Electronic Supplementary Material (ESI) for RSC Advances.

Supporting Information

Stereoselective synthesis of functionalized 1,2,3,4-tetrahydroisoquinolines (THIQs) *via* highly diastereoselective Ugi three-component reactions (U3CR) with chiral 3,4-dihydroisoquinolines (DHIQs)

T. Ramanivas,[a,b] G. Gayatri,[c] D. Priyanka,[a] V. L. Nayak,[a] K. K. Singarapu[d] and A. K. Srivastava*[a,b]

[a]*Medicinal Chemistry and Pharmacology Division, CSIR-Indian Institute of Chemical Technology, Hyderabad 500 007, India*

[b]*Academy of Scientific and Innovative Research, New Delhi 110025, India*

[c]*Centre for Molecular Modeling, CSIR-Indian Institute of Chemical Technology, Hyderabad500 007, India*

[d]*Centre for NMR and Structural Facility, CSIR-Indian Institute of Chemical Technology, Hyderabad 500 007, India*

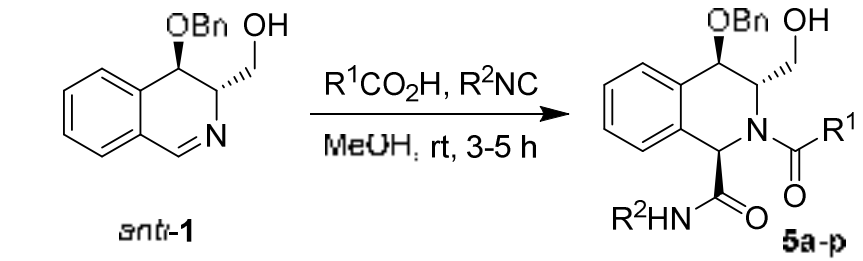
Table of Contents

Section 1: Experimental Procedures and Characterization Data

General: All reagents and solvents were obtained from commercial suppliers and were used without further purification. Anhydrous THF for Mitsunobu reaction was obtained by distilling over sodium/benzophenone under nitrogen. ^{1}H NMR spectra were recorded on Avance 300 and Avance 500 spectrometers using tetramethylsilane (TMS) as the internal standard. Chemical shifts are reported in parts per million (ppm) downfield from tetramethylsilane. Spin multiplicities are described as s (singlet), bs (broad singlet), d (doublet), dd (double douplet), t (triplet), q (quartet), and m (multiplet). Coupling constant (*J*) values are reported in hertz (Hz). HRMS of purified samples were recorded by Thermo Scientific Exactive "ORBITRAP" using H_2O/MeOH mixed with 0.1% formic acid as mobile phase. IR spectra were recorded by Thermo Electron Corporation "NICOLET 380 FT-IR" instrument of KBr pellets. Specific rotation of chiral compounds were measured by automatic polarimeter "DigiPol 781 M6U NOVA". Analytical thin layer chromatography (TLC) was performed on MERCK precoated silica gel 60F254 (0.5mm) aluminium plates. Visualization of the spots on TLC plates was achieved either by exposure to iodine vapour or UV light or by dipping the plates into ethanolic ninhydrin solution or to ethanolic anisaldehyde solution and heating the plates to 120°C. Column chromatography was performed using silica gel of 100-200 mesh size.

General Procedure for U3CR: To a round bottom flask charged with (1eq) 3,4-dihydroisoquinoline **1**, dissolved in methanol (1mL) and benzoic acid (1eq) was added and finally *t*-butylisocyanide (1eq) was added and stirred overnight at room temperature. The reaction was quenched with saturated aq. sodium bicarbonate solution and extracted with

dichloromethane. The lower organic layer was collected and dried over anhydrous sodium sulphate. The crude was purified by column chromatography (Methanol / Dichloromethane 1%→2%→3%→4%→5%) to obtain product.



anti-**1**
Prepared from
Garner's aldehyde[1]

(1*R*,3*S*,4*R*)-4-(benzyloxy)-*N*-(*tert*-butyl)-3-(hydroxymethyl)-2-(4-nitrobenzoyl)-1,2,3,4-tetrahydroisoquinoline-1-carboxamide(5a): Yield 89 % (167 mg from 100 mg of DHIQ **1**) as white solid; Melting point (°C) 198 – 200; $[a]_D^{25}$ +6.96 [c = 1.1, $CHCl_3$]; IR (neat) ν 3344, 2924, 1673, 1598.21, 1530, 1453, 1291, 1064, 860, 754 cm^{-1}; ^1H NMR (300 MHz, $CDCl_3$) δ 8.33 (d, *J* = 8.68 Hz, 2H), 7.83 (d, *J* = 8.49 Hz, 2H), 7.52 – 7.31 (m, 8H), 7.21 (d, *J* = 6.42 Hz, 1H), 6.72 (s, 1H), 5.28 (s, 1H), 4.63 (s, 2H), 4.59 – 4.51 (m, 1H), 4.46 (d, *J* = 2.45 Hz, 1H), 3.77 (bs, 1H), 3.37 – 3.19 (m, 2H), 0.96 (s, 9H); ^{13}C NMR (75 MHz, $CDCl_3$) δ 171.61, 169.95, 148.19, 142.81, 136.70, 131.37, 129.94, 129.19, 128.96, 128.81, 128.52, 127.80, 123.72, 73.83, 70.19, 61.69, 61.11, 60.30, 50.59, 29.61, 28.10; HRMS Calculated *m/z* for $C_{29}H_{31}N_3O_6$ $[M+H]^+$ 518.2291, found 518.2261.

(1*R*,3*S*,4*R*)-4-(benzyloxy)-*N*-(*tert*-butyl)-3-(hydroxymethyl)-2-(4-(trifluoromethoxy)-benzoyl)-1,2,3,4-tetrahydroisoquinoline-1-carboxamide (5b): Yield 72% (150 mg from 100 mg of DHIQ **1**) as white solid; Melting point

(°C) 96 – 98; $[a]_D^{25}$ +7.31 [c = 1.1, $CHCl_3$]; IR (neat) ν 3349, 3066, 3033, 2967, 2928, 1673, 1587, 1455, 1260, 1166, 1044, 829, 766 cm^{-1}; ^1H NMR (500 MHz, $CDCl_3$) δ 7.70 (d, *J* = 8.69 Hz, 2H), 7.48 (d, *J* = 7.32 Hz, 1H), 7.42 – 7.32 (m, 7H), 7.29 (d, *J* = 8.24 Hz, 2H), 7.21 (dd, *J* = 7.32, 1.37 Hz, 1H), 6.71 (s, 1H), 5.26 (s, 1H), 4.67 – 4.63 (m, 1H), 4.62 (d, *J* = 3.05 Hz, 2H), 4.47 (d, *J* = 2.74 Hz, 1H), 4.29 (bs, 1H), 3.31 – 3.21 (m, 2H), 0.93 (s, 9H); ^{13}C NMR (125 MHz, $CDCl_3$) δ 172.45, 170.17, 149.89, 136.96, 135.21, 131.81, 129.90, 129.73, 129.59, 128.68, 128.33, 127.77, 127.54, 120.70, 74.15, 70.21, 61.73, 61.06, 60.10, 53.37, 50.45, 28.08; HRMS Calculated *m/z* for $C_{30}H_{31}F_3N_2O_5$ $[M+H]^+$ 557.2263, found 557.2235.

(1*R*,3*S*,4*R*)-4-(benzyloxy)-*N*-(*tert*-butyl)-2-(4-fluorobenzoyl)-3-(hydroxymethyl)-1,2,3,4-tetrahydroisoquinoline-1-carboxamide(5c): Yield 76% (139.5 mg from 100 mg of DHIQ **1**) as white solid; Melting point (°C) 199 – 200; $[a]_D^{25}$ +10.97 [c = 1.1, $CHCl_3$]; IR (neat) ν 3430, 3370, 2963, 2927, 1668, 1643, 1454, 1291, 1253, 1038, 851, 766 cm^{-1}; ^1H NMR (500 MHz, $CDCl_3$) δ 7.66 (t, *J* = 5.95 Hz, 2H), 7.61 (bs, 1H), 7.44 – 7.32 (m, 8H), 7.20 (d, *J* = 7.62 Hz, 1H), 7.16 (t, *J* = 8.39 Hz, 2H), 6.71 (s, 1H), 5.33 (bs, 1H), 4.70 (t, *J* = 7.01Hz, 1H), 4.63 (s, 2H), 4.50 (s, 1H), 3.23 (bs, 2H), 0.96 (s, 9H); ^{13}C NMR (75 MHz, $CDCl_3$) δ 172.68, 170.06, 137.09, 132.67, 132.22, 129.91, 128.71, 128.33, 127.83, 127.51, 115.70, 115.41, 74.26, 70.24, 62.02, 61.15, 59.90, 50.47, 28.17; HRMS Calculated *m/z* for $C_{29}H_{31}FN_2O_4$ $[M+H]^+$ 491.2346, found 491.2315.

(1*R*,3*S*,4*R*)-4-(benzyloxy)-*N*-cyclohexyl-3-(hydroxymethyl)-2-(4-nitrobenzoyl)-1,2,3,4-tetrahydroisoquinoline-1-carboxamide (5d): Yield 74% (150.5 mg from 100 mg of DHIQ **1**) as Pale yellow solid; Melting point (°C) 97 – 99; $[a]_D^{25}$ –5.00 [c = 1.1, $CHCl_3$]; IR (neat) ν 3329, 2933, 2854, 1665, 1597, 1453, 1315, 1253, 1043, 861, 753 cm^{-1}; ^1H NMR (300

MHz, $CDCl_3$) δ 8.34 (d, *J* = 8.86 Hz, 2H), 7.80 (d, *J* = 8.49 Hz, 2H), 7.59 (d, *J* = 7.55 Hz, 1H), 7.47 – 7.30 (m, 8H), 6.81(d, *J* = 8.30 Hz, 1H), 5.45 (s, 1H), 4.65 – 4.49 (m, 4H), 3.46 – 3.17 (m, 3H), 1.46 – 1.34 (m, 5H), 1.15 – 1.01 (m, 2H), 0.94 – 0.74 (m, 2H), 0.50 – 0.28 (m, 2H); ^{13}C NMR (75 MHz, $CDCl_3$) δ 171.41, 169.80, 148.32, 142.76, 136.72, 131.59, 130.11, 129.99, 128.92, 128.86, 128.57, 127.96, 127.83, 123.76, 74.39, 70.37, 61.89, 60.59, 60.15, 47.89, 32.44, 32.30, 29.67, 25.03, 24.61, 24.57, 22.67; HRMS Calculated *m/z* for $C_{31}H_{33}N_3O_6$ $[M+H]^+$ 544.2448, found 544.2448.

(1*R*,3*S*,4*R*)-4-(benzyloxy)-2-(3-bromo-4-fluorobenzoyl)-*N*-(*tert*-butyl)-3-(hydroxyl-methyl)-1,2,3,4-tetrahydroisoquinoline-1-carboxamide (5e): Yield 61% (129.5 mg from 100 mg of DHIQ **1**) as white solid; Melting point (°C) 194 – 196; $[a]_D^{25}$ +19.45 [c = 1.1, $CHCl_3$]; IR (neat) ν 3429, 3343, 2973, 2902, 2871, 1674, 1654, 1495, 1309, 1057, 769, 758 cm^{-1}; ^1H NMR (500 MHz, $CDCl_3$) δ 7.87 (d, *J* = 6.40, 1.67 Hz, 1H), 7.67 (m, 1H), 7.55 (d, *J* = 7.47 Hz, 1H), 7.44 – 7.32 (m, 5H), 7.25 – 7.20 (m, 2H), 6.68 (s, 1H), 5.29 (bs, 1H), 4.71 – 4.67 (m, 1H), 4.62 (dd, *J* = 11.9, 25.63 Hz, 2H), 4.47 (d, *J* = 2.59 Hz, 1H), 3.64 (bs, 1H), 3.28 (dd, *J* = 4.57, 11.44 Hz, 1H), 3.21 (t, *J*= 9.46 Hz, 1H), 0.92 (s, 9H); ^{13}C NMR (75 MHz, $CDCl_3$) δ 171.31, 169.98, 158.05, 136.84, 133.96, 132.68, 131.72, 129.89, 128.78, 128.35, 127.85, 127.56, 117.09, 116.80, 73.97, 70.07, 61.69, 61.79, 61.00, 60.27, 50.47, 28.03; HRMS Calculated *m/z* for $C_{29}H_{30}BrFN_2O_4$ $[M+H]^+$ 569.1451, found 569.1431.

(1*R*,3*S*,4*R*)-4-(benzyloxy)-*N*-(*tert*-butyl)-2-((*E*)-3-(4-fluorophenyl)acryloyl)-3-(hydroxyl-methyl)-1,2,3,4-tetrahydroisoquinoline-1-carboxamide (5f): Yield 46% (88.9 mg from 100 mg of DHIQ **1**) as pale yellow sticky semisolid; $[a]_D^{25}$ –4.00 [c = 1.1, $CHCl_3$]; IR (neat) ν 3854, 2922, 2852, 1685, 1648, 1458, 1376, 1227 ,1081, 829 cm^{-1}; ^1H

NMR (500 MHz, $CDCl_3$) δ 7.76 (d, *J* = 15.1 Hz, 1H), 7.63 (d, *J* = 7.62 Hz, 1H), 7.56 (dd, *J* = 5.49, 8.39 Hz, 2H), 7.4 (t, *J* = 7.47 Hz, 1H), 7.40 – 7.31 (m, 7H), 7.23 (s, 1H), 7.20 (d, *J* = 7.32 Hz, 1H), 7.07 (t, *J* = 8.54 Hz, 2H), 7.00 (d, *J* = 15.1 Hz, 1H), 5.45 (td, *J* = 2.29, 6.86 Hz, 1H), 5.40 (s, 1H), 4.72 (d, *J* = 2.13 Hz, 1H), 4.59 (s, 2H), 3.40 (dd, *J* = 6.4, 10.83 Hz, 1H), 3.21(dd, *J* = 7.32, 10.98 Hz, 1H), 0.95 (s, 9H); ^{13}C NMR (75 MHz, $CDCl_3$) δ 170.97, 170.42, 143.47, 131.43, 130.29, 130.18, 129.95, 128.70, 128.08, 127.93, 124.01, 123.49, 116.85, 116.19, 115.90, 73.89, 70.14, 63.85, 63.24, 56.05, 50.96, 31.94, 29.69, 29.38, 27.90, 22.72; HRMS Calculated *m/z* for $C_{31}H_{33}FN_2O_4$ $[M+H]^+$ 517.2503, found 517.2495.

(1*R*,3*S*,4*R*)-4-(benzyloxy)-*N*-(*tert*-butyl)-3-(hydroxymethyl)-2-(2-(4-methoxy-phenyl)-acetyl)-1,2,3,4-tetrahydroisoquinoline-1-carboxamide (5g): Yield 61% (117.9 mg from 100 mg of DHIQ **1**) as pale yellow solid; Melting point (°C) 169 – 170; $[a]_D^{25}$ –2.12 [c = 1.1, $CHCl_3$]; IR (neat) ν 3494, 3343, 1683, 1634, 1455, 1284, 1029, 784 cm^{-1}; ^{1}H NMR (500 MHz, $CDCl_3$, mixture of rotamers 1: 0.7) δ 7.53 (t, *J* = 7.02 Hz, 1.8H), 7.39 – 7.36 (m, 6H), 7.35 – 7.30 (m, 5.8H), 7.28(d, *J* = 8.69 Hz, 1.3H), 7.16 (d, *J* = 7.32 Hz, 0.7H), 7.12 (d, *J* = 7.48 Hz, 1H), 7.07 (d, *J* = 8.08 Hz, 2.1H), 6.90 (d, *J* = 8.69 Hz, 2H), 6.85 (d, *J* = 8.69 Hz, 1.3H), 6.51 (s, 1H), 5.30 – 5.26 (m, 0.7H), 5.16 (s, 0.7H), 5.09 (s, 1H), 4.77 – 4.73 (m, 1H), 4.69 (d, *J* = 2.29 Hz, 0.7H), 4.58 (s, 1.4H), 4.43 (d, *J* = 2.75 Hz, 1H), 4.29 (d, *J* = 14.65 Hz, 1H), 4.26 (d, *J* = 12.67 Hz, 1H), 4.20 (d, *J* = 12.51 Hz, 1H), 3.80 (s, 3H), 3.79 (s, 1.7H), 3.77 (d, *J* = 15.71 Hz, 0.7H), 3.70 (d, *J* = 15.70 Hz, 0.7H), 3.80 – 3.77 (m, 1H), 3.36 – 3.30 (m, 3.6H), 3.03 (t, *J* = 7.93 Hz, 0.7H), 1.06 (s, 6H), 0.89 (s, 9H); ^{13}C NMR (75 MHz, $CDCl_3$) δ 173.56, 170.42, 158.60, 130.35, 130.09, 129.63, 128.67, 128.47, 128.00, 127.94, 127.51, 127.45, 114.27,

114.06, 74.38, 70.28, 69.53, 63.56, 62.98, 61.93, 58.50, 56.20, 55.30, 51.02, 50.30, 40.99, 40.34, 29.70, 28.01; HRMS Calculated *m/z* for $C_{31}H_{36}N_2O_5$ $[M+H]^+$ 517.2702, found 517.2690.

(1*R*,3*S*,4*R*)-4-(benzyloxy)-*N*-(*tert*-butyl)-3-(hydroxymethyl)-2-(4-methoxybenzoyl)-1,2,3,4-tetrahydroisoquinoline-1-carboxamide (5h): Yield 79% (148 mg from 100 mg of DHIQ **1**) as pale yellow solid; Melting point (°C) 119 – 120; $[\alpha]_D^{25}$ –20.20 [c = 1.1, $CHCl_3$]; IR (neat) ν 3358, 3064, 3031, 2963, 2925, 1672, 1608, 1250, 1111, 840 cm^{-1}; ^1H NMR (500 MHz, $CDCl_3$) δ 7.53(t, *J* =10.22 Hz, 3H), 7.35 – 7.28(m, 5H), 7.28 – 7.22(m, 2H), 7.11(dd, *J* = 1.06, 7.47 Hz, 1H), 6.89(d, *J* = 8.24 Hz, 2H), 6.67(s, 1H), 4.72(bs, 1H), 4.55(dd, *J* = 11.9, 15.86 Hz, 2H), 4.44(s, 1H), 3.78(s, 3H), 3.17 – 3.07 (m, 2H), 0.86(s, 9H); ^{13}C NMR (100Hz, $CDCl_3$) δ 173.34, 170.26, 160.63, 137.22, 132.33, 130.18, 129.86, 129.61,129.43, 129.31, 128.72, 128.62, 128.16, 127.96, 127.79, 127.33, 113.77, 74.31, 70.14, 62.01, 61.04, 59.82, 55.31, 50.35, 29.63, 28.12; HRMS Calculated m/z for $C_{30}H_{34}N_2O_5$ $[M+H]^+$ 503.2501, found 503.2529.

(1*R*,3*S*,4*R*)-4-(benzyloxy)-*N*-(*tert*-butyl)-2-(2-chlorobenzoyl)-3-(hydroxymethyl)-1,2,3,4-tetrahydroisoquinoline-1-carboxamide (5i): Yield 56% (106 mg from 100 mg of DHIQ **1**) as white solid; Melting point (°C): 88 – 90; $[\alpha]_D^{25}$ +52.31 [c = 1.1, $CHCl_3$]; IR (neat) ν 3336, 3063, 2965, 2925, 1664, 1591, 1453,1314, 1248,1057, 757 cm^{-1}; ^1H NMR (300 MHz, $CDCl_3$, mixture of rotamers 1: 0.34) δ 7.71 (d, *J* = 8.30 Hz, 1H), 7.52 – 7.28 (m, 17H), 7.18 (t, *J* = 7.36 Hz, 1.6H), 7.01 (s, 0.6H), 5.38 (s, 0.6H), 4.67 – 4.49 (m, 4.2H), 4.26 (bs, 0.7H), 3.89 – 3.77 (m, 0.3H), 3.48 – 3.28 (m, 1.2H), 3.08 (t, *J* = 9.06 Hz, 1.4H), 1.02 (s, 9H), 0.95 (s, 3.1H); ^{13}C NMR (75 MHz, $CDCl_3$) δ 169.74, 169.43, 137.27, 135.59, 135.15, 132.13,

130.47, 129.85, 129.47, 128.40, 129.34, 127.95, 127.47, 127.12, 126.51, 74.03, 70.40, 62.30,61.55, 59.55, 58.56, 50.69, 50.44, 28.07; HRMS Calculated *m/z* for $C_{29}H_{31}ClN_2O_4$ $[M+H]^+$ 507.2051, found 507.2024.

(1*R*,3*S*,4*R*)-2-((*3R*,*5R*,*7R*)-adamantane-1-carbonyl)-4-(benzyloxy)-*N*-(*tert*-butyl)-3-(hydroxymethyl)-1,2,3,4-tetrahydroisoquinoline-1-carboxamide (5j): Yield 64% (127 mg from 100 mg of DHIQ **1**) as pale yellow solid; Melting point (°C) 200 – 202; $[a]_D^{25}$ –13.57 [c = 1.1, $CHCl_3$]; IR (neat) ν 3421, 3359, 2923, 2870, 2852, 1663, 1631, 1454, 1055, 744 cm^{-1}; ^1H NMR (500 MHz, $CDCl_3$) δ 7.53 (d, *J* = 7.47 Hz, 1H), 7.31 – 7.21 (m, 7H), 7.19 (s, 1H), 7.17 (dd, *J* = 7.32, 1.22 Hz, 1H), 6.44 (s, 1H), 5.12 – 5.06 (m, 1H), 5.01 (s, 1H), 4.58 (d, *J* = 11.90 Hz, 1H), 4.49 (d, *J* = 12.05, Hz, 2H), 3.38 (dd, *J* = 10.83,5.34 Hz, 1H), 3.05 (t, *J* = 10.22 Hz, 1H), 2.18 (d, *J* = 12.20 Hz, 3H), 2.07 – 1.98 (m, 6H), 1.72 (s, 6H), 0.83 (s, 9H); ^{13}C NMR (100MHz, $CDCl_3$) δ 178.30, 170.73, 137.43, 132.95, 129.78, 129.51, 128.50, 128.09, 127.98, 127.87, 127.83, 127.65, 127.13, 74.71, 70.40, 63.08, 62.67, 60.37, 57.30, 50.06, 43.01, 39.69, 38.72, 36.65, 36.33, 29.66, 28.57, 28.49, 28.19, 27.78, 21.01, 14.16; HRMS Calculated *m/z* for $C_{33}H_{42}N_2O_4$ $[M+H]^+$ 531.3178, found 531.3207.

(1*R*,3*S*,4*R*)-4-(benzyloxy)-*N*-(*tert*-butyl)-2-(2-(3,4-dimethoxyphenyl)acetyl)-3-(hydroxyl-methyl)-1,2,3,4-tetrahydroisoquinoline-1-carboxamide (5k):Yield 56% (114 mg from 100 mg of DHIQ **1**) as white solid; Melting point (°C) 136 – 138; $[a]_D^{25}$ –19.84 [c = 1.1, $CHCl_3$]; IR (neat) ν 3338, 2960, 2923, 2851, 1656, 1589, 1421, 1398, 1086, 800, 758 cm^{-1}; ^1H NMR (500 MHz, $CDCl_3$, mixture of rotamers ~2.5:1) δ 7.46 (d, *J* = 8.30 Hz, 1H), 7.39 – 7.34 (m, 3.3H), 7.33 – 7.28 (m, 3.9H), 7.19 – 7.06 (m, 3.3H), 7.04 (s, 0.4H), 6.99 (s, 1.3H), 6.84 – 6.74 (m, 2.3H), 6.53 (s, 0.9H), 5.18 (s, 0.5H), 5.05 (s, 0.9H), 4.85 (bs, 1H), 4.74 (d, *J* = 2.26 Hz, 0.5H), 4.60 (s, 1H), 4.46 (d, *J* = 2.26 Hz, 0.9H), 4.36 (d, *J* = 14.54 Hz,

1H), 4.28 (dd, *J* = 12.46, 16.61 Hz, 2H), 3.88 (s, 2.2H), 3.84 (t, J = 3.58 Hz, 6H), 3.76 (d, *J* = 0.94 Hz, 0.9H), 3.71 (s, 0.8H), 3.58 (s, 0.8H), 3.46 – 3.27 (m, 2.4H), 3.00 (dd, *J* = 7.93, 10.95 Hz, 0.5H),1.06 (s, 3.7H), 0.84 (s, 9H); ^{13}CNMR (125MHz, $CDCl_3$) δ 171.31, 170.57, 149.19, 148.10, 137.00, 132.27, 130.24, 129.62, 129.17, 128.60, 128.45, 128.08, 127.98, 127.42, 121.06, 112.81, 111.43, 111.22, 74.33, 73.95, 69.61, 63.39, 62.83, 61.80, 58.63, 56.06, 55.92, 55.79, 50.18, 41.07, 29.63, 27.92; HRMS Calculated m/z for $C_{32}H_{38}N_2O_6$ $[M+H]^+$ 547.2763, found 547.2789.

(1*R*,3*S*,4*R*)-4-(benzyloxy)-*N*-(*tert*-butyl)-2-(3,5-dimethoxybenzoyl)-3-(hydroxymethyl)-1,2,3,4-tetrahydroisoquinoline-1-carboxamide (5l): Yield 86% (171 mg from 100 mg of DHIQ **1**) as pale yellow solid; Melting point (°C) 151 – 152; $[a]_D^{25}$ –16.80 [c = 1.1, $CHCl_3$]; IR (neat) ν 3357, 2961, 2924, 2853, 2359, 1670, 1592, 1425, 1344, 1157, 765, 745 cm^{-1}; ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.57 (d, *J* = 7.78 Hz, 1H), 7.39 – 7.22 (m, 8H), 7.13 (d, *J* = 7.17 Hz, 1H), 6.71 (d, *J* = 2.13 Hz, 2H), 6.70 (s, 1H), 6.46 (bs, 1H), 5.26 (s, 1H), 4.76 – 4.71 (m, 1H), 4.53 (dd, *J* = 26.39,11.9 Hz, 2H), 4.48 (d, *J* = 2.59 Hz, 1H), 3.71 (s, 6H), 3.18 – 3.09 (m, 2H), 0.89 (s, 9H); ^{13}C NMR (100MHz, $CDCl_3$) δ 172.75, 170.01, 160.85, 138.13, 137.11, 132.19, 129.89, 129.71, 129.22, 128.6, 128.17, 128.02, 127.4, 105.66, 101.79, 74.43, 70.28, 62.17, 61.13, 59.42, 55.47, 53.39, 50.41, 29.65, 28.15; HRMS Calculated *m/z* for $C_{31}H_{36}N_2O_6$ $[M+H]^+$ 533.2607, found 533.2634.

(1*R*,3*S*,4*R*)-4-(benzyloxy)-2-(2-(4-bromophenyl)acetyl)-*N*-*tert*-butyl-3-(hydroxymethyl)-1,2,3,4-tetrahydroisoquinoline-1-carboxamide (5m): Yield 77% (159 mg from 100 mg of DHIQ **1**) as pale yellow solid; Melting point (°C) 154 – 156; $[a]_D^{25}$ –16.80 [c = 1.1, $CHCl_3$]; IR (neat) ν 3422, 2962, 2924, 1636, 1593, 1405, 1261, 1095, 1024,

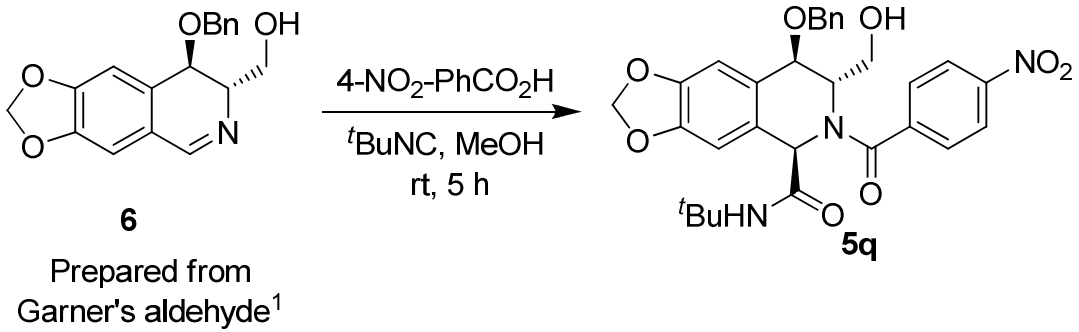
802, 698 cm^{-1}; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.53 (d, *J* = 7.94 Hz, 2H), 7.46 (d, *J* = 5.38 Hz, 3H), 7.36 – 7.24 (m, 8H), 7.12 (d, *J* = 7.09 Hz, 1H), 6.63 (s, 1H), 4.59 (t, *J* = 5.62 Hz, 1H), 4.54 (s,1H), 4.40 (s, 1H), 3.21 – 3.12 (m, 2H), 0.86 (s, 9H); ^{13}C NMR (75MHz, $CDCl_3$) δ 172.59, 170.17, 136.99, 135.46, 131.87, 131.60, 129.88, 129.70, 129.46, 129.29, 128.67, 128.28, 128.12, 127.78, 127.49, 123.93, 74.19, 70.21, 61.75, 61.07, 60.02, 50.42, 29.60, 28.09; HRMS Calculated *m/z* for $C_{29}H_{31}BrN_2O_4$ $[M+H]^+$ 551.1501, found 551.1530.

(1*R*,3*S*,4*R*)-4-(benzyloxy)-*N*-*tert*-butyl-2-(2-(2-chloro-3-methoxyphenyl)acetyl)-3-(hydroxymethyl)-1,2,3,4-tetrahydroisoquinoline-1-carboxamide (5n): Yield 51% (103 mg from 100 mg of DHIQ **1**) as white solid; Melting point (°C) 172 – 174; $[a]_D^{25}$ +67.04 [c = 1.1, $CHCl_3$]; IR (neat) ν 3352, 2962, 2925, 1667, 1572, 1394, 1297, 1223, 1062, 800, 759 cm^{-1}; ^{1}H NMR (500 MHz, $CDCl_3$, mixture of rotamrs 1:0.4) δ 7.64 (d, *J* = 7.78 Hz, 0.5H), 7.60 (d, *J* = 7.78 Hz, 1H), 7.37 – 7.29 (m, 6.6H), 7.27 (d, *J* = 3.50 Hz, 4H), 7.25 – 7.20 (m, 3.8H), 7.12 (t, *J* = 7.32 Hz, 1.1H), 7.08 (d, *J* = 7.32 Hz, 1.1H), 6.99 (s, 0.9H), 6.97 – 6.91 (m, 2.8H), 6.89 (d, *J* = 6.71 Hz, 1.4H), 6.73 (s, 0.4H), 5.28 (s, 0.4H), 5.21 (s, 0.8H), 4.86 (s, 0.4H), 4.59 (d, *J* = 2.74 Hz, 0.6H), 4.57 (bs, 1.8H), 4.44 (d, *J* = 12.20 Hz, 1.8H), 4.45 (s, 0.6H), 4.42 (s, 0.6H) 4.22 – 4.16 (m, 1.1H), 3.91 (s, 3H), 3.86 (d, *J* = 6.40 Hz, 2.1H), 3.38 (dd, *J* =6.10, 10.90 Hz, 0.5H), 3.28 (q, *J* = 5.34 Hz, 1.1H), 2.97 (t, *J* = 10.22 Hz, 1.9H), 0.94 (s, 9H), 0.92 (s, 3.7H); ^{13}C NMR (75MHz, $CDCl_3$) δ 169.66, 169.55, 154.84, 137.31, 137.18, 136.98, 136.73, 129.56, 128.23, 127.56, 120.44, 118.32, 112.68, 112.51, 74.41, 74.02, 73.87, 70.47, 70.37,62.33, 56.85, 56.43, 56.36, 56.20, 53.48, 50.97, 50.80, 50.49, 28.08; HRMS Calculated *m/z* for $C_{30}H_{33}ClN_2O_5$ $[M+H]^+$ 537.2112, found 537.2135.

(1*R*,3*S*,4*R*)-4-(benzyloxy)-*N*-(*tert*-butyl)-2-(2-chloro-3-methoxybenzoyl)-3-(hydroxyl-methyl)-1,2,3,4-tetrahydroisoquinoline-1-carboxamide (5o): Yield 79% (158 mg from 100 of DHIQ **1**) as white solid; Melting point (°C) 171 – 172; $[a]_D^{25}$ –0.019 [c = 1.1, $CHCl_3$]; IR (neat) ν 3421, 2996, 2924, 2897, 1670, 1636, 1418, 1394, 1229, 1026, 756 cm^{-1}; ^1H NMR (500 MHz, $CDCl_3$) δ 7.56 (d, *J* = 7.47 Hz, 1H), 7.38 – 7.23 (m, 8H), 7.13(s, 1H), 7.11 (d, *J* = 7.47 Hz, 1H), 6.85 (d, *J* = 8.08 Hz, 1H), 6.69 (s, 1H), 5.30 (s, 1H), 4.79 (bs, 1H), 4.54 (s,2H), 4.47 (s, 1H), 3.85 (s, 1H), 3.74 (s, 1H), 3.14 (d, *J* = 6.25 Hz, 2H), 0.91 (s, 9H); ^{13}C NMR (125MHz, $CDCl_3$) δ 172.97, 170.04, 149.95, 148.62, 136.84, 131.98, 129.68, 129.44, 128.92, 128.60, 128.38, 127.97, 127.78, 127.64, 127.08, 120.34, 111.12, 110.38, 74.02, 69.81, 61.80, 60.77, 59.59, 55.71, 55.66, 50.14, 29.38, 27.90; HRMS Calculated *m/z* for $C_{31}H_{36}N_2O_6$ $[M+H]^+$ 533.2607, found 533.2635.

(1*R*,3*S*,4*R*)-4-(benzyloxy)-*N*-(*tert*-butyl)-3-(hydroxymethyl)-2-(*N*-*tosyl*-*L*-phenylalanyl)-1,2,3,4-tetrahydroiso-quinoline-1-carboxamide (5p): Yield 68% (170 mg from 100 mg of DHIQ **1**) as pale yellow solid; Melting point (°C) 79 – 81; $[a]_D^{25}$ –59.00 [c = 1.1, $CHCl_3$]; IR (neat) ν 3341, 3062, 3029, 2923, 2852, 1666, 1600, 1454, 1321, 1222, 1067, 812, 757 cm^{-1}; ^1H NMR (500 MHz, $CDCl_3$, mixture of rotamers 1:0.6) δ 7.64 (d, *J* = 7.45 Hz, 0.6 H), 7.57 (d, *J* = 7.7 Hz, 1.2H), 7.50 (dd, *J* = 7.58, 15.4 Hz, 2H), 7.45 – 7.27 (m, 14H), 7.22 – 7.02 (m, 14H), 5.71 (bs, 1H), 5.55 (s, 1H), 5.15 (s, 0.6H), 5.03 (bs, 0.6H), 4.79 (d, *J* = 7.58 Hz, 0.6H), 4.73 (s, 1H), 4.69 (s, 2H), 4.55 (s, 0.7H), 4.5 (bs, 1H), 3.45 (d, *J* = 11.37 Hz, 1H), 3.25 – 3.05 (m, 3H), 2.81 (t, *J* = 12.74 Hz, 1H), 2.71 – 2.54 (m, 2H), 2.41 (s, 1.7H), 2.35 (s, 3H), 1.10 (s, 5.3H), 0.95 (s, 9H); ^{13}C NMR (75 MHz, $CDCl_3$) δ 171.03, 170.47, 143.33, 137.31, 131.96, 130.33, 129.62, 129.57, 129.51, 129.45,

128.67, 128.32, 128.17, 128.06, 127.01, 126.01, 126.78, 74.09, 73.54, 70.43, 70, 64.08, 62.89, 61.78, 57.78, 57.45, 56.05, 53.34, 51.34, 50.56, 29.64, 28.18, 28.10, 21.46; HRMS Calculated *m/z* for $C_{38}H_{43}N_3O_6S$ $[M+H]^+$ 670.2951, found 670.2960.

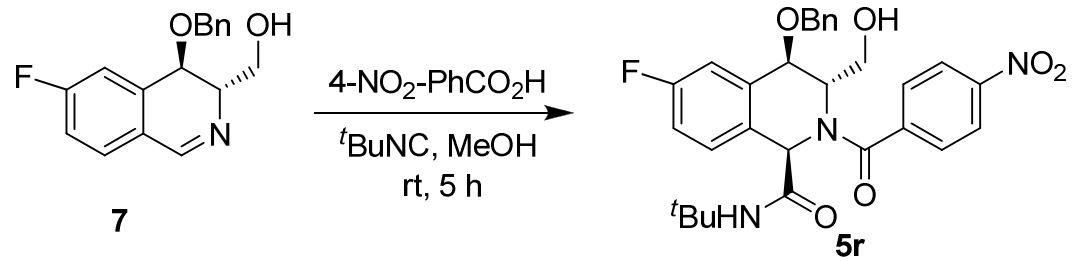


6

Prepared from Garner's aldehyde[1]

5q

(5*R*,7*S*,8*R*)-8-(benzyloxy)-N-*tert*-butyl-7-(hydroxymethyl)-6-(4-nitrobenzoyl)-5,6,7,8-tetrahydro-[1,3]dioxolo[4,5-g]isoquinoline-5-carboxamide (5q): Yield 72 % (258 mg from 200 mg of DHIQ **6**) as pale yellow solid; Melting point (°C) 249 – 250; $[a]_D^{25}$ +20.40 [c = 1.1, $CHCl_3$]; IR (neat) ν 3354, 2969 2923, 1672, 1643, 1600, 1405,1253, 1034, 932, 854, 721 cm^{-1}; ^1H NMR (500 MHz, $CDCl_3$) δ 8.33 (d, *J* = 8.69 Hz, 2H), 7.80 (d, *J* = 8.54 Hz, 2H), 7.46 – 7.33 (m, 5H), 6.96 (s, 1H), 6.70 (s, 1H), 6.64(s, 1H), 6.05 (d, *J* = 4.27 Hz, 2H), 5.17 (s, 1H), 4.63 (dd, *J* = 11.9, 15.86 Hz, 2H), 4.52 – 4.4 (m, 1H), 4.35 (d, *J* = 2.74 Hz, 1H), 3.72 (bs, 1H), 3.36 – 3.23 (m, 2H), 0.99 (s, 9H); ^{13}C NMR (75 MHz, $CDCl_3$) δ 171.48, 169.95, 148.88, 148.30, 147.35, 142.85, 136.76, 128.96, 128.86, 128.56, 127.82, 125.30, 123.77, 122.92, 109.66, 107.97, 101.70, 73.86, 70.37, 61.91, 61.22, 60.27, 50.65, 29.67, 28.22; HRMS Calculated *m/z* for $C_{30}H_{31}N_3O_8$ $[M+H]^+$ 562.2183, found 562.2158.

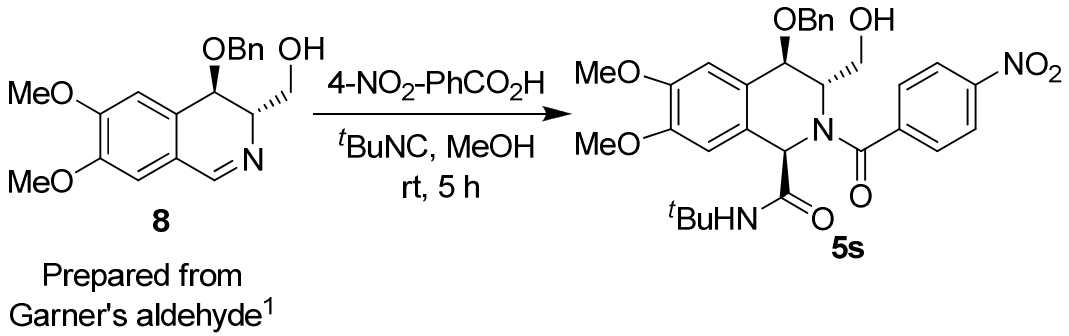


7

Prepared from Garner's aldehyde[1]

5r

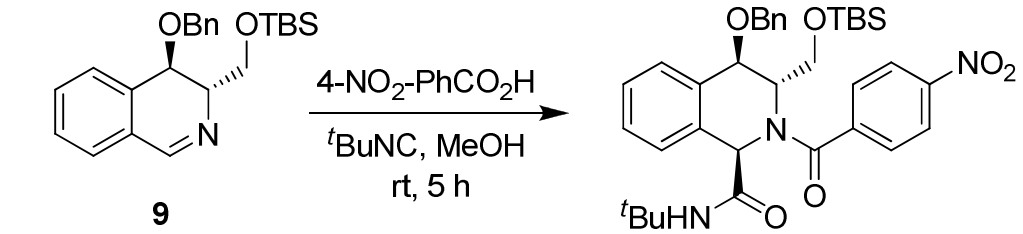
(1*R*,3*S*,4*R*)-4-(benzyloxy)-N-*tert*-butyl-6-fluoro-3-(hydroxymethyl)-2-(4-nitrobenzoyl)-1,2,3,4-tetrahydroisoquinoline-1-carboxamide(5r): Yield 84% (185mg from 114mg of compound **7**) as white solid; Melting point (°C) 190 – 192; $[\alpha]_D^{25}$ +35.56 [c = 1.1, $CHCl_3$]; IR (neat) ν 3347, 3066, 2966, 2929, 1674 1644, 1346, 1250, 1042, 852, 747 cm^{-1}; ^1H NMR (500 MHz, $CDCl_3$) δ 8.33 (d, *J* = 8.69 Hz, 2H), 7.81 (d, *J* = 8.69 Hz, 2H), 7.45–7.33 (m, 5H), 7.23 – 7.19 (m, 2H), 7.09 (td, *J* = 2.44, 8.08 Hz, 1H), 6.69 (s, 1H), 5.24 (s, 1H), 4.61 (s, 2H), 4.58 – 4.53 (m, 1H), 4.46 (d, *J* = 2.74 Hz, 1H), 3.94 (s, 1H), 3.33 (dd, *J* = 4.27, 11.44 Hz, 1H), 3.23 (t, *J* = 9.91 Hz, 1H), 0.97 (s, 9H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 171.58, 169.24, 148.37, 142.58, 136.56, 131.79, 131.70, 128.95, 128.90, 128.65, 127.86, 123.80, 115.08, 73.24, 70.35, 61.71, 61.09, 60.25, 53.39, 50.79, 28.14; HRMS Calculated *m/z* for $C_{29}H_{31}O_6N_3F$ $[M+H]^+$ 536.21914, found 536.21941.



Prepared from Garner's aldehyde[1]

(1*R*,3*S*,4*S*)-4-(benzyloxy)-N-*tert*-butyl-3-(hydroxymethyl)-6,7-dimethoxy-2-(4-nitrobenzoyl)-1,2,3,4-tetrahydronaphthalene-1-carboxamide (5s): DHIQ **8** was prepared by the similar procedure as reported for DHIQ **6** and **7**.[1] Characterization data for DHIQ **8**: Pale yellow solid; Melting point (°C) 150 – 152; $[a]_D^{25}$ -114.24 [c = 1.1, $CHCl_3$]; IR (neat) ν 3449, 2927, 1633, 1453, 1023, 763 cm^{-1}; ^1H NMR (400 MHz, $CDCl_3$) δ 8.33 (s, 1H), 7.45 – 7.28 (m ,5H), 6.88 (s, 1H), 6.81(s, 1H), 4.69 (d, *J* = 6.96 Hz, 1H), 4.65 (dd, *J* = 11.86, 25.43 Hz, 2H), 4.08 (bs, 1H), 3.91 (s, 3H), 3.85 (s, 3H), 3.83 – 3.73 (m, 2H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 159.71, 152.03, 149.04, 138.00, 129.08, 128.53, 128.06, 127.92, 110.53, 109.96, 72.51, 71.56, 63.37, 62.81, 56.13, 56.04, 53.40; HRMS Calculated *m/z* for $C_{19}H_{21}NO_4$ $[M+H]^+$ 328.1504, found 328.1547; DHIQ **8** was subjected to U3CR in presence of 4-nitrobenzoic and *tert*-butylisocyanide to obtain product **5s:** Yield 75% (66 mg from 50mg of compound **8**) as white solid; Melting point (°C) 159 – 161; $[a]_D^{25}$ +6.94 [c = 1.1, $CHCl_3$]; IR (neat) ν 3341, 2964, 2929, 1670, 1520, 1413, 1264, 1045, 856, 745 cm^{-1}; ^1H NMR (500 MHz, $CDCl_3$) δ 8.34 (d, *J* = 8.69 Hz, 2H), 7.82 (d, *J* = 8.54 Hz, 2H), 7.46 – 7.33 (m, 5H), 6.97 (d, *J* = 7.32 Hz, 2H), 6.66 (s, 1H), 6.58 (s, 1H),

5.20 (d, J = 3.35 Hz, 1H), 4.63 (dd, J = 12.2, 14.95 Hz, 2H), 4.56 – 4.52 (m, 1H), 4.40 (s, 1H), 3.88 (s, 3H), 3.73 (d, J = 6.25 Hz, 3H), 3.38 – 3.25 (m, 2H), 1.00 (s, 9H); ^{13}C NMR (75 MHz, $CDCl_3$) δ 171.58, 170.12, 150.16, 148.33, 142.98, 136.92, 128.89, 127.86, 123.97, 123.82, 121.46, 112.38, 109.70, 73.71, 70.40, 60.85, 60.41, 55.79, 50.65, 28.22; HRMS Calculated *m/z* for $C_{31}H_{36}O_8N_3$ 578.24969 $[M+H]^+$ found 578.25054.



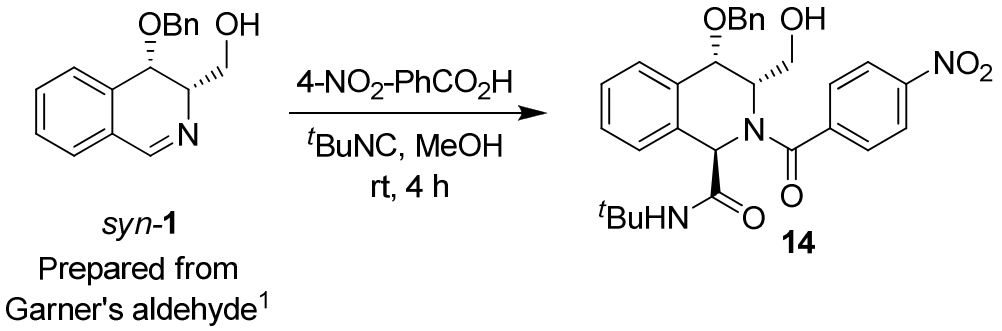
9

Prepared from *anti*-**1**

10

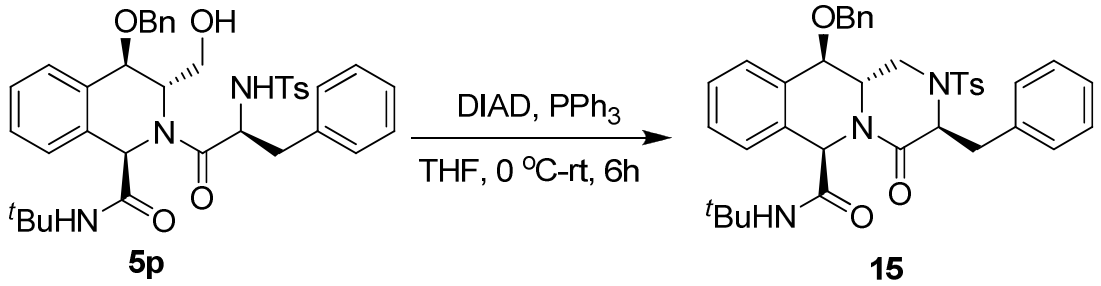
(1*R*,3*S*,4*R*)-4-(benzyloxy)-*N*-(*tert*-butyl)-3-(((*tert*-butyldimethylsilyl)oxy)methyl)-2-(4-nitrobenzoyl)-1,2,3,4-tetrahydroisoquinoline-1-carboxamide (10): Compound **10** was prepared from U3CR of DHIQ **9**, which was synthesized by treating *anti*-**1** (70mg, 1eq) with TBSCl (118mg, 3eq), Imidazole (106mg, 6eq), DMAP (catalytic) in DCM (3 mL). Yield 69% (85 mg from 74 mg of compound **6**) as pale yellow sticky solid; $[a]_D^{25}$ +7.50 [c = 1.1, $CHCl_3$]; IR (neat) ν 3359, 2961, 2926, 2855, 1687, 1649, 1603, 1407, 1313, 1223, 1027, 836, 755 cm^{-1}; ^{1}H NMR (500 MHz, $CDCl_3$) δ 8.60 (d, J = 8.85 Hz, 2H), 8.05 (dt, J = 8.69,2.13 Hz, 2H), 8.02 (s, 1H), 7.72 (dd, J = 7.47, 1.22 Hz, 1H), 7.70 – 7.57 (m, 9H), 7.43 (dd, J = 7.32, 0.76 Hz,1H), 6.98 (s, 1H), 5.61 (s, 1H), 4.89 (q, J = 9.91 Hz, 2H), 4.80 (d, J = 2.72 Hz,1H), 4.76 (td, J = 7.32, 2.74 Hz, 1H), 3.37 (dd, J = 10.37,7.01 Hz, 1H), 3.30 (dd, J = 10.37,7.62 Hz, 1H), 1.27 (s, 9H), 0.94 (s, 9H), 0.04 (s, 3H);

^{13}C NMR (125 MHz, $CDCl_3$) δ 170.42, 169.14, 148.44, 142.27, 136.72, 130.04, 129.96, 128.80, 128.74, 128.48, 128.02, 127.91, 127.59, 123.79, 73.72, 70.23, 62.60, 61.43,59.66, 50.46, 28.22, 25.61, 18.08; HRMS Calculated *m/z* for $C_{35}H_{45}N_3O_6Si$ $[M+H]^+$ 632.3111, found 632.3147.



(1*R*,3*S*,4*S*)-4-(benzyloxy)-*N*-(*tert*-butyl)-3-(hydroxymethyl)-2-(4-nitrobenzoyl)-1,2,3,4-tetrahydroisoquinoline-1-carboxamide (14): Yield 83 % (161 mg from 100 mg of compound *syn*-**1**) as white solid; Melting point (°C) 198 – 200; $[a]_D^{25}$ +8.45 [c = 1.1, $CHCl_3$]; IR (neat) ν 3411, 2963, 2924, 2854, 1671, 1629, 1453, 1345, 1259, 1105, 797, 750 cm^{-1}; ^{1}H NMR (500 MHz, $CDCl_3$): δ 8.23(d, *J* = 8.06 Hz, 1H), 8.20 (d, *J* = 8.29 Hz, 2H), 7.61(d, *J* = 7.61Hz, 1H), 7.55 (d, *J* = 8.57 Hz, 2H), 7.43 – 7.38(m, 2H), 7.36 (d, *J* = 7.51 Hz, 1H), 7.33 – 7.29 (m, 6H), 5.46 (bs, 1H), 5.40 (d, *J* = 4.72 Hz, 1H), 4.83 (d, *J* = 11.82 Hz, 1H), 4.67 (d, *J* = 11.82 Hz, 1H), 4.30 – 4.24 (m, 1H), 3.47 (dd, *J* = 4.95, 11.73 Hz, 1H), 3.02 (dd, *J* = 8.29, 11.69 Hz, 1H), 1.26 (s, 9H); ^{13}C NMR (125 MHz, $CDCl_3$) δ 171.40, 169.59, 148.12, 142.74, 137.37, 135.62, 130.15, 128.60, 128.44, 128.26, 128.15, 128.00, 127.89, 127.74, 127.67, 126.17, 124.83, 123.86, 123.44, 75.02, 73.28, 61.21,

60.76, 60.33, 57.07, 53.35, 51.63, 29.63, 28.52; HRMS Calculated *m/z* for $C_{29}H_{31}N_3O_6$ $[M+Na]^+$ 540.2111, found 540.2089.



(3*S*,6*R*,11*R*,11a*S*)-3-benzyl-11-(benzyloxy)-*N*-*tert*-butyl-4-oxo-2-*tosyl*-2,3,4,6,11,11a-hexahydro-1H-pyrazino[1,2-b]isoquinoline-6-carboxamide (15): Intramolecular Mitsunobu reaction was performed with compound **5p** in the presence of DIAD and PPh_3 using THF as solvent. First compound **5p** (1eq) was dissolved in THF then PPh_3 (2 eq) was added under N_2 and ice bath conditions to maintain 0 °C and stirred. Finally DIAD (2eq) dissolved in THF was slowly added and stirred at room temperature for additional 4h. TLC was analysed after completion of the reaction extracted with DCM and dried over sodium sulphate, concentrated under reduced pressure to obtain the product. Yield 52% (37 mg from 70 mg of compound **5p**) as white solid; IR (neat) ν 3252.52, 2922.45, 2851.34, 1692.54, 1651.07, 1455.55, 1259.14, 1110.27, 1047, 754 cm^{-1};^{1}H NMR (500 MHz, $CDCl_3$) δ 7.62 (d, *J* = 8.24 Hz, 2H), 7.46 – 7.43 (m, 1H), 7.35 (d, *J* = 4.42 Hz, 4H), 7.31 –

7.26 (m, 4H), 7.24 (d, J = 7.93 Hz, 2H), 7.21 – 7.14 (m, 4H), 6.97 – 6.91 (m, 2H), 5.85 (s, 1H), 4.76 (t, J = 4.88 Hz, 1H), 4.73 – 4.67 (m, 1H), 4.64 – 4.56 (m, 2H), 4.12 – 4.05 (m, 2H), 3.37 – 3.30 (m, 1H), 3.13 – 3.06 (m, 1H), 2.84 – 2.77 (m, 1H), 2.42 (s, 3H), 1.39 (s, 9H); ^{13}C NMR (75 MHz, $CDCl_3$) δ 167.42, 156.39, 136.90, 136.32, 129.80, 129.43, 128.61, 128.29, 127.82, 127.33, 127.16, 127.01, 126.77, 123.40, 72.96, 70.04, 69.44, 58.64, 57.36, 53.26, 51.96, 38.63, 37.52, 33.83, 29.64, 28.65, 22.69, 21.90, 14.08; HRMS Calculated *m/z* for $C_{38}H_{41}N_3O_5S$ $[M+H]^+$ 652.2845, found 652.2840;

Method for *in vitro* screening: The antiproliferative activity of the compounds was determined using Sulphorhodamine B (SRB) assay.[19]Cells grown in DMEM, supplemented with 10% FBS were seeded in each well of 96 well microculture plates and incubated for 24 h at 37 ^{o}C in a CO_2 incubator. Compounds, diluted to the desired concentrations (0.5, 1 and 5 μM) in DMSO, were added to the wells with respective control. After 48 h cells were fixed with 10% trichloro acetic acid (TCA) solution and were further incubated for 60 min at 4 ^{o}C. The plates were washed with tap water and air dried. Later Sulforhodamine B (SRB) solution (50 μL) at 0.4% (w/v) in 1% acetic acid was added to each of the wells, and plates were incubated for 20 min at room temperature. The residual dye was removed by washing with 1% acetic acid and the plates were air dried. Bound stain was subsequently eluted with 10 mM trizma base, and the absorbance was recorded on multimode reader (TECAN) at a wavelength of 540 nm.

Reference: 1. A. K. Srivastava, M. Koh, S. B. Park, *Chem. Eur. J.,* 2011, **17**, 4905 – 4913.

Section 2: ^{1}H and ^{13}C NMR of compounds 5a-q, 7, 11 and 12

Figure 1: ^{1}H NMR of post aqueous workup sample (crude sample) of compound **5a:**

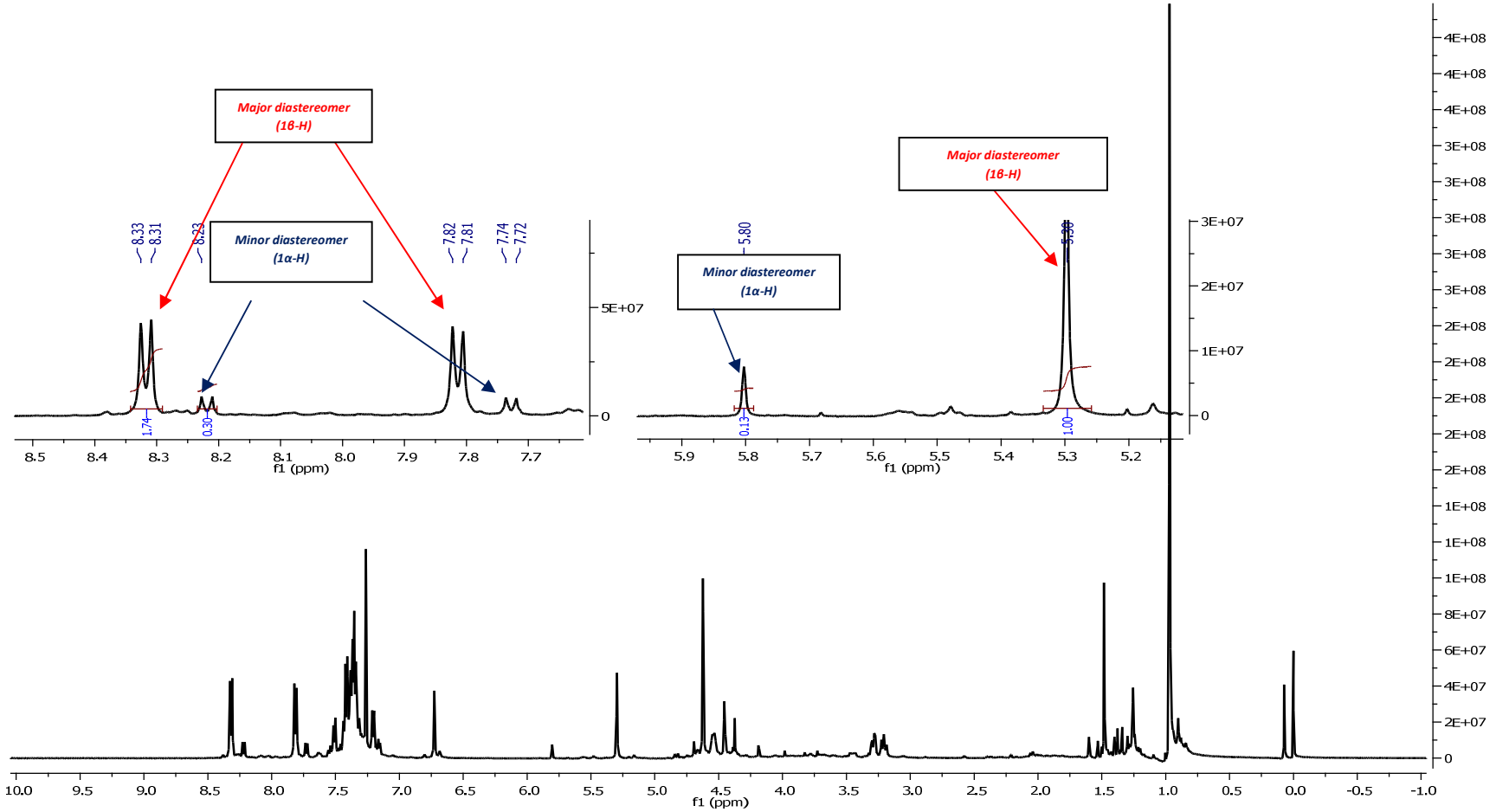


Figure 2:[1]H NMR Spectrum of compound**5a**:

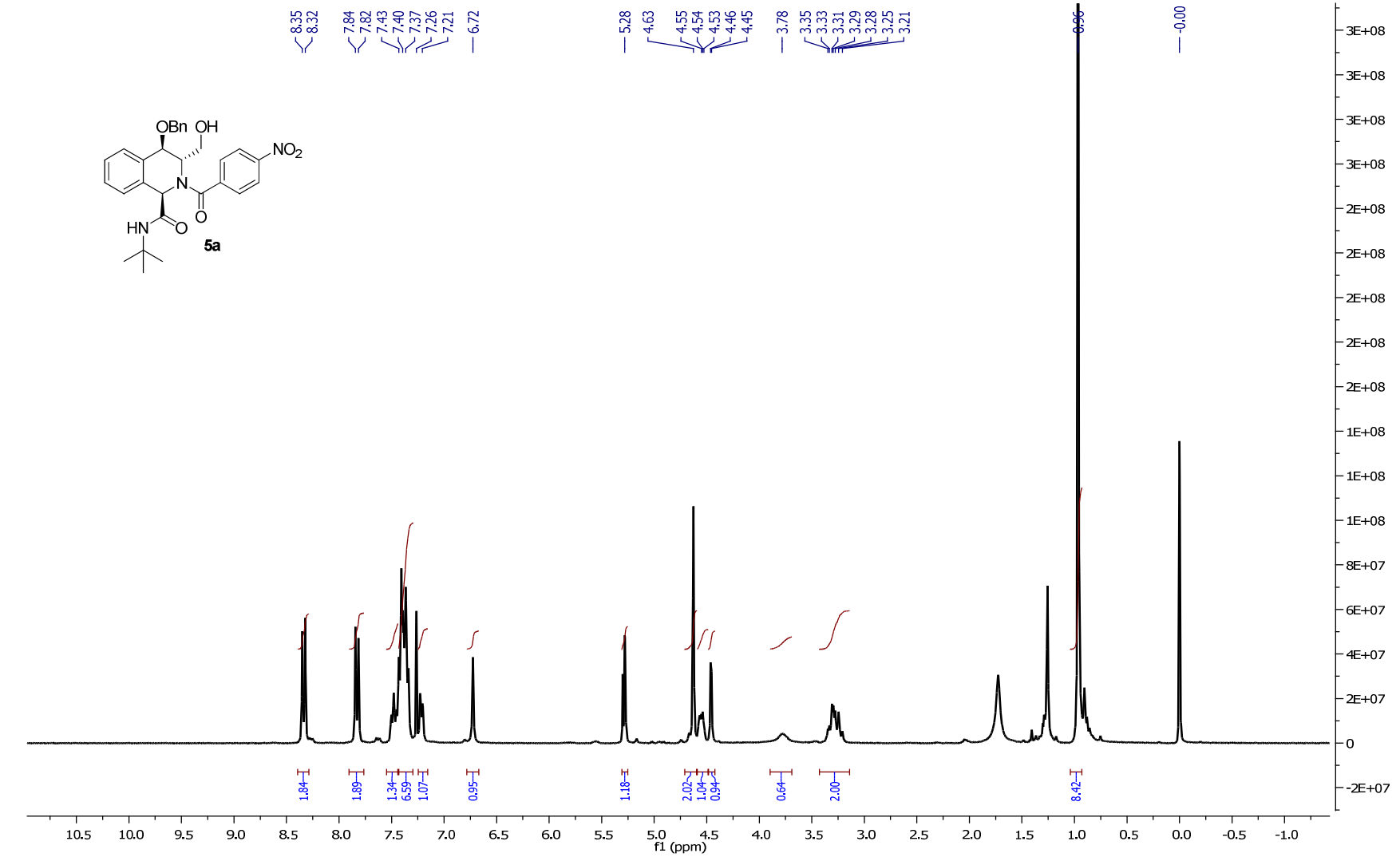


Figure 3: ^{13}C NMR Spectrum of compound**5a**:

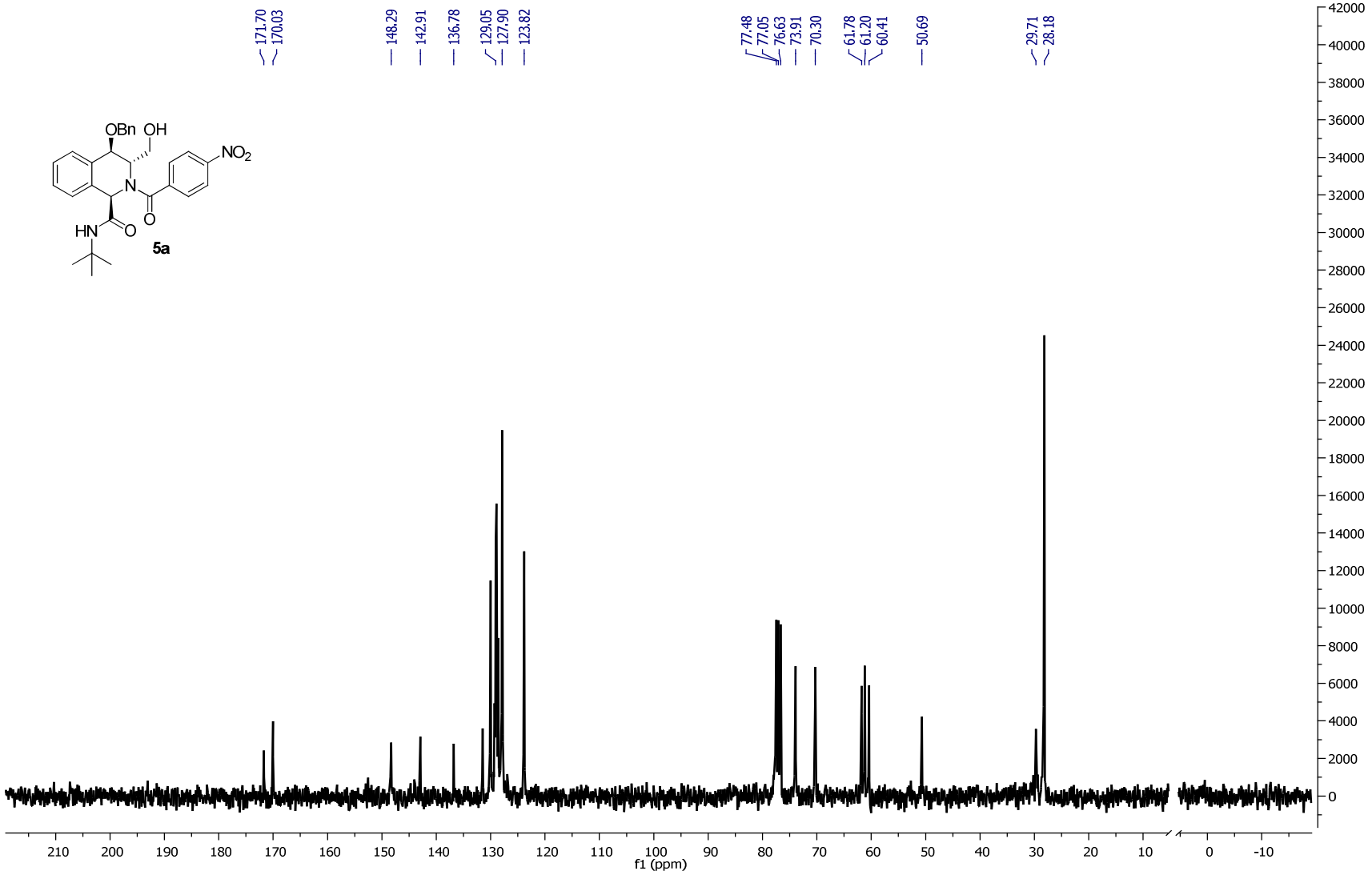


Figure 4: 2D DQFCOSY (Double Quantum Filtered Correlation Spectroscopy) Spectrum of compound **5a** recorded at 500 MHz NMR spectrometer.

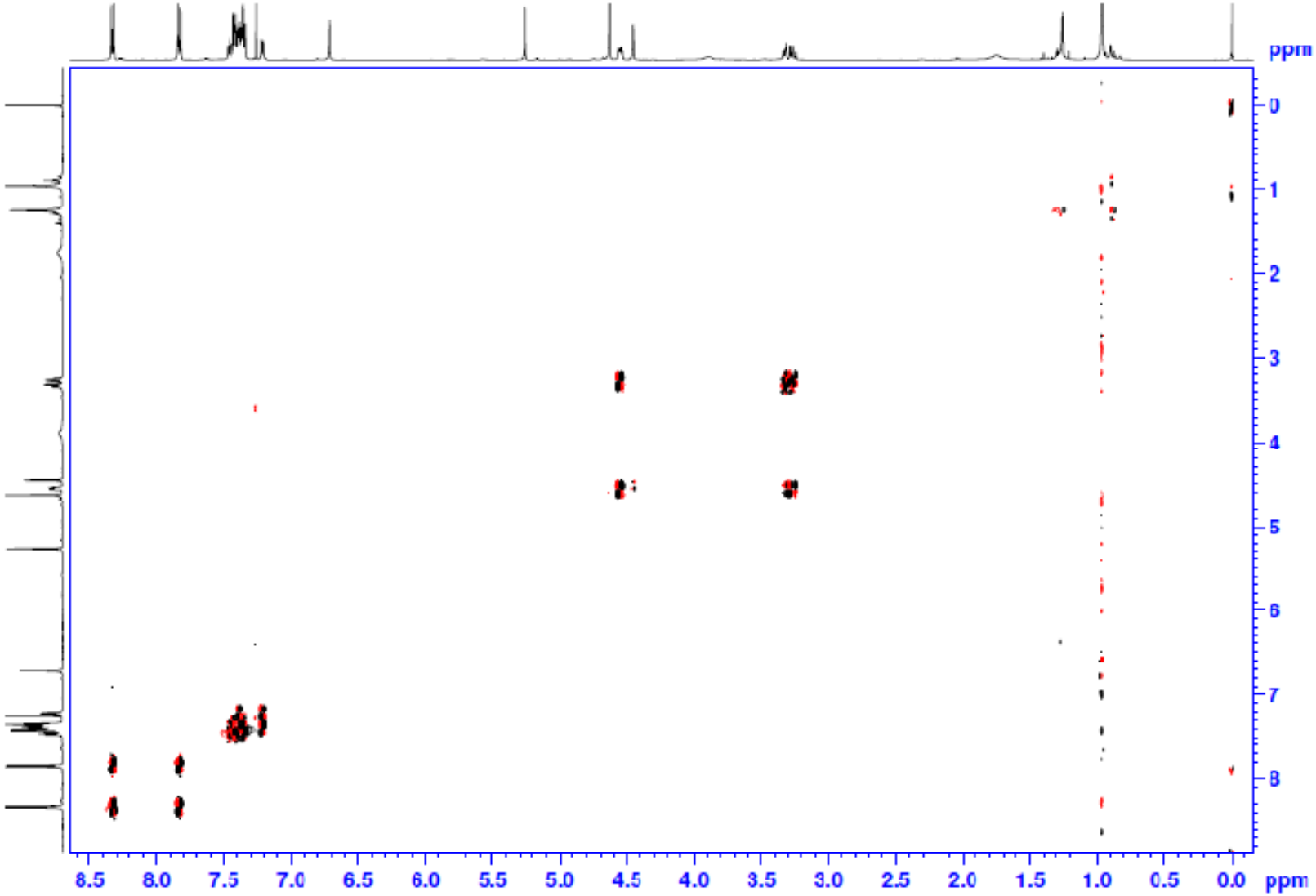


Figure 5: 2D NOESY (Nuclear Overhauser effect Spectroscopy) Spectrum of compound **5a** recorded at 500 MHz NMR spectrometer.

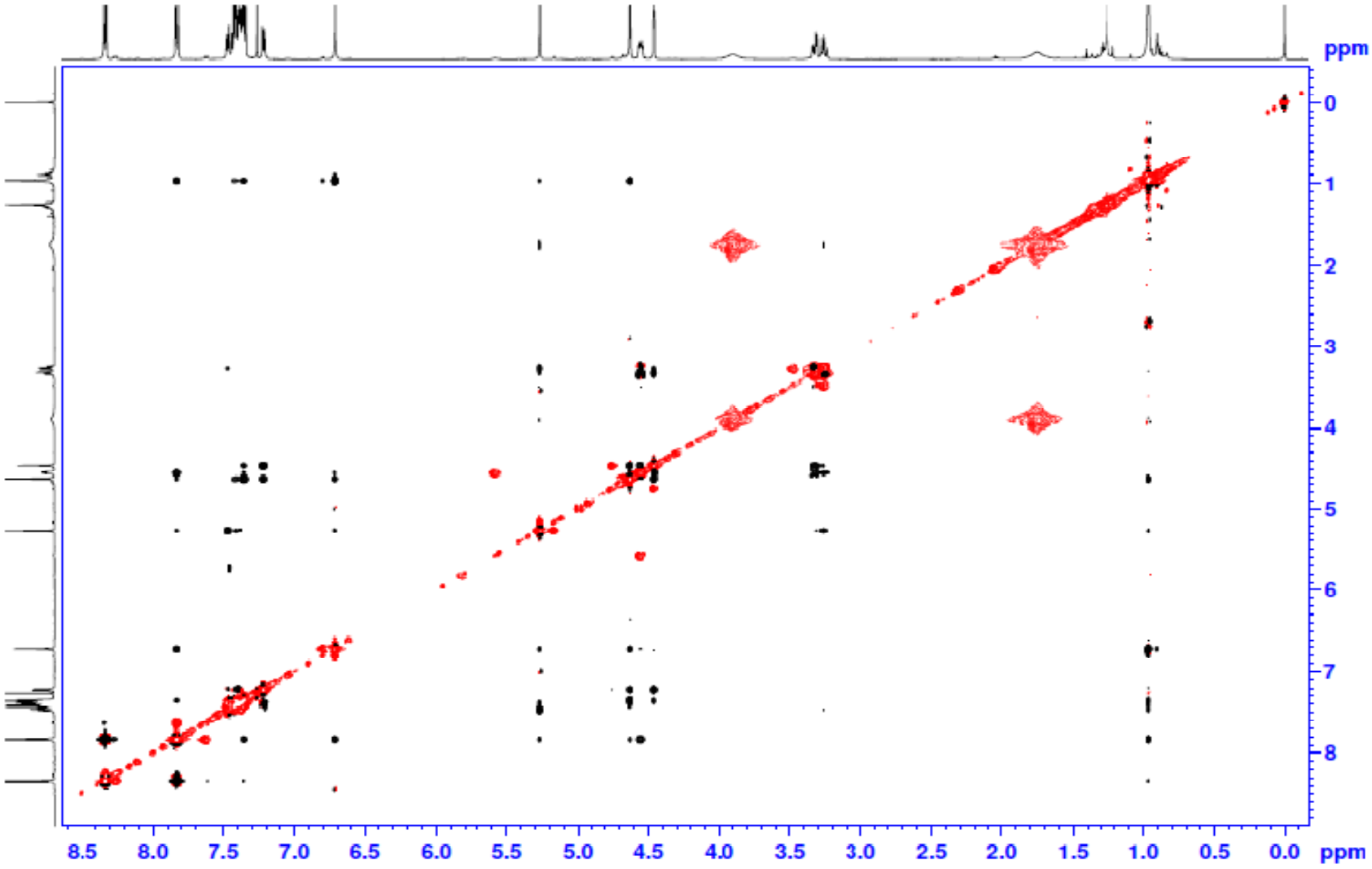


Figure 6: Expansion of 2D NOESY spectrum of compound **5a** recorded at 500 MHz NMR spectrometer. (X indicate the exchange cross peaks coming from conformational exchange between two isomers).

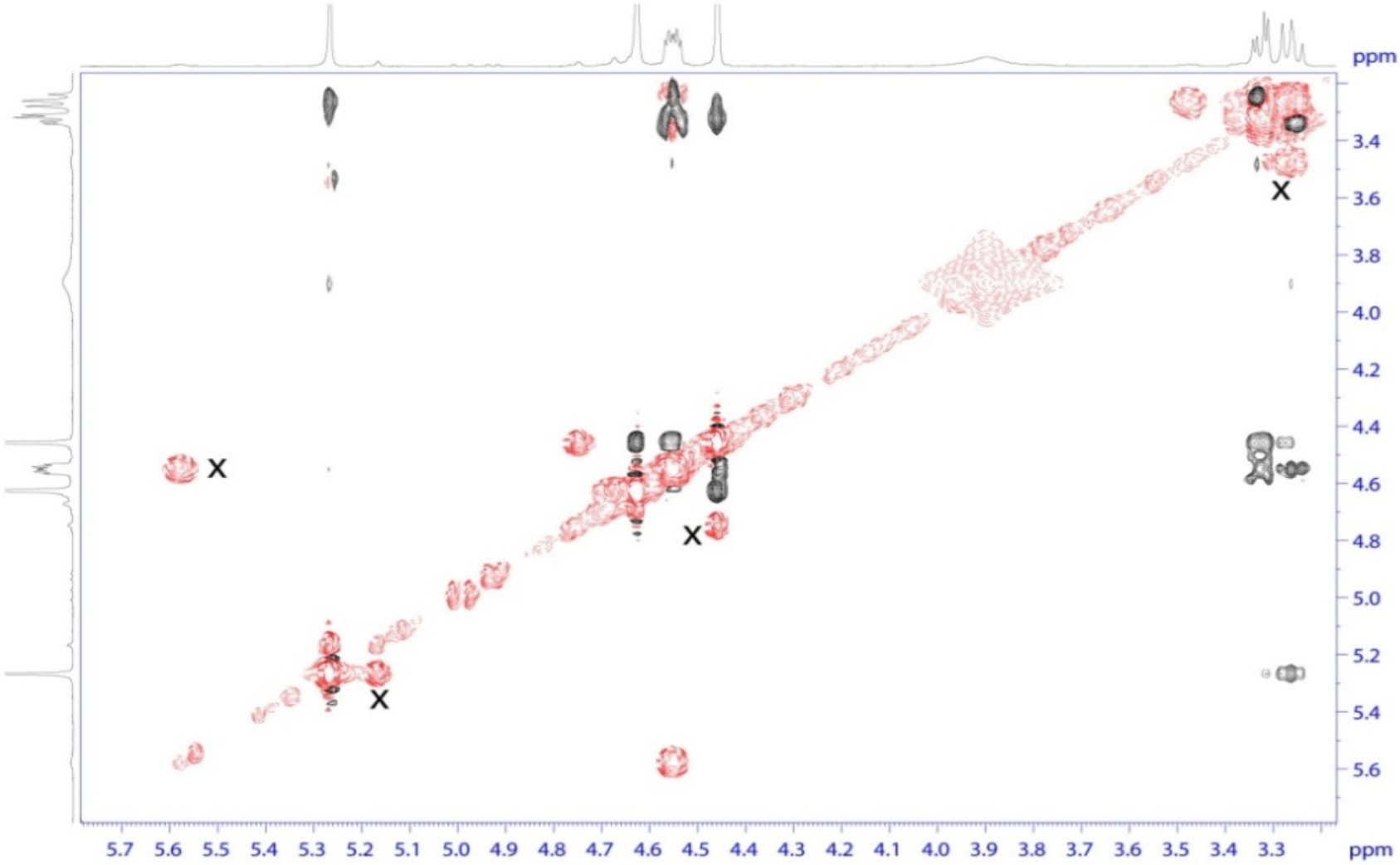


Figure 7: ^{1}H NMR of post aqueous workup sample (crude sample) of compound **5b:**

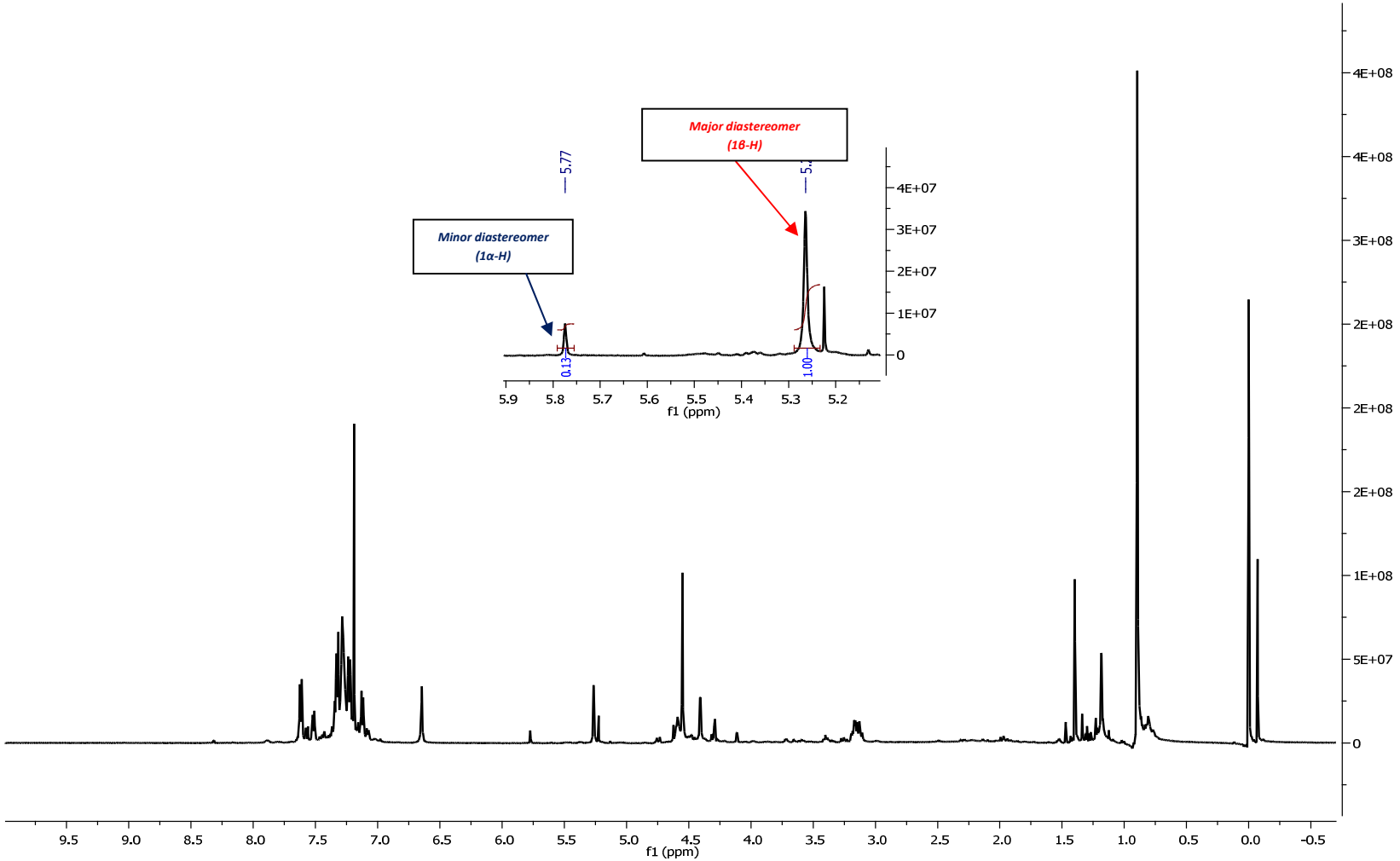


Figure 8: ^{1}H NMR Spectrum of compound **5b**:

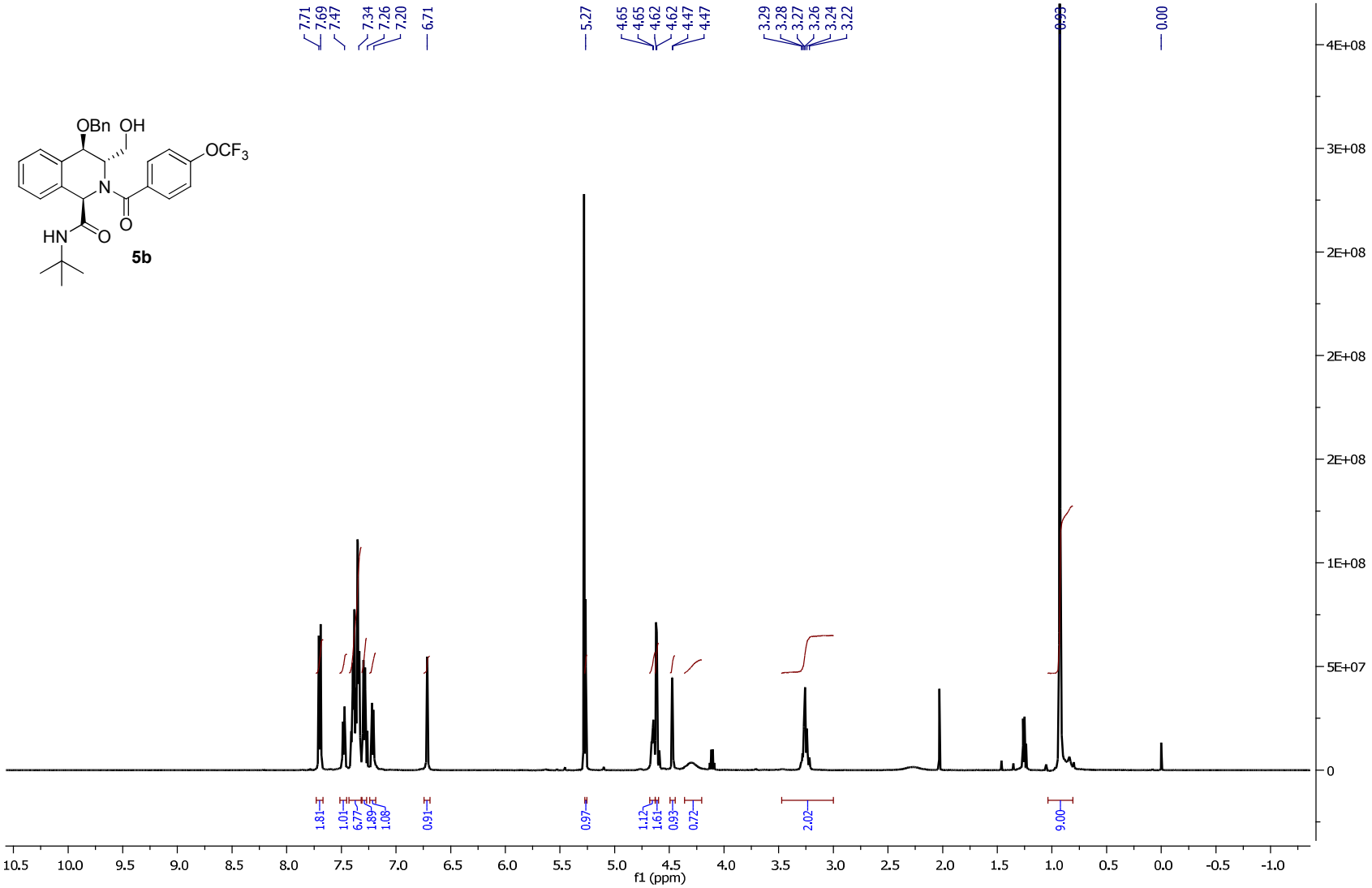


Figure 9: ^{13}C NMR Spectrum of compound **5b**:

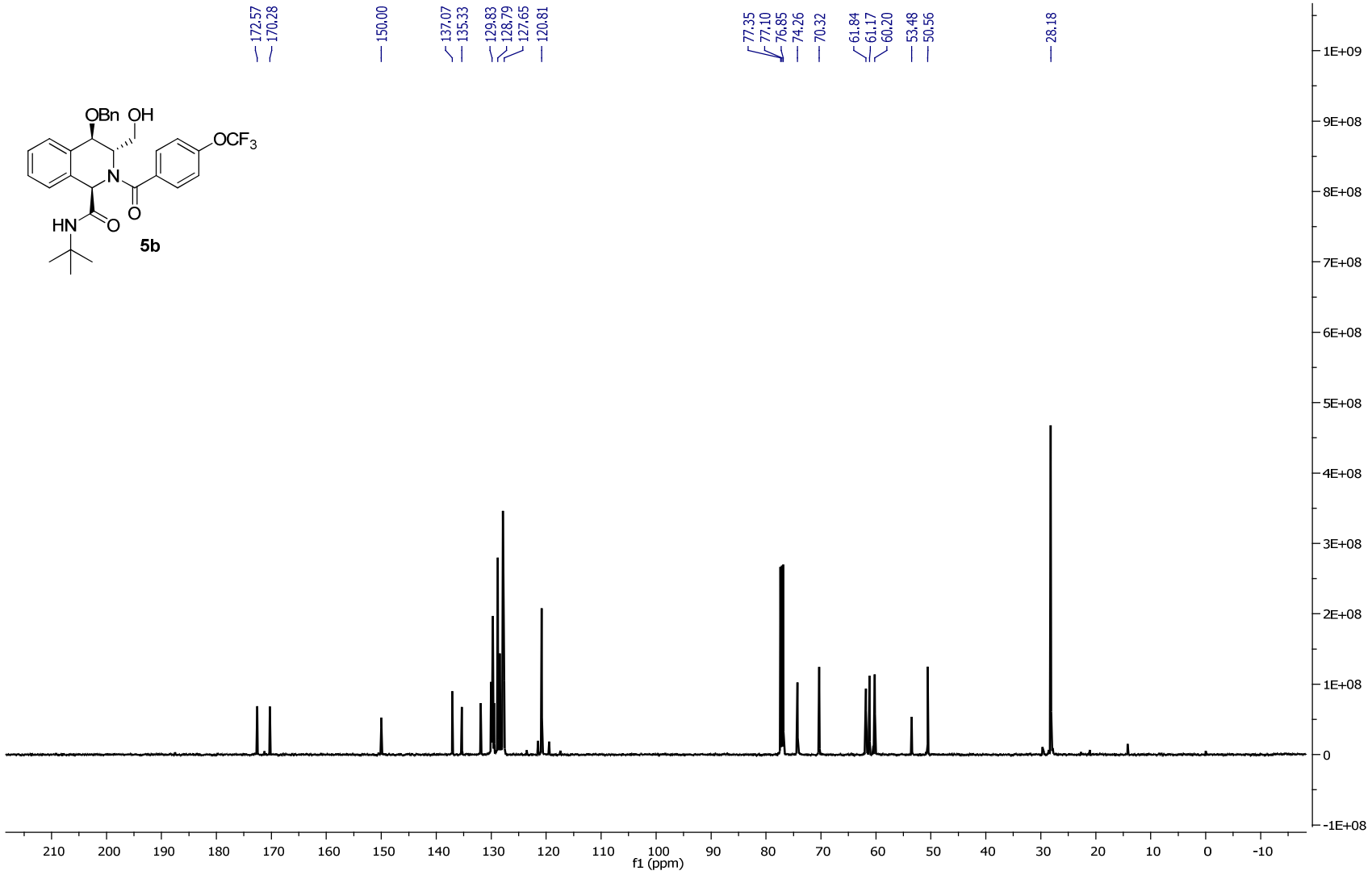


Figure 10: ^{1}H NMR of post aqueous workup sample (crude sample) of compound **5c:**

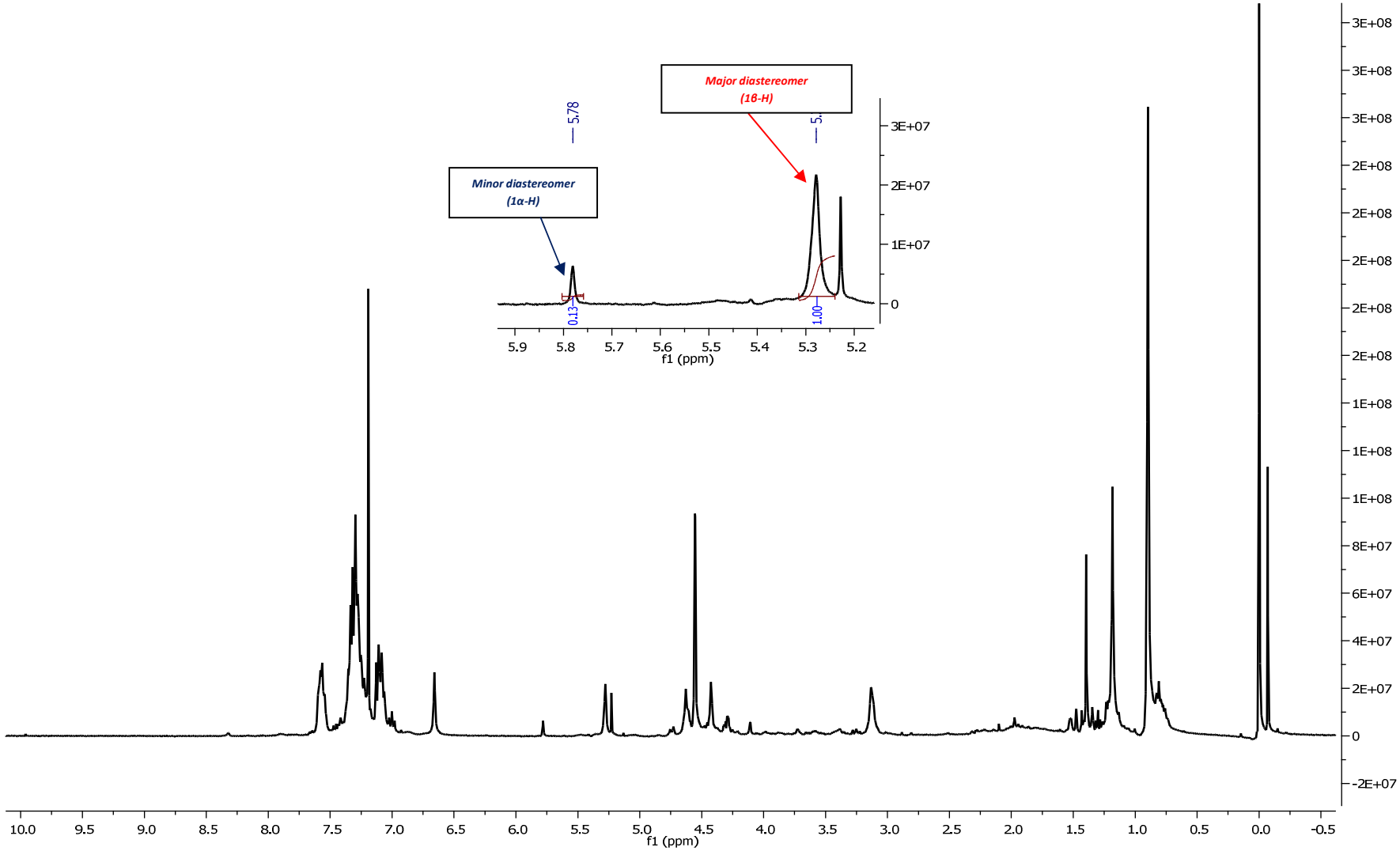


Figure 11: ^{1}H NMR Spectrum of compound **5c**:

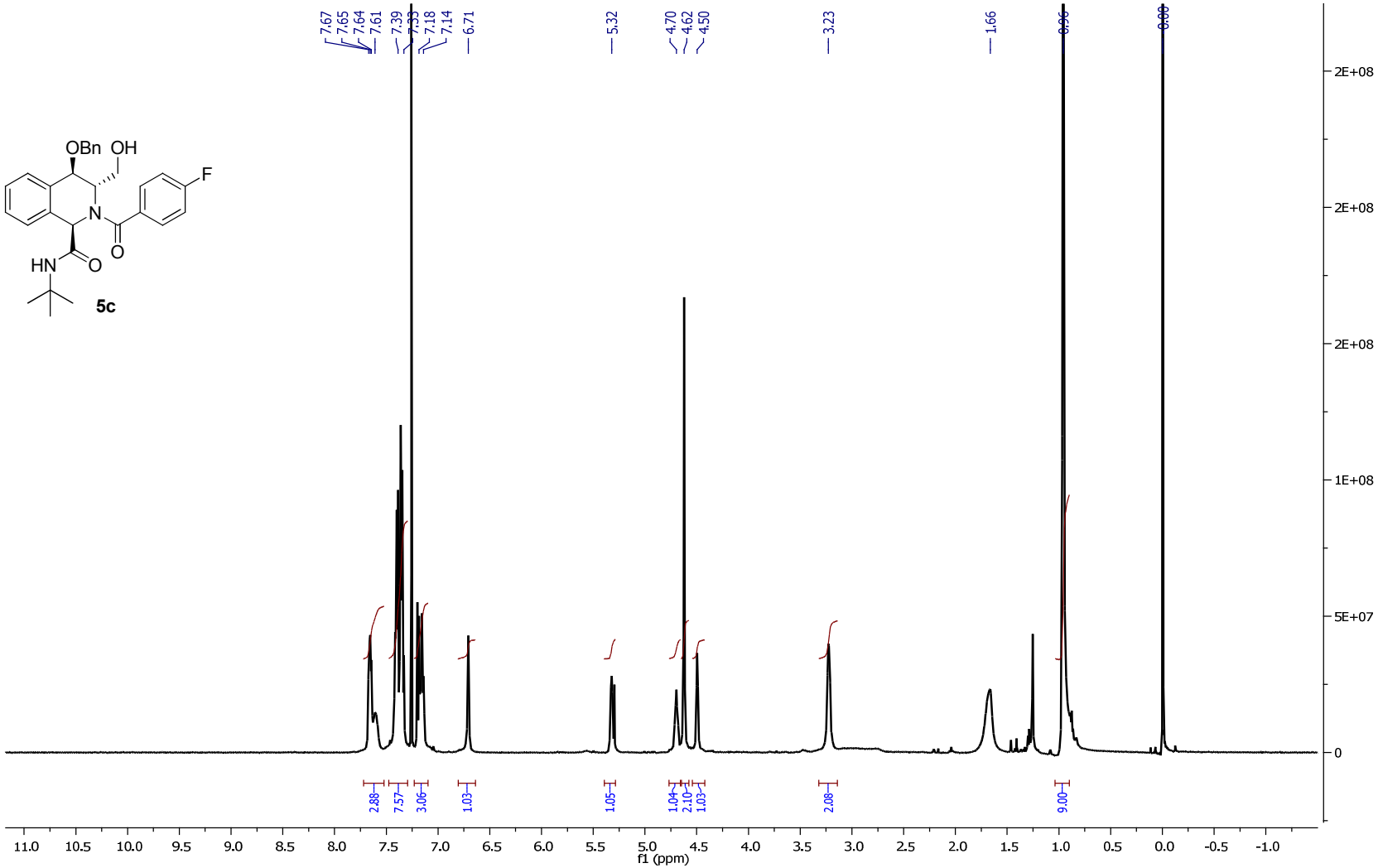


Figure 12: ^{13}C NMR Spectrum of compound **5c:**

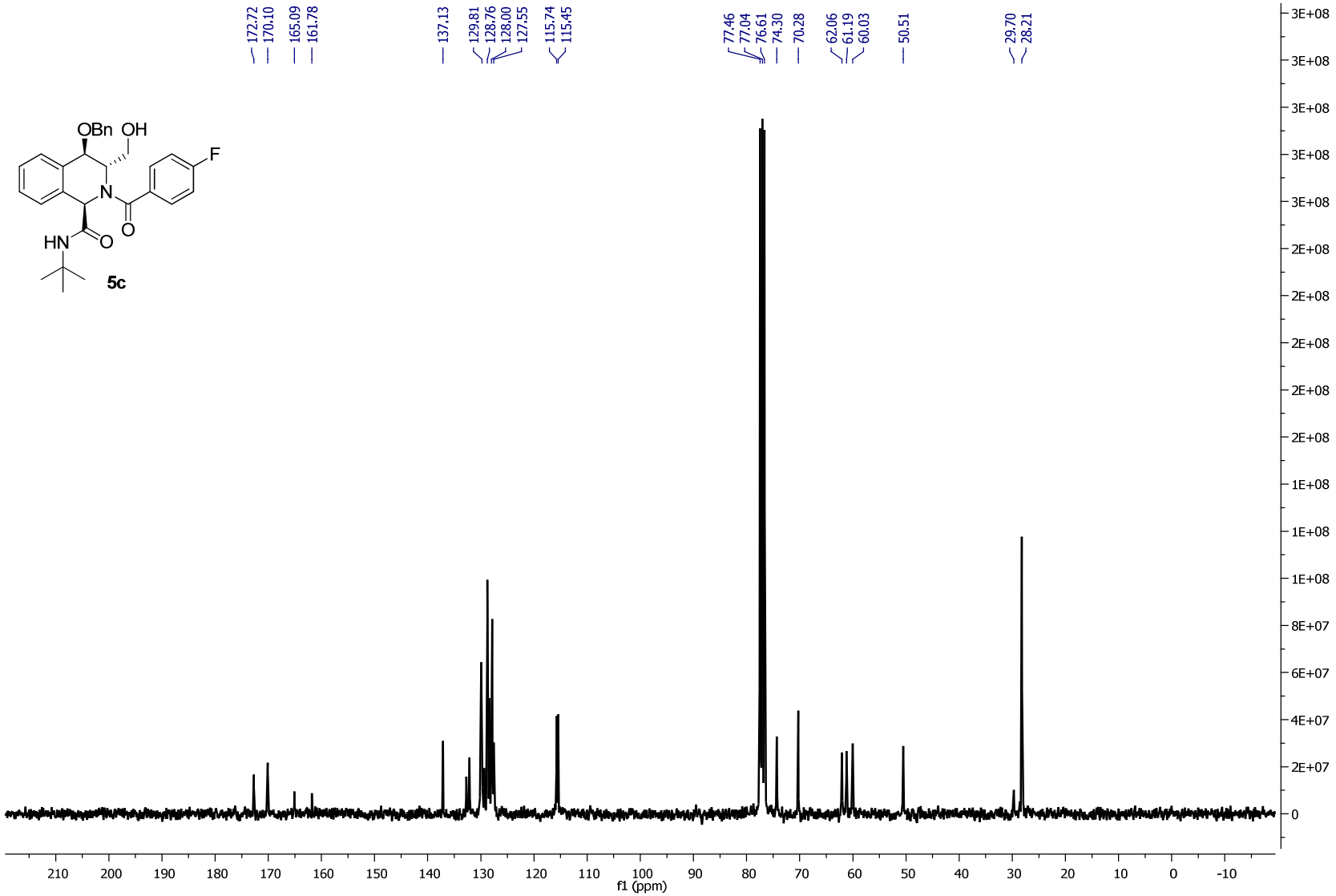


Figure 13: ^{1}H NMR of post aqueous workup sample (crude sample) of compound **5d:**

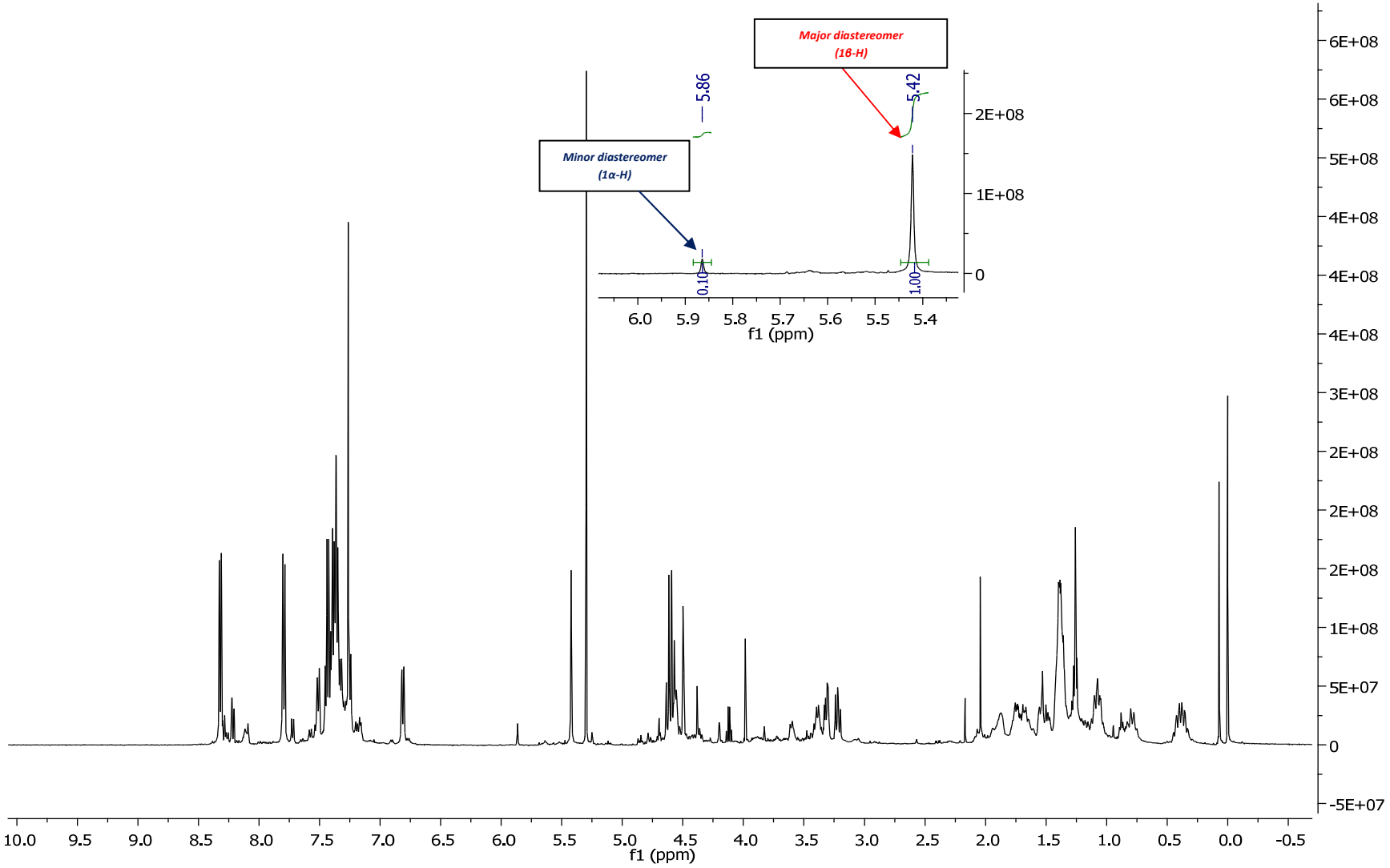


Figure 14:[1]H NMR Spectrum of compound **5d**:

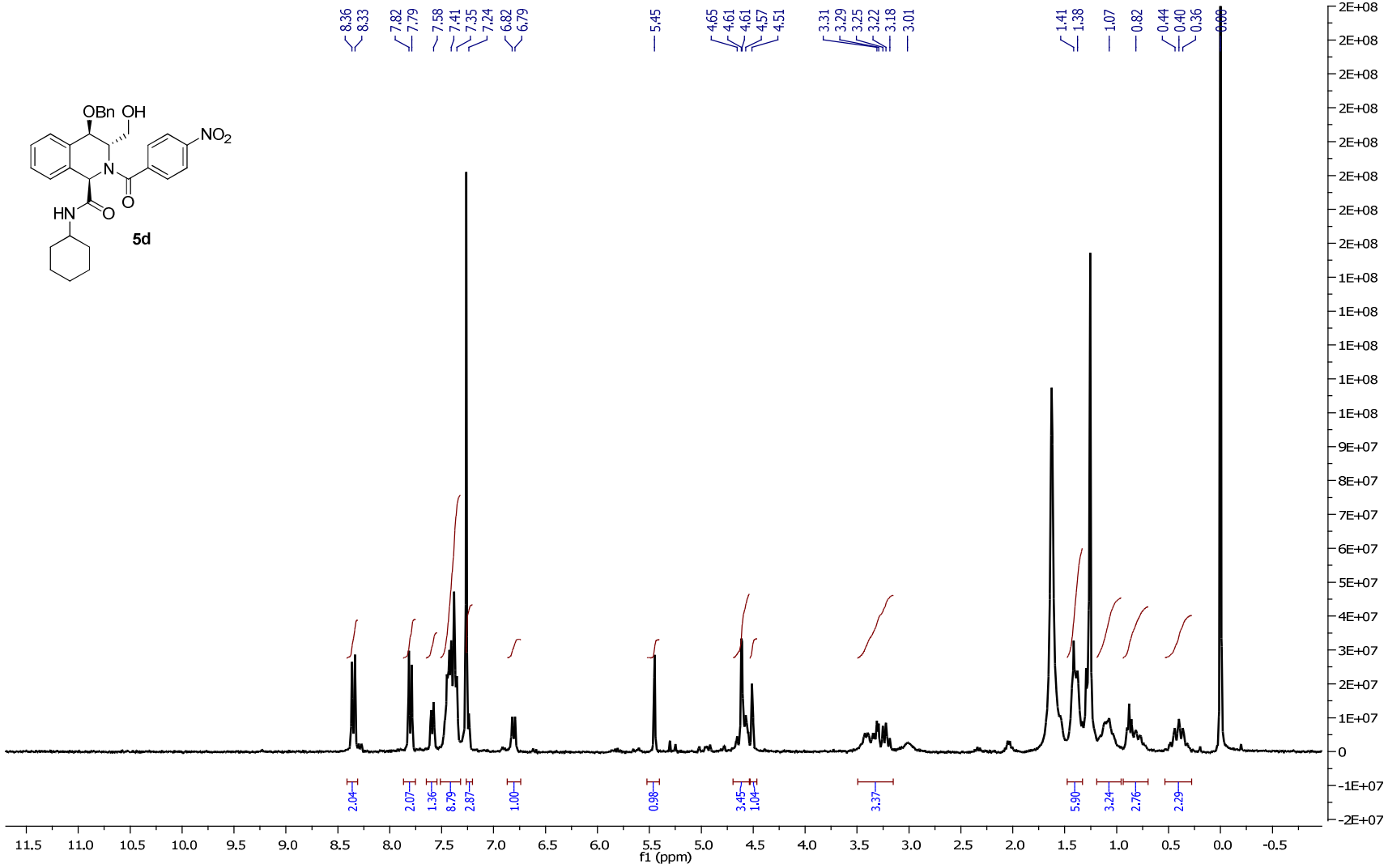


Figure 15:[13]C NMR Spectrum of compound **5d**:

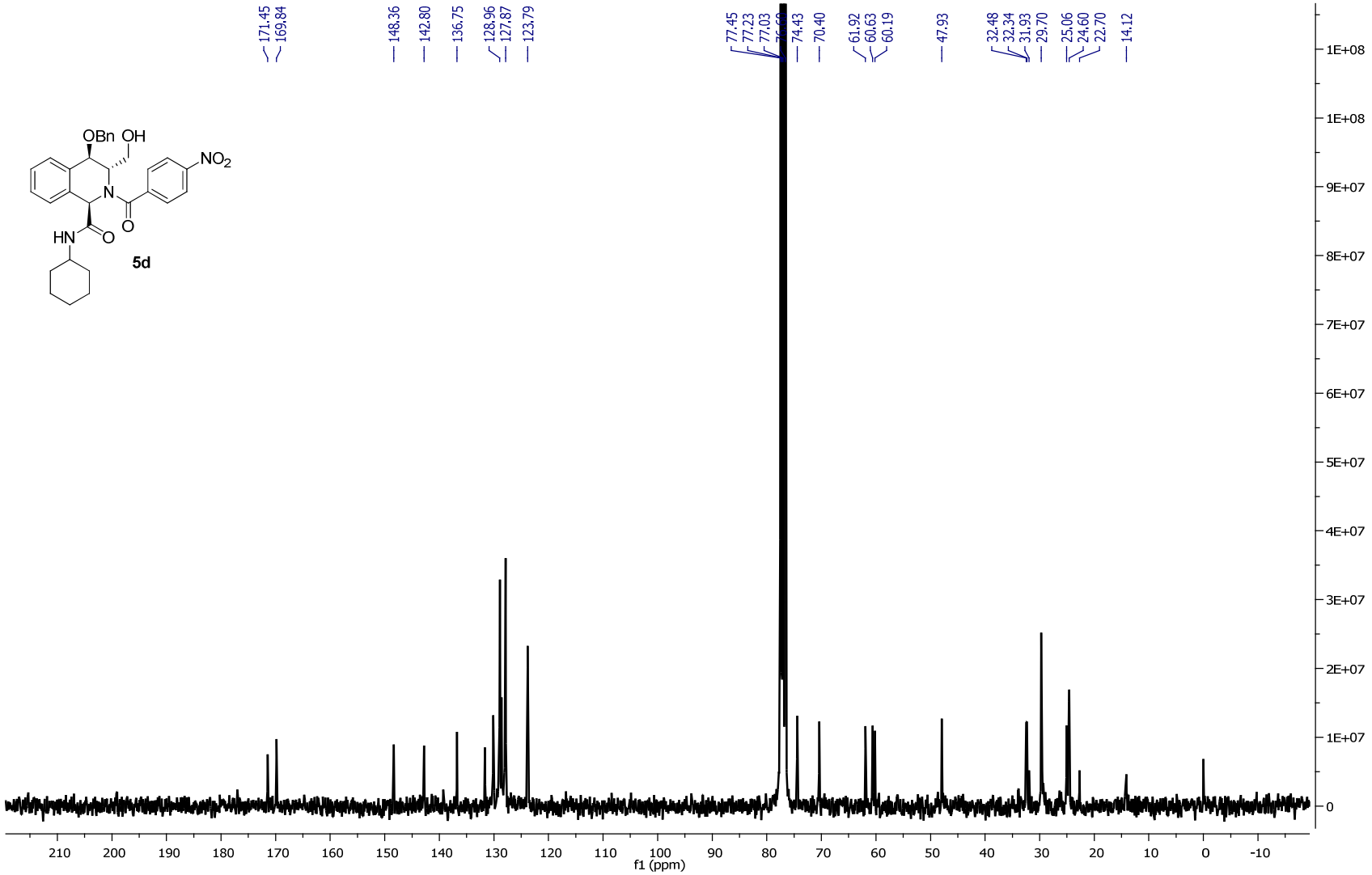


Figure 16: ^{1}H NMR of post aqueous workup sample (crude sample) of compound **5e:**

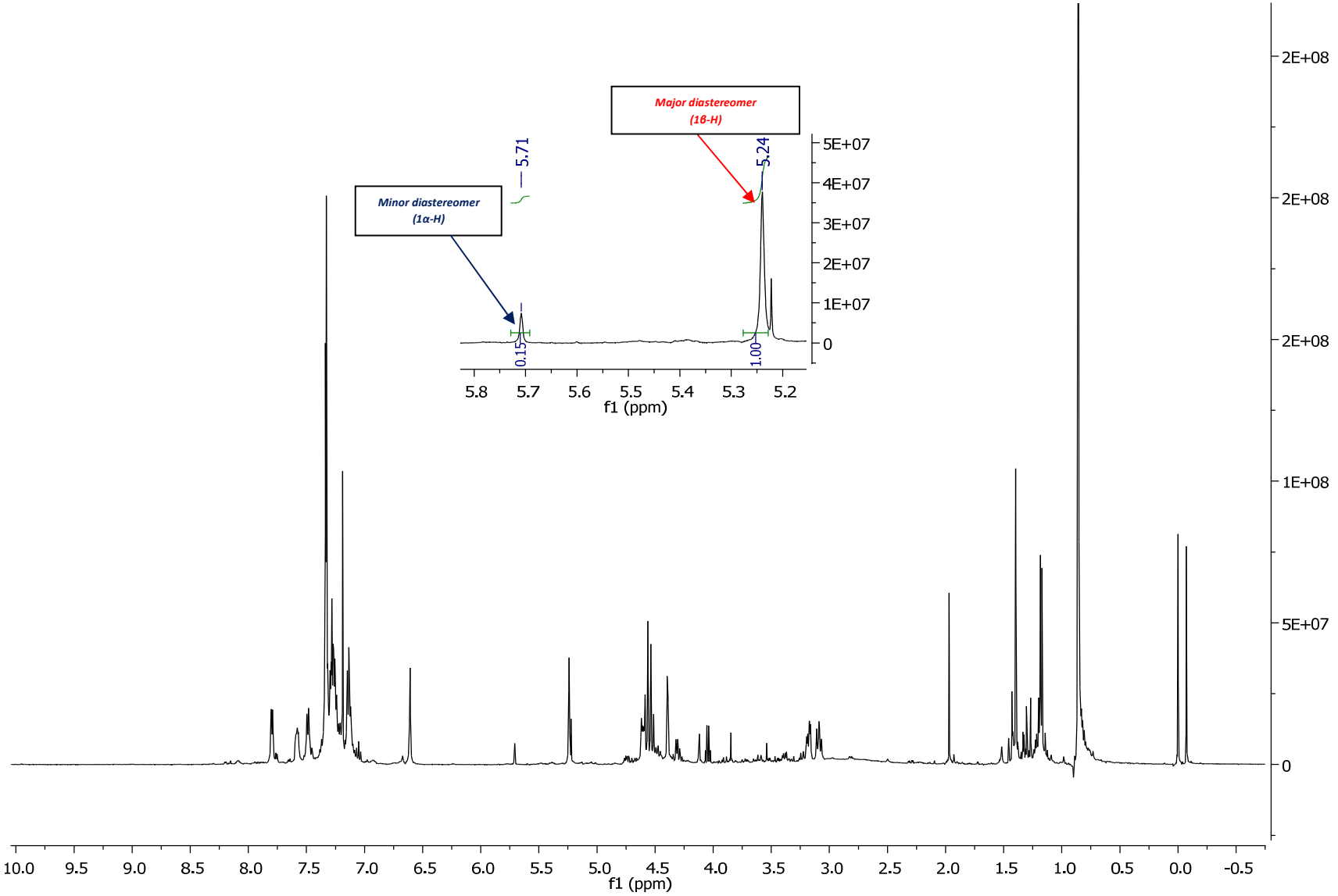


Figure 17: ^{1}H NMR Spectrum of compound **5e**:

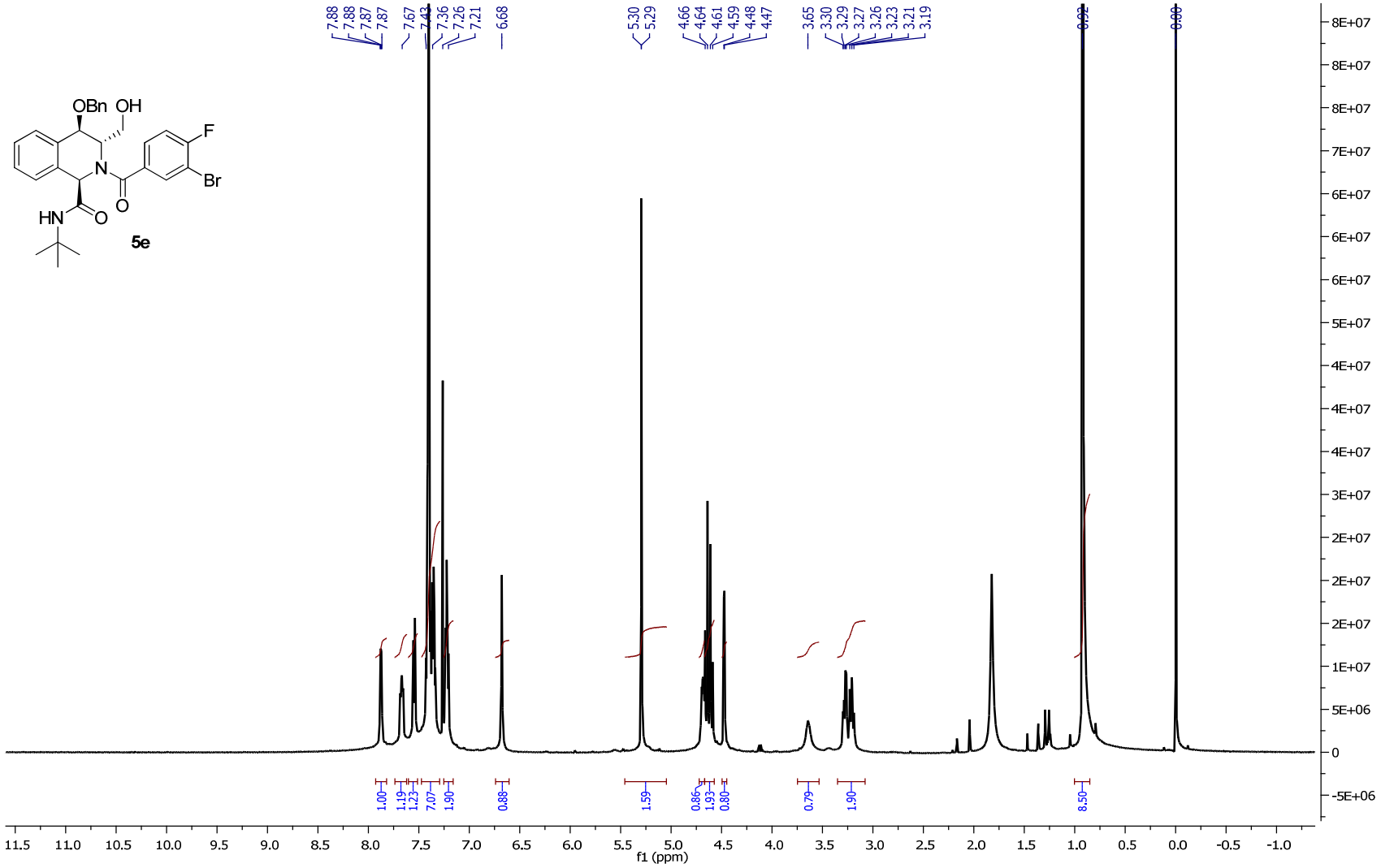


Figure 18: ^{13}C NMR Spectrum of compound **5e**:

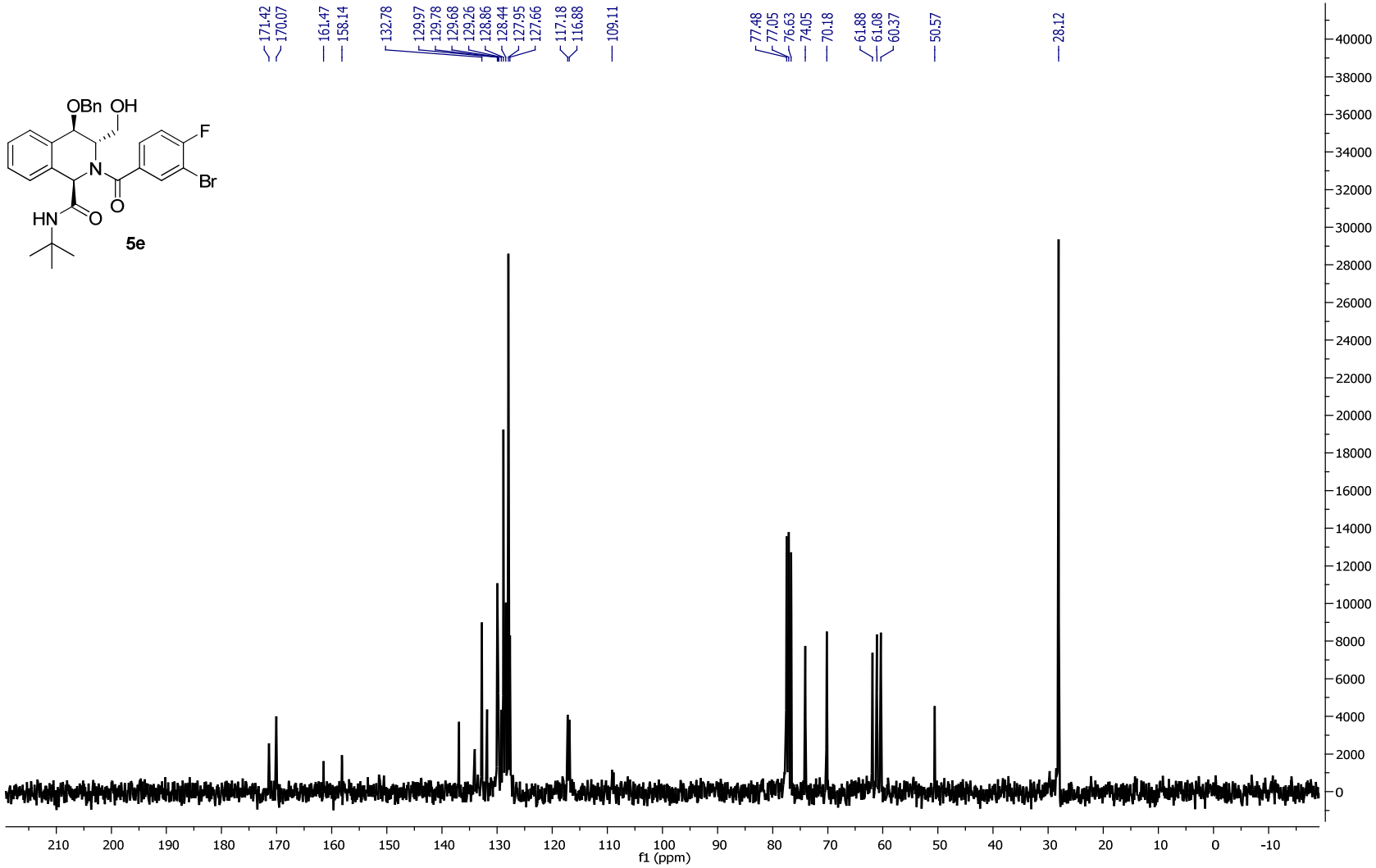


Figure 19: ^{1}H NMR of post aqueous workup sample (crude sample) of compound **5f:**

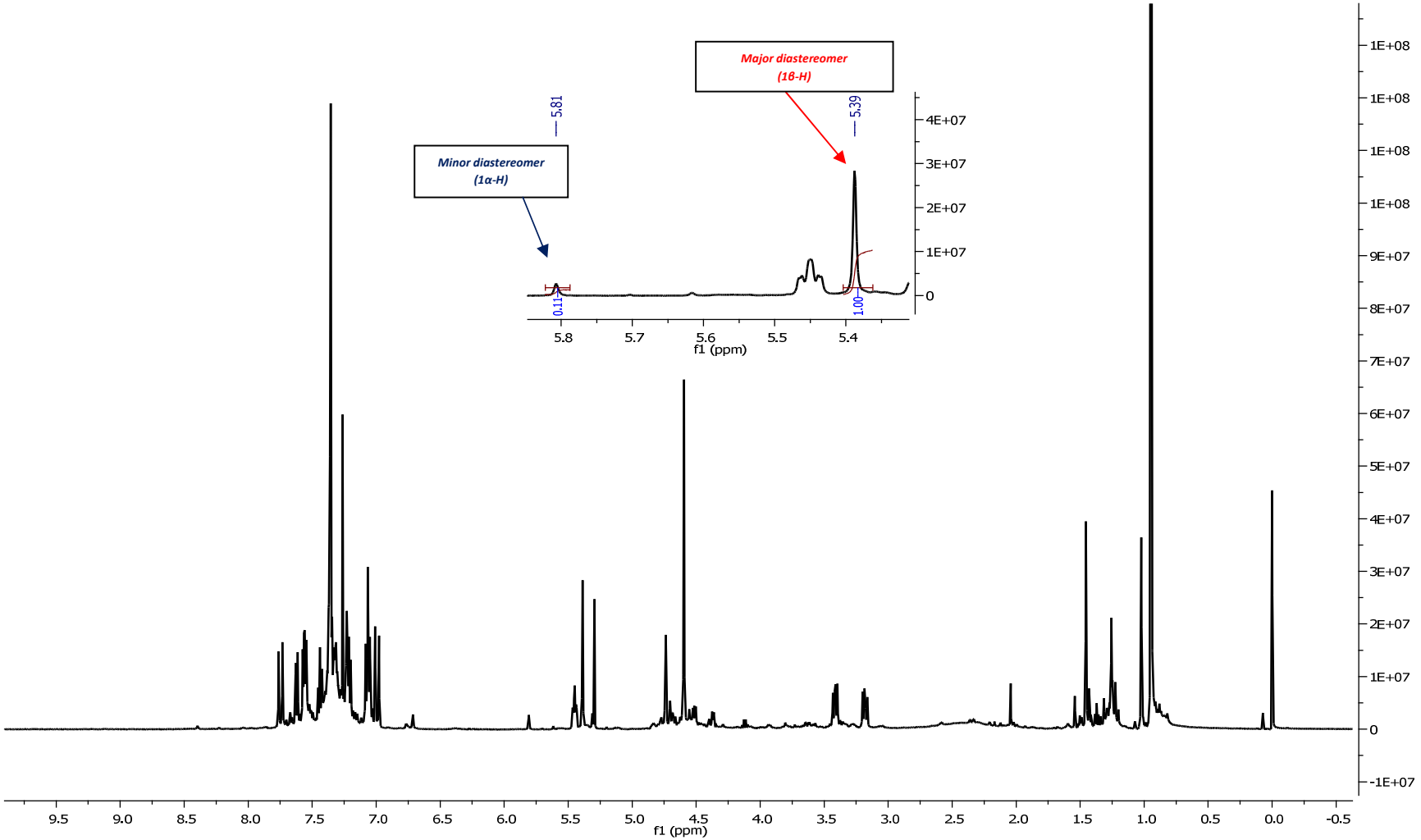


Figure 20:[1]H NMR Spectrum of compound **5f**:

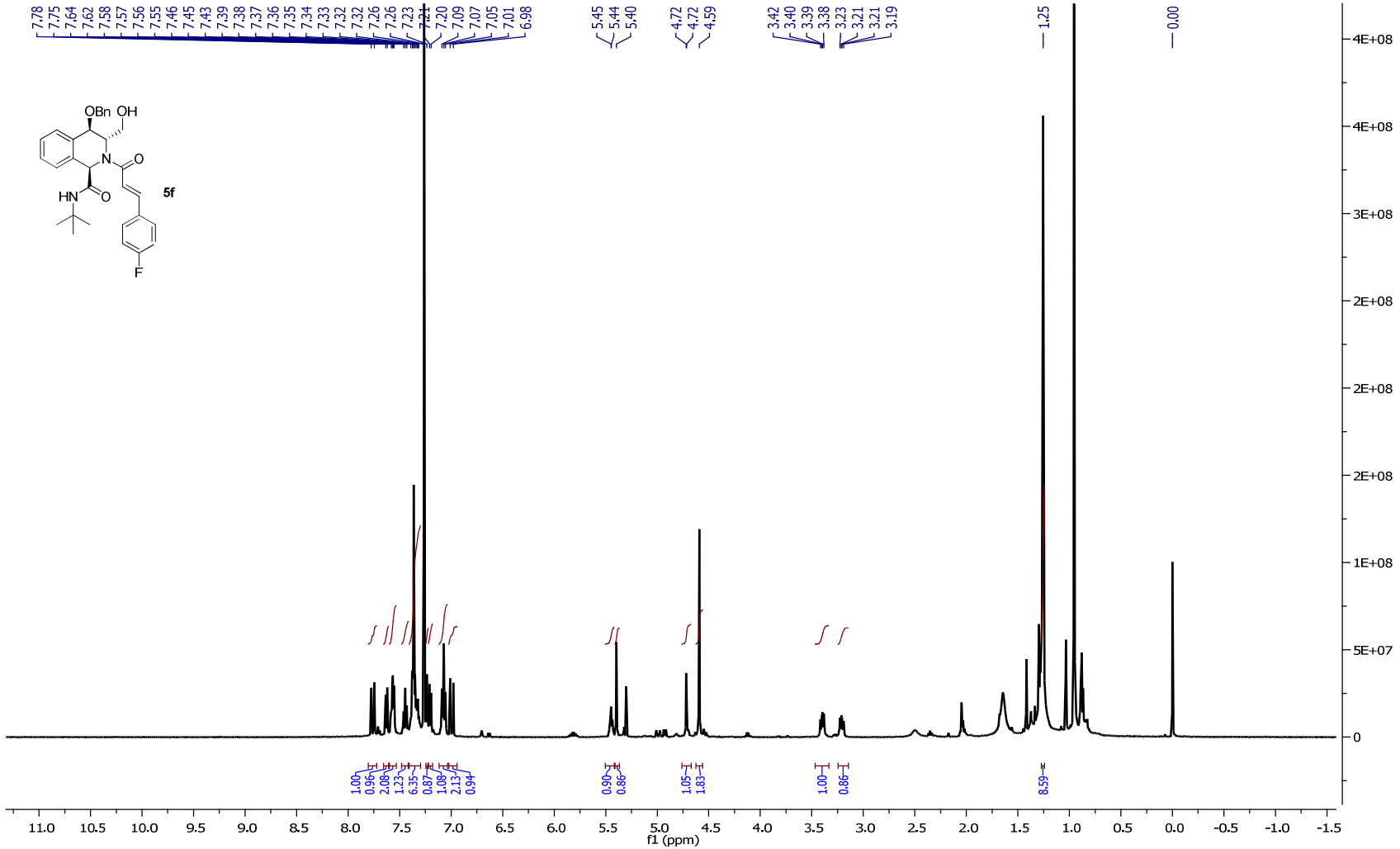


Figure 21: ^{13}C NMR Spectrum of compound **5f**:

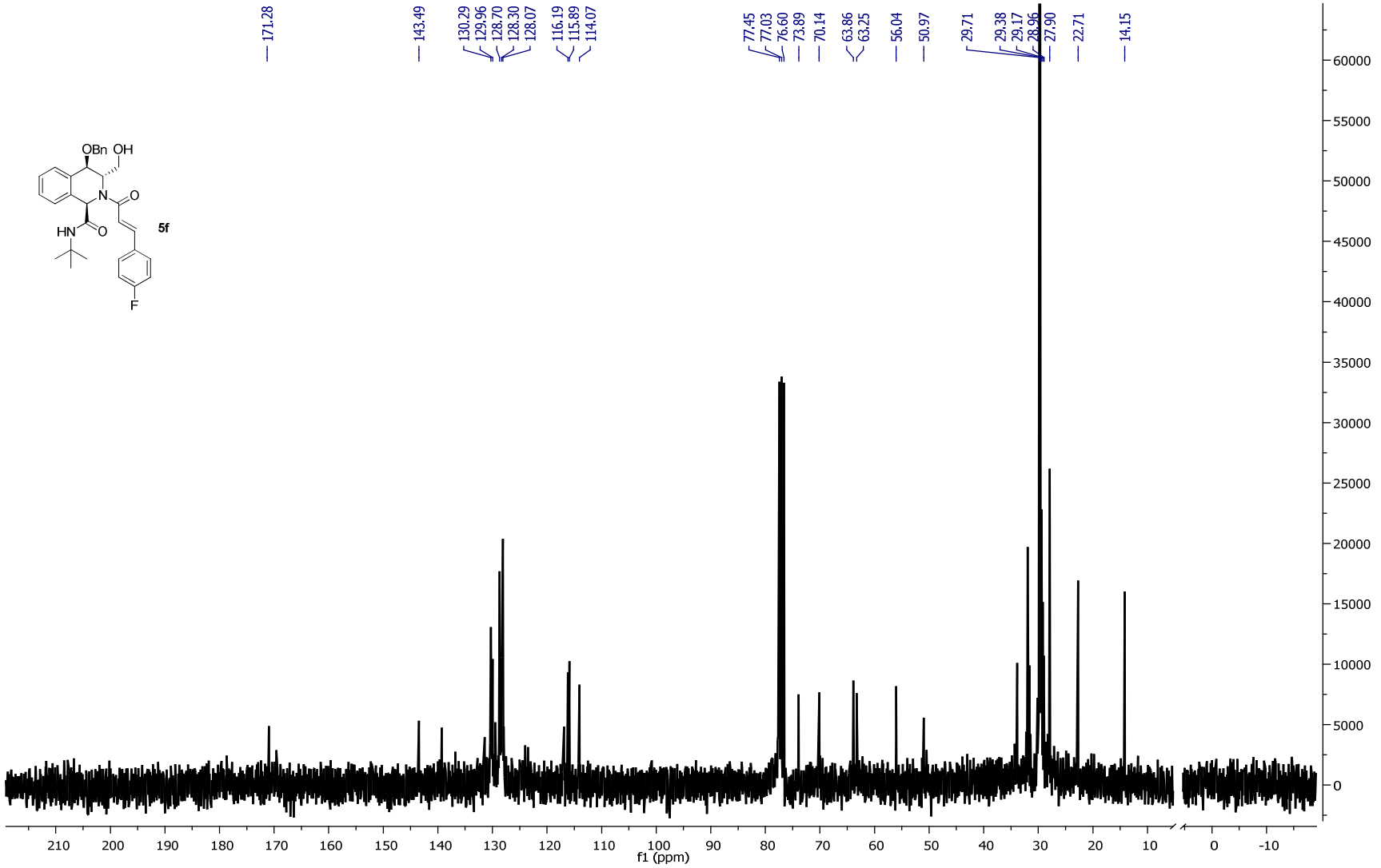


Figure 22: ^{1}H NMR of post aqueous workup sample (crude sample) of compound **5g:**

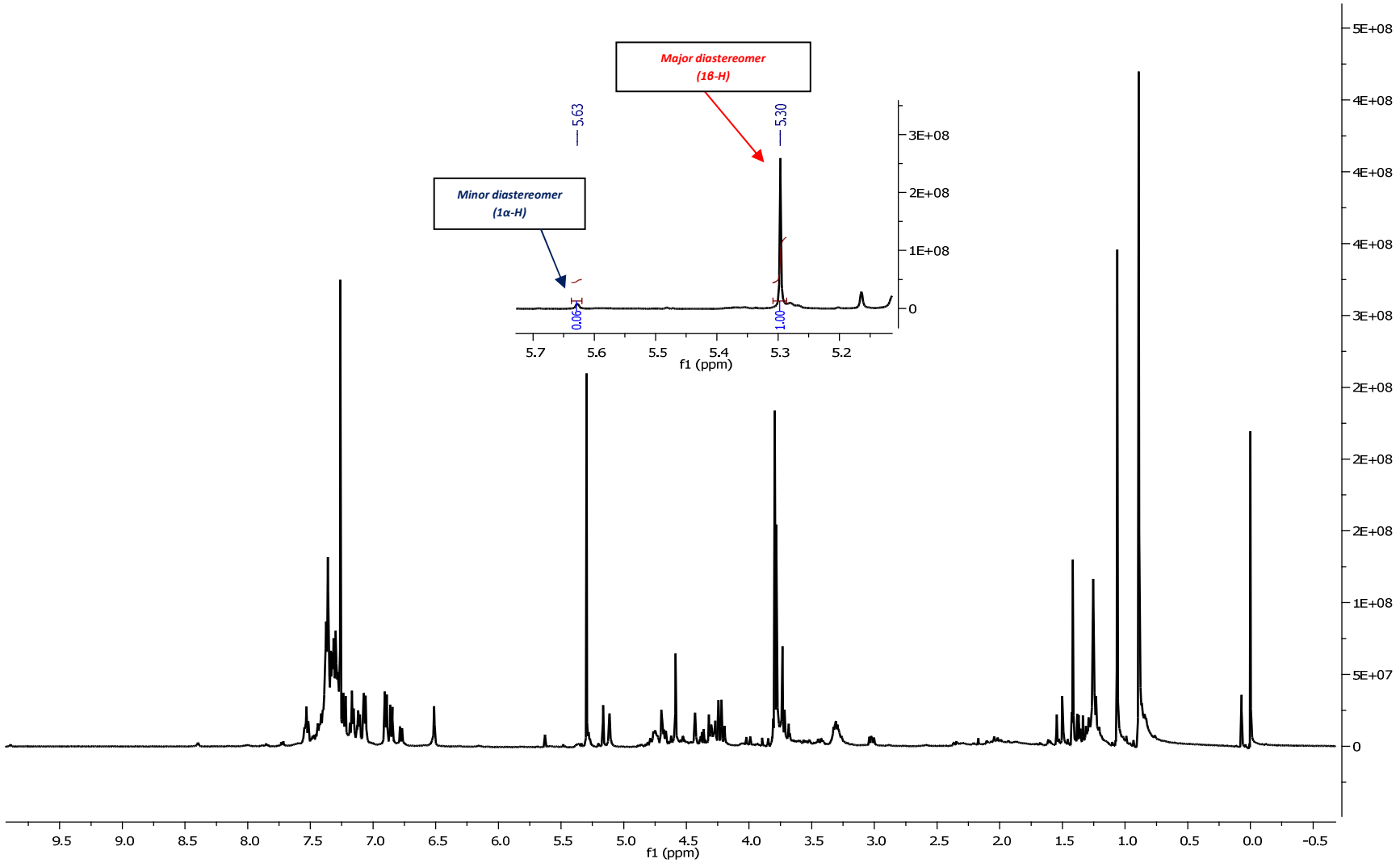


Figure 23: ^{1}H NMR Spectrum of compound **5g**:

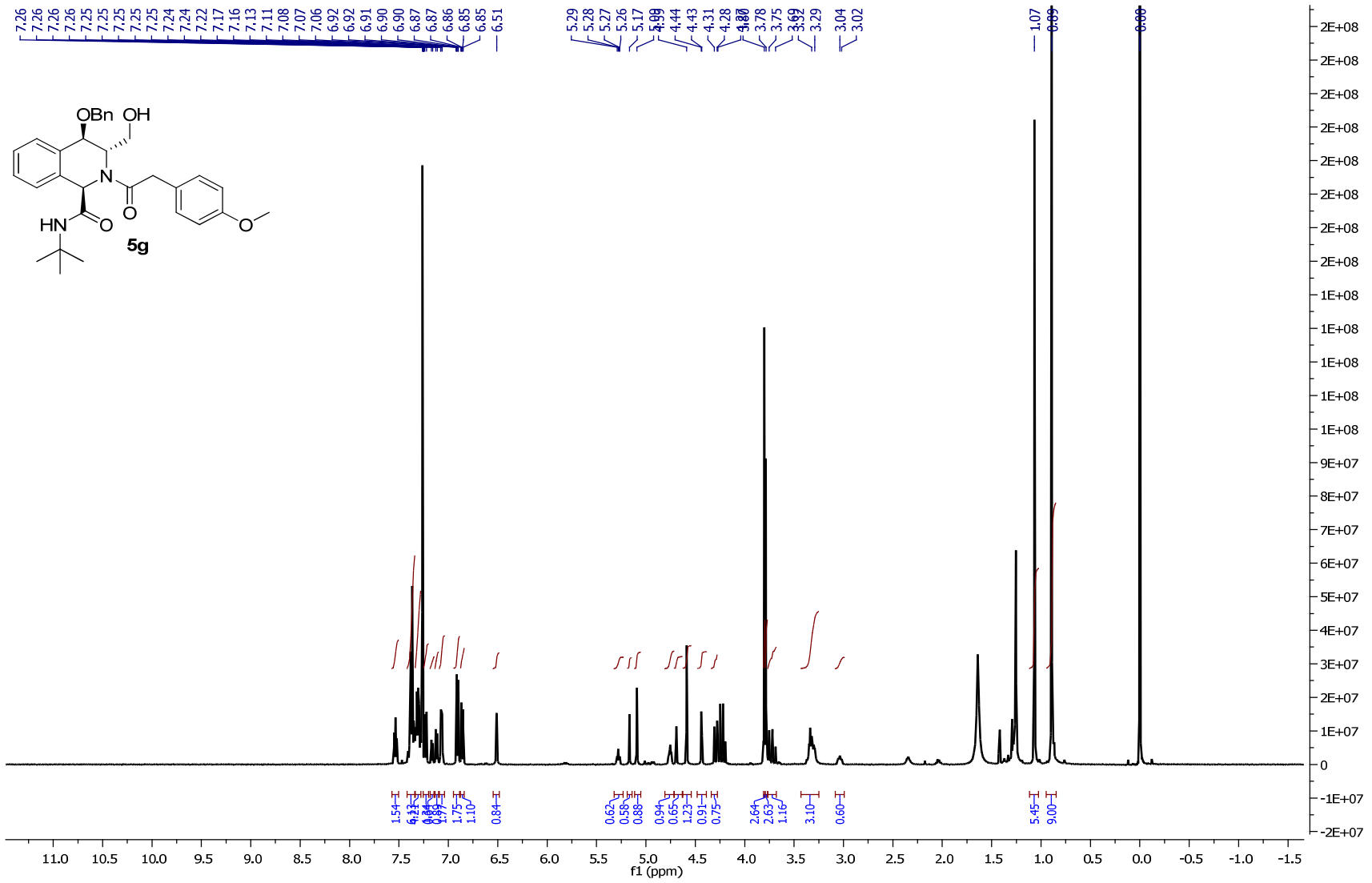


Figure 24:[13]C NMR Spectrum of compound **5g**:

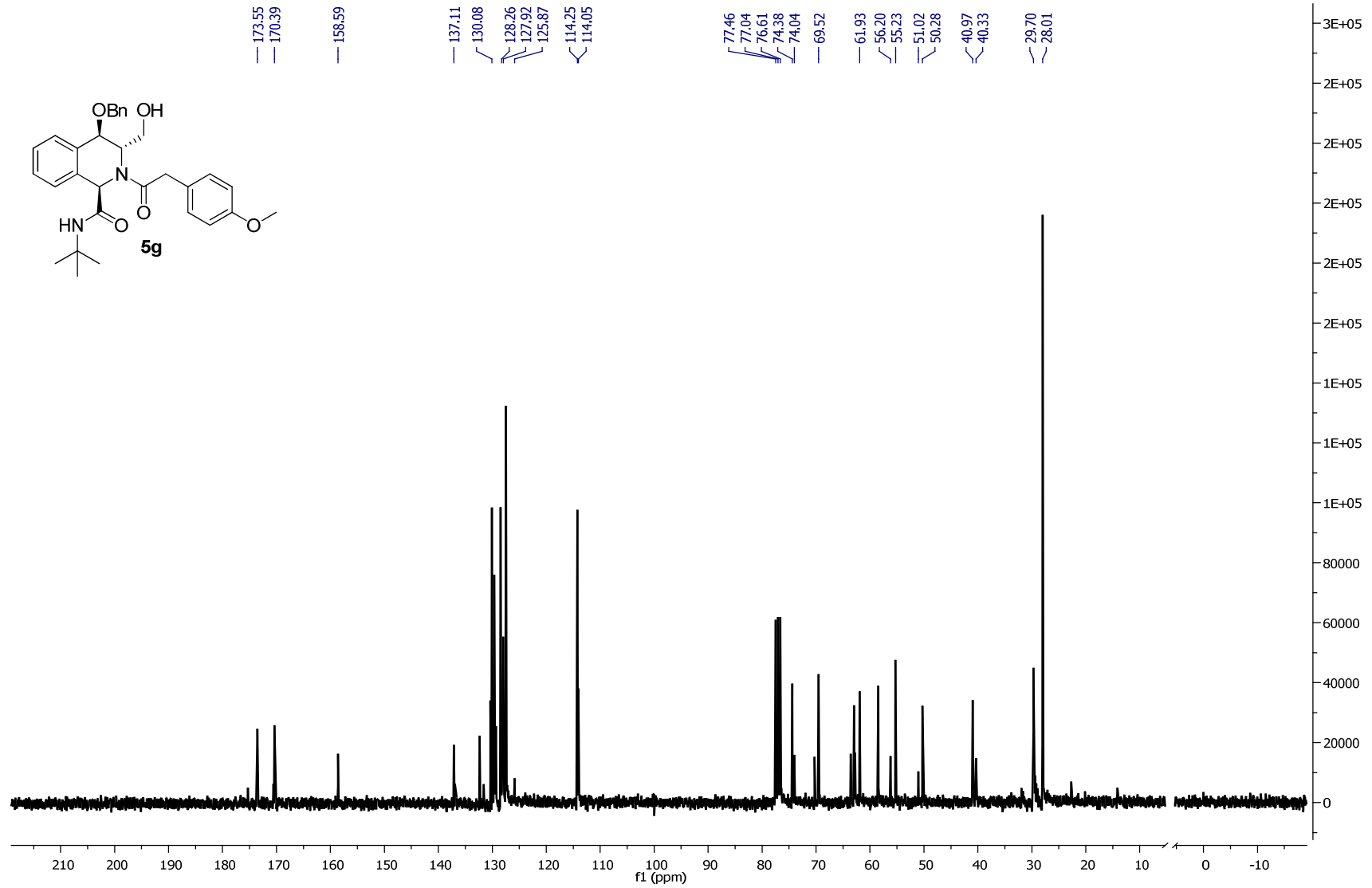


Figure 25: ^{1}H NMR of post aqueous workup sample (crude sample) of compound **5h:**

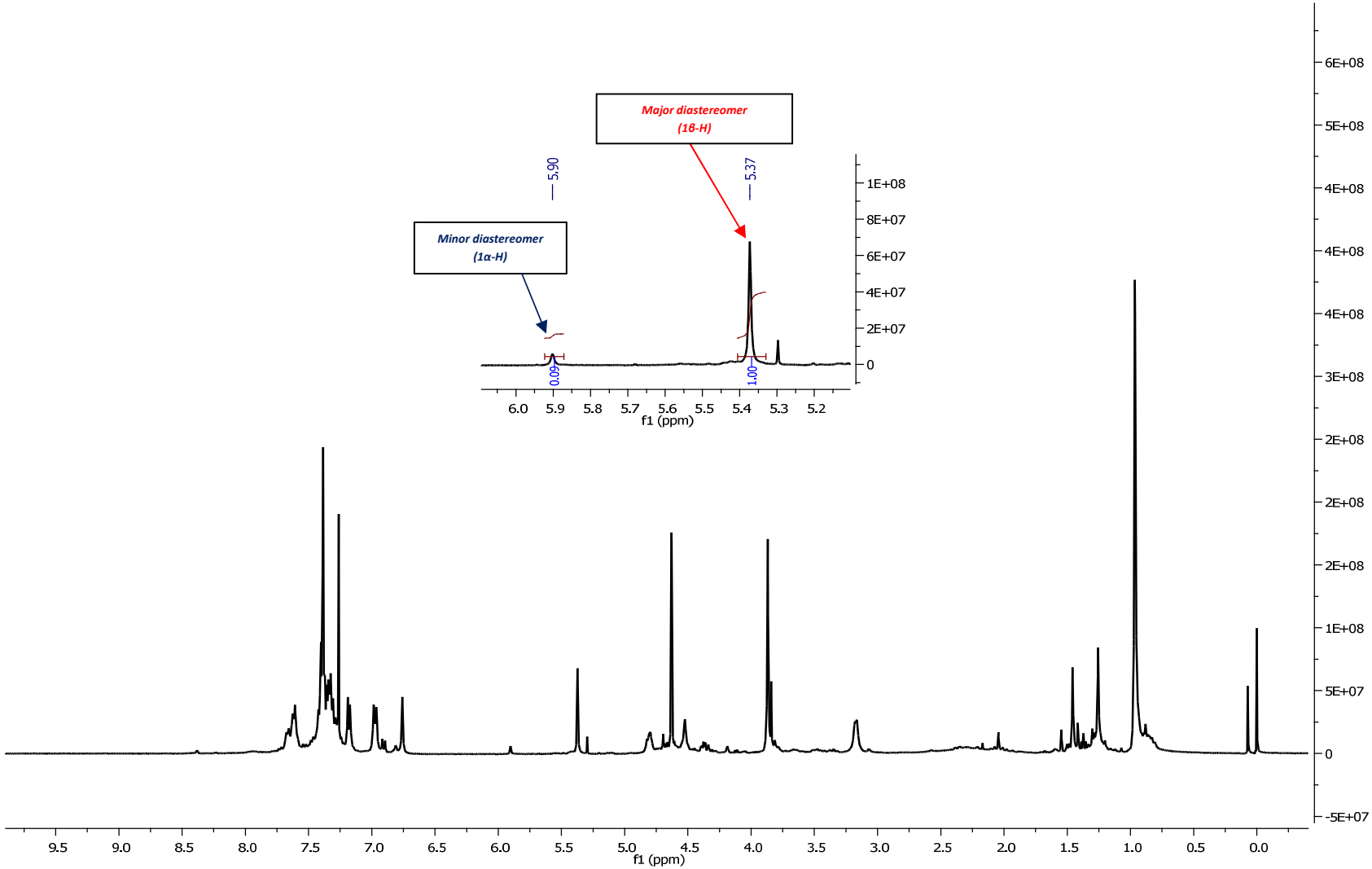


Figure 26:[1]H NMR Spectrum of compound **5h**:

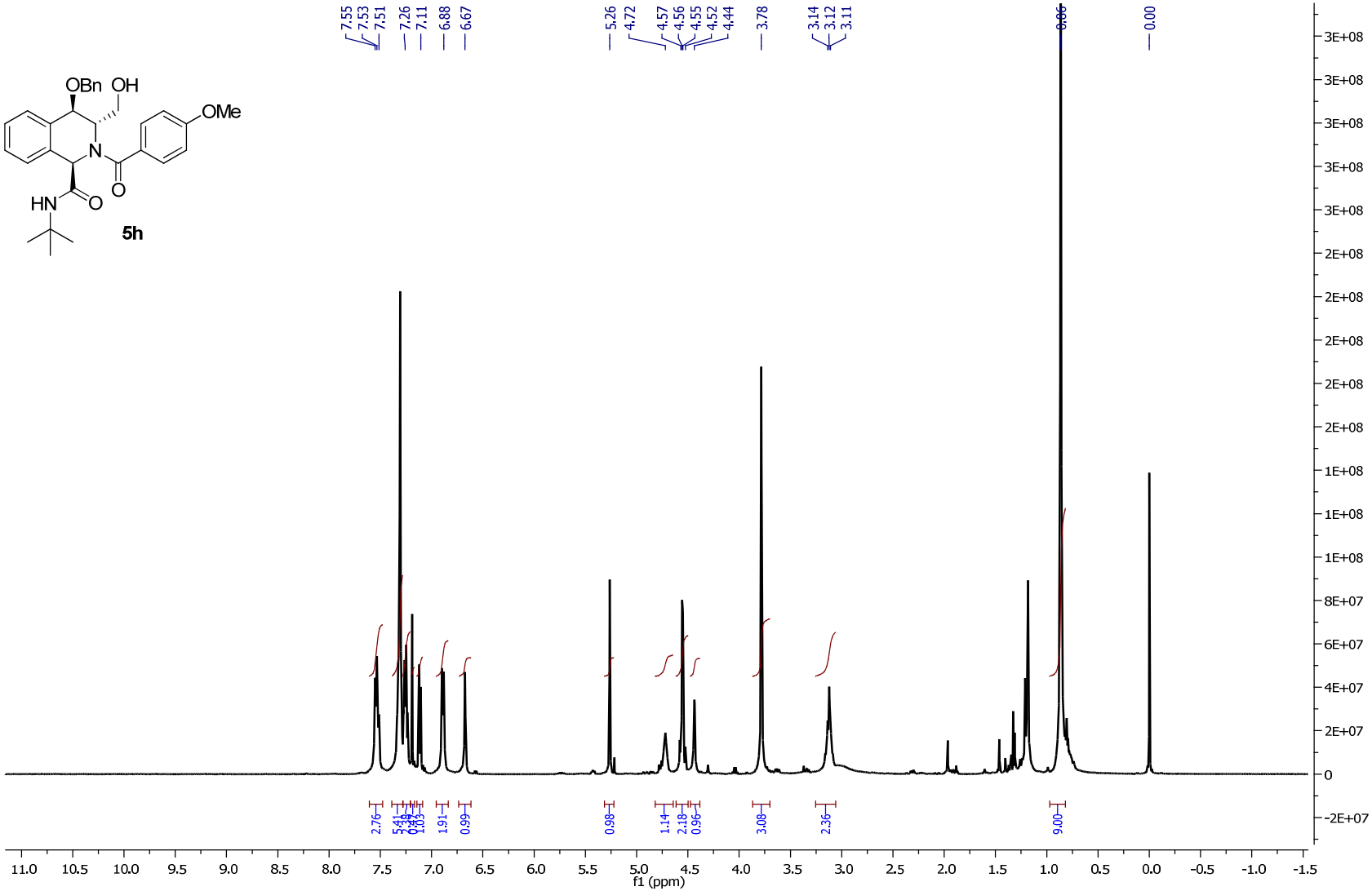


Figure 27:[13]C NMR Spectrum of compound **5h**:

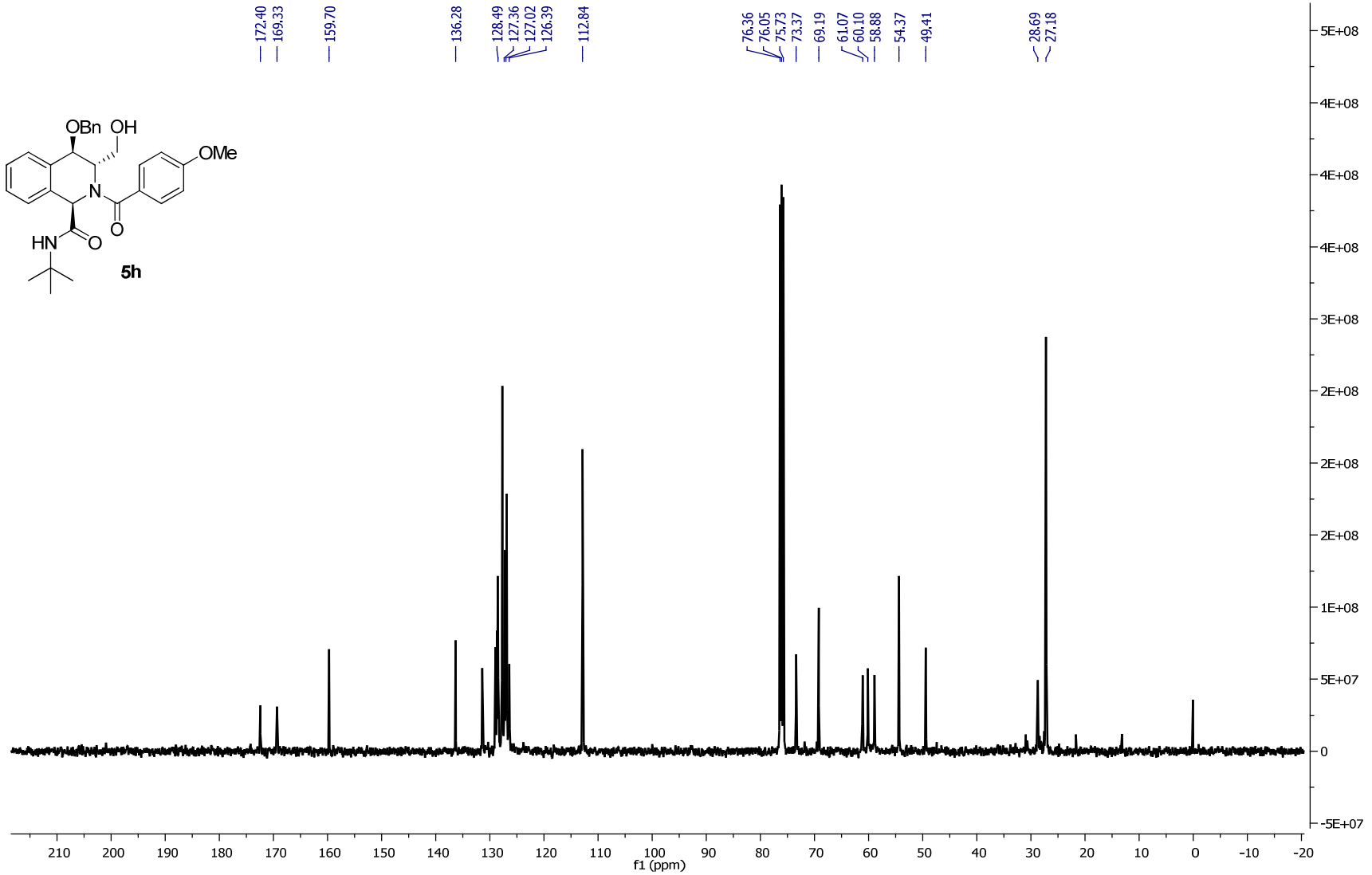


Figure 28: ^{1}H NMR of post aqueous workup sample (crude sample) of compound **5i:**

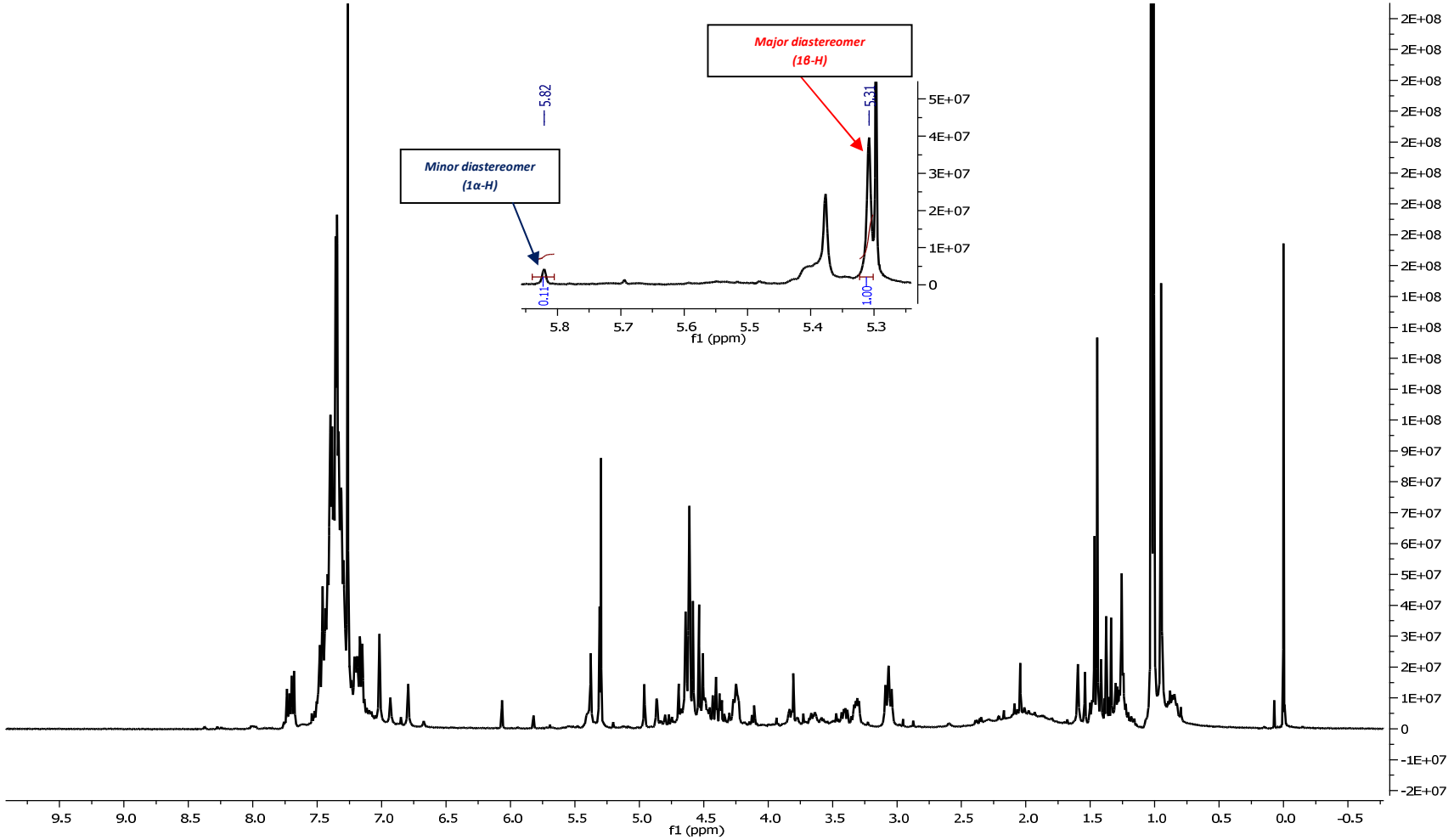


Figure 29:[1]H NMR Spectrum of compound **5i**:

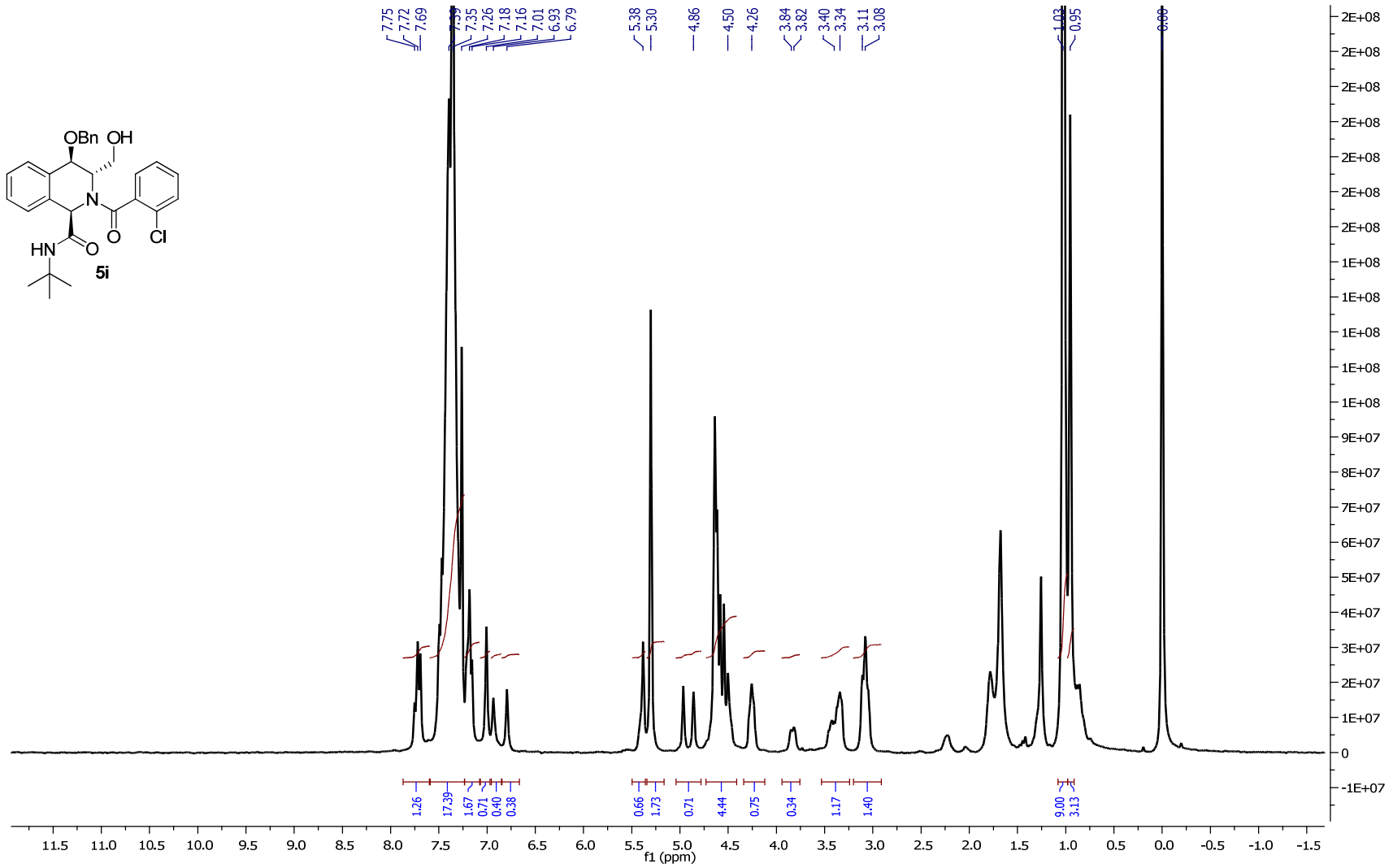


Figure 30: ^{13}C NMR Spectrum of compound **5i**:

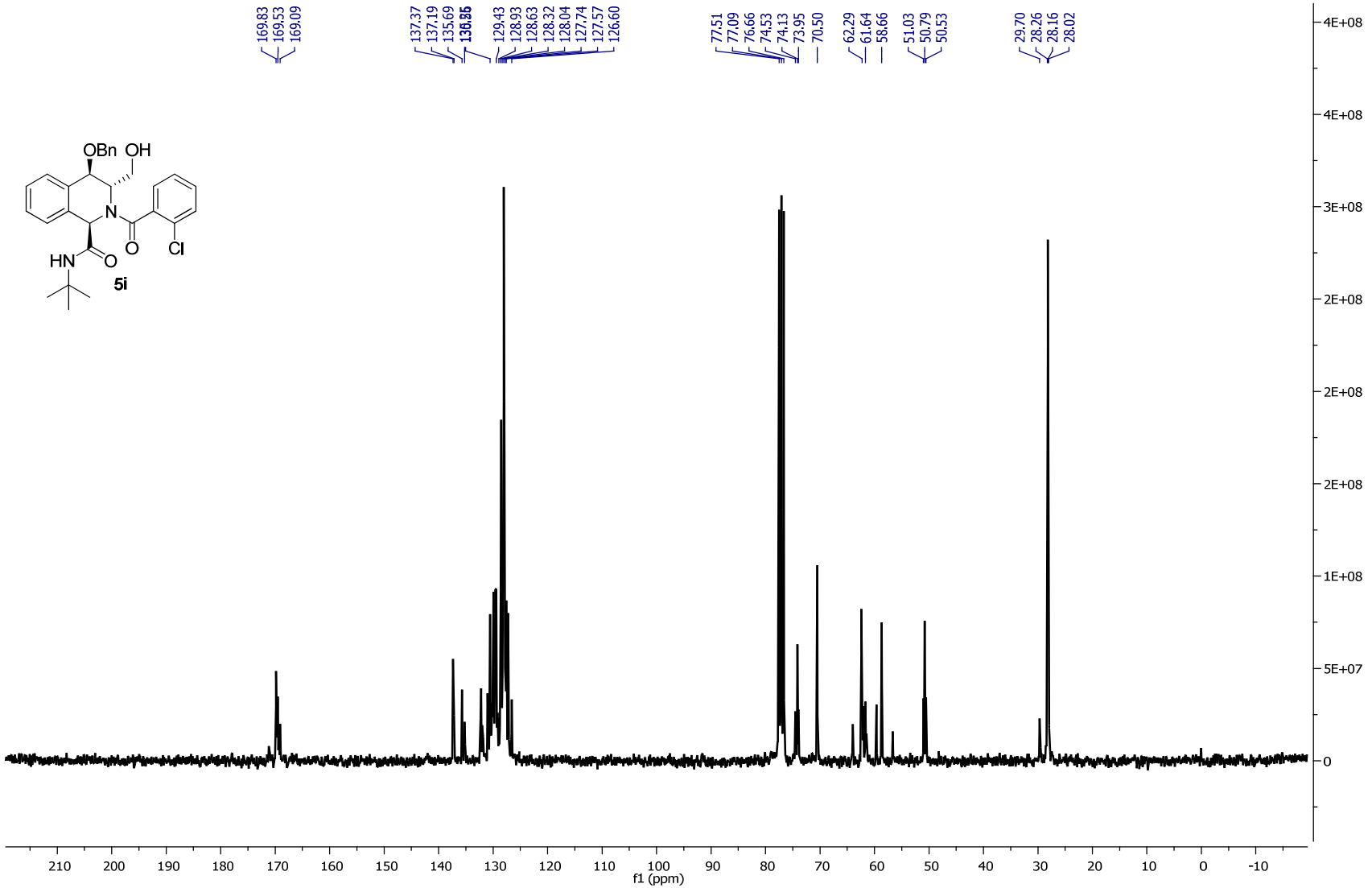


Figure 31: ^{1}H NMR of post aqueous workup sample (crude sample) of compound **5j:**

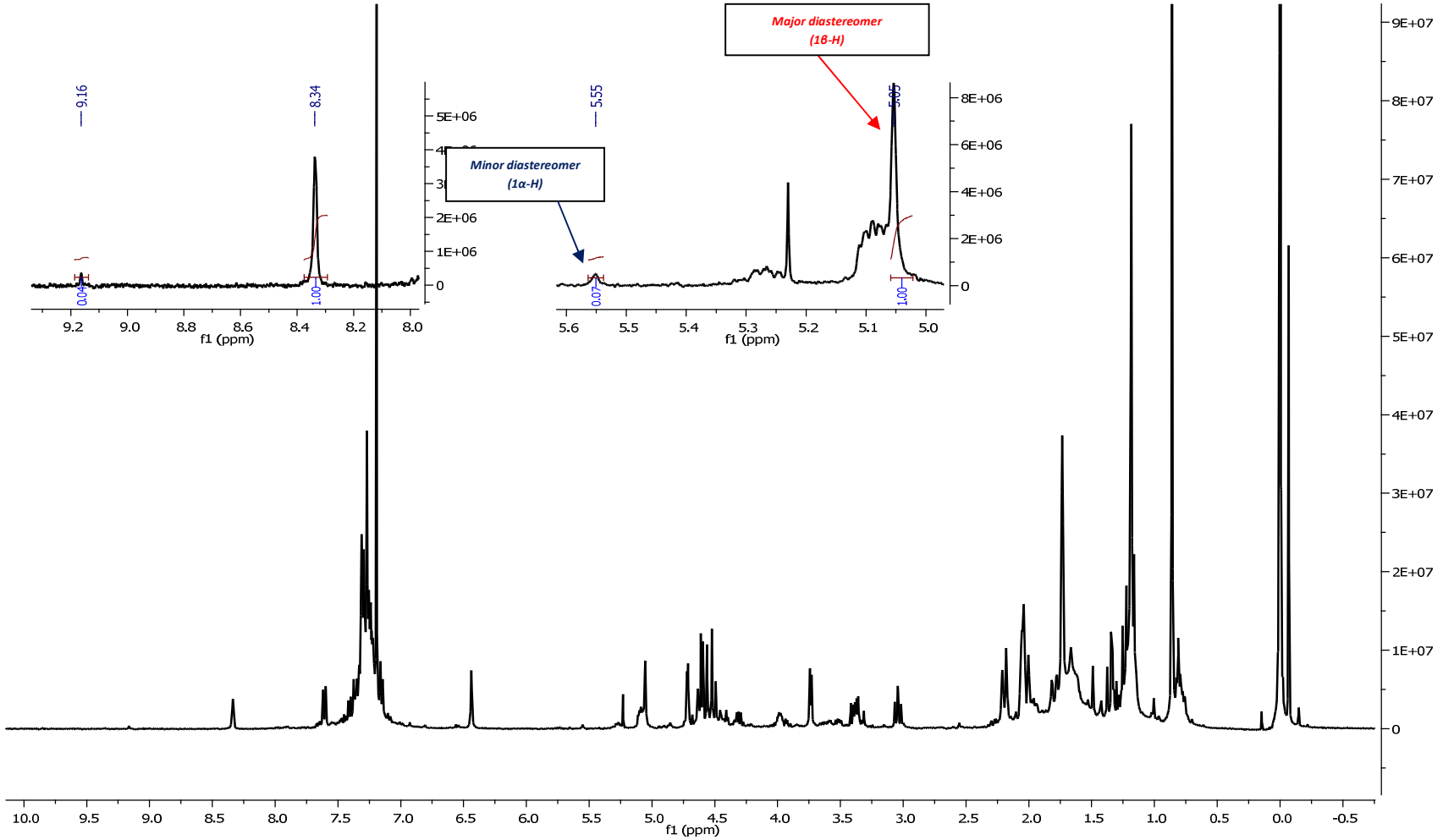


Figure 32:[1]H NMR Spectrum of compound **5j**:

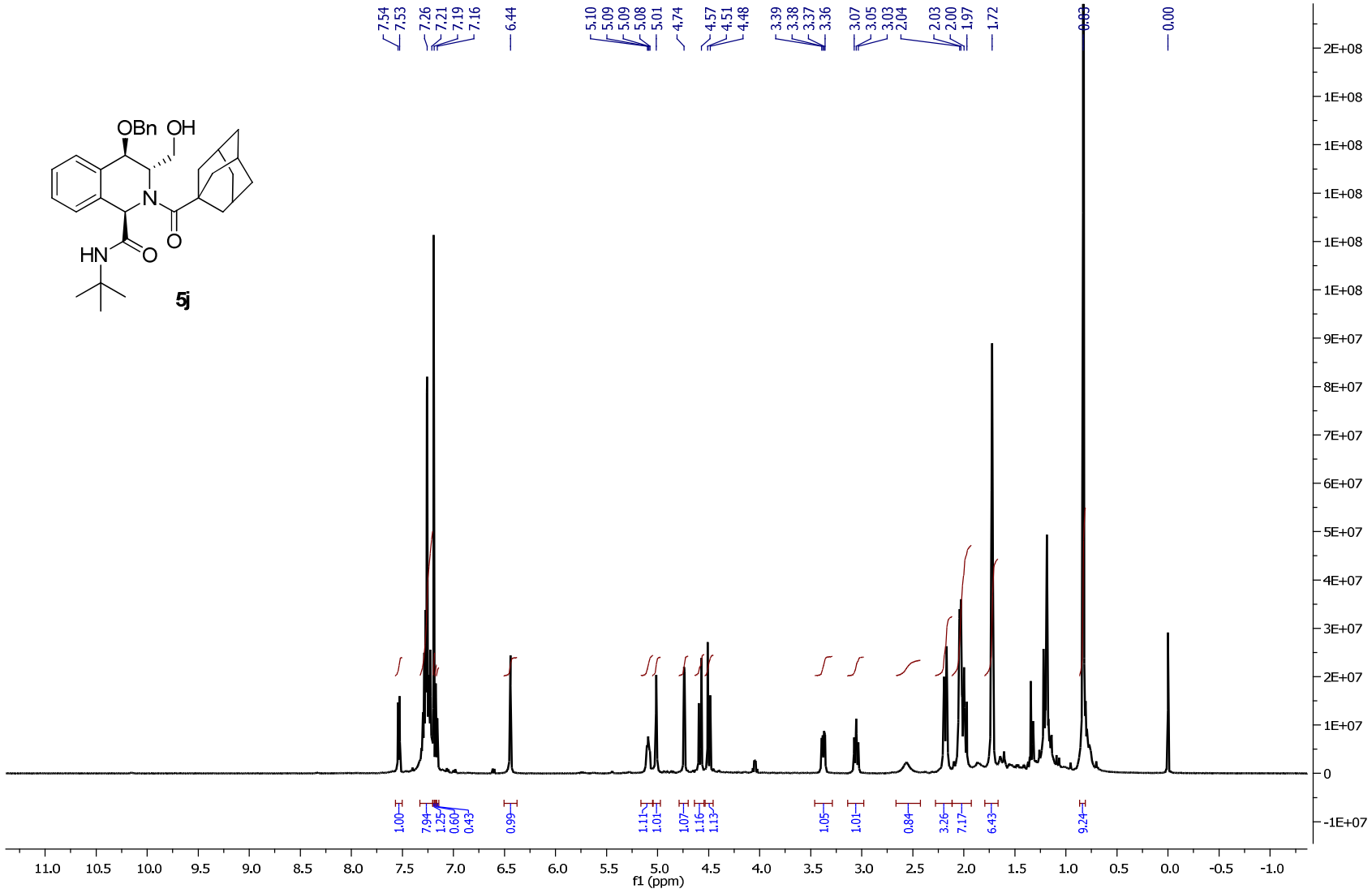


Figure 33:[13]C NMR Spectrum of compound **5j**:

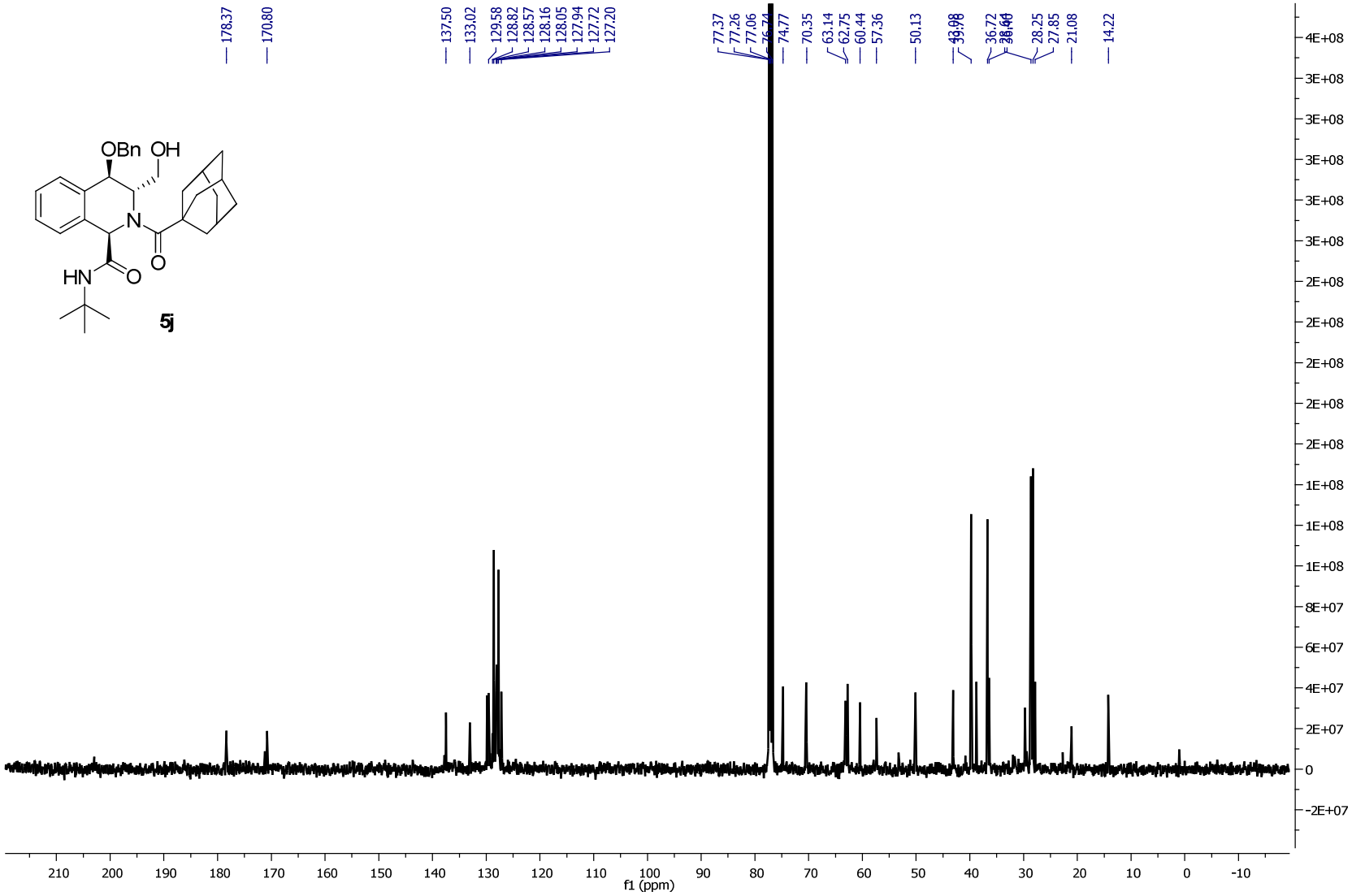


Figure 34: ^{1}H NMR of post aqueous workup sample (crude sample) of compound **5k:**

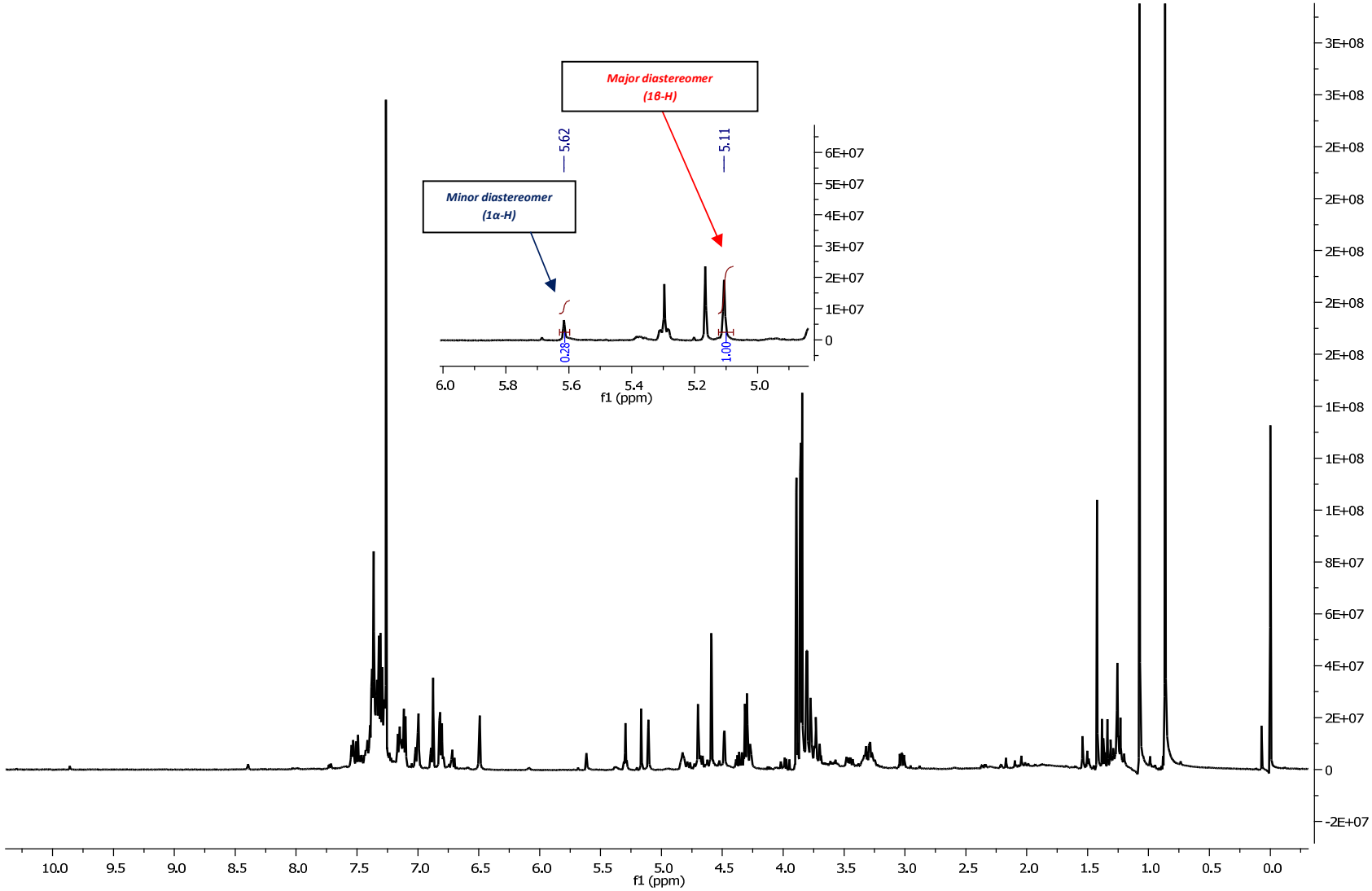


Figure 35: ^{1}H NMR Spectrum of compound **5k**:

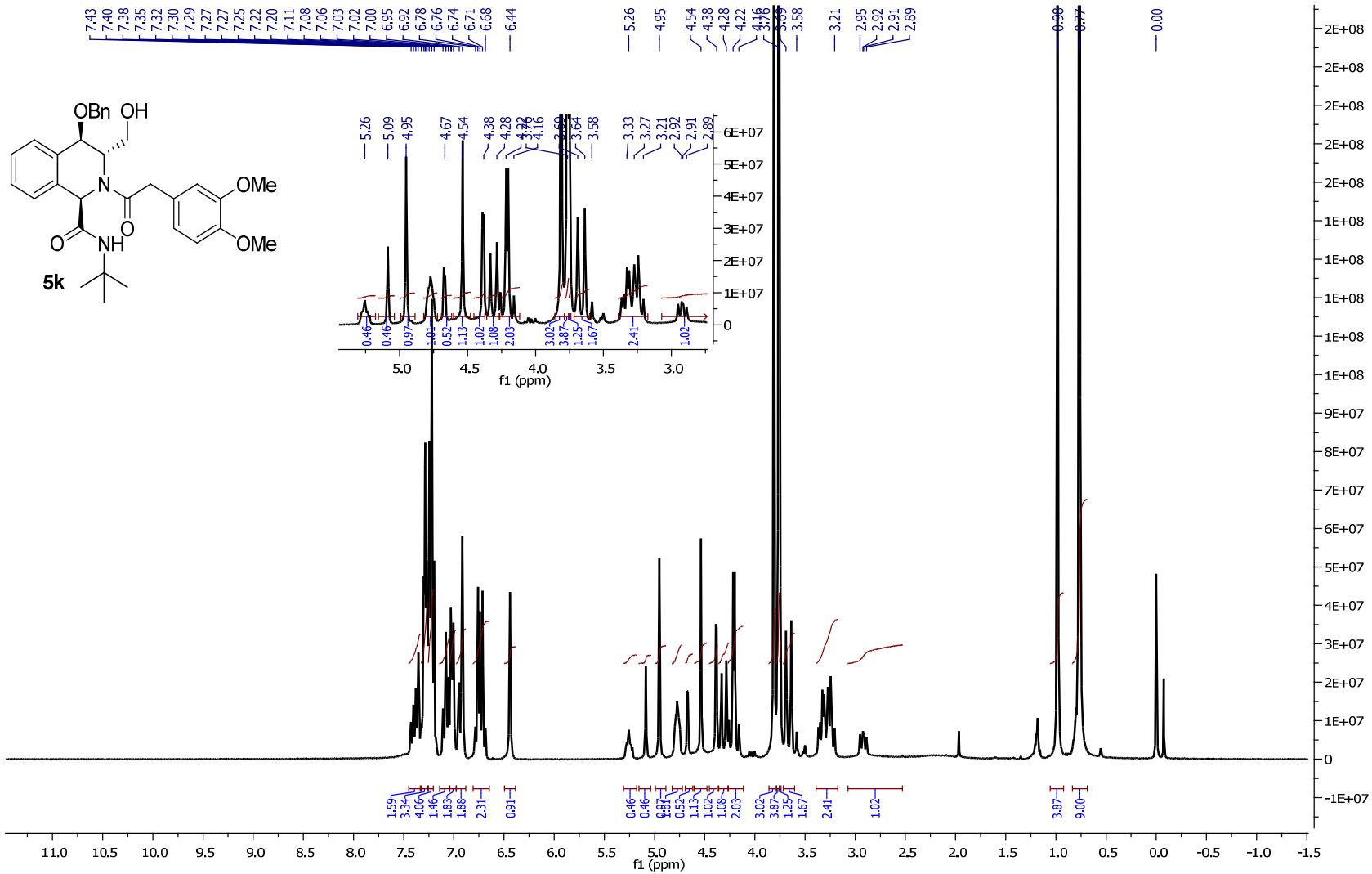


Figure 36:[13]C NMR Spectrum of compound **5k**:

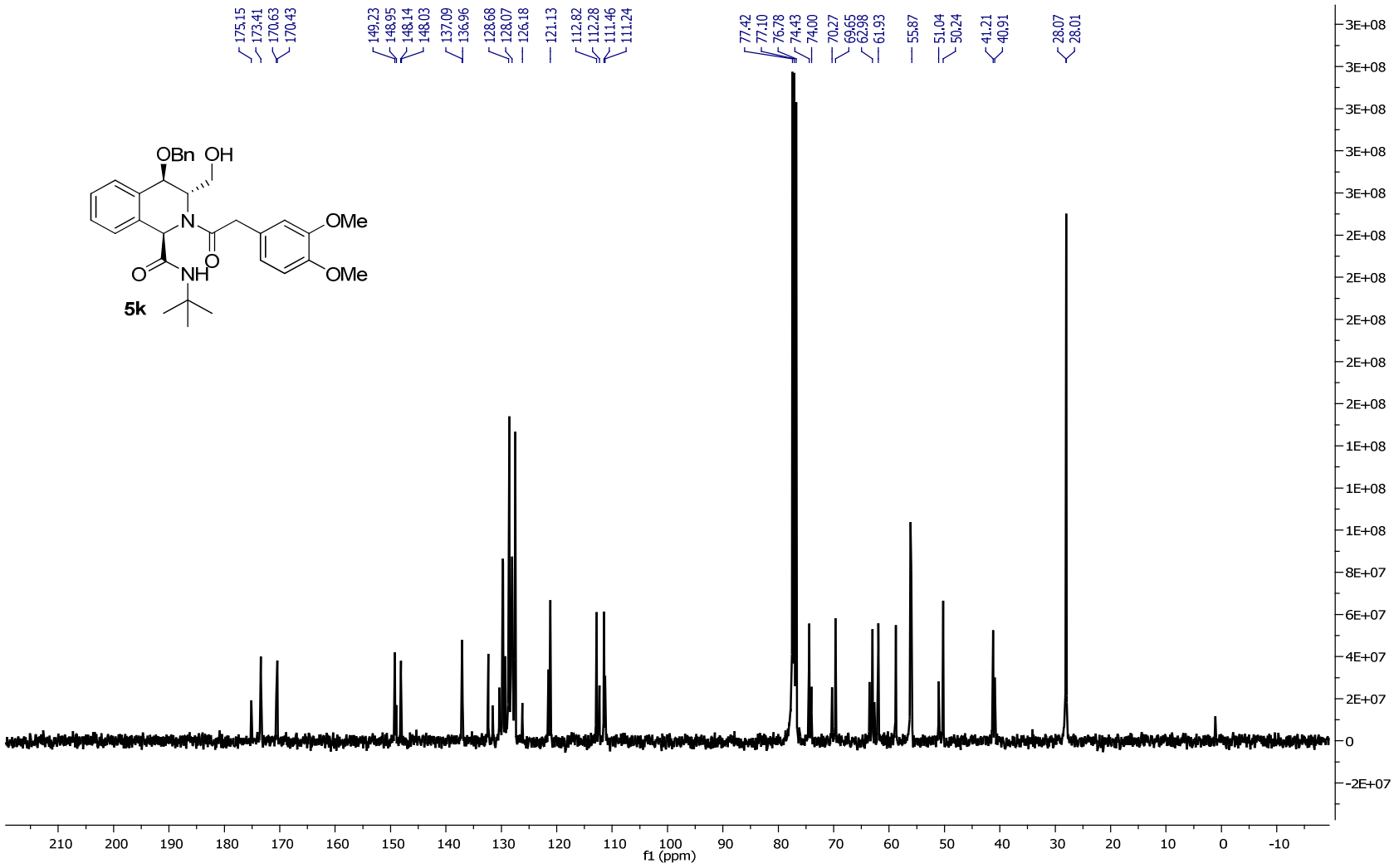


Figure 37: ^{1}H NMR of post aqueous workup sample (crude sample) of compound **5l:**

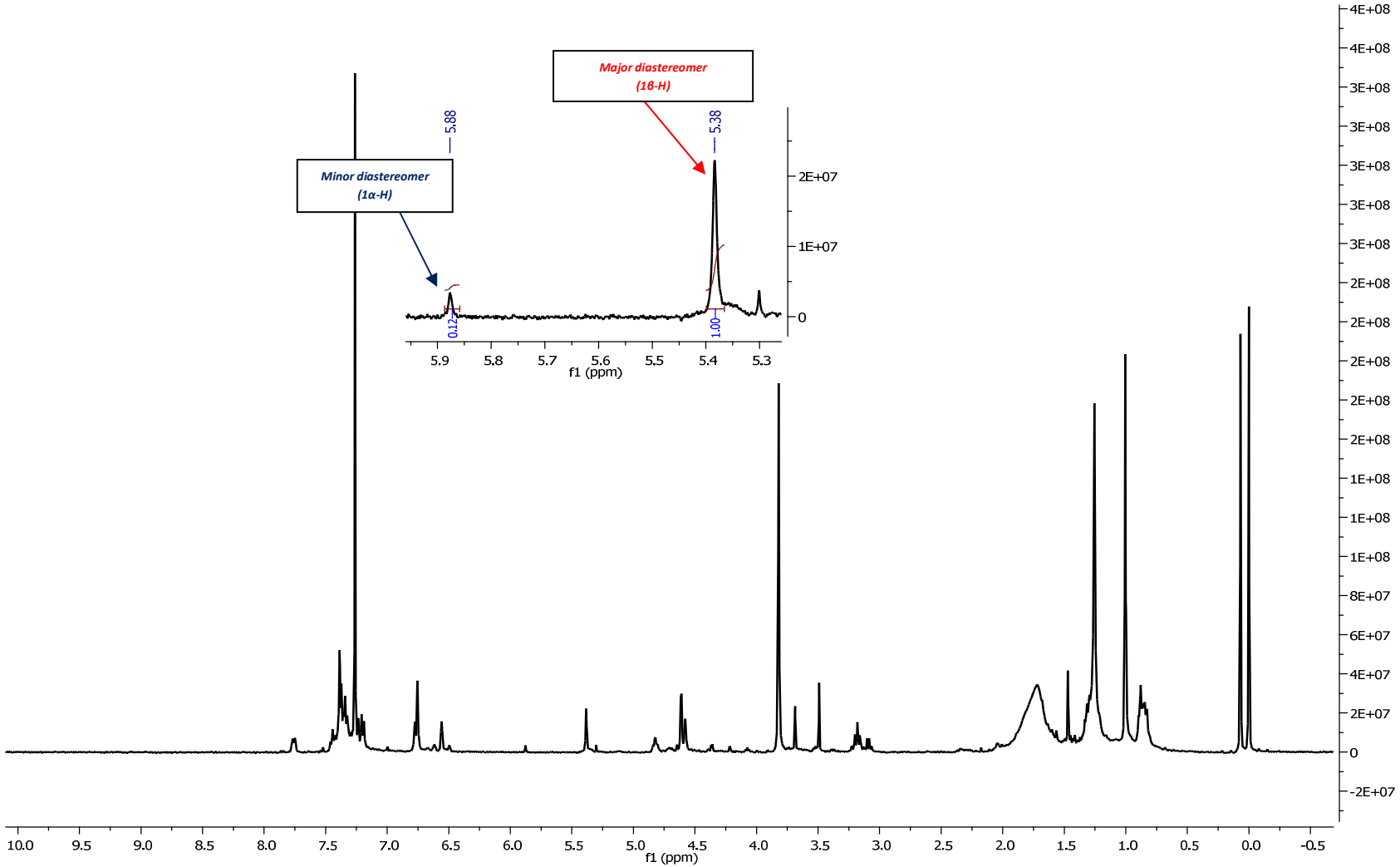


Figure 38:[1]H NMR Spectrum of compound**5l**:

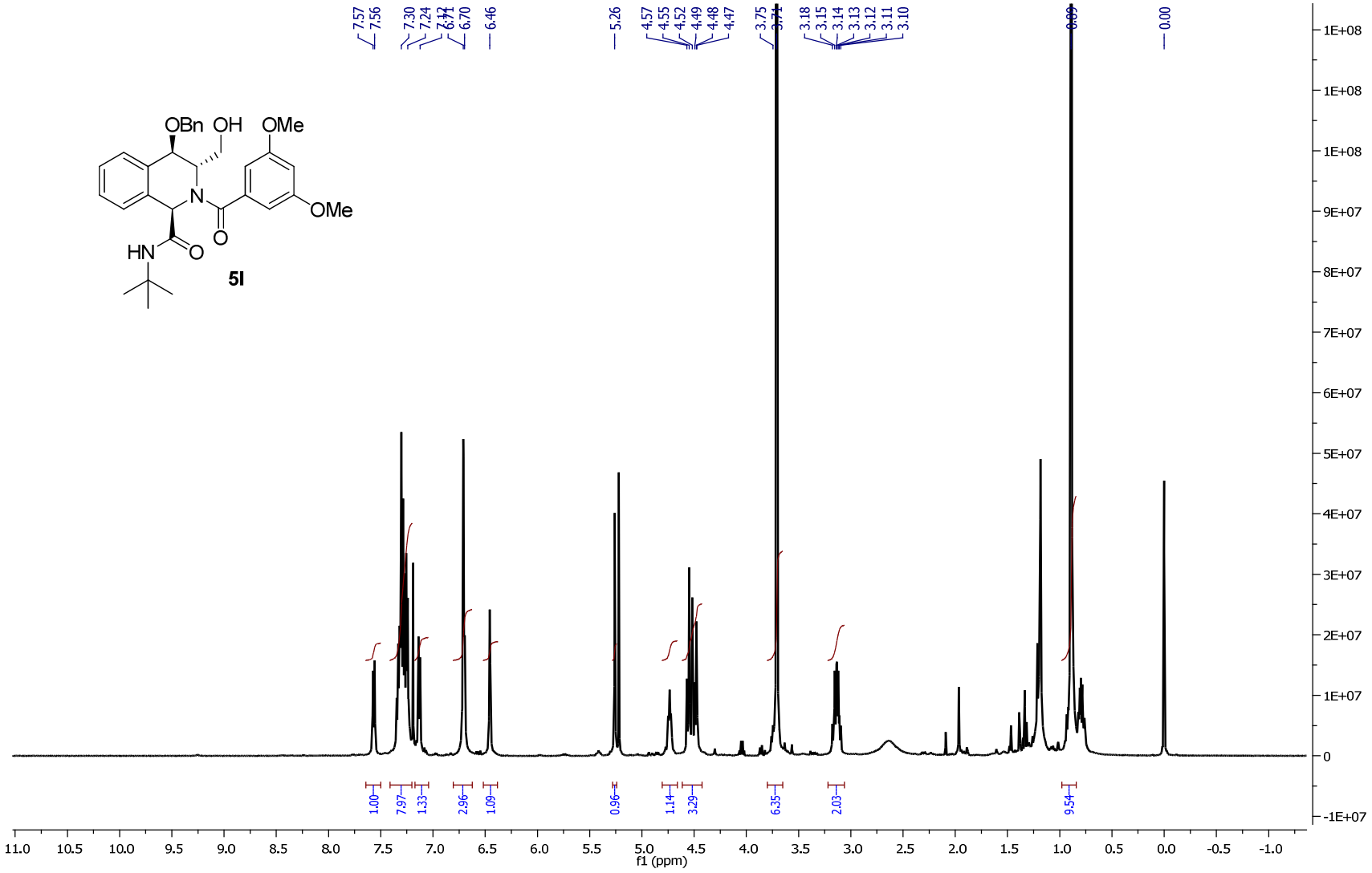


Figure 39: ^{13}C NMR Spectrum of compound **5l**:

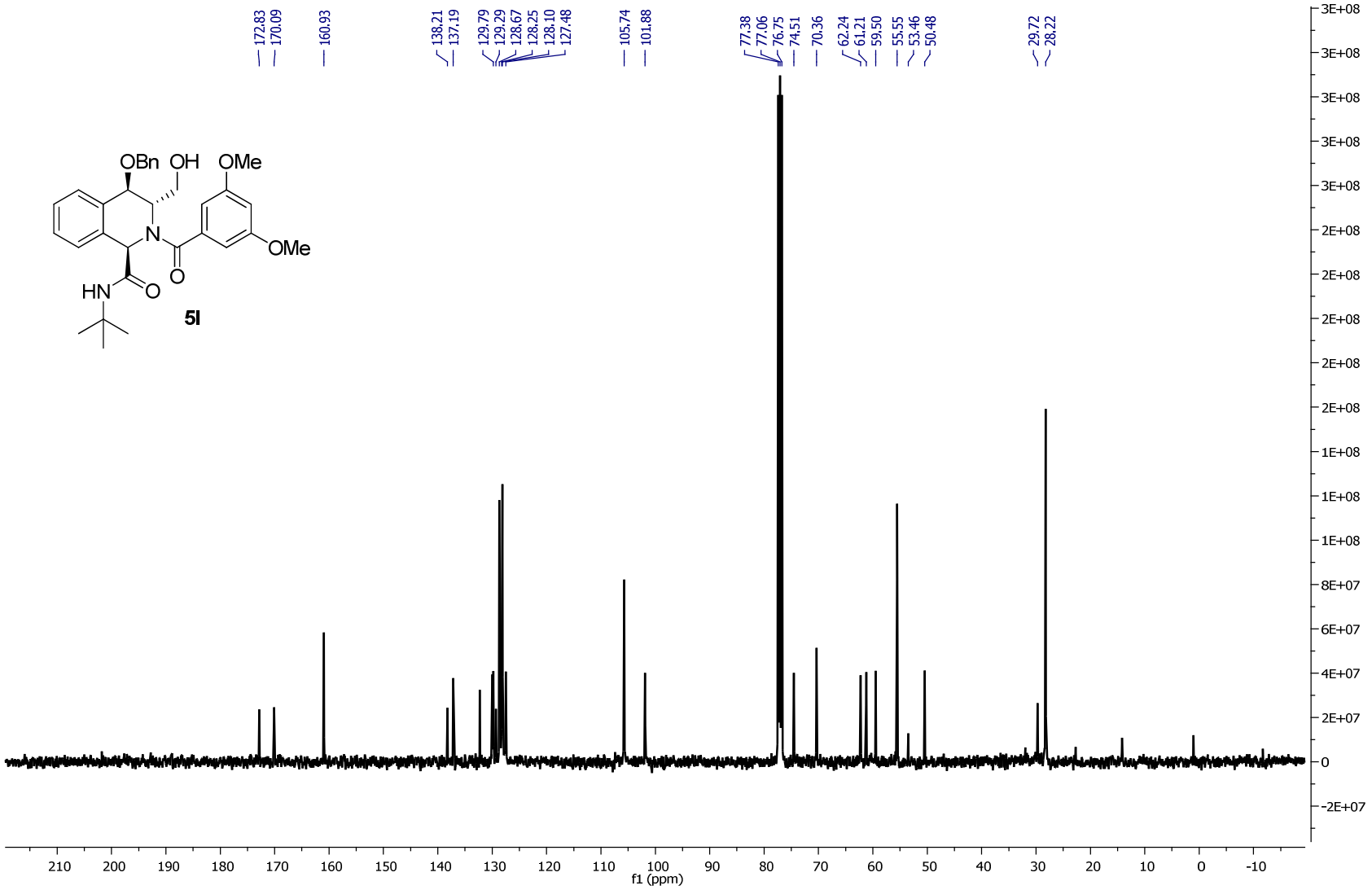


Figure 40: ^{1}H NMR of post aqueous workup sample (crude sample) of compound **5m:**

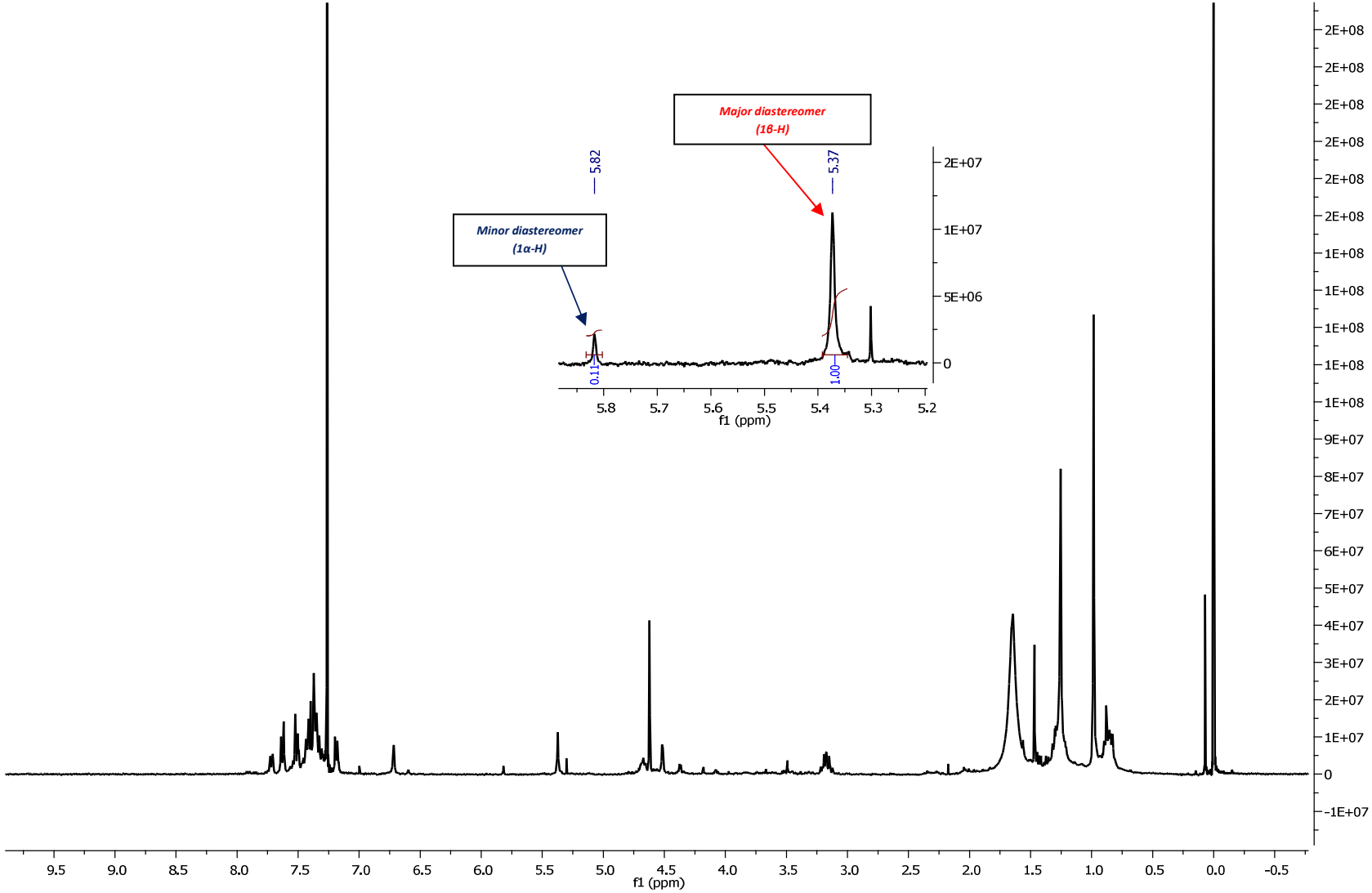


Figure 41:[1]H NMR Spectrum of compound **5m**:

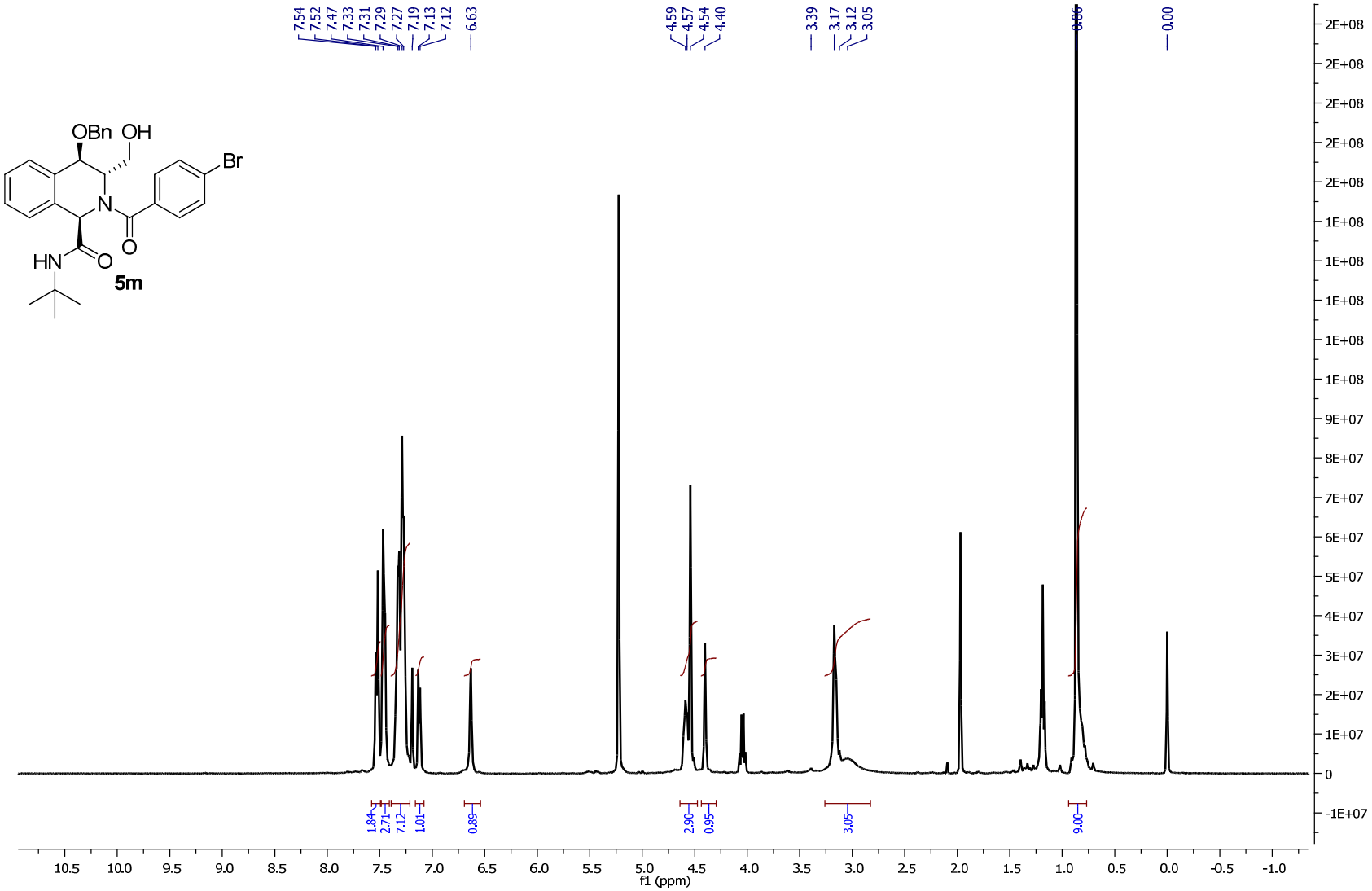


Figure 42: ^{13}C NMR Spectrum of compound **5m**:

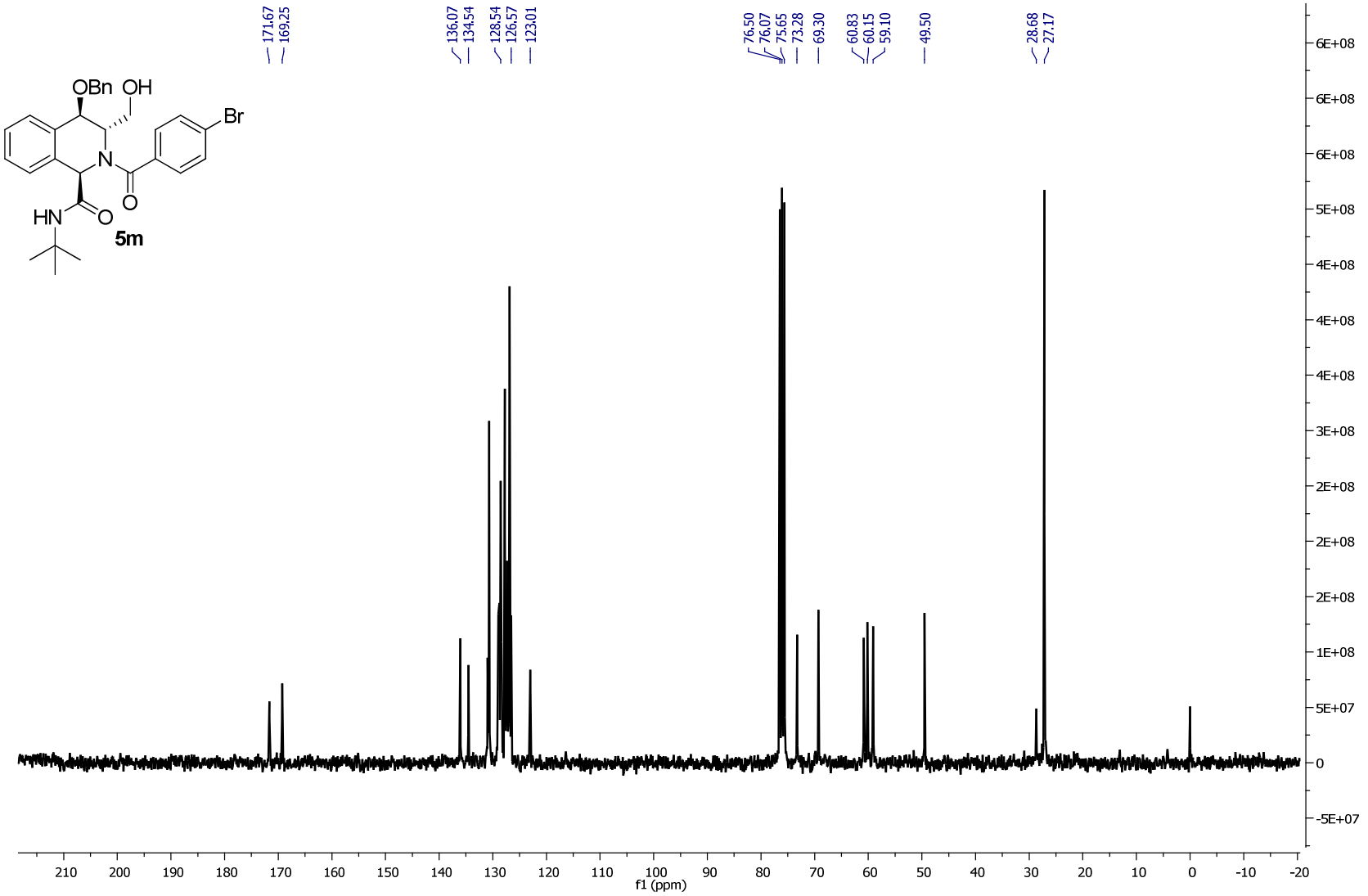


Figure 43: ^{1}H NMR of post aqueous workup sample (crude sample) of compound **5n :**

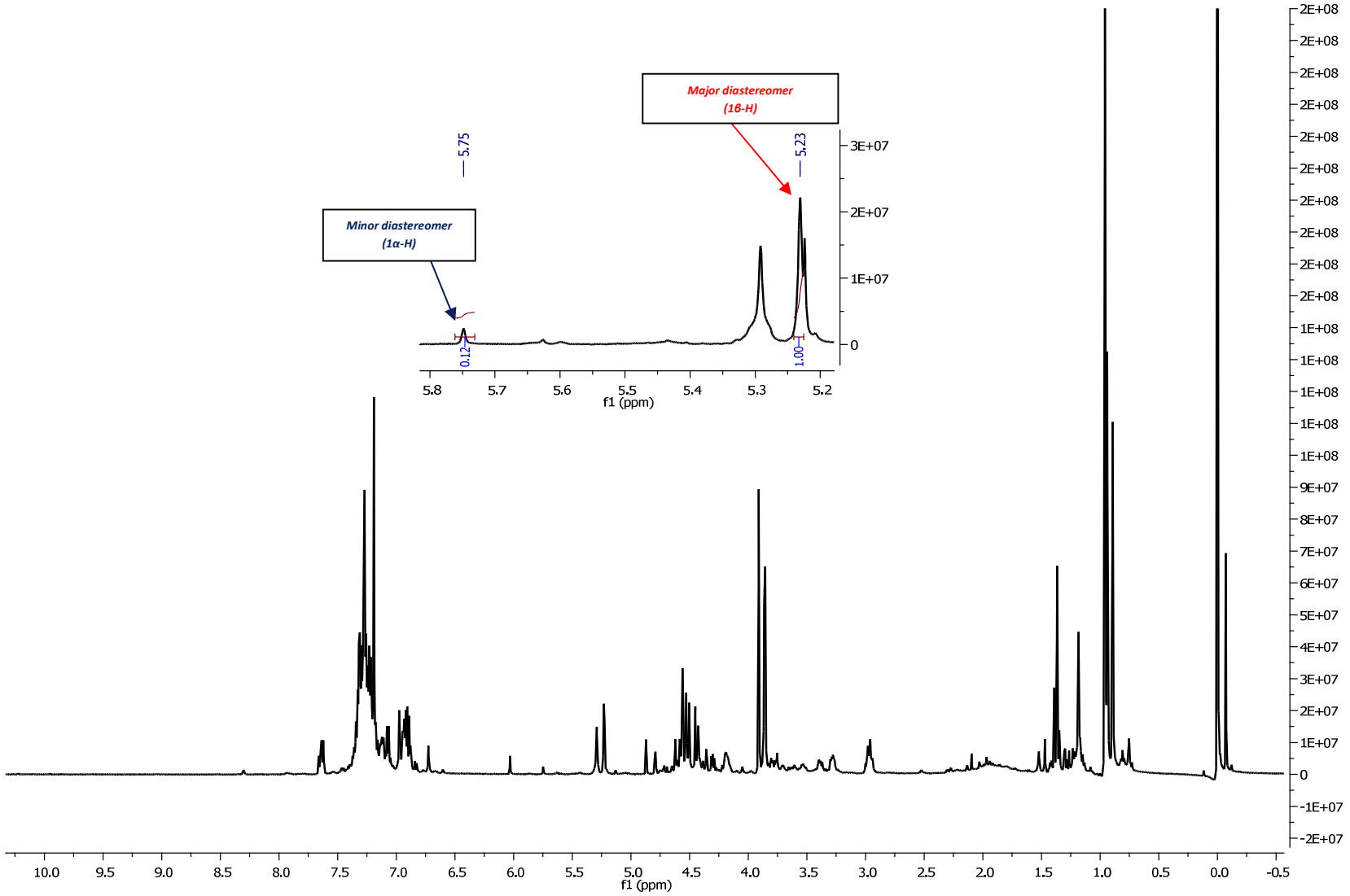


Figure 44:[1]H NMR Spectrum of compound **5n**:

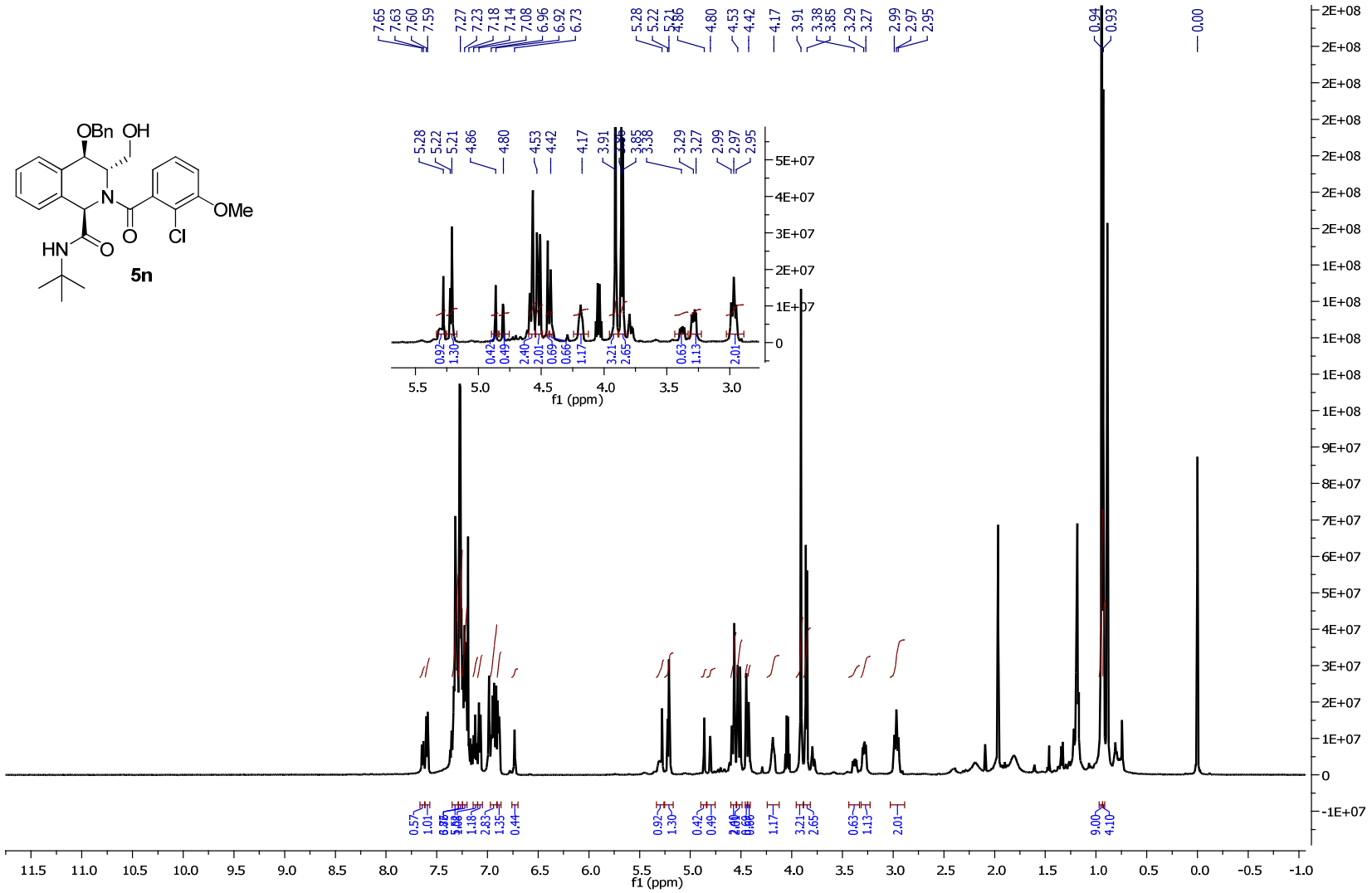


Figure 45: ^{13}C NMR Spectrum of compound **5n**:

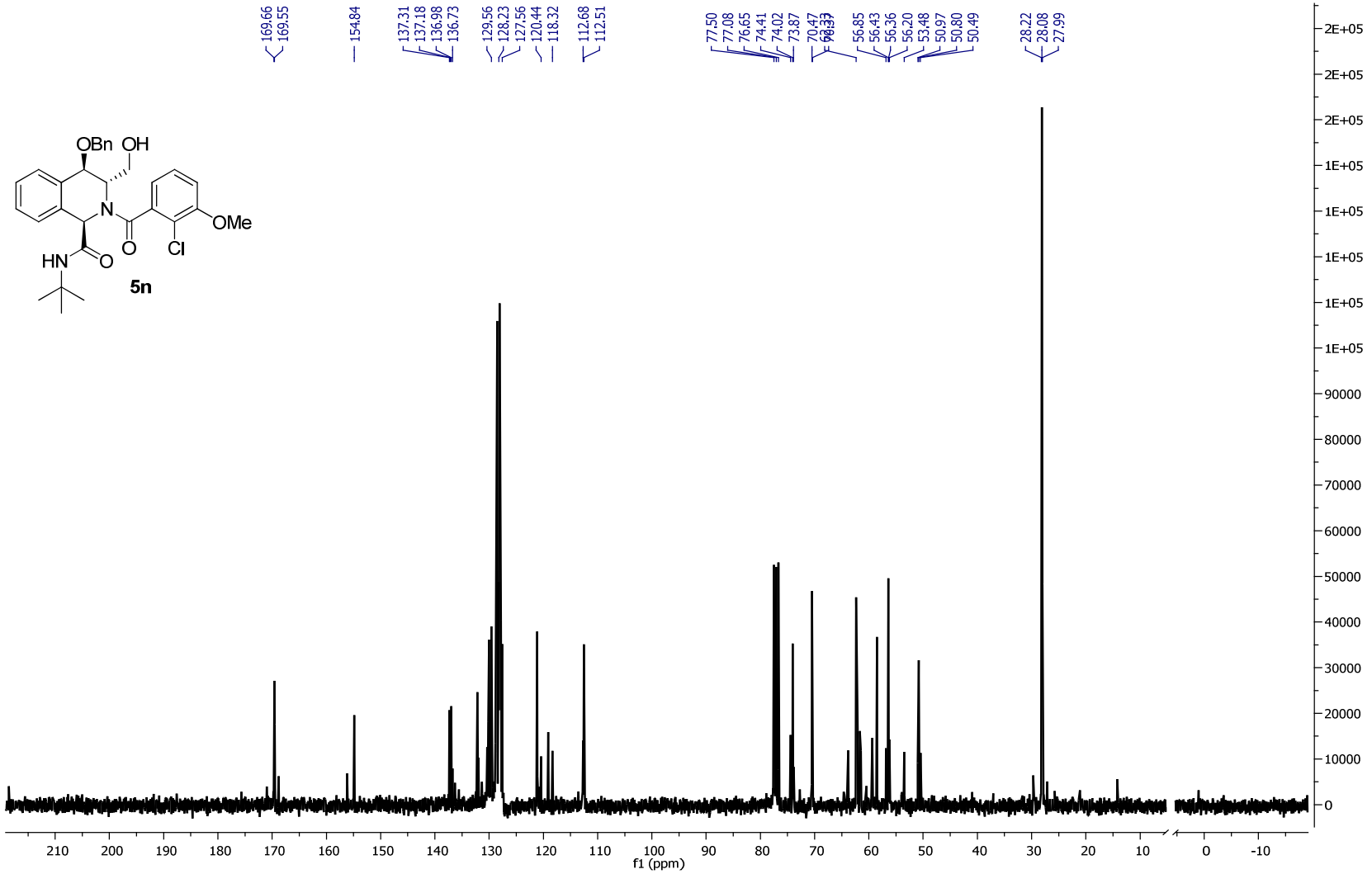


Figure 46: ^{1}H NMR of post aqueous workup sample (crude sample) of compound **5o :**

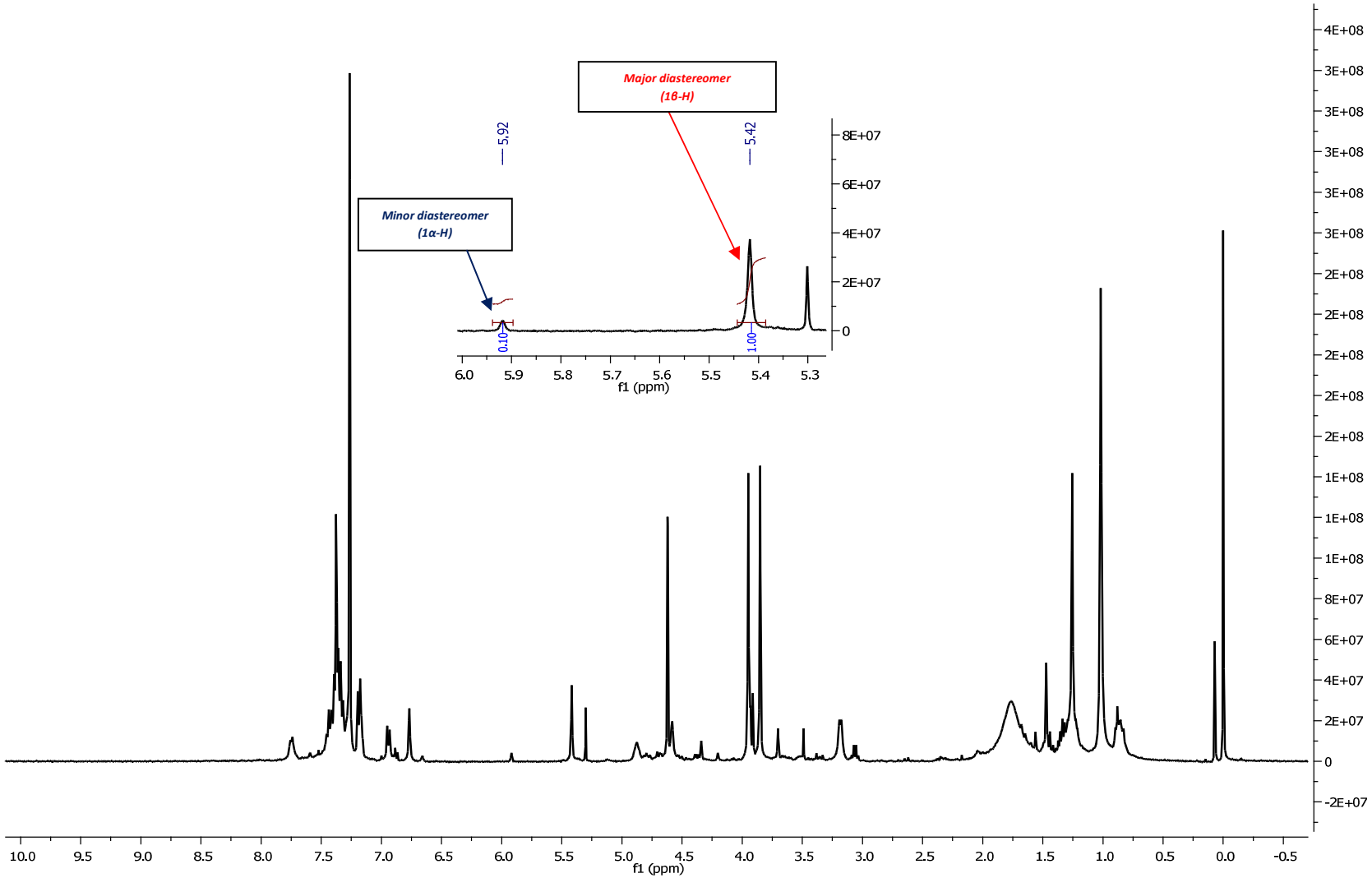


Figure 47:[1]H NMR Spectrum of compound **5o**:

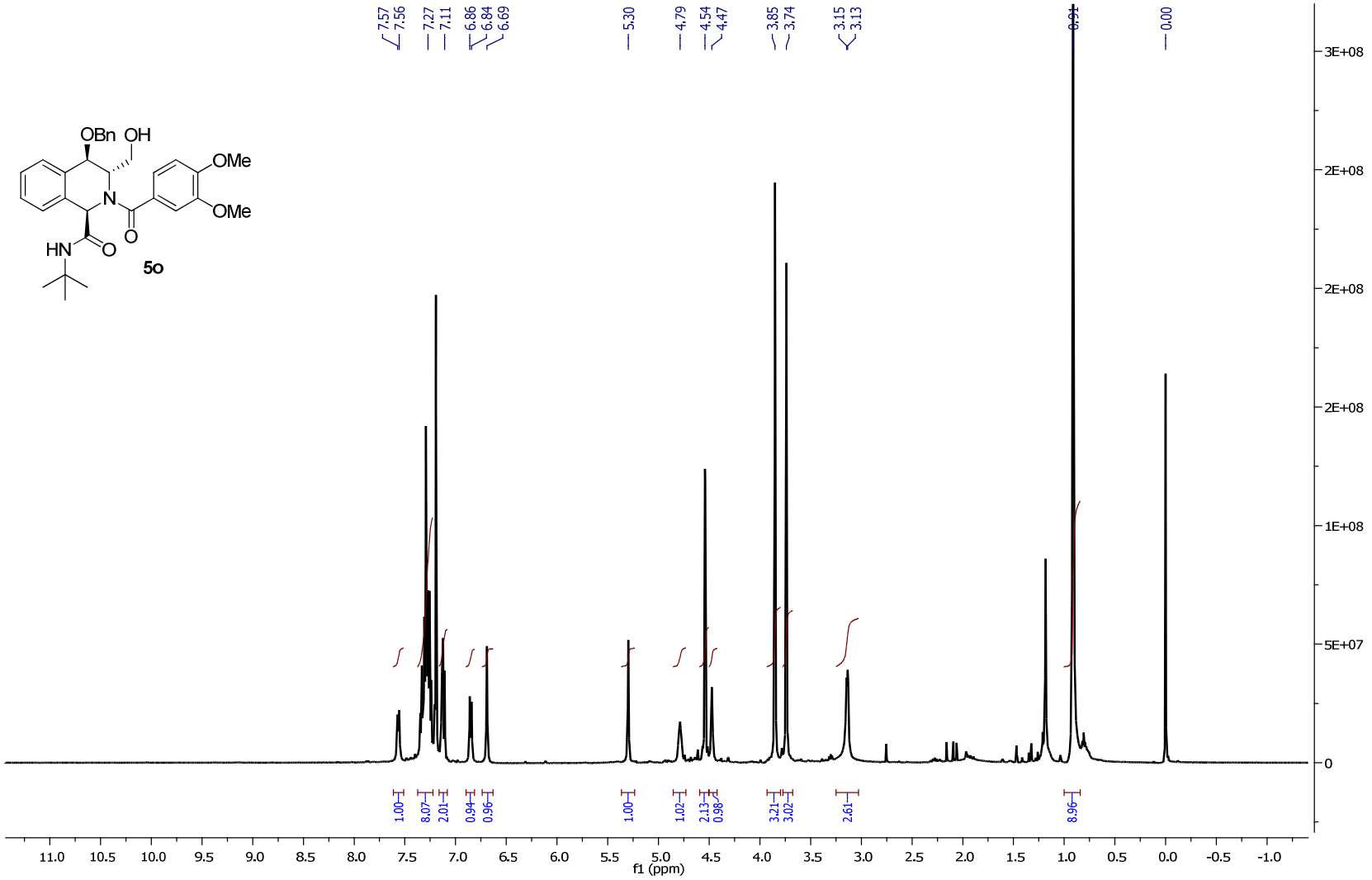


Figure 48: ^{13}C NMR Spectrum of compound **5o**:

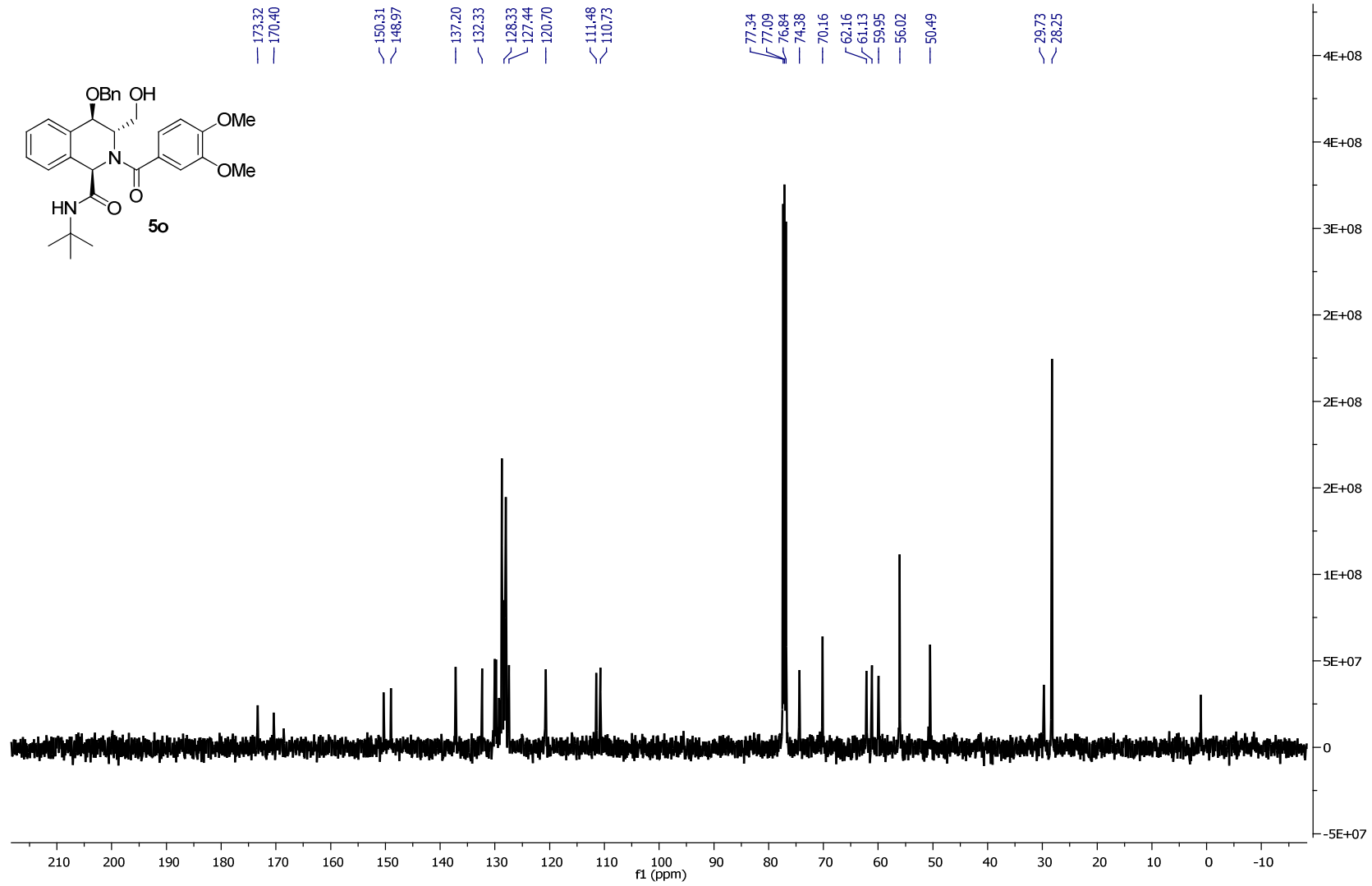


Figure 49: ^{1}H NMR of post aqueous workup sample (crude sample) of compound **5p:**

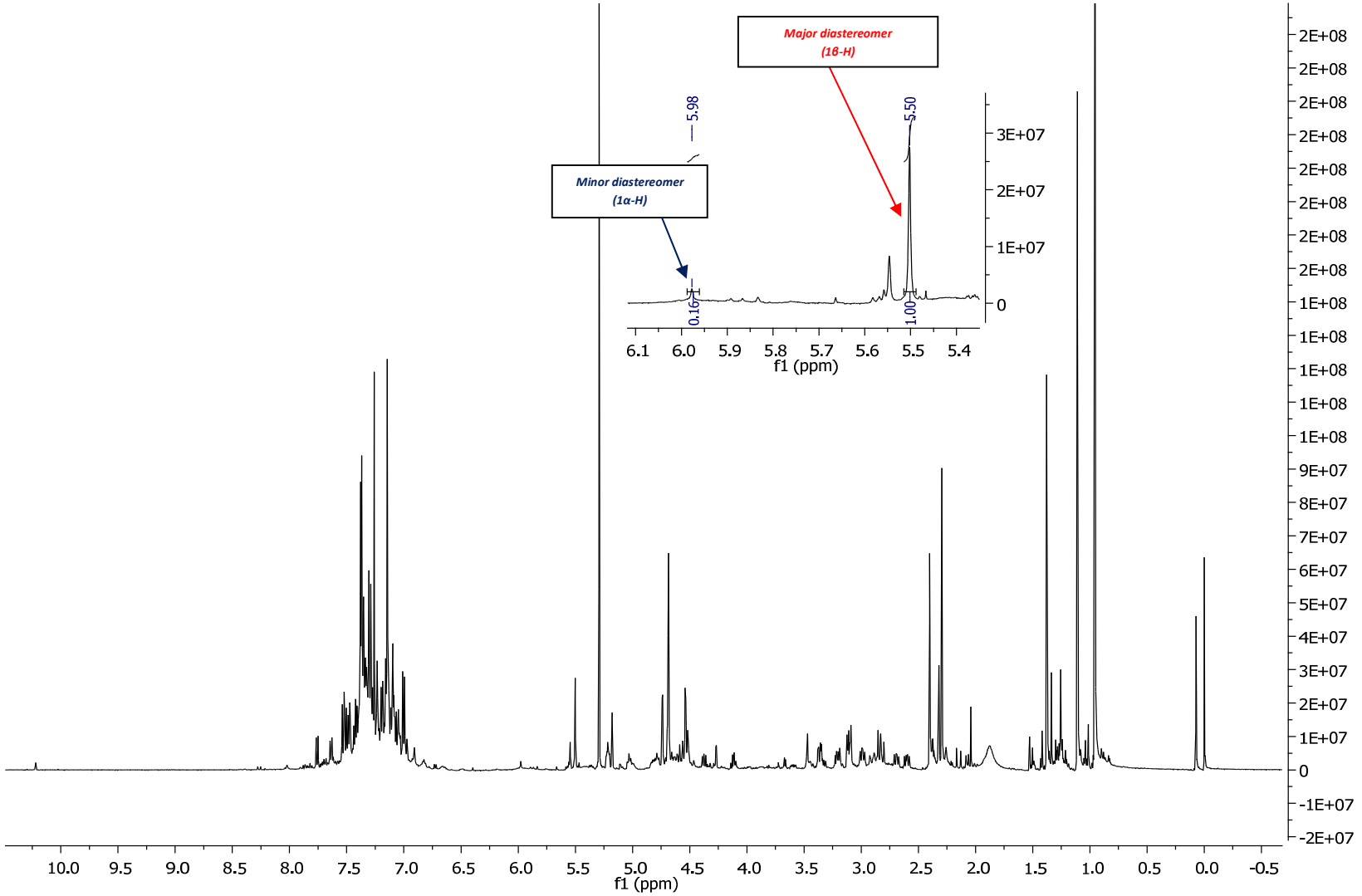


Figure 50:[1]H NMR Spectrum of compound **5p**:

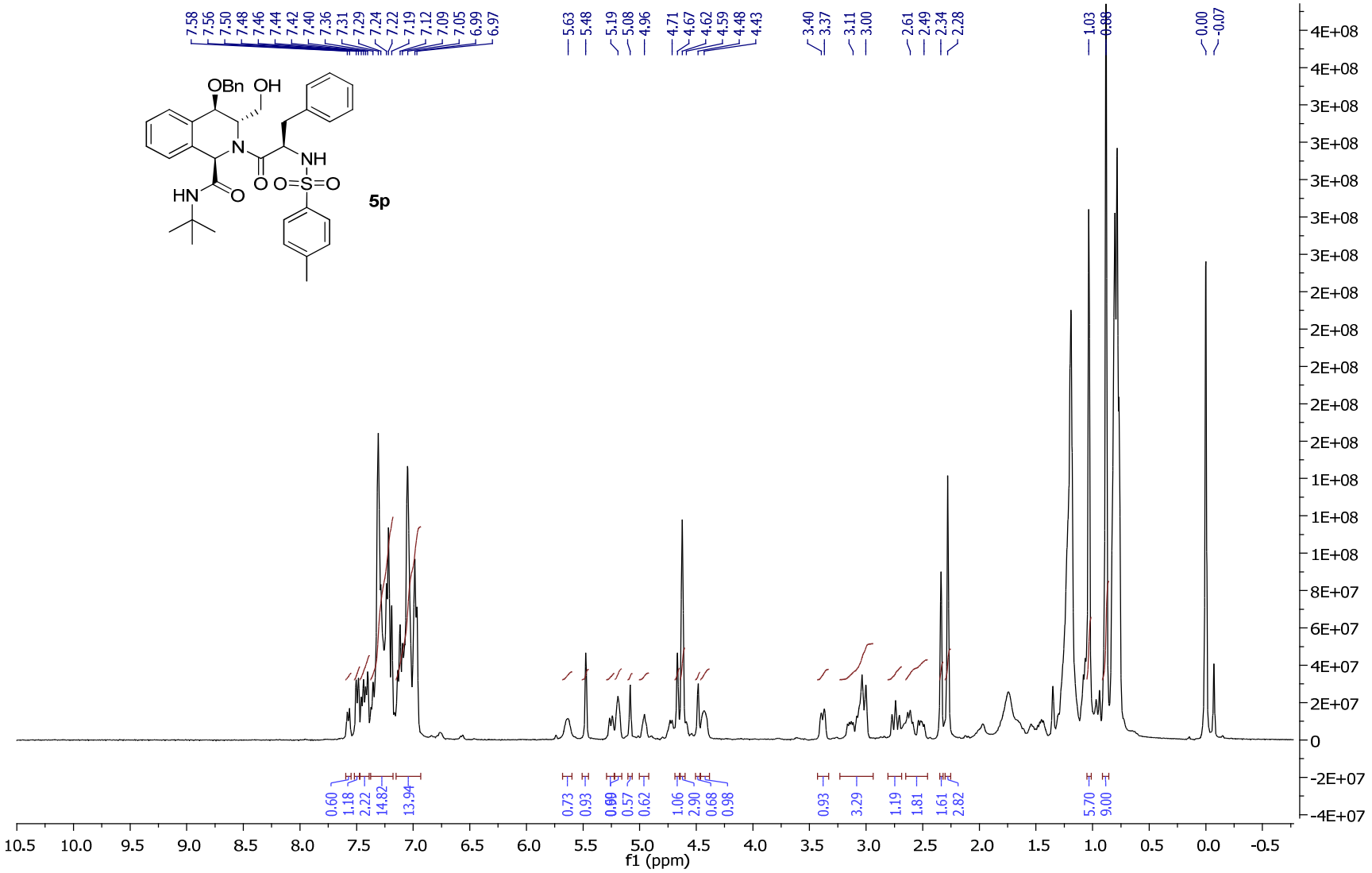


Figure 51:[13]C NMR Spectrum of compound **5p**:

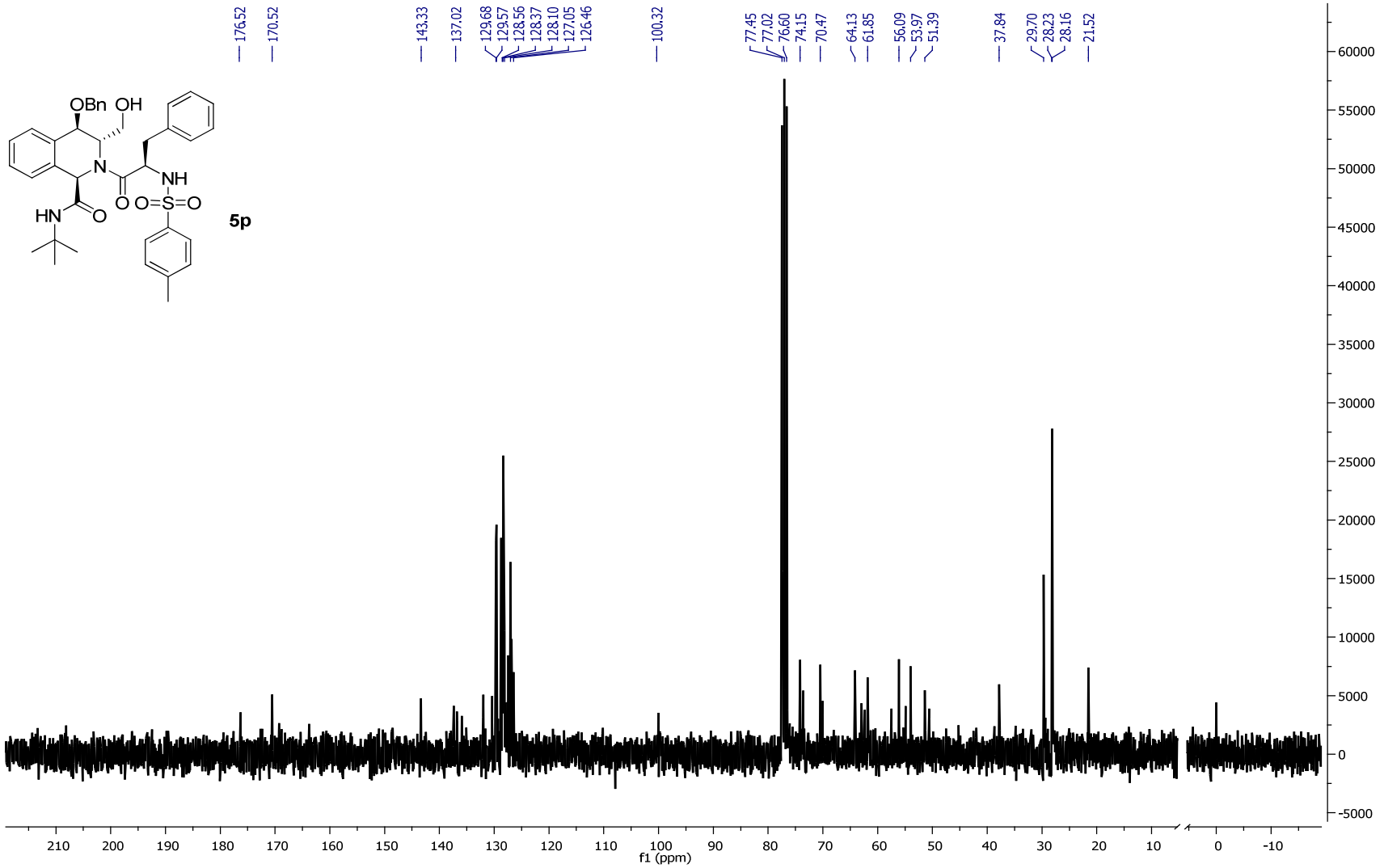


Figure 52:[1]H NMR of post aqueous workup sample (crude sample) of compound **5q :**

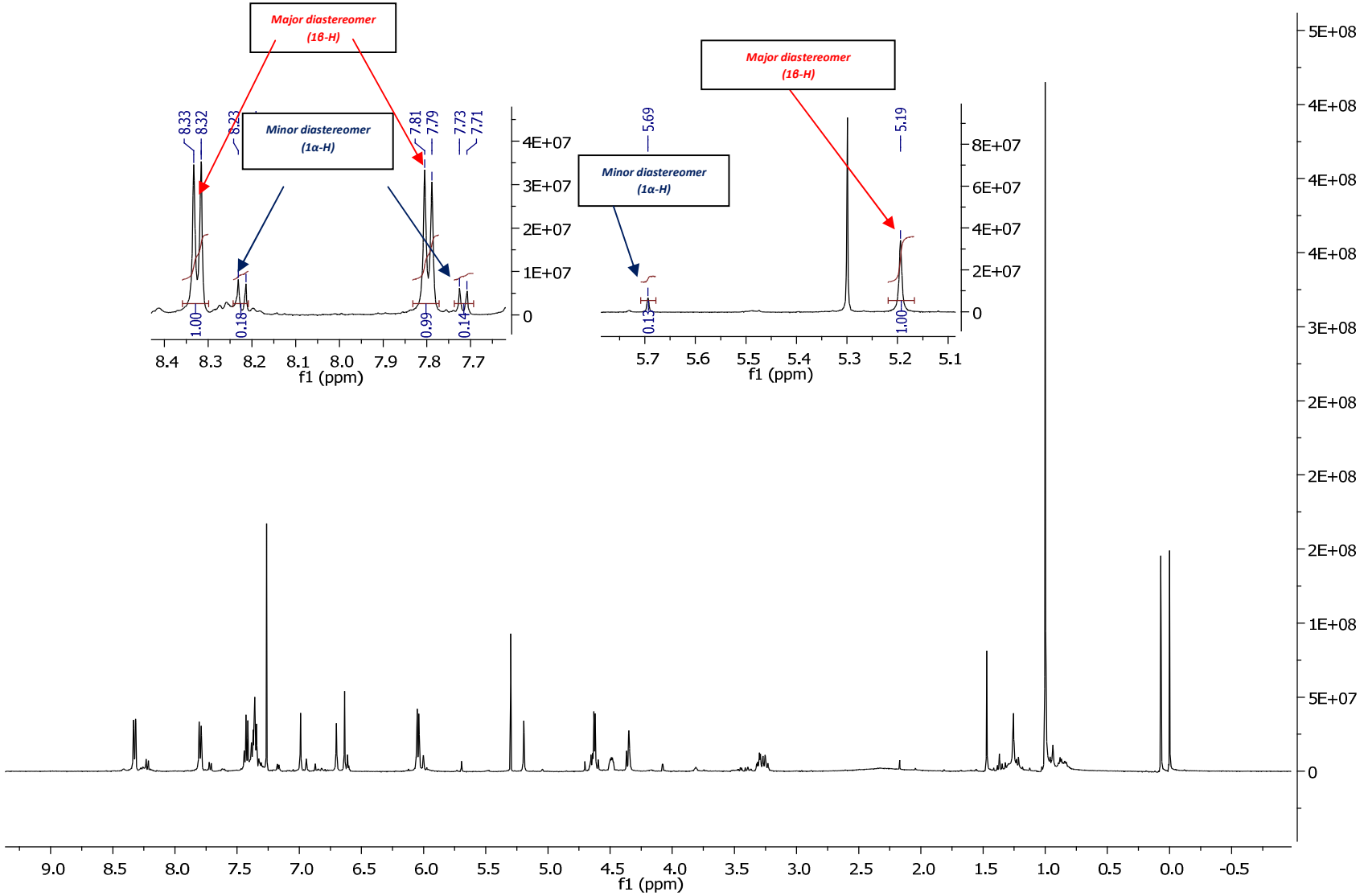


Figure 53: ^{1}H NMR Spectrum of compound **5q**:

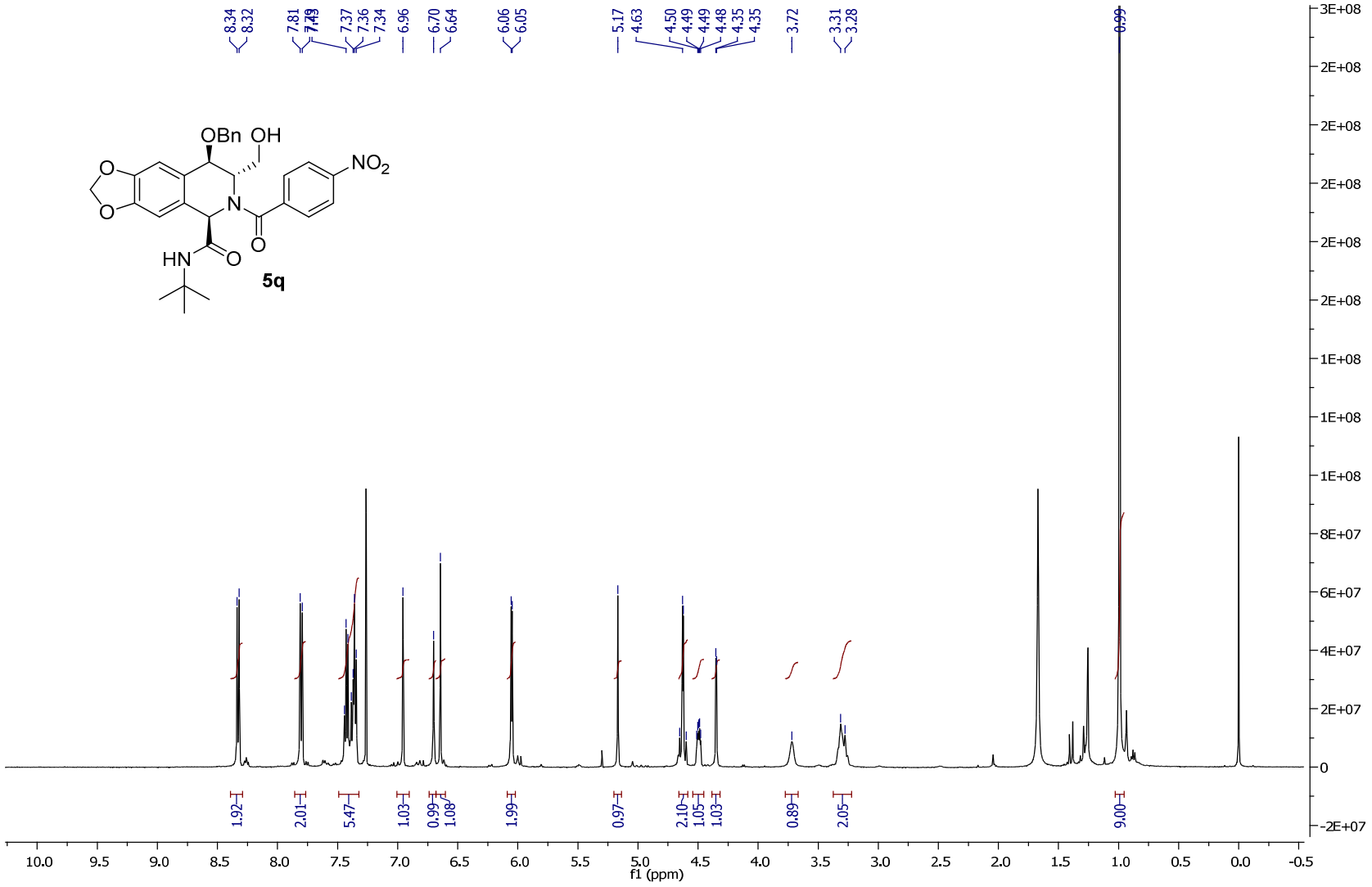


Figure 54: ^{13}C NMR Spectrum of compound **5q**:

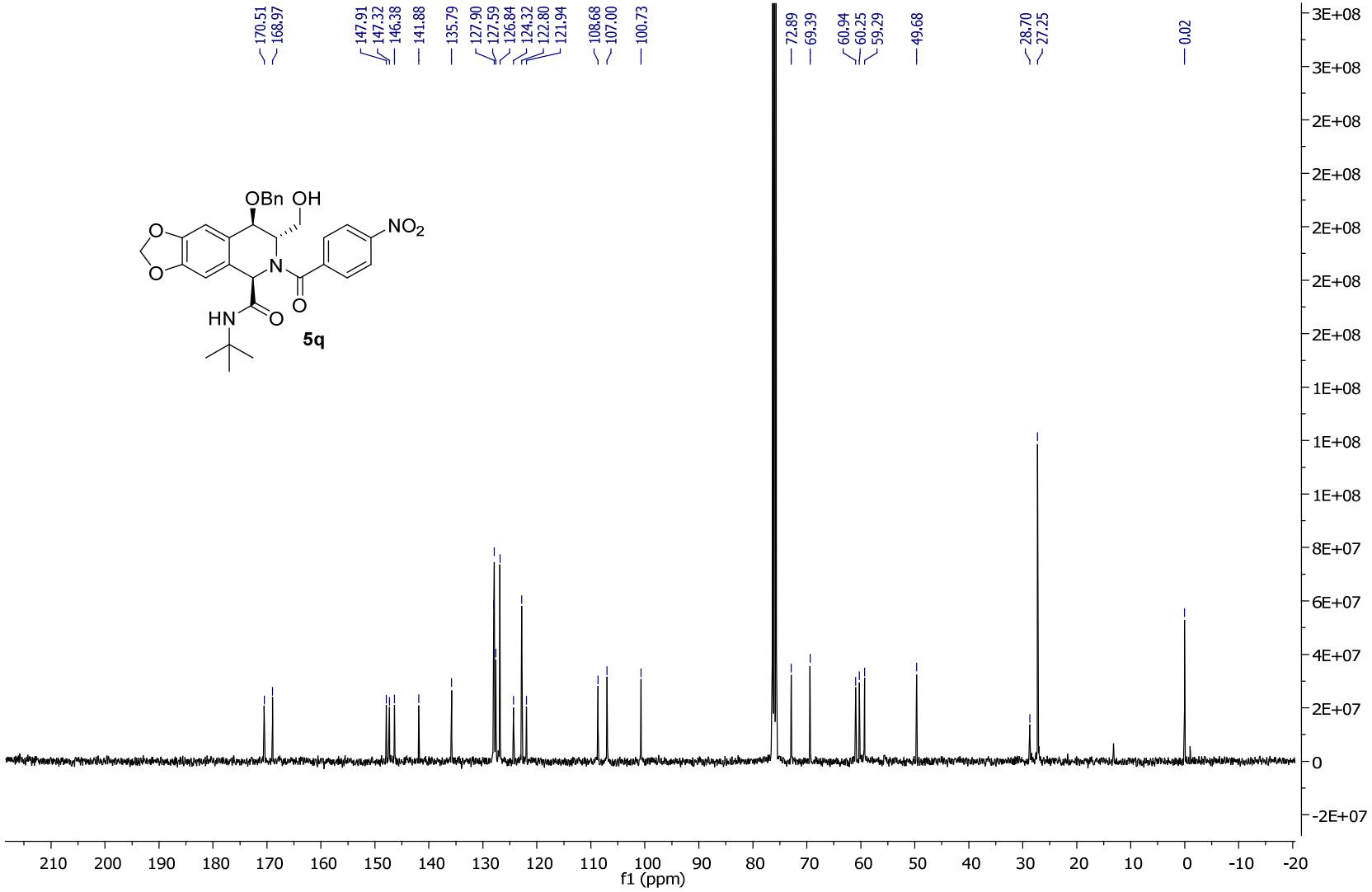


Figure 55: ^{1}H NMR of post aqueous workup sample (crude sample) of compound **5r:**

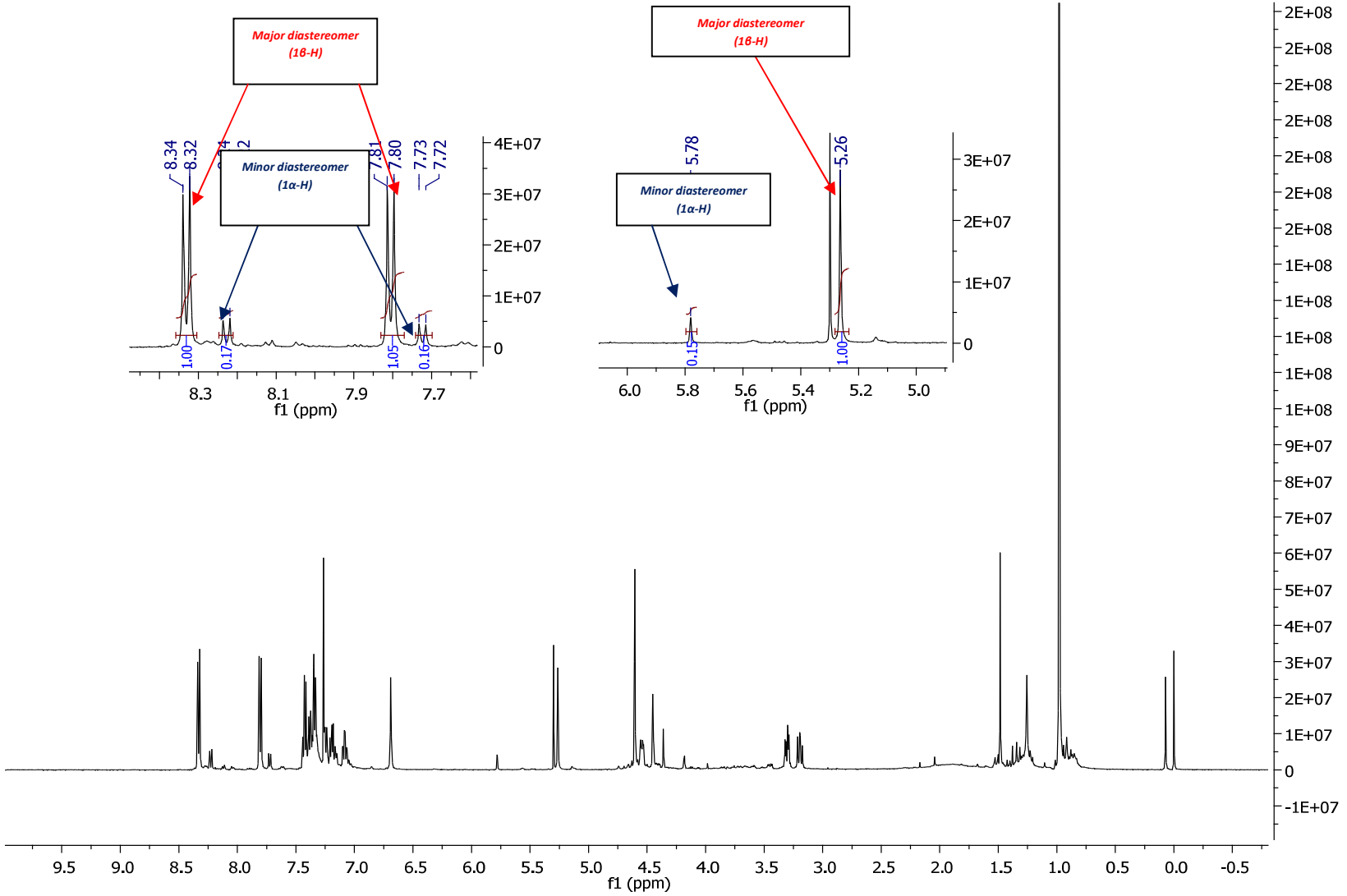


Figure 56: ^{1}H NMR Spectrum of compound **5r**:

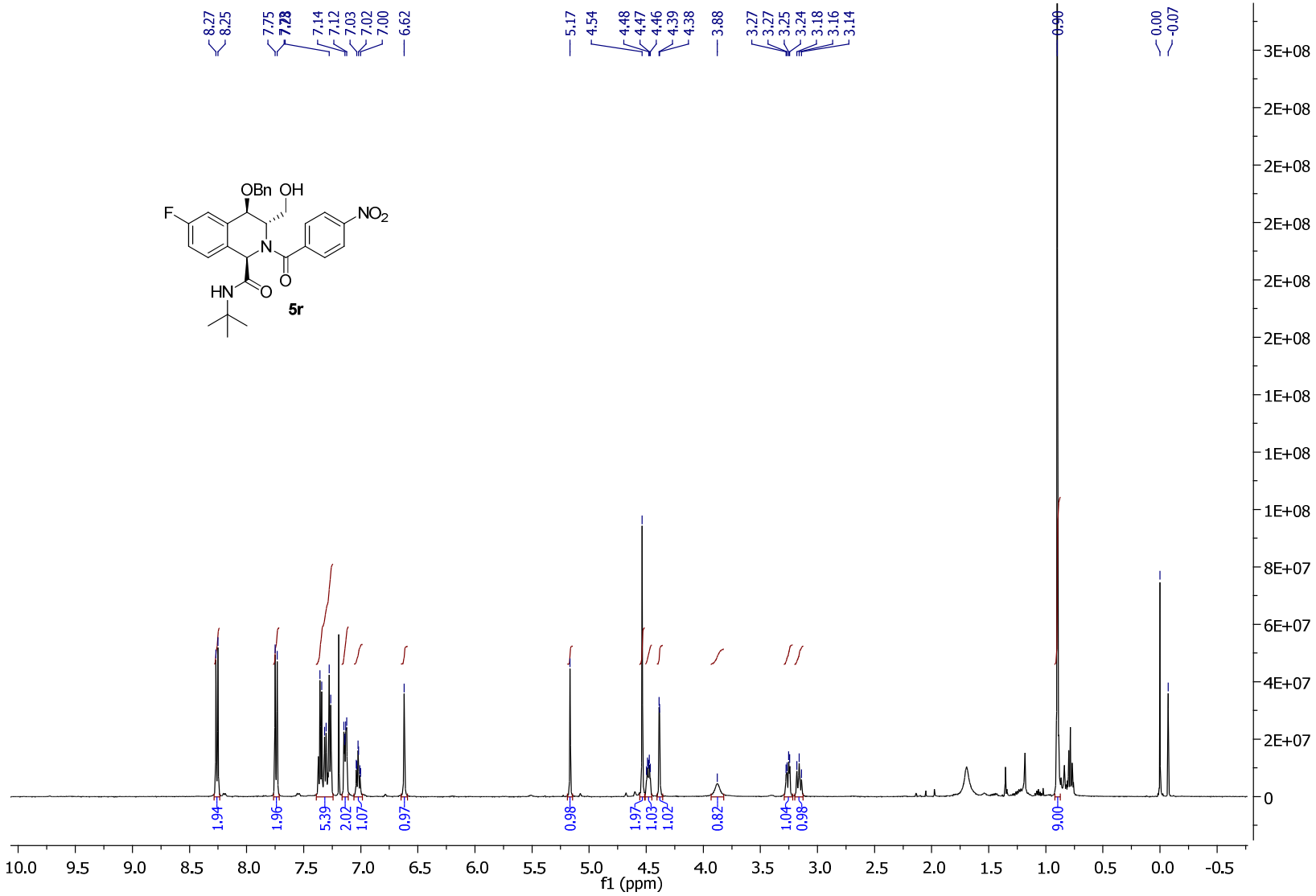


Figure 57: ^{13}C NMR Spectrum of compound **5r**:

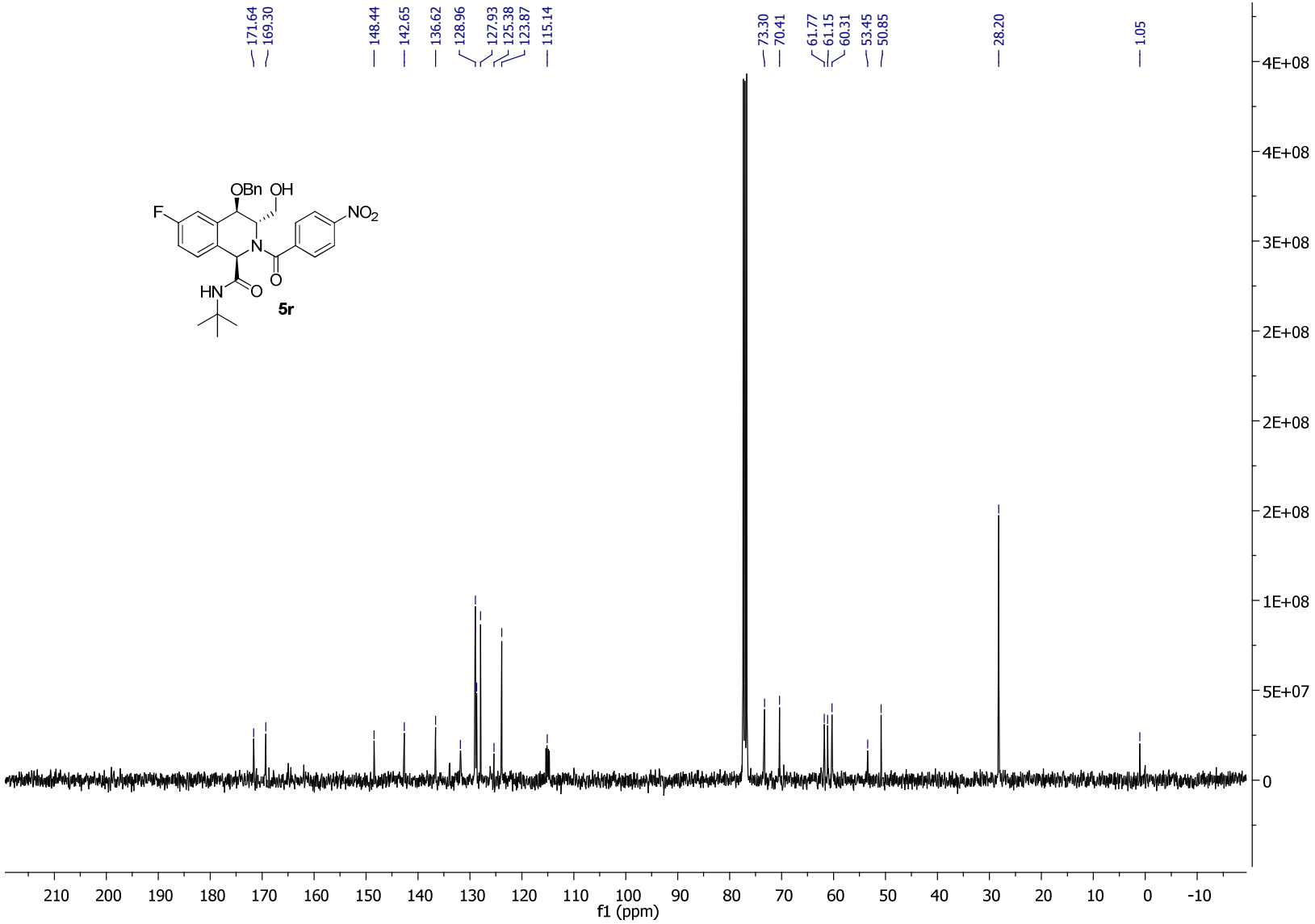


Figure 58: ^{1}H NMR Spectrum of compound **8**:

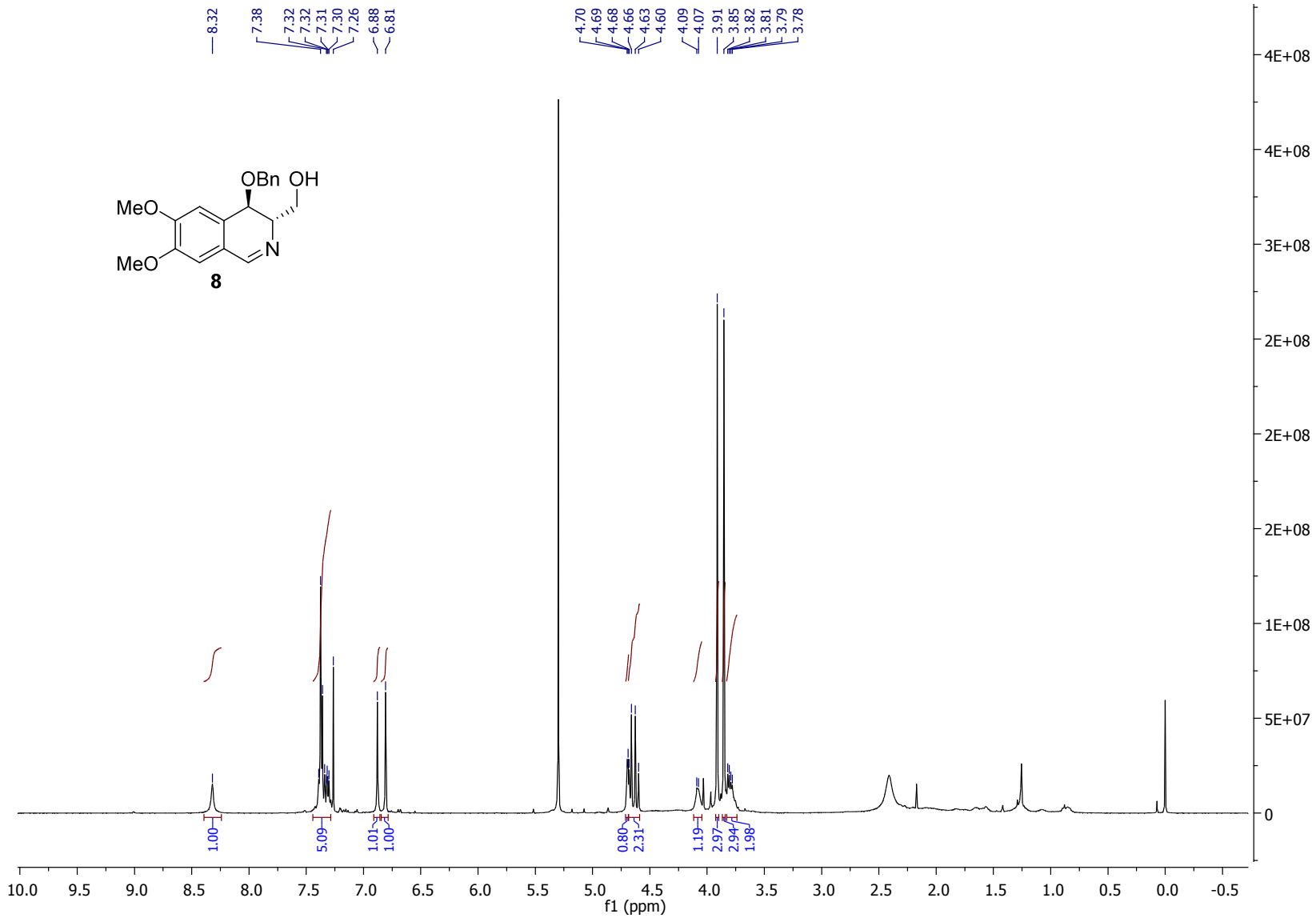


Figure 59: ^{13}C NMR Spectrum of compound **8**:

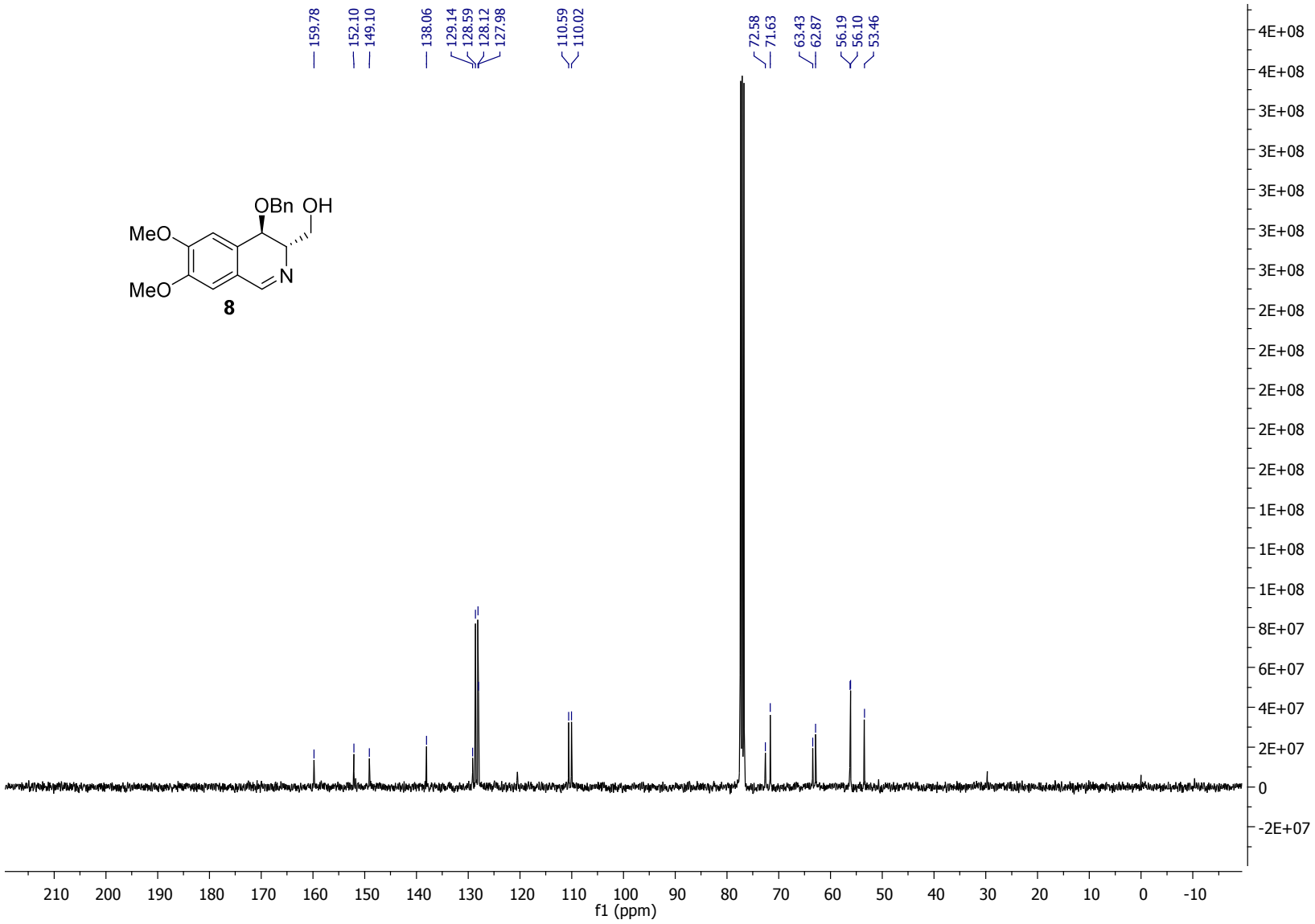


Figure 60:[1]H NMR of post aqueous workup sample (crude sample) of compound **5s :**

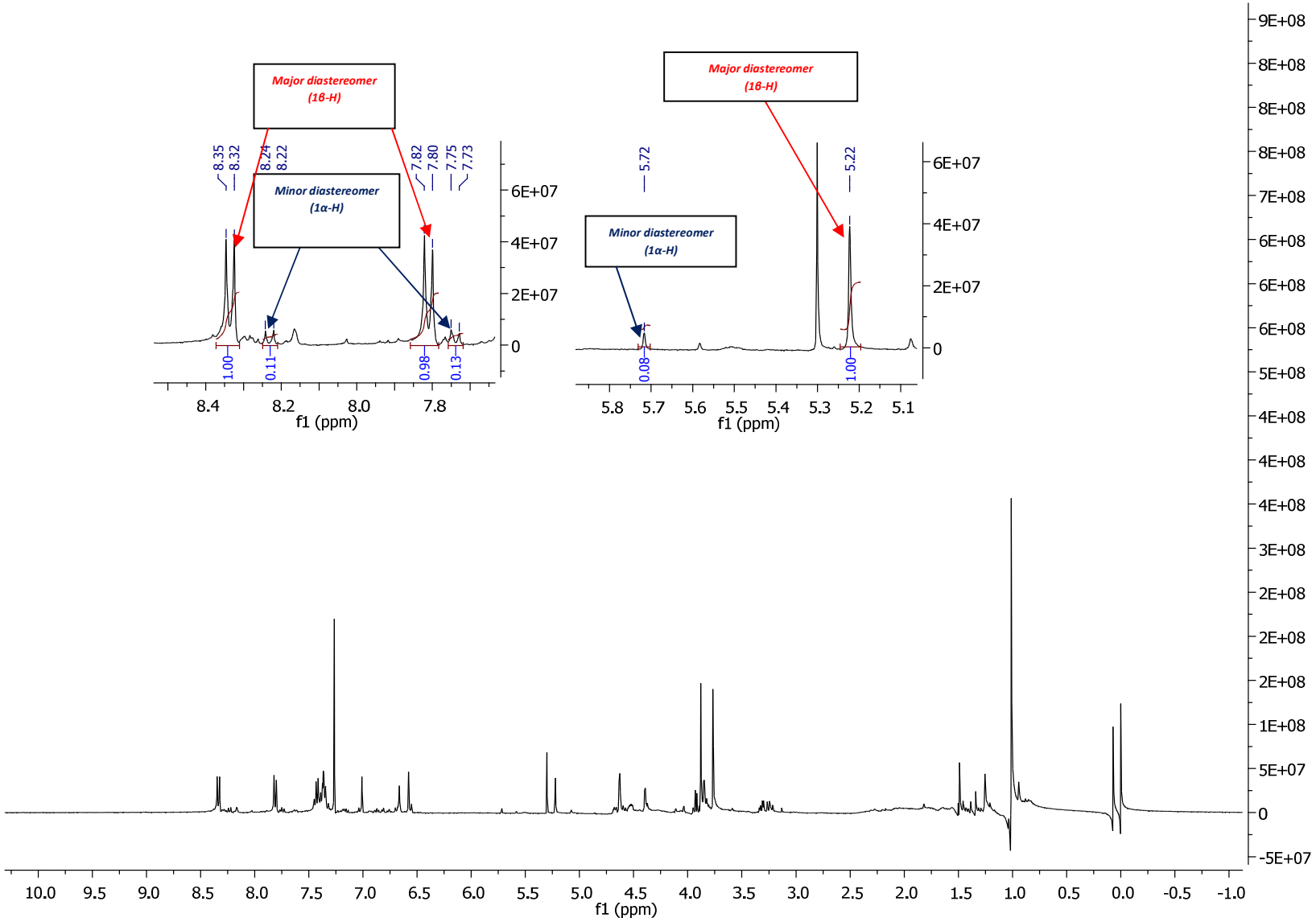


Figure 61: ^{1}H NMR Spectrum of compound **5s**:

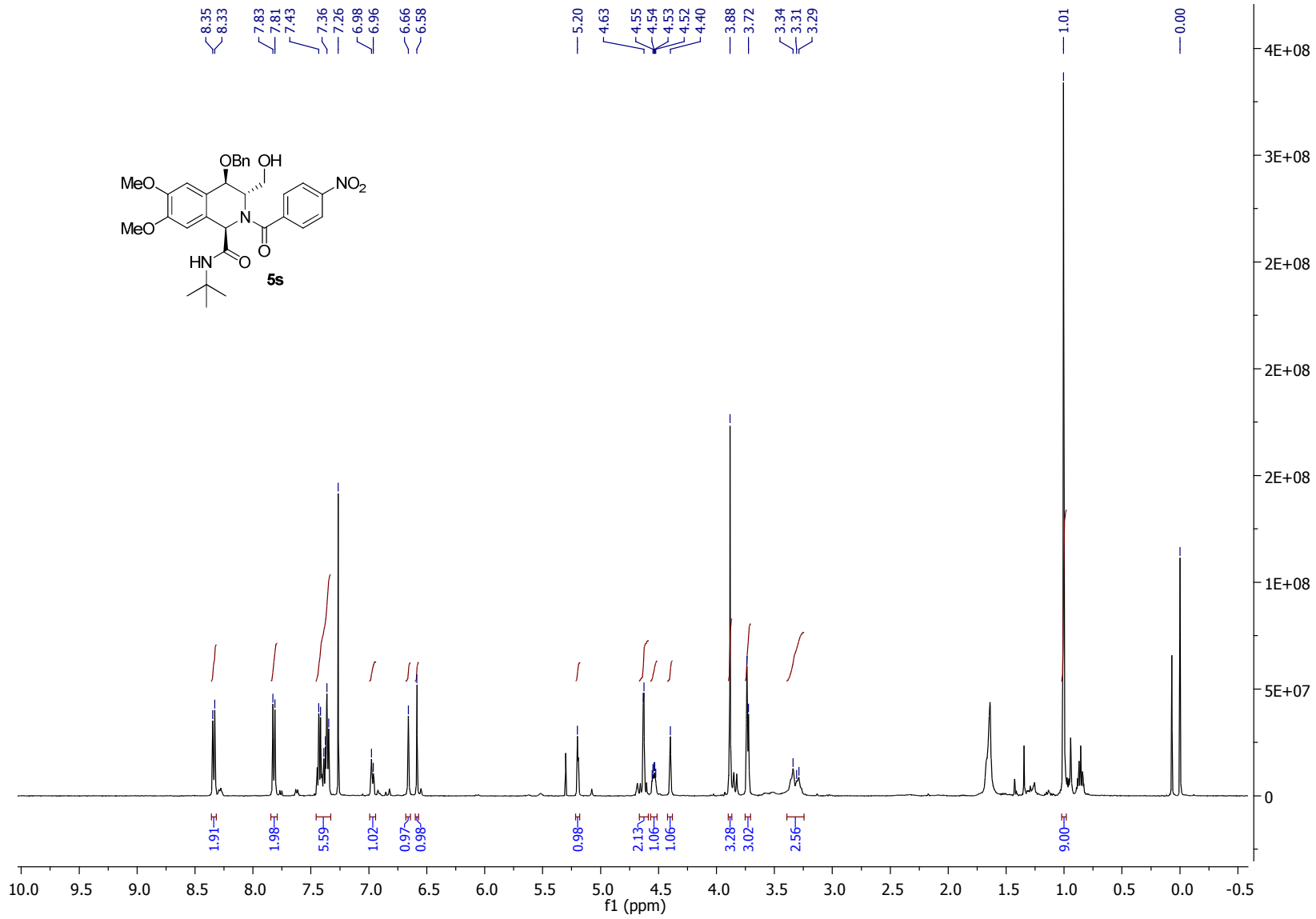


Figure 62: ^{13}C NMR Spectrum of compound **5s**:

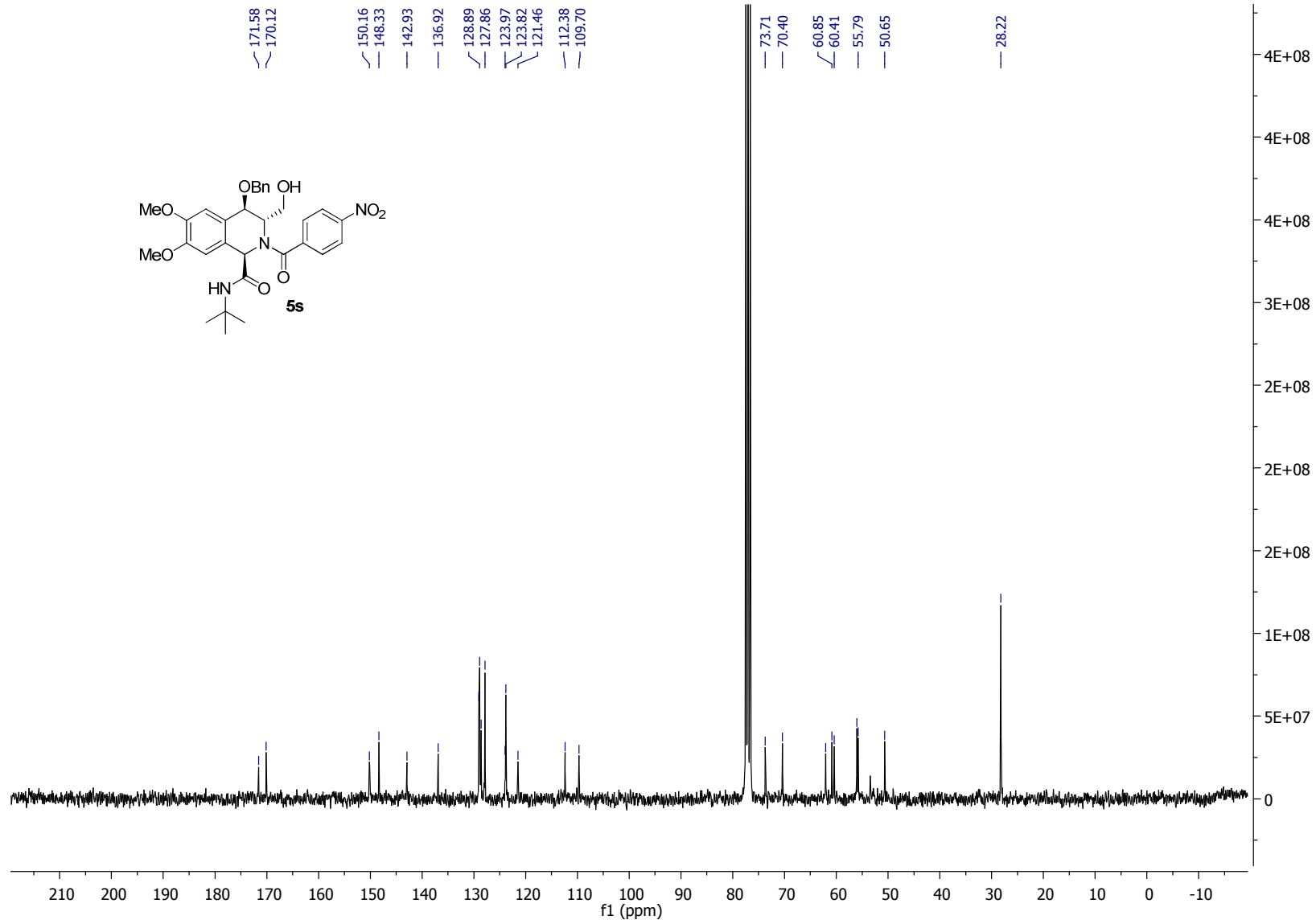


Figure 63:[1]H NMR Spectrum of compound **10**:

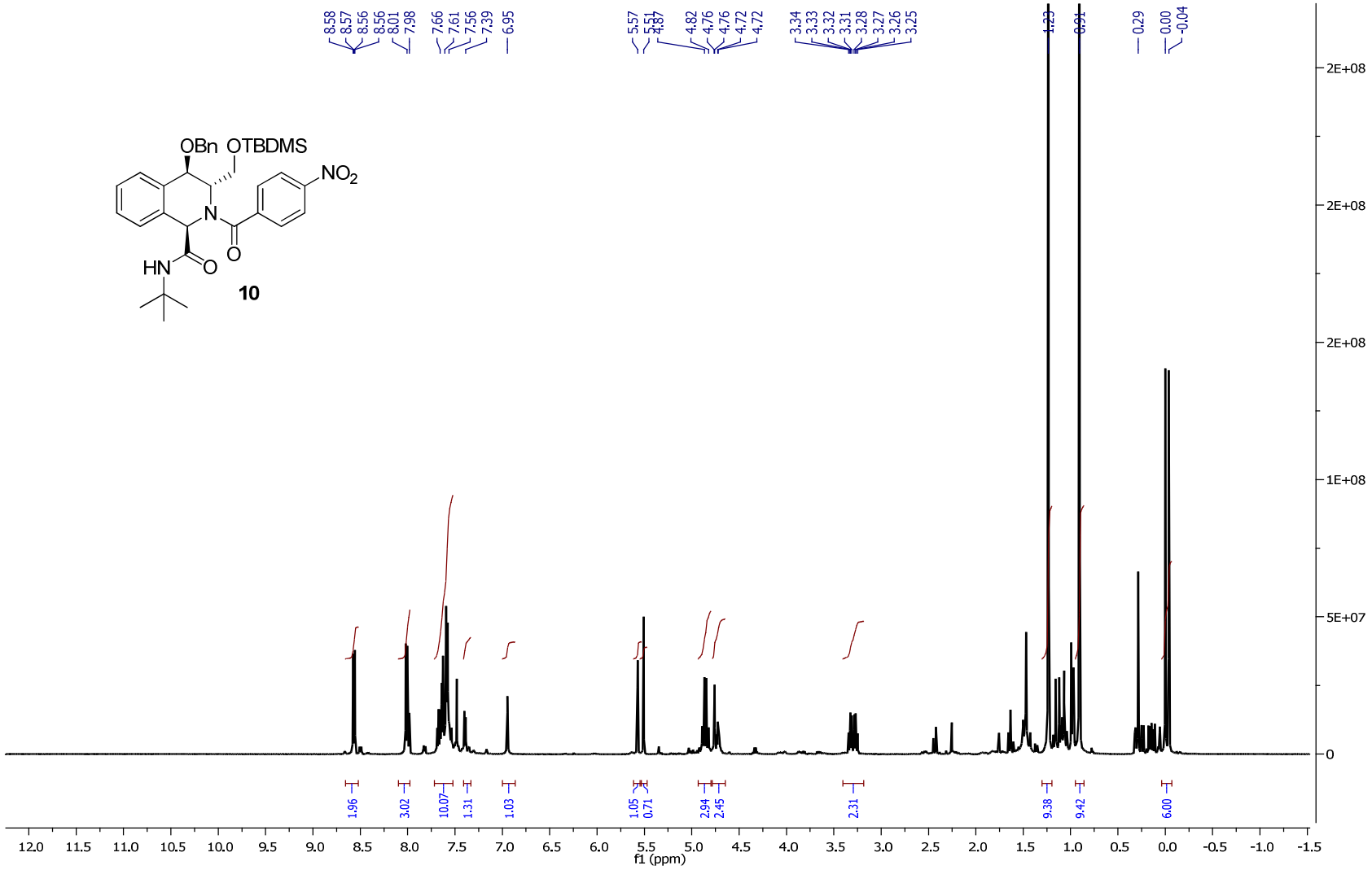


Figure 64: ^{13}C NMR Spectrum of compound **10**:

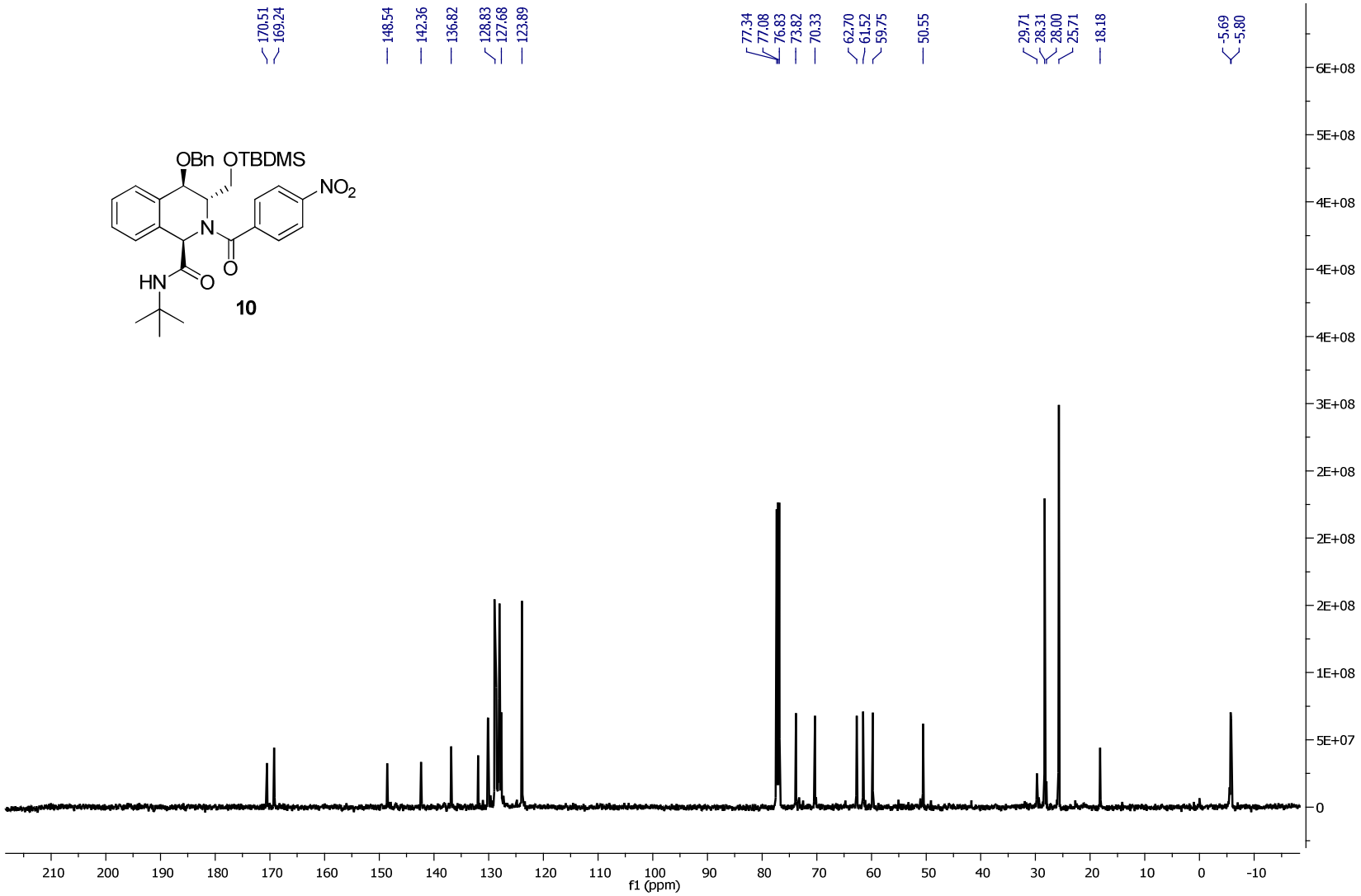


Figure 65:DQFCOSEY Spectrum of compound **10**:

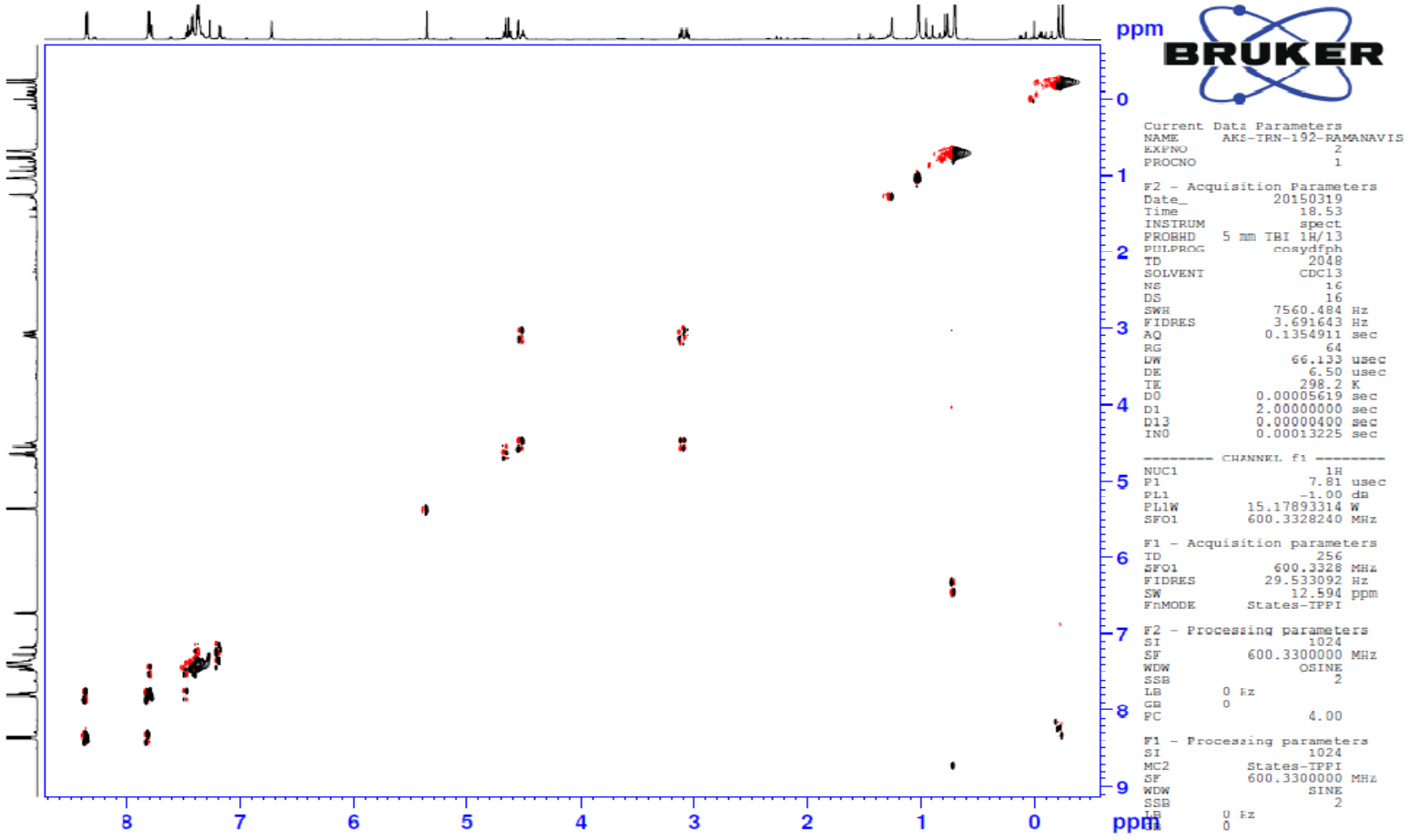


Figure 66: NOESY Spectrum of compound **10**:

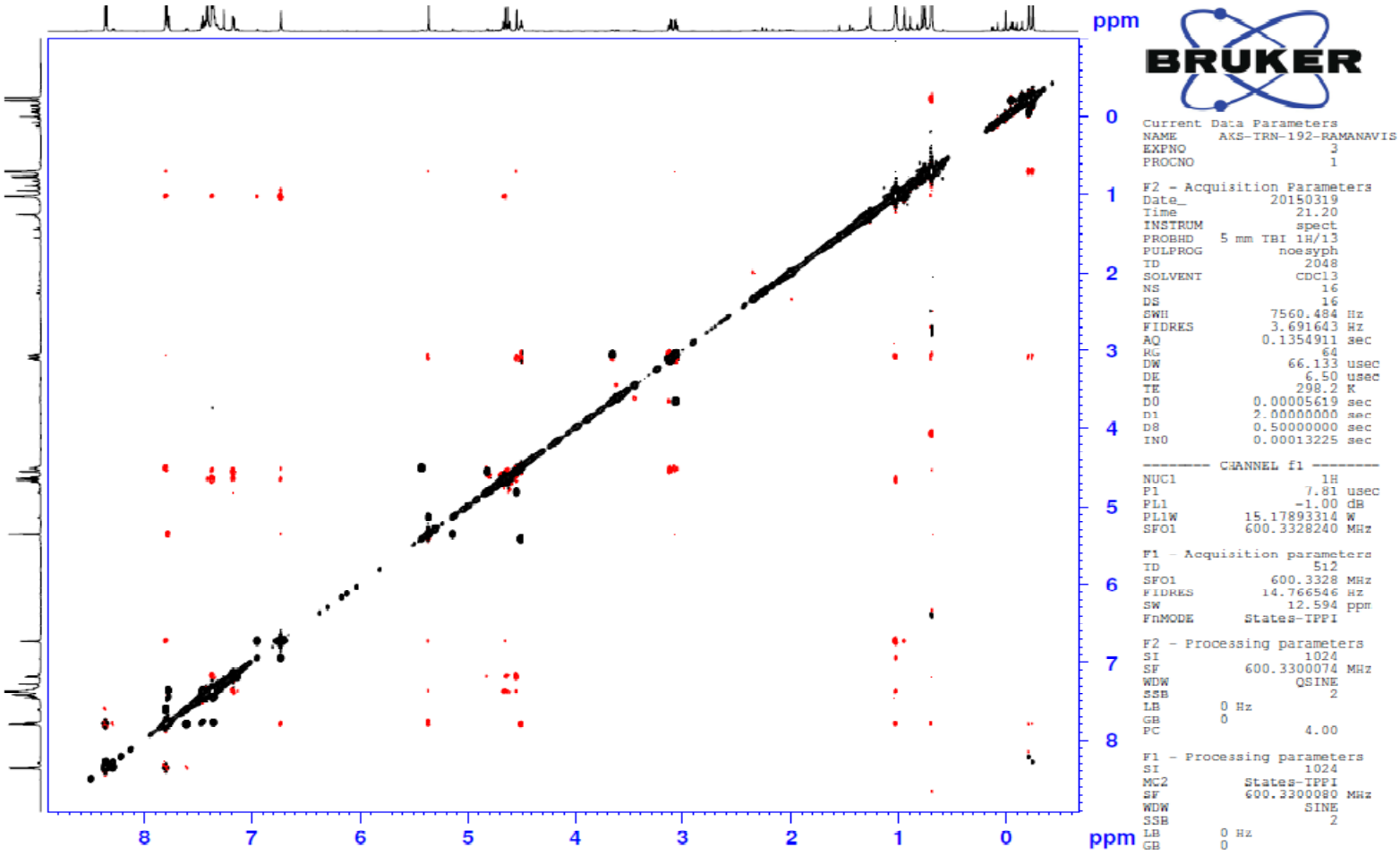


Figure 67: ^{1}H NMR of post aqueous workup sample (crude sample) of compound **14 :**

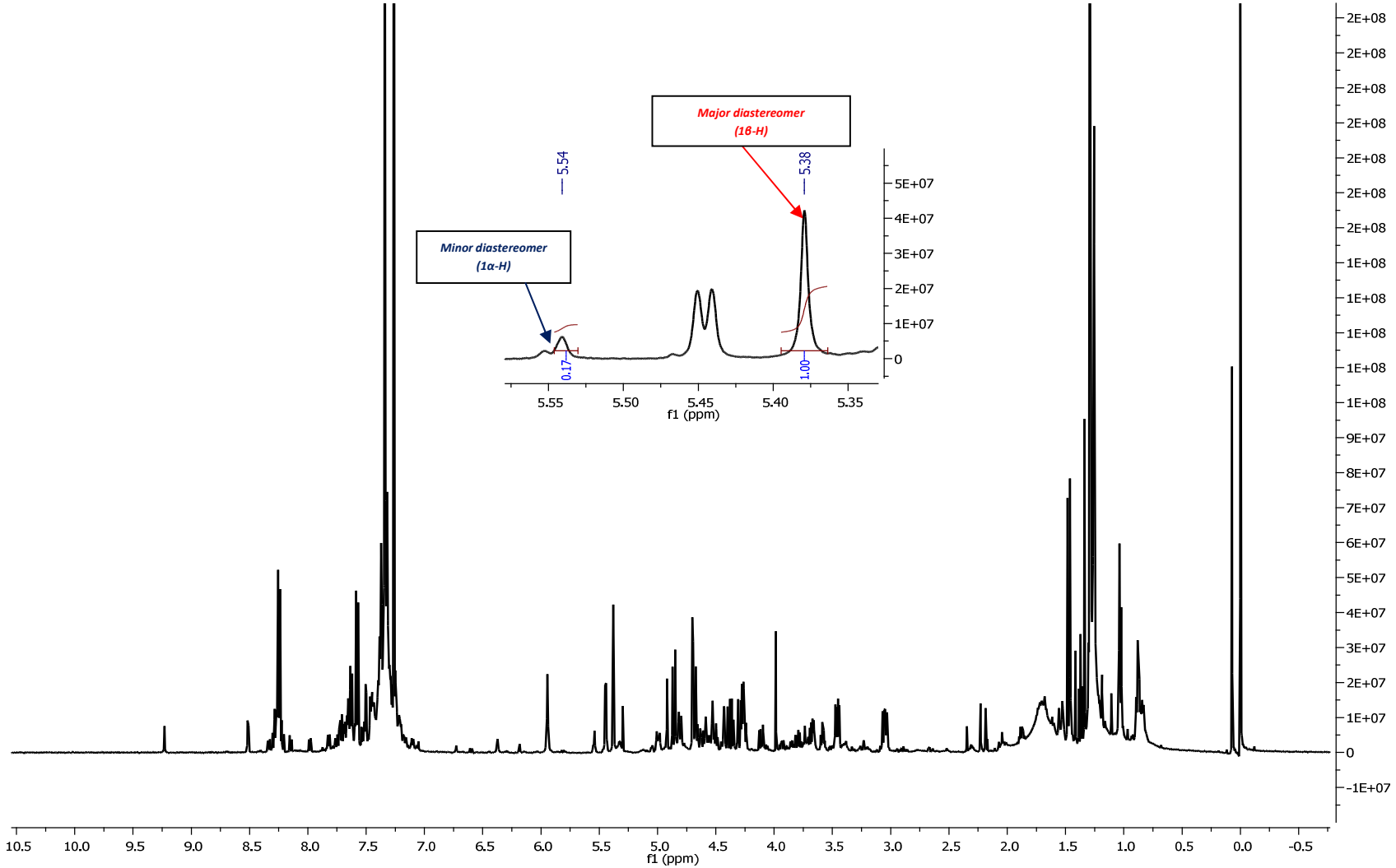


Figure 68: ^{1}H NMR Spectrum of compound **14**:

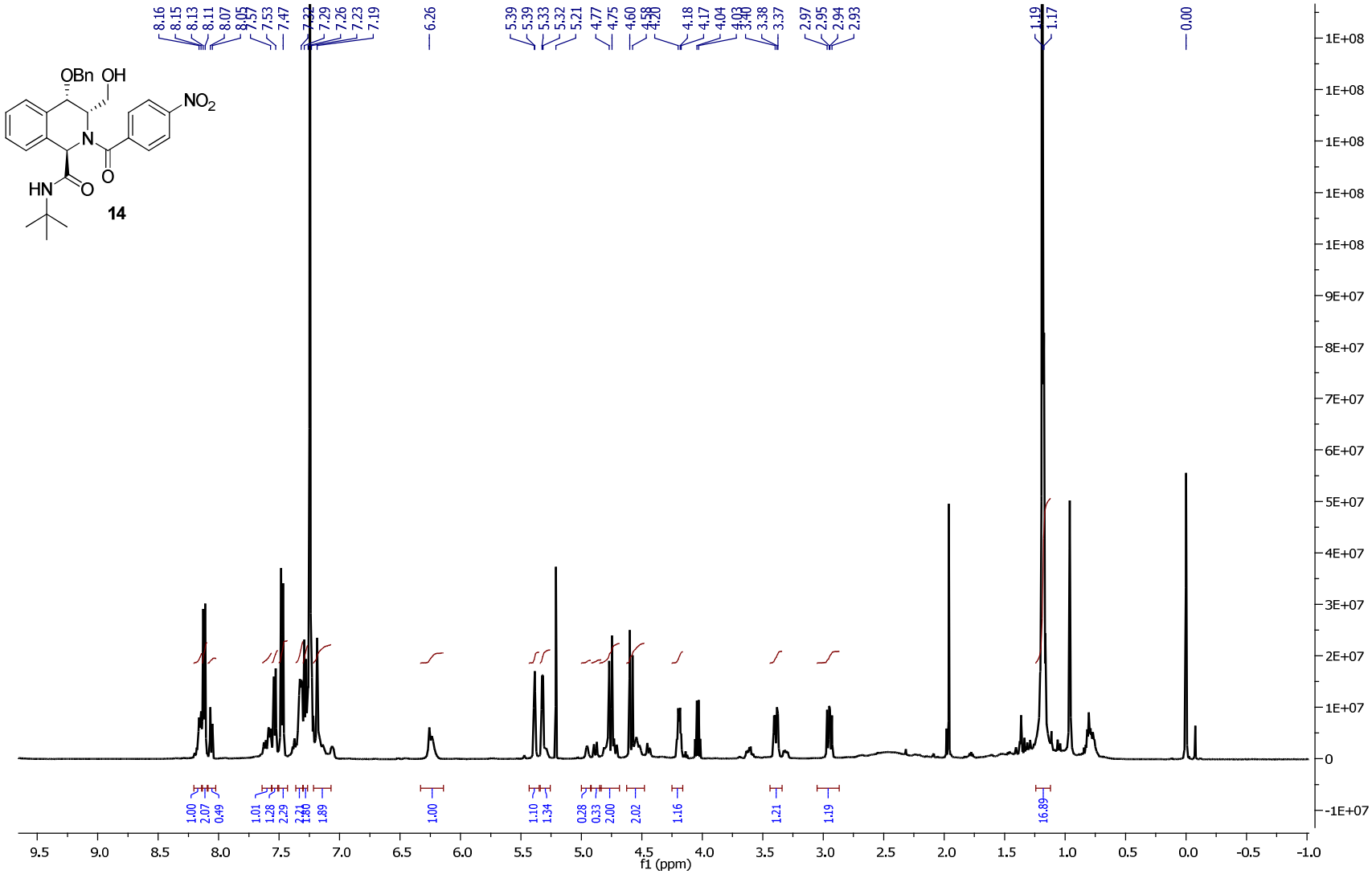


Figure 69: ^{13}C NMR Spectrum of compound **14**:

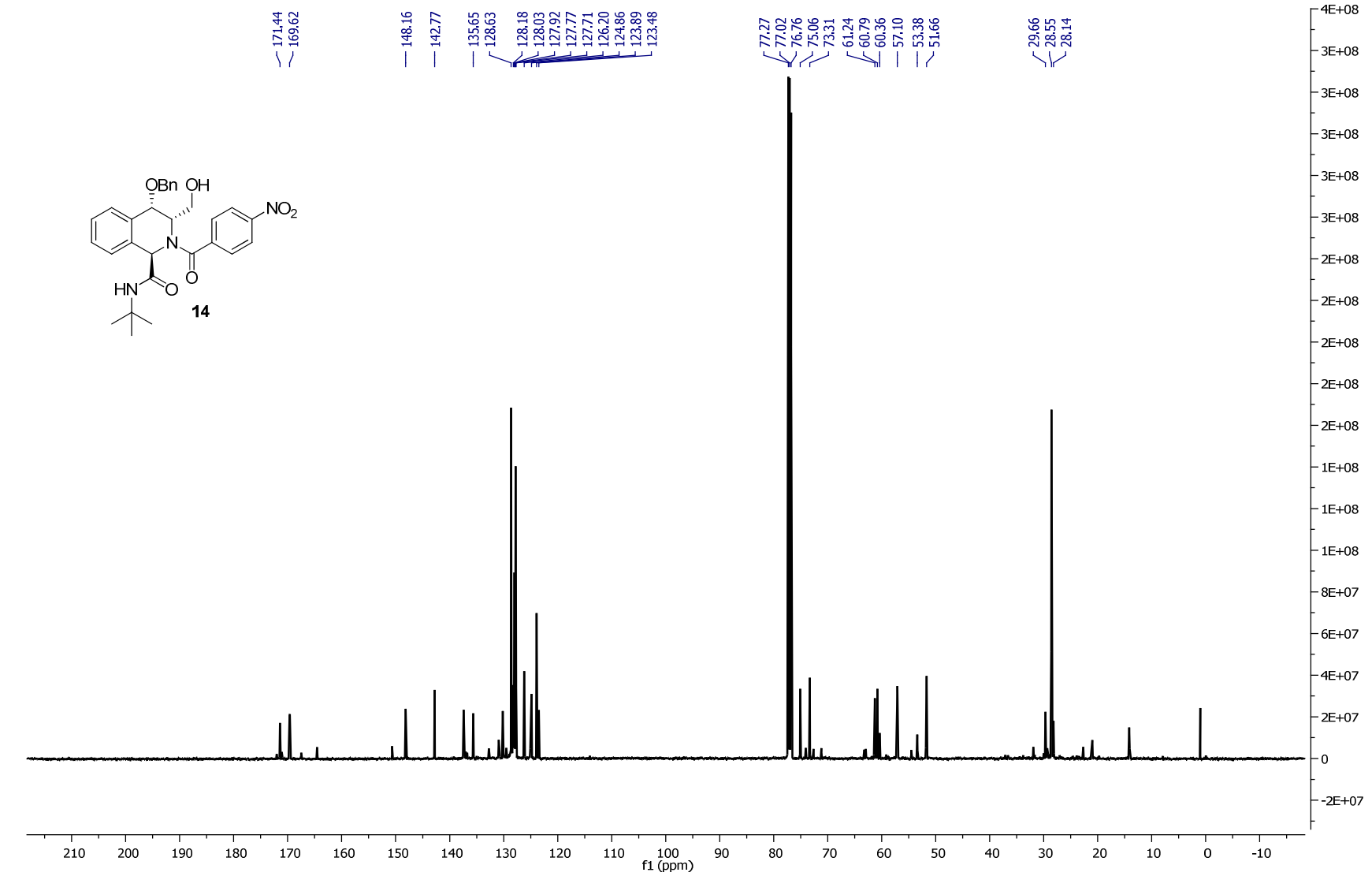


Figure 70: DQFCOSEY Spectrum of compound **14**:

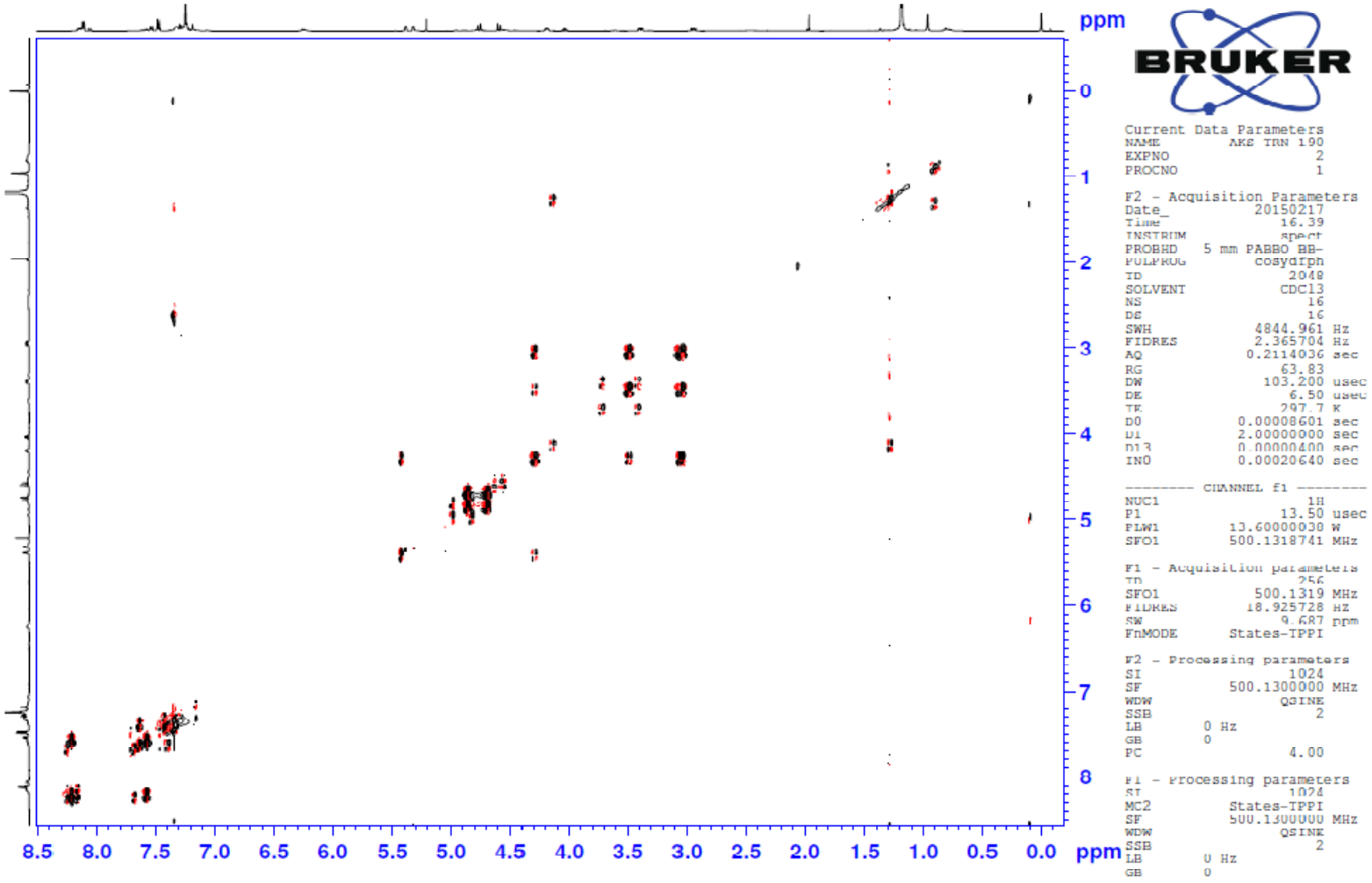


Figure 71: NOESY Spectrum of compound **14**:

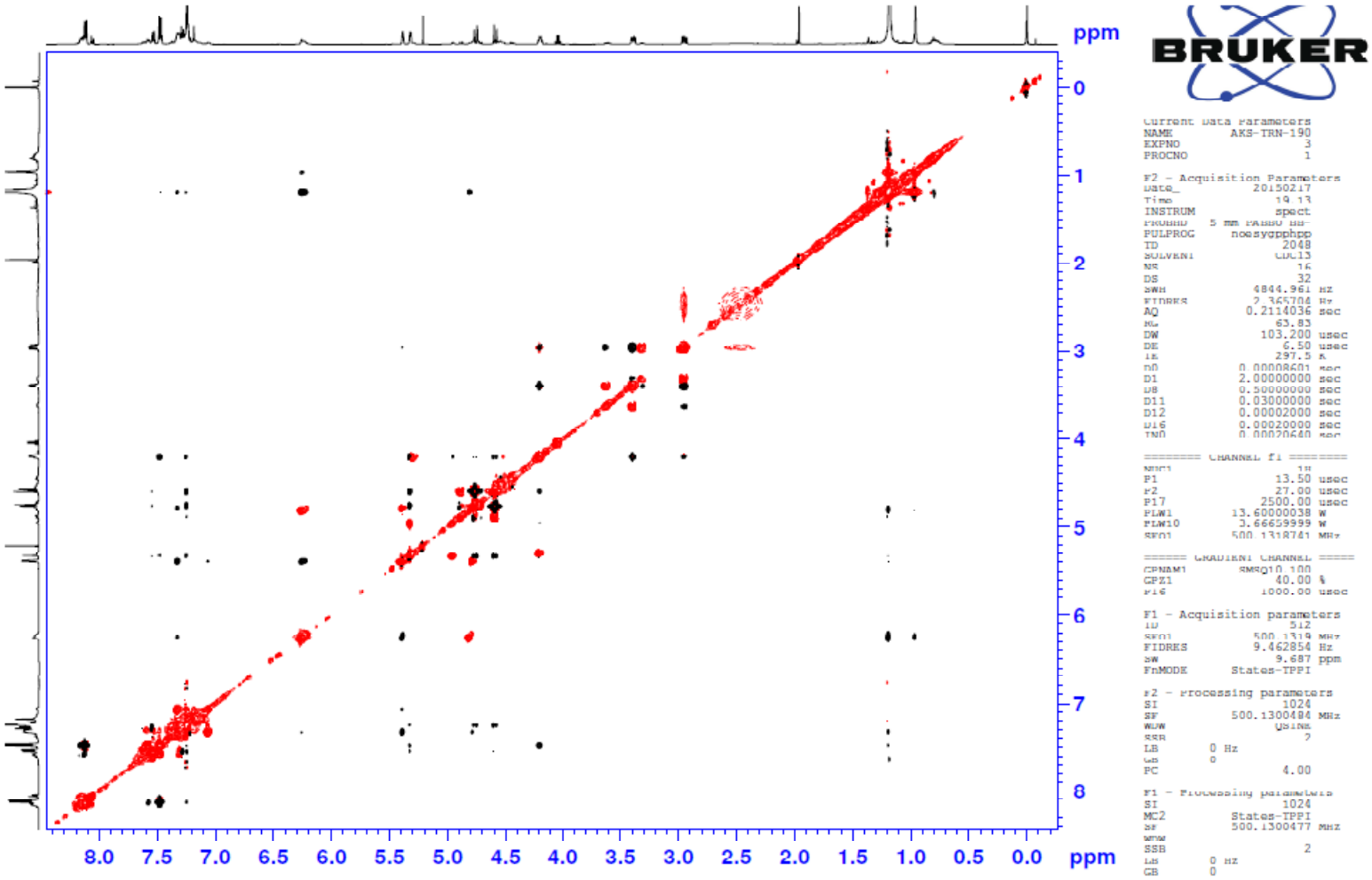


Figure 72: ^{1}H NMR Spectrum of compound **15**:

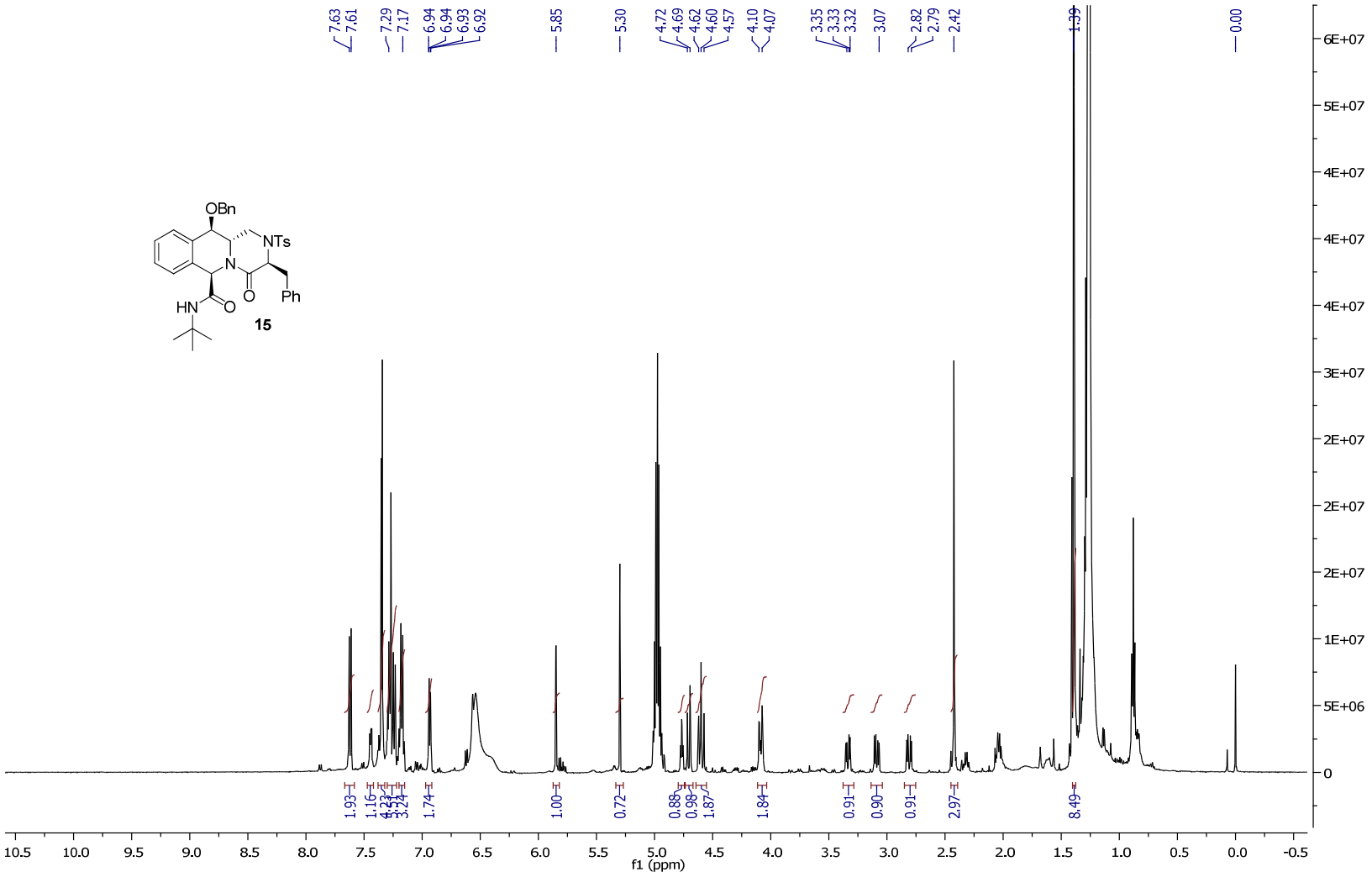
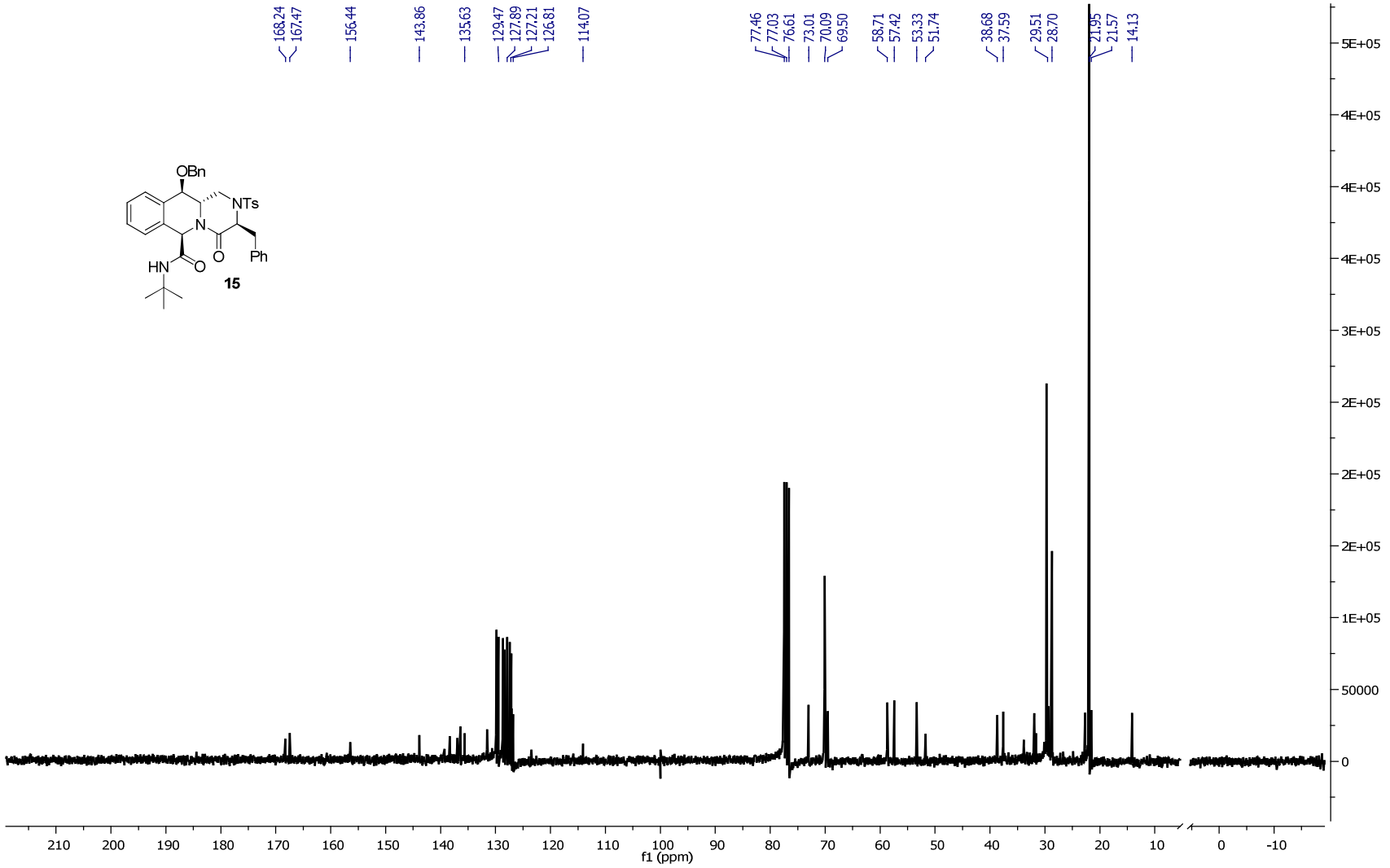
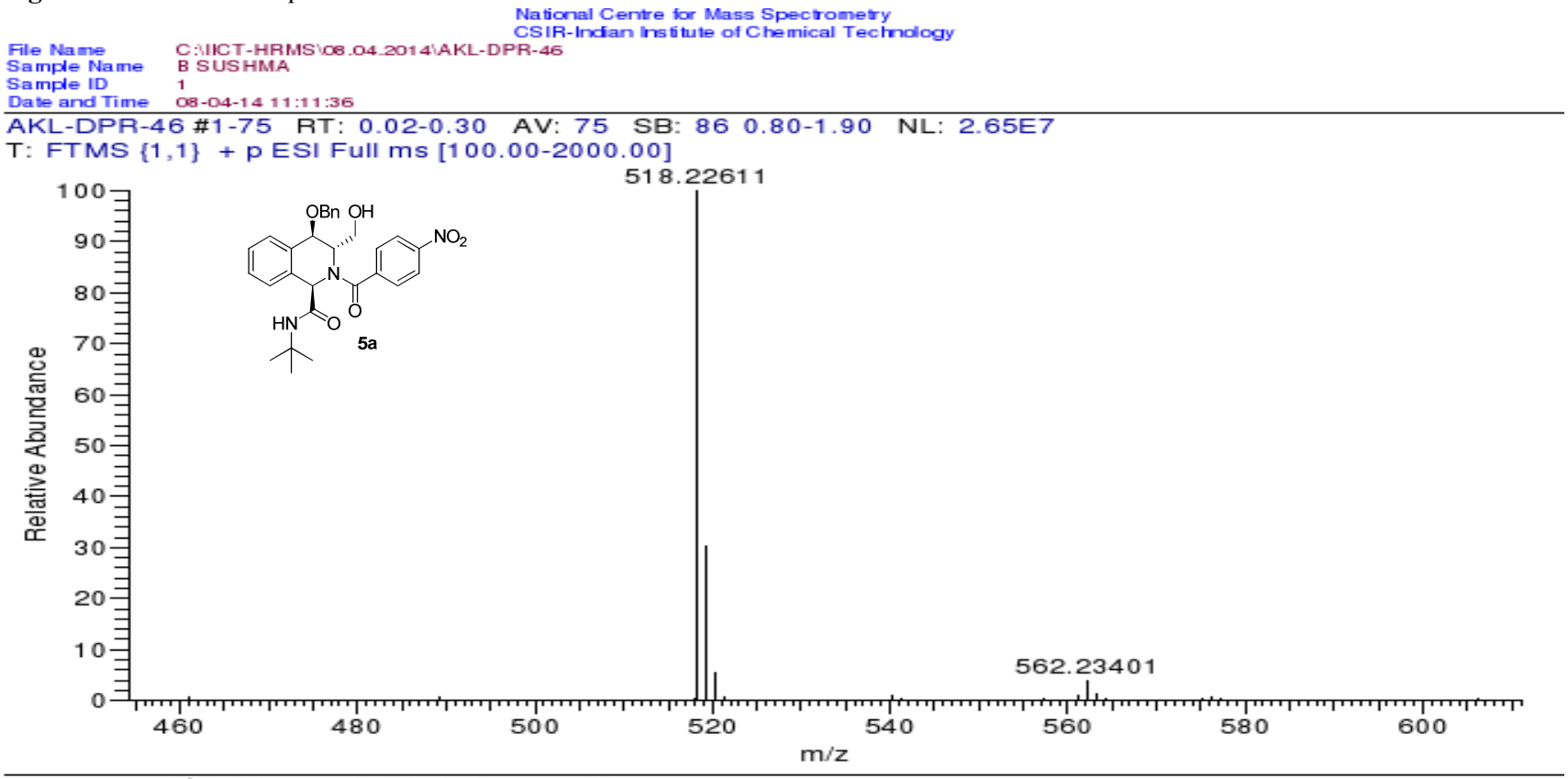


Figure 73: ^{13}C NMR Spectrum of compound **15**:



Section 3: HRMS Data

Figure 74: HRMS of compound **5a**:



AKL-DPR-46#8-30 RT: 0.06-0.14 AV: 23
T: FTMS {1,1} + p ESI Full ms [100.00-2000.00]
m/z= 514.35-520.91

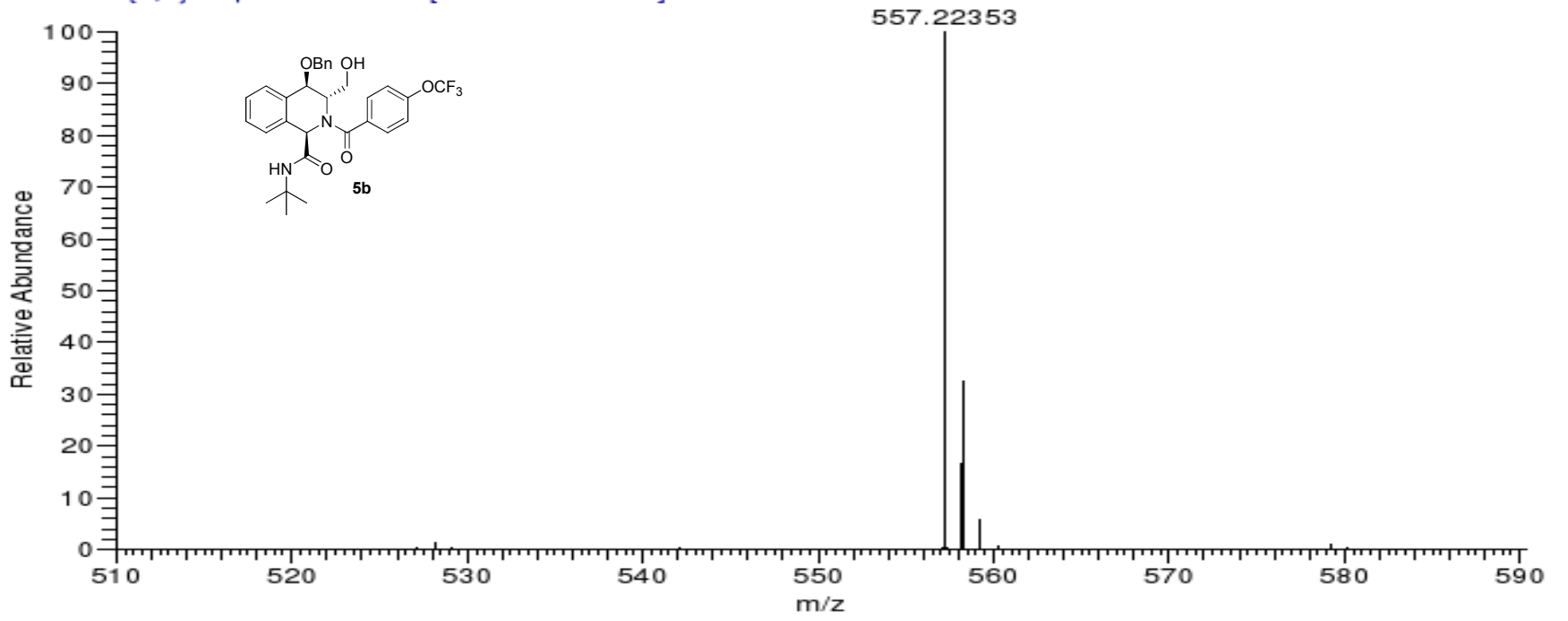
m/z	Intensity	Relative	Theo. Mass	Delta (ppm)	RDB equiv.	Composition
518.22599	55813508.0	100.00	518.22856	-4.97	15.5	$C_{29}H_{32}O_6N_3$

Figure 75: HRMS of compound **5b**:

National Centre for Mass Spectrometry
CSIR-Indian Institute of Chemical Technology

File Name C:\IICT-HRMS\08.04.2014\AKL-DPR-47
Sample Name B SUSHMA
Sample ID 1
Date and Time 08-04-14 11:08:55

AKL-DPR-47 #1-75 RT: 0.02-0.30 AV: 75 SB: 89 0.80-1.89 NL: 3.37E7
T: FTMS {1,1} + p ESI Full ms [100.00-2000.00]



AKL-DPR-47#8-30 RT: 0.07-0.15 AV: 23
T: FTMS {1,1} + p ESI Full ms [100.00-2000.00]

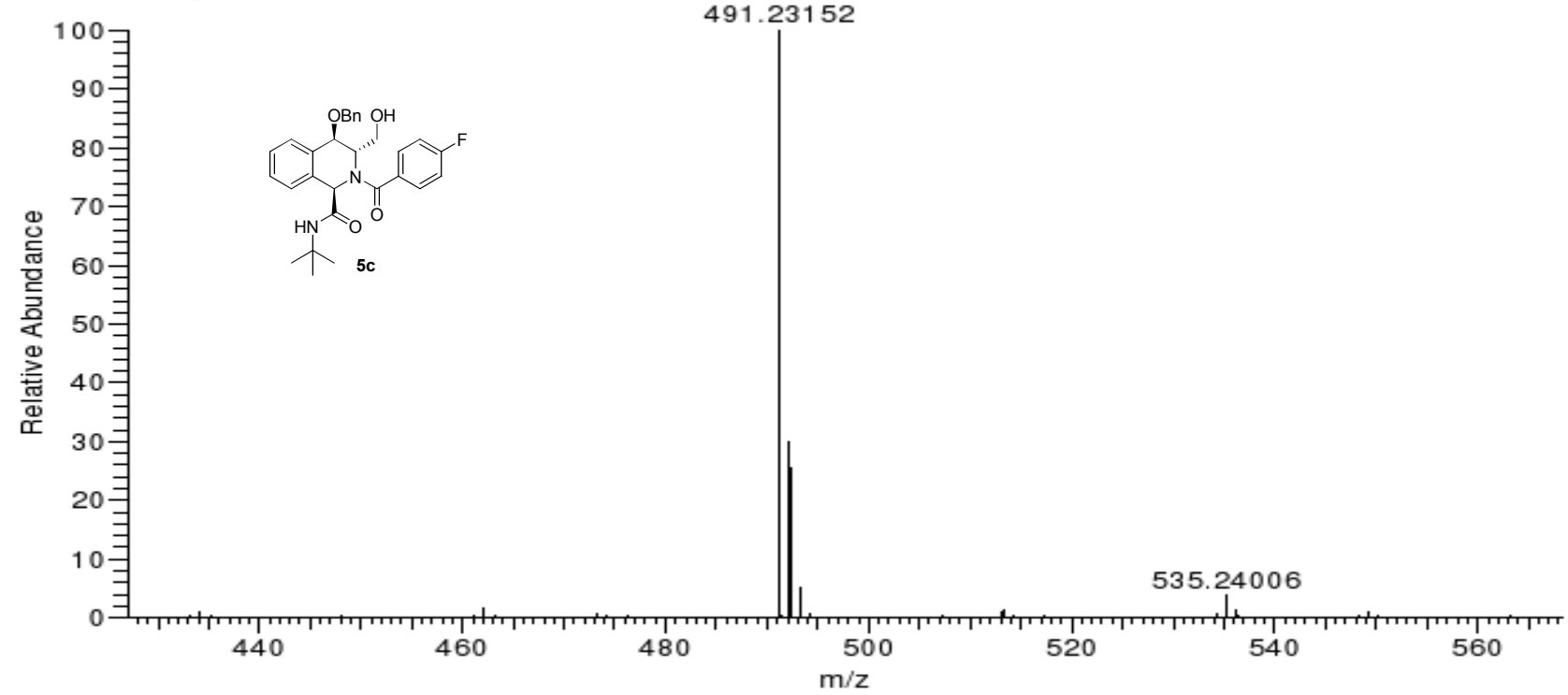
m/z	Intensity	Relative	Theo. Mass	Delta (ppm)	RDB equiv.	Composition
557.22343	62172108.0	100.00	557.22578	-4.23	14.5	$C_{30}H_{32}O_5N_2F_3$

Figure 76: HRMS of compound **5c:**

National Centre for Mass Spectrometry
CSIR-Indian Institute of Chemical Technology

File Name C:\IICT-HRMS\08.04.2014\AKL-DPR-44
Sample Name B SUSHMA
Sample ID 1
Date and Time 08-04-14 11:16:58

AKL-DPR-44 #1-78 RT: 0.02-0.30 AV: 78 SB: 95 0.80-1.90 NL: 2.70E7
T: FTMS {1,1} + p ESI Full ms [100.00-2000.00]



AKL-DPR-44#8-30 RT: 0.06-0.14 AV: 23
T: FTMS {1,1} + p ESI Full ms [100.00-2000.00]

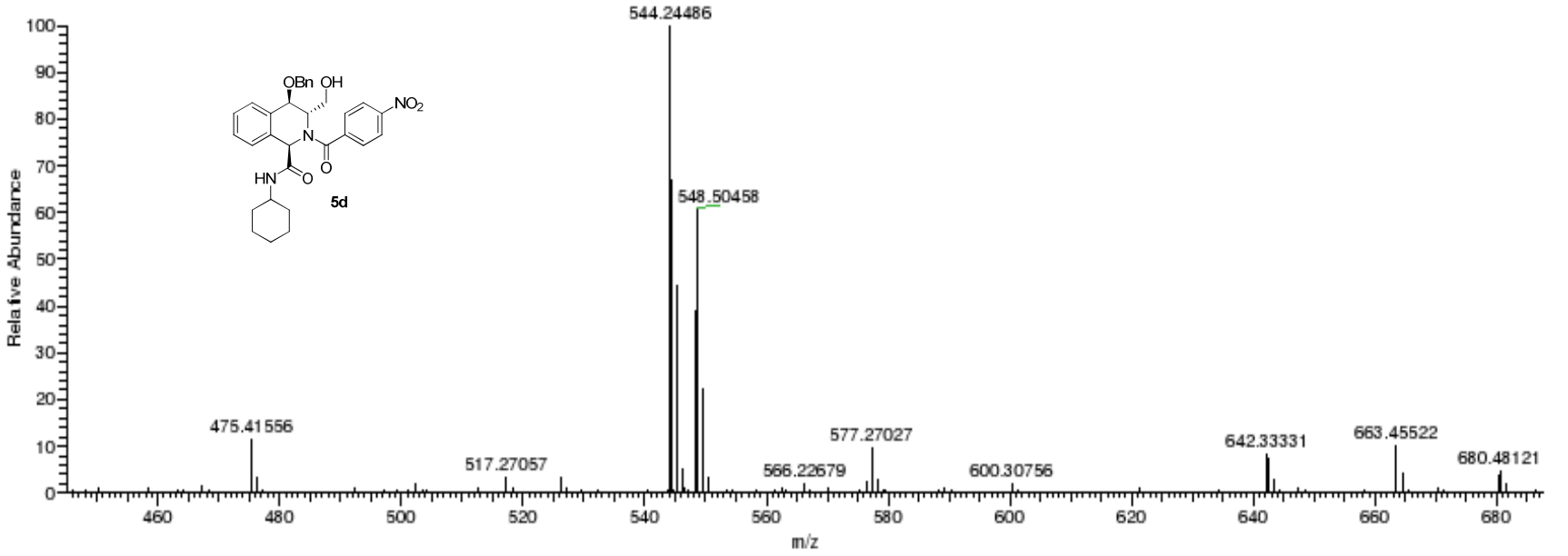
m/z	Intensity	Relative	Theo. Mass	Delta (ppm)	RDB equiv.	Composition
491.23158	48993324.0	100.00	491.23406	-5.06	14.5	$C_{29}H_{32}O_4N_2F$

Figure 77: HRMS of compound **5d:**

National Centre for Mass Spectrometry
CSIR-Indian Institute of Chemical Technology

File Name C:\IICT-HRMS\23.05.2014\AKL-DPR-64
Sample Name
Sample ID D-PRIYANKA
Date and Time 24-05-14 12:24:16

AKL-DPR-64 #2-18 RT: 0.03-0.30 AV: 17 SB: 53 0.79-1.89 NL: 2.17E5
T: FTMS {1,1} + p ESI Full ms [100.00-2000.00]



AKL-DPR-64#8-30 RT: 0.12-0.54 AV: 23
T: FTMS {1,1} + p ESI Full ms [100.00-2000.00]
m/z= 539.83-548.01

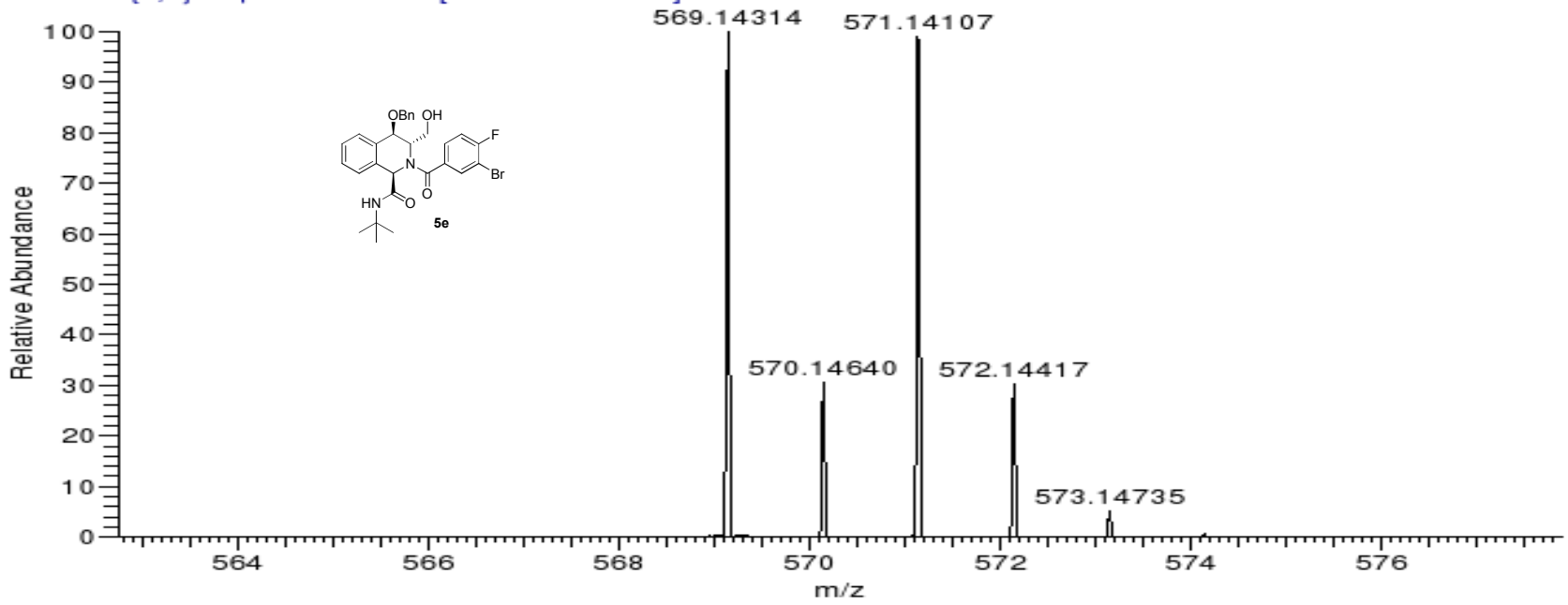
m/z	Intensity	Relative	Theo. Mass	Delta (ppm)	RDB equiv.	Composition
544.24500	47175.6	100.00	544.24421	0.79	16.5	$C_{31}H_{34}O_6N_3$

Figure 78: HRMS of compound **5e**:

National Centre for Mass Spectrometry
CSIR-Indian Institute of Chemical Technology

File Name C:\IICT-HRMS\08.04.2014\AKL-DPR-48
Sample Name B SUSHMA
Sample ID 1
Date and Time 08-04-14 11:06:14

AKL-DPR-48 #1-75 RT: 0.02-0.30 AV: 75 SB: 86 0.79-1.90 NL: 1.40E7
T: FTMS {1,1} + p ESI Full ms [100.00-2000.00]



AKL-DPR-48#8-30 RT: 0.07-0.14 AV: 23
T: FTMS {1,1} + p ESI Full ms [100.00-2000.00]
m/z= 566.84-569.81

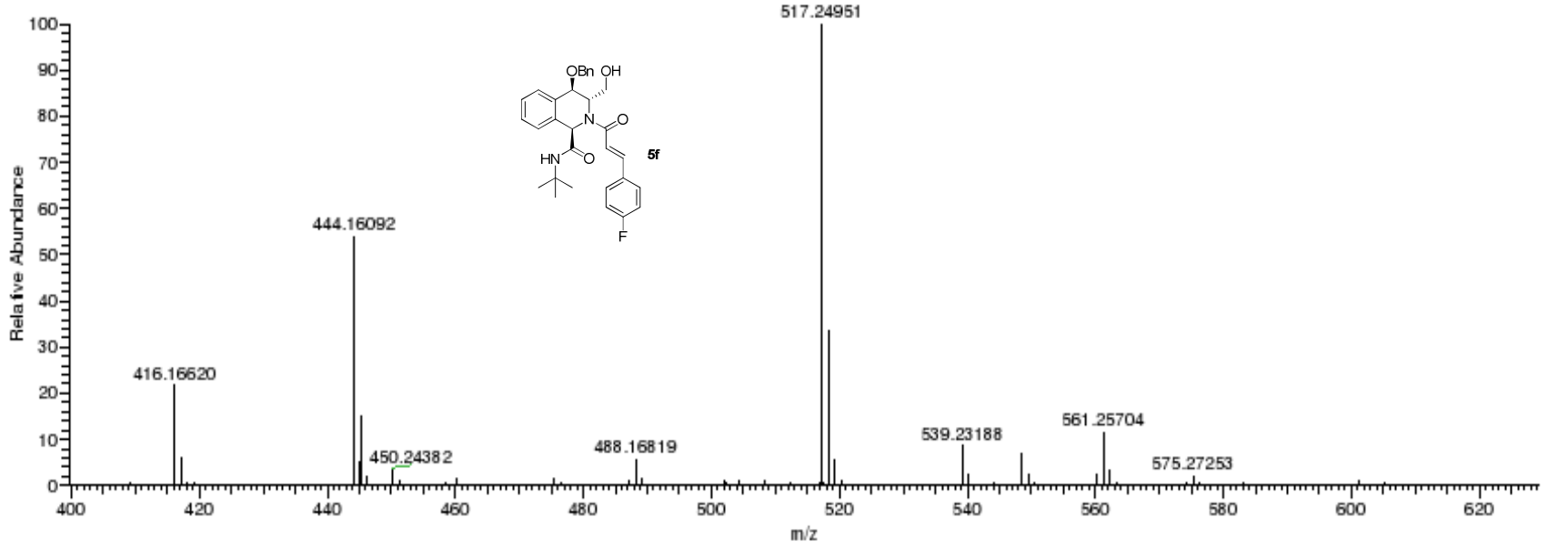
m/z	Intensity	Relative	Theo. Mass	Delta (ppm)	RDB equiv.	Composition
569.14265	26524184.0	100.00	569.14457	-3.37	14.5	$C_{29}H_{31}O_4N_2BrF$

Figure 79: HRMS of compound **5f**:

National Centre for Mass Spectrometry
CSIR-Indian Institute of Chemical Technology

File Name C:\IICT-HRMS\23.05.2014\AKL-DPR-55
Sample Name
Sample ID D-PRIYANKA
Date and Time 24-05-14 12:43:01

AKL-DPR-55 #2-18 RT: 0.03-0.29 AV: 17 SB: 52 0.80-1.90 NL: 1.44E6
T: FTMS {1,1} + p ESI Full ms [100.00-2000.00]



AKL-DPR-55#8-30 RT: 0.12-0.53 AV: 23
T: FTMS {1,1} + p ESI Full ms [100.00-2000.00]
m/z= 515.41-519.28

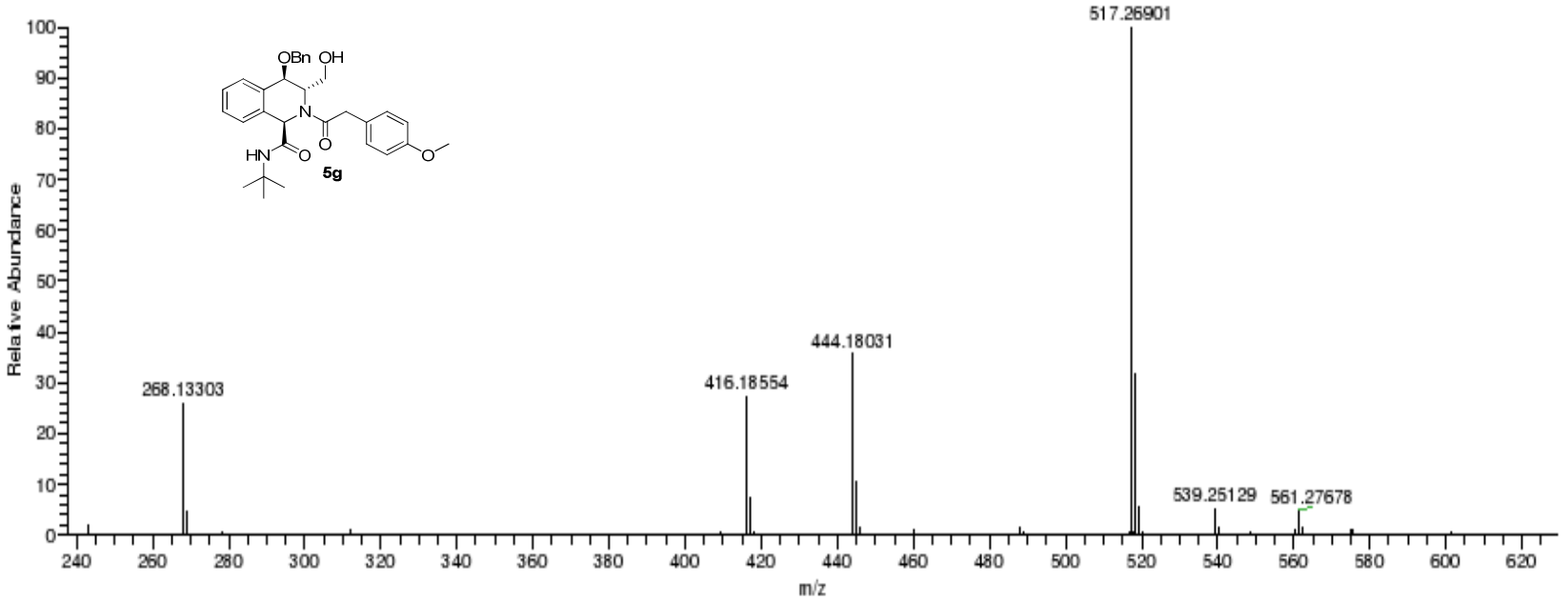
m/z	Intensity	Relative	Theo. Mass	Delta (ppm)	RDB equiv.	Composition
517.24952	589947.4	100.00	517.24971	-0.19	15.5	$C_{31}H_{34}O_4N_2F$

Figure 80: HRMS ofcompound **5g**:

National Centre for Mass Spectrometry
CSIR-Indian Institute of Chemical Technology

File Name C:\IICT-HRMS\23.05.2014\AKL-DPR-62
Sample Name
Sample ID D-PRIYANKA
Date and Time 24-05-14 12:29:38

AKL-DPR-62 #2-20 RT: 0.03-0.30 AV: 19 SB: 53 0.79-1.90 NL: 8.36E6
T: FTMS {1,1} + p ESI Full ms [100.00-2000.00]



AKL-DPR-62#8-30 RT: 0.12-0.49 AV: 23
T: FTMS {1,1} + p ESI Full ms [100.00-2000.00]
m/z= 508.22-527.76

m/z	Intensity	Relative	Theo. Mass	Delta (ppm)	RDB equiv.	Composition
517.26934	3857234.8	100.00	517.26970	-0.36	14.5	$C_{31}H_{37}O_5N_2$

Figure 81: HRMS of compound **5h**:

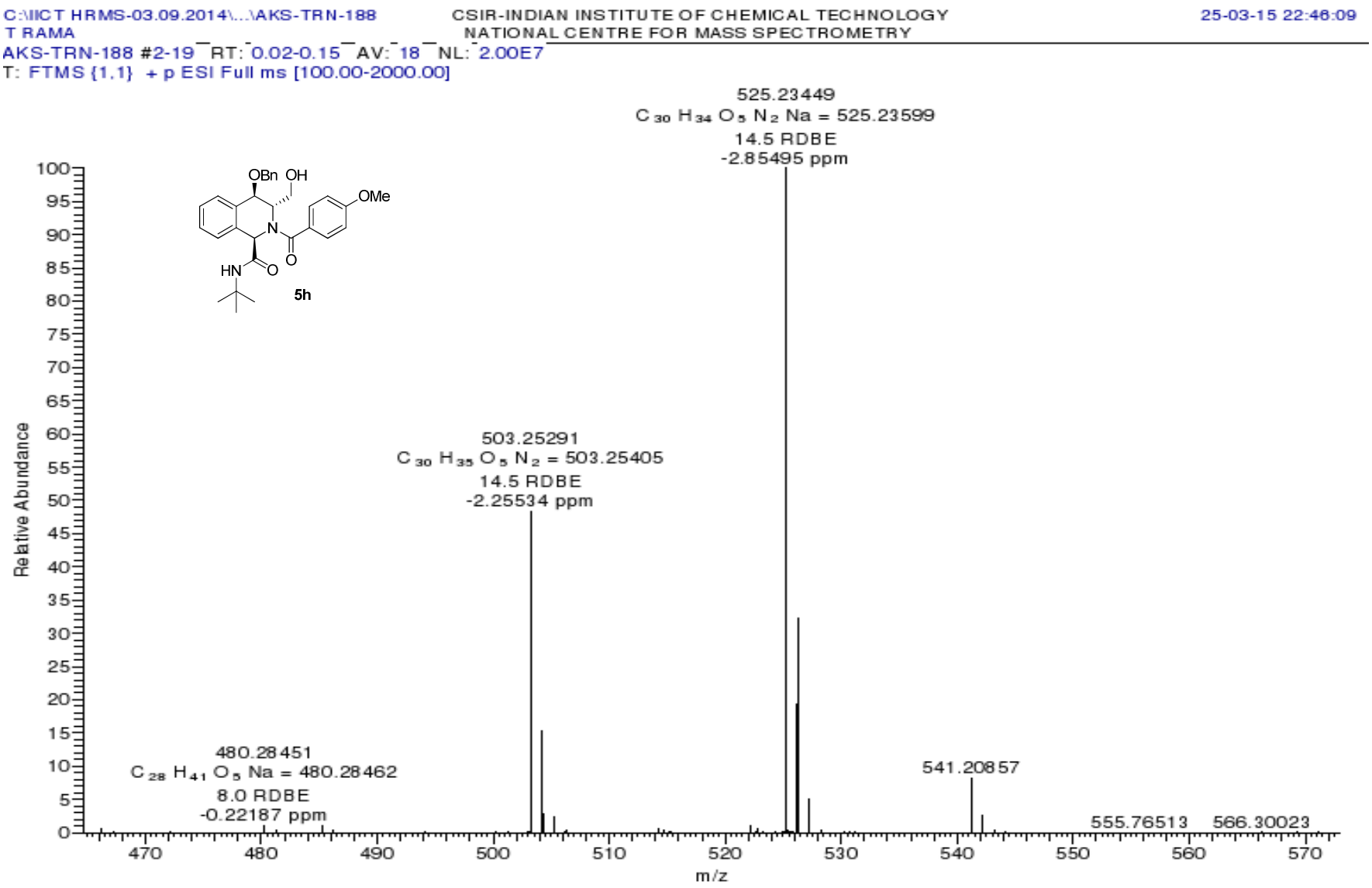
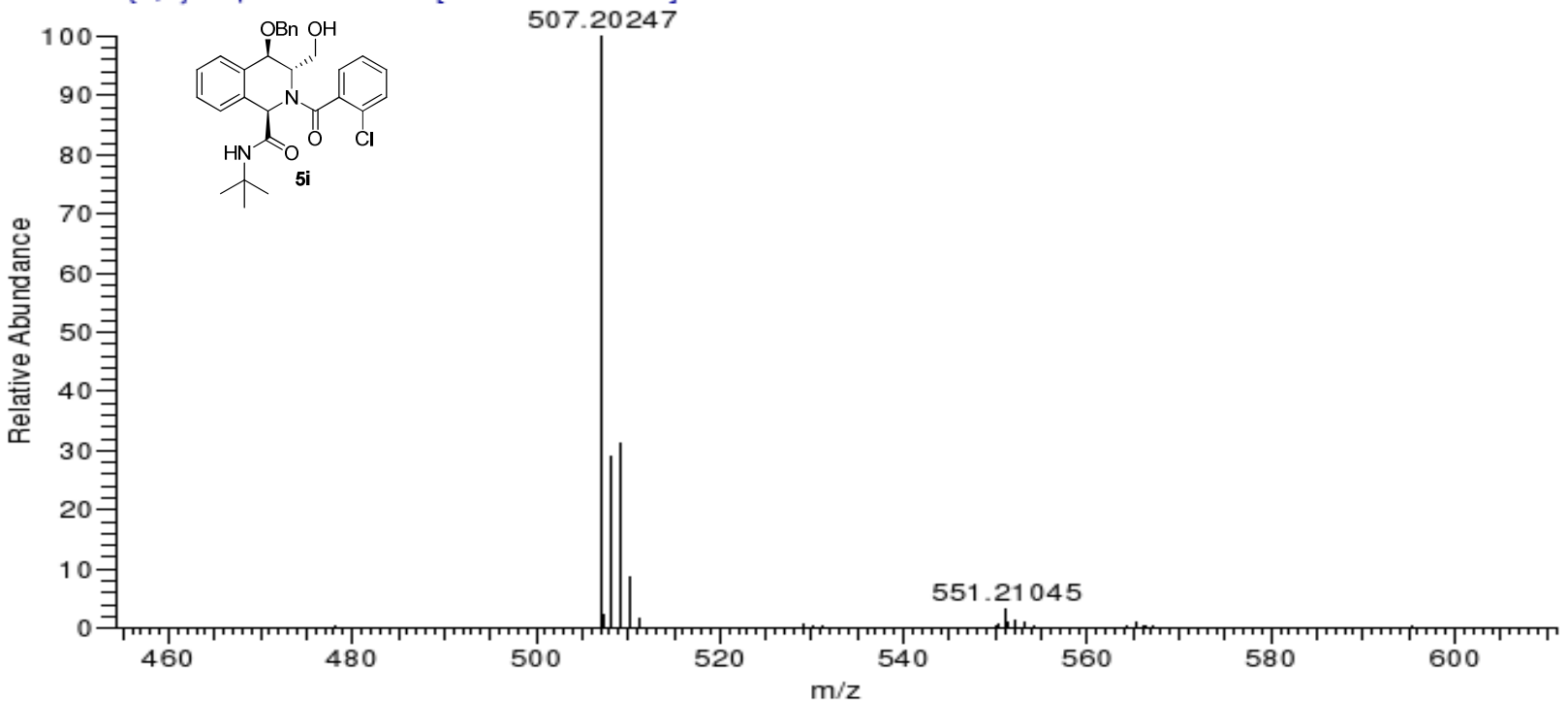


Figure 82: HRMS of compound **5i**:

National Centre for Mass Spectrometry
CSIR-Indian Institute of Chemical Technology

File Name C:\IICT-HRMS\08.04.2014\AKL-DPR-45
Sample Name B SUSHMA
Sample ID 1
Date and Time 08-04-14 11:14:17

AKL-DPR-45 #1-77 RT: 0.02-0.30 AV: 77 SB: 90 0.81-1.90 NL: 3.15E7
T: FTMS {1,1} + p ESI Full ms [100.00-2000.00]



AKL-DPR-45#8-30 RT: 0.07-0.14 AV: 23
T: FTMS {1,1} + p ESI Full ms [100.00-2000.00]
m/z= 501.12-512.97

m/z	Intensity	Relative	Theo. Mass	Delta (ppm)	RDB equiv.	Composition
507.20205	51237492.0	100.00	507.20451	-4.86	14.5	$C_{29}H_{32}O_4N_2Cl$

Figure 83: HRMS of compound **5j**:

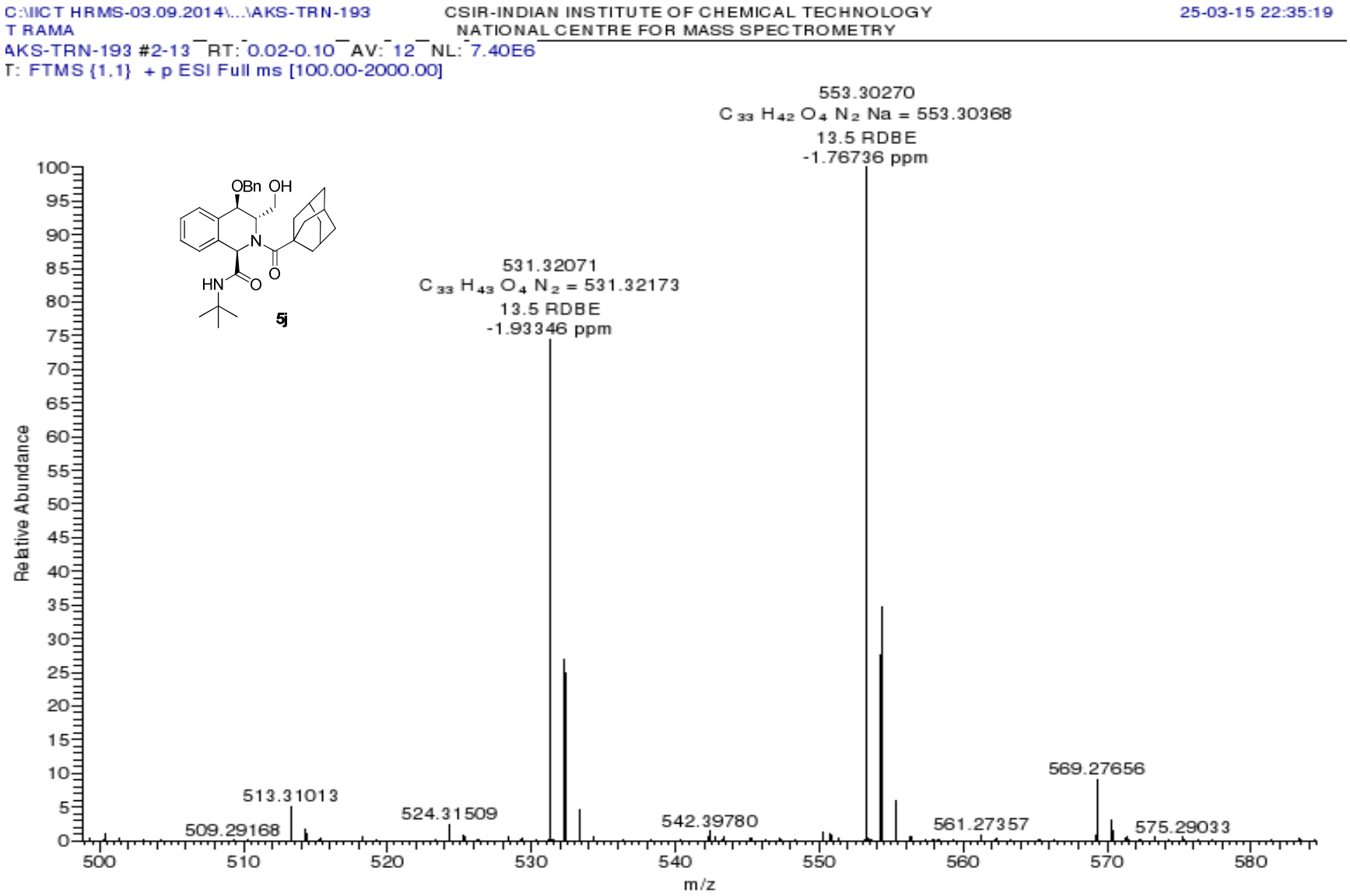


Figure 84: HRMS of compound **5k**:

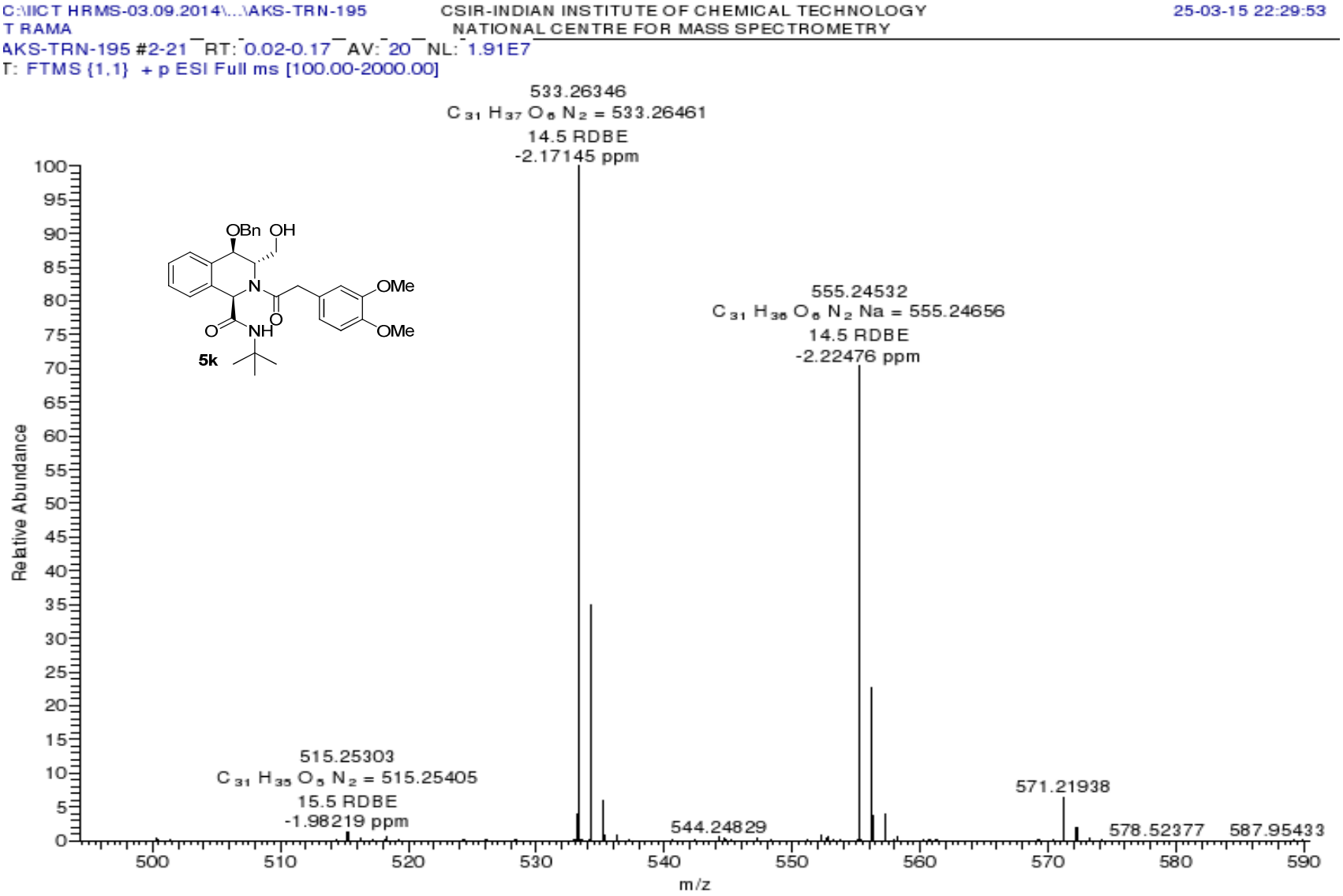


Figure 85: HRMS of compound **5l**:

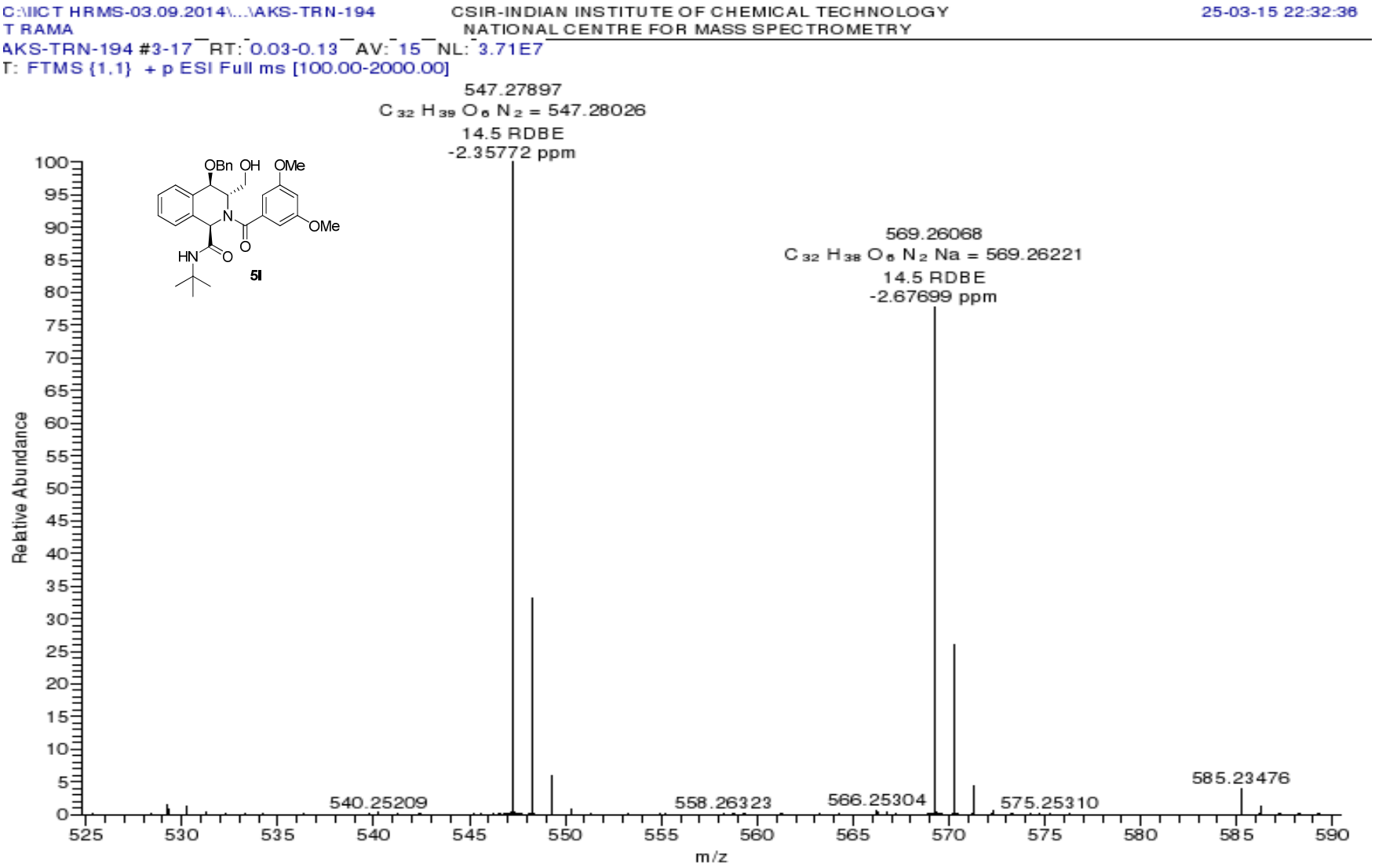


Figure 86: HRMS of compound **5m**:

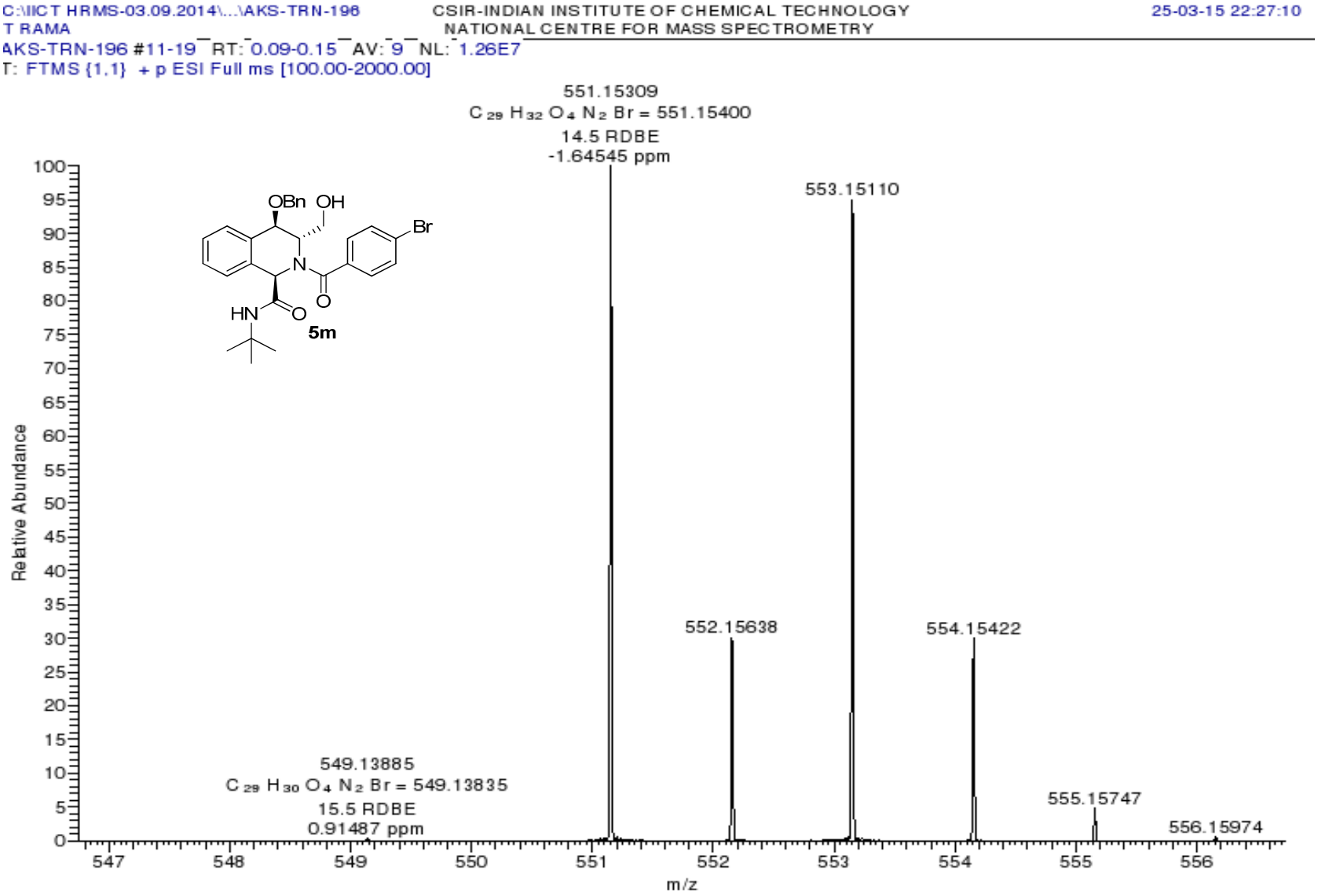


Figure 87: HRMS of compound **5n**:

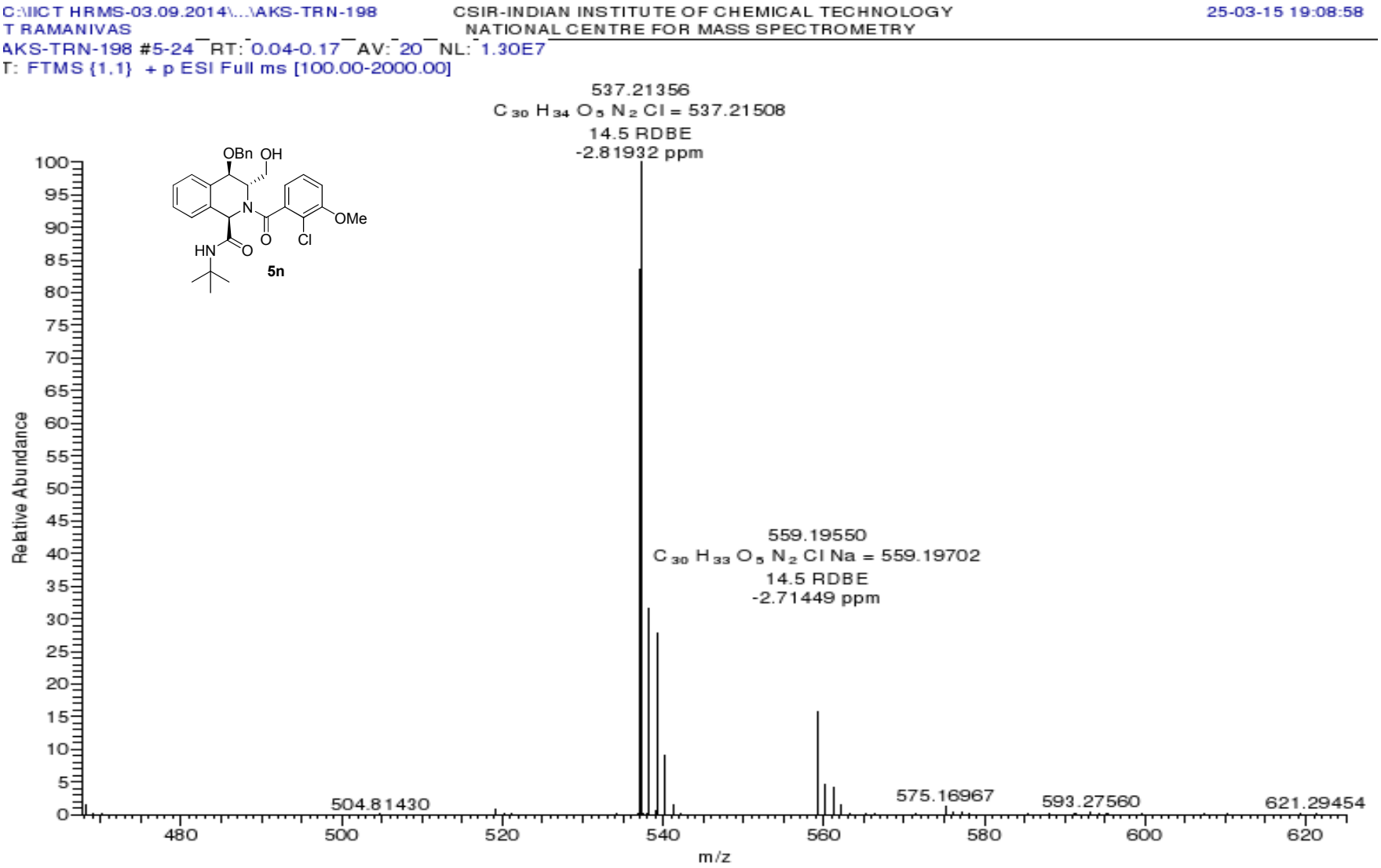


Figure 88: HRMS of compound **5o**:

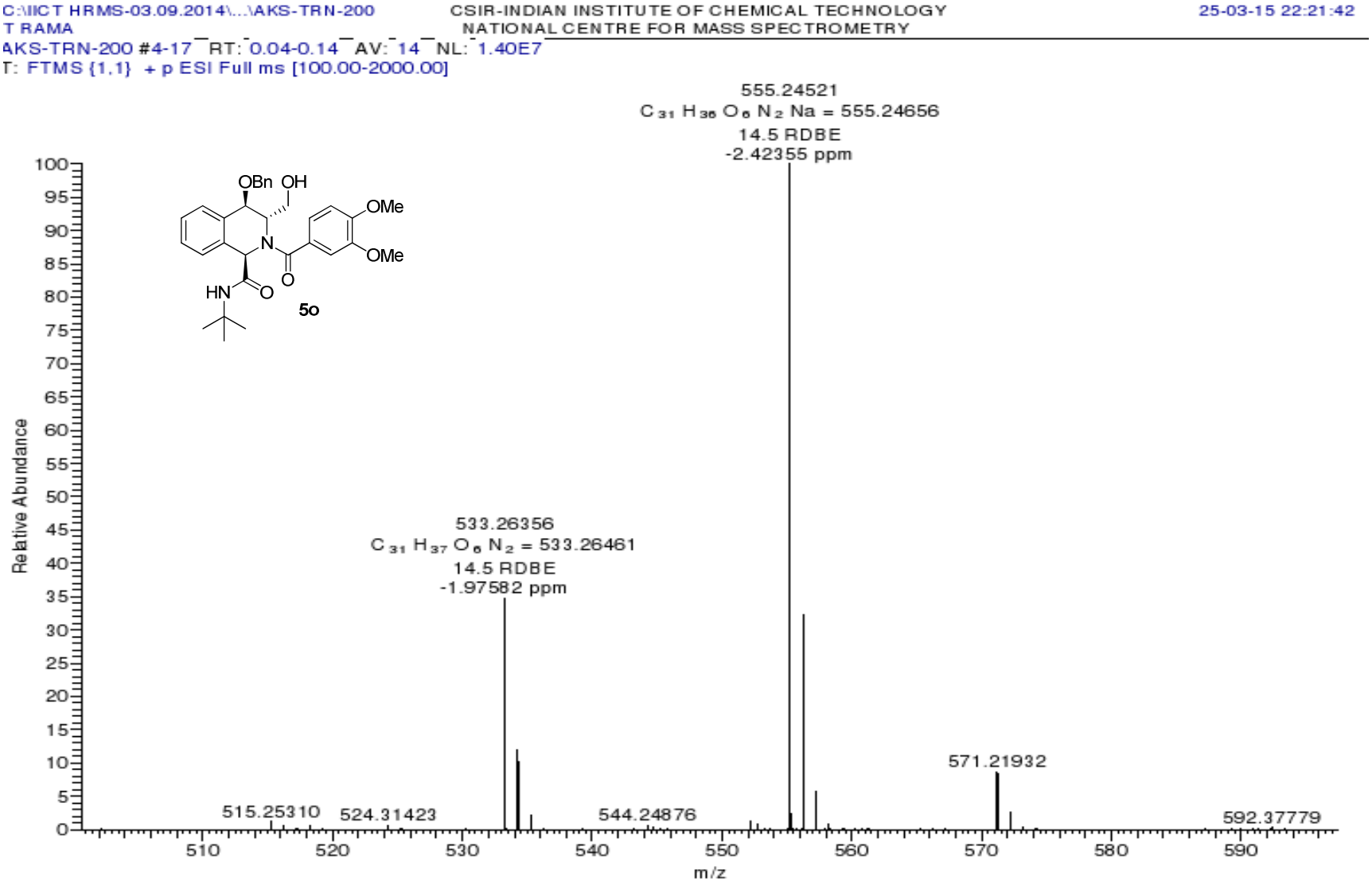
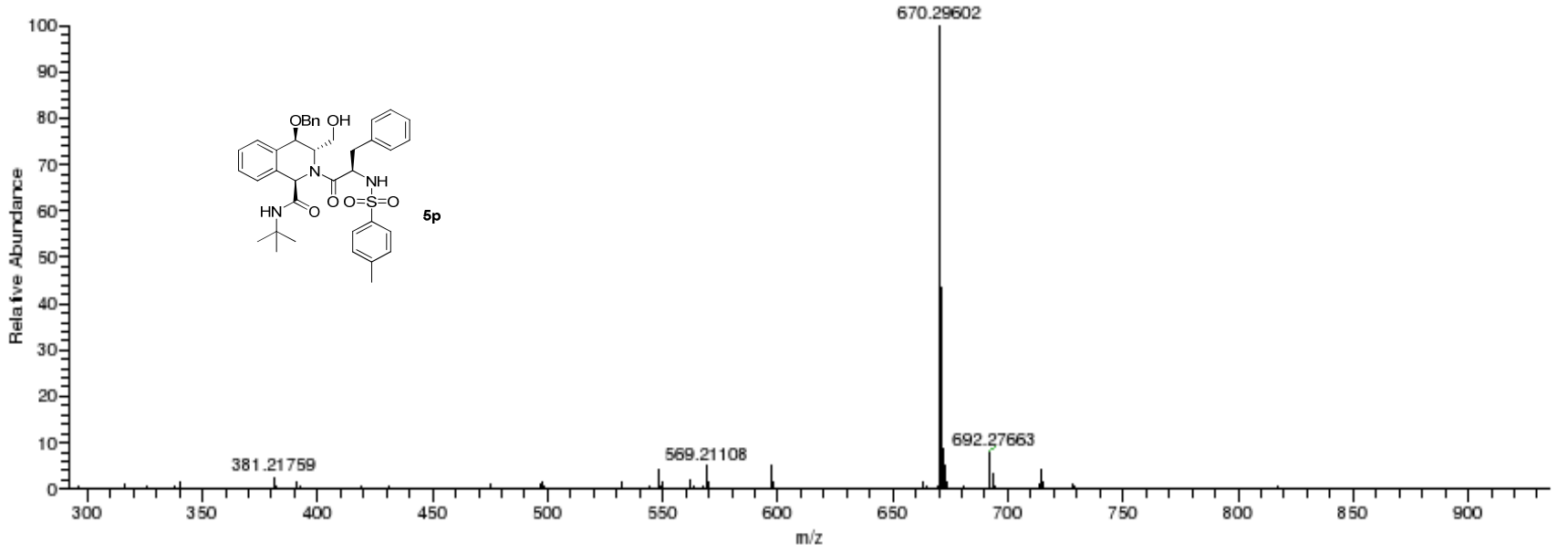


Figure 89: HRMS of compound **5p**:

National Centre for Mass Spectrometry
CSIR-Indian Institute of Chemical Technology

File Name C:\IICT-HRMS\23.05.2014\AKL-60-2
Sample Name
Sample ID D-PRIYANKA
Date and Time 24-05-14 12:34:58

AKL-60-2 #2-19 RT: 0.03-0.31 AV: 18 SB: 53 0.79-1.90 NL: 3.29E6
T: FTMS {1,1} + p ESI Full ms [100.00-2000.00]



AKL-60-2#8-30 RT: 0.12-0.52 AV: 23
T: FTMS {1,1} + p ESI Full ms [100.00-2000.00]
m/z= 635.34-693.91

m/z	Intensity	Relative	Theo. Mass	Delta (ppm)	RDB equiv.	Composition
670.29607	1151522.6	100.00	670.29453	1.53	18.5	$C_{38}H_{44}O_6N_3S$

Figure 90: HRMS of compound **5q**:

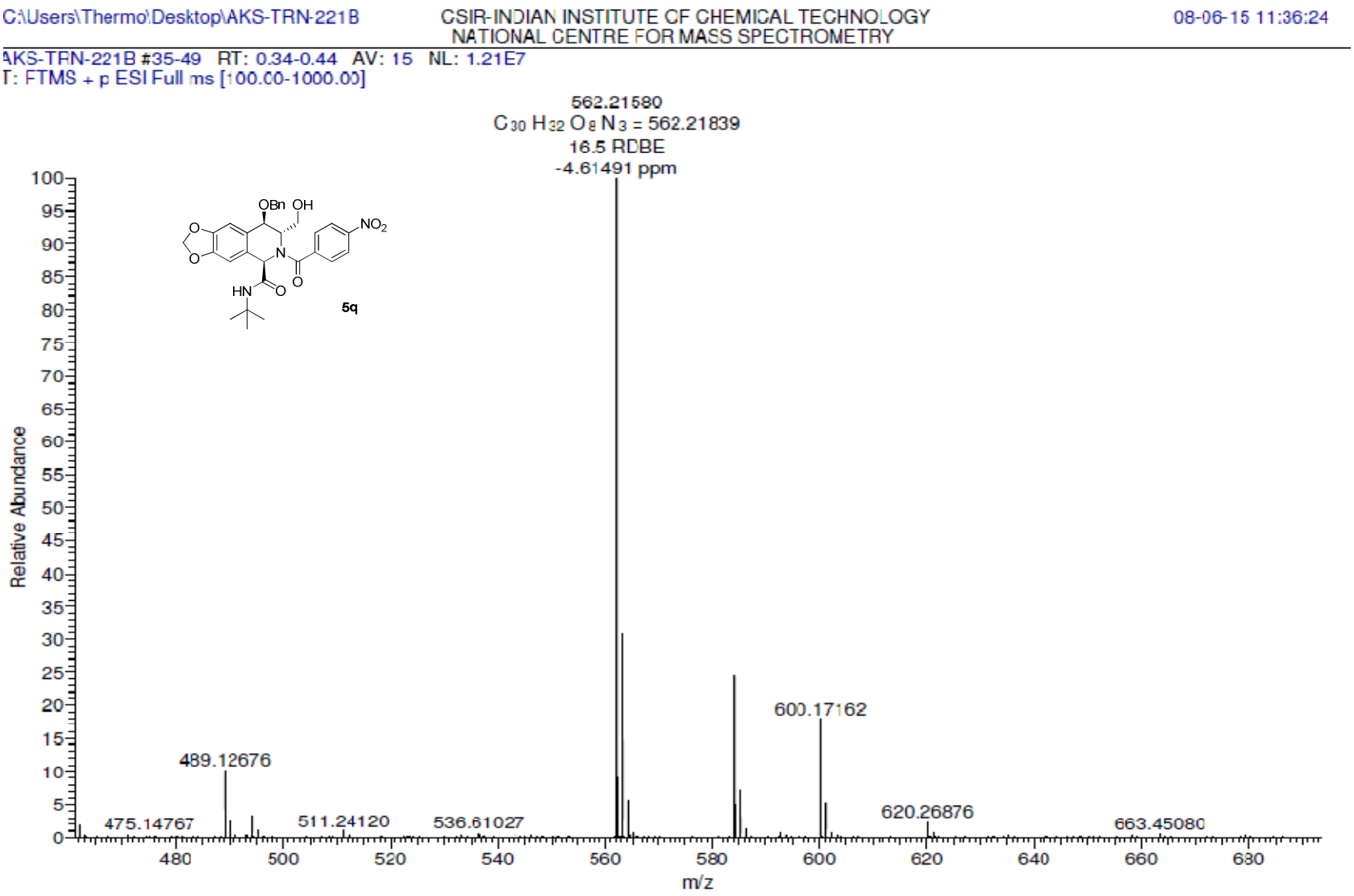


Figure 91: HRMS of compound **5r**:

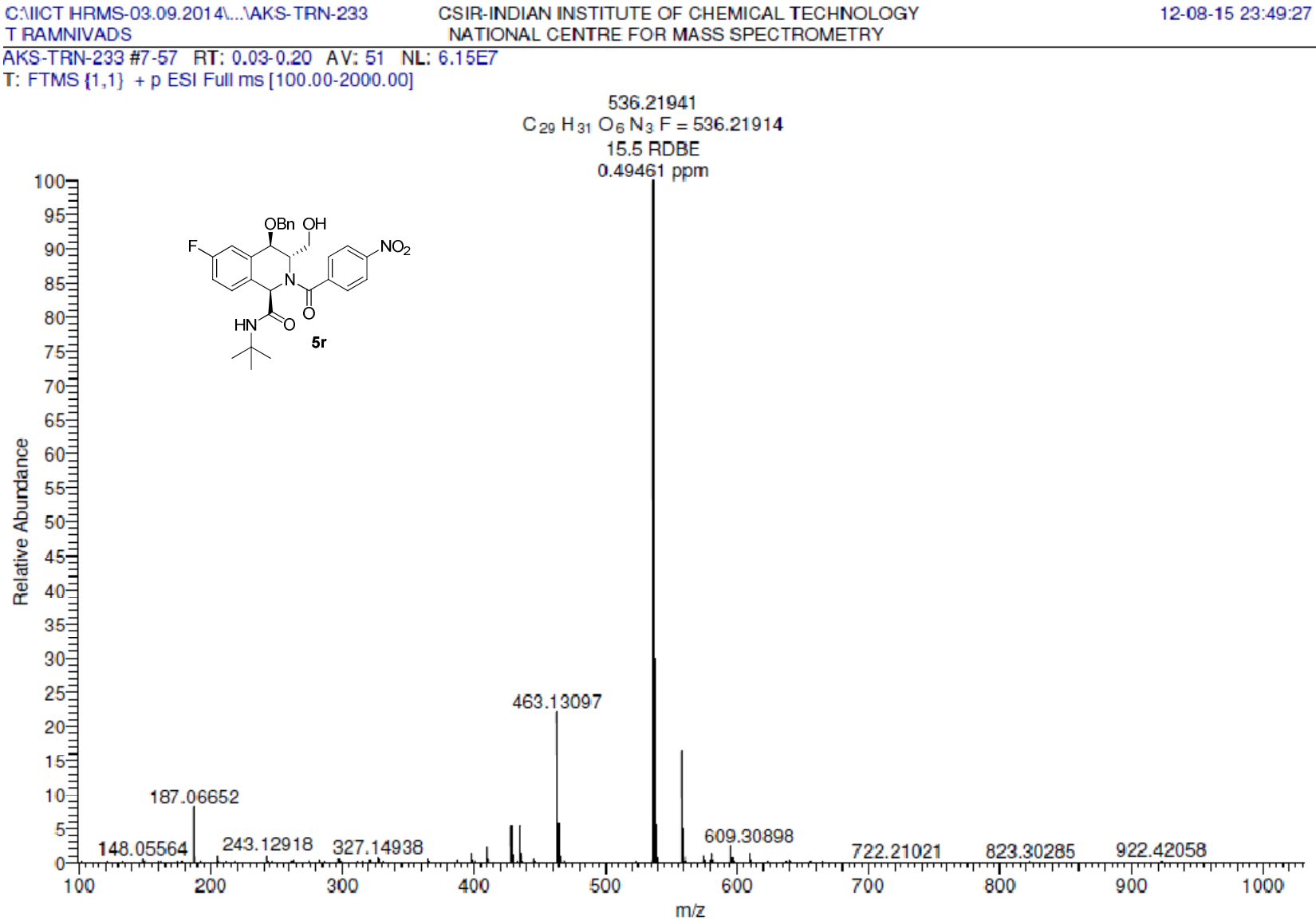


Figure 92: HRMS of compound **8**:

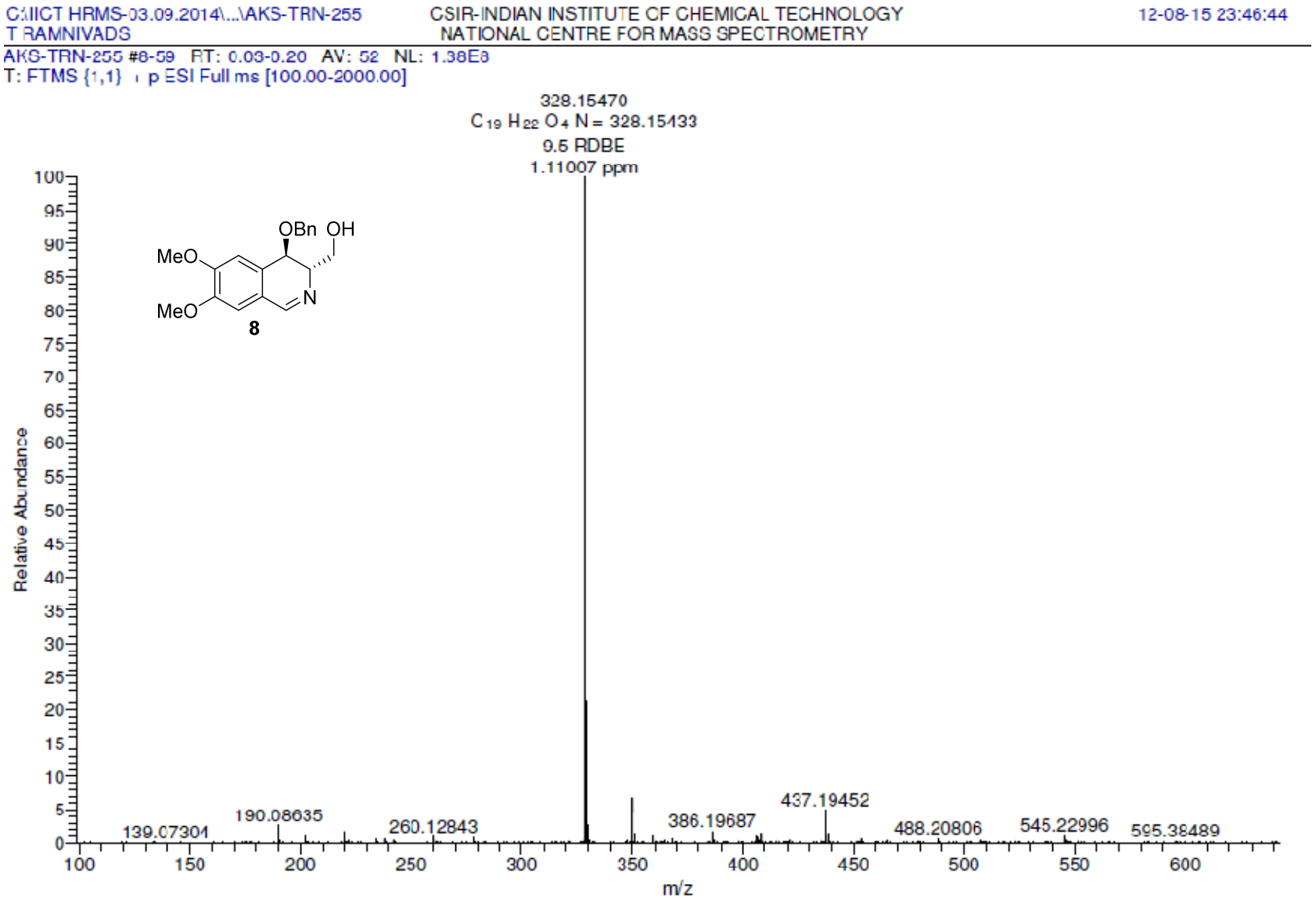


Figure 93: HRMS of compound **5s**:

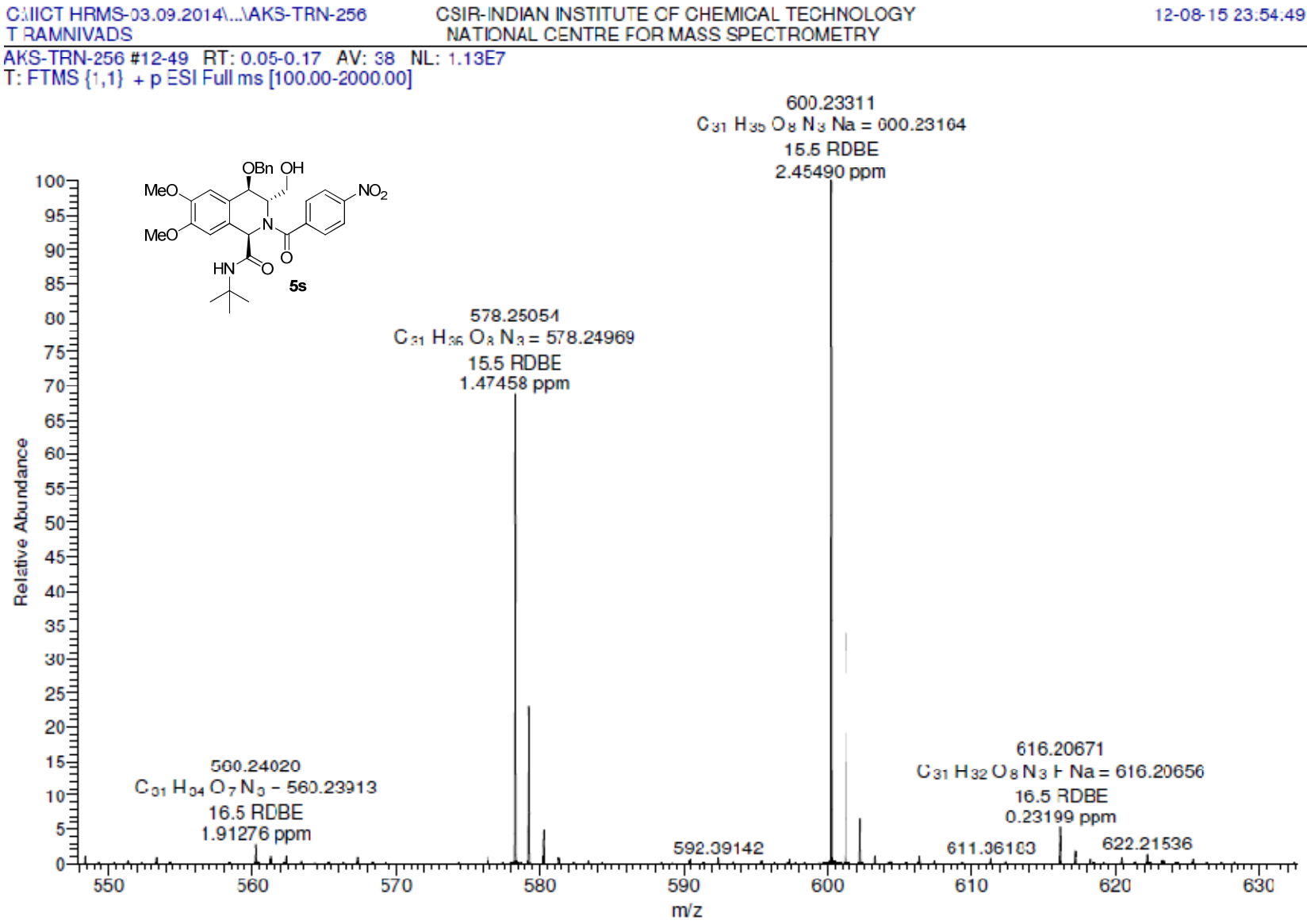


Figure 94: HRMS of compound **10**:

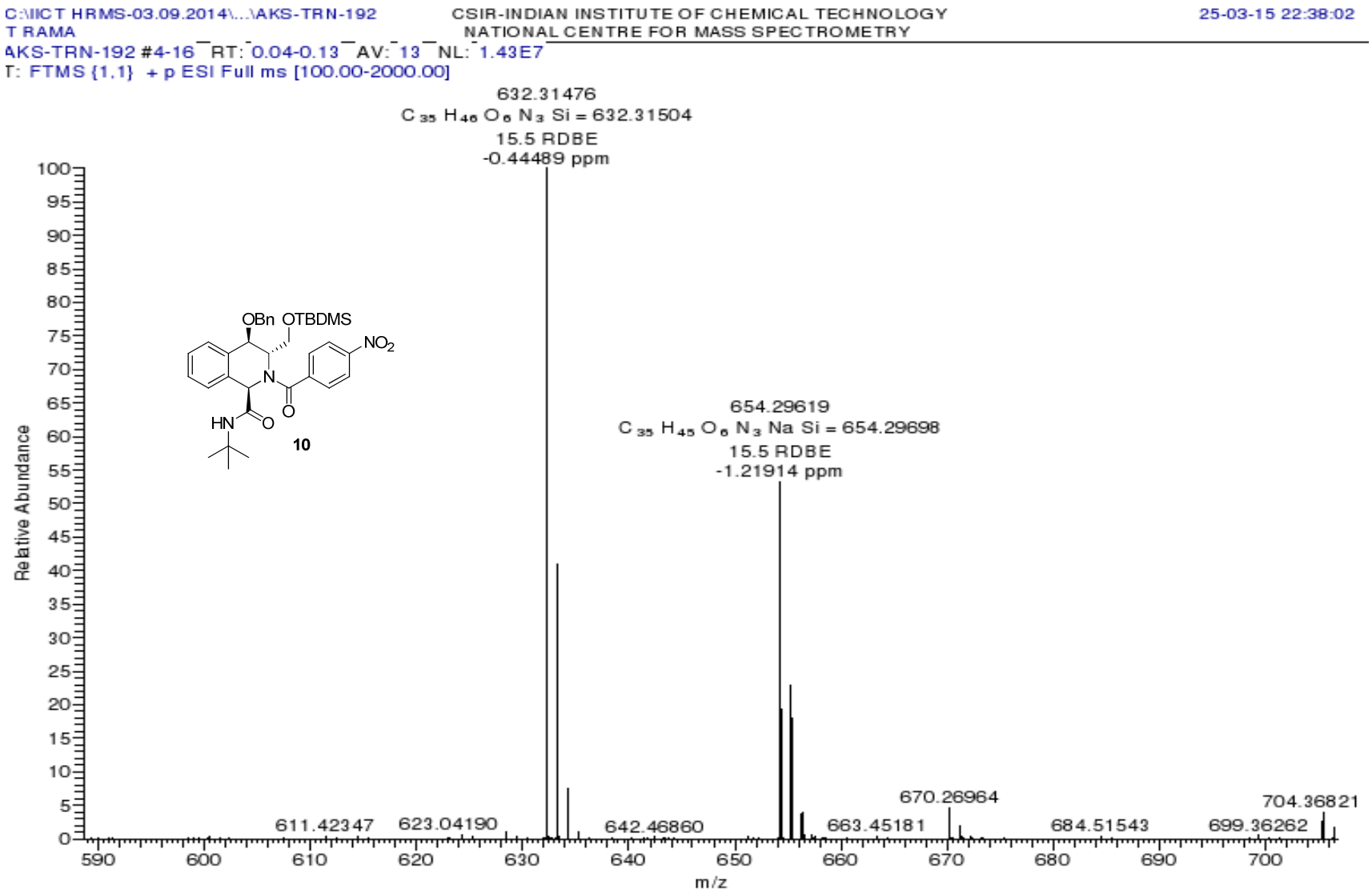


Figure 95: HRMS of compound **14**:

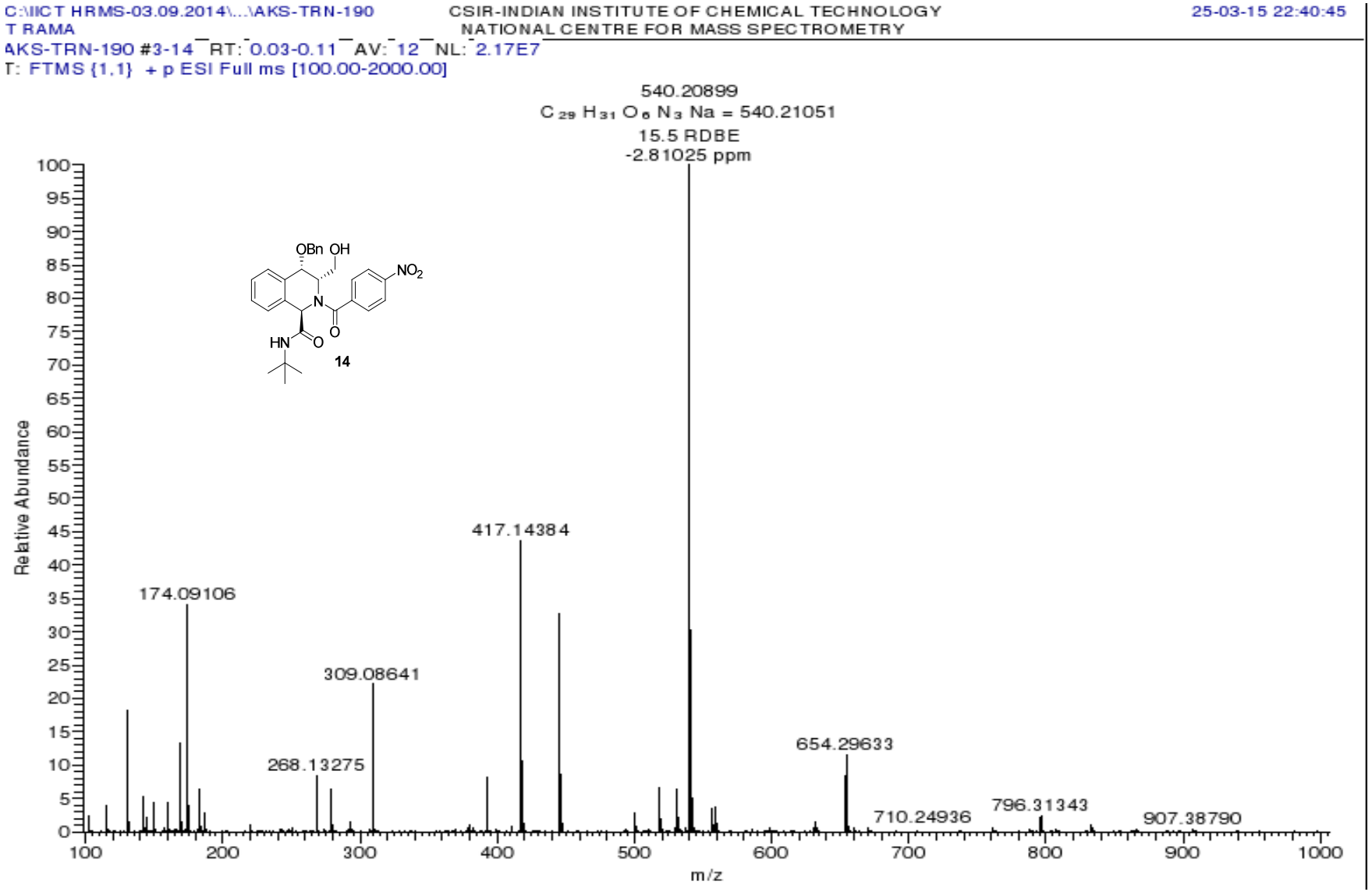
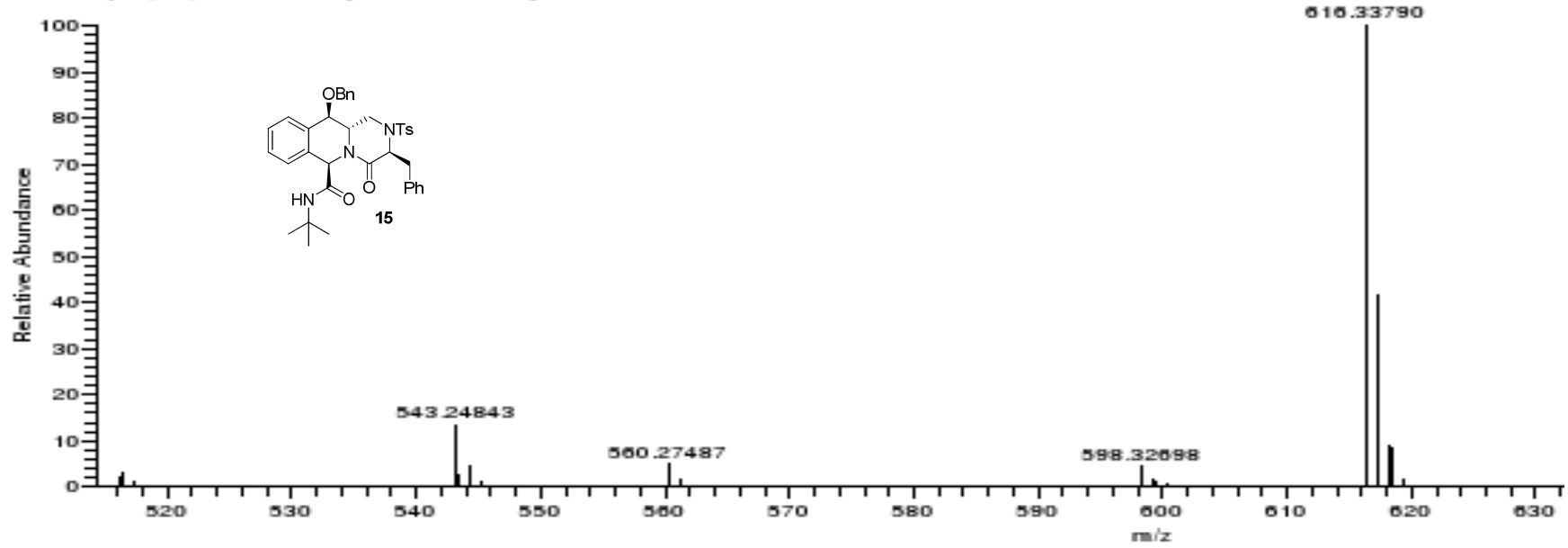


Figure 96: HRMS of compound **15**:

National Centre for Mass Spectrometry
CSIR-Indian Institute of Chemical Technology

File Name C:\IICT-HRMS\01.08.2014\AKL-DPR-75
Sample Name
Sample ID MURALI
Date and Time 04-08-14 16:33:14

AKL-DPR-75 #5-83 RT: 0.02-0.30 AV: 79 SB: 274 0.80-1.90 NL: 1.38E8
T: FTMS {1,1} + p ESI Full ms [100.00-2000.00]



AKL-DPR-75#8-30 RT: 0.03-0.12 AV: 23
T: FTMS {1,1} + p ESI Full ms [100.00-2000.00]
m/z= 588.01-607.81

m/z	Intensity	Relative	Theo. Mass	Delta (ppm)	RDB equiv.	Composition
598.32690	2456714.5	100.00	598.32755	-1.09	16.5	$C_{36}H_{44}O_5N_3$

Section 4: Computational Data [Cartesian coordinates and total energies]

Figure S1: Reaction energy profiles generated at B3LYP/6-31+G(d) level of theory.(obtained by single point calculations using– a: gas phase optimized geometries, b: could not be obtained)

Table S1: Cartesian coordinates of the final optimized geometries of the reactants and reaction complex (**RC**)at B3LYP/6-31+G(d) level of theory, in the presence of methanol as solvent, along with the total energies (E, in Hartrees) inparenthesis.

Table S2: Cartesian coordinates of the final optimized geometries of products (-a= alpha and -b=beta) at B3LYP/6-31+G(d) level of theory, in the presence of methanol as solvent, along with the total energies (E, in Hartrees) in parenthesis.

Table S3: Cartesian coordinates of the final optimized geometries of intermediates (-a= alpha and -b=beta) at B3LYP/6-31+G(d) level of theory, in the presence of methanol as solvent, along with the total energies (E, in Hartrees) in parenthesis.

Table S4: Cartesian coordinates of the final optimized geometries of transition states (-a= alpha and -b=beta) at B3LYP/6-31+G(d) level of theory, in the presence of methanol as solvent, along with the total energies (E, in Hartrees) in parenthesis (**TS2-a**: optimized using gas phase).

Figure S1: Reaction energy profiles generated at B3LYP/6-31+G(d) level of theory.(obtained by single point calculations using– a: gas phase optimized geometries, b: solvent phase optimized geometries, c: could not be obtained)

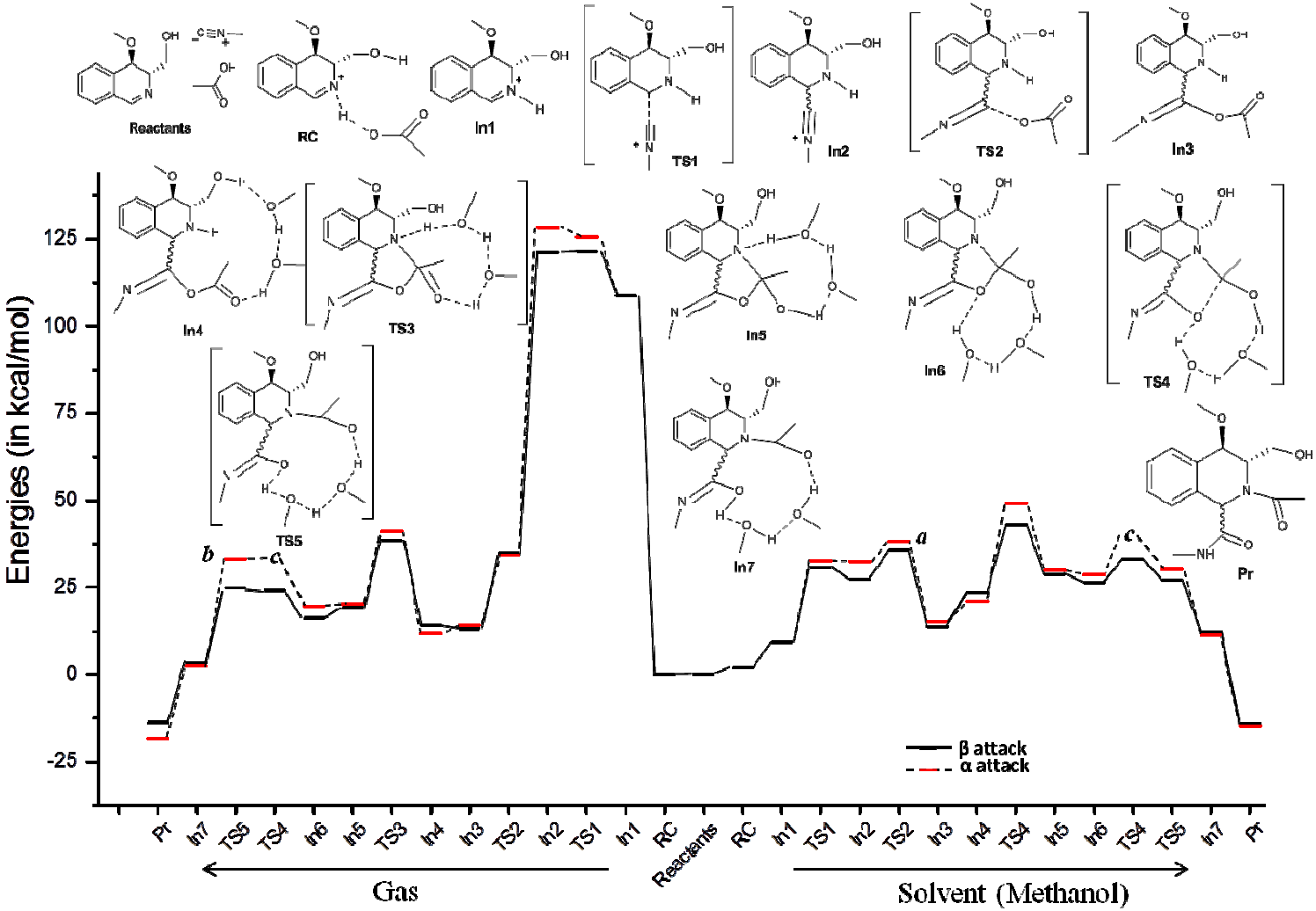


Table S1: Cartesian coordinates of the final optimized geometries of the reactants and reaction complex (**RC**) at B3LYP/6-31+G(d) level of theory, in the presence of methanol as solvent, along with the total energies (E, in Hartrees) in parenthesis.

Imine (E = -632.194680)

C	-2.12810900	-1.40352100	0.78365300
C	-0.90187700	-0.75682900	0.55835600
C	-0.79488000	0.23048100	-0.43741700
C	-1.91702000	0.55267800	-1.20574600
C	-3.13484100	-0.09890100	-0.98668100
C	-3.24219900	-1.07650800	0.01122200
H	-2.20059100	-2.16225500	1.55963900
H	-1.83883400	1.31497000	-1.97748300
H	-3.99970700	0.15374300	-1.59414700
H	-4.18970500	-1.58011800	0.18147300
C	0.52327100	0.95877400	-0.61579400
C	0.28996500	-1.10486800	1.34232500
H	0.14632500	-1.78869900	2.18297000
C	1.72629700	0.17051900	-0.04370300
N	1.48423600	-0.69057800	1.12315000
O	0.46142000	2.30614100	-0.10771200
C	0.24802000	2.45162400	1.29627800
H	-0.70097300	1.99994200	1.61165400
H	1.06878100	2.01254500	1.87841700
H	2.48322200	0.90486100	0.25900400
C	2.37553700	-0.71673700	-1.12637300
H	2.70089600	-0.09714100	-1.96695700
H	1.64212000	-1.44915400	-1.49595600
O	3.54098400	-1.38068500	-0.63997800
H	3.30551000	-1.76723900	0.22242700
H	0.69738700	1.12198000	-1.68468500
H	0.21170600	3.52667800	1.48640500

Isocyanide (E = -132.733215)

C	1.48571500	0.00001100	0.00000500
N	0.31394400	-0.00002100	-0.00000500
C	-1.11350600	0.00000200	-0.00000100
H	-1.47695200	0.31352100	0.98168200
H	-1.47692500	0.69344200	-0.76232800
H	-1.47698600	-1.00689800	-0.21933900

Acetic Acid (E = -229.103889)

C	-0.08762800	0.12070800	0.00011600
H	-1.74137800	-0.81826000	0.00000600
O	-0.63590900	1.20943300	-0.00008500
O	-0.78891300	-1.03682800	0.00001500
C	1.39656000	-0.11933600	-0.00002400
H	1.67976300	-0.70118000	0.88359000
H	1.67945900	-0.70287000	-0.88260900
H	1.92713900	0.83323500	-0.00098000

Acetate ion (E = -228.642067)

C	0.18647800	-0.00064600	-0.00011100
O	0.80936700	-1.10422100	0.00002400
O	0.71813300	1.15101800	0.00002000
C	-1.35369600	-0.04410700	-0.00003400
H	-1.74007300	0.47879000	0.88355200
H	-1.74063600	0.48451800	-0.87992700
H	-1.73599000	-1.06917000	-0.00310600

Methanol dimer (E = -231.470429)

O	-1.36364400	-0.43979100	-0.56481000
H	-0.45867700	-0.08516200	-0.42273000
C	-2.23816500	0.14646300	0.39736000
H	-2.28004500	1.24039900	0.29784600
H	-3.23847700	-0.25755200	0.21730400
H	-1.94032100	-0.10368200	1.42551400
O	1.22667700	0.58416800	-0.14427200
H	1.54307600	1.07582100	-0.91910300
C	2.23990700	-0.35262900	0.25937200
H	2.45464700	-1.07347900	-0.53806400
H	3.16108800	0.16827400	0.54377200
H	1.84399200	-0.88263400	1.12772600

RC (E = -861.315271)

C	2.79568800	-2.01830100	-0.12756100
C	1.81726100	-1.01183700	-0.07706400
C	2.18675800	0.32980700	0.13253300
C	3.53712400	0.64803800	0.29653600
C	4.50956300	-0.35649000	0.25773400
C	4.13983600	-1.69091200	0.04463100
H	2.49779800	-3.05023200	-0.29736900
H	3.83008100	1.68301100	0.45604000
H	5.55638100	-0.09946700	0.39472500
H	4.89777200	-2.46841900	0.01302200
C	1.11466900	1.40453200	0.12187000
C	0.40029700	-1.32849800	-0.26384300
H	0.14625600	-2.33514000	-0.60212800
C	-0.28902100	0.83659300	0.43881000
N	-0.57077400	-0.51020400	-0.07501300
O	1.14623000	2.18649900	-1.08425700
C	0.84381000	1.50730000	-2.30350400
H	1.53689100	0.67722800	-2.48985400
H	-0.18636800	1.12832300	-2.31049800
H	-1.02648400	1.50538500	-0.02169500
C	-0.52497500	0.87072500	1.97025400
H	-0.47990500	1.92457100	2.28378600
H	0.27828500	0.33054700	2.48394000
O	-1.74078900	0.27226400	2.38909400
H	-2.45620200	0.47990200	1.74904500
H	1.35428100	2.14833100	0.88867500
H	-2.13745400	-0.88624300	-0.44917300
O	-3.07318000	-1.15363600	-0.79634900
C	-4.03915000	-0.39624900	-0.29609600
O	-3.84340900	0.49536300	0.53384700
C	-5.40381700	-0.73370000	-0.83968600
H	-6.15769600	-0.07547100	-0.40598500
H	-5.40655700	-0.63385000	-1.93036100
H	-5.64640300	-1.77633700	-0.60633900
H	0.95566200	2.24932200	-3.09710100

Table S2: Cartesian coordinates of the final optimized geometries of products (-a= alpha and -b=beta) at B3LYP/6-31+G(d) level of theory, in the presence of methanol as solvent, along with the total energies (E, in Hartrees) in parenthesis.

Pr-b (E = -994.101980)

C	2.08125700	-0.73174800	-1.80818000
C	1.11981300	-0.50930700	-0.81652700
C	1.01240100	-1.39901800	0.26274600
C	1.86497500	-2.50183500	0.34671800
C	2.83396300	-2.71695500	-0.63945000
C	2.94158000	-1.83167100	-1.71573600
H	2.15656500	-0.05408400	-2.65566900
H	1.77130800	-3.19361700	1.18052800
H	3.49595000	-3.57572400	-0.57081500
H	3.68520100	-2.00076700	-2.48960900
C	-0.06026300	-1.10373700	1.28106600
C	0.18022300	0.67951800	-0.86404500
H	0.14235100	1.02752300	-1.89936100
C	-1.38743500	-0.76235500	0.56494300
N	-1.18162900	0.28198200	-0.47575900
O	0.42001700	-0.03865200	2.10844400
C	-0.29690500	0.14359700	3.32861600
H	-1.31268800	0.52327500	3.15947600
H	-0.35227800	-0.79772400	3.89330500
H	-2.08483900	-0.35477400	1.30348100
C	-2.04160500	-2.04975700	-0.01136100
H	-1.65964200	-2.93158700	0.51197000
H	-1.77492800	-2.14751800	-1.07294900
O	-3.45568300	-2.07685700	0.16422700
H	-3.76567900	-1.19339200	-0.13045500
H	-0.24277500	-1.98307800	1.91285000
C	0.65647500	1.92766200	-0.04505000
N	1.98911300	2.10969200	0.02839500
C	2.58189300	3.26261700	0.69593800
O	-0.16041100	2.74050600	0.39723600
C	-2.28405200	0.87092300	-1.01782700
O	-3.43207200	0.52107300	-0.67283500
C	-2.11758500	1.93455800	-2.08473300
H	2.60060800	1.36124800	-0.27029600
H	2.17729700	4.19007800	0.28088600
H	2.37958200	3.24466800	1.77293000
H	3.66068400	3.23796200	0.53333900
H	0.26367100	0.88087900	3.90743500
H	-3.10409500	2.34976900	-2.29636200
H	-1.44732800	2.73646600	-1.76839600
H	-1.72457600	1.49516500	-3.01002700

Pr-a (E = -994.103747)

C	1.29029300	-2.44842400	-0.62114300
C	0.96901300	-1.10037600	-0.38598500
C	1.93156400	-0.26758400	0.20206400
C	3.17992200	-0.79220100	0.56907100
C	3.48838200	-2.13187200	0.34563100
C	2.53599900	-2.95970700	-0.25899900
H	0.55716400	-3.09681700	-1.08807100
H	3.91118700	-0.13376800	1.03236800
H	4.45831200	-2.52654900	0.63562500
H	2.76126900	-4.00584800	-0.44868300
C	1.65685200	1.20082200	0.40501800
C	-0.40097100	-0.56740900	-0.82349400
H	-0.41717700	-0.59817000	-1.91751800
C	0.16668400	1.47159500	0.64107000
N	-0.64755700	0.82070500	-0.40171800
O	2.13501000	1.89283500	-0.75869800
C	2.44674900	3.26888600	-0.54574100
H	1.56040000	3.85805500	-0.27437400

H	3.20740100	3.38095800	0.23962500
H	-0.00976800	2.54008300	0.50910600
C	-0.27648300	1.11894000	2.07158800
H	0.21482500	1.80538300	2.77320700
H	-0.00084900	0.09631900	2.34755100
O	-1.70101500	1.19304000	2.21264200
H	-2.01797600	1.97183100	1.71581500
H	2.21672900	1.56023500	1.28054800
C	-1.53296300	-1.55208100	-0.40315600
N	-2.25549800	-1.25291100	0.68872400
C	-3.33083500	-2.12400900	1.15036400
O	-1.72322600	-2.57118700	-1.08395400
C	-1.68583400	1.54953000	-0.93271100
O	-2.03493500	2.62571000	-0.41939500
C	-2.39082100	1.02066800	-2.16512100
H	-2.10724600	-0.37284000	1.18710300
H	-4.10418200	-2.23388400	0.38247500
H	-2.94616800	-3.11852800	1.39821800
H	-3.77279500	-1.67791000	2.04299000
H	2.84400200	3.64514300	-1.49113400
H	-3.13208700	1.76011300	-2.47093800
H	-1.68895000	0.85389100	-2.98983900
H	-2.90470600	0.07390000	-1.96862000

Table S3: Cartesian coordinates of the final optimized geometries of intermediates (-a= alpha and -b=beta) at B3LYP/6-31+G(d) level of theory, in the presence of methanol as solvent, along with the total energies (E, in Hartrees) in parenthesis.

In1 (E = -632.640539)

C	-2.16998600	-1.40789800	0.77480800
C	-0.93674600	-0.76327400	0.55113500
C	-0.80366200	0.22584800	-0.45024800
C	-1.91523700	0.54849400	-1.22422000
C	-3.13671900	-0.10299700	-1.01092100
C	-3.26759100	-1.07750100	-0.01267100
H	-2.25260100	-2.16206800	1.55224300
H	-1.83326400	1.30923400	-1.99540900
H	-3.99250600	0.15232000	-1.62905000
H	-4.22015400	-1.57309500	0.14485600
C	0.50889600	0.97482400	-0.61869000
C	0.20920600	-1.11683600	1.33895800
H	0.11693500	-1.79613800	2.18175800
C	1.72970200	0.19695500	-0.07669900
N	1.39563200	-0.65307600	1.08343000
O	0.43155800	2.30463200	-0.10109500
C	0.19789400	2.45122200	1.30346900
H	-0.74208500	1.97798900	1.61112500
H	1.02801300	2.04512900	1.89541000
H	2.47356700	0.91878000	0.27429500
C	2.39189200	-0.68309600	-1.14619300
H	2.70562500	-0.03726100	-1.97575100
H	1.68091300	-1.42887800	-1.52453200
O	3.51162600	-1.30823700	-0.52507200
H	3.88153700	-1.97327600	-1.12727400
H	0.68295600	1.13745200	-1.68580300
H	0.13032800	3.52563900	1.48199100
H	2.17994600	-0.96989500	1.64909900

In2-b (E = -765.365116)

C	0.43099100	2.03038800	-1.56902400
C	0.25623400	0.87835700	-0.80004500
C	0.80043900	0.78470700	0.48950000
C	1.53620600	1.85649400	1.00020800
C	1.70927600	3.01702800	0.23736900
C	1.15661300	3.10499600	-1.04376100
H	0.01407800	2.09000700	-2.57147500
H	1.97567900	1.78429100	1.99216500
H	2.27836000	3.84934000	0.64188500
H	1.29619900	4.00340200	-1.63812200
C	0.56756800	-0.50793500	1.24277100
C	-0.47881100	-0.34769100	-1.32928200
H	-0.50775300	-0.31241100	-2.42469100
C	0.83609000	-1.71590300	0.33402400
N	0.04251200	-1.63886800	-0.90998100
O	-0.80067500	-0.63076100	1.66349000
C	-1.17167400	0.25159500	2.72388000
H	-1.09962600	1.30335800	2.41978600
H	-2.20844800	0.01616100	2.97249600
H	0.50696700	-2.60680400	0.88592900
C	2.33603900	-1.87037500	0.02561300
H	2.89383600	-2.04419500	0.95476000
H	2.72779400	-0.96945600	-0.45429600
O	2.56595100	-2.92903500	-0.91023200
H	2.43638800	-3.78150200	-0.46254600
H	1.22308100	-0.56414500	2.12270400
H	0.53216300	-2.09850800	-1.67244200
H	-0.53738100	0.08479000	3.60524300
C	-1.92083400	-0.28730900	-0.93255200
N	-3.04748300	-0.25912700	-0.71058100
C	-4.43988600	-0.24100300	-0.39506400
H	-4.98405900	-0.73022800	-1.20505000
H	-4.58641200	-0.77829600	0.54401800
H	-4.75777500	0.79843600	-0.29431700

In2-a (E = -765.357504)

C	-0.89068500	2.09261400	-0.59337600
C	-0.26943800	0.95494300	-0.08095700
C	1.12465700	0.78885200	-0.17718200
C	1.88485900	1.77489700	-0.80895600
C	1.26781000	2.92179500	-1.32307700
C	-0.11473800	3.08199000	-1.21054500
H	-1.96793000	2.22164000	-0.52658600
H	2.96160400	1.65029300	-0.89516400
H	1.86691500	3.68717600	-1.80815600
H	-0.59618500	3.97083100	-1.60811400
C	1.72645800	-0.45790900	0.44068000
C	-0.96463200	-0.25011300	0.54482900
H	-0.71759100	-0.30314300	1.61536200
C	0.92626700	-1.73557200	0.06421700
N	-0.53727300	-1.51617400	-0.07324500
O	1.69762600	-0.39829600	1.87810400
C	2.57641900	0.57014800	2.44998800
H	2.28784400	1.59275900	2.17696200
H	2.50205900	0.45022600	3.53293000
H	1.08345600	-2.44365800	0.88763100
C	1.48133700	-2.34058600	-1.23374900
H	2.52194300	-2.64643400	-1.06536200
H	1.46998200	-1.59331200	-2.03451300
O	0.70259600	-3.42995500	-1.72520800
H	0.75336000	-4.16604700	-1.09306700
H	2.77071700	-0.57255000	0.11573700
H	-0.77977300	-1.49829400	-1.06395700
H	3.61306200	0.38961800	2.13278200
C	-2.43060600	-0.19425600	0.50284300
N	-3.57714400	-0.17949800	0.48049100
C	-5.00593600	-0.16562800	0.45847000
H	-5.32982200	0.44100200	-0.38902700
H	-5.35347200	-1.19481800	0.35099900
H	-5.35767700	0.26337100	1.39854800

In3-b (E = -994.052726)

C	0.28506600	2.25735000	-1.02981200
C	0.61789100	0.99616600	-0.50915000
C	1.96985100	0.65036400	-0.36583800
C	2.96086700	1.57967500	-0.72385000
C	2.62452700	2.83522200	-1.22416500
C	1.27431200	3.17315800	-1.38204300
H	-0.76058900	2.52832200	-1.15677400
H	4.00673300	1.30333500	-0.60904900
H	3.40359500	3.54174400	-1.49783700
H	0.99492200	4.14566100	-1.77885000
C	2.39444000	-0.70790500	0.15739300
C	-0.48947200	-0.00323900	-0.18290100
H	-0.92236600	-0.32835100	-1.14395400
C	1.25285500	-1.73484300	0.05527700
N	0.02486600	-1.13850300	0.58934200
O	2.85176500	-0.52901400	1.50762700
C	3.74483000	-1.54028200	1.96423700
H	3.26328500	-2.52633500	2.01821100
H	4.62802200	-1.60942600	1.31232800
H	1.49095200	-2.57792500	0.71586000
C	1.14278500	-2.30247500	-1.37675600
H	2.09441700	-2.77446500	-1.65835600
H	0.93521900	-1.51327000	-2.10557200
O	0.06315700	-3.23364100	-1.50840000
H	0.28121100	-4.03806900	-1.00946300
H	3.24799300	-1.06318200	-0.44053600
H	-0.70887900	-1.84262400	0.63824100
H	4.05952000	-1.24716600	2.96869000
C	-1.63054900	0.65213800	0.60328900
N	-1.46903600	1.25602900	1.69222600
C	-2.57123500	1.86683500	2.41948100
H	-2.40906800	2.95081400	2.44496000
H	-3.56121900	1.66271000	1.99773400
H	-2.53681100	1.51241700	3.45515500

O	-2.89146800	0.62643500	-0.05314800
C	-3.49852300	-0.57911400	-0.25038100
O	-3.04832000	-1.61400400	0.20254000
C	-4.75027300	-0.43716600	-1.06806600
H	-5.27781700	-1.39099300	-1.10285600
H	-5.39726300	0.33621600	-0.64267200
H	-4.48798000	-0.12560600	-2.08548200

In3-a (E = -994.050273)

C	0.76182300	2.40360400	0.22225900
C	0.87892800	1.00406000	0.19257300
C	2.09244800	0.42163800	-0.19595900
C	3.16592800	1.25321600	-0.56152500
C	3.04427300	2.64002000	-0.53462800
C	1.83155900	3.21960000	-0.13635100
H	-0.17983400	2.85131700	0.53150600
H	4.10523400	0.79629900	-0.86440800
H	3.88423400	3.26751800	-0.82113500
H	1.72415900	4.30075100	-0.10613300
C	2.30187100	-1.08507400	-0.23332300
C	-0.30625600	0.15715900	0.61233300
H	-0.68761500	0.56621800	1.55713300
C	0.99978500	-1.88972300	-0.04721000
N	0.10345400	-1.22335800	0.90645500
O	3.35792400	-1.50355500	0.65338100
C	3.15491300	-1.28568900	2.04982400
H	2.96870000	-0.22675500	2.27013600
H	2.32012900	-1.88182700	2.43540600
H	1.27899200	-2.84008600	0.42715800
C	0.38833200	-2.24247700	-1.42217800
H	1.11015200	-2.84629700	-1.98965200
H	0.16796000	-1.34224200	-2.00001300
O	-0.85618500	-2.93949300	-1.29992100
H	-0.68045100	-3.83693500	-0.97266500
H	2.71829100	-1.34439700	-1.21320600
H	-0.71423700	-1.80349700	1.08008900
H	4.08175100	-1.59693100	2.53864100
C	-1.48429500	0.24739000	-0.36471600
N	-1.43653700	0.65451400	-1.55179000
C	-2.59992800	0.65987400	-2.42581200
H	-2.75320900	1.68212700	-2.78843700
H	-2.37398000	0.03844100	-3.29990800
H	-3.52293000	0.29838900	-1.95947500
O	-2.66544300	-0.31662400	0.20529800
C	-3.43432200	0.48014800	1.00382900
O	-3.18055400	1.65370200	1.19135400
C	-4.58843100	-0.28436200	1.58890500
H	-5.24707600	0.39815900	2.12729800
H	-5.14410400	-0.79850500	0.79855300
H	-4.21027800	-1.04838700	2.27743100

In4-b (E = -1225.533840)

C	3.66853300	-0.54850100	-1.41419900
C	2.44041700	-0.43583100	-0.75672000
C	2.05213400	-1.41027800	0.17610900
C	2.90045500	-2.49182700	0.43761500
C	4.13549300	-2.59748800	-0.20985800
C	4.52034500	-1.62194200	-1.13476500
H	3.95938900	0.19875600	-2.14876900
H	2.59218700	-3.25399400	1.14995500
H	4.78984300	-3.43893200	0.00171900
H	5.47552000	-1.70123900	-1.64713000
C	0.71766300	-1.24022100	0.86923100
C	1.45961400	0.67426000	-1.08051700
H	1.67026800	1.02779900	-2.09644800
C	-0.38331300	-0.80580500	-0.11365300
N	0.06149000	0.22864100	-1.07353100
O	0.76964200	-0.23655500	1.89778800
C	1.56526900	-0.59020900	3.02437900
H	1.43544800	0.20850600	3.75848200
H	1.22802300	-1.54257800	3.45950600
H	-1.19016800	-0.36479200	0.48850600

C	-0.96392500	-2.01292200	-0.88081800
H	-0.15440400	-2.59095700	-1.34164100
H	-1.61007100	-1.63888800	-1.68949600
O	-1.68549800	-2.89229800	-0.03519700
H	-2.58389000	-2.50849000	0.11849600
H	0.40455700	-2.18973600	1.32489800
H	-0.23402700	-0.00731500	-2.01724900
H	2.62827800	-0.67233200	2.76354700
C	1.57654500	1.91241800	-0.17556900
N	2.68674500	2.37290500	0.21471600
C	2.70802100	3.60073100	1.00589400
H	2.30536400	3.42285900	2.01221500
H	3.74217000	3.94025800	1.10724800
H	2.11477100	4.40247600	0.54697300
O	0.38169700	2.50461400	0.15928700
C	-0.83799300	2.17691600	-0.46845600
O	-1.77698500	1.91688400	0.27596200
C	-1.00302300	2.73865800	-1.85938700
H	-1.82237200	2.22852800	-2.37044100
H	-1.26460500	3.79993200	-1.75902900
H	-0.09218500	2.67165200	-2.45713200
H	-3.42977900	1.27919500	-0.03768600
O	-4.33139500	0.89077400	-0.10865200
H	-4.25468700	-0.85014800	0.16270300
O	-4.21722500	-1.83103500	0.29338200
C	-5.20991000	1.60806100	0.76756100
H	-6.20284800	1.16360800	0.66552900
H	-4.88631500	1.52574900	1.81283200
H	-5.26351900	2.66695000	0.48692300
C	-5.22400700	-2.44622500	-0.51670800
H	-5.15372900	-3.52581400	-0.36126300
H	-6.22600700	-2.11066300	-0.22117400
H	-5.07066800	-2.22906100	-1.58175600

In4-a (E = -1225.535194)

C	2.23979000	0.83739800	-2.48451000
C	1.77004500	0.39317000	-1.24577200
C	2.57627400	-0.42996100	-0.44228400
C	3.84937400	-0.79819100	-0.88681300
C	4.32416500	-0.33645900	-2.11962600
C	3.51977700	0.48030400	-2.92051500
H	1.60633400	1.46378700	-3.10889800
H	4.46261600	-1.45615500	-0.27910100
H	5.31651500	-0.62411600	-2.45765700
H	3.88330100	0.83178400	-3.88272500
C	1.95930200	-0.93107000	0.85217700
C	0.37908200	0.70675800	-0.72906900
H	-0.24957900	1.02172100	-1.56800600
C	0.55167200	-1.48927500	0.53712900
N	-0.27993700	-0.45691700	-0.11940100
O	2.72957900	-1.95664700	1.46583700
C	3.60160300	-1.50168300	2.49935600
H	4.15183100	-2.37735100	2.85150200
H	4.31381200	-0.75235300	2.12910900
H	0.70185300	-2.34793800	-0.13698300
C	-0.17013200	-2.00408800	1.78788100
H	-0.41361000	-1.15130100	2.43949700
H	0.47910100	-2.69038700	2.33764800
O	-1.34928400	-2.74778400	1.47234700
H	-1.87440900	-2.28841400	0.78124500
H	1.85036200	-0.09465700	1.56243500
H	-0.90946900	-0.89308700	-0.78729700
H	3.03026800	-1.07220600	3.33396300
C	0.40263900	1.91652700	0.23138000
N	1.27333500	2.82391600	0.17782100
C	1.23791200	3.98440200	1.05718600
H	2.07832700	3.91599400	1.75838300
H	1.39823700	4.88100100	0.44949700
H	0.30802600	4.09247300	1.62605800
O	-0.58566700	1.92122700	1.24047700
C	-1.89494000	1.78150100	0.92822500
O	-2.31790900	1.93441500	-0.20684700

C	-2.72204900	1.47327000	2.14212500
H	-3.77788800	1.64942200	1.93315100
H	-2.57637100	0.42034500	2.40945900
H	-2.39806700	2.08043200	2.99206900
H	-3.71462800	0.96507100	-0.95966700
O	-4.28902300	0.28815000	-1.37635700
H	-3.40967400	-1.21520200	-1.01860700
O	-2.81946100	-1.98731400	-0.83819600
C	-5.63181000	0.44568700	-0.89955100
H	-6.23990300	-0.31197700	-1.39888700
H	-5.69185600	0.29476800	0.18560500
H	-6.02234400	1.43901400	-1.15086300
C	-3.31243400	-3.13422100	-1.53571200
H	-4.31822800	-3.40967600	-1.19262700
H	-3.33650000	-2.95955800	-2.61901300
H	-2.62934100	-3.96121300	-1.32595500

In5-b (E = -1225.530548)

C	-2.45290500	2.29810100	0.27342300
C	-1.76881100	1.08345600	0.36573900
C	-2.46493600	-0.12929800	0.21755200
C	-3.83487800	-0.11667900	-0.05447200
C	-4.51780600	1.10112100	-0.14704500
C	-3.82961200	2.30553000	0.02251400
H	-1.91555700	3.23271200	0.40041000
H	-4.36563000	-1.05180200	-0.20232100
H	-5.58479900	1.10663300	-0.35350700
H	-4.35953000	3.25182300	-0.04678800
C	-1.62735300	-1.38926500	0.31327000
C	-0.27724500	0.93594400	0.63701300
H	-0.14546500	0.63202000	1.68280600
C	-0.41038100	-1.25952500	-0.63773900
N	0.38813300	-0.07057900	-0.24505700
O	-2.33950400	-2.57537300	-0.03248700
C	-2.97651100	-3.22510900	1.07592500
H	-3.51566600	-4.08029900	0.66398500
H	-2.22894200	-3.57399000	1.79961900
H	-0.81377000	-1.14083900	-1.65082900
C	0.47040300	-2.52361900	-0.63759200
H	0.68268900	-2.83016400	0.39829200
H	1.41917800	-2.30466700	-1.13097400
O	-0.12940700	-3.59491000	-1.36492400
H	-1.04270000	-3.67042900	-1.02853300
H	-1.24234000	-1.50411900	1.34034100
H	-3.68378800	-2.55463100	1.57716900
C	0.58315000	2.15583700	0.39176100
N	0.62395400	3.18792700	1.12371400
C	1.52151300	4.27577100	0.73190600
H	1.27990000	4.66271600	-0.26704900
H	1.42534300	5.09143000	1.45292900
H	2.56928500	3.94692400	0.71670000
O	1.33294700	1.96353900	-0.73067400
C	1.01332900	0.68922800	-1.36915900
O	2.16992700	0.10650600	-1.82978500
C	0.13554900	0.98355500	-2.58557600
H	-0.01322600	0.08589900	-3.19056500
H	-0.83686100	1.38198100	-2.28570800
H	0.64850400	1.72704700	-3.20163100
H	2.86030100	0.01838600	-1.11718000
O	2.42409700	-0.56862100	1.88741300
H	3.79196200	-0.39226200	0.77024200
C	2.25076900	-1.65203300	2.80961500
O	4.25549800	-0.17293100	-0.07345400
H	3.03757400	-1.55689300	3.56118900
H	1.27443100	-1.59322500	3.30520600
H	2.34876800	-2.62442200	2.31142300
C	5.14482600	-1.23993500	-0.42584600
H	4.60752400	-2.19096500	-0.53162900
H	5.59914400	-0.97886300	-1.38457400
H	5.93655200	-1.35283200	0.32463500
H	1.71942800	-0.58279000	1.19931100

In5-a (E = -1225.527316)

C	-1.88683500	-0.50104400	-2.30329900
C	-1.21412200	-0.52240000	-1.07337800
C	-1.27743700	-1.67317200	-0.26859300
C	-2.05535200	-2.76286700	-0.68838500
C	-2.73097800	-2.73448200	-1.90914100
C	-2.63920100	-1.59975200	-2.72173800
H	-1.82780700	0.38485500	-2.92757300
H	-2.14009500	-3.63671400	-0.04675300
H	-3.32654600	-3.58797300	-2.22182500
H	-3.15748700	-1.56673300	-3.67645000
C	-0.53057400	-1.71775200	1.05174900
C	-0.39371300	0.67706300	-0.65385700
H	0.35504000	0.84121800	-1.44098100
C	-0.36135300	-0.30928200	1.63157700
N	0.33659200	0.51278200	0.62172900
O	0.78174900	-2.30868000	0.93121100
C	0.79084500	-3.73744800	0.86335300
H	1.83797700	-4.04455900	0.90485500
H	0.25176100	-4.16686700	1.71792500
H	0.29908600	-0.38457700	2.49976700
C	-1.73201800	0.20224600	2.13922400
H	-2.52562900	-0.00525000	1.41092300
H	-1.70945000	1.28217000	2.31143000
O	-1.99238600	-0.49208600	3.36686300
H	-2.88796300	-0.26812400	3.66595700
H	-1.09764600	-2.31616200	1.77529200
H	0.34575700	-4.09977800	-0.07074900
C	-1.10046500	2.02741200	-0.46085800
N	-2.10096000	2.47361500	-1.09761100
C	-2.56494600	3.82578800	-0.78228800
H	-1.79065800	4.57721000	-0.98922500
H	-3.44040700	4.05391200	-1.39640200
H	-2.84729400	3.92392200	0.27494600
O	-0.42331700	2.70579000	0.50965900
C	0.72404100	1.86800700	0.98205200
O	1.85975500	2.28593700	0.29317700
C	0.95081600	2.17654900	2.45115700
H	1.26676200	3.22034000	2.52689500
H	0.06084400	2.03772400	3.06461900
H	1.75890800	1.54656500	2.83336500
H	2.23841800	-1.66961400	0.01542000
O	2.68651700	0.77322100	-1.82138400
H	2.89890100	-0.09068400	-1.38252100
C	3.85572600	1.28885000	-2.46724000
O	3.09912600	-1.54767200	-0.44761400
H	4.20328700	0.60444600	-3.25079700
H	3.58071000	2.24183200	-2.92595300
H	4.66798500	1.45893200	-1.74896200
C	4.14577100	-1.48541000	0.53006000
H	4.01549100	-0.62760400	1.20152500
H	4.18368900	-2.40691500	1.12334500
H	5.08766700	-1.37493000	-0.01247100
H	2.07651000	1.70266500	-0.48209500

In6-b (E = -1225.532427)

C	2.73960700	1.95078000	-1.20667000
C	2.18237900	0.81097000	-0.61090700
C	3.02392100	-0.13438100	0.00963900
C	4.41049500	0.08788800	0.00723300
C	4.95911500	1.23547100	-0.56656800
C	4.11689200	2.17432500	-1.17030000
H	2.08574300	2.66451400	-1.69716200
H	5.06827300	-0.65620100	0.44989300
H	6.03490100	1.38905900	-0.55394900
H	4.53148700	3.06903200	-1.62743700
C	2.46364700	-1.38686900	0.67145300
C	0.70427900	0.51619700	-0.77212600
H	0.52233200	0.34568300	-1.85188000
C	1.11165400	-1.80931400	0.06560100
N	0.27921600	-0.61185500	0.04145400
O	2.22217400	-1.19992800	2.07709800

C	3.38540800	-1.15186000	2.89532900
H	3.03287300	-1.14294700	3.92971600
H	4.01898300	-2.03720500	2.73693000
H	0.65693100	-2.52118400	0.76050400
C	1.26971800	-2.51820900	-1.29517200
H	2.00353600	-3.32444000	-1.19728200
H	1.64463900	-1.81865700	-2.05669100
O	0.05926800	-3.13228500	-1.73365800
H	-0.66316800	-2.47264400	-1.66231700
H	3.18564500	-2.20895500	0.55609800
H	3.97989400	-0.24752000	2.71299300
C	-0.32100700	1.55312100	-0.33128900
N	-0.23885000	2.80851400	-0.42855300
C	-1.35500500	3.63495600	0.02791800
H	-1.64283400	3.40414600	1.06245500
H	-1.05982700	4.68622400	-0.02016500
H	-2.23832700	3.50014800	-0.61034600
O	-1.40644400	0.86840600	0.17979100
C	-1.14377000	-0.58012700	0.14177600
O	-1.73770400	-1.09443300	-1.03465400
C	-1.72024100	-1.20343600	1.40231300
H	-1.52760500	-2.27963400	1.41042300
H	-1.26993000	-0.74916300	2.28785500
H	-2.80333700	-1.05566600	1.43303700
H	-3.33248000	1.47166700	0.45625700
H	-2.73352400	-1.08441000	-0.98345900
O	-4.44984700	-0.88396000	-1.00932800
H	-4.59642000	-0.05797500	-0.48862800
C	-5.34006800	-1.91285900	-0.56013100
O	-4.30569700	1.47886200	0.38385200
H	-6.38450700	-1.62251300	-0.72474000
H	-5.12279100	-2.80723500	-1.14856200
H	-5.18936500	-2.13821200	0.50309000
C	-4.88480200	1.79742800	1.65815700
H	-4.60803900	1.05816900	2.41924900
H	-4.57468700	2.79557900	1.98805300
H	-5.96827900	1.78592700	1.52341100

In6-a (E = -1225.526989)

C	2.36712100	2.52557700	0.05266500
C	1.97532100	1.19402500	0.19776900
C	2.94302100	0.16948200	0.19501500
C	4.29214700	0.49175700	0.02847400
C	4.68669100	1.82733600	-0.11683200
C	3.72438300	2.83953500	-0.10062600
H	1.61589400	3.30763900	0.05842400
H	5.03718400	-0.30096400	0.01343400
H	5.73821800	2.07289600	-0.24041300
H	4.02512900	3.87821600	-0.21254100
C	2.46225900	-1.25934900	0.37851300
C	0.55906200	0.69254100	0.35967700
H	0.43798500	0.35173400	1.40269100
C	1.24732300	-1.56852100	-0.52457700
N	0.32944600	-0.41825300	-0.58684800
O	2.05024800	-1.52127600	1.73157700
C	3.12056500	-1.55488000	2.67120000
H	2.68244600	-1.83878000	3.63097400
H	3.87431900	-2.30134500	2.38042400
H	0.74509300	-2.44582600	-0.09669200
C	1.72071200	-1.91090000	-1.94595700
H	2.37882100	-1.11412000	-2.31925500
H	0.85851700	-1.98181000	-2.61668100
O	2.41543600	-3.16330500	-1.89424500
H	2.74161000	-3.37385100	-2.78321500
H	3.26556600	-1.96031500	0.11752100
H	3.60699100	-0.57590200	2.77143400
C	-0.63537600	1.56381900	0.04918700
N	-0.76907300	2.80047400	0.27996300
C	-2.03372400	3.45334300	-0.05138600
H	-2.80789700	3.20034300	0.68578100
H	-1.89104400	4.53694000	-0.02270500
H	-2.40320000	3.17899900	-1.04867300

O	-1.60537000	0.75401200	-0.50011300
C	-1.10036100	-0.63473100	-0.59402500
O	-1.49485800	-1.33374700	0.54833900
C	-1.66458500	-1.23310400	-1.87363800
H	-2.75807600	-1.22758900	-1.84002900
H	-1.33309700	-0.65844500	-2.74165900
H	-1.33596800	-2.27117300	-1.97513600
H	-3.66343700	0.94777500	-0.55474300
O	-4.19695900	-1.83960300	0.52995100
H	-4.51736800	-0.97409600	0.17933700
C	-4.75582800	-2.06563900	1.83044000
O	-4.58208700	0.62563400	-0.62498100
H	-5.84828200	-2.14485900	1.77758700
H	-4.34854200	-3.01075300	2.19716600
H	-4.48317800	-1.26339400	2.52774800
C	-5.49694200	1.63918800	-0.18229600
H	-5.31611600	1.91068300	0.86458300
H	-5.42414200	2.53332200	-0.81183400
H	-6.50011300	1.21812900	-0.27538400
H	-2.46195200	-1.55959700	0.51420400

In7-b (E = -1225.553163)

C	-2.35542700	-1.80113900	-1.47574700
C	-1.88589300	-0.73696900	-0.69119100
C	-2.66821600	-0.27809100	0.37931900
C	-3.90349700	-0.88755900	0.64605700
C	-4.35621000	-1.95859900	-0.12420400
C	-3.57630500	-2.41393600	-1.19262600
H	-1.75416500	-2.15066000	-2.30992100
H	-4.51923500	-0.50617500	1.45758000
H	-5.31340500	-2.42339700	0.09602300
H	-3.92235900	-3.23778200	-1.81117500
C	-2.20481200	0.92062800	1.17920800
C	-0.53227600	-0.11930300	-1.05262200
H	-0.51291600	0.05511300	-2.13348600
C	-1.40348500	1.87127800	0.28592500
N	-0.28208400	1.16214700	-0.35501800
O	-1.36119900	0.59234800	2.28845900
C	-2.01738600	-0.08371700	3.35614200
H	-1.28390600	-0.17430800	4.16068600
H	-2.88228500	0.49250100	3.71675300
H	-0.98138600	2.63786300	0.93363400
C	-2.30776200	2.57929000	-0.74732400
H	-3.08655200	3.12659200	-0.20785700
H	-2.79801700	1.85646900	-1.40926900
O	-1.59453500	3.55254700	-1.51034400
H	-1.13444800	3.10868400	-2.24009500
H	-3.08364000	1.46273400	1.56098600
H	-2.35178300	-1.08598300	3.05945700
C	0.56969900	-1.16138900	-0.80272500
N	0.92398800	-1.90811000	-1.77297800
C	1.85085400	-3.00994400	-1.53863000
H	1.67135400	-3.53641300	-0.58985800
H	1.75156400	-3.73147400	-2.35541200
H	2.89095300	-2.65798400	-1.53274100
O	0.95661500	-1.22090300	0.48911600
C	0.95209500	1.72405100	-0.48112600
O	1.81601500	1.18937400	-1.20537700
C	1.28262700	2.99363000	0.28143100
H	0.66459400	3.83338700	-0.04927700
H	1.13714500	2.86601500	1.35963100
H	2.33051800	3.23075700	0.09185800
H	1.87194200	-1.60096400	0.61760800
H	3.48710500	0.68629900	-0.81025400
O	4.34308000	0.24841700	-0.59247100
H	3.93479300	-1.05977300	0.51184500
C	5.32753700	1.24109100	-0.28642200
O	3.53182300	-1.79838700	1.03612000
H	6.25706500	0.71467700	-0.05639000
H	5.49733500	1.90247900	-1.14499500
H	5.03406500	1.84416800	0.58228300

C	3.80508600	-1.59223900	2.42757200
H	3.39933500	-0.63460500	2.77798200
H	3.32468600	-2.40554900	2.97685700
H	4.88415300	-1.62058000	2.62127800

In7-a (E = -1225.553828)

C	-1.66177000	2.53215600	-0.59450000
C	-1.62279900	1.14111300	-0.41651100
C	-2.78754100	0.47943100	0.00647700
C	-3.94904500	1.21428900	0.28042900
C	-3.97975900	2.59831800	0.10637800
C	-2.82965400	3.25473900	-0.34043500
H	-0.77211500	3.05161200	-0.93419600
H	-4.83358800	0.69107200	0.63675100
H	-4.88744100	3.15694900	0.31813200
H	-2.83526900	4.33190900	-0.48542100
C	-2.76612500	-1.02094500	0.17214900
C	-0.33777800	0.36903100	-0.74234800
H	-0.25503200	0.30565900	-1.83210000
C	-1.40179400	-1.48457000	0.68569500
N	-0.34727600	-1.02094000	-0.23002400
O	-2.97684600	-1.71825400	-1.06600400
C	-4.31022900	-1.65495800	-1.56310600
H	-4.34022400	-2.29328700	-2.44929100
H	-5.02673200	-2.03211600	-0.81889000
H	-1.41440900	-2.57385600	0.65609600
C	-1.12108700	-1.05879300	2.13502700
H	-1.17005400	0.03079700	2.24253700
H	-0.11037600	-1.38249700	2.41123700
O	-2.10237700	-1.69647800	2.96020400
H	-1.95363100	-1.42814900	3.88065400
H	-3.53460000	-1.33145000	0.89146800
H	-4.59144000	-0.63246300	-1.84625800
C	0.91932400	1.12739800	-0.29391300
N	1.45392300	1.96020800	-1.09622100
C	2.57537300	2.78286400	-0.65736100
H	3.52745900	2.26589800	-0.83376900
H	2.58861600	3.70233800	-1.25093400
H	2.53093900	3.05917600	0.40597800
O	1.27639600	0.84094700	0.97902700
C	0.66790700	-1.82827000	-0.63450600
O	1.55083800	-1.39420900	-1.40382500
C	0.72345900	-3.26519200	-0.15157900
H	1.65773500	-3.70062300	-0.50907100
H	0.69114500	-3.34272300	0.93956800
H	-0.10984200	-3.85033800	-0.55709200
H	2.25606700	0.93419600	1.14731500
O	4.21203000	-1.30136600	-0.59166800
H	4.10797900	-0.14575600	0.74503600
C	5.07806100	-1.02833300	-1.69967100
O	3.86935900	0.46425200	1.48872700
H	6.09322500	-0.94503400	-1.30413300
H	5.04719800	-1.84536000	-2.43073400
H	4.80865800	-0.08790500	-2.19678900
C	4.98144900	1.30027200	1.82145300
H	5.27639400	1.93403300	0.97558000
H	4.67093200	1.93833900	2.65231900
H	5.84081300	0.69691000	2.13829600
H	3.28792700	-1.39264000	-0.92233400

Table S4: Cartesian coordinates of the final optimized geometries of transition states (-a= alpha and -b=beta) at B3LYP/6-31+G(d) level of theory, in the presence of methanol as solvent, along with the total energies (E, in Hartrees) in parenthesis (**TS2-a**: optimized using gas phase).

TS1-b (E = -765.356603)

C	0.54101100	2.08283200	-1.60180400
C	0.36794400	0.90643400	-0.86845900
C	0.96092600	0.75261100	0.39548700
C	1.74695100	1.78622100	0.90891700
C	1.92530900	2.96616200	0.17713500
C	1.31967200	3.11678800	-1.07384900
H	0.08270200	2.18720000	-2.58200400
H	2.22148700	1.67199000	1.88044600
H	2.53739100	3.76600300	0.58427400
H	1.45997400	4.03160900	-1.64218500
C	0.66907900	-0.52317100	1.16066800
C	-0.37655000	-0.25303200	-1.43515300
H	-0.61572500	-0.18791400	-2.49320300
C	0.69656100	-1.75549200	0.24544600
N	0.04579500	-1.47364500	-1.04228300
O	-0.64714400	-0.49508700	1.73319500
C	-0.80030800	0.40588000	2.82999900
H	-0.68219200	1.45124800	2.51888100
H	-1.81235200	0.25487900	3.21108200
H	0.12242000	-2.54137400	0.74995000
C	2.11416700	-2.28214800	0.00640100
H	2.57939500	-2.51647600	0.97292200
H	2.72193300	-1.52744600	-0.50899000
O	1.98825100	-3.46214600	-0.79142900
H	2.87341600	-3.76066400	-1.05324700
H	1.40619700	-0.66038700	1.96378900
H	-0.23363200	-2.27902000	-1.58836200
H	-0.07377900	0.17968900	3.62291800
C	-2.15714300	0.02734600	-0.86941100
N	-3.27205700	-0.04352500	-0.56364100
C	-4.64085500	-0.12380500	-0.16402500
H	-5.17458500	-0.76797900	-0.86563900
H	-4.68809700	-0.54306600	0.84308800
H	-5.07015200	0.88001500	-0.17448600

TS1-a (E = -765.354277)

C	0.34385800	2.40525400	0.61355000
C	0.36394500	1.00783200	0.52431100
C	1.30659300	0.35864100	-0.29323000
C	2.19323000	1.13983300	-1.04667700
C	2.16787800	2.53349300	-0.96454700
C	1.24931400	3.16863000	-0.12174000
H	-0.38919300	2.89648500	1.24922400
H	2.90542600	0.65292600	-1.70764600
H	2.86271000	3.12256500	-1.55638800
H	1.23100900	4.25189000	-0.04693400
C	1.40236700	-1.16015900	-0.30100500
C	-0.62986800	0.19688400	1.29767600
H	-0.86855400	0.56200700	2.29376700
C	0.05690800	-1.81128600	0.04038100
N	-0.50076100	-1.14688900	1.22427400
O	2.33119400	-1.63454900	0.68312600
C	3.70954500	-1.45498500	0.36546000
H	3.99927900	-0.39688100	0.37809700
H	4.27100400	-1.98706600	1.13665800
H	0.25832900	-2.84349800	0.34033700
C	-0.91409600	-1.82665400	-1.15560600
H	-0.45862400	-2.39518800	-1.97619100
H	-1.10627900	-0.81416700	-1.52213400
O	-2.18777100	-2.36207000	-0.80249700
H	-2.11244200	-3.32580600	-0.70906300
H	1.72831300	-1.50463700	-1.29311700
H	-1.06932500	-1.70948400	1.84464900
H	3.94574400	-1.88505100	-0.61820600
C	-2.27805500	0.71795500	0.56168500

N	-3.35812600	0.79653900	0.15291400
C	-4.68726500	0.89724200	-0.36033300
H	-4.63459800	1.12242400	-1.42728500
H	-5.19674500	-0.05508700	-0.19981500
H	-5.20734200	1.69789500	0.16916300

TS2-b (E = -994.012162)

C	-1.14034200	-1.98467100	-1.28571300
C	-1.07404500	-0.74743700	-0.62678800
C	-2.24992400	-0.03275300	-0.35616300
C	-3.48229000	-0.59031500	-0.73540300
C	-3.55003300	-1.82909900	-1.36887900
C	-2.37004900	-2.52816200	-1.65116400
H	-0.22676400	-2.52875600	-1.51413200
H	-4.39401000	-0.03464200	-0.52970500
H	-4.51323200	-2.24337100	-1.65390400
H	-2.40779800	-3.48914900	-2.15645800
C	-2.23923600	1.34638900	0.28945800
C	0.28658500	-0.14714100	-0.26292400
H	0.83510700	0.10555900	-1.18073400
C	-0.83075400	1.96689100	0.31815100
N	0.17157000	0.95895600	0.68607300
O	-2.90794300	1.36620500	1.56096600
C	-2.36158100	0.56192400	2.60817500
H	-2.27910700	-0.49006900	2.30642500
H	-1.37649400	0.92180300	2.92305700
H	-0.81774400	2.71012000	1.12506600
C	-0.53631900	2.70913900	-1.00490300
H	-1.28360200	3.50085700	-1.15169700
H	-0.59815900	2.03164600	-1.86279900
O	0.78576200	3.25015300	-1.04087100
H	0.83836800	3.99429700	-0.41870000
H	-2.88031800	1.99982000	-0.31259300
H	1.10253800	1.37094500	0.76905400
H	-3.06535100	0.64222700	3.44059800
C	1.10731000	-1.18031800	0.42460500
N	1.41777000	-2.06371100	1.10034300
C	2.08483100	-3.08810100	1.83119200
H	2.06908100	-2.82712000	2.89153000
H	1.56072400	-4.03308300	1.67441900
H	3.11467400	-3.15845300	1.47173500
O	3.15138000	-0.82986300	-0.99796300
C	3.66134500	0.11424000	-0.32015100
O	3.09224700	0.67985100	0.66316100
C	5.04286500	0.62994700	-0.73628100
H	5.61214800	0.97204700	0.13352500
H	5.60996600	-0.13510000	-1.27450400
H	4.91283900	1.48972800	-1.40670400

TS2-a (E = -994.011188)

C	0.66628900	2.40488200	-0.13938600
C	0.85492000	1.02522300	0.04024100
C	2.10481700	0.44964300	-0.21981400
C	3.15516000	1.27447300	-0.65634200
C	2.96837600	2.64245400	-0.83444600
C	1.71479200	3.21082100	-0.57422900
H	-0.30952400	2.83869500	0.06651100
H	4.12793200	0.82671900	-0.84690400
H	3.79185500	3.26496500	-1.17499900
H	1.55797900	4.27792600	-0.70877600
C	2.37459800	-1.03488500	-0.02714100
C	-0.30951000	0.18396900	0.54360700
H	-0.72117400	0.66840100	1.43123000
C	1.08329800	-1.86679800	0.10551400
N	0.09026500	-1.16116700	0.91990600
O	3.32386100	-1.28871800	1.01804000
C	2.98836000	-0.84008700	2.32940200
H	2.84745300	0.24875300	2.35919400
H	2.08210700	-1.32619300	2.70835000
H	1.35008900	-2.76399400	0.68226800
C	0.60720200	-2.34926400	-1.28376500
H	1.40147700	-2.95854400	-1.74187400

H	0.40549500	-1.50510100	-1.94701300
O	-0.61501800	-3.08306300	-1.21840100
H	-0.44326900	-3.95165800	-0.82214900
H	2.91318600	-1.39641100	-0.91116700
H	-0.73923900	-1.72756100	1.08379000
H	3.84209700	-1.10724600	2.95771300
C	-1.44146800	0.19356100	-0.47148200
N	-1.64124000	0.03478200	-1.64330000
C	-2.79045100	-0.05928800	-2.50239500
H	-2.49452800	0.14073700	-3.53470900
H	-3.19604300	-1.07411800	-2.43557700
H	-3.55015200	0.66413900	-2.18634400
O	-2.90096300	-0.66380500	0.80151400
C	-3.35810300	0.50445200	0.98827600
O	-2.82638500	1.50597600	0.41925300
C	-4.52719500	0.71167900	1.93177900
H	-5.11123100	1.58701400	1.63658400
H	-5.15927200	-0.17915100	1.96385100
H	-4.13687600	0.88918300	2.94161800

TS3-b (E = -1225.501507)

C	-2.39658200	2.34105800	0.20045700
C	-1.73724500	1.11714900	0.34176200
C	-2.45441700	-0.08747400	0.23160700
C	-3.82145300	-0.05759200	-0.05167200
C	-4.48017300	1.16828700	-0.19081000
C	-3.77037500	2.36457000	-0.05995700
H	-1.84277000	3.26843900	0.30048500
H	-4.36759500	-0.98729800	-0.17279200
H	-5.54536700	1.18620900	-0.40453400
H	-4.28085200	3.31768400	-0.16650900
C	-1.64909400	-1.36610900	0.36170700
C	-0.26003300	0.98357200	0.65911900
H	-0.13294100	0.69941600	1.70918500
C	-0.42380700	-1.27109500	-0.58220900
N	0.42374900	-0.09919300	-0.15555700
O	-2.37507000	-2.53654600	0.00800600
C	-3.02356300	-3.18787200	1.11130000
H	-3.56810100	-4.03433100	0.68945200
H	-2.28168000	-3.54809000	1.83451700
H	-0.79567200	-1.08166800	-1.59067600
C	0.41982800	-2.56033300	-0.61821900
H	0.59448100	-2.92698700	0.40262600
H	1.38688900	-2.35598100	-1.08187100
O	-0.21169000	-3.55495700	-1.41626400
H	-1.11731300	-3.65346000	-1.06607600
H	-1.28061700	-1.48018100	1.39424800
H	-3.72651200	-2.51297400	1.61208300
C	0.63811400	2.17659600	0.38799600
N	0.61853200	3.25037400	1.05174800
C	1.55222600	4.31785300	0.69231900
H	1.23669700	5.24220700	1.18238800
H	2.56387200	4.07370300	1.04213800
H	1.60172100	4.48614200	-0.39074400
O	1.49930900	1.89878200	-0.63552500
C	1.18753700	0.65233200	-1.31913900
O	2.29770600	0.01056100	-1.68708100
C	0.30102400	0.94844500	-2.52077900
H	0.15653800	0.05302600	-3.12912400
H	-0.66974500	1.35961100	-2.23361500
H	0.82830200	1.68937700	-3.12772400
H	3.07980100	-0.05393900	-0.93131300
O	2.25804900	-0.62365300	1.60512900
H	3.26205800	-0.48780000	0.91445000
C	2.28837300	-1.70765400	2.51398100
O	4.05181200	-0.22357700	0.05587800
H	2.51803900	-2.66328200	2.01545600
H	3.04797800	-1.54244400	3.29300600
H	1.31454900	-1.81135500	3.01264700
C	4.93223700	-1.30233500	-0.23054100
H	4.38394600	-2.22568100	-0.47538900
H	5.56773300	-1.04353800	-1.08708400

H	5.58416900	-1.50730000	0.62982600
H	1.20992800	-0.45903200	0.54891300

TS3-a (E = -1225.493859)

C	-1.84988700	0.60424000	-2.34628200
C	-1.33193300	0.19254200	-1.10994400
C	-2.07532400	-0.68770600	-0.30485600
C	-3.34909800	-1.09516300	-0.73118500
C	-3.86592900	-0.67415200	-1.95716000
C	-3.10664300	0.17240900	-2.77183300
H	-1.26738800	1.27468800	-2.97062300
H	-3.94363300	-1.74221600	-0.09065600
H	-4.85230000	-1.00252900	-2.27387800
H	-3.49468400	0.50143800	-3.73228700
C	-1.50493600	-1.18536400	1.01333700
C	0.02632100	0.69716500	-0.67788800
H	0.73168300	0.50234200	-1.49474900
C	-0.47699600	-0.19684300	1.57884000
N	0.57152400	0.03871200	0.53715800
O	-0.83667800	-2.45025600	0.89708000
C	-1.68534700	-3.57818800	0.71596600
H	-1.04548200	-4.46116200	0.78719000
H	-2.45378200	-3.62382400	1.50155700
H	0.02384900	-0.68877300	2.41658900
C	-1.21899000	1.03536300	2.14608200
H	-1.97009000	1.40514800	1.43710400
H	-0.53051900	1.85279300	2.36617600
O	-1.85865800	0.58752600	3.35151700
H	-2.39496000	1.31600400	3.70271100
H	-2.31651300	-1.28906100	1.74611400
H	-2.17408700	-3.56943600	-0.26643200
C	0.17015700	2.19666700	-0.35493800
N	-0.45291000	3.13986100	-0.94072900
C	-0.13371100	4.50755700	-0.53044000
H	0.93407900	4.73611100	-0.65653400
H	-0.71146800	5.20767600	-1.14102200
H	-0.38452100	4.68467100	0.52525900
O	1.08274800	2.33902900	0.62238900
C	1.73883900	0.94405500	0.91166100
O	2.78382500	0.79337500	0.13631100
C	2.09909100	0.94850900	2.39605500
H	2.91092400	1.66824000	2.53095500
H	1.28344000	1.21538400	3.06949700
H	2.47652100	-0.04235100	2.66959200
H	1.20151600	-1.40817700	0.00416500
O	3.11792700	-0.71678200	-1.81741600
H	2.44769500	-1.62380400	-1.16786200
C	4.50696400	-0.97928900	-2.08855600
O	1.71040500	-2.17310300	-0.49813500
H	4.55932700	-1.82084400	-2.78266700
H	4.95527700	-0.09652600	-2.55322400
H	5.04654700	-1.22549700	-1.16735600
C	2.33927600	-3.09001700	0.43637100
H	3.09237400	-2.56773000	1.03249900
H	1.55563800	-3.49595700	1.07488500
H	2.80051400	-3.88320100	-0.15267000
H	3.00207600	0.01757100	-1.07469400

TS4-b (E = -1225.522405)

C	2.76302700	0.80826400	-2.09378200
C	2.10547500	0.29556300	-0.97051700
C	2.84256000	-0.00559400	0.18525800
C	4.22485600	0.21073400	0.20507000
C	4.87540400	0.74388200	-0.91146100
C	4.14060900	1.04265900	-2.06301800
H	2.19553800	1.02670900	-2.99485000
H	4.79489200	-0.04631100	1.09526800
H	5.94843300	0.91376600	-0.88638100
H	4.63957500	1.44626200	-2.94007800
C	2.10497200	-0.60837600	1.36142800
C	0.61636500	0.06397300	-0.99880700
H	0.30915500	-0.11301700	-2.03343600

C	1.07396800	-1.63588200	0.87605700
N	0.19224300	-1.09618300	-0.18095000
O	1.38529600	0.35927900	2.13314500
C	2.21126900	1.26236500	2.86275400
H	1.53822400	1.88824400	3.45304600
H	2.88780100	0.71810900	3.53798800
H	0.45970500	-1.91405600	1.73269100
C	1.75948900	-2.91782700	0.35923600
H	2.33388000	-3.36959100	1.17293800
H	2.44671900	-2.68471200	-0.46322800
O	0.80978700	-3.90135900	-0.04690300
H	0.38579400	-3.58990500	-0.86389500
H	2.81893600	-1.12539400	2.02048700
H	2.80503100	1.89918900	2.19490900
C	-0.26148000	1.25823600	-0.47702300
N	0.10081000	2.46029300	-0.76750900
C	-0.78843600	3.52957500	-0.31968900
H	-0.99744800	3.47880900	0.76019600
H	-0.32171800	4.49773500	-0.53046500
H	-1.75876900	3.50529100	-0.83885600
O	-1.32297100	0.85676300	0.16989300
C	-1.16266400	-1.14456600	-0.08496400
O	-1.78447500	-1.21882200	-1.25768600
C	-1.88076900	-1.66928500	1.12477000
H	-1.77603100	-2.75900100	1.17534600
H	-1.49909500	-1.22474600	2.04423000
H	-2.94339200	-1.43603600	1.03747500
H	-2.96190900	1.52516400	0.18329200
H	-2.78166500	-1.07608000	-1.18349700
O	-4.34875900	-0.62468800	-1.22823300
H	-4.38394000	0.22236700	-0.70994600
C	-5.44494800	-1.47948900	-0.87902300
O	-3.93768100	1.68293000	0.12557400
H	-5.43650100	-1.72643500	0.18982800
H	-6.39869400	-1.00378900	-1.13426600
H	-5.33756100	-2.39818100	-1.46002300
C	-4.45121400	1.97751900	1.42862900
H	-4.25961500	1.15646300	2.13136700
H	-4.00861500	2.90022100	1.82367500
H	-5.53058100	2.11683200	1.32955500

TS5-b (E = -1225.526456)

C	-2.54390500	-1.74069800	-1.35228800
C	-1.95172400	-0.68498900	-0.63969600
C	-2.69821800	-0.03711400	0.35712400
C	-4.01102900	-0.45386100	0.62727400
C	-4.58343900	-1.51862600	-0.06675500
C	-3.84253600	-2.16063400	-1.06579800
H	-1.96781900	-2.23650400	-2.12717500
H	-4.58989300	0.07589700	1.38052000
H	-5.59963100	-1.83332000	0.15508900
H	-4.27973100	-2.98117300	-1.62897500
C	-2.11540900	1.16457000	1.06788200
C	-0.52056200	-0.29819000	-0.99344700
H	-0.43907900	-0.22368400	-2.08158400
C	-1.16297400	1.91955900	0.14021800
N	-0.13139300	1.01567300	-0.41017600
O	-1.36979300	0.85664600	2.25077400
C	-2.14586500	0.35394300	3.33398300
H	-1.46490900	0.26182300	4.18320700
H	-2.95827400	1.04865800	3.59380700
H	-0.65873800	2.67294200	0.74292600
C	-1.91965100	2.65282600	-0.98981400
H	-2.62716800	3.34902600	-0.52941700
H	-2.48677400	1.95020700	-1.60962800
O	-1.03974100	3.43868100	-1.79305800
H	-0.70987700	2.89955800	-2.52871100
H	-2.93255200	1.84838800	1.34539500
H	-2.57313400	-0.63086800	3.10676900
C	0.46123200	-1.44753400	-0.56788400
N	0.62780300	-2.34731000	-1.49455600
C	1.42936500	-3.50505600	-1.11242700

H	1.09446100	-3.96353900	-0.16746800
H	1.36506900	-4.26422700	-1.90095700
H	2.49466600	-3.25520800	-0.98187800
O	0.93386400	-1.41386300	0.62760300
C	1.13541900	1.41501900	-0.53414000
O	1.91812400	0.73369700	-1.27858600
C	1.65120900	2.64875100	0.16630600
H	1.19071300	3.54897200	-0.25109300
H	1.44395700	2.62037200	1.24023100
H	2.72887500	2.71783500	0.01492500
H	2.51438800	-1.57002300	0.91863300
H	3.10282300	0.57941000	-0.99031900
O	4.17661900	0.15664400	-0.71537400
H	4.02009800	-0.50617700	0.06162200
C	5.22880400	1.11205900	-0.43969800
O	3.51236100	-1.53496600	1.09673100
H	6.17371900	0.56979400	-0.37373400
H	5.26008000	1.80925100	-1.27778600
H	5.03304600	1.64684100	0.49381500
C	3.74007200	-1.26878300	2.48672700
H	3.30691300	-0.30605100	2.78559000
H	3.30692800	-2.06588200	3.10160700
H	4.82076000	-1.24301900	2.64757900

TS5-a (E = -1225.519321)

C	-1.71700400	-2.04814800	-1.93576100
C	-1.50261500	-1.02885900	-1.00221000
C	-2.56945400	-0.20474300	-0.61717500
C	-3.83809200	-0.39833300	-1.16958500
C	-4.05141700	-1.42848500	-2.09241900
C	-2.99152500	-2.25838600	-2.47146300
H	-0.88561400	-2.67727200	-2.24685200
H	-4.65555700	0.25544200	-0.88146600
H	-5.04099900	-1.57789600	-2.51675900
H	-3.15194700	-3.05646400	-3.19176900
C	-2.26480800	0.83970000	0.43169600
C	-0.12688100	-0.74456500	-0.45121800
H	0.61217300	-1.14509400	-1.14293800
C	-0.97334600	1.63472000	0.09760000
N	0.08220200	0.74395200	-0.47494600
C	0.24634500	-1.34714900	0.93636800
N	-0.69246900	-2.00092500	1.55836100
C	-0.28805900	-2.61499000	2.81843400
H	0.00286600	-1.86676300	3.57415000
H	-1.12594600	-3.19358700	3.22475200
H	0.57236600	-3.29405700	2.70312100
O	1.46945500	-1.16898700	1.30021200
C	1.13325900	1.22831700	-1.12969000
O	1.94701200	0.40815100	-1.69358600
C	1.40532200	2.70292600	-1.27516100
H	0.51442200	3.32647300	-1.20447100
H	2.11201500	3.02773600	-0.50264100
H	1.87388900	2.86510800	-2.24868300
H	2.94859400	-1.32814200	0.61276400
H	3.11549000	0.56094300	-1.65825500
O	4.32449800	0.36392600	-1.48826600
H	4.30096800	-0.33327900	-0.73921200
C	5.13928600	1.50544000	-1.13145900
O	3.89941100	-1.44758700	0.30228800
H	6.18053500	1.18286500	-1.06840600
H	5.02892200	2.24287300	-1.92742800
H	4.81607500	1.92839500	-0.17574200
C	4.73554300	-1.75574900	1.42223600
H	4.73032800	-0.94405600	2.16051300
H	4.40411300	-2.68335900	1.90320000
H	5.75333100	-1.89375500	1.04813500
O	-3.29548500	1.81247000	0.56908600
H	-2.11060600	0.32693300	1.38803400
C	-4.14595900	1.61567600	1.69981500
H	-3.57635200	1.68245200	2.63583600
H	-4.89089100	2.41421700	1.66979400
H	-4.65553400	0.64431500	1.65600800

C	-0.51753000	2.45774500	1.31137100
H	0.43616500	2.95318200	1.10754200
H	-1.27615300	3.23436600	1.47194000
H	-1.25813500	2.34497900	-0.68507800
O	-0.40310200	1.62109000	2.46068800
H	-0.07535500	2.15904500	3.19834300