**Supporting information**

# Rhodium(III)-Catalyzed C($sp^3$)-H Amination. Synthesis of Cyclic Amines from *ω*-Unsaturated *N*-Sulfonylamines.

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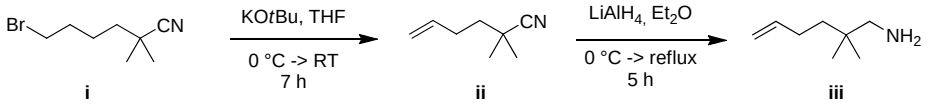
I. General remarks ..... 1
II. Synthesis of substrates ..... 2
1. Synthesis of **1** and **4a-f** ..... 2
2. Synthesis of **4g** and **7** ..... 5
3. Synthesis of **4i** and **4j**. ..... 6
4. Synthesis of **4h** ..... 8
5. Synthesis of **9a**, **9b** and **12** ..... 9
III. Cyclisation products ..... 11
IV. $^1$H NMR and $^{13}$C NMR spectra for all the compounds. ..... 20

## I. General remarks

Infrared (IR) spectra were recorded on a Bruker TENSORTM 27 (IRFT) on an ATR plate, wave numbers are indicated in $cm^{-1}$. NMR was performed on a Bruker Avance-1 400 instrument. $^1$H NMR spectra were recorded at 400 MHz in $CDCl_3$ and data are reported as follows: chemical shift in ppm from tetramethylsilane as an internal standard, multiplicity (s = singlet, d = doublet, t = triplet, q = quartet, quint = quintuplet, sext = sextuplet, m = multiplet or overlap of non-equivalent resonances, br = broad), integration. $^{13}$C NMR spectra were recorded at 100 MHz in $CDCl_3$ and data are reported as follows: chemical shift in ppm from tetramethylsilane with the solvent as an internal indicator ($CDCl_3$, 77.16 ppm), multiplicity, with respect to proton (deduced from DEPT experiments, s = quaternary C, d = CH, t = $CH_2$, q = $CH_3$). High resolution mass spectra (HRMS) were performed by the Groupe de Spectrométrie de Masse de l'Université Pierre et Marie Curie (Paris-France). Optical rotations were measured with a Perkin Elmer model 343 polarimeter with a 1 dm path length. TLC was performed on Merck 60F254 silica gel plates with UV and Hanessian stain or *para*-anisaldehyde. $CH_2Cl_2$ was distillated from $CaH_2$, $Et_2O$ and THF were distillated from sodium/benzophenone. Other reagents were obtained from commercial suppliers and used as received. Flash column chromatography was performed on silica gel (230-400 mesh). Diastereomeric ratios were measured by examination of the $^1$H NMR spectrum of the crude material.

## II. Synthesis of substrates

### 1. *Synthesis of 1 and 4a-f*




**2,2-Dimethylhex-5-enenitrile (ii):**[1]

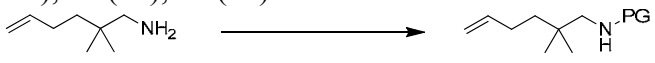
To a solution of 6-bromo-2,2-dimethylhexanenitrile (2.040 g, 10 mmol, 1 equiv) in THF (20 mL) at 0 °C was added KO*t*Bu (1.232 g, 11 mmol, 1.1 equiv) and the reaction was allowed to warm to room temperature. After 7 h, volatiles are evaporated, the crude material retaken in $Et_2O$ (40 mL). The organic phase was washed with $H_2O$ (4 mL), dried over $MgSO_4$, filtrated and evaporated under *vacuum* to afford compound **ii** as a colourless oil which was used without further purification. Spectral data for **ii** match those previously described in the literature.

**IR** (film): $\upsilon$ 3081, 2979, 2939, 2876, 2234, 1710, 1643, 1472, 1456, 1392, 1371, 1207, 997, 914 $cm^{-1}$. **$^1$H NMR** ($CDCl_3$, 400 MHz): $\delta$ 5.79 (ddt, 1H, $J$ = 16.8, 10.4, 6.6 Hz), 5.05 (dq, 1H, $J$ = 16.8, 1.6 Hz), 4.98 (dq, 1H, $J$ = 10.4, 1.4 Hz), 2.21 (m, 2H), 1.59 (m, 2H), 1.33 (s, 6H). **$^{13}$C NMR** ($CDCl_3$, 100 MHz): $\delta$ 137.2 (d), 125.0 (s), 115.6 (t), 40.3 (t), 32.4 (s), 29.7 (t), 26.8 (q, $2CH_3$).

**2,2-Dimethylhex-5-en-1-amine (iii):**[2]

To a solution of 2,2-dimethylhex-5-enenitrile (~ 10 mmol, 1 equiv) in $Et_2O$ (20 mL) at 0 °C was added portionwise $LiAlH_4$ (418 mg, 11 mmol, 1.1 equiv). After 15 min, the reaction mixture was allowed to warm to room temperature, then refluxed 5 h and finally let at room temperature overnight. After 16 h, the reaction was quenched by consecutive additions of $H_2O$ (418 µL), $NaOH_{aq}$ (15%) (418 µL) and $H_2O$ (1.254 mL). The resulting mixture was filtrated through Celite® and concentrated under *vacuum* to afford compound **iii** (934 mg, 7.3 mmol, 73%) as slightly yellow oil which was used without further purification. Spectral data for **iii** match those previously described in the literature.

**IR** (film): $\upsilon$ 3306, 3077, 2955, 2933, 2868, 1640, 1471, 1388, 1364, 1305, 1063, 994, 907 $cm^{-1}$. **$^1$H NMR** ($CDCl_3$, 400 MHz) : $\delta$ 5.79 (ddt, 1H, $J$ = 17.2, 10.4, 6.4 Hz), 4.98 (dq, 1H, $J$ = 17.2, 2.0 Hz), 4.89 (br d, 1H, $J$ = 10.2 Hz), 2.42 (s, 2H), 1.96 (m, 2H), 1.25 (m, 2H), 1.15 (br s, 2H, $NH_2$), 0.82 (s, 6H). **$^{13}$C NMR** ($CDCl_3$, 100 MHz) : $\delta$ 139.7 (d), 114.1 (t), 53.0 (t), 38.8 (t), 34.7 (s), 28.6 (t), 24.8 (q, $2CH_3$). **SM** (EI) *m/z* (abundance): 128 ($M^{+\cdot}$, 7), 115 (7), 97 (41), 69 (40), 57 (100), 56 (37), 55 (66).




***N*-(2,2-Dimethylhex-5-en-1-yl)-4-methylbenzenesulfonamide (1):**

To a solution of 2,2-dimethylhex-5-en-1-amine **(iii)** (~10 mmol, 1 equiv) in $CH_2Cl_2$ (20 mL) at 0 °C were added $Et_3N$ (2.020 g, 20 mmol, 2 equiv) followed by TsCl (1.900 g, 10 mmol, 1 equiv). After 15 min, the reaction mixture was allowed to warm to room temperature and stirred for 3 h. The reaction was then quenched by addition of water (10 mL), extracted with $Et_2O$ (20 mL), washed with brine (10 mL), dried over $MgSO_4$, filtrated and concentrated under *vacuum* to afford after purification on silica gel (PE/EtOAc : 90/10) compound **1** (1.518 g, 5.4 mmol, 54% over three steps) as a white solid.

**mp**: 68 °C. **IR** (film): $\upsilon$ 3268, 2960, 2918, 2875, 1640, 1598, 1474, 1423, 1321, 1157, 1095, 1071, 997, 901 $cm^{-1}$. **$^1$H NMR** ($CDCl_3$, 400 MHz) : $\delta$ 7.73 (br d, 2H, $J$ = 8.0 Hz), 7.28 (br d, 2H, $J$ = 8.0 Hz), 5.71 (ddt, 1H, $J$ = 16.8, 10.0, 6.8 Hz), 4.93 (br d, 1H, $J$ = 17.2 Hz), 4.87 (br d, 1H, $J$ = 10.0 Hz), 4.77 (br s, 1H, NH), 2.65 (br d, 2H, $J$ = 6.8 Hz), 2.40 (s, 3H), 1.89 (m, 2H), 1.24 (m, 2H), 0.82 (s, 6H). **$^{13}$C NMR** ($CDCl_3$, 100 MHz) : $\delta$ 143.5 (d), 139.0 (s), 137.1

(s), 129.9 (d, 2CH), 127.3 (d, 2CH), 114.4 (t), 53.1 (t), 38.7 (t), 33.9 (s), 28.3 (t), 25.0 (q, $2CH_3$), 21.7 (q). **SM** (EI) *m/z* (abundance) : 184 ($TsNHCH_3^+$, 27), 155 (55), 126 (22), 112 (22), 110 (11), 97 (13), 92 (15), 91 (100), 81 (12), 65 (40), 56 (16), 55 (97). **HRMS** (ESI): Calculated for $C_{15}H_{23}NO_2SNa$: 304.1342. Found: 304.1341.

***N*-(2,2-Dimethylhex-5-en-1-yl)-4-methoxybenzenesulfonamide (4a):**
To a solution of 2,2-dimethylhex-5-en-1-amine **(iii)** (190 mg, 1.5 mmol, 1 equiv) in $CH_2Cl_2$ (5 mL) at 0 °C was added $Et_3N$ (454 g, 4.5 mmol, 3 equiv) followed by 4-methoxybenzenesulfonyl chloride (323 mg, 1.57 mmol, 1.05 equiv). After 15 min, the reaction mixture was allowed to warm to room temperature and stirred for 3 h. The reaction was then quenched by addition of water (10 mL), extracted with $Et_2O$ (20 mL), washed with brine (10 mL), dried over $MgSO_4$, filtrated and concentrated under *vacuum* to afford after purification on silica gel (PE/EtOAc : 95/5) compound **4a** (347 mg, 1.17 mmol, 78%) as a white solid.
**mp:** 39 °C. **IR** (film): $\upsilon$ 3315, 2967, 2936, 1704, 1642, 1558, 1471, 1370, 1207, 1156, 993, 910 $cm^{-1}$. **$^1$H NMR** ($CDCl_3$, 400 MHz): $\delta$ 7.18 (br d, 2H, $J$ = 8.8 Hz), 6.33 (br d, 2H, $J$ = 8.8 Hz), 5.09 (ddt, 1H, $J$ = 17.0, 10.2, 6.4 Hz), 4.52 (br s, 1H), 4.31 (br d, 1H, $J$ = 17.2 Hz), 4.24 (br d, 1H, $J$ = 10.2 Hz), 3.21 (s, 3H), 2.01 (d, 2H, $J$ = 6.8 Hz), 1.27 (m, 2H), 0.63 (m, 2H), 0.20 (s, 6H). **$^{13}$C NMR** ($CDCl_3$, 100 MHz): $\delta$ 162.7 (s), 139.0 (d), 131.6 (s), 129.2 (d, 2CH), 114.2 (d, 2CH), 114.2 (t), 55.6 (q), 52.9 (t), 38.6 (t), 33.8 (s), 28.1 (t), 24.9 (q, $2CH_3$). **SM** (EI) *m/z* (abundance) : 282 ($(M - Me)^+$, 1), 200 (26), 172 (10), 171 (100), 126 (22), 123 (13), 112 (33), 107 (23), 92 (11), 77 (22), 55 (37). **HRMS** (ESI): Calculated for $C_{15}H_{23}NO_3SNa$ $[M + Na]^+$: 320.1291. Found: 320.1286.

***N*-(2,2-Dimethylhex-5-en-1-yl)benzenesulfonamide (4b):**
To a solution of 2,2-dimethylhex-5-en-1-amine **(iii)** (171 mg, 1.35 mmol, 1 equiv) in $CH_2Cl_2$ (5 mL) at 0 °C was added $Et_3N$ (409 mg, 4.05 mmol, 3 equiv) followed by $PhSO_2Cl$ (249 mg, 1.4 mmol, 1.05 equiv). After 15 min, the reaction mixture was allowed to warm to room temperature and stirred for 3 h. The reaction was then quenched by addition of water (10 mL), extracted into ether (20 mL), washed with brine (10 mL), dried over $MgSO_4$, filtrated and concentrated under *vacuum* to afford after purification on silica gel (PE/EtOAc: 9/1) compound **4b** as a white solid (232 mg, 0.87 mmol, 64%).
**mp:** 63 °C. **IR** (film): $\upsilon$ 3274, 2975, 2930, 2872, 1639, 1467, 1449, 1432, 1418, 1322, 1157, 1094, 1067, 912 $cm^{-1}$. **$^1$H NMR** ($CDCl_3$, 400 MHz): $\delta$ 7.88-7.84 (m, 2H), 7.58-7.46 (m, 3H), 5.71 (ddt, 1H, $J$ = 17.0, 10.2, 6.6 Hz), 4.99-4.89 (m, 2H), 4.87 (br d, 1H, $J$ = 10.0 Hz) 2.67 (d, 2H, $J$ = 6.4 Hz), 1.89 (m, 2H), 1.25 (m, 2H), 0.82 (m, 6H). **$^{13}$C NMR** ($CDCl_3$, 100 MHz): $\delta$ 140.1 (s), 139.0 (d), 132.7 (d), 129.3 (d, 2CH), 127.2 (d, 2CH), 114.5 (t), 53.1 (t), 38.7 (t), 34.0 (s), 28.3 (t), 25.0 (q, $2CH_3$). **SM** (EI) *m/z* (abundance): 252 ($(M-Me)^+$, 1), 170 (55), 141 (62), 126 (29), 112 (22), 110 (15), 109 (12), 97 (24), 96 (14), 81 (16), 77 (72), 56 (12), 55 (100), 51 (14). **HRMS (ESI):** calculated for $C_{14}H_{21}NO_2SNa$ $[M + Na]^+$: 290.1185. Found: 290.1187.

***N*-(2,2-Dimethylhex-5-en-1-yl)-4-bromobenzenesulfonamide (4c):**
To a solution of of 2,2-dimethylhex-5-en-1-amine **(iii)** (190 mg, 1.5 mmol, 1 equiv) in $CH_2Cl_2$ (5 mL) at 0 °C was added $Et_3N$ (454 g, 4.5 mmol, 3 equiv) followed by 4-bromobenzenesulfonyl chloride (400 mg, 1.57 mmol, 1.05 equiv). After 15 min, the reaction mixture was allowed to warm to room temperature and stirred for 3 h. The reaction was then quenched by addition of water (10 mL), extracted into ether (20 mL), washed with brine (10 mL), dried over $MgSO_4$, filtrated and concentrated under *vacuum* to afford after purification on silica gel (PE/EtOAc : 98/8) compound **4c** (441 mg, 1.27 mmol, 85%) as a

white solid.
**mp :** 74 °C. **IR** (film) : $\upsilon$ 3271, 3076, 2969, 1640, 1574, 1472, 1454, 1428, 1389, 1327, 1273, 1154, 1089, 1066, 1055, 1010, 993, 911 $cm^{-1}$. **$^1$H NMR** ($CDCl_3$, 400 MHz) : $\delta$ 7.73 ($dt_{app.}$, 2H, $J$ = 8.7, 2.1 Hz), 7.66 ($dt_{app.}$, 2H, $J$ = 8.7, 2.1 Hz), 5.74 (ddt, 1H, $J$ = 17.2, 10.0, 6.6 Hz), 4.97 (dq, 1H, $J$ = 17.2, 1.6 Hz), 4.92 (br d, 1H, $J$ = 10.0 Hz), 4.71 (t, 1H, $J$ = 6.8 Hz, NH), 2.7 (d, 2H, $J$ = 6.8 Hz), 1.93 (m, 2H), 1.27 (m, 2H), 0.86 (s, 6H). **$^{13}$C NMR** ($CDCl_3$, 100 MHz) : $\delta$ 139.2 (s), 138.9 (d), 132.6 (d, 2CH), 128.8 (d, 2CH), 127.7 (s), 114.6 (t), 53.2 (t), 38.7 (t), 34.0 (s), 28.3 (t), 25.0 (q, $2CH_3$). **SM** (EI) *m/z* (abundance) : 292 ((M($^{81}$Br) - butenyl)$^+$, 1), 290 ((M($^{79}$Br) - butenyl)$^+$, 1), 250 (18), 248 (16), 221 (18), 219 (18), 157 (12), 155 (12), 126 (25), 112 (25), 110 (13), 109 (14), 97 (30), 96 (14), 95 (10), 81 (17), 76 (11), 69 (10), 56 (15), 55 (100). **HRMS** (ESI): Calculated for $C_{14}H_{20}(^{79}Br)NO_2SNa$ $[M + Na]^+$: 368.0290. Found: 368.0295.

***N*-(2,2-Dimethylhex-5-en-1-yl)-4-nitrobenzenesulfonamide (4d):**
To a solution of 2,2-dimethylhex-5-en-1-amine **(iii)** (127 mg, 1 mmol, 1 equiv) in $CH_2Cl_2$ (5 mL) at 0 °C was added $Et_3N$ (303 mg, 3 mmol, 3 equiv) followed by 4-NsCl (232 g, 1.05 mmol, 1.05 equiv). After 15 min, the reaction mixture was allowed to warm to room temperature and stirred for 3 h. The reaction was then quenched by addition of water (5 mL), extracted with $Et_2O$ (20 mL), washed with brine (10 mL), dried over $MgSO_4$, filtrated and concentrated under *vacuum* to afford after purification on silica gel (PE/EtOAc : 90/10) compound **4d** (270 mg, 0.86 mmol, 86%) as a yellow solid.
**mp**: 66 °C. **IR** (film): $\upsilon$ 3289, 3101, 2965, 2934, 1641, 1607, 1532, 1423, 1350, 1310, 1159, 1090, 1064, 1026, 1012, 991, 906 $cm^{-1}$. **$^1$H NMR** ($CDCl_3$, 400 MHz): $\delta$ 8.32 (br d, 2H, $J$ = 8.7 Hz), 8.04 (br d, 2H, $J$ = 9.2 Hz), 5.68 (ddt, 1H, $J$ = 17.0, 10.2, 6.4 Hz), 5.37 (br s, 1H, NH), 4.91 ($dq_{app.}$, 1H, $J$ = 17.2, 1.6 Hz), 4.94 (br d, 1H, $J$ = 10.4 Hz), 2.71 (s, 2H), 1.89 (m, 2H), 1.23 (m, 2H), 0.82 (s, 6H). **$^{13}$C NMR** ($CDCl_3$, 100 MHz): $\delta$ 150.1 (s), 146.0 (s), 138.7 (d), 128.4 (d, 2CH), 124.6 (d, 2CH), 114.5 (t), 53.2 (t), 38.5 (t), 34.0 (s), 28.2 (t), 24.8 (q, $2CH_3$). **SM** (EI) *m/z* (abundance): 257 ((M-butenyl)$^+$, 1), 156 (28), 126 (12), 112 (17), 97 (36), 92 (11), 69 (11), 57 (17), 56 (12), 55 (100). **HRMS** (ESI): Calculated for $C_{15}H_{23}NO_2SNa$: 335.1036. Found: 335.1038.

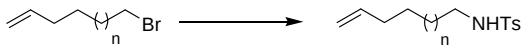
***N*-(2,2-Dimethylhex-5-en-1-yl)-2-nitrobenzenesulfonamide (4e):**
To a solution of 2,2-dimethylhex-5-en-1-amine **(iii)** (127 mg, 1 mmol, 1 equiv) in $CH_2Cl_2$ (5 mL) at 0 °C was added $Et_3N$ (303 mg, 3 mmol, 3 equiv) followed by 2-NsCl (232 g, 1.05 mmol, 1.05 equiv). After 15 min, the reaction mixture was allowed to warm to room temperature and stirred for 3 h. The reaction was then quenched by addition of water (5 mL), extracted with $Et_2O$ (20 mL), washed with brine (10 mL), dried over $MgSO_4$, filtrated and concentrated under *vacuum* to afford after purification on silica gel (PE/EtOAc : 90/10) compound **4e** (274 mg, 0.88 mmol, 88%) as a yellow oil.
**IR** (film): $\upsilon$ 3354, 3079, 2963, 2932, 1640, 1594, 1538, 1469, 1441, 1416, 1344, 1164, 1125, 1063, 911 $cm^{-1}$. **$^1$H NMR** ($CDCl_3$, 400 MHz) : $\delta$ 8.10 (m, 1H), 7.84 (m, 1H), 7.76-7.69 (m, 2H), 5.73 (ddt, 1H, $J$ = 17.0, 10.2, 6.4 Hz), 5.25 (br t, 1H, $J$ = 6.4 Hz, NH), 4.96 ($dq_{app.}$, 1H, $J$ = 17.1, 1.6 Hz), 4.90 (ddt, 1H, $J$ = 10.1, 1.7, 1.3 Hz), 2.82 (d, 2H, $J$ = 6.8 Hz), 1.95 (m, 2H), 1.30 (m, 2H), 0.89 (s, 6H). **$^{13}$C NMR** ($CDCl_3$, 100 MHz): $\delta$ 148.3 (s), 138.8 (d), 133.8 (s), 133.7, 133.0, 131.4, 125.6 (d, $4CH_{ar}$), 114.7 (t), 53.7 (t), 38.8 (t), 34.1 (s), 28.4 (t), 25.1 (q, $2CH_3$). **SM** (EI) *m/z* (abundance): 215 ($NsNHCH_2^+$, 5), 186 (27), 156 (12), 126 (18), 112 (15), 97 (32), 96 (10), 95 (12), 93 (11), 92 (16), 81 (15), 69 (14), 57 (10), 56 (13), 55 (100). **HRMS** (ESI): Calculated for $C_{15}H_{23}NO_2SNa$: 335.1036. Found: 335.1038.

***N*-(2,2-Dimethylhex-5-en-1-yl)methanesulfonamide (4f):**
To a solution of amine (63 mg, 0.5 mmol, 1 equiv) and $Et_3N$ (151 g, 1.5 mmol, 3 equiv) in

$CH_2Cl_2$ (5 mL) cooled to 0 °C was added MsCl (60 mg, 0.525 mmol, 1.05 equiv). After 15 min le reaction was allowed to warm to room temperature and stirred 1 h. The reaction was then quenched with water (10 mL) and the phases separated. The organic phase was washed with brine (5mL), dried over $MgSO_4$, filtrated and concentrated under *vacuum* to afford after purification on silica gel (PE/EtOAc : 70/30) compound **4f** (67 mg, 0.33 mmol, 66%) as a colourless solid.

**mp:** 35 °C. **IR** (film): $\upsilon$ 3291, 2963, 2932, 1640, 1413, 1369, 1314, 1174, 1150, 1068, 995, 972, 910 $cm^{-1}$. **$^1$H NMR** ($CDCl_3$, 400 MHz): $\delta$ 5.81 (ddt, 1H, $J$ = 17.0, 10.2, 6.4 Hz), 5.02 (dq, 1H, $J$ = 17.1, 1.6 Hz), 4.94 (br d, 1H, $J$ = 10.1 Hz), 4.88 (t, 1H, $J$ = 6.7 Hz), 2.95 (s, 3H), 2.90 (d, 2H, $J$ = 6.8 Hz), 2.02 (m, 2H), 1.34 (m, 2H), 0.93 (s, 6H). **$^{13}$C NMR** ($CDCl_3$, 100 MHz): $\delta$ 138.9 (d), 114.4 (t), 53.1 (t), 39.9 (q), 38.6 (t), 33.9 (s), 28.2 (t), 24.8 (q, $2CH_3$). **SM** (EI) *m/z* (abundance): 150 ((M-butenyl)$^+$, 1), 108 (16), 97 (31), 96 (14), 81 (16), 56 (11), 55 (100). **HRMS** (ESI): Calculated for $C_9H_{19}NO_2SNa$ [M + Na]$^+$: 228.1029. Found: 228.1028.

## 2. *Synthesis of 4g and 7*




n = 1, **4g**
n = 2, **7**

***N*-(Hex-5-en-1-yl)-4-methylbenzenesulfonamide (4g):**[3]

To a solution of 6-bromohex-1-ene (815 mg, 5 mmol, 1 equiv) in MeCN (20 mL) were added $K_2CO_3$ (1.38 g, 10 mmol, 2 equiv) and $TsNH_2$ (1.171 g, 10 mmol, 2 equiv), and the reaction was heated to reflux. After 5 h, the reaction mixture was filtrated through Celite® and evaporated under *vacuum* to afford after purification on silica gel (PE/EtOAc: 90/10) product **7a** as a colourless oil (1.265 g, 4.99 mmol, 99%). Spectral data for **4g** match those previously described in the literature.

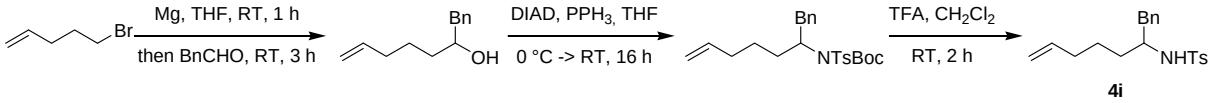
**IR** (film): $\upsilon$ 3280, 2930, 2862, 1640, 1599, 1424, 1322, 1306, 1156, 1093, 909, 814, 661 $cm^{-1}$. **$^1$H NMR** ($CDCl_3$, 400 MHz): $\delta$ 7.75 ($dt_{app.}$, 2H, $J$ = 8.4, 2.2 Hz), 7.31 (br d, 2H, $J$ = 8.0 Hz), 5.71 (ddt, 1H, $J$ = 16.8, 10.3, 6.8 Hz), 4.99-4.89 (m, 2H), 4.63 (br s, 1H, NH), 2.93 ($q_{app.}$, 2H, $J$ = 6.8 Hz), 2.43 (s, 3H), 1.98 ($q_{app.}$, 2H, $J$ = 7.1 Hz), 1.51-1.42 (m, 2H), 1.41-1.31 (m, 2H). **$^{13}$C NMR** ($CDCl_3$, 100 MHz): $\delta$ 143.5 (s), 138.3 (d), 137.1 (s), 129.9 (d, 2CH), 127.3 (d, 2CH), 115.1 (t), 43.2 (t), 33.3 (t), 29.1 (t), 25.9 (t), 21.7 (q). **SM** (EI) *m/z* (abundance): 184 ((M-pentenyl)$^+$, 5), 155 (40), 98 (24), 92 (13), 91 (100), 89 (11), 84 (27), 82 (12), 81 (25), 65 (45), 56 (12).

***N*-(hept-6-en-1-yl)-4-methylbenzenesulfonamide (7):**

To a solution of 7-bromohept-1-ene (885 mg, 5 mmol, 1 equiv) in MeCN (20 mL) were added $K_2CO_3$ (1.38 g, 10 mmol, 2 equiv) and $TsNH_2$ (1.171 g, 10 mmol, 2 equiv), and the reaction was heated to reflux. After 5 h, the reaction mixture was filtrated through Celite® and evaporated under *vacuum* to afford after purification on silica gel (PE/EtOAc: 90/10) product **7** as a colourless oil (958 mg, 3.8 mmol, 72%).

**IR** (film): $\upsilon$ 3281, 2929, 2858, 1640, 1599, 1424, 1322, 1306, 1290, 1156, 1093, 908 $cm^{-1}$. **$^1$H NMR** ($CDCl_3$, 400 MHz): $\delta$ 7.73 (br d, 2H, $J$ = 8.4 Hz), 7.28 (br d, 2H, $J$ = 8.0 Hz), 5.72 (ddt, 1H, $J$ = 17.2, 10.4, 6.4 Hz), 4.93 (br d, 1H, $J$ = 17.2 Hz), 4.90 (br d, 1H, $J$ = 10.4 Hz), 4.49 (br s, 1H, NH), 2.90 ($q_{app.}$, 2H, $J$ = 6.8 Hz), 2.40 (s, 3H), 1.96 ($q_{app.}$, 2H, $J$ = 7.0 Hz), 1.43 ($quint_{app.}$, 2H, $J$ = 7.2 Hz), 1.34-1.20 (m, 4H). **$^{13}$C NMR** ($CDCl_3$, 100 MHz): $\delta$ 143.5 (d), 138.8 (s), 137.2 (s), 129.9 (d, 2CH), 127.3 (d, 2CH), 114.8 (t), 42.4 (t), 33.7 (t), 29.6 (t), 28.5 (t), 26.2 (t), 21.7 (q). **SM** (EI) *m/z* (abundance): 267 ($M^{+\cdot}$, 1), 184 (12), 155 (48), 112 (21), 95 (19), 92 (11), 91 (100), 67 (12), 55 (14). **HRMS** (ESI): Calculated for $C_{14}H_{21}NO_2SNa$: 290.1185. Found: 290.1186.

### 3. *Synthesis of 4i and 4j.*




**1-Phenylhept-6-en-2-ol:**[4]

To a suspension of mg turnings (115 mg, 4.8 mmol, 1 equiv) in a minimum of THF was added dropwise a solution of 5-bromopent-1-ene (715 mg, 4.8 mmol, 1 equiv) in THF (20 mL). After complete dissolution of mg turnings (~ 2 h), the reaction mixture was cooled to 0 °C and phenylacetaldehyde (601 mg, 5 mmol, 1.05 equiv) was added dropwise. The reaction was warmed to room temperature. After 5 h, the reaction was quenched by addition of a saturated aqueous $NH_4Cl$ solution (10 mL) and diluted with EtOAc (20 mL). The phases were separated and the aqueous phase extracted with EtOAc (2 x 20 mL). The combined organic phases were washed with brine (20 mL), dried over $MgSO_4$, filtrated and concentrated under *vacuum* to afford after purification on silica gel (PE/EtOAc: 90/10) the title compound (155 mg, 0.82 mmol, 17%) as a colourless oil. Spectral data match those previously described in the literature.

**IR** (film): $\upsilon$ 3381, 3028, 2933, 1640, 1495, 1454, 1081, 1031, 996, 909 $cm^{-1}$. **$^1$H NMR** ($CDCl_3$, 400 MHz): $\delta$ 7.34-7.28 (m, 2H), 7.26-7.18 (m, 3H), 5.81 (ddt, 1H, $J$ = 17.2, 10.2, 6.8 Hz), 5.01 (br d, 1H, $J$ = 17.2 Hz), 4.96 (br d, 1H, $J$ = 10.2 Hz), 3.81 (m, 1H), 2.82 ($dd_{systAB}$, 1H, $J$ = 13.6, 4.3 Hz), 2.64 ($dd_{systAB}$, 1H, $J$ = 13.6, 8.4 Hz), 2.16-2.01 (m, 2H), 1.67-1.42 (m, 5H). **$^{13}$C NMR** ($CDCl_3$, 100 MHz): $\delta$ 138.7 (d), 138.6 (s), 129.4 (d, 2CH), 128.6 (d, 2CH), 126.5 (d), 114.7 (t), 72.6 (d), 44.1 (t), 36.3 (t), 33.7 (t) 25.1 (t). **SM** (EI) *m/z* (abundance) : 190 ($M^{+\cdot}$, 1), 92 (100), 91 (30), 81 (15), 55 (13).

***tert*-Butyl *N*-(1-phenylhept-6-en-2-yl)-*N*-(tosyl)carbamate:**

To a stirred solution of 1-phenylhept-6-en-2-ol (115 mg, 0.82 mmol, 1 equiv), $PPh_3$ (629 mg, 2.4 mmol, 3 equiv) and *N*-(*tert*-butoxycarbonyl)-*p*-toluenesulfonamide (542 mg, 2 mmol, 2.5 equiv) in THF (10 mL) at 0 °C was added dropwise DIAD (404 mg, 2 mmol, 2.5 equiv). After 15 min, the reaction was allowed to warm to room temperature and stirred overnight. After 16 h, the volatiles were evaporated to afford after purification on silica gel (PE/EtOAc: 98/2) the title compound as a colourless oil (151 mg, 0.34 mmol, 41%).

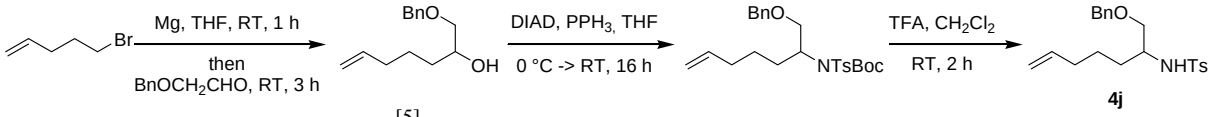
**IR** (film): $\upsilon$ 2979, 2931, 1723, 1598, 1456, 1347, 1279, 1255, 1149, 1087, 910 $cm^{-1}$. **$^1$H NMR** ($CDCl_3$, 400 MHz): $\delta$ 7.31-7.19 (m, 5H), 7.13-6.99 (m, 4H), 5.79 (ddt, 1H, $J$ = 16.8, 10.4, 6.8 Hz), 5.00 (br d, 1H, $J$ = 17.2 Hz), 4.95 (br d, 1H, $J$ = 10.4 Hz), 4.73 (m, 1H), 3.31 ($dd_{systAB}$, 1H, $J$ = 13.6, 9.4 Hz), 3.00 ($dd_{systAB}$, 1H, $J$ = 13.6, 6.4 Hz), 2.34 (s, 3H), 2.16-2.02 (m, 3H), 1.75 (m, 1H), 1.58-1.44 (m, 2H), 1.35 (s, 9H). **$^{13}$C NMR** ($CDCl_3$, 100 MHz) : $\delta$ 150.8 (s), 143.3 (s), 139.1 (s), 138.4 (d), 137.6 (s), 129.6 (d, 2CH), 128.9 (d, 2CH), 128.7 (d, 2CH), 127.9 (d, 2CH), 126.5 (d), 114.8 (t), 84.0 (s), 61.2 (t), 39.7 (t), 33.5 (t), 32.8 (t), 28.0 (q, $3CH_3$), 26.1 (t), 21.5 (q). **SM** (EI) *m/z* (abundance): 274 (2), 252 (39), 172 (17), 155 (45), 92 (11), 91 (100), 81 (25), 65 (15). **HRMS** (ESI): Calculated for $C_{25}H_{33}NO_4SNa$: 466.2022. Found: 466.2021.

**4-Methyl-*N*-(1-phenylhept-6-en-2-yl)benzenesulfonamide (4i):**

To a stirred solution of *tert*-butyl *N*-(1-phenylhept-6-en-2-yl)-*N*-(tosyl)carbamate (151 mg, 0.34 mmol, 1 equiv) in $CH_2Cl_2$ (10 mL) was added dropwise TFA (300 µL). After 2 h at RT, the reaction was quenched by addition of a saturated aqueous $NaHCO_3$ solution (10 mL). The phases were separated and the organic phase was washed with brine (10 mL), dried over $MgSO_4$, filtrated and evaporated to afford compound **4i** (98 mg, 0.29 mmol, 85%) as a colourless oil. The product was sufficiently pure to be used without further purification.

**IR** (film): $\upsilon$ 3280, 2925, 1640, 1599, 1495, 1454, 1423, 1322, 1155, 1091, 1031, 994, 909 $cm^{-1}$. **$^1$H NMR** ($CDCl_3$, 400 MHz): $\delta$ 7.66 (br d, 2H, $J$ = 8.4 Hz), 7.26-7.14 (m, 5H), 7.05-6.98 (m, 2H), 5.64 (m, 1H), 4.91-4.83 (m, 2H), 4.68 (d, 1H, $J$ = 8.4 Hz, NH), 3.42

($sext_{app.}$, 1H, $J$ = 6.6 Hz), 2.72-2.61 (m, 2H), 2.40 (s, 3H), 1.94-1.82 (m, 2H), 1.51-1.18 (m, 4H). **$^{13}$C NMR** ($CDCl_3$, 100 MHz): $\delta$ 143.1 (s), 138.2 (d), 137.9 (s), 137.3 (s), 129.6 (d, 2CH), 129.5 (d, 2CH), 128.4 (d, 2CH), 127.0 (d, 2CH), 126.5 (d), 114.7 (t), 55.0 (d), 41.4 (t), 33.8 (t), 33.2 (t), 24.6 (t), 21.5 (q). **SM** (EI) *m/z* (abundance): 252 ($(M\text{-benzyl})^+$, 34), 172 (19), 155 (45), 92 (10), 91 (100), 81 (24), 65 (16). **HRMS** (ESI): Calculated for $C_{20}H_{25}NO_2SNa$: 366.1498. Found: 366.1502.




**4j**

**1-(Benzyloxy)hept-6-en-2-ol:**[5]

To a suspension of mg turnings (115 mg, 4.8 mmol, 1 equiv) in a minimum of THF was added dropwise a solution of 5-bromopent-1-ene (715 mg, 4.8 mmol, 1 equiv) in THF (20 mL). After complete dissolution of mg turnings (~ 2 h), the reaction mixture was cooled to 0 °C and benzyloxyacetaldehyde (720 mg, 4.8 mmol, 1 equiv) was added dropwise. The reaction was warmed to room temperature. After 5 h, the reaction was quenched by addition of a saturated aqueous $NH_4Cl$ solution (10 mL) and diluted with EtOAc (20 mL). The phases were separated and the aqueous phase extracted with EtOAc (2 x 20 mL). The combined organic phases were washed with brine (20 mL), dried over $MgSO_4$, filtrated and concentrated under *vacuum* to afford after purification on silica gel (PE/EtOAc: 85/15) the title compound (781 mg, 3.5 mmol, 74%) as a colourless oil. Spectral data match those previously described in the literature.

**IR** (film): $\upsilon$ 3441, 3065, 3031, 2927, 2860, 1640, 1454, 1364, 1254, 1206, 1093, 996, 909 $cm^{-1}$. **$^1$H NMR** ($CDCl_3$, 400 MHz): $\delta$ 7.38-7.25 (m, 5H), 5.78 (ddt, 1H, $J$ = 17.0, 10.2, 6.8 Hz), 4.99 (dq, 1H, $J$ = 17.1, 1.9 Hz), 4.93 (m, 1H), 4.54 (s, 2H), 3.80 (m, 1H), 3.49 ($dd_{systAB}$, 1H, $J$ = 9.4, 3.0 Hz), 3.31 ($dd_{systAB}$, 1H, $J$ = 9.4, 7.8 Hz), 2.36 (br d, 1H, $J$ = 3.6 Hz), 2.09-2.00 (m, 2H), 1.56 (m, 1H), 1.50-1.35 (m, 3H). **$^{13}$C NMR** ($CDCl_3$, 100 MHz): $\delta$ 138.8 (d), 138.2 (s), 128.7 (d, 2CH), 128.0 (d), 127.9 (d, 2CH), 114.9 (t), 74.8 (t), 73.5 (t), 70.5 (d), 33.9 (t), 32.7 (t), 25.0 (t). **SM** (EI) *m/z* (abundance): 220 ($M^{+\cdot}$, 1), 107 (16), 92 (55), 91 (100), 81 (64), 65 (14), 57 (12), 55 (26). **HRMS (ESI):** Calculated for $C_{14}H_{20}O_2Na$: 243.1356. Found: 243.1350.

***tert*-Butyl [1-(benzyloxy)hept-6-en-2-yl]-*N*-(tosyl)carbamate:**

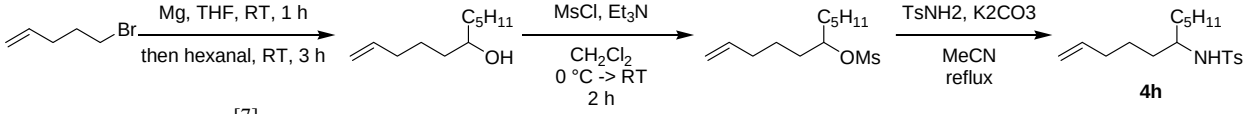
To a stirred solution of 1-(benzyloxy)hept-6-en-2-ol (202 mg, 1 mmol, 1 equiv), $PPh_3$ (776 mg, 3 mmol, 3 equiv) and *N*-(*tert*-butoxycarbonyl)-*p*-toluenesulfonamide (677 mg, 2.5 mmol, 2.5 equiv) in THF (14 mL) at 0 °C was added dropwise DIAD (505 mg, 2.5 mmol, 2.5 equiv). After 15 min, the reaction was allowed to warm to room temperature and stirred overnight. After 16 h, the volatiles were evaporated to afford after purification on silica gel (PE/EtOAc: 95/5) the title compound as a colourless oil (315 mg, 0.66 mmol, 67%).

**IR** (film): $\upsilon$ 2980, 2930, 2865, 1723, 1640, 1598, 1455, 1348, 1282, 1255, 1151, 1087, 993, 911 $cm^{-1}$. **$^1$H NMR** ($CDCl_3$, 400 MHz): $\delta$ 7.87 (d, $J$ = 8.4 Hz, 2H), 7.33-7.22 (m, 5H), 7.05 (d, $J$ = 8.4 Hz, 2H), 5.79 (ddt, $J$ = 17.2, 10.2, 6.6 Hz, 1H), 5.02 (dq, $J$ = 17.2, 1.8 Hz, 1H), 4.96 (m, 1H), 4.79 (m, 1H), 4.56 ($d_{systAB}$, $J$ = 11.6 Hz, 1H), 4.44 ($d_{systAB}$, $J$ = 11.6 Hz, 1H), 3.99 ($dd_{systAB}$, $J$ = 9.6, 9.6 Hz, 1H), 3.58 ($dd_{systAB}$, $J$ = 10.0, 5.2 Hz, 1H), 2.34 (s, 3H), 2.12 (m, 2H), 1.94 (m, 1H), 1.69-1.44 (m, 3H), 1.30 (s, 9H). **$^{13}$C NMR** ($CDCl_3$, 100 MHz): $\delta$ 150.7 (s), 143.6 (s), 138.4 (d), 138.1 (s, $C_{qar}$), 137.9 (s), 128.9 (d, 2CH), 128.5 (d, 2CH), 128.4 (d, 2CH), 127.9 (d, 2CH), 127.6 (d), 115.0 (t), 84.0 (s), 73.1 (t), 70.8 (t), 58.6 (d), 33.5 (t), 29.9 (t), 28.0 (q, $3CH_3$), 25.8 (t), 21.6 (q). **SM** (EI) *m/z* (abundance): 343 (1), 252 (30), 172 (17), 155 (34), 91 (100), 81 (19), 65 (11). **HRMS (ESI):** Calculated for $C_{26}H_{35}NO_5SNa$ $[M + Na]^+$: 496.2128. Found: 496.2129.

***N*-[1-(Benzyloxy)hept-6-en-2-yl]-4-methylbenzenesulfonamide (4j):**[6]

To a stirred solution of *tert*-butyl [1-(benzyloxy)hept-6-en-2-yl]-*N*-(tosyl)carbamate (315 mg, 0.67 mmol, 1 equiv) in $CH_2Cl_2$ (10 mL) was added dropwise TFA (600 µL). After 2 h at RT, the reaction was quenched by addition of a saturated aqueous $NaHCO_3$ solution (10 mL). The phases were separated and the organic phase was washed with brine (10 mL), dried over $MgSO_4$, filtrated and evaporated to afford compound **4j** (116 mg, 0.31 mmol, 46%) as a slightly yellow oil. The product was sufficiently pure to be used without further purification. Spectral data for **4j** match those previously described in the literature.
**IR** (film): $\upsilon$ 3276, 3064, 2924, 2861, 1746, 1640, 1598, 1496, 1454, 1417, 1325, 1158, 1091, 1022, 996, 909 $cm^{-1}$. **$^1$H NMR** ($CDCl_3$, 400 MHz): $\delta$ 7.71 (br d, 2H, $J$ = 8.4 Hz), 7.36-7.18 (m, 7H), 5.68 (ddt, 1H, $J$ = 16.8, 10.4, 6.6 Hz), 4.97-4.88 (m, 3H), 4.34 (s, 2H), 3.38-3.28 (m, 2H), 3.24 (m, 1H), 2.39 (s, 3H), 1.93 ($q_{app.}$, 2H, $J$ = 7.2 Hz), 1.59-1.53 (m, 2H), 1.40-1.17 (m, 2H). **$^{13}$C NMR** ($CDCl_3$, 100 MHz): $\delta$ 143.3 (s), 138.4 (d), 138.3 (s), 137.9 (s), 129.7 (d, 2CH), 128.5 (d, 2CH), 127.9 (d), 127.7 (d, 2CH), 127.2 (d, 2CH), 114.8 (t), 73.3 (t), 71.4 (t), 53.7 (d), 33.4 (t), 32.1 (t), 24.9 (t), 21.7 (q). **SM** (EI) *m/z* (abundance): 252 ($(M\text{-}BnOCH_2)^+$, 27), 218 (10), 172 (19), 155 (37), 92 (12) 91 (100), 81 (20), 65 (13).

### *4. Synthesis of 4h*




**Undec-1-en-6-ol:**[7]
To a suspension of mg turnings (115 mg, 4.8 mmol, 1.2 equiv) in a minimum of anhydrous THF was added dropwise a solution of 5-bromopent-1-ene (715 mg, 4.8 mmol, 1.2 equiv) in anhydrous THF (20 mL). After complete dissolution of mg turnings (~ 2 h), the reaction mixture was cooled to 0 °C and hexanal (400 mg, 4 mmol, 1 equiv) was added dropwise. The reaction was warmed to room temperature. After 5 h, the reaction was quenched by addition of a saturated aqueous $NH_4Cl$ solution (10 mL) and diluted with EtOAc (20 mL). The phases were separated and the aqueous phase extracted with EtOAc (2 x 20 mL). The combined organic phases were washed with brine (20 mL), dried over $MgSO_4$, filtrated and concentrated under *vacuum* to afford after purification on silica gel (PE/EtOAc: 9/1) the title compound (395 mg, 2.3mmol, 58%) as a colourless oil. Spectral data match those previously described in the literature.
**IR** (film): $\upsilon$ 3334, 2929, 2859, 1641, 1459, 1378, 1126, 994, 909 $cm^{-1}$. **$^1$H NMR** ($CDCl_3$, 400 MHz): $\delta$ 5.81 (ddt, 1H, $J$ = 17.0, 10.2, 6.8 Hz), 5.01 ($dq_{app.}$, 1H, $J$ = 17.1, 1.8 Hz), 4.95 (br d, 1H, $J$ = 10.2 Hz), 3.60 (m, 1H), 2.12-2.04 (m, 2H), 1.63-1.22 (m, 13H), 0.89 (t, 3H, $J$ = 7.0 Hz). **$^{13}$C NMR** ($CDCl_3$, 100 MHz): $\delta$ 139.0 (d), 114.8 (t), 72.0 (d), 37.7, 37.1, 34.0, 32.1, 25.6, 25.2, 22.9 (t, 7$CH_2$), 14.3 (q). **SM** (EI) *m/z* (abundance): 152 ($(M\text{-}H_2O)^{+\cdot}$, 1), 83 (34), 82 (14), 81 (69), 68 (10), 67 (15), 57 (32), 55 (100), 54 (24).
**Undec-1-en-6-yl methanesulfonate:**
To a solution of undec-1-en-6-ol (391 mg, 2.3 mmol, 1 equiv) and $Et_3N$ (353 mg, 3.5 mmol, 1.5 equiv) in $CH_2Cl_2$ (7 mL) cooled to 0 °C was added MsCl (285 mg, 2.5 mmol, 1.1 equiv). After 15 min the reaction was allowed to warm to room temperature and stirred for 1 h. The reaction was then quenched with water (5 mL) and the phases separated. The organic phase was washed with brine (7 mL), dried over $MgSO_4$, filtrated and concentrated under *vacuum* to afford the title compound (470 mg, 1.89 mmol, 82%) as a colourless oil. The product was used without further purification.

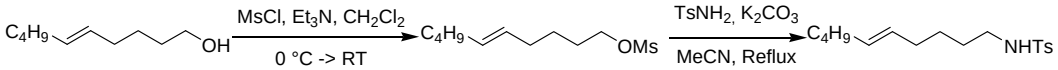
**IR** (film): $\upsilon$ 2933, 2862, 1641, 1460, 1333, 1172, 970, 901. **$^1$H NMR** ($CDCl_3$, 400 MHz): $\delta$ 5.79 (ddt, 1H, $J$ = 17.1, 10.2, 6.8 Hz), 5.06-4.95 (m, 2H), 4.72 ($quint_{app.}$, 1H, $J$ = 6.0 Hz), 3.00 (s, 3H), 2.09 ($q_{app.}$, 2H, $J$ = 7.2 Hz), 1.77-1.24 (m, 12H), 0.90 (t, 3H, $J$ = 6.8 Hz). **$^{13}$C NMR** ($CDCl_3$, 100 MHz): $\delta$ 138.2 (d), 115.3 (t), 84.2 (d), 38.9 (q), 34.6, 34.0, 33.5, 31.7, 24.8, 24.3, 22.6 (d, 7$CH_2$), 14.2 (q). **SM** (EI) *m/z* (abundance): 152 ((M-MsOH)$^+$, 1), 97 (16), 96 (20), 95 (15), 83 (22), 82 (37), 81 (64), 69 (38), 68 (36), 67 (52), 57 (12), 56 (15), 55 (100), 54 (96), 53 (16). **HRMS (ESI):** Calculated for $C_{12}H_{24}O_3SNa$: 271.1338. Found: 271.1340.

**4-Methyl-*N*-(undec-1-en-6-yl)benzenesulfonamide (4h):**[8]

To a solution of undec-1-en-6-yl methanesulfonate (470 mg, 1.9 mmol, 1 equiv) in $CH_3CN$ (7 mL) was added $K_2CO_3$ (552 mg, 4 mmol, 2.1 equiv) followed by $TsNH_2$ (684 mg, 4 mmol, 2.1 equiv). The reaction mixture was refluxed overnight. After 16 h, the mixture was cooled to room temperature, filtered through Celite® and concentrated under *vacuum* to afford after purification on silica gel (PE/EtOAc: 95/5) compound **4h** (182 mg, 0.56 mmol, 30%) as a colourless oil. Spectral data for **4h** match those previously described in the literature.

**IR** (film): $\upsilon$ 3278, 2930, 2859, 1641, 1599, 1496, 1425, 1322, 1158, 1094, 1038, 993, 908 cm$^{-1}$. **$^1$H NMR** ($CDCl_3$, 400 MHz): $\delta$ 7.76 (br d, 2H, $J$ = 8.3 Hz), 7.29 (br d, 2H, $J$ = 8.2 Hz), 5.67 (ddt, 1H, $J$ = 16.8, 10.4, 6.8 Hz), 4.95-4.87 (m, 2H), 4.43 (br s, 1H, NH), 3.20 ($sext_{app.}$, 1H), 2.42 (s, 3H), 1.91 ($q_{app.}$, 2H, $J$ = 6.9 Hz), 1.47-1.02 (m, 12H), 0.81 (t, 3H, $J$ = 7.2 Hz). **$^{13}$C NMR** ($CDCl_3$, 100 MHz): $\delta$ 143.3 (s), 138.6 (s), 138.5 (d), 129.7 (d, 2CH), 127.2 (d, 2CH), 114.8 (t), 54.2 (d), 35.2 (t), 34.7 (t), 33.6, 31.7, 25.1, 24.6, 22.7 (t, 5$CH_2$), 21.7 (q), 14.1 (q). **SM** (EI) *m/z* (abundance): 254 ((M-pentenyl)$^+$, 16), 155 (33), 92 (10), 91 (100), 81 (13), 65 (23), 55 (15).

## 5. *Synthesis of 9a, 9b and 12*




**9a**

**(*E*)-Dec-5-en-1-yl methanesulfonate:**

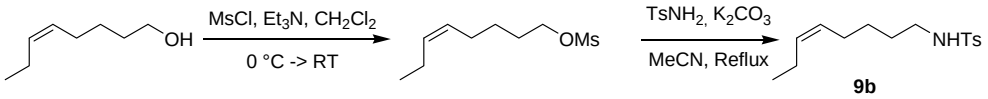
To a solution of (*E*)-dec-5-en-1-ol (472 mg, 2.7 mmol, 1 equiv) and $Et_3N$ (372 mg, 3.7 mmol, 1.4 equiv) in $CH_2Cl_2$ (10 mL) cooled to 0 °C was added MsCl (370 mg, 2.5 mmol, 1.2 equiv). After 15 min the reaction was allowed to warm to room temperature and stirred for 1 h. The reaction was then quenched with water (5 mL) and the two phases were separated. The organic phase was washed with brine (10 mL), dried over $MgSO_4$, filtrated and concentrated under *vacuum* to afford the title compound (630 mg, 2.7 mmol, quant) as a yellow oil. The product was engaged in the next step without further purification.

**IR** (film): $\upsilon$ 2929, 2859, 1725, 1459, 1352, 1172, 969, 929 cm$^{-1}$. **$^1$H NMR** ($CDCl_3$, 400 MHz): $\delta$ 5.44-5.28 (m, 2H), 4.20 (t, 2H, $J$ = 6.6 Hz), 2.98 (s, 3H), 2.00 ($q_{app.}$, 2H, $J$ = 7.0 Hz), 1.95 ($q_{app.}$, 2H, $J$ = 7.0 Hz), 1.72 (m, 2H), 1.44 (m, 2H), 1.32-1.23 (m, 4H), 0.86 (t, 3H, $J$ = 7.0 Hz). **$^{13}$C NMR** ($CDCl_3$, 100 MHz): $\delta$ 131.7 (d), 129.2 (d), 70.3 (t), 37.6 (q), 32.4 (t), 32.0 (t), 31.9 (t), 28.7 (t), 25.5 (t), 22.4 (t), 14.2 (q). **SM** (EI) *m/z* (abundance): 138 ((M-MsOH)$^{+\cdot}$, 20), 110 (23), 109 (12), 96 (28), 95 (51), 83 (10), 82 (57), 81 (80), 69 (18), 68 (70), 67 (100), 55 (68), 54 (68), 53 (11). **HRMS** (ESI): Calculated for $C_{11}H_{22}O_3SNa$: 257.1182. Found: 257.1185.

**(*E*)-*N*-(Dec-5-en-1-yl)-4-methylbenzenesulfonamide (9a):**

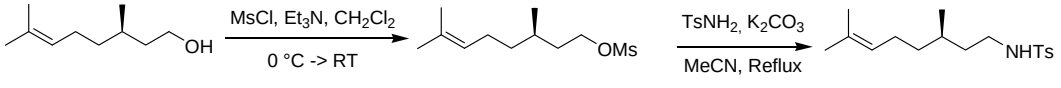
To a solution of (*E*)-dec-5-en-1-yl methanesulfonate (~2.7 mmol, 1 equiv) in MeCN (10 mL) were added $K_2CO_3$ (745 mg, 5.4 mmol, 2 equiv) and $TsNH_2$ (923 mg, 5.4 mmol, 2 equiv), and the reaction was heated to reflux. After 5 h, the reaction mixture was filtrated through Celite® and evaporated under *vacuum* to afford after purification on silica gel (PE/EtOAc: 90/10) product **9a** as a colourless oil (172 mg, 0.55 mmol, 20% (over two steps)).

**IR** (film): $\upsilon$ 3281, 2926, 2858, 1599, 1434, 1325, 1158, 1094, 968, 920 $cm^{-1}$. **$^1$H NMR** ($CDCl_3$, 400 MHz): $\delta$ 7.75 (br d, 2H, $J$ = 8.4 Hz), 7.31 (br d, 2H, $J$ = 8.0 Hz), 5.39-5.24 (m, 2H), 4.46 (br s, 1H, NH), 2.93 ($q_{app.}$, 2H, $J$ = 6.8 Hz), 2.43 (s, 3H), 1.98-1.88 (m, 4H), 1.45 (m, 2H), 1.35-1.25 (m, 6H), 0.88 (t, 3H, $J$ = 6.9 Hz). **$^{13}$C NMR** ($CDCl_3$, 100 MHz): $\delta$ 143.3 (s), 137.0 (s), 131.2 (d), 129.7 (d, 2CH), 129.3 (d), 127.1 (d, 2CH), 43.1 (t, C), 32.2, 31.9, 31.8, 29.0, 26.4, 22.2 (t, 6$CH_2$), 21.5 (q), 14.0 (q). **SM** (EI) *m/z* (abundance): 309 ($M^{+\cdot}$, 4), 210 (16), 184 (15), 155 (57), 154 (44), 138 (17), 96 (14), 95 (47), 92 (12), 91 (100), 84 (18), 82 (14), 81 (57), 69 (15), 68 (11), 67 (53), 56 (11), 55 (27). **HRMS** (ESI): Calculated for $C_{17}H_{27}NO_2SNa$: 332.1655. Found: 332.1654.




**9b**

**(*Z*)-Oct-5-en-1-yl methanesulfonate:**
To a solution of (*Z*)-oct-5-en-1-ol (640 mg, 5 mmol, 1 equiv) and $Et_3N$ (725 mg, 7.5 mmol, 1.5 equiv) in $CH_2Cl_2$ (10 mL) cooled to 0 °C was added MsCl (626 mg, 5.5 mmol, 1.1 equiv). After 15 min the reaction was allowed to warm to room temperature and stirred for 1 h. The reaction was then quenched with water (10 mL) and the two phases were separated. The organic phase was washed with brine, dried over $MgSO_4$, filtrated and concentrated under *vacuum* to afford the title compound (1.031 g, 5 mmol, quant) as a colourless oil. The product was used without further purification.
**IR** (film): $\upsilon$ 2937, 1460, 1351, 1171, 972, 931 $cm^{-1}$. **$^1$H NMR** ($CDCl_3$, 400 MHz): $\delta$ 5.38 (dtt, 1H, $J$ = 10.9, 7.1, 1.5 Hz), 5.26 (dtt, 1H, $J$ = 10.9, 7.2, 1.5 Hz), 4.20 (t, 2H, $J$ = 6.6 Hz), 2.98 (s, 3H), 2.04 ($quint_{app.}$, 2H, $J$ = 7.5 Hz), 2.01 ($quint_{app.}$, 2H, $J$ = 7.7 Hz), 1.73 (tt, 2H, $J$ = 7.7, 6.8 Hz), 1.44 ($quint_{app.}$, 2H, $J$ = 7.5 Hz), 0.93 (t, 3H, $J$ = 7.6 Hz). **$^{13}$C NMR** ($CDCl_3$, 100 MHz): $\delta$ 132.8 (d), 128.2 (d), 70.2 (t), 37.6 (q), 28.8 (t), 26.5 (t), 25.7 (t), 20.7 (t), 14.5 (q). **SM** (EI) *m/z* (abundance): 110 ($(M\text{-}MsOH)^+$, 22), 95 (19), 82 (63), 81 (51), 79 (23), 69 (21), 68 (67), 67 (100), 55 (28), 54 (17), 53 (11). **HRMS** (ESI): Calculated for $C_9H_{18}O_3SNa$: 229.0869. Found: 229.0870.
**(*Z*)-4-Methyl-*N*-(oct-5-en-1-yl)benzenesulfonamide (9b):**
To a solution of (*Z*)-oct-5-en-1-yl methanesulfonate (~ 5 mmol, 1 equiv) in MeCN (10 mL) were added $K_2CO_3$ (1.38 g, 10 mmol, 2 equiv) and $TsNH_2$ (1.78 g, 10 mmol, 2 equiv), and the reaction was heated to reflux. After 5 h, the reaction mixture was filtrated through Celite® and evaporated under *vacuum* to afford after purification on silica gel (PE/EtOAc: 95/5) product **9b** as a colourless oil (624 mg, 2.2 mmol, 44% over two steps).
**IR** (film): $\upsilon$ 3280, 2961, 2933, 2869, 1599, 1455, 1425, 1323, 1156, 1093 $cm^{-1}$. **$^1$H NMR** ($CDCl_3$, 400 MHz): $\delta$ 7.75 (br d, 2H, $J$ = 8.4 Hz), 7.31 (br d, 2H, $J$ = 8.4 Hz), 5.44-5.16 (m, 2H), 4.50 (m, 1H, NH), 2.93 ($q_{app.}$, 2H, $J$ = 6.8 Hz), 2.43 (s, 3H), 2.02-1.88 (m, 4H), 1.46 (m, 2H), 1.31 (m, 2H), 0.92 (t, 3H, $J$ = 7.5 Hz). **$^{13}$C NMR** ($CDCl_3$, 100 MHz): $\delta$ 143.3 (s), 137.0 (s), 132.3 (d) 129.7 (d, 2CH), 128.2 (d), 127.1 (d, 2CH), 43.1 (t), 29.1 (t), 26.6 (t), 26.4 (t), 21.5 (q), 20.5 (t), 14.3 (q). **SM** (EI) *m/z* (abundance): 281 ($M^{+\cdot}$, 5), 210 (17), 184 (14), 155 (56), 126 (42), 110 (22), 109 (37), 92 (12), 91 (100), 84 (14), 81 (13), 68 (12), 67 (79), 65 (25), 55 (20). **HRMS** (ESI): Calculated for $C_{15}H_{28}NO_2SNa$: 304.1342. Found: 304.1343.




**12**

**(*R*)-3,7-Dimethyloct-6-en-1-yl methanesulfonate:**
To a solution of (*R*)-3,7-dimethyloct-6-en-1-ol (391 mg, 2.5 mmol, 1 equiv) and $Et_3N$ (757 mg, 7.5 mmol, 3 equiv) in $CH_2Cl_2$ (5 mL) cooled to 0 °C was added MsCl (300 mg,

2.625 mmol, 1.05 equiv). After 15 min the reaction was allowed to warm to room temperature and stirred for 1 h. The reaction was then quenched with water (10 mL) and the phases separated. The organic phase was washed with brine (10 mL), dried over $MgSO_4$, filtrated and concentrated under *vacuum* to afford the title compound (553 mg, 2.36 mmol, 95%) as a colourless oil. The product was used without further purification.
**$[\alpha]_D^{20}$** : + 3.1 (*c* 1.09, $CHCl_3$). **IR** (film): $\upsilon$ 2964, 2915, 1455, 1351, 1172, 973, 938 $cm^{-1}$. **$^1$H NMR** ($CDCl_3$, 400 MHz): $\delta$ 5.08 (br t, 1H, $J$ = 7.0 Hz), 4.32-4.20 (m, 2H), 3.00 (s, 3H), 2.07-1.91 (m, 2H), 1.80 (m, 1H), 1.68 (s, 3H), 1.65-1.50 (m, 2H), 1.60 (s, 3H), 1.37 (m, 1H, $H_4$), 1.20 (m, 1H), 0.94 (d, 3H, $J$ = 6.4 Hz). **$^{13}$C NMR** ($CDCl_3$, 100 MHz): $\delta$ 131.6 (s), 124.3 (d), 68.6 (t), 37.4 (q), 36.8 (t), 35.9 (t), 29.0 (d), 25.7 (q), 25.3 (t), 19.2 (q), 17.7 (q). **SM** (EI) *m/z* (abundance): 234 ($M^{+\cdot}$, 1), 138 (21), 123 (34), 123 (34), 109 (31), 96 (16), 95 (70), 83 (17), 82 (72), 81 (79), 79 (20), 70 (15), 69 (100), 68 (42), 67 (10), 57(10), 56 (20), 55 (67), 53 (12). **HRMS** (ESI): Calculated for $C_{11}H_{22}O_3SNa$: 257.1182. Found: 257.1184.

**(*R*)-*N*-(3,7-Dimethyloct-6-en-1-yl)-4-methylbenzenesulfonamide (12):**
To a solution of (*R*)-3,7-dimethyloct-6-en-1-yl methanesulfonate (553 mg, 2.36 mmol, 1 equiv) in MeCN (10 mL) were added $K_2CO_3$ (657 mg, 4.76 mmol, 2 equiv) and $TsNH_2$ (814 g, 4.76 mmol, 2 equiv), and the reaction was heated to reflux. After 5 h, the reaction mixture was filtrated through Celite® and evaporated under *vacuum* to afford after purification on silica gel (PE/EtOAc: 95/5 to 90/10) product **12** as a very low melting point solid (mp < 25 °C) (560 mg, 1.81 mmol, 78%).
**IR** (film): $\upsilon$ 3281, 2962, 2922, 1599, 1450, 1324, 1158, 1094 $cm^{-1}$. **$^1$H NMR** ($CDCl_3$, 400 MHz): $\delta$ 7.75 (br d, 2H, $J$ = 8.4 Hz), 7.31 (br d, 2H, $J$ = 8.2 Hz), 5.02 (br t, 1H, $J$ = 7.0 Hz), 4.48 (m, 1H, NH), 3.02-2.88 (m, 2H), 2.43 (s, 3H), 1.98-1.80 (m, 2H), 1.67 (s, 3H), 1.57 (s, 3H), 1.51-1.36 (m, 2H), 1.31-1.03 (m, 3H), 0.81 (d, 3H, $J$ = 6.6 Hz). **$^{13}$C NMR** ($CDCl_3$, 100 MHz): $\delta$ 143.3 (s), 137.0 (s), 131.4 (s), 129.7 (d, 2CH), 127.1 (d, 2CH), 124.4 (d), 41.3 (t), 36.8, 36.5 (t, 2C), 29.8 (d), 25.7 (q), 25.3 (t), 21.5 (q), 19.2 (q), 17.1 (q). **SM** (EI) *m/z* (abundance): 309 ($M^{+\cdot}$, 1), 224 (34), 184 (12), 155 (47), 154 (44), 138 (27), 137 (11), 95 (42), 92 (10), 91 (84), 82 (18), 81 (100), 70 (10), 69 (43), 67 (20), 65 (19), 55 (20). **HRMS** (ESI): Calculated for $C_{17}H_{27}NO_2SNa$: 332.1655. Found: 332.1656.

## III. Cyclisation products

**4,4-Dimethyl-1-tosyl-2-vinylpyrrolidine (2)**[9] and
**3,3,6-trimethyl-1-(toluene-4-sulfonyl)-1,2,3,4-tetrahydropyridine (3)**
$[(MeCN)_3RhCp^*](SbF_6)_2$ (4.2 mg, 0.005 mmol, 5 mol %) and $Cu(OAc)_2.H_2O$ (42 mg, 0.21 mmol, 2.1 equiv) were added to a solution of sulfonamide **1** (28 mg, 0.1 mmol, 1 equiv) in DCE (1 mL) and the reaction mixture was heated to reflux. After 16 h, the reaction was cooled to room temperature and filtered through Celite® to afford after purification on silica gel (PE/EtOAc: 98/2) compound **2** as a white solid and compound **3** as a colourless oil (21.6 mg, 0.077 mmol, 77%) in a 5/1 ratio in favour of **2**. Spectral data for **2** match those previously described in the literature.
**4,4-Dimethyl-1-tosyl-2-vinylpyrrolidine (2):**[9]
**mp**: 65 °C. **IR** (film): $\upsilon$ 2959, 2873, 1644, 1598, 1467, 1345, 1214, 1158, 1093, 1056, 1029, 1017, 984, 922 $cm^{-1}$. **$^1$H NMR** ($CDCl_3$, 100 MHz): $\delta$ 7.68 (d, 2H, $J$ = 8.2 Hz), 7.28 (d, 2H, $J$ = 8.2 Hz), 5.84 (ddd, 1H, $J$ = 17.2, 10.4, 7.6 Hz), 5.15 (br d, 1H, $J$ = 17.2 Hz), 5.05 (br d, 1H, $J$ = 10.4 Hz), 3.99 (dt, 1H, $J$ = 8.4, 7.4 Hz), 3.17 ($d_{systAB}$, 1H, $J$ = 10.4 Hz), 3.12 ($dd_{systAB}$, 1H, $J$ = 10.1, 0.9 Hz), 2.41 (s, 3H), 1.71 ($ddd_{systAB}$, 1H, $J$ = 12.4, 7.4, 0.9 Hz), 1.55 ($dd_{systAB}$, 1H, $J$ = 12.7, 8.4 Hz), 1.03 (s, 3H, $H_6$), 0.67 (s, 3H). **$^{13}$C NMR** ($CDCl_3$, 400 MHz): $\delta$ 143.4 (s), 140.0 (d), 135.6 (s), 129.7 (d, 2CH), 127.8 (d, 2CH), 115.4 (d), 62.7 (d), 61.7 (d), 47.7 (t), 37.7 (s), 26.7 (q), 26.3 (q), 21.8 (q). **SM** (EI) *m/z* (abundance): 279 ($M^{+\cdot}$, 3), 252 (21), 215 (20), 214 (33), 200 (16), 155 (23), 124 (28), 119 (21), 91 (64), 81 (21), 68 (100), 67 (13), 65 (18), 55

(13).

**3,3,6-Trimethyl-1-(toluene-4-sulfonyl)-1,2,3,4-tetrahydropyridine (3):**
**$^1$H NMR** ($CDCl_3$, 400 MHz): $\delta$ 7.72 (br d, 2H, $J$ = 8.4 Hz), 7.29-7.23 (br d, 2H, J = 8.4 Hz), 5.47 (br d, 1H, $J$ = 10.0 Hz), 5.44 (dd, 1H, $J$ = 10.0, 3.2 Hz), 4.36 (qd, 1H, $J$ = 6.7, 3.1 Hz), 3.42 ($d_{systAB}$, 1H, $J$ = 12.8 Hz), 2.83 ($d_{systAB}$, 1H, $J$ = 12.8 Hz), 2.41 (s, 3H), 1.04 (d, 3H, $J$ = 6.7 Hz), 0.96 (s, 3H), 0.93 (s, 3H). **$^{13}$C NMR** ($CDCl_3$, 100 MHz): $\delta$ 142.9 (s), 138.5 (s), 135.1 (d), 129.5 (d, 2CH), 127.1 (d, 2CH), 126.9 (d), 50.2 (t), 49.3 (d), 33.0 (s), 26.6, 26.4 (q, $2CH_3$), 21.5 (q), 18.1 (q). **SM** (EI) *m/z* (abundance): 264 ($(M - Me)^+$, 100), 155 (21), 108 (37), 96 (76), 91 (61), 81 (43), 67 (11), 65 (18), 55 (14). **HRMS** (ESI): Calculated for $C_{15}H_{21}NO_2SNa$ $[M + Na]^+$: 302.2285. Found: 302.1188.

**1-[(4-Methoxyphenyl)sulfonyl]-4,4-dimethyl-2-vinylpyrrolidine (5a)** and
***N*-(4-methoxyphenyl)sulfonyl-3,3,6-trimethyl-1,2,3,6-tetrahydropyridine (6a)**
$[(MeCN)_3RhCp^*](SbF_6)_2$ (4.2 mg, 0.005 mmol, 5 mol %) and $Cu(OAc)_2.H_2O$ (42 mg, 0.21 mmol, 2.1 equiv) were added to a solution of sulfonamide **4a** (30 mg, 0.1 mmol, 1 equiv) in DCE (1 mL) and the reaction mixture was heated to reflux. After 16 h, the reaction was cooled to room temperature, filtered through Celite® and concentrated under *vacuum* to afford after purification on silica gel (PE/EtOAc: 98/2) compounds **5a** and **6a** as colourless oils (18.4 mg, 0.061 mmol, 61%) in a 15/1 ratio in favour of **5a**.
**1-[(4-Methoxyphenyl)sulfonyl]-4,4-dimethyl-2-vinylpyrrolidine (5a):**
**IR** (film): $\upsilon$ 3080, 2960, 2873, 1597, 1578, 1497, 1466, 1344, 1259, 1156, 1094, 1055, 1026, 923 $cm^{-1}$. **$^1$H NMR** ($CDCl_3$, 400 MHz): $\delta$ 7.76 (br d, 2H, $J$ = 8.8 Hz), 6.98 (br d, 2H, $J$ = 8.8 Hz), 5.87 (ddd, 1H, $J$ = 17.2, 10.0, 7.6 Hz), 5.17 (br d, 1H, $J$ = 17.2 Hz), 5.07 (br d, 1H, $J$ = 10.0 Hz), 4.00 ($q_{app.}$, 1H, $J$ = 7.6 Hz), 3.87 (s, 3H), 3.19 ($d_{systAB}$, 1H, $J$ = 10.4 Hz), 3.13 ($d_{systAB}$, 1H, $J$ = 10.4 Hz), 1.74 ($dd_{systAB}$, 1H, $J$ = 12.8, 7.6 Hz), 1.58 ($dd_{systAB}$, 1H, $J$ = 12.8, 8.4 Hz), 1.06 (s, 3H), 0.71 (s, 3H). **$^{13}$C NMR** ($CDCl_3$, 100 MHz): $\delta$ 163.0 (s), 140.1 (d), 130.3 (s), 129.8 (d, 2CH), 115.3 (t), 114.2 (d, 2CH), 62.6 (d), 61.7 (t), 55.8 (q), 47.7 (t), 37.7 (s), 26.8, 26.3 (q, $2CH_3$). **SM** (EI) *m/z* (abundance): 295 ($M^{+\cdot}$, 5), 268 (15), 231 (15), 230 (20), 216 (15), 171 (35), 135 (18), 108 (12), 107 (21), 92 (14), 81 (16), 77 (26), 68 (100), 55 (11). **HRMS** (ESI): Calculated for $C_{15}H_{21}NO_3SNa$: 318.1134. Found 318.1127.
***N*-(4-Methoxyphenyl)sulfonyl-3,3,6-trimethyl-1,2,3,6-tetrahydropyridine (6a):**
**IR** (film): $\upsilon$ 2960, 2923, 2868, 1597, 1579, 1498, 1461, 1335, 1303, 1259, 1156, 1096, 1026, 1000, 912 $cm^{-1}$. **$^1$H NMR** ($CDCl_3$, 400 MHz): $\delta$ 7.77 (br d, 2H, $J$ = 9.2 Hz), 6.95 (br d, 2H, $J$ = 9.2 Hz), 5.49-5.42 (m, 2H), 4.35 (qd, 1H, $J$ = 6.8, 2.8 Hz), 3.86 (s, 3H), 3.38 ($d_{systAB}$, 1H, $J$ = 12.8 Hz), 2.82 ($d_{systAB}$, 1H, $J$ = 12.4 Hz), 1.06 (d, 3H, $J$ = 6.4 Hz), 0.96 (s, 3H), 0.92 (s, 3H). **$^{13}$C NMR** ($CDCl_3$, 100 MHz): $\delta$ 162.5 (s), 135.0 (d), 133.2 (s), 129.2 (d, 2CH), 127.0 (d), 114.0 (d, 2CH), 55.6 (d), 50.1 (t), 49.3 (q), 33.0 (s), 26.6, 26.4 (q, $2CH_3$), 18.1 (q). **SM** (EI) *m/z* (abundance): 282 ($(M - Me)^+$, 6), 281 (19), 280 (100), 171 (62), 123 (15), 108 (24), 107 (32), 96 (91), 92 (14), 81 (50), 79 (11), 77 (29), 67 (12), 55 (20). **HRMS** (ESI): Calculated for $C_{15}H_{21}NO_3SNa$: 318.1134. Found 318.1132.

**4,4-Dimethyl-1-(phenylsulfonyl)-2-vinylpyrrolidine (5b)** and
**3,3,6-trimethyl-1-(phenylsulfonyl)-1,2,3,6-tetrahydropyridine (6b)**
$[(MeCN)_3RhCp^*](SbF_6)_2$ (4.2 mg, 0.005 mmol, 5 mol %) and $Cu(OAc)_2.H_2O$ (42 mg, 0.21 mmol, 2.1 equiv) were added to a solution of sulfonamide **4b** (27 mg, 0.1 mmol, 1 equiv)

in DCE (1 mL) and the reaction mixture was heated to reflux. After 16 h, the reaction was cooled to room temperature, filtered on Celite® and concentrated under *vacuum* to afford after purification on silica gel (PE/EtOAc: 98/2) compounds **5b** and **6b** as colourless oils (8.5 mg, 0.032 mmol, 32%) in a 7/1 ratio in favour of **5b**.

**4,4-Dimethyl-1-(phenylsulfonyl)-2-vinylpyrrolidine (5b):**

**IR** (film): $\upsilon$ 2959, 2926, 2872, 1468, 1447, 1344, 1161, 1094, 1057, 923 $cm^{-1}$. **$^1$H NMR** ($CDCl_3$, 400 MHz): $\delta$ 7.85-7.81 (m, 2H), 7.58-7.49 (m, 3H), 5.86 (ddd, 1H, $J$ = 17.2, 10.2, 7.6 Hz), 5.19 (dt, 1H, $J$ = 17.2, 1.0 Hz), 5.08 (dt, 1H, $J$ = 10.4, 1.0 Hz), 4.06 (br $q_{app.}$, 1H, $J$ = 7.7 Hz), 3.20 ($d_{systAB}$, 1H, $J$ = 10.4 Hz), 3.17 (br $d_{systAB}$, 1H, $J$ = 10.4 Hz), 1.75 ($ddd_{systAB}$, 1H, $J$ = 12.4, 7.4, 0.8 Hz), 1.58 ($dd_{systAB}$, 1H, $J$ = 12.6, 8.4 Hz), 1.06 (s, 3H), 0.68 (s, 3H). **$^{13}$C NMR** ($CDCl_3$, 100 MHz): $\delta$ 139.6 (d), 138.4 (s), 132.5 (d), 128.9 (d, 2CH), 127.5 (d, 2CH), 115.3 (t), 62.6 (d), 61.4 (t), 47.6 (t), 37.5 (s), 26.4, 25.9 (q, $2CH_3$). **SM** (EI) *m/z* (abundance): 265 ($M^{+\cdot}$, 2), 238 (25), 201 (17), 200 (40), 186 (17), 141 (21), 124 (28), 105 (20), 96 (11), 81 (27), 77 (69), 69 (10), 68 (100), 67 (14), 55 (17), 51 (15). **HRMS** (ESI): Calculated for $C_{14}H_{19}NO_2SNa$: 288.1029. Found 288.1029.

**3,3,6-Trimethyl-1-(phenylsulfonyl)-1,2,3,6-tetrahydropyridine (6b):**

**IR** (film): $\upsilon$ 2960, 2927, 2868, 1714, 1447, 1333, 1160, 1095, 1002, 913 $cm^{-1}$. **$^1$H NMR** ($CDCl_3$, 400 MHz): $\delta$ 7.87-7.82 (m, 2H), 7.58-7.46 (m, 3H), 5.48 (br d, 1H, $J$ = 10.4 Hz), 5.44 (dd, 1H, $J$ = 10.4, 3.0 Hz), 4.39 (qd, 1H, $J$ = 6.6, 3.0 Hz), 3.45 ($d_{systAB}$, 1H, $J$ = 12.8 Hz), 2.85 ($d_{systAB}$, 1H, $J$ = 12.7 Hz), 1.04 (d, 3H, $J$ = 6.6 Hz), 0.96 (s, 3H), 0.92 (s, 3H). **$^{13}$C NMR** ($CDCl_3$, 100 MHz): $\delta$ 139.6 (s), 135.1 (d), 132.2 (d), 128.9 (d, 2CH), 127.1 (d, 2CH), 126.8 (d), 50.2 (t), 49.4 (d), 33.0 (s), 26.6, 26.4 (q, $2CH_3$), 18.2 (q). **SM** (EI) *m/z* (abundance): 250 ($(M - Me)^+$, 100), 141 (16), 109 (10), 108 (53), 96 (64), 81 (47), 77 (51), 67 (12), 55 (18), 51 (11). **HRMS** (ESI): Calculated for $C_{14}H_{19}NO_2SNa$: 288.1029. Found 288.1033.

**1-[(4-Bromophenyl)sulfonyl]-4,4-dimethyl-2-vinylpyrrolidine (5c)** and
***N*-(4-bromophenyl)sulfonyl-3,3,6-trimethyl-1,2,3,6-tetrahydropyridine (6c)**

$[(MeCN)_3RhCp^*](SbF_6)_2$ (4.2 mg, 0.005 mmol, 5 mol %) and $Cu(OAc)_2.H_2O$ (42 mg, 0.21 mmol, 2.1 equiv) were added to a solution of sulfonamide **4c** (35 mg, 0.1 mmol, 1 equiv) in DCE (1 mL) and the reaction mixture was heated to reflux. After 16 h, the reaction was cooled to room temperature, filtered through Celite® and concentrated under *vacuum* to afford after purification on silica gel (PE/EtOAc: 98/2) compounds **5c** and **6c** as colourless oils (8.7 mg, 0.025 mmol, 25%) in a 3/1 ratio in favour of **5c**.

**1-[(4-Bromophenyl)sulfonyl]-4,4-dimethyl-2-vinylpyrrolidine (5c):**

**IR** (film): $\upsilon$ 3087, 2960, 2872, 1574, 1470, 1389, 1350, 1164, 1092, 1067, 1008, 923 $cm^{-1}$. **$^1$H NMR** ($CDCl_3$, 400 MHz): $\delta$ 7.72-7.61(m, 4H), 5.79 (ddd, 1H, $J$ = 17.2, 10.2, 7.8 Hz), 5.18 (br d, 1H, $J$ = 17.2 Hz), 5.08 (br d, 1H, $J$ = 10.1 Hz), 4.06 ($q_{app.}$, 1H, $J$ = 7.8 Hz), 3.18 (s, 2H), 1.79 ($dd_{systAB}$, 1H, $J$ = 12.8, 7.6 H), 1.58 ($dd_{systAB}$, 1H, $J$ = 12.8, 8.4 Hz), 1.07 (s, 3H), 0.77 (s, 3H). **$^{13}$C NMR** ($CDCl_3$, 100 MHz): $\delta$ 139.2 (d), 137.9 (s), 132.1 (d, 2CH), 129.0 (d, 2CH), 127.4 (s), 115.8 (t), 62.6 (d), 61 .4 (t), 47.5 (t), 37.6 (s), 26.3, 26.1 (q, $2CH_3$). **SM** (EI) *m/z* (abundance): 345 ($M(^{81}Br)^{+\cdot}$, 1), 343 ($M(^{79}Br)^{+\cdot}$, 1), 318 (10), 280 (13), 278 (13), 157 (13), 155 (13), 124 (27), 108 (10), 96 (12), 81 (30), 76 (13), 75 (11), 68 (100), 67 (16), 55 (18). **HRMS** (ESI): Calculated for $C_{14}H_{18}(^{79}Br)NO_2SNa$: 366.0134. Found 366.0136.

***N*-(4-Bromophenyl)sulfonyl-3,3,6-trimethyl-1,2,3,6-tetrahydropyrindine (6c):**

**IR** (film): $\upsilon$ 2959, 2925, 2868, 1714, 1575, 1470, 1389, 1340, 1162, 1094, 1069 1001, 913 $cm^{-1}$. **$^1$H NMR** ($CDCl_3$, 400 MHz): $\delta$ 7.73-7.60 (m, 4H), 5.49 (br d, 1H, $J$ = 10.4 Hz), 5.44 (dd, 1H, $J$ = 10.0, 3.6 Hz), 4.37 (m, 1H), 3.43 (br $d_{systAB}$, 1H, J = 12.8 Hz), 2.84 ($d_{systAB}$, 1H, $J$ = 12.8 Hz), 1.05 (d, 3H, $J$ = 6.7 Hz), 0.97 (s, 3H), 0.93 (s, 3H). **$^{13}$C NMR** ($CDCl_3$, 100 MHz): $\delta$ 140.6 (s), 139.7 (s), 135.1 (d), 132.2 (d, 2CH), 128.6 (d, 2CH), 126.7 (d), 50.2 (t), 49.5 (d), 33.0 (s), 26.5, 26.4 (q, $2CH_3$), 18.2 (q). **SM** (EI) *m/z* (abundance): 330 ((M($^{81}$Br)

- Me)$^+$, 68), 328 (M($^{79}$Br) - Me)$^+$, 65), 221 (11), 219 (11), 157 (15), 155 (14), 109 (16), 108 (73), 96 (100), 94 (10), 82 (11), 81 (67), 79 (14), 76 (14), 75 (12), 55 (27), 53 (13). **HRMS** (ESI): Calculated for $C_{14}H_{18}(^{79}Br)NO_2SNa$: 366.0134. Found 366.0135.

**4,4-Dimethyl-1-[(4-nitrophenyl)sulfonyl]-2-vinylpyrrolidine (5d)** and
**3,3,6-trimethyl-1-[(4-nitrophenyl)sulfonyl]-1,2,3,6-tetrahydropyridine (6d)**
$[(MeCN)_3RhCp^*](SbF_6)_2$ (4.2 mg, 0.005 mmol, 5 mol %) and $Cu(OAc)_2.H_2O$ (42 mg, 0.21 mmol, 2.1 equiv) were added to a solution of sulfonamide **4d** (31 mg, 0.1 mmol, 1 equiv) in DCE (1 mL) and the reaction mixture was heated to reflux. After 16 h, the reaction was cooled to room temperature, filtered through Celite® and concentrated under *vacuum* to afford after purification on silica gel (PE/EtOAc: 98/2) compounds **5d** and **6d** as colourless oils (4.5 mg, 0.014 mmo, 14%) in a 4/1 ratio in favour of **5d**.
**4,4-Dimethyl-1-[(4-nitrophenyl)sulfonyl]-2-vinylpyrrolidine (5d):**
**IR** (film): $\upsilon$ 3105, 2961, 2872, 1720, 1605, 1528, 1348, 1306, 1161, 1092, 1058, 925 cm$^{-1}$. **$^1$H NMR** ($CDCl_3$, 400 MHz): $\delta$ 8.36-8.30 (m, 2H), 8.00-7.95 (m, 2H), 5.67 (ddd, 1H, $J$ = 17.2, 10.0, 7.6 Hz), 5.19 (br d, 1H, $J$ = 17.2 Hz), 5.07 (br d, 1H, $J$ = 10.0 Hz), 4.16 (q, 1H, $J$ = 8.0 Hz), 3.28 ($dd_{systAB}$, 1H, $J$ = 10.0, 1.6 Hz), 3.15 ($d_{systAB}$, 1H, $J$ = 10.0 Hz), 1.82 ($ddd_{systAB}$, 1H, $J$ = 12.8, 7.4, 1.6 Hz), 1.56 ($dd_{systAB}$, 1H, $J$ = 12.8, 8.2 Hz), 1.06 (s, 3H), 0.80 (s, 3H). **$^{13}$C NMR** ($CDCl_3$, 100 MHz): $\delta$ 150.1 (s), 145.4 (s), 138.7 (d), 128.7 (d, 2CH), 124.3 (d, 2CH), 116.8 (t), 63.1 (d), 61.5 (t), 47.7 (t), 38.0 (s), 26.3, 26.1 (q, $2CH_3$). **SM** (EI) *m/z* (abundance): 295 ((M-Me)$^+$, 2), 283 (14), 246 (12), 245 (33), 231 (17), 156 (12), 124 (25), 122 (14), 108 (14), 96 (12), 93 (10), 92 (14), 82 (13), 81 (30), 76 (12), 69 (13), 68 (100), 67 (19), 65 (11), 55 (24). **HRMS (ESI):** Calculated for $C_{14}H_{18}N_2O_4SNa$: 333.0880. Found: 333.0879.
**3,3,6-Trimethyl-1-[(4-nitrophenyl)sulfonyl]-1,2,3,6-tetrahydropyridine (6d):**
**IR** (film): $\upsilon$ 2958, 2925, 2854, 1735, 1606, 1530, 1464, 1349, 1162, 1095, 1001, 914 cm$^{-1}$. **$^1$H NMR** ($CDCl_3$, 400 MHz): $\delta$ 8.38-8.32 (m, 2H), 8.05-7.99 (m, 2H), 5.51 (br d., 1H, $J$ = 10.2 Hz), 4.45 ($dd_{app.}$, 1H, $J$ = 10.2, 3.8 Hz), 4.43 (m, 1H), 3.51 ($d_{systAB}$, 1H, $J$ = 12.8 Hz), 2.89 ($d_{systAB}$, 1H, $J$ = 12.8 Hz), 1.05 (d, 3H, $J$ = 6.8 Hz), 0.99 (s, 3H), 0.93 (s, 3H). **$^{13}$C NMR** ($CDCl_3$, 100 MHz): $\delta$ 149.8 (s), 147.5 (s), 135.2 (d), 128.2 (d, 2CH), 126.3 (d), 124.3 (d, 2CH), 50.4 (t), 49.7 (d), 33.1 (s), 26.4 (q, $2CH_3$), 18.5 (q). **SM** (EI) *m/z* (abundance): 295 ((M-Me)$^+$, 100), 207 (20), 108 (66), 96 (72), 81 (54), 55 (22).

**4,4-Dimethyl-1-(methylsulfonyl)-2-vinylpyrrolidine (5f)** and
**3,3,6-trimethyl-1-(methylsulfonyl)-1,2,3,6-tetrahydropyridine (6f)**
$[(MeCN)_3RhCp^*](SbF_6)_2$ (4.2 mg, 0.005 mmol, 5 mol %) and $Cu(OAc)_2.H_2O$ (42 mg, 0.21 mmol, 2.1 equiv) were added to a solution of sulfonamide **4f** (21 mg, 0.1 mmol, 1 equiv) in DCE (1 mL) and the reaction mixture was heated to reflux. After 16 h, the reaction was cooled to room temperature, filtered through Celite® and concentrated under *vacuum* to afford after purification on silica gel (PE/EtOAc: 98/2) compounds **5f** and **6f** as an inseparable mixture (8.2 mg, 0.040 mmol, 40%) in a 8/2 ratio in favour of **5f**.
**4,4-Dimethyl-1-(methylsulfonyl)-2-vinylpyrrolidine (5f):**
**$^1$H NMR** ($CDCl_3$, 400 MHz): $\delta$ 5.78 (ddd, 1H, $J$ = 17.2, 10.0, 8.0 Hz), 5.25 ($dt_{app.}$, 1H, $J$ = 17.2, 1.0 Hz), 5.13 (br d, 1H, $J$= 10.1 Hz), 4.30 ($q_{app.}$, 1H, $J$ = 8.0 Hz), 3.38 ($dd_{systAB}$, 1H, $J$ = 9.9, 1.5 Hz), 3.06 ($dd_{systAB}$, 1H, $J$ = 10.0, 1.4 Hz), 2.85 (s, 3H, $H_9$), 1.95 ($ddd_{systAB}$, 1H, $J$ = 12.8, 7.6, 1.2 Hz), 1.59 ($dd_{systAB}$, 1H, $J$ = 12.8, 8.4 Hz), 1.10 (s, 3H), 1.08 (s, 3H). **$^{13}$C NMR** ($CDCl_3$, 100 MHz): $\delta$ 139.0 (d), 116.9 (t), 62.2 (d), 60.7 (t), 47.7 (t), 40.1 (q), 37.9 (s), 26.1 (d, $2CH_3$).**SM** (EI) *m/z* (abundance): 203 ($M^{+\cdot}$, 13), 188 (22), 176 (22), 124 (81), 108 (25), 98

(27), 96 (14), 82 (11), 81 (42), 79 (13), 69 (15), 68 (100), 67 (22), 55 (27), 54 (11).

**3,3,6-Trimethyl-1-(methylsulfonyl)-1,2,3,6-tetrahydropyridine (6f):**
**$^1$H NMR** ($CDCl_3$, 400 MHz): $\delta$ 5.51 ($dt_{app.}$, 1H, $J$ = 10.2, 1.4 Hz), 5.46 (dd, 1H, $J$ = 10.2, 3.8 Hz), 4.30 (m, 1H), 3.33 (br $d_{systAB}$, 1H, $J$ = 12.7 Hz), 2.87 (s, 3H), 2.82 (br $d_{systAB}$, 1H, $J$ = 12.5 Hz), 1.24 (d, 3H, $J$ = 6.8 Hz), 1.07 (s, 3H), 0.98 (s, 3H). **$^{13}$C NMR** ($CDCl_3$, 100 MHz): $\delta$ 135.3 (d), 126.7 (d), 49.9 (t), 49.2 (d), 40.2 (q), 29.8 (s), 26.5, 26.4 (q, $2CH_3$), 18.3 (q). **SM** (EI) *m/z* (abundance): 188 ($(M - Me)^+$, 100), 110 (14), 109 (15), 108 (75), 96 (60), 94 (13), 82 (12), 81 (65), 79 (14), 68 (19), 67 (16), 55 (19), 53 (11).

**1-Tosyl-2-vinylpyrrolidine (5g):**[10]
$[(MeCN)_3RhCp^*](SbF_6)_2$ (4.2 mg, 0.005 mmol, 5 mol %) and $Cu(OAc)_2.H_2O$ (42 mg, 0.21 mmol, 2.1 equiv) were added to a solution of sulfonamide **7a** (26 mg, 0.1 mmol, 1 equiv) in DCE (1 mL) and the reaction mixture was heated to reflux. After 16 h, the reaction was cooled to room temperature, filtered through Celite® concentrated under *vacuum* to afford after purification on silica gel (PE/EtOAc: 98/2) compound **8a** (12.6 mg, 0.050 mmol, 50%) as a white solid. Spectral data for **8a** match those previously described in the literature.
**mp**: 70 °C (litt:[12] mp 65-66 °C). **IR** (film): $\upsilon$ 2920, 1597, 1449, 1404, 1344, 1196, 1158, 1093, 1055, 1010, 920 cm$^{-1}$. **$^1$H NMR** ($CDCl_3$, 400 MHz): $\delta$ 7.72 ($d_{app.}$, 2H, $J$ = 8.0 Hz), 7.31 ($d_{app.}$, 2H, $J$ = 8.0 Hz), 5.81 (ddd, 1H, $J$ = 16.8, 10.4, 6.0 Hz), 5.28 ($dt_{app.}$, 1H, $J$ = 16.8, 1.4 Hz), 5.12 ($dt_{app.}$, 1H, $J$ = 10.4, 1.3 Hz), 4.14 (m, 1H), 3.45 ($ddd_{systAB}$, 1H, $J$ = 11.6, 7.2, 4.2 Hz), 3.23 ($dt_{systAB}$, 1H, $J$ = 9.6, 7.4 Hz), 2.43 (s, 3H), 1.87-1.58 (m, 4H). **$^{13}$C NMR** ($CDCl_3$, 100 MHz): $\delta$ 143.4 (s), 138.9 (d), 135.3 (s), 129.8 (d, 2CH), 127.7 (d, 2CH), 115.5 (t), 62.1 (d), 49.0 (t), 32.5 (t) , 23.9 (t), 21.7 (q). **SM** (EI) *m/z* (abundance): 251 ($M^{+\cdot}$, 9), 224 (30), 187 (15), 186 (30), 155 (36), 96 (63), 92 (14), 91 (100), 69 (21), 68 (41), 67 (14), 65 (30), 54 (16).

**2-Pentyl-1-tosyl-5-vinylpyrrolidine (5h)** and
**6-methyl-2-pentyl-1-tosyl-1,2,3,6-tetrahydropyridine (6h):**
$[(MeCN)_3RhCp^*](SbF_6)_2$ (2.5 mg, 0.003 mmol, 5 mol %) and $Cu(OAc)_2.H_2O$ (24 mg, 0.13 mmol, 2.1 equiv) were added to a solution of sulfonamide **4h** (19 mg, 0.060 mmol, 1 equiv) in DCE (0.6 mL) and the reaction mixture was heated to reflux. After 16 h, the reaction was cooled to room temperature, filtered through Celite® and concentrated under *vacuum* to afford after purification on silica gel (PE/EtOAc: 98/2) compounds **5h** and **6h** (8.7 mg, 0.030 mmol, 50%) in a 90/10 ratio in favour of **5h**.
**IR** (film): $\upsilon$ 2955, 2927, 2859, 1599, 1494, 1460, 1347, 1203, 1160, 1094, 1040, 986 cm$^{-1}$.
**2-Pentyl-1-tosyl-5-vinylpyrrolidine (5h)**
***cis*-2-Pentyl-1-tosyl-5-vinylpyrrolidine** (major diastereoisomer)**:**
**$^1$H NMR** ($CDCl_3$, 400 MHz): $\delta$ 7.65 (br d, 2H, $J$ = 8.0 Hz), 7.23 (br d, 2H, $J$ = 8.0 Hz), 5.76 (ddd, 1H, $J$ = 17.0, 10.4, 5.8 Hz), 5.22 (dt, 1H, $J$ = 17.0, 1.4 Hz), 5.04 (dt, 1H, $J$ = 10.4, 1.4 Hz), 4.04 (m, 1H), 3.55 (m, 1H), 2.36 (s, 3H), 1.86 (m, 1H), 1.74-1.10 (m, 11H), 0.82 (m, 3H). **$^{13}$C NMR** ($CDCl_3$, 100 MHz): $\delta$ 143.2 (s), 139.6 (d), 135.5 (s), 129.6 (d, 2CH), 127.6 (d, 2CH), 115.2 (t), 62.9 (d), 62.1 (d), 36.9, 31.7, 31.0, 29.7, 22.6, 21.6 (t, $6CH_2$), 21.5 (q), 14.1 (q). **SM** (EI) *m/z* (abundance): 294 ($(M - vinyl)^+$, 1), 251 (15), 250 (100), 155 (32), 94 (42), 91 (70), 65 (11).
***trans*-2-Pentyl-1-tosyl-5-vinylpyrrolidine** (minor diastereoisomer, only the following signals of the $^1$H NMR and $^{13}$C NMR spectroscopic data were assigned unambiguously):

**$^1$H NMR** ($CDCl_3$, 400 MHz): $\delta$ 5.48 (m, 1H), 5.10 (d, 1H, $J$ = 16.8 Hz), 4.91 (br d, 1H, $J$ = 10.4 Hz), 4.26 ($t_{app.}$, 1H, $J$ = 7.6 Hz), 3.74 (m, 1H), 2.34 (s, 3H). **$^{13}$C NMR** ($CDCl_3$, 100 MHz): $\delta$ 137.9 (d), 129.1 (d, 2CH), 126.7 (d, 2CH), 116.1 (t), 63.2 (d), 60.6 (d). **SM** (EI) *m/z* (abundance): 250 ((M - pentyl)$^+$, 100), 155 (31), 94 (48), 91 (69), 65 (11).

**6-Methyl-2-pentyl-1-tosyl-1,2,3,6-tetrahydropyridine (6h) (**only the following signals of the $^1$H NMR spectroscopic data were assigned unambiguously**):**

**$^1$H NMR** ($CDCl_3$, 400 MHz): $\delta$ 5.55-5.46 (m, 2H), 4.26 (m, 1H), 3.91 (m, 1H), 2.33 (s, 3H), 1.31 (d, 3H, $J$ = 7.2 Hz). **SM** (EI) *m/z* (abundance): 306 ((M - methyl)$^+$, 16), 251 (14), 250 (31), 155 (33), 94 (23), 91 (74).

**HRMS** (ESI): Calculated for $C_{18}H_{27}NO_2SNa$: 344.1655. Found 344.1659.

**2-Benzyl-1-tosyl-5-vinylpyrrolidine (5i)** and
**2-benzyl-6-methyl-1-tosyl-1,2,3,6-tetrahydropyridine (6i)**

$[(MeCN)_3RhCp^*](SbF_6)_2$ (4.2 mg, 0.005 mmol, 5 mol %) and $Cu(OAc)_2.H_2O$ (42 mg, 0.21 mmol, 2.1 equiv) were added to a solution of sulfonamide **4i** (31 mg, 0.09 mmol, 1 equiv) in DCE (1 mL) and the reaction mixture was heated to reflux. After 16 h, the reaction was cooled to room temperature, filtered on Celite® and concentrated under *vacuum* to afford after purification on silica gel (PE/EtOAc: 98/2) compounds **5i** and **6i** as a colourless oil (7.5 mg, 0.022 mmol, 25%) in a 15/1 ratio in favour of **5i**.

**IR**: $\upsilon$ 2926, 1726, 1598, 1495, 1453, 1342, 1157, 1092, 1030, 986, 921 cm$^{-1}$.

**2-Benzyl-1-tosyl-5-vinylpyrrolidine (5i):**

***cis*-2-Benzyl-1-tosyl-5-vinylpyrrolidine** (major diastereoisomer):

**$^1$H NMR** ($CDCl_3$, 400 MHz): $\delta$ 7.76 (br d, 2H, $J$ = 8.4 Hz), 7.34-7.19 (m, 7H), 5.80 (ddd, 1H, $J$ = 16.8, 10.4, 6.0 Hz), 5.28 (dt, 1H, $J$ = 17.2, 1.3 Hz), 5.12 (dt, 1H, $J$ = 10.4, 1.2 Hz), 4.08 (m, 1H), 3.84 (m, 1H), 3.38 ($d_{systAB}$, 1H, $J$ = 13.2, 3.6 Hz), 2.72 ($dd_{systAB}$, 1H, $J$ = 13.2, 10.0 Hz), 2.42 (s, 3H), 1.66-1.36 (m, 4H). **$^{13}$C NMR** ($CDCl_3$, 100 MHz): $\delta$ 143.4 (s), 139.4 (d), 138.5 (s), 135.1 (s), 129.7, 129.6, 128.5, 127.7, 126.5 (d, 9CH), 115.4 (t), 63.5 (d), 63.3 (d), 43.2 (t), 30.9, 28.9 (t, $2CH_2$), 21.6 (q). **SM** (EI) *m/z* (abundance): 250 ((M - benzyl)$^+$, 63), 155 (26), 94 (44), 91 (100), 65 (18).

***trans*-2-Benzyl-1-tosyl-5-vinylpyrrolidine** (minor diastereoisomer, only the following signals of the $^1$H NMR and $^{13}$C NMR spectroscopic data were assigned unambiguously):

**$^1$H NMR** ($CDCl_3$, 400 MHz): $\delta$ 5.48 (ddd, 1H, $J$ = 17.0, 10.2, 8.8 Hz), 5.18 (d, 1H, $J$ = 16.8 Hz), 4.97 (d, 1H, $J$ = 10.0 Hz), 4.36 ($t_{app.}$, 1H, $J$ = 8.2 Hz), 4.07 (m, 1H), 3.42 ($dd_{systAB}$, 1H, $J$ = 13.2, 3.2 Hz), 2.63 ($dd_{systAB}$, 1H, $J$ = 13.2, 10.1 Hz), 2.41 (s, 3H). **$^{13}$C NMR** ($CDCl_3$, 100 MHz): $\delta$ 137.7 (d), 129.3, 128.5, 127.7, 127.1, 126.8 (d, 9CH), 116.5 (t), 61.8 (d), 59.9 (d), 41.3 (t), 30.6, 27.6 (t, $2CH_2$), 21.3 (q).

**2-Benzyl-6-methyl-1-tosyl-1,2,3,6-tetrahydropyridine (6i)** (only the following signals of the $^1$H NMR spectroscopic data were assigned unambiguously):

**$^1$H NMR** ($CDCl_3$, 400 MHz): $\delta$ 5.68-5.61 (m, 2H), 0.81 (d, 3H, $J$ = 6.4 Hz).

**2-[(Benzyloxy)methyl]-1-tosyl-5-vinylpyrrolidine (5j)** and
**2-[(benzyloxy)methyl]-6-methyl-1-tosyl-1,2,3,6-tetrahydropyridine (6j)**

$[(MeCN)_3RhCp^*](SbF_6)_2$ (4.2 mg, 0.005 mmol, 5 mol %) and $Cu(OAc)_2.H_2O$ (42 mg, 0.21 mmol, 2.1 equiv) were added to a solution of sulfonamide **4j** (37 mg, 0.1 mmol, 1 equiv) in DCE (1 mL) and the reaction mixture was heated to reflux. After 16 h, the reaction was cooled to room temperature, filtered through Celite® and concentrated under *vacuum* to afford after purification on silica gel (EP/AcOEt: 98/2) compounds **5j** and **6j** as a colourless oil (11.1 mg, 0.030 mmol, 30%) in a 7/1 ratio in favour of **5j**.

**2-[(Benzyloxy)methyl]-1-tosyl-5-vinylpyrrolidine (5j):**

***cis*-2-[(Benzyloxy)methyl]-1-tosyl-5-vinylpyrrolidine** (major diastereoisomer):
**$^1$H NMR** ($CDCl_3$, 400 MHz): $\delta$ 7.71 (br d, 2H, $J$ = 8.4 Hz), 7.38-7.18 (m, 7H), 5.83 (ddd, 1H, $J$ = 17.1, 10.4, 6.3 Hz), 5.23 (dt, 1H, $J$ = 17.1, 1.3 Hz), 5.09 (dt, 1H, $J$ = 10.4, 1.3 Hz), 4.55 ($d_{systAB}$, 2H), 4.02 ($q_{app.}$, 1H, $J$ = 6.6 Hz), 3.85 (m, 1H), 3.82 (m, 1H), 3.46 (m, 1H), 2.43 (s, 3H), 1.89-1.54 (m, 4H). **$^{13}$C NMR** ($CDCl_3$, 100 MHz): $\delta$ 143.5 (s), 139.4 (d), 138.3 (s), 134.9 (s), 129.7, 128.4, 127.7 (d, 9CH), 115.4 (t), 73.5, 73.4 (t, $2CH_2$), 63.5 (d), 60.6 (d), 31.2, 27.8 (t, $2CH_2$), 21.6 (q, $C_{10}$). **SM** (EI) *m/z* (abundance): 250 ($(M - CH_2OBn)^+$, 81), 155 (28), 110 (10), 94 (34), 91 (100), 65 (15).
***trans*-2-[(Benzyloxy)methyl]-1-tosyl-5-vinylpyrrolidine** (minor diastereoisomer, only the following signals of the $^1$H NMR and $^{13}$C NMR spectroscopic data were assigned unambiguously)**:**
**$^1$H NMR** ($CDCl_3$, 400 MHz): $\delta$ 5.50 (m, 1H), 5.18 (d, 1H, $J$ = 16.8 Hz), 4.99 (d, 1H, $J$ = 10.0 Hz), 4.48 ($d_{systAB}$, 1H, $J$ = 11.8 Hz), 4.43 ($d_{systAB}$, 1H, $J$ = 11.8 Hz), 4.36 (m, 1H), 3.99 (m, 1H), 3.82 (m, 1H), 3.46 (m, 1H). **$^{13}$C NMR** ($CDCl_3$, 100 MHz): $\delta$ 134.9 (d), 116.5 (t), 73.3, 73.0 (t, $2CH_2$), 63.8 (d), 59.1 (d), 31.0, 27.3 (t, $2CH_2$).
**2-[(Benzyloxy)methyl]-6-methyl-1-tosyl-1,2,3,6-tetrahydropyridine (6j)** (only the following signals of the $^1$H NMR and $^{13}$C NMR spectroscopic data were assigned unambiguously)**:**
**$^1$H NMR** ($CDCl_3$, 400 MHz): $\delta$ 5.59-5.51 (m, 2H), 4.35 (m, 1H), 4.23 ($q_{app.}$, 1H, $J$ = 7.2 Hz), 3.82 (m, 1H), 3.46 (m, 1H), 1.30 (d, 3H, $J$ = 7.2 Hz). **$^{13}$C NMR** ($CDCl_3$, 100 MHz): $\delta$ 128.0, 121.6 (d, 2CH), 71.7, 71.3 (t, $2CH_2$), 49.2 (d), 48.8 (d), 24.2 (q), 23.4 (t).

**(*E*)-2-(Prop-1-en-1-yl)-1-tosylpyrrolidine (8a)**[11] and **1-tosyl-2-vinylpiperidine (8b):**[8]
$[(MeCN)_3RhCp^*](SbF_6)_2$ (4.2 mg, 0.005 mmol, 5 mol %) and $Cu(OAc)_2.H_2O$ (42 mg, 0.21 mmol, 2.1 equiv) were added to a solution of sulfonamide **7** (27 mg, 0.1 mmol, 1 equiv) in DCE (1 mL) and the reaction mixture was heated to reflux. After 16 h, the reaction was cooled to room temperature, filtered through Celite® concentrated under *vacuum* to afford after purification on silica gel (PE/EtOAc: 98/2) compounds **8a** and **8b** (8.2 mg, 0.031 mmol, 31%) in a 45/55 ratio in favour of **8b**. Spectral data for **8a** and **8b** match those previously described in the literature.
**(*E*)-2-(Prop-1-en-1-yl)-1-tosylpyrrolidine (8a):**[11]
**IR** (film): $\upsilon$ 2919, 2873, 1598, 1449, 1345, 1196, 1158, 1094, 988, 965 cm$^{-1}$. **$^1$H NMR** ($CDCl_3$, 400 MHz): $\delta$ 7.68 (br d, 2H, $J$ = 8.0 Hz), 7.27 (br d, 2H, $J$ = 8.4 Hz), 5.64 (dqd, 1H, $J$ =15.2, 6.6, 1.0 Hz), 5.34 (ddq, 1H, $J$ = 15.2, 6.8, 1.6 Hz), 4.09 (m, 1H), 3.39 (m, 1H), 3.23 (m, 1H), 2.40 (s, 3H), 1.84-1.54 (m, 4H), 1.64 (br d, 3H, $J$ = 6.5 Hz). **$^{13}$C NMR** ($CDCl_3$, 100 MHz): $\delta$ 143.3 (s), 135.8 (s), 131.7 (d), 129.7 (d, 2CH), 127.8 (d, 2CH), 126.8 (d), 61.8 (d), 48.8 (t), 32.9 (t), 24.1 (t), 21.7 (q), 17.8 (q). **SM** (EI) *m/z* (abundance): 265 ($M^{+\cdot}$, 11), 250 (12), 283 (18), 224 (10), 186 (27), 184 (13), 173 (13), 155 (40), 110 (91), 108 (11), 92 (13), 91 (100), 83 (11), 82 (34), 81 (12), 80 (10), 68 (24), 67 (15), 65 (31), 55 (28), 54 (10).
**1-Tosyl-2-vinylpiperidine (8b):**[8]
**IR** (film): $\upsilon$ 2937, 2860, 1598, 1453, 1337, 1156, 1111, 1093, 1054, 963, 918 cm$^{-1}$. **$^1$H NMR** ($CDCl_3$, 400 MHz): $\delta$ 7.69 (br d, 2H, $J$ = 8.0 Hz), 7.27 (br d, 2H, $J$ = 8.0 Hz), 5.70 (ddd, 1H, $J$ = 17.2, 10.8, 5.2 Hz), 5.18-5.10 (m, 2H), 4.59 (br s, 1H), 3.67 (br d, 1H, $J$ = 13.2 Hz), 2.99 ($td_{app.}$, 1H, $J$ = 13.2, 3.2 Hz), 2.42 (s, 3H), 1.75-1.34 (m, 6H). **$^{13}$C NMR** ($CDCl_3$, 100 MHz): $\delta$ 143.1 (s), 138.1 (s), 135.7 (d), 129.7 (d, 2CH), 127.5 (d, 2CH), 117.4 (t), 55.2 (d), 41.9 (t), 29.9 (t), 21.7 (q), 21.7 (t), 19.3 (t). **SM** (EI) *m/z* (abundance): 265 ($M^{+\cdot}$, 12), 239 (10), 238 (56), 155 (34), 110 (100), 108 (11), 91 (85), 83 (11), 82 (11), 68 (11), 65 (23), 55 (32), 54 (21).

**(*E*)-2-(Hex-1-en-1-yl)-1-tosylpyrrolidine (11a)**[12] and **(*E*)-2-(pent-1-en-1-yl)-1-**

**tosylpiperidine (10a):**
$[(MeCN)_3RhCp^*](SbF_6)_2$ (4.2 mg, 0.005 mmol, 5 mol %) and $Cu(OAc)_2.H_2O$ (42 mg, 0.21 mmol, 2.1 equiv) were added to a solution of sulfonamide **9a** (31 mg, 0.1 mmol, 1 equiv) in DCE (1 mL) and the reaction mixture was heated to reflux. After 16 h, the reaction was cooled to room temperature, filtered through Celite® concentrated under *vacuum* to afford after purification on silica gel (PE/EtOAc: 98/2) compounds **10a** and **11a** (9.5 mg, 0.031 mmol, 50%) in a 1/1 ratio. Spectral data for **11a** match those previously described in the literature.

**(*E*)-2-(Hex-1-en-1-yl)-1-tosylpyrrolidine (11a):**[12]
**IR** (film): $\upsilon$ 2955, 2927, 2857, 1694, 1598, 1460, 1347, 1196, 1160, 1094, 970 $cm^{-1}$. **$^1$H NMR** ($CDCl_3$, 400 MHz): $\delta$ 7.71 (br d, 2H, $J$ = 8.0 Hz), 7.29 (br d, 2H, $J$ = 8.4 Hz), 5.63 (dtd, 1H, $J$ = 15.2, 6.7, 1.0 Hz), 5.33 (ddt, 1H, $J$ = 15.2, 6.8, 1.6 Hz), 4.12 (m, 1H), 3.41 (m, 1H), 3.27 (m, 1H), 2.42 (s, 3H), 2.00 (br $q_{app.}$, 2H, $J$ = 6.6 Hz), 1.87-1.56 (m, 4H), 1.35-1.24 (m, 4H), 0.89 (t, 3H, $J$ = 7.0 Hz). **$^{13}$C NMR** ($CDCl_3$, 100 MHz): $\delta$ 143.2 (s), 135.9 (s), 132.2 (d), 130.3 (d), 129.6 (d, 2CH), 127.7 (d, 2CH), 61.8 (d), 48.8 (t), 33.0 (t), 32.0, 31.4, 24.1, 22.5 (t, $4CH_2$), 21.7 (q), 14.2 (q). **SM** (EI) *m/z* (abundance): 264 ((M-propyl)$^+$, 6), 250 (39), 225 (19), 224 (20), 186 (14), 173 (14), 155 (52), 152 (59), 136 (30), 124 (15), 110 (10), 108 (10), 96 (15), 92 (12), 91 (100), 81 (13), 80 (14), 68 (12), 67 (14), 65 (22), 55 (14), 54 (10).

**(*E*)-2-(Pent-1-en-1-yl)-1-tosylpiperidine (10a):**
**IR** (film): $\upsilon$ 2956, 2852, 1712, 1598, 1454, 1336, 1255, 1181, 1154, 1095, 1025 $cm^{-1}$. **$^1$H NMR** ($CDCl_3$, 400 MHz): $\delta$ 7.64 (br d, 2H, $J$ = 8.0 Hz), 7.23 (br d, 2H, $J$ = 8.0 Hz), 5.50 (dtd, 1H, $J$ = 15.6, 6.6, 1.2 Hz), 5.29 (ddt, 1H, $J$ = 15.6, 6.0, 1.3 Hz), 4.54 (br s, 1H), 3.66 (dt, 1H, $J$ = 13.2, 4.0 Hz), 2.92 (td, 1H, $J$ = 12.4, 3.2 Hz), 2.39 (s, 3H), 1.87 (m, 2H), 1.71-1.38 (m, 6H), 1.32-1.22 (m, 2H), 0.82 (t, 3H, $J$ = 7.4 Hz). **$^{13}$C NMR** ($CDCl_3$, 100 MHz): $\delta$ 142.9 (s), 138.1 (s), 133.6 (d), 129.5 (d, 2CH), 127.6 (d, 2CH), 126.6 (t), 54.9 (d), 41.8 (t), 34.6 (t), 22.3 (t), 21.7 (q), 30.7, 25.4, 19.3 (t, $3CH_2$), 13.9 (q, $C_{11}$). **SM** (EI) *m/z* (abundance): 238 ((M-pentenyl)$^+$, 44), 225 (14), 155 (49), 152 (99), 136 (67), 108 (33), 96 (20), 91 (100), 65 (36), 55 (35).

**(*E*)-2-(But-1-en-1-yl)-1-tosylpyrrolidine (11b)** and
**(*E*)-2-(prop-1-en-1-yl)-1-tosylpiperidine (10b)**[8]
$[(MeCN)_3RhCp^*](SbF_6)_2$ (4.2 mg, 0.005 mmol, 5 mol %) and $Cu(OAc)_2.H_2O$ (42 mg, 0.21 mmol, 2.1 equiv) were added to a solution of sulfonamide **9b** (25 mg, 0.09 mmol, 1 equiv) in DCE (1 mL) and the reaction mixture was heated to reflux. After 16 h, the reaction was cooled to room temperature, filtered through Celite® and concentrated under *vacuum* to afford after purification on silica gel (PE/EtOAc: 98/2) compounds **11b** and **10b** as colourless oils (9.5 mg, 0.034 mmol, 38%) in a 1/1 ratio. Spectral data for **10b** match those previously described in the literature.

**(*E*)-2-(But-1-en-1-yl)-1-tosylpyrrolidine (11b):**
**IR** (film): $\upsilon$ 2956, 2923, 1736, 1670, 1599, 1459, 1344, 1160, 1095, 1009, 969, 913 $cm^{-1}$. **$^1$H NMR** ($CDCl_3$, 400 MHz): $\delta$ 7.71 (br d, 2H, $J$ = 8.4 Hz), 7.29 (br d, 2H, $J$ = 8.4 Hz), 5.68 (dtd, 1H, $J$ = 15.2, 6.2, 1.0 Hz), 5.32 (ddt, 1H, $J$ =15.2, 6.8, 1.6 Hz), 4.14 (m, 1H), 3.44-3.38 (m, 1H), 3.31-3.24 (m, 1H), 2.42 (s, 3H), 2.02 (quint$_{app.}$, 2H, $J$ = 7.2 Hz), 1.87-1.54 (m, 4H), 0.96 (t, 3H, $J$ = 7.4 Hz). **$^{13}$C NMR** ($CDCl_3$, 100 MHz): $\delta$ 144.3 (s), 135.7 (s), 133.5 (d), 129.5 (d, 2CH), 129.2 (d), 127.6 (d, 2CH), 61.6 (d), 48.6 (t), 32.8 (t), 25.2 (t), 23.9 (t), 21.5 (q), 13.3 (q). **SM** (EI) *m/z* (abundance): 279 ($M^{+\cdot}$, 8), 250 (31), 224 (15), 186 (14), 155 (51), 124 (81), 108 (25), 96 (25), 95 (14), 94 (12), 92 (10), 91 (100), 82 (16), 81 (11), 79 (10), 68 (10), 67 (13), 65 (26), 55 (16).

**(*E*)-2-(Prop-1-en-1-yl)-1-tosylpiperidine (10b):**[6]

**IR** (film): $\upsilon$ 2936, 2863, 1734, 1598, 1451, 1337, 1159, 1093, 1057, 965, 934 $cm^{-1}$. **$^1$H NMR** ($CDCl_3$, 400 MHz): $\delta$ 7.65 (br d, 2H, $J$ = 8.4 Hz), 7.29-7.22 (m, 2H), 5.59-5.51 (m, 1H), 5.34 (ddq, 1H, $J$ = 15.2, 6.4, 1.6 Hz), 4.54 (m, 1H), 3.67 (m, 1H), 2.92 (m, 1H), 2.41 (s, 3H), 1.78-1.37 (m, 6H), 1.57 (dt, 3H, $J$ = 6.8, 1.4 Hz). **$^{13}$C NMR** ($CDCl_3$, 100 MHz): $\delta$ 142.7 (s), 138.2 (s), 129.3 (d, 2CH), 128.3 (d), 127.5 (d, 2CH), 127.3 (d), 54.8 (d), 41.7, 30.4, 25.2 (d, $3CH_2$), 21.5 (q), 19.0 (d), 17.8 (q). **SM** (EI) *m/z* (abundance): 128 ((M - propenyl)$^+$, 12), 155 (15), 124 (100), 108 (19), 91 (73), 82 (19), 68 (38), 65 (13), 55 (39).

**4-Methyl-2-(2-methylprop-1-en-1-yl)-1-tosylpiperidine (13):**
$[(MeCN)_3RhCp^*](SbF_6)_2$ (4.2 mg, 0.005 mmol, 5 mol %) and $Cu(OAc)_2.H_2O$ (42 mg, 0.21 mmol, 2.1 equiv) were added to a solution of sulfonamide **13** (31 mg, 0.1 mmol, 1 equiv) in DCE (1 mL) and the reaction mixture was heated to reflux. After 16 h, the reaction was cooled to room temperature, filtered through Celite® concentrated under *vacuum* to afford after purification on silica gel (PE/EtOAc: 98/2) the title compound **13** as a colourless oil (8.4 mg, 0.027 mmol, 27%) in a 9/1 ratio in favour of the *cis* compound.
***cis*-(2*R*,4*S*)-4-methyl-2-(2-methylprop-1-en-1-yl)-1-tosylpiperidine (13):**
**IR** (film): $\upsilon$ 2926, 2870, 1598, 1445, 1338, 1306, 1261, 1154, 1097, 1083, 1049, 921 $cm^{-1}$. **$^1$H NMR** ($CDCl_3$, 400 MHz): $\delta$ 7.57 (br d, 2H, $J$ = 8.3 Hz), 7.22 (br d, 2H, $J$ = 8.1 Hz), 5.01 (m, 1H), 4.84 (m, 1H), 3.73 (m, 1H), 2.83 (td, 1H, $J$ = 12.7, 2.6 Hz), 2.40 (s, 3H), 1.66 (s, 3H), 1.68-1.55 (m, 2H, $H_4$), 1.48 (s, 3H), 1.53-1.35 (m, 2H), 1.21 (m, 1H), 0.85 (d, 3H, $J$ = 6.3 Hz). **$^{13}$C NMR** ($CDCl_3$, 100 MHz): $\delta$ 142.6 (s), 137.1 (s, $C_{qar}$), 133.9 (s, $C_{qar}$), 129.0 (d, $2CH_{ar}$), 127.5 (d, $2CH_{ar}$), 120.1 (d, $C_7$), 51.6 (d, $C_2$), 41.4 (t), 39.9 (t), 33.7 (t), 25.7 (d), 25.2 (q), 22.1 (q), 21.5 (q), 18.0 (q). **SM** (EI) *m/z* (abundance): 252 ((M - isopropenyl)$^+$, 20), 153 (10), 152 (100), 136 (44), 123 (21), 96 (19), 91 (56), 82 (22), 81 (11), 69 (17), 67 (17), 65 (15), 55 (21). **HRMS** (ESI): Calculated for $C_{17}H_{25}NO_2SNa$: 330.1498. Found: 330.1496.
***trans*-(2*S*,4*S*)-4-methyl-2-(2-methylprop-1-en-1-yl)-1-tosylpiperidine (13')** (only the following signals of the $^1$H NMR spectroscopic data were assigned unambiguously)**:**
**$^1$H NMR** ($CDCl_3$, 400 MHz): $\delta$ 5.29 (dquint, 1H, $J$ = 9.3, 1.3 Hz), 4.00 (dt, 1H, $J$ = 12.1, 4.1 Hz), (3.36, m, 1H), 2.62 (ddd, 1H, $J$ = 12.1, 11.2, 2.9 Hz), 2.41 (s, 3H), 1.66 (s, 3H), 1.48 (s, 3H), 0.90 (d, 3H, $J$ = 6.4 Hz).

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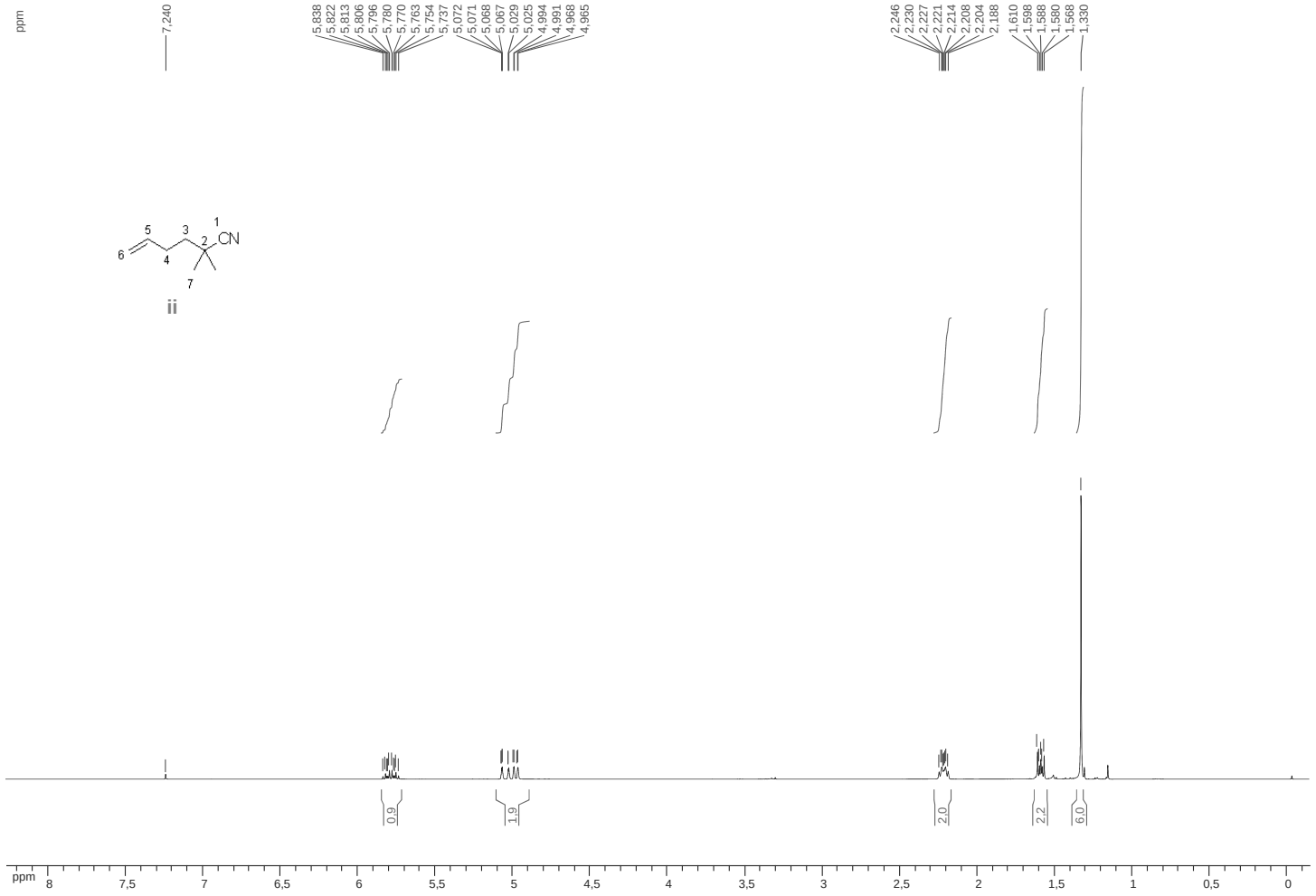
## IV. $^{1}$H NMR and $^{13}$C NMR spectra for all the compounds.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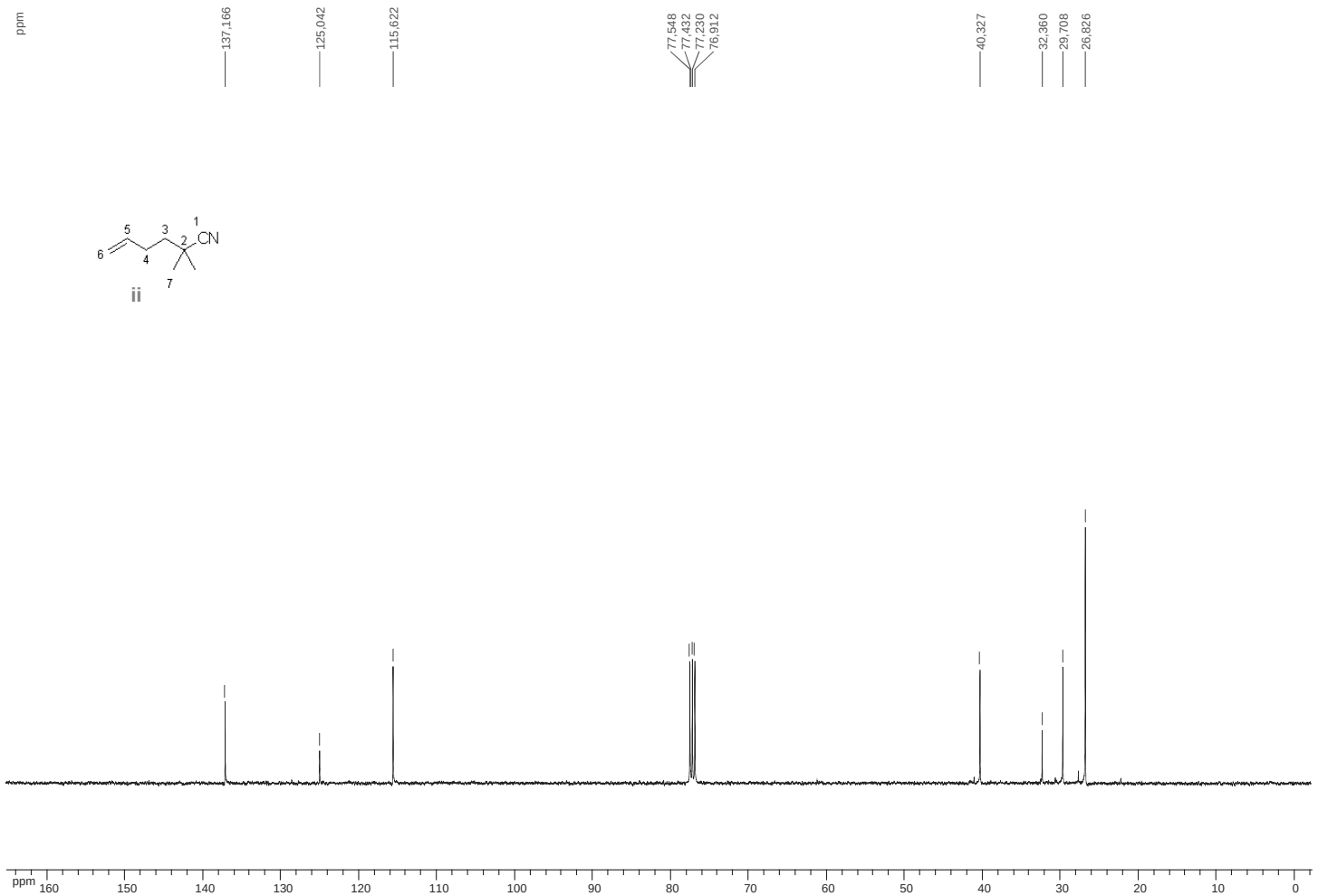
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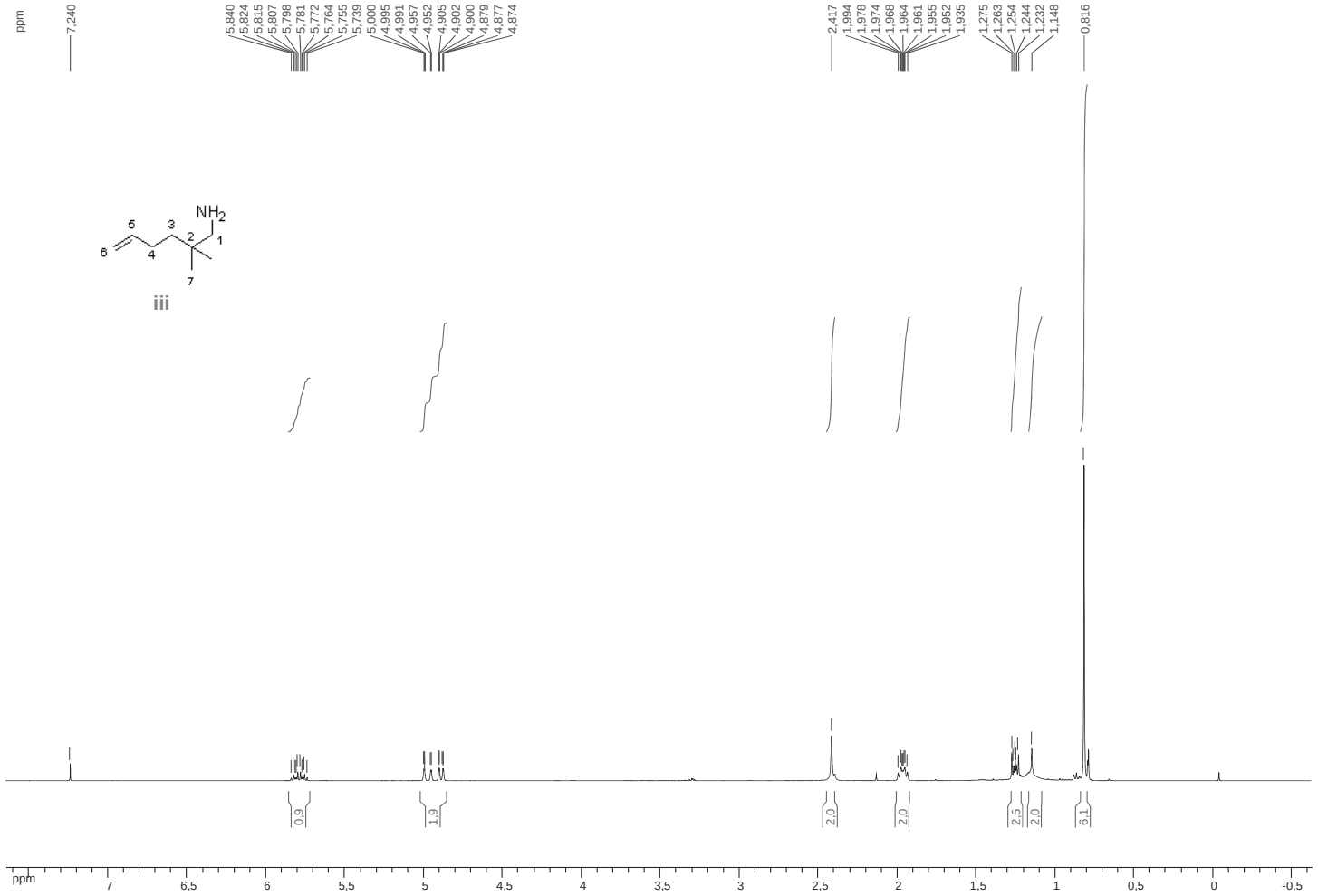
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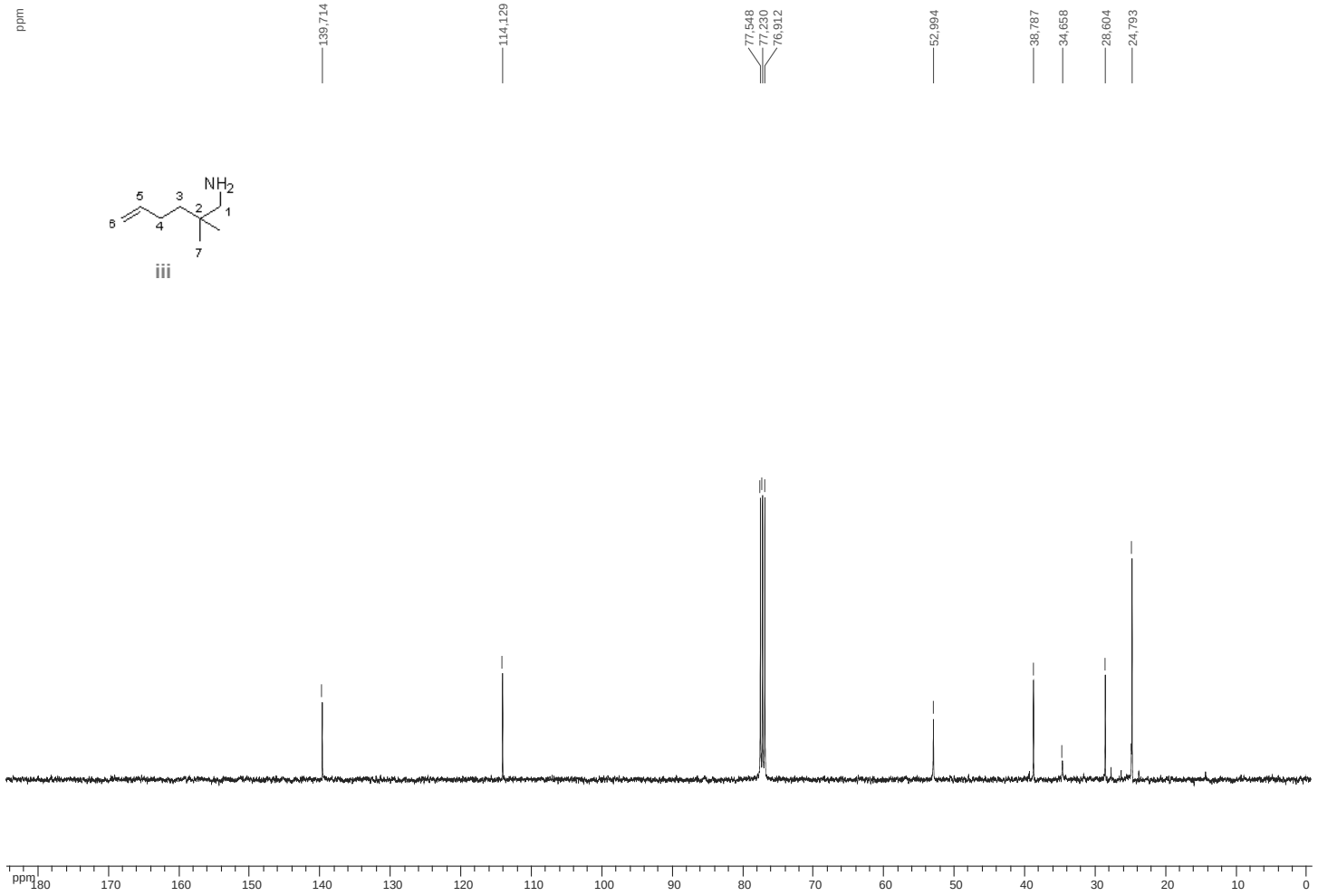
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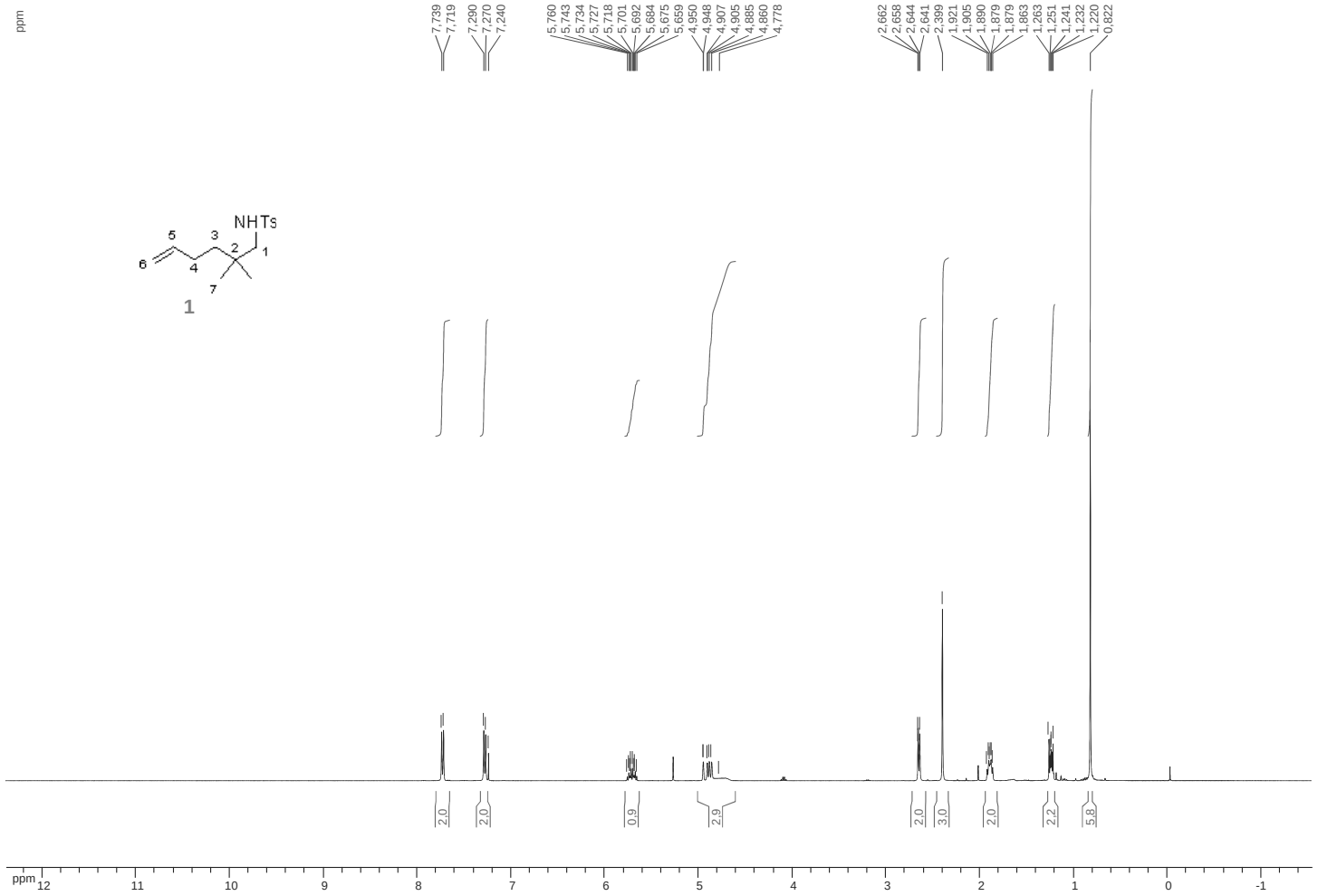


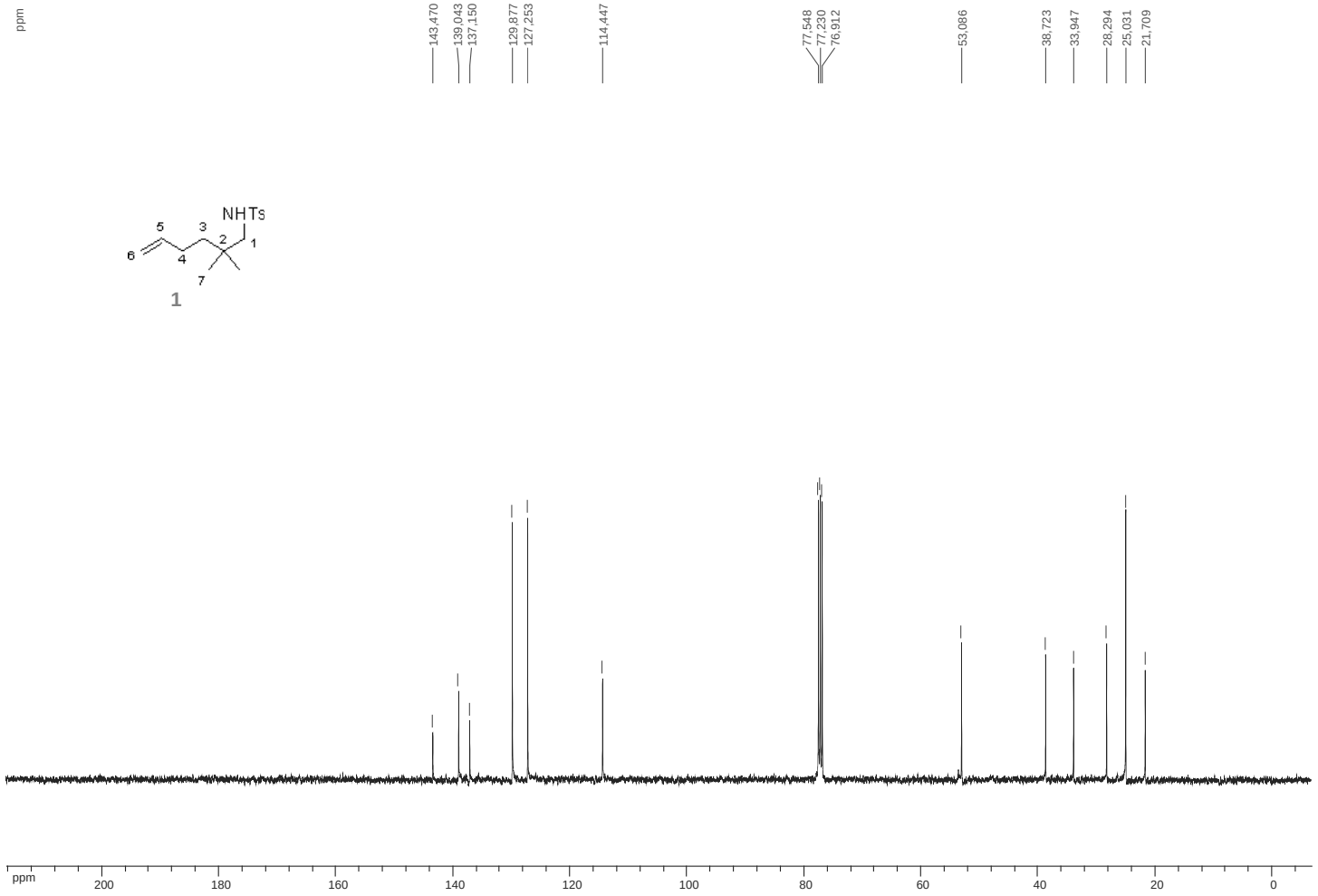

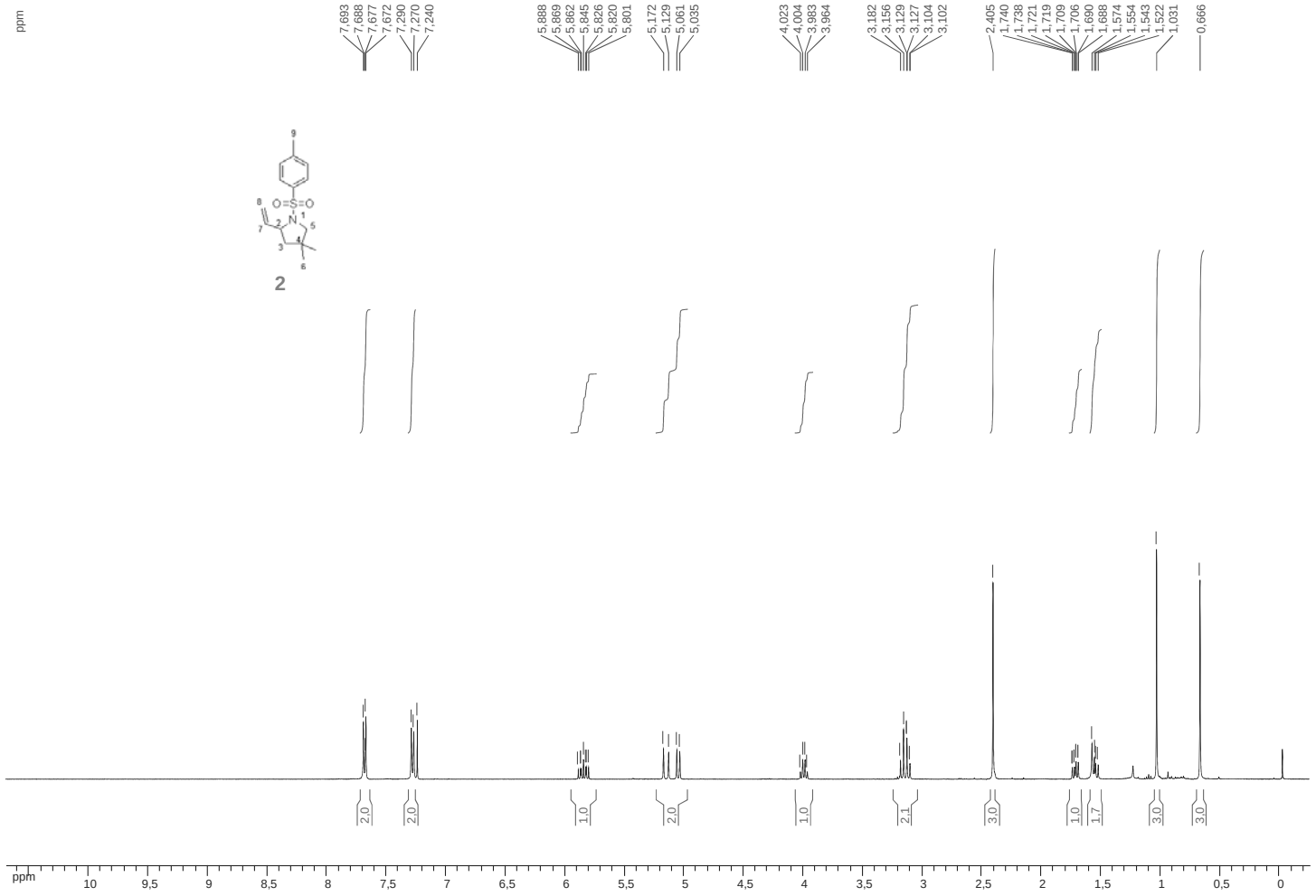
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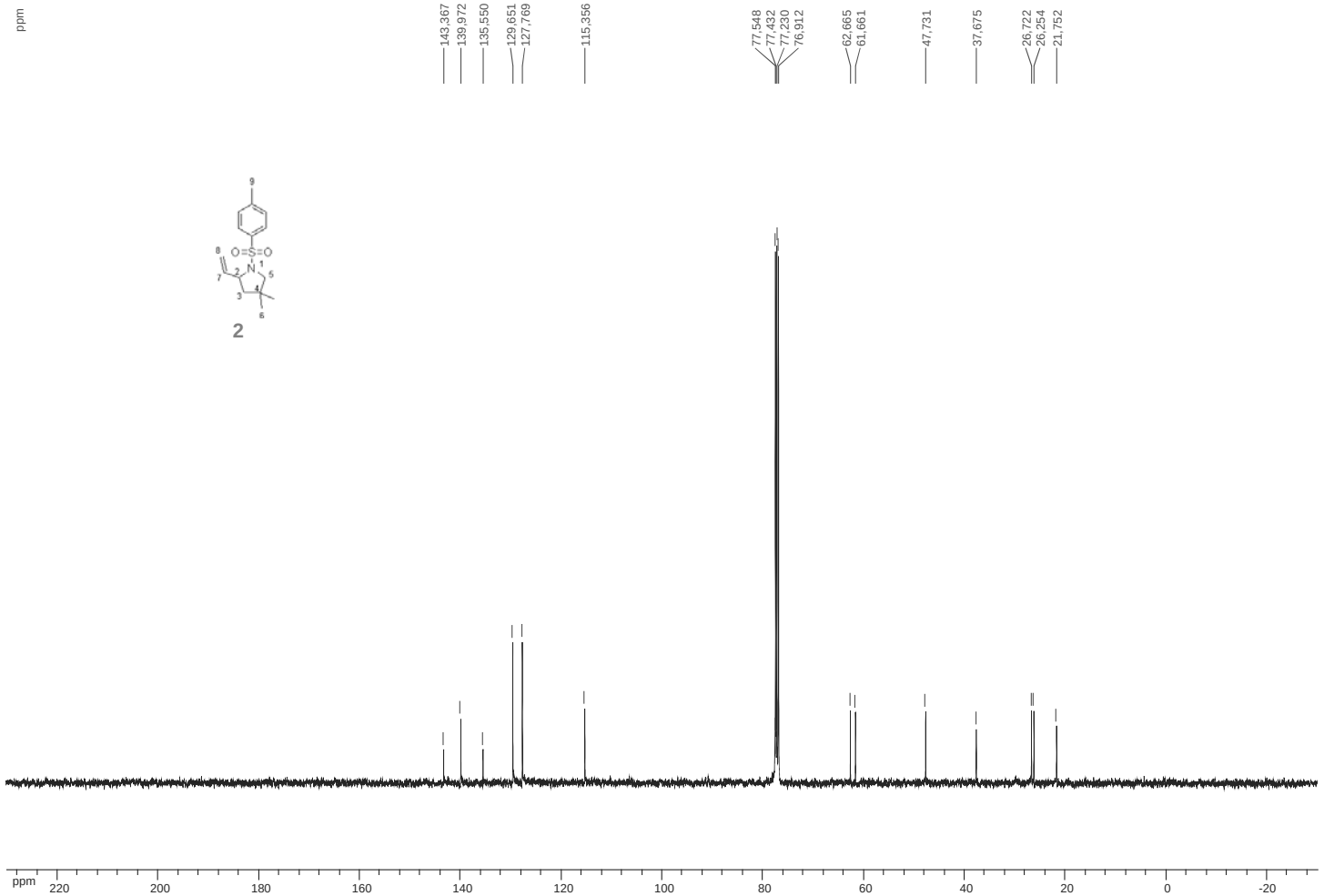
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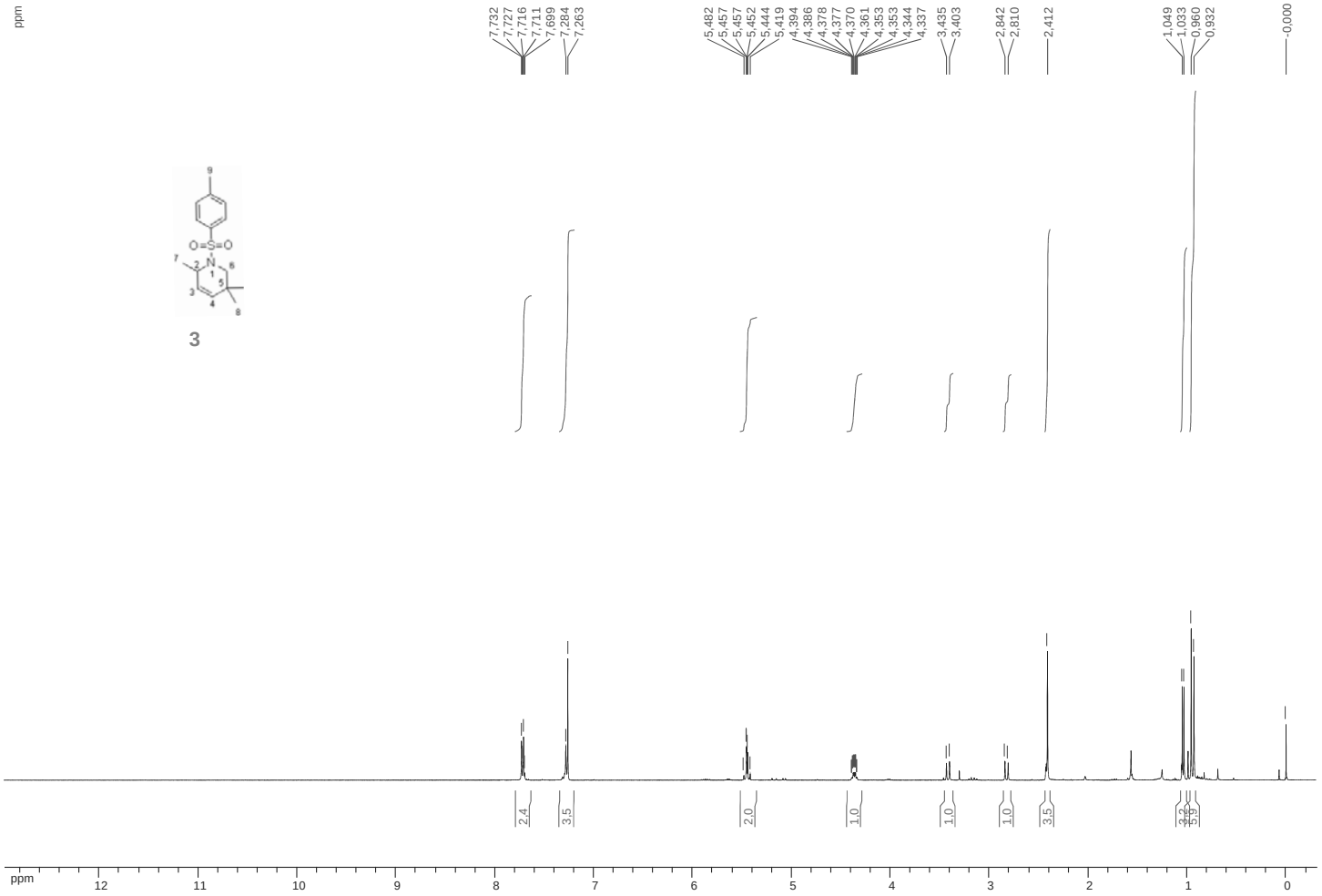
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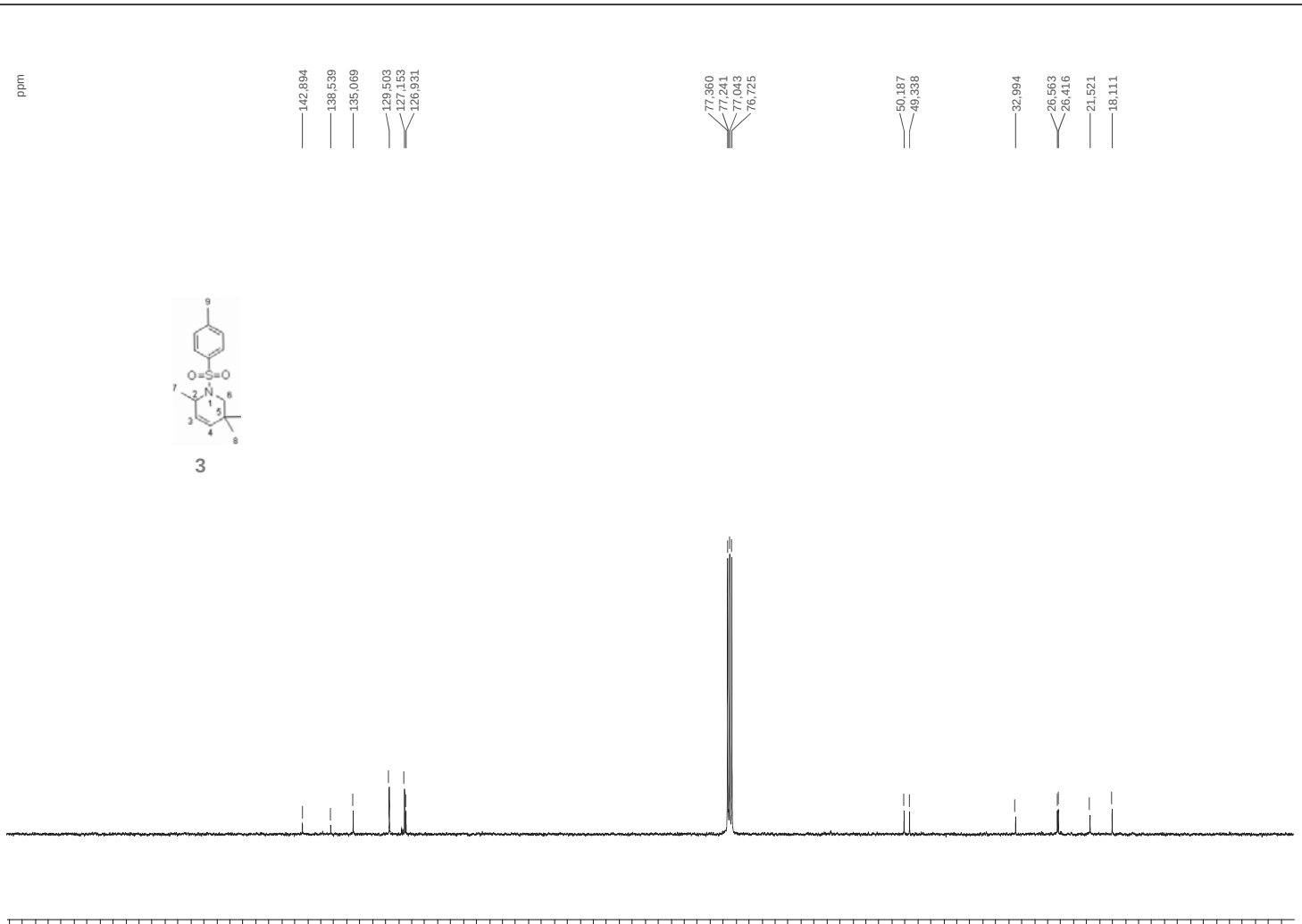
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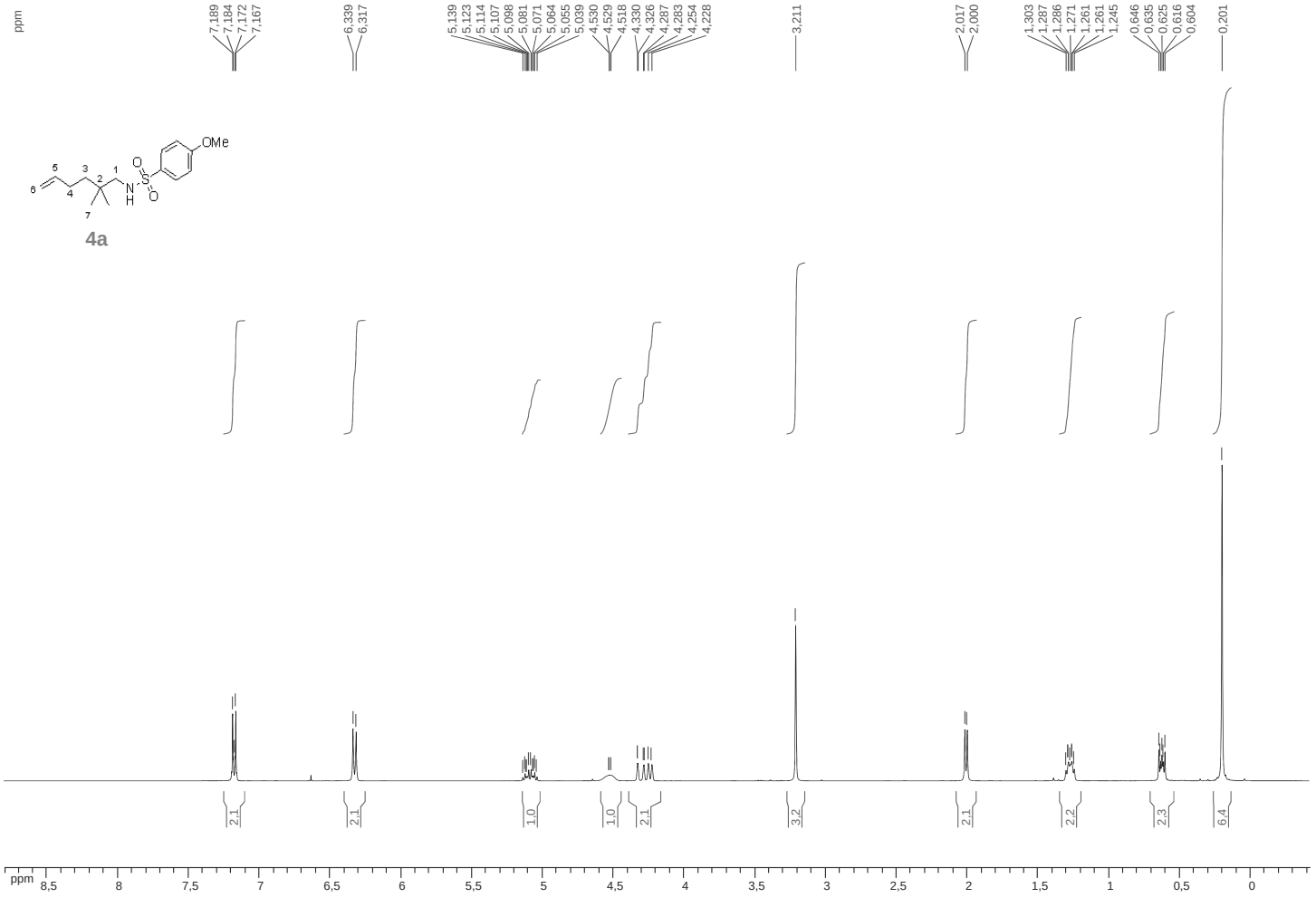
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5.139
5.123
5.114
5.107
5.098
5.081
5.071
5.064
5.055
5.039
4.530
4.529
4.518
4.330
4.326
4.287
4.283
4.254
4.228
3.211
2.017
2.000
1.303
1.287
1.286
1.271
1.261
1.261
1.245
0.646
0.635
0.625
0.616
0.604
0.201
OMe
4a
2.1
2.1
1.0
1.0
2.1
3.2
2.1
2.2
2.3
6.4
ppm
8,5
8
7,5
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2,5
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1,5
1
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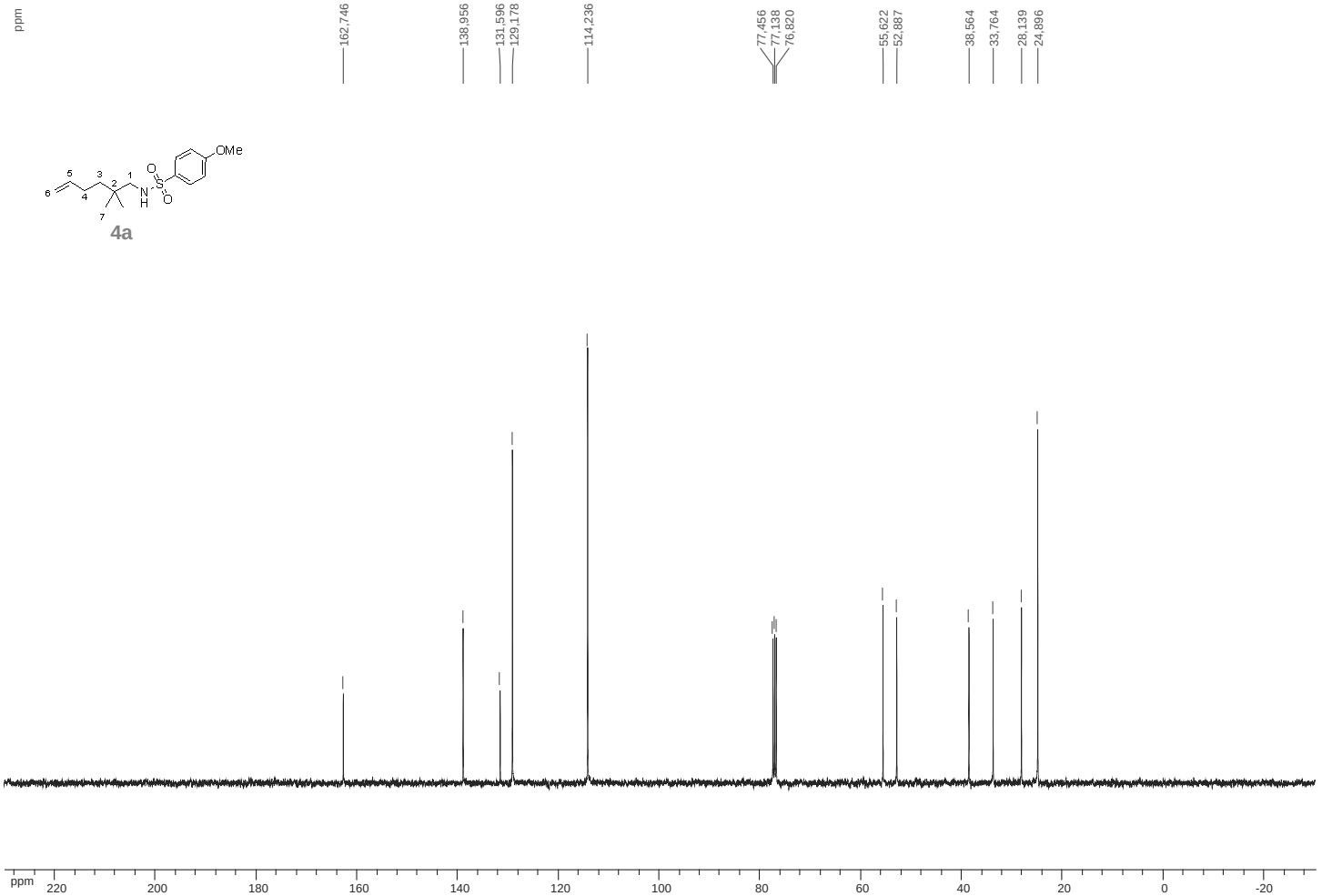
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129,178
114,236
77,456
77,138
76,820
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52,887
38,564
33,764
28,139
24,896
OMe
4a
ppm
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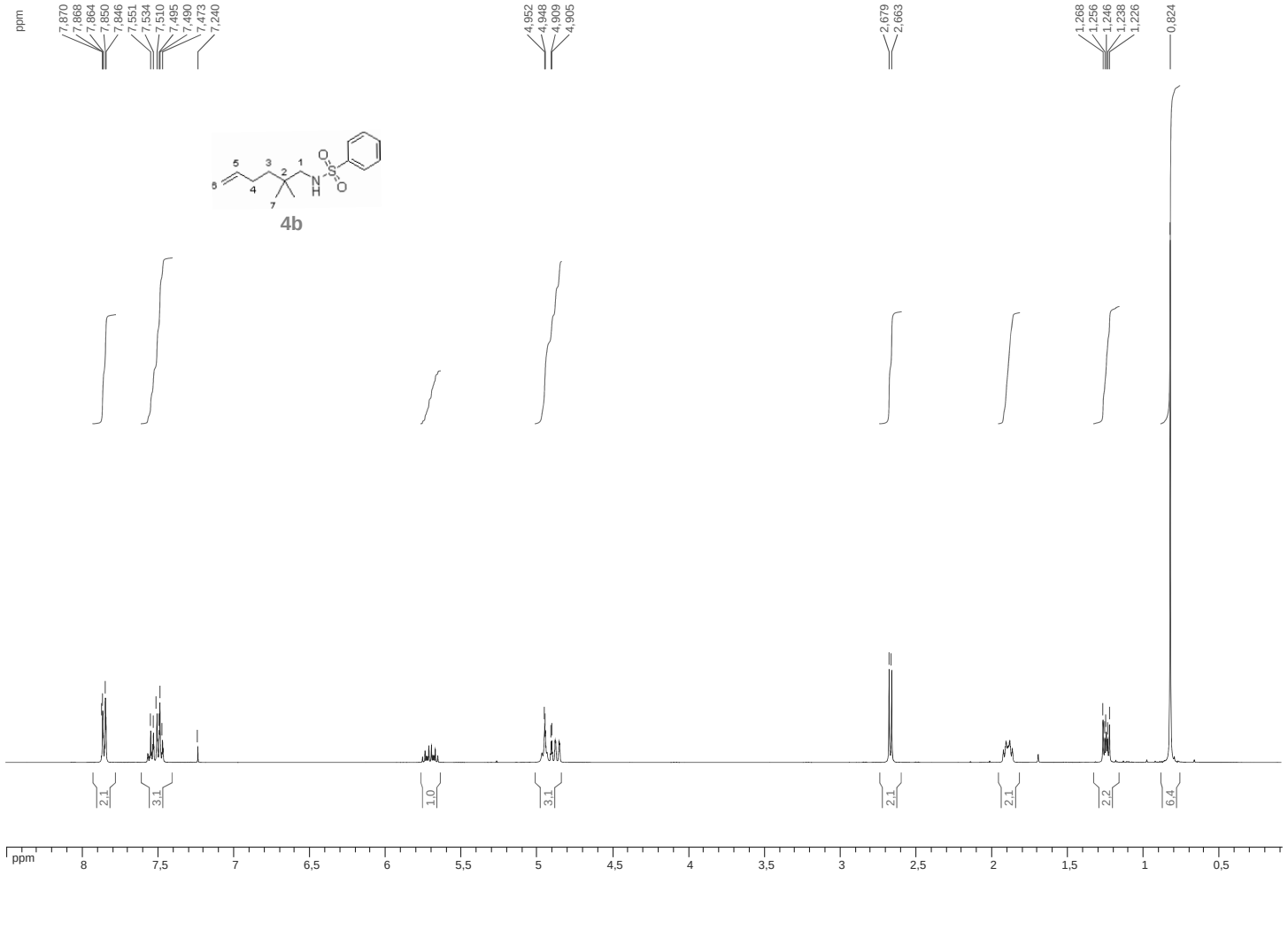
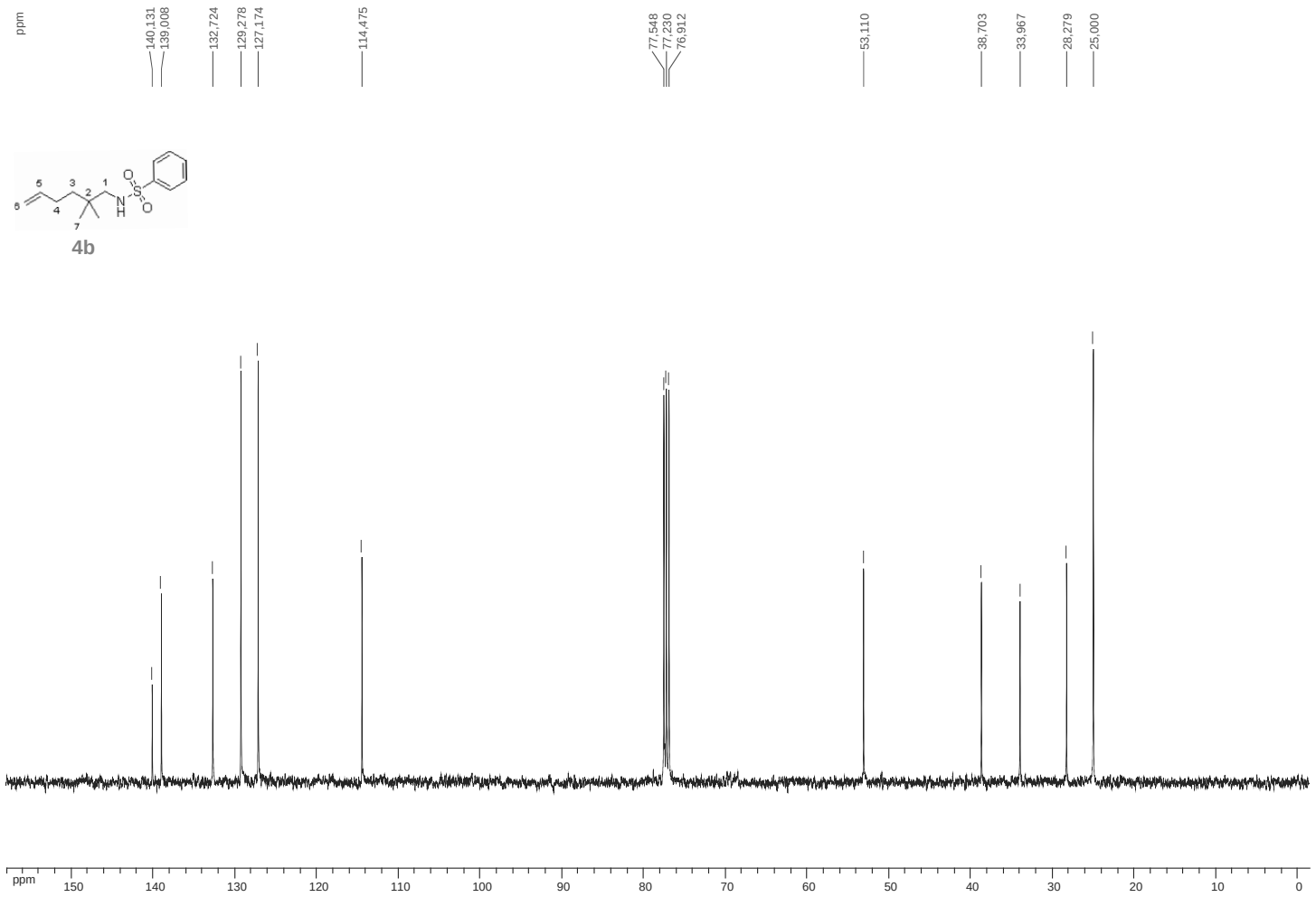
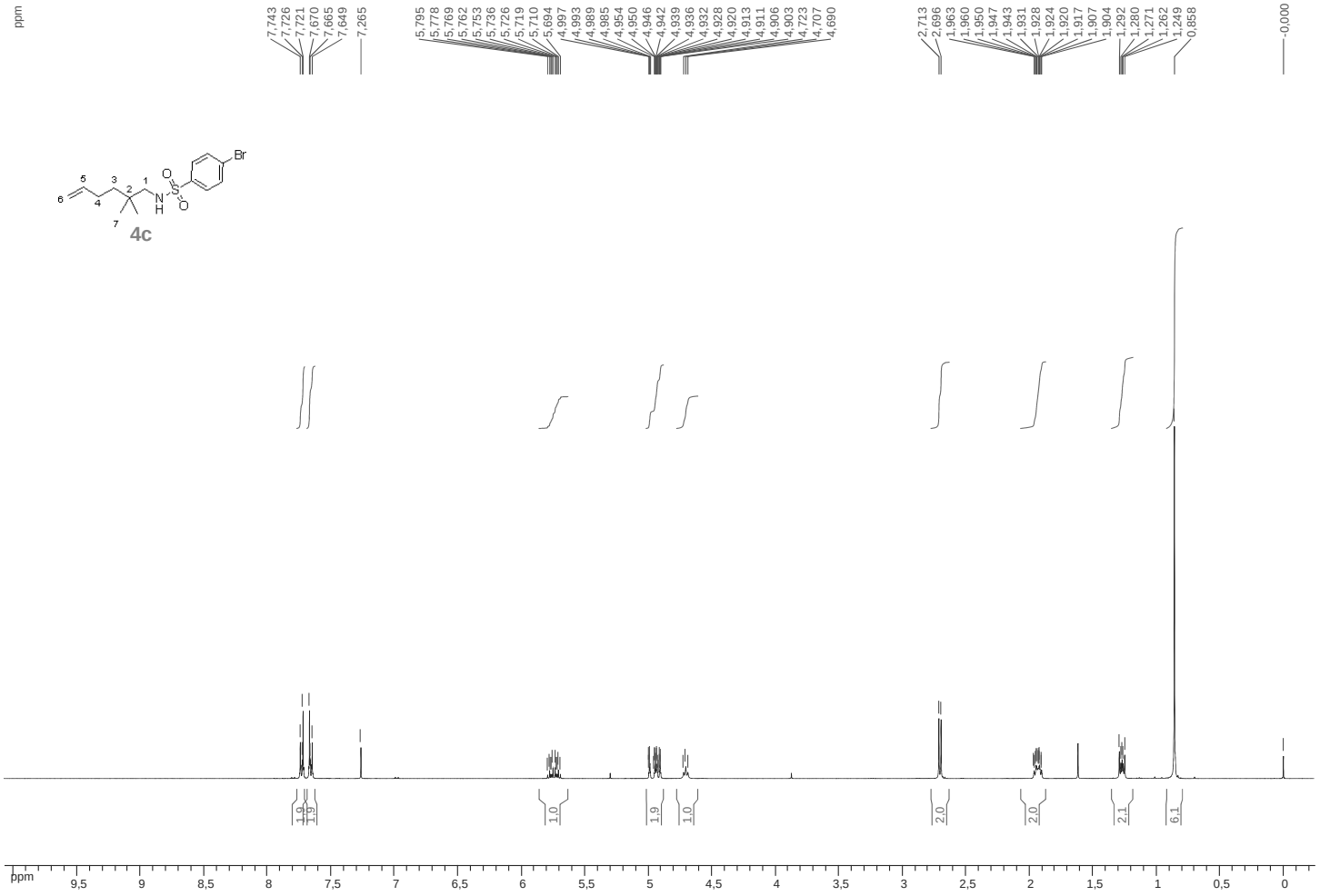
200
180
160
140
120
100
80
60
40
20
0
-20

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7,726
7,721
7,670
7,665
7,649
7,265
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5,778
5,769
5,762
5,753
5,736
5,726
5,719
5,710
5,694
4,997
4,993
4,989
4,985
4,954
4,950
4,946
4,942
4,939
4,936
4,932
4,928
4,920
4,913
4,911
4,906
4,903
4,723
4,707
4,690
2,713
2,696
1,963
1,960
1,950
1,947
1,943
1,931
1,928
1,924
1,920
1,917
1,907
1,904
1,292
1,280
1,271
1,262
1,249
0,858
0,000
Br
O
S
O
N
H
1
2
3
4
5
6
7
4c
1,0
1,0
1,0
1,0
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6,1
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8
7,5
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6,5
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5,5
5
4,5
4
3,5
3
2,5
2
1,5
1
0,5
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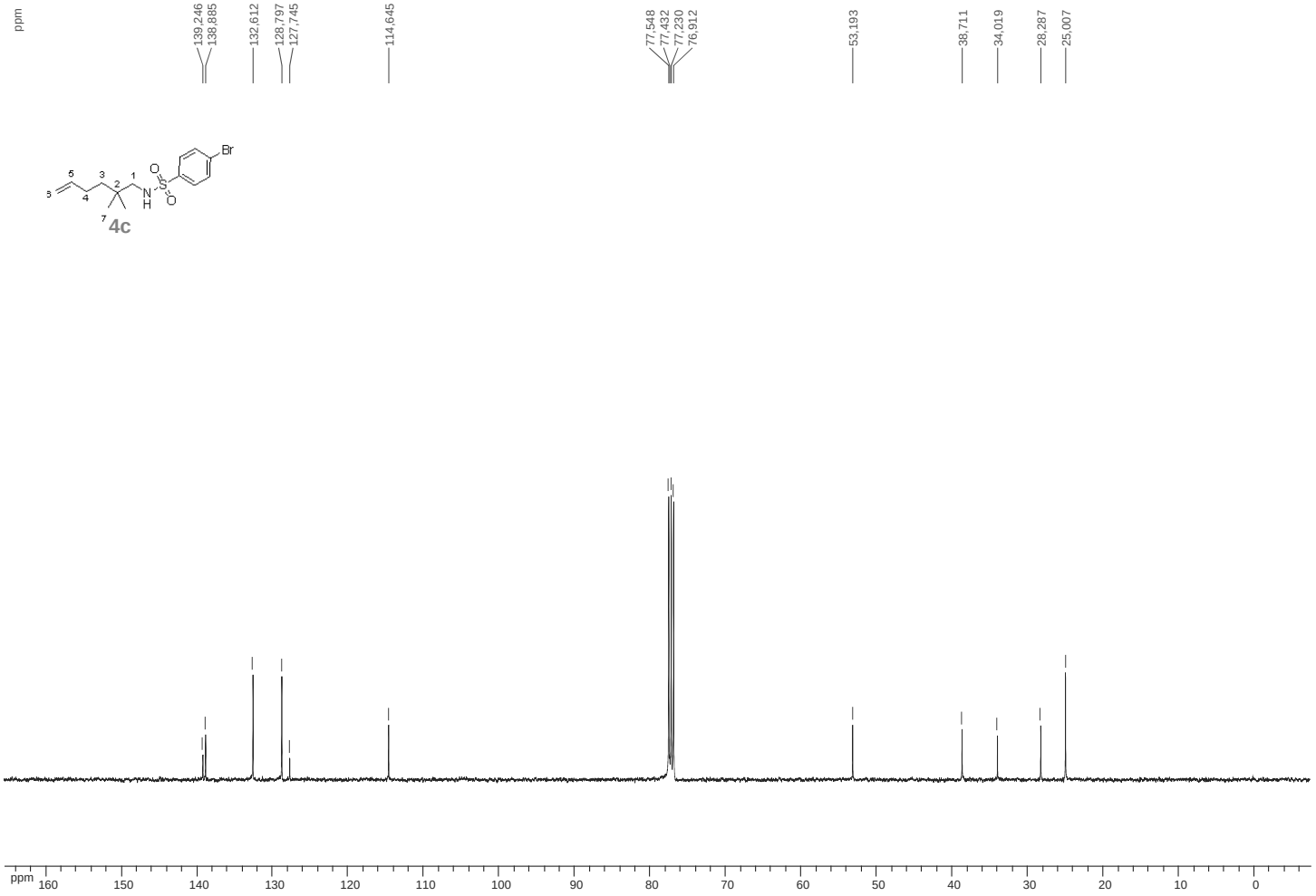
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139,246
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132,612
128,797
127,745
114,645
77,548
77,432
77,230
76,912
53,193
38,711
34,019
28,287
25,007
Br
O
S
O
N
H
1
2
3
4
5
6
7
4c
ppm
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150
140
130
120
110
100
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70
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30
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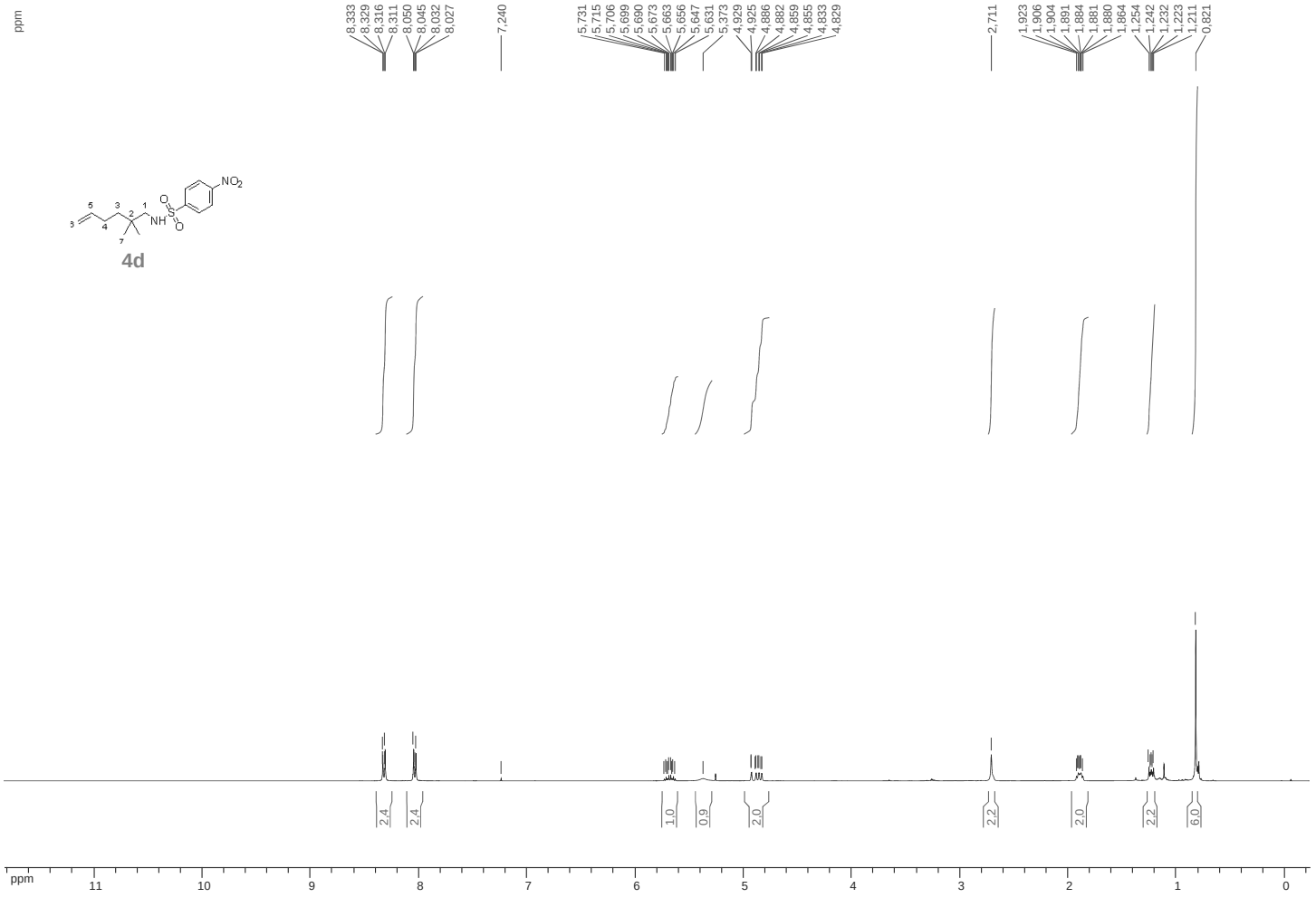
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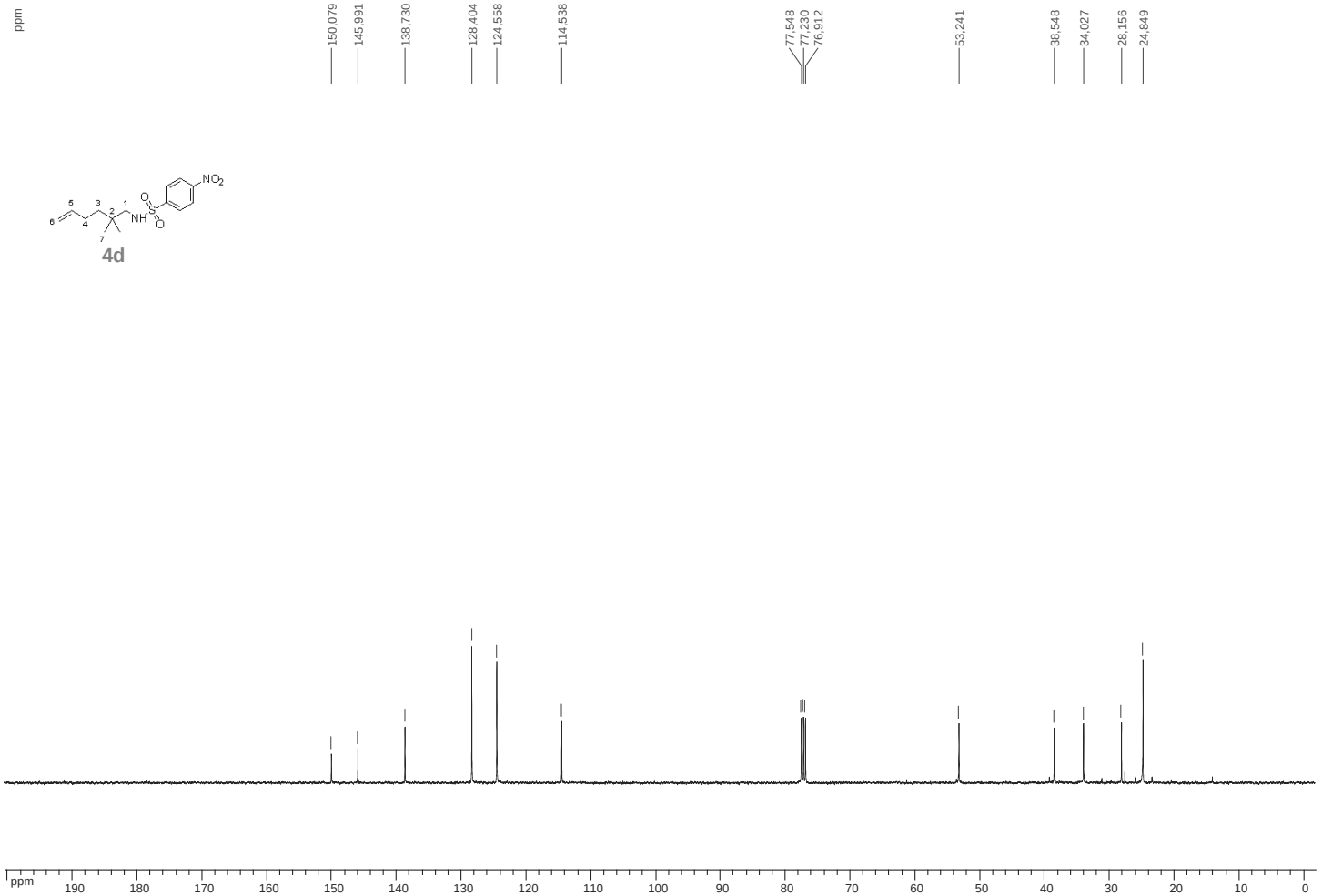
8.333
8.329
8.316
8.311
8.050
8.045
8.032
8.027
7.240
5.731
5.715
5.706
5.699
5.690
5.673
5.663
5.656
5.647
5.631
5.373
4.929
4.925
4.886
4.882
4.859
4.855
4.833
4.829
2.711
1.923
1.906
1.904
1.891
1.884
1.881
1.880
1.864
1.254
1.242
1.232
1.223
1.211
0.821
NO2
NH
4d
2.4
2.4
1.0
0.9
2.0
2.2
2.0
2.2
6.0
ppm
11
10
9
8
7
6
5
4
3
2
1
0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138,730
128,404
124,558
114,538
77,548
77,230
76,912
53,241
38,548
34,027
28,156
24,849
NO2
NH
4d
ppm
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
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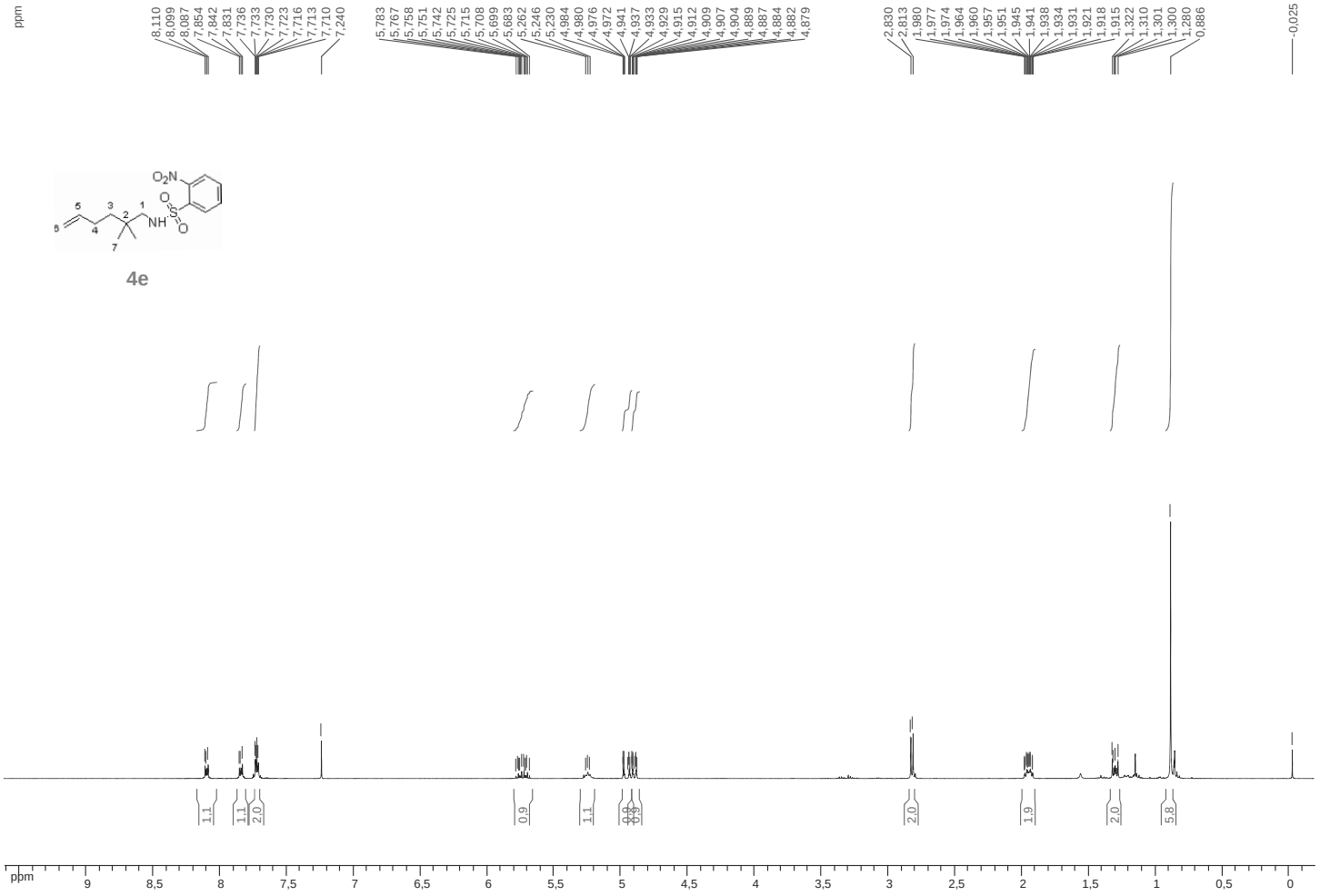
ppm
8.110
8.099
8.087
7.854
7.842
7.831
7.736
7.733
7.730
7.723
7.716
7.713
7.710
7.240
5.783
5.767
5.758
5.751
5.742
5.725
5.715
5.708
5.699
5.683
5.262
5.246
5.230
4.984
4.980
4.976
4.972
4.941
4.937
4.933
4.929
4.915
4.912
4.909
4.907
4.904
4.889
4.887
4.884
4.882
4.879
2.830
2.813
1.980
1.977
1.974
1.964
1.960
1.957
1.951
1.945
1.941
1.938
1.934
1.931
1.921
1.918
1.915
1.322
1.310
1.301
1.300
1.280
0.886
-0.025
4e
1.1
1.1
2.0
0.9
1.1
0.9
0.9
2.0
1.9
2.0
5.8
ppm
9
8,5
8
7,5
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6,5
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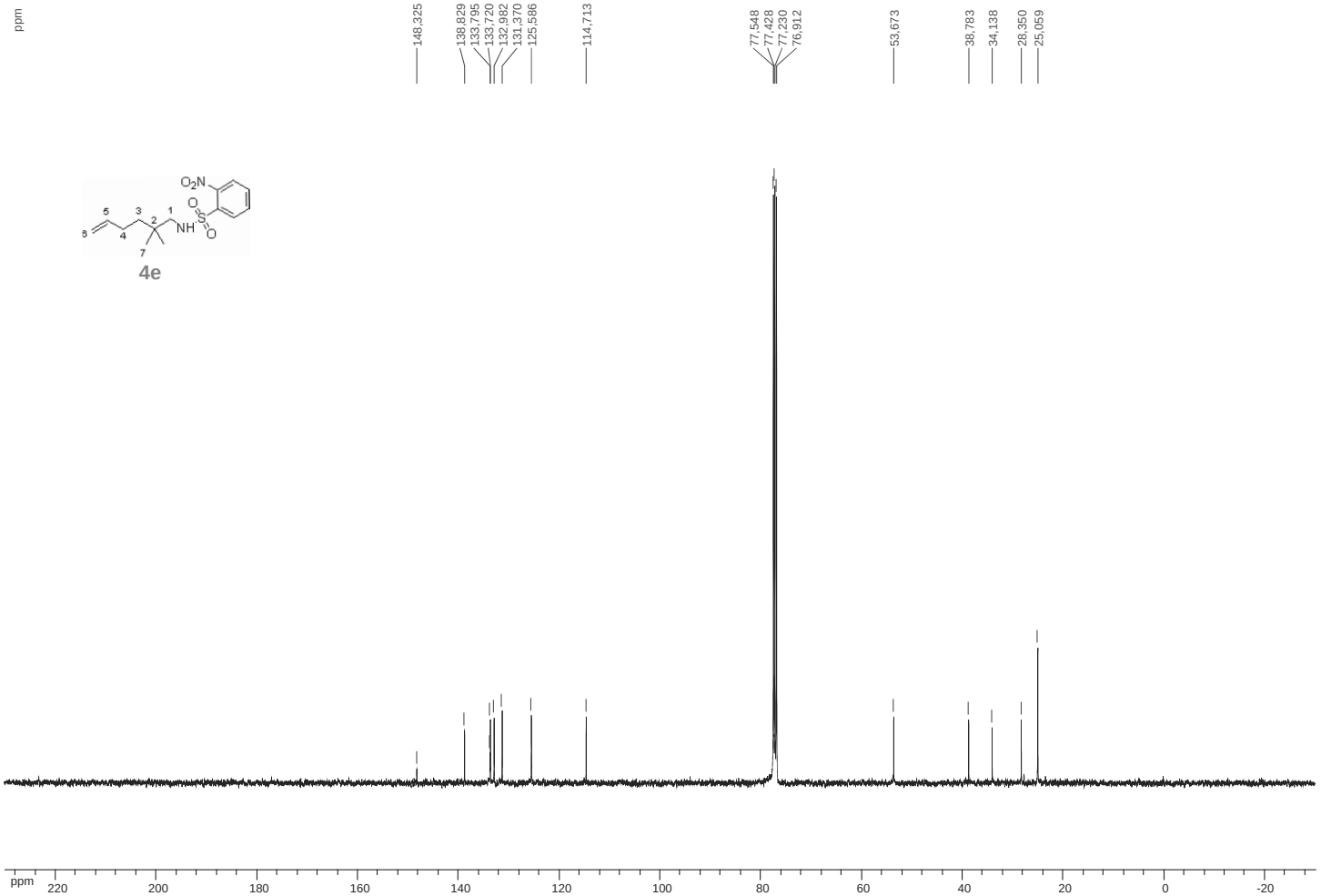
5,5
5
4,5
4
3,5
3
2,5
2
1,5
1
0,5
0


ppm
148,325
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133,795
133,720
132,982
131,370
125,586
114,713
77,548
77,428
77,230
76,912
53,673
38,783
34,138
28,350
25,059
4e
ppm
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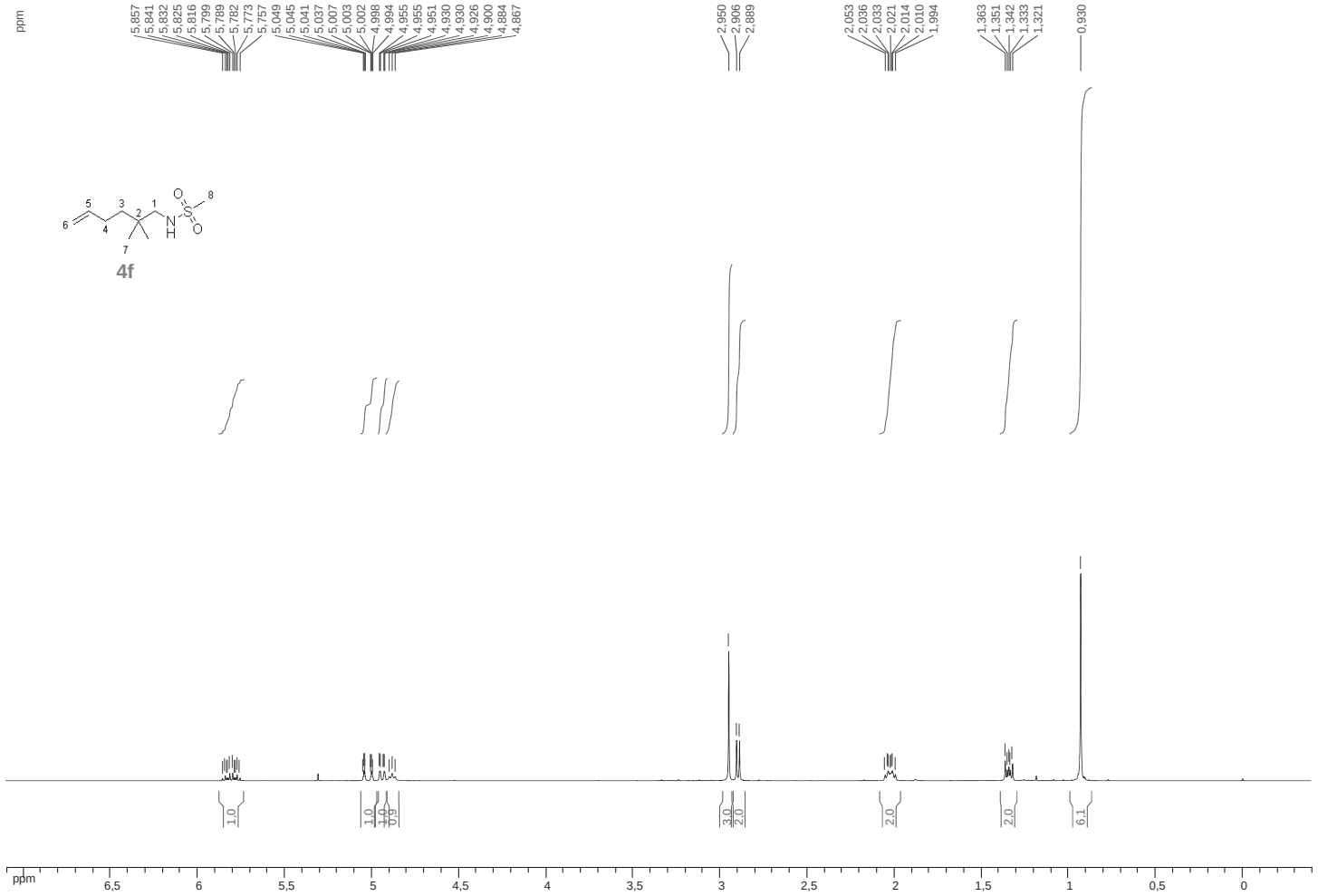
200
180
160
140
120
100
80
60
40
20
0
-20


ppm
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5,841
5,832
5,825
5,816
5,799
5,789
5,782
5,773
5,757
5,049
5,045
5,041
5,037
5,007
5,003
5,002
4,998
4,994
4,955
4,955
4,951
4,930
4,930
4,926
4,900
4,884
4,867
2,950
2,906
2,889
2,053
2,036
2,033
2,021
2,014
2,010
1,994
1,363
1,351
1,342
1,333
1,321
0,930
1,0
1,0
1,0
0,9
3,0
2,0
2,0
2,0
6,1
ppm
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6
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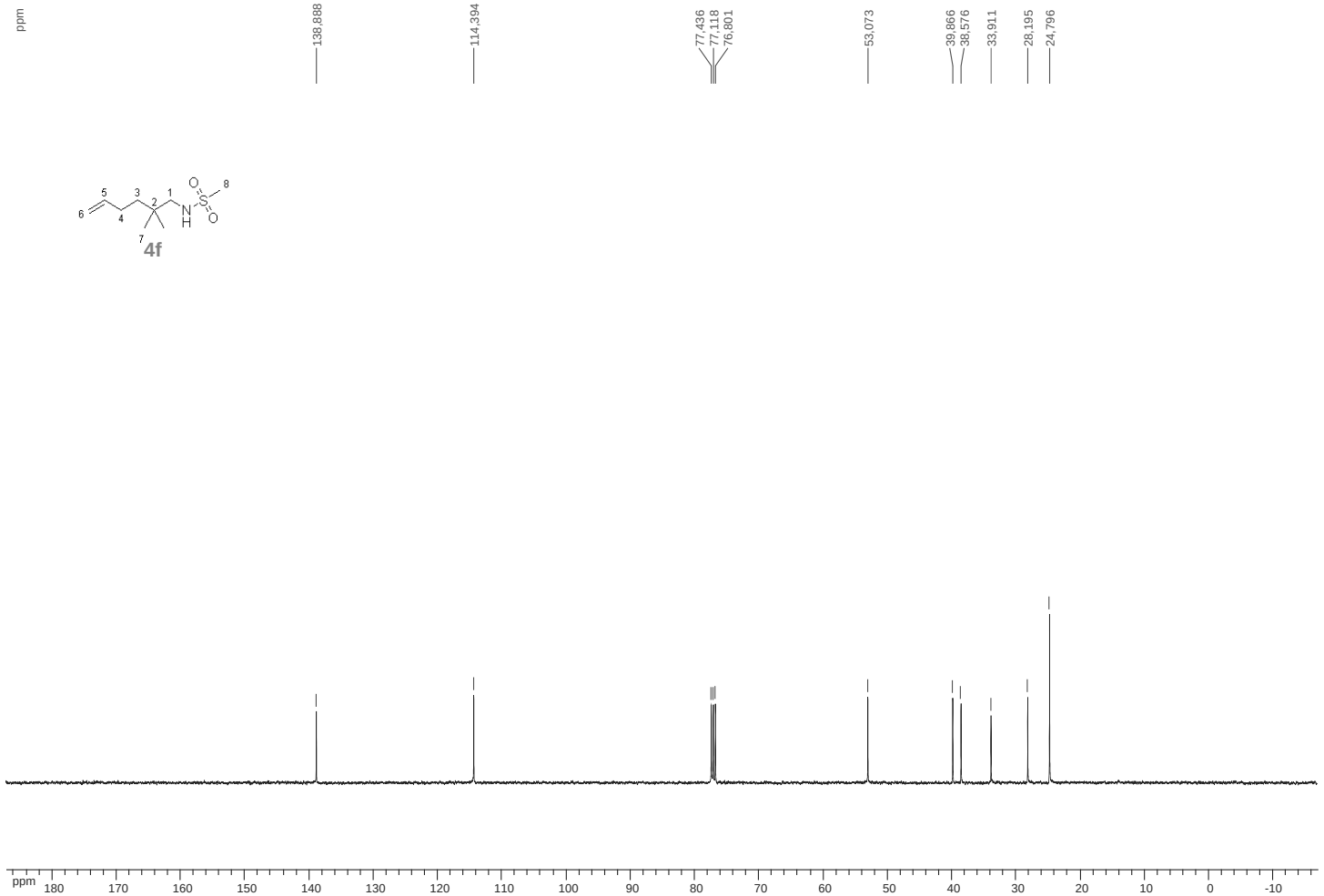
5
4,5
4
3,5
3
2,5
2
1,5
1
0,5
0



4f


ppm
138,888
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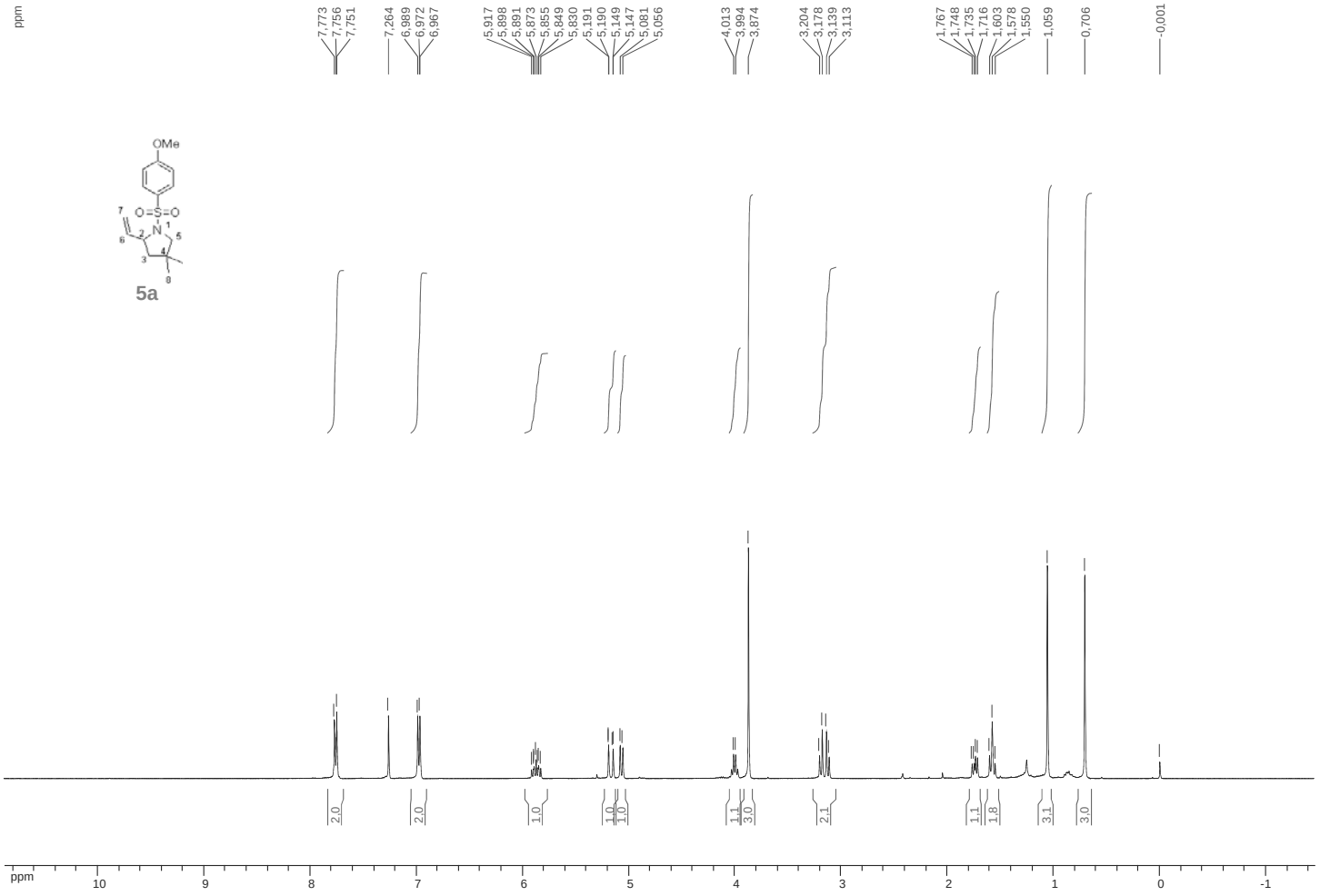
77,436
77,118
76,801
53,073
39,866
38,576
33,911
28,195
24,796
ppm
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
-10



4f


ppm
7,773
7,756
7,751
7,264
6,989
6,972
6,967
5,917
5,898
5,891
5,873
5,855
5,849
5,830
5,191
5,190
5,149
5,147
5,081
5,056
4,013
3,994
3,874
3,204
3,178
3,139
3,113
1,767
1,748
1,735
1,716
1,603
1,578
1,550
1,059
0,706
-0,001
OMe
5a
2,0
2,0
1,0
1,0
1,0
1,1
3,0
2,1
1,1
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3,1
3,0
10
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8
7
6
5
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3
2
1
0
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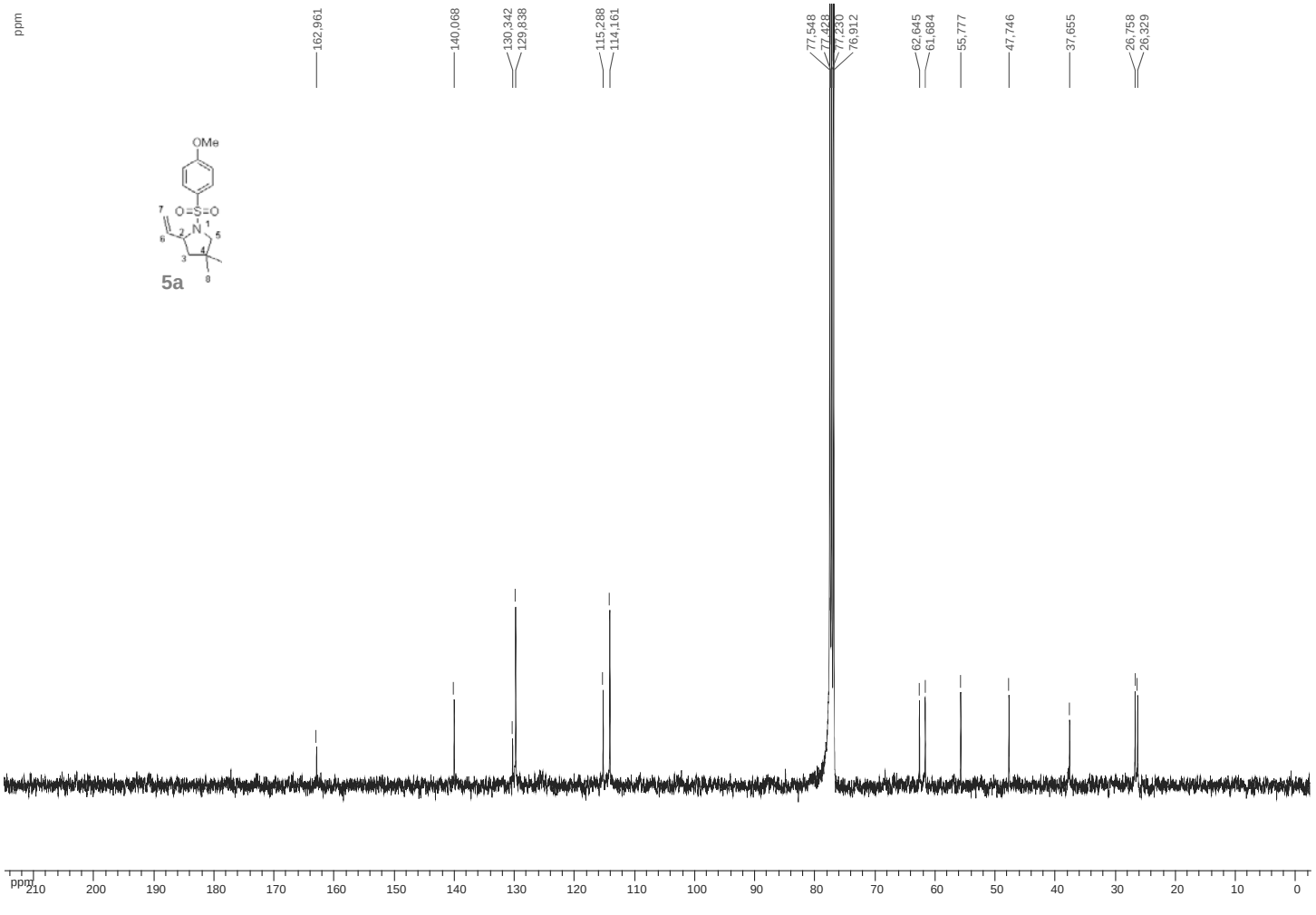
ppm
162,961
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129,838
115,288
114,161
77,548
77,428
77,230
76,912
62,645
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47,746
37,655
26,758
26,329
OMe
5a
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
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30
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10
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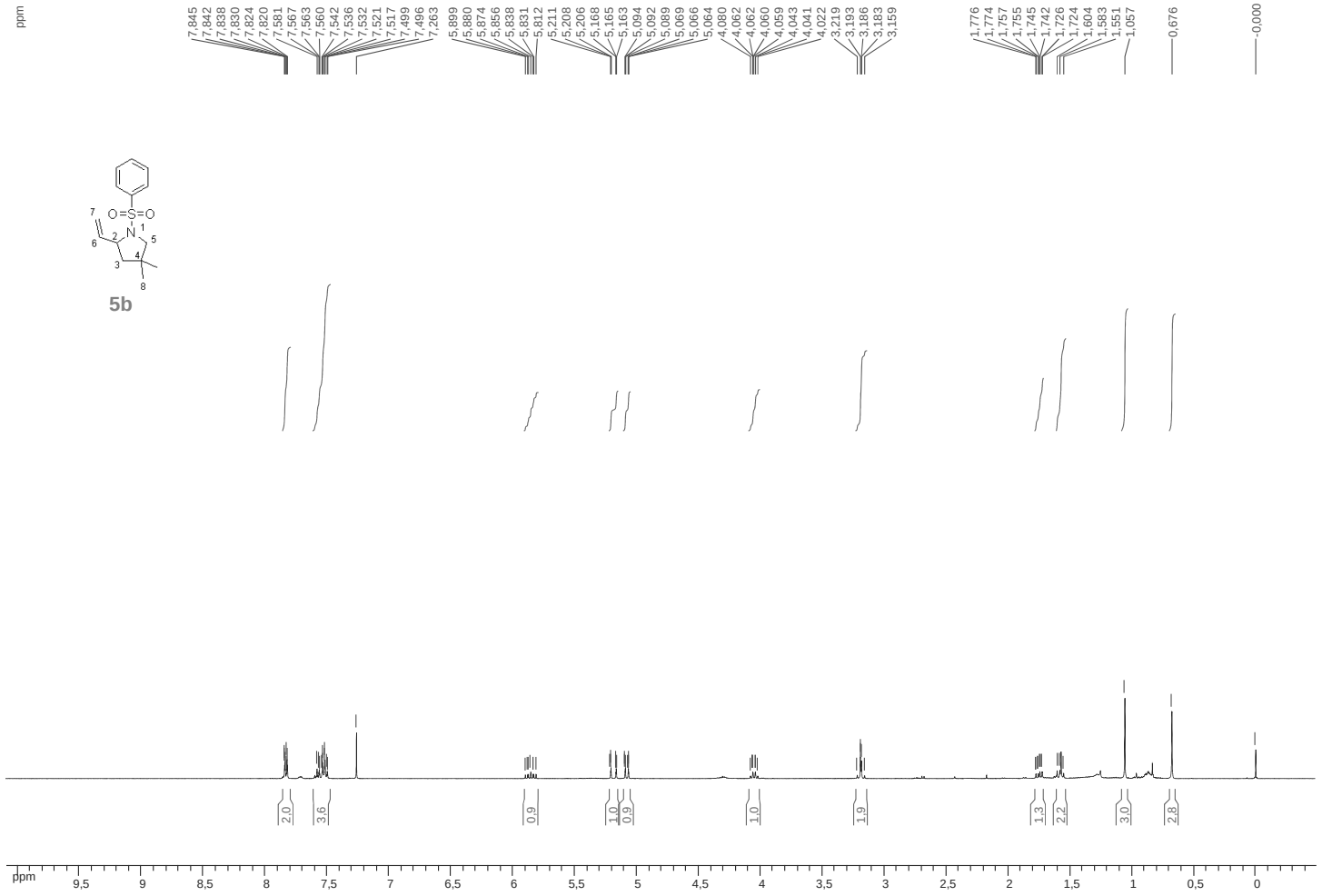
ppm
7,845
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7,838
7,830
7,824
7,820
7,581
7,567
7,563
7,560
7,542
7,536
7,532
7,521
7,517
7,499
7,496
7,263
5,899
5,880
5,874
5,856
5,838
5,831
5,812
5,211
5,208
5,206
5,168
5,165
5,163
5,094
5,092
5,089
5,069
5,066
5,064
4,080
4,062
4,062
4,060
4,059
4,043
4,041
4,022
3,219
3,193
3,186
3,183
3,159
1,776
1,774
1,757
1,755
1,745
1,742
1,726
1,724
1,604
1,583
1,551
1,057
0,676
0,000
5b
2,0
3,6
0,9
1,0
0,9
1,0
1,9
1,3
2,2
3,0
2,8
ppm
9,5
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8,5
8
7,5
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6,5
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5,5
5
4,5
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3,5
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2,5
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1,5
1
0,5
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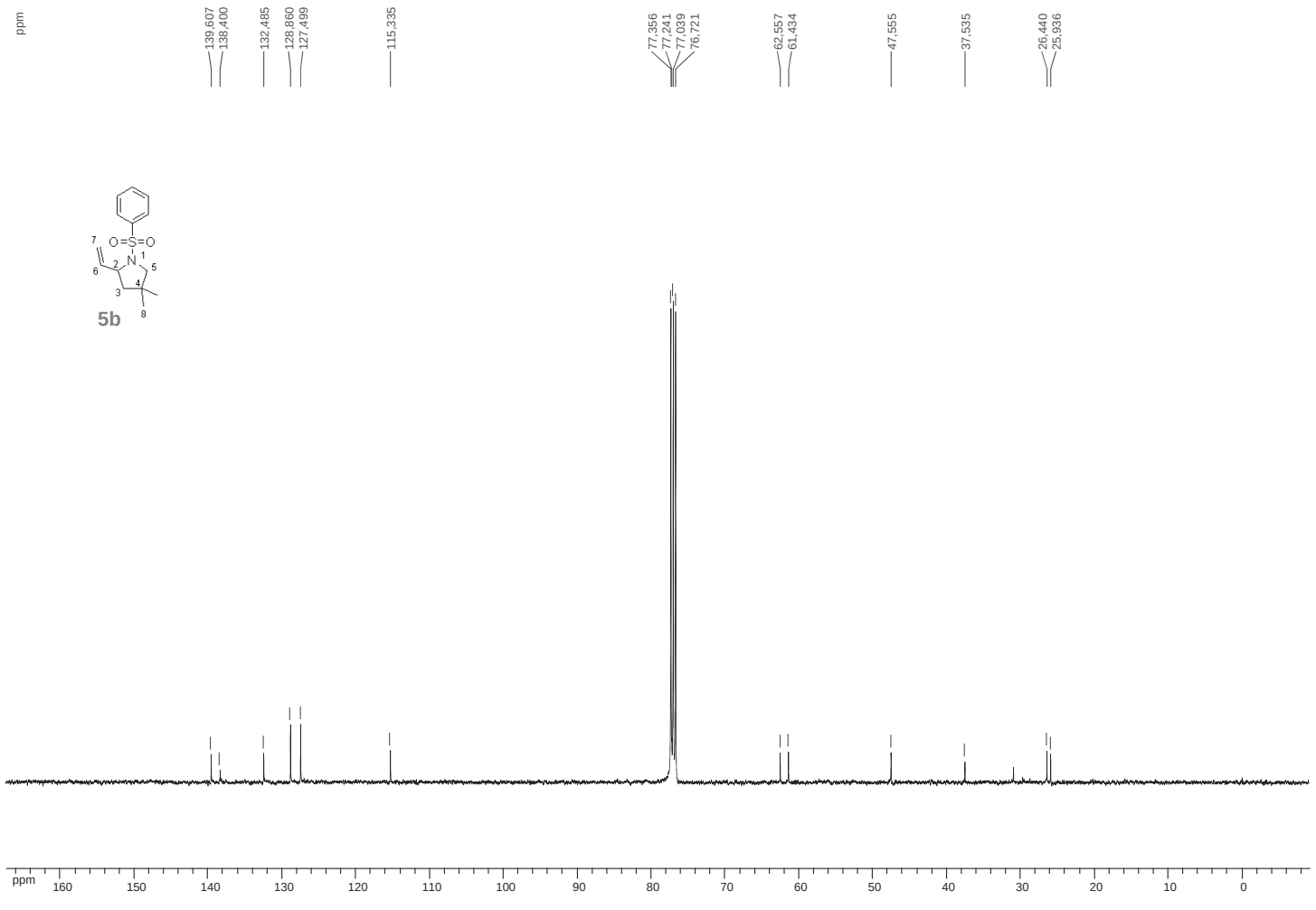
ppm
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128,860
127,499
115,335
77,356
77,241
77,039
76,721
62,557
61,434
47,555
37,535
26,440
25,936
5b
ppm
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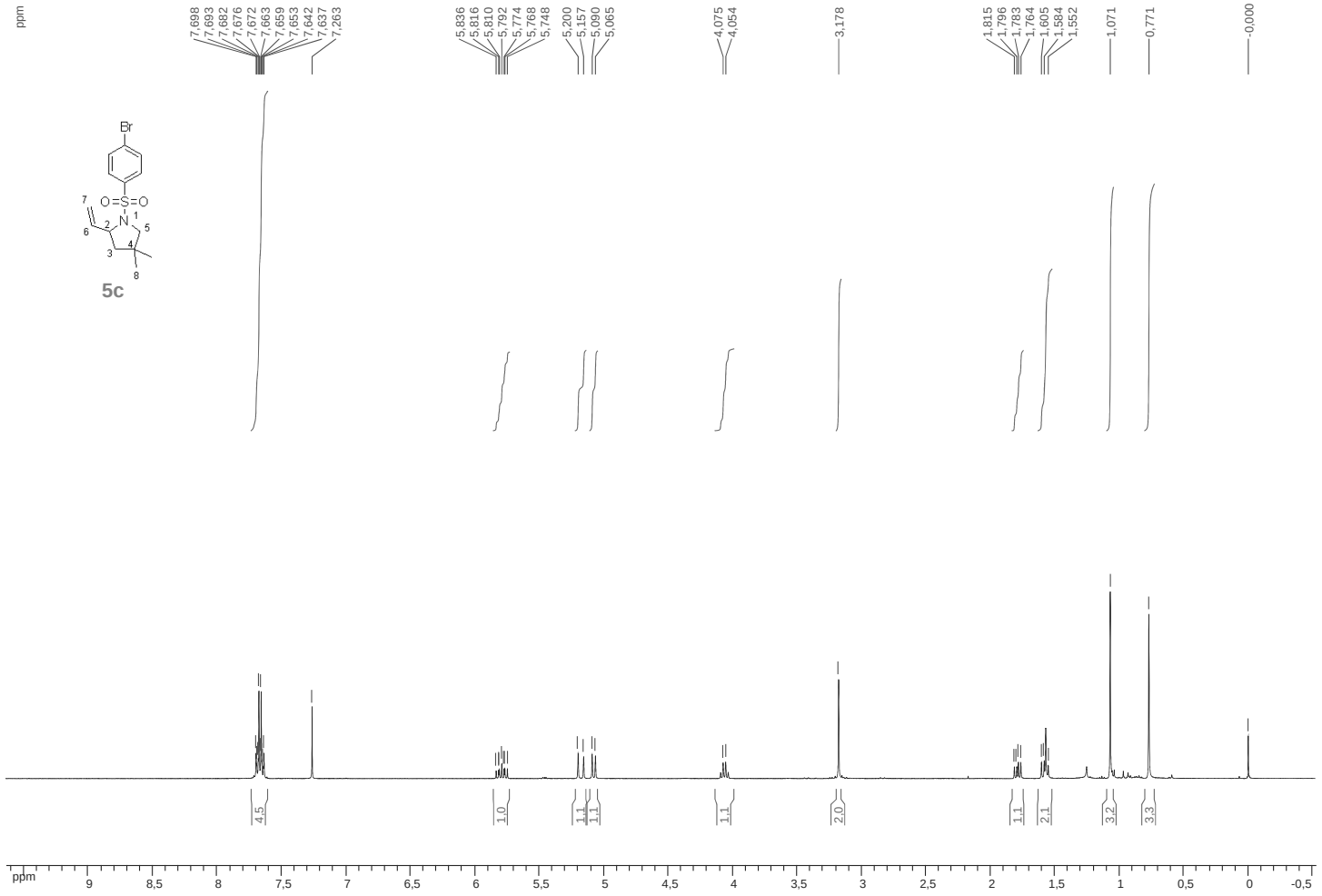
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0


ppm
7,698
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7,682
7,676
7,672
7,663
7,659
7,653
7,642
7,637
7,263
5,836
5,816
5,810
5,792
5,774
5,768
5,748
5,200
5,157
5,090
5,065
4,075
4,054
3,178
1,815
1,796
1,783
1,764
1,605
1,584
1,552
1,071
0,771
0,000
Br
O=S=O
N
1
2
3
4
5
6
7
8
5c
4,5
1,0
1,1
1,1
1,1
2,0
1,1
2,1
3,2
3,3
ppm
9
8,5
8
7,5
7
6,5
6
5,5
5
4,5
4
3,5
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2,5
2
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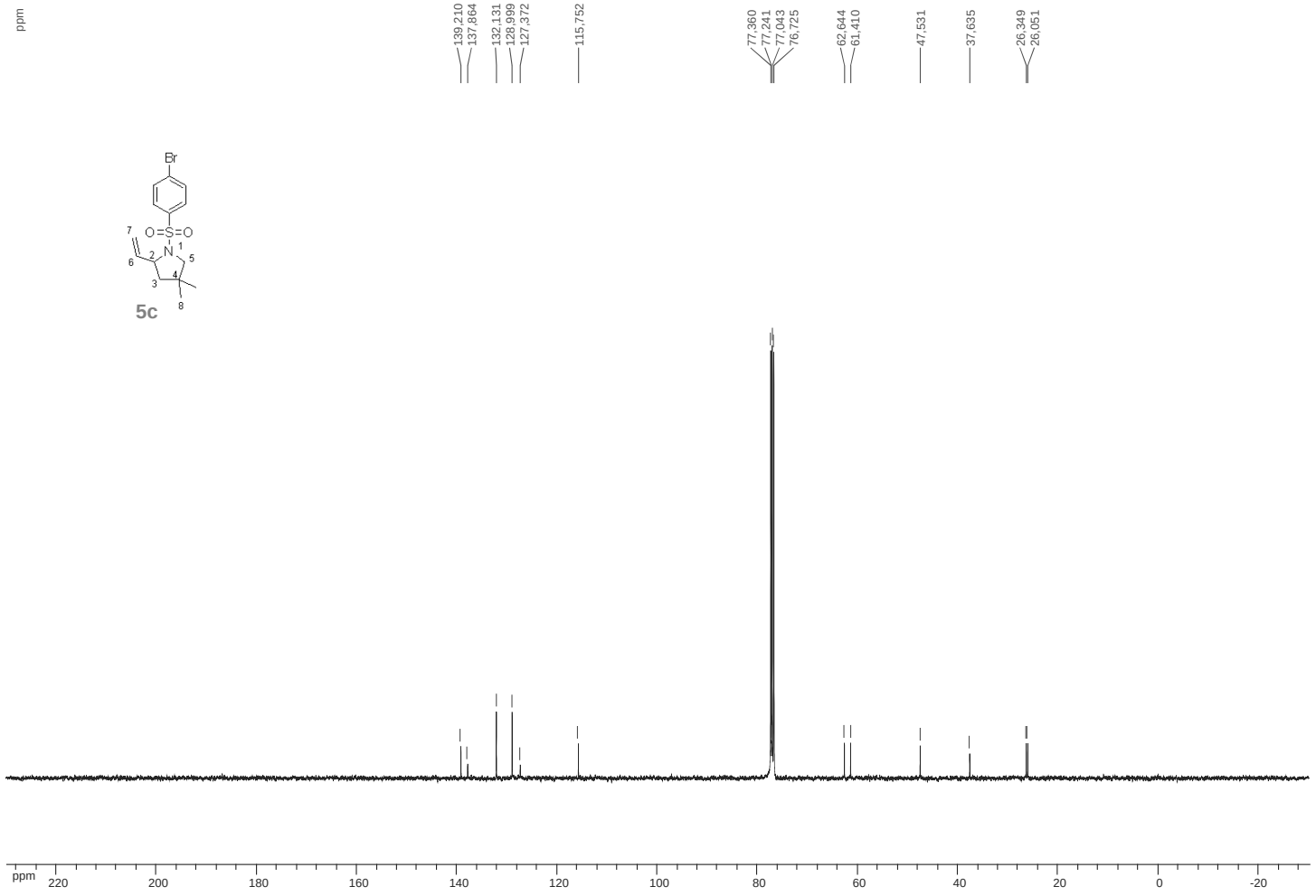
-0,5


ppm
139,210
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127,372
115,752
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77,241
77,043
76,725
62,644
61,410
47,531
37,635
26,349
26,051
Br
O=S=O
N
1
2
3
4
5
6
7
8
5c
ppm
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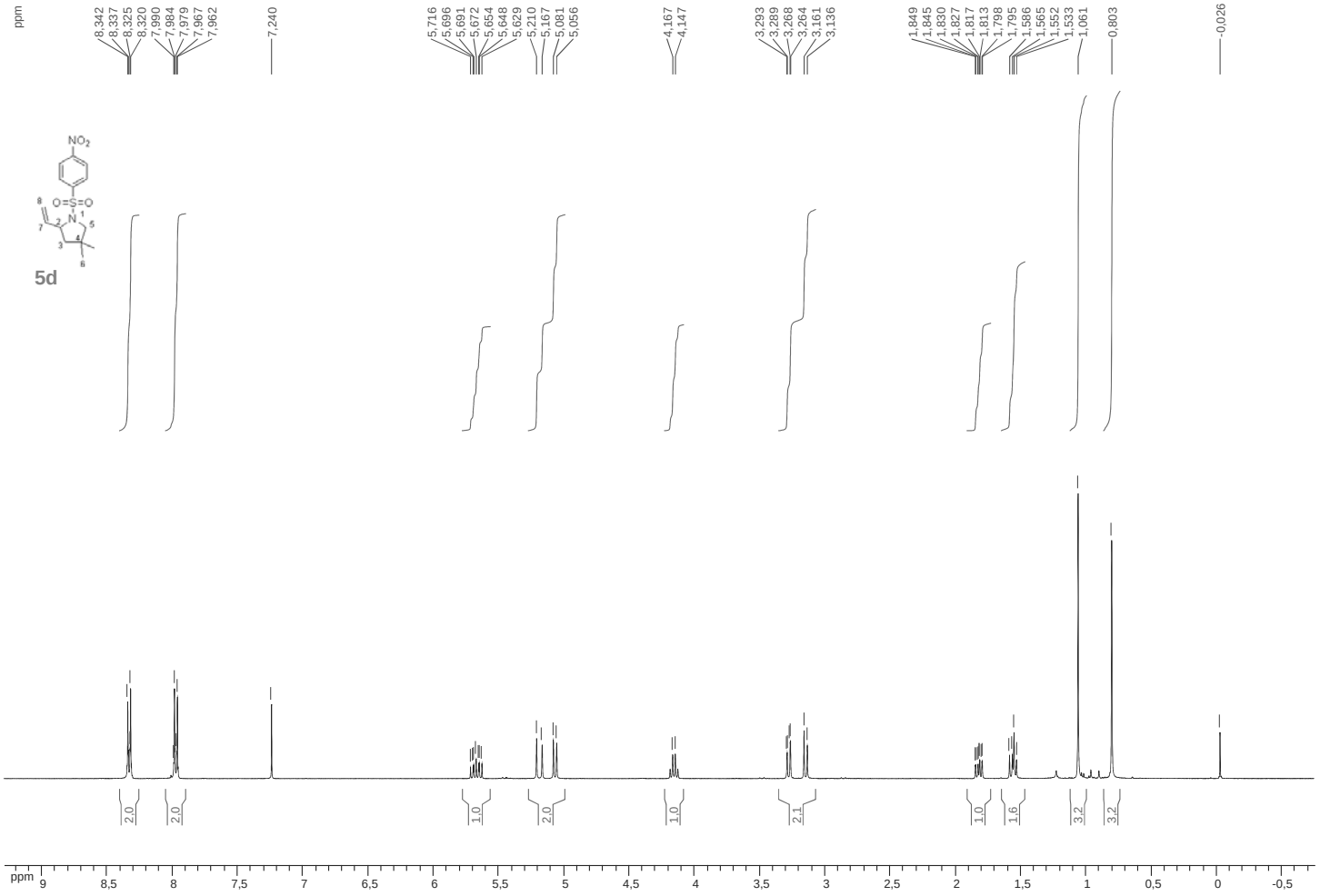
200
180
160
140
120
100
80
60
40
20
0
-20


ppm
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7,979
7,967
7,962
7,240
5,716
5,696
5,691
5,672
5,654
5,648
5,629
5,210
5,167
5,081
5,056
4,167
4,147
3,293
3,289
3,268
3,264
3,161
3,136
1,849
1,845
1,830
1,827
1,817
1,813
1,798
1,795
1,586
1,565
1,552
1,533
1,061
0,803
-0,026
5d
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2,0
1,0
2,0
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2,1
1,0
1,6
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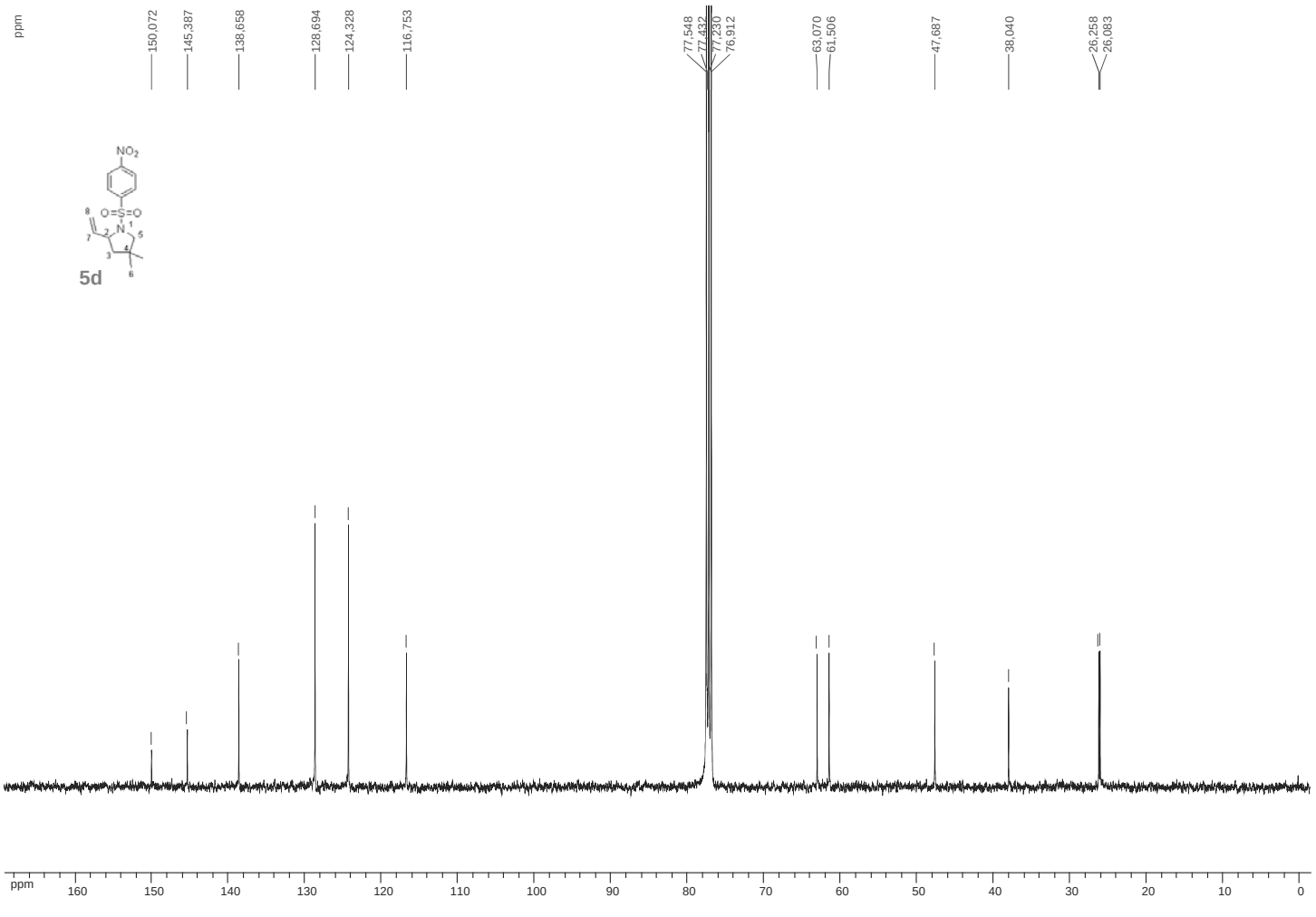
3,2
ppm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150,072
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128,694
124,328
116,753
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77,230
76,912
63,070
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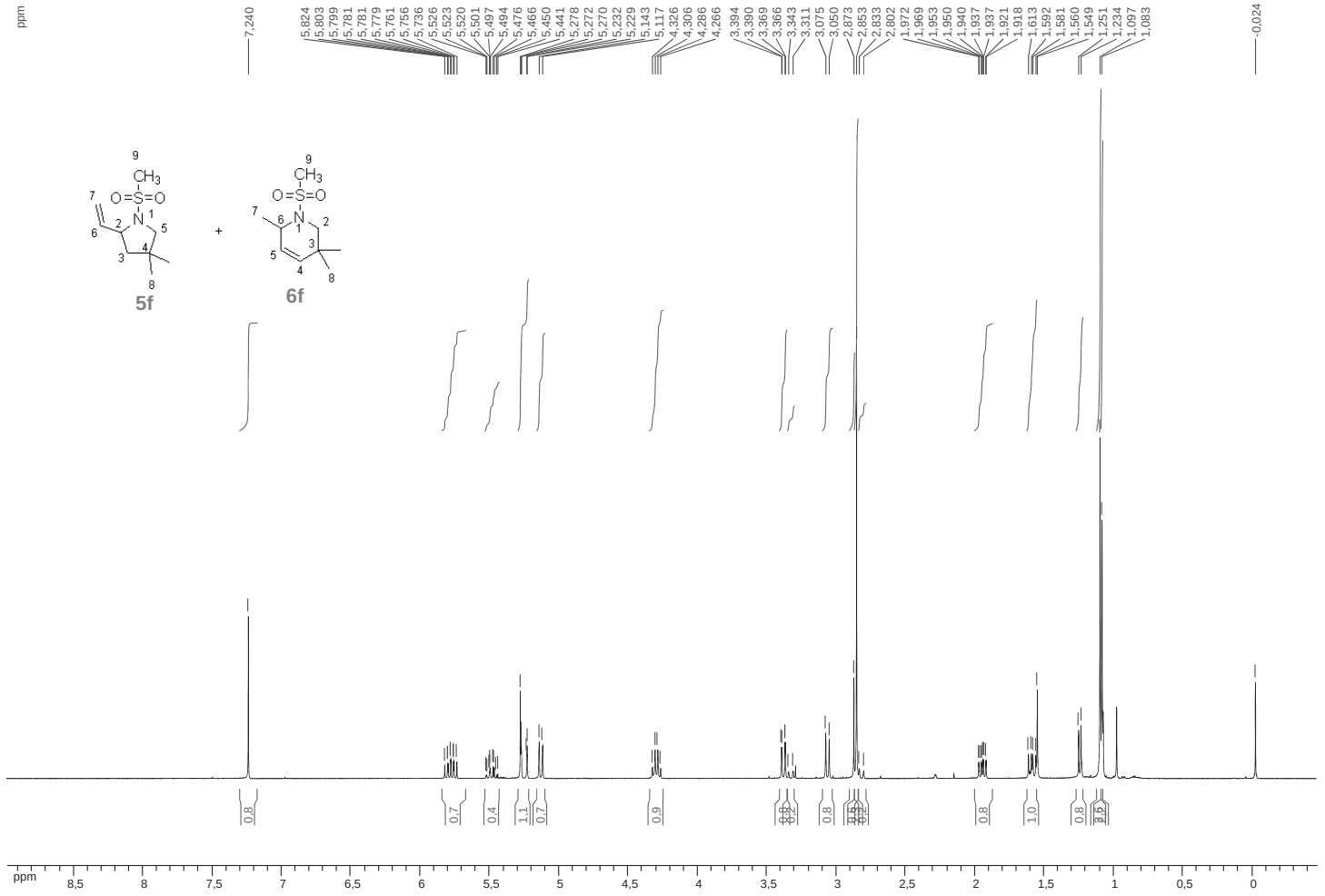
47,687
38,040
26,258
26,083
5d
ppm


ppm
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5,781
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5,756
5,736
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5,520
5,501
5,497
5,494
5,476
5,466
5,450
5,441
5,278
5,272
5,270
5,232
5,229
5,143
5,117
4,326
4,306
4,286
4,266
3,394
3,390
3,369
3,366
3,343
3,311
3,075
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2,853
2,833
2,802
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1,969
1,953
1,950
1,940
1,937
1,937
1,921
1,918
1,613
1,592
1,581
1,560
1,549
1,251
1,234
1,097
1,083
-0,024
5f
6f
0,8
0,7
0,4
1,1
0,7
0,9
0,8
0,8
1,0
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2,5
8,5
8
7,5
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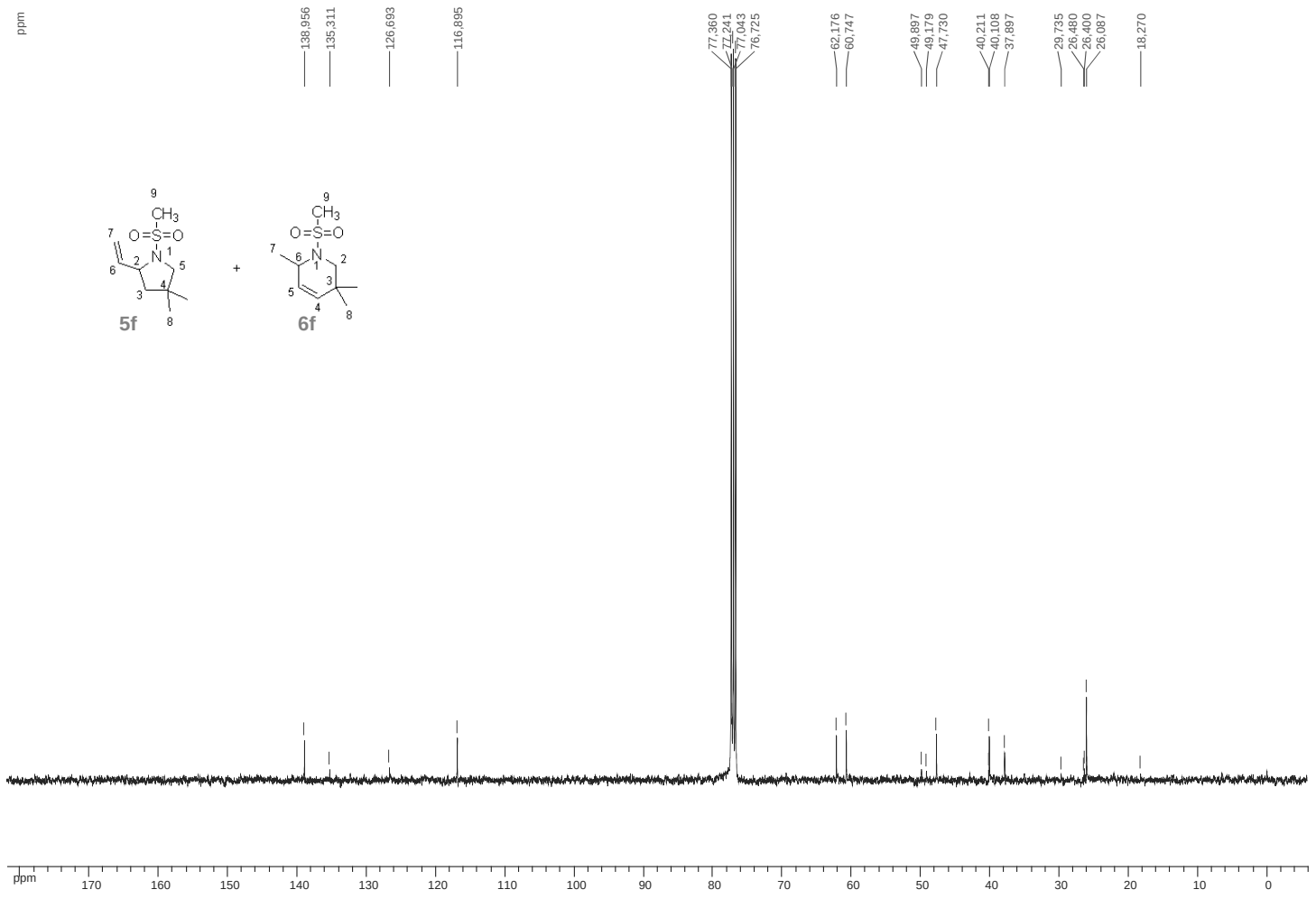
ppm
138,956
135,311
126,693
116,895
77,360
77,241
77,043
76,725
62,176
60,747
49,897
49,179
47,730
40,211
40,108
37,897
29,735
26,480
26,400
26,087
18,270
5f
6f
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
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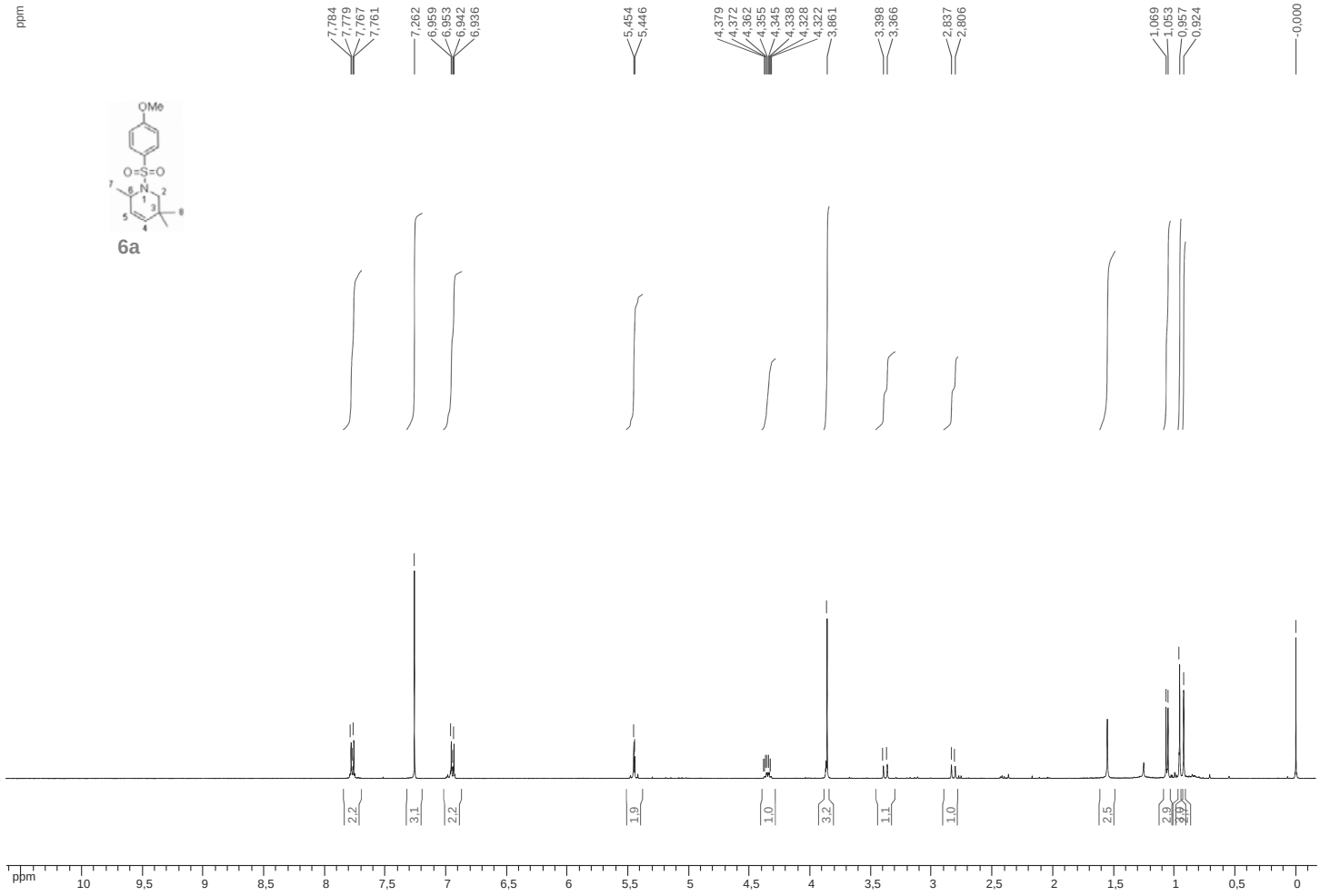
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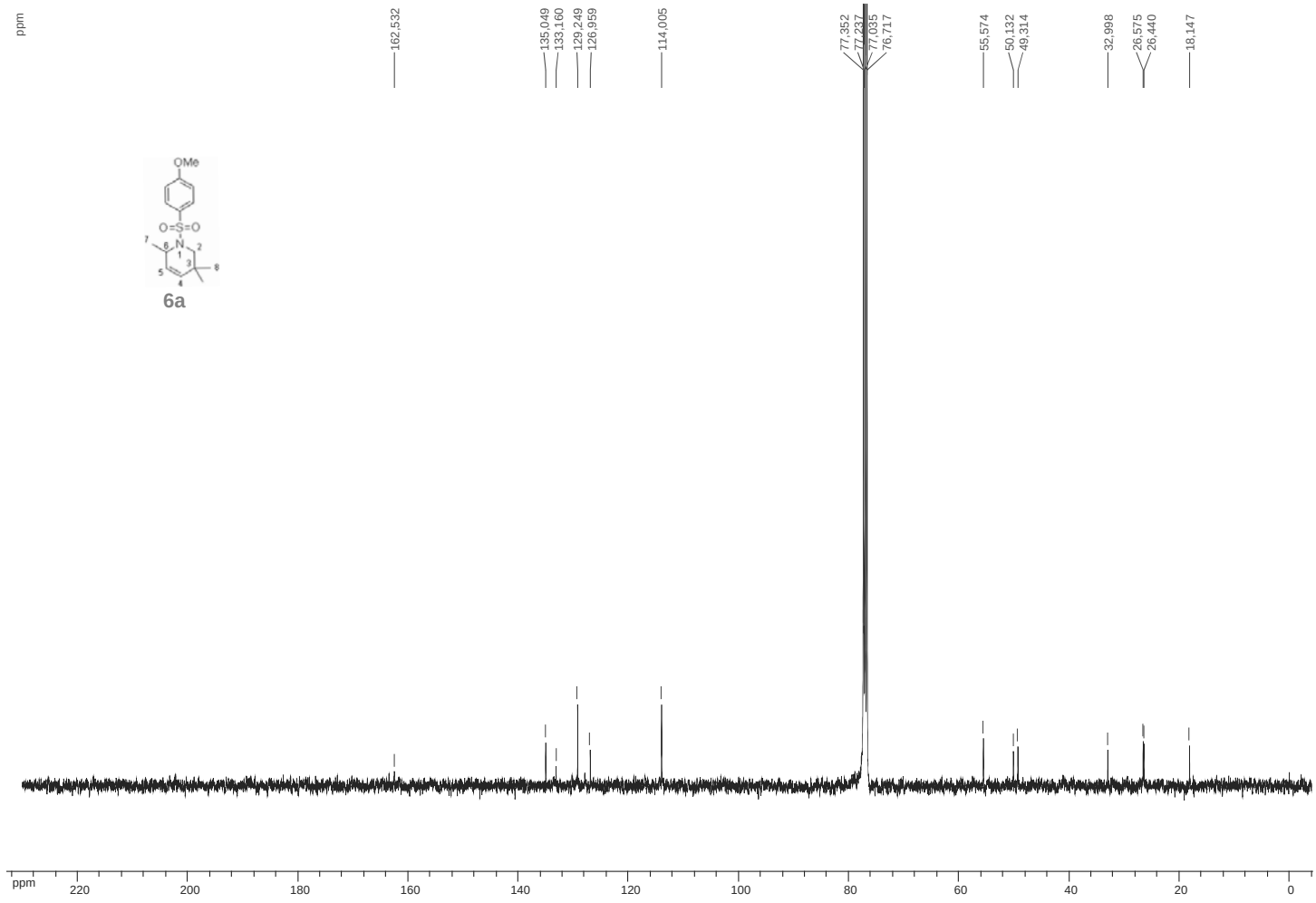
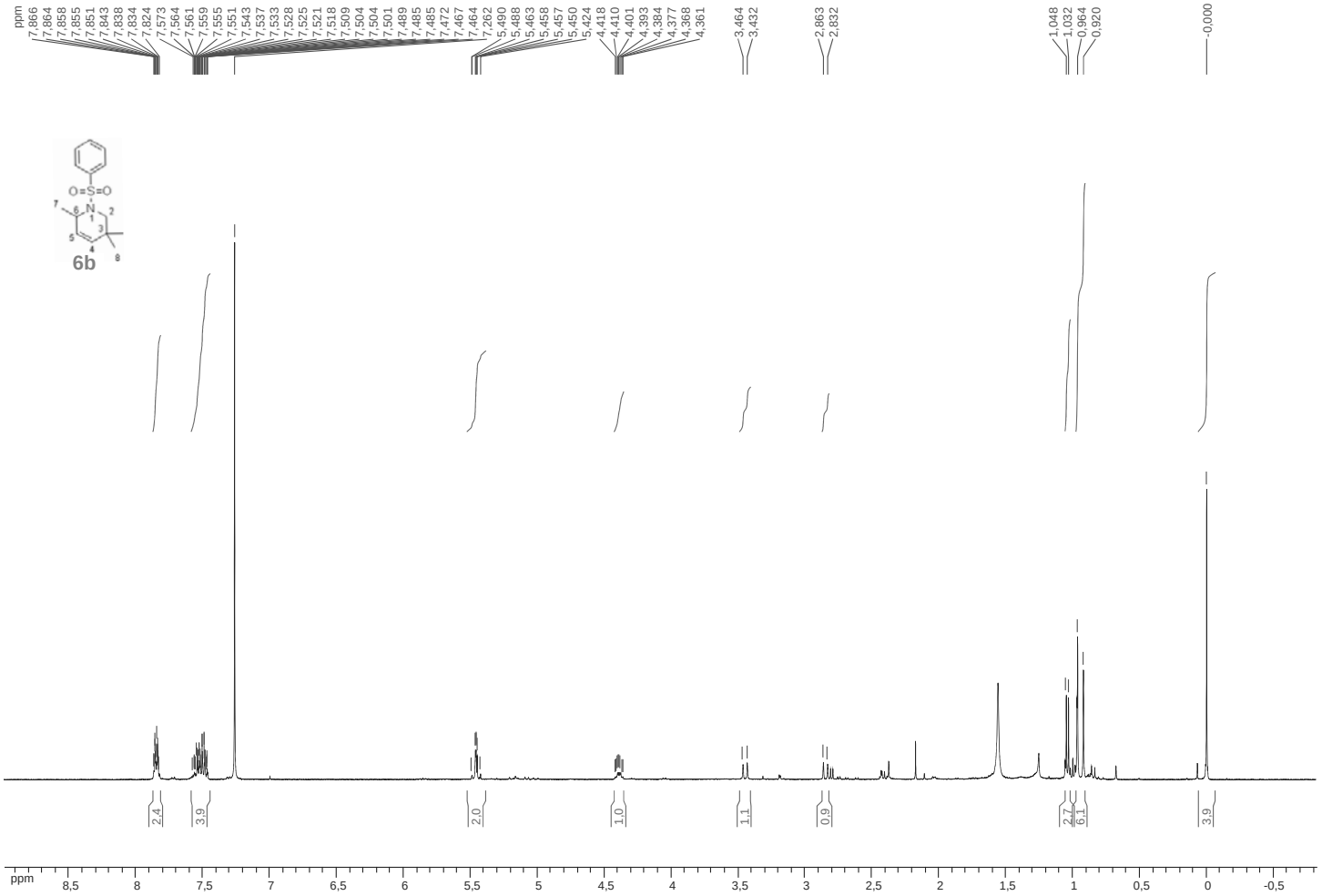
7,784
7,779
7,767
7,761
7,262
6,959
6,953
6,942
6,936
5,454
5,446
4,379
4,372
4,362
4,355
4,345
4,338
4,328
4,322
3,861
3,398
3,366
2,837
2,806
1,069
1,053
0,957
0,924
0,000
OMe
O=S=O
6a
2,2
3,1
2,2
1,9
1,0
3,2
1,1
1,0
2,5
2,9
3,0
ppm
10
9,5
9
8,5
8
7,5
7
6,5
6
5,5
5
4,5
4
3,5
3
2,5
2
1,5
1
0,5
0


ppm
162,532
135,049
133,160
129,249
126,959
114,005
77,352
77,237
77,035
76,717
55,574
50,132
49,314
32,998
26,575
26,440
18,147
OMe
O=S=O
6a
ppm
220
200
180
160
140
120
100
80
60
40
20
0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7,866
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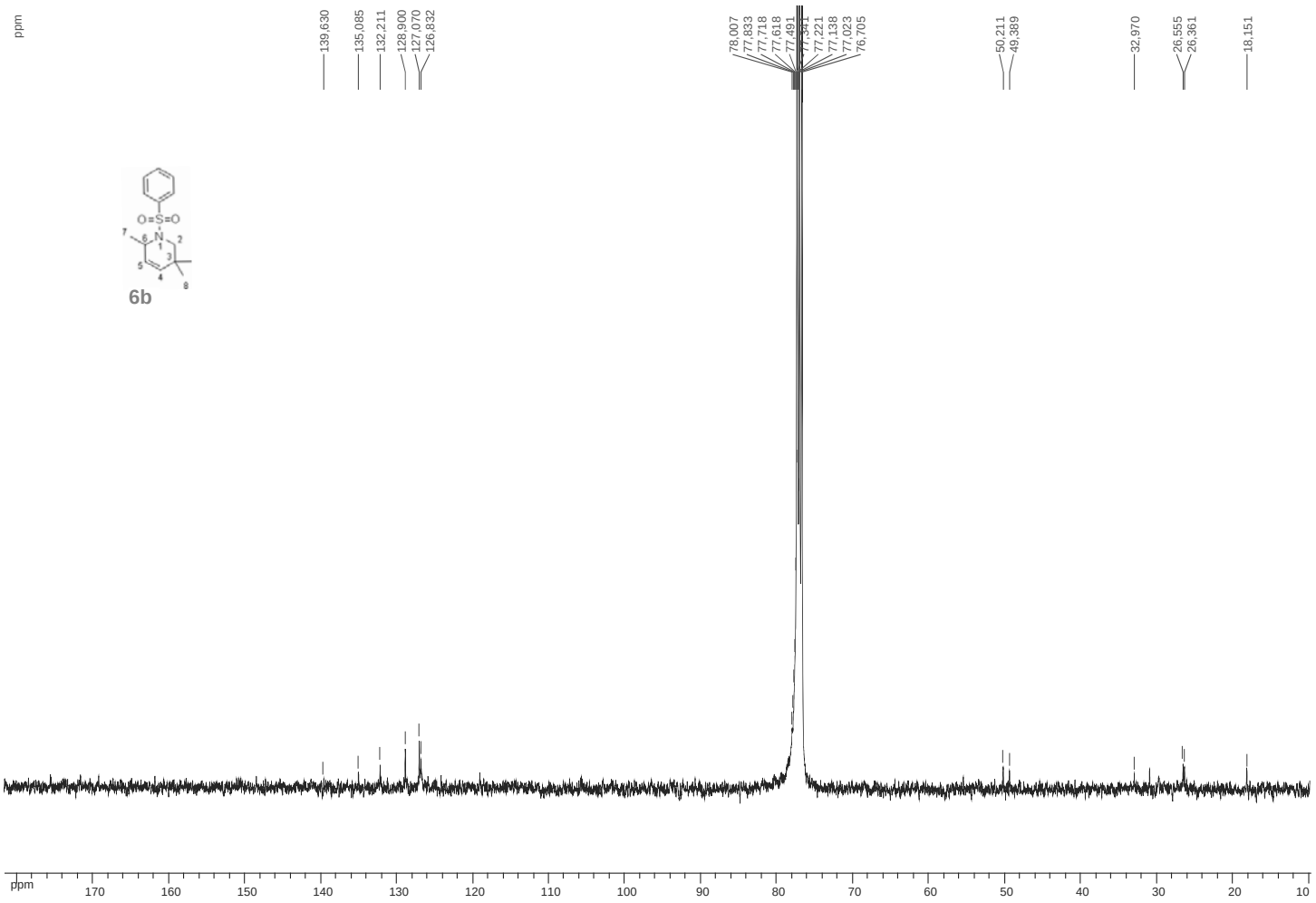
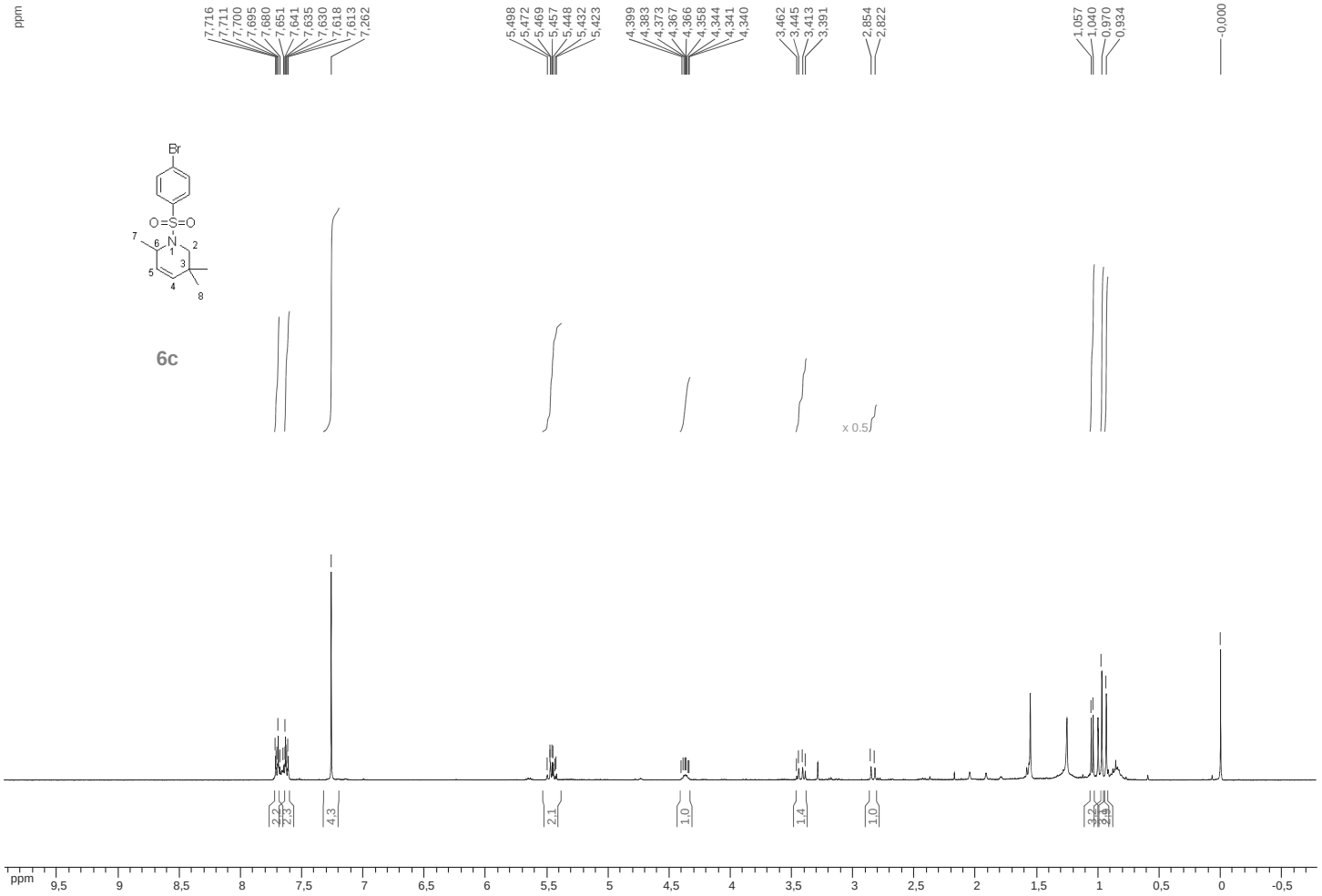
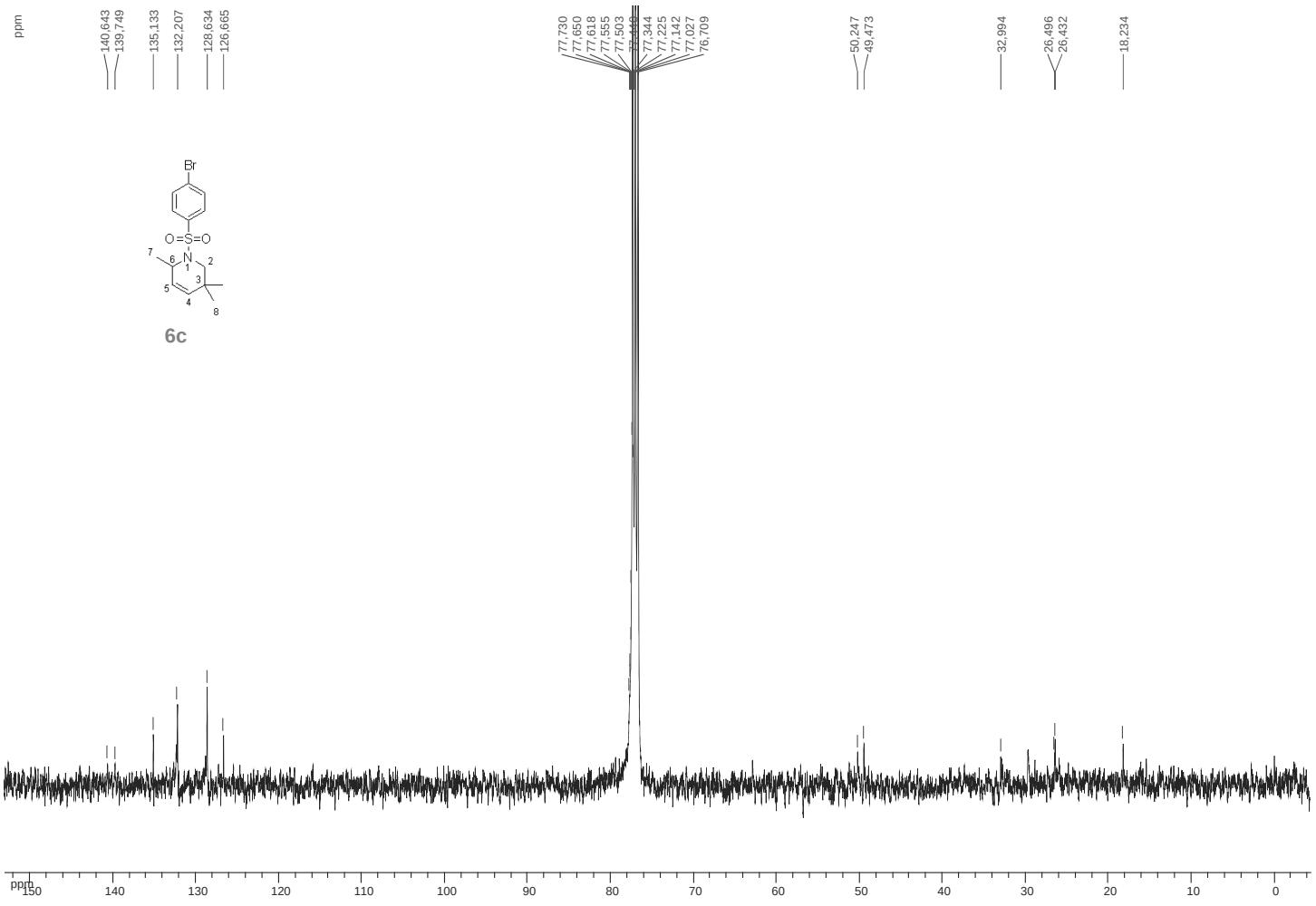
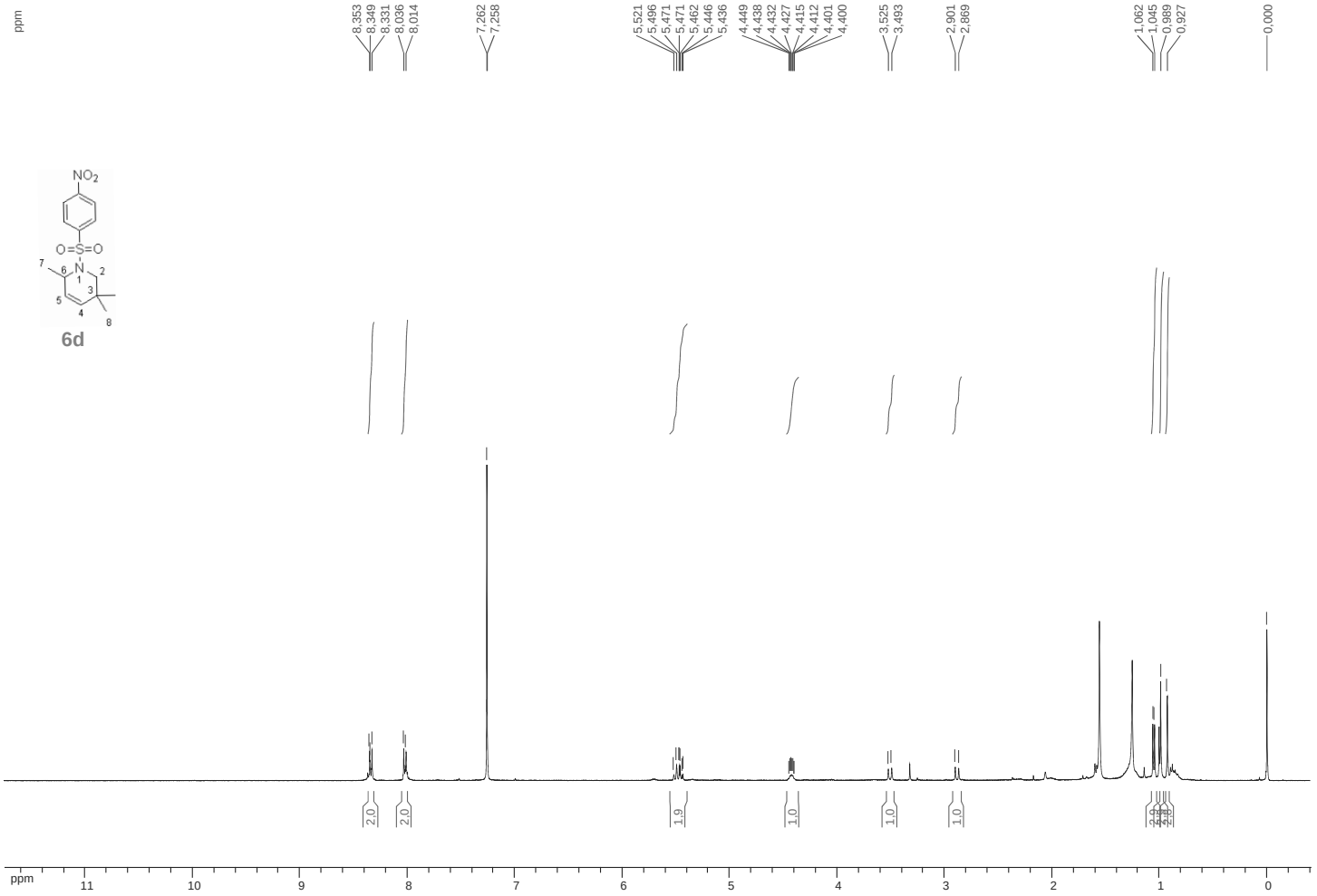
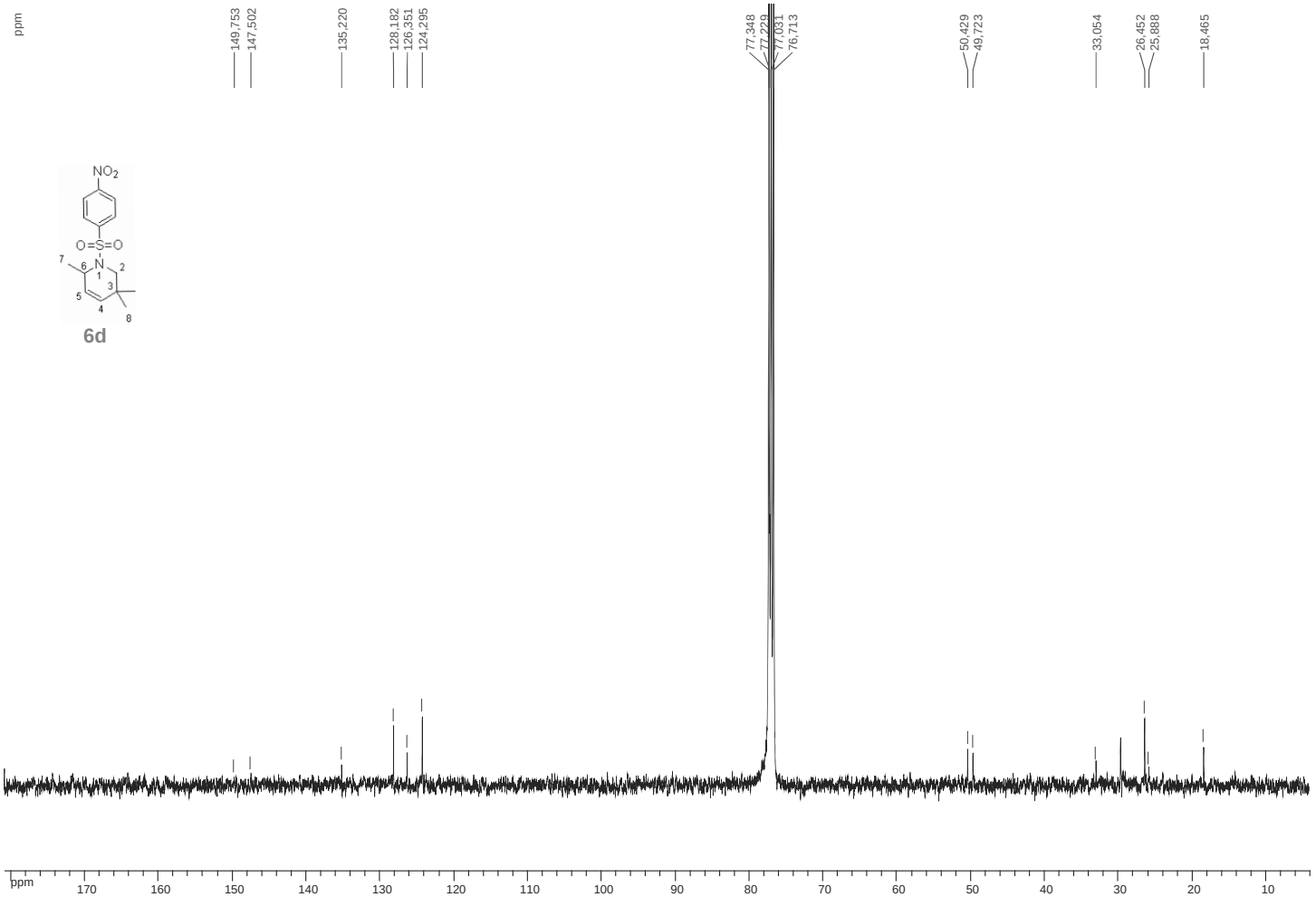
7,858
7,855
7,851
7,843
7,838
7,834
7,824
7,573
7,564
7,561
7,559
7,555
7,551
7,543
7,537
7,533
7,528
7,525
7,521
7,518
7,509
7,504
7,504
7,501
7,489
7,485
7,485
7,472
7,467
7,464
7,262
5,490
5,488
5,463
5,458
5,457
5,450
5,424
4,418
4,410
4,401
4,393
4,384
4,377
4,368
4,361
3,464
3,432
2,863
2,832
1,048
1,032
0,964
0,920
0,000
6b
2,4
3,9
2,0
1,0
1,1
0,9
2,7
6,1
3,9
ppm
8,5
8
7,5
7
6,5
6
5,5
5
4,5
4
3,5
3
2,5
2
1,5
1
0,5
0
-0,5

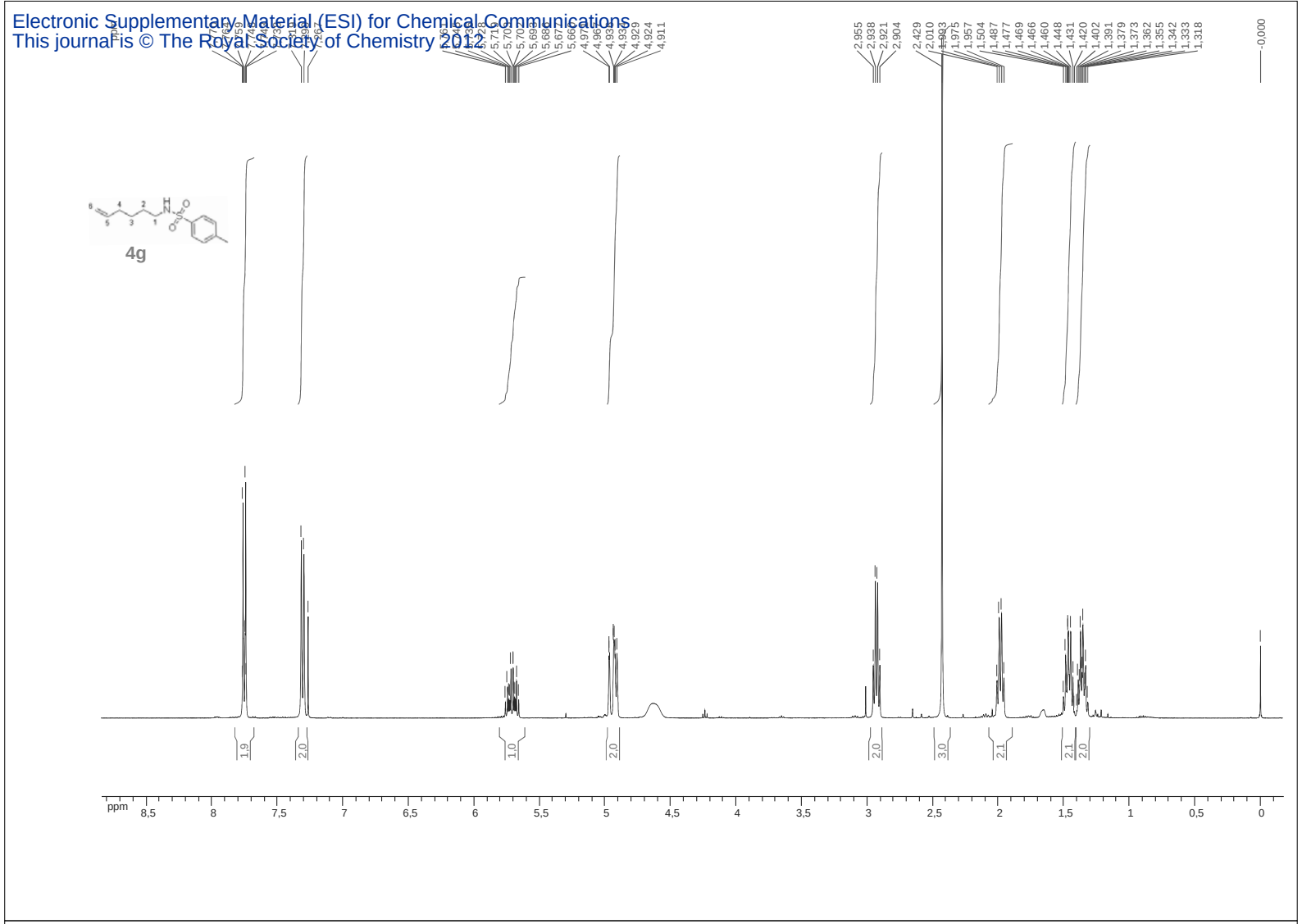

ppm
139,630
135,085
132,211
128,900
127,070
126,832
78,007
77,833
77,718
77,618
77,491
77,341
77,221
77,138
77,023
76,705
50,211
49,389
32,970
26,555
26,361
18,151
6b
ppm
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10

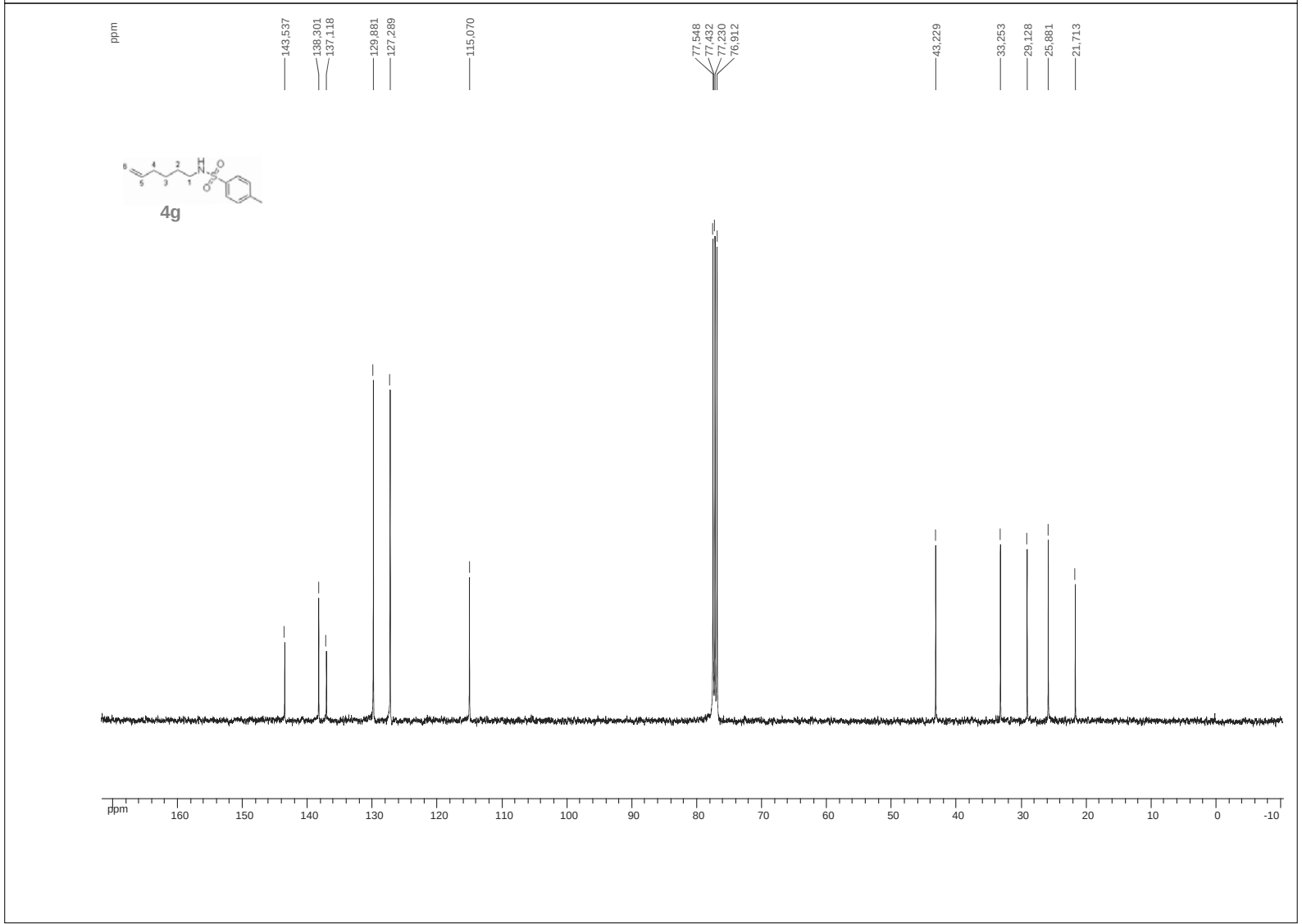

ppm
7,716
7,711
7,700
7,695
7,680
7,651
7,641
7,635
7,630
7,618
7,613
7,262
5,498
5,472
5,469
5,457
5,448
5,432
5,423
4,399
4,383
4,373
4,367
4,366
4,358
4,344
4,341
4,340
3,462
3,445
3,413
3,391
2,854
2,822
1,057
1,040
0,970
0,934
0,000
Br
O=S=O
N
6c
x 0.5
2,2
2,3
4,3
2,1
1,0
1,4
1,0
3,2
2,8
ppm
9,5
9
8,5
8
7,5
7
6,5
6
5,5
5
4,5
4
3,5
3
2,5
2
1,5
1
0,5
0
-0,5

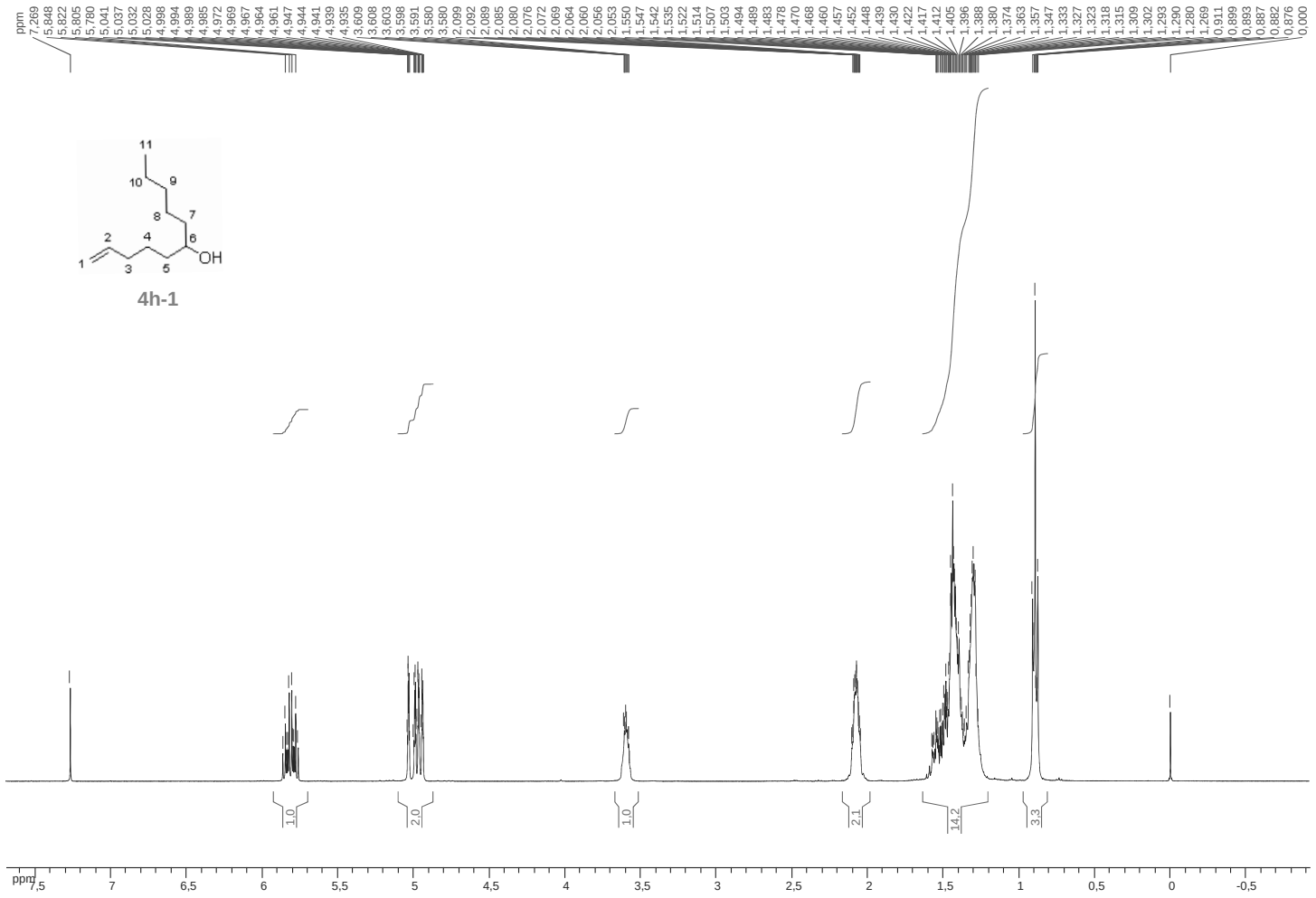

ppm
140,643
139,749
135,133
132,207
128,634
126,665
77,730
77,650
77,618
77,555
77,503
77,344
77,225
77,142
77,027
76,709
50,247
49,473
32,994
26,496
26,432
18,234
Br
O=S=O
N
6c
ppm
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0


ppm
8.353
8.349
8.331
8.036
8.014
7.262
7.258
5.521
5.496
5.471
5.471
5.462
5.446
5.436
4.449
4.438
4.432
4.427
4.415
4.412
4.401
4.400
3.525
3.493
2.901
2.869
1.062
1.045
0.989
0.927
0.000
NO2
O=S=O
N
6d
2.0
2.0
1.9
1.0
1.0
1.0
ppm
11
10
9
8
7
6
5
4
3
2
1
0


ppm
149,753
147,502
135,220
128,182
126,351
124,295
77,348
77,229
77,031
76,713
50,429
49,723
33,054
26,452
25,888
18,465
NO2
O=S=O
N
6d
ppm
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10


4g
ppm
8,5
8
7,5
7
6,5
6
5,5
5
4,5
4
3,5
3
2,5
2
1,5
1
0,5
0


ppm
143,537
138,301
137,118
129,881
127,289
115,070
77,548
77,432
77,230
76,912
43,229
33,253
29,128
25,881
21,713
4g
ppm
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
-10


ppm
7.269
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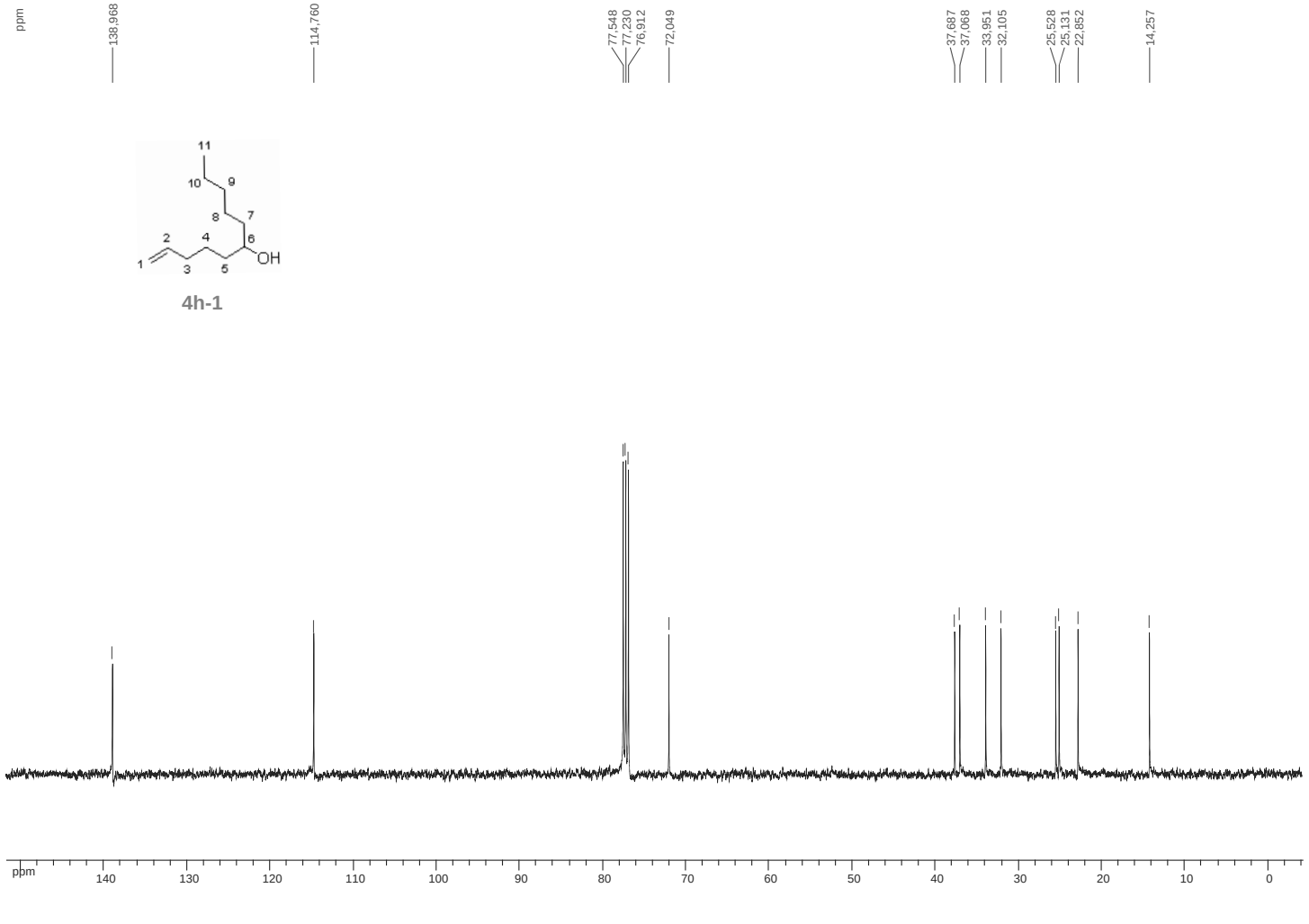
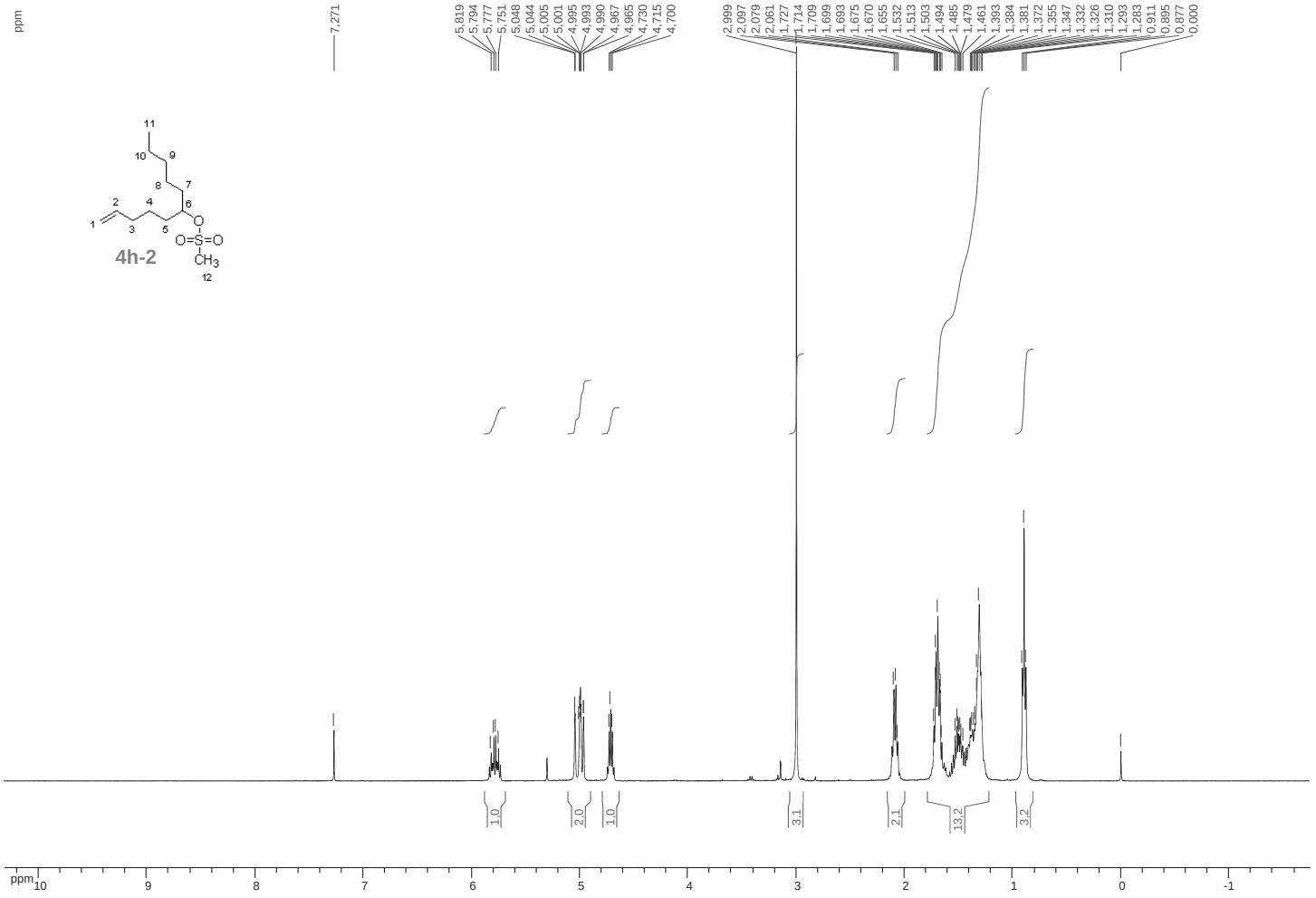
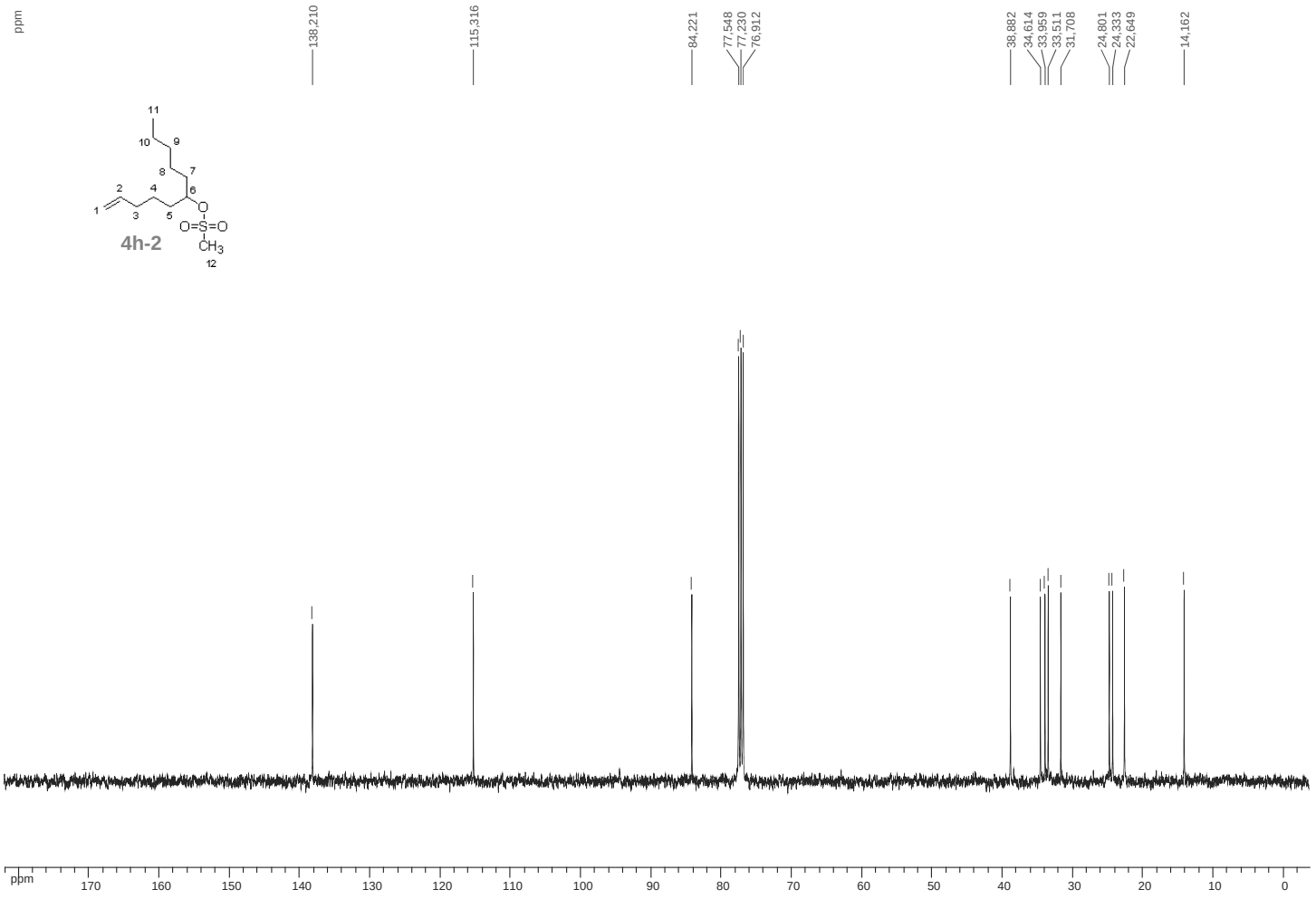
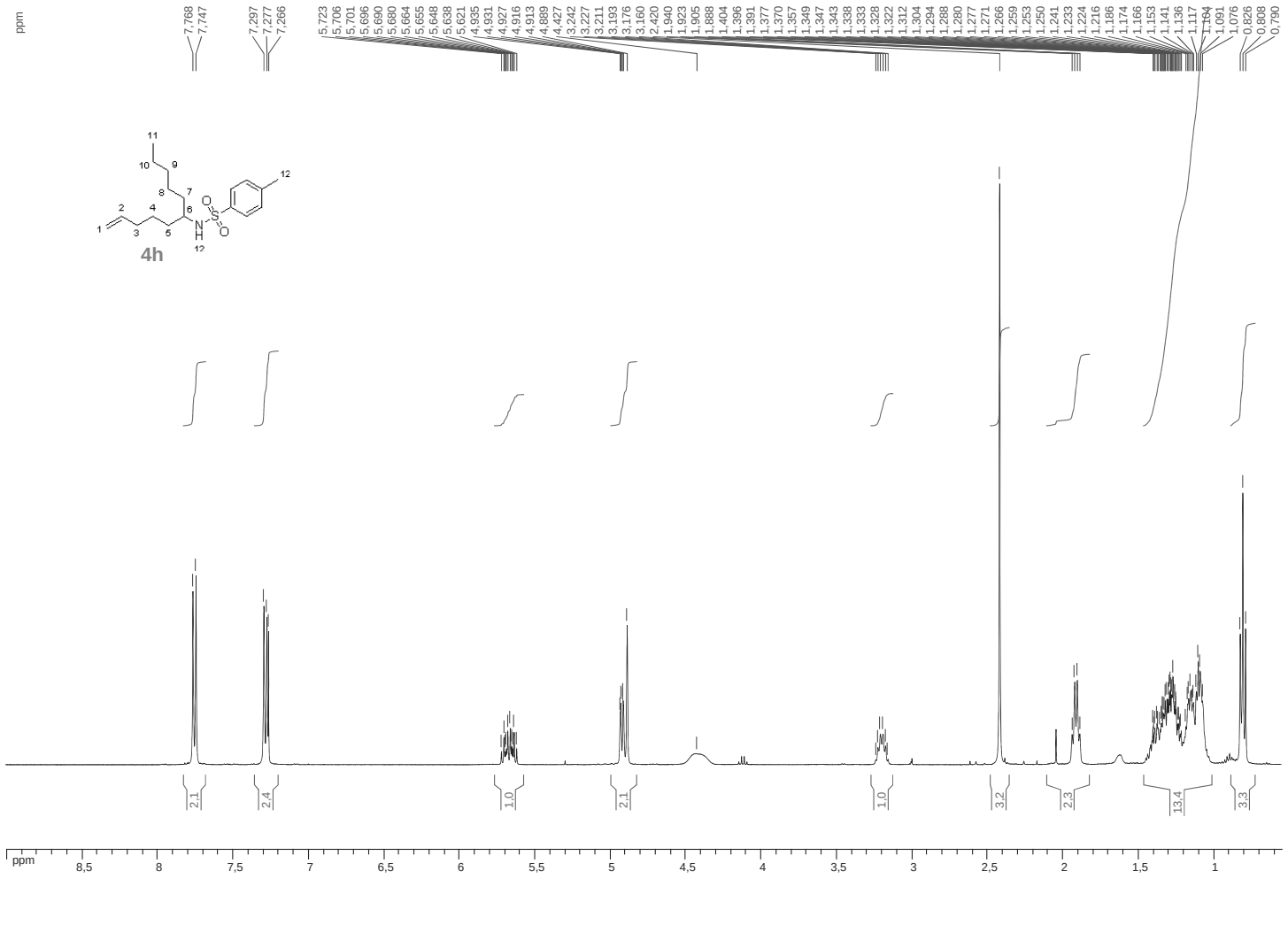
5.822
5.805
5.780
5.041
5.037
5.032
5.028
4.998
4.994
4.989
4.985
4.972
4.969
4.967
4.964
4.961
4.947
4.944
4.941
4.939
4.935
3.609
3.608
3.603
3.598
3.591
3.580
3.580
3.580
2.099
2.092
2.089
2.085
2.080
2.076
2.072
2.069
2.064
2.060
2.056
2.053
1.550
1.547
1.542
1.535
1.522
1.514
1.507
1.503
1.494
1.489
1.483
1.478
1.470
1.468
1.460
1.457
1.452
1.448
1.439
1.430
1.422
1.417
1.412
1.405
1.396
1.388
1.380
1.374
1.363
1.357
1.347
1.333
1.327
1.323
1.318
1.315
1.309
1.302
1.293
1.290
1.280
1.269
0.911
0.899
0.893
0.887
0.882
0.876
0.000
11
10
9
8
7
6
OH
2
4
1
3
5
4h-1
1,0
2,0
1,0
2,1
14,2
3,3
ppm
7,5
7
6,5
6
5,5
5
4,5
4
3,5
3
2,5
2
1,5
1
0,5
0
-0,5


ppm
138,968
114,760
77,548
77,230
76,912
72,049
37,687
37,068
33,951
32,105
25,528
25,131
22,852
14,257
11
10
9
8
7
6
OH
2
4
1
3
5
4h-1
ppm
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0


ppm
7.271
5.819
5.794
5.777
5.751
5.048
5.044
5.005
5.001
4.995
4.993
4.990
4.967
4.965
4.730
4.715
4.700
2.999
2.097
2.079
2.061
1.727
1.714
1.709
1.699
1.693
1.675
1.670
1.655
1.532
1.513
1.503
1.494
1.485
1.479
1.461
1.393
1.384
1.381
1.372
1.355
1.347
1.332
1.326
1.310
1.293
1.283
0.911
0.895
0.877
0.000
4h-2
1.0
2.0
1.0
3.1
2.1
13.2
3.2
ppm


ppm
138.210
115.316
84.221
77.548
77.230
76.912
38.882
34.614
33.959
33.511
31.708
24.801
24.333
22.649
14.162
4h-2
ppm


ppm
7.768
7.747
7.297
7.277
7.266
5.723
5.706
5.701
5.696
5.690
5.680
5.664
5.655
5.648
5.638
5.621
4.935
4.931
4.927
4.916
4.913
4.889
4.427
3.242
3.227
3.211
3.193
3.176
3.160
2.420
1.940
1.923
1.905
1.888
1.404
1.396
1.391
1.377
1.370
1.357
1.349
1.347
1.343
1.338
1.333
1.328
1.322
1.312
1.304
1.294
1.288
1.280
1.277
1.271
1.266
1.259
1.253
1.250
1.241
1.233
1.224
1.216
1.186
1.174
1.166
1.153
1.141
1.136
1.117
1.104
1.091
1.076
0.826
0.808
0.790
4h
2.1
2.4
1.0
2.1
1.0
3.2
2.3
13.4
3.3
ppm
8,5
8
7,5
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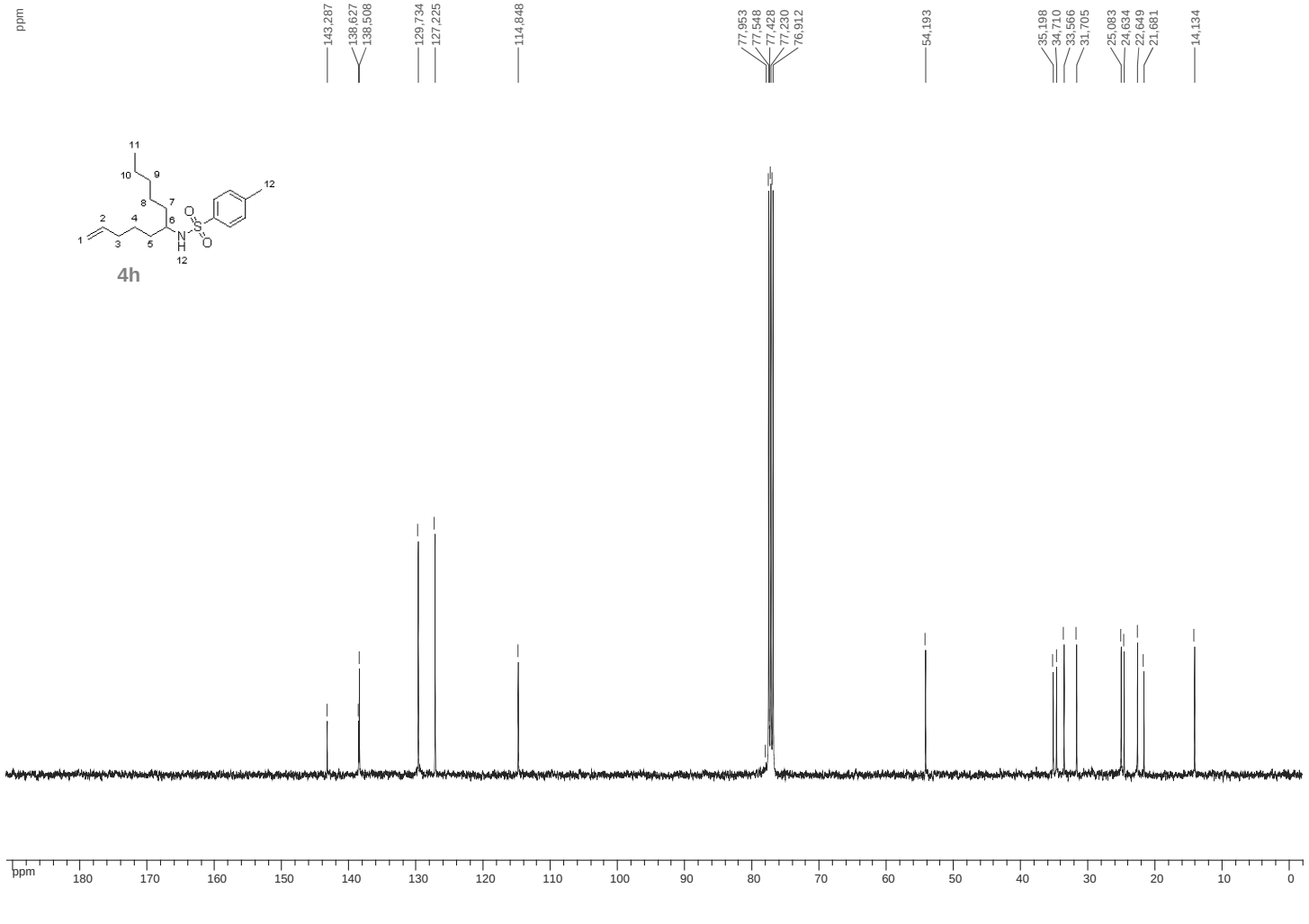
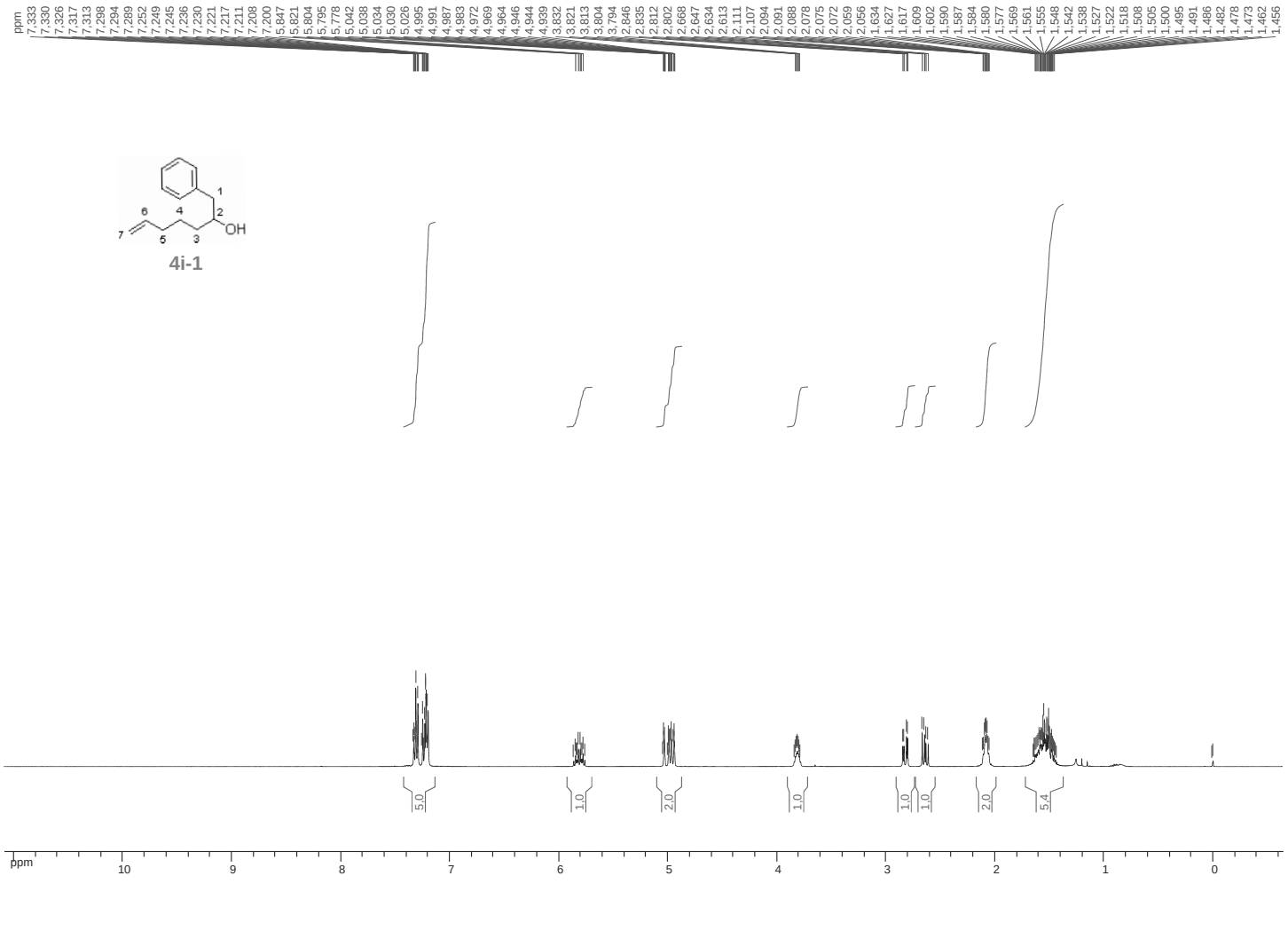
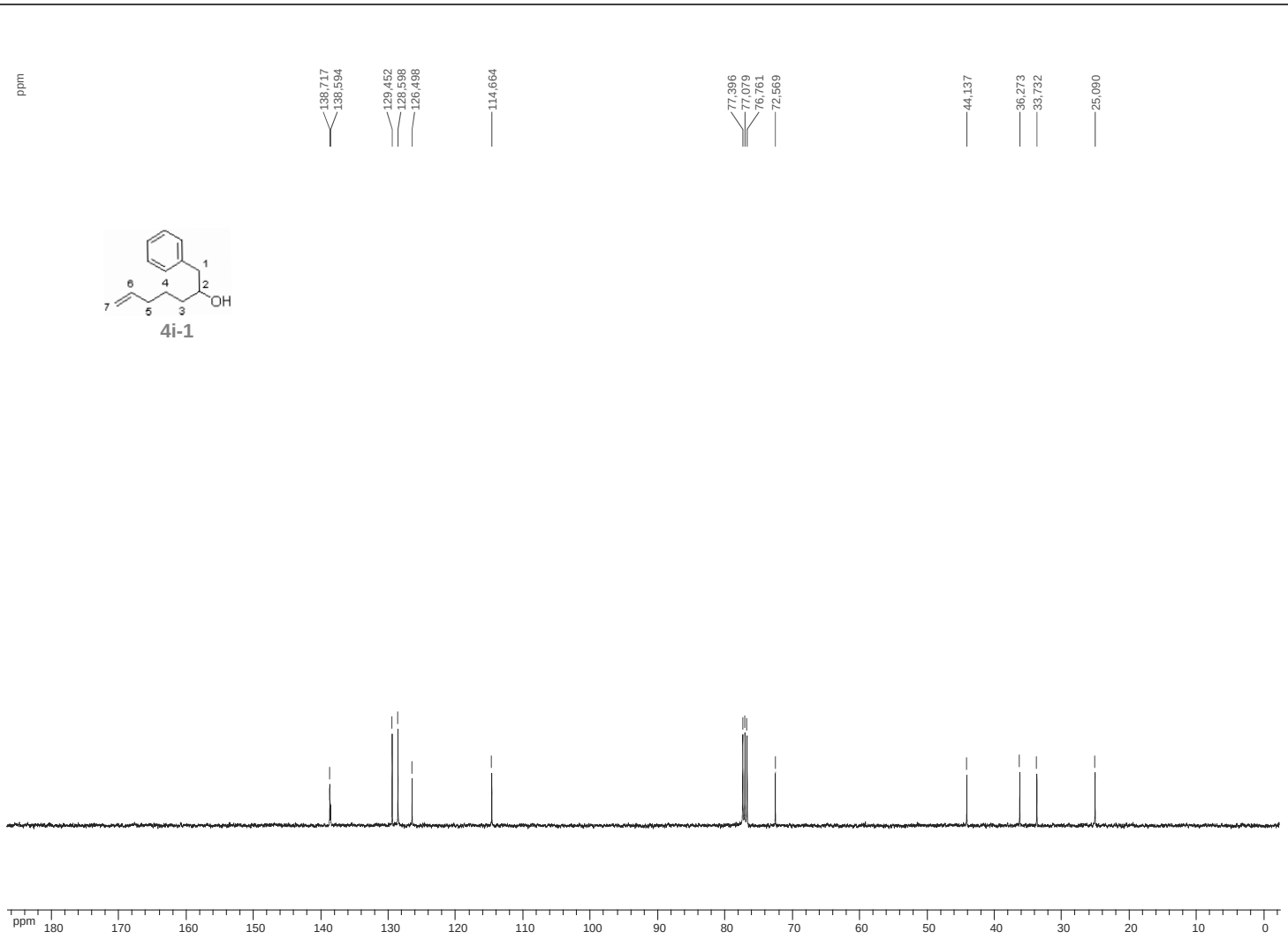
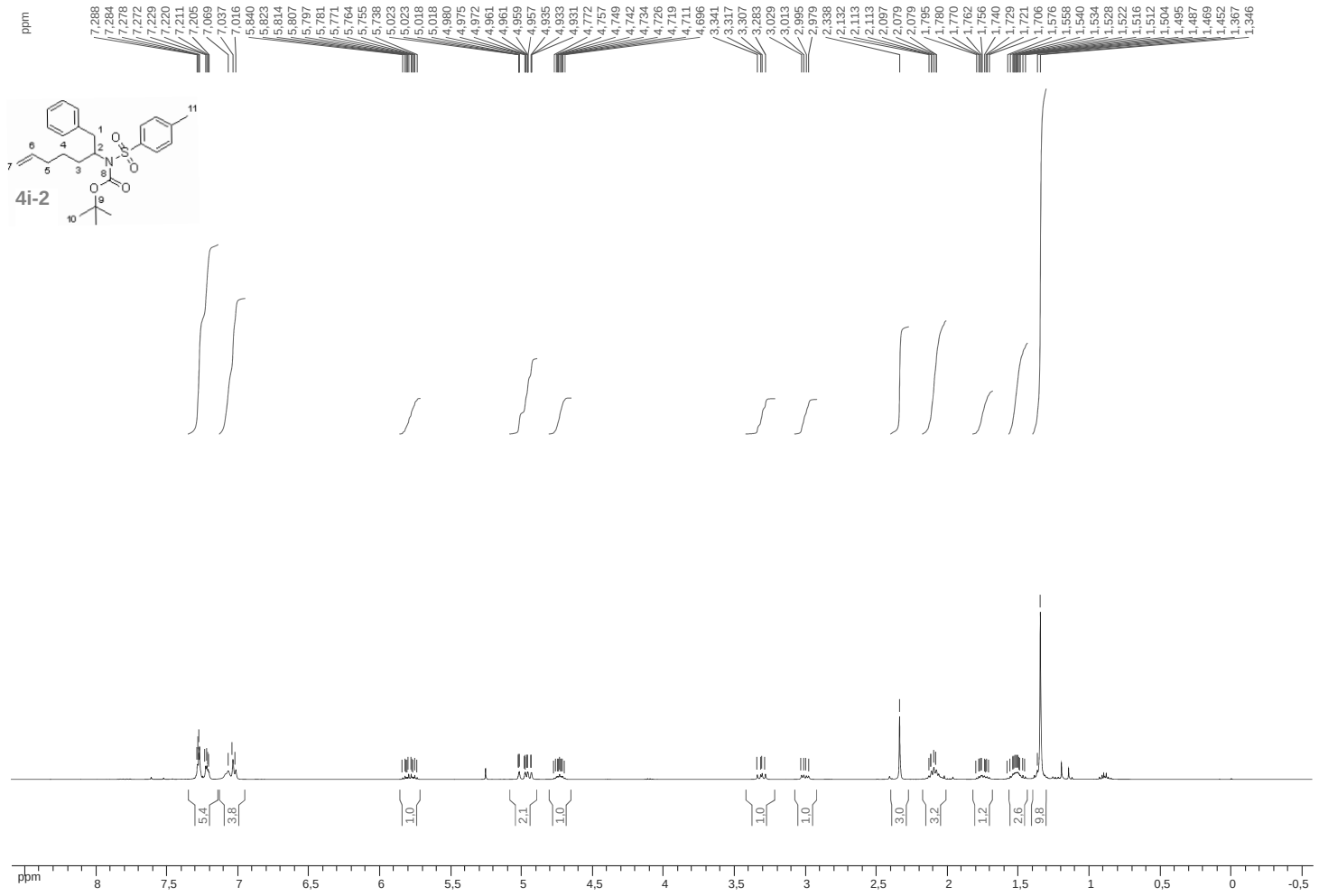
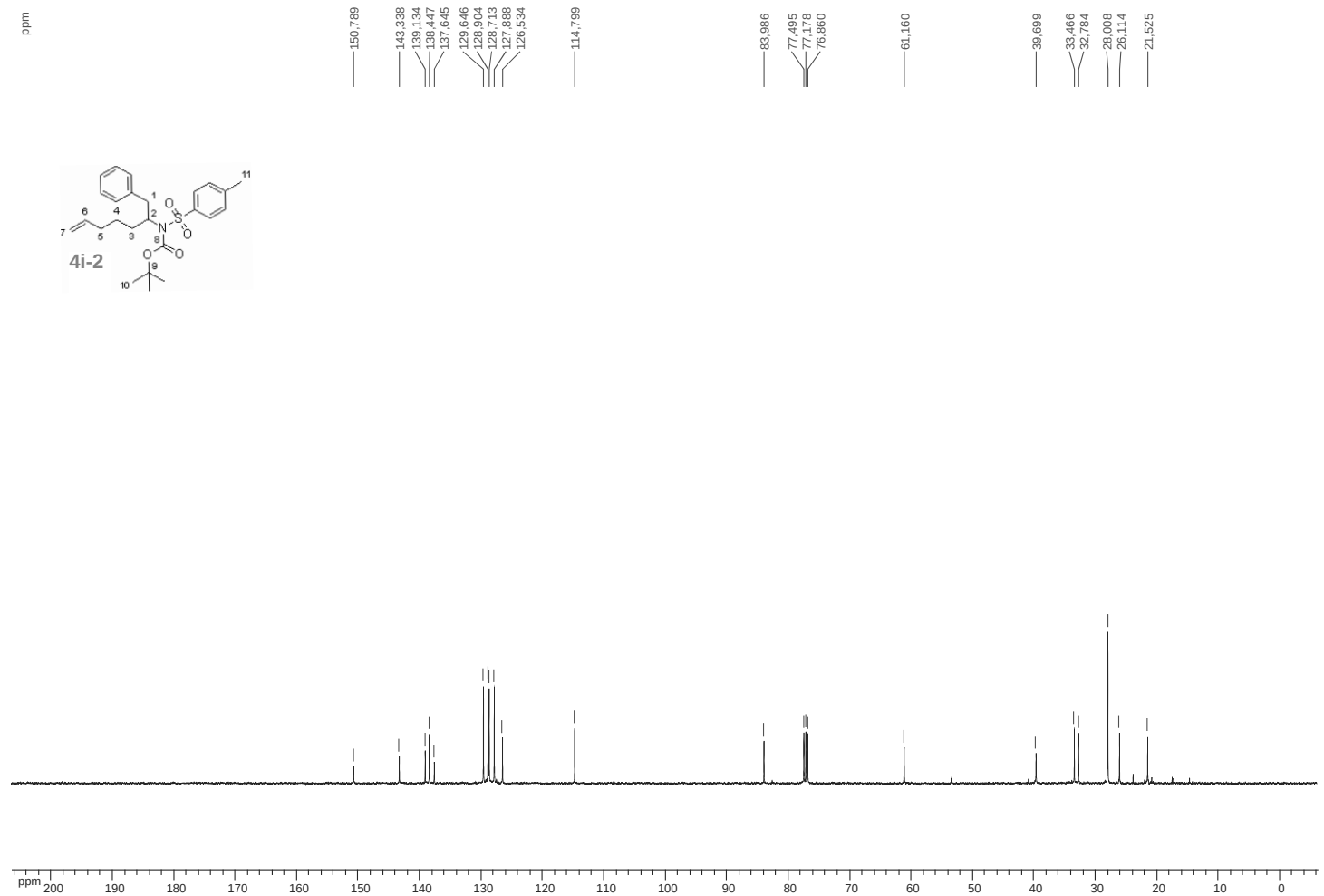
6,5
6
5,5
5
4,5
4
3,5
3
2,5
2
1,5
1

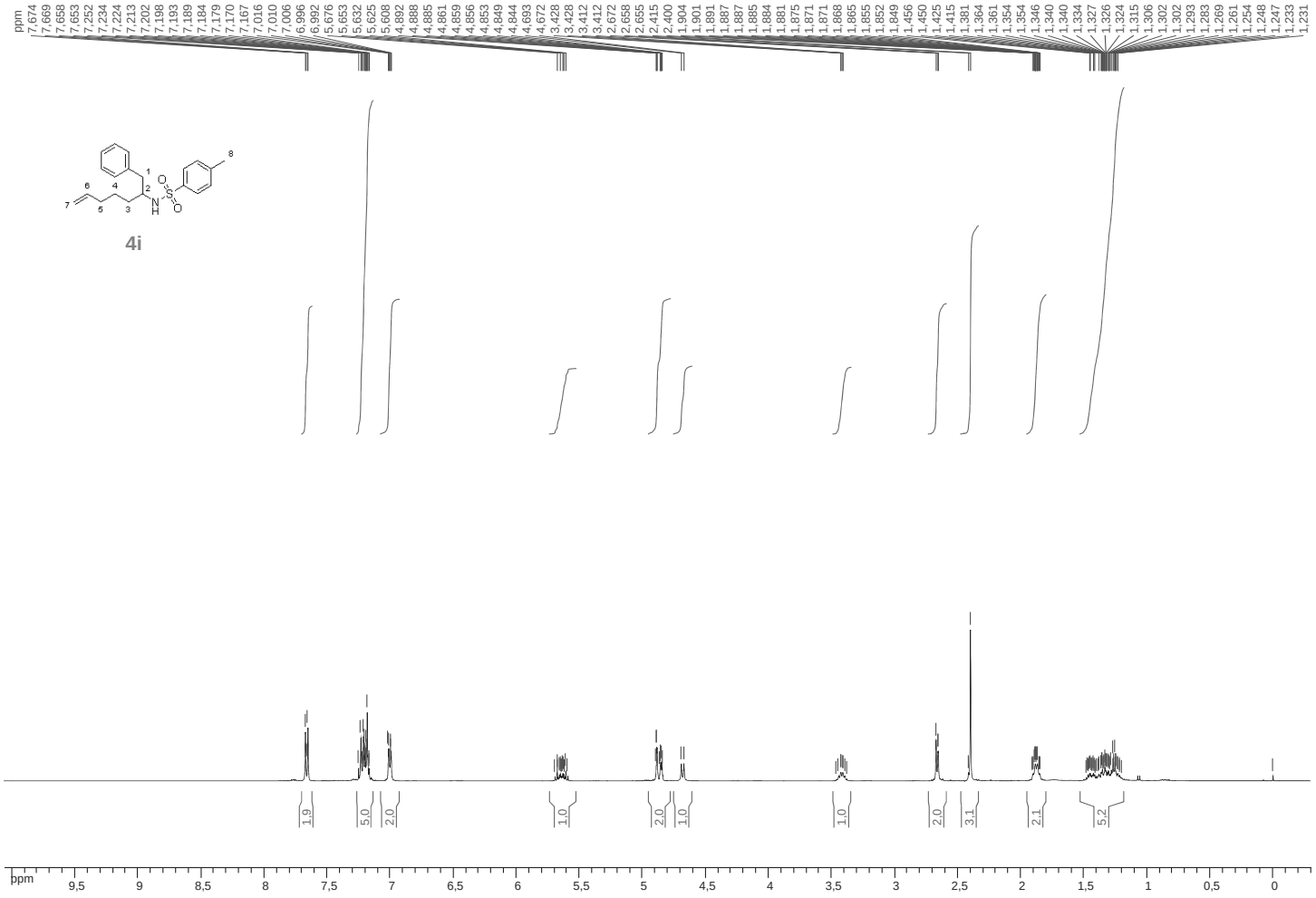

ppm
143,287
138,627
138,508
129,734
127,225
114,848
77,953
77,548
77,428
77,230
76,912
54,193
35,198
34,710
33,566
31,705
25,083
24,634
22,649
21,681
14,134
4h
ppm
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0


ppm
7.333 7.330 7.326 7.317 7.313 7.298 7.294 7.289 7.252 7.249 7.245 7.236 7.230 7.221 7.217 7.211 7.208 7.200 5.847 5.821 5.804 5.795 5.778 5.042 5.038 5.034 5.030 5.026 4.995 4.991 4.987 4.983 4.972 4.969 4.964 4.946 4.944 4.939 3.832 3.821 3.813 3.804 3.794 2.846 2.835 2.812 2.802 2.668 2.647 2.634 2.613 2.111 2.107 2.094 2.091 2.088 2.078 2.075 2.072 2.059 2.056 1.634 1.627 1.617 1.609 1.602 1.590 1.587 1.584 1.580 1.577 1.569 1.561 1.555 1.548 1.542 1.538 1.527 1.522 1.518 1.508 1.505 1.500 1.495 1.491 1.486 1.482 1.478 1.473 1.462 1.456
1
2
3
4
5
6
7
OH
4i-1
5.0
1.0
2.0
1.0
1.0
1.0
2.0
5.4
ppm
10
9
8
7
6
5
4
3
2
1
0


ppm
138.717
138.594
129.452
128.598
126.498
114.664
77.396
77.079
76.761
72.569
44.137
36.273
33.732
25.090
1
2
3
4
5
6
7
OH
4i-1
ppm
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0


ppm
7.288 7.284 7.278 7.272 7.229 7.220 7.211 7.205 7.069 7.037 7.016 5.840 5.823 5.814 5.807 5.797 5.781 5.771 5.764 5.755 5.738 5.023 5.023 5.018 5.018 4.980 4.975 4.972 4.961 4.961 4.959 4.957 4.935 4.933 4.931 4.772 4.757 4.749 4.742 4.734 4.726 4.719 4.711 4.696 3.341 3.317 3.307 3.283 3.029 3.013 2.995 2.979 2.338 2.132 2.113 2.097 2.079 2.079 1.795 1.780 1.770 1.762 1.756 1.740 1.729 1.721 1.706 1.576 1.558 1.540 1.534 1.528 1.522 1.516 1.512 1.504 1.495 1.487 1.469 1.452 1.367 1.346
4i-2
5.4 3.8 1.0 2.1 1.0 1.0 1.0 3.0 3.2 1.2 2.6 9.8
ppm
8 7,5 7 6,5 6 5,5 5 4,5 4 3,5 3 2,5 2 1,5 1 0,5 0 -0,5


ppm
150,789 143,338 139,134 138,447 137,645 129,646 128,904 128,713 127,888 126,534 114,799 83,986 77,495 77,178 76,860 61,160 39,699 33,466 32,784 28,008 26,114 21,525
4i-2
ppm
200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0


ppm
7.674
7.669
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7.653
7.252
7.234
7.224
7.213
7.202
7.198
7.193
7.189
7.184
7.179
7.170
7.167
7.016
7.010
7.006
6.996
6.992
5.676
5.653
5.632
5.625
5.608
4.892
4.888
4.885
4.861
4.859
4.856
4.853
4.849
4.844
4.693
4.672
3.428
3.428
3.412
3.412
2.672
2.658
2.655
2.415
2.400
1.904
1.901
1.891
1.887
1.887
1.885
1.884
1.881
1.875
1.871
1.871
1.868
1.865
1.855
1.852
1.849
1.456
1.450
1.425
1.415
1.381
1.364
1.361
1.354
1.354
1.346
1.340
1.340
1.334
1.327
1.326
1.324
1.315
1.306
1.302
1.302
1.293
1.283
1.269
1.261
1.254
1.248
1.247
1.233
1.231
4i
1.9
5.0
2.0
1.0
2.0
1.0
1.0
2.0
3.1
2.1
5.2
ppm
9,5
9
8,5
8
7,5
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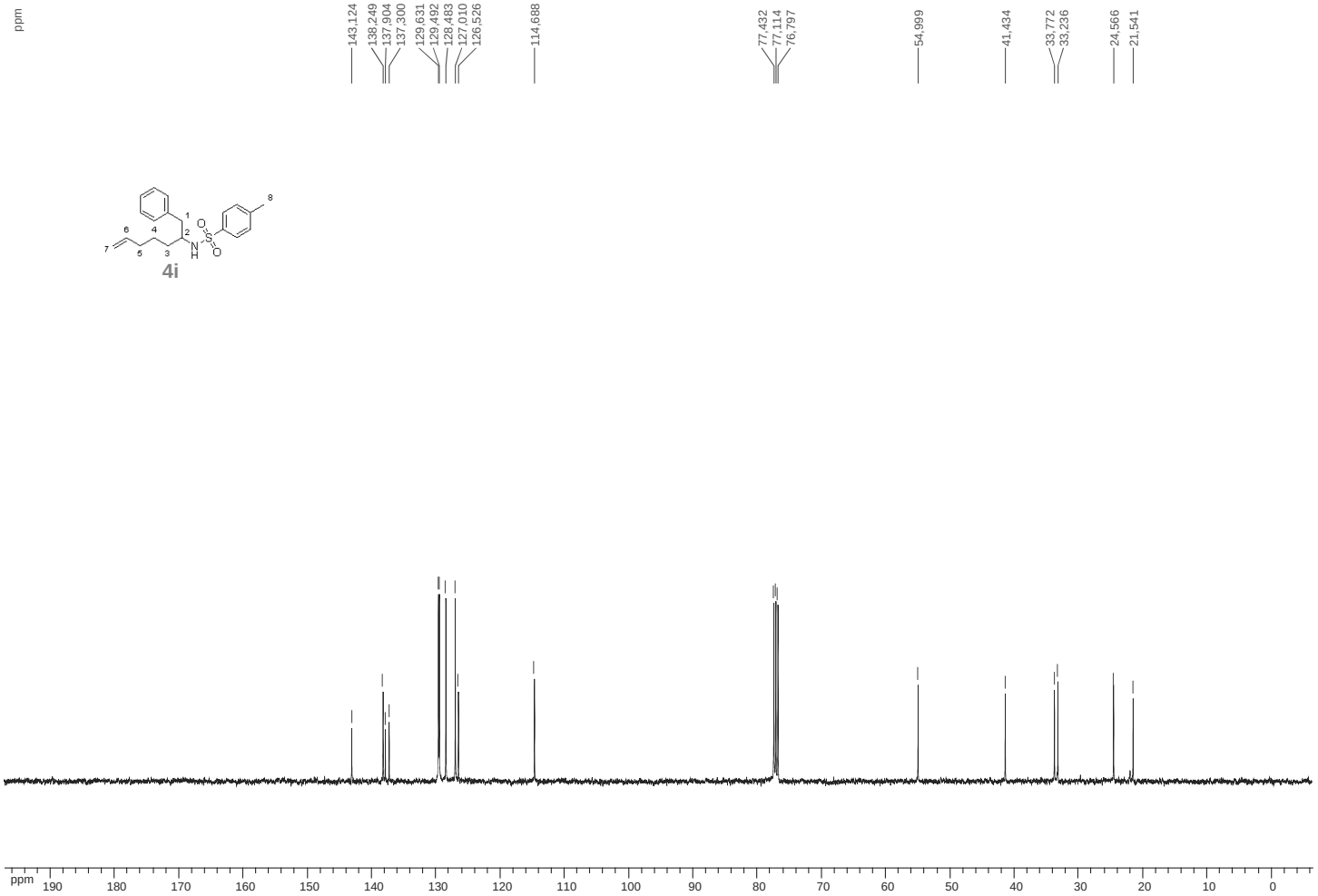
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137.300
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129.492
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127.010
126.526
114.688
77.432
77.114
76.797
54.999
41.434
33.772
33.236
24.566
21.541
4i
ppm
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150
140
130
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110
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70
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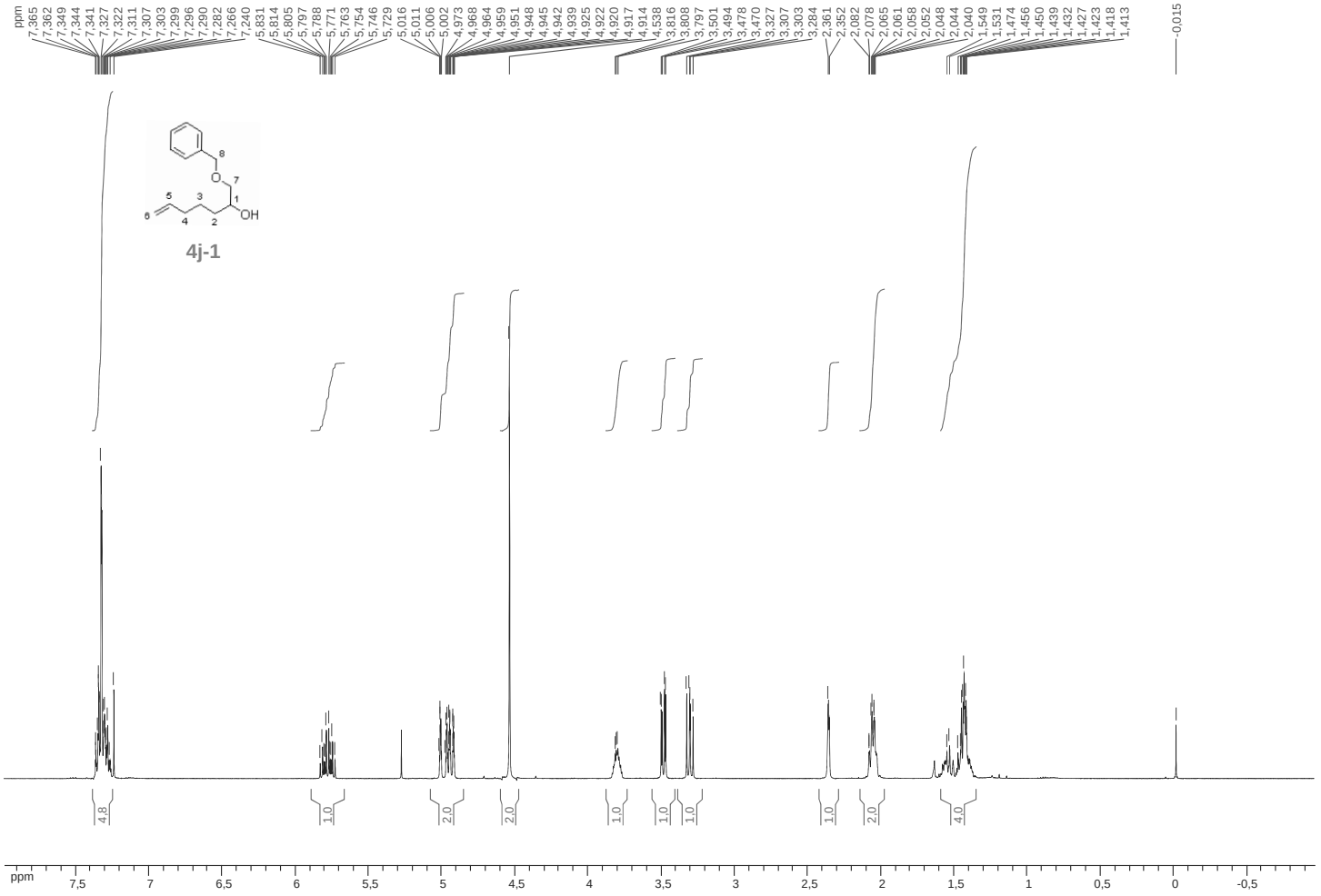
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7,322
7,311
7,307
7,303
7,299
7,296
7,290
7,282
7,266
7,240
5,831
5,814
5,805
5,797
5,788
5,771
5,763
5,754
5,746
5,729
5,016
5,011
5,006
5,002
4,973
4,968
4,964
4,959
4,951
4,948
4,945
4,942
4,939
4,925
4,922
4,920
4,917
4,914
4,538
3,816
3,808
3,797
3,501
3,494
3,478
3,470
3,327
3,307
3,303
3,284
2,361
2,352
2,082
2,078
2,065
2,061
2,058
2,052
2,048
2,044
2,040
1,549
1,531
1,474
1,456
1,450
1,439
1,432
1,427
1,423
1,418
1,413
-0,015
4j-1
4,8
1,0
2,0
2,0
1,0
1,0
1,0
1,0
2,0
4,0
ppm
7,5
7
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6
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5
4,5
4
3,5
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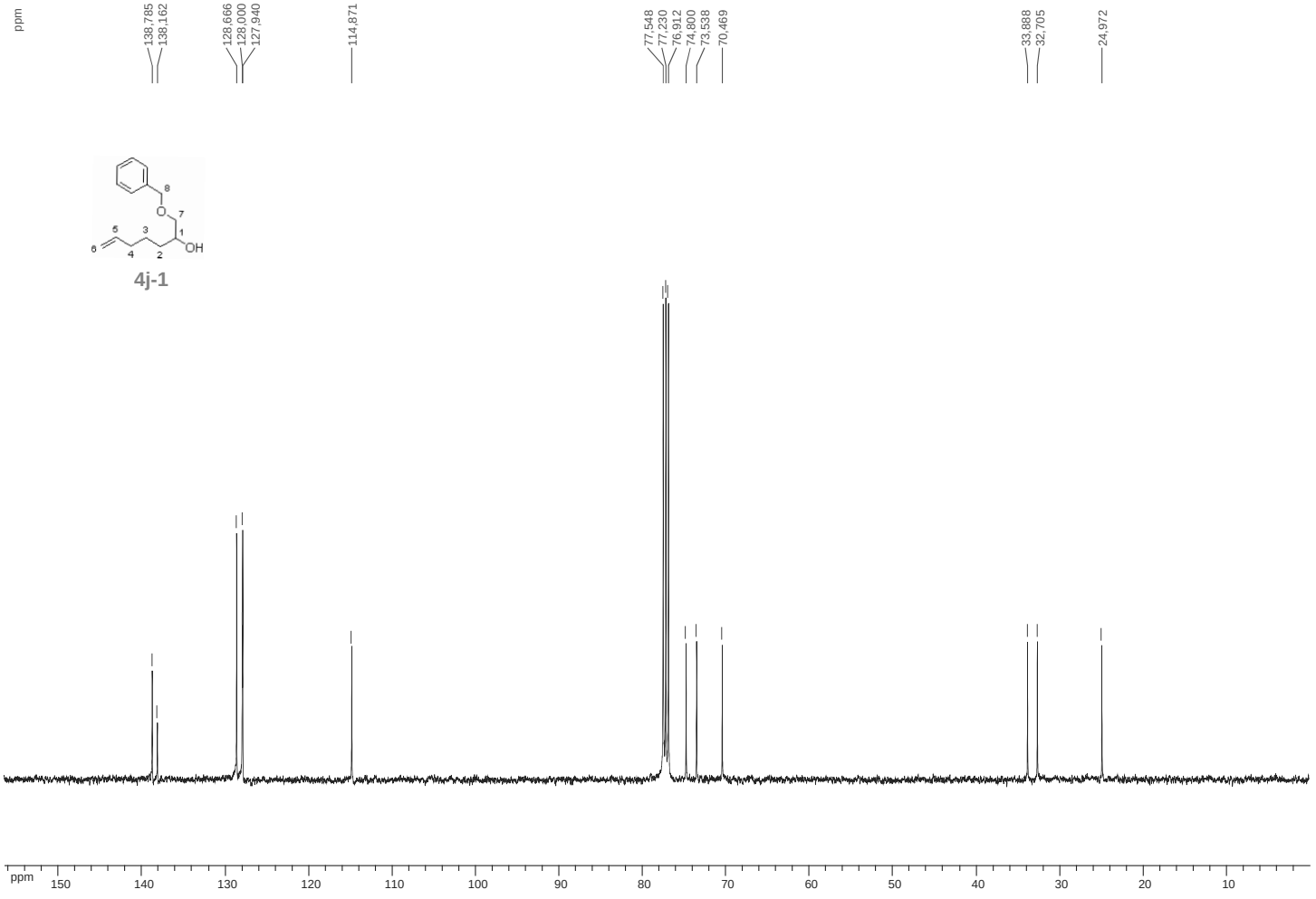
2,5
2
1,5
1
0,5
0
-0,5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128,000
127,940
114,871
77,548
77,230
76,912
74,800
73,538
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32,705
24,972
4j-1
ppm
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140
130
120
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90
80
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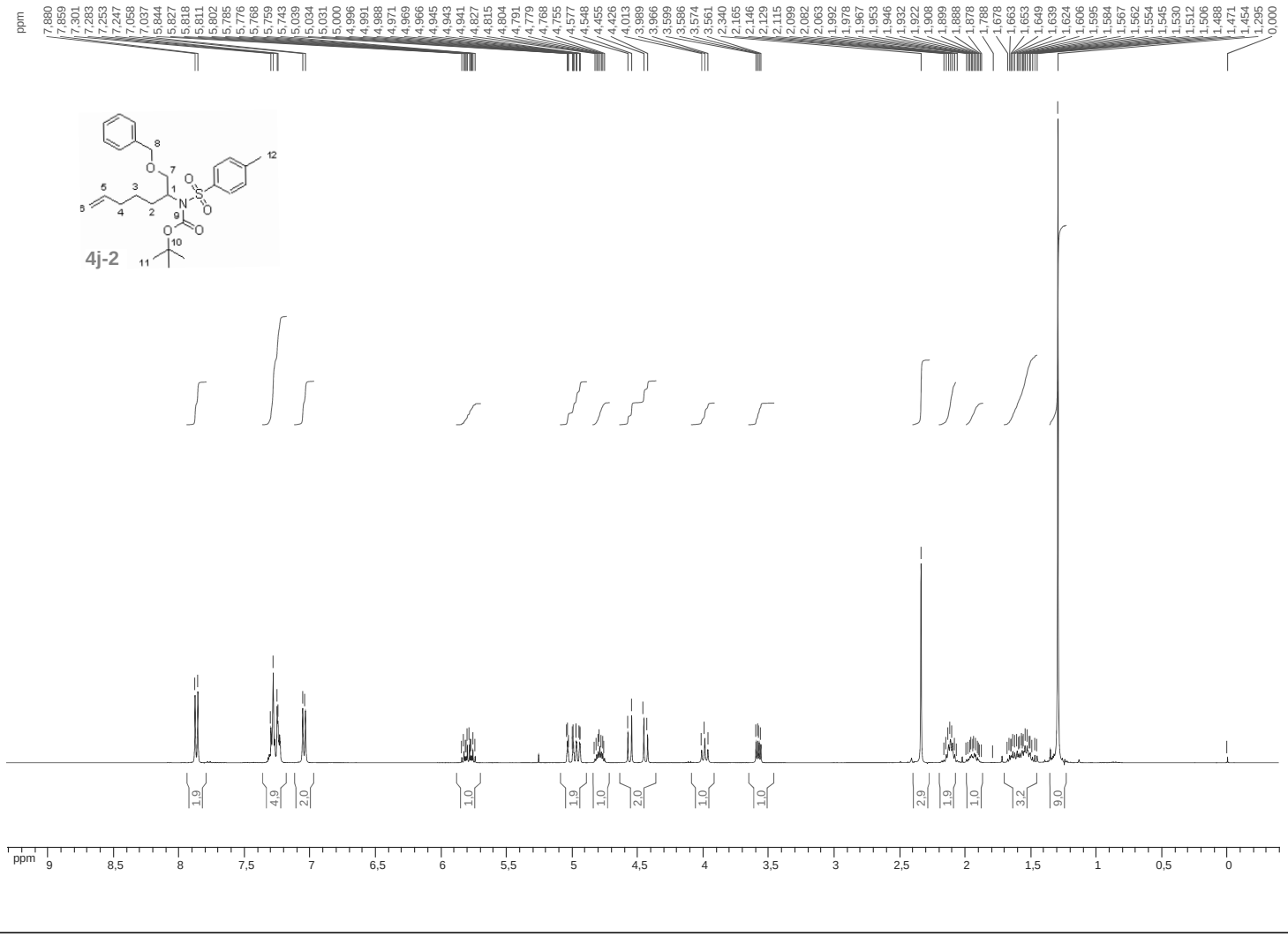
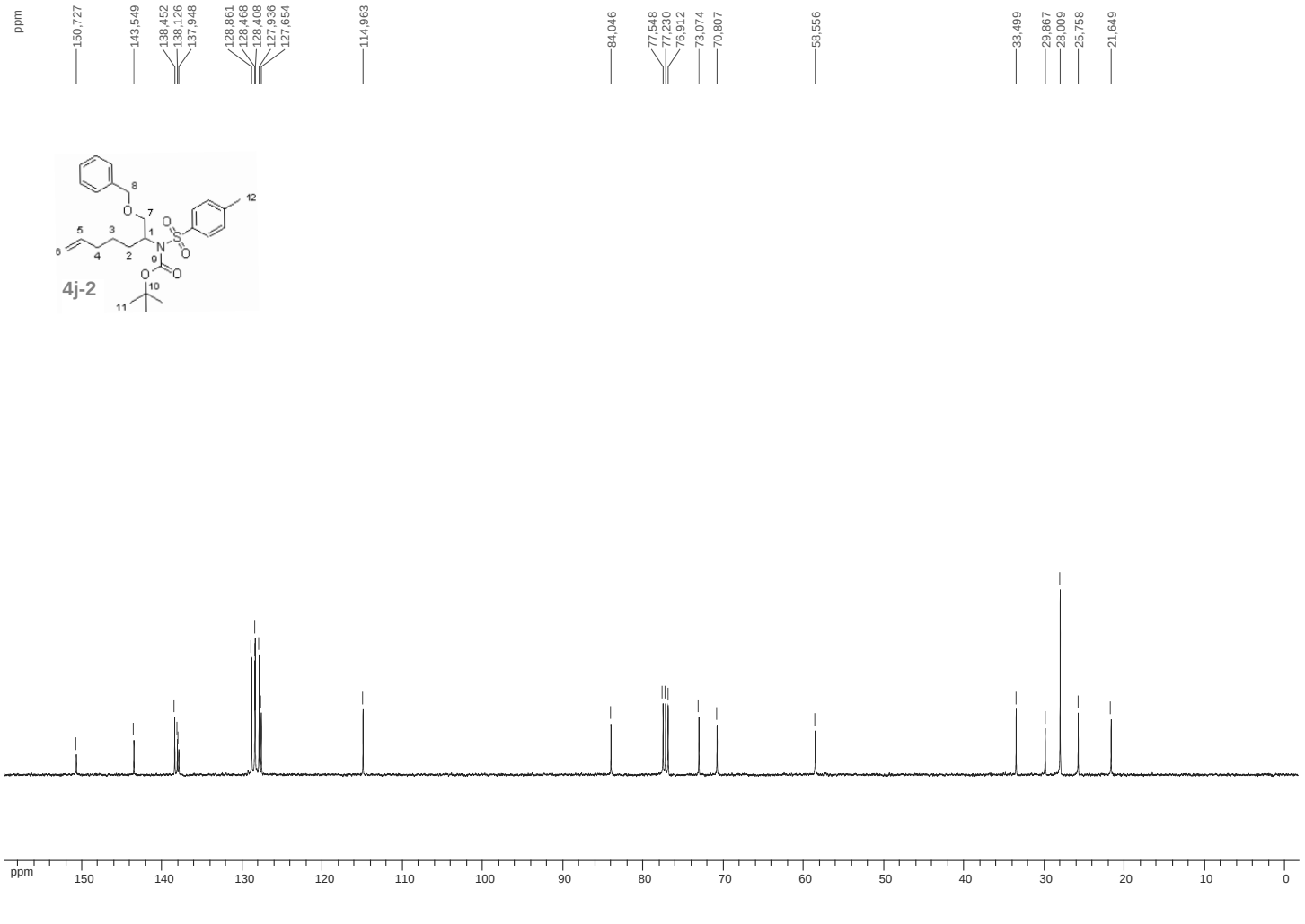
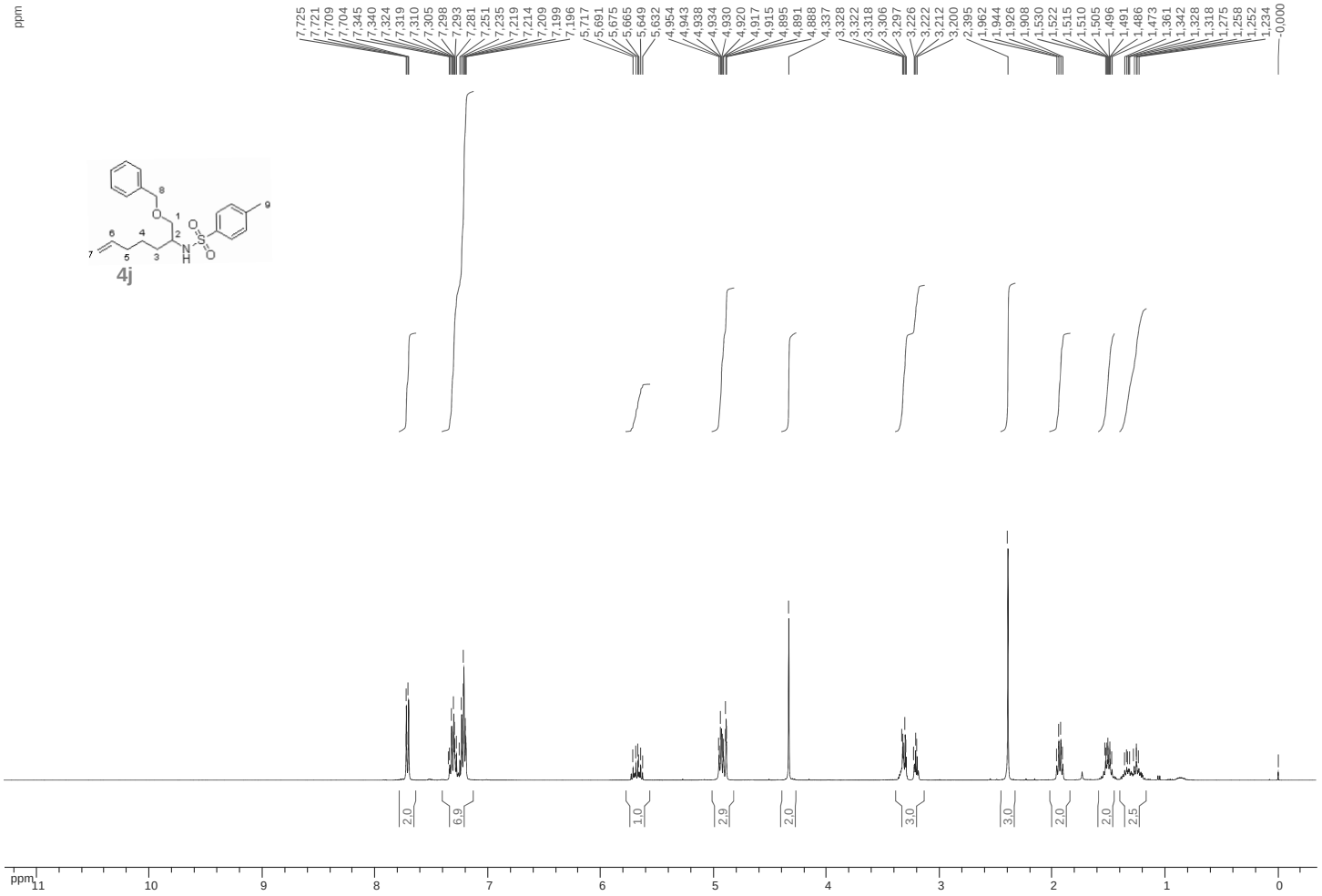
50
40
30
20
10


4j-2


4j-2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7,345
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7,324
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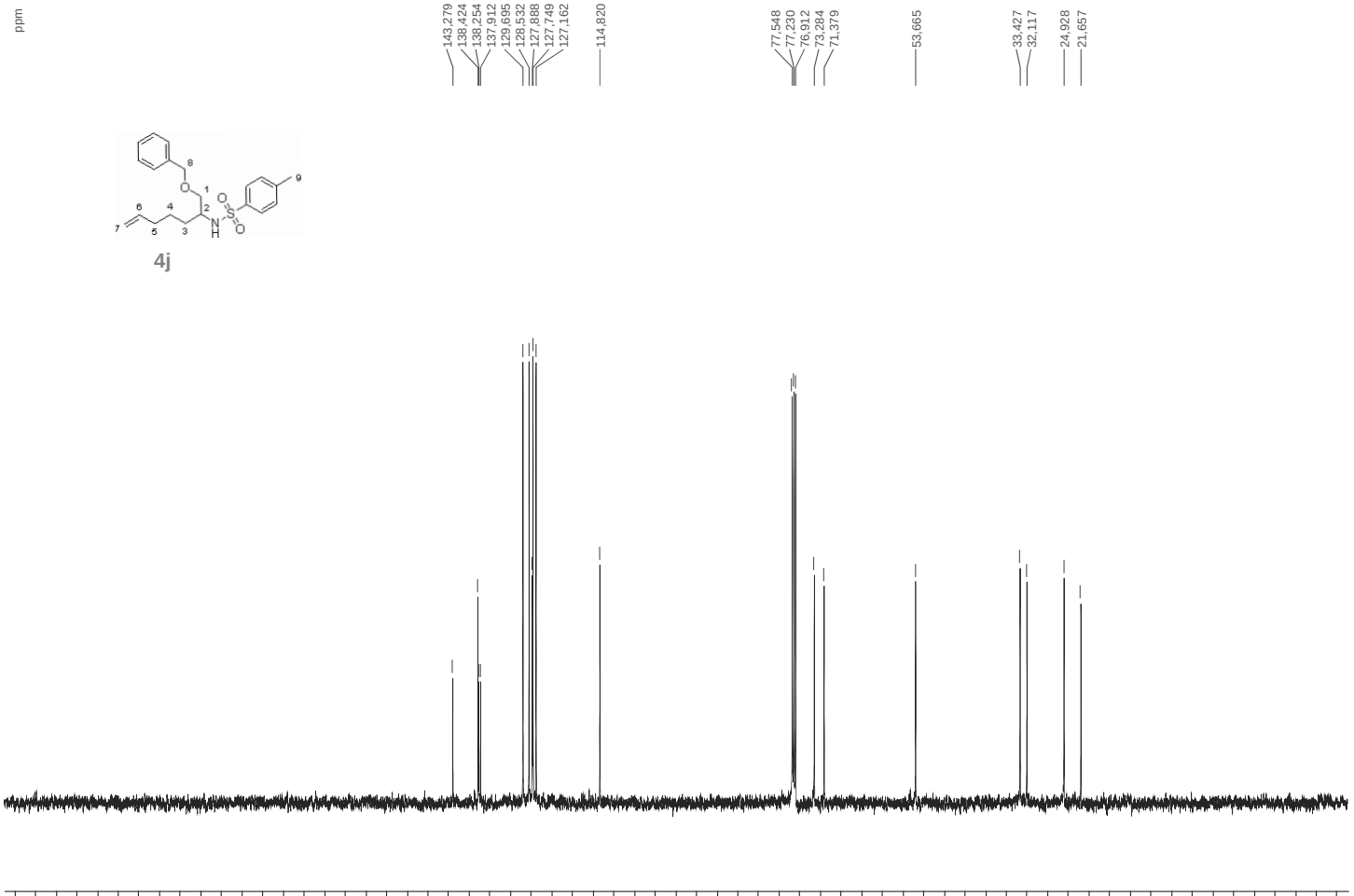
7,310
7,305
7,298
7,293
7,281
7,251
7,235
7,219
7,214
7,209
7,199
7,196
5,717
5,691
5,675
5,665
5,649
5,632
4,954
4,943
4,938
4,934
4,930
4,920
4,917
4,915
4,895
4,891
4,888
4,337
3,328
3,322
3,318
3,306
3,297
3,226
3,222
3,212
3,200
2,395
1,962
1,944
1,926
1,908
1,530
1,522
1,515
1,510
1,505
1,496
1,491
1,486
1,473
1,361
1,342
1,328
1,318
1,275
1,258
1,252
1,234
-0,000
2,0
6,9
1,0
2,9
2,0
3,0
3,0
2,0
2,0
2,5
ppm
11
10
9
8
7
6
5
4
3
2
1
0

4j


ppm
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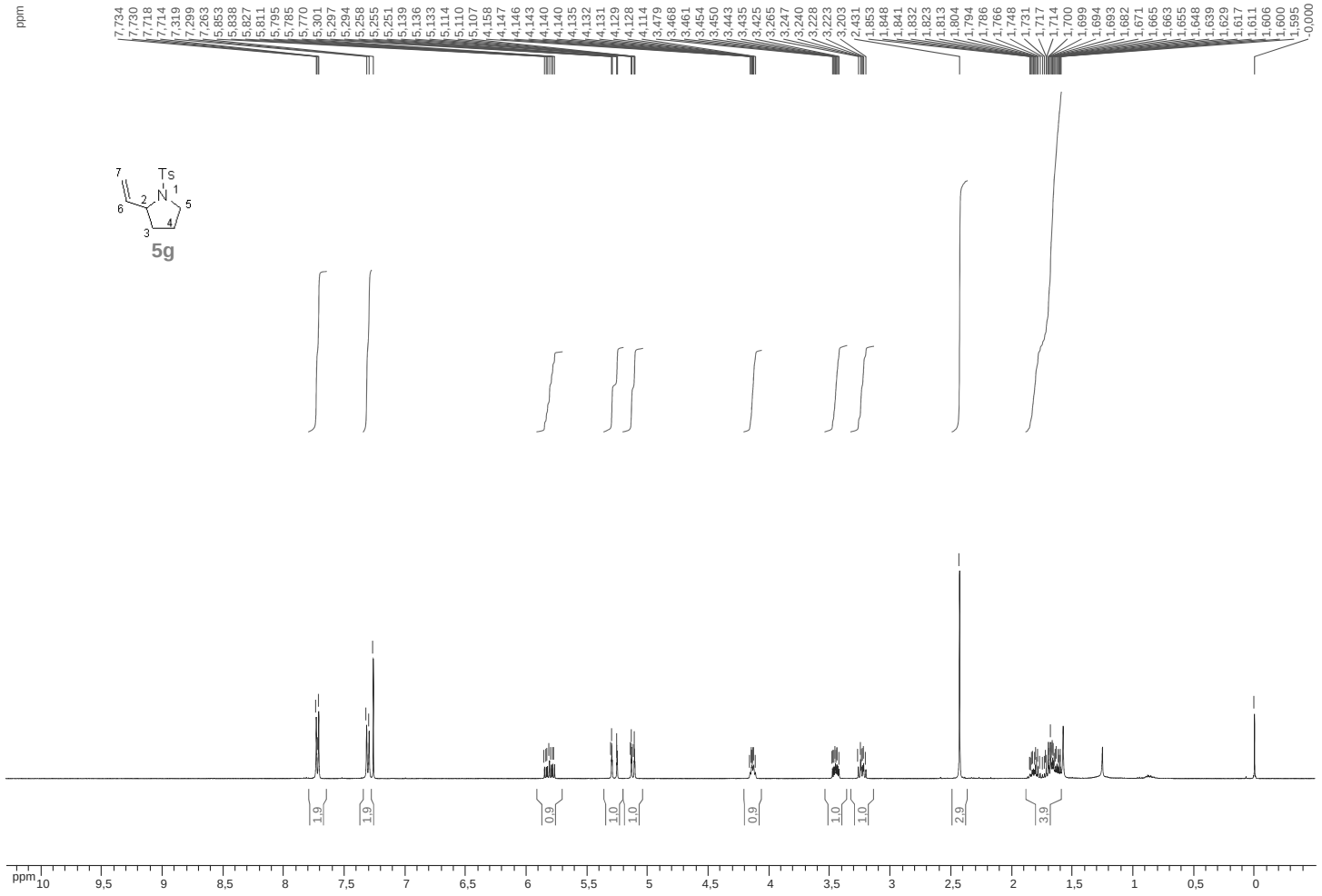
137,912
129,695
128,532
127,888
127,749
127,162
114,820
77,548
77,230
76,912
73,284
71,379
53,665
33,427
32,117
24,928
21,657
ppm
220
200
180
160
140
120
100
80
60
40
20
0
-20

4j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7,714
7,319
7,299
7,263
5,853
5,838
5,827
5,811
5,795
5,785
5,770
5,301
5,297
5,294
5,258
5,255
5,251
5,139
5,136
5,133
5,114
5,110
5,107
4,158
4,147
4,146
4,143
4,140
4,140
4,135
4,132
4,131
4,129
4,128
4,114
3,479
3,468
3,461
3,454
3,450
3,443
3,435
3,425
3,265
3,247
3,240
3,228
3,223
3,203
2,431
1,853
1,848
1,841
1,832
1,823
1,813
1,804
1,794
1,786
1,766
1,748
1,731
1,717
1,714
1,700
1,699
1,694
1,693
1,682
1,671
1,665
1,663
1,655
1,648
1,639
1,629
1,617
1,611
1,606
1,600
1,595
0,000
Ts
5g
1,9
1,9
0,9
1,0
1,0
0,9
1,0
1,0
2,9
3,9
ppm
10
9,5
9
8,5
8
7,5
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6,5
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5,5
5
4,5
4
3,5
3
2,5
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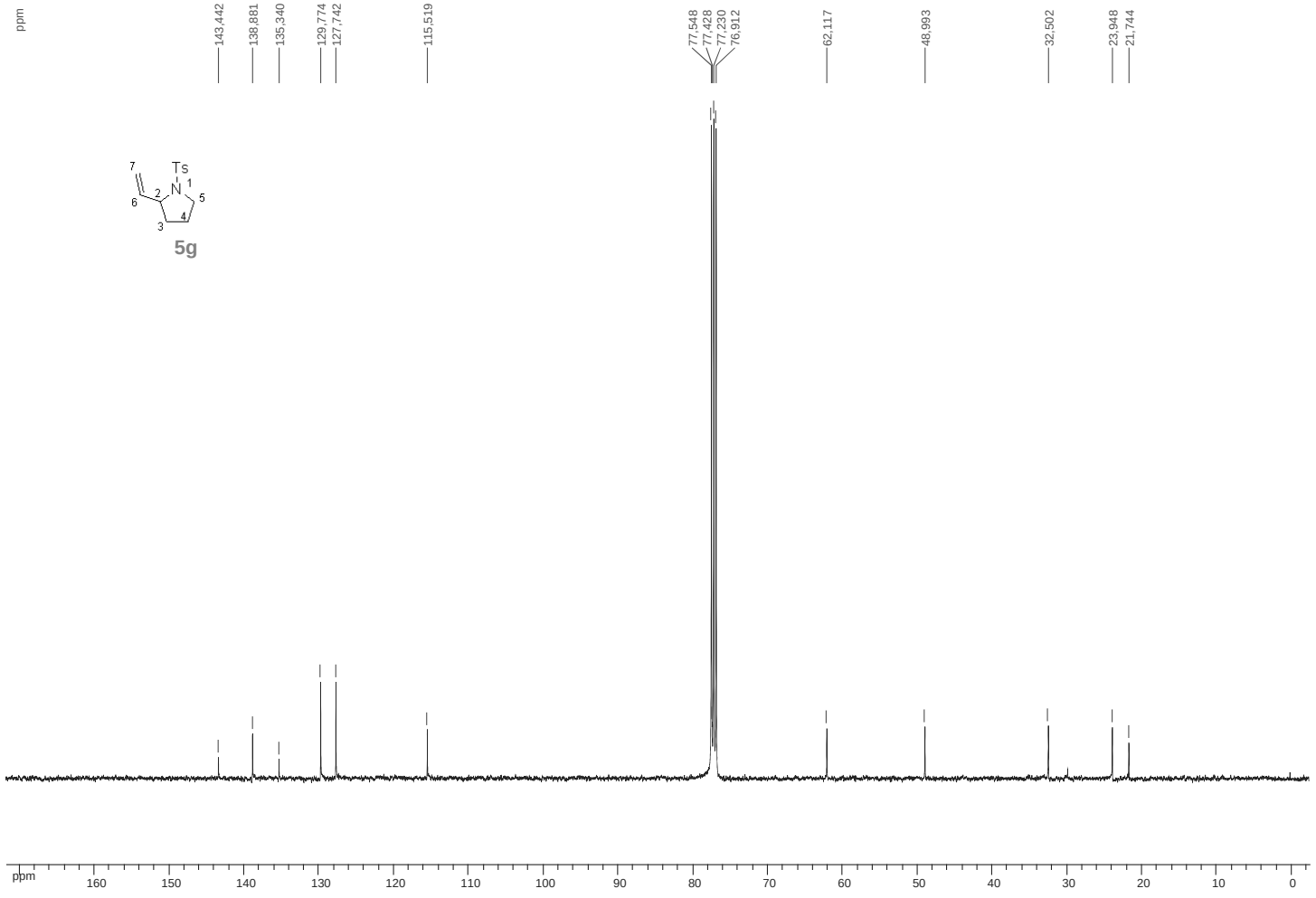
1,5
1
0,5
0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135,340
129,774
127,742
115,519
77,548
77,428
77,230
76,912
62,117
48,993
32,502
23,948
21,744
Ts
5g
ppm
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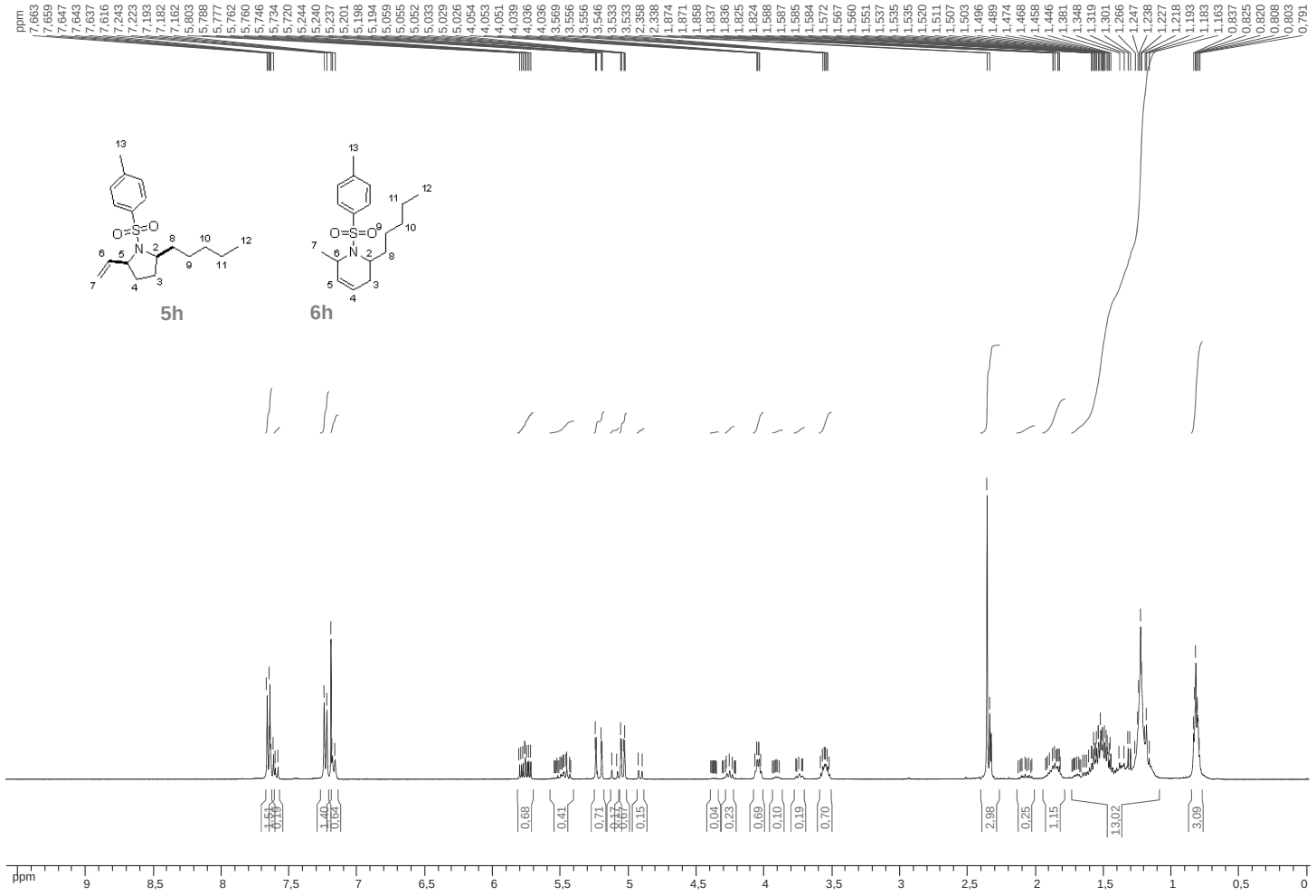
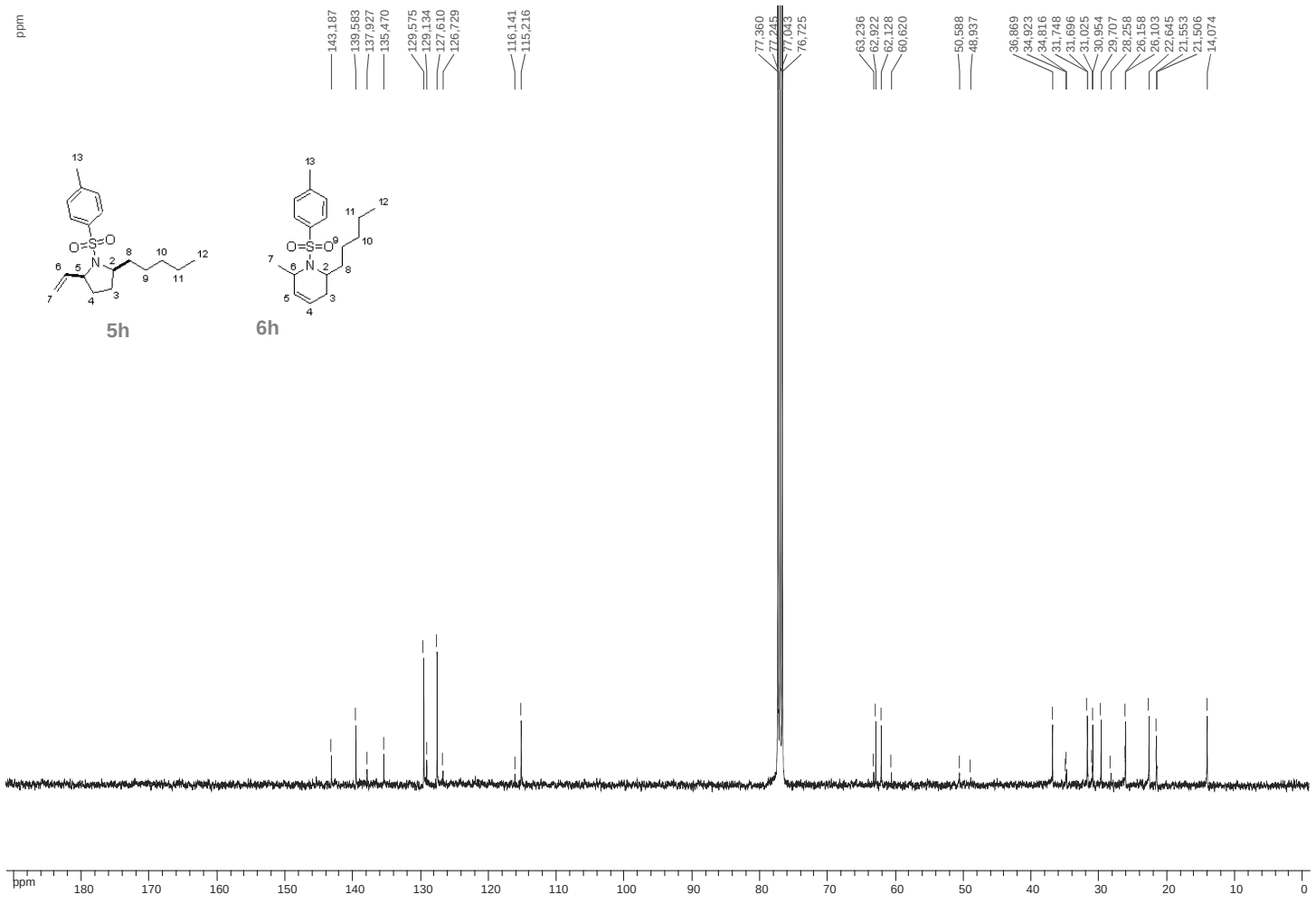
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0


ppm
7.663 7.659 7.647 7.643 7.637 7.616 7.243 7.223 7.193 7.182 7.162 5.803 5.788 5.777 5.762 5.760 5.746 5.734 5.720 5.244 5.240 5.237 5.201 5.198 5.194 5.059 5.055 5.052 5.033 5.029 5.026 4.054 4.053 4.051 4.039 4.036 4.036 3.569 3.556 3.546 3.533 3.533 2.358 2.338 1.874 1.871 1.858 1.837 1.836 1.825 1.824 1.588 1.587 1.585 1.584 1.572 1.567 1.560 1.551 1.537 1.535 1.520 1.511 1.507 1.503 1.496 1.489 1.474 1.468 1.458 1.446 1.381 1.348 1.319 1.301 1.266 1.247 1.238 1.227 1.218 1.193 1.183 1.163 0.837 0.825 0.820 0.808 0.803 0.791
5h
6h
1,51
0,19
1,40
0,64
0,68
0,41
0,71
0,67
0,60
0,15
0,04
0,23
0,69
0,10
0,19
0,70
2,98
0,25
1,15
13,02
3,09
ppm
9 8,5 8 7,5 7 6,5 6 5,5 5 4,5 4 3,5 3 2,5 2 1,5 1 0,5 0


ppm
143,187 139,583 137,927 135,470 129,575 129,134 127,610 126,729 116,141 115,216 77,360 77,245 77,043 76,725 63,236 62,922 62,128 60,620 50,588 48,937 36,869 34,923 34,816 31,748 31,696 31,025 30,954 29,707 28,258 26,158 26,103 22,645 21,553 21,506 14,074
5h
6h
ppm
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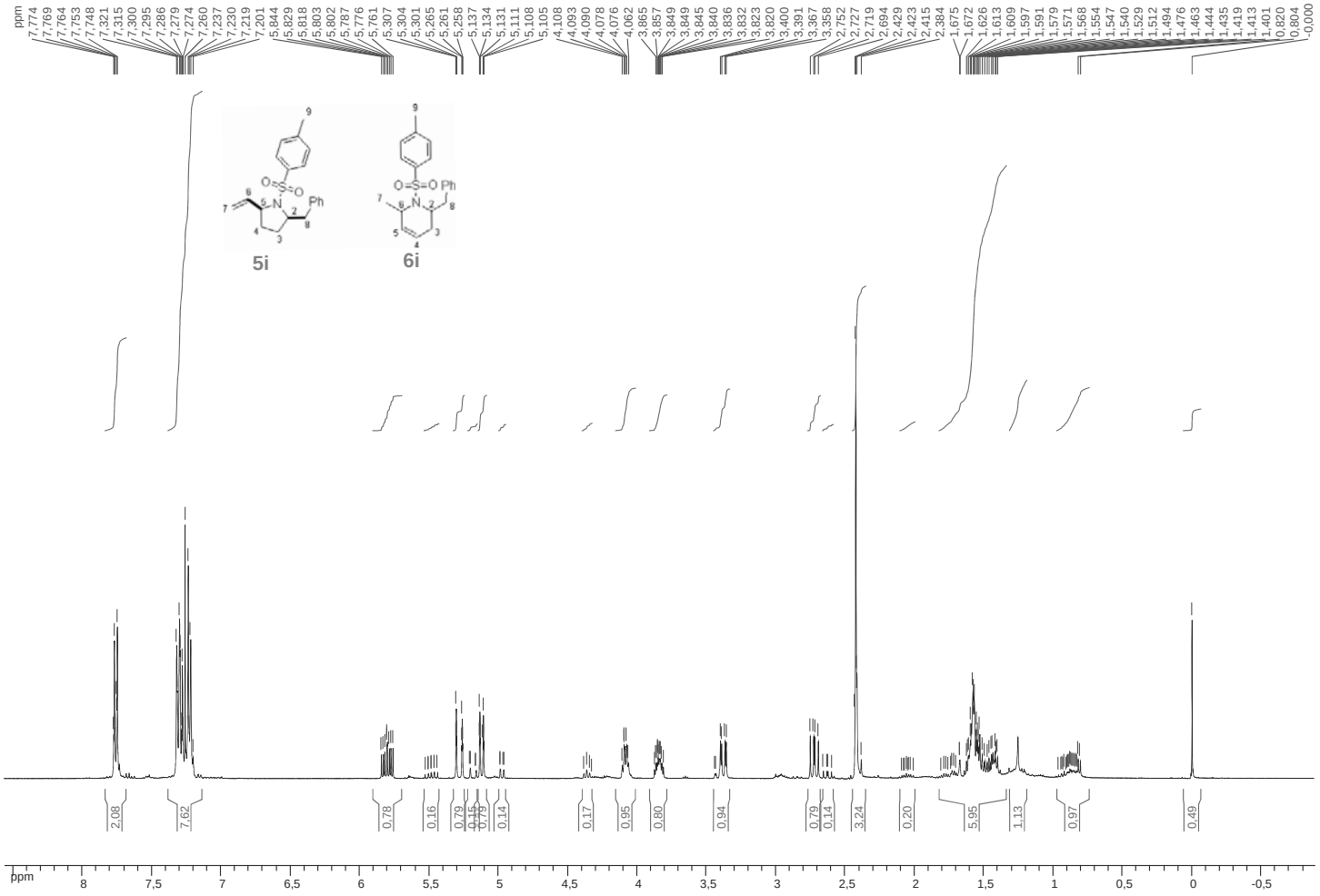
ppm
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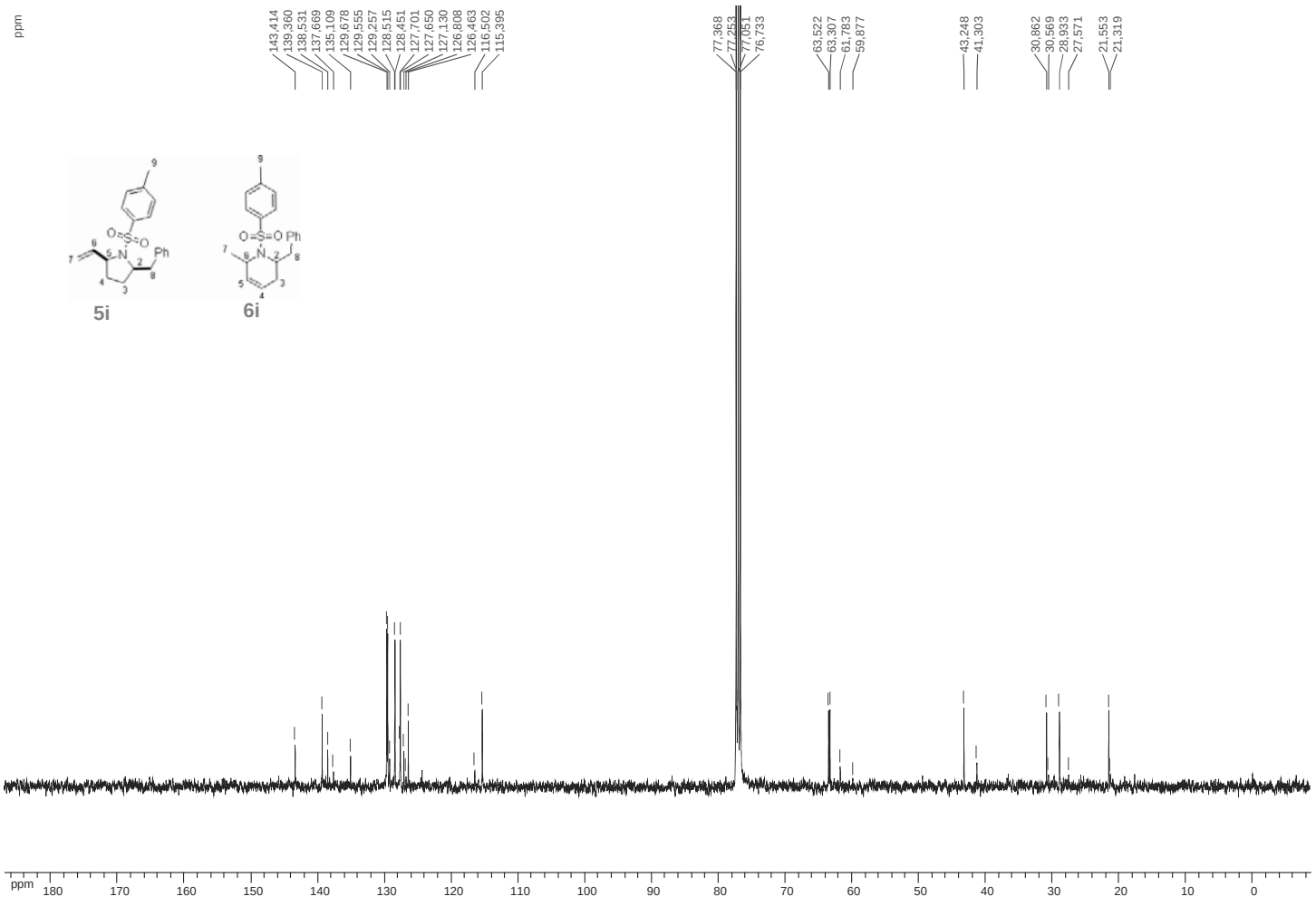
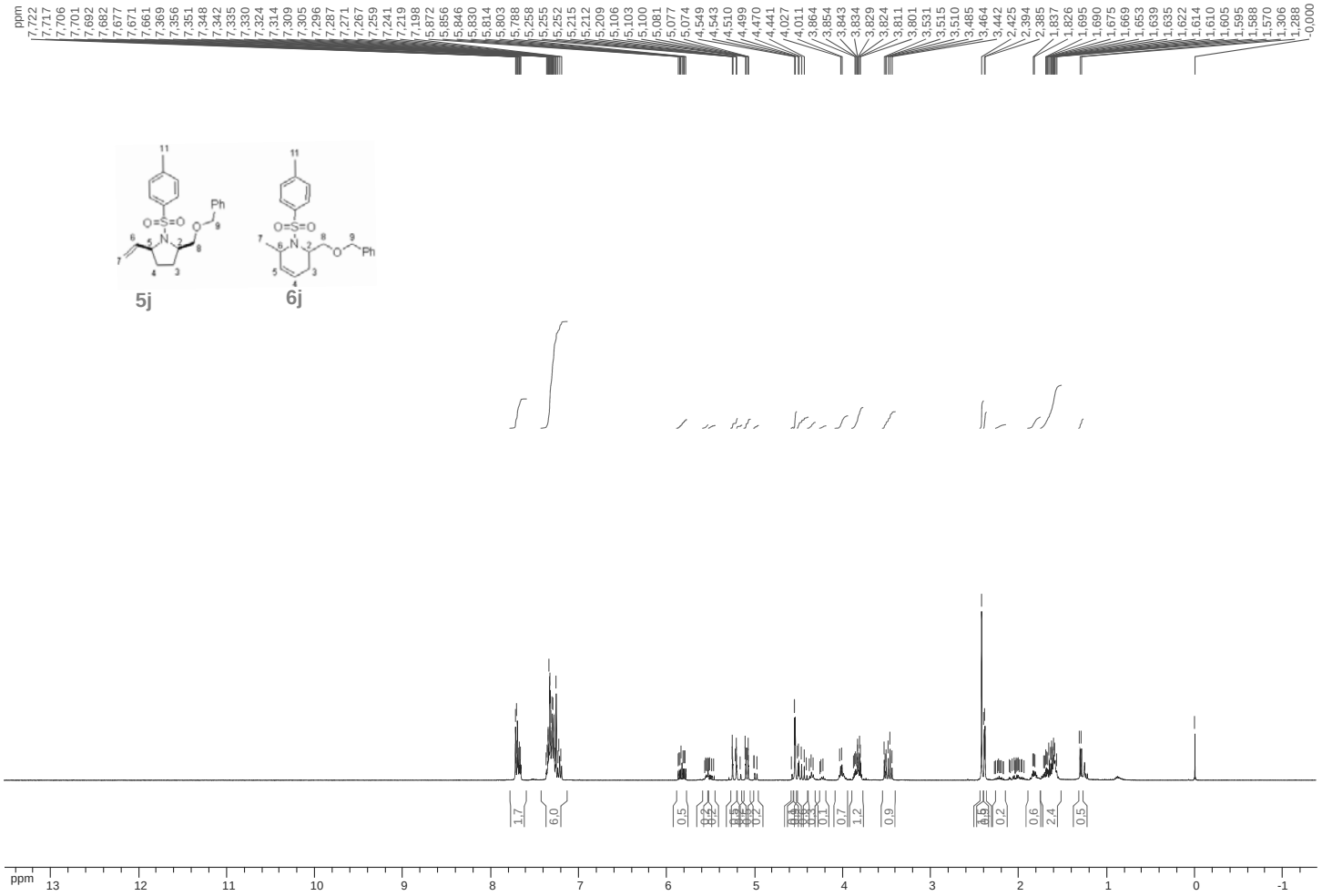
5,844 5,829 5,818 5,803 5,802 5,787 5,776 5,761 5,307 5,304 5,301 5,265 5,261 5,258 5,137 5,134 5,131 5,111 5,108 5,105
4,108 4,093 4,090 4,078 4,076 4,062
3,865 3,857 3,849 3,849 3,845 3,840 3,836 3,832 3,823 3,820 3,400 3,391 3,367 3,358 2,752 2,727 2,719 2,694 2,429 2,423 2,415 2,384
1,675 1,672 1,626 1,613 1,609 1,597 1,591 1,579 1,571 1,568 1,554 1,547 1,540 1,529 1,512 1,494 1,476 1,463 1,444 1,435 1,419 1,413 1,401 0,820 0,804 0,000
5i
6i
2,08 7,62 0,78 0,16 0,79 0,15 0,79 0,14 0,17 0,95 0,80 0,94 0,79 0,14 3,24 0,20 5,95 1,13 0,97 0,49
ppm 8 7,5 7 6,5 6 5,5 5 4,5 4 3,5 3 2,5 2 1,5 1 0,5 0 -0,5


ppm
143,414 139,360 138,531 137,669 135,109 129,678 129,555 129,257 128,515 128,451 127,701 127,650 127,130 126,808 126,463 116,502 115,395
77,368 77,253 77,051 76,733
63,522 63,307 61,783 59,877
43,248 41,303
30,862 30,569 28,933 27,571
21,553 21,319
5i
6i
ppm 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0


ppm
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5j
6j
1.7 6.0 0.5 0.2 0.2 0.3 0.2 0.1 0.1 0.7 1.2 0.9 3.9 0.2 0.6 2.4 0.5
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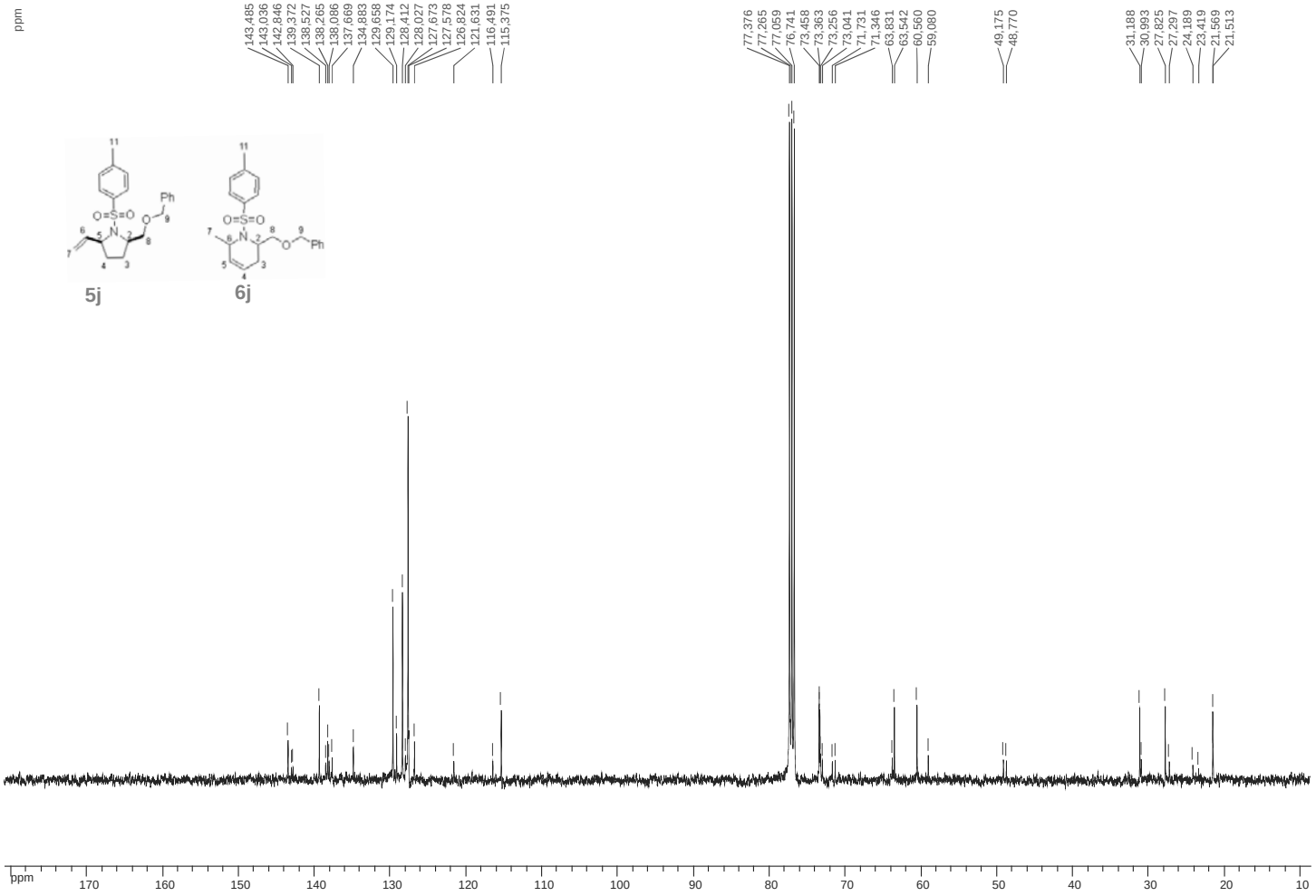
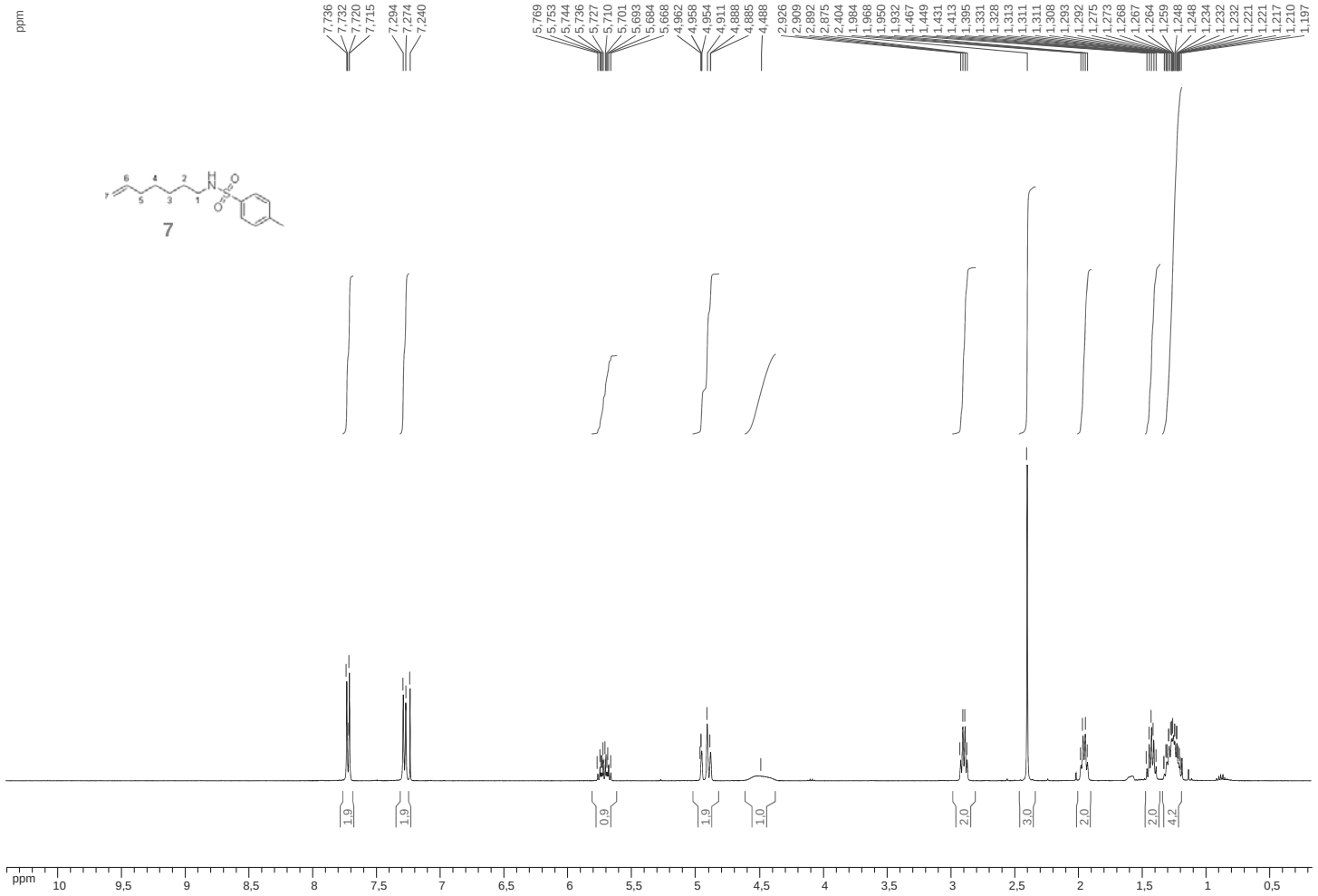

ppm
143.485 143.036 142.846 139.372 138.527 138.265 138.086 137.669 134.883 129.658 129.174 128.412 128.027 127.673 127.578 126.824 121.631 116.491 115.375
77.376 77.265 77.059 76.741 73.458 73.363 73.256 73.041 71.731 71.346 63.831 63.542 60.560 59.080
49.175 48.770
31.188 30.993 27.825 27.297 24.189 23.419 21.569 21.513
5j
6j
ppm 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10


ppm
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5.744
5.736
5.727
5.710
5.701
5.693
5.684
5.668
4.962
4.958
4.954
4.911
4.888
4.885
4.488
2.926
2.909
2.892
2.875
2.404
1.984
1.968
1.950
1.932
1.467
1.449
1.431
1.413
1.395
1.331
1.328
1.313
1.311
1.311
1.308
1.293
1.292
1.275
1.273
1.268
1.267
1.264
1.259
1.248
1.248
1.234
1.232
1.232
1.221
1.221
1.217
1.210
1.197
7
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1,9
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1,0
2,0
3,0
2,0
2,0
4,2
ppm
10
9,5
9
8,5
8
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6
5,5
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4,5
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3
2,5
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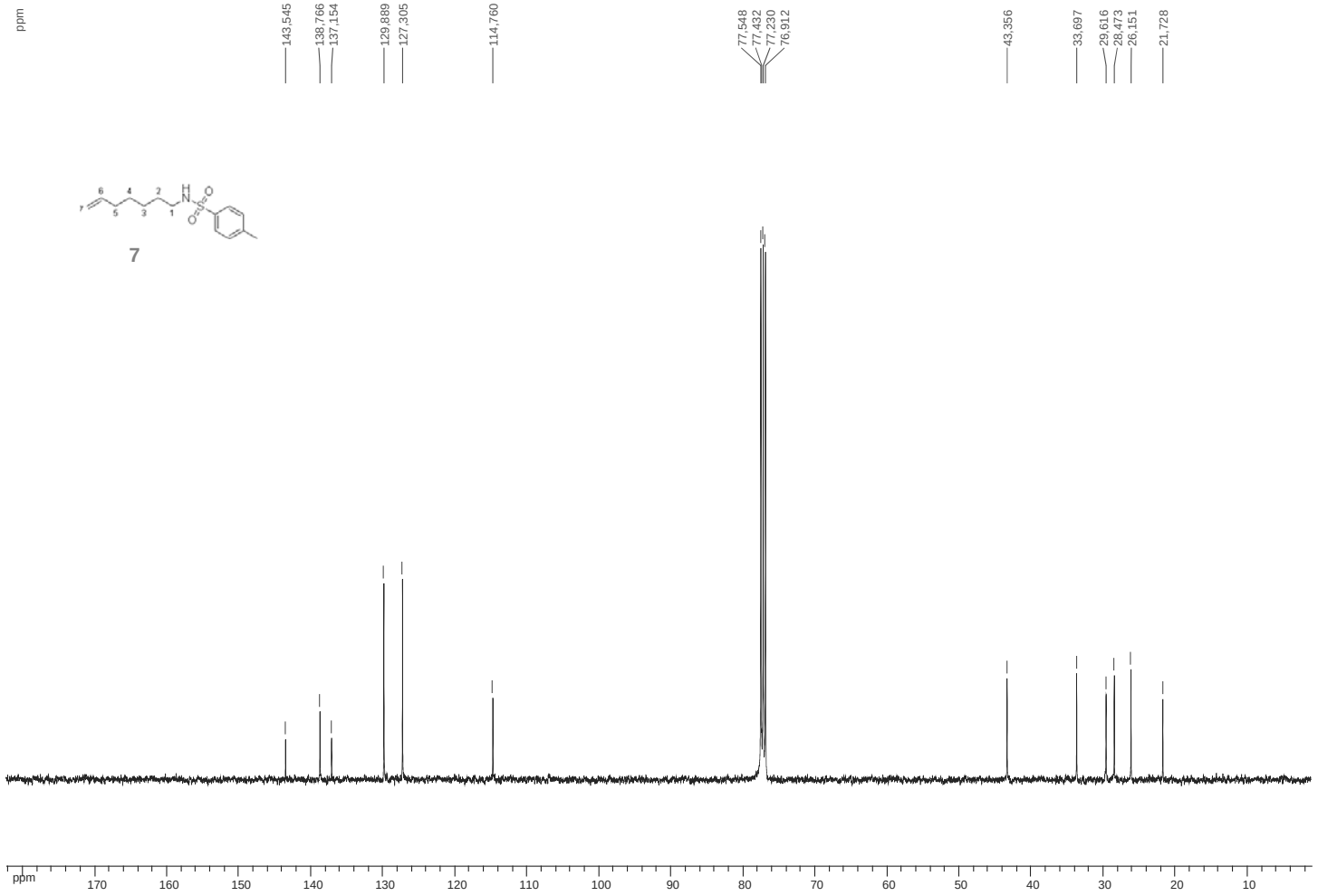
1,5
1
0,5


ppm
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127,305
114,760
77,548
77,432
77,230
76,912
43,356
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26,151
21,728
7
ppm
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160
150
140
130
120
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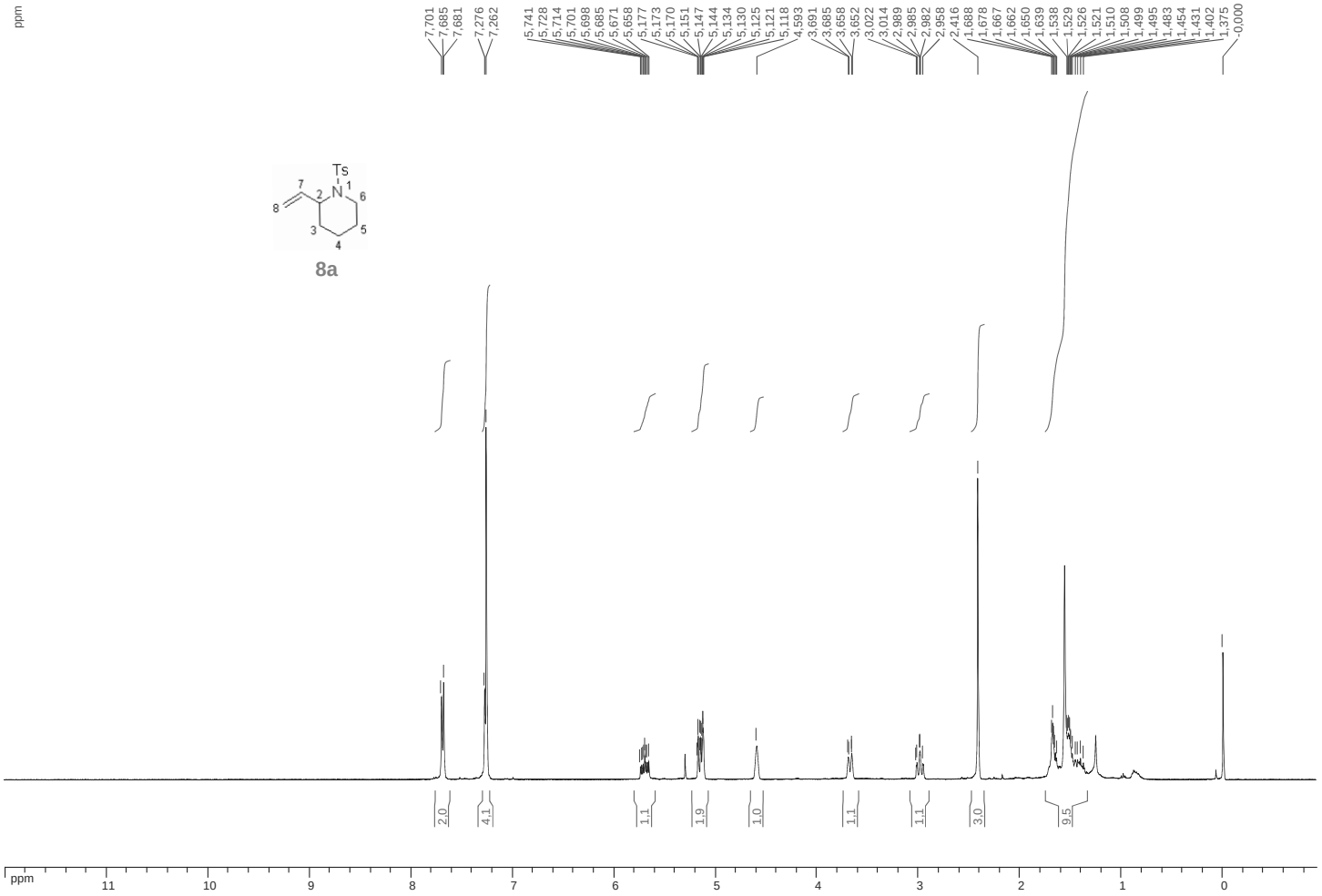
100
90
80
70
60
50
40
30
20
10


ppm
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7,262
5,741
5,728
5,714
5,701
5,698
5,685
5,671
5,658
5,177
5,173
5,170
5,151
5,147
5,144
5,134
5,130
5,125
5,121
5,118
4,593
3,691
3,685
3,658
3,652
3,022
3,014
2,989
2,985
2,982
2,958
2,416
1,688
1,678
1,667
1,662
1,650
1,639
1,538
1,529
1,526
1,521
1,510
1,508
1,499
1,495
1,483
1,454
1,431
1,402
1,375
0,000
Ts
8a
2,0
4,1
1,1
1,9
1,0
1,1
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3,0
9,5
ppm
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10
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7
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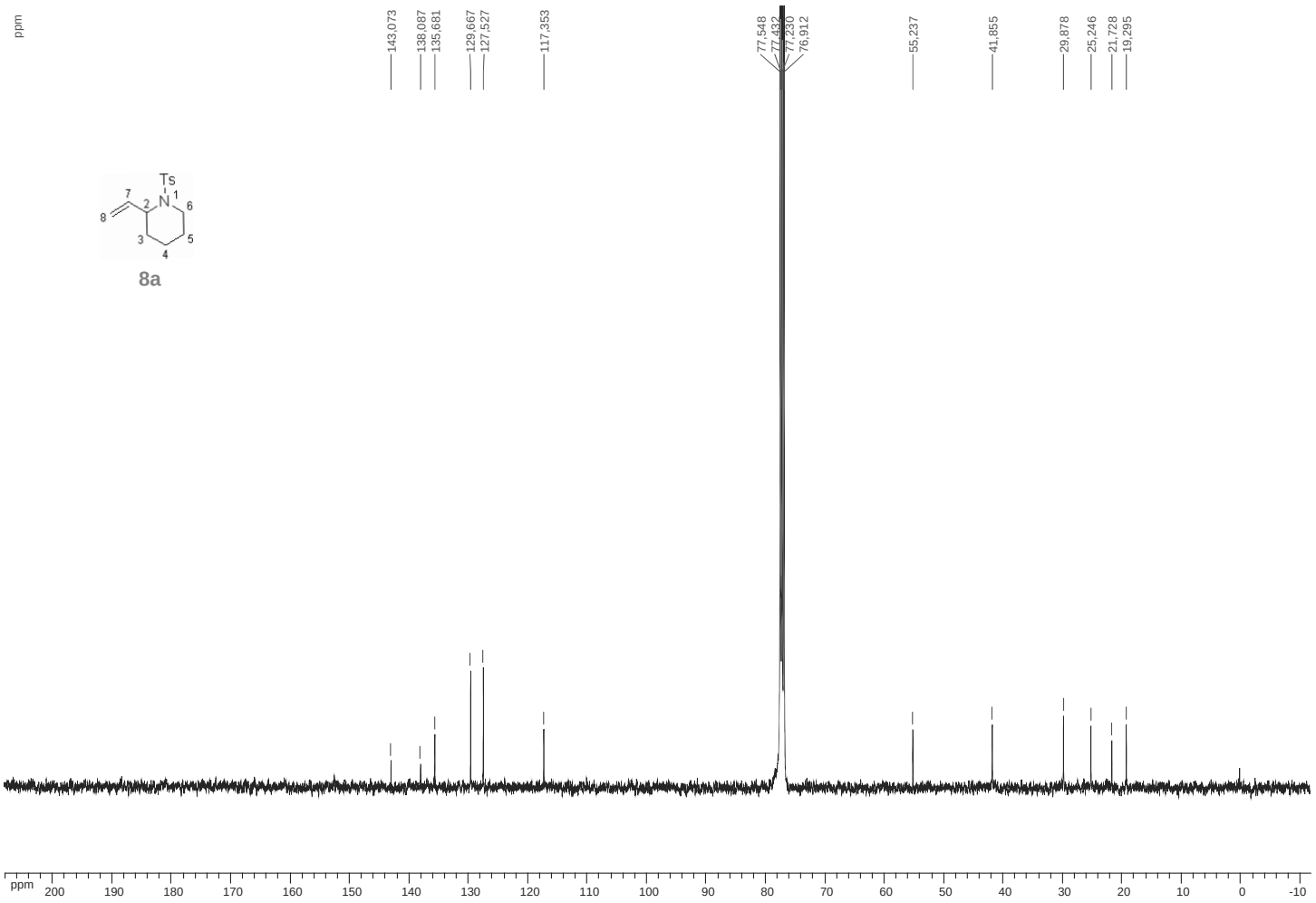
3
2
1
0


ppm
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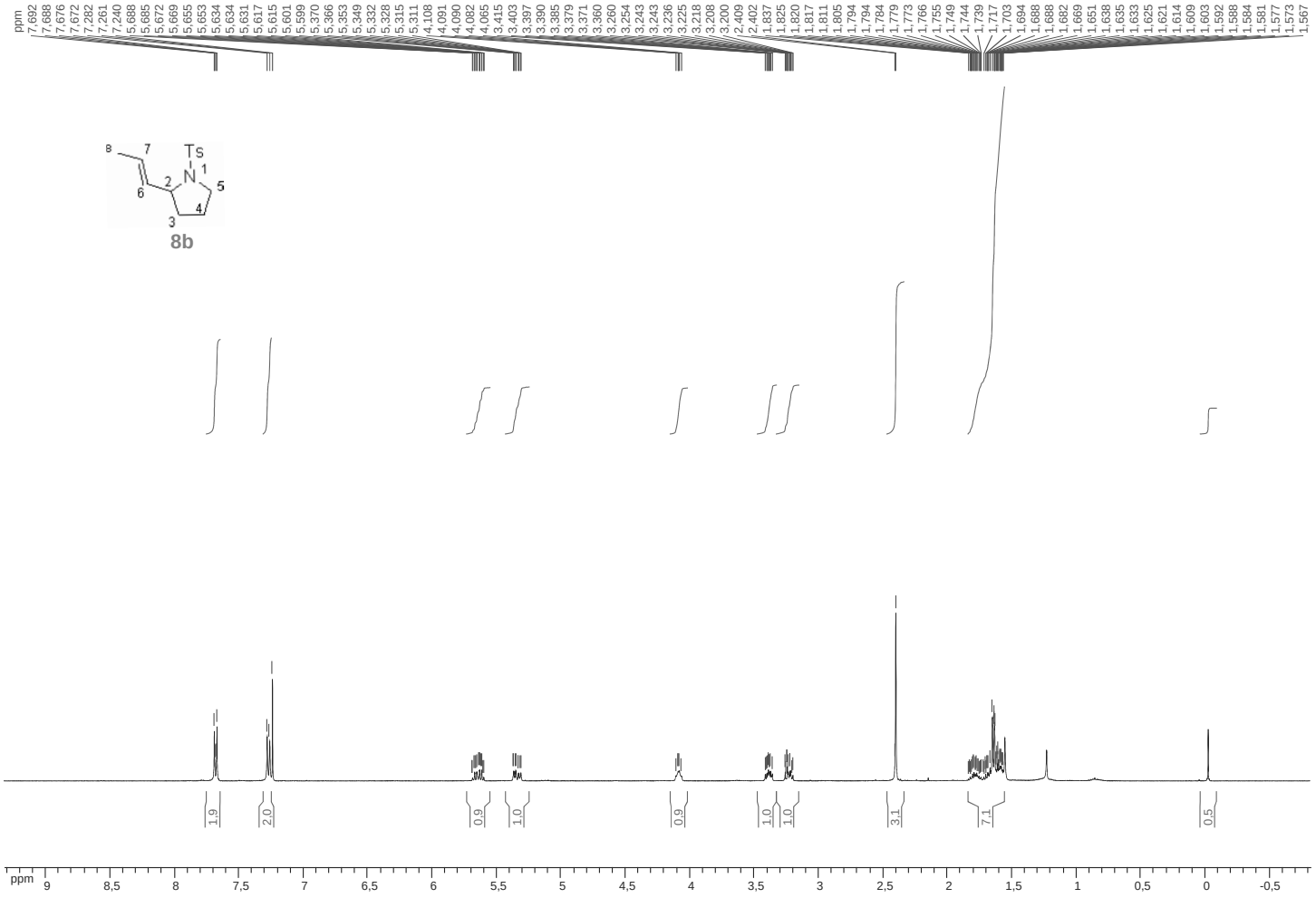
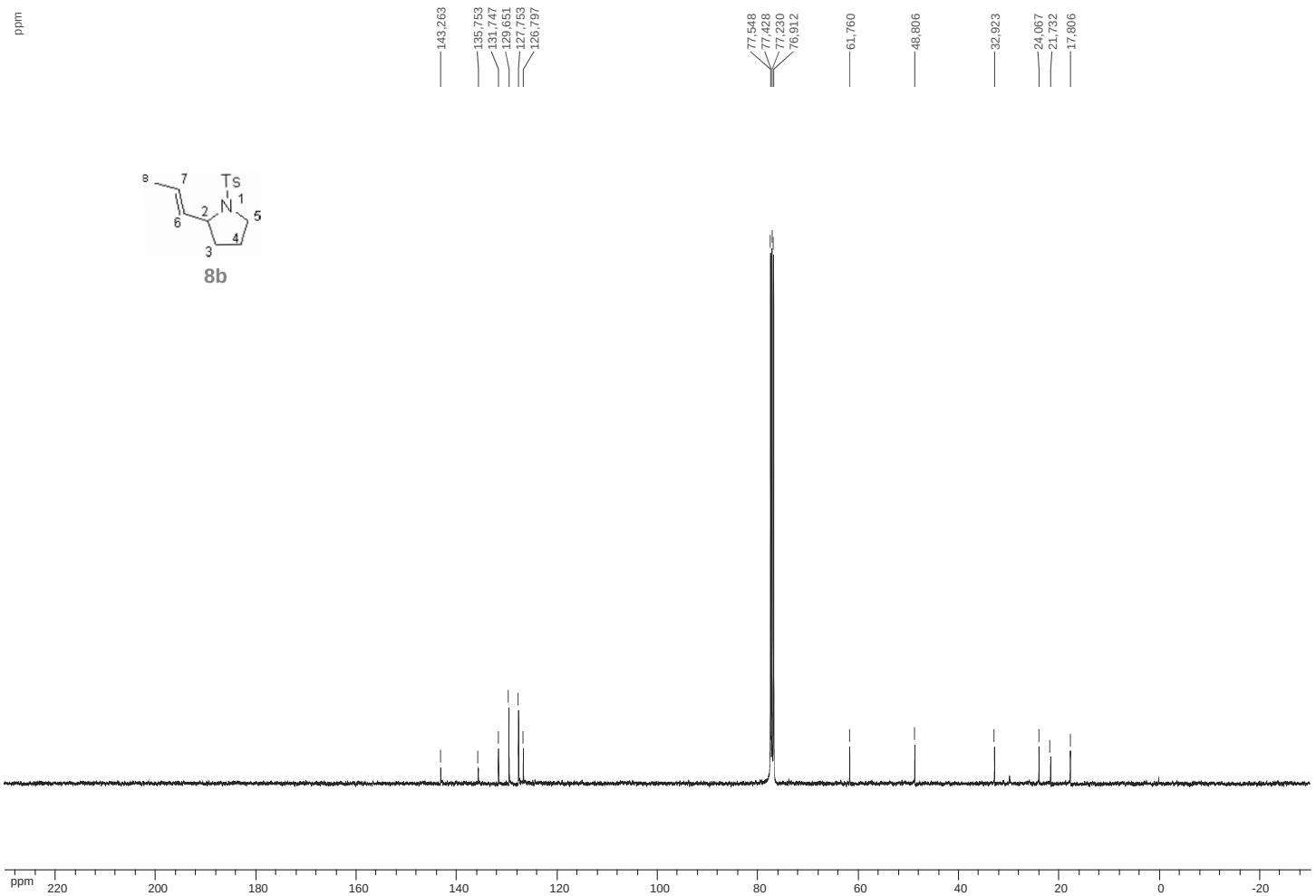
127,527
117,353
77,548
77,432
77,230
76,912
55,237
41,855
29,878
25,246
21,728
19,295
Ts
8a
ppm
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
-10


ppm
7.692 7.688 7.676 7.672 7.282 7.261 7.240 5.688 5.685 5.672 5.669 5.655 5.653 5.634 5.634 5.631 5.617 5.615 5.601 5.599 5.370 5.366 5.353 5.349 5.332 5.328 5.315 5.311 4.108 4.091 4.090 4.082 4.065 3.415 3.403 3.397 3.390 3.385 3.379 3.371 3.360 3.260 3.254 3.243 3.243 3.236 3.225 3.218 3.208 3.200 2.409 2.402 1.837 1.825 1.820 1.817 1.811 1.805 1.794 1.794 1.784 1.779 1.773 1.766 1.755 1.749 1.744 1.739 1.717 1.703 1.694 1.688 1.688 1.682 1.669 1.651 1.638 1.635 1.633 1.625 1.621 1.614 1.609 1.603 1.592 1.588 1.584 1.581 1.577 1.573 1.567
Ts
N
8b
1.9
2.0
0.9
1.0
0.9
1.0
1.0
3.1
7.1
0.5
ppm
9 8,5 8 7,5 7 6,5 6 5,5 5 4,5 4 3,5 3 2,5 2 1,5 1 0,5 0 -0,5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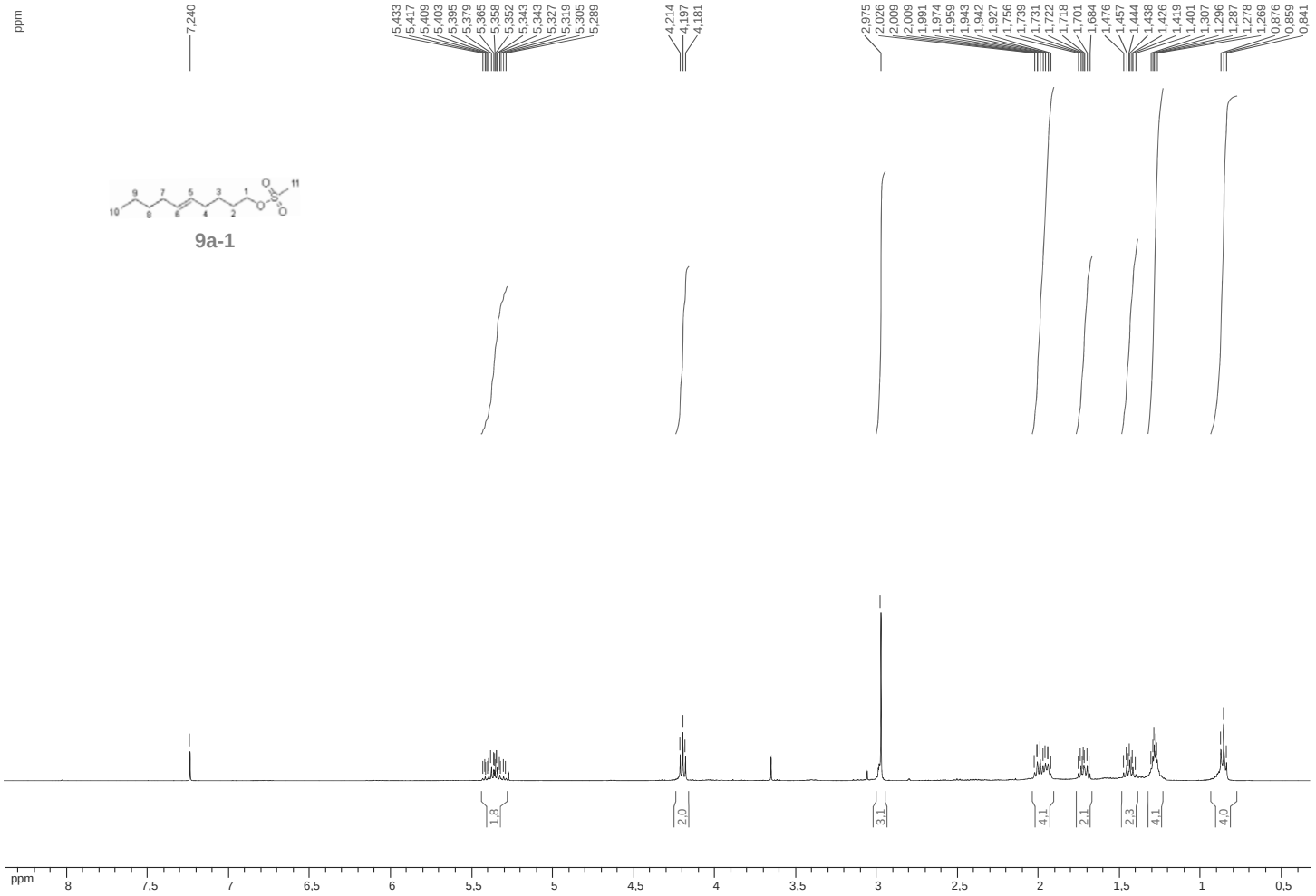
131,747
129,651
127,753
126,797
77,548
77,428
77,230
76,912
61,760
48,806
32,923
24,067
21,732
17,806
Ts
N
8b
ppm
220 200 180 160 140 120 100 80 60 40 20 0 -20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5,409
5,403
5,395
5,379
5,365
5,358
5,352
5,343
5,343
5,327
5,319
5,305
5,289
4,214
4,197
4,181
2,975
2,026
2,009
2,009
1,991
1,974
1,959
1,943
1,942
1,927
1,756
1,739
1,731
1,722
1,718
1,701
1,684
1,476
1,457
1,444
1,438
1,426
1,419
1,401
1,307
1,296
1,287
1,278
1,269
0,876
0,859
0,841
9a-1
1,8
2,0
3,1
4,1
2,1
2,3
4,1
4,0
ppm
8
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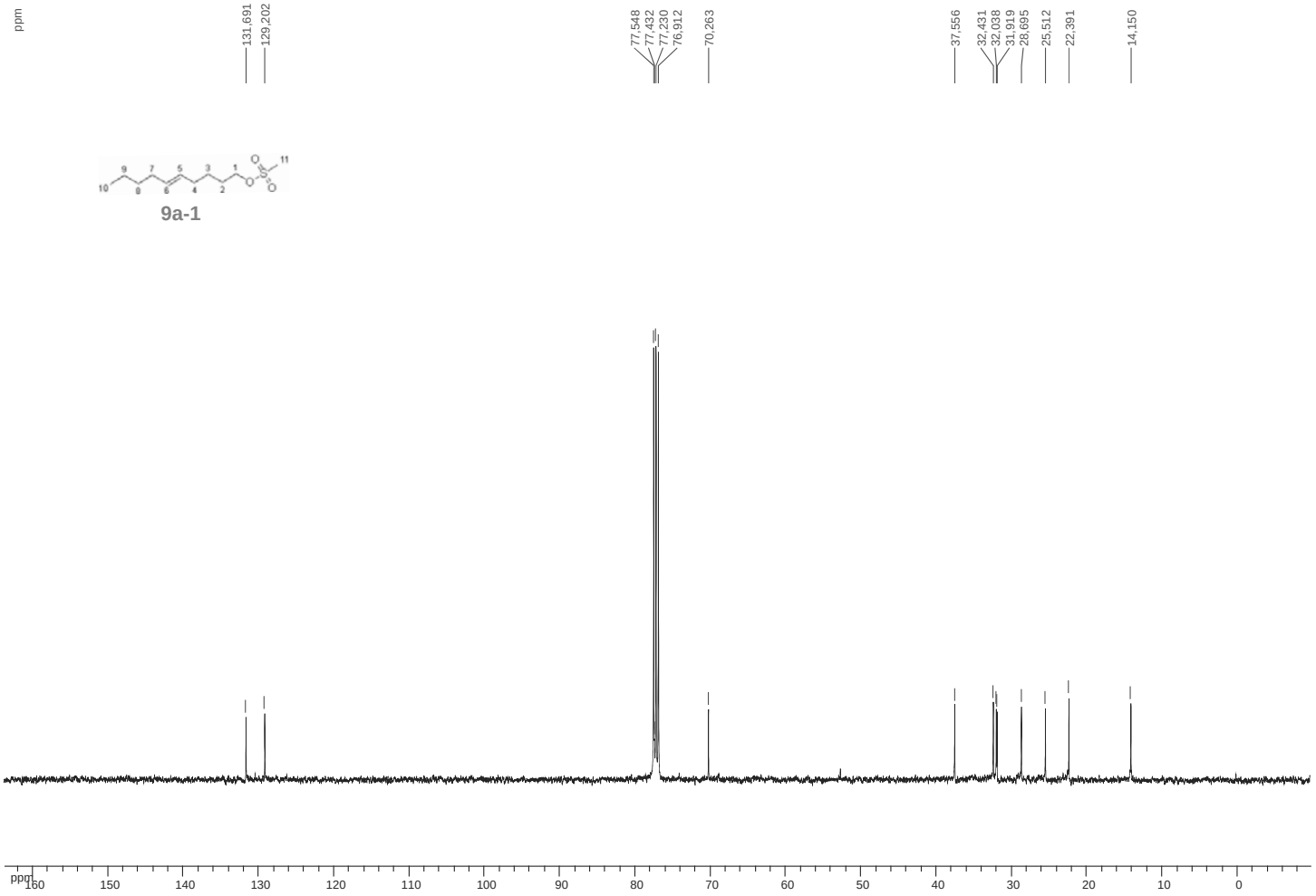
7
6,5
6
5,5
5
4,5
4
3,5
3
2,5
2
1,5
1
0,5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77,432
77,230
76,912
70,263
37,556
32,431
32,038
31,919
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25,512
22,391
14,150
9a-1
ppm
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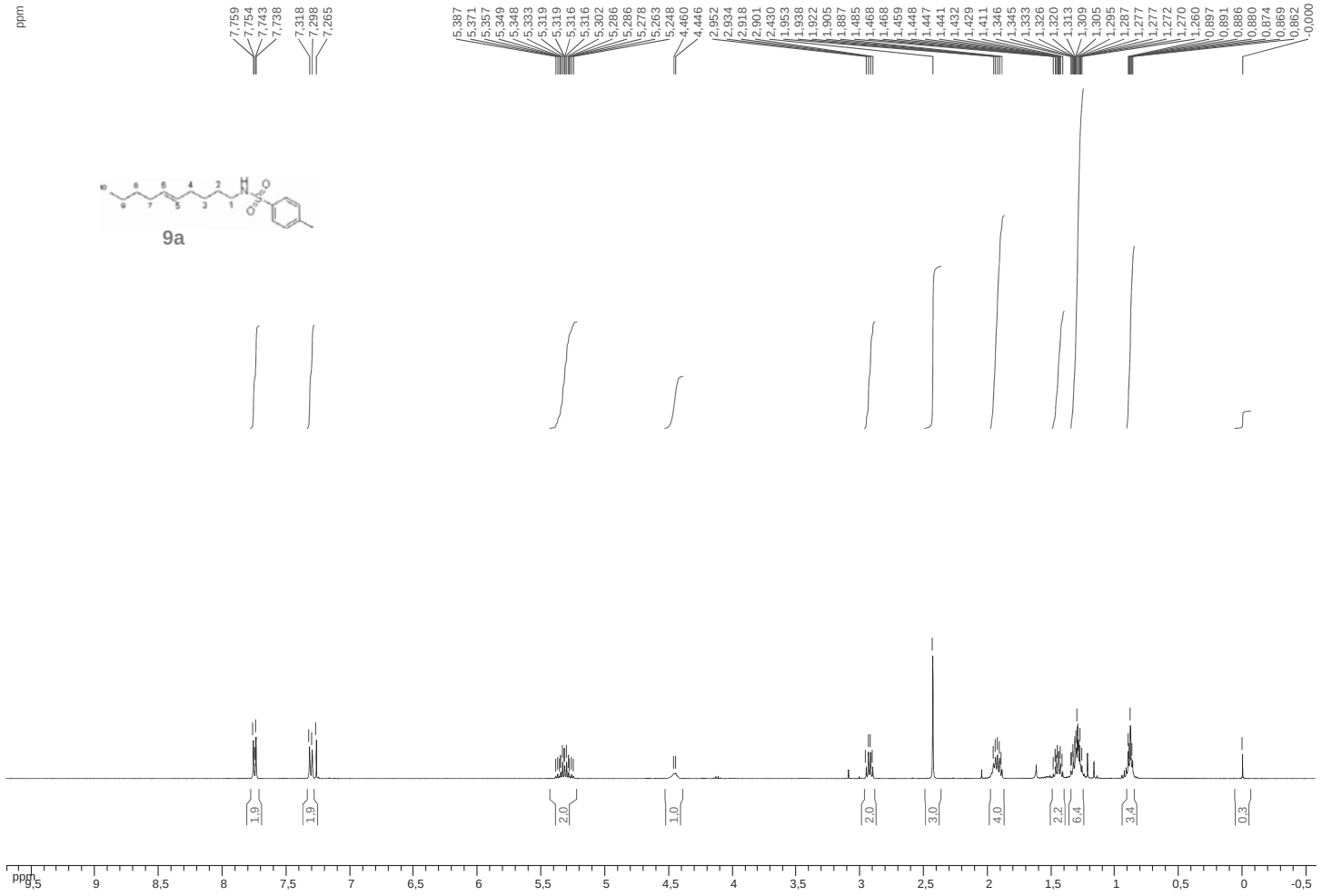
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0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7,759
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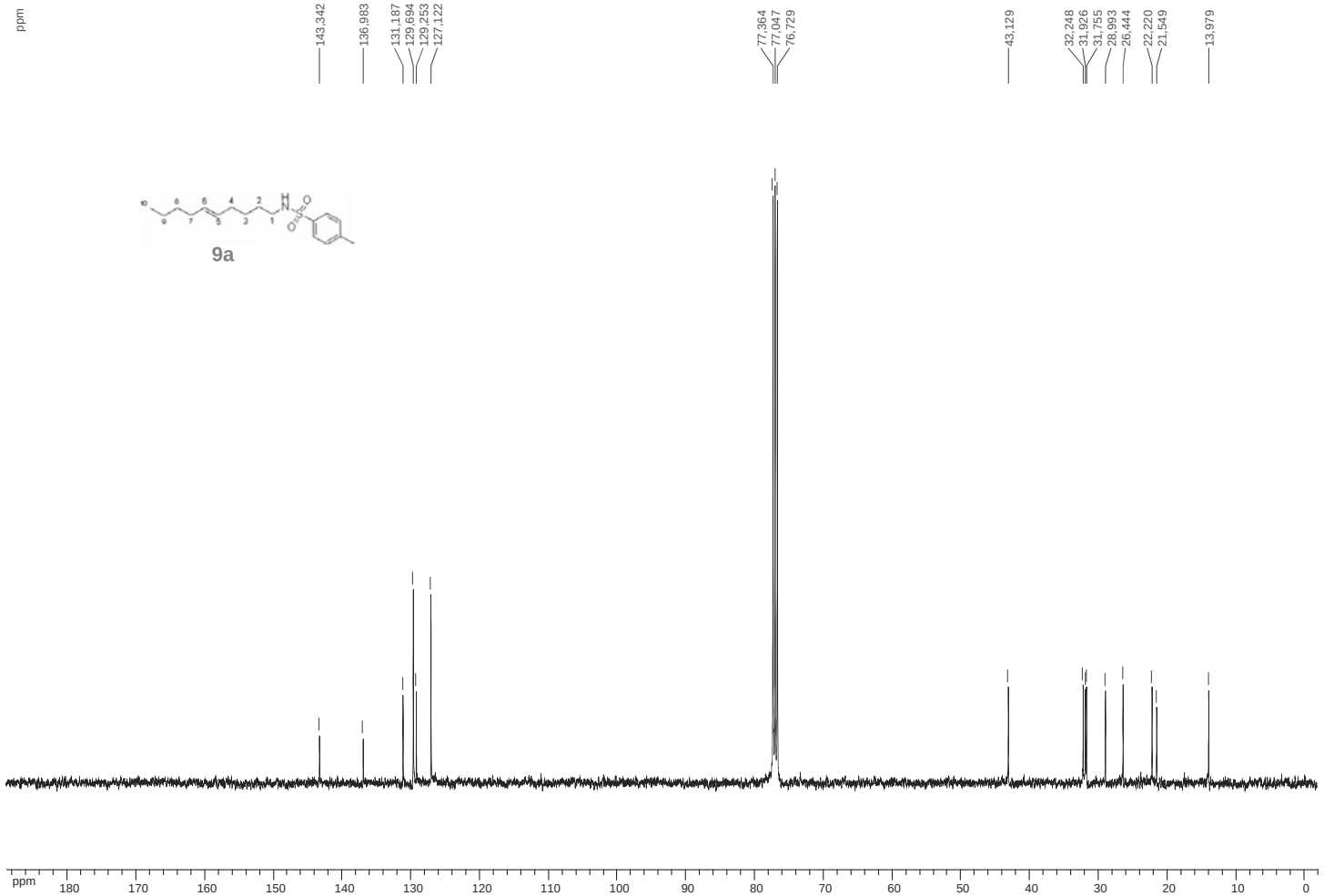
7,738
7,318
7,298
7,265
5,387
5,371
5,357
5,349
5,348
5,333
5,319
5,319
5,316
5,316
5,302
5,286
5,278
5,263
5,248
4,460
4,446
2,952
2,934
2,918
2,901
2,430
1,953
1,938
1,922
1,905
1,887
1,485
1,468
1,468
1,459
1,448
1,447
1,441
1,432
1,429
1,411
1,346
1,345
1,333
1,326
1,320
1,313
1,309
1,305
1,295
1,287
1,277
1,277
1,272
1,270
1,260
0,897
0,891
0,886
0,880
0,874
0,869
0,862
0,000
9a
1,9
1,9
2,0
1,0
2,0
3,0
4,0
2,2
6,4
3,4
0,3
ppm
9,5
9
8,5
8
7,5
7
6,5
6
5,5
5
4,5
4
3,5
3
2,5
2
1,5
1
0,5
0
-0,5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129,694
129,253
127,122
77,364
77,047
76,729
43,129
32,248
31,926
31,755
28,993
26,444
22,220
21,549
13,979
9a
ppm
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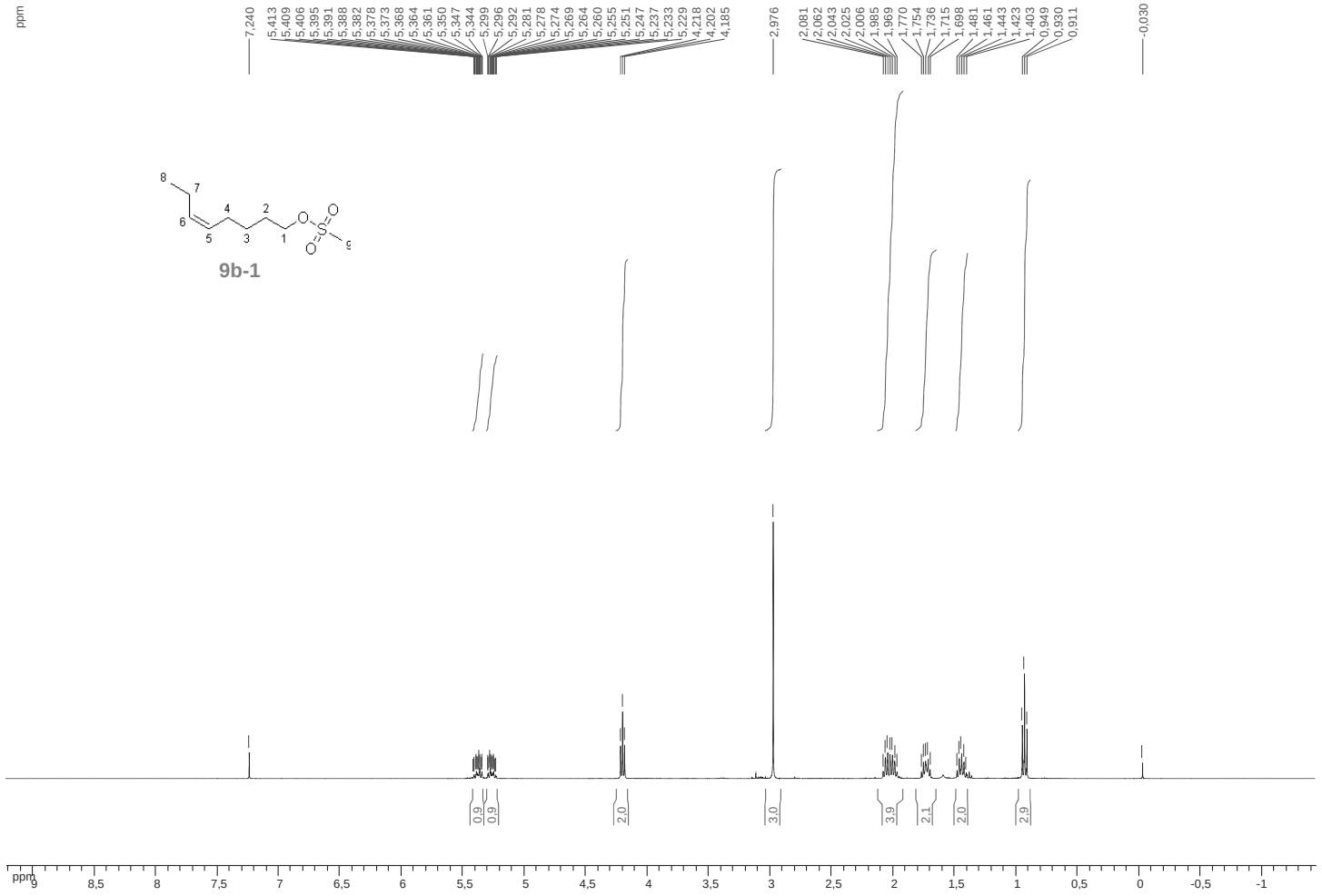
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0


ppm
7,240
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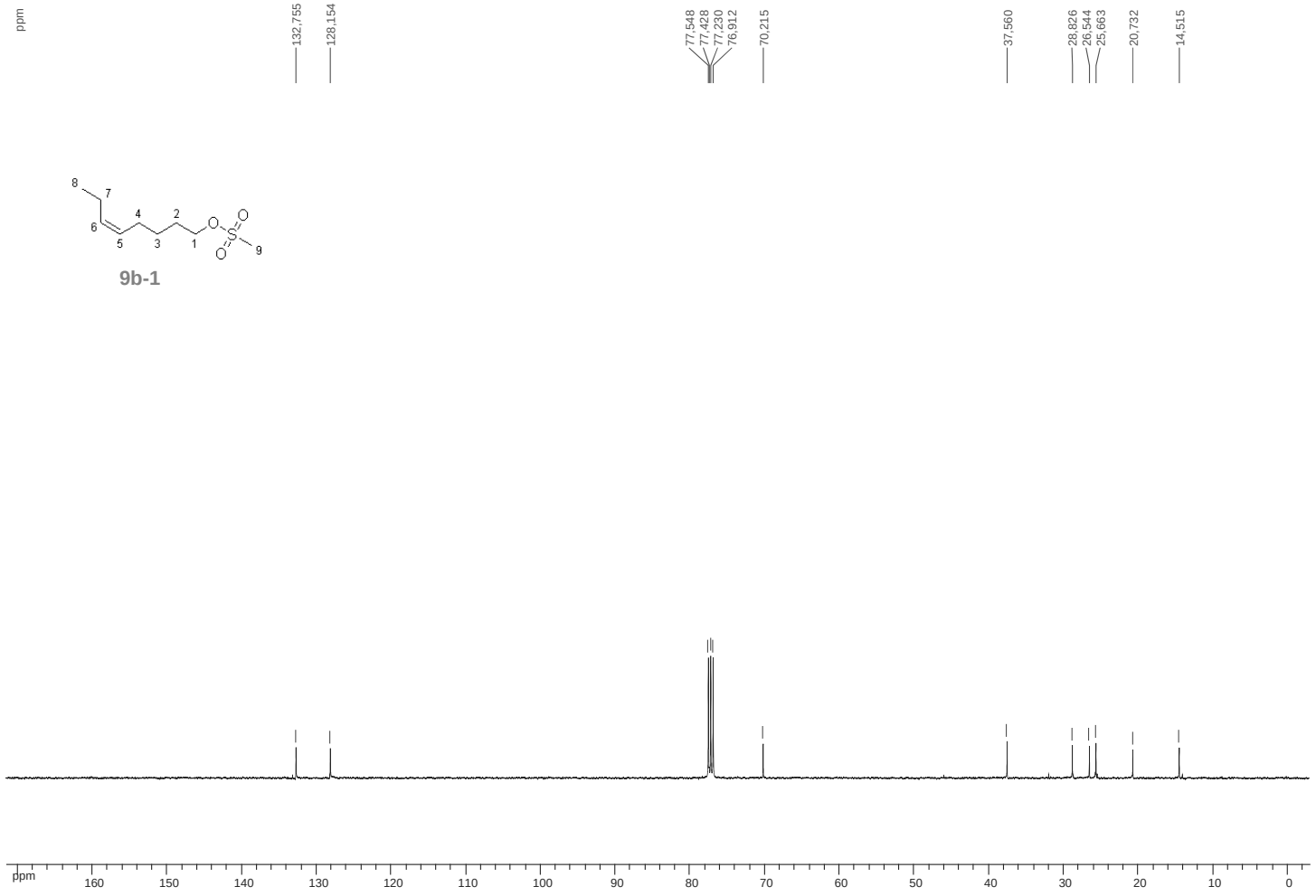
5,409
5,406
5,395
5,391
5,388
5,382
5,378
5,373
5,368
5,364
5,361
5,350
5,347
5,344
5,299
5,296
5,292
5,281
5,278
5,274
5,269
5,264
5,260
5,255
5,251
5,247
5,237
5,233
5,229
4,218
4,202
4,185
2,976
2,081
2,062
2,043
2,025
2,006
1,985
1,969
1,770
1,754
1,736
1,715
1,698
1,481
1,461
1,443
1,423
1,403
0,949
0,930
0,911
-0,030
0,9
0,9
2,0
3,0
3,9
2,1
2,0
2,9
9
8,5
8
7,5
7
6,5
6
5,5
5
4,5
4
3,5
3
2,5
2
1,5
1
0,5
0
-0,5
-1


8
7
6
5
4
3
2
1
O
S
O
O
9

**9b-1**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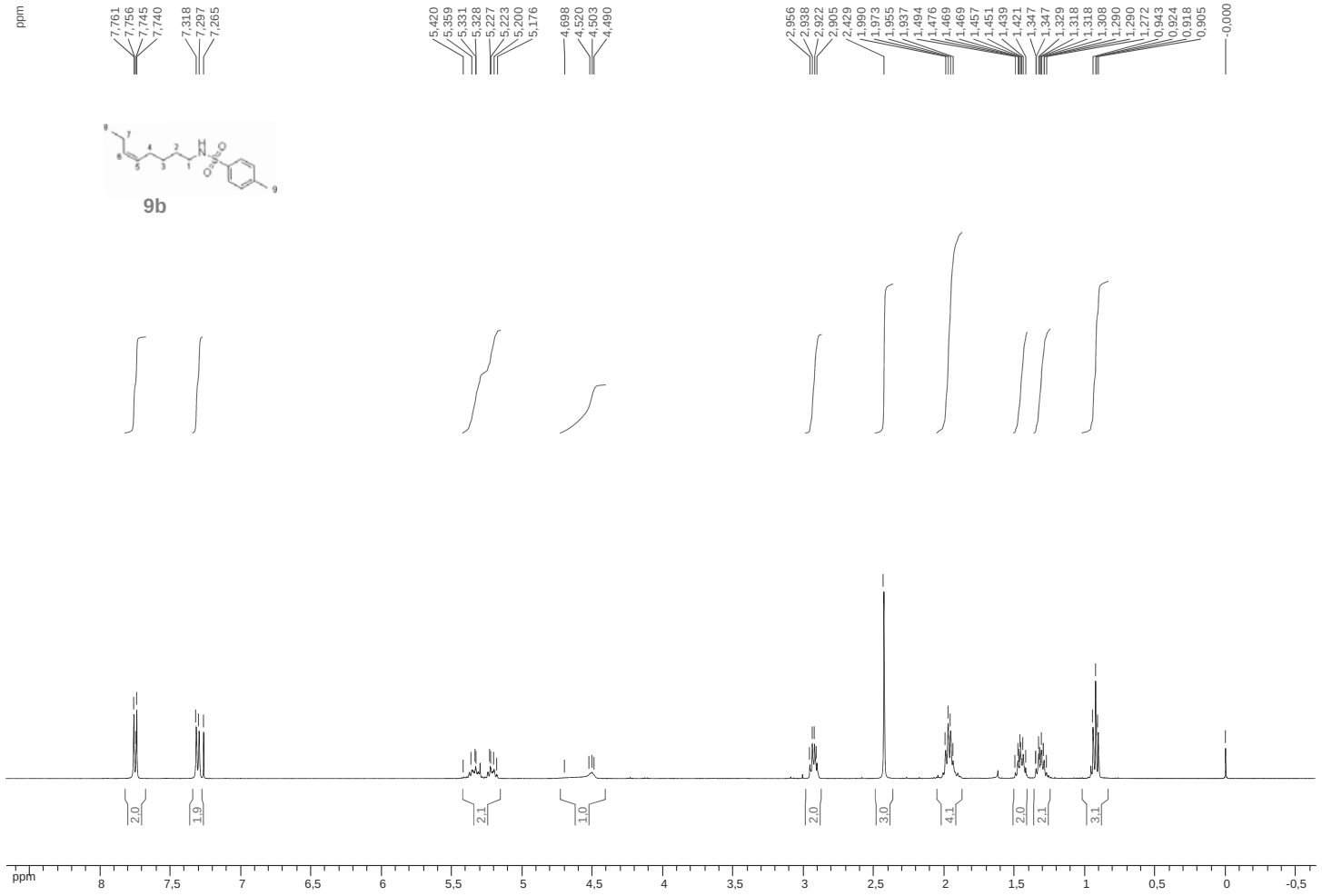
77,548
77,428
77,230
76,912
70,215
37,560
28,826
26,544
25,663
20,732
14,515
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0


8
7
6
5
4
3
2
1
O
S
O
O
9

**9b-1**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7,318
7,297
7,265
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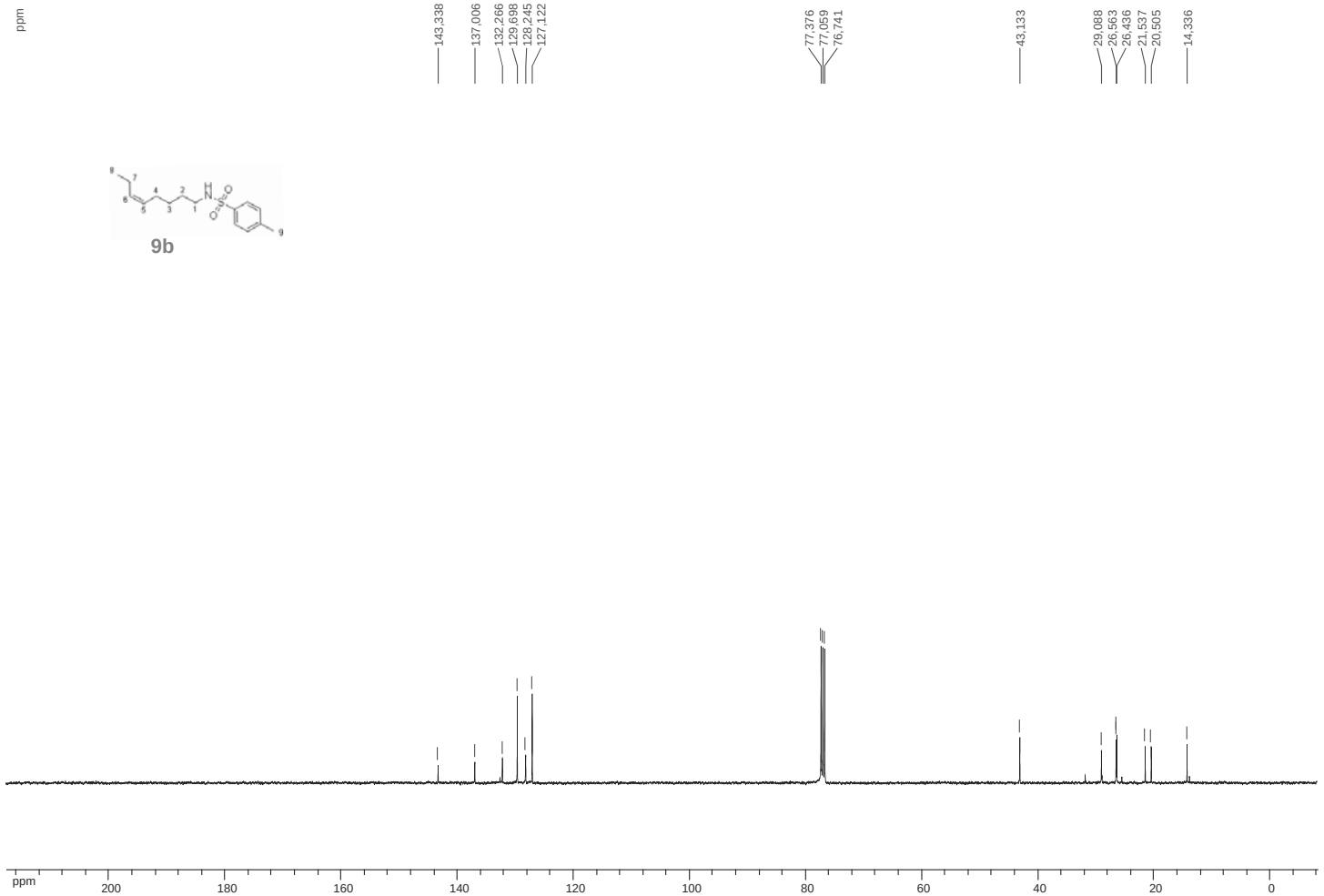
5,359
5,331
5,328
5,227
5,223
5,200
5,176
4,698
4,520
4,503
4,490
2,956
2,938
2,922
2,905
2,429
1,990
1,973
1,955
1,937
1,494
1,476
1,469
1,469
1,457
1,451
1,439
1,421
1,347
1,347
1,329
1,318
1,318
1,308
1,290
1,290
1,272
0,943
0,924
0,918
0,905
-0,000
9b
2,0
1,9
2,1
1,0
2,0
3,0
4,1
2,0
2,1
3,1
ppm
8
7,5
7
6,5
6
5,5
5
4,5
4
3,5
3
2,5
2
1,5
1
0,5
0
-0,5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129,698
128,245
127,122
77,376
77,059
76,741
43,133
29,088
26,563
26,436
21,537
20,505
14,336
9b
ppm
200
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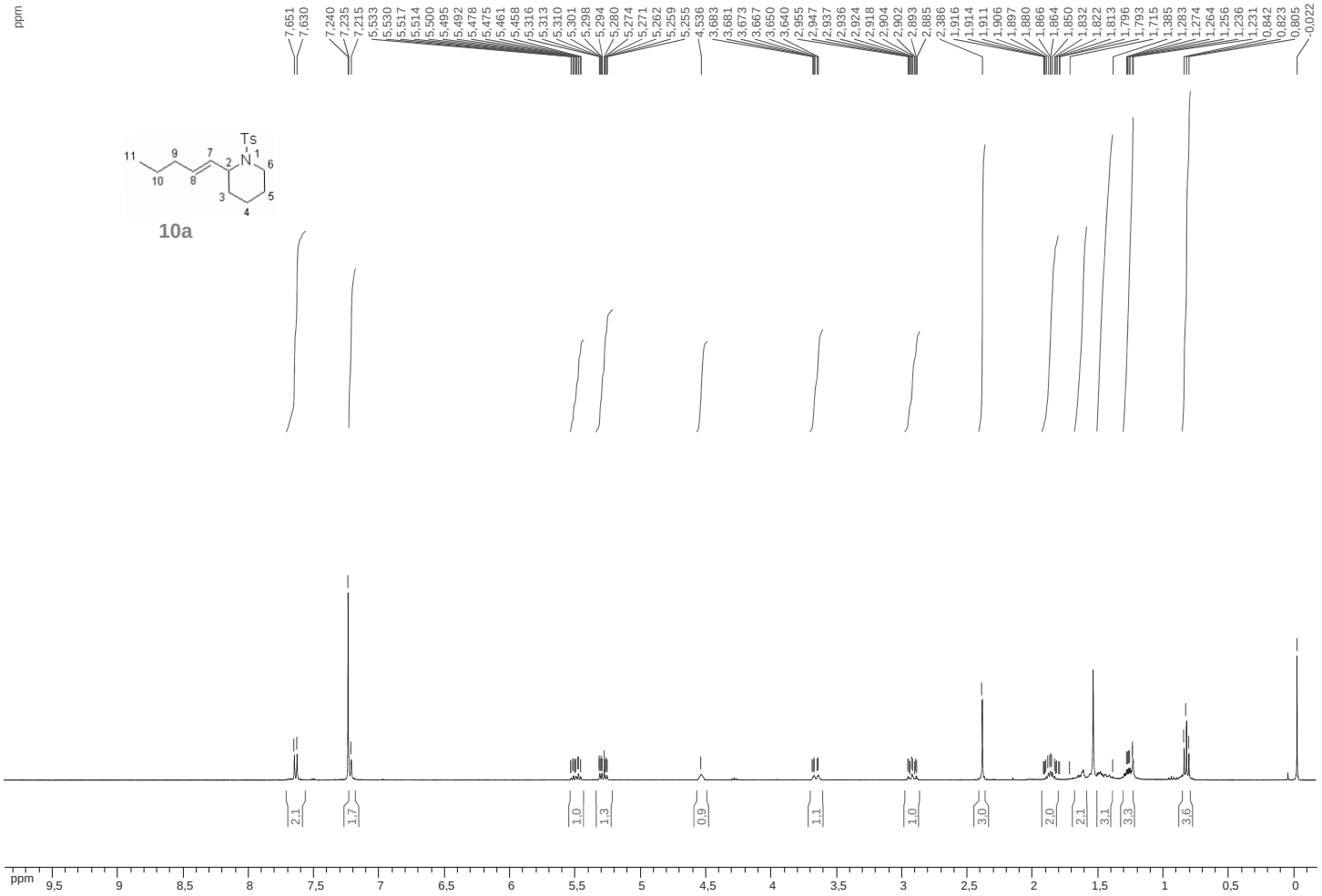
160
140
120
100
80
60
40
20
0


ppm
7.651
7.630
7.240
7.235
7.215
5.533
5.530
5.517
5.514
5.500
5.495
5.492
5.478
5.475
5.461
5.458
5.316
5.313
5.310
5.301
5.298
5.294
5.280
5.274
5.271
5.262
5.259
5.255
4.536
3.683
3.681
3.673
3.667
3.650
3.640
2.955
2.947
2.937
2.936
2.924
2.918
2.904
2.902
2.893
2.885
2.386
1.916
1.914
1.911
1.906
1.897
1.880
1.866
1.864
1.850
1.832
1.822
1.813
1.796
1.793
1.715
1.385
1.283
1.274
1.264
1.256
1.236
1.231
0.842
0.823
0.805
0.022
Ts
10a
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1.7
1.0
1.3
0.9
1.1
1.0
3.0
2.0
2.1
3.1
3.3
3.6
ppm
9,5
9
8,5
8
7,5
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6,5
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5,5
5
4,5
4
3,5
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2,5
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1,5
1
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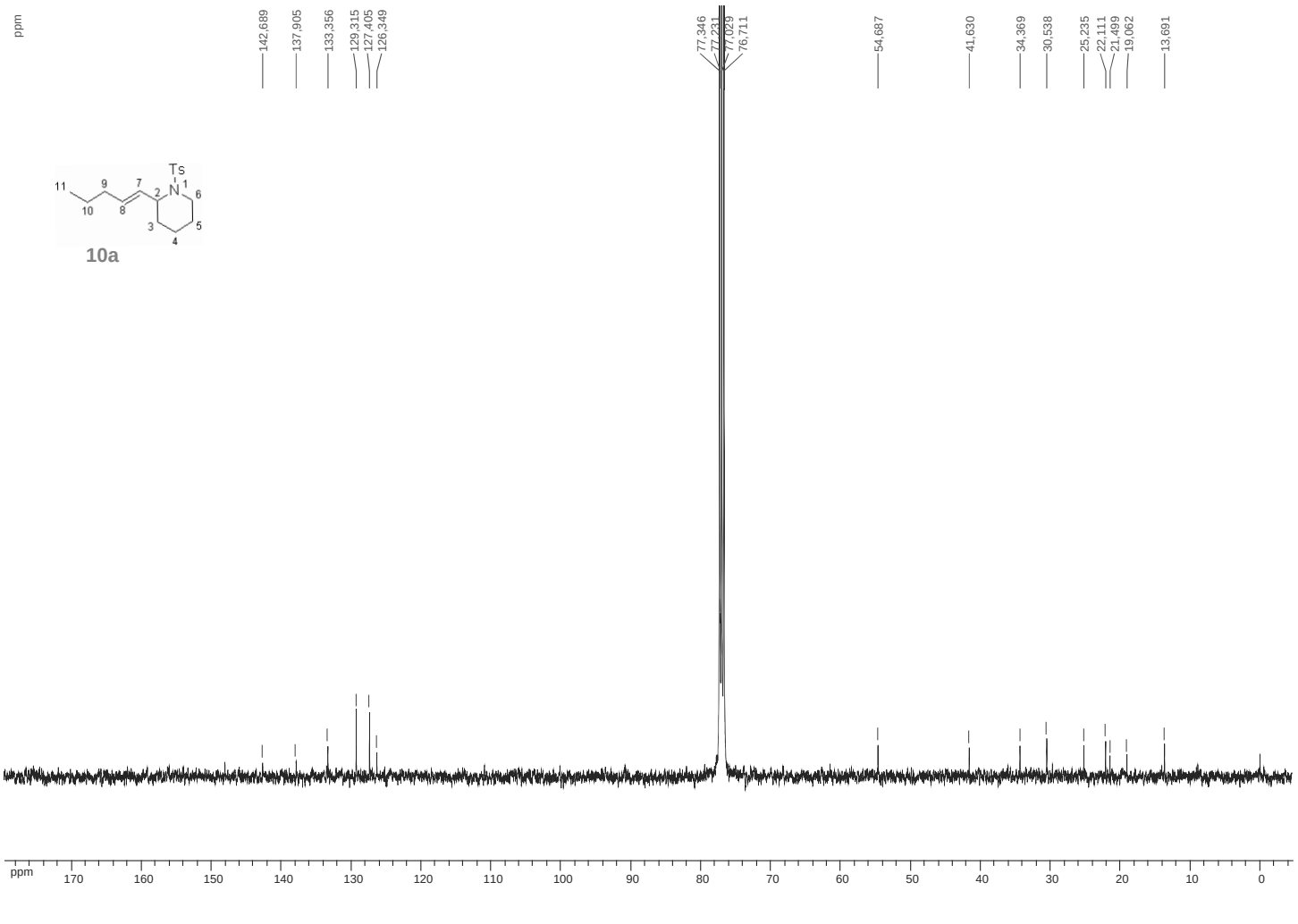
0


ppm
142,689
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127,405
126,349
77,346
77,231
77,029
76,711
54,687
41,630
34,369
30,538
25,235
22,111
21,499
19,062
13,691
Ts
10a
ppm
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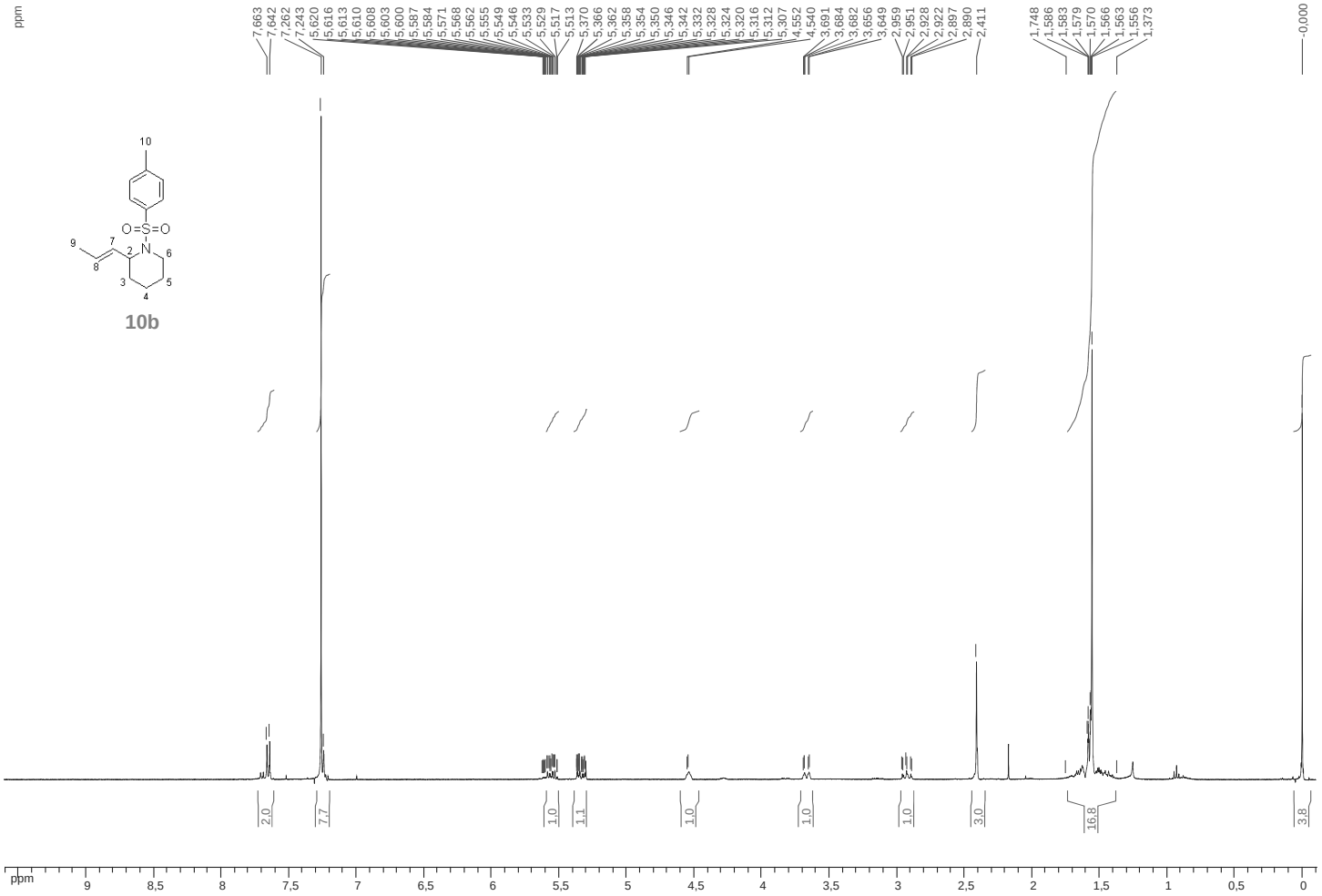
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0


ppm
7,663
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7,262
7,243
5,620
5,616
5,613
5,610
5,608
5,603
5,600
5,587
5,584
5,571
5,568
5,562
5,555
5,549
5,546
5,533
5,529
5,517
5,513
5,370
5,366
5,362
5,358
5,354
5,350
5,346
5,342
5,332
5,328
5,324
5,320
5,316
5,312
5,307
4,552
4,540
3,691
3,684
3,682
3,656
3,649
2,959
2,951
2,928
2,922
2,897
2,890
2,411
1,748
1,586
1,583
1,579
1,570
1,566
1,563
1,556
1,373
0,000
10
O=S=O
9
7
2
N
6
8
3
5
4
10b
2,0
7,7
1,0
1,1
1,0
1,0
1,0
3,0
16,8
3,8
ppm
9
8,5
8
7,5
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6,5
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5,5
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2,5
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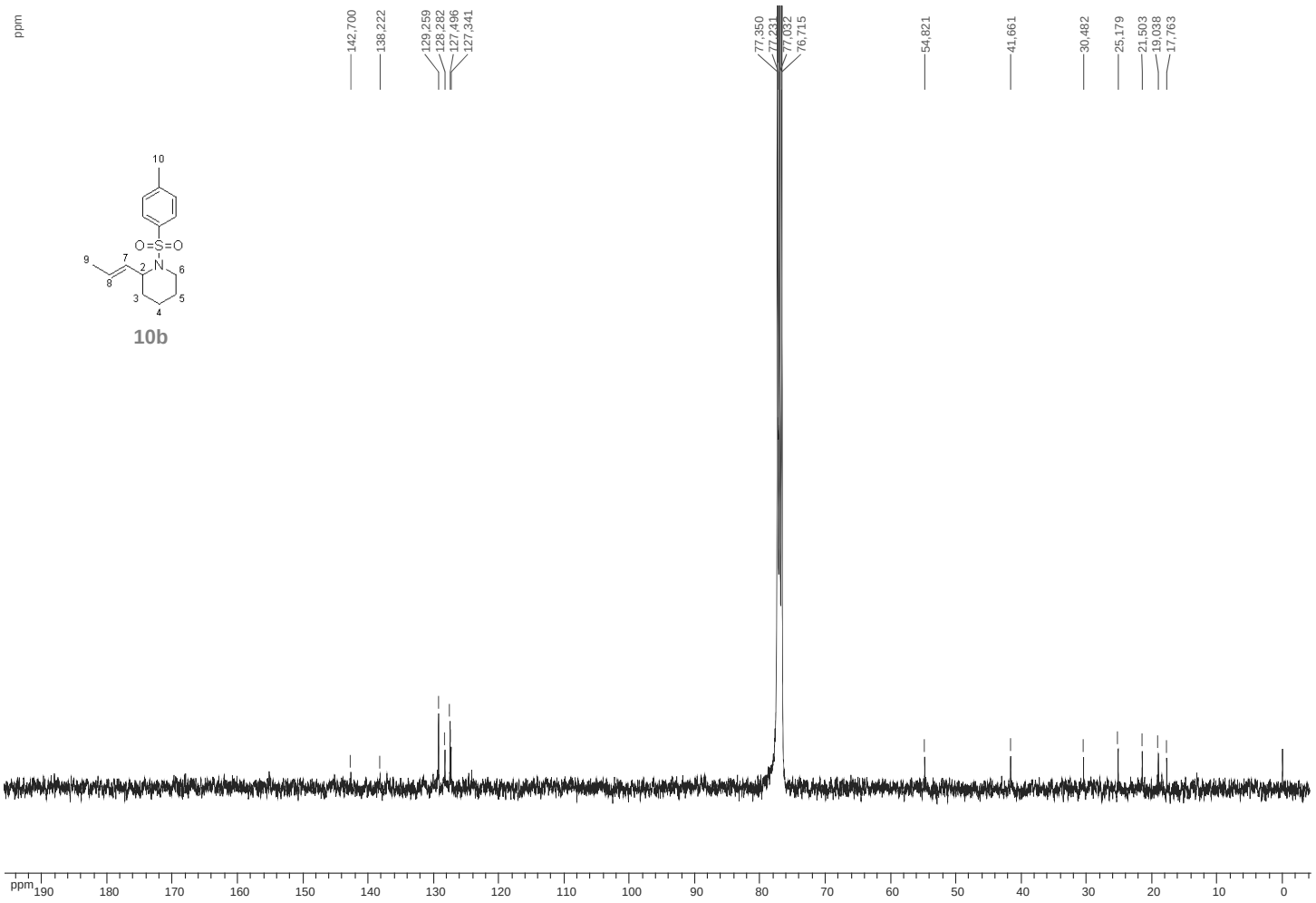
0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128,282
127,496
127,341
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77,231
77,032
76,715
54,821
41,661
30,482
25,179
21,503
19,038
17,763
10
O=S=O
9
7
2
N
6
8
3
5
4
10b
ppm
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180
170
160
150
140
130
120
110
100
90
80
70
60
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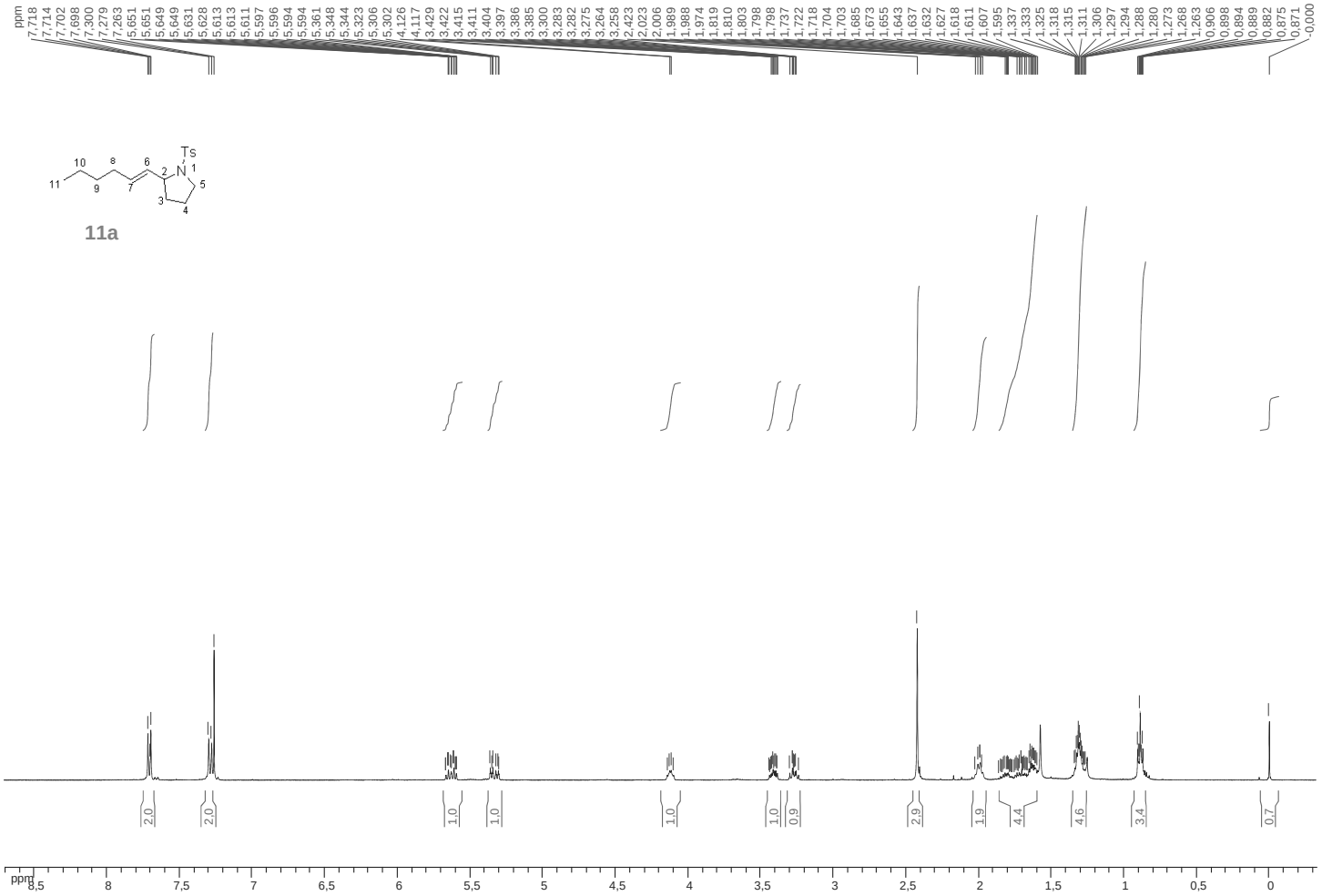
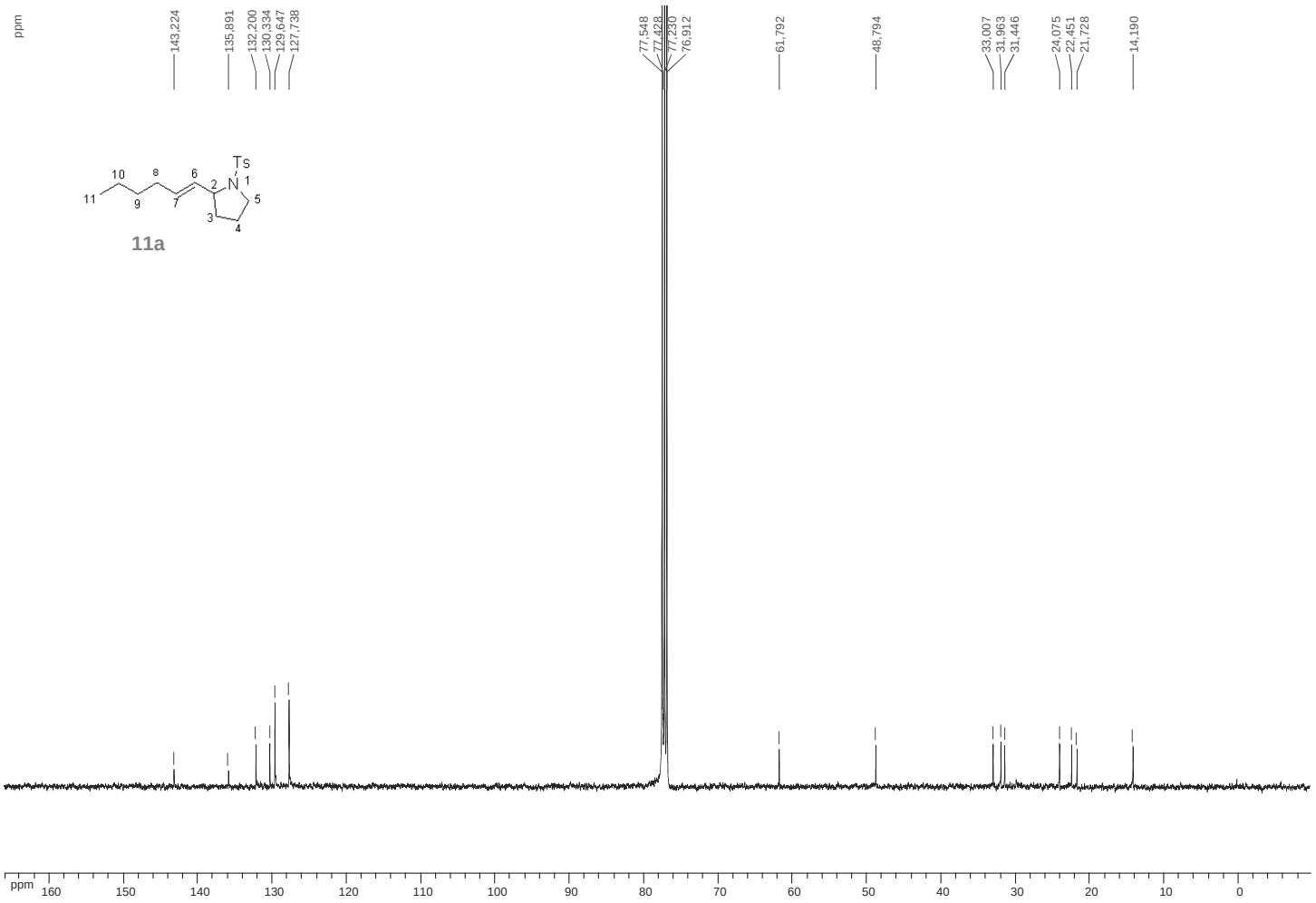
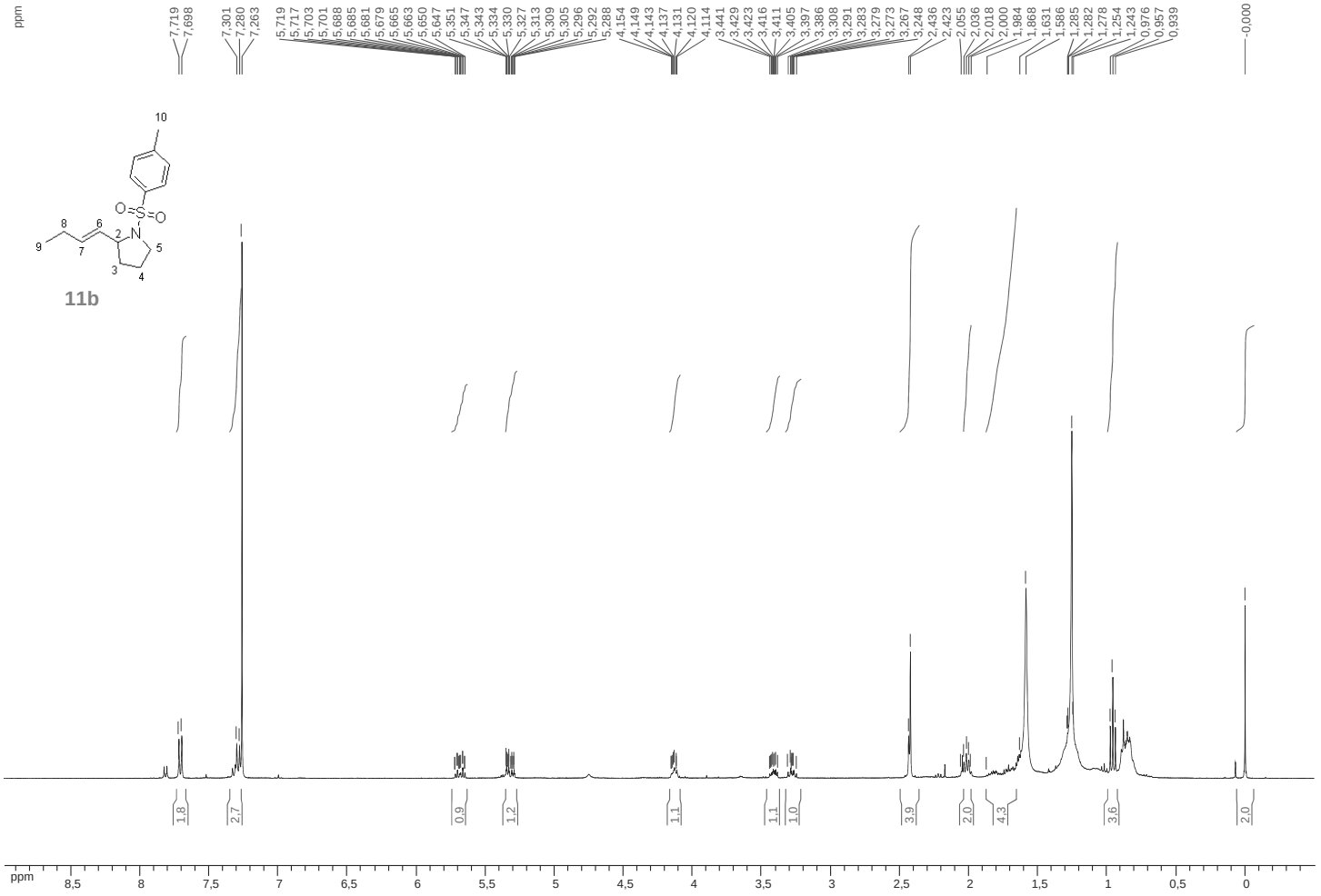
40
30
20
10
0




ppm
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7,263
5,719
5,717
5,703
5,701
5,688
5,685
5,681
5,679
5,665
5,663
5,650
5,647
5,351
5,347
5,343
5,334
5,330
5,327
5,313
5,309
5,305
5,296
5,292
5,288
4,154
4,149
4,143
4,137
4,131
4,120
4,114
3,441
3,429
3,423
3,416
3,411
3,405
3,397
3,386
3,308
3,291
3,283
3,279
3,273
3,267
3,248
2,436
2,423
2,055
2,036
2,018
2,000
1,984
1,868
1,631
1,586
1,285
1,282
1,278
1,254
1,243
0,976
0,957
0,939
0,000
10
8
6
2
N
5
9
7
3
4
11b
1,8
2,7
0,9
1,2
1,1
1,1
1,0
3,9
2,0
4,3
3,6
2,0
ppm
8,5
8
7,5
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5,5
5
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4
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2,5
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1
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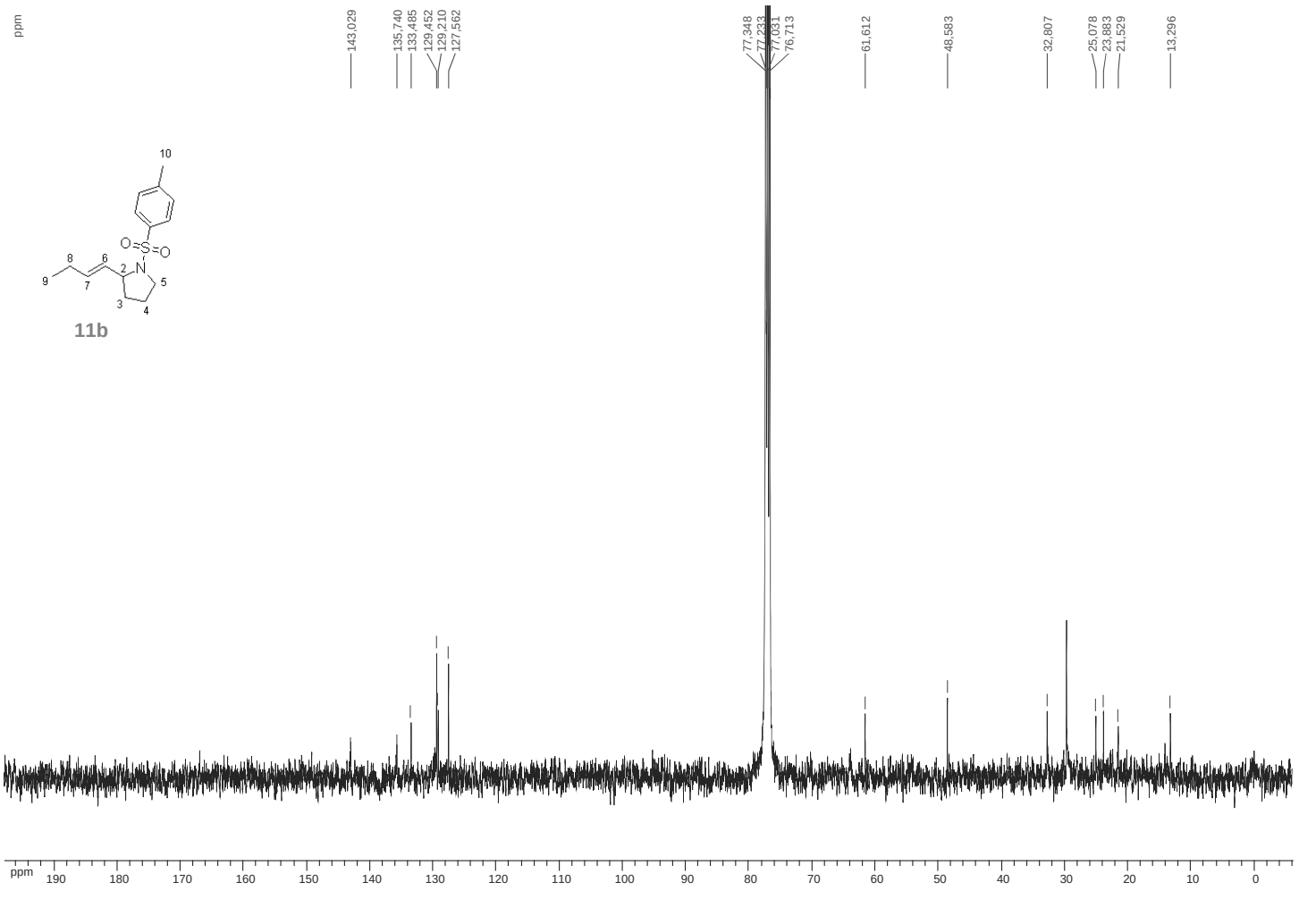
ppm
143,029
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129,210
127,562
77,348
77,233
77,031
76,713
61,612
48,583
32,807
25,078
23,883
21,529
13,296
10
8
6
2
N
5
9
7
3
4
11b
ppm
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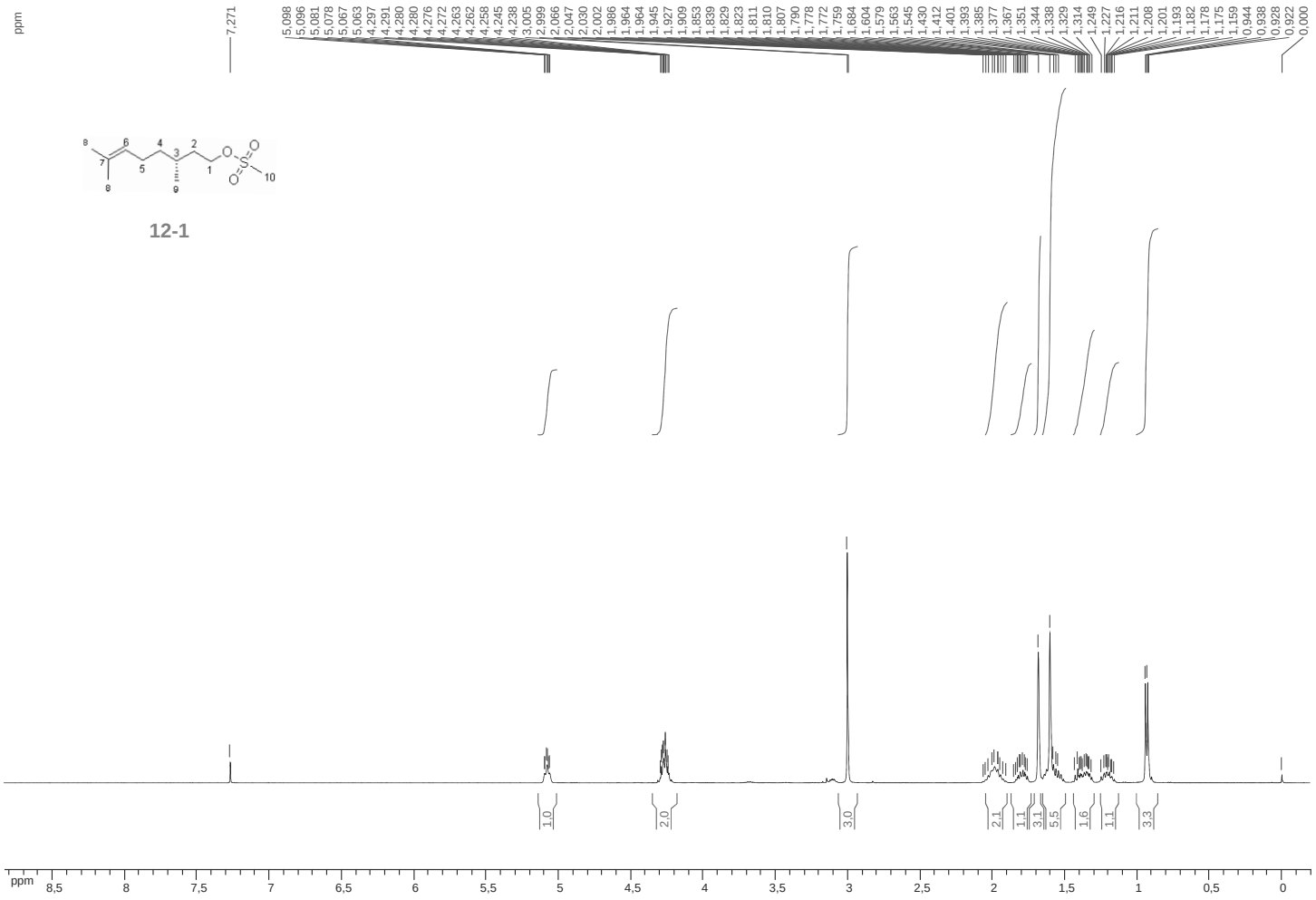
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0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5.078
5.067
5.063
4.297
4.291
4.280
4.280
4.276
4.272
4.263
4.262
4.258
4.245
4.238
3.005
2.999
2.066
2.047
2.030
2.002
1.986
1.964
1.964
1.945
1.927
1.909
1.853
1.839
1.829
1.823
1.811
1.810
1.807
1.790
1.778
1.772
1.759
1.684
1.604
1.579
1.563
1.545
1.430
1.412
1.401
1.393
1.385
1.377
1.367
1.351
1.344
1.338
1.329
1.314
1.249
1.227
1.216
1.211
1.208
1.201
1.193
1.182
1.178
1.175
1.159
0.944
0.938
0.928
0.922
0.000
1.0
2.0
3.0
2.1
1.1
3.1
5.5
1.6
1.1
3.3
ppm
8,5
8
7,5
7
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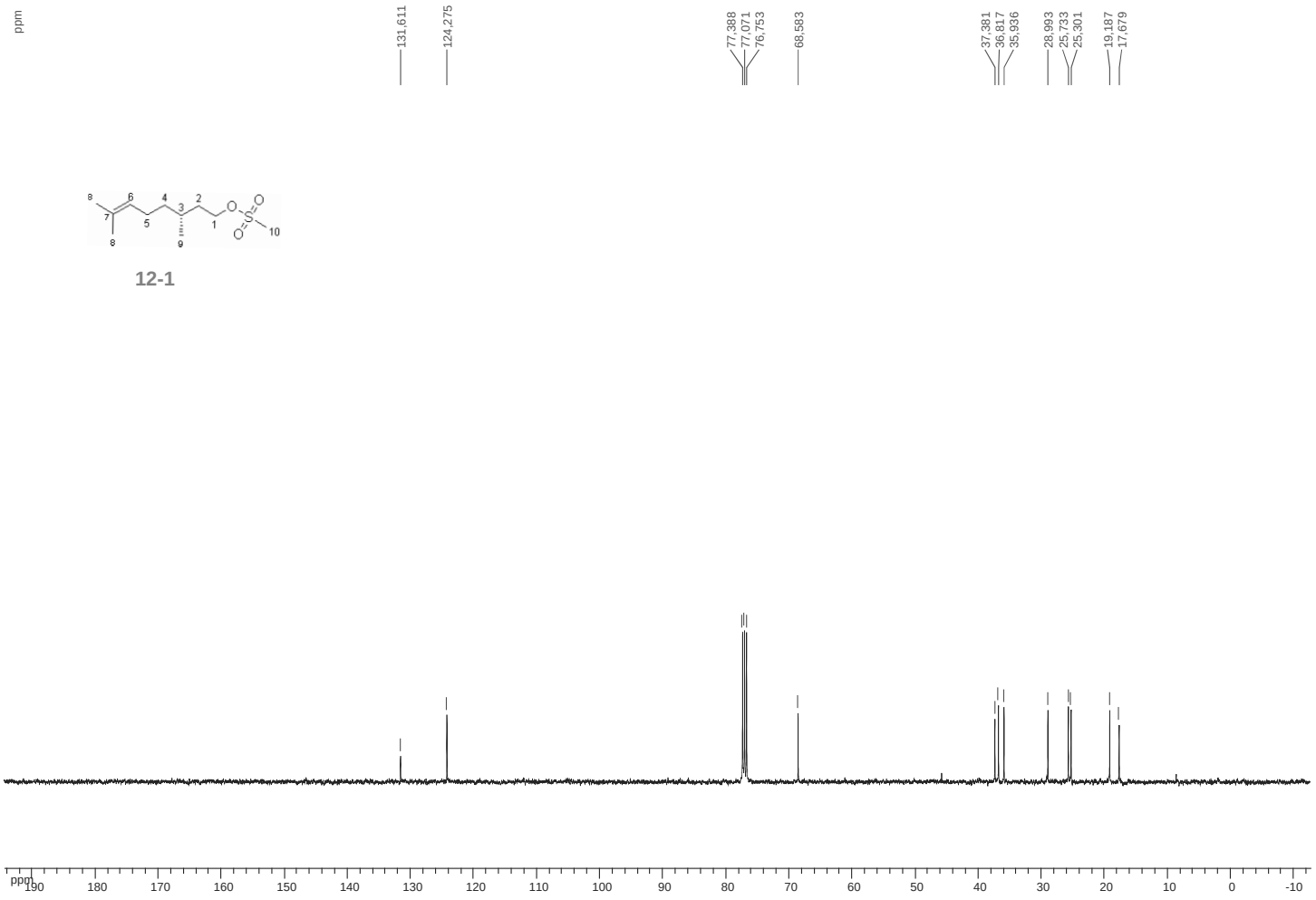
4,5
4
3,5
3
2,5
2
1,5
1
0,5
0

12-1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68,583
37,381
36,817
35,936
28,993
25,733
25,301
19,187
17,679
ppm
190
180
170
160
150
140
130
120
110
100
90
80
70
60
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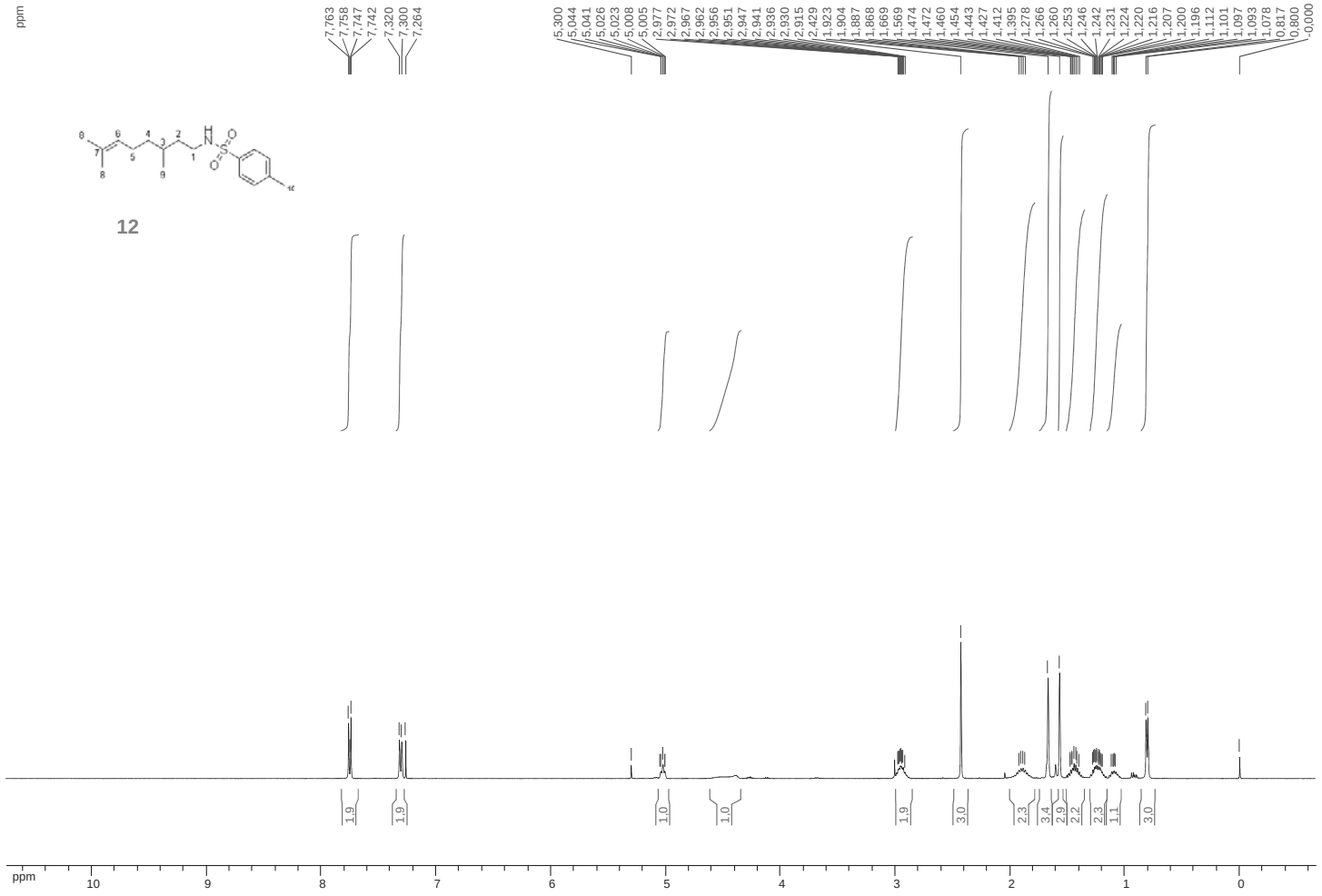
40
30
20
10
0
-10

12-1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7,742
7,320
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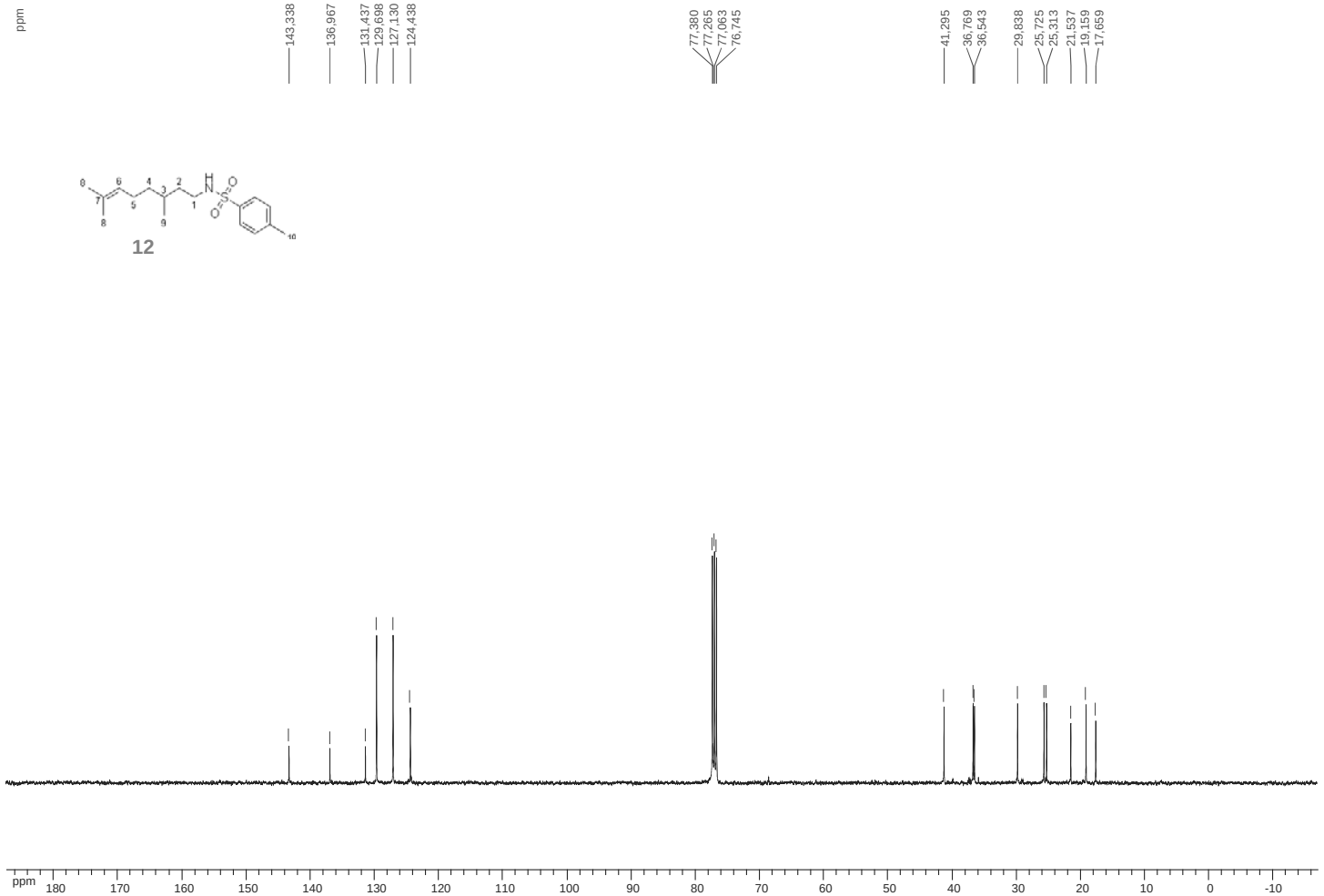
5,041
5,026
5,023
5,008
5,005
2,977
2,972
2,967
2,962
2,956
2,951
2,947
2,941
2,936
2,930
2,915
2,429
1,923
1,904
1,887
1,868
1,669
1,569
1,474
1,472
1,460
1,454
1,443
1,427
1,412
1,395
1,278
1,266
1,260
1,253
1,246
1,242
1,231
1,224
1,220
1,216
1,207
1,200
1,196
1,112
1,101
1,097
1,093
1,078
0,817
0,800
0,000
12
1,9
1,9
1,0
1,0
1,9
3,0
2,3
3,4
2,9
2,2
2,3
1,1
3,0
ppm
10
9
8
7
6
5
4
3
2
1
0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136,967
131,437
129,698
127,130
124,438
77,380
77,265
77,063
76,745
41,295
36,769
36,543
29,838
25,725
25,313
21,537
19,159
17,659
12
ppm
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
-10