47 (dd, *J* = 13.8, 6.3 Hz, 1H), 2.16 (m, 2H), 1.58 (s, 3H), 1.53 (s, 3H), 1.49 (s, 3H), 1.27 (m, 1H), 1.19 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 205.3, 169.8, 167.0, 165.8, 161.8, 156.1, 153.2, 149.2, 135.3, 134.7, 132.7, 125.4, 118.4, 110.5, 109.2, 108.0, 98.2, 84.7, 84.4, 83.0, 49.4, 46.1, 40.6, 40.5, 40.4, 40.1, 30.1, 29.7, 29.0, 28.2, 27.3, 25.9, 17.8; HRMS calc. for $C_{32}H_{39}N_3O_7$ $(M + Na)^+$ 600.2680, found 600.2688.

BODIPY conjugate 20. To a solution containing acid **17** (4.0 mg, 13.1 µmol) and BODIPY FL EDA (4,4-difluoro-5,7-dimethyl-4-bora-3a,4a-diaza-*s*-indacene-3-propionyl ethylenediamine) (5.3 mg, 14.4 µmol) in DCM (0.27 mL) was added DIPEA (4.56 µL, 26.2 µmol). Upon adding solid HATU (5.9 mg, 15.6 µmol) portionwise to the reaction mixture, the reaction mixture turned to pale yellow in color within 5 min. After 4 hours, the reaction mixture was partitioned between ethyl acetate (5 mL) and water (2 mL). The organic layer was washed with water (2 x 1 mL) and brine (2 mL). The combined organic layers were then dried over $MgSO_4$, filtered, and concentrated by rotary evaporation. The crude material was purified by preparative TLC (silica, 100% EtOAc) to obtain the amide **20** (5.60 mg, 68%). **20**: red solid; R_f = 0.62 (100% EtOAc); ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.54 (br s, 1H), 7.11 (s, 1H), 6.92 (s, 1H), 6.87 (d, *J* = 3.8 Hz, 1H), 6.69 (d, *J* = 7.0 Hz, 1H), 6.26 (br s, 1H), 6.24 (d, *J* = 3.8 Hz, 1H), 6.15 (s, 1H), 4.64 (t, *J* = 6.9 Hz, 1H), 3.40-3.10 (m, 6H), 2.71-2.56 (m, 4H), 2.56 (s, 3H), 2.27 (s, 3H), 2.18-2.15 (m, 2H), 1.59 (s, 6H), 1.51 (s, 3H), 1.36-1.27 (m, 1H), 1.19 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 205.8, 174.5, 167.4, 161.4, 156.1, 145.0, 135.4, 134.6, 131.9, 128.2, 124.2, 121.1, 118.8, 117.2, 85.3, 84.3, 83.2, 49.7, 46.3, 42.1, 39.4, 35.9, 30.3, 29.3, 28.6, 27.5, 26.2, 25.1, 18.0, 15.3, 11.6; HRMS calc. for $C_{33}H_{41}BF_2N_4O_5$ $(M + Na)^+$ 645.3030, found 645.3043.

3-(2,3-Dihydroxylphenoxy)propanenitrile 22. To a 250 mL round-bottomed flask was added pyrogallol **21** (10.0 g, 79.3 mmol) and acrylonitrile (14.7 g, 278 mmol) followed by NaOMe (4.3 g, 79.3 mmol). The reaction vessel was then equipped with a reflux condenser and stirred under argon at 78 ºC for 7 hours. The onset of a dark black color indicated the formation of the 3-(2,3-dihydorxylphenoxy)propanenitrile **22**. The reaction mixture was then cooled to 25 ºC and the excess acrylonitrile was removed by rotary evaporation. The residue was extracted with ethyl acetate (5 x 100 mL), and the combined organic layers were dried over $MgSO_4$, filtered, and concentrated by rotary evaporation. The crude material was purified through flash column chromatography (silica, 40% EtOAc-hexane) to yield the nitrile **22** (4.5 g, 32%). **22**: off-white solid; R_f = 0.43 (50% EtOAc-hexane); ^{1}H NMR (400 MHz, DMSO-d6) δ 6.55 (t, *J* = 8.0 Hz, 1H), 6.44 (m, 2H), 4.11 (t, *J* = 6.0 Hz, 2H), 2.94 (t, *J* = 6.0 Hz, 2H); ^{13}C NMR (100 MHz, DMSO-d6) δ 146.8, 146.2, 135.0, 119.0, 118.3, 109.8, 106.0, 64.2, 18.1; HRMS calc. for $C_9H_9NO_3$ $(M + Na)^+$ 202.0471, found 202.0475.

7,8-Dihydroxychroman-4-one 23. To a 100 mL round-bottomed flask containing 3-(2,3-dihydroxylphenoxy)propanenitrile **22** (2.05 g, 11.8 mmol) was added slowly dropwise, via the

addition funnel, aqueous sulfuric acid (50% v/v, 42 mL). The reaction vessel was then equipped with a reflux condenser and stirred under argon at 105 ºC for 3 hours. The cooled solution was diluted with water (50 mL) and extracted with ethyl acetate (4 x 100 mL). The organic layers were washed with water, brine, and dried over $MgSO_4$. The combined organic layers were then filtered and concentrated by rotary evaporation. The crude material was purified through flash column chromatography (silica, 60-70% EtOAc-hexane) to yield 7,8-dihydroxychroman-4-one **23** (0.98 g, 48%). **23**: off-white solid; R_f = 0.38 (70% EtOAc-hexane); ^{1}H NMR (400 MHz, DMSO-d6) δ 7.15 (dd, *J* = 8.7, 1.3 Hz, 1H), 6.49 (dd, *J* = 8.6, 1.3 Hz, 1H), 4.48 (t, *J* = 6.3 Hz, 2H), 2.67 (t, *J* = 6.3 Hz, 2H); ^{13}C NMR (100 MHz, DMSO-d6) δ 190.3, 152.0, 151.3, 132.7, 117.4, 114.5, 109.6, 67.1, 37.1; HRMS calc. for $C_9H_8O_4$ $(M + H)^+$ 181.0495, found 181.0494.

Aldehyde 34 and Alcohol 35. A solution of SeO_2 (0.67 mg, 6.00 μmol) and *t*BuOOH (5.5M in decane, 40.0 μL, 0.22 mmol) in DCM (1.4 mL) was prepared. To the stirring solution was added a solution of caged xanthone **7** (42.7 mg, 0.12 mmol) in DCM (0.5 mL) dropwsie, via syringe, at room temperature. After stirring for 19 hours at room temperature, the reaction mixture was dissolved in diethyl ether (10 mL) and washed with 10% KOH (10 mL), water (10 mL), and brine (10 mL). The ether layer was dried over $MgSO_4$, filtered, and concentrated by rotary evaporation. The crude yellow oil was purified through flash column chromatography to yield the aldehyde **34** (26 mg, 57%) and alcohol **35** (9.6 mg, 21%). **34**: white solid; R_f = 0.42 (17% EtOAC-hexane); ^{1}H NMR (400 MHz, $CDCl_3$): δ 9.22 (s, 1H), 7.91 (d, *J* = 7.8 Hz, 1H), 7.59 (d, *J* = 6.9 Hz, 1H), 7.53 (d, *J* = 7.5 Hz, 1H), 7.07 (t, *J* = 7.4 Hz, 1H), 6.94 (d, *J* = 8.4 Hz, 1H), 6.41 (t, *J* = 7.2 Hz, 1H), 3.55 (m, 1H), 2.82 (dd, *J* = 15.9, 7.5 Hz, 1H), 2.65 (dd, *J* = 15.9, 7.0 Hz, 1H), 2.56 (d, *J* = 9.5 Hz, 1H), 2.38 (dd, *J* = 13.6, 4.6 Hz, 1H), 1.76 (s, 3H), 1.42-1.36 (m, 1H), 1.34 (s, 3H), 1.18 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 202.8, 194.8, 176.6, 159.5, 147.3, 140.3, 137.2, 136.6, 134.7, 127.6, 122.7 119.0, 118.2, 91.1, 84.4, 83.4, 48.9, 47.0, 30.3, 29.3, 29.2, 25.1, 8.8; HRMS calc. for $C_{23}H_{22}O_5(M + H)^+$ 379.1540, found 379.1550. **35**: white solid; R_f = 0.21 (17% EtOAC-hexane); ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.93 (d, *J* = 8.2 Hz, 1H), 7.56 (t, *J* = 8.4 Hz, 1H), 7.54 (d, *J* = 6.9 Hz, 1H), 7.10-7.07 (m, 2H), 4.75-4.71 (m, 1H), 3.67-3.53 (m, 3H), 2.75-2.67 (m, 2H), 2.49 (d, *J* = 9.6 Hz, 1H), 2.37 (dd, *J* = 13.6, 4.7 Hz, 1H), 1.74 (s, 3H), 1.39-1.34 (m, 1H), 1.31(s, 3H), 0.94 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 203.0, 178.8, 159.9, 138.1, 137.0, 135.4, 134.7, 127.4, 122.5, 119.8, 119.4, 118.3, 90.4, 84.7, 84.0, 68.4, 48.9, 47.2, 30.5, 29.3, 29.0, 25.2, 12.7; HRMS calc. for $C_{23}H_{24}O_5$ $(M + Na)^+$ 403.1516, found 403.1524.

Oxidation of alcohol 35 to aldehyde 34. A mixture of alcohol **35** (20 mg, 52.6 μmol) and PCC (17 mg, 78.9 μmol) in DCM (0.2 mL) was stirred at room temperature for 30 min. The reaction mixture was diluted with DCM and filtered through a pad of celite. The solvent was removed by rotary evaporation and the crude was purified by preparative TLC (silica, 50% EtOAc-hexane) to yield aldehyde **34** (19 mg, 95%).

Epoxide 36. $NaH_2PO_4.H_2O$ (6.8 mg, 49.1 μmol) was added to a solution of **34** (6.2 mg, 16.4 μmol) in *t*BuOH/H_2O (2:1, 0.43 mL). The reaction mixture was stirred at room temperature to fully dissolve the white precipitate and the reaction vessel was placed in an ice bath. To the stirring solution in an ice bath was added 2-methylbut-2-ene (13.9 μL, 131.2 μmol) via syringe. After 30 min, $NaClO_2$ (4.4 mg, 49.1 μmol) was added to the reaction mixture. When the reaction was complete 4 hours later, the reaction mixture was partitioned between ethyl acetate (2 x 3 mL) and water (3 mL). The combined organic layers were dried over $MgSO_4$, filtered, and

concentrated by rotary evaporation. The crude material was purified through preparative TLC (silica, 50% EtOAc-Hexane) to yield the epoxide **36** (4.4 mg, 70%). **36**: white solid; R_f = 0.52 (50% EtOAc-hexane); ^{1}H NMR (400 MHz, $CDCl_3$): δ 9.48 (s, 1H), 7.97 (d, *J* = 7.9 Hz, 1H), 7.65 (t, *J* = 7.4 Hz, 1H), 7.20 (t, *J* = 7.7 Hz, 1H), 7.10 (d, *J* = 8.3 Hz, 1H), 7.01 (t, *J* = 8.1 Hz, 1H), 4.29 (d, *J* = 4.5 Hz, 1H), 3.12 (t, *J* = 4.6 Hz, 1H), 3.03-3.01 (m, 2H), 2.58 (d, *J* = 9.2 Hz, 1H), 2.23 (dd, *J* = 5.1, 14.5 Hz, 1H), 1.81-1.73 (m, 1H), 1.70 (s, 3H), 1.60 (s, 3H), 1.24 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 204.3, 195.6, 184.5, 159.0, 150.3, 139.8, 138.2, 127.8, 123.4, 122.6, 119.4, 89.6, 88.7, 84.0, 59.8, 55.0, 46.9, 42.1, 30.2, 28.3, 27.9, 24.4, 9.5; HRMS calc. for $C_{23}H_{22}O_6$ $(M + Na)^+$ 417.1309, found 417.1313.

5-Methylbenzene-1,2,3-triol 38. To a 50 mL round-bottomed flask was added pyrogallol **29** (372 mg, 2.04 mmol) followed by DCM (4.0 mL). The flask was placed on an ice bath and 1.0 M solution of boron tribromide in DCM (6.5 mL, 6.52 mmol) was added dropwise, via syringe, while stirring over 10 min. The reaction vessel was then stirred under argon at room temperature for 3.5 hours. The reaction was quenched by adding water (10 mL), and the reaction mixture was extracted with ethyl acetate (3 x 20 mL). The combined organic layers were washed with water, brine, and dried over $MgSO_4$. The solution was then filtered and concentrated by rotary evaporation. The crude material was purified through flash column chromatography (silica, 60-70% EtOAc-hexane) to yield 5-methylbenzene-1,2,3-triol (170 mg, 59%). **38**: off-white solid; R_f = 0.32 (40% EtOAc-hexane); ^{1}H NMR (400 MHz, $CDCl_3$) δ 6.30 (s, 2H), 5.05 (s, 2H), 5.00 (s, 1H), 2.20 (s, 3H); ^{13}C NMR (100 MHz, DMSO-d6) δ 145.9, 130.4, 127.2, 107.6, 20.6; HRMS calc. for $C_7H_8O_3$ (M) 140.0468, found 140.0470.

3,4-Dihydroxy-1-methyl-9*H*-xanthen-9-one 39. 2-Fluorobenzoyl chloride **28** (170 mg, 1.07 mmol) was added dropwise to a mixture of 5-methylbenzene-1,2,3-triol **38** (100 mg, 0.71 mmol), aluminum chloride (187 mg, 1.40 mmol), chloroform (2 mL) and dichloromethane (6 mL) in a 50 mL round-bottomed flask. The reaction mixture was stirred at room temperature under argon for 1.5 hours. The reaction vessel was then equipped with a reflux condenser and stirred under argon at 60 ºC for 6 hours. The cooled, red homogeneous solution was acidified with 1N HCl (15 mL). The reaction mixture was then partitioned between water and ethyl acetate (3 x 50 mL). The aqueous layer was back extracted with ethyl acetate (2 x 30 mL) until the color of the aqueous layer was almost clear. The combined organic layers were dired over $MgSO_4$, filtered, and concentrated to yield dark brown oil. The crude oil was then added to a 100 mL round-bottomed flask containing sodium carbonate (98 mg, 0.92 mmol) and DMF (4 mL). The reaction vessel was the equipped with a reflux condenser and stirred under argon at 90 ºC for 4 hours. The dark reaction mixture was cooled to room temperature and acidified with 1 N HCl (15 mL). The reaction mixture was then partitioned between water and ethyl acetate (3 x 50 mL). The aqueous layer was back extracted with ethyl acetate (2 x 30 mL). The combined brown organic layers were dried over $MgSO_4$, filtered, and concentrated by rotary evaporation. The crude material was purified through flash column chromatography (silica, 40-50% EtOAc-hexane) to yield the methyl xanthone **39** (120 mg, 70%). **39**: off-white solid; R_f = 0.21 (40% EtOAc-hexane); ^{1}H NMR (400 MHz, DMSO-d6) δ 10.15 (br s, 1H), 9.34 (br s, 1H), 8.10 (dd, *J* = 7.9, 1.6 Hz, 1H), 7.76 (ddd, *J* = 8.6, 7.3, 1.7 Hz, 1H), 7.56 (d, *J* = 8.3 Hz, 1H), 7.38 (t, *J* = 7.5 Hz, 1H), 6.68 (s, 1H), 2.68 (s, 3H); ^{13}C NMR (100 MHz, DMSO-d6) δ 176.8, 154.6, 150.3, 147.4, 134.3, 131.1, 130.7, 126.0, 123.6, 121.8, 117.4, 115.2, 112.8, 22.4; HRMS calc. for $C_{14}H_{10}O_4$ $(M + H)^+$ 243.0652, found 243.0654.

Piperidine addition product 42. A solution of compound **7** (7.1 mg, 0.019 mmol) in DCM (0.5 mL) was treated with piperidine (7 μL, 0.76 mmol) at 60 °C for 6 h. The crude material was purified through flash column chromatography (silica, 20-70% Et_2O-hexane) to yield adduct **42** (7.3 mg, 86%). **42**: white solid; R_f = 0.71 (70 % Et_2O-hexane); ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.90 (d, *J* = 8 Hz, 1H), 7.56-7.52 (m, 1H), 7.08-7.01 (m, 2H), 5.23-5.50 (m, 1H), 3.36 (s, 1H), 3.26 (s, 1H), 3.15 (b, 1H), 2.91-2.78 (m, 3H), 2.53 (b, 1H), 2.45 (d, *J* = 8.8 Hz, 1H), 2.34-2.23 (b, 2H), 1.95 (dd, *J* = 14.8 Hz, 6.4 Hz, 1H), 1.93-1.84 (b, 1H), 1.68 (s, 3H), 1.62 (s, 3H), 1.51-1.40 (m, 6H), 1.37 (s, 3H), 1.13 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 209.1, 191.7, 158.3, 136.4, 132.9, 127.0, 125.4, 121.4, 120.7, 118.3, 118.2, 89.4, 86.7, 81.5, 62.1, 51.3, 48.3, 43.4, 42.0, 30.4, 29.8, 28.0, 27.5, 26.0, 25.7, 24.6, 22.0, 18.1; HRMS calc. for $C_{28}H_{35}NO_4$ ($M + H^+$) 450.2639, found 450.2620.

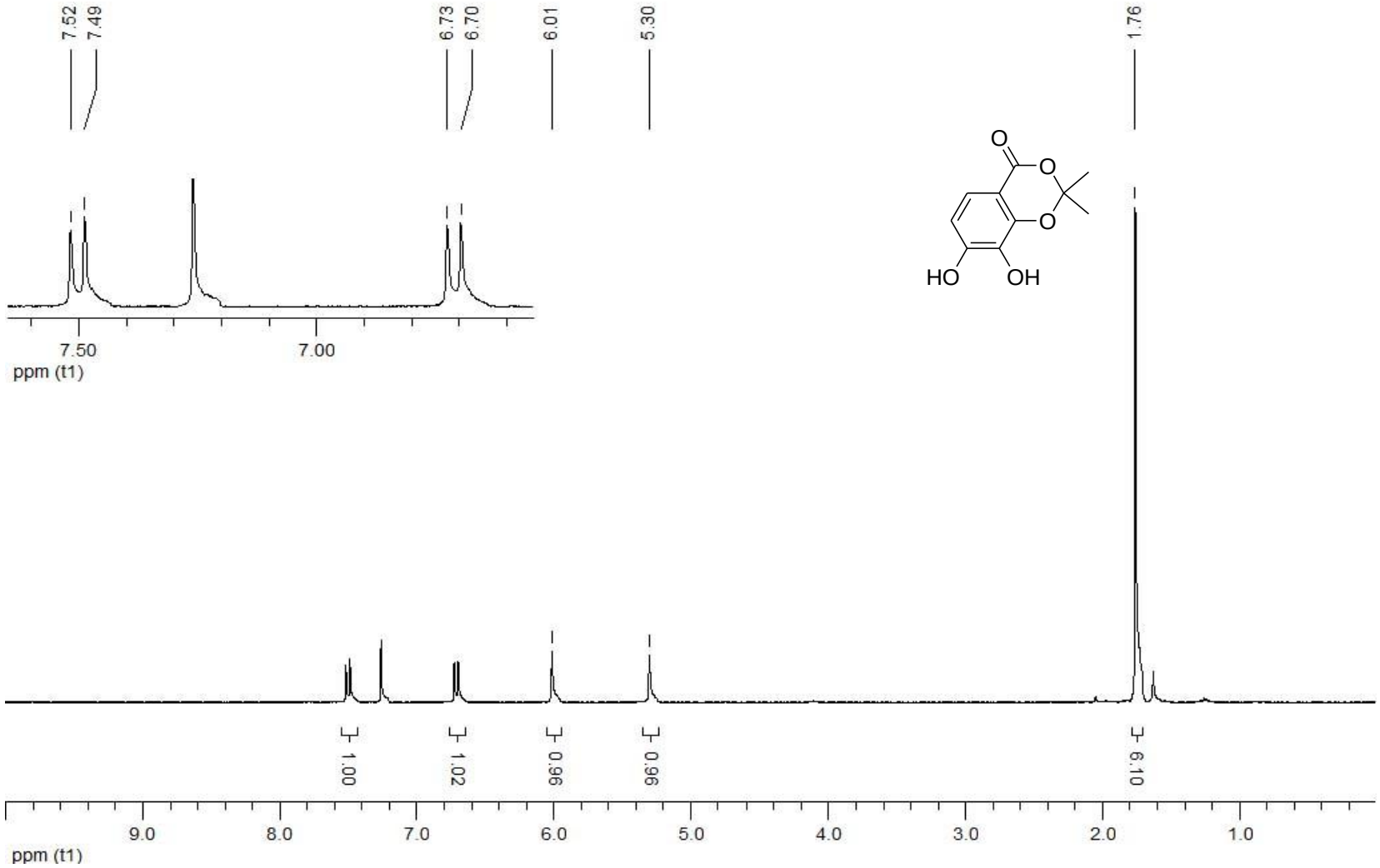
Methanol addition product 43. A solution of compound **7** (14 mg, 0.038 mmol) in MeOH (0.5 mL) was refluxed at 65 ºC under argon for 3 days. The reaction mixture was then cooled to room temperature and the solvent was removed by rotary evaporation. The crude material was purified through flash column chromatography (silica, 20% EtOAc-hexane) to yield adduct **43** (6.3 mg, 41%). **43**: white solid; R_f= 0.39 (25% EtOAc-hexane); ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.92 (d, *J* = 7.8 Hz, 1H), 7.57 (t, *J* = 8.5 Hz, 1H), 7.11-7.03 (m, 2H), 5.27-5.23 (m, 1H), 4.38 (d, *J* = 4.3 Hz, 1H), 3.38 (s, 1H), 3.30 (s, 3H), 2.92-2.78 (m, 3H), 2.42 (d, *J* = 8.9 Hz, 1H), 1.98 (dd, *J* = 6.13, 14.7 Hz, 1H), 1.64 (s, 3H), 1.60 (s, 3H), 1.41-1.35 (m, 1H), 1.37 (s, 3H), 1.14 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 208.6, 191.0, 158.8, 137.1, 134.1, 127.5, 122.0, 120.7, 118.7, 118.5, 88.9, 86.9, 81.7, 75.3, 55.8, 49.1, 44.6, 43.6, 29.9, 27.9, 27.7, 26.1, 20.2, 18.1; HRMS calc. for $C_{24}H_{28}O_5$ ($M + H^+$) 397.2010, found 397.2016.

Biotin conjugate 44. To a solution containing gambogic acid (5.0 mg, 7.95 μmol) and biotin ethylenediamine hydrobromide (3.2 mg, 8.75 μmol) in DCM (0.34 mL) was added DIPEA (2.77 μL, 15.9 μmol) via syringe. Upon adding solid HATU (3.6 mg, 9.46 μmol) portionwise to the reaction mixture, the reaction mixture turned to pale yellow in color within 5 min. After 24 hours, the reaction mixture was diluted with ethyl acetate (5 mL) and washed with water (2 x 1 mL) and brine (2 mL). The organic layers were dried over $MgSO_4$, filtered and concentrated by rotary evaporation. The crude material was purified through preparative TLC (silica, 17% MeOH-EtOAc) to yield the biotin conjugate **44** (4.8 mg, 67%). **44**: yellow solid; R_f = 0.11 (17% MeOH-EtOAc); ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.59 (d, *J* = 6.9 Hz, 1H), 6.90-7.05 (m, 2H), 6.68 (d, *J* = 10.2 Hz, 1H), 6.02 (br s, 1H), 5.47 (d, *J* = 10.3 Hz, 1H), 5.28 (m, 2H), 5.03 (m, 2H), 4.49 (m, 1H), 4.32 (m, 1H), 3.00-3.60 (m, 6H), 2.89 (dd, *J* = 12.8, 4.8 Hz, 1H), 2.72 (d, *J* = 13.1 Hz, 2H), 2.54 (d, *J* = 9.3 Hz, 1H), 2.34 (m, 2H), 2.20 (m, 2H), 2.03 (m, 1H), 1.77 (s, 3H), 1.73 (s, 3H), 1.68 (br s, 6H), 1.65 (m, 6H), 1.45 (s, 3H), 1.29 (s, 3H), 1.25 (s, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 205.1, 179.0, 174.0, 170.2, 163.9, 162.1, 157.9, 157.3, 136.0, 135.6, 133.2, 132.1, 125.2, 123.9, 122.1, 115.9, 108.0, 103.0, 100.6, 91.3, 84.6, 84.0, 81.8, 61.8, 60.4, 55.5, 49.1, 47.0, 42.3, 40.8, 40.0, 39.5, 35.9, 30.1, 29.9, 29.3, 29.1, 28.2, 28.1, 28.0, 25.9, 25.7, 25.4, 22.9, 21.8, 21.3, 18.4, 17.9; HRMS calc. for $C_{50}H_{64}N_4O_9S$ $(M + Na)^+$ 919.4286, found 919.4329.

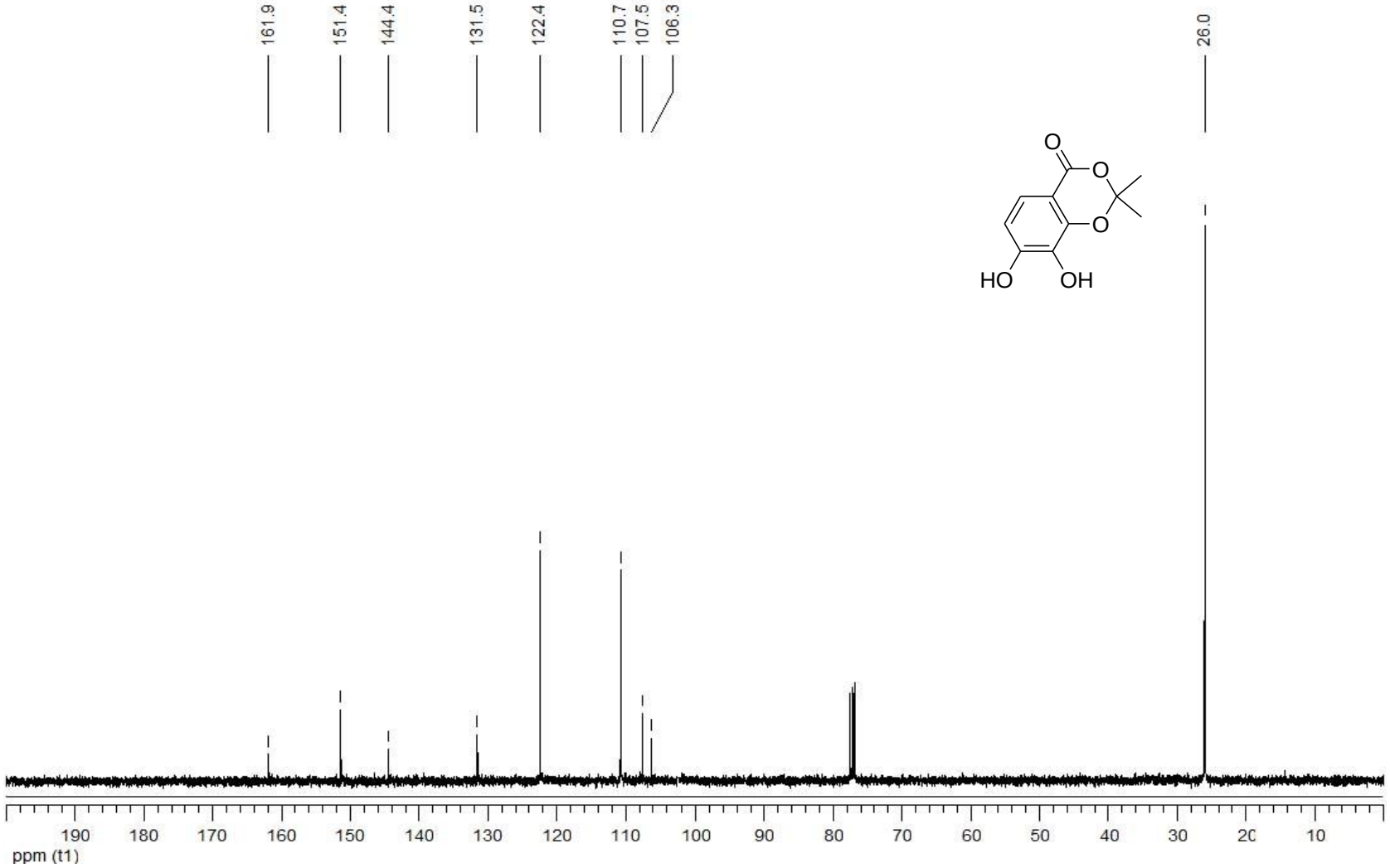
Coumarin conjugate 45. To a solution containing gambogic acid (5.8 mg, 9.22 μmol) and coumarin hexanediamine TFA salt (4.6 mg, 10.1 μmol) in DCM (0.30 mL) was added DIPEA (3.21 μL, 18.4 μmol). Upon adding solid HATU (4.2 mg, 10.9 μmol) portionwise to the reaction

mixture, the reaction mixture turned to pale yellow in color within 5 min. After 24 hours, the reaction mixture was diluted with ethyl acetate (5 mL) and washed with water (2 x 1 mL) and brine (2 mL). The organic layers were dried over $MgSO_4$, filtered and concentrated by rotary evaporation. The crude material was then purified through preparative TLC (silica, 100% EtOAc) to yield the coumarin conjugate **45** (7.7 mg, 87%). **45**: yellow solid; R_f = 0.29 (100% EtOAc); ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.49 (d, *J* = 9.1 Hz, 2H), 6.66 (d, *J* = 10.1 Hz, 1H), 6.60 (dd, *J* = 9.0, 2.4 Hz, 1H), 6.47 (s, 2H), 6.04 (s, 2H), 5.46 (d, *J* = 10.0 Hz, 1H), 5.30 (t, *J* = 8.2 Hz, 1H), 5.07-5.02 (m, 2H), 3.63 (s,2 H), 3.46 (t, *J* = 6.1 Hz, 1H), 3.33-3.19 (m, 5H), 3.03 (s, 6H), 2.55 (d, *J* = 9.2 Hz, 2H),, 2.38-2.29 (m, 2H), 2.08-2.01 (m, 2H), 1.77-1.25 (m, 36H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 204.4, 178.9, 169.5, 168.1, 162.0, 157.9, 156.3, 153.3, 150.1, 135.9, 132.2, 132.1, 126.0, 125.1, 124.1, 123.9, 122.2, 115.9, 110.6, 109.4, 108.6, 108.1, 103.0, 100.5, 98.3, 91.3, 84.3, 83.7, 81.8, 49.2, 47.2, 42.3, 41.0, 40.3, 39.6, 38.9, 30.2, 29.9, 29.5, 29.3, 29.2, 29.0, 28.1, 26.1, 26.0, 25.9, 25.4, 22.9, 21.8, 21.5, 18.4, 17.9; HRMS calc. for $C_{57}H_{69}N_3O_{10}$ $(M + H)^+$ 956.5056, found 956.5069.

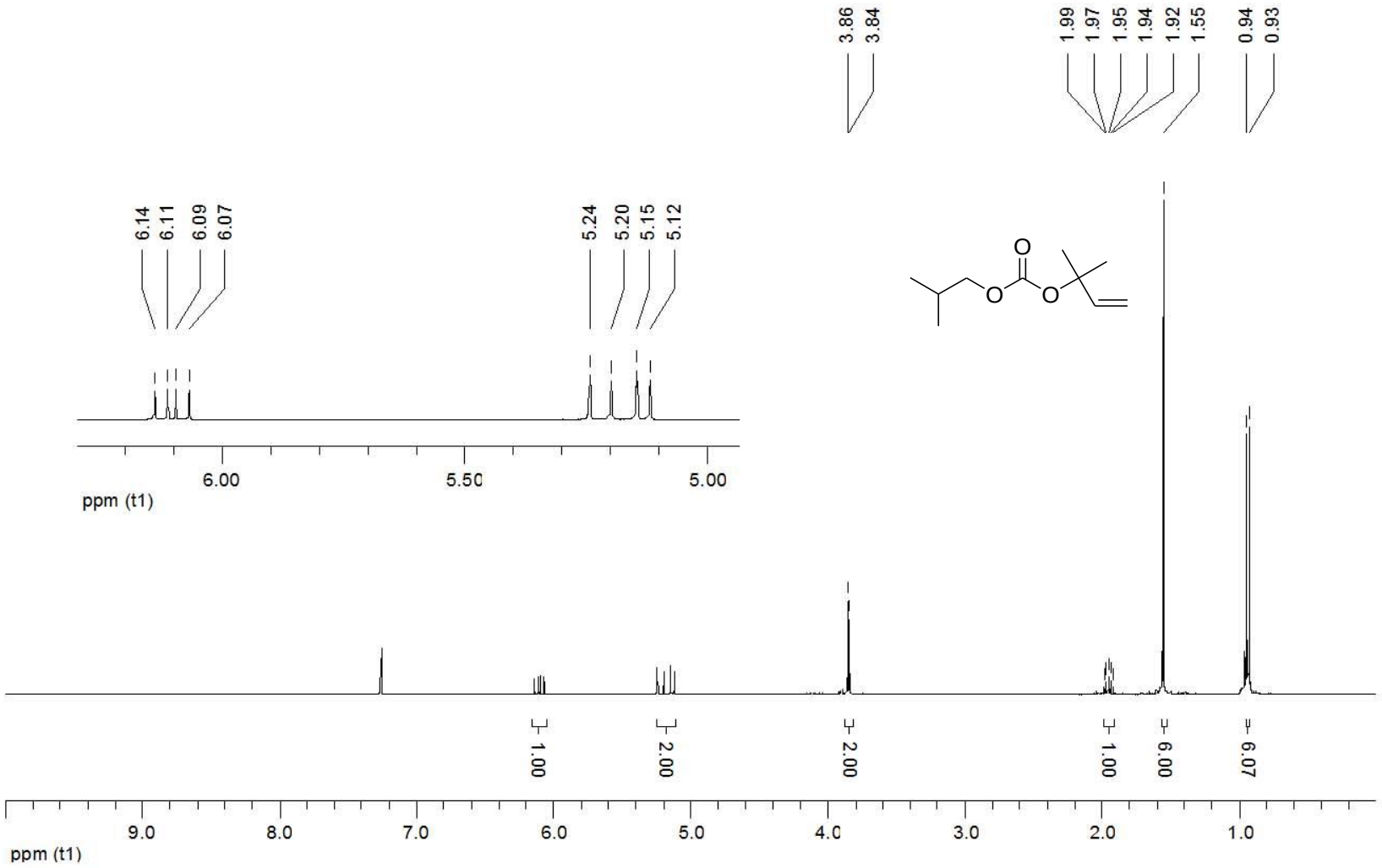
Amide 46. To a solution containing gambogic acid (6.1 mg, 9.70 μmol) and BODIPY FL EDA (3.95 mg, 10.7 μmol) in DCM (0.24 mL) was added DIPEA (3.38 μL, 19.4 μmol). Upon adding solid HATU (4.37 mg, 11.5 μmol) portionwise to the reaction mixture, the reaction mixture turned to pale yellow in color within 5 min. After 24 hours, the reaction mixture was diluted with ethyl acetate (5 mL) and washed with water (2 x 1 mL) and brine (2 mL). The organic layers were dried over $MgSO_4$, filtered and concentrated by rotary evaporation. The crude material was purified by preparative TLC (silica, 100% EtOAc) to yield the amide **46** (7.05 mg, 77%). **46**: red solid; R_f = 0.38 (100% EtOAc); ^{1}H NMR (400 MHz, $CDCl_3$): δ 7.51 (d, *J* = 6.9 Hz, 1H), 7.03 (s, 1H), 6.85 (d, *J* = 4.1 Hz, 1H), 6.68 (d, *J* = 10.2 Hz, 1H), 6.62 (m, 1H), 6.27 (d, *J* = 3.9 Hz, 1H), 6.09 (s, 1H), 3.49-3.15 (m, 7H), 2.64 (d, *J* = 6.9 Hz, 2H), 2.53 (s, 3H), 2.31-2.27 (m, 1H), 2.21 (s, 3H), 2.06-2.02 (m, 2H), 1.75-1.24 (m, 27H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 204.8, 178.9, 172.4, 169.5, 162.0, 157.9, 157.3, 135.8, 133.3, 132.1, 128.8, 125.2, 124.9, 124.0, 123.9, 122.2, 120.4, 117.9, 115.9, 108.0, 103.0, 100.5, 91.3, 84.5, 84.0, 81.8, 49.1, 46.9, 42.3, 39.9, 39.8, 35.8, 30.1, 29.9, 29.2, 29.0, 28.1, 25.9, 25.4, 24.9, 22.9, 21.8, 21.4, 18.4, 17.9, 15.1, 11.5; HRMS calc. for $C_{54}H_{63}BF_2N_4O_8S$ $(M + H)^+$ 944.4816, found 944.4860.



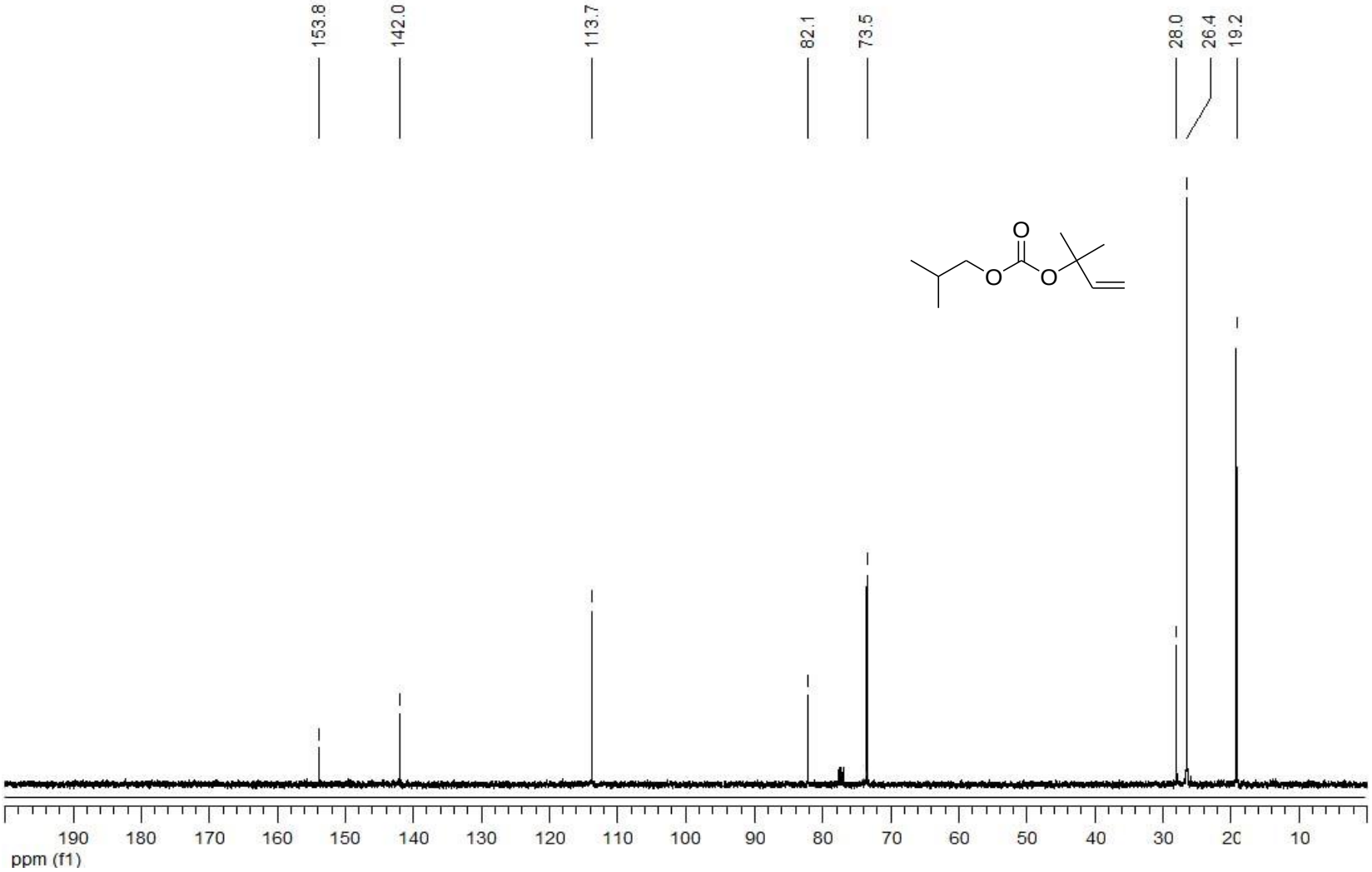
Spectrum 1: ^{1}H NMR ($CDCl_3$, 400 MHz) of compound 9.



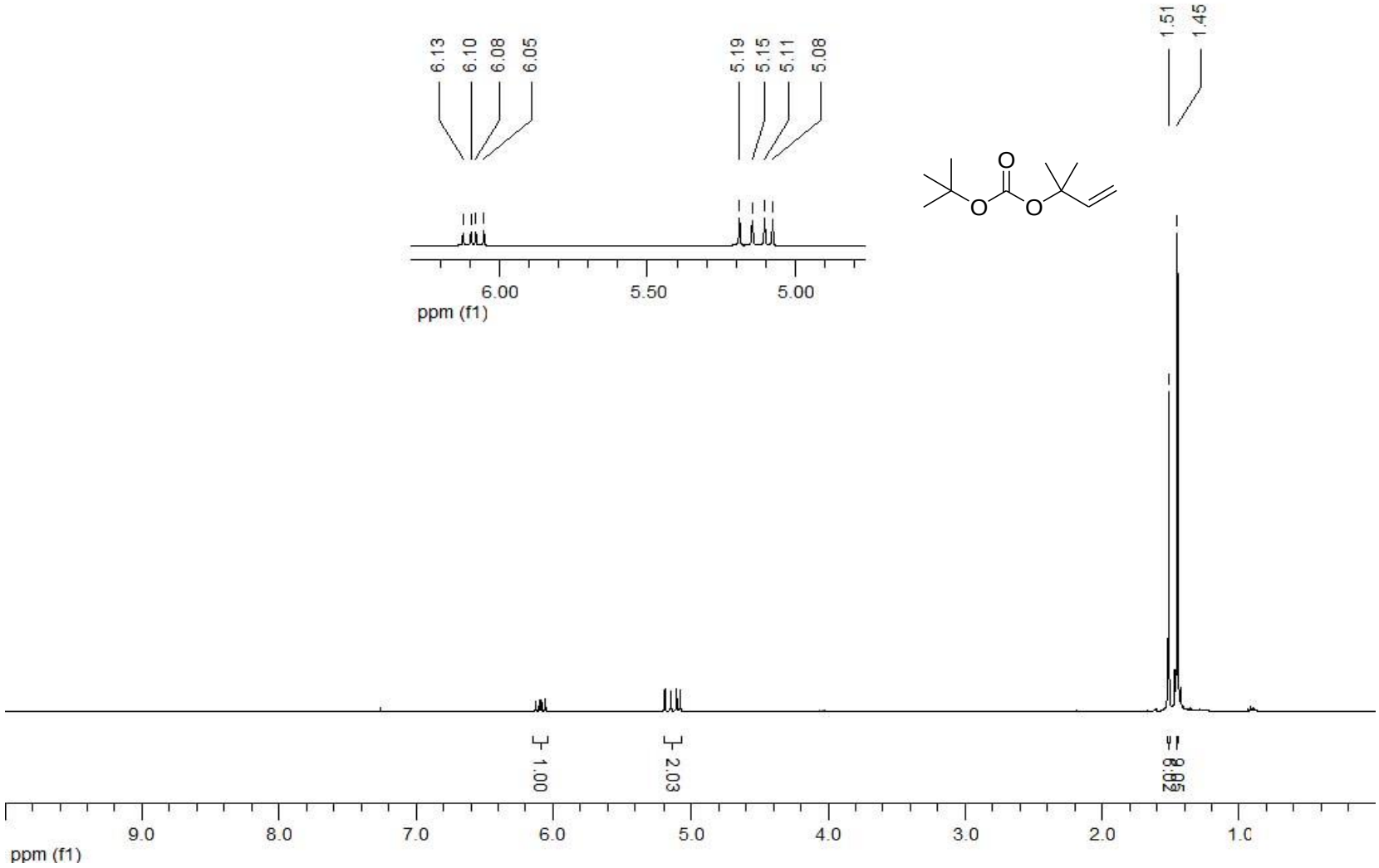
Spectrum 2: ^{13}C NMR ($CDCl_3$, 100 MHz) of compound 9.



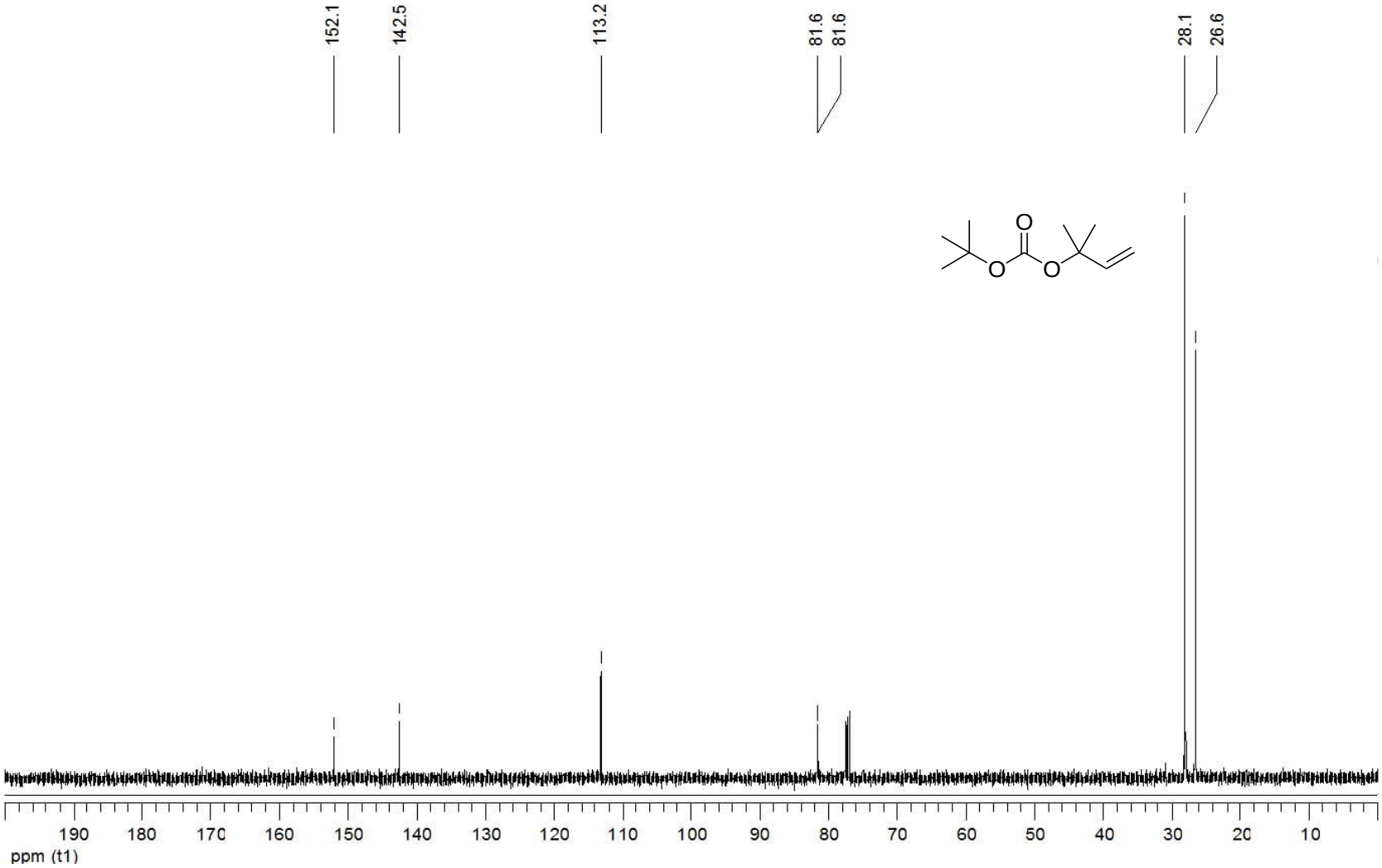
Spectrum 3: ^{1}H NMR ($CDCl_3$, 400 MHz) of compound 10a.



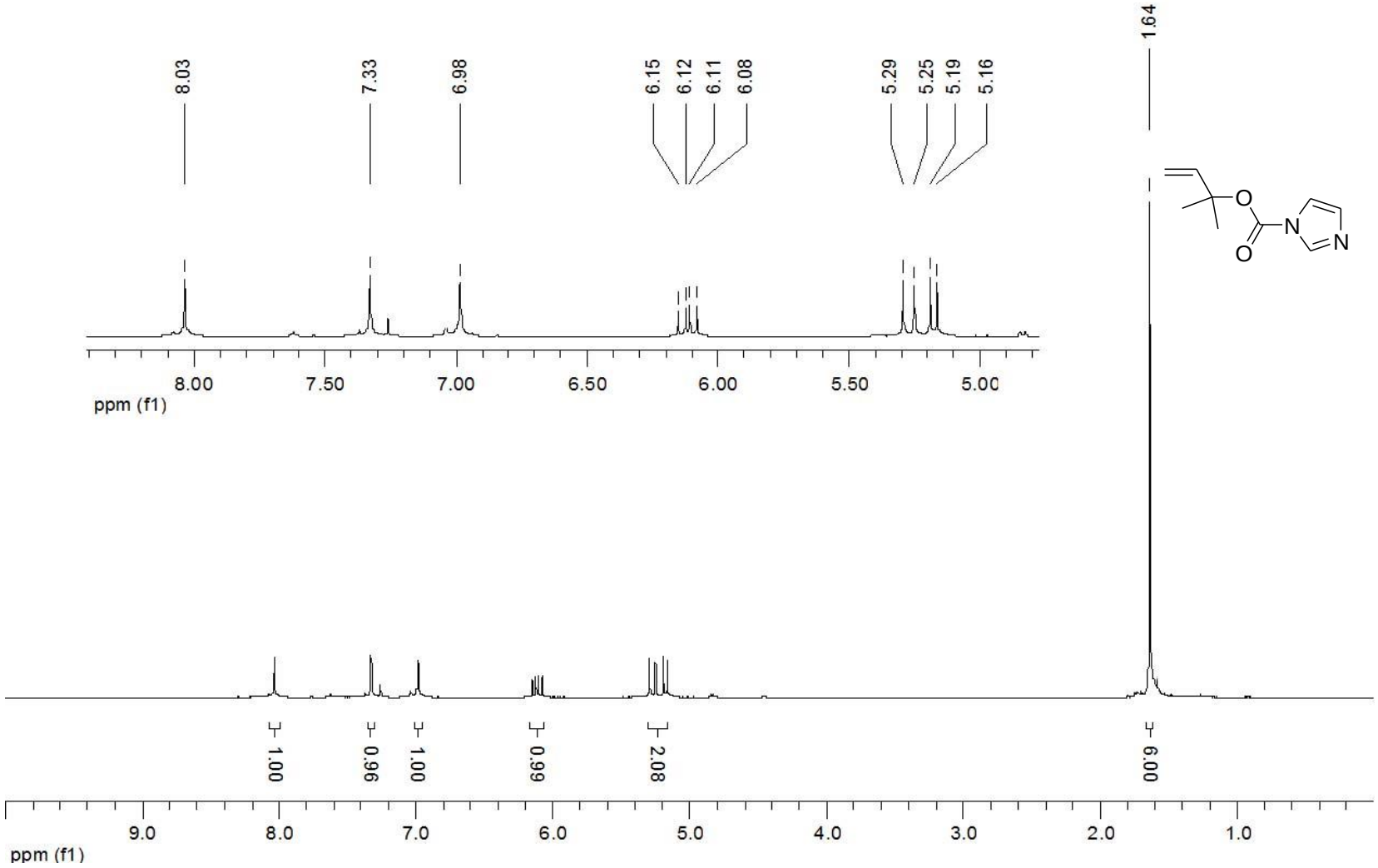
Spectrum 4: ^{13}C NMR ($CDCl_3$, 100 MHz) of compound 10a.



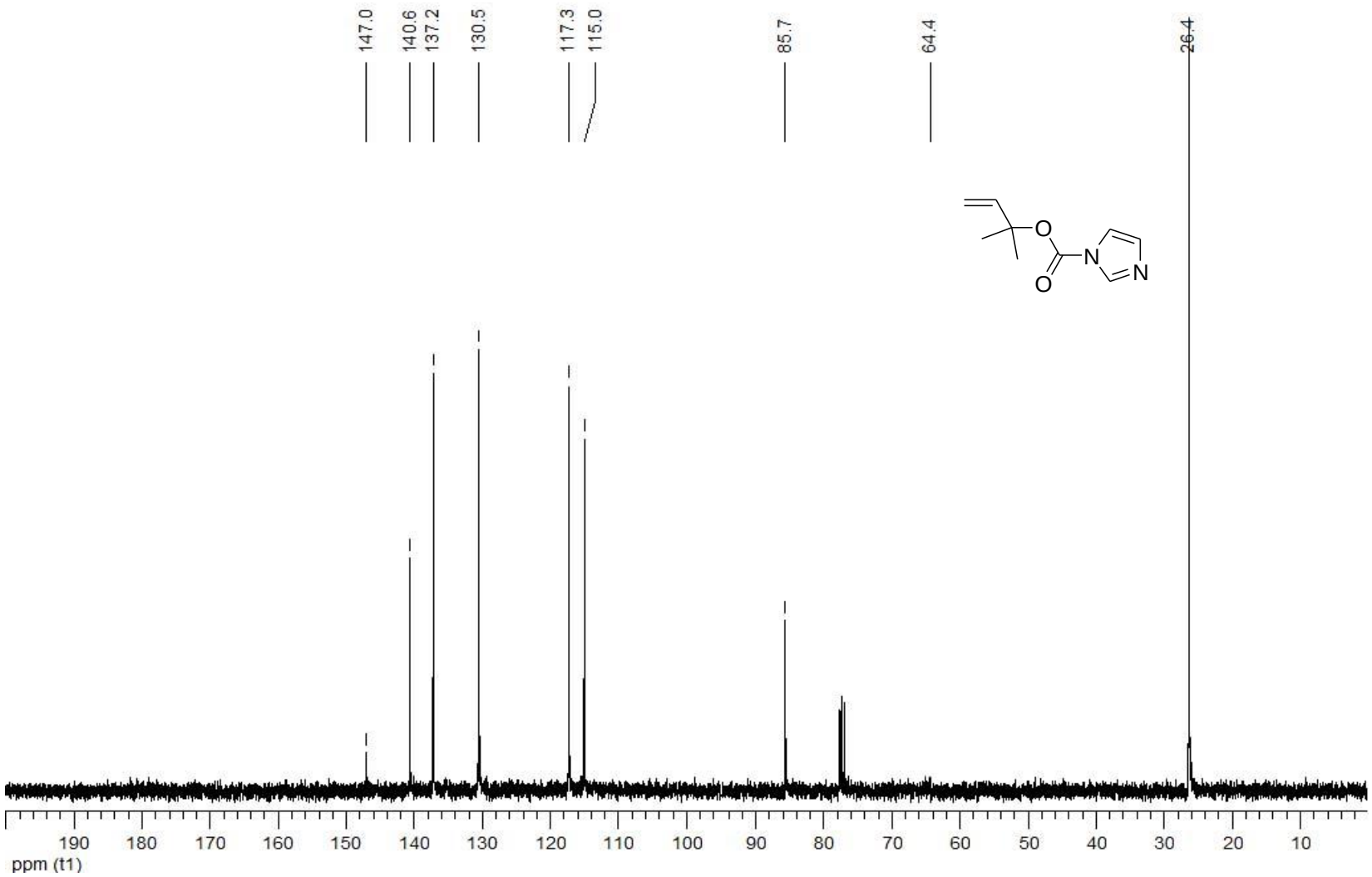
Spectrum 5: ^{1}H NMR ($CDCl_3$, 400 MHz) of compound 10b.



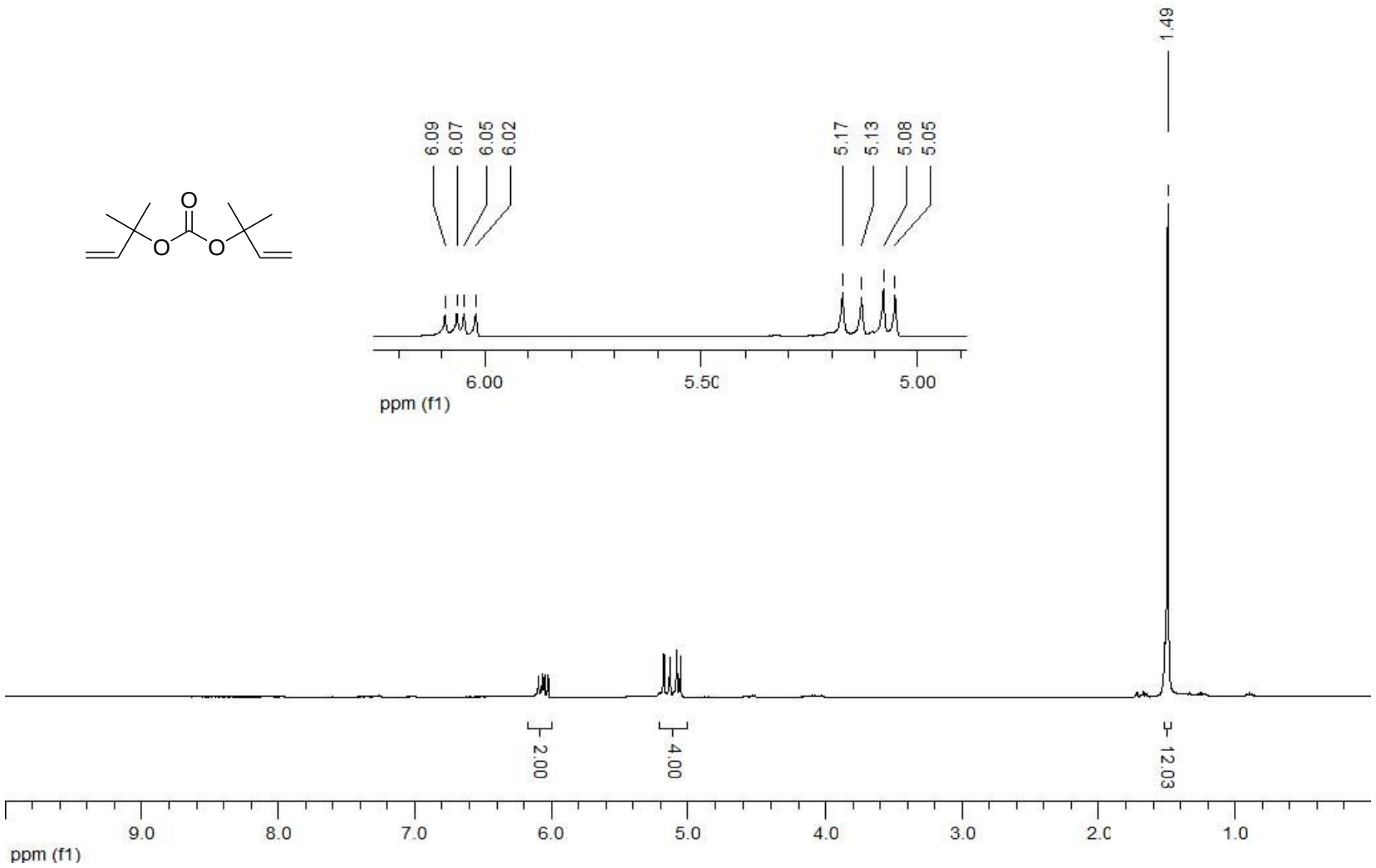
Spectrum 6: ^{13}C NMR ($CDCl_3$, 100 MHz) of compound 10b.



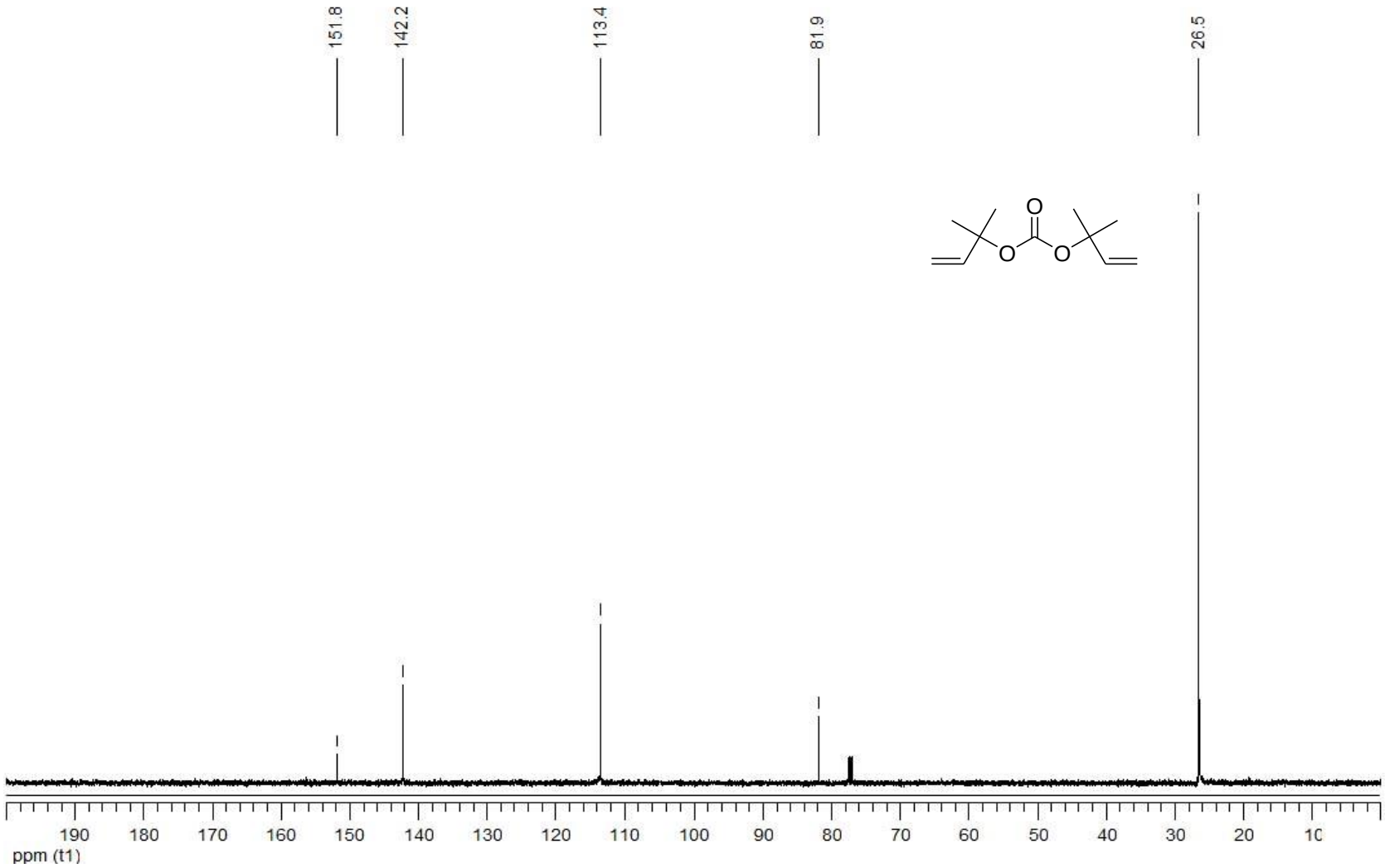
Spectrum 7: ^{1}H NMR ($CDCl_3$, 400 MHz) of precursor of compound 10c.



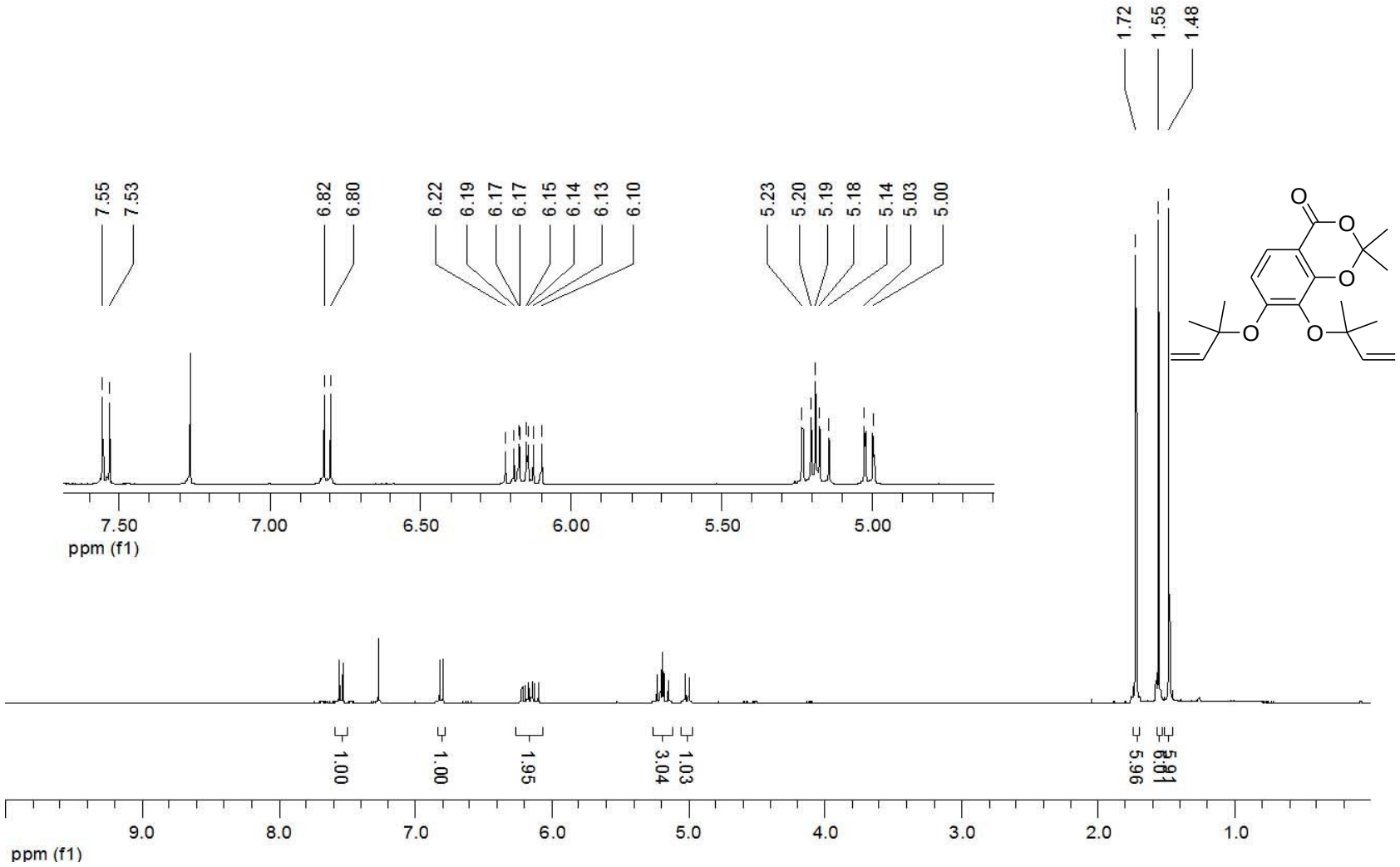
Spectrum 8: ^{13}C NMR ($CDCl_3$, 100 MHz) of precursor of compound 10c.



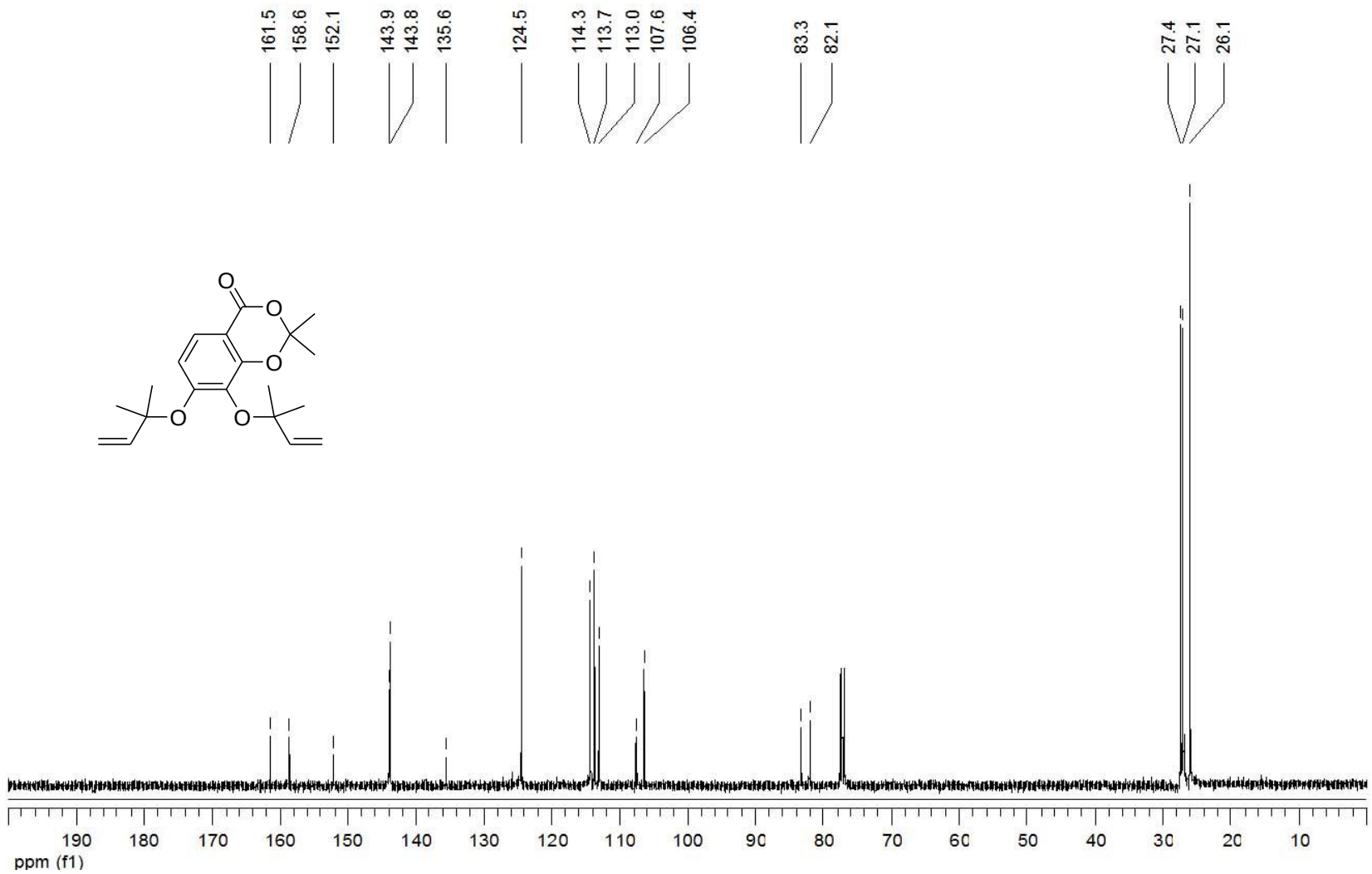
Spectrum 9: ^{1}H NMR ($CDCl_3$, 400 MHz) of compound 10c.



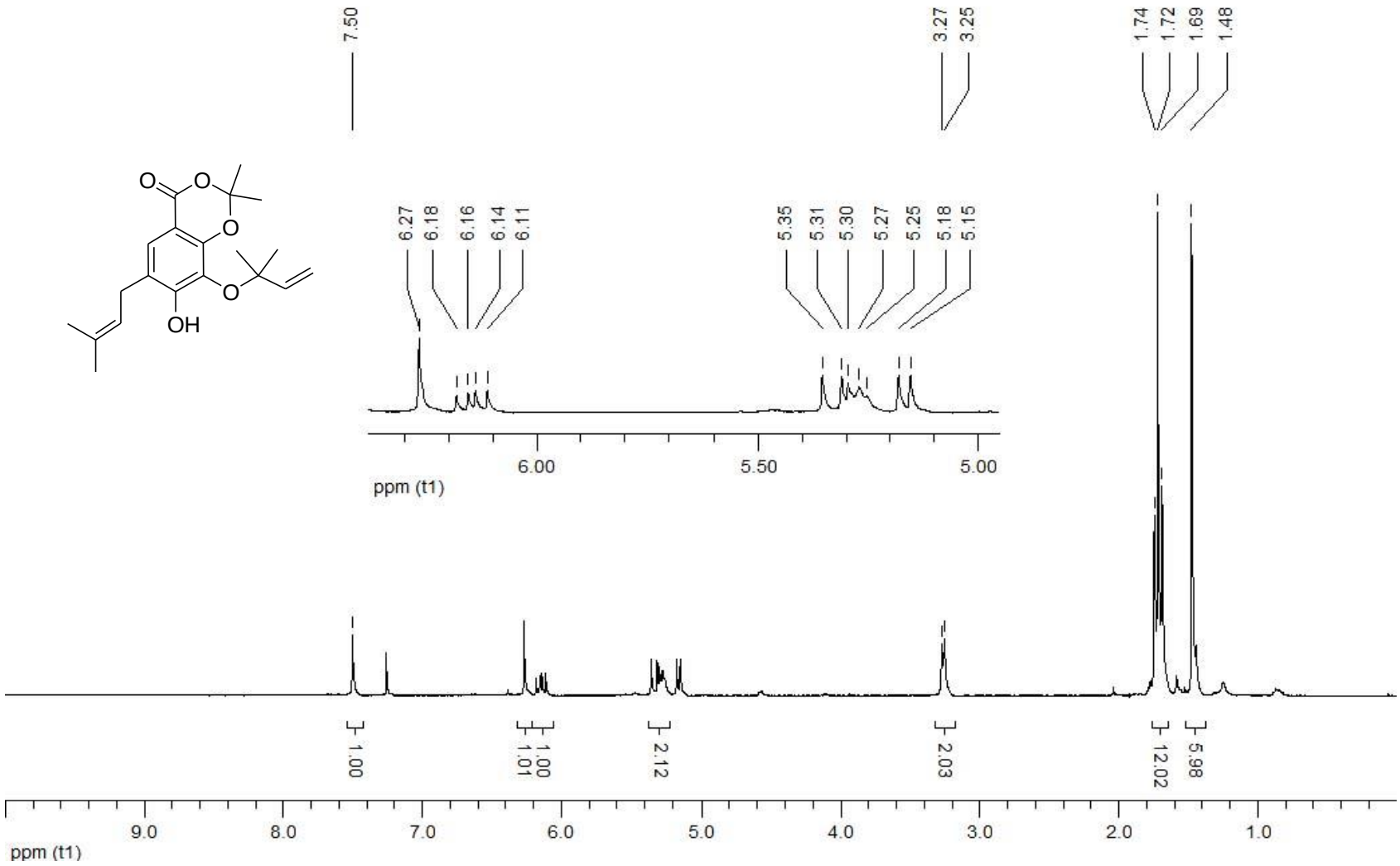
Spectrum 10: ^{13}C NMR ($CDCl_3$, 100 MHz) of compound 10c.



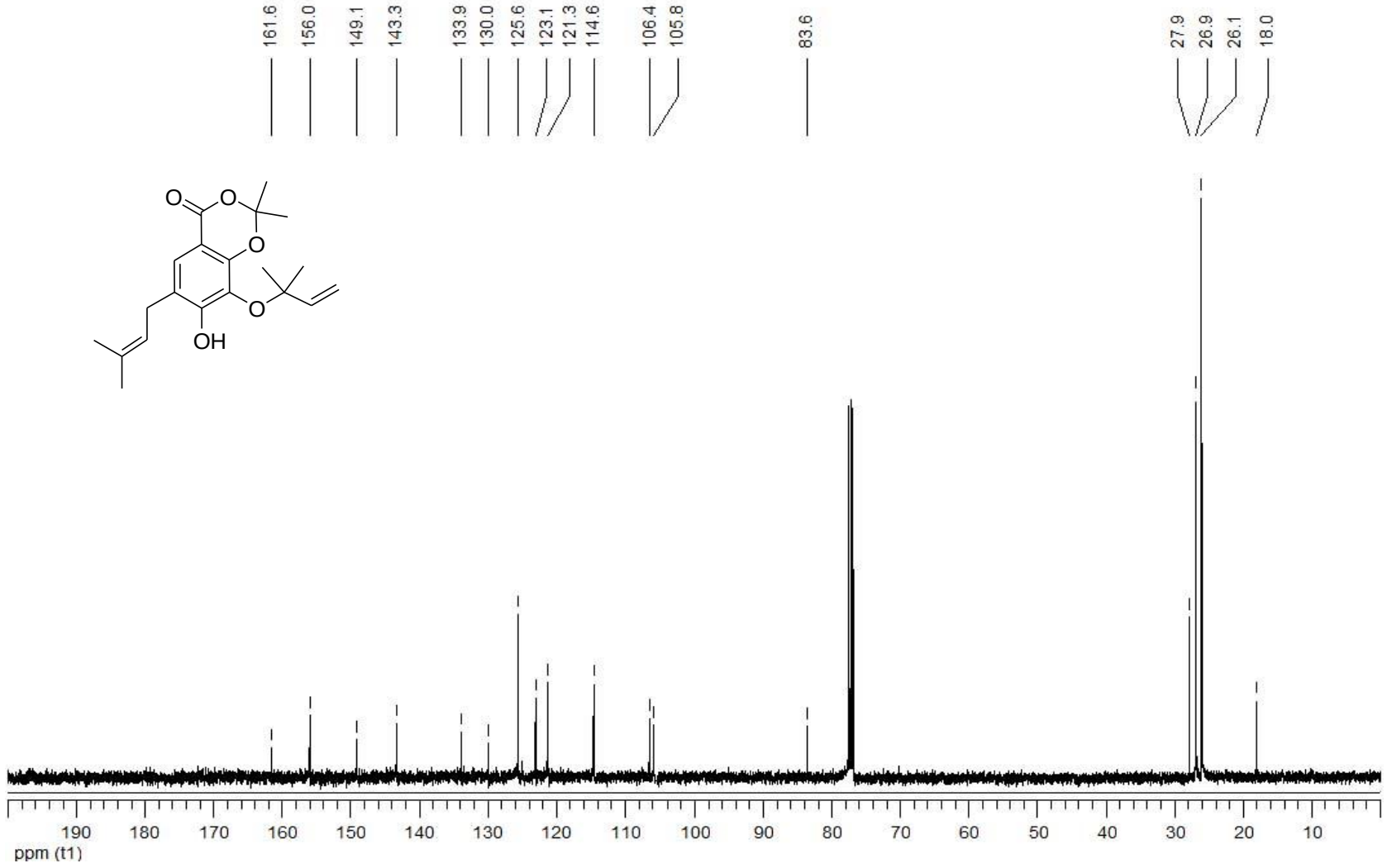
Spectrum 11: ^{1}H NMR ($CDCl_3$, 400 MHz) of compound 11.



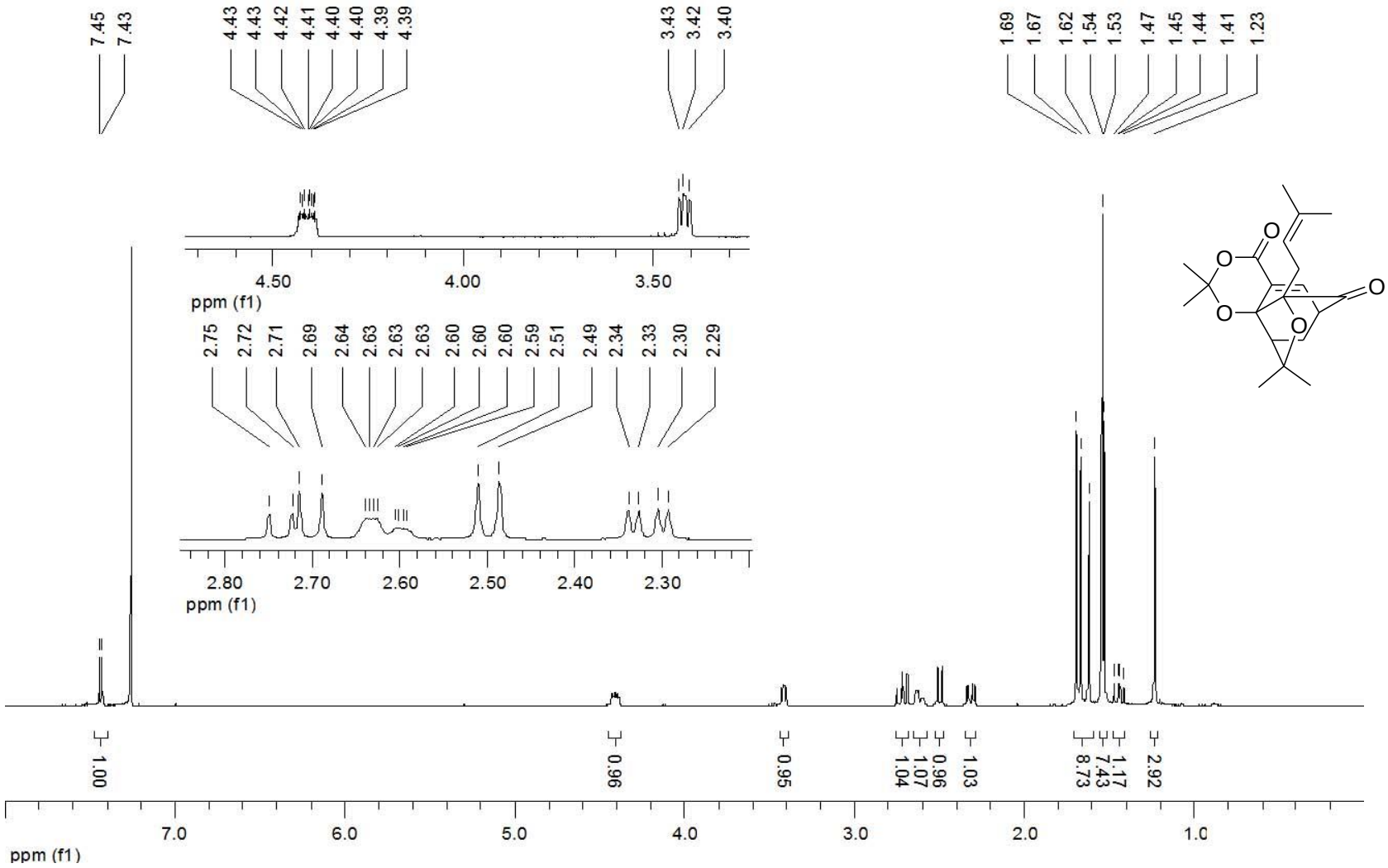
Spectrum 12: ^{13}C NMR ($CDCl_3$, 100 MHz) of compound 11.



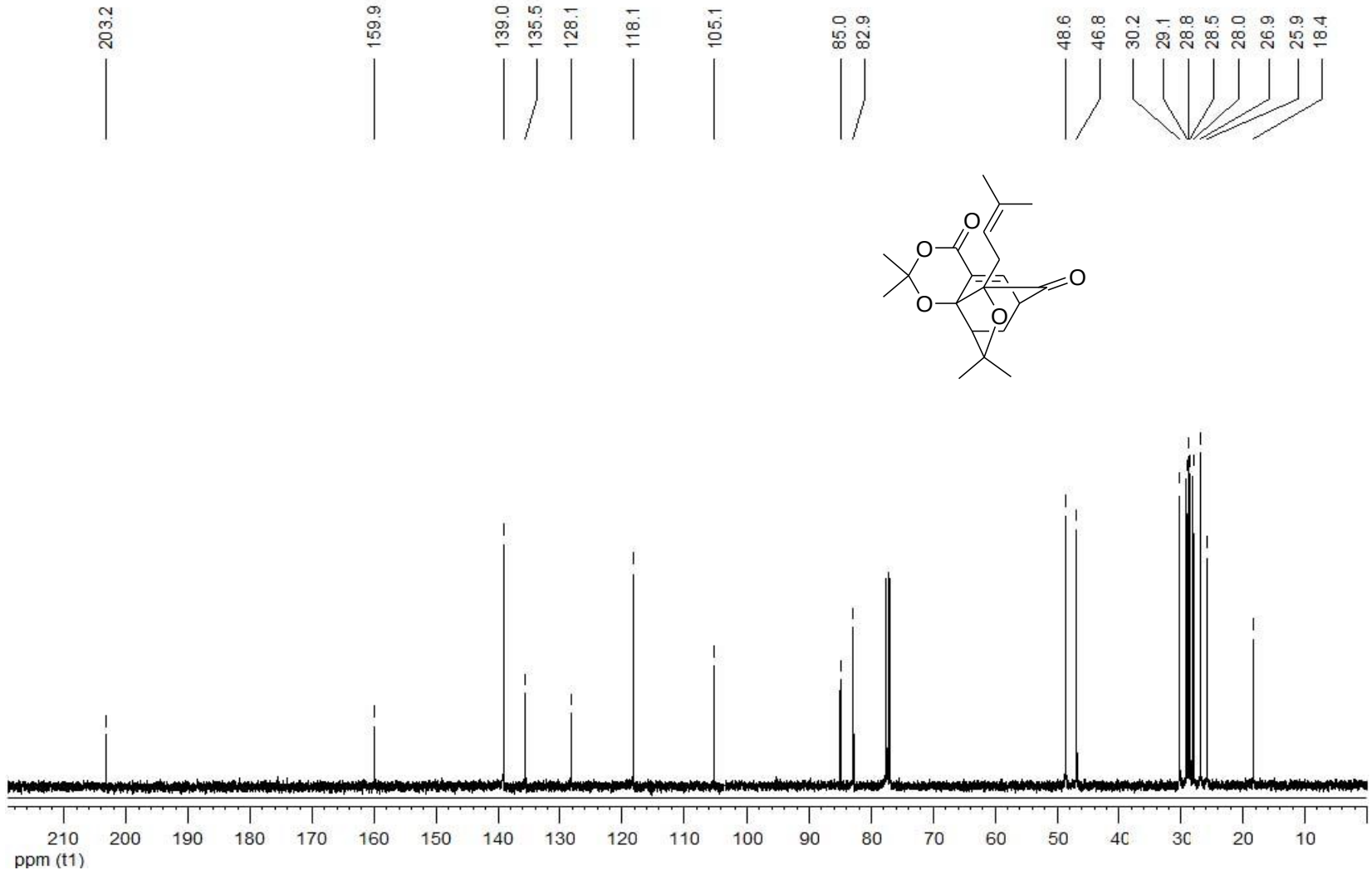
Spectrum 13: ^{1}H NMR ($CDCl_3$, 400 MHz) of compound 14.



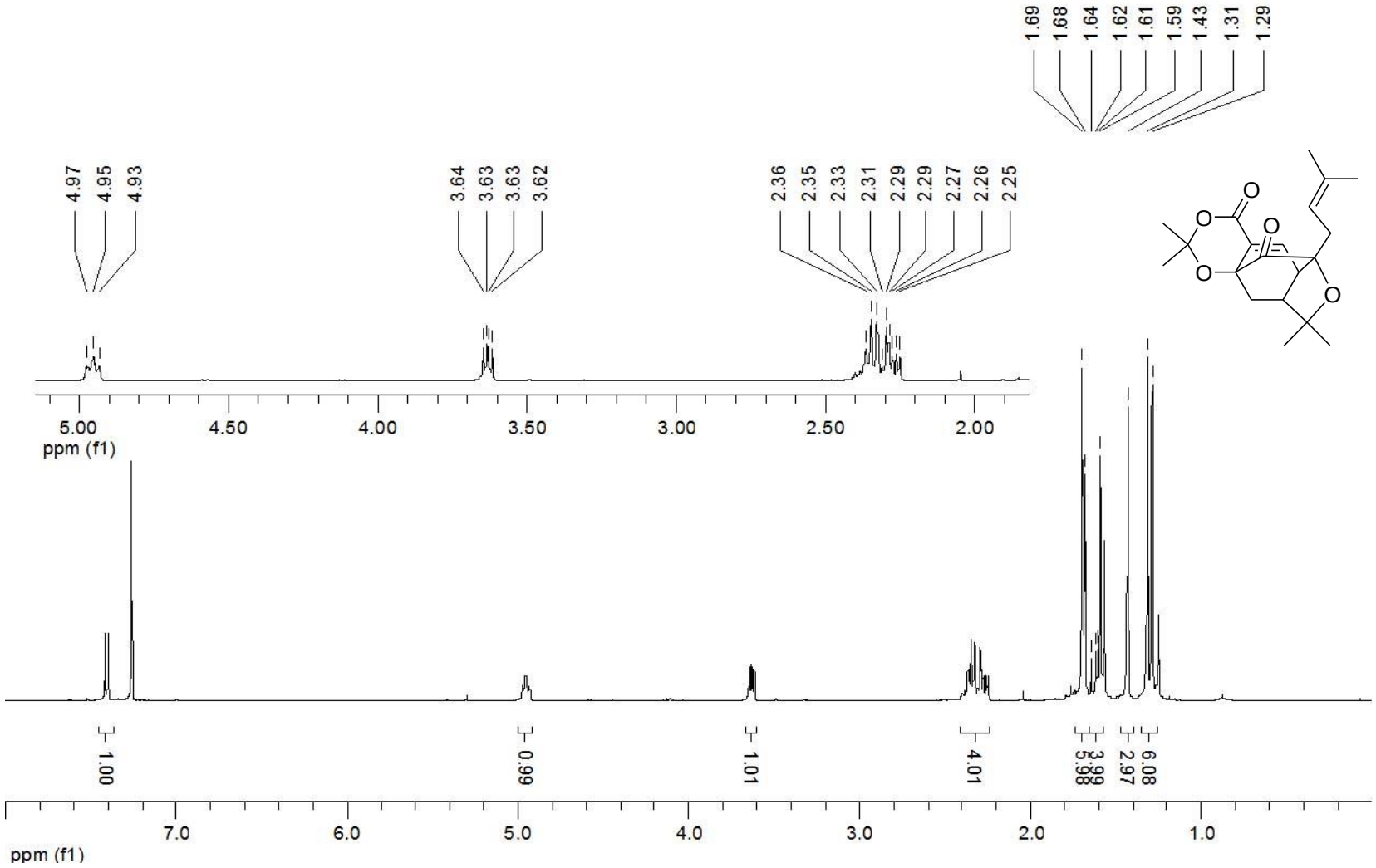
Spectrum 14: ^{13}C NMR ($CDCl_3$, 100 MHz) of compound 14.



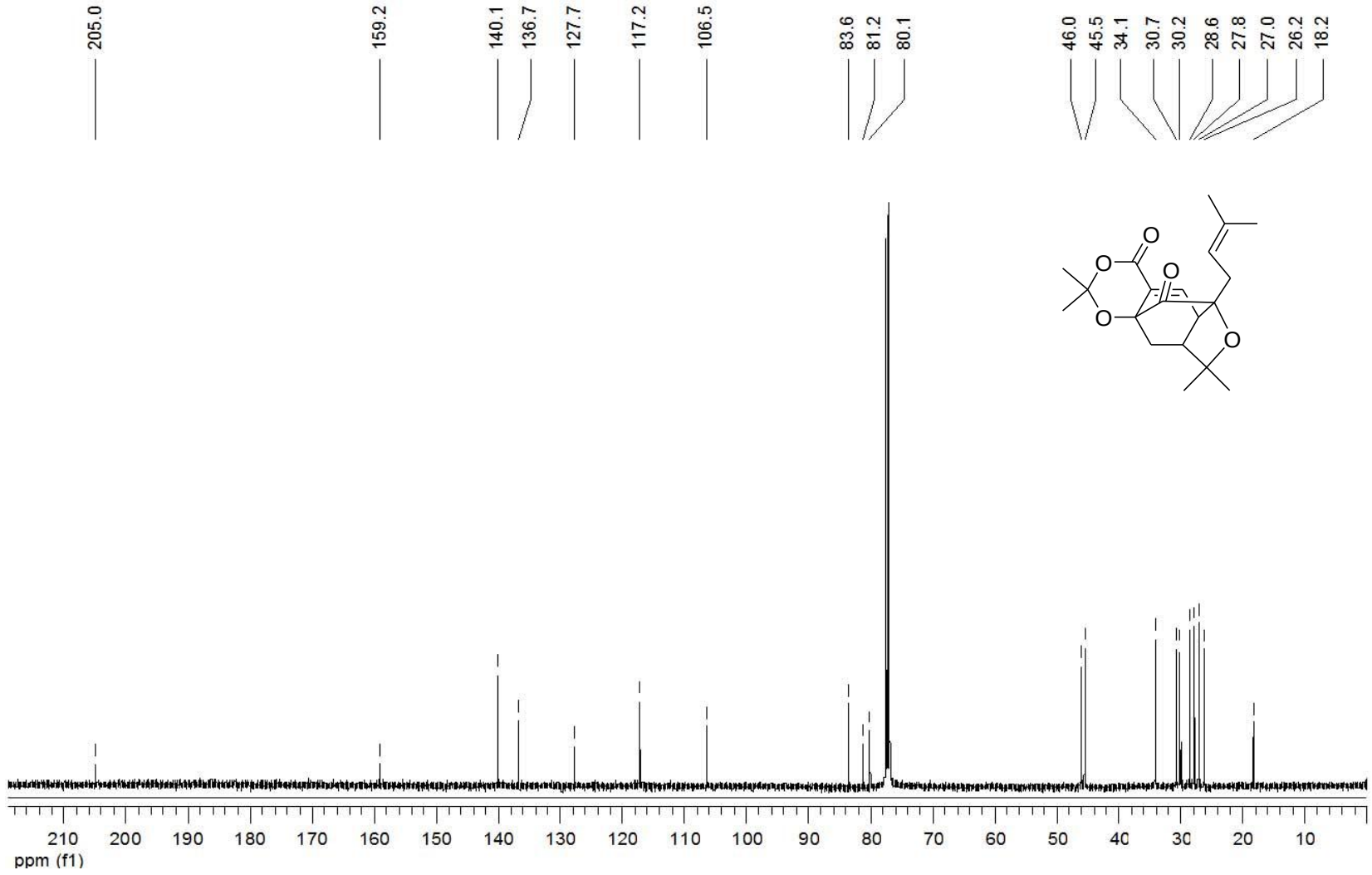
Spectrum 15: ^{1}H NMR ($CDCl_3$, 400 MHz) of compound 15.



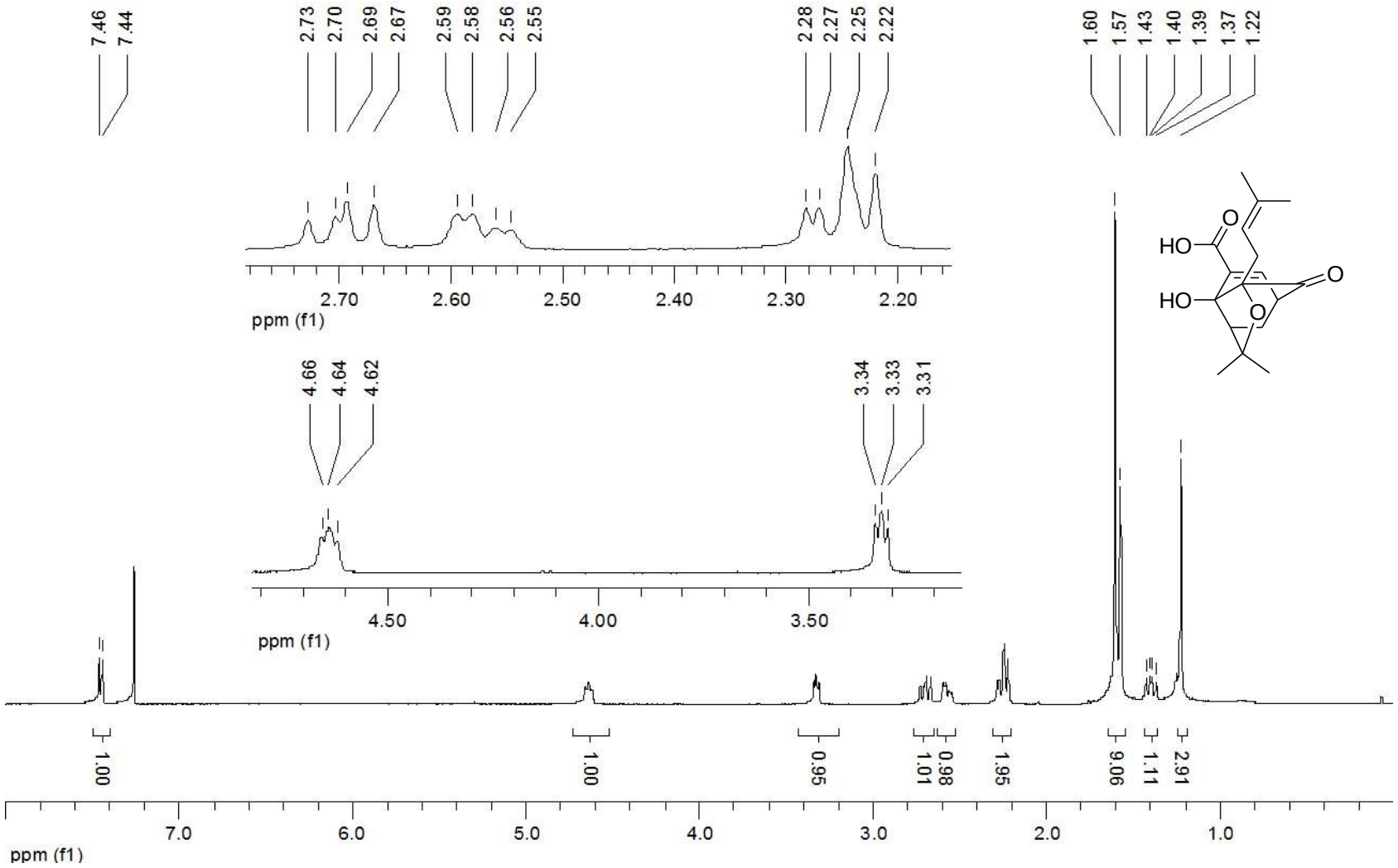
Spectrum 16: ^{13}C NMR ($CDCl_3$, 100 MHz) of compound 15.



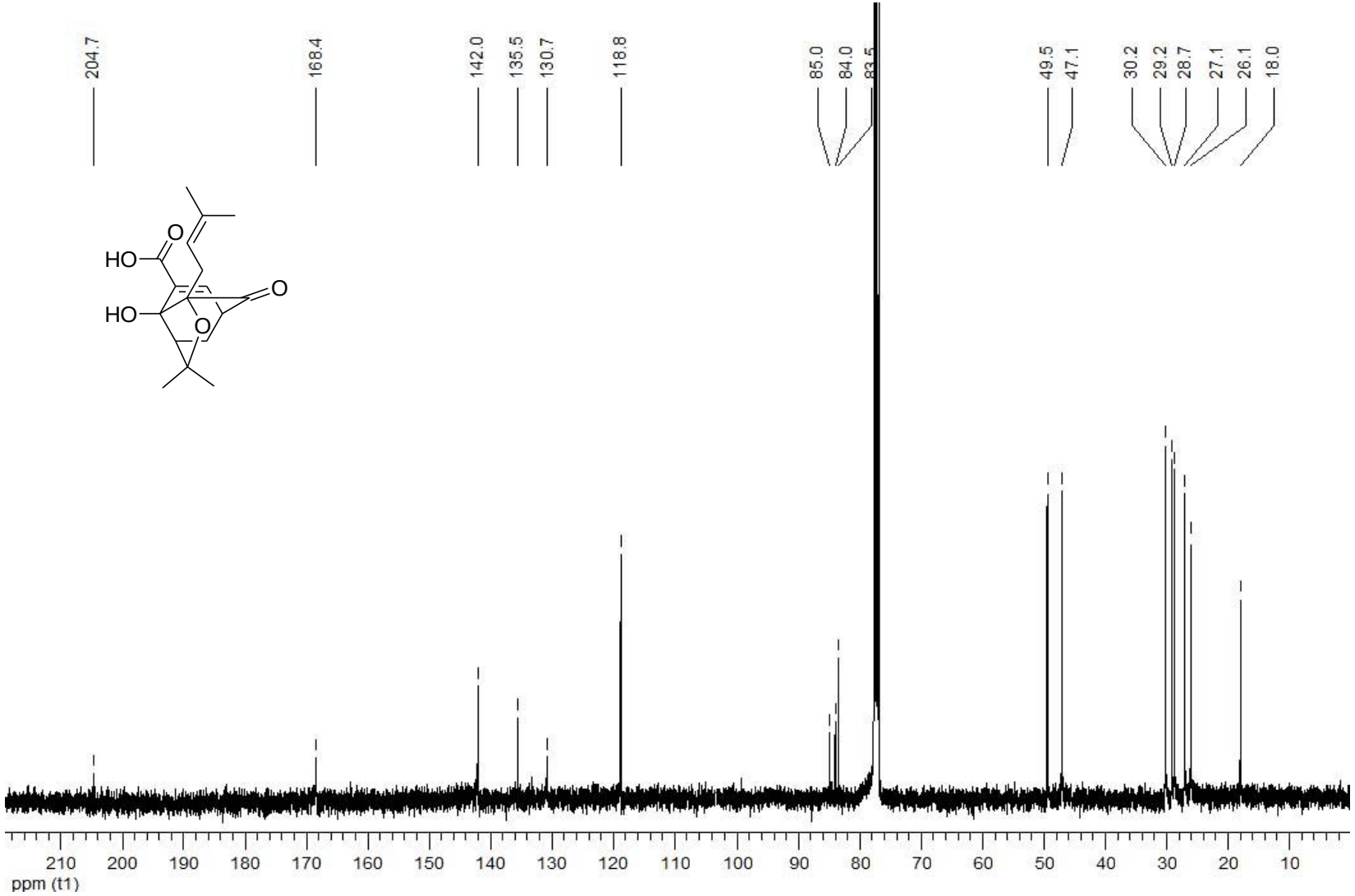
Spectrum 17: ^{1}H NMR ($CDCl_3$, 400 MHz) of compound 16.



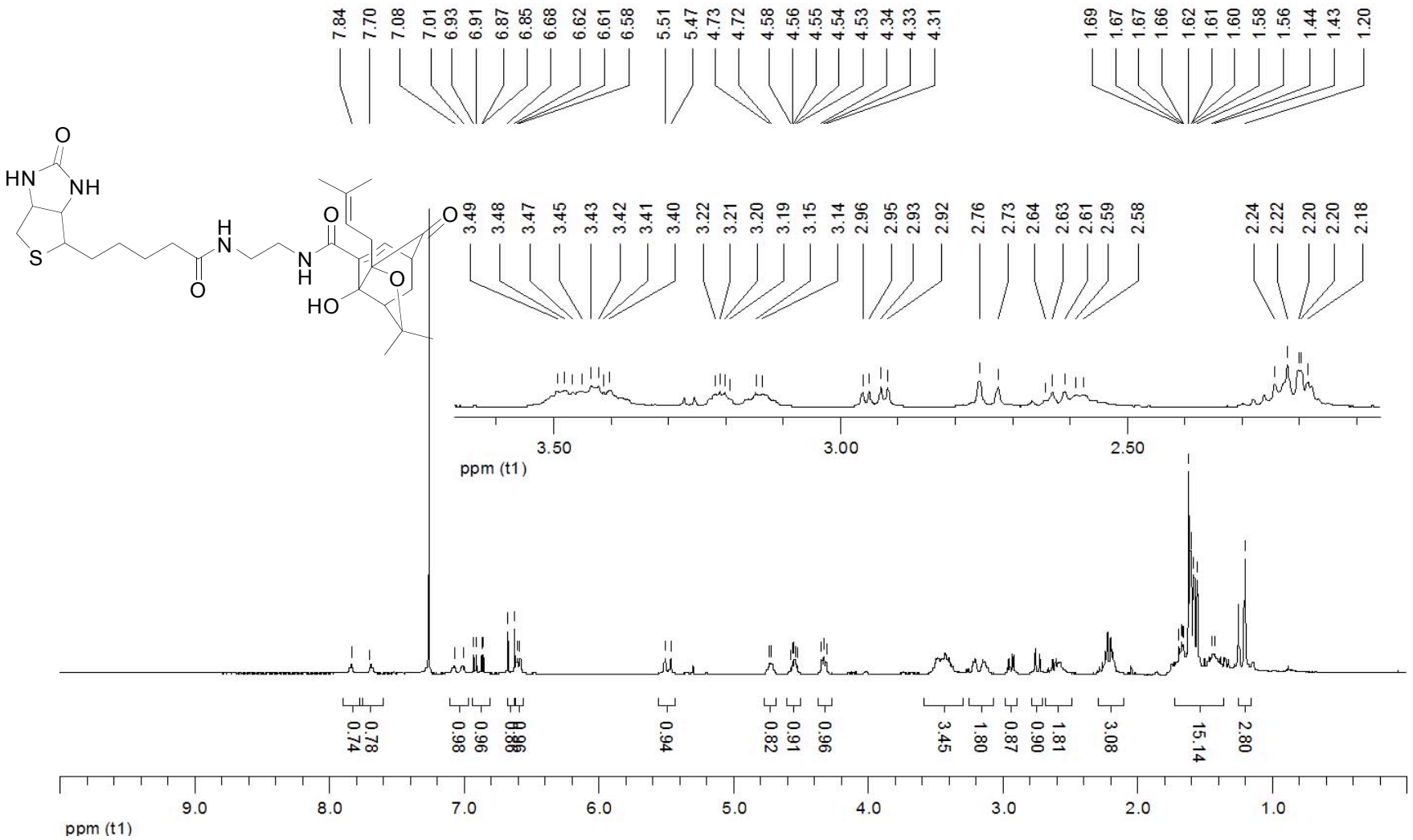
Spectrum 18: ^{13}C NMR ($CDCl_3$, 100 MHz) of compound 16.



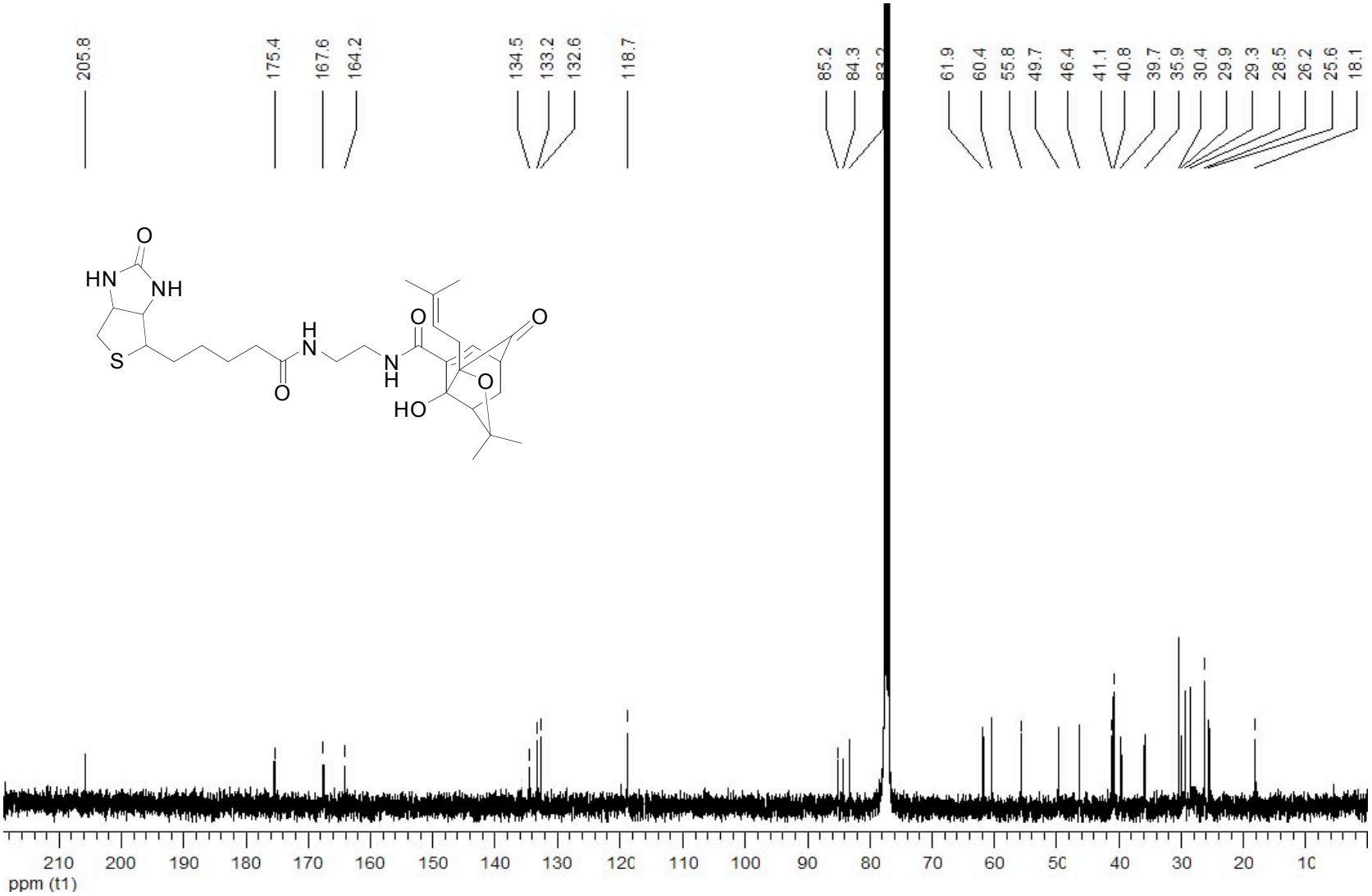
Spectrum 19: ^{1}H NMR ($CDCl_3$, 400 MHz) of compound 17.



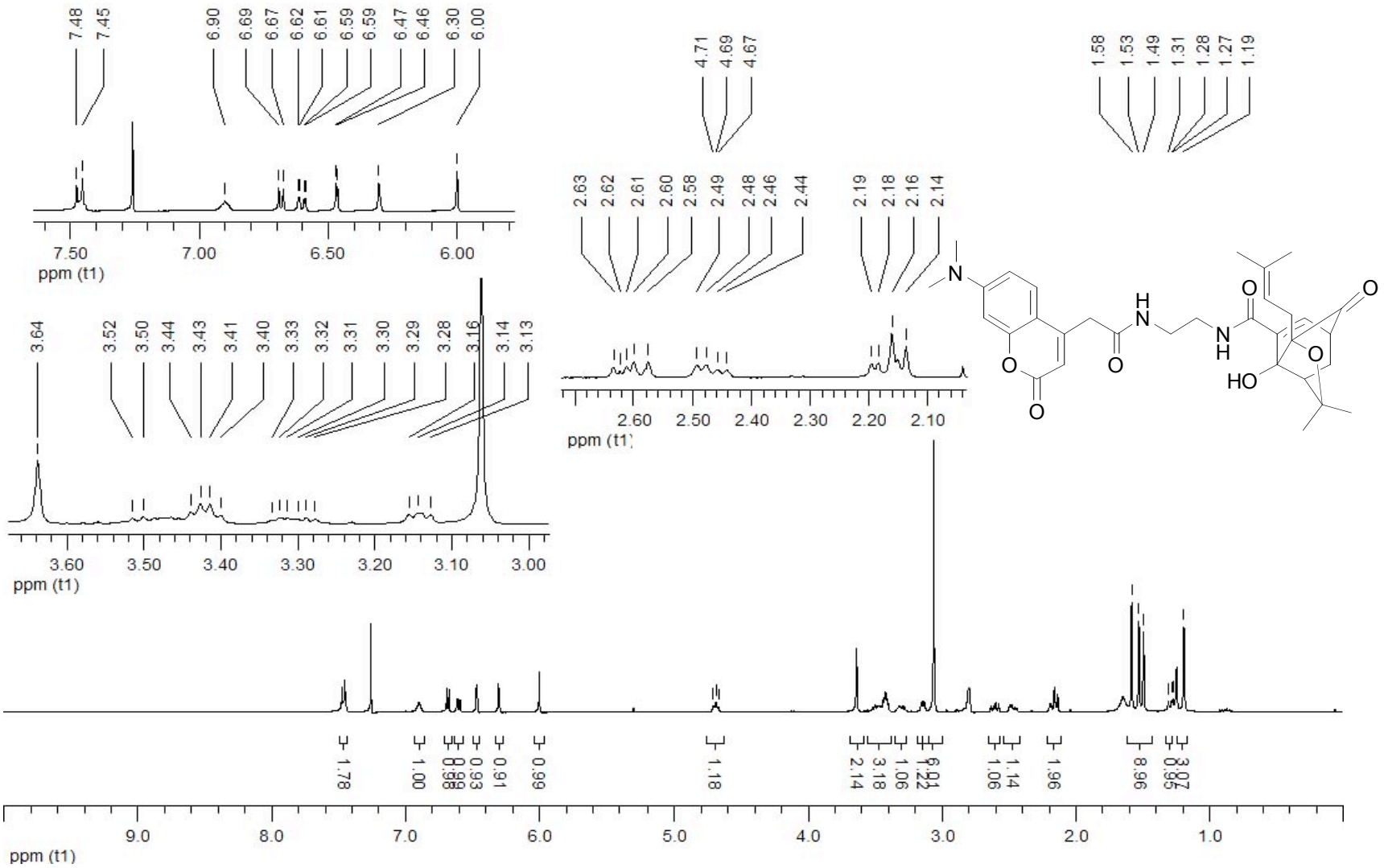
Spectrum 20: ^{13}C NMR ($CDCl_3$, 100 MHz) of compound 17.



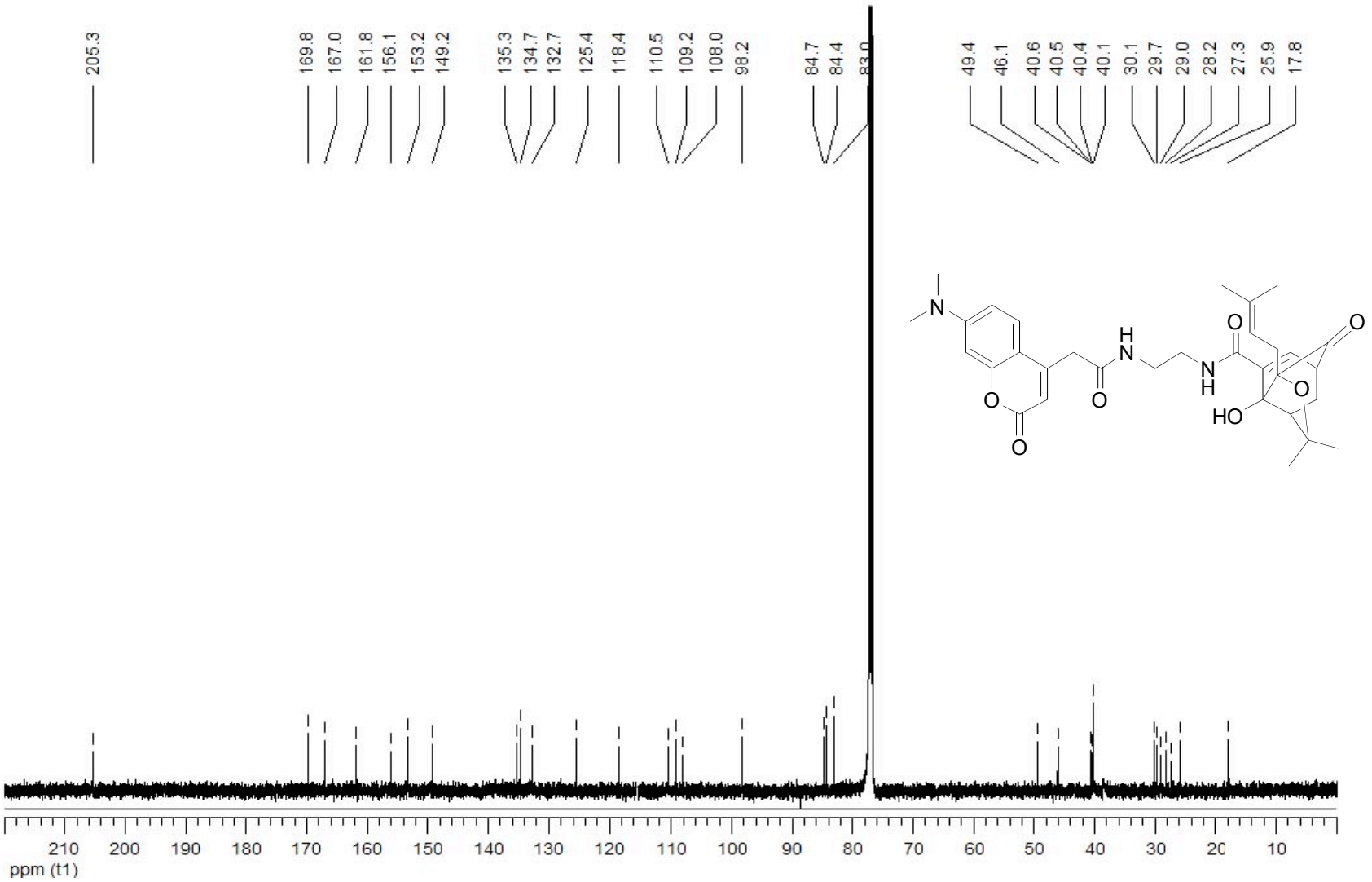
Spectrum 21: ^{1}H NMR ($CDCl_3$, 400 MHz) of compound 18.



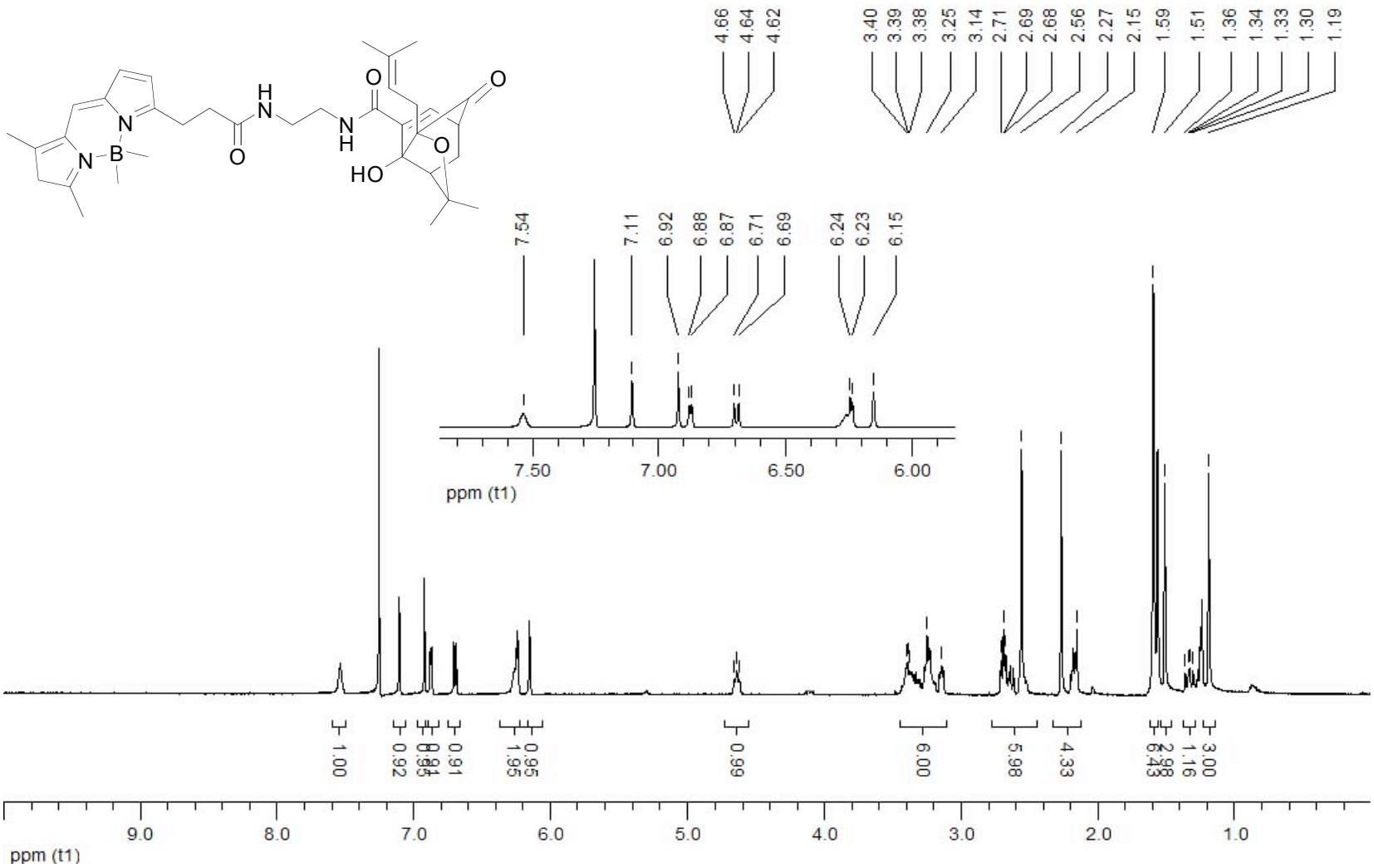
Spectrum 22: ^{13}C NMR ($CDCl_3$, 100 MHz) of compound 18.



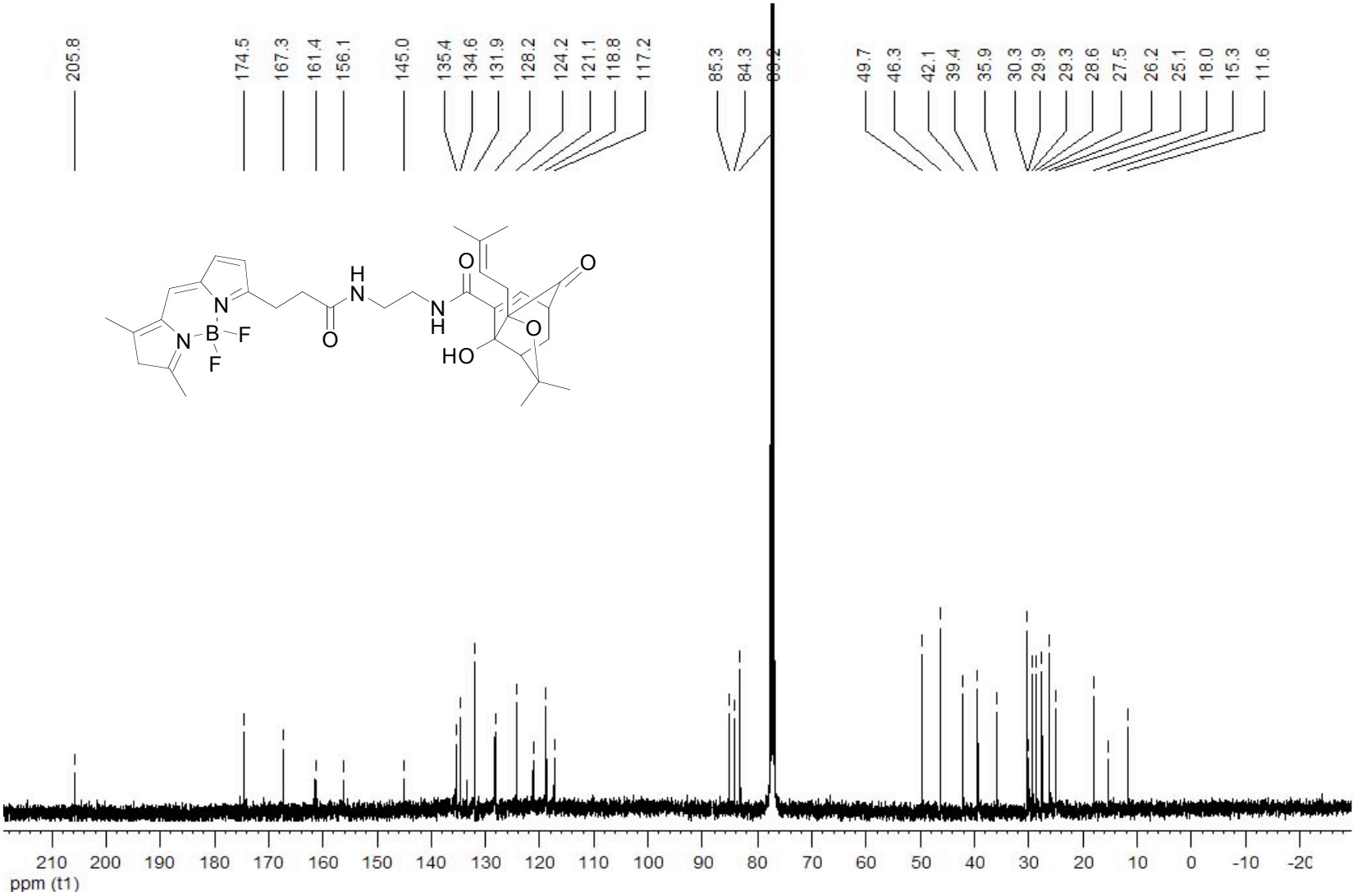
Spectrum 23: ^{1}H NMR ($CDCl_3$, 400 MHz) of compound 19.



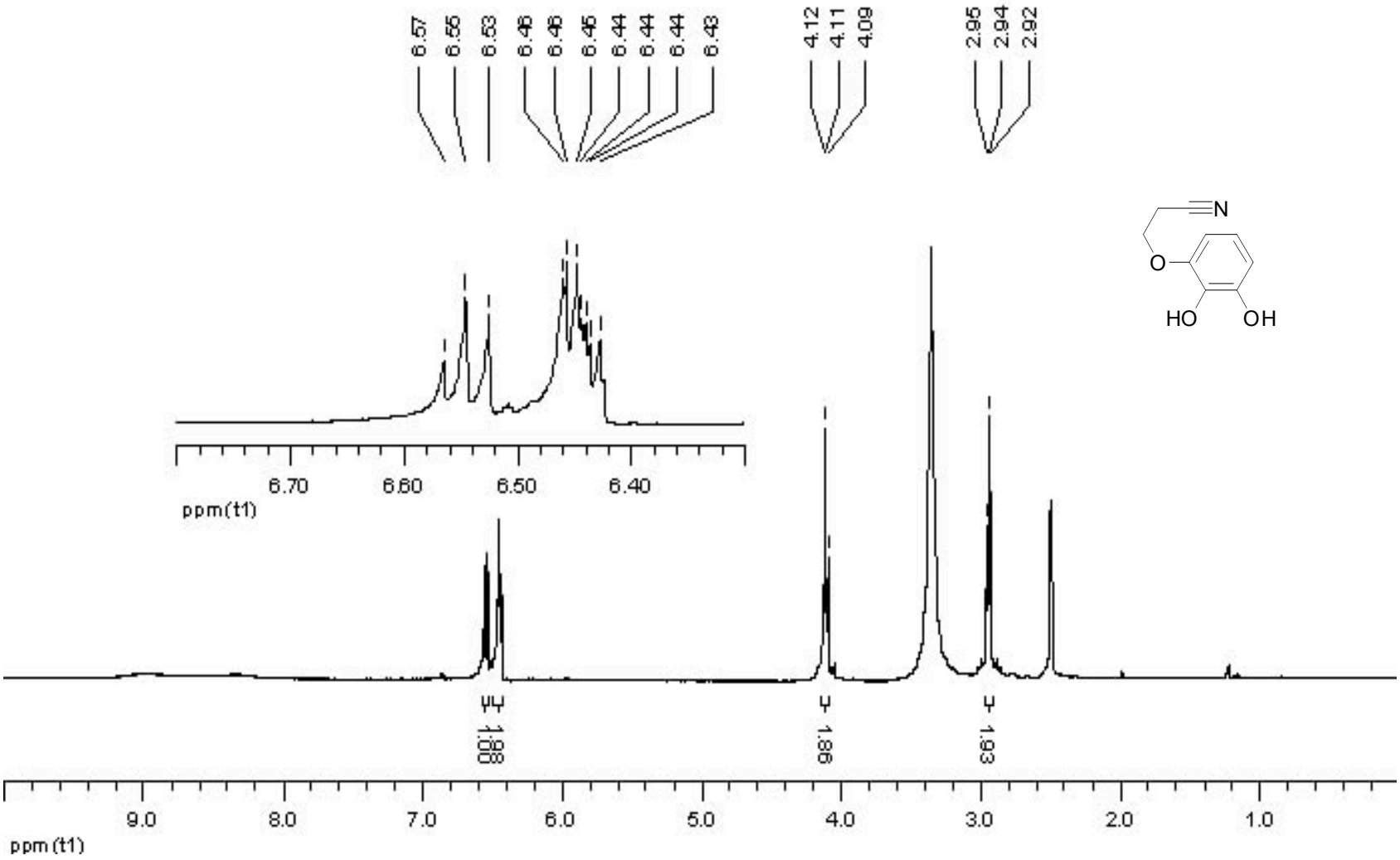
Spectrum 24: ^{13}C NMR ($CDCl_3$, 100 MHz) of compound 19.



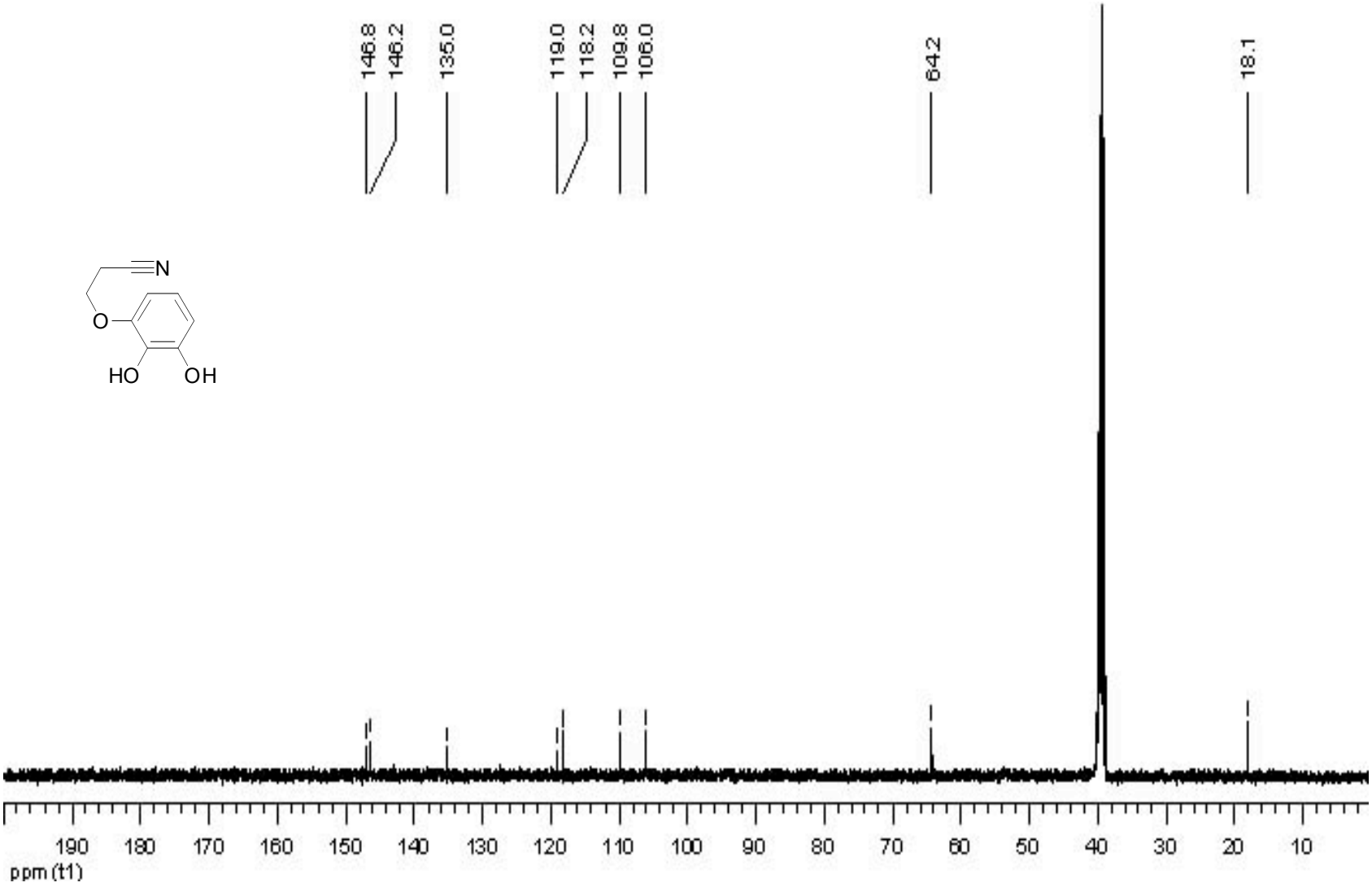
Spectrum 25: ^{1}H NMR ($CDCl_3$, 400 MHz) of compound 20.



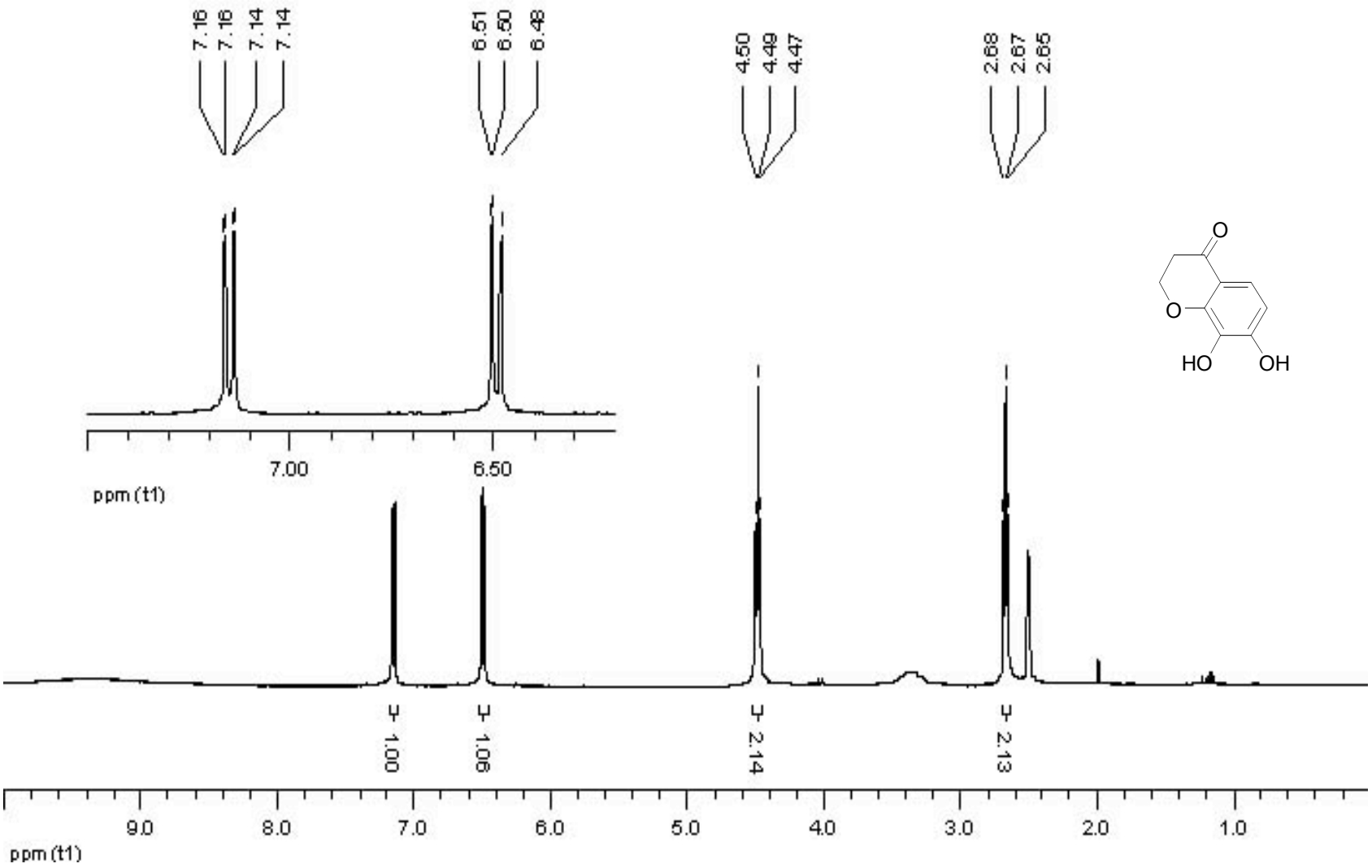
Spectrum 26: ^{13}C NMR ($CDCl_3$, 100 MHz) of compound 20.



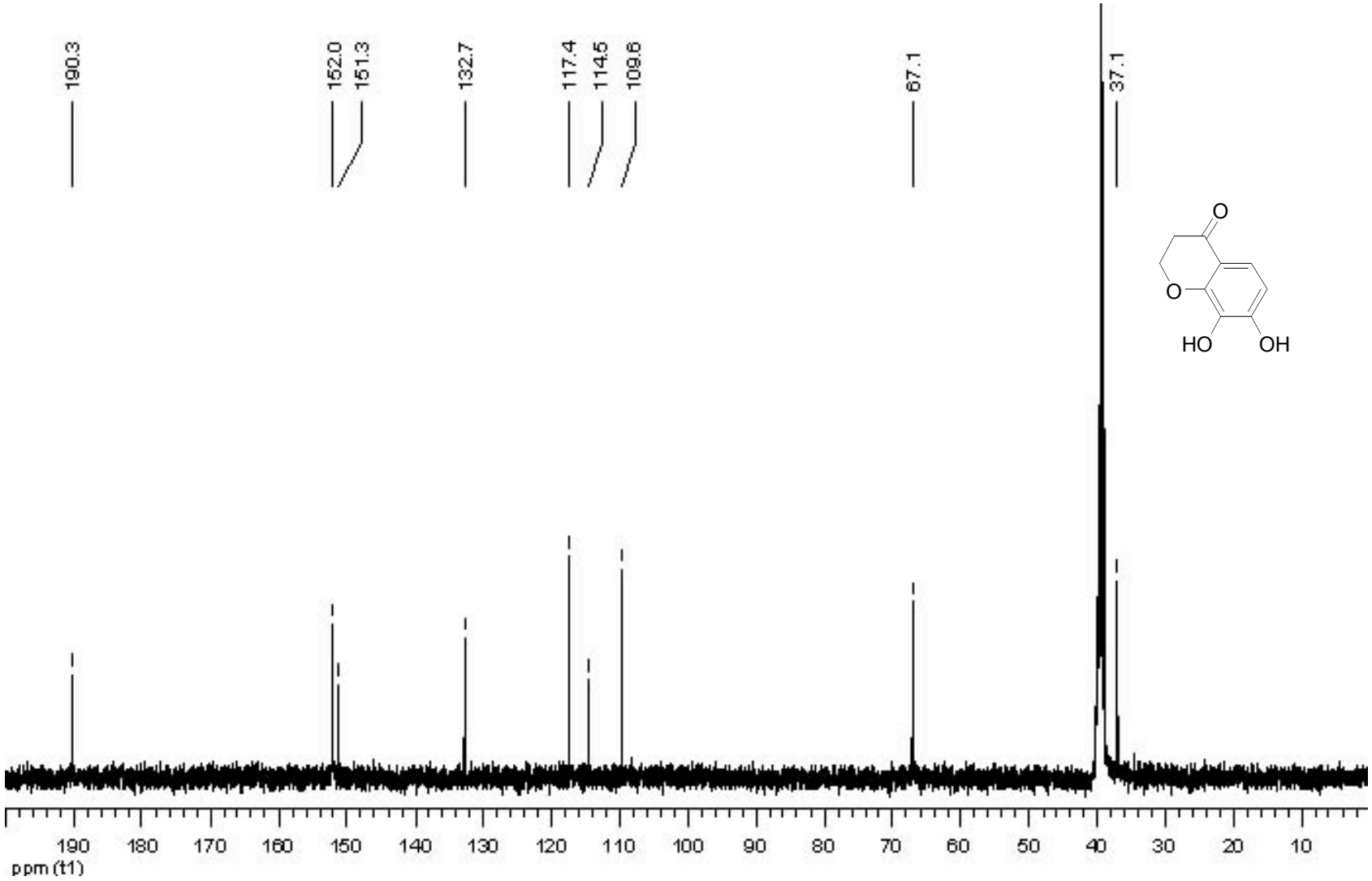
Spectrum 27: ^{1}H NMR (DMSO-d6, 400 MHz) of compound 22.



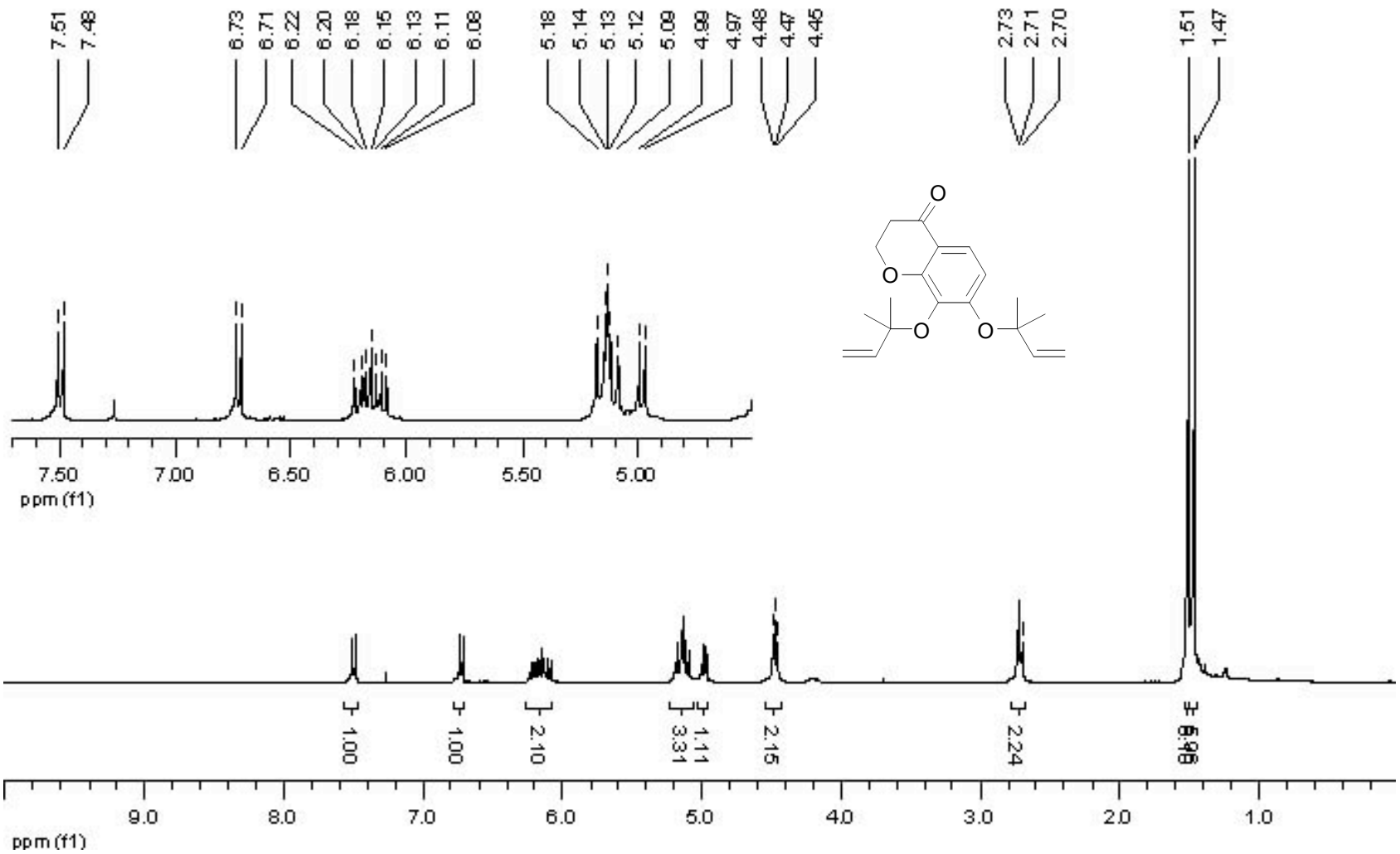
Spectrum 28: ^{13}C NMR (DMSO-d6, 100 MHz) of compound 22.



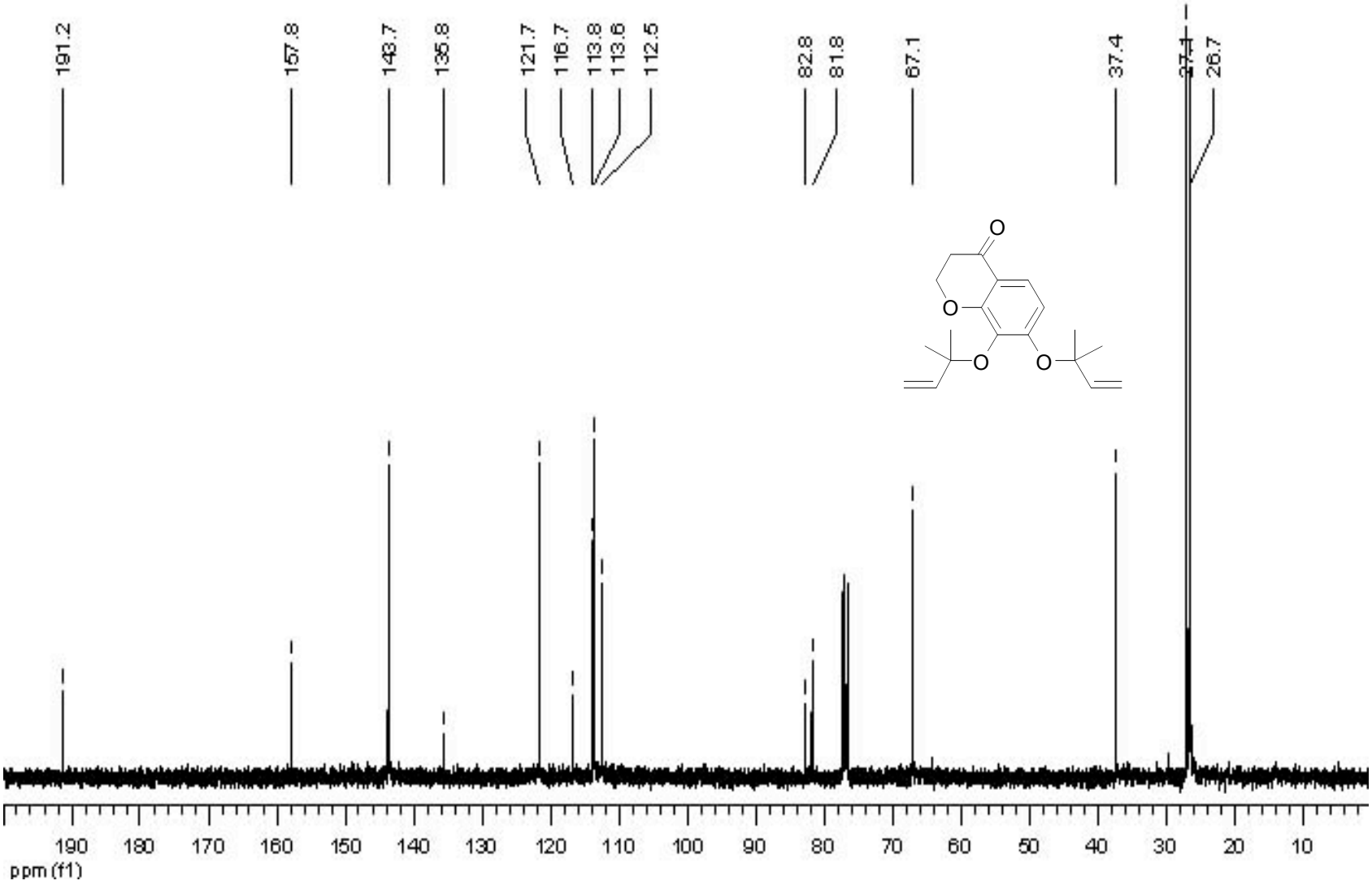
Spectrum 29: ^{1}H NMR (DMSO-d6, 400 MHz) of compound 23.



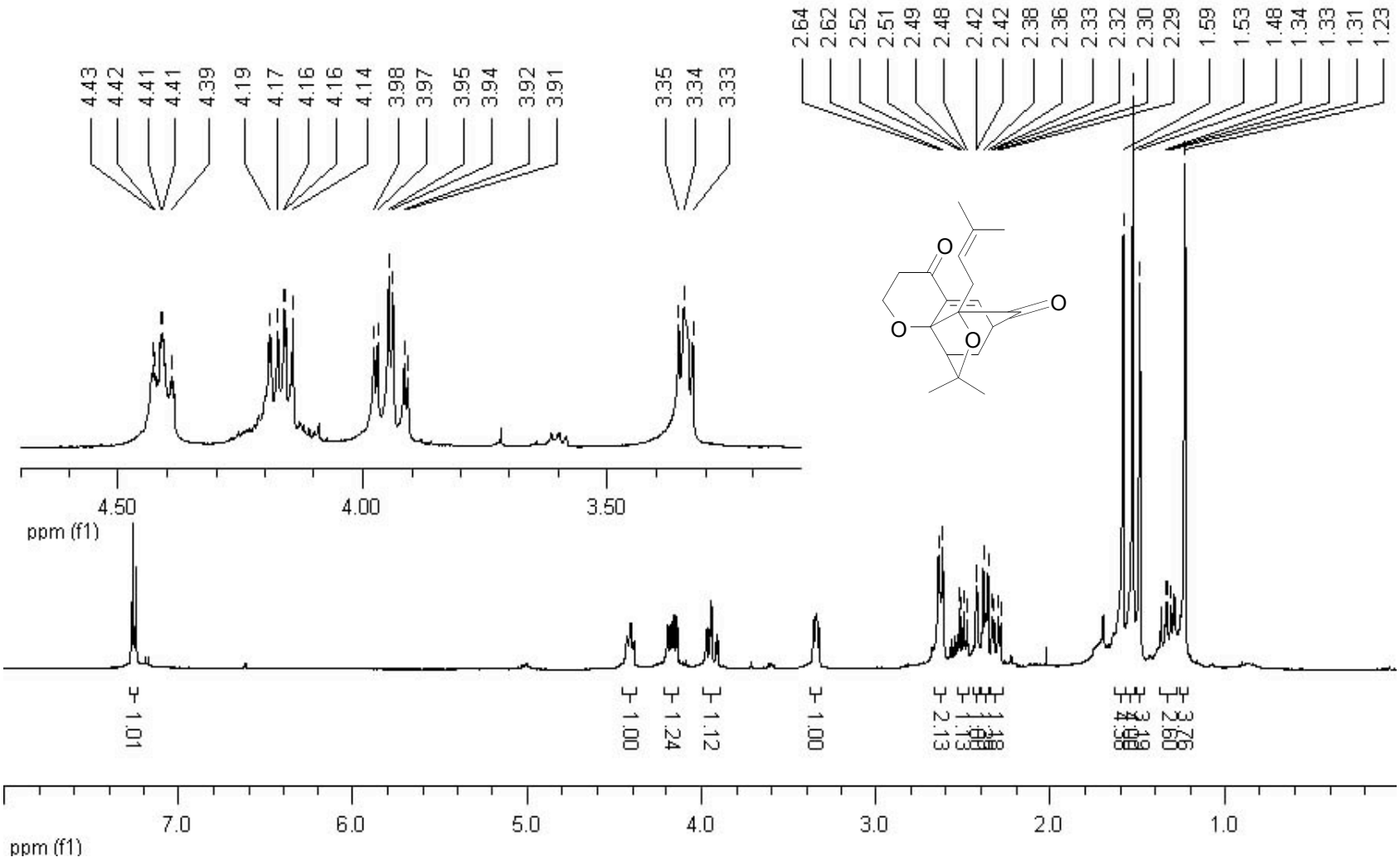
Spectrum 30: ^{13}C NMR (DMSO-d6, 100 MHz) of compound 23.



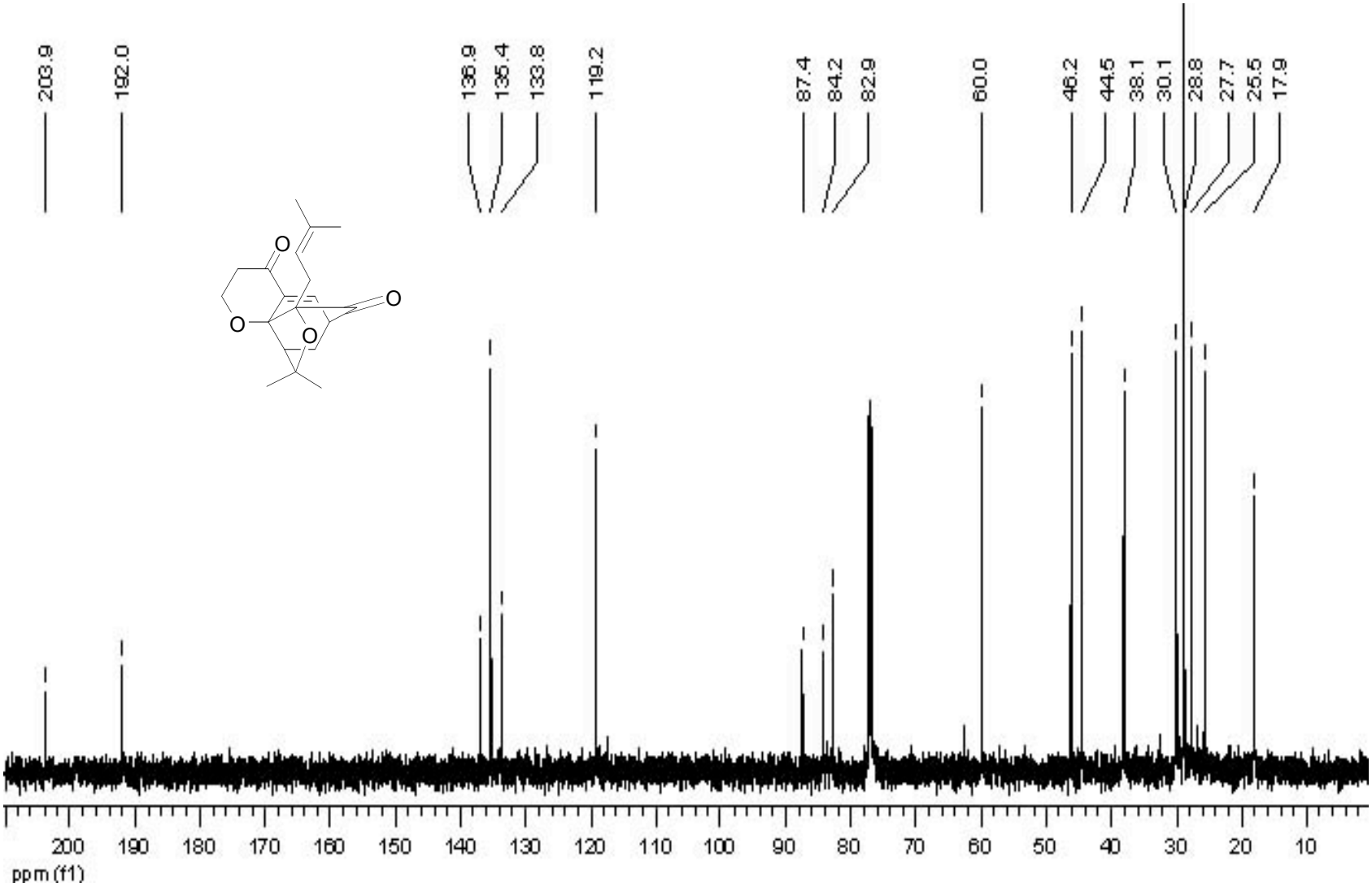
Spectrum 31: ^{1}H NMR ($CDCl_3$, 400 MHz) of compound 24.



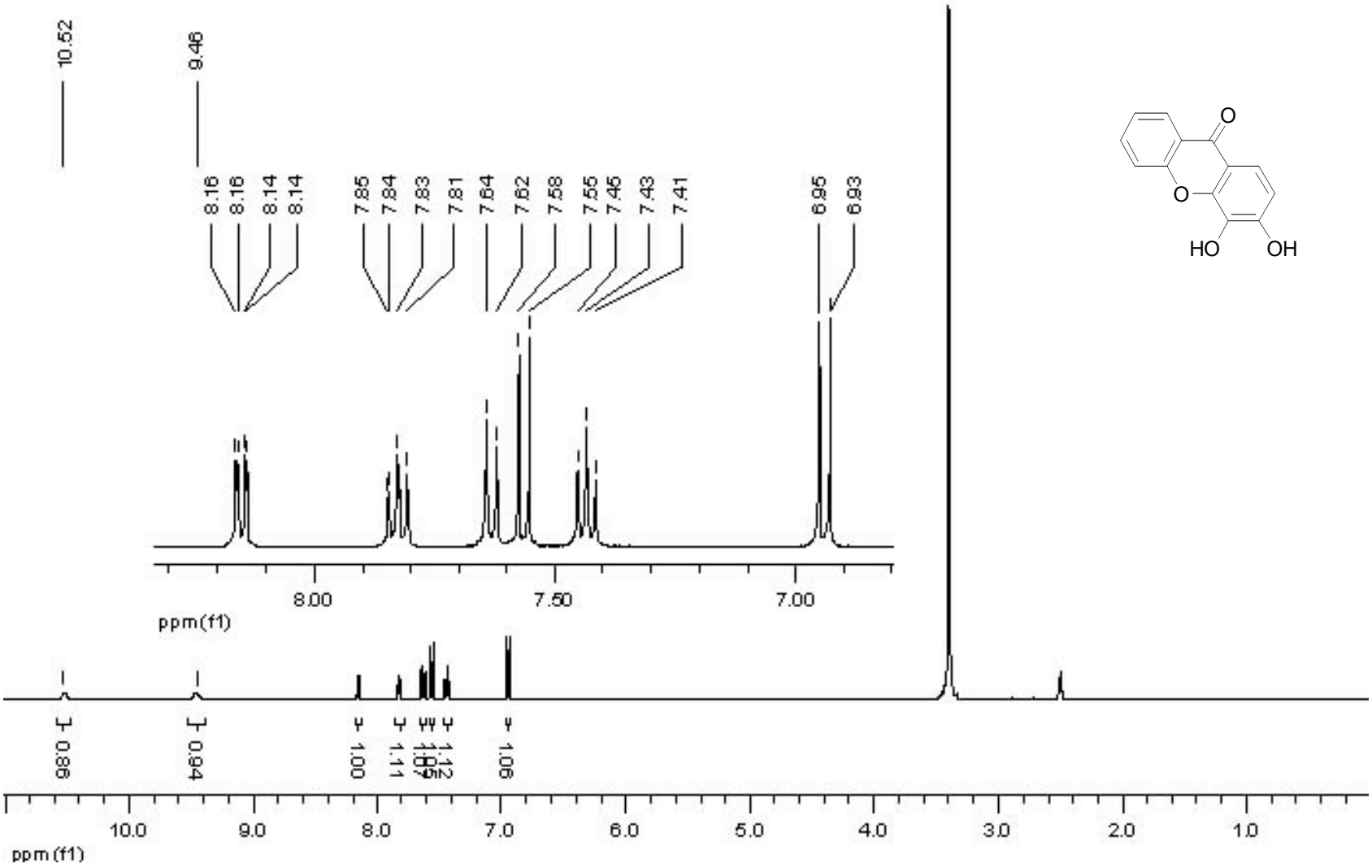
Spectrum 32: ^{13}C NMR ($CDCl_3$, 100 MHz) of compound 24.



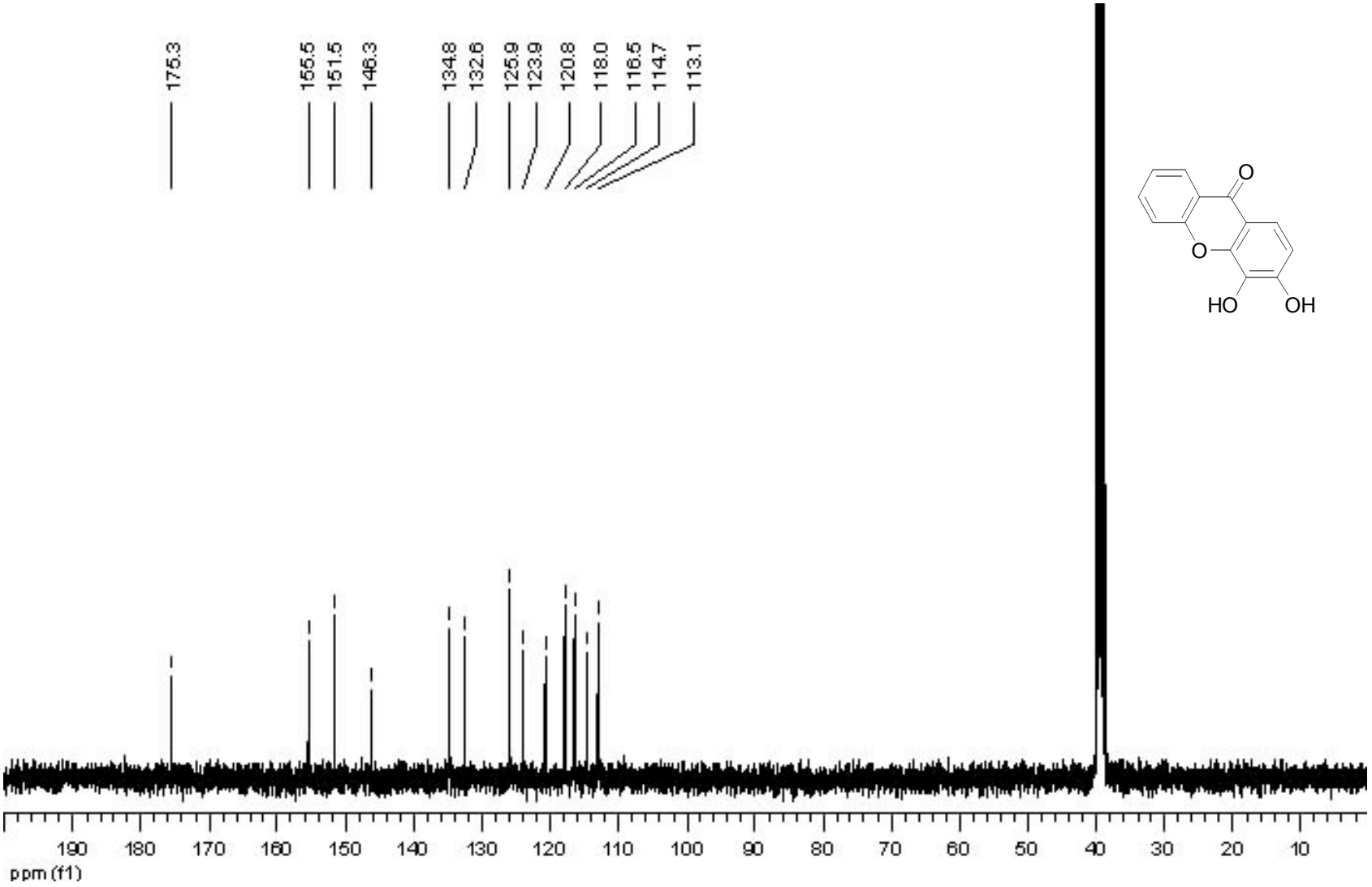
Spectrum 33: ^{1}H NMR ($CDCl_3$, 400 MHz) of compound 26.



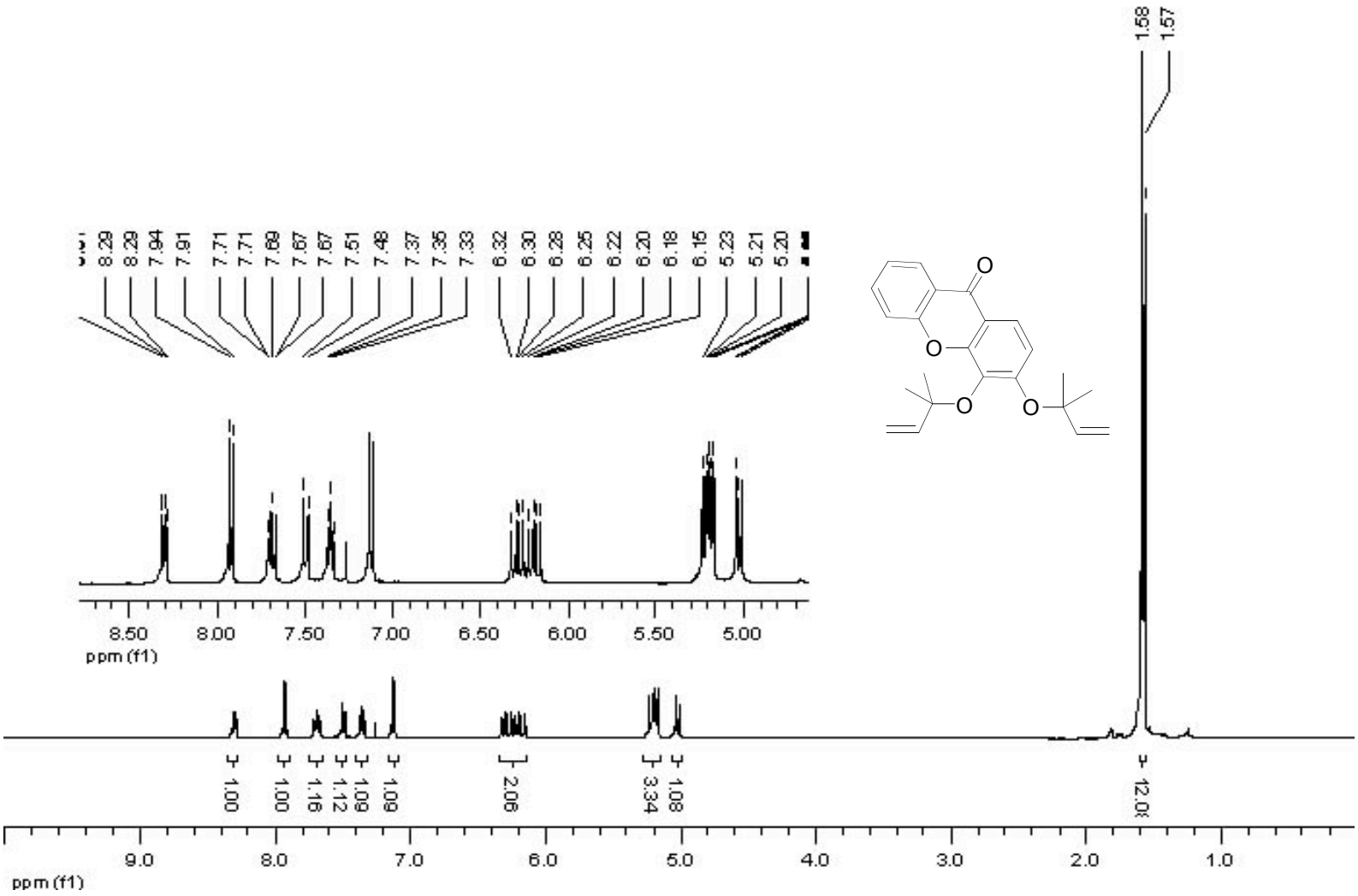
Spectrum 34: ^{13}C NMR ($CDCl_3$, 100 MHz) of compound 26.



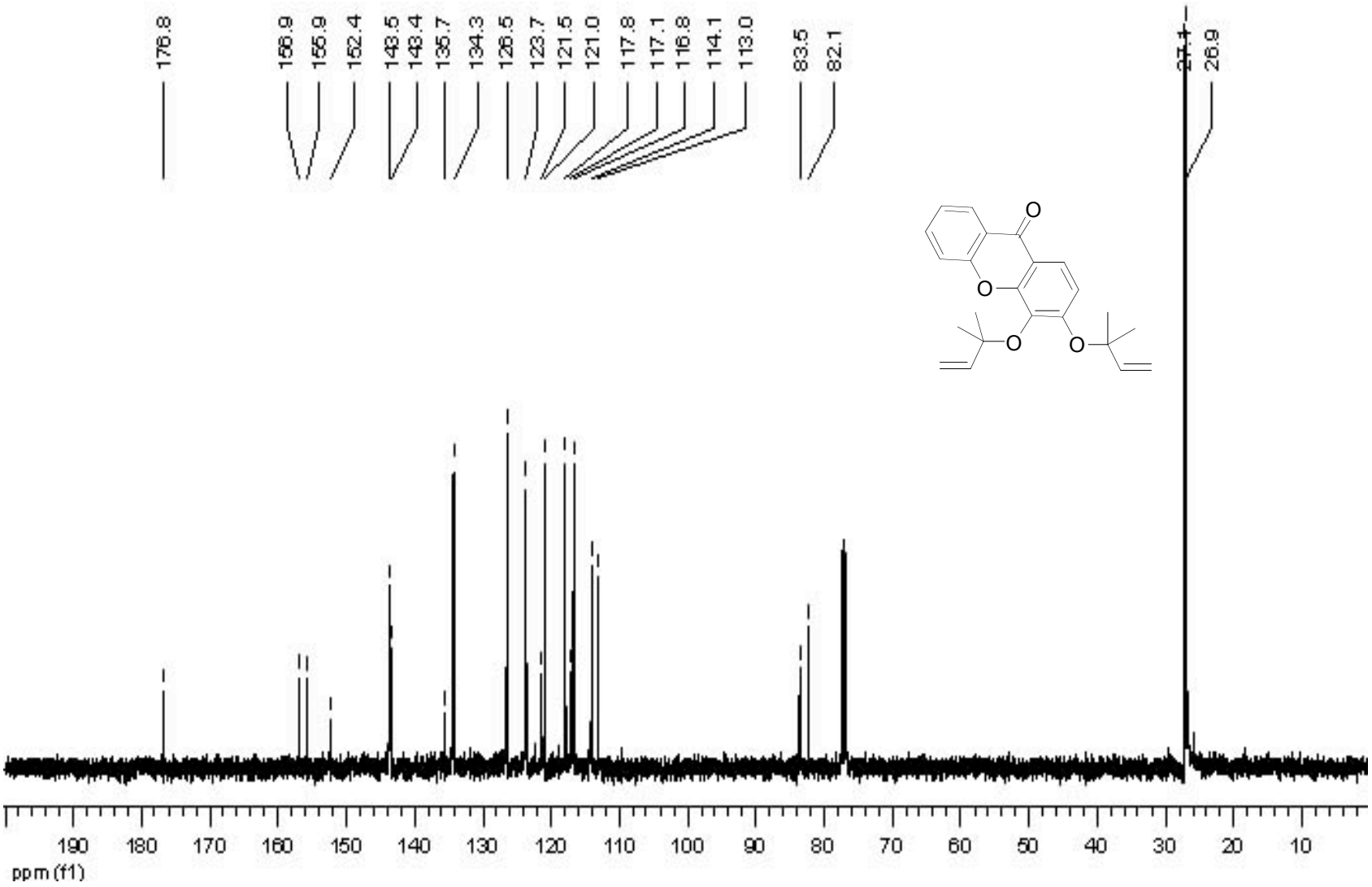
Spectrum 35: ^{1}H NMR (DMSO-d6, 400 MHz) of compound 31.



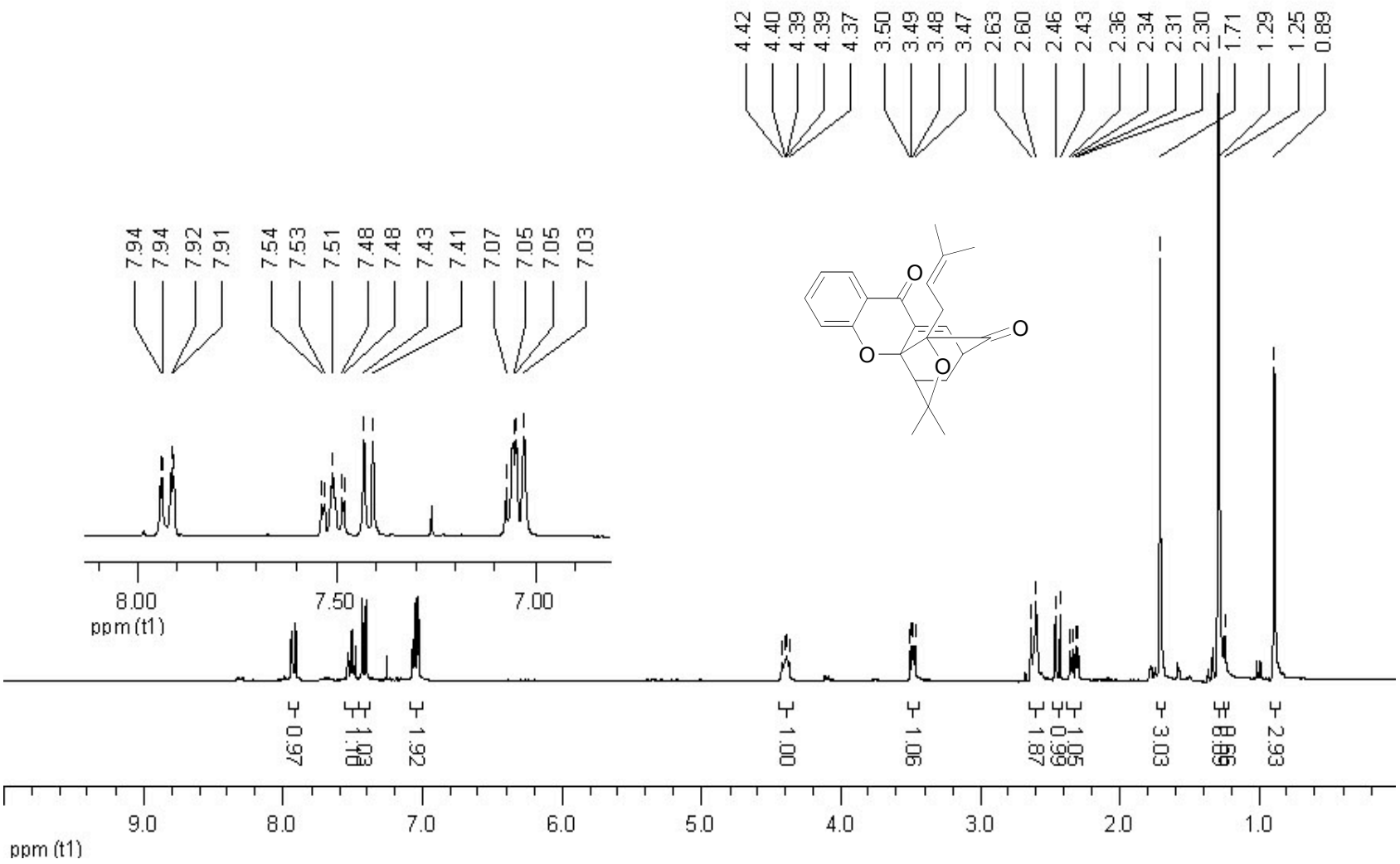
Spectrum 36: ^{13}C NMR (DMSO-d6, 100 MHz) of compound 31.



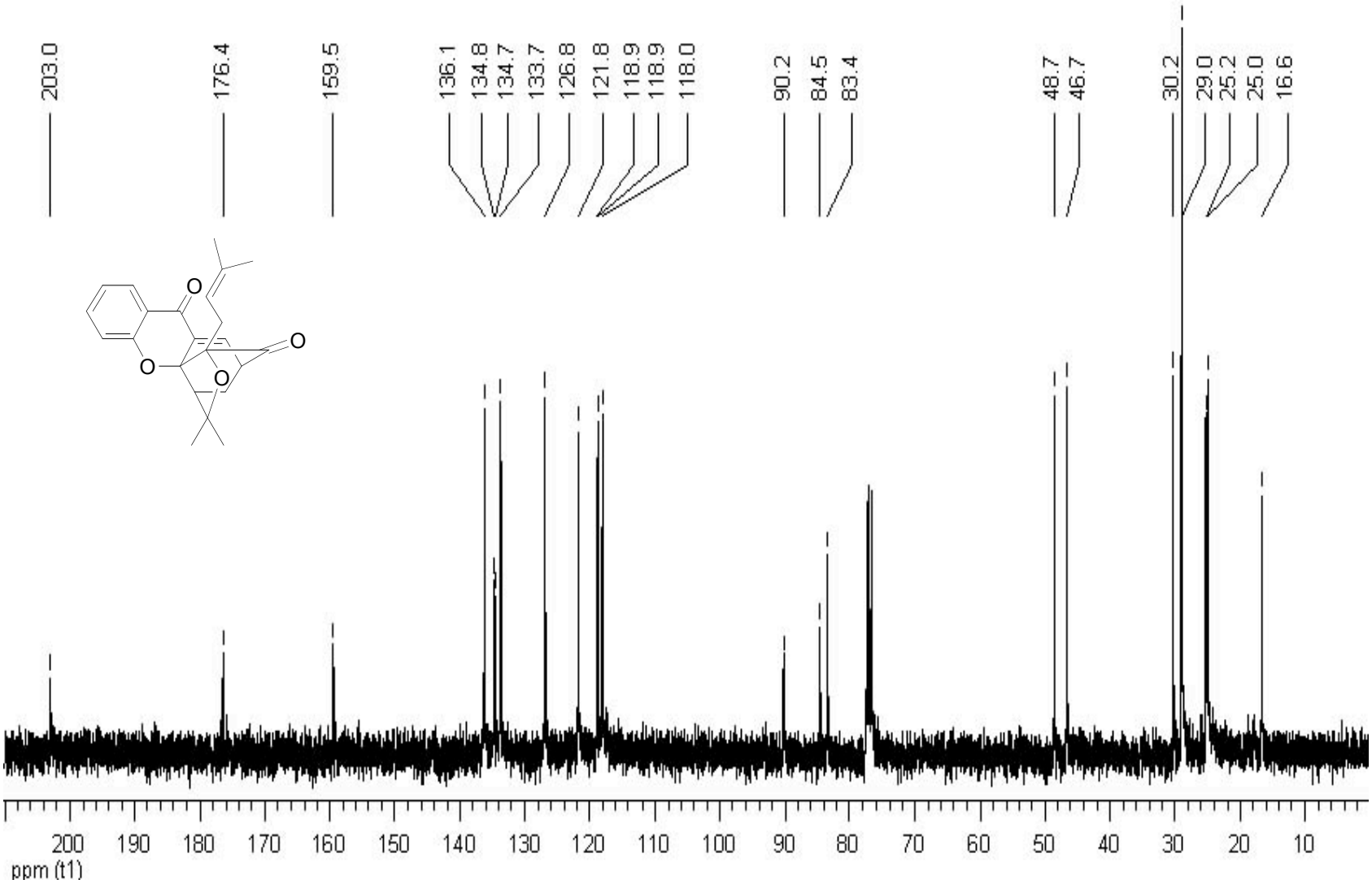
Spectrum 37: ^{1}H NMR ($CDCl_3$, 400 MHz) of compound 32.



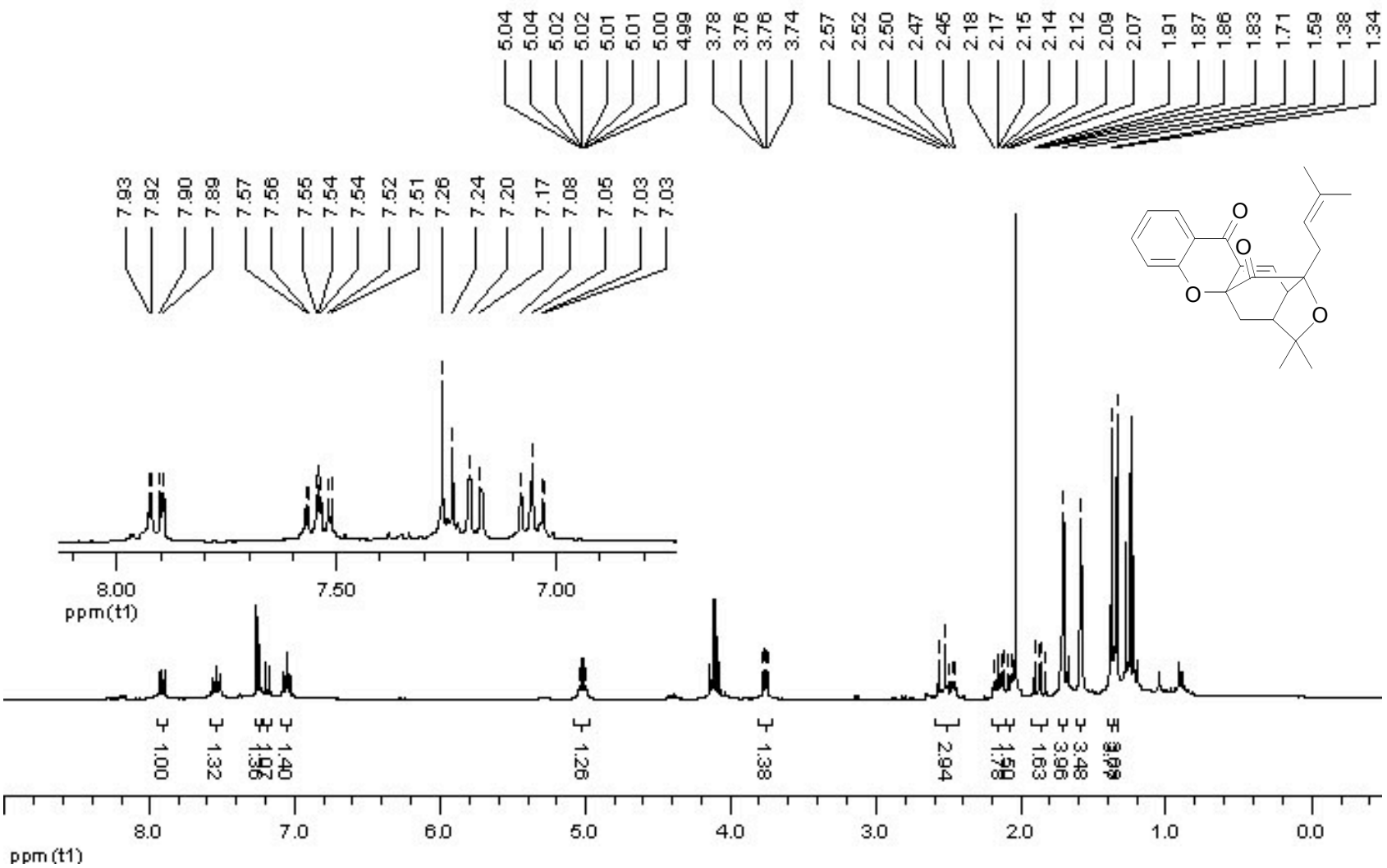
Spectrum 38: ^{13}C NMR ($CDCl_3$, 100 MHz) of compound 32.



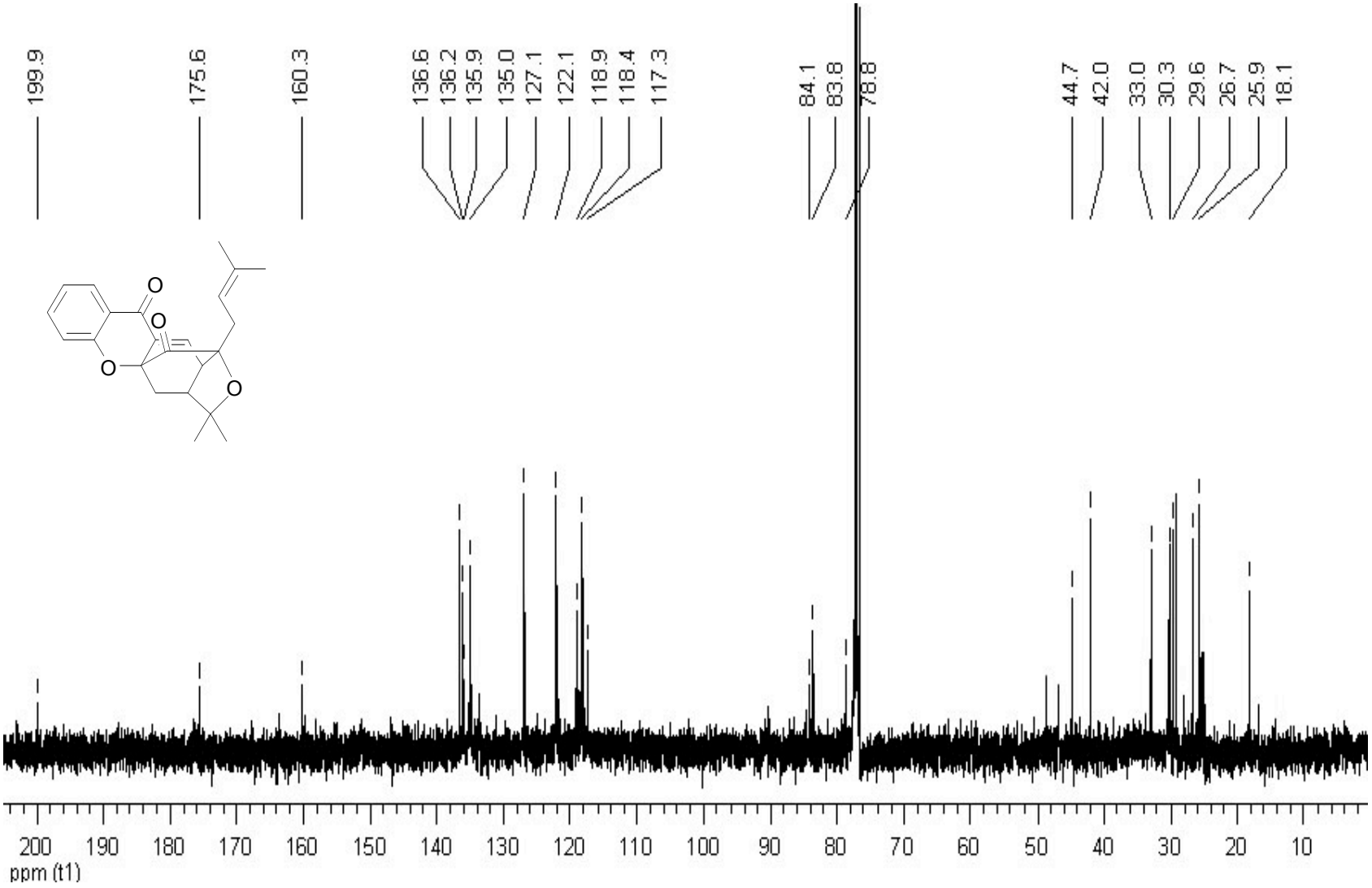
Spectrum 39: ^{1}H NMR ($CDCl_3$, 400 MHz) of compound 7.



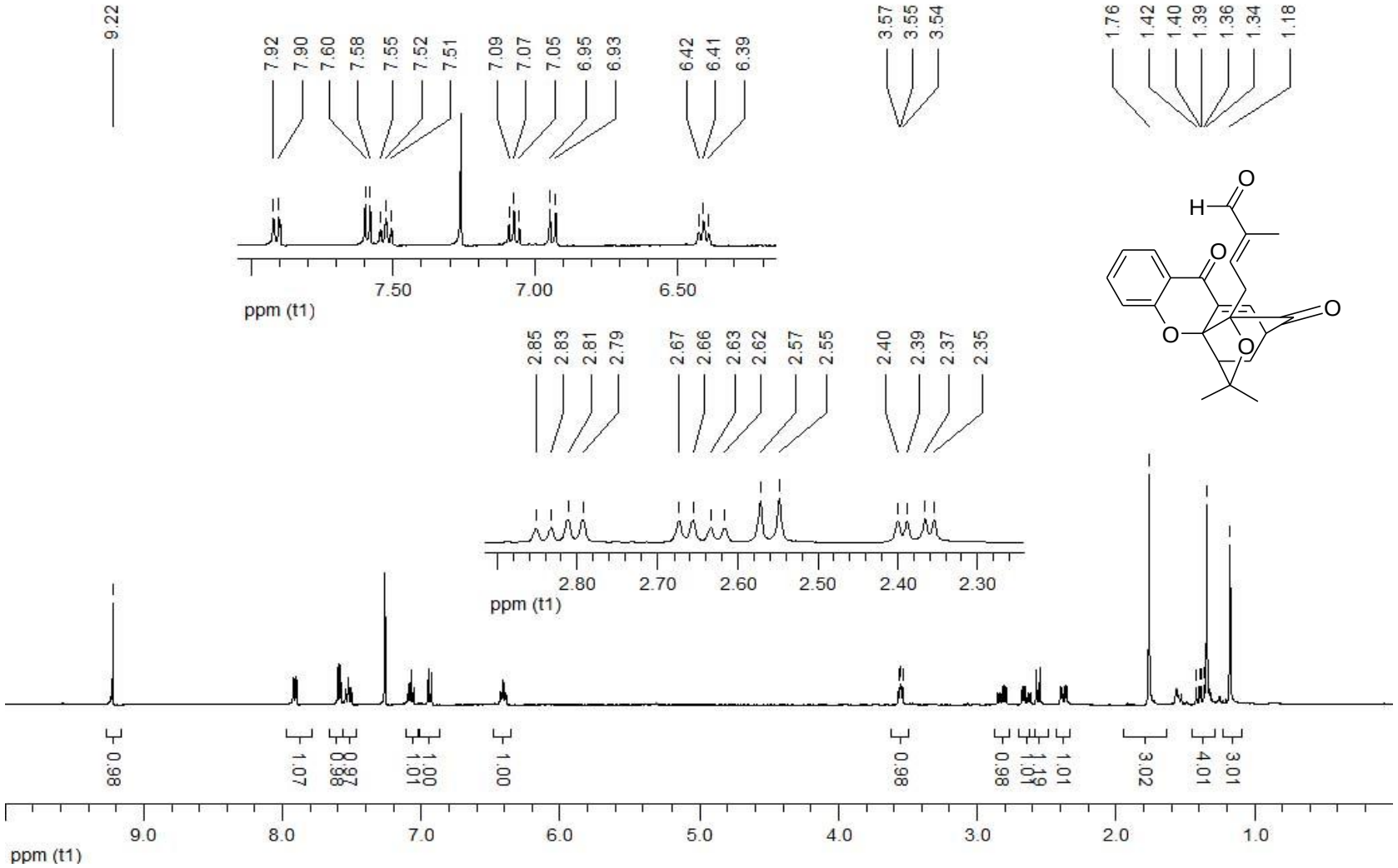
Spectrum 40: ^{13}C NMR ($CDCl_3$, 100 MHz) of compound 7.



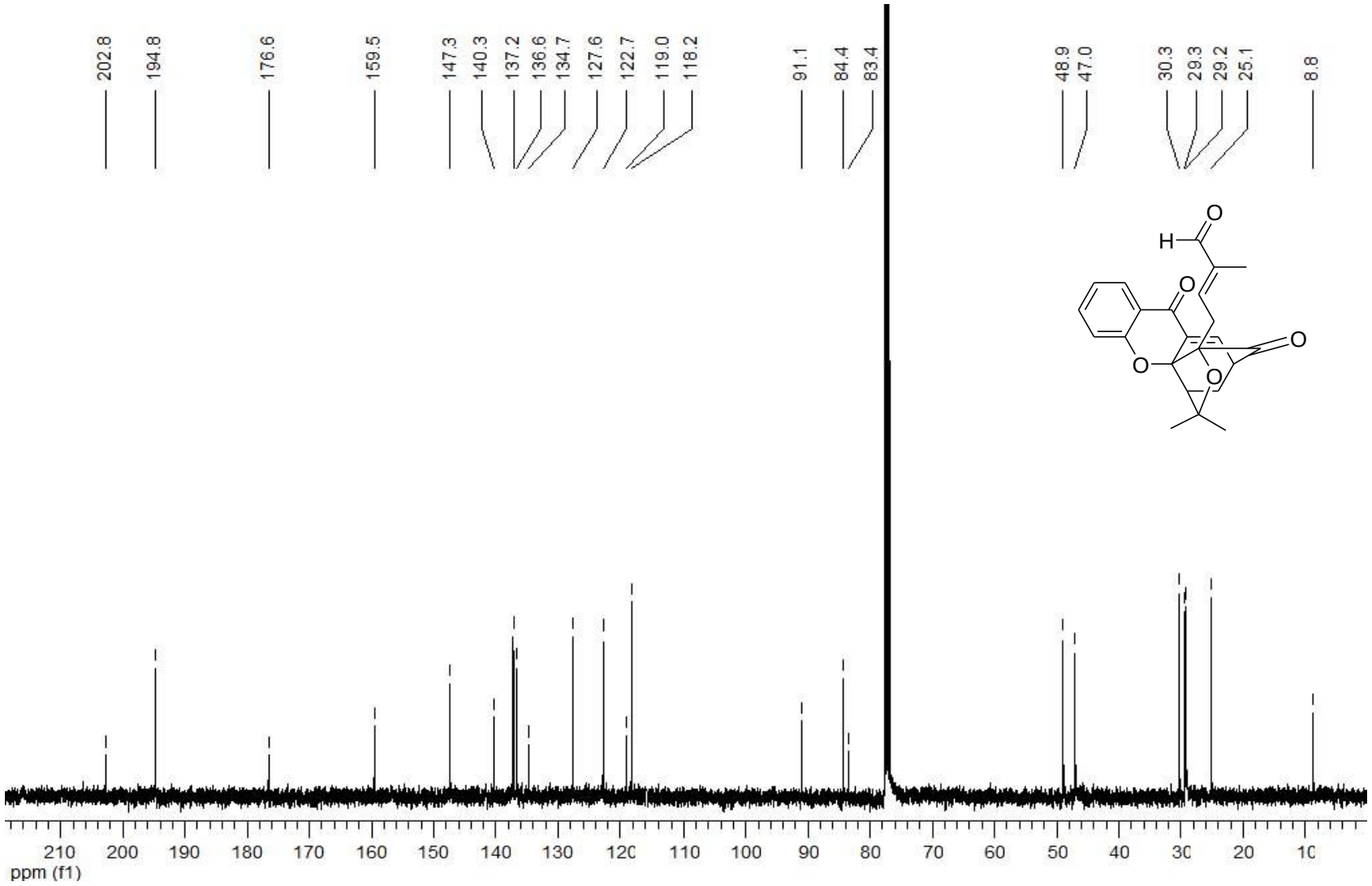
Spectrum 41: ^{1}H NMR ($CDCl_3$, 400 MHz) of compound 33.



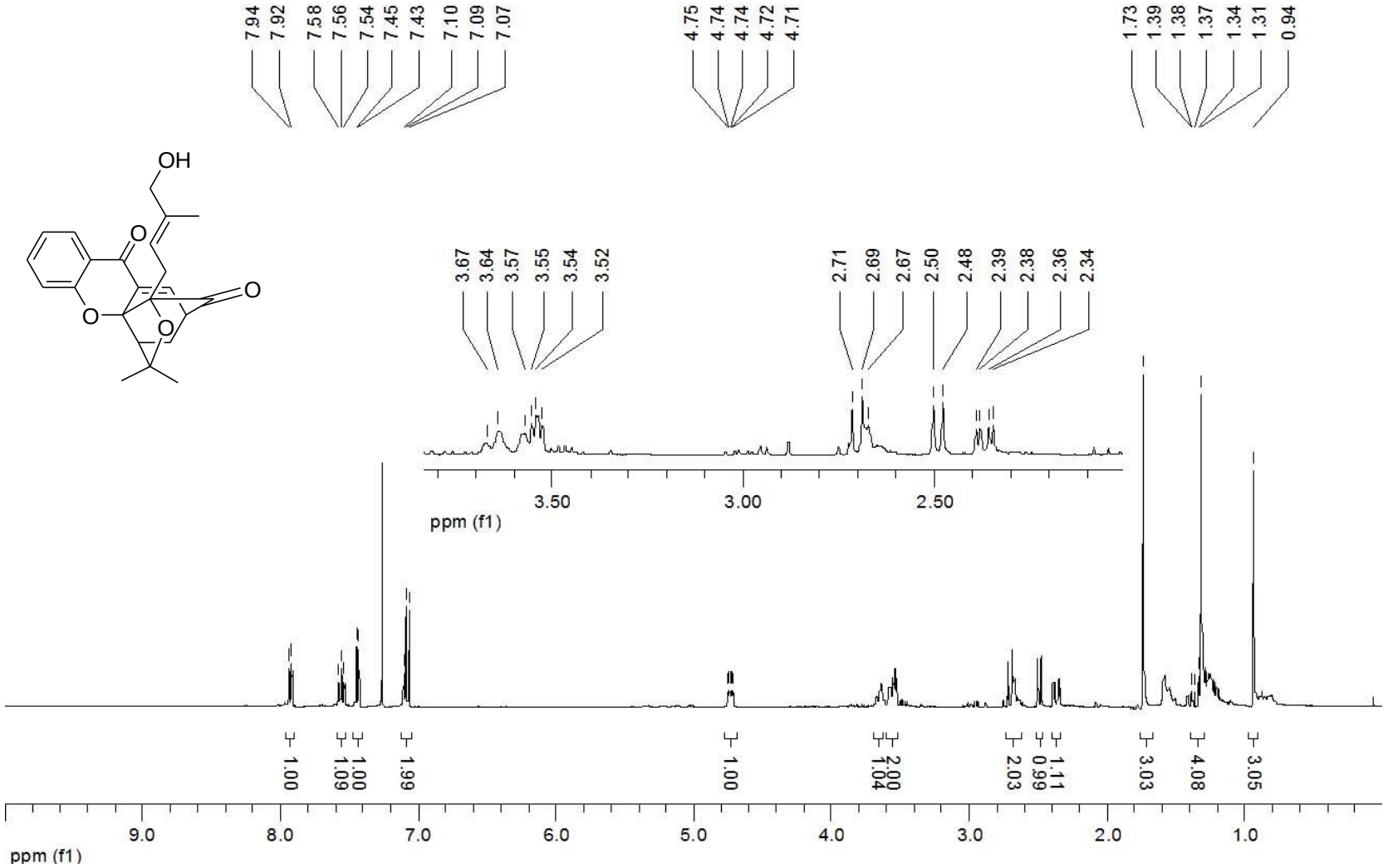
Spectrum 42: ^{13}C NMR ($CDCl_3$, 100 MHz) of compound 33.



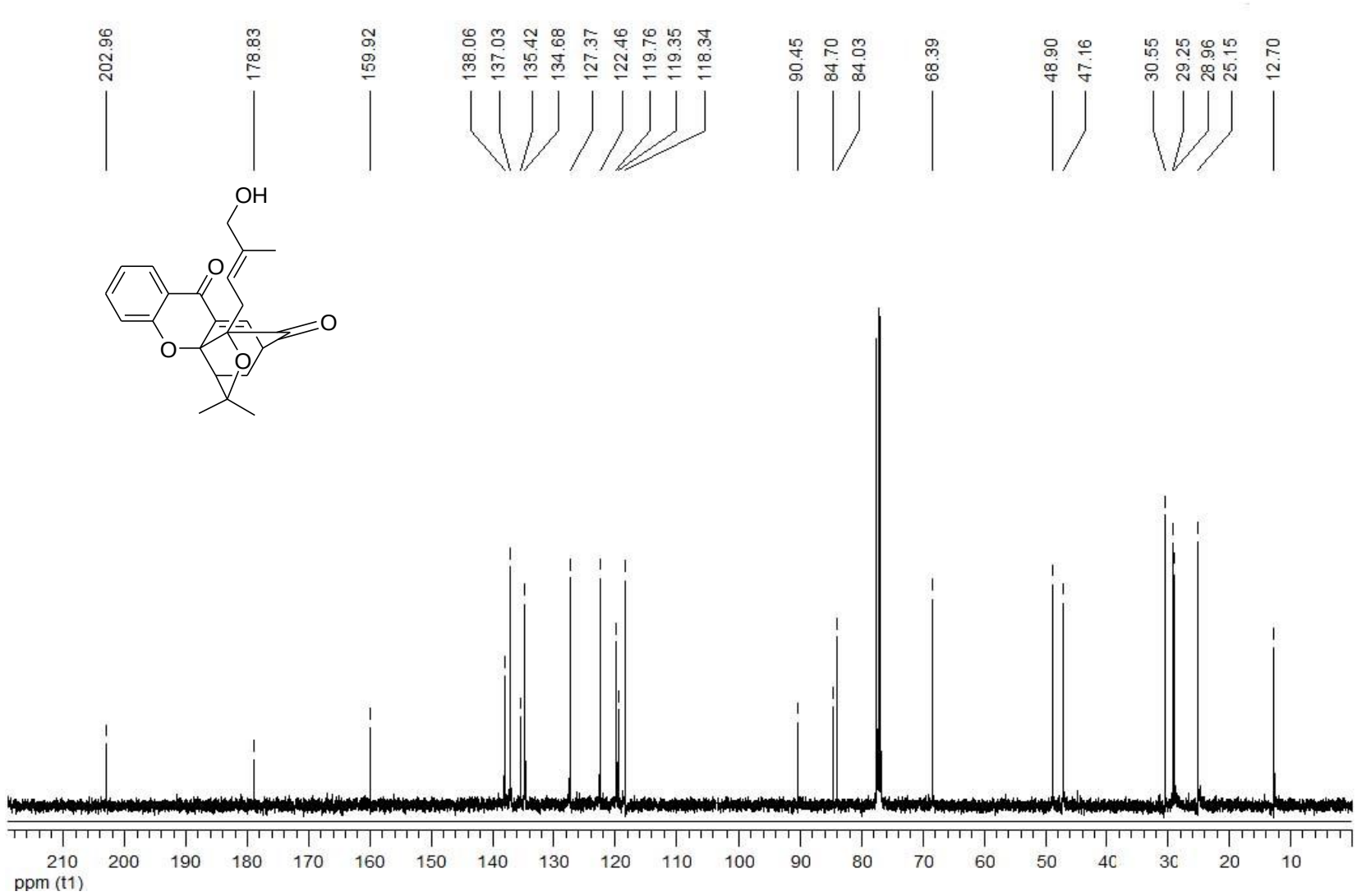
Spectrum 43: ^{1}H NMR ($CDCl_3$, 400 MHz) of compound 34.



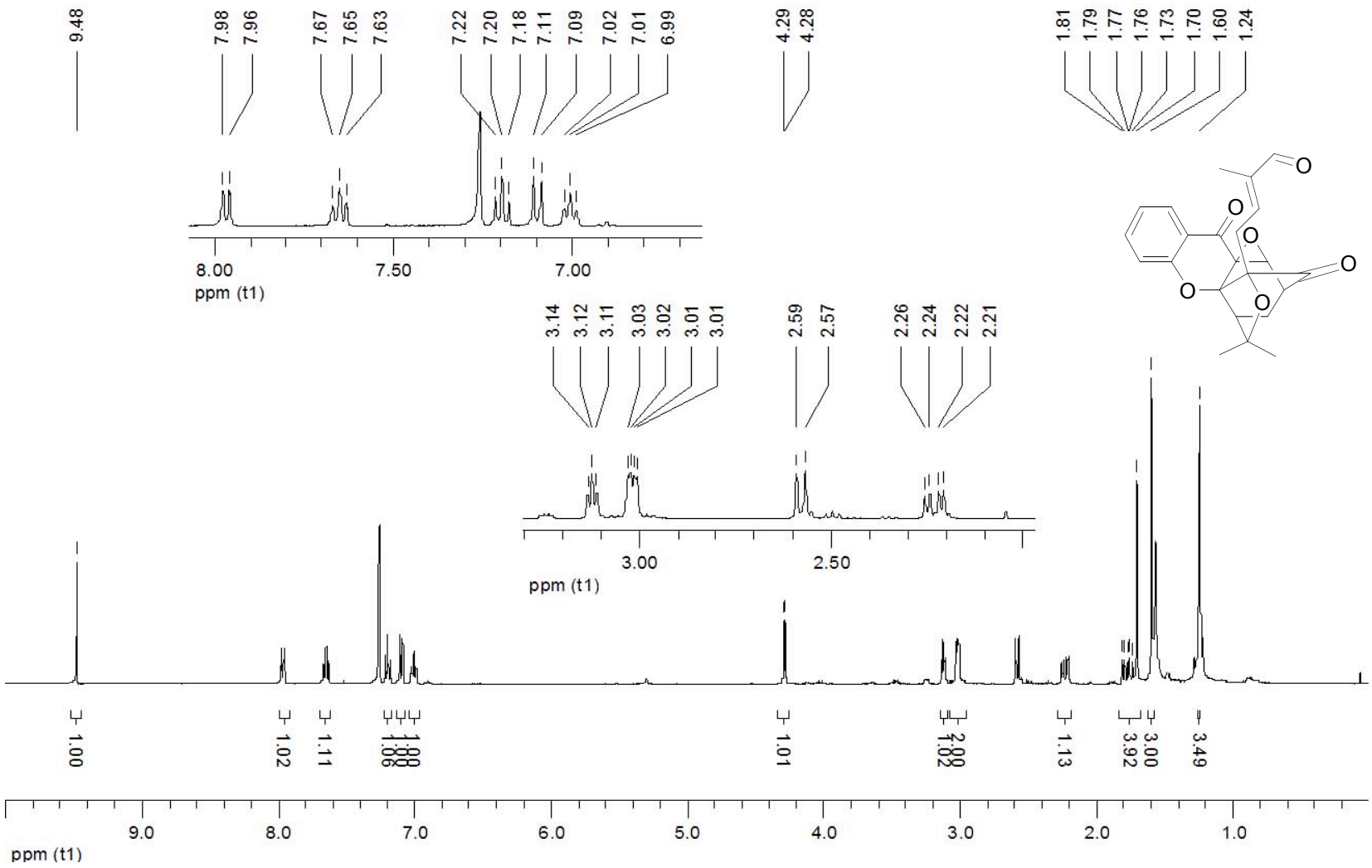
Spectrum 44: ^{13}C NMR ($CDCl_3$, 100 MHz) of compound 34.



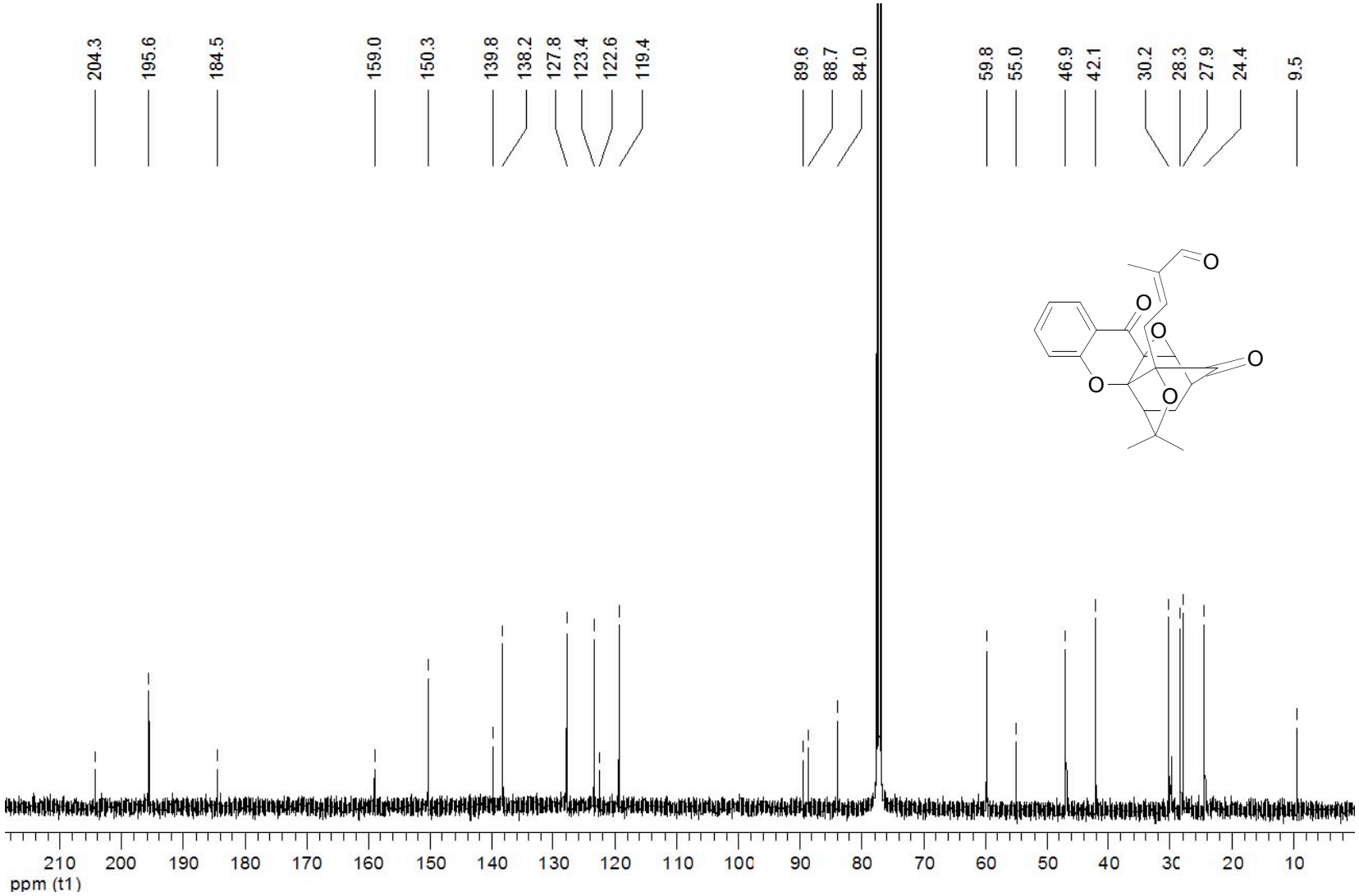
Spectrum 45: ^{1}H NMR ($CDCl_3$, 400 MHz) of compound 35.



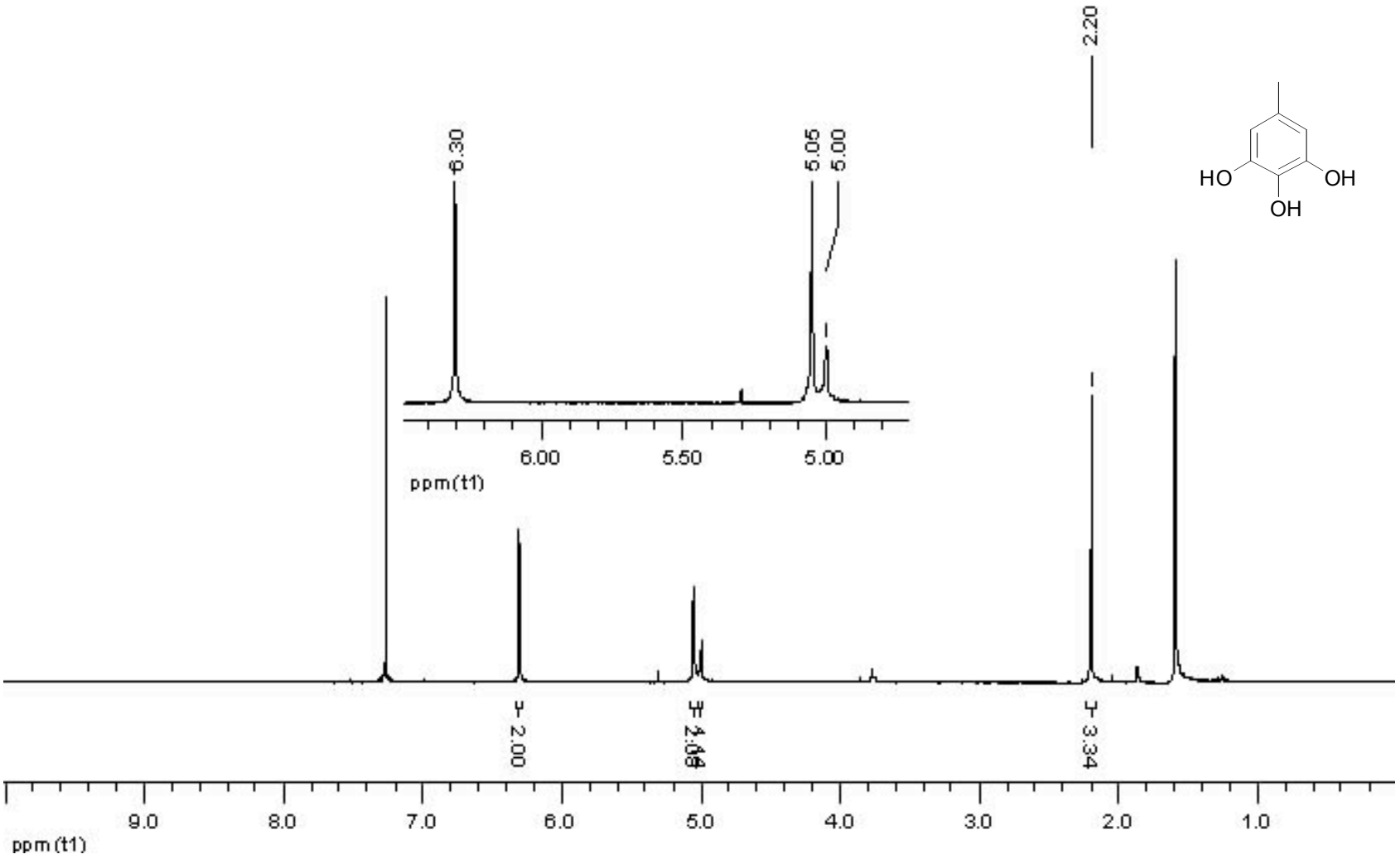
Spectrum 46: ^{13}C NMR ($CDCl_3$, 100 MHz) of compound 35.



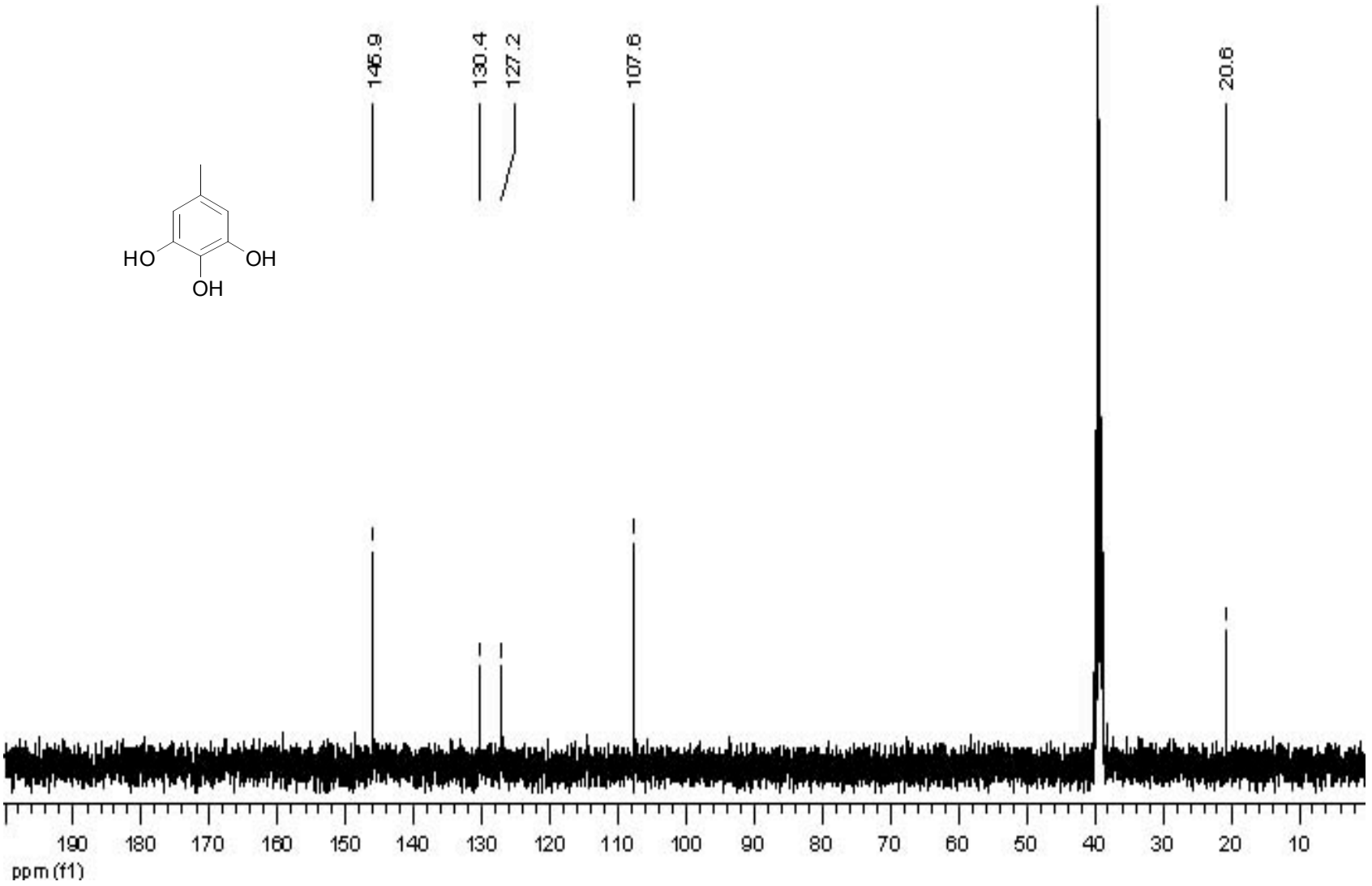
Spectrum 47: ^{1}H NMR ($CDCl_3$, 400 MHz) of compound 36.



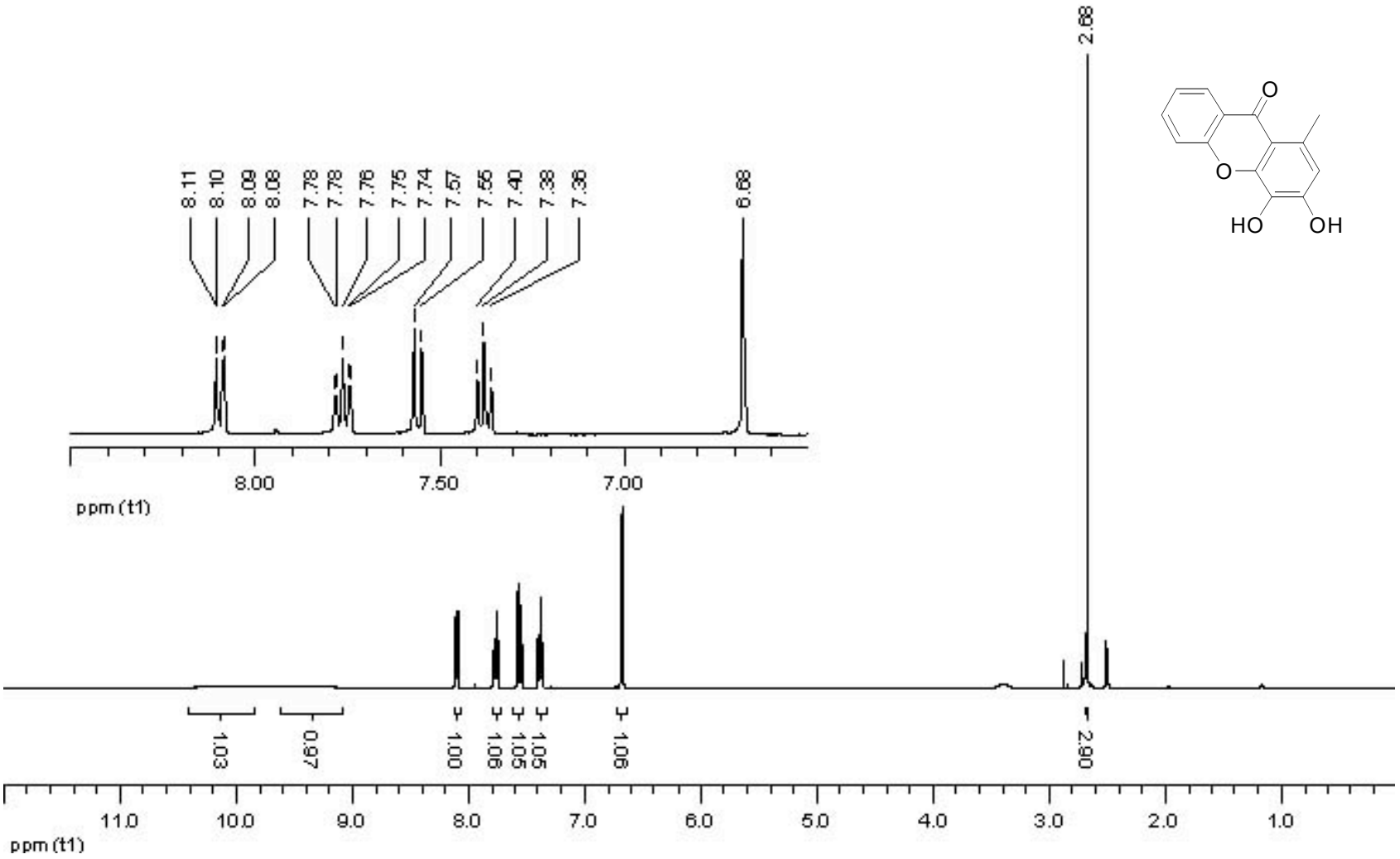
Spectrum 48: ^{13}C NMR ($CDCl_3$, 100 MHz) of compound 36.



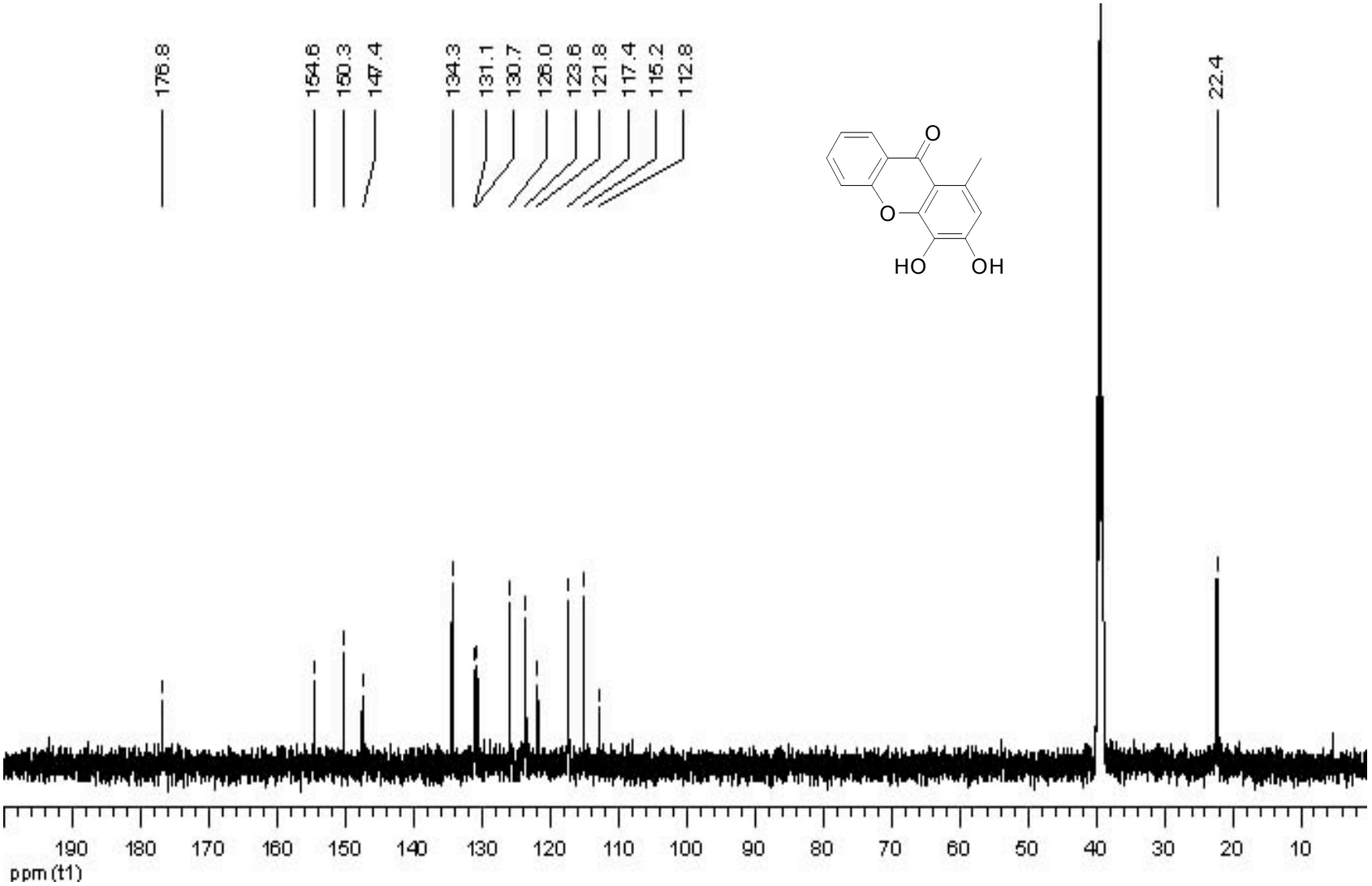
Spectrum 49: ^{1}H NMR ($CDCl_3$, 400 MHz) of compound 38.



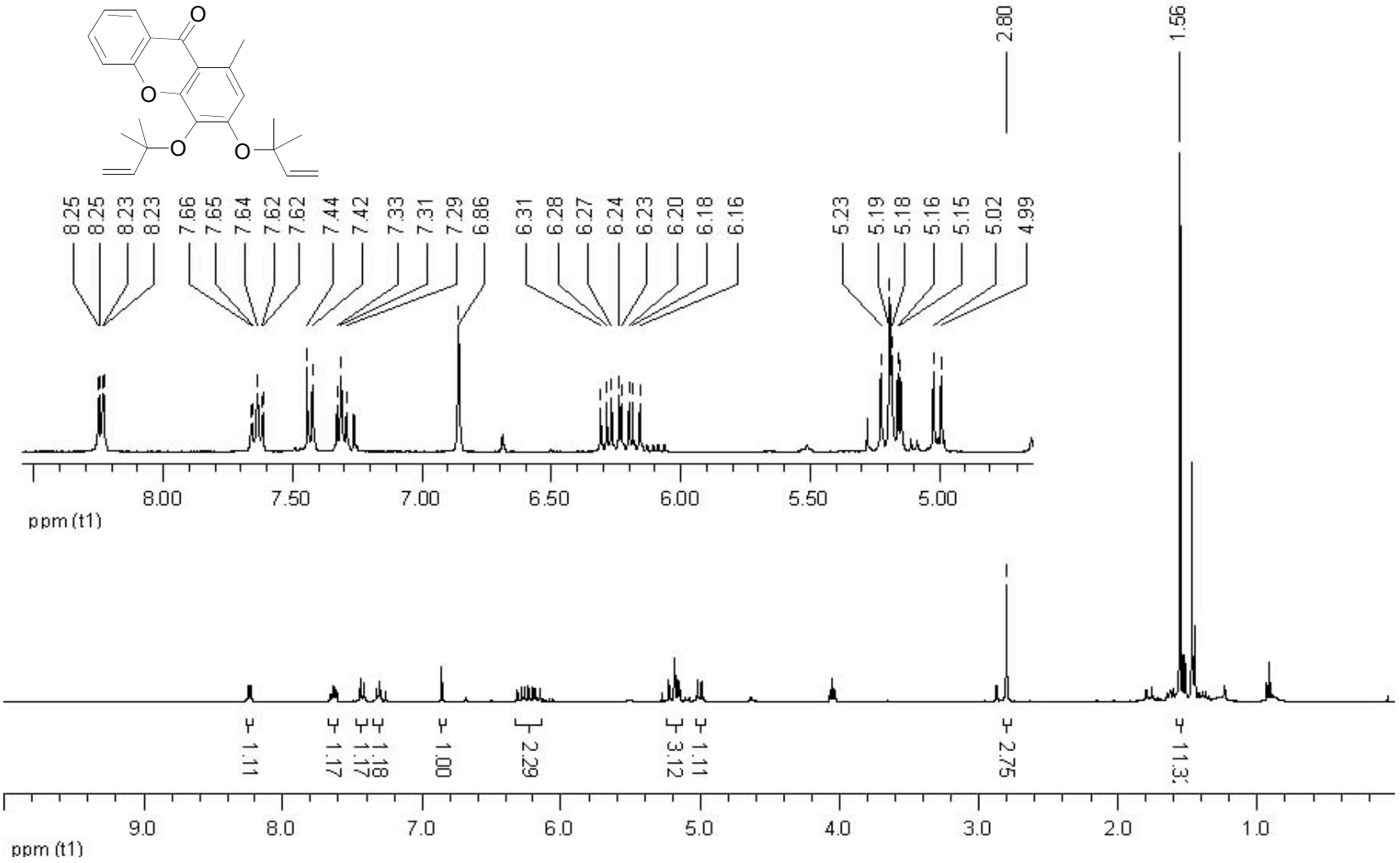
Spectrum 50: ^{13}C NMR (DMSO-d6, 100 MHz) of compound 38.



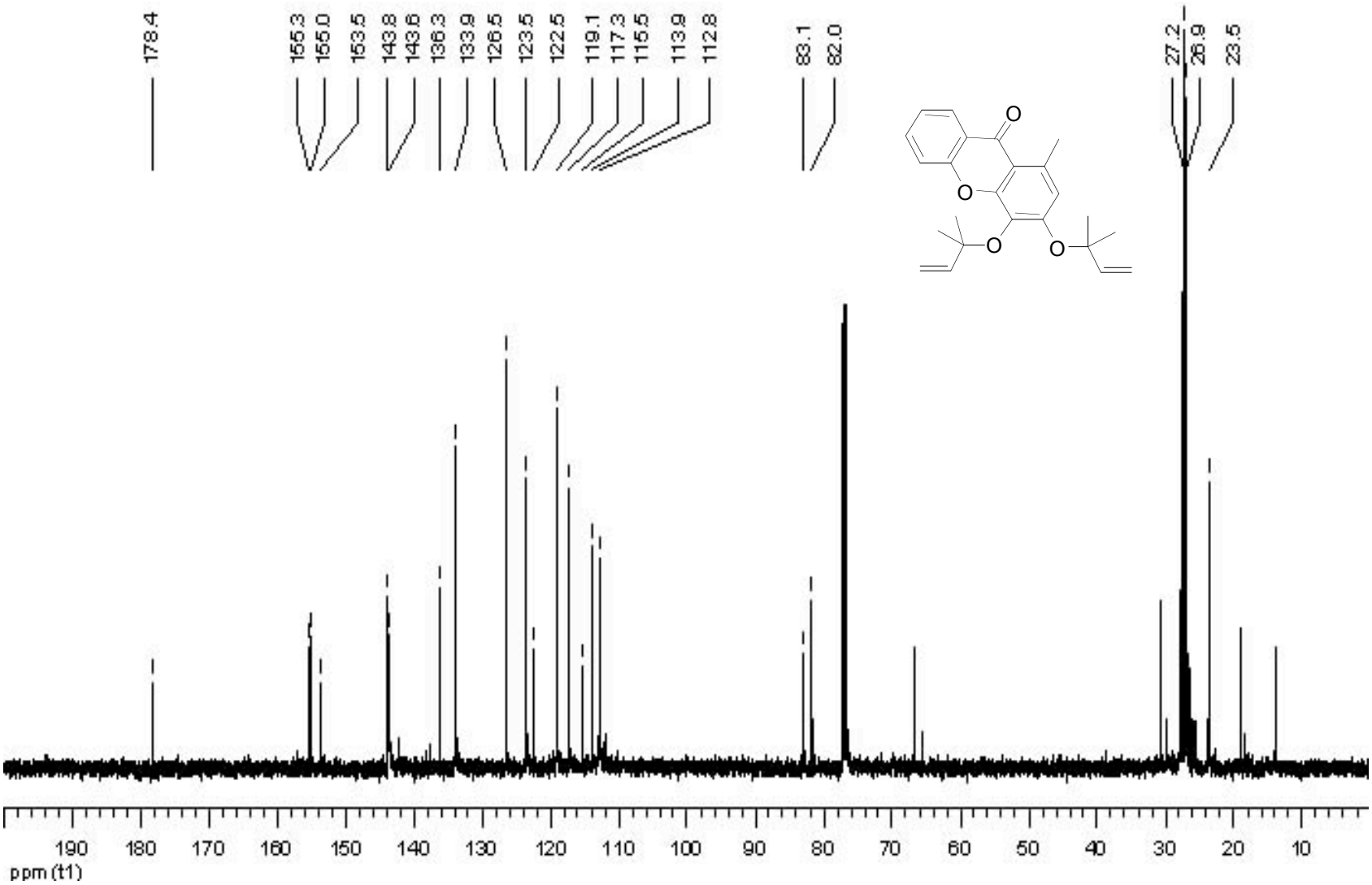
Spectrum 51: ^{1}H NMR (DMSO-d6, 400 MHz) of compound 39.



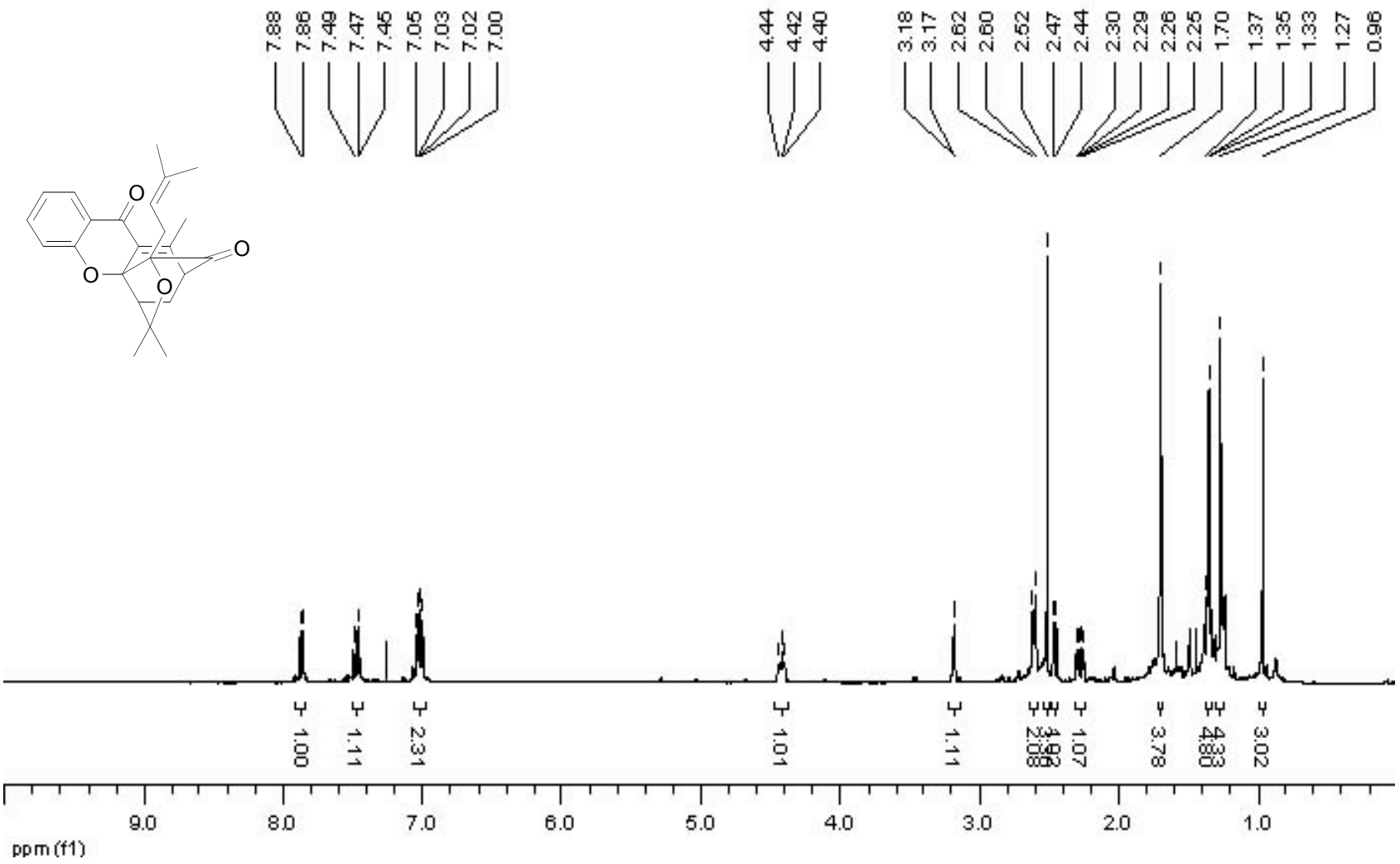
Spectrum 52: ^{13}C NMR (DMSO-d6, 100 MHz) of compound 39.



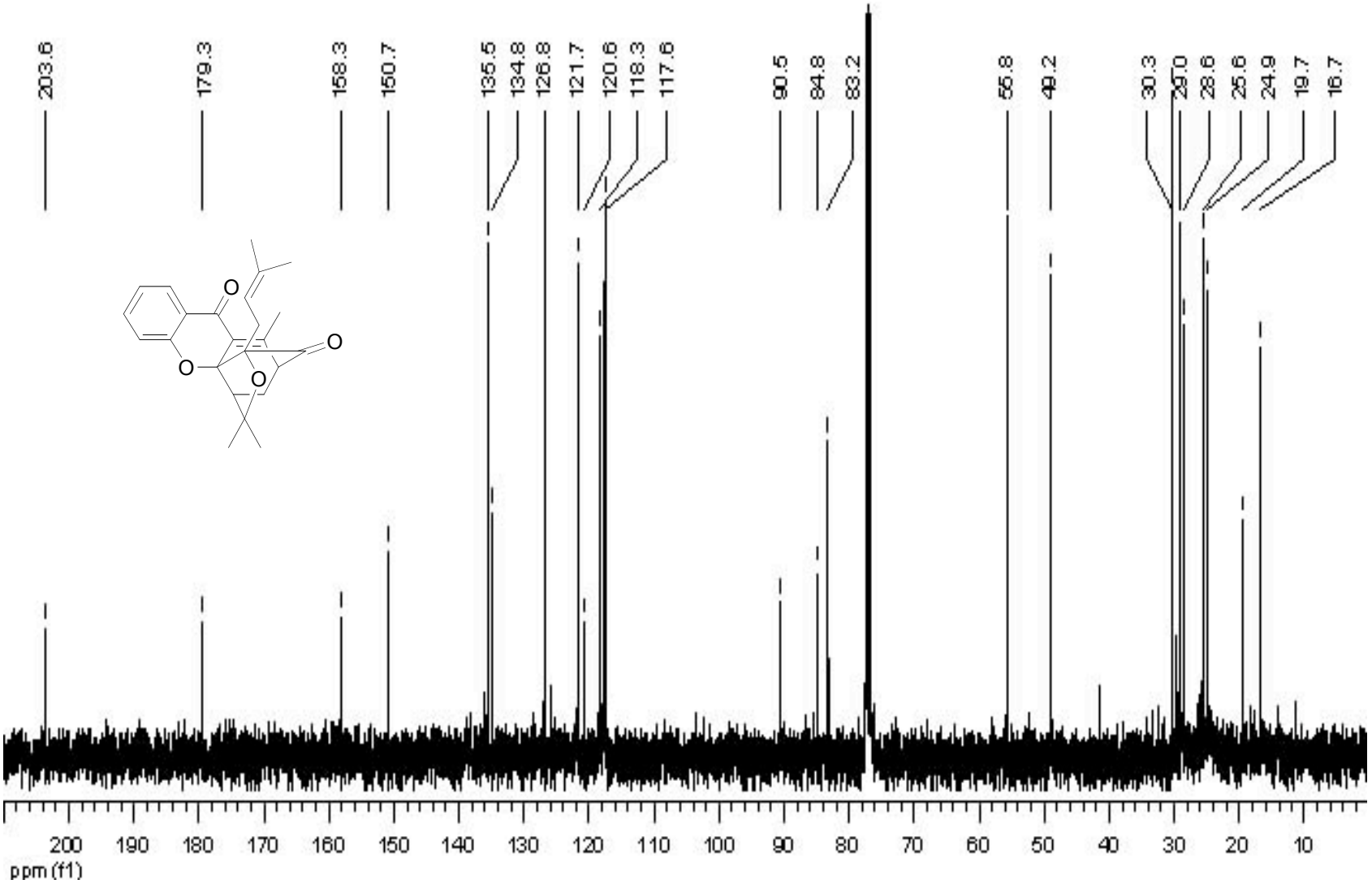
Spectrum 53: ^{1}H NMR ($CDCl_3$, 400 MHz) of compound 40.



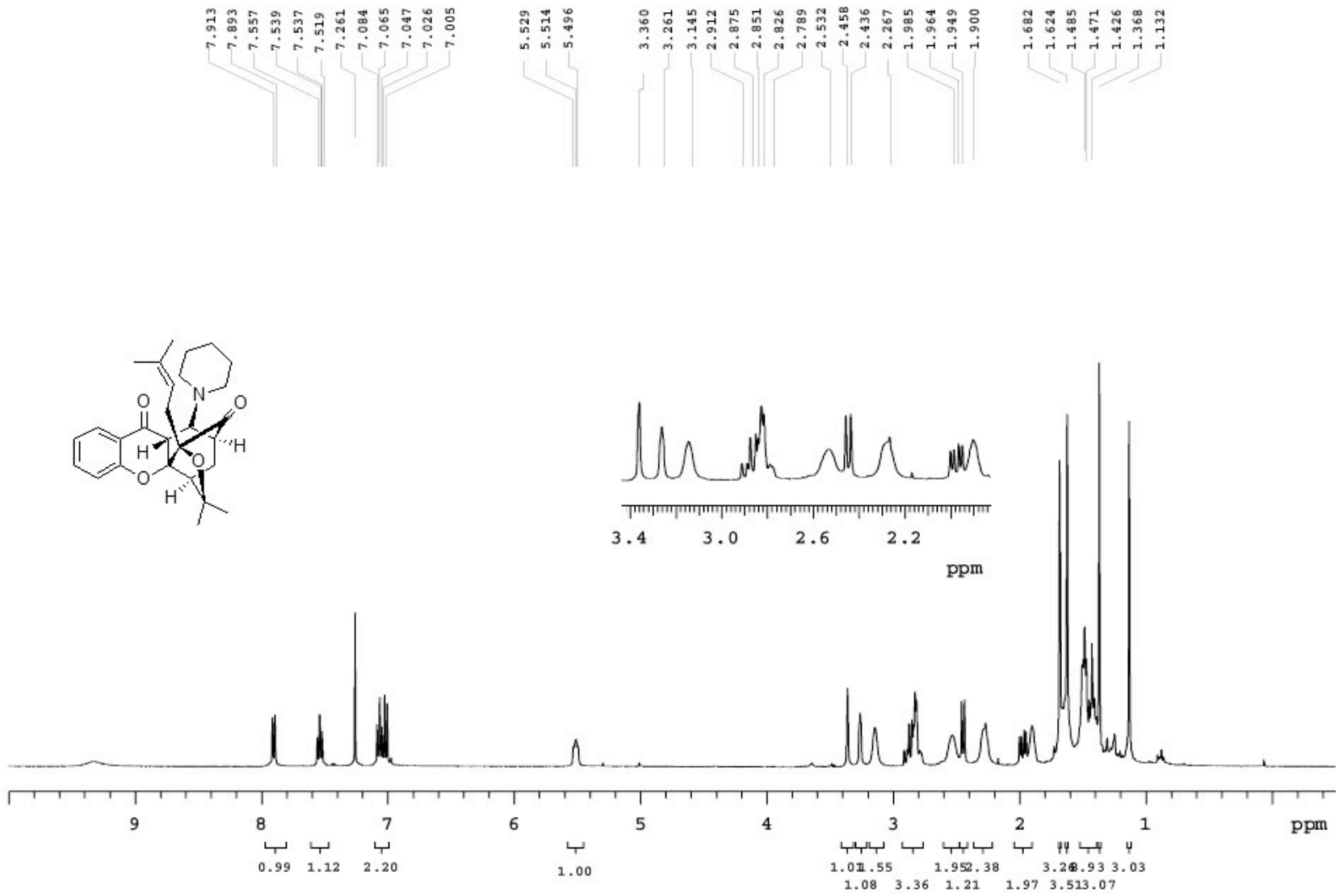
Spectrum 54: ^{13}C NMR ($CDCl_3$, 100 MHz) of compound 40.



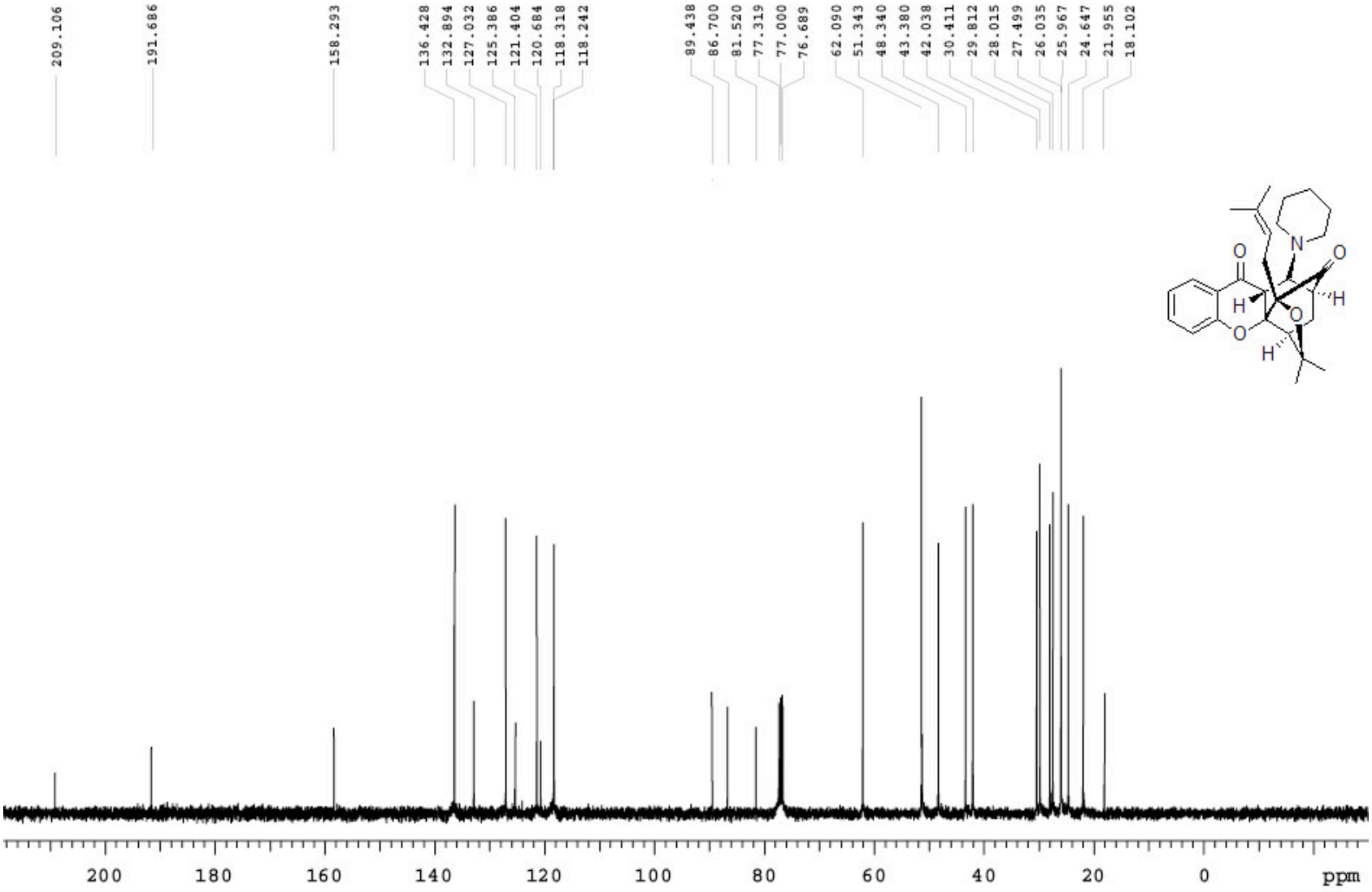
Spectrum 55: ^{1}H NMR ($CDCl_3$, 400 MHz) of compound 41.



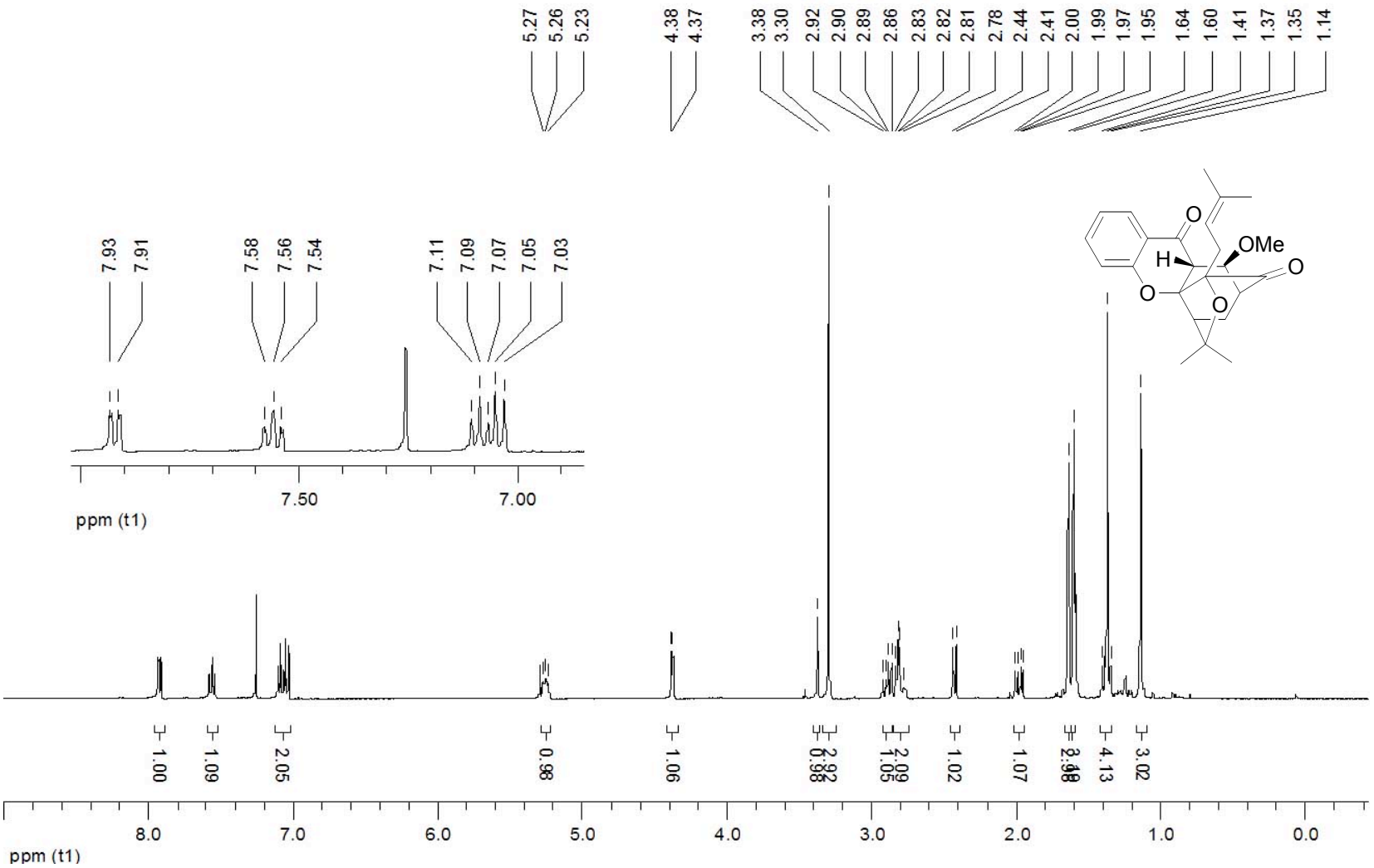
Spectrum 56: ^{13}C NMR ($CDCl_3$, 100 MHz) of compound 41.



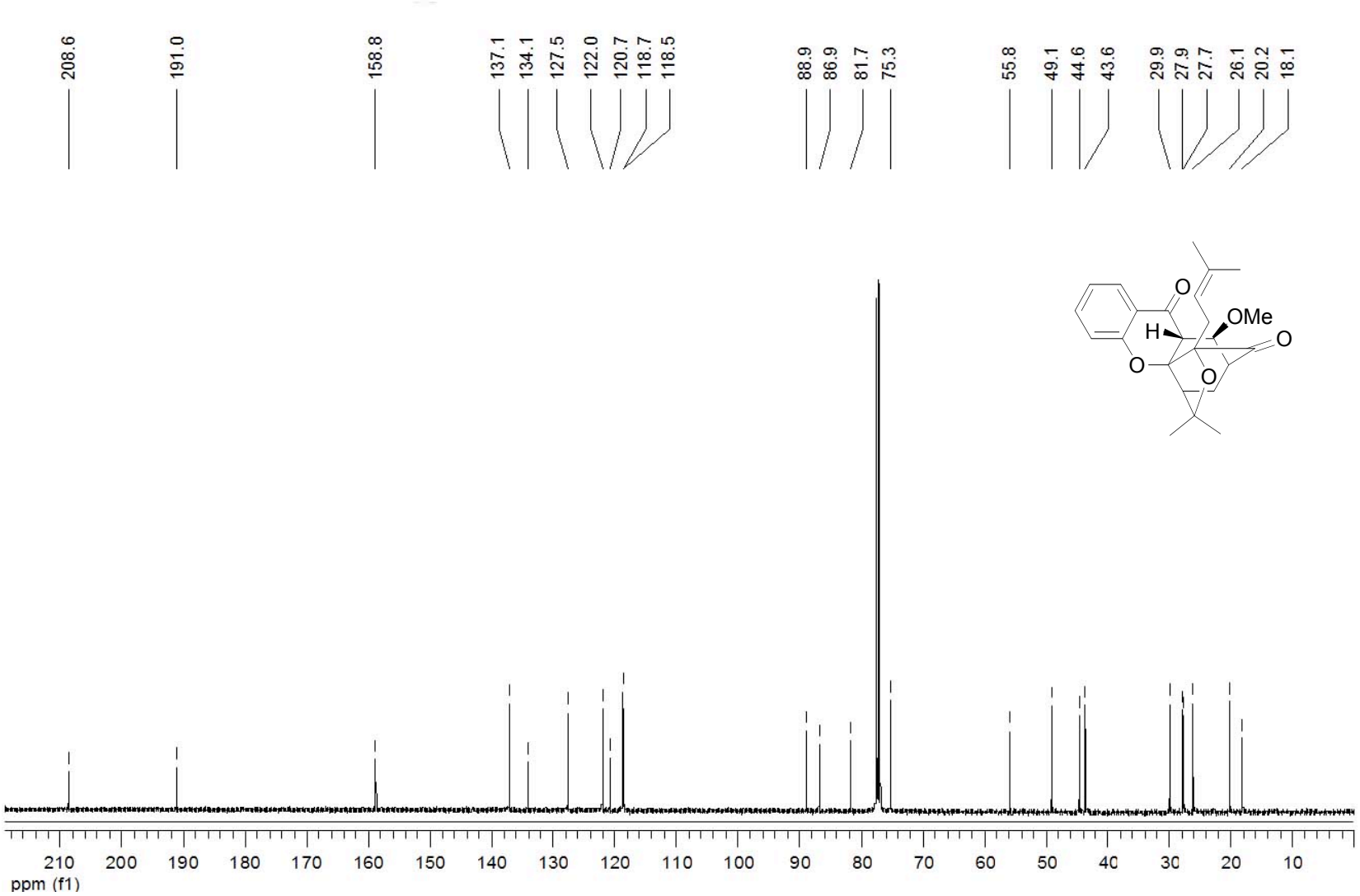
Spectrum 57: ^{1}H NMR ($CDCl_3$, 400 MHz) of compound 42.



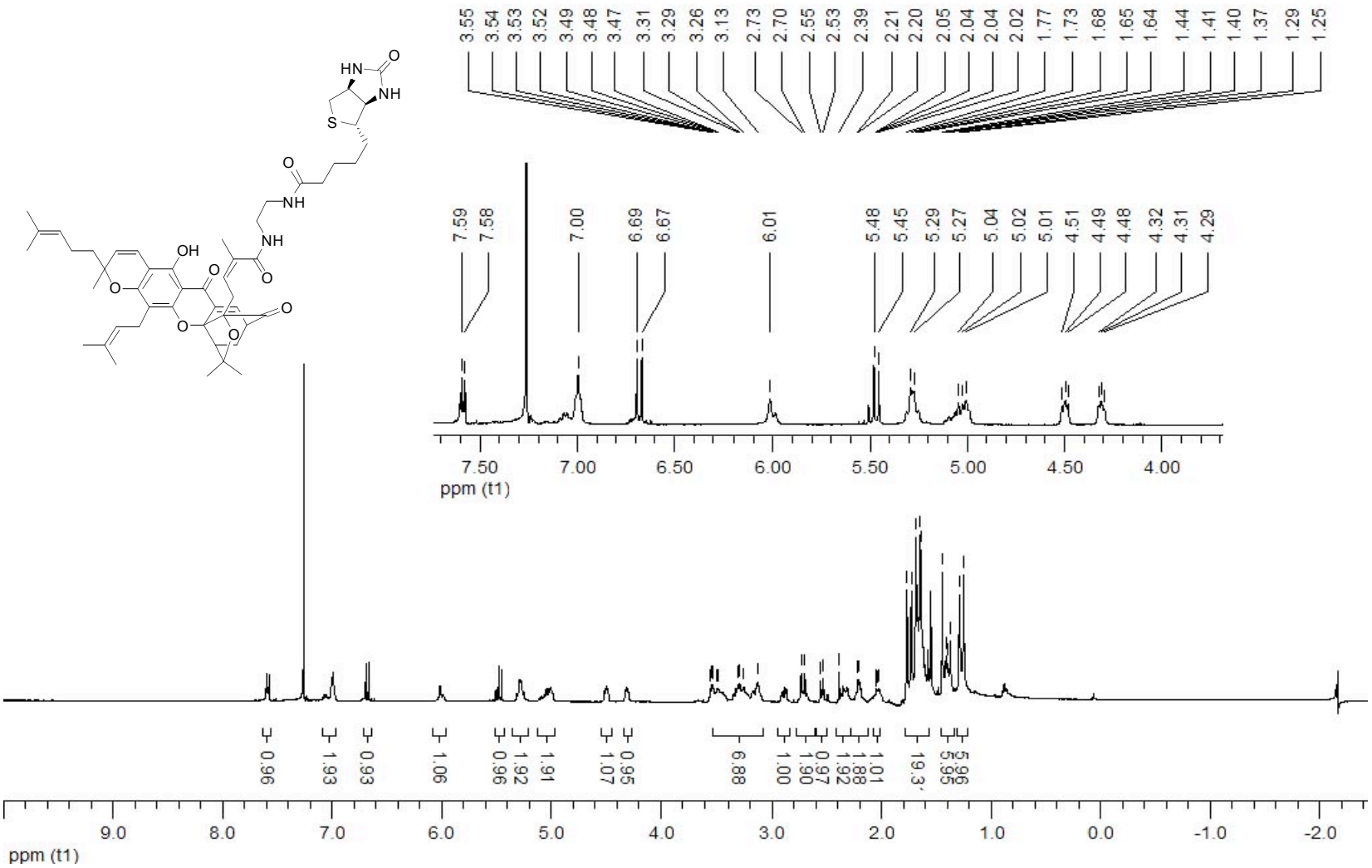
Spectrum 58: ^{13}C NMR ($CDCl_3$, 100 MHz) of compound 42.



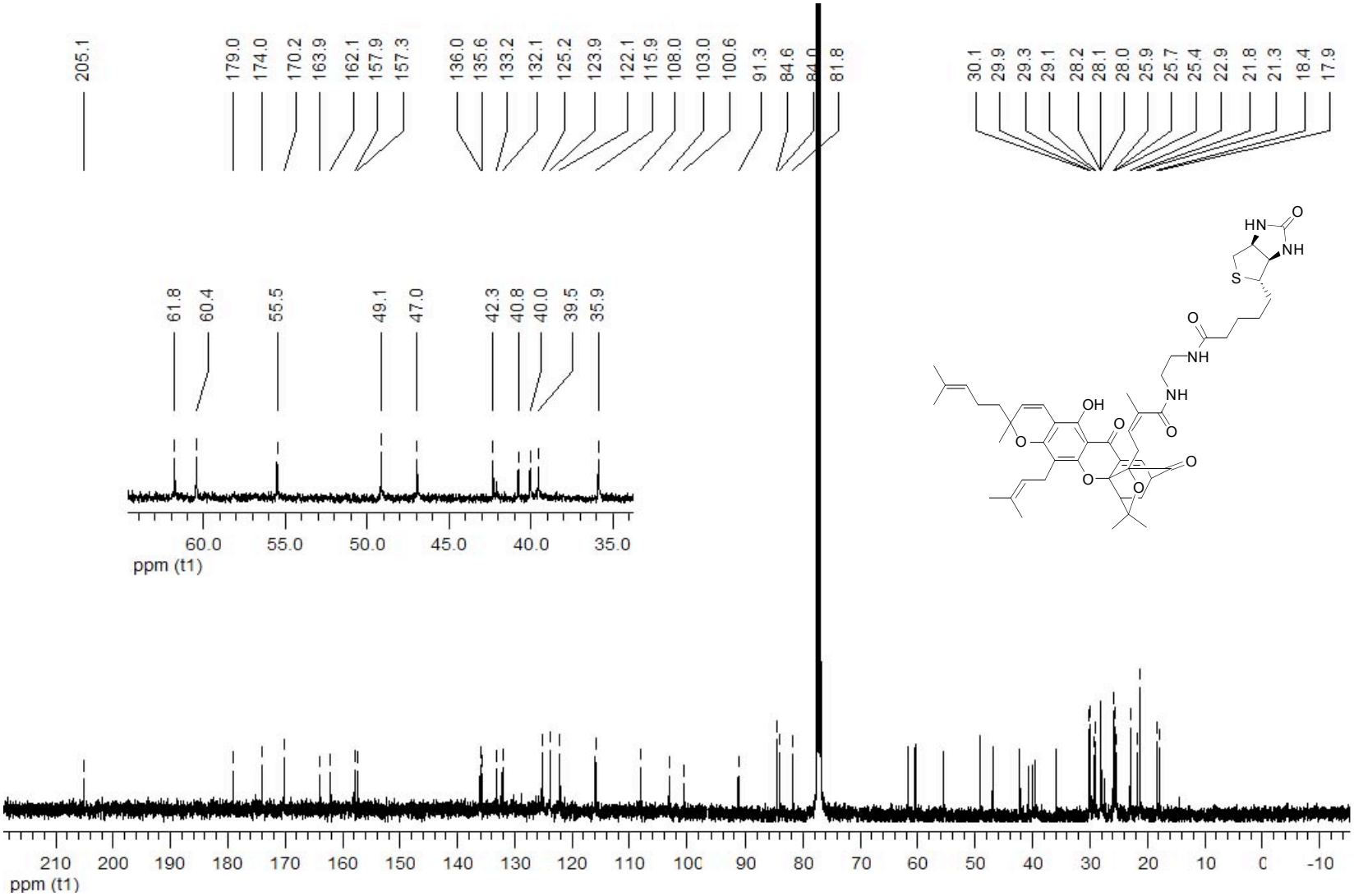
Spectrum 59: ^{1}H NMR ($CDCl_3$, 400 MHz) of compound 43.



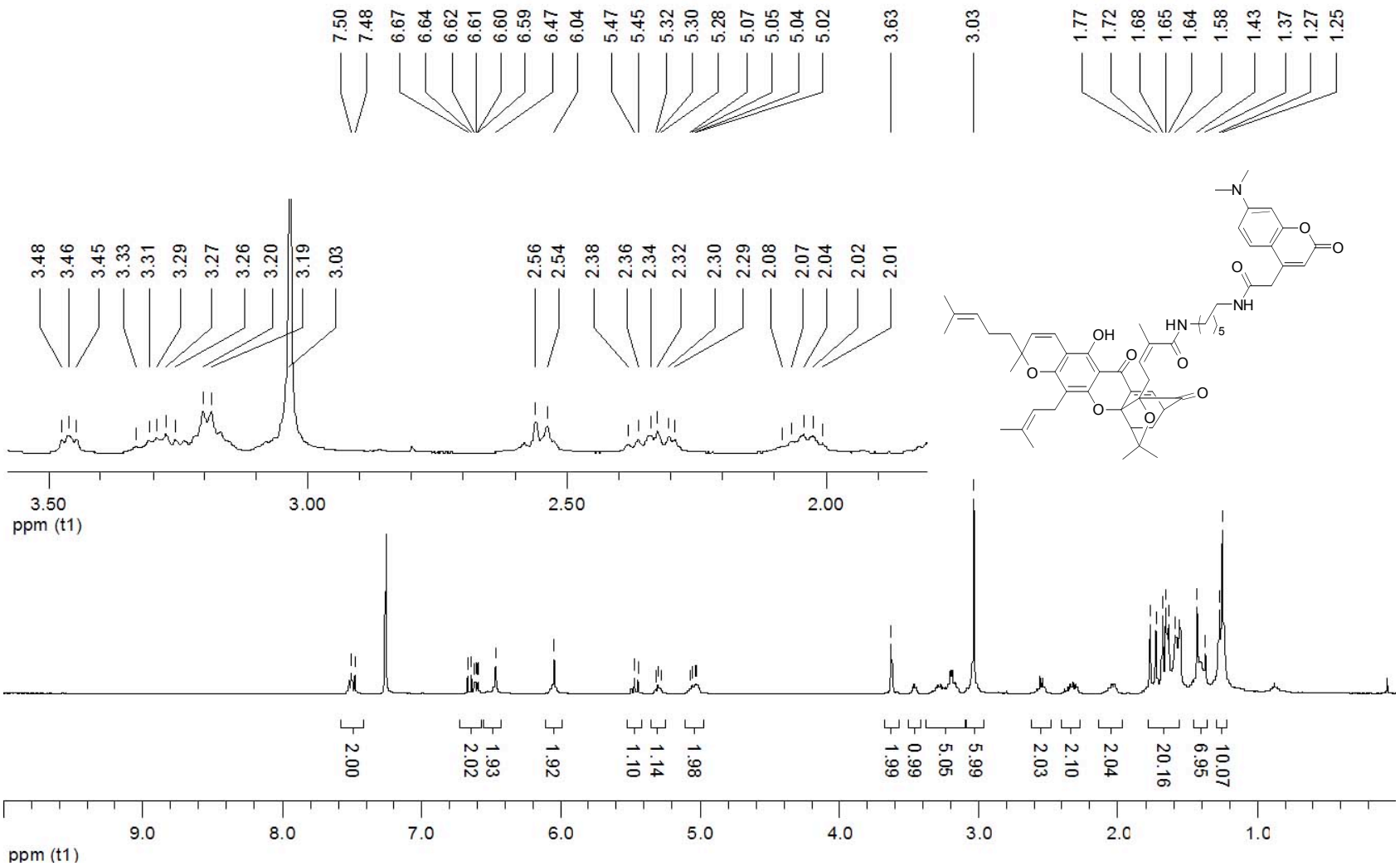
Spectrum 60: ^{13}C NMR ($CDCl_3$, 400 MHz) of compound 43.



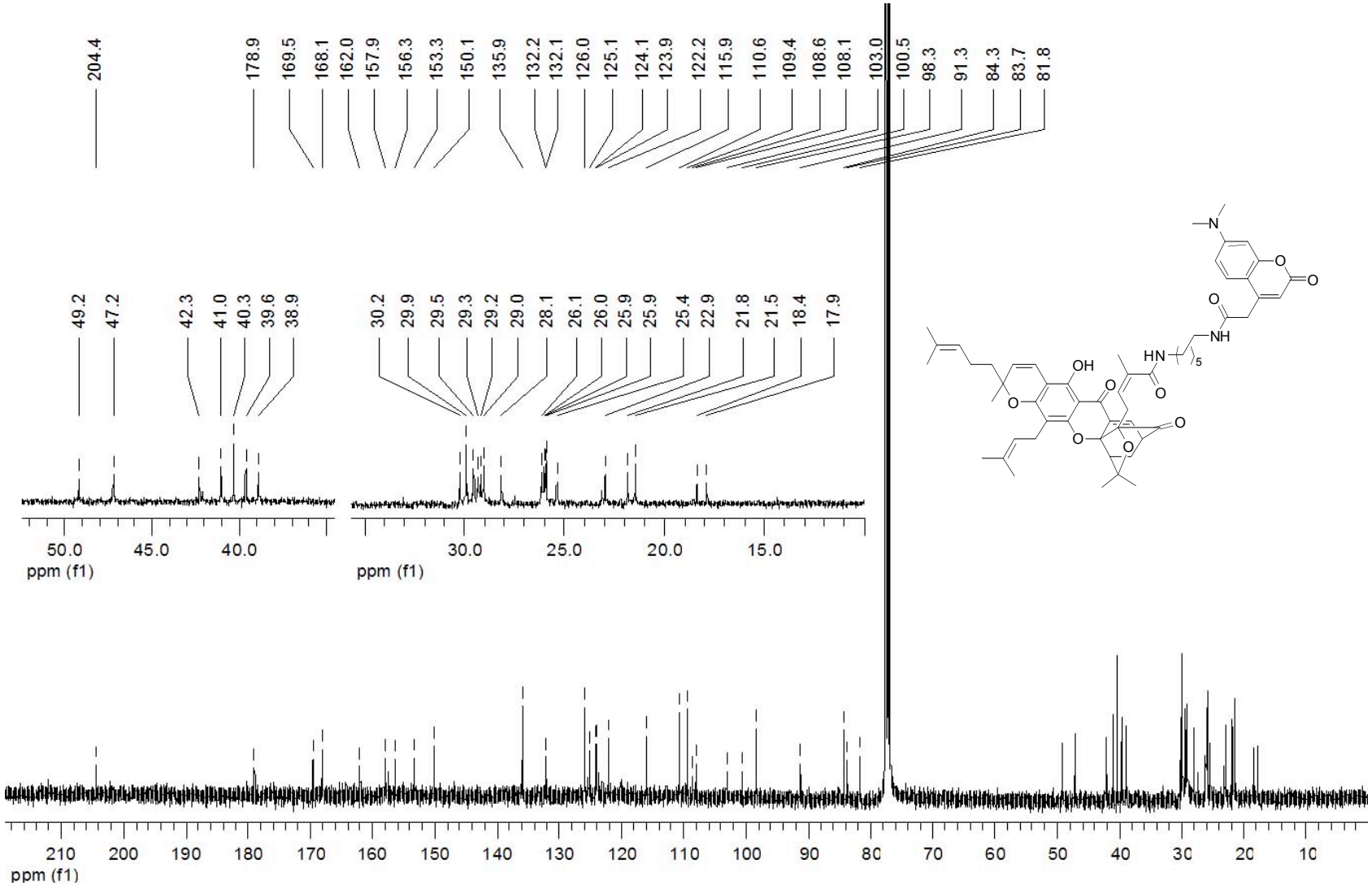
Spectrum 61: ^{1}H NMR ($CDCl_3$, 400 MHz) of compound 44.



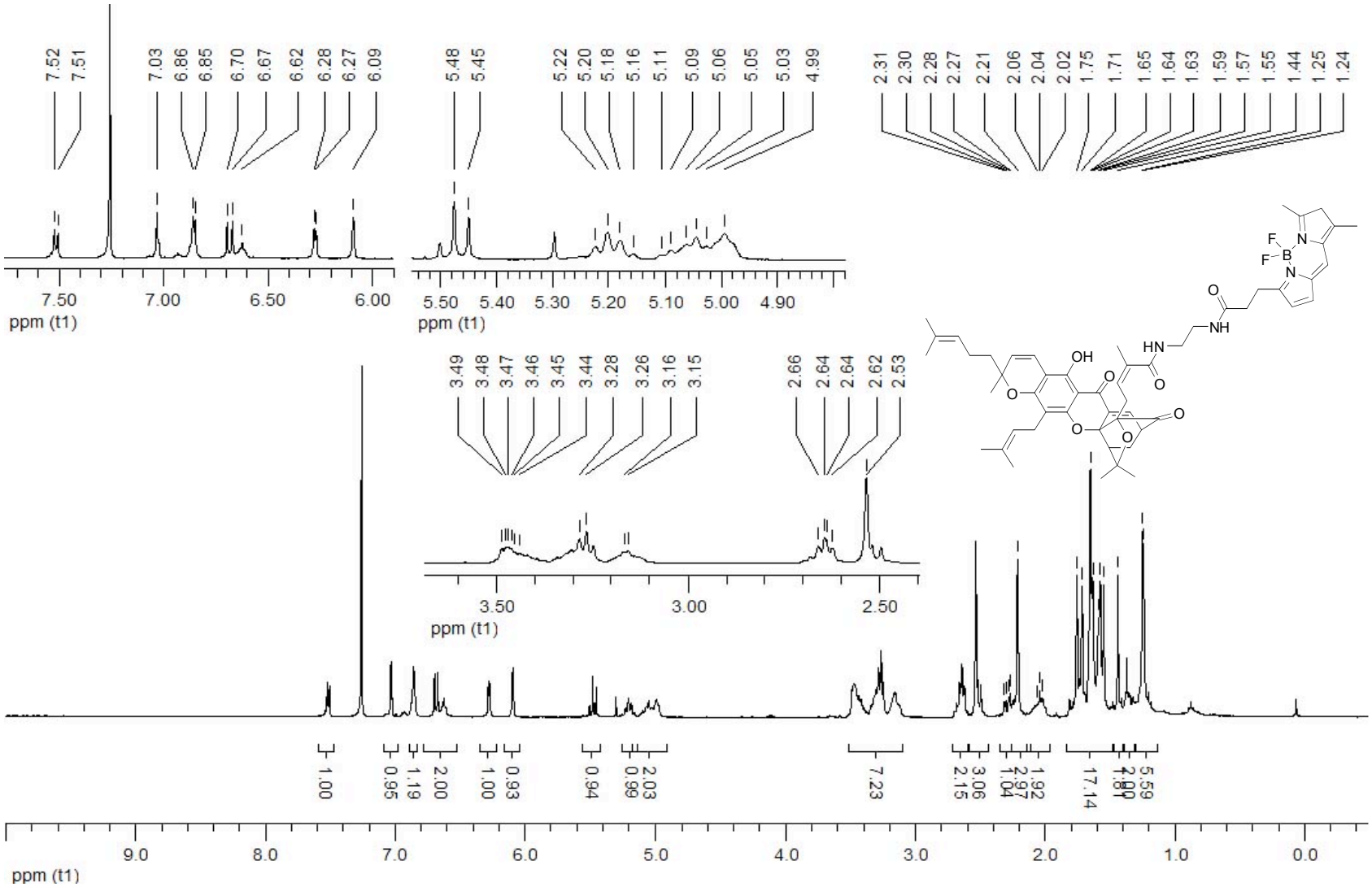
Spectrum 62: ^{13}C NMR ($CDCl_3$, 100 MHz) of compound 44.



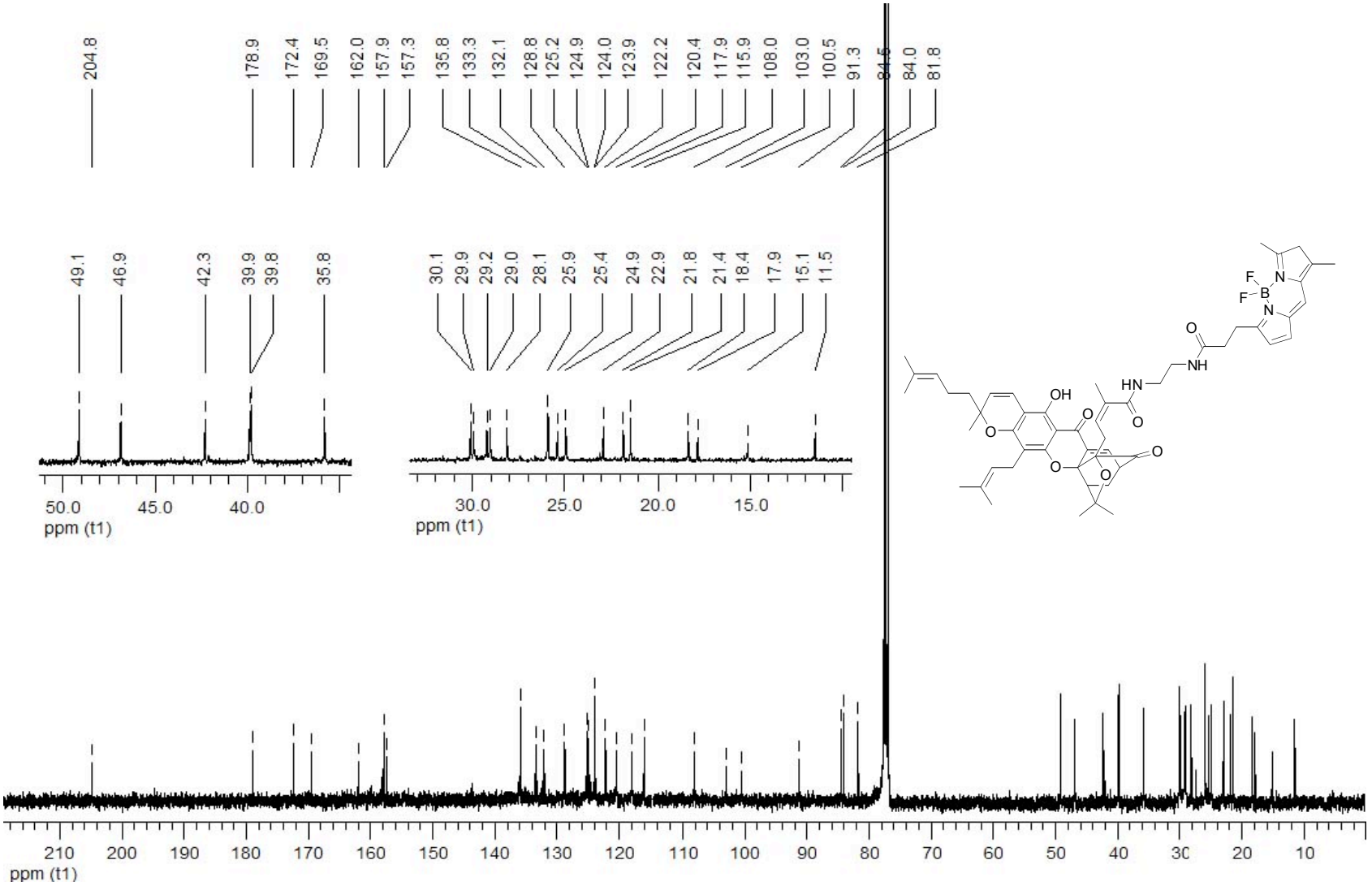
Spectrum 63: ^{1}H NMR ($CDCl_3$, 400 MHz) of compound 45.



Spectrum 64: ^{13}C NMR ($CDCl_3$, 100 MHz) of compound 45.



Spectrum 65: ^{1}H NMR ($CDCl_3$, 400 MHz) of compound 46.



Spectrum 66: ^{13}C NMR ($CDCl_3$, 100 MHz) of compound 46.