Asymmetric synthesis of vicinal amino alcohols: xestoaminol C, sphinganine and sphingosine

Elin Abraham, Stephen G. Davies,* Nicholas L. Millican, Rebecca L. Nicholson, Paul M. Roberts and Andrew D. Smith

Department of Chemistry, Chemistry Research Laboratory, University of Oxford, Mansfield Road, Oxford, OX1 3TA, UK.

E-mail: steve.davies@chem.ox.ac.uk

Experimental

General Experimental

All reactions involving organometallic or other moisture-sensitive reagents were carried out under a nitrogen or argon atmosphere using standard vacuum line techniques and glassware that was flame dried and cooled under nitrogen before use. Solvents were dried according to the procedure outlined by Grubbs and co-workers. Water was purified by an Elix® UV-10 system. All other solvents were used as supplied (analytical or HPLC grade) without prior purification. Organic layers were dried over MgSO₄. Thin layer chromatography was performed on aluminium plates coated with 60 F₂₅₄ silica. Plates were visualised using UV light (254 nm), iodine, 1% aq KMnO₄, or 10% ethanolic phosphomolybdic acid. Flash column chromatography was performed on Kieselgel 60 silica.

Elemental analyses were recorded by the microanalysis service of the Inorganic Chemistry Laboratory, University of Oxford, UK. Melting points were recorded on a Gallenkamp Hot Stage apparatus and are uncorrected. Optical rotations were recorded on a Perkin-Elmer 241 polarimeter with a water-jacketed 10 cm cell. Specific rotations are reported in 10⁻¹ deg cm² g⁻¹ and concentrations in g/100 mL. IR spectra were recorded on Bruker Tensor 27 FT-IR spectrometer as either a thin film on NaCl plates (film) or a KBr disc (KBr), as stated. Selected characteristic peaks are reported in cm⁻¹. NMR spectra were recorded on Bruker Avance spectrometers in the deuterated solvent stated. Spectra were recorded at rt unless otherwise stated. The field was locked by external referencing to the relevant deuteron resonance. Low-resolution mass spectra were recorded on either a VG MassLab 20-250 or a Micromass Platform 1 spectrometer. Accurate mass measurements were run on either a Bruker MicroTOF internally calibrated with polyanaline, or a

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Micromass GCT instrument fitted with a Scientific Glass Instruments BPX5 column (15 m × 0.25 mm) using amyl acetate as a lock mass.

**tert-Butyl (2S,3S,αS)-2-hydroxy-3-[N-benzyl-N-(α-methylbenzyl)amino]butanoate 10**

BuLi (2.5 M in hexanes, 10.9 mL, 27.3 mmol) was added dropwise via syringe to a stirred solution of (S)-N-benzyl-N-(α-methylbenzyl)amine (5.94 g, 28.2 mmol) in THF (50 mL) at −78 °C. After stirring for 30 min a solution of tert-butyl crotonate (2.5 g, 17.6 mmol) in THF (20 mL) at −78 °C was added dropwise via cannula. After stirring for a further 2 h at −78 °C the reaction mixture was quenched with (+)-CSO (8.06 g, 35.2 mmol) and allowed to warm to rt over 12 h. Sat aq NH₄Cl (5 mL) was added and the mixture was stirred for 5 min before being concentrated in vacuo. The residue was partitioned between DCM (50 mL) and 10% aq citric acid (10 mL). The organic layer was separated and the aqueous layer was extracted with DCM (2 × 50 mL). The combined organic extracts were washed sequentially with sat aq NaHCO₃ (50 mL) and brine (50 mL), dried and concentrated in vacuo. The residue was dissolved in Et₂O (50 mL), the insoluble CSO residues were filtered off, and the filter cake was washed with Et₂O (2 × 20 mL). The filtrate was concentrated in vacuo and the process was repeated. Purification via flash column chromatography (eluent 30-40 °C petrol/Et₂O, 10:1) gave 10 as a white solid (4.99 g, 77%, >98% de); Rf 0.22 (30-40 °C petrol/Et₂O, 10:1); mp 87-88 °C (30-40 °C petrol/Et₂O, 10:1); [α]D²⁵ +34.7 (c 1.05 in CHCl₃); {lit.² for enantiomer [α]D²⁵ −33.4 (c 1.0 in CHCl₃)}; δH (400 MHz, CDCl₃) 1.14 (3H, d, J 7.2, C(4)H₃), 1.38 (3H, d, J 6.8, C(α)Me), 1.42 (9H, s, CMe₃), 3.02 (1H, bs, OMe), 3.25-3.36 (1H, m, C(3)H), 3.94 (1H, d, J 14.7, NCH₃), 4.05-4.11 (3H, m, C(2)H, C(α)H, NCH₃), 7.24-7.55 (10H, m, Ph).

**tert-Butyl (2S,3S,αS)-2-benzyloxy-3-[N-benzyl-N-(α-methylbenzyl)amino]butanoate 11**

A solution of 10 (1.5 g, 4.1 mmol) in THF (5 mL) at room temperature was added dropwise via syringe to a stirred slurry of NaH (60% dispersion in oil, 103 mg, 4.3 mmol) in THF (5 mL) at 0 °C. The reaction

mixture was allowed to warm to rt over 1 h, after which 15-crown-5 ether (0.94 mL, 4.3 mmol) and BnBr (1.2 mL, 44.6 mmol) were sequentially added dropwise via syringe. Stirring was continued for 12 h before the reaction was quenched with sat aq NH₄Cl (2 mL). Brine (10 mL) was added, the organic layer was separated and the aqueous layer was extracted with Et₂O (3 × 10 mL). The combined organic extracts were dried and concentrated in vacuo. Purification via flash column chromatography (eluent 30-40 °C petrol/Et₂O, 20:1) gave 11 as a colourless oil (1.61 g, 88%, >98% de); [α]D²³ −67.3 (c 1.0 in CHCl₃); νmax (film) 2976 (C−H), 1739 (C=O); δH (400 MHz, CDCl₃) 1.14 (3H, d, J 7.1, C(4)H₃), 1.30 (3H, d, J 6.8, C(α)Me), 1.40 (9H, s, CMe₃), 3.32-3.38 (1H, m, C(3)H), 3.80 (1H, d, J 3.5, C(2)H), 3.81 (1H, d, J 14.9, NCH₂), 3.94 (1H, q, J 6.8, C(α)H), 4.05 (1H, d, J 14.9, NCH₂B), 4.30 (1H, d, J 3.5, C(2)H), 4.81 (1H, d, J 11.1, OCH₂A), 4.61 (1H, d, J 11.1, OCH₂B), 7.21-7.41 (15H, m, Ph); δC (100 MHz, CDCl₃) 12.9 (C(4)), 17.8 (C(α)Me), 28.0 (CMe₃), 50.6 (NCH₂), 54.5 (C(3)), 58.9 (C(α)), 72.3 (OCH₂), 80.9 (CMe₃), 82.0 (C(2)), 126.3, 126.6, 127.6 (p-Ph), 127.8, 128.01, 128.04, 128.2, 128.23 (o-Ph, m-Ph), 137.8, 142.5, 144.4 (i-Ph), 171.2 (C(1)); m/z (ESI⁺) 460 ([M+H]+, 100%); HRMS (ESI+) C₃₀H₃₇NO₃⁺ ([M+H]+) requires 460.2852; found 460.2849.

(2S,3S,αS)-2-Benzyloxy-3-[N-benzyl-N-(α-methylbenzyl)amino]butan-1-ol 12

LiAlH₄ (1 M in THF, 1.12 mL, 1.12 mmol) was added dropwise via syringe to a stirred solution of 11 (250 mg, 0.56 mmol) in THF (5 mL) at 0 °C and the reaction mixture allowed to warm to rt over 6 h. The reaction was quenched with H₂O (0.5 mL) and filtered through Celite (eluent EtOAc) to give 12 as a colourless oil (200 mg, 91%, >98% de) that was used without purification. Purification of an aliquot via flash column chromatography (eluent 30-40 °C petrol/Et₂O, 20:1) gave an analytical sample; [α]D²² −9.5 (c 4.0 in CHCl₃); νmax (film) 3413 (O−H), 2972 (C−H); δH (400 MHz, CDCl₃) 1.32 (3H, d, J 6.6, C(4)H₃), 1.46 (3H, d, J 6.8, C(α)Me), 3.03 (1H, app s, OH), 3.10-3.16 (2H, m, C(1)H₂), 3.24-3.29 (1H, m, C(2)H), 3.49-3.54 (1H, m, C(3)H), 3.82 (2H, ABq, J 13.4, NCH₂), 3.99 (1H, q, J 6.8, C(α)H), 4.46 (1H, d, J 11.1, OCH₂A), 4.58 (1H, d, J 11.1, OCH₂B), 7.24-7.42 (15H, m, Ph); δC (100 MHz, CDCl₃) 13.6 (C(α)Me), 14.4 (C(4)), 50.9 (NCH₂), 54.0 (C(3)), 56.8 (C(α)), 63.0 (C(1)), 72.7 (OCH₂), 80.8 (C(2)), 127.2, 127.3, 127.7 (p-Ph), 128.0, 128.2, 128.22 128.4, 128.6, 129.4 (o-Ph, m-Ph), 138.2, 139.7, 143.1 (i-Ph); m/z (ESI⁺) 390 ([M+H]+, 100%); HRMS (ESI⁺) C₂₆H₃₂NO₂⁺ ([M+H]+) requires 390.2433; found 390.2423.
(2S,3S,αS)-2-Benzylloxy-3-[N-benzyl-N-(α-methylbenzyl)amino]butanal 13

DMSO (0.04 mL, 0.57 mmol) was added dropwise via syringe to a stirred solution of oxaloyl chloride (0.02 mL, 0.23 mmol) in DCM (2 mL) at –78 °C. After 20 min a solution of 12 (50 mg, 0.13 mmol) in DCM (2 mL) was added dropwise via syringe. After a further 20 min Et3N (0.11 mL, 0.78 mmol) was added dropwise via syringe and the reaction mixture was stirred for a further 30 min before being allowed to warm to rt over a further 30 min. Volatiles were removed in vacuo and the residue was partitioned between H2O (10 mL) and Et2O (10 mL). The organic layer was separated and the aqueous layer was extracted with Et2O (2 × 10 mL). The combined organic extracts were dried and concentrated in vacuo to give 13 as a colourless oil (44 mg, 88%, >98% de) that was used without purification;

δH (500 MHz, CDCl3) 1.27 (3H, d, J 6.4, C(4)H3), 1.38 (3H, d, J 7.0, C(α)Me), 3.28-3.34 (1H, m, C(3)H), 3.40-3.43 (1H, m, C(2)H), 3.77 (2H, app d, J 3.1, NCH2), 3.86 (1H, q, J 7.0, C(α)H), 4.31 (1H, d, J 11.4, OCHA), 4.48 (1H, d, J 11.4, OCHB), 7.20-7.71 (15H, m, Ph), 8.59 (1H, d, J 4.5, C(1)H).

(2S,3R,4Z,αS)-2-[N-Benzyl-N-(α-methylbenzyl)amino]-3-benzyloxytetradec-4-ene (Z)-14

BuLi (2.5 M in hexanes, 1.84 mL, 4.5 mmol) was added dropwise via syringe to a stirred solution of (1-decyl)triphenylphosphonium bromide (2.5 g, 5.17 mmol) in THF (20 mL) at –78 °C. After 30 min, hexane (25 mL) was added, followed by the dropwise addition via syringe of a solution of 13 (400 mg, 1.03 mmol) in THF (5 mL). Stirring was continued and the reaction mixture was allowed to warm to rt over 12 h. The reaction was quenched with sat aq NH4Cl (2 mL). Brine (10 mL) was added, the organic layer separated and the aqueous layer extracted with Et2O (3 × 10 mL). The combined organic extracts were dried and concentrated in vacuo. Purification via flash column chromatography (eluent 30-40 °C petrol/Et2O, 200:1) gave (Z)-14 as a colourless oil (500 mg, 95%, >98% de); [α]D23 =−26.7 (c 1.0 in CHCl3); νmax (film) 2925 (C−H), 1644 (C=C); δH (400 MHz, CDCl3) 0.91 (3H, t, J 7.2, C(14)H), 1.20-1.35 (20H, m, C(1)H, C(7)H2-C(13)H2, C(α)Me), 1.66-1.73 (2H, m, C(6)H2), 2.74-2.80 (1H, m, C(2)H), 3.87 (1H, d, J 14.0, NCHA), 3.98 (1H, q, J 6.8, C(α)H), 4.08 (1H, d, J 14.0, NCHB), 4.16 (1H, dd, J 9.3, 4.4, C(3)H), 4.30 (1H, d, J 11.6,
OCH$_A$), 4.48 (1H, d, J 11.6, OCH$_B$), 5.11 (1H, dd, J 10.9, 9.3, C(4)H), 5.40-5.47 (1H, m, C(5)H), 7.15-7.46 (15H, m, Ph); $\delta$C (100 MHz, CDCl$_3$) 12.8 (C(1)), 14.1 (C(14)), 14.5 (C(α)Me), 22.7, 27.4, 29.26, 29.33, 29.6, 29.7, 31.9 (C(6)-C(13)), 51.3 (NCH$_2$), 55.2 (C(2)), 56.7 (C(α)), 70.2 (OCH$_2$), 79.6 (C(3)), 126.2, 126.3, 126.4 (p-Ph), 127.2, 127.7, 127.71, 128.0, 128.1, 128.6 (o-Ph, m-Ph), 129.9 (C(5)), 133.2 (C(4)), 139.0, 142.3, 145.0 (i-Ph); m/z (ESI$^+$) 512 ([M+H]$^+$, 100%); HRMS (ESI$^+$) C$_{36}$H$_{50}$NO$^+$ ([M+H]$^+$) requires 512.3892; found 512.3898.

$(2S,3R,\alpha S)$-2-[$N$-(α-Methylbenzyl)amino]tetradecan-3-ol 15

![Structure of 15]

Pd/C (20 mg, 50% w/w) was added to a stirred solution of (Z)-14 (40 mg, 0.78 mmol) in MeOH/AcOH/H$_2$O (40:4:1, 5 mL) at rt. The reaction mixture was stirred under H$_2$ (1 atm) for 6 h. The reaction mixture was filtered through Celite (eluent MeOH) and concentrated *in vacuo* to give 15, contaminated with an unidentified impurity, as a colourless oil (15 mg); $\delta$H (400 MHz, CDCl$_3$) 0.87-0.89 (6H, m, C(1)H$_3$, C(14)H$_3$), 1.23-1.33 (16H, m, C(6)H$_2$-C(13)H$_2$), 1.36-1.52 (7H, m, C(4)H$_2$, C(5)H$_2$, C(α)Me), 2.54 (1H, qd, J 6.5, 3.1, C(2)H), 3.62-3.66 (1H, m, C(3)H), 3.88 (1H, q, J 6.8, C(α)H), 7.24-7.71 (5H, m, Ph).

tert-Butyl $(2S,3S)$-2-hydroxy-3-($N$-tert-butoxycarbonylamino)butanoate 16

![Structure of 16]

Pearlman’s catalyst (250 mg, 25% w/w) was added to a vigorously stirred solution of 10 (1.0 g, 27.1 mmol) and Boc$_2$O (2.01 g, 92.1 mmol) in EtOAc (50 mL) and the mixture was placed under H$_2$ (5 atm). Stirring continued for 12 h, after which time the reaction mixture was filtered through Celite (eluent EtOAc) and concentrated *in vacuo*. Purification via flash column chromatography (eluent 30-40 °C petrol/Et$_2$O, 5:1; then 30-40 °C petrol/Et$_2$O, 1:1) gave 16 as a colourless oil (740 mg, 98%, >98% de); $R_f$ 0.08 (30-40 °C petrol/Et$_2$O, 5:1); [α]$^D_{23}$ +10.8 (c 1.2 in CHCl$_3$); {lit.$^3$ [α]$^D_{23}$ +10.6 (c 2.4 in CHCl$_3$)}; $\delta$H (400 MHz, CDCl$_3$) 1.02 (3H, d, J 6.8, C(4)H$_3$), 1.46 (9H, s, CMe$_3$), 1.50 (9H, s, CMe$_3$), 3.03 (1H, d, J 5.5, OH), 4.07-4.14 (1H, m, C(3)H), 4.20-4.22 (1H, m, C(2)H), 4.90 (1H, d, J 8.9, NH).

(4S,5S)-2,2,4-Trimethyl-N(3),5-di-tert-butoxycarbonyl-oxazolidine 17

BF₃·Et₂O (1 M in Et₂O) was added dropwise to a stirred solution of 16 (1.7 g, 6.18 mmol) and 2,2-dimethoxypropane (10 mL) in acetone (50 mL) until a permanent colour change from colourless to dark orange was observed. After stirring at rt for 12 h the reaction was quenched with Et₃N until pH 7 was achieved. The reaction mixture was concentrated in vacuo. Purification via flash column chromatography (elucent 30-40 °C petrol/Et₂O, 10:1) gave 17 as a white crystalline solid (1.72 g, 88%, >98% de); Rf 0.1 (30-40 °C petrol/Et₂O); [α]D₂⁰ −17.4 (c 1.2 in CHCl₃); νmax (KBr) 2978 (C−H), 1749 (C=O), 1699 (C=O); δH (400 MHz, CDCl₃) 1.07-1.16 (3H, m, C(4)Me), 1.35-1.52 (21H, m, C(2)Me₂, 2 × CMe₃), 1.55-1.66 (3H, m, C(2)Me₃), 4.02-4.27 (1H, m, C(4)H); δH (500 MHz, DMSO-d₆, 363 K) 1.11 (3H, d, J 6.4, C(4)Me), 1.46 (9H, s, CMe₃), 1.48 (12H, s, C(2)Me₂, CMe₃), 1.57 (3H, s, C(2)Me₃), 4.12 (1H, m, C(4)H), 4.60 (1H, d, J 5.8, C(5)H); δC (125 MHz, DMSO-d₆, 363 K) 16.0 (C(4)Me), 25.2 (C(2)Me₂), 28.4 (C(2)Me₃), 28.7 (CMe₃), 29.0 (CMe₃), 54.8 (C(4)), 76.2 (C(5)), 80.2 (CMe₃), 82.5 (CMe₃), 94.1 (C(2)), 151.7 (NCO), 167.5 (CO₂tBu); m/z (ESI⁺) 316 ([M+H]⁺, 19%), 260 (83), 204 (100); HRMS (ESI⁺) C₁₆H₃₀NO₅⁺ ([M+H]⁺) requires 316.2124; found 316.2135.

(4S,5S)-2,2,4-Trimethyl-N(3)-tert-butoxycarbonyl-5-hydroxymethyl-oxazolidine 18

LiAlH₄ (1 M in THF, 0.6 mL, 0.6 mmol) was added dropwise via syringe to a stirred solution of 17 (189 mg, 0.6 mmol) in THF (10 mL) at 0 °C. After stirring for 6 h, the reaction was quenched with H₂O (ca 0.5 mL) and filtered through Celite (elucent EtOAc) to give 18 as a colourless oil (152 mg, quant, >98% de) that was used without purification. Purification of an aliquot via flash column chromatography (elucent 30-40 °C petrol/Et₂O, 20:1) gave an analytical sample; Rf 0.27 (30-40 °C petrol/Et₂O, 2:1); C₁₂H₂₃NO₄ requires C, 58.75; H, 9.45; N, 5.7%; found C, 58.8; H, 9.7; N, 5.5%; [α]D₂⁰ −1.2 (c 1.1 in CHCl₃); νmax (film) 3449 (O−H), 2980 (C−H), 1698 (C=O); δH (400 MHz, CDCl₃) 1.08-1.17 (1H, m, C(4)Me), 1.43-1.66 (15H, m, C(2)Me₂, CMe₃), 3.66-3.83 (2H, m, C(5)CH₂), 3.89-4.10 (1H, m, C(4)H), 4.13-4.20 (1H, m, C(5)H); δH (500
MHz, DMSO-$d_6$, 363 K), 1.08 (3H, d, J 6.4, C(4)Me), 1.41-1.50 (12H, m, C(2)Me$_A$, CMe$_3$), 1.52 (3H, s, C(2)Me$_B$), 2.99 (1H, br s, OH), 3.53 (1H, br dd, J 11.0, 6.4, C(5)CH$_A$), 3.58 (1H, br dd, J 11.0, 6.1, C(5)CH$_B$), 3.89-3.97 (1H, m, C(4)H), 4.05-4.13 (1H, m, C(5)H); $\delta_C$ (125 MHz, DMSO-$d_6$, 363 K) 14.7 (C(4)Me), 25.2 (C(2)Me$_A$), 28.5 (C(2)Me$_B$), 55.0 (C(4)), 60.3 (C(5)CH$_2$), 77.6 (C(5)), 79.7 (CMe$_3$), 93.1 (C(2)), 119.1 (NCO); m/z (ESI$^+$) 246 ([M+H]$^+$, 12%), 190 (100), 146 (94); HRMS (ESI$^+$) C$_{12}$H$_{24}$NO$_4$ $^+$ ([M+H]$^+$) requires 246.1705; found 246.1714.

$(4S,5S)$-2,2,4-Trimethyl-N(3)-tert-butoxycarbonyl-5-formyl-oxazolidine 19

![](image1)

IBX (2.06 g, 7.35 mmol) was added to a solution of 18 (600 mg, 2.45 mmol) in DMSO (20 mL) at rt and stirred for 12 h. The reaction mixture was diluted with Et$_2$O (20 mL), washed with H$_2$O (5 × 20 mL), dried and concentrated in vacuo to give 19 as a colourless oil (600 mg, quant, >98% de) that was used without purification; $\delta_H$ (400 MHz, CDCl$_3$) 1.13-1.19 (3H, m, C(4)Me), 1.43-1.57 (12H, m, C(2)Me$_A$, CMe$_3$), 1.68 (3H, s, C(2)Me$_B$), 4.13-4.39 (1H, m, C(5)H), 4.40-4.66 (1H, m, C(4)H), 9.71 (1H, s, CHO).

$(4S,5R,1'Z)$-2,2,4-Trimethyl-N(3)-tert-butoxycarbonyl-5-undec-1'en-1'-yl-oxazolidine (Z)-20

| BuLi (2.5 M in hexanes, 5.74 mL, 14.3 mmol) was added dropwise via syringe to a stirred solution of (1-decyl)triphenylphosphonium bromide (7.95 g, 16.4 mmol) in THF (40 mL) at −78 °C. After 30 min, hexane (50 mL) was added, followed by the dropwise addition via cannula of a solution of 19 (800 mg, 3.29 mmol) in THF (10 mL). The reaction mixture was allowed to warm to rt over 12 h. The reaction mixture was quenched with sat aq NH$_4$Cl (2 mL). Brine (10 mL) was added, the organic layer was separated, and the aqueous layer was extracted with Et$_2$O (3 × 10 mL). The combined organic extracts were dried and concentrated in vacuo. Purification via flash column chromatography (eluent 30-40 °C petrol/Et$_2$O, 10:1) gave (Z)-20 as a colourless oil (1.03 g, 85%, >98% de); $R_f$ 0.16 (30-40 °C petrol/Et$_2$O, 10:1); [α]$_D^{21}$ −23.6 (c 1.3 in CHCl$_3$); $\nu_{\text{max}}$ (film) 2927 (C=H), 1700 (C=O); $\delta_H$ (400 MHz, CDCl$_3$) 0.83-0.94 (3H, m, C(11')H$_3$), 1.04-1.17 (3H, m, C(4)Me), 1.43-1.68 (29H, m, C(2)Me$_2$, C(4')H$_2$-C(10')H$_2$, CMe$_3$), 1.97-2.20 (2H, m, C(3')H$_2$), 3.79-4.06 (1H, m, C(4)H), 4.79-4.86 (1H, m, C(5)H), 5.39-5.48 (1H, m, C(1')H), 5.63-5.73 (1H,
m, C(2')H); δ_H (500 MHz, DMSO-d_6, 363 K) 0.90 (3H, t, J 6.8, C(11')H_3), 1.07 (3H, d, J 6.5, C(4)Me), 1.25-1.57 (29H, m, C(2)Me_2, C(4')H_2-C(10')H_2, CMe_3), 2.04-2.21 (2H, m, C(3')H_2), 3.91 (1H, app quintet, J 6.1, C(4)H), 4.81-4.88 (1H, m, C(5)H), 5.35-5.44 (1H, m, C(1')H), 5.62-5.72 (1H, m, C(2')H); δ_C (125 MHz, DMSO-d_6, 363 K) 14.5 (C(11')), 15.7 (C(4)Me), 22.7, 25.2, 28.3, 28.6, 29.1, 29.3, 29.4, 29.6, 29.7, 32.0 (C(2)Me_2, C(3')-C(10'), CMe_3), 56.3 (C(4)), 73.4 (C(5)), 79.8 (CMe_3), 92.6 (C(2)), 125.9 (C(2')), 135.4 (C(1')), 151.9 (NCO); m/z (ESI^+) 368 ([M+H]^+), 271 (100); HRMS (ESI^+) C_{22}H_{42}NO_3^+ ([M+H]^+) requires 368.3165; found 368.3179.

(4S,5R)-2,2,4-Trimethyl-N(3)-tert-butoxycarbonyl-5-undecan-1'-yl-oxazolidine 21

Pd/C (5 mg, 10% w/w) was added to a stirred solution of (Z)-20 (50 mg, 0.14 mmol) in EtOAc (5 mL) at rt. The reaction mixture was stirred under H_2 (1 atm) for 6 h. The reaction mixture was filtered through Celite (eluente EtOAc) and concentrated in vacuo. Purification via flash column chromatography (eluente 30-40 °C petrol/Et_2O, 1:1) gave 21 as a colourless oil (45 mg, 90%, >98% de); R_f 0.05 (30-40 °C petrol/Et_2O, 1:1); [α]_D^{19} = -20.1 (c 1.2 in CHCl_3); ν_max (film) 2926 (C−H), 1699 (C=O); δ_H (400 MHz, CDCl_3) 0.88 (3H, app t, J 6.8, C(11')H_3), 1.04-1.14 (3H, m, C(4)Me), 1.22-1.67 (35H, m, C(2)Me_2, C(1')H_2-C(10')H_2, CMe_3), 3.76-4.01 (2H, m, C(4)H, C(5)H); δ_H (500 MHz, PhMe-d_8, 363 K) 0.92 (3H, t, J 6.9, C(11')H_3), 1.13 (3H, d, J 6.3 C(4)Me), 1.23-1.39 (18H, m, C(2')H_2-C(10')H_2), 1.46 (9H, s, CMe_3), 1.57 (3H, s, C(2)Me_A), 1.66 (3H, s, C(2)Me_B), 1.83-1.96 (2H, m, C(1')H_2), 3.84-3.90 (2H, m, C(4)H, C(5)H); m/z (F^+) 369 ([M+H]^+), 25%; 354 (100); HRMS (F^+) C_{22}H_{43}NO_3^+ ([M+H]^+) requires 369.3234; found 369.3240.

(2S,3R)-2-Acetamido-3-acetoxy-tetradecane [N,O-diacetyl xestoaminol C] 22

3 M aq HCl (1 mL) was added to a solution of 21 (50 mg, 0.14 mmol) in MeOH (10 mL) and heated at 50 °C for 3 h. The reaction mixture was concentrated in vacuo. The residue was dissolved in pyridine (10 mL) and Ac_2O (0.06 mL, 0.68 mmol) and DMAP (2 mg) were added sequentially. The reaction mixture was stirred for 12 h before being quenched with H_2O (2 mL). The reaction mixture was diluted with H_2O (10mL) and Et_2O (10mL) and the layers were separated. The aqueous layer was extracted with Et_2O (2 × 10
mL). The combined organic layers were washed sequentially with sat aq CuSO₄ (2 × 10 mL), H₂O (10 mL) and brine (10 mL), dried and concentrated in vacuo. Purification via flash column chromatography (eluent 30-40 °C petrol/EtOAc, 1:1) gave 22 as white solid (34 mg, 80%, >98% de); Rf 0.18 (30-40 °C petrol/EtOAc, 1:1); mp 51-53 °C (30-40 °C petrol/EtOAc); [α]_D⁰ 22 −22.7 (c 0.6 in MeOH); {lit.⁴ [α]_D⁰ 24 −21.8 (c 0.4 in MeOH), lit.⁵ [α]_D⁰ 24 22.1 (c 0.2 in MeOH)}; vmax (KBr) 3354, 2980, 2935, 1791, 1755, 1714, 1519; δ_H (400 MHz, CDCl₃) 0.87 (3H, t, J 6.8, C(14)H₃), 1.08 (3H, d, J 6.8, C(1)H₃), 1.20-1.37 (18H, m, C(5)H₂-C(13)H₂), 1.43-1.62 (2H, m, C(4)H₂), 1.94, (3H, s, COMe), 2.08 (3H, s, COMe), 4.10-4.19 (1H, m, C(2)H), 4.80-4.86 (1H, ddd, J 8.5, 5.1, 3.4, C(3)H), 5.90 (1H, br d, J 8.2, NH); δ_C (125 MHz, CHCl₃) 14.1, 14.8, 21.1, 22.7, 23.5, 25.6, 29.31, 29.34, 29.4, 29.5, 29.6, 31.3, 31.9, 47.5, 77.0, 169.3, 171.6; m/z (ESI⁺) 336 ([M+Na]⁺, 100%); HRMS (ESI⁺) C₁₈H₃₅NNaO₃⁺ ([M+Na]⁺) requires 336.2509; found 336.2502.

(2S,3R,4Z)-2-Acetamido-3-acetoxy-tetradec-4-ene 23

3 M aq HCl (1 mL) was added to a solution of (Z)-20 (50 mg, 0.14 mmol) in MeOH (10 mL) and heated at 50 °C for 3 h. The reaction mixture was concentrated in vacuo. The residue was dissolved in pyridine (10 mL) and Ac₂O (0.06 mL, 0.68 mmol) and DMAP (2 mg) were added sequentially. The reaction mixture was stirred for 12 h before being quenched with H₂O (2 mL). The reaction mixture was diluted with H₂O (10 mL) and Et₂O (10 mL) and the layers were separated. The aqueous layer was extracted with Et₂O (2 × 10 mL). The combined organic layers were washed sequentially with sat aq CuSO₄ (2 × 10 mL), H₂O (10 mL) and brine (10 mL), dried and concentrated in vacuo. Purification via flash column chromatography (eluent 30-40 °C petrol/EtOAc, 1:1) gave 23 as white solid (34 mg, 80%, >98% de); Rf 0.21 (30-40 °C petrol/EtOAc, 1:1); mp 55-57 °C (30-40 °C petrol/EtOAc); [α]_D⁰ 23 −14.9 (c 0.8 in CHCl₃); vmax (film) 2925, 1742, 1651, 1549; δ_H (400 MHz, CDCl₃) 0.88 (3H, t, J 6.8, C(14)H₃), 1.13 (3H, d, J 6.8, C(1)H₃), 1.17-1.42 (14H, m, C(7)H₂-C(13)H₂), 1.97 (3H, s, COMe), 2.07 (3H, s, COMe), 2.08-2.25 (2H, m, C(6)H₂), 4.16-4.27 (1H, m, C(2)H), 5.29 (1H, dd, J 10.9, 9.2, C(3)H), 5.51-5.60 (2H, m, C(4)H, NH), 5.61-5.70 (1H, m, C(5)H); δ_C (125 MHz, CHCl₃) 14.5, 15.9, 21.6, 23.1, 23.9, 28.5, 29.7, 29.9, 29.95, 29.97, 32.3, 48.4, 73.2, 124.5,

136.8, 169.7, 171.0; m/z (ESI$^+$) 334 ([M+Na]$^+$, 100%); HRMS (ESI$^+$) C$_{18}$H$_{33}$NNaO$_3$ $^+$ ([M+Na]$^+$) requires 334.2358; found 334.2354.

**Methyl (E)-4-**-**tert**-**butyldimethylsilyloxy-but-2-ene**

TBDMSCl (3.43 g, 22.7 mmol) was added in one portion to a stirred solution of but-2-ene-1,4-diol (0.93 mL, 11.4 mmol), imidazole (2.33 g, 34.1 mmol) and DMAP (30 mg) in DCM (30 mL) at rt. After stirring for 12 h, the reaction mixture was concentrated in vacuo. The residue was dissolved in Et$_2$O (30 mL) and washed with 1M aq HCl (30 mL), dried and concentrated in vacuo to give 1,4-bis-(**tert**-butyldimethylsilyloxy)but-2-ene as a colourless oil (3.5 g, 97%) that was used without purification; $\delta$$_H$ (400 MHz, CDCl$_3$) 0.07 (12H, s, $2 \times$ SiMe$_2$), 0.90 (18H, s, $2 \times$ SiCMe$_3$), 4.24 (4H, dd, $J$ 2.7, 0.7, C(1)H$_2$, C(4)H$_2$), 5.56 (2H, td, $J$ 2.7, 0.7, C(2)H, C(3)H).

O$_3$ was bubbled through a stirred solution of 1,4-bis-(**tert**-butyldimethylsilyloxy)but-2-ene (3.5 g, 11.0 mmol) in DCM (30 mL) at −78 °C until the solution turned blue. O$_2$ was then bubbled through the solution until it turned colourless. DMS (30 mL) was added dropwise via syringe and the reaction mixture stirred for 12 h. The reaction mixture was concentrated in vacuo. The residue was redissolved in Et$_2$O (30 mL) and washed with H$_2$O (30 mL), dried and concentrated in vacuo to give (**tert**-butyldimethylsilyloxy)acetaldehyde as a colourless oil (3.36 g, 86%) that was used without purification; $\delta$$_H$ (400 MHz, CDCl$_3$) 0.08 (6H, s, SiMe$_2$), 0.90 (9H, s, SiCMe$_3$), 4.17-4.21 (2H, m, C$_2$H$_2$), 9.67-9.69 (1H, m, CHO).

Methyl diethylphosphonoacetate (4.87 g, 23.2 mmol), LiCl (5.43 g, 129 mmol) and iPr$_2$NEt (3.46 mL, 21.2 mmol) were added to a stirred solution of (tri-**iso**-propylsilyloxy)acetaldehyde (3.36 g, 19.3 mmol) in MeCN (50 mL). The reaction mixture was stirred for 48 h and then quenched by addition of H$_2$O (5 mL). The organic layer was separated and the aqueous layer was extracted with EtOAc (40 mL). The combined organic extracts were dried and concentrated in vacuo. Purification via flash column chromatography (eluent 30-40 °C petrol/Et$_2$O, 60:1) gave 26 as a colourless oil (2.29 g, 52%, >98% de);$^6$ $R_f$ 0.07 (30-40 °C petrol/Et$_2$O, 60:1); $\delta$$_H$ (400 MHz, CDCl$_3$) 0.09 (6H, s, SiMe$_2$), 0.93 (9H, s, SiCMe$_3$), 3.75 (3H, s, OMe), 4.34 (2H, dd, $J$ 3.4, 2.4, C(4)H$_2$), 6.12 (1H, dt, $J$ 15.4, 2.4, C(3)H), 7.01 (1H, dt, $J$ 15.4, 3.4, C(2)H).

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**tert-Butyl (E)-4-tert-butyldimethylsilyloxy-but-2-enote 27**

tert-Butyl diethylphosphonoacetate (5.74 g, 22.8 mmol), LiCl (5.39 g, 127 mmol) and 1Pr₂NEt (2.77 mL, 17.1 mmol) were added to a stirred solution of (tert-butyldimethylsilyloxy)acetaldehyde (3.30 g, 19.0 mmol) in MeCN (50 mL). The reaction mixture was stirred for 48 h and then quenched by addition of H₂O (5 mL). The organic layer was separated and the aqueous layer was extracted with EtOAc (40 mL). The combined organic extracts were dried and concentrated in vacuo. Purification via flash column chromatography (eluent 30-40 °C petrol/Et₂O, 60:1) gave 27 as a colourless oil (2.17 g, 67%, >98% de); Rf 0.2 (30-40 °C petrol/Et₂O, 60:1); νmax (film) 1717 (C=O), 1661 (C=C); δH (400 MHz, CDCl₃) 0.06 (6H, s, SiMe₂), 0.90 (9H, s, SiCMe₃), 1.46 (9H, s, OCMes), 4.29 (2H, dd, J 3.5, 2.3, C(4)H₂), 5.97 (1H, dt, J 15.4, 2.3, C(2)H), 6.86 (1H, dt, J 15.4, 3.5, C(3)H); δC (100 MHz, CDCl₃) –5.5 (SiMe₂), 18.3 (SiCMe₃), 25.8 (SiCMe₃), 28.1 (OCMe₃), 62.1 (C(4)), 80.1 (OCMe₃), 121.4 (C(2)), 146.0 (C(3)), 166.0 (C(1)); m/z (Cl⁺) 272 ([M]⁺, 100%); HRMS (CI⁺) C₁₄H₂₈O₃Si⁺ ([M]⁺) requires 272.1808; found 272.1808.

**Methyl (E)-4-tri-iso-propylsilyloxy- but-2-enote 28**

TIPSCI (4.86 mL, 22.7 mmol) was added in one portion to a stirred solution of but-2-ene-1,4-diol (0.93 mL, 11.4 mmol), imidazole (2.33 g, 34.1 mmol) and DMAP (30 mg) in DCM (30 mL) at rt. After stirring for 12 h, the reaction mixture was concentrated in vacuo. The residue was dissolved in Et₂O (30 mL) and washed with 1M aq HCl (30 mL), dried and concentrated in vacuo to give 1,4-bis-(tri-iso-propylsilyloxy)but-2-ene as a colourless oil (4.41 g, 97%) that was used without purification; δH (400 MHz, CDCl₃) 1.02-1.12 (42H, m, 2 × Si(CHMe₂)₃), 4.29-4.33 (4H, m, C(1)H₂, C(4)H₂), 5.30-5.33 (2H, m, C(2)H, C(3)H). O₂ was bubbled through a stirred solution of 1,4-bis-(tri-iso-propylsilyloxy)but-2-ene (4.41 g, 11.0 mmol) in DCM (30 mL) at −78 °C until the solution turned blue. O₂ was then bubbled through the solution until it turned colourless. DMS (30 mL) was added dropwise via syringe and the reaction mixture stirred for 12 h. The reaction mixture was concentrated in vacuo. The residue was redissolved in Et₂O (30 mL) and washed with H₂O (30 mL), dried and concentrated in vacuo to give (tri-iso-propylsilyloxy)acetaldehyde as a colourless oil (4.38 g, 92%) that was used without purification; δH (400 MHz, CDCl₃) 1.02-1.10 (21H, m, Si(CHMe₂)₃), 4.25 (2H, d, J 1.0, CH₂), 9.73 (1H, t, J 1.0, CHO). Methyl diethylphosphonoacetate (4.97 g, 23.6 mmol), LiCl (5.54 g, 132 mmol) and 1Pr₂NEt (3.76 mL, 21.6 mmol) were added to a stirred solution of (tri-iso-propylsilyloxy)acetaldehyde (4.25 g, 19.7 mmol) in MeCN.
(50 mL). The reaction mixture was stirred for 48 h and then quenched by addition of H₂O (5 mL). The organic layer was separated and the aqueous layer was extracted with EtOAc (40 mL). The combined organic extracts were dried and concentrated in vacuo. Purification via flash column chromatography (eluent 30-40 °C petrol/Et₂O, 30:1) gave 28 as a colourless oil (2.79 g, 52%, >98% de); Rf 0.14 (30-40 °C petrol/Et₂O, 30:1); ν_max (film) 1728 (C=O), 1663 (C=C); δ_H (400 MHz, CDCl₃) 1.04-1.09 (21H, m, Si(CHMe₂)₃), 3.75 (3H, s, OMe), 4.38 (2H, dd, J 3.1, 2.4, C(4)H₂), 6.18 (1H, dt, J 15.4, 2.4, C(2)H), 7.02 (1H, dt, J 15.4, 3.1, C(3)H); δ_C (100 MHz, CDCl₃) 11.9 (Si(CHMe₂)₃), 17.9 (Si(CHMe₂)₃), 51.5 (OMe), 62.4 (C(4)), 119.0 (C(2)), 147.8 (C(3)), 167.2 (C(1)); m/z (ESI⁺) 273 ([M+H]+, 100%); HRMS (ESI⁺) C₁₄H₂₉O₃Si⁺ ([M+H]+) requires 273.1886; found 273.1880.

tert-Butyl (E)-4-tri-iso-propylsilyloxy-but-2-enoate 29

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tert-Butyl diethylphosphonoacetate (6.13 g, 24.3 mmol), LiCl (4.84 g, 114 mmol) and tPr₂NEt (2.77 mL, 17.0 mmol) were added to a stirred solution of (tri-iso-propylsilyloxy)acetaldehyde (4.38 g, 20.3 mmol) in MeCN (50 mL). The reaction mixture was stirred for 48 h and then quenched by addition of H₂O (5 mL). The organic layer was separated and the aqueous layer was extracted with EtOAc (40 mL). The combined organic extracts were dried and concentrated in vacuo. Purification via flash column chromatography (eluent 30-40 °C petrol/Et₂O, 50:1) gave 29 as a colourless oil (2.94 g, 68%, >98% de); Rf 0.2 (30-40 °C petrol/Et₂O, 50:1); ν_max (film) 1717 (C=O), 1661 (C=C); δ_H (400 MHz, CDCl₃) 1.03-1.16 (21H, m, Si(CHMe₂)₃), 1.49 (9H, s, CMe₃), 4.38-4.42 (2H, m, C(4)H₂), 6.02-6.08 (1H, m, C(2)H), 6.85-6.92 (1H, m, C(3)H); δ_C (100 MHz, CDCl₃) 11.9 (Si(CHMe₂)₃), 17.9 (Si(CHMe₂)₃), 28.1 (CMe₃), 62.4 (C(4)), 80.1 (CMe₃), 121.3 (C(2)), 146.1 (C(3)), 166.1 (C(1)); m/z (ESI⁺) 315 ([M+NH₄]⁺, 100%); HRMS (ESI⁺) C₁₇H₃₈NO₃Si⁺ ([M+NH₄]⁺) requires 332.2621; found 332.2615.

tert-Butyl (E)-4-tert-butyldiphenylsilyloxy-but-2-enoate 30

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TBDPSCl (5.91 mL 22.7 mmol) was added in one portion to a stirred solution of but-2-ene-1,4-diol (0.93 mL, 11.4 mmol), imidazole (2.33 g, 34.1 mmol) and DMAP (30 mg) in DCM (30 mL) at rt. After stirring for 12 h, the reaction mixture was concentrated in vacuo. The residue was dissolved in Et₂O (30 mL) and washed with 1M aq HCl (30 mL), dried and concentrated in vacuo to give 1,4-bis-(tert-butyldiphenyloxy)but-2-eno as a colourless oil (6.28 g, 98%) that was used without purification; δ_H (400
MHz, CDCl$_3$) 1.01 (18H, s, 2 × SiCMe$_3$), 4.10-4.13 (4H, m, C(1)H$_2$, C(4)H$_2$), 5.62-5.65 (2H, m, C(2)H, C(3)H), 7.31-7.44 (12H, m, Ph), 7.60-7.65 (8H, m, Ph).

O$_3$ was bubbled through a stirred solution of 1,4-bis-(tert-butyldiphenylsilyloxy)but-2-ene (6.28 g, 11.1 mmol) in DCM (30 mL) at −78 °C until the solution turned blue. O$_2$ was then bubbled through the solution until it turned colourless. DMS (30 mL) was added dropwise via syringe and the reaction mixture stirred for 12 h. The reaction mixture was concentrated in vacuo. The residue was redissolved in Et$_2$O (30 mL) and washed with H$_2$O (30 mL), dried and concentrated in vacuo to give (tert-butyldiphenylsilyloxy)acetaldehyde as a colourless oil (5.77 g, 87%) that was used without purification; δ$_H$ (400 MHz, CDCl$_3$) 1.10 (9H, s, SiCMe$_3$), 4.22 (2H, d, J 0.7, CH$_2$), 7.38-7.49 (6H, m, Ph), 7.63-7.69 (4H, m, Ph), 9.73 (1H, t, J 0.7, CHO).

tert-Butyl diethylphosphonoacetate (6.72 g, 26.7 mmol), LiCl (5.25 g, 124 mmol) and iPr$_2$NEt (3.0 mL, 18.5 mmol) were added to a stirred solution of (tert-butyldiphenylsilyloxy)acetaldehyde (5.60 g, 22.2 mmol) in MeCN (50 mL). The reaction mixture was stirred for 48 h and then quenched by addition of H$_2$O (5 mL). The organic layer was separated and the aqueous layer was extracted with EtOAc (40 mL). The combined organic extracts were dried and concentrated in vacuo. Purification via flash column chromatography (eluent 30-40 °C petrol/Et$_2$O, 50:1) gave 30 as a white solid (3.89 g, 68%, >98% de); R$_f$ 0.2 (30-40 °C petrol/Et$_2$O, 50:1); C$_{24}$H$_{32}$O$_3$Si requires C, 72.7; H, 8.1%; found C, 72.6; H, 8.1%; mp 73-75 °C (30-40 °C petrol/Et$_2$O); ν$_{max}$ (KBr) 1709 (C=O), 1652 (C=C); δ$_H$ (400 MHz, CDCl$_3$) 1.18 (9H, s, SiCMe$_3$), 1.59 (9H, s, OCMMe$_3$), 4.41 (2H, app t, J 2.4, C(4)H$_2$), 6.26-6.34 (1H, m, C(2)H), 6.95-7.02 (1H, m, C(3)H), 7.42-7.51 (6H, m, Ph), 7.73-7.78 (4H, m, Ph); δ$_C$ (100 MHz, CDCl$_3$) 19.3 (SiCMMe$_3$), 26.9 (SiCMMe$_3$), 28.2 (OCMMe$_3$), 63.0 (C(4)), 80.2 (CMe$_3$), 121.6 (C(2)), 127.9, 129.9, 133.1, 135.5 (Ph), 145.6 (C(3)), 166.0 (C(1)); m/z (CI$^+$) 414 ([M+NH$_4^+$]$^+$, 100%); HRMS (CI$^+$) C$_{24}$H$_{36}$NO$_3$Si ([M+NH$_4^+$]$^+$) requires 414.2464; found 414.2454.

Methyl (2S,3S,αS)-2-hydroxy-3-[N-benzyl-N-(α-methylbenzyl)amino]-4-(tert-butyldimethylsilyloxy)butanoate 31

BuLi (2.5 M in hexanes, 2.7 mL, 6.74 mmol) was added dropwise via syringe to a stirred solution of (S)-N-benzyl-N-(α-methylbenzyl)amine (1.47 g, 6.96 mmol) in THF (20 mL) at −78 °C. After stirring for 30 min a solution of 26 (1.0 g, 4.35 mmol) in THF (10 mL) at −78 °C was added dropwise via cannula. After stirring for a further 2 h at −78 °C the reaction mixture was quenched with (+)-CSO (4.2 g, 18.4 mmol) and
allowed to warm to rt over 12 h. Sat aq NH₄Cl (5 mL) was added and the mixture was stirred for 5 min before being concentrated *in vacuo*. The residue was partitioned between DCM (50 mL) and 10% aq citric acid (10 mL). The organic layer was separated and the aqueous layer was extracted with DCM (2 × 50 mL). The combined organic extracts were washed sequentially with sat aq NaHCO₃ (50 mL) and brine (50 mL), dried and concentrated *in vacuo*. The residue was dissolved in Et₂O (50 mL), the insoluble CSO residues were filtered off, and the filter cake was washed with Et₂O (2 × 20 mL). The filtrate was concentrated *in vacuo* and the process was repeated. Purification *via* flash column chromatography (eluent 30-40 °C petrol/Et₂O, 20:1) gave 31 as a colourless oil (1.55 g, 78%, >98% de); \( R_f 0.25 \) (30-40 °C petrol/Et₂O 20:1); \( [\alpha]_{D}^{21} +26.2 \) (c 1.0 in CHCl₃); \{lit. \( [\alpha]_{D}^{21} +25.0 \) (c 1.2 in CHCl₃)}; \( \delta_H \) (400 MHz, CDCl₃) 0.02 (3H, s, SiMe₃A), 0.03 (3H, s, SiMe₃B), 0.88 (SiMe₃C), 1.37 (3H, d, \( J 6.8 \), C(α)Me), 2.98 (1H, d, \( J 6.5 \), OH), 3.55-3.62 (1H, m, C(3)H), 3.68 (3H, s, OMe), 3.70-3.76 (1H, m, C(4)H₂A), 3.83 (1H, d, \( J 15.2 \), NCH₃B), 3.87-4.02 (3H, m, C(2)H, C(4)H₂B, C(α)H), 4.14 (1H, d, \( J 15.2 \), NCH₃B), 7.16-7.48 (10H, m, Ph).

**tert-Butyl (2S,3S,αS)-2-hydroxy-3-[N-benzyl-N-(α-methylbenzyl)amino]-4-tert-butyldimethylsilyloxy-butanoate 32**

BuLi (2.5 M in hexanes, 5.7 mL, 14.2 mmol) was added dropwise *via* syringe to a stirred solution of (S)-N-benzyl-N-(α-methylbenzyl)amine (3.1 g, 14.7 mmol) in THF (50 mL) at −78 °C. After stirring for 30 min a solution of 27 (2.5 g, 9.19 mmol) in THF (20 mL) at −78 °C was added dropwise *via* cannula. After stirring for a further 2 h at −78 °C the reaction mixture was quenched with (+)-CSO (4.2 g, 18.4 mmol) and allowed to warm to rt over 12 h. Sat aq NH₄Cl (5 mL) was added and the mixture was stirred for 5 min before being concentrated *in vacuo*. The residue was partitioned between DCM (50 mL) and 10% aq citric acid (10 mL). The organic layer was separated and the aqueous layer was extracted with DCM (2 × 50 mL). The combined organic extracts were washed sequentially with sat aq NaHCO₃ (50 mL) and brine (50 mL), dried and concentrated *in vacuo*. The residue was dissolved in Et₂O (50 mL), the insoluble CSO residues were filtered off, and the filter cake was washed with Et₂O (2 × 20 mL). The filtrate was concentrated *in vacuo* and the process was repeated. Purification *via* flash column chromatography (eluent 30-40 °C petrol/Et₂O, 30:1)

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gave 32 as a colourless oil (3.33 g, 91%, >98% de); \(R_f 0.05\) (30-40 °C petrol:Et₂O, 1:3); [\(\alpha\)]\textsubscript{D}\textsuperscript{22} +58.7 (c 1.05 in CHCl₃); \(v\)\textsubscript{max} (film) 3491 (O–H), 1724 (C=O); \(\delta\)\textsubscript{H} (400 MHz, CDCl₃) 0.01 (3H, s, SiMe₃), 0.04 (3H, s, SiMe₃), 0.90 (9H, s, SiMe₃), 3.51-3.56 (1H, m, C(3)H), 3.73-3.83 (3H, m, C(4)H₂, NCH₂), 3.92 (1H, dd, J 6.3, 1.8, C(2)H), 4.00 (1H, q, J 6.8, C(α)H), 4.21 (1H, d, J 15.2, NCH₃), 7.20-7.47 (10H, m, Ph); \(\delta\)\textsubscript{C} (100 MHz, CDCl₃) −5.6 (SiMe₃), −5.5 (SiMe₃), 18.5 (SiMe₃), 18.8 (C(α)Me), 26.1 (SiMe₃), 28.1 (OCH₃), 31.2 (NCH₃), 35.0 (C(α)), 59.9 (C(3)), 61.9 (C(4)), 71.7 (C(2)), 82.0 (OCH₃), 126.4, 126.8 (p-Ph), 127.8, 127.9, 128.1, 128.2 (o-Ph, m-Ph), 142.2, 143.5 (i-Ph), 173.7 (C(1)); \(m/z\) (ESI⁺) 500 ([M+H]⁺, 100%); HRMS (ESI⁺) \(C_{29}H_{45}NO_4Si^+\) requires 500.3196; found 500.3209.

**Methyl (2S,3S,αS)-2-hydroxy-3-[N-benzyl-N-(α-methylbenzyl)amino]-4-tri-iso-propylsilyloxy-butanoate 33**

BuLi (2.5 M in hexanes, 8.14 mL, 11.4 mmol) was added dropwise via syringe to a stirred solution of (S)-N-benzyl-N-(α-methylbenzyl)amine (2.48 g, 11.8 mmol) in THF (50 mL) at −78 °C. After stirring for 30 min a solution of 28 (2.0 g, 7.35 mmol) in THF (20 mL) at −78 °C was added dropwise via cannula. After stirring for a further 2 h at −78 °C the reaction mixture was quenched with (+)-CSO (3.37 g, 14.7 mmol) and allowed to warm to rt over 12 h. Sat aq NH₄Cl (5 mL) was added and the mixture was stirred for 5 min before being concentrated \textit{in vacuo}. The residue was partitioned between DCM (50 mL) and 10% aq citric acid (10 mL). The organic layer was separated and the aqueous layer was extracted with DCM (2 × 50 mL). The combined organic extracts were washed sequentially with sat aq NaHCO₃ (50 mL) and brine (50 mL), dried and concentrated \textit{in vacuo}. The residue was dissolved in Et₂O (50 mL), the insoluble CSO residues were filtered off, and the filter cake was washed with Et₂O (2 × 20 mL). The filtrate was concentrated \textit{in vacuo} and the process was repeated. Purification via flash column chromatography (eluent 30-40 °C petrol/Et₂O, 20:1) gave 33 as a colourless oil (2.75 g, 75%, >98% de); \(R_f 0.18\) (30-40 °C petrol/Et₂O, 20:1); \(C_{29}H_{45}NO_4Si\) requires C, 69.7; H, 9.1; N, 2.8%; found C, 69.6; H, 9.1; N, 2.8%; [\(\alpha\)]\textsubscript{D}\textsuperscript{22} +37.0 (c 2.3 in CHCl₃); \(v\)\textsubscript{max} (film) 3515 (O–H), 1737 (C=O); \(\delta\)\textsubscript{H} (400 MHz, CDCl₃) 1.02-1.06 (21H, m, Si(CHMe₂)₃), 1.36 (3H, d, J 6.8, C(α)Me), 3.03 (1H, d, J 6.2, OH), 3.55-3.61 (1H, m, C(3)H), 3.67 (3H, s, OMe), 3.82 (1H, d, J 15.0, NCH₂), 3.79-3.85 (1H, m, C(4)H₂), 3.93-4.02 (2H, m, C(4)H₂, C(α)H), 4.05-4.10 (1H, m, C(2)H),
4.14 (1H, d, $J$ 15.0, NCH$_B$), 7.20-7.46 (10H, m, Ph); \( \delta_C \) (100 MHz, CDCl$_3$) 11.9 (Si(CHMe$_2$)$_3$), 17.9 (Si(CHMe$_2$)$_3$), 18.1 (C(\( \alpha \)Me)), 51.4 (NCH$_2$), 52.1 (OMe), 58.0 (C(\( \alpha \))), 60.1 (C(3)), 62.2 (C(4)), 71.0 (C(2)), 126.6, 127.0 (p-Ph), 127.9, 128.1, 128.2, 128.3 (o-Ph, m-Ph), 141.7, 143.1 (i-Ph), 174.7 (C(1)); \( m/z \) (ESI$^+$) 522 ([M+Na$^+$], 28%), 500 (100); HRMS (ESI$^+$) $C_{29}H_{46}NO_4Si^+$ ([M+H$^+$]) requires 500.3196; found 500.3194.

tert-Butyl (2S,3S,\( \alpha \)S)-2-hydroxy-3-[N-benzyl-N-(\( \alpha \)-methylbenzyl)amino]-4-tri-\( \alpha \)-propysilyloxybutanoate 34

BuLi (2.5 M in hexanes, 4.9 mL, 12.3 mmol) was added dropwise via syringe to a stirred solution of (S)-N-benzyl-N-(\( \alpha \)-methylbenzyl)amine (2.70 g, 12.7 mmol) in THF (50 mL) at −78 °C. After stirring for 30 min a solution of 29 (2.5 g, 8.0 mmol) in THF (20 mL) at −78 °C was added dropwise via cannula. After stirring for a further 2 h at −78 °C the reaction mixture was quenched with (+)-CSO (3.64 g, 16.0 mmol) and allowed to warm to rt over 12 h. Sat aq NH$_4$Cl (5 mL) was added and the mixture was stirred for 5 min before being concentrated in vacuo. The residue was partitioned between DCM (50 mL) and 10% aq citric acid (10 mL). The organic layer was separated and the aqueous layer was extracted with DCM (2 x 50 mL). The combined organic extracts were washed sequentially with sat aq NaHCO$_3$ (50 mL) and brine (50 mL), dried and concentrated in vacuo. The residue was dissolved in Et$_2$O (50 mL), the insoluble CSO residues were filtered off, and the filter cake was washed with Et$_2$O (2 x 20 mL). The filtrate was concentrated in vacuo and the process was repeated. Purification via flash column chromatography (eluent 30-40 °C petrol/Et$_2$O, 10:1) gave 34 as a colourless oil (3.56 g, 82%, >98% de); \( [\alpha]_D^28 \) +37.4 (c 1.1 in CHCl$_3$); \( \nu_{max} \) (film) 3505 (O–H), 1724 (C=O); \( \delta_H \) (400 MHz, CDCl$_3$) 0.98-1.14 (21H, m, Si(CHMe$_2$)$_3$), 1.35 (3H, d, $J$ 6.8, C(\( \alpha \)Me)), 1.42 (9H, s, CMe$_3$), 3.48-3.54 (1H, m, C(3)H), 3.80 (1H, q, $J$ 6.8, C(\( \alpha \)H)), 4.20 (1H, d, $J$ 15.2, NCH$_A$), 3.84-3.88 (2H, m, C(4)H$_2$), 3.97-4.00 (1H, m, C(2)H), 4.02 (1H, q, $J$ 6.8, C(\( \alpha \)H)), 4.20 (1H, d, $J$ 15.2, NCH$_B$), 7.20-7.47 (10H, m, Ph); \( \delta_C \) (100 MHz, CDCl$_3$) 12.0 (Si(CHMe$_2$)$_3$), 18.1 (Si(CHMe$_2$)$_3$), 18.2 (C(\( \alpha \)Me)), 28.1 (CMe$_3$), 51.2 (NCH$_2$), 58.3 (C(\( \alpha \))), 60.6 (C(3)), 62.0 (C(4)), 71.8 (C(2)), 82.1 (CMe$_3$), 126.5, 126.8 (p-Ph), 128.0, 128.1, 128.2, 128.3 (o-Ph, m-Ph), 142.2, 144.0 (i-Ph), 173.7 (C(1)); \( m/z \) (ESI$^+$) 542 ([M+H$^+$], 100%); HRMS (ESI$^+$) $C_{32}H_{52}NO_4Si^+$ ([M+H$^+$]) requires 542.3666; found 542.3676.
tert-Butyl (2S,3S,αS)-2-hydroxy-3-[N-benzyl-N-(α-methylbenzyl)amino]-4-tert-butylidiphenylsilyloxy-butanoate 35

BuLi (2.5 M in hexanes, 3.9 mL, 9.8 mmol) was added dropwise via syringe to a stirred solution of (S)-N-benzyl-N-(α-methylbenzyl)amine (2.12 g, 10.1 mmol) in THF (50 mL) at −78 °C. After stirring for 30 min a solution of 30 (2.5 g, 6.3 mmol) in THF (20 mL) at −78 °C was added dropwise via cannula. After stirring for a further 2 h at −78 °C the reaction mixture was quenched with (+)-CSO (2.9 g, 12.6 mmol) and allowed to warm to rt over 12 h. Sat aq NH₄Cl (5 mL) was added and the mixture was stirred for 5 min before being concentrated in vacuo. The residue was partitioned between DCM (50 mL) and 10% aq citric acid (10 mL). The organic layer was separated and the aqueous layer was extracted with DCM (2 × 50 mL). The combined organic extracts were washed sequentially with sat aq NaHCO₃ (50 mL) and brine (50 mL), dried and concentrated in vacuo. The residue was dissolved in Et₂O (50 mL), the insoluble CSO residues were filtered off, and the filtrate was washed with Et₂O (2 × 20 mL). The filtrate was concentrated in vacuo and the process was repeated. Purification via flash column chromatography (eluent 30-40 °C petrol/Et₂O, 10:1) gave 35 as a colourless oil (3.5 g, 89%, >98% de); Rf 0.2 (30-40 °C petrol/Et₂O, 10:1); [α]Dº +40.1 (c 1.1 in CHCl₃); νmax (film) 3499 (O−H), 1724 (C=O); δH (400 MHz, CDCl₃) 1.06 (9H, s, SiCMe₃), 1.27 (3H, d, J 6.8, C(α)Me), 1.31 (9H, s, OCMe₃), 3.03 (1H, d, J 5.6, OH), 3.59 (1H, td, J 6.8, 1.8, C(3)H), 3.80 (1H, d, J 15.2, NCH₃), 3.84 (2H, d, J 7.3, C(4)H₂), 4.00 (1H, q, J 6.8, C(α)H), 4.02-4.06 (1H, m, C(2)H), 4.13 (1H, d, J 14.9, NCH₂), 7.20-7.76 (20H, m, Ph); δC (100 MHz, CDCl₃) 18.4 (SiCMe₃), 19.2 (C(α)Me), 27.0 (SiCMe₃), 28.0 (OCMe₃), 51.2 (NCH₂), 58.0 (C(α)), 60.4 (C(3)), 62.5 (C(4)), 71.6 (C(2)), 82.2 (OCMe₃), 126.5, 126.9, 127.6, 127.72, 127.74, 127.9, 128.2, 128.3, 129.6, 129.7, 133.4, 134.8, 135.56, 135.59, 141.9, 143.9 (Ph), 173.5 (C(1)); m/z (ESI⁺) 625 ([M+H]⁺, 100%); HRMS (ESI⁺) C₃₀H₅₀NO₄Si ([M+H]⁺) requires 624.3509; found 624.3514.

Methyl (2S,3S)-2-hydroxy-3-[N-(tert-butoxycarbonyl)amino]-4-tert-butylidimethylsilyloxy-butanoate 36

Pearlman’s catalyst (125 mg, 25% w/w) was added to a vigorously stirred solution of 31 (500 mg, 1.09 mmol) and Boc₂O (262 mg, 1.20 mmol) in EtOAc (15 mL) and the mixture was placed under H₂ (5 atm).
Stirring continued for 12 h, after which time the reaction mixture was filtered through Celite (eluent EtOAc) and concentrated in vacuo. Purification via flash column chromatography (eluent 30-40 °C petrol/Et2O, 5:1; then 30-40 °C petrol/Et2O, 1:1) gave 36 as a colourless oil (270 mg, 68%, >98% de); $R_f$ 0.08 (30-40 °C petrol/Et2O, 5:1); C$_{16}$H$_{33}$NO$_6$Si requires C, 52.9; H, 9.15; N, 3.85%; found C, 52.9; H, 9.2; N, 4.0%; $[\alpha]_D^{21} +26.8$ (c 1.0 in CHCl$_3$); $\nu_{\text{max}}$ (film) 3452 (O$\sim$H), 1719 (C=O); $\delta$H (400 MHz, CDCl$_3$) 0.04 (6H, s, SiMe$_2$), 0.87 (9H, s, SiCMe$_3$), 1.43 (9H, s, CMe$_3$), 3.38-3.49 (1H, br s, OH), 3.64-3.78 (2H, m, C(4)H$_2$), 3.75 (3H, s, OMe), 3.97-4.06 (1H, m, C(3)H), 4.21-4.28 (1H, m, C(2)H), 5.12 (1H, d, $J$ 8.9, NH); $\delta$C (100 MHz, CDCl$_3$) $-5.7$ (SiMe$_2$A), $-5.7$ (SiMe$_2$B), 18.3 (SiCMe$_3$), 25.8 (SiCMe$_3$), 28.3 (OCMe$_3$), 52.4 (OMe), 53.4 (C(3)), 62.0 (C(4)), 71.6 (C(2)), 79.7 (OCMe$_3$), 155.3 (NCO), 173.2 (C(1)); m/z (ESI$^+$) 386 ([M+Na]$^+$, 100%); HRMS (ESI$^+$) C$_{16}$H$_{33}$NNaO$_6$Si ([M+Na$^+$]) requires 386.1975; found 386.1962.

tert-Butyl (2S,3S)-2-hydroxy-3-[N-(tert-butoxycarbonyl)amino]-4-tert-butyldimethylsilyloxy-butanoate 37

Pearlman’s catalyst (62.5 mg, 25% w/w) was added to a vigorously stirred solution of 32 (250 mg, 0.50 mmol) and Boc$_2$O (120 mg, 0.55 mmol) in EtOAc (10 mL) and the mixture was placed under H$_2$ (5 atm). Stirring continued for 12 h, after which time the reaction mixture was filtered through Celite (eluent EtOAc) and concentrated in vacuo. Purification via flash column chromatography (eluent 30-40 °C petrol/Et2O, 5:1; then 30-40 °C petrol/Et2O, 1:1) gave 37 as a colourless oil (175 mg, 86%, >98% de); $R_f$ 0.18 (30-40 °C petrol/Et2O, 5:1); $[\alpha]_D^{17} +22.0$ (c 0.8 in CHCl$_3$); $\nu_{\text{max}}$ (film) 3447 (O$\sim$H), 1722 (C=O), 1716 (C=O); $\delta$H (400 MHz, CDCl$_3$) 0.065 (3H, s, SiMe$_2$A), 0.068 (3H, s, SiMe$_2$B), 0.90 (9H, s, SiCMe$_3$), 1.46 (9H, s, OCMe$_3$), 1.50 (9H, s, OCMe$_3$), 3.41 (1H, d, $J$ 8.9, OH), 3.76 (2H, dq, $J$ 13.7, 3.8, C(4)H$_2$), 3.91-4.00 (1H, m, C(3)H), 4.18 (1H, dd, $J$ 8.9, 4.4, C(2)H), 5.20 (1H, d, $J$ 8.9, NH); $\delta$C (100 MHz, CDCl$_3$) $-6.6$ (SiMe$_2$), 17.3 (SiCMe$_3$) 24.8 (SiCMe$_3$), 27.0 (OCMe$_3$), 27.4 (OCMe$_3$), 52.1 (C(3)), 62.1 (C(4)), 71.7 (C(2)), 78.6 (OCMe$_3$), 81.5 (OCMe$_3$), 154.4 (NCO), 170.6 (C(1)); m/z (ESI$^+$) 406 ([M+Na]$^+$, 100%); HRMS (ESI$^+$) C$_{19}$H$_{40}$NO$_6$Si ([M+H$^+$]) requires 406.2625; found 406.2633.
Methyl (2S,3S)-2-hydroxy-3-[N-(tert-butoxycarbonyl)amino]-4-tri-iso-propylsilyloxy-butanoate 38

Pearlman’s catalyst (1.25 g, 25% w/w) was added to a vigorously stirred solution of 33 (5.0 g, 10.0 mmol) and Boc₂O (2.4 g, 11.0 mmol) in EtOAc (50 mL) and the mixture was placed under H₂ (5 atm). Stirring continued for 12 h, after which time the reaction mixture was filtered through Celite (eluent EtOAc) and concentrated in vacuo. Purification via flash column chromatography (eluent 30-40 °C petrol/Et₂O, 10:1; then 30-40 °C petrol/Et₂O, 1:1) gave 38 as a colourless oil (3.81 g, 94%, >98% de); Rᵢ 0.08 (30-40 °C petrol/Et₂O, 10:1); C₁₉H₃₉NO₆Si requires C, 56.3; H, 9.7; N, 3.45%; found C, 56.2; H, 9.7; N, 3.5%; [α]D²¹ +17.3 (c 0.4 in CHCl₃); νₘₐₓ (film) 3453 (O−H), 1732 (C=O), 1720 (C=O); δH (400 MHz, CDCl₃) 1.01-1.09 (21H, m, Si(CH₂Me₂)₃), 1.45 (9H, s, CMe₃), 3.54 (1H, br s, OMe), 3.78 (3H, s, OMe); δC (100 MHz, CDCl₃) 11.8 (Si(CH₂Me₂)₃), 17.8 (Si(CH₂Me₂)₃), 28.3 (CMe₃), 52.5 (OMe), 53.5 (C(3)), 62.9 (C(4)), 72.1 (C(2)), 79.7 (CMe₃), 155.4 (NCO), 173.1 (C(1)); m/z (ESI⁺) 428 ([M+Na]⁺, 44%), 406 (100); HRMS (ESI⁺) C₁₉H₄₀NO₆Si⁺ ([M+H]⁺) requires 406.2625; found 406.2615.

tert-Butyl (2S,3S)-2-hydroxy-3-[N-(tert-butoxycarbonyl)amino]-4-tri-iso-propylsilyloxy-butanoate 39

Pearlman’s catalyst (250 mg, 25% w/w) was added to a vigorously stirred solution of 34 (1.0 g, 1.85 mmol) and Boc₂O (443 mg, 2.03 mmol) in EtOAc (20 mL) and the mixture was placed under H₂ (5 atm). Stirring continued for 12 h, after which time the reaction mixture was filtered through Celite (eluent EtOAc) and concentrated in vacuo. Purification via flash column chromatography (eluent 30-40 °C petrol/Et₂O, 9:1; then 30-40 °C petrol/Et₂O, 1:1) gave 39 as a colourless oil (744 mg, 90%, >98% de); Rᵢ 0.08 (30-40 °C petrol/Et₂O, 9:1); C₂₂H₄₅NO₆Si requires C 59.0, H 10.1, N 3.1%; found C 59.0, H 10.15, N 3.1%; [α]D¹⁸ +36.9 (c 1.0 in CHCl₃); νₘₐₓ (film) 3452 (O−H), 1721 (C=O); δH (400 MHz, CDCl₃) 1.03-1.16 (21H, m, Si(CHMe₂)₃), 1.45 (9H, s, CMe₃), 1.49 (9H, s, CMe₃), 3.54 (1H, d, J = 9.6, OH), 3.82-3.98 (3H, m, C(3)H, C(4)H₂), 4.22 (1H, dd, J = 9.6, 4.3, C(2)H), 5.31 (1H, d, J = 8.8, NH); δC (100 MHz, CDCl₃) 11.6 (Si(CHMe₂)₃), 17.8 (Si(CHMe₂)₃), 27.9 (CMe₃), 28.3 (CMe₃), 53.1 (C(3)), 63.4 (C(4)), 72.8 (C(2)), 79.4 (CMe₃), 82.3
(CMe₃), 155.3 (NCO), 171.5 (C(1)); m/z (ESI⁺) 448 ([M+H⁺], 100%); HRMS (ESI⁺) C₂₂H₄₆NO₆Si ([M+H⁺]) requires 448.3094; found 448.3088.

tert-Butyl (2S,3S)-2-hydroxy-3-[N-(tert-butoxycarbonyl)amino]-4-tert-butyldiphenylsilyloxy-butanoate 40

Pearman’s catalyst (500 mg, 25% w/w) was added to a vigorously stirred solution of 35 (1.00 g, 1.60 mmol) and Boc₂O (350 mg, 1.76 mmol) in EtOAc (50 mL) and the mixture was placed under H₂ (5 atm). Stirring continued for 12 h, after which time the reaction mixture was filtered through Celite (eluent EtOAc) and concentrated in vacuo. Purification via flash column chromatography (eluent 30-40 °C petrol/Et₂O, 9:1; then 30-40 °C petrol/Et₂O, 1:1) gave 40 as a colourless oil (696 mg, 82%, >98% de); Rf 0.05 (30-40 °C petrol/Et₂O, 9:1); [α]D²⁸ +17.2 (c 1.1 in CHCl₃); νmax (film) 3452 (O−H), 1720 (C=O); δH (400 MHz, CDCl₃) 1.07 (9H, s, SiCMe₃), 1.41 (9H, s, OCMMe₃), 1.47 (9H, s, OCMMe₃), 3.40 (1H, d, J 8.8, OCH), 3.68-3.83 (2H, m, C(4)H₂), 3.97-4.08 (1H, m, C(3)H), 4.24 (1H, dd, J 8.6, 4.3, C(2)H), 5.24 (1H, d, J 8.8, NH), 7.34-7.48 (6H, m, Ph), 7.63-7.71 (4H, m, Ph); δC (100 MHz, CDCl₃) 19.1 (SiCMe₃), 26.8 (SiCMe₃), 27.9 (OCMe₃), 28.4 (OCMe₃), 53.5 (C(3)), 63.7 (C(4)), 72.6 (C(2)), 79.6 (OCMe₃), 82.7 (OCMe₃), 127.8, 129.9, 132.5, 132.6 (Ph), 155.5 (NCO), 171.6 (C(1)); m/z (ESI⁺) 552 ([M+Na⁺], 100%), 530 (11); HRMS (ESI⁺) C₂₀H₄₃NNaO₆Si ([M+Na⁺]) requires 552.2757; found 552.2758.

(4S,5S)-2,2-Dimethyl-N(3)-tert-butoxycarbonyl-4-tert-butyldimethylsilyloxyethyl-5-methoxycarbonyl-oxazolidine 41

BF₃·Et₂O (1 M in Et₂O) was added dropwise to a stirred solution of 36 (240 mg, 0.66 mmol) and 2,2-dimethoxypropane (5 mL) in acetone (10 mL) until a permanent colour change from colourless to dark orange was observed. After stirring at rt for 12 h Et₃N was added dropwise until pH 7 was achieved and the reaction mixture was concentrated in vacuo. Purification via flash column chromatography (eluent 30-40 °C petrol/Et₂O, 10:1; then 30-40 °C petrol/Et₂O, 2:1) gave 41 as a colourless oil (first to elute, 132 mg, 48%, >98% de) and unreacted 36 as a colourless oil (second to elute, 93 mg, 39%, >98% de).
Data for 41: $R_f$ 0.4 (30-40 °C petrol/Et₂O, 2:1); $C_{19}H_{37}NO_6Si$ requires C, 56.5; H, 9.2; N, 3.5%; found C, 56.7; H, 9.25; N, 3.5%; $[\alpha]_D^{22}$ +18.9 (c 0.2 in CHCl₃); $\nu_{\text{max}}$ (film) 1770 (C=O), 1704 (C=O); $\delta_H$ (400 MHz, CDCl₃) 0.03-0.05 (6H, m, SiMe₂), 0.86-0.90 (9H, m, SiCMe₃), 1.46-1.50 (9H, s, OMe₃), 1.50-1.56 (3H, m, C(2)Me₆A), 1.61-1.67 (3H, m, C(4)CH₂), 3.77 (3H, s, OMe), 4.08-4.26 (1H, m, C(4)H); $m/z$ (ESI⁺) 404 ([M+H]+, 100%); HRMS (ESI⁺) $C_{19}H_{38}NO_6Si^+$ ([M+H]+) requires 404.2468; found 404.2463.

(4S,5S)-2,2-Dimethyl-N(3),5-di-tert-butoxycarbonyl-4-tert-butyldimethylsilyloxymethyl-oxazolidine 42 and (4S,5S)-2,2-dimethyl-N(3)-tert-butoxycarbonyl-4-tert-butyldimethylsilyloxymethyl-oxazolidine-5-carboxylic acid 43

BF₃·Et₂O (1 M in Et₂O) was added dropwise to a stirred solution of 37 (1.20 g, 2.96 mmol) and 2,2-dimethoxypropane (25 mL) in acetone (100 mL) until a permanent colour change from colourless to dark orange was observed. After stirring at rt for 12 h Et₃N was added dropwise until pH 7 was achieved and the reaction mixture was concentrated in vacuo. Purification via flash column chromatography (eluent 30-40 °C petrol/Et₂O, 10:1; then 30-40 °C petrol/Et₂O, 2:1) gave 42 as a colourless oil (first to elute, 686 mg, 52%, >98% de) and 43 as a pale yellow oil (second to elute, 230 mg, 20%, >98% de).

Data for 42: $R_f$ 0.54 (30-40 °C petrol/Et₂O, 2:1); $[\alpha]_D^{22}$ +10.5 (c 1.6 in CHCl₃); $\nu_{\text{max}}$ (film) 1759 (C=O), 1699 (C=O); $\delta_H$ (400 MHz, CDCl₃) 0.03-0.08 (6H, m, SiMe₂), 0.86-0.91 (9H, m, SiCMe₃), 1.42-1.67 (24H, m, C(2)Me₂, 2 × OMe₃), 3.58-3.76 (1H, m, C(4)CH₄), 3.82-3.99 (1H, m, C(4)CH₂), 4.03-4.23 (1H, m, C(4)H), 4.49-4.56 (1H, m, C(5)H); $\delta_H$ (250 MHz, DMSO-d₆, 363 K) 0.04 (6H, s, SiMe₂), 0.88 (9H, s, SiCMe₃), 1.45 (9H, s, OMe₃), 1.47 (9H, s, OMe₃), 1.54 (6H, s, C(2)Me₂), 3.66 (1H, dd, J 10.4, 3.4, C(4)CH₄), 3.87 (1H, dd, J 10.4, 5.2, C(4)CH₂), 4.05 (1H, ddec, J 6.4, 5.2, 3.4, C(4)H), 4.59 (1H, d, J 6.4, C(5)H); $m/z$ (ESI⁺) 446 ([M+H]+, 100%); HRMS (ESI⁺) $C_{22}H_{44}NO_6Si^+$ ([M+H]+) requires 446.2938; found 446.2937.

Data for 43: $R_f$ 0.38 (30-40 °C petrol/Et₂O, 2:1); $[\alpha]_D^{22}$ +7.56 (c 1.6 in CHCl₃); $\nu_{\text{max}}$ (film) 1801 (C=O), 1716 (C=O); $\delta_H$ (250 MHz, CDCl₃) 0.03 (6H, s, SiMe₂), 0.85 (9H, s, SiCMe₃), 1.39 (9H, s, OMe₃), 1.52 (3H, s, C(2)Me₆A), 1.55 (3H, s, C(2)Me₆B), 3.59-3.65 (1H, m, C(4)CH₄), 3.71-3.78 (1H, m, C(4)CH₂), 3.93-3.97 (1H, m, C(4)H), 4.56 (1H, d, J 2.7, C(5)H); $\delta_C$ (62.5 MHz, CDCl₃) –5.1 (SiMe₂), 18.6 (SiCMe₃), 26.2 (SiCMe₃),
26.8 (C(2)Meₐ), 27.3 (C(2)Meₐ), 28.7 (OCMe₃), 53.1 (C(4)), 61.5 (C(4)CH₂), 73.8 (C(5)), 80.4 (OCMe₃), 111.2 (C(2)), 155.6 (NCO), 171.2 (CO₂H); m/z (ESI⁺) 390 ([M+H]⁺, 100%); HRMS (ESI⁺) C₁₈H₃₆NO₆Si ([M+H]⁺) requires 390.2312; found 390.2300.

(4S,5S)-2,2-Dimethyl-N(3)-tert-butoxycarbonyl-4-tri-iso-propylsilyloxyethyl-5-methoxycarbonyloxazolidine 44

BF₃·Et₂O (1 M in Et₂O) was added dropwise to a stirred solution of 38 (1.10 g, 2.72 mmol) and 2,2-dimethoxypropane (10 mL) in acetone (20 mL) until a permanent colour change from colourless to dark orange was observed. After stirring at 50 °C for 12 h the reaction mixture was allowed to cool to rt and Et₃N was added dropwise until pH 7 was achieved. The reaction mixture was then concentrated in vacuo. Purification via flash column chromatography (eluent 30-40 °C petrol/Et₂O, 10:1; then 30-40 °C petrol/Et₂O, 2:1) gave 44 as a colourless oil (first to elute, 907 mg, 75%, >98% de) and unreacted 38 as a colourless oil (second to elute, 218 mg, 20%, >98% de).

Data for 44: Rf 0.53 (30-40 °C petrol/Et₂O, 2:1); [α]D²² +15.2 (c 1.8 in CHCl₃); νmax (film) 1739 (C=O), 1699 (C=O); δH (400 MHz, CDCl₃) 1.01-1.10 (21H, m, Si(CHMe₂)₃), 1.47 (9H, s, CMe₃), 1.50-1.57 (3H, m, C(2)Meₐ), 1.63-1.69 (3H, m, C(2)Meₐ), 3.70-3.98 (2H, m, C(4)CH₂), 3.77 (3H, s, OMe), 4.12-4.29 (1H, m, C(4)H), 4.62-4.69 (1H, m, C(5)H); δH (500 MHz, DMSO-d₆, 363 K) 1.02-1.10 (21H, m, Si(CHMe₂)₃), 1.45 (9H, s, CMe₃), 1.50 (3H, m, C(2)Meₐ), 1.56 (3H, s, C(2)Meₐ), 2.70 (3H, s, OMe), 3.73 (1H, dd, J 10.1, 3.0, C(4)CHₐ), 3.84 (1H, dd, J 10.1, 6.7, C(4)CHₐ), 4.12 (1H, dt, J 6.3, 3.0, C(4)H), 4.76 (1H, d, C(5)H); δC (125 MHz, DMSO-d₆, 363 K) 12.4 (Si(CHMe₂)₃), 18.6 (Si(CHMe₂)₃), 25.1 (C(2)Meₐ), 27.6 (C(2)Meₐ), 28.9 (CMe₃), 52.2 (OMe), 60.7 (C(4)CH₂), 61.3 (C(4)), 74.0 (C(5)), 80.6 (CMe₃), 94.1 (C(2)), 151.8 (NCO), 168.5 (CO₂Me); m/z (ESI⁺) 468 ([M+Na]⁺, 54%), 446 (100); HRMS (ESI⁺) C₂₂H₄₄NO₆Si⁺ ([M+H]⁺) requires 446.2938; found 446.2934.
(4S,5S)-2,2-Dimethyl-N(3),5-di-tert-butoxycarbonyl-4-tri-iso-propylsilyloxymethyl-oxazolidine 45 and (4S,5S)-2,2-dimethyl-N(3)-tert-butoxycarbonyl-4-tri-iso-propylsilyloxymethyl-oxazolidine-5-carboxylic acid 46

BF₃·Et₂O (1 M in Et₂O) was added dropwise via syringe to a stirred solution of 39 (400 mg, 0.89 mmol) and 2,2-dimethoxypropane (10 mL) in acetone (50 mL) until a permanent colour change from colourless to dark orange was observed. After stirring at rt for 12 h Et₃N was added dropwise until pH 7 was achieved and the reaction mixture was concentrated in vacuo. Purification via flash column chromatography (eluent 30-40 °C petrol/Et₂O, 2:1) gave 45 as a colourless oil (first to elute, 328 mg, 75%, >98% de) and 46 as a colourless oil (second to elute, 96 mg, 25%, >98% de).

Data for 45: Rf 0.53 (30-40 °C petrol/Et₂O, 2:1); C₂₅H₄₉NO₆Si requires C, 61.6; H, 10.1; N, 2.9%; found C, 61.7; H, 10.1; N, 2.9%; [α]D²² +8.1 (c 1.8 in CHCl₃); νmax (film) 1759 (C=O), 1701 (C=O); δH (400 MHz, CDCl₃) 1.06-1.11 (21H, m, Si(C₆HMe₂)₃), 1.48 (9H, s, CMe₃), 1.49-1.59 (12H, m, C(2)MeA, CMe₃), 1.61-1.69 (3H, s, C(2)MeB), 3.70-4.04 (2H, m, C(4)C₆H₂), 4.07-4.31 (1H, m, C(4)H), 4.50-4.56 (1H, m, C(5)H); δC (100 MHz, CDCl₃) 12.3 (Si(C₆HMe₂)₃), 17.8 (Si(CHMe₂)₃), 26.2 (C(2)MeA), 26.9 (C(2)MeB), 28.2 (CMe₃), 52.8 (C(4)), 61.5 (C(4)CH₂), 73.1 (C(5)), 79.7 (CMe₃), 110.6 (C(2)), 155.2 (NCO), 170.7 (CO₂H); m/z (ESI⁺) 510 ([M+Na]⁺, 32%), 488 (100); HRMS (ESI⁺) C₂₅H₅₀NO₆Si⁺ ([M+H]⁺) requires 488.3407; found 488.3427.

Data for 46: Rf 0.38 (30-40 °C petrol/Et₂O, 2:1); C₂₁H₄₁NO₆Si requires C, 58.4; H, 9.6; N, 3.25%; found C, 58.5; H, 9.6; N, 3.3%; [α]D³¹ +11.1 (c 1.9 in CHCl₃); νmax (film) 3358 (O−H), 1802 (C=O), 1721 (C=O); δH (400 MHz, CDCl₃) 1.01-1.08 (21H, m, Si(CHMe₂)₃), 1.43 (9H, s, CMe₃), 1.53 (3H, s, C(2)MeA), 1.60 (3H, s, C(2)MeB), 3.82 (2H, d, J 5.8, C(4)CH₂), 4.10-4.21 (1H, m, C(4)H), 4.48-4.61 (1H, m, C(5)H), 4.75 (1H, d, J 9.2, NH); δC (100 MHz, CDCl₃) 11.8 (Si(CHMe₂)₃), 17.8 (Si(CHMe₂)₃), 26.2 (C(2)MeA), 26.9 (C(2)MeB), 28.2 (CMe₃), 52.8 (C(4)), 61.5 (C(4)CH₂), 73.1 (C(5)), 79.7 (CMe₃), 110.6 (C(2)), 155.2 (NCO), 170.7 (CO₂H); m/z (ESI⁺) 454 ([M+Na]⁺, 45%) 432 (100); HRMS (ESI⁺) C₂₁H₄₁NNaO₆Si⁺ ([M+Na]⁺) requires 454.2595; found 454.2587.
(4S,5S)-2,2-Dimethyl-N(3)-tert-butoxycarbonyl-4,5-bis(hydroxymethyl)oxazolidine 47

From 42: LiAlH₄ (1 M in THF, 0.11 mL, 0.11 mmol) was added dropwise via syringe to a stirred solution of 42 (50 mg, 0.11 mmol) in THF (2 mL) at 0 °C. After stirring for 12 h, the reaction was quenched with crushed ice, diluted with EtOAc (5 mL), and stirred for a further 3 h. The resultant mixture was filtered through Celite (eluent EtOAc) and concentrated in vacuo to give 47 as a colourless oil (29 mg, quant, >98% de).

From 45: LiAlH₄ (1 M in THF, 0.4 mL, 0.4 mmol) was added dropwise via syringe to a stirred solution of 45 (50 mg, 0.10 mmol) in THF (5 mL) at 0 °C. After stirring for 12 h, the reaction was quenched with crushed ice, diluted with EtOAc (10 mL), and stirred for a further 3 h. The resultant mixture was filtered through Celite (eluent EtOAc) and concentrated in vacuo to give 47 as a colourless oil (27 mg, quant, >98% de).

Data for 47: [α]D²⁺¹ +0.9 (c 0.9 in CHCl₃); νmax (film) 3425 (O−H), 1669 (C=O); δH (400 MHz, CDCl₃) 1.48 (9H, s, CMe₃), 1.49-1.60 (6H, m, C(2)Me₂), 3.18 (2H, br s, 2 × OH), 3.62-3.80 (2H, m, C(4)CH₂), 3.81-4.16 (3H, m, C(4)H, C(5)CH₂), 4.19-4.34 (1H, m, C(5)H); m/z (ESI⁺) 262 ([M+H]⁺, 100%); HRMS (ESI⁺) C₁₂H₂₄NO₅ ([M+H]⁺) requires 262.1654; found 262.1656.

(4S,5S)-2,2-Dimethyl-N(3)-tert-butoxycarbonyl-4-tert-butyldimethylsilyloxymethyl-5-hydroxymethyl-oxazolidine 48

DIBAL-H (1 M in DCM, 0.47 mL, 0.47 mmol) was added dropwise via syringe to a stirred solution of 42 (50 mg, 0.12 mmol) in DCM (5 mL) at 0 °C. After stirring for 12 h the reaction was quenched with sat aq NH₄Cl (0.1 mL) and stirred for a further 1 h. The resultant mixture was filtered through Celite (eluent DCM) and concentrated in vacuo. Purification via flash column chromatography (eluent 30-40°C petrol/Et₂O, 1:1) gave 48 as a colourless oil (first to elute, 24 mg, 51%, >98% de) and 47 as a colourless oil (second to elute, 8 mg, 24%, >98% de).
Data for 48: $R_f$ 0.09 (30-40°C petrol/Et$_2$O, 1:1); $[\alpha]_D^{22} +12.4$ (c 0.9 in CHCl$_3$); $\nu_{\text{max}}$ (film) 3501 (O−H), 1703 (C=O); $\delta_\text{H}$ (400 MHz, CDCl$_3$) 0.06-0.16 (6H, m, SiMe$_2$), 0.88-0.94 (9H, m, SiCMe$_3$), 1.45-1.56 (12H, m, C(2)Me$_2$, OCMMe$_3$), 3.10-3.30 (1H, m, OH), 3.59-3.76 (2H, m, C(4)CH$_2$), 3.79-3.88 (2H, m, C(5)CH$_2$), 3.93-4.09 (1H, m, C(4)H), 4.23-4.31 (1H, m, C(5)H); $\delta_\text{H}$ (250 MHz, DMSO-$d_6$, 363 K) 0.07 (3H, s, SiMe$_A$), 0.08 (3H, s, SiMe$_B$), 0.91 (9H, s, SiCMe$_3$), 1.45 (9H, s, OCMMe$_3$), 1.47 (3H, s, C(2)Me$_A$), 1.50 (3H, s, C(2)Me$_B$), 3.06 (1H, br s, OH), 3.55-3.85 (4H, m, C(4)CH$_2$, C(5)CH$_2$), 4.17 (1H, dt, $J$ 7.3, 5.5 C(4)H), 4.33 (1H, t, $J$ 5.5, C(5)H); $m/z$ (ESI$^+$) 376 ([M+H]$^+$, 100%); HRMS (ESI$^+$) C$_{18}$H$_{38}$NO$_5$Si ([M+H]$^+$) requires 376.2519; found 376.2520.

(4S,5S)-2,2-Dimethyl-N(3)-tert-butoxycarbonyl-4-tri-iso-propylsilyloxymethyl-5-hydroxymethyl-oxazolidine 49

From 44: DIBAL-H (1 M in DCM, 5.38 mL, 5.38 mmol) was added dropwise via syringe to a stirred solution of 44 (1.2 g, 2.69 mmol) in DCM (20 mL) at 0 °C. After stirring for 6 h, the reaction mixture was quenched with sat aq NH$_4$Cl (0.5 mL), filtered through Celite (eluent DCM) and concentrated in vacuo to give 49 as a colourless oil (1.1 g, 98%, >98% de) that was used without purification. Purification of an aliquot via flash column chromatography (eluent 30-40 °C petrol/Et$_2$O, 2:1) gave an analytical sample; $R_f$ 0.09 (30-40 °C petrol/Et$_2$O, 2:1); $[\alpha]_D^{22} +9.8$ (c 0.8 in CHCl$_3$); $\nu_{\text{max}}$ (film) 3495 (O−H), 1700 (C=O); $\delta_\text{H}$ (400 MHz, CDCl$_3$) 1.06-1.44 (21H, m, Si(C$_3$HMe$_2$)$_3$), 1.69-1.77 (18H, m, C(2)Me$_2$, CMe$_3$), 3.09-3.33 (1H, br m, OH), 3.67-3.82 (2H, m, C(5)CH$_2$), 3.84-3.92 (2H, m, C(4)CH$_2$), 3.98-4.16 (1H, m, C(4)H), 4.25-4.33 (1H, m, C(5)H); $\delta_\text{H}$ (500 MHz, DMSO-$d_6$, 363 K) 1.05-1.12 (21H, m, Si(CHMe$_2$)$_3$), 1.45 (9H, s, CMe$_3$), 1.48 (3H, s, C(2)Me$_A$), 1.50 (3H, s, C(2)Me$_B$), 3.72-3.91 (4H, m, C(4)CH$_2$, C(5)CH$_2$), 4.12-4.22 (1H, m, C(4)H), 4.35 (1H, app t, $J$ 5.8, C(5)H); $\delta_\text{C}$ (125 MHz, DMSO-$d_6$, 363 K) 12.5 (Si(CHMe$_2$)$_3$), 18.7 (Si(CHMe$_2$)$_3$), 29.0 (CMe$_3$), 32.2 (C(2)Me$_2$), 60.2 (C(4)), 60.7 (C(4)CH$_2$, C(5)CH$_2$), 79.8 (C(5)), 80.8 (CMe$_3$), 93.1 (C(2)), 152.0 (NCO); $m/z$ (ESI$^+$) 440 ([M+Na]$^+$, 14%), 418 (100); HRMS (ESI$^+$) C$_{21}$H$_{44}$NO$_5$Si$^+$ ([M+H]$^+$) requires 418.2989; found 418.2997.

From 45: DIBAL-H (1 M in DCM, 0.80 mL, 0.80 mmol) was added dropwise via syringe to a stirred solution of 45 (200 mg, 0.40 mmol) in DCM (5 mL) at 0 °C. After stirring for 18 h, the reaction was quenched with sat aq NH$_4$Cl (0.1 mL) and stirred for a further 1 h. The resultant mixture was filtered...
through Celite (eluent DCM) and concentrated in vacuo to give 49 as a colourless oil (157 mg, 92%, >98% de) that was used without purification.

(4S,5S)-2,2-Dimethyl-N(3)-tert-butoxycarbonyl-4-tri-iso-propylsilyloxymethyl-5-carbonylmethyl-oxazolidine 50

IBX (2.21 g, 7.89 mmol) was added to a solution of 49 (1.10 g, 2.63 mmol) in DMSO (20 mL) at rt and stirred for 12 h. The reaction mixture was diluted with Et2O (20 mL), washed with H2O (5 × 20 mL), dried and concentrated in vacuo to give 50 as a colourless oil (1.09 g, quant, >98% de) that was used without purification; δH (400 MHz, CDCl3) 1.00-1.10 (21H, m, Si(CHMe2)3), 1.43-1.57 (12H, m, C(2)MeA, CMe3), 1.63-1.69 (3H, m, C(2)MeB), 3.67-3.97 (2H, m, C(4)CH2), 4.20-4.36 (1H, m, C(4)H), 4.44-4.54 (1H, m, C(5)H), 9.72-9.82 (1H, m, CHO).

(4S,5R,1′Z)-2,2-Dimethyl-N(3)-tert-butoxycarbonyl-4-tri-iso-propylsiloxyethyl-5-pentadec-1′-en-1′-yl-oxazolidine (Z)-51

BuLi (2.5M in hexanes, 2.1 mL, 5.29 mmol) was added dropwise via syringe to a stirred solution of (1-tetradecyl)triphenylphosphonium bromide (3.25 g, 6.01 mmol) in THF (60 mL) at −78 °C. After 30 min hexane (75 mL) was added, followed by the dropwise addition of a solution of 50 (500 mg, 1.20 mmol) in THF (15 mL) via cannula. The reaction mixture was allowed to warm to rt over 12 h and quenched with sat aq NH4Cl (10 mL). Brine (100 mL) was added, the organic layer was separated, and the aqueous layer was extracted with Et2O (3 × 50 mL). The combined organic extracts were dried and concentrated in vacuo. Purification via flash column chromatography (eluent 30-40 °C petrol/Et2O, 200:1; increased to 30-40 °C petrol/Et2O, 10:1) gave (Z)-51 as a colourless oil (645 mg, 90%, >98% de); Rf 0.16 (30-40 °C petrol/Et2O, 10:1); [α]D20 −7.8 (c 1.7 in CHCl3); νmax (film) 2926 (C−H), 1702 (C=O); δH (400 MHz, CDCl3) 0.89-0.91 (3H, m, C(15)H3), 1.02-1.09 (21H, m, Si(CHMe2)3), 1.20-1.65 (37H, m, C(2)Me2, C(4′)H2-C(14′)H2, CMe3), 1.99-2.20 (2H, m, C(3′)H2), 3.64 (1H, dd, J 10.2, 2.0, C(4)CHA), 3.71-3.93 (1H, m, C(5)H), 4.00 (1H, dd, J 10.2, 4.6, C(4)CHB), 4.88-4.95 (1H, m, C(5)H), 5.62-5.77 (2H, m, C(1′)H, C(2′)H); δH (500 MHz,
BuLi (2.5M in hexanes, 2.1 mL, 5.29 mmol) was added dropwise via syringe to a stirred solution of (1-tetradecyl)triphenylphosphonium bromide (3.25 g, 6.01 mmol) in THF (60 mL) at −78 °C. After 30 min hexane (75 mL) was added, followed by the dropwise addition of a solution of 50 (500 mg, 1.20 mmol) in THF (15 mL) via cannula. The reaction mixture was stirred at −78 °C for 2 h before the addition of MeOH (50 mL). The reaction mixture was allowed to warm to rt over a further 12 h and quenched with sat aq NH₄Cl (10 mL). Brine (100 mL) was added, the organic layer was separated, and the aqueous layer was extracted with Et₂O (3 × 50 mL). The combined organic extracts were dried and concentrated in vacuo. Purification via flash column chromatography (eluent 30-40 °C petrol/Et₂O, 10:1) gave (E)-52 as a colourless oil (523 mg, 73%, (E):(Z) 94:6); Rf 0.16 (30-40 °C petrol/Et₂O, 10:1); [α]D²⁰ +3.5 (c 2.2 in CHCl₃); νmax (film) 2926 (C−H), 1703 (C=O); δH (400 MHz, CDCl₃) 0.95-0.99 (3H, m, C(15′)H₃), 1.10-1.23 (21H, m, Si(CH₂Me₂)₃), 1.31-1.72 (37H, m, C(2)Me₂, C(4)H₂-C(14′)H₂, CMe₃), 2.10-2.19 (2H, m, C(3′)H₂), 3.70-3.78 (1H, m, C(4)CH₃), 3.84-4.12 (2H, m, C(4)H, C(4)CH₃), 4.59-4.64 (1H, m, C(5)H), 5.80-5.96 (2H, m, C(1′)H, C(2′)H); δH (500 MHz, PhMe-d₈, 363 K) 0.92 (3H, t, J 6.9, C(15′)H₃), 1.11-1.18 (21H, m, Si(CH₂Me₂)₃), 1.26-1.50 (31H, m, C(4′)H₂-C(14′)H₂, CMe₃), 1.58 (3H, s, C(2)Me₃), 1.68 (3H, s, C(2)Me₃), 2.10-2.14 (2H, m, C(3′)H₂), 3.80-3.86 (1H, m, C(4)CH₃), 3.93 (1H, br s, C(4)H), 4.04 (1H, dd, J 9.8, 7.6, C(4)CH₃), 4.50-4.52 (1H, m, C(5)H), 5.77-5.85 (1H, m, C(2′)H), 5.87-5.93 (1H, m, C(1′)H); δC (125 MHz, PhMe-d₈, 363 K) 0.92 (3H, t, J 6.9, C(15′)H₃), 1.10-1.20 (21H, m, Si(CH₂Me₂)₃), 1.27-1.46 (22H, m, C(3′)H₂), 3.86 (1H, dd, J 6.9, C(4)CH₃), 4.01 (1H, br s, C(4)H), 4.12 (1H, dd, J 9.8, 6.4, C(4)CH₃), 4.96-4.99 (1H, m, C(5)H), 5.62-5.67 (1H, m, C(2′)H), 5.91-5.96 (1H, m, C(1′)H); δC (125 MHz, PhMe-d₈, 363 K) 12.2 (Si(CH₂Me₂)₃), 13.6 (C(15′)), 17.9 (Si(CH₂Me₂)₃), 22.5, 27.8, 28.2, 29.15, 29.23, 29.5, 29.55, 29.59, 29.61, 29.64, 29.7, 31.9 (C(2)Me₂, C(3′)-C(14′), CMe₃), 61.3 (C(4)) 61.8 (C(4)CH₃), 72.3 (C(5)), 79.0 (CMe₃), 92.0 (C(2)), 125.7 (C(2′)), 133.9 (C(1′)), 151.5 (NCO); m/z (CI+) 596.5 ([M+H]+, 100%); HRMS (CI+) C₃₅H₇₀NO₄Si+ ([M+H]+) requires 596.5074; found 596.5054.
PhMe-d$_8$, 363 K) 12.2 (Si(CHMe$_2$)$_3$), 13.6 (C(15')), 17.9 (Si(CHMe$_2$)$_3$), 22.5, 24.1, 27.3, 28.1, 29.2, 29.27, 29.30, 29.53, 29.57, 29.61, 31.9 (C(2)Me$_2$, C(3')-C(14'), CMe$_3$), 61.3 (C(4)), 62.0 (C(4)CH$_2$), 77.2 (C(5)), 79.0 (CMe$_3$), 92.4 (C(2)), 125.7 (C(2')), 134.1 (C(1')), 151.5 (NCO); m/z (Cl$^+$) 596.5 ([M+H]$^+$, 100%); HRMS (Cl$^+$) C$_{35}$H$_{70}$NO$_4$Si$^+$ ([M+H]$^+$) requires 596.5074; found 596.5084.

(4S,5R)-2,2-Dimethyl-N(3)-tert-butoxycarbonyl-4-tri-iso-propylsiloxymethyl-5-pentadecan-1'-yl-oxazolidine 53

Pd/C (5 mg, 10% w/w) was added to a stirred solution of (Z)-51 (50 mg, 0.08 mmol) in EtOAc (5 mL) at rt. The reaction mixture was stirred under H$_2$ (1 atm) for 6 h. The reaction mixture was filtered through Celite (eluent EtOAc) and concentrated in vacuo. Purification via flash column chromatography (eluent 30-40 °C petrol/Et$_2$O, 2:1) gave 53 as a colourless oil (43 mg, 86%, >98% de); $R_f$ 0.8 (30-40 °C petrol/Et$_2$O, 2:1); $[\alpha]_D^2$ +10.0 (c 2.2 in CHCl$_3$); $\nu$$_{\text{max}}$ (film) 2925 (C−H), 1702 (C=O); $\delta$$_{\text{H}}$ (400 MHz, CDCl$_3$) 0.85-0.91 (3H, m, C(15')H$_3$), 1.02-1.12 (21H, m, Si(CHMe$_2$)$_3$), 1.20-1.37 (26H, m, C(2')H$_2$-C(14')H$_2$), 1.45-1.54 (15H, m, C(2)Me$_2$, CMe$_3$), 1.55-1.85 (2H, m, C(1')H$_2$), 3.59-3.89 (3H, m, C(4)H, C(4)H$_2$), 4.00-4.06 (1H, m, C(5)H); $\delta$$_{\text{C}}$ (125 MHz, PhMe-d$_8$, 363 K) 12.2, 13.5, 17.8, 22.5, 23.9, 26.8, 27.4, 28.0, 28.1, 29.2, 29.3, 29.6, 29.7, 31.8, 61.2, 76.7, 78.9, 92.0, 151.5; m/z (ESI$^+$) 598.5 ([M+H]$^+$, 100%); HRMS (ESI$^+$) C$_{35}$H$_{72}$NO$_4$Si$^+$ ([M+H]$^+$) requires 598.5231; found 598.5252.

(2S,3R)-1,3-Diacetoxy-2-acetamido-octadecane [N,O-diacetyl sphinganine] 54

3 M aq HCl (1 mL) was added to a solution of 53 (30 mg, 0.05 mmol) in MeOH (10 mL) and heated at 50 °C for 3 h. The reaction mixture was concentrated in vacuo. The residue was dissolved in pyridine (10 mL) and Ac$_2$O (0.1 mL, excess) and DMAP (2 mg) were added sequentially. The reaction mixture was stirred for 12 h before being quenched with H$_2$O (2 mL). The reaction mixture was diluted with H$_2$O (10 mL) and Et$_2$O (10 mL) and the layers were separated. The aqueous layer was extracted with Et$_2$O (2 × 10 mL). The combined organic layers were washed sequentially with sat aq CuSO$_4$ (2 × 10 mL), H$_2$O (10 mL) and brine
(10 mL), dried and concentrated in vacuo. Recrystallisation from CHCl₃/pentane (1:1) gave 54 as a white solid (11 mg, 75%, >98% de); mp 83-85 °C (CHCl₃/pentane); [α]ᵣ₂⁰ +18.4 (c 0.25 in CHCl₃); {lit.⁸ [α]ᵣ₂⁰ +19.2 (c 1.0 in CHCl₃); lit.⁹ [α]ᵣ₂⁰ +17.2 (c 0.2 in CHCl₃)}; νₚₓₗ (KBr) 3306, 2912, 2853, 1732, 1649, 1545, 1232; δₜ (400 MHz, CDCl₃) 0.87 (3H, t, J 6.7, C(18)H₃), 1.21-1.38 (22H, m, C(7)H₂-C(17)H₂), 1.52-1.70 (2H, m, C(6)H₂), 2.01 (3H, s, CO₂Me), 2.07 (3H, s, CO₂Me), 2.08 (3H, s, COMe), 4.07 (1H, dd, J 11.6, 3.9, C(1)Hₐ), 4.26 (1H, dd, J 11.6, 6.1, C(1)Hₐ), 4.34-4.45 (1H, m, C(2)H), 4.88-4.95 (1H, m, C(3)H), 5.85 (1H, d, J 8.9 NH₁); δₙ (125 MHz, CDCl₃) 14.1, 20.8, 21.0, 22.7, 23.3, 25.3, 29.3, 29.4, 29.5, 29.60, 29.63, 29.7, 31.5, 31.9, 50.5, 62.6, 73.9, 169.8, 170.9, 171.0; m/z (ESI⁺) 450 ([M+Na]+, 100%); HRMS (ESI⁺) C₂₄H₄₅NNaO₅⁺ ([M+Na]+) requires 450.3190; found 450.3180.

(2S,3R,4Z)-1,3-Diacetoxo-2-acetamido-octadec-4-ene [N,O,O-triacetyl-(Z)-sphingosine] 55

3 M aq HCl (1 mL) was added to a solution of (Z)-51 (30 mg, 0.05 mmol) in MeOH (10 mL) and heated at 50 °C for 3 h. The reaction mixture was concentrated in vacuo. The residue was dissolved in pyridine (10 mL) and Ac₂O (0.1 mL, excess) and DMAP (2 mg) were added sequentially. The reaction mixture was stirred for 12 h before being quenched with H₂O (2 mL). The reaction mixture was diluted with H₂O (10 mL) and Et₂O (10 mL) and the layers were separated. The aqueous layer was extracted with Et₂O (2×10 mL). The combined organic layers were washed sequentially with sat aq CuSO₄ (2×10 mL), H₂O (10 mL) and brine (10 mL), dried and concentrated in vacuo. Recrystallisation from CHCl₃/pentane (1:1) gave 55 as a white solid (13 mg, 87%, >98% de); mp 83-85 °C (CHCl₃/pentane); [α]ᵣ₂⁰ +6.6 (c 0.9 in CHCl₃); {lit.⁹ [α]ᵣ₂⁰ +4.3 (c 0.9 in CHCl₃)}; νₚₓₗ (KBr) 3336, 2926, 2851, 1734, 1655, 1539, 1236; δₜ (400 MHz, CDCl₃) 0.88 (3H, t, J 6.8, C(18)H₃), 1.14-1.43 (22H, m, C(7)H₂-C(17)H₂), 1.99 (3H, s, COMe), 2.05 (3H, s, COMe), 2.11 (3H, s, COMe), 2.12-2.25 (2H, m, C(5)H₂), 4.04 (1H, dd, J 11.6, 3.9, C(1)Hₐ), 4.34 (1H, dd, J 11.6, 6.5, C(1)Hₐ), 4.39-4.47 (1H, m, C(2)H), 5.28-5.36 (1H, m, C(3)H), 5.60-5.73 (2H, m, C(4)H, C(5)H); δₙ (125 MHz, CDCl₃) 14.1, 20.8, 21.1, 22.7, 23.4, 28.0, 29.3, 29.3, 29.4, 29.5, 29.6, 29.64, 29.66, 29.67, 31.9, 51.1, 62.6, 69.6, 77.2, 123.8, 137.0, 169.8, 170.0, 171.0; m/z (ESI⁺) 448 ([M+Na]+, 100%); HRMS (ESI⁺) C₂₄H₄₅NNaO₅⁺ ([M+Na]+) requires 448.3033; found 448.3030.

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(2S,3R,4E)-1,3-Diacetoxy-2-acetamido-octadec-4-ene [N,O,O-triacetyl sphingosine] 56

3 M aq HCl (1 mL) was added to a solution of (E)-52 (50 mg, 0.05 mmol, (E):(Z) 94:6) in MeOH (10 mL) and heated at 50 °C for 3 h. The reaction mixture was concentrated in vacuo. The residue was dissolved in pyridine (10 mL) and Ac₂O (0.1 mL, excess) and DMAP (2 mg) were added sequentially. The reaction mixture was stirred for 12 h before being quenched with H₂O (2 mL). The reaction mixture was diluted with H₂O (10 mL) and Et₂O (10 mL) and the layers were separated. The aqueous layer was extracted with Et₂O (2 × 10 mL). The combined organic layers were washed sequentially with sat aq CuSO₄ (2 × 10 mL), H₂O (10 mL) and brine (10 mL), dried and concentrated in vacuo. Recrystallisation from CHCl₃/pentane (1:1) gave 56 as a white solid (29 mg, 80%, >98% de); mp 99-101 °C (CHCl₃/pentane); [α]D²⁰