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Supporting Information of

A Comparative Study of Thallium(III) and Iodine(III)-Mediated Ring Contraction Reactions for the Synthesis of Indane

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Supoorting information includes

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2) Experimental
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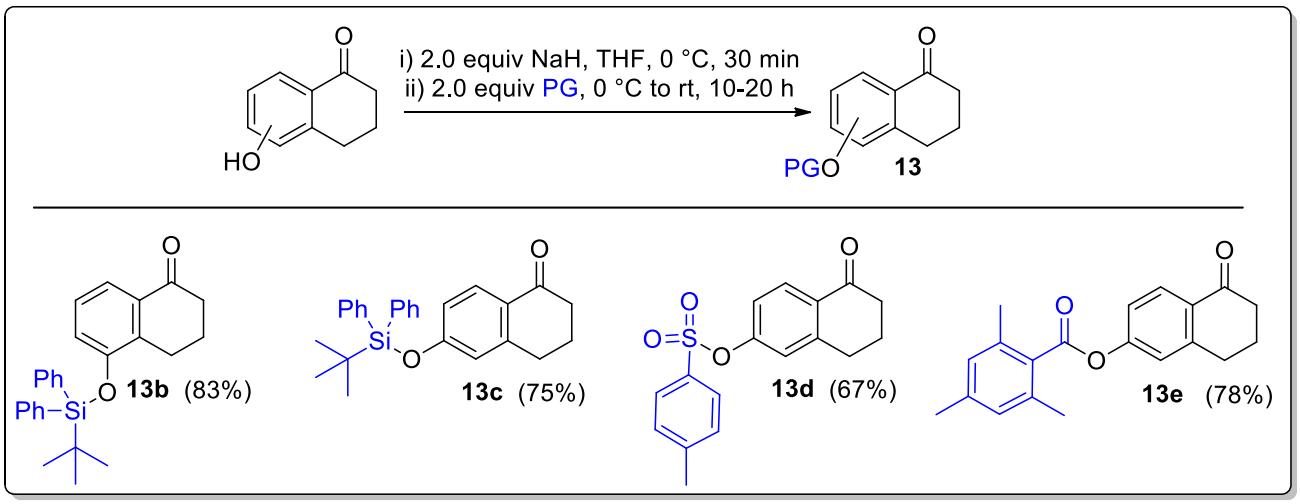
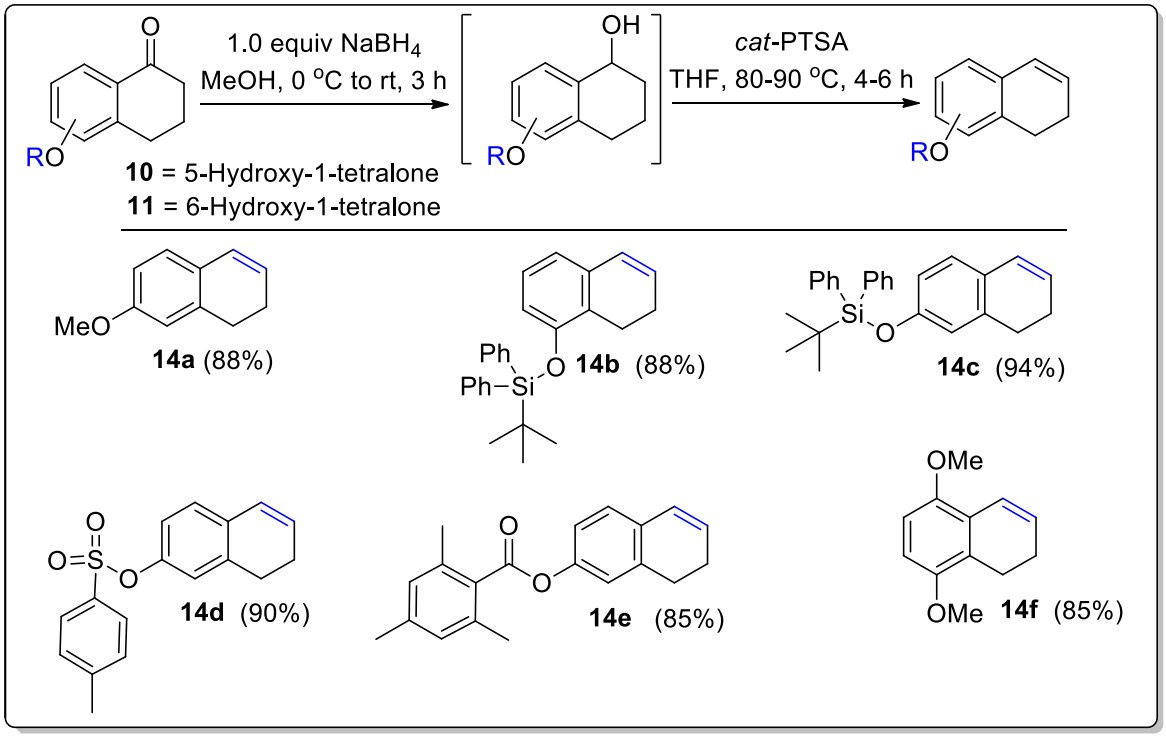
1. Substarte Preparation:

TTN- and HTIB-mediated ring contraction reactions were studied for selected derivatives of tetralones. Tetralones having -OH or -NH_2 groups were commercially acquired and were protected to prevent any side reactions with these oxidative agents (HTIB and TTN). Different protecting groups were introduced, aiming to investigate their tolerance as well as their electronic and steric effects in the ring contraction reactions. The protected compounds (**13b**-**e**) were obtained in reasonable to good yields from the corresponding tetralones (**Scheme 1**).



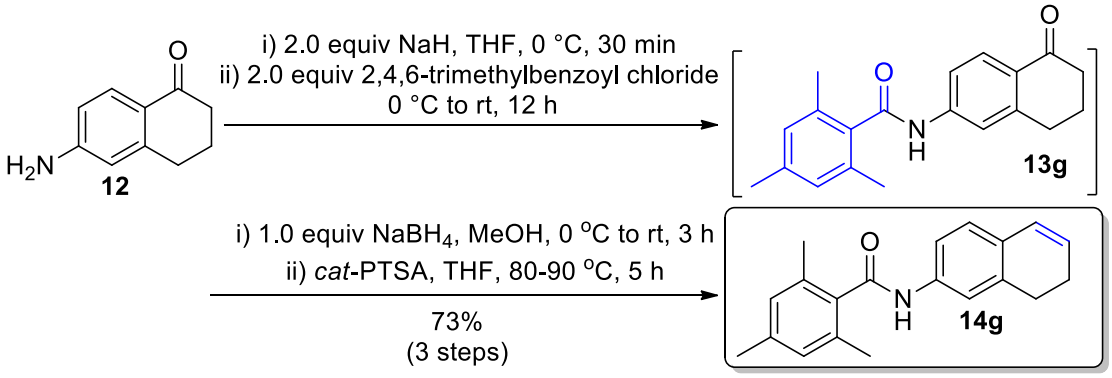
Scheme 1. Illustration of the chemistry utilized for the protection of the OH group.

Subsequently, commercially available tetralones **10** and **11**, and protected tetralones (**13b**-**e**) were reacted with $NaBH_4$ in MeOH in order to reduce to the corresponding alcohols which were transformed into the corresponding alkenes **14a-14f** and proceeded without purification via dehydration reaction using catalytic amount *p*-TsOH.H_2O in THF. These results, along with the relevant reaction conditions, are summarized in **Scheme 2**.



Scheme 2. Reduction of protected tetralones.

Similarly, 6-amino-tetralone (**12**) was protected with 2,4,6-trimethylbenzoyl chloride to produce the corresponding protected ketone **13g,** which was directly converted to alkene **14g** via the reduction and dehydration protocol (**Scheme 3**).



Scheme 3 Preparation of compound **14g**.

2. Experimental:

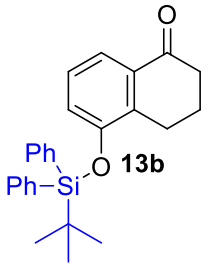
The described compounds were characterized by ^{1}H NMR, ^{13}C NMR, and melting point (for solids) and compared with literature data when available. All novel compounds were characterized by ^{1}H NMR,^{13}C NMR, IR, HRMS, and melting point (for solids). All protection reactions, as well as reduction reactions, have been performed in septum-sealed flasks under the nitrogen atmosphere. Similarly, all dehydration reactions have been performed using the round bottom flask, fitted with Dean-Stark apparatus. The progress of these reactions was monitored by thin-layer chromatographic (TLC) analysis. The TLC employed silica gel plates (Merck Type 60 F_{254} on aluminum), with detection by UV light (254 nm) and stained with phosphomolybdic acid solution, vanillin, $KMnO_4$ solution or *p*-anisaldehyde. Chromatographic purifications in flash column chromatography were performed using 200-400 mesh silica gel. The reagents and solvents have been treated and/or dried, when necessary, according to the usual methods.

Chemical shifts are reported in parts per million (ppm) and coupling constants (*J*) in Hertz. Standard and peak multiplicities are designated as follows: s, singlet; d, doublet; dd, doublet of doublets; t, triplet; q, quin; br s, broad singlet; and m, multiplet. All NMR samples were prepared using $CDCl_3$ as a solvent.

Protection of tetralones; General procedure

To the 2-neck round bottom flask (under N_2 atmosphere), NaH (0.160 g, 4.00 mmol, 60% dispersed in mineral oil) was added in a portion-wise fashion to a magnetically stirred solution of **10** or **11** (0.324 g, 2.00 mmol) dissolved in THF (6 mL) at 0 °C. After 30 min *t*-butyl(chloro)diphenylsilane (1.100 g, 4.00 mmol) was added and the mixture was allowed to rt and stirred for 10 h. After completion of the reaction, distilled H_2O (10 mL) was added followed by extraction with EtOAc (3 x 10 mL). The organic layers were combined, washed with brine (10 mL), dried over $MgSO_4$, filtered and under reduced pressure all solvents were removed. The crude organic residue was purified by flash column chromatography (10-30% EtOAc in hexane).

5-((*t*-Butyldiphenylsilyl)oxy)-3,4-dihydronaphthalen-1(2*H*)-one (13b)



The title compound was prepared according to the general procedure (stirred at 0 °C to rt for 10 h), as described above.

Yield: 0.665 g, 1.66 mmol, (83%); white crystal; 115-116 °C.

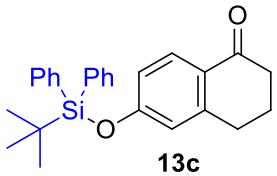
IR (film): 3341, 3134, 3072, 3050, 2999, 2953, 2932, 2891, 2859, 2709, 2590, 1961, 1891, 1824, 1777, 1678, 1596, 1569, 1490, 1472, 1462, 1428, 1391, 1361, 1348, 1333, 1318, 1275, 1253, 1186, 1157, 1114, 1067, 1025, 1007, 998, 972, 938, 900, 880, 823, 701, 660 cm^{-1}.

^1H NMR (500 MHz, $CDCl_3$): δ = 7.81 (d, *J* = 8.5 Hz, 1 H), 7.70 (dd, *J* = 1.5 and 8.2 Hz, 4 H), 7.41 (t, *J* = 7.5 Hz, 2 H), 7.36, (t, *J* = 7.2 Hz, 4 H), 6.64 (dd, *J* = 2.5 and 8.5 Hz, 1 H), 6.60 (d, *J* = 2.0 Hz, 1 H), 2.71 (t, *J* = 6.0 Hz, 2 H), 2.52 (t, *J* = 6.5 Hz, 2 H), 2.00 (quin, *J* = 6.4 Hz, 2 H), 1.11 (s, 9H).

^{13}C NMR (125 MHz, $CDCl_3$): δ = 197.2, 160.1, 146.7, 135.4, 132.2, 130.2, 129.4, 128.0, 126.7, 119.0, 118.6, 39.0, 29.9, 26.5, 23.3, 19.5.

HRMS (ESI): m/z $[M + Na]^+$ calcd for $C_{26}H_{28}O_2SiNa$: 423.1756; found: 423.1734.

6-((*t*-Butyldiphenylsilyl)oxy)-3,4-dihydronaphthalen-1(2*H*)-one (13c)



13c

The title compound was prepared according to the general procedure (stirred at 0 °C to rt for 10 h), as described above.

Yield: 0.601 g, 1.50 mmol (75%); colorless oil.

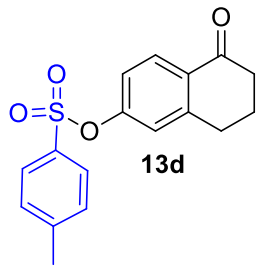
IR (film): 3134, 3072, 3050, 2999, 2653, 2932, 2891, 2859, 2709, 2590, 1961, 1891, 1824, 1777, 1678, 1596, 1569, 1490, 1472, 1462, 1428, 1391, 1361, 1348, 1333, 1318, 1275, 1253, 1186, 1157, 1114, 1067, 1025, 1007, 998, 972, 938, 900, 880, 823, 742, 710, 701 cm^{-1}.

^1H NMR (300 MHz, $CDCl_3$): δ = 7.80 (d, *J* = 8.4 Hz, 1 H), 7.70 (dd, *J* = 1.8 and 8.1 Hz, 4 H), 7.33-7.45, (m, 6 H), 6.60-6.66 (m, 2 H), 2.72 (t, *J* = 6.0 Hz, 2 H), 2.53 (t, *J* = 6.4 Hz, 2 H), 2.00 (quin, *J* = 6.3 Hz, 2 H). 1.10 (s, 9H).

^{13}C NMR (75 MHz, $CDCl_3$): δ = 197.3, 160.1, 146.7, 135.5, 132.3, 130.2, 129.4, 128.0, 126.7, 119.0, 118.6, 39.0, 29.9, 26.5, 23.4, 19.5.

HRMS (ESI): m/z $[M + H]^+$ calcd for $C_{27}H_{28}O_2S$: 401.1937; found: 401.1915.

3.5-Oxo-5,6,7,8-tetrahydronaphthalen-2-yl 4-methylbenzenesulfonate (13d)



13d

The title compound was prepared according to the general procedure (stirred at 0 °C to rt for 20 h), as described above.

Yield: 0.423 g, 1.34 mmol (67%); light red oil.

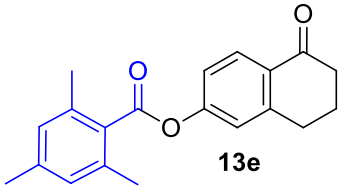
IR (film): 3368, 3067, 2948, 2873, 1923, 1686, 1601, 1577, 1482, 1455, 1433, 1403, 1376 1350, 1323, 1308, 1276, 1228, 1213, 1190, 1178, 1134, 1114, 1092, 1027, 945, 893, 865, 835, 816, 786, 748, 716, 691, 665, 643 cm^{-1}.

^{1}H NMR (300 MHz, $CDCl_3$): δ = 7.93 (d, *J* = 8.4 Hz, 1 H), 7.74 (d, *J* = 8.4 Hz, 2 H), 7.33 (d, *J* = 8.1 Hz, 2 H), 7.05 (d, *J* = 2.4 Hz, 1 H), 6.78 (dd, *J* = 2.2 and 8.4 Hz, 1 H), 2.93 (t, *J* = 6.1 Hz, 2 H), 2.64 (t, *J* = 6.6 Hz, 2 H), 2.46 (s, 3 H), 2.13 (quin, *J* = 6.4 Hz, 2 H).

^{13}C NMR (75 MHz, $CDCl_3$): δ = 197.2, 153.1, 146.7, 145.9, 132.5, 131.4, 130.0, 129.4, 128.6, 122.6, 120.6, 39.0, 29.9, 23.2, 21.9.

HRMS (ESI): m/z $[M + H]^+$ calcd for $C_{17}H_{17}SO_4$: 317.0848; found: 317.0838.

5-Oxo-5,6,7,8-tetrahydronaphthalen-2-yl 2,4,6-trimethylbenzoate (13e)



13e

The title compound was prepared according to the general procedure (stirred at 0 °C to rt for 10 h), as described above.

Yield: 0.480 g, 1.56 mmol (78%); light-yellow solid; mp 113-115 °C.

IR (film): 3466, 3350, 2943, 2876, 2739, 2418, 1912, 1743, 1689, 1607, 1578, 1486, 1448, 1434, 1380, 1349, 1323, 1280, 1260, 1248, 1229, 1215, 1186, 1165, 1142, 1115, 1069, 1051, 1023, 956, 935, 901, 889, 856, 807, 755, 713, 691, 649, 609, 584, 571, 528, 506 cm^{-1}.

^{1}H NMR (500 MHz, $CDCl_3$): δ = 8.12 (d, *J* = 8.0 Hz , 1 H), 7.14-7.17 (m, 2 H), 6.92 (2 H, s), 2.99 (t, *J* = 6.2 Hz, 2 H), 2.65 (t, *J* = 6.5 Hz, 2 H), 2.44 (s, 6 H), 2.31 (s, 3 H), 2.15 (quin, *J* = 6.4 Hz, 2 H).

^{13}C NMR (125 MHz, $CDCl_3$): δ = 197.1, 167.8, 154.5, 146.5, 140.4, 135.8, 130.6, 129.5, 129.4, 128.8, 121.5, 120.2, 39.0, 29.9, 23.2, 21.2, 20.1.

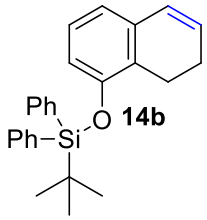
HRMS (ESI): m/z $[M + H]^+$ calcd for $C_{20}H_{21}O_3$: 309.1491; found: 309.1478.

Reduction and dehydration reactions; General procedure

A 2-neck round bottom flask was charged with ketone **13b** (0.600 g, 1.50 mmol) dissolved in anhydrous MeOH (6 mL) under nitrogen atmosphere. To this solution $NaBH_4$ (0.0.57 g, 1.50 mmol) was added in portion wise at 0 °C. After 30 min the reaction mixture was allowed to rt and stirred for another 3 hours. To the reaction mixture, distilled H_2O (10 mL) was added followed by extraction with EtOAc (3 x 10 mL). The organic extracts were combined, washed with brine (10 mL), dried over $MgSO_4$, filtered and under reduced pressure all solvents were removed. The crude alcohol **13bb** (was obtained as a colorless oil which was used in the next step without purification and characterization.

The crude alcohol **13bb** dissolved in THF (10 mL) and few crystals of PTSA (*p*-TsOH.H_2O) were added to the round bottom flask, fitted with Dean-Stark apparatus. The reaction was heated at 80-90 °C for 6 h. After completion of the reaction (analyzed by TLC) the mixture was quenched by the addition of a saturated aqueous solution of $NaHCO_3$ followed by extraction with EtOAc (3 x 10 mL). The organic extracts were combined, washed with brine (10 mL), dried over $MgSO_4$, filtered and under reduced pressure all solvents were removed. The crude residue was purified by flash column chromatography (5-10% EtOAc in hexane).

***t*-Butyl((7,8-dihydronaphthalen-1-yl)oxy)diphenylsilane (14b)**



Yield: 0.504 g, 1.32 mmol (88%); colorless oil.

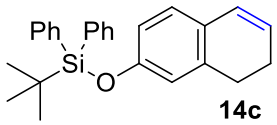
R (film): 3071, 3053, 3009, 3001, 2953, 2931, 2895, 2860, 1960, 1888, 1825, 1740, 1610, 1583, 1472, 1435, 1393, 1362, 1299, 1267, 1192, 1170, 1145, 1111, 1033, 999, 974, 855, 823, 700, 672 cm^{-1}.

^{1}H NMR (300 MHz, $CDCl_3$): δ = 7.70-7.73 (m, 4 H), 7.32-7.41 (m, 6 H), 6.70 (d, *J* = 8.1 Hz, 1 H), 6.58 (s, 1 H), 6.46 (dd, *J* = 1.8 and 8.1 Hz, 1 H), 6.32 (d, *J* = 9.6 Hz, 1 H), 5.83 (quin, *J* = 4.6 Hz, 1 H), 2.61 (t, *J* = 8.1 Hz, 2 H), 2.18-2.24 (m, 2 H), 1.09 (s, 9 H).

^{13}C NMR (75 MHz, $CDCl_3$): δ = 154.6, 137.0, 135.6, 133.2, 130.0, 127.9, 127.7, 127.3, 126.7, 126.0, 119.3, 117.3, 27.8, 26.7, 23.0, 19.6.

HRMS (ESI): m/z $[M + Na]^+$ calcd for $C_{26}H_{28}OSiNa$: 407.1807; found: 407.1801.

_t_-Butyl((7,8-dihydronaphthalen-2-yl)oxy)diphenylsilane (14c)



14c

The reaction was heated at 80-90 °C for 6 h in dehydration step.

Yield: 1.082 g, 2.82 mmol (94%); colorless oil.

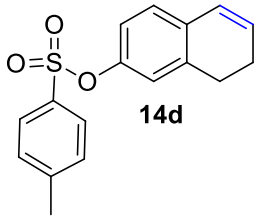
IR (film): 3071, 3049, 3016, 2999, 2956, 2932, 2893, 2858, 1960, 1888, 1822, 1738, 1607, 1582, 1487, 1472, 1428, 1390, 1361, 1294, 1269, 1189, 1167, 1143, 1113, 1029, 998, 973, 855, 822, 742, 701, 683 cm^{-1}.

^{1}H NMR (300 MHz, $CDCl_3$): δ = 7.70-7.74 (m, 4H), 7.32-7.44 (m, 6H), 6.69 (d, *J* = 8.1 Hz, 1 H), 6.58 (s, 1 H), 6.47 (dd, *J* = 2.7 and 8.1 Hz, 1 H), 6.30-6.34 (m, 1 H), 5.82 (quin, *J* = 4.6 Hz, 1 H), 2.61 (t, *J* = 8.2 Hz, 2 H), 2.16-2.24 (m, 2 H), 1.09 (s, 9 H).

^{13}C NMR (75 MHz, $CDCl_3$): δ = 154.6, 137.0, 135.7, 133.3, 130.0, 127.9, 127.7, 127.3, 126.7, 126.1, 119.3, 117.3, 27.9, 26.7, 23.6, 19.6.

HRMS (ESI): m/z $[M + Na]^+$ calcd for $C_{26}H_{28}OSiNa$: 407.1807; found: 407.1812.

7,8-Dihydronaphthalen-2-yl 4-methylbenzenesulfonate (14d)



14d

The reaction was heated at 80-90 °C for 5 h in dehydration step.

Yield: 0.810 g, 2.70 mmol (90%); off-white solid; mp 102-104 °C.

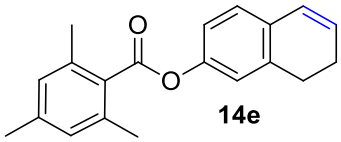
IR (film): 3033, 2930, 2883, 2829, 1921, 1600, 1566, 1490, 1458, 1378, 1291, 1243, 1230, 1207, 1188, 1177, 1120, 1099, 1080, 1030, 1000, 966, 901, 875, 819, 767, 703, 671 cm^{-1}.

^{1}H NMR (300 MHz, $CDCl_3$): δ = 7.71, (d, *J* = 8.4 Hz, 2 H), 7.29, (d, *J* = 8.4 Hz, 2 H), 6.85 (d, *J* = 8.1 Hz, 1 H), 6.79 (s, 1 H), 6.65 (m, 1 H), 6.37 (m, 1 H), 6.00 (quin, *J* = 4.6 Hz, 1 H), 2.70 (t, *J* = 8.2 Hz, 2 H), 2.42 (s, 3 H), 2.21-2.30 (m, 2 H).

^{13}C NMR (75 MHz, $CDCl_3$): δ = 148.1, 145.3, 137.2, 133.1, 132.7, 129.7, 129.3, 128.5, 126.7, 126.6, 121.6, 119.4, 27.4, 22.7, 21.7.

HRMS (ESI): m/z $[M + Na]^+$ calcd for $C_{17}H_{16}O_3SNa$: 323.0712; found: 323.0715.

7,8-Dihydronaphthalen-2-yl 2,4,6-trimethylbenzoate (14e)



14e

The reaction was heated at 80-90 °C for 5 h in dehydration step.

Yield: 0.495 g, 1.70 mmol (85%); colorless oil.

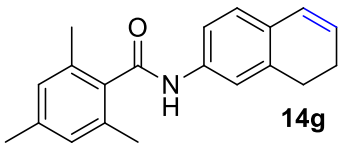
IR (film): 3468, 3032, 2930, 2884, 2830, 2737, 2105, 1870, 1744, 1611, 1576, 1491, 1437, 1425, 1395, 1379, 1335, 1322, 1297, 1254, 1221, 1199, 1164, 1141, 1113, 1053, 955, 888, 849, 815, 785, 754, 707, 688, 676 cm^{-1}.

^{1}H NMR (500 MHz, $CDCl_3$): δ = 7.05 (d, *J* = 8.0 Hz, 1 H), 6.97-7.00 (m, 2 H), 6.91 (s, 2 H), 6.44-6.47 (m, 1 H), 6.02 (quin, *J* = 4.5 Hz, 1 H), 2.83 (t, *J* = 8.2 Hz, 2 H), 2.45 (s, 6H), 2.30-2.34 (m, 5 H).

^{13}C NMR (125 MHz, $CDCl_3$): δ = 168.7, 149.4, 140.0, 137.2, 135.7, 132.3, 130.2, 128.7, 128.6, 127.1, 126.9, 120.9, 119.4, 27.7, 22.9, 21.3, 20.1.

HRMS (ESI): m/z $[M + Na]^+$ calcd for $C_{20}H_{20}O_2Na$: 315.1361; found: 315.1344.

***N*-(7,8-Dihydronaphthalen-2-yl)-2,4,6-trimethylbenzamide (14g)**



14g

Tetralone **12** was protected according to the general procedure as for the protection of tetralones **10** and **11** (stirred at 0 °C to rt for 12 h). The protected ketone **13g** was proceeded to the next step of reduction and dehydration without purification and characterization as described above. The reaction mixture was heated at 80-90 °C for 5 h in dehydration step.

Yield: 0.425 g, 1.46 mmol (73%); off-white solid; mp 142-143 °C.

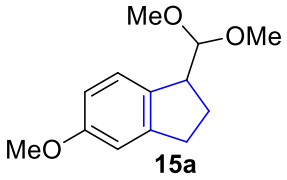
IR (film): 3270, 3097, 3031, 2928, 2883, 2829, 1888, 1649, 1610, 1584, 1525, 1420, 1378, 1328, 1312, 1285, 1266, 1248, 1223, 1178, 1123, 1094, 1030, 1015, 953, 882, 848, 833, 789, 755, 714, 692, 677, 605 cm^{-1}.

^1H NMR (500 MHz, $CDCl_3$): δ = 7.47 (s, 1 H), 7.33 (br, 1 H), 7.29 (dd, *J* = 2.0 and 8.0 Hz, 1 H), 6.98 (d, *J* = 8.0 Hz, 1 H), 6.87 (s, 2H), 6.42-6.44 (m, 1 H), 5.99 (quin, *J* = 4.6 Hz, 1 H), 2.81 (t, *J* = 8.0 Hz, 2 H), 2.28-2.33 (m, 11 H).

^{13}C NMR (75 MHz, $CDCl_3$): δ = 168.8, 139.0, 136.8, 136.5, 135.2, 134.4, 131.0, 128.5, 128.0, 127.2, 126.5, 119.3, 117.7, 27.9, 23.1, 21.2, 19.3.

HRMS (ESI): m/z $[M + H]^+$ calcd for $C_{20}H_{23}NO$: 292.1701; found: 292.1704.

1-(Dimethoxymethyl)-5-methoxy-2,3-dihydro-1*H*-indene (15a)[1]



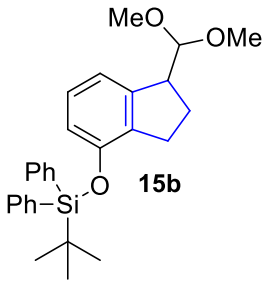
15a

Yield: 0.032 g, 0.14 mmol (29%); colorless oil.

^1H NMR (300 MHz, $CDCl_3$): δ = 7.31 (d, J = 9.6 Hz, 1 H), 6.75 (s, 1 H), 6.71 (d, J = 8.2 Hz, 1 H), 4.27 (d, J = 7.5 Hz, 1 H), 3.76 (s, 3 H), 3.41 (s, 3 H), 3.35 (s, 3 H), 2.75-2.96 (m, 2 H), 2.14-22.5 (m, 1 H), 1.89-2.02 (m, 1 H).

^{13}C NMR (75 MHz, $CDCl_3$): δ = 159.1, 146.4, 134.8, 126.1, 112.2, 109.7, 107.4, 55.3, 54.2, 52.9, 46.6, 31.6, 27.8.

***t*-Butyl((1-(dimethoxymethyl)-2,3-dihydro-1*H*-inden-4-yl)oxy)diphenylsilane (15b)**



15b

Yield: 0.033 g, 0.07 mmol (28%); colorless oil.

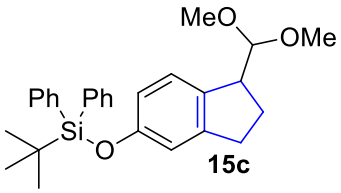
IR (film): 3429, 3072, 3049, 2957, 2932, 2893, 2858, 2829, 2711, 1961, 1888, 1822, 1724, 1607, 1582, 1486, 1473, 1428, 1390, 1361, 1298, 1272, 1188, 1172, 1144, 1114, 1079, 1059, 1008, 997, 967, 940, 904, 852, 822, 743, 701, 685 cm^{-1}.

^1H NMR (300 MHz, $CDCl_3$): δ = 7.63-7.66 (m, 4 H), 7.25-7.37 (m, 6 H), 7.00 (d, *J* = 8.1 Hz, 1 H), 6.57 (d, *J* = 2.4 Hz, 1 H), 6.46 (dd, *J* = 2.4 and 8.1 Hz, 1 H), 4.15 (d, *J* = 7.5 Hz, 1 H), 3.29 (s, 3 H), 3.24 (s, 3 H), 2.54-2.74 (m, 2 H), 2.00-2.12 (m, 1 H), 1.78-1.88 (m, 1 H),1.01 (s, 9 H).

^{13}C NMR (75 MHz, $CDCl_3$): δ = 155.0, 146.2, 135.7, 135.2, 133.4, 129.9, 127.8, 125.7, 117.6, 115.7, 107.6, 54.1, 53.2, 46.8, 31.5, 27.8, 26.7, 19.6.

HRMS (ESI): m/z [M + Na]$^+$ calcd for $C_{28}H_{34}O_3SiNa$: 469.2175; found: 469.2148.

_t_-Butyl((1-(dimethoxymethyl)-2,3-dihydro-1_H_-inden-5-yl)oxy)diphenylsilane (15c)



15c

Yield: 0.039 g, 0.09 mmol (34%); colorless oil.

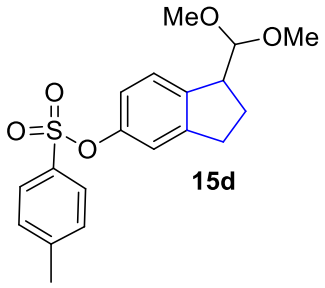
IR (film): 3430, 3070, 3048, 2958, 2931, 2892, 2857, 2830, 2710, 1963, 1888, 1820, 1720, 1604, 1580, 1488, 1477, 1433, 1390, 1360, 1300, 1271, 1188, 1171, 1144, 1111, 1080, 1069, 1005, 999, 966, 943, 902, 850, 823, 743, 700, 681 cm^{-1}.

^{1}H NMR (800 MHz, $CDCl_3$): δ = 7.72 (d, *J* = 7.2 Hz, 4 H), 7.41 (t, *J* = 7.2 Hz, 2 H), 7.35 (t, *J* = 7.2 Hz, 4 H), 7.09 (d, *J* = 8.0 Hz, 1 H), 6.65 (s, 1 H), 6.54 (d, *J* = 8.0 Hz, 1 H), 4.23 (d, *J* = 8.0 Hz, 1 H), 3.36 (s, 3 H), 3.30-3.33 (m, 4 H), 2.73-2.77 (m, 1 H), 2.65-2.69 (m 1 H), 2.11-2.15 (m 1 H), 1.87-1.91 (m, 1 H), 1.09 (s, 9 H).

^{13}C NMR (200 MHz, $CDCl_3$): δ = 154.9, 146.1, 135.7, 135.2, 133.3, 129.9, 127.9, 125.7, 117.6, 115.7, 107.5, 54.0, 53.1, 46.7, 31.5,27.8, 26.7, 19.6.

HRMS (ESI): m/z [M + Na]$^+$ calcd for $C_{28}H_{34}O_3SiNa$: 469.2175; found: 469.2172.

1-(Dimethoxymethyl)-2,3-dihydro-1_H_-inden-5-yl 4-methylbenzenesulfonate (**15d**)



15d

Yield: 0.027 g, 0.07 mmol (29%); light yellow oil.

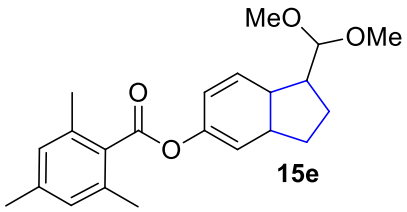
IR (film): 3468, 2925, 2853, 2380, 2346, 1921, 1733, 1597, 1478, 1455, 1372, 1306, 1292, 1257, 1224, 1190, 1178, 1159, 1122, 1091, 1058, 1019, 988, 931, 904, 873, 833, 814, 774, 729, 706, 691, 662 cm^{-1}.

^{1}H NMR (500 MHz, $CDCl_3$): δ = 7.72 (d, *J* = 8.5 Hz, 2 H), 7.29 (dd, *J* = 8.2 and 16.7 Hz, 3 H), 6.89 (s, 1 H), 6.67 (dd, *J* = 2.2 and 8.2 Hz, 1 H), 4.26 (d, *J* = 7.5 Hz, 1 H), 3.34-3.42 (m, 7 H), 2.85-2.90 (m, 1 H), 2.75-2.82 (m, 1 H), 2.45 (s, 3 H), 2.17-2.24 (m, 1 H), 1.93-2.00 (m, 1 H).

^{13}C NMR (75 MHz, $CDCl_3$): δ = 148.9, 146.7, 145.2, 141.8, 132.9, 129.8, 128.6, 126.2, 120.0, 118.5, 107.0, 54.3, 53.1, 47.1, 31.4, 27.7, 21.8.

HRMS (ESI): m/z $[M + Na]^+$ calcd for $C_{19}H_{22}O_5SNa$: 385.1086: found: 385.1083.

1-(Dimethoxymethyl)-2,3,3a,7a-tetrahydro-1*H*-inden-5-yl 2,4,6-trimethylbenzoate (15e)



15e

Yield: 0.022 g, 0.06 mmol (31%); colorless oil.

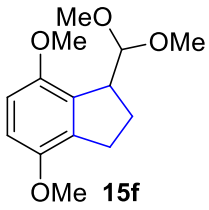
IR (film): 3468, 2925, 2831, 2736, 1743, 1611, 1592, 1483, 1428, 1378, 1254, 1226, 1189, 1163, 1129, 1095, 1051, 987, 956, 924, 887, 852, 806, 711, 601 cm^{-1}.

^{1}H NMR (500 MHz, $CDCl_3$): δ = 7.46 (d, *J* = 8.1 Hz, 1 H),7.07 (d, *J* = 2.0 Hz, 1 H), 6.99 (dd, *J* = 2.2 and 8.2 Hz, 1 H), 6.91 (s, 2 H), 4.32 (d, *J* = 7.5 Hz, 1 H), 3.37-3.50 (m, 7 H), 2.83-3.03 (m, 2 H), 2.44 (s, 6 H), 2.31 (s, 3 H), 2.19-2.29 (m, 1 H), 1.98-2.08 (m, 1 H).

^{13}C NMR (75 MHz, $CDCl_3$): δ = 168.9, 150.0, 146.6, 140.7, 140.0, 135.7, 130.3, 128.7, 126.4, 119.4, 107.7, 107.2, 54.5, 52.9, 47.1, 31.6, 27.9, 21.3, 20.1.

HRMS (ESI): m/z $[M + Na]^+$ calcd for $C_{22}H_{26}O_4Na$: 377.1729; found: 377.1725.

1-(Dimethoxymethyl)-4,7-dimethoxy-2,3-dihydro-1*H*-indene (15f)



15f

Yield: 0.023 g, 0.09 mmol (18%); colorless oil.

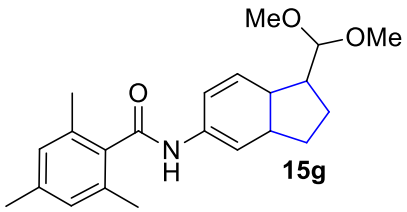
IR (film): 3368, 2931, 2826, 2872, 1733, 1669, 1608, 1574, 1488, 1433, 1369, 1255, 1094, 1078, 816 cm^{-1}.

^{1}H NMR (300 MHz, $CDCl_3$): δ = 6.63 (dd, *J* = 9.0 and 11.4 Hz, 2 H), 4.70 (d, *J* = 3.0 Hz, 1 H), 3.80 (s, 3 H), 3.78 (s, 3 H), 3.56-3.60 (m, 1 H), 3.45 (s, 3 H), 3.20 (s, 3 H), 2.88-2.99 (m,1 H), 2.75-2.84 (m, 1 H), 2.28-2.39 (m, 1 H), 1.98-2.11 (m, 1 H).

^{13}C NMR (75 MHz, $CDCl_3$): δ = 150.7, 150.4, 135.3, 132.3, 109.4, 108.6, 107.1, 57.4, 55.7, 55.7, 55.5, 48.0, 29.5, 24.9.

HRMS (ESI): m/z $[M + Na]^+$ calcd for $C_{15}H_{22}O_3Na$: 273.1461; found: 273.1458.

_N_-(1-(Dimethoxymethyl)-2,3,3a,7a-tetrahydro-1_H_-inden-5-yl)-2,4,6-trimethylbenzamide (15g)



15g

Yield: 0.031 g, 0.09 mmol (32%); yellow oil.

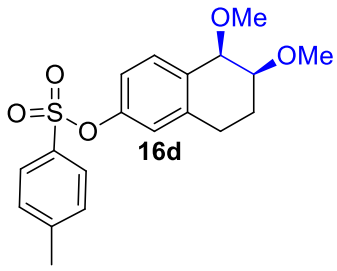
IR (film): 3748, 3276, 3120, 2924, 2854, 2830, 2734, 1728, 1651, 1611, 1597, 1530,92 1491, 1454, 1425, 1377, 1329, 1286, 1251, 1177, 1154, 1122, 1076, 1058, 987, 954, 887, 850, 729, 600 cm^{-1}

^{1}H NMR (800 MHz, $CDCl_3$): δ = 7.65 (s, 1 H), 7.38 (d, *J* = 8.0 Hz, 1 H), 7.32 (s, 1 H), 7.22 (d, *J* = 8.8 Hz, 1 H), 6.88 (s, 2 H), 4.30 (d, *J* = 8.0 Hz, 1 H), 3.43 (s, 3 H), 3.38 (s, 3 H), 2.95-2.99 (m, 1 H), 2.85-2.89 (m, 1 H), 2.34 (s, 6 H), 2.30 (s, 3 H), 2.18-2.28 (m, 2 H), 1.98-2.02 (m, 1 H).

^{13}C NMR (200 MHz, $CDCl_3$): δ = 168.8, 146.2, 139.4, 139.0, 136.5, 135.2, 134.4, 128.5, 126.0, 118.1, 116.3, 107.3, 54.5, 52.9, 47.1, 31.7, 27.7, 21.2, 19.3.

HRMS (ESI): m/z $[M + H]^+$ calcd for $C_{22}H_{28}O_3N$: 354.2069; found: 354.2056.

(5R,6S)-5,6-Dimethoxy-5,6,7,8-tetrahydronaphthalen-2-yl 4-methylbenzenesulfonate (16d)



16d

Yield: 0.015 g, 0.04 mmol (16%); light yellow oil.

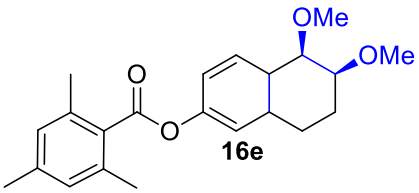
IR (film): 2927, 2825, 1923, 1726, 1607, 1597, 1492, 1456, 1372, 1307, 1294, 1251, 1210, 1190, 1178, 1137, 1115, 1093, 1046, 1018, 983, 944, 920, 879, 816, 773, 721, 708, 663 cm^{-1}.

^{1}H NMR (500 MHz, $CDCl_3$): δ = 7.72 (d, *J* = 8.5 Hz, 2 H), 7.31 (d, *J* = 8.0 Hz, 2 H), 7.24 (d, *J* = 8.5 Hz, 1 H), 6.82 (d, *J* = 2.0 Hz, 1 H), 6.72 (dd, *J* = 2.5 and 8.0 Hz, 1 H), 4.28 (d, *J* = 2.5 Hz, 1 H), 3.64-3.67 (dt, *J* = 3.0 and 9.5 Hz, 1 H), 3.46 (s, 3 H), 3.45 (s, 3 H), 2.91-2.97 (m, 1 H), 2.66-2.73 (m, 1 H), 2.45 (s, 3 H), 2.14-2.23 (m, 1 H), 1.86-1.92 (m, 1 H).

^{13}C NMR (125 MHz, $CDCl_3$): δ = 149.3, 145.4, 138.7, 133.8, 132.7, 130.7, 129.9, 128.6, 122.5, 119.5, 77.7, 77.1, 57.4, 56.7, 26.8, 22.3, 21.8.

HRMS (ESI): m/z $[M + Na]^+$ calcd for $C_{19}H_{22}O_5SNa$: 385.1086; found: 385.1080.

(5R,6S)-5,6-Dimethoxy-4a,5,6,7,8,8a-hexahydronaphthalen-2-yl 2,4,6-trimethylbenzoate (16e)



16e

Yield: 0.011 g, 0.03 mmol (15%); colorless oil.

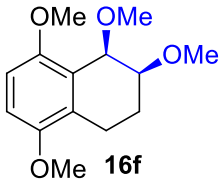
IR (film): 3469, 2926, 2824, 2086, 1743, 1611, 1587, 1494, 1456, 1427, 1378, 1245, 1219, 1190, 1164, 1144, 1116, 1100, 1082, 1052, 984, 942, 914, 888, 853, 802, 778, 708, 668 cm^{-1}.

^{1}H NMR (300 MHz, $CDCl_3$): δ = 7.37 (d, *J* = 8.4 Hz, 1 H), 7.00-7.06 (m, 2 H), 6.91 (s, 2 H), 4.36 (d, *J* = 2.7 Hz, 1 H), 3.65 (dt, *J* = 3.3 and 10.2 Hz, 1 H), 3.48 (s, 6 H), 3.01-3.10 (m, 1 H), 2.77-2.89 (m, 1 H), 2.44 (s, 6 H), 2.31 (s, 3 H), 2.19-2.27 (m, 1 H), 1.92-2.00 (m, 1 H).

^{13}C NMR (75 MHz, $CDCl_3$): δ = 168.5, 150.6, 140.1, 138.6, 135.7, 132.5, 131.1, 130.0, 128.8, 121.6, 118.9, 78.0, 77.7, 57.3, 56.6, 27.3, 22.3, 21.3, 20.1

HRMS (ESI): m/z $[M + Na]^+$ calcd for $C_{22}H_{26}O_4Na$: 377.1729; found: 377.1722.

(1R,2S)-1,2,5,8-Tetramethoxy-1,2,3,4-tetrahydronaphthalene (16f)



16f

Yield: 0.026 g, 0.10 mmol (21%); colorless oil.

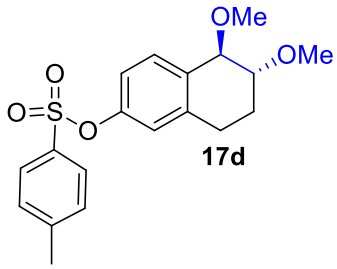
IR (film): 2935, 2900, 2832, 2034, 1726, 1602, 1481, 1464, 1439, 1364, 1331, 1257, 1202, 1184, 1153, 1091, 1070, 1016, 977, 947, 913, 829, 799, 767, 714, 660 cm^{-1}

^{1}H NMR (300 MHz, $CDCl_3$): δ = 6.71 (t, *J* = 6.3 Hz, 2 H), 4.86 (dd, *J* = 1.2, 2.7 Hz, 1 H), 3.82 (s, 3 H), 3.76 (s, 3 H), 3.56 (s, 3 H), 3.50 (s, 3 H), 3.38 (dt, *J* = 5. 3.3 and 12.3 Hz, 1 H), 2.96-3.04 (m, 1 H), 2.46-2.60 (m, 1 H), 2.04-2.18 (m, 1 H), 1.93-2.00 (m, 1 H).

^{13}C NMR (75 MHz, $CDCl_3$): δ = 153.2, 151.1, 127.6, 124.0, 109.5, 108.0, 74.8, 71.0, 58.1, 56.6, 56.0, 55.8, 20.3, 18.0.

HRMS (ESI): m/z $[M + Na]^+$ calcd for $C_{15}H_{22}O_3Na$: 273.1461; found: 273.1458.

(5R,6R)-5,6-Dimethoxy-5,6,7,8-tetrahydronaphthalen-2-yl 4-methylbenzenesulfonate (**17d**)



17d

Yield: 0.017 g, 0.05 mmol (18%); light yellow oil.

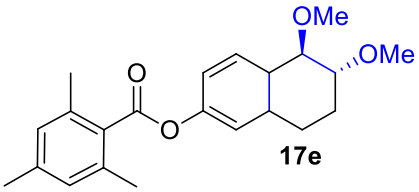
IR (film): 2929, 2824, 1922, 1727, 1608, 1598, 1492, 1455, 1401, 1373, 1307, 1295, 1249, 1213, 1189, 1178, 1137, 1113, 1093, 1042, 1009, 928, 914, 879, 831, 816, 776, 726, 694, 661 cm^{-1}.

^1H NMR (500 MHz, $CDCl_3$): δ = 7.72 (2H, d, *J* = 8.0 Hz), 7.31 (2H, d, *J* = 8.0 Hz), 7.24 (1H, d, *J* = 8.5 Hz), 6.80 (1H, d, *J* = 2.5 Hz), 6.73 (1H, dd, *J* = 2.2 and 8.2 Hz), 4.16 (1H, d, *J* = 5.0 Hz), 3.67-3.70 (1H, m), 3.50 (3H, s), 3.43 (3H, s), 2.74-2.80 (1H, m), 2.63-2.69 (1H, dt, *J* = 5.5 and 17.0 Hz), 2.45 (3H, s), 2.03-2.08 (1H, m), 1.87-1.93 (1H, m).

^{13}C NMR (125 MHz, $CDCl_3$): δ = 149.0, 145.3, 139.0, 133.8, 132.7, 131.3, 129.8, 128.7, 122.2, 119.8, 79.2, 77.6, 58.0, 56.8, 25.4, 23.1, 21.8.

HRMS (ESI): m/z $[M + Na]^+$ calcd for $C_{19}H_{22}O_5SNa$: 385.1086; found: 385.1082.

(5R,6R)-5,6-Dimethoxy-4a,5,6,7,8,8a-hexahydronaphthalen-2-yl 2,4,6-trimethylbenzoate (17e)



17e

Yield: 0.011 g, 0.03 mmol (17%); colorless oil.

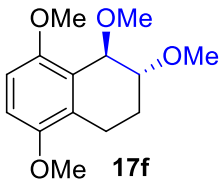
IR (film): 2928, 2822, 1744, 1611, 1586, 1494, 1455, 1427, 1377, 1320, 1299, 1244, 1222, 1164, 1144, 1115, 1096, 1053, 1010, 954, 918, 888, 852, 809, 787, 705, 660 cm^{-1}.

^1H NMR (300 MHz, $CDCl_3$): δ = 7.41 (d, *J* = 8.4 Hz, 1 H), 7.05 (dd, *J* = 2.4 and 8.1 Hz, 1 H), 6.98 (d, *J* = 2.1 Hz, 1 H), 6.91 (s, 2 H), 4.26 (d, *J* = 4.8 Hz, 1 H), 3.70-3.75 (m, 1 H), 3.51 (s, 3 H), 3.45 (s, 3 H), 2.72-2.94 (m, 2 H), 2.43 (s, 6 H), 2.30 (s, 3 H), 2.08-2.18 (m, 1 H), 1.87-1.98 (m, 1 H).

^{13}C NMR (75 MHz, $CDCl_3$): δ = 168.3, 150.1, 139.9, 138.7, 135.5, 132.5, 131.0, 130.0, 128.6, 121.1, 119.2, 79.2, 77.7, 57.4, 56.6, 25.5, 23.3, 21.1, 20.0.

HRMS (ESI): m/z $[M + Na]^+$ calcd for $C_{22}H_{26}O_4Na$: 377.1729; found: 377.1720.

(1R,2R)-1,2,5,8-Tetramethoxy-1,2,3,4-tetrahydronaphthalene (17f)



17f

Yield: 0.031 g, 0.12 mmol (25%); colorless oil.

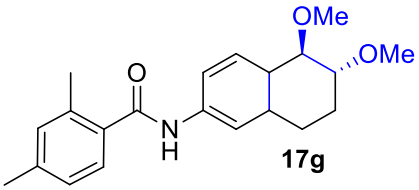
IR (film): 2939, 2831, 2029, 1726, 1602, 1481, 1464, 1438, 1378, 1358, 1339, 1319, 1292, 1258, 1194, 1154, 1112, 1086, 1052, 1019, 951, 870, 840, 799, 758, 723, 710 cm^{-1}.

^{1}H NMR (300 MHz, $CDCl_3$): δ = 6.69 (dd, *J* = 9.0 and 10.5 Hz, 2 H), 4.47 (d, *J* = 1.5 Hz, 1 H), 3.75 (s, 3 H), 3.74-3.81 (m, 7 H), 3.53 (s, 3 H), 3.40 (s, 3 H), 2.68-2.77 (m, 1 H), 2.45-2.60 (m, 1 H), 2.06-2.14 (m, 1 H), 1.89-2.00 (m, 1 H).

^{13}C NMR (75 MHz, $CDCl_3$): δ = 152.1, 151.5, 127.2, 125.7, 109.6, 108.0, 80.6, 70.0, 55.8, 59.8, 56.6, 56.0, 23.3, 21.1.

HRMS (ESI): m/z $[M + Na]^+$ calcd for $C_{15}H_{22}O_3Na$: 273.1461; found: 273.1458**.**

_N_-((5R,6R)-5,6-Dimethoxy-4a,5,6,7,8,8a-hexahydronaphthalen-2-yl)-2,4,6-trimethylbenzamide (17g)



17g

Yield: 0.020 g, 0.05 mmol (19%); yellow oil.

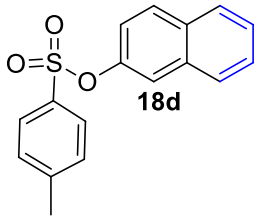
IR (film): 3748, 3282, 3118, 2925, 2855, 2824, 1656, 1611, 1594, 1530, 1504, 1455, 1418, 1376, 1331, 1279, 1177, 1096, 1084, 989, 954, 916, 884, 850, 828, 791, 755, 665, 603 cm^{-1}.

^{1}H NMR (500 MHz, $CDCl_3$): δ = 7.52 (s, 1 H). 7.33 (s, 2 H), 7.23 (br, 1 H), 6.88 (s, 2 H), 4.24 (d, *J* = 4.5 Hz, 1 H), 3.71-3.74 (m, 1 H), 3.49 (s, 3 H), 3.45 (s, 3 H), 2.84-2.90 (m, 1 H), 2.74-2.79 (m, 1 H), 2.33 (s, 6 H), 2.30 (s, 3 H), 2.10-2.16 (m, 1 H), 1.89-1.96 (m, 1 H).

^{13}C NMR (125 MHz, $CDCl_3$): δ = 168.8, 139.0, 138.4, 137.4, 135.2, 134.4, 131.1, 130.9, 128.5, 119.5, 117.5, 79.3, 77.8, 57.4, 56.8, 25.6, 23.4, 21.3, 19.3.

HRMS (ESI): m/z $[M + H]^+$ calcd for $C_{22}H_{28}O_3N$: 354.2069; found: 354.2059.

Naphthalen-2-yl 4-methylbenzenesulfonate (**18d**).[2]



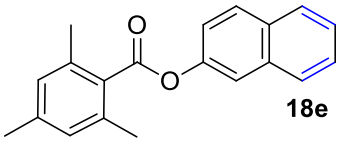
18d

Yield: 0.003 g, 0.01 mmol (3%); pale yellow crystals mp 119-120 °C.

^{1}H NMR (500 MHz, $CDCl_3$): δ = 7.80 (t, *J* = 4.7 Hz, 1 H), 7.71-7.76 (m, 4 H), 7.46-7.50 (m, 3 H), 7.29 (d, *J* = 8.0 Hz, 2 H), 7.09 (dd, *J* = 2.5 and 9.0 Hz, 1 H), 2.43 (s, 3 H).

^{13}C NMR (125 MHz, $CDCl_3$): δ = 1326, 147.3.145.5, 133.6, 132.0, 129.9, 129.9, 128.7, 128.0, 127.9, 127.0, 126.5, 121.3, 120.1, 21.8.

Naphthalen-2-yl 2,4,6-trimethylbenzoate (18e)



18e

Yield: 0.03 g, 0.01 mmol (4%); colorless oil.

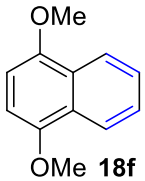
IR (film): 3450, 3051, 2920, 2851, 2346, 1736, 1629, 1599, 1581, 1510, 1461, 1426, 1377, 1354, 1267, 1254, 1236, 1207, 1165, 1154, 1137, 1119, 1048, 959, 943, 898, 886, 863, 855, 848, 827, 804, 777, 751, 735, 701, 639 cm^{-1}.

^{1}H NMR (500 MHz, $CDCl_3$): δ = 7.91 (d, *J* = 9.0 Hz, 1 H), 7.86 (dd, *J* = 8.0 and 13.0 Hz, 2 H), 7.69 (d, *J* = 2.0 Hz, 1 H), 7.47-7.53 (m, 2 H), 7.37 (dd, *J* = 2.2 and 9.2 Hz, 1 H), 6.95 (s, 2 H), 2.50 (s, 6 H), 2.33 (s, 3 H).

^{13}C NMR (75 MHz, $CDCl_3$): δ = 168.7, 148.5, 140.2, 135.8, 134.0, 131.7, 130.1, 129.7, 128.8, 127.9, 127.8, 126.8, 125.9, 121.3, 118.7, 21.4, 20.2.

HRMS (ESI): m/z $[M + Na]^+$ calcd for $C_{20}H_{18}O_2Na$: 313.1204; found: 313.1193.

1,4-Dimethoxynaphthalene (18f).[3]



18f

Yield: 0.002 g, 0.01 mmol (2%); colorless solid; mp 88-90 °C.

3. Refrences.

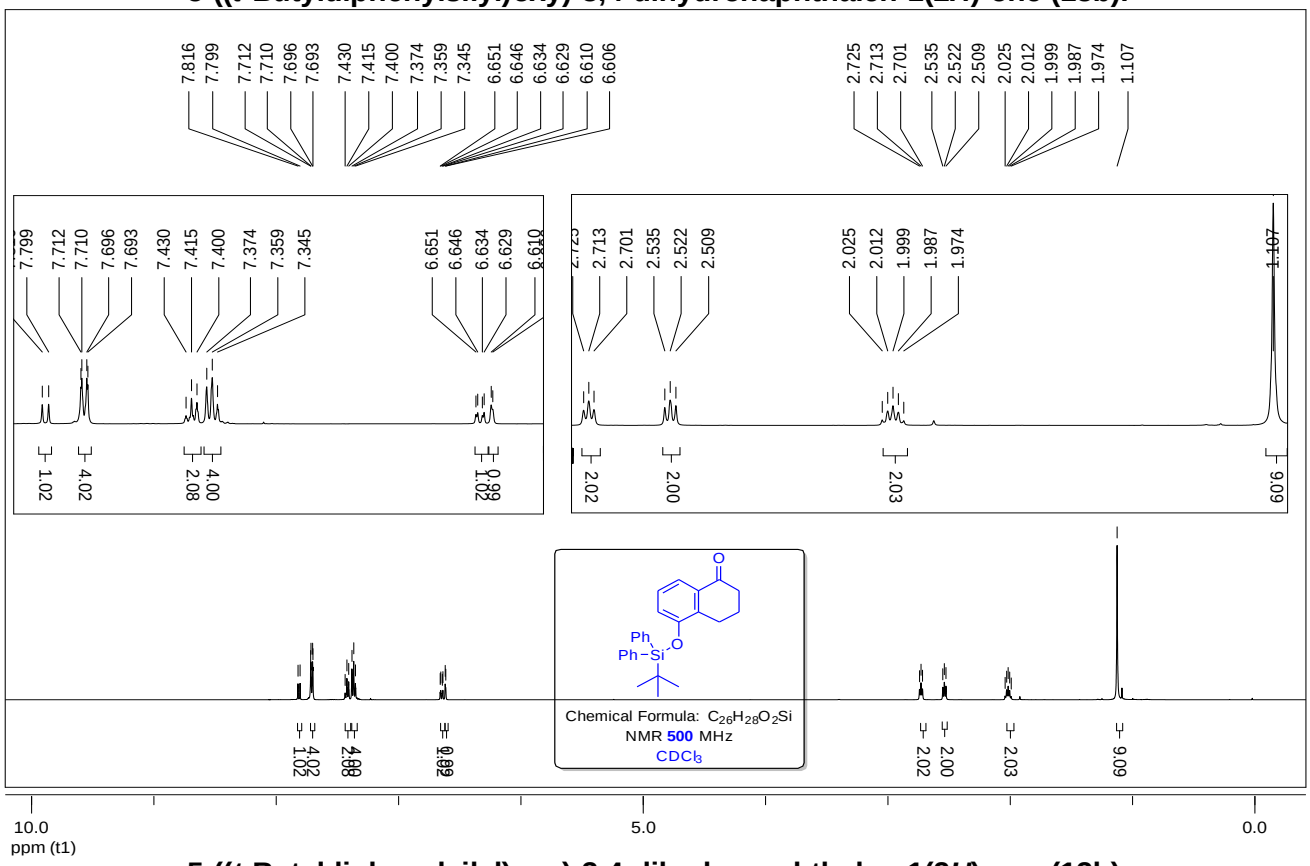
1 H. M. C. Ferraz, A. M. Aguilar and L. F. Silva, *Synthesis (Stuttg)*, 2003, **2003**, 1031–1034.

2 R. L. Jezorek, N. Zhang, P. Leowanawat, M. H. Bunner, N. Gutsche, A. K. R. Pesti, J. T. Olsen and V. Percec, *Org Lett*, 2014, **16**, 6326–6329.

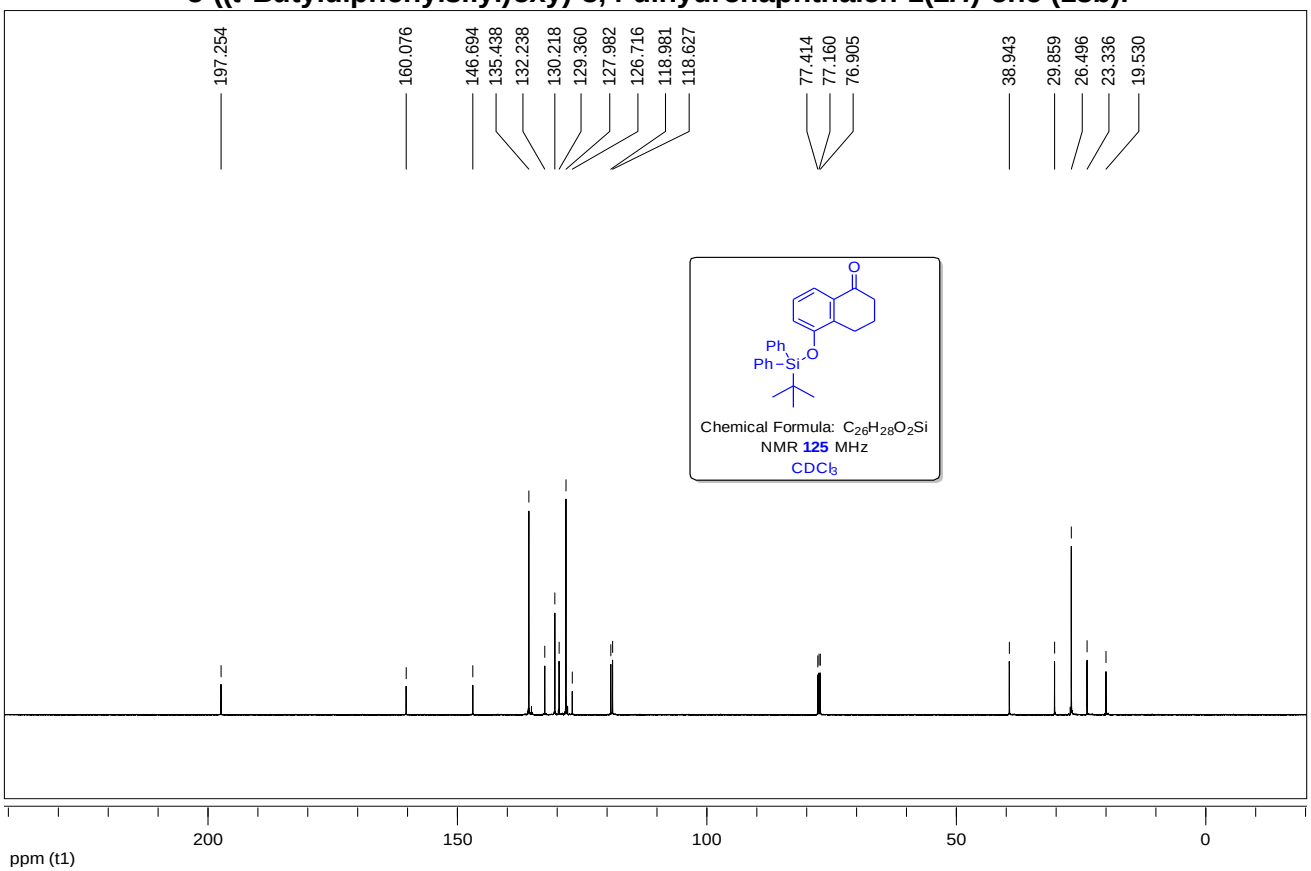
3 S. M. Rafiq, R. Sivasakthikumaran and A. K. Mohanakrishnan, *Org Lett*, 2014, **16**, 2720–2723.

4. Spectra:

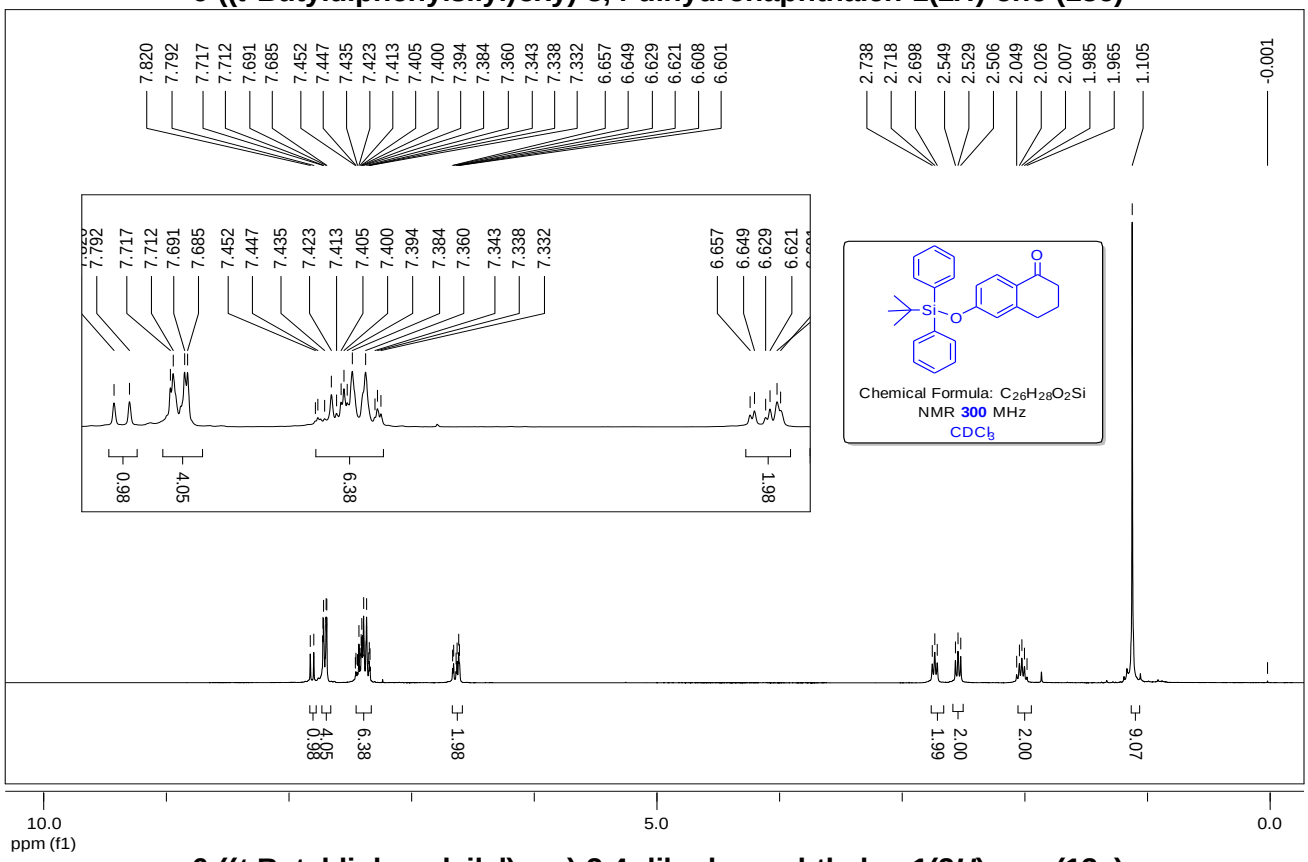
5-((*t*-Butyldiphenylsilyl)oxy)-3,4-dihydronaphthalen-1(2*H*)-one (13b).



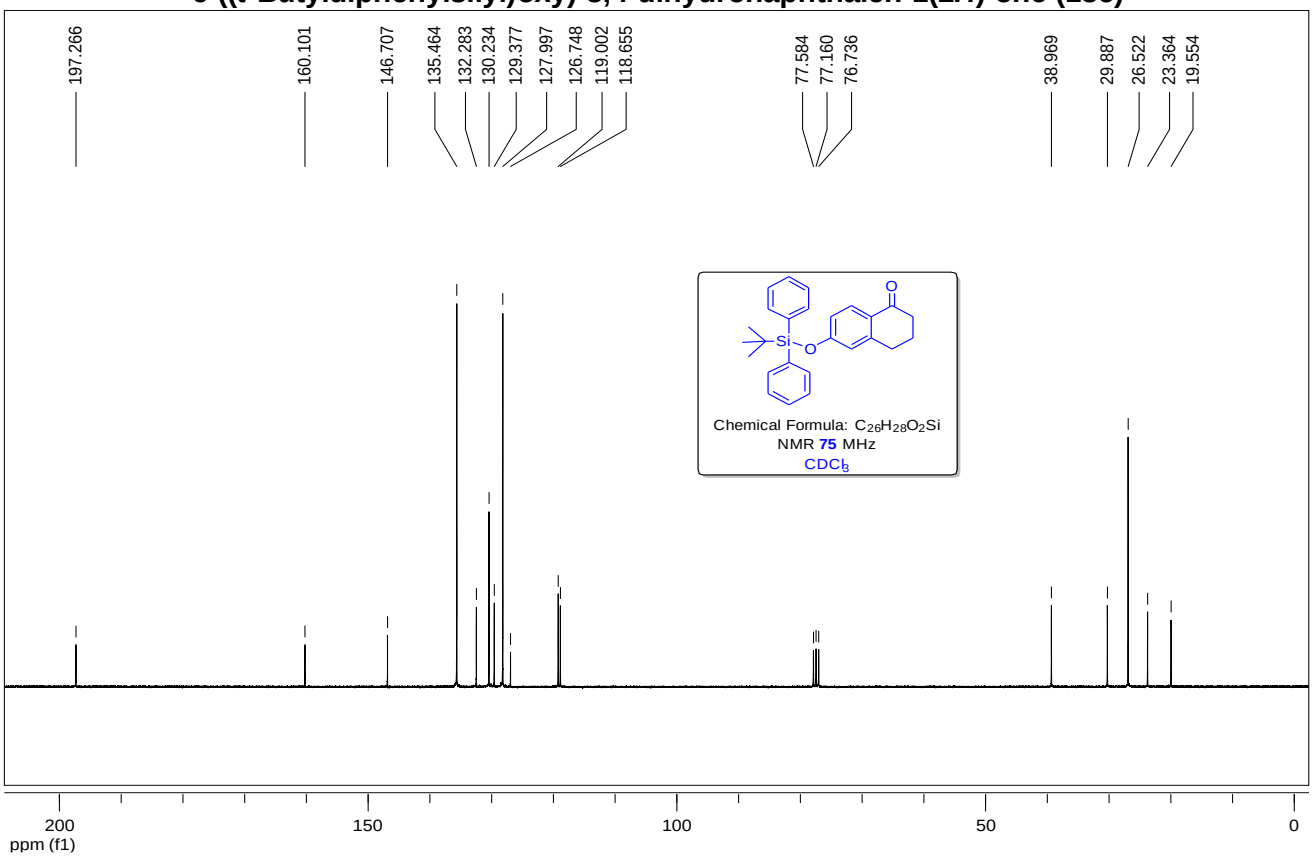
5-((*t*-Butyldiphenylsilyl)oxy)-3,4-dihydronaphthalen-1(2*H*)-one (13b).



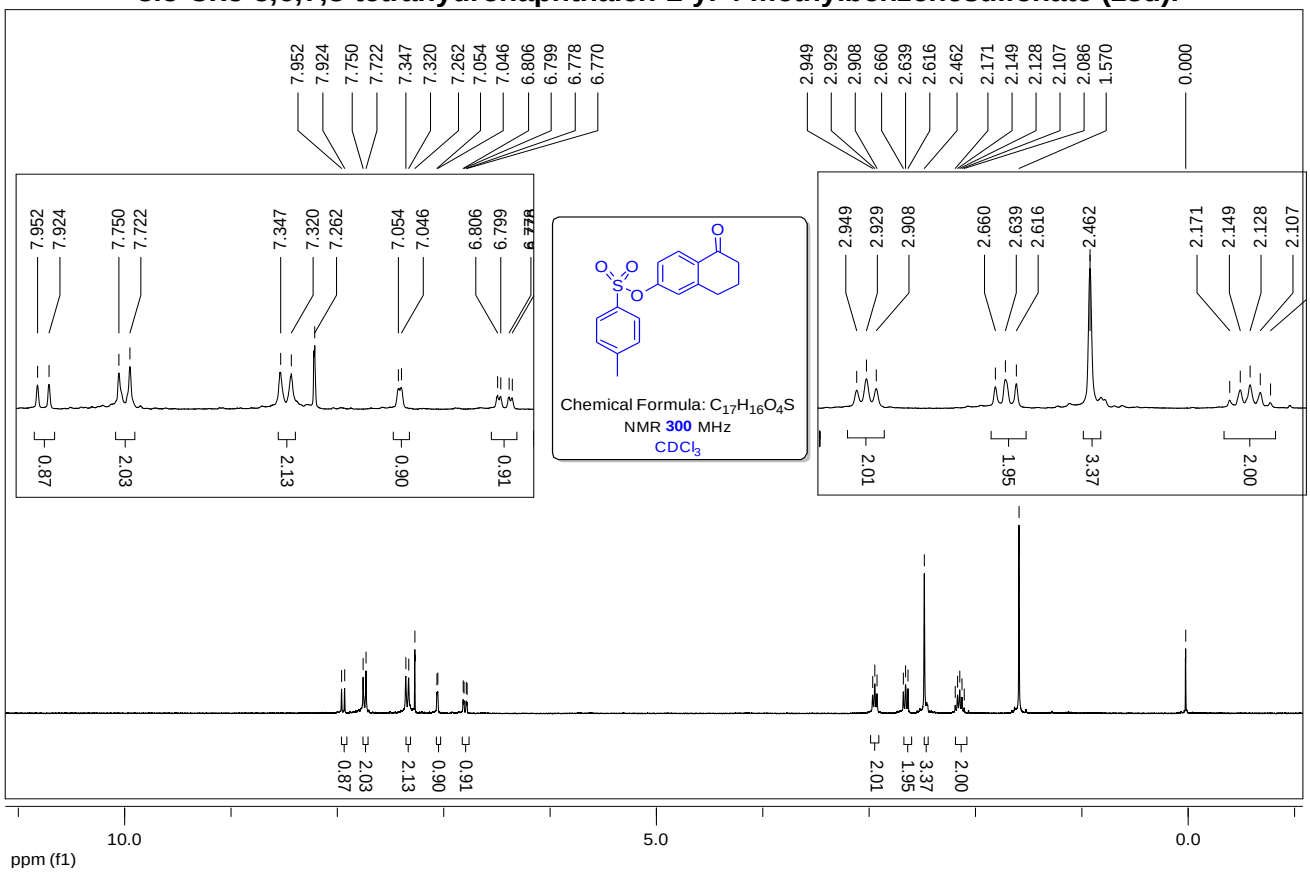
6-((*t*-Butyldiphenylsilyl)oxy)-3,4-dihydronaphthalen-1(2*H*)-one (13c)



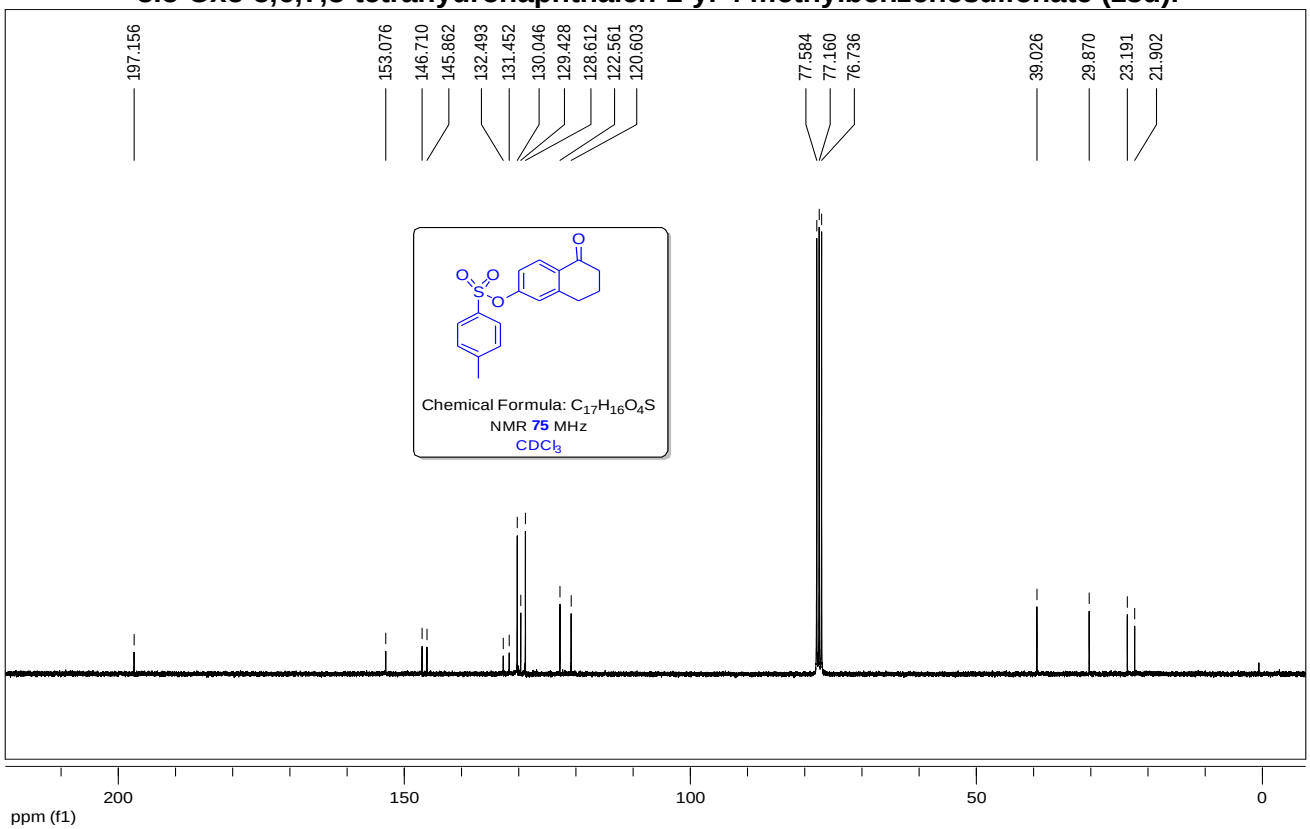
6-((*t*-Butyldiphenylsilyl)oxy)-3,4-dihydronaphthalen-1(2*H*)-one (13c)



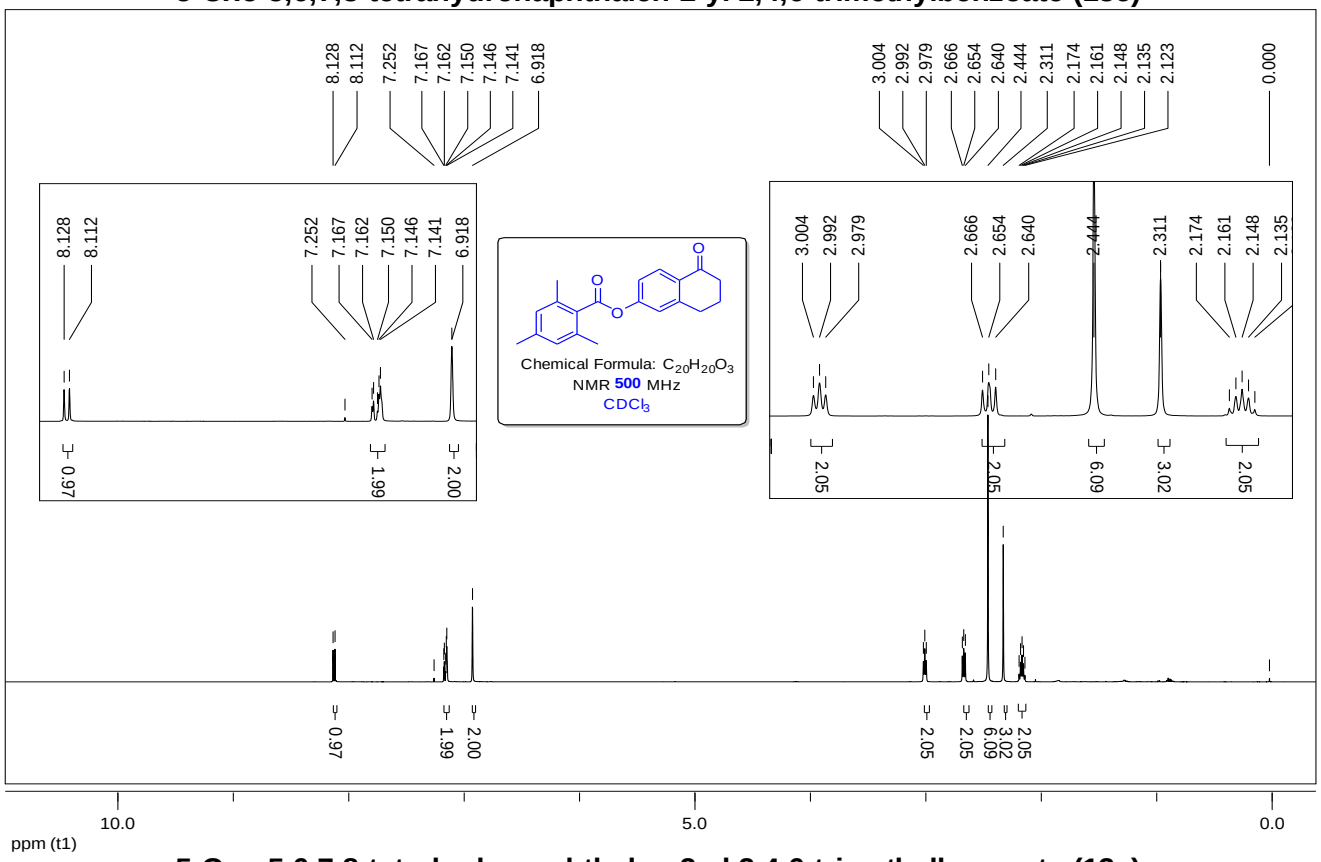
3.5-Oxo-5,6,7,8-tetrahydronaphthalen-2-yl 4-methylbenzenesulfonate (13d).



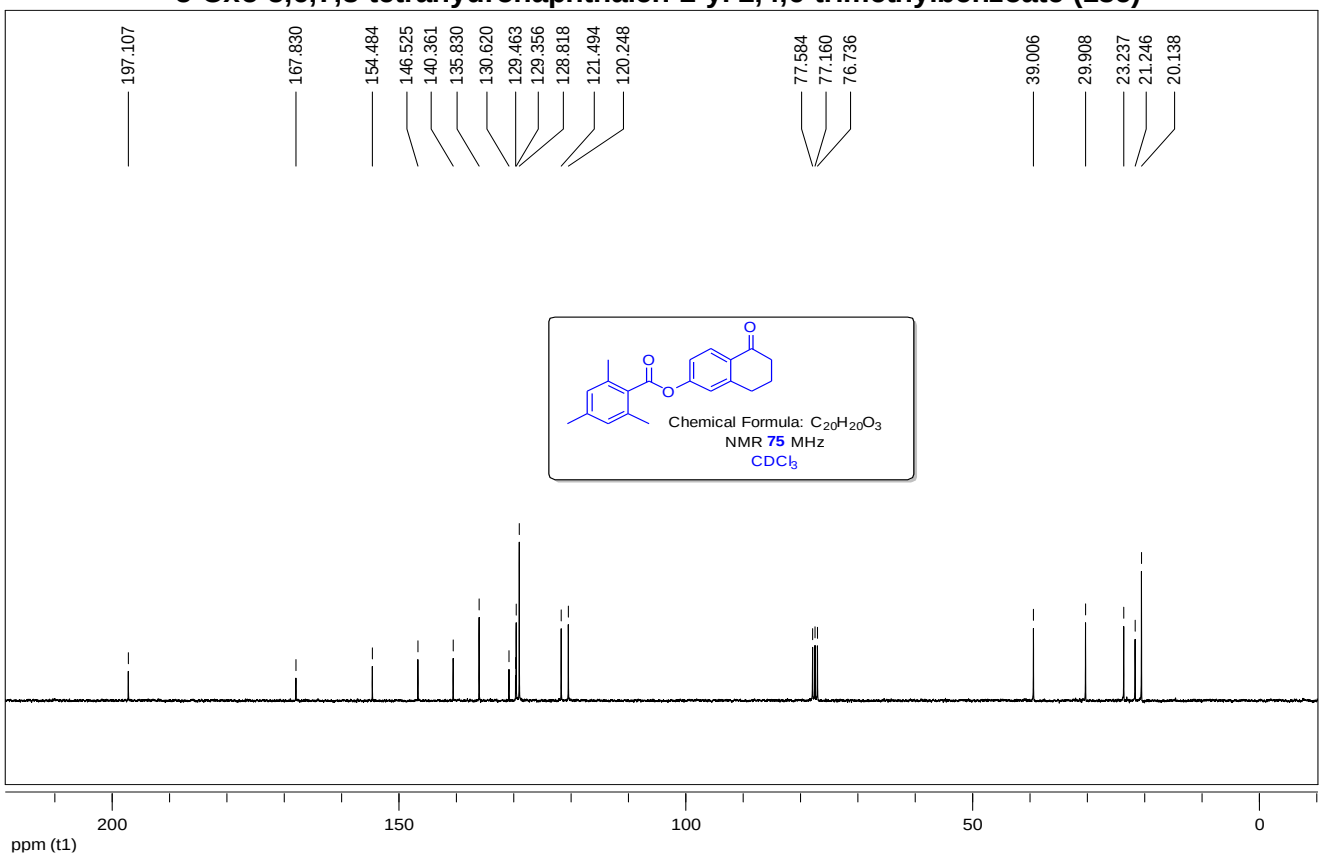
3.5-Oxo-5,6,7,8-tetrahydronaphthalen-2-yl 4-methylbenzenesulfonate (13d).



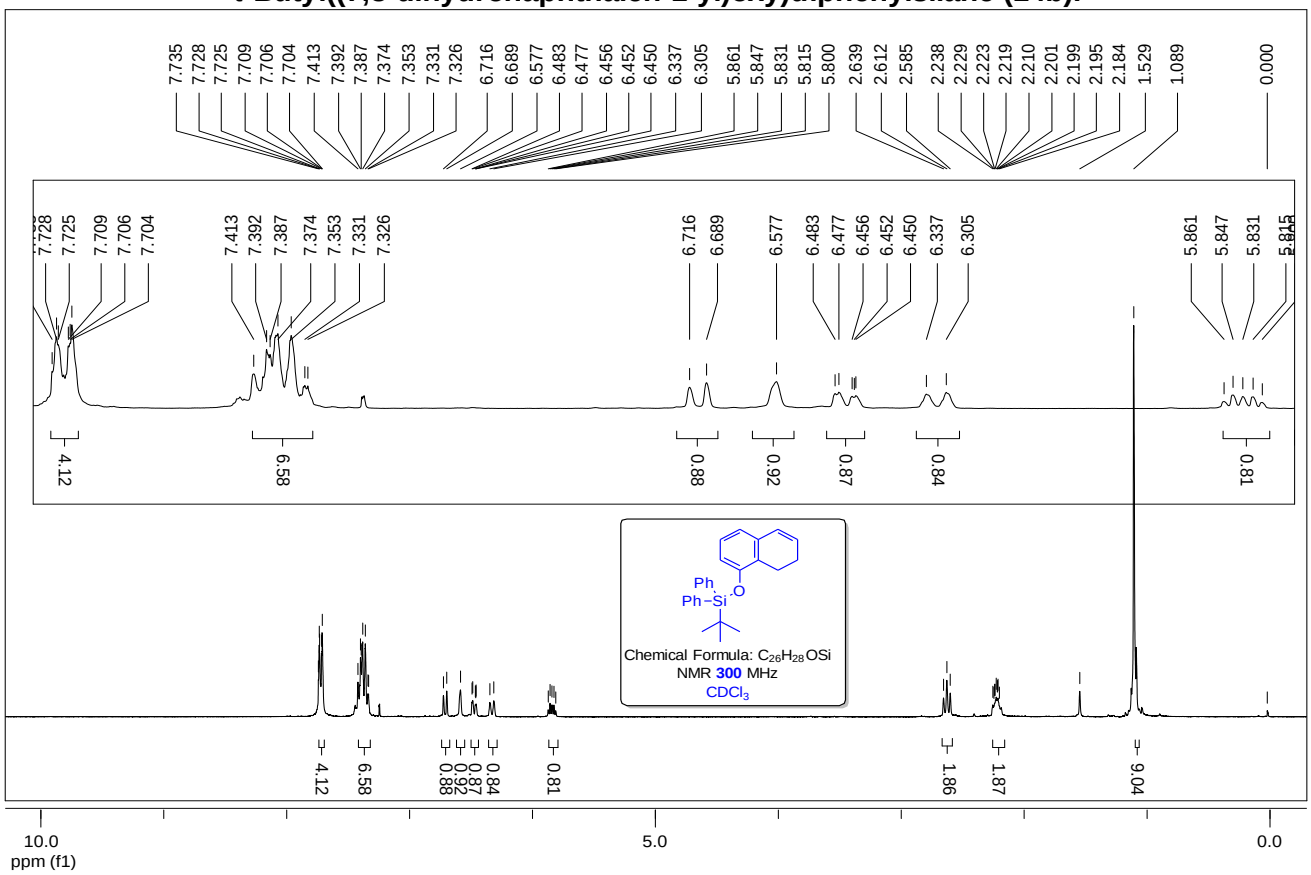
5-Oxo-5,6,7,8-tetrahydronaphthalen-2-yl 2,4,6-trimethylbenzoate (13e)



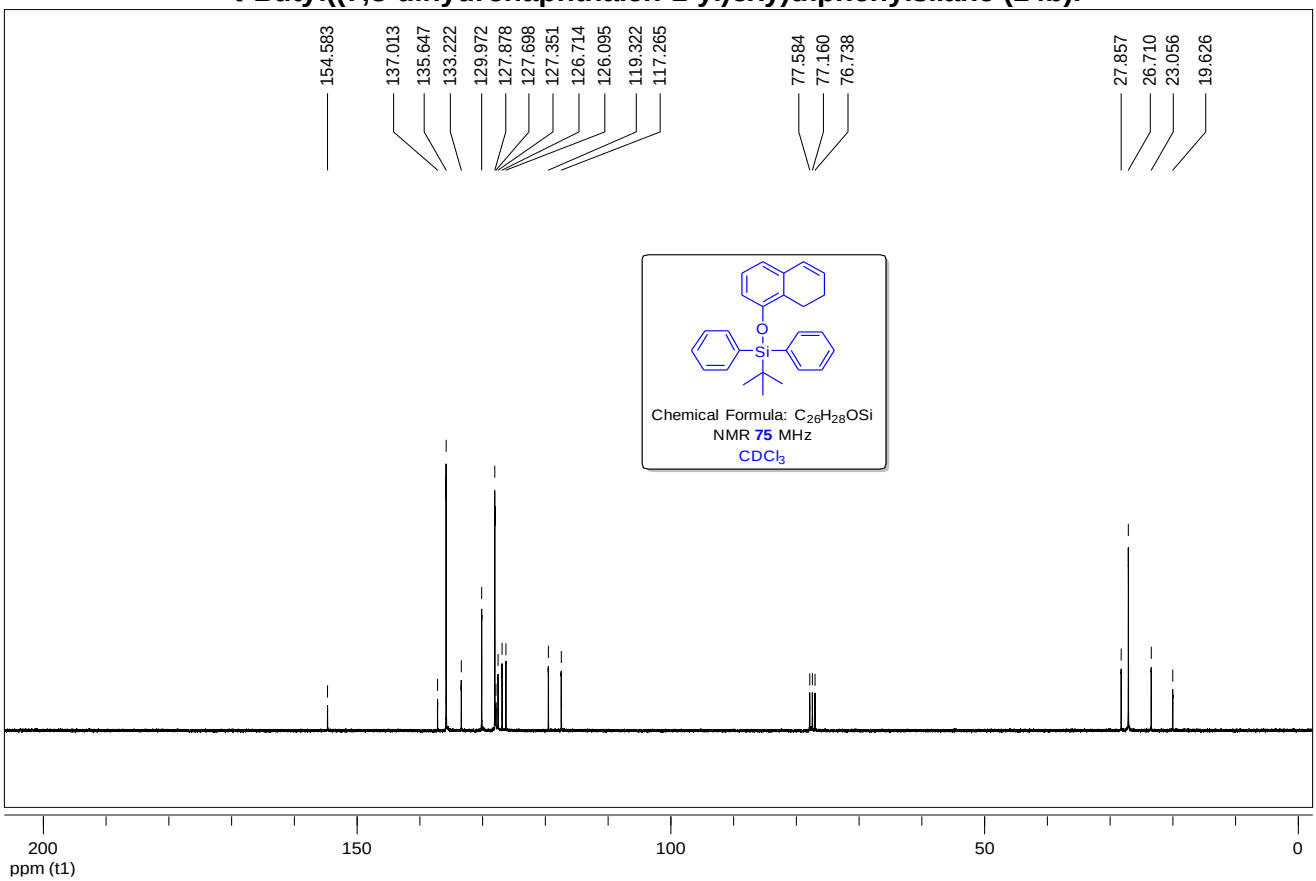
5-Oxo-5,6,7,8-tetrahydronaphthalen-2-yl 2,4,6-trimethylbenzoate (13e)



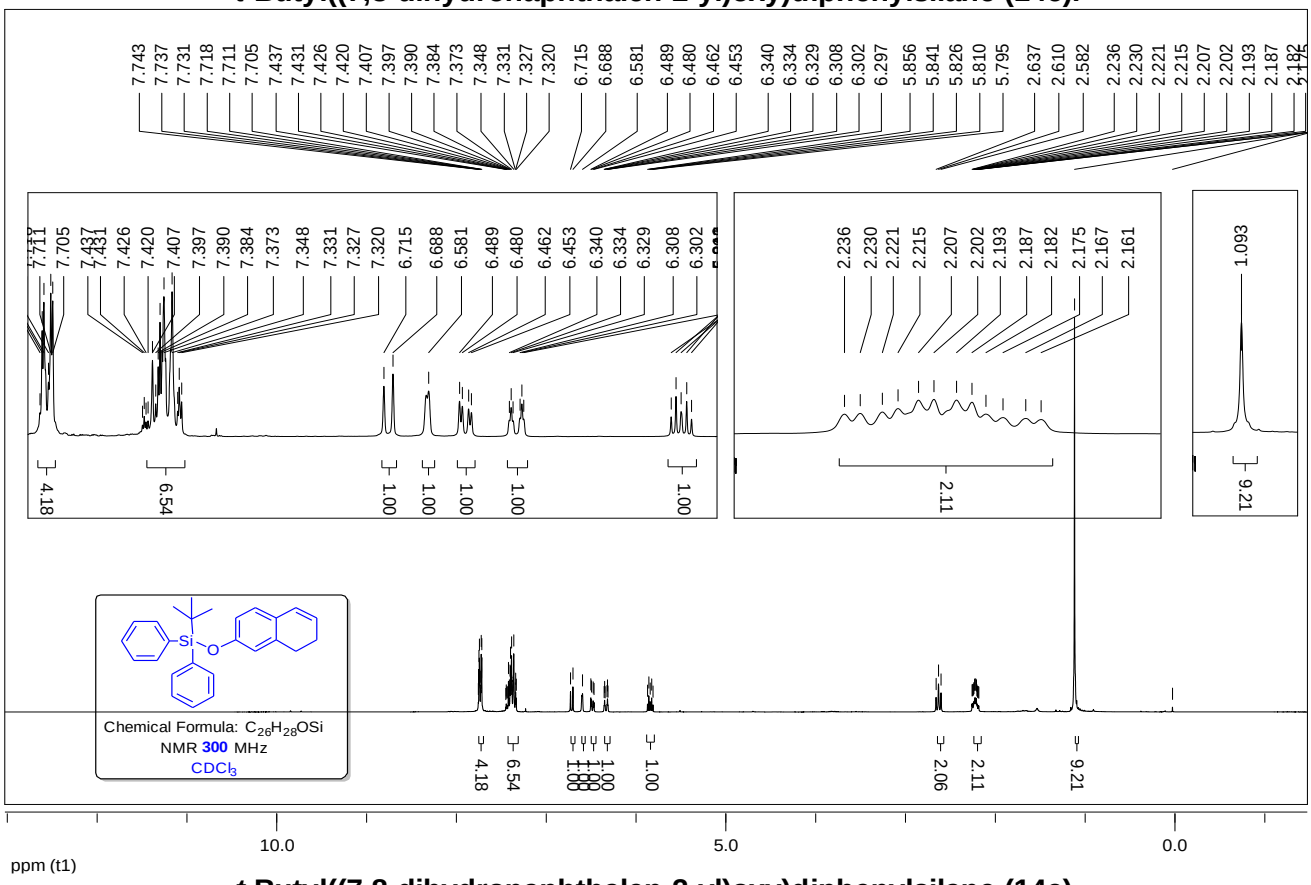
t-Butyl((7,8-dihydronaphthalen-1-yl)oxy)diphenylsilane (14b).



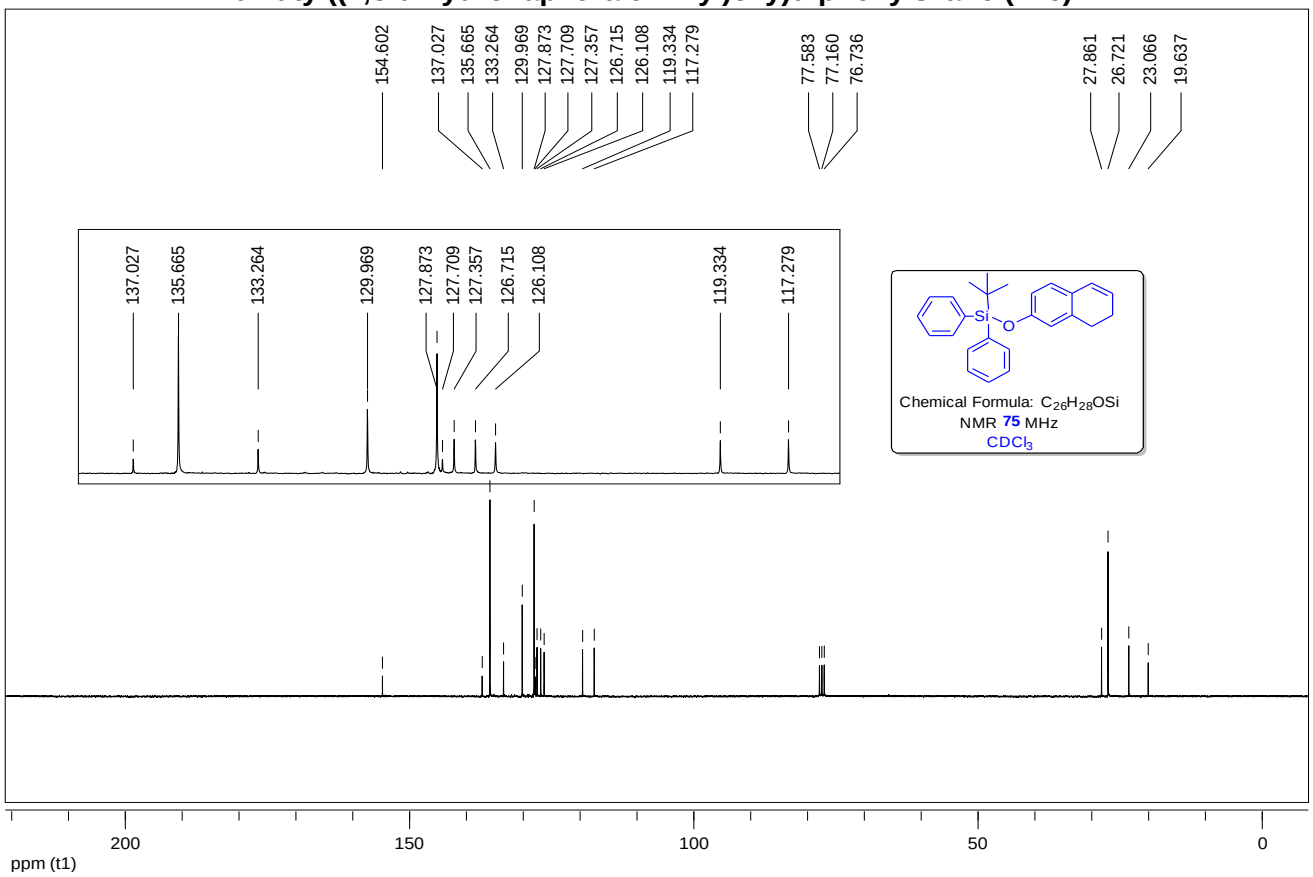
t-Butyl((7,8-dihydronaphthalen-1-yl)oxy)diphenylsilane (14b).



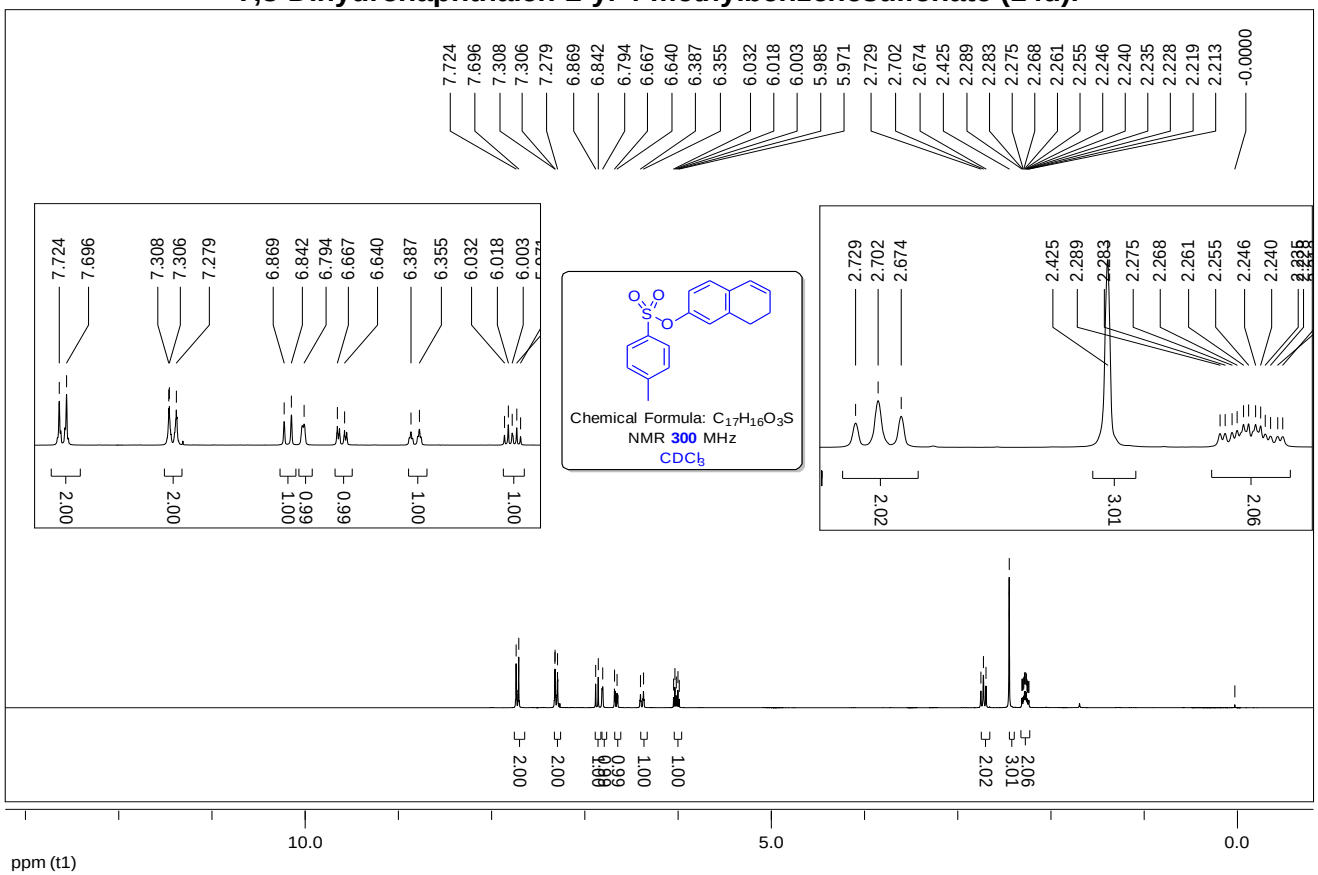
t-Butyl((7,8-dihydronaphthalen-2-yl)oxy)diphenylsilane (14c).



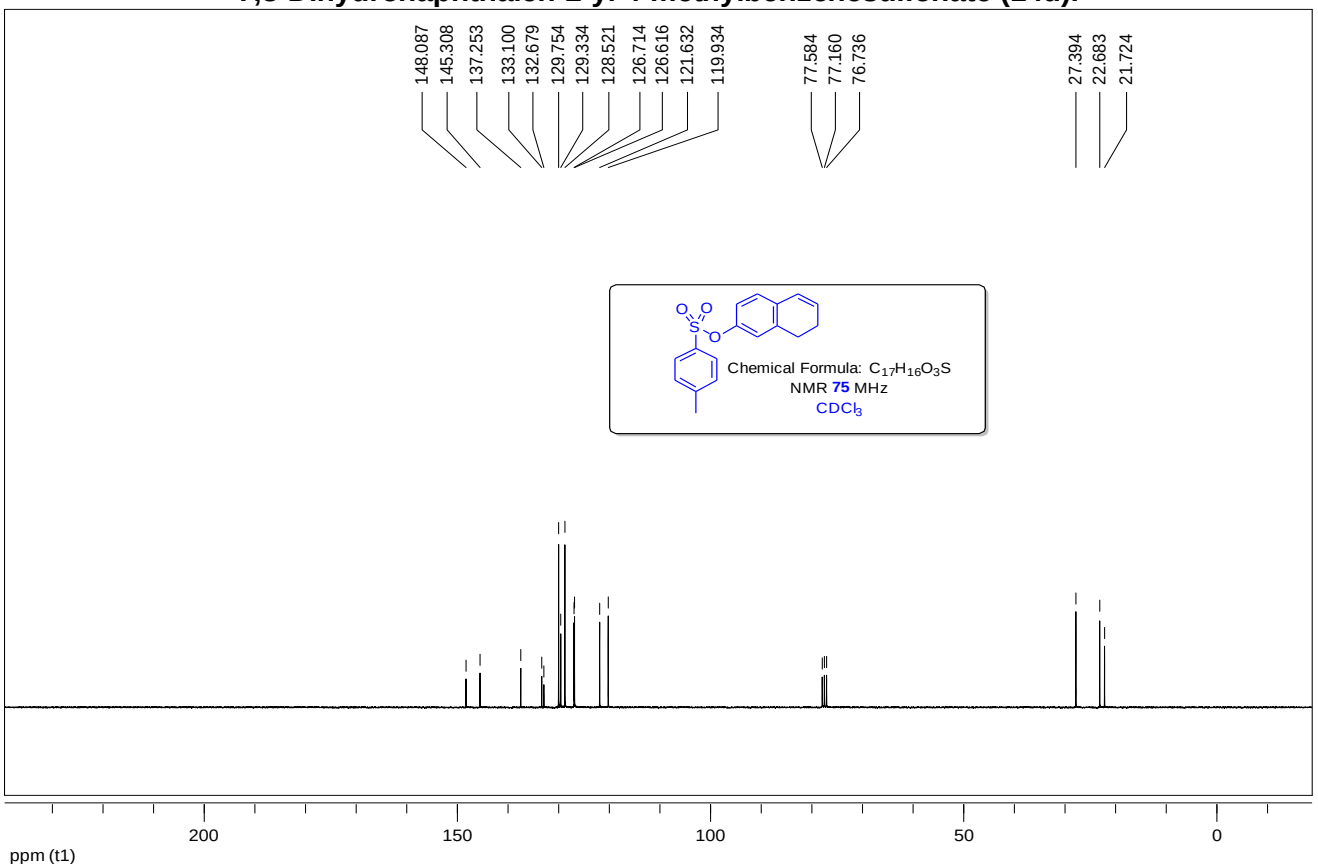
t-Butyl((7,8-dihydronaphthalen-2-yl)oxy)diphenylsilane (14c).



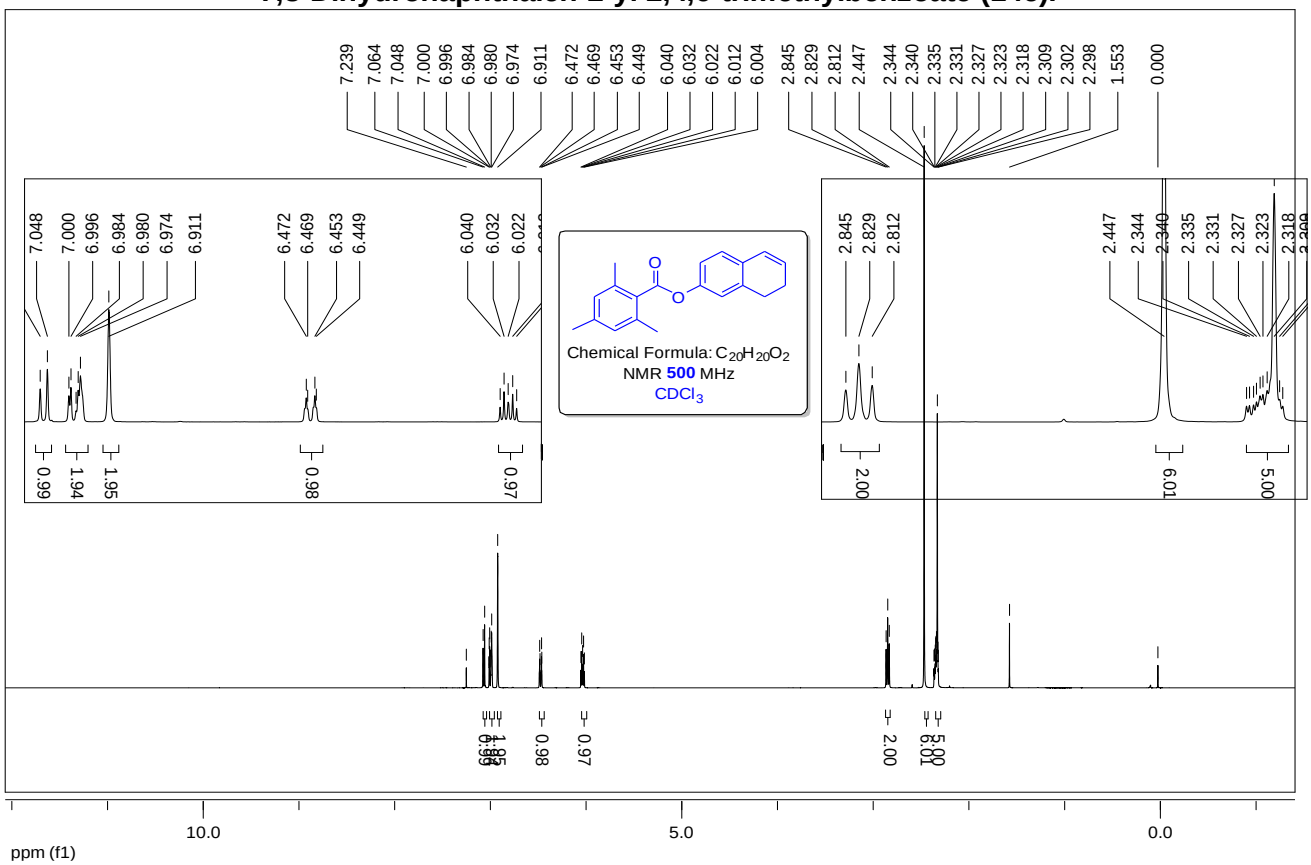
7,8-Dihydronaphthalen-2-yl 4-methylbenzenesulfonate (14d).



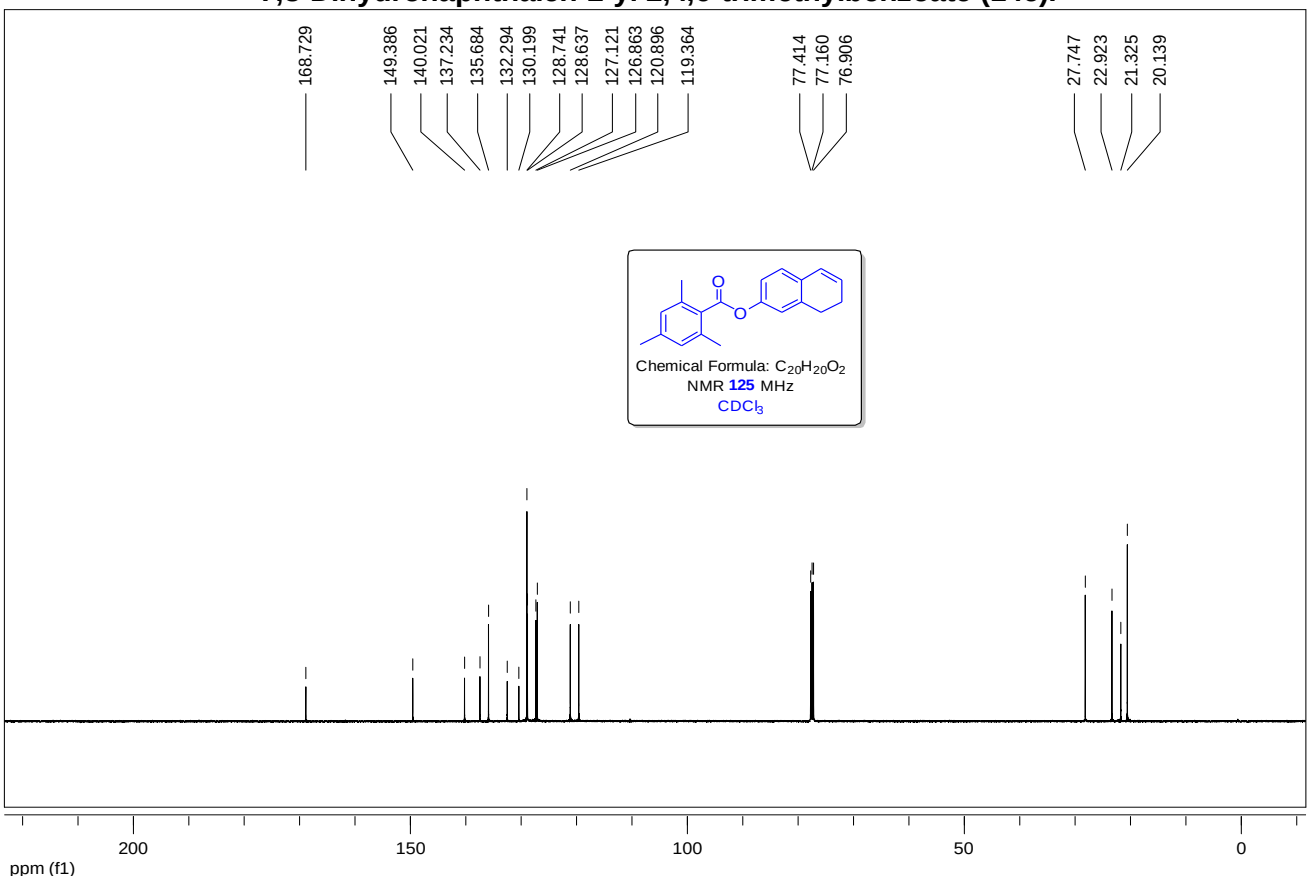
7,8-Dihydronaphthalen-2-yl 4-methylbenzenesulfonate (14d).



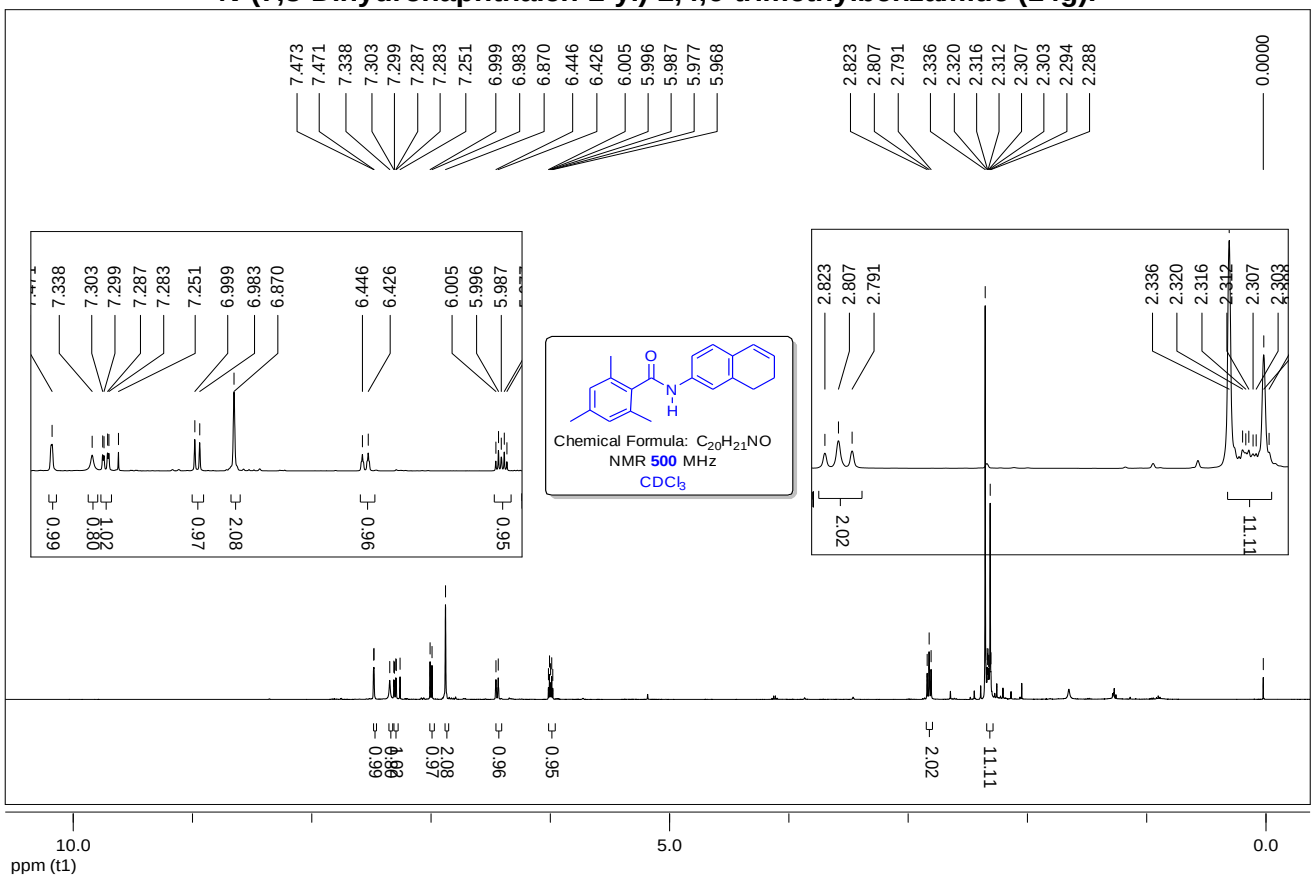
7,8-Dihydronaphthalen-2-yl 2,4,6-trimethylbenzoate (14e).



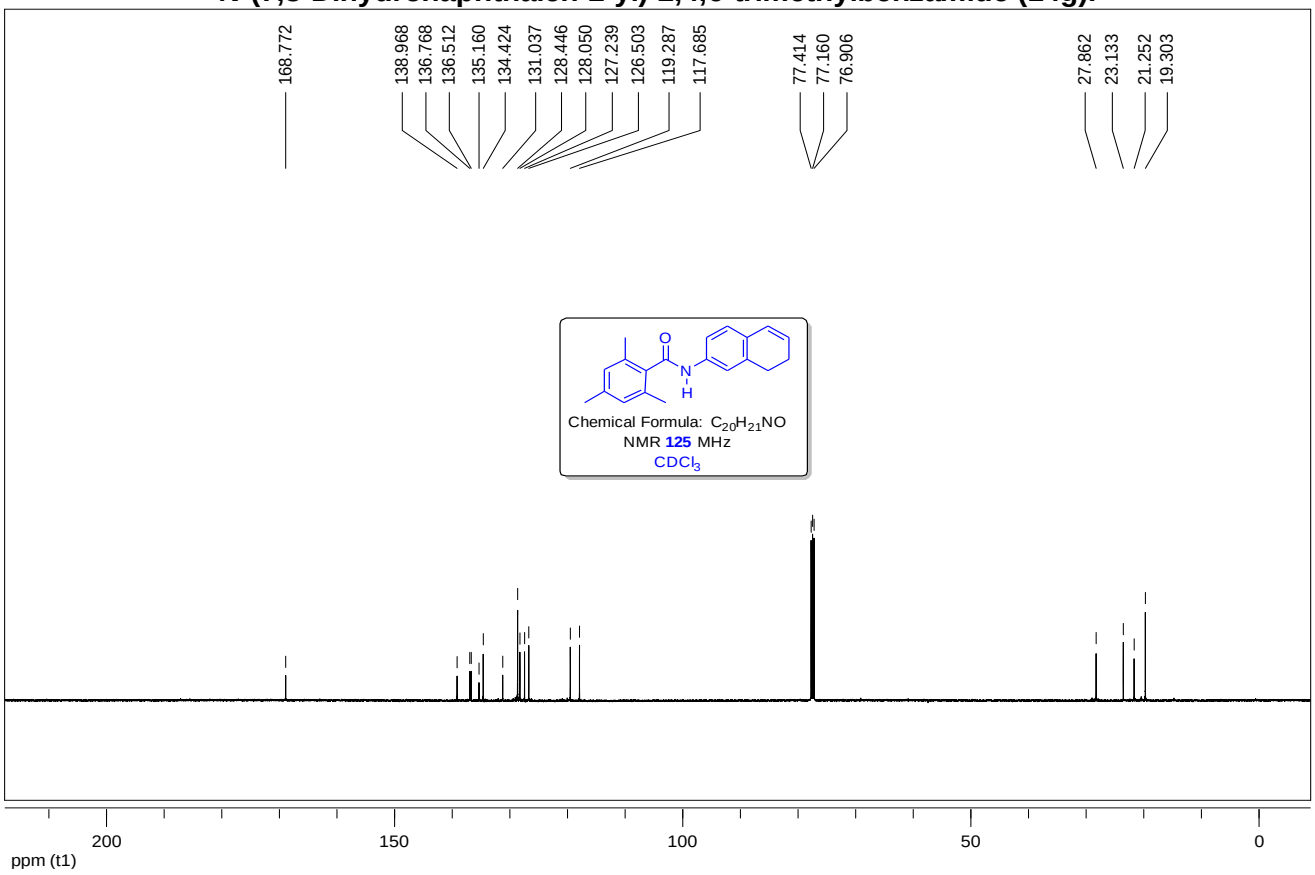
7,8-Dihydronaphthalen-2-yl 2,4,6-trimethylbenzoate (14e).



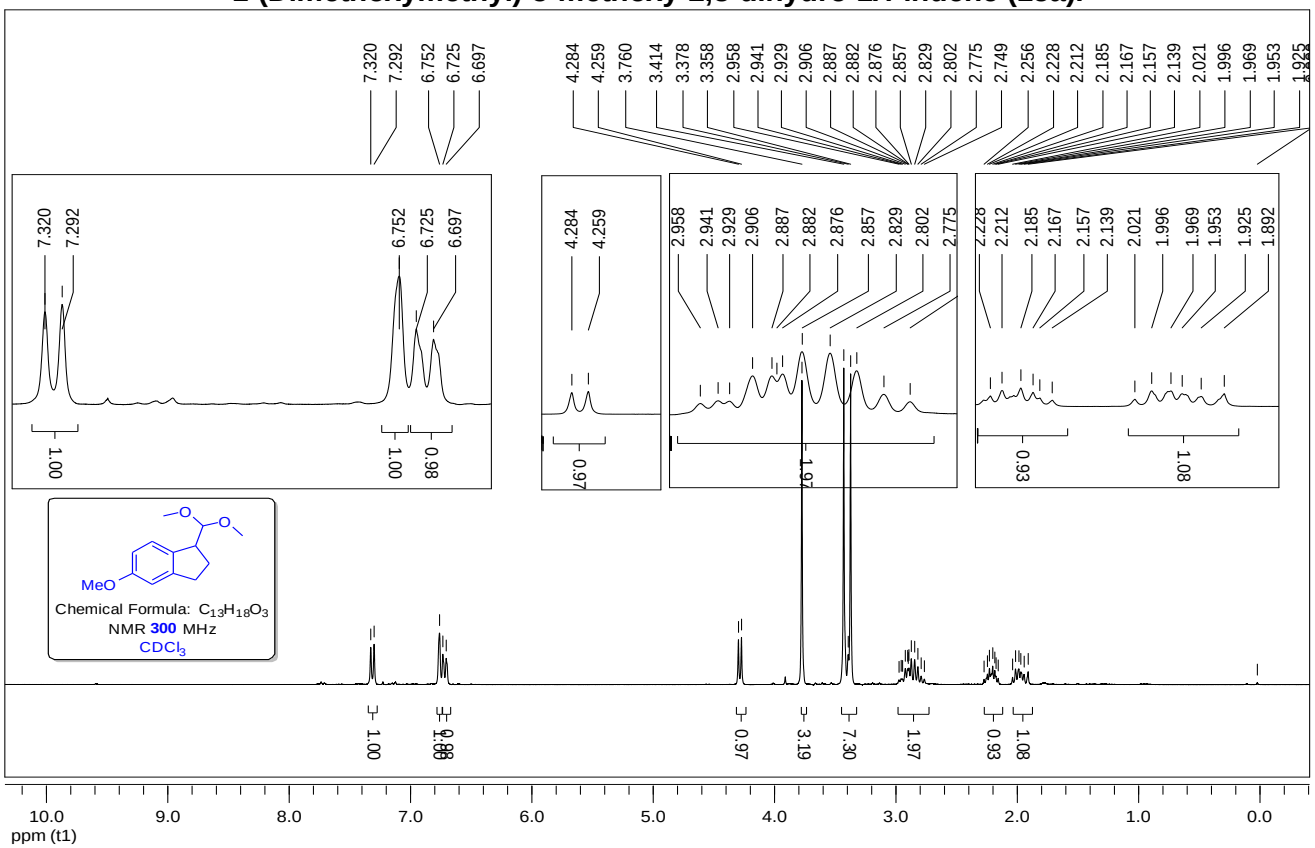
_N_-(7,8-Dihydronaphthalen-2-yl)-2,4,6-trimethylbenzamide (14g).



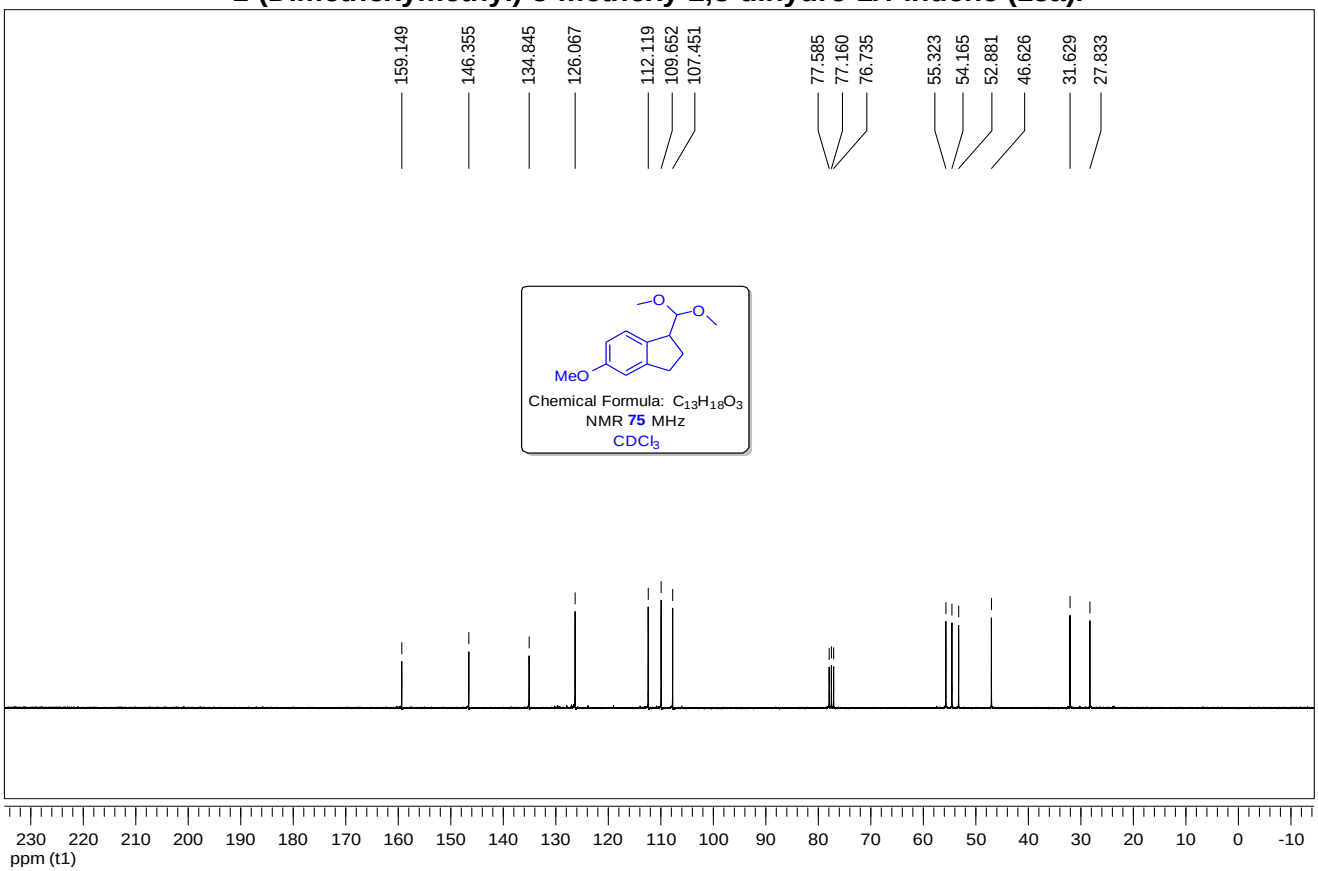
_N_-(7,8-Dihydronaphthalen-2-yl)-2,4,6-trimethylbenzamide (14g).



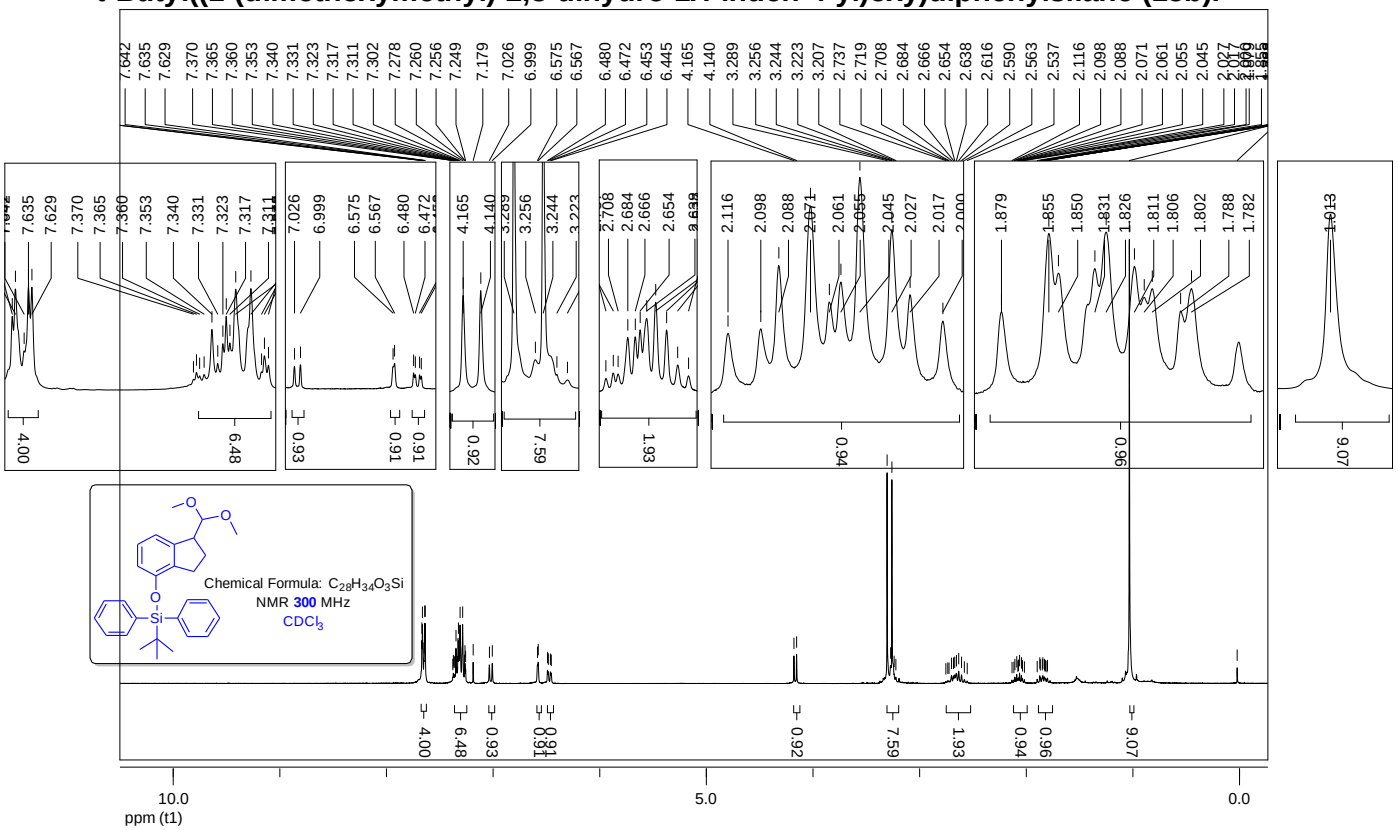
1-(Dimethoxymethyl)-5-methoxy-2,3-dihydro-1*H*-indene (15a).



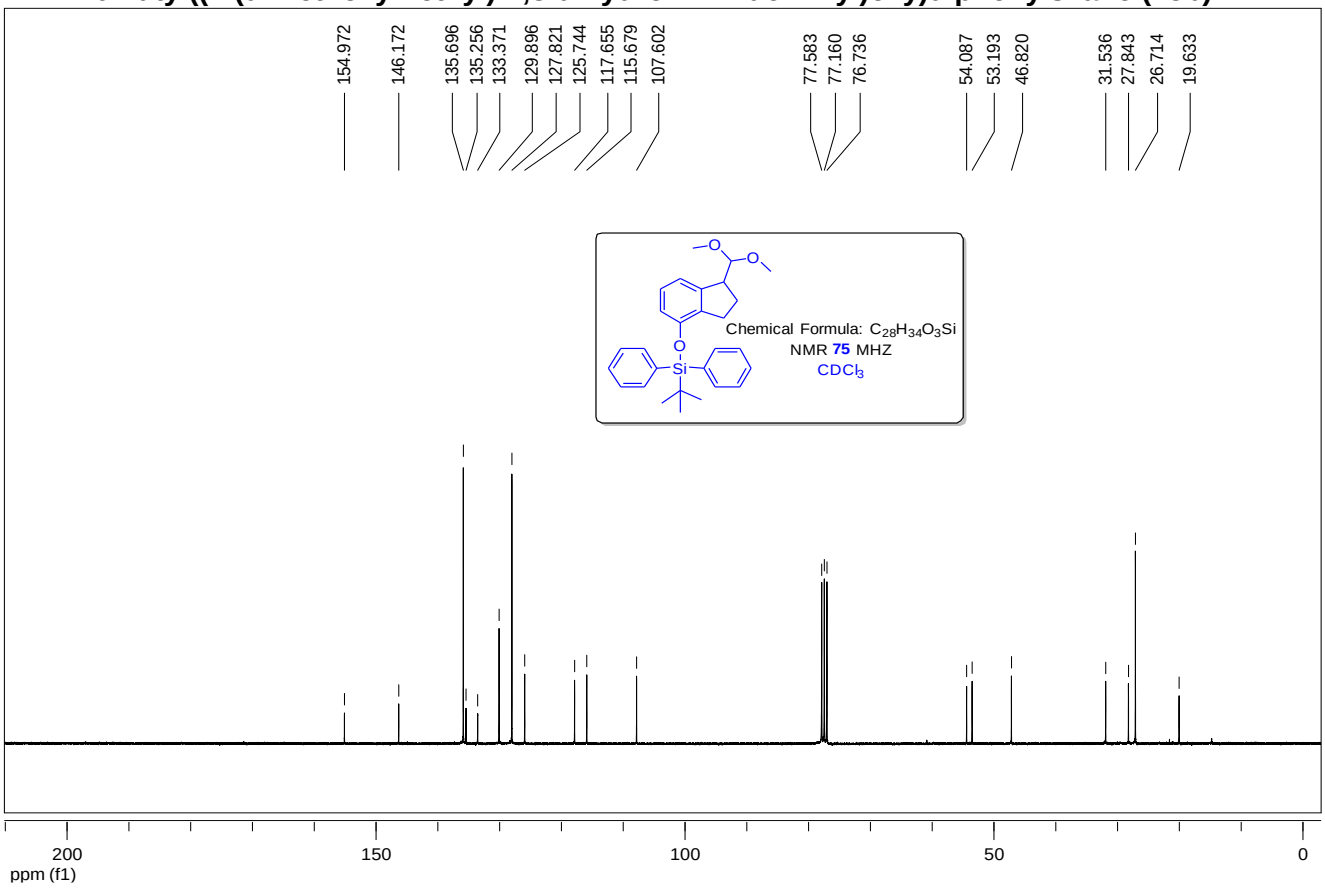
1-(Dimethoxymethyl)-5-methoxy-2,3-dihydro-1*H*-indene (15a).



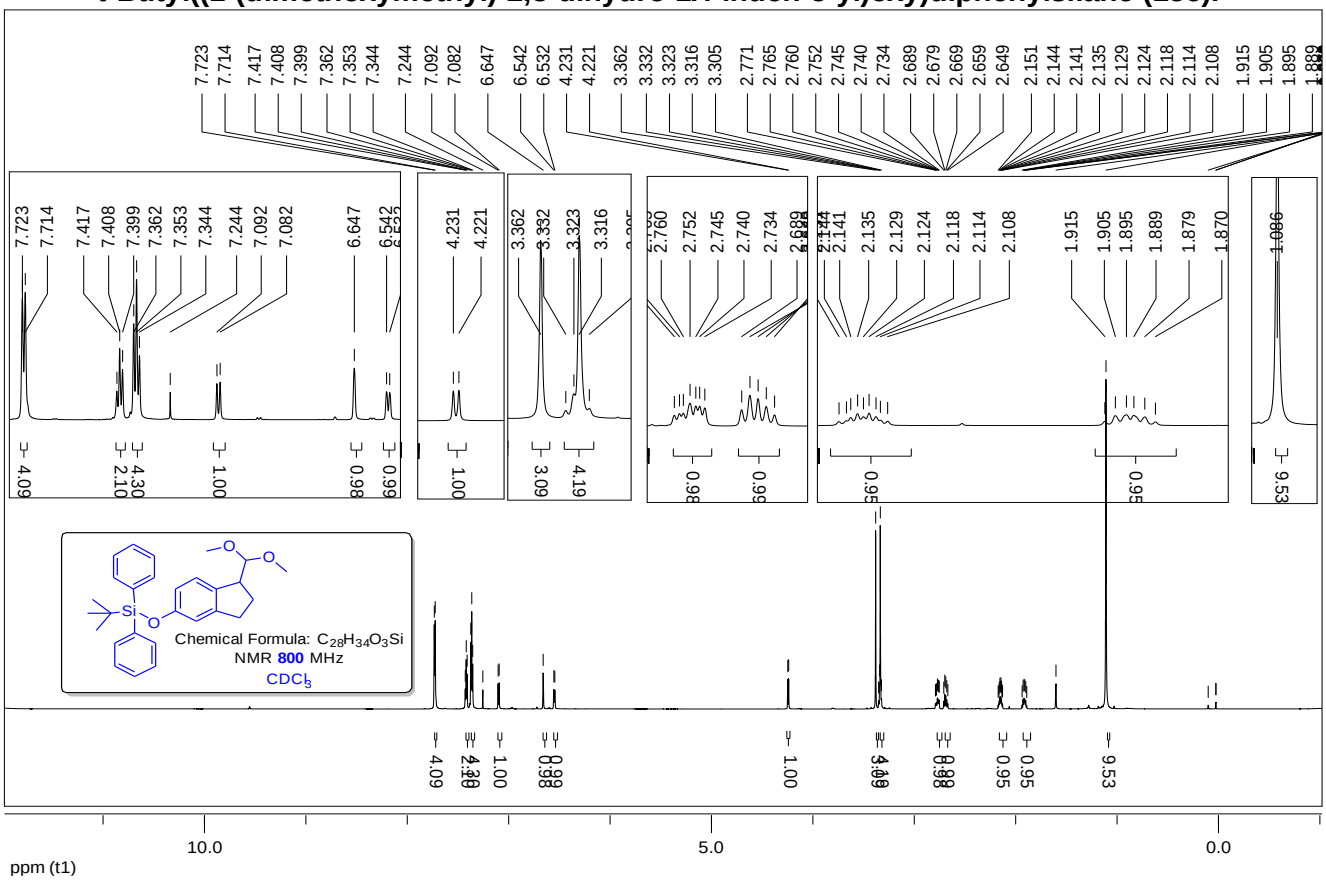
***t*-Butyl((1-(dimethoxymethyl)-2,3-dihydro-1*H*-inden-4-yl)oxy)diphenylsilane (15b).**



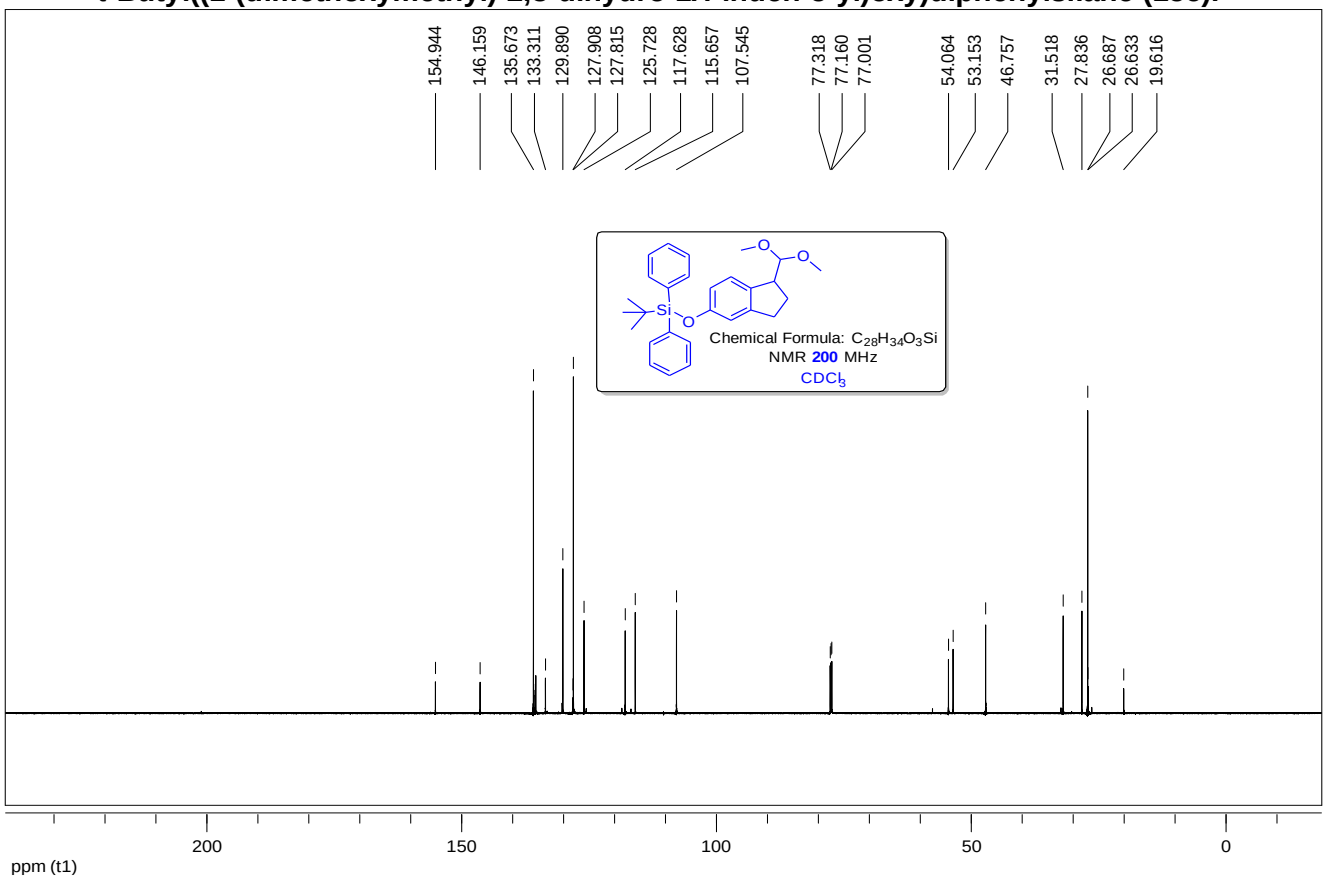
***t*-Butyl((1-(dimethoxymethyl)-2,3-dihydro-1*H*-inden-4-yl)oxy)diphenylsilane (15b).**



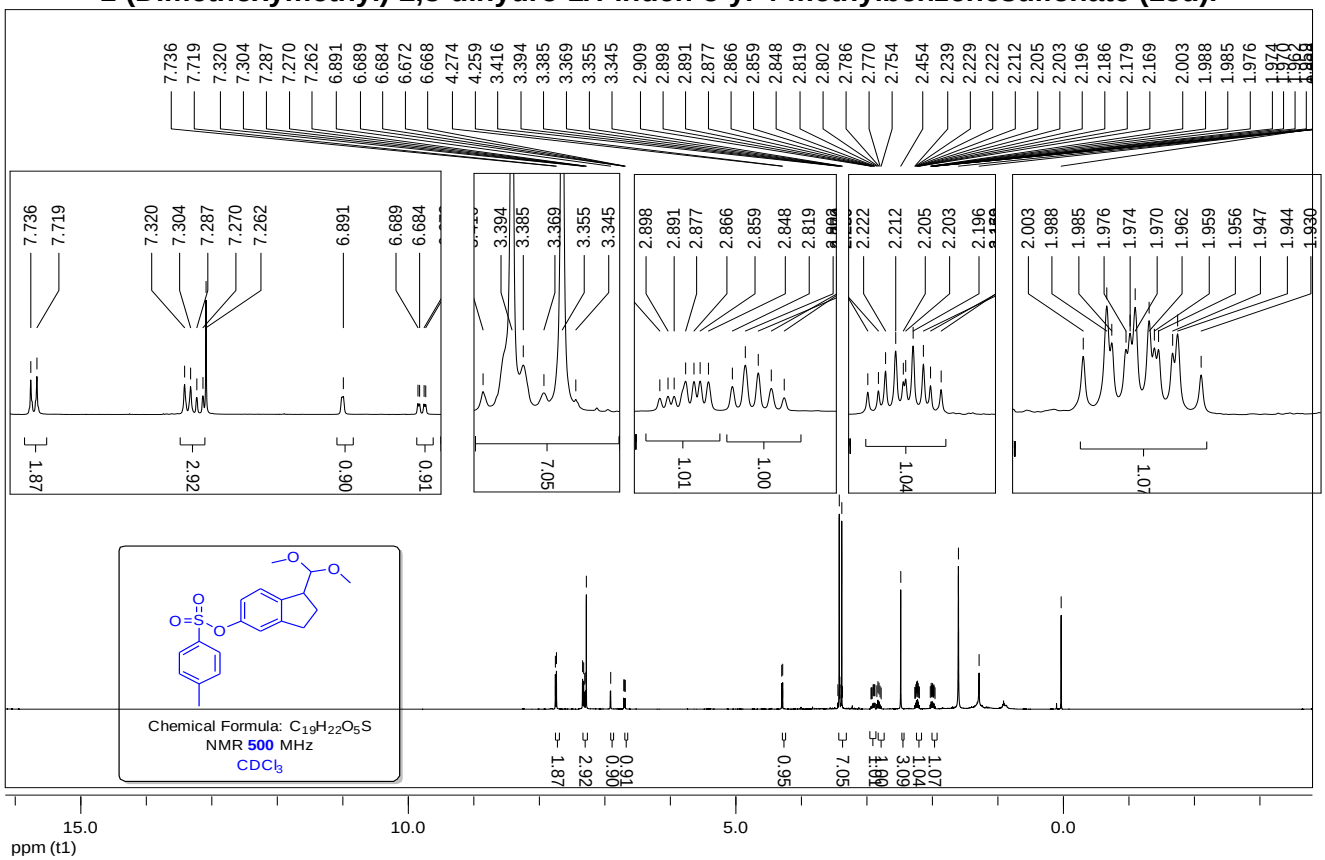
_t_-Butyl((1-(dimethoxymethyl)-2,3-dihydro-1_H_-inden-5-yl)oxy)diphenylsilane (15c).



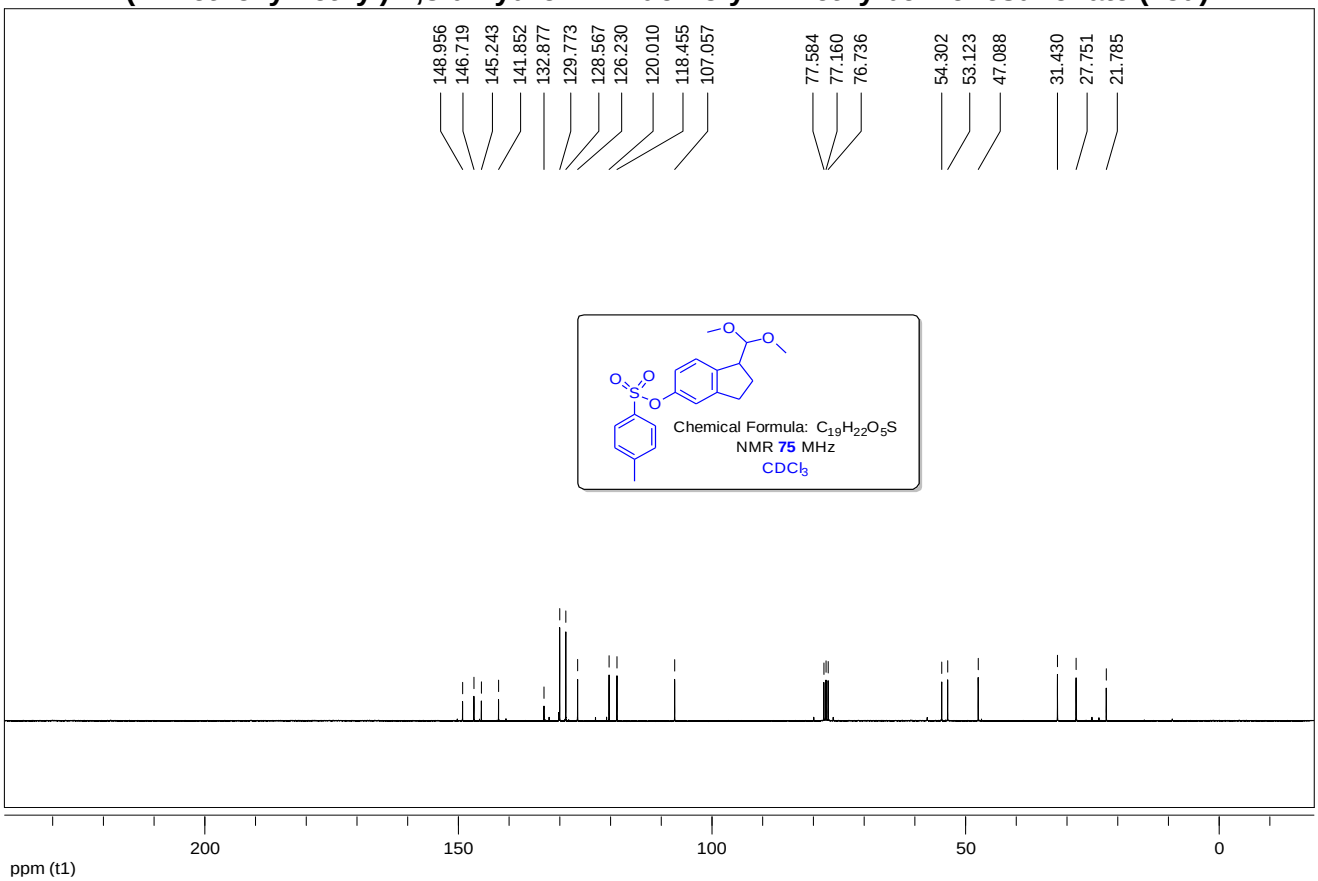
_t_-Butyl((1-(dimethoxymethyl)-2,3-dihydro-1_H_-inden-5-yl)oxy)diphenylsilane (15c).



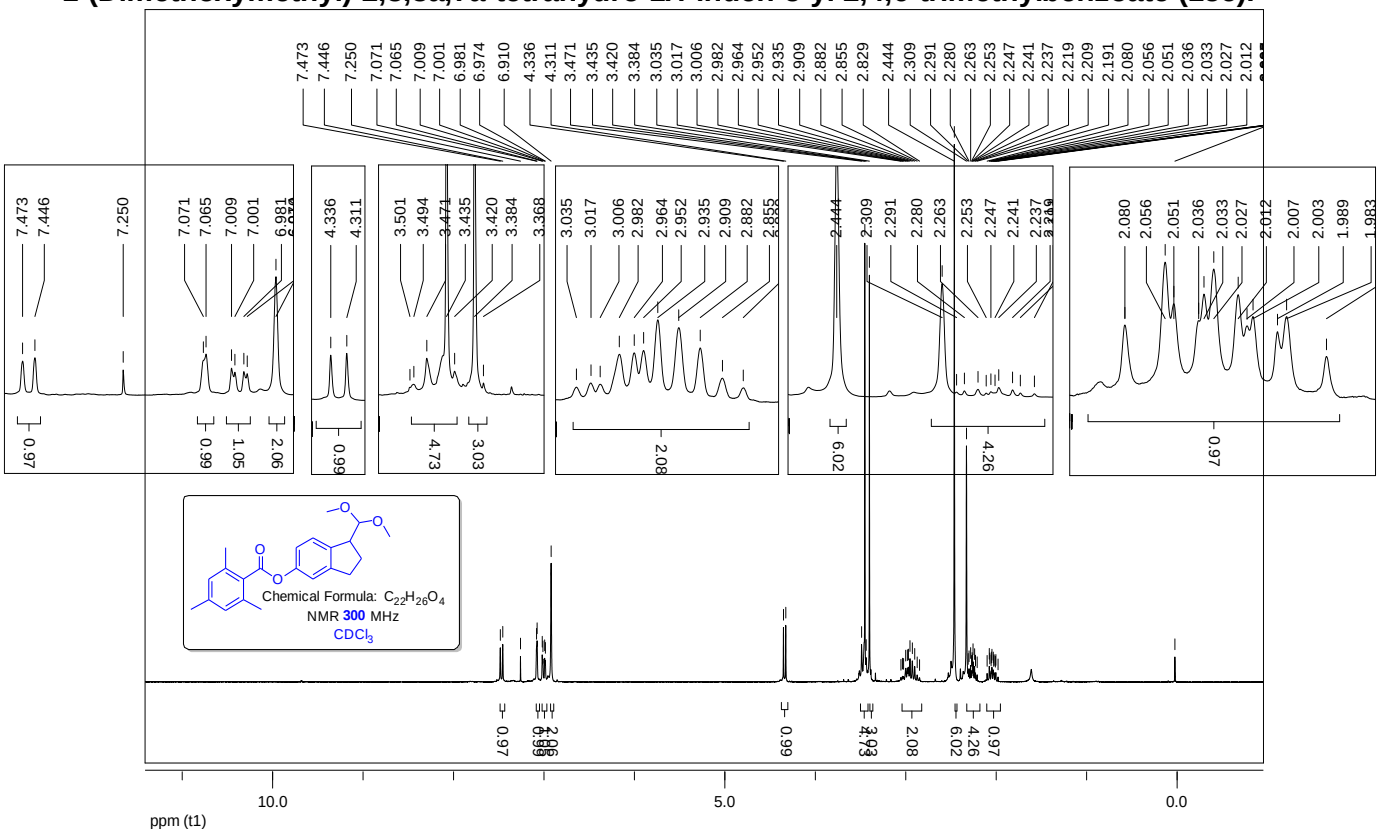
1-(Dimethoxymethyl)-2,3-dihydro-1*H*-inden-5-yl 4-methylbenzenesulfonate (15d).



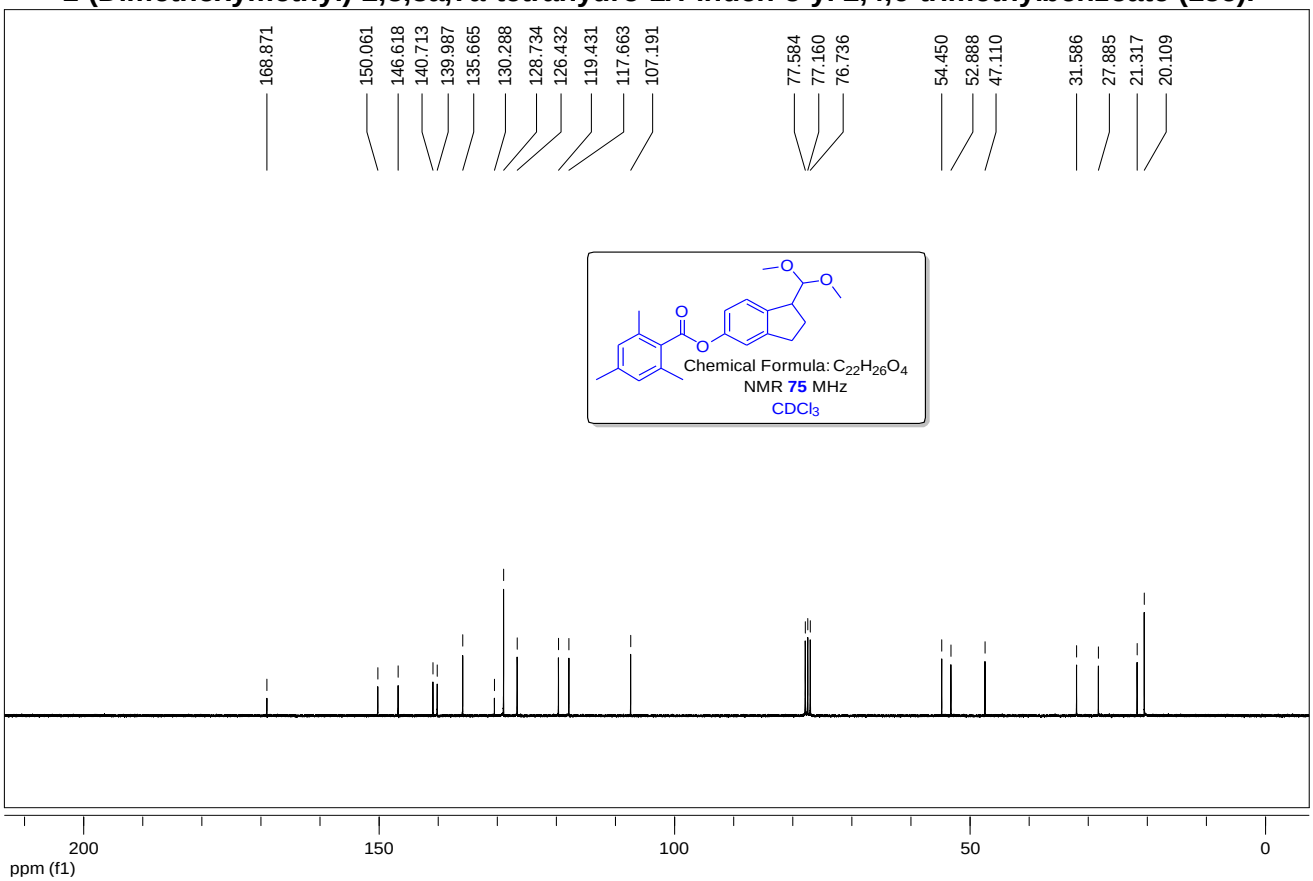
1-(Dimethoxymethyl)-2,3-dihydro-1*H*-inden-5-yl 4-methylbenzenesulfonate (15d).



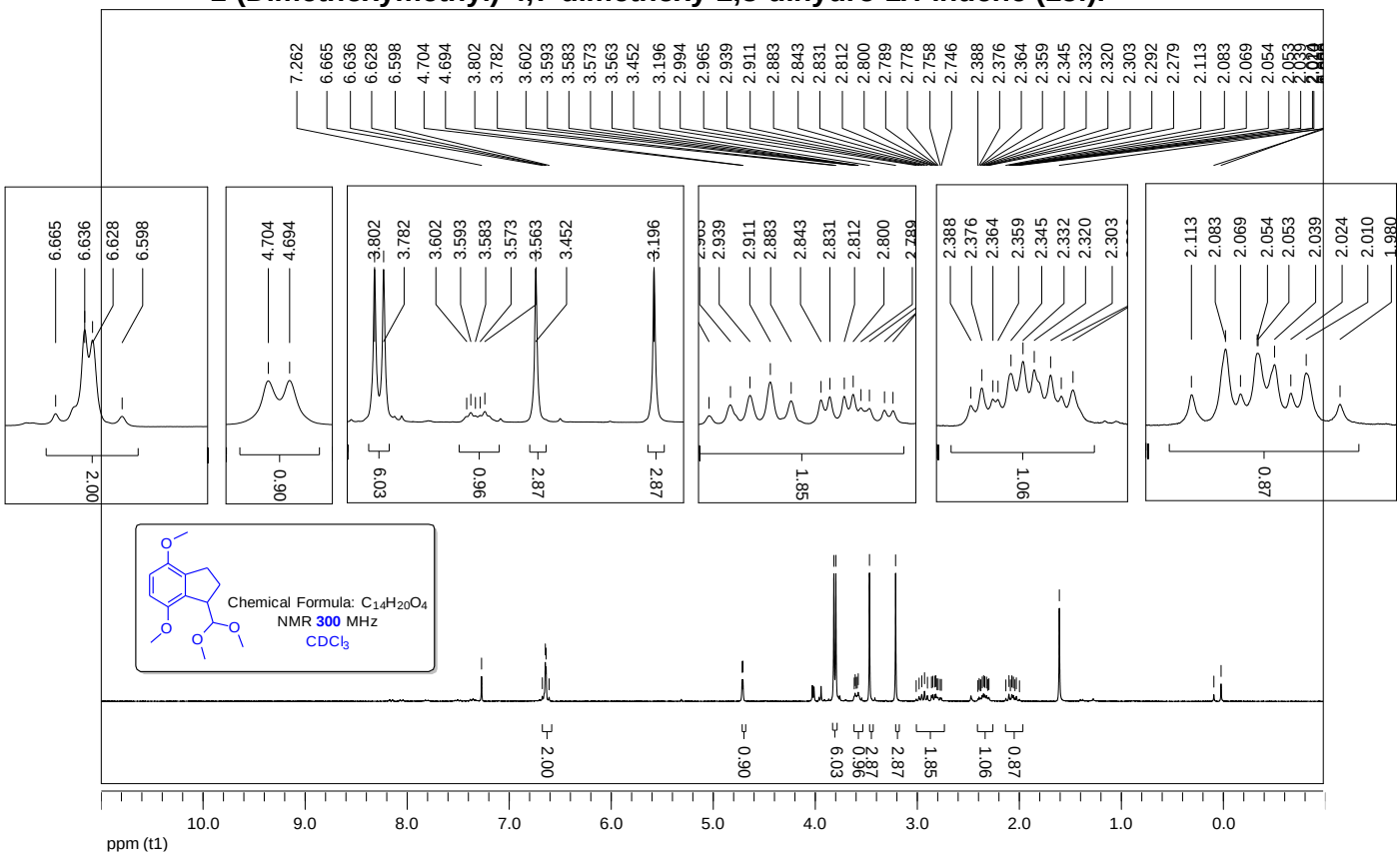
1-(Dimethoxymethyl)-2,3,3a,7a-tetrahydro-1*H*-inden-5-yl 2,4,6-trimethylbenzoate (15e).



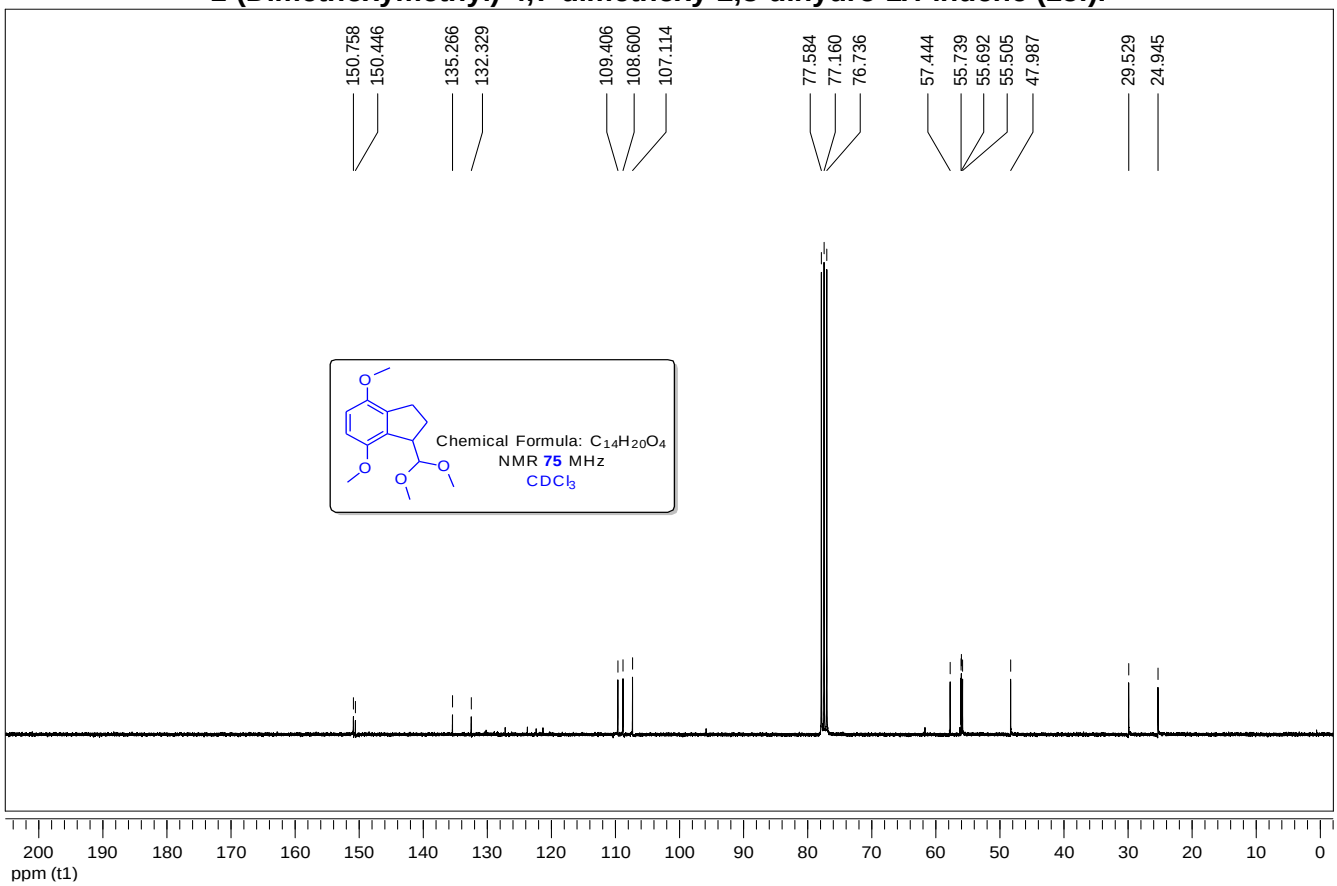
1-(Dimethoxymethyl)-2,3,3a,7a-tetrahydro-1*H*-inden-5-yl 2,4,6-trimethylbenzoate (15e).



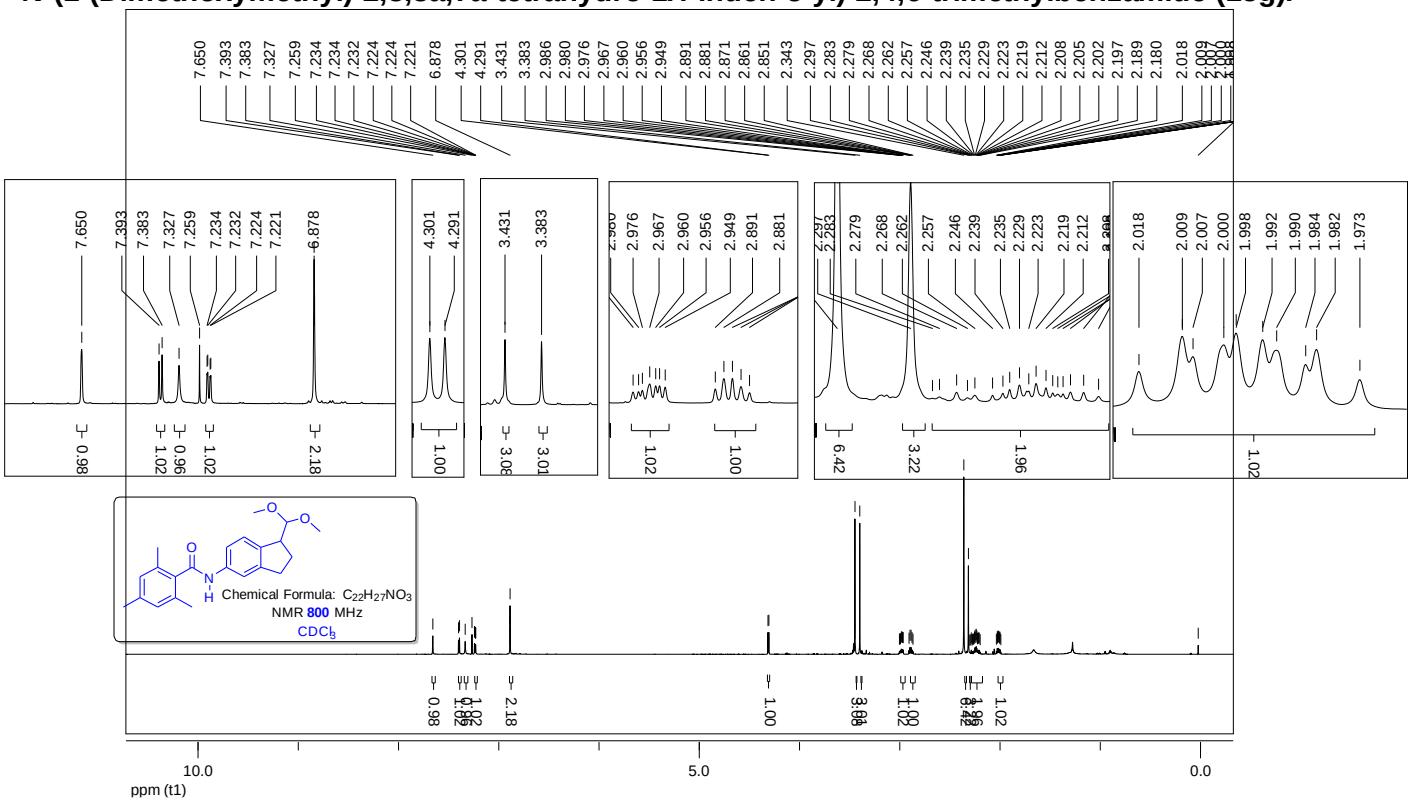
1-(Dimethoxymethyl)-4,7-dimethoxy-2,3-dihydro-1*H*-indene (15f).



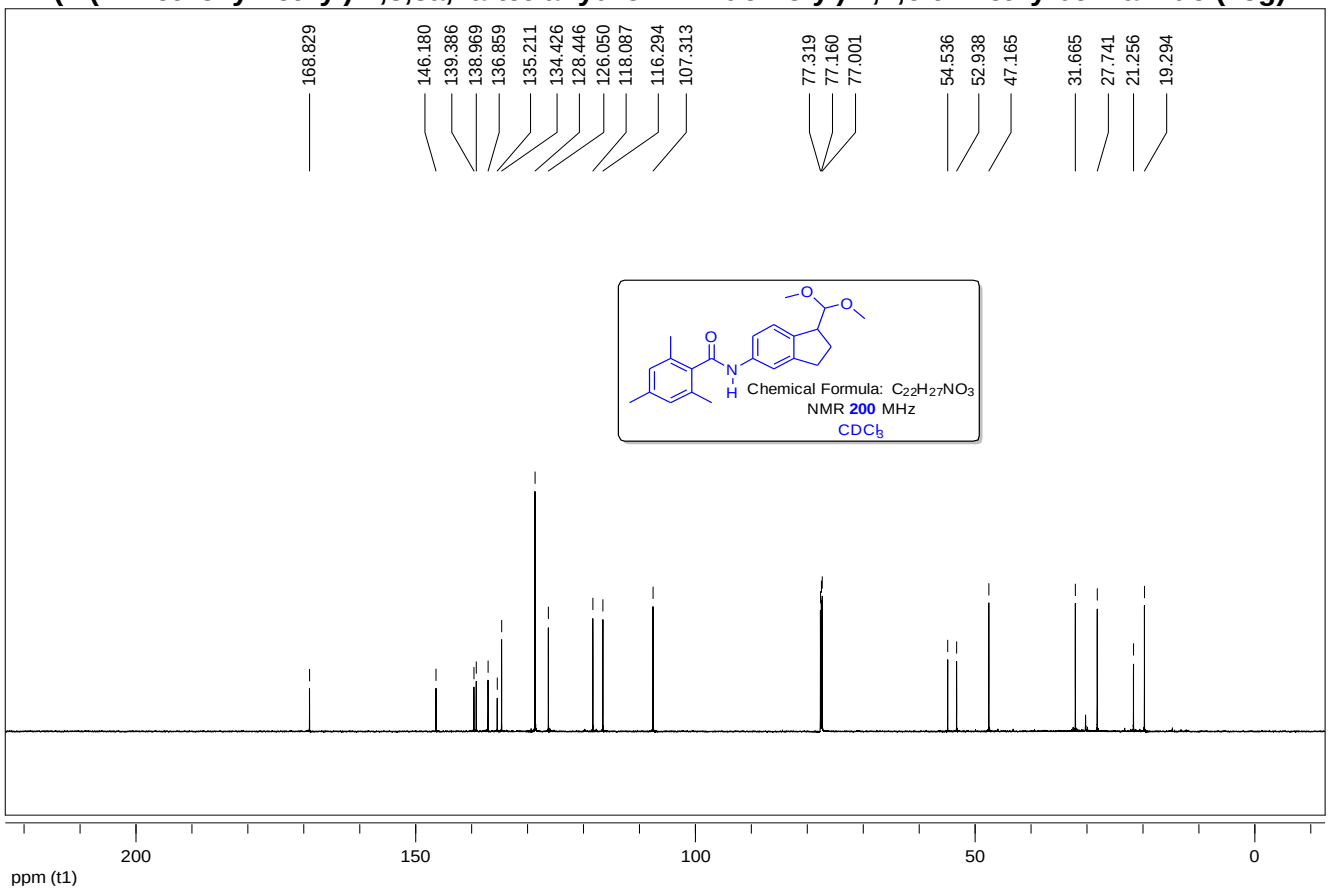
1-(Dimethoxymethyl)-4,7-dimethoxy-2,3-dihydro-1*H*-indene (15f).



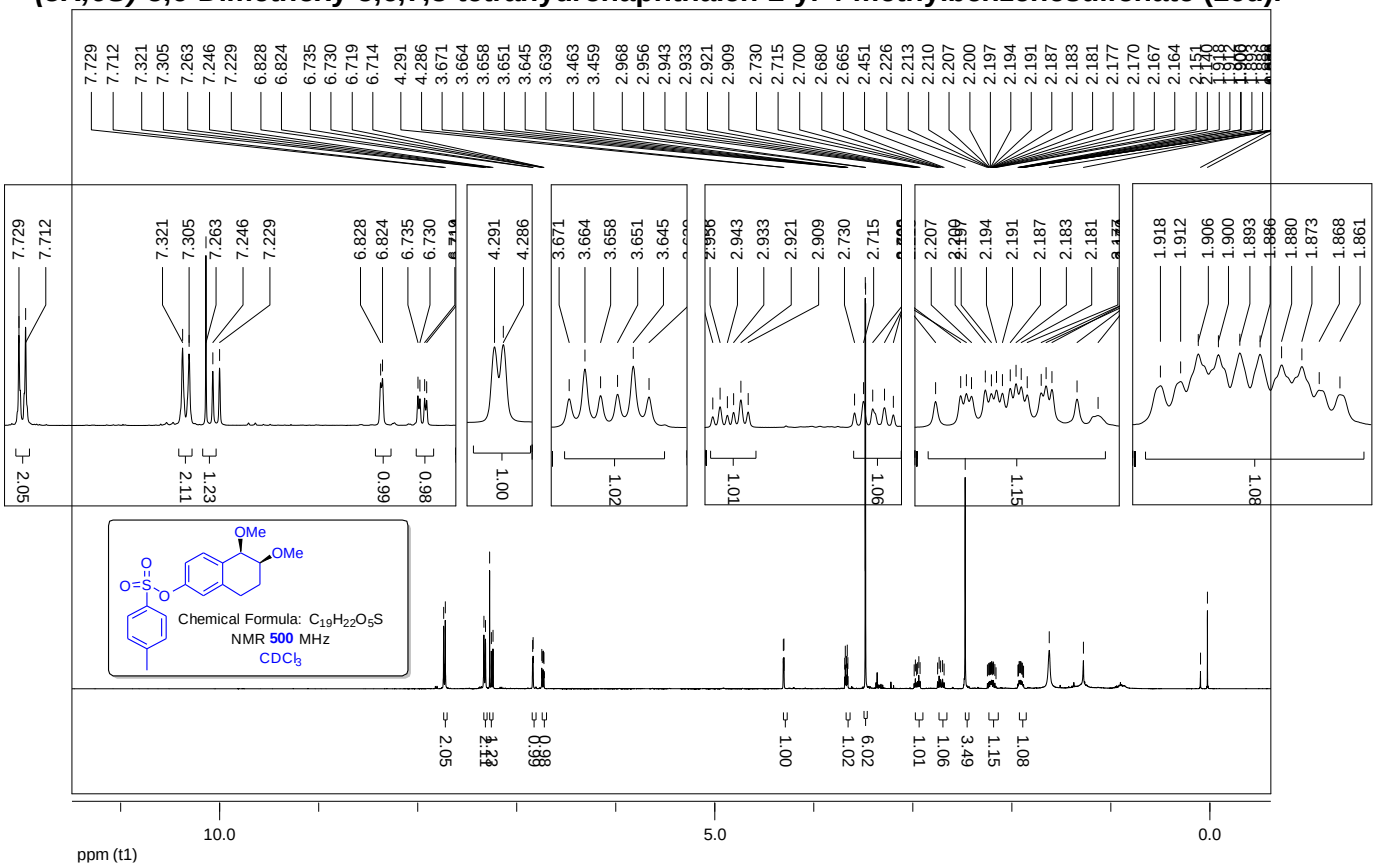
***N*-(1-(Dimethoxymethyl)-2,3,3a,7a-tetrahydro-1*H*-inden-5-yl)-2,4,6-trimethylbenzamide (15g).**



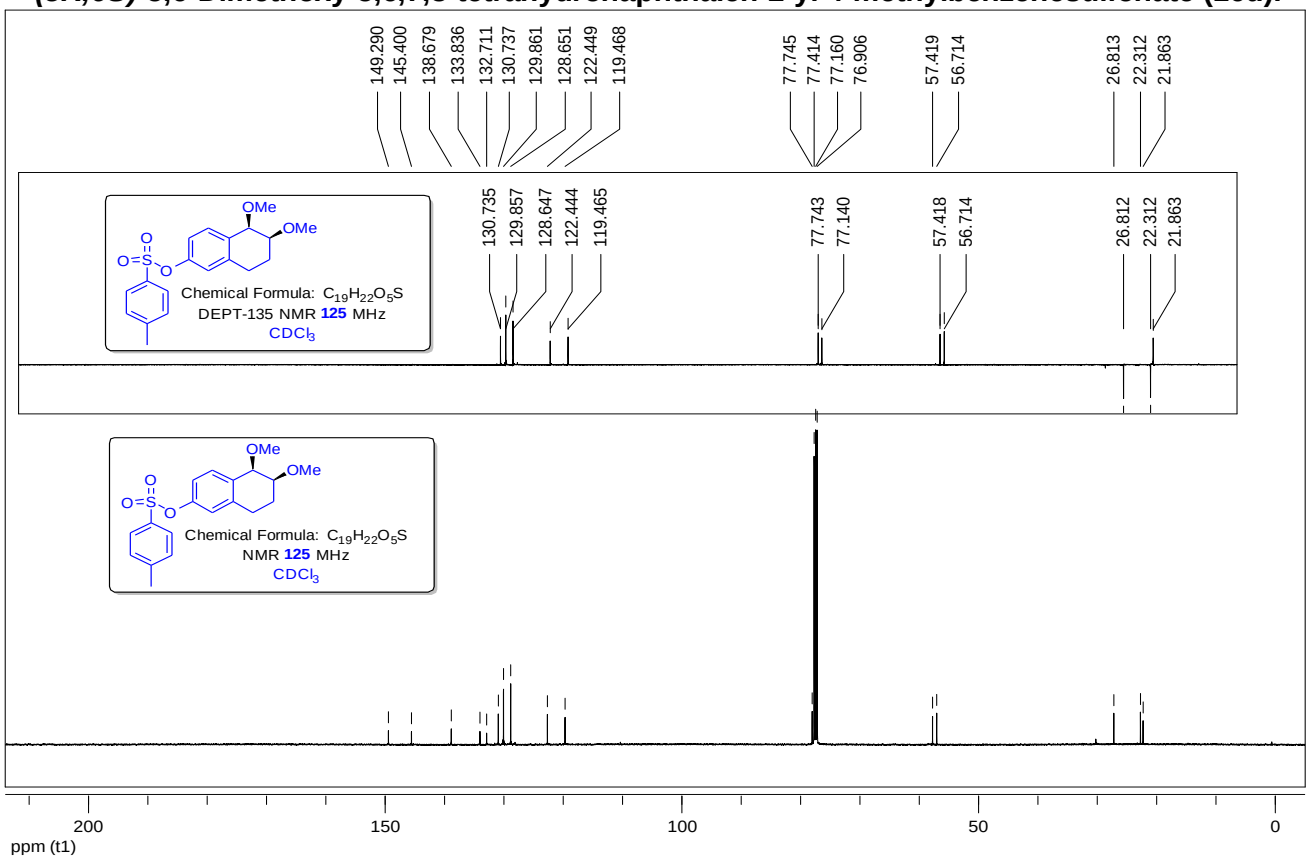
***N*-(1-(Dimethoxymethyl)-2,3,3a,7a-tetrahydro-1*H*-inden-5-yl)-2,4,6-trimethylbenzamide (15g).**



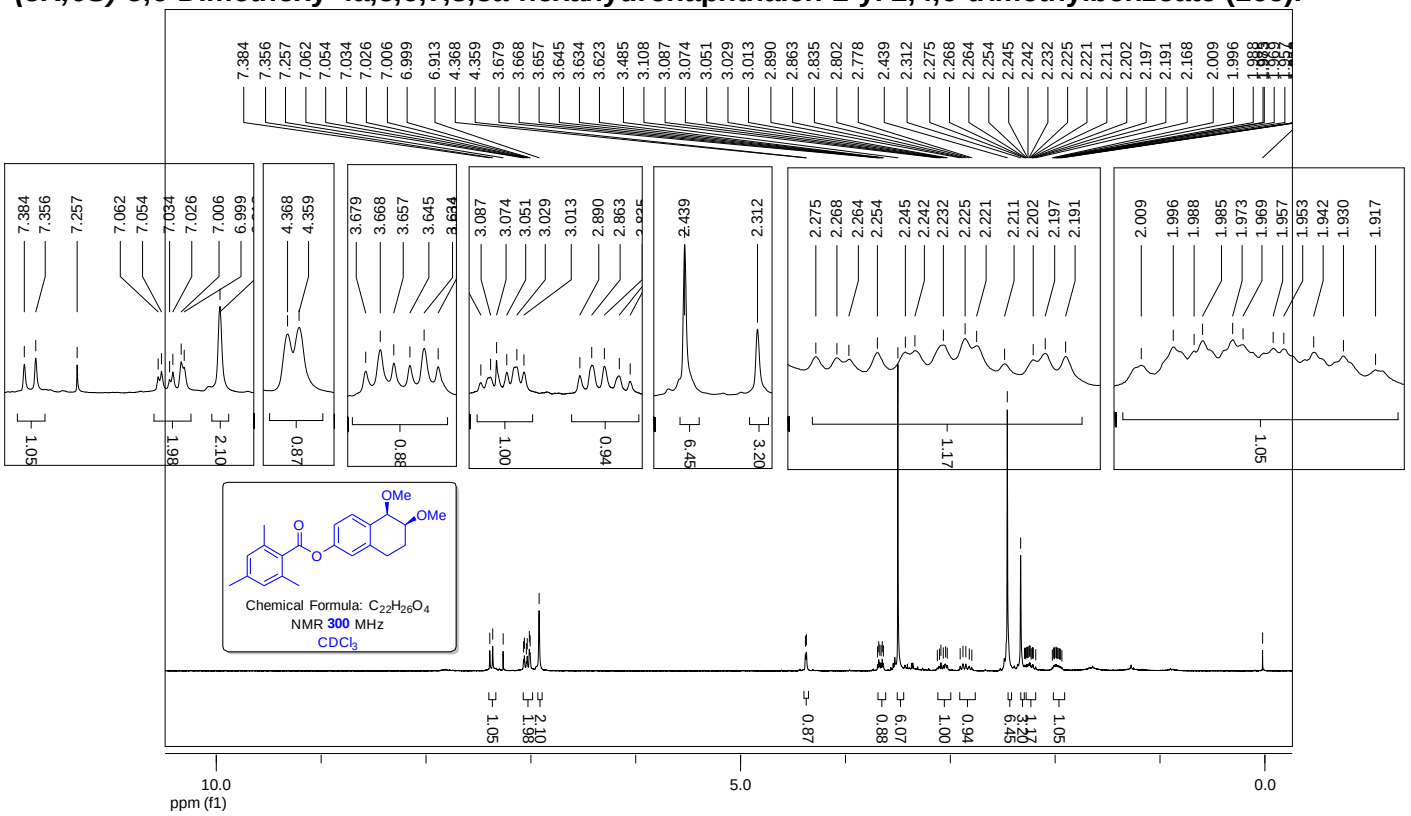
***(5R,6S)*-5,6-Dimethoxy-5,6,7,8-tetrahydronaphthalen-2-yl 4-methylbenzenesulfonate (16d).**



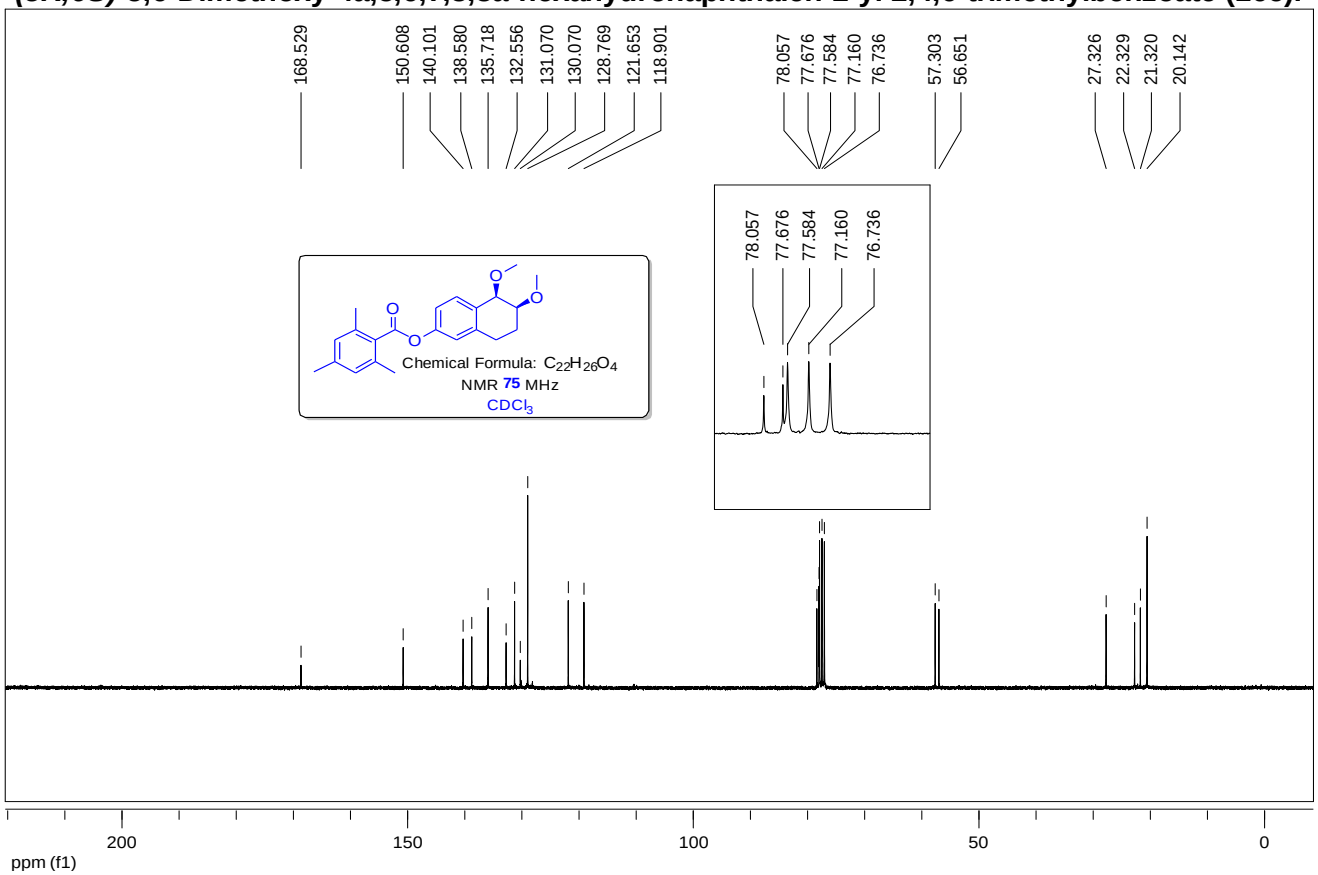
***(5R,6S)*-5,6-Dimethoxy-5,6,7,8-tetrahydronaphthalen-2-yl 4-methylbenzenesulfonate (16d).**



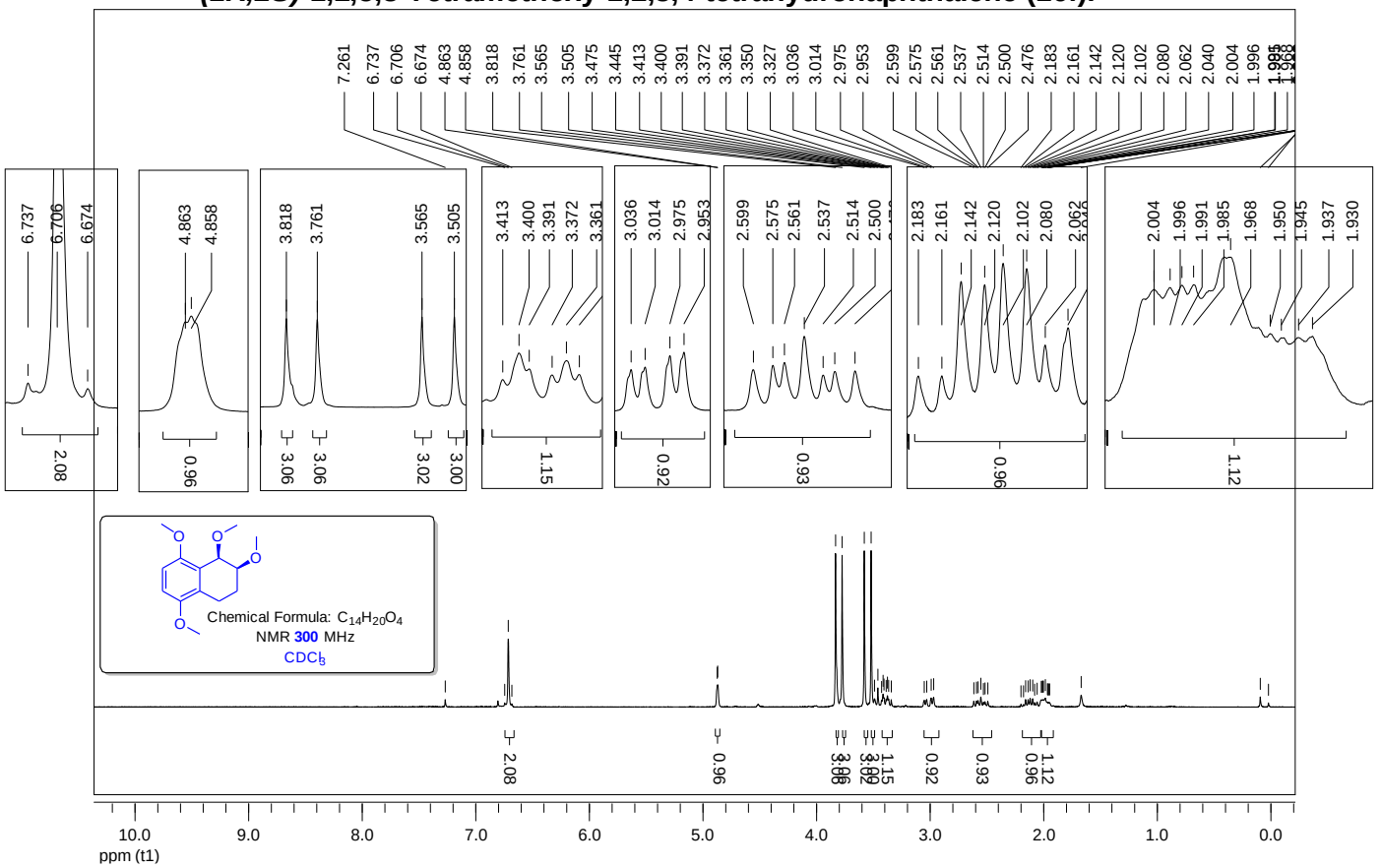
***(5R,6S)*-5,6-Dimethoxy-4a,5,6,7,8,8a-hexahydronaphthalen-2-yl 2,4,6-trimethylbenzoate (16e).**



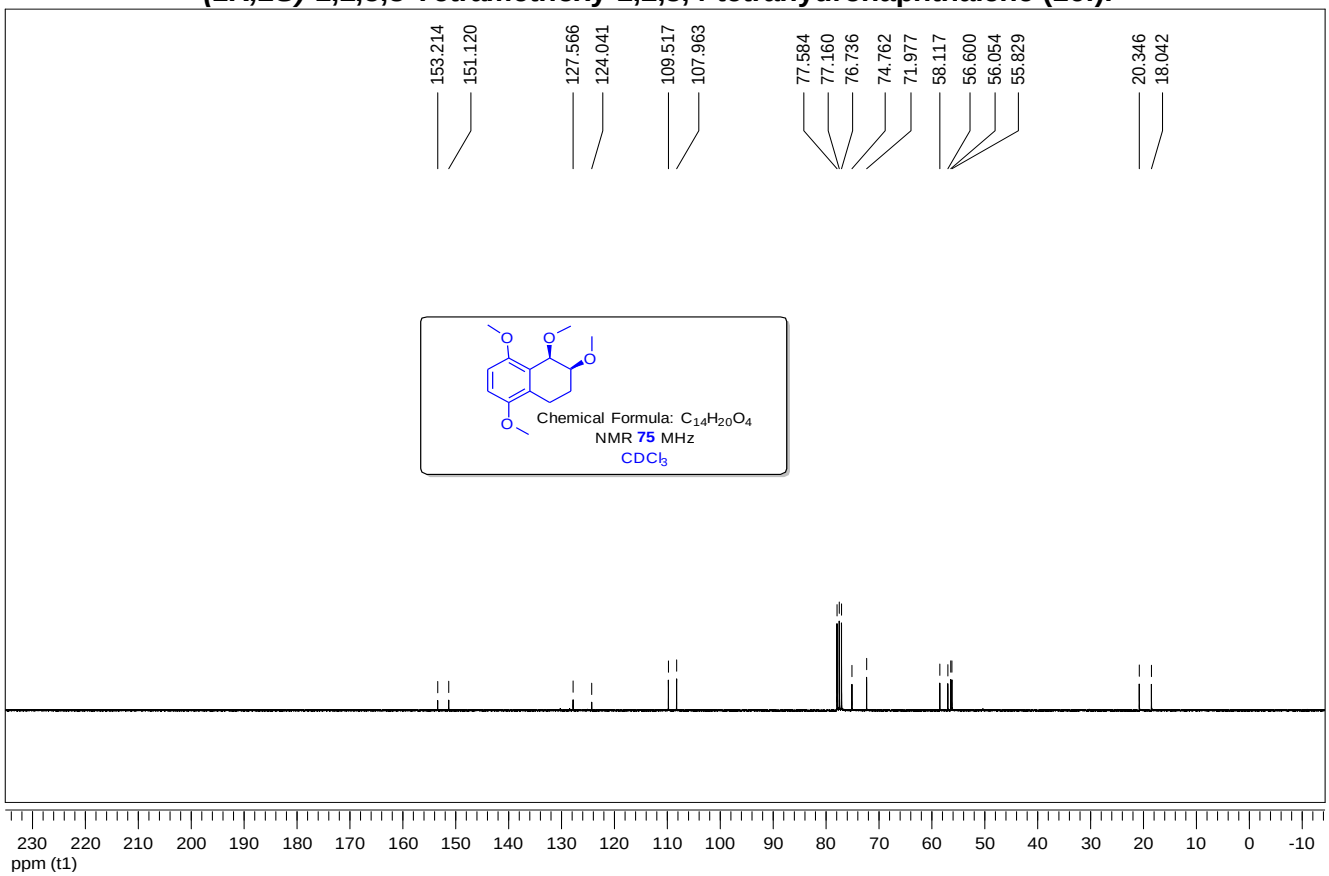
***(5R,6S)*-5,6-Dimethoxy-4a,5,6,7,8,8a-hexahydronaphthalen-2-yl 2,4,6-trimethylbenzoate (16e).**



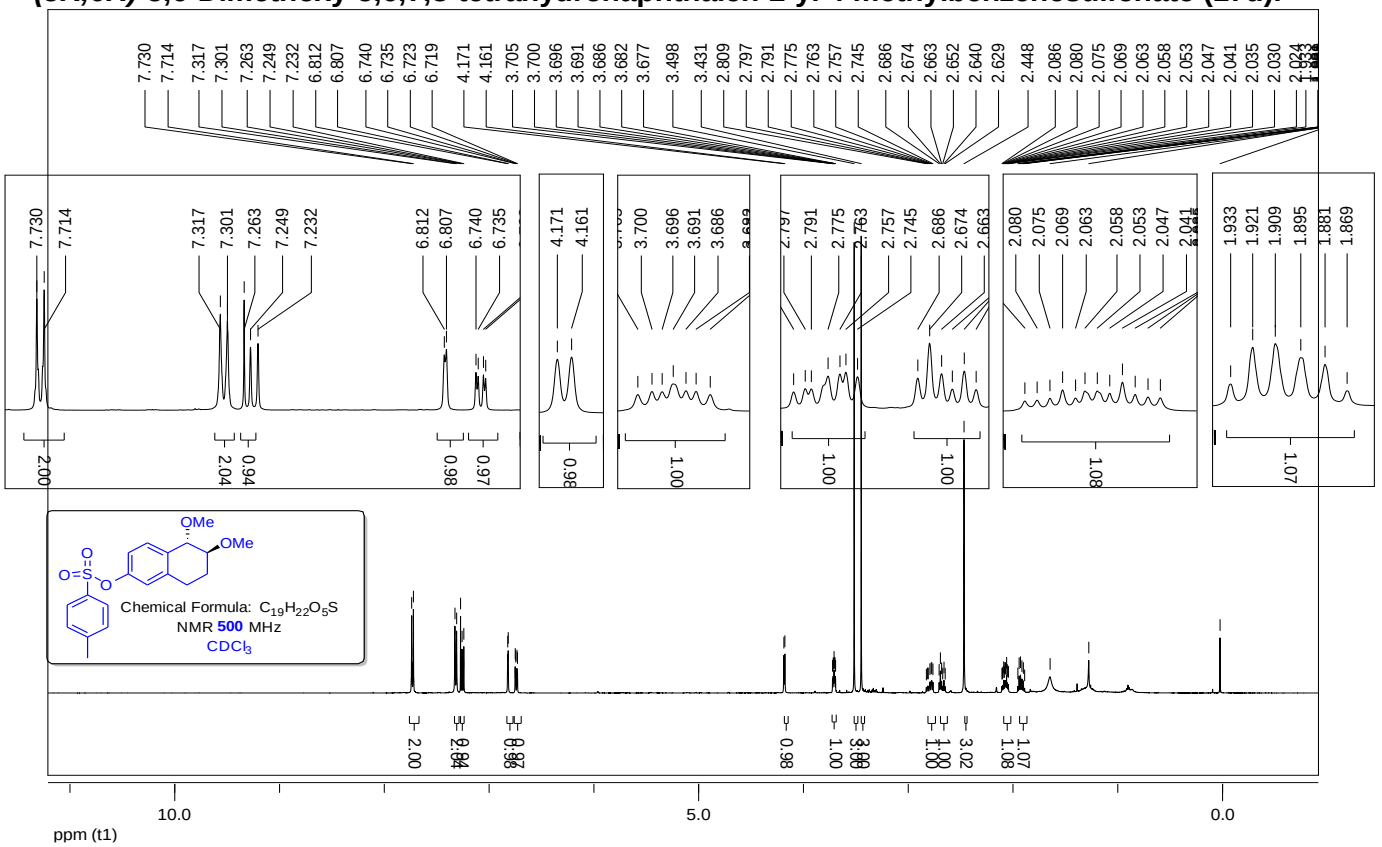
***(1R,2S)*-1,2,5,8-Tetramethoxy-1,2,3,4-tetrahydronaphthalene (16f).**



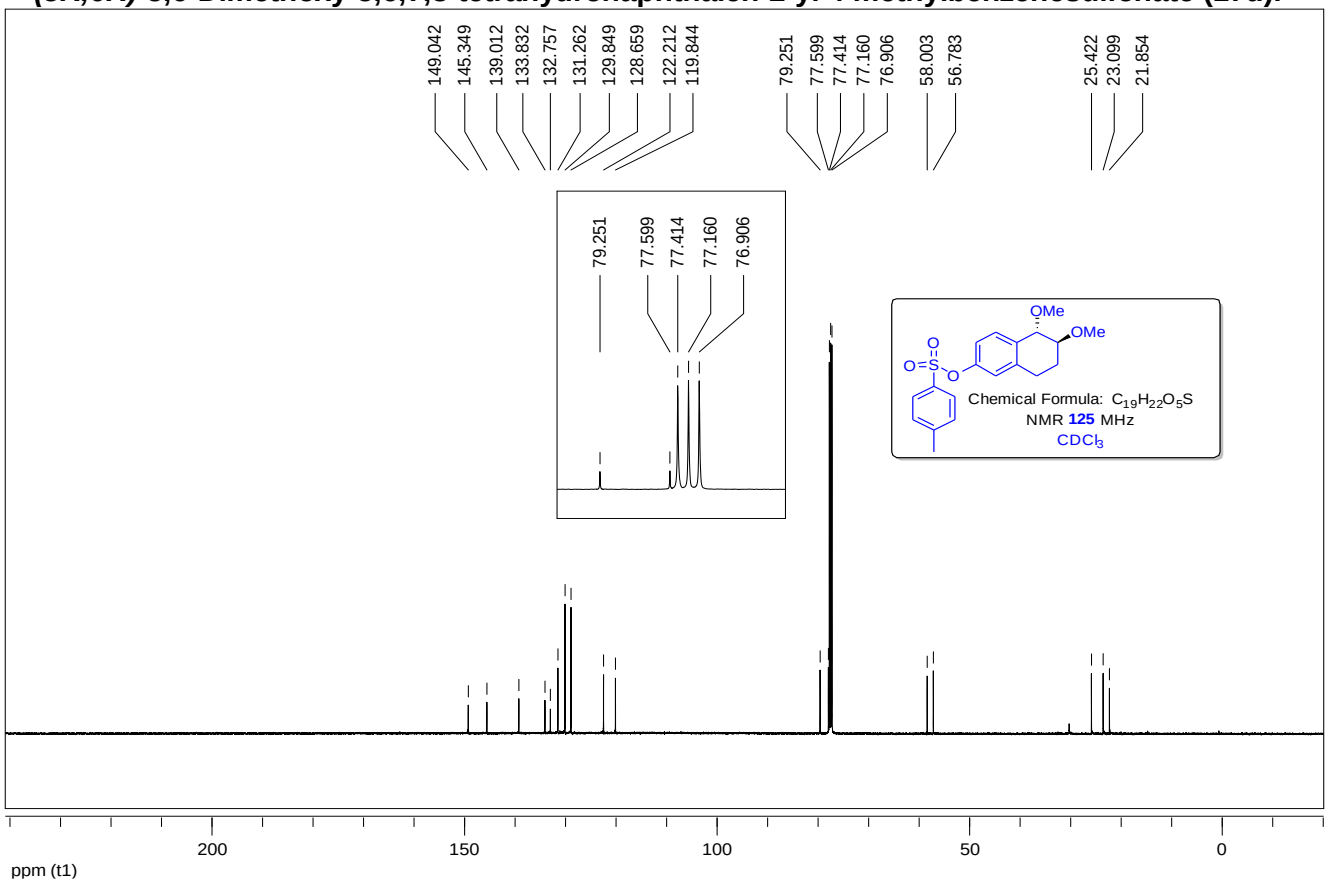
***(1R,2S)*-1,2,5,8-Tetramethoxy-1,2,3,4-tetrahydronaphthalene (16f).**



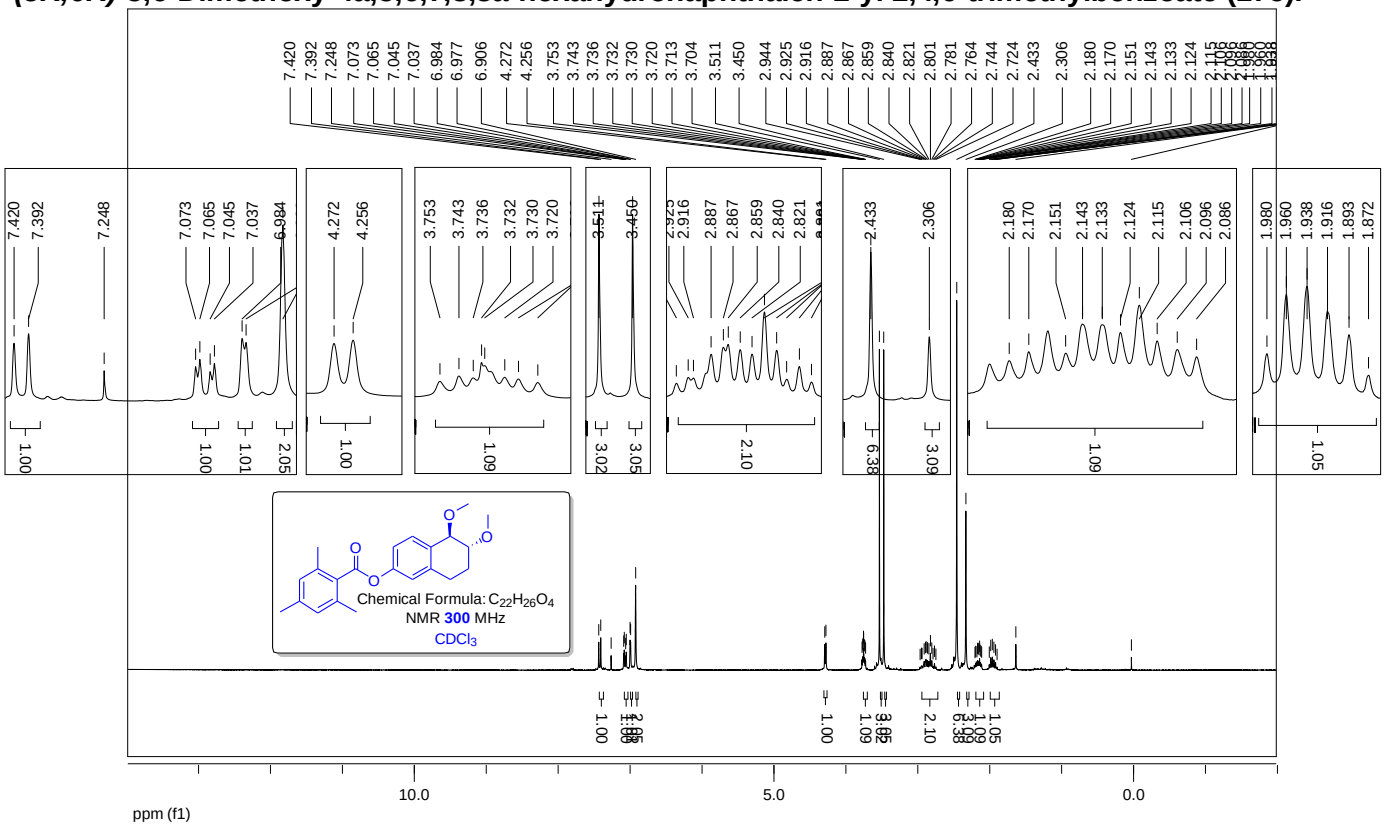
***(5R,6R)*-5,6-Dimethoxy-5,6,7,8-tetrahydronaphthalen-2-yl 4-methylbenzenesulfonate (17d).**



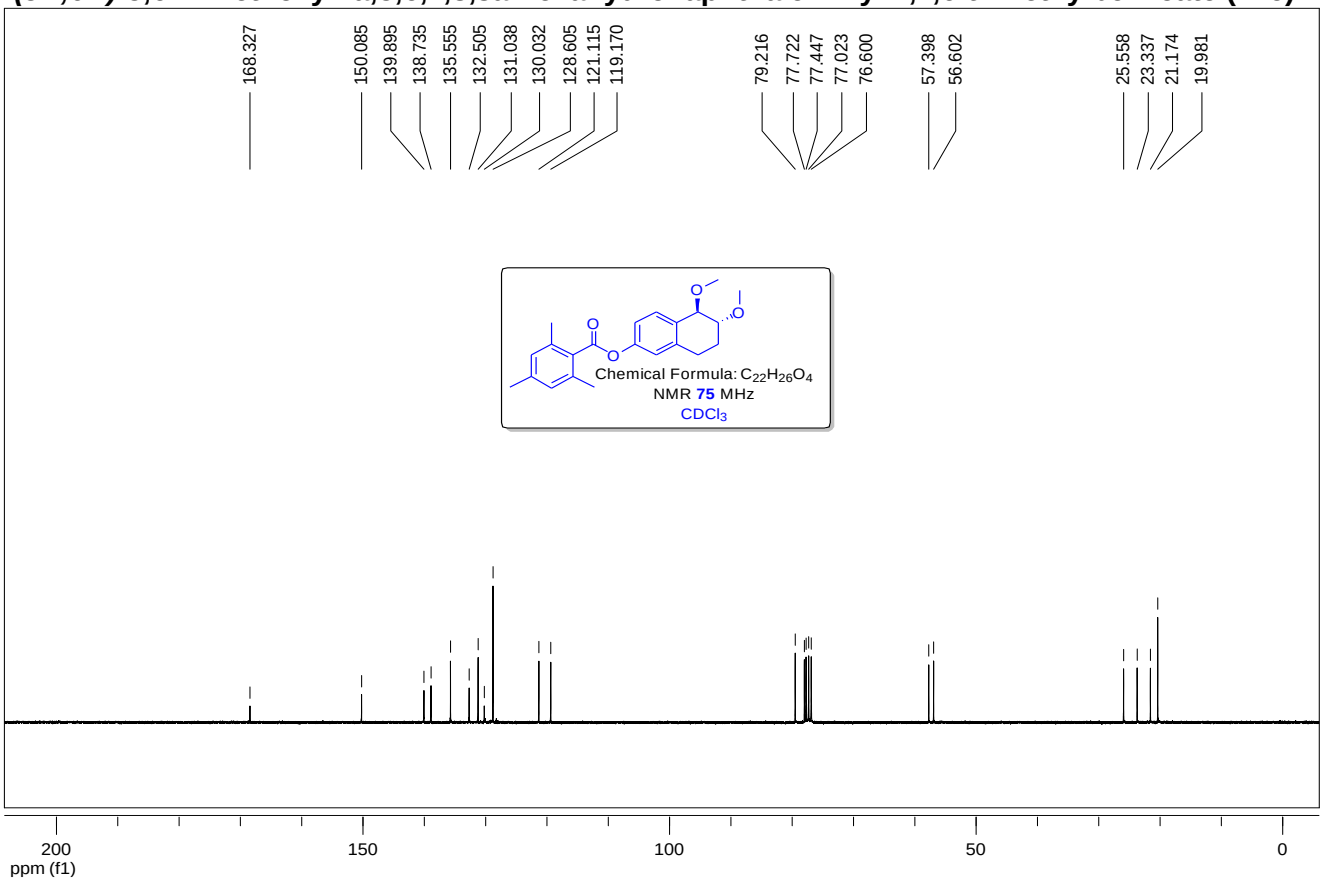
***(5R,6R)*-5,6-Dimethoxy-5,6,7,8-tetrahydronaphthalen-2-yl 4-methylbenzenesulfonate (17d).**



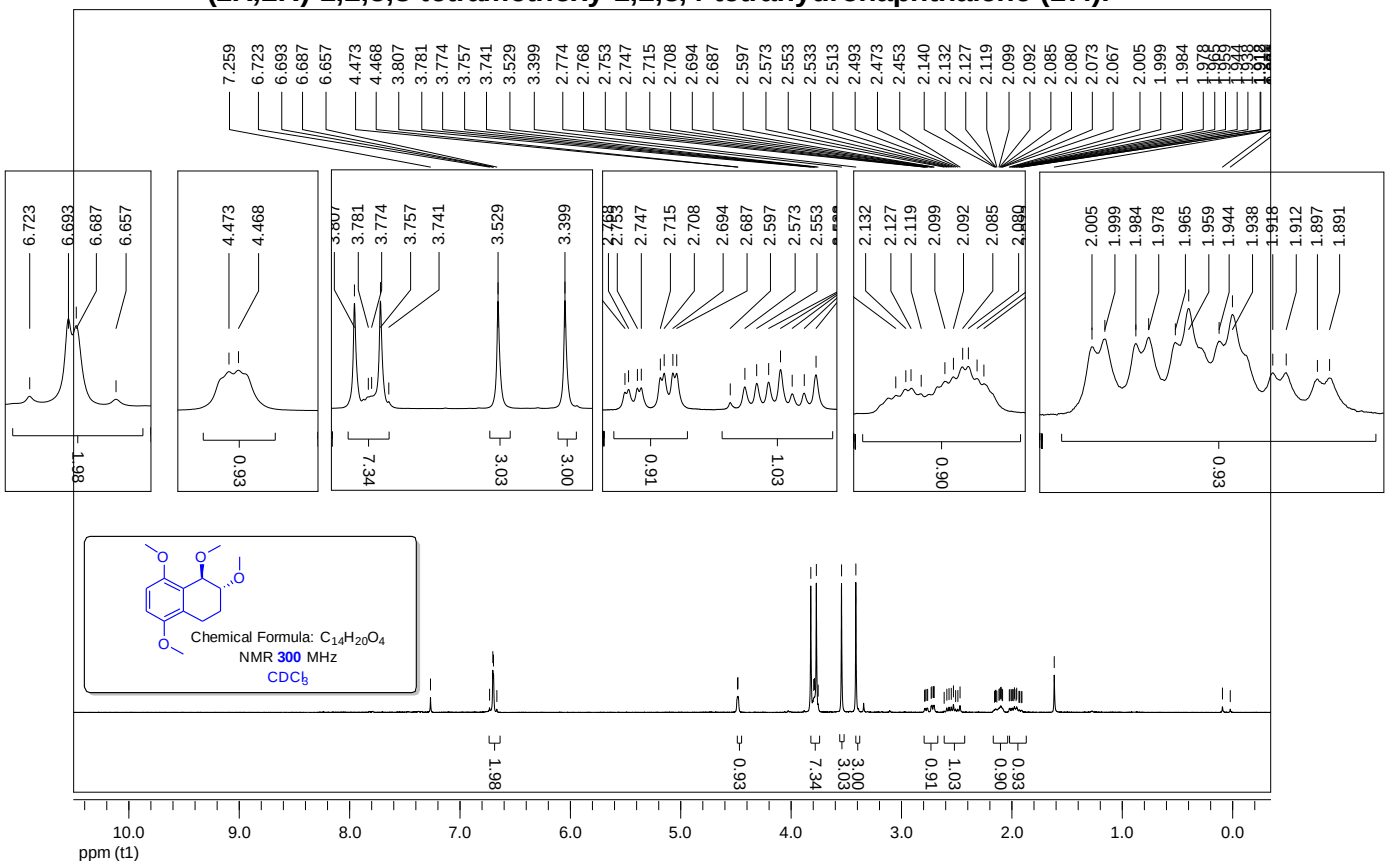
***(5R,6R)*-5,6-Dimethoxy-4a,5,6,7,8,8a-hexahydronaphthalen-2-yl 2,4,6-trimethylbenzoate (17e).**



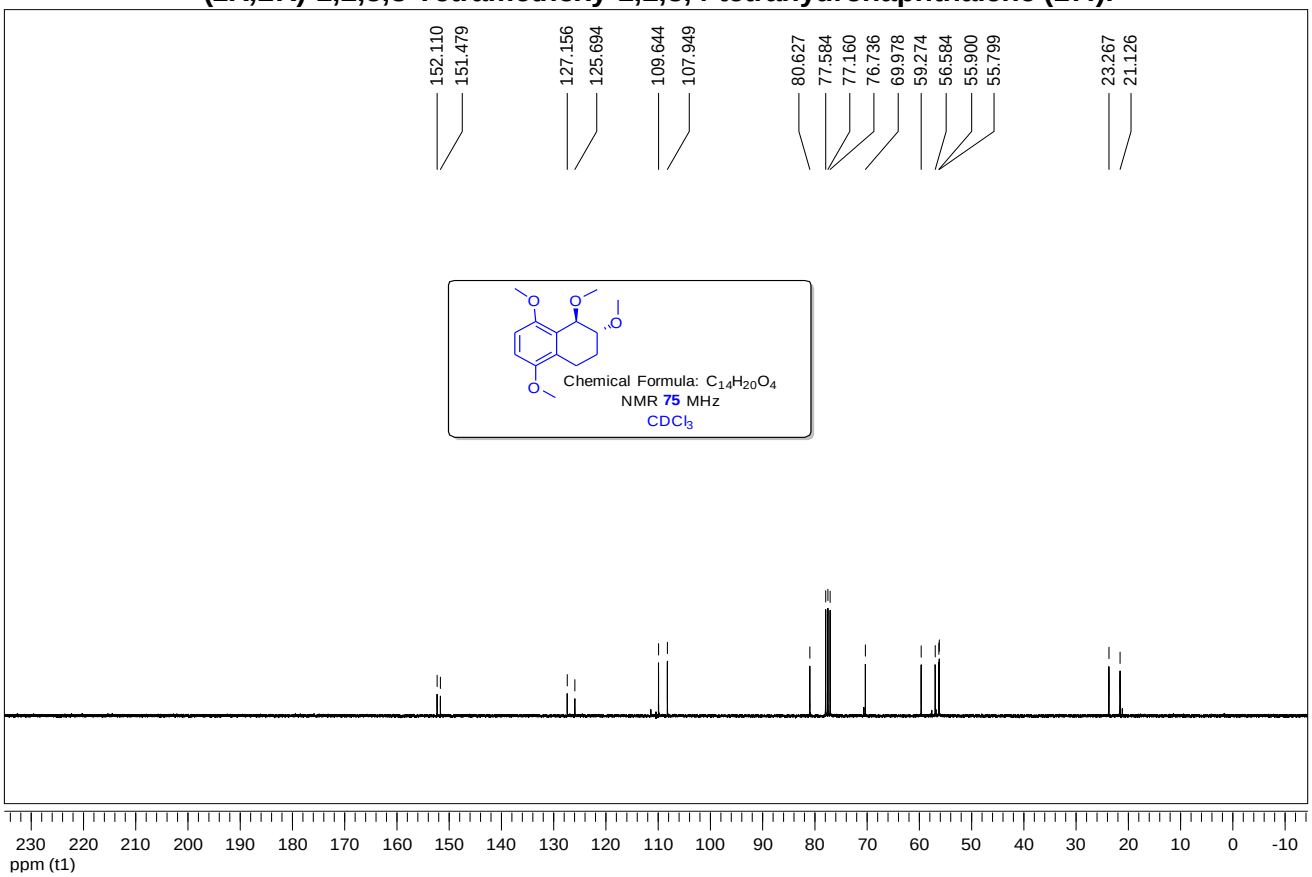
***(5R,6R)*-5,6-Dimethoxy-4a,5,6,7,8,8a-hexahydronaphthalen-2-yl 2,4,6-trimethylbenzoate (17e).**



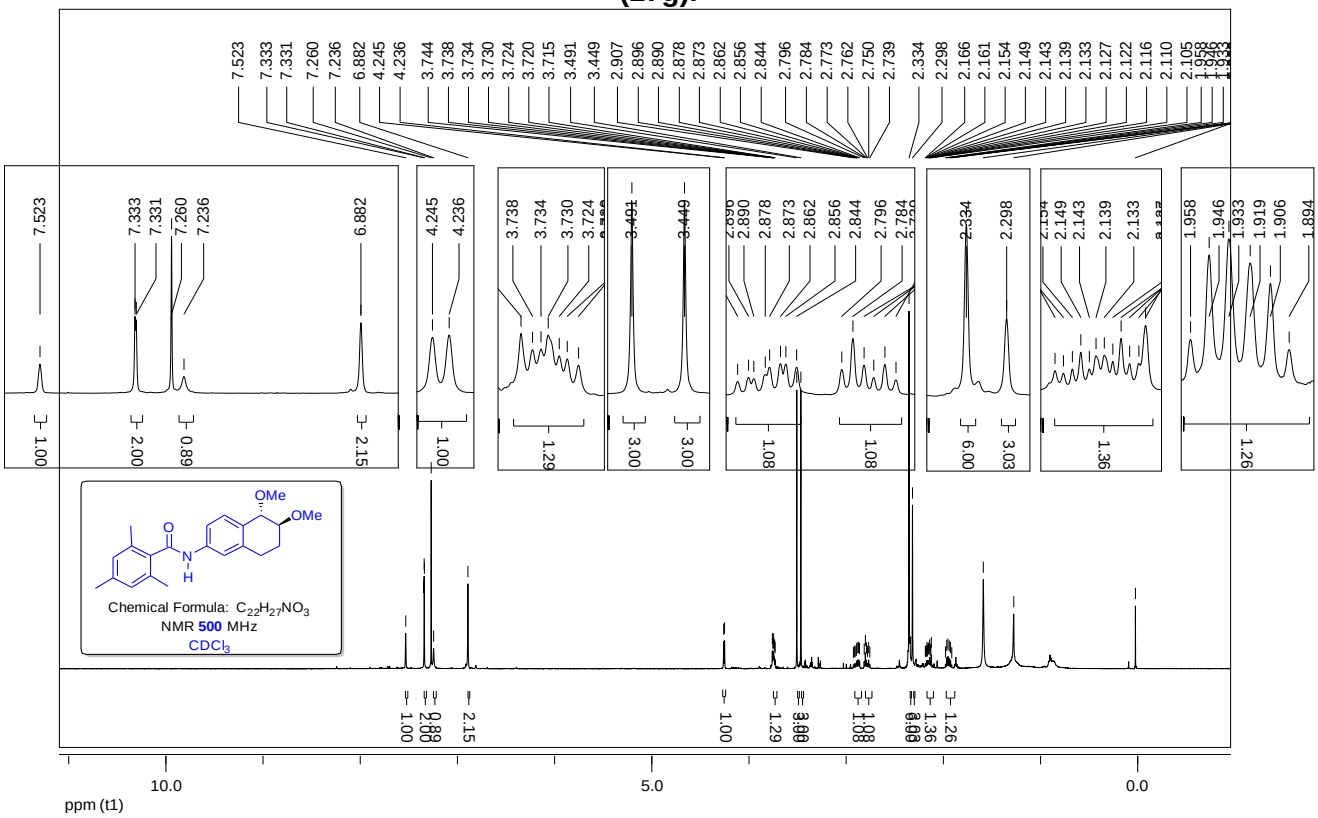
(*1R,2R*)-1,2,5,8-*t*etramethoxy-1,2,3,4-tetrahydronaphthalene (17f).



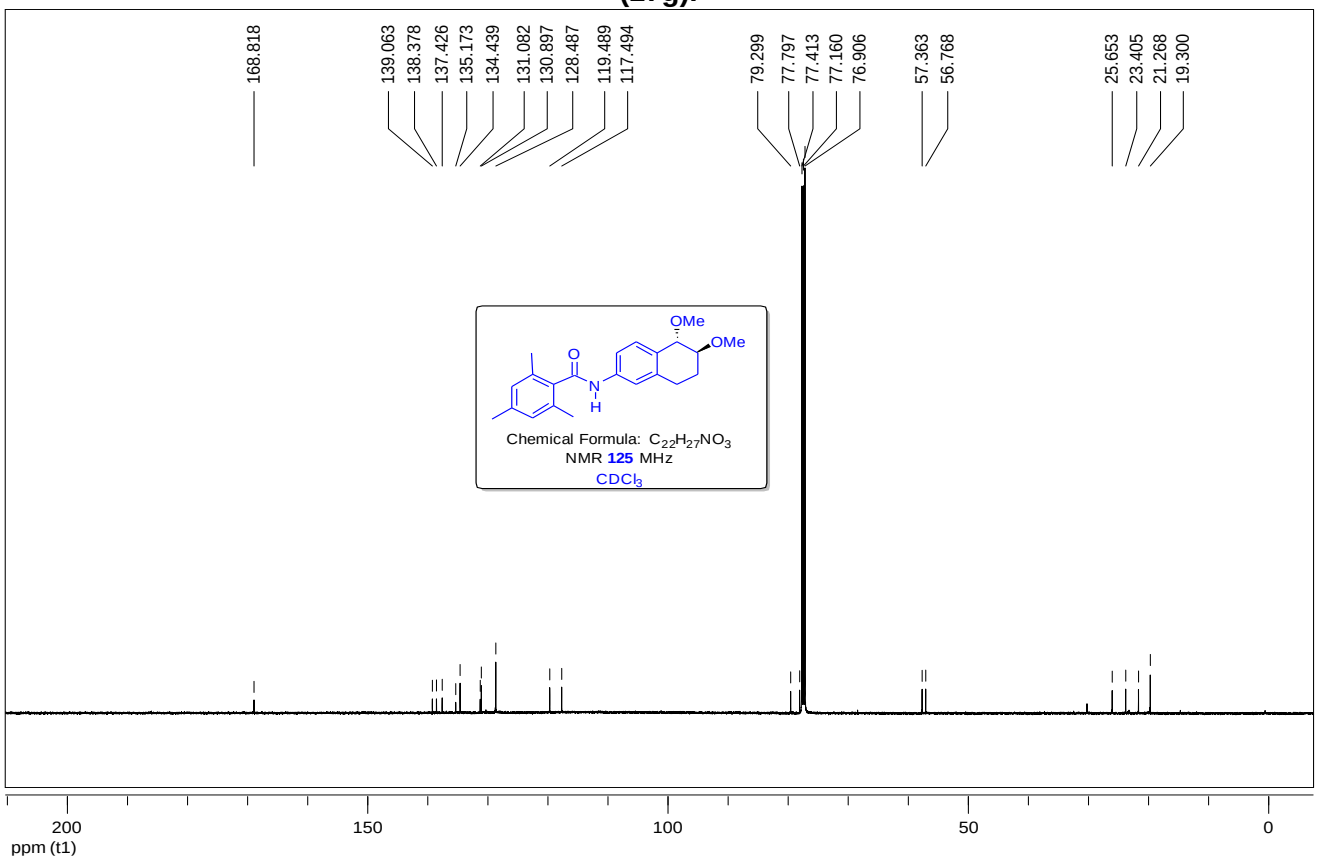
(*1R,2*R)-1,2,5,8-Tetramethoxy-1,2,3,4-tetrahydronaphthalene (17f).



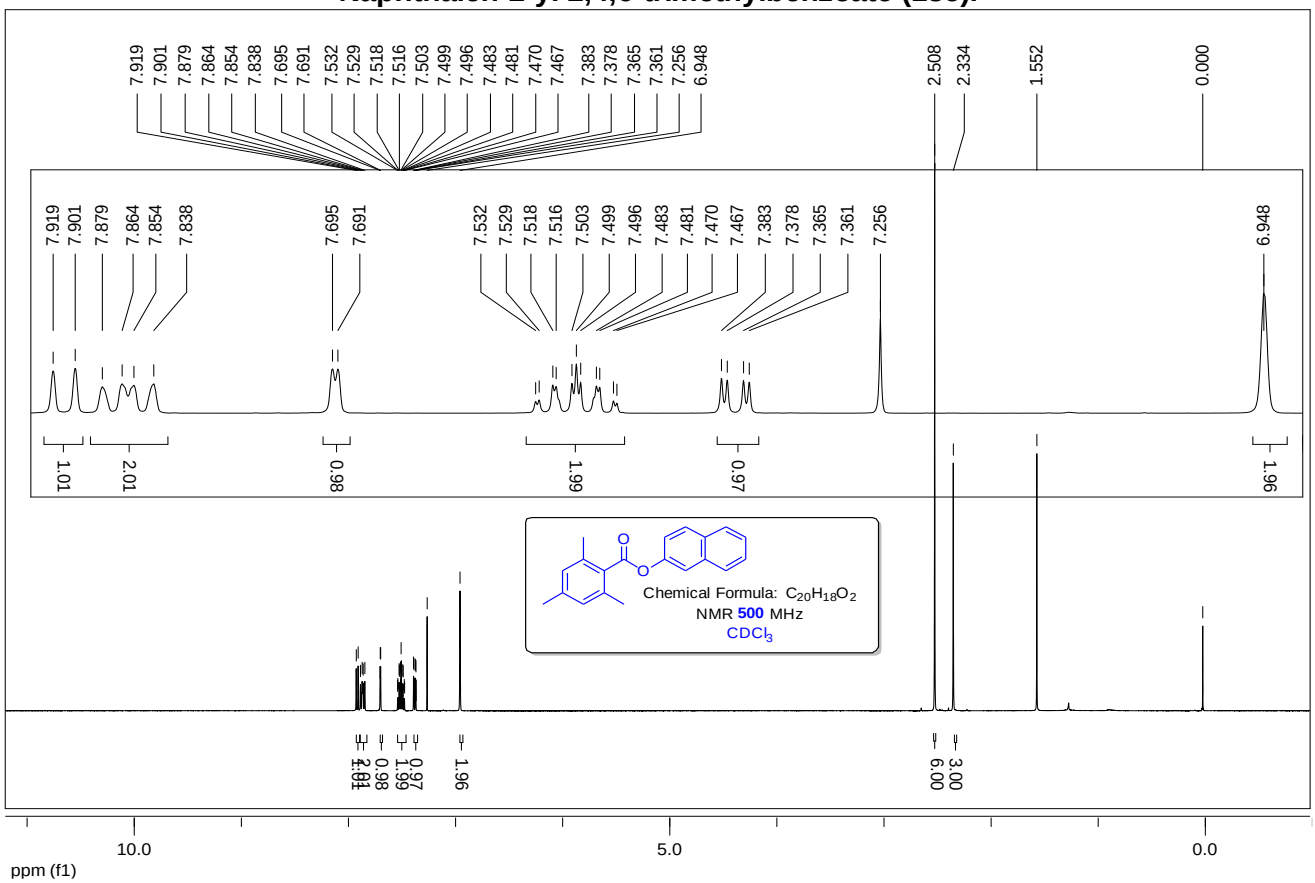
_N_-((_5R,6R_)-5,6-Dimethoxy-4a,5,6,7,8,8a-hexahydronaphthalen-2-yl)-2,4,6-trimethylbenzamide (17g).



_N_-((_5R,6R_)-5,6-Dimethoxy-4a,5,6,7,8,8a-hexahydronaphthalen-2-yl)-2,4,6-trimethylbenzamide (17g).



Naphthalen-2-yl 2,4,6-trimethylbenzoate (18e).



Naphthalen-2-yl 2,4,6-trimethylbenzoate (18e).