Exploring the synthetic potential of a marine transaminase in the enantioselective synthesis of amines with stereocontrol at both the site of reaction and a remote stereocentre

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Electronic Supplementary Information

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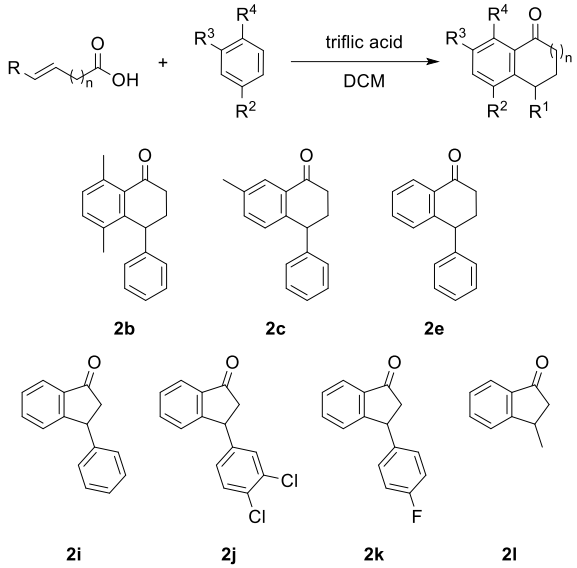
1. Synthesis and characterisation of substrates

1 .1 General Procedures

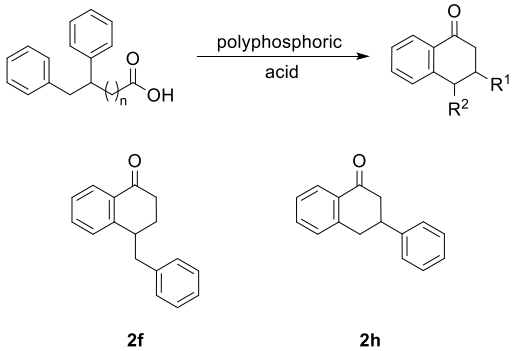
All enzymatic reactions were performed on a VWR Incubating Mini Shaker 4450. Infrared spectra were recorded neat using a Perkin–Elmer FTIR UATR2 spectrometer. ^{1}H (300 MHz) and ^{13}C (75.5 MHz) NMR spectra were recorded on a Bruker Avance 300 NMR spectrometer. ^{1}H (400 MHz) and ^{13}C (100 MHz) NMR spectra were recorded on a Bruker 400 MHz NMR spectrometer. ^{1}H (500 MHz) and ^{13}C (125 MHz) NMR spectra were recorded on a Bruker Avance III 500 NMR spectrometer. All spectra were recorded at 300 K, the chemical shifts (δ_H & δ_C) are reported in parts per million (ppm) and coupling constants are expressed in hertz (Hz). Splitting patterns in ^{1}H NMR spectra are designated as s (singlet), bs (broad singlet), d (doublet), dd (doublet of doublets), ddd (doublet of doublet of doublets), t (triplets), dt (doublet of triplets), td (triplet of doublets), ddt (doublet of doublet of triplets), and m (multiplet). ^{1}H NMR spectra were referenced to tetramethylsilane (TMS) as an internal standard, at δ_H 0 ppm. ^{13}C NMR spectra were calibrated using the solvent signal, *i.e.*, $CDCl_3$ δ_C 77.0 ppm. High-resolution (precise) mass spectra (HRMS) were recorded on a Waters LCT Premier Time of Flight (Tof) LC−MS instrument in electrospray ionization (ESI) mode using 50% acetonitrile−water containing 0.1% formic acid as eluent. High-resolution (precise) mass spectra (HRMS) were also recorded on an Agilent 6530B Accurate Mass Q-TOF LC/MS instrument in electrospray ionization mode using 50% acetonitrile−water containing 0.1% formic acid as eluent. Samples were prepared for HRMS by employing acetonitrile as solvent. Melting points were obtained using a Unimelt Thomas−Hoover capillary melting point apparatus and are uncorrected. Flash column chromatography was carried out using Kieselgel silica gel 60, 0.035−0.075 mm (Merck). Thin-layer chromatography (TLC) was carried out on precoated silica gel plates (Merck 60 PF254). Visualization was achieved by UV (254 nm) light absorption and potassium permanganate staining. Enantiomeric excess values were measured by high performance liquid chromatography (HPLC) on a Waters alliance 2690 separations module with a PDA detector, using a Chiralcel® OD-H, OJ-H, AS-H column (5 x 250 mm) purchased from Daicel Chemical Industries, Japan or Phenomenex Cellulose 2, Cellulose 4, Amylose 1 column (5 x 250 mm) purchased from Phenomenex Inc., UK. Mobile phase, flow rate and detector wavelength are included where appropriate with column temperature set at 25 °C, unless otherwise stated. When only a single enantiomer was detected, the enantiomeric excess is quoted as >99%. Samples for chiral HPLC analysis were prepared at a concentration of ~1 mg/mL; in each case, all of the enzymatic reaction product was dissolved in 90:10 hexane: IPA to a concentration of 1 mg/mL to ensure a representative sample was taken for analysis.

1.2 Synthesis of ketone compounds

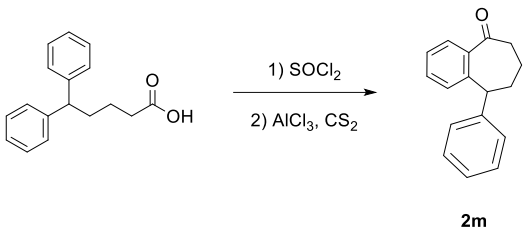
Most of the ketones used for this work were synthesized from commercially available unsaturated carboxylic acid derivatives by reaction with the appropriate arenes in the presence of the strong Bronsted acid, triflic acid (Scheme 1).[1-6] Both 3-phenyltetralone **2h** and 4-benzyltetralone **2f** were accessed in good yield through cyclisation of the corresponding acid in polyphosphoric acid at 120°C as previously reported (Scheme 2).[7, 8] 9-Phenylbenzosuber-5-one **2m** was synthesized by cyclisation of the acid chloride, as previously described,[9, 10] using a Friedel–Crafts cyclisation without isolation of the intermediate acid chloride (Scheme 3).



Scheme 1: Synthetic route to various ketones from the corresponding unsaturated carboxylic acid.

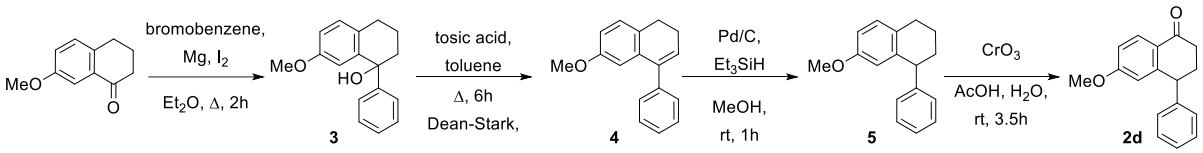


*Scheme 2: Cyclisation of the corresponding acid to furnish ketones **2f** and **2h**.*



*Scheme 3: Synthesis of the acid chloride followed by a Friedel–Crafts cyclisation to yield **2m**.*

To generate the 6-methoxy tetralone **2d**, phenylmagnesium bromide was added to 7-methoxytetral-1-one to synthesis naphthol **3**, which was then dehydrated to form naphthalene **4**, followed by hydrogenation to the saturated naphthalene **5** with subsequent benzylic oxidation using CrO_3 in $AcOH/H_2O$ affording the desired 6-methoxy-4-phenyl-1-tetralone **2d** (Scheme 4).[11]



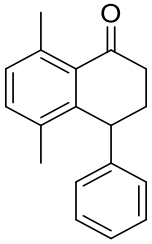
*Scheme 4: 4-step synthetic route from 7-methoxytetral-1-one to form **2d**.*

General Method A - Ketone Synthesis

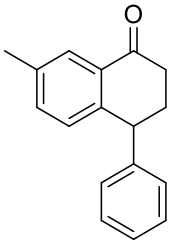
Triflic acid (5 eq) was slowly added to a solution of *trans*-styrylacetic acid (1 eq) and arene (1 eq) in dichloromethane under a nitrogen atmosphere at 0°C. Subsequently the mixture was stirred at room temperature overnight. The mixture was poured onto ice, extracted with dichloromethane ($\times$ 3), dried over Na_2SO_4 and concentrated under reduced pressure. The pure product was afforded by flash column chromatography (hexane:EtOAc 95:5), followed by recrystallization from hexane.

General Method B - Ketone Synthesis/Cyclisation with PPA

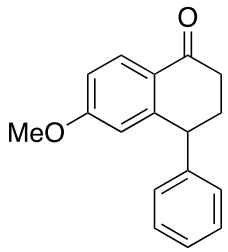
Phenylbutanoic acid (1 eq) and polyphosphoric acid (200 wt%) were heated to 120°C and stirred for 3 h. After allowing to cool to room temperature, H_2O and Et_2O were added to dissolve the mixture. The two layers were separated and the aqueous layer was extracted two more times with Et_2O. The combined organic layers were washed with H_2O and brine, dried over Na_2SO_4 and concentrated under reduced pressure.



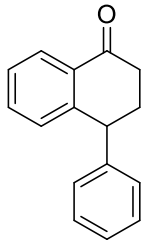
5,8-Dimethyl-4-phenyl-3,4-dihydronaphthalen-1(2H)-one 2b[2] was prepared from *p*-xylene according to general method A to give a white solid (0.419 g, 56%); m.p.: 73–74 °C. ν_{max}/cm^{-1} (ATR): 2931 (CH), 1678 (C=O), 1452 (CH), 1264 (CH), 836 (C=C); δ_H (300 MHz; $CDCl_3$): 7.32 – 7.14 (m, 5H, ArH), 7.11 (d, *J* = 7.7, 1H, ArH), 7.06 – 6.92 (m, 2H, ArH), 4.53 – 4.40 (m, 1H, C(4)H), 2.68 (s, 3H, CH_3), 2.59 – 2.38 (m, 3H, C(2)H_2, one of C(3)H_2), 2.29 – 2.19 (m, 1H, one of C(3)H_2), 2.07 (s, 3H, CH_3); δ_C (75 MHz; $CDCl_3$): 200.8, 144.4, 142.1, 139.2, 134.8, 134.6, 132.2, 131.1, 128.6, 128.4, 126.6, 41.9, 35.4, 30.5, 23.6, 19.6; enantiomers separated using a Phenomenex Cellulose 4 column [conditions: *n*-hexane/*i*PrOH [containing 2% diethylamine (DEA)] = 90/10, flow rate = 0.25 mL min^{-1}], R_t = 16.3 min, R_t = 18.0 min.



7-Methyl-4-phenyl-3,4-dihydronaphthalen-1(2H)-one 2c[3] was prepared from toluene according to general method A to give a white solid (0.311 g, 44%); m.p.: 72–74 °C (lit.[3] 72–74 °C). ν_{max} (ATR): 2947 (CH), 1678 (C=O), 1489 (CH), 1280 (C=C), 1177 (CH), 1148 (CH); δ_H (300 MHz; $CDCl_3$): 7.92 (d, *J* = 2.0, 1H, ArH), 7.36 – 7.19 (m, 4H, ArH), 7.15 – 7.05 (m, 2H, ArH), 6.87 (d, *J* = 7.9, 1H, ArH), 4.26 (dd, *J* = 8.0, 4.6, 1H, C(4)H), 2.77 – 2.53 (m, 2H, C(2)H_2), 2.51 – 2.40 (m, 1H, one of C(3)H_2)), 2.37 (s, 3H, CH_3), 2.34 – 2.21 (m, 1H, one of C(3)H_2); δ_C (75 MHz; $CDCl_3$): 198.5, 144.1, 143.6, 136.9, 134.7, 132.7, 129.6, 128.73, 128.71, 127.3, 126.9, 45.1, 36.9, 32.1, 21.1; enantiomers separated using a Chiralcel AS-H column [conditions: *n*-hexane/*i*PrOH (containing 2% DEA) = 95/5, flow rate = 0.25 mL min^{-1}], R_t = 29.5 min, R_t = 31.6 min.

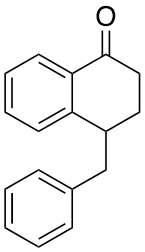


6-Methoxy-4-phenyl-3,4-dihydronaphthalen-1(2H)-one 2d[11] was prepared by addition of CrO_3 (1.125 g, 11.25 mmol, 1.5 eq) dissolved in AcOH (5 ml) and H_2O (2 ml) was to a solution of 7-methoxy-1-phenyltetralin (1.79 g, 7.5 mmol, 1 eq) in AcOH (30 ml). The mixture was then heated to 80°C and stirred for 3.5 h. EtOH (10 ml) was added to destroy any remaining CrO_3. The mixture was basified to pH >10 with 5 M KOH and extracted with EtOAc (3 × 50 ml). The combined organic layers were washed with sat. aqueous $NaHCO_3$ (100 ml), H_2O (100 ml) and brine (100 ml), dried over Na_2SO_4 and concentrated under reduced pressure. The title product was obtained by flash column chromatography (hexane:EtOAc 9:1) as a colourless oil (1.495 g, 79%). ν_{max}/cm^{-1} (ATR): 1672 (C=O), 1594 (C=C), 1263 (CH), 1235 (CO); δ_H (300 MHz; $CDCl_3$): 8.10 (d, *J* = 8.7, 1H, C(8)H), 7.40 – 7.19 (m, 3H, ArH), 7.19 – 7.06 (m, 2H, ArH), 6.87 (dd, *J* = 8.8, 2.6, 1H, C(7)H), 6.43 (dd, *J* = 2.6, 0.9, 1H, C(5)H), 4.25 (dd, *J* = 7.8, 4.5, 1H, C(4)H), 3.73 (s, 3H, OCH_3), 2.74 – 2.36 (m, 3H, C(2)H_2, one of C(3)H_2), 2.36 – 2.17 (m, 1H, one of C(3)H_2); δ_C (75 MHz; $CDCl_3$): 197.0, 163.9, 148.8, 143.6, 129.8, 128.8, 128.7, 126.9, 126.7, 113.9, 113.4, 77.4, 55.5, 45.7, 36.5, 32.0; enantiomers separated using a Phenomenex Amylose 1 column [conditions: *n*-hexane/*i*PrOH (containing 2% DEA) = 90/10, flow rate = 0.5 mL min^{-1}], R_t = 18.8 min, R_t = 19.9 min.

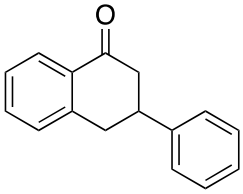


4-Phenyl-3,4-dihydronaphthalen-1(2H)-one 2e[2,12,13] was prepared from benzene according to general method A to give a white solid (5.53 g, 36%) m.p.: 69–72 °C (lit.[12] 70–72 °C). ν_{max}/cm^{-1} (ATR): 2917 (CH), 1682 (C=O), 762 (C=C), 702 (CH); δ_H (300 MHz; $CDCl_3$): 8.12 (dd, *J* = 7.6, 1.1, 1H, ArH), 7.49 – 7.19 (m, 5H, ArH), 7.16 – 7.06 (m, 2H, ArH), 6.98 (d, *J* = 7.7, 1H, ArH), 4.30 [dd, *J* = 8.0, 4.6, 1H, C(4)H], 2.81 – 2.54 [2 x ddd appears as sym m, C(2)H_2], 2.54 – 2.38 [m, 1H, one of C(3)H_2], 2.38 – 2.20 [m, 1H, one of C(3)H_2]; δ_C (75 MHz; $CDCl_3$): 198.1, 146.3, 143.7, 133.6, 132.9, 129.6, 128.7, 128.6, 127.13, 127.06, 126.8, 45.3, 36.8, 31.9; enantiomers separated using Chiralcel OJ-H column [conditions: *n*-hexane/*i*PrOH (containing 2% DEA) = 95/5, flow rate = 0.5 mL min^{-1}], R_t = 22.7 min; 41.2 min (amine

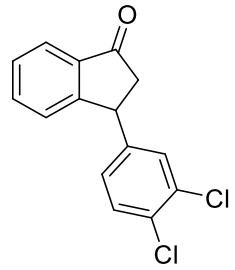
cis-**1e**, R_t = 23.8 min, does not separate from the ketone **2e** under these conditions; the *cis*-**1e** peak overlaps with ketone **2e** by chiral HPLC analysis - post biotransformation *cis*-**1e** and **2e** are separated on a silica plug using 70:30 hexane:ethyl acetate to elute the ketone **2e** followed by 100% methanol to elute the *cis*-**1e**).



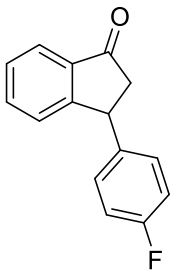
4-Benzyl-3,4-dihydronaphthalen-1(2H)-one 2f[8] was prepared from 1-benzyl-1-phenylbutanoic acid according to general method B. Flash column chromatography (hexane:CH_2Cl_2 30:70) afforded a colourless oil (1.02 g, 61%). ν_{max}/cm^{-1} (ATR): 1681 (C=O), 1597 (C=C), 1452 (CH), 1285 (C=C); δ_H (300 MHz; $CDCl_3$): 8.07 (dd, *J* = 7.8, 1.6, 1H, ArH), 7.47 (td, *J* = 7.5, 1.6, 1H, ArH), 7.40 – 7.12 (m, 7H, ArH), 3.33 – 3.18 (m, 1H, C(4)H), 3.13 (dd, *J* = 13.5, 5.9, 1H, one of $PhCH_2$), 2.96 – 2.70 (m, 2H, one of $C(3)H_2$, one of $PhCH_2$), 2.58 (dt, *J* = 17.9, 5.0, 1H, one of $C(3)H_2$), 2.27 – 2.06 (m, 1H, one of $C(2)H_2$), 2.04 – 1.86 (m, 1H, one of $C(2)H_2$); δ_C (75 MHz; $CDCl_3$): 198.3, 147.5, 139.9, 133.6, 132.1, 129.2, 128.7, 128.5, 127.5, 127.0, 126.6, 41.4, 40.1, 34.9, 26.2; enantiomers separated using a Phenomenex Amylose 1 column [conditions: *n*-hexane/*i*PrOH (containing 2% DEA) = 95/5, flow rate = 0.25 mL min^{-1}], R_t = 28.3 min, R_t = 29.2 min.



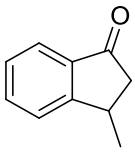
3-Phenyl-3,4-dihydronaphthalen-1(2H)-one 2h[7] was prepared from 1,2-diphenylbutanoic acid according to general method B. Flash column chromatography (gradient elution, hexane:EtOAc 100:0 to 90:10) afforded a white solid (1.30 g, 94%); m.p.: 63–64 °C (lit.[7] 63 °C). ν_{max}/cm^{-1} (ATR): 1681 (C=O), 1602 (C=C), 1455 (CH), 1287 (C=C); δ_H (300 MHz; $CDCl_3$): δ_H (300 MHz; $CDCl_3$): δ_H (300 MHz; $CDCl_3$): 8.09 (dd, *J* = 7.8, 1.5, 1H, ArH), 7.52 (td, *J* = 7.5, 1.5, 1H, ArH), 7.44 – 7.22 (m, 7H, ArH), 3.56 – 3.38 (m, 1H, C(3)H), 3.29 – 3.12 (m, 2H, $C(4)H_2$), 2.99 (ddd, *J* = 16.7, 3.9, 1.4, 1H, one of $C(2)H_2$), 2.84 (dd, *J* = 16.7, 12.9, 1H, one of $C(2)H_2$); δ_C ($CDCl_3$, 75 MHz): 197.9, 143.6, 143.5, 133.9, 132.3, 129.0, 128.9, 127.4, 127.1, 127.1, 126.8, 46.1, 41.3, 37.8; enantiomers were not separated by chiral HPLC as the corresponding amines **1h** were not processed by *P*-ω-TA or *Cv*-ω-TA.



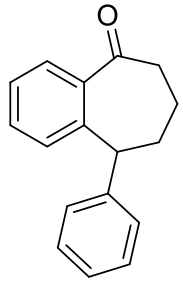
3-(3,4-Dichlorophenyl)-2,3-dihydro-1*H*-inden-1-one 2j[4-6] was prepared from *trans*-cinnamic acid and dichlorobenzene according to general method A to give a white solid (8.91 g, 63%); m.p.: 110–112 °C (lit.[14] 113–115 °C). ν_{max}/cm^{-1} (ATR): 2919 (CH), 1698 (C=O), 762 (CH); δ_H (300 MHz; $CDCl_3$): 7.88 – 7.77 (m, 1H, ArH), 7.61 (td, *J* = 7.5, 1.3, 1H, ArH), 7.53 – 7.41 (m, 1H, ArH), 7.38 (d, J = 8.3, 1H, ArH), 7.29 – 7.20 (m, 2H, ArH), 6.95 (dd, *J* = 8.3, 2.1, 1H, ArH), 4.55 [dd, *J* = 8.2, 3.9, 1H, C(3)H], 3.23 [dd, *J* = 19.2, 8.2, 1H, one of $C(2)H_2$, B of ABq], 2.62 [dd, *J* = 19.2, 3.9, 1H, one of $C(2)H_2$, A of ABq]; δ_C (75 MHz; $CDCl_3$): 204.9, 156.5, 144.0, 136.8, 135.4, 133.0, 131.2, 130.9, 129.7, 128.4, 127.0, 126.7, 123.7, 46.5, 43.6; enantiomers separated using a Chiralcel OB-H column [conditions: *n*-hexane/*i*PrOH (containing 2% DEA) = 98/2, flow rate = 0.5 mL min^{-1}], R_t = 72.1 min, R_t = 82.9 min.



3-(4-Fluorophenyl)-2,3-dihydro-1*H*-inden-1-one 2k[1,14] was prepared from 4-fluorocinnamic acid and benzene according to general method A to give a yellow solid (6.20 g, 92%) m.p. 112–114 °C (lit.[14] 116–118 °C). ν_{max}/cm^{-1} (ATR): 3054 (CH), 1701 (CO), 1507 (C=C), 1219 (CO), 763 (CH); δ_H (300 MHz; $CDCl_3$): 7.81 (1H, d, *J* = 7.7, ArH), 7.58 (1H, td, *J* = 7.5, 1.3, ArH), 7.43 (1H, t, *J* = 7.5, ArH), 7.30 – 7.22 (1H, m, ArH), 7.14 – 7.04 (2H, m, ArH), 7.04 – 6.94 (2H, m, ArH), 4.57 (1H, dd, *J* = 8.2, 3.9, C(3)H), 3.23 (1H, dd, *J* = 19.2, 8.1, one of $C(2)H_2$), 2.64 (1H, dd, *J* = 19.2, 8.9, one of $C(2)H_2$); δ_C (75 MHz; $CDCl_3$): 205.6, 161.8 (d, J_{CF} = 245.9), 157.6, 139.4 (d, J_{CF} = 3.2), 136.7, 135.1, 129.1 (d, J_{CF} = 8.0), 128.0, 126.7, 123.4, 115.7 (d, J_{CF} = 21.4), 46.9, 43.7; δ_F (282 MHz; $CDCl_3$): –115.72; enantiomers separated using a Chiralcel AS-H [conditions: *n*-hexane/*i*PrOH (containing 2% DEA) = 90/10, flow rate = 1.0 mL min^{-1}], R_t = 13.4 min, R_t = 24.0 min.



3-Methyl-2,3-dihydro-1*H*-inden-1-one 2l[2] was prepared from crotonic acid and benzene according to general method A to give an orange oil (2.1 g, 44%). ν_{max}/cm^{-1} (ATR): 3288 (CH), 1708 (C=O), 1603 (C=C), 1281 (CO), 1247 (CH), 758 (CH); δ_H (300 MHz; $CDCl_3$): 7.78 – 7.66 (1H, m, ArH), 7.65 – 7.55 (1H, m, ArH), 7.54 – 7.44 (1H, m, ArH), 7.42 – 7.26 (1H, m, ArH), 3.52 – 3.33 (1H, m, CH), 2.92 (1H, ddd, *J* = 19.0, 7.5, 1.3, one of CH_2), 2.26 (1H, dd, *J* = 19.1, 3.5, 1.3, one of CH_2), 1.40 (3H, dd, *J* = 7.2, 1.2, CH_3); δ_C (75 MHz; $CDCl_3$): 206.3, 159.9, 136.4, 134.7, 127.4, 125.3, 123.4, 45.3, 32.8, 21.3; enantiomers separated using a Chiralcel AS-H column [conditions: *n*-hexane/*i*PrOH (containing 2% DEA) = 90/10, flow rate = 0.5 mL min^{-1}], R_t = 16.2 min, R_t = 20.5 min.



9-Phenyl-6,7,8,9-tetrahydro-5H-benzo[7]annulen-5-one 2m[10] was prepared from a solution of diethyl 2-(3,3-diphenylpropyl)malonate (1.780 g, 7 mmol, 1 eq) in $SOCl_2$ (21 ml) that was heated at reflux for 24 h. $SOCl_2$ was removed under reduced pressure and the crude acid chloride was dissolved in CS_2 (49 ml). The solution was slowly added with a syringe pump over 6.5 h to a mixture of $AlCl_3$ (1.47 g, 11.04 mmol, 1.59 eq, added in three portions of 0.490 g) in CS_2 (140 ml) and heated at reflux. Further portions of $AlCl_3$ (0.490 g, 3.68 mmol, 0.53 eq, each) were added sequentially after 2, 4, and 6 h, upon cooling the reaction mixture below reflux for the purposes of the addition in each case. The reaction mixture was heated at reflux for another 16 h and after cooling to room temperature carefully quenched with water. The mixture was filtered through Celite®, the two phases were separated and the organic layer was concentrated under reduced pressure. The residue was dissolved in EtOAc washed with saturated aqueous $NaHCO_3$ and brine, dried over Na_2SO_4 and concentrated under reduced pressure. Column chromatography (hexane:EtOAc 90:10) afforded the title product as a white solid (0.99 g, 60%); m.p.: 69–71 °C (lit.[10] 71.0–71.5 °C). ν_{max}/cm^{-1} (ATR): 2949 (CH), 1670 (C=O), 1595 (C=C), 1282 (C=C), 1247 (CH); δ_H (300 MHz; $CDCl_3$): 7.72 – 7.60 (m, 1H, ArH), 7.43 – 7.12 (m, 7H,

ArH), 6.90 – 6.77 (m, 1H, ArH), 4.41 (dd, *J* = 10.5, 4.4, 1H, C(5)H), 2.90 – 2.62 (m, 2H, C(6)H_2), 2.44 – 2.27 (m, 1H, one of C(8)H_2), 2.27 – 2.10 (m, 1H, one of C(8)H_2), 2.09 – 1.91 (m, 1H, one of C(7)H_2), 1.87 – 1.65 (m, 1H, one of C(7)H_2); δ_C (75 MHz; $CDCl_3$): 207.3, 142.9, 142.4, 139.8, 131.9, 129.1, 128.8, 128.7, 128.4, 126.9, 47.2, 41.2, 31.6, 20.6; enantiomers separated using a Phenomenex Amylose 1 column [conditions: *n*-hexane/*i*PrOH (containing 2% DEA) = 90/10, flow rate = 0.5 mL min^{-1}], R_t = 10.9 min, R_t = 11.3 min or using a Chiralcel OJ-H column [conditions: *n*-hexane/*i*PrOH (containing 2% DEA) = 90/10, flow rate = 0.5 mL min^{-1}], R_t = 22.5, R_t = 25.5 min

1.3 Synthesis of alcohols

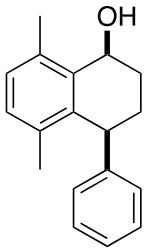
General Method C – Ketone reduction to alcohol

$NaBH_4$ (1.5 eq) was added to a stirred mixture of ketone (1 eq) in MeOH at 0°C under a nitrogen atmosphere. The mixture was stirred at room temperature for 2 h. H_2O was added, and the volatile components were removed under reduced pressure. The aqueous remainder was extracted with EtOAc (× 2). The combined organic layers were washed with H_2O and brine, dried over $MgSO_4$ and concentrated under reduced pressure.

General Method D – Ketone reduction to alcohol

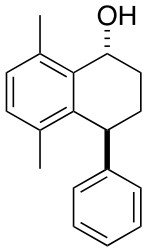
$NaBH_4$ (1.1 eq.) in methanol was added to a stirring solution of ketone (1 eq.) in methanol at 0 °C and stirred at room temperature for 16–20 h. The pH was adjusted to 2 using HCl (1M, aqueous), and the reaction mixture was extracted with ethyl acetate (2 x reaction volume), the organic layer was washed with brine (1 x 1.5 reaction volumes), dried over $MgSO_4$, filtered and concentrated to give the crude alcohols as a mixture of diastereomers.

1-Hydroxy-5,8-dimethyl-4-phenyltetralin 6b was prepared from 5,8-dimethyl-4-phenyltetral-1-one **2b** according to general method C. The two diastereomers could be separated by flash column chromatography (hexane:EtOAc 85:15) to afford;



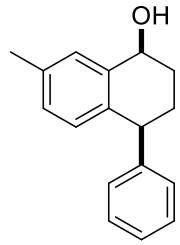
***cis*-1-Hydroxy-5,8-dimethyl-4-phenyltetralin** *cis*-**6b** as a white solid (0.817 g, 46%); m.p.: 126–128 °C. ν_{max}/cm^{-1} (ATR): 3380 (OH), 2943 (CH), 1448 (OH), 1049 (CO), 1032 (C=C), 805 (CH); δ_H (300 MHz; $CDCl_3$): 7.30 – 7.22 (m, 2H, ArH), 7.21 – 7.13 (m, 1H, ArH), 7.11 – 7.02 (m, 3H, ArH), 6.99 (d, *J* = 7.6, 1H, ArH), 5.06 (apparent q, *J* = 5.5, 1H, C(1)H), 4.16 (apparent t, *J* = 6.1, 1H, C(4)H), 2.52 (s, 3H, CH_3), 2.21 – 2.09 (m, 1H, one of C(3)H_2), 2.09 – 1.93 (m, 2H, one of C(2)H_2, one of C(3)H_2), 1.93 – 1.79 (m, 4H, CH_3, one of C(2)H_2),

1.70 – 1.58 (m, 1H, OH); δ_C (75 MHz; $CDCl_3$): 146.6, 137.9, 137.8, 135.7, 135.2, 130.3, 129.1, 128.5, 128.1, 125.8, 66.6, 43.5, 29.6, 29.6, 20.4, 19.8; HRMS (ESI^+): found $[M+Na]^+$ 275.1405, $C_{18}H_{20}ONa$ requires 275.1406.



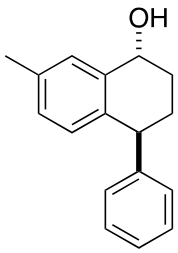
and ***trans*-1-Hydroxy-5,8-dimethyl-4-phenyltetralin** *trans*-**6b** as a white solid (0.055 g, 3%); m.p.: 119–121 °C. ν_{max}/cm^{-1} (ATR): 3151 (OH), 2934 (CH), 1449 (OH), 1058 (CO), 799 (CH); δ_H (300 MHz; $CDCl_3$): 7.24 – 7.10 (m, 3H, ArH), 7.07 (d, *J* = 7.6, 1H, ArH), 7.00 (d, *J* = 7.6, 1H, ArH), 6.88 (d, *J* = 7.3, 2H, ArH), 4.99 (dt, *J* = 5.8, 3.0, 1H, C(1)H), 4.31 – 4.22 (m, 1H, C(4)H), 2.57 – 2.38 (m, 4H, CH_3, one of C(2)H_2), 1.91 (s, 3H, CH_3), 1.89 – 1.76 (m, 3H, one of C(2)H_2, C(3)H_2), 1.57 (d, *J* = 5.8, 1H, OH); δ_C (75 MHz; $CDCl_3$): 145.2, 136.8, 135.5, 135.1, 130.3, 129.2, 128.5, 128.2, 125.9, 64.7, 41.8, 26.3, 26.0, 19.6, 19.0; HRMS (ESI^+): found $[M+Na]^+$ 275.1406, $C_{18}H_{20}ONa$ requires 275.1406.

1-Hydroxy-7-methyl-4-phenyltetralin 6c was prepared from 7-methyl-4-phenyltetral-1-one **2c** according to general method C. The two diastereomers could be separated by flash column chromatography (hexane:EtOAc 95:5 to 85:15) to afford;



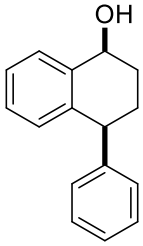
***cis*-1-Hydroxy-7-methyl-4-phenyltetralin** *cis*-**6c** as a colourless oil (0.127 g, 27%). ν_{max}/cm^{-1} (ATR): 3306 (OH), 2936 (CH), 1492 (CH), 1450 (OH), 1080 (CO); δ_H (400 MHz; $CDCl_3$): 7.41 – 7.08 (m, 6H, ArH), 6.95 (d, *J* = 7.8, 1H, ArH), 6.74 (d, *J* = 7.9, 1H, ArH), 4.81 (apparent t, *J* = 4.4, 1H, C(1)H), 3.97 (dd, *J* = 9.0, 5.4, 1H, C(4)H), 2.32 (s, 3H, CH_3), 2.22 – 1.76 (m, 5H, C(2)H_2, C(3)H_2, OH); δ_C (100 MHz; $CDCl_3$): 146.9, 138.8, 136.8,

136.3, 130.0, 129.4, 128.9, 128.5, 126.3, 68.3, 45.6, 30.4, 28.5, 21.1; HRMS (ESI^+): found $[M+Na]^+$ 261.1249, $C_{17}H_{18}ONa$ requires 261.1250.



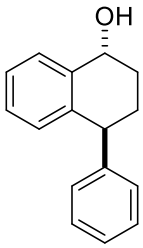
***trans*-1-Hydroxy-7-methyl-4-phenyltetralin** *trans*-**6c** as a white solid (0.187 g, 37%); m.p.: 102–104 °C. ν_{max}/cm^{-1} (ATR): 3326 (OH), 2934 (CH), 1493 (CH), 1450 (OH), 1049 (CO); δ_H (300 MHz; $CDCl_3$): 7.37 (s, 1H, ArH), 7.31 – 7.12 (m, 4H, ArH), 7.09 – 6.94 (m, 3H, ArH), 6.78 (d, *J* = 7.9, 1H, ArH), 4.87 (apparent t, *J* = 5.6, 1H, C(1)H), 4.14 (apparent t, *J* = 6.2, 1H, C(4)H), 2.40 – 2.28 (m, 4H, CH_3, , one of C(3)H_2), 2.22 – 2.09 (m, 1H, one of C(2)H_2), 1.91 – 1.72 (m, 2H, one of C(2)H_2, one of C(3)H_2), 1.66 (br s, 1H, OH); δ_C (75 MHz; $CDCl_3$): 146.9, 139.6, 136.4, 136.3, 130.2, 128.8, 128.8, 128.4, 128.4, 126.2, 68.7, 45.1, 30.5, 29.4, 21.2; HRMS (ESI^+): found $[M+Na]^+$ 261.1253, $C_{18}H_{20}ONa$ requires 261.1250.

4-Phenyl-1,2,3,4-tetrahydronaphthalen-1-ol 6e[15] was prepared from 4-phenyl-3,4-dihydronaphthalen-1(2H)-one **2e** according to general method D to give the crude material as a viscous yellow oil containing a mixture of *cis*-**6e** and *trans*-**6e** diastereomers (46:54). The pure *trans* and *cis* diastereomers were obtained by recrystallization and column chromatography, respectively.

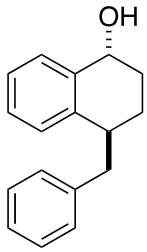


***cis*-4-Phenyl-1,2,3,4-tetrahydronaphthalen-1-ol** *cis*-**6e**[16, 17] was obtained as a colourless oil (0.754 g, 20%) by column chromatography of the *cis* enriched material (24:76), which remained in the mother liquor upon crystallisation of the *trans* isomer, using diethyl ether/hexane (15/85) as eluent. ν_{max}/cm^{-1} (ATR): 3307 (OH), 760 (CH), 731 (CH), 699 (CH); δ_H (300 MHz; $CDCl_3$): 7.46 (m, 1H, ArH), 7.38 – 7.07 (m, 7H, ArH), 6.85 (d, *J* = 7.7, 1H, ArH), 4.87 [br s, 1H, C(1)H], 4.02 [dd, *J* = 8.3, 5.6, 1H, C(4)H], 2.25 – 1.89 [m, 4H, C(2)H_2

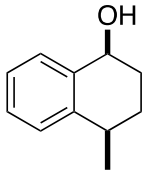
& C(3)H_2], 1.81 (br s, 1H, OH); δ_C (75 MHz; $CDCl_3$): 146.6, 139.8, 139.0, 130.0, 128.9, 128.8, 128.4, 127.9, 126.6, 126.3, 68.2, 45.8, 30.3, 28.3.



***trans*-4-phenyl-1,2,3,4-tetrahydronaphthalen-1-ol** *trans*-**6e**[16, 17] was obtained as a white solid (1.46 g, 39%); m.p.: 121–122 °C (lit.[18] 122–123 °C) by crystallisation of the crude mixture from diethyl ether and hexane. ν_{max}/cm^{-1} (ATR): 3230 (OH), 745 (CH), 696 (CH) cm^{-1}; δ_H (300 MHz; $CDCl_3$): 7.55 (d, *J* = 7.6, 1H, ArH), 7.37 – 7.09 (m, 5H, ArH), 7.06 – 6.99 (m, 2H, ArH), 6.88 (d, *J* = 7.9, 1H, ArH), 4.96 – 4.85 [m, 1H, C(1)H], 4.22 – 4.13 [m, 1H, C(4)H], 2.43 – 2.27 [m, 1H, one of C(3)H_2], 2.25 – 2.08 [m, 1H, one of C(2)H_2], 1.96 – 1.66 [m, 3H, OH [1.73 (d, *J* = 6.0)], one of C(2)H_2 and one of C(3)H_2]; δ_C (75 MHz; $CDCl_3$): 146.5, 139.7, 139.1, 130.2, 128.7, 128.3, 127.9, 127.7, 126.7, 126.1, 68.5, 45.3, 30.3, 29.2.

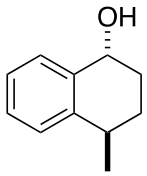


***trans*-1-Hydroxy-4-benzyltetralin** *trans*-**6f**[8] was prepared from 4-benzyltetral-1-one according to general method C. Recrystallization from hexane gave the *trans* diastereomer exclusively as a white solid (0.298 g, 59%); m.p.: 98–100 °C (lit.[8] 98–100 °C). ν_{max}/cm^{-1} (ATR): 3288 (OH), 2941 (CH), 1491 (CH), 1453 (OH), 1055 (CO); δ_H (300 MHz; $CDCl_3$): 7.59 – 7.45 (m, 1H, ArH), 7.42 – 7.14 (m, 8H, ArH), 4.86 – 4.67 (m, 1H, C(1)H), 3.22 (dd, *J* = 13.5, 4.5, 1H, one of $PhCH_2$), 3.14 – 2.97 (m, 1H, C(4)H), 2.77 (dd, *J* = 13.5, 10.3, 1H, one of $PhCH_2$), 2.06 – 1.82 (m, 2H, C(2)H_2), 1.82 – 1.61 (m, 3H, C(3)H_2, OH); δ_C (75 MHz; $CDCl_3$): 140.8, 140.5, 139.3, 129.3, 128.5, 128.5, 128.3, 127.8, 126.6, 126.3, 69.1, 43.2, 39.5, 29.5, 23.4.



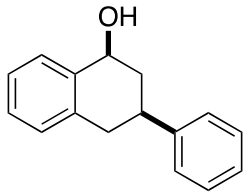
***cis*-1-Hydroxy-4-methyltetralin** *cis*-**6g**[19] was prepared from 4-methyltetral-1-one

according to general method C. Recrystallization from hexane twice gave the *cis* diastereomer as a white solid (0.697 g, 35%); m.p.: 70–72 °C (lit.[19] 66–68 °C). ν_{max} (ATR): 3210 (OH), 2968 (CH), 2924 (CH), 1458 (OH), 1066 (CO), 1027 (C=C); δ_H (400 MHz; $CDCl_3$): 7.45 – 7.37 (m, 1H, ArH), 7.26 – 7.14 (m, 3H, ArH), 4.74 (apparent t, *J* = 5.3, 1H, C(1)H), 2.90 – 2.76 (m, 1H, C(4)H), 2.00 – 1.80 (m, 3H, one of $C(3)H_2$, $C(2)H_2$), 1.80 – 1.62 (m, 2H, one of $C(3)H_2$, OH), 1.33 (d, *J* = 7.0, 3H, CH_3); δ_C (100 MHz; $CDCl_3$): 142.2, 138.7, 128.6, 127.9, 127.8, 126.3, 68.8, 32.6, 30.2, 27.3, 22.3.

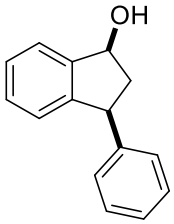


***trans*-1-Hydroxy-4-methyltetralin** *trans*-**6g**[19] was prepared with DIAD (1.97 ml, 10 mmol, 4 eq) slowly added to a suspension of *cis*-1-hydroxy-4-methyltetralin *cis*-**6g** (0.406 g, 2.5 mmol, 1 eq) and triphenylphosphine (2.62 g, 10 mmol, 4 eq) in dry THF (5 ml) under a nitrogen atmosphere and the solution was stirred for 22 h at 60°C. Et_2O (50 ml) was added and the mixture washed with sat. aqueous $NaHCO_3$ (2 × 50 ml). The combined aqueous layer was back-extracted with EtO_2 (100 ml) and the combined organic layers dried over Na_2SO_4 and concentrated under reduced pressure. The residue was dissolved in a 1:1 mixture of Et_2O and hexane and sonicated to facilitate precipitation of Ph_3PO. The precipitate was removed by filtration and the filtrate concentrated under reduced pressure. The residue was filtered through a plug of silica gel, washing with hexane:EtOAC 95:5. The crude intermediate was then dissolved in MeOH (25 ml) and K_2CO_3 (1.38 g, 10 mmol, 4 eq) was added. The mixture was stirred at room temperature overnight, H_2O (10 ml) was added and the volatile components were removed under reduced pressure. The aqueous remainder was extracted with EtOAc (3 × 20 ml). The combined organic layers were washed with brine, dried over Na_2SO_4 and concentrated under reduced pressure, after which the crude product was subjected to flash column chromatography (hexane:EtOAc 85:15) which afforded *trans*-**6g** as a colourless oil (0.140 g, 35%). ν_{max} (ATR): 3221 (OH), 2968 (CH), 2925 (CH), 1458 (OH), 1060 (CO), 1027

(C=C); δ_H (400 MHz; $CDCl_3$): 7.51 – 7.37 (m, 1H, ArH), 7.31 – 7.13 (m, 3H, ArH), 4.83 – 4.70 (m, 1H, C(1)H), 3.08 – 2.90 (m, 1H, C(4)H), 2.24 – 2.06 (m, 2H, one of C(2)H_2, one of C(3)H_2), 1.89 – 1.66 (m, 2H, one of C(2)H_2, OH), 1.58 – 1.45 (m, 1H, one of C(3)H_2), 1.27 (d, *J* = 7.1, 3H, CH_3); δ_C (100 MHz; $CDCl_3$): 142.1, 138.6, 128.5, 128.4, 127.9, 126.3, 68.6, 32.5, 29.6, 27.0, 22.7.



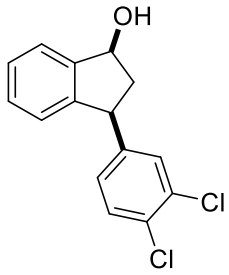
***cis*-1-Hydroxy-3-phenyltetralin** *cis*-**6h**[20] was prepared from 3-phenyltetral-1-one **2h** according to general method C. Recrystallization from hexane gave the *cis* diastereomer, *cis*-**6h** exclusively as a white solid (0.731 g, 72%); m.p.: 94–96 °C (lit.[20] 96–98 °C). ν_{max}/cm^{-1} (ATR): 3261 (OH), 1494 (CH), 1452 (OH), 995 (CH); δ_H (300 MHz; $CDCl_3$): 7.72 – 7.59 (m, 1H, ArH), 7.45 – 7.16 (m, 7H, ArH), 7.17 – 7.06 (m, 1H, ArH), 5.11 – 4.90 (m, 1H, C(1)H), 3.20 – 2.85 (m, 3H, C(3)H, C(4)H_2), 2.52 (ddt, *J* = 12.2, 6.0, 2.1, 1H, one of C(2)H_2), 1.97 (td, *J* = 12.2, 10.5, 1H, one of C(2)H_2), 1.81 (d, *J* = 8.0, 1H, OH); δ_C (75 MHz; $CDCl_3$): 145.5, 139.4, 136.4, 128.8, 128.7, 127.6, 126.9, 126.7, 126.7, 70.3, 40.8, 39.5, 38.4.



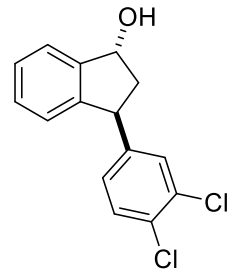
***cis*-3-Phenyl-2,3-dihydro-1*H*-inden-1-ol** *cis*-**6i**[21] was prepared from 3-phenyl-2,3-dihydroindanone **2i** in ethanol (20 mL) according to general method D to afford a mixture of *cis*-**6i** and *trans*-**6i** diastereomers (95:5). Recrystallisation (CH_2Cl_2/hexane) gave the *cis*-**6i** as a white solid (1.54 g, 73 %); m.p. 93–94 °C (lit.[21] 94.5–95 °C). ν_{max}/cm^{-1} (ATR): 3305 (OH), 2963 (CH), 1325 (OH), 1056 (CO), 757 (CH), 700 (CH); δ_H (300 MHz; $CDCl_3$): 7.48 (d, *J* = 7.4, 1H, ArH), 7.17 – 7.04 (m, ArH, 7H), 6.95 (d, J = 7.6, 1H, ArH), 5.29 [apparent q, *J* = 7.4, 1H, C(1)H], 4.19 [t, *J* = 8.4, 1H, C(3)H], 3.03 [dt, *J* = 12.8, 7.5, 1H, one of C(2)H], 2.03 – 1.86 [m, 2H, OH (d at 2.19, *J* = 7.4) and one of C(2)H_2 (ddd at 1.95, *J* = 16.9, 9.2, 7.6)]; δ_C (75 MHz; $CDCl_3$): 145.6, 145.3, 144.3, 128.6, 128.4, 128.2, 127.2, 126.6, 125.1, 123.7, 75.1, 48.3, 47.2.

3-(3,4-Dichlorophenyl)-2,3-dihydro-1*H*-inden-1-ol 6j[5, 14, 15]

Ketone **2j** (8.91 g, 32.1mmol, 1 eq) in THF (100 mL) was cooled to –15 °C using a salt/ice bath. A solution of sodium borohydride (2.45 g, 64.8 mmol, 2 eq.) in water (10 mL) was slowly added to the stirring solution, maintaining the temperature below 0 °C. When the addition was complete the reaction solution was allowed warm to room temperature and stirred for 3 h. The solution was diluted with ice-water (50 mL) and stirred for 1 h. The THF was removed under reduced pressure and the aqueous layer was extracted with ethyl acetate (2 × 50 mL). The organic layer was washed with water (2 × 50 mL) and brine (75 mL) and concentrated afford a mixture of *cis*-**6j** and *trans*-**6j** diastereomers (91:9). The product was purified by column chromatography using diethyl ether/hexane (25:75) as eluent which gave;

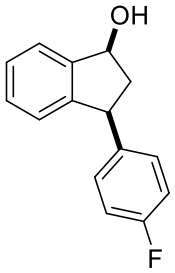


***cis*-3-(3,4-Dichlorophenyl)-2,3-dihydro-1*H*-inden-1-ol** *cis*-**6j**[4] the major diastereomer as a colourless oil (4.975 g, 55%). ν_{max}/cm^{-1} (ATR): 3306 (OH), 1468 (OH), 1030 (C=C), 756 (CH), 742 (CH); δ_H (300 MHz; $CDCl_3$): 7.48 (1H, d, *J* =7.4, ArH), 7.38 (1H, d, *J* = 8.3, ArH), 7.36 – 7.22 (3H, m, ArH), 7.07 (1H, dd, *J* = 8.3, 2.1, ArH), 6.94 (1H, d, *J* = 7.7, ArH), 5.30 [1H, expected ddd appears as m, C(1)H], 4.15 [1H, dd appears as t, *J* = 8.2, C(3)H], 3.01 [1H, ddd, *J* = 13.0, 7.6, 7.0, one of $C(2)H_2$], 1.99 (1H, d, *J* = 7.0, OH), 1.89 [1H, ddd, *J* = 13.1, 8.9, 7.3, one of $C(2)H_2$]; δ_C (75 MHz; $CDCl_3$): 145.2, 144.7, 144.4, 132.6, 130.59, 130.55, 130.2, 128.7, 127.68, 127.67, 124.9, 123.9, 74.9, 47.6, 46.7.

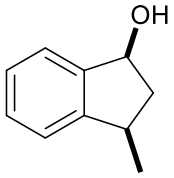


***trans*-3-(3,4-Dichlorophenyl)-2,3-dihydro-1*H*-inden-1-ol** *trans*-**6j**[4] the minor diastereomer *trans*-**6j** as a colourless oil (0.358 g, 4%). ν_{max}/cm^{-1} (ATR): 3306 (OH), 1469 (CH), 1032 (C=C), 755 (CH); δ_H (300 MHz;

$CDCl_3$): 7.44 – 7.53 (1H, m, ArH), 7.39 – 7.27 (3H, m, ArH), 7.21 (1H, d, *J* = 2.1, ArH), 7.05–6.98 (1H, m, ArH), 6.96 (1H, dd, *J* = 8.3, 2.1, ArH), 5.38 [1H, dd, *J* = 6.2, 2.7, C(1)H], 4.59 [1H, t, *J* = 7.4, C(3)H], 2.63 – 2.45 [1H, m, 7.7, 2.9, one of $C(2)H_2$, B of ABq], 2.40 – 2.24 [1H, m, one of $C(2)H_2$, A of ABq]; δ_C (75 MHz; $CDCl_3$): 145.6, 145.1, 144.9, 132.6, 130.6, 130.5, 129.8, 129.3, 127.8, 127.4, 125.3, 124.6, 75.1, 48.2, 46.3.



***cis*-3-(4-Fluorophenyl)-2,3-dihydro-1*H*-inden-1-ol** *cis*-**6k**[22] was prepared from 3-(4-fluorophenyl)-2,3-dihydro-1*H*-inden-1-one **2k** according to general method D to afford a white solid (2.055 g, 83%); m.p. 73–74 °C (lit.[22] 74–75 °C). ν_{max}/cm^{-1} (ATR): 3231 (OH), 2969 (CH), 1508 (C=C), 1220 (CO), 1042 (CO), 762 (CH); δ_H (300 MHz; $CDCl_3$): 7.48 (d, *J* = 7.3, ArH), 7.36 – 7.12 (m, 5H, ArH), 7.08–6.96 (m, 2H, ArH), 6.93 (d, *J* = 7.3, 1H, ArH), 5.29 [t, *J* = 7.2, 1H, C(1)H], 4.18 [t, J = 8.4, C(3)H], 3.02 (dt, *J* = 12.7, 7.2, 1H, one of CH_2), 1.99 (1H, d, *J* = 7.2, OH), 1.90 (ddd, *J* = 7.6, 9.2, 16.6, 1H, one of CH_2); δ_C (75 MHz; $CDCl_3$): 161.7 (d, J_{CF} = 244.7), 145.5, 145.1, 140.0 (d, J_{CF} = 3.0), 129.6 (d, J_{CF} = 7.8), 128.5, 127.3, 125.0, 123.7, 115.4 (d, J_{CF} = 21.1), 75.0, 47.6, 47.2; δ_F (282 MHz; $CDCl_3$): –116.6.

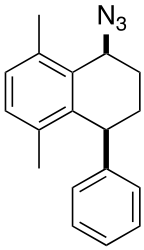


***cis*-3-Methyl-2,3-dihydro-1*H*-inden-1-ol** *cis*-**6l**[22] was prepared form ketone **2l** according to general method D to afford a mixture of *cis*-**6l** and *trans*-**6l** (90:10). The crude reaction mixture was purified by column chromatography 70:30 hexane:Et_2O to give pure *cis*-**6l** as a white solid (0.602 g, 80%); m.p. 71–72 °C (lit.[22] 72°C). ν_{max}/cm^{-1} (ATR): 3305 (OH), 2963 (CH), 1325 (OH), 1056 (CO), 757 (CH), 700 (CH); δ_H (300 MHz; $CDCl_3$): 7.46 – 7.34 (m, 1H, ArH), 7.33 – 7.15 (m, 3H, ArH), 5.16 [t, *J* = 7.2, 1H, C(1)OH], 3.14 – 2.96 [m, 1H, C(3)H], 2.76 [dt, *J* = 12.6, 7.2, 1H, one of $C(2)H_2$], 1.88 (1H, br d, OH), 1.47 [ddd, 1H, *J* = 12.6, 8.6, 7.6, one of $C(2)H_2$], 1.35 (3H, d, *J* = 6.9, CH_3); δ_C (75 MHz; $CDCl_3$): 147.4, 145.0, 128.2, 126.8, 123.7, 123.4, 75.2, 45.8, 36.3, 20.2.

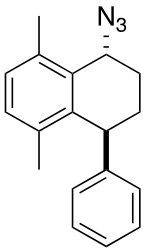
1.4 Synthesis of azides

General Method E – Azide Synthesis[23]

To a stirred suspension of alcohol (1 eq) in toluene under a nitrogen atmosphere diphenyl phosphoryl azide (1.2 eq or 1.3 eq) was added. The mixture was cooled to 0°C and 1,8-diazabicyclo[5.4.0]undec-7-ene (1.2 eq or 1.3 eq) added dropwise. The reaction was warmed to room temperature and stirred overnight. The resulting two-phase mixture was subsequently diluted with EtOAc and washed with H_2O, 5% aqueous HCl and brine, dried over Na_2SO_4 and concentrated under reduced pressure. Flash column chromatography (hexane:EtOAc 95:5) afforded the azide.

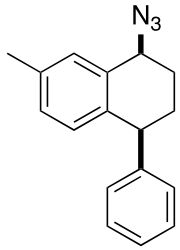


***cis*-1-Azido-5,8-dimethyl-4-phenyltetralin** *cis*-**7b** was prepared from *trans*-1-hydroxy-5,8-dimethyl-4-phenyltetralin *trans*-**6b** according to general method E to give a colourless oil (0.128 g, 95%). ν_{max}/cm^{-1} (ATR): 2940 (CH), 2093 (N_3), 1450 (CH), 1235 (CN), 1031 (CH); δ_H (300 MHz; $CDCl_3$): 7.35 – 7.13 (m, 4H, ArH), 7.13 – 6.93 (m, 4H, ArH), 4.74 (apparent t, *J* = 4.9, 1H, C(1)H), 4.17 (apparent t, *J* = 6.5, 1H, C(4)H), 2.46 (s, 3H, CH_3), 2.25 – 2.09 (m, 1H, one of C(3)H_2), 2.09 – 1.94 (m, 3H, C(2)H_2, one of C(3)H_2), 1.84 (s, 3H, CH_3); δ_C (75 MHz; $CDCl_3$): 146.5, 138.5, 135.8, 135.6, 133.1, 131.0, 129.1, 128.6, 127.9, 126.0, 58.0, 43.5, 30.0, 27.1, 20.6, 19.8 ; HRMS (ESI^+): found $[M\text{-}N_3]^+$ 235.1483, $C_{18}H_{19}$ requires 235.1481.

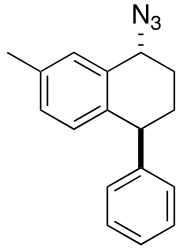


***trans*-1-Azido-5,8-dimethyl-4-phenyltetralin** *trans*-**7b** was prepared from *cis*-1-hydroxy-5,8-dimethyl-4-phenyltetralin *cis*-**6b** according to general method E to give a white solid (0.596 g, 86%); m.p.: 97–99 °C. ν_{max}/cm^{-1} (ATR): 2938 (CH), 2094 (N_3), 1449 (CH), 1232 (CN), 1033 (CH); δ_H (300 MHz; $CDCl_3$): 7.27 – 7.01

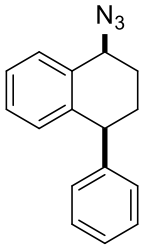
(m, 5H, ArH), 6.88 (d, *J* = 7.2, 2H, ArH), 4.77 – 4.70 (m, 1H, C(1)H), 4.30 (apparent d, *J* = 5.4, 1H, C(4)H), 2.51 – 2.36 (m, 4H, CH_3, one of C(3)H_2), 1.98 – 1.85 (m, 6H, CH_3, C(2)H_2, one of C(3)H_2); δ_C (75 MHz; $CDCl_3$): 145.3, 137.2, 135.4, 135.3, 131.9, 130.9, 129.1, 128.4, 128.3, 126.1, 57.0, 41.6, 27.0, 24.1, 19.6, 19.3; HRMS (ESI^+): found $[M\text{-}N_3]^+$ 235.1481, $C_{18}H_{19}$ requires 235.1481.



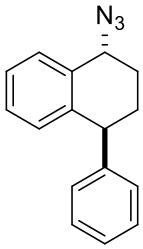
***cis*-1-Azido-7-methyl-4-phenyltetralin** *cis*-**7c** was prepared from *trans*-1-hydroxy-7-methyl-4-phenyltetralin *trans*-**6c** according to general method E to give a colourless oil (0.157 g, 73%). ν_{max}/cm^{-1} (ATR): 2940 (CH), 2089 (N_3), 1500 (CH), 1450 (CH), 1240 (CN); δ_H (300 MHz; $CDCl_3$): 7.35 – 7.19 (m, 3H, ArH), 7.18 – 7.10 (m, 3H, ArH), 7.00 (dd, *J* = 8.0, 1.9, 1H, ArH), 6.78 (d, *J* = 7.9, 1H, ArH), 4.61 (t, *J* = 4.0, 1H, C(1)H), 4.01 (t, *J* = 6.8, 1H, C(4)H), 2.35 (s, 3H, CH_3), 2.15 – 1.98 (m, 4H, C(2)H_2, C(3)H_2); δ_C (75 MHz; $CDCl_3$): 146.6, 137.3, 136.3, 133.9, 130.4, 129.8, 129.6, 128.9, 128.6, 126.5, 59.9, 45.4, 29.1, 28.3, 21.1; HRMS (ESI^+): found $[M\text{-}N_3]^+$ 221.1324, $C_{17}H_{18}$ requires 221.1325.



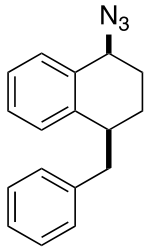
***trans*-1-Azido-7-methyl-4-phenyltetralin** *trans*-**7c** was prepared from *cis*-1-hydroxy-7-methyl-4-phenyltetralin *cis*-**6c** according to general method E to give a colourless oil (0.307 g, 73%). ν_{max}/cm^{-1} (ATR): 2940 (CH), 2091 (N_3), 1492 (CH), 1450 (CH), 1239 (CN); δ_H (300 MHz; $CDCl_3$): 7.32 – 7.13 (m, 5H, ArH), 7.06 – 6.94 (m, 3H, ArH), 6.83 (d, *J* = 7.9, 1H, ArH), 4.64 (apparent t, *J* = 5.3, 1H, C(1)H), 4.18 (apparent t, *J* = 5.7, 1H, C(4)H), 2.45 – 2.28 (m, 4H, one of C3()H_2, CH_3), 2.21 – 2.07 (m, 1H, one of C(2)H_2), 1.95 – 1.79 (m, 2H, one of C(2)H_2, one of C(3)H_2); δ_C (75 MHz; $CDCl_3$): 146.7, 136.5, 136.3, 134.6, 130.7, 129.4, 129.1, 128.8, 128.4, 126.3, 59.9, 44.3, 29.2, 26.4, 21.2; HRMS (ESI^+): found $[M\text{-}N_3]^+$ 221.1323, $C_{17}H_{18}$ requires 221.1325.



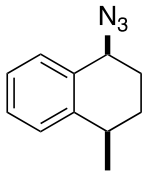
***cis*-1-Azido-4-phenyl-1,2,3,4-tetrahydronaphthalene** *cis*-**7e** was prepared from *trans*-4-phenyl-1,2,3,4-tetrahydronaphthalen-1-ol *trans*-**6e** according to general method E to give the pure product *cis*-**7e** as a yellow solid (0.966 g, 77%); m.p.: 80–82 °C. ν_{max}/cm^{-1} (ATR): 2943 (CH), 2091 (N_3), 1486 (CH), 755 (CH), 699 (CH); δ_H (300 MHz; $CDCl_3$): 7.42 – 7.03 (m, 8H, ArH), 6.89 (d, *J* = 7.7, 1H, ArH), 4.64 [t, *J* = 4.7, 1H, C(1)H], 4.04 [t, *J* = 6.7, 1H, C(4)H], 2.32 – 1.85 [m, 4H, C(2)H_2 and C(3)H_2]; δ_C (75 MHz; $CDCl_3$): 146.3, 140.2, 133.9, 130.4, 129.3, 128.8, 128.5, 126.5, 126.4, 59.7, 45.6, 28.9, 28.1.



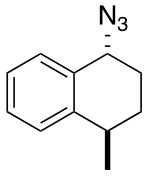
***trans* 1-Azido-4-phenyl-1,2,3,4-tetrahydronaphthalene** *trans*-**7e** was prepared from *cis*-4-phenyl-1,2,3,4-tetrahydronaphthalen-1-ol *cis*-**6e** according to general method E to give the pure product *trans*-**7e** as a colourless oil (0.902 g, 90%). ν_{max}/cm^{-1} (ATR): 2939 (CH), 2091 (N_3), 1491 (CH), 1239 (CN), 749 (CH), 700 (CH); δ_H (300 MHz; $CDCl_3$): 7.45 – 7.38 (1H, m, ArH), 7.32 – 7.15 (5H, m, ArH), 7.03 – 6.96 (2H, m, ArH), 6.94 (1H, d, *J* = 7.8, ArH), 4.67 [1H, t, *J* = 5.4, C(1)HN_3], 4.22 [1H, t, *J* = 5.8, C(4)H], 2.49 – 2.30 [1H, m, one of C(3)H_2], 2.23 – 2.05 [1H, m, one of C(2)H_2],1.96 – 1.80 [2H, m, one of C(2)H_2 and one of C(3)H_2]; δ_C (75 MHz; $CDCl_3$): 146.4, 139.3, 134.6, 130.7, 128.64, 128.63, 128.34, 128.32, 126.7, 126.2, 59.7, 44.5, 28.9, 26.1; HRMS (ESI^+): found $[M-N_3]^+$ 207.1168, $C_{16}H_{16}N_3$ requires 207.1170.



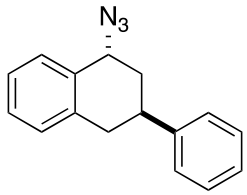
***cis*-1-Azido-3-benzyltetralin** *cis*-**7f** was prepared from *trans*-1-hydroxy-4-benzyltetralin *trans*-**6f** according to general method E to give a colourless oil (0.232 g, 88%). ν_{max}/cm^{-1} (ATR): 2937 (CH), 2093 (N_3), 1452 (CH), 1238 (CN), 1033 (CH); δ_H (300 MHz; $CDCl_3$): 7.43 – 7.08 (m, 9H, ArH), 4.57 (apparent t, *J* = 4.1, 1H, C(1)H), 3.23 – 3.09 (m, 1H, C(4)H), 3.03 (dd, *J* = 13.7, 4.8, 1H, one of $PhCH_2$), 2.68 (dd, *J* = 13.7, 10.5, 1H, one of $PhCH_2$), 2.22 – 2.05 (m, 1H, one of C(2)H_2), 2.02 – 1.80 (m, 2H, one of C(2)H_2, one of C(3)H_2), 1.67 – 1.53 (m, 1H, one of C(3)H_2); δ_C (75 MHz; $CDCl_3$): 140.9, 140.4, 133.5, 129.6, 129.5, 129.3, 128.6, 128.5, 126.6, 126.4, 59.6, 43.2, 39.0, 25.1, 21.7; HRMS (ESI^+): found $[M\text{-}N_2+H]^+$ 236.1431, $C_{17}H_{18}N$ requires 236.1434.



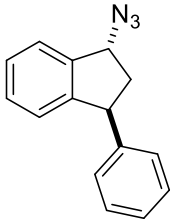
***cis*-1-Azido-4-methyltetralin** *cis*-**7g**[23] was prepared from *trans*-1-hydroxy-4-methyltetralin *trans*-**6g** according to general method D to give a colourless oil (0.109 g, 78%). ν_{max} (ATR): 2932 (CH), 2090 (N_3), 1239 (CN); δ_H (300 MHz; $CDCl_3$): 7.39 – 7.16 (m, 4H, ArH), 4.56 (apparent t, *J* = 4.8, 1H, C(1)H), 2.98 – 2.78 (m, 1H, C(4)H), 2.13 – 1.85 (m, 3H, C(2)H_2, one of C(3)H_2), 1.82 – 1.61 (m, 1H, one of C(3)H_2), 1.36 (d, *J* = 6.9, 3H, CH_3); δ_C (75 MHz; $CDCl_3$): 142.4, 133.5, 129.2, 128.5, 128.2, 126.2, 60.2, 32.4, 27.7, 27.5, 22.3; HRMS (ESI^+) found $[M\text{-}N_2+H]^+$ 160.1119 $C_{11}H_{14}N$ requires 160.1121.



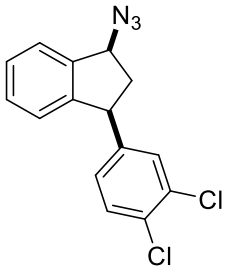
***trans*-1-Azido-4-methyltetralin** *trans*-**7g**[23] was prepared from cis-1-hydroxy-4-methyltetralin *cis*-**6g** according to general method D to give a colourless oil (0.220 g, 70%). ν_{max} (ATR): 2935 (CH), 2091 (N_3), 1238 (CN); δ_H (300 MHz; $CDCl_3$): 7.33 – 7.17 (m, 4H, ArH), 4.55 (apparent t, *J* = 4.3, 1H, C(1)H), 3.09 – 2.91 (m, 1H, C(4)H), 2.25 – 2.05 (m, 2H, one of C(2)H_2, one of C(3)H_2), 2.00 – 1.83 (m, 1H, one of C(2)H_2), 1.65 – 1.46 (m, 1H, one of C(3)H_2), 1.27 (d, *J* = 7.1, 3H, CH_3); δ_C (75 MHz; $CDCl_3$): 142.5, 133.4, 129.1, 129.0, 128.5, 126.2, 59.9, 32.0, 26.8, 25.8, 23.1; HRMS (ESI^+): found $[M\text{-}N_2+H]^+$ 160.1118, $C_{11}H_{14}N$ requires 160.1121.



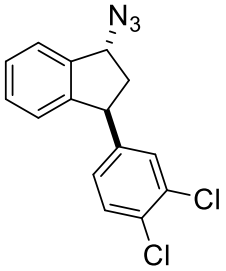
***trans*-1-Azido-3-phenyltetralin** *trans*-**7h** was prepared from *cis*-1-hydroxy-3-phenyltetralin *cis*-**6h** according to general method E to give a colourless oil (0.386 g, 77%). ν_{max}/cm^{-1} (ATR): 2921 (CH), 2090 (N_3), 1494 (CH), 1453 (CH), 1234 (CN); δ_H (300 MHz; $CDCl_3$): 7.48 – 7.11 (m, 9H, ArH), 4.78 (dd, *J* = 4.0, 2.7, 1H, C(1)H), 3.41 – 3.22 (m, 1H, C(3)H), 3.13 (ddd, *J* = 17.0, 5.2, 1.4, 1H, one of C(3)H_2), 2.91 (dd, *J* = 16.9, 12.0, 1H, one of C(3)H_2), 2.36 – 2.24 (m, 1H, one of C(2)H_2), 2.15 (ddd, *J* = 13.6, 12.3, 4.0, 1H, one of C(2)H_2); δ_C (75 MHz; $CDCl_3$): 145.3, 137.1, 132.8, 129.8, 129.7, 128.9, 128.8, 127.1, 126.9, 126.7, 126.5, 60.0, 37.4, 36.1, 35.6; HRMS (ESI^+): found $[M-N_2+H]^+$ 222.1273, $C_{16}H_{16}N$ requires 222.1277.



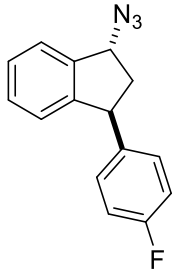
***trans*-1-Azido-3-phenyl-2,3-dihydro-1*H*-indene** *trans*-**7i** was prepared from *cis*-3-phenyl-2,3-dihydro-1*H*-inden-1-ol *cis*-**6i** according to general method E to give *trans*-**7i** as a yellow oil (0.450 g, 80%). ν_{max}/cm^{-1} (ATR): 2932 (CH), 2089 (N_3), 1454 (CH), 1234 (CN), 749 (CH), 699 (CH); δ_H (300 MHz; $CDCl_3$): 7.52 – 7.40 (m, 1H), 7.37 – 7.18 (m, 5H, ArH), 7.17 – 7.09 (m, 2H, ArH), 7.07 – 6.96 (m, 1H, ArH), 5.03 (dd, *J* = 6.9, 2.5, 1H, C(1)H), 4.57 (t, *J* = 7.8, 1H, C(3)H), 2.61 (ddd, *J* = 7.5, 6.3, 2.5, 1H, one of C(2)H_2), 2.37 (ddd, *J* = 6.9, 5.5, 1.4, 1H, one of C(2)H_2); δ_C (75 MHz; $CDCl_3$): 147.1, 143.7, 140.6 (3 × Aromatic qC), 129.4, 128.6 (2 × C), 128.0 (2 × C), 127.3, 126.7, 125.6, 124.6 (9 × Aromatic CH), 64.9 (CH), 49.3 (CH), 43.4 [C(2)H_2]; HRMS (ESI^+): found $[M+H]^+$ 236.1059, $C_{15}H_{14}N_3$ requires 236.1070.



***cis*-1-Azido-3-(3,4-dichlorophenyl)-2,3-dihydro-1*H*-indene** *cis*-**7j**[25] was prepared from *trans*-3-(3,4-dichlorophenyl)-2,3-dihydro-1*H*-inden-1-ol *trans*-**6j** according to general method E to give the pure product *cis*-**7j** as a dark orange oil (0.691 g, 53%). ν_{max}/cm^{-1} (ATR): 2929 (CH), 2090 (N_3), 1468 (CH), 1254 (CN), 758 (CH), 747 (CH); δ_H (300 MHz; $CDCl_3$): 7.52 – 7.26 (5H, m, ArH), 7.05 (1H, dd, *J* = 8.2, 2.1, ArH), 6.97 (1H, d, *J* = 7.3, ArH), 4.93 [1H, dd appears as t, *J* = 7.3, C(1)H], 4.24 [1H, dd appears as t, *J* = 8.2, C(3)H], 3.01 [1H, dt, *J* = 13.3, 7.7, one of C(2)H_2], 2.02 [1H, ddd, *J* = 13.3, 8.4, 7.6, one of C(2)H_2]; δ_C (75 MHz; $CDCl_3$): 144.6, 144.2, 141.2, 132.7, 130.9, 130.7, 130.2, 129.2, 127.9, 127.6, 125.2, 124.3, 64.3, 48.1, 42.6.

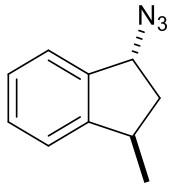


***trans*-1-Azido-3-(3,4-dichlorophenyl)-2,3-dihydro-1*H*-indene** *trans*-**7j**[25] was prepared from *cis*-3-(3,4-dichlorophenyl)-2,3-dihydro-1*H*-inden-1-ol *cis*-**6j** according to general method E to afford the pure as an orange oil (0.928 g, 86%). ν_{max}/cm^{-1} (ATR): 2935 (CH), 2092 (N_3), 1474 (CH), 1237 (CN), 757 (CH); δ_H (300 MHz; $CDCl_3$): 7.52 – 7.42 (1H, m, ArH), 7.42 – 7.28 (3H, m, ArH), 7.23 (1H, d, *J* = 2.1, ArH), 7.05 – 6.94 (2H, m, ArH), 5.03 (1H, dd, *J* = 6.8, 2.3, C(1)H], 4.53 [1H, t, *J* = 7.9, C(3)H], 2.61 [1H, ddd, *J* = 13.7, 7.5, 2.4, one of C(2)H_2], 2.30 [1H, ddd, *J* = 13.7, 8.3, 6.8, one of C(2)H_2]; δ_C (75 MHz; $CDCl_3$): 145.8, 144.1, 140.7, 132.7, 130.8, 130.7, 129.9, 129.7, 127.8, 127.4, 125.4, 124.8, 64.7, 48.5, 43.4.



***trans*-1-Azido-3-(4-fluorophenyl)-2,3-dihydro-1*H*-indene** *trans*-**7k** was prepared from *cis*-3-(4-fluorophenyl)-2,3-dihydro-1*H*-inden-1-ol *cis*-**6k** according to general method E to give *trans*-**7k** as a colourless oil (0.975 g, 88%*). δ_H (300 MHz; $CDCl_3$): 7.52 – 7.18 (5H, m, ArH), 7.15 – 7.06 (2H, m, ArH), 7.05 – 6.92 (1H, m, ArH), 5.02 [1H, dd, *J* = 6.8, 2.3, C(1)H], 4.56 [1H, t, *J* = 7.6, C(3)H], 2.60 [1H, ddd, *J* = 13.7, 7.4, 2.3, one of CH_2], 2.31 [1H, ddd, *J* = 13.5, 7.2, 6.8, one of CH_2]; δ_C (75 MHz; $CDCl_3$): 161.7 (d, J_{CF} = 245.0),

146.9, 140.6, 139.4 (d, J_{CF} = 3.3), 129.5 (d, J_{CF} = 4.3), 129.4, 127.5, 125.5, 124.7, 115.5 (d, J_{CF} = 21.3), 64.8, 48.6, 43.7; δ_F (282 MHz; $CDCl_3$): –116; HRMS (ESI^+): found $[M+H]^+$ 254.0553, $C_{15}H_{13}FN_3$ requires 254.0642. *Note a small amount of the *cis*-diastereomer is present (<4%) but the *cis*-amine is not evident in the next step.



***trans*-1-Azido-3-methyl-2,3-dihydro-1*H*-indene** *trans*-**7l**[26] was prepared from *cis*-3-methyl-2,3-dihydro-1*H*-inden-1-ol *cis*-**6l** according to general method E to afford *trans*-**7l** (0.566 g, 54%). δ_H (300 MHz; $CDCl_3$): 7.52 – 7.11 (4H, m, ArH), 4.87 [1H, dd, *J* = 6.9, 2.3, C(4)H], 3.51 – 3.33 [1H, m, C(3)H], 2.36 (1H, ddd, *J* = 13.5, 7.2, 2.1, one of CH_2), 1.94 (1H, ddd, *J* = 13.5, 6.5, 5.6, one of CH_2), 1.29 (3H, d, *J* = 6.9, CH_3); δ_C (75 MHz; $CDCl_3$): 148.7, 140.0, 129.2, 126.9, 124.7, 123.9, 64.8, 41.7, 37.2, 19.6. Note: A small amount of the *cis*-diastereomer is present (<5%) but the *cis*-amine is not evident in the next step.

1.5 Synthesis of amines

General Method F – Azide reduction to Amine[25]

A solution of azide (1 eq) in dry THF was added slowly to a solution of $LiAlH_4$ (1 M in dry THF, 1.5 eq) under a nitrogen atmosphere at 0°C. The reaction mixture was stirred at room temperature overnight. The reaction was quenched through slow addition of 10:1 THF:H_2O, while cooling on ice. The mixture was filtered through Celite® and concentrated under reduced pressure. The residue was dissolved in Et_2O, and a few drops of 10% HCl were added under vigorous stirring until precipitate started to form. The precipitate was collected by filtration and dissolved in H_2O. After basifying the mixture to pH >10 with 5 M aqueous KOH and stirring for 10 min, it was extracted with EtOAc (× 3). The combined organic layers were washed with brine, dried over Na_2SO_4 and concentrated under reduced pressure to afford the amine.

OR

The azide (1 eq) was dissolved in dry THF and PPh_3 (1.2 equiv.) and H_2O (2 equiv.) were added. The solution was heated under reflux for 4 h and allowed to cool. The solvent was removed under reduced pressure.

Removal of the triphenylphosphine oxide by-product: The residue was dissolved in a 50:50 mix of hexane and Et_2O (50 ml) and stored overnight at –20°C. The white precipitate was removed by filtration and the filtrate concentrated under vacuum. The residue was dissolved in CH_2Cl_2 (10 ml) and 5M aqueous HCl solution was added dropwise until pH 1. The resulting white precipitate was collected by filtration. The solid was re-suspended in H_2O (50 ml) and the pH was adjusted to 10 with 1M aqueous NaOH solution. The mixture was stirred for 30 min, then extracted using ethyl acetate (2 x 50 ml). The combined organic layer was washed with water (100 ml), brine (100 ml), dried (Na_2SO_4), filtered and concentrated *in vacuo* to give the pure product.

General Method G – Reductive Amination

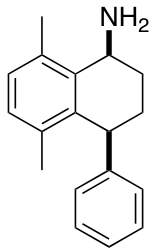
A mixture of ketone (1 eq), titanium isopropoxide (3 eq) and methanolic ammonia (2M, 10 eq) was stirred under nitrogen for 16 h. The reaction mixture was cooled to 0 °C and sodium borohydride (1.5 eq) was added. The mixture was allowed to warm to room temperature and stirred for 3 h. The reaction was quenched by pouring onto ammonium hydroxide (2M) and stirred for 5–10 min. The inorganic precipitate was removed by filtration and the filter cake was washed with CH_2Cl_2. The layers were separated, and the

aqueous layer was extracted with CH_2Cl_2 (× 2). The combined organic layers were concentrated, dried over Na_2SO_4 and concentrated under reduced pressure to afford the crude amine.

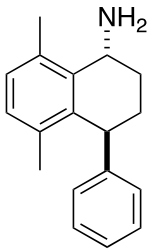
General Method H – Boc protection: A solution of crude amine and di-*tert*-butyl-dicarbonate (1 eq) was stirred at room temperature for 3 – 16h and then concentrated under reduced pressure. The NHBoc diastereomers were separated by flash column chromatography (hexane/$CHCl_3$/EtOAc 18:2:1).

General Method I – Boc deprotection

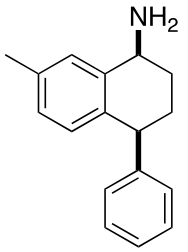
The amine was dissolved in HCl (4M in dioxane, 4 mL per mmol amine) and stirred for 3 h. The solvent was removed under reduced pressure and the residue triturated using diethyl ether. The precipitate was collected by filtration and dissolved in H_2O. After basifying the mixture to pH >10 with 5 M aqueous KOH and stirring for 10 min, it was extracted with EtOAc (× 3). The combined organic layers were washed with brine, dried over Na_2SO_4 and concentrated under reduced pressure to afford the amine.



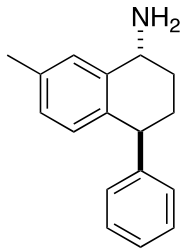
***cis*-1-Amino-5,8-dimethyl-4-phenyltetralin** ***cis*-1b** was prepared from *cis*-1-azido-5,8-dimethyl-4-phenyltetralin *cis*-**7b** according to general method F to give a colourless oil (0.070 g, 75%). ν_{max}/cm^{-1} (ATR): 2925 (NH), 1492 (CH), 1450 (CH), 1031 (CN); δ_H (300 MHz; $CDCl_3$): 7.29 – 7.11 (m, 3H, ArH), 7.08 – 7.00 (m, 3H, ArH), 6.94 (d, *J* = 7.6, 1H, ArH), 4.25 (apparent t, *J* = 5.1, 1H, C(1)H), 4.17 (apparent t, *J* = 6.7, 1H, C(4)H), 2.48 (s, 3H, CH_3), 2.22 – 1.89 (m, 3H, one of C(2)H_2, C(3)H_2), 1.85 (s, 3H, CH_3), 1.75 – 1.61 (m, 1H, one of C(2)H_2), 1.50 (br s, 2H, NH_2); δ_C (75 MHz; $CDCl_3$): 147.4, 140.7, 137.2, 135.5, 134.2, 129.3, 129.0, 128.6, 127.8, 125.7, 47.1, 43.5, 30.4, 29.8, 20.6, 19.5; HRMS (ESI^+): found $[M+H]^+$ 252.1750, $C_{18}H_{22}N$ requires 252.1747; enantiomers separated using a Phenomenex Cellulose 4 column [conditions: *n*-hexane/*i*PrOH (containing 2% DEA) = 90/10, flow rate = 0.5 mL min^{-1}], R_t = 19.1 min, R_t = 23.8 min.



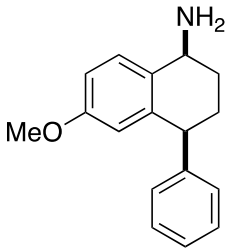
***trans*-1-Amino-5,8-dimethyl-4-phenyltetralin** *trans*-**1b** was prepared from *trans*-1-azido-5,8-dimethyl-4-phenyltetralin *trans*-**7b** according to general method F to give a colourless oil (0.066 g, 88%). ν_{max}/cm^{-1} (ATR): 2925 (NH), 1492 (CH), 1449 (CH), 1029 (CN); δ_H (300 MHz; $CDCl_3$): 7.25 – 7.08 (m, 3H, ArH), 7.04 (d, *J* = 7.6, 1H, ArH), 6.95 (d, *J* = 7.6, 1H, ArH), 6.88 (d, *J* = 7.3, 2H, ArH), 4.33 – 4.16 (m, 2H, C(1)H, C(4)H), 2.57 – 2.40 (m, 4H, CH_3, one of C(3)H_2), 1.97 – 1.78 (m, 5H, CH_3, CH_3, one of C(2)H_2, one of 3-H_2), 1.65 – 1.55 (m, 1H, one of C(2)H_2), 1.46 (br s, 2H, NH_2); δ_C (75 MHz; $CDCl_3$): 146.0, 139.6, 135.9, 135.2, 134.2, 129.2, 129.1, 128.5, 128.2, 125.8, 45.8, 42.0, 26.7, 26.0, 19.8, 19.1; HRMS (ESI$^+$): found $[M+H]^+$ 252.1748, $C_{18}H_{22}N$ requires 252.1747; enantiomers not separated by chiral HPLC as amine was not processed by *P*-ω-TA or *Cv*-ω-TA.



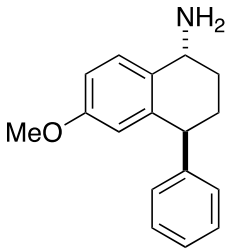
***cis*-1-Amino-7-methyl-4-phenyltetralin** *cis*-**1c** was prepared from *cis*-1-azido-7-methyl-4-phenyltetralin *cis*-**7c** according to general method F to give a yellow oil (0.082 g, 69%). ν_{max}/cm^{-1} (ATR): 2922 (NH), 1601 (C=C), 1492 (CH), 1450 (CH); δ_H (300 MHz; $CDCl_3$): 7.34 – 7.17 (m, 4H, ArH), 7.16 – 7.08 (m, 2H, ArH), 6.92 (dd, *J* = 7.9, 1.9, 1H, ArH), 6.74 (d, *J* = 7.9, 1H, ArH), 4.09 – 3.97 (m, 2H, C(1)H, C(4)H), 2.33 (s, 3H, CH_3), 2.14 – 1.93 (m, 3H, C(3)H_2, one of C(2)H_2), 1.86 – 1.74 (m, 1H, one of C(2)H_2), 1.62 (br s, 2H, NH_2); δ_C (75 MHz; $CDCl_3$): 147.1, 141.1, 136.0 (2 × C), 130.0, 128.8, 128.8, 128.3, 127.8, 126.1, 49.5, 45.5, 31.0, 29.0, 21.0; HRMS (ESI$^+$): found $[M+H]^+$ 238.1588, $C_{17}H_{20}N$ requires 238.1590; enantiomers separated using a Chiralcel AS-H column [conditions: *n*-hexane/*i*PrOH (containing 2% DEA) = 95/5, flow rate = 0.25 mL min^{-1}], R_t = 23.0 min, R_t = 24.7 min.



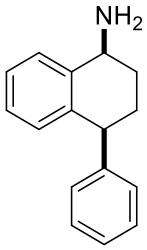
***trans*-1-Amino-7-methyl-4-phenyltetralin** *trans*-**1c** was prepared from *trans*-1-azido-7-methyl-4-phenyltetralin *trans*-**7c** according to general method F to give a yellow oil (0.101 g, 85%). ν_{max}/cm^{-1} (ATR): 2923 (NH), 1600 (C=C), 1492 (CH), 1449 (CH); δ_H (300 MHz; $CDCl_3$): 7.32 (s, 1H, ArH), 7.30 – 7.14 (m, 3H, ArH), 7.09 – 7.01 (m, 2H, ArH), 6.90 (dd, *J* = 7.9, 1.9, 1H, ArH), 6.73 (d, *J* = 7.9, 1H, ArH), 4.15 – 4.01 (m, 2H, C(1)H, C(4)H), 2.33 (d, *J* = 0.9, 3H, CH_3), 2.30 – 2.20 (m, 1H, one of C(3)H_2), 2.18 – 2.06 (m, 1H, one of C(2)H_2), 1.91 – 1.78 (m, 1H, one of C(3)H_2), 1.67 – 1.50 (m, 3H, one of C(2)H_2, NH_2); δ_C (75 MHz; $CDCl_3$): 147.3, 141.4, 136.1, 136.1, 130.2, 128.8, 128.4, 128.1, 127.8, 126.1, 49.9, 45.5, 32.0, 30.3, 21.2; HRMS (ESI^+): found $[M+H]^+$ 238.1592, $C_{17}H_{20}N$ requires 238.1590; enantiomers not separated by chiral HPLC as amine was not processed by *P*-ω-TA or *Cv*-ω-TA.



***cis*-1-Amino-6-methoxy-4-phenyltetralin** *cis*-**1d** was prepared from *cis*-1-(Boc-amino)-6-methoxy-4-phenyltetralin *cis*-**8d** according to general method I to give a colourless oil (0.037 g, 45%). ν_{max}/cm^{-1} (ATR): 2930 (NH), 1608 (C=C), 1493 (CH), 1238 (CN), 1038 (CN); δ_H (300 MHz; $CDCl_3$): 7.43 – 7.04 (m, 6H, ArH), 6.78 (dd, *J* = 8.5, 2.5, 1H, C(7)H), 6.36 (d, *J* = 2.5, 1H, C(5)H), 4.12 – 3.92 (m, 2H, C(1)H, C(4)H), 3.64 (s, 3H, OCH_3), 2.18 – 1.89 (m, 3H, C(2)H_2, one of C(3)H_2), 1.89 – 1.69 (m, 1H, one of C(3)H_2), 1.63 (br s, 2H, NH_2); δ_C (75 MHz; $CDCl_3$): 158.4, 146.8, 140.5, 134.2, 129.6, 129.0, 128.5, 126.3, 114.7, 112.9, 55.3, 49.1, 46.2, 31.3, 29.0; HRMS (ESI^+): found $[M-NH_2]^+$ 237.1272, $C_{17}H_{17}O$ requires 237.1274; the enantiomers of *cis*-**1d** were not analysed by chiral HPLC; the resulting reaction solutions from the relevant biotransformations were subject to Boc protection (according to general method H, the Boc-protected amines were then analysed by chiral HPLC, as per conditions detailed for *cis*-**8d**.

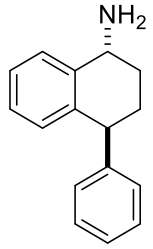


***trans*-1-Amino-6-methoxy-4-phenyltetralin** *trans*-**1d** was prepared from *trans*-1-(Boc-amino)-6-methoxy-4-phenyltetralin *trans*-**8d** according to general method I to give a colourless oil (0.043 g, 48%). ν_{max}/cm^{-1} (ATR): 2929 (NH), 1608 (C=C), 1493 (CH), 1239 (CN), 1036 (CN); δ_H (300 MHz; $CDCl_3$): 7.42 (d, *J* = 8.5, 1H, C(8)H), 7.34 – 7.12 (m, 3H, ArH), 7.09 – 6.99 (m, 2H, ArH), 6.79 (dd, *J* = 8.5, 2.6, 1H, C(7)H), 6.37 (d, *J* = 2.6, 1H, C(5)H), 4.17 – 3.98 (m, 2H, C(1)H, C(2)H), 3.64 (s, 3H, OCH_3), 2.36 – 2.20 (m, 1H, one of C(3)H_2), 2.18 – 2.03 (m, 1H, one of C(2)H_2), 1.92 – 1.76 (m, 1H, one of C(3)H_2), 1.76 – 1.49 (m, 3H, one of C(2)H_2, NH_2); δ_C (75 MHz; $CDCl_3$): 158.3, 146.9, 140.4, 134.3, 128.9, 128.8, 128.4, 126.2, 114.8, 112.9, 55.3, 49.3, 46.1, 32.0, 30.0; HRMS (ESI^+): found $[M\text{-}NH_2]^+$ 237.1273, $C_{17}H_{17}O$ requires 237.1274; the enantiomers of *trans*-**1d** were not analysed by chiral HPLC; the resulting reaction solution from the relevant biotransformations were subject to Boc protection (according to general method H, the Boc-protected amines were then analysed by chiral HPLC, as per conditions detailed for *trans*-**8d**.

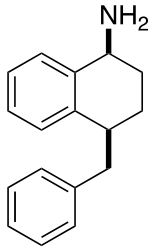


***cis*-4-Phenyl-1,2,3,4-tetrahydronaphthalen-1-amine** cis-**1e**[24] was prepared from *cis*-1-azido-4-phenyl-1,2,3,4-tetrahydronaphthalene *cis*-**7e** according to general method F (polystyrene bound triphenylphosphine used) to give the *cis*-**1e** as a brown oil (0.070 g, 9%). ν_{max}/cm^{-1} (ATR): 3279 (NH), 2928 (NH), 1489 (CH), 1447 (CH), 759 (CH), 726 (CH), 700 (CH); δ_H (300 MHz; $CDCl_3$): 7.43 (1H, d, *J* = 7.0, ArH), 7.35 – 7.00 (7H, m, ArH), 6.84 (1H, d, *J* = 7.7, ArH), 4.11 – 3.99 [2H, m, C(1)H and C(4)H], 2.92 – 2.22 [3H, m, one of C(2)H_2 and C(3)H_2], 1.88 – 1.75 [1H, m, one of C(2)H_2], 1.66 (br s, 2H, NH_2); δ_C (75 MHz; $CDCl_3$): 146.9, 141.6, 139.0, 130.0, 128.9, 128.3, 128.2, 126.8, 126.5, 126.1, 49.4, 45.8, 30.9, 28.9; HRMS (ESI^+): found $[M+H]^+$ 224.1434, $C_{16}H_{18}N$ requires 224.1434; enantiomers separated using a Phenomenex Cellulose 2 [conditions: *n*-hexane/*i*PrOH (containing 2% DEA) = 95/5, flow rate = 0.5 mL min^{-1}], R_t = 17.5 min, R_t = 18.7 min, (ketone **2e** overlaps with *cis*-**1e** peaks under analysis by chiral HPLC; post

biotransformation, *cis*-**1e** and **2e** are separated on a silica plug using 70:30 hexane:ethyl acetate to elute ketone **2e** followed by 100% methanol to elute *cis*-**1e**.

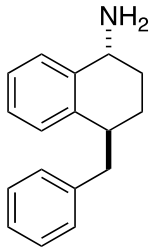


***trans*-4-Phenyl-1,2,3,4-tetrahydronaphthalen-1-amine** *trans*-**1e** was prepared from *trans*-1-azido-4-phenyl-1,2,3,4-tetrahydronaphthalene *trans*-**7e** according to general method F to give the product *trans*-**1e** as a yellow oil (0.313 g, 52%). ν_{max}/cm^{-1} (ATR): 3357 (NH), 2925 (NH), 1491 (CH), 1450 (CH), 749 (CH), 700 (CH); δ_H (300 MHz; $CDCl_3$): 7.51 (1H, d, *J* = 7.7, ArH), 7.35 – 7.15 (4H, m, ArH), 7.10 (1H, d, *J* = 7.3, ArH), 7.05 (2H, d, *J* = 7.1, ArH), 6.85 (1H, d, *J* = 7.8, ArH), 4.15 [1H, t, *J* = 6.8, C(4)H], 4.11 (1H, t, *J* = 6.1, C(1)H], 2.37 – 2.24 [1H, m, one of $C(3)H_2$], 2.20 – 2.09 (1H, m, one of $C(2)H_2$), 1.95 – 1.79 [1H, m, one of $C(3)H_2$], 1.73 – 1.57 (1H, m, one of $C(2)H_2$); δ_C (75 MHz; $CDCl_3$): 147.0, 139.0, 130.2, 128.7, 128.3, 127.5, 126.7, 126.5, 126.1, 49.8, 45.7, 31.8, 30.1; HRMS (ESI^+): found $[M+H]^+$ 224.1435 $C_{16}H_{18}N$ requires 224.1434; enantiomers separated using a Chiralcel OJ-H column [conditions: *n*-hexane/*i*PrOH (containing 2% DEA) = 90/10, flow rate = 0.5 mL min^{-1}], R_t = 18.8 min, R_t = 24.1 min.

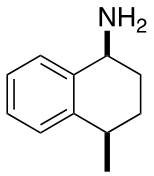


cis-1-Amino-4-benzyltetralin *cis*-**1f** was prepared from *cis*-1-azido-4-benzyltetralin *cis*-**7f** according to general method F to give a colourless oil (0.177 g, 75%). ν_{max}/cm^{-1} (ATR): 2928 (NH), 2857 (NH), 1601 (C=C), 1494 (CH), 1452 (CH); δ_H (300 MHz; $CDCl_3$): 7.45 – 7.12 (m, 9H, ArH), 4.00 (apparent t, *J* = 4.7, 1H, C(1)H), 3.20 – 3.01 (m, 2H, C(4)H, one of $PhCH_2$), 2.78 – 2.60 (m, 1H, one of $PhCH_2$), 2.22 – 2.04 (m, 1H, one of $C(2)H_2$), 1.99 – 1.82 (m, 1H, one of $C(3)H_2$), 1.69 – 1.39 (m, 4H, one of $C(2)H_2$, one of $C(3)H_2$, NH_2); δ_C (75 MHz; $CDCl_3$): 141.1, 140.9, 140.1, 129.3, 129.0, 128.7, 128.5, 126.9, 126.4, 126.2, 49.3, 43.3, 39.7, 29.4, 22.1; HRMS (ESI^+): found $[M+H]^+$ 238.1587, $C_{17}H_{20}N$ requires 238.1590; enantiomers separated using a

Phenomenex Amylose 1 column [conditions: *n*-hexane/*i*PrOH (containing 2% DEA) = 95/5, flow rate = 0.25 mL min^{-1}], R_t = 45.1 min, R_t = 49.3 min.

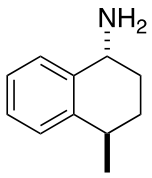


***trans*-1-Amino-4-benzyltetralin** *trans*-**1f** was prepared from 4-benzyltetral-1-one **2f** according to general method G. The crude amine was dissolved in Et_2O, and a few drops of 10% HCl were added under vigorous stirring until precipitate started to form. The HCl salt was collected by filtration, recrystallized from *i*PrOH and dissolved in H_2O. After basifying the mixture to pH >10 with 5 M aqueous KOH and stirring for 10 min, it was extracted with dichloromethane (× 3). The combined organic layers were dried over Na_2SO_4 and concentrated under reduced pressure. The title product was afforded as a colourless oil (0.178 g, 39%). ν_{max}/cm^{-1} (ATR): 2923 (NH), 2859 (NH), 1601 (C=C), 1494 (CH), 1452 (CH); δ_H (300 MHz; $CDCl_3$): 7.52 – 7.42 (m, 1H, ArH), 7.44 – 7.03 (m, 8H, ArH), 4.00 – 3.87 (m, 1H, C(1)H), 3.17 (dd, *J* = 13.4, 4.5, 1H, one of $PhCH_2$), 3.11 – 2.98 (m, 1H. C(4)H), 2.77 (dd, *J* = 13.4, 10.2, 1H, one of $PhCH_2$), 2.00 – 1.84 (m, 1H, one of C(2)H_2), 1.80 – 1.64 (m, 3H, one of C(2)H_2, C(3)H_2), 1.57 (br s, 2H, NH_2); δ_C (75 MHz; $CDCl_3$): 141.4, 140.9, 140.3, 129.3, 128.6, 128.5, 127.7, 126.8, 126.4, 126.2, 50.2, 43.3, 39.7, 30.5, 24.0; HRMS (ESI^+): found $[M+H]^+$ 238.1588, $C_{17}H_{20}N$ requires 238.1590; enantiomers separated using a Phenomenex Amylose 1 column [conditions: *n*-hexane/*i*PrOH (containing 2% DEA) = 95/5, flow rate = 0.25 mL min^{-1}], R_t = 20.6, R_t = 22.1 min.

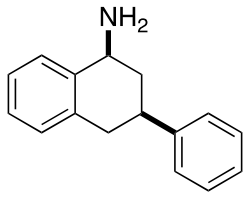


***cis*-1-Amino-4-methyltetralin** *cis*-**1g** was prepared from *cis*-1-azido-4-methyltetralin *cis*-**7g** according to general method E to give a yellow oil (0.061 g, 69%). ν_{max}/cm^{-1} (ATR): 2926 (NH), 1575 (C=C), 1443 (CH), 1373 (CH); δ_H (300 MHz; $CDCl_3$): 7.44 – 7.36 (m, 1H, ArH), 7.25 – 7.14 (m, 3H, ArH), 3.95 (apparent t, *J* = 5.9, 1H, C(1)H), 2.94 – 2.79 (m, 1H, C(4)H), 2.05 – 1.84 (m, 2H, one of C(2)H_2, one of C(3)H_2), 1.82 – 1.60 (m, 4H, one of C(2)H_2, one of C(3)H_2, NH_2), 1.34 (d, *J* = 7.0, 3H, CH_3); δ_C (75 MHz; $CDCl_3$): 141.8, 141.0, 127.9, 127.8, 126.9, 126.1, 49.9, 32.7, 31.0, 27.9, 22.6; HRMS (ESI^+): found $[M+H]^+$ 162.1273, $C_{11}H_{16}N$

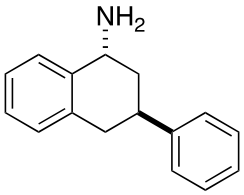
requires 162.1277; enantiomers separated using a Phenomenex Amylose 1 column [conditions: *n*-hexane/*i*PrOH (containing 2% DEA) = 95/5, flow rate = 0.25 mL min^{-1}], R_t = 42.5 min, R_t = 46.2 min.



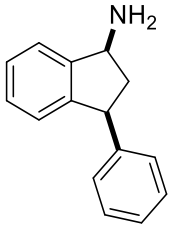
***trans*-1-Amino-4-methyltetralin** *trans*-**1g** was prepared from *trans*-1-azido-4-methyltetralin *trans*-**7g** according to general method E to give a yellow oil (0.120 g, 85%). ν_{max}/cm^{-1} (ATR): 2927 (NH), 1579 (C=C), 1444 (CH), 1374 (CH); δ_H (300 MHz; $CDCl_3$): 7.45 – 7.34 (m, 1H, ArH), 7.23 – 7.07 (m, 3H, ArH), 3.97 (dd, *J* = 6.5, 4.5, 1H, C(1)H), 3.04 – 2.86 (m, 1H, C(4)H), 2.23 – 2.02 (m, 2H, one of $C(2)H_2$, one of $C(3)H_2$), 1.71 – 1.43 (m, 4H, one of $C(2)H_2$, one of $C(3)H_2$, NH_2), 1.27 (d, *J* = 7.1, 3H, CH_3); δ_C (75 MHz; $CDCl_3$): 141.7, 140.9, 128.3, 128.1, 126.8, 126.1, 49.8, 32.8, 31.0, 27.8, 22.9; HRMS (ESI^+): found $[M+H]^+$ 162.1273, $C_{11}H_{16}N$ requires 162.1277; enantiomers separated using a Phenomenex Amylose 1 column [conditions: *n*-hexane/*i*PrOH (containing 2% DEA) = 95/5, flow rate = 0.25 mL min^{-1}], R_t = 42.5 min, R_t = 46.2 min.



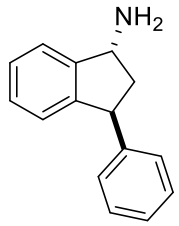
***cis*-1-Amino-3-phenyltetralin** *cis*-**1h**[27] was prepared from 3-phenyltetral-1-one **2h** according to general method F. The crude amine was dissolved in Et_2O, and a few drops of 10% HCl were added under vigorous stirring until precipitate started to form. The HCl salt was collected by filtration, recrystallized from *i*PrOH and dissolved in H_2O. After basifying the mixture to pH >10 with 5 M aqueous KOH and stirring for 10 min, it was extracted with EtOAc (× 3). The combined organic layers were washed with brine, dried over Na_2SO_4 and concentrated under reduced pressure. The title product was afforded as a colourless oil (0.143 g, 28%). ν_{max}/cm^{-1} (ATR): 2915 (NH), 1602 (C=C), 1493 (CH), 1451 (CH); δ_H (300 MHz; $CDCl_3$): 7.62 (dd, *J* = 7.7, 1.4, 1H, ArH), 7.44 – 7.14 (m, 7H, ArH), 7.14 – 7.03 (m, 1H, ArH), 4.17 (dd, *J* = 11.0, 5.7, 1H, C(1)H), 3.19 – 2.90 (m, 3H, C(3)H, $C(4)H_2$), 2.47 – 2.32 (m, 1H, one of $C(2)H_2$), 1.82 (ddd, *J* = 12.2, 12.2, 11.0, 1H, one of $C(2)H_2$), 1.62 (s, 2H, NH_2); δ_C (75 MHz; $CDCl_3$): 146.0, 140.9, 136.5, 128.9, 128.7, 126.9, 126.8, 126.8, 126.5, 126.5, 51.5, 42.71, 40.2, 38.8; HRMS (ESI^+): found $[M+H]^+$ 224.1434, $C_{16}H_{18}N$ requires 224.1434; enantiomers not separated by chiral HPLC as the amine was not processed by *P*-ω-TA or *Cv*-ω-TA.



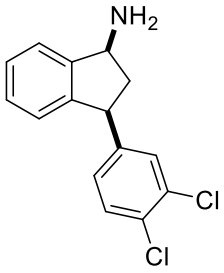
***trans*-1-Amino-3-phenyltetralin** *trans*-**1h** was prepared from *trans*-1-azido-3-phenyltetralin *trans*-**7h** according to general method E to give a colourless oil (0.153 g, 50%). ν_{max}/cm^{-1} (ATR): 2919 (NH), 1602 (C=C), 1493 (CH), 1452 (CH), 1055 (CN); δ_H (300 MHz; $CDCl_3$): 7.42 – 7.06 (m, 9H, ArH), 4.20 (dd, *J* = 4.6, 2.8, 1H, C(1)H), 3.40 – 3.25 (m, 1H, C(3)H), 3.07 (ddd, *J* = 16.7, 5.0, 1.6, 1H, one of C(4)H_2), 2.87 (dd, *J* = 16.6, 11.6, 1H, one of C(4)H_2), 2.17 (ddd, *J* = 13.3, 12.0, 4.6, 1H, one of C(2)H_2), 2.11 – 1.99 (m, 1H, one of C(2)H_2), 1.55 (s, 2H, NH_2); δ_C (75 MHz; $CDCl_3$): 146.3, 140.1, 136.3, 129.2, 129.2, 128.7, 127.2, 127.1, 126.4, 126.4, 49.4, 39.6, 37.9, 35.0; HRMS (ESI$^+$): found $[M+H]^+$ 224.1433, $C_{16}H_{18}N$ requires 224.1434; enantiomers not separated by chiral HPLC as amine was not processed by *P*-ω-TA or *Cv*-ω-TA.



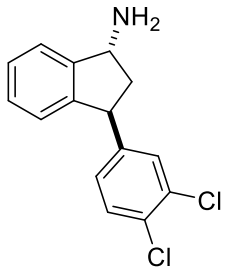
***cis*-3-Phenyl-2,3-dihydro-1*H*-inden-1-amine** *cis*-**1i**[28, 29] was prepared from 3-phenyl-1-indanone **2i** accoding to general method G to give *cis*-**1i** (0.273 g, 26%). ν_{max}/cm^{-1} (ATR): 3365 (NH), 3025 (NH), 2917 (NH), 1493 (CH), 1454 (CH), 752 (CH), 698 (CH); δ_H (300 MHz; $CDCl_3$): 7.41 (1H, br d, *J* = 7.5, ArH), 7.17 – 7.13 (7H, m, ArH), 6.90 (1H, br d, *J* = 7.7, ArH), 4.62 – 4.17 [1H, dd, *J* = 10.5, 7.2, C(3)H], 4.38 [1H, dd, *J* = 9.2, 7.1, C(1)H], 2.95 (1H, dt, *J* = 12.4, 6.9, one of CH_2), 1.81 – 1.66 (1H, m, one of CH_2); δ_C (75 MHz; $CDCl_3$): 147.6, 145.9, 144.2, 128.5, 128.4, 127.3, 126.9, 126.5, 124.8, 122.9, 56.1, 49.0, 48.8; HRMS (ESI$^+$): found $[M+H]^+$ 210.1275, $C_{15}H_{16}N$ requires 210.1277; enantiomers separated using a Chiracel AS-H column [conditions: *n*-hexane/*i*PrOH (containing 2% DEA) = 95/5, flow rate = 0.5 mL min^{-1}], R_t = 14.4 min, R_t = 16.0 min.



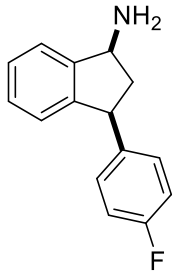
***trans*-3-Phenyl-2,3-dihydro-1*H*-inden-1-amine** trans-**1i**[28, 29] was prepared from *trans*-1-azido-3-phenyl-2,3-dihydro-1*H*-indene *trans*-**7i** according to general method F to give *trans*-**1l** as a dark green oil (0.198 g, 20%). ν_{max}/cm^{-1} (ATR): 2955 (NH), 754 (CH), 730 (CH); δ_H (300 MHz; $CDCl_3$): 7.40 (1H, d, 7.4, ArH), 7.33 – 7.15 (5H, m, ArH), 7.14 – 7.08 (2H, m, ArH), 7.05 (1H, br d, *J* = 7.4, ArH), 4.62 – 4.49 (2H, m, 2 x CH), 2.47 (1H, ddd, *J* = 12.9, 6.9, 5.7, one of CH_2), 2.30 (1H, ddd, *J* = 13.5, 8.5, 5.4, one of CH_2); δ_C (75 MHz; $CDCl_3$;): 147.6, 145.7, 145.2, 128.5, 127.8, 127.7, 127.3, 126.3, 125.4, 123.7, 56.0, 48.8, 47.1; HRMS (ESI^+): found $[M-H]^+$ 208.1123, $C_{15}H_{14}N$ requires 208.1121; enantiomers separated using a Chiracel AS-H column [conditions: *n*-hexane/*i*PrOH (containing 2% DEA) = 90/10, flow rate = 0.5 mL min^{-1}], R_t = 11.5, R_t = 12.6 min.



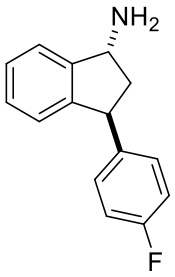
***cis*-3-(3,4-Dichlorophenyl)-2,3-dihydro-1*H*-inden-1-amine** *cis*-**1j**[25] was prepared from *cis*-1-azido-3-(3,4-dichlorophenyl)-2,3-dihydro-1*H*-indene *cis*-**7j** according to general method F to give *cis*-**1j** as a yellow oil (0.313 g, 52%). ν_{max}/cm^{-1} (ATR): 3372 (NH), 2957 (NH), 1468 (CH), 762 (CH), 731 (CH); δ_H (300 MHz; $CDCl_3$): 7.50 – 7.16 (5H, m, ArH), 7.07 (1H, dd, *J* = 8.3, 2.1, ArH), 6.88 (1H, d, *J* = 7.4, ArH), 4.37 (1H, dd, *J* = 9.0, 7.2, C(1)H], 4.14 [1H, dd, *J* = 10.6, 7.3, C(3)H], 2.94 [1H, ddd appears as dt, *J* = 12.4, 7.0, one of $C(2)H_2$], 1.67 [1H, ddd, *J* = 12.4, 10.5, 9.5, one of $C(2)H_2$]; δ_C (75 MHz; $CDCl_3$): 144.6, 132.5, 132.0, 130.5, 130.3, 128.6, 127.8, 127.7, 127.4, 127.3, 124.6, 123.2, 55.9, 48.7, 48.0; HRMS (ESI^+): $[M+H]^+$ 278.0504, $C_{15}H_{14}Cl_2N$ requires 278.0498; enantiomers separated using a Chiralcel OB-H column [conditions: *n*-hexane/*i*PrOH (containing 2% DEA) = 95/5, flow rate = 0.5 mL min^{-1}], R_t = 21.1 min, R_t = 26.5 min.



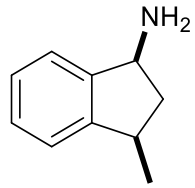
***trans*-3-(3,4-Dichlorophenyl)-2,3-dihydro-1*H*-inden-1-amine** *trans*-**1j**[25] was prepared from *trans*-1-azido-3-(3,4-dichlorophenyl)-2,3-dihydro-1*H*-indene *trans*-**7j** according to general method F to give *trans*-**1j** as a yellow oil (0.067 g, 30%). ν_{max}/cm^{-1} (ATR): 3364 (NH), 3007 (NH), 1469 (CH), 1264 (CN), 732 (CH), 703 (CH); δ_H (300 MHz; $CDCl_3$): 7.40 (1H, d, *J* = 7.3, ArH), 7.37 – 7.20 (3H, m, ArH), 7.18 (1H, d, *J* = 2.1, ArH), 7.02 (1H, d, *J* = 7.5, ArH), 6.93 (1H, dd, *J* = 8.3, 2.1, ArH), 4.57 [1H, dd appears as t, *J* = 6.0, C(1)H], 4.51 [1H, X of ABX, *J* = 8.0, 6.0, C(3)H], 2.46 – 2.22 [2H, AB of ABX, C(2)H_2]; δ_C (75 MHz; $CDCl_3$): 147.4, 145.6, 144.5, 132.5, 130.4, 130.3, 129.7, 128.2, 127.7, 127.2, 125.2, 123.9, 55.8, 48.2, 46.9; HRMS (ESI^+): $[M+H]^+$ 278.0498, $C_{15}H_{14}Cl_2N$ requires 278.0498; enantiomers separated using a Chiralcel OJ-H column [conditions: *n*-hexane/*i*PrOH (containing 2% DEA) = 90/10, flow rate = 0.5 mL min^{-1}], R_t = 17.3 min, R_t = 19.5 min.



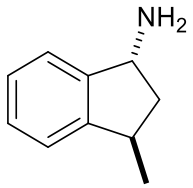
***cis*-3-(4-Fluorophenyl)-2,3-dihydro-1*H*-inden-1-amine** *cis*-**1k** was prepared from **3**-(4-fluorophenyl)-2,3-dihydro-1*H*-inden-1-one **2k** according to general method G to give *cis*-**1k** as a dark green oil (0.3 g, 50%). ν_{max}/cm^{-1} (ATR): 2957 (NH), 1508 (CH), 1221 (CN), 1157 (CN), 832 (C=C), 762 (CH); δ_H (300 MHz; $CDCl_3$): 7.40 (1H, br d, *J* = 7.5, ArH), 7.32 – 7.27 (1H, br d, *J* = 7.3, ArH), 7.23 –7.12 (3H, m, ArH), 7.08 – 6.94 (2H, m, ArH), 6.87 (1H, d, *J* = 7.5, ArH), 4.37 [1H, br t, *J* = 8.1, C(1)H], 4.16 [1H, dd, *J* = 10.5, 7.1, C(3)H], 2.93 (1H, dt, *J* = 12.4, 7.0, one of CH_2), 2.01 (2H, br s, NH_2), 1.76 – 1.60 (1H, m, one of CH_2) ppm; δ_C (75 MHz; $CDCl_3$): 161.6 (d, J_{CF} = 244.6), 147.2, 145.7, 139.9 (d, J_{CF} = 3.2), 129.7 (d, J_{CF} = 8.0), 127.5, 127.1 (d, J_{CF} = 30.6), 124.7, 123.0, 115.3 (d, J_{CF} = 21.3), 55.9, 48.9, 48.1; δ_F (282 MHz; $CDCl_3$): –116.7 ppm; HRMS (ESI^-): found $[M-H]^-$ 226.1028, $C_{15}H_{13}FN$ requires 226.1027; enantiomers separated using a Chiralcel OB-H [conditions: *n*-hexane/*i*PrOH (containing 2% DEA) = 95/5, flow rate = 0.5 mL min^{-1}], R_t = 17.4 min, R_t = 21.9 min.



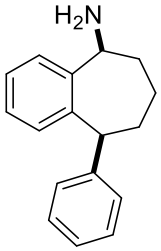
***trans*-3-(4-Fluorophenyl)-2,3-dihydro-1*H*-inden-1-amine** *trans*-**1k** was prepared from *trans*-1-azido-3-(4-fluorophenyl)-2,3-dihydro-1*H*-indene *trans*-**7k** according to general method F to give *trans*-**1k** as a colourless oil (0.229 g, 27%). ν_{max}/cm^{-1} (ATR): 3049 (NH), 1508 (CH), 1265 (CN), 834 (C=C), 732 (CH); δ_H (300 MHz; $CDCl_3$;): 7.40 (1H, br d, *J* = 7.3, ArH), 7.34–7.16 (2H, m, ArH), 7.13 – 6.87 (5H, m, ArH), 4.62–4.48 [2H, m, C(1) & C(3)], 2.48 – 2.21 (2H, m, CH_2), 1.73 (2H, s, NH_2); δ_C (75 MHz; $CDCl_3$): 161.5 (d, J_{CF} = 243.9), 147.5, 145.6, 140.9 (d, J_{CF} = 3.1), 129.1 (d, J_{CF} = 7.8), 127.9, 127.4, 125.3, 123.8, 115.2 (d, J_{CF} = 21.1), 55.9, 48.1, 47.2; δ_F (282 MHz; $CDCl_3$): − 117.1; HRMS (ESI^+): found $[M+H]^+$ 228.8645, $C_{15}H_{15}FN$ requires 228.8556; enantiomers separated using Chiralcel AS-H [conditions: *n*-hexane/*i*PrOH (containing 2% DEA) = 90/10, flow rate = 1.0 mL min^{-1}], R_t = 6.2 min, R_t = 6.8 min.



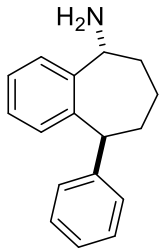
***cis*-3-Methyl-2,3-dihydro-1*H*-inden-1-amine** *cis*-**1l**[26] was prepared from 3-methyl-2,3-dihydro-1*H*-inden-1-one **2l** according to general method G to give *cis*-**1l** as a brown oil (0.216 g, 49%). ν_{max}/cm^{-1} (ATR): 2955 (NH), 1474 (CH), 1457 (CH), 753 (CH), 730 (CH); δ_H (300 MHz; $CDCl_3$): 7.40 – 7.09 (4H, m, ArH), 4.26 [1H, dd, *J* = 9.3, 7.2, CH], 3.12 – 2.96 [1H, m, CH], 2.70 (1H, dt, *J* = 12.1, 7.1, one of CH_2), 1.31 – 1.17 (1H, m, one of CH_2), 1.34 (3H, d, *J* = 6.8, CH_3); δ_C (75 MHz; $CDCl_3$): 147.50, 147.45, 127.2, 126.5, 123.0, 122.9, 56.0, 47.5, 36.5, 19.4; enantiomers separated using a Phenomenex Amylose 1 column [conditions: *n*-hexane/*i*PrOH (containing 2% DEA) = 95/5, flow rate = 0.25 mL min^{-1}], R_t = 27.9 min, R_t = 30.1 min.



***trans*-3-Methyl-2,3-dihydro-1*H*-inden-1-amine** *trans*-**1l**[26] was prepared from *trans*-1-azido-3-methyl-2,3-dihydro-1*H*-indene *trans*-**7l** according to general method F to give *trans*-**1l** (0.210 g, 39%). ν_{max}/cm^{-1} (ATR): 2954 (NH), 1475 (CH), 1457 (CH), 750 (CH); δ_H (300 MHz; $CDCl_3$): 7.40 – 7.12 (4H, m, ArH), 4.34 [1H, dd appears as t, *J* = 6.5, C(1)H], 3.51 – 3.26 [1H, m, C(3)H], 2.13 – 1.93 (2H, m, CH_2), 1.24 (3H, d, *J* = 7.0, CH_3); δ_C (75 MHz; $CDCl_3$): 148.1, 146.8, 127.6, 126.7, 123.7, 123.6, 55.7, 45.5, 36.9, 20.7; enantiomers separated using a Chiracel AS-H column [conditions: *n*-hexane/*i*PrOH (containing 2% DEA) = 90/10, flow rate = 0.5 mL min^{-1}], R_t = 10.0 min, R_t = 12.6 min.



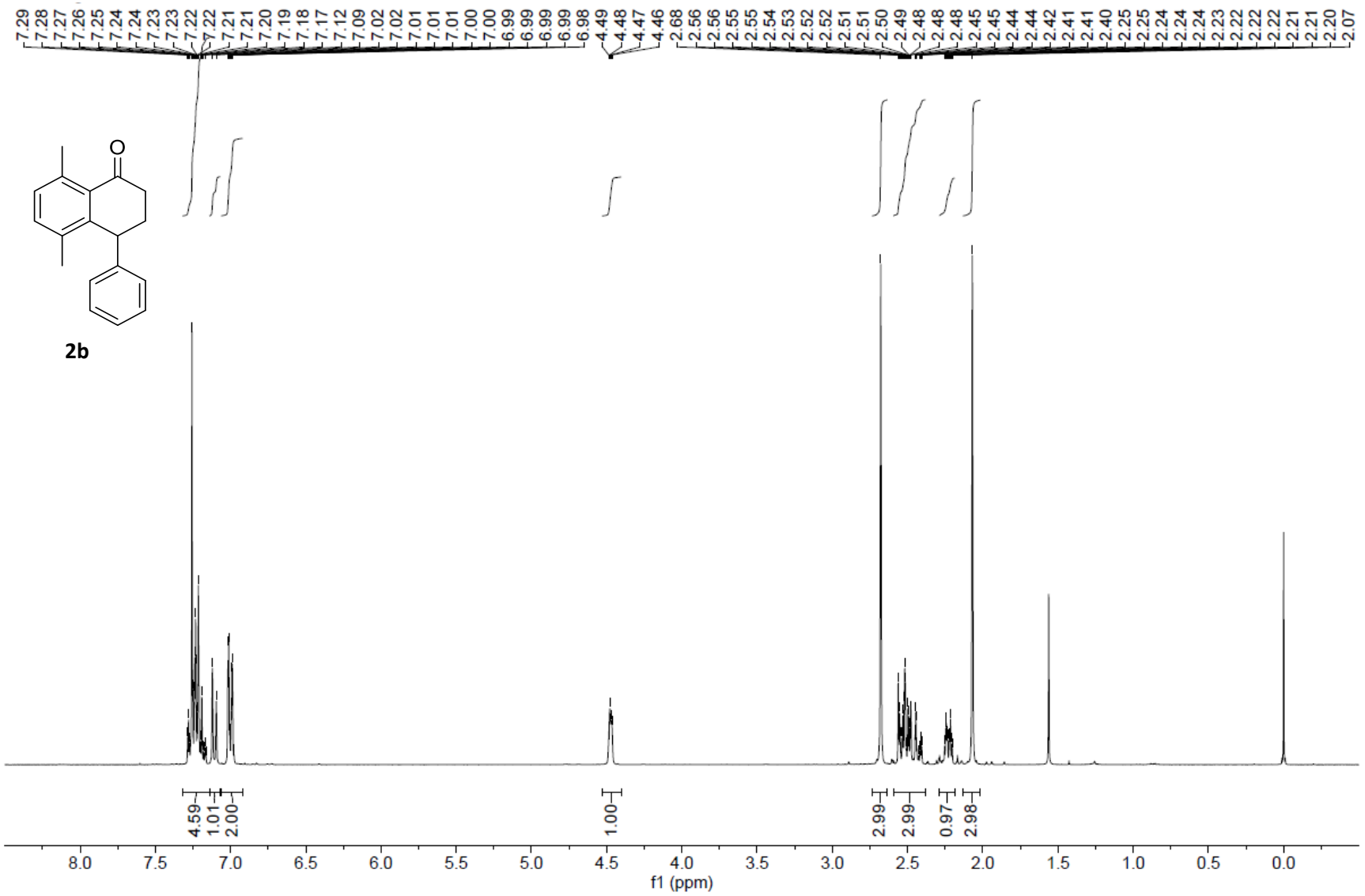
***cis*-5-Amino-9-phenyl-6,7,8,9-tetrahydro-5*H*-benzo[7]annulene** *cis*-**1m** was prepared from *cis*-5-(Boc-amino)-9-phenyl-6,7,8,9-tetrahydro-5*H*-benzo[7]annulene *cis*-**8m** according to general method I to give a colourless oil (0.041 g, 98 %). ν_{max} (ATR): 2921 (NH), 2852 (NH), 1599 (C=C), 1495 (CH), 1447 (CH); δ_H (500 MHz; $CDCl_3$): 7.58 (dd, *J* = 7.7, 1.4, 1H, ArH), 7.45 – 7.33 (m, 2H, ArH), 7.33 – 7.16 (m, 4H, ArH), 7.02 (td, *J* = 7.5, 1.4, 1H, ArH), 6.53 (d, *J* = 7.7, 1H, ArH), 4.53 (d, *J* = 9.8, 1H, C(5)H), 4.29 (dd, *J* = 10.2, 2.0, 1H, C(9)H), 2.28 – 2.14 (m, 1H, one of C(8)H_2), 2.06 – 1.75 (m, 4H, C(7)H_2, one of C(6)H_2, one of C(8)H_2), 1.75 – 1.42 (m, 3H, one of C(6)H_2, NH_2); δ_C (125 MHz; $CDCl_3$): 145.2, 144.2, 129.0, 128.6, 127.2, 126.4, 126.3, 122.9, 53.4, 48.1, 37.4, 33.4, 28.8; HRMS (ESI$^+$): found $[M+H]^+$ 238.1587, $C_{17}H_{20}N$ requires 238.1590; the enantiomers of *cis*-**1m** were not analysed by chiral HPLC; the resulting reaction solution from the relevant biotransformations were subject to Boc protection (according to general method H, the Boc-protected amines were then analysed by chiral HPLC spectroscopy, as per conditions detailed for *cis*-**8m**.

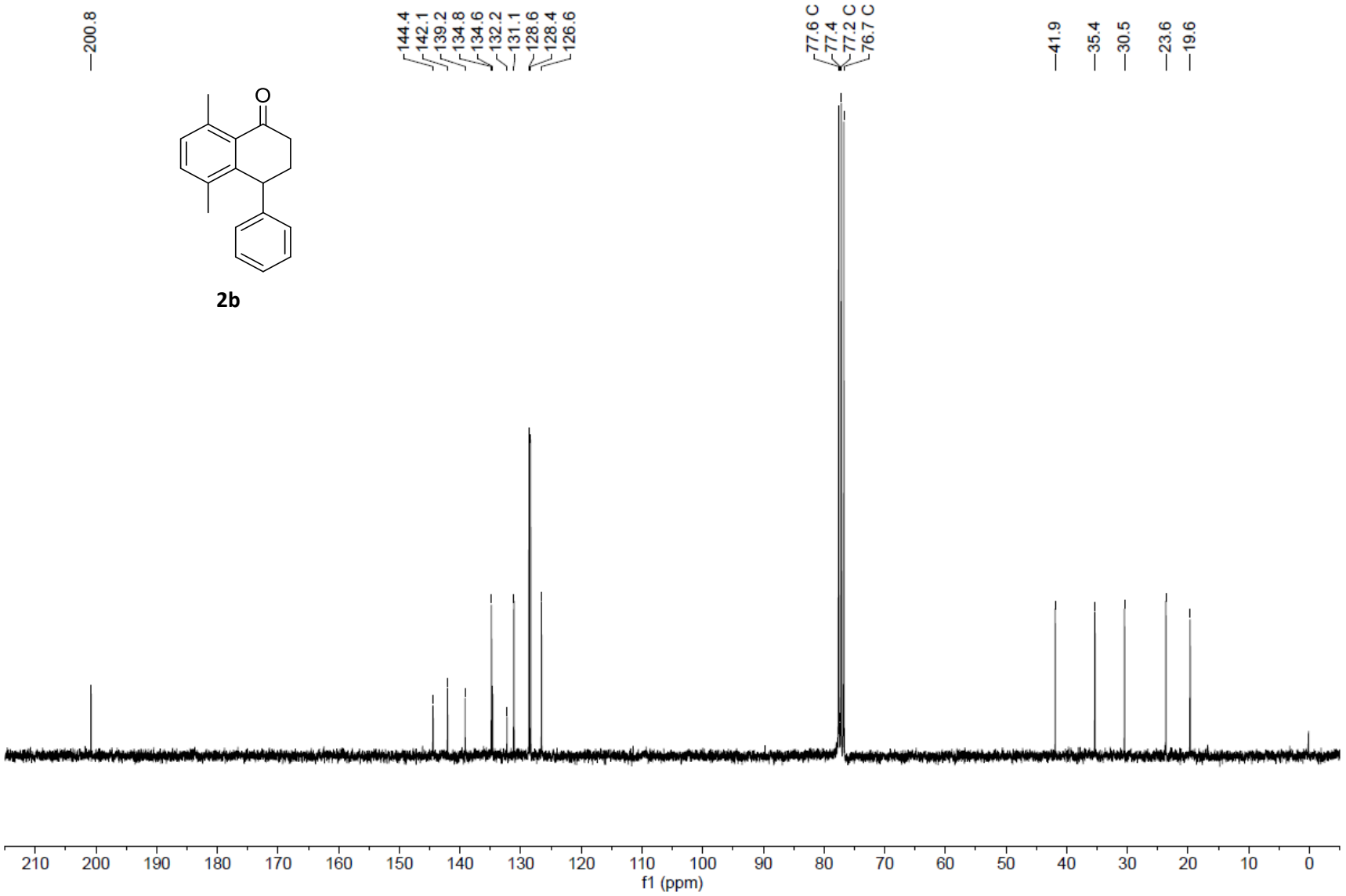


***trans*-5-Amino-9-phenyl-6,7,8,9-tetrahydro-5*H*-benzo[7]annulene** trans-**1m** was prepared from *trans*-5-(Boc-amino)-9-phenyl-6,7,8,9-tetrahydro-5*H*-benzo[7]annulene *trans*-**8m** according to general method I to give a colourless oil (0.081 g, 97 %). ν_{max} (ATR): 2923 (NH), 2854 (NH), 1600 (C=C), 1494 (CH), 1445 (CH); δ_H (500 MHz; $CDCl_3$): 7.47 (d, *J* = 7.6, 1H, ArH), 7.30 (t, *J* = 7.6, 2H, ArH), 7.27 – 7.18 (m, 2H, ArH), 7.17 – 7.08 (m, 3H, ArH), 6.93 (d, *J* = 7.5, 1H, ArH), 4.55 (dd, *J* = 8.0, 3.4, 1H, C(9)H), 4.09 (dd, *J* = 8.9, 2.6, 1H, C(5)H), 2.39 – 2.24 (m, 1H, one of C(8)H_2), 2.14 – 2.06 (m, 1H, one of C(8)H_2), 1.95 – 1.63 (m, 6H, C(6)H_2, C(7)H_2, NH_2); δ_C (125 MHz; $CDCl_3$): 145.1, 143.9, 142.4, 130.6, 128.5, 128.0, 126.9, 126.8, 125.9, 54.8, 49.6, 36.6, 32.3, 23.9; HRMS (ESI^+): found $[M+H]^+$ 238.1593, $C_{17}H_{20}N$ requires 238.1590; enantiomers not separated by chiral HPLC.

1.6 ^{1}H NMR and ^{13}C NMR spectra of ketones, alcohols, azides and amines

^{1}H NMR and ^{13}C NMR spectra of ketone compounds


7.29 7.28 7.27 7.26 7.25 7.24 7.24 7.23 7.23 7.22 7.22 7.21 7.21 7.20 7.19 7.18 7.17 7.12 7.09 7.02 7.02 7.01 7.01 7.01 7.00 7.00 6.99 6.99 6.99 6.99 6.98 4.49 4.48 4.47 4.46 2.68 2.56 2.56 2.55 2.55 2.54 2.53 2.52 2.52 2.51 2.51 2.50 2.49 2.48 2.48 2.45 2.45 2.44 2.44 2.42 2.41 2.41 2.40 2.25 2.25 2.24 2.24 2.23 2.22 2.22 2.22 2.21 2.21 2.20 2.07
O
2b
4.59
1.01
2.00
1.00
2.99
2.99
0.97
2.98
8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)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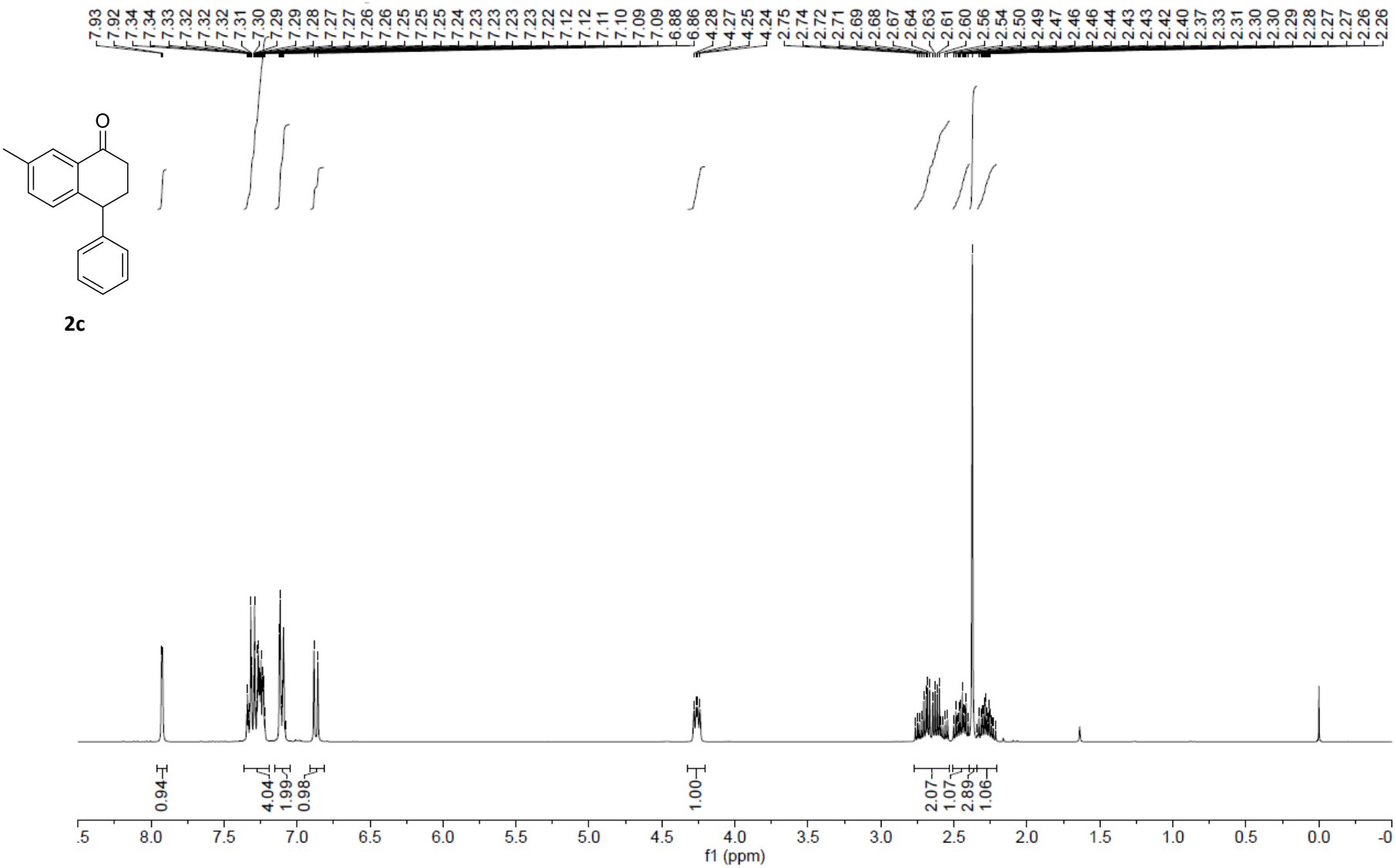
144.4
142.1
139.2
134.8
134.6
132.2
131.1
128.6
128.4
126.6
77.6 C
77.4
77.2 C
76.7 C
41.9
35.4
30.5
23.6
19.6
O
2b
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)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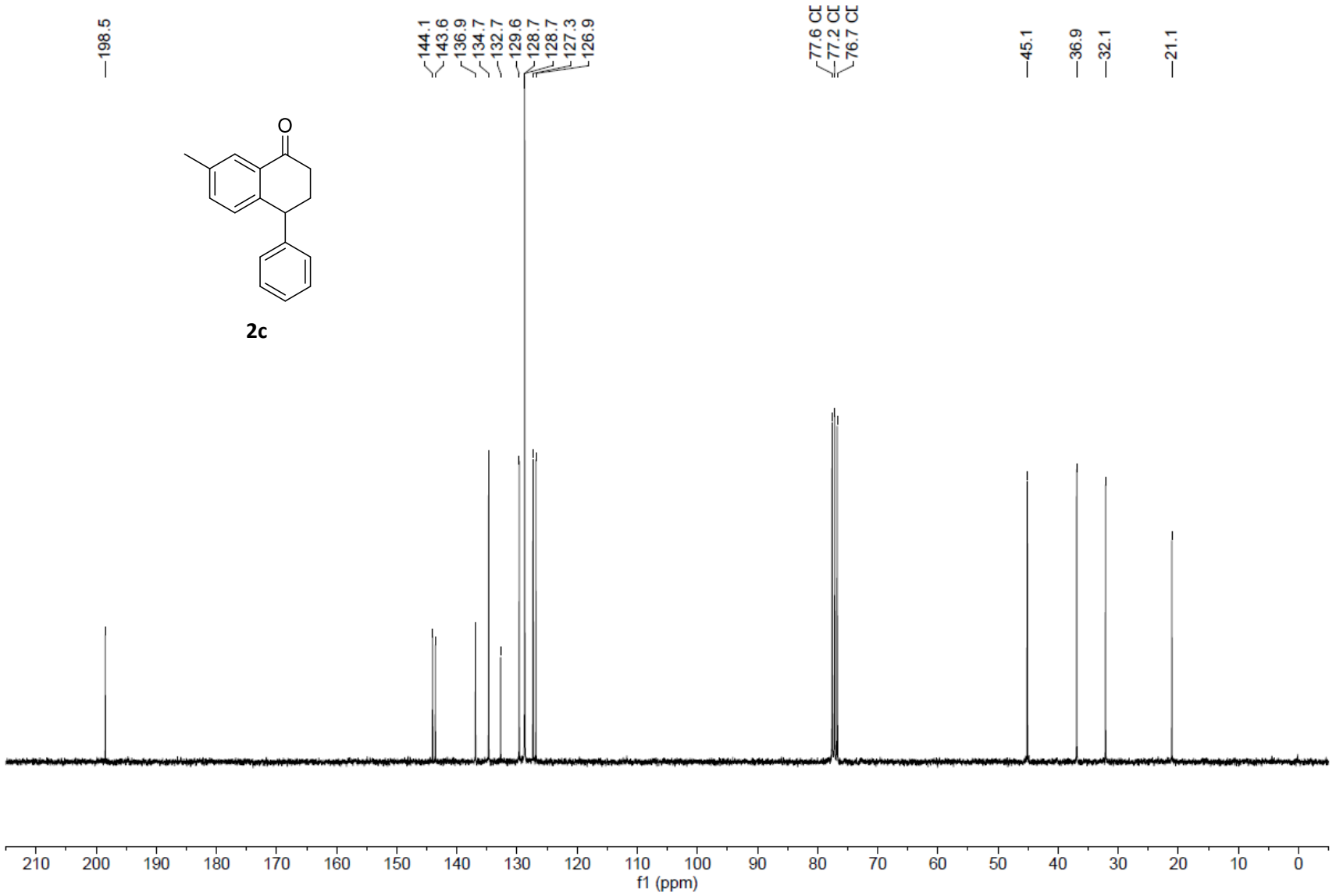
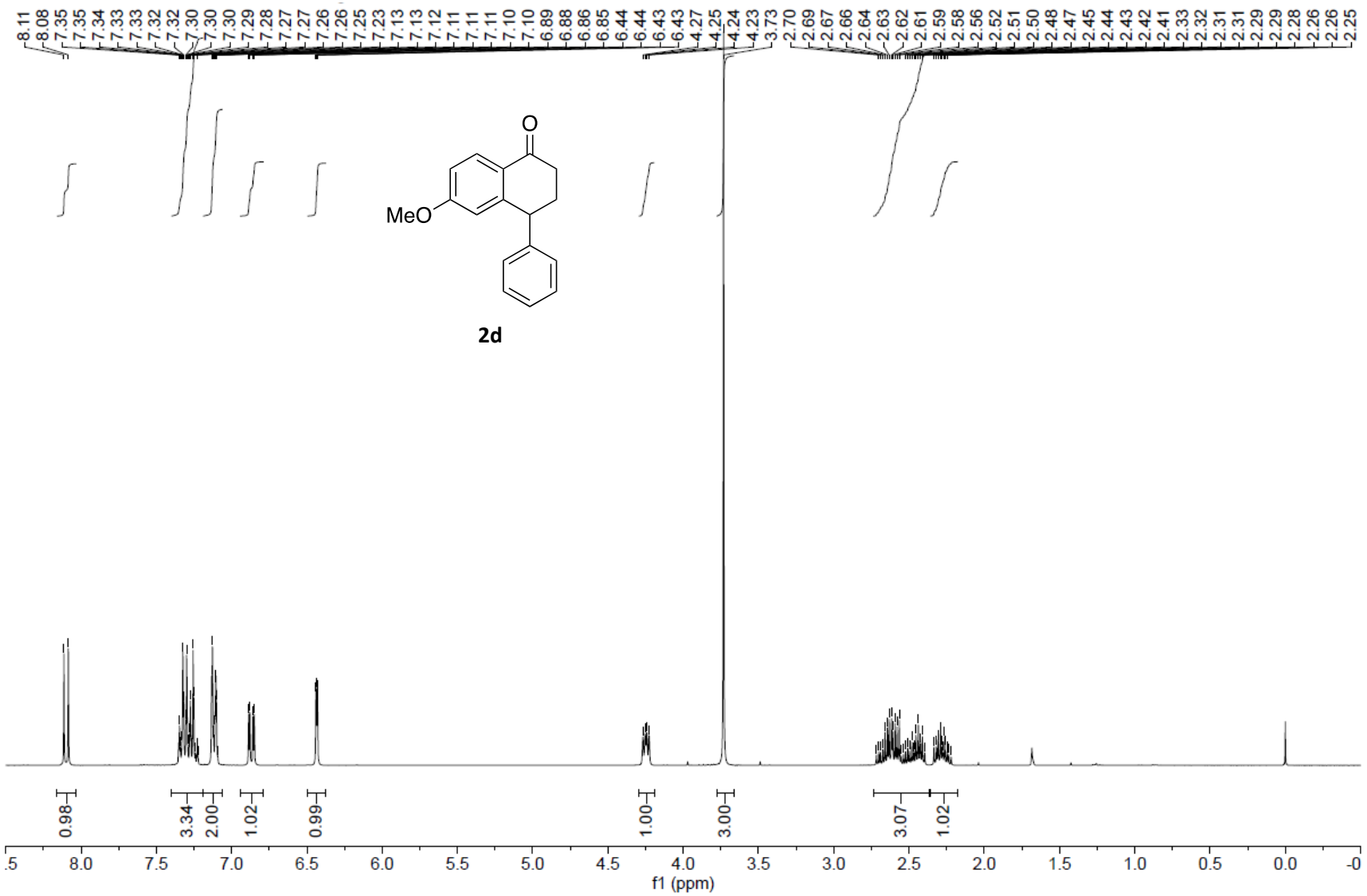
O
0.94 4.04 1.99 0.98 1.00 2.07 1.07 2.89 1.06
8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)

2c


198.5
144.1
143.6
136.9
134.7
132.7
129.6
128.7
128.7
127.3
126.9
77.6 CD
77.2 CD
76.7 CD
45.1
36.9
32.1
21.1
O
2c
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)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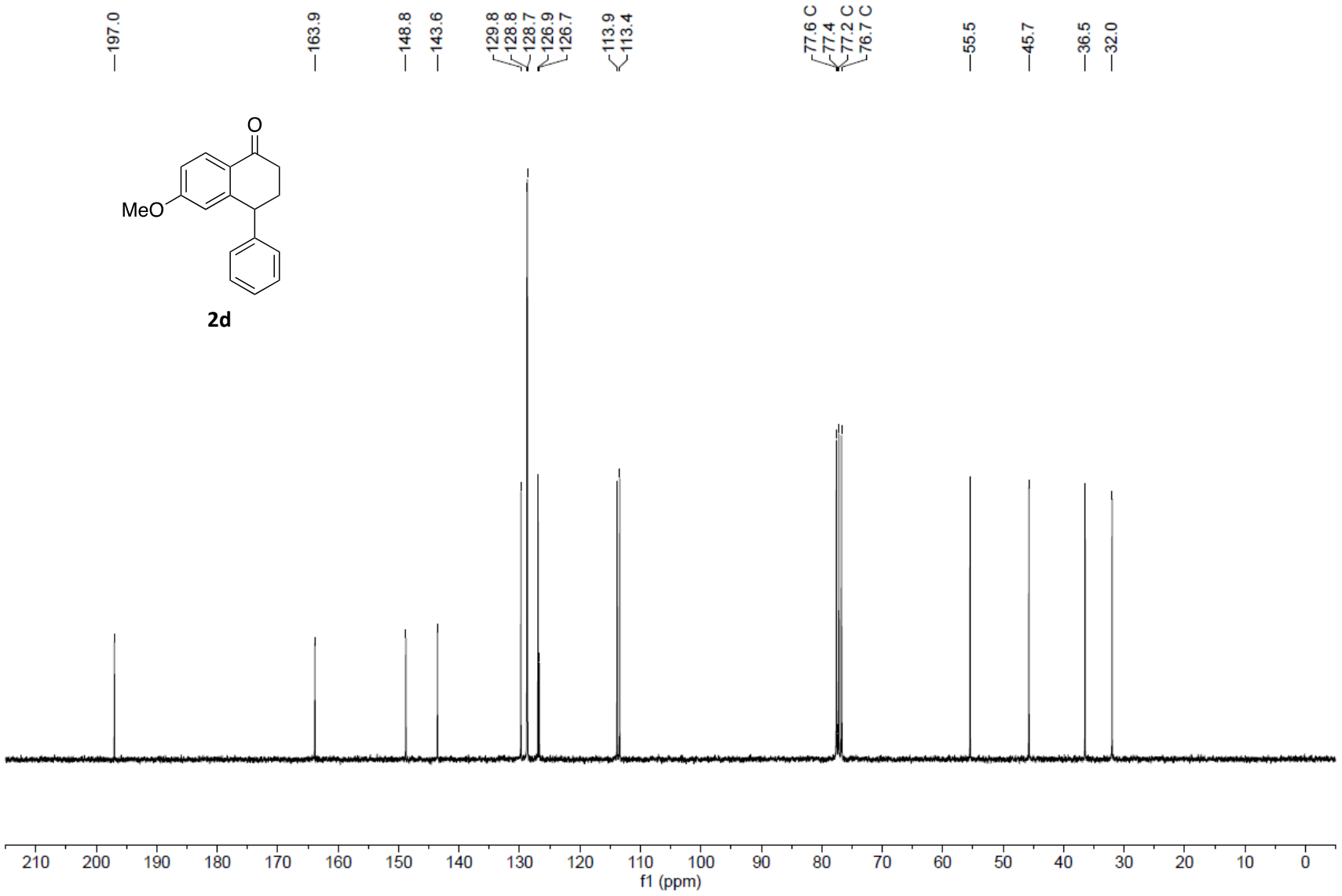
O
MeO
2d
0.98
3.34
2.00
1.02
0.99
1.00
3.00
3.07
1.02
8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)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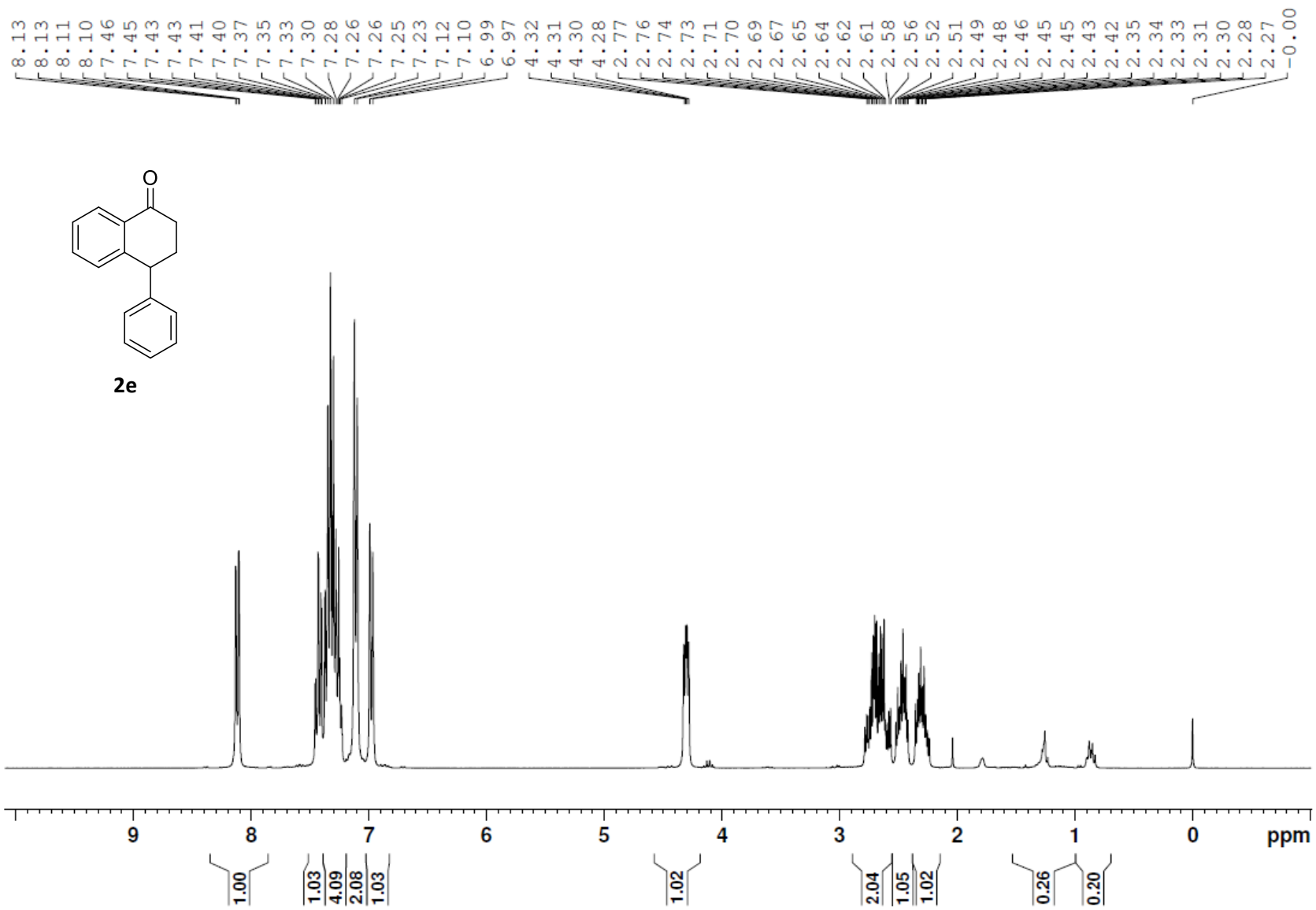
163.9
148.8
143.6
129.8
128.8
128.7
126.9
126.7
113.9
113.4
77.6 C
77.4
77.2 C
76.7 C
55.5
45.7
36.5
32.0
O
MeO
2d
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)


8.13
8.13
8.11
8.10
7.46
7.45
7.43
7.43
7.41
7.40
7.37
7.35
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7.30
7.28
7.26
7.26
7.25
7.23
7.12
7.10
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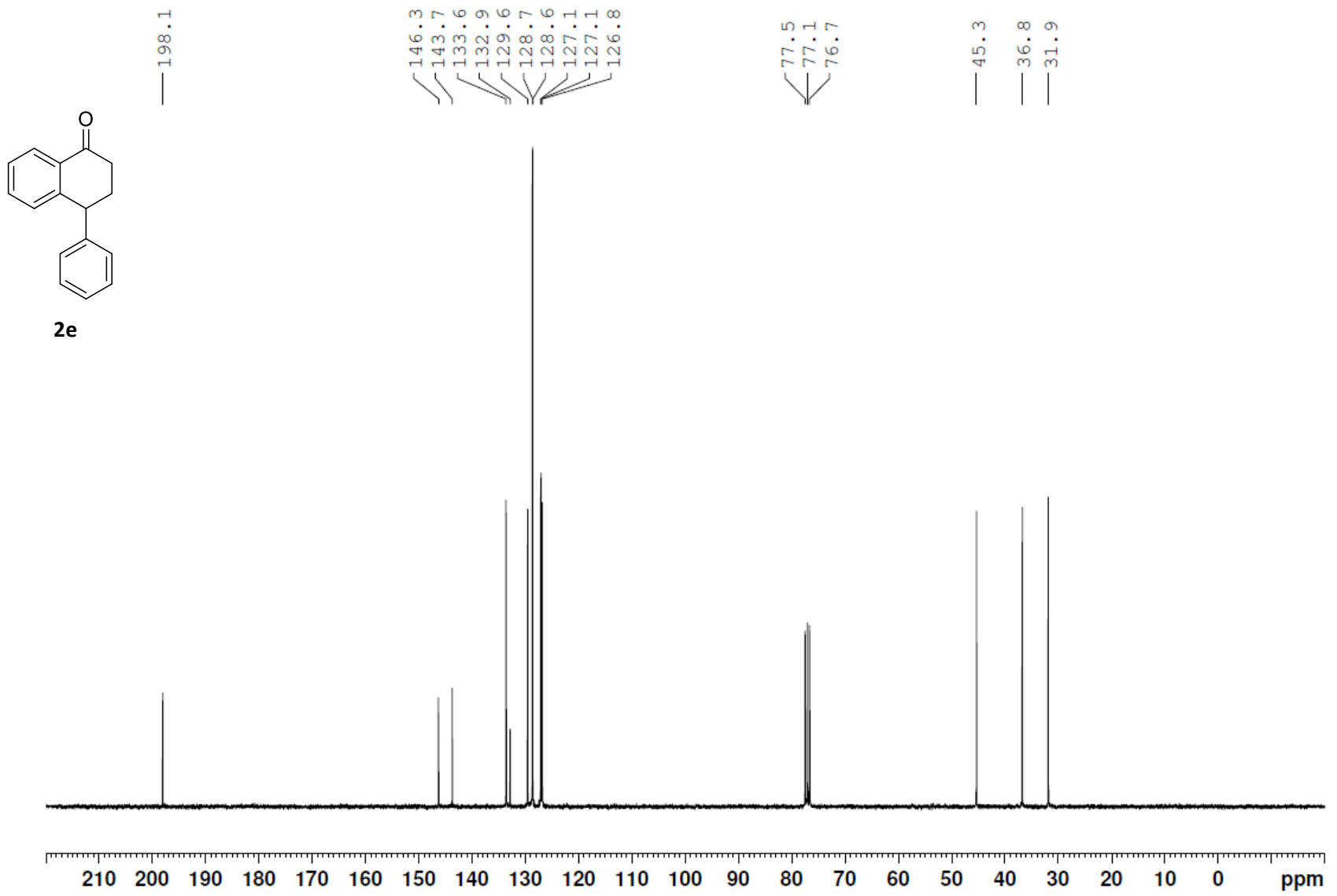
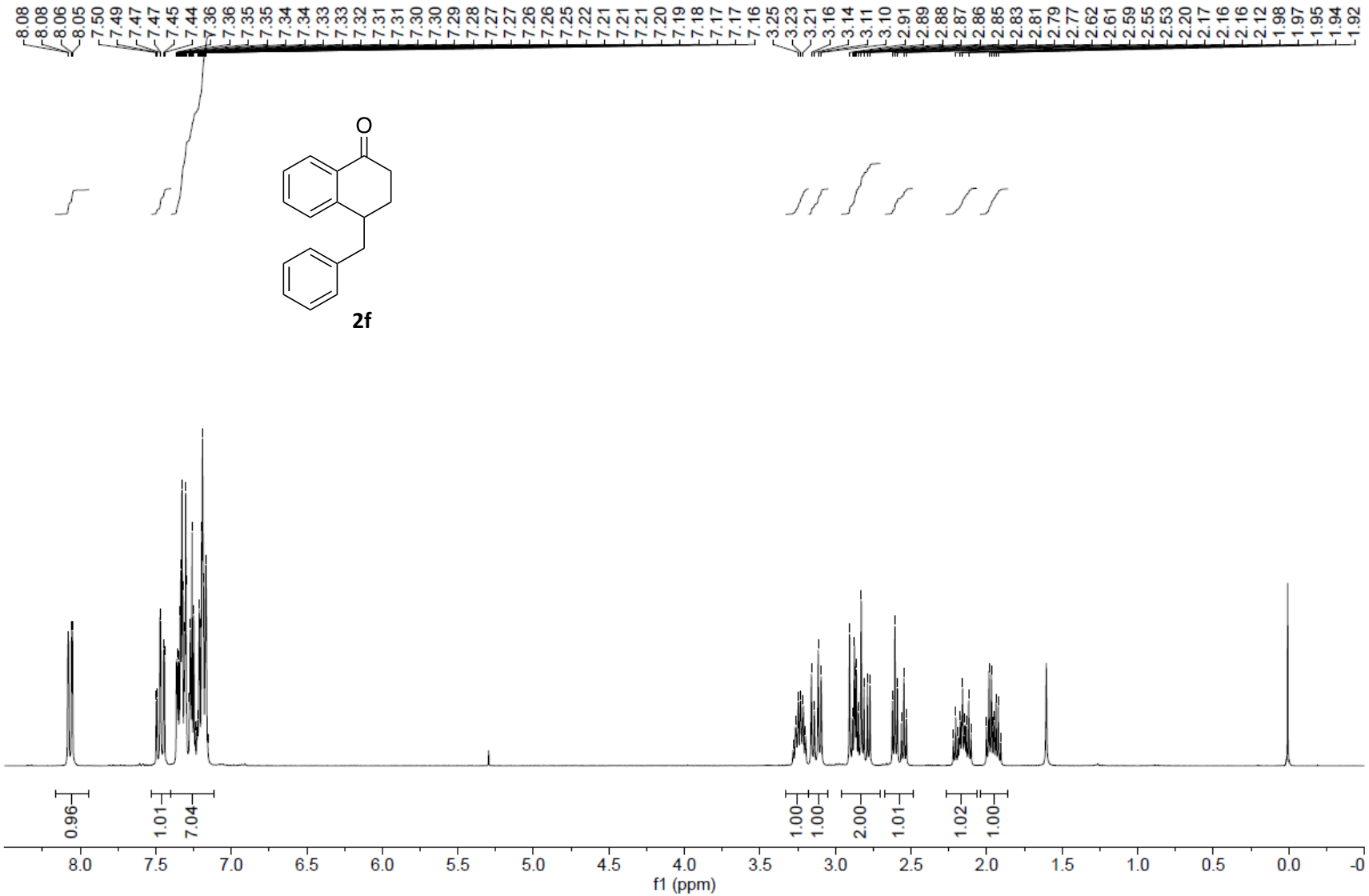
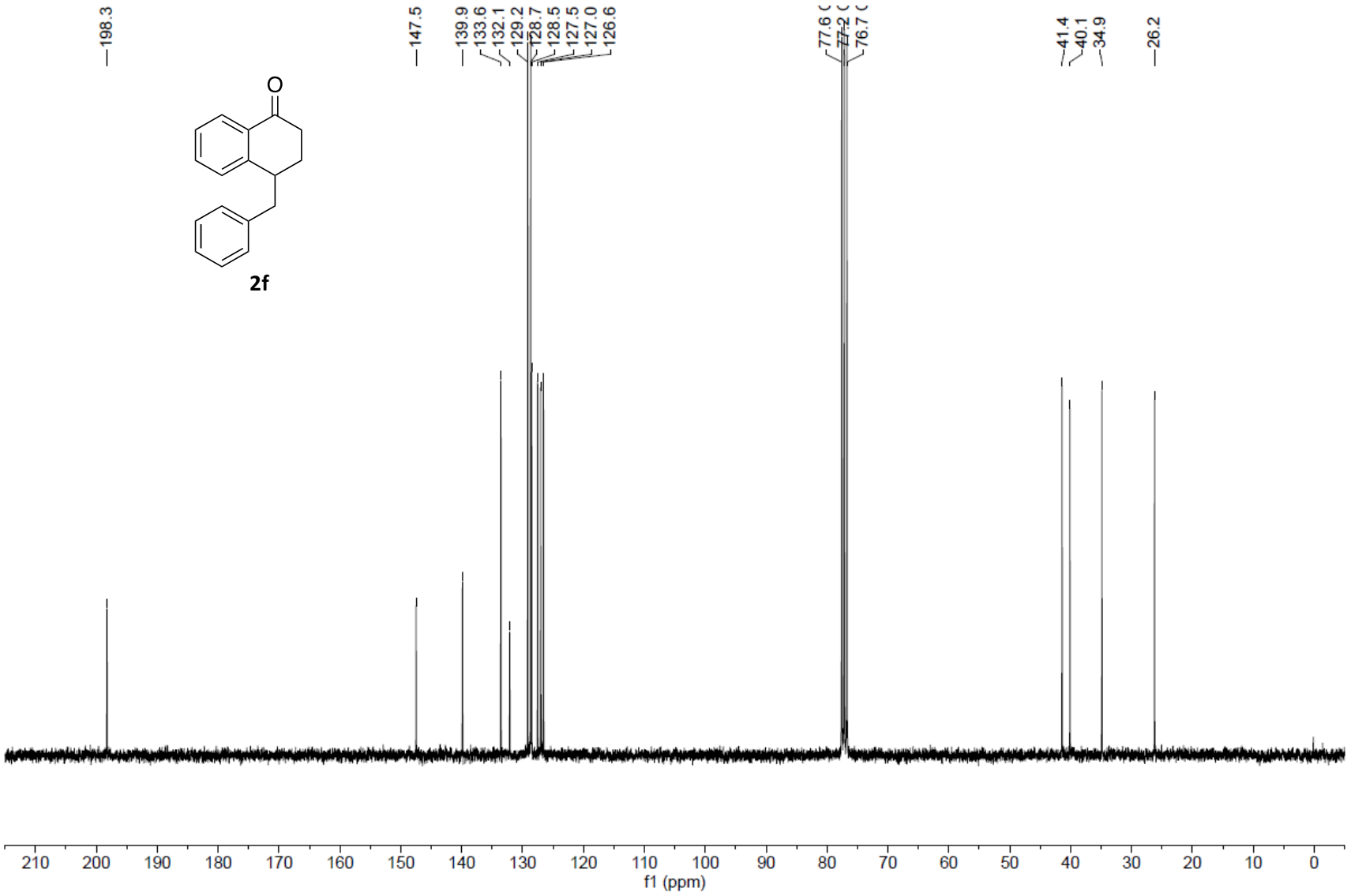
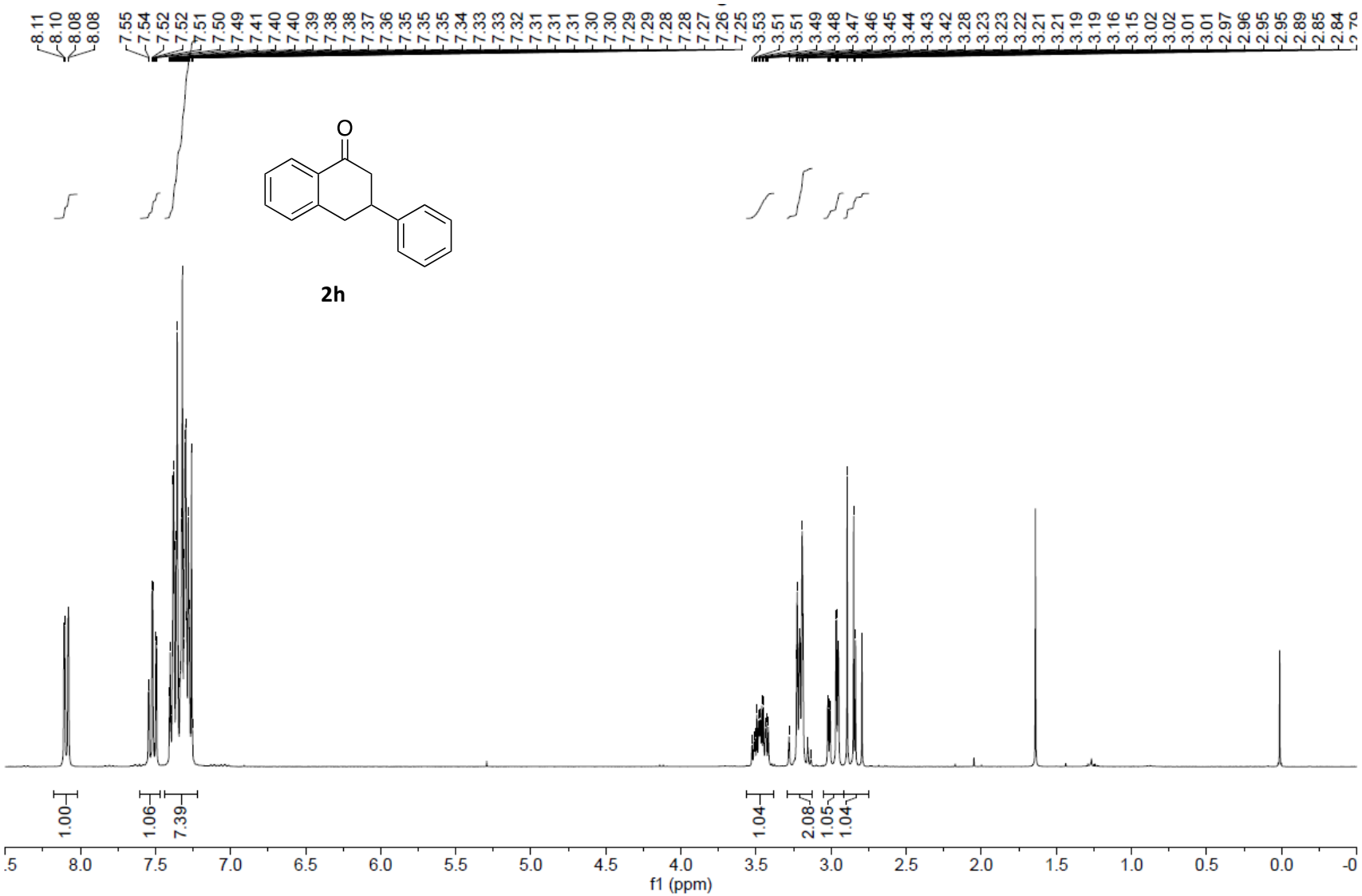
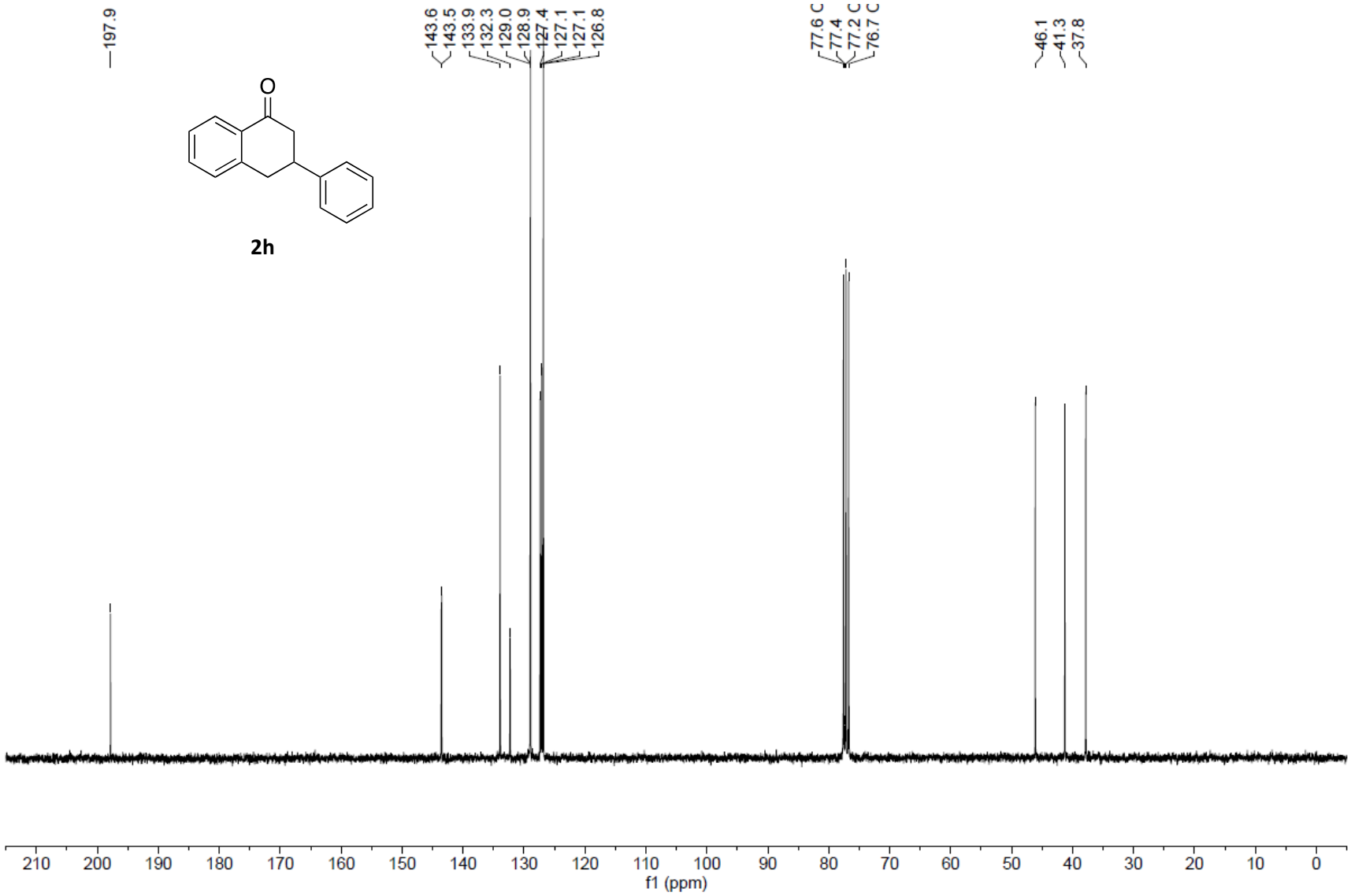
4.32
4.31
4.30
4.28
2.77
2.76
2.74
2.73
2.71
2.70
2.69
2.67
2.65
2.64
2.62
2.61
2.58
2.56
2.52
2.51
2.49
2.48
2.46
2.45
2.45
2.43
2.42
2.35
2.34
2.33
2.31
2.30
2.28
2.27
0.00
O
2e
9
8
7
6
5
4
3
2
1
0
ppm
1.00
1.03
4.09
2.08
1.03
1.02
2.04
1.05
1.02
0.26
0.20

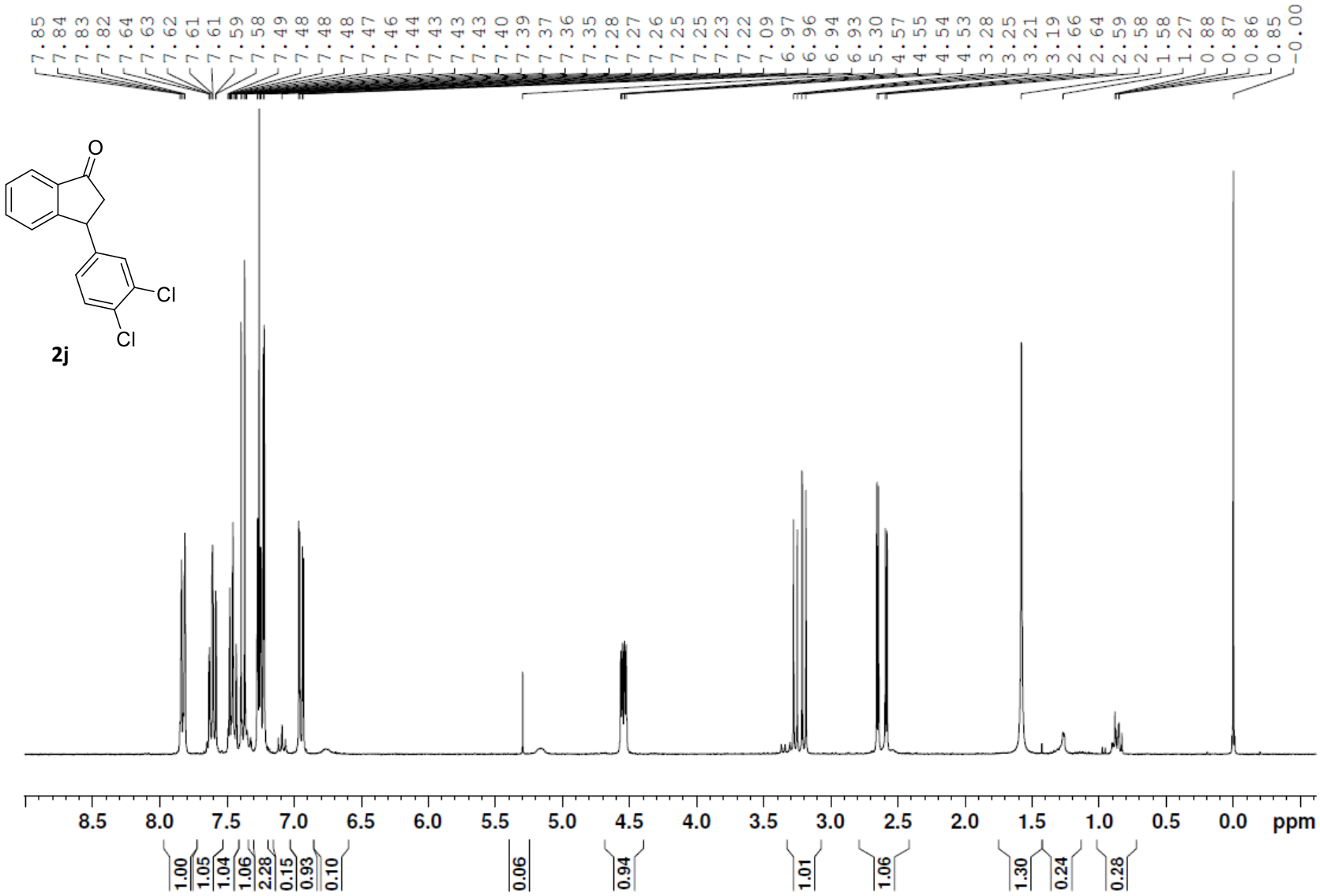

198.1
146.3
143.7
133.6
132.9
129.6
128.7
128.6
127.1
127.1
126.8
77.5
77.1
76.7
45.3
36.8
31.9
O
2e
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 ppm

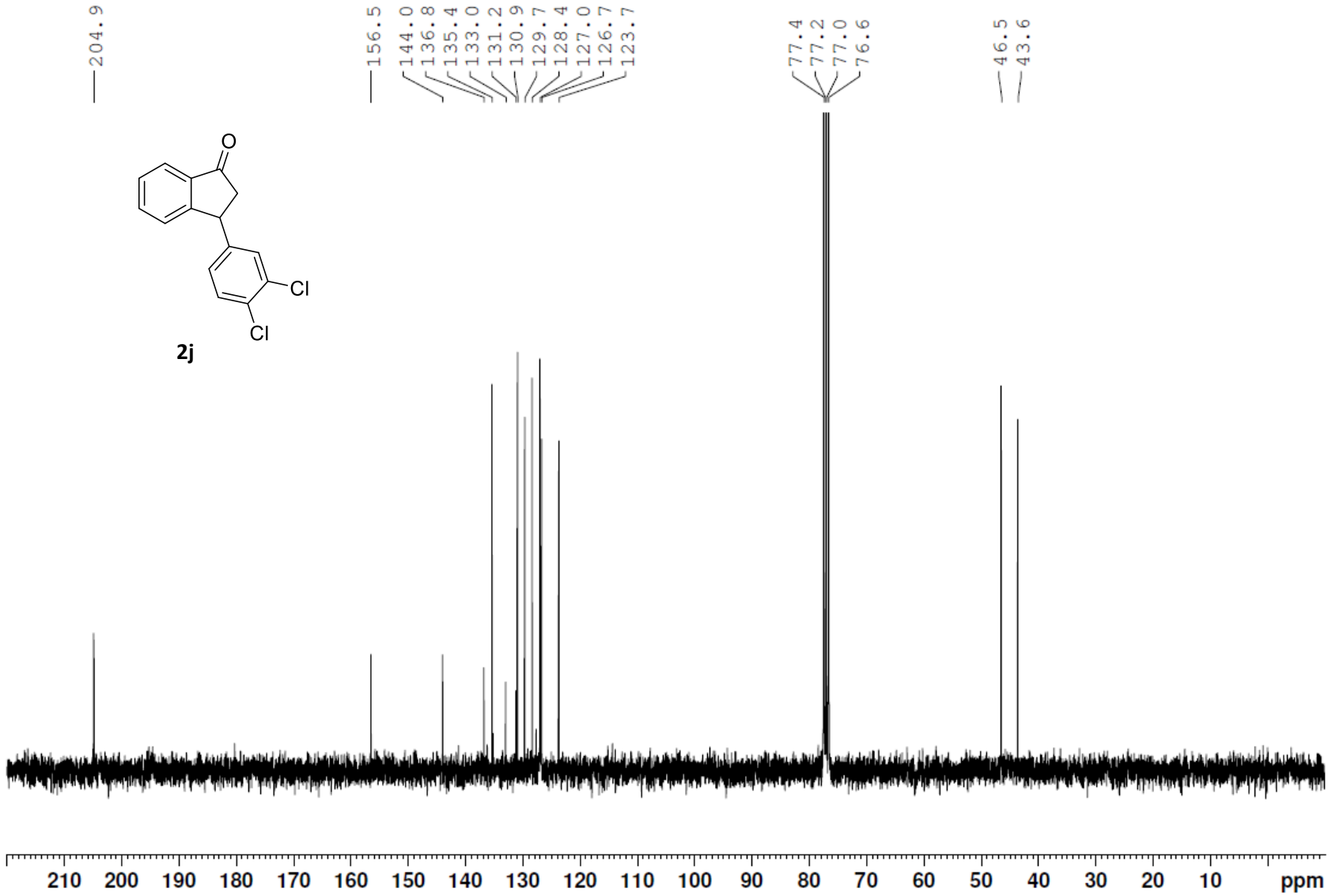

8.08 8.08 8.06 8.05 7.50 7.49 7.47 7.47 7.45 7.44 7.36 7.36 7.35 7.35 7.34 7.34 7.33 7.33 7.32 7.31 7.31 7.30 7.30 7.29 7.28 7.27 7.27 7.26 7.26 7.25 7.22 7.21 7.21 7.21 7.20 7.19 7.18 7.17 7.17 7.16 3.25 3.23 3.21 3.16 3.14 3.11 3.10 2.91 2.89 2.88 2.87 2.86 2.85 2.83 2.81 2.79 2.77 2.62 2.61 2.59 2.55 2.53 2.20 2.17 2.16 2.16 2.12 1.98 1.97 1.95 1.94 1.92
O
2f
0.96
1.01
7.04
1.00
1.00
2.00
1.01
1.02
1.00
8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0
f1 (ppm)

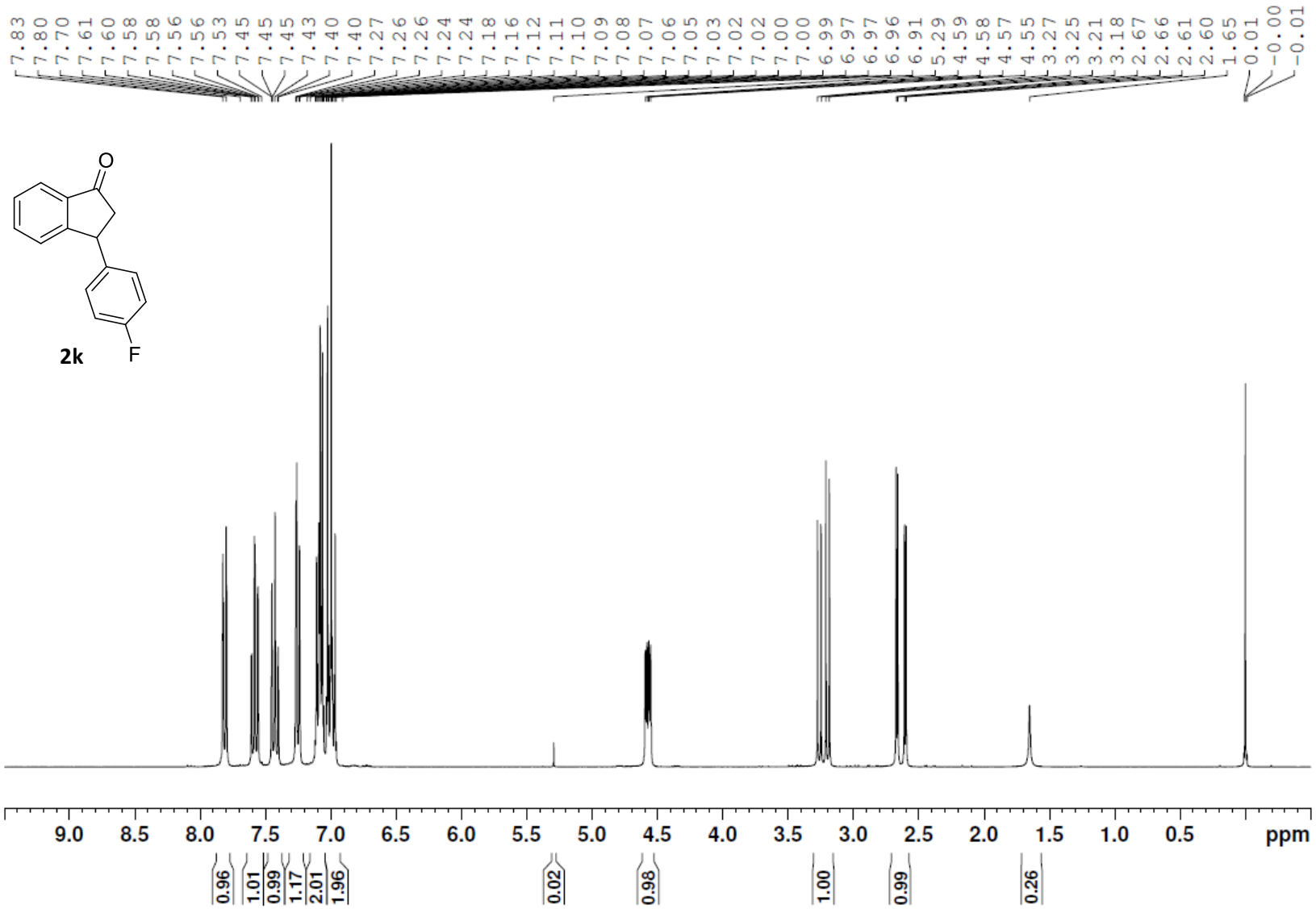

198.3
147.5
139.9
133.6
132.1
129.2
128.7
128.5
127.5
127.0
126.6
77.6
77.2
76.7
41.4
40.1
34.9
26.2
O
2f
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)

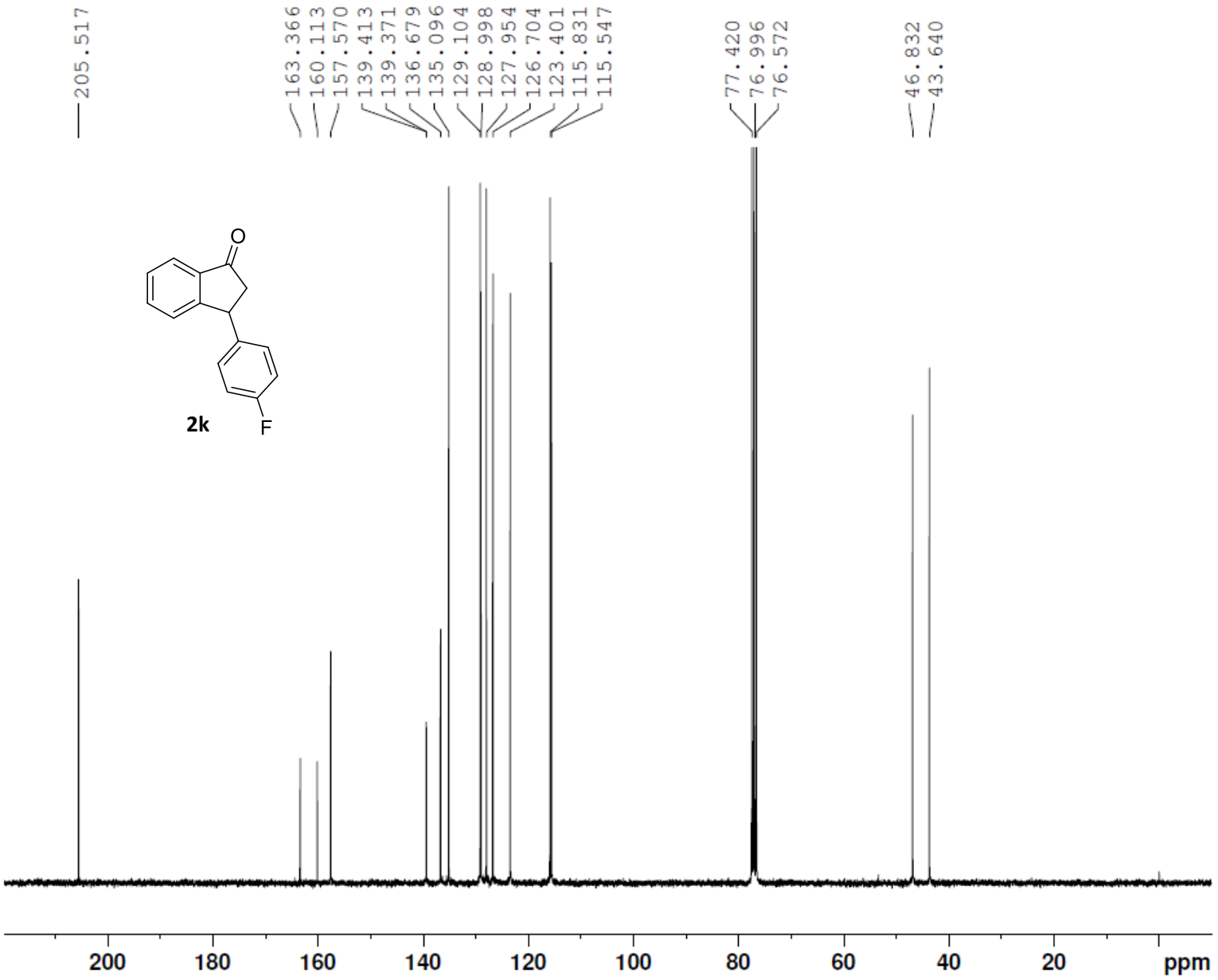

O
2h
1.00
1.06
7.39
1.04
2.08
1.05
1.04
f1 (ppm)

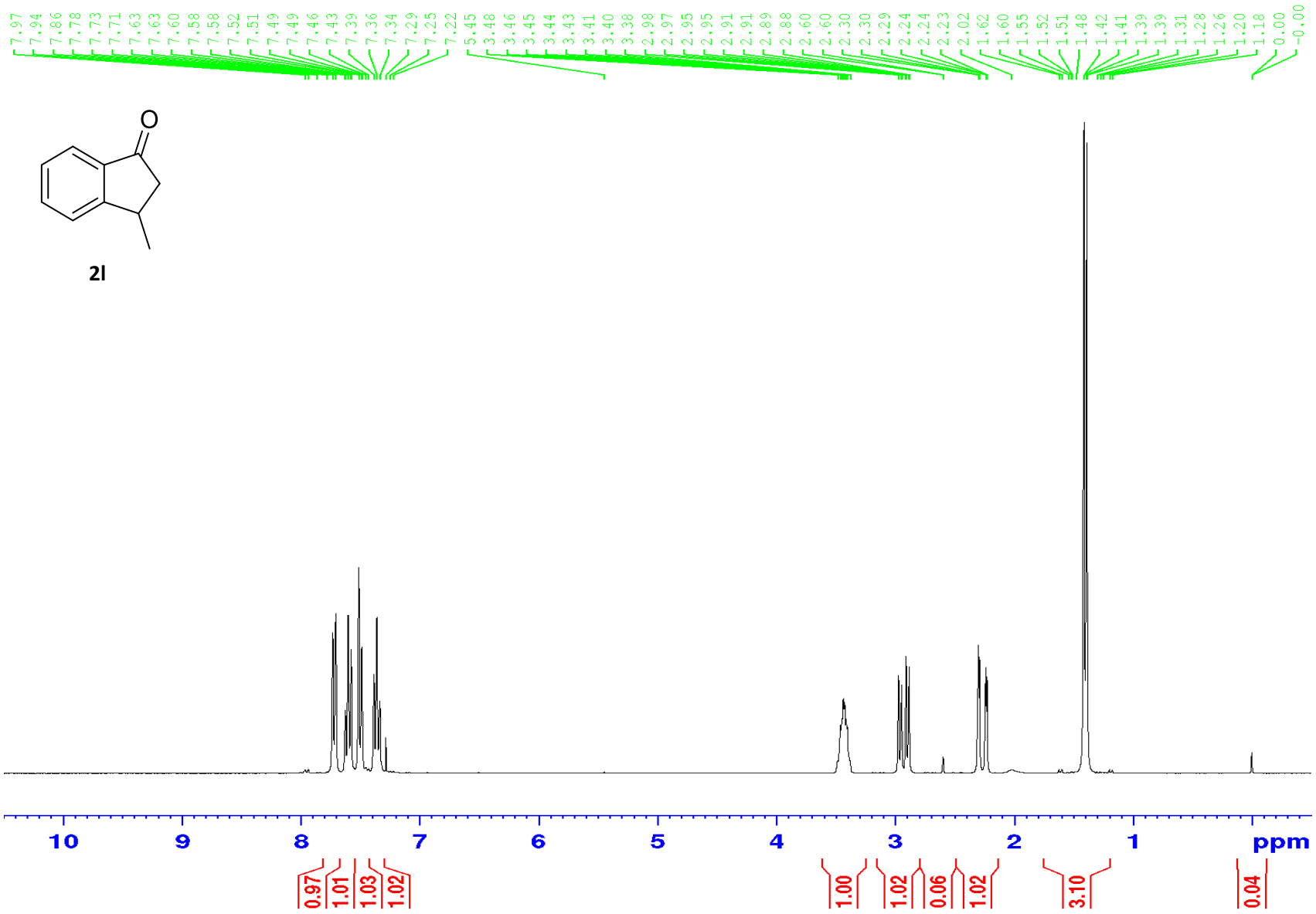

197.9
143.6
143.5
133.9
132.3
129.0
128.9
127.4
127.1
127.1
126.8
77.6 C
77.4
77.2 C
76.7 C
46.1
41.3
37.8
O
2h
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)


7.85
7.84
7.83
7.82
7.64
7.63
7.62
7.61
7.61
7.59
7.58
7.49
7.48
7.48
7.48
7.47
7.46
7.44
7.43
7.43
7.43
7.40
7.39
7.37
7.36
7.35
7.28
7.27
7.26
7.25
7.25
7.23
7.22
7.09
6.97
6.96
6.94
6.93
5.30
4.57
4.55
4.54
4.53
3.28
3.25
3.21
3.19
2.66
2.64
2.59
2.58
1.58
1.27
0.88
0.87
0.86
0.85
0.00
O
Cl
Cl
2j
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
ppm
1.00
1.05
1.04
1.06
2.28
0.15
0.93
0.10
0.06
0.94
1.01
1.06
1.30
0.24
0.28

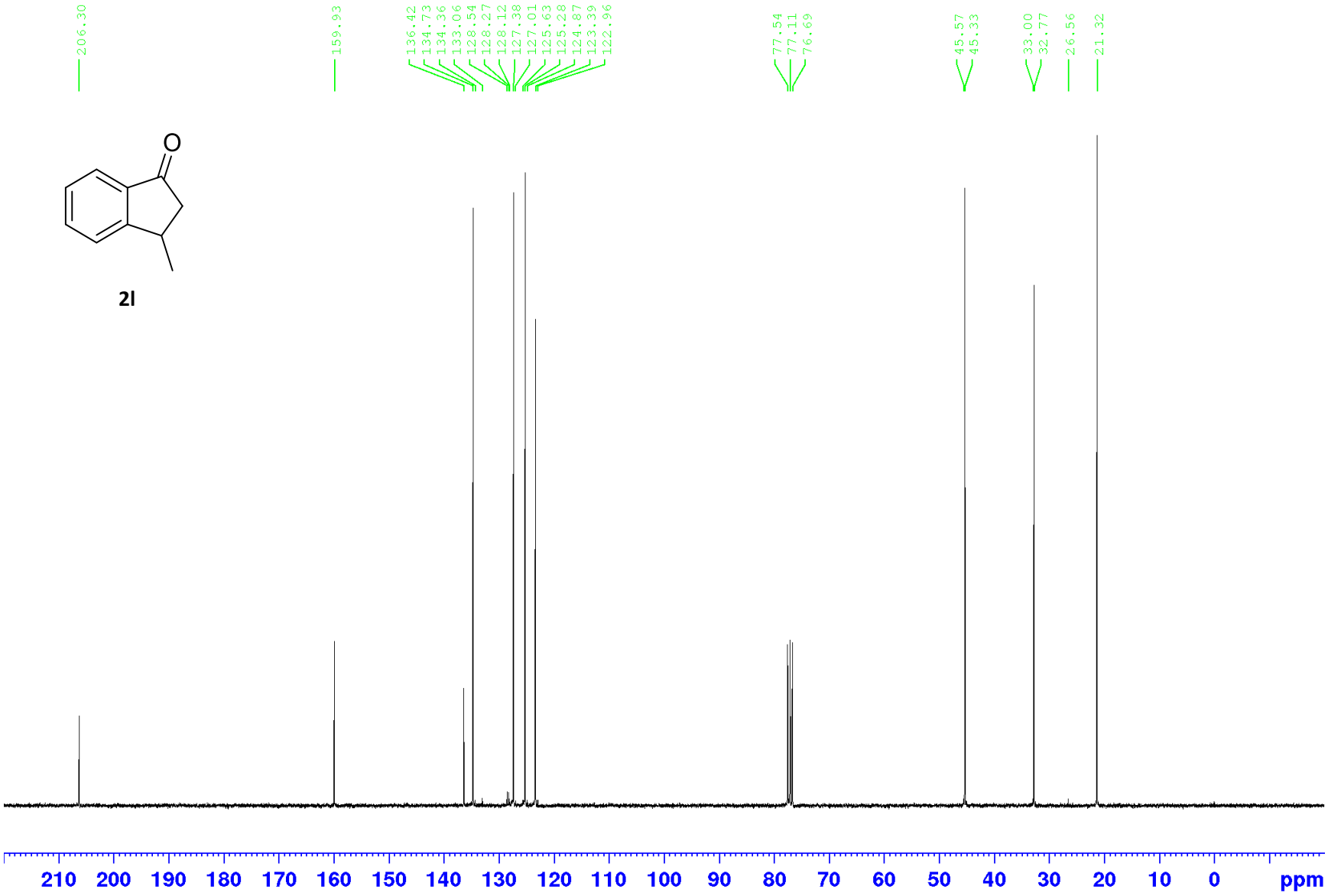

204.9
156.5
144.0
136.8
135.4
133.0
131.2
130.9
129.7
128.4
127.0
126.7
123.7
77.4
77.2
77.0
76.6
46.5
43.6
O
Cl
Cl
2j
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 ppm

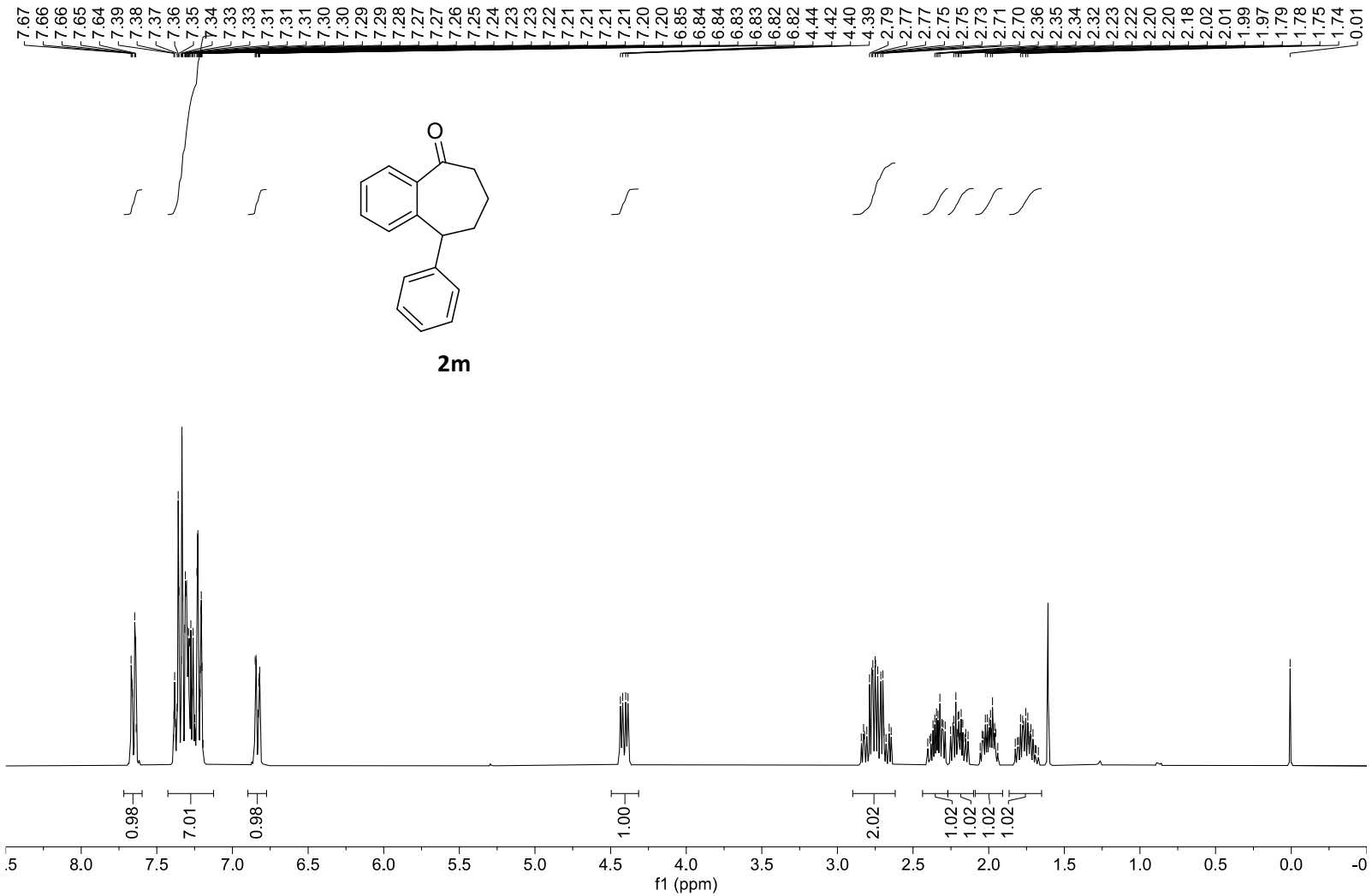

7.83
7.80
7.70
7.61
7.60
7.58
7.58
7.56
7.56
7.53
7.45
7.45
7.45
7.43
7.40
7.40
7.27
7.26
7.26
7.24
7.24
7.18
7.16
7.12
7.11
7.10
7.09
7.08
7.07
7.06
7.05
7.03
7.02
7.02
7.00
7.00
6.99
6.97
6.97
6.96
6.91
5.29
4.59
4.58
4.57
4.55
3.27
3.25
3.21
3.18
2.67
2.66
2.61
2.60
1.65
0.01
-0.00
-0.01
O
F
2k
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
ppm
0.96
1.01
0.99
1.17
2.01
1.96
0.02
0.98
1.00
0.99
0.26


205.517
163.366
160.113
157.570
139.413
139.371
136.679
135.096
129.104
128.998
127.954
126.704
123.401
115.831
115.547
77.420
76.996
76.572
46.832
43.640
O
F
2k
200
180
160
140
120
100
80
60
40
20
ppm

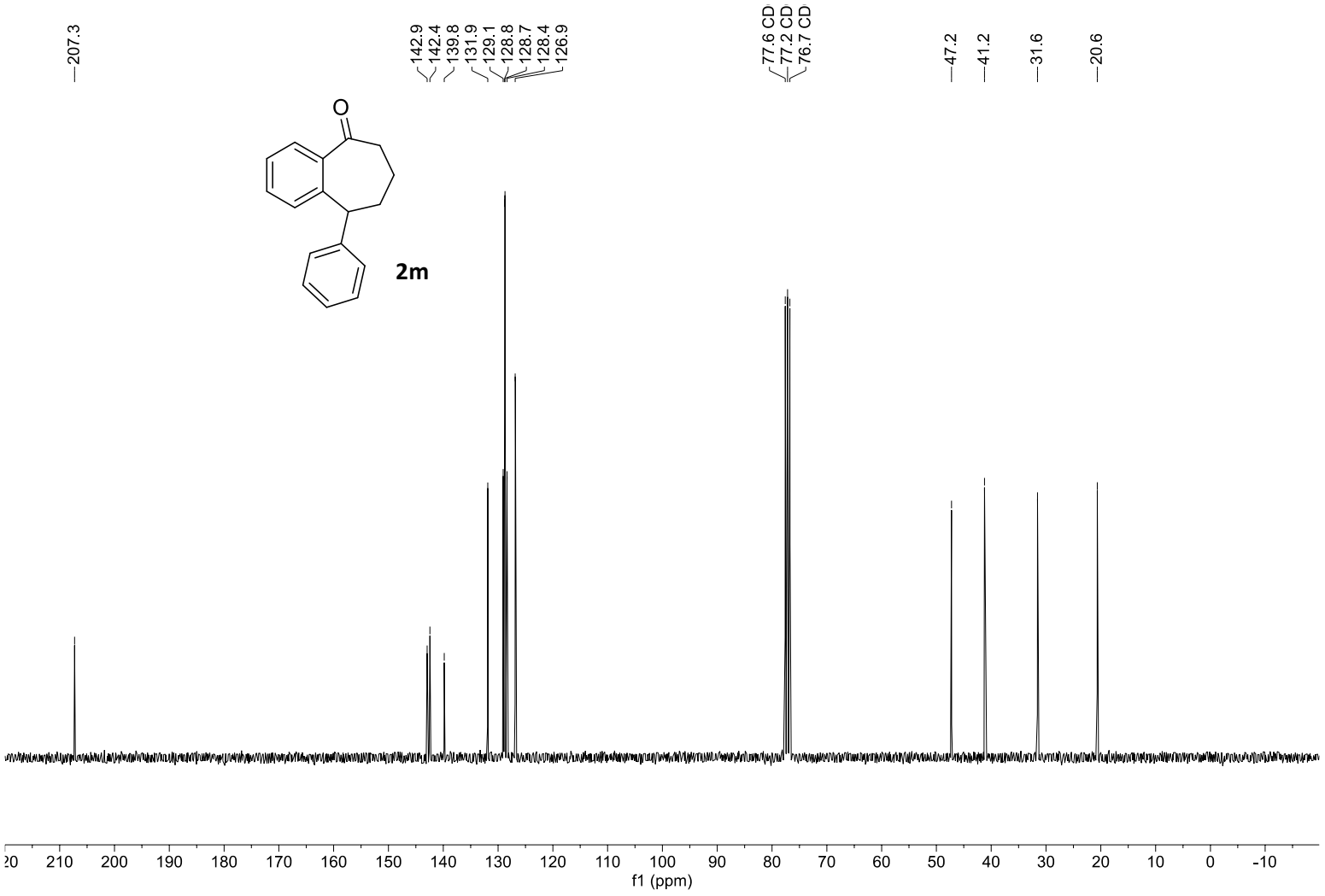

7.97
7.94
7.86
7.78
7.73
7.71
7.63
7.63
7.60
7.58
7.58
7.52
7.51
7.49
7.49
7.46
7.43
7.39
7.36
7.34
7.29
7.25
7.22
5.45
3.48
3.46
3.45
3.44
3.43
3.41
3.40
3.38
2.98
2.97
2.95
2.95
2.91
2.91
2.89
2.88
2.60
2.60
2.30
2.30
2.29
2.24
2.24
2.23
2.02
1.62
1.60
1.55
1.52
1.51
1.48
1.42
1.41
1.39
1.39
1.31
1.28
1.26
1.20
1.18
0.00
-0.00
O
10
9
8
7
6
5
4
3
2
1
ppm
0.97
1.01
1.03
1.02
1.00
1.02
0.06
1.02
3.10
0.04

2l

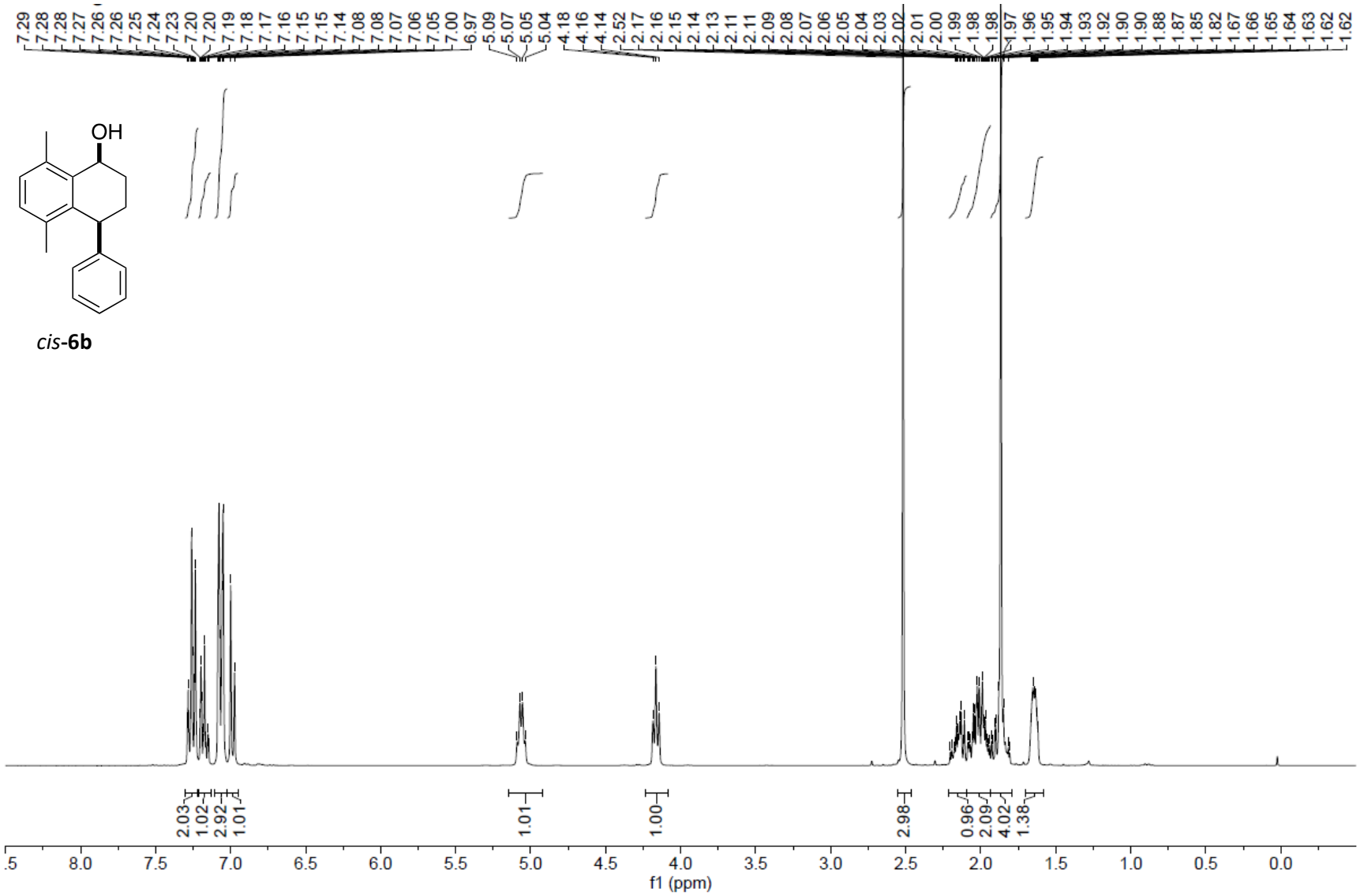

206.30
159.93
136.42
134.73
134.36
133.06
128.54
128.27
128.12
127.38
127.01
125.63
125.28
124.87
123.39
122.96
77.54
77.11
76.69
45.57
45.33
33.00
32.77
26.56
21.32
O
2l
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 ppm

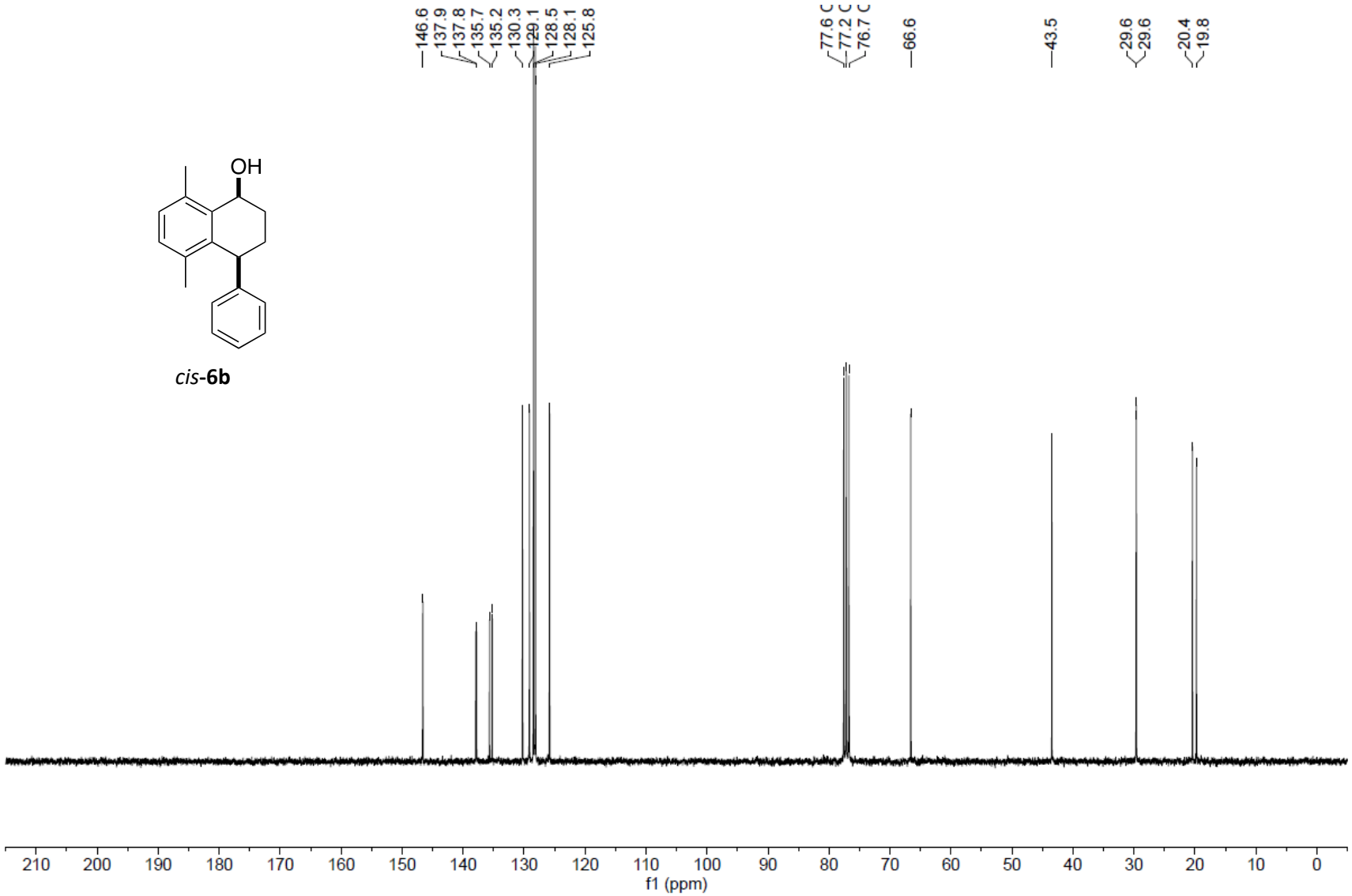

7.67 7.66 7.66 7.65 7.64 7.39 7.38 7.37 7.36 7.35 7.34 7.33 7.33 7.31 7.31 7.31 7.30 7.30 7.29 7.29 7.28 7.27 7.27 7.26 7.25 7.24 7.23 7.23 7.22 7.21 7.21 7.21 7.20 7.20 6.85 6.84 6.84 6.83 6.83 6.82 6.82 4.44 4.42 4.40 4.39 2.79 2.77 2.77 2.75 2.75 2.73 2.71 2.70 2.36 2.35 2.34 2.32 2.23 2.22 2.20 2.20 2.18 2.02 2.01 1.99 1.97 1.79 1.78 1.75 1.74 0.01
O
0.98
7.01
0.98
1.00
2.02
1.02
1.02
1.02
1.02
f1 (ppm)

2m

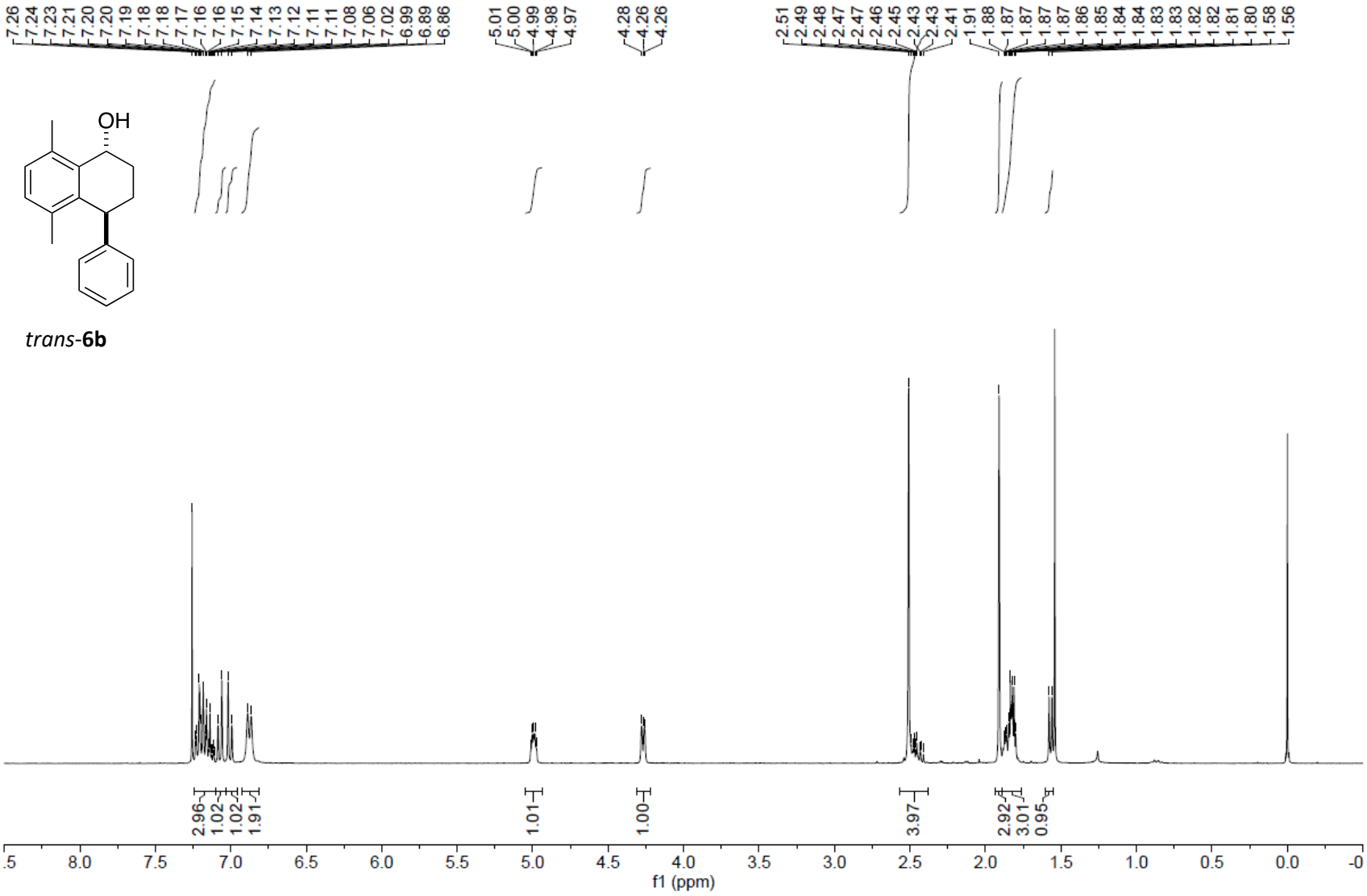

207.3
142.9
142.4
139.8
131.9
129.1
128.8
128.7
128.4
126.9
77.6 CD
77.2 CD
76.7 CD
47.2
41.2
31.6
20.6
O
2m
f1 (ppm)

1.6.2 ^{1}H NMR and ^{13}C NMR spectra of alcohol compounds

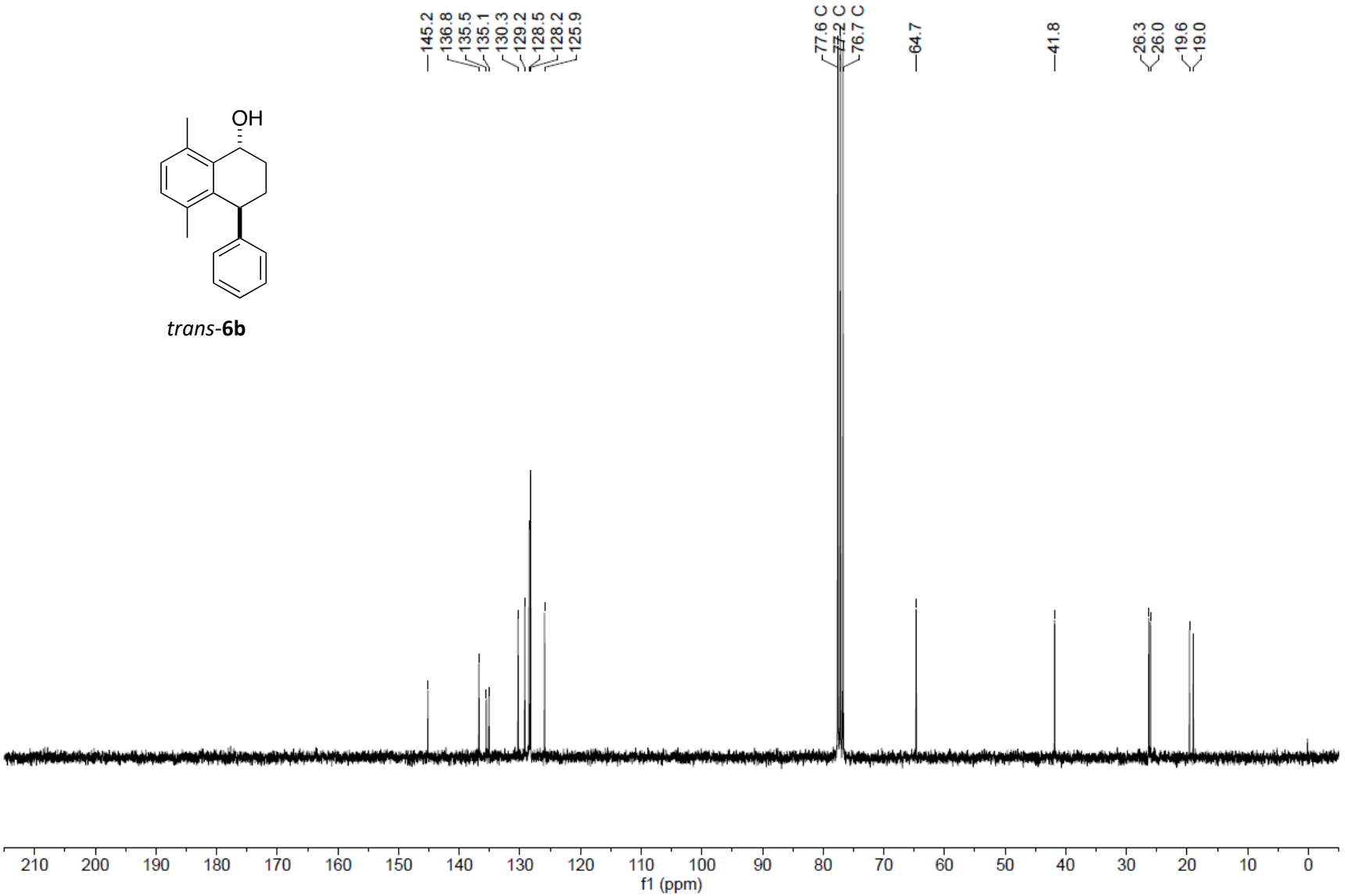

OH
cis-6b
f1 (ppm)


146.6
137.9
137.8
135.7
135.2
130.3
129.1
128.5
128.1
125.8
77.6 C
77.2 C
76.7 C
66.6
43.5
29.6
29.6
20.4
19.8
OH
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)

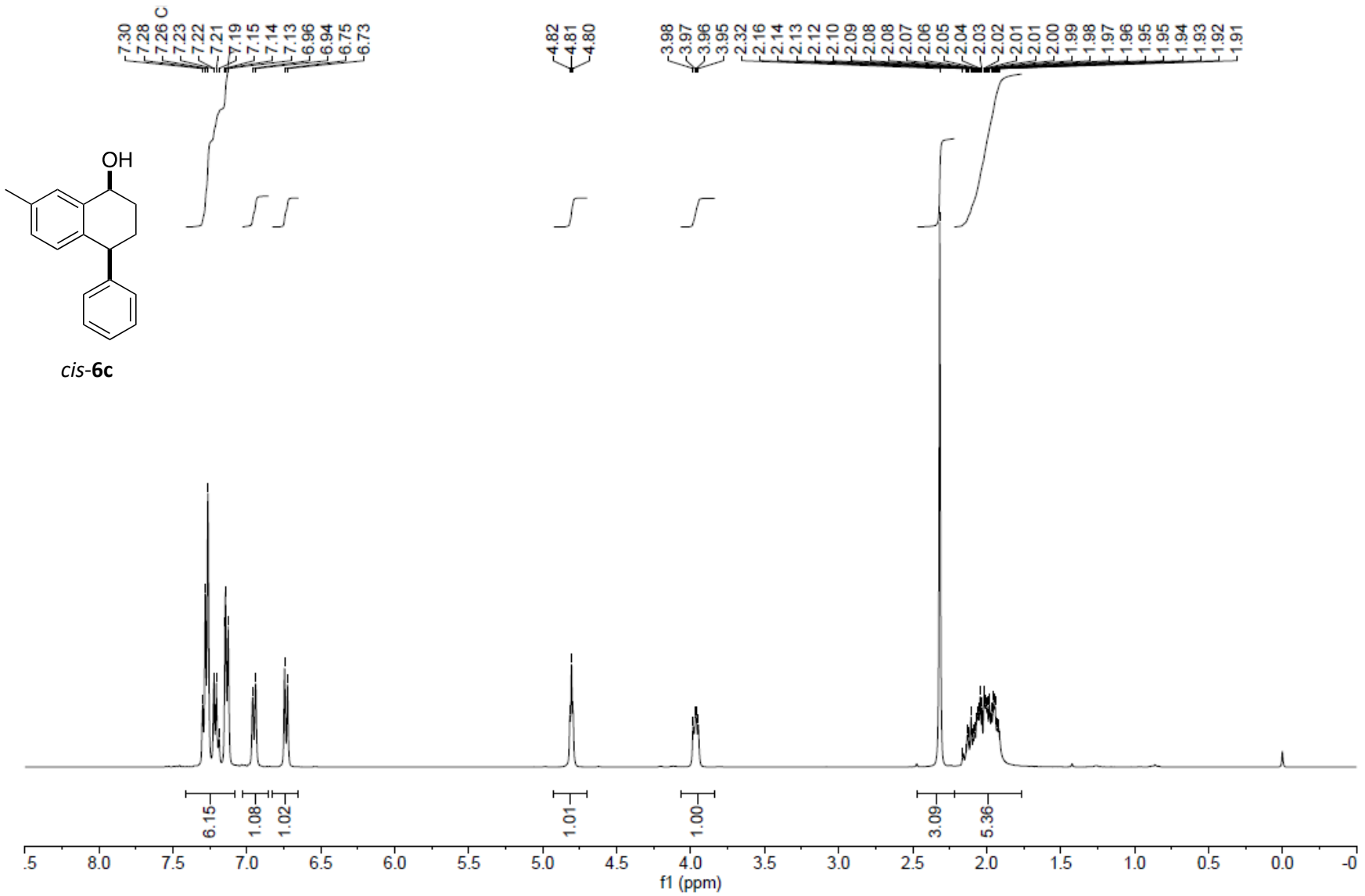
cis-**6b**


7.26
7.24
7.23
7.21
7.20
7.20
7.19
7.18
7.18
7.17
7.16
7.16
7.15
7.14
7.13
7.12
7.11
7.11
7.08
7.06
7.02
6.99
6.89
6.86
5.01
5.00
4.99
4.98
4.97
4.28
4.26
4.26
2.51
2.49
2.48
2.47
2.47
2.46
2.45
2.43
2.43
2.41
1.91
1.88
1.87
1.87
1.87
1.87
1.86
1.85
1.84
1.84
1.83
1.83
1.82
1.82
1.81
1.80
1.58
1.56
OH
2.96
1.02
1.02
1.91
1.01
1.00
3.97
2.92
3.01
0.95
f1 (ppm)

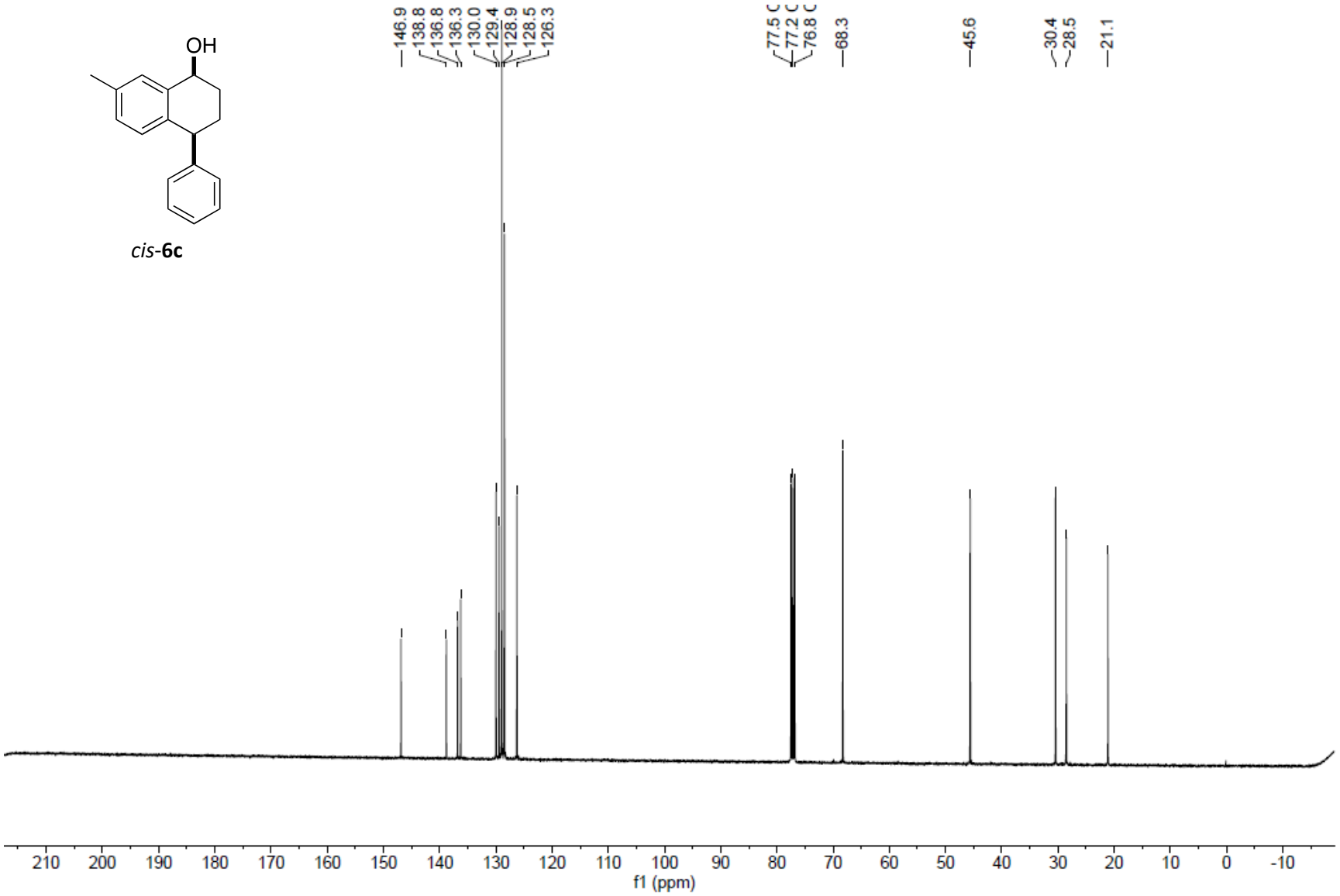
trans-**6b**


145.2
136.8
135.5
135.1
130.3
129.2
128.5
128.2
125.9
77.6 C
77.2 C
76.7 C
64.7
41.8
26.3
26.0
19.6
19.0
OH
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

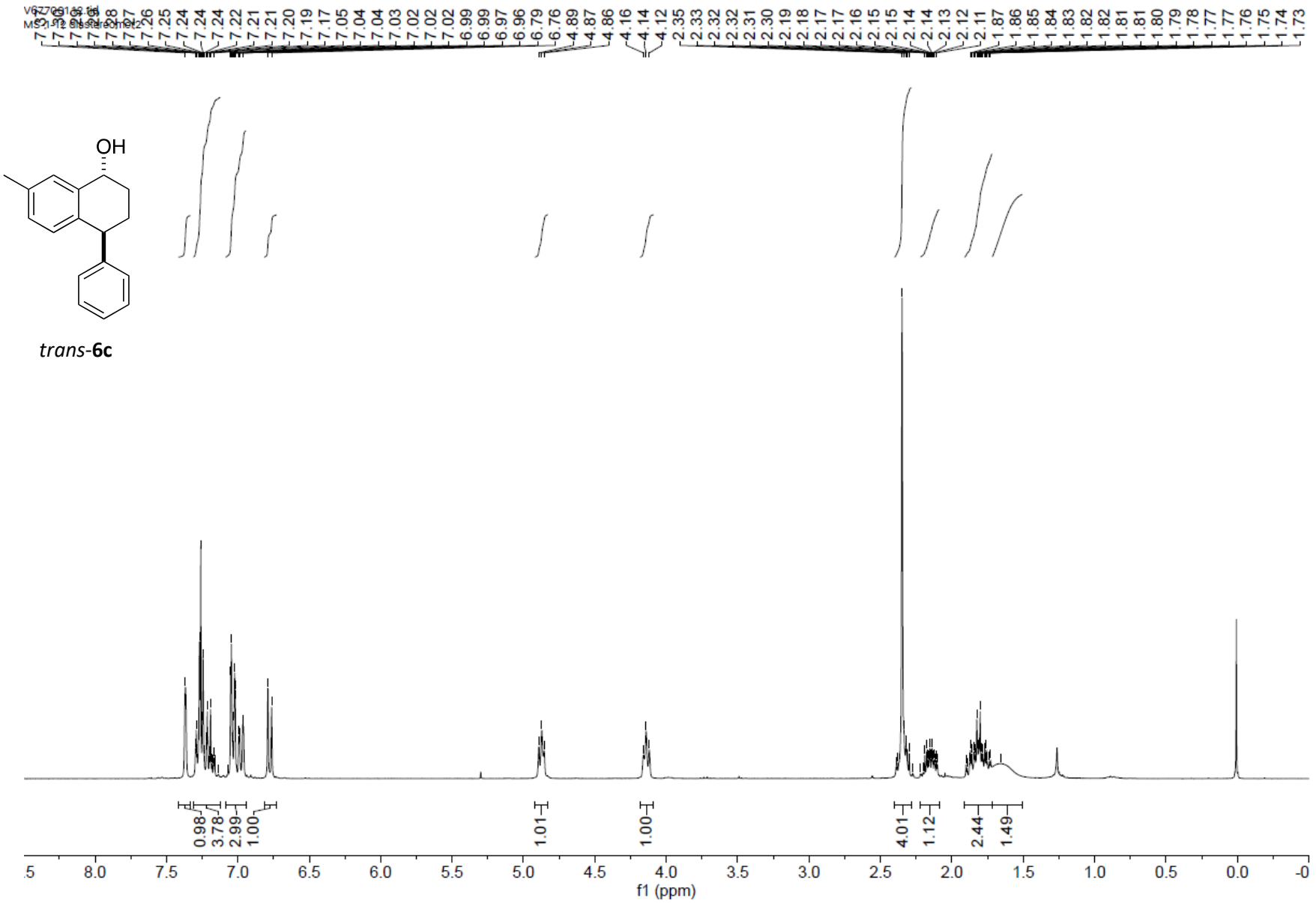
trans-**6b**


OH
7.30
7.28
7.26 C
7.23
7.22
7.21
7.19
7.15
7.14
7.13
6.96
6.94
6.75
6.73
4.82
4.81
4.80
3.98
3.97
3.96
3.95
2.32
2.16
2.14
2.13
2.12
2.10
2.09
2.08
2.08
2.07
2.06
2.05
2.04
2.03
2.02
2.01
2.01
2.00
1.99
1.98
1.97
1.96
1.95
1.95
1.94
1.93
1.92
1.91
6.15
1.08
1.02
1.01
1.00
3.09
5.36
f1 (ppm)

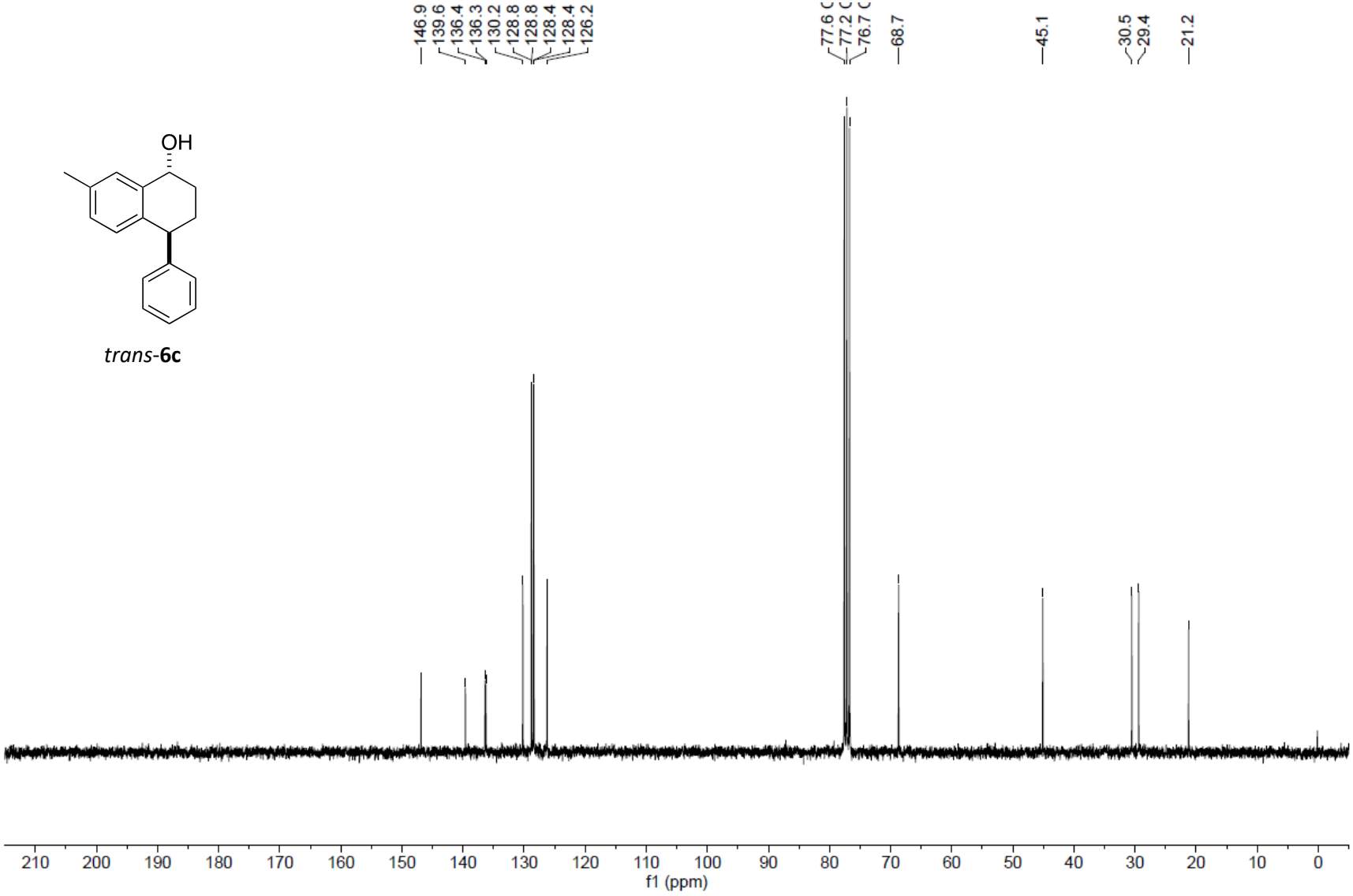
cis-**6c**


OH
146.9
138.8
136.8
136.3
130.0
129.4
128.9
128.5
126.3
77.5 C
77.2 C
76.8 C
68.3
45.6
30.4
28.5
21.1
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

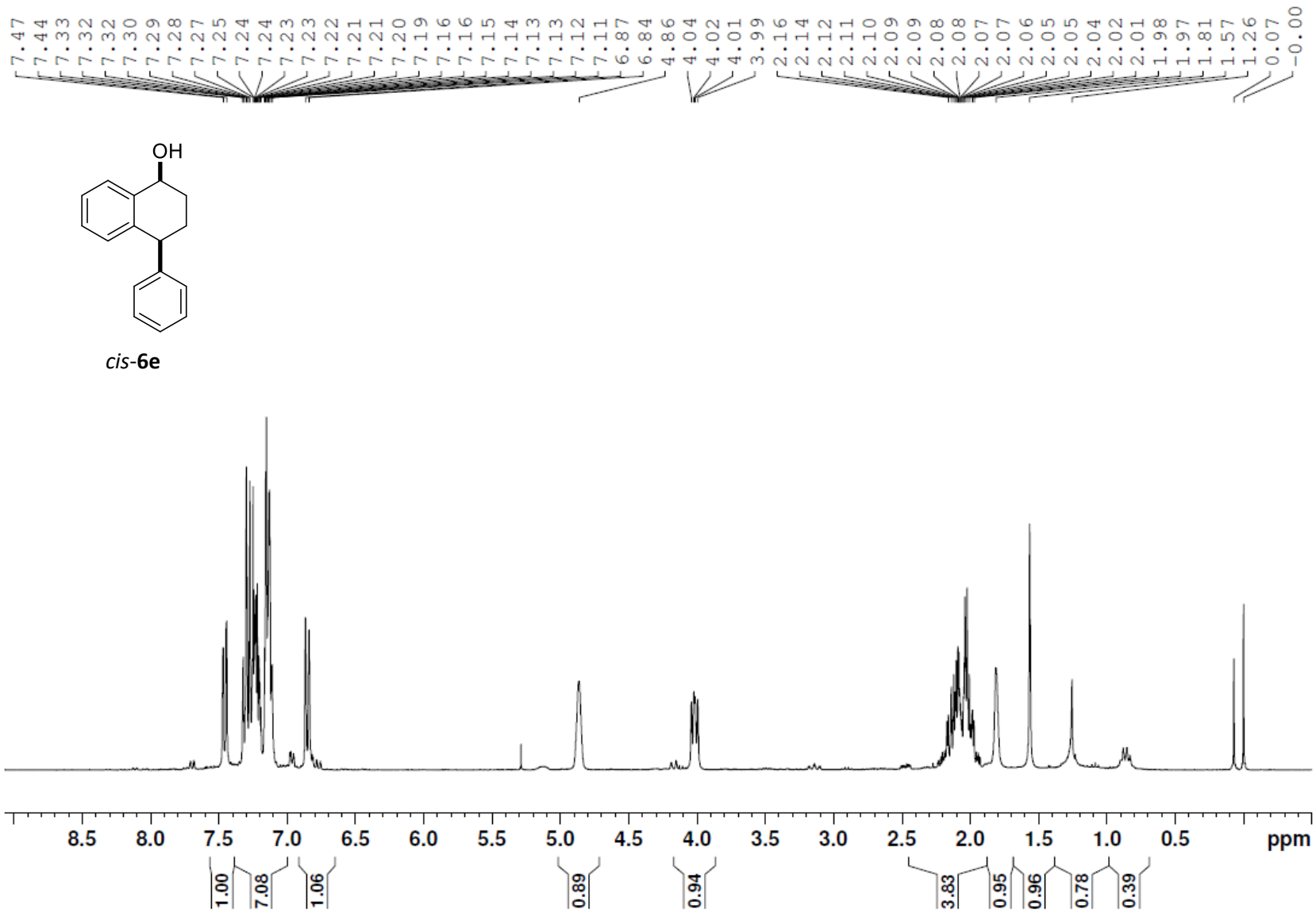
cis-**6c**



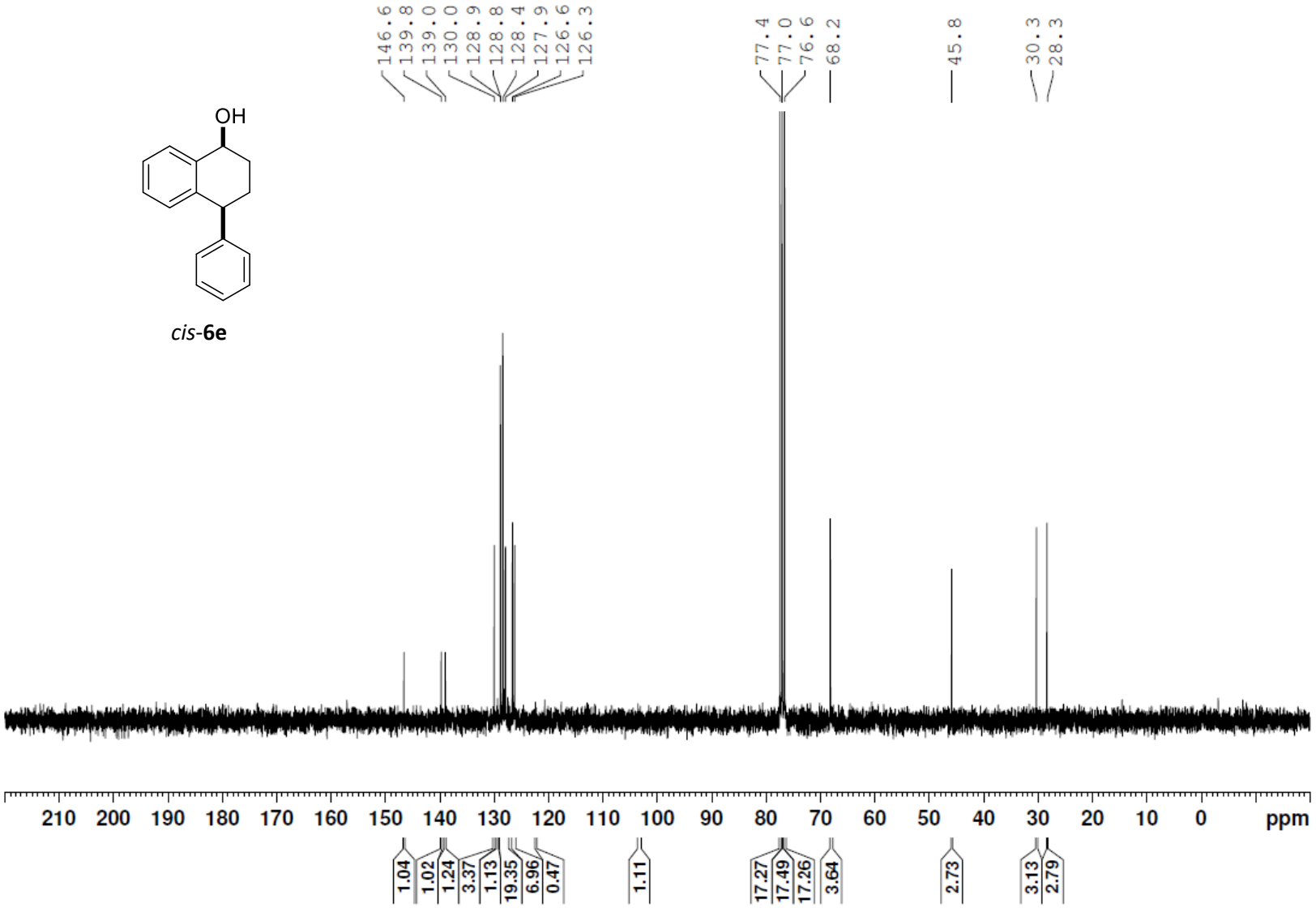
trans-**6c**

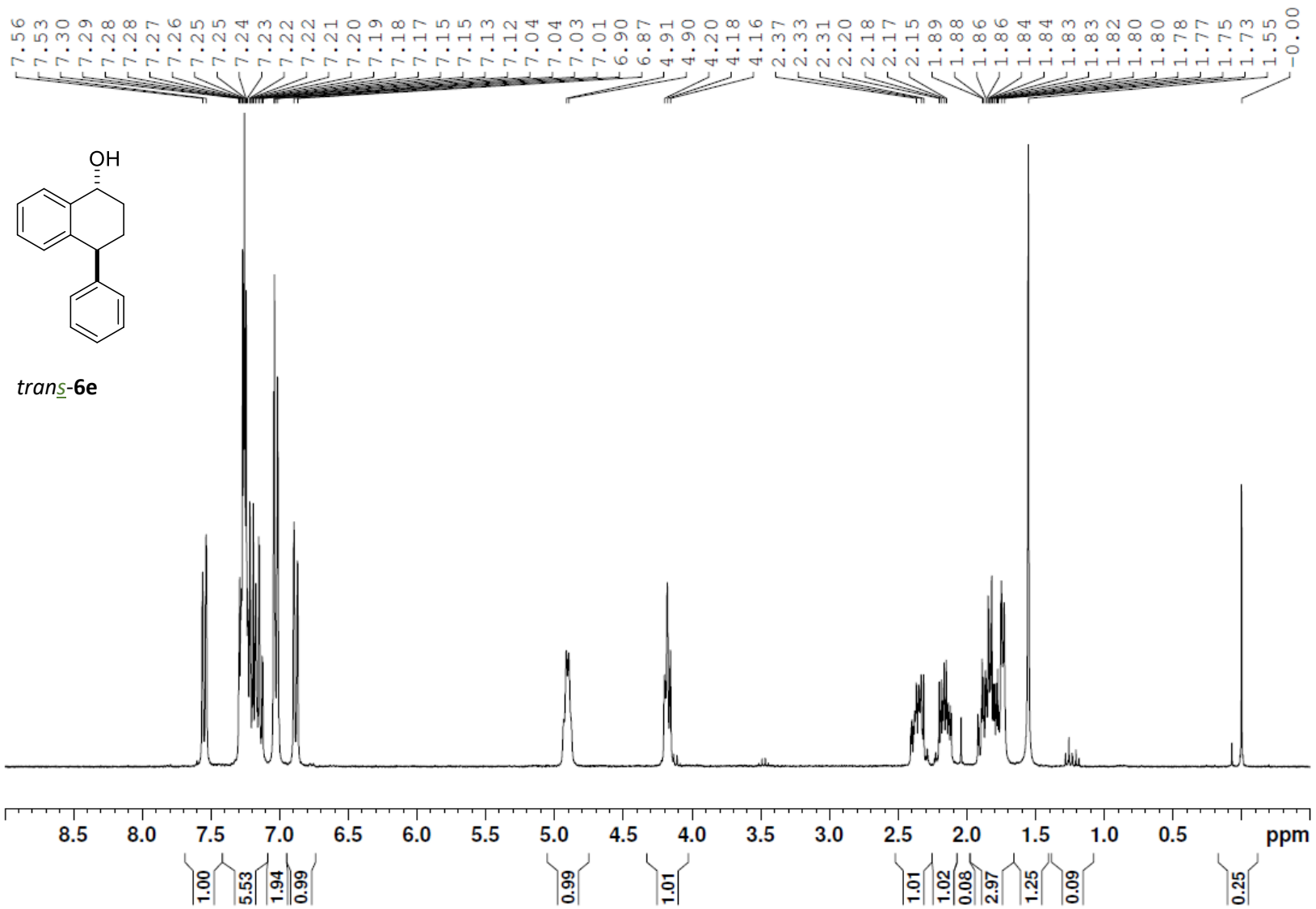

146.9
139.6
136.4
136.3
130.2
128.8
128.8
128.4
128.4
126.2
77.6
77.2
76.7
68.7
45.1
30.5
29.4
21.2
OH
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

trans-**6c**

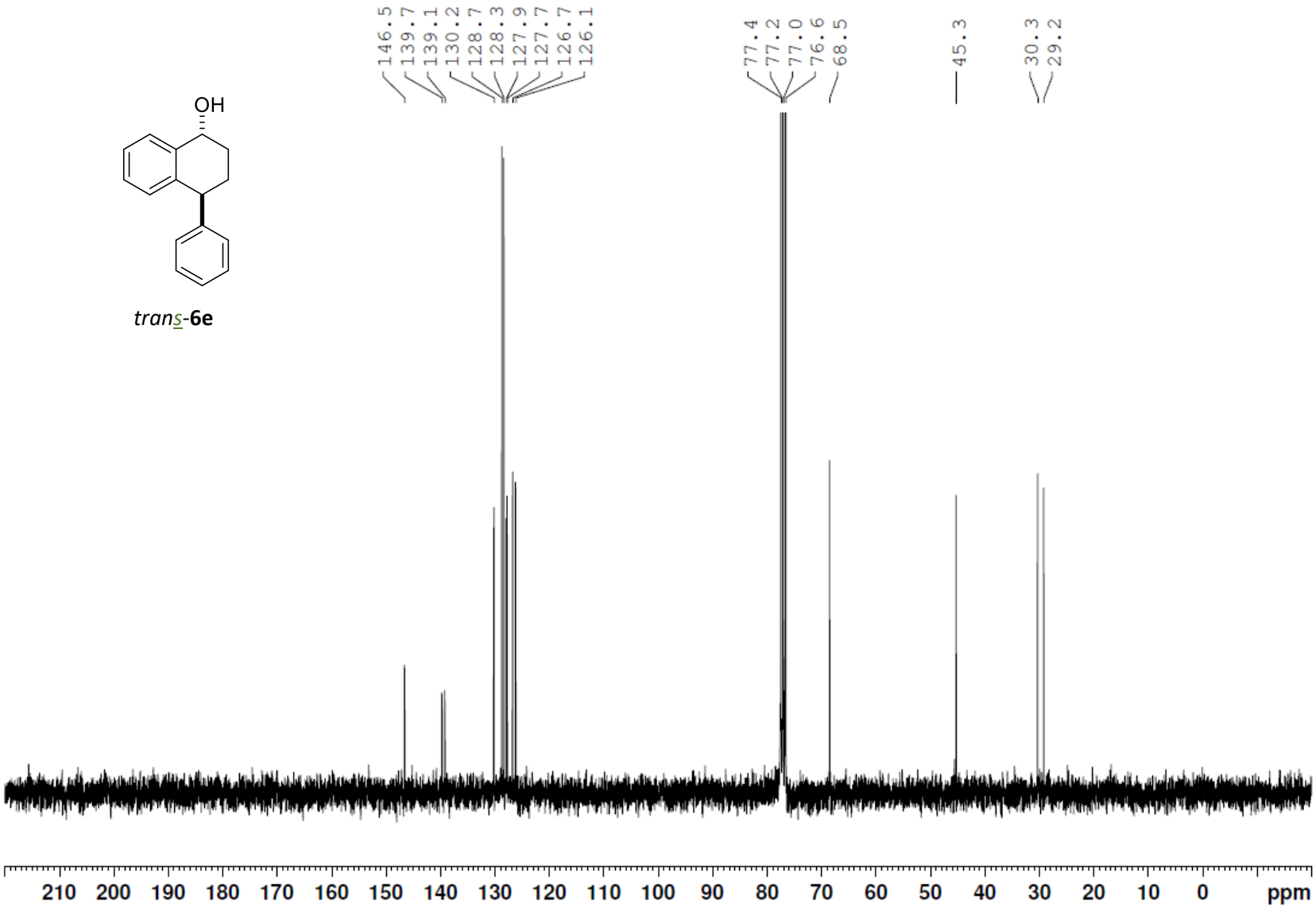

7.47
7.44
7.33
7.32
7.32
7.30
7.29
7.28
7.27
7.25
7.24
7.24
7.23
7.23
7.22
7.21
7.21
7.20
7.19
7.16
7.16
7.15
7.14
7.13
7.13
7.12
7.11
6.87
6.84
4.86
4.04
4.02
4.01
3.99
2.16
2.14
2.12
2.11
2.10
2.09
2.09
2.08
2.08
2.07
2.07
2.06
2.05
2.05
2.04
2.02
2.01
1.98
1.97
1.81
1.57
1.26
0.07
-0.00
OH
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
ppm
1.00
7.08
1.06
0.89
0.94
3.83
0.95
0.96
0.78
0.39

cis-**6e**

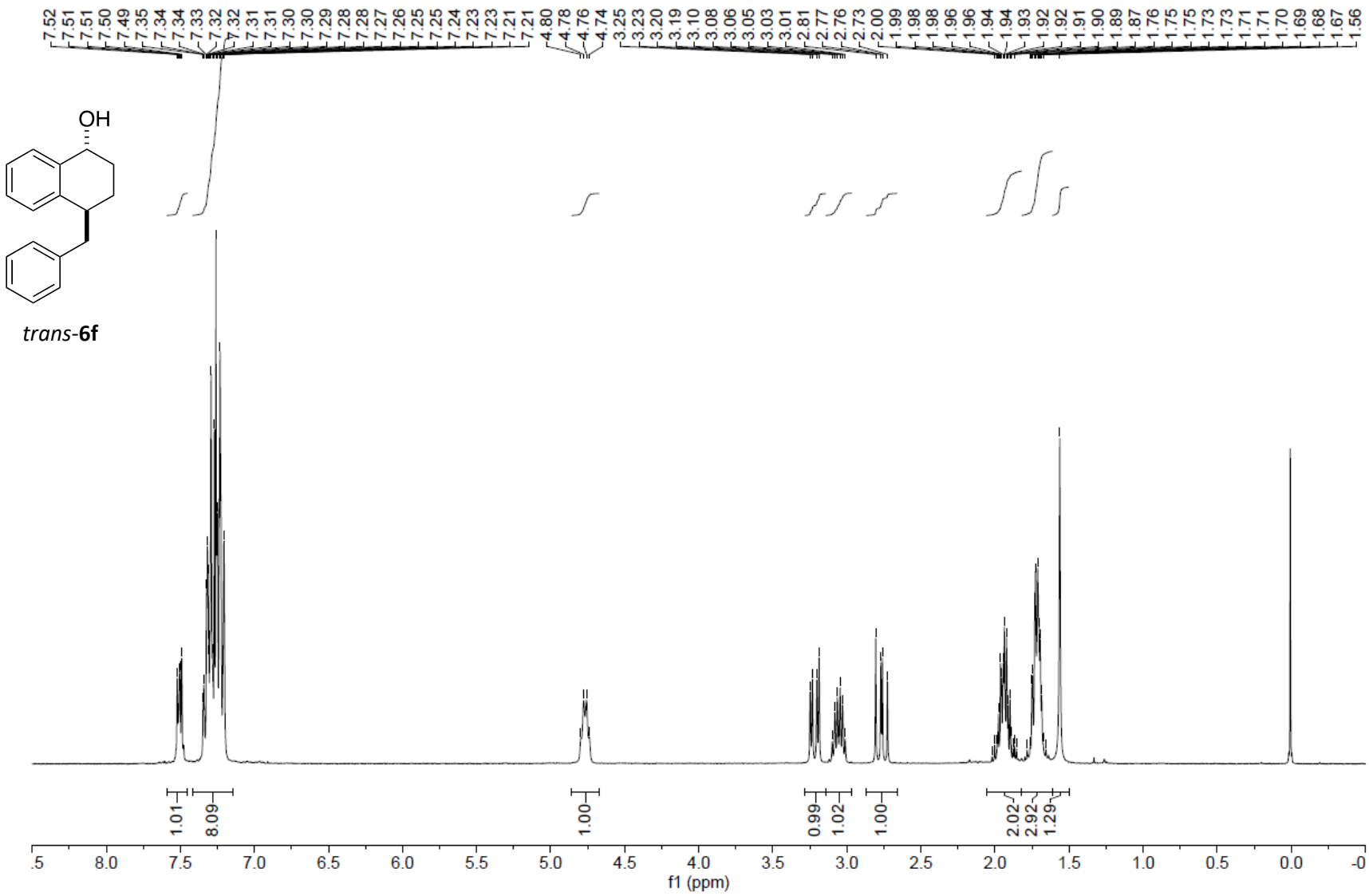

146.6
139.8
139.0
130.0
128.9
128.8
128.4
127.9
126.6
126.3
77.4
77.0
76.6
68.2
45.8
30.3
28.3
OH
cis-6e
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 ppm
1.04
1.02
1.24
3.37
1.13
19.35
6.96
0.47
1.11
17.27
17.49
17.26
3.64
2.73
3.13
2.79

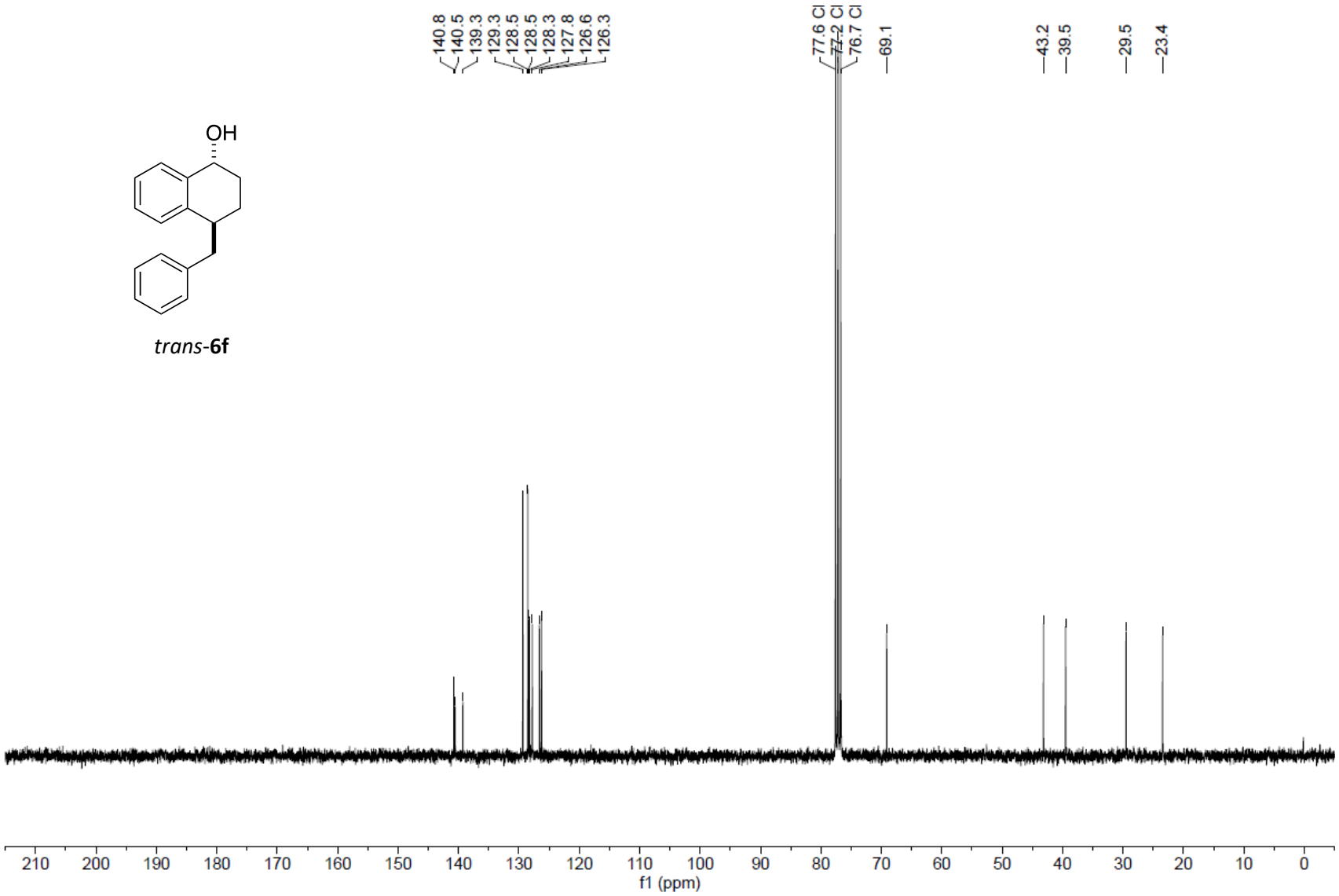

7.56
7.53
7.30
7.29
7.28
7.28
7.27
7.26
7.25
7.25
7.24
7.23
7.22
7.22
7.21
7.20
7.19
7.18
7.17
7.15
7.15
7.13
7.12
7.04
7.04
7.03
7.01
6.90
6.87
4.91
4.90
4.20
4.18
4.16
2.37
2.33
2.31
2.20
2.18
2.17
2.15
1.89
1.88
1.86
1.86
1.84
1.84
1.83
1.83
1.82
1.80
1.80
1.78
1.77
1.75
1.73
1.55
-0.00
OH
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
ppm
1.00
5.53
1.94
0.99
0.99
1.01
1.01
1.02
0.08
2.97
1.25
0.09
0.25

trans-**6e**

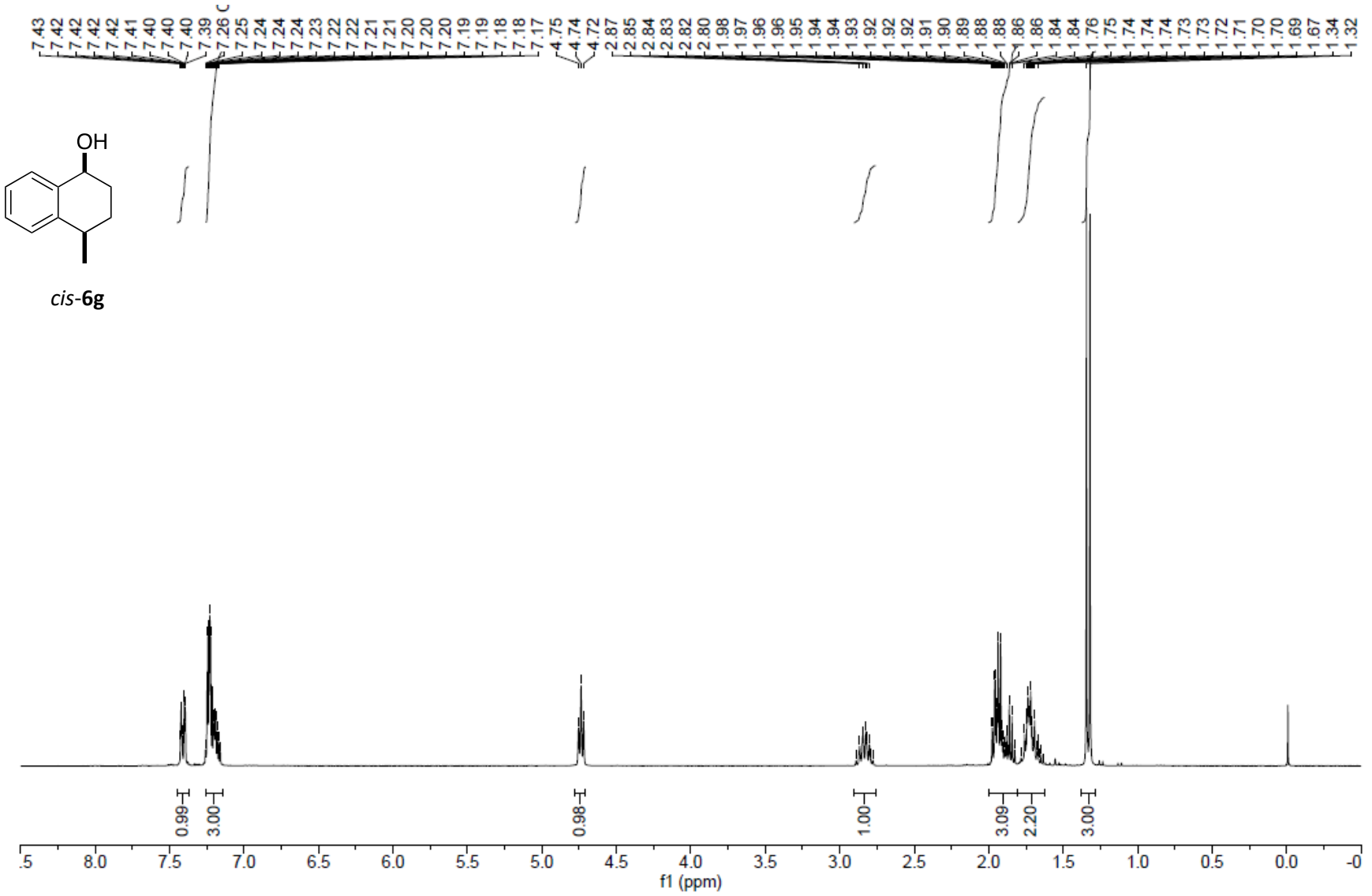

146.5
139.7
139.1
130.2
128.7
128.3
127.9
127.7
126.7
126.1
77.4
77.2
77.0
76.6
68.5
45.3
30.3
29.2
OH
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 ppm

trans-**6e**

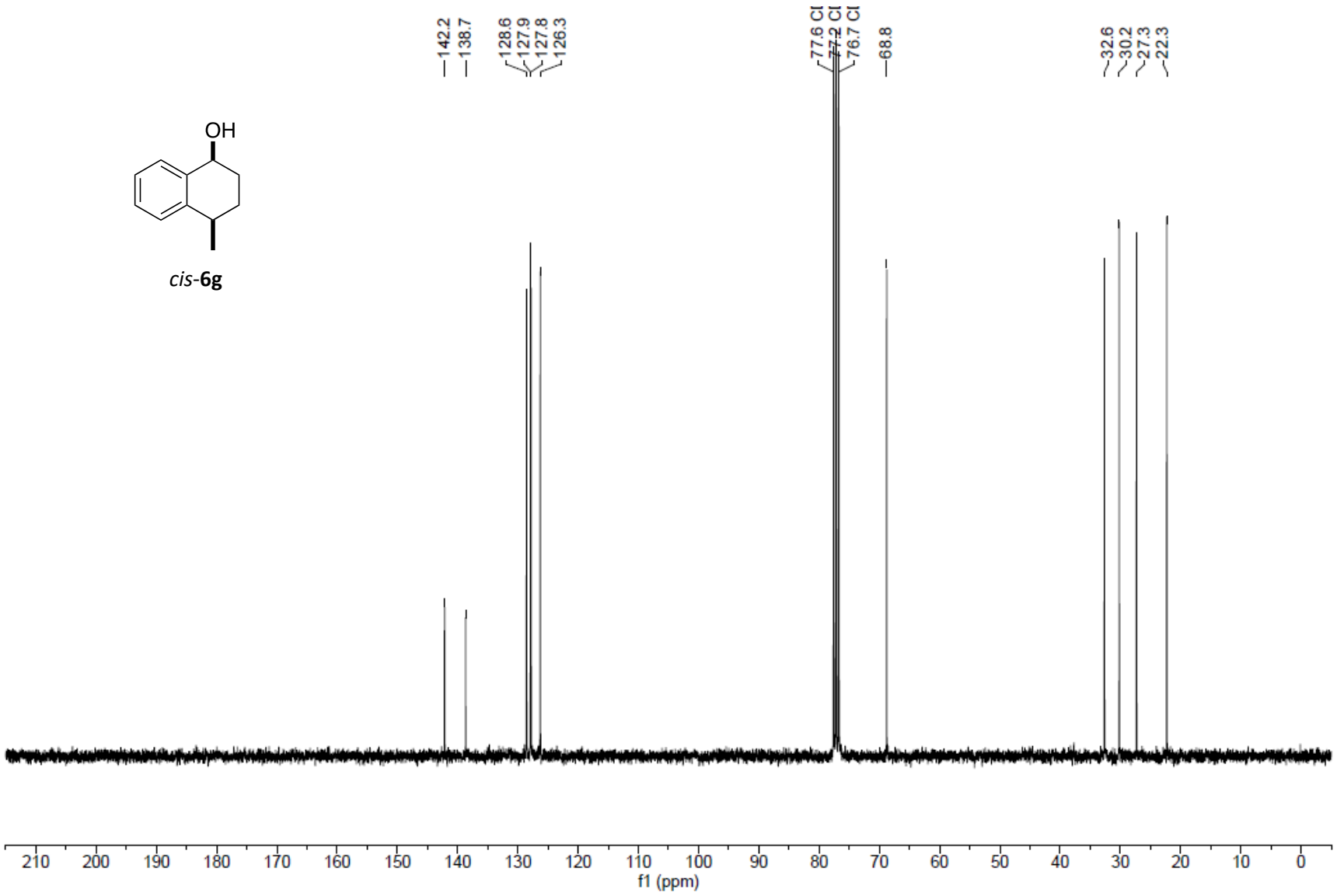

OH
trans-6f
7.52 7.51 7.51 7.50 7.49 7.35 7.34 7.34 7.33 7.32 7.32 7.31 7.31 7.30 7.30 7.29 7.28 7.28 7.27 7.26 7.25 7.25 7.24 7.23 7.23 7.21 7.21
4.80 4.78 4.76 4.74
3.25 3.23 3.20 3.19 3.10 3.08 3.06 3.05 3.03 3.01 2.81 2.77 2.76 2.73 2.00 1.99 1.98 1.98 1.96 1.96 1.94 1.94 1.93 1.92 1.92 1.91 1.90 1.89 1.87 1.76 1.75 1.75 1.73 1.73 1.71 1.71 1.70 1.69 1.68 1.67 1.56
1.01
8.09
1.00
0.99
1.02
1.00
2.02
2.92
1.29
f1 (ppm)


OH
140.8
140.5
139.3
129.3
128.5
128.5
128.3
127.8
126.6
126.3
77.6 Cl
77.2 Cl
76.7 Cl
69.1
43.2
39.5
29.5
23.4
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

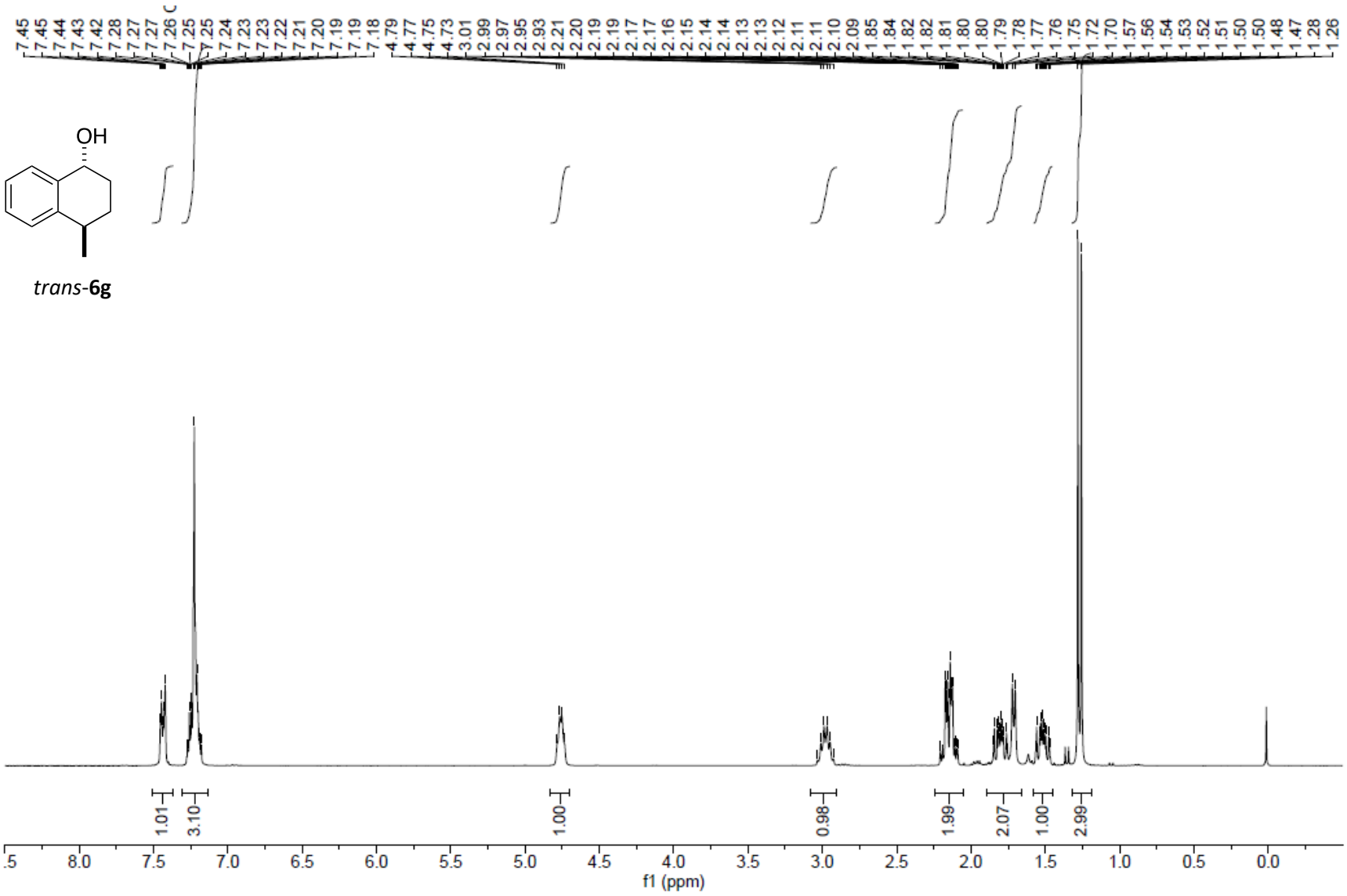
trans-**6f**


OH
7.43 7.42 7.42 7.42 7.42 7.41 7.40 7.40 7.40 7.39 7.26 7.25 7.24 7.24 7.24 7.23 7.22 7.22 7.21 7.21 7.20 7.20 7.20 7.19 7.19 7.18 7.18 7.17
4.75 4.74 4.72
2.87 2.85 2.84 2.83 2.82 2.80 1.98 1.97 1.96 1.96 1.95 1.94 1.94 1.93 1.92 1.92 1.92 1.91 1.90 1.89 1.88 1.88 1.86 1.86 1.84 1.84 1.76 1.75 1.74 1.74 1.74 1.73 1.73 1.72 1.71 1.70 1.70 1.69 1.67 1.34 1.32
0.99
3.00
0.98
1.00
3.09
2.20
3.00
f1 (ppm)

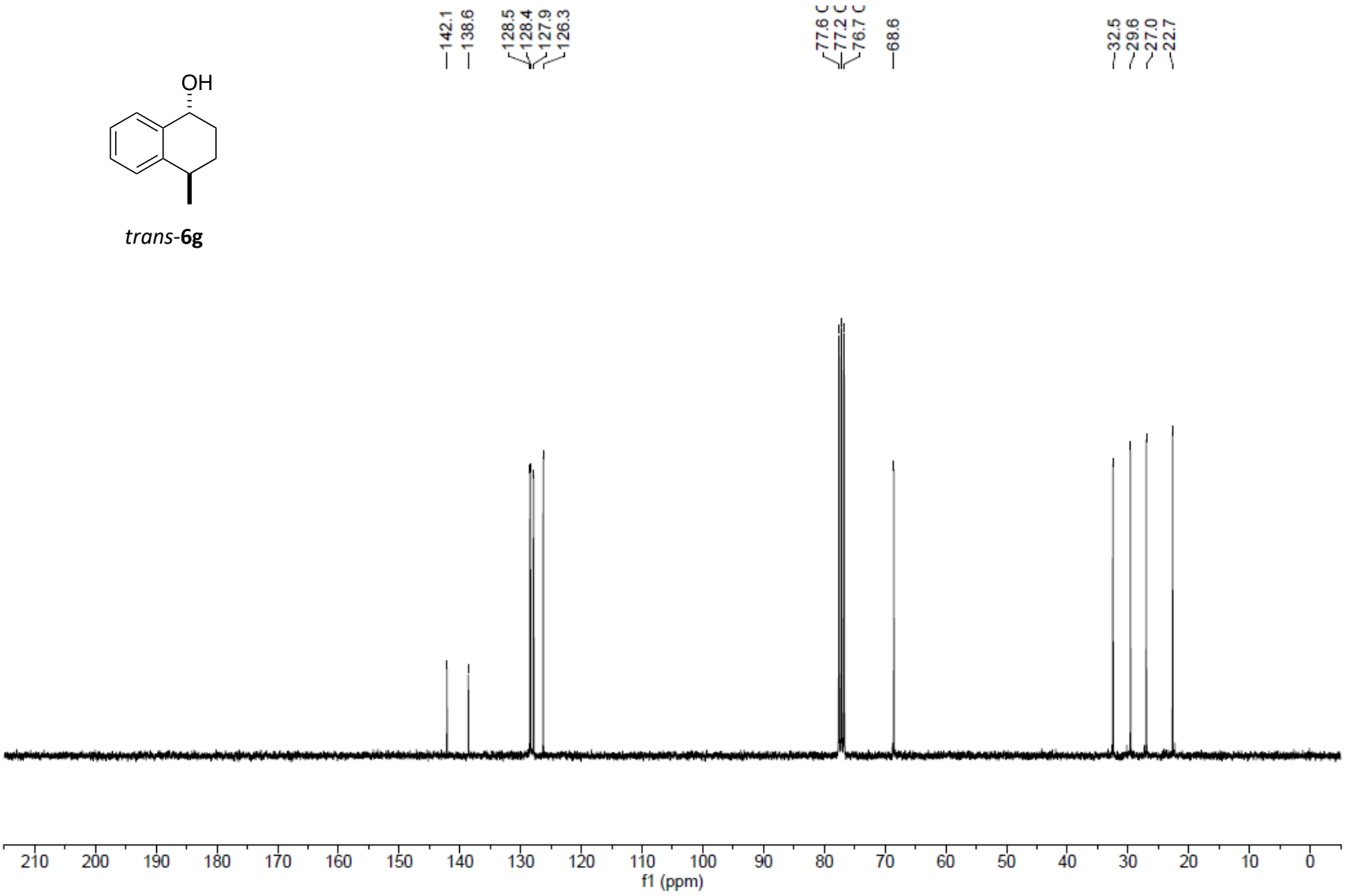
cis-**6g**


OH
142.2
138.7
128.6
127.9
127.8
126.3
77.6 Cl
77.2 Cl
76.7 Cl
68.8
32.6
30.2
27.3
22.3
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

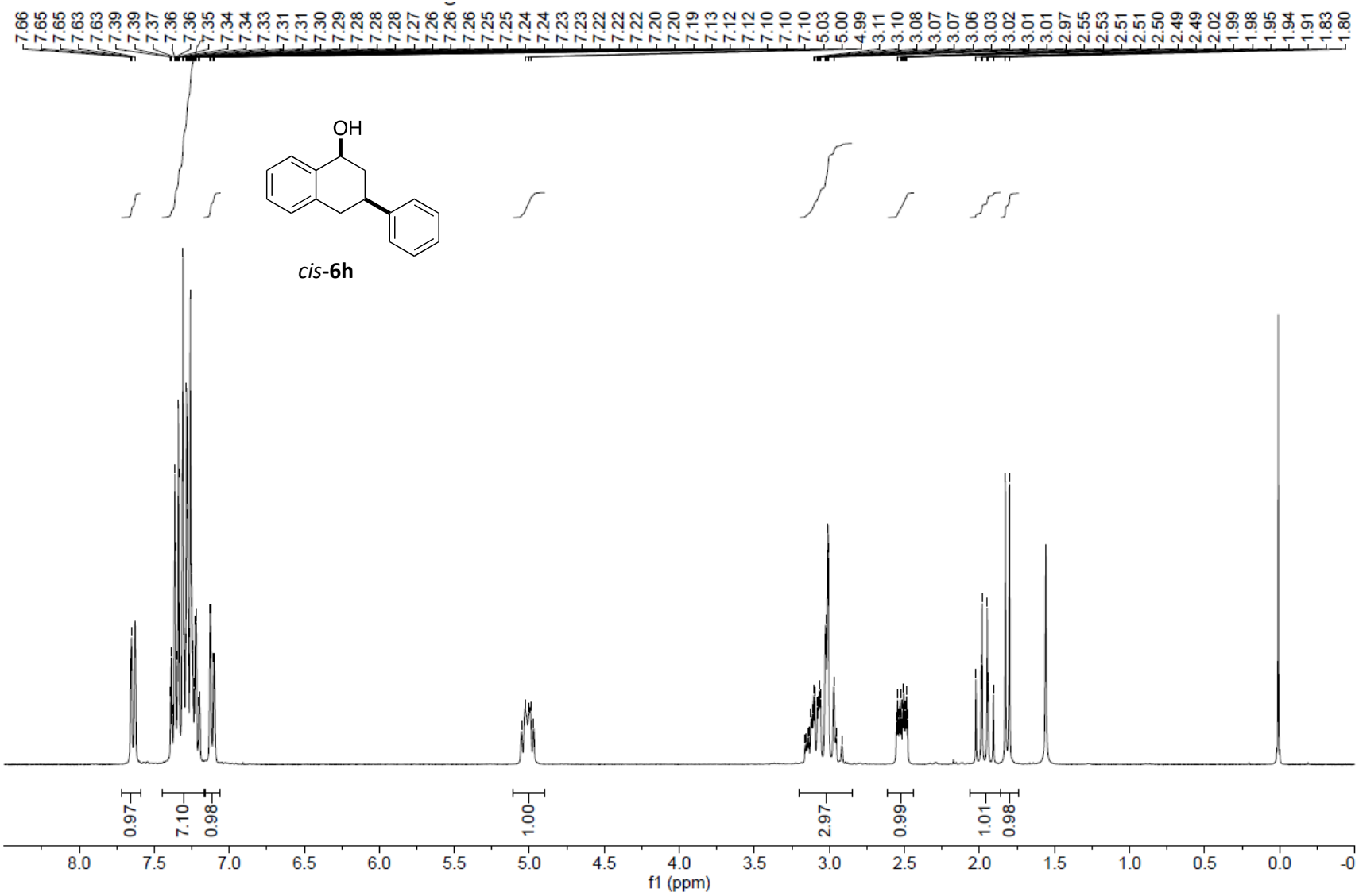
cis-**6g**

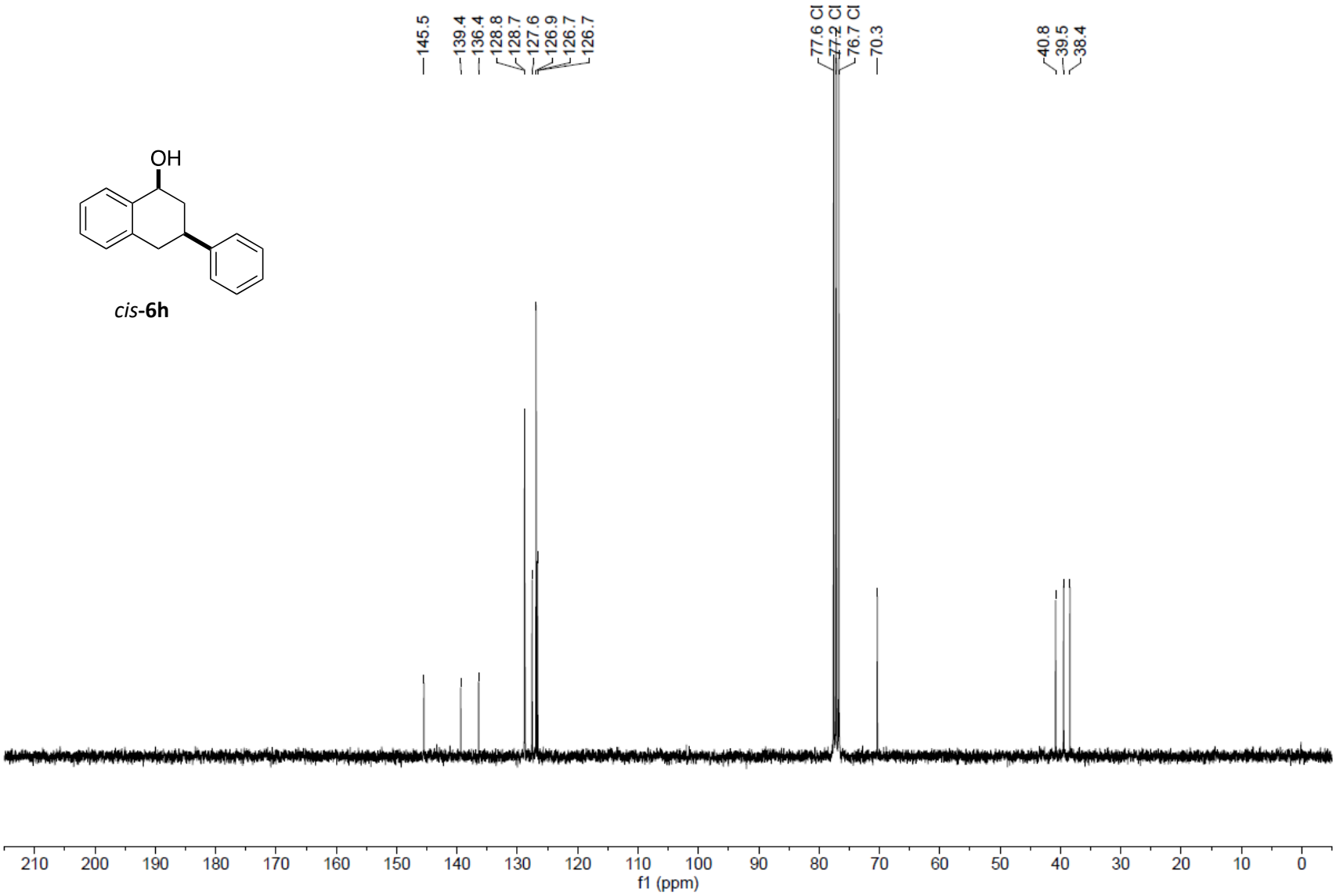

OH
7.45 7.45 7.44 7.43 7.42 7.28 7.27 7.27 7.26 7.25 7.25 7.24 7.23 7.23 7.22 7.21 7.20 7.19 7.19 7.18
4.79 4.77 4.75 4.73 3.01 2.99 2.97 2.95 2.93 2.21 2.20 2.19 2.19 2.17 2.17 2.16 2.15 2.14 2.14 2.13 2.13 2.12 2.11 2.11 2.10 2.09 1.85 1.84 1.82 1.82 1.81 1.80 1.80 1.79 1.78 1.77 1.76 1.75 1.72 1.70 1.57 1.56 1.54 1.53 1.52 1.51 1.50 1.50 1.48 1.47 1.28 1.26
1.01
3.10
1.00
0.98
1.99
2.07
1.00
2.99
f1 (ppm)

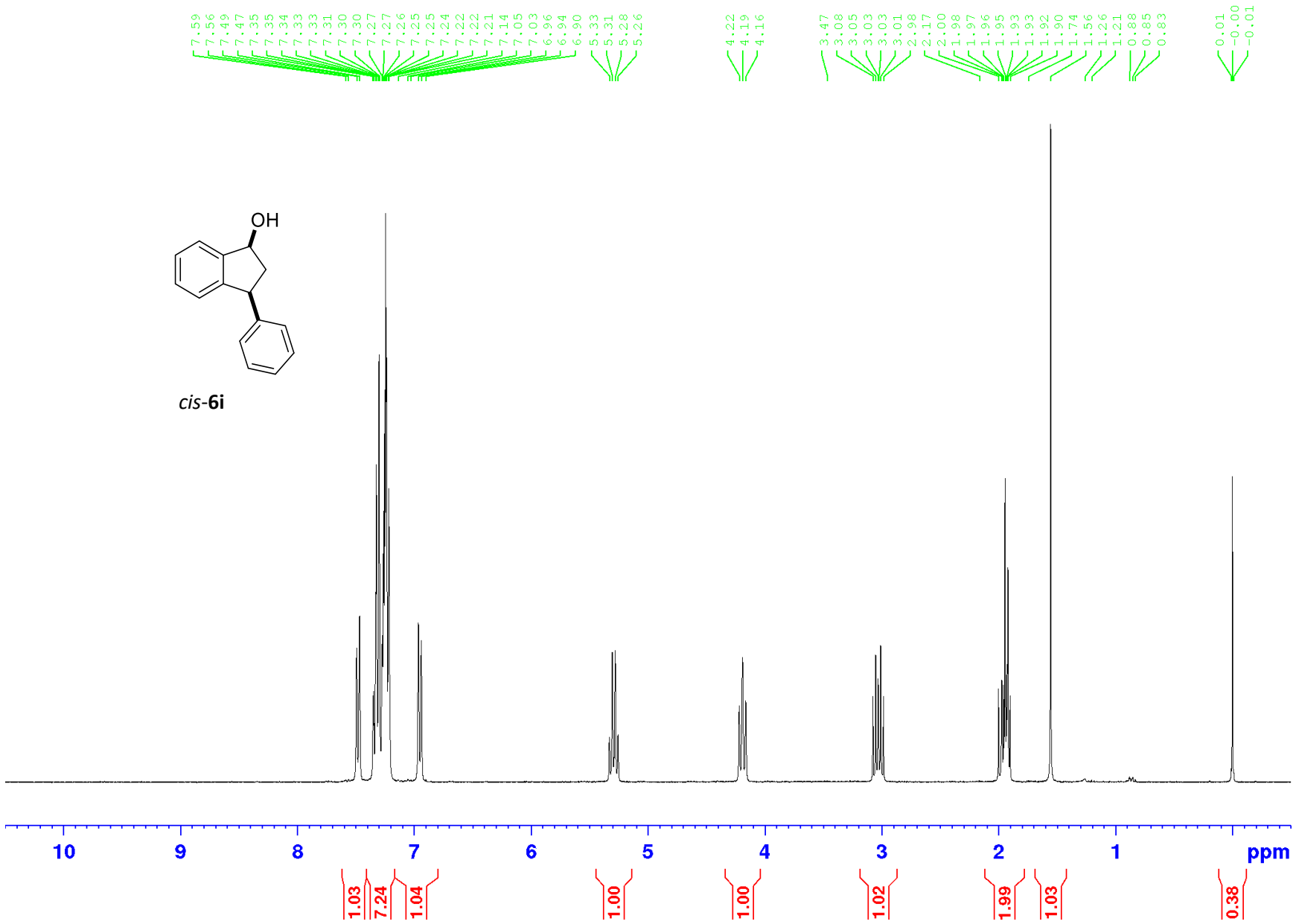
trans-**6g**

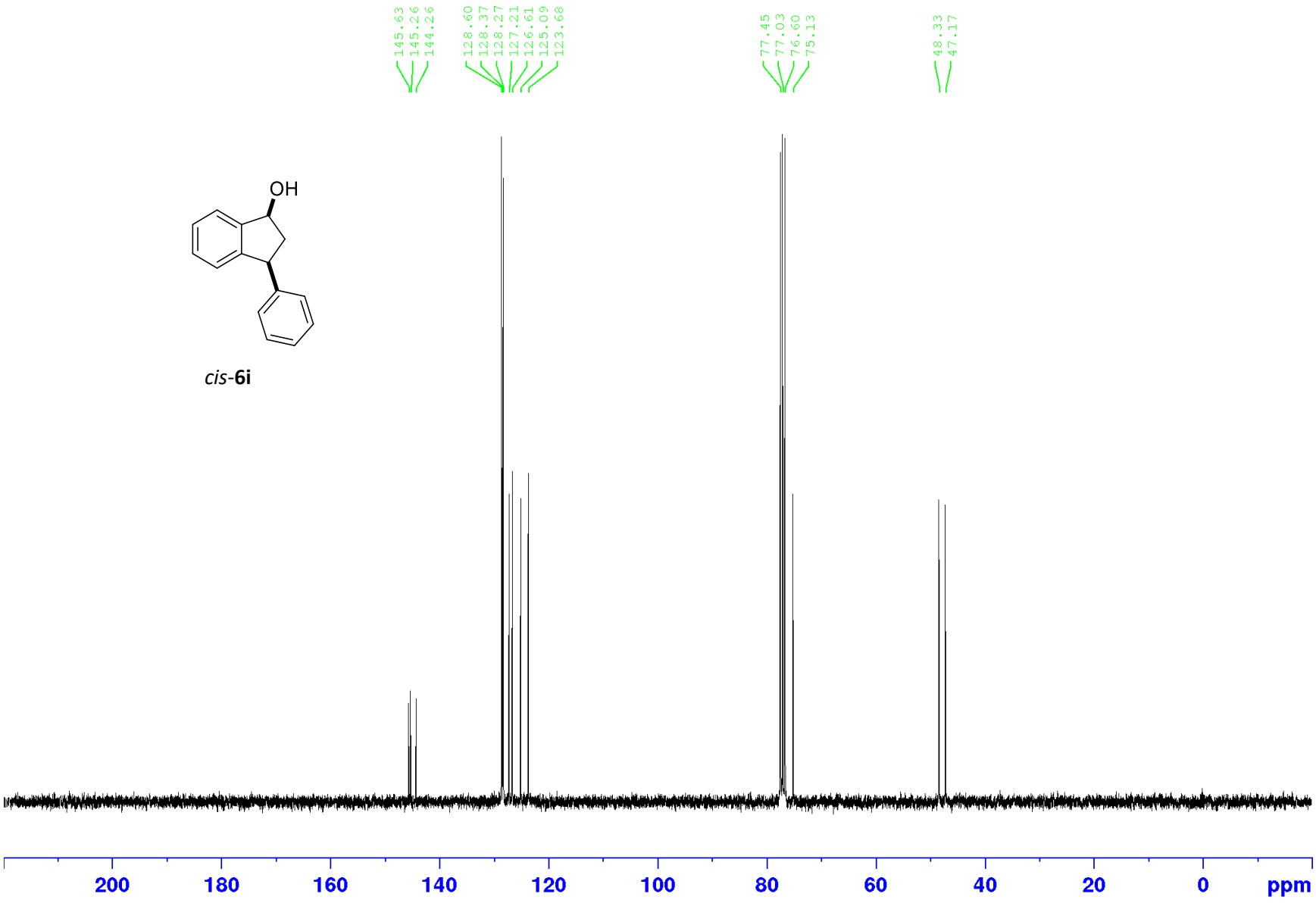

OH
142.1
138.6
128.5
128.4
127.9
126.3
77.6 C
77.2 C
76.7 C
68.6
32.5
29.6
27.0
22.7
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)

trans-**6g**

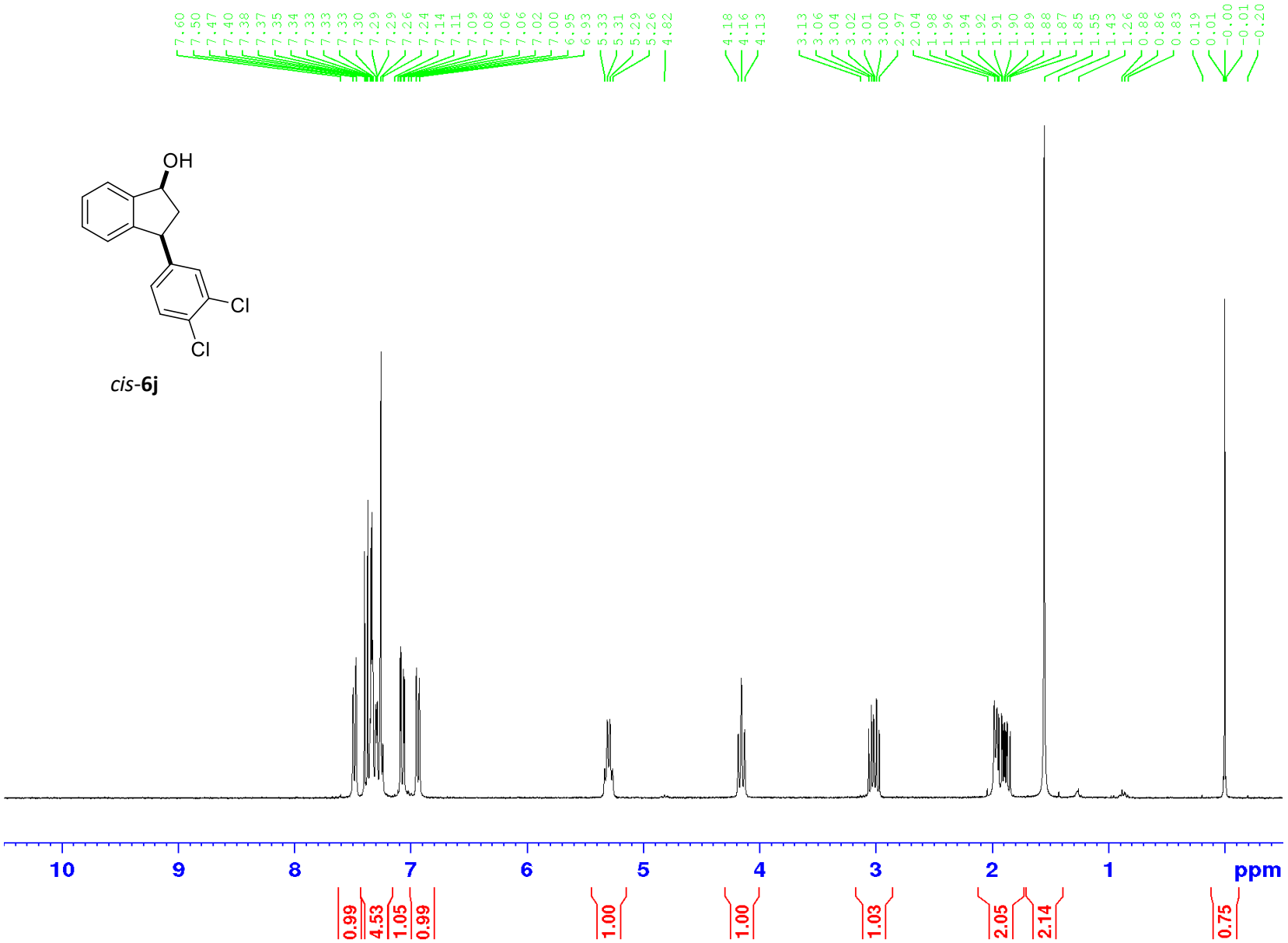

OH
cis-6h
0.97
7.10
0.98
1.00
2.97
0.99
1.01
0.98
f1 (ppm)


OH
cis-6h
145.5
139.4
136.4
128.8
128.7
127.6
126.9
126.7
126.7
77.6 Cl
77.2 Cl
76.7 Cl
70.3
40.8
39.5
38.4
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)

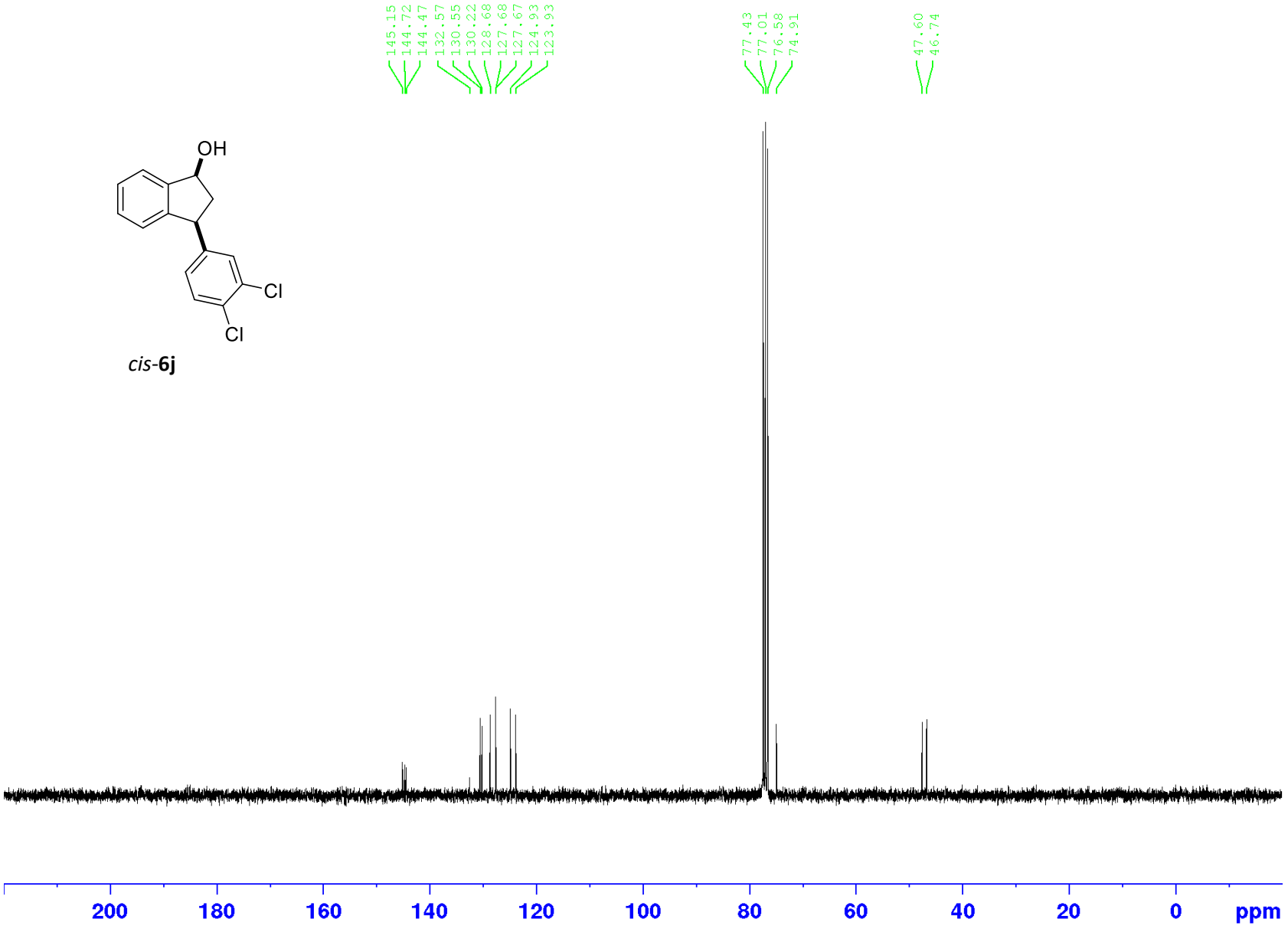

7.59
7.56
7.49
7.47
7.35
7.35
7.34
7.33
7.33
7.31
7.30
7.30
7.27
7.27
7.26
7.25
7.25
7.24
7.22
7.22
7.21
7.14
7.05
7.03
6.96
6.94
6.90
5.33
5.31
5.28
5.26
4.22
4.19
4.16
3.47
3.08
3.05
3.03
3.03
3.01
2.98
2.17
2.00
1.98
1.97
1.96
1.95
1.93
1.93
1.92
1.90
1.74
1.56
1.26
1.21
0.88
0.85
0.83
0.01
-0.00
-0.01
OH
cis-6i
10
9
8
7
6
5
4
3
2
1
ppm
1.03
7.24
1.04
1.00
1.00
1.02
1.99
1.03
0.38


145.63
145.26
144.26
128.60
128.37
128.27
127.21
126.61
125.09
123.68
77.45
77.03
76.60
75.13
48.33
47.17
OH
200
180
160
140
120
100
80
60
40
20
0
ppm

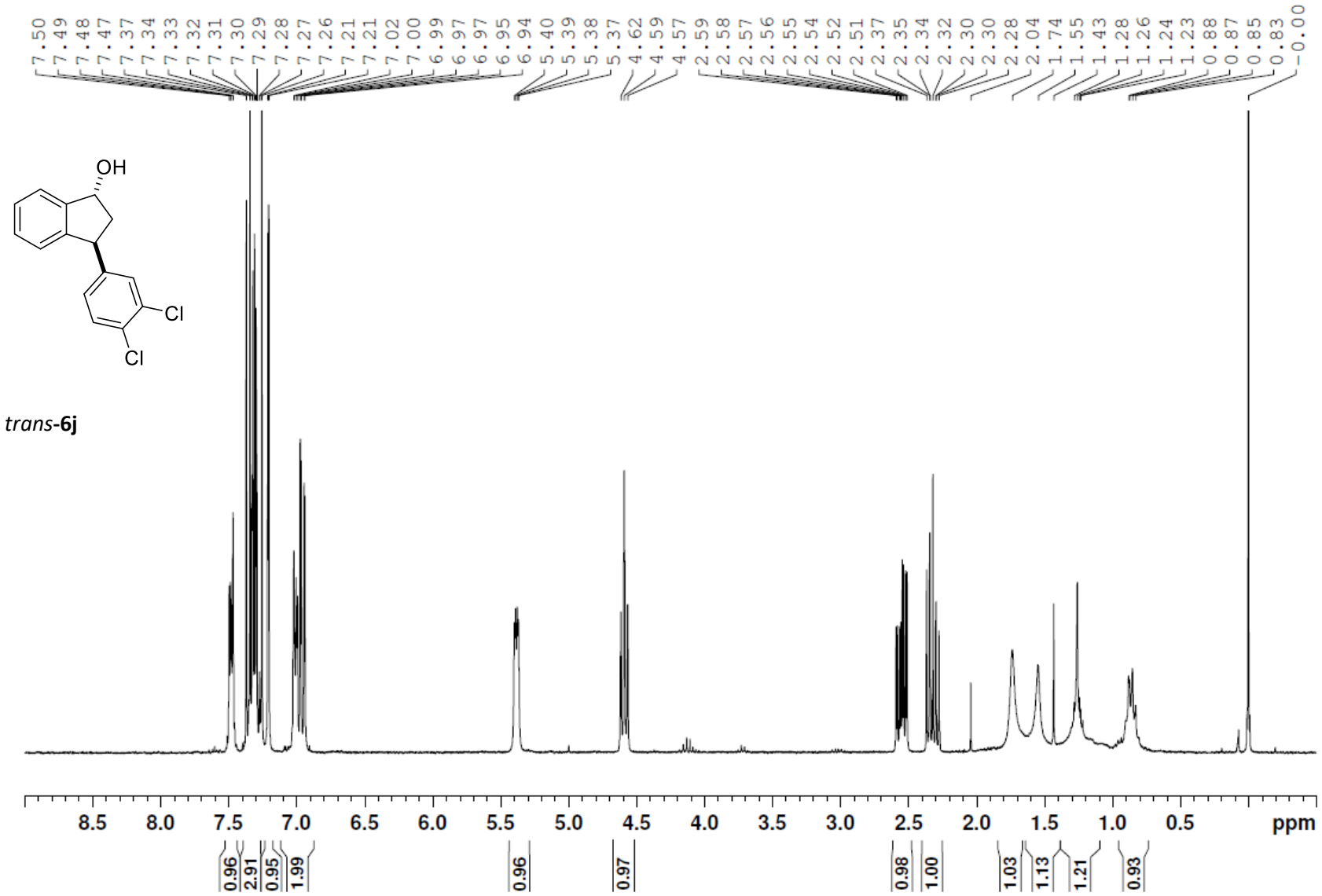
cis-**6i**


7.60
7.50
7.47
7.40
7.38
7.37
7.35
7.34
7.33
7.33
7.33
7.30
7.29
7.29
7.26
7.24
7.14
7.11
7.09
7.08
7.06
7.06
7.02
7.00
6.95
6.93
5.33
5.31
5.29
5.26
4.82
4.18
4.16
4.13
3.13
3.06
3.04
3.02
3.01
3.00
2.97
2.04
1.98
1.96
1.94
1.92
1.91
1.90
1.89
1.88
1.87
1.85
1.55
1.43
1.26
0.88
0.86
0.83
0.19
0.01
-0.00
-0.01
-0.20
OH
Cl
Cl
10
9
8
7
6
5
4
3
2
1
ppm
0.99
4.53
1.05
0.99
1.00
1.00
1.03
2.05
2.14
0.75

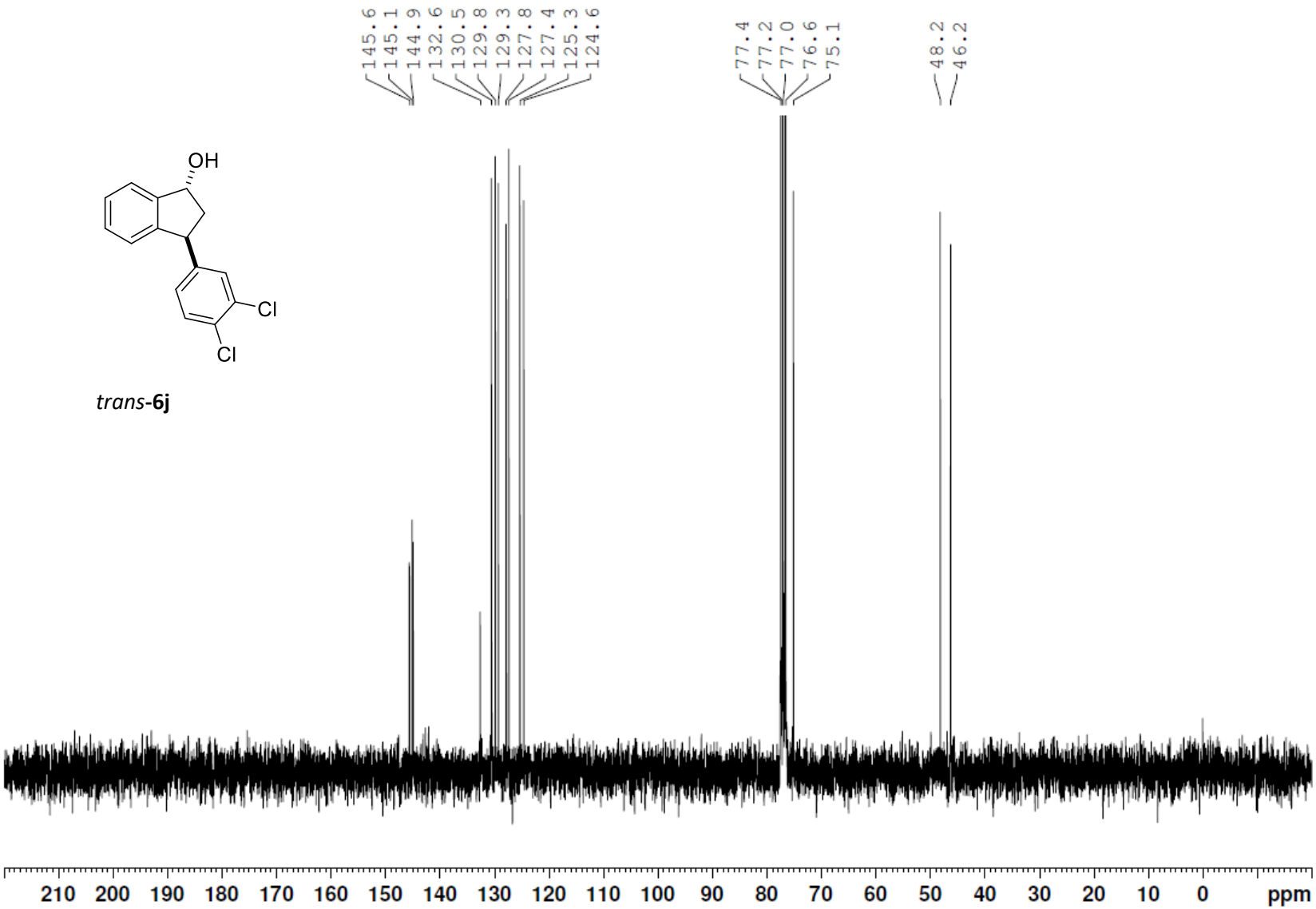
cis-**6j**


145.15
144.72
144.47
132.57
130.55
130.22
128.68
127.68
127.67
124.93
123.93
77.43
77.01
76.58
74.91
47.60
46.74
OH
Cl
Cl
200
180
160
140
120
100
80
60
40
20
0
ppm

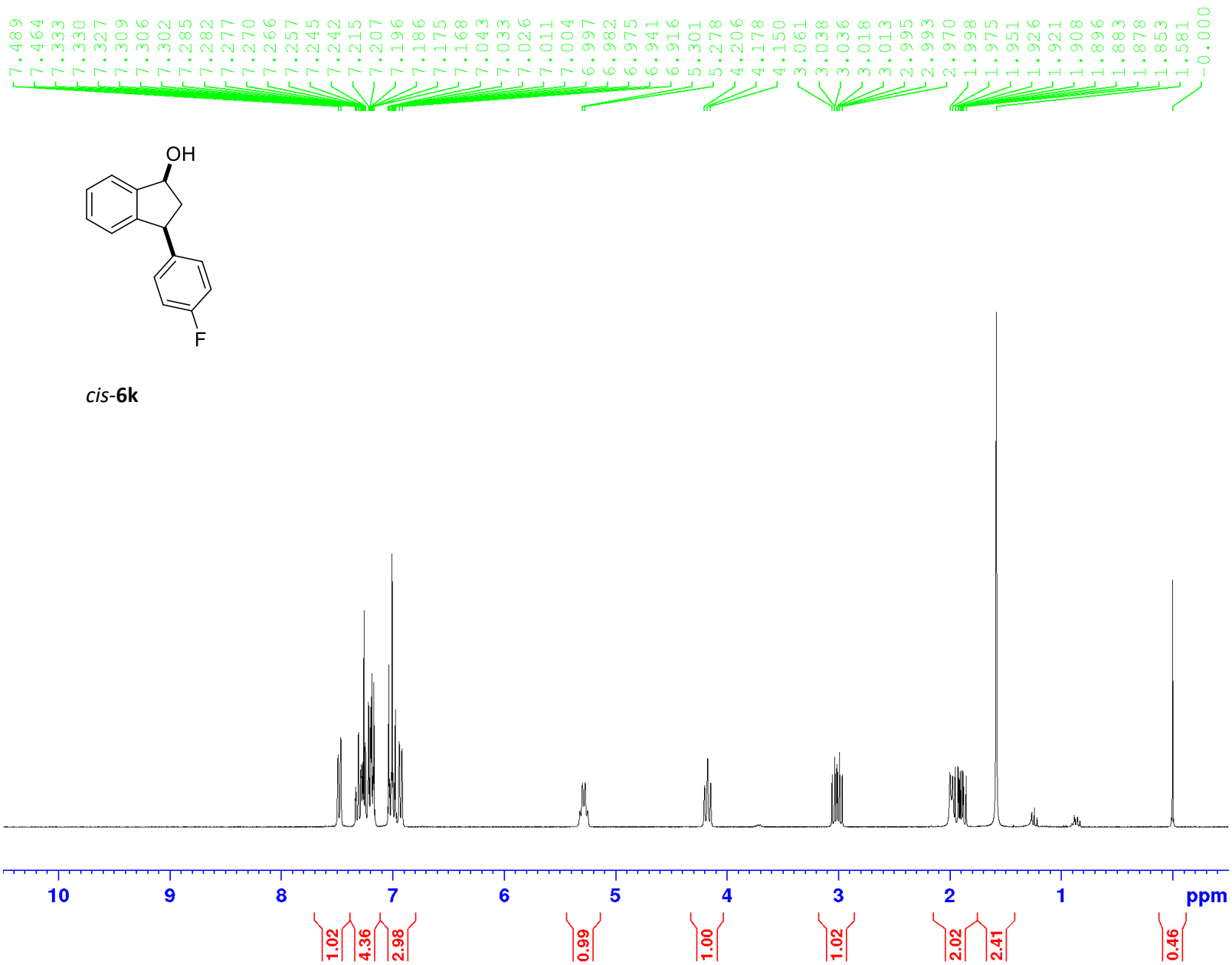
cis-**6j**


7.50
7.49
7.48
7.47
7.37
7.34
7.33
7.32
7.31
7.30
7.29
7.28
7.27
7.26
7.21
7.21
7.02
7.00
6.99
6.97
6.97
6.95
6.94
5.40
5.39
5.38
5.37
4.62
4.59
4.57
2.59
2.58
2.57
2.56
2.55
2.54
2.52
2.51
2.37
2.35
2.34
2.32
2.30
2.30
2.28
2.04
1.74
1.55
1.43
1.28
1.26
1.24
1.23
0.88
0.87
0.85
0.83
0.00
OH
Cl
Cl
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
ppm
0.96
2.91
0.95
1.99
0.96
0.97
0.98
1.00
1.03
1.13
1.21
0.93

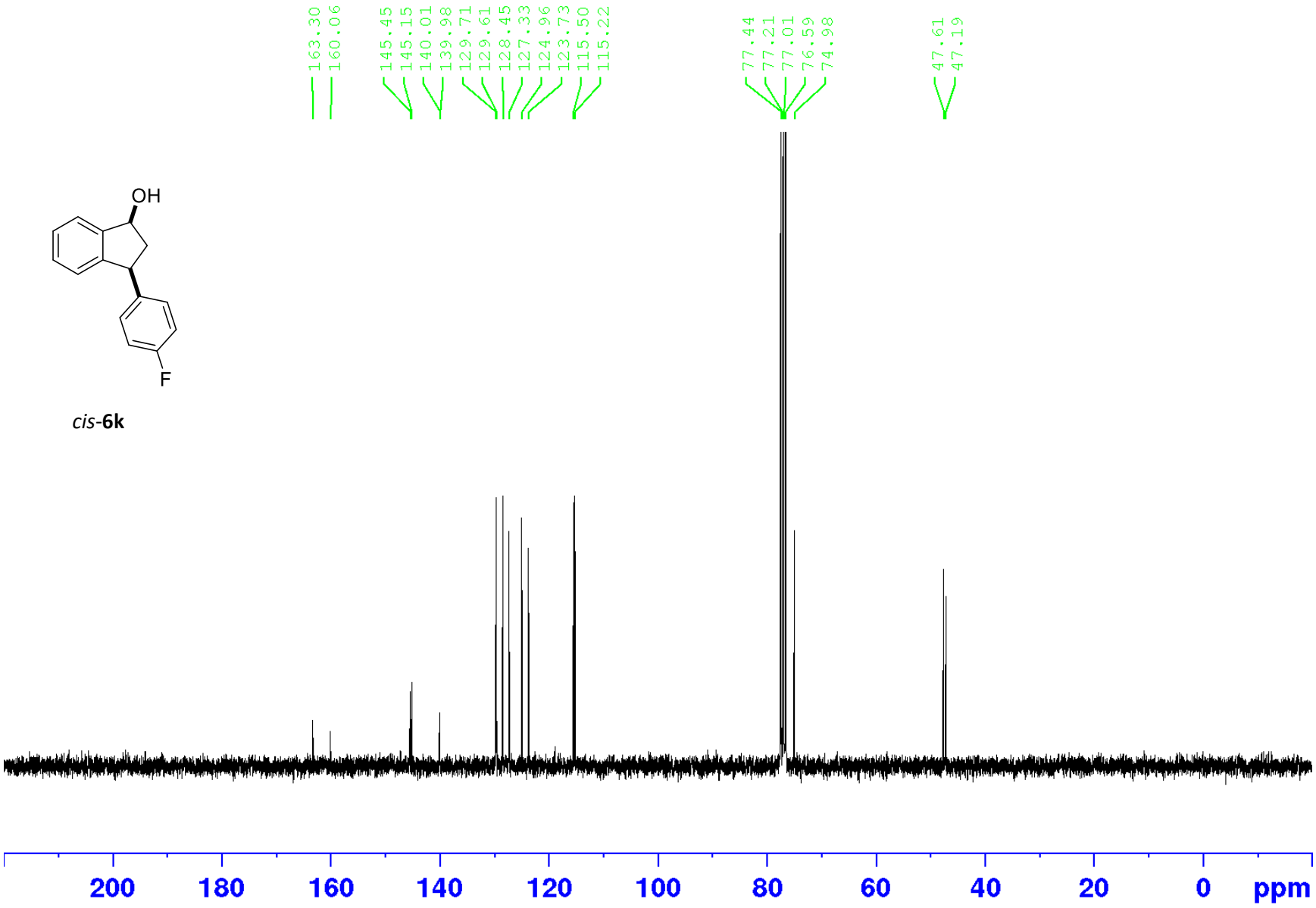
trans-**6j**


145.6
145.1
144.9
132.6
130.5
129.8
129.3
127.8
127.4
125.3
124.6
77.4
77.2
77.0
76.6
75.1
48.2
46.2
OH
Cl
Cl
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 ppm

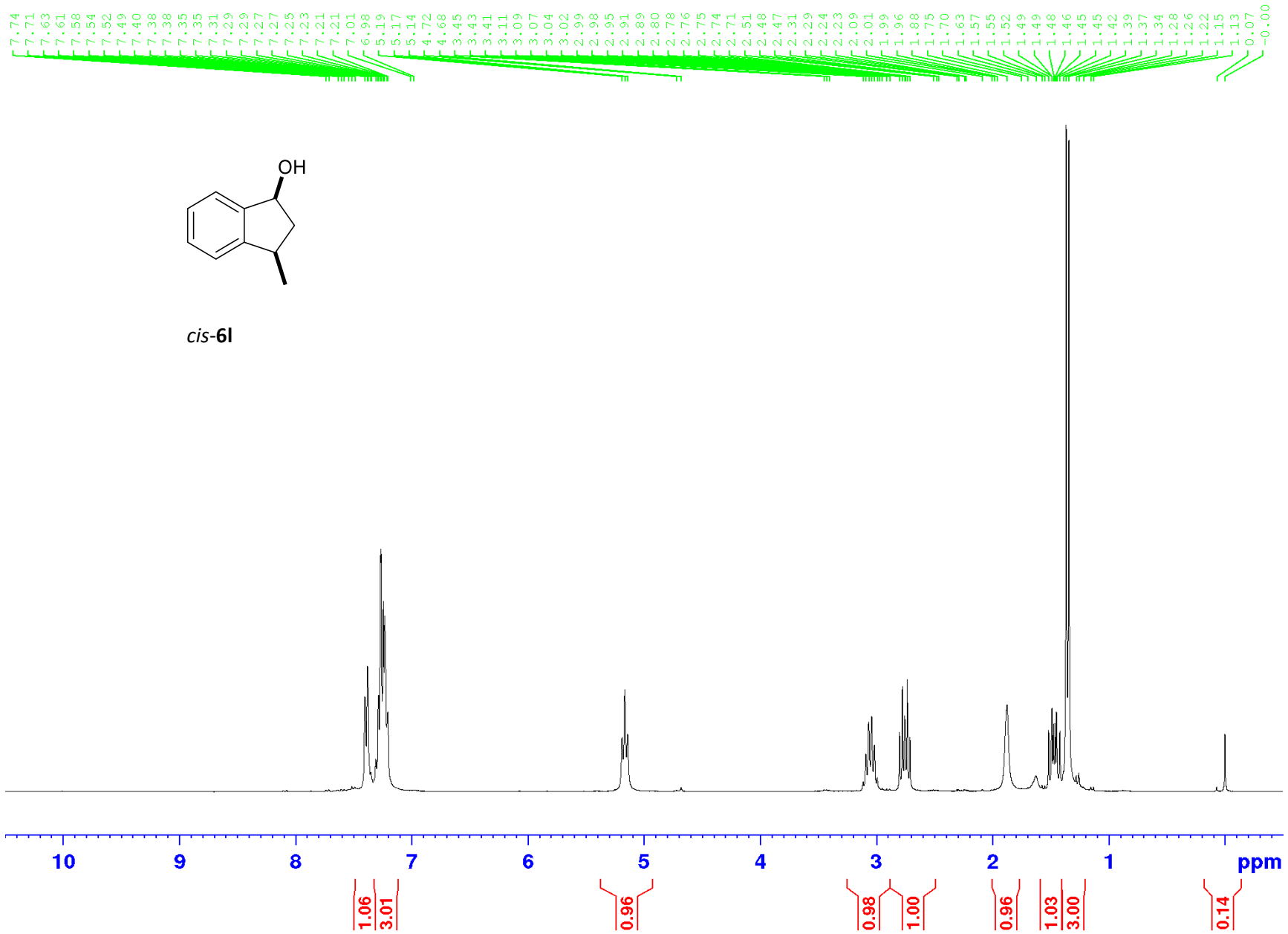
trans-**6j**


7.489
7.464
7.333
7.330
7.327
7.309
7.306
7.302
7.285
7.282
7.277
7.270
7.266
7.257
7.245
7.242
7.215
7.207
7.196
7.186
7.175
7.168
7.043
7.033
7.026
7.011
7.004
6.997
6.982
6.975
6.941
6.916
5.301
5.278
4.206
4.178
4.150
3.061
3.038
3.036
3.018
3.013
2.995
2.993
2.970
1.998
1.975
1.951
1.926
1.921
1.908
1.896
1.883
1.878
1.853
1.581
0.000
OH
F
10
9
8
7
6
5
4
3
2
1
ppm
1.02
4.36
2.98
0.99
1.00
1.02
2.02
2.41
0.46

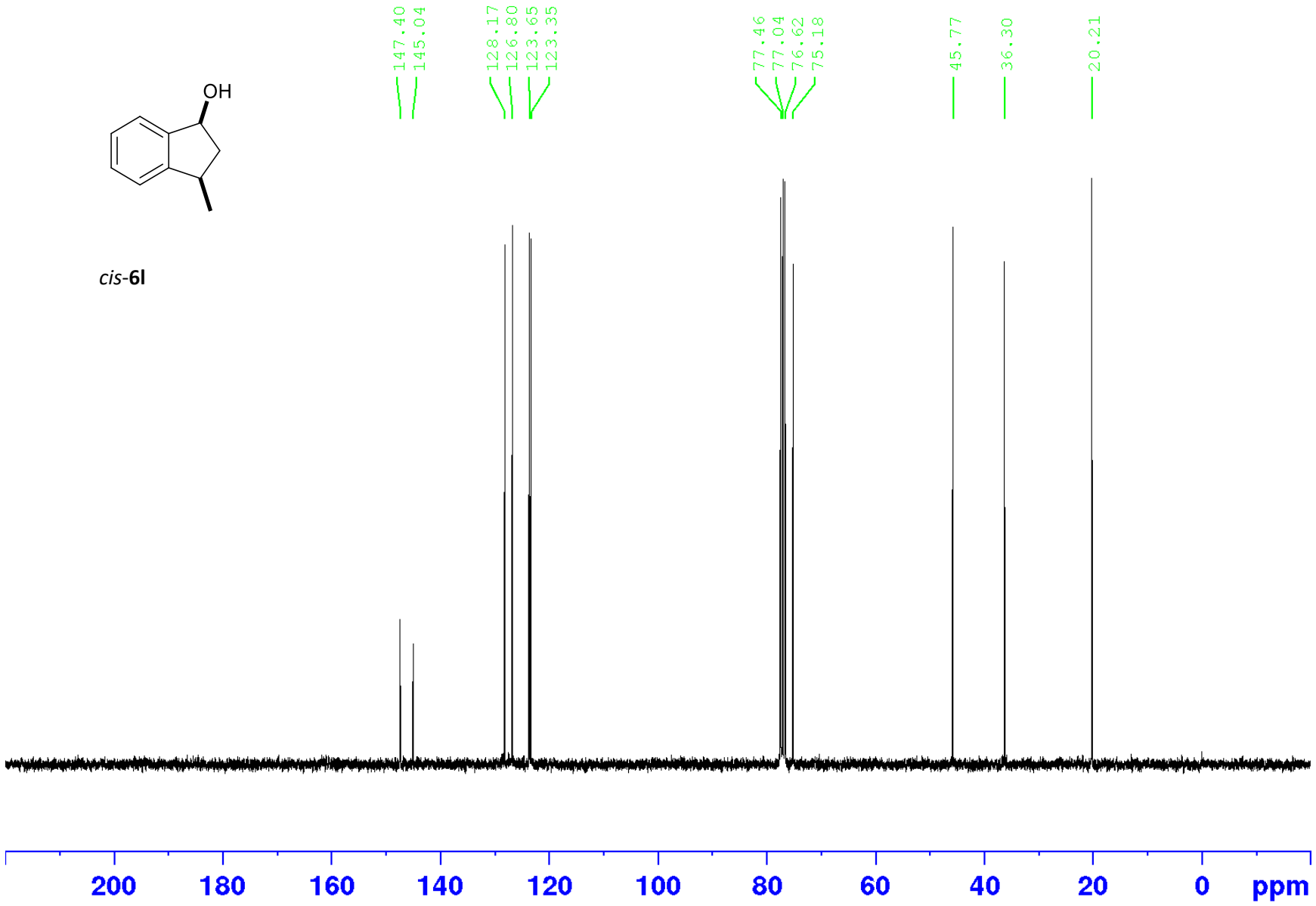
cis-**6k**


163.30
160.06
145.45
145.15
140.01
139.98
129.71
129.61
128.45
127.33
124.96
123.73
115.50
115.22
77.44
77.21
77.01
76.59
74.98
47.61
47.19
OH
F
200
180
160
140
120
100
80
60
40
20
0
ppm

cis-**6k**

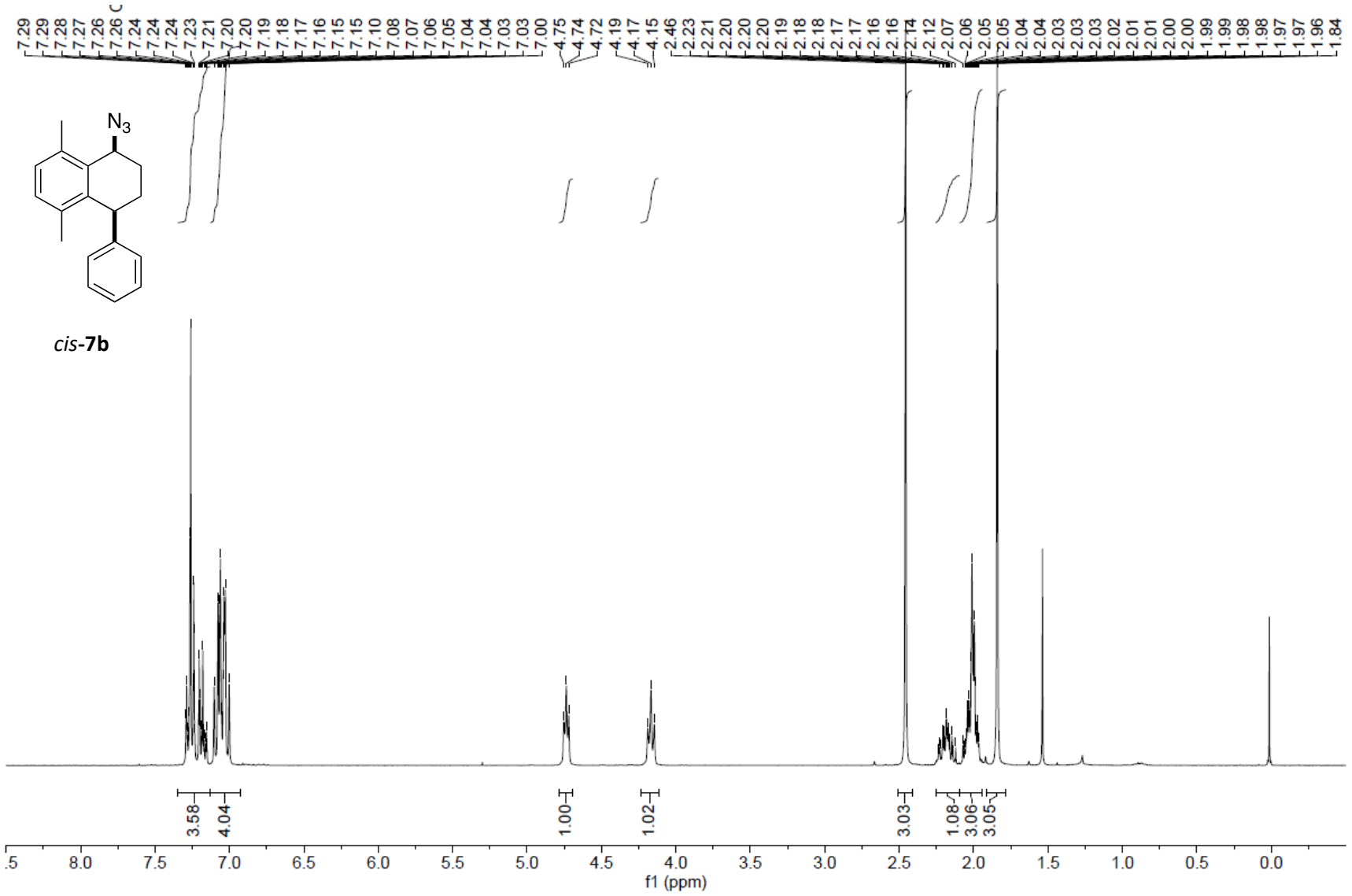

7.74
7.71
7.63
7.61
7.58
7.54
7.52
7.49
7.40
7.38
7.38
7.35
7.35
7.31
7.29
7.29
7.27
7.27
7.25
7.23
7.21
7.21
7.01
6.98
5.19
5.17
5.14
4.72
4.68
3.45
3.43
3.41
3.11
3.09
3.07
3.04
3.02
2.99
2.98
2.95
2.91
2.89
2.80
2.78
2.76
2.75
2.74
2.71
2.51
2.48
2.47
2.31
2.29
2.24
2.23
2.09
2.01
1.99
1.96
1.88
1.75
1.70
1.63
1.57
1.55
1.52
1.49
1.49
1.48
1.46
1.45
1.45
1.42
1.39
1.37
1.34
1.28
1.26
1.22
1.15
1.13
0.07
-0.00
OH
10
9
8
7
6
5
4
3
2
1
ppm
1.06
3.01
0.96
0.98
1.00
0.96
1.03
3.00
0.14

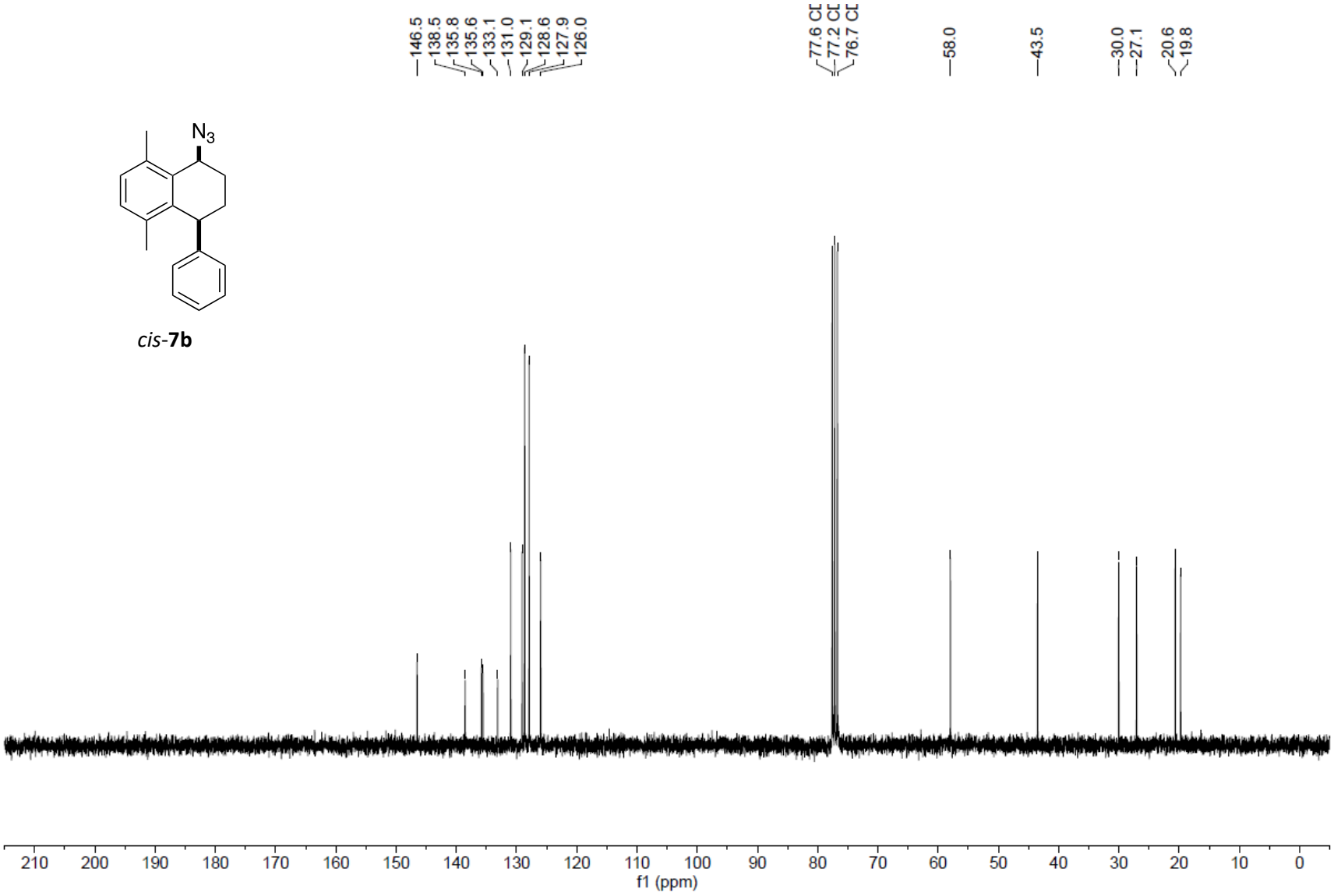
cis-**6l**


147.40
145.04
128.17
126.80
123.65
123.35
77.46
77.04
76.62
75.18
45.77
36.30
20.21
OH
200
180
160
140
120
100
80
60
40
20
0
ppm

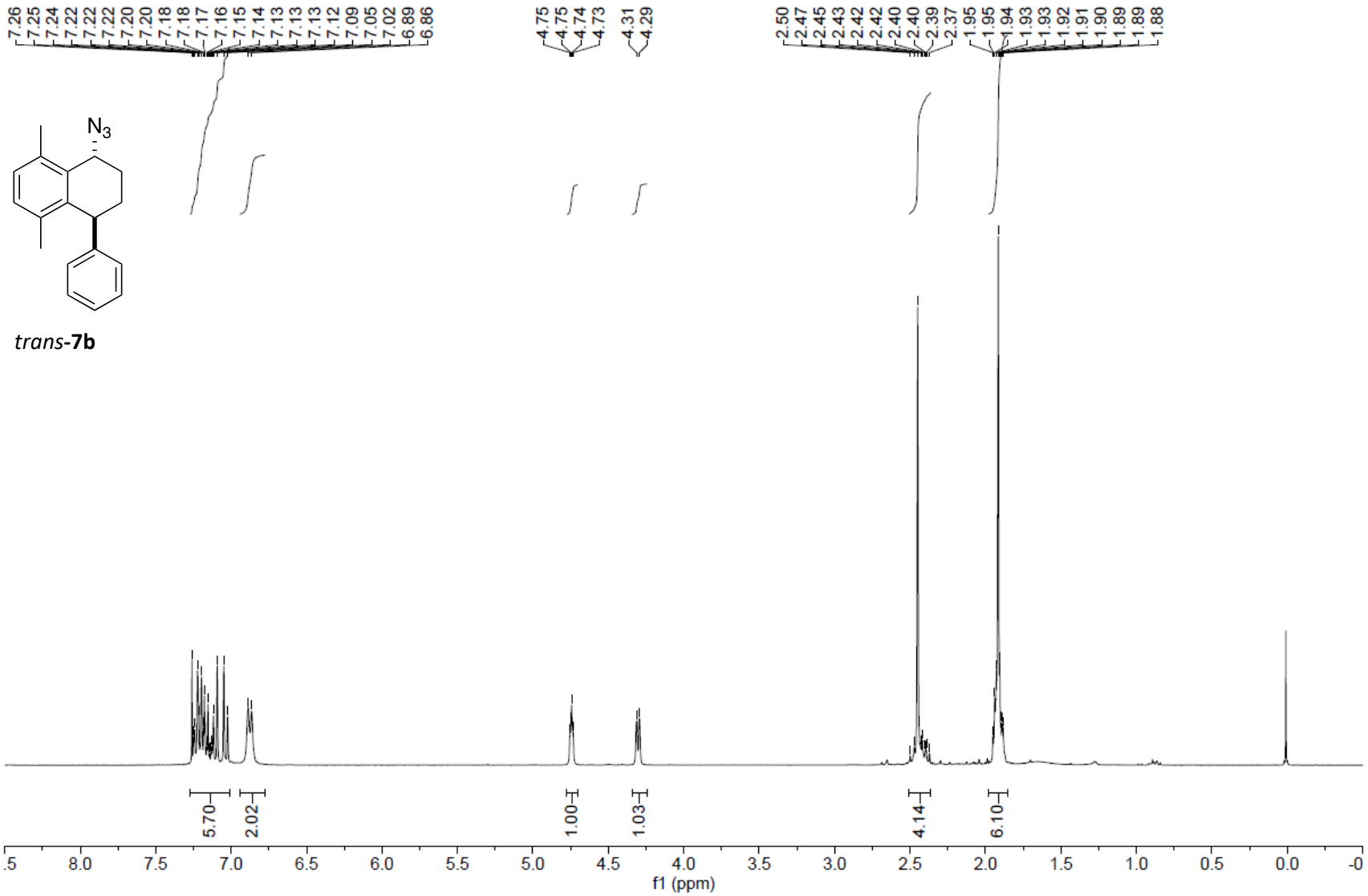
cis-**6l**

1.6.3 ^{1}H NMR and ^{13}C NMR spectra of azide compounds

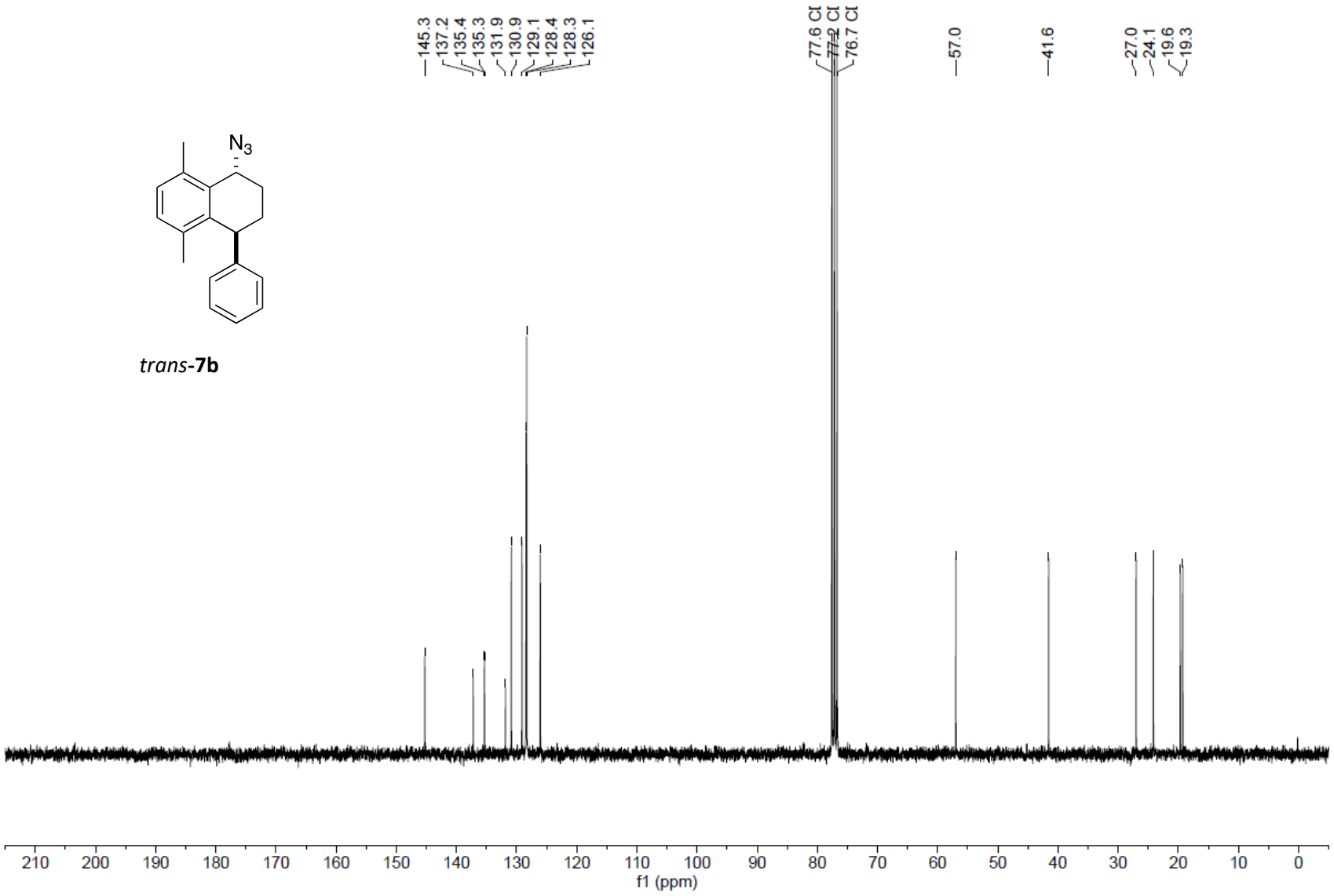

N3
cis-7b
f1 (ppm)


146.5
138.5
135.8
135.6
133.1
131.0
129.1
128.6
127.9
126.0
77.6 CD
77.2 CD
76.7 CD
58.0
43.5
30.0
27.1
20.6
19.8
N3
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

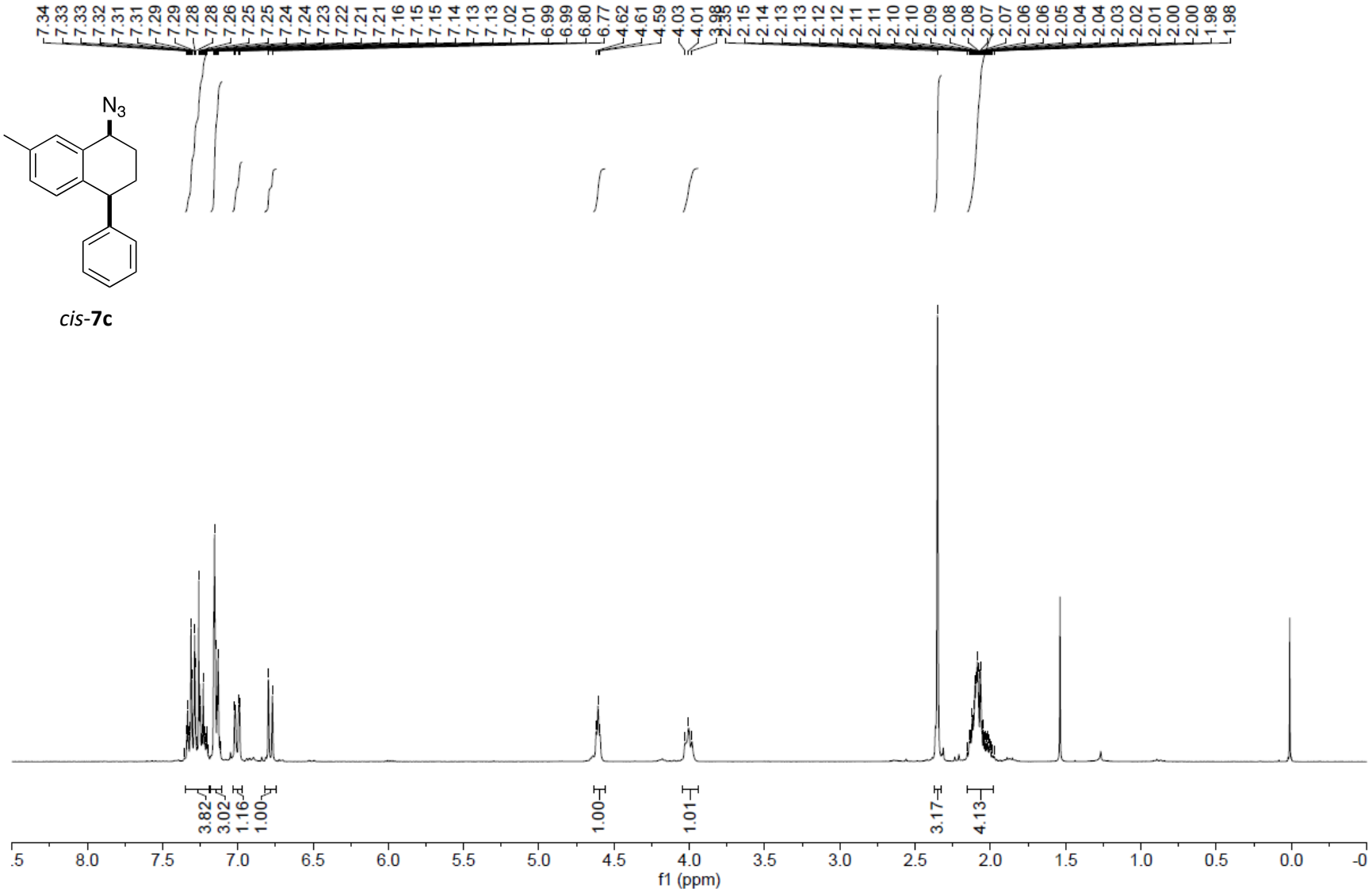
cis-**7b**


7.26
7.25
7.24
7.22
7.22
7.22
7.20
7.20
7.18
7.18
7.17
7.16
7.15
7.14
7.13
7.13
7.13
7.12
7.09
7.05
7.02
6.89
6.86
4.75
4.75
4.74
4.73
4.31
4.29
2.50
2.47
2.45
2.43
2.42
2.42
2.40
2.40
2.39
2.37
1.95
1.95
1.94
1.93
1.93
1.92
1.91
1.90
1.89
1.89
1.88
N3
5.70
2.02
1.00
1.03
4.14
6.10
f1 (ppm)

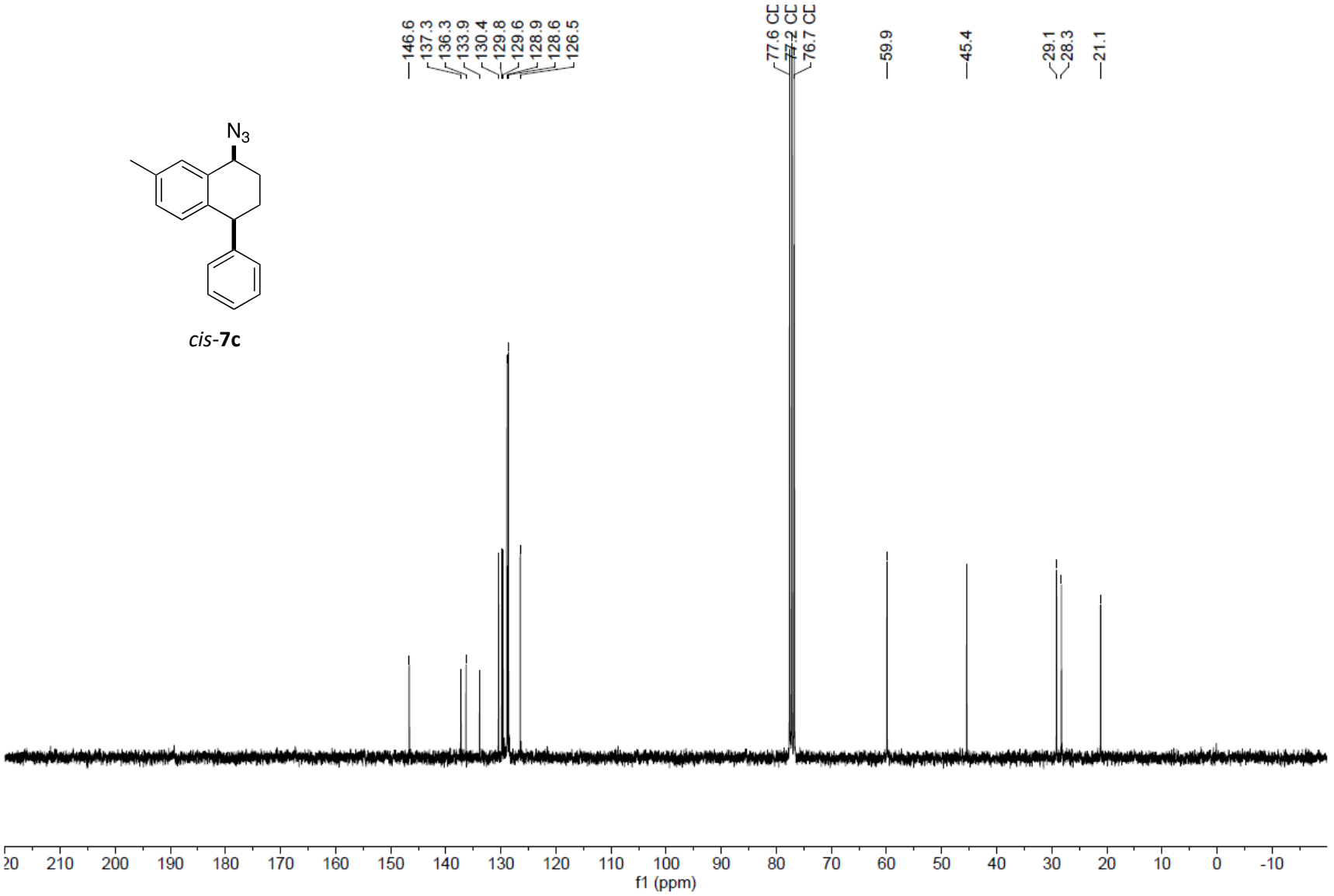
trans-**7b**


145.3
137.2
135.4
135.3
131.9
130.9
129.1
128.4
128.3
126.1
77.6 Cl
77.2 Cl
76.7 Cl
57.0
41.6
27.0
24.1
19.6
19.3
N3
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)

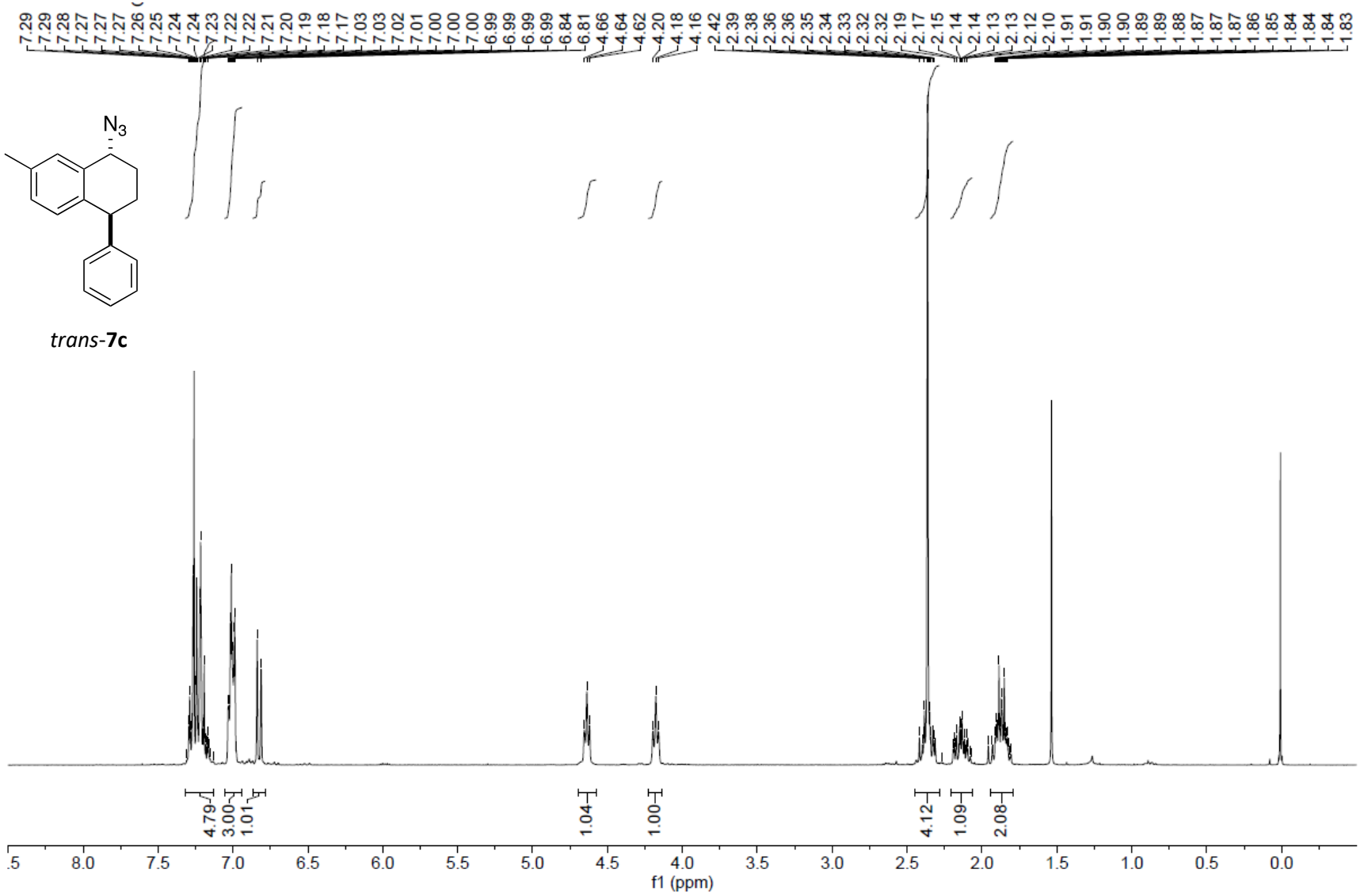
trans-**7b**


7.34 7.33 7.33 7.32 7.31 7.31 7.29 7.29 7.28 7.28 7.26 7.25 7.25 7.24 7.24 7.23 7.22 7.21 7.21 7.16 7.15 7.15 7.14 7.13 7.13 7.02 7.01 6.99 6.99 6.80 6.77 4.62 4.61 4.59 4.03 4.01 3.98 3.95 2.15 2.14 2.13 2.13 2.12 2.12 2.11 2.11 2.10 2.10 2.09 2.08 2.08 2.07 2.07 2.06 2.06 2.05 2.04 2.04 2.03 2.02 2.01 2.00 2.00 1.98 1.98
N3
3.82
3.02
1.16
1.00
1.00
1.01
3.17
4.13
8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)

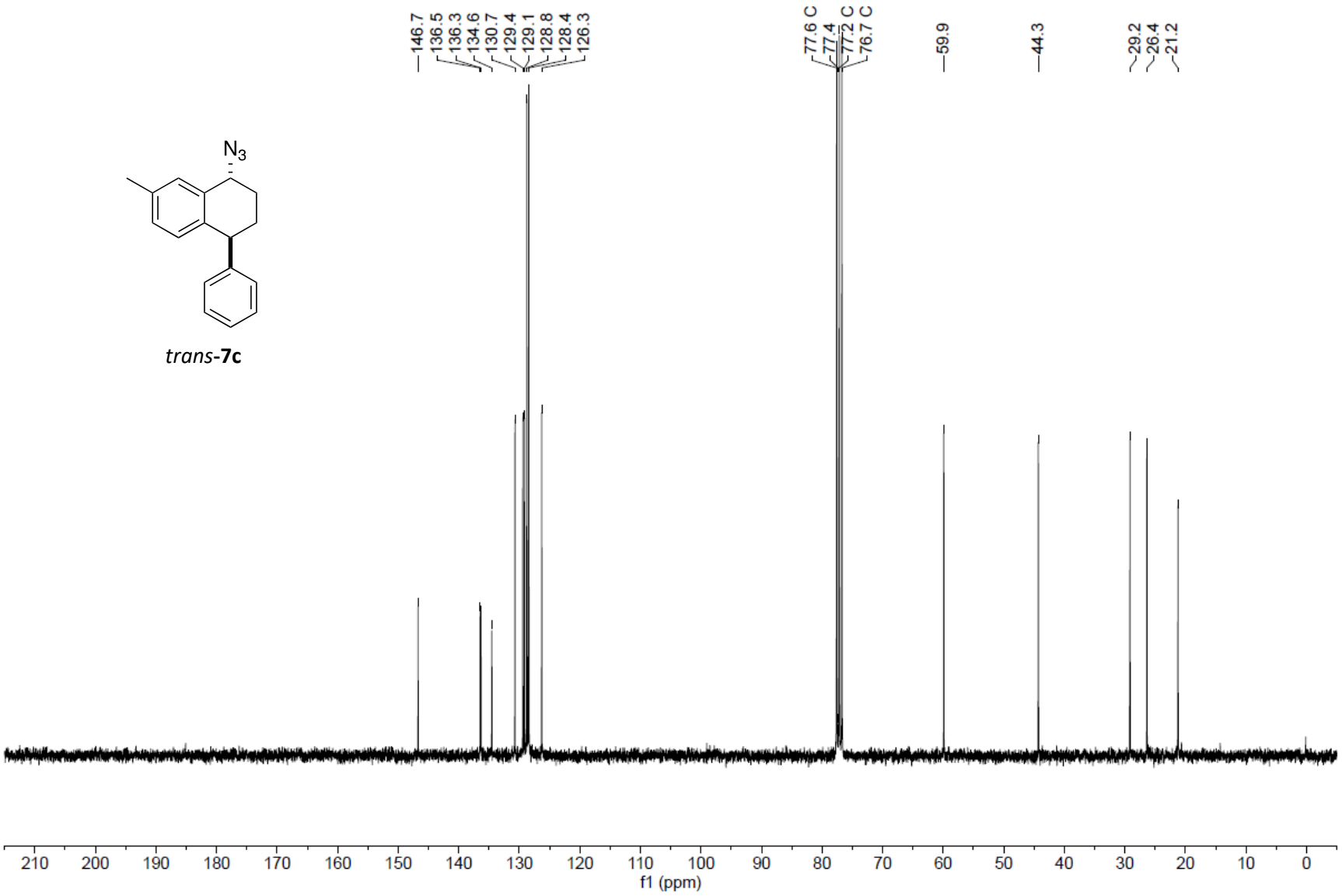
cis-**7c**


N3
146.6
137.3
136.3
133.9
130.4
129.8
129.6
128.9
128.6
126.5
77.6 CD
77.2 CD
76.7 CD
59.9
45.4
29.1
28.3
21.1
f1 (ppm)

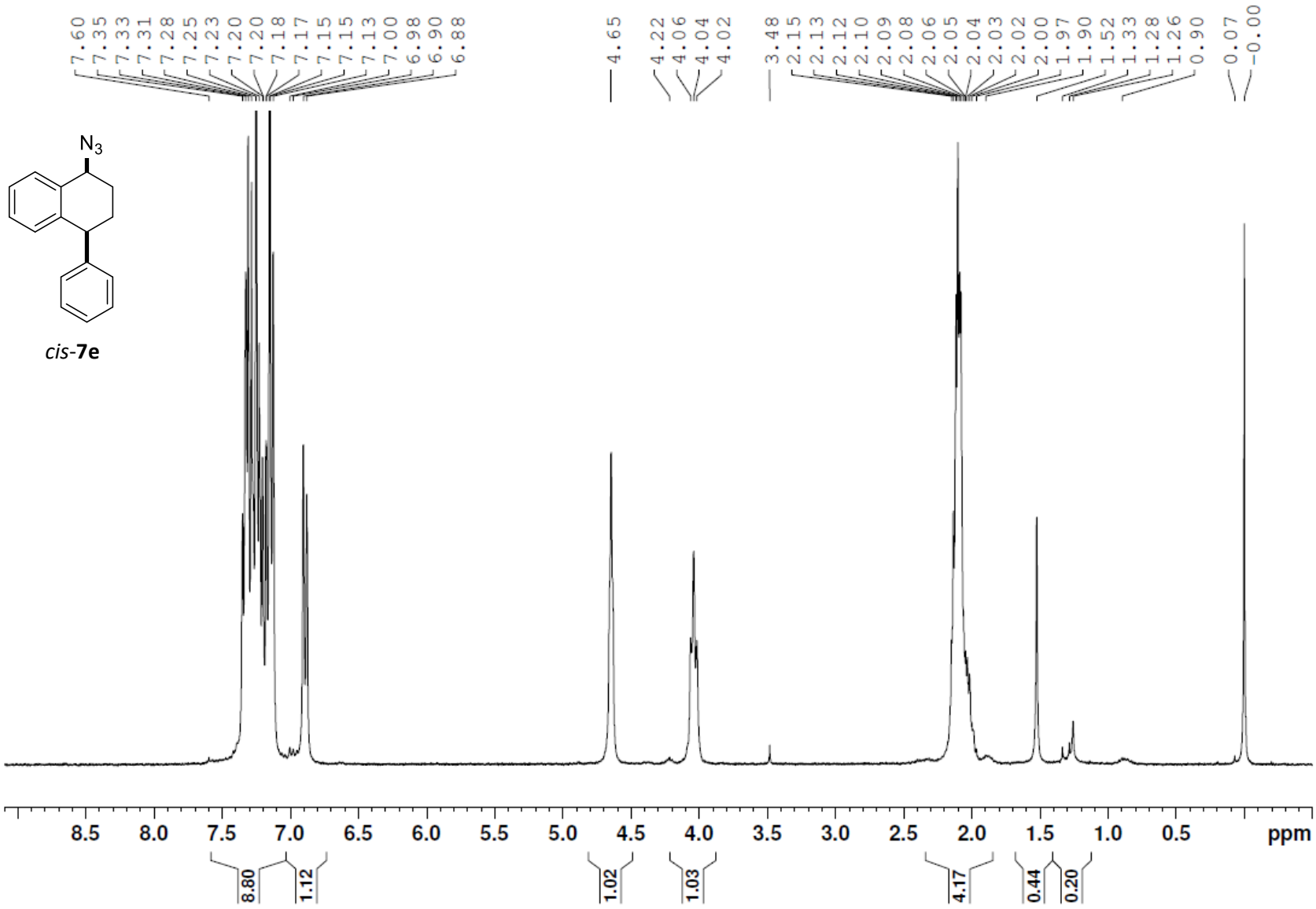
cis-**7c**


N3
7.29 7.29 7.28 7.27 7.27 7.27 7.26 7.25 7.24 7.24 7.23 7.22 7.22 7.21 7.20 7.19 7.18 7.17 7.03 7.03 7.02 7.01 7.00 7.00 7.00 6.99 6.99 6.99 6.99 6.84 6.81 4.66 4.64 4.62 4.20 4.18 4.16 2.42 2.39 2.38 2.36 2.36 2.35 2.34 2.33 2.32 2.32 2.19 2.17 2.15 2.14 2.14 2.13 2.13 2.12 2.10 1.91 1.91 1.90 1.90 1.89 1.89 1.88 1.87 1.87 1.87 1.86 1.85 1.84 1.84 1.84 1.83
4.79
3.00
1.01
1.04
1.00
4.12
1.09
2.08
8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)

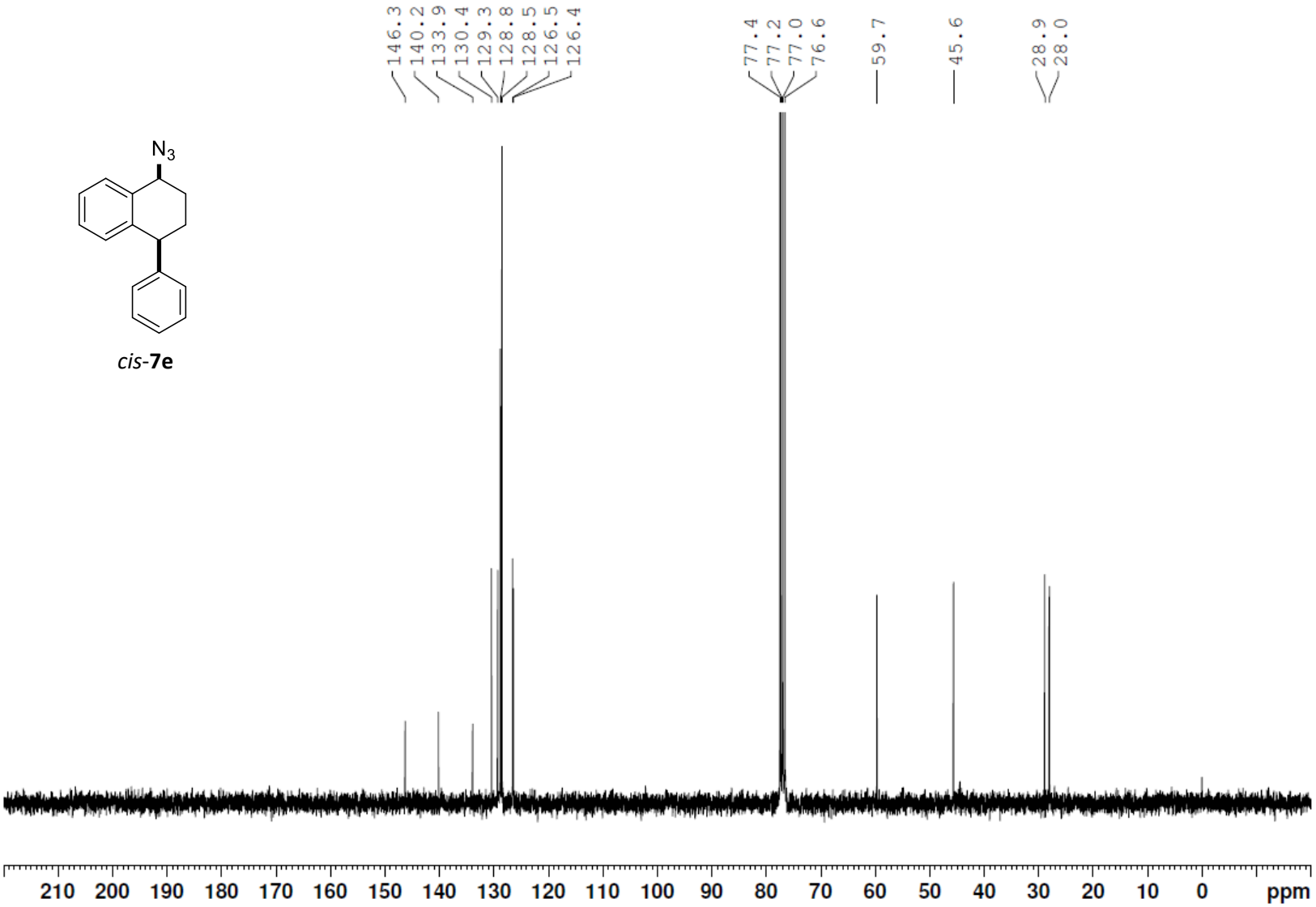
trans-**7c**


N3
146.7
136.5
136.3
134.6
130.7
129.4
129.1
128.8
128.4
126.3
77.6 C
77.4
77.2 C
76.7 C
59.9
44.3
29.2
26.4
21.2
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

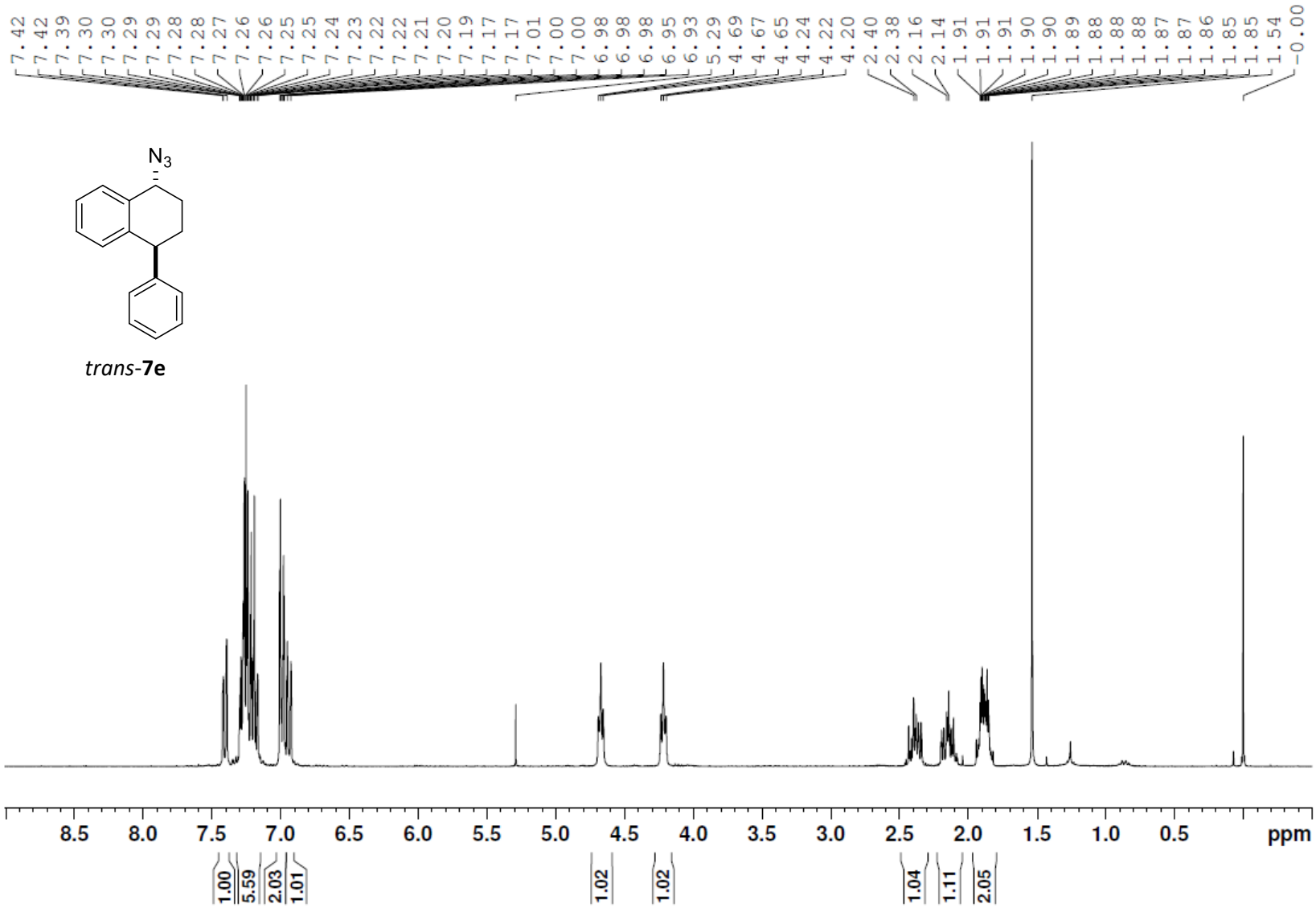
trans-**7c**


7.60
7.35
7.33
7.31
7.28
7.25
7.23
7.20
7.20
7.18
7.17
7.15
7.15
7.13
7.00
6.98
6.90
6.88
4.65
4.22
4.06
4.04
4.02
3.48
2.15
2.13
2.12
2.10
2.09
2.08
2.06
2.05
2.04
2.03
2.02
2.00
1.97
1.90
1.52
1.33
1.28
1.26
0.90
0.07
-0.00
N3
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
ppm
8.80
1.12
1.02
1.03
4.17
0.44
0.20

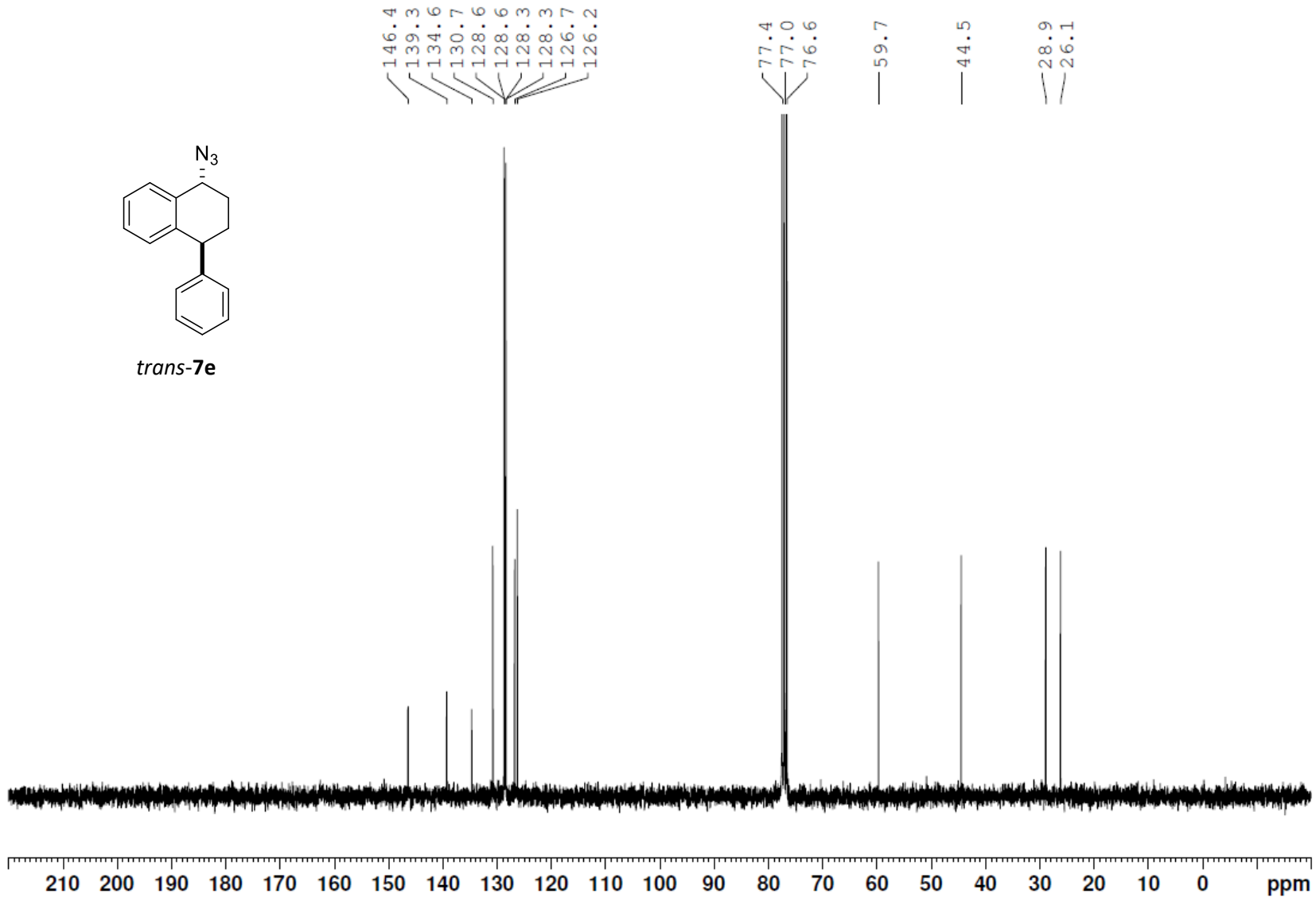
cis-**7e**


146.3
140.2
133.9
130.4
129.3
128.8
128.5
126.5
126.4
77.4
77.2
77.0
76.6
59.7
45.6
28.9
28.0
N3
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 ppm

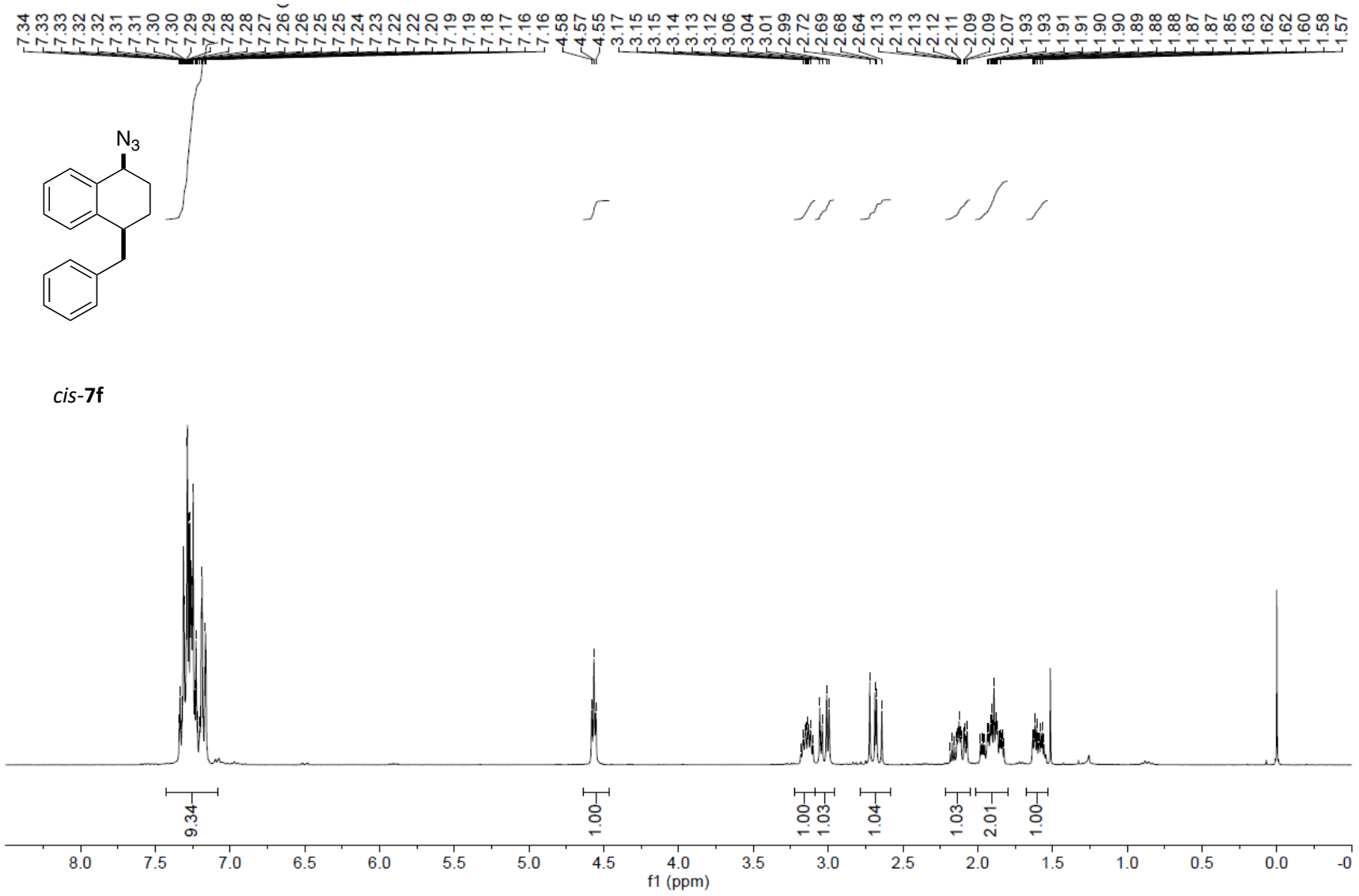
cis-**7e**


7.42
7.42
7.39
7.30
7.30
7.29
7.29
7.28
7.28
7.27
7.26
7.26
7.25
7.25
7.24
7.23
7.22
7.22
7.21
7.20
7.19
7.17
7.17
7.01
7.00
7.00
6.98
6.98
6.98
6.95
6.93
5.29
4.69
4.67
4.65
4.24
4.22
4.20
2.40
2.38
2.16
2.14
1.91
1.91
1.91
1.90
1.90
1.89
1.88
1.88
1.88
1.87
1.87
1.86
1.85
1.85
1.54
0.00
N3
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
ppm
1.00
5.59
2.03
1.01
1.02
1.02
1.04
1.11
2.05

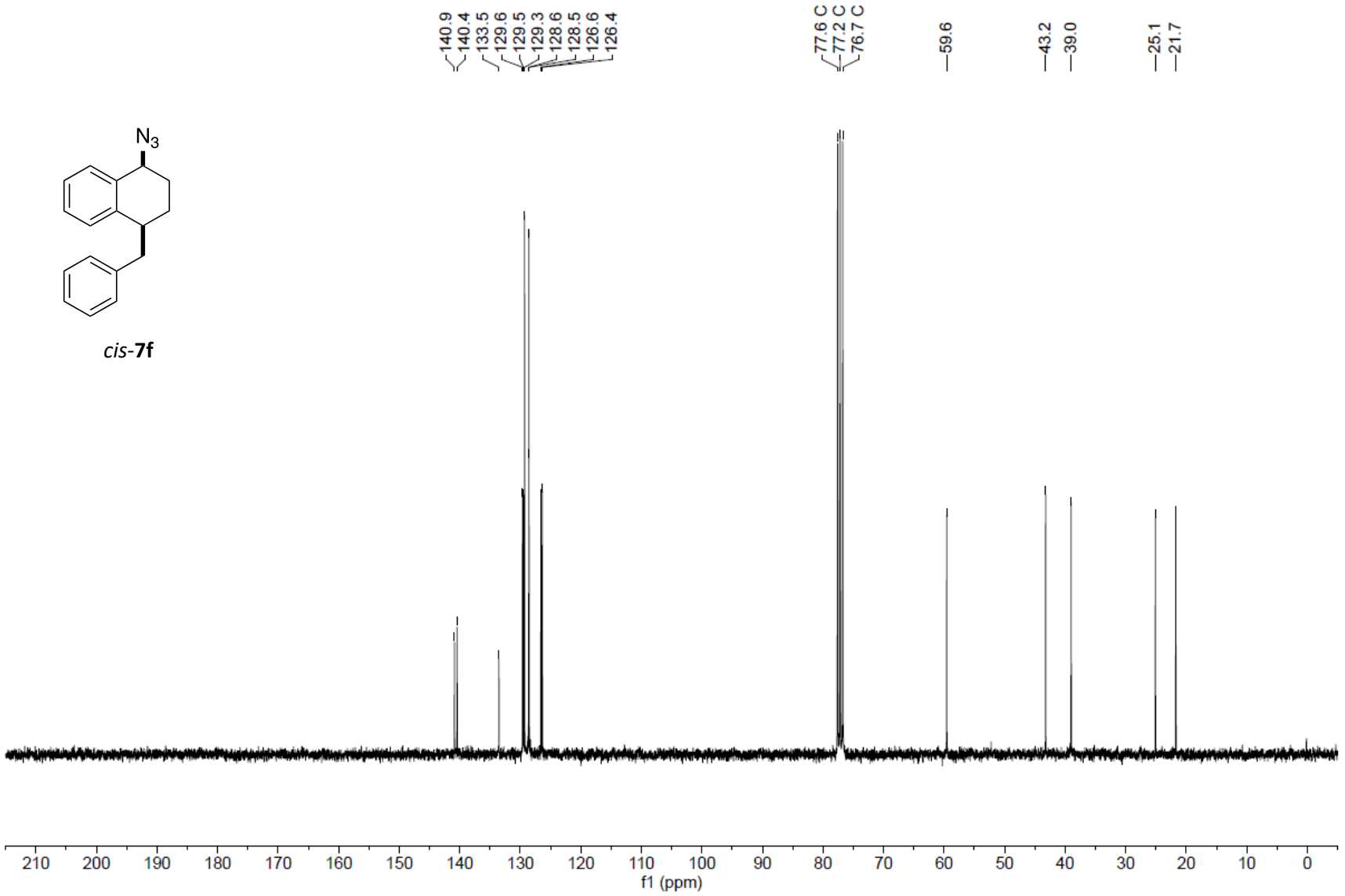
trans-**7e**


146.4
139.3
134.6
130.7
128.6
128.6
128.3
128.3
126.7
126.2
77.4
77.0
76.6
59.7
44.5
28.9
26.1
N3
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 ppm

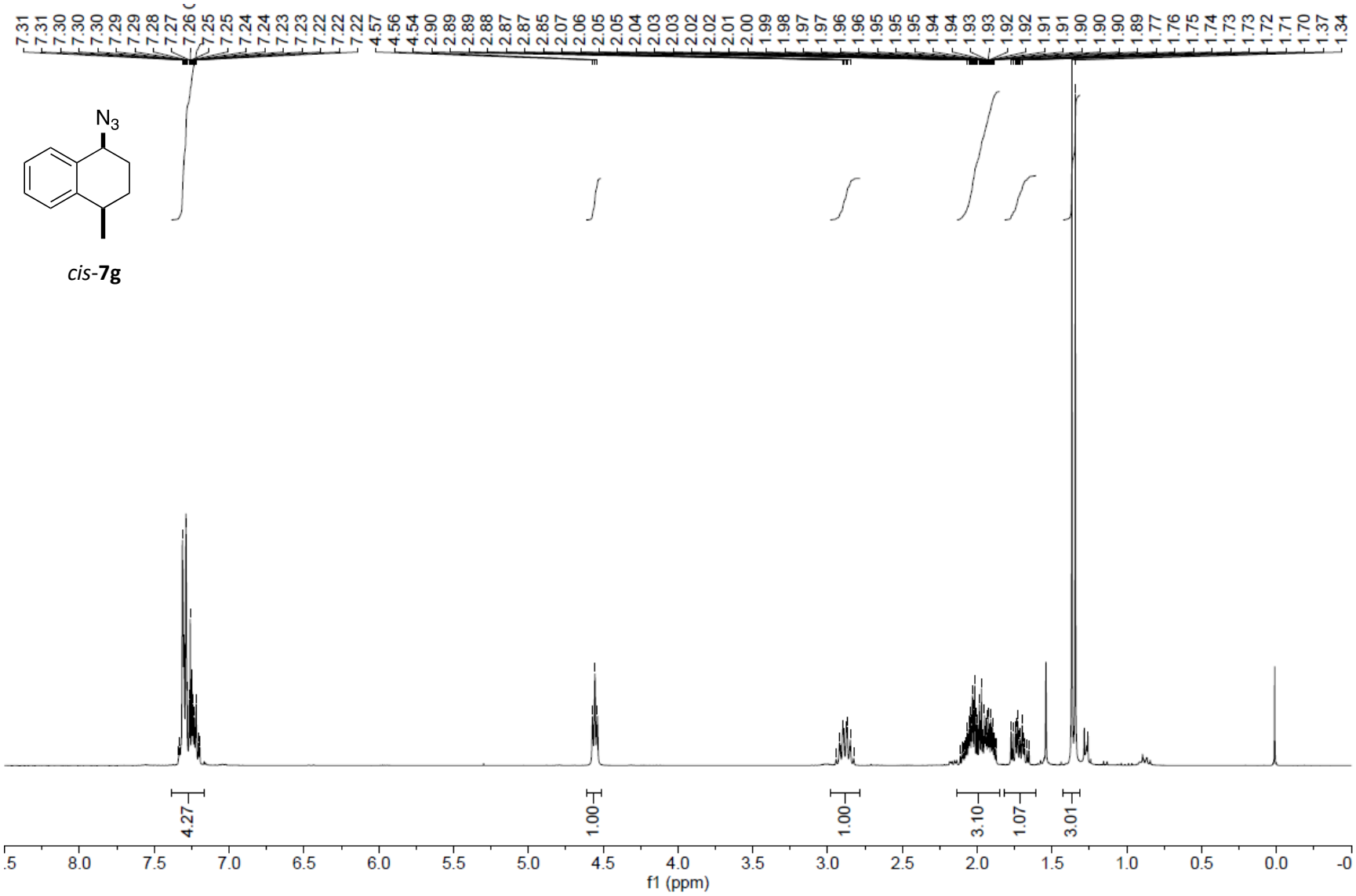
trans-**7e**

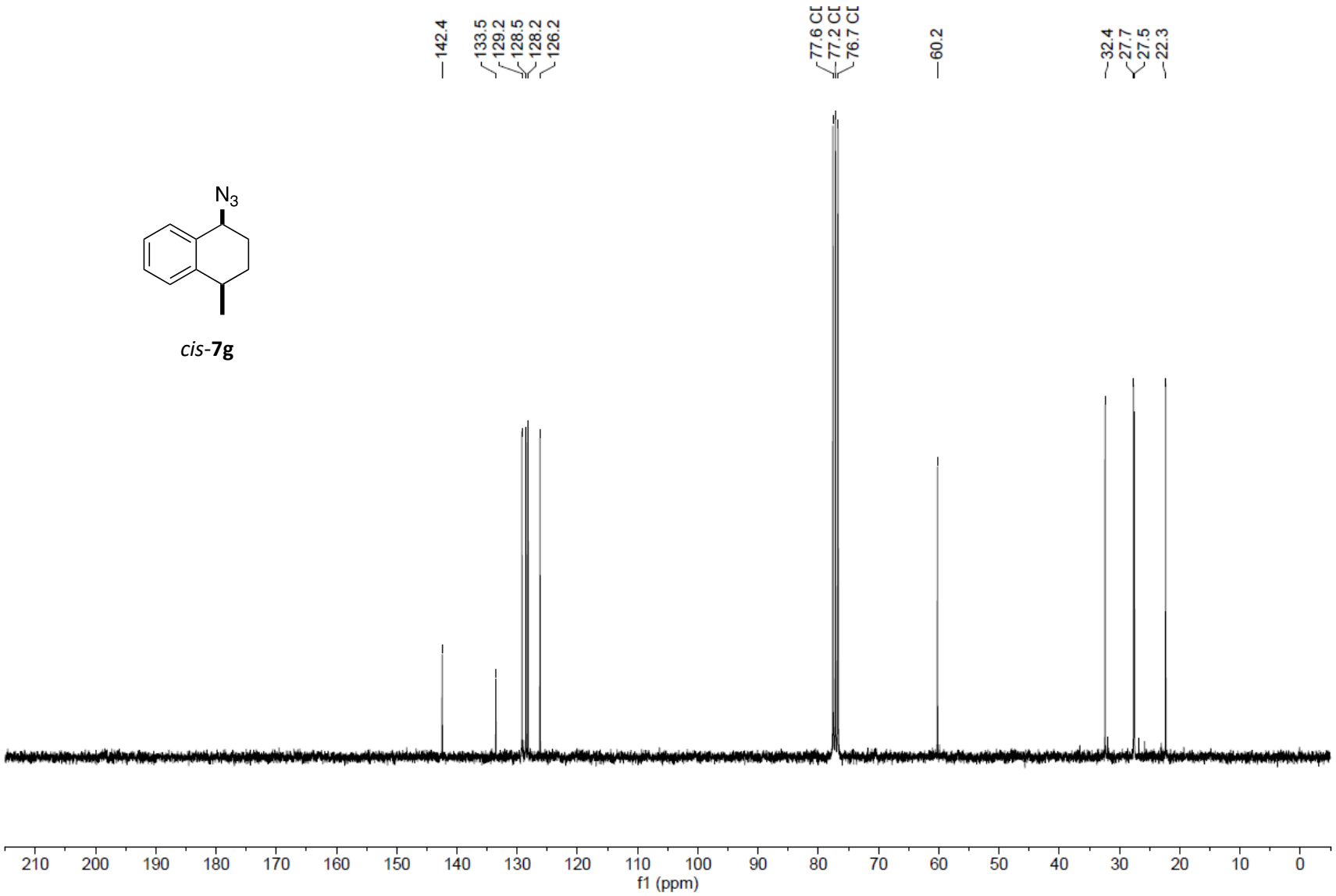

7.34 7.33 7.33 7.32 7.32 7.31 7.31 7.30 7.30 7.29 7.29 7.28 7.28 7.27 7.26 7.26 7.25 7.25 7.24 7.23 7.22 7.22 7.20 7.19 7.19 7.18 7.17 7.16 7.16 4.58 4.57 4.55 3.17 3.15 3.15 3.14 3.13 3.12 3.06 3.04 3.01 2.99 2.72 2.69 2.68 2.64 2.13 2.13 2.12 2.11 2.09 2.09 2.07 1.93 1.91 1.91 1.90 1.90 1.89 1.88 1.88 1.87 1.87 1.85 1.63 1.62 1.62 1.60 1.58 1.57
N3
9.34
1.00
1.00
1.03
1.04
1.03
2.01
1.00
8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0
f1 (ppm)

cis-**7f**

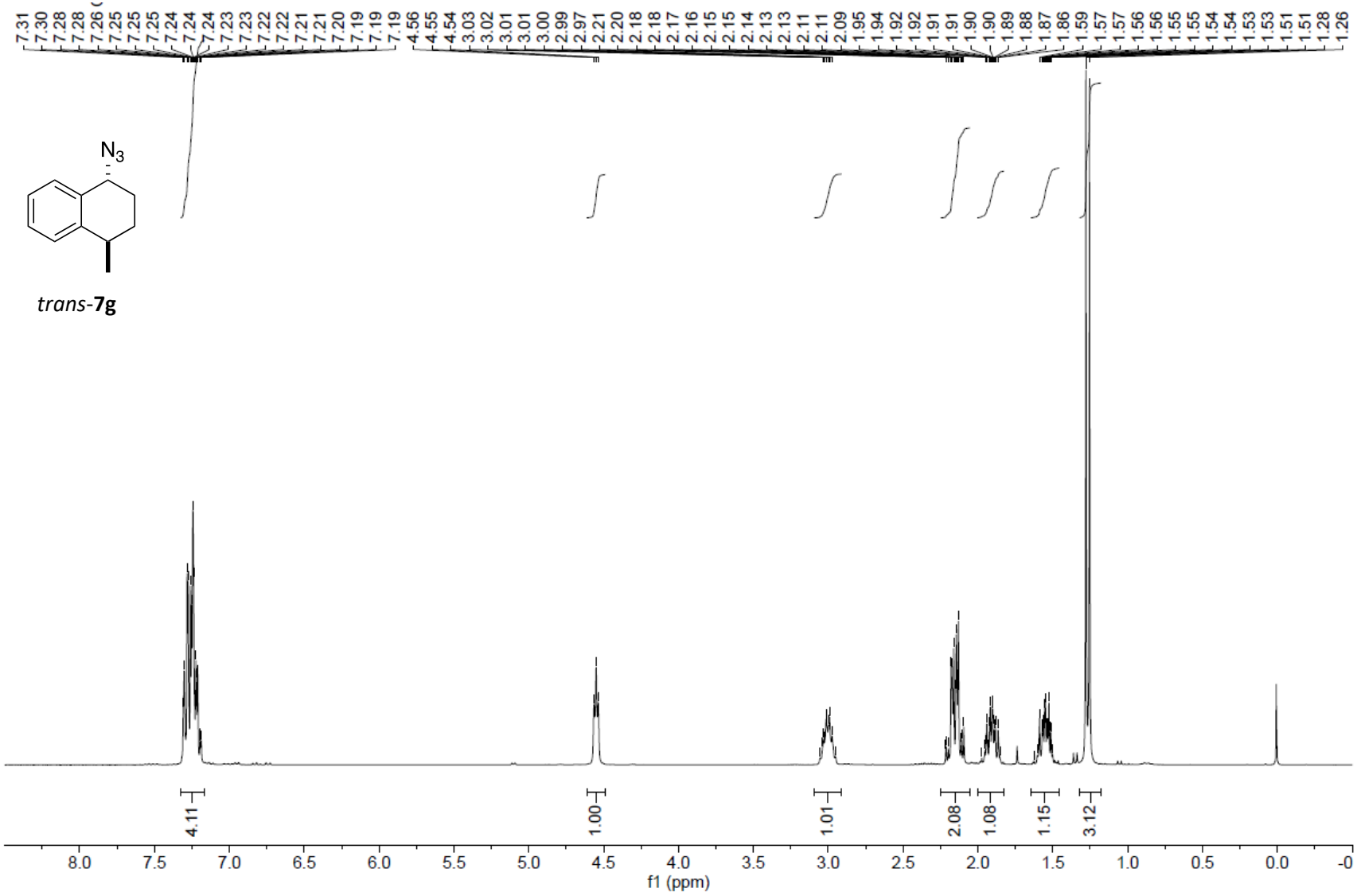

140.9
140.4
133.5
129.6
129.5
129.3
128.6
128.5
126.6
126.4
77.6 C
77.2 C
76.7 C
59.6
43.2
39.0
25.1
21.7
N3
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

cis-**7f**

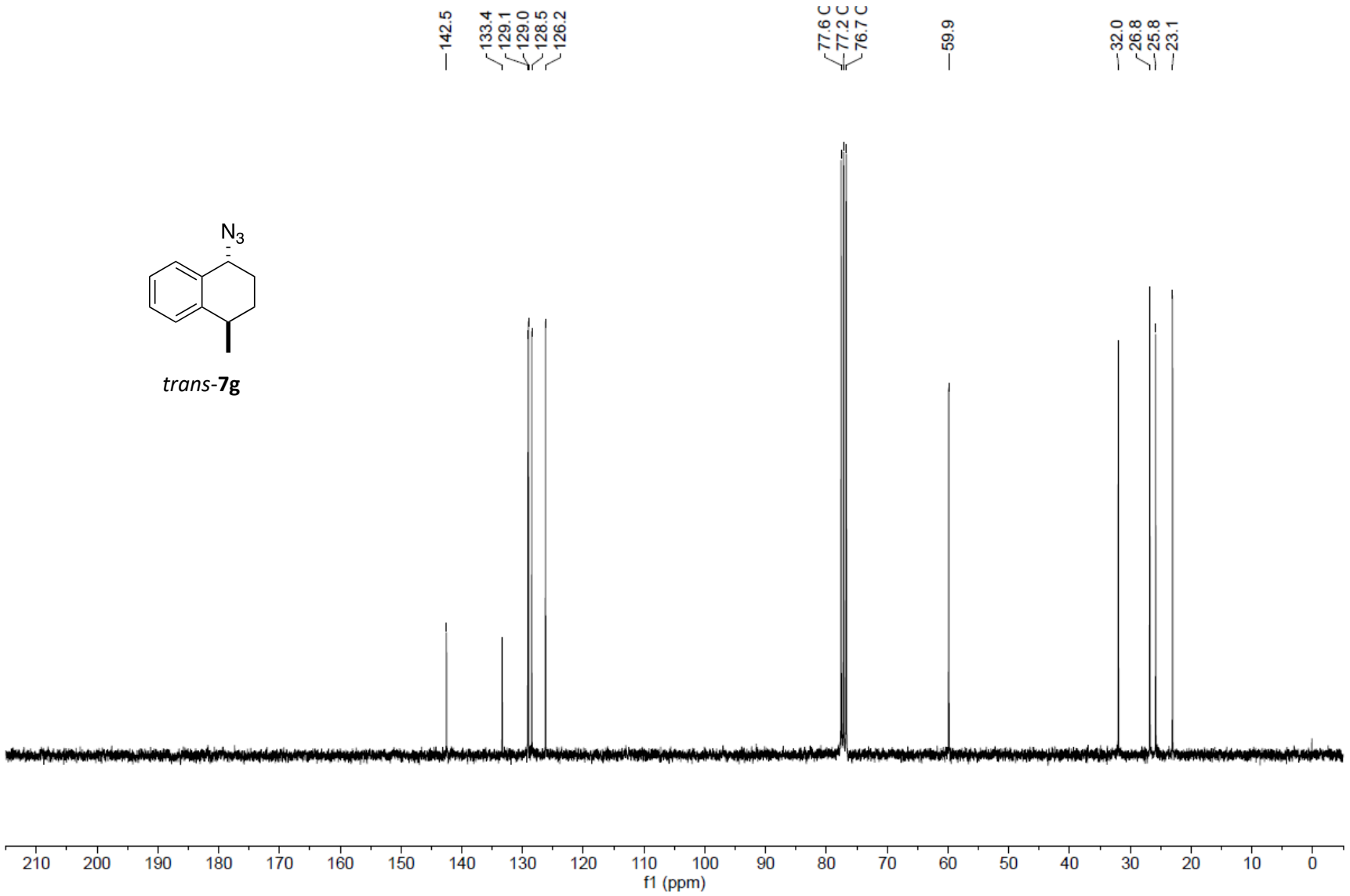

N3
cis-7g
7.31 7.31 7.30 7.30 7.30 7.29 7.29 7.28 7.27 7.26 7.25 7.25 7.24 7.24 7.23 7.23 7.22 7.22 7.22
4.57 4.56 4.54 2.90 2.89 2.89 2.88 2.87 2.87 2.85 2.07 2.06 2.05 2.05 2.04 2.03 2.03 2.02 2.02 2.01 2.00 1.99 1.98 1.97 1.97 1.96 1.96 1.95 1.95 1.95 1.94 1.94 1.93 1.93 1.92 1.92 1.91 1.91 1.90 1.90 1.90 1.89 1.77 1.76 1.75 1.74 1.73 1.73 1.72 1.71 1.70 1.37 1.34
4.27
1.00
1.00
3.10
1.07
3.01
8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)


142.4
133.5
129.2
128.5
128.2
126.2
77.6 CD
77.2 CD
76.7 CD
60.2
32.4
27.7
27.5
22.3
N3
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

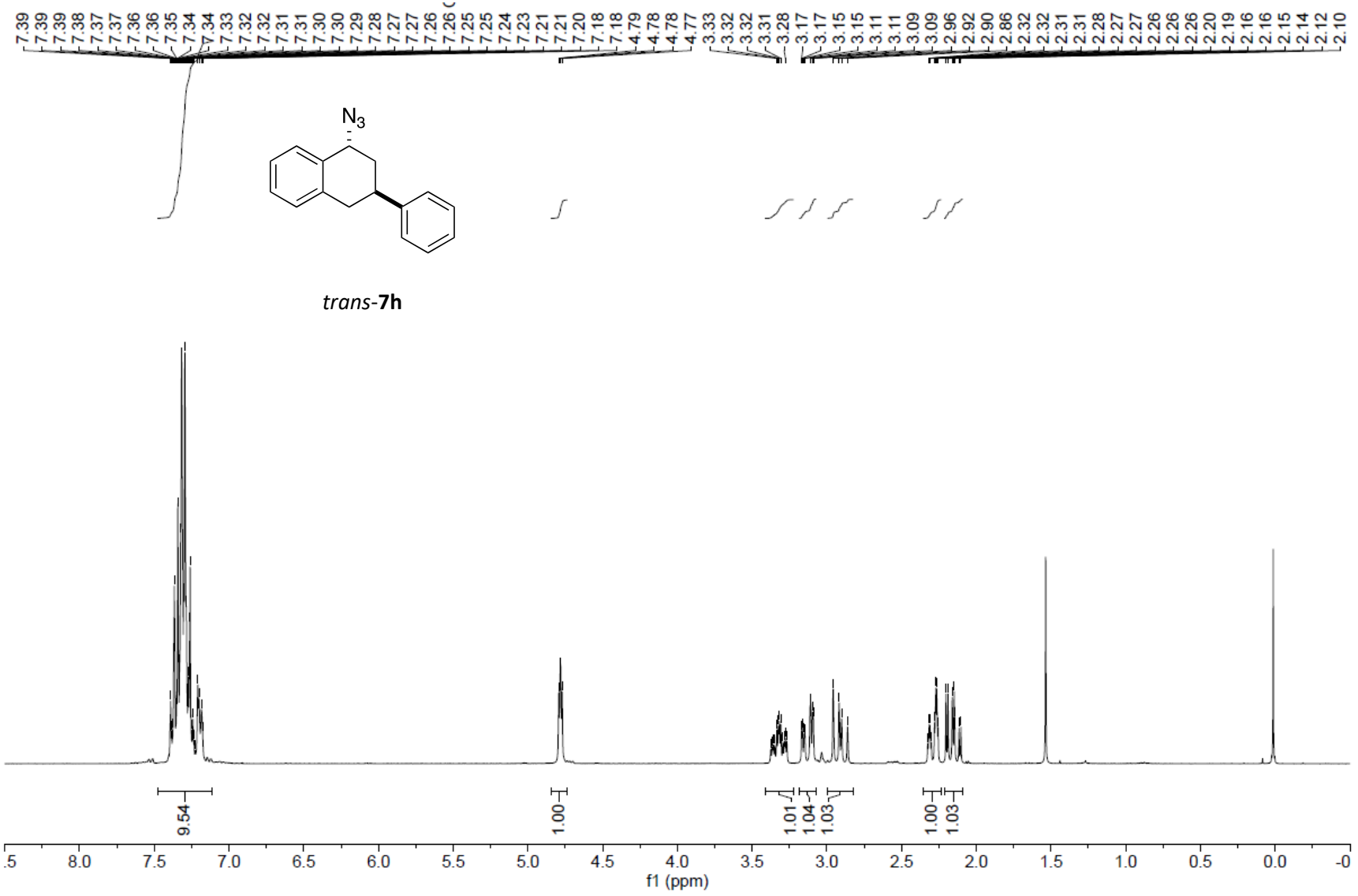
cis-**7g**


7.31 7.30 7.28 7.28 7.26 7.25 7.25 7.25 7.24 7.24 7.24 7.23 7.23 7.22 7.22 7.21 7.21 7.20 7.19 7.19 7.19
4.56 4.55 4.54 3.03 3.02 3.01 3.01 3.00 2.99 2.97 2.21 2.20 2.18 2.18 2.17 2.16 2.15 2.15 2.14 2.13 2.13 2.11 2.11 2.09 1.95 1.94 1.92 1.92 1.91 1.91 1.90 1.90 1.89 1.88 1.87 1.86 1.59 1.57 1.57 1.56 1.56 1.55 1.55 1.54 1.54 1.53 1.53 1.51 1.51 1.28 1.26
N3
4.11
1.00
1.01
2.08
1.08
1.15
3.12
8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0
f1 (ppm)

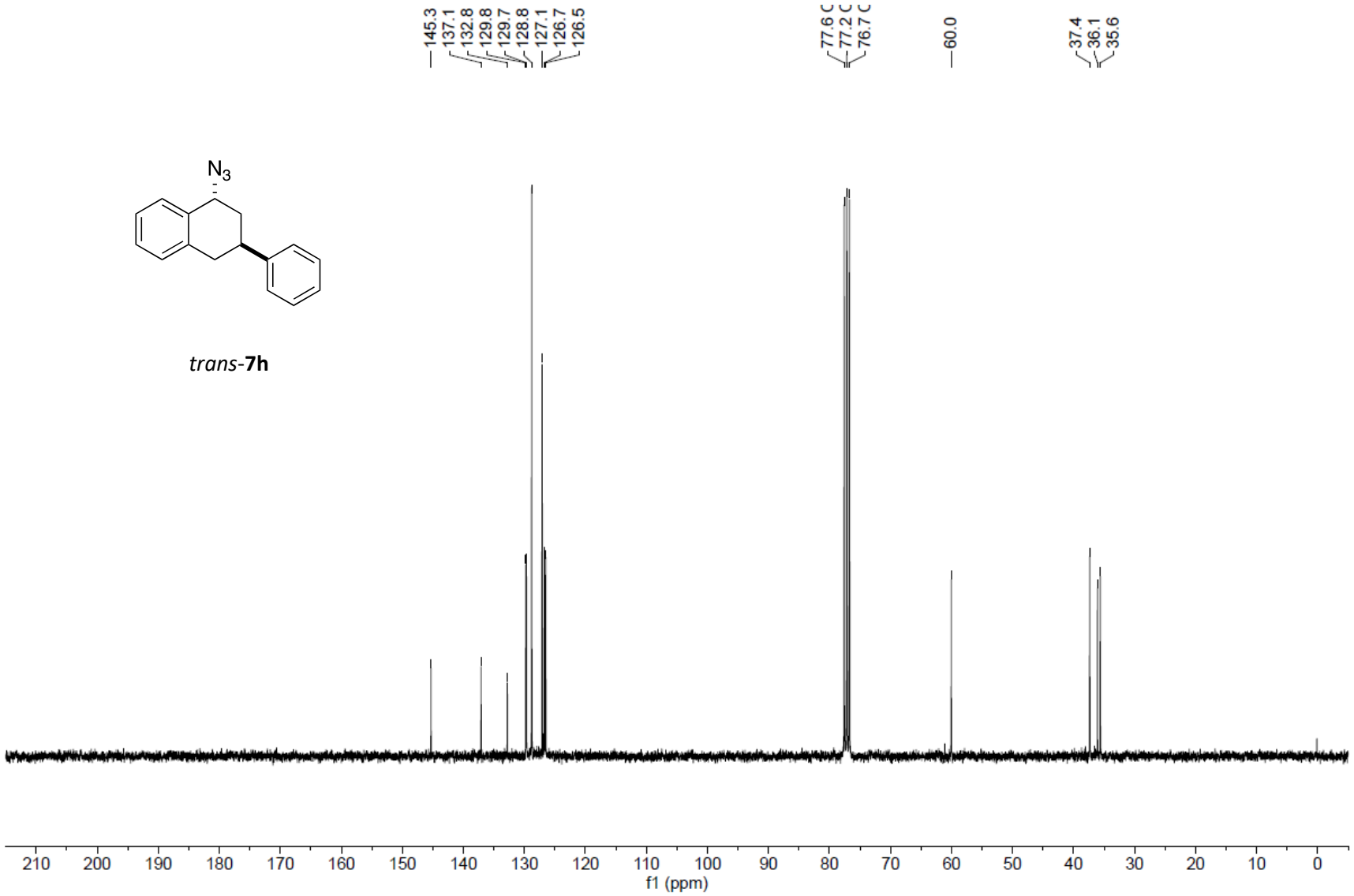
trans-**7g**


142.5
133.4
129.1
129.0
128.5
126.2
77.6 C
77.2 C
76.7 C
59.9
32.0
26.8
25.8
23.1
N3
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)

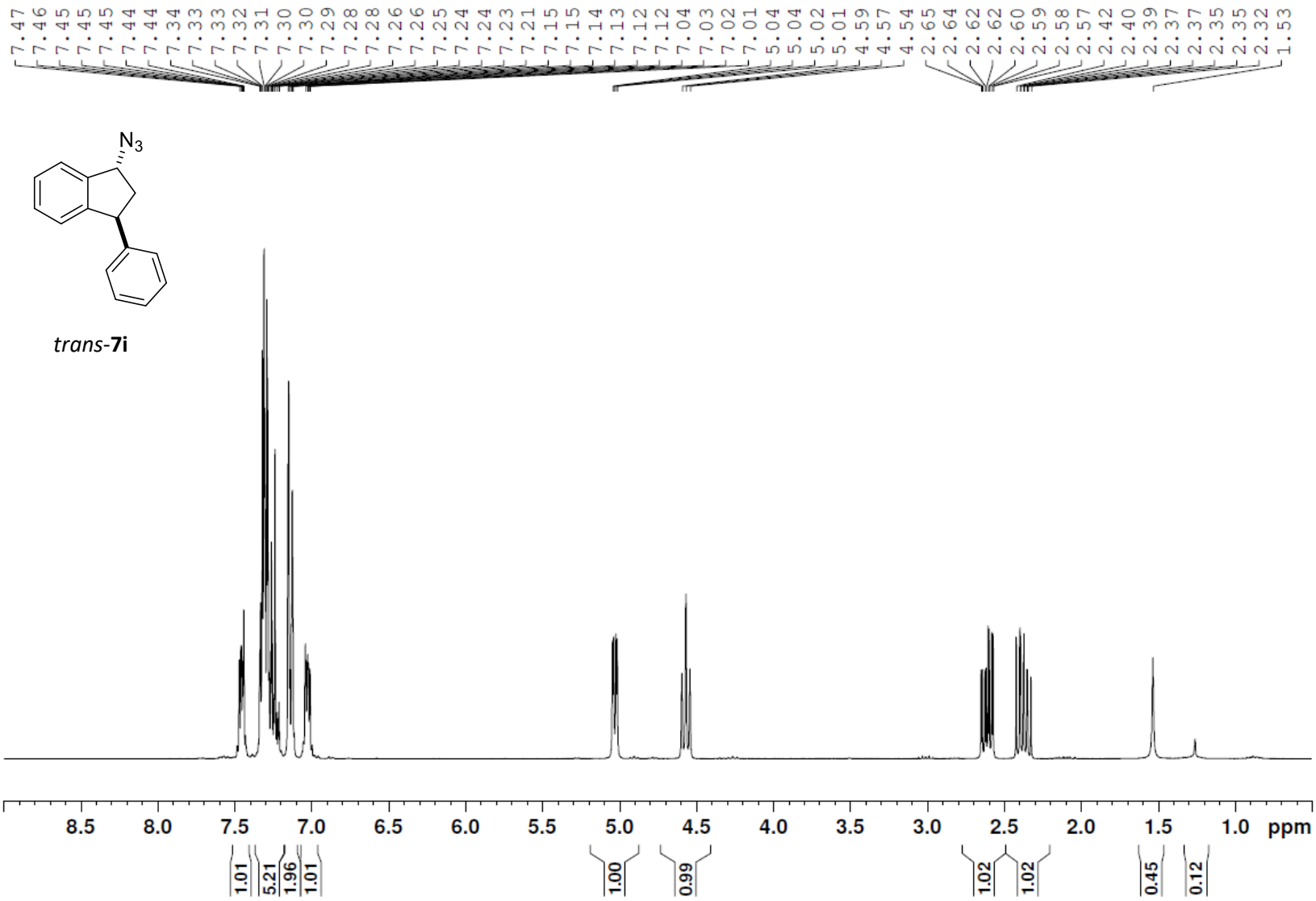
trans-**7g**


7.39 7.39 7.39 7.38 7.37 7.37 7.36 7.36 7.35 7.34 7.34 7.33 7.32 7.32 7.31 7.31 7.30 7.30 7.29 7.28 7.27 7.27 7.26 7.25 7.25 7.24 7.23 7.21 7.21 7.20 7.18 7.18 4.79 4.78 4.77 3.33 3.32 3.32 3.31 3.28 3.17 3.17 3.15 3.15 3.11 3.11 3.09 3.09 2.96 2.92 2.90 2.86 2.32 2.32 2.31 2.31 2.28 2.27 2.27 2.26 2.26 2.26 2.20 2.19 2.16 2.16 2.15 2.14 2.12 2.10
N3
9.54
1.00
1.01
1.04
1.03
1.00
1.03
f1 (ppm)

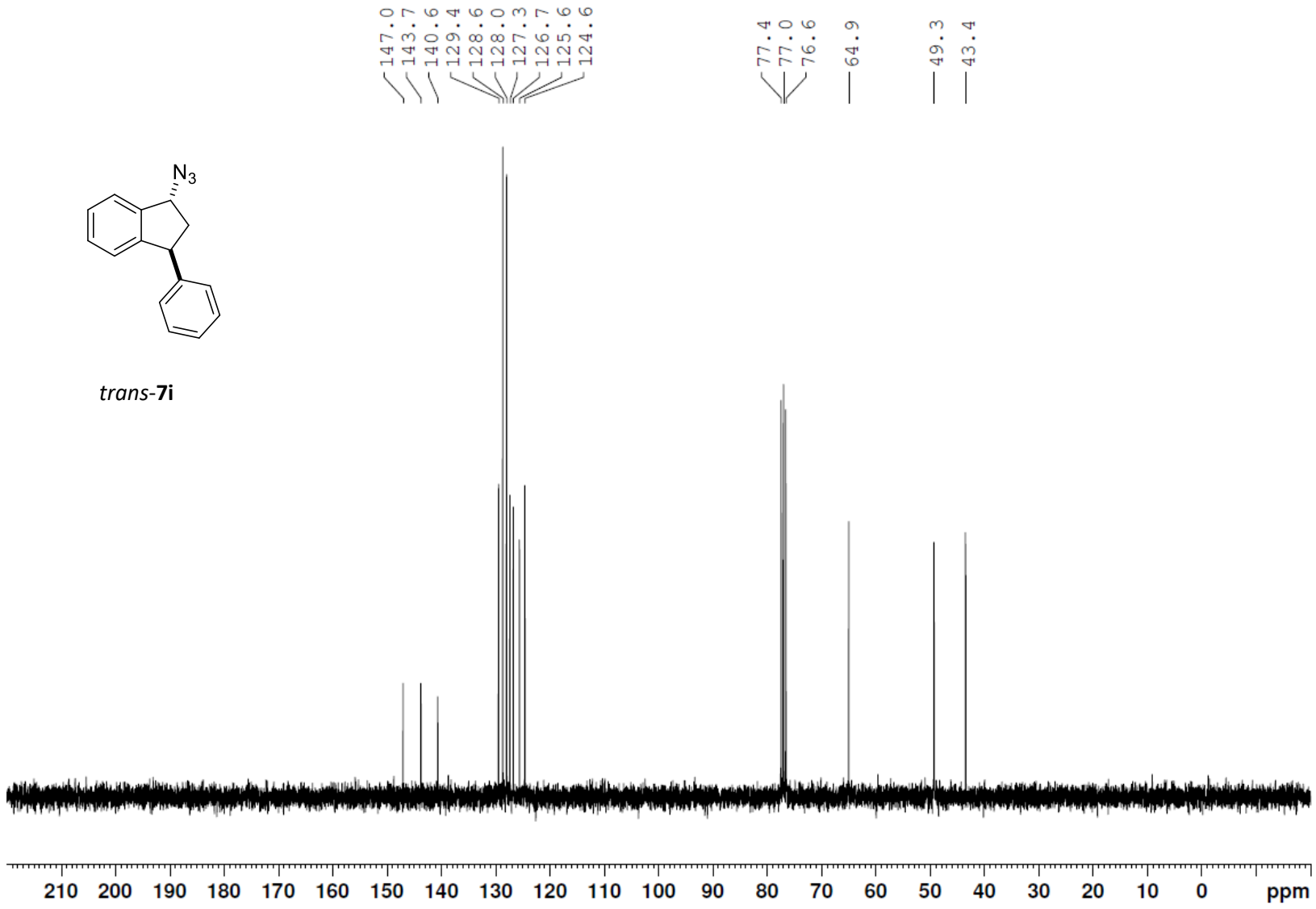
trans-**7h**


145.3
137.1
132.8
129.8
129.7
128.8
127.1
126.7
126.5
77.6 C
77.2 C
76.7 C
60.0
37.4
36.1
35.6
N3
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

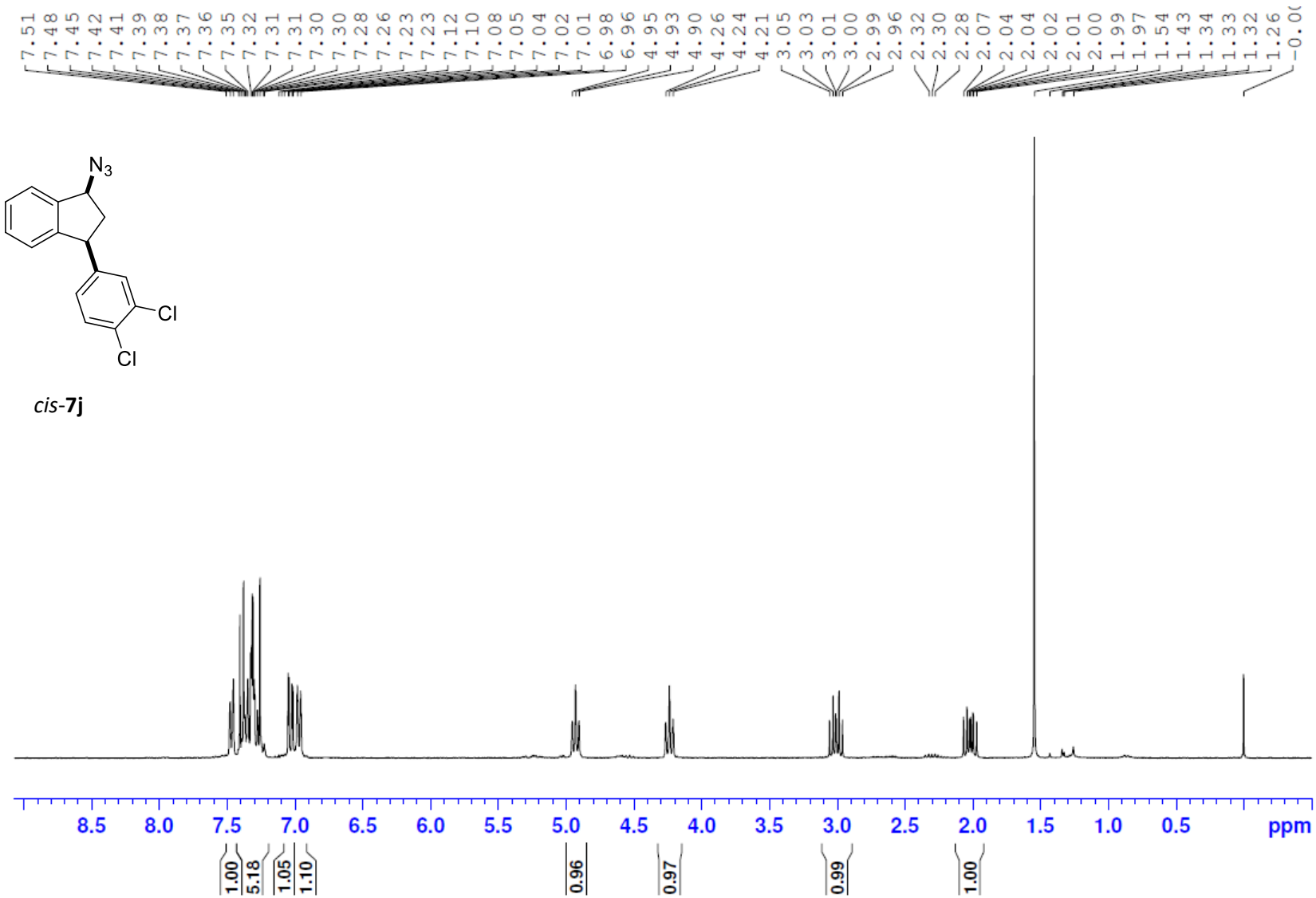
trans-**7h**


7.47
7.46
7.45
7.45
7.45
7.44
7.44
7.34
7.33
7.33
7.32
7.31
7.30
7.30
7.29
7.28
7.28
7.26
7.26
7.25
7.24
7.24
7.23
7.21
7.15
7.15
7.14
7.13
7.12
7.12
7.04
7.03
7.02
7.01
5.04
5.04
5.02
5.01
4.59
4.57
4.54
2.65
2.64
2.62
2.62
2.60
2.59
2.58
2.57
2.42
2.40
2.39
2.37
2.37
2.35
2.35
2.32
1.53
N3
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
ppm
1.01
5.21
1.96
1.01
1.00
0.99
1.02
1.02
0.45
0.12

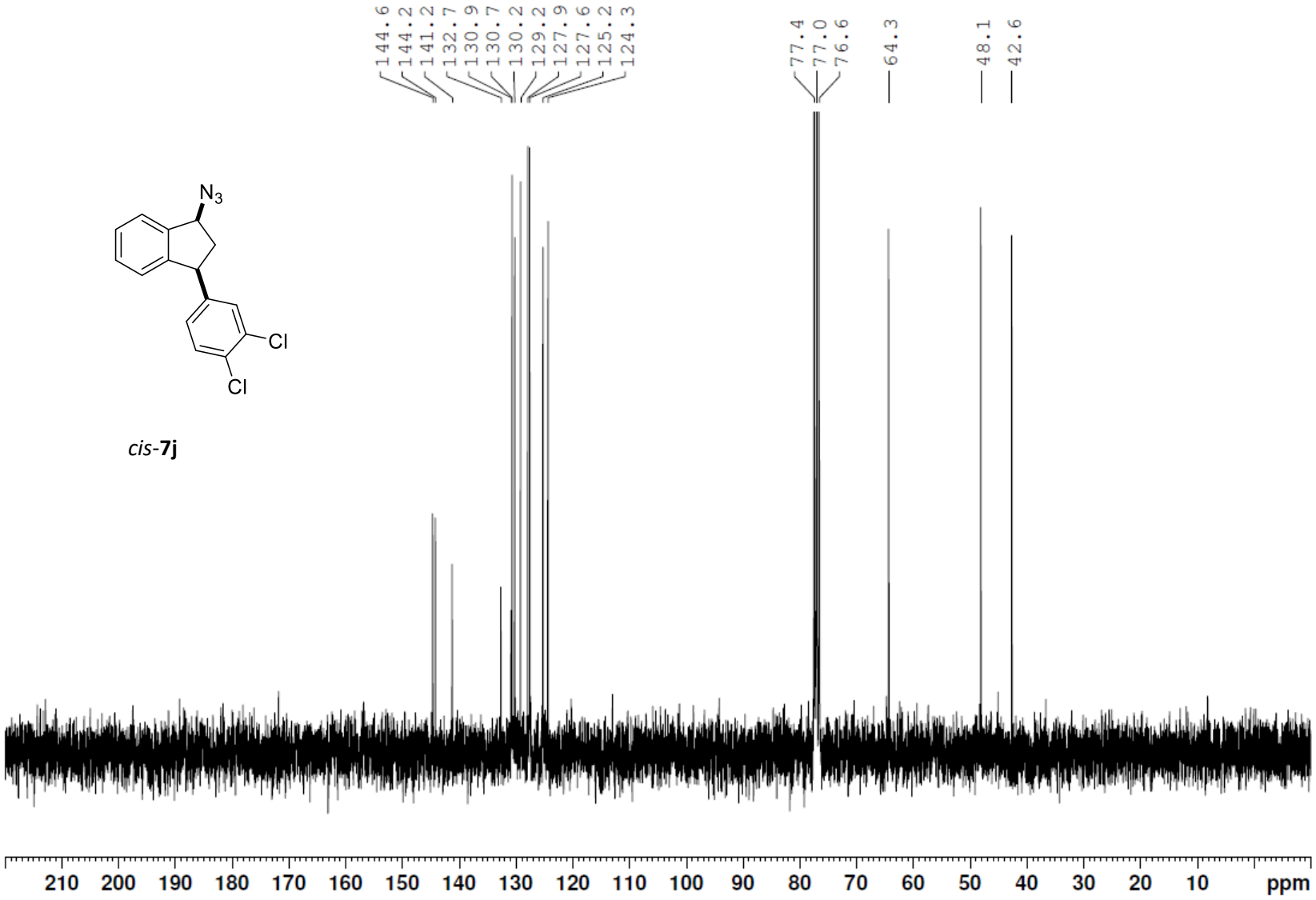
trans-**7i**


147.0
143.7
140.6
129.4
128.6
128.0
127.3
126.7
125.6
124.6
77.4
77.0
76.6
64.9
49.3
43.4
N3
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 ppm

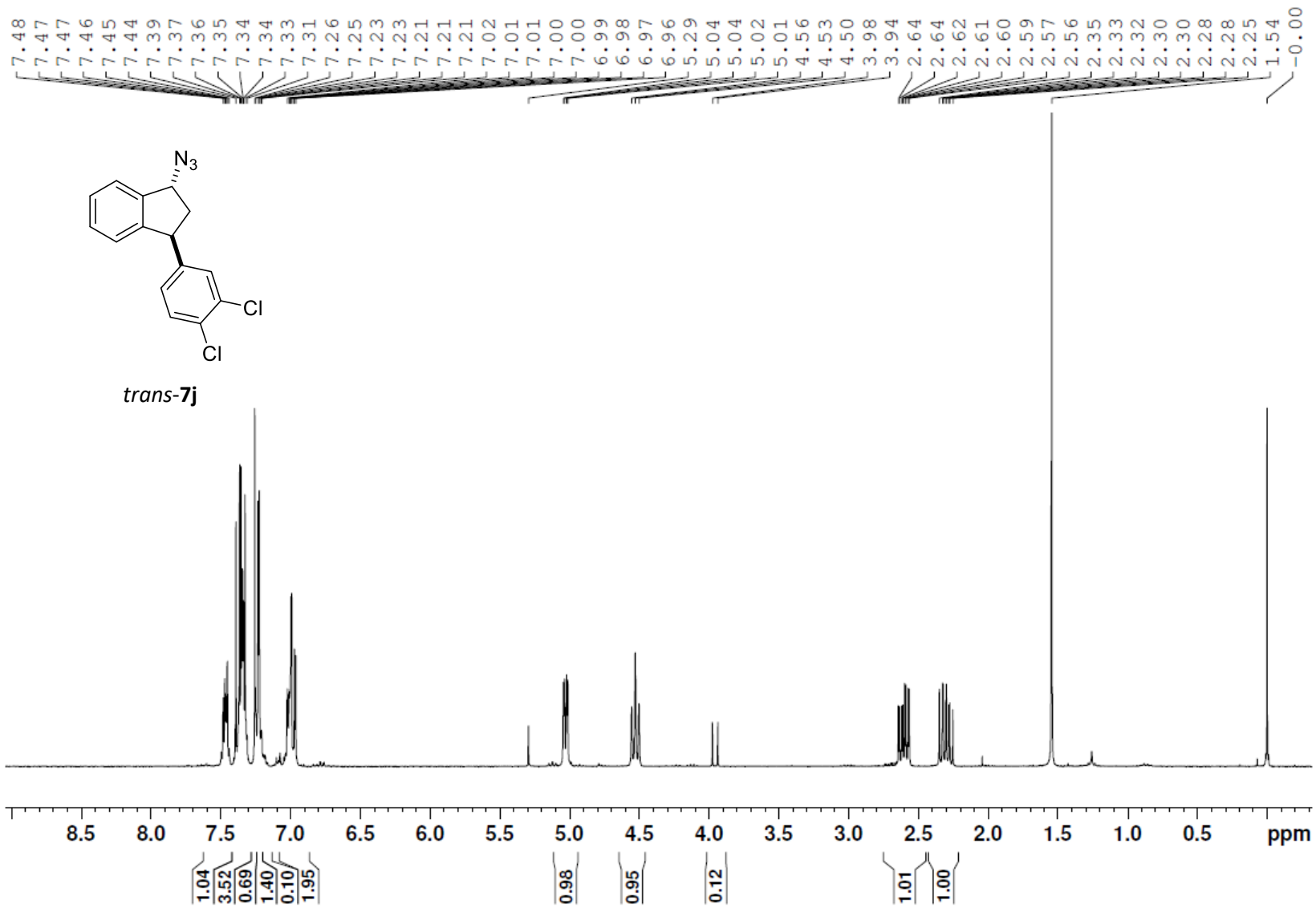
trans-**7i**


7.51
7.48
7.45
7.42
7.41
7.39
7.38
7.37
7.36
7.35
7.32
7.31
7.31
7.30
7.30
7.28
7.26
7.23
7.23
7.12
7.10
7.08
7.05
7.04
7.02
7.01
6.98
6.96
4.95
4.93
4.90
4.26
4.24
4.21
3.05
3.03
3.01
3.00
2.99
2.96
2.32
2.30
2.28
2.07
2.04
2.04
2.02
2.01
2.00
1.99
1.97
1.54
1.43
1.34
1.33
1.32
1.26
N3
Cl
Cl
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
ppm
1.00
5.18
1.05
1.10
0.96
0.97
0.99
1.00

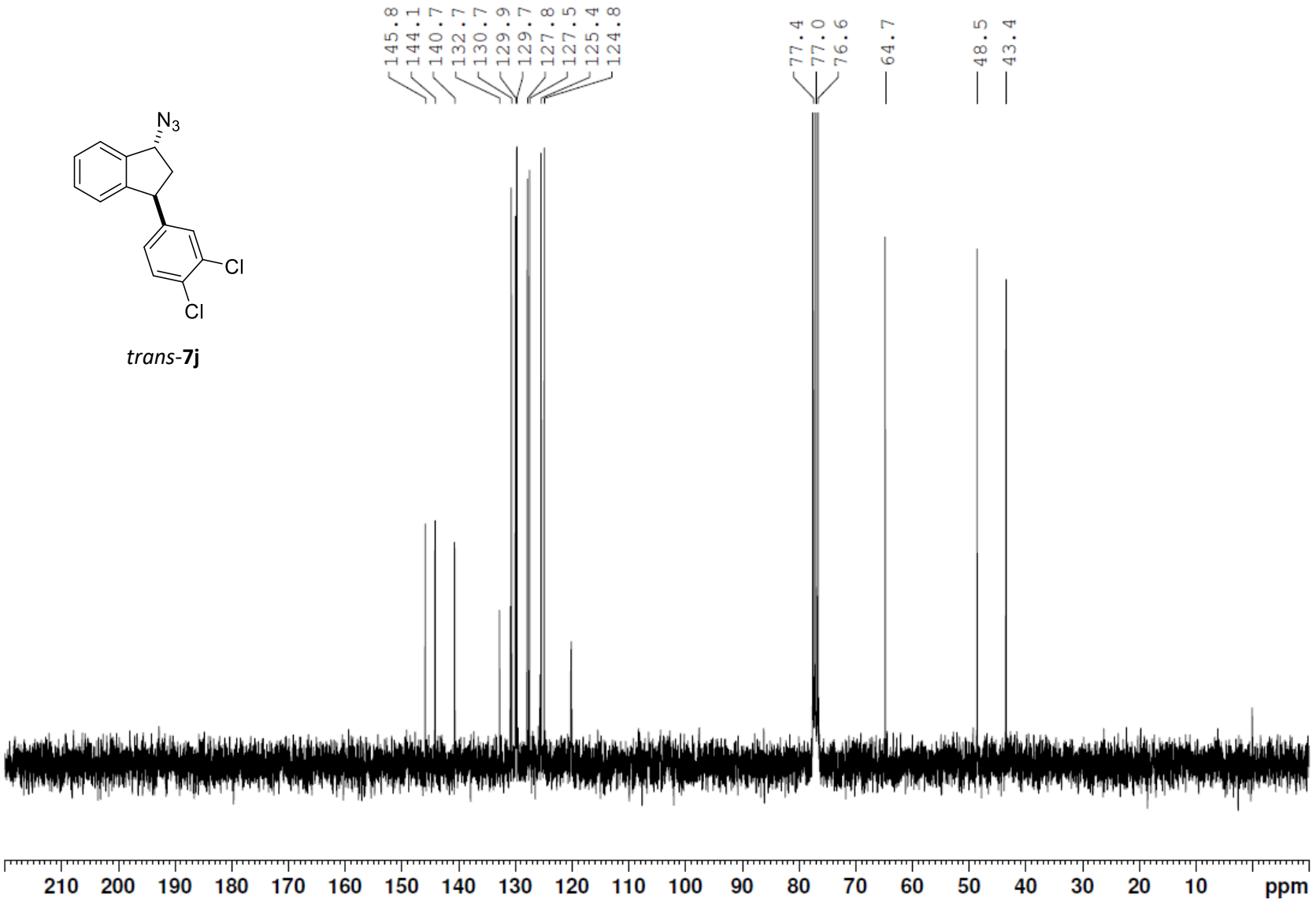
cis-**7j**


144.6
144.2
141.2
132.7
130.9
130.7
130.2
129.2
127.9
127.6
125.2
124.3
77.4
77.0
76.6
64.3
48.1
42.6
N3
Cl
Cl
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 ppm

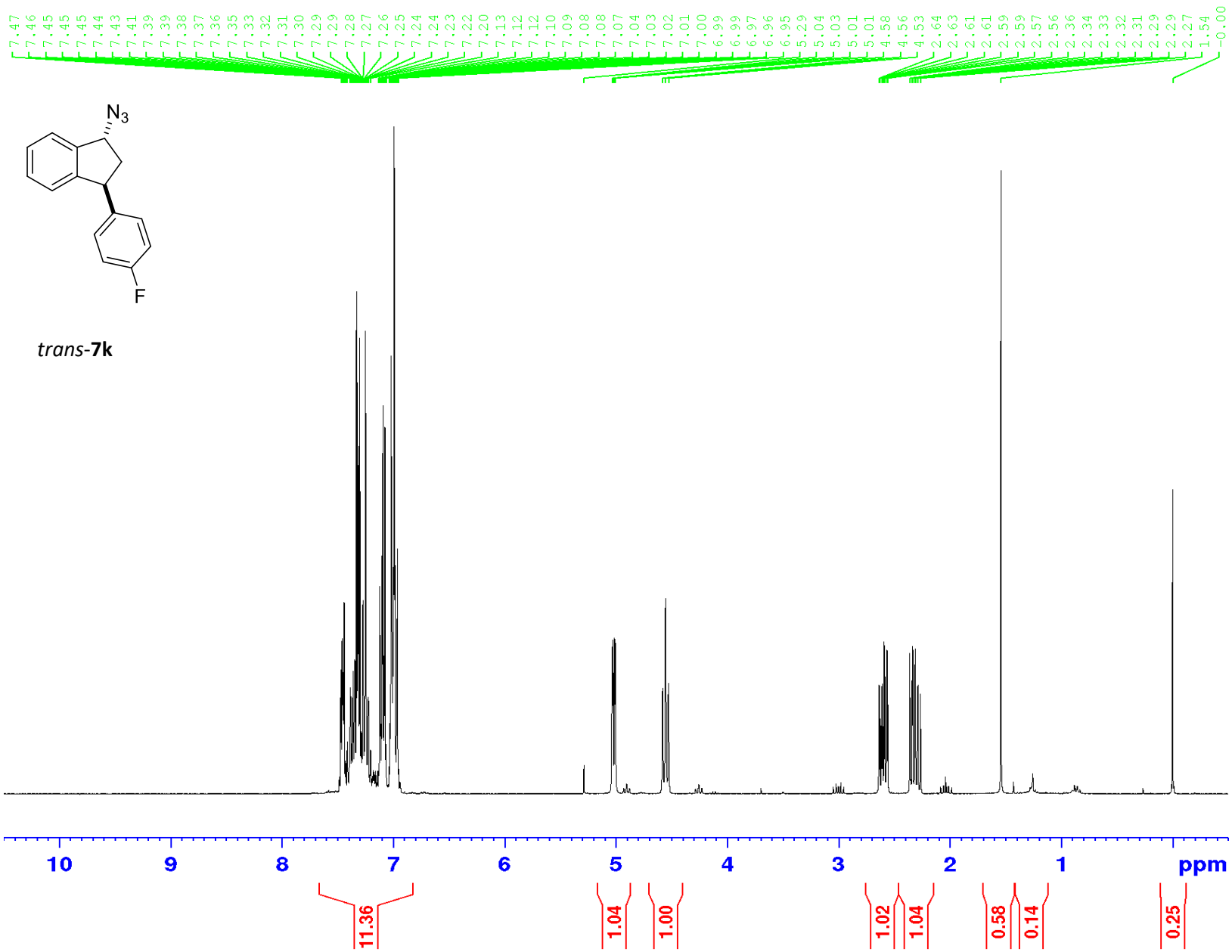
cis-**7j**


7.48
7.47
7.47
7.46
7.45
7.44
7.39
7.37
7.36
7.35
7.34
7.34
7.33
7.31
7.26
7.25
7.23
7.23
7.21
7.21
7.21
7.02
7.01
7.01
7.00
7.00
6.99
6.98
6.97
6.96
5.29
5.04
5.04
5.02
5.01
4.56
4.53
4.50
3.98
3.94
2.64
2.64
2.62
2.61
2.60
2.59
2.57
2.56
2.35
2.33
2.32
2.30
2.30
2.28
2.28
2.25
1.54
-0.00
N3
Cl
Cl
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
ppm
1.04
3.52
0.69
1.40
0.10
1.95
0.98
0.95
0.12
1.01
1.00

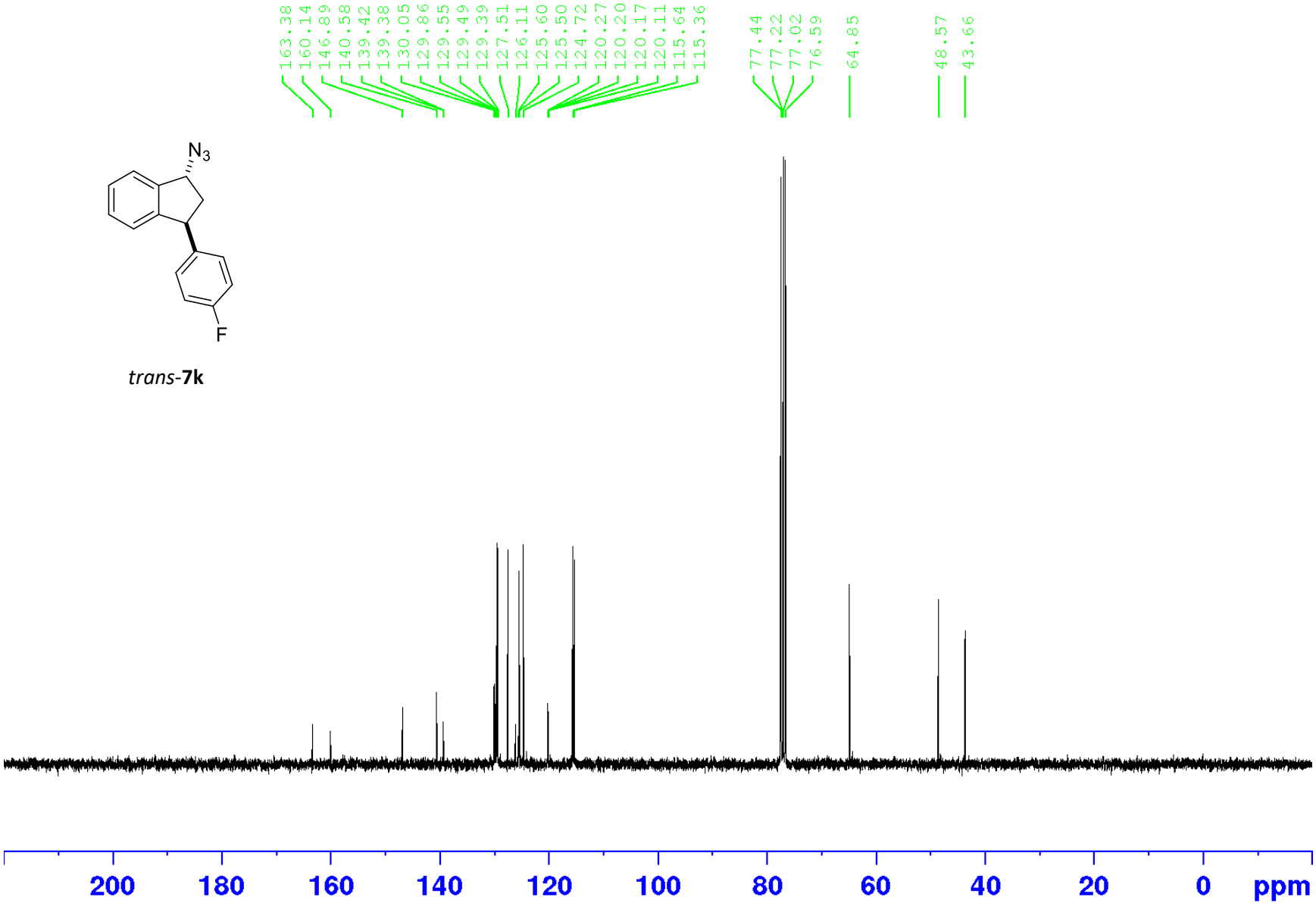
trans-**7j**


145.8
144.1
140.7
132.7
130.7
129.9
129.7
127.8
127.5
125.4
124.8
77.4
77.0
76.6
64.7
48.5
43.4
N3
Cl
Cl
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 ppm

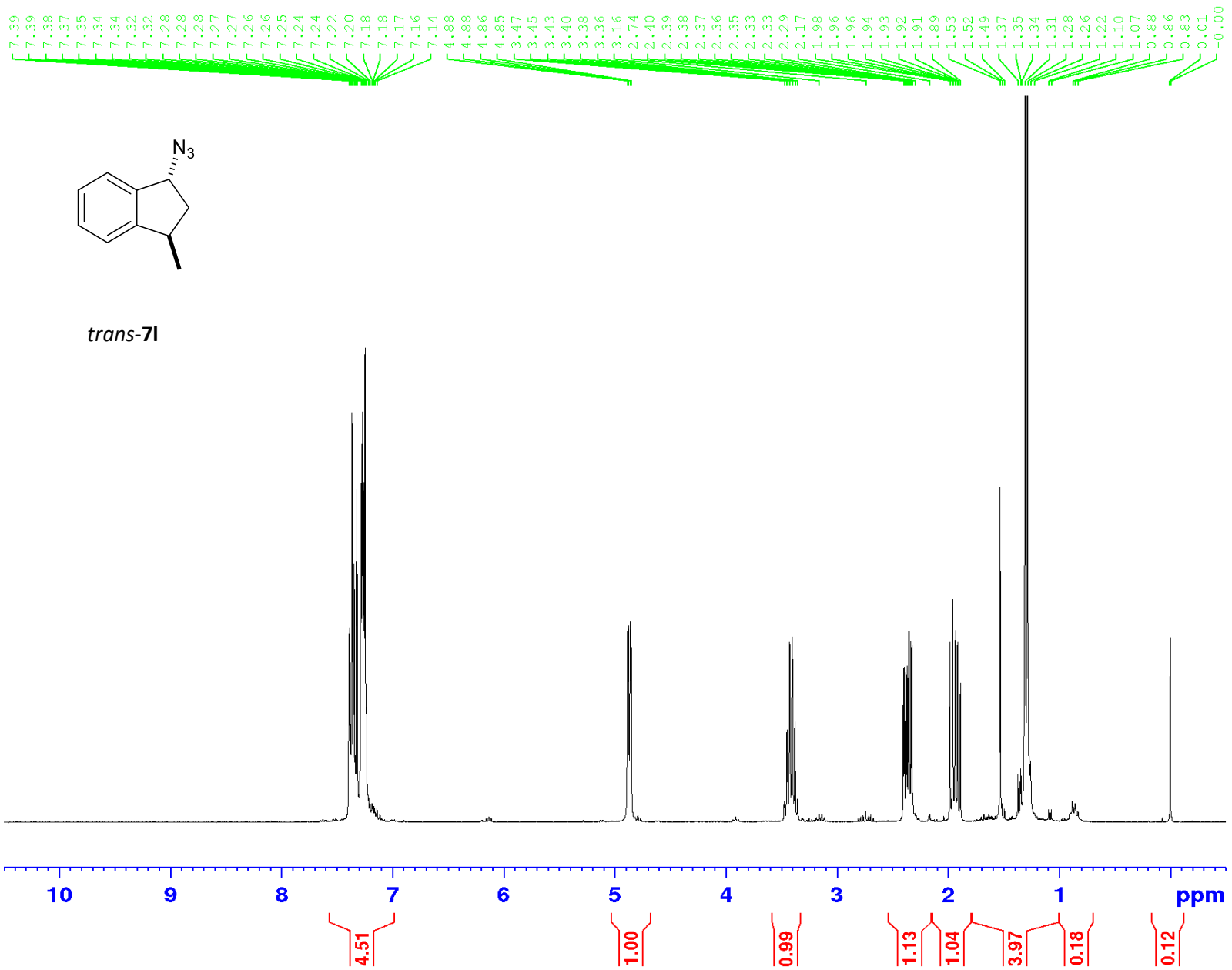
trans-**7j**


7.47 7.46 7.45 7.45 7.45 7.44 7.43 7.41 7.39 7.39 7.38 7.37 7.36 7.35 7.33 7.32 7.31 7.30 7.29 7.29 7.28 7.27 7.26 7.25 7.24 7.24 7.23 7.22 7.20 7.13 7.12 7.12 7.10 7.09 7.08 7.08 7.07 7.04 7.03 7.02 7.01 7.00 6.99 6.99 6.97 6.96 6.95 5.29 5.04 5.03 5.01 5.01 4.58 4.56 4.53 2.64 2.63 2.61 2.61 2.59 2.59 2.57 2.56 2.36 2.34 2.33 2.32 2.31 2.29 2.29 2.27 1.54 -0.00
N3
F
10 9 8 7 6 5 4 3 2 1 ppm
11.36 1.04 1.00 1.02 1.04 0.58 0.14 0.25

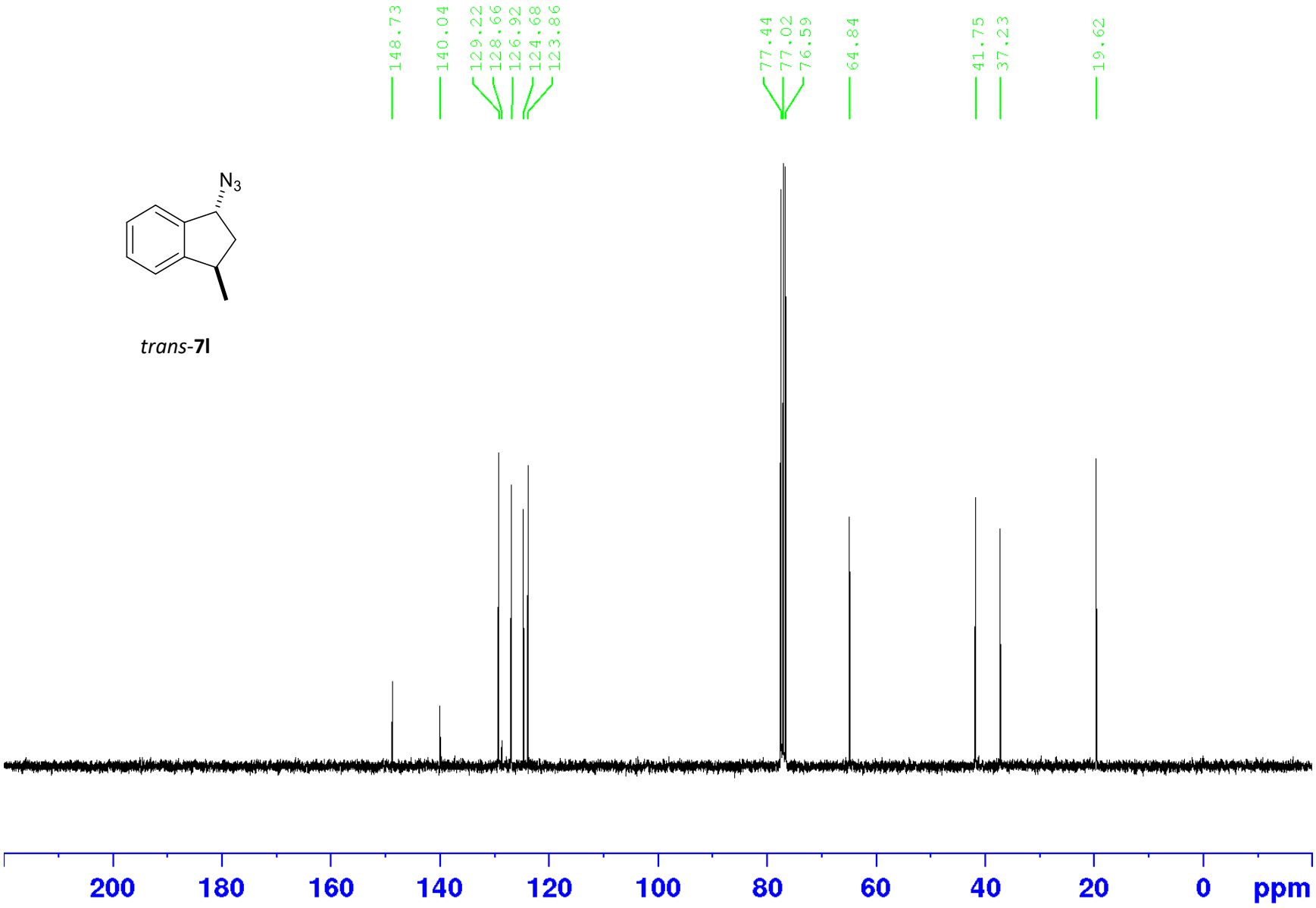
trans-**7k**


163.38
160.14
146.89
140.58
139.42
139.38
130.05
129.86
129.55
129.49
129.39
127.51
126.11
125.60
125.50
124.72
120.27
120.20
120.17
120.11
115.64
115.36
77.44
77.22
77.02
76.59
64.85
48.57
43.66
N3
F
200
180
160
140
120
100
80
60
40
20
0
ppm

trans-**7k**

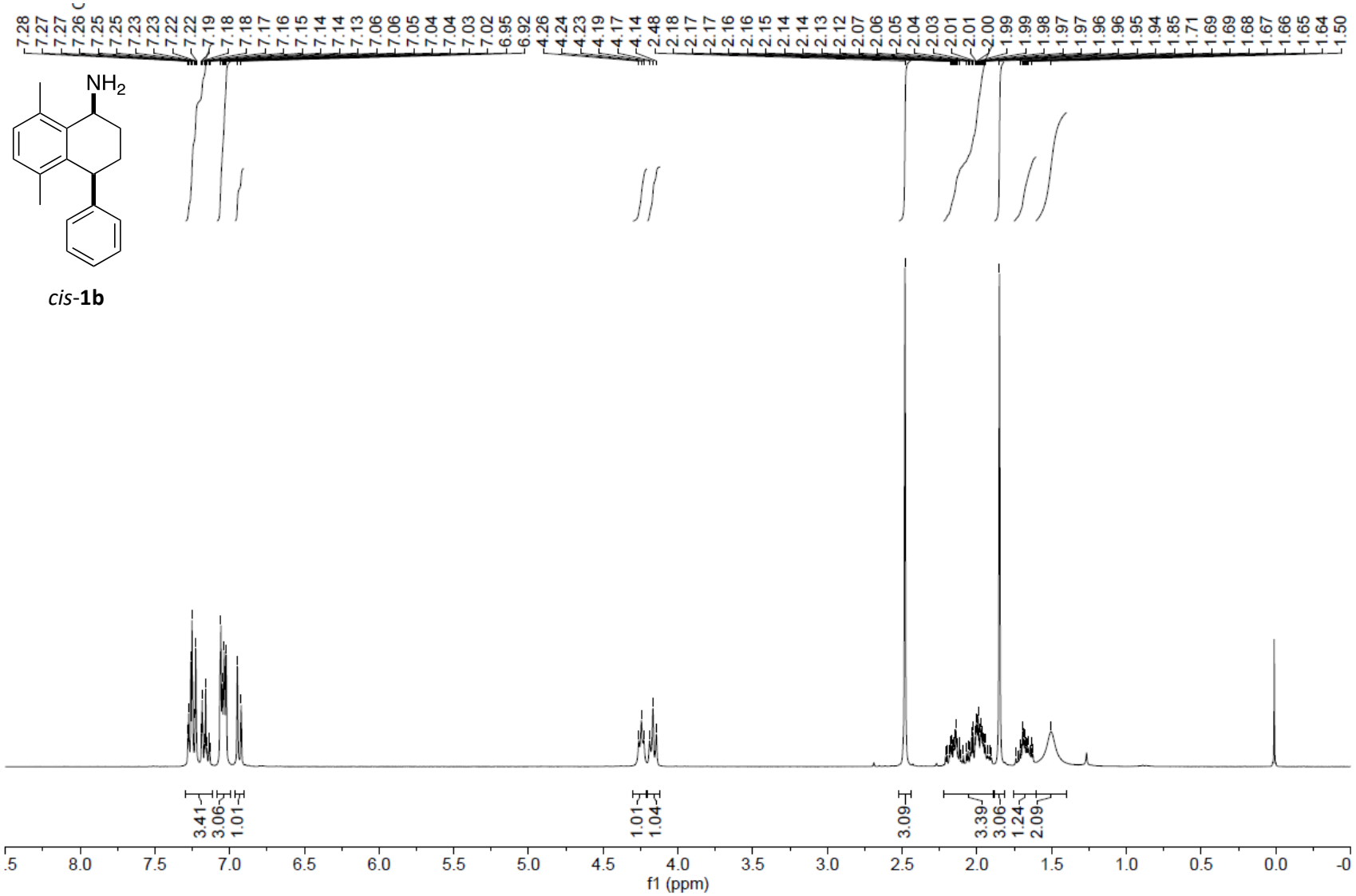

7.39
7.39
7.38
7.37
7.35
7.34
7.34
7.32
7.32
7.28
7.28
7.28
7.27
7.27
7.26
7.26
7.25
7.24
7.24
7.22
7.20
7.18
7.18
7.17
7.16
7.14
4.88
4.86
4.85
3.47
3.45
3.43
3.40
3.38
3.36
3.16
2.74
2.40
2.39
2.38
2.37
2.36
2.35
2.33
2.33
2.29
2.17
1.98
1.96
1.96
1.94
1.93
1.92
1.91
1.89
1.53
1.52
1.49
1.37
1.35
1.34
1.31
1.28
1.26
1.22
1.10
1.07
0.88
0.86
0.83
0.01
-0.00
N3
10
9
8
7
6
5
4
3
2
1
ppm
4.51
1.00
0.99
1.13
1.04
3.97
0.18
0.12

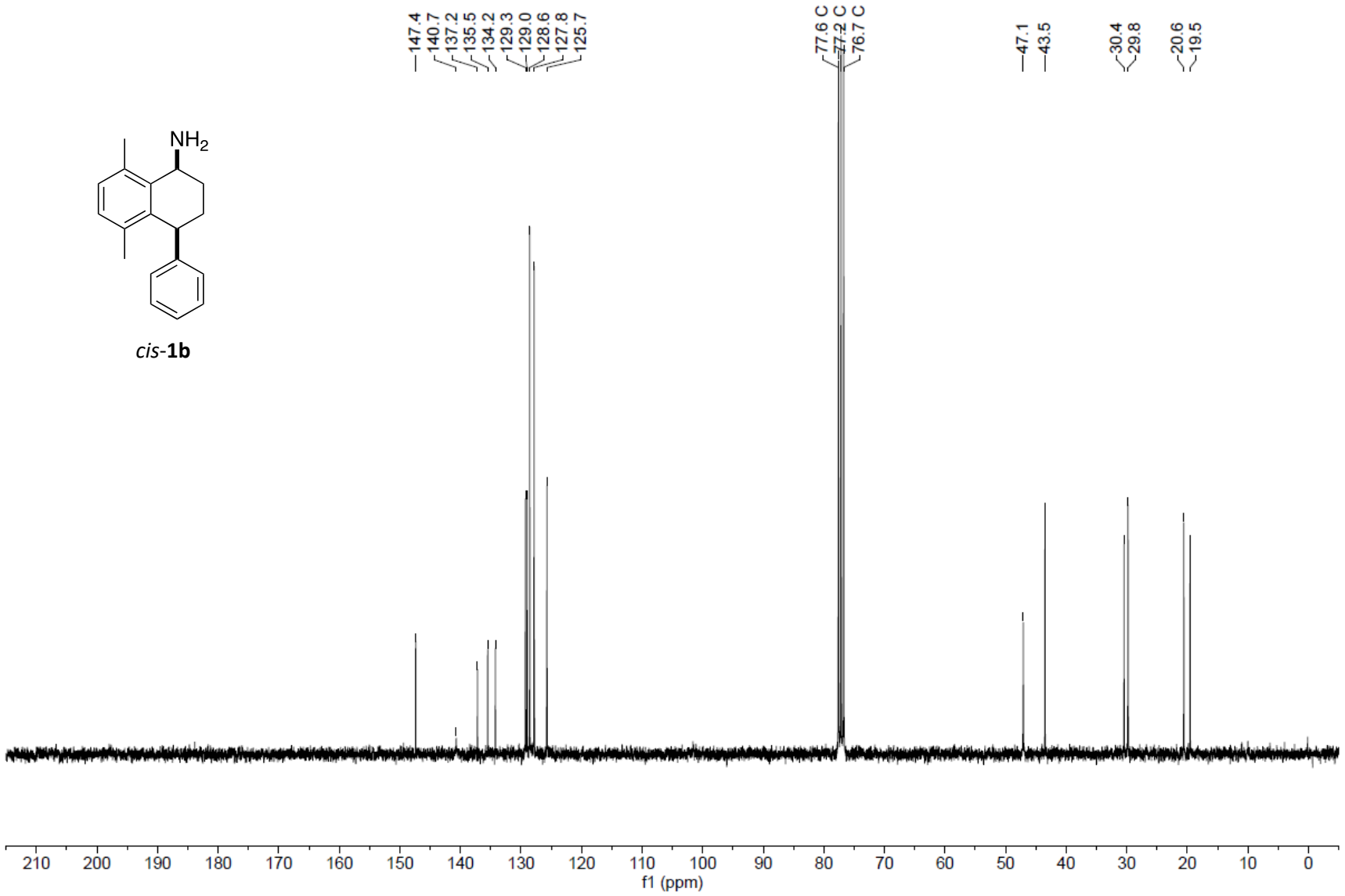
trans-**7l**


148.73
140.04
129.22
128.66
126.92
124.68
123.86
77.44
77.02
76.59
64.84
41.75
37.23
19.62
N3
200
180
160
140
120
100
80
60
40
20
0
ppm

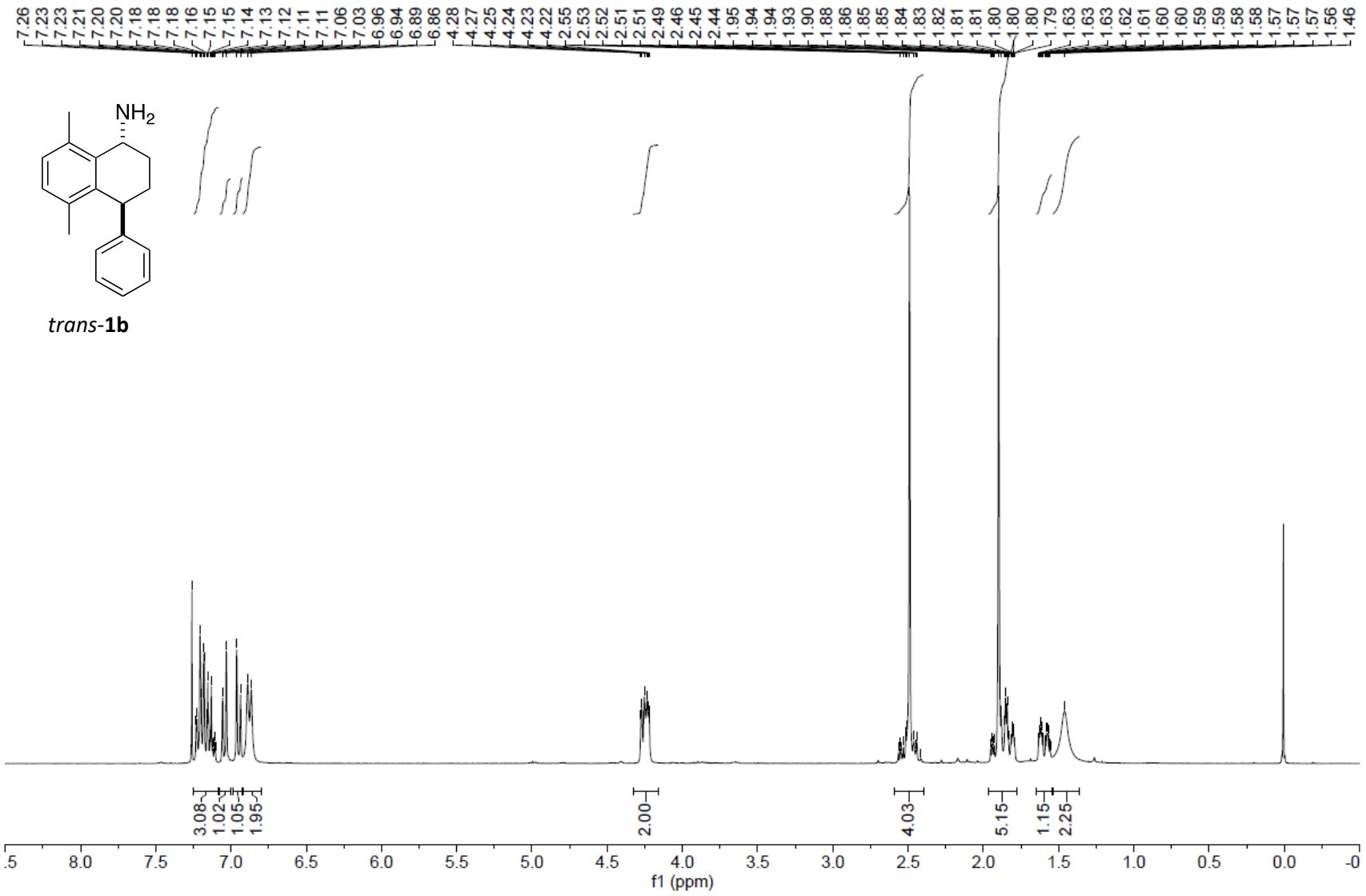
trans-**7l**

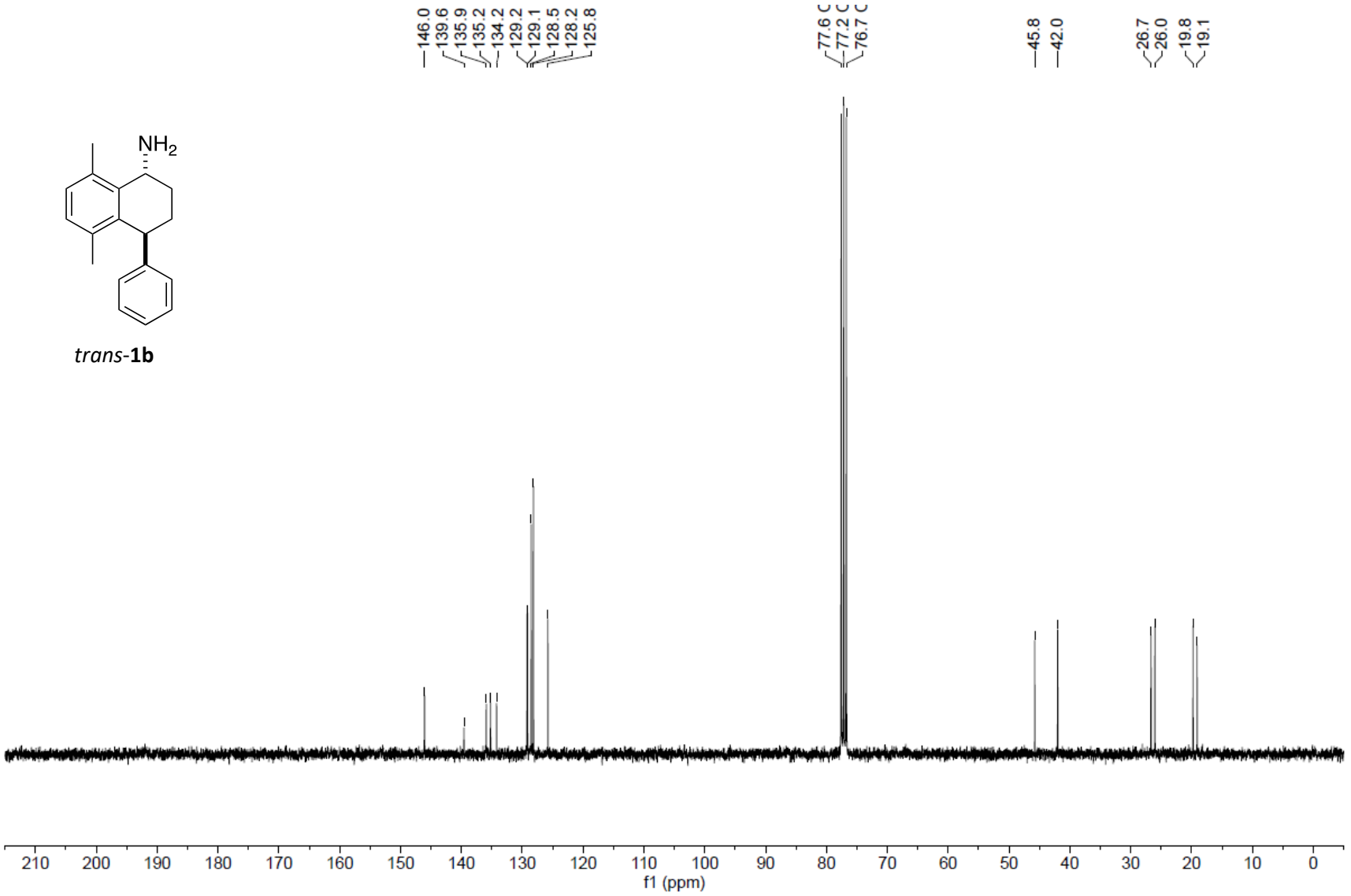
1.6.4 ^{1}H NMR and ^{13}C NMR spectra of amine compounds


NH2
cis-1b
7.28 7.27 7.27 7.26 7.25 7.25 7.23 7.23 7.22 7.22 7.19 7.18 7.18 7.17 7.16 7.15 7.14 7.14 7.13 7.06 7.06 7.05 7.04 7.04 7.03 7.02 6.95 6.92 4.26 4.24 4.23 4.19 4.17 4.14 2.48 2.18 2.17 2.17 2.16 2.16 2.15 2.14 2.14 2.13 2.12 2.07 2.06 2.05 2.04 2.03 2.01 2.01 2.00 1.99 1.99 1.98 1.97 1.97 1.96 1.96 1.95 1.94 1.85 1.71 1.69 1.69 1.68 1.67 1.66 1.65 1.64 1.50
3.41 3.06 1.01 1.01 1.04 3.09 3.39 3.06 1.24 2.09
f1 (ppm)

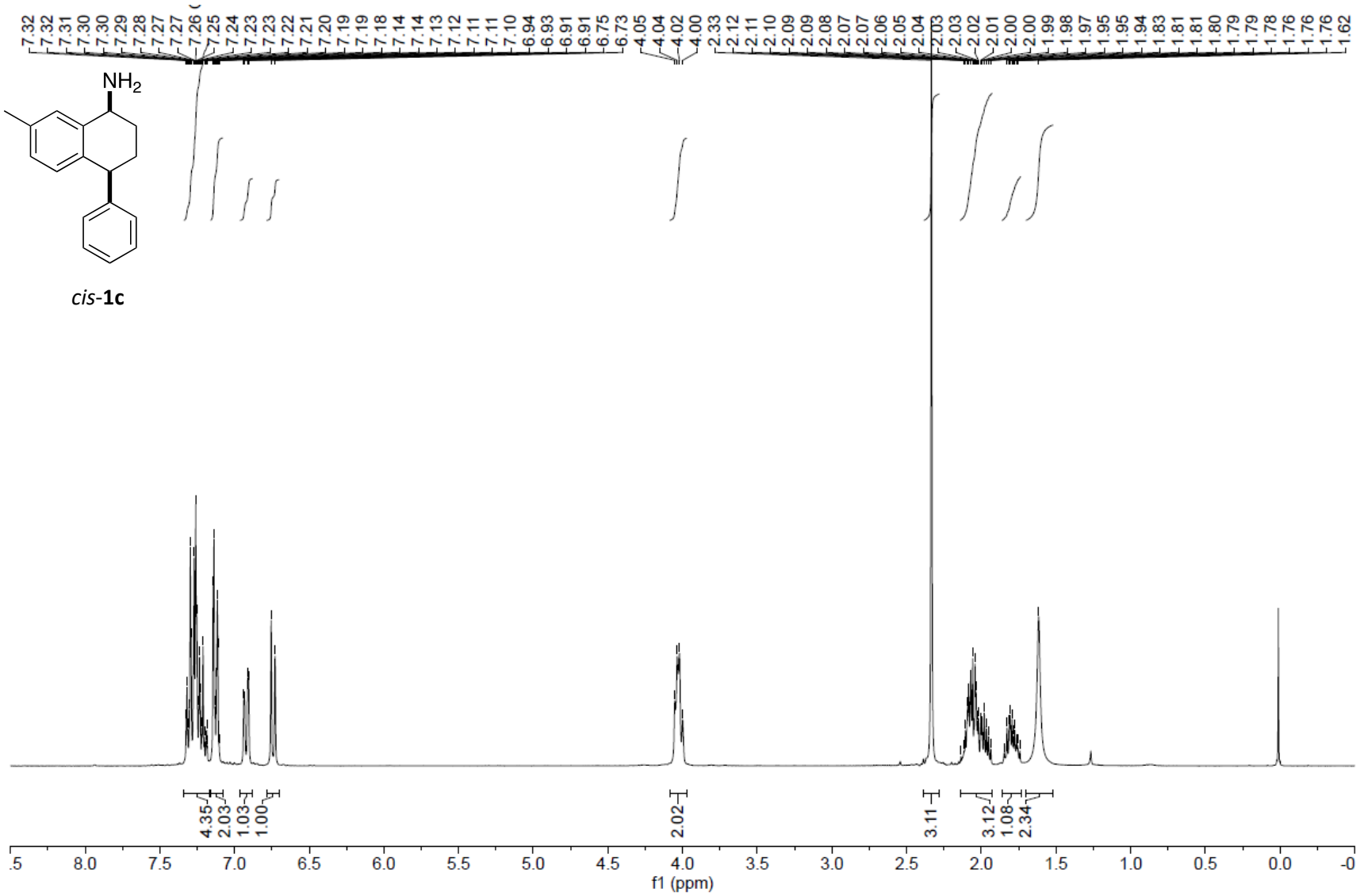

147.4
140.7
137.2
135.5
134.2
129.3
129.0
128.6
127.8
125.7
77.6 C
77.2 C
76.7 C
47.1
43.5
30.4
29.8
20.6
19.5
NH2
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

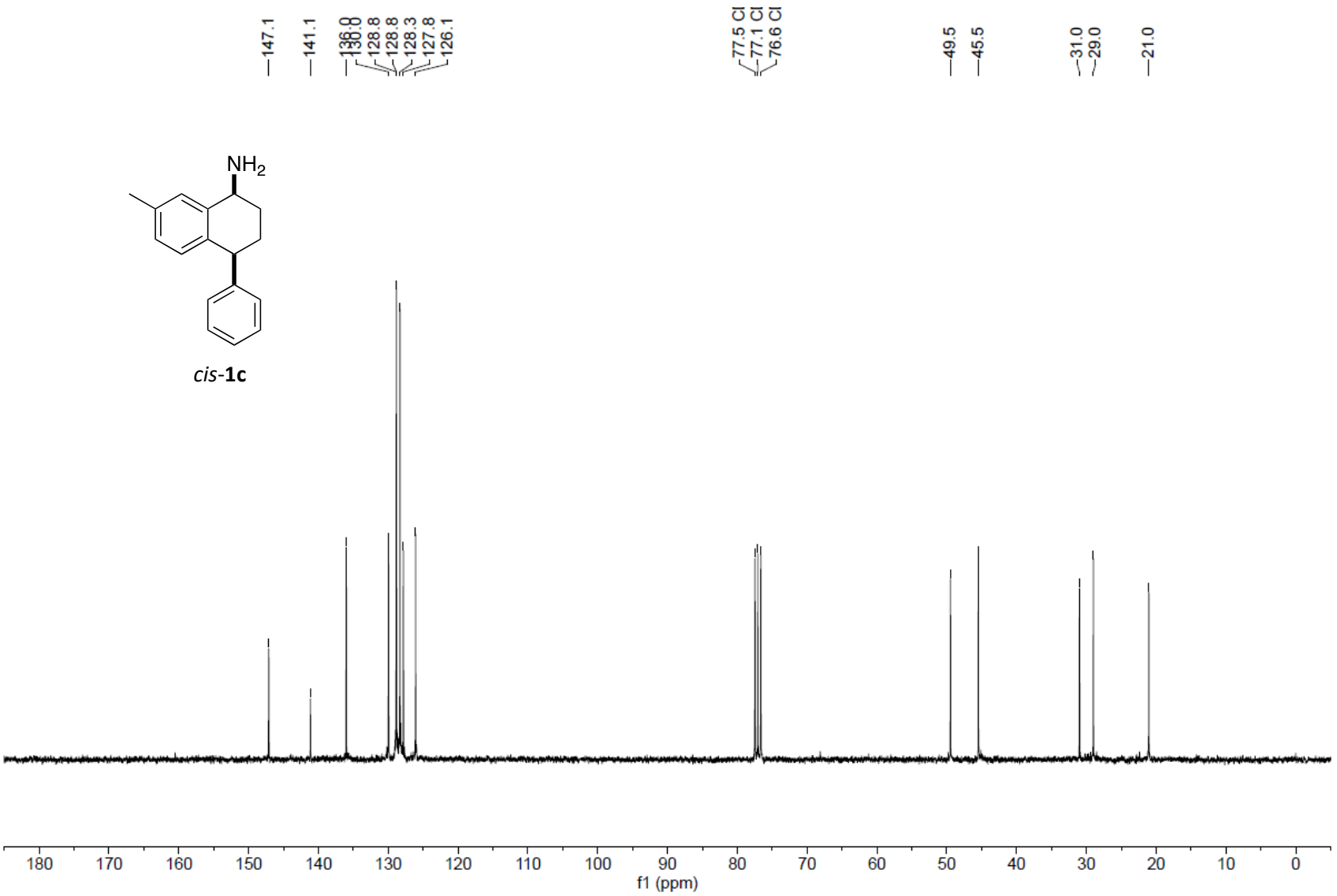
cis-**1b**

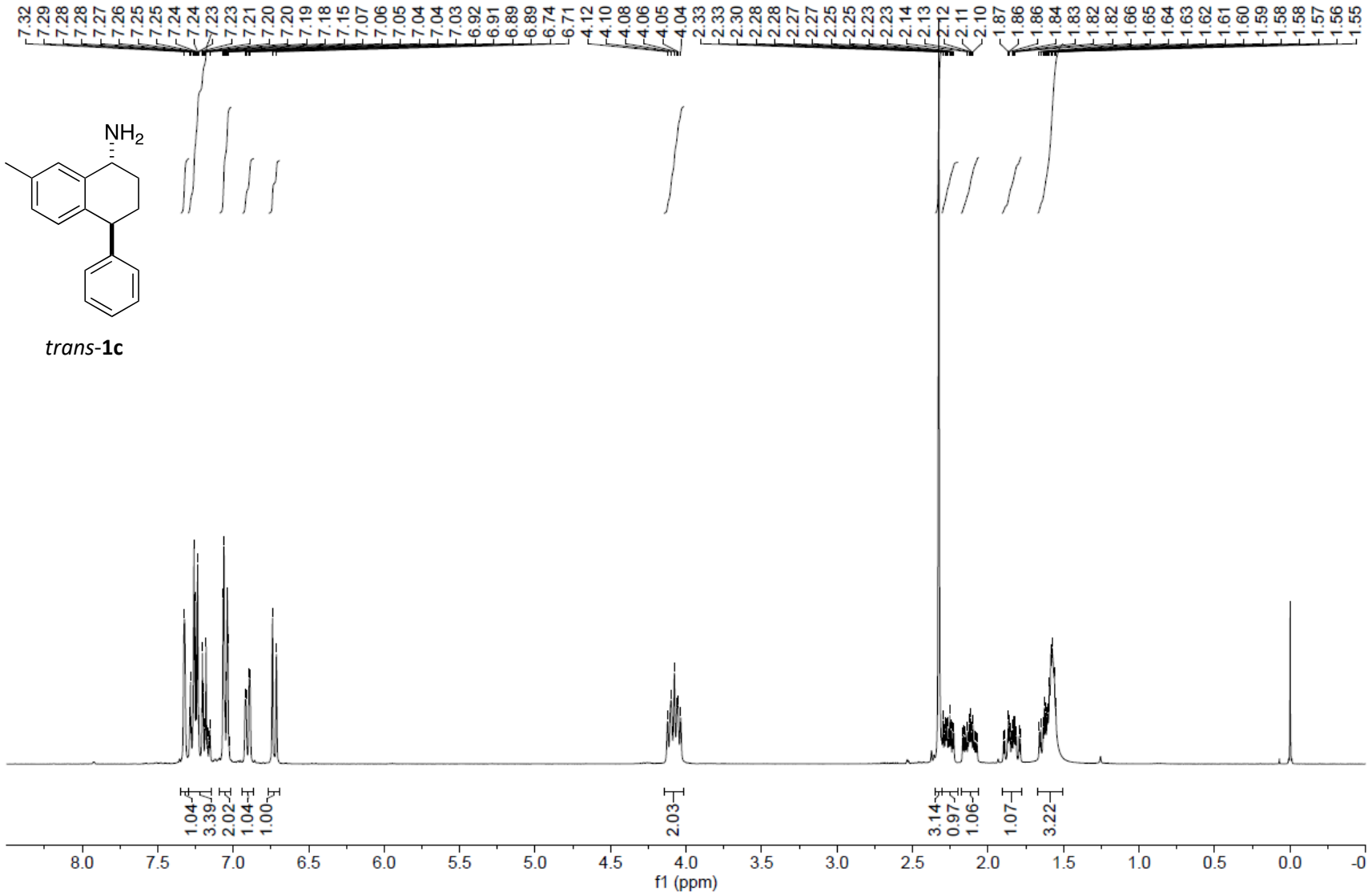

NH2
trans-1b
3.08
1.02
1.05
1.95
2.00
4.03
5.15
1.15
2.25
f1 (ppm)


146.0
139.6
135.9
135.2
134.2
129.2
129.1
128.5
128.2
125.8
77.6 C
77.2 C
76.7 C
45.8
42.0
26.7
26.0
19.8
19.1
NH2
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

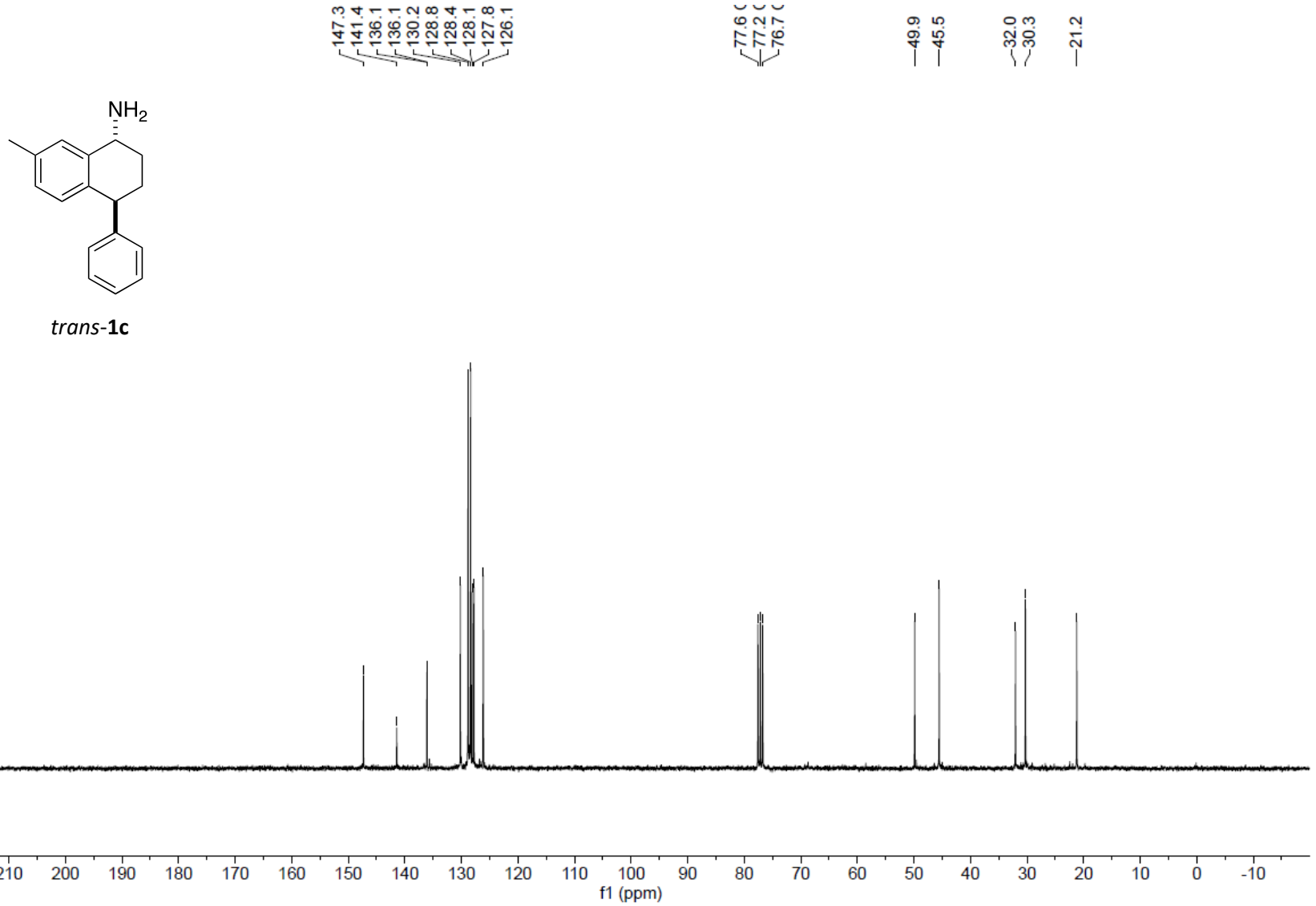
trans-**1b**


NH2
cis-1c
7.32 7.32 7.31 7.30 7.30 7.29 7.28 7.27 7.27 7.26 7.25 7.24 7.23 7.23 7.22 7.21 7.20 7.19 7.19 7.18 7.14 7.14 7.13 7.12 7.11 7.11 7.10 6.94 6.93 6.91 6.91 6.75 6.73 4.05 4.04 4.02 4.00 2.33 2.12 2.11 2.10 2.09 2.09 2.08 2.07 2.07 2.06 2.05 2.04 2.03 2.03 2.02 2.01 2.00 2.00 1.99 1.98 1.97 1.95 1.95 1.94 1.83 1.81 1.81 1.80 1.79 1.79 1.78 1.76 1.76 1.76 1.62
4.35
2.03
1.03
1.00
2.02
3.11
3.12
1.08
2.34
.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0
f1 (ppm)

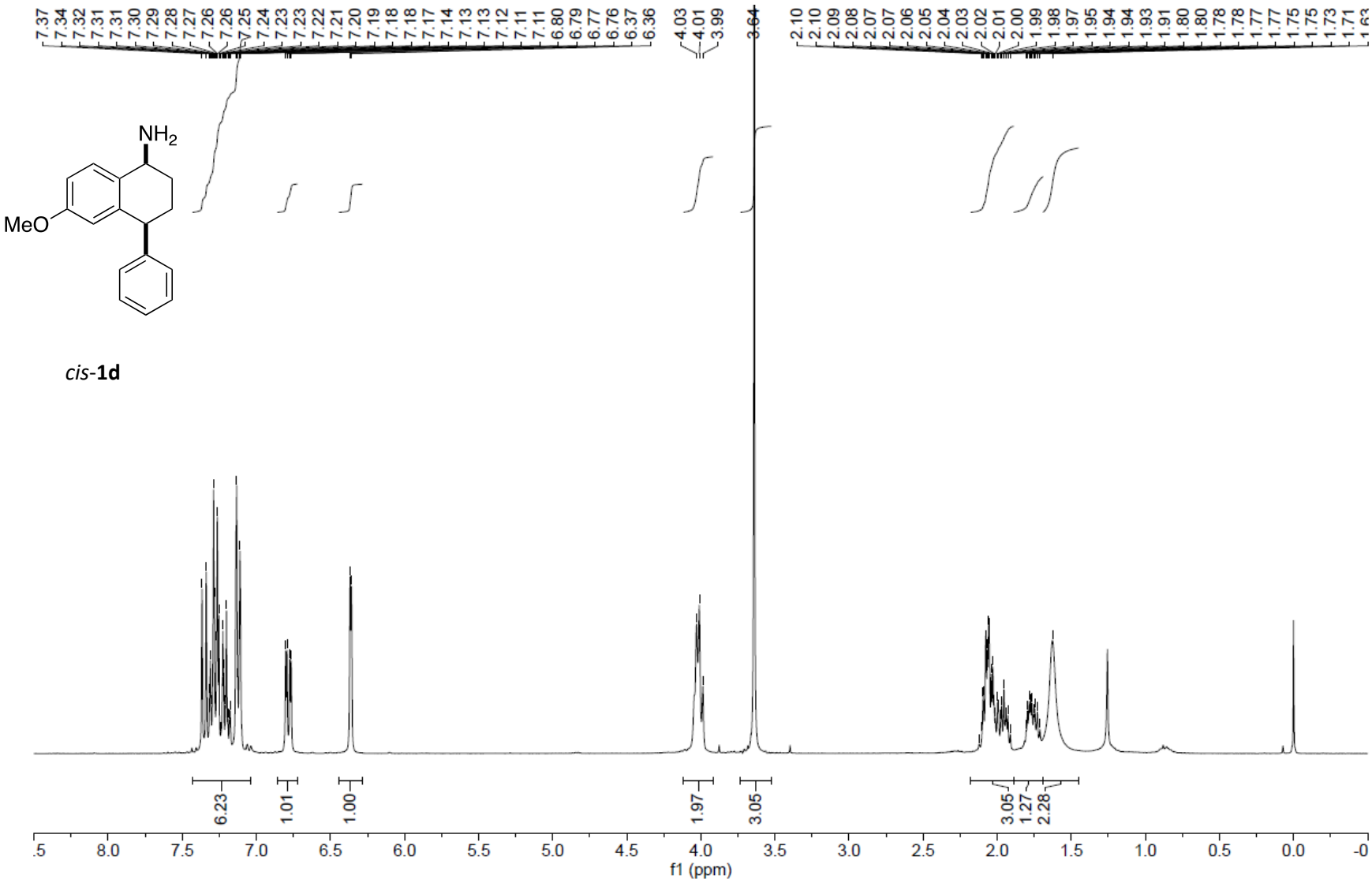

147.1
141.1
136.0
130.0
128.8
128.8
128.3
127.8
126.1
77.5 Cl
77.1 Cl
76.6 Cl
49.5
45.5
31.0
29.0
21.0
NH2
cis-1c
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)


NH2
7.32 7.29 7.28 7.28 7.27 7.26 7.25 7.25 7.24 7.24 7.23 7.23 7.21 7.20 7.20 7.19 7.18 7.15 7.07 7.06 7.05 7.04 7.04 7.03 6.92 6.91 6.89 6.89 6.74 6.71
4.12 4.10 4.08 4.06 4.05 4.04
2.33 2.30 2.28 2.28 2.27 2.27 2.25 2.25 2.23 2.23 2.14 2.13 2.12 2.11 2.10
1.87 1.86 1.86 1.84 1.83 1.82 1.82 1.66 1.65 1.64 1.63 1.62 1.61 1.60 1.59 1.58 1.58 1.57 1.56 1.55
1.04 3.39 2.02 1.04 1.00
2.03
3.14 0.97 1.06
1.07
3.22
8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0
f1 (ppm)

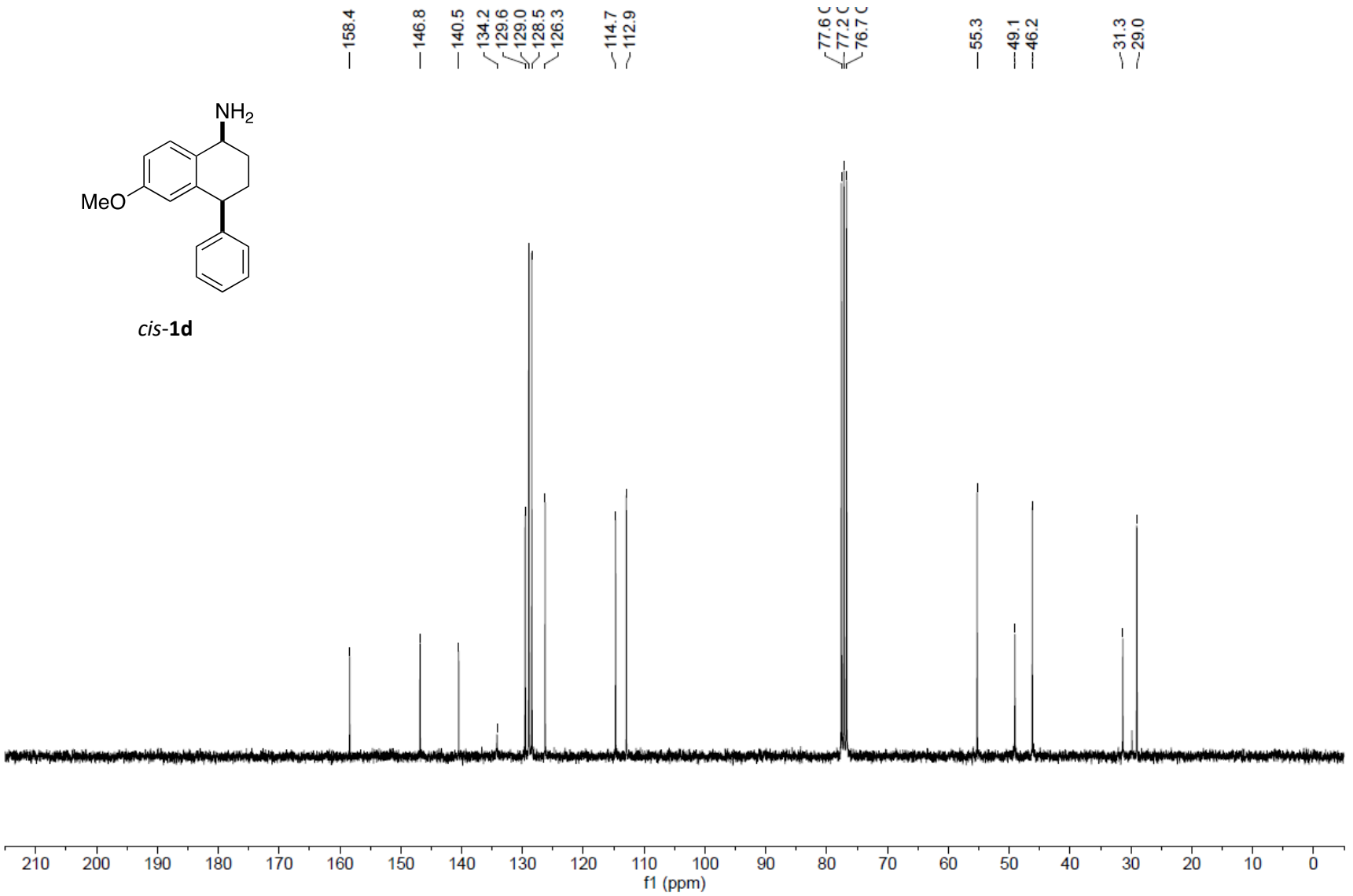
trans-**1c**


147.3
141.4
136.1
136.1
130.2
128.8
128.4
128.1
127.8
126.1
77.6
77.2
76.7
49.9
45.5
32.0
30.3
21.2
NH2
f1 (ppm)

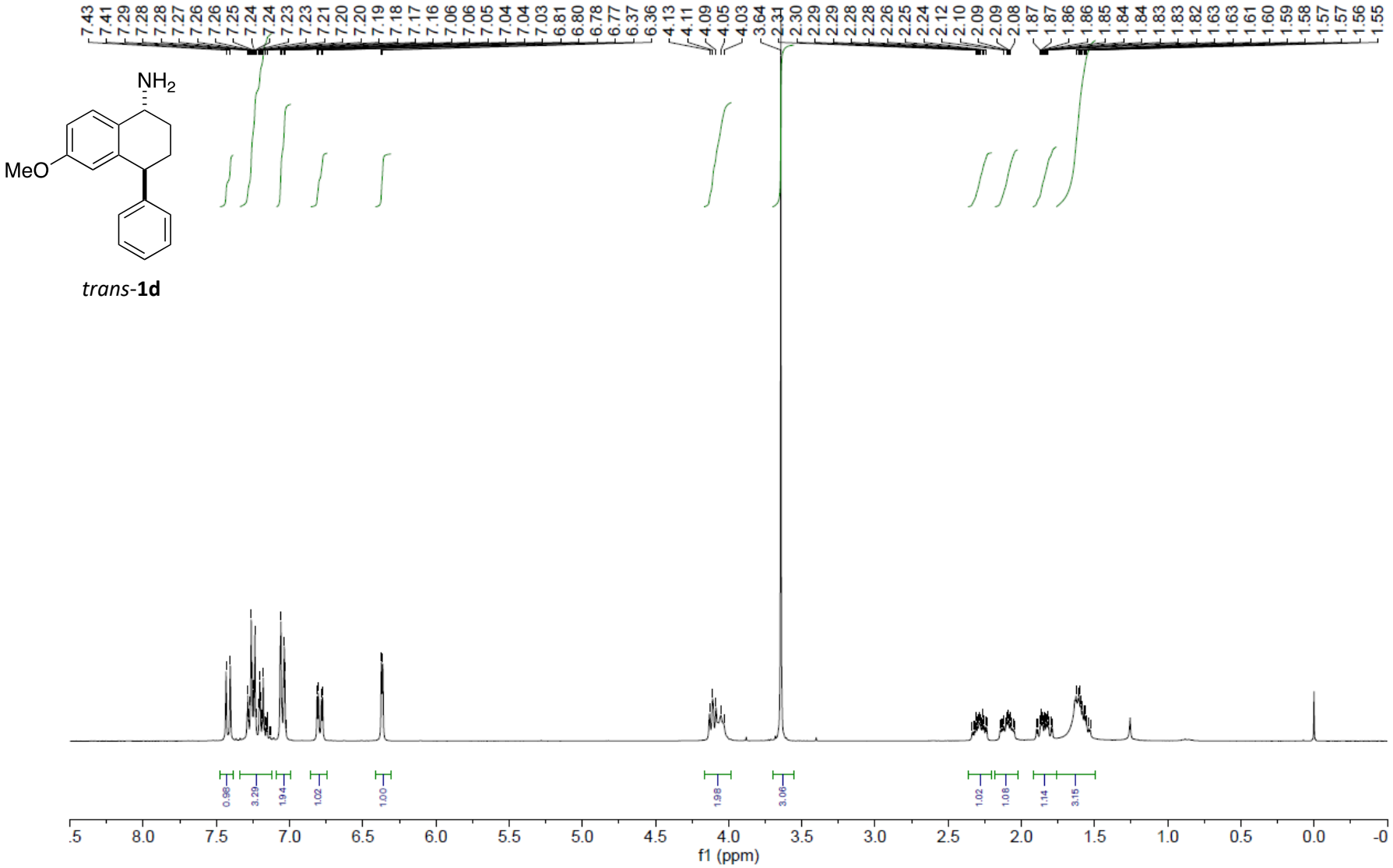
trans-**1c**

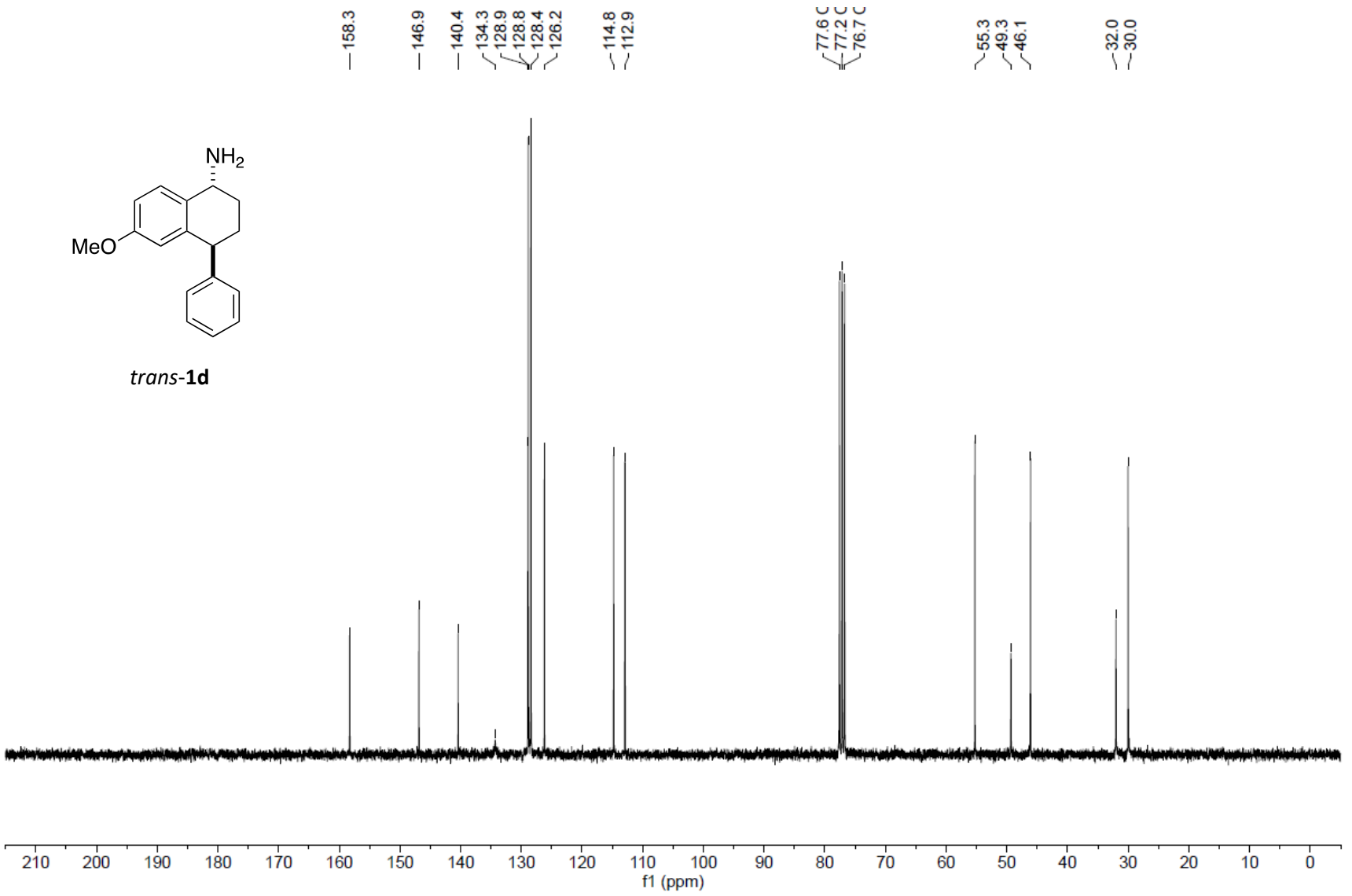

NH2
MeO
7.37 7.34 7.32 7.31 7.31 7.30 7.29 7.28 7.27 7.26 7.26 7.25 7.24 7.23 7.23 7.22 7.21 7.20 7.19 7.18 7.18 7.17 7.14 7.13 7.13 7.12 7.11 7.11 6.80 6.79 6.77 6.76 6.37 6.36
4.03 4.01 3.99
3.64
2.10 2.10 2.09 2.08 2.07 2.07 2.06 2.05 2.04 2.03 2.02 2.01 2.00 1.99 1.98 1.97 1.95 1.94 1.94 1.93 1.91 1.80 1.80 1.78 1.78 1.77 1.77 1.75 1.75 1.73 1.71
6.23
1.01
1.00
1.97
3.05
3.05
1.27
2.28
8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)

cis-**1d**

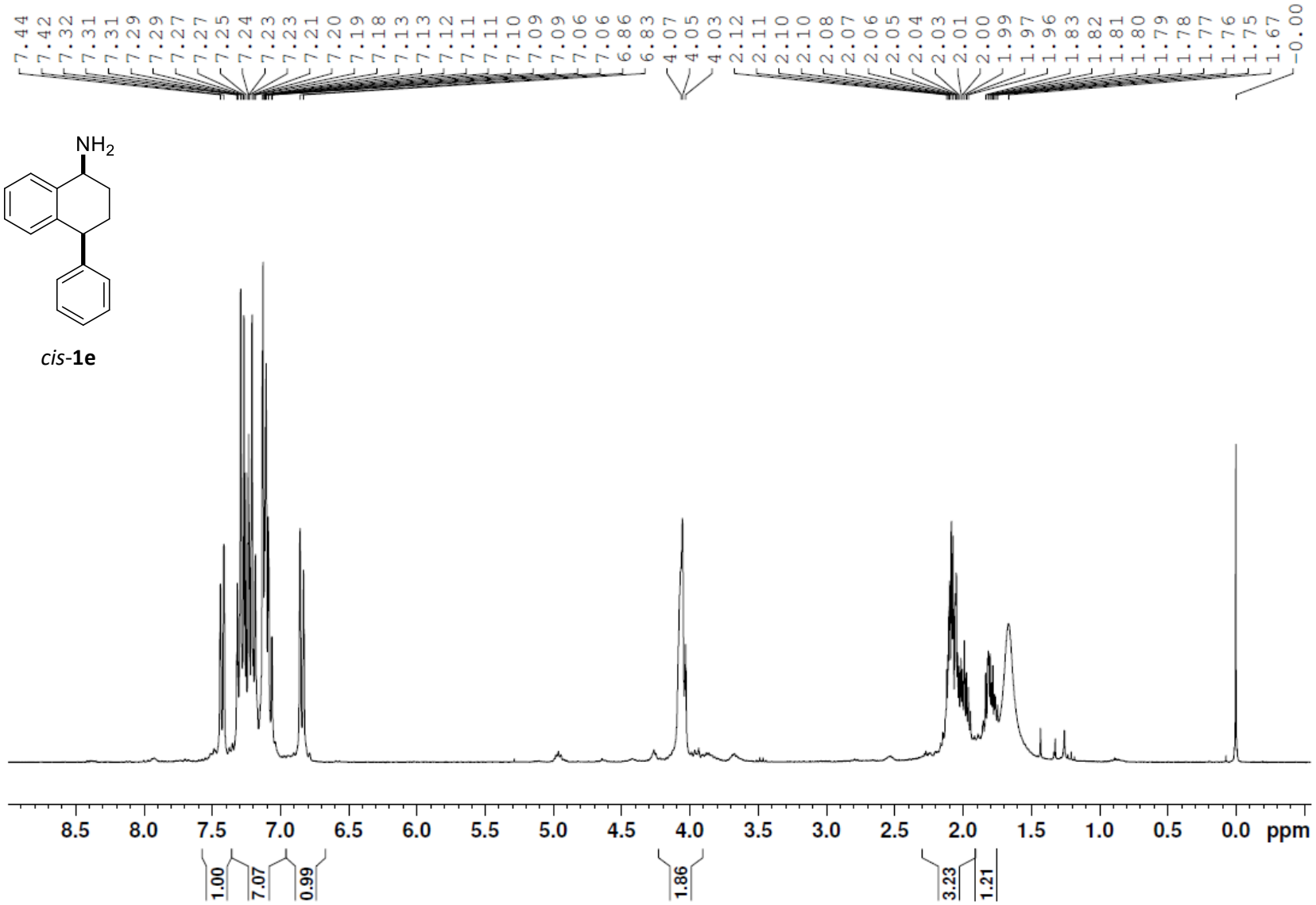

158.4
146.8
140.5
134.2
129.6
129.0
128.5
126.3
114.7
112.9
77.6
77.2
76.7
55.3
49.1
46.2
31.3
29.0
NH2
MeO
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

cis-**1d**

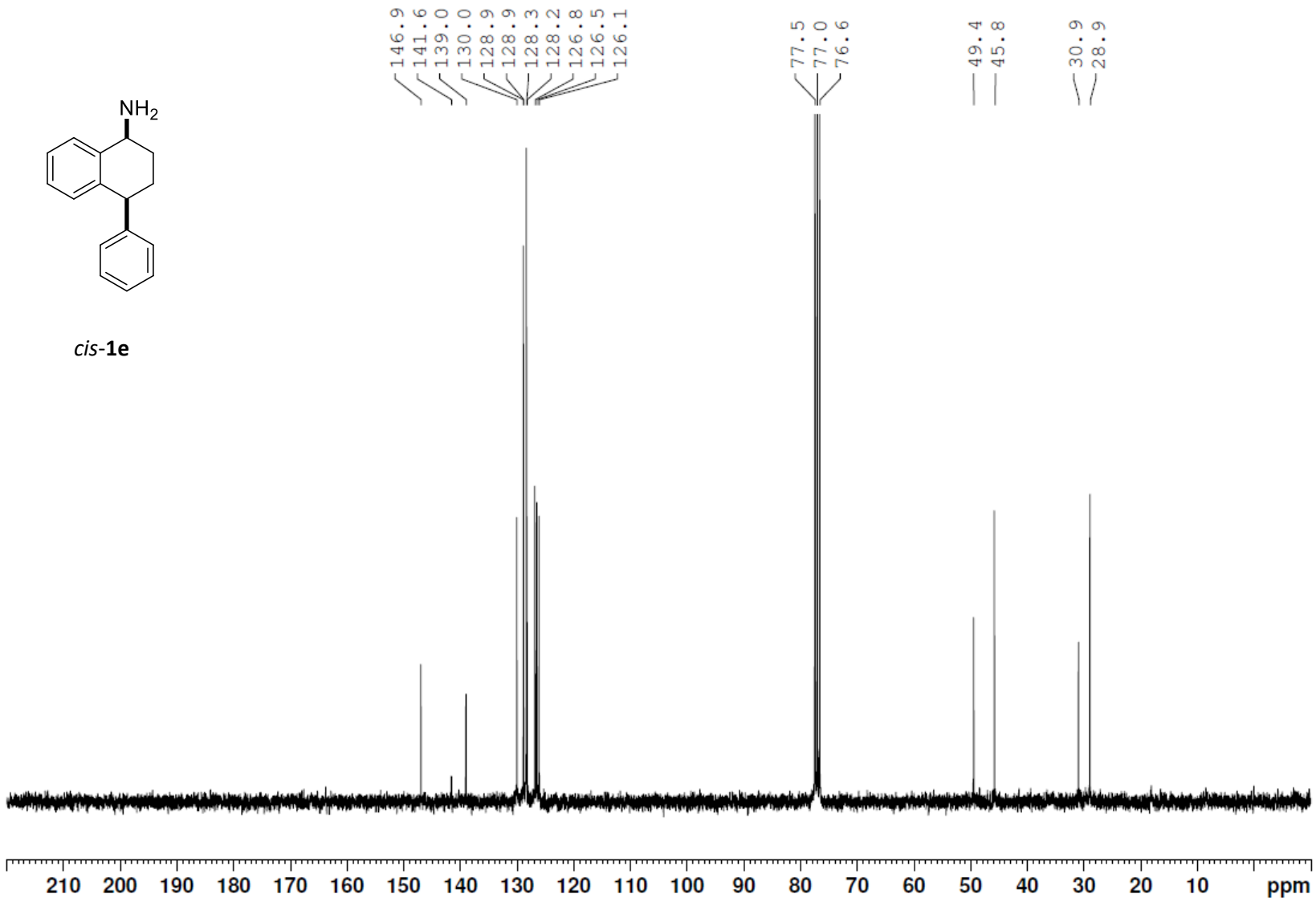

NH2
MeO
trans-1d
f1 (ppm)


158.3
146.9
140.4
134.3
128.9
128.8
128.4
126.2
114.8
112.9
77.6 C
77.2 C
76.7 C
55.3
49.3
46.1
32.0
30.0
NH2
MeO
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

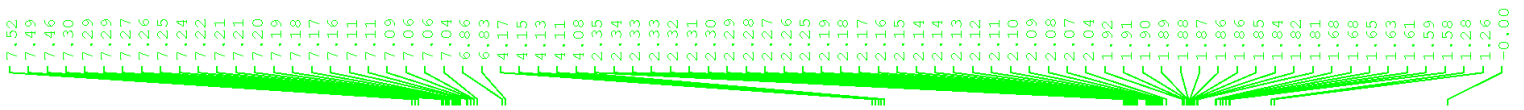
trans-**1d**

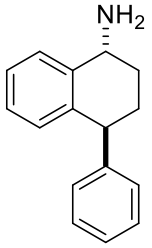

7.44
7.42
7.32
7.31
7.31
7.29
7.29
7.27
7.27
7.25
7.24
7.23
7.23
7.21
7.20
7.19
7.18
7.13
7.13
7.12
7.11
7.11
7.10
7.09
7.09
7.06
7.06
6.86
6.83
4.07
4.05
4.03
2.12
2.11
2.10
2.10
2.08
2.07
2.06
2.05
2.04
2.03
2.01
2.00
1.99
1.97
1.96
1.83
1.82
1.81
1.80
1.79
1.78
1.77
1.76
1.75
1.67
0.00
NH2
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
ppm
1.00
7.07
0.99
1.86
3.23
1.21

cis-**1e**

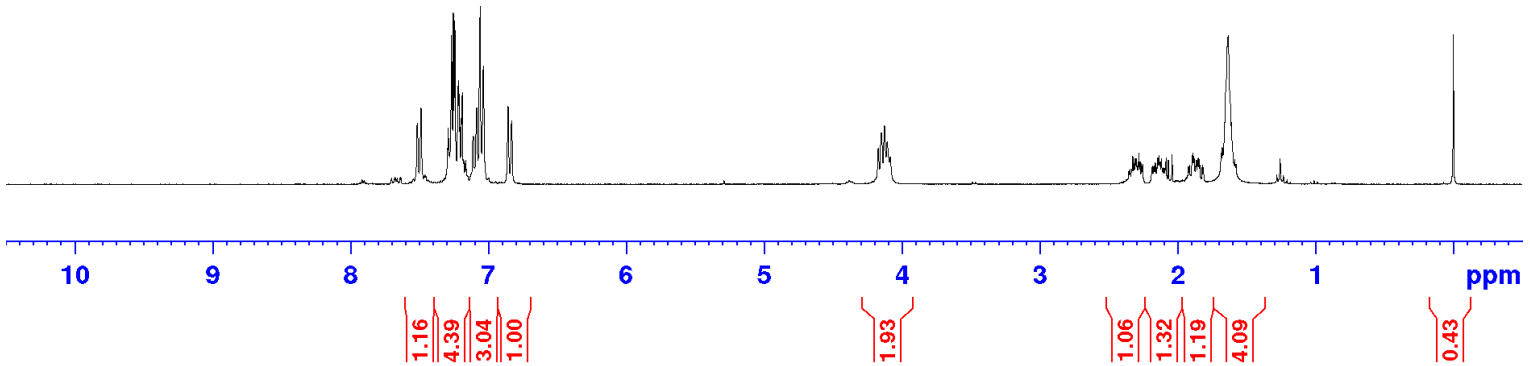

NH2
146.9
141.6
139.0
130.0
128.9
128.9
128.3
128.2
126.8
126.5
126.1
77.5
77.0
76.6
49.4
45.8
30.9
28.9
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 ppm

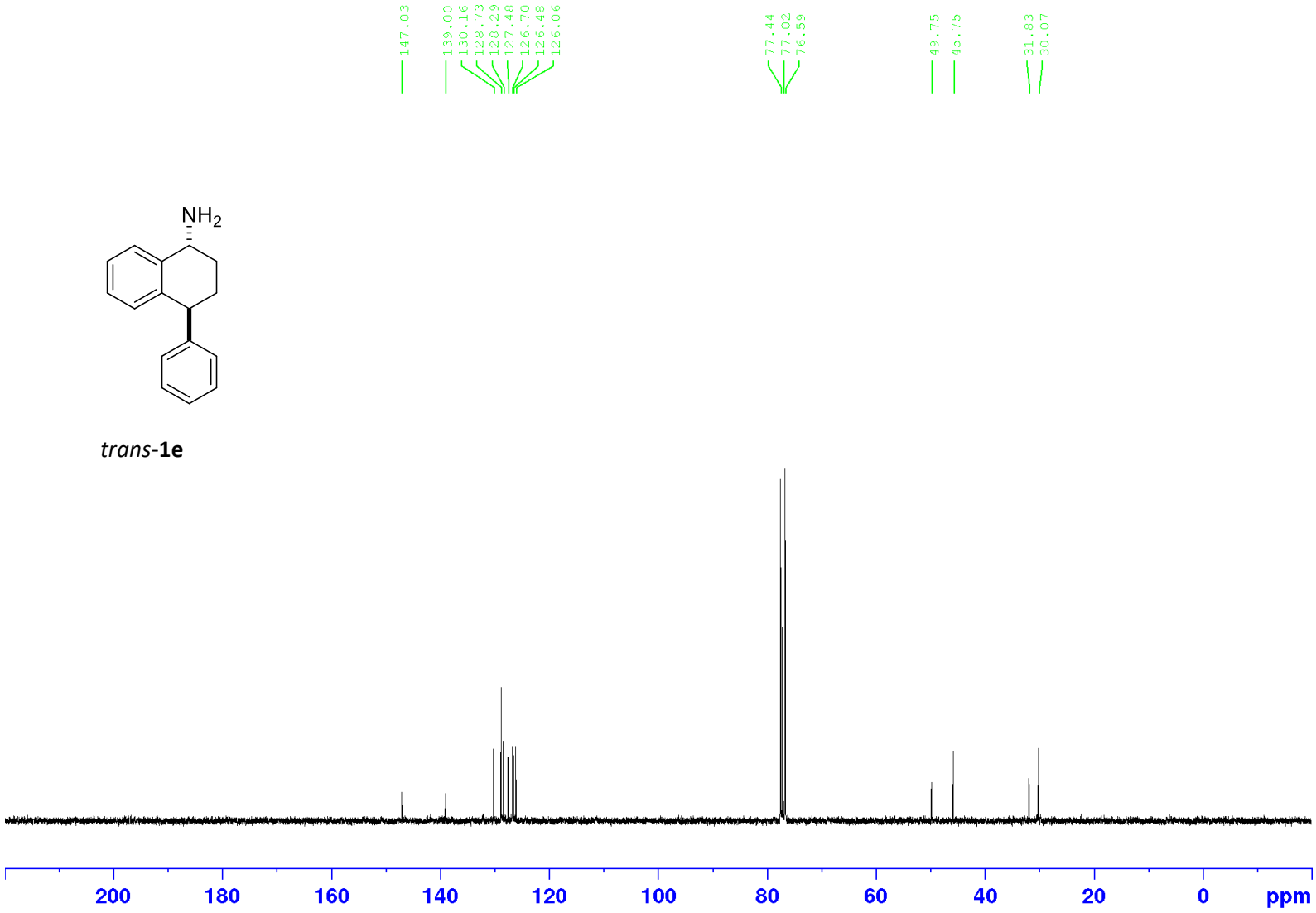
cis-**1e**


7.52
7.49
7.46
7.30
7.29
7.29
7.27
7.26
7.25
7.24
7.22
7.21
7.21
7.20
7.19
7.18
7.17
7.16
7.11
7.11
7.09
7.06
7.06
7.04
6.86
6.83
4.17
4.15
4.13
4.11
4.08
2.35
2.34
2.33
2.33
2.32
2.31
2.30
2.29
2.28
2.27
2.26
2.25
2.19
2.18
2.17
2.16
2.15
2.14
2.14
2.13
2.12
2.11
2.10
2.09
2.08
2.07
2.04
1.92
1.91
1.90
1.89
1.88
1.87
1.86
1.86
1.85
1.84
1.82
1.81
1.68
1.68
1.65
1.63
1.61
1.59
1.58
1.28
1.26
-0.00

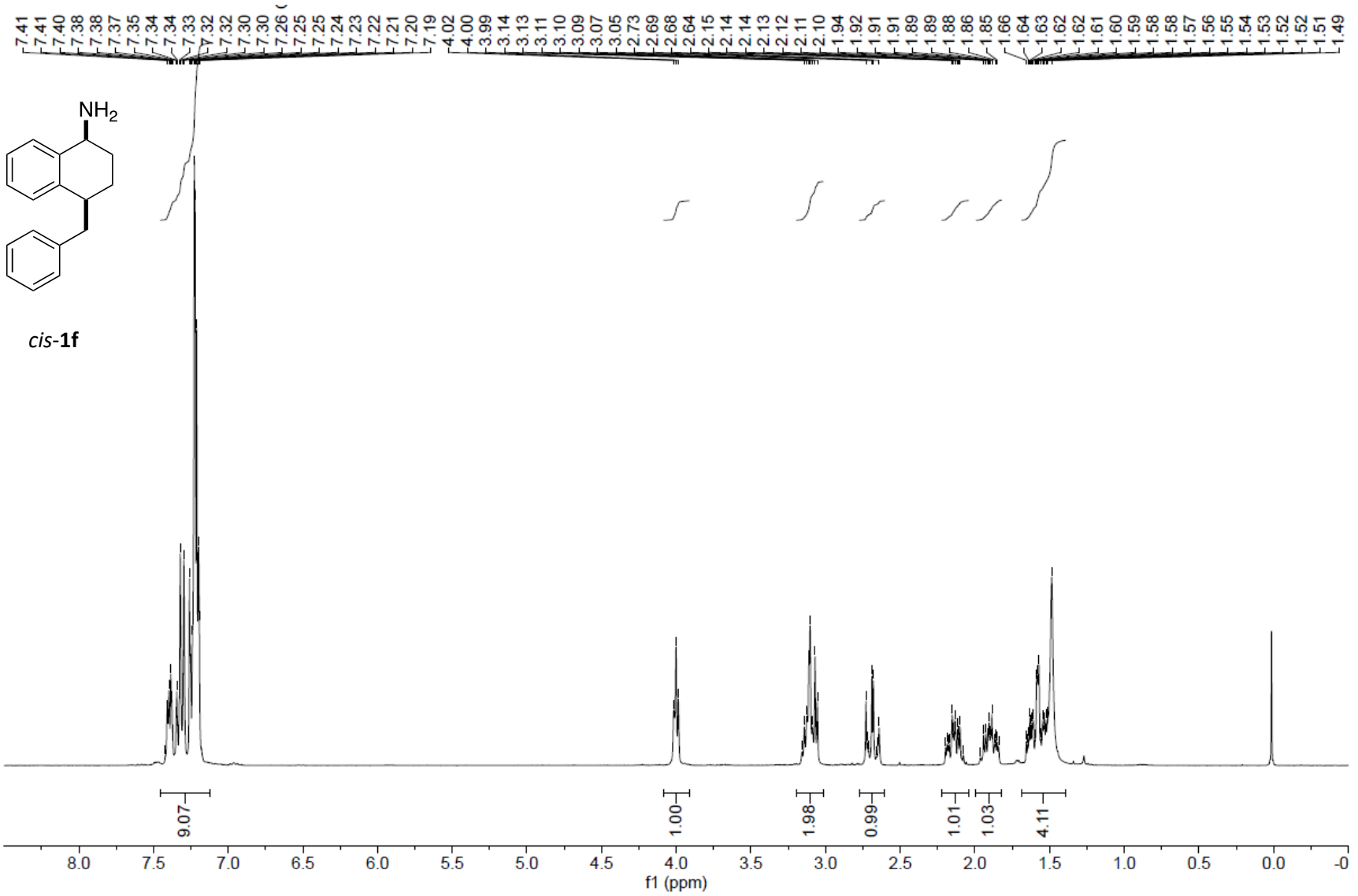

NH2

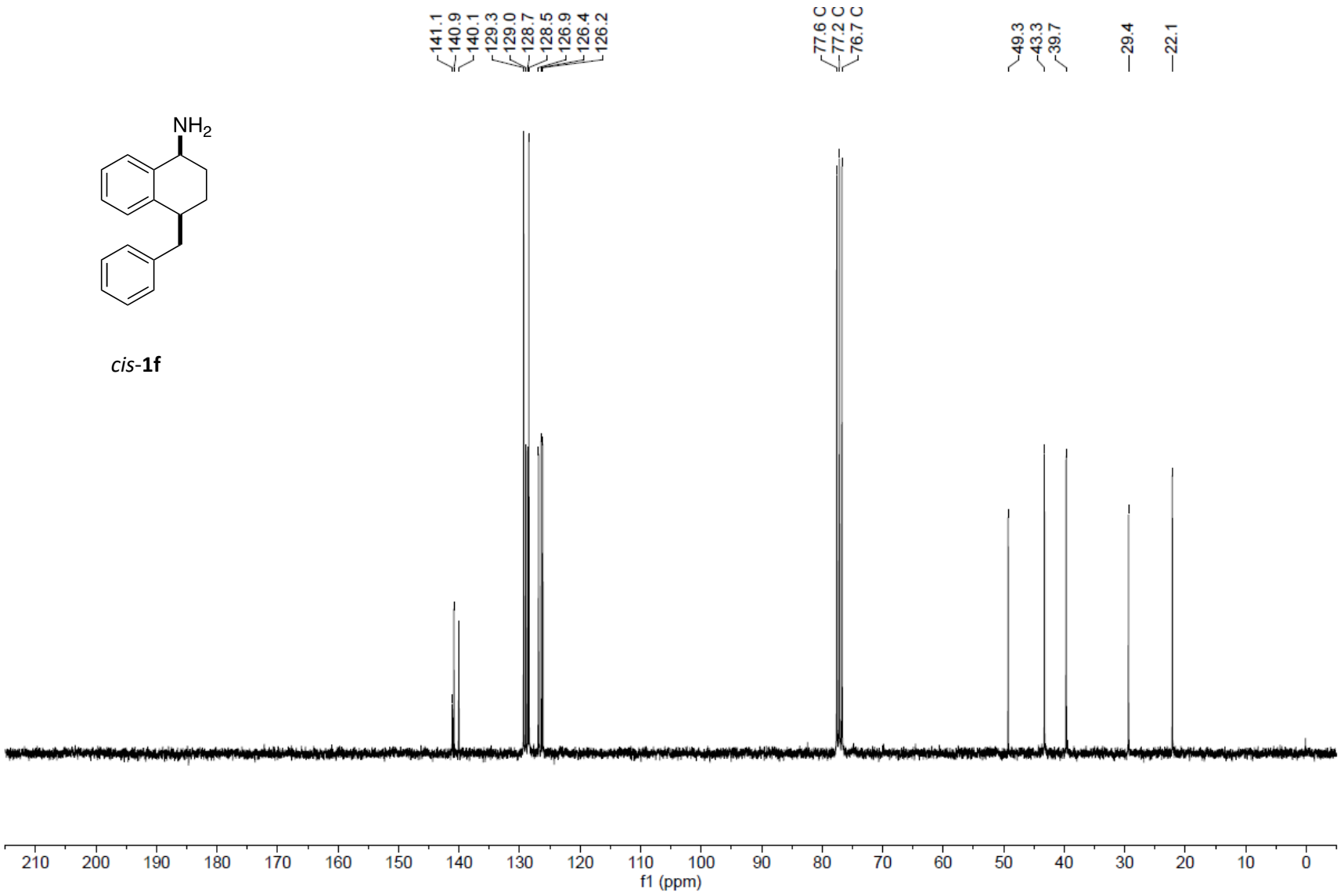
trans-**1e**


10
9
8
7
6
5
4
3
2
1
ppm
1.16
4.39
3.04
1.00
1.93
1.06
1.32
1.19
4.09
0.43

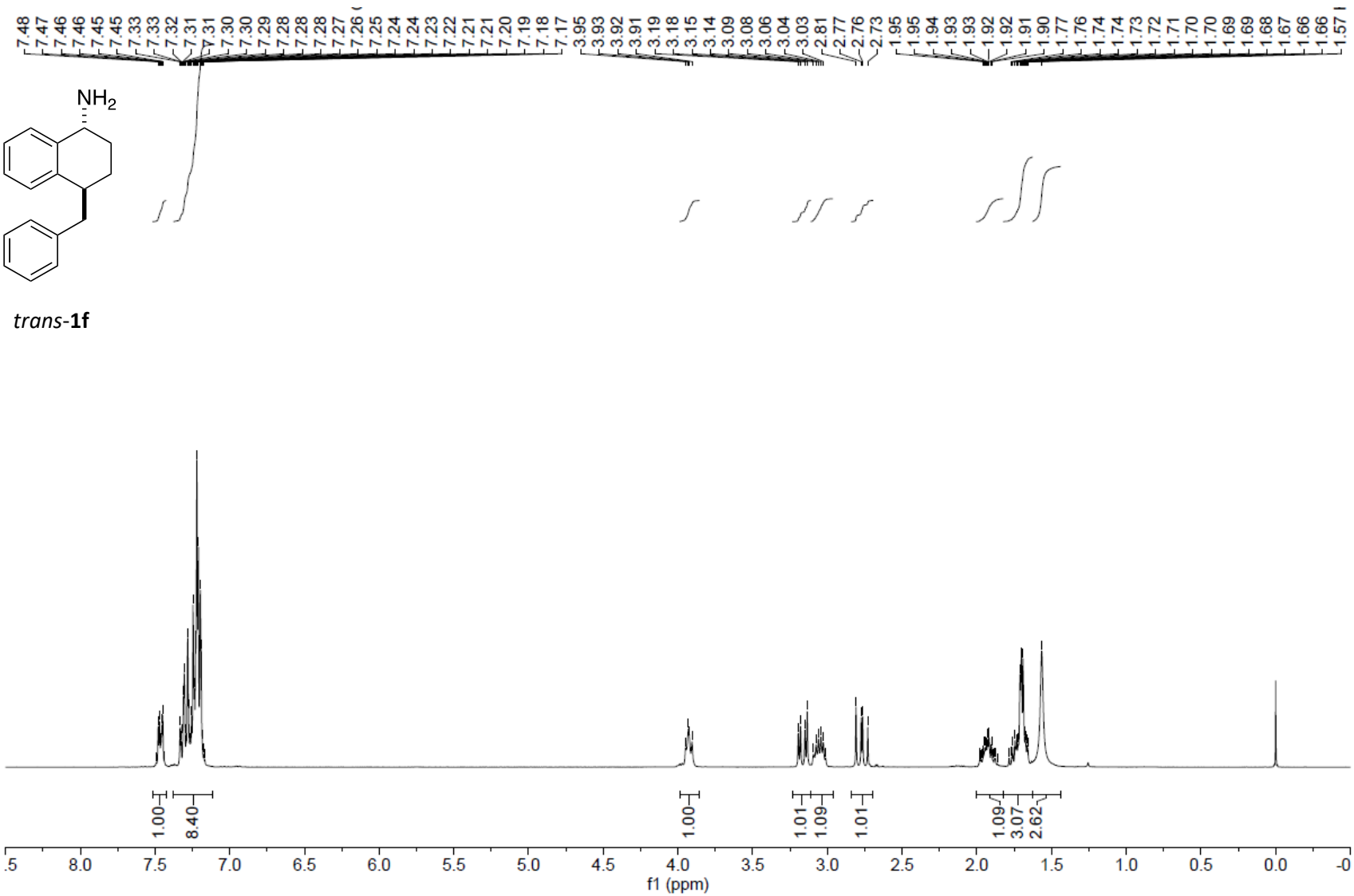

147.03
139.00
130.16
128.73
128.29
127.48
126.70
126.48
126.06
77.44
77.02
76.59
49.75
45.75
31.83
30.07
NH2
200
180
160
140
120
100
80
60
40
20
0
ppm

trans-**1e**

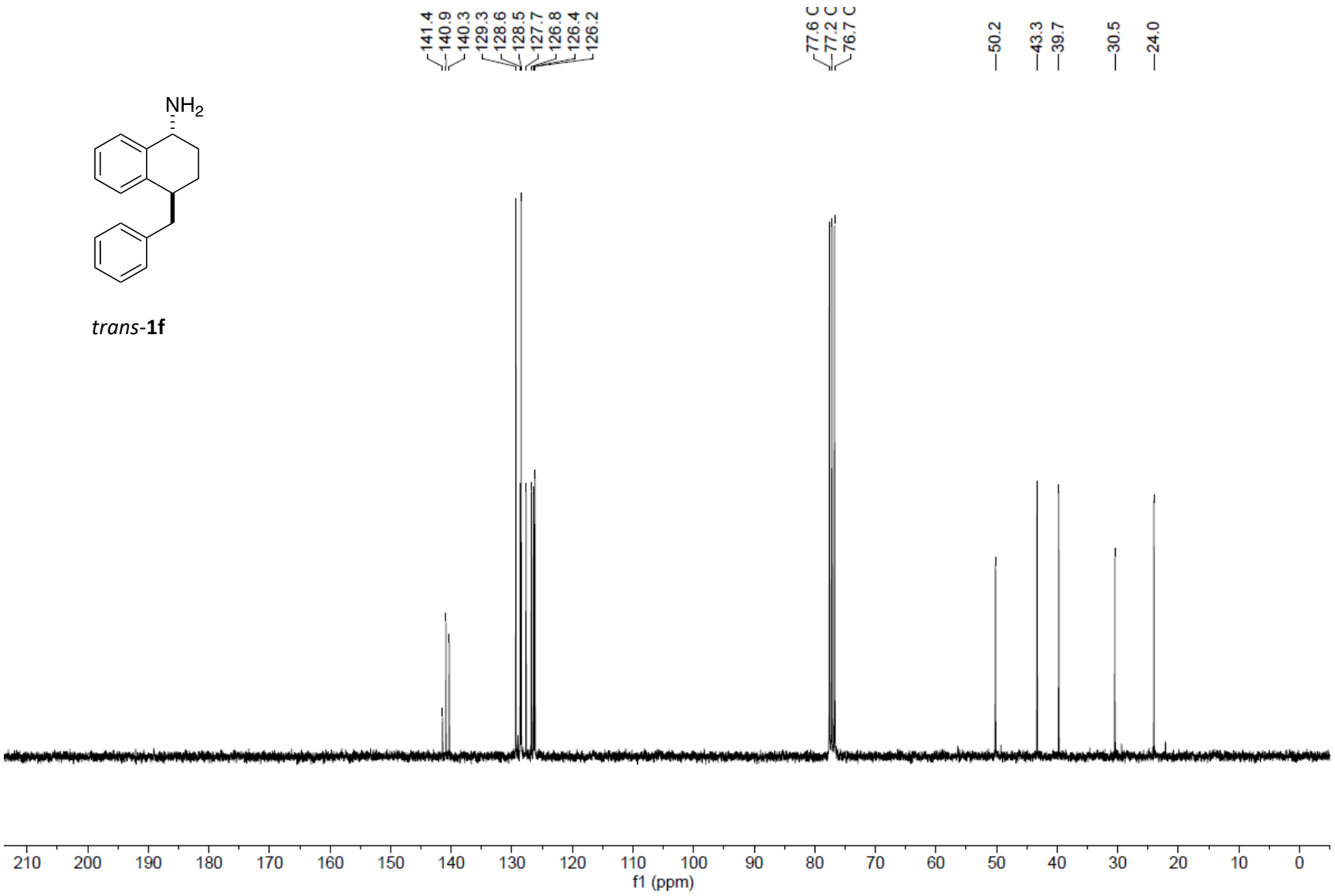

NH2
cis-1f
9.07
1.00
1.98
0.99
1.01
1.03
4.11
f1 (ppm)


141.1
140.9
140.1
129.3
129.0
128.7
128.5
126.9
126.4
126.2
77.6 C
77.2 C
76.7 C
49.3
43.3
39.7
29.4
22.1
NH2
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

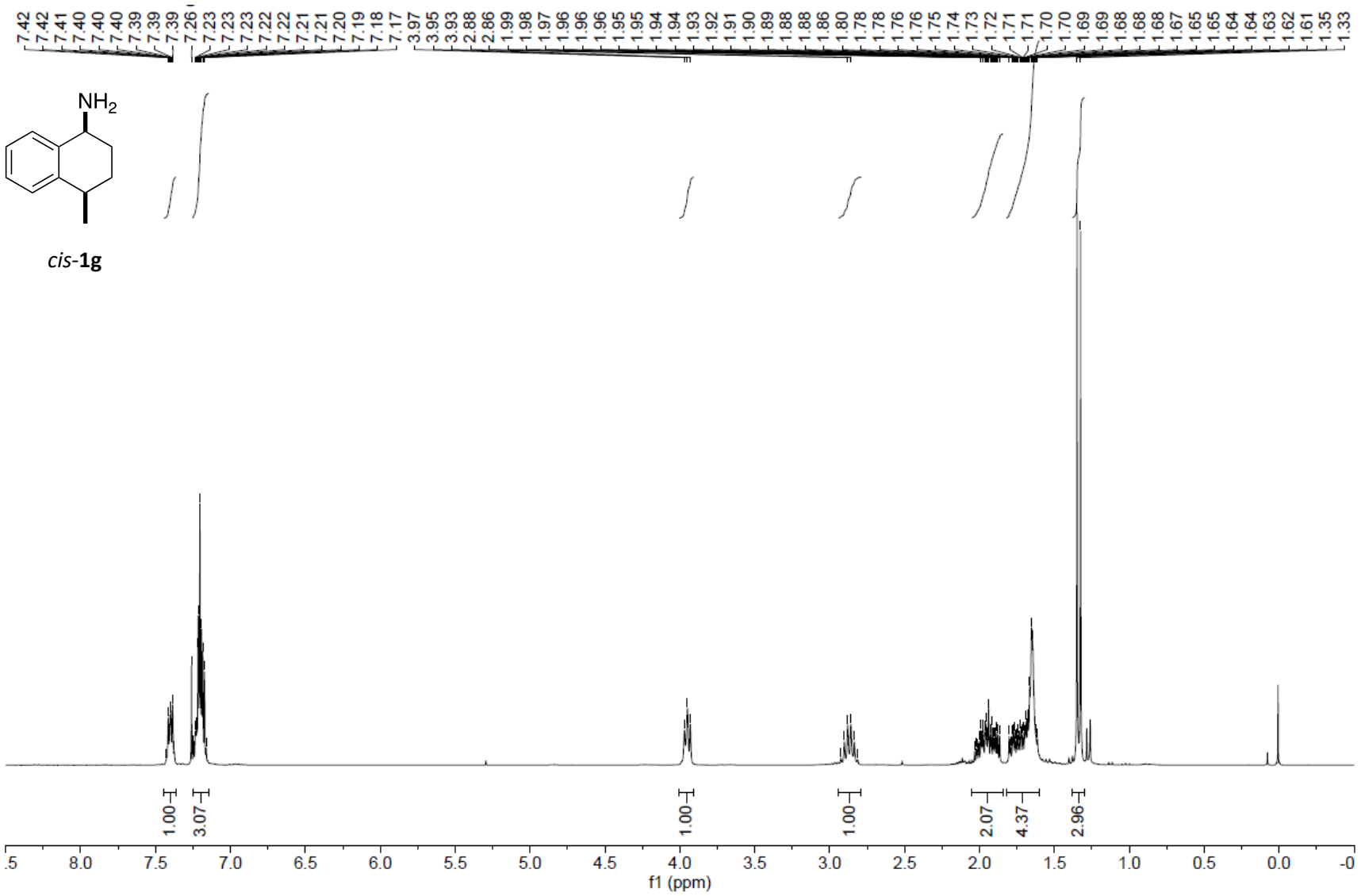
cis-**1f**

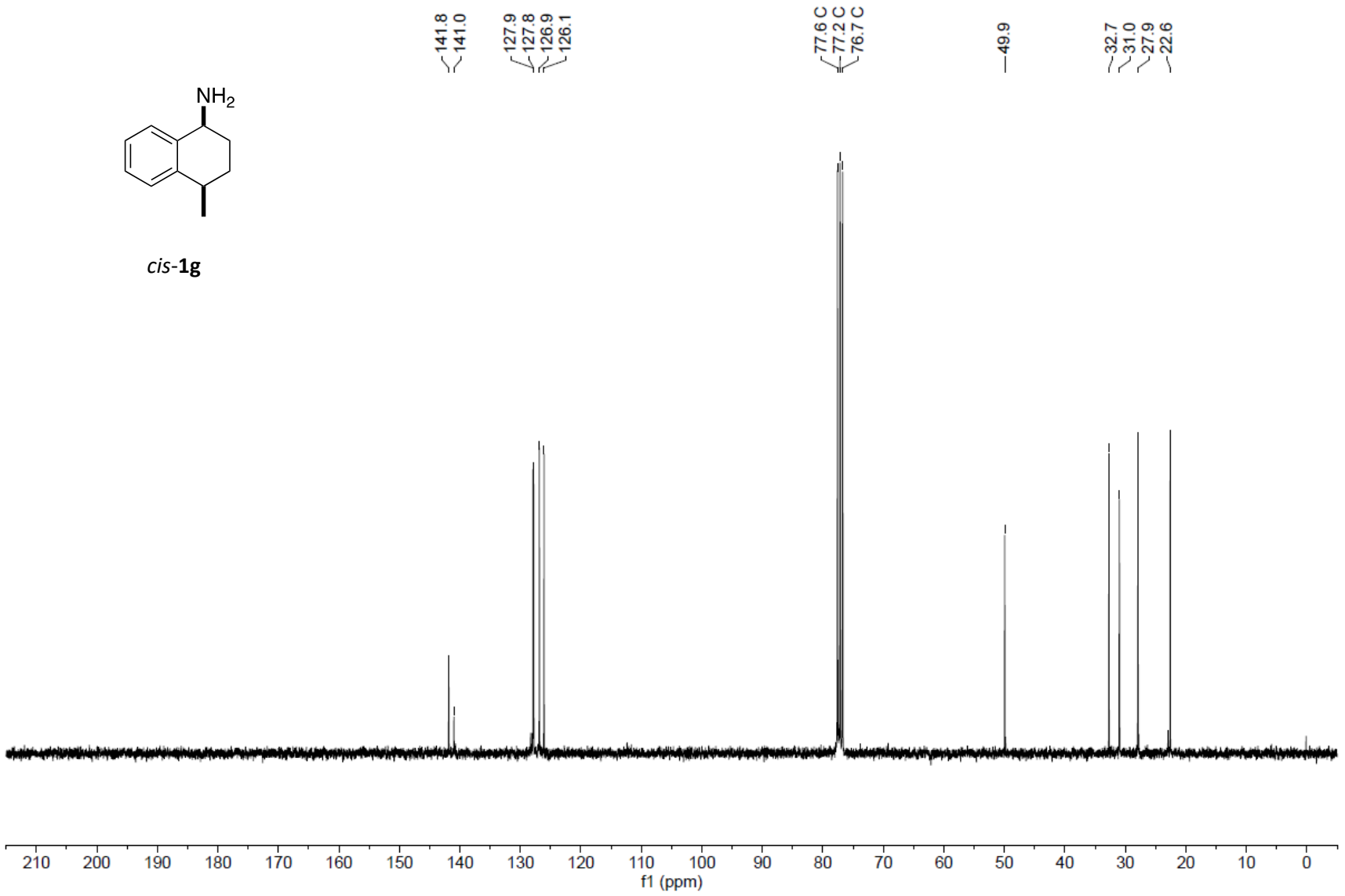

NH2
7.48 7.47 7.46 7.46 7.45 7.45 7.33 7.33 7.32 7.31 7.31 7.30 7.30 7.29 7.28 7.28 7.28 7.27 7.26 7.25 7.24 7.24 7.23 7.22 7.21 7.21 7.20 7.19 7.18 7.17
3.95 3.93 3.92 3.91 3.19 3.18 3.15 3.14 3.09 3.08 3.06 3.04 3.03 2.81 2.77 2.76 2.73
1.95 1.95 1.94 1.93 1.93 1.92 1.92 1.91 1.90 1.77 1.76 1.74 1.74 1.73 1.72 1.71 1.70 1.70 1.69 1.69 1.68 1.67 1.66 1.66
1.00 8.40 1.00 1.01 1.09 1.01 1.09 3.07 2.62
f1 (ppm)

trans-**1f**

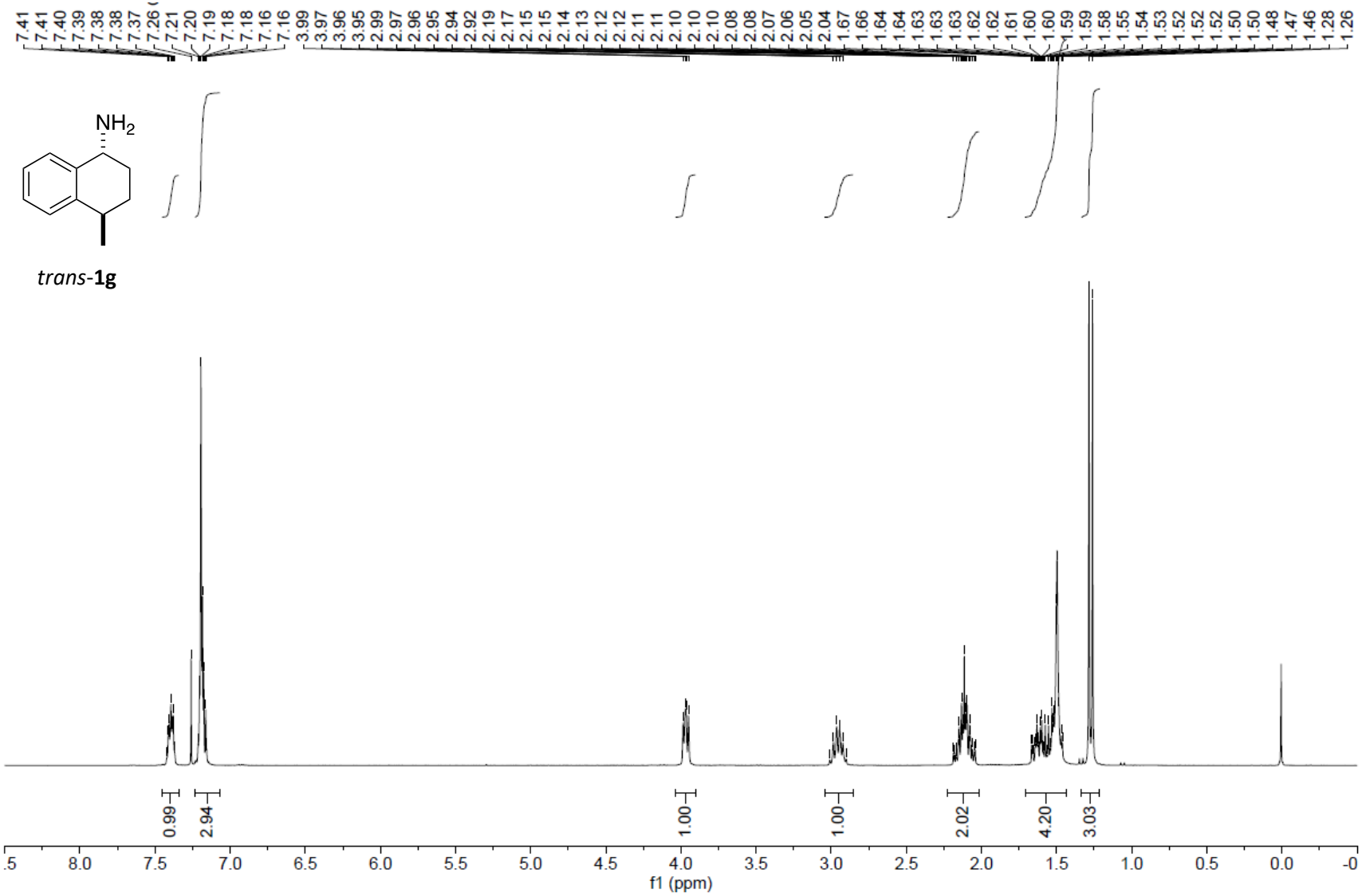

141.4
140.9
140.3
129.3
128.6
128.5
127.7
126.8
126.4
126.2
77.6 C
77.2 C
76.7 C
50.2
43.3
39.7
30.5
24.0
NH2
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

trans-**1f**

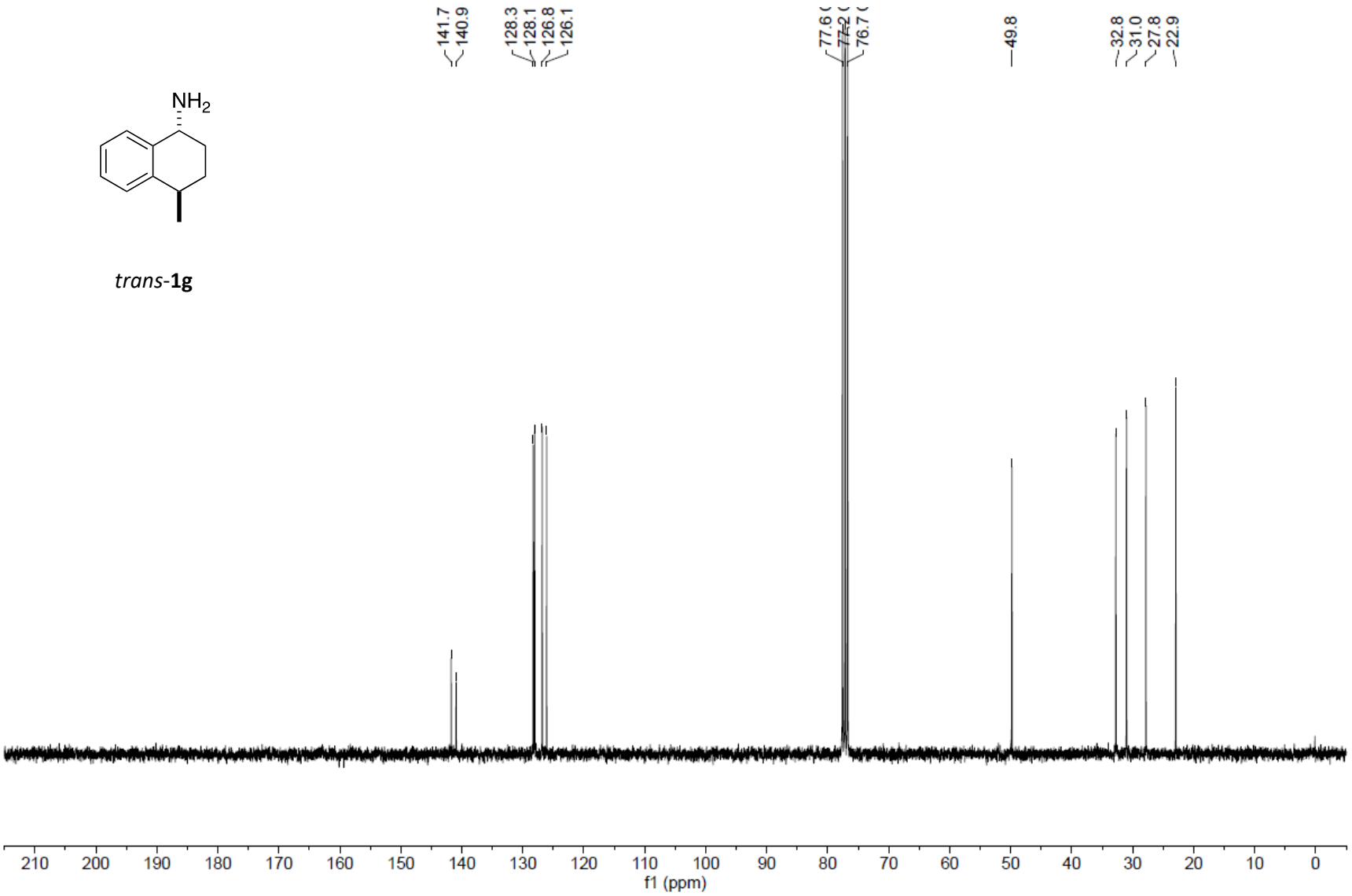

NH2
cis-1g
f1 (ppm)


141.8
141.0
127.9
127.8
126.9
126.1
77.6 C
77.2 C
76.7 C
49.9
32.7
31.0
27.9
22.6
NH2
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

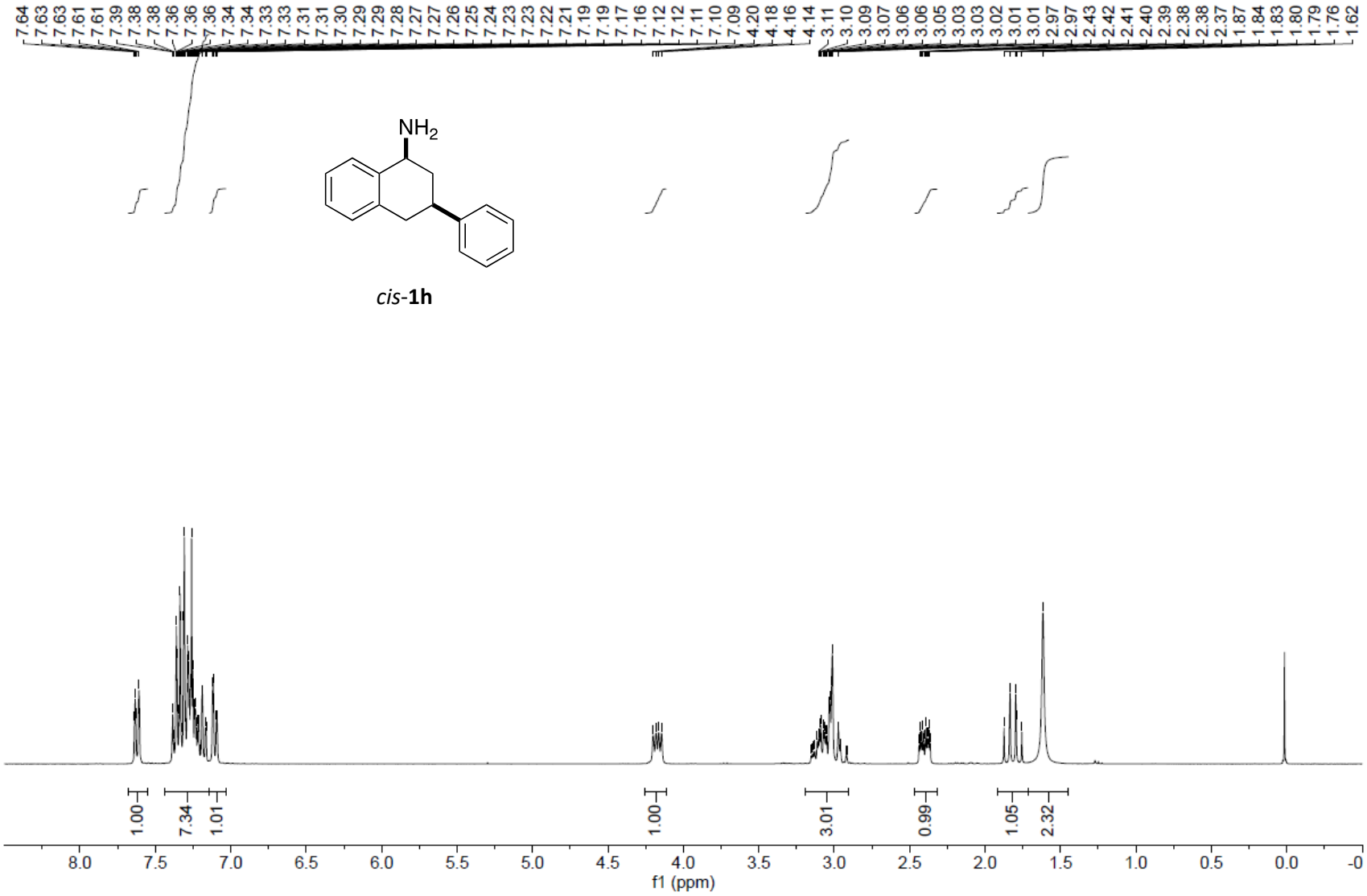
cis-**1g**



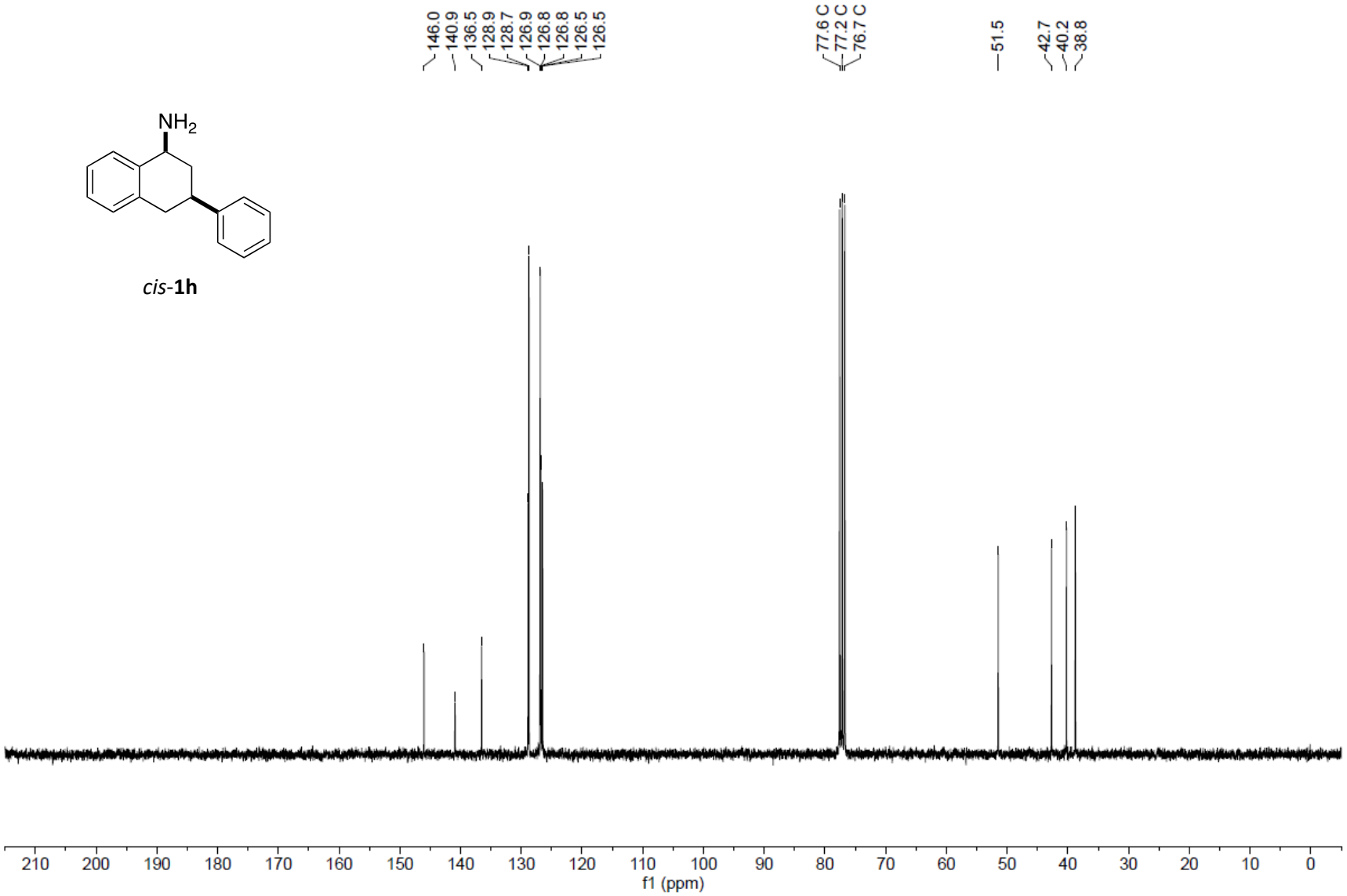
trans-**1g**

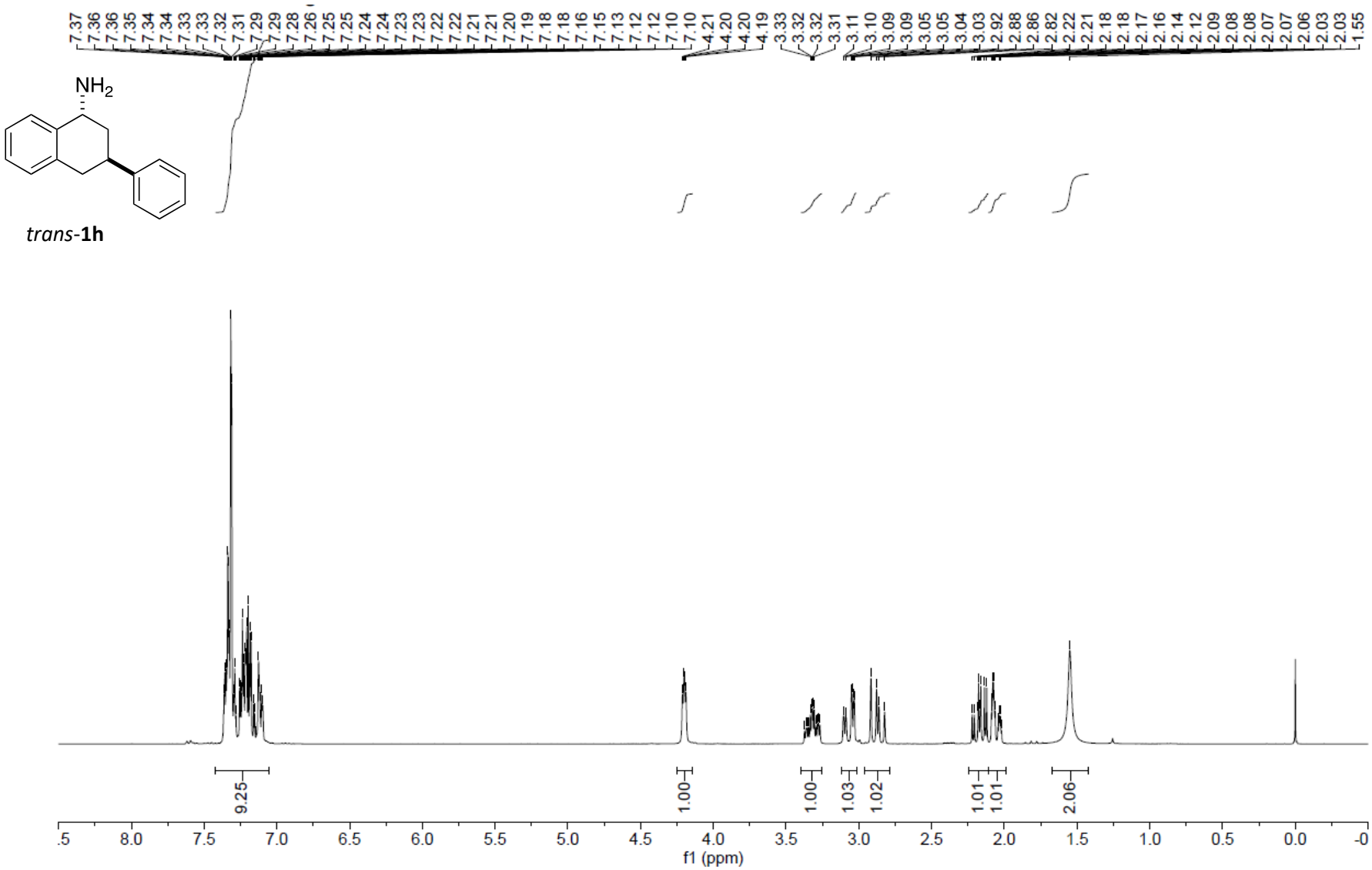

NH2
141.7
140.9
128.3
128.1
126.8
126.1
77.6
77.2
76.7
49.8
32.8
31.0
27.8
22.9
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)

trans-**1g**

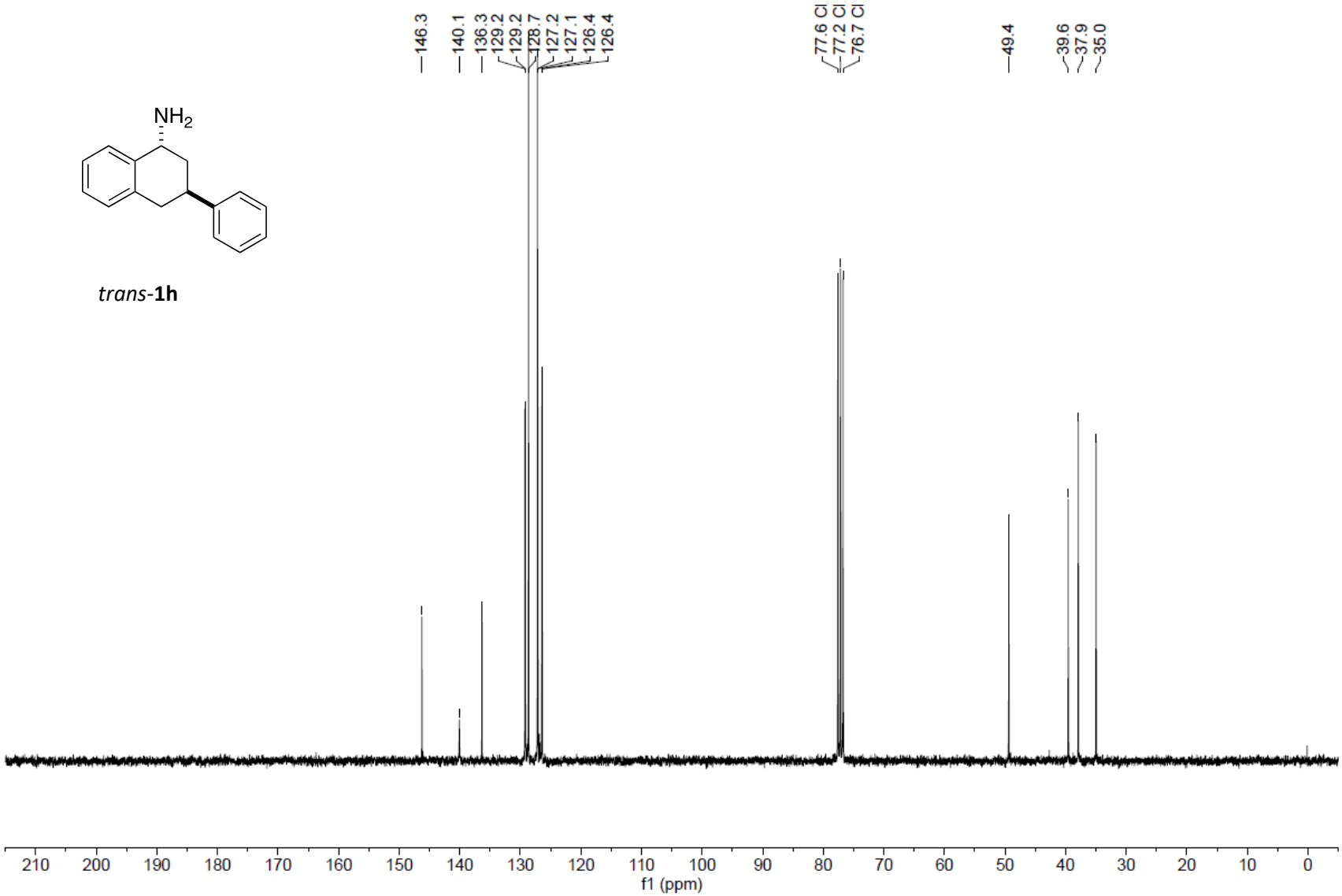

7.64 7.63 7.63 7.61 7.61 7.39 7.38 7.38 7.36 7.36 7.36 7.34 7.34 7.33 7.33 7.31 7.31 7.30 7.29 7.29 7.28 7.27 7.27 7.26 7.25 7.24 7.23 7.23 7.22 7.21 7.19 7.19 7.17 7.16 7.12 7.12 7.11 7.10 7.09 4.20 4.18 4.16 4.14
3.11 3.10 3.09 3.07 3.06 3.06 3.05 3.03 3.03 3.02 3.01 3.01 2.97 2.97 2.43 2.42 2.41 2.40 2.39 2.38 2.38 2.37 1.87 1.84 1.83 1.80 1.79 1.76 1.62
NH2
1.00 7.34 1.01 1.00 3.01 0.99 1.05 2.32
8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0
f1 (ppm)

cis-**1h**

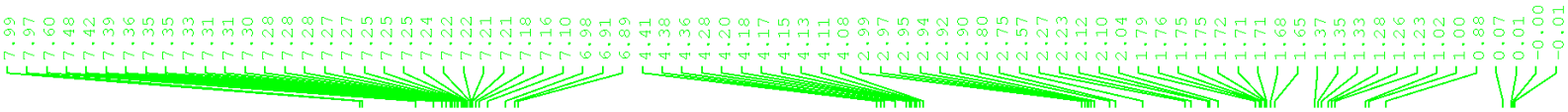

146.0
140.9
136.5
128.9
128.7
126.9
126.8
126.8
126.5
126.5
77.6 C
77.2 C
76.7 C
51.5
42.7
40.2
38.8
NH2
cis-1h
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

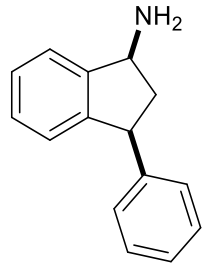

7.37 7.36 7.36 7.35 7.34 7.34 7.33 7.33 7.32 7.31 7.29 7.29 7.28 7.26 7.25 7.25 7.24 7.24 7.23 7.23 7.22 7.22 7.21 7.21 7.20 7.19 7.18 7.18 7.16 7.15 7.13 7.12 7.12 7.10 7.10 4.21 4.20 4.20 4.19 3.33 3.32 3.31 3.11 3.10 3.09 3.09 3.05 3.05 3.04 3.03 2.92 2.88 2.86 2.82 2.22 2.21 2.18 2.18 2.17 2.16 2.14 2.12 2.09 2.08 2.08 2.07 2.07 2.06 2.03 2.03 1.55
NH2
9.25
1.00
1.00
1.03
1.02
1.01
1.01
2.06
8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)

trans-**1h**

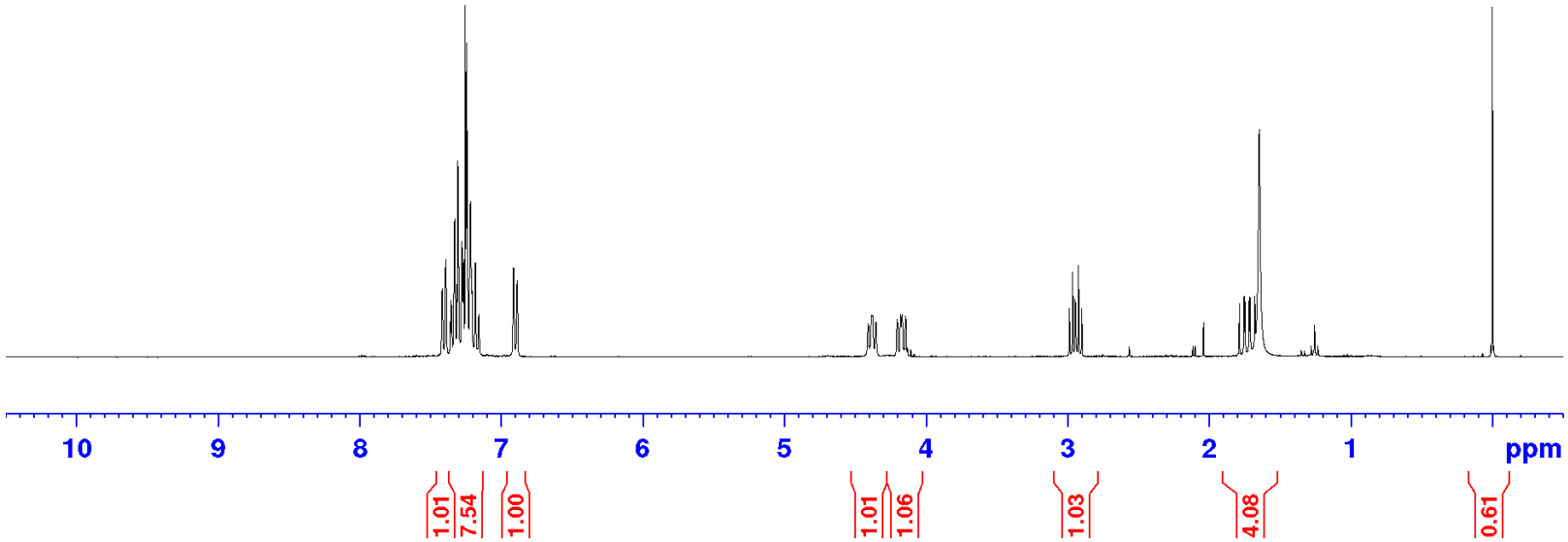

NH2
146.3
140.1
136.3
129.2
129.2
128.7
127.2
127.1
126.4
126.4
77.6 Cl
77.2 Cl
76.7 Cl
49.4
39.6
37.9
35.0
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

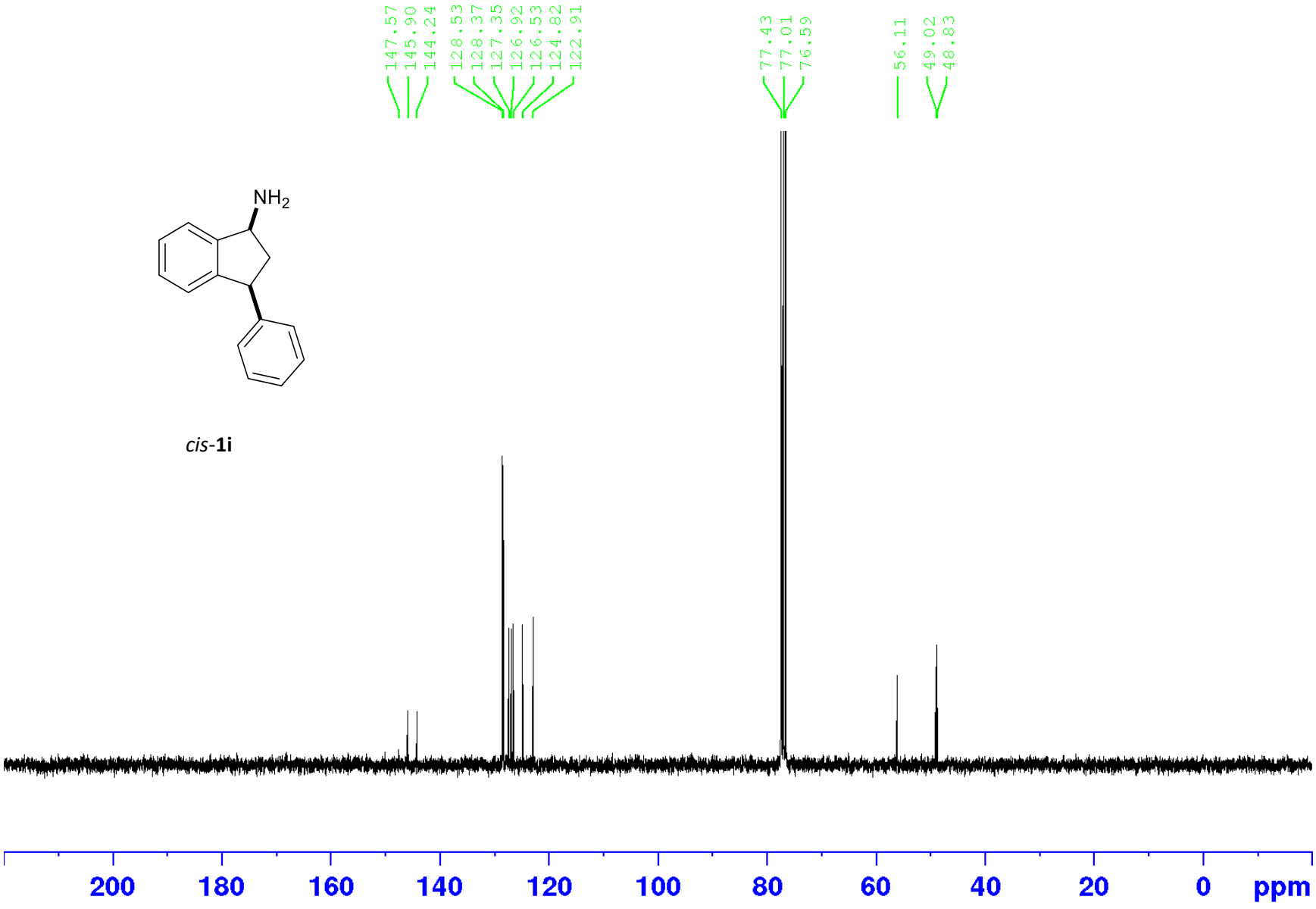
trans-**1h**


7.99
7.97
7.60
7.48
7.42
7.39
7.36
7.35
7.35
7.33
7.31
7.31
7.30
7.28
7.28
7.28
7.27
7.27
7.25
7.25
7.25
7.24
7.22
7.22
7.21
7.21
7.18
7.16
7.10
6.98
6.91
6.89
4.41
4.38
4.36
4.28
4.20
4.18
4.17
4.15
4.13
4.11
4.08
2.99
2.97
2.95
2.94
2.92
2.90
2.80
2.75
2.57
2.27
2.23
2.12
2.10
2.04
1.79
1.76
1.75
1.75
1.72
1.71
1.71
1.68
1.65
1.37
1.35
1.33
1.28
1.26
1.23
1.02
1.00
0.88
0.07
0.01
-0.00
-0.01

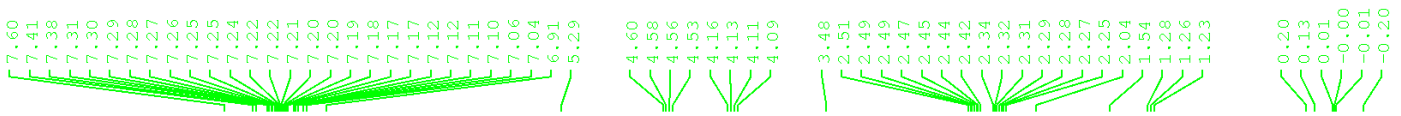

NH2

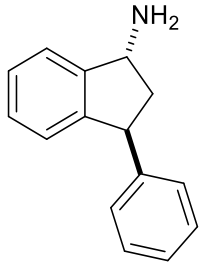
cis-**1i**


10
9
8
7
6
5
4
3
2
1
ppm
1.01
7.54
1.00
1.01
1.06
1.03
4.08
0.61

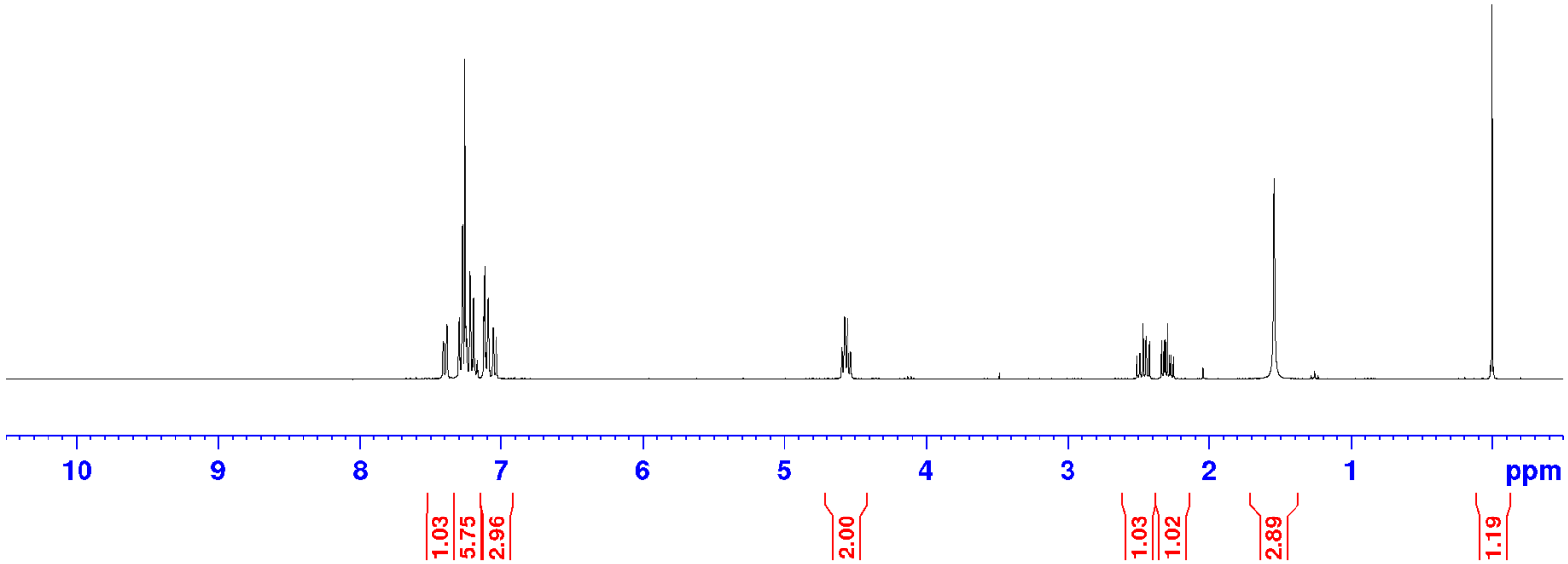

147.57
145.90
144.24
128.53
128.37
127.35
126.92
126.53
124.82
122.91
77.43
77.01
76.59
56.11
49.02
48.83
NH2
200
180
160
140
120
100
80
60
40
20
0
ppm

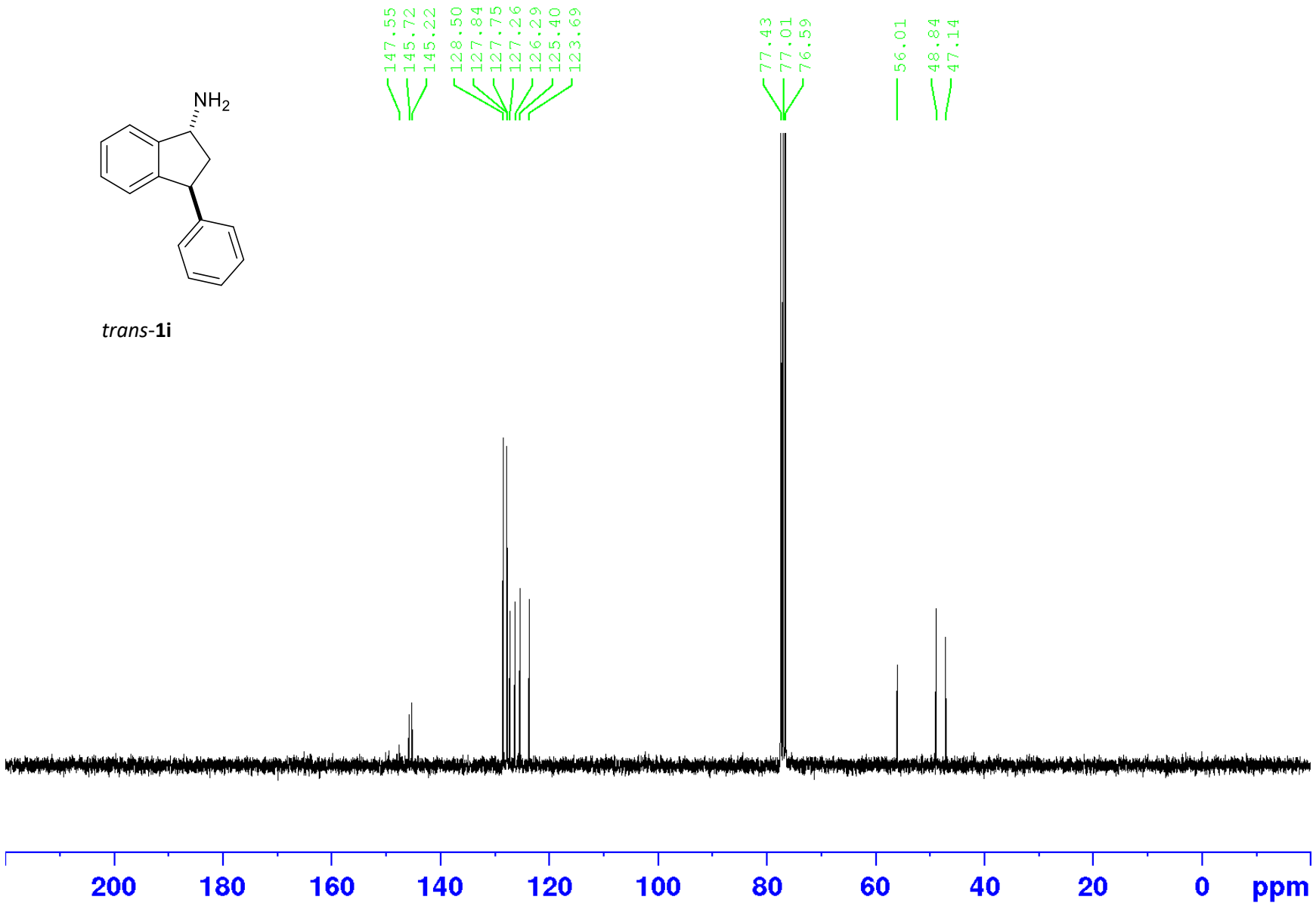
cis-**1i**


7.60
7.41
7.38
7.31
7.30
7.29
7.28
7.27
7.26
7.25
7.24
7.22
7.22
7.21
7.20
7.20
7.19
7.18
7.17
7.17
7.12
7.12
7.11
7.10
7.06
7.04
6.91
5.29
4.60
4.58
4.56
4.53
4.16
4.13
4.11
4.09
3.48
2.51
2.49
2.49
2.47
2.45
2.44
2.42
2.34
2.32
2.31
2.29
2.28
2.27
2.25
2.04
1.54
1.28
1.26
1.23
0.20
0.13
0.01
-0.00
-0.01
-0.20

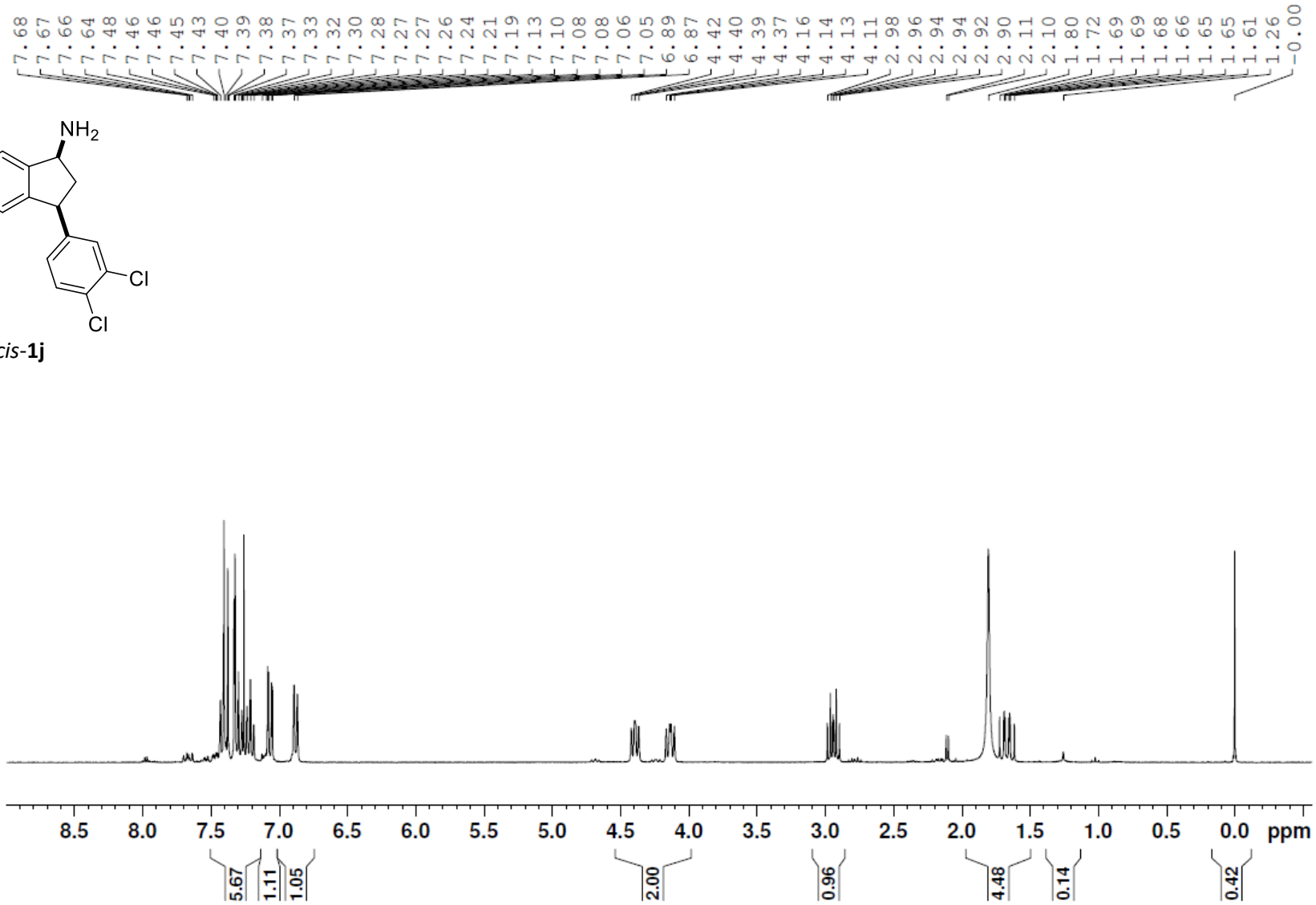

NH2

trans-**1i**

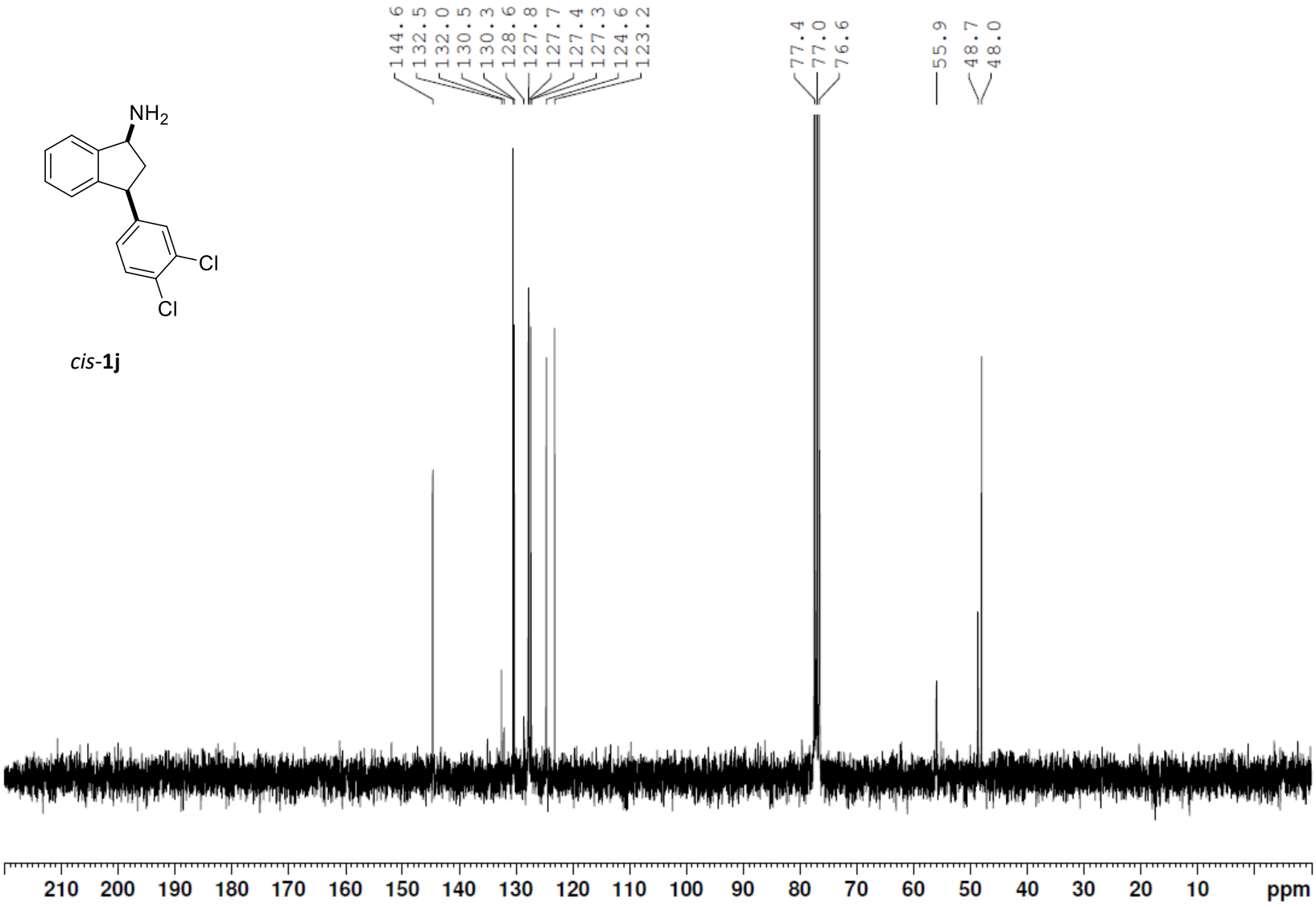

10
9
8
7
6
5
4
3
2
1
ppm
1.03
5.75
2.96
2.00
1.03
1.02
2.89
1.19


147.55
145.72
145.22
128.50
127.84
127.75
127.26
126.29
125.40
123.69
77.43
77.01
76.59
56.01
48.84
47.14
NH2
200
180
160
140
120
100
80
60
40
20
0
ppm

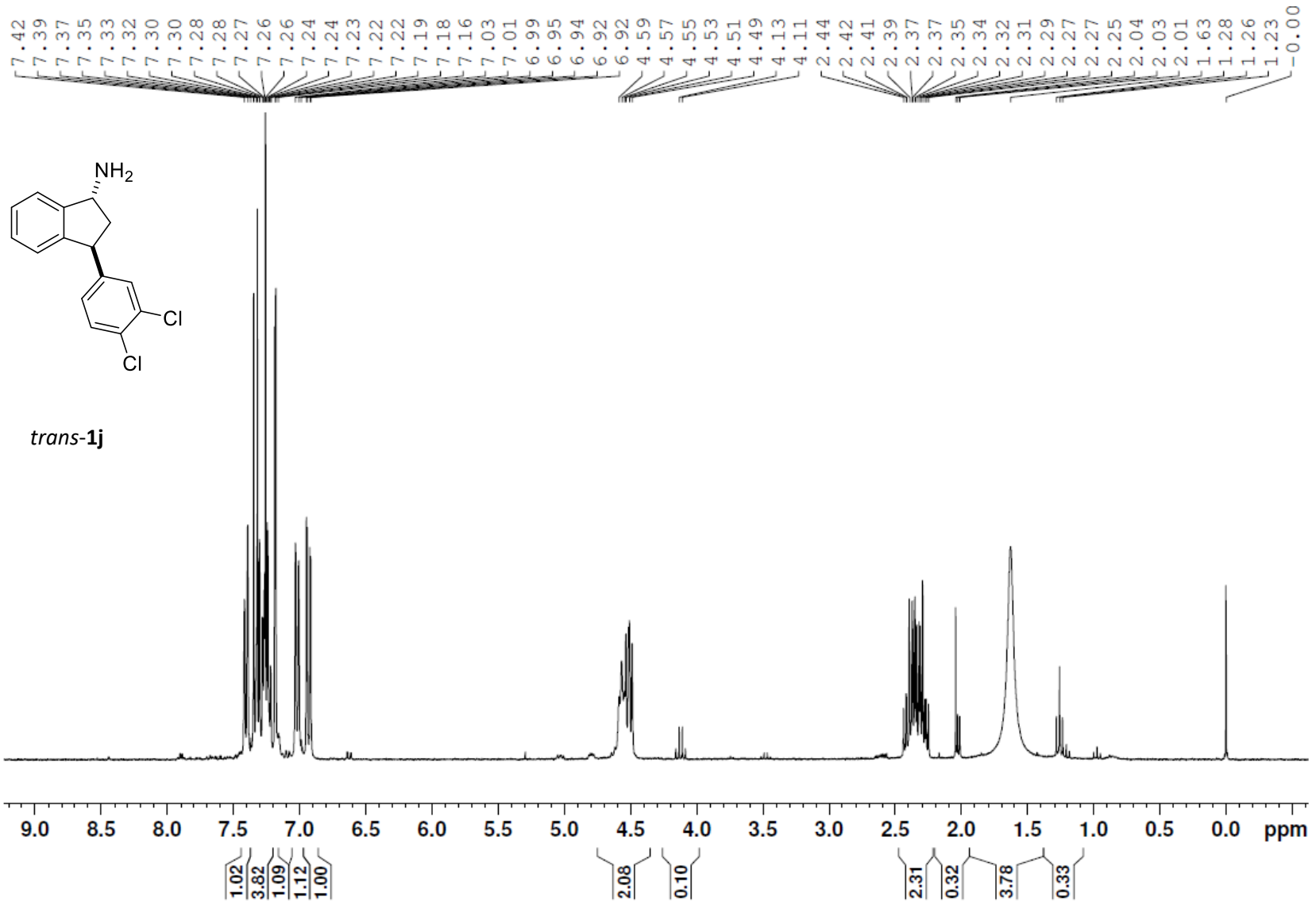
trans-**1i**

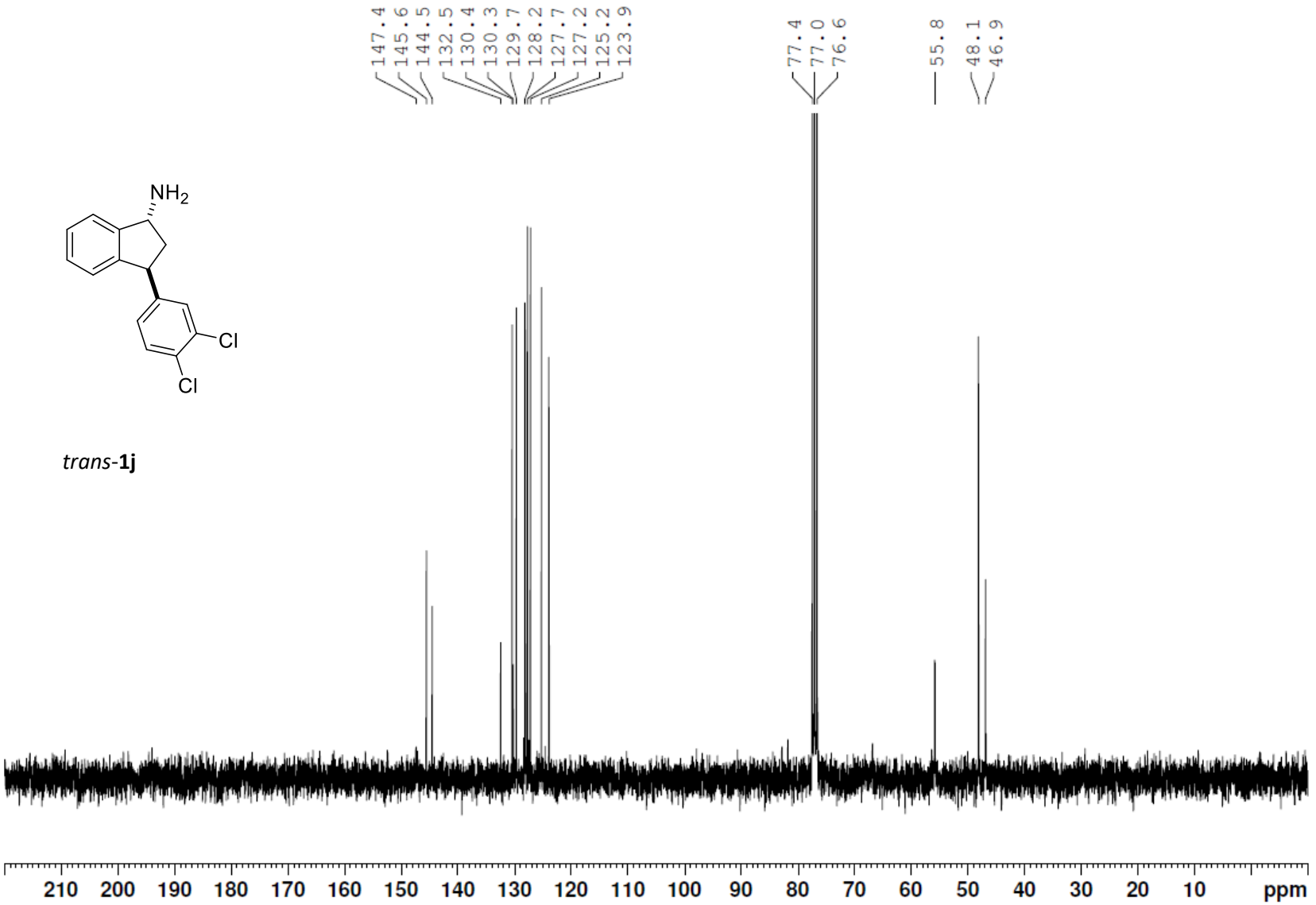

7.68
7.67
7.66
7.64
7.48
7.46
7.46
7.45
7.43
7.40
7.39
7.38
7.37
7.33
7.32
7.30
7.28
7.27
7.27
7.26
7.24
7.21
7.19
7.13
7.10
7.08
7.08
7.06
7.05
6.89
6.87
4.42
4.40
4.39
4.37
4.16
4.14
4.13
4.11
2.98
2.96
2.94
2.94
2.92
2.90
2.11
2.10
1.80
1.72
1.69
1.69
1.68
1.66
1.65
1.65
1.61
1.26
0.00
NH2
Cl
Cl
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
ppm
5.67
1.11
1.05
2.00
0.96
4.48
0.14
0.42

cis-**1j**

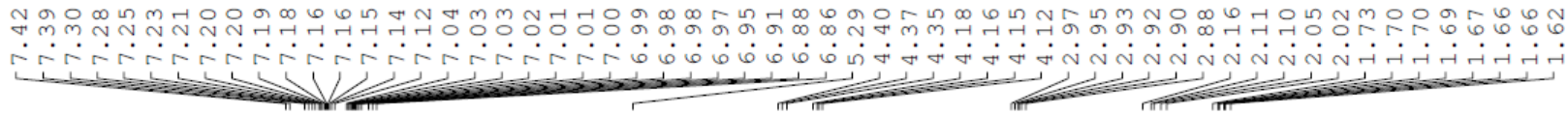

144.6
132.5
132.0
130.5
130.3
128.6
127.8
127.7
127.4
127.3
124.6
123.2
77.4
77.0
76.6
55.9
48.7
48.0
NH2
Cl
Cl
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 ppm

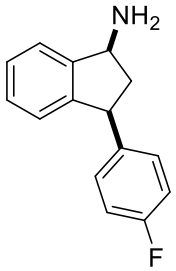
cis-**1j**


7.42
7.39
7.37
7.35
7.33
7.32
7.30
7.30
7.28
7.28
7.27
7.26
7.26
7.24
7.24
7.23
7.22
7.22
7.19
7.18
7.16
7.03
7.01
6.99
6.95
6.94
6.92
6.92
4.59
4.57
4.55
4.53
4.51
4.49
4.13
4.11
2.44
2.42
2.41
2.39
2.37
2.37
2.35
2.34
2.32
2.31
2.29
2.27
2.27
2.25
2.04
2.03
2.01
1.63
1.28
1.26
1.23
0.00
NH2
Cl
Cl
trans-1j
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
ppm
1.02
3.82
1.09
1.12
1.00
2.08
0.10
2.31
0.32
3.78
0.33

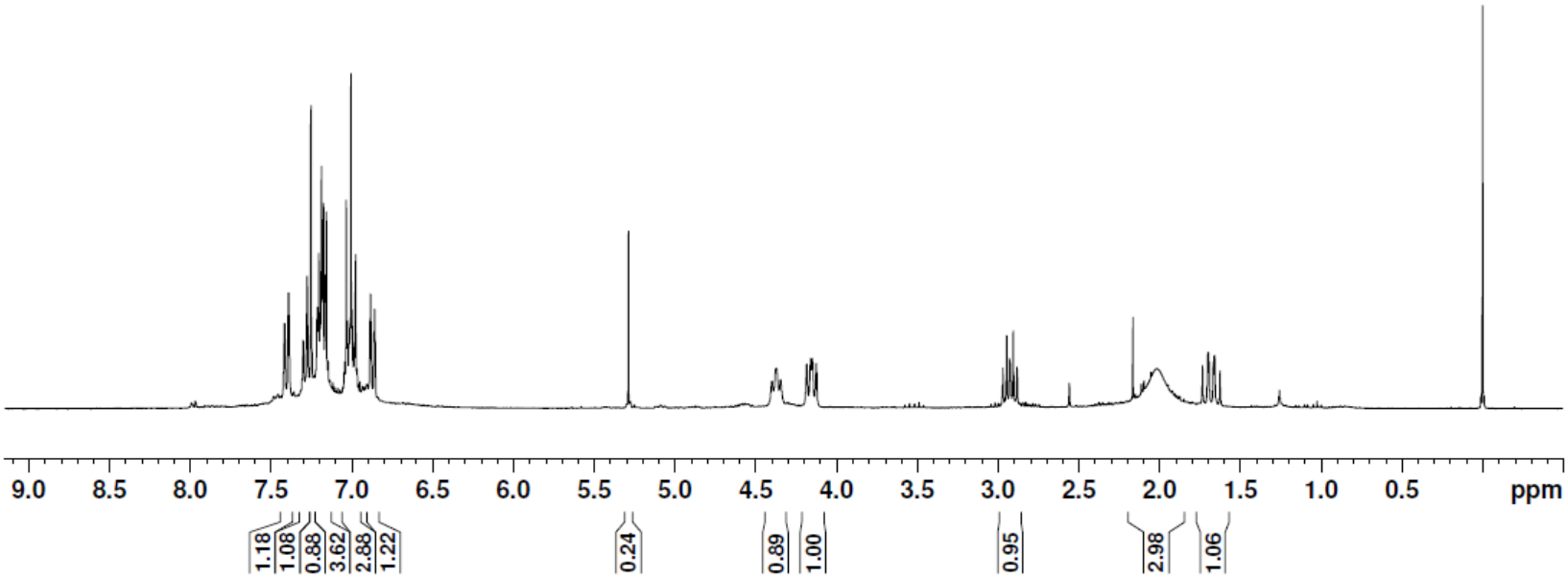

147.4
145.6
144.5
132.5
130.4
130.3
129.7
128.2
127.7
127.2
125.2
123.9
77.4
77.0
76.6
55.8
48.1
46.9
NH2
Cl
Cl
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 ppm

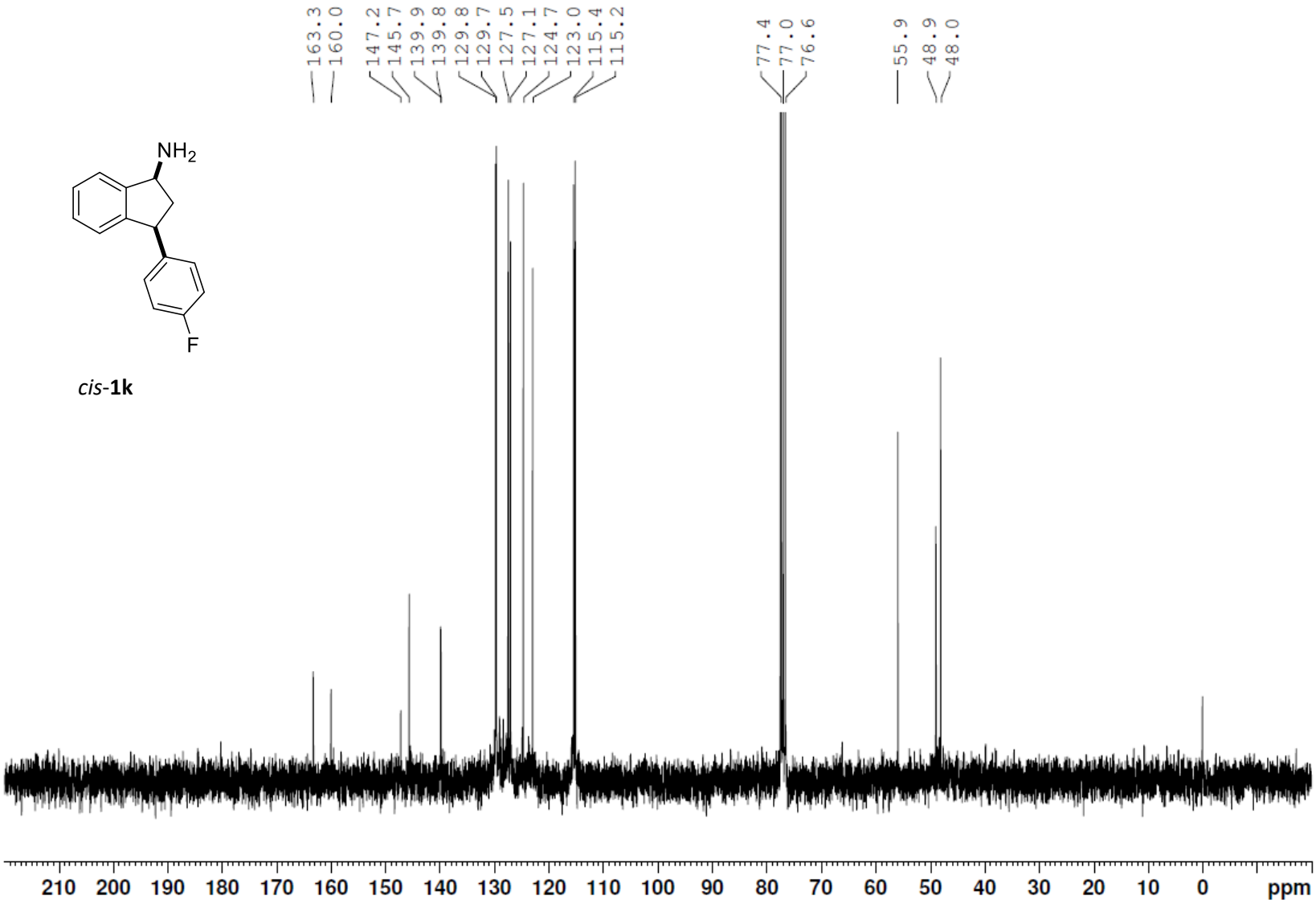
trans-**1j**


7.42
7.39
7.30
7.28
7.25
7.23
7.21
7.20
7.20
7.19
7.18
7.16
7.16
7.15
7.14
7.12
7.04
7.03
7.03
7.02
7.01
7.01
7.00
6.99
6.98
6.98
6.97
6.95
6.91
6.88
6.86
5.29
4.40
4.37
4.35
4.18
4.16
4.15
4.12
2.97
2.95
2.93
2.92
2.90
2.88
2.16
2.11
2.10
2.05
2.02
1.73
1.70
1.70
1.69
1.67
1.66
1.66
1.62


NH2
F

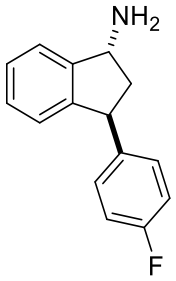
cis-**1k**


9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
ppm
1.18
1.08
0.88
3.62
2.88
1.22
0.24
0.89
1.00
0.95
2.98
1.06

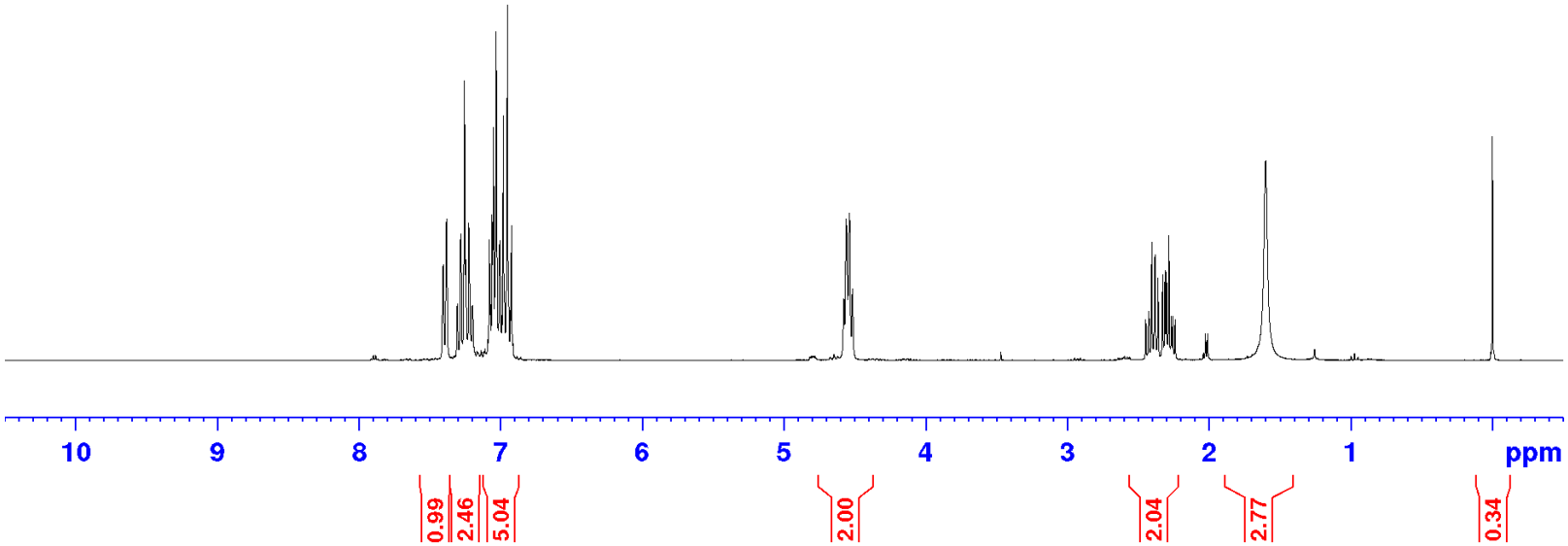

163.3
160.0
147.2
145.7
139.9
139.8
129.8
129.7
127.5
127.1
124.7
123.0
115.4
115.2
77.4
77.0
76.6
55.9
48.9
48.0
NH2
F
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 ppm

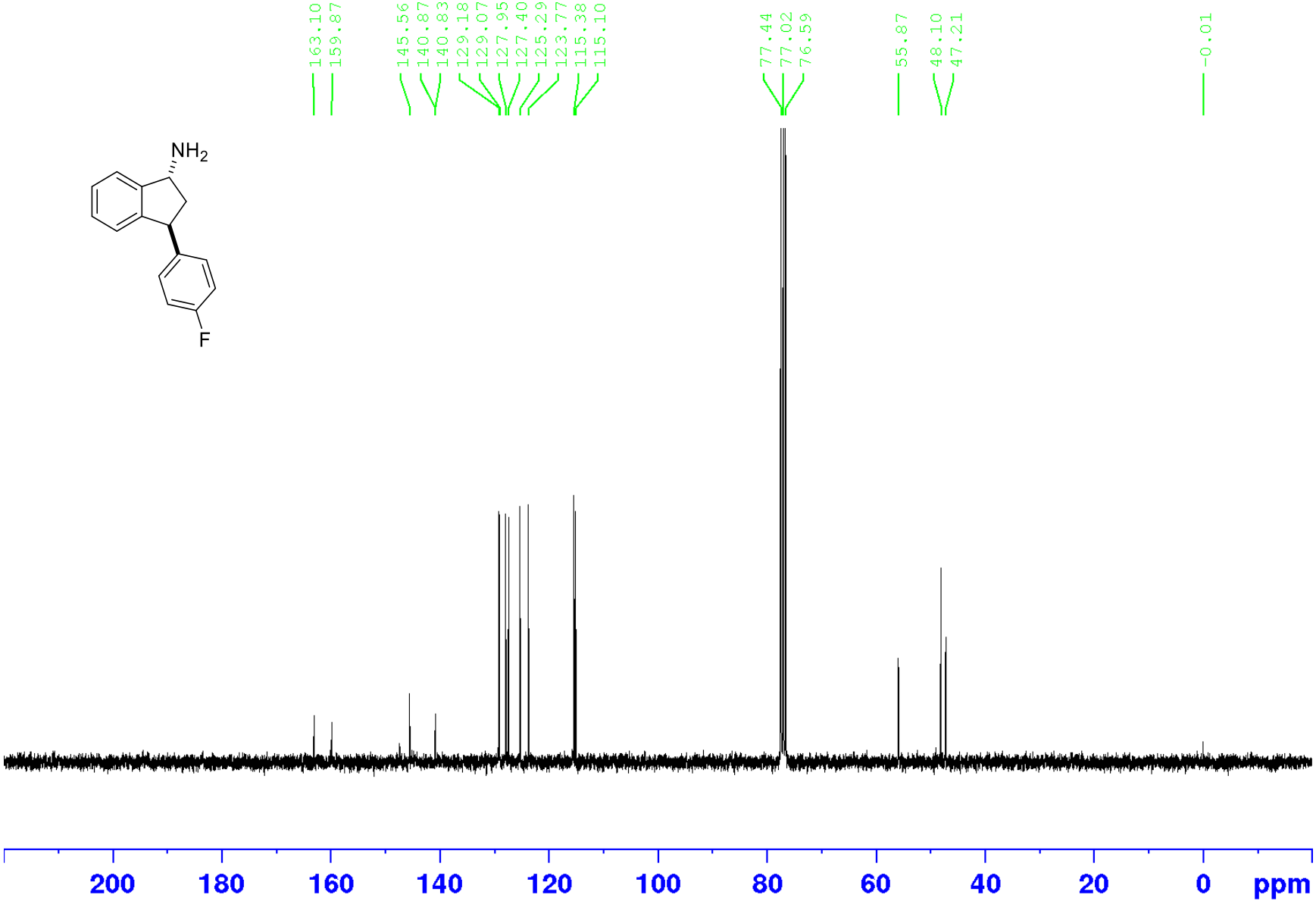
cis-**1k**

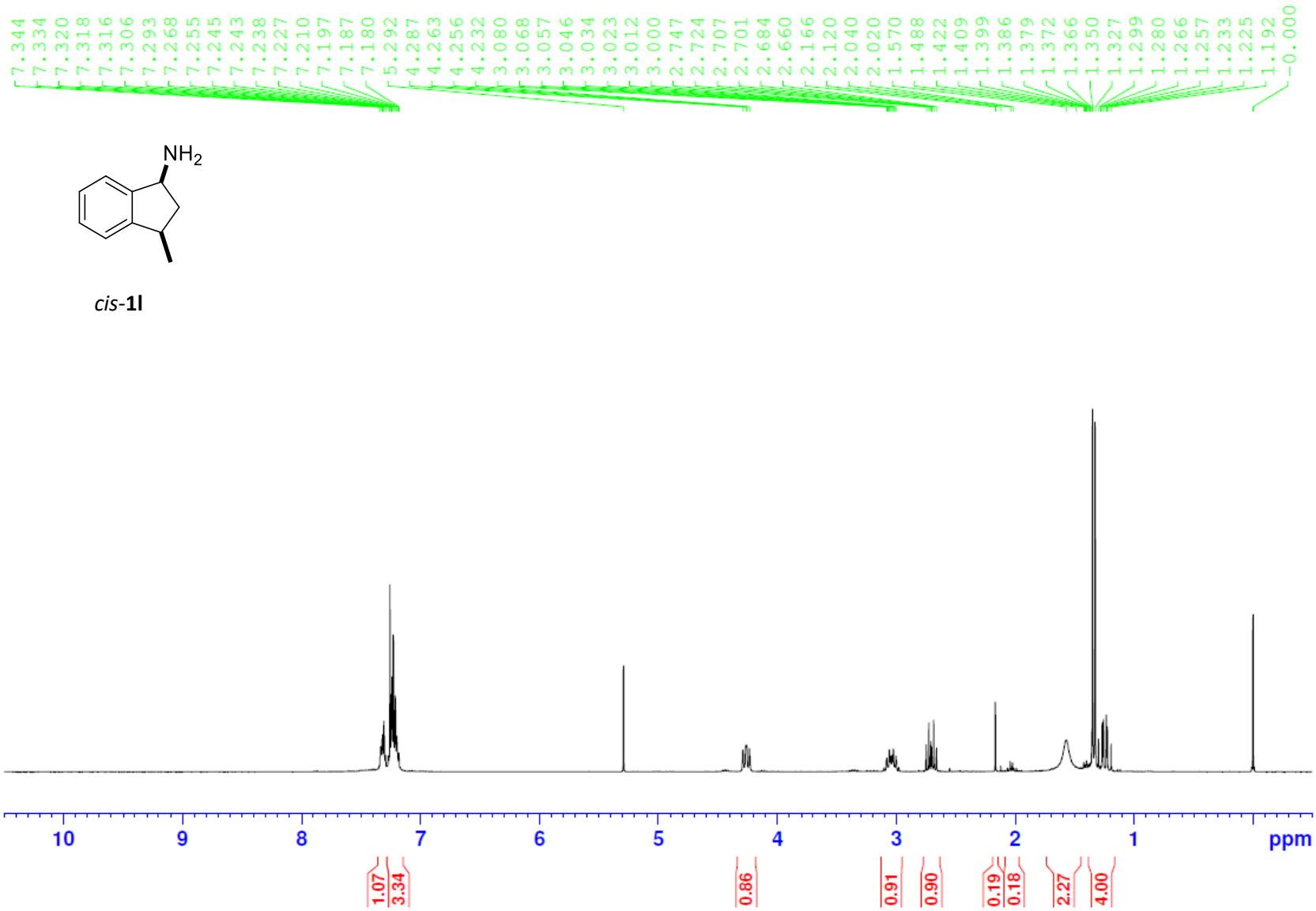

7.90
7.88
7.41
7.38
7.31
7.28
7.28
7.26
7.25
7.23
7.22
7.20
7.20
7.17
7.16
7.14
7.11
7.09
7.08
7.07
7.06
7.05
7.04
7.03
7.01
6.99
6.98
6.97
6.96
6.95
6.95
6.93
6.92
6.91
6.89
6.86
4.82
4.81
4.79
4.78
4.67
4.65
4.62
4.58
4.56
4.54
4.52
3.47
2.60
2.59
2.57
2.56
2.45
2.43
2.42
2.40
2.38
2.38
2.36
2.33
2.31
2.30
2.28
2.27
2.26
2.24
2.04
2.03
2.01
1.73
1.60
1.28
1.26
1.00
0.97
0.95
0.01
-0.00
-0.01


NH2
F

trans-**1k**


10
9
8
7
6
5
4
3
2
1
ppm
0.99
2.46
5.04
2.00
2.04
2.77
0.34


163.10
159.87
145.56
140.87
140.83
129.18
129.07
127.95
127.40
125.29
123.77
115.38
115.10
77.44
77.02
76.59
55.87
48.10
47.21
-0.01
NH2
F
200
180
160
140
120
100
80
60
40
20
0
ppm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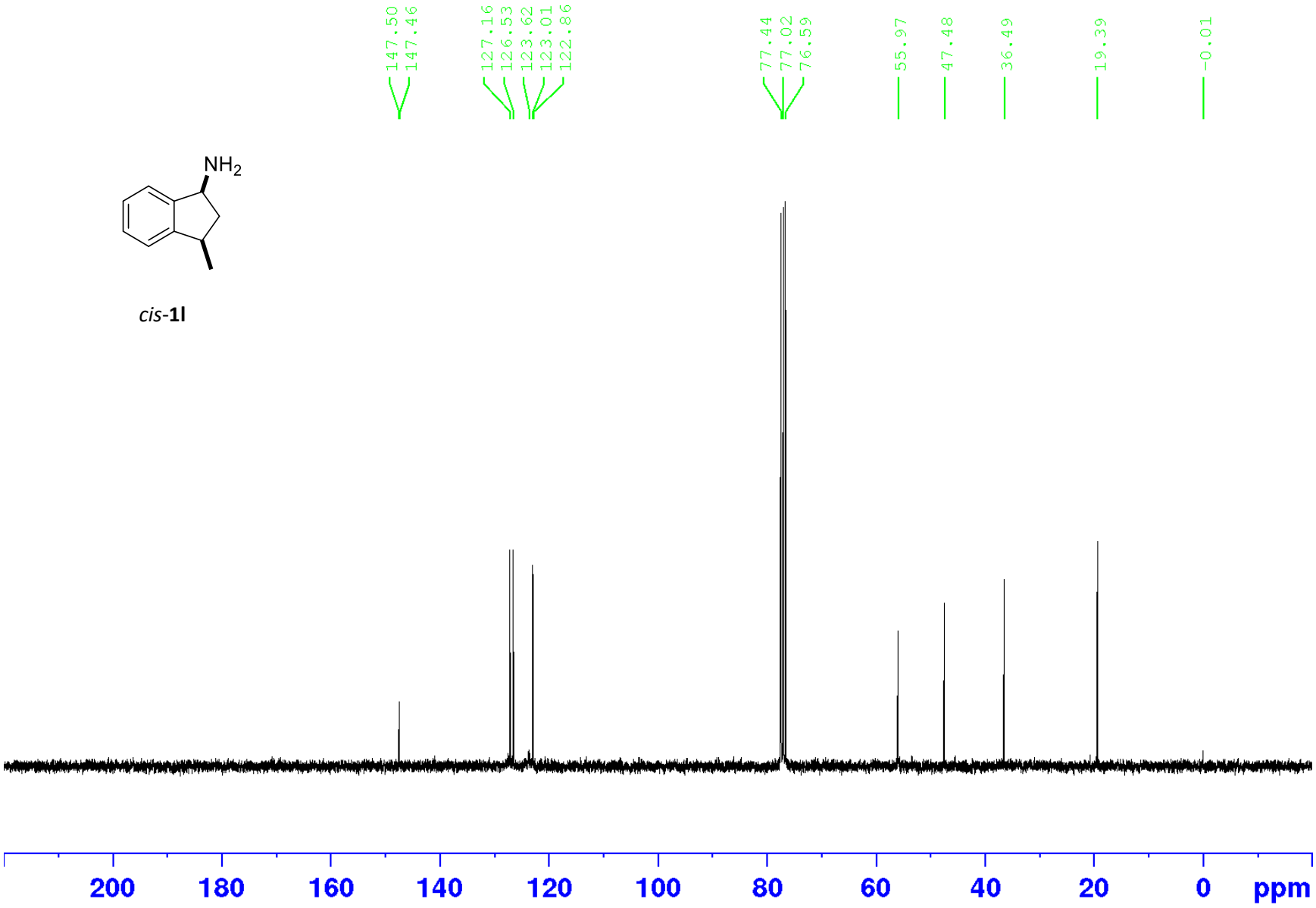
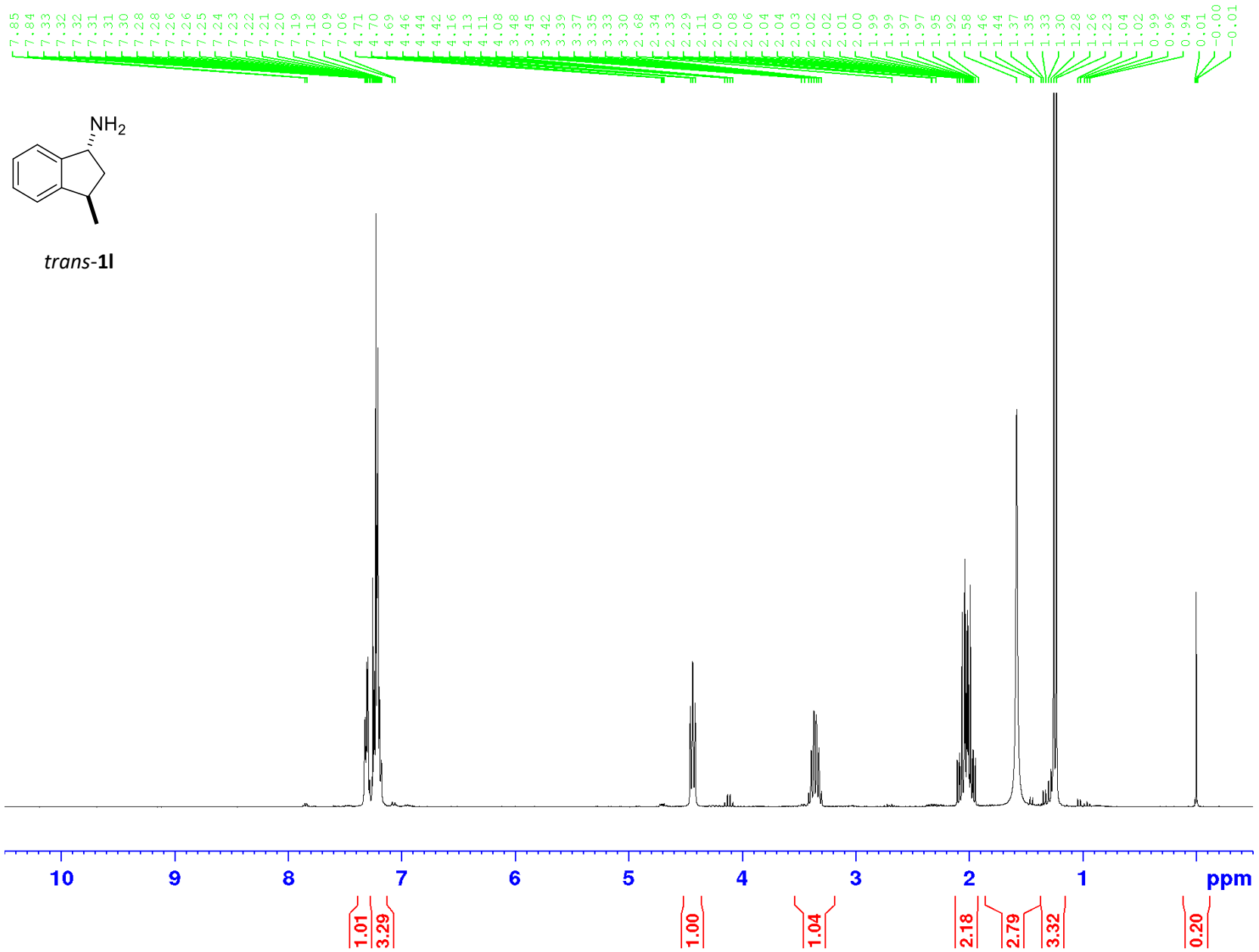
7.334
7.320
7.318
7.316
7.306
7.293
7.268
7.255
7.245
7.243
7.238
7.227
7.210
7.197
7.187
7.180
5.292
4.287
4.263
4.256
4.232
3.080
3.068
3.057
3.046
3.034
3.023
3.012
3.000
2.747
2.724
2.707
2.701
2.684
2.660
2.166
2.120
2.040
2.020
1.570
1.488
1.422
1.409
1.399
1.386
1.379
1.372
1.366
1.350
1.327
1.299
1.280
1.266
1.257
1.233
1.225
1.192
0.000
NH2
10
9
8
7
6
5
4
3
2
1
ppm
1.07
3.34
0.86
0.91
0.90
0.19
0.18
2.27
4.00

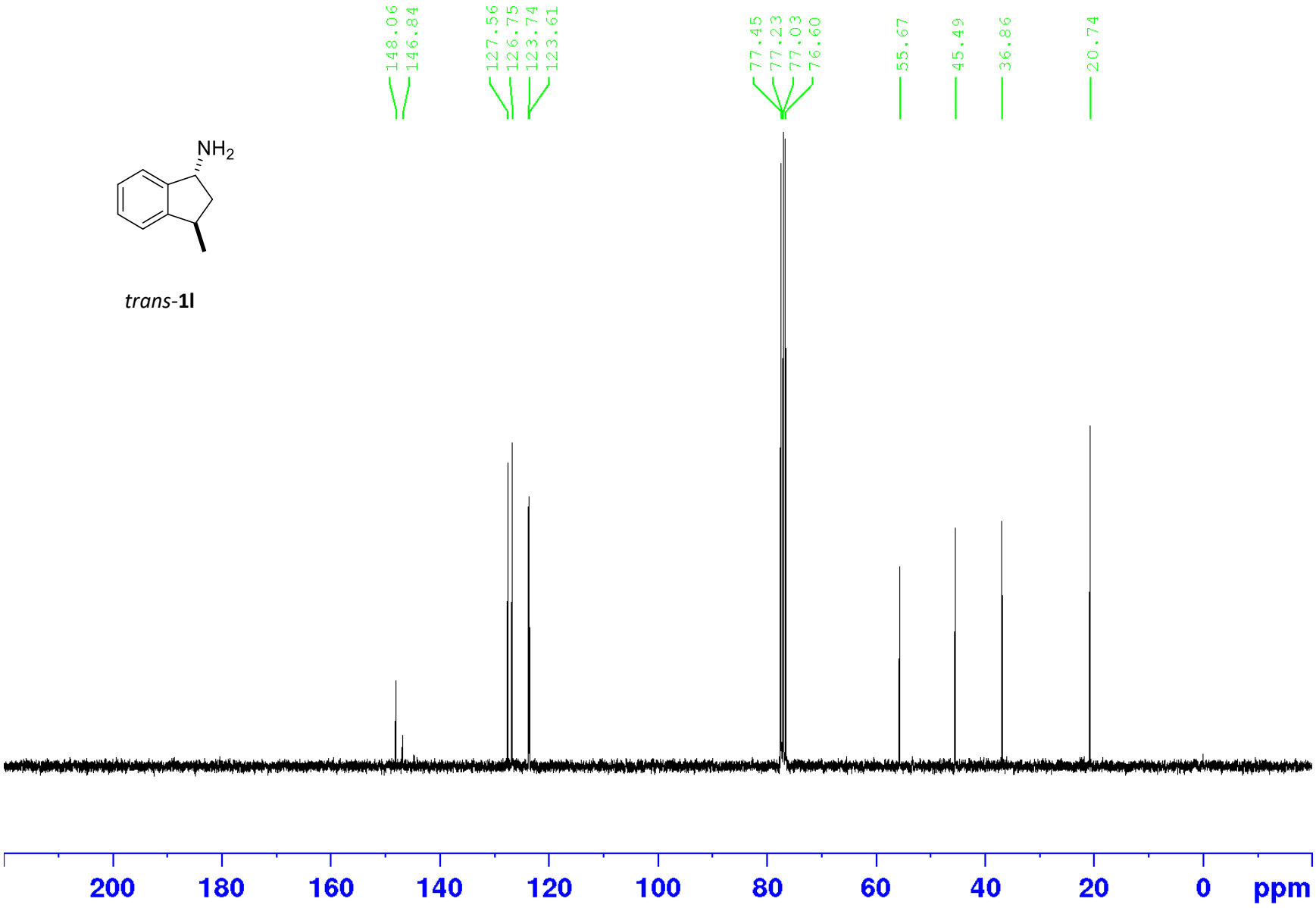
cis-**1l**


147.50
147.46
127.16
126.53
123.62
123.01
122.86
77.44
77.02
76.59
55.97
47.48
36.49
19.39
-0.01
NH2
200
180
160
140
120
100
80
60
40
20
0
ppm

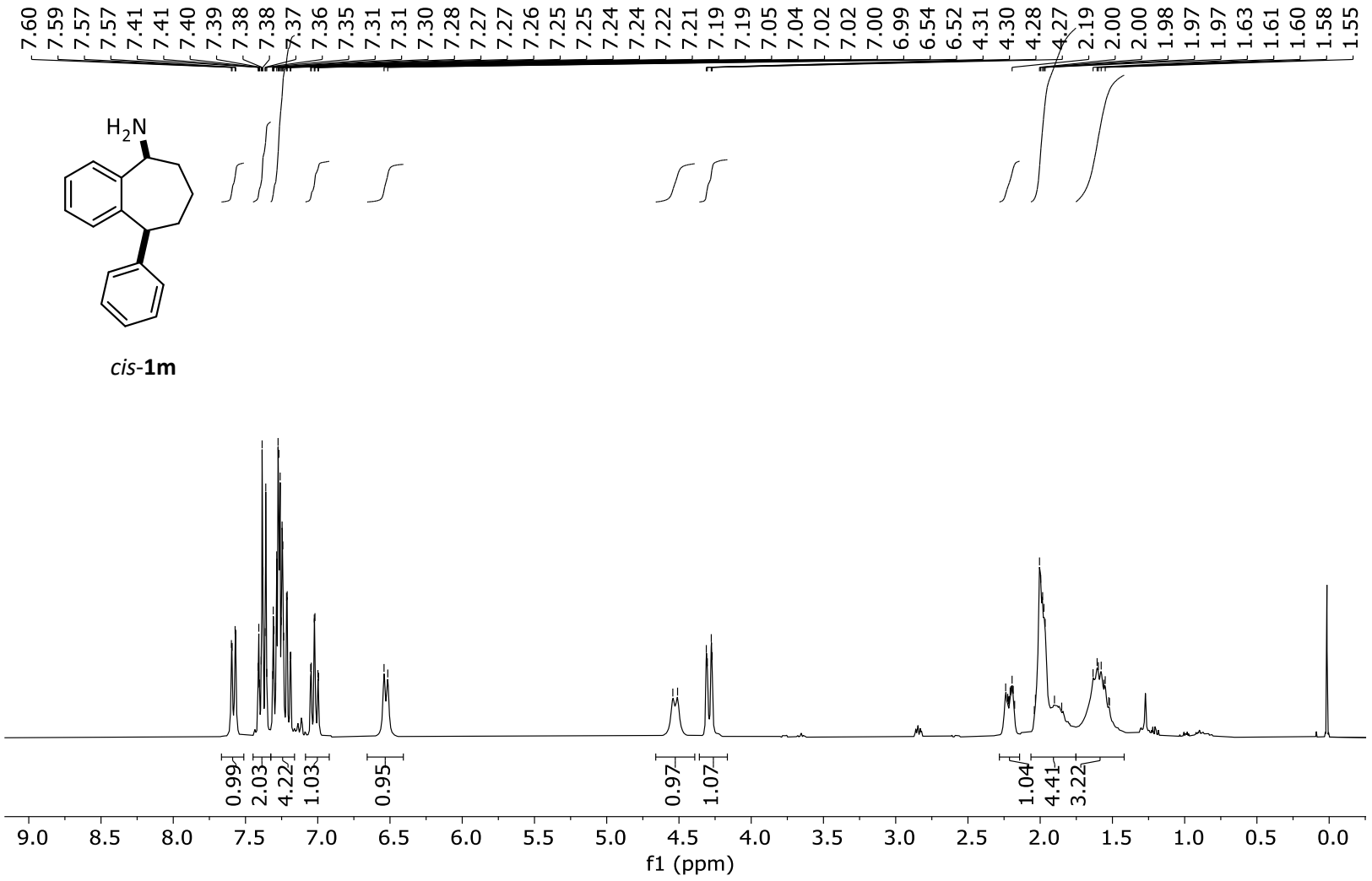
cis-**1l**


7.85 7.84 7.33 7.32 7.32 7.31 7.31 7.30 7.28 7.28 7.26 7.26 7.25 7.24 7.23 7.22 7.21 7.20 7.19 7.18 7.09 7.06 4.71 4.70 4.69 4.46 4.44 4.42 4.16 4.13 4.11 4.08 3.48 3.45 3.42 3.39 3.37 3.35 3.33 3.30 2.68 2.34 2.33 2.29 2.11 2.09 2.08 2.06 2.04 2.04 2.03 2.02 2.02 2.01 2.00 1.99 1.99 1.97 1.97 1.95 1.92 1.58 1.46 1.44 1.37 1.35 1.33 1.30 1.28 1.26 1.23 1.04 1.02 0.99 0.96 0.94 0.01 -0.00 -0.01
NH2
10 9 8 7 6 5 4 3 2 1 ppm
1.01 3.29 1.00 1.04 2.18 2.79 3.32 0.20

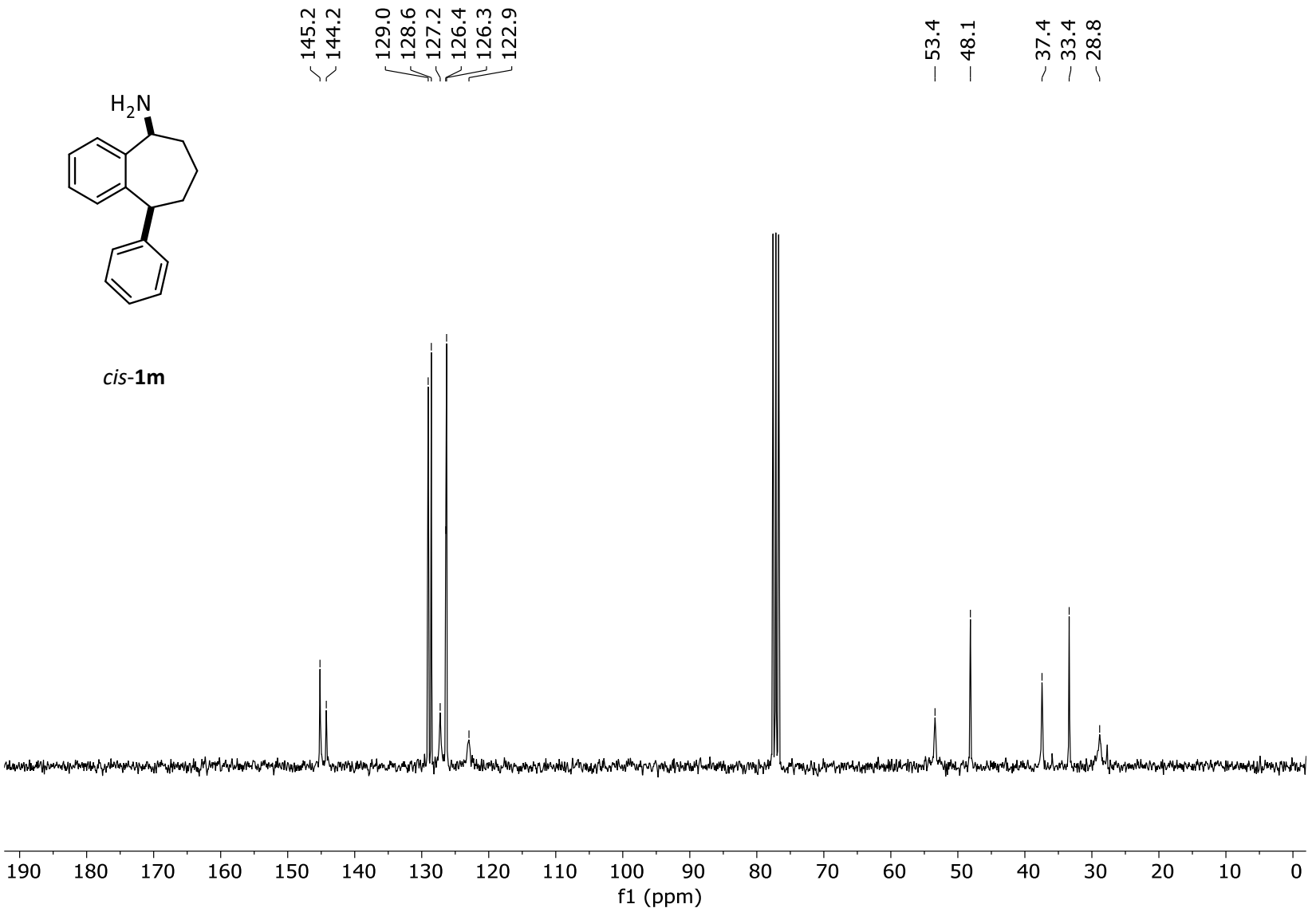
trans-**1l**

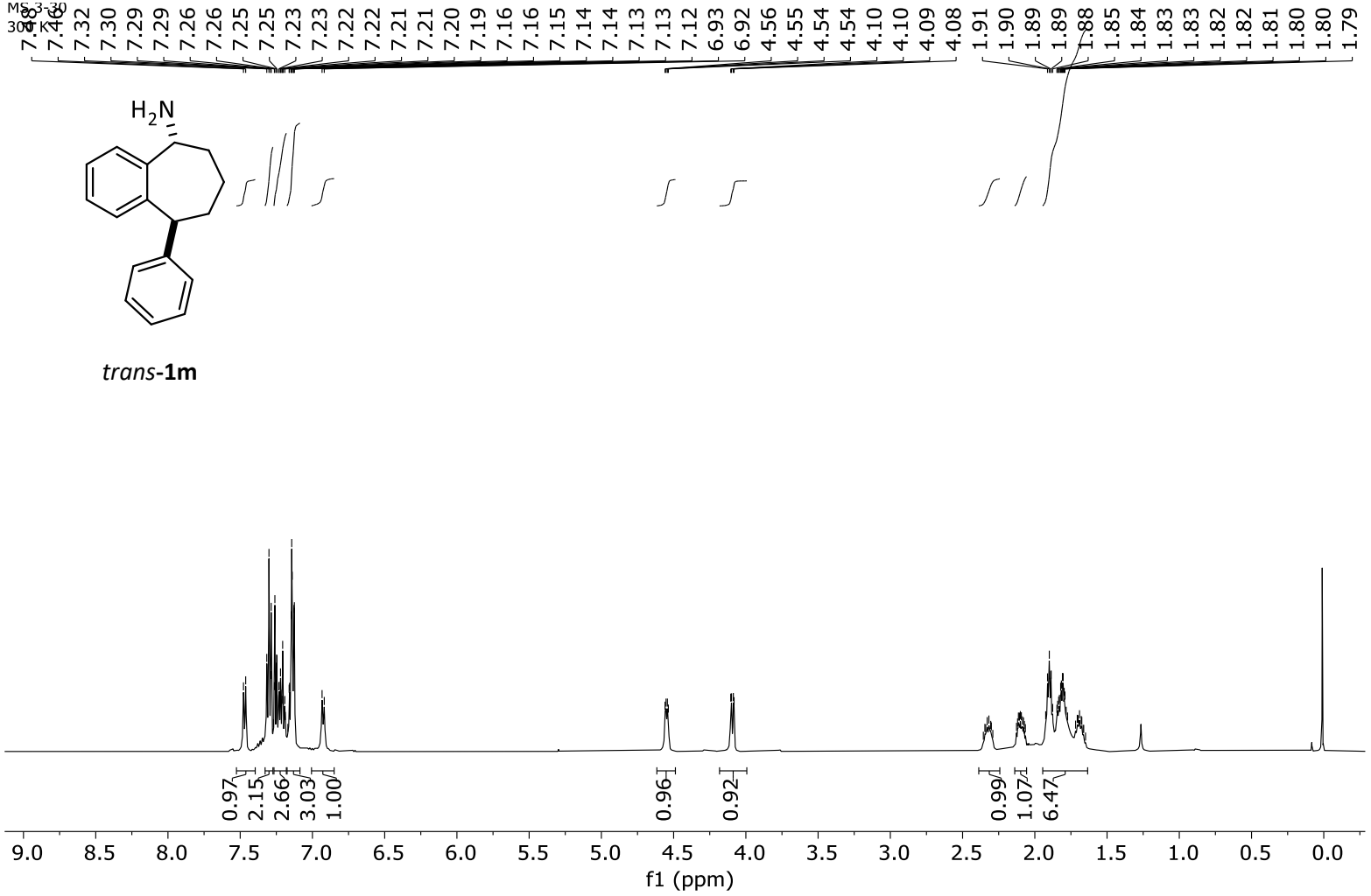

148.06
146.84
127.56
126.75
123.74
123.61
77.45
77.23
77.03
76.60
55.67
45.49
36.86
20.74
NH2
200
180
160
140
120
100
80
60
40
20
0
ppm

trans-**1l**

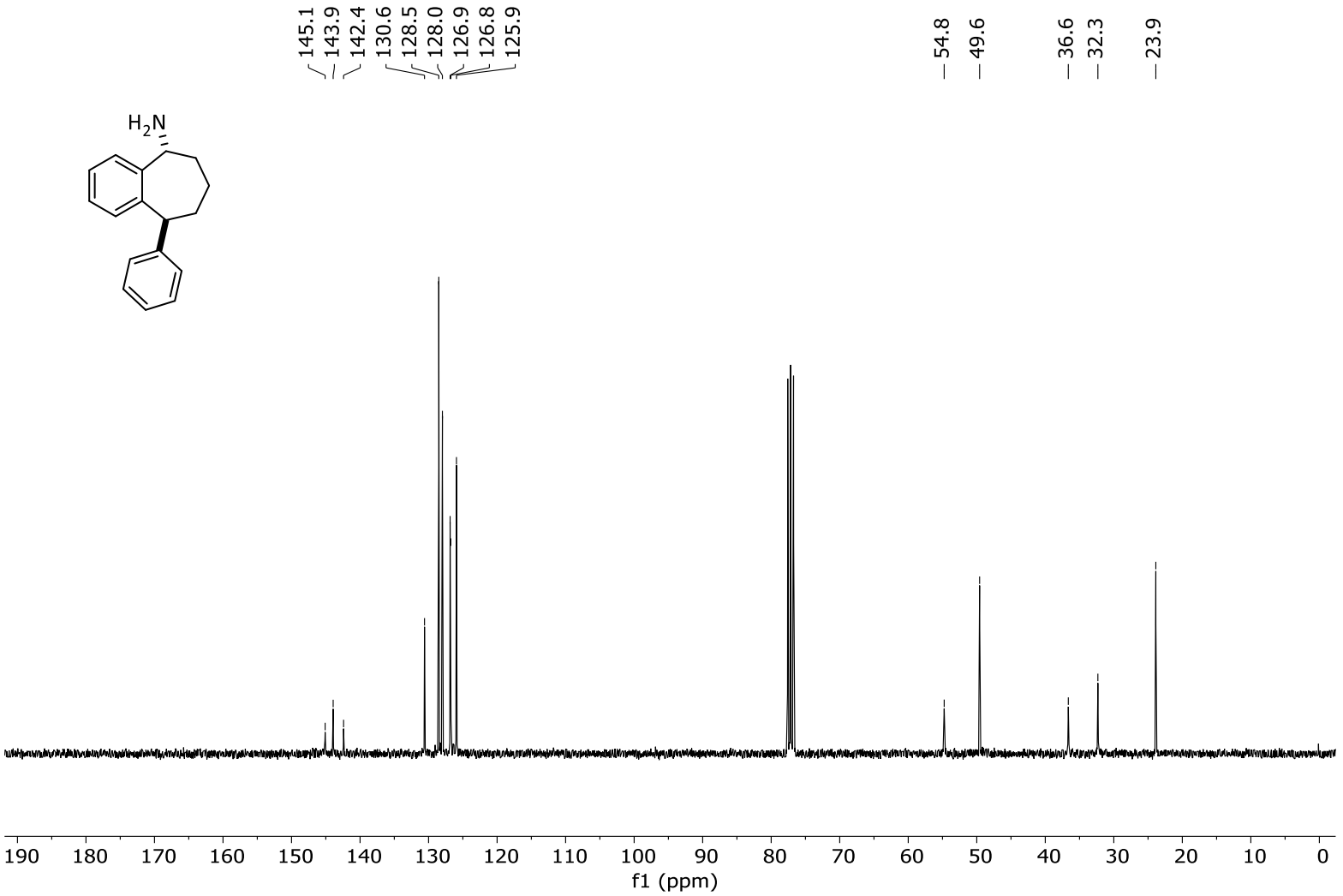

7.60 7.59 7.57 7.57 7.41 7.41 7.40 7.39 7.38 7.38 7.37 7.36 7.35 7.31 7.31 7.30 7.28 7.27 7.27 7.26 7.25 7.25 7.24 7.24 7.22 7.21 7.19 7.19 7.05 7.04 7.02 7.02 7.00 6.99 6.54 6.52 4.31 4.30 4.28 4.27 2.19 2.00 2.00 1.98 1.97 1.97 1.63 1.61 1.60 1.58 1.55
H2N
0.99 2.03 4.22 1.03 0.95 0.97 1.07 1.04 4.41 3.22
9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)

cis-**1m**


145.2
144.2
129.0
128.6
127.2
126.4
126.3
122.9
53.4
48.1
37.4
33.4
28.8
H_2N
cis-**1m**
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)

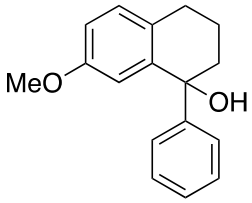

MS-3-30
30 °C
7.49
7.48
7.32
7.30
7.29
7.29
7.26
7.26
7.25
7.25
7.23
7.23
7.22
7.22
7.21
7.21
7.20
7.19
7.16
7.16
7.15
7.14
7.14
7.13
7.13
7.12
6.93
6.92
4.56
4.55
4.54
4.54
4.10
4.10
4.09
4.08
1.91
1.90
1.89
1.89
1.88
1.85
1.84
1.83
1.83
1.82
1.82
1.81
1.80
1.80
1.79
H2N
0.97
2.15
2.66
3.03
1.00
0.96
0.92
0.99
1.07
6.47
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)

trans-**1m**


145.1
143.9
142.4
130.6
128.5
128.0
126.9
126.8
125.9
54.8
49.6
36.6
32.3
23.9
H2N
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)

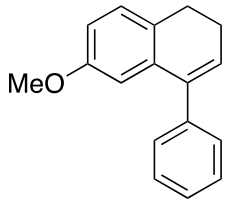
1.7 Synthesis of ketone **2d** intermediates with corresponding spectra

1-Hydroxy-7-methoxy-1-phenyltetralin 3



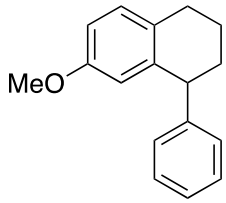
Bromobenzene (7.17 ml, 68 mmol, 1.2 eq) and a few crystals of iodine were added to a suspension of magnesium turnings (1.79 g, 74 mmol, 1.3 eq) in dry Et_2O (60 ml) and the mixture was heated under reflux for 2 h. After the addition of 7-methoxy-1-tetralone (10 g, 57 mmol, 1 eq) the mixture was stirred under reflux for another 2 h. The reaction was carefully quenched with aq. 1M HCl (30 ml) on ice and filtered through Celite®. The two layers were separated, and the organic layer was washed with aq. 1M HCl (60 ml) and brine (60 ml), dried over Na_2SO_4 and concentrated under reduced pressure. The title product was obtained by flash column chromatography (CH_2Cl_2: hexane 80:20 to 100:0) as a colourless oil (10.30 g, 71%). ν_{max}/cm^{-1} (ATR): 3451 (OH), 2935 (OH), 1610 (C=C), 1495 (CH), 1234, 1034 (CO); δ_H (300 MHz; $CDCl_3$): 7.34 – 7.10 (m, 5H, ArH), 7.03 (d, *J* = 8.5, 1H, ArH), 6.74 (dd, *J* = 8.5, 2.7, 1H, ArH), 6.55 (d, *J* = 2.7, 1H, ArH), 3.60 (s, 3H, OCH_3), 2.88 – 2.66 (m, 2H, C(4)H_2), 2.13 (s, 1H, OH), 2.11 – 2.00 (m, 2H, C(2)H_2), 1.99 – 1.79 (m, 1H, one of C(3)H_2), 1.79 – 1.62 (m, 1H, one of C(3)H_2); δ_C (75 MHz; $CDCl_3$): 158.2, 148.8, 143.1, 130.0, 130.0, 127.9, 126.8, 126.6, 114.4, 113.3, 75.8, 55.4, 41.7, 29.1, 19.9; HRMS (ESI^+) found $[M+Na]^+$ 277.1193, $C_{17}H_{18}O_2Na$ requires 277.1190.

7-Methoxy-1-phenyl-3,4-dihydronaphthalene 4[30]

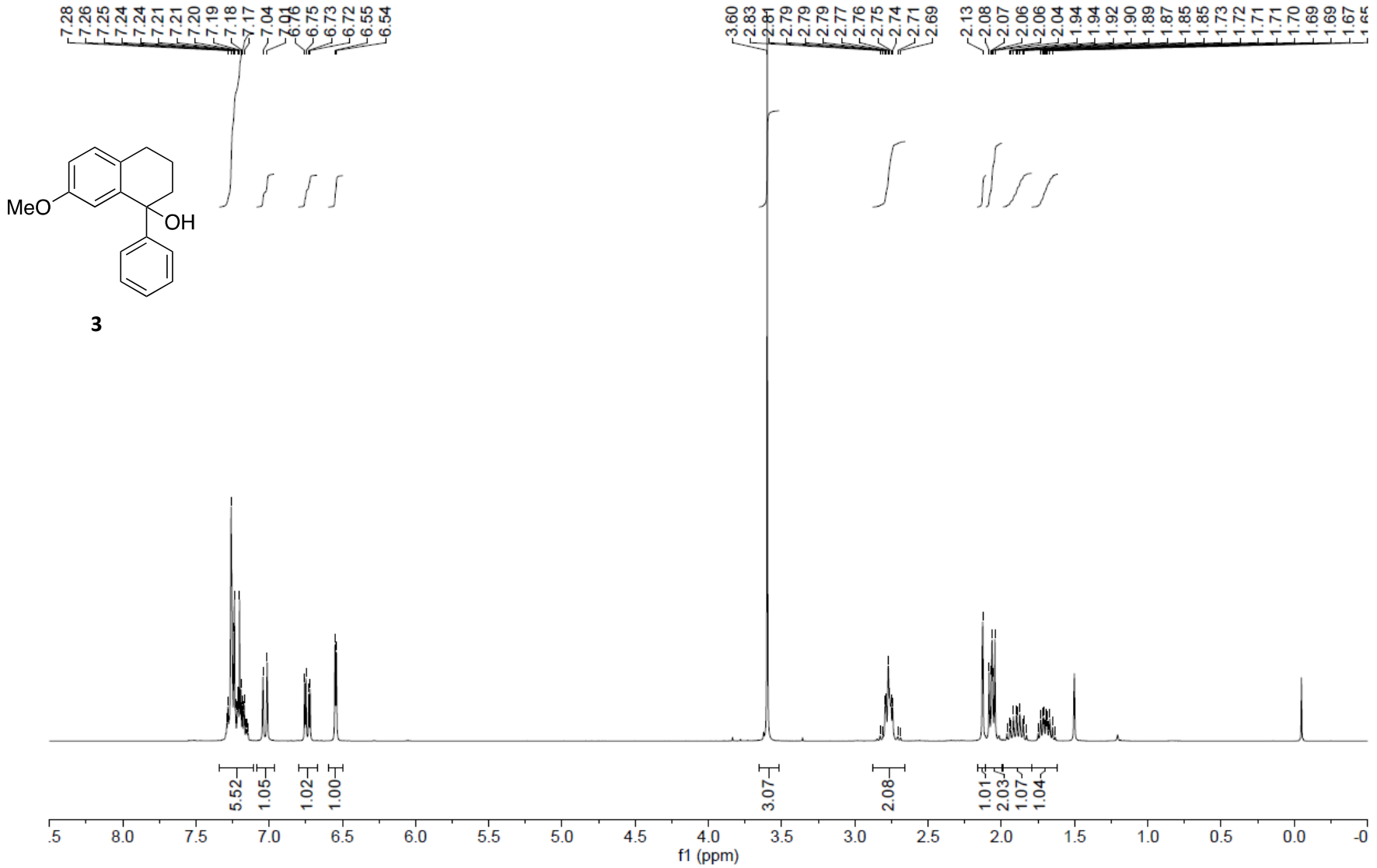


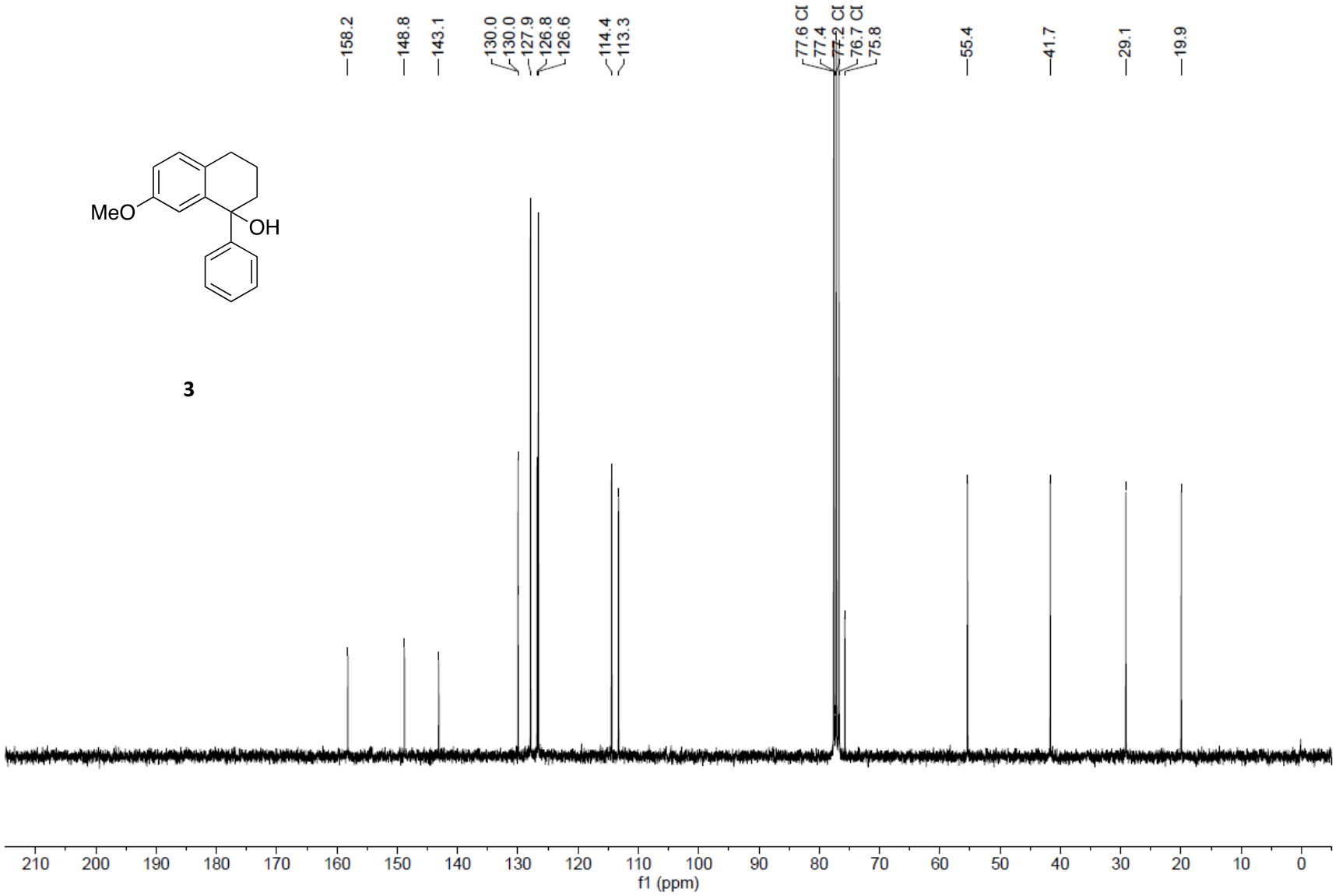
A solution of 1-hydroxy-7-methoxy-1-phenyltetralin (10.17 g, 40 mmol, 1 eq) and *p*-toluenesulfonic acid monohydrate (0.380 g, 2 mmol, 5 mol%) in toluene (200 ml) was heated to reflux for 6 h with a Dean–Stark trap attached. The reaction mixture was then washed with sat. aq. $NaHCO_3$ (200 ml), H_2O (200 ml) and brine (200 ml), dried over Na_2SO_4 and concentrated under reduced pressure. The title product was obtained by flash column chromatography (hexane:EtOAc 9:1) as a colourless oil (7.590 g, 80%). ν_{max}/cm^{-1} (ATR): 2933 (CH), 2830 (CH), 1602 (C=C), 1489 (CH), 1226 (CO), 1044 (CO); δ_H (300 MHz; $CDCl_3$): 7.46 – 7.29 (m, 5H, ArH), 7.13 (d, *J* = 8.2, 1H, ArH), 6.73 (dd, *J* = 8.2, 2.7, 1H, ArH), 6.62 (d, *J* = 2.7, 1H, ArH), 6.12 (t, *J* = 4.7, 1H, C(2)H), 3.69 (s, 3H, OCH_3), 2.80 (t, *J* = 7.9, 2H, C(2)H_2), 2.48 – 2.32 (m, 2H, C(3)H_2); δ_C (75 MHz; $CDCl_3$): 158.3, 140.8, 140.0, 136.3, 129.1, 128.9, 128.4, 128.4, 128.3, 127.2, 112.2, 111.7, 55.4, 27.5, 24.0.

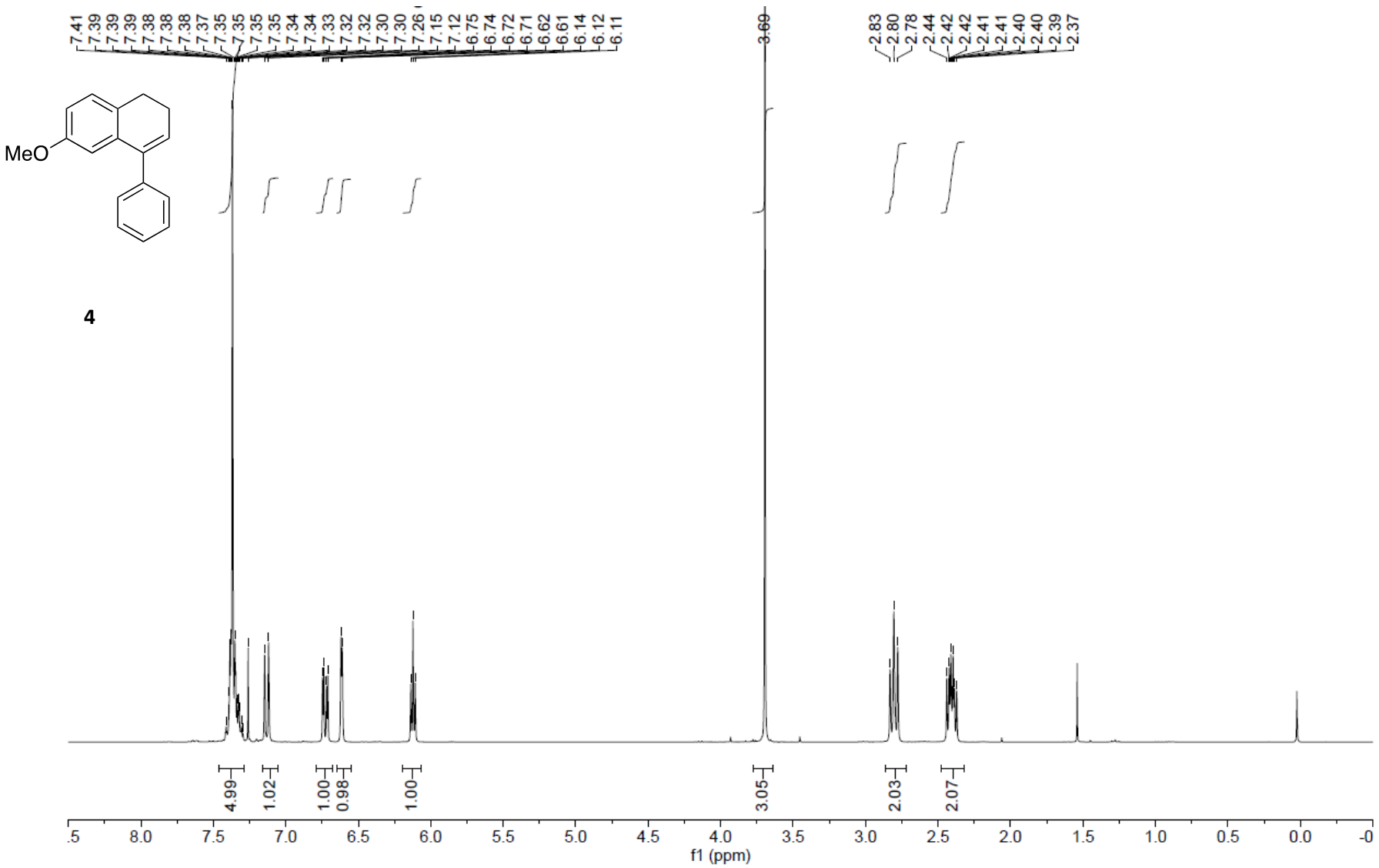
7-Methoxy-1-phenyltetralin 5[31]



Triethylsilane (6.76 ml, 42.5 mmol, 5 eq) was slowly added to a mixture of 6-methoxy-4-phenyl-1,2-dihydronaphthalene (2.01 g, 85 mmol, 1 eq) and 10% Pd/C (0.201 g, 10 wt%) in MeOH (21 ml) under a nitrogen atmosphere. The mixture was stirred for 1 h at room temperature, filtered through Celite® and concentrated under reduced pressure. The byproduct Et_3SiOMe was removed overnight under high vacuum (<0.1 mm Hg). The title product was obtained by flash column chromatography (hexane:EtOAc 9:1) as a white solid (1.865 g, 92%); m.p.: 53–55 °C(lit.[30] 55 °C). ν_{max}/cm^{-1} (ATR): 2921 (CH), 1607 (C=C), 1496 (CH), 1276 (CO), 1038 (CO); δ_H (300 MHz; $CDCl_3$): 7.35 – 7.14 (m, 3H, ArH), 7.14 – 6.99 (m, 3H, ArH), 6.71 (dd, *J* = 8.4, 2.7, 1H, ArH), 6.38 (d, *J* = 2.7, 1H, ArH), 4.08 (t, *J* = 6.6, 1H, C(1)H), 3.64 (s, 3H, OCH_3), 2.91 – 2.67 (m, 2H, C(4)H_2), 2.23 – 2.05 (m, 1H, one of C(2)H_2), 1.96 – 1.63 (m, 3H, one of C(2)H_2, C(3)H_2); δ_C (75 MHz; $CDCl_3$): 157.6, 147.4, 140.6, 130.0, 129.9, 129.0, 128.4, 126.1, 115.0, 112.5, 55.3, 46.0, 33.4, 29.1, 21.2.


MeO
OH
3
f1 (ppm)


158.2
148.8
143.1
130.0
130.0
127.9
126.8
126.6
114.4
113.3
77.6 Cl
77.4
77.2 Cl
76.7 Cl
75.8
55.4
41.7
29.1
19.9
MeO
OH
3
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)


MeO
4
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7.39
7.39
7.38
7.38
7.38
7.37
7.35
7.35
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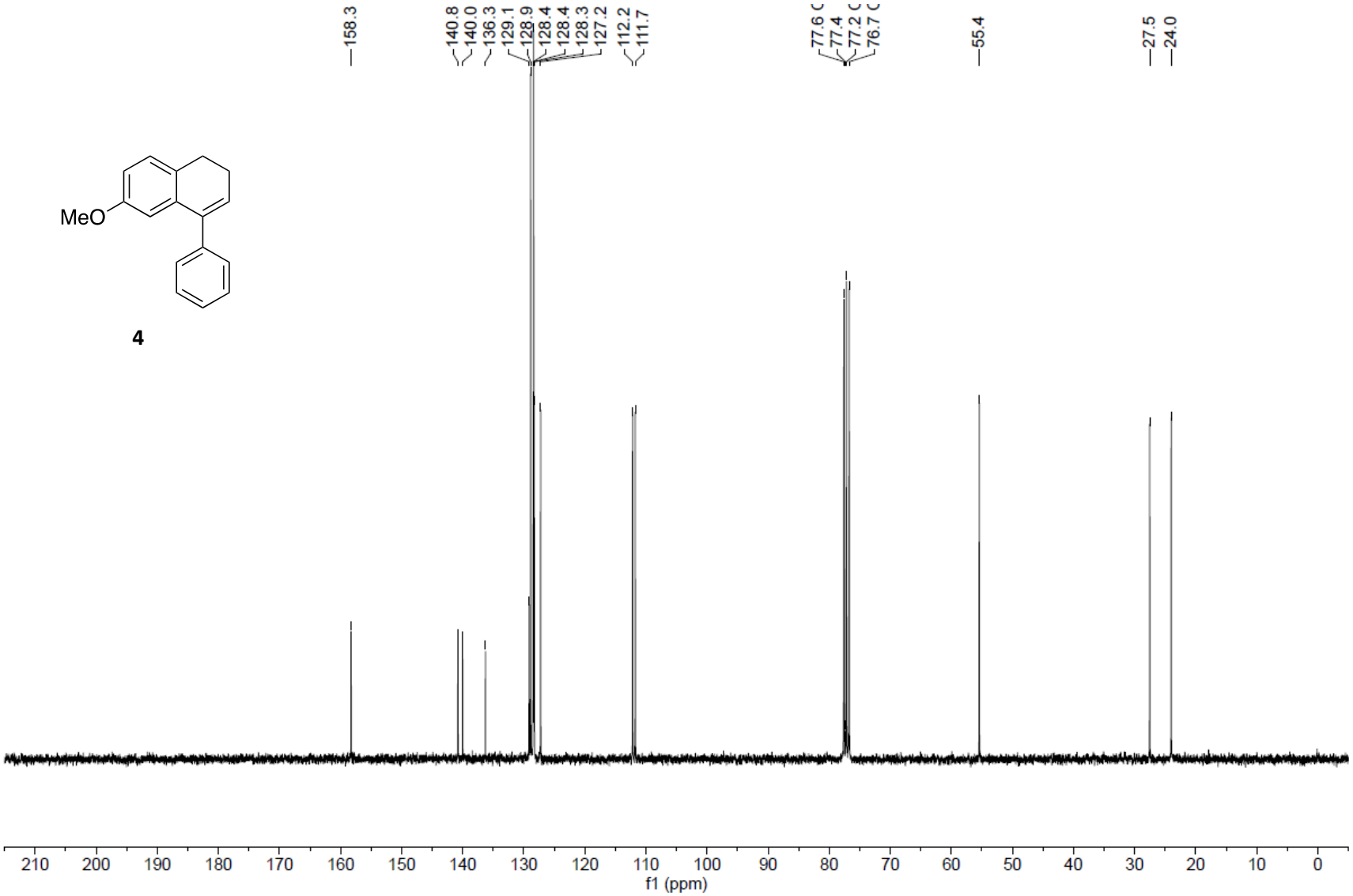
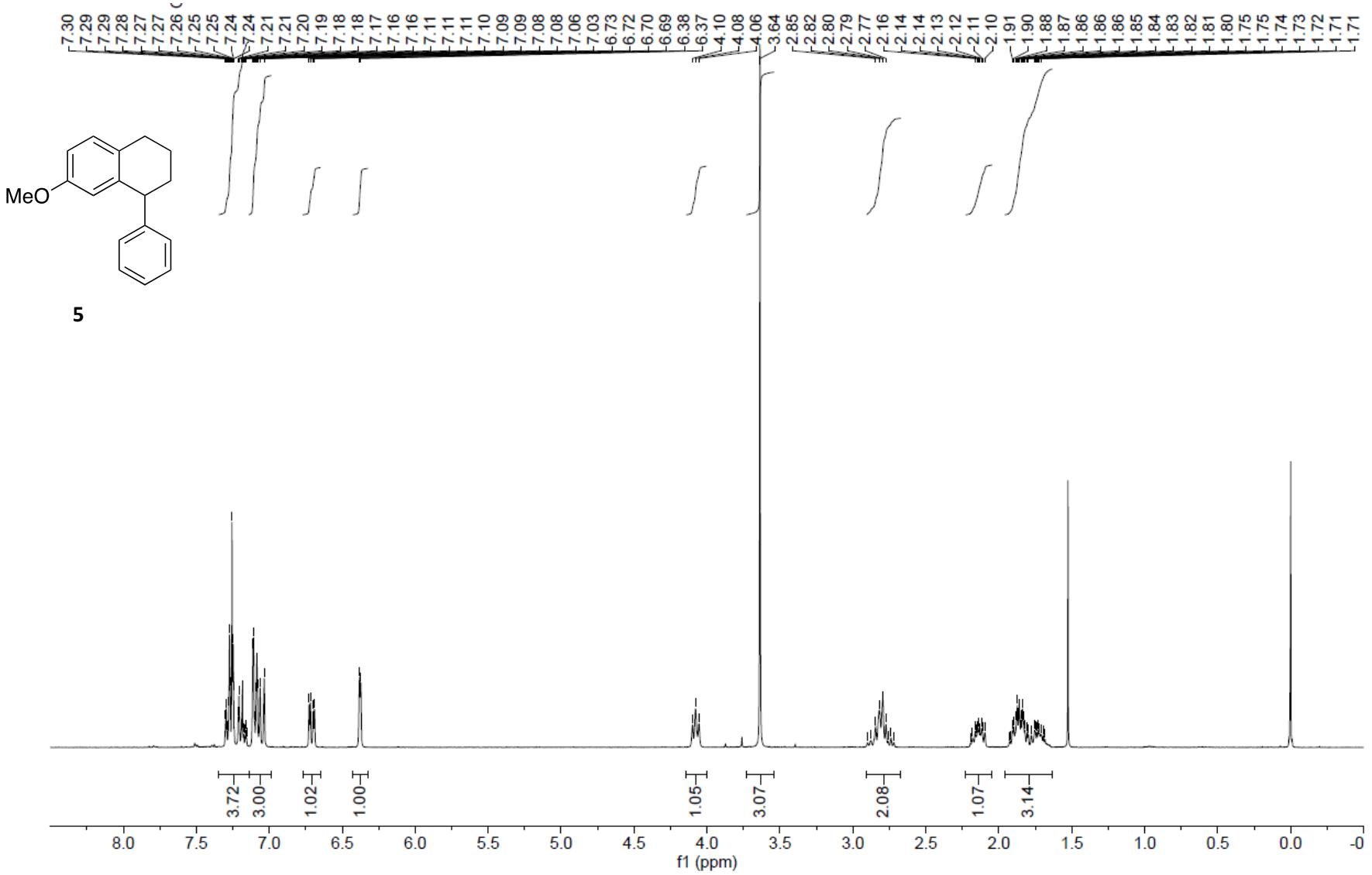
7.34
7.34
7.33
7.32
7.32
7.30
7.30
7.26
7.15
7.12
6.75
6.74
6.72
6.71
6.62
6.61
6.14
6.12
6.11
3.69
2.83
2.80
2.78
2.44
2.42
2.42
2.41
2.41
2.40
2.40
2.39
2.37
4.99
1.02
1.00
0.98
1.00
3.05
2.03
2.07
f1 (ppm)


158.3
140.8
140.0
136.3
129.1
128.9
128.4
128.4
128.3
127.2
112.2
111.7
77.6
77.4
77.2
76.7
55.4
27.5
24.0
MeO
4
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)


MeO
5
7.30 7.29 7.29 7.28 7.27 7.27 7.26 7.25 7.25 7.24 7.24 7.21 7.21 7.20 7.19 7.18 7.18 7.17 7.16 7.16 7.11 7.11 7.11 7.10 7.09 7.09 7.08 7.08 7.06 7.03 6.73 6.72 6.70 6.69 6.38 6.37 4.10 4.08 4.06 3.64 2.85 2.82 2.80 2.79 2.77 2.16 2.14 2.14 2.13 2.12 2.11 2.10 1.91 1.90 1.88 1.87 1.86 1.86 1.86 1.85 1.84 1.83 1.82 1.81 1.80 1.75 1.75 1.74 1.73 1.72 1.71 1.71
3.72 3.00 1.02 1.00 1.05 3.07 2.08 1.07 3.14
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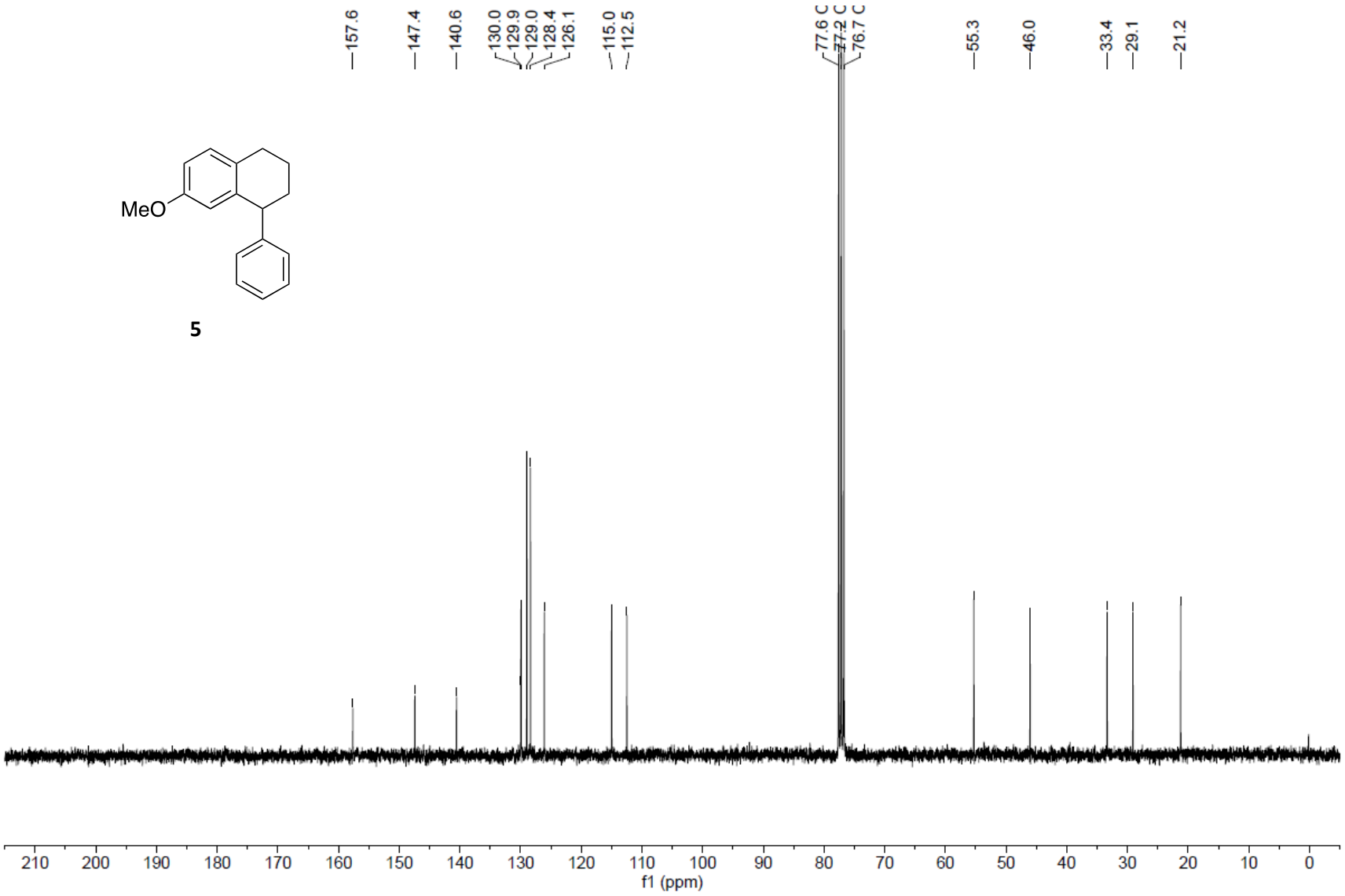
f1 (ppm)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55.3
46.0
33.4
29.1
21.2
MeO
5
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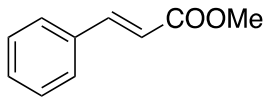
f1 (ppm)

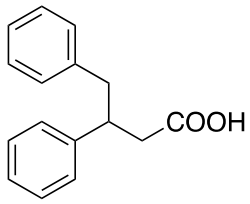
1.8 Synthesis of ketone **2f** intermediates

Methyl cinnamate[32]



Concentrated sulfuric acid (3 ml) was added to a solution of *trans*-cinnamic acid (15 g, 101.2 mmol, 1 eq) in MeOH (120 ml) and the mixture was heated to reflux for 16 h. The mixture was neutralized with NaOH pellets and MeOH was removed under reduced pressure. The residue was dissolved in EtOAc (150 ml), washed with sat. aq. $NaHCO_3$ and brine, dried over Na_2SO_4 and concentrated under reduced pressure. The title product was obtained as a white solid (16.33 g, 99%); m.p.: 32–34 °C (lit.[32] 34 °C). ν_{max}/cm^{-1} (ATR): 2945, 1711, 1636, 1314, 1165, 981; δ_H (300 MHz; $CDCl_3$): 7.70 (d, *J* = 16.0, 1H, PhCH), 7.58 – 7.46 (m, 2H, ArH), 7.44 – 7.33 (m, 3H, ArH), 6.44 (d, *J* = 16.0, 1H, COOMeCH), 3.80 (s, 3H, CH_3); δ_C (75 MHz; $CDCl_3$): 167.5, 145.0, 134.5, 130.4, 129.0, 128.2, 117.9, 51.8.

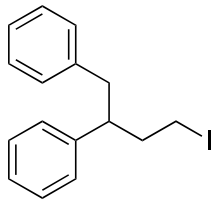
3,4-Diphenylbutanoic acid[7]



A flask was charged with magnesium turnings (5.3 g, 215 mol, 3.44 eq) and dry THF (80 ml) under a nitrogen atmosphere at 0 °C. Benzyl chloride (10 ml, 87 mmol, 1.39 eq) was slowly added and the reaction mixture stirred for 2 h at room temperature. To a different flask was consecutively added CuI (11.9 g, 62.5 mmol, 1 eq), dry THF (125 ml) and TMEDA (10.3 ml, 68.8 mmol, 1.1 eq) under a nitrogen atmosphere. After stirring at room temperature for 15 min the solution became brown in colour and the flask was cooled to –60 °C. The BnMgCl solution was transferred *via* a cannula, upon which the colour of the solution changed to yellow and a solid formed. The mixture was stirred for 10 min before a solution of TMSCl (19.8 ml, 156.3 mmol, 2.5 eq) and methyl cinnamate (10 g, 62.5 mmol, 1 eq) in dry THF (40 ml) was added, after which the colour changed to red immediately. The reaction mixture was stirred at –30 °C for 5 h and a further 16 h at 0°C, before it was quenched by adding saturated NH_4Cl in concentrated NH_4OH (250 ml) and stirred for 30 min at room temperature. The top (THF) layer was separated and the blue aqueous

layer was extracted with diethyl ether (3 × 100 ml). The combined organic layer was washed with saturated aqueous NH_4Cl (× 2) and brine (× 2), dried over Na_2SO_4 and concentrated under reduced pressure. The crude product was used for the next step without further purification. Aqueous KOH (25.5 g, 455 mmol in 70 mL H_2O) was added to the crude ester and the mixture was heated at reflux for 2 h. After cooling to room temperature, the aqueous solution was acidified to pH 5-6, and then extracted with CH_2Cl_2 (3 × 50 ml). The combined organic layers were dried over Na_2SO_4 and concentrated under reduced pressure. The crude product was recrystallised from hexane to yield the title product as a white solid (8.852 g, 59%); m.p.: 92–93 °C (lit.[33] 91–92.5 °C). ν_{max}/cm^{-1} (ATR): 3028, 2855, 1703, 1407, 1428, 1237; δ_H (300 MHz; $CDCl_3$): 10.74 (br s, 1H, COOH), 7.40 – 6.75 (m, 10H, ArH), 3.47 – 3.29 (m, 1H, C(3)H), 3.03 – 2.80 (m, 2H, C(4)H_2), 2.77 – 2.51 (m, 2H, C(2)H_2); δ_C (75 MHz; $CDCl_3$): 178.4, 143.3, 139.4, 129.4, 128.6, 128.4, 127.6, 126.8, 126.4, 43.7, 43.1, 39.9.

1-Iodo-3,4-diphenylbutane

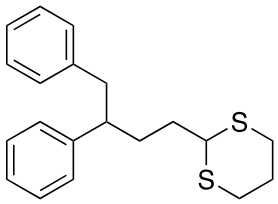


$LiAlH_4$ (2 M in THF, 9.06 ml, 18.12 mmol, 2 eq) was slowly added to a solution of 3,4-diphenylbutanoic acid (2.18 g, 9.06 mmol, 1 eq) in THF (18 ml) at 0 °C under a nitrogen atmosphere and the reaction mixture was stirred at room temperature for 18 h. A 10:1 mixture of THF and water was added carefully to quench the reaction and the mixture was filtered through Celite® and concentrated under reduced pressure. The crude product was used for the next step without further purification.

To a mixture of imidazole (2.5 g, 36.25 mmol, 4 eq) and PPh_3 (7.13 g, 27.2 mmol, 3 eq) in CH_2Cl_2 (40 ml) under a nitrogen atmosphere at 0°C was added iodine (6.90 g, 27.2 mmol, 3 eq) and the reaction mixture was stirred for 5 min. The crude alcohol, dissolved in CH_2Cl_2 (5 ml) was added and then it was stirred at room temperature overnight. The solution was filtered through Celite® and washed with saturated aqueous sodium thiosulfate, water and brine. The organic layers were combined, dried over Na_2SO_4 and concentrated under reduced pressure. Then hexane was added, the mixture filtered and the filtrate evaporated under reduced pressure. The residue was purified by column chromatography (hexane) to afford the title product as a colourless oil (2.404 g, 79%). ν_{max}/cm^{-1} (ATR): 3026, 2924, 1494, 1452, 1228; δ_H (300 MHz; $CDCl_3$): 7.49 – 6.85 (m, 10H, ArH), 3.15 – 2.66 (m, 5H, C(3)H, C(1)H_2, C(4)H_2), 2.31 – 2.02 (m,

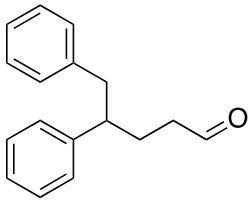
2H, C(2)H_2); δ_C (75 MHz; $CDCl_3$): 143.1, 139.9, 129.2, 128.7, 128.3, 127.9, 126.8, 126.2, 48.5, 43.3, 39.3, 5.1.

2-(3',4'-Diphenylbutyl)-1,3-dithiane



n-BuLi (2.5 M in hexanes, 5.24 ml, 13.1 mmol, 1.9 eq) was added dropwise to a stirred solution of 1,3-dithiane (1.66 g, 13.8 mmol, 2 eq) in THF (38 ml) at –30 °C under a nitrogen. The mixture was stirred at -30 °C for 2 h, followed by the dropwise addition of a solution of 1-iodo-3,4-diphenylbutane (2.32 g, 6.9 mmol, 1 eq) in THF (15 ml). The reaction mixture was stirred for another 40 min at –30 °C and then quenched with saturated aqueous NH_4Cl. The resulting biphasic mixture was extracted with EtOAc (3 × 20 ml) and the combined organic layers were dried over Na_2SO_4 and concentrated under reduced pressure. Column chromatography (hexane) yielded the title product as a colourless oil (2.224 g, 98%). ν_{max}/cm^{-1} (ATR): 3026, 2933, 1495, 1452; δ_H (400 MHz; $CDCl_3$): 7.50 – 6.63 (m, 10H, ArH), 3.91 (t, *J* = 6.9, 1H, C(2)H), 3.09 – 2.61 (m, 7H, C(3')H, C(4)H_2, C(6)H_2, C(4')H_2), 2.15 – 1.98 (m, 1H, one of C(5)H_2), 1.98 – 1.70 (m, 3H, one of C(5)H_2, C(2')H_2), 1.70 – 1.46 (m, 2H, C(1')H_2); δ_C (100 MHz; $CDCl_3$): 144.3, 140.5, 129.3, 128.5, 128.2, 127.8, 126.4, 126.0, 48.0, 47.8, 43.9, 33.6, 32.6, 30.6, 30.5, 26.1; HRMS (ESI^+) found $[M+H]^+$ 329.1384, $C_{20}H_{25}S_2$ requires 329.1392.

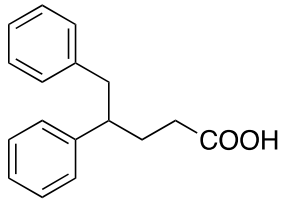
4,5-Diphenylpentanal



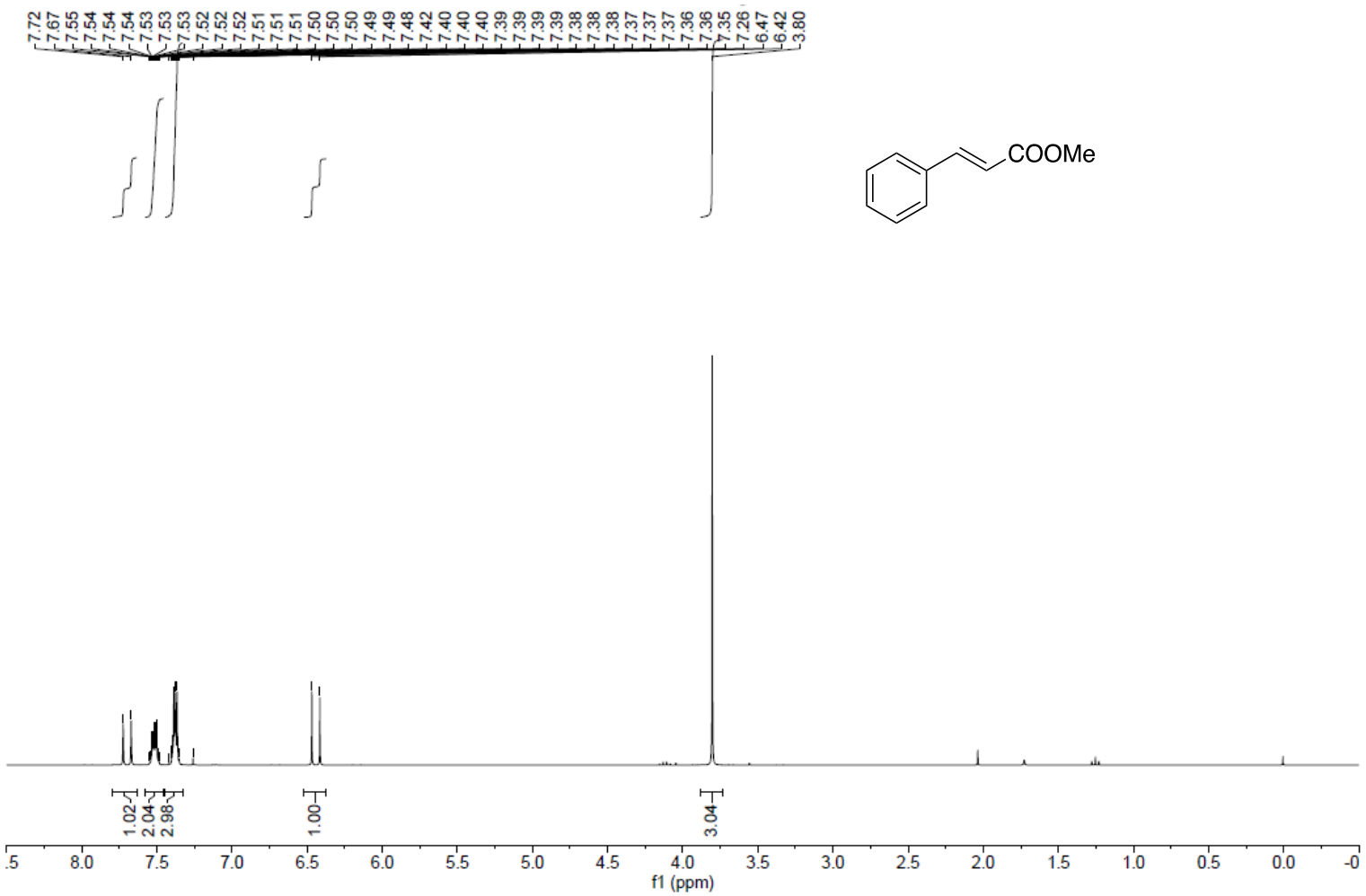
To a mixture of 2-(3,4-diphenylbutyl)-1,3-dithiane (3.12 g, 9.5 mmol, 1 eq) and $NaHCO_3$ (11.97 g, 142.5 mmol, 15 eq) in MeCN/water (95 mL/19 mL) at room temperature was added MeI (5.91 ml, 95 mmol, 10 eq) and the resulting mixture was stirred for 22 h. The reaction mixture was diluted with EtOAc and washed with aqueous sodium thiosulfate and brine. The organic layers were combined, dried over Na_2SO_4

and concentrated under reduced pressure to provide the crude aldehyde, which was purified by column chromatography (hexane:EtOAc 1:0 to 9:1) to afford the title product as a colourless oil (2.042 g, 90%). ν_{max}/cm^{-1} (ATR): 2923, 1721, 1495, 1453, 1056, 908; δ_H (300 MHz; $CDCl_3$): 9.59 (t, *J* = 1.6, 1H), 7.44 – 6.73 (m, 10H), 2.99 – 2.74 (m, 3H), 2.28 – 2.18 (m, 2H), 2.13 – 1.75 (m, 2H); δ_C (75 MHz; $CDCl_3$): 202.2, 143.8, 140.2, 129.2, 128.7, 128.3, 127.8, 126.7, 126.1, 47.4, 43.9, 42.2, 27.8; HRMS (ESI^+) found $[M+Na]^+$ 261.1241, $C_{17}H_{18}ONa$ requires 261.1250.

4,5-Diphenylpentanoic acid[8]



A solution of $NaClO_2$ (80%, 1.25 g, 11.07 mmol, 3.5 eq) and $NaH_2PO_4{\cdot}H_2O$ (2.47 g, 15.82 mmol, 5 eq) in H_2O (10 ml) was slowly added over 1.5 h to a mixture of 4,5-diphenylpentanal (0.754 g, 3.16 mmol, 1 eq) and 2- methylbut-2-ene (4.69 ml, 44.29 mmol, 14 eq) in *t*-BuOH (20 ml) and the reaction mixture was stirred for another 45 min. After this time, it was diluted with saturated aqueous NH_4Cl (20 ml) and extracted with EtOAc (3 × 20 ml), the combined organic layers were washed with brine and dried over Na_2SO_4, filtered, and concentrated under reduced pressure. The crude product was dissolved in aq. 1 M KOH and washed with Et_2O (2 × 20 ml). The solution was acidified to pH 2 and extracted with CH_2Cl_2 (4 × 20 ml). The combined organic layers were washed with brine, dried over Na_2SO_4 and concentrated under reduced pressure to give the title product as colourless oil (0.754 g, 94%). ν_{max}/cm^{-1} (ATR): 3027, 2926, 1703, 1453, 1412; δ_H (300 MHz; $CDCl_3$): 9.71 (br s, 1H, COOH), 7.38 – 6.90 (m, 10H, ArH), 3.05 – 2.75 (m, 3H, C(4)H, C(5)H_2), 2.27 – 1.72 (m, 4H, C(2)H_2, C(3)H_2); δ_C (75 MHz; $CDCl_3$): 179.6, 143.7, 140.2, 129.2, 128.6, 128.3, 127.9, 126.7, 126.1, 47.4, 43.8, 32.2, 30.4.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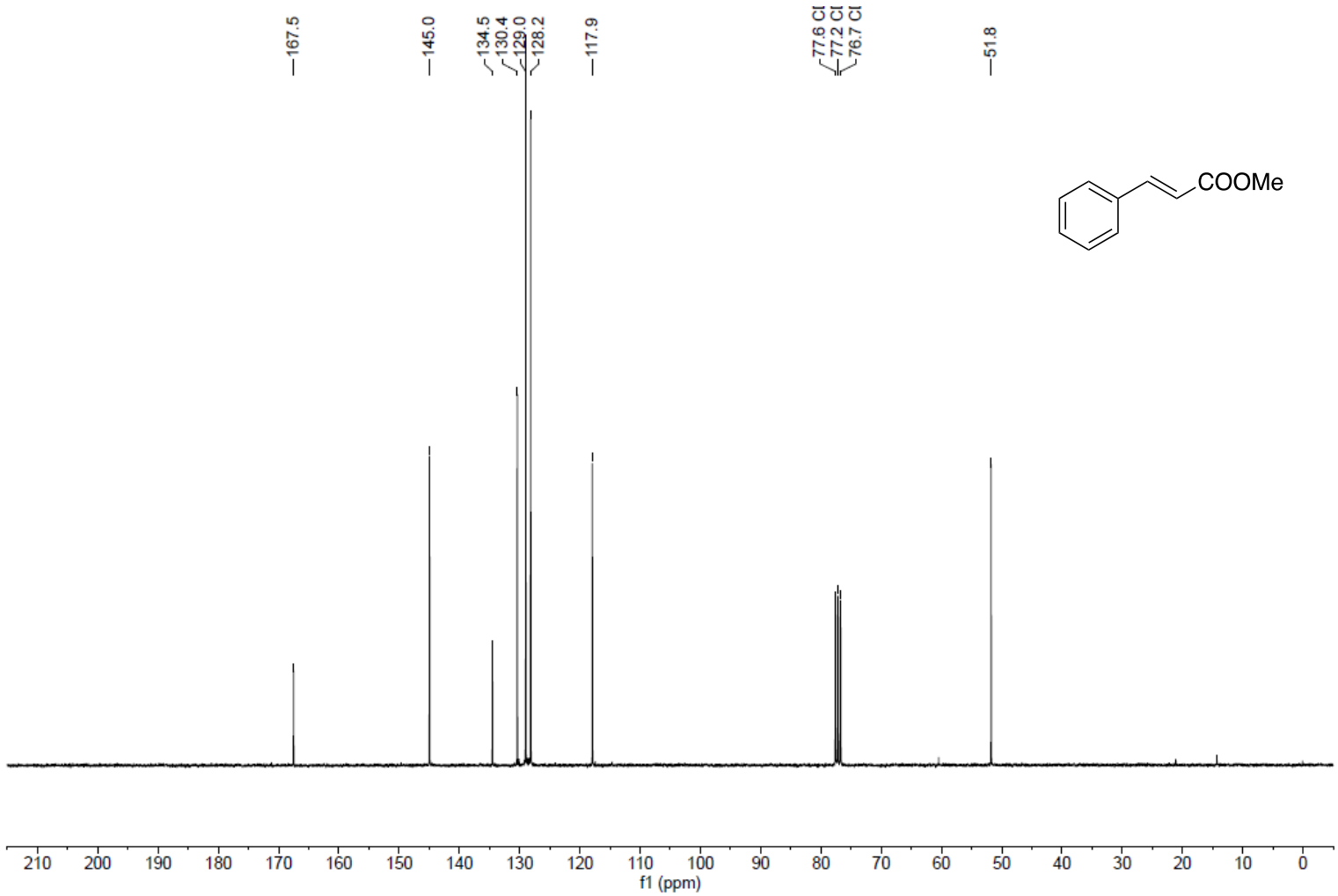
f1 (ppm)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COOMe
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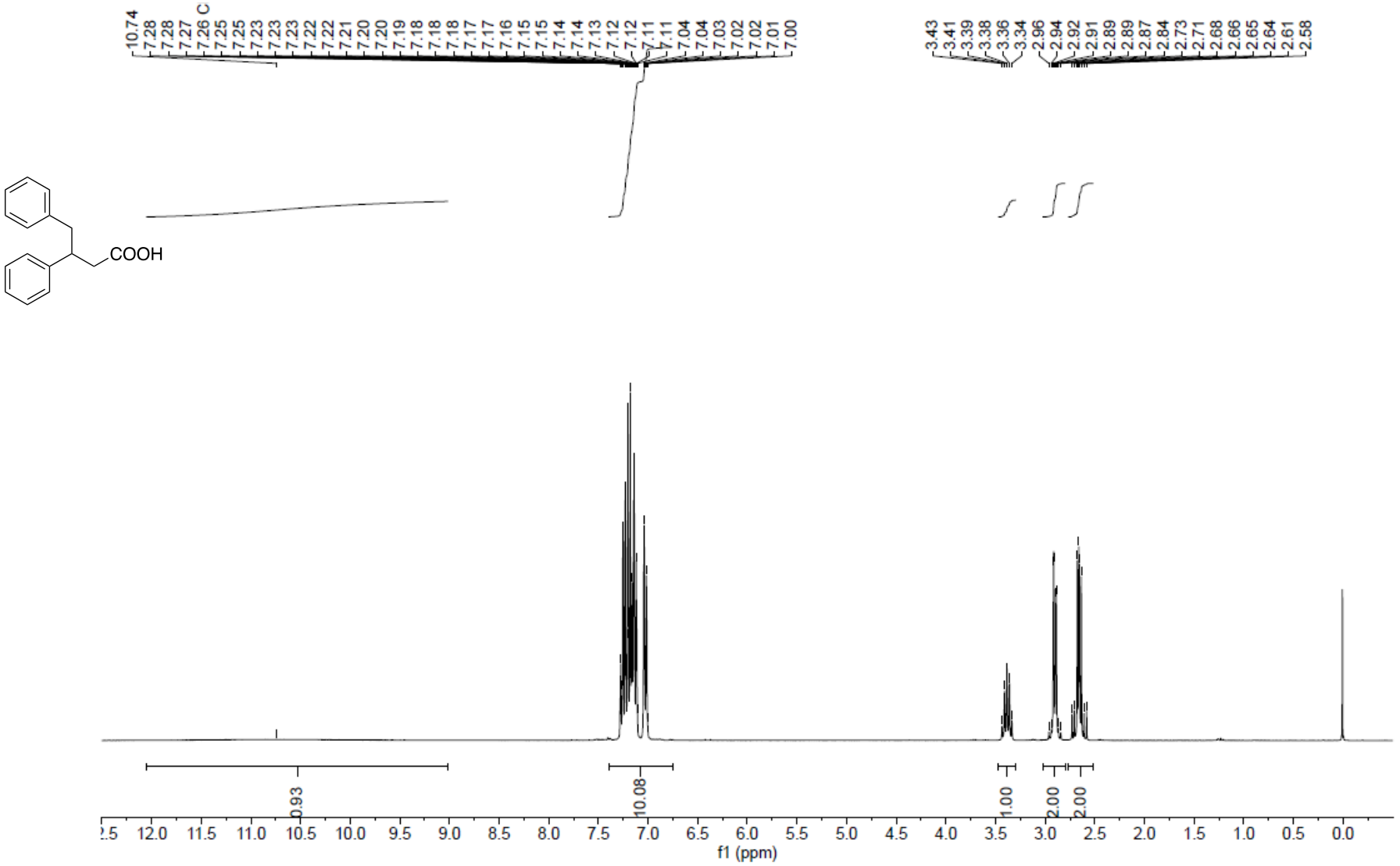
f1 (ppm)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7.15
7.15
7.14
7.14
7.13
7.12
7.12
7.11
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11.0
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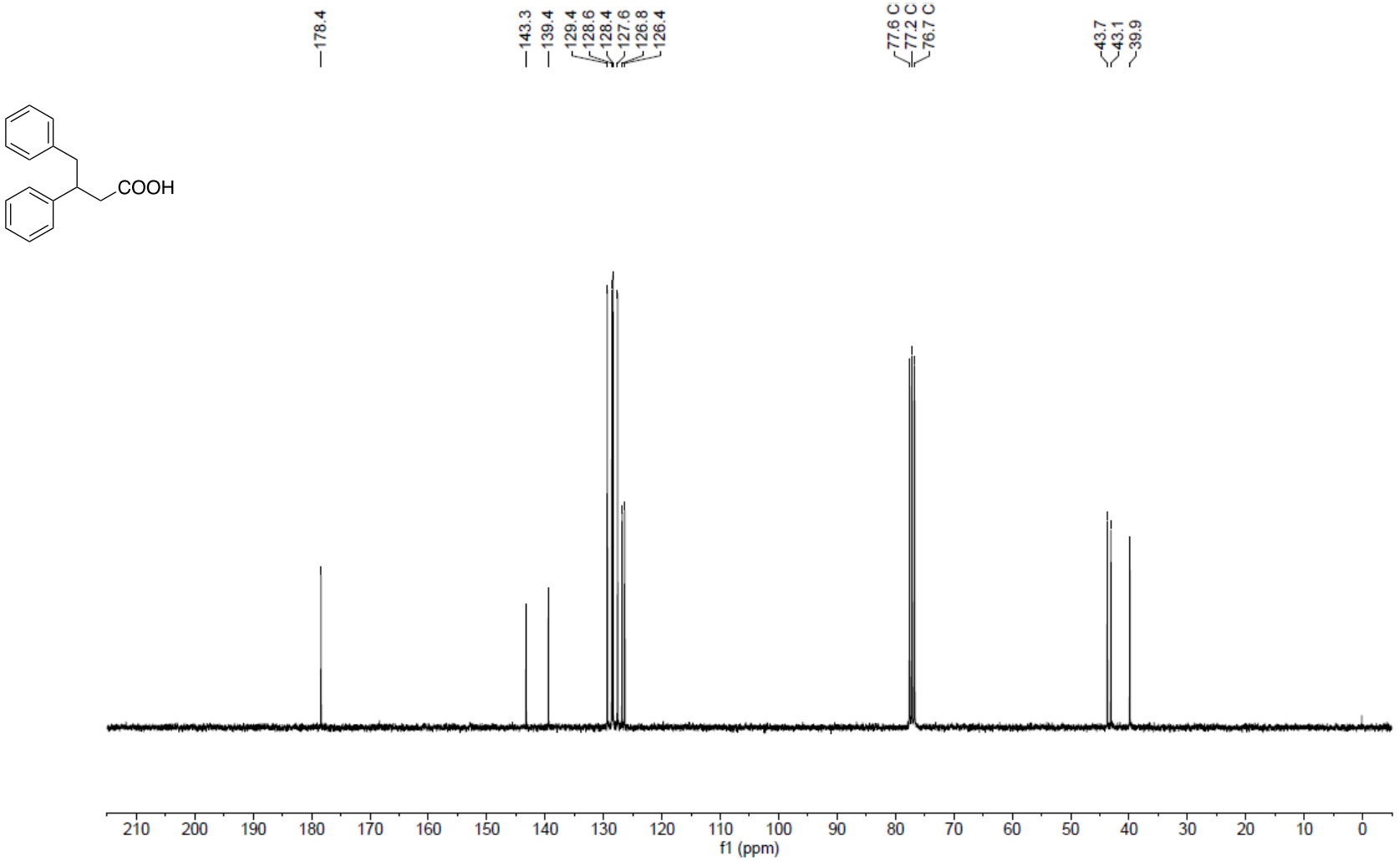
f1 (ppm)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126.8
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77.2 C
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43.1
39.9
COOH
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200
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180
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100
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10
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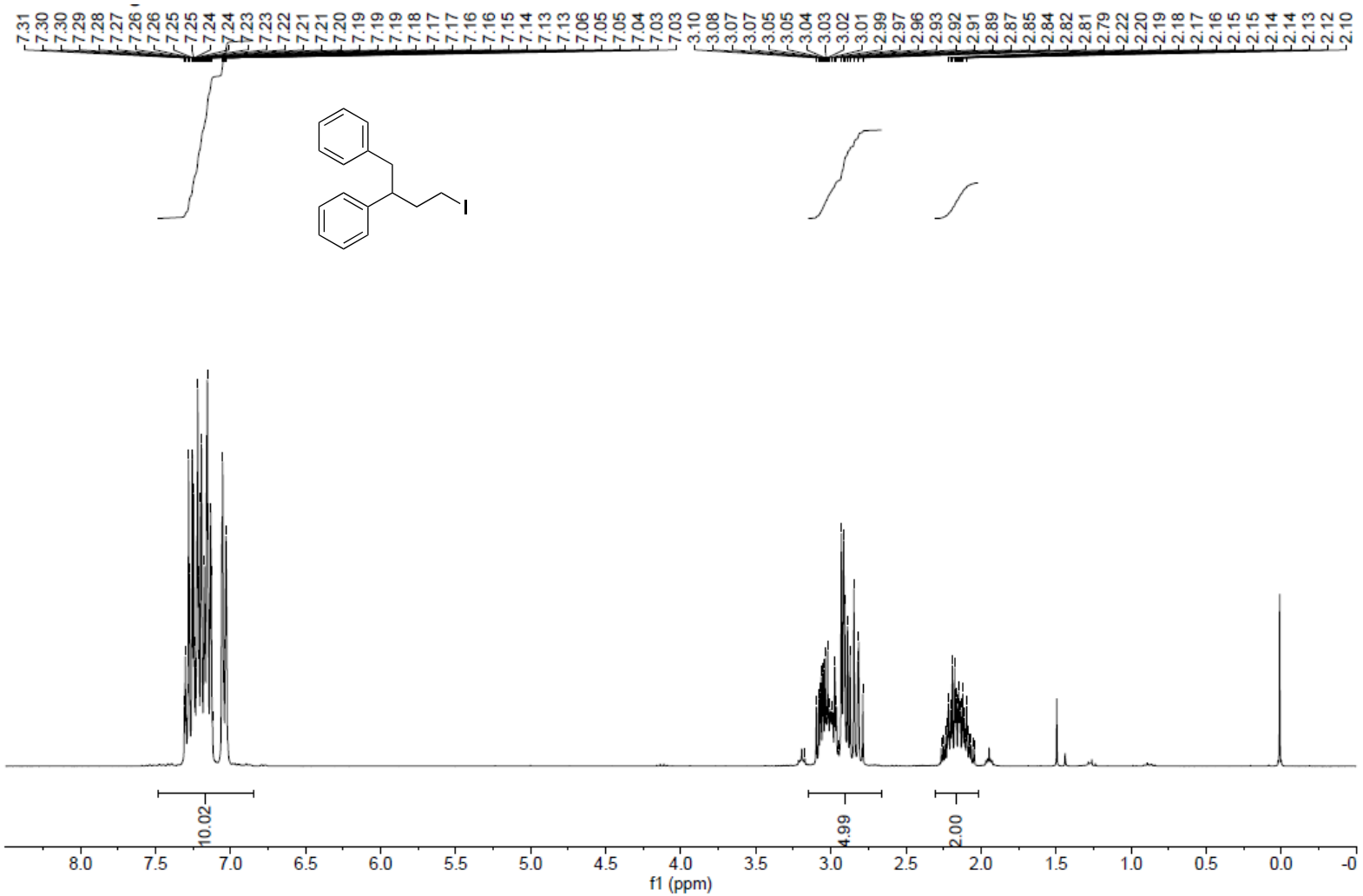
f1 (ppm)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3.10 3.08 3.07 3.07 3.05 3.05 3.04 3.03 3.02 3.01 2.99 2.97 2.96 2.93 2.92 2.91 2.89 2.87 2.85 2.84 2.82 2.81 2.79 2.22 2.20 2.19 2.18 2.17 2.16 2.15 2.15 2.14 2.14 2.13 2.12 2.10
I
10.02
4.99
2.00
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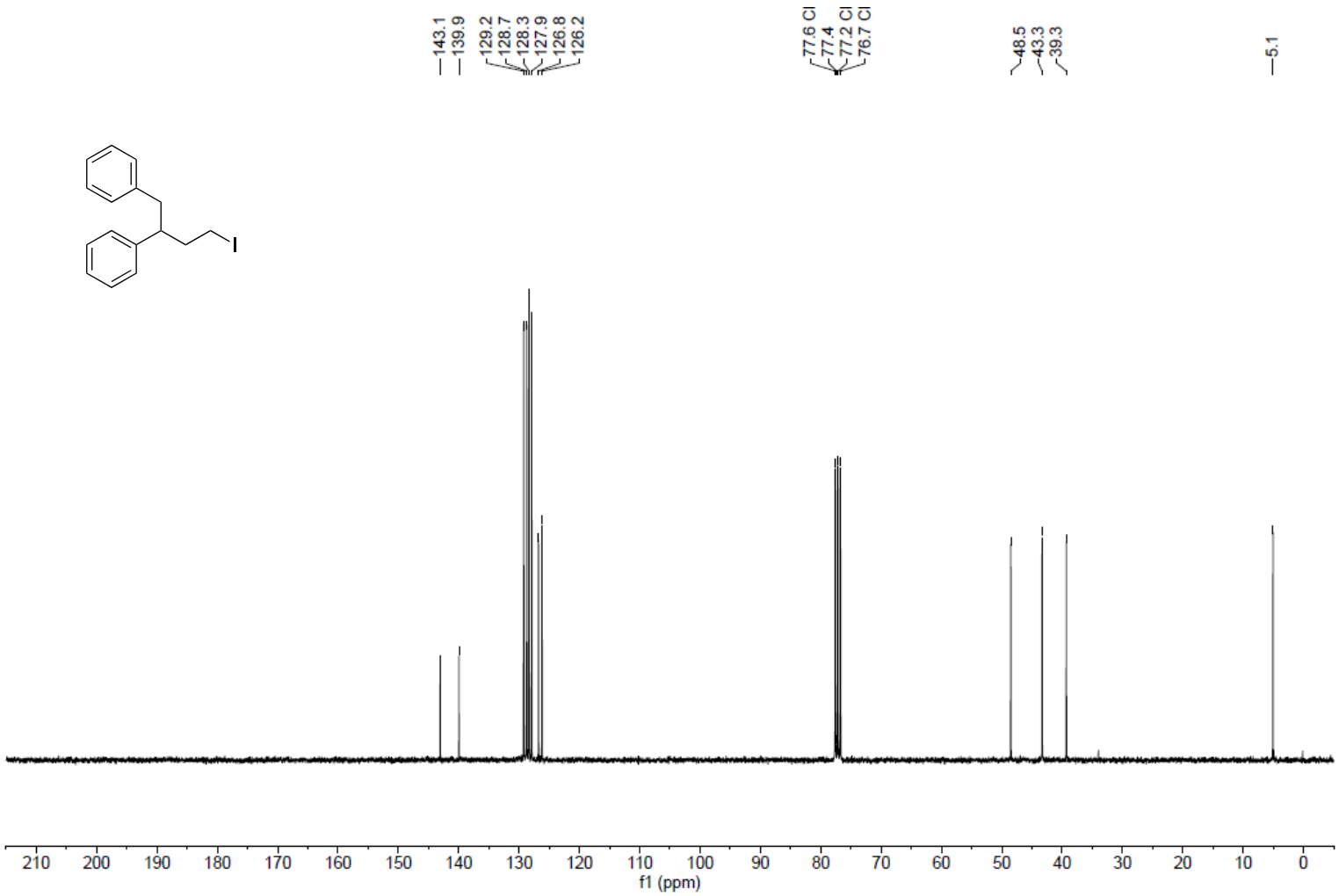
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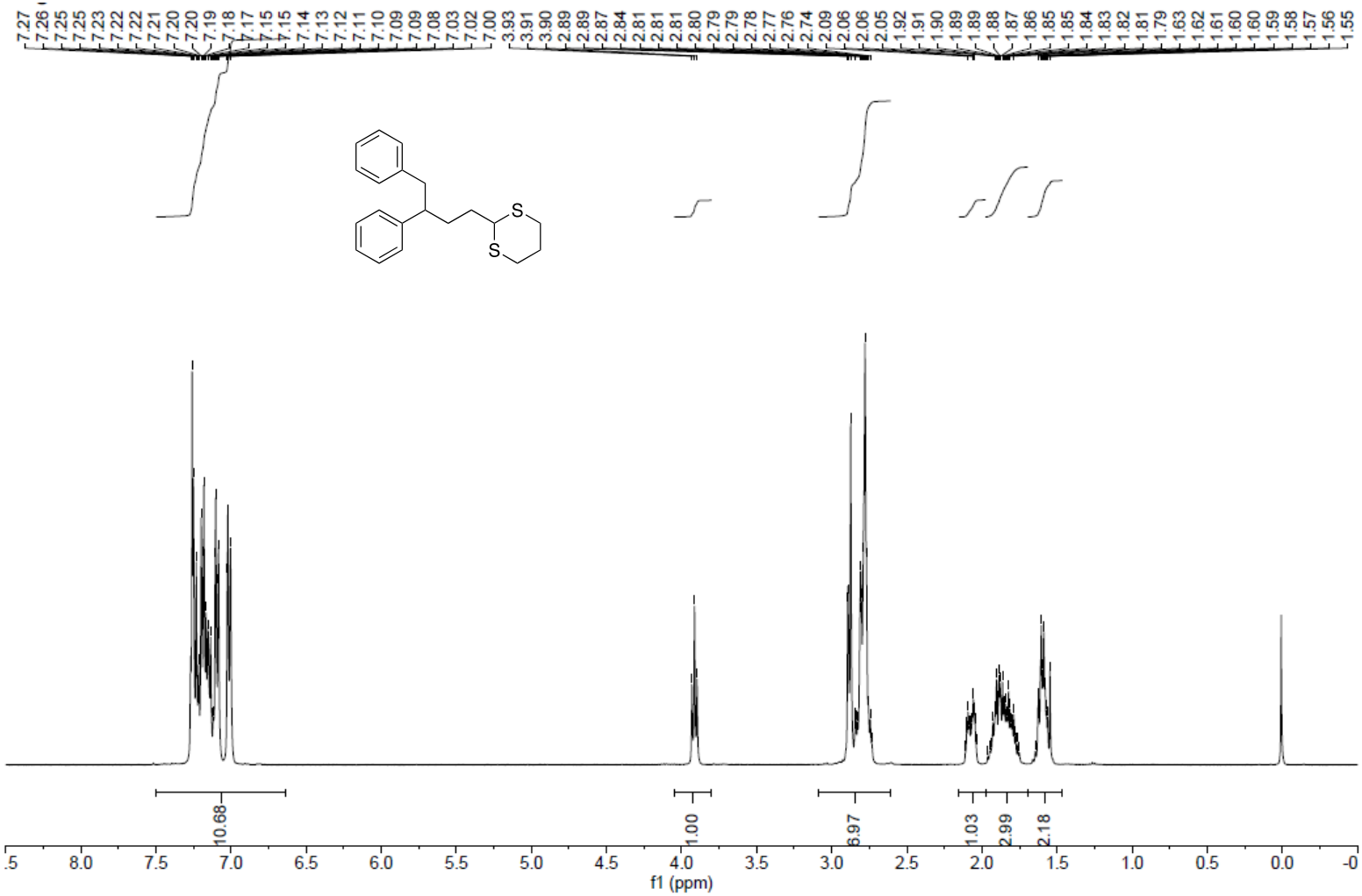
f1 (ppm)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3.93 3.91 3.90 2.89 2.89 2.87 2.84 2.81 2.81 2.81 2.80 2.79 2.79 2.78 2.77 2.76 2.74 2.09 2.06 2.06 2.05 1.92 1.91 1.90 1.89 1.89 1.88 1.87 1.86 1.85 1.85 1.84 1.83 1.82 1.81 1.79 1.63 1.62 1.61 1.60 1.60 1.59 1.58 1.57 1.56 1.55
S
S
10.68
1.00
6.97
1.03
2.99
2.18
.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0
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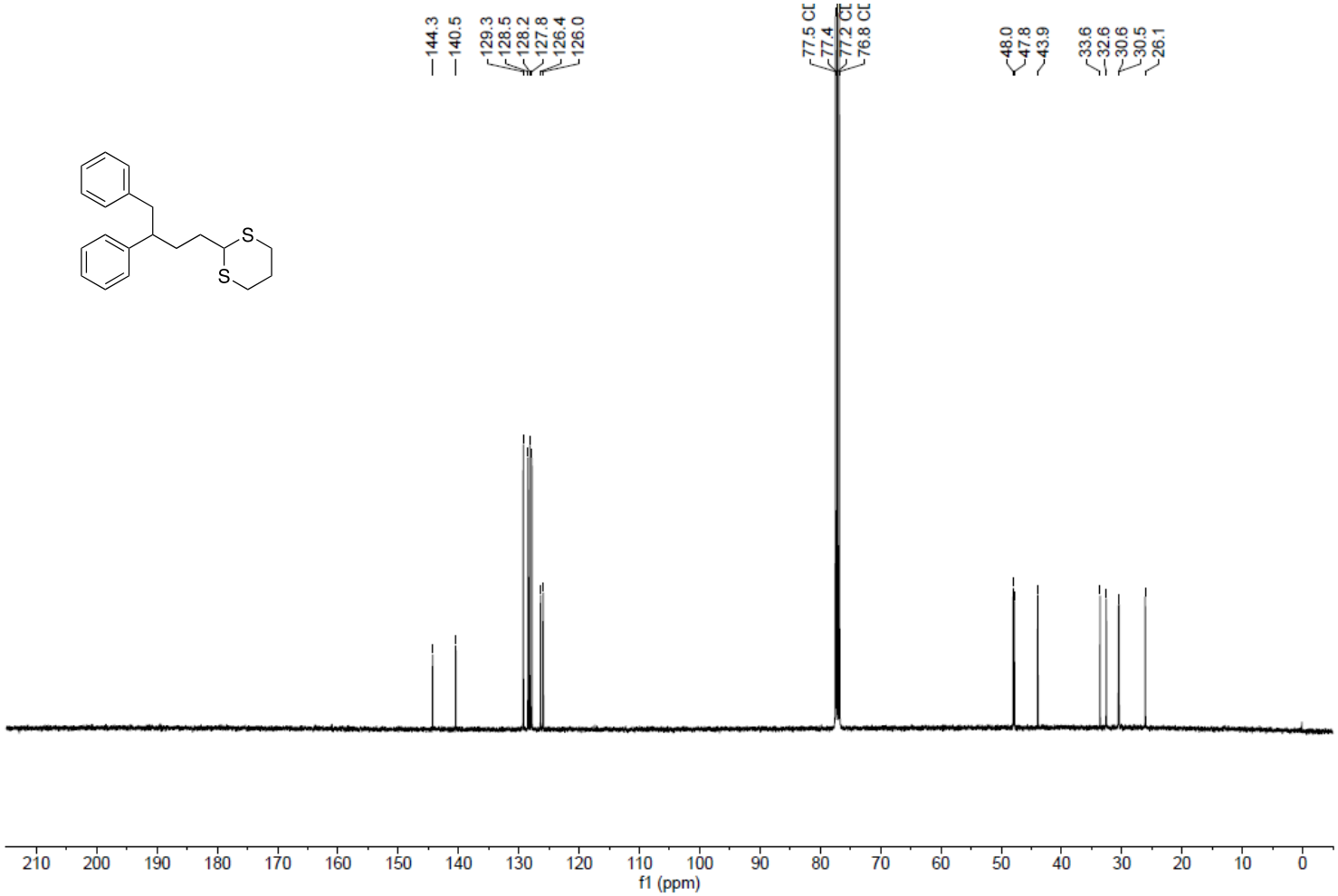
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43.9
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30.5
26.1
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S
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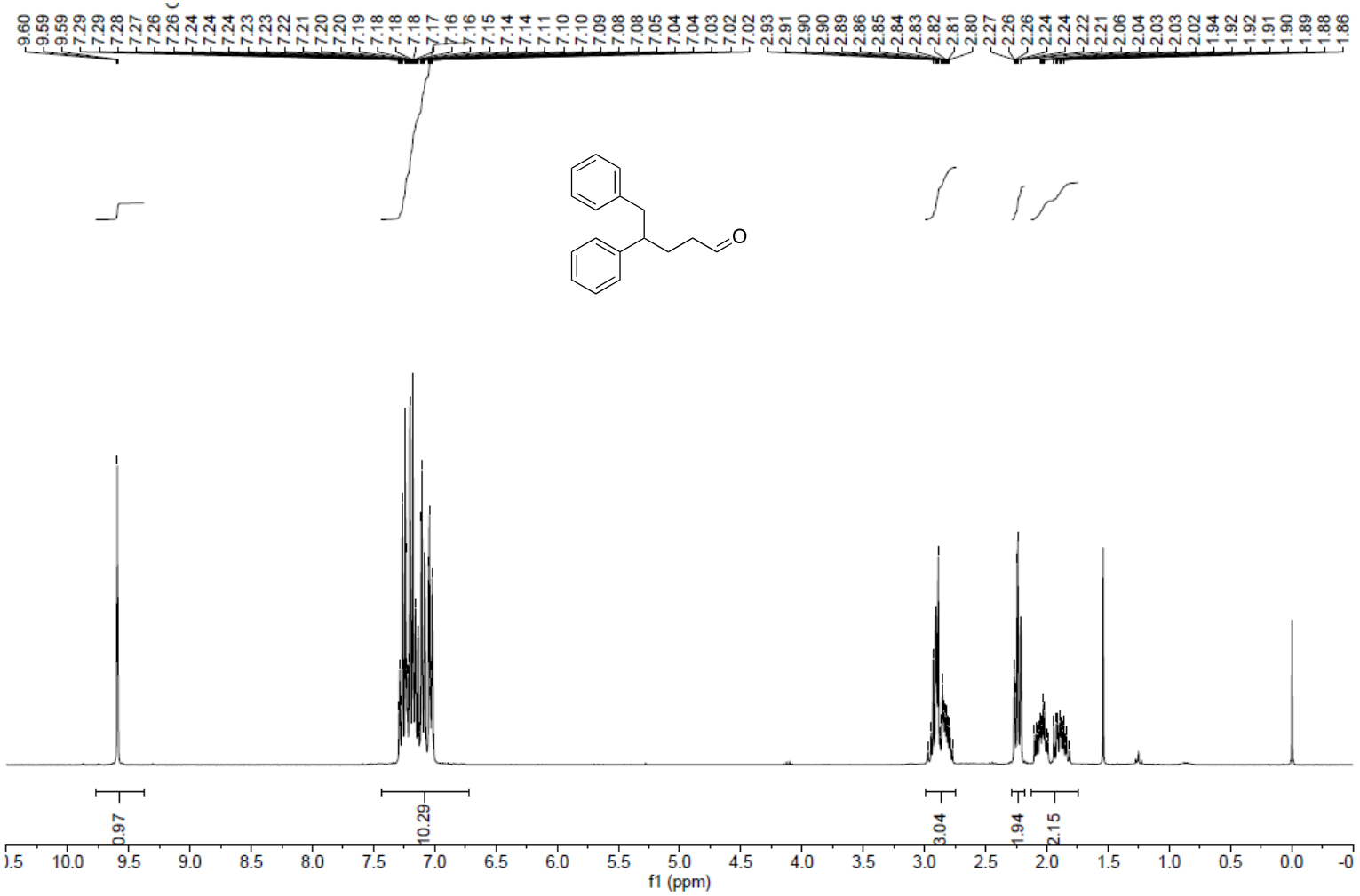
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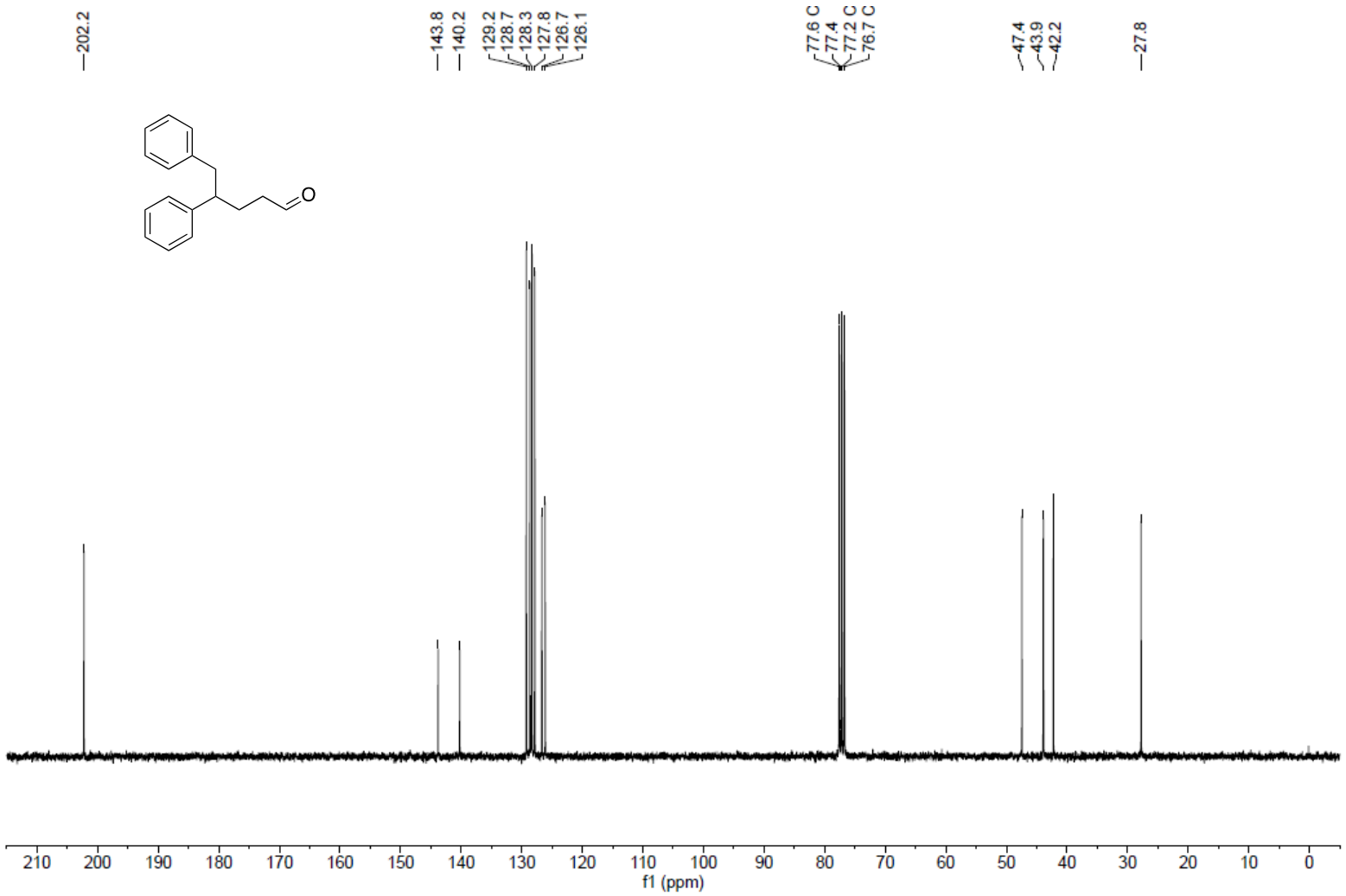
f1 (ppm)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77.4
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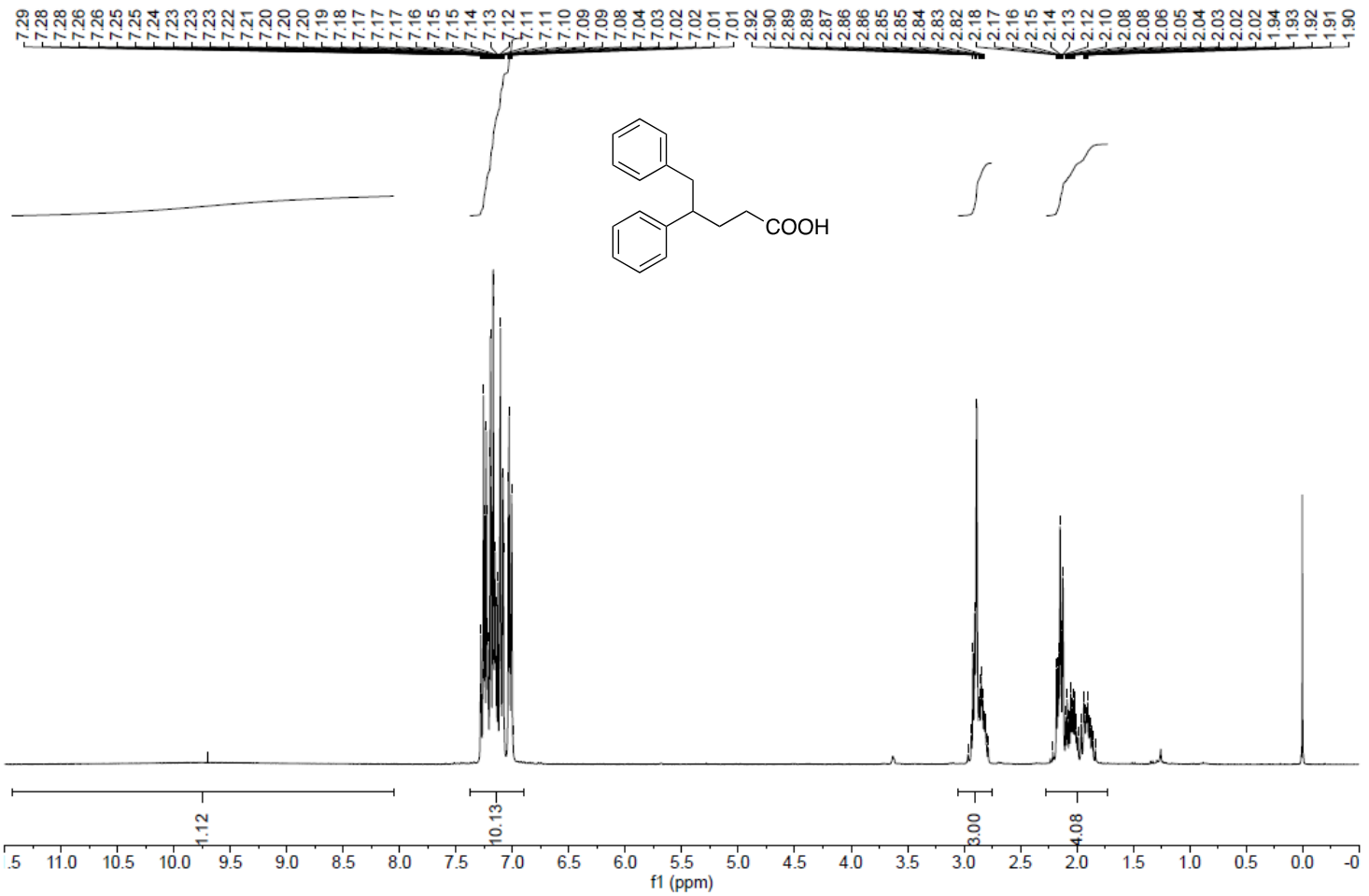
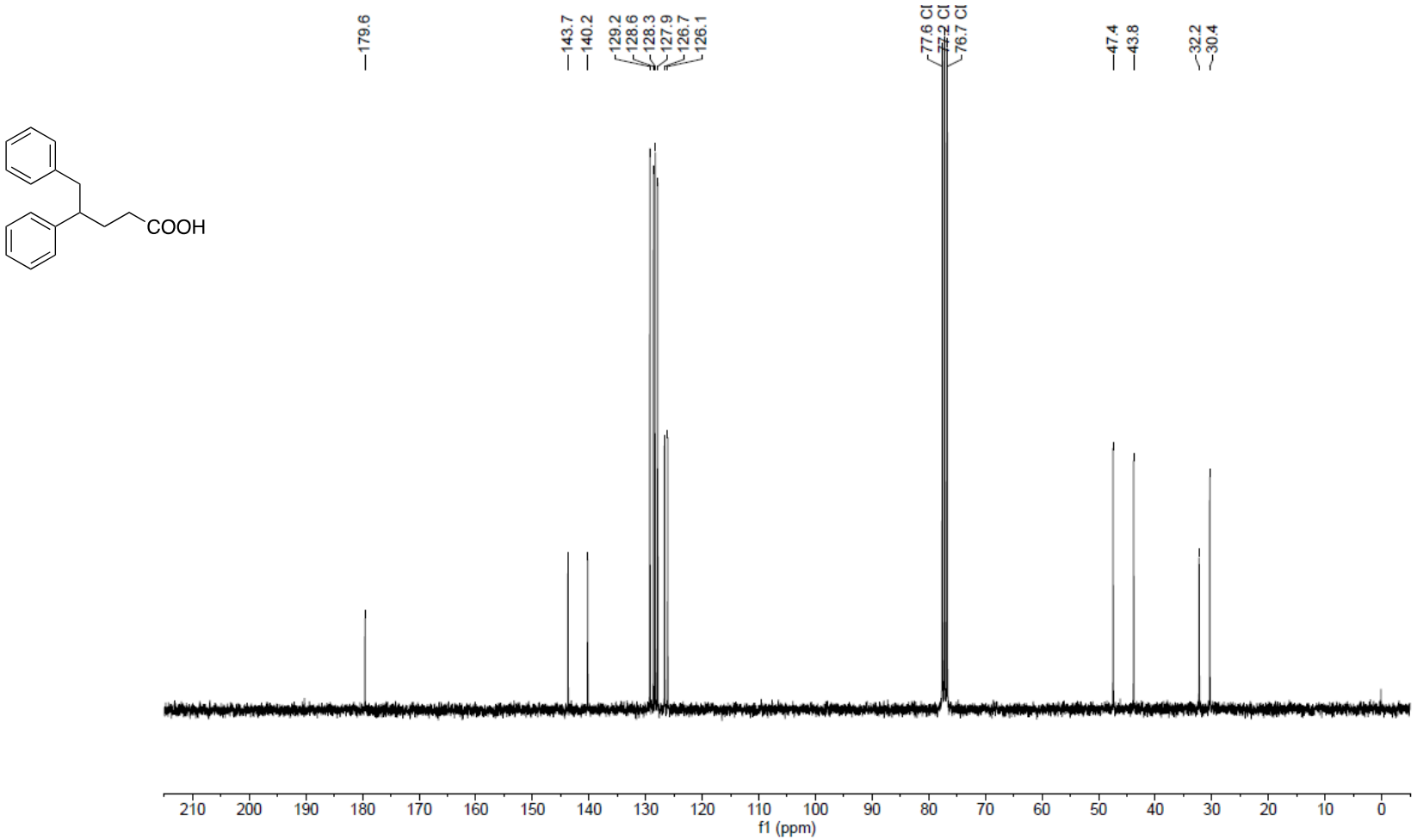
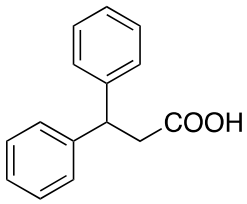
f1 (ppm)


7.29 7.28 7.28 7.26 7.26 7.25 7.25 7.24 7.23 7.23 7.23 7.22 7.21 7.20 7.20 7.20 7.19 7.18 7.17 7.17 7.17 7.16 7.15 7.15 7.14 7.13 7.12 7.11 7.11 7.10 7.09 7.09 7.08 7.04 7.03 7.02 7.02 7.01 7.01
2.92 2.90 2.89 2.89 2.87 2.86 2.86 2.85 2.85 2.84 2.83 2.82 2.18 2.17 2.16 2.15 2.14 2.13 2.12 2.10 2.08 2.08 2.06 2.05 2.04 2.03 2.02 2.02 1.94 1.93 1.92 1.91 1.90
COOH
1.12
10.13
3.00
4.08
.5 11.0 10.5 10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0
f1 (ppm)


COOH
179.6
143.7
140.2
129.2
128.6
128.3
127.9
126.7
126.1
77.6 Cl
77.2 Cl
76.7 Cl
47.4
43.8
32.2
30.4
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)

1.9 Synthesis of ketone 2m intermediate and corresponding spectra

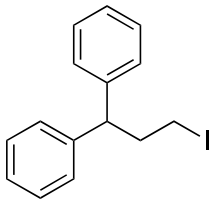
3,3-Diphenylpropanoic acid[34]



A flask was charged with magnesium turnings (5.32 g, 218.8 mol, 3.5 eq) and dry THF (80 ml) under a nitrogen atmosphere at 0 °C. Bromobenzene (13.2 ml, 125 mmol, 2 eq) was slowly added and the reaction mixture stirred for 2 h at room temperature. To a different flask was consecutively added CuI (11.9 g, 62.5 mmol, 1 eq), dry THF (125 ml) and TMEDA (10.3 ml, 68.8 mmol, 1.1 eq) under a nitrogen atmosphere. After stirring at room temperature for 15 min, the flask was cooled to –60 °C. The PhMgBr solution was transferred *via* a cannula and the solution was stirred for 10 min before a solution of TMSCl (19.8 ml, 156.3 mmol, 2.5 eq) and methyl cinnamate (10 g, 62.5 mmol, 1 eq) in dry THF (40 ml) was added. The reaction mixture was stirred at –30 °C for 5 h and a further 16 h at 0°C, before it was quenched by adding saturated NH_4Cl in NH_4OH (250 ml) and stirred for 30 min at room temperature. The top (THF) layer was separated and the blue aqueous layer was extracted with diethyl ether (3 × 100 ml). The combined organic layer was washed with saturated aqueous NH_4Cl (× 2) and brine (× 2), dried over Na_2SO_4 and concentrated under reduced pressure. The crude product was used for the next step without further purification.

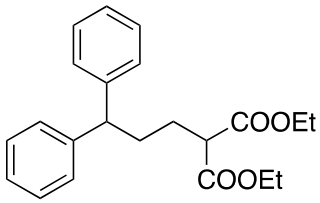
Aqueous KOH (25.5 g, 455 mmol in 70 mL H_2O) was added to the crude ester and the mixture was heated at reflux for 2 h. After cooling to room temperature, the aqueous solution was acidified to pH 5-6, and then extracted with CH_2Cl_2 (3 × 50 ml). The combined organic layers were dried over Na_2SO_4 and concentrated under reduced pressure. The crude product was dissolved in CH_2Cl_2 and precipitated by slow addition of hexane to yield the title product as a white solid (7.716 g, 55%); m.p.: 152–154 °C (lit.[35] 155 °C). ν_{max}/cm^{-1} (ATR): 3025, 1711, 1493, 1452, 1066; δ_H (300 MHz; $CDCl_3$): 7.35 – 7.02 (m, 10H, ArH), 4.55 (t, *J* = 7.5, 1H, C(3)H), 3.11 (d, *J* = 7.5, 2H, C(2)H_2); δ_C (75 MHz; $CDCl_3$): 206.7, 143.9, 128.7, 127.8, 126.5, 49.7, 45.8.

1-Iodo-3,3-diphenylpropane[36]



$LiAlH_4$ (1 M in THF, 18.6 ml, 18.6 mmol, 2 eq) was slowly added to a solution of 3,4-diphenylpropanoic acid (2.10 g, 9.3 mmol, 1 eq) in THF (9.3 ml) at 0 °C under a nitrogen atmosphere and the reaction mixture was stirred at room temperature for 18 h. Water was added carefully to quench the reaction and the mixture was filtered through Celite® and concentrated under reduced pressure. The crude product was used for the next step without further purification. To a mixture of imidazole (2.53 g, 37.2 mmol, 4 eq) and PPh_3 (7.32 g, 27.9 mmol, 3 eq) in CH_2Cl_2 (40 ml) under a nitrogen atmosphere at 0°C was added iodine (7.08 g, 27.9 mmol, 3 eq) and the reaction mixture was stirred for 5 min. The crude alcohol, dissolved in CH_2Cl_2 (5 ml) was added and then it was stirred at room temperature overnight. The solution was filtered through Celite® and washed with saturated aqueous sodium thiosulfate, water and brine. The organic layers were combined, dried over Na_2SO_4 and concentrated under reduced pressure. Then hexane was added, the mixture filtered and the filtrate evaporated under reduced pressure. The residue was purified by column chromatography (hexane) to afford the title product as a colourless oil (1.232 g, 41%). ν_{max}/cm^{-1} (ATR): 3024, 1492, 1450, 1227; δ_H (300 MHz; $CDCl_3$): 7.43 – 7.09 (m, 10H, ArH), 4.11 (t, *J* = 7.7, 1H, C(3)H), 3.09 (t, *J* = 7.0, 2H, C(1)H_2), 2.55 (apparent q, *J* = 7.1, 2H, C(2)H_2); δ_C (75 MHz; $CDCl_3$): 143.4, 128.8, 128.0, 126.7, 51.5, 39.2, 5.4.

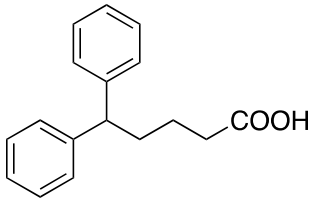
Diethyl 2-(3',3'-diphenylpropyl)malonate[36]



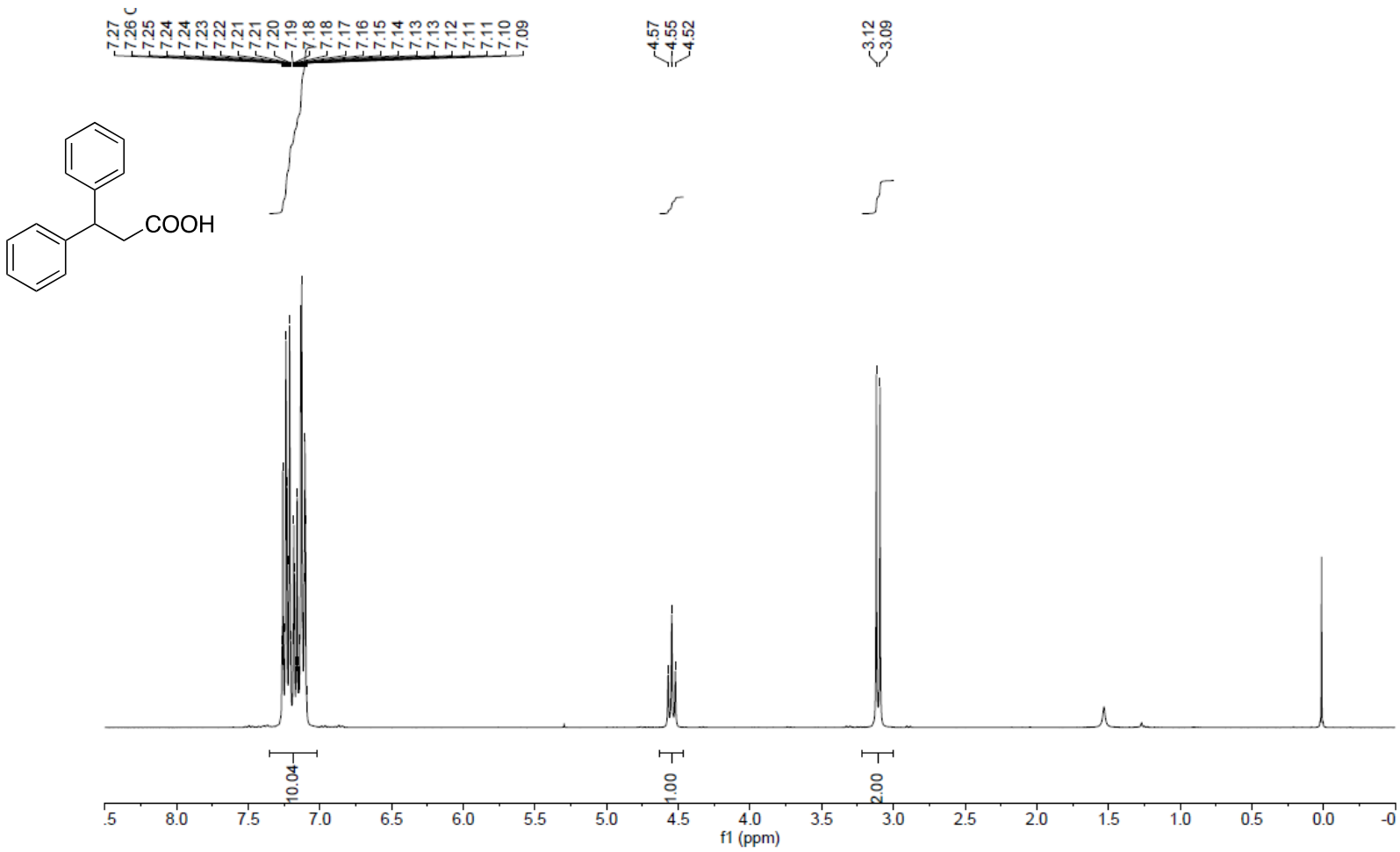
NaH (60%, 0.172 g, 4.31 mmol, 2.4 eq) was added to a solution of diethyl malonate (0.39 ml, 2.58 mmol, 1.5 eq) in dry THF (10 mL) at room temperature under a nitrogen atmosphere and the mixture was stirred for 20 min. Then a solution of 1-iodo-3,3-diphenylpropane (0.555 g, 1.72 mmol, 1 eq) in dry THF (5 mL)

was added and heated at reflux for 18 h. After cooling down to room temperature water was added and the reaction mixture was extracted with EtOAc (3×10 ml). The combined organic layers were washed with brine, dried over Na_2SO_4 and concentrated under reduced pressure. The crude product was purified by column chromatography (hexane:EtOAc 9:1) to give the title product as a colourless oil (0.355 g, 69%). ν_{max}/cm^{-1} (ATR): 2981, 1728, 1216, 1145 1032; δ_H (300 MHz; $CDCl_3$): 7.36 – 7.11 (m, 10H, ArH), 4.25 – 4.08 (m, 4H, 2 × OCH_2), 3.92 (t, *J* = 7.7, 1H, C(3')H), 3.34 (t, *J* = 7.4, 1H, C(2)H), 2.16 – 1.99 (m, 2H, C(2')H_2), 1.97 – 1.80 (m, 2H, C(1')H_2), 1.24 (t, *J* = 7.1, 6H, 2 × CH_3); δ_C (75 MHz; $CDCl_3$): 169.4, 144.5, 128.6, 127.9, 126.4, 61.5, 52.1, 51.3, 33.4, 27.4, 14.2.

5,5-Diphenylpentanoic acid[36]



To a solution of diethyl 2-(3,3-diphenylpropyl)malonate (0.783 g, 2.63 mmol, 1 eq) in EtOH (10 ml) was added NaOH (2 M, aq., 6.6 ml, 13.13 mmol, 5 eq). Then the mixture was heated at reflux for 2 h, after which EtOH was evaporated under reduced pressure and the aqueous solution was washed with EtOAc. Then the aqueous phase was acidified with 5 M HCl to pH 1 and extracted with EtOAc (3 × 10 ml), the combined organic layers were washed with brine, dried over Na_2SO_4 and concentrated under reduced pressure. The residue was then heated at 185 °C with stirring for 3 h, dissolved in 3 M KOH and washed with Et_2O. The aqueous phase was acidified with aq. 5 M HCl to pH 1 and extracted with EtOAc (3 × 10 ml), the combined organic layers were washed with brine, dried over Na_2SO_4 and concentrated under reduced pressure to give the title product as a white solid (0.511 g, 72%); m.p.: 90–92 °C (lit.[10] 92.5–93.5 °C). ν_{max}/cm^{-1} (ATR): 3025, 2937, 1705; δ_H (300 MHz; $CDCl_3$): 7.40 – 7.06 (m, 10H, ArH), 3.90 (t, *J* = 7.8, 1H, C(5)H), 2.37 (t, *J* = 7.4, 2H, C(2)H_2), 2.20 – 2.01 (m, 2H, C(4)H_2), 1.73 – 1.49 (m, 2H, C(3)H_2); δ_C (75 MHz; $CDCl_3$): 179.0, 144.8, 128.6, 127.9, 126.4, 51.3, 35.1, 33.9, 23.4.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7.12
7.11
7.11
7.10
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4.52
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3.09
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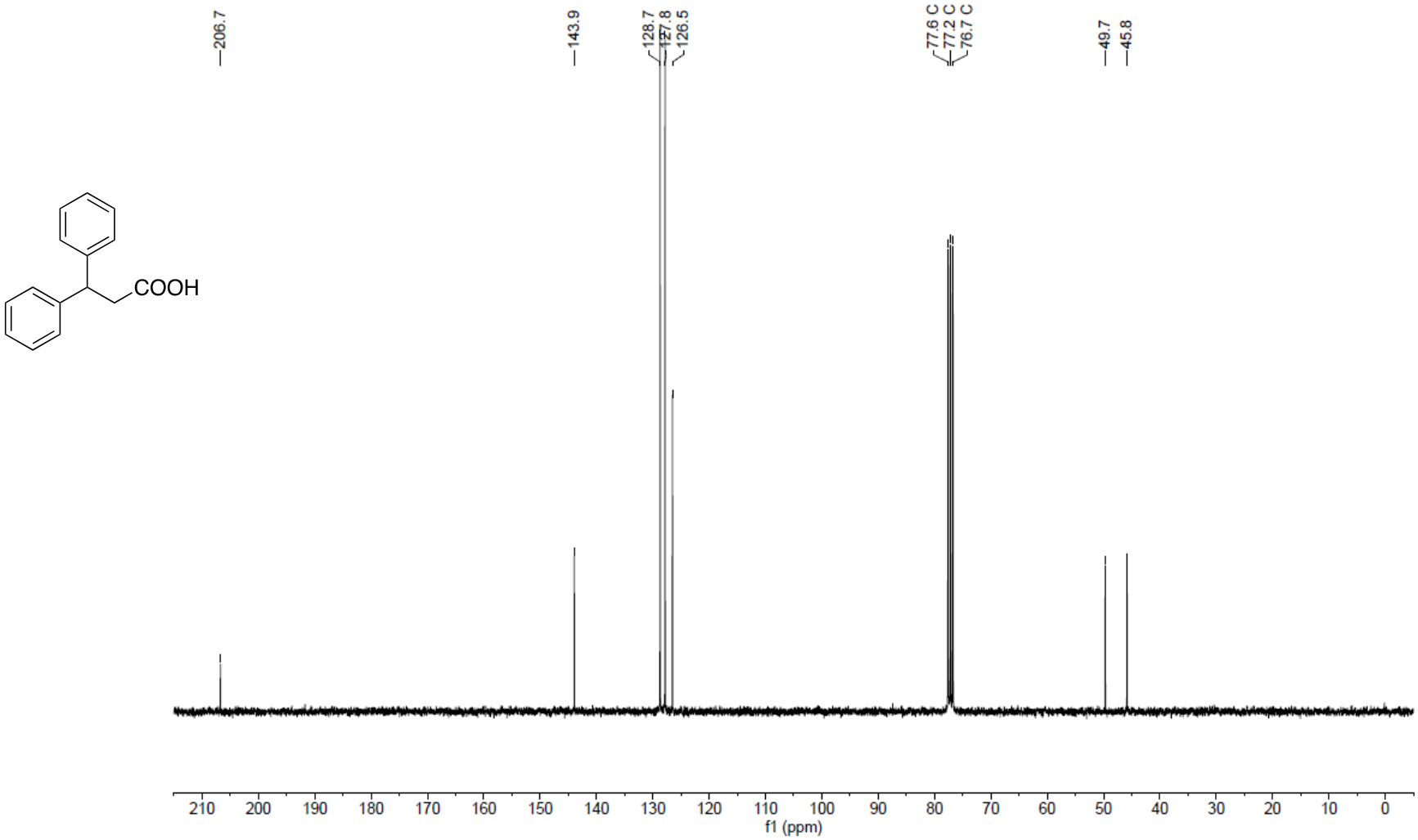
10.04
1.00
2.00
f1 (ppm)


206.7
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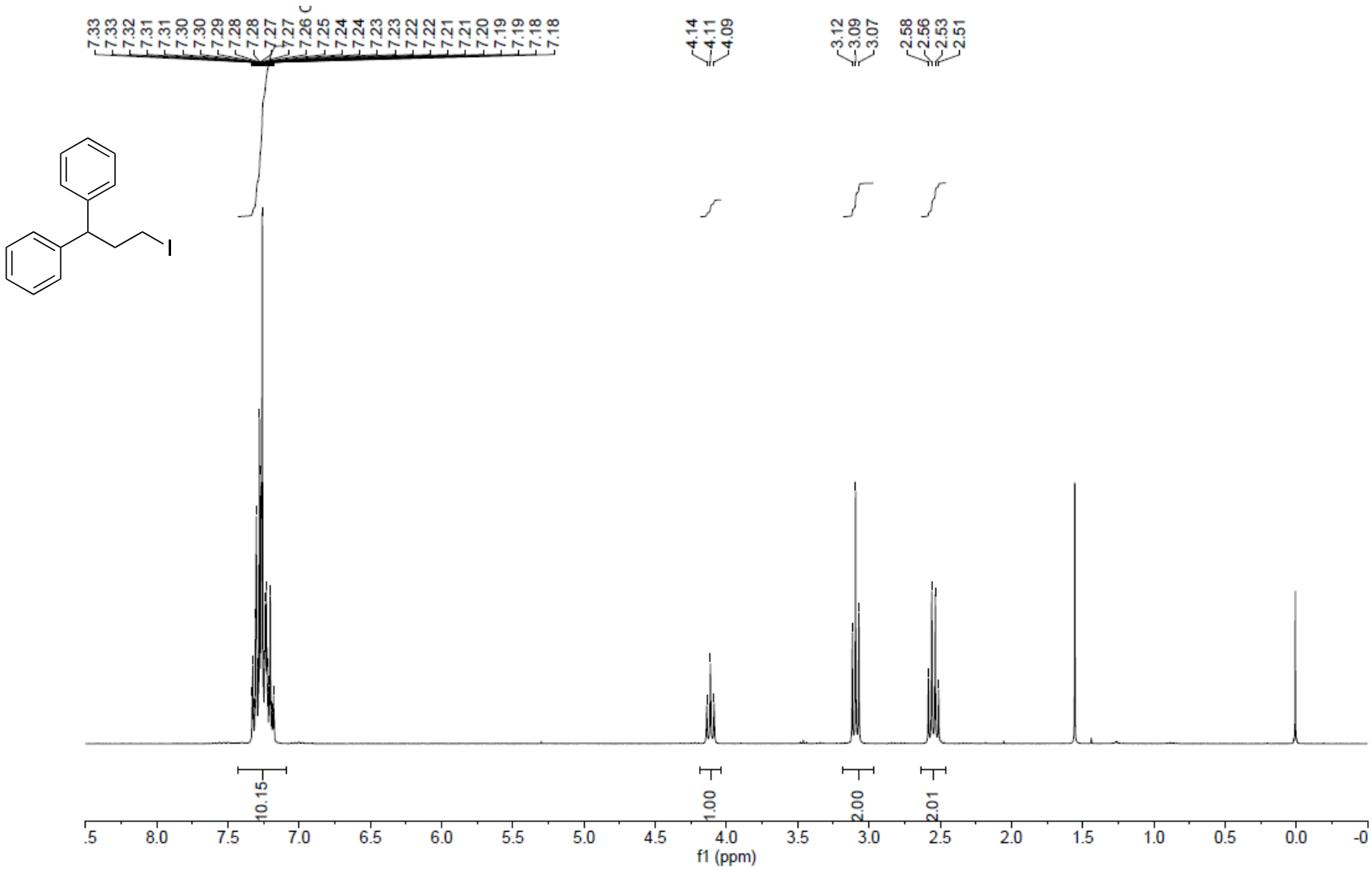
127.8
126.5
77.6 C
77.2 C
76.7 C
49.7
45.8
COOH
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)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7.19
7.18
7.18
4.14
4.11
4.09
3.12
3.09
3.07
2.58
2.56
2.53
2.51
I
10.15
1.00
2.00
2.01
.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
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3.0
2.5
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1.5
1.0
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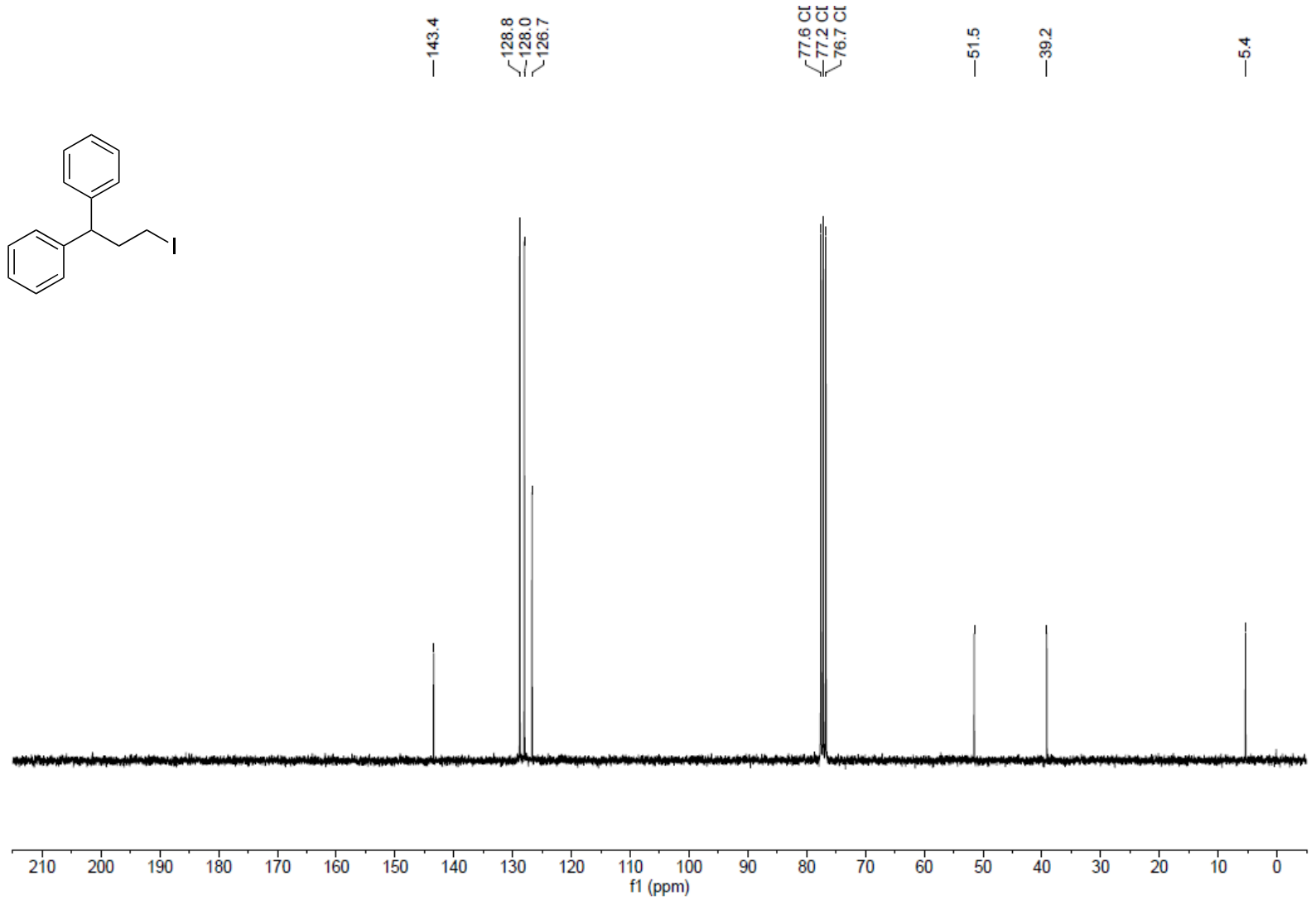
f1 (ppm)


143.4
128.8
128.0
126.7
77.6 Cl
77.2 Cl
76.7 Cl
51.5
39.2
5.4
I
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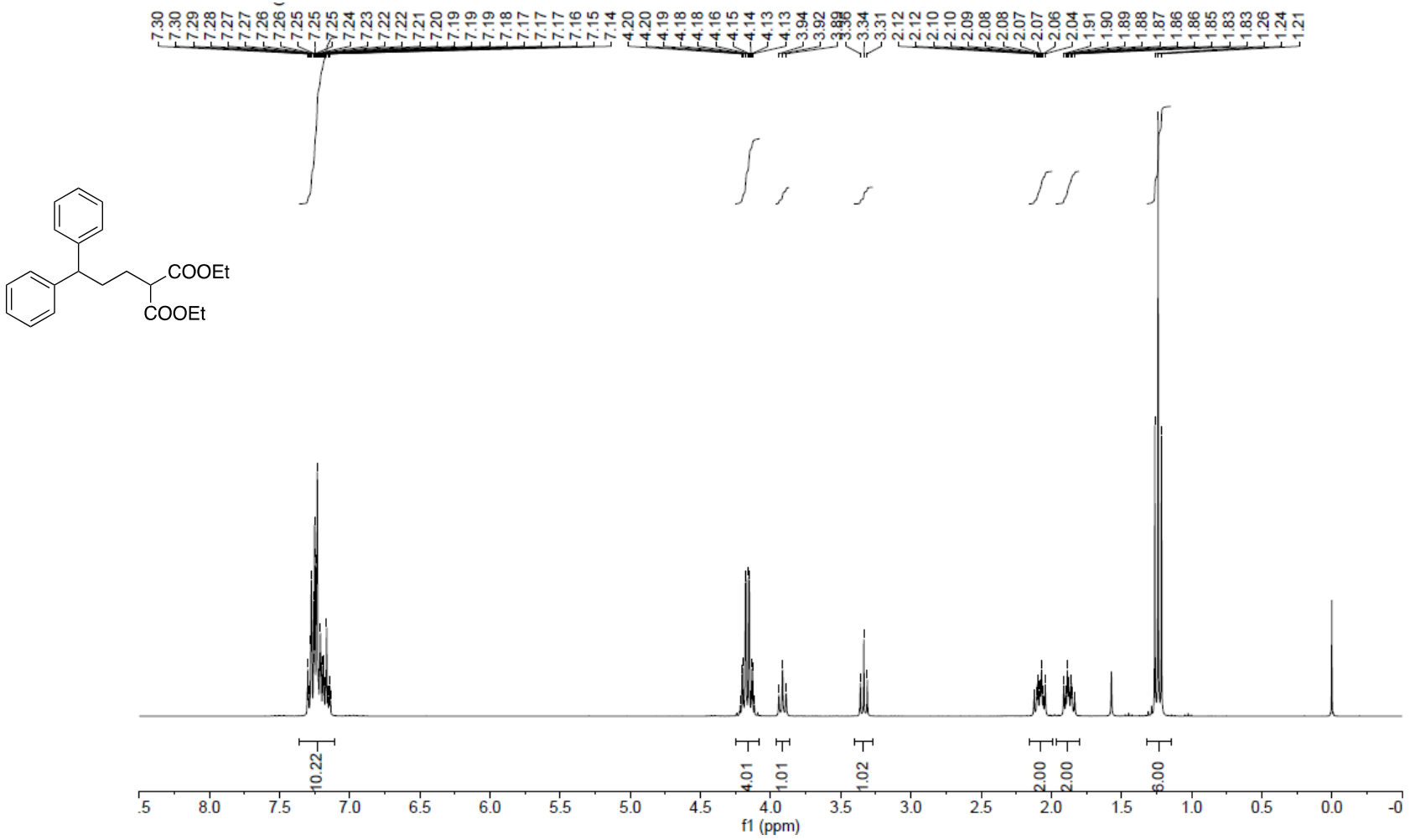
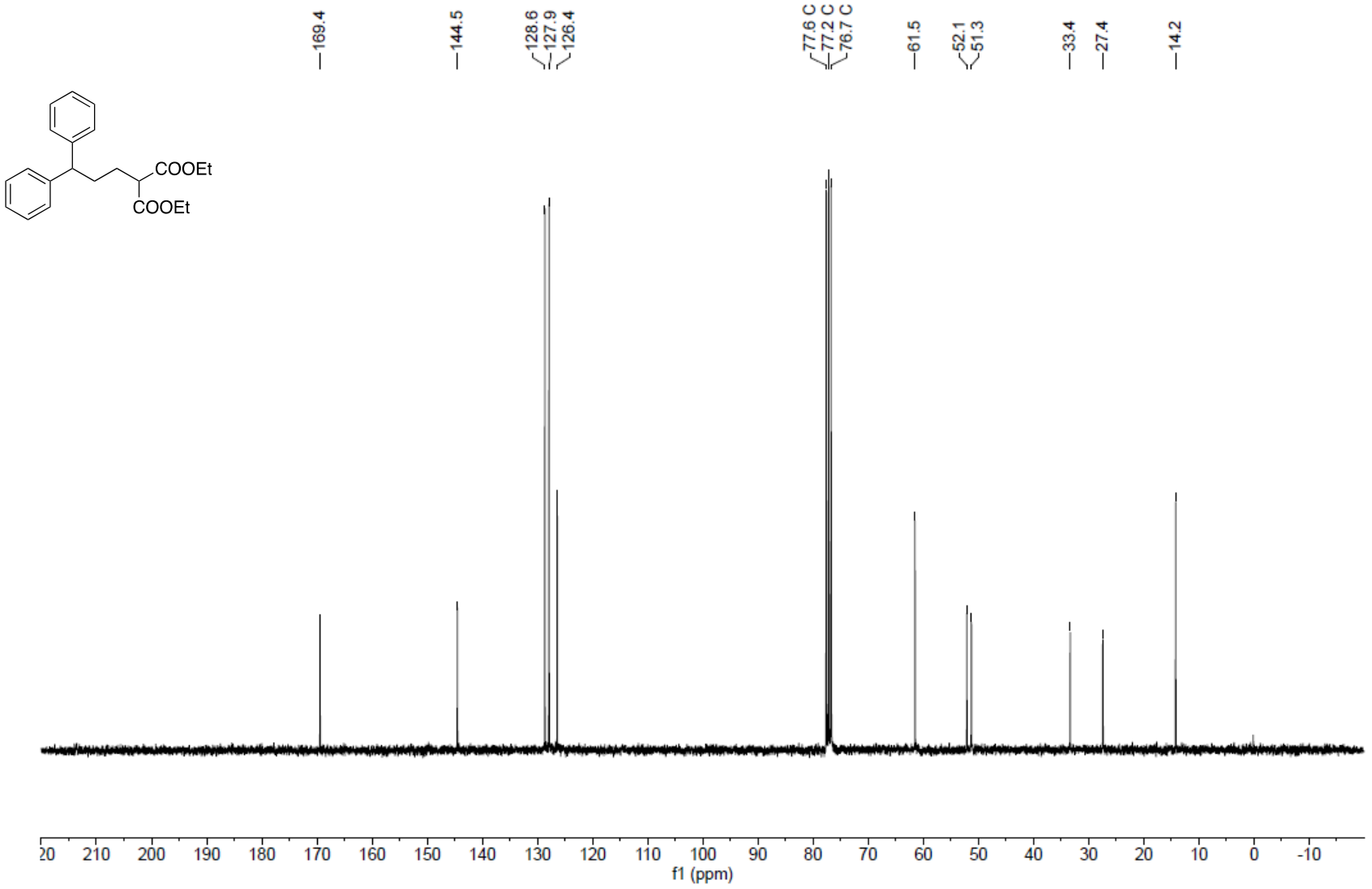
f1 (ppm)


COOEt
COOEt
7.30 7.30 7.29 7.28 7.27 7.27 7.26 7.26 7.25 7.25 7.25 7.24 7.23 7.22 7.22 7.21 7.20 7.19 7.19 7.19 7.18 7.17 7.17 7.17 7.16 7.15 7.14
4.20 4.20 4.19 4.18 4.18 4.16 4.15 4.14 4.13 4.13 3.94 3.92 3.34 3.31
2.12 2.12 2.10 2.10 2.09 2.08 2.08 2.07 2.07 2.06 2.04 1.91 1.90 1.89 1.88 1.87 1.86 1.86 1.85 1.83 1.26 1.24 1.21
10.22
4.01
1.01
1.02
2.00
2.00
6.00
8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)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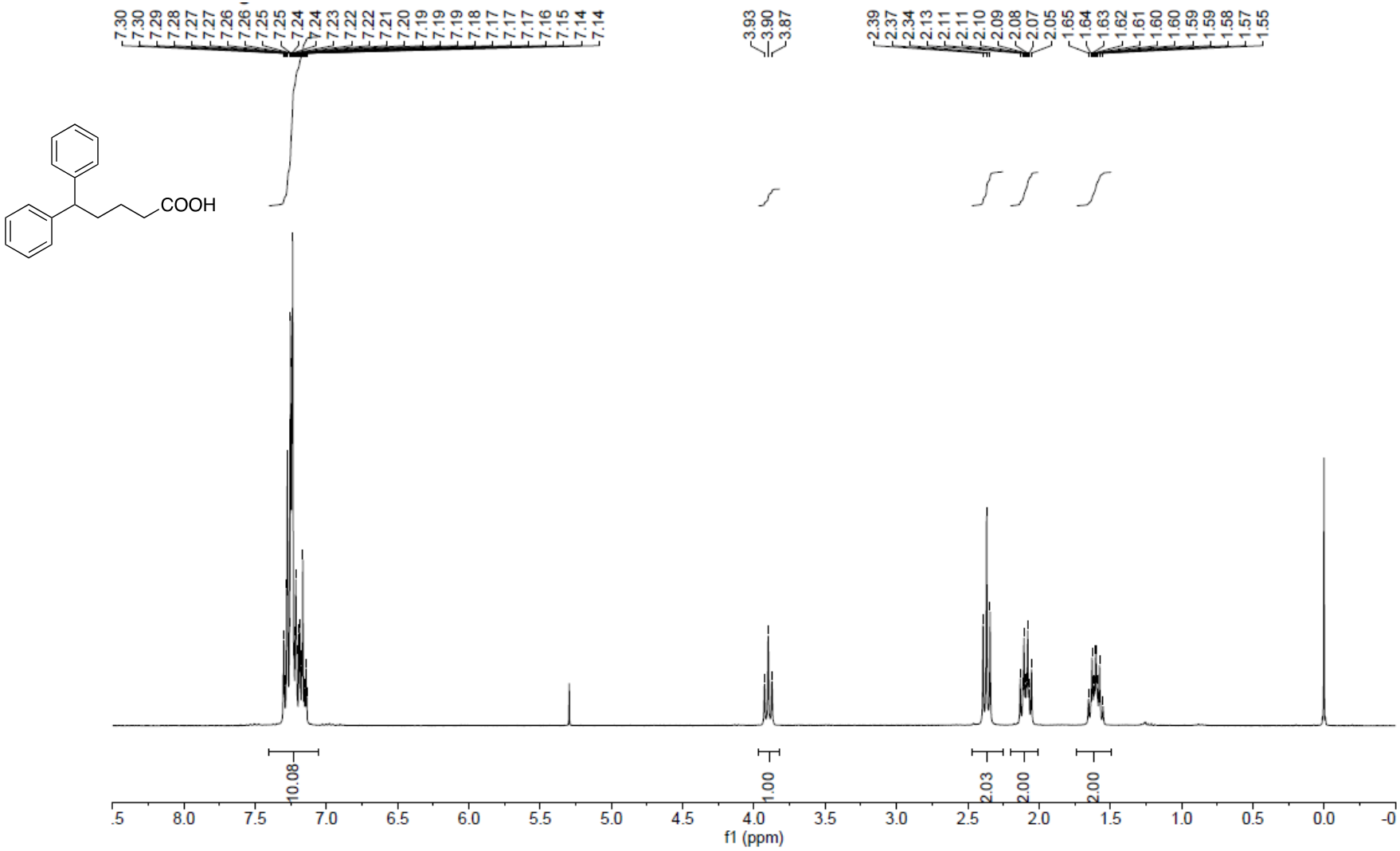
127.9
126.4
77.6 C
77.2 C
76.7 C
61.5
52.1
51.3
33.4
27.4
14.2
COOEt
COOEt
f1 (ppm)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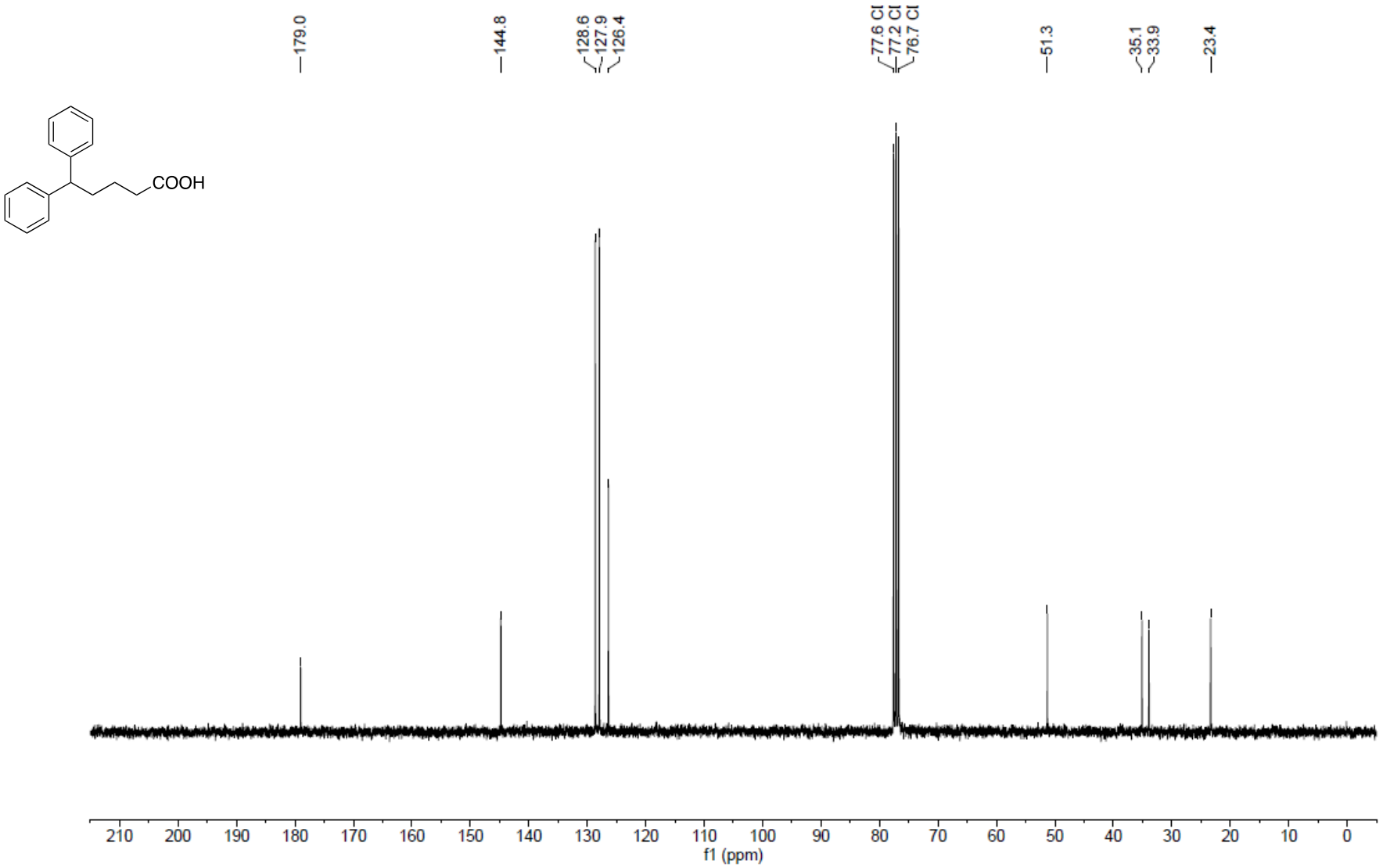
7.17
7.17
7.16
7.15
7.14
7.14
3.93
3.90
3.87
2.39
2.37
2.34
2.13
2.11
2.11
2.10
2.09
2.08
2.07
2.05
1.65
1.64
1.63
1.62
1.61
1.60
1.60
1.59
1.59
1.58
1.57
1.55
COOH
10.08
1.00
2.03
2.00
2.00
f1 (ppm)


179.0
144.8
128.6
127.9
126.4
77.6 Cl
77.2 Cl
76.7 Cl
51.3
35.1
33.9
23.4
COOH
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

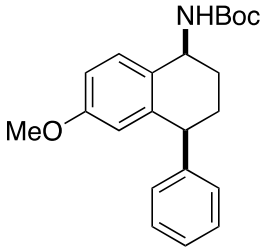
1.10 Synthesis of Boc-protected amines with corresponding spectra

General Method G – Reductive Amination

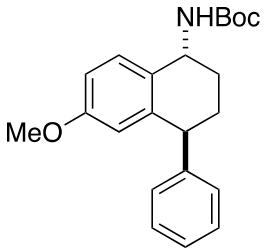
A mixture of ketone (1 eq), titanium isopropoxide (3 eq) and methanolic ammonia (2M, 10 eq) was stirred under nitrogen for 16 h. The reaction mixture was cooled to 0 °C and sodium borohydride (1.5 eq) was added. The mixture was allowed to warm to room temperature and stirred for 3 h. The reaction was quenched by pouring onto ammonium hydroxide (2M) and stirred for 5–10 min. The inorganic precipitate was removed by filtration and the filter cake was washed with CH_2Cl_2. The layers were separated, and the aqueous layer was extracted with CH_2Cl_2 (× 2). The combined organic layers were concentrated, dried over Na_2SO_4 and concentrated under reduced pressure to afford the crude amine

Boc protection: A solution of crude amine and di-*tert*-butyl-dicarbonate (1 eq) was stirred at room temperature for 3 – 16h and then concentrated under reduced pressure. The NHBoc diastereomers were separated by flash column chromatography (hexane/$CHCl_3$/EtOAc 18:2:1).

1-(Boc-amino)-6-methoxy-4-phenyltetralin 8d was prepared from 5,8-dimethyl-4-phenyltetral-1-one according to general method G with subsequent Boc protection and purification of the diastereomers to afford;

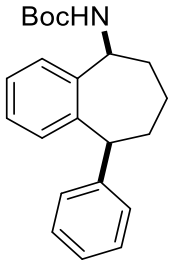


***cis*-1-(Boc-amino)-6-methoxy-4-phenyltetralin** *cis*-**8d** as a white solid (0.150 g, 11%); m.p.: 121–122 °C. ν_{max}/cm^{-1} (ATR): 3331 (NH), 2935 (NH), 1688 (C=C), 1494 (CH), 1238 (CN), 1159 (CN); δ_H (300 MHz; $CDCl_3$): 7.38 – 7.15 (m, 4H, ArH), 7.14 – 7.01 (m, 2H, ArH), 6.77 (dd, *J* = 8.6, 2.6, 1H, ArH), 6.36 (d, *J* = 2.6, 1H, ArH), 4.84 (br s, 2H, C(1)H, NH), 4.09 – 3.94 (m, 1H, C(4)H), 3.63 (s, 3H, OCH_3), 2.20 – 2.02 (m, 1H, one of C(3)H_2), 2.02 – 1.78 (m, 3H, C(2)H_2, one of C(3)H_2), 1.49 (s, 9H, 3 × CH_3); δ_C (75 MHz; $CDCl_3$): 158.8, 155.5, 146.5, 141.2, 130.3, 130.1, 128.9, 128.5, 126.4, 114.6, 113.3, 79.5, 55.3, 48.5, 45.9, 29.5, 28.6, 28.2; HRMS (ESI^+): found $[M+H]^+$ 354.2060, $C_{22}H_{28}NO_3$ requires 354.2064; enantiomers separated using a Phenomenex Amylose 1 column [conditions: *n*-hexane/*i*PrOH (containing 2% DEA) = 90/10, flow rate = 0.5 mL min^{-1}], R_t = 10.8 min, R_t = 14.2 min.



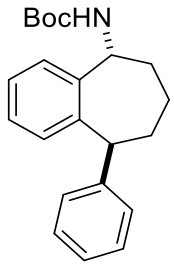
***trans*-1-(Boc-amino)-6-methoxy-4-phenyltetralin**, *trans*-**8d** as a white solid (0.211 g, 15%); m.p.: 105–107 °C. ν_{max}/cm^{-1} (ATR): 3346 (NH), 2934 (NH), 1692 (C=C), 1494 (CH), 1239 (CN), 1164 (CN); δ_H (300 MHz; $CDCl_3$): 7.39 – 7.16 (m, 4H, ArH), 7.11 – 7.00 (m, 2H, ArH), 6.79 (dd, *J* = 8.6, 2.7, 1H, ArH), 6.37 (dd, *J* = 2.7, 0.9, 1H, ArH), 5.04 – 4.75 (m, 2H, C(1)H, NH), 4.18 – 4.01 (m, 1H, C(4)H), 3.64 (s, 3H, CH_3), 2.28 – 2.06 (m, 2H, one of C(2)H_2, one of C(3)H_2), 1.99 – 1.82 (m, 1H, one of C(3)H_2), 1.81 – 1.64 (m, 1H, one of C(2)H_2), 1.51 (s, 9H, 3 × CH_3); δ_C (75 MHz; $CDCl_3$): 158.7, 155.7, 146.5, 141.1, 130.5, 129.4, 128.8, 128.4, 126.3, 114.7, 113.2, 79.4, 55.2, 48.7, 45.8, 30.3, 28.8, 28.6; HRMS (ESI^+): found $[M+H]^+$ 354.2061, $C_{22}H_{28}NO_3$ requires 354.2064; enantiomers separated using a Phenomenex Amylose 1 column [conditions: *n*-hexane/*i*PrOH (containing 2% DEA) = 90/10, flow rate = 0.5 mL min^{-1}], R_t = 14.7 min, R_t = 28.0 min.

5-(Boc-amino)-9-phenyl-6,7,8,9-tetrahydro-5*H*-benzo[7]annulene 8m was prepared from 9-Phenylbenzosuber-5-one **2m** according to general method G with subsequent Boc protection and purification of the diastereomers to afford;

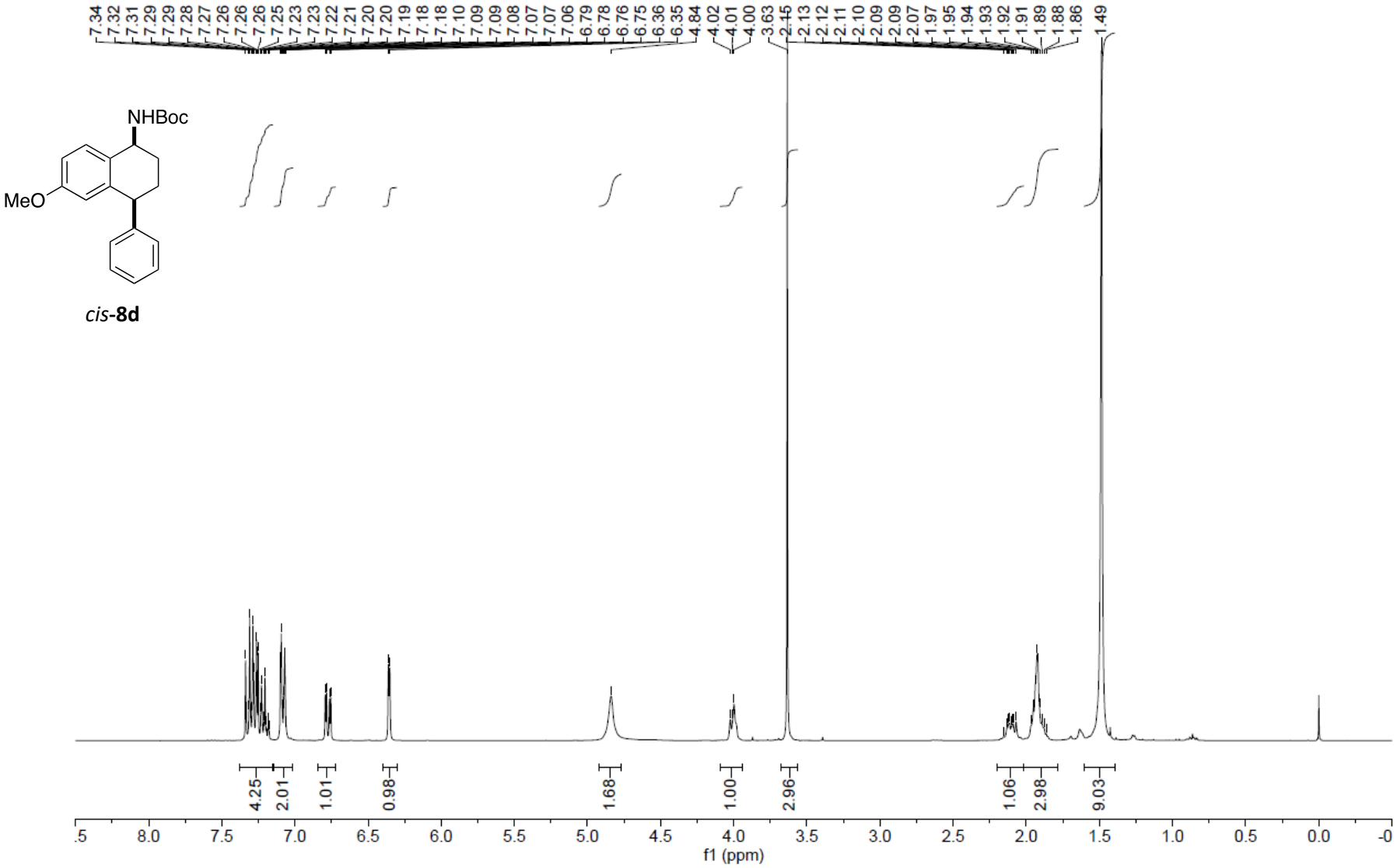


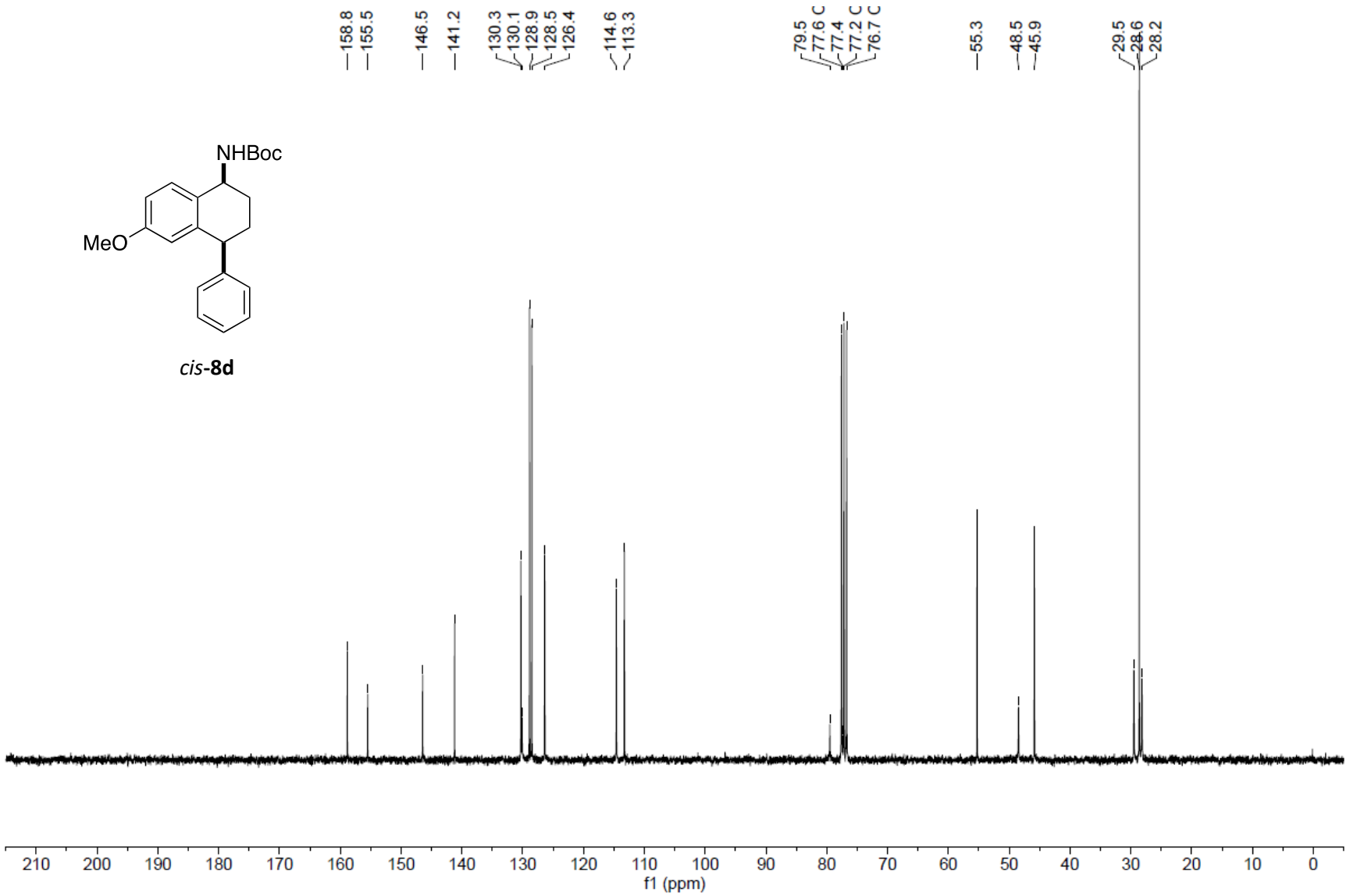
***cis*-5-(Boc-amino)-9-phenyl-6,7,8,9-tetrahydro-5*H*-benzo[7]annulene**, *cis*-**8m** as a white solid (0.092 g, 16%); m.p.: 179–180 °C; ν_{max}/cm^{-1} (ATR): 3334 (NH), 2928 (NH), 1693 (C=C), 1495 (CH), 1365 (CH), 1248 (CN), 1164 (CN); δ_H (500 MHz; $CDCl_3$): 7.42 – 7.34 (m, 2H, ArH), 7.34 – 7.20 (m, 4H, ArH), 7.20 – 7.14 (m, 1H, ArH), 7.08 – 6.95 (m, 1H, ArH), 6.60 (br s, 1H, ArH), 5.15 (br s, 1H, C(5)H), 4.94 (br s, 1H, NH), 4.35 (d, *J* = 9.7, 1H, C(9), 2.32 – 2.15 (m, 1H, one of C(8)H_2), 2.12 – 1.80 (m, 4H, C(7)H_2, one of C(8)H_2, one of C(6)H_2), 1.71 – 1.58 (m, 1H, one of C(6)H_2), 1.47 (br s, 9H, 3 × CH_3); δ_C (125 MHz; $CDCl_3$): 155.1, 144.7,

143.6, 142.0, 128.9, 128.6, 128.2, 126.8, 126.4, 126.4, 79.6, 53.4, 48.2, 35.0, 32.9, 28.6; HRMS (ESI^+): found $[M+H]^+$ 338.2119, $C_{22}H_{28}NO_2$ requires 338.2115; enantiomers separated using a Phenomenex Amylose 1 column [conditions: *n*-hexane/*i*PrOH (containing 2% DEA) = 90/10, flow rate = 0.5 mL min^{-1}], R_t = 8.9 min, R_t = 9.5 min.

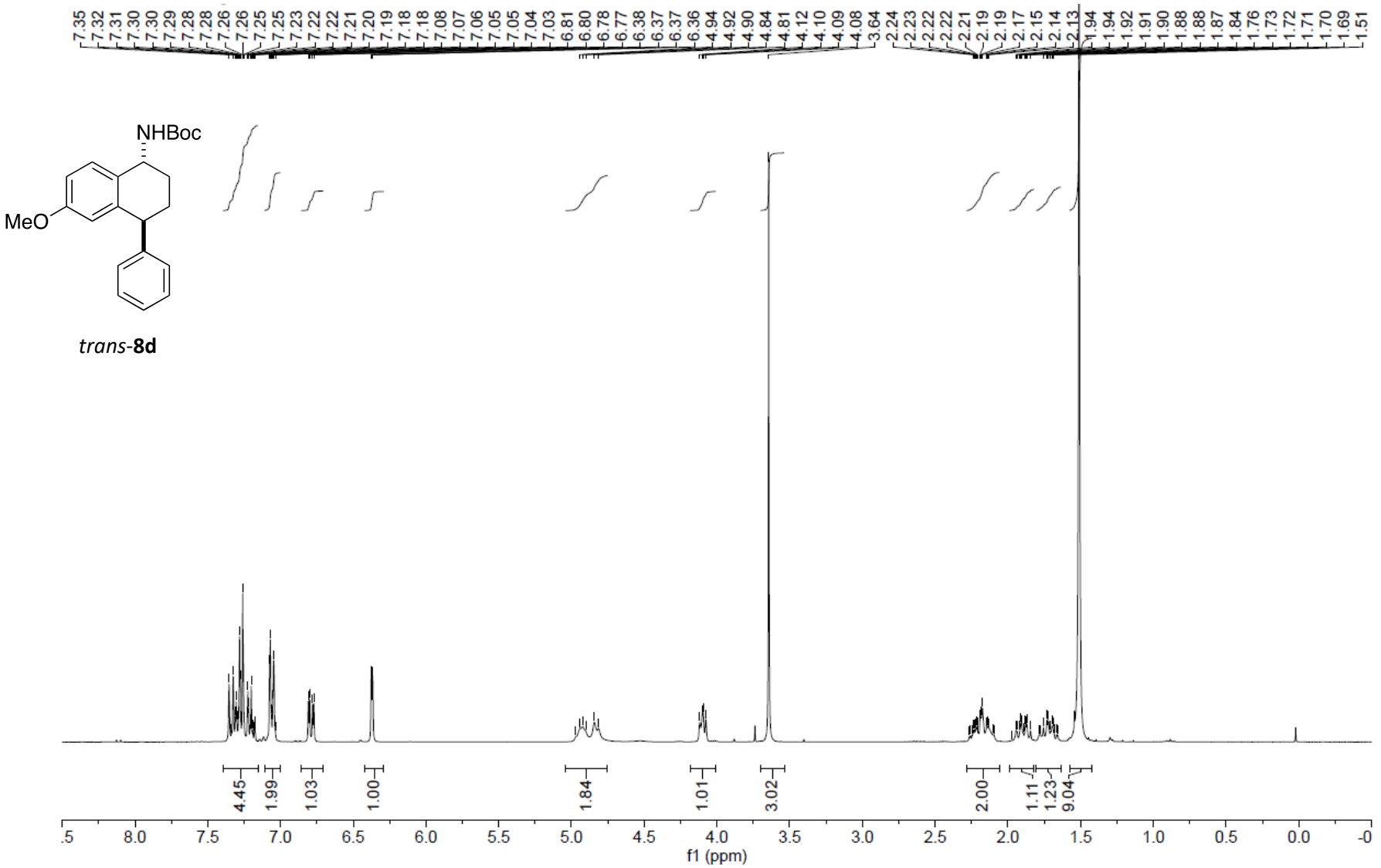


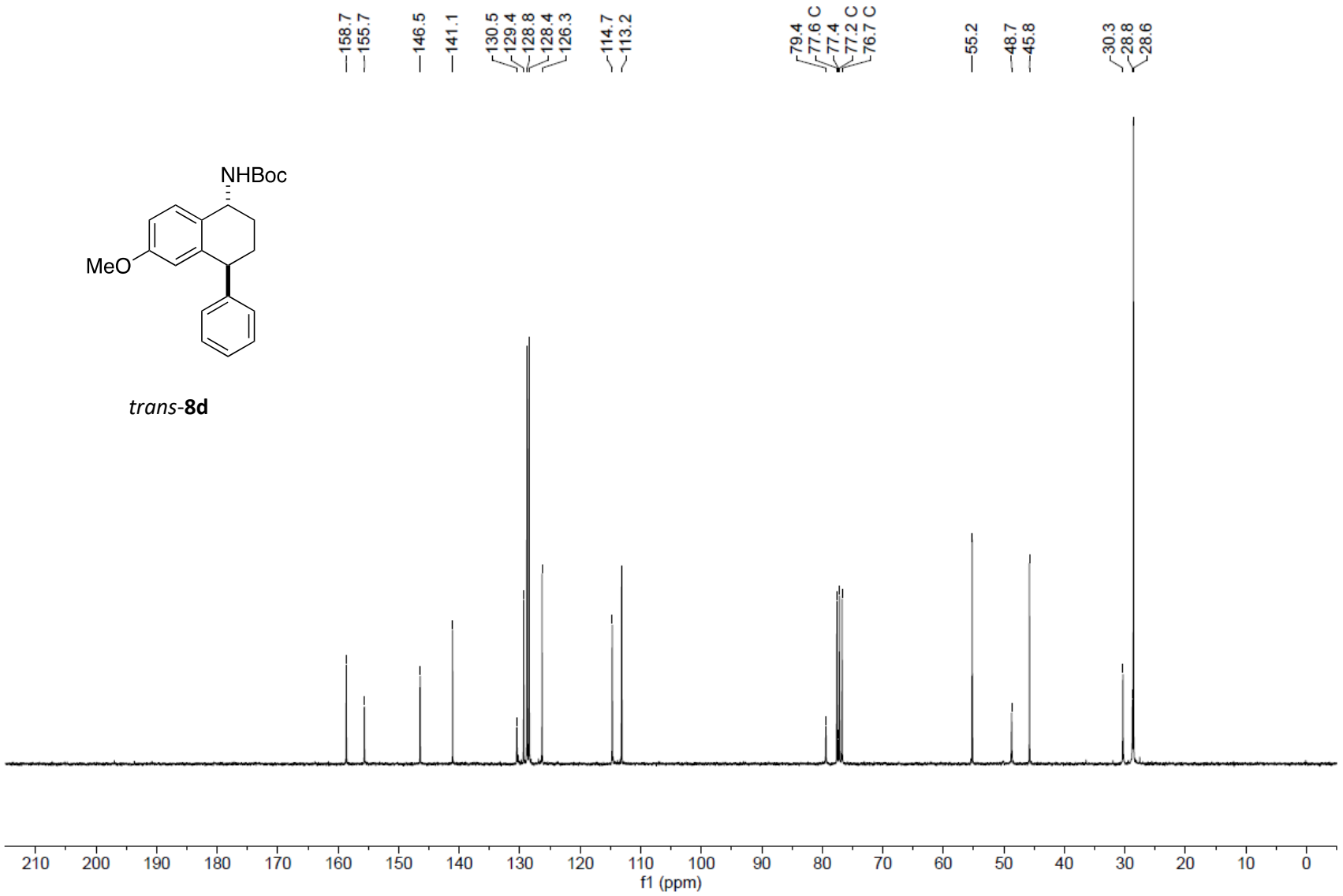
***trans*-5-(Boc-amino)-9-phenyl-6,7,8,9-tetrahydro-5*H*-benzo[7]annulene**, trans-**8m**, as a white solid (0.130 g, 23%); m.p.: 171–173 °C; ν_{max}/cm^{-1} (ATR): 3284 (NH), 2928 (NH), 1694 (C=C), 1495 (CH), 1365 (CH), 1167 (CN); δ_H (500 MHz; $CDCl_3$): 7.48 – 7.28 (m, 3H, ArH), 7.25 – 7.02 (m, 5H, ArH), 6.83 (br s, 1H, ArH), 5.19 – 4.51 (m, 2H, C(5)H, NH), 4.37 (dd, *J* = 8.4, 3.6, 1H, C(9)H), 2.24 (br s, 1H, one of $C(8)H_2$), 2.13 (br s, 1H, one of $C(8)H_2$), 2.03 – 1.71 (m, 4H, $C(6)H_2$, $C(7)H_2$), 1.44 (br s, 9H, $3 \times CH_3$); δ_C (125 MHz; $CDCl_3$): 155.1, 143.7, 142.5, 141.7, 130.6, 128.7, 128.2, 127.6, 127.4, 126.8, 126.2, 79.5, 55.1, 50.1, 33.4, 33.1, 28.6, 23.9; HRMS (ESI^+): found $[M+H]^+$ 338.2110, $C_{22}H_{28}NO_2$ requires 338.2115; enantiomers not separated by chiral HPLC.


NHBoc
MeO
cis-8d
7.34 7.32 7.31 7.29 7.29 7.28 7.27 7.26 7.26 7.26 7.25 7.23 7.23 7.22 7.21 7.20 7.20 7.19 7.18 7.18 7.10 7.09 7.09 7.08 7.07 7.07 7.06 6.79 6.78 6.76 6.75 6.36 6.35 4.84 4.02 4.01 4.00 3.63 2.15 2.13 2.12 2.11 2.10 2.09 2.09 2.07 1.97 1.95 1.94 1.93 1.92 1.91 1.89 1.88 1.86 1.49
4.25 2.01 1.01 0.98 1.68 1.00 2.96 1.06 2.98 9.03
f1 (ppm)

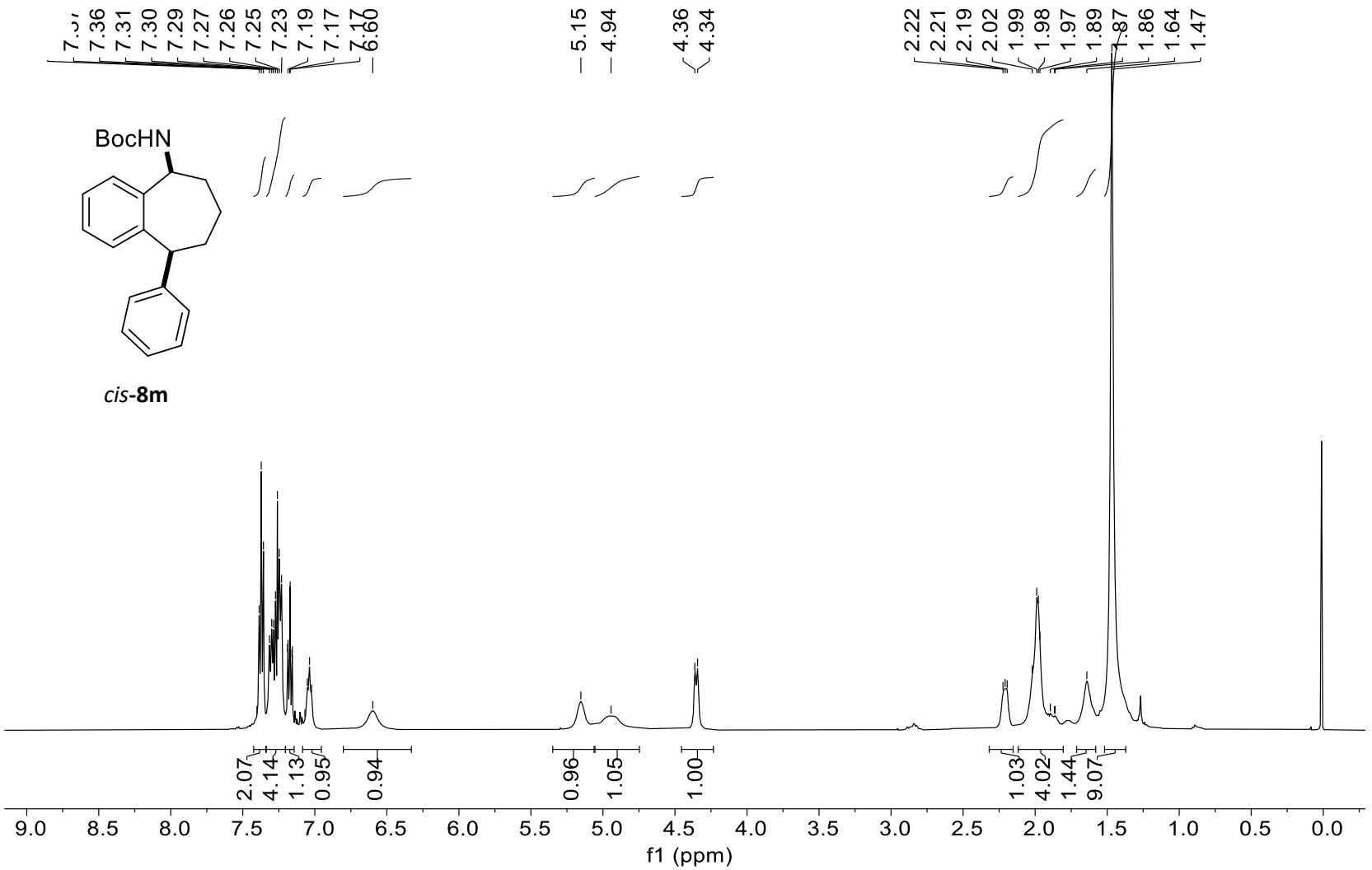

158.8
155.5
146.5
141.2
130.3
130.1
128.9
128.5
126.4
114.6
113.3
79.5
77.6 C
77.4
77.2 C
76.7 C
55.3
48.5
45.9
29.5
28.6
28.2
NHBoc
MeO
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

cis-**8d**

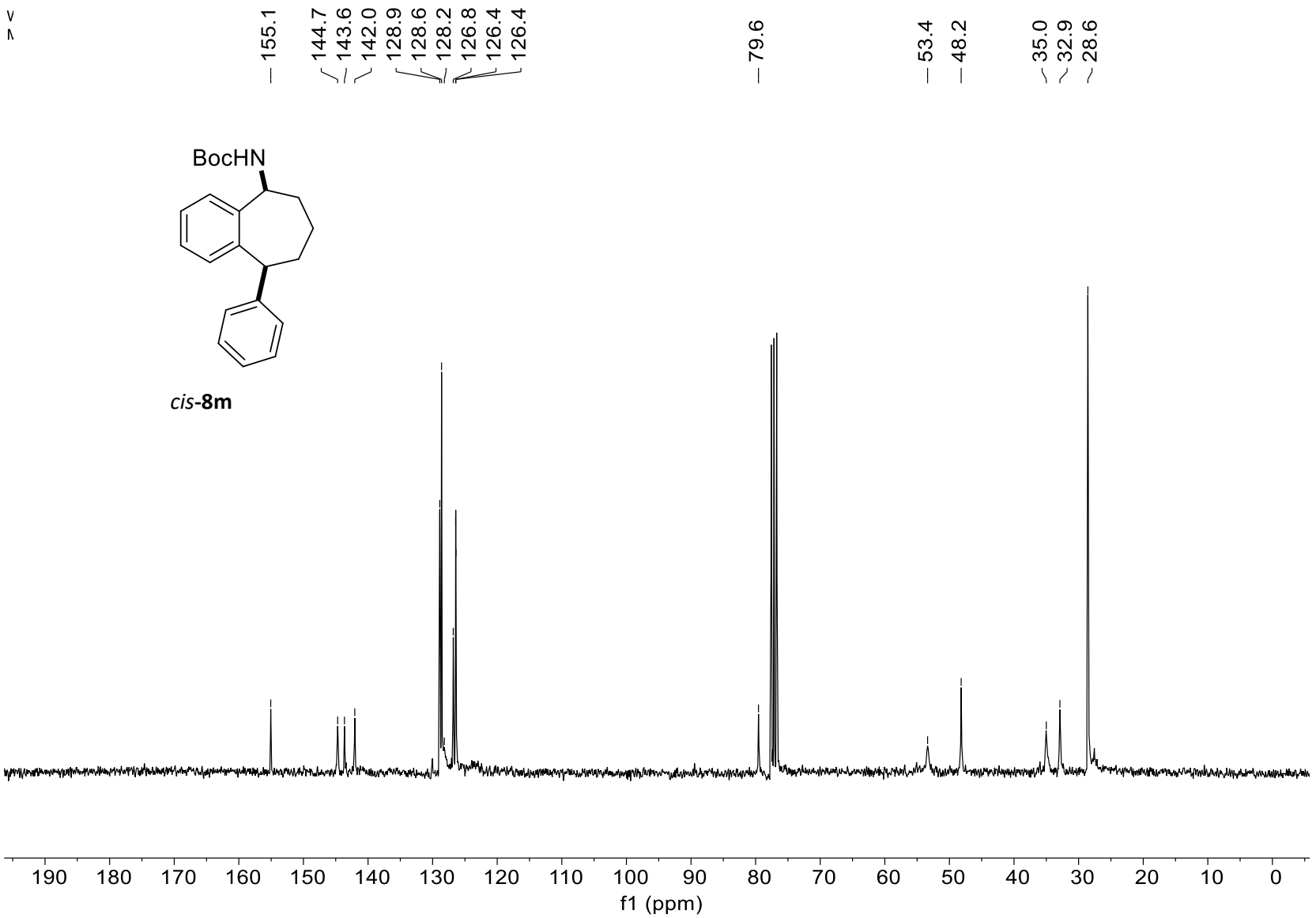

NHBoc
MeO
trans-8d
7.35 7.32 7.31 7.30 7.30 7.29 7.28 7.28 7.26 7.26 7.25 7.25 7.23 7.22 7.22 7.21 7.20 7.19 7.18 7.18 7.08 7.07 7.06 7.05 7.05 7.04 7.03 6.81 6.80 6.78 6.77 6.38 6.37 6.37 6.36 4.94 4.92 4.90 4.84 4.81 4.12 4.10 4.09 4.08 3.64 2.24 2.23 2.22 2.22 2.21 2.19 2.19 2.17 2.15 2.14 2.13 1.94 1.94 1.92 1.91 1.90 1.88 1.88 1.87 1.84 1.76 1.73 1.72 1.71 1.70 1.69 1.51
4.45
1.99
1.03
1.00
1.84
1.01
3.02
2.00
1.11
1.23
9.04
f1 (ppm)

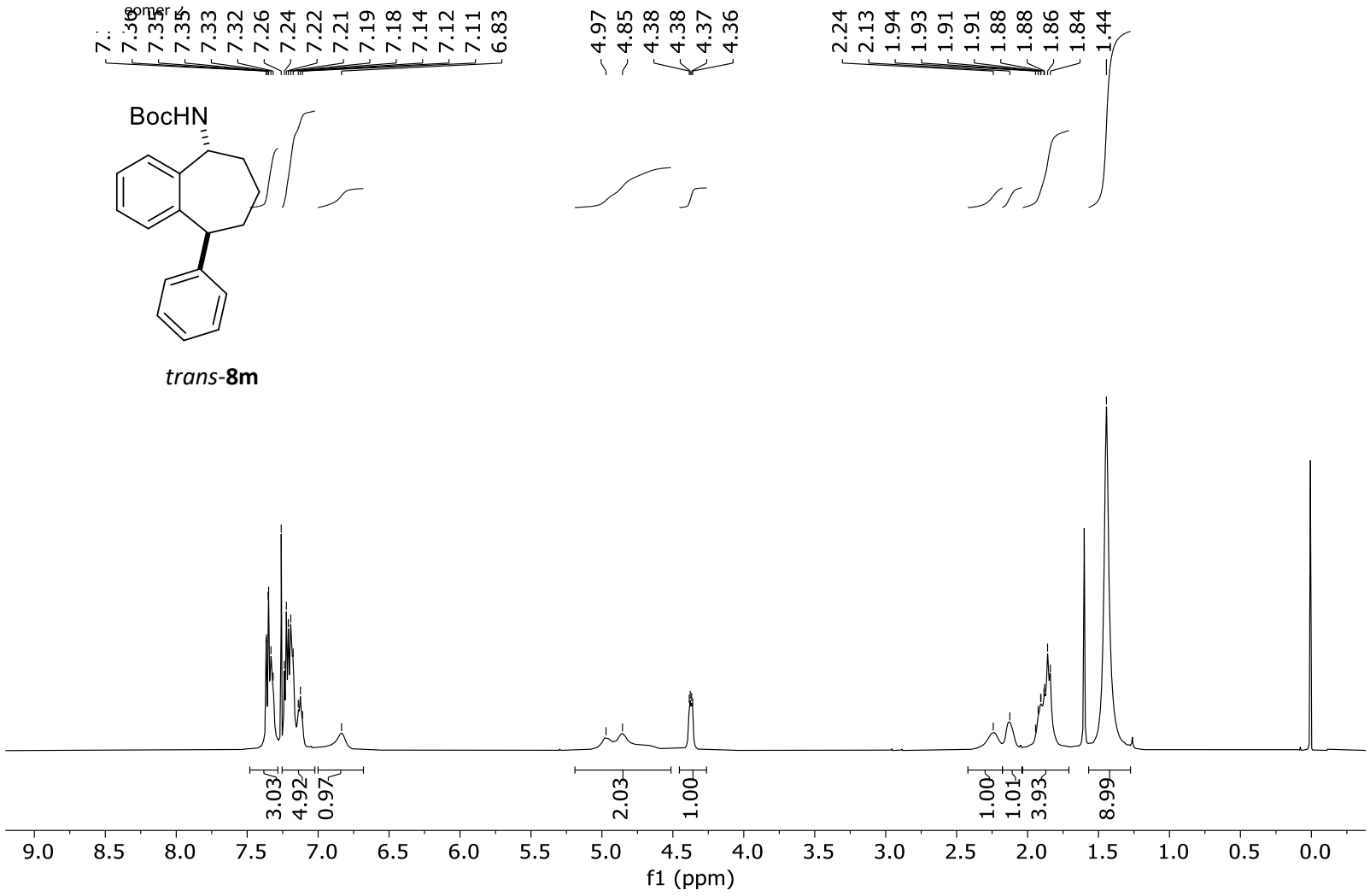

158.7
155.7
146.5
141.1
130.5
129.4
128.8
128.4
126.3
114.7
113.2
79.4
77.6 C
77.4
77.2 C
76.7 C
55.2
48.7
45.8
30.3
28.8
28.6
NHBoc
MeO
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

trans-**8d**

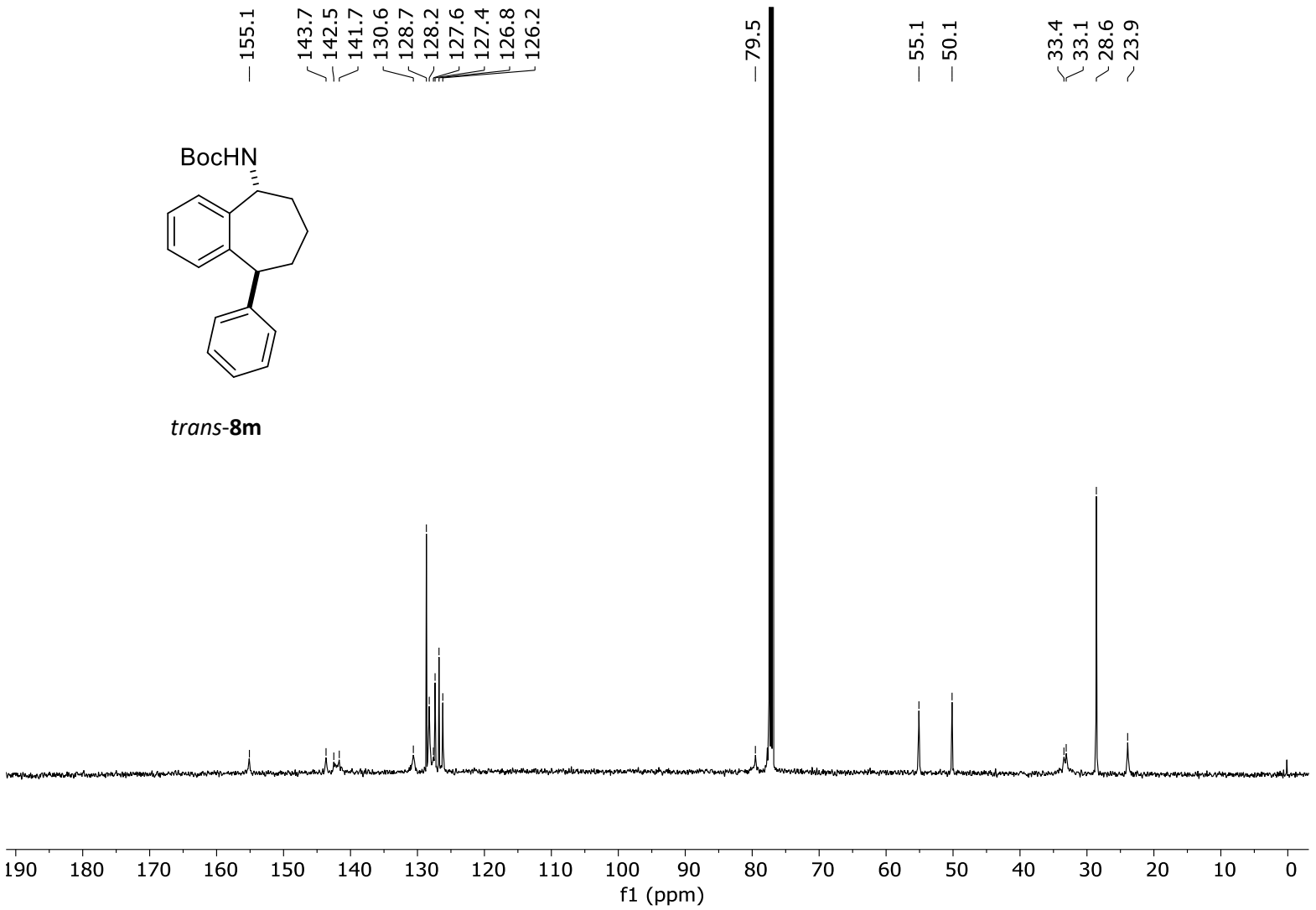

7.36
7.31
7.30
7.29
7.27
7.26
7.25
7.23
7.19
7.17
6.60
5.15
4.94
4.36
4.34
2.22
2.21
2.19
2.02
1.99
1.98
1.97
1.89
1.87
1.86
1.64
1.47
BocHN
2.07
4.14
1.13
0.95
0.94
0.96
1.05
1.00
1.03
4.02
1.44
9.07
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)

cis-**8m**


155.1
144.7
143.6
142.0
128.9
128.6
128.2
126.8
126.4
126.4
79.6
53.4
48.2
35.0
32.9
28.6
BocHN
cis-8m
190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)


BocHN
7.35
7.33
7.32
7.26
7.24
7.22
7.21
7.19
7.18
7.14
7.12
7.11
6.83
4.97
4.85
4.38
4.38
4.37
4.36
2.24
2.13
1.94
1.93
1.91
1.91
1.88
1.88
1.86
1.84
1.44
3.03
4.92
0.97
2.03
1.00
1.00
1.01
3.93
8.99
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)

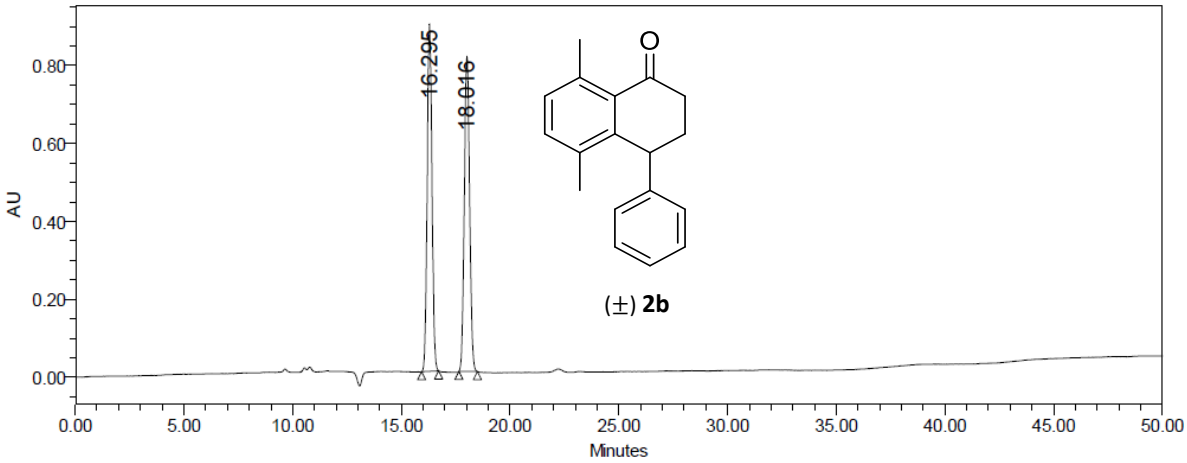
trans-**8m**


155.1
143.7
142.5
141.7
130.6
128.7
128.2
127.6
127.4
126.8
126.2
79.5
55.1
50.1
33.4
33.1
28.6
23.9
BocHN
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

trans-**8m**

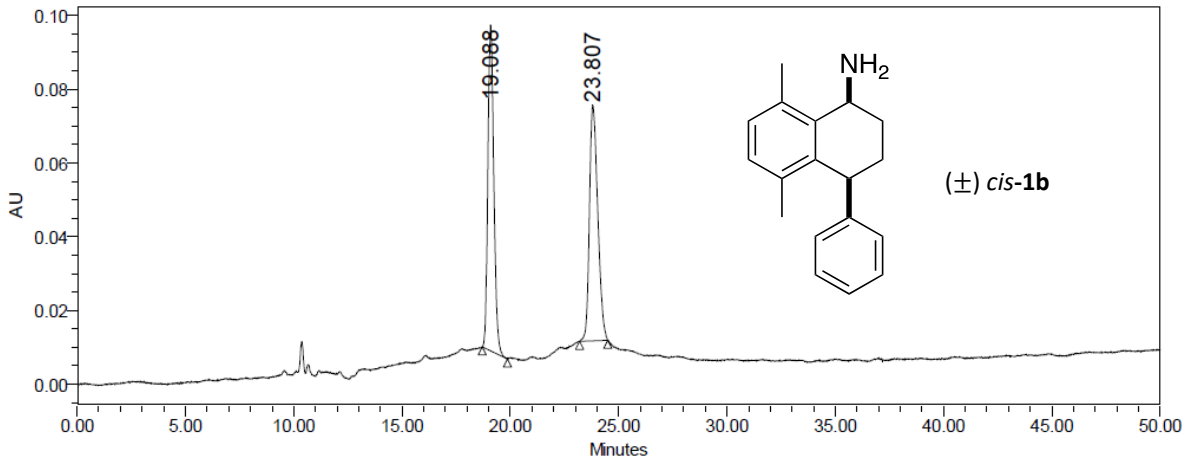
1.11 Chromatographic data (HPLC) for compounds **1b**, **1c**, **1e–1g**, **1i–1l**, **2b–2g**, **2i-2m**, **8d** & **8m**

Racemic ketone and amine samples were used for chiral HPLC method development to identify the conditions required to separate the enantiomers of each component. In some cases, two distinct sets of conditions were required to resolve the enantiomers for the ketones and amines, while in other both components could be resolve using one set of chiral HPLC conditions. In all instances the reference chromatograms of the racemic ketone and amines were used to identify the relevant peaks in the chromatograms of the reaction mixtures containing both ketone and amine components. A concentration of approximately 1 mg/mL was used for all samples analysed by chiral HPLC analysis. In all cases the chromatograms of the racemic ketone and amines are included above the chromatogram for the reaction mixture to facilitate interpretation.



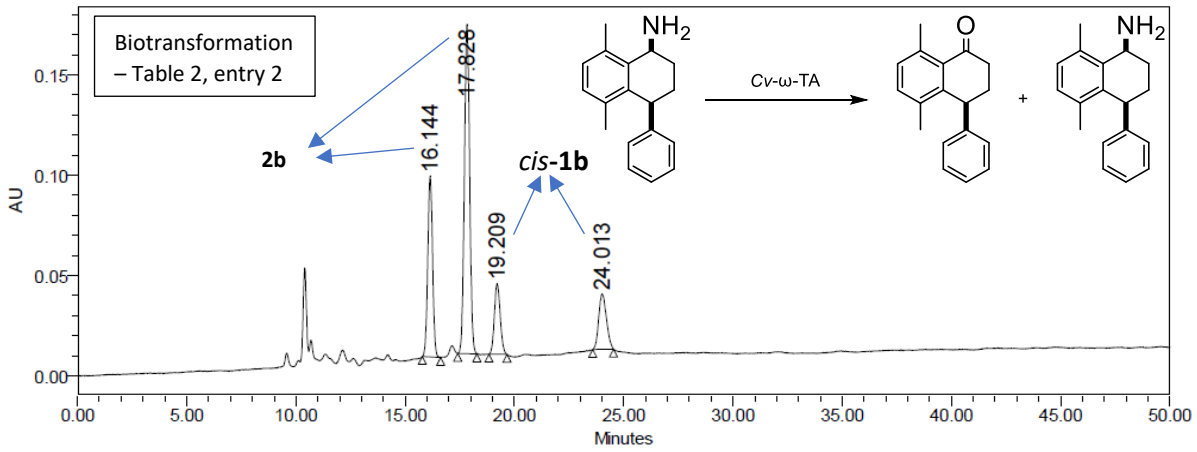
	RT	Area	% Area	Height	Result Id
1	16.295	13668754	49.99	893442	5474
2	18.016	13672750	50.01	809499	5474

Phenomenex Cellulose 4 [conditions: *n*-hexane/*i*PrOH (containing 2% DEA) = 90/10, flow rate = 0.25 mL min^{-1}]



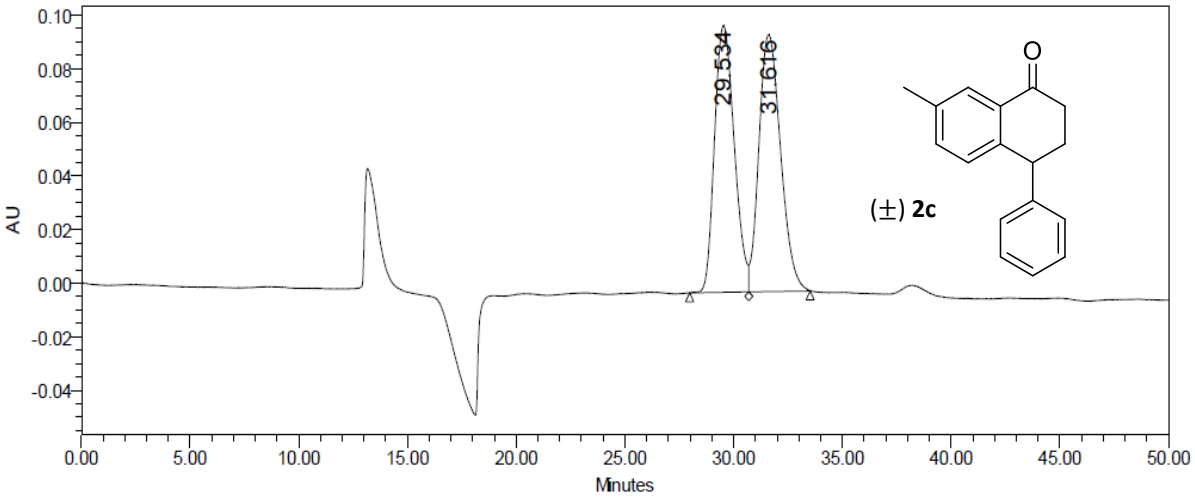
	RT	Area	% Area	Height	Result Id
1	19.088	1682191	49.70	88456	5477
2	23.807	1702693	50.30	63767	5477

Phenomenex Cellulose 4 [conditions: *n*-hexane/*i*PrOH (containing 2% DEA) = 90/10, flow rate = 0.5 mL min^{-1}]



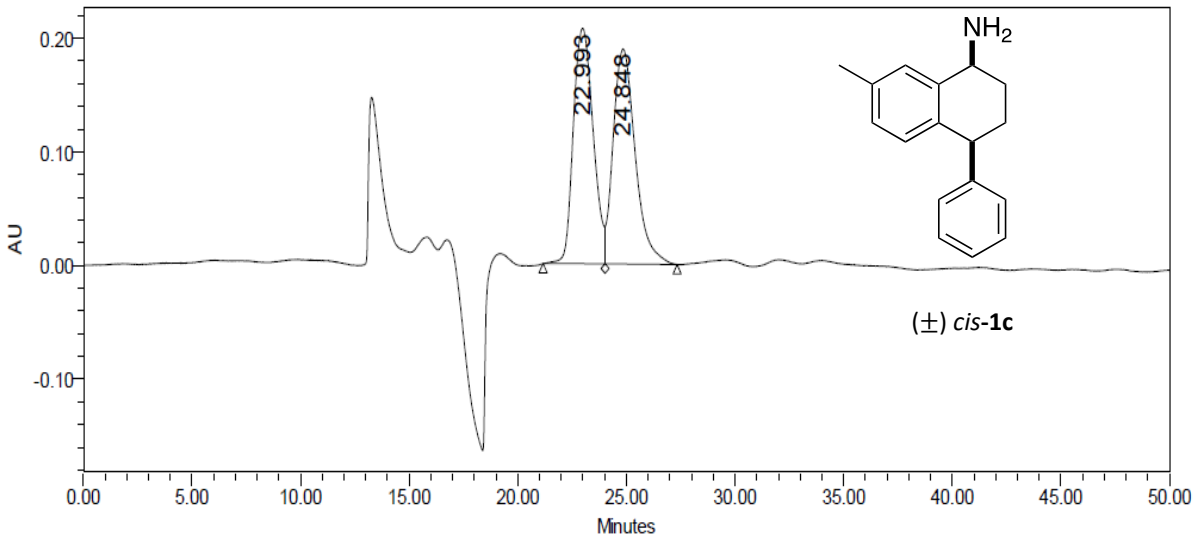
	RT	Area	% Area	Height	Result Id
1	16.144	1385802	25.35	90366	5480
2	17.828	2747377	50.26	164362	5480
3	19.209	656555	12.01	35124	5480
4	24.013	676493	12.38	27477	5480

Phenomenex Cellulose 4 [conditions: *n*-hexane/*i*PrOH (containing 2% DEA) = 90/10, flow rate = 0.5 mL min^{-1}]



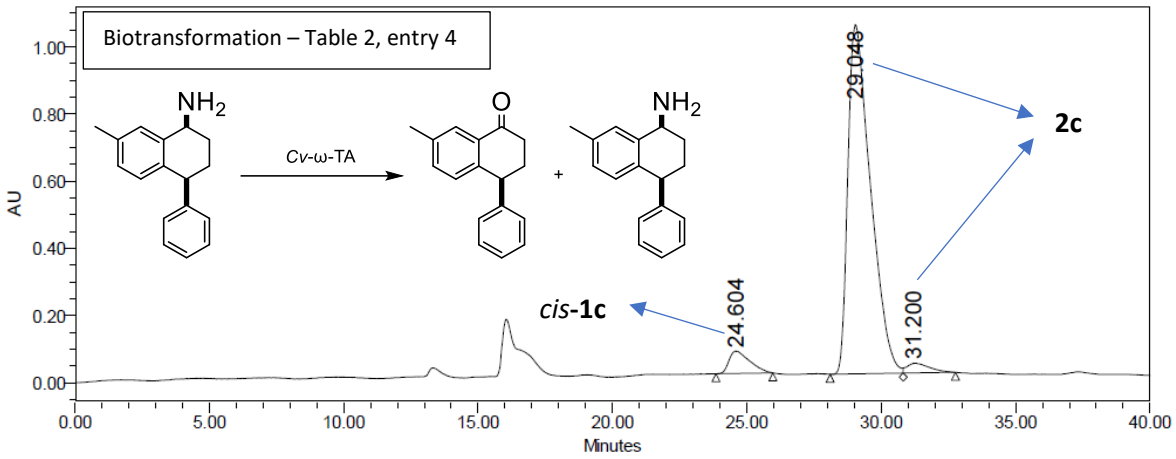
	RT	Area	% Area	Height	Result Id
1	29.534	6281423	48.59	99644	2183
2	31.616	6645404	51.41	95937	2183

Chiralcel AS-H [conditions: *n*-hexane/*i*PrOH (containing 2% DEA) = 95/5, flow rate = 0.25 mL min^{-1}]



	RT	Area	% Area	Height	Result Id
1	22.993	13101266	49.54	207073	2186
2	24.848	13346557	50.46	189124	2186

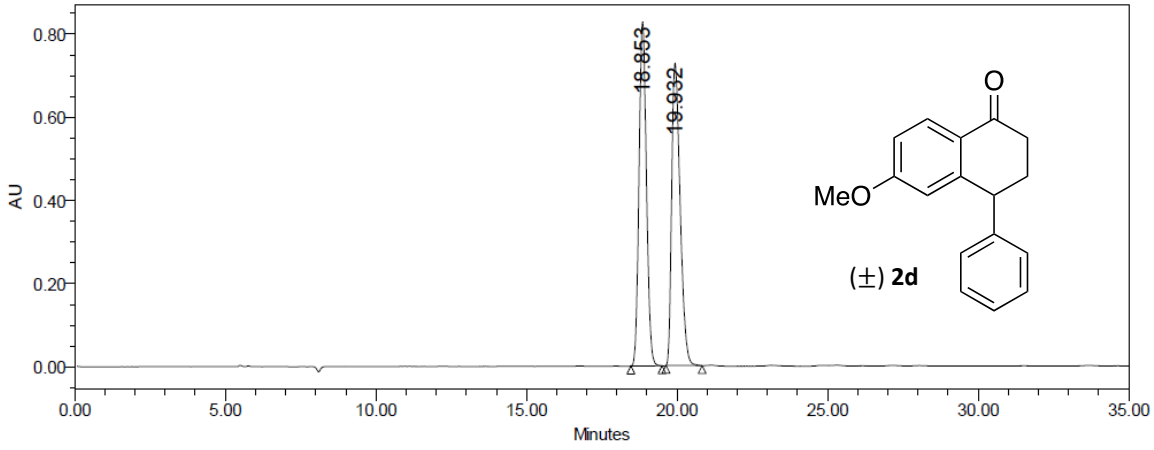
Chiralcel AS-H [conditions: *n*-hexane/*i*PrOH (containing 2% DEA) = 95/5, flow rate = 0.25 mL min^{-1}]



	RT	Area	% Area	Height	Result Id
1	24.604	3550276	5.38	66458	5504
2	29.048	60786281	92.04	1039549	5504
3	31.200	1704134	2.58	29058	5504

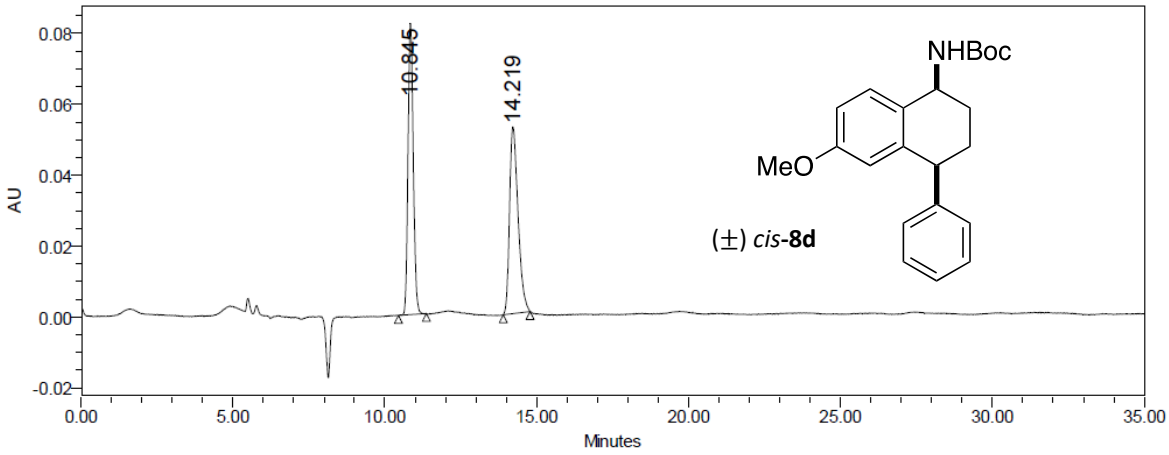
Chiralcel AS-H [conditions: *n*-hexane/*i*PrOH (containing 2% DEA) = 95/5, flow rate = 0.25 mL min^{-1}]

The enantiomers of *cis*- and *trans*-**1d** were not readily resolved by chiral HPLC; accordingly the resulting reaction solutions from the relevant biotransformations were subject to Boc protection (according to general method H) and then analysed by chiral HPLC, as per conditions detailed below for *cis*- and *trans*-**8d**



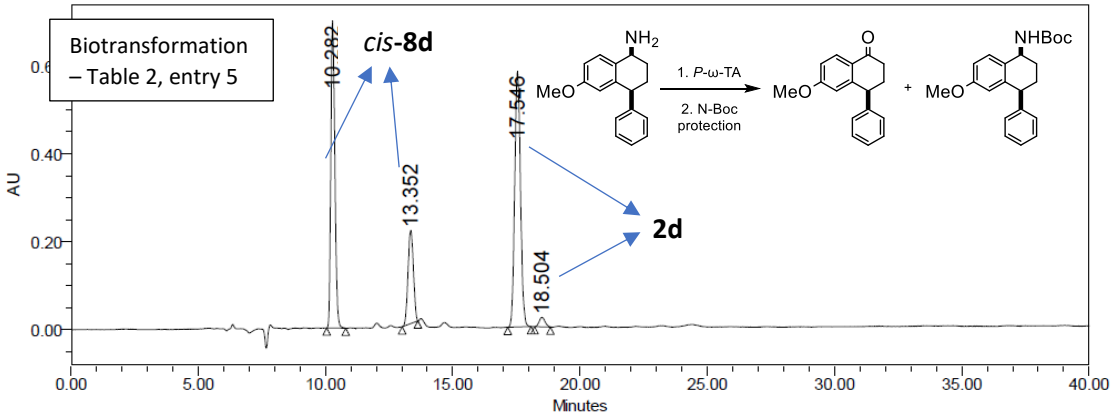
	RT	Area	% Area	Height	Result Id
1	18.853	14143883	50.02	826382	3221
2	19.932	14133344	49.98	726568	3221

Phenomenex Amylose 1 [conditions: *n*-hexane/*i*PrOH (containing 2% DEA) = 90/10, flow rate = 0.5 mL min^{-1}]



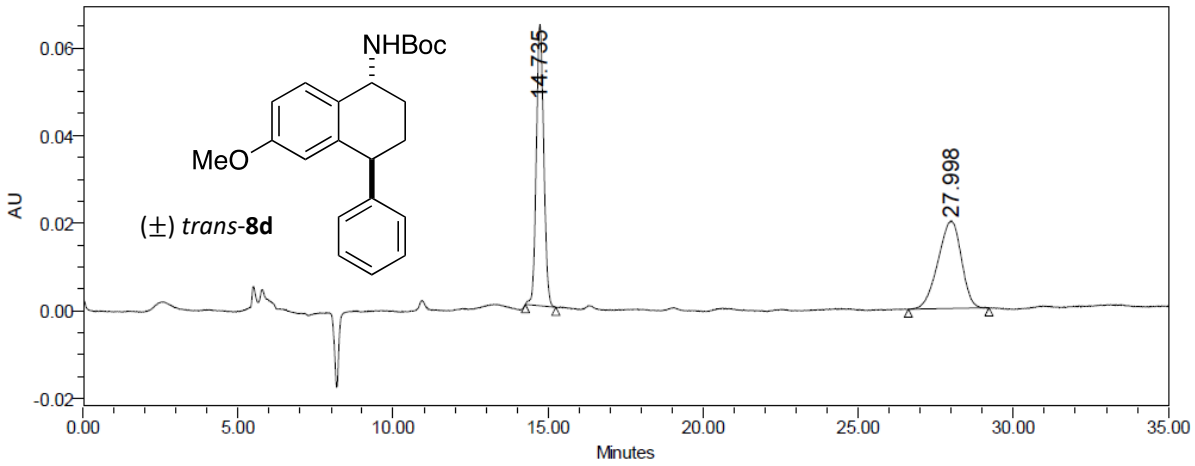
	RT	Area	% Area	Height	Result Id
1	10.845	990243	49.13	82324	3224
2	14.219	1025228	50.87	52738	3224

Phenomenex Amylose 1 [conditions: *n*-hexane/*i*PrOH (containing 2% DEA) = 90/10, flow rate = 0.5 mL min^{-1}]



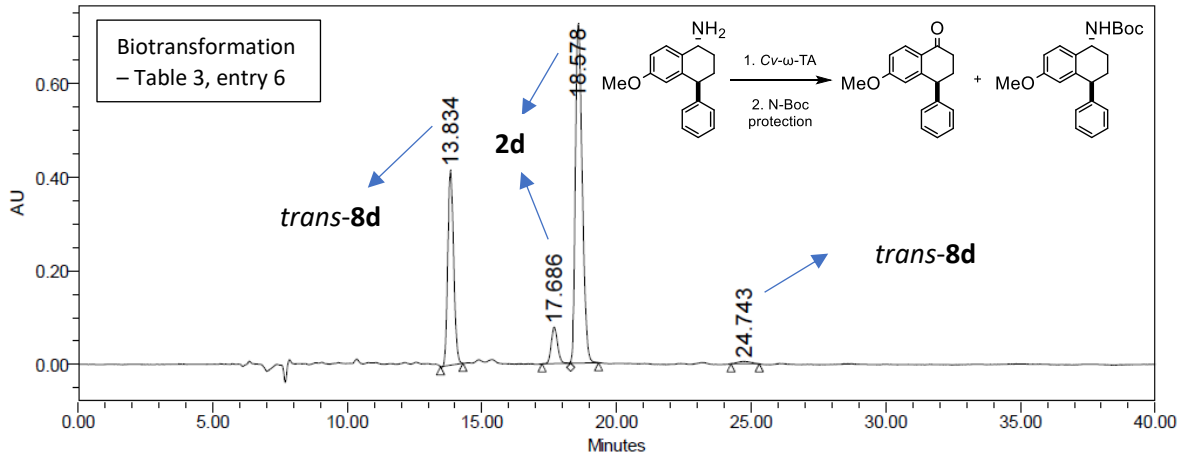
	RT	Area	% Area	Height	Result Id
1	10.282	7666276	37.88	697858	5542
2	13.352	3115191	15.39	212185	5542
3	17.546	9116479	45.04	581847	5542
4	18.504	341735	1.69	21405	5542

Phenomenex Amylose 1 [conditions: *n*-hexane/*i*PrOH (containing 2% DEA) = 90/10, flow rate = 0.5 mL min^{-1}]



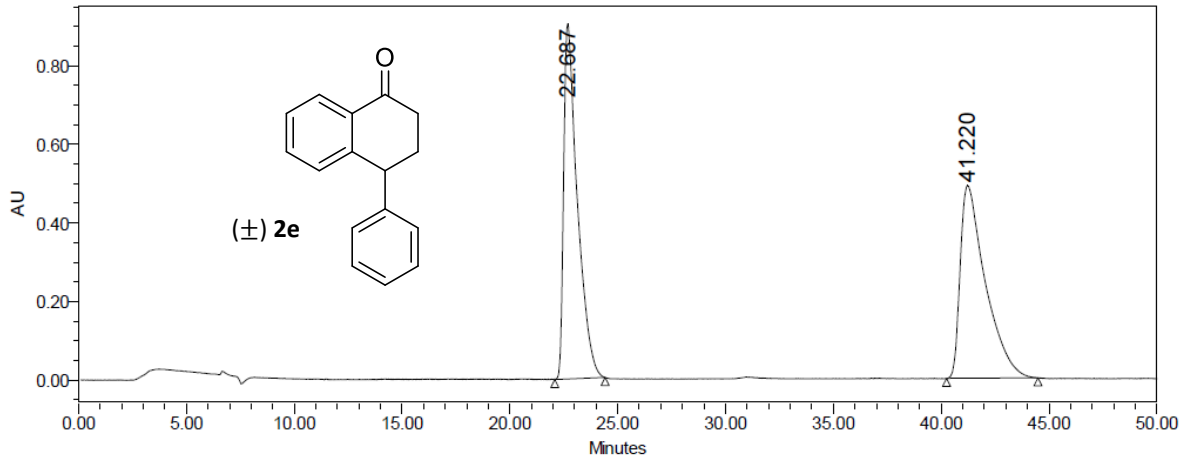
	RT	Area	% Area	Height	Result Id
1	14.735	1067267	50.60	64200	3227
2	27.998	1041917	49.40	20002	3227

Phenomenex Amylose 1 [conditions: *n*-hexane/*i*PrOH (containing 2% DEA) = 90/10, flow rate = 0.5 mL min^{-1}]



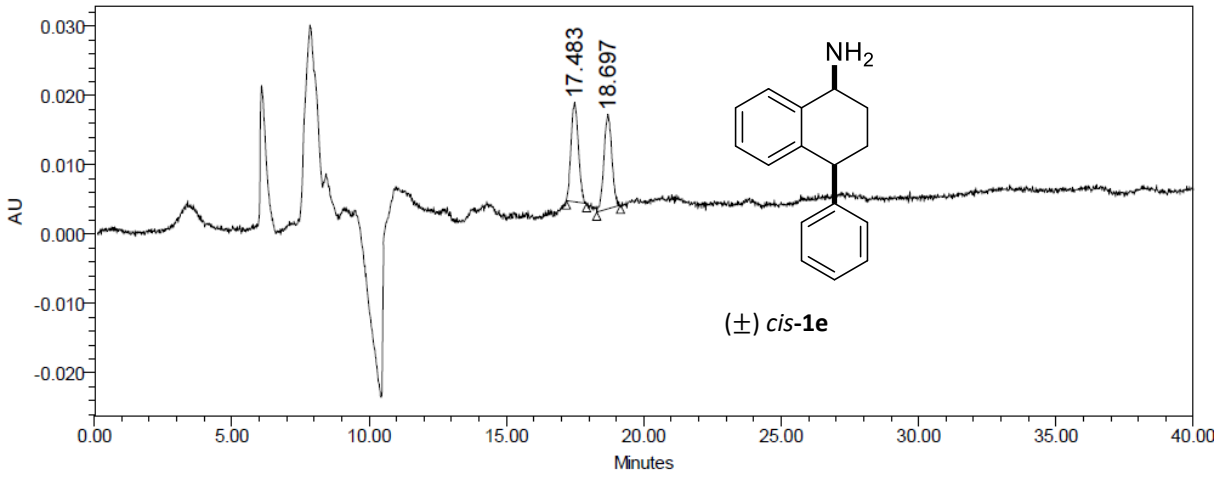
	RT	Area	% Area	Height	Result Id
1	13.834	6298704	30.65	416688	5522
2	17.686	1273190	6.20	78166	5522
3	18.578	12792177	62.25	726192	5522
4	24.743	186088	0.91	5479	5522

Phenomenex Amylose 1 [conditions: *n*-hexane/*i*PrOH (containing 2% DEA) = 90/10, flow rate = 0.5 mL min^{-1}]



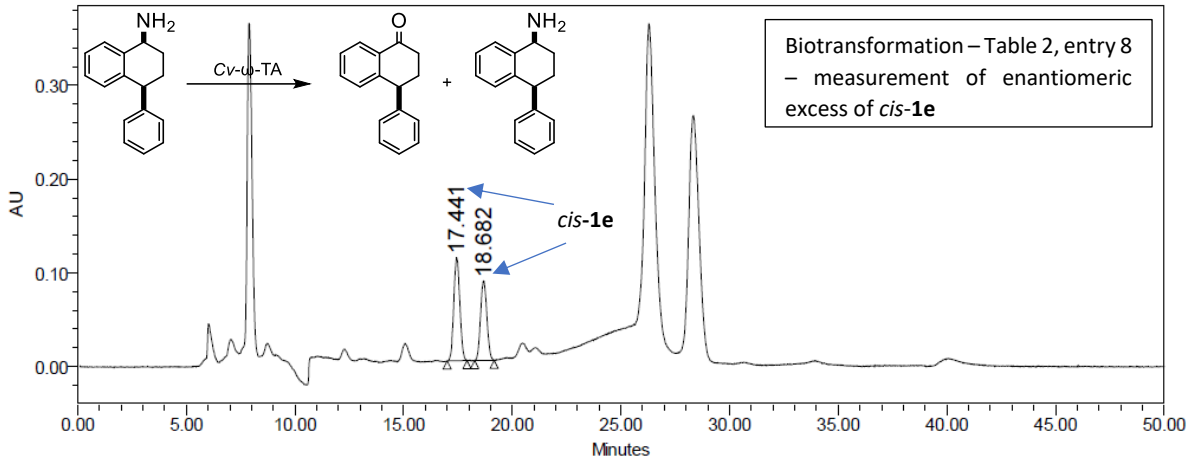
	RT	Area	% Area	Height
1	22.687	39743359	50.01	905143
2	41.220	39722482	49.99	490376

Chiralcel OJ-H column [conditions: *n*-hexane/*i*PrOH (containing 2% DEA) = 95/5, flow rate = 0.5 mL min^{-1}]



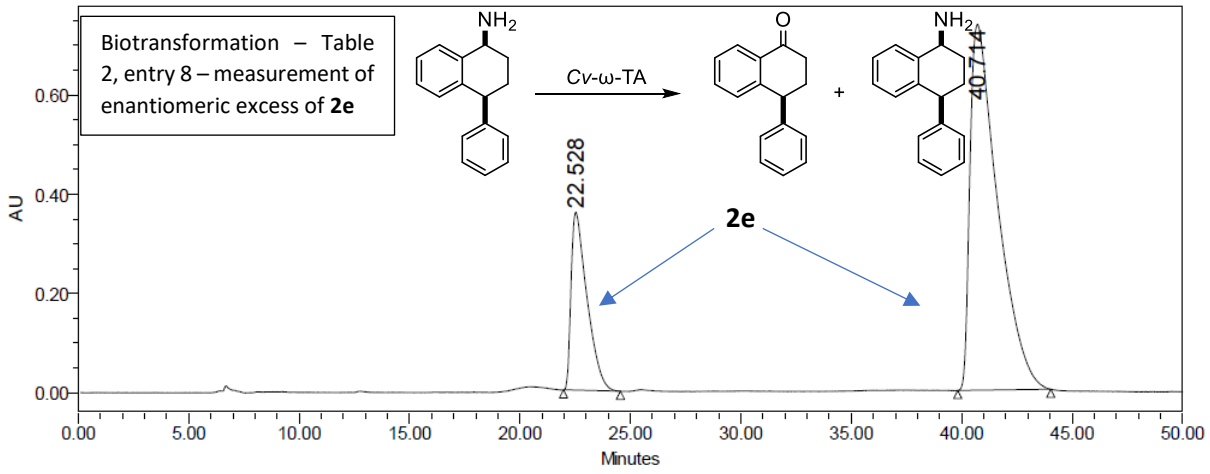
	RT	Area	% Area	Height
1	17.483	266805	49.45	14175
2	18.697	272687	50.55	13580

Phenomenex Cellulose 2 [conditions: *n*-hexane/*i*PrOH (containing 2% DEA) = 95/5, flow rate = 0.5 mL min^{-1}]



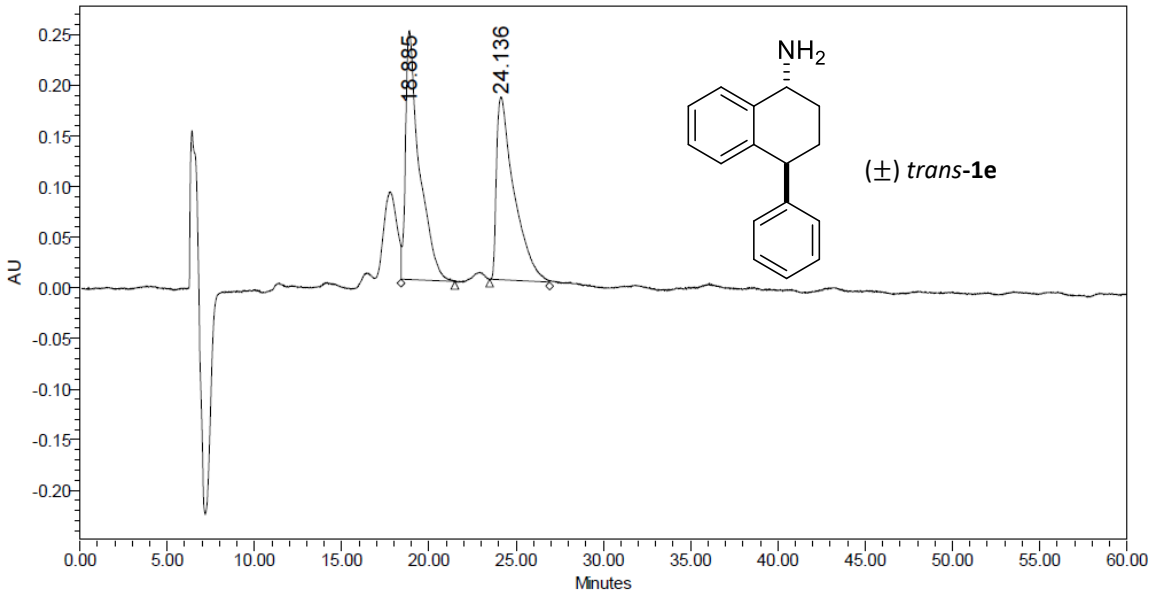
	RT	Area	% Area	Height
1	17.441	2133952	55.37	110203
2	18.682	1719939	44.63	85168

Phenomenex Cellulose 2 [conditions: *n*-hexane/*i*PrOH (containing 2% DEA) = 95/5, flow rate = 0.5 mL min^{-1}]



	RT	Area	% Area	Height
1	22.528	17963816	21.87	358351
2	40.714	64182562	78.13	737295

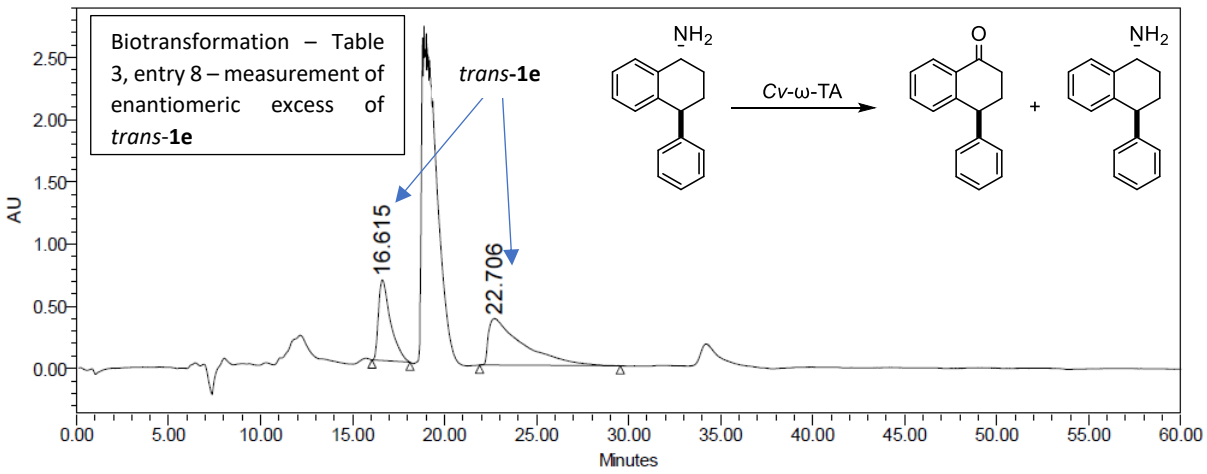
Chiralcel OJ-H column [conditions: *n*-hexane/*i*PrOH (containing 2% DEA) = 95/5, flow rate = 0.5 mL min^{-1}]



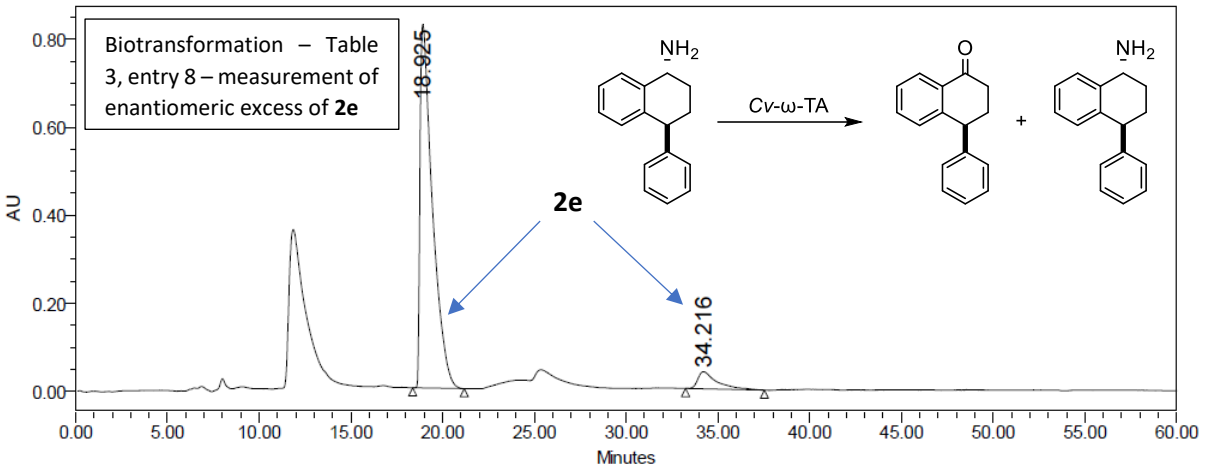
	RT	Area	% Area	Height
1	18.885	13505290	51.67	245846
2	24.136	12630587	48.33	180446

Chiralcel OJ-H column conditions: *n*-hexane/*i*PrOH (containing 2% DEA) = 90/10, flow rate = 0.5 mL min^{-1}

HPLC trace recorded during optimization of conditions for resolution of the enantiomers of *trans*-**1e**.

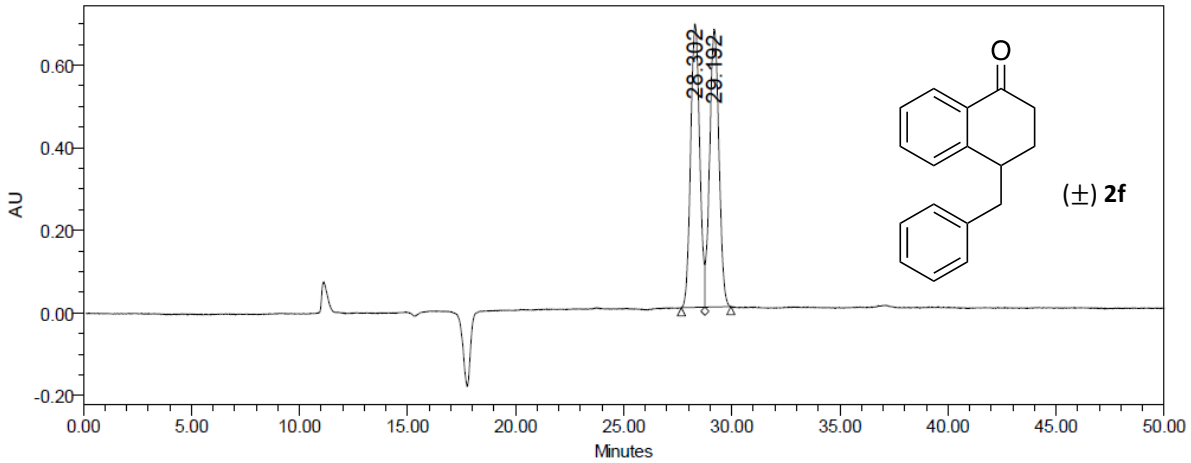


Chiralcel OJ-H column conditions: *n*-hexane/*i*PrOH (containing 2% DEA) = 90/10, flow rate = 0.5 mL min^{-1}



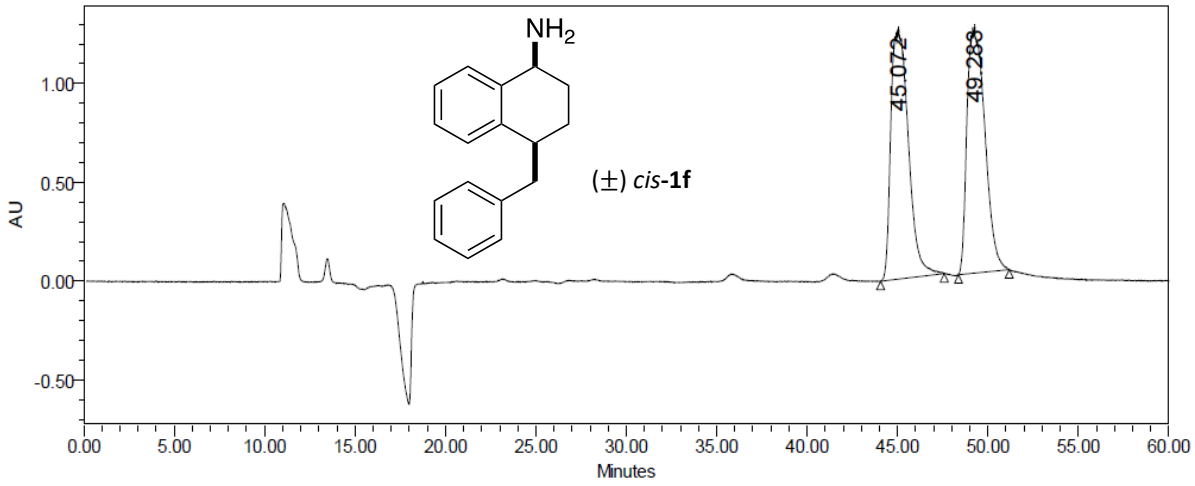
	RT	Area	% Area	Height
1	16.615	29587025	37.94	647862
2	18.925	38877825	93.22	826131
3	22.706	48392379	62.06	374412
4	34.216	2827108	6.78	39002

Chiralcel OJ-H column conditions: *n*-hexane/*i*PrOH (containing 2% DEA) = 90/10, flow rate = 0.5 mL min^{-1}



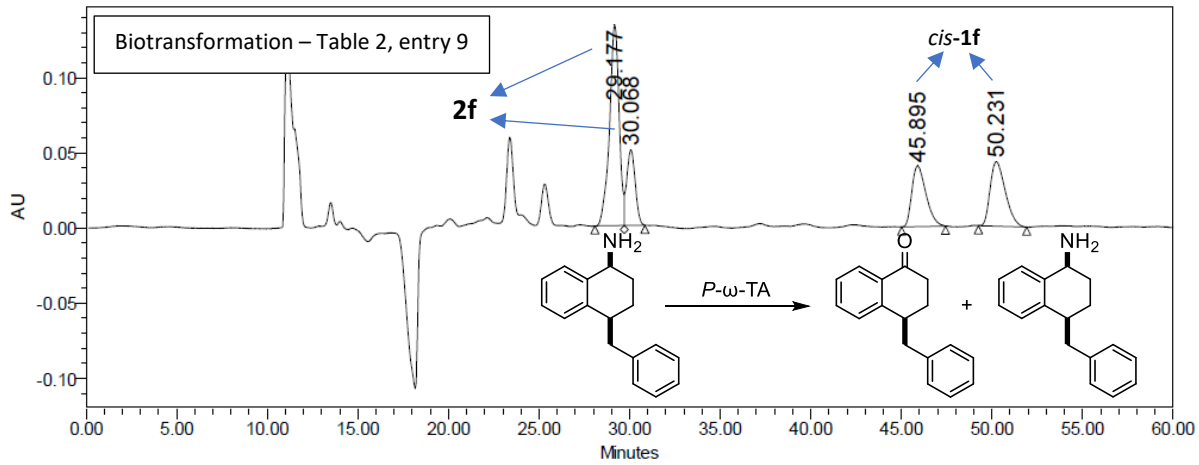
	RT	Area	% Area	Height	Result Id
1	28.302	19858348	49.62	685620	5429
2	29.192	20163668	50.38	672030	5429

Phenomenex Amylose 1 [conditions: *n*-hexane/*i*PrOH (containing 2% DEA) = 95/5, flow rate = 0.25 mL min^{-1}]



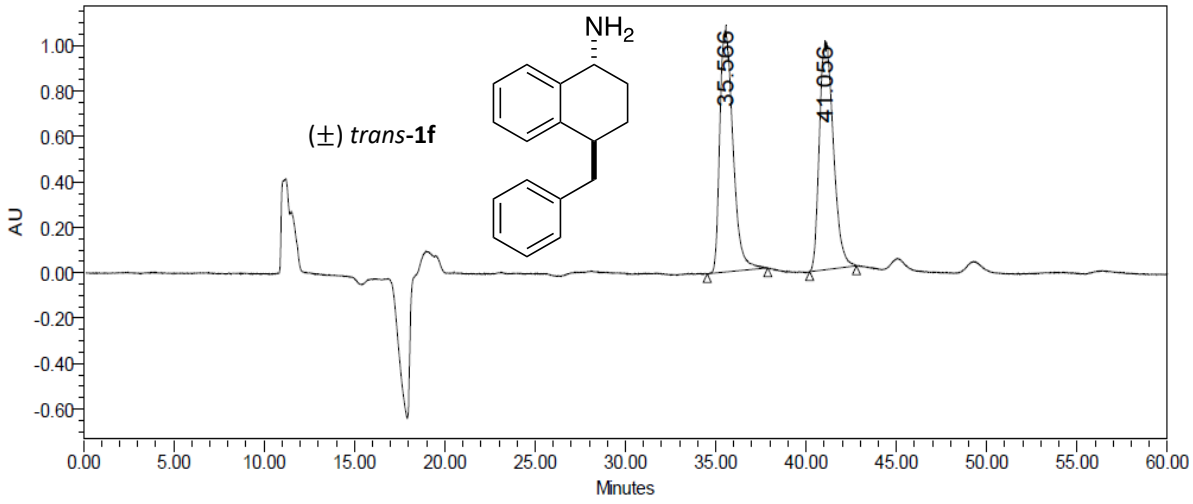
	RT	Area	% Area	Height	Result Id
1	45.072	84960849	49.91	1258310	5435
2	49.283	85256294	50.09	1256262	5435

Phenomenex Amylose 1 [conditions: *n*-hexane/*i*PrOH (containing 2% DEA) = 95/5, flow rate = 0.25 mL min^{-1}]



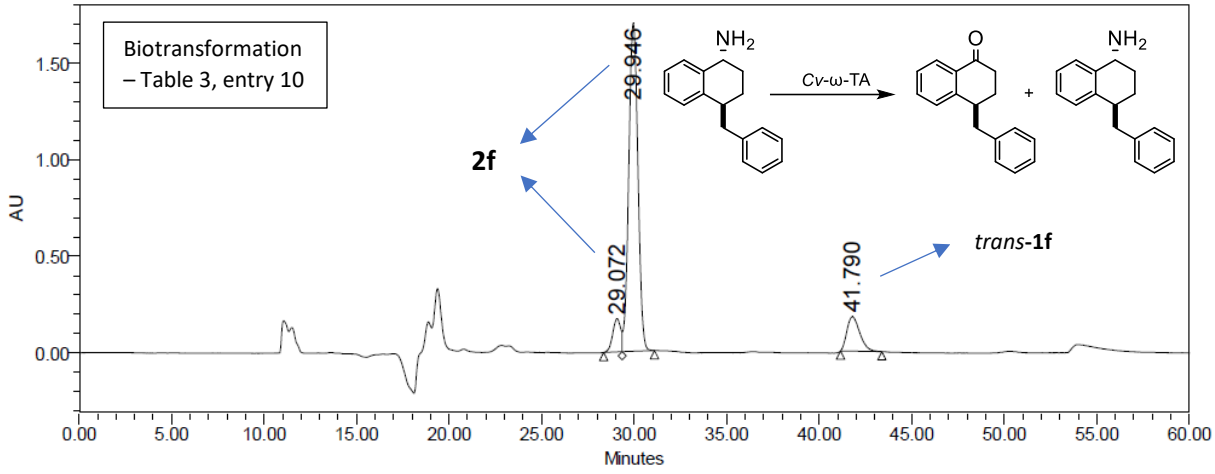
	RT	Area	% Area	Height	Result Id
1	29.177	4932860	43.69	133642	5462
2	30.068	1647838	14.60	50300	5462
3	45.895	2200064	19.49	40473	5462
4	50.231	2509445	22.23	43006	5462

Phenomenex Amylose 1 [conditions: *n*-hexane/*i*PrOH (containing 2% DEA) = 95/5, flow rate = 0.25 mL min^{-1}]



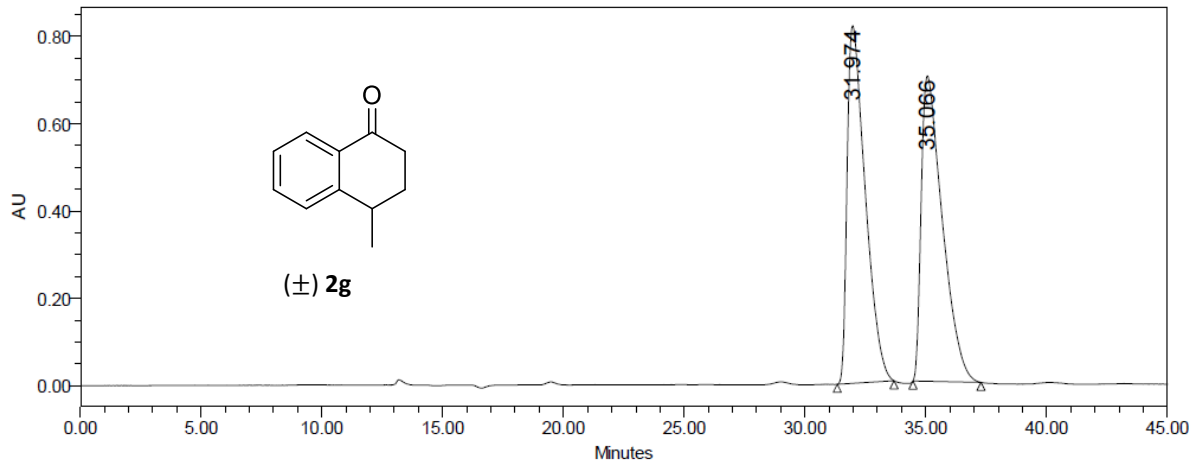
	RT	Area	% Area	Height	Result Id
1	35.566	53911091	49.84	1066708	5432
2	41.056	54251699	50.16	1008222	5432

Phenomenex Amylose 1 [conditions: *n*-hexane/*i*PrOH (containing 2% DEA) = 95/5, flow rate = 0.25 mL min^{-1}]



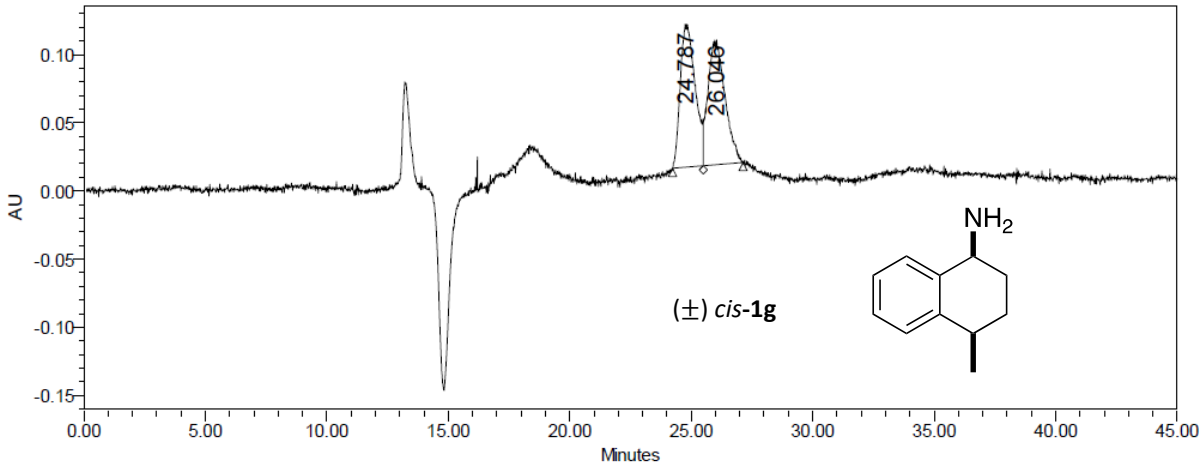
	RT	Area	% Area	Height	Result Id
1	29.072	5116850	7.07	172650	5453
2	29.946	58592343	80.99	1699615	5453
3	41.790	8639609	11.94	178934	5453

Phenomenex Amylose 1 [conditions: *n*-hexane/*i*PrOH (containing 2% DEA) = 95/5, flow rate = 0.25 mL min^{-1}]



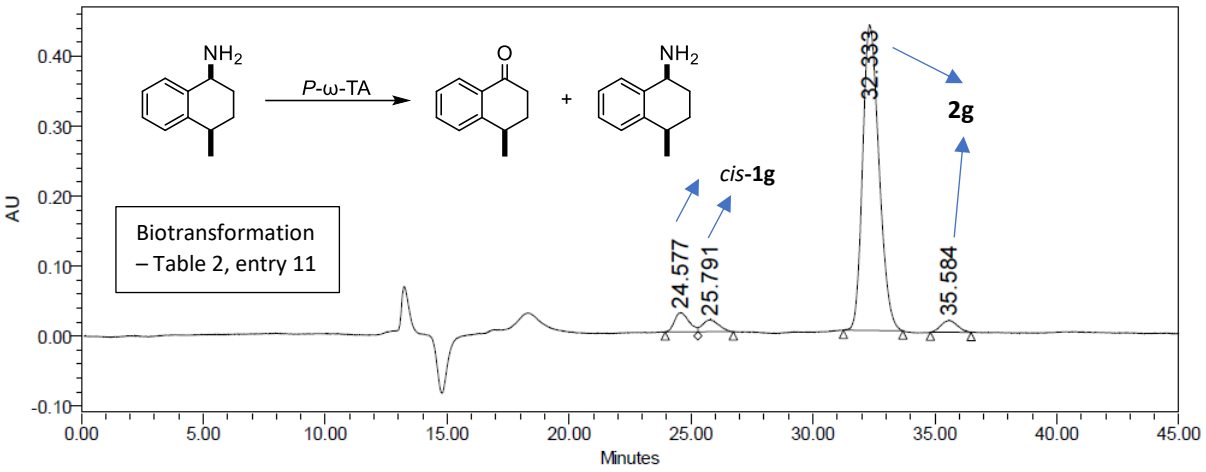
	RT	Area	% Area	Height	Result Id
1	31.974	42631290	50.03	818865	5569
2	35.066	42583446	49.97	699761	5569

Chiralcel OB-H column conditions: *n*-hexane/*i*PrOH (containing 2% DEA) = 95/5, flow rate = 0.25 mL min^{-1}



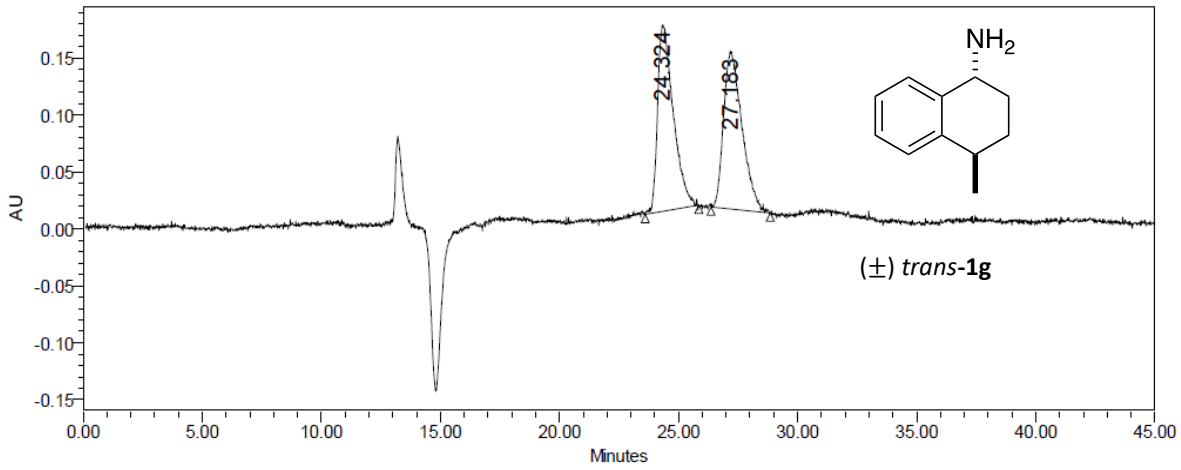
	RT	Area	% Area	Height	Result Id
1	24.787	4462773	50.18	103335	5585
2	26.046	4431639	49.82	90169	5585

Chiralcel OB-H column conditions: *n*-hexane/*i*PrOH (containing 2% DEA) = 95/5, flow rate = 0.25 mL min^{-1}



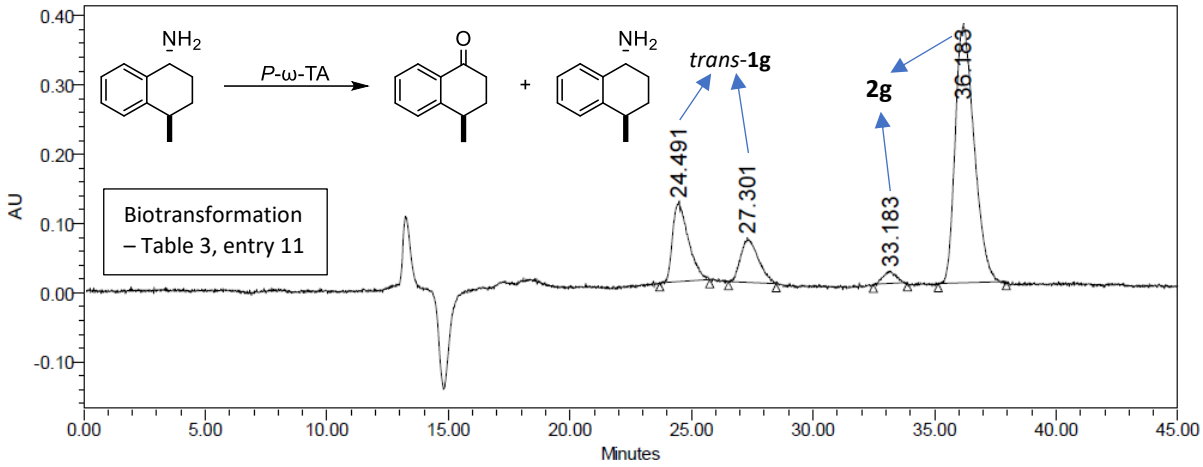
	RT	Area	% Area	Height	Result Id
1	24.577	1125752	4.88	27429	5595
2	25.791	786930	3.41	17259	5595
3	32.333	20360193	88.29	435820	5595
4	35.584	788442	3.42	17029	5595

Chiralcel OB-H column conditions: *n*-hexane/*i*PrOH (containing 2% DEA) = 95/5, flow rate = 0.25 mL min^{-1}



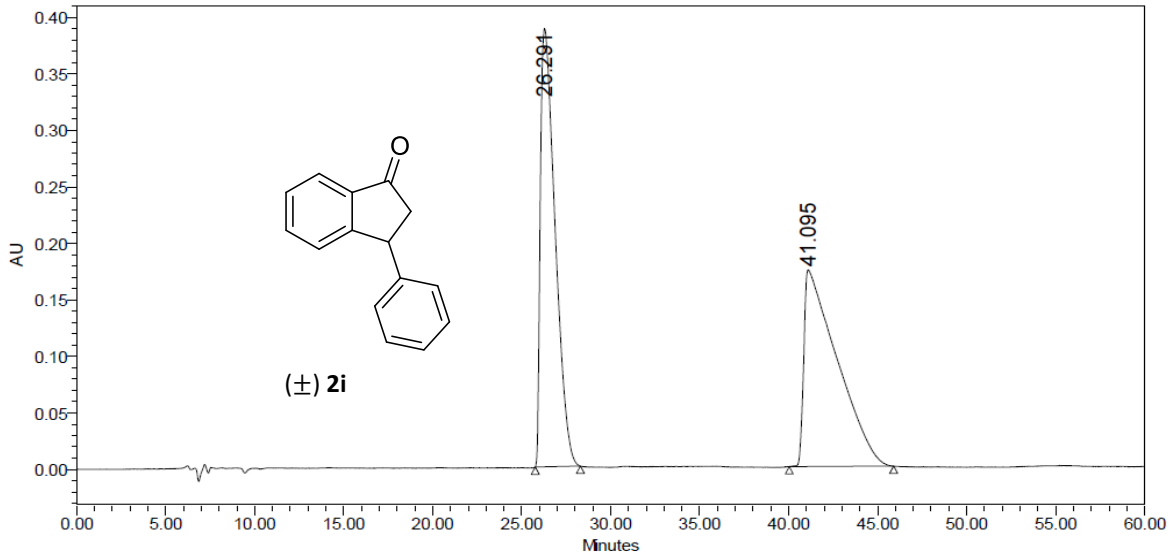
	RT	Area	% Area	Height	Result Id
1	24.324	7475652	50.02	163087	5572
2	27.183	7470909	49.98	137910	5572

Chiralcel OB-H column conditions: *n*-hexane/*i*PrOH (containing 2% DEA) = 95/5, flow rate = 0.25 mL min^{-1}



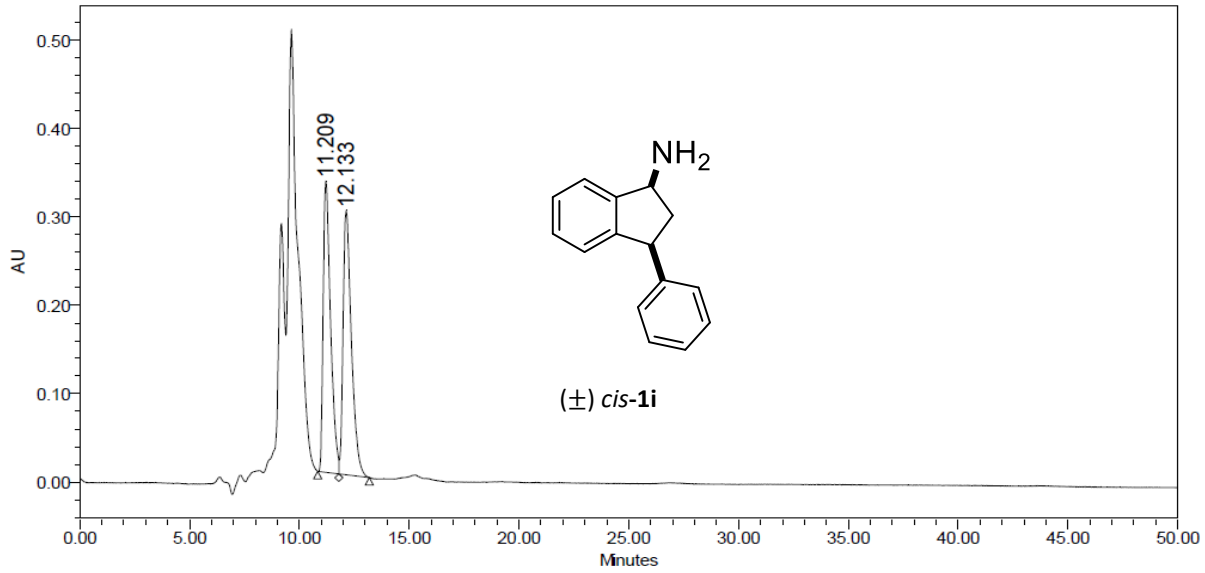
	RT	Area	% Area	Height	Result Id
1	24.491	5145495	17.68	116306	5581
2	27.301	3193875	10.97	62249	5581
3	33.183	649210	2.23	17727	5581
4	36.183	20122570	69.12	370789	5581

Chiralcel OB-H column conditions: *n*-hexane/*i*PrOH (containing 2% DEA) = 95/5, flow rate = 0.25 mL min^{-1}



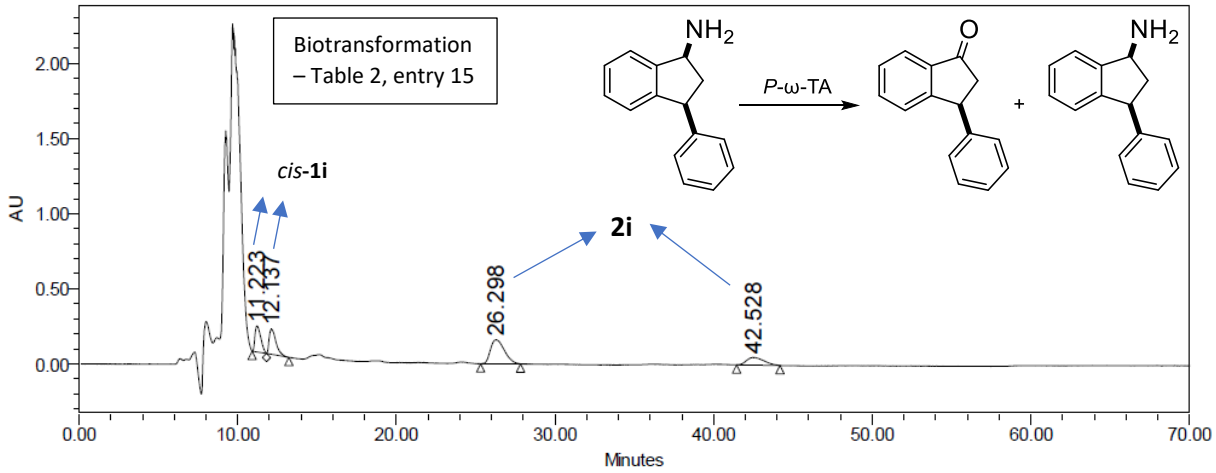
	RT	Area	% Area	Height
1	26.291	22325896	49.73	387534
2	41.095	22571624	50.27	173944

Chiralcel AS-H column conditions: *n*-hexane/*i*PrOH (containing 2% DEA) = 90/10, flow rate = 0.5 mL min^{-1}



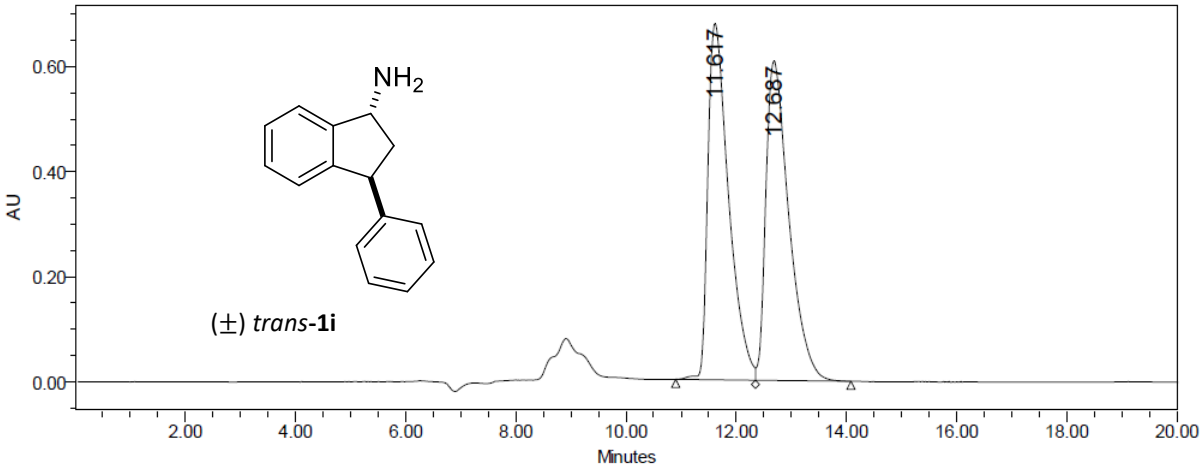
	RT	Area	% Area	Height
1	11.209	7692606	49.36	329719
2	12.133	7891948	50.64	298940

Chiralcel AS-H column conditions: *n*-hexane/*i*PrOH (containing 2% DEA) = 90/0, flow rate = 0.5 mL min^{-1}



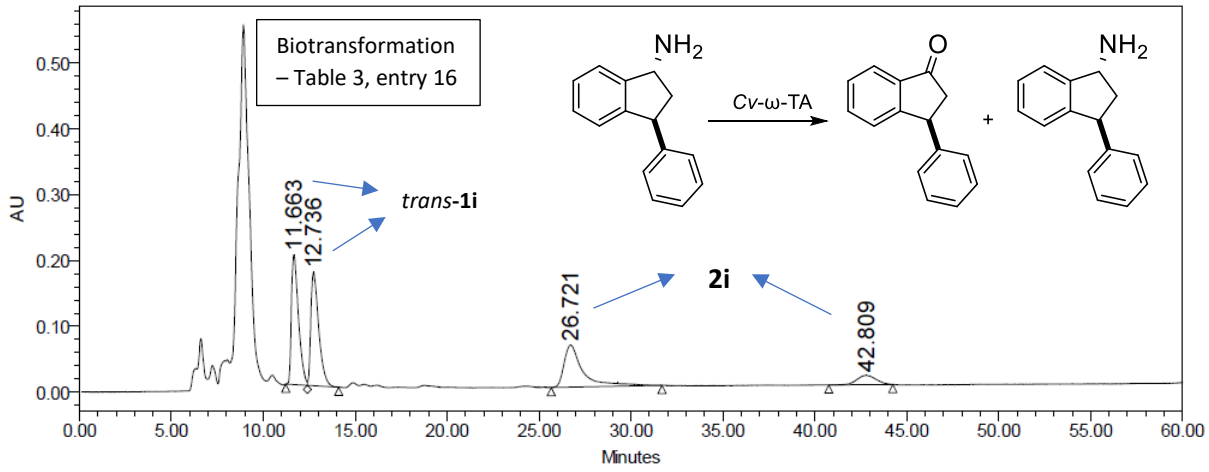
	RT	Area	% Area	Height
1	11.223	4386049	19.03	173211
2	12.137	5045157	21.89	168055
3	26.298	9767612	42.37	159028
4	42.528	3852526	16.71	51238

Chiralcel AS-H column conditions: *n*-hexane/*i*PrOH (containing 2% DEA) = 90/0, flow rate = 0.5 mL min^{-1}



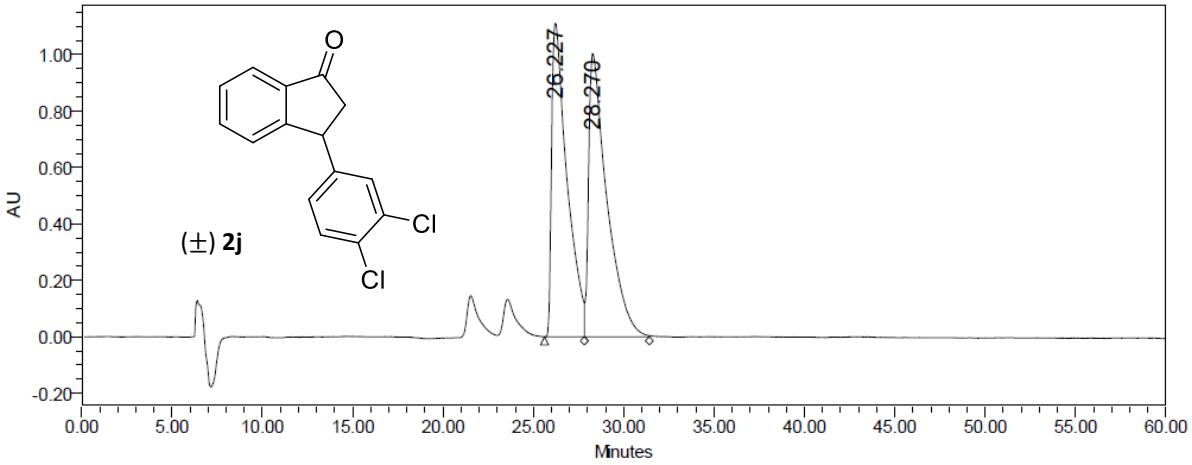
	RT	Area	% Area	Height
1	11.617	17754459	50.12	678484
2	12.687	17672834	49.88	608105

Chiralcel AS-H column conditions: *n*-hexane/*i*PrOH (containing 2% DEA) = 90/10, flow rate = 0.5 mL min^{-1}



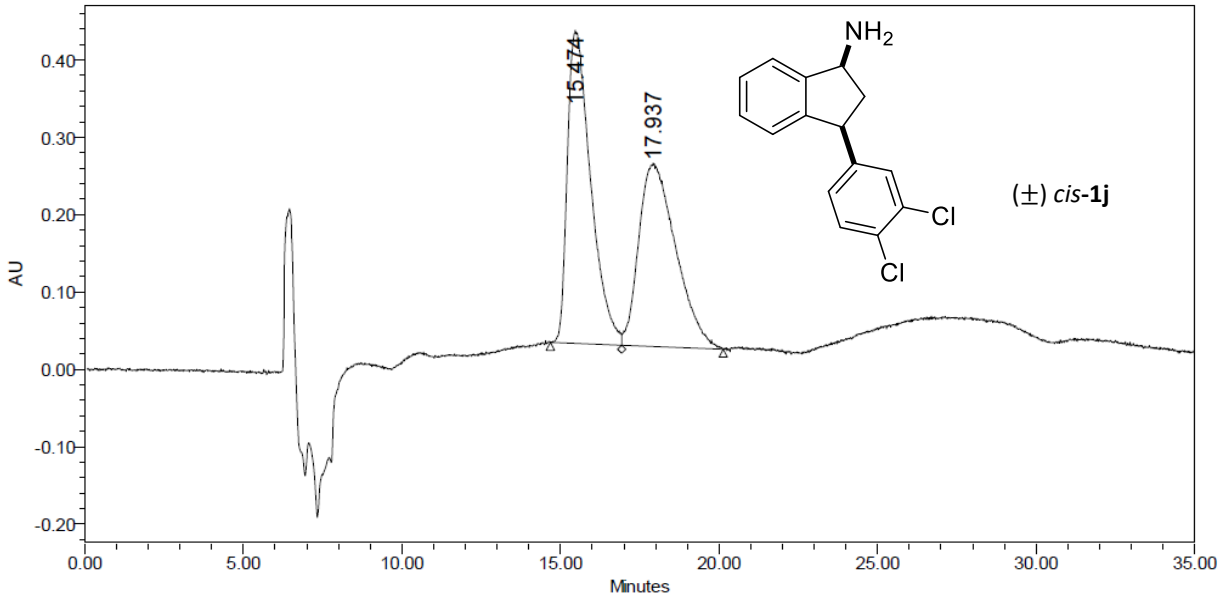
	RT	Area	% Area	Height
1	11.663	5279515	32.91	197673
2	12.736	5156095	32.14	172801
3	26.721	4579433	28.55	63864
4	42.809	1026773	6.40	14055

Chiralcel AS-H column conditions: *n*-hexane/*i*PrOH (containing 2% DEA) = 90/10, flow rate = 0.5 mL min^{-1}



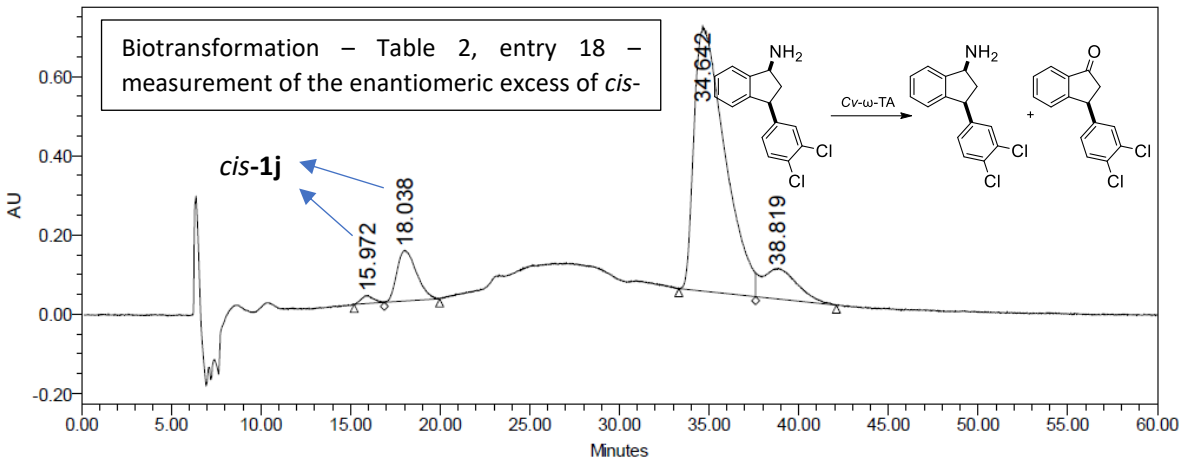
	RT	Area	% Area	Height
1	26.227	65513494	48.12	1109665
2	28.270	70625781	51.88	1003150

Chiralcel OJ-H column conditions: *n*-hexane/*i*PrOH (containing 2% DEA) = 90/10, flow rate = 0.5 mL min^{-1}



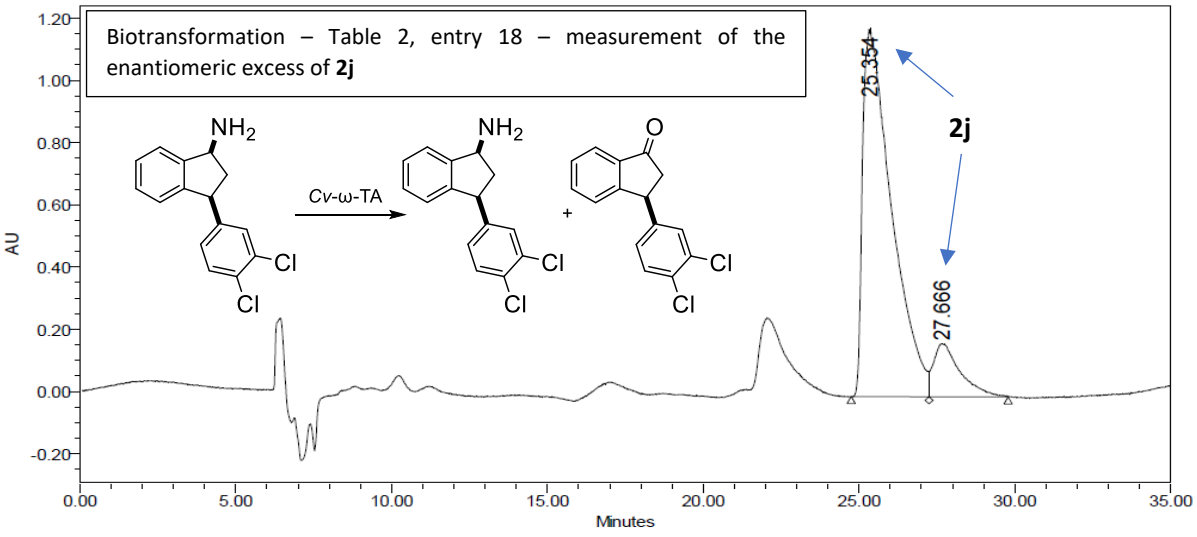
	RT	Area	% Area	Height
1	15.474	20660726	51.80	402492
2	17.937	19222802	48.20	236379

Chiralcel OB-H column conditions: *n*-hexane/*i*PrOH (containing 2% DEA) = 90/10, flow rate = 0.5 mL min^{-1}



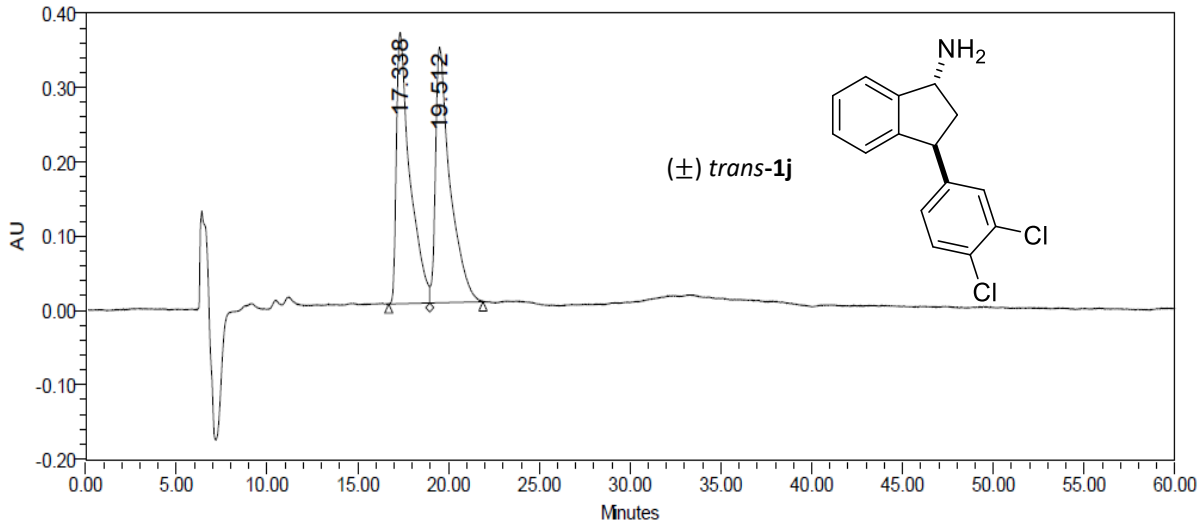
	RT	Area	% Area	Height	Result Id
1	15.972	954802	0.95	19610	16527
2	18.038	9720291	9.63	127850	16527
3	34.642	79643873	78.94	665675	16527
4	38.819	10567967	10.48	76367	16527

Chiralcel OB-H column conditions: *n*-hexane/*i*PrOH (containing 2% DEA) = 90/10, flow rate = 0.5 mL min^{-1}



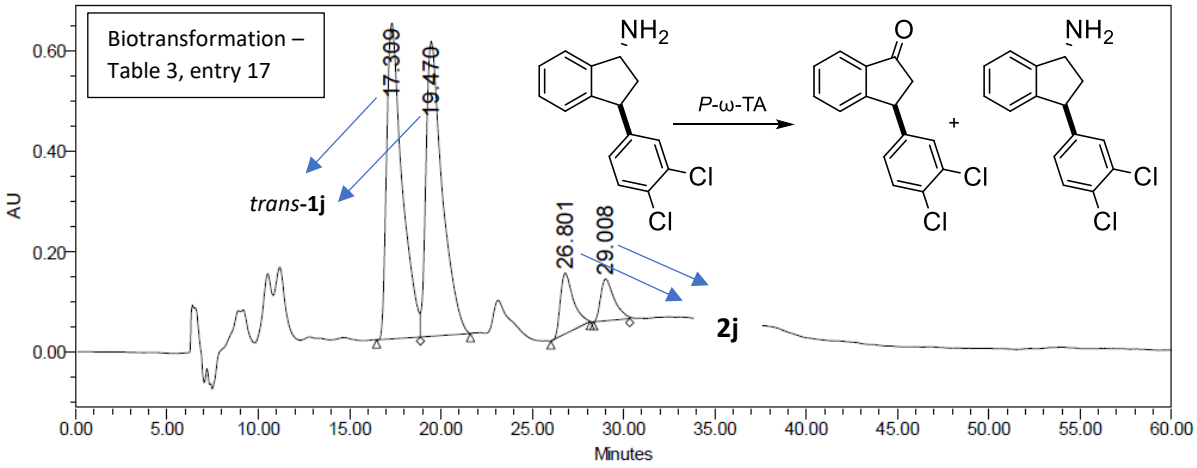
	RT	Area	% Area	Height
1	25.354	76203388	88.23	1177895
2	27.666	10169075	11.77	169780

Chiralcel OJ-H column conditions: *n*-hexane/*i*PrOH (containing 2% DEA) = 90/10, flow rate = 0.5 mL min^{-1}



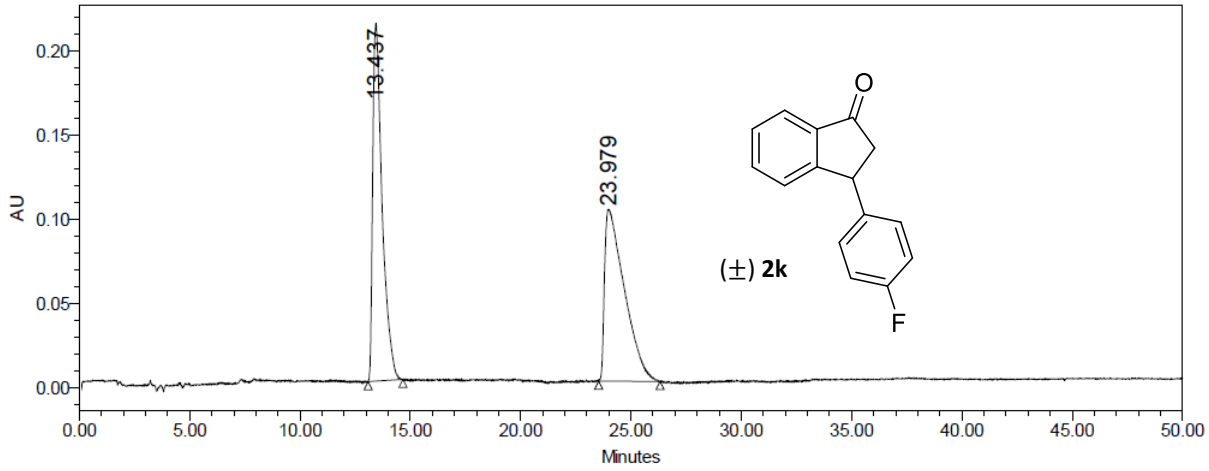
	RT	Area	% Area	Height
1	17.338	18854358	49.52	365175
2	19.512	19216525	50.48	343448

Chiralcel OJ-H [conditions: *n*-hexane/*i*PrOH (containing 2% DEA) = 90/10, flow rate = 0.5 mL min^{-1}]



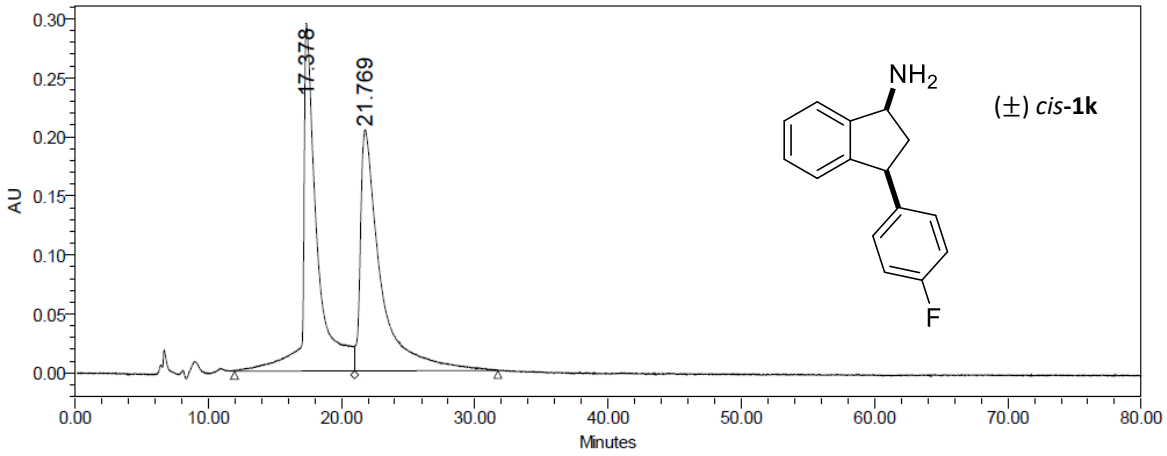
	RT	Area	% Area	Height
1	17.309	36978685	44.18	628327
2	19.470	36423895	43.52	586733
3	26.801	5984845	7.15	120480
4	29.008	4303304	5.14	83194

Chiralcel OJ-H [conditions: *n*-hexane/*i*PrOH (containing 2% DEA) = 90/10, flow rate = 0.5 mL min^{-1}]



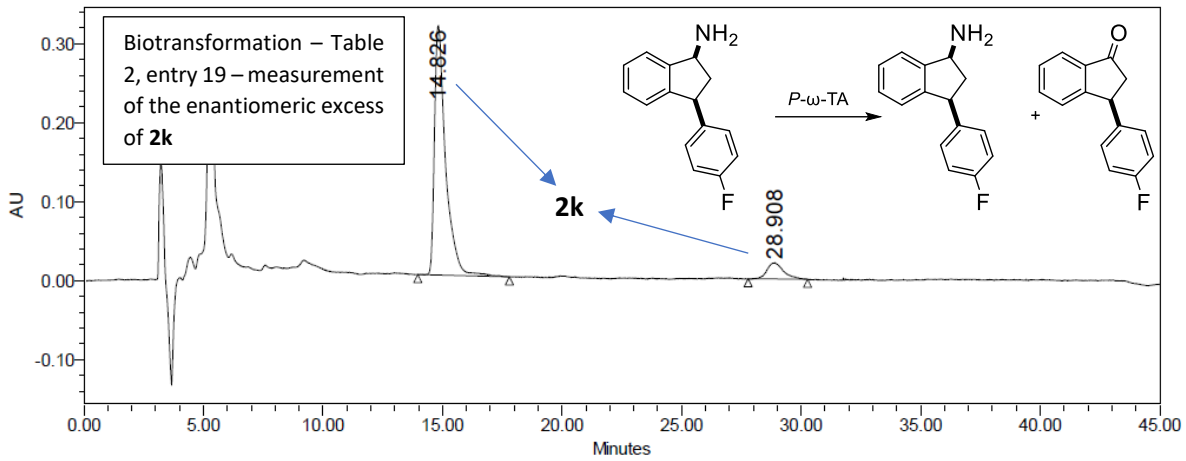
	RT	Area	% Area	Height
1	13.437	6304359	49.70	212484
2	23.979	6380191	50.30	102183

Chiralcel AS-H conditions: *n*-hexane/*i*PrOH (containing 2% DEA) = 90/10, flow rate = 1.0 mL min^{-1}



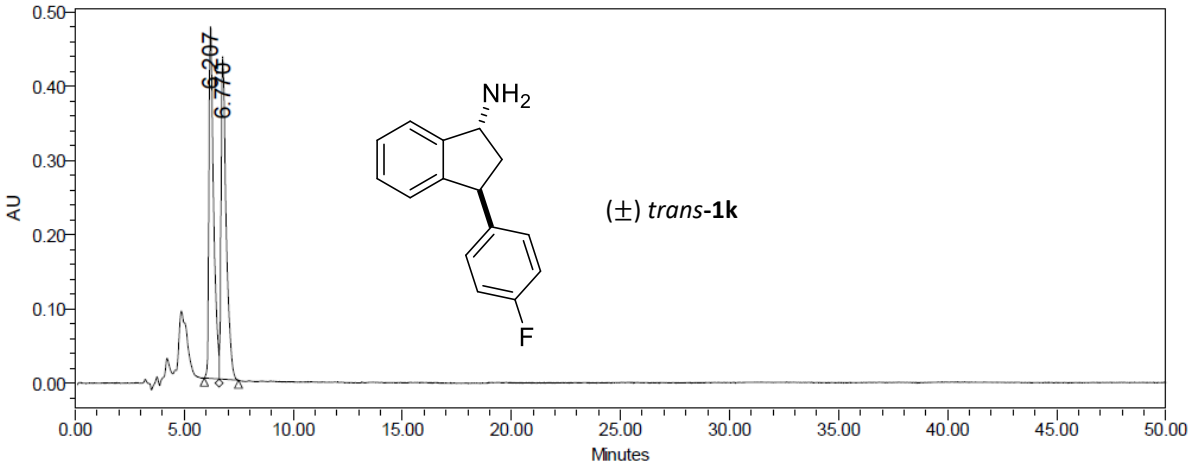
	RT	Area	% Area	Height
1	17.378	21199535	49.67	294048
2	21.769	21481532	50.33	204151

Chiralcel OB-H [conditions: *n*-hexane/*i*PrOH (containing 2% DEA) = 95/5, flow rate = 0.5 mL min^{-1}]



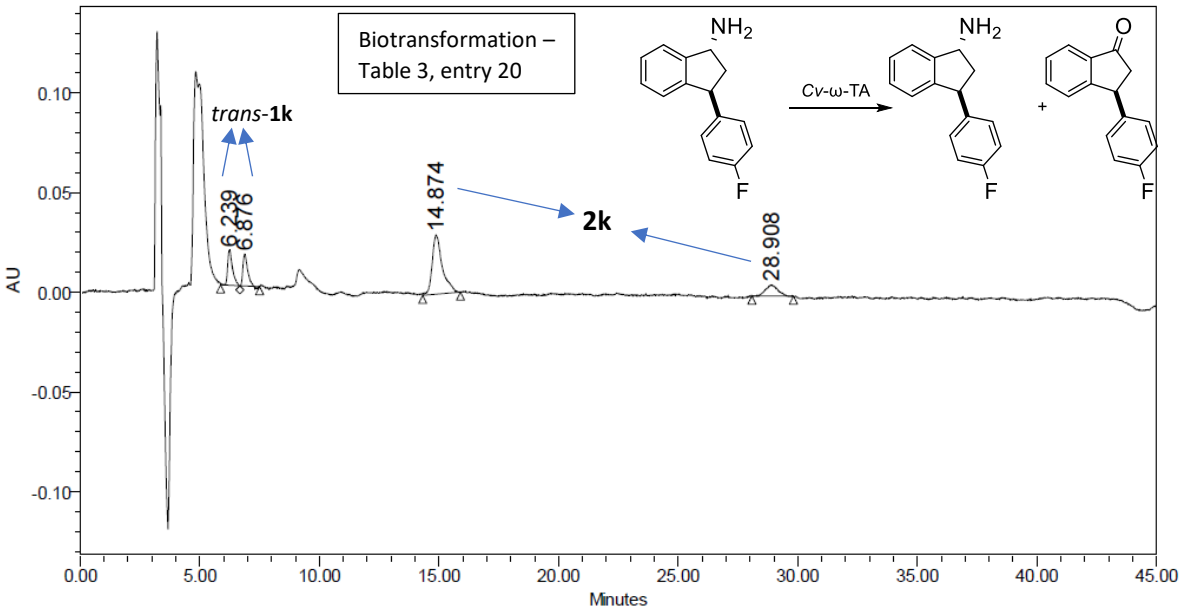
	RT	Area	% Area	Height	Result Id
1	14.826	10208895	91.19	316217	17002
2	28.908	986382	8.81	20496	17002

Chiralcel AS-H conditions: *n*-hexane/*i*PrOH (containing 2% DEA) = 90/10, flow rate = 1.0 mL min^{-1}



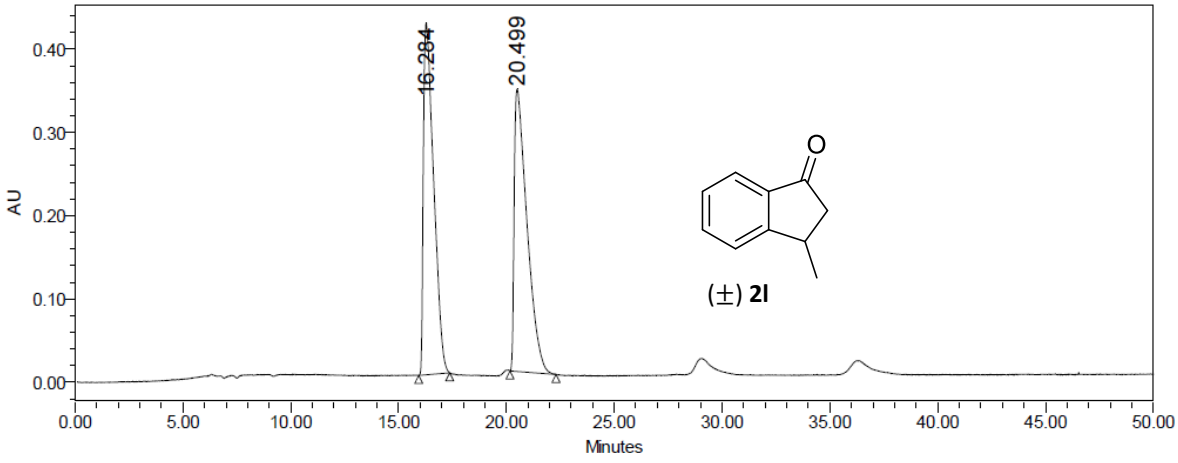
	RT	Area	% Area	Height
1	6.207	7073937	50.02	475103
2	6.770	7067464	49.98	434627

Chiralcel AS-H [conditions: *n*-hexane/*i*PrOH (containing 2% DEA) = 90/10, flow rate = 1.0 mL min^{-1}]



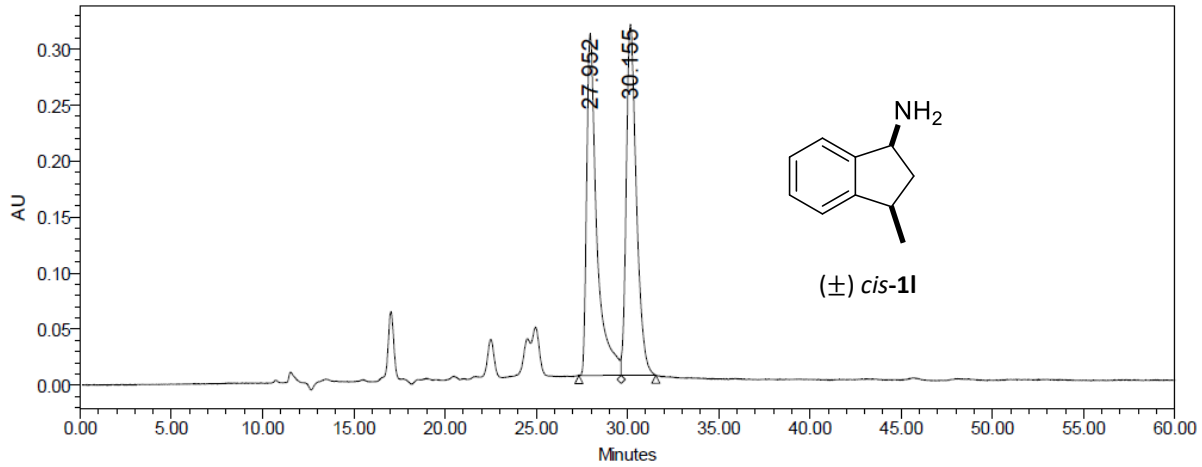
	RT	Area	% Area	Height
1	6.239	249696	16.04	17775
2	6.876	230676	14.82	16089
3	14.874	875680	56.27	29642
4	28.908	200258	12.87	5483

Chiralcel AS-H [conditions: *n*-hexane/*i*PrOH (containing 2% DEA) = 90/10, flow rate = 1.0 mL min^{-1}]



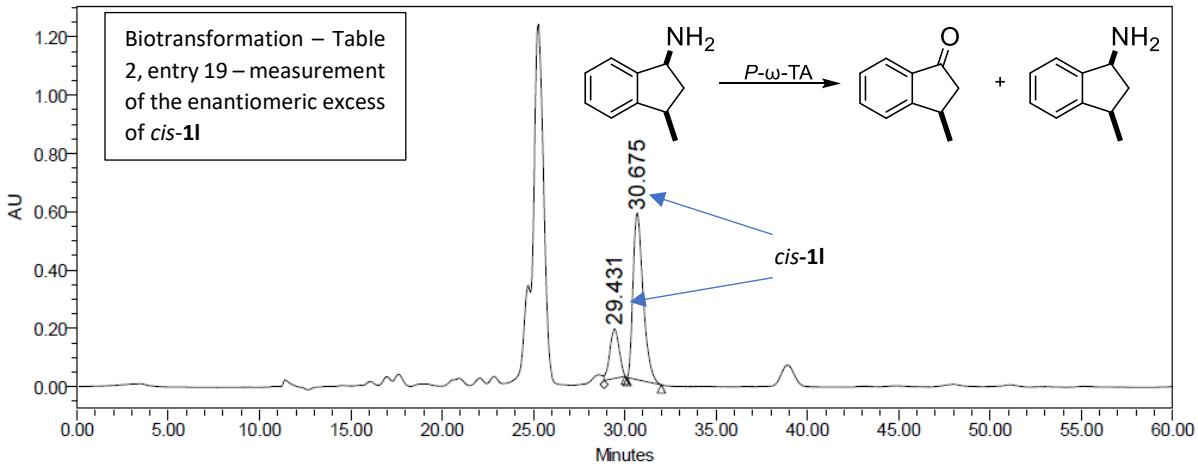
	RT	Area	% Area	Height
1	16.284	13952480	50.04	422220
2	20.499	13928513	49.96	338822

Chiracel AS-H column conditions: *n*-hexane/*i*PrOH (containing 2% DEA) = 90/10, flow rate = 0.5 mL min^{-1}



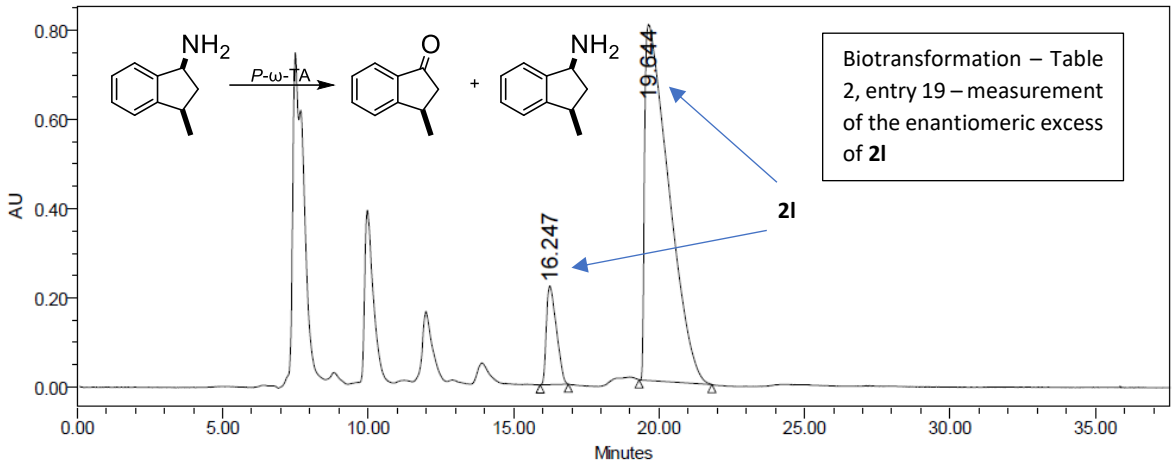
	RT	Area	% Area	Height
1	27.952	11830182	49.68	305101
2	30.155	11984419	50.32	313223

Phenomenex Amylose 1 column conditions: *n*-hexane/*i*PrOH (containing 2% DEA) = 95/5, flow rate = 0.25 mL min^{-1}



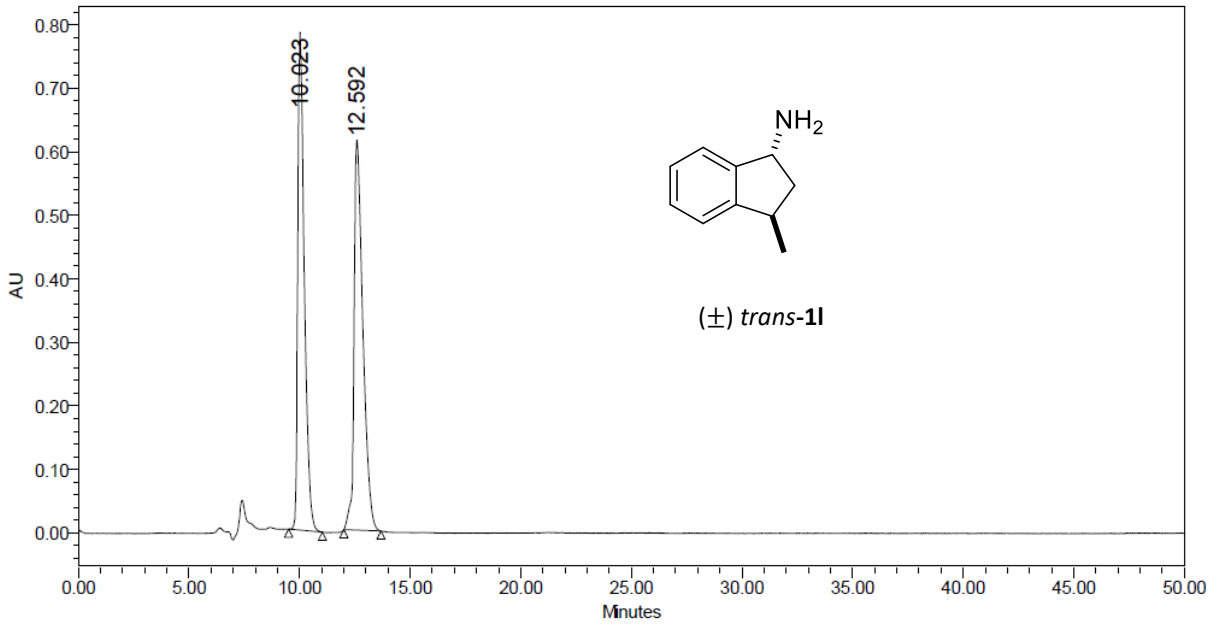
	RT	Area	% Area	Height
1	29.431	5971681	21.27	168823
2	30.675	22101283	78.73	569577

Phenomenex Amylose 1 column conditions: *n*-hexane/*i*PrOH (containing 2% DEA) = 95/5, flow rate = 0.25 mL min^{-1}



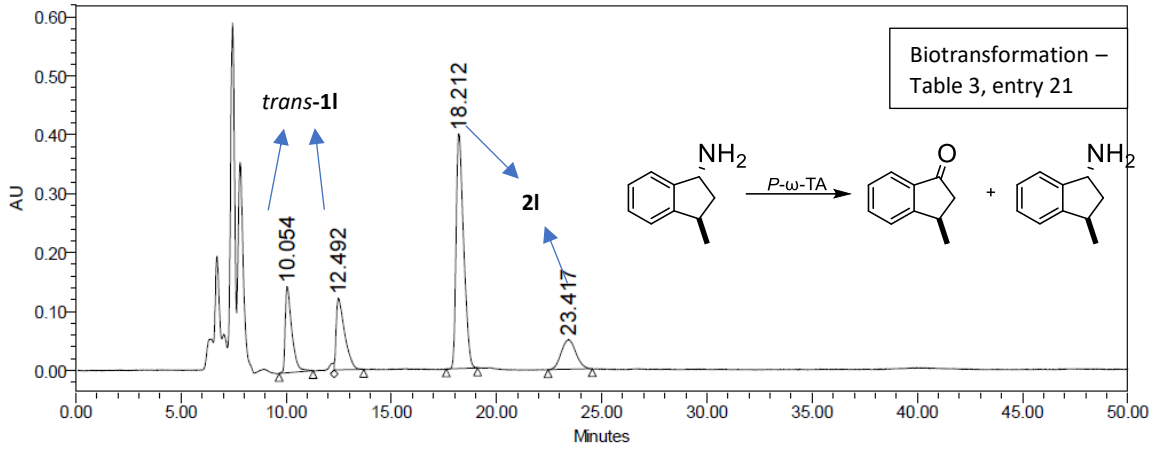
	RT	Area	% Area	Height
1	16.247	5278906	10.33	221366
2	19.644	45813074	89.67	797718

Chiracel AS-H column conditions: *n*-hexane/*i*PrOH (containing 2% DEA) = 90/10, flow rate = 0.5 mL min^{-1}



	RT	Area	% Area	Height
1	10.023	16172352	48.69	783707
2	12.592	17042218	51.31	614215

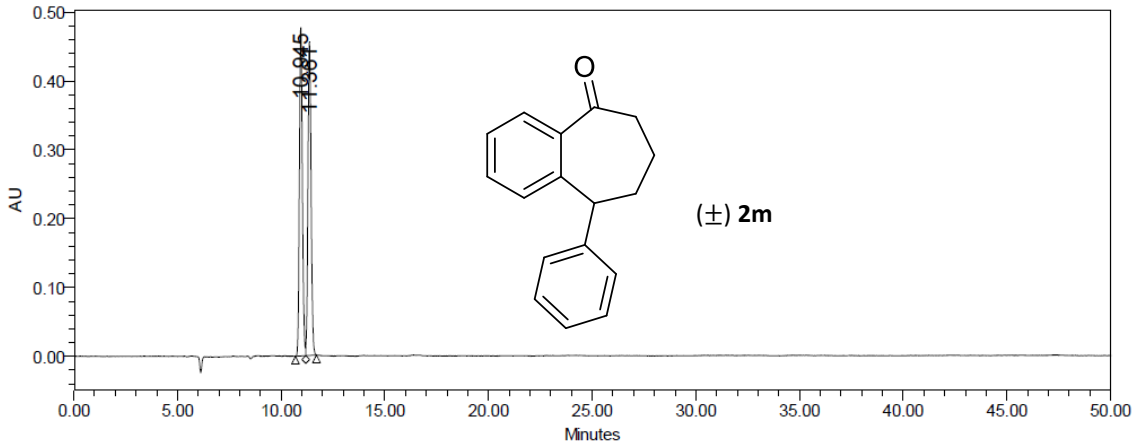
Chiracel AS-H column conditions: *n*-hexane/*i*PrOH (containing 2% DEA) = 90/10, flow rate = 0.5 mL min^{-1}



	RT	Area	% Area	Height
1	10.054	3195314	16.88	145852
2	12.492	3383018	17.87	121178
3	18.212	9929849	52.46	399477
4	23.417	2420831	12.79	50320

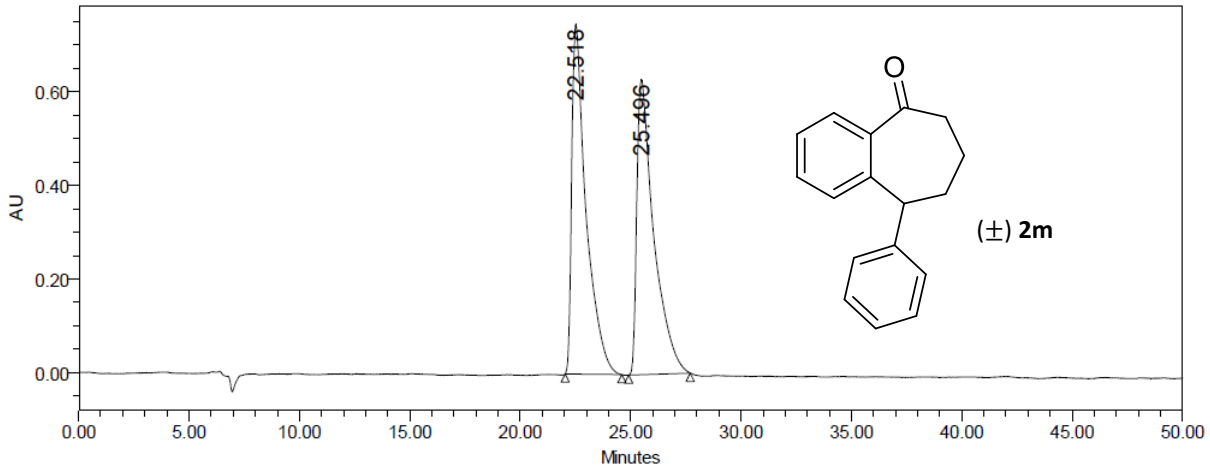
Chiracel AS-H column conditions: *n*-hexane/*i*PrOH (containing 2% DEA) = 90/10, flow rate = 0.5 mL min^{-1}

The enantiomers of *cis*- and *trans*-**1m** were not readily resolved by chiral HPLC; accordingly the resulting reaction solutions from the relevant biotransformations were subject to Boc protection (according to general method H) and then analysed by chiral HPLC, as per conditions detailed below for *cis*- and *trans*-**8m**



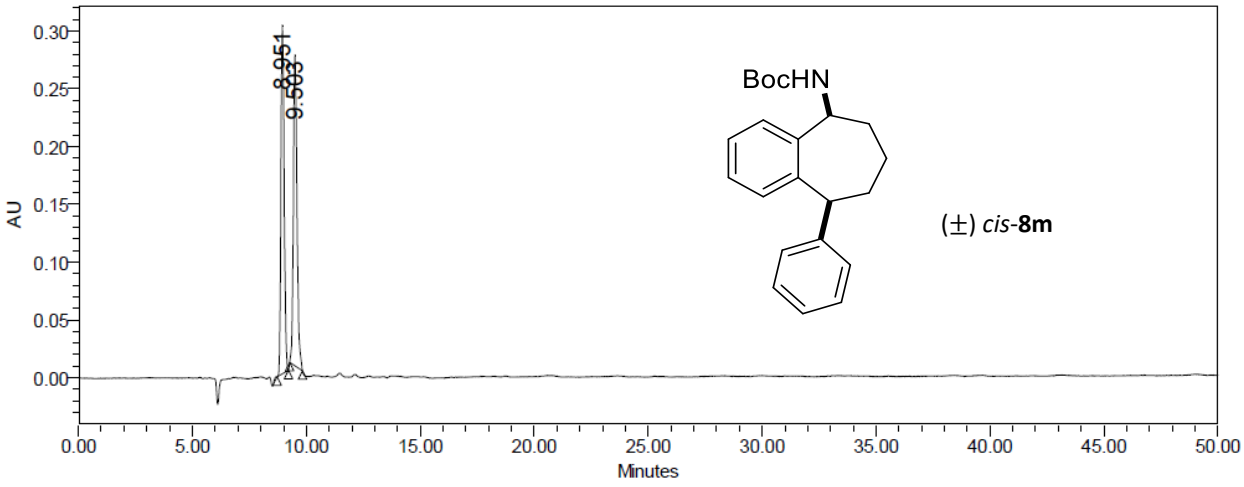
	RT	Area	% Area	Height	Result Id
1	10.945	4791623	50.01	477561	5545
2	11.361	4789620	49.99	456747	5545

Phenomenex Amylose 1 column conditions: *n*-hexane/*i*PrOH (containing 2% DEA) = 90/10, flow rate = 0.5 mL min^{-1}



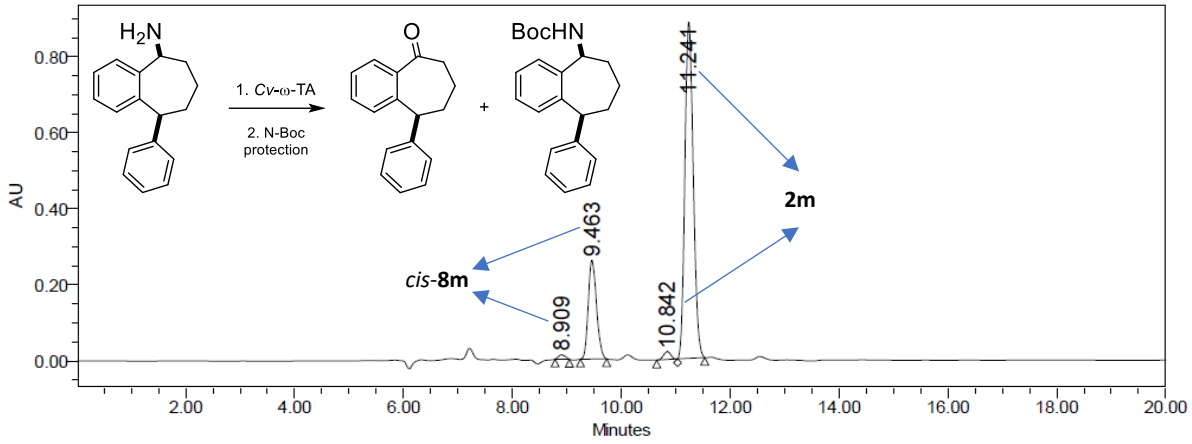
	RT	Area	% Area	Height	Result Id
1	22.518	33754827	50.06	747039	5563
2	25.496	33673674	49.94	630504	5563

Chiracel OJ-H column conditions: *n*-hexane/*i*PrOH (containing 2% DEA) = 90/10, flow rate = 0.5 mL min^{-1}



	RT	Area	% Area	Height	Result Id
1	8.951	2953748	49.93	301537	5548
2	9.503	2961790	50.07	269146	5548

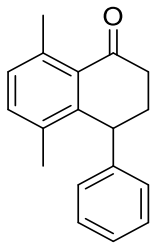
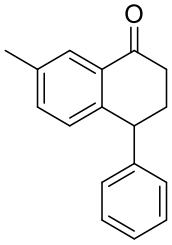
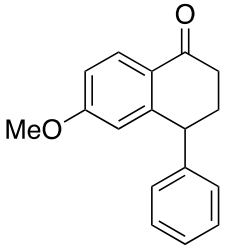
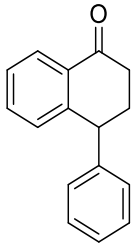
Phenomenex Amylose 1 column conditions: *n*-hexane/*i*PrOH (containing 2% DEA) = 90/10, flow rate = 0.5 mL min^{-1}

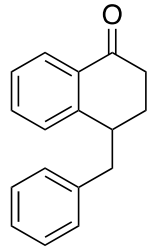
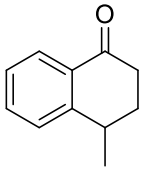
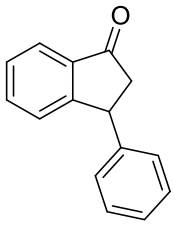
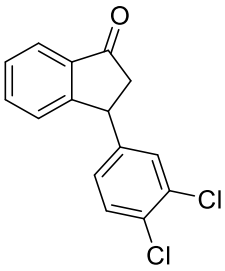
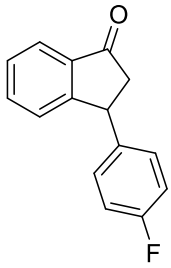
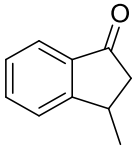


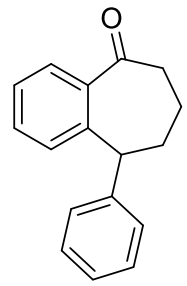
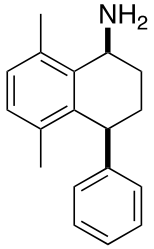
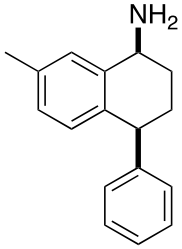
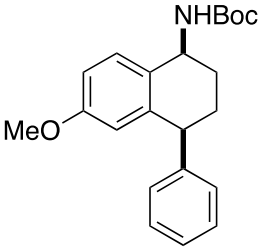
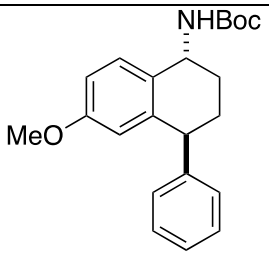
	RT	Area	% Area	Height	Result Id
1	8.909	102223	0.82	11491	5551
2	9.463	2742021	22.01	259720	5551
3	10.842	191790	1.54	20661	5551
4	11.241	9420689	75.63	888561	5551

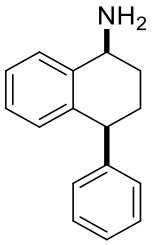
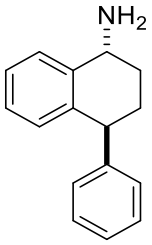
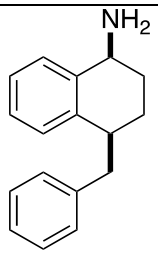
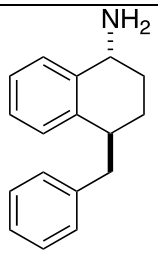
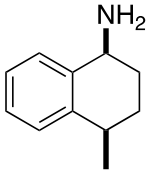
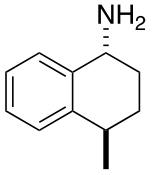
Phenomenex Amylose 1 column conditions: *n*-hexane/*i*PrOH (containing 2% DEA) = 90/10, flow rate = 0.5 mL min^{-1}

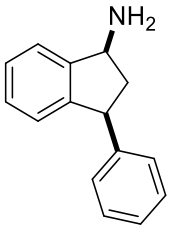
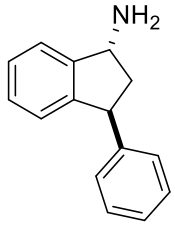
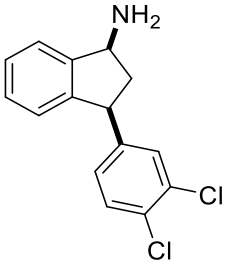
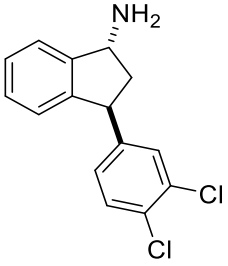
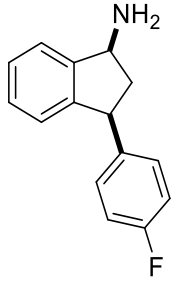
Table of HPLC conditions:

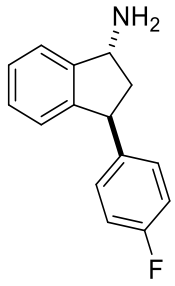
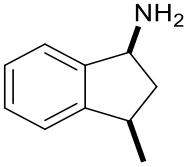
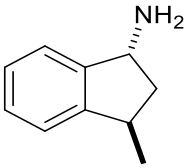
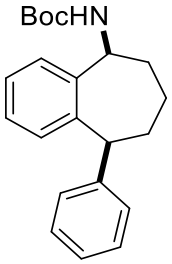
Compound	Column	Flow (mL min^{-1})	Mobile phase *n*-hexane/*i*PrOH [containing 2% diethylamine (DEA)]	Temp (°C)	Retention time
 (±) **2b**	Cellulose 4	0.25	90/10	25	R_t = 16.3 min, R_t = 18.0 min
 (±) **2c**	AS-H	0.25	95/5	25	R_t = 29.5 min, R_t = 31.6 min
 (±) **2d**	Amylose 1	0.5	90/10	25	R_t = 18.8 min, R_t = 19.9 min
 (±) **2e**	OJ-H	0.5	95/5	25	R_t = 22.7 min, R_t = 41.2 min

 (±) **2f**	Amylose 1	0.25	95/5	25	R_t = 28.3 min, R_t = 29.2 min
 (±) **2g**	OB-H	0.25	95/5	25	R_t = 32.0 min, R_t = 35.0 min
 (±) **2i**	AS-H	0.5	90/10	25	R_t = 26.3 min, R_t = 41.1 min
 (±) **2j**	OJ-H	0.5	90/10	25	R_t = 26.2 min, R_t = 28.3 min
 (±) **2k**	AS-H	1.0	90/10	25	R_t = 13.4 min, R_t = 24.0 min
 (±) **2l**	AS-H	0.5	90/10	25	R_t = 16.2 min, R_t = 20.5 min

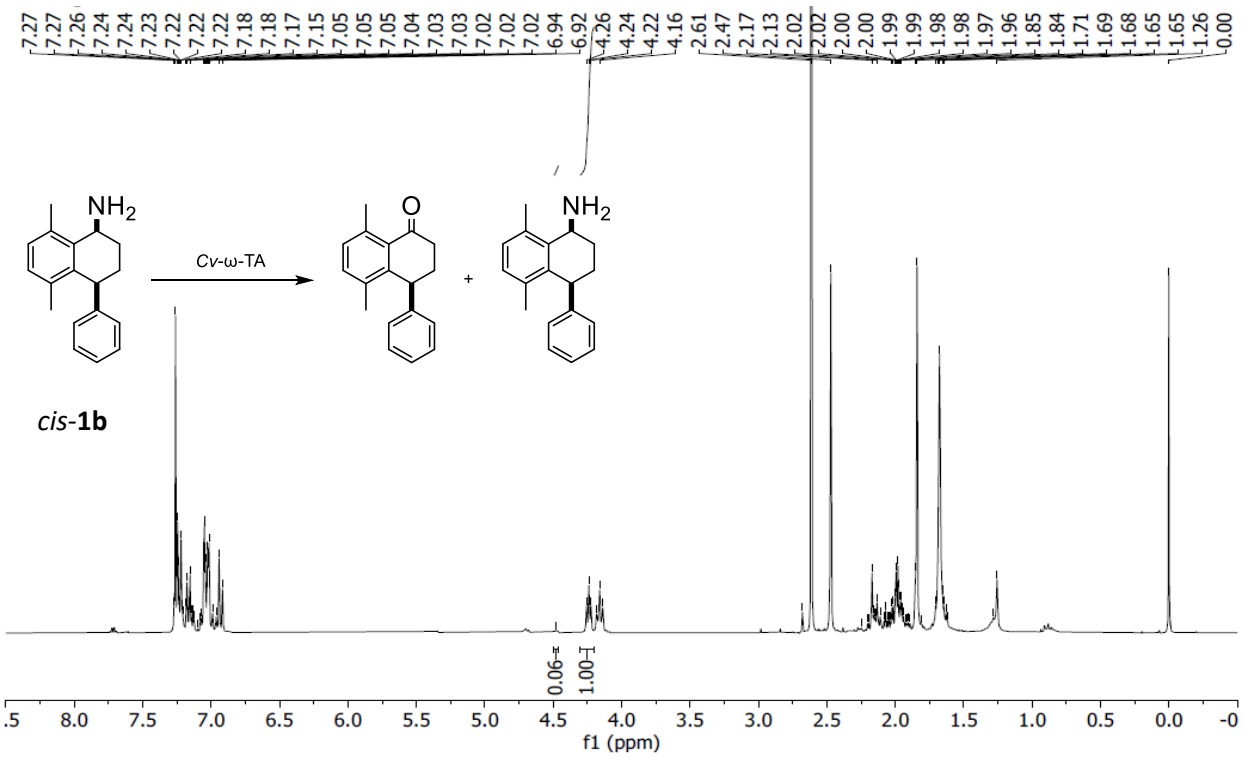
 (±) **2m**	Amylose 1	0.5	90/10	25	R_t = 10.9 min, R_t = 11.3 min
	OJ-H	0.5	90/10	25	R_t = 22.5 min, R_t = 25.5 min
 (±) *cis*-**1b**	Cellulose 4	0.5	90/10	25	R_t = 19.1 min, R_t = 23.8 min
 (±) *cis*-**1c**	AS-H	0.25	95/5	25	R_t = 23.0 min, R_t = 24.7 min
 (±) *cis*-**8d**	Amylose 1	0.5	90/10	25	R_t = 10.8 min, R_t = 14.2 min
 (±) *trans*-**8d**	Amylose 1	0.5	90/10	25	R_t = 14.7 min, R_t = 28.0 min

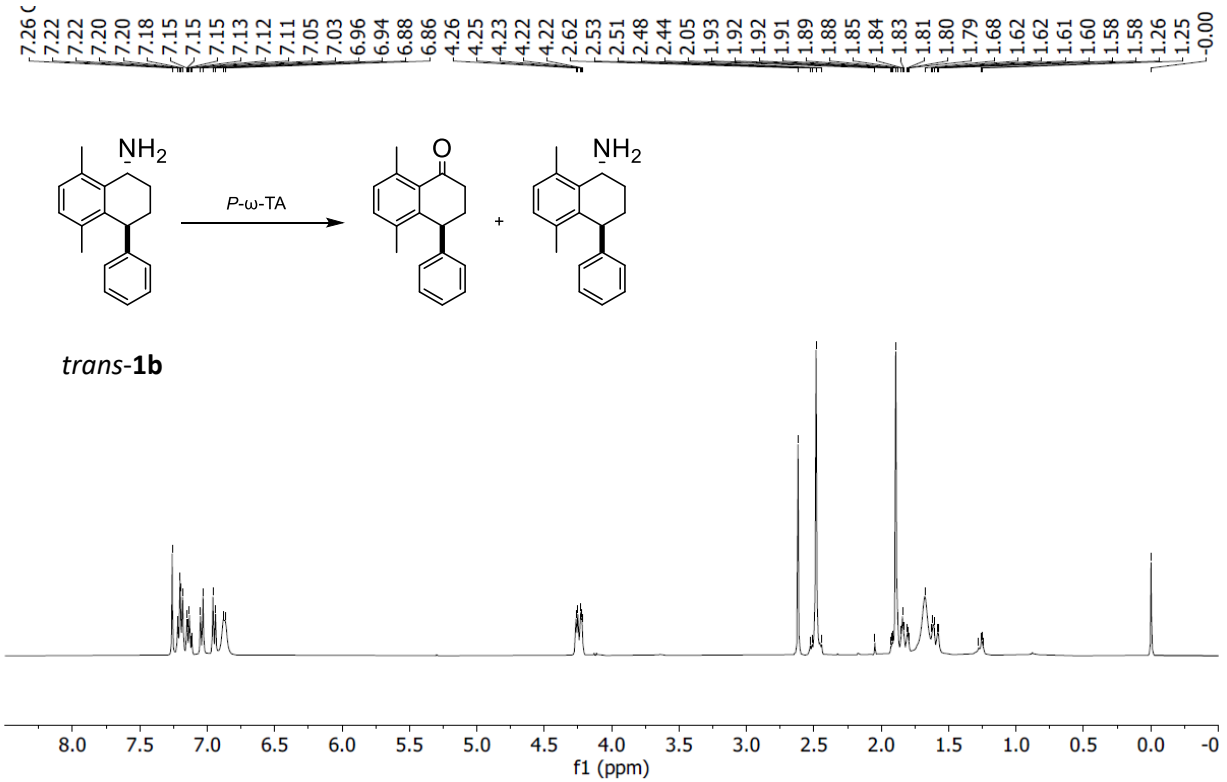
 (±) *cis*-**1e**	Cellulose 2	0.5	95/5	25	R_t = 17.5 min, R_t = 18.7 min
 (±) *trans*-**1e**	OJ-H	0.5	90/10	25	R_t = 18.8 min, R_t = 24.1 min
 (±) *cis*-**1f**	Amylose 1	0.25	95/5	25	R_t = 45.1 min, R_t = 49.3 min
 (±) *trans*-**1f**	Amylose 1	0.25	95/5	25	R_t = 35.5 min, R_t = 41.1 min
 (±) *cis*-**1g**	OB-H	0.25	95/5	25	R_t = 24.8 min, R_t = 26.1 min
 (±) *trans*-**1g**	OB-H	0.25	95/5	25	R_t = 24.3 min, R_t = 27.2 min

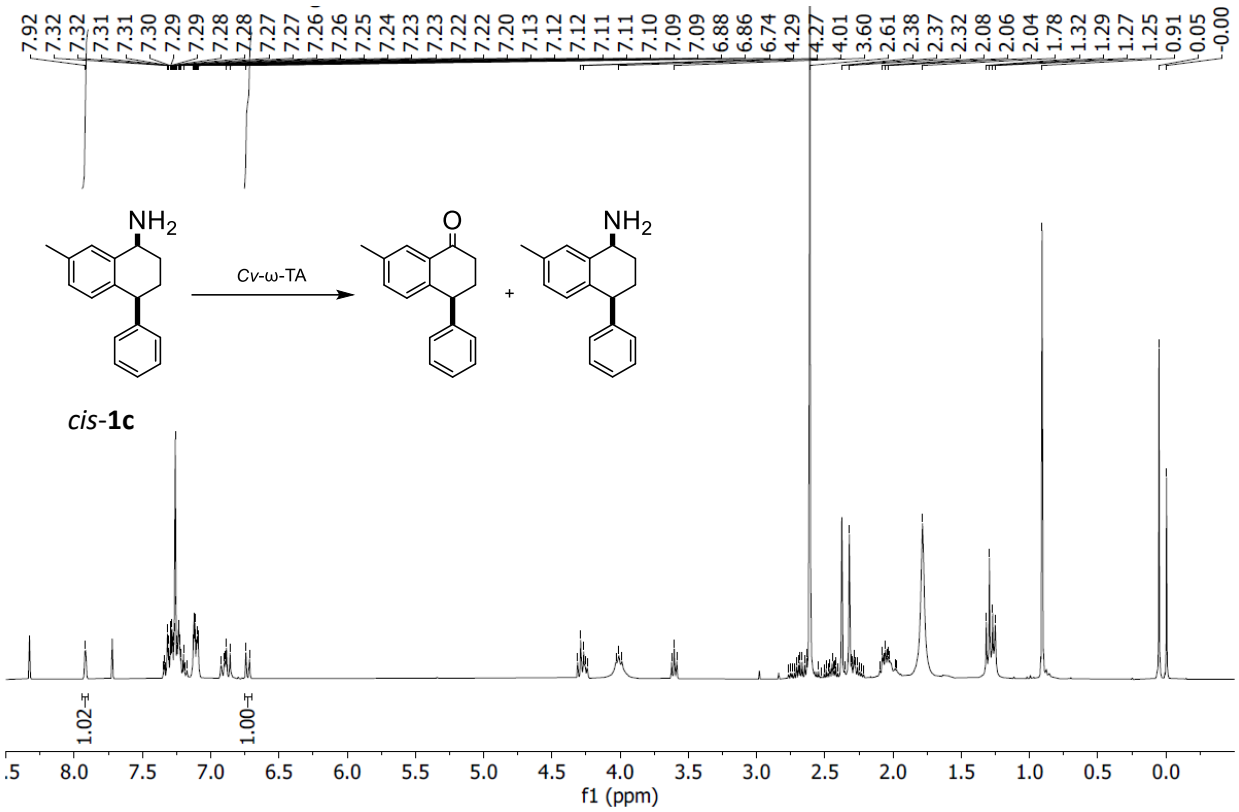
 (±) *cis*-**1i**	AS-H	0.5	90/10	25	R_t = 11.2 min, R_t = 12.1 min
 (±) *trans*-**1i**	AS-H	0.5	90/10	25	R_t = 11.5 min, R_t = 12.6 min
 (±) *cis*-**1j**	OB-H	0.5	90/10	25	R_t = 15.5 min, R_t = 18.0 min
 (±) *trans*-**1j**	OJ-H	0.5	90/10	25	R_t = 17.3 min, R_t = 19.5 min
 (±) *cis*-**1k**	OB-H	0.5	95/5	25	R_t = 17.4 min, R_t = 21.8 min

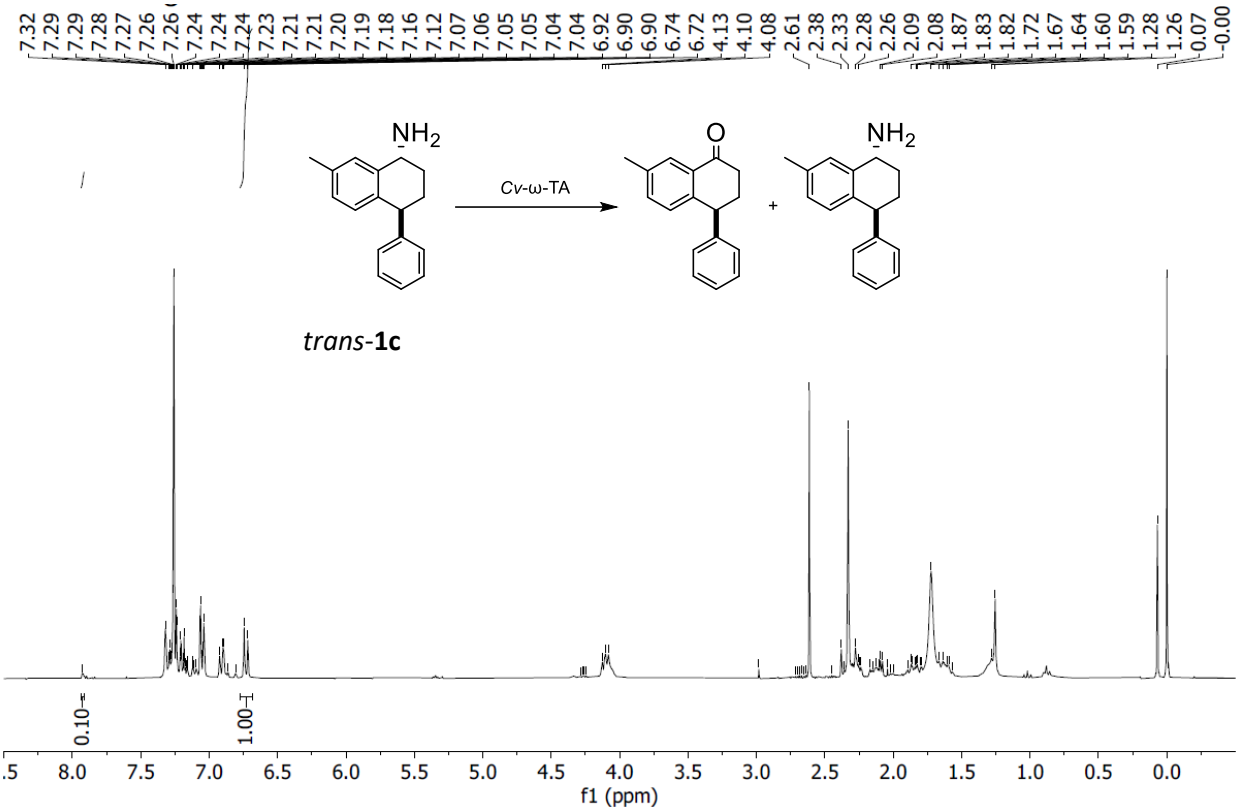
 (±) *trans*-**1k**	AS-H	1.0	90/10	25	R_t = 6.2 min, R_t = 6.8 min
 (±) *cis*-**1l**	Amylose 1	0.25	95/5	25	R_t = 27.9 min, R_t = 30.1 min
 (±) *trans*-**1l**	AS-H	0.5	90/10	25	R_t = 10.0 min, R_t = 12.6 min
 (±) *cis*-**8m**	Amylose 1	0.5	90/10	25	R_t = 8.9 min, R_t = 9.5 min

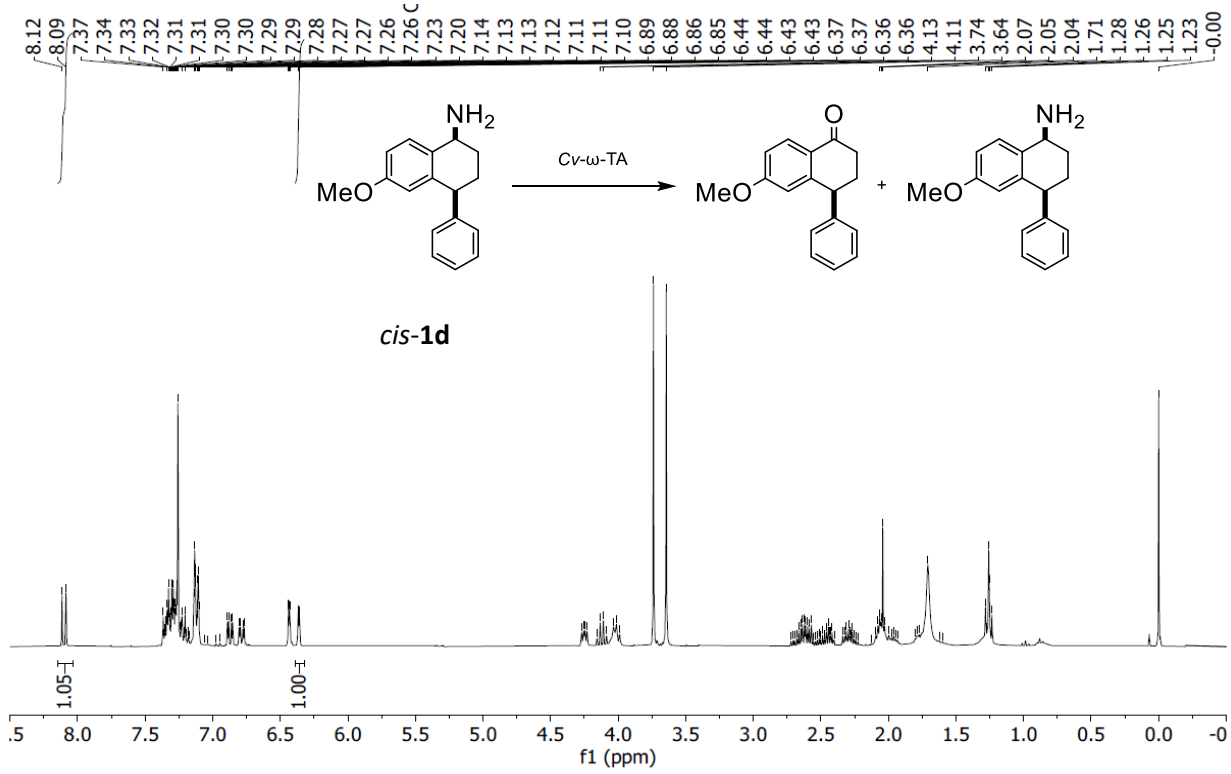
1.12 ^{1}H NMR spectra of the biotransformation reactions:

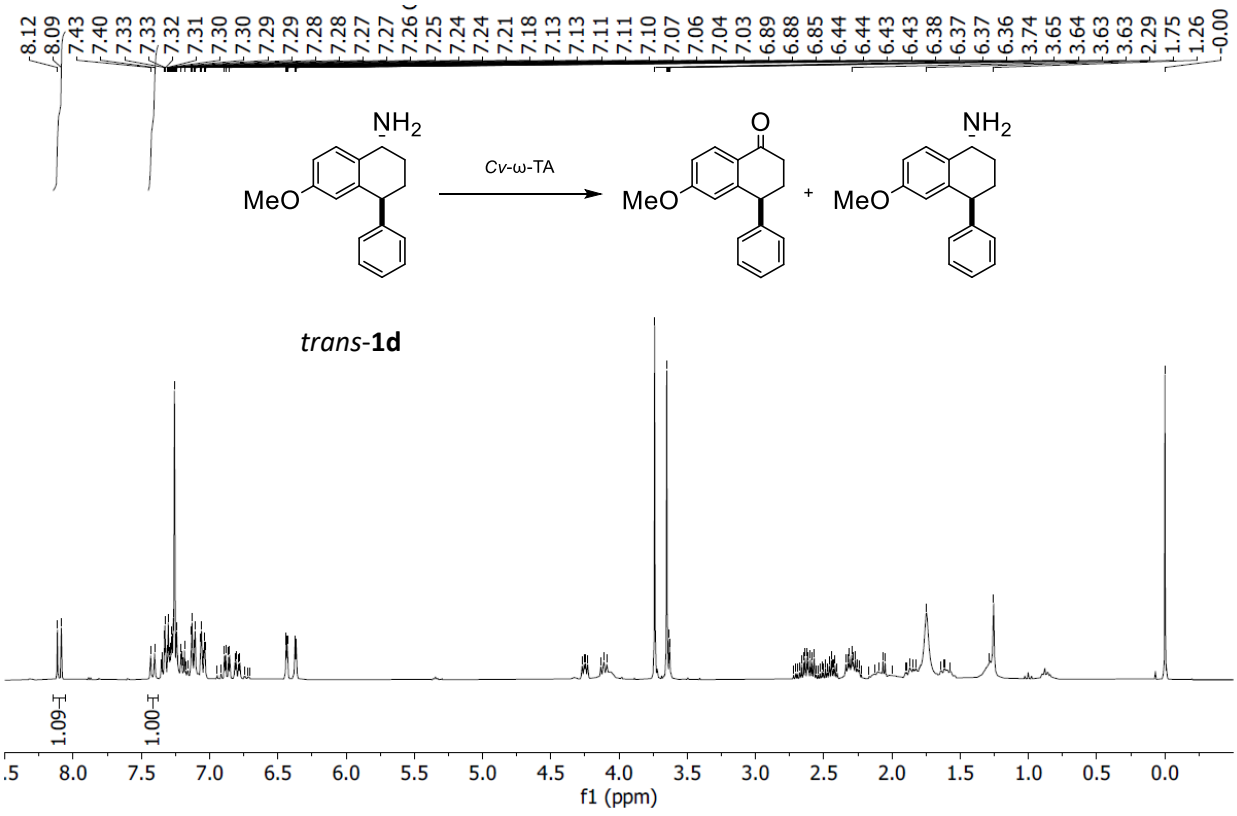


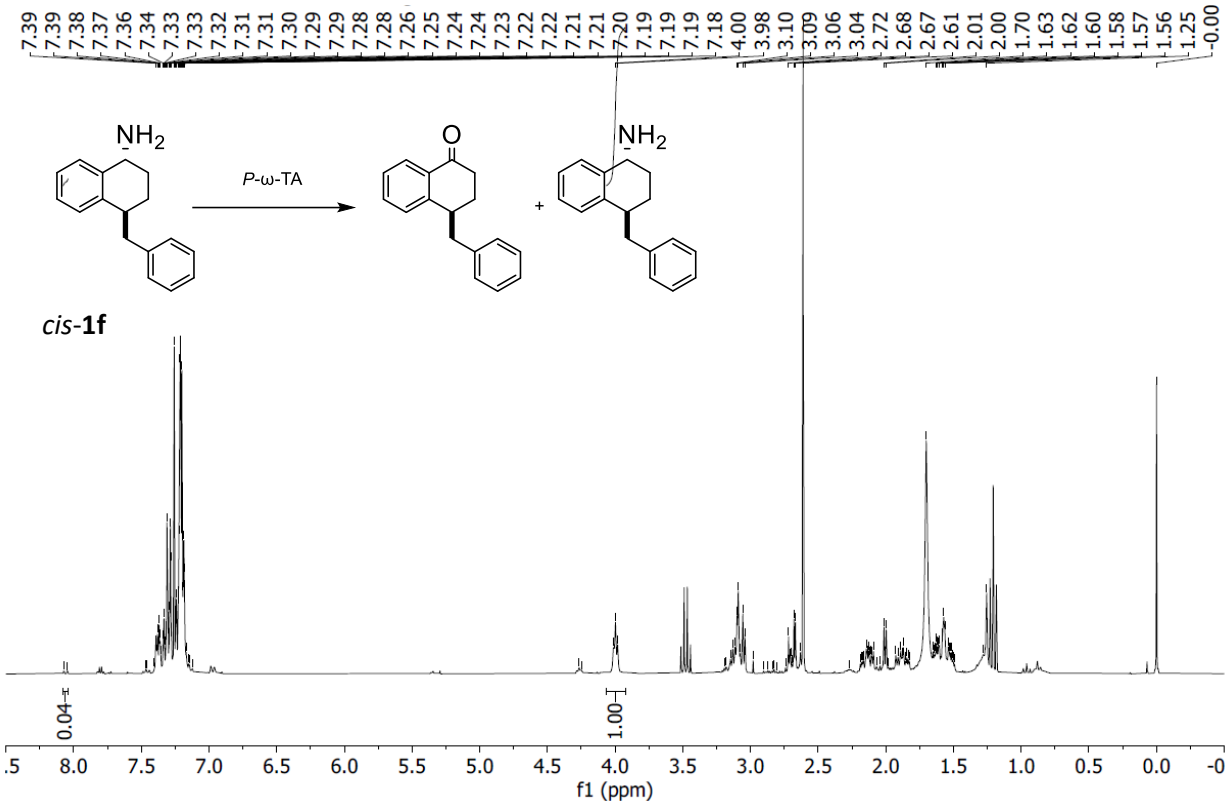


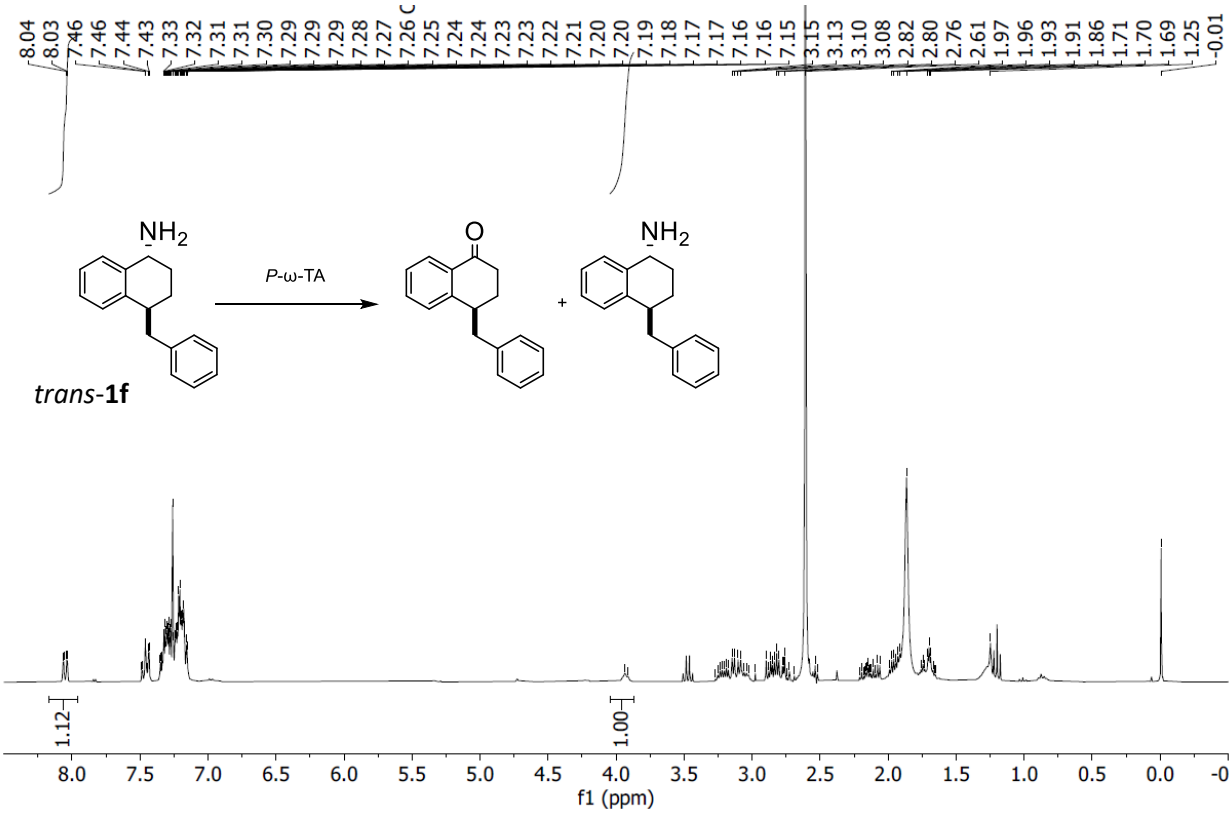

NH2
Cv-ω-TA
O
NH2
cis-1c
1.02
1.00
f1 (ppm)

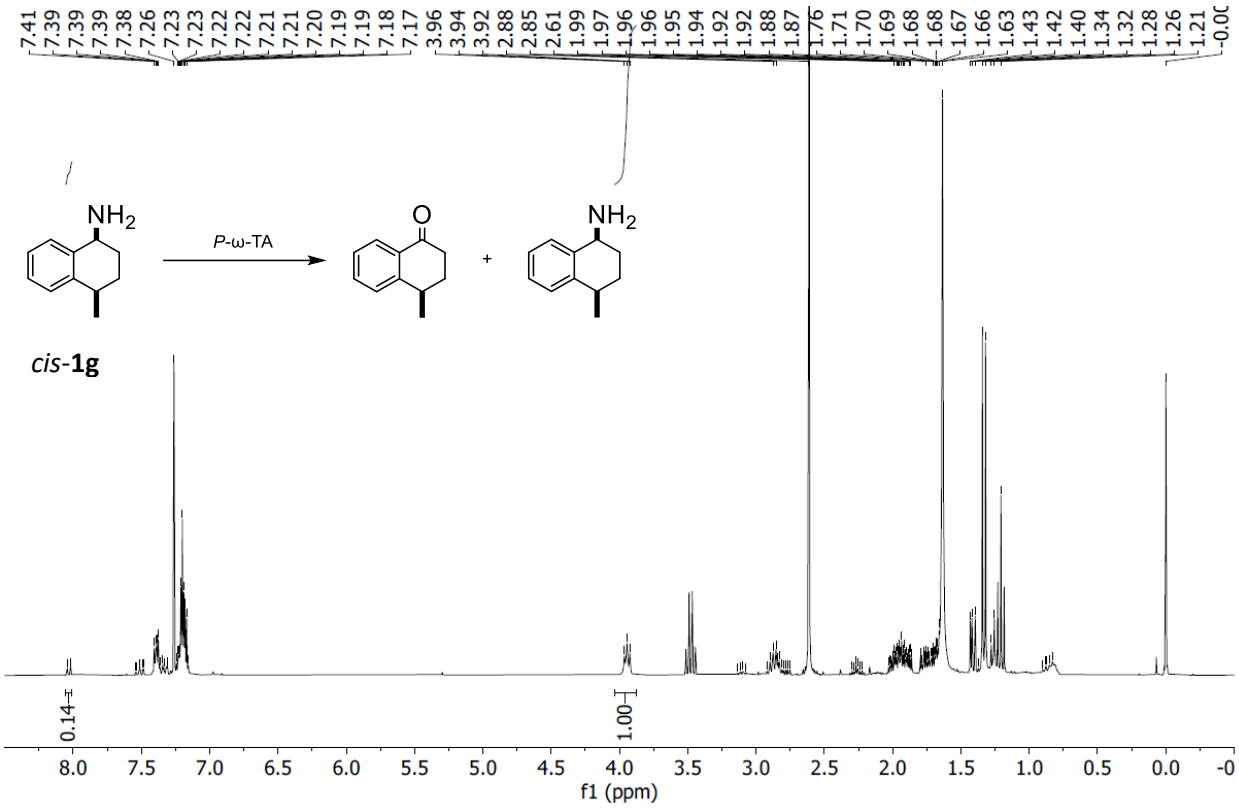

NH2
Cv-ω-TA
O
NH2
trans-1c
0.10
1.00
f1 (ppm)

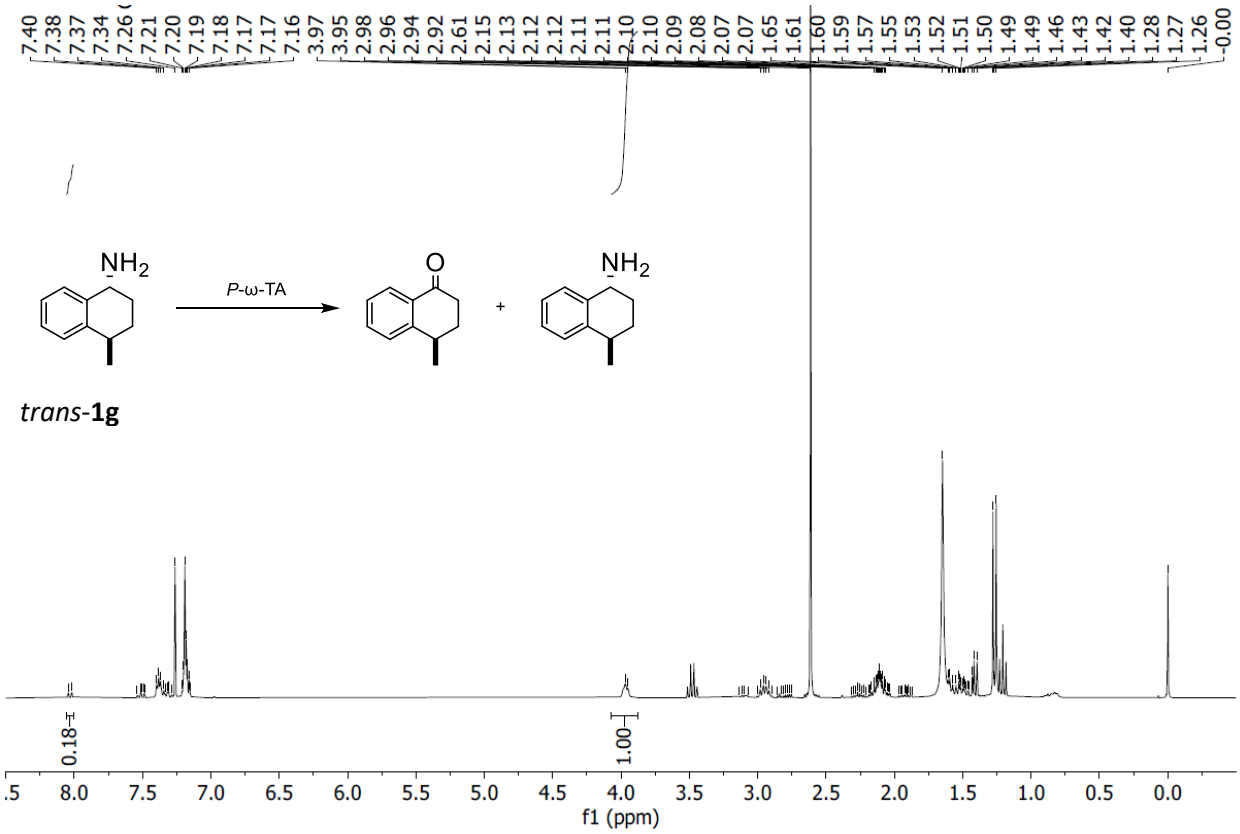

NH2
MeO
Cv-ω-TA
O
MeO
+
NH2
MeO
cis-1d
1.05
1.00
f1 (ppm)

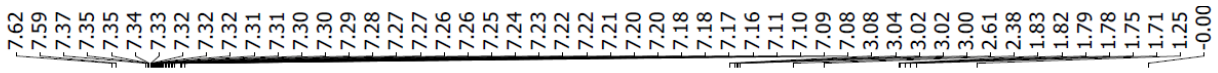

NH2
MeO
Cv-ω-TA
O
MeO
+
NH2
MeO
trans-1d
1.09
1.00
f1 (ppm)

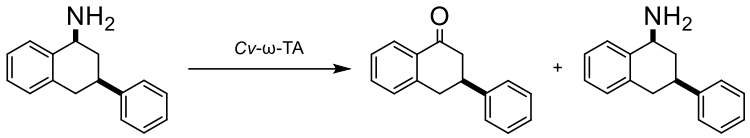

NH2
P-ω-TA
O
NH2
cis-1f
0.04
1.00
f1 (ppm)


NH2
P-ω-TA
O
NH2
trans-1f
1.12
1.00
f1 (ppm)

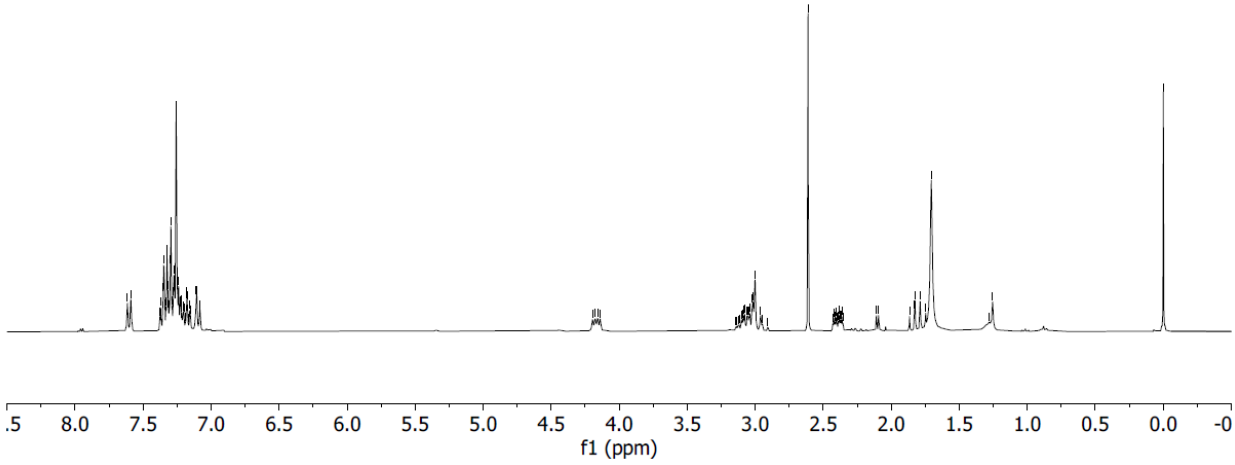

NH2
P-ω-TA
O
NH2
cis-1g
0.14
1.00
f1 (ppm)

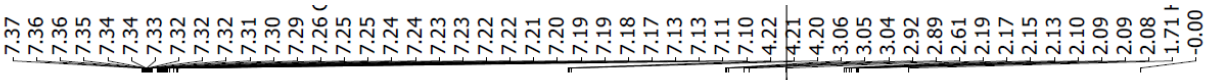

NH2
P-ω-TA
O
NH2
trans-1g
0.18
1.00
f1 (ppm)

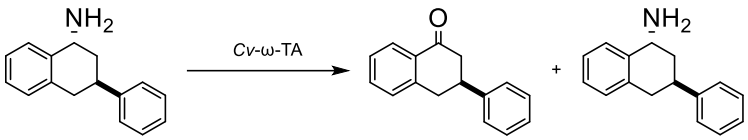




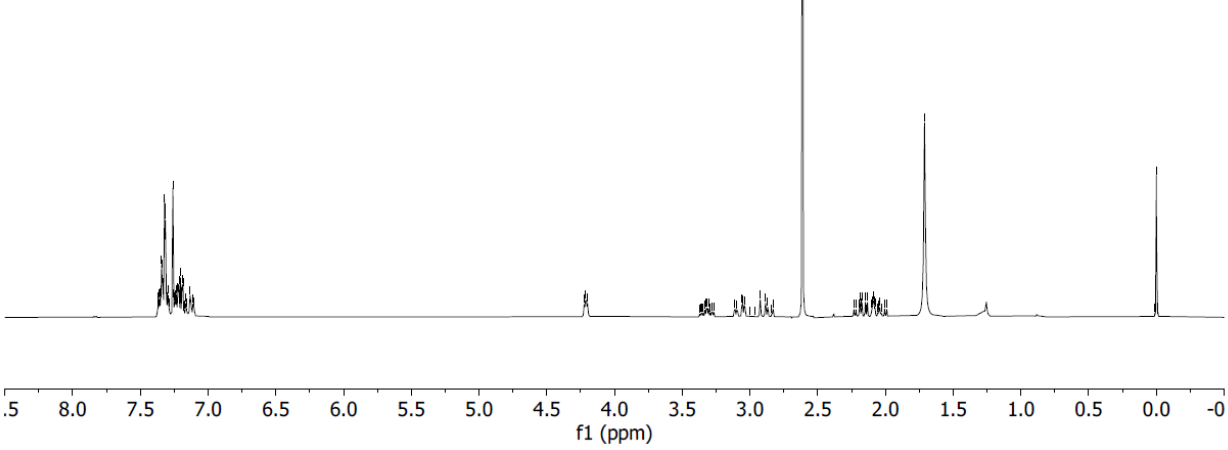
cis-**1h**

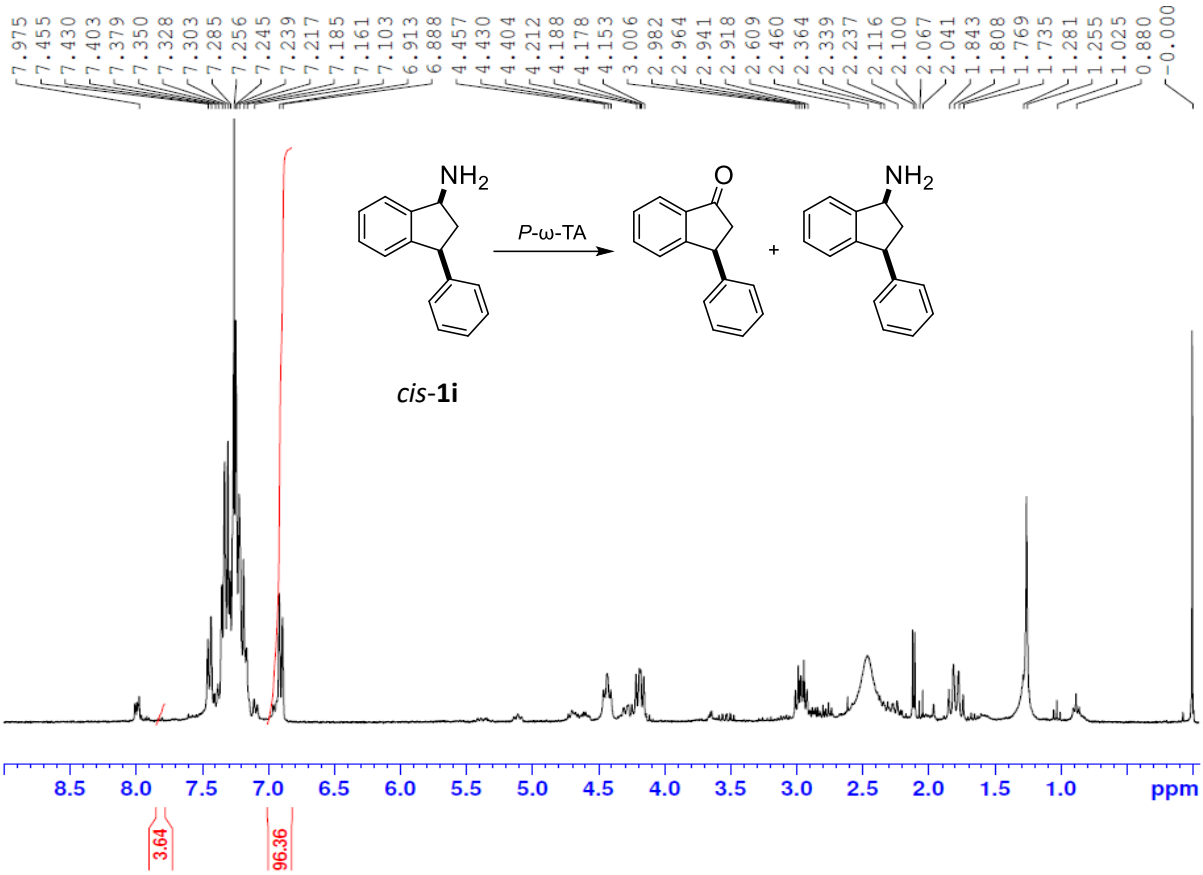


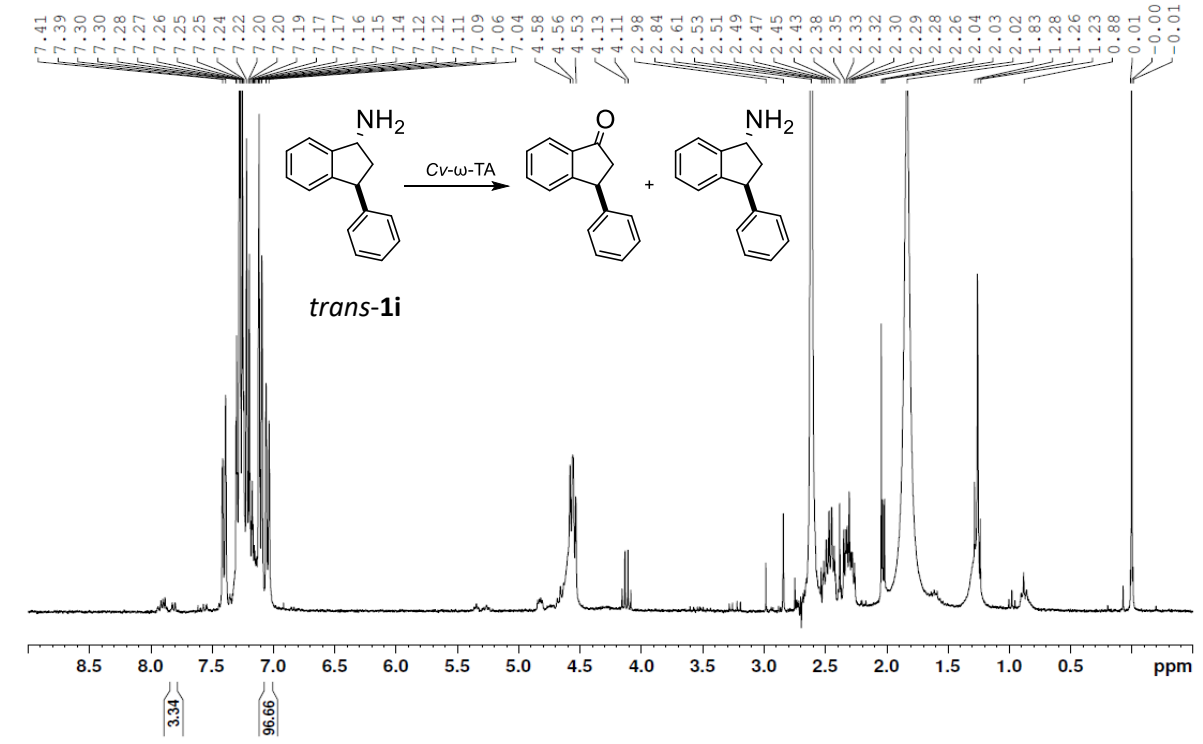


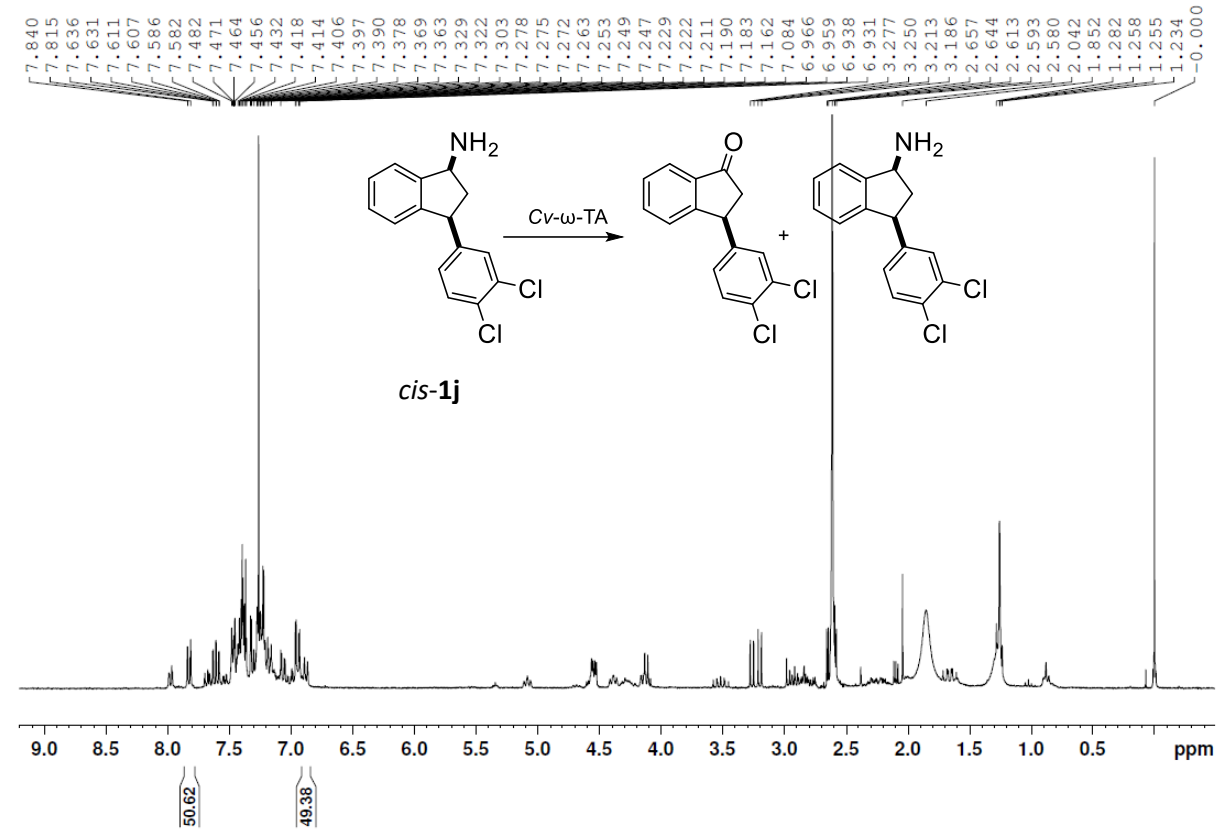


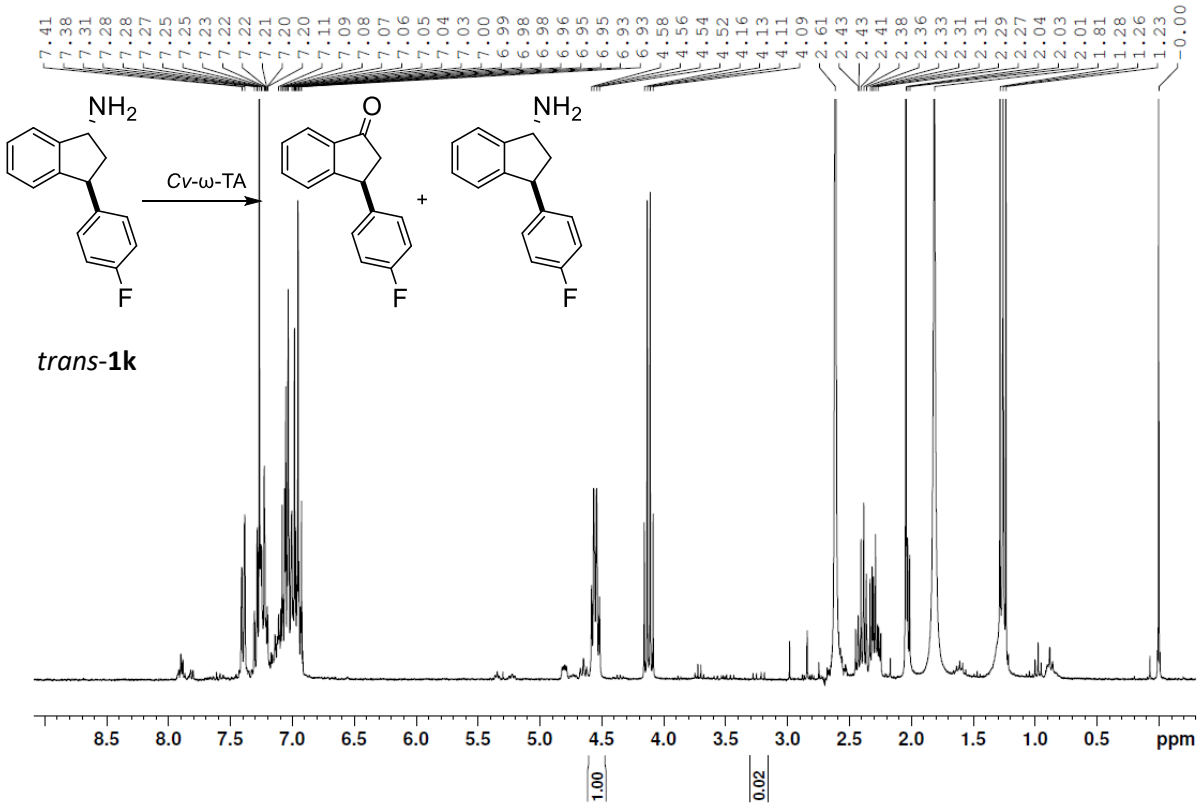
trans-**1h**

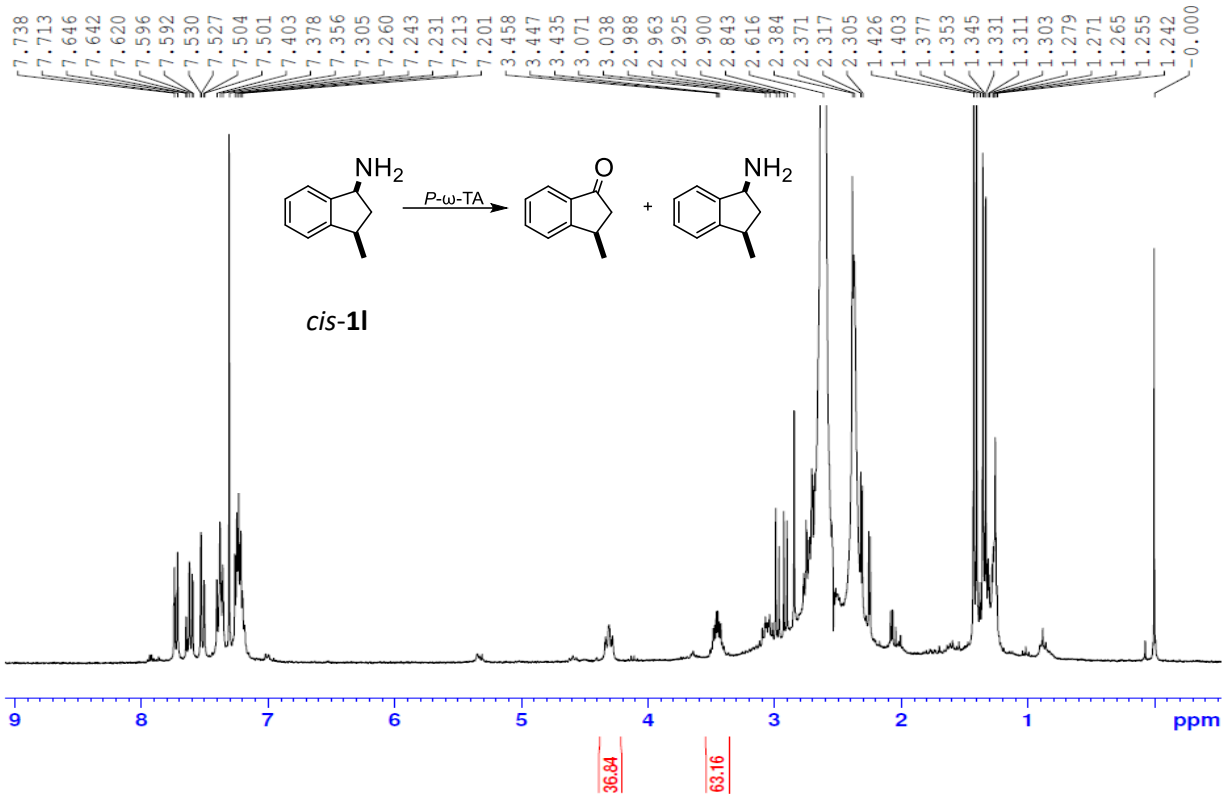


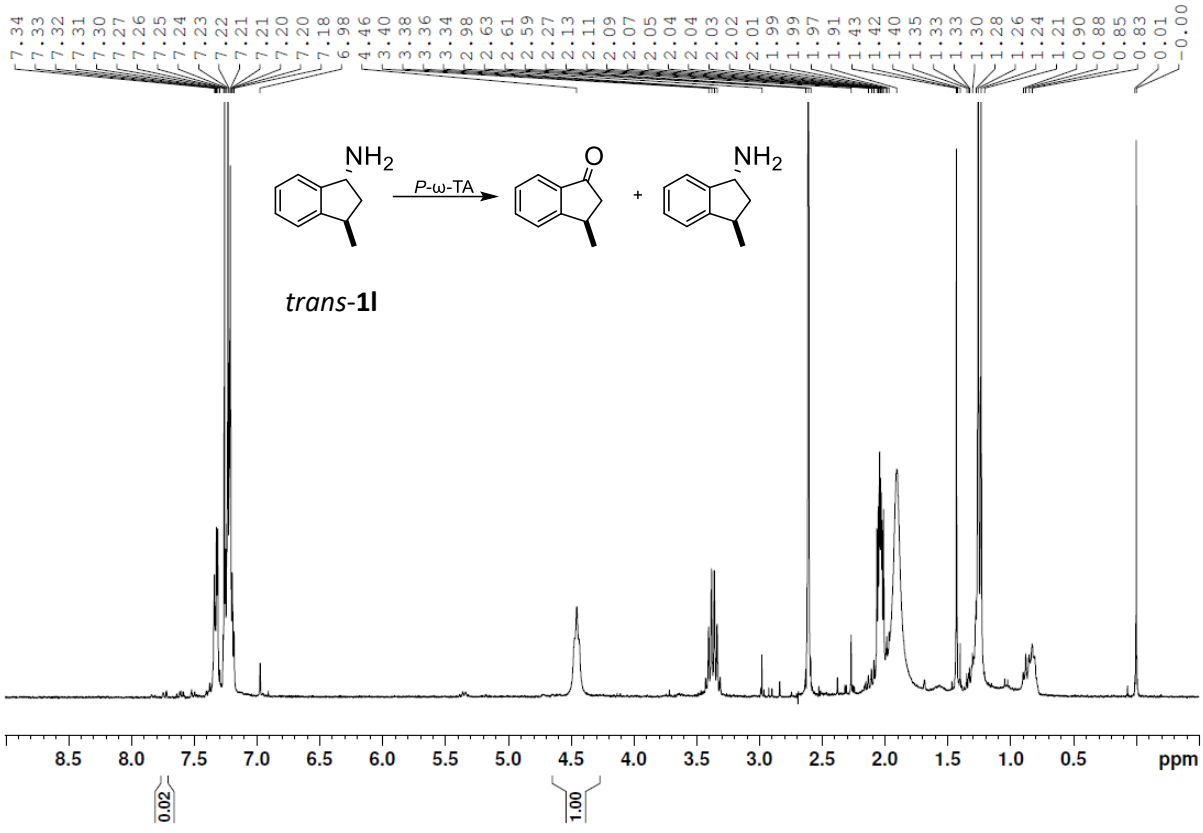

7.975
7.455
7.430
7.403
7.379
7.350
7.328
7.303
7.285
7.256
7.245
7.239
7.217
7.185
7.161
7.103
6.913
6.888
4.457
4.430
4.404
4.212
4.188
4.178
4.153
3.006
2.982
2.964
2.941
2.918
2.609
2.460
2.364
2.339
2.237
2.116
2.100
2.067
2.041
1.843
1.808
1.769
1.735
1.281
1.255
1.025
0.880
-0.000
NH2
P-ω-TA
O
NH2
cis-1i
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
ppm
3.64
96.36

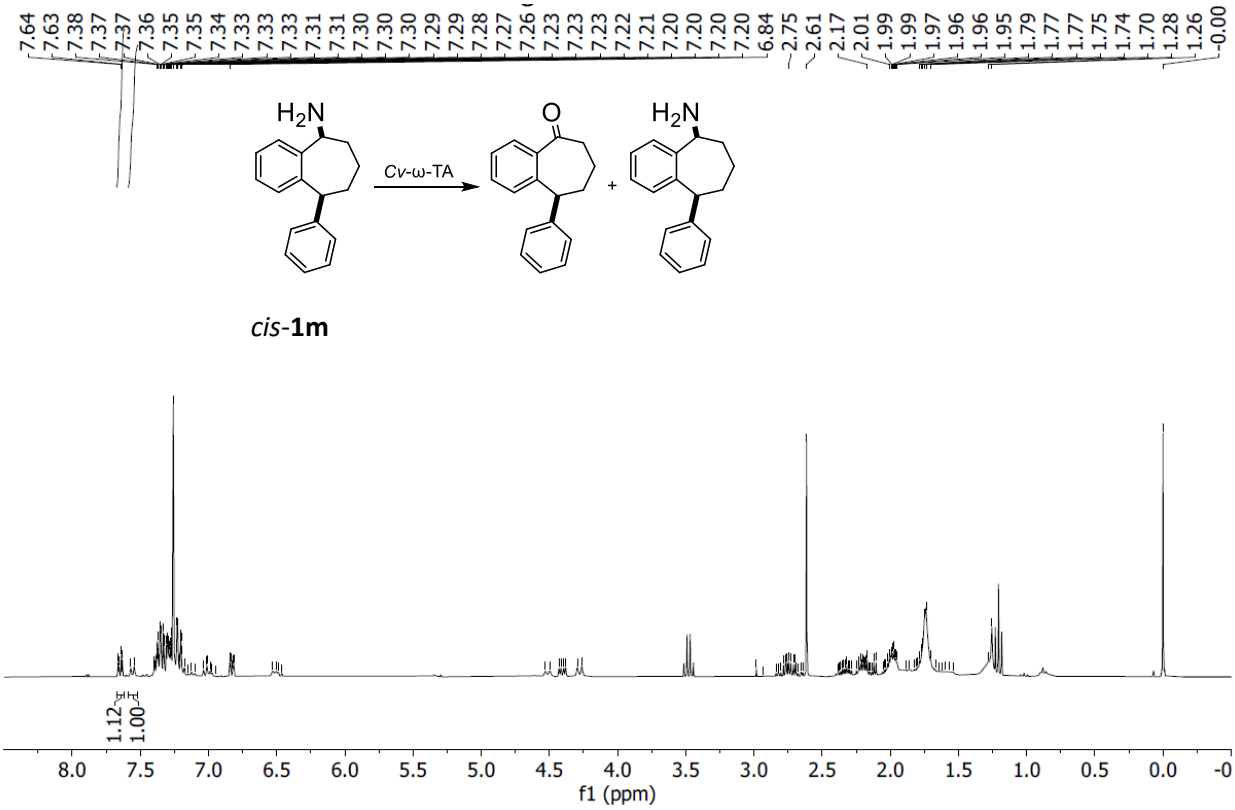

7.41
7.39
7.30
7.30
7.28
7.27
7.26
7.25
7.25
7.24
7.22
7.20
7.20
7.19
7.17
7.17
7.16
7.15
7.14
7.12
7.12
7.11
7.09
7.06
7.04
4.58
4.56
4.53
4.13
4.11
2.98
2.84
2.61
2.53
2.51
2.49
2.47
2.45
2.43
2.38
2.35
2.33
2.32
2.30
2.29
2.28
2.26
2.04
2.03
2.02
1.83
1.28
1.26
1.23
0.88
0.01
-0.00
-0.01
NH2
Cv-ω-TA
O
NH2
trans-1i
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
ppm
3.34
96.66


NH2
Cv-ω-TA
O
NH2
Cl
Cl
cis-1j
9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 ppm
50.62
49.38

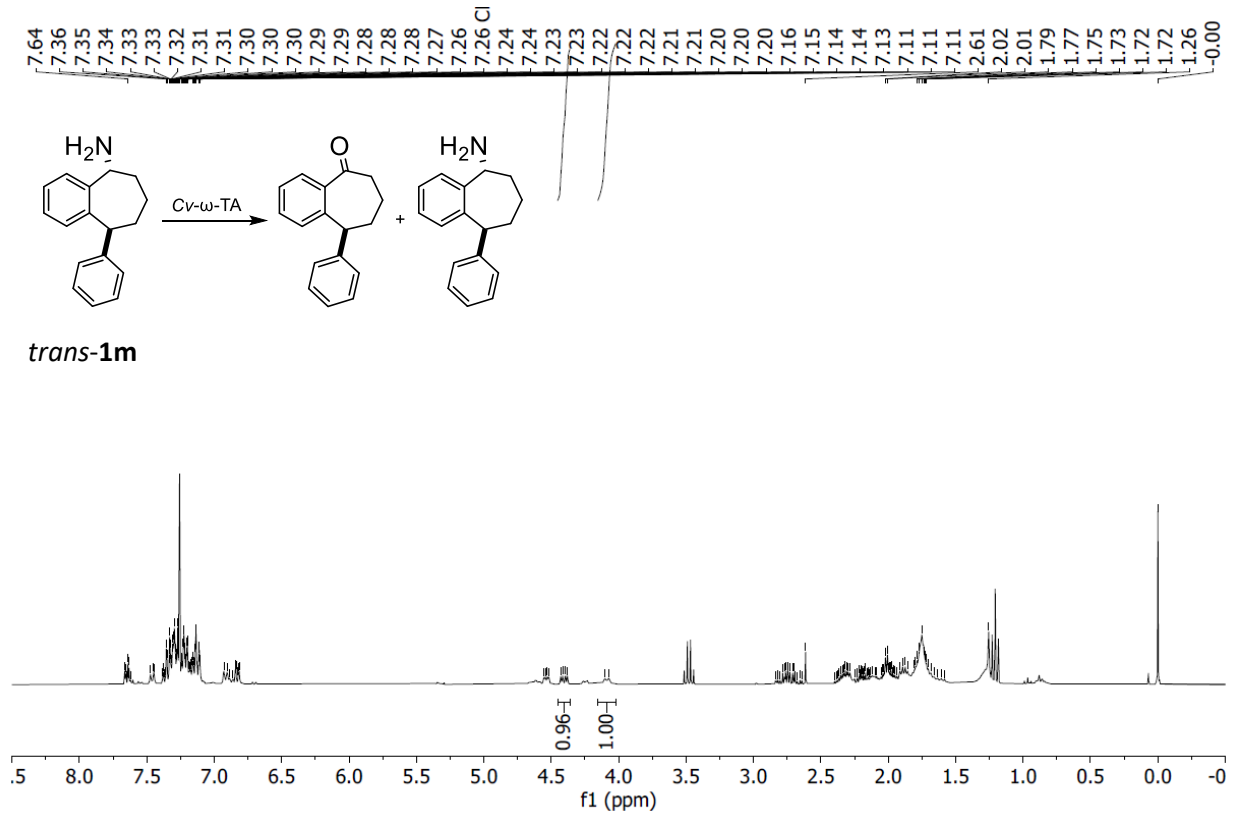

NH2
Cv-ω-TA
O
NH2
F
trans-1k
8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 ppm
1.00
0.02


NH2
P-ω-TA
O
NH2
cis-1l
9
8
7
6
5
4
3
2
1
ppm
36.84
63.16


NH2
P-ω-TA
O
NH2
trans-1l
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
ppm
0.02
1.00



cis-**1m**



trans-**1m**

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