Concise Seven-Membered Oxepene / Oxepane Synthesis – Structural Motifs in Natural and Synthetic Products
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Supporting Information

General Methods
NMR spectra were recorded on either Varian Inova-500 MHz or Varian VXR-500 MHz spectrometers. Chemical shifts were reported in δ, parts per million (ppm), relative to chloroform (δ = 7.26 ppm), dichloromethane (5.32), or benzene (δ = 7.16 ppm) as internal standards unless otherwise stated for proton nuclear magnetic resonance (1H NMR). Chemical shifts for carbon nuclear magnetic resonance (13C NMR) were reported in δ, parts per million (ppm), and/or relative to the center line of the chloroform triplet (δ = 77.16 ppm). Coupling constants, J, were reported in Hertz (Hz) and refer to apparent peak multiplicities and not true coupling constants. The abbreviations s, d, dd, ddd, dddd, t, q, br., m and obs stand for resonance multiplicities singlet, doublet, doublet of doublet, doublet of doublet of doublet, doublet of doublet of doublet of doublet of doublet, triplet, quartet, broad, multiplet and partially obscured peak, respectively. Mass Spectra were recorded at the Mass Spectrometry facility at the Department of Chemistry of the University of Utah at Salt Lake City on a Finnigan MAT 95 mass. IR Spectra were recorded on a Nicolet Impact 400 or Bruker Tensor 27 FT-IR spectrometer, and Optical Rotations were recorded on a Perkin Elmer Model 343 Polarimeter. Thin layer chromatography was performed on Merck silica gel 60 F254 precoated plates, visualized by a 254 nm UV lamp and stained with p-anisaldehyde. Flash chromatography was performed using 40–63 μm silica gel (200 × 400
Solvents were purified according to the guidelines in *Purification of Common Laboratory Chemicals* (Perrin, Armarego, and Perrin: Oxford, 1966). Ether, THF, benzene and toluene were distilled from sodium/benzophenone. CH\textsubscript{2}Cl\textsubscript{2}, CHCl\textsubscript{3}, Hexanes, DMSO, \((i-\text{Pr})\text{NEt}, \text{NEt}_3,\) pyridine, TMEDA, 2,6-lutidine, PhCl, MeOH, and CH\textsubscript{3}CN were distilled from CaH\textsubscript{2}. DMF was distilled from K\textsubscript{2}CO\textsubscript{3}. Spectroscopic grade DMF and DMSO were stored over activated 4Å molecular sieves and used without purification. Zn dust (<10 mm, Aldrich) was activated by sequentially washing with HCl, H\textsubscript{2}O, ether, and acetone and then drying under vacuum overnight. All other reagents were used without further purification. Unless otherwise stated, all reactions were run under an atmosphere of dried nitrogen in flame-dried glassware. Concentration refers to removal of solvent under reduced pressure (house vacuum at ca. 20 mm Hg) with a Buchi Rotavapor.

**Experimental Procedures**

\[(\text{but-3-ynyloxy})(\text{tert-butyl})\text{diphenylsilane} \]  \(\text{1}\). To a solution of homopropargyl alcohol (500. mg, 7.13 mmol) in dry CH\textsubscript{2}Cl\textsubscript{2} (10.0 mL) under N\textsubscript{2} with stirring was added imidazole (1.20 mg, 17.8 mmol) at room temperature. The mixture was cooled to 0 °C and TBDPSCl (2.00 mL, 7.85 mmol) were added sequentially. After being stirred for 4 h at rt, the reaction mixture was quenched with sat. aqueous NaHCO\textsubscript{3} solution and extracted with CH\textsubscript{2}Cl\textsubscript{2}. The organic extracts were combined, dried over Na\textsubscript{2}SO\textsubscript{4}, filtered, and concentrated in vacuo. The residue was purified by column chromatography (10:1 hexanes:ethyl acetate) to give 1.88 g of compound \(\text{1}\) (85%) as a colorless oil. R\textsubscript{f} 0.75 (10:1 hexanes:ethyl acetate); \textsuperscript{1}H NMR (300 MHz, CDCl\textsubscript{3}) \(\delta \) 7.90–7.87 (m, aromatic, 4H), 7.57–7.53 (m, aromatic, 6H), 3.98 (dd, \(J = 6.9, 7.2 \text{ Hz}, 2\text{H})\), 2.62 (ddd, \(J = 2.7,\)
6.9, 7.2 Hz, 2H), 1.88 (dd, \( J = 2.7 \) Hz, 1H), 1.02 (s, 9H, tBu); \(^{13}\)C NMR (75 MHz, CDCl\(_3\)) \( \delta \) 136.0, 133.9, 130.1, 128.1, 81.8, 69.9, 62.7, 27.2, 23.0, 19.6; IR (CH\(_2\)Cl\(_2\)) 3308, 3069, 2912, 2856, 2122, 1472, 1112, 823 cm\(^{-1}\).

\[
\text{TBDPSO} \quad \text{OH}
\]

\( \text{2} \)

**5-(tert-butylphenylsilyloxy)pent-2-yn-1-ol 2.** To a solution of 1 (1.40 g, 4.53 mmol) in THF (25 mL) at \(-78^\circ\) C was added \( n \)-BuLi (2.00 mL of a 2.50 M solution in hexane, 4.99 mmol). The reaction mixture was slowly warmed up to 0 \( ^\circ \) C over 30 min. Paraformaldehyde (205 mg, 6.81 mmol) was then added and the reaction mixture was stirred at rt for 4 h. The reaction was quenched with sat. NH\(_4\)Cl (aq., 10 mL) solution, and extracted with EtOAc (3 x 20 mL). The combined organic extracts were washed with brine (20 mL), dried (Na\(_2\)SO\(_4\)) and concentrated. Purification of the residue by column chromatography (5:1 hexanes:ethyl acetate) provided 1.31 g of compound 2 (85%) as a colorless oil. \( R_f \) 0.40 (5:1 hexanes:ethyl acetate); \(^1\)H NMR (300 MHz, CDCl\(_3\)) \( \delta \) 7.71–7.67 (m, aromatic, 4H), 7.48–7.35 (m, aromatic, 6H), 4.20 (m, 2H), 3.80 (dd, \( J = \) Hz, 2H), 2.51–2.49 (m, 2H), 1.60 (s, 1H, OH), 1.04 (s, 9H, tBu); \(^{13}\)C NMR (50 MHz, CDCl\(_3\)) \( \delta \) 135.8, 133.9, 129.9, 127.9, 83.7, 79.8, 62.7, 51.5, 27.0, 23.1, 19.5; IR (CH\(_2\)Cl\(_2\)) 3363, 3071, 2877, 2290, 2227, 1590, 1112, 1010 cm\(^{-1}\).

\[
\text{TBDPSO} \quad \text{OH}
\]

\( \text{3} \)

**(E)-5-(tert-butylphenylsilyloxy)pent-2-en-1-ol 3.** To a solution of 2 (1.44 g, 4.26 mmol) in THF (30 mL) at 0 \( ^\circ \) C was slowly added sodium bis(2-methoxyethoxy)aluminumhydride (2.20 mL of a 3.40 M solution in toluene, 7.24 mmol) over a period of 5 min. The reaction mixture was stirred for 4 h and quenched by careful addition of
H₂O (15 mL) and extracted with EtOAc (3 x 20 mL). The combined organic extracts were washed successively with H₂O (8 mL), brine (6 mL), dried Na₂SO₄ and concentrated. The resulting oil was purified by column chromatography (3:1 hexanes:ethyl acetate) to give 870 mg of compound 3 (60%) as a colorless oil. R₇ 0.40 (3:1 hexanes:ethyl acetate); ¹H NMR (300 MHz, CDCl₃) δ 7.75–7.71 (m, aromatic, 4H), 7.49–7.39 (m, aromatic, 6H), 5.72–5.68 (m, 2H, olefinic), 4.09–4.07 (m, 2H), 3.77 (dd, J = 6.6 (2x) Hz, 2H), 2.39–2.32 (m, 2H), 1.92 (s, 1H, OH), 1.06 (s, 9H, tBu); ¹³C NMR (75 MHz, CDCl₃) δ 135.9, 134.2, 131.3, 129.9, 129.6, 127.9, 63.9, 63.8, 35.9, 27.2, 19.5; IR (CH₂Cl₂) 3374, 3072, 2958, 2858, 1111, 1006 cm⁻¹.

![TBDPSO-OH](image)

((2S,3S)-3-(2-(tert-butyldiphenylsilyloxy)ethyl)oxiran-2-yl)methanol 4. To a suspension of activated powdered 4 Å molecular sieves at -20 °C (150 mg, 20.0 wt%) and CH₂Cl₂ (15 mL) was added Ti(OiPr)₄ (1.05 mL, 3.50 mmol) and L-DIPT (1.03 g, 4.40 mmol). After being stirred for 0.5 h, a solution of 3 (1.50 g, 4.40 mmol) in CH₂Cl₂ (10 mL) was added. After 0.5 h, TBHP (2.94 mL of a 3.00 M solution in pentane, 8.81 mmol) was added to the reaction mixture and was stirred for 24 h at -20 °C. The reaction was quenched with H₂O (20 mL) and warmed to rt for 1 h. After cooling the mixture to 0 °C, 30.0% solution of NaOH (10 mL) in brine was added and stirred for 30 min CH₂Cl₂ was removed and remaining compound extracted with ether (3 x 20 mL), washed with brine (20 mL), dried (Na₂SO₄), filtered and concentrated in vacuo. Purification by column chromatography (3:1 hexanes:ethyl acetate) afforded 1.26 g of compound 4 (80%) as a colorless oil. R₇ 0.20 (3:1 hexanes:ethyl acetate); [α]D₂₀ = -16.7 ° (c 1.05, CHCl₃); Lit. [α]D₂₀ = -19.4 ° (c 1.37, CHCl₃); ¹H NMR (300 MHz, CDCl₃) δ 7.75–7.68 (m, aromatic, 4H), 7.49–7.39 (m, aromatic, 6H), 3.97–3.89 (ddd, J = 2.4, 5.7, 8.1 Hz,
1H), 3.87–3.80 (dddd, $J = 4.2$ (2x), 7.5, 10.5 Hz, 1H), 3.65–3.57 (ddd, $J = 4.5$, 6.6, 11.4 Hz, 1H) 3.15 (ddd, $J = 2.4$, 5.7, 7.8 Hz, 1H), 3.00 (ddd, $J = 2.7$ (2x), 4.8 Hz, 1H), 2.33 (dd, $J = 6.3$ (2x) Hz, 1H, OH), 1.87 (ddd, $J = 6.0$ (3x) Hz), 1.04 (s, 9H, tBu); $^{13}$C NMR (75 MHz, CDCl$_3$) δ 135.8, 133.8, 130.0, 128.0, 62.0, 61.0, 59.0, 54.0, 35.1, 27.1, 19.4; IR (CH$_2$Cl$_2$) 3424, 3072, 2930, 2858, 1655, 1473, 1110 cm$^{-1}$.

![Chemical Structure](image)

(2S,3R)-3-(allyloxy)-5-(tert-butyldiphenylsilyloxy)pentane-1,2-diol 5. To a stirred solution of Ti(OiPr)$_4$ (0.063 mL, 0.21 mmol) in toluene at 0 °C was added allyl alcohol (0.020 mL, 0.28 mmol). After 30 min, epoxy alcohol 4 (50 mg, 0.14 mmol) was added and the mixture heated for 5 h. The solvent was removed and the reaction mixture diluted with ether. Then, 10% NaOH solution (1 mL), in brine was added to this solution and stirred overnight. The reaction mixture was filtered through a pad of Celite, washed with CHCl$_3$ (20 mL), dried (Na$_2$SO$_4$) and concentrated. The crude product was chromatographed (2:1 hexanes:ethyl acetate) to afford 46.3 mg of compound 5 (80%) as a colorless liquid. R$_f$ 0.20 (2:1 hexanes:ethyl acetate); $^1$H NMR (300 MHz, CDCl$_3$) δ 7.70–7.65 (m, aromatic, 4H), 7.49–7.39 (m, aromatic, 6H), 5.93–5.80 (dddd, $J = 5.7$ (2x), 10.3, 17.1 Hz, 1H), 5.26–5.19 (ddd, $J = 1.5$, 3.3, 17.4 Hz, 1H, trans terminal olefin), 5.17–5.12 (ddd, $J = 1.2$, 3.0, 10.5 Hz, 1H, cis terminal olefin), 4.10 (m, 2H), 3.87–3.63 (m, 6H), 3.33 (s, 1H, OH), 2.54 (s, 1H, OH), 1.90–1.70 (m, 2H), 1.04 (s, 9H, tBu); $^{13}$C NMR (75 MHz, CDCl$_3$) δ 135.8, 134.9, 133.4, 130.1, 128.0, 117.4, 78.3, 73.1, 71.6, 63.9, 60.4, 33.5, 27.1, 19.3; IR (CH$_2$Cl$_2$) 3406, 3072, 2931, 2858, 1647, 1472, 1111, 1085 cm$^{-1}$.
(2S,3R)-3-(allyloxy)-5-(tert-butyldiphenylsilyloxy)-2-hydroxypentyl-4-methylbenzenesulfonate 6. To a stirred solution of diol 5 (100 mg, 0.240 mmol) in CH₂Cl₂ (2 mL) was added NEt₃ (0.170 mL, 1.21 mmol) and a catalytic amount of DMAP (3.0 mg, 0.024 mmol). After cooling to 0 °C, tosyl chloride (55 mg, 0.29 mmol) was added. The reaction was quenched with H₂O (1 mL), and the aqueous layer was extracted with CH₂Cl₂ (3 x 2 mL). The combined organic layers were washed with brine, dried (MgSO₄) and concentrated. The resulting residue was purified by flash chromatography to yield 88 mg of tosylate 6 (74%) as a colorless oil. Rf 0.40 (5:1 hexanes:ethyl acetate); ¹H NMR (500 MHz, CDCl₃) δ 7.82 (d, J = 5.1 Hz, 2H), 7.72-7.62 (m, aromatic, 4H), 7.46-7.37 (m, aromatic, 6H), 7.33 (d, J = 4.8 Hz, 2H), 5.84-5.75 (dd, J = 3.6 (2x), 6.6, 9.9 Hz, 1H), 5.20-5.15 (dd, J = 0.9, 10.5 Hz, 1H, trans terminal olefin), 5.13-5.10 (dd, J = 6.0 Hz, 1H, cis terminal olefin), 4.30-4.10 (m, 2H), 4.20-3.80 (m, 3H), 3.73 (ddd, J = 3.0, 4.2, 7.2 Hz, 1H), 3.61 (m, 1H), 3.44 (m, 1H), 3.25 (m, 1H), 3.08 (brd, J = 3 Hz, 1H₉), 2.44 (s, 3H, Me), 2.10 (s, 1H, OH), 1.8 (m, 2H), 1.06 (s, 9H, tBu); ¹³C NMR (125 MHz, CDCl₃) δ 145.1, 135.8 (2X), 134.8, 133.4, 130.2, 130.1, 128.3, 128.0, 117.4, 77.1, 73.9, 71.4, 66.0, 60.2, 32.9, 27.1, 21.9, 19.3; IR (CH₂Cl₂) 3423, 2931, 1647, 1428, 1111 cm⁻¹.

**7**
((R)-3-(allyloxy)-3-((S)-oxiran-2-yl)propoxy)(tert-butyl)diphenylsilane \( \mathbf{7} \). To a solution of tosylate \( \mathbf{6} \) (30 mg, 0.053 mmol) in MeOH at 0 °C was added \( \mathbf{K}_2\mathbf{CO}_3 \) (7.3 mg, 0.053 mmol). After 6 h the mixture was concentrated. Flash chromatography (10:1 hexanes:ethyl acetate) gave 15 mg of epoxide \( \mathbf{7} \) (71%) as a colorless oil. \( \text{Rf} \) 0.60 (8:1 hexanes:ethyl acetate); \( [\alpha]_D^{20} = +10.6 ^\circ \) (c 0.16, CHCl\(_3\)); \( ^1\text{H} \) NMR (300 MHz, CDCl\(_3\)) \( \delta \) 7.72-7.62 (m, aromatic, 4H), 7.46-7.37 (m, aromatic, 6H), 5.95-5.82 (dddd, \( J = 5.7 \) (2x), 10.5, 17.4 Hz, 1H), 5.30-5.20 (dd, \( J = 1.5, 3.3, 17.1 \) Hz, 1H, trans terminal olefin), 5.19-5.12 (dd, \( J = 1.2, 3, 10.2 \) Hz, 1H, cis terminal olefin), 4.19-4.11 (dd, \( J = 2.7, 5.7, 12.6 \) Hz, 1H), 4.00 (dd, \( J = 2.7, 5.4, 12.6 \) Hz, 1H), 3.84 (m, 2H), 3.60 (m, 1H), 2.96 (m, 1H), 2.78 (m, 2H), 1.94 (m, 1H), 1.78 (m, 1H), 1.08 (s, 9H, tBu); \( ^{13}\text{C} \) NMR (125 MHz, CDCl\(_3\)) \( \delta \) 135.8, 135.3, 134.0, 129.8, 127.9, 117.0, 74.8, 71.8, 60.0, 53.8, 45.6, 35.8, 27.1, 22.3, 19.4; IR (CH\(_2\)Cl\(_2\)) 3072, 2960, 2858, 1648, 1473, 1111, 823 cm\(^{-1}\).

(4S,5R)-5-(allyloxy)-7-(tert-butyldiphenylsilyloxy)hept-1-en-4-ol \( \mathbf{8} \). Vinylmagnesium bromide (0.600 mL, 0.605 mmol) was added to CuCN (13.3 mg, 0.152 mmol) at -65 °C. The resulting slurry was allowed to warm to -40 °C over 1 h. After being cooled to -65 °C, a solution of the epoxide \( \mathbf{7} \) (30 mg, 0.076 mmol) in THF (2.0 mL) was added. The mixture was then warmed to -40 °C for 30 min, then to 0 °C for another 30 min. The reaction was quenched with sat. NH\(_4\)Cl solution (aq. 5 mL) and the aq. phase was extracted with ether (3 x 5 mL). The combined organic layers were washed with brine (5 mL), dried Na\(_2\)SO\(_4\) and concentrated. The resulting residue was purified by flash chromatography (3:1 hexanes:ethyl acetate) to yield 26 mg of alcohol \( \mathbf{8} \) (81%) as a colorless oil. \( \text{Rf} \) 0.40 (4:1 hexanes:ethyl acetate); \( ^1\text{H} \) NMR (300 MHz, CDCl\(_3\)) \( \delta \) 7.74-7.66 (m, aromatic, 4H), 7.46-7.37 (m, aromatic, 6H), 5.90 (m, 2H), 5.30-
5.10 (m, 4H), 4.12-3.98 (m, 2H), 3.92 (m, 2H), 3.84 (m, 3H), 3.64-3.58 (ddd, $J = 1.5$ (2x), 6.0 Hz, 1H), 2.56 (d, $J = 3.6$ Hz, 1H), 2.30 (m, 2H), 1.85-1.74 (m, 2H), 1.05 (s, 9H, tBu); $^{13}$C NMR (75 MHz, CDCl$_3$) δ 135.8, 135.3, 133.9, 133.8, 130.0, 128.0, 117.8, 117.1, 78.8, 71.7, 71.2, 60.5, 37.4, 32.1, 27.1, 21.6, 19.4; IR (CH$_2$Cl$_2$) 3454, 3073, 2932, 2858, 1643, 1590, 1472, 1111 cm$^{-1}$.

(3R,4S)-3-(allyloxy)-4-methoxyhept-6-enyloxy)(tert-butyl)diphenylsilane $^9$. NaH (0.400 mg, 0.0153 mmol) was added to a solution of alcohol $^8$ (5.00 mg, 0.0118 mmol) in THF (1.0 mL) at 0 °C. After 0.5 h MeI (8.4 mg, 0.059 mmol) was added and the reaction mixture warmed to rt and stirred for 8 h. The reaction was quenched with H$_2$O (1 mL), and the aqueous layer was extracted with ether (3 x 2 mL). The combined organic layers were washed with brine (2 mL), dried (Na$_2$SO$_4$) and concentrated. The resulting residue was purified by flash chromatography (10:1 hexanes:ethyl acetate) to yield 4.2 mg of methyl ether $^9$ (81%) as a colorless oil. $R_f$ 0.60 (10:1 hexanes:ethyl acetate); $^1$H NMR (500 MHz, CDCl$_3$) δ 7.74–7.66 (m, aromatic, 4H), 7.46–7.37 (m, aromatic, 6H), 5.90 (m, 2H), 5.30-5.10 (m, 4H), 4.14-4.10 (dd, $J = 5.5$, 12.5 Hz, 1H), 4.00-3.96 (dd, $J = 6.0$, 7.5 Hz, 1H), 3.84 (m, 1H), 3.78 (m, 1H), 3.71 (m, 1H), 3.41 (s, 3H), 3.33 (m, 1H), 2.34 (m, 1H), 2.21 (m, 1H), 1.81-1.64 (m, 2H), 1.06 (s, 9H, tBu); $^{13}$C NMR (125 MHz, CDCl$_3$) δ 135.8, 135.6, 134.2, 129.8, 127.9, 127.8, 117.0, 116.8, 82.9, 74.5, 71.6, 60.7, 58.4, 35.2, 33.6, 27.1, 23.4, 19.4; IR (CH$_2$Cl$_2$) 3073, 2932, 2858, 1643, 1590, 1472, 1111 cm$^{-1}$.
tert-butyl(2-((2R,3S)-3-methoxy-2,3,4,7-tetrahydrooxepin-2yl)ethoxy)

diphenylsilane 10. To a solution of acyclic enol ether 9 (20.0 mg, 0.0456 mmol) in benzene (4 mL) at rt was added Grubbs’ 2nd generation catalyst 11 (2.0 mg, 0.0023 mmol). After stirring for 15 h at 60 °C, the reaction mixture was concentrated. Flash chromatography (hexane/EtOAc, 100:1 to 10:1) gave 13.1 mg of compound 10 (70 %) as a colorless oil. Rf 0.50 (10:1 hexanes:ethyl acetate); [α]D20 = +15.4 ° (c 0.1, CHCl3); 1H NMR (500 MHz, CDCl3) δ 7.74-7.68 (m, aromatic, 4H), 7.44-7.30 (m, aromatic, 6H), 5.60 (brd, J = 2.1, 4.2 Hz, 1H), 4.34 (brd, J = 2.1, 3.3, 16 Hz, 1H), 4.08 (brd, J = 2.1, 16 Hz, 1H), 3.82 (m, 1H), 3.78 (m, 2H), 3.41 (m, 1H), 3.82 (m, 1H), 3.32 (s, 3H), 3.30 (m, 1H), 2.62 (brd, J = 3.0, 5.4, 15.9 Hz, 1H), 2.38 (m, 1H), 1.88 (m, 1H), 1.70 (m, 1H), 1.04 (s, 9H, rBu); 13C NMR (125 MHz, CDCl3) δ 135.8, 130.6, 129.7, 127.8, 124.8, 86.2, 80.0, 70.2, 60.9, 57.0, 37.3, 28.1, 27.1, 19.4; IR (CH2Cl2) 3071, 2957, 2857, 1590, 1472, 1109 cm\(^{-1}\); ESI/MS (m/z) calcd for C25H35O3Si 411.2 (MH\(^{+}\)), found 411.2.

Summary of COSY spectrum for 10:
1. Protons at 3.78 ppm (C-13) show cross peaks with protons at 1.88, 1.70 ppm (C-14).
2. Protons at 1.88, 1.70 ppm (C-14) show cross peaks with proton at 3.30 ppm (C-15)
3. Proton at 3.30 ppm (C-15) shows cross peaks with proton at 3.41 ppm (C-16).
4. Proton at 3.41 ppm (C-16) shows cross peaks with protons at 2.62, 2.38 pm (C-17).
5. Protons at 2.62, 2.38 ppm (C-17) show cross peaks with proton at 5.6 ppm (C-18).
6. Proton at 5.60 ppm (C-18) shows cross peaks with proton at 4.34 ppm (C-19).
7. Proton at 4.34 ppm (C-19) shows cross peaks with protons at 4.08 ppm (C-20).

![Diagram](image)

**tert-butyl(2-((2R,3S)-3-methoxy-2,3,4,5-tetrahydrooxepin-2yl)ethoxy)**

**diphenylsilane 13.** A solution of oxepene 10 (10 mg, 0.024 mmol), RhCl(PPh₃)₃ (4.5 mg, 0.0050 mmol) and diazabicyclo[2.2.2]octane (1.7 mg, 0.015 mmol) in 5% aqueous ethanol (1.5 mL) was heated at reflux for 24 h. The reaction mixture was poured into H₂O, extracted with ether (3 x 3 mL), washed with brine (4 mL), dried (Na₂SO₄) and concentrated. Preparative thin layer chromatography (hexane/EtOAc, 100:1) gave 4 mg of enol ether 13 (40%) yield as a colorless oil. R_f 0.55 (10:1 hexanes:ethyl acetate); ¹H NMR (300 MHz, CDCl₃) δ 7.72–7.64 (m, aromatic, 4H), 7.44–7.33 (m, aromatic, 6H), 6.20 (dd, J = 2.1, 6.3 Hz, 1H), 4.70 (ddd, J = 2.4, 6.6, 9.3 Hz, 1H), 4.01 (ddd, J = 2.4, 9.3, 9.3 Hz, 1H), 3.81-3.75 (m, 1H), 3.78 (m, 1H), 3.32 (s, 3H), 3.29 (m, 1H), 2.40 (m, 1H), 1.96 (m, 2H), 1.88-1.68 (m, 3H), 1.05 (s, 9H, tBu); IR (CH₂Cl₂) 3046, 2930, 2857, 1648, 1472, 1103cm⁻¹; ESI/MS (m/z) calcd for C₂₅H₃₅O₃Si 410.2 (M⁺), found 410.5.

![Diagram](image)

**Summary of COSY spectrum for cyclic enol ether 13:**

1. Protons at 3.81 ppm (C-13) show cross peaks with protons at 1.96, 1.88 ppm (C-14).
2. Protons at 1.96, 1.88 ppm (C-14) show cross peaks with proton at 4.01 ppm (C15)
3. Proton at 4.01 ppm (C-15) shows cross peaks with proton at 3.29 ppm (C-16).
4. Proton at 3.29 ppm (C-16) shows cross peaks with protons at 2.40, 1.96 ppm (C-17).

5. Protons at 2.40, 1.96 ppm (C-17) show cross peaks with protons at 1.88 ppm (C-18).

6. Protons at 1.88 ppm (C-18) show cross peaks with proton at 4.70 ppm (C-19).

7. Proton at 4.70 ppm (C-19) shows cross peaks with proton at 6.20 ppm (C-20).

(2S,3R,6S,7R)-2-allyl-7-(2-((tert-butyldiphenylsilyl)oxy)ethyl)-6-methoxyoxepan-3-ol

14. To a solution of 13 (3.5 mg, 0.0085 mmol) in CH$_2$Cl$_2$ (2 mL) at -60 °C was added dimethyl dioxirane (0.17 mL of a 0.1 M solution in CH$_2$Cl$_2$, 0.017 mmol) dropwise. The reaction was slowly warmed to rt and then concentrated. The resulting residue was taken up in THF (2 mL) and cooled to -60 °C. Propenylmagnesium chloride (0.043 mL of a 2.0 M solution in THF, 0.085 mmol) was added and the reaction mixture was allowed to warm to rt at which point it was quenched with sat. NH$_4$Cl (aq., 2 mL). The aqueous phase was extracted with ether (3 x 3 mL), the extracts were washed with brine (3 mL), dried (Na$_2$SO$_4$), and concentrated. Flash chromatography (10:1 hexanes:ethyl acetate) afforded 3.6 mg of an alcohol 14 (90%) as a colorless oil. R$_f$ 0.21 (10:1 hexanes:ethyl acetate); $^1$H NMR (500 MHz, CDCl$_3$) δ 7.72–7.64 (m, aromatic, 4H), 7.44-7.33 (m, aromatic, 6H), 5.85-5.75 (m, 1H), 5.06-4.93 (m, 2H), 3.84-3.72 (m, 2H), 3.62-3.56 (m, 1H), 3.55-3.46 (m, 1H), 3.37-3.31 (m, 1H), 3.30-3.29 (s, 3H), 3.00-2.94 (m, 1H), 2.38-2.23 (m, 2H), 2.09-2.00 (m, 1H), 1.99-1.88 (m, 2H), 1.76-1.66 (m, 1H), 1.63-1.56 (m, 1H), 1.50-1.40 (m, 1H), 1.05-1.04 (s, 9H, tBu); $^{13}$C NMR (125 MHz, CDCl$_3$) δ 135.9, 135.8, 135.3, 129.7, 127.8, 117.4, 85.4, 77.7, 75.7, 74.1, 61.3, 57.2, 37.5, 35.7, 32.9, 27.1, 26.3, 19.4;
IR (CH₂Cl₂) 3461, 3076, 2857, 1643, 1472, 1103 cm⁻¹; ESI/MS (m/z) calcd for C_{28}H_{40}O_{4}Si 468.3 (M⁺), found 468.2.

Summary of COSY spectrum for alcohol 14:

1. Protons at 5.85 ppm (C-22) show cross peaks with protons at 2.38 ppm (C-21) and 5.06 ppm (C-23).
2. Protons at 2.38 ppm (C-21) show cross peaks with proton at 3.37 ppm (C-20)
3. Proton at 3.37 ppm (C-20) shows cross peaks with proton at 3.62 ppm (C-19).
4. Proton at 3.62 ppm (C-19) shows cross peaks with protons at 2.09, 1.99 ppm (C-18).
5. Protons at 2.09, 1.99 ppm (C-18) show cross peaks with protons at 1.63 ppm (C-17).
6. Protons at 1.63 ppm (C-17) show cross peaks with proton at 3.00 ppm (C-16).
7. Proton at 3.00 ppm (C-16) shows cross peaks with proton at 3.55 ppm (C-15).
8. Proton at 3.55 ppm (C-15) shows cross peaks with proton at 1.99 ppm (C-14).
9. Protons at 1.99, 1.76 ppm (C-14) shows cross peaks with protons at 3.84 ppm (C-13).

(2S,3R,6S,7R)-2-allyl-7-(2-((tert-butyldiphenylsilyl)oxy)ethyl)-6-methoxyoxepan-3-yl acetate 15. A solution of alcohol 14 (3 mg, 0.002 0.0064 mmol) in CH₂Cl₂ (1.5 mL) at rt was treated with Ac₂O (0.003 mL, 0.032 mmol), DMAP (ca. 0.1 mg) and NEt₃ (0.009 mL, 0.064
mmol). After stirring for 1 h, the reaction was quenched with sat. NaHCO₃ (aq., 1 mL). The aqueous phase was extracted with CH₂Cl₂ (3×3 mL), washed with H₂O, brine, dried (MgSO₄), and concentrated. Flash chromatography (10:1 hexanes/ethyl acetate) provided acetate 15 (3 mg, 92%) as a colorless oil. Rf 0.39 (10:1 hexanes:ethyl acetate); ¹H NMR (500 MHz, CDCl₃) δ 7.70-7.62 (m, aromatic, 4H), 7.44-7.33 (m, aromatic, 6H), 5.78-5.64 (m, 1H), 5.06-4.90 (m, 2H), 4.67-4.60 (m, 1H, CH-OAc), 3.83-3.72 (m, 2H), 3.66-3.59 (m, 1H), 3.58-3.52 (m, 1H), 3.31-3.26 (s, 3H), 3.02-2.96 (m, 1H), 2.25-2.15 (m, 2H), 2.11-2.04 (m, 1H), 2.02 (s, 3H, COCH₃), 2.00-1.90 (m, 2H), 1.76-1.67 (m, 1H), 1.66-1.57 (m, 1H), 1.52-1.42 (m, 1H), 1.06-1.02 (s, 9H, tBu); ¹³C NMR (125 MHz, CDCl₃) δ 170.2 (OAc), 135.8, 135.7, 134.5, 129.7, 127.7, 117.3, 85.0, 75.7, 75.6, 75.2, 61.1, 57.0, 37.2, 35.6, 28.5, 27.0, 26.1, 21.5, 19.3; IR (CH₂Cl₂) 3077, 2930, 2857, 1745, 1643, 1472, 1103cm⁻¹; ESI/MS (m/z) calcd for C₃₀H₄₂O₅Si 510.3 (M⁺), found 510.2.