Supporting Information
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Supporting Information Lange, Heydenreuter, Menz, Kirsch

Transition-Metal-Catalyzed Rearrangement of 1,1-(Oligomethylene)-4-aryl-2-butene-1,4-diols: Ring Expansion vs. Aryl Group Migration

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Supporting Information

Representative experimental procedures for the synthesis of 2a-d, 3a-c, 1d-e, 4b-c, and 6. 1H NMR monitoring for the conversion of 1g → 4d → 3a. Analytical data of 2a-d, 3a-c, 1a-e, 1g, 1j-l, 4b-c, and 6 and copies of 1H and 13C NMR of 2a-d, 3a-c, 1d-e, and 4b.

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**General experimental details:** All commercially available chemicals were used without further purification.

$^1$H NMR spectra were obtained on Bruker 500 MHz FT-NMR, 360 MHz FT-NMR and 250 MHz FT-NMR spectrometers. $^{13}$C NMR spectra were recorded at 90.6 MHz. Chemical shifts are reported in ppm relative to solvent signal. Multiplicity is indicated as follows: s (singlet); d (doublet); t (triplet); q (quartet); m (multiplet); dd (doublet of doublets); sep (septet). High resolution mass spectra and EI were determined on a Finnigan MAT 95S and MAT 8200. Flash chromatography was performed with E. Merck silica gel (43−60 μm). The eluent used is reported in parentheses (P = pentanes). Thin-layer chromatography (TLC) was performed on precoated glass-backed plates (Merck Kieselgel 60 F$_{254}$), and components were visualized by observation under UV light or by treating the plates with KMnO$_4$/H$_2$SO$_4$ followed by heating.

The aldehydes (3a-c) were not stable at room temperature and, therefore, were stored at -20 °C. PPTS = pyridinium 4-toluenesulfonate.

**General procedure for the conversion of (E)-1-(4-methoxyphenyl)-3-(1-(triethylsilyloxy)cycloalkyl)prop-2-en-1-ols in the presence of catalytic amounts of a Lewis acid.**

**(E)-2-(4-methoxystyryl)cyclohexanone (2b)**

$\text{Cu(OTf)}_2$ (1 mg, 0.003 mmol, 1 mol%) was added to a solution of (E)-1-(4-methoxyphenyl)-3-(1-(triethylsilyloxy)cyclopentyl)prop-2-en-1-ol (1c) (100 mg, 0.28 mmol) in 2.8 mL CH$_2$Cl$_2$ and stirred at room temperature for 30 min (until TLC analysis indicated complete conversion). The reaction mixture was concentrated under reduced pressure and the residue was purified by flash chromatography on silica (P/Et$_2$O = 95/5). The product was isolated as a colorless solid in 96% yield (62 mg, 0.27 mmol).

$^1$H NMR (360 MHz, CDCl$_3$) $\delta$ 1.69−1.83 (m, 3H), 1.89−1.96 (m, 1H), 2.01−2.09 (m, 1H), 2.14−2.20 (m, 1H), 2.31−2.40 (m, 1H), 2.45−2.51 (m, 1H), 3.17 (ddd, $J = 0.9, 6.4, 11.3$ Hz,
$^1$H, 3.80 (s, 3H), 6.27 (dd, $J = 5.9, 16.1$ Hz, 1H), 6.33 (d, $J = 16.1$ Hz, 1H), 6.77–6.91 (m, 2H), 7.29–7.33 (m, 2H).

$^{13}$C NMR (90.6 MHz, CDCl$_3$) δ 24.4, 27.6, 34.5, 41.7, 54.0, 55.3, 113.9, 125.3, 127.4, 130.0, 130.8, 159.0, 211.3.

LRMS (EI) 230 (100) [M$^+$], 202 (26), 173 (25), 159 (21), 134 (38), 121(37).

HRMS m/z calcd for C$_{15}$H$_{18}$O$_2$ (M$^+$) 230.1307, found 230.1307.

(E)-2-(4-methoxystyryl)cyclopentanone (2a)

According to the general procedure allylic methyl ether 1a (40 mg, 0.16 mmol) was converted to the corresponding cyclopentanone 2a in the presence of Cu(OTf)$_2$ (0.5 mg, 1 mol%). Purification by flash chromatography on silica (pentanes/EtOAc = 98/2) gave 2a as colorless oil in 72% yield (25 mg, 0.12 mmol).

$^1$H NMR (360 MHz, CDCl$_3$) δ 1.81–1.95 (m, 2H), 2.05–2.14 (m, 1H), 2.16–2.26 (m, 1H), 2.32–2.41 (m, 2H), 2.90–2.97 (m, 1H), 3.80 (s, 3H), 6.08 (dd, $J = 6.3, 16.1$ Hz, 1H), 6.41 (dd, $J = 1.4, 16.1$ Hz, 1H), 6.81–6.85 (m, 2H), 7.28–7.32 (m, 2H).

$^{13}$C NMR (90.6 MHz, CDCl$_3$) δ 20.8, 29.9, 37.9, 52.5, 55.3, 113.9, 123.8, 127.4, 129.8, 131.4, 159.1, 218.4.

LRMS (EI) 216 (88) [M$^+$], 188 (10), 160 (85), 145 (13), 135 (100), 129 (20), 107 (18), 92 (16), 77 (35).

HRMS m/z calcd for C$_{14}$H$_{16}$O$_2$ (M$^+$) 216.1150, found 216.1150.
(E)-2-styrylcyclohexanone (2d)

According to the general procedure allylic alcohol 1k (20 mg, 0.06 mmol) was converted to the corresponding cyclohexanone 2d in the presence of Cu(OTf)₂ (2 mg, 10 mol%). Purification by flash chromatography on silica (pentanes/EtOAc = 98/2) gave 2d as colorless oil in 84% yield (10 mg, 0.5 mmol).

1H NMR (360 MHz, CDCl₃) δ 1.72–1.83 (m, 3H), 1.90–1.96 (m, 1H), 2.02–2.10 (m, 1H), 2.14–2.22 (m, 1H), 2.32–2.38 (m, 1H), 2.46–2.52 (m, 1H), 3.17–3.23 (m, 1H), 3.17–3.23 (m, 1H), 3.17–3.23 (m, 1H), 6.38 (dd, J = 16.1 Hz, 1H), 6.45 (d, J = 6.3, 16.1 Hz, 1H), 7.19–7.23 (m, 1H), 7.28–7.33 (m, 2H), 7.36–7.40 (m, 2H).

13C NMR (90.6 MHz, CDCl₃) δ 24.4, 27.6, 34.5, 41.8, 54.0, 126.3, 127.3, 127.6, 128.5, 131.4, 137.1, 211.1.

LRMS (EI) 200 (100) [M⁺], 156 (44), 129 (37), 105 (91), 77 (72).

HRMS m/z calcd for C₁₄H₁₆O (M⁺) 200.1201, found 200.1205.

(E)-3-ethyl-5-(4-methoxyphenyl)pent-4-en-2-one (2c)

According to the general procedure allylic alcohol 1j (50 mg, 0.13 mmol) was converted to the corresponding ketone 2c in the presence of Cu(OTf)₂ (0.5 mg, 1 mol%). Purification by
flash chromatography on silica (pentanes/EtOAc = 98/2) gave 2e as colorless oil in 12% yield (3 mg, 0.02 mmol) and 3c in 63% (see below).

\[ ^1 \text{H-NMR} (360 \text{ MHz, CDCl}_3) \delta 0.89 (t, J = 7.4 \text{ Hz, 3H}), 1.04 (t, J = 7.3 \text{ Hz, 3H}), 1.53–1.64 (m, 1H), 1.76–1.91 (m, 1H), 2.37–2.67 (m, 2H), 3.07–3.21 (m, 1H), 3.80 (s, 3H), 5.93 (dd, J = 9.2, 15.8 Hz, 1H), 6.43 (d, J = 15.8 Hz, 1H), 6.83–6.87 (m, 2H), 7.27–7.32 (m, 2H). \]

\[ ^{13} \text{C-NMR} (90 \text{ MHz, CDCl}_3): \delta 7.7, 11.8, 24.7, 34.9, 55.3, 58.4, 114.0, 125.9, 127.4, 129.7, 132.2, 159.2, 212.1. \]

HRMS m/z calcd for C\text{\textsubscript{15}}H\text{\textsubscript{20}}O\text{\textsubscript{2}} (M\textsuperscript{+}) 232.1463, found 232.1463.

3-cyclohexylidene-2-(4-methoxyphenyl)propanal (3a)

Following the general procedure to prepare 2b, allylic alcohol 1g (100 mg, 0.26 mmol) was converted to the corresponding aldehyde 3a in the presence of Cu(OTf)\textsubscript{2} (1 mg, 1 mol%). The reaction mixture was concentrated under reduced pressure, and the residue was purified by flash chromatography on silica (pentanes/Et\textsubscript{2}O = 95/5). 3a was obtained in 79% yield (50 mg, 0.20 mmol).

\[ ^1 \text{H NMR} (360 \text{ MHz, CDCl}_3) \delta 1.45–1.59 (m, 6H), 2.12–2.20 (m, 4H), 3.80 (s, 3H), 4.41 (dd, J = 2.6, 8.8 Hz, 1H), 5.39–5.46 (m, 1H), 6.88–6.94 (m, 2H), 7.13–7.19 (m, 2H), 9.55 (d, J = 2.6 Hz, 1H). \]

\[ ^{13} \text{C NMR} (90.6 \text{ MHz, CDCl}_3) \delta 26.6, 27.6, 28.5, 29.6, 37.3, 55.3, 56.3, 114.4, 115.1, 128.9, 129.4, 145.7, 158.8, 198.5. \]

LRMS (EI) 244 (2) [M\textsuperscript{+}], 215 (100), 147 (23), 121 (25).
Following the general procedure to prepare 2b, allylic methyl ether 1i (50 mg, 0.12 mmol) was converted to the corresponding aldehyde 3b in the presence of Cu(OTf)$_2$ (1 mg, 1 mol%). The reaction mixture was concentrated under reduced pressure, and the residue was purified by flash chromatography on silica (pentanes/Et$_2$O = 95/5). 3b was obtained in 82% yield (26 mg, 0.10 mmol).

$^1$H NMR (360 MHz, CDCl$_3$) δ 1.48–1.57 (m, 8 H), 2.24–2.35 (m, 4H), 3.80 (s, 3 H), 4.35 (dd, $J = 2.7$, 9.0 Hz, 1 H), 5.53 (d, $J = 9.0$ Hz, 1 H), 6.89–6.92 (m, 2H), 7.15–7.18 (m, 2 H), 9.54 (d, $J = 2.7$ Hz, 1 H).

$^{13}$C NMR (90.6 MHz, CDCl$_3$) δ 26.8, 29.1, 29.1, 29.7, 30.7, 38.0, 55.3, 56.8, 114.4, 118.4, 128.6, 129.5, 147.5, 158.8, 198.3.

LRMS (EI) 258 (6) [M$^+$], 229 (100), 147 (32), 121 (36).

HRMS m/z calcd for C$_{17}$H$_{22}$O$_2$ (M$^+$) 258.1620, found 258.1620.
4-ethyl-2-(4-methoxyphenyl)hex-3-enal (3c)

According to the general procedure to prepare 2b, allylic alcohol 1j (50 mg, 0.13 mmol) was converted to the corresponding aldehyde 3c in the presence of Cu(OTf)₂ (0.5 mg, 1 mol%). Purification by flash chromatography on silica (pentanes/EtOAc = 98/2) gave 3c as colorless oil in 63% yield (17 mg, 0.08 mmol) and 2c in 12% (see above).

\[
\begin{align*}
^1H-NMR & \text{ (360 MHz, CDCl}_3) \ \delta 0.95 \ (t, \ J = 7.6 \ Hz, \ 3\ H), \ 1.06 \ (t, \ J = 7.4 \ Hz, \ 3\ H), \ 2.07–2.17 \ (m, \ 4\ H), \ 3.80 \ (s, \ 3\ H), \ 4.39 \ (dd, \ J = 2.7, 9.2 \ Hz, \ 1\ H), \ 5.45 \ (d, \ J = 9.2 \ Hz, \ 1\ H), \ 6.89–6.93 \ (m, \ 2\ H), \ 7.14–7.19 \ (m, \ 2\ H), \ 9.55 \ (d, \ J = 2.8 \ Hz, \ 1\ H). \\
^13C-NMR & \text{ (90.6 MHz, CDCl}_3) \ \delta 12.7, \ 13.0, \ 24.0, \ 29.4, \ 55.3, \ 56.7, \ 114.5, \ 116.4, \ 128.9, \ 129.4, \ 148.9, \ 158.9, \ 198.5. \\
\end{align*}
\]

LRMS (EI) 232 (4) [M⁺], 203 (100), 161 (23), 147 (20), 121 (25).

HRMS m/z calcd for C₁₄H₁₉O (M⁺ - CHO) 203.1436, found 203.1436.

(E)-triethyl(6-ethoxy-3-ethyl-6-(4-methoxyphenyl)hex-4-en-3-yloxy)silane (1d)

Allylic alcohol 1j (25 mg, 0.07 mmol) was dissolved in 0.7 ml CH₂Cl₂. Ethanol (20 mg, 6 eq) and, subsequently, PPTS (1 mg, 10 mol%) were added, and the resulting mixture was stirred for one hour until TLC-analysis indicated full conversion. The mixture was filtrated over a
short plug of silica and the solvent was evaporated. 1d was isolated in 88% yield (22 mg, 0.06 mmol).

$^1$H-NMR (360 MHz, CDCl$_3$) $\delta$ 0.49–0.56 (m, 6H), 0.79–0.83 (m, 6H), 0.88–0.93 (m, 9H), 1.22 (t, $J = 7.0$ Hz, 3H), 1.51–1.60 (m, 4H), 3.38–3.46 (m, 1H), 3.48–3.57 (m, 1H), 3.80 (s, 3H), 4.71 (d, $J = 5.6$ Hz, 1H), 5.61 (d, $J = 15.7$ Hz, 1H), 5.67 (dd, $J = 5.6$, 15.7 Hz, 1H), 6.85–6.88 (m, 2H), 7.24–7.26 (m, 2H).

$^{13}$C-NMR (90.6 MHz, CDCl$_3$) $\delta$ 6.8, 7.1, 8.3, 8.4, 15.3, 32.2, 32.5, 55.3, 63.7, 77.8, 81.9, 113.7, 128.0, 129.8, 134.2, 137.6, 158.9.

LRMS (EI) 392 (1) [M$^+$], 363 (60), 203 (55), 165 (100), 137 (40).

HRMS m/z calcd for C$_{21}$H$_{35}$O$_3$Si (M$^+$ - CHO) 363.2355, found 363.2355.

(E)-triethyl(1-(3-ethoxy-3-(4-methoxyphenyl)prop-1-enyl)cyclopentyloxy)silane (1e)

![Chemical structure of 1e]

According to the procedure to prepare 1d, allylic alcohol 1g (25 mg, 0.07 mmol) was converted to the corresponding ethyl ether 1e in 80% yield (20 mg, 0.06 mmol).

$^1$H-NMR (360 MHz, CDCl$_3$) $\delta$ 0.44–0.51 (m, 6H), 0.86–0.90 (m, 9H), 1.19–1.23 (m, 3H), 1.41–1.50 (m, 4H), 1.59–1.67 (m, 4H), 3.37–3.53 (m, 2H), 3.80 (s, 3H), 4.68 (d, $J = 6.4$ Hz, 1H), 5.65 (dd, $J = 6.4$, 15.9 Hz, 1H), 5.75 (d, $J = 15.9$ Hz, 1H), 6.86–6.89 (m, 2H), 7.23–7.26 (m, 2H).

$^{13}$C-NMR (90.6 MHz, CDCl$_3$) $\delta$ 6.7, 7.1, 15.3, 22.2, 25.9, 38.0, 38.7, 55.3, 63.7, 73.2, 82.1, 113.7, 128.0, 129.1, 133.9, 139.3, 159.0.

Due to the instability of 1e, LRMS and HRMS data were not obtained.
(E)-triethyl(1-(1-methoxy-3-(4-methoxyphenyl)allyl)cyclopentyloxy)silan (4b)

![Chemical structure of 4b](image)

Allylic methyl ether 1b (30 mg, 0.08 mmol) was dissolved in 0.8 ml dry CH₂Cl₂ and PPTS (1 mg, 5 mol%) was added. The resulting mixture was stirred for 24 hours until TLC-analysis indicated full conversion. The reaction mixture was filtrated over a short plug of silica and the solvent was evaporated. 4b was isolated as a colorless oil in 95% yield (29 mg, 0.08 mmol).

¹H-NMR (360 MHz, CDCl₃) δ 0.56–0.63 (m, 6H), 0.91–0.96 (m, 9H), 1.52–1.62 (m, 4H), 1.68–1.78 (m, 4H), 3.28 (s, 3H), 3.53 (d, J = 8.2 Hz, 1H), 6.03 (dd, J = 8.3, 16.0 Hz, 1H), 6.47 (d, J = 16.0 Hz, 1H), 6.85–6.89 (m, 2 H), 7.32–7.35 (m, 2H).

¹³C-NMR (90.6 MHz, CDCl₃) δ 6.5, 7.3, 24.1, 24.2, 37.0, 37.3, 55.3, 56.6, 86.7, 88.2, 113.8, 125.0, 127.5, 129.5, 133.1, 158.9.

Due to the instability of 4b, LRMS and HRMS data were not obtained.

(E)-3-(4-Methoxyphenyl)-1-(1-(triethylsilyloxy)cyclopentyl)prop-2-en-1-ol (4c)

![Chemical structure of 4c](image)

Allylic alkohol 1c (100 mg, 0.28 mmol) was dissolved in 2.8 ml dry CH₂Cl₂ and PPTS (1 mg, 5 mol%) was added. The resulting mixture was stirred for 48 hours until TLC-analysis indicated full conversion. The reaction mixture was filtrated over a short plug of silica and the solvent was evaporated. 4c was isolated as a colorless oil in 99% yield (99 mg, 0.28 mmol).
\(^1\text{H-NMR}\) (360 MHz, CDCl\(_3\)) \(\delta\) 0.58–0.70 (m, 6H), 0.95–1.02 (m, 9H), 1.49–1.98 (m, 8H), 2.71 (d, \(J = 7.2\) Hz, OH), 3.81 (s, 3H), 4.01–4.09 (m, 1H), 6.11 (dd, \(J = 7.2, 15.8\) Hz, 1H), 6.59 (d, \(J = 15.8\) Hz, 1H), 6.83–6.93 (m, 2H), 7.28–7.33 (m, 2H).

\(^{13}\text{C-NMR}\) (90.6 MHz, CDCl\(_3\)) \(\delta\) 6.5, 7.1, 24.3, 24.5, 36.0, 37.0, 55.2, 78.8, 87.7, 113.9, 126.0, 127.6, 129.8, 131.8, 159.1.

LRMS (EI) 362 (23%) [M\(^+\)], 333 (20), 226 (23), 225 (100), 121 (34).

HRMS m/z calcd for C\(_{21}\)H\(_{34}\)O\(_3\)Si (M\(^+\)) 362.2277, found 362.2277.

\((E)-4\text{-cyclopentenyl-1-phenylbut-3-en-2-ol}\) (6)

According to the general procedure to prepare 2b, allylic alcohol 11 (50 mg, 0.14 mmol) was converted to the corresponding elimination product 6 in the presence of Cu(OTf)\(_2\) (2.5 mg, 5 mol%). Purification by flash chromatography on silica (pentanes/EtOAc = 90/10) gave 6 as colorless oil in 56% yield (17 mg, 0.08 mmol).

\(^1\text{H-NMR}\) (360 MHz, CDCl\(_3\)) \(\delta\) 1.61 (d, \(J = 3.5\) Hz, OH), 1.86–1.99 (m, 2H), 2.41 (t, \(J = 7.4\) Hz, 4H), 2.75–2.95 (m, 2H), 4.34–4.43 (m, 1H), 5.62 (dd, \(J = 6.5, 15.6\) Hz, 1H), 5.72 (bs, 1H), 6.47 (d, \(J = 15.7\) Hz, 1H), 7.19–7.36 (m, 5H).

\(^{13}\text{C-NMR}\) (90.6 MHz, CDCl\(_3\)) \(\delta\) 23.1, 31.3, 32.9, 44.3, 73.5, 126.5, 127.5, 128.5, 129.5, 131.4, 137.9, 141.8.

\(^1\text{H NMR monitoring}\) (200 MHz, CDCl\(_3\)) for the conversion of 1g → 4d → 3a

(see page S11)
Synthesis and spectral data of starting materials 1a-c, 1g, 1j, 1k, 1l

All the starting materials were prepared following a reaction sequence of acetylene addition onto ketones, protecting group operations, and Red-Al reduction of the propargylic alcohols\(^1\) to the corresponding allylic alcohols.

\[(E)-1-(3\text{-methoxy}-3-(4\text{-methoxyphenyl})\text{prop-1-enyl})\text{cyclobutanol} (1a)\]

\(^{1}\text{H-NMR (360 MHz, CDCl}_3\text{) }\delta 1.52 - 1.65 (m, 2H), 1.74 - 1.85 (m, 2H), 2.15 - 2.23 (m, 2H), 3.29 (s, 3H), 3.81 (s, 3H), 4.63 (d, } J = 6.6 \text{ Hz, 1H}), 5.81 (dd, } J = 6.6, 15.6 \text{ Hz, 1H}), 5.99 (dd, } J = 0.8, 15.6 \text{ Hz, 1H}), 6.88 - 6.91 (m, 2H), 7.23 - 7.27 (m, 2H).

\(^{13}\text{C-NMR (90.6 MHz, CDCl}_3\text{) }\delta 12.1, 36.2, 36.3, 55.3, 56.2, 74.7, 83.3, 113.9, 127.4, 128.1, 133.1, 136.2, 159.2.

LRMS (EI) 248 (6%) [M\(^+\)], 216 (15), 188 (21), 177 (37), 160 (31), 151 (100).

HRMS m/z calcd for C\(_{15}\)H\(_{20}\)O\(_3\) (M\(^+\)) 248.1413, found 248.1411.

\(^1\text{C.T. Meta, K. Koide, Org. Lett., 2004, 6, 1785-1787.}\)
(E)-(1-(3-methoxy-3-(4-methoxyphenyl)prop-1-enyl)cyclopentyloxy)triethyilsilane (1b)

\[
\text{[Image of compound structure]}
\]

\(^1\)H-NMR (360 MHz, CDCl\(_3\)) \(\delta\) 0.49 (q, \(J = 7.8\) Hz, 6 H), 0.87 (t, \(J = 7.9\) Hz, 9H), 1.56 – 1.63 (m, 2H), 1.66 – 1.83 (m, 6H), 3.29 (s, 3H), 3.80 (s, 3H), 4.57 (d, \(J = 6.7\) Hz, 1H), 5.66 (dd, \(J = 6.8, 15.7\) Hz, 1H), 5.87 (dd, \(J = 15.7\) Hz, 1H), 6.85 – 6.91 (m, 2H), 7.20 – 7.25 (m, 2H).

\(^13\)C-NMR (90.6 MHz, CDCl\(_3\)) \(\delta\) 6.4, 7.0, 23.0, 23.1, 39.9, 40.5, 55.3, 56.2, 83.4, 83.8, 113.8, 127.9, 128.0, 133.4, 138.2, 159.1.

LRMS (EI) 376 (55%) [M\(^+\)], 225 (100), 151 (83), 121 (64).

HRMS m/z calcd for C\(_{22}\)H\(_{36}\)O\(_3\)Si (M\(^+\)) 376.2434, found 376.2433.

(E)-3-(1-(triethylsilyloxy)cyclopentyl)-1-(4-methoxyphenyl)prop-2-en-1-ol (1c)

\[
\text{[Image of compound structure]}
\]

\(^1\)H-NMR (360 MHz, CDCl\(_3\)) \(\delta\) 0.47 – 0.57 (m, 6H), 0.87 – 0.93 (m, 9H), 1.54 – 1.82 (m, 8H), 1.86 (d, \(J = 2.7\) Hz, OH), 3.80 (s, 3H), 5.16 (dd, \(J = 3.3, 6.0\) Hz, 1H), 5.77 (dd, \(J = 6.1, 15.6\) Hz, 5.95 (dd, \(J = 1.0, 15.6\) Hz, 1H), 6.85 – 6.92 (m, 2H), 7.25 – 7.32 (m, 2H).

\(^13\)C-NMR (90.6 MHz, CDCl\(_3\)) \(\delta\) 6.4, 7.0, 23.0, 23.0, 40.0, 40.3, 55.3, 74.5, 83.3, 113.9, 127.5, 129.3, 135.3, 137.1, 159.1.

LRMS (EI) 362 (23%) [M\(^+\)], 333 (20), 226 (23), 225 (100), 121 (34).

HRMS m/z calcd for C\(_{21}\)H\(_{34}\)O\(_3\)Si (M\(^+\)) 362.2277, found 362.2277.
(E)-3-(1-(triethylsilyloxy)cyclohexyl)-1-(4-methoxyphenyl)prop-2-en-1-ol (1g)

![Chemical structure](attachment:image)

\(^1\)H-NMR (360 MHz, CDCl\(_3\)) \(\delta 0.45 – 0.57 \) (m, 6H), 0.87 – 0.91 (m, 9H), 1.35 – 1.56 (m, 6H), 1.56 – 1.71 (m, 4H), 1.81 (d, \(J = 3.4\) Hz, OH), 3.81 (s, 3H), 5.16 (dd, \(J = 3.5, 5.6\) Hz, 1H), 5.75 (dd, \(J = 5.7, 15.8\) Hz, 1H), 5.86 (d, \(J = 15.9\) Hz, 1H), 6.85 – 6.94 (m, 2H), 7.24 – 7.32 (m, 2H).

\(^{13}\)C-NMR (90.6 MHz, CDCl\(_3\)) \(\delta 6.8, 7.1, 22.3, 25.8, 38.3, 38.6, 55.3, 73.1, 74.7, 113.9, 127.5, 130.0, 135.3, 138.7, 159.1\).

LRMS (EI) 376 (28%) \([M^+]\), 347 (35), 239 (35), 193 (69), 137 (100).

HRMS m/z calcd for C\(_{22}\)H\(_{36}\)O\(_3\)Si (M\(^+\)) 376.2434, found 376.2431.

(E)-4-(triethylsilyloxy)-4-ethyl-1-(4-methoxyphenyl)hex-2-en-1-ol (1j)

![Chemical structure](attachment:image)

\(^1\)H-NMR (360 MHz, CDCl\(_3\)) \(\delta 0.51–0.60 \) (m, 6H), 0.82 (dt, \(J = 1.9, 7.4\) Hz, 6H), 0.90–0.94 (m, 9H), 1.52 – 1.60 (m, 4H), 1.77 (d, \(J = 3.0\) Hz, OH), 3.81 (s, 3H), 5.18 (dd, \(J = 3.6, 5.6\) Hz, 1H), 5.69 (dd, \(J = 0.9, 15.6\) Hz, 1H), 5.79 (dd, \(J = 5.9, 15.6\) Hz, 1H), 6.85–6.92 (m, 2H), 7.25–7.35 (m, 2H).

\(^{13}\)C-NMR (90.6 MHz, CDCl\(_3\)) \(\delta 6.9, 7.2, 8.4, 8.4, 32.5, 32.6, 55.3, 74.6, 77.8, 113.9, 127.6, 130.9, 135.5, 136.8, 159.1\).

LRMS (EI) 335 (61%) \([M^+ - C\(_2\)H\(_5\)]\), 203 (16), 137 (100).
HRMS m/z calcd for C₁₉H₃₁O₃Si (M⁺ -C₂H₅) 335.2043, found 335.2045.

(E)-3-(1-(triethylsilyloxy)cyclopentyl)-1-phenylprop-2-en-1-ol (1k)

\[
\begin{align*}
\text{OH} & \quad \text{OTES} \\
\text{CH}_2 & \quad \text{CH}_2 \\
\text{C}_6\text{H}_{12} & \quad \text{C}_5\text{H}_{10} \\
\end{align*}
\]

\(^1\text{H-NMR (360 MHz, CDCl}_3\text{)} \delta 0.52 \text{ (q, } J = 7.9 \text{ Hz, 6H}), 0.89 \text{ (t, } J = 7.9 \text{ Hz, 9H}), 1.56–1.81 \text{ (m, 8H), 1.83–1.90 (m, OH), 5.21 (dd, } J = 3.7, 5.7 \text{ Hz, 1H), 5.78 (dd, } J = 6.4, 15.6 \text{ Hz, 1H), 5.97 (dd, } J = 1.1, 15.6 \text{ Hz, 1H), 7.27–7.44 (m, 5H).}

\(^{13}\text{C-NMR (90.6 MHz, CDCl}_3\text{)} \delta 6.5, 7.0, 23.1, 23.1, 40.1, 40.3, 75.0, 83.4, 126.1, 126.2, 127.6, 128.4, 128.5, 129.2, 137.6, 143.0.

LRMS (EI) 303 (7%) [M⁺ -C₂H₅], 225 (20), 200 (28), 163 (21), 107 (66), 94 (40), 79 (100).

HRMS m/z calcd for C₁₈H₂₇O₂Si (M⁺ -C₂H₅) 303.1780, found 303.1780.

(E)-4-(1-(trimethylsilyloxy)cyclopentyl)-1-phenylbut-3-en-2-ol (1l)

\[
\begin{align*}
\text{OH} & \quad \text{OTES} \\
\text{CH}_2 & \quad \text{CH}_2 \\
\text{C}_6\text{H}_{12} & \quad \text{C}_5\text{H}_{10} \\
\end{align*}
\]

\(^1\text{H-NMR (360 MHz, CDCl}_3\text{)} \delta 0.48–0.61 \text{ (m, 6H), 0.93 (t, } J = 7.9 \text{ Hz, 9H), 1.54–1.82 (m, 8H), 2.75–2.91 (m, 2H), 4.31–4.41 (m, 1H), 5.65 (dd, } J = 6.2, 15.7 \text{ Hz, 1H), 5.87 (dd, } J = 0.8, 15.7 \text{ Hz, 1H), 7.10–7.39 (m, 5H).}

\(^{13}\text{C-NMR (90.6 MHz, CDCl}_3\text{)} \delta 6.5, 7.1, 23.0, 23.0, 40.1, 40.1, 44.0, 73.3, 83.3, 126.5, 128.5, 128.7, 129.5, 137.3, 137.8.
LRMS (EI) 346 (1%) [M^+], 317 (35), 255 (20), 225 (100), 123 (72).

HRMS m/z calcd for C_{19}H_{29}O_{2}Si (M^+ - CHO) 317.1937, found 317.1938.