Electronic Supplementary Material (ESI) for Organic Chemistry Frontiers.


**Supporting Information**

# Dearomatization of naphthols using oxy-allyl cations: efficient construction of α-all-carbon quaternary center-containing 2-(2-oxocycloalkyl)cycloalkyl diketones

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**Experimental procedures:**

**Experimental procedures:**

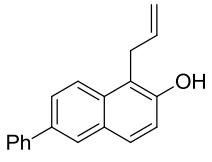
**1. General Information**

All reactions under standard conditions were carried out under argon atmosphere and were monitored by thin layer chromatography (TLC) on gel $F_{254}$ plates. Solvents were dried by standard methods and distilled under argon. $^{1}H$ and $^{13}C$ NMR spectra were recorded on Bruker AX-400 MHz instruments using $CDCl_3$ as solvent. Chemical shifts of $^{1}H$ NMR were recorded in parts per million (ppm, δ) relative to tetramethylsilane (δ = 0.00 ppm) with the solvent resonance as an internal standard ($CDCl_3$: δ = 7.26 ppm). NMR multiplicities are abbreviated as follows: s = singlet, d = doublet, t = triplet, sept = septet, m = multiplet, br = broad signal. High-resolution mass spectral analysis (HRMS) data were measured on a VG Auto Spec-3000 spectrometer by means of the ESI technique. Column chromatography was performed on silica gel (200–300 mesh). Melting point (m.p.) was measured on a microscopic melting point apparatus.

Compounds **1a-1q**,[1] **2d-2f**,[2] **2h**[2] **4a**[3] and **4d**[3] were prepared according to literature procedures. Compounds **2a**, **2b**, **2c** and **2g** are commercial available.

**2. Experimental Details for 1p**

Compound **1p** was prepared according to literature procedures.[1d]

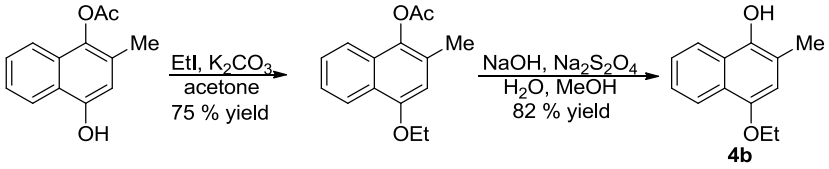



**1p**

Offwhite amorphous solid: **$^{1}$H NMR** (400 MHz, $CDCl_3$, ppm): δ 8.01-7.98 (m, 2H), 7.78-7.72 (m, 4H), 7.49 (t, *J* = 7.6 Hz, 2H), 7.38 (t, *J* = 7.6 Hz, 1H), 7.14 (d, *J* = 8.8 Hz, 1H), 6.16-6.07 (m, 1H), 5.17-5.09 (m, 3H), 3.87 (d, *J* = 5.6 Hz, 2H); **$^{13}$C NMR** (100 MHz, $CDCl_3$, ppm): δ 151.3 (C), 140.9 (C), 135.8 (C), 135.6 (CH), 132.4 (C), 129.7 (C), 128.8 (CH), 128.6 (CH), 127.2 (CH), 127.1 (CH), 126.4 (CH), 126.1 (CH), 123.6 (CH), 118.4 (CH), 116.7 (C), 116.0 ($CH_2$), 29.3 ($CH_2$); **HRMS** (ESI) calcd for $C_{19}H_{17}O_1$ $[M+H]^+$: 261.1274, found 261.1275.

**2. Experimental Details for 4b and 4c**

Compound **2b** and **2c** was prepared according to literature procedures.[3]




**4b**

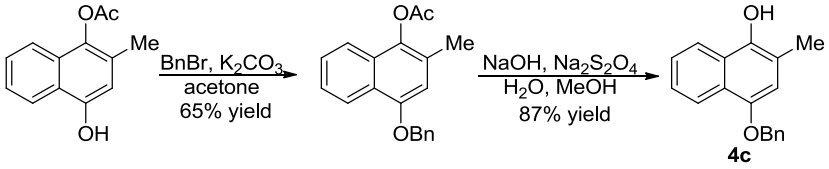
## 4-ethoxy-2-methylnaphthalen-1-yl acetate

Offwhite amorphous solid: **$^{1}$H NMR** (400 MHz, $CDCl_3$, ppm): δ 8.28 (d, *J* = 8.4 Hz, 1H), 7.70 (d, *J* = 8.4 Hz, 1H), 7.53 (td, *J* = 6.8, 1.2 Hz, 1H), 7.46 (td, *J* = 8.0, 1.2 Hz, 1H), 6.65 (s, 1H), 4.19 (q, *J* = 6.8 Hz, 2H), 2.48 (s, 3H), 2.33 (s, 3H),1.55 (t, *J* = 6.8 Hz, 3H); **$^{13}$C NMR** (100 MHz, $CDCl_3$, ppm): δ 169.5 (C), 152.5 (C), 137.4 (C), 127.6 (C), 127.0 (CH), 126.1 (C), 125.0 (C), 124.6 (CH), 122.4 (CH), 120.3 (CH), 107.0 (CH), 63.8 ($CH_2$), 20.5 ($CH_3$), 16.8 ($CH_3$), 14.8 ($CH_2$); **HRMS** (ESI) calcd for $C_{15}H_{16}O_3Na_1$ $[M+Na]^+$: 267.0992, found 267.0991.

## 4-ethoxy-2-methylnaphthalen-1-ol (**4b**)

Offwhite amorphous solid: **$^{1}$H NMR** (400 MHz, $CDCl_3$, ppm): δ 8.22 (d, *J* = 8.4 Hz, 1H), 8.06 (d, *J* = 8.0 Hz, 1H), 7.50 (t, *J* = 7.2 Hz, 1H), 7.44 (t, *J* = 7.6 Hz, 1H), 6.59 (s, 1H), 4.69-4.12 (m, 1H), 4.15 (q, *J* = 6.8 Hz, 2H), 2.39 (s, 3H), 1.53 (t, *J* = 6.8 Hz, 1H); **$^{13}$C NMR** (100 MHz, $CDCl_3$, ppm): δ 148.7 (C), 142.0 (C), 126.0 (CH), 125.4 (C),

125.2 (C), 124.6 (CH), 122.1 (CH), 120.7 (CH), 116.3 (C), 108.2 (CH), 64.2 ($CH_2$), 16.2 ($CH_3$),15.0 ($CH_3$);; **HRMS** (ESI) calcd for $C_{13}H_{15}O_2$ $[M+H]^+$: 203.1067, found 203.1067.



**4c**

## 4-(benzyloxy)-2-methylnaphthalen-1-yl acetate

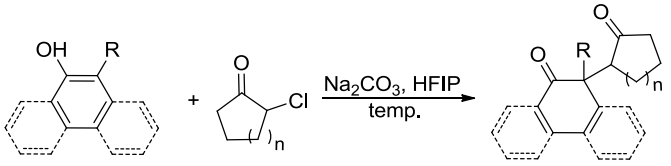
Offwhite amorphous solid: **$^1$H NMR** (400 MHz, $CDCl_3$, ppm): δ 8.29 (d, *J* = 8.0 Hz, 1H), 7.67 (d, *J* = 8.0 Hz, 1H), 7.51-7.48 (m, 3H), 7.43-7.39 (m, 3H), 7.36-7.20 (m, 1H), 6.71 (s, 1H), 5.18 (s, 2H), 2.44 (s, 3H), 2.29 (s, 3H); **$^{13}$C NMR** (100 MHz, $CDCl_3$, ppm): δ 169.4 (C), 152.2 (C), 137.8 (C), 136.9 (C), 128.5 (CH), 127.9 (CH), 127.7 (C), 127.4 (CH), 126.1 (C), 125.0 (C), 124.8 (CH), 122.5 (CH), 120.4 (CH), 107.5 (CH), 70.2 ($CH_2$), 20.5 ($CH_3$), 16.8 ($CH_3$); **HRMS** (ESI) calcd for $C_{20}H_{18}O_3Na_1$ $[M+Na]^+$: 329.1148, found 329.1149.

## 4-(benzyloxy)-2-methylnaphthalen-1-ol (**4c**)

Offwhite amorphous solid: **$^1$H NMR** (400 MHz, $CDCl_3$, ppm): δ 8.29 (d, *J* = 8.4 Hz, 1H), 8.09 (d, *J* = 8.4 Hz, 1H), 7.56-7.50 (m, 3H),7.48-7.42 (m, 3H), 7.39-7.35 (m, 1H), 6.69 (s, 1H), 5.20 (s, 2H), 4.73 (s, 1H), 2.40 (s, 3H); **$^{13}$C NMR** (100 MHz, $CDCl_3$, ppm): δ 148.4 (C), 142.3 (C), 137.4 (C), 128.5 (CH), 127.8 (CH), 127.4 (CH), 126.0 (CH), 125.4 (C), 125.2 (C), 124.8 (CH), 122.1 (CH), 120.7 (CH), 116.1 (C), 108.6 (CH), 70.5 ($CH_2$), 16.1 ($CH_3$); **HRMS** (ESI) calcd for $C_{18}H_{17}O_2$ $[M+H]^+$: 265.1223, found 265.1223.

**4. Experimental Details for 3**

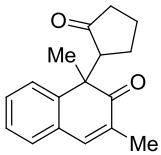
**Typical Procedure for dearomatization of naphthols using oxy-allyl cations: efficient Construction of α-all-carbon quaternary center containing 2-(2-oxocycloalkyl)cycloalkyl diketones**



**1** or **4** **2** **3**

Substrate **1** or **4** (0.1 mmol) and $Na_2CO_3$ were dissolved in HFIP (1 mL) under argon atmosphere. After which 2-haloketone **2** was added, the mixture was stirred at room temperature or 59 $^o$C. The reaction system was monitored by TLC until **1** or **4** disappeared completely. After which, the reaction mixture was concentrated under vacuum. Purification of the residue by column chromatography on silica gel (eluting with ethyl acetate/petroleum ether 20:1-10:1 ) provided **3**.

1,3-dimethyl-1-(2-oxocyclopentyl)naphthalen-2(1H)-one (**3a**):

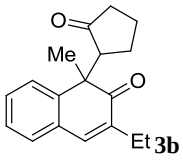


**3a**

Light yellow oil: **$^1$H NMR** (400 MHz, $CDCl_3$, ppm): δ 7.34-7.33 (m, 2H), 7.26-7.24 (m, 3H), 2.69 (t, *J* = 8.0 Hz, 1H), 2.67-2.49 (m, 1H), 2.25 (dd, *J* = 17.6, 7.6 Hz, 1H), 2.00 (s, 3H), 1.95-1.80 (m, 2H), 1.73-1.58 (m, 4H),

1.41-1.36 (m, 1H); **$^{13}$C NMR** (100 MHz, $CDCl_3$, ppm): δ 218.4 (C), 203.9 (C), 145.1 (C), 141.7 (CH),132.4 (C), 129.8 (C), 129.1 (CH), 128.9 (CH), 126.8 (CH), 126.0 (CH), 56.2 (C), 53.2 (CH), 39.9 ($CH_2$), 27.8 ($CH_2$), 27.7 ($CH_3$), 20.6 ($CH_2$), 15.8 ($CH_3$); **HRMS** (ESI) calcd for $C_{17}H_{18}O_2Na_1$ $[M+Na]^+$: 277.1199, found 277.1199.

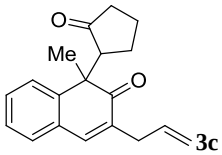
3-ethyl-1-methyl-1-(2-oxocyclopentyl)naphthalen-2(1H)-one (**3b**)**:**



**3b**

Light yellow oil: **$^{1}$H NMR** (400 MHz, $CDCl_3$, ppm): δ 7.37-7.30 (m, 2H), 7.28-7.24 (m, 3H), 7.18 (s, 1H), 2.68 (t, *J* = 9.2 Hz, 1H), 2.61-2.52 (m, 1H), 2.49-2.33 (m, 1H), 2.26 (dd, *J* = 16.0, 8.0 Hz, 1H),1.69-1.58 (m, 1H), 1.40-1.30 (m, 1H), 1.14 (t, *J* = 7.6 Hz, 3H); **$^{13}$C NMR** (100 MHz, $CDCl_3$, ppm): δ 218.5 (C), 203.5 (C), 145.0 (C), 139.8 (CH), 137.9 (C), 129.9 (C), 129.1 (CH), 129.1 (CH), 126.8 (CH), 125.9 (CH), 56.6 (C), 52.9 (CH), 40.0 ($CH_2$), 27.9 ($CH_2$), 27.6 ($CH_3$), 22.3 ($CH_2$), 20.6 ($CH_2$), 12.5 ($CH_3$); **HRMS** (ESI) calcd for $C_{18}H_{20}O_2Na_1$ $[M+Na]^+$: 291.1356, found 291.1356.

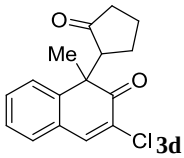
3-allyl-1-methyl-1-(2-oxocyclopentyl)naphthalen-2(1H)-one (**3c**):



**3c**

Offwhite amorphous solid; **$^{1}$H NMR** (400 MHz, $CDCl_3$, ppm): δ 7.36-7.33 (m, 2H),7.30-7.25 (m, 2H), 7.21 (s, 1H), 5.94-5.87 (m, 1H), 5.17-5.12 (m, 2H), 3.25-3.04 (m 2H), 2.70 (t, *J* = 9.2 Hz, 1H), 2.58-2.49 (m, 1H), 2.25 (dd, *J* = 17.6, 7.6 Hz, 1H), 1.93-1.80 (m, 2H), 1.65-1.59 (m, 4H), 1.39-1.33 (m, 1H); **$^{13}$C NMR** (100 MHz, $CDCl_3$, ppm): δ 218.3 (C), 203.0 (C), 145.1 (C), 141.5 (CH), 134.9 (CH), 134.5 (C), 129.7 (C), 129.3 (CH), 129.3 (CH),126.9 (CH), 126.0 (CH), 117.1 ($CH_2$), 56.4 (C), 53.2 (CH), 39.9 ($CH_2$), 33.2 ($CH_2$), 27.8 ($CH_2$), 27.7 ($CH_3$), 20.6 ($CH_2$); **HRMS** (ESI) calcd for $C_{19}H_{20}O_2Na_1$ $[M+Na]^+$: 303.1356, found 303.1353.

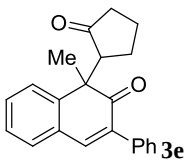
3-chloro-1-methyl-1-(2-oxocyclopentyl)naphthalen-2(1H)-one (**3d**):



**3d**

Colorless oil: **$^{1}$H NMR** (400 MHz, $CDCl_3$, ppm): δ 7.66 (s, 1H), 7.46-7.37 (m, 2H), 7.34-7.31 (m, 2H), 2.79 (t, *J* = 5.6 Hz, 1H), 2.51-2.41 (m, 1H), 2.26 (dd, *J* = 18.0, 5.6 Hz, 1H), 2.05-1.91 (m, 1H), 1.90-1.84 (m, 1H), 1.71-1.60 (m, 4H), 1.50-1.40 (m, 1H); **$^{13}$C NMR** (100 MHz, $CDCl_3$, ppm): δ 217.3 (C), 196.6 (C), 144.4 (C), 142.6 (CH), 130.4 (CH), 129.6 (CH), 129.5 (C), 128.8 (C), 127.4 (CH), 126.5 (CH), 57.4 (C), 54.4 (CH), 39.6 ($CH_2$), 27.6 ($CH_2$), 27.6 ($CH_3$), 20.6 ($CH_2$); **HRMS** (ESI) calcd for $C_{16}H_{15}ClO_2Na_1$ $[M+Na]^+$: 297.0653, found 297.0652.

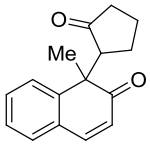
1-methyl-1-(2-oxocyclopentyl)-3-phenylnaphthalen-2(1H)-one (**3e**)**:**



**3e**

Light yellow oil: **$^1$H NMR** (400 MHz, $CDCl_3$, ppm): δ 7.51-7.43 (m, 3H), 7.41-7.30 (m, 7H), 2.74 (t, *J* = 9.6 Hz, 1H), 2.70-2.60 (m, 1H), 2.33-2.19 (m, 2H), 2.02-1.95 (m, 1H), 1.90-1.84 (m, 1H), 1.81 (s, 3H), 1.71-1.62 (m, 1H), 1.50-1.40 (m, 1H); **$^{13}$C NMR** (100 MHz, $CDCl_3$, ppm): δ 218.6 (C), 202.6 (C), 145.4 (C), 141.6 (CH), 135.4 (C), 135.2 (C), 130.1 (CH), 129.9 (CH), 129.8 (CH), 128.5 (CH), 128.3 (CH), 128.3 (CH), 127.1 (CH), 126.0 (CH), 58.1 (C), 52.4 (CH), 39.9 ($CH_2$), 28.2 ($CH_2$), 27.6 ($CH_3$), 20.7 ($CH_2$); **HRMS** (ESI) calcd for $C_{22}H_{20}O_2Na_1$ $[M+Na]^+$: 339.1356, found 339.1358.

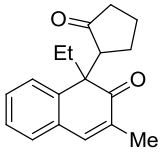
1-methyl-1-(2-oxocyclopentyl)naphthalen-2(1H)-one (**3f**)**:**



**3f**

Light yellow oil: **$^1$H NMR** (400 MHz, $CDCl_3$, ppm): δ 7.44-7.37 (m, 3H), 7.32-7.27 (m, 2H), 6.17 (d, *J* = 10.0 Hz, 1H), 2.70 (t, *J* = 8.0 Hz, 1H), 2.56-2.46 (m, 1H), 2.49 (dd, *J* = 16.0, 8.0 Hz, 1H), 1.94-1.81 (m, 2H), 1.67 (s, 3H), 1.63-1.55 (m, 1H), 1.44-1.34 (m, 1H); **$^{13}$C NMR** (100 MHz, $CDCl_3$, ppm): δ218.2 (C), 203.7 (C), 145.8 (C), 145,2 (CH),130.3 (CH), 129.8 (CH), 129.3 (C), 126.9 (CH), 126.3 (CH), 125.0 (CH), 56.3 (C), 53.3 (CH), 39.9 ($CH_2$), 27.8 ($CH_2$), 27.5 ($CH_3$), 20.7 ($CH_2$); **HRMS** (ESI) calcd for $C_{16}H_{16}O_2Na_1$ $[M+Na]^+$: 263.1043, found 263.1043.

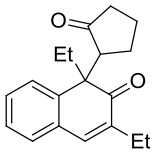
1-ethyl-3-methyl-1-(2-oxocyclopentyl)naphthalen-2(1H)-one (**3g**)**:**



**3g**

Light yellow oil: **$^1$H NMR** (400 MHz, $CDCl_3$, ppm): δ 7.37-7.29 (m, 2H), 7.28-7.26 (m, 3H), 2.74 (t, *J* = 8.8 Hz, 1H), 2.53-2.44 (m, 1H), 2.42-2.33 (m, 1H), 2.24-2.15 (m, 1H), 2.11-2.02 (m, 1H), 1.99 (s, 3H), 1.93-1.85 (m, 1H), 1.84-1.75 (m, 1H), 1.68-1.56 (m, 2H), 1.48-1.38 (m, 1H), 0.52 (t, *J* = 7.6 Hz, 3H); **$^{13}$C NMR** (100 MHz, $CDCl_3$, ppm): δ 217.9 (C), 204.5 (C), 142.9 (C), 142.2 (CH), 133.9 (C), 131.6 (C), 128.8 (CH), 128.7 (CH), 126.9 (CH), 126.6 (CH), 59.9 (C), 54.6 (CH), 39.9 ($CH_2$), 34.2 ($CH_2$), 27.4 ($CH_2$), 20.8 ($CH_2$), 15.7 ($CH_3$), 8.5 ($CH_3$); **HRMS** (ESI) calcd for $C_{18}H_{20}O_2Na_1$ $[M+Na]^+$: 291.1356, found 291.1355.

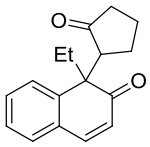
1,3-diethyl-1-(2-oxocyclopentyl)naphthalen-2(1H)-one (**3h**):



**3h**

Light yellow oil: **$^1$H NMR** (400 MHz, $CDCl_3$, ppm): δ 7.37-7.25 (m, 4H), 7.20 (s, 1H), 2.73 (t, *J* = 5.6 Hz, 1H), 2.53-2.33 (m, 4H), 2.24-2.17 (m, 1H), 2.12-2.03 (m, 1H), 1.92-1.76 (m, 2H), 1.67-1.55 (m, 1H), 1.45-1.35 (m, 1H), 1.15 (t, *J* = 7.6 Hz, 3H), 0.53 (t, *J* = 7.6 Hz, 3H); **$^{13}$C NMR** (100 MHz, $CDCl_3$, ppm): δ 217.9 (C), 204.0 (C), 142.9 (C), 140.4 (CH), 139.3 (C), 131.6 (C), 128.9 (CH), 128.8 (CH), 126.9 (CH), 126.5 (CH), 60.2 (C), 54.2 (CH), 40.0 ($CH_2$), 34.2 ($CH_2$), 27.4 ($CH_2$), 22.4 ($CH_2$), 20.8 ($CH_2$), 12.6 ($CH_3$), 8.5 ($CH_3$); **HRMS** (ESI) calcd for $C_{19}H_{23}O_2$ $[M+H]^+$: 283.1693, found 283.1693.

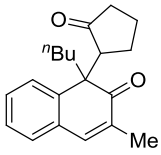
1-ethyl-1-(2-oxocyclopentyl)naphthalen-2(1H)-one (**3i**)**:**




**3i**

Light yellow oil: **$^1$H NMR** (400 MHz, $CDCl_3$, ppm): δ 7.46-7.31 (m, 5H), 6.25 (d, *J* = 10.0 Hz, 1H), 2.75 (t, *J* = 9.2 Hz, 1H), 2.58-2.49 (m, 1H), 2.41-2.35 (m, 1H), 2.28-2.12 (m, 1H), 2.13-2.04 (m, 1H), 1.93-1.79 (m, 2H), 1.68-1.56 (m, 1H), 1.51-1.41 (m, 1H), 0.55 (t, *J* = 7.2 Hz, 3H); **$^{13}$C NMR** (100 MHz, $CDCl_3$, ppm): δ 217.7 (C), 204.3 (C), 145.7 (CH), 143.7 (C), 131.0 (C), 130.0 (CH), 129.7 (CH), 127.0 (CH), 126.8 (CH), 126.6 (CH), 60.0 (C), 54.8 (CH), 39.9 ($CH_2$), 34.2 ($CH_2$), 27.3 ($CH_2$), 20.8 ($CH_2$), 8.5 ($CH_3$); **HRMS** (ESI) calcd for $C_{17}H_{18}O_2Na_1$ $[M+Na]^+$: 277.1199, found 277.1199.

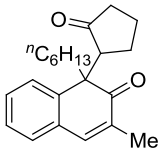
1-butyl-3-methyl-1-(2-oxocyclopentyl)naphthalen-2(1H)-one (**3j**)**:**




**3j**

Light yellow oil: **$^1$H NMR** (400 MHz, $CDCl_3$, ppm): δ 7.36-7.32 (m, 2H), 7.30-7.25 (m, 3H), 2.75 (t, *J* = 9.2 Hz, 1H), 2.47-2.38 (m, 1H), 2.36-2.28 (m, 1H), 2.22-2.16 (m, 1H), 2.05-1.97 (m, 4H), 1.93-1.85 (m, 1H), 1.83-1.74 (m, 1H), 1.68-1.55 (m, 1H), 1.49-1.39 (m, 1H), 1.19-1.05 (m, 2H), 0.88-0.75 (m, 2H), 0.71 (t, *J* = 7.2 Hz, 3H); **$^{13}$C NMR** (100 MHz, $CDCl_3$, ppm): δ 217.7 (C), 204.3 (C), 143.3 (C), 142.1 (CH), 133.8 (C), 131.4 (C), 128.8 (CH), 128.7 (CH), 126.8 (CH), 126.5 (CH), 59.2 (C), 55.2 (CH), 40.8 ($CH_2$), 39.8 ($CH_2$), 27.2 ($CH_2$), 26.1 ($CH_2$), 22.9 ($CH_2$), 20.8 ($CH_2$), 15.7 ($CH_3$), 13.8 ($CH_3$); **HRMS** (ESI) calcd for $C_{20}H_24O_2Na_1$ $[M+Na]^+$: 319.1669, found 319.1668.

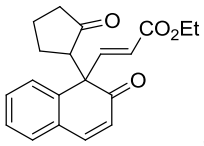
1-hexyl-3-methyl-1-(2-oxocyclopentyl)naphthalen-2(1H)-one (**3k**):




**3k**

Light yellow oil: **$^1$H NMR** (400 MHz, $CDCl_3$, ppm): δ 7.36-7.31 (m, 2H), 7.29-7.25 (m, 3H), 2.75 (t, *J* = 8.0 Hz, 1H), 2.46-2.38 (m, 1H), 2.36-2.29 (m, 1H), 2.22-2.15 (m, 1H), 2.04-1.97 (m, 4H), 1.93-1.85 (m, 1H), 1.83-1.74 (m, 1H), 1.67-1.57 (m, 1H), 1.48-1.38 (m, 1H), 1.15-1.00 (m, 6H), 0.86-0.75 (m, 5H); **$^{13}$C NMR** (100 MHz, $CDCl_3$, ppm): δ 217.7 (C), 204.4 (C), 143.3 (C), 142.1 (CH), 133.8 (C), 131.4 (C), 138.7 (CH), 128.7 (CH), 126.8 (CH), 126.5 (CH), 59.2 (C), 55.2 (CH), 41.1 ($CH_2$), 39.8 ($CH_2$), 31.5 ($CH_2$), 29.5 ($CH_2$), 27.2 ($CH_2$), 23.9 ($CH_2$), 22.5 ($CH_3$), 20.8 ($CH_2$), 15.8 ($CH_2$), 14.0 ($CH_3$); **HRMS** (ESI) calcd for $C_{22}H_{28}O_2Na_1$ $[M+Na]^+$: 347.1982, found 347.1983.

(E)-ethyl 3-(2-oxo-1-(2-oxocyclopentyl)-1,2-dihydronaphthalen-1-yl)acrylate (**3l**)**:**

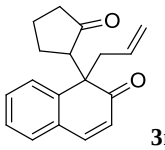



**3l**

Offwhite amorphous solid: **$^1$H NMR** (400 MHz, $CDCl_3$, ppm): δ 7. 45 (d, *J* = 10.0 Hz, 1H), 7.43-7.30 (m, 6H), 6.12 (d, *J* = 10.0 Hz, 1H), 5.36 (d, *J* = 15.6 Hz, 1H), 4.14 (q, *J* = 7.2 Hz, 2H), 3.26 (dd, *J* = 10.4, 8.4 Hz, 1H), 2.31

(dd, *J* = 18.0, 6.8, 1H), 2.09-1.95 (m, 2H), 1.90-1.84 (m, 1H), 1.77-1.65 (m, *2*H), 1.24 (t, *J* = 7.2 Hz, 3H); **$^{13}$C NMR** (100 MHz, $CDCl_3$, ppm): δ 218.1 (C), 198.6 (C), 165.8 (C), 149.7 (CH), 145.9 (CH), 140.8 (CH), 130.7 (C), 130.5 (CH), 130.3 (CH), 128.7 (CH), 128.0 (CH), 124.7 (CH), 122.2 (CH), 60.5 (CH), 58.8 (C), 58.3 ($CH_2$), 39.2 ($CH_2$), 26.2 ($CH_2$), 20.5 ($CH_2$), 14.2 ($CH_3$); **HRMS** (ESI) calcd for $C_{20}H_{20}O_4Na_1$ $[M+Na]^+$: 347.1254, found 347.1254.

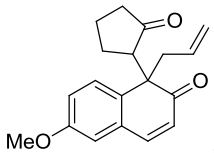
1-allyl-1-(2-oxocyclopentyl)naphthalen-2(1H)-one (**3m**):



**3m**

White solid: **m.p.** 119-121 °C; **$^1$H NMR** (400 MHz, $CDCl_3$, ppm): δ 7.44-7.40 (m, 2H), 7.37-7.28 (m, 3H), 6.18 (d, *J* = 10.0 Hz, 1H), 5.36-5.26 (m, 1H), 4.85 (d, *J* = 8.0 Hz, 1H), 4.82 (s, 1H), 3.10 (dd, *J* = 13.2, 8.0 Hz, 1H), 2.89 (dd, *J* = 13.2, 6.8 Hz, 1H), 2.74 (t, *J* = 9.2 Hz, 1H), 2.50-2.40 (m, 1H), 2.28-2.22 (m, 1H), 1.92-1.80 (m, 2H), 1.68-1.53 (m, 2H), 1.47-1.37 (m, 1H); **$^{13}$C NMR** (100 MHz, $CDCl_3$, ppm): δ 217.7 (C), 203.5 (C), 145.6 (CH), 143.1 (C), 132.1 (CH), 130.6 (C), 129.8 (CH), 129.7 (CH), 127.1 (CH), 127.1 (CH), 126.1 (C), 119.0 ($CH_2$), 60.0 (C), 53.2 (CH), 44.8 ($CH_2$), 40.1 ($CH_2$), 27.4 ($CH_2$), 20.8 ($CH_2$); **HRMS** (ESI) calcd for $C_{18}H_{18}O_2Na_1$ $[M+Na]^+$: 289.1199, found 289.1200.

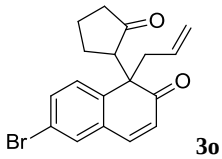
1-allyl-6-methoxy-1-(2-oxocyclopentyl)naphthalen-2(1H)-one (**3n**)**:**



**3n**

Colorless oil: **$^1$H NMR** (400 MHz, $CDCl_3$, ppm): δ 7. 36 (d, *J* = 10.0 Hz, 1H), 7.26 (d, *J* = 8.4 Hz, 1H), 6.96 (d, *J* = 8.8 Hz, 1H), 6.83 (s, 1H), 6.19 (d, *J* = 9.6 Hz, 1H), 5.36-5.26 (m, 1H), 4.86 (d, *J* = 10.8 Hz, 1H), 4.82 (s, 1H), 3.85 (s, 3H), 3.07 (dd, *J* = 13.2, 8.0 Hz, 1H), 2.84 (dd, *J* = 13.2, 6.8 Hz, 1H), 2.72 (t, *J* = 9.6 Hz, 1H), 2.46-2.37 (m, 1H), 2.26-2.17 (m, 1H), 1.68-1.56 (m, 1H), 1.48-1.38 (m, 1H); **$^{13}$C NMR** (100 MHz, $CDCl_3$, ppm): δ 217.8 (C), 203.8 (C), 158.2 (C), 145.4 (C), 135.0 (C), 132.2 (CH), 131.6 (C), 128.3 (CH), 126.6 (CH), 118.9 ($CH_2$), 115.7 (CH), 114.2 (CH), 59.3 (C), 55.4 (CH), 53.7 ($CH_3$), 44.9 ($CH_2$), 40.1 ($CH_2$), 27.3 ($CH_2$), 20.8 ($CH_2$); **HRMS** (ESI) calcd for $C_{19}H_{20}O_3Na_1$ $[M+Na]^+$: 319.1305, found 319.1305.

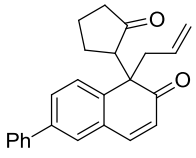
1-allyl-6-bromo-1-(2-oxocyclopentyl)naphthalen-2(1H)-one (**3o**)**:**



**3o**

Light yellow oil: **$^1$H NMR** (400 MHz, $CDCl_3$, ppm): δ 7. 52 (dd, *J* = 8.0, 1.6 Hz, 1H), 7.47 (d, *J* = 1.6 Hz, 1H), 7.33 (d, *J* = 10.0 Hz, 1H), 7.23 (d, *J* = 8.4 Hz, 1H), 6.22 (d, *J* = 10.0 Hz, 1H), 5.37-5.26 (m, 1H), 4.87 (s, 1H), 4.83 (d, *J* = 9.2 Hz, 1H), 3.05 (dd, *J* = 13.2, 7.6 Hz, 1H), 2.86 (dd, *J* = 13.2, 7.2 Hz, 1H), 2.73 (t, *J* = 10.4 Hz, 1H), 2.46-2.39 (m, 1H), 2.28-2.17 (m, 1H), 1.94-1.83 (m, *2*H), 1.70-1.59 (m, 1H), 1.48-1.38 (m, 1H); **$^{13}$C NMR** (100 MHz, $CDCl_3$, ppm): δ 217.2 (C), 202.8 (C), 143.9 (C), 141.7 (C), 132.5 (CH), 132.4 (CH), 132.2 (CH), 131.7 (CH), 128.8 (CH), 127.2 (CH), 120.9 (C), 119.5 ($CH_2$), 59.6 (C), 53.3 (CH), 44.6 ($CH_2$), 39.9 ($CH_2$), 27.3 ($CH_2$), 20.8 ($CH_2$); **HRMS** (ESI) calcd for $C_{18}H_{17}Br_1O_2Na_1$ $[M+Na]^+$: 367.0304, found 367.0305.

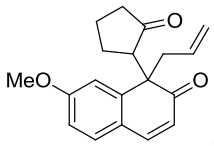
1-allyl-1-(2-oxocyclopentyl)-6-phenylnaphthalen-2(1H)-one (**3p**)：




**3p**

Colorless oil: **$^1$H NMR** (400 MHz, $CDCl_3$, ppm): δ 7.63-7.61 (m, 3H), 7.54 (d, *J* = 1.6 Hz, 1H), 7.49-7.39 (m, 5H), 6.23 (d, *J* = 10.0 Hz, 1H), 5.40-5.34 (m, 1H), 4.91-4.85 (m, 1H), 3.12 (dd, *J* = 13.2, 7.6 Hz, 1H), 2.93 (dd, *J* =13.2, 6.8 Hz, 1H), 2.79 (t, *J* = 9.2 Hz,1H), 2.50-2.41 (m, 1H), 2.26 (ddd, *J* = 17.6, 8.0, 1.2 Hz, 1H), 1.98-1.82 (m, 2H), 1.70-1.58 (m, 1H), 1.53-1.43 (m, 1H); **$^{13}$C NMR** (100 MHz, $CDCl_3$, ppm): δ 217.8 (C), 203.5 (C), 145.6 (CH), 141.9 (CH), 140.0 (C), 139.6 (C), 132.1 (CH), 131.0 (C), 129.0 (CH), 128.4 (CH), 128.2 (CH), 127.8 (CH), 127.7 (CH), 127.0 (CH), 126.5 (CH), 119.2 ($CH_2$), 59.8 (C), 53.4 (CH), 44.8 ($CH_2$), 40.1 ($CH_2$), 27.4 ($CH_2$), 20.8 ($CH_2$); **HRMS** (ESI) calcd for $C_{24}H_{22}O_2Na_1$ $[M+Na]^+$: 365.1512, found 365.1511.

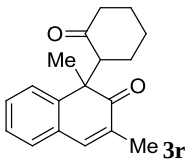
1-allyl-7-methoxy-1-(2-oxocyclopentyl)naphthalen-2(1H)-one (**3q**)：




**3q**

Light yellow oil: **$^1$H NMR** (400 MHz, $CDCl_3$, ppm): δ 7. 37 (d, *J* = 9.6 Hz, 1H), 7.27 (d, *J* = 8.0 Hz, 1H), 6.89 (s, 1H), 6.82 (dd, *J* = 8.4, 2.4 Hz, 1H), 6.06 (d, *J* = 10.0 Hz, 1H), 5.40-5.29 (m, 1H), 4.89-4.84 (m, 1H), 3.86 (s, 3H), 3.10 (dd, *J* = 12.8, 7.6 Hz, 1H), 2.85 (dd, *J* = 13.6, 6.8 Hz, 1H), 2.67 (t, *J* = 9.6 Hz, 1H), 2.52-2.42 (m, 1H), 2.27-2.21 (m, 1H), 1.94-1.80 (m, 2H), 1.68-1.56 (m, 1H), 1.47-1.37 (m, 1H); **$^{13}$C NMR** (100 MHz, $CDCl_3$, ppm): δ 217.8 (C), 203.3 (C), 161.2 (C), 145.6 (CH), 145.5 (C), 132.2 (CH), 131.2 (CH), 123.9 (C), 123.6 (CH), 119.0 ($CH_2$), 114.3 (CH), 111.4 (CH), 60.2 (C), 55.5 ($CH_3$), 53.2 (CH), 45.1 ($CH_2$), 40.1 ($CH_2$), 27.4 ($CH_2$), 20.8 ($CH_2$); **HRMS** (ESI) calcd for $C_{19}H_{20}O_3Na_1$ $[M+Na]^+$: 319.1305, found 319.1305.

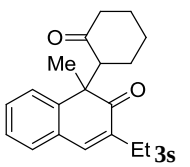
1,3-dimethyl-1-(2-oxocyclohexyl)naphthalen-2(1H)-one (**3r**)：




**3r**

Light yellow oil: **$^1$H NMR** (400 MHz, $CDCl_3$, ppm): δ 7.31-7.18 (m, 5H), 3.32 (dd, *J* = 12.0, 6.4 Hz, 1H), 2.52-2.44 (m, 2H), 2.27-2.23 (m, 1H), 2.10-1.90 (m, 5H), 1.71-1.59 (m, 2H), 1.30 (s, 3H); **$^{13}$C NMR** (100 MHz, $CDCl_3$, ppm): δ 209.8 (C), 204.2 (C), 147.0 (C), 140.3 (CH),132.8 (C), 130.3 (C), 128.8 (CH), 128.4 (CH), 126.3 (CH), 125.2 (CH), 63.5 (CH), 49.1 (C), 42.5 ($CH_2$), 30.0 ($CH_2$), 27.1 ($CH_2$), 26.8 ($CH_3$), 26.2 ($CH_2$), 16.1 ($CH_3$); **HRMS** (ESI) calcd for $C_{18}H_{20}O_2Na_1$ $[M+Na]^+$: 291.1356, found 291.1355.

3-ethyl-1-methyl-1-(2-oxocyclohexyl)naphthalen-2(1H)-one (**3s**)：

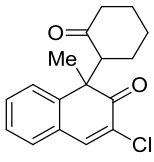



**3s**

Light yellow oil: **$^1$H NMR** (400 MHz, $CDCl_3$, ppm): δ 7.37-7.19 (m, 5H), 3.32 (t, *J* = 12.0, 6.0 Hz, 1H), 2.52-2.41

(m, 4H), 2.27-2.23 (m, 1H), 2.19-2.11 (m, 1H), 2.03-1.93 (m, 2H), 1.71-1.60 (m, 2H), 1.30 (s, 3H), 1.17 (t, *J* = 7.6 Hz, 3H); **$^{13}$C NMR** (100 MHz, $CDCl_3$, ppm): δ 209.8 (C), 203.7 (C), 146.8 (C), 138.5 (CH), 138.1 (C), 130.3 (C), 129.0 (CH), 128.4 (CH), 126.3 (CH), 125.1 (CH), 63.2 (CH), 49.2 (C), 42.5 ($CH_2$), 30.0 ($CH_2$), 27.1 ($CH_2$), 26.6 ($CH_3$), 26.2 ($CH_2$), 22.2 ($CH_2$), 12.4 ($CH_3$); **HRMS** (ESI) calcd for $C_{19}H_{22}O_2Na_1$ $[M+Na]^+$: 305.1512, found 305.1512.

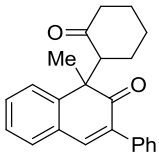
3-chloro-1-methyl-1-(2-oxocyclohexyl)naphthalen-2(1H)-one (**3t**)：



**3t**

White amorphous powder: **$^1$H NMR** (400 MHz, $CDCl_3$, ppm): δ 7.67 (s, 1H), 7.36-7.23 (m, 4H), 3.35 (dd, *J* = 11.6, 6.8 Hz, 1H), 2.57-2.48 (m, 2H), 2.28-2.25 (m, 1H), 2.18-2.02 (m, 3H), 1.73-1.61 (m, 2H), 1.35 (s, 3H); **$^{13}$C NMR** (100 MHz, $CDCl_3$, ppm): δ 209.4 (C), 196.5 (C), 146.7 (C), 140.8 (CH), 130.7 (C), 129.7 (CH), 129.3 (CH), 129.3 (C), 126.8 (CH), 125.4 (CH), 64.5 (CH), 51.0 (C), 42.3 ($CH_2$), 29.8 ($CH_2$), 27.1 ($CH_2$), 26.8 ($CH_3$), 26.2 ($CH_2$); **HRMS** (ESI) calcd for $C_{17}H_{17}Cl_1O_2Na_1$ $[M+Na]^+$: 311.0809, found 311.0809.

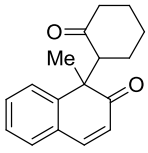
1-methyl-1-(2-oxocyclohexyl)-3-phenylnaphthalen-2(1H)-one (**3u**)：



**3u**

White amorphous powder: **$^1$H NMR** (400 MHz, $CDCl_3$, ppm): δ 7.54-7.50 (m, 3H), 7.43-7.30 (m, 7H), 7.28-7.23 (M, 1H), 3.37 (dd, *J* = 12.4, 6.0 Hz, 1H), 2.58-2.43 (m, 2H), 2.30-2.26 (m, 1H), 2.23-2.13 (m, 1H), 2.04-1.96 (m, 2H), 1.69-1.64 (m, 2H), 1.59 (s, 3H); **$^{13}$C NMR** (100 MHz, $CDCl_3$, ppm): δ 209.7 (C), 202.5 (C), 147.4 (C), 141.3 (CH), 136.4 (C), 135.9 (C), 130.2 (C), 130.0 (CH), 129.2 (CH), 129.0 (CH), 128.9 (CH), 128.0 (CH), 127.8 (CH), 126.6 (CH), 125.3 (CH), 63.4 (CH), 50.1 (C), 42.5 ($CH_2$), 30.1 ($CH_2$), 27.1 ($CH_2$), 26.5 ($CH_3$), 26.3 ($CH_2$); **HRMS** (ESI) calcd for $C_{23}H_{22}O_2Na_1$ $[M+Na]^+$: 353.1512, found 353.1513.

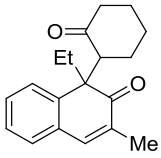
1-methyl-1-(2-oxocyclohexyl)naphthalen-2(1H)-one (**3v**)：



**3v**

Light yellow oil: **$^1$H NMR** (400 MHz, $CDCl_3$, ppm): δ 7.54 (d, *J* = 9.6 Hz, 1H), 7.36-7.31 (m, 3H), 7.26-7.21 (m, 1H), 6.20 (d, *J* = 9.6 Hz, 1H), 3.33 (dd, *J* = 11.2, 6.8 Hz, 1H), 2.51-2.42 (m, 2H), 2.28-2.27 (m, 1H), 2.25-2.08 (m, 1H), 2.04-1.99 (m, 2H), 1.70-1.61 (m, 2H), 1.33 (s, 3H); **$^{13}$C NMR** (100 MHz, $CDCl_3$, ppm): δ 209.7 (C), 204.2 (C), 147.6 (C), 143.7 (CH), 129.7 (CH), 129.6 (C), 129.6 (CH), 126.4 (CH), 126.0 (CH), 125.4 (CH), 63.3 (CH), 49.4 (C), 42.5 ($CH_2$), 30.0 ($CH_2$), 27.1 ($CH_2$), 26.6 ($CH_3$), 26.2 ($CH_2$); **HRMS** (ESI) calcd for $C_{17}H_{18}O_2Na_1$ $[M+Na]^+$: 277.1199, found 277.1199.

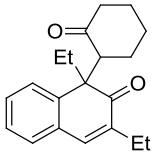
1-ethyl-3-methyl-1-(2-oxocyclohexyl)naphthalen-2(1H)-one (**3w**)：



**3w**

Light yellow oil: **$^{1}$H NMR** (400 MHz, $CDCl_3$, ppm): δ 7.28-7.19 (m, 5H), 3.31 (dd, *J* = 12.8, 5.2 Hz, 1H), 2.49-2.32 (m, 2H), 2.23-2.08 (m, 3H), 2.05-1.97 (m, 5H), 1.81-1.72 (m, 1H), 1.69-1.58 (m, 2H), 0.37 (t *J* = 7.6 Hz, 3H); **$^{13}$C NMR** (100 MHz, $CDCl_3$, ppm): 210.0 (C), 204.5 (C), 145.1 (C), 140.4 (CH), 134.6 (C), 132.4 (C), 128.4 (CH), 128.3 (CH), 126.3 (CH), 125.4 (CH), 64.8 (CH), 53.5 (C), 42.8 ($CH_2$), 34.2 ($CH_2$), 29.7 ($CH_2$), 27.4 ($CH_2$), 26.3 ($CH_2$), 15.9 ($CH_3$), 7.9 ($CH_3$); **HRMS** (ESI) calcd for $C_{19}H_{22}O_2Na_1$ $[M+Na]^+$: 305.1512, found 305.1512.

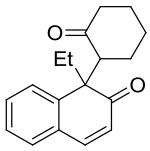
1,3-diethyl-1-(2-oxocyclohexyl)naphthalen-2(1H)-one (**3x**)**:**



**3x**

Light yellow oil: **$^{1}$H NMR** (400 MHz, $CDCl_3$, ppm): δ 7.30-7.25 (m, 3H), 7.24-7.21 (m, 1H), 7.19 (s, 1H), 3.30 (dd, *J* = 12.8, 7.6 Hz, 1H), 2.51-2.31 (m, 4H), 2.24-2.08 (m, 3H), 2.04-1.96 (m, 2H), 1.82-1.73 (m, 1H), 1.69-1.58 (m, 2H), 1.17 (t, *J* = 7.2 Hz, 3H), 0.38 (t, *J* = 7.6 Hz, 3H); **$^{13}$C NMR** (100 MHz, $CDCl_3$, ppm): δ 209.9 (C), 204.0 (C), 145.0 (C), 139.9 (C), 138.8 (CH), 132.4 (C), 128.6 (CH), 128.3 (CH), 126.3 (CH), 125.4 (CH), 64.6 (CH), 53.6 (C), 42.8 ($CH_2$), 34.2 ($CH_2$), 29.8 ($CH_2$), 27.4 ($CH_2$), 26.3 ($CH_2$), 22.3 ($CH_2$), 12.6 ($CH_3$), 7.9 ($CH_3$); **HRMS** (ESI) calcd for $C_{20}H_{24}O_2Na_1$ $[M+Na]^+$: 319.1669, found 319.1669.

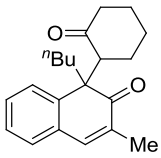
1-ethyl-1-(2-oxocyclohexyl)naphthalen-2(1H)-one (**3y**)**:**



**3y**

Light yellow oil: **$^{1}$H NMR** (400 MHz, $CDCl_3$, ppm): δ 7.42 (d, *J* = 9.6 Hz, 1H), 7.36-7.30 (m, 3H), 7.27-7.22 (m, 1H), 6.26 (d, *J* = 9.6 Hz, 1H), 3.32 (dd, *J* = 12.8, 5.2 Hz, 1H), 2.49-2.44 (m, 1H), 2.39-2.29 (m, 1H), 2.24-2.21 (m, 3H), 2.02-1.99 (m, 2H), 1.83-1.74 (m, 1H), 1.69-1.58 (m, 2H), 1.63 (t, *J* = 5.6 Hz, 3H); **$^{13}$C NMR** (100 MHz, $CDCl_3$, ppm): δ 209.9 (C), 204.5 (C), 145.8 (C), 143.7 (CH), 131.8 (C), 129.5 (CH), 129.3 (CH), 127.8 (CH), 126.4 (CH), 125.7 (CH), 64.7 (CH), 54.0 (C), 42.7 ($CH_2$), 34.0 ($CH_2$), 29.6 ($CH_2$), 27.4 ($CH_2$), 7.8 ($CH_3$); **HRMS** (ESI) calcd for $C_{18}H_{20}O_2Na_1$ $[M+Na]^+$: 291.1356, found 291.1358.

1-butyl-3-methyl-1-(2-oxocyclohexyl)naphthalen-2(1H)-one (**3z**)**:**

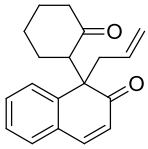


**3z**

Light yellow oil: **$^{1}$H NMR** (400 MHz, $CDCl_3$, ppm): δ 7.30-7.18 (m, 5H), 3.30 (dd, *J* = 12.8, 5.2 Hz, 1H), 2.50-2.45 (m, 1H), 2.39-2.30 (m, 1H), 2.22-2.04 (m, 3H), 2.02-1.96 (m, 5H), 1.75-1.68 (m, 1H), 1.65-1.59 (m, 2H), 1.19-0.94 (m, 2H), 0.90-0.81 (m, 2H), 0.80-0.71 (m, 1H); **$^{13}$C NMR** (100 MHz, $CDCl_3$, ppm): δ 210.0 (C), 204.4 (C), 145.5 (C), 140.4 (CH), 134.4 (C), 132.2 (C), 128.4 (CH), 128.3 (CH), 126.3 (CH), 125.4 (CH), 65.0 (CH), 53.0 (C), 42.8 ($CH_2$), 41.0 ($CH_2$), 29.7 ($CH_2$), 27.4 ($CH_2$), 26.3 ($CH_2$), 25.3 ($CH_2$), 23,0 ($CH_2$), 16.0 ($CH_3$), 13.7

($CH_3$); **HRMS** (ESI) calcd for $C_{21}H_{26}O_2Na_1$ $[M+Na]^+$: 333.1825, found 333.1825.

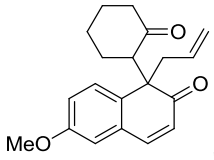
1-allyl-1-(2-oxocyclohexyl)naphthalen-2(1H)-one (**3aa**):



**3aa**

Colorless oil: **$^1$H NMR** (400 MHz, $CDCl_3$, ppm): δ 7.40-7.19 (m, 6H), 6.22 (d, *J* = 8.0 Hz, 1H), 5.21-5.11 (m, 1H), 4.80-4.73 (m, 2H), 3.36 (dd, *J* = 12.4, 5.6 Hz, 1H), 2.77 (dd, *J* = 12.8, 7.6 Hz, 1H), 2.57 (dd, *J* = 13.2, 7.2 Hz, 1H), 2.46-2.34 (m, 3H), 2.20-2.12 (m, 1H), 2.05-2.00 (m, 2H), 1.67-1.60 (m, 3H); **$^{13}$C NMR** (100 MHz, $CDCl_3$, ppm): δ 209.7 (C), 203.7 (C), 145.2 (C), 143.8 (CH), 131.8 (CH), 131.4 (C), 129.5 (CH), 129.4 (CH), 127.3 (CH), 126.6 (CH), 126.1 (CH), 118.5 ($CH_2$), 63.9 (CH), 53.7 (C), 45.0 ($CH_2$), 42.8 ($CH_2$), 29.8 ($CH_2$), 27.4 ($CH_2$), 26.2 ($CH_2$); **HRMS** (ESI) calcd for $C_{19}H_{20}O_2Na_1$ $[M+Na]^+$: 303.1356, found 303.1356.

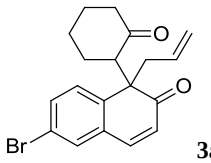
1-allyl-6-methoxy-1-(2-oxocyclohexyl)naphthalen-2(1H)-one (**3ab**):



**3ab**

Light yellow oil: **$^1$H NMR** (400 MHz, $CDCl_3$, ppm): δ 7.34-7.30 (m, 2H), 6.90 (dd, *J* = 8.8, 2.8 Hz, 1H), 6.81 (d, *J* = 2.8 Hz, 1H), 6.22 (d, *J* = 10.0 Hz, 1H), 5.22-5.12 (m, 1H), 4.81-4.74 (m, 2H), 3.82 (s, 3H), 3.32 (dd, *J* = 12.4, 4.2 Hz, 1H), 2.75 (dd, *J* = 12.8, 7.6 Hz, 1H), 2.57 (dd, *J* = 12.8, 6.8 Hz, 1H), 2.42-2.10 (m, 5H), 2.05-1.98 (m, 2H), 1.70-1.55 (m, 2H); **$^{13}$C NMR** (100 MHz, $CDCl_3$, ppm): δ 209.9 (C), 203.9 (C), 157.8 (C), 143.7 (C), 137.1 (C), 132.4 (C), 132.0 (CH), 127.8 (CH), 127.4 (CH), 118.4 ($CH_2$), 115.5 (CH), 113.8 (CH), 63.9 (C), 55.3 (CH), 53.3 ($CH_3$), 45.0 ($CH_2$), 42.8 ($CH_2$), 29.8 ($CH_2$), 27.5 ($CH_2$), 26.2 ($CH_2$); **HRMS** (ESI) calcd for $C_{20}H_{22}O_3Na_1$ $[M+Na]^+$: 333.1461, found 333.1461.

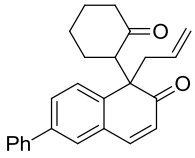
1-allyl-6-bromo-1-(2-oxocyclohexyl)naphthalen-2(1H)-one (**3ac**):



**3ac**

Light yellow oil: **$^1$H NMR** (400 MHz, $CDCl_3$, ppm): δ 7.46-7.43 (m, 2H), 7.31-7.26 (m, 2H), 6.24 (d, *J* = 9.6 Hz, 1H), 5.21-5.10 (m, 1H), 4.79 (d, *J* = 7.2 Hz, 1H), 4.76 (s, 1H), 3.31 (dd, *J* = 12.4, 5.6 Hz, 1H), 2.76 (dd, *J* = 13.2, 8.0 Hz, 1H), 2.53 (dd, *J* = 12.8, 6.8 Hz, 1H), 2.44-2.33 (m, 2H), 2.27-2.11 (m, 1H), 2.04-2.00 (m, 2H), 1.67-1.58 (m, 2H); **$^{13}$C NMR** (100 MHz, $CDCl_3$, ppm): δ 209.7 (C), 202.9 (C), 144.0 (C), 142.1 (CH), 133.4 (C), 132.0 (CH), 131.9 (CH), 131.3 (CH), 128.4 (CH), 127.9 (CH), 120.2 (C), 119.0 ($CH_2$), 63.9 (CH), 53.6 (C), 44.8 ($CH_2$), 42.7 ($CH_2$), 29.7 ($CH_2$), 27.4 ($CH_2$), 26.2 ($CH_2$); **HRMS** (ESI) calcd for $C_{19}H_{19}Br_1O_2Na_1$ $[M+Na]^+$: 381.0461, found 381.0461.

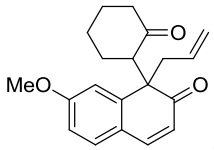
1-allyl-1-(2-oxocyclohexyl)-6-phenylnaphthalen-2(1H)-one (**3ad**):




**3ad**

White amorphous solid: **$^1$H NMR** (400 MHz, $CDCl_3$, ppm): δ 7.60-7.56 (m, 3H), 7.51 (d, *J* = 2.0 Hz, 1H), 7.47-7.43 (m, 1H), 7.38-7.34 (m, 1H), 6.26 (d, *J* = 10.0 Hz, 1H), 5.28-5.17 (m, 1H), 4.84-4.77 (m, 2H), 3.40 (dd, *J* = 12.4, 6.0 Hz, 1H), 2.79 (dd, *J* = 12.8, 7.6 Hz, 1H), 2.61 (dd, *J* = 12.8, 6.8 Hz, 1H), 2.47-2.34 (m, 2H), 2.29-2.15 (m, 2H), 2.05-2.01 (m, 2H), 1.72-1.61 (m, 2H); **$^{13}$C NMR** (100 MHz, $CDCl_3$, ppm): δ 209.8 (C), 203.6 (C), 144.0 (C), 143.7 (CH), 139.9 (C), 139.4 (C), 131.8 (CH), 131.7 (C), 128.8 (CH), 127.9 (CH), 127.6 (CH), 127.5 (CH), 126.9 (CH), 126.6 (CH), 118.6 ($CH_2$), 63.9 (CH), 53.5 (C), 44.9 ($CH_2$), 42.8 ($CH_2$), 29.8 ($CH_2$), 27.4 ($CH_2$), 26.2 ($CH_2$); **HRMS** (ESI) calcd for $C_{25}H_{24}O_2Na_1$ $[M+Na]^+$: 379.1669, found 379.1669.

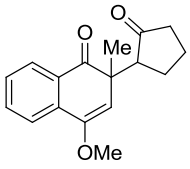
1-allyl-7-methoxy-1-(2-oxocyclohexyl)naphthalen-2(1H)-one (**3ae**)：




**3ae**

Colorless oil: **$^1$H NMR** (400 MHz, $CDCl_3$, ppm): δ 7. 35 (d, *J* = 9.6 Hz, 1H), 7.24 (d, *J* = 8.0 Hz, 1H), 6.98 (d, *J* = 2.0 Hz, 1H), 6.77 (dd, *J* = 8.4, 2.4 Hz, 1H), 6.10 (d, *J* = 9.6 Hz, 1H), 5.25-5.15 (m, 1H), 4.84-4.76 (m, 2H), 3.84 (s, 3H), 3.31 (dd, *J* = 12.4, 5.6 Hz, 1H), 2.76 (dd, *J* = 13.2, 8.0 Hz, 1H), 2.59 (dd, *J* = 13.2, 6.8 Hz, 1H), 2.39-2.15 (m, 4H), 2.05-1.97 (m, 2H), 1.65-1.60 (m, 2H); **$^{13}$C NMR** (100 MHz, $CDCl_3$, ppm): δ 209.9 (C), 203.6 (C), 160.9 (C), 147.4 (C), 143.9 (CH), 132.0 (CH), 130.9 (CH), 124.8 (CH), 118.4 ($CH_2$), 114.0 (CH), 110.6 (CH), 63.8 (CH), 55.4 ($CH_3$), 54.1 (C), 45.2 ($CH_2$), 42.9 ($CH_2$), 29.9 ($CH_2$), 27.4 ($CH_2$), 26.2 ($CH_2$); **HRMS** (ESI) calcd for $C_{20}H_{22}O_3Na_1$ $[M+Na]^+$: 333.1461, found 333.1463.

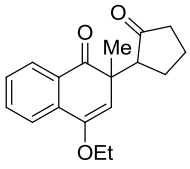
4-methoxy-2-methyl-2-(2-oxocyclopentyl)naphthalen-1(2H)-one (**3af**)：




**3af**

Colorless oil: **$^1$H NMR** (400 MHz, $CDCl_3$, ppm): δ 8.06 (dd, *J* = 6.8, 1.2 Hz, 1H), 7.78 (dd, *J* = 8.0, 0.8 Hz, 1H), 7.65 (td, *J* = 7.6, 1.2 Hz, 1H), 7.43 (td, *J* = 7.6, 1.2 Hz, 1H), 5.02 (s, 1H), 3.75 (s, 3H), 2.70 (ddd, *J* = 12.0, 7.6, 0.8 Hz, 1H), 2.38-2.32 (m, 1H), 2.08-1.99 (m, 1H), 1.91-1.83 (m, 2H), 1.70-1.62 (m, 1H), 1.60 (s, 3H), 1.41-1.30 (m, 1H); **$^{13}$C NMR** (100 MHz, $CDCl_3$, ppm): δ 219.7 (C), 201.5 (C), 149.7 (C), 135.6 (C), 134.5 (CH), 129.2 (C), 128.5 (CH), 127.1 (CH), 122.6 (CH), 102.9 (CH), 55.6 (CH), 55.0 ($CH_3$), 49.4 (C), 39.9 ($CH_2$), 26.9 ($CH_2$), 24.6 ($CH_3$), 20.1 ($CH_2$); **HRMS** (ESI) calcd for $C_{17}H_{18}O_3Na_1$ $[M+Na]^+$: 293.1148, found 293.1149.

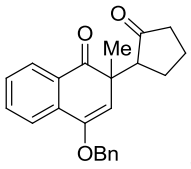
4-ethoxy-2-methyl-2-(2-oxocyclopentyl)naphthalen-1(2H)-one (**3ag**)：




**3ag**

Colorless oil: **$^1$H NMR** (400 MHz, $CDCl_3$, ppm): δ 8.08 (dd, *J* = 7.6, 0.8 Hz, 1H), 7.79 (d, *J* = 7.6 Hz, 1H), 7.62 (td, *J* = 8.0, 1.2 Hz, 1H), 7.43 (td, *J* = 7.6, 0.8 Hz, 1H), 4.99 (s, 1H), 3.97-3.82 (m, 2H), 3.07-3.03 (m, 1H), 2.27-2.16 (m, 2H), 2.09-1.99 (m, 2H), 1.88-1.74 (m, 2H), 1.43 (t, *J* = 7.2 Hz, 3H), 1.27 (s, 3H); **$^{13}$C NMR** (100 MHz, $CDCl_3$, ppm): δ 217.1 (C), 202.2 (C), 148.7 (C), 135.4 (C), 133.9 (CH), 129.6 (C), 128.3 (CH), 126.8 (CH), 122.6 (CH), 102.8 (CH), 62.9 ($CH_2$), 58.6 (CH), 48.4 (C), 38.3 ($CH_2$), 28.3 ($CH_2$), 25.1 ($CH_3$), 25.0 ($CH_2$), 20.9 ($CH_2$), 14.5 ($CH_3$); **HRMS** (ESI) calcd for $C_{18}H_{20}O_3Na_1$ $[M+Na]^+$: 307.1305, found 307.1305.

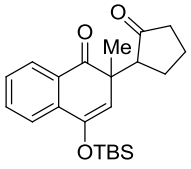
4-(benzyloxy)-2-methyl-2-(2-oxocyclopentyl)naphthalen-1(2H)-one (**3ah**)：




**3ah**

White amorphous solid: **$^1$H NMR** (400 MHz, $CDCl_3$, ppm): δ 8.07 (d, *J* = 7.6 Hz, 1H), 7.89 (d, *J* = 8.0 Hz, 1H), 7.67 (t, *J* = 7.6 Hz, 1H), 7.46-7.31 (m, 6H), 5.10 (d, *J* = 12.0 Hz, 1H), 5.07 (s, 1H), 4.96 (d, *J* = 12.0 Hz, 1H), 2.65 (dd, *J* =12.0, 8.0 Hz, 1H), 2.23 (dd, *J* = 8.0, 7.2 Hz, 1H), 1.83-1.66 (m, 3H), 1.62-1.54 (m, 4H), 1.25-1.13 (m, 1H); **$^{13}$C NMR** (100 MHz, $CDCl_3$, ppm): δ 219.7 (C), 201.3 (C), 148.2 (C), 136.8 (C), 135.7 (C), 134.5 (CH), 129.2 (C), 128.6 (CH), 128.5 (CH), 127.9 (CH), 127.2 (CH), 127.1 (CH), 122.8 (CH), 105.1 (CH), 69.2 ($CH_2$), 55.4 (CH), 49.4 (C), 39.7 ($CH_2$), 26.7 ($CH_2$), 24.4 ($CH_3$), 20.0 ($CH_3$); **HRMS** (ESI) calcd for $C_{23}H_{23}O_3$ $[M+H]^+$: 347.1642, found 347.1641.

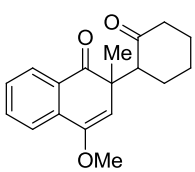
4-((tert-butyldimethylsilyl)oxy)-2-methyl-2-(2-oxocyclopentyl)naphthalen-1(2H)-one (**3ai**)：




**3ai**

Colorless oil: **$^1$H NMR** (400 MHz, $CDCl_3$, ppm): δ 8.08 (dd, *J* = 7.6, 0.4 Hz, 1H), 7.67-7.60 (m, 2H), 7.42 (td, *J* = 8.0, 1.6 Hz, 1H), 5.21 (s, 1H), 3.12-3.07 (m, 1H), 2.27-2.19 (m, 2H), 2.11-1.97 (m, 2H), 1.87-1.70 (m, 2H), 1.25 (s, 3H), 1.03 (s, 9H), 0.20 (s, 3H), 0.17 (s, 3H); **$^{13}$C NMR** (100 MHz, $CDCl_3$, ppm): δ 216.9 (C), 202.0 (C), 145.6 (C), 136.9 (C), 133.9 (CH), 130.0 (C), 128.2 (CH), 127.0 (CH), 123.1 (CH), 111.8 (CH), 58.6 (CH), 48.8 (C), 38.1 ($CH_2$), 25.8 ($CH_3$), 24.9 ($CH_2$), 24.6 ($CH_3$), 20.9 (C), 18.3 ($CH_2$), -4.3 ($CH_3$), -4.6 ($CH_3$); **HRMS** (ESI) calcd for $C_{22}H_{30}O_3Si_1Na_1$ $[M+Na]^+$: 393.1856, found 393.1858.

4-methoxy-2-methyl-2-(2-oxocyclohexyl)naphthalen-1(2H)-one (**3aj**)：

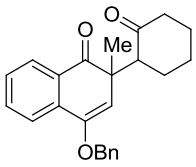



**3aj**

White amorphous solid: **$^1$H NMR** (400 MHz, $CDCl_3$, ppm): δ 8.08 (d, *J* = 7.6 Hz, 1H), 7.80 (d, *J* = 7.6 Hz, 1H), 7.62 (t, *J* = 7.6 Hz, 1H), 7.43 (t, *J* = 7.2 Hz, 1H), 5.00 (s, 1H), 3.74 (s, 3H), 3.38 (dd, *J* = 13.6, 6.0 Hz, 1H), 2.34-2.25 (m, 3H), 2.08-2.05 (m, 2H), 1.80-1.55 (m, 2H), 1.15 (s, 3H); **$^{13}$C NMR** (100 MHz, $CDCl_3$, ppm): δ 209.3 (C), 202.1 (C), 149.1 (C), 135.1 (C), 133.6 (CH), 129.4 (C), 128.1 (CH), 126.8 (CH), 122.5 (CH), 102.7

(CH), 60.5 (CH), 54.6 ($CH_3$), 47.1 (C), 41.8 ($CH_2$), 26.8 ($CH_2$), 26.7 ($CH_2$), 25.3 ($CH_2$), 24.8 ($CH_3$); **HRMS** (ESI) calcd for $C_{18}H_{20}O_3Na_1$ $[M+Na]^+$: 307.1305, found 307.1306.

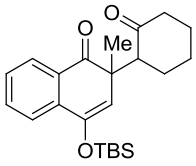
4-(benzyloxy)-2-methyl-2-(2-oxocyclohexyl)naphthalen-1(2H)-one (**3ak**):




**3ak**

White amorphous solid: **$^1$H NMR** (400 MHz, $CDCl_3$, ppm): δ 8.10 (d, *J* = 7.6 Hz, 1H), 7.89 (d, *J* = 8.0 Hz, 1H), 7.63 (t, *J* = 6.4 Hz, 1H), 7. 45-7.33 (m, 6H), 5.07 (s, 1H), 5.00 (d, *J* = 11.6 Hz, 1H), 4.95 (d, *J* = 11.6 Hz, 1H), 3.36 (dd, *J* = 13.2, 5.2 Hz, 1H), 2.29-2.19 (m, 3H), 2.05-2.01 (m, 2H), 1.80-1.70 (m, 1H), 1.61-1.48 (m, 2H), 1.14 (s, 3H); **$^{13}$C NMR** (100 MHz, $CDCl_3$, ppm): δ 209.0 (C), 201.9 (C), 148.0 (C), 137.0 (C), 135.0 (C), 133.6 (CH), 129.5 (C), 128.5 (CH), 128.2 (CH), 127.8 (CH), 127.3 (CH), 126.8 (CH), 122.6 (CH), 104.7 (C), 69.2 ($CH_2$), 60.5 (CH), 47.2 (C), 41.7 ($CH_2$), 26.7 ($CH_2$), 26.5 ($CH_2$), 25.2 ($CH_2$), 24.6 ($CH_3$); **HRMS** (ESI) calcd for $C_{24}H_{24}O_3Na_1$ $[M+Na]^+$: 383.1618, found 383.1617.

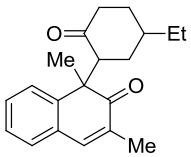
4-((tert-butyldimethylsilyl)oxy)-2-methyl-2-(2-oxocyclohexyl)naphthalen-1(2H)-one (**3al**)




**3al**

Colorless oil: **$^1$H NMR** (400 MHz, $CDCl_3$, ppm): δ 8.06 (dd, *J* = 7.6, 0.4 Hz, 1H), 7.69 (d, *J* = 7.6 Hz, 1H), 7.61 (td, *J* = 7.6, 1.2 Hz, 1H), 7.40 (td, *J* = 7.6, 0.8 Hz, 1H), 5.23 (s, 1H), 3.35 (dd, *J* = 13.2, 5.6 Hz, 1H), 2.33-2.20 (m, 3H), 2.08-2.04 (m, 2H), 1.81-1.70 (m, 1H), 1.62-1.50 (m, 2H), 1.12 (s, 3H), 1.03 (s, 9H), 0.18 (s, 3H), 0.17 (s, 3H); **$^{13}$C NMR** (100 MHz, $CDCl_3$, ppm): δ 208.9 (C), 202.0 (C), 145.2 (C), 136.8 (C), 133.5 (CH), 129.9 (C), 127.9 (CH), 126.9 (CH), 123.0 (CH), 112.8 (CH), 60.2 (CH), 47.6 (C), 41.8 ($CH_2$), 26.9 ($CH_2$), 26.8 ($CH_2$), 25.9 ($CH_3$), 25.3 ($CH_2$), 24.0 ($CH_3$), 18.4 (C), -4.2 ($CH_3$), -4.4 ($CH_3$); **HRMS** (ESI) calcd for $C_{23}H_{32}O_3Si_1Na_1$ $[M+Na]^+$: 407.2013, found 407.2013.

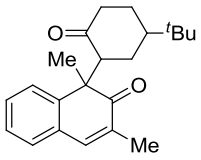
1-(5-ethyl-2-oxocyclohexyl)-1,3-dimethylnaphthalen-2(1H)-one (**3am**)




**3am**

Colorless oil: **$^1$H NMR** (400 MHz, $CDCl_3$, ppm): δ 7.31-7.19 (m, 5H), 3.41 (dd, *J* = 12.4, 6.0 Hz, 1H), 2.56 (td, *J* = 132, 4.4 Hz, 1H), 2.30-2.24 (m, 1H), 2.19-2.08 (m, 2H), 2.02 (s, 3H), 1.85-1.82 (m, 3H), 1.66-1.59 (m, 2H), 1.33 (s, 3H), 1.02 (t, *J* = 7.2 Hz, 3H); **$^{13}$C NMR** (100 MHz, $CDCl_3$, ppm): δ 210.7 (C), 204.3 (C), 146.8 (C), 140.5 (CH), 132.8 (C), 130.3 (C), 128.8 (CH), 128.4 (CH), 128.4 (CH), 125.5 (CH), 57.8 (CH), 49.3 (C), 38.4 ($CH_2$), 34.5 ($CH_2$), 32.5 ($CH_2$), 29.6 ($CH_2$), 26.5 ($CH_2$), 24.5 ($CH_3$), 16.1 ($CH_3$), 12.3 ($CH_3$); **HRMS** (ESI) calcd for $C_{20}H_{24}O_2Na_1$ $[M+Na]^+$: 319.1669, found 319.1669.

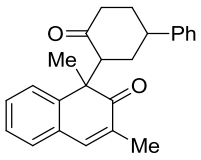
1-(5-(tert-butyl)-2-oxocyclohexyl)-1,3-dimethylnaphthalen-2(1H)-one (**3an**)




**3an**

Colorless oil: **$^1$H NMR** (400 MHz, $CDCl_3$, ppm): δ 7.30-7.20 (m, 5H), 3.35 (t, *J* = 8.0 Hz, 1H), 2.48-2.41 (m, 1H), 2.29 (ddd, *J* = 18.0, 4.8, 2.0 Hz, 1H), 2.12-2.04 (m, 1H), 2.01 (d, *J* = 0.8 Hz, 3H), 1.97-1.89 (m, 1H), 1.81-1.78 (m, 1H), 1.64-1.53 (m, 1H), 1.42 (s, 3H), 1.40-1.34 (m, 1H), 0.91 (s, 9H); **$^{13}$C NMR** (100 MHz, $CDCl_3$, ppm): δ 212.9 (C), 204.6 (C), 146.3 (C), 140.8 (CH), 132.8 (C), 130.3 (C), 128.8 (CH), 128.4 (CH), 126.6 (CH), 125.8 (CH), 58.0 (CH), 50.0 (C), 43.2 (CH), 39.9 ($CH_2$), 33.2 ($CH_2$), 27.0 ($CH_3$), 26.0 (C), 25.5 ($CH_2$), 22.5 ($CH_3$), 16.0 ($CH_3$); **HRMS** (ESI) calcd for $C_{22}H_{28}O_2Na_1$ $[M+Na]^+$: 347.1982, found 347.1984.

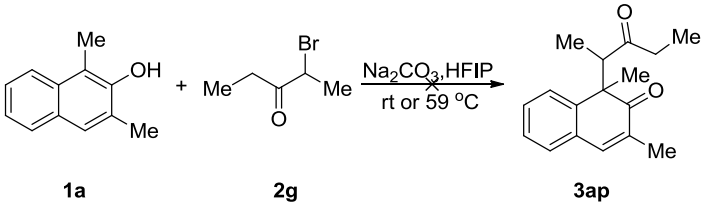
1,3-dimethyl-1-(2-oxo-5-phenylcyclohexyl)naphthalen-2(1H)-one (**3ao**)



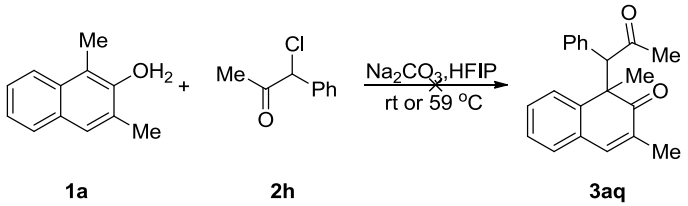

**3ao**

Colorless oil: **$^1$H NMR** (400 MHz, $CDCl_3$, ppm): δ 7.36-7.35 (m, 3H), 7.24-7.12 (m, 6H), 7.04-7.02 (m, 1H), 3.36 (dd, *J* = 10.8, 6.4 Hz, 1H), 3.14-3.12 (m, 1H), 2.85-2.78 (m, 1H), 2.65-2.60 (m, 1H), 2.39-2.33 (m, 1H), 2.19-2.12 (m, 1H), 2.08-2.00 (m, 1H), 1.95 (d, *J* = 1.2 Hz, 3H), 1.29 (s, 3H); **$^{13}$C NMR** (100 MHz, $CDCl_3$, ppm): δ 210.3 (C), 204.3 (C), 146.5 (C), 143.3 (C), 140.7 (CH), 132.8 (C), 130.2 (C), 128.8 (CH), 128.8 (CH), 126.7 (CH), 126.5 (CH), 126.3 (CH), 125.4 (CH), 58.2 (CH), 49.4 (C), 39.2 ($CH_2$), 37.3 (CH), 33.2 ($CH_2$), 29.5 ($CH_2$), 26.3 ($CH_3$), 16.0 ($CH_3$); **HRMS** (ESI) calcd for $C_{24}H_{24}O_2Na_1$ $[M+Na]^+$: 367.1669, found 367.1671.

Acyclic 2-haloketones **2g** and **2h** we tested failed to complete the corresponding dearomatization process

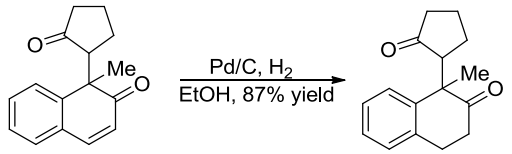



**1a** **2g** **3ap**




**1a** **2h** **3aq**

**4. Experimental Details for 5 and 6**

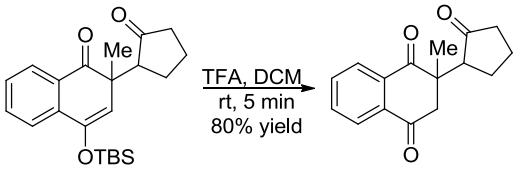



**3f** **5**

To a solution of **3f** (0.1 mmol) in EtOH (1mL) was added Pd/C (10% w/w, 0.1eq.). the reaction mixture was stirred at room temperature under $H_2$ atmosphere until the reaction was complete (monitored by TLC). After which, the reaction mixture was filtered by silica gel. The filtrate was concentrated under vacuum. Purification of the residue by column chromatography on silica gel (eluting with petroleum ether/ethyl acetate 15:1) provided **5** (87% yield).

1-methyl-1-(2-oxocyclopentyl)-3,4-dihydronaphthalen-2(1H)-one (**5**)

Colorless oil: **$^1$H NMR** (400 MHz, $CDCl_3$, ppm): δ 7.20-7.15 (m, 2H), 7.13-7.07 (m, 2H), 3.22-3.14 (m, 1H), 3.01-2.95 (m, 1H), 2.80-2.68 (m, 2H), 2.55 (dt, *J* = 14.0, 4.0 Hz, 1H), 2.30-2.11 (m, 2H), 1.86-1.79 (m, 2H), 1.63 (s, 3H), 1.59-1.40 (m, 2H); **$^{13}$C NMR** (100 MHz, $CDCl_3$, ppm): δ 218.0 (C), 213.5 (C), 141.4 (C), 135.8 (C), 128.4 (CH), 127.2 (CH), 126.7 (CH), 126.5 (CH), 55.6 (CH), 54.8 (C), 39.0 ($CH_2$), 37.4 ($CH_2$), 29.0 ($CH_2$), 27.2 ($CH_2$), 26.8 ($CH_3$), 20.6 ($CH_2$); **HRMS** (ESI) calcd for $C_{16}H_{18}O_2Na_1$ $[M+Na]^+$: 265.1199, found 265.1200.




**3ai** **6**

To a solution of **3ai** (0.1 mmol) in AR DCM (1mL) was added TFA (0.1 mL) at room temperature. The reaction mixture was stirred for 5min. After which, the resultant mixture was concentrated and then purified by flash chromatography (PE:EA= 15:1) to give the corresponding product **6** (80% yield).

2-methyl-2-(2-oxocyclopentyl)-2,3-dihydronaphthalene-1,4-dione (**6**)

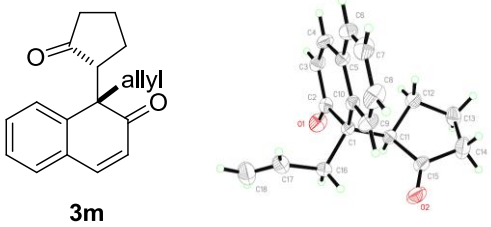
Colorless oil: **$^1$H NMR** (400 MHz, $CDCl_3$, ppm): δ 8.10 (dd, *J* = 7.2, 1.6 Hz, 1H), 7.97 (dd, *J* = 6.8, 1.6 Hz, 1H), 7.77-7.69 (m, 2H), 3.17 (d, *J* = 15.6 Hz, 1H), 2.91 (dd, *J* = 12.8, 8.0 Hz, 1H), 2.69 (d, *J* = 15.6 Hz, 1H), 2.36 (dd, *J* = 18.4, 8.0 Hz, 3H), 2.23-2.15 (m, 1H), 2.13-2.02 (m, 2H), 1.86-1.75 (m, 1H), 1.72-1.61 (m, 1H), 1.33 (s, 3H); **$^{13}$C NMR** (100 MHz, $CDCl_3$, ppm): δ 217.3 (C), 198.9 (C), 196.1 (C), 134.7 (C), 134.4 (CH), 134.0 (CH), 133.3 (C), 127.8 (CH), 125.9 (CH), 54.8 (CH), 49.2 (C), 46.6 ($CH_2$), 38.4 ($CH_2$), 25.0 ($CH_2$), 23.7 ($CH_3$), 20.2 ($CH_2$); **HRMS** (ESI) calcd for $C_{17}H_{18}O_3Na_1$ $[M+Na]^+$: 293.1148, found 293.1149.

**Reference**


1. (*a*) A. Rudolph, P. H. Bos, A. Meetsma, A. J. Minnaard and B. L. Feringa, *Angew. Chem., Int. Ed.* 2011, **50**, 5834; (*b*) T. Oguma, T. atsuki, *J. Am. Chem. Soc.*, **2012**, **134**, 20017; (*c*) J. Zheng, S.-B. Wang, C. Zheng and S.-L. You, *J. Am. Chem. Soc.*, 2015, **137**, 4880; (*d*) S. Kotha, K. Mandal, A. Tiwari and S. M. Mobin, *Chem. - Eur. J.* 2006, **12**, 8024.
2. D. Zhou, X. Yu, J. Zhang, W. Wang, H. Xie. *Org. Lett.* 2018, **20**, 174.

3. (*a*) Y. Jing, C. G. Daniliuc and A. Studer, *Org. Lett.* **2014**, *16*, 4932; (*b*) S.-Z. Tang, W. Zhao, T. Chen, Y. Liu, X.-M. Zhang and F.-M. Zhang, *Adv. Synth. Catal.* **2017**, *359*, 4177.

**5. X-ray Crystallography of 3m:**

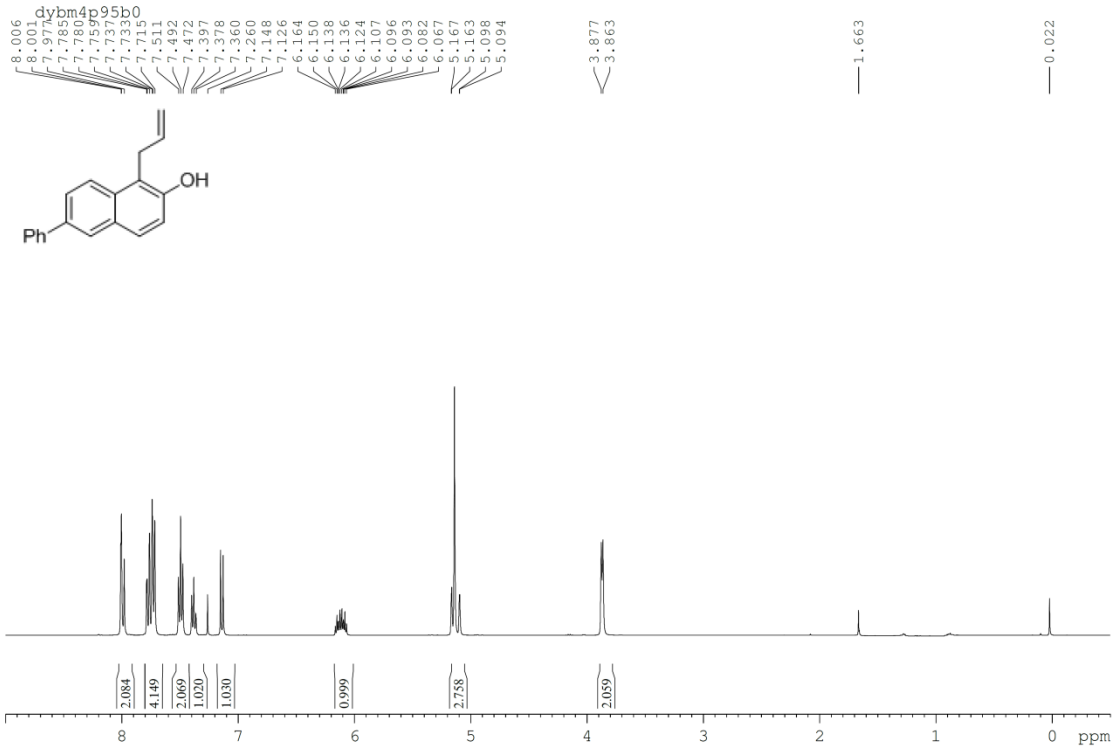



**3m**

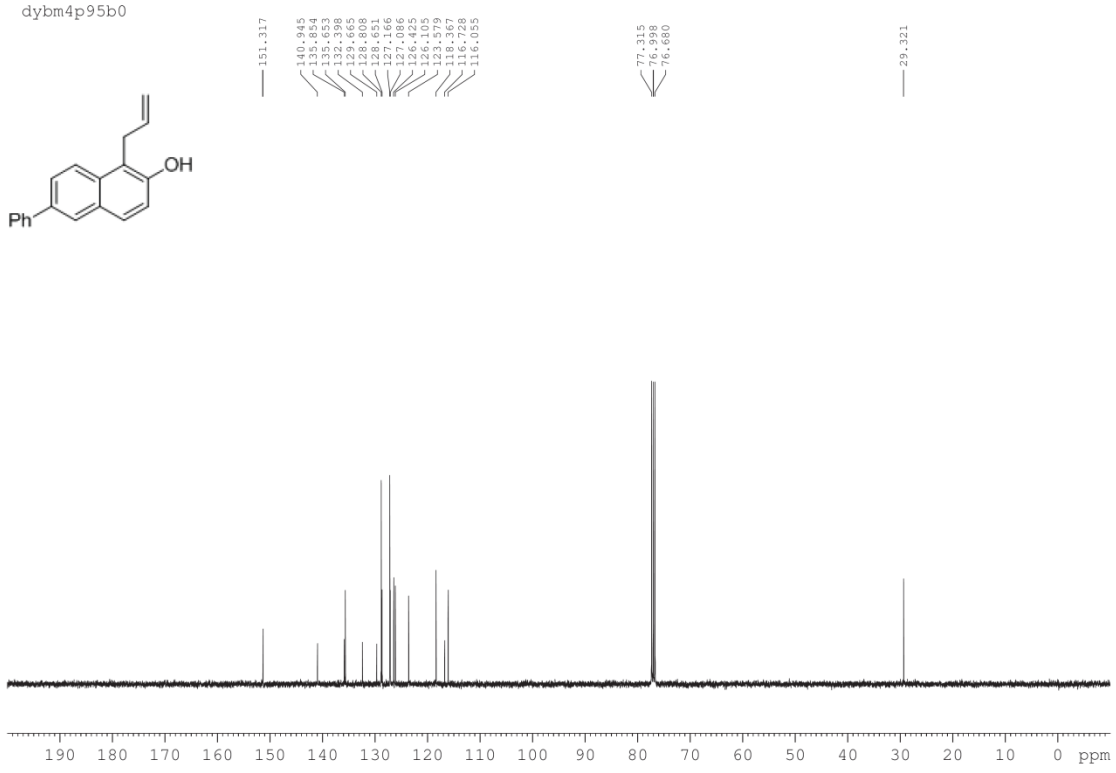
X-ray Crystallography of **3m** (the major diastereoisomer) with thermal ellipsoids are drawn at 50% probability level. The crystal structure of **3m** has been deposited at the Cambridge Crystallographic Data Centre and allocated the deposition numbers (CCDC number): 1831764.

**6. Copies of $^{1}H$ and $^{13}C$ spectra of new compounds**

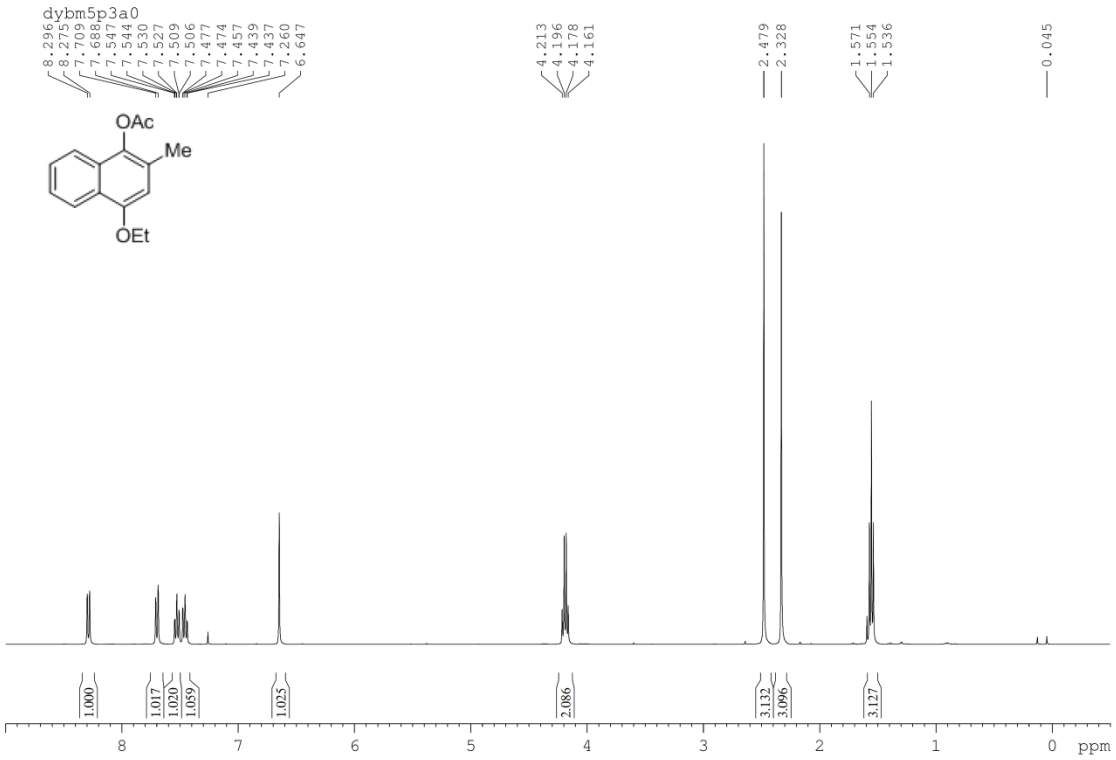
$^{1}H$ NMR spectrum of compound **1p** (400 MHz, $CDCl_3$)



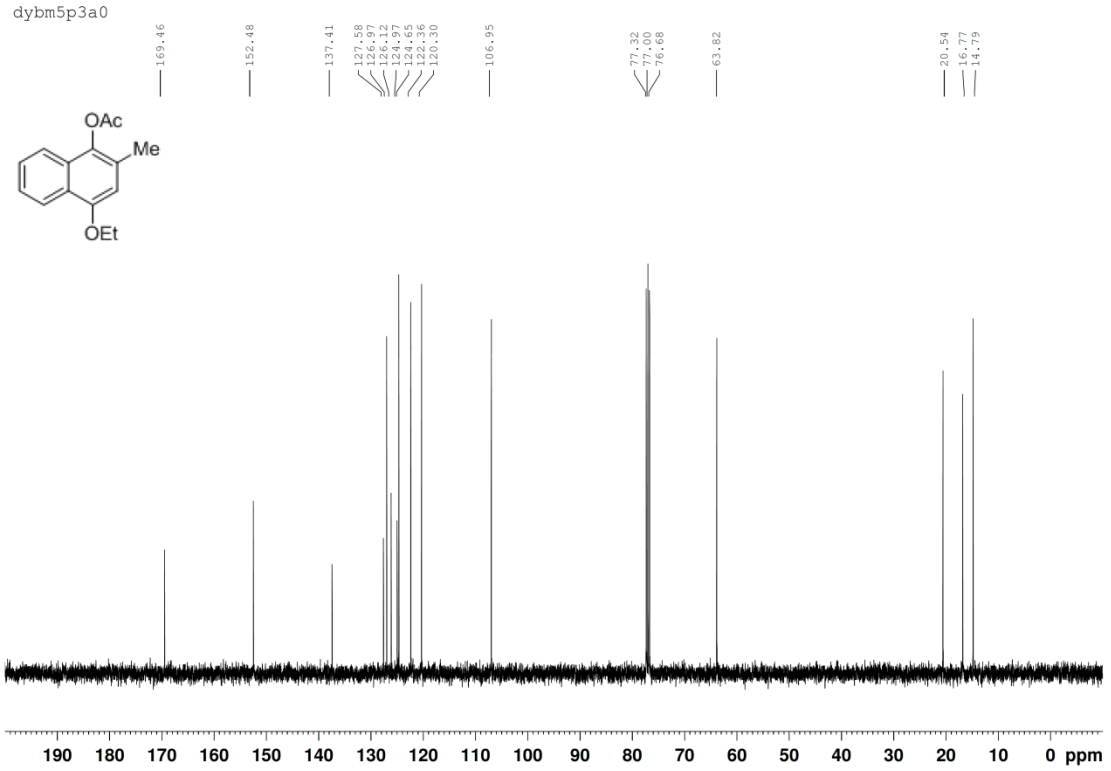

$^{13}C$ NMR spectrum of compound **1p** (100 MHz, $CDCl_3$)



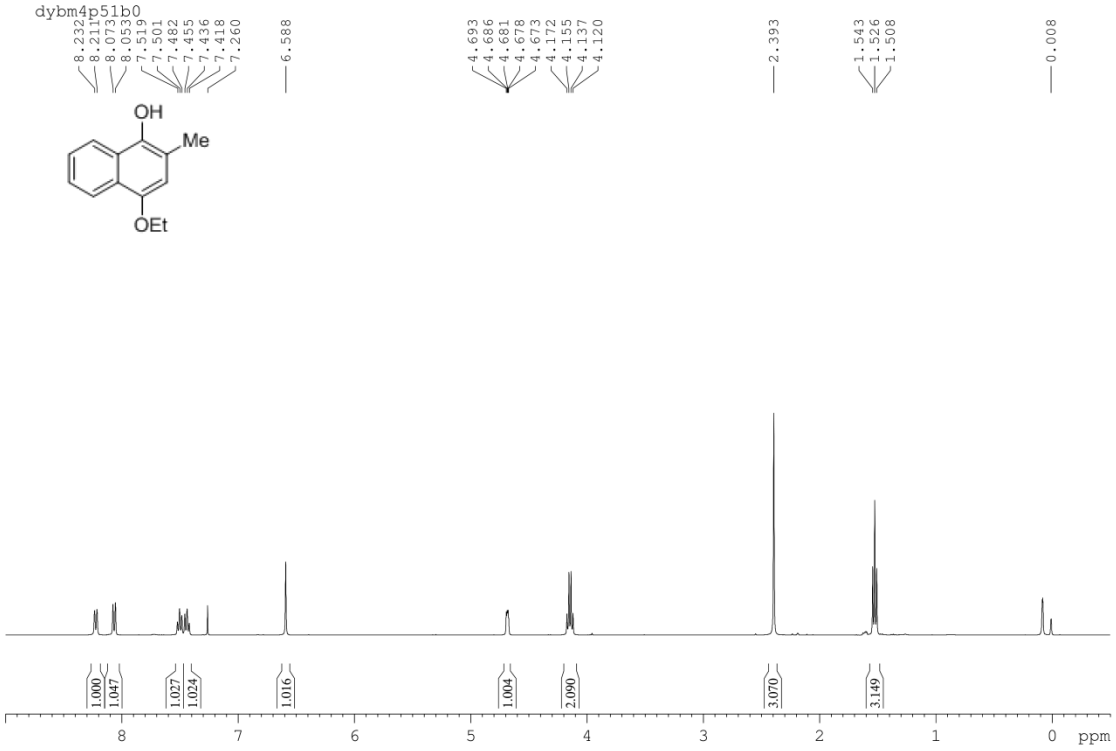
$^{1}$H NMR spectrum of compound **4-ethoxy-2-methylnaphthalen-1-yl acetate** (400 MHz, $CDCl_3$)



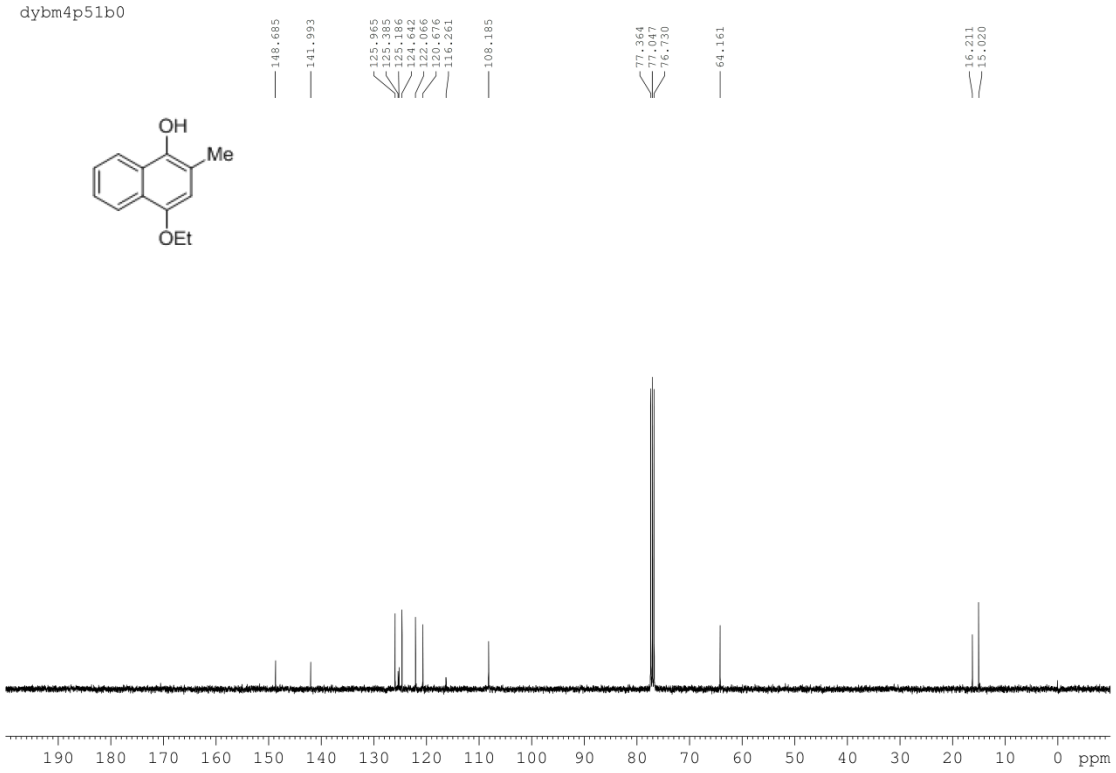

$^{13}$C NMR spectrum of compound **4-ethoxy-2-methylnaphthalen-1-yl acetate** (100 MHz, $CDCl_3$)



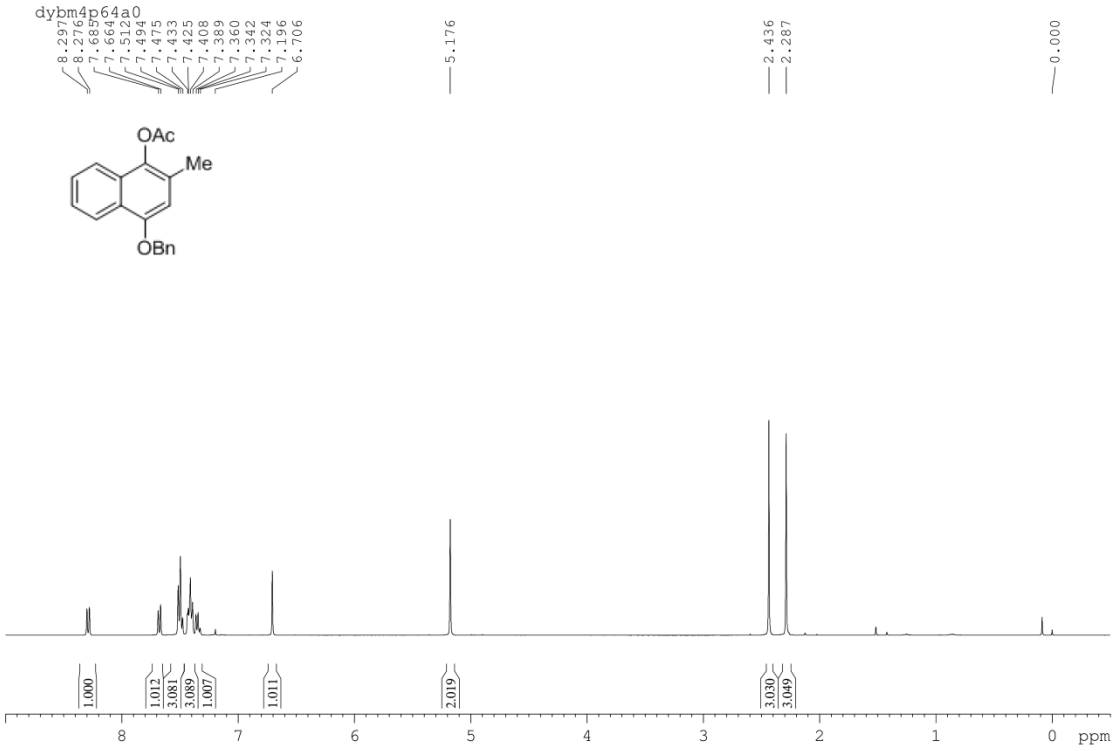
$^{1}$H NMR spectrum of compound **4b** (400 MHz, $CDCl_3$)



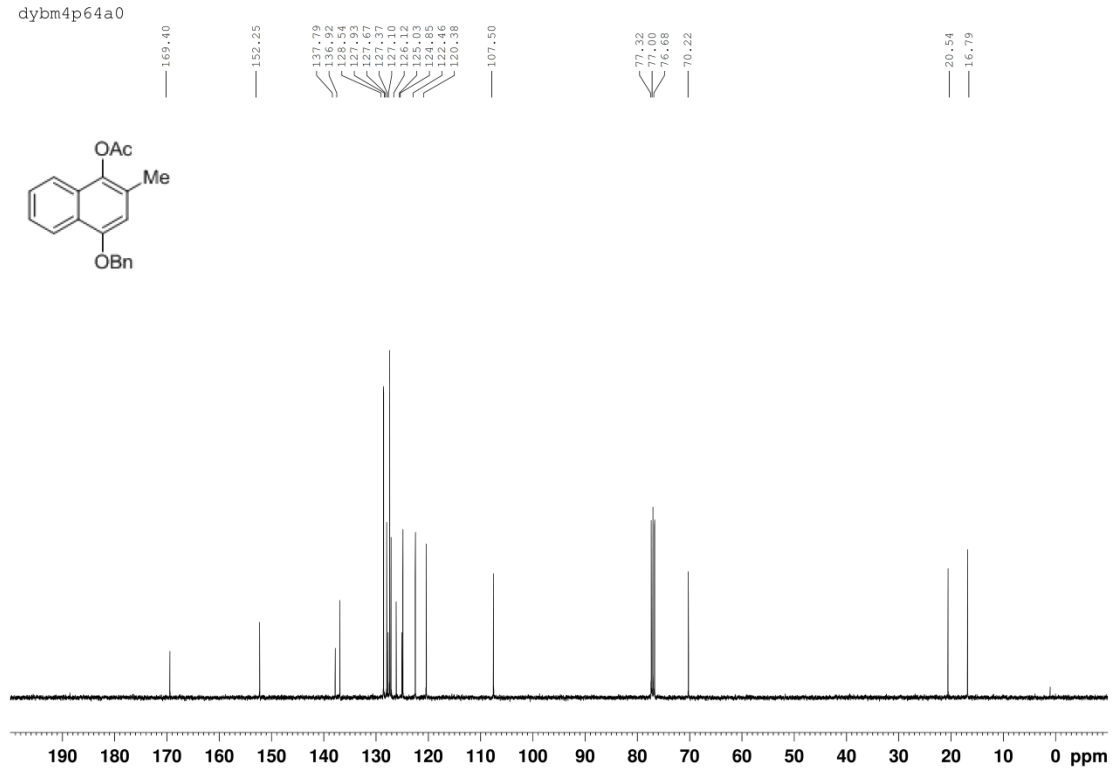

$^{13}$C NMR spectrum of compound **4b** (100 MHz, $CDCl_3$)



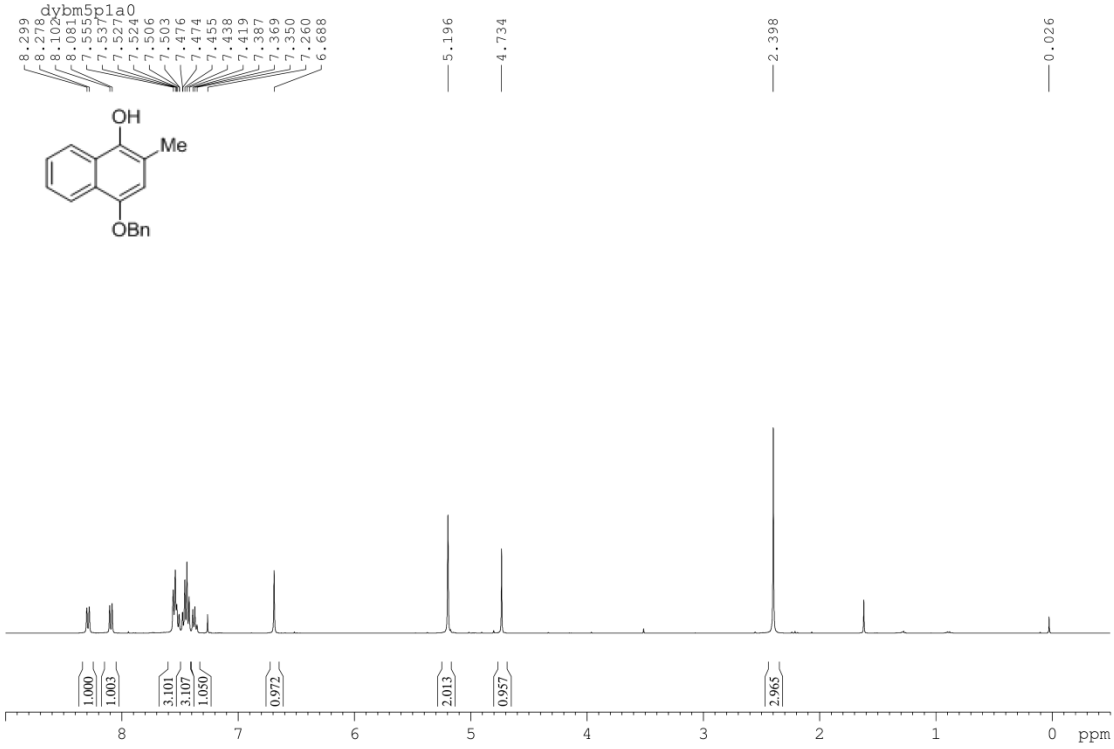
$^{1}$H NMR spectrum of compound **4-(benzyloxy)-2-methylnaphthalen-1-yl acetate** (400 MHz, $CDCl_3$)



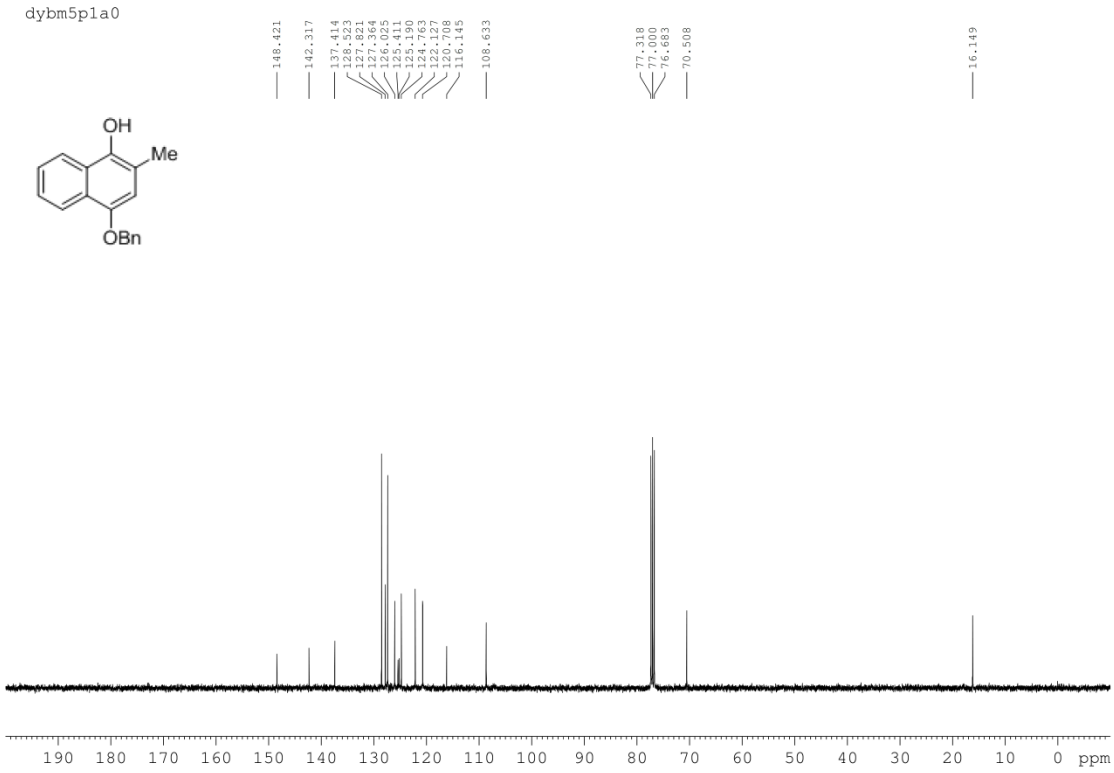

$^{13}$C NMR spectrum of compound **4-(benzyloxy)-2-methylnaphthalen-1-yl acetate** (100 MHz, $CDCl_3$)



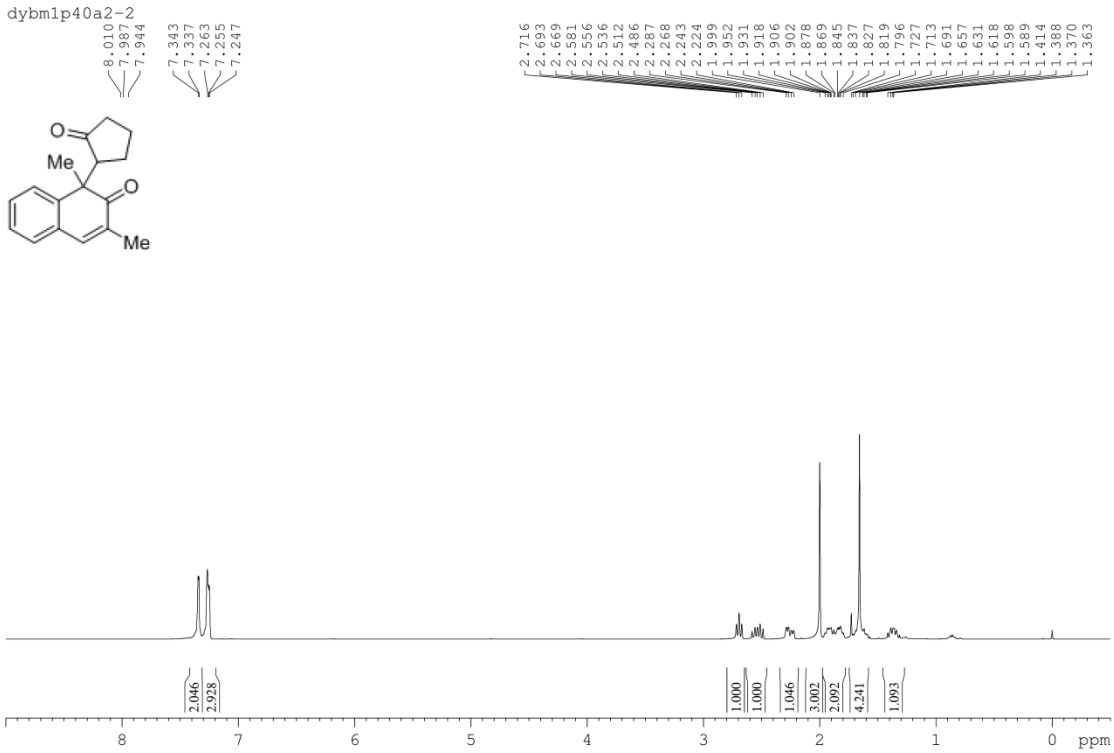
$^{1}$H NMR spectrum of compound **4c** (400 MHz, $CDCl_3$)



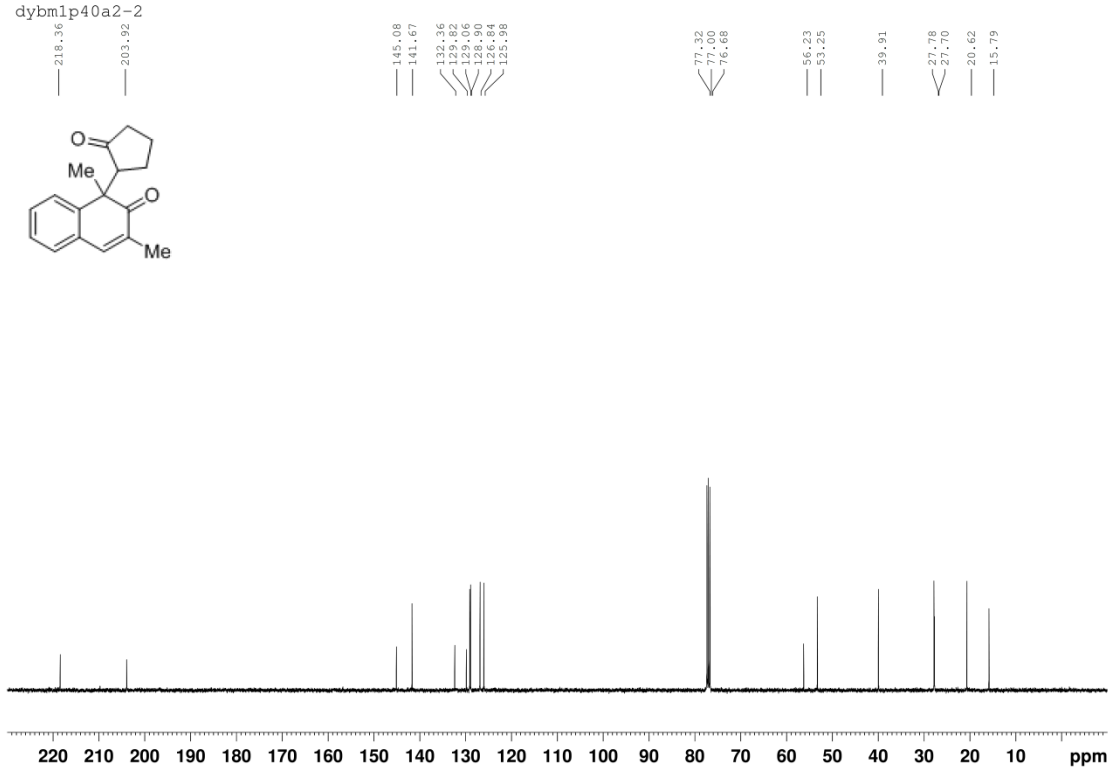

$^{13}$C NMR spectrum of compound **4c** (100 MHz, $CDCl_3$)



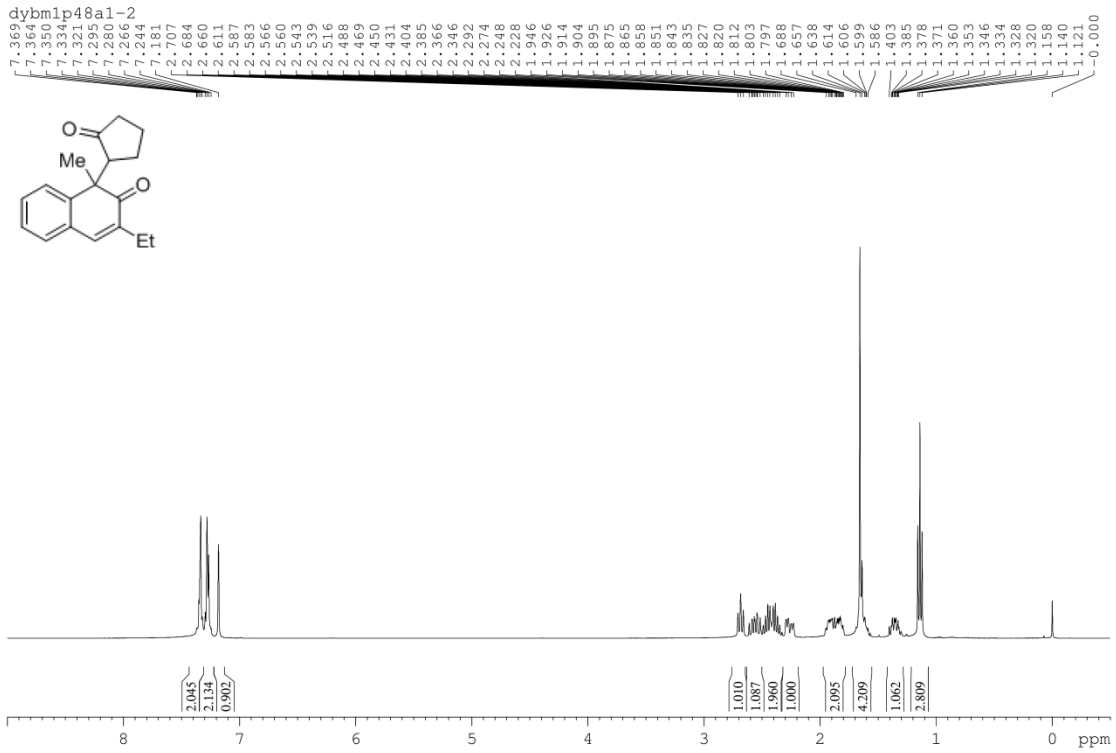
$^{1}$H NMR spectrum of compound **3a** (400 MHz, $CDCl_3$)



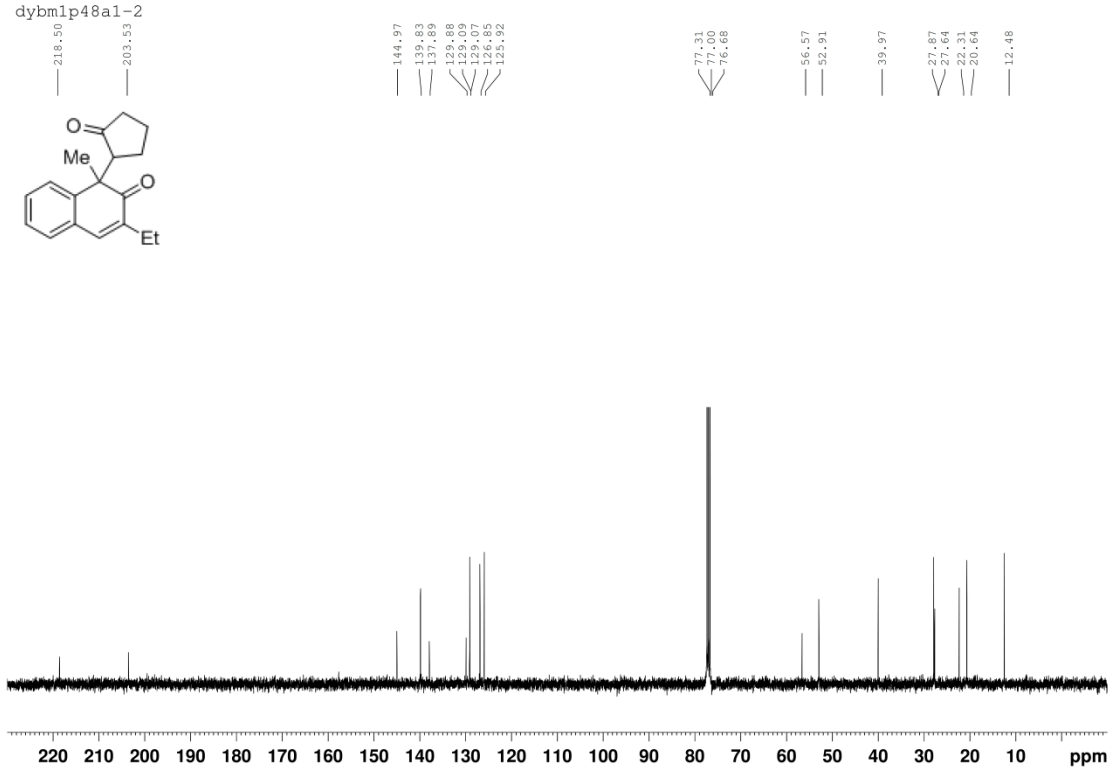

$^{13}$C NMR spectrum of compound **3a** (100 MHz, $CDCl_3$)



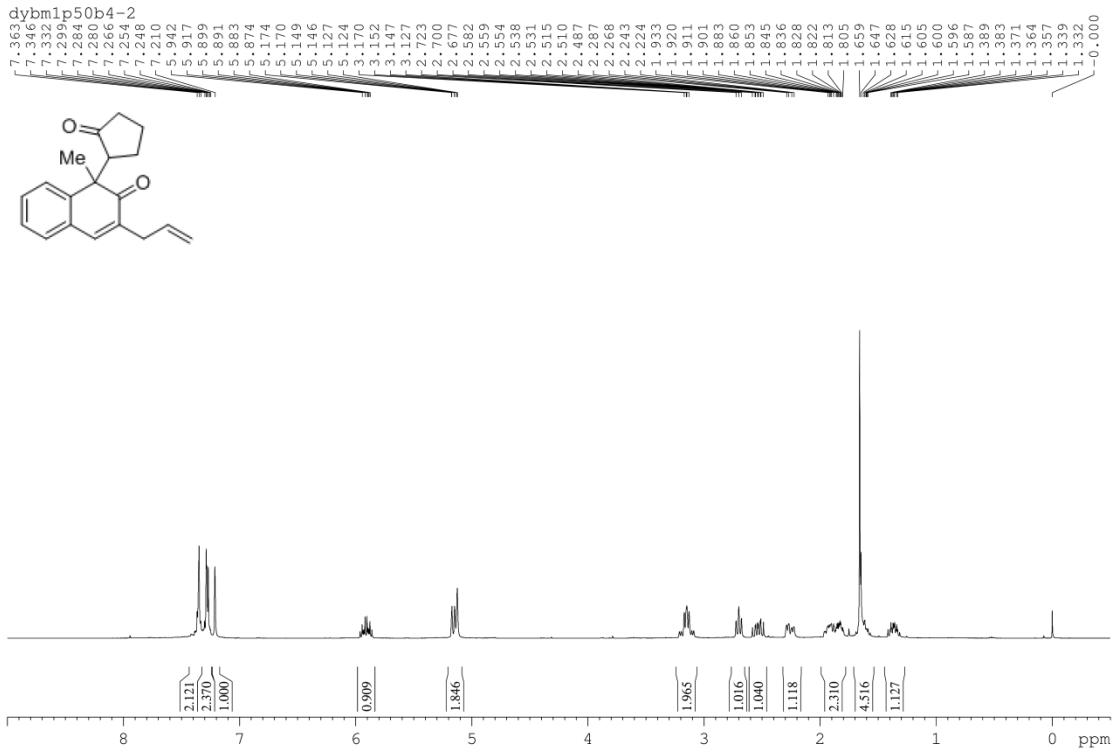
$^{1}$H NMR spectrum of compound **3b** (400 MHz, $CDCl_3$)



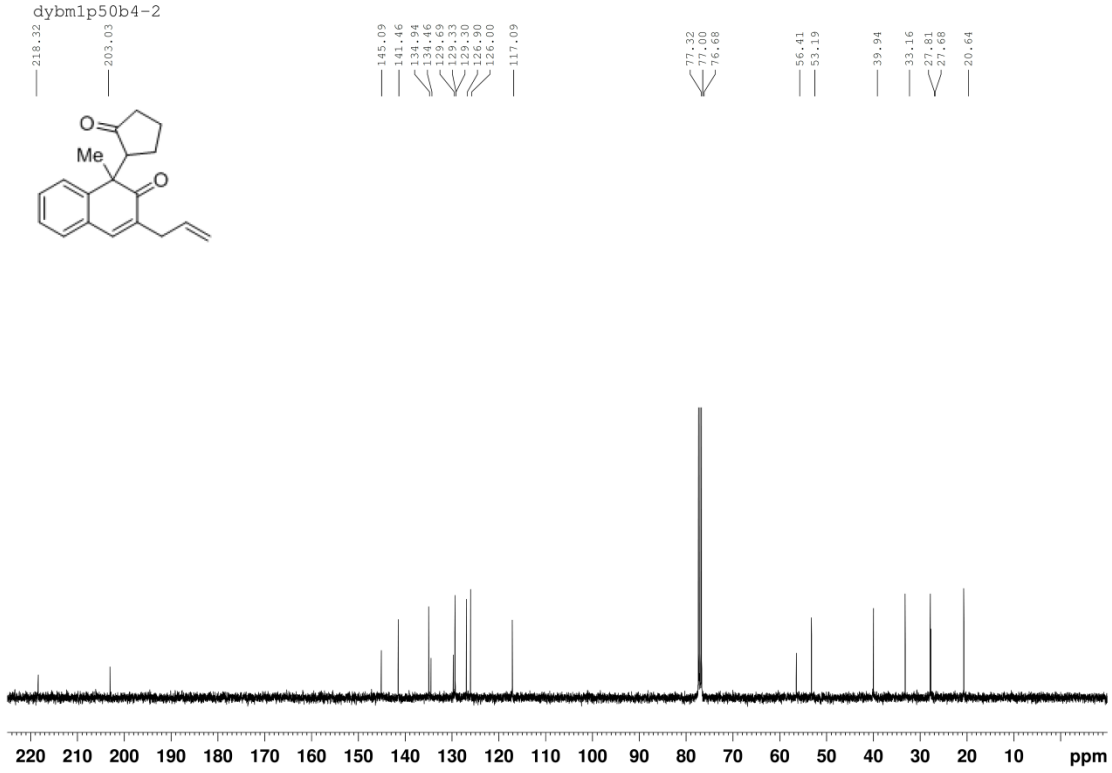

$^{13}$C NMR spectrum of compound **3b** (100 MHz, $CDCl_3$)



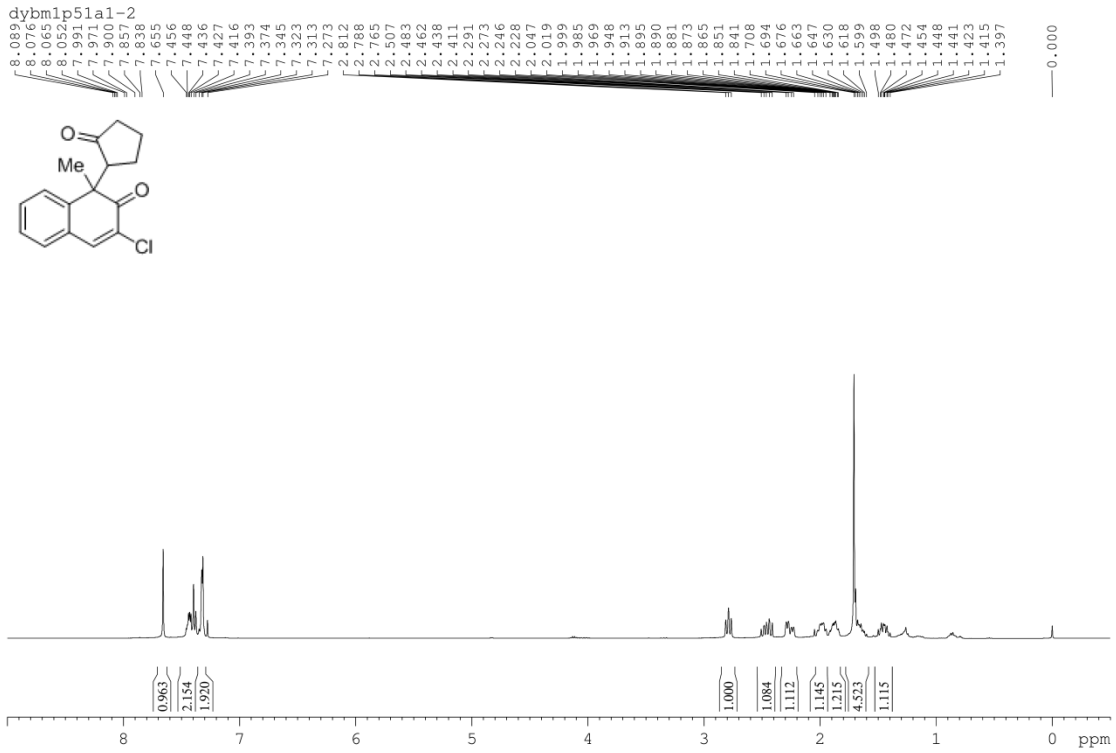
$^{1}$H NMR spectrum of compound **3c** (400 MHz, $CDCl_3$)



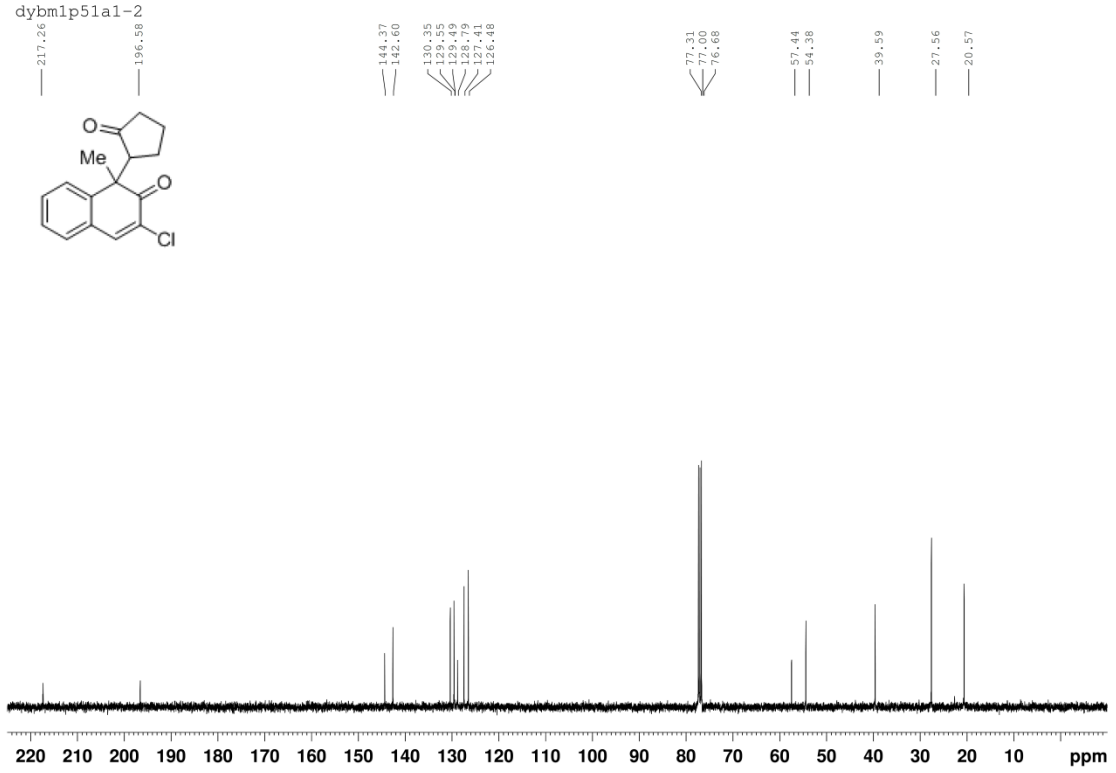

$^{13}$C NMR spectrum of compound **3c** (100 MHz, $CDCl_3$)



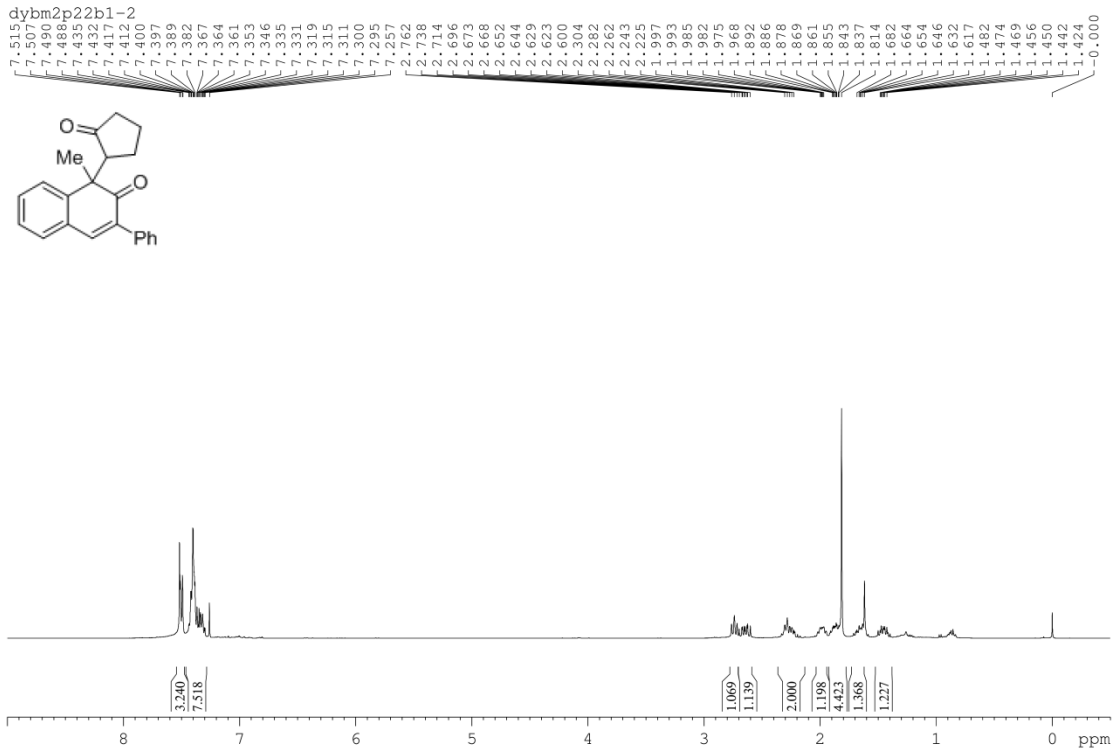
$^{1}$H NMR spectrum of compound **3d** (400 MHz, $CDCl_3$)



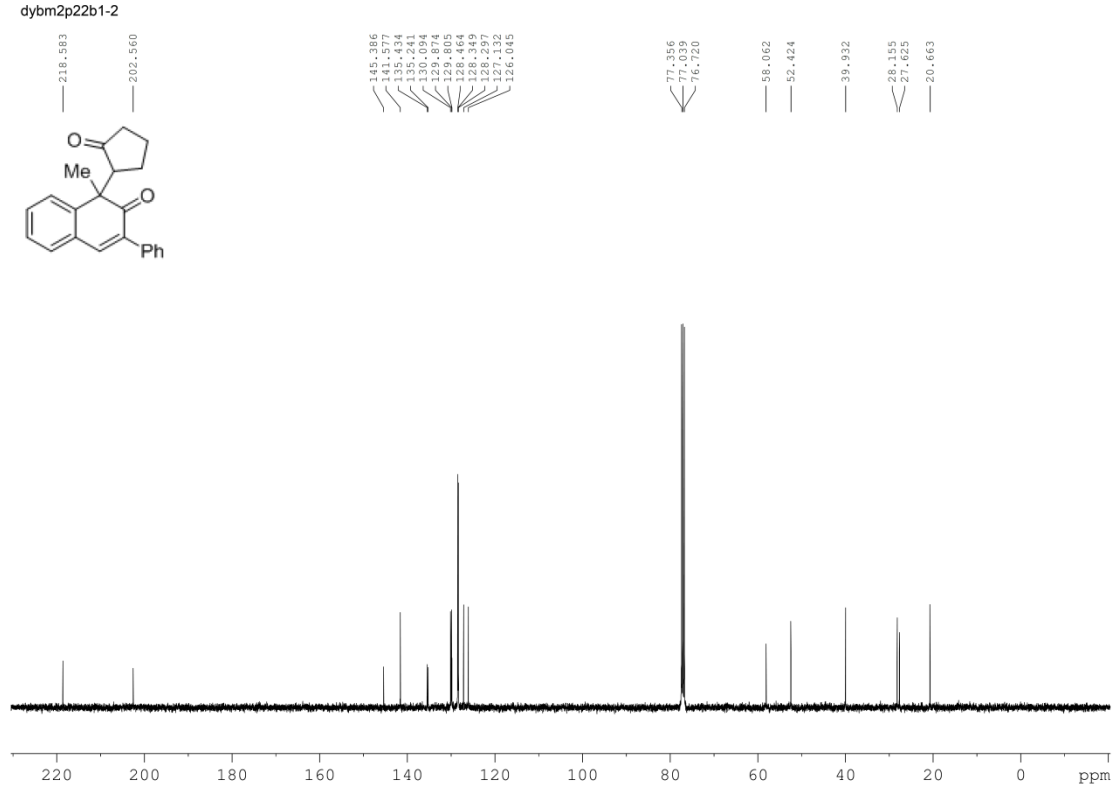

$^{13}$C NMR spectrum of compound **3d** (100 MHz, $CDCl_3$)



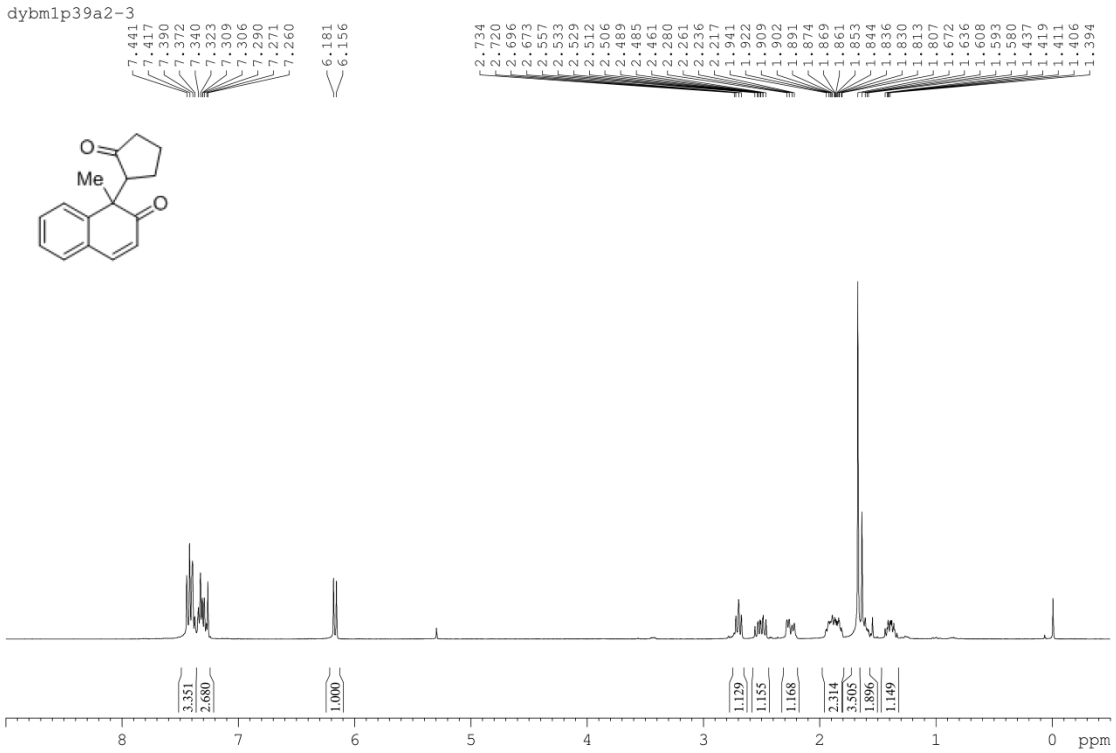
$^{1}$H NMR spectrum of compound **3e** (400 MHz, $CDCl_3$)



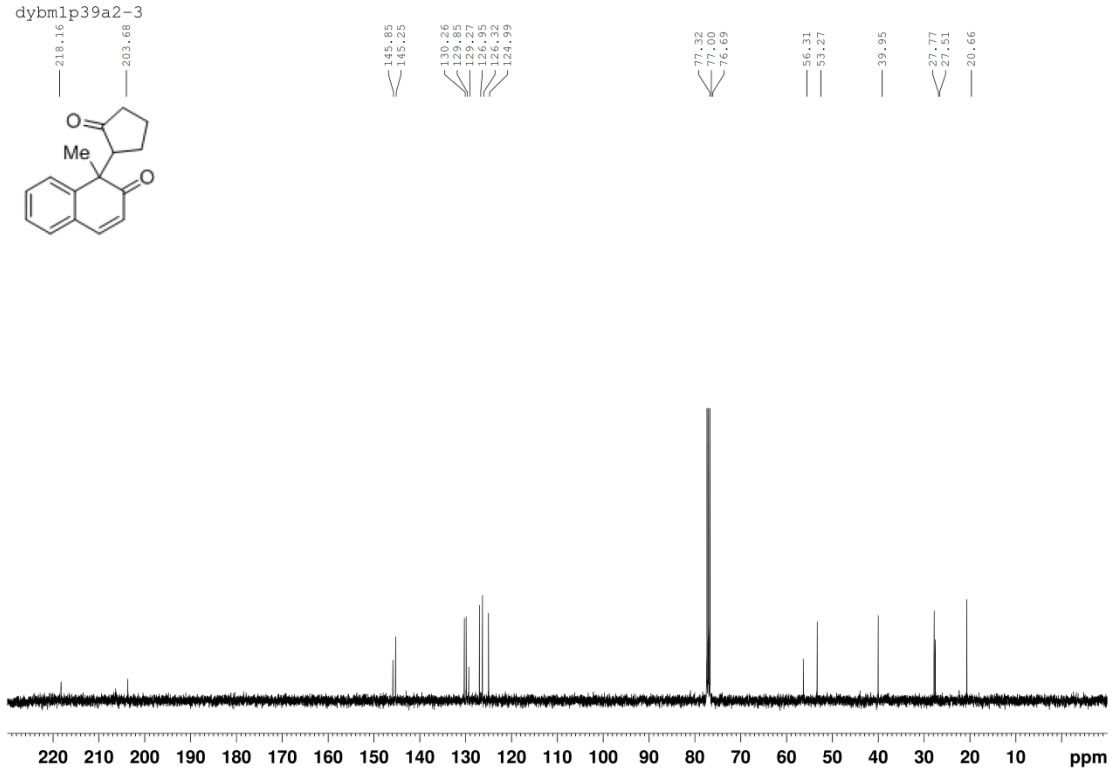

$^{13}$C NMR spectrum of compound **3e** (100 MHz, $CDCl_3$)



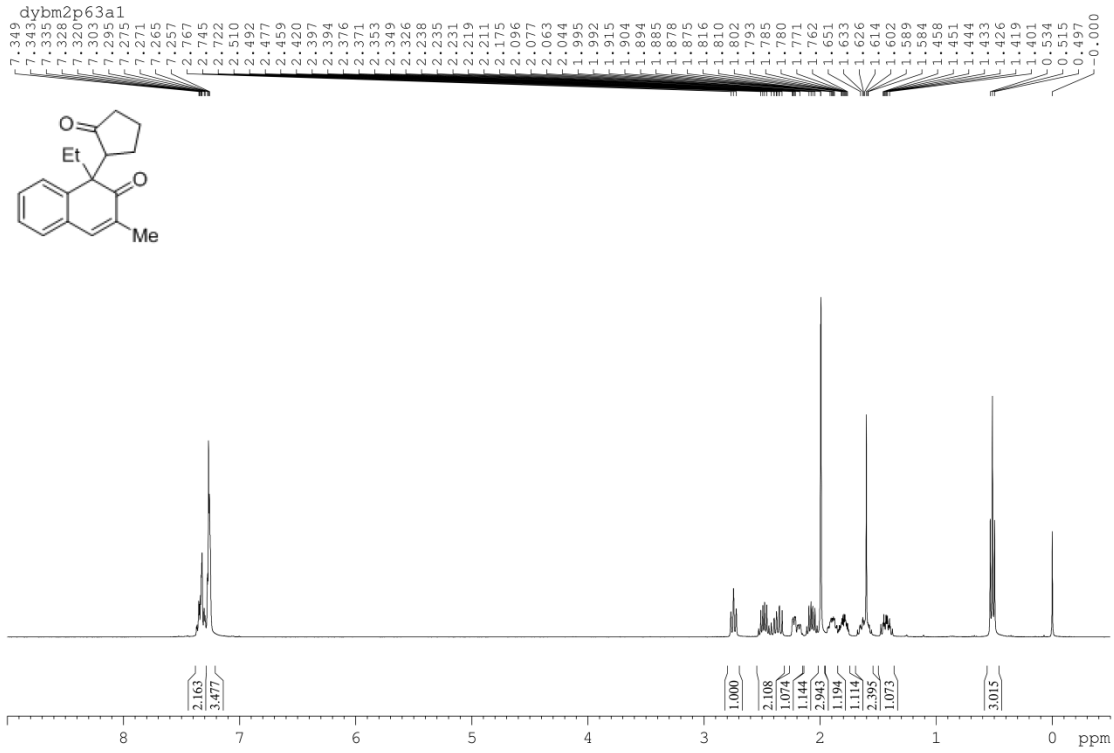
$^{1}$H NMR spectrum of compound **3f** (400 MHz, $CDCl_3$)



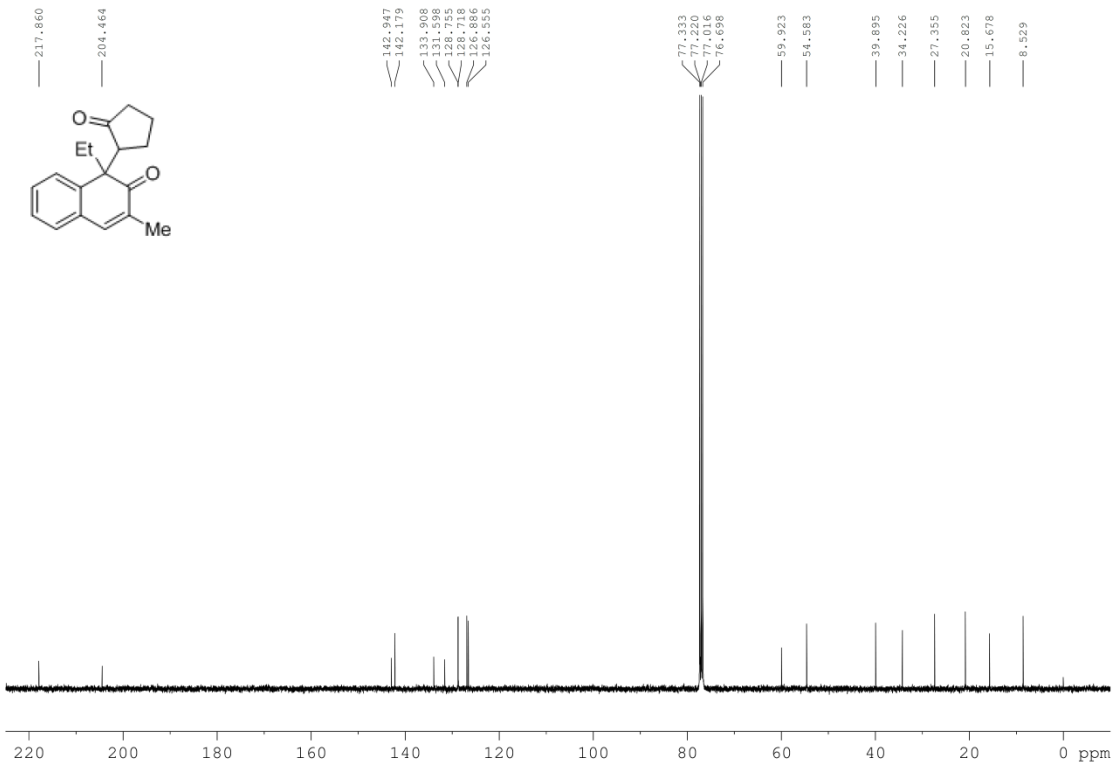

$^{13}$C NMR spectrum of compound **3f** (100 MHz, $CDCl_3$)



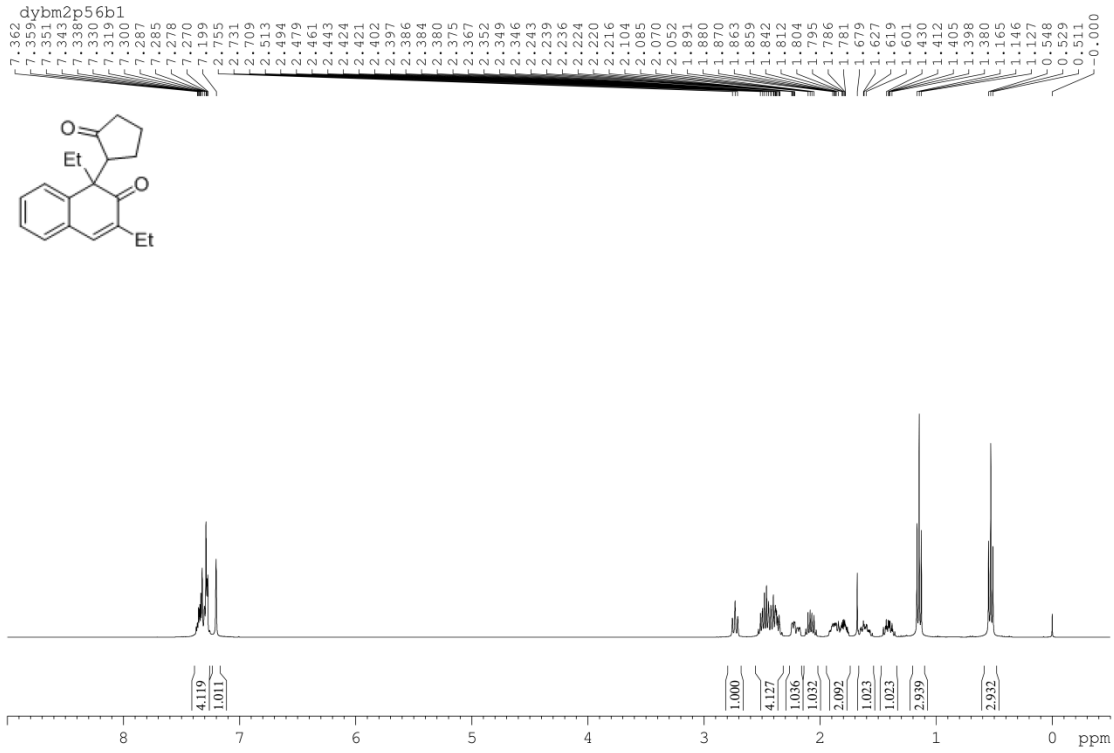
$^{1}$H NMR spectrum of compound **3g** (400 MHz, $CDCl_3$)



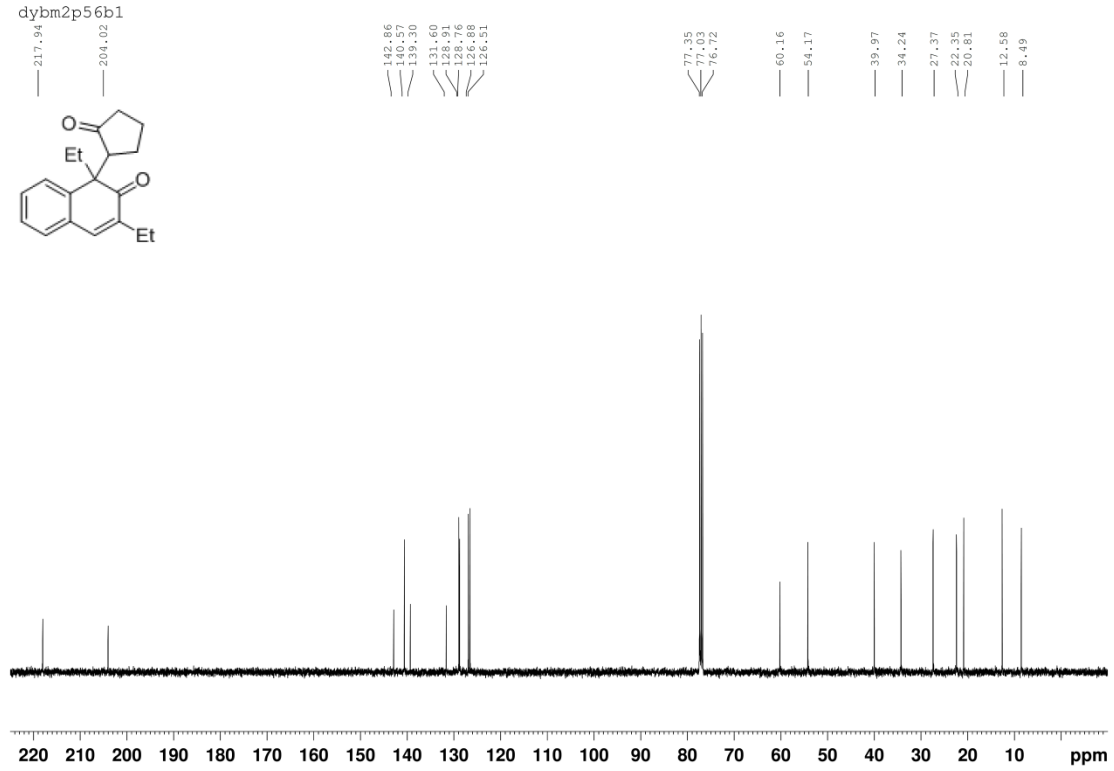

$^{13}$C NMR spectrum of compound **3g** (100 MHz, $CDCl_3$)



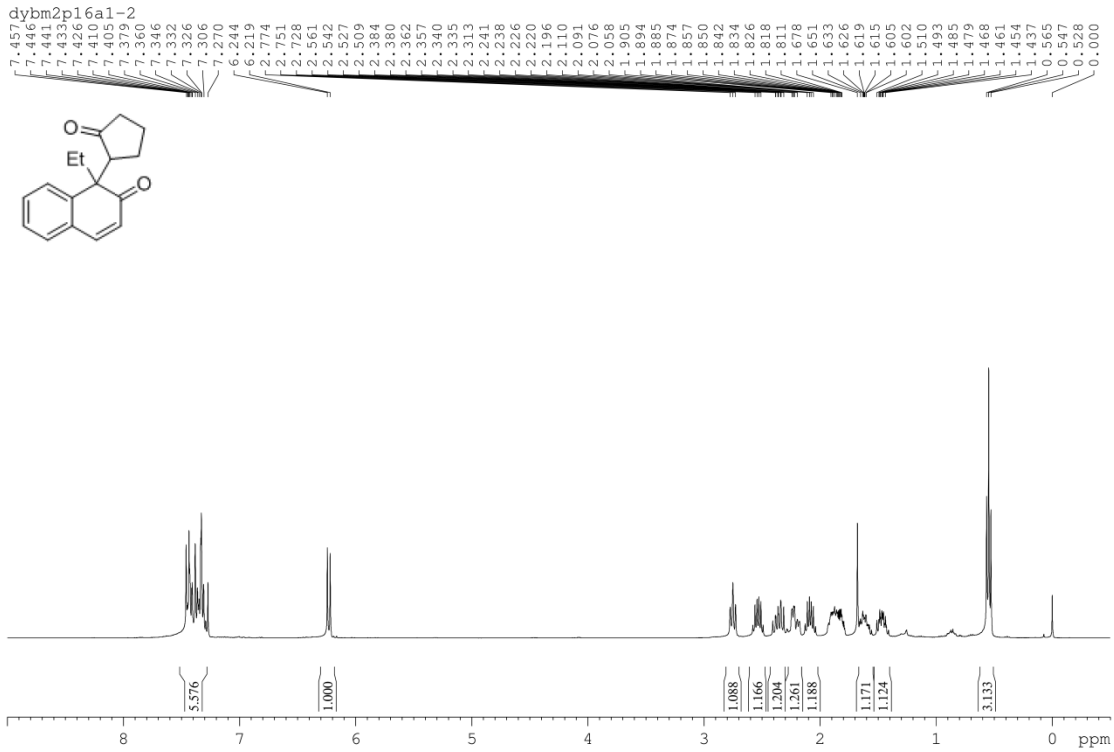
$^{1}$H NMR spectrum of compound **3h** (400 MHz, $CDCl_3$)



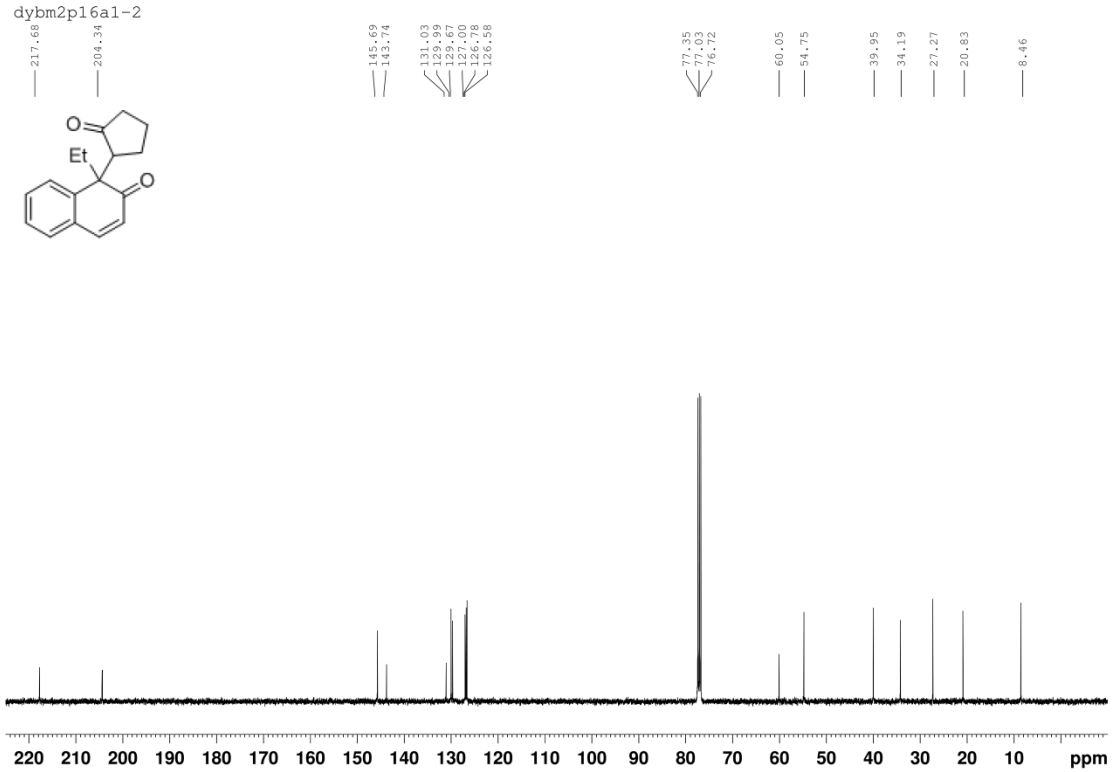

$^{13}$C NMR spectrum of compound **3h** (100 MHz, $CDCl_3$)



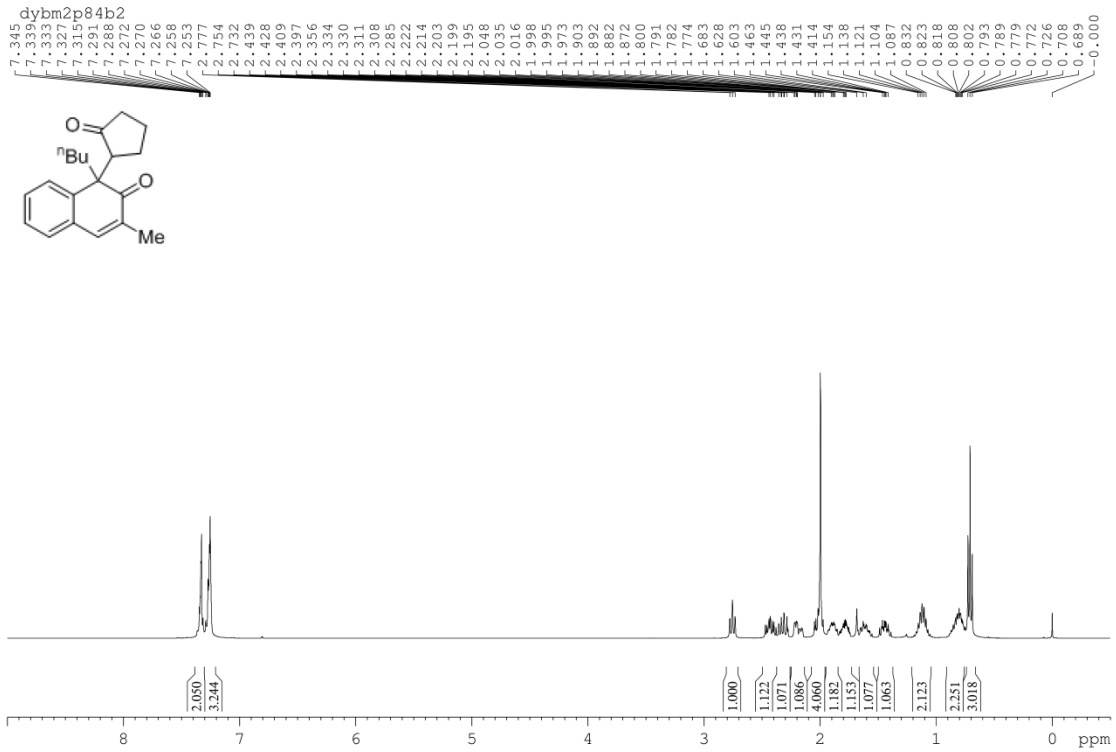
$^{1}$H NMR spectrum of compound **3i** (400 MHz, $CDCl_3$)



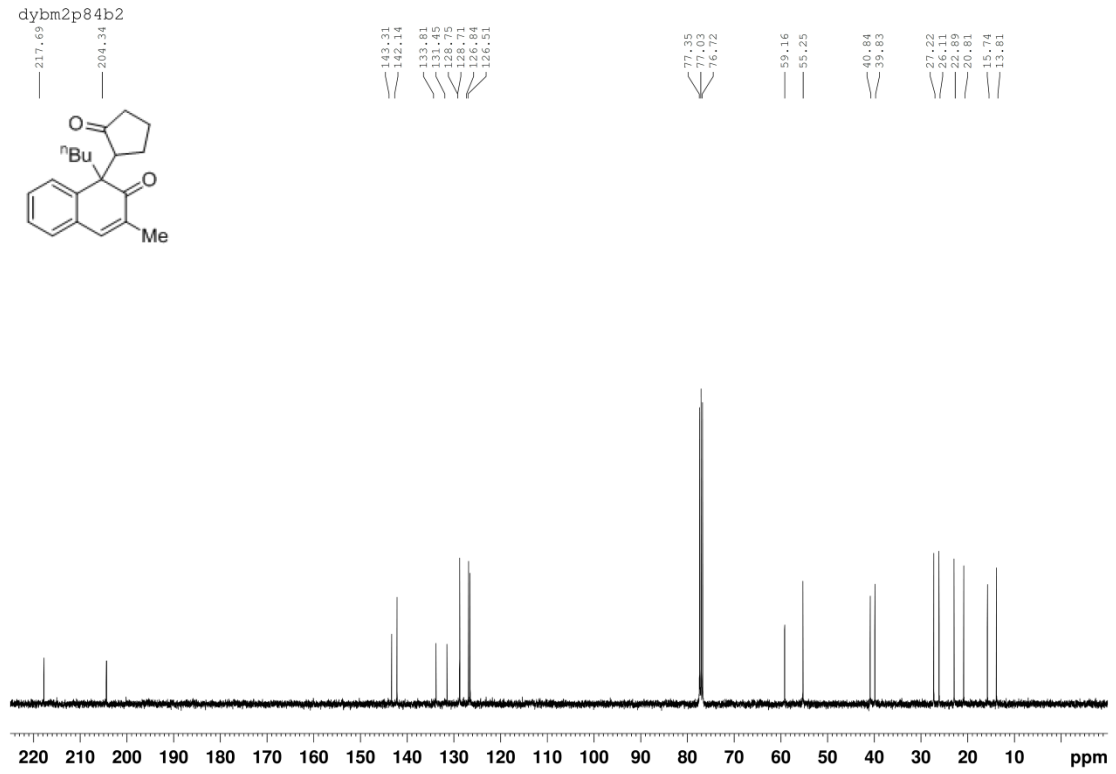

$^{13}$C NMR spectrum of compound **3i** (100 MHz, $CDCl_3$)



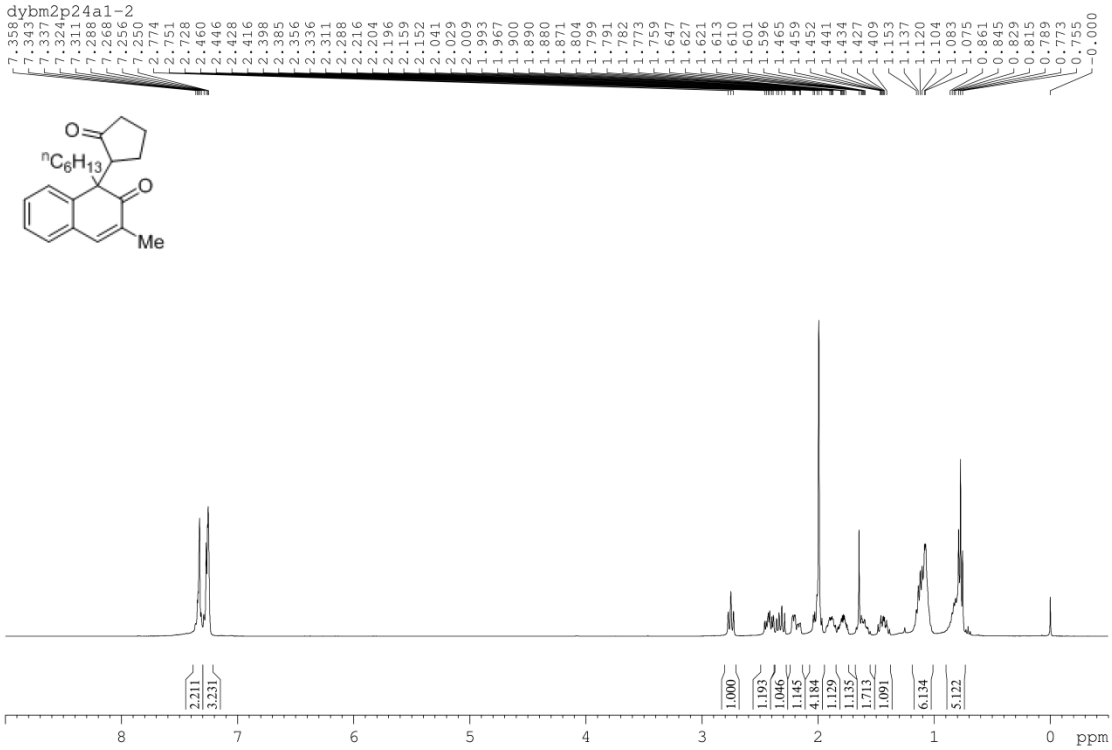
$^{1}$H NMR spectrum of compound **3j** (400 MHz, $CDCl_3$)



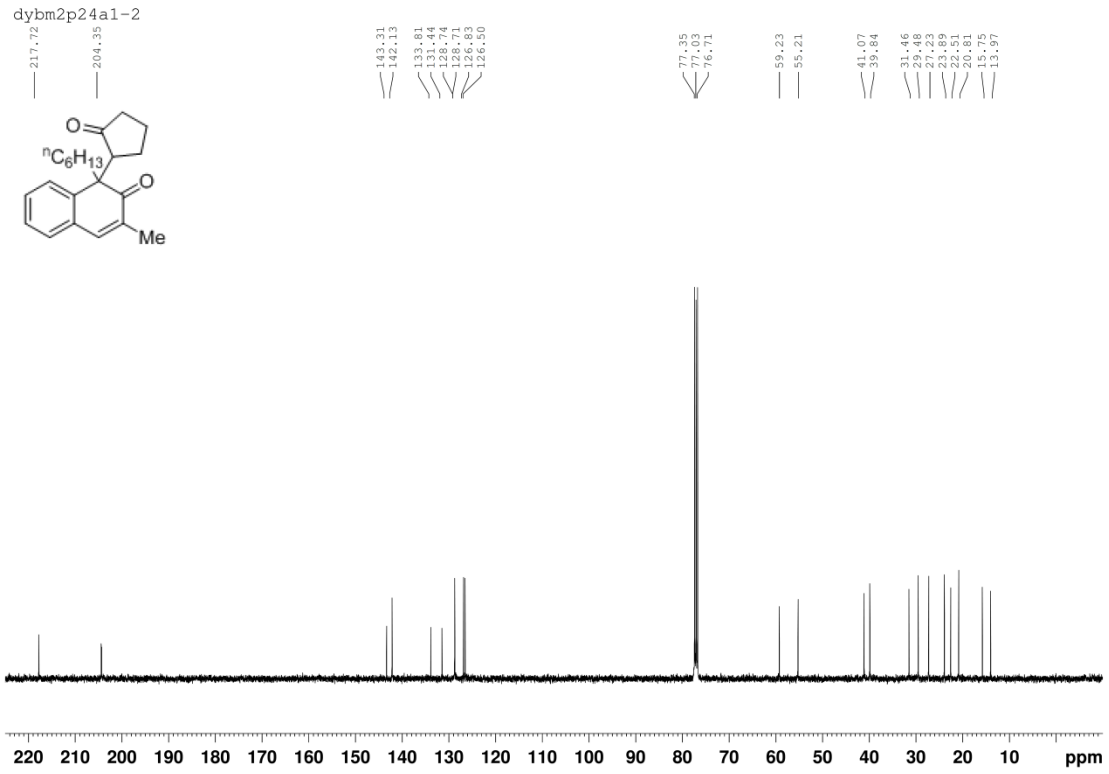

$^{13}$C NMR spectrum of compound **3j** (100 MHz, $CDCl_3$)



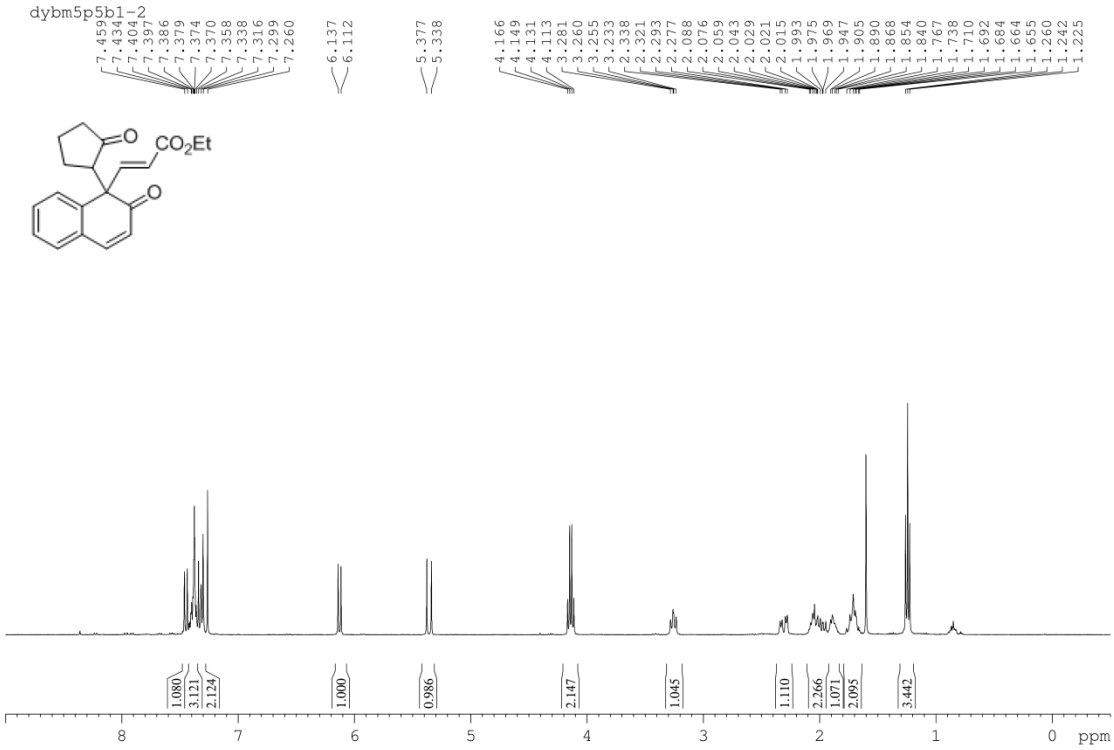
$^{1}$H NMR spectrum of compound **3k** (400 MHz, $CDCl_3$)



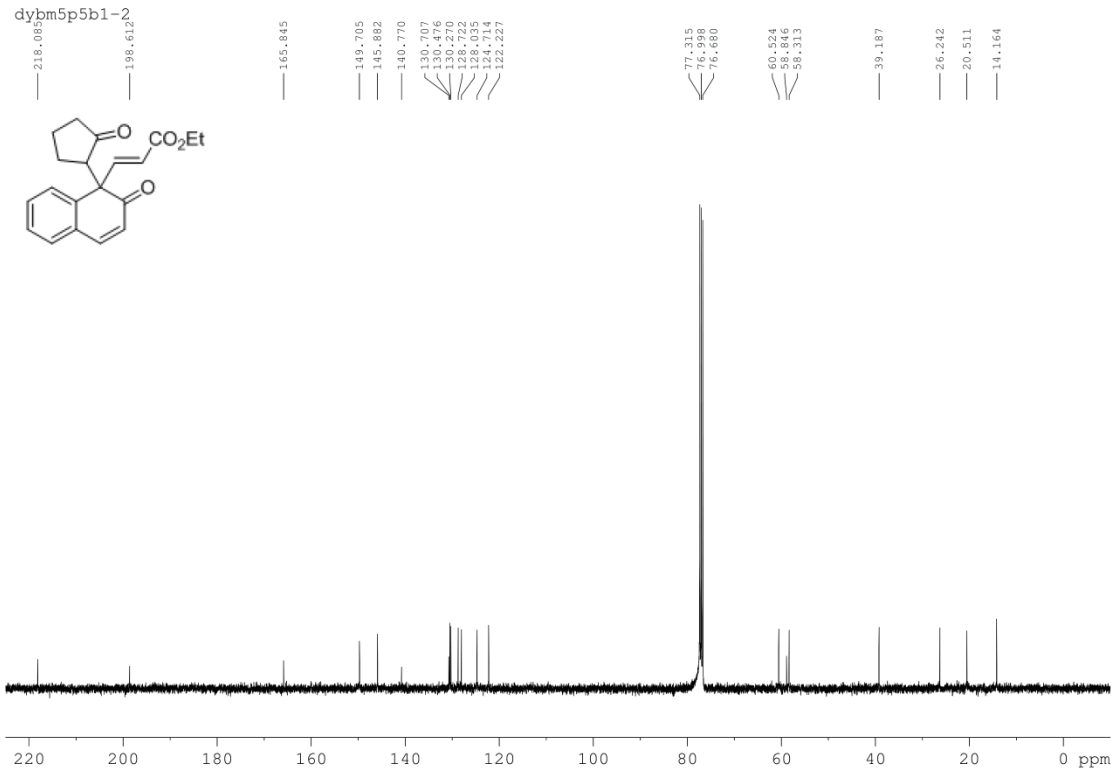

$^{13}$C NMR spectrum of compound **3k** (100 MHz, $CDCl_3$)



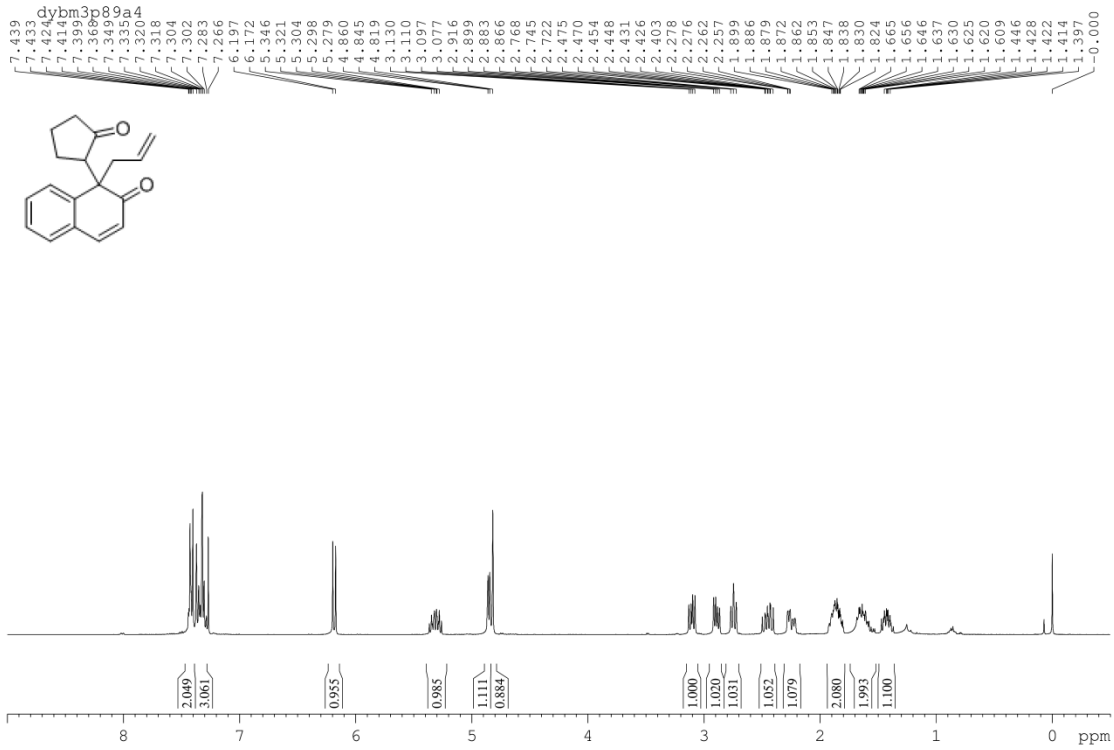
$^{1}$H NMR spectrum of compound **3l** (400 MHz, $CDCl_3$)



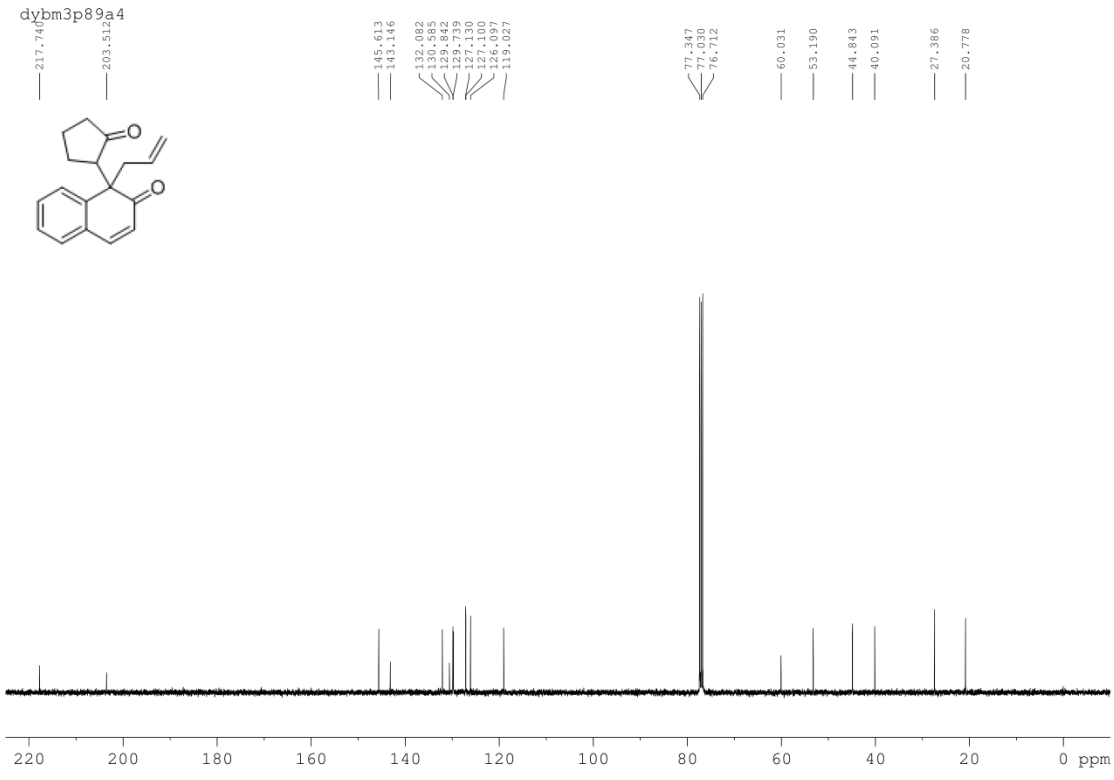

$^{13}$C NMR spectrum of compound **3l** (100 MHz, $CDCl_3$)



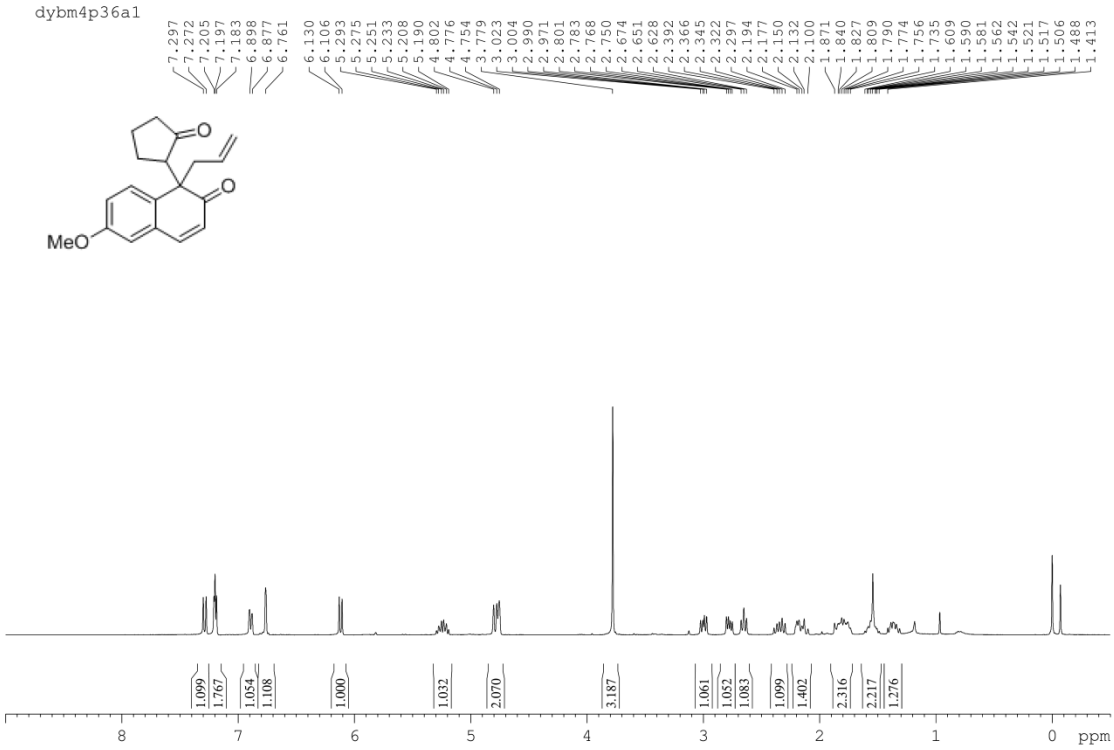
$^{1}$H NMR spectrum of compound **3m** (400 MHz, $CDCl_3$)



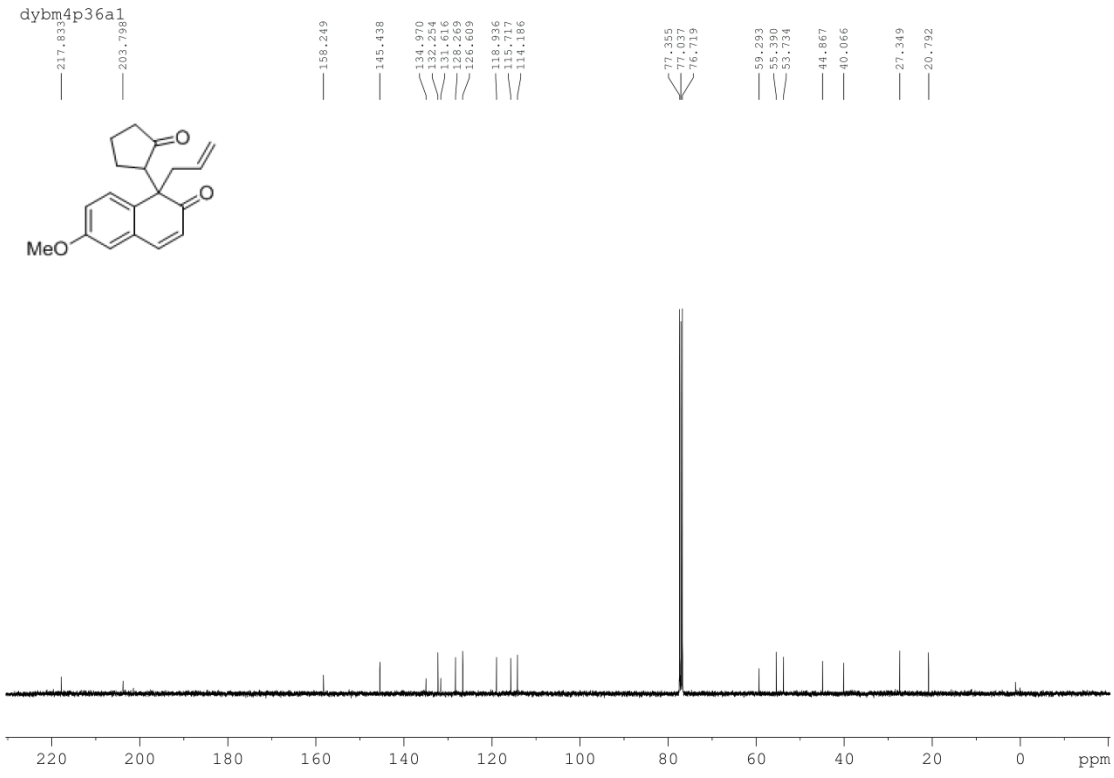

$^{13}$C NMR spectrum of compound **3m** (100 MHz, $CDCl_3$)



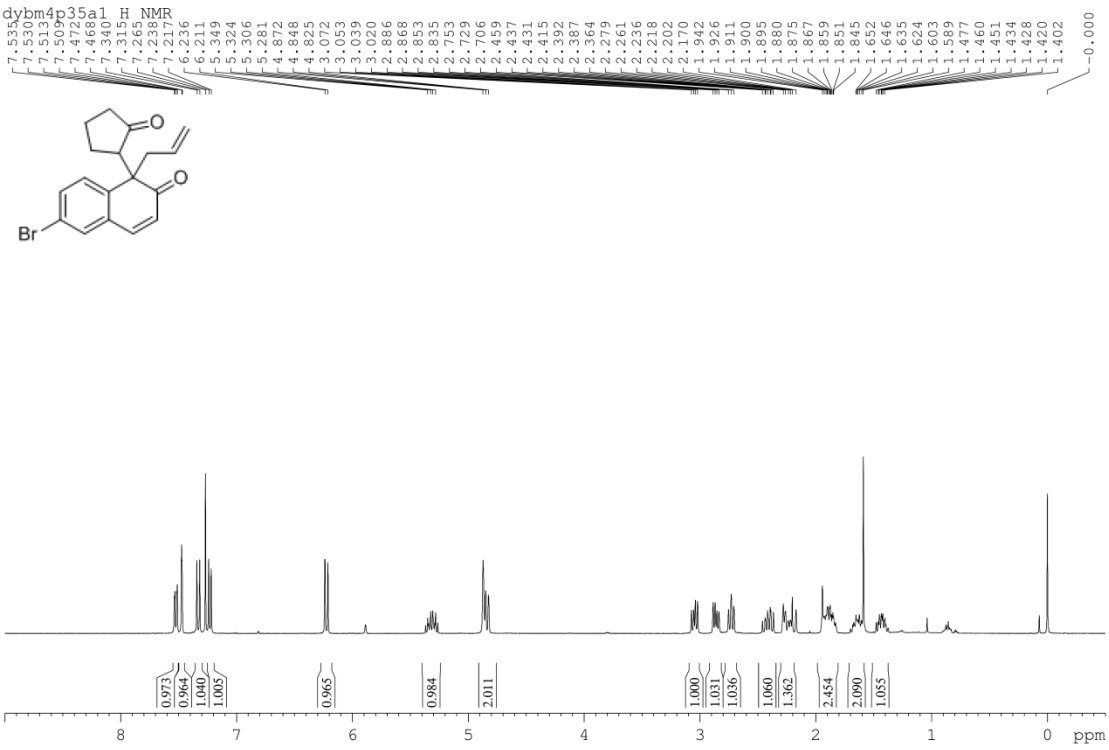
$^{1}$H NMR spectrum of compound **3n** (400 MHz, $CDCl_3$)



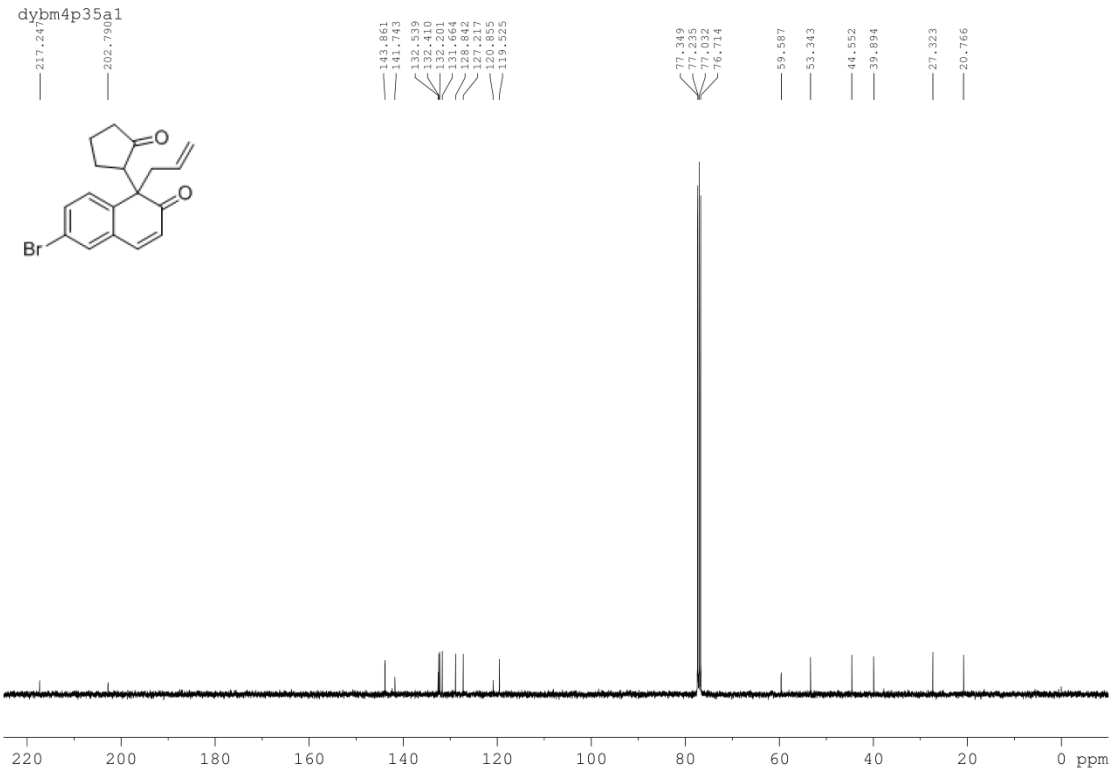

$^{13}$C NMR spectrum of compound **3n** (100 MHz, $CDCl_3$)



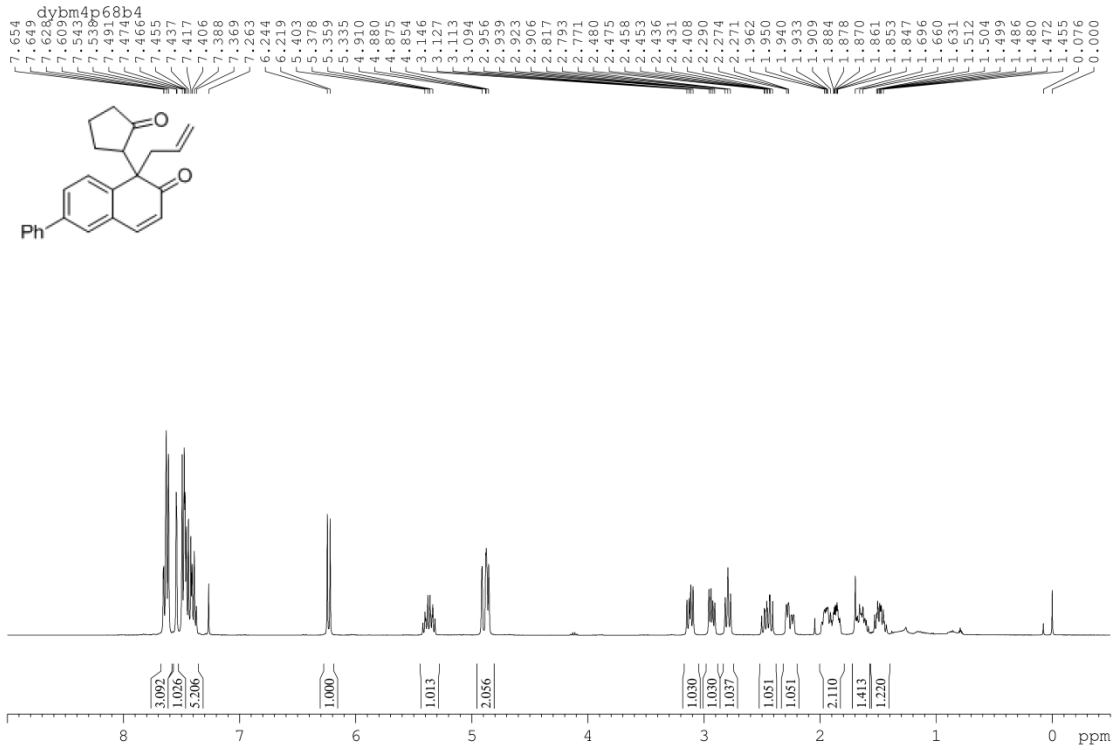
$^{1}$H NMR spectrum of compound **3o** (400 MHz, $CDCl_3$)



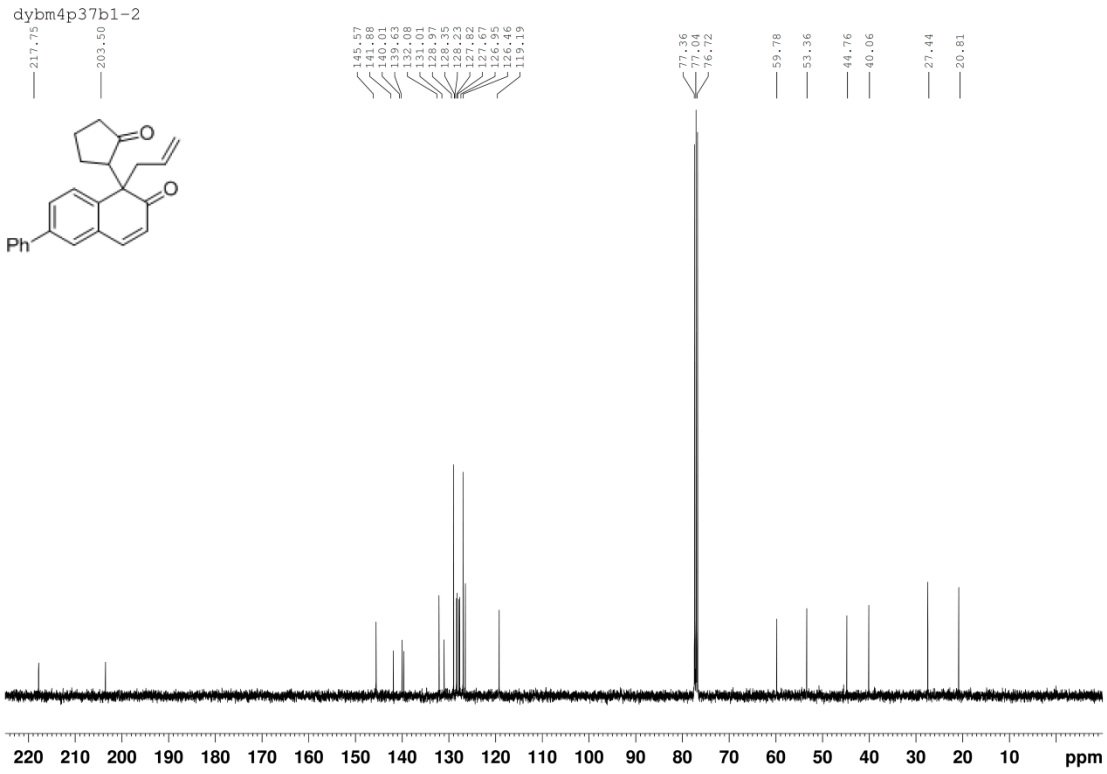

$^{13}$C NMR spectrum of compound **3o** (100 MHz, $CDCl_3$)



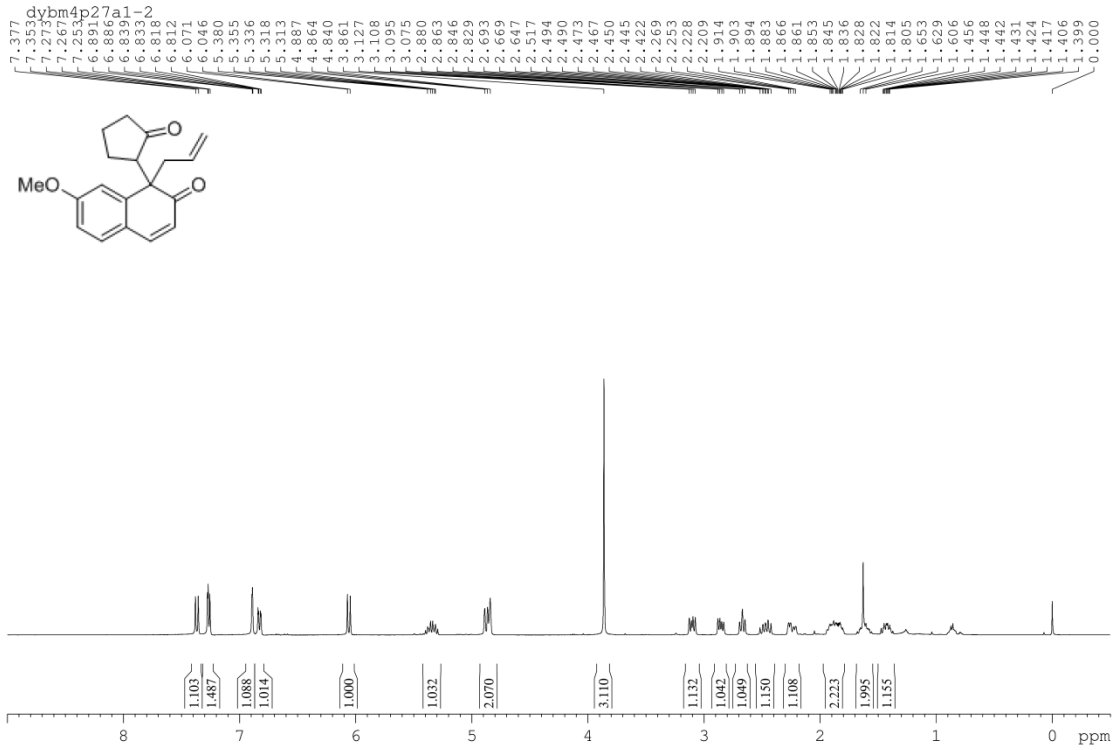
$^{1}$H NMR spectrum of compound **3p** (400 MHz, $CDCl_3$)



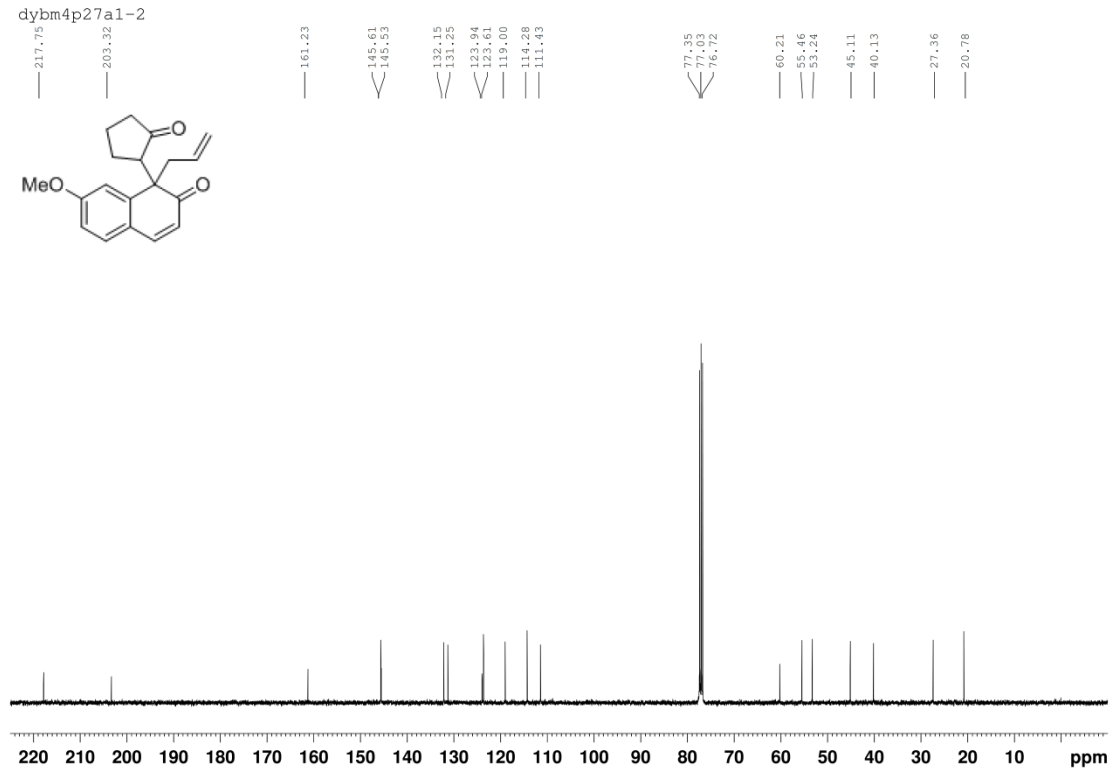

$^{13}$C NMR spectrum of compound **3p** (100 MHz, $CDCl_3$)



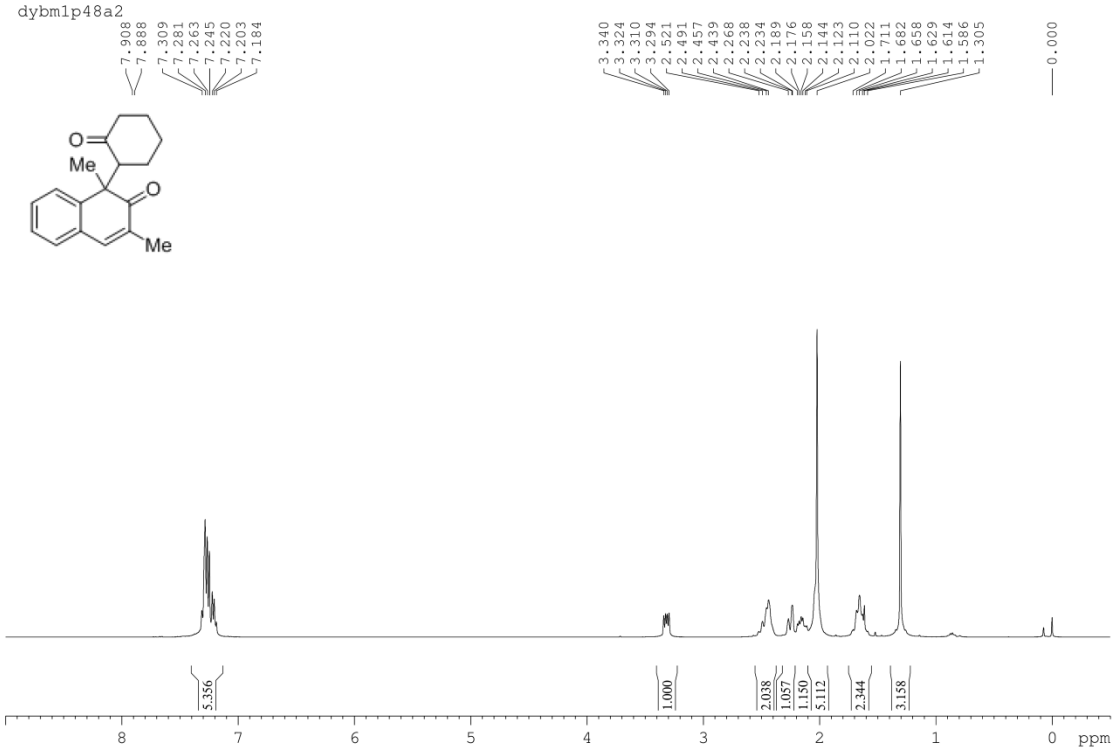
$^{1}$H NMR spectrum of compound **3q** (400 MHz, $CDCl_3$)



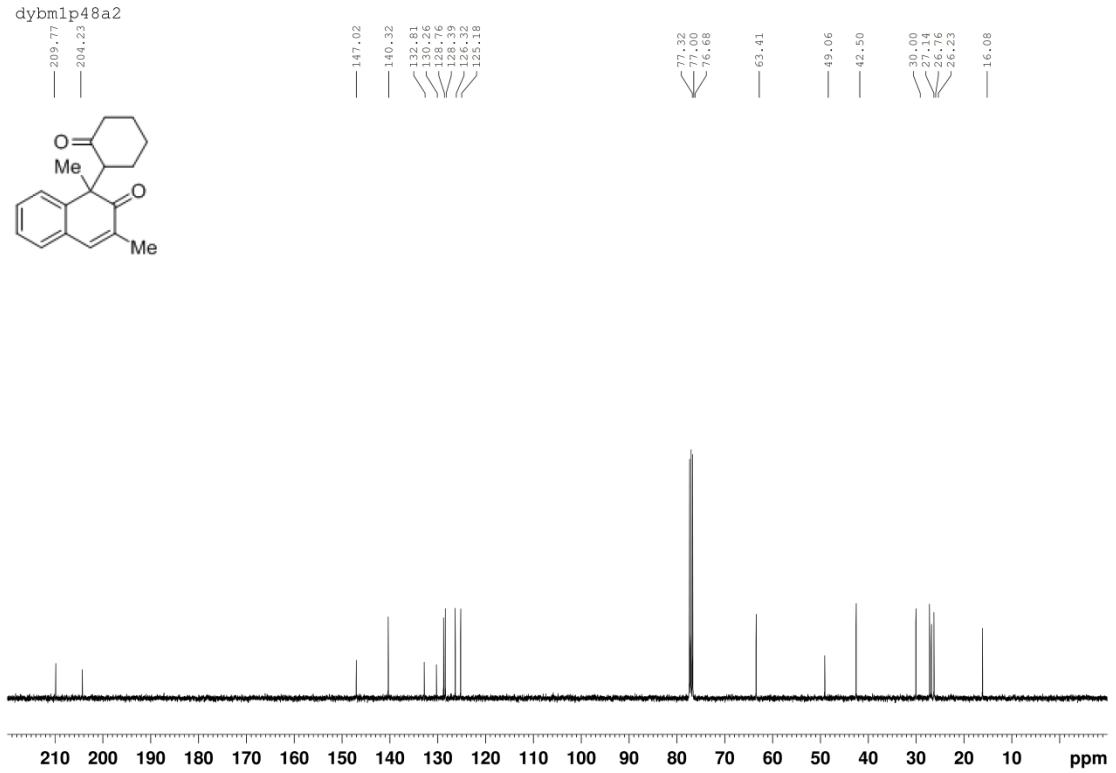

$^{13}$C NMR spectrum of compound **3q** (100 MHz, $CDCl_3$)



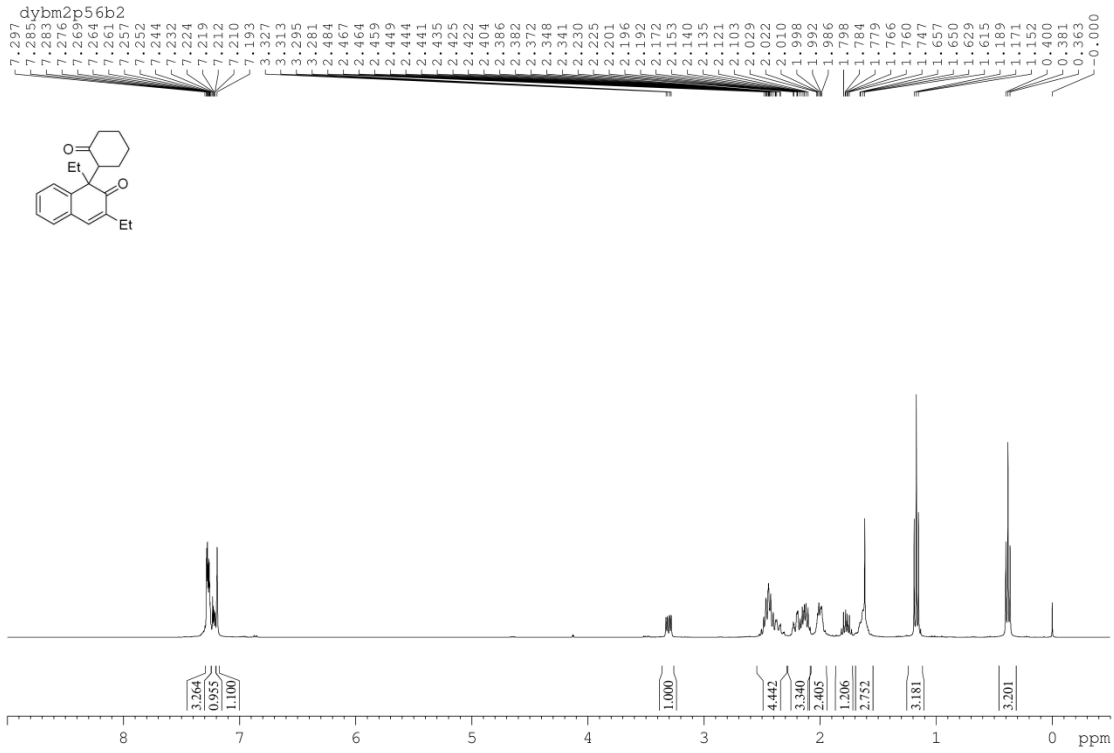
$^{1}$H NMR spectrum of compound **3r** (400 MHz, $CDCl_3$)



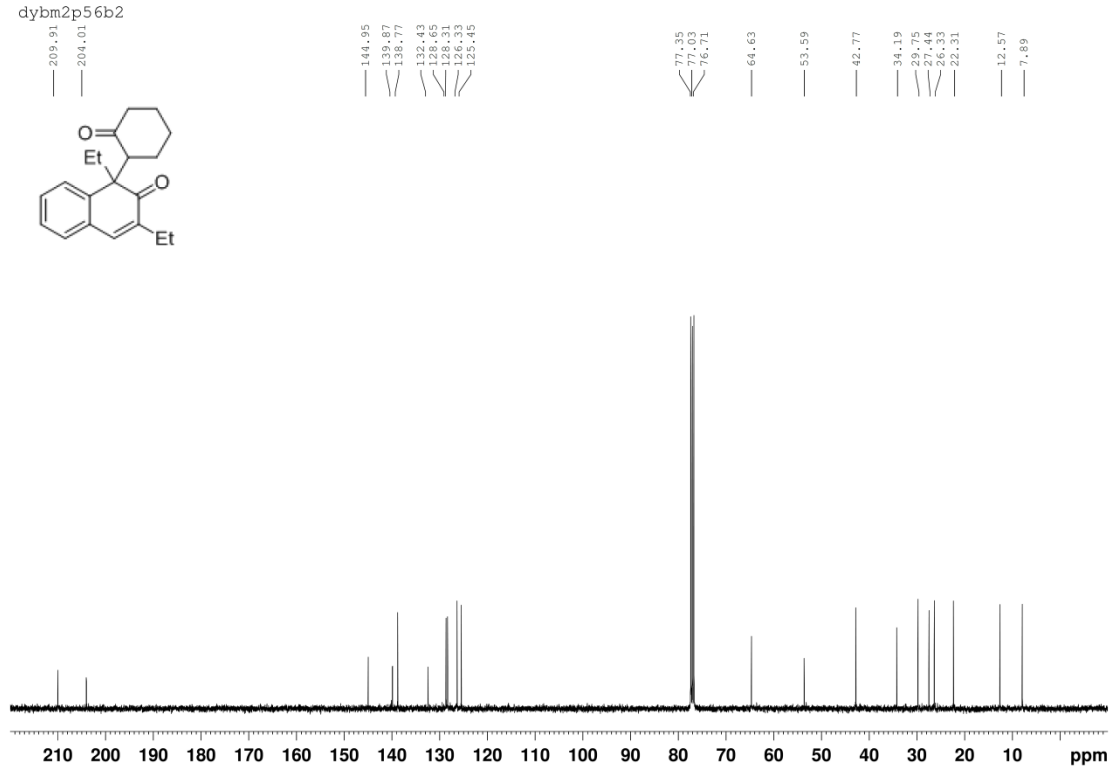

$^{13}$C NMR spectrum of compound **3r** (100 MHz, $CDCl_3$)



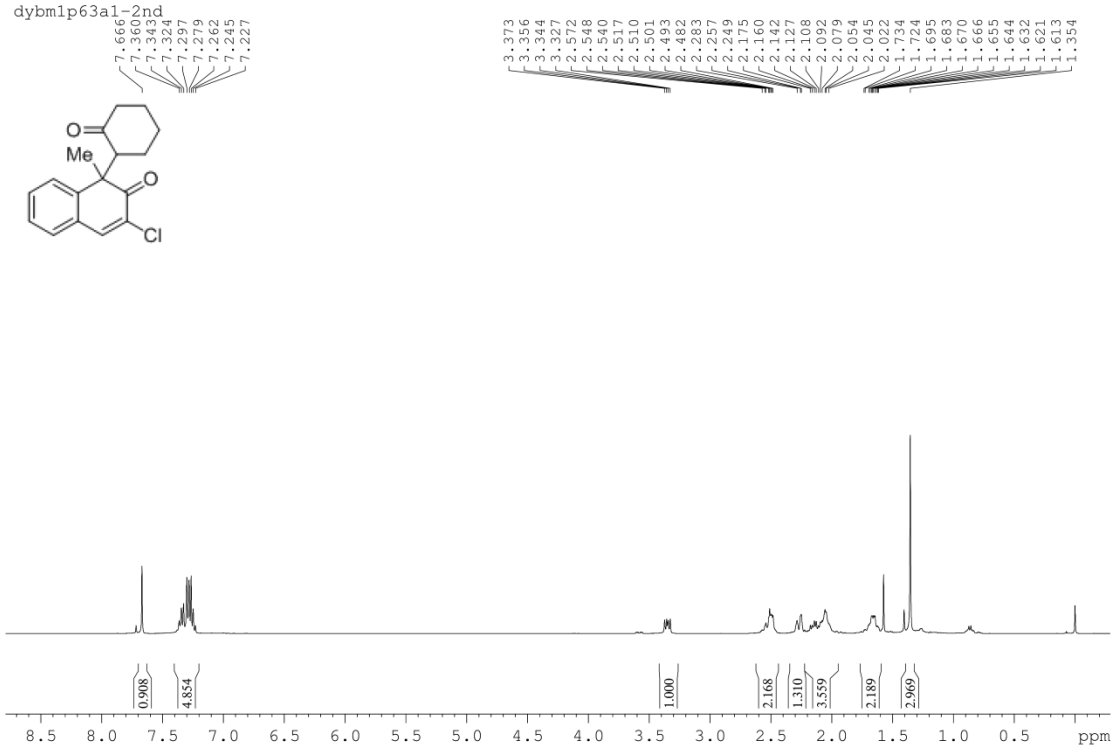
$^{1}$H NMR spectrum of compound **3s** (400 MHz, $CDCl_3$)



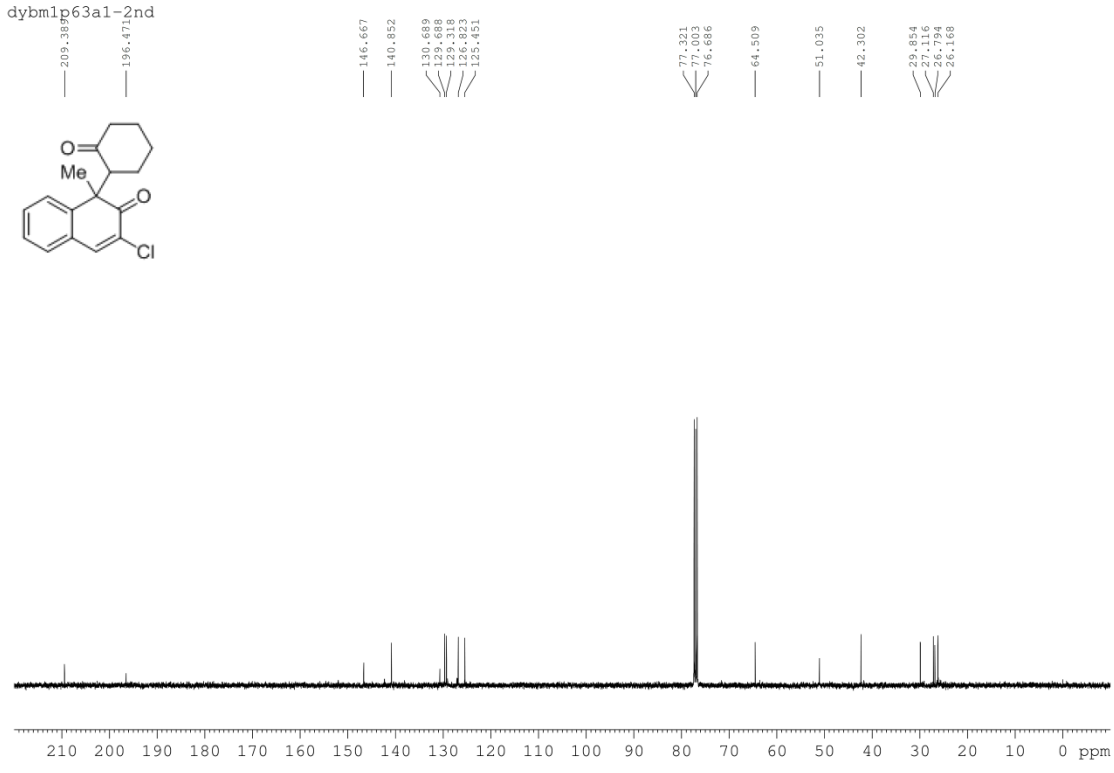

$^{13}$C NMR spectrum of compound **3s** (100 MHz, $CDCl_3$)



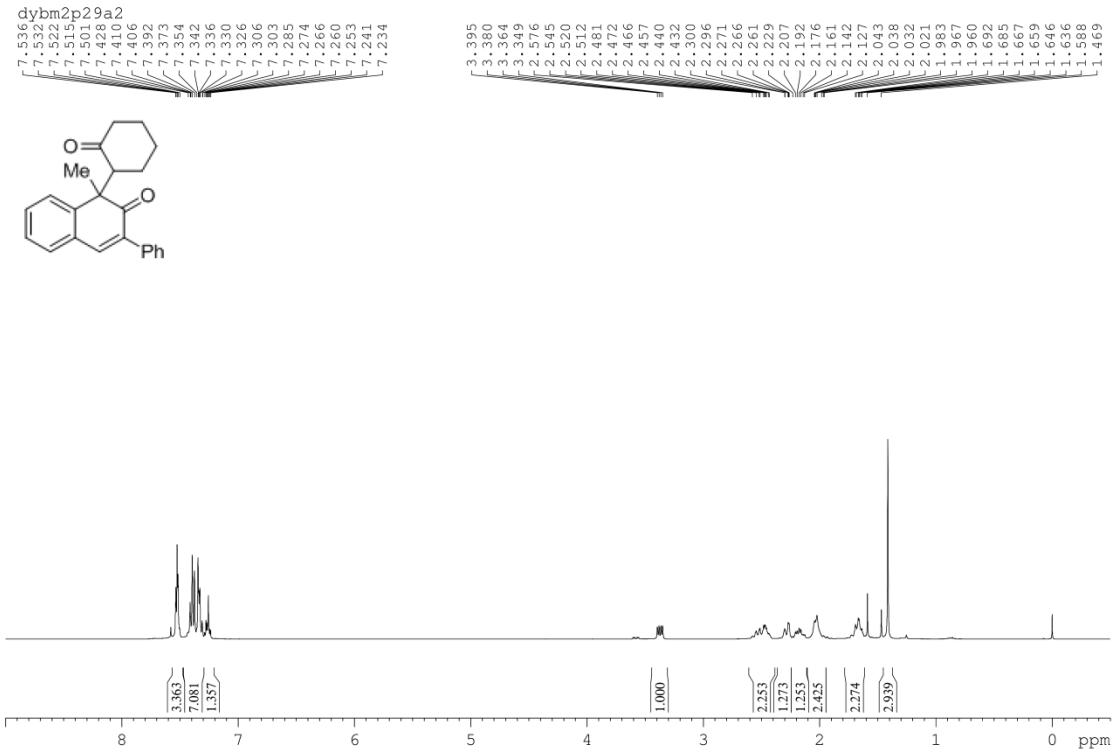
$^{1}$H NMR spectrum of compound **3t** (400 MHz, $CDCl_3$)



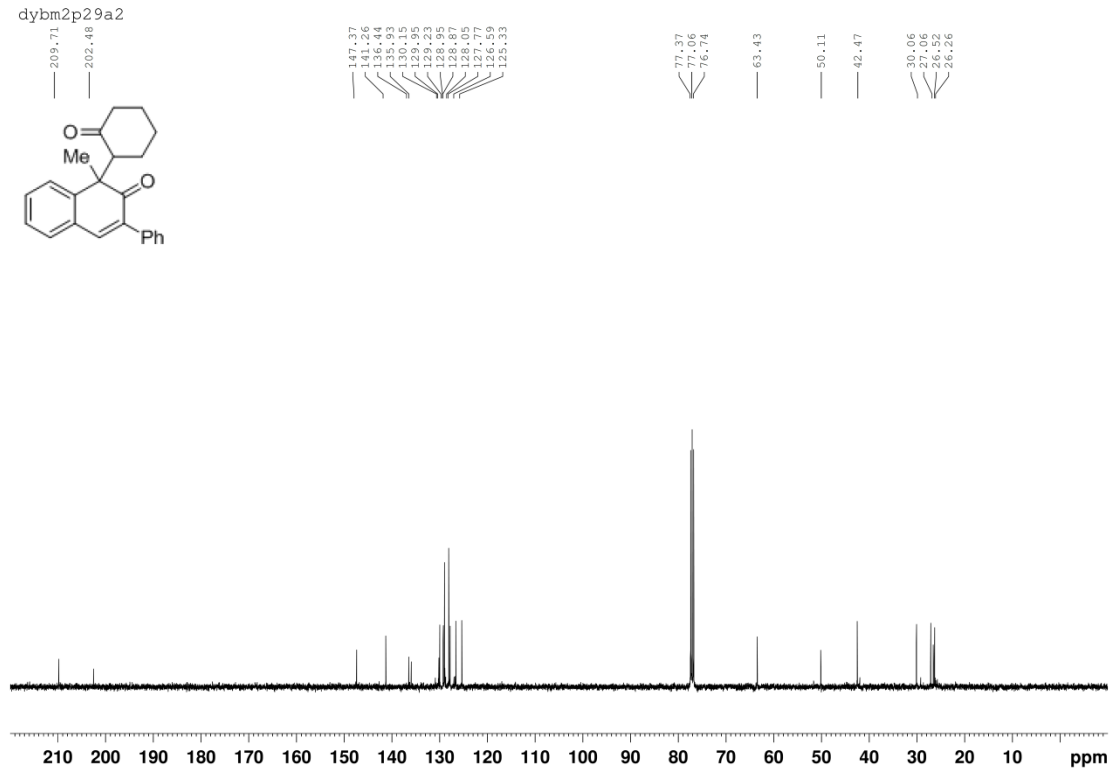

$^{13}$C NMR spectrum of compound **3t** (100 MHz, $CDCl_3$)



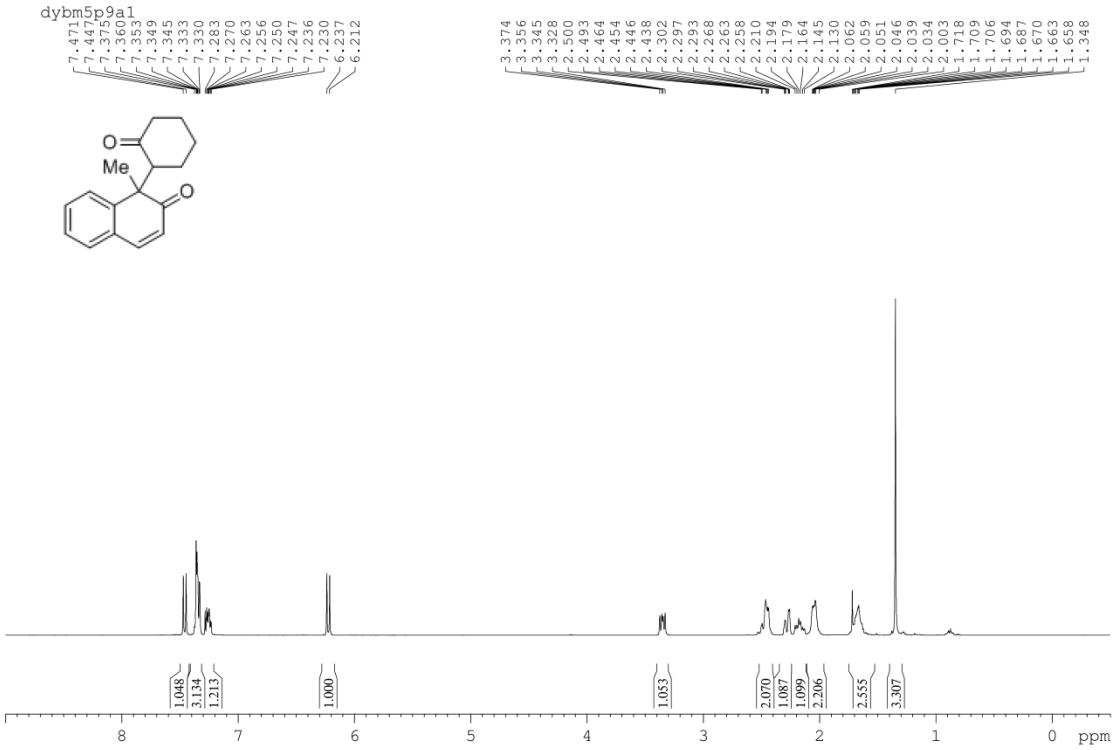
$^{1}$H NMR spectrum of compound **3u** (400 MHz, $CDCl_3$)



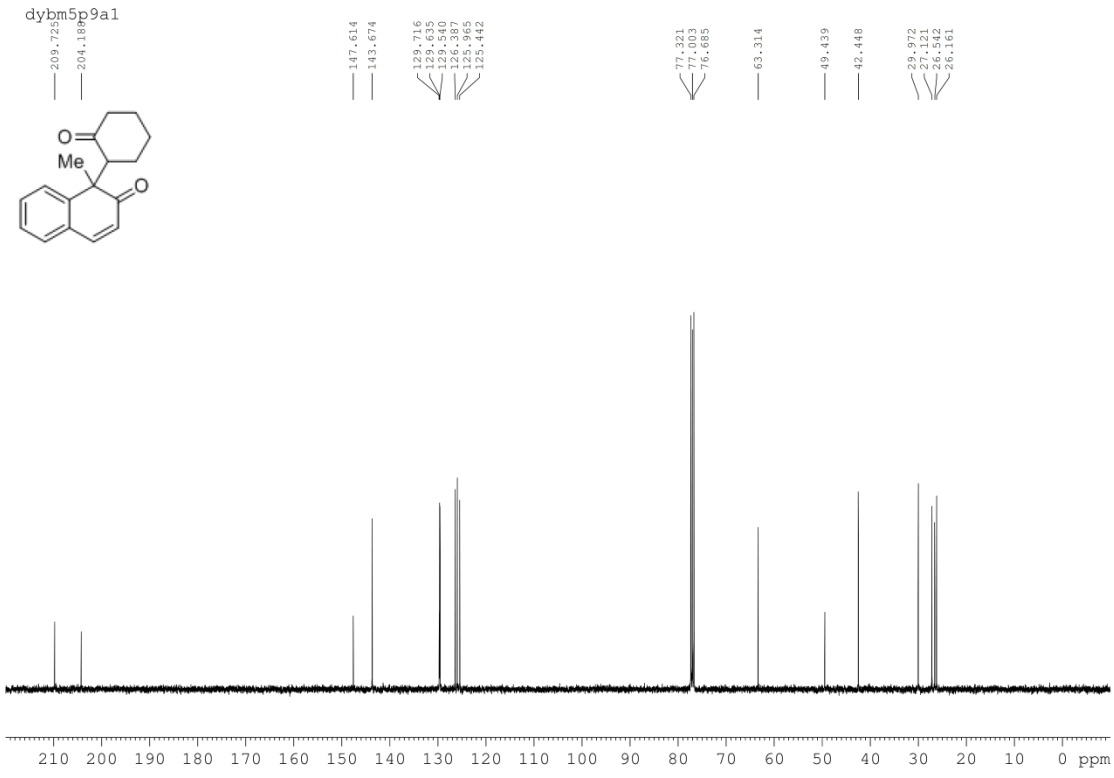

$^{13}$C NMR spectrum of compound **3u** (100 MHz, $CDCl_3$)



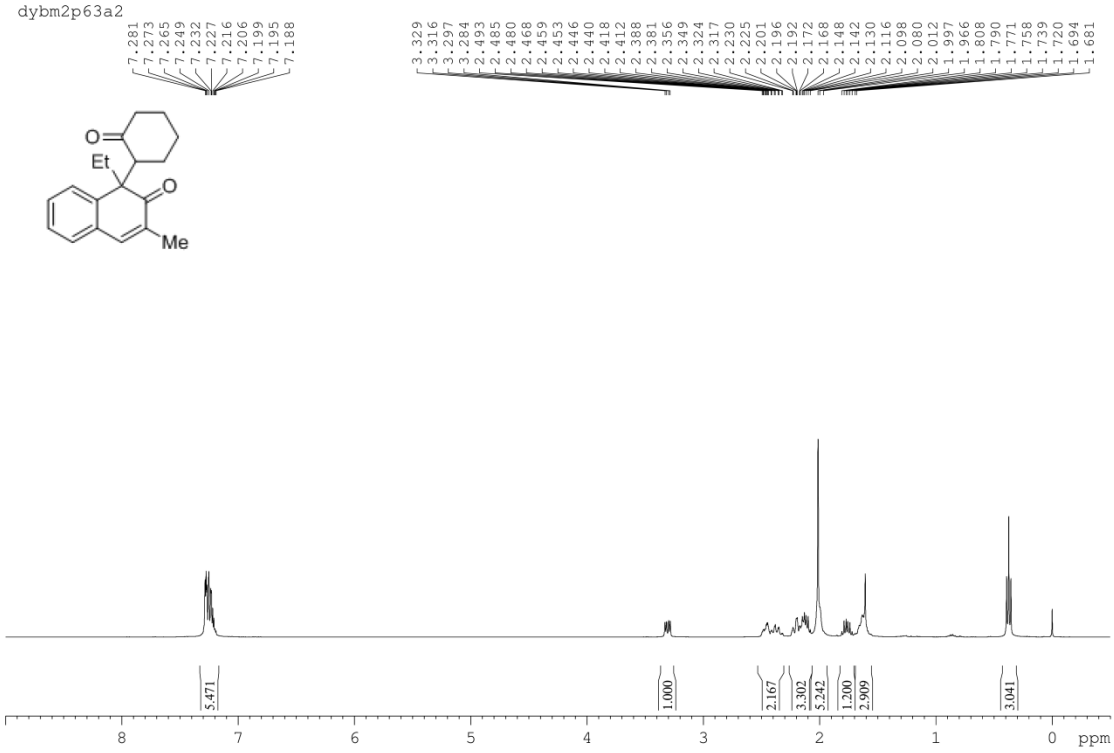
$^{1}$H NMR spectrum of compound **3v** (400 MHz, $CDCl_3$)



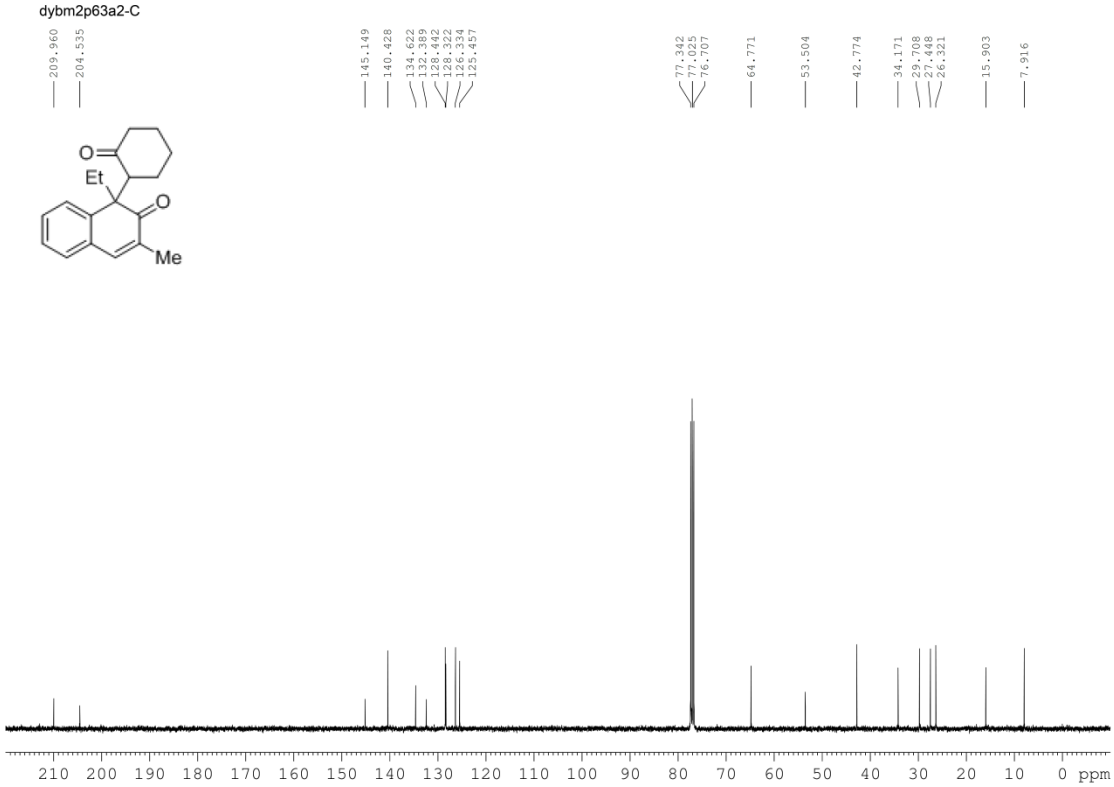

$^{13}$C NMR spectrum of compound **3v** (100 MHz, $CDCl_3$)



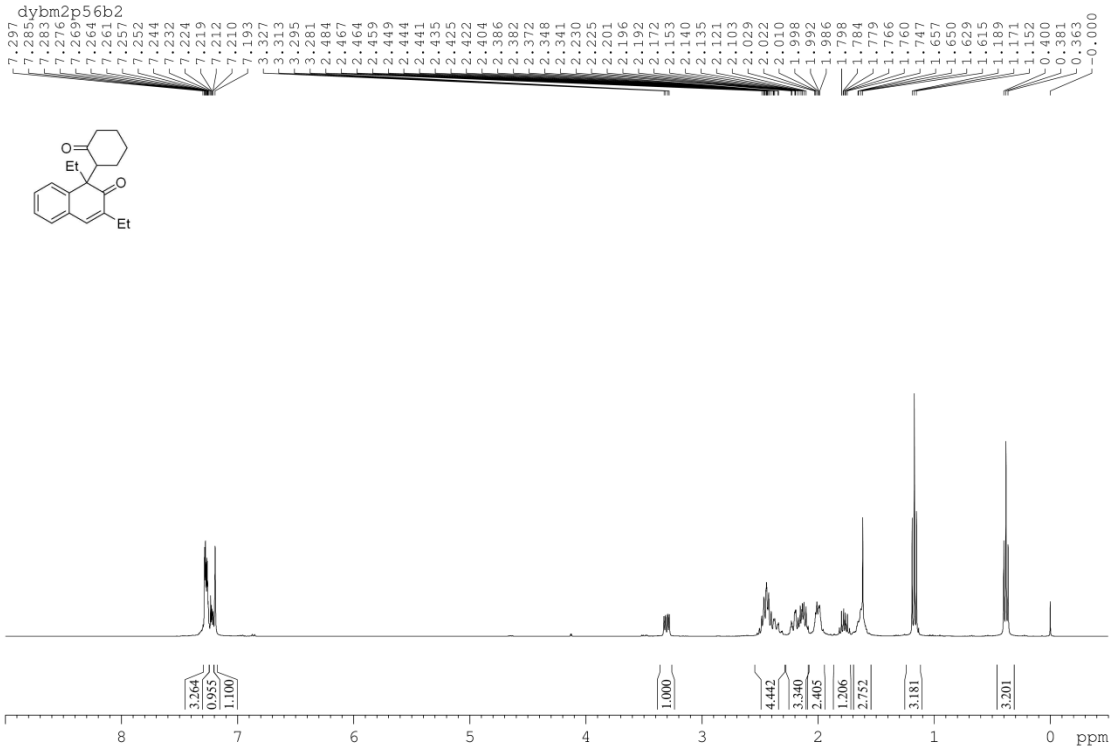
$^{1}$H NMR spectrum of compound **3w** (400 MHz, $CDCl_3$)



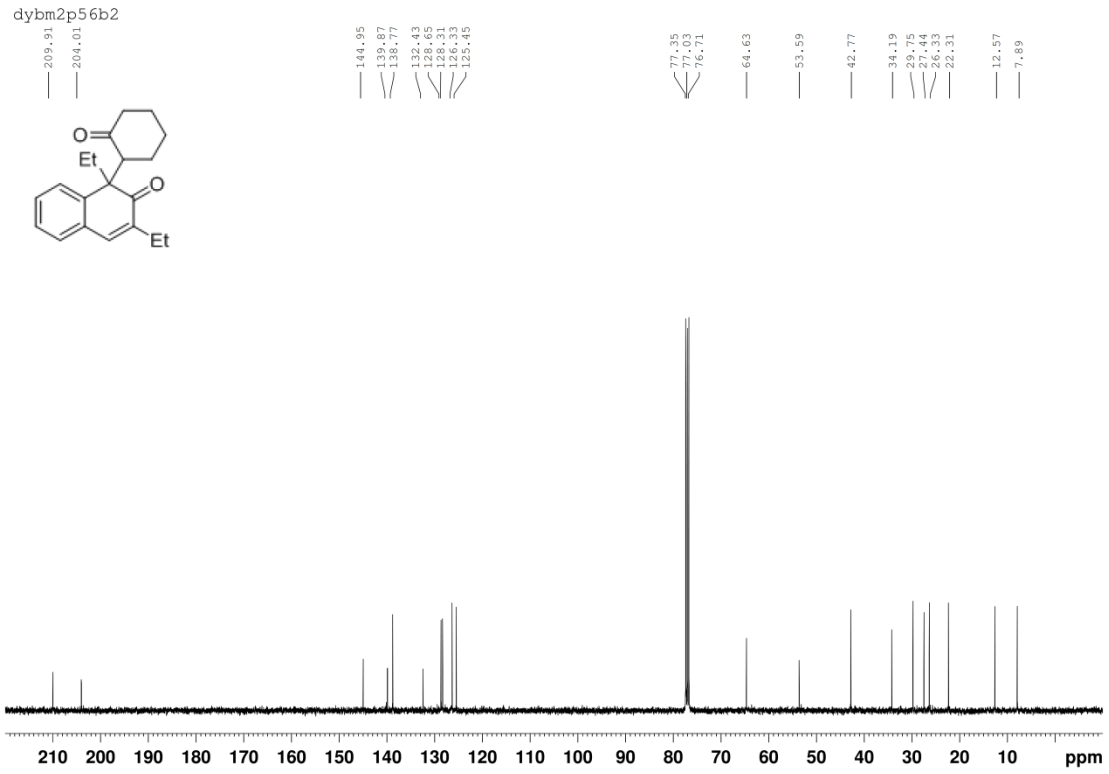

$^{13}$C NMR spectrum of compound **3w** (100 MHz, $CDCl_3$)



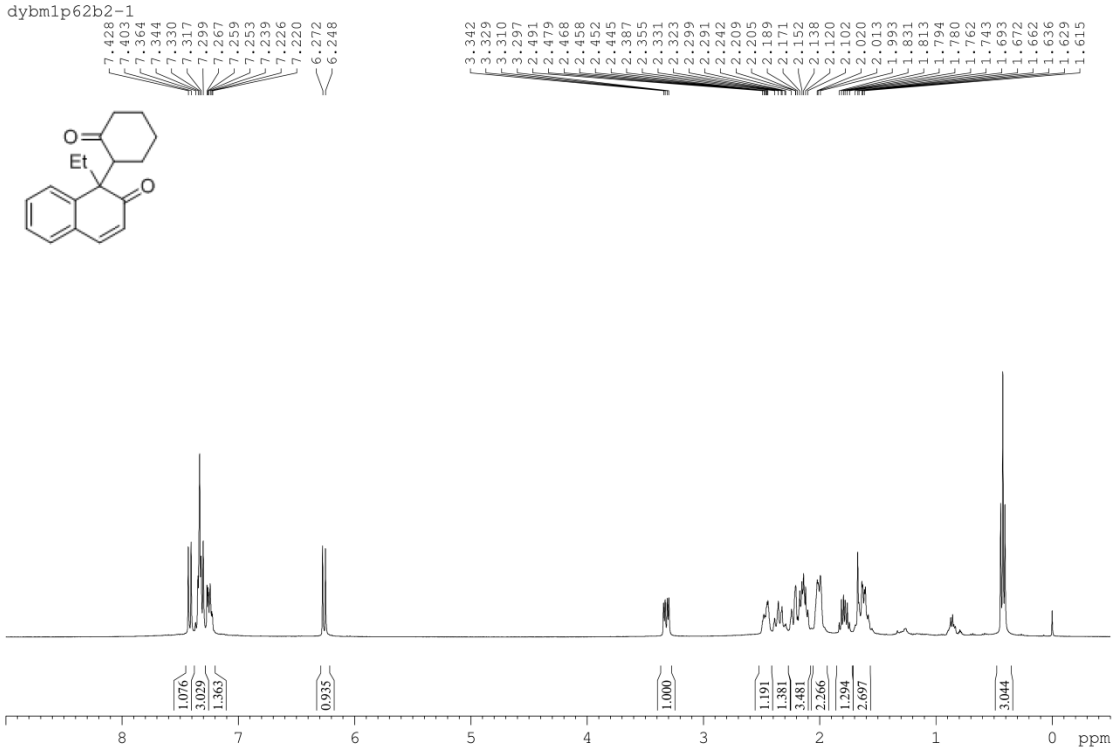
$^{1}$H NMR spectrum of compound **3x** (400 MHz, $CDCl_3$)



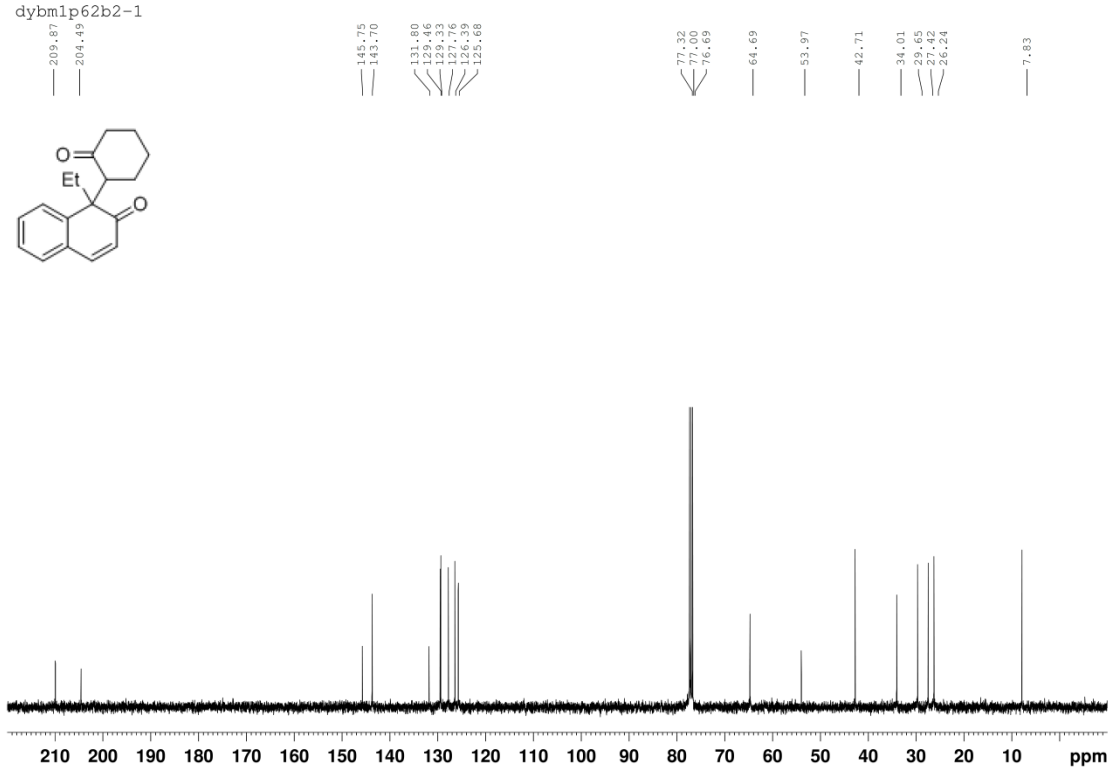

$^{13}$C NMR spectrum of compound **3x** (100 MHz, $CDCl_3$)



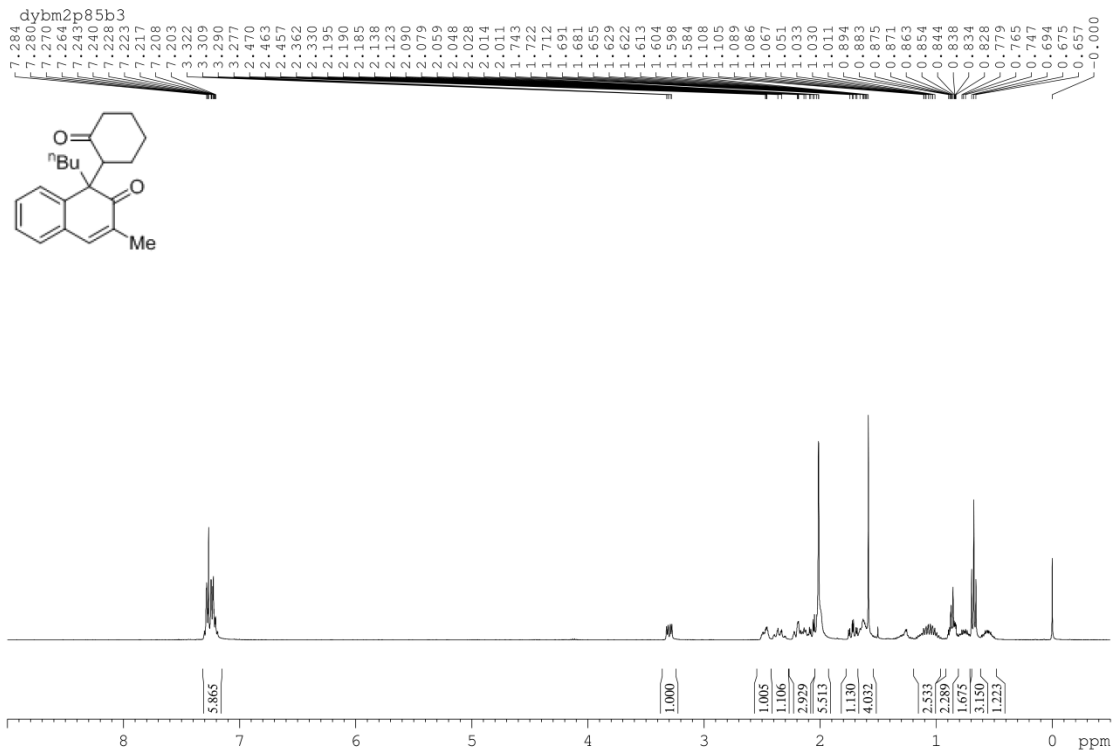
$^{1}$H NMR spectrum of compound **3y** (400 MHz, $CDCl_3$)



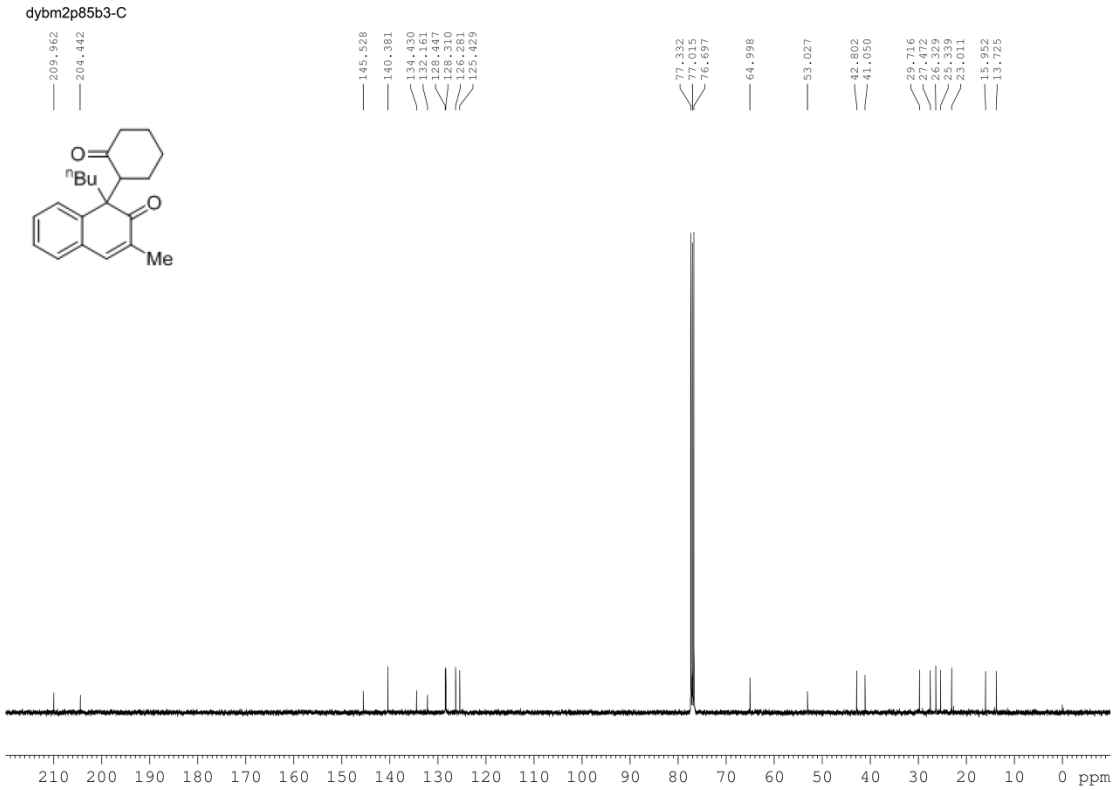

$^{13}$C NMR spectrum of compound **3y** (100 MHz, $CDCl_3$)



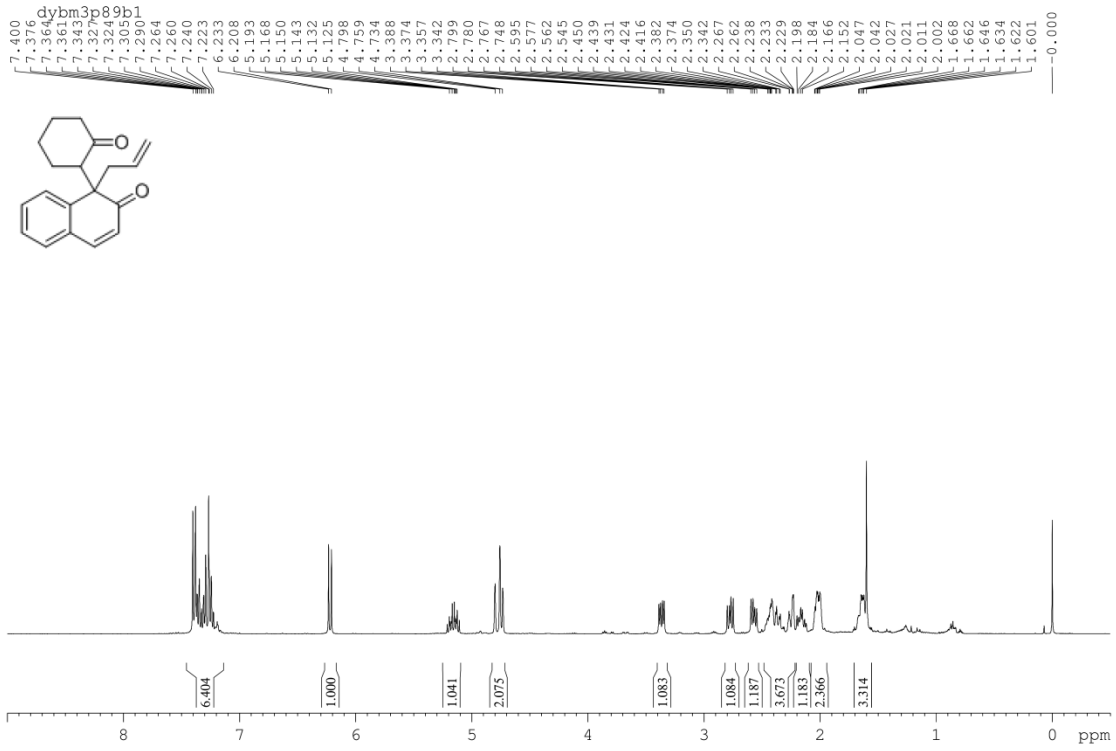
$^{1}$H NMR spectrum of compound **3z** (400 MHz, $CDCl_3$)



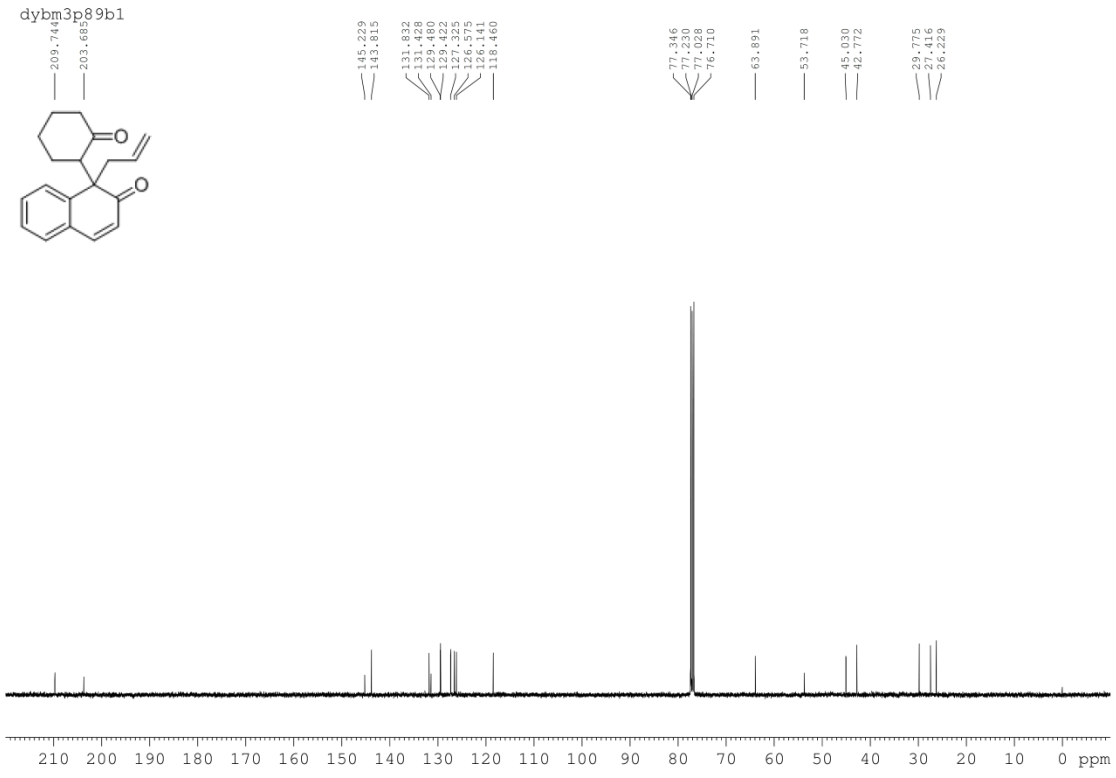

$^{13}$C NMR spectrum of compound **3z** (100 MHz, $CDCl_3$)



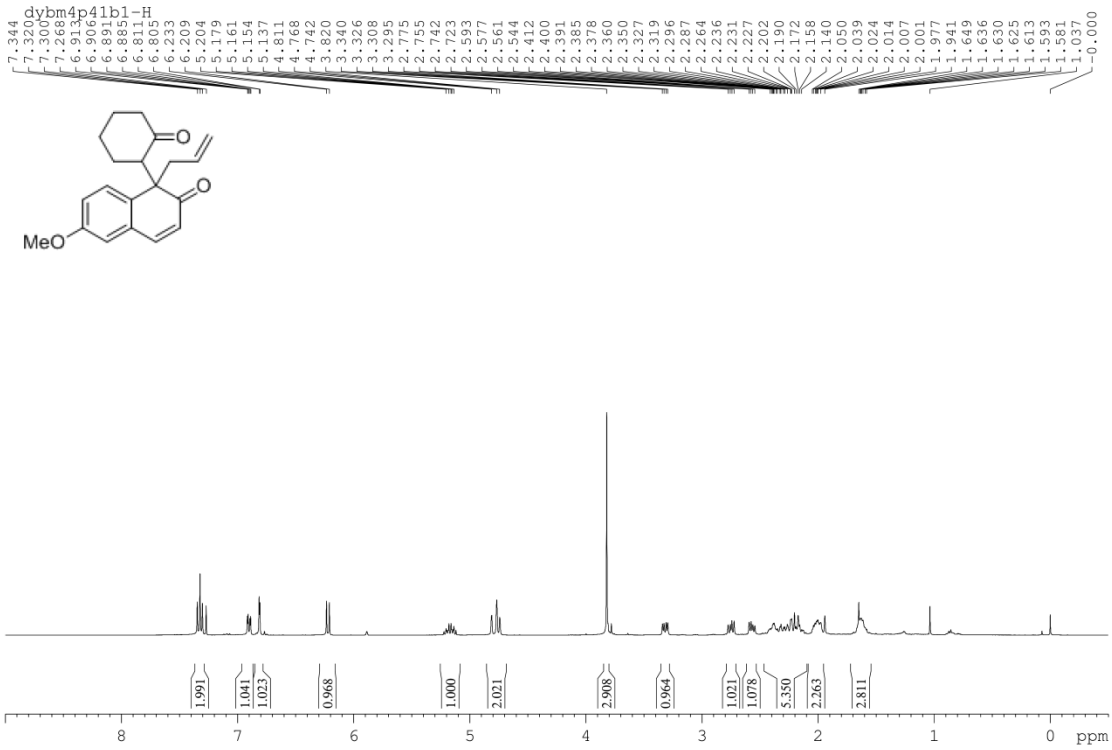
$^{1}$H NMR spectrum of compound **3aa** (400 MHz, $CDCl_3$)



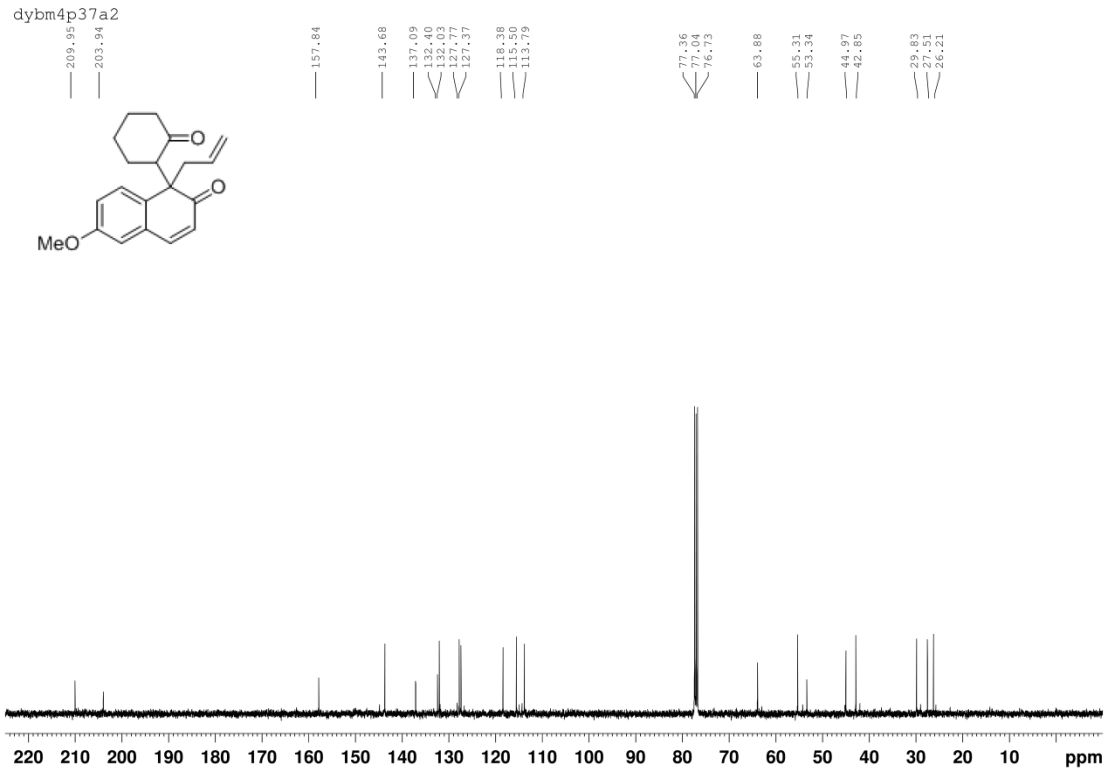

$^{13}$C NMR spectrum of compound **3aa** (100 MHz, $CDCl_3$)



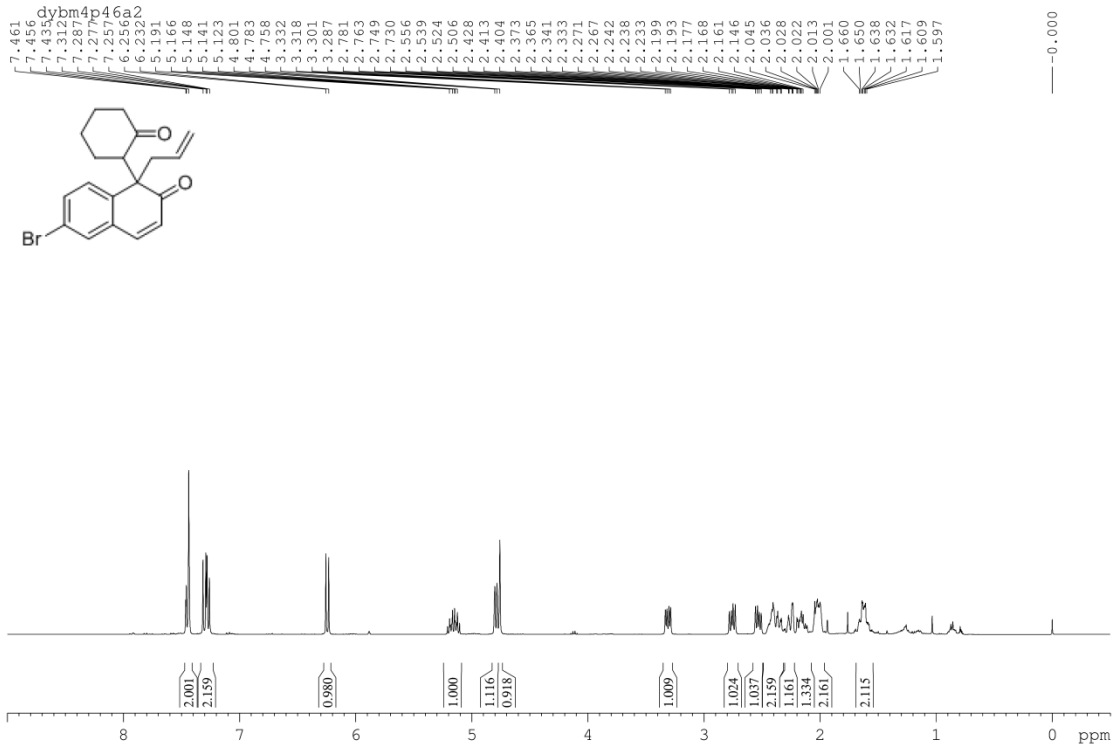
$^{1}$H NMR spectrum of compound **3ab** (400 MHz, $CDCl_3$)



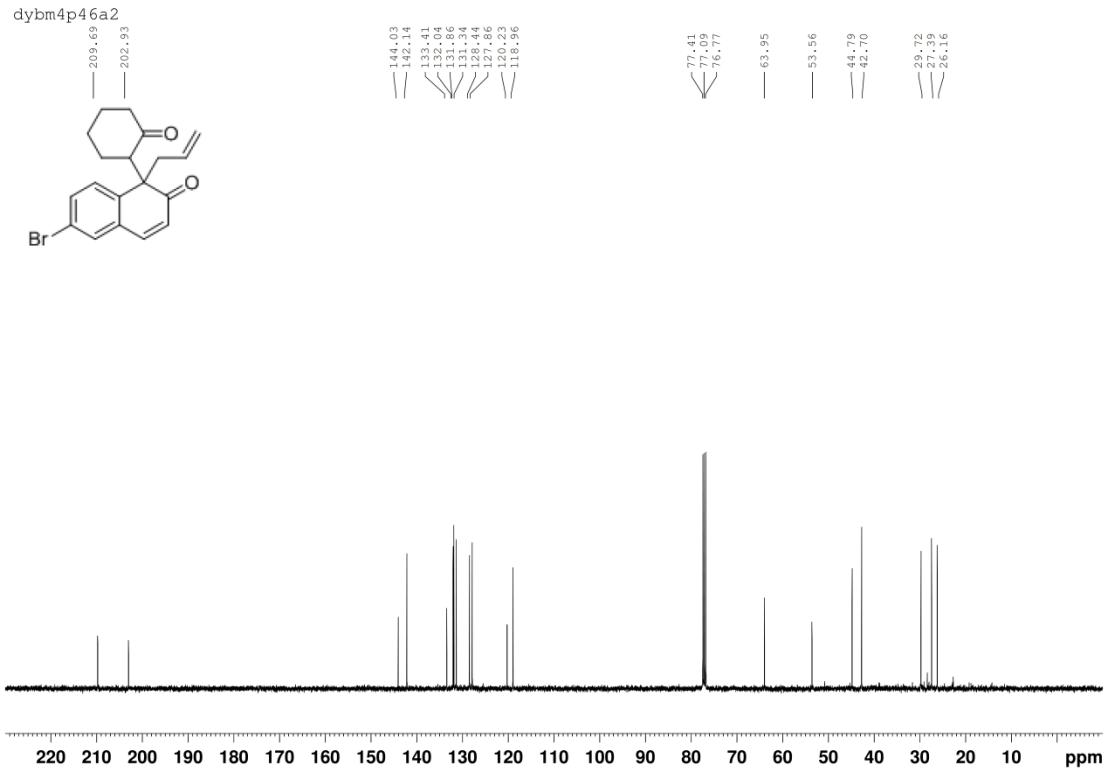

$^{13}$C NMR spectrum of compound **3ab** (100 MHz, $CDCl_3$)



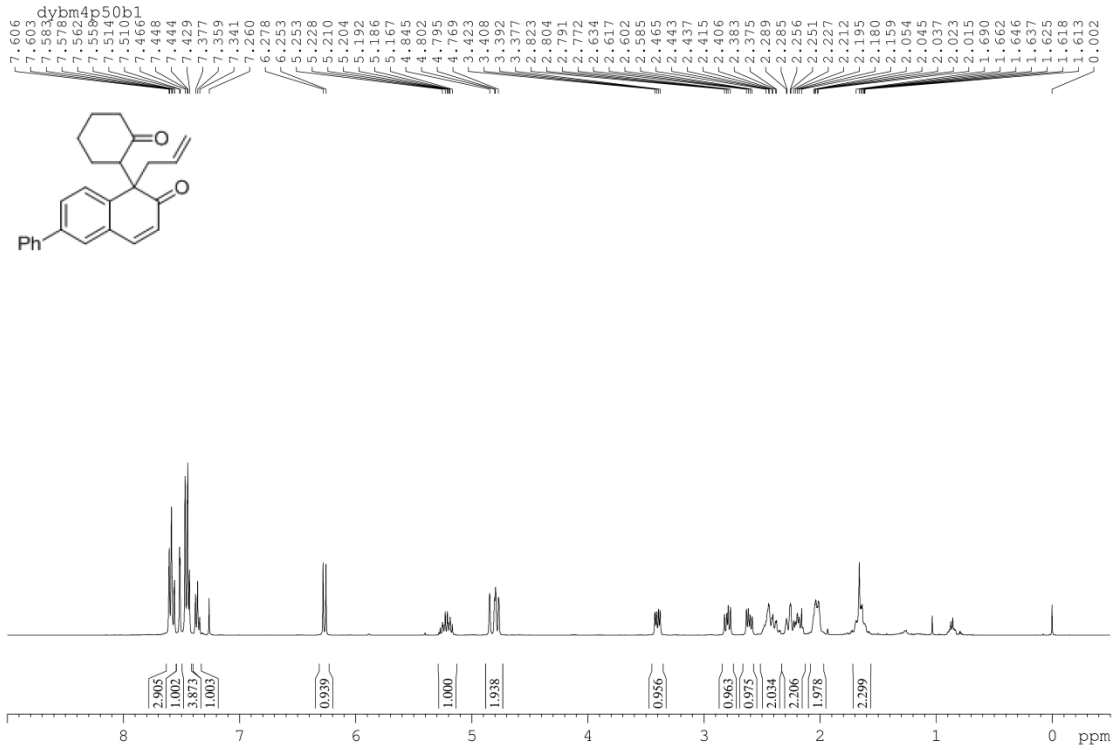
$^{1}$H NMR spectrum of compound **3ac** (400 MHz, $CDCl_3$)



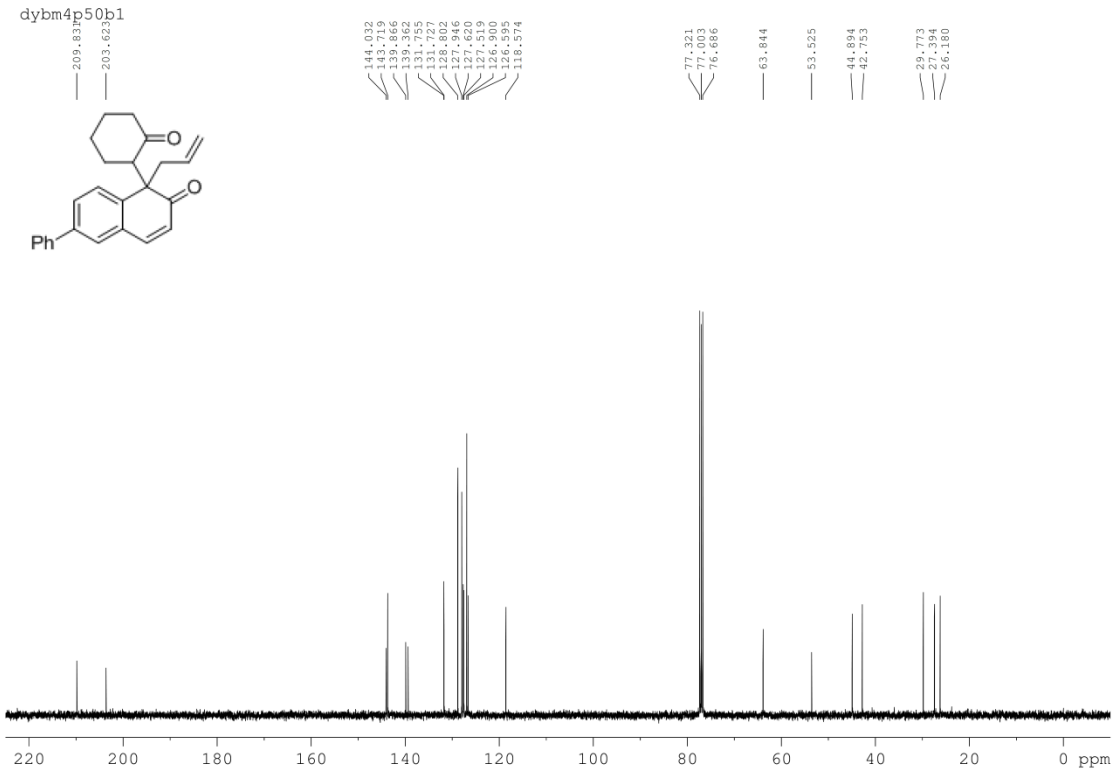

$^{13}$C NMR spectrum of compound **3ac** (100 MHz, $CDCl_3$)



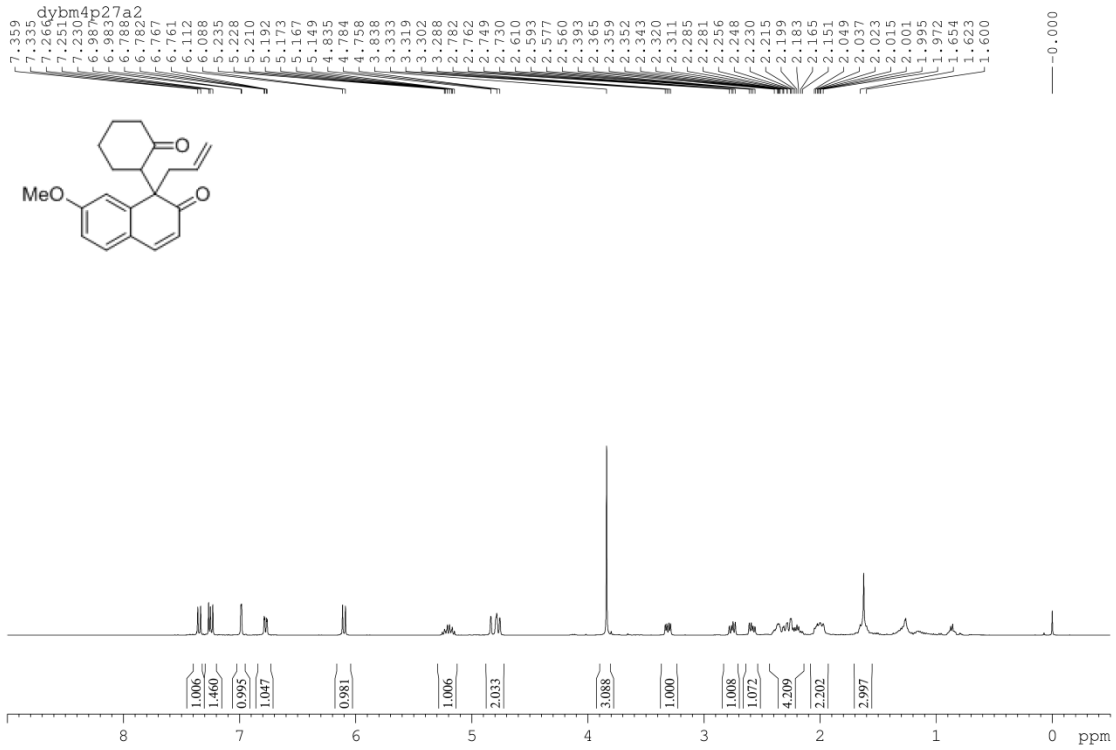
$^{1}$H NMR spectrum of compound **3ad** (400 MHz, $CDCl_3$)



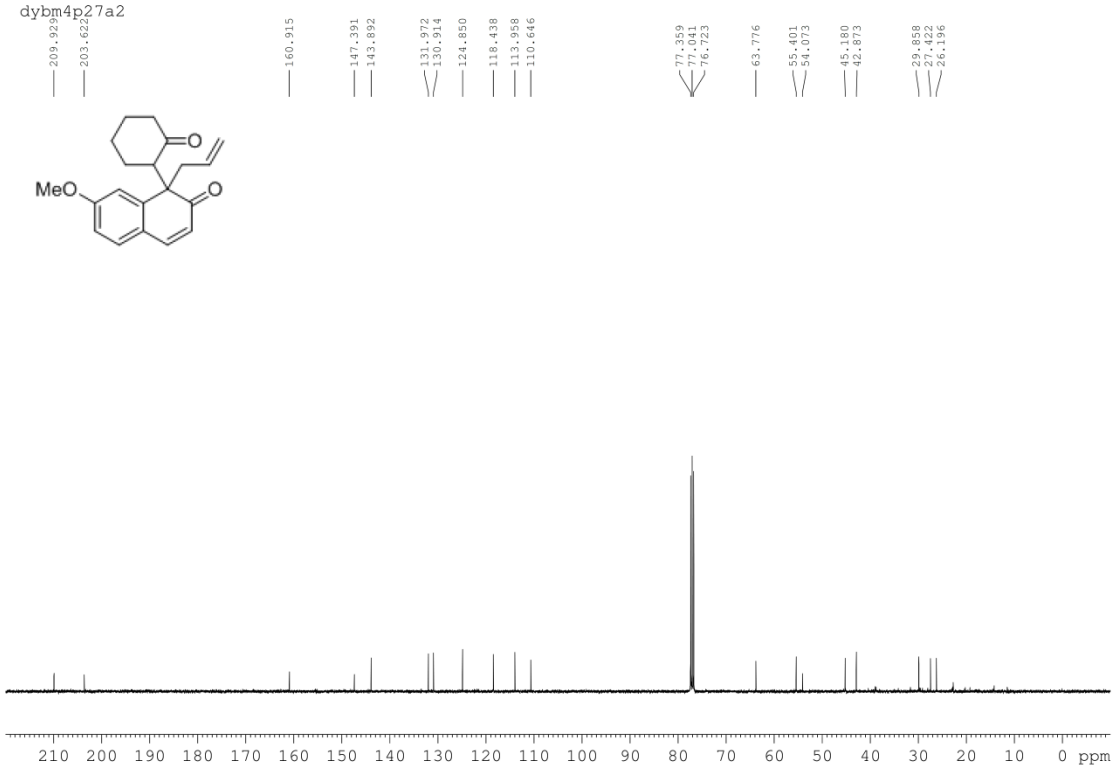

$^{13}$C NMR spectrum of compound **3ad** (100 MHz, $CDCl_3$)



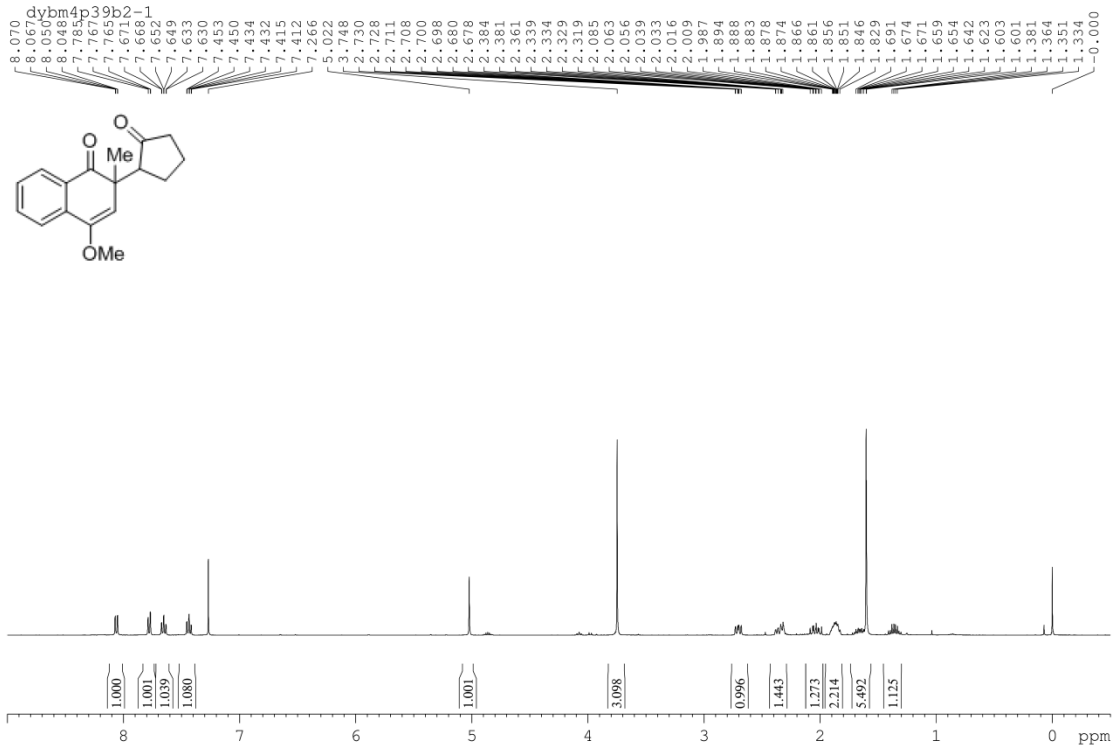
$^{1}$H NMR spectrum of compound **3ae** (400 MHz, $CDCl_3$)



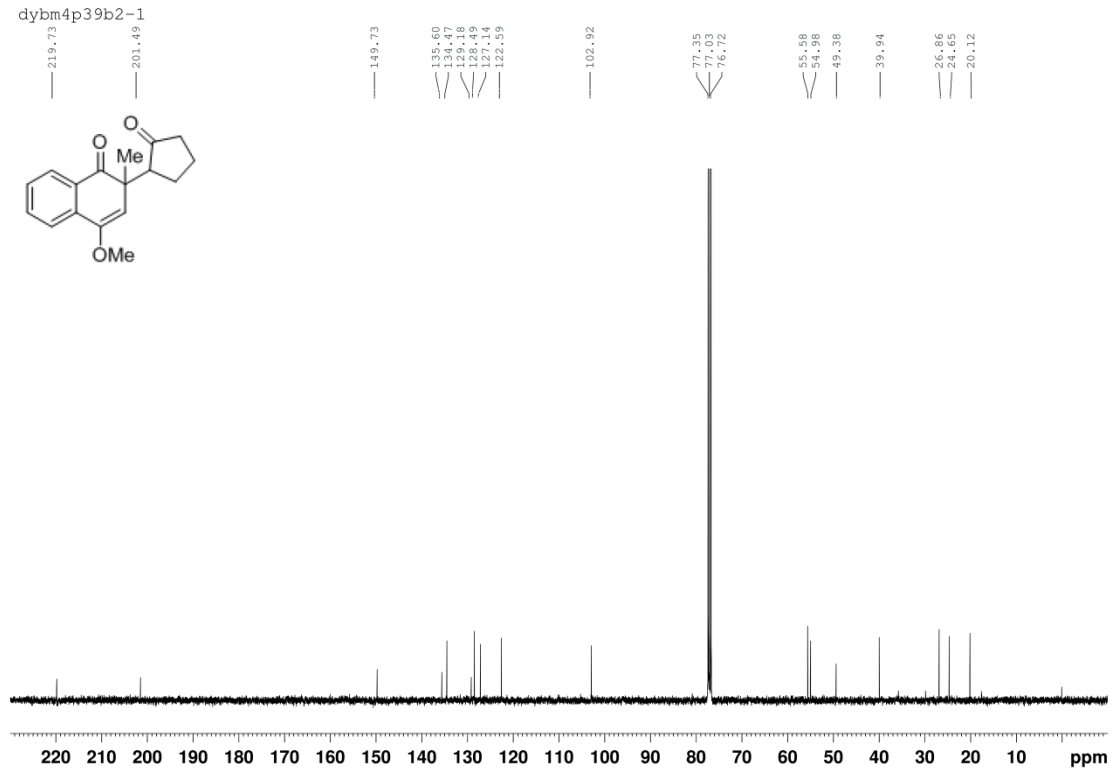

$^{13}$C NMR spectrum of compound **3ae** (100 MHz, $CDCl_3$)



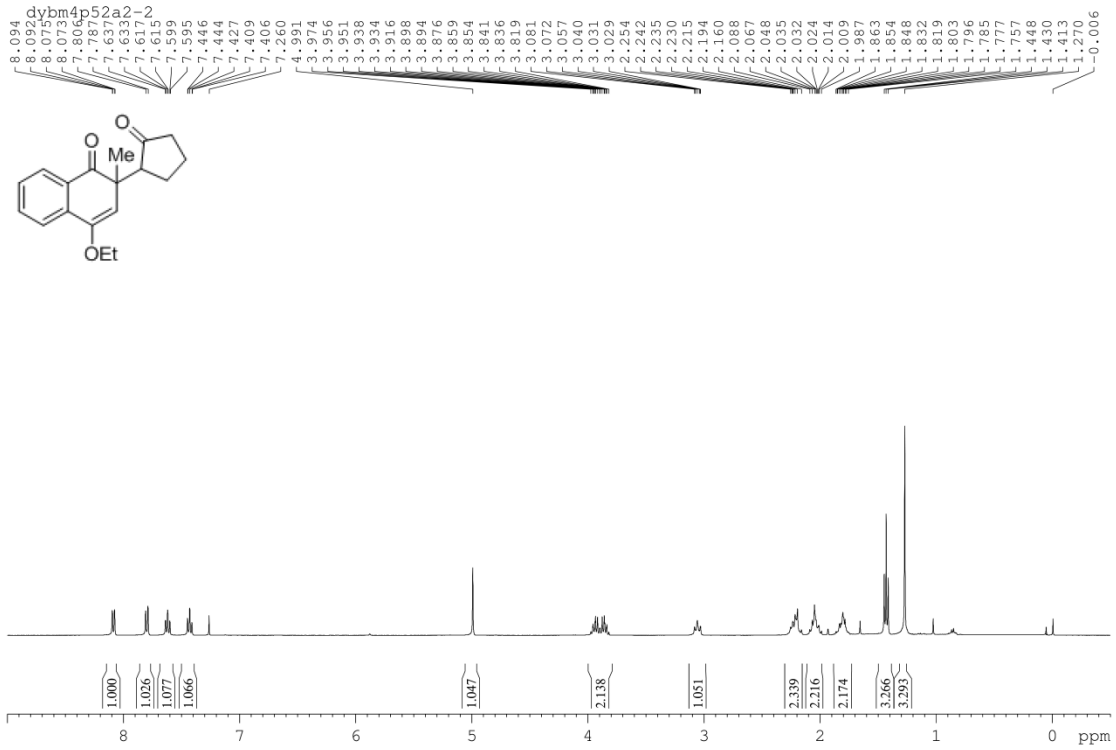
$^{1}$H NMR spectrum of compound **3af** (400 MHz, $CDCl_3$)



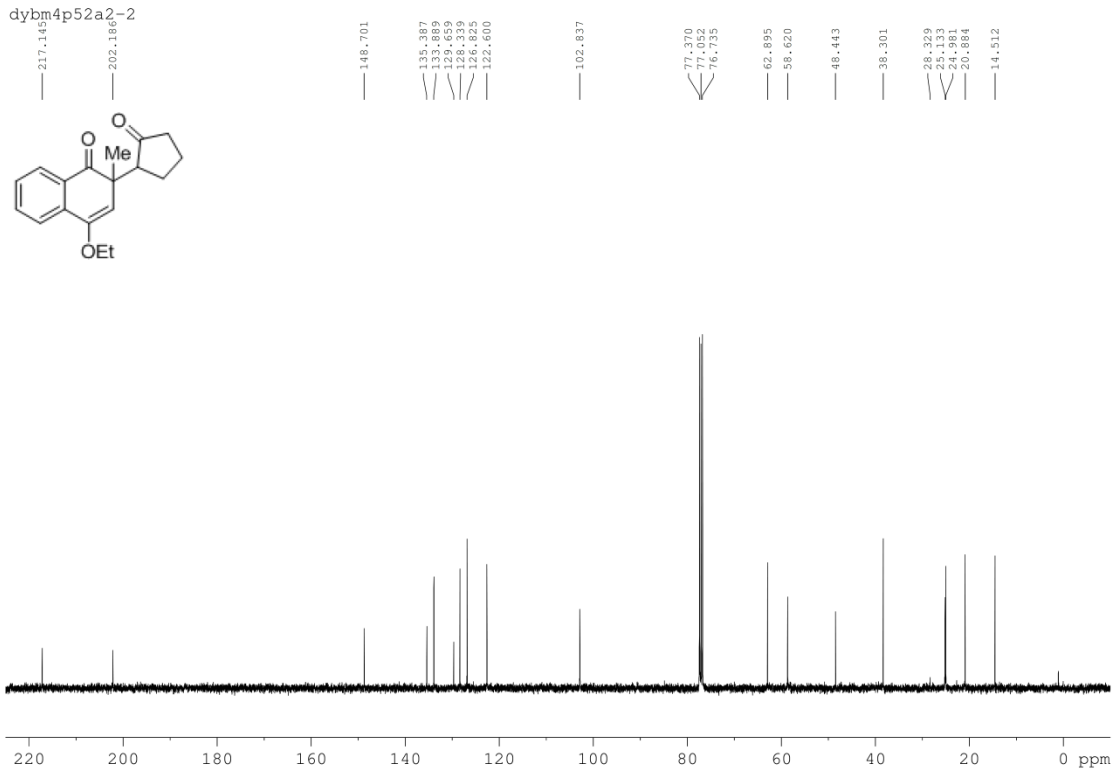

$^{13}$C NMR spectrum of compound **3af** (100 MHz, $CDCl_3$)



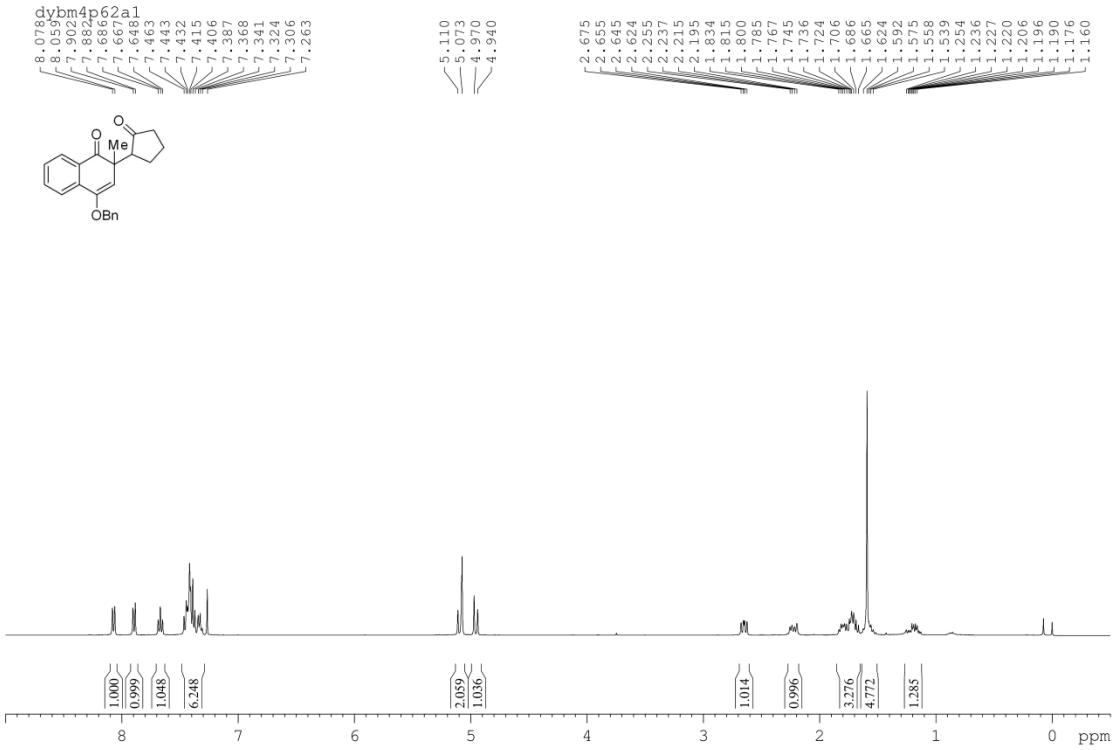
$^{1}$H NMR spectrum of compound **3ag** (400 MHz, $CDCl_3$)



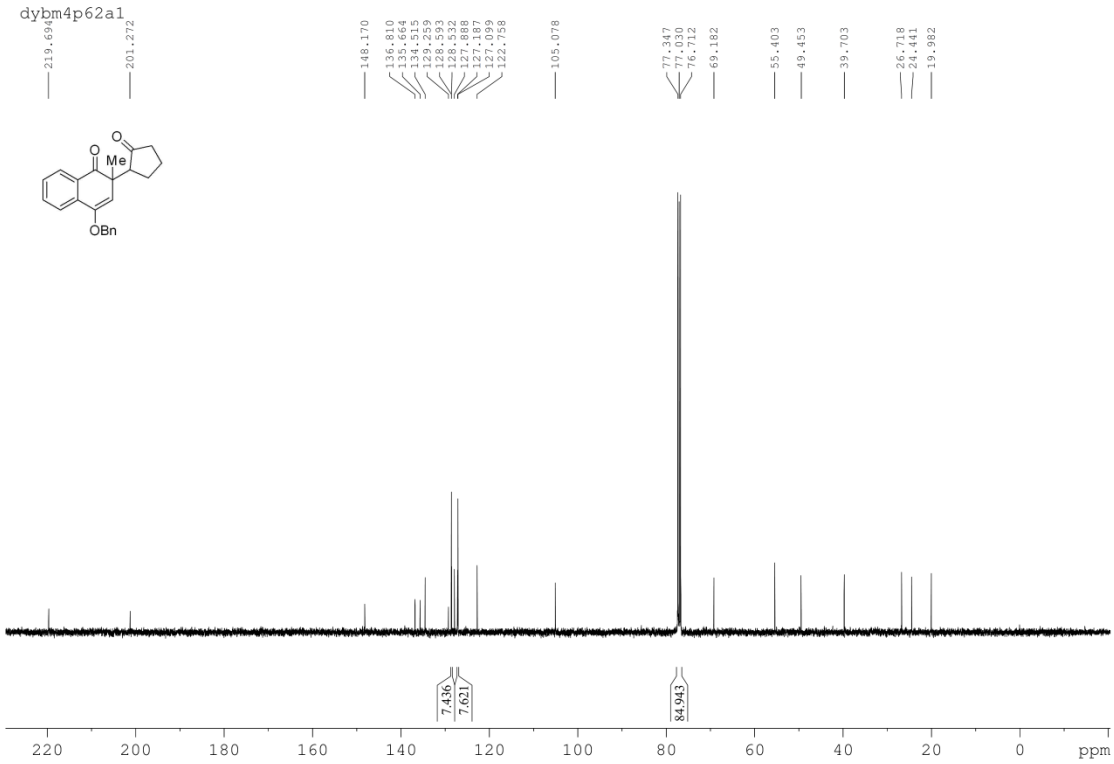

$^{13}$C NMR spectrum of compound **3ag** (100 MHz, $CDCl_3$)



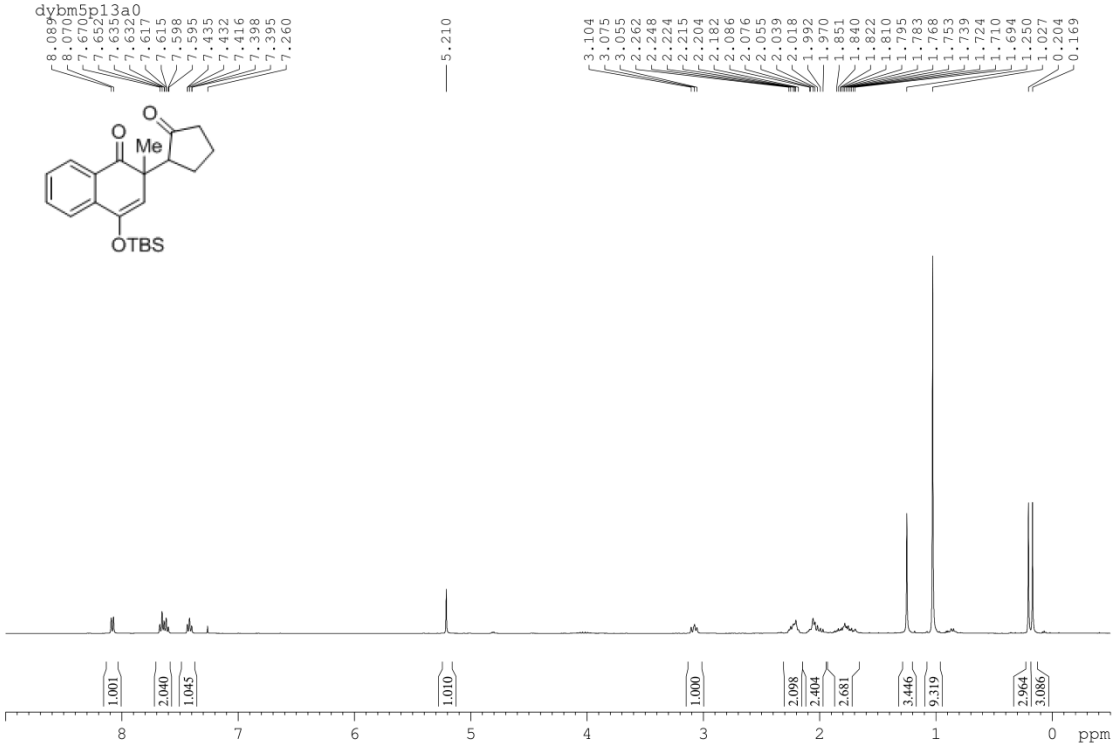
$^{1}$H NMR spectrum of compound **3ah** (400 MHz, $CDCl_3$)



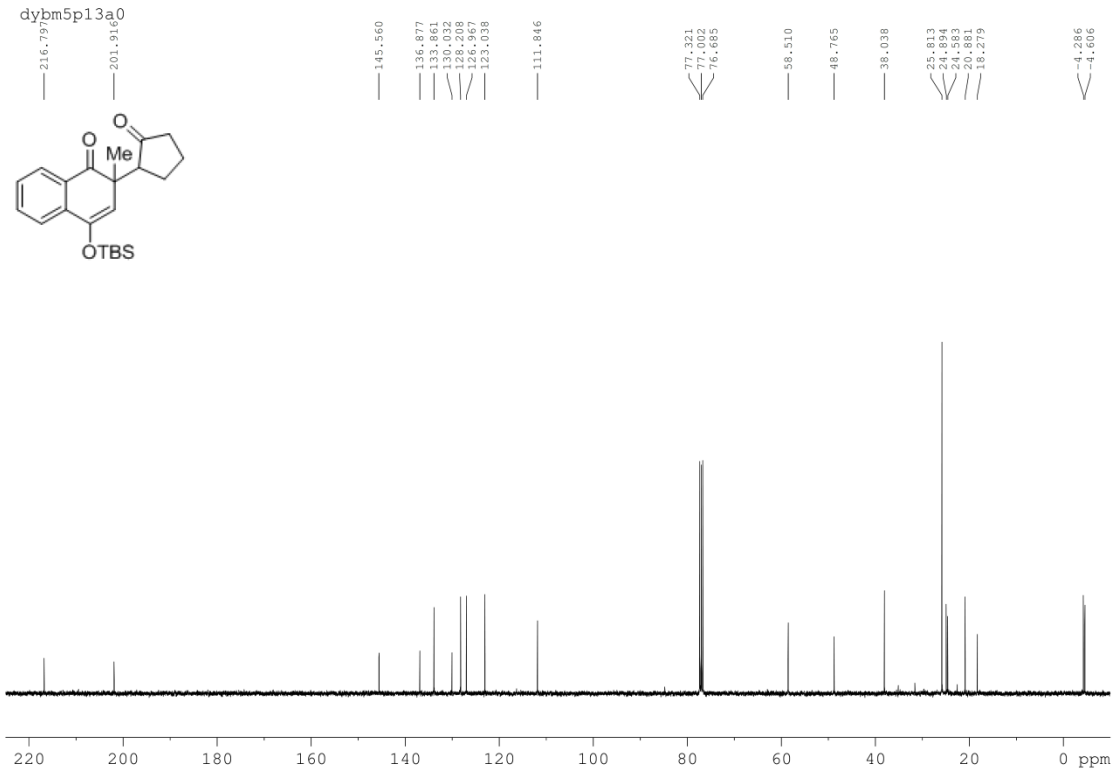

$^{13}$C NMR spectrum of compound **3ah** (100 MHz, $CDCl_3$)



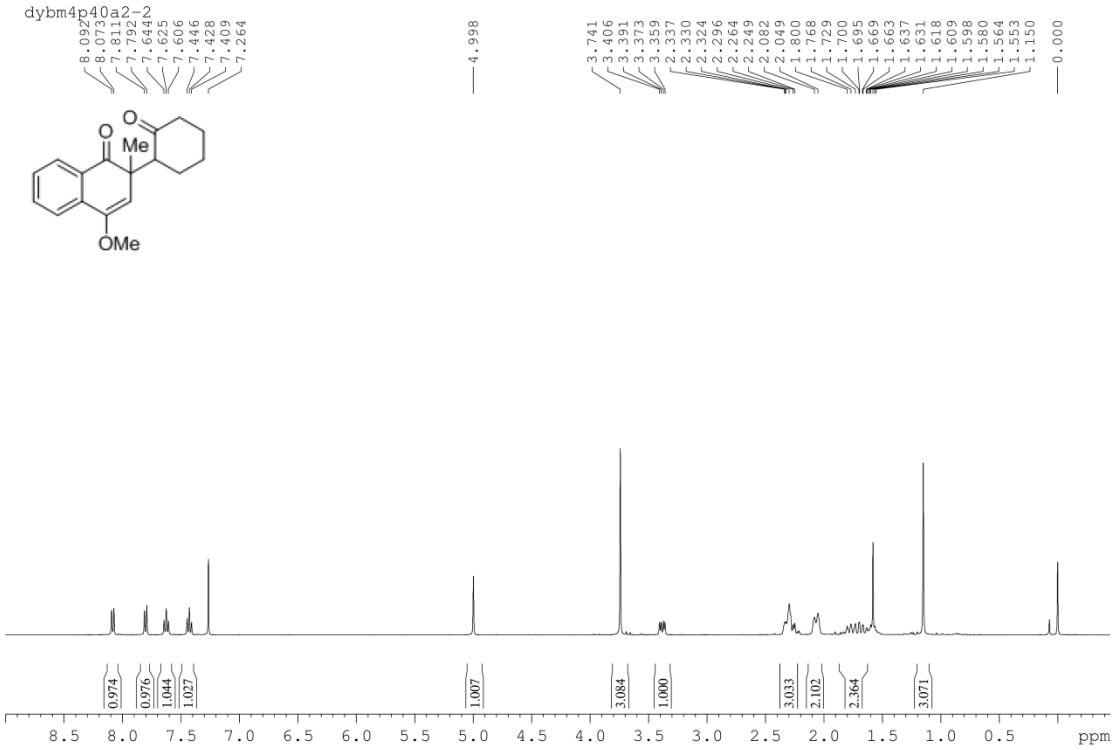
$^{1}$H NMR spectrum of compound **3ai** (400 MHz, $CDCl_3$)



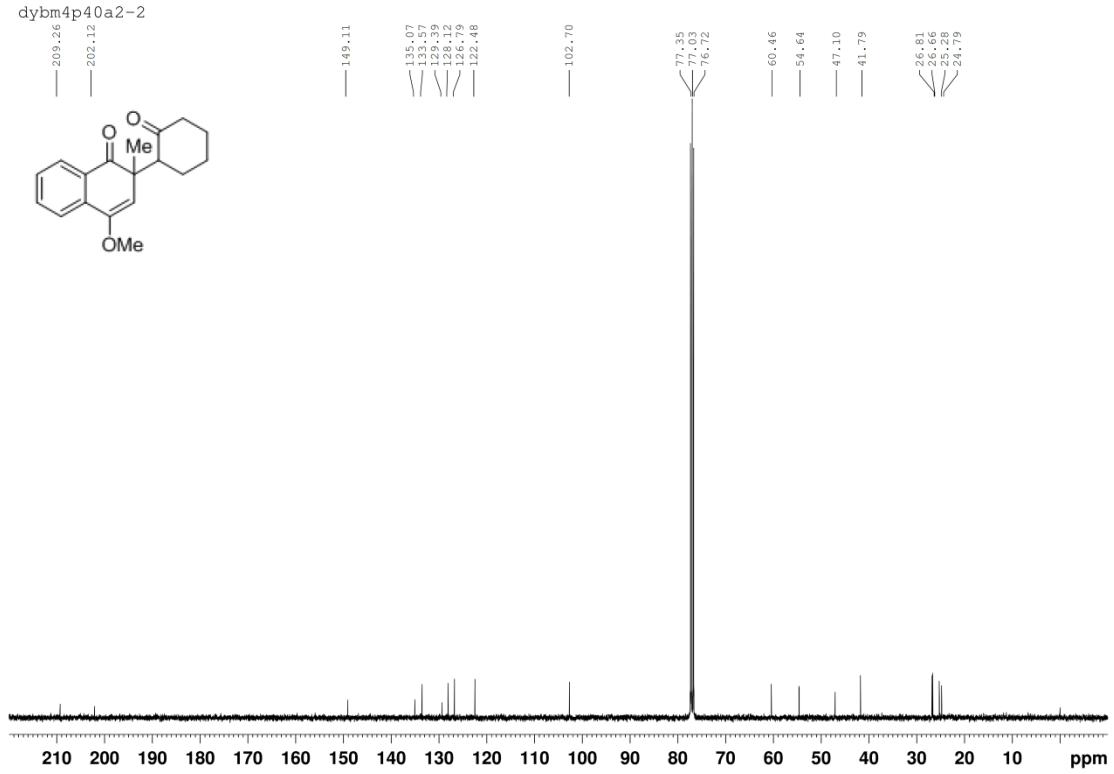

$^{13}$C NMR spectrum of compound **3ai** (100 MHz, $CDCl_3$)



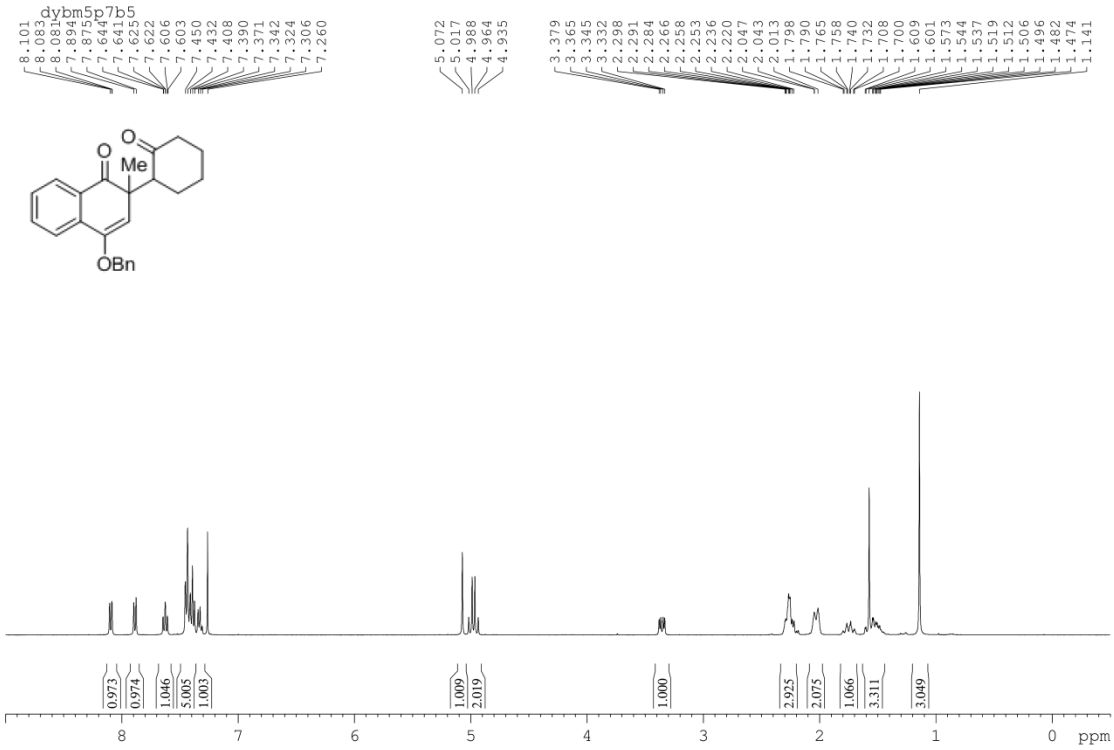
$^{1}$H NMR spectrum of compound **3aj** (400 MHz, $CDCl_3$)



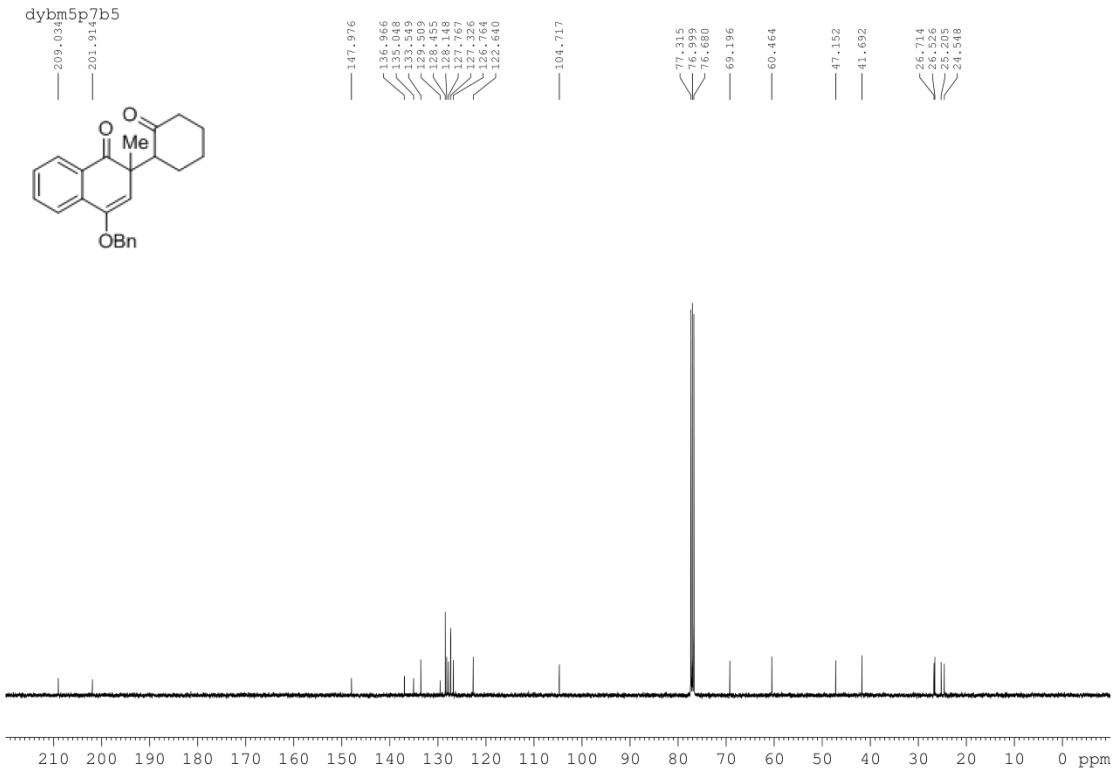

$^{13}$C NMR spectrum of compound **3aj** (100 MHz, $CDCl_3$)



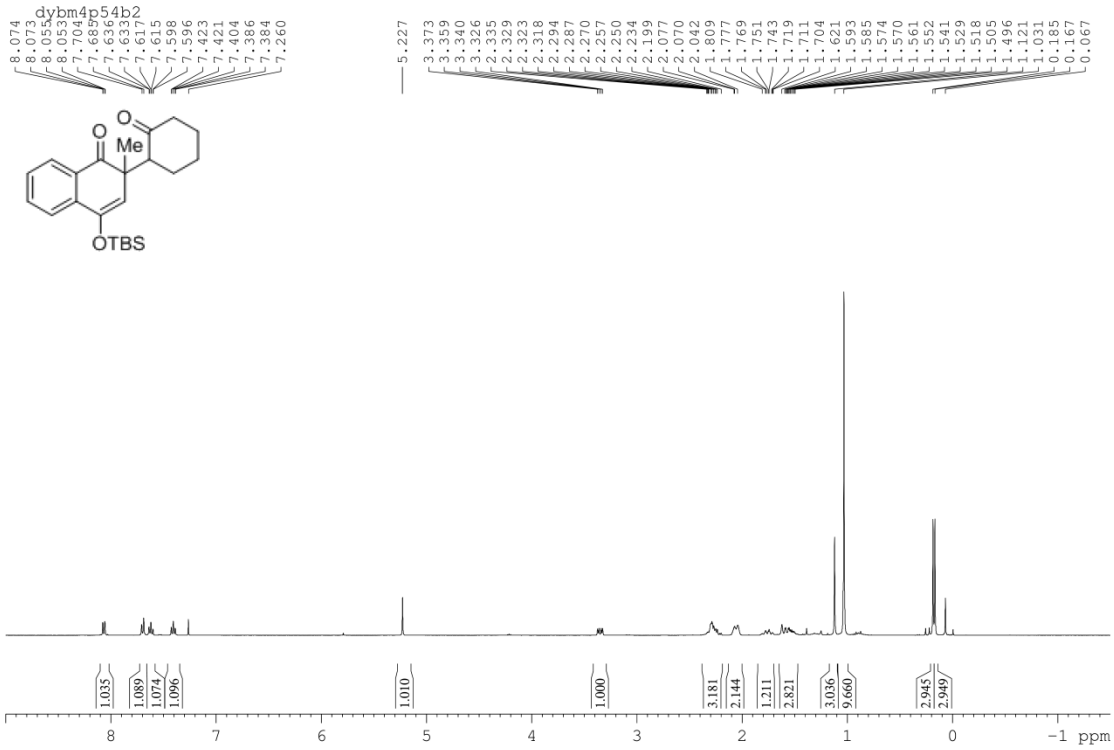
$^{1}$H NMR spectrum of compound **3ak** (400 MHz, $CDCl_3$)



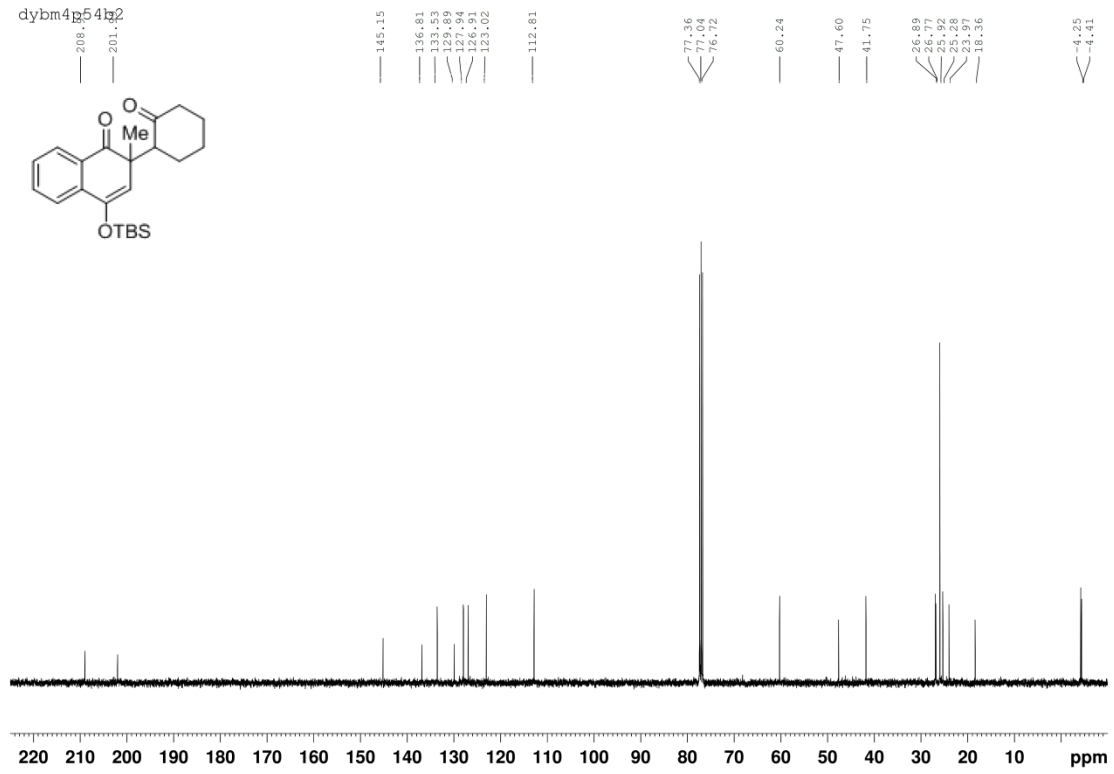

$^{13}$C NMR spectrum of compound **3ak** (100 MHz, $CDCl_3$)



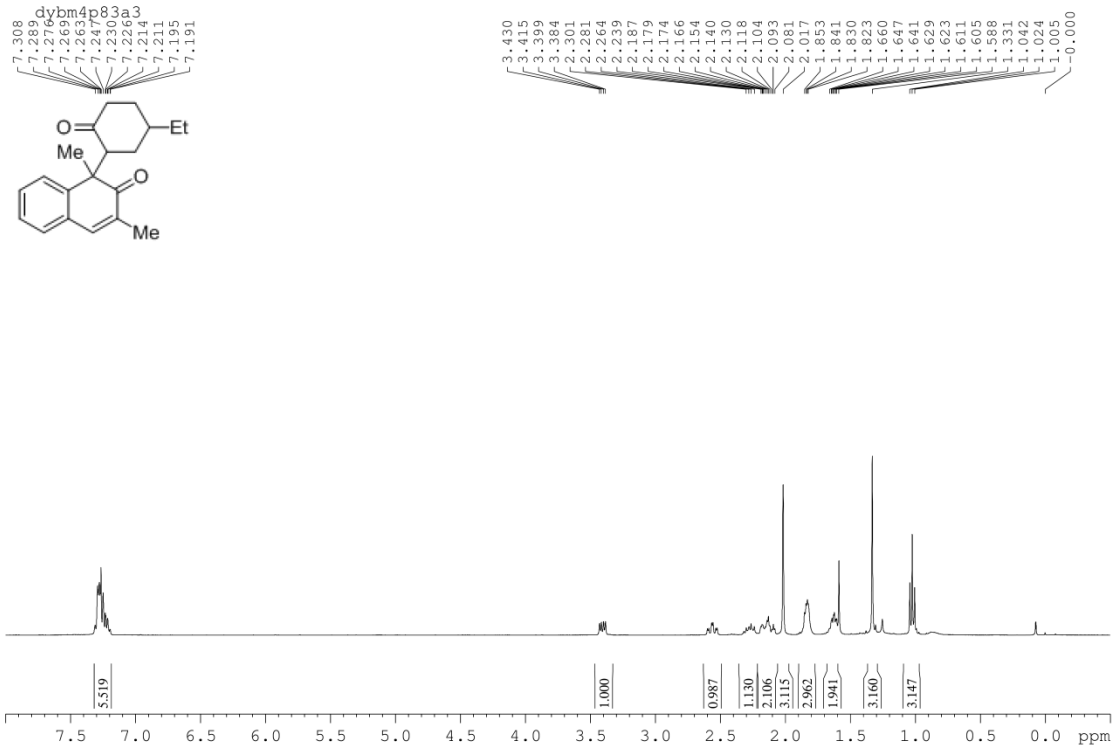
$^{1}$H NMR spectrum of compound **3al** (400 MHz, $CDCl_3$)



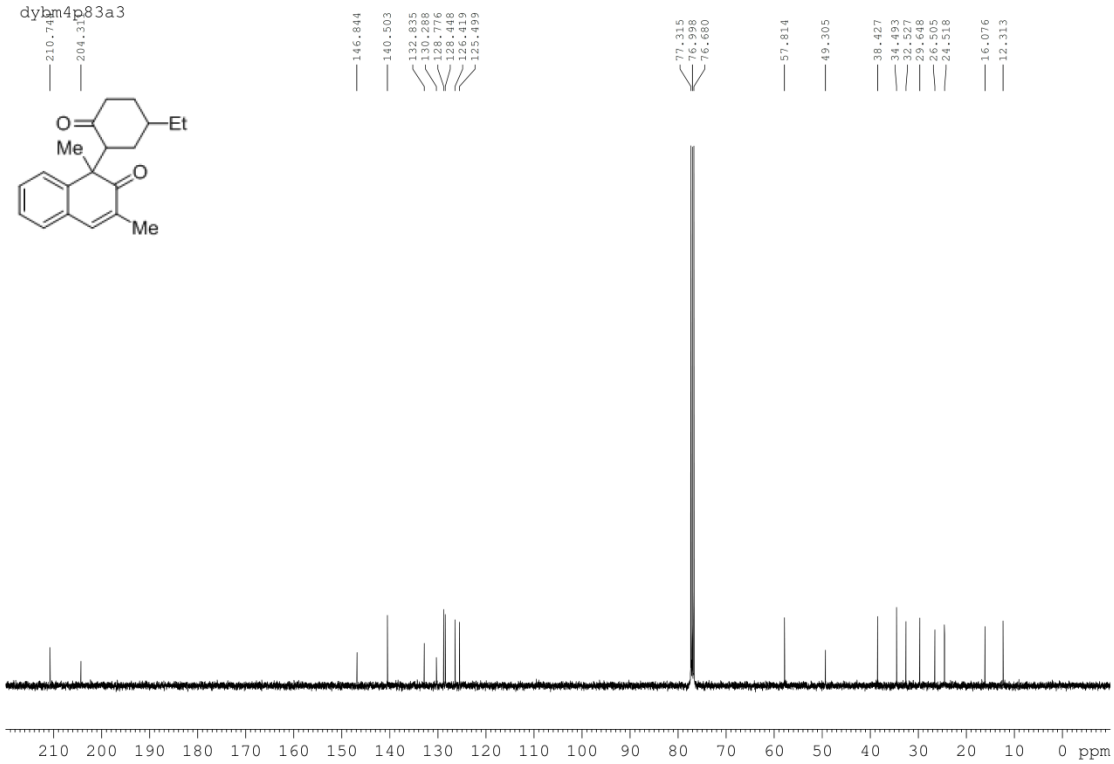

$^{13}$C NMR spectrum of compound **3al** (100 MHz, $CDCl_3$)



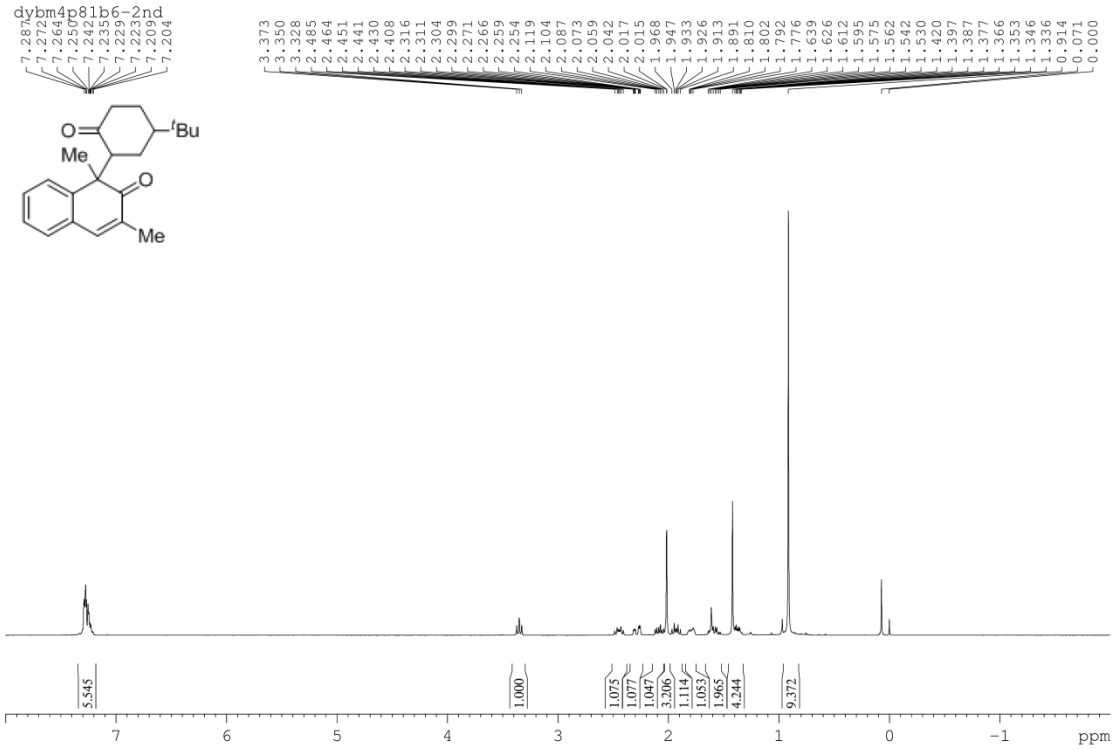
$^{1}$H NMR spectrum of compound **3am** (400 MHz, $CDCl_3$)



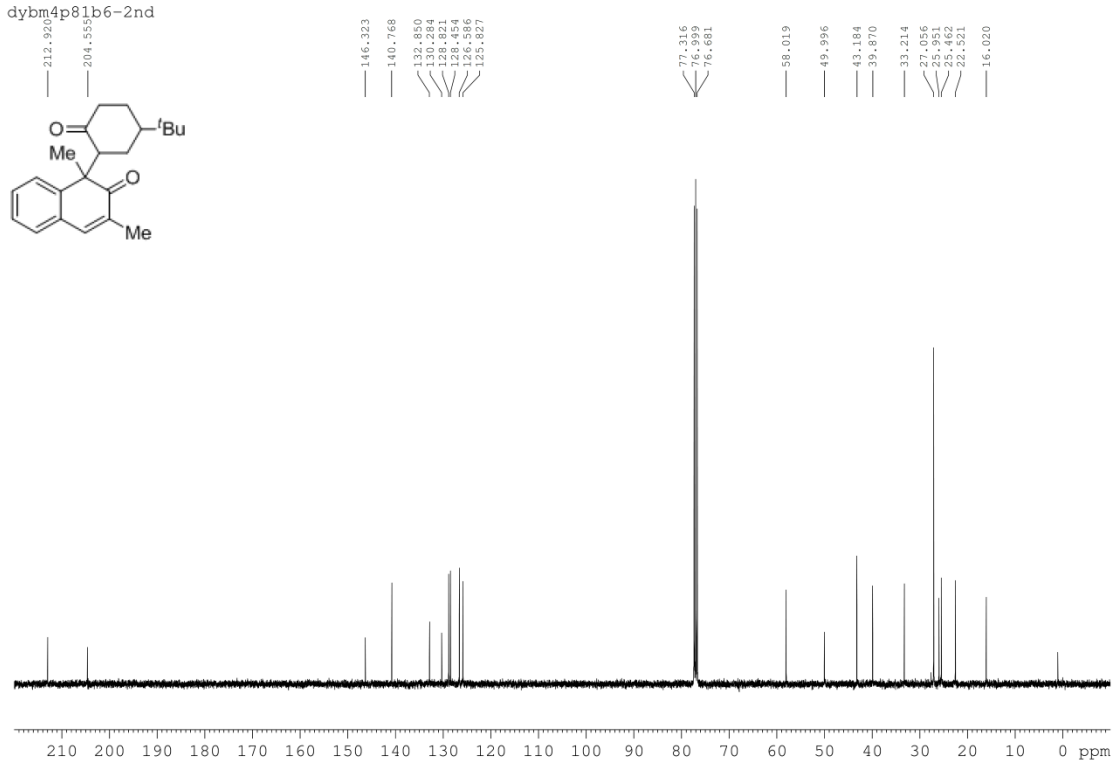

$^{13}$C NMR spectrum of compound **3am** (100 MHz, $CDCl_3$)



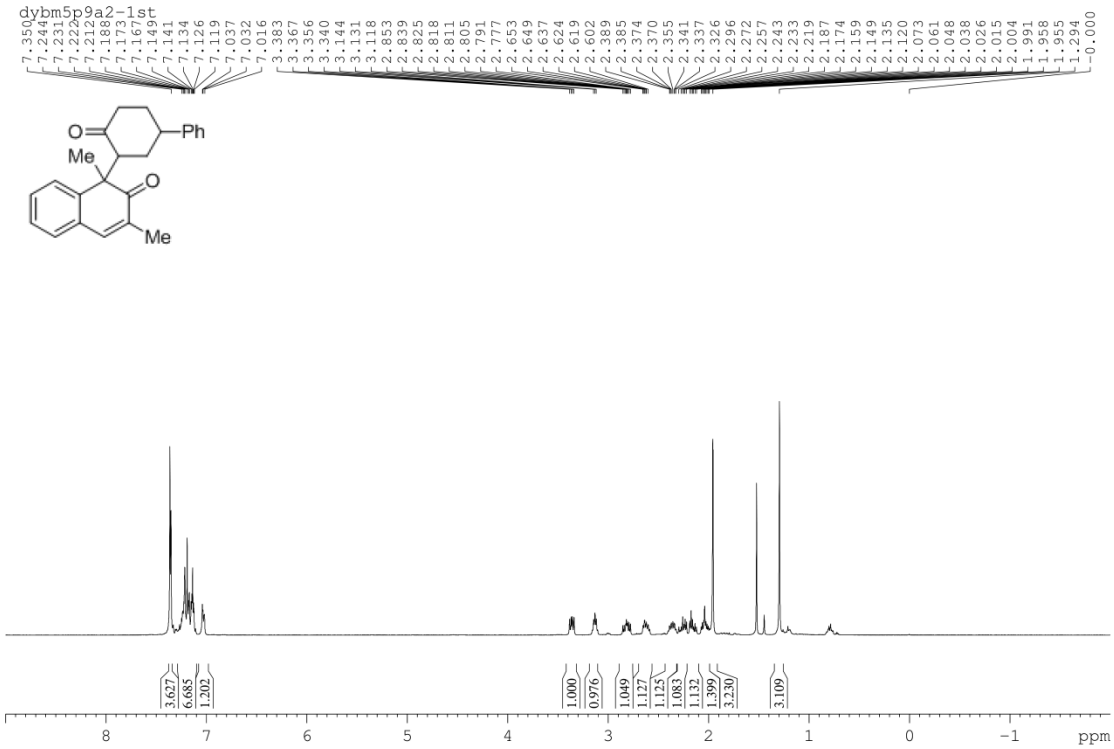
$^{1}$H NMR spectrum of compound **3an** (400 MHz, $CDCl_3$)




$^{13}$C NMR spectrum of compound **3an** (100 MHz, $CDCl_3$)



$^{1}$H NMR spectrum of compound **3ao** (400 MHz, $CDCl_3$)




$^{13}$C NMR spectrum of compound **3ao** (100 MHz, $CDCl_3$)