Total synthesis of epothilones using functionalised allylstannanes for remote stereocontrol#

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Supplementary Experimental Data

General experimental procedures

^{1}H and ^{13}C NMR spectra were recorded on Varian Unity 500, Varian Unity Inova 400 and Varian Unity Inova 300 spectrometers with residual non-deuterated solvent as the internal standard. IR spectra were recorded on an ATI Mattson Genesis FTIR as thin films produced by evaporation of a DCM solution on sodium chloride plates unless otherwise stated. Mass spectra were recorded on Fison VG Trio 2000 and Kratos Concept spectrometers. Chemical ionisation (CI) was performed using ammonia. Typical clusters of isoptope peaks were observed for tin containing compounds. Only those corresponding to ^{120}Sn are reported. Chromatography refers to flash column chromatography using Merck silica gel 60H (230-300 mesh).

Tetrahydrofuran (THF) was dried and distilled from sodium metal using benzophenone as an indicator under an atmosphere of nitrogen. Dichloromethane (DCM) was dried and distilled from calcium hydride under an atmosphere of nitrogen. Ether refers to diethyl ether, which was dried and distilled from sodium metal using benzophenone as an indicator under an atmosphere of nitrogen. Light petroleum refers to the fraction of petroleum ether distilled between 40-60 °C. Benzene and hexane were dried over sodium metal. Butyllithium (1.6 M in hexanes) was titrated against a solution of propan-2-ol in xylene with 2,2'-bipyridine as an indicator. Triethylamine and diisopropylamine were dried over potassium hydroxide pellets. Brine refers to saturated aqueous sodium chloride. Anhydrous cerium(III) chloride was prepared by heating the heptahydrate overnight at 80 °C under reduced pressure and was stored under an atmosphere of N_2.

(*4R*)-2,2-Dimethyl-4-iodomethyl-1,3-dioxolane 15[8]

Imidazole (20.70 g, 0.303 mol), triphenylphosphine (39.85 g, 0.152 mol) and iodine (38.58 g, 0.152 mol) were added to the 4-hydroxymethyl-1,3-dioxolane (20.05 g, 0.152 mol) in THF (500 mL) and the resulting dark purple solution stirred for 16 h. Saturated aqueous sodium bicarbonate (500 mL) and ether (500 mL) were added and the aqueous layer extracted with ether. The organic extracts were washed with water and brine, dried ($MgSO_4$) and concentrated under reduced pressure. The residue was triturated with ice-cold ether (200 mL) and the precipitate removed by filtration. The filtrate was concentrated under reduced pressure in a cold-water bath and chromatography of the residue eluting with ethyl acetate-petrol (50:1 to 35:1) gave the title compound **15** (32.45 g, 88 %) as a colourless oil (Found: M^+ + H, 242.9889. $C_6H_{12}IO_2$ requires *M*, 242.9884); $[\alpha]_D^{20}$ + 31 (*c* 5.3 in EtOH), lit.[8] $[\alpha]_D^{22}$ + 35.5 (*c* 13 in EtOH); υ_{max}/cm^{-1} 1372, 1225, 1150, 1059 and 844; δ_H (300 MHz, $CDCl_3$) 1.33 and 1.44 (each 3 H, s, 2-CH_3), 3.12 (1 H, dd, *J* 10.0, 8.0, 4-CH), 3.24 (1 H, dd, *J* 10.0, 4.5, 4-CH), 3.78 (1 H, dd *J* 8.5, 5.5, 5-H) 4.12 (1 H, dd *J* 8.5, 6.0, 5-H) and 4.26 (1 H, m, 4-H); δ_C (75 MHz, $CDCl_3$) 6.7, 25.5, 27.1, 69.5, 75.5 and 110.3; *m/z* (CI) 243 (M^+ + 1, 100 %) and 227 (16).

(3*RS*,5*S*)-5,6-(Dimethylmethylene)dioxy-2-methylhex-1-en-3-yl phenyl sulfone 17

n-Butyllithium in hexane (2.5 M, 50.8 mL, 0.127 mol) was added dropwise to the sulfone **16** (23.79 g, 0.121 mol) in THF (230 mL) at -78 °C and the solution stirred for 15 min before DMPU (58.40 mL, 0.484 mol) was added. After 15 min, iodide **15** (29.38 g, 0.121 mol) was added and the solution stirred for 4 h. Saturated aqueous ammonium chloride was added and the mixture allowed to warm to room temperature. The aqueous phase was extracted with ether and the organic extracts washed with brine, dried ($MgSO_4$) and concentrated under reduced pressure. Chromatography of the residue eluting with petrol-ethyl acetate (25:1) gave the *title compound* **17** (32.26 g, 86 %) as a 75:25 mixture of diastereoisomers (^1H NMR) as a colourless oil (Found: M^+ + NH_4, 328.1589. $C_{16}H_{26}NO_4S$ requires *M*, 328.1582); υ_{max}/cm^{-1} 1447, 1375, 1307, 1148, 1081 and 1062; δ_H (300 MHz, $CDCl_3$) major diastereoisomer 1.32 (6 H, s, 2 x CH_3), 1.82 (3 H, s, 2-CH_3), 2.05 and 2.23 (each 1 H, m, 4-H), 3.61 (1 H, m, 6-H), 3.92 (1 H, dd, *J* 12.0, 3.0, 3-H), 4.04 (2 H, m, 5-H, 6-H), 4.92 and 5.19 (each 1 H, s, 1-H), 7.58 (2 H, m, ArH), 7.68 (1 H, m, ArH) and 7.90 (2 H, m, ArH); minor diastereoisomer 1.35 and 1.42 (each 3 H, s, CH_3), 1.82 (3 H, s, 2-CH_3) and 4.73 and 5.01 (each 1 H, s, 1-H); δ_C (75 MHz, $CDCl_3$) major diastereomer 21.2, 25.6, 26.9, 31.0, 68.6, 69.1, 72.3, 109.2, 120.5, 128.8, 129.0, 133.5, 136.1 and 137.5; minor diastereoisomer 20.3, 26.8, 31.2, 68.9, 69.3, 73.6, 120.2 and 133.6; *m/z* (CI) 328 (M^+ + 18, 100 %), 311 (M^+ + 1, 75) and 253 (67).

(2*S*,4*RS*)-5-Methyl-4-(phenylsulfonyl)hex-5-ene-1,2-diol 18

Amberlyst-15 ion exchange resin (ca. 1 g) was added to the sulfone **17** (28.02 g, 0.090 mol) in methanol (200 mL). The mixture was stirred for 4 h then filtered through a plug of celite and concentrated under reduced pressure. Chromatography of the residue, eluting with light petroleum-ethyl acetate (1:1), gave the *title compound* **18** (23.43 g, 96 %) as a 75:25 mixture of diastereoisomers (^1H NMR), a white solid (Found: M^+ + NH_4, 288.1265. $C_{13}H_{22}NO_4S$ requires *M*, 288.1269); υ_{max}/cm^{-1} 3300-3400, 1642, 1447, 1301, 1144, 1083, 914, 757, 721 and 690; δ_H (300 MHz, $CDCl_3$) major diastereoisomer 1.78 (3 H, s, 5-CH_3), 1.98 and 2.24 (each 1 H, m, 3-H), 2.79 (1 H, br. t, *J* 5.5, OH), 3.16 (1 H, br. d, *J* 5.0, OH), 3.46-3.74 (3 H, m, 1-H_2, 2-H), 4.04 (1 H, dd, *J* 11.5 and 3.5, 4-H), 4.84 and 5.10 (each 1 H, s, 6-H), 7.58 (2 H, m, ArH), 7.68 (1 H, m, ArH) and 7.89 (2 H, m, ArH); minor diastereoisomer 4.74 and 4.98 (each 1 H, s, 6-H); δ_C (75 MHz, $CDCl_3$) major diastereoisomer 20.6, 29.3, 66.7, 68.8, 69.7, 120.8, 128.8, 129.0, 133.6, 136.4 and 137.1; minor diastereoisomer 20.3, 30.4, 65.8, 68.6, 120.2, 128.7, 129.0, 133.7 and 138.0; *m/z* (CI) 288 (M^+ + 18, 100%), 271 (M^+ + 1, 12) and 148 (15).

(2*S*,4*RS*)-1-*tert*-Butyldimethylsilyloxy-5-methyl-4-(phenylsulfonyl)hex-5-en-2-ol 19

Imidazole (25.33 g, 0.372 mol), DMAP (1.10 g, 9.70 mmol) and *tert*-butyldimethylsilyl chloride (14.58 g, 0.097 mol) were added to the diol **18** (25.0 g, 0.093 mol) in DCM (200 mL) at 0 °C. The reaction was allowed to warm to room temperature and stirred for 6 h. Saturated aqueous ammonium chloride was added and the aqueous phase extracted with ether. The organic extracts were washed with brine, dried ($MgSO_4$) and concentrated under reduced pressure. Chromatography of the residue, eluting with petrol-ethyl acetate (6:1), gave the *title compound* **19** (32.94 g, 90 %) as a 75:25 mixture of diastereoisomers, a clear viscous oil that crystallised on standing (Found: $M^+ + NH_4$, 402.2138. $C_{19}H_{36}NO_4SiS$ requires *M*, 402.2134); υ_{max}/cm^{-1} 3538, 1471, 1447, 1305, 1256, 1146, 1084 and 838; δ_H (300 MHz, $CDCl_3$) major diastereoisomer 0.06 [6 H, s, $Si(CH_3)_2$], 0.88 [9 H, s, $SiC(CH_3)_3$], 1.81 (3 H, s, 5-CH_3), 1.92 (1 H, ddd, *J* 14.0, 12.0, 2.0, 3-H), 2.09 (1 H, ddd, *J* 14.0, 10.5, 3.0, 3-H), 2.24 (1 H, br. d, *J* 5.0, OH), 3.46 (3 H, dd, *J* 9.5, 6.0 1-H), 3.54 (1 H, m, 2-H), 3.62 (1 H, dd, *J* 9.5, 3.5, 1-H), 3.99 (1 H, dd, *J* 12.0, 3.0, 4-H), 4.87 and 5.12 (each 1 H, s, 6-H), 7.53 (2 H, m, ArH), 7.64 (1 H, m, ArH) and 7.87 (2 H, m, ArH); minor diastereoisomer 4.72 and 4.99 (each 1 H, s, 6-H); δ_C (75 MHz, $CDCl_3$) major diastereoisomer -5.5, 18.2, 20.9, 25.8, 29.6, 67.0, 68.2, 68.6, 120.6, 128.7, 129.0, 133.5, 136.4 and 137.6; *m/z* (CI) 402 ($M^+ + 18$, 100 %) and 385 ($M^+ + 1$, 23).

(5*S*,2*EZ*)-6-*tert*-Butyldimethylsilyloxy-5-hydroxy-2-methylhex-2-enyl(tributyl)stannane 20
Tributyltin hydride (2.36 mL, 9.07 mmol) and AIBN (40 mg) were added to the hydroxy sulfone **19** (1.75 g, 4.54 mmol) in benzene (20 mL) and the solution was degassed then heated under reflux for 1.5 h. After concentration under reduced pressure, chromatography of the residue eluting with ethyl acetate-petrol (75:1) with 1 % TEA, gave the *title compound* **20** (1.50 g, 62 %), a 1:1 mixture of (*E*)- and (*Z*)-isomers, as a clear, colourless oil (Found: $M^+ - C_4H_9$, 477.2212. $C_{21}H_{45}O_2Si^{120}Sn$ requires *M*, 477.2210); υ_{max}/cm^{-1} 3477, 1654, 1463, 1254, 1112, 1074, 838 and 778; δ_H (300 MHz, $CDCl_3$) 0.00 [6 H, s, $Si(CH_3)_2$], 0.82 (15 H, m, 3 x CH_3CH_2), 0.83 [9 H, s, $SiC(CH_3)_3$], 1.21 and 1.39 (each 6 H, m, 3 x CH_2), 1.52 and 1.60 (each 1.5 H, m, 2-CH_3), 1.64 and 1.68 (each 1 H, s, 1-H), 2.07 (2 H, m, 4-H_2), 2.29 and 2.32 (each 0.5 H, d, *J* 3.6, OH), 3.37 (1 H, m, 6-H), 3.56 (2 H, m, 6-H, 5-H), 4.79 (0.5 H, t, *J* 7.0, 3-H) and 4.91 (0.5 H, t, *J* 8.0, 3-H); δ_C (75 MHz, $CDCl_3$) -5.5, -5.4, 9.4, 9.6, 13.6(2), 15.5, 18.2, 18.6, 22.2, 25.8, 27.3, 29.0, 29.1, 32.0, 32.1, 66.5, 66.7, 71.9, 72.1, 114.4, 114.8, 138.0 and 138.1; *m/z* (CI) 535 ($M^+ + 1$, 5 %), 477 ($M^+ - 57$, 5), 308 (100) and 245 (48).

(2*S*)-1-*tert*-Butyldimethylsilyloxy-5-methylhex-5-en-2-ol 21
Stannane **20** (300 mg, 0.562 mmol) was added to a slurry of silica (ca. 0.5 g of Merck silica gel 60 H (40-63 μ, 230-400 mesh) in DCM (3.0 mL) and the mixture stirred for 4 h at room temperature. After being filtered, the filtrate was concentrated under reduced pressure. Chromatography of the residue using light petroleum-ethyl acetate (25:1) with 1% TEA gave the *title compound* **21** (136 mg, 100%) as a colourless oil; $[\alpha]_D^{18}$ –18.4 (*c* 1.8, EtOH); (Found: $M^+ + H$, 245.1939. $C_{13}H_{29}O_2Si$ requires *M*, 245.1937); υ_{max}/cm^{-1} 3332, 1465, 1255, 1120, 1083, 838 and 777; δ_H (300 MHz, $CDCl_3$) 0.08 [6 H, s, $Si(CH_3)_2$], 0.90 [9 H, s, $SiC(CH_3)_3$], 1.56 (2 H, m, 3-H_2), 1.73 (3 H, s, 5-CH_3), 2.13 (2 H, m, 4-H_2), 2.44 (1 H, br. d, *J* 3.0, OH), 3.42 (1 H, dd, *J* 10.5, 8.0, 1-H), 3.63 (2 H, m, 1-H, 2-H) and 4.71 and 4.72 (each 1 H, br. s, 6-H); δ_C (75 MHz, $CDCl_3$) –5.5, -5.4, 18.2, 22.4, 25.8, 30.7, 33.6, 67.1, 71.4, 109.9 and 145.5; *m/z* (CI) 262 ($M^+ + 18$, 37 %), 245 ($M^+ + 1$, 100) and 132 (39).

(1*S*)-1-*tert*-Butyldimethylsilyloxymethyl-5-methylhex-5-en-2-yl (*R*)-3,3,3-trifluoro-2-methoxy-2-phenylpropanoate 22
The alcohol **21** (37 mg, 0.152 mmol) was added to (*S*)-2-methoxy-2-phenyl-3,3,3-trifluoropropanoyl chloride (37 μL, 0.198 mmol) and pyridine (0.5 mL) in carbon tetrachloride (0.5 mL) and the solution stirred for 16 h at room temperature. 3-(Dimethylamino)propylamine (0.4 mL) was added and the mixture stirred for a further 5 min then diluted with ether and washed with aqueous hydrogen chloride (1 M), saturated aqueous sodium carbonate and brine, then dried ($MgSO_4$). Concentration under reduced pressure gave the *title compound* **22** (58 mg, 83 %) as a colourless oil (Found: $M^+ + H$, 461.2332. $C_{23}H_{36}F_3O_4Si$ requires *M*, 461.2335); $[\alpha]_D^{20}$ +14.2 (*c* 3.6, EtOH); υ_{max}/cm^{-1} 1748, 1650, 1451, 1257, 1170, 1124, 1019, 838 and 778; δ_F (300 MHz, $CDCl_3$) -245.16 (97 %) and -244.98 (3 %); δ_H (300 MHz, $CDCl_3$) 0.00 [6 H, s, $Si(CH_3)_2$], 0.86 [9 H, s, $SiC(CH_3)_3$], 1.72 (3 H, s, 5-CH_3), 1.85 (2 H, m, 3-H_2), 2.06 (2 H, t, *J* 8.0, 4-H_2), 3.54 (3 H, s, OCH_3), 3.68 (2 H, m, 1-H_2), 4.68 and 4.74 (each 1 H, s, 6-H), 5.11 (1 H, m, 2-H), 7.40 (3 H, m, ArH) and 7.59 (2 H, m, ArH); δ_C (75 MHz, $CDCl_3$) –5.8, -5.7, 18.1, 22.2, 25.7, 28.3, 33.1, 55.2, 63.4, 110.6, 121.3, 125.2, 127.5, 128.3, 129.4, 132.1, 144.1 and 166.1; *m/z* (CI) 478 ($M^+ + 18$, 20 %), 461 ($M^+ + 1$, 100) and 132 (35).

(1*S*)-1-*tert*-Butyldimethylsilyloxymethyl-5-methylhex-5-en-2-yl (*S*)-3,3,3-trifluoro-2-methoxy-2-phenylpropanoate 23
Following the procedure used to prepare ester **22**, (*R*)-2-methoxy-2-phenyl-3,3,3-trifluoropropanoyl chloride gave the *title compound* **23** (55 mg, 79 %) as a colourless oil (Found: $M^+ + H$, 461.2342. $C_{23}H_{36}F_3O_4Si$ requires *M*, 461.2335); $[\alpha]_D^{20}$ -32 (*c* 4.4, EtOH); υ_{max}/cm^{-1} 1748, 1651, 1451, 1257, 1170, 1124, 1019, 838 and 778; δ_F (300 MHz, $CDCl_3$) -245.16 (5 %) and -244.98 (95 %); δ_H (300 MHz, $CDCl_3$) 0.00 [6 H, s, $Si(CH_3)_2$], 0.82 [9 H, s, $SiC(CH_3)_3$], 1.60 (3 H, s, 5-CH_3), 1.67 (2 H, m, 3-H_2), 1.85 (2 H, t, *J* 8.0, 4-H_2), 3.55 (3 H, s, OCH_3), 3.79 (2 H, m, 1-H_2), 4.54 and 4.64 (each 1 H, s, 6-H), 5.08 (1 H, m, 2-H), 7.34 (3 H, m, ArH) and 7.55 (2 H, m, ArH); δ_C (75 MHz, $CDCl_3$) –5.6, -5.6, 18.1, 22.2, 25.7, 28.2, 32.8, 55.4, 63.8, 110.4, 121.1, 125.0, 127.3, 128.2, 129.4, 132.5, 144.4 and 166.1; *m/z* (CI) 478 ($M^+ + 18$, 23 %), 461 ($M^+ + 1$, 100) and 132 (32).

(1*R*,6*S*,3*Z*)-7-*tert*-Butyldimethylsilyloxy-3-methyl-1-phenylhept-3-ene-1,6-diol 24
Tin(IV) bromide (4.49 mL, 1 M in DCM, 4.49 mmol) was added to the stannane **20** (2.0 g, 3.75 mmol) in DCM (20 mL) at -78 °C. After 5 min, benzaldehyde (0.82 mL, 7.49 mmol) was added and the solution was stirred at -78 °C for a further 40 min. Saturated methanolic ammonium chloride was added and the mixture was allowed to warm to room temperature. Ethyl acetate and water were added and the aqueous layer was washed with ethyl acetate. The organic extracts were washed with brine, dried ($MgSO_4$) concentrated under reduced pressure. Chromatography of the residue, using light petroleum-ethyl acetate-TEA (87:12:1) as eluent, gave the diol **24** (0.968 g, 74 %), containing ca. 20% of its C(2)-epimer (HPLC), as a white crystalline solid. Repeated chromatography, eluting with light petroleum-ethyl acetate-TEA (80:20:1) gave a sample of the *title compound* **24** (Found: $M^+ + NH_4$, 368.2611. $C_{20}H_{38}NO_3Si$ requires *M*, 368.2621); υ_{max}/cm^{-1} 3323, 1453, 1254, 1119, 1054, 838, 777 and 699; δ_H (300 MHz, $CDCl_3$) major diastereoisomer 0.00 [6 H, s, $Si(CH_3)_2$], 0.80 [9 H, s, $SiC(CH_3)_3$], 1.78 (3 H, s, 3-CH_3), 1.95 (1 H, m, 5-H), 2.08 (1 H, dd, *J* 13.5, 3.5,

2-H), 2.20 (1 H, dt, *J* 14.0, 10.0, 5-H), 2.66 (1 H, dd, *J* 13.5, 10.0, 2-H), 2.95 (1 H, br. s, OH), 3.38 (1 H, dd, *J* 10.0, 8.0, 7-H), 3.52 (1 H, dd, *J* 10.0, 4.0, 7-H), 3.58 (1 H, m, 6-H), 4.75 (1 H, dd, *J* 10.0, 3.5, 1-H), 5.35 (1 H, m, 4-H) and 7.14-7.34 (5 H, m, ArH); minor diastereoisomer 1.68 (3 H, s, 3-CH_3) and 2.59 (1 H, dd, *J* 13.5, 9.0, 2-H); δ_C (75 MHz, $CDCl_3$) -5.4, 23.5, 25.8, 29.7, 31.5, 42.4, 67.1, 71.4, 71.7, 124.6, 125.5, 127.1, 128.2, 134.5 and 145.2; *m/z* (CI) 368 (M^+ + 18, 5 %), 350 (M^+, 44), 333 (35) and 229 (100)..

(2*SR*,7*SR*,4*Z*)-1-*tert*-Butyldimethylsilyloxy-5-methyldec-4-ene-2,7-diol 25

Following the procedure outlined for the synthesis of diol **24**, tin(IV) bromide (0.52 mL, 1 M in DCM, 0.52 mmol), the racemic stannane **20** (230 mg, 0.431 mmol) in DCM (2.5 mL) and butanal (0.127 μL, 0.862 mL), after chromatography using light petroleum-ethyl acetate-TEA (87:12:1) as eluant gave the *title compound* **25** (110 mg, 81 %) as an (80:20) mixture of diastereoisomers (^{1}H NMR) (Found: M^+ + H, 317.2514. $C_{17}H_{37}O_3Si$ requires *M*, 317.2512); υ_{max}/cm^{-1} 3368, 1463, 1255, 1091, 838 and 777; δ_H (300 MHz, $CDCl_3$) 0.05 [6 H, s, $Si(CH_3)_2$], 0.83 [9 H, s, $SiC(CH_3)_3$], 0.87 (3 H, t, *J* 7.0, 10-H_3], 1.28-1.50 (4 H, m, 9-H_2, 8-H_2), 1.73 (0.6 H, s, 5-CH_3), 1.77 (2.4 H, s, 5-CH_3), 1.93 (1 H, dd, *J* 13.5, 2.5, 6-H), 2.07 (1 H, m, 3-H), 2.27 (1 H, dt, *J* 14.0, 9.5, 3-H), 2.43 (1 H, dd, *J* 13.5, 10.0, 6-H), 2.92 (2 H, br. s, 2 x OH), 3.46 (1 H, dd, *J* 10.0, 7.5, 1-H), 3.55 (1 H, dd, *J* 10.0, 4.0, 1-H), 3.67 (2 H, m, 2-H, 7-H) and 5.37 (1 H, m, 4-H); δ_C (75 MHz, $CDCl_3$) major diastereoisomer -5.5, 14.0, 18.1, 18.9, 23.7, 25.8, 31.5, 39.8, 40.1, 67.0, 68.8, 71.7, 123.9 and 134.9; *m/z* (CI) 334 (M^+ + 18, 21 %) and 317 (M^+ + 1, 100).

(1*R*,6*S*,3*Z*)-6,7-(Dimethylmethylene)dioxy-3-methyl-1-phenylhept-3-en-1-ol 27

Tetra-*n*-butylammonium fluoride (1.0 M in THF, 4.56 mL, 4.56 mmol) was added to the diol **24** (800 mg, 2.28 mmol) in THF (4 mL) at 0 °C. The mixture was allowed to warm to room temperature and stirred for 16 h. After concentration under reduced pressure, chromatography of the residue using 1% methanol in DCM as the eluant, gave (2*S,*7*R,*4*Z*)-5-methyl-7-phenylhept-4-ene-1,2,7-triol (530 mg, 98 %) containing ca. 20% of its C(7)-epimer (^{1}H NMR) as a colourless oil (Found: M^+ + NH_4, 254.1759. $C_{14}H_{24}NO_3$ requires *M*, 254.1756); υ_{max}/cm^{-1} 3367, 1451, 1074, 1029, 754 and 700; δ_H (300 MHz, $CDCl_3$) major diastereoisomer 1.82 (3 H, s, 5-CH_3), 2.00 (1 H, m, 3-H), 2.07 (1 H, dd, *J* 13.5, 3.0, 6-H), 2.35 (1 H, dt, *J* 14.1, 10.0, 3-H), 2.75 (1 H, dd, *J* 13.5, 10.5, 6-H), 3.20 (1 H, br. m, OH), 3.42 (1 H, dd, *J* 11.0, 7.0, 1-H), 3.55 (1 H, dd, *J* 11.0, 3.0, 1-H), 3.66 (1 H, m, 2-H), 4.10 (2 H, br. s, 2 x OH), 4.74 (1 H, dd, *J* 10.5, 3.0, 7-H), 5.40 (1 H, dd, *J* 10.0, 5.5, 4-H) and 7.27-7.37 (5 H, m, ArH); minor diastereoisomer 1.72 (3 H, s, 5-CH_3), 2.18 (1 H, dd, *J* 14.0, 3.5, 6-H) and 5.28 (1 H, m, 4-H); δ_C (75 MHz, $CDCl_3$) major diastereoisomer 23.5, 31.6, 41.9, 66.7, 71.4, 71.7, 124.5, 125.6, 127.3, 128.3, 134.5 and 144.9; *m/z* (CI) 254 (M^+ + 1, 43 %), 236 (M^+, 100), 219 (56) and 115 (30).

Toluene *p*-sulphonic acid (35 mg, 0.185 mmol) was added to the heptenyltriol (236 mg, 1.850 mmol) in 2,2-dimethoxypropane (1.5 mL) and the solution stirred at room temperature for 1 h. Triethylamine (5 drops), water and ether were added and the organic layer washed with brine and dried ($MgSO_4$). After concentration under reduced pressure chromatography of the residue, eluting with light petroleum-ethyl acetate (20:1), gave the *title compound* **27** (352 mg, 69 %) containing ca. 20% of its C(1)-epimer (^{1}H NMNR), as a colourless oil (Found: M^+ + H, 277.1806. $C_{17}H_{25}O_3$ requires *M*, 277.1803); υ_{max}/cm^{-1} 3453, 1451, 1374,1248, 1216, 1155, 1062, 843 and 701; δ_H (300 MHz, $CDCl_3$) major diastereoisomer 1.42 and 1.52 (each 3 H, s, CH_3), 1.90 (3 H, s, 3-CH_3), 2.18 (1 H, m, 5-H), 2.28 (1 H, dd, *J* 13.5, 4.0, 2-H), 2.40 (1 H, m, 5-H), 2.74 (1 H, dd, *J* 13.5, 10.0, 2-H), 3.10 (1 H, d, *J* 3.5, OH), 3.54 (1 H, m, 7-H), 4.08 (2 H, m, 6-H, 7-H), 4.88 (1 H, dt, *J* 10.0, 4.0, 1-H), 5.44 (1 H, t, *J* 8.5, 4-H) and 7.25-7.45 (5 H, m, ArH); minor diastereoisomer 1.38 and 1.44 (each 3 H, s, CH_3) and 1.82 (3 H, s, 3-CH_3); δ_C (75 MHz, $CDCl_3$) 23.5, 25.6, 26.7, 32.1, 42.6, 69.1, 71.4, 75.7, 109.1, 124.0, 125.5, 127.1, 128.2, 134.4 and 145.0; *m/z* (CI) 294 (M^+ + 18, 7 %), 277 (M^+ + 1, 14), 259 (55) and 58 (100).

(1*S*,6*S*,3*Z*)-6,7-(Dimethylmethylene)dioxy-3-methyl-1-phenylhept-3-en-1-yl 4-nitrobenzoate 28

Triphenylphosphine (214 mg, 0.815 mmol), 4-nitrobenzoic acid (136 mg, 0.815 mmol) and DEAD (142 mg, 0.815 mmol) were added to the alcohol **27** (150 mg, 0.544 mmol) in benzene (1.5 mL) and the mixture stirred for 16 h. Water was added and the mixture extracted with ether. The organic extracts were washed with brine and dried ($MgSO_4$). After concentration under reduced pressure, chromatography of the residue, eluting with light petroleum-ethyl acetate (25:1), gave the *title compound* **28** (179 mg, 78 %) containing ca. 20% of its C(1)-epimer (^{1}H NMR) as a yellow oil (Found: M^+ + NH_4, 443.2173. $C_{24}H_{31}N_2O_6$ requires *M*, 443.2182); υ_{max}/cm^{-1} 1725, 1528, 1345, 1271, 1102 and 1064; δ_H (300 MHz, $CDCl_3$) 1.36 and 1.45 (each 3 H, s, CH_3), 1.83 (3 H, s, 3-CH_3), 2.17 and 2.35 (each 1 H, m, 5-H), 2.64 (1 H, dd, *J* 13.5, 6.5, 2-H), 2.96 (1 H, dd, *J* 13.5, 8.0, 2-H), 3.49 (1 H, m, 7-H), 3.88-4.02 (2 H, m, 6-H, 7-H), 5.28 (1 H, t, *J* 7.0, 4-H), 6.19 (1 H, dd, *J* 8.0, 6.5, 1-H), 7.28-7.50 (5 H, m, ArH) and 8.30 (4 H, m ArH); δ_C (75 MHz, $CDCl_3$) 24.0, 25.5, 26.8, 32.1, 39.3, 68.8, 75.3, 76.0, 108.8, 123.5, 126.3, 128.2, 128.3, 130.6, 132.9, 135.6, 139.7, 150.5 and 163.7; *m/z* (CI) 443 (M^+ + NH_4, 6 %), 259 (44), 201 (51) and 58 (100).

(1*S*,6*S*,3*Z*)-6,7-(Dimethylmethylene)dioxy-3-methyl-1-phenylhept-3-en-1-ol 29

Sodium hydroxide (75 mg, 1.89 mmol) was added to the nitrobenzoate **28** (160 mg, 0.377 mmol) in anhydrous methanol (1.5 mL) and the solution stirred for 2 h. Saturated aqueous ammonium chloride was added and the mixture extracted with ether. The organic extracts were washed with saturated aqueous sodium bicarbonate and brine, dried ($MgSO_4$) and concentrated under reduced pressure to give the *title compound* **29** (89 mg, 86 %) containing ca. 20% of its C(1)-epimer (^{1}H NMR) as a colourless oil (Found: M^+ + H, 277.1803. $C_{17}H_{25}O_3$ requires *M*, 277.1803); υ_{max}/cm^{-1} 3449, 1451, 1374, 1248, 1216, 1155, 1062, 845, 755 and 701; δ_H (300 MHz, $CDCl_3$) major diastereoisomer 1.38 and 1.44 (each 3 H, s, CH_3), 1.82 (3 H, s, 3-CH_3), 2.24-2.42 (3 H, m, 5-H_2, 2-H), 2.63-2.74 (2 H, m, 2-H, OH), 3.60 (1 H, dd, *J* 7.5, 7.0, 7-H), 3.99-4.13 (2 H, m, 6-H, 7-H), 4.86 (1 H, dd, *J* 6.5, 4.5, 1-H), 5.44 (1 H, t, *J* 7.0, 4-H) and 7.26-7.44 (5 H, m, ArH); minor diastereoisomer 1.42 and 1.52 (each 3 H, s, CH_3) and 1.90 (3 H, s, 3-CH_3); δ_C (75 MHz, $CDCl_3$) 24.0, 25.5, 26.6, 31.5, 42.4, 68.6, 72.0, 75.4, 108.9, 123.0, 125.6, 127.3, 128.2, 134.6 and 144.3; *m/z* (CI) 294 (M^+ + 18, 8 %), 277 (M^+ + 1, 12), 259 (47) and 58 (100).

(1*S*,6*S*,3*Z*)-6,7-(Dimethylmethylene)dioxy-3-methyl-1-phenylhept-3-en-1-yl (*R*)-2-acetoxy-2-phenylacetate 30

4-Dimethylaminopyridine (2 mg) was added to (*R*)-*O*-acetyl mandelic acid (70 mg, 0.362 mmol), DCC (74 mg, 0.362 mmol) and the alcohol **29** (50 mg, 0.181 mmol) in DCM (5 mL) and the solution stirred for 16 h. Saturated aqueous ammonium chloride was added

and the mixture extracted with ether. The organic extracts were washed with brine, dried ($MgSO_4$), and concentrated under reduced pressure. Chromatography of the residue, eluting with light petroleum-ethyl acetate (11:1) gave the *title compound* **30** (55 mg, 68%) containing ca. 20% of its C(1)-epimer as a colourless oil (Found: $M^+ + NH_4$, 470.2543. $C_{27}H_{36}NO_6$ requires *M*, 470.2542); υ_{max}/cm^{-1} 1748, 1372, 1230, 1176, 1058 and 699; δ_H (300 MHz, $CDCl_3$) 1.35 and 1.41 (each 3 H, s, CH_3), 1.55 (3 H, s, 3-CH_3), 1.80 and 2.06 (each 1 H, m, 5-H), 2.19 (3 H, s, $COCH_3$), 2.35 (1 H, dd, *J* 13.5, 6.5, 2-H), 2.64 (1 H, dd, *J* 13.5, 8.0, 2-H), 3.40 (1 H, t, *J* 7.5, 7-H), 3.80 (1 H, m, 6-H), 3.90 (1 H, dd, *J* 7.5, 6.0, 7-H), 5.04 (1 H, t, *J* 7.0, 4-H), 5.90 (1 H, m, 1-H), 5.98 (1 H, s, C*H*PhOAc) and 7.30-7.60 (10 H, m, ArH); δ_C (75 MHz, $CDCl_3$) 20.6, 23.5, 25.6, 26.8, 31.7, 38.8, 68.8, 74.5, 75.4, 75.7, 108.7, 123.3, 126.1, 127.8, 128.0, 128.4, 128.6, 129.2, 132.6, 133.8, 139.5, 168.0 and 170.0; *m/z* (CI) 470 ($M^+ + 18$, 100 %), 259 (46) and 201 (30).

(1*S*,6*S*,3*Z*)-6,7-(Dimethylmethylene)dioxy-3-methyl-1-phenylhept-3-en-1-yl (*S*)-2-acetoxy-2-phenylacetate 31
Following the procedure outlined for the synthesis of ester **30**, DMAP (2 mg), (*S*)-*O*-acetyl mandelic acid (54 mg, 0.282 mmol), DCC (58 mg, 0.282 mmol) and the alcohol **29** (39 mg, 0.141 mmol) in DCM (3.5 mL), after chromatography using light petroleum-ethyl acetate (11:1) as eluant, gave the *title compound* **31** (47 mg, 72%) containing ca. 20% of its C(1)-epimer (^{1}H NMR) as a colourless oil (Found: $M^+ + NH_4$, 470.2544. $C_{27}H_{36}NO_6$ requires *M*, 470.2542); υ_{max}/cm^{-1} 1747, 1372, 1231, 1176, 1058 and 698; δ_H (300 MHz, $CDCl_3$) 1.36 and 1.42 (each 3 H, s, CH_3), 1.76 (3 H, s, 3-CH_3), 2.14 (2 H, m, 5-H_2), 2.21 (3 H, s, $COCH_3$), 2.46 (1 H, dd, *J* 14.0, 6.5, 2-H), 2.74 (1 H, dd, *J* 14.0, 8.0, 2-H), 3.48 (1 H, dd, *J* 7.5, 7.0, 7-H), 3.85-4.00 (2 H, m, 6-H, 7-H), 5.25 (1 H, t, *J* 7.0, 4-H), 5.86 (1 H, m, 1-H), 6.05 (1 H, s, C*H*PhOAc), 6.98 (2 H, m, ArH), 7.20 (3 H, m, ArH) and 7.30-7.50 (5 H, m, ArH); δ_C (75 MHz, $CDCl_3$) 20.6, 23.8, 25.5, 26.8, 32.0, 39.1, 68.9, 74.4, 75.4, 75.9, 108.7, 132.4, 125.8, 127.7, 127.8, 128.1, 128.6, 129.1, 132.7, 133.5, 139.4, 167.7 and 170.1; *m/z* (CI) 470 ($M^+ + 18$, 100%), 259 (51) and 201 (30).

Methyl (2*R*,3*S*,10*S*,4*E*)-3,7-dimethyl-10,11-(dimethylmethylene)dioxy-7,8-epoxy-2-(4-methoxybenzyl)oxyundeca-4-enoate 36
m-Chloroperoxybenzoic acid (60 %) was added portionwise to the diene **35** (85 mg, 0.197 mmol) in DCM, until TLC indicated complete consumption of the diene. Saturated aqueous sodium thiosulfate, water and DCM were added and the organic layer was washed with brine, dried ($MgSO_4$) and concentrated under reduced pressure. Chromatography of the residue, eluting with light petroleum-ethyl acetate (6:1), gave the *title compound* **36** (79 mg, 88 %), a 60:40 mixture of α- and β-epoxides, a colourless oil (Found: $M^+ + NH_4$, 466.2808. $C_{25}H_{40}NO_7$ requires *M*, 466.2804); υ_{max}/cm^{-1} 1749, 1613, 1514, 1462, 1379, 1250, 1064 and 832; δ_H (300 MHz, $CDCl_3$) 0.98 (3 H, d, *J* 7.0, 3-CH_3), 1.16 and 1.28 (each 3 H, s, CH_3), 1.34 (1.8 H, s, 7-CH_3), 1.36 (1.2 H, s, 7-CH_3), 1.50 (0.6 H, ddd, *J* 14.0, 8.5, 5.5, 9-H), 1.77 (0.8 H, m, 2 x 9-H), 1.93 (0.6 H, ddd, *J* 14.0, 7.5, 3.5, 9-H), 2.05 and 2.19 (each 1 H, m, 6-H), 2.54 (1 H, m, 3-H), 2.76 (0.4 H, dd, *J* 7.0, 5.0, 8-H), 2.81 (0.6 H, dd, *J* 8.5, 3.5, 8-H), 3.47 (0.6 H, dd, *J* 8.0, 7.5, 11-H), 3.52-3.79 (7.4 H, m, 2-H, 11-H, CO_2CH_3, OCH_3), 3.98-4.08 (1 H, m, 11-H), 4.14-4.28 (2 H, m, 10-H, OHC*H*Ar), 4.54 (1 H, d, *J* 11.5, OHC*H*Ar), 5.30-5.46 (2 H, m, 4-H, 5-H), 6.79 (2 H, d, *J* 8.5, ArH) and 7.18 (2 H, d, *J* 8.5, ArH); δ_C (75 MHz, $CDCl_3$) 15.9, 16.0, 21.9, 25.5, 25.6, 26.7, 26.8, 32.1, 33.0, 36.5(2), 40.3, 51.5, 55.2, 59.7, 60.3, 60.4, 61.1, 68.6, 69.4, 72.1, 73.7, 73.9, 81.8, 81.9, 108.8, 108.9, 113.6, 125.7, 125.8, 129.4, 129.6, 134.3, 134.4, 159.3 and 172.3; *m/z* (CI) 466 ($M^+ + 18$, 14 %) and 168 (100).

Methyl (2*R*,3*S*,10*S*)-3,7-dimethyl-10,11-(dimethylmethylene)dioxy-7,8-epoxy-2-(4-methoxybenzyl)oxyundecanoate 37
Platinum(IV) oxide (Adams' catalyst) was added to the unsaturated ester **36** (72 mg, 0.160 mmol) in anhydrous ethanol (5 mL) and the suspension stirred under an atmosphere of hydrogen for 2 h. The mixture was filtered through celite, the celite being washed with ethanol, and the filtrate and washings were concentrated under reduced pressure to give the *title compound* **37** (70 mg, 98 %), a 60:40 mixture of α- and β-epoxides, a colourless oil (Found: $M^+ + NH_4$, 468.2952. $C_{25}H_{42}NO_7$ requires *M*, 468.2960); υ_{max}/cm^{-1} 1748, 1613, 1514, 1461, 1376, 1249, 1208, 1064 and 830; δ_H (300 MHz, $CDCl_3$) 0.85 (3 H, d, *J* 7.0, 3-CH_3), 1.03-1.58 (4 H, m), 1.17 and 1.29 (each 3 H, s, CH_3), 1.35 (1.8 H, s, 7-CH_3), 1.36 (1.2 H, s, 7-CH_3), 1.61-1.95 (5 H, m), 2.72 (0.4 H, dd, *J* 7.5, 4.5, 8-H), 2.77 (0.6 H, dd, *J* 8.5, 3.5, 8-H), 3.48 (0.6 H, dd, *J* 8.0, 7.5, 11-H), 3.62 (0.4 H, dd, *J* 8.0, 7.5, 11-H), 3.65-3.79 (7 H, m, 2-H, CO_2CH_3, OCH_3), 4.03 (1 H, m, 11-H), 4.13-4.25 (2 H, m, 10-H, OHC*H*Ar), 4.59 (1 H, d, *J* 11.5, OHC*H*Ar), 6.80 (2 H, d, *J* 8.5, ArH) and 7.18 (2 H, d, *J* 8.5, ArH); δ_C (75 MHz, $CDCl_3$) 14.7, 14.8, 21.9, 22.8, 22.9, 25.5, 25.6, 26.7, 26.8, 32.0, 32.8, 32.9(2), 33.0, 36.3, 51.6, 55.1, 60.1, 60.6(2), 61.4, 68.6, 69.4, 72.0, 73.7, 73.9, 80.4, 80.6, 108.8(2), 113.6, 129.6(2), 159.3 and 173.0; *m/z* (CI) 468 ($M^+ + 18$, 16 %), 154 (26) and 121 (100).

Methyl (2*R*,3*S*,10*S*,7*Z*)-3,7-dimethyl-10,11-(dimethylmethylene)dioxy-2-(4-methoxybenzyl)oxyundec-7-enoate 38
Potassium selenocyanate (2.80 g, 19.4 mmol) was added to a solution of the epoxide **37** (350 mg, 0.78 mmol) in anhydrous methanol (20 mL) and the solution heated at 65 °C for 14 h. After filtration with washing of the precipitate with methanol, the filtrate was diluted with water and ether. The organic layer was washed with brine, dried ($MgSO_4$) and concentrated under reduced pressure. Chromatography of the residue, eluting with light petroleum-ethyl acetate (9:1), gave the *title compound* **38** (267 mg, 79 %) as a colourless oil; $[\alpha]_D^{21}$ +21 (*c* 1.10 in DCM) (Found: $M^+ + NH_4$, 452.3020. $C_{25}H_{42}NO_6$ requires *M*, 452.3012); υ_{max}/cm^{-1} 1748, 1613, 1513, 1461, 1373, 1249, 1209, 1063 and 833; δ_H (300 MHz, $CDCl_3$) 0.93 (3 H, d, *J* 7.0, 3-CH_3), 1.17-1.38 (4 H, m, 4-H_2 5-H_2), 1.35 and 1.41 (each 3 H, s, CH_3), 1.61 (3 H, s, 7-CH_3), 1.93 (1 H, m, 3-H), 1.97 (2 H, m, 6-H_2), 2.19 and 2.35 (each 1 H, m, 9-H), 3.53 (1 H, t, 7.0, 11-H), 3.75 (3 H, s, OCH_3), 3.78-3.84 (4 H, m, 2-H, CO_2CH_3), 4.03 (2 H, m, 10-H, 11-H), 4.29 and 4.67 (each 1 H, d, *J* 11.5, OHC*H*Ar), 5.11 (1 H, t, *J* 7.0, 8-H), 6.86 (2 H, d, *J* 8.5, ArH) and 7.27 (2 H, d, *J* 8.5, ArH); δ_C (125 MHz, $CDCl_3$) 14.8, 23.4, 25.3, 25.6, 26.8, 31.8, 32.1, 32.8, 36.4, 51.6, 55.2, 69.1, 72.1, 75.9, 80.7, 108.7, 113.6, 119.4, 129.6(2), 138.2, 159.2 and 173.2; *m/z* (CI) 452 ($M^+ + 18$, 100 %), 359 (20) and 121 (55).

Methyl (2*R*,3*S*,10*S*,7*Z*)-3,7-dimethyl-10,11-(dimethylmethylene)dioxy-2-hydroxyundec-7-enoate 39
Dichlorodicyanoquinone (123 mg, 0.540 mmol) was added to the PMB-ether **38** (213 mg, 0.491 mmol) in DCM : water (18:1; 4.0 mL) and the mixture stirred for 2 h. Saturated aqueous sodium bicarbonate was added and the mixture diluted with DCM. The organic layer was washed five times with saturated aqueous sodium bicarbonate and brine then dried ($MgSO_4$). After concentration under reduced pressure, chromatography of the residue, eluting with light petroleum-ethyl acetate (9:1), gave the *title compound* **39**

(124 mg, 80 %) as a colourless oil; $[\alpha]_D^{21}$ –3.2 (*c* 4.47 in DCM) (Found: M^+, 314.2092. $C_{17}H_{30}O_5$ requires *M*, 314.2093); υ_{max}/cm^{-1} 3427, 1731, 1599, 1462, 1378, 1272, 1123 and 1069; δ_H (300 MHz, $CDCl_3$) 0.85 (3 H, d, *J* 7.0, 3-CH_3), 1.20-1.61 (4 H, m, 4-H_2 5-H_2), 1.40 and 1.44 (each 3 H, s, CH_3), 1.74 (3 H, s, 7-CH_3), 1.94 (1 H, m, 3-H), 2.04 (2 H, m, 6-H_2), 2.24 and 2.40 (each 1 H, m, 9-H), 2.73 (1 H, d, *J* 6.0, OH), 3.58 (1 H, t, 7.0, 11-H), 3.83 (3 H, s, CO_2CH_3), 3.99-4.17 (2 H, m, 10-H, 11-H), 4.20 (1 H, dd, *J* 6.0, 3.0, 2-H) and 5.11 (1 H, t, *J* 7.0, 8-H); δ_C (75 MHz, $CDCl_3$) 13.4, 23.4, 25.5, 25.6, 26.8, 31.9, 32.1, 32.8, 36.2, 52.4, 69.1, 73.2, 75.9, 108.7, 119.5, 138.2 and 175.6; *m/z* (CI) 332 (M^+ + 18, 50 %), 315 (M^+ + 1, 28), 274 (100) and 101 (70).

(2*R*,3*S*,10*S*,7*Z*)-3,7-Dimethyl-10,11-(dimethylmethylene)dioxyundec-7-ene-1,2-diol 40

Lithium aluminium hydride (1 M in ether, 331 µL, 0.31 mol) was added dropwise to the ester **39** (52 mg, 0.166 mol) in ether (1 mL) at 0 °C and the mixture stirred at 0 °C for 2 h. Saturated aqueous sodium sulfate was added carefully, and the mixture acidified with dilute hydrochlogen chloride and extracted with ether. The organic extracts were washed with brine, dried ($MgSO_4$) and concentrated under reduced pressure. Chromatography of the residue using light petroleum-ethyl acetate (1:1) as eluent gave the *title compound* **40** (37 mg, 78 %) as a colourless oil; $[\alpha]_D^{22}$ +2.3 (*c* 1.58 in DCM) (Found: M^+, 286.2145. $C_{16}H_{30}O_4$ requires *M*, 286.2142); υ_{max}/cm^{-1} 3408, 1455, 1374, 1249, 1217, 1155 and 1063; δ_H (300 MHz, $CDCl_3$) 0.84 (3 H, d, *J* 6.5, 3-CH_3), 1.16-1.41 (4 H, m, 4-H_2, 5-H_2), 1.38 and 1.44 (each 3 H, s, CH_3), 1.58 (1 H, m, 3-H), 1.72 (3 H, s, 7-CH_3), 2.04 (2 H, m, 6-H_2), 2.24 and 2.40 (each 1 H, m, 9-H), 2.50 (2 H, m, 2 x OH), 3.51-3.70 (4 H, m, 1-H_2, 2-H, 11-H), 4.00-4.17 (2 H, m, 10-H, 11-H) and 5.14 (1 H, t, *J* 7.0, 8-H); δ_C (75 MHz, $CDCl_3$) 14.5, 23.4, 25.3, 25.6, 26.8, 32.0, 32.1, 32.8, 35.6, 65.0, 69.0, 75.5, 75.9, 108.8, 119.4 and 138.2; *m/z* (CI) 304 (M^+ + 18, 90 %), 246 (100), 229 (50) and 211 (62).

(2*S*,9*S*,6*Z*)-2,6-Dimethyl-9,10-(dimethylmethylene)dioxydec-6-en-1-ol 41

Sodium periodate (28 mg, 0.135 mmol) was added to the diol **40** (35 mg, 0.122 mmol) in THF:water (3:1, 0.75 mL) and the solution stirred for 4 h. Water and ether were added and the aqueous phase was extracted with ether. The organic extracts were washed with brine and dried ($MgSO_4$). After concentration under reduced pressure, the residue was immediately taken up in methanol, and sodium borohydride was added. The suspension was stirred for 1 h, then water and ether were added. The aqueous phase was extracted with ether and the organic extracts were washed with brine, dried ($MgSO_4$) and concentrated under reduced pressure. Chromatography of the residue, eluting with light petroleum-ethyl acetate (15:1), gave the *title compound* **41** (23 mg, 74 %) as a colourless oil; $[\alpha]_D^{21}$ +6.0 (*c* 0.53 in DCM) (Found: $M^+ + NH_4^+$ 274.2375. $C_{15}H_{32}NO_3$ requires *M*, 274.2380); υ_{max}/cm^{-1} 3443, 1457, 1374, 1257, 1218, 1154, 1062, 849, 799 and 758; δ_H (300 MHz, $CDCl_3$) 0.86 (3 H, d, *J* 7.0, 2-CH_3), 1.14 (1 H, m, 3-H), 1.30-1.59 (3 H, m, 3-H, 4-H_2), 1.40 and 1.46 (each 3 H, s, CH_3), 1.66 (1 H, m, 2-H), 1.74 (3 H, s, 6-CH_3), 2.06 (2 H, m, 5-H_2), 2.26 and 2.40 (each 1 H, m, 8-H), 3.48 and 3.53 (each 1 H, m, 1-H), 3.60 (1 H, t, *J* 7.0, 10-H), 3.98-4.17 (2 H, m, 9-H, 10-H) and 5.16 (1 H, t, *J* 7.0, 7-H); δ_C (75 MHz, $CDCl_3$) 16.5, 23.4, 25.2, 25.6, 26.9, 32.1(2), 32.9, 35.6, 68.2, 69.0, 75.9, 108.7, 119.3 and 138.3; *m/z* (CI) 274 (M^+ + 18, 100 %), 256 (12) and 244 (5).

(3*S*)-4-(4-Methoxybenzyl)oxy-3-methylbutyronitrile 43

Toluene *p*-sulfonyl chloride (26.39 g, 0.138 mol) was added in several portions to the alcohol **42** (28.78 g, 13.73 mmol) and dry triethylamine (27.0 mL, 0.206 mol) in DCM at 0 °C and the solution stirred for 16 h at room temperature. Water was added and the organic phase was washed with water, saturated aqueous sodium carbonate and brine, then dried ($MgSO_4$) and concentrated under reduced pressure. Chromatography of the residue using light petroleum-ethyl acetate (30:1) as eluent gave the corresponding toluene *p*-sulfonate (41.89 g, 84 %) as a colourless oil (Found: $M^+ + NH_4$, 382.1686. $C_{19}H_{28}NO_5S$ requires *M*, 382.1688); $[\alpha]_D^{21}$ –18.4 (*c* 3.76 in DCM); υ_{max}/cm^{-1} 1612, 1513, 1359, 1248, 1177, 1097, 1035, 974 and 815; δ_H (300 MHz, $CDCl_3$) 0.94 (3 H, d, *J* 7.0, 2-CH_3), 2.14 (1 H, m, 2-H), 2.48 (3 H, s, ArCH_3), 3.32 (1 H, dd, *J* 9.5, 7.5, 3-H), 3.37 (1 H, dd, *J* 9.5, 5.5, 3-H), 3.86 (3 H, s, OCH_3), 4.01 (1 H, dd, *J* 9.5, 6.0, 1-H), 4.07 (1 H, dd, *J* 9.5, 5.5, 1-H), 4.38 (2 H, s, OCH_2Ar), 6.90 (2 H, d, *J* 8.5, ArH), 7.20 (2 H, d, *J* 8.5, ArH), 7.36 (2 H, d, *J* 8.0, ArH) and 7.83 (2 H, d, *J* 8.0, ArH); δ_C (75 MHz, $CDCl_3$) 13.6, 21.5, 33.6, 55.2, 70.8, 72.2, 72.7, 113.7, 127.8, 129.0, 129.7, 130.2, 133.0, 144.5 and 159.1; *m/z* (CI) 382 (M^+ + 18, 70 %) and 121 (100).

Potassium cyanide (11.31 g, 0.174 mol) was added to the toluene *p*-sulfonate (31.61 g, 0.087 mol)) in DMSO (125 mL) and the solution stirred for 20 h at room temperature. Water was added and the aqueous layer was extracted with pentane. The organic extract was washed with water and brine, dried ($MgSO_4$) and concentrated under reduced pressure. Chromatography of the residue, eluting with light petroleum-ethyl acetate (40:1), gave the *title compound* **43** (18.63 g, 98 %) as a colourless oil (Found: M^+, 219.1261. $C_{13}H_{17}NO_2$ requires *M*, 219.1261); $[\alpha]_D^{20}$-22.3 (*c* 1.3, DCM); υ_{max}/cm^{-1} 1611, 1513, 1461, 1301, 1247, 1175, 1095 and 1033; δ_H (300 MHz, $CDCl_3$) 1.11 (3 H, d, *J* 7.0, 3-CH_3), 2.18 (1 H, m, 3-H), 2.40 (1 H, dd, *J* 16.5, 7.0, 2-H), 2.53 (1 H, dd, *J* 16.5, 5.5, 2-H) 3.31 (1 H, dd, *J* 9.5, 8.0, 4-H), 3.47 (1 H, dd, *J* 9.5, 5.0, 4-H), 3.85 (3 H, s, OCH_3), 4.49 (2 H, s, OCH_2Ar), 6.93 (2 H, d, *J* 8.5, ArH) and 7.29 (2 H, d, *J* 8.5, ArH); δ_C (75 MHz, $CDCl_3$) 16.2, 21.3, 31.0, 55.2, 72.8, 72.9, 113.8, 118.6, 129.2, 130.0 and 159.2; *m/z* (EI) 219 (M^+, 53 %), 137 (45) and 121 (100).

(3*S*)-4-(4-Methoxybenzyl)oxy-3-methylbutanal 44

Di-isobutylaluminium hydride (1 M in heptanes, 8.20 mL, 8.20 mmol) was added dropwise to the nitrile **43** (1.50 g, 6.85 mmol) in THF (12 mL) at 0 °C. The mixture was stirred at 0 °C for 15 min then allowed to warm to room temperature and stirred for a further 5 h. Methanol (4 mL), brine and aqueous hydrogen chloride (1 M) were added. The aqueous layer was washed with ether and the organic extracts were washed with water and brine, and dried ($MgSO_4$). After concentration under reduced pressure, chromatography of the residue using light petroleum-ethyl acetate (30:1) as the eluent, gave the *title compound* **44** (1.16 g, 76 %) as a colourless oil (Found: M^+, 222.1250. $C_{13}H_{18}O_3$ requires *M*, 222.1255); $[\alpha]_D^{20}$ -4.4 (*c* 0.63, DCM); υ_{max}/cm^{-1} 1723, 1612, 1513, 1462, 1301, 1248, 1175, 1092, 1034 and 820; δ_H (300 MHz, $CDCl_3$) 1.00 (3 H, d, *J* 6.5, 3-CH_3), 2.29 (1 H, ddd, *J* 15.5, 6.5, 2.0, 2-H), 2.44 (1 H, m, 3-H), 2.56 (1 H, ddd, *J* 15.5, 6.0, 2.5, 2-H), 3.24 (1 H, dd, *J* 9.0, 7.5, 4-H), 3.42 (1 H, dd, *J* 9.0, 5.0, 4-H), 3.83 (3 H, s, OCH_3), 4.44 (2 H, s, OCH_2Ar), 6.92 (2 H, d, *J* 8.5, ArH), 7.26 (2 H, d, *J* 8.5, ArH) and 9.77 (1 H, t, *J* 2.0, 1-H); δ_C (75 MHz, $CDCl_3$) 17.0, 29.0, 48.4, 55.2, 72.6, 74.5, 113.7, 129.1, 130.3, 159.1 and 202.3; *m/z* (EI) 222 (M^+, 47 %) and 121 (100).

(2*S*,7*S*,9*S*,4*Z*)-1-*tert*-Butyldimethylsilyloxy-10-(4-methoxybenzyl)oxy-5,9-dimethyldec-4-ene-2,7-diol 45

Tin(IV) bromide (1.55 mL, 1 M in DCM, 1.55 mol) was added to the stannane **20** (750 mg, 1.40 mmol) in DCM (10 mL) at -78 °C. After 5 min, the aldehyde **44** (468 mg, 2.11 mmol) was added and the solution stirred at -78 °C for a further 30 min. Saturated methanolic ammonium chloride was added and the mixture allowed to warm to room temperature. Ethyl acetate and water were added and the aqueous layer was washed with ethyl acetate. The organic extracts were washed with brine, dried ($MgSO_4$) and concentrated under reduced pressure. Chromatography of the residue using light petroleum-ethyl acetate-TEA (85:15:1) as eluent gave the *title compound* **45** (471 mg, 72 %) assumed to contain ca. 20% of its C(7)-epimer, as a colourless oil (Found: $M^+ + H$, 467.3193. $C_{26}H_{47}O_5Si$ requires *M*, 467.3192); υ_{max}/cm^{-1} 3412, 1612, 1513, 1464, 1249, 1088, 838 and 778; δ_H (300 MHz, $CDCl_3$) major diastereoisomer 0.07 [6 H, s, $Si(CH_3)_2$], 0.88 [9 H, m, $SiC(CH_3)_3$], 0.93 (3 H, d, *J* 6.5, 9-CH_3), 1.34 (1 H, ddd, *J* 14.0, 7.0, 2.5, 8-H), 1.52 (1 H, m, 8-H), 1.76 (3 H, s, 5-CH_3), 1.91 (1 H, dd, *J* 13.5, 3.0, 6-H), 2.01 (1 H, m, 9-H), 2.12 and 2.22 (each 1 H, m, 3-H), 2.45 (1 H, dd, *J* 13.5, 9.5, 6-H), 3.18-3.29 (2 H, m, 10-H_2), 3.43-3.57 (2 H, m, 1-H_2), 3.62 (1 H, m, 2-H), 3.79 (3 H, s, OCH_3), 3.81 (1 H, m, 7-H), 4.45 (2 H, s, OCH_2Ar), 5.37 (1 H, t, *J* 7.0, 4-H), 6.87 (2 H, d, *J* 8.5, ArH) and 7.27 (2 H, d, *J* 8.5, ArH); δ_C (75 MHz, $CDCl_3$) major diastereoisomer –5.4, 17.7, 18.2, 23.8, 25.8, 31.4, 31.8, 40.4, 43.5, 55.2, 67.1, 67.5, 71.7, 72.6, 76.1, 113.7, 123.8, 129.3, 130.1, 135.0 and 159.1; *m/z* (CI) 467 ($M^+ + 1$, 5 %), 245 (4) and 121 (100).

(2*S*,4*S*,9*S*,6*Z*)-2,6-Dimethyl-9,10-(dimethylmethylene)dioxy-1-(4-methoxybenzyl)oxydec-6-en-4-ol 46

Tetra-*n*-butylammonium fluoride (1.0 M in THF, 1.54 mL, 1.54 mmol) was added to the diol **45** (471 mg, 1.02 mmol) in THF (5 mL) at 0 °C and the mixture allowed to warm to room temperature then stirred for 4 h. After concentration under reduced pressure, chromatography of the residue using 1% methanol in ethyl acetate as the eluent gave (*2S,7S,9S,4Z*)-10-(4-methoxybenzyloxy)-5,9-dimethyldec-4-ene-1,2,7-triol (343 mg, 95 %) containing ca. 20% of its C(7)-epimer, as a colourless oil (Found: $M^+ + H$, 353.2325. $C_{20}H_{33}O_5$ requires *M*, 353.2328); υ_{max}/cm^{-1} 3383, 1613, 1513, 1455, 1302, 1248, 1174, 1085, 1036, 910 and 734; δ_H (300 MHz, $CDCl_3$) 0.93 (3 H, d, *J* 6.5, 9-CH_3), 1.36 (1 H, ddd, *J* 14.0, 6.5, 2.5, 8-H), 1.51 (1 H, m, 8-H), 1.75 (3 H, s, 5-CH_3), 1.85 (1 H, dd, *J* 13.5, 2.0, 6-H), 1.93-2.07 (2 H, m, 9-H, 3-H), 2.35 (1 H, m, 3-H), 2.48 (1 H, dd, *J* 13.5, 10.0, 6-H), 3.18-3.29 (2 H, m, 10-H_2), 3.42 (1 H, dd, *J* 11.0, 6.5, 1-H), 3.50-3.69 (3 H, m, 1-H, 2-H, OH), 3.79 (3 H, s, OCH_3), 3.80 (1 H, m, 7-H), 4.21 (2 H, br. s, 2 x OH), 4.45 (2 H, s, OCH_2Ar), 5.34 (1 H, dd, *J* 10.0, 5.5, 4-H), 6.88 (2 H, d, *J* 8.5, ArH) and 7.26 (2 H, d, *J* 8.5, ArH); δ_C (75 MHz, $CDCl_3$) 17.8, 23.7, 31.5, 31.9, 40.1, 43.8, 55.2, 66.7, 67.6, 71.6, 72.7, 76.1, 113.7, 123.7, 129.3, 129.9, 135.0 and 159.2; *m/z* (CI) 353 ($M^+ + 1$, 9 %) and 121 (100).

Toluene *p*-sulfonic acid (7 mg, 0.04 mmol) was added to the triol (128 mg, 0.36 mmol) in 2,2-dimethoxypropane (2 mL) and the solution stirred at room temperature for 1 h. Triethylamine (5 drops), water and ether were added and the organic layer was washed with brine and dried ($MgSO_4$). After concentration under reduced pressure, chromatography of the residue eluting with light petroleum-ethyl acetate (20:1), gave the *title compound* **46** (117 mg, 83 %) as a colourless oil (Found: $M^+ + H$, 393.2641. $C_{23}H_{37}O_5$ requires *M*, 393.2641); υ_{max}/cm^{-1} 3480, 1612, 1513, 1455, 1373, 1247, 1154, 1065 and 843; δ_H (300 MHz, $CDCl_3$) 0.95 (3 H, d, *J* 7.0, 2-CH_3), 1.28 (1 H, m, 3-H), 1.35 and 1.42 (each 3 H, s, CH_3), 1.48 (1 H, m, 3-H), 1.75 (3 H, s, 6-CH_3), 1.93-2.10 (2 H, m, 2-H, 5-H), 2.23 (1 H, m, 8-H), 2.30-2.45 (2 H, m, 5-H, 8-H), 3.12 (1 H, d, *J* 3.5, OH), 3.24-3.38 (2 H, m, 1-H_2), 3.53 (1 H, t, *J* 7.5, 10-H), 3.80 (3 H, s, OCH_3), 3.83 (1 H, m, 4-H), 3.92 (1 H, dd, *J* 7.5, 6.0, 10-H), 4.11 (1 H, m, 9-H), 4.47 (2 H, s, OCH_2Ar), 5.36 (1 H, t, *J* 7.5, 7-H), 6.88 (2 H, d, *J* 9.0, ArH) and 7.26 (2 H, d, *J* 9.0, ArH); δ_C (75 MHz, $CDCl_3$) 17.6. 23.8. 25.6. 26.7. 31.1. 32.2. 40.5. 42.9. 55.2. 67.6. 69.1. 72.6. 75.8. 76.1. 108.9. 113.7. 122.6. 129.2. 130.3. 135.4 and 159.1; *m/z* (CI) 393 ($M^+ + 1$, 6 %), 335 (9) and 121 (100).

***O*-(2*S*,4*S*,9*S*,6*Z*)-2,6-Dimethyl-9,10-(dimethylmethylene)dioxy-1-(4-methoxybenzyl)oxydec-6-en-4-yl *O*-phenyl thiocarbonate 47**

O-Phenyl thiochloroformate (128 μL, 0.849 mmol) was added dropwise to the alcohol **46** (333 mg, 0.934 mmol) and pyridine (254 μL, 3.14 mmol) in DCM (1.0 mL) and the solution stirred for 16 h. Water and ether were added and the organic phase was washed with cold aqueous hydrogen chloride (1 M), saturated aqueous sodium bicarbonate and brine, then dried ($MgSO_4$) and concentrated under reduced pressure. Chromatography of the residue, eluting with light petroleum-ethyl acetate (50:1), gave the *title compound* **47** (406 mg, 91 %) containing ca. 20% of its C(4)-epimer as a light yellow oil (Found: $M^+ + NH_4$, 546.2877. $C_{30}H_{44}NO_6S$ requires *M*, 546.2889); δ_H (300 MHz, $CDCl_3$), major diastereoisomer 1.05 (3 H, d, *J* 6.5, 2-CH_3), 1.39 and 1.46 (each 3 H, s, CH_3), 1.49 (1 H, m, 3-H), 1.82 (3 H, s, 6-CH_3), 1.92-2.06 (2 H, m, 2-H, 3-H), 2.30-2.50 (3 H, m, 8-H_2, 5-H), 2.70 (1 H, dd, *J* 13.5, 7.5, 5-H), 3.30-3.50 (2 H, m, 1-H_2) 3.60 (1 H, t, *J* 7.5, 10-H), 3.84 (3 H, s, OCH_3), 4.07 (1 H, dd, *J* 8.0, 6.0, 10-H), 4.16 (1 H, m, 9-H), 4.48 (2 H, s, OCH_2Ar), 5.36 (1 H, t, *J* 7.0, 7-H), 5.73 (1 H, m, 4-H), 6.92 (2 H, d, *J* 9.0, ArH), 7.11 (2 H, m, ArH), 7.23-7.35 (3 H, m, ArH, ArH) and 7.44 (2 H, m, ArH); δ_C (75 MHz, $CDCl_3$) major diastereoisomer 17.1, 24.2, 25.6, 26.8, 30.0, 32.3, 36.8, 38.1, 55.2, 69.0, 72.6, 75.4, 75.7, 81.9, 108.8, 113.7, 121.9, 123.4, 126.4, 129.2, 129.4, 130.5, 133.2, 153.3, 159.0 and 194.7; *m/z* (CI) 546 ($M^+ + 18$, 2 %), 392 (4), 317 (6), 197 (10) and 121 (100).

(2*S*,9*S*,6*Z*)-2,6-Dimethyl-9,10-(dimethylmethylene)dioxy-1-(4-methoxybenzyl)oxydec-6-ene 48

Tributyltin hydride (336 mg, 1.15 mmol) and AIBN (16 mg, 0.104 mmol) were added to the thiocarbonate **47** (406 mg, 0.769 mmol) in benzene (10 mL). The solution was degassed then heated under reflux for 1.5 h. After concentration under reduced pressure, chromatography of the residue, eluting with petrol and 1 % TEA, gave the *title compound* **48** (208 mg, 72 %) as a clear, colourless oil; $[\alpha]_D^{20}$ +16 (*c* 1.20 in DCM) (Found: M^+, 376.2620. $C_{23}H_{36}O_4$ requires *M*, 376.2612); υ_{max}/cm^{-1} 1613, 1513, 1456, 1372, 1302, 1247, 1152, 1090, 1065 and 845; δ_H (300 MHz, $CDCl_3$) 0.95 (3 H, d, *J* 6.5, 2-CH_3), 1.14 (1 H, m, 4-H), 1.30-1.50 (2 H, m, 4-H, 3-H_2), 1.40 and 1.46 (each 3 H, s, CH_3), 1.72 (3 H, s, 6-CH_3), 1.80 (1 H, m, 2-H), 2.04 (2 H, m, 5-H_2), 2.25 and 2.42 (each 1 H, m, 8-H), 3.25 (1 H, dd, *J* 9.0, 6.5, 1-H), 3.32 (1 H, dd, *J* 9.0, 6.0, 1-H), 3.58 (1 H, t, *J* 7.0, 10-H), 3.84 (3 H, s, OCH_3), 4.03-4.27 (2 H, m, 9-H, 10-H), 4.48 (2 H, s, OCH_2Ar), 5.14 (1 H, t, *J* 7.0, 7-H), 6.92 (2 H, d, *J* 9.0, ArH) and 7.28 (2 H, m, ArH); δ_C (75 MHz, $CDCl_3$) 17.1, 23.4, 25.2, 25.6, 26.8, 32.1(2), 33.3, 33.5, 55.2, 69.1, 72.6, 75.6, 75.9, 108.7, 113.6, 119.2, 129.0, 130.8, 138.5 and 159.0; *m/z* (CI) 394 ($M^+ + 18$, 10 %), 319 (13) and 121 (100).

DDQ (155 mg, 0.682 mmol) was added to the PMB-ether **48** (233 mg, 0.620 mmol) in DCM:water (18:1; 4.0 mL) and the solution stirred for 2 h. Saturated aqueous sodium bicarbonate and DCM were added and the organic layer was washed five times with

saturated aqueous sodium bicarbonate and brine, then dried ($MgSO_4$). After concentration under reduced pressure, chromatography of the residue, eluting with light petroleum-ethyl acetate (9:1) gave the alcohol **41** (125 mg, 79 %) as a colourless oil; $[\alpha]_D^{22}$ +6.0 (*c* 0.96 in DCM) (Found: $M^+ + NH_4$, 274.2375. $C_{15}H_{32}NO_3$ requires *M*, 274.2380), with spectroscopic data identical with those of the sample prepared earlier.

(3*S*)-3-*tert*-Butyldimethylsilyloxy-2,2-dimethylpent-4-en-1-ol 62

Tebbe reagent (2.0 mL, 0.5 M in toluene, 1.00 mmol) was added dropwise to the lactol **61** (246 mg, 1.00 mmol) at 0 °C. The mixture was allowed to warm to room temperature and was stirred for a further 0.5 h. Sodium hydroxide was carefully added (0.1 M) until no further gas evolved and the reaction mixture was dried ($NaSO_4$) and filtered through Celite. After concentration under reduced pressure, chromatography of the residue using light petroleum-ethyl acetate (25:1) gave the *title compound* **62** (193 mg, 79 %) as a light orange oil, b.p. 180 °C/20-25 mmHg, (Found: $M^+ + H$, 245.1932. $C_{13}H_{29}O_2Si$ requires *M*, 245.1937) $[\alpha]_D^{21}$ -6.2 (*c* 5.5 in DCM); υ_{max}/cm^{-1} 3451, 1642, 1472, 1254, 1075, 1047, 837 and 776; δ_H (300 MHz, $CDCl_3$) 0.03 and 0.09 (each 3 H, s, $SiCH_3$), 0.78 (3 H, s, 2-CH_3), 0.90 [9 H, s, $SiC(CH_3)_3$], 1.00 (3 H, s, 2-CH), 2.90 (1 H, dd, *J* 7.5, 4.0, OH), 3.28 (1 H, dd, *J* 11.0, 7.5, 1-H), 3.62 (1 H, dd, *J* 11.0, 4.0, 1-H), 3.92 (1 H, d, *J* 7.5 3-H), 5.16 and 5.20 (each 1 H, m, 5-H) and 5.88 (1 H, ddd, *J* 17.0, 11.0, 7.5, 4-H); δ_C (75 MHz, $CDCl_3$) –5.2, -4.1, 18.0, 20.9, 22.6, 25.8, 38.9, 70.3, 82.4, 116.8 and 137.9; *m/z* (CI) 245 ($M^+ + 1$, 100 %) and 83 (90).

(3*R*,5*S*)- and (3*S*,5*S*)-5-*tert*-Butyldimethylsilyloxy-4,4-dimethylhept-6-en-3-ol 63

Dess-Martin periodinane (2.60 g, 6.15 mmol) was added to the alcohol **62** (1.00 g, 4.09 mmol) in DCM (10 mL) and the suspension stirred for 0.5 h then diluted with ether (100 mL) and poured into a vigorously stirred solution of sodium thiosulphate (15 g) in saturated aqueous sodium bicarbonate (100 mL). After 5 min, the organic layer was washed with saturated aqueous sodium bicarbonate and water then dried ($MgSO_4$). Concentration under reduced pressure gave (3*S*)-*tert*-butyldimethylsilyloxy-2,2-dimethylpent-4-enal (997 mg, 100%) as a colourless oil used immediately (Found: $M^+ + H$, 243.1782. $C_{13}H_{27}O_2Si$ requires *M*, 243.1780); $[\alpha]_D^{21}$ –12.1 (*c* 1.75 in DCM); υ_{max}/cm^{-1} 1730, 1471, 1255, 1083 and 837; δ_H (300 MHz, $CDCl_3$) -0.03 and 0.01 (each 3 H, s, $SiCH_3$), 0.83 [9 H, m, $SiC(CH_3)_3$], 0.94 and 1.00 (each 3 H, s, 2-CH_3), 4.14 (1 H, d, *J* 7.5, 3-H), 5.20 (2 H, m, 5-H_2), 5.78 (1 H, m, 4-H) and 9.56 (1 H, s, 1 H); δ_C (75 MHz, $CDCl_3$) -5.2, -4.0, 16.6, 18.0, 19.0, 25.6, 50.6, 78.4, 117.4, 136.7 and 206.2; *m/z* (CI) 260 ($M^+ + 18$, 3 %), 243 ($M^+ + 1$, 38), 171 (85) and 132 (100).

Anhydrous cerium(III) chloride (2.82 g, 11.45 mmol) was added to the pentenal (997 mg, 4.09 mmol) in THF (100 mL) and the suspension cooled to 0 °C and stirred for 0.5 h before ethyl magnesium bromide (5.73 mL, 1 M in ether, 5.73 mmol) was added dropwise. The mixture was stirred at 0 °C for 1 h and saturated aqueous ammonium chloride was added. The mixture was allowed to warm to room temperature and diluted with ether. The mixture was filtered through celite and the aqueous layer extracted twice with ether. The organic extracts were washed with brine, dried ($MgSO_4$) and concentrated under reduced pressure. Chromatography of the residue, eluting with light petroleum-ethyl acetate (15:1), gave the alcohol **62** (80 mg, 8 %) as a colourless oil and the C(3)-epimers of the *title compound* **63** (845 mg, 76 %), ratio ca. 50:50; less polar epimer (Found: $M^+ + H$, 273.2256. $C_{15}H_{33}O_2Si$ requires *M*, 273.2250); $[\alpha]_D^{20}$ -32.7 (*c* 1.43 in DCM); υ_{max}/cm^{-1} 3506, 1468, 1254, 1048, 838 and 777; δ_H (300 MHz, $CDCl_3$) 0.00 and 0.06 (each 3 H, s, $SiCH_3$), 0.70 (3 H, s, 4-CH_3), 0.85 [9 H, m, $SiC(CH_3)_3$], 0.94 (3 H, s, 4-CH_3), 0.96 (3 H, m, 1-H_3), 1.20-1.42 (2 H, m, 2-H_2), 3.48 (1 H, m, 3-H), 3.86 (1 H, d, *J* 7.5, 5-H), 4.24 (1 H, br. s, OH), 5.10-5.20 (2 H, m, 7-H_2) and 5.90 (1 H, ddd, *J* 17.0, 10.5, 7.5, 4-H); δ_C (75 MHz, $CDCl_3$) –5.0, -3.6, 11.3, 17.0, 18.0, 20.4, 24.3, 25.8, 41.9, 79.1, 82.1, 116.7 and 138.7; *m/z* (CI) 273 ($M^+ + 1$, 100 %); more polar isomer, $[\alpha]_D^{20}$ -6.2 (*c* 0.93 in DCM); δ_H (300 MHz, $CDCl_3$) 0.00 and 0.04 (each 3 H, s, $SiCH_3$), 0.72 and 0.86 (each 3 H, s, 4-CH_3), 0.88 [9 H, m, $SiC(CH_3)_3$], 0.96 (3 H, t, *J*, 7.5, 1-H_3), 1.26 and 1.54 (each 1 H, m, 2-H), 2.54 (1 H, d, *J* 4.0, OH), 3.36 (1 H, ddd, *J* 10.5, 4.0, 2.0, 3-H), 3.96 (1 H, d, *J* 8.0, 5-H), 5.10-5.20 (2 H, m, 7-H_2) and 5.82 (1 H, ddd, *J* 16.5, 11.0, 8.0, 4-H); δ_C (75 MHz, $CDCl_3$) -5.2, -4.2, 11.1, 17.9, 19.6, 22.6, 24.3, 25.8, 40.7, 77.5, 84.8, 117.1 and 137.2.

(3*R*,5*S*)- and (3*S*,5*S*)-7-[Di-(4-methoxyphenyl)(phenyl)methoxy]-5-*tert*-butyldimethylsilyloxy-4,4-dimethylheptan-3-ol 65

Borane.THF (2 M in THF, 6.49 mL, 12.98 mmol) was added dropwise to the alkenol **63** (1.77 g, 6.49 mmol) in THF (50 mL) at 0 °C. The solution was allowed to warm to room temperature and was stirred for 6 h. Aqueous sodium hydroxide (5 %, 10 mL) and 30 % hydrogen peroxide (5 mL) were added and the mixture stirred for 0.5 h. Water and ethyl acetate were added and the aqueous layer was extracted three times with ethyl acetate. The organic extracts were washed with saturated aqueous ammonium chloride and brine, then dried ($MgSO_4$). After concentration under reduced pressure, chromatography of the residue eluting with light petroleum-ethyl acetate (10:1 to 3:1) gave the diol **64** as a colourless oil together with minor amounts of the less polar (5*S*)-5-*tert*-butyldimethylsilyloxy-4,4-dimethylheptan-3,6-diols as a complex mixture of diastereoisomers.

Di-(4-methoxyphenyl)(phenyl)methyl chloride (1.52 g, 4.70 mmol) and DMAP (55 mg, 0.45 mmol) were added to the diol **64** (1.30 g, 4.48 mmol) and *N,N*-di-*iso*propylethylamine (1.56 mL, 8.96 mmol) in DCM (20 mL) and the mixture stirred at room temperature for 16 h. Saturated aqueous ammonium chloride was added and the organic layer washed with brine then dried ($MgSO_4$). After concentration under reduced pressure, chromatography of the residue, eluting with light petroleum-ethyl acetate (18:1), gave the C(3)-epimers of the *title compound* **65** (1.99 g, 52 % from alkenols **63**), ratio ca. 50 : 50, as colourless oils; less polar epimer, $[\alpha]_D^{20}$ –6.1 (*c* 0.98 in DCM); υ_{max}/cm^{-1} 3484, 1608, 1509, 1466, 1301, 1252, 1176, 1071, 1038 and 833; δ_H (300 MHz, $CDCl_3$) -0.25 and 0.00 (each 3 H, s, $SiCH_3$), 0.76 [9 H, m, $SiC(CH_3)_3$], 0.77 and 0.96 (each 3 H, s, 4-CH_3), 1.03 (3 H, t, *J* 7.5, 1-H_3), 1.15-1.55 (2 H, m, 2-H_2), 1.87 and 2.11 (each 1 H, m, 6-H), 3.01 (1 H, ddd, *J* 8.5, 7.5, 7.5, 7-H), 3.31 (1 H, dt, *J* 8.5, 5.0, 7-H), 3.53 (1 H, dd, *J* 7.5, 2.0, 5-H), 3.66 (1 H, dd, *J* 9.5, 2.0, 3-H), 3.80 (6 H, s, $ArOCH_3$), 4.25 (1 H, br. s, OH), 6.83 (4 H, d, *J* 9.0, ArH), 7.15-7.35 (7 H, m, ArH) and 7.43 (2 H, m, ArH); *m/z* (ES) 610 ($M^+ + 18$, 6 %), 451 (6), 303 (98) and 102 (100); more polar epimer, $[\alpha]_D^{20}$ –1.0 (*c* 0.78 in DCM); δ_H (300 MHz, $CDCl_3$) -0.25 and -0.09 (each 3 H, s, $SiCH_3$), 0.75 (3 H, s, 4-CH_3), 0.80 [9 H, m, $SiC(CH_3)_3$], 0.84 (3 H, s, 4-CH_3), 1.00 (3 H, t, *J* 7.0, 1-H_3), 1.27 (1 H, m, 2-H), 1.47-1.69 (2 H, m, 2-H, 6-H), 2.09 (1 H, m, 6-H), 2.29 (1 H, br. s, OH), 3.04 (1 H, t, *J* 8.0, 7-H), 3.27-3.41 (2 H, m, 3-H, 7-H), 3.61 (1 H, dd, *J* 6.0, 3.0, 5-H), 3.79 (6 H, s, $ArOCH_3$), 6.83 (4 H, d, *J* 9.0, ArH), 7.15-7.35 (7 H, m, ArH) and 7.43 (2 H, m, ArH).

(5*S*)-7-[Di-(4-methoxyphenyl)(phenyl)methoxy]-5-*tert*-butyldimethylsilyloxy-4,4-dimethylheptan-3-one 66

Dess-Martin periodinane (92 mg, 0.218 mmol) was added to the alcohol **65** (66 mg, 0.145 mmol) in DCM (1 mL) and the suspension stirred for 0.5 h. Ether (15 mL) was added and the mixture poured into a vigorously stirred solution of sodium thiosulphate (2 g) in saturated aqueous sodium bicarbonate (10 mL). After 5 min, the organic layer was washed with saturated aqueous sodium bicarbonate and water, and then dried ($MgSO_4$). Concentration under reduced pressure gave the *title compound* **66** (66 mg, 99 %) as a colourless gum, $[\alpha]_D^{21}$ –46.6 (*c* 1.3 in DCM); υ_{max}/cm^{-1} 1704, 1583, 1509, 1465, 1251, 1177, 1039 and 832; δ_H (400 MHz, C_6D_6) -0.20 and -0.10 (each 3 H, s, $SiCH_3$), 0.80 [9 H, m, $SiC(CH_3)_3$], 0.92 (3 H, s, 4-CH_3), 0.96 (3 H, t, *J* 7.0, 1-H_3), 1.01 (3 H, s, 4-CH_3), 1.72 and 1.90 (each 1 H, m, 6-H), 2.14 and 2.20 (each 1 H, dq, *J* 19.0, 7.0, 2-H), 3.16 (1 H, m, 7-H), 3.20 (6 H, s, $ArOCH_3$), 3.34 (1 H, m, 7-H), 4.10 (1 H, dd, *J* 7.5, 2.5, 5-H), 6.72 (4 H, d, *J* 9.0, ArH), 7.02 (1 H, m, ArH), 7.14 (2 H, m, ArH), 7.42 (4 H, d, *J* 9.0, ArH) and 7.58 (2 H, m, ArH); δ_C (75 MHz, C_6D_6) -4.5, -4.4, 7.6, 18.0, 20.2, 21.1, 25.8, 31.3, 34.6, 52.5, 54.3, 61.7, 74.4, 86.2, 113.1, 128.1, 128.3, 130.1, 136.5, 136.6, 145.6, 158.7 and 213.3; *m/z* (ES^+) 608 (M^+ + 18, 7 %), 496 (10), 303 (100) and 271 (52).