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An efficient procedure for the synthesis of 2-*N*-Boc-amino-3,5-diols

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ABSTRACT

We wish to describe here the diastereoselective reaction between chiral *N*-Boc-α-amino aldehydes with both achiral allyltrichlorostannanes leading to 1,2-*syn*-*N*-Boc-α-amino alcohols, which are easily converted to the corresponding 4-*N*-Boc-amino-3-hydroxy ketones after treatment with catalytic amounts of OsO_4 in the presence of $NaIO_4$. After reduction of the carbonyl function, these 4-*N*-Boc-amino-3-hydroxy ketones were converted to 1-deoxy-5-hydroxy sphingosine analogues.

1. Introduction

Sphingolipids, a class of lipids derived from the aliphatic amino alcohol sphingosine (**1**) are a diverse family of biomolecules structurally characterized by a long carbon chain 'sphingoid' base that is derivatized with amide-linked fatty acids and various polar head groups (Fig. 1).[1–4] Sphingolipids have been found to possess a wide range of biological properties, being important in the chemistry of cellular membranes, cell growth differentiation, and apoptosis.[5,6] A 1,2-amino-alcohol moiety is present in sphingolipids, and recently, the 1-deoxy-5-hydroxy sphingosine analogues **2** and **3** have been identified as a potential new class of anticancer principles (Fig. 1).[5,6]

The primary hydroxyl group of sphingosine is phosphorylated in vivo, which results in undesired mitogenic/anti-apoptotic activity. Menaldino and co-workers[3c,4] have proposed that 1-deoxy-5-hydroxy sphingosine analogues like **2** and **3**, designed by moving the hydroxyl group to the 5-position, showed similar lipophilicity to sphingosine while decreasing phosphorylation.

Encouraged by this, we developed a general and efficient approach to 4-*N*-Boc-amino-3-hydroxy ketones, which provides

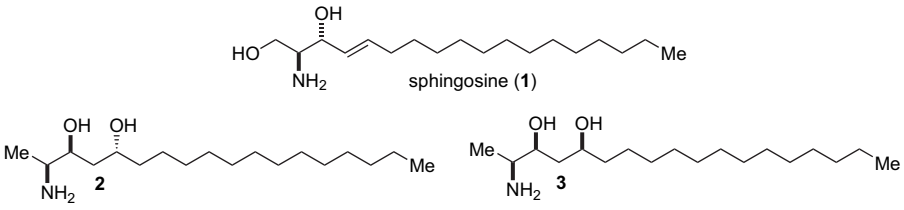

Figure 1. Sphingosine (**1**) and 1-deoxy-analogues **2** and **3**.

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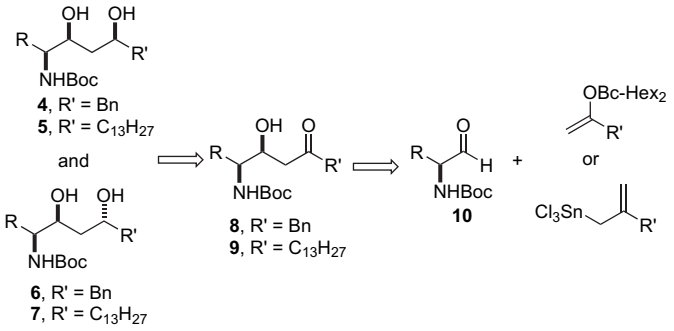
access to aminopolyhydroxylated structures analogous to **2** and **3**, after selective reduction of the carbonyl group.[7]

2. Results and discussion

Our strategy to prepare the 2-amino-3,5-diols of type **4**–**7** is based on the selective *syn* or *anti* reduction of 4-*N*-Boc-amino-3-hydroxy ketones **8** (R′=Bn) and **9** (R′=$C_{13}H_{27}$) (Scheme 1). These aminoketones are viewed as arising either from the addition of dicyclohexylboron enolates or from the addition of allyltrichlorostannes to α-aminoaldehydes **10**.[8,9] In the case of allyltrichlorostanne addition, the resulting double bond in the homoallylic alcohol should be converted to the ketone carbonyl function.



Scheme 1. Synthetic strategy for the preparation of amino-3,5-diols.

Our first approach to prepare the desired 4-*N*-Boc-amino-3-hydroxy ketones **8** and **9** involved the aldol addition of boron enolates generated from methyl ketones **11a**–**d** to α-aminoaldehydes **10a**–**c**.[10–13] The reaction conditions were optimized by studying the additions of the dicyclohexylboron enolate (formed by adding *c*-Hex_2BCl and Et_3N to the methyl ketones **11a**–**d** in Et_2O at 0 °C for 30 min) to the aldehydes **10a**–**c** at −78 °C in Et_2O as solvent (Scheme 2, Table 1).[13] The corresponding yields are for the two-step sequence, preparation of the aldehyde and coupling with the boron enolate.

When achiral boron enolates were used, selectivities ranged from very low to good in favor of the 1,2-*syn* (*anti*-Felkin) product.[14] Stereochemical assignments for the aldol adducts were based on their spectral properties by chemical correlation with known compounds or by comparison of their ^1H and ^{13}C NMR spectra with those of 1,2-*syn* products prepared in this work.[7,11] Although good levels of diastereoselectivity were obtained in some cases, unfortunately, we were not able to get better yields than those presented in Table 1.[15,16]

In light of these results, we decided to investigate the addition of allyltrichlorostannanes to α-amino aldehydes.[17,18] Our strategy began with the preparation of allylsilanes **17** and **20** (Scheme 3). The methyl esters **16** and **19** were treated with $CeCl_3$ and trimethylsilylmethylmagnesium chloride followed by reaction with Amberlyst 15® resin in *n*-hexane to give allylsilanes **17** and **20** in 88% and 70% yield, respectively (Scheme 3).[19]

Table 1
Boron enolate additions to α-aminoaldehydes **10a**–**c**

Entry	Ketone (R′)	Aldehyde (**10**) (R)	Aldol adducts	ds[a] (*syn*/*anti*)	Yield (%) (two steps)
1	$C_{13}H_{27}$	Me	**9a**/**15a**	95:05	20
2	$C_{13}H_{27}$	*i*-Pr	**9b**/**15b**	66:34	43
3	*i*-Pr	Me	**12a**/**15c**	75:25	38
4	*i*-Pr	*i*-Pr	**12b**/**15d**	95:05	15
5	*i*-Pr	Bn	**12c**/**15e**	95:05	92
6	Ph	Me	**13a**/**15f**	95:05	41
7	Ph	*i*-Pr	**13b**/**15g**	95:05	30
8	Ph	Bn	**13c**/**15h**	95:05	10
9[11]	*t*-Bu	*i*-Pr	**14**/**15i**	50:50	42

[a] Refers to the ratio of isolated *syn*/*anti* aldol products.

Treatment of allylsilanes **17** and **20** with $SnCl_4$ provided the corresponding allyltrichlorostannanes **18** and **21**, respectively.[17,18]

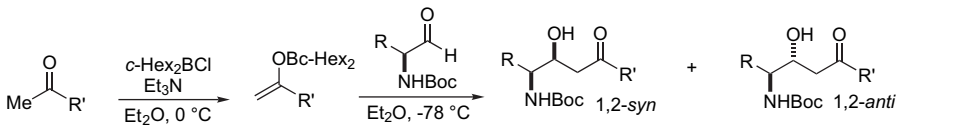
The coupling reaction of aldehydes **10a**–**g** with allyltrichlorostannane **18** proceeded smoothly at −78 °C to give 1,2-*syn* amino alcohols **22a**–**g** (*anti*-Felkin addition) in good yields and with moderate to high levels of diastereoselectivity for the two-step sequence (preparation of the aldehyde and addition reaction with **18**) (Scheme 4).[15–18]

The observed sense of induction can be explained by the six-member transition state **A** where the chiral residue of the aldehyde occupies a pseudo-equatorial position and the nucleophile approaches from the less hindered *Si*-face (Scheme 4).[17]

In order to determine the relative stereochemistry, homoallylic alcohols **22b**–**d** were converted to the corresponding *trans*-oxazolidinones **23b**–**d** (Scheme 5).[20,21] Treatment of **22b**–**d** with trifluoroacetic acid (TFA) followed by cyclization with triphosgene gave oxazolidinones **23b**–**d** in good yields. Observed coupling constants (^3J=4.9 Hz for **23b**, 5.1 Hz for **23c** and 5.5 Hz for **23d**), upon irradiation of the hydrogens adjacent to Ha and Hb, indicated that hydrogens Ha and Hb are on opposite faces of the heterocyclic ring, and the oxazolidinones are derived from 1,2-*syn* adducts.[16,20,21]

We next moved to the preparation of the desired 4-*N*-Boc-amino-3-hydroxy ketones. Our initial attempts to promote the double bond oxidation in homoallylic alcohol **22a** by ozonolysis led to the desired product **8a** in 48% yield together with the *N*-Boc pyrrol derivative **24** as a by-product in 19% yield (Scheme 6).[22,23]

After several other unsuccessful attempts, we found that oxidation of the homoallylic alcohols **22a**–**d** proceeded smoothly in the presence of sodium periodate and catalytic amounts of osmium tetroxide in Et_2O/H_2O to give the corresponding 4-*N*-Boc-amino-3-hydroxy ketones **8a**–**d** in excellent yields (Scheme 7).[22,24] Based on these results, we suggest that this methodology stands as probably the most efficient method to prepare this class of molecules.[7,11,12]



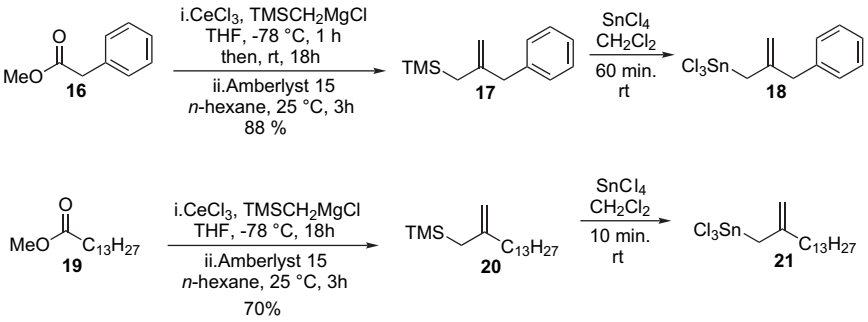
11a, R' = $C_{13}H_{27}$
11b, R' = *i*-Pr
11c, R' = Bn
11d, R' = *t*-Bu

10a, R = Me
10b, R = *i*-Pr
10c, R = Bn

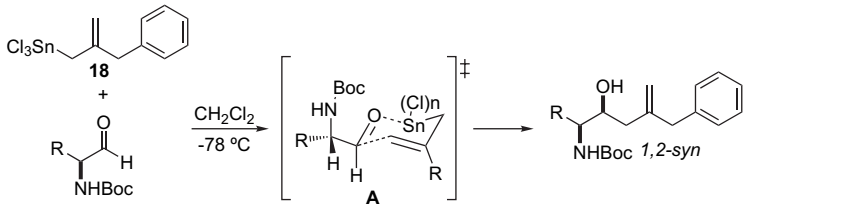
9a, R = Me, R' = $C_{13}H_{27}$
9b, R = *i*-Pr, R' = $C_{13}H_{27}$
12a, R = Me, R' = *i*-Pr
12b, R = *i*-Pr, R' = *i*-Pr
12c, R = Bn, R' = *i*-Pr
13a, R = Me, R' = Ph
13b, R = *i*-Pr, R' = Ph
13c, R = Bn, R' = Ph
14, R = i-Pr, R' = *t*-Bu

15a, R = Me, R' = $C_{13}H_{27}$
15b, R = *i*-Pr, R' = $C_{13}H_{27}$
15c, R = Me, R' = *i*-Pr
15d, R = *i*-Pr, R' = *i*-Pr
15e, R = Bn, R' = *i*-Pr
15f, R = Me, R' = Ph
15g, R = *i*-Pr, R' = Ph
15h, R = Bn, R' = Ph
15i, R = *i*-Pr, R' = *t*-Bu

Scheme 2. Boron enolate additions to α-aminoaldehydes **10a**–**c**.



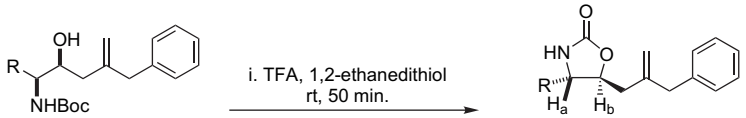
Scheme 3. Preparation of allyltrichlorostannanes **18** and **21**.



10a - R = Me
10b - R = *i*-Pr
10c - R = Bn
10d - R = *i*-Bu
10e - R = CH_2OTBS
10f - R = $CH_3S(CH_2)_2$
10g - R = $CH_2OTBDPS$

22a - R = Me, 61%, *ds* 86:14
22b - R = *i*-Pr, 50%, *ds* > 95:5
22c - R = Bn, 40%, *ds* > 95:5
22d - R = *i*-Bu, 40%, *ds* > 95:5
22e - R = CH_2OTBS, 62%, *ds* 75:25
22f - R = $CH_3S(CH_2)_2$, 34%, *ds* 86:14
22g - R = $CH_2OTBDPS$, 58%, *ds* > 95:5

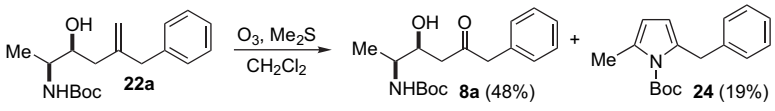
Scheme 4. Coupling reaction of aldehydes **10a**–**g** with allyltrichlorostannane **18**.



22b, R = *i*-Pr
22c, R = Bn
22d, R = *i*-Bu

23b, R = *i*-Pr, 45% ($J_{Ha/Hb}$ = 4.9 Hz)
23c, R = Bn, 70% ($J_{Ha/Hb}$ = 5.1 Hz)
23d, R = *i*-Bu, 53% ($J_{Ha/Hb}$ = 5.5 Hz)

Scheme 5. Proof of the relative stereochemistry for **22b**–**d**.



Scheme 6. Ozonolysis of homoallylic alcohol **22a**.

Treatment of amino alcohol **22f** under the same oxidation reaction conditions provided ketone **8f** with concomitant oxidation to the sulfone in 89% yield (Scheme 7).[25]

Diastereoselective reduction of hydroxyketones **8a**–**d** using a slight modification of the Narasaka protocol (*n*-Bu_3B/$LiBH_4$) provided the desired 1,3-*syn* diols **4a**–**d** in good yields and with excellent diastereoselectivities (Scheme 7).[26–28]

The relative stereochemistry of the 1,3-diols was determined after analysis of acetonides **25** and **26**, easily prepared from diols **4b** and **4c**, respectively (Scheme 8).[29] Analysis of the ^{13}C NMR spectra showed resonances at 19.5, 30.3, and 98.5 for **25** and 19.8, 30.0, and 98.8 for **26**, characteristic of 1-3-*syn* acetonides.[29,30]

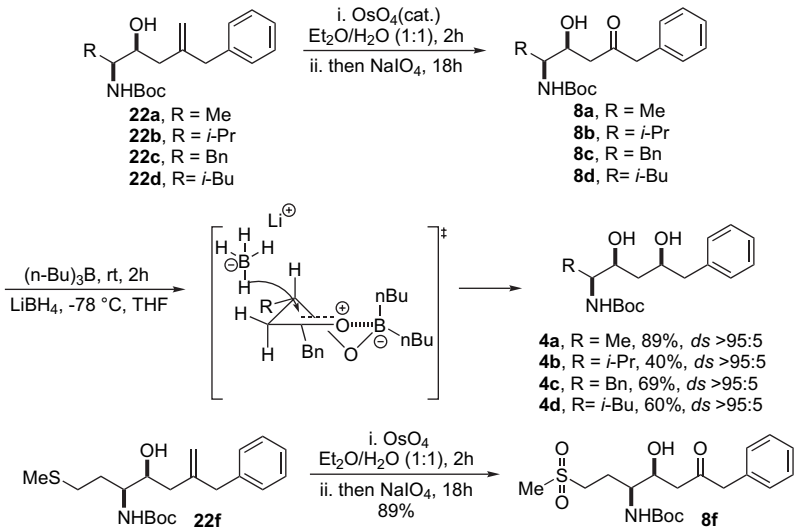
Treatment of aminoketones **8b** and **8f** with with $Me_4NBH(OAc)_3$ in CH_3CN provided the corresponding 1,3-*anti* diols **6b** (ds>95:05) and **6f** (ds 60:40) in good yields (Scheme 9).[31]

The relative stereochemistry for diol **6b** was ascertained by its conversion to acetonide **27** (Scheme 9). The observed ^{13}C NMR chemical shifts at 24.8, 28.4, and 100.3 ppm are characteristic of a 1,3-*anti* dimethyl acetonide.

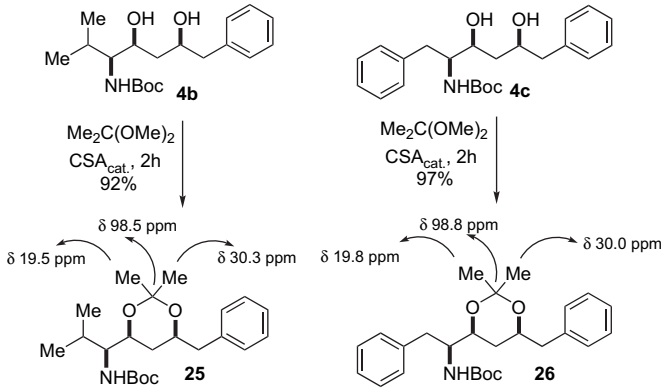
The coupling reaction of allyltrichlorostannane **21** with α-aminoaldehydes **10a**–**d** and **10h** led to the *anti*-Felkin homoallylic alcohols **28a**–**d** and **28h**, respectively, in good yields and with high levels of diastereoselectivity (for the two steps, preparation of the aldehyde and coupling with allyltrichlorostannane **21**) (Scheme 10).[7,15]

The relative stereochemistry was determined after conversion of **28a**–**c** to the corresponding *N*-Boc-oxazolidinones **29a** (55%), **29b** (49%), and **29c** (53%), respectively, by treatment of **28a**–**c** with triphosgene (Scheme 11). The observed coupling constants in the ^1H NMR spectra ($J_{Ha/Hb}$=3.6 Hz for **29a**, *J* 2.4 Hz for **29b** and 2.3 Hz for **29c**) unambiguously established that hydrogens Ha and Hb are on opposite faces of the heterocyclic ring (Scheme 11).[16,21]

As observed before, attempts to promote double bond oxidation in homoallylic alcohol **28a** by ozonolysis led to low yields of the



Scheme 7. Synthesis of 4-*N*-Boc-amino-3-hydroxy ketones and diastereoselective reduction to 1,3-*syn* diols.



Scheme 8. Proof of the relative stereochemistry for diols **4b** and **4c**.

desired product **9a** (10% yield) together with pyrrol derivative **30** in 13% yield (Scheme 12).[23]

Again, as noted for **22a–d**, the best way to promote this double bond oxidation is by treatment of homoallylic alcohols **28a–d** and **28h** with $OsO_4/NaIO_4$. This protocol led to 4-*N*-Boc-amino-3-hydroxy ketones **9a–d** and **9h** in good yields (Scheme 13).[7,22,24]

However, attempts to reduce these aminoketones using the modified Narasaka[26] conditions led to low yields and low diastereoselectivities and the use of DIBAL-H gave a 50:50 mixture of 1,3-*syn* (**5**) and 1,3-*anti* (**7**) diols in good yields. Treatment of ketones **9a–d** with $Zn(BH_4)_2$ in CH_2Cl_2 gave 1,3-*syn* diols **5a–d** with moderate to high levels of diastereoselectivity in good yields for the two-step sequence (oxidation of the double bond and reduction).[30] The 1,3-*syn* (**5**) and 1,3-*anti* (**7**) diols are separated by flash chromatography (Scheme 13).[14,26]

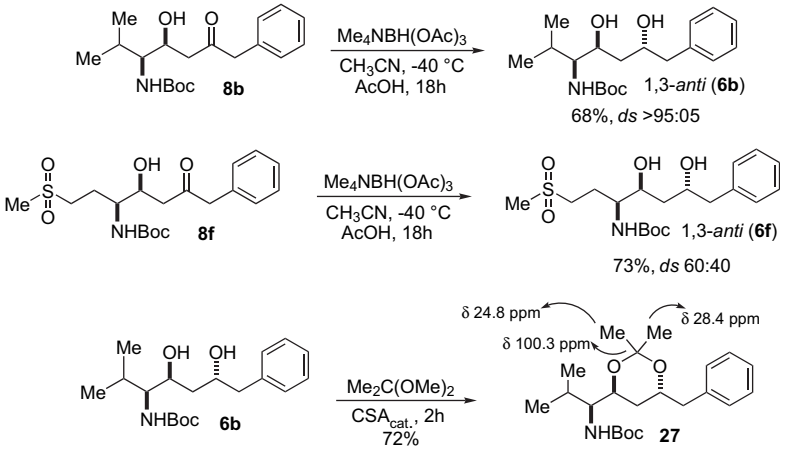
The relative stereochemistry of the 1,3-*syn* diols was determined after analysis of acetonide **31**, prepared from diol **5c** (Scheme 13). Analysis of the ^{13}C NMR spectra showed resonances at 19.8, 30.1, and 98.6 for **31**, characteristic of a 1,3-*syn* acetonide.[29]

The corresponding 1,3-*anti* diols **7a–d** were obtained in good yields and good levels of diastereoselectivity after reduction of aminoketones **9a–d** with $Me_4NBH(OAc)_3$ in CH_3CN as solvent (Scheme 14).[31]

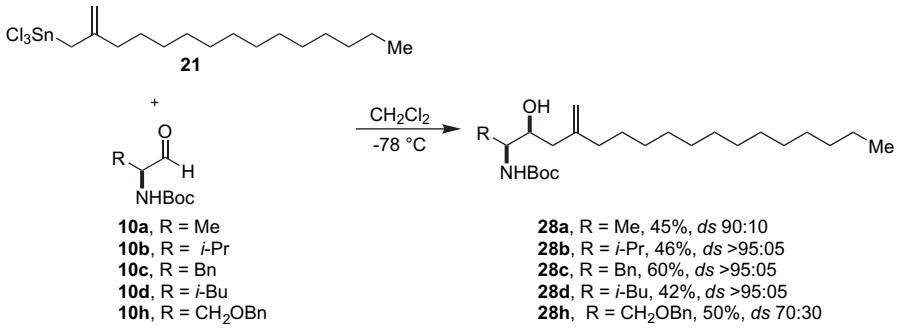
The relative stereochemistry of the 1,3-diols was established after analysis of acetonide **32**, prepared from diol **7d** (Scheme 14). ^{13}C NMR chemical shifts at 24.6, 25.4, and 100.3 for **32**, confirmed the 1-3-*anti* relationship.[29]

3. Conclusions

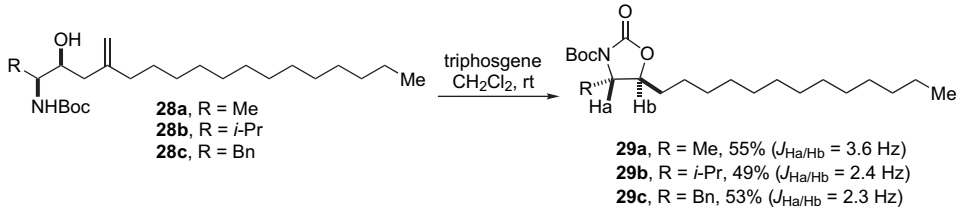
We have described herein that high levels of substrate-based 1,2-*syn*-stereocontrol could be achieved in the achiral allyltrichlorostannane addition reactions to *N*-Boc-α-amino aldehydes leading to the *anti*-Felkin products, which were easily converted



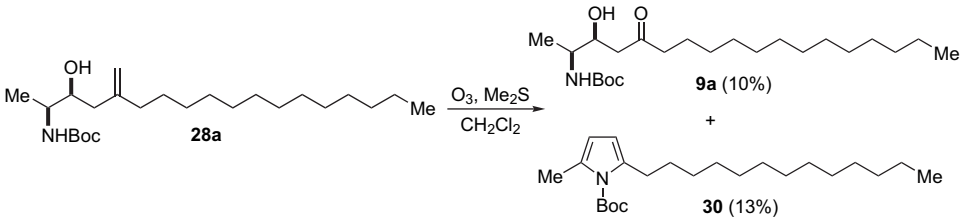
Scheme 9. 1,3-*anti* Diols **6b** and **6f** and proof of the relative stereochemistry for **6b**.



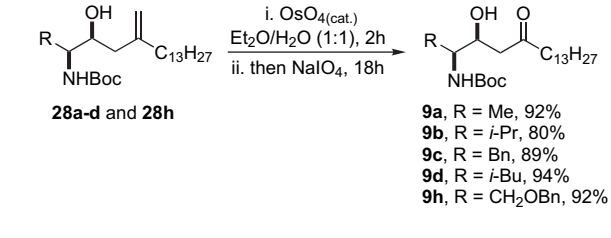
Scheme 10. Coupling reaction with of allyltrichlorostannane **21** with α-aminoaldehydes.

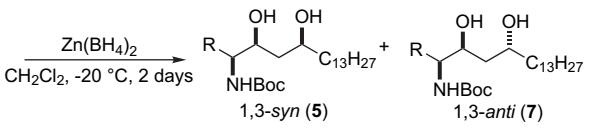


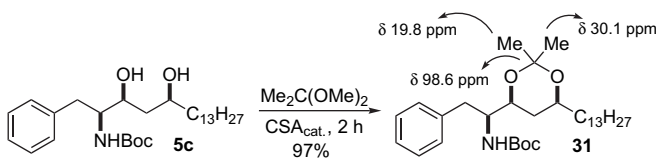
Scheme 11. Oxazolidinone formation.



Scheme 12. Ozonolysis of homoallylic alcohol **28a**.

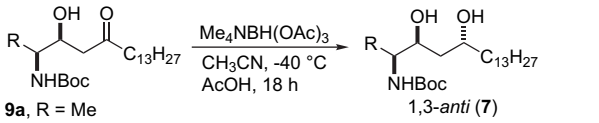


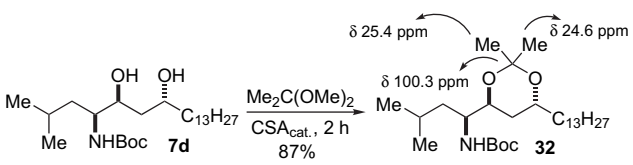




Scheme 13. Synthesis of 1,3-*syn* diols **5a–d** and proof of stereochemistry of diol **5c**.

to the corresponding 4-*N*-Boc-amino-3-hydroxy ketones in good yields. This methodology stands as a new and very efficient approach to 4-*N*-Boc-amino-3-hydroxy ketones. After reduction of the carbonyl function, these ketones were converted to 1-deoxy-5-hydroxy sphingosine analogues. This synthetic methodology allows compounds with programmed variations of substituents to be synthesized and is particularly important in the screening of pharmacological activity and in the study of structure–activity relationships directed toward the design of new classes of anti-cancer principles. Further studies in this direction are underway.[32]





Scheme 14. Synthesis of 1,3-*anti* diols **7a–d** and proof of stereochemistry of diol **7d**.

4. Experimental

4.1. General information

All reactions were carried out under an atmosphere of argon or nitrogen in flame-dried glassware with magnetic stirring. Dichloromethane, triethylamine, 2,6-lutidine, diisopropylamine, dimethylformamide, and *N*-methylpyrrolidone were distilled from CaH_2. Dimethyl sulfoxide was distilled under reduced pressure from calcium hydride and stored over molecular sieves. THF and toluene were distilled from sodium/benzophenone ketyl. Oxalyl chloride was distilled immediately prior to use. MeOH was distilled from $Mg(OMe)_2$. Petrol ether refers to the fraction boiling between 40–60 °C. Purification of reaction products was carried out by flash chromatography using silica gel (230–400 mesh). Analytical thin layer chromatography was performed on silica gel 60 and GF (5–40-μm thickness) plates. Visualization was accomplished with UV light and anisaldehyde, ceric ammonium nitrate stain or phosphomolybdic acid followed by heating or I_2 staining. ^1H NMR spectra were taken in $CDCl_3$ at 250 MHz, 300 MHz or 500 MHz and are reported in parts per million using solvent as an internal standard ($CDCl_3$ at 7.26 ppm) unless otherwise indicated. Data are reported as ap=apparent, s=singlet, d=doublet, t=triplet, q=quartet, quint=quintet, sext=sextet, ap t=apparent triplet, m=multiplet, br=broad, td=triplet of doublets, quint d=quintet of doublets, coupling constant(s) in hertz; integration. Proton-decoupled ^{13}C NMR spectra were taken in $CDCl_3$ at 62.5 MHz, 75 MHz or 125 MHz and are recorded in parts per million using solvent as an internal standard ($CDCl_3$ at 77.0 ppm) unless otherwise indicated.

4.2. Representative procedure for methyl ketone aldol reactions

To a solution of the corresponding methyl ketone (0.592 mmol) in Et_2O (5.0 mL) under an argon atmosphere at −10 °C was added dropwise (c-Hex)$_2$BCl (1.776 mmol). After this, Et_3N (2.5 equiv, 2.072 mmol) was added dropwise. The resulting mixture was stirred for 1 h at 0 °C. The solution was cooled to −78 °C and the aldehyde (1.0 equiv, 0.296 mmol) was added dropwise to the enolate solution. The resulting mixture was stirred for 3 h at −78 °C. The reaction was quenched by addition of 4.0 mL of MeOH and warmed to rt. The solvent was removed under reduced pressure, and the resulting oil was purified by flash chromatography (silica gel 230–400 mesh), providing the aldol adducts.

*4.2.1. tert-Butyl (3S,4R)-4-hydroxy-2-methyl-6-oxononadecan-3-ylcarbamate (**15b**)*

Minor isomer; ds 66:34 (*syn*/*anti*); ^1H NMR (C_6D_6, 300 MHz): δ 4.31 (d, *J* 9.5 Hz, 1H), 3.85 (m, 2H), 3.53 (d, *J* 4.5 Hz, 1H), 2.49 (d, *J* 4.5 Hz, 2H), 2.27 (m, 1H), 2.15 (dt, *J* 6.25, 3.0 Hz, 2H), 1.55 (br s, 11H), 1.40 (s, 20H), 1.01 (t, *J* 6.8 Hz, 3H), 1.00 (d, *J* 6.8 Hz, 6H); ^{13}C NMR (C_6D_6, 75 MHz): δ 211.7, 156.4, 78.9, 69.2, 58.8, 46.3, 32.3, 30.2, 30.1, 30.1, 30.1, 29.9, 29.8, 29.5, 28.5, 27.5, 23.7, 23.1, 20.4, 15.8, 14.4.

*4.2.2. tert-Butyl (3S,4S)-4-hydroxy-2,7-dimethyl-6-oxooctan-3-ylcarbamate (**12b**)*

Yield: 15%; ds 95:05 (*syn*/*anti*); ^1H NMR (C_6D_6, 300 MHz): δ 4.88 (d, *J* 8.5 Hz, 1H), 4.19 (d, *J* 9.0 Hz, 1H), 3.44 (br s, 1H), 3.29 (t, *J* 9.1 Hz, 1H), 2.50 (dd, *J* 9.6, 18.3 Hz, 1H), 2.34 (dd, *J* 2.7, 18.3 Hz, 1H), 2.03 (m, 1H), 1.86 (m, 1H), 0.98 (d, *J* 6.6 Hz, 3H), 0.92 (d, *J* 6.6 Hz, 3H), 0.80 (d, *J* 6.9 Hz, 6H); ^{13}C NMR ($CDCl_3$, 75 MHz): δ 215.8, 156.5, 78.5, 67.2, 60.0, 44.6, 41.3, 30.8, 28.5, 19.8, 17.9; IR (film): ν 3443, 2971, 2924, 1703, 1500, 1217, 1166, 1041, 926 cm^{-1}.

*4.2.3. tert-Butyl (2S,3S)-3-hydroxy-6-methyl-5-oxo-1-phenylheptan-2-ylcarbamate (**12c**)*

Yield: 92%; ds 95:05 (*syn*/*anti*); ^1H NMR (C_6D_6, 300 MHz): δ 7.26–6.87 (m, 5H), 5.00 (d, *J* 10.8 Hz, 1H), 3.99 (d, *J* 9.5 Hz, 1H), 3.87 (q, *J* 6.5 Hz, 1H), 3.75 (s, 1H), 2.96 (dd, *J* 4.8, 16.6 Hz, 1H), 2.93 (dd, *J* 3.3, 16.6 Hz, 1H), 2.44 (dd, *J* 9.9, 17.9 Hz, 1H), 2.10 (dd, *J* 2.4, 17.9 Hz, 1H), 1.90 (sept, *J* 6.9 Hz, 1H), 1.43 (s, 9H), 0.72 (d, *J* 6.9 Hz, 3H), 0.69 (d, *J* 6.9 Hz, 3H); ^{13}C NMR (C_6D_6, 62.5 MHz): δ 215.8, 198.4, 156.0, 139.0, 129.8, 128.7, 126.6, 78.8, 67.1, 56.1, 44.0, 41.2, 39.1, 28.4, 17.8, 17.7; IR (film): ν 3388, 2971, 2918, 2846, 1701, 1497, 1445, 1365, 1254, 1169, 1043, 866 cm^{-1}. HRMS (ESI TOF-MS ES$^+$): calcd for $C_{19}H_{30}NO_4$: 336.2175; found: 336.2176.

*4.2.4. tert-Butyl (3S,4S)-4-hydroxy-2,7,7-trimethyl-6-oxooctan-3-ylcarbamate (**14**)*

Yield: 42%; ds 50:50 (1,2-*syn*); ^1H NMR ($CDCl_3$, 300 MHz): δ 4.85 (d, *J* 9.3 Hz, 1H), 4.23 (d, *J* 9.0 Hz, 1H), 3.12 (t, *J* 9.3 Hz, 1H), 2.73 (dd, *J* 2.7, 18.0 Hz, 1H), 2.58 (dd, *J* 9.6, 18.0 Hz, 1H), 1.85 (m, 1H), 1.45 (s, 9H), 1.14 (s, 9H), 0.97 (t, *J* 6.9 Hz, 6H); IR (film): ν 3446, 2935, 2864, 1709, 1502, 1367, 1217, 1171, 1081, 1020 cm^{-1}.

*4.2.5. tert-Butyl (3S,4R)-4-hydroxy-2,7,7-trimethyl-6-oxooctan-3-ylcarbamate (**15i**)*

Yield: 42%; ds 50:50 (1,2-*anti*); ^1H NMR ($CDCl_3$, 300 MHz): δ 4.32 (d, *J* 9.5 Hz, 1H), 3.77 (dt, *J* 7.5, 2.8 Hz, 1H), 3.41 (dt, *J* 10.0, 2.3 Hz, 1H), 2.71 (dd, *J* 8.5, 2.5 Hz, 1H), 2.55 (dd, *J* 8.5, 2.5 Hz, 1H), 2.12 (m, 1H), 1.35 (s, 9H), 1.04 (s, 9H), 0.84 (d, *J* 6.75 Hz, 3H), 0.76 (d, *J* 6.75 Hz, 3H); ^{13}C NMR ($CDCl_3$, 75 MHz): δ 218.2, 156.2, 79.3, 69.0, 58.2, 44.4, 40.4, 28.3, 27.0, 26.3, 20.2, 15.6; IR (film): ν 3446, 3013, 2968, 2935, 2875, 1699, 1506, 1367, 1313, 1217, 1072, 925, 872 cm^{-1}.

*4.2.6. tert-Butyl (2S,3S)-3-hydroxy-5-oxo-5-phenylpentan-2-ylcarbamate (**13a**)*

Yield: 41%; ds (95:05); ^1H NMR (C_6D_6, 250 MHz): δ 7.80–6.85 (m, 5H), 4.92 (d, *J* 9.8 Hz, 1H), 3.85 (d, *J* 8.8 Hz, 1H), 3.73 (t, *J* 7.0 Hz, 1H), 3.54 (s, 1H), 2.85 (dd, *J* 9.25, 18.0 Hz, 1H), 2.69 (dd, *J* 3.0, 18.0 Hz, 1H), 1.45 (s, 9H) 1.17 (d, *J* 6.8 Hz, 3H); ^{13}C NMR (C_6D_6, 75 MHz): δ 200.8, 156.0, 137.1, 133.2, 78.7, 70.4, 50.3, 42.7, 28.5, 27.9, 18.7. HRMS (ESI TOF-MS ES$^+$): calcd for $C_{16}H_{24}NO_4$: 294.1705; found: 294.1620.

*4.2.7. tert-Butyl (3S,4S)-4-hydroxy-2-methyl-6-oxo-6-phenylhexan-3-ylcarbamate (**13b**)*

Yield: 30%; ds 95:05 (*syn*/*anti*); ^1H NMR (C_6D_6, 250 MHz): δ 7.79–6.98 (m, 5H), 5.16 (d, *J* 10.3 Hz, 1H), 4.37 (d, *J* 7.8 Hz, 1H), 3.7 (t, *J* 8.8 Hz, 1H), 3.02 (dd, *J* 9.0, 18.0 Hz, 1H), 2.90 (dd, *J* 3.3, 18.0 Hz, 1H), 1.95 (m, 1H), 1.46 (s, 9H), 1.02 (d, *J* 6.8 Hz, 3H), 0.96 (d, *J* 6.5 Hz, 3H); ^{13}C NMR (C_6D_6, 62.5 MHz): δ 201.2, 156.7, 137.1, 133.2, 128.6, 78.6, 67.3, 50.0, 30.7, 28.5, 20.0, 19.9, 8.7. IR (film): ν 3487, 3055, 2985, 2930, 2852, 1670, 1600, 1448, 1373, 1265, 1212, 1085, 1010 cm^{-1}. HRMS (ESI TOF-MS ES$^+$): calcd for $C_{18}H_{28}NO_4$: 322.2018; found: 322.1960.

*4.2.8. tert-Butyl (2S,3S)-3-hydroxy-5-oxo-1,5-diphenylpentan-2-ylcarbamate (**13c**)*

Yield: 10%; ds 95:05 (*syn*/*anti*); ^1H NMR ($CDCl_3$, 300 MHz): δ 7.69–7.01 (m, 10H), 5.19 (d, *J* 9.5 Hz, 1H), 4.21 (d, *J* 8.5 Hz, 1H), 4.00 (t, *J* 8.5 Hz, 1H), 3.11 (dd, *J* 3.8, 7.5 Hz, 1H), 2.95 (dd, *J* 9.8, 18.3 Hz, 1H), 2.72 (dd, *J* 9.8, 3.8 Hz,1H), 2.60 (dd, *J* 7.3, 2.5 Hz, 1H), 1.43 (s, 9H); ^{13}C NMR ($CDCl_3$, 75 MHz): δ 201.2, 139.1, 136.9, 133.1, 129.9, 129.5, 128.8, 128.5, 126.5, 78.8, 67.1, 56.3, 42.4, 39.1, 28.3; IR (film): ν 3487, 3055, 2985, 2930, 2852, 1670, 1600, 1448, 1373, 1265, 1212, 1085, 1010 cm^{-1}.

4.3. Allylsilanes 17 and 20 (general procedure)

In a 3-necked 500 mL round-bottomed flask powdered $CeCl_3 \cdot H_2O$ (15.44 g, 41.4 mmol) was heated under vacuum (1 Torr) at 160 °C for 12 h with vigorous stirring, resulting in the formation of a free flowing white solid. The reaction flask was flushed with argon and allowed to cool to rt when anhydrous THF (65 mL) was added to the vigorously stirred anhydrous cerium(III) chloride forming a uniform white suspension, which was kept under stirring for 2 h. During this time, a separate three-necked 100 mL flask, fitted with a condenser and a pressure-equalizing dropping funnel, was charged with Mg turnings (1 g, 41.4 mmol) and the whole apparatus was flame dried under a flow of argon. To this flask was added dropwise a solution of $ClCH_2SiMe_3$ (5.8 mL, 41.4 mmol) in anhydrous THF (27 mL). This mixture was stirred for 3 h until almost all of the Mg had dissolved. The anhydrous $CeCl_3$ suspension was now cooled to −78 °C. To this suspension was added dropwise the previously prepared Grignard reagent forming an off-white suspension that was stirred at −78 °C for 2 h. At this time, a solution of the corresponding ester **16** or **19** (13.8 mmol) in anhydrous THF (8 mL) was added to the Grignard–cerium chloride complex dropwise over 5 min, and the resulting mixture was warmed gradually to rt. When consumption of the starting ester was complete, as determined by TLC (3 h), the resulting gray solution was cooled to 0 °C and quenched by the addition of a satd aq solution of NH_4Cl (30 mL). The organic layer was separated, and the aqueous layer was extracted with Et_2O (2×50 mL). The combined organic layers were washed with brine (2×50 mL) and dried ($MgSO_4$). After filtration, the solvent was removed under reduced pressure to give a slightly yellow liquid that was dissolved in CH_2Cl_2 (100 mL). To this flask was added Amberlyst 15 (1.0 g) and this mixture was stirred at rt until complete consumption of starting material. The resin was then removed by filtration and washed with CH_2Cl_2 (100 mL). The solvent was removed under reduced pressure to give allylsilanes **17** and **20**.

4.3.1. 2-Benzyl(allyl)trimethylsilane (**17**)

Colorless liquid; Yield: 88%; TLC: R_f 0.60 (hexane); ^{1}H NMR ($CDCl_3$, 300 MHz): δ 0.0 (s, 9H), 1.44 (s, 2H), 3.23 (s, 2H), 4.53 (br s, 1H), 4.58 (br s, 1H), 7.10–7.25 (m, 5H); ^{13}C NMR (C_6D_6, 75 MHz): δ −1.0, 26.3, 45.6, 110.0, 126.4, 128.6, 129.5, 140.0, 146.8; MS (70 eV): *m*/*z* (%)=204 (M^+, 12), 189 (2), 173 (5), 147 (40), 134 (21), 115 (24), 104 (7), 91 (87), 73 (100); IR (film): ν 3074, 3026, 2955, 2897, 1633, 1495, 1452, 1248, 1160, 1074, 1030 cm^{-1}; HRMS: *m*/*z* calcd for $C_{13}H_{20}Si$: 204.1334, found: 204.1354; Anal. Calcd for $C_{13}H_{20}Si$: C, 76.40; H, 9.86; Si, 13.74. Found: C, 76.32; H, 9.81.

4.3.2. Trimethyl(2-methylenepentadecyl)silane (**20**)

Yellow oil; Yield: 70%; TLC: R_f 0.68 (5% EtOAc in hexane); ^{1}H NMR ($CDCl_3$, 300 MHz): δ 0.04 (s, 9H), 0.91 (t, *J* 7.0 Hz, 3H), 1.29 (br s, 20H), 1.46 (m, 2H), 1.57 (s, 2H), 1.97 (t, *J* 7.0 Hz, 2H), 4.52 (br s, 1H), 4.60 (d, *J* 1.0 Hz, 1H); ^{13}C NMR ($CDCl_3$, 75 MHz): δ 2.1, 14.2, 22.5, 22.8, 27.8, 29.4, 29.6, 29.8, 32.0, 37.9, 109.4, 146.2; IR (film): ν 3072, 2953, 2926, 2854, 1633, 1466, 1248, 1157 cm^{-1}.

4.3.3. 2-Benzyl(allyl)trichlorostannane (**18**)

^{1}H NMR ($CDCl_3$, 300 MHz): δ 1.64 (s, 2H), 3.1 (s, 2H), 5.15 (s, 1H), 5.23 (s, 1H), 7.20–7.40 (m, 5H) (Obs. The signal at δ 0.45 ppm corresponds to TMSCl).

4.3.4. Trichloro(2-methylenepentadecyl)stannane (**21**)

^{1}H NMR ($CDCl_3$, 300 MHz): δ 0.89 (t, *J* 6.0 Hz, 3H), 1.30 (br s, 20H), 1.51 (m, 2H), 2.14 (t, *J* 8.0 Hz, 2H), 3.15 (s, 2H), 5.07 (br s, 1H), 5.10 (br s, 1H) (Obs. The signal at δ 0.45 ppm corresponds to TMSCl); ^{13}C NMR ($CDCl_3$, 75 MHz): δ 14.2, 22.7, 27.4, 29.1, 29.4, 29.7, 32.0, 37.4, 40.0, 116.0, 139.0 (Obs. The signal at δ 3.3 ppm corresponds to TMSCl).

4.4. Homoallylic alcohols: general procedure

To a solution of the corresponding allylsilane (1.5 mmol) in CH_2Cl_2 (5 mL) at rt was added $SnCl_4$ (1.1 mmol). The resulting solution was stirred at 0 °C for 2 h and then cooled to −78 °C when a solution of aminoaldehydes (1.2 mmol) in CH_2Cl_2 (2 mL) was added. This mixture was stirred for 2 h at −78 °C and quenched by the slow addition of CH_2Cl_2 (5 mL) and satd aq solution of NH_4Cl (5 mL). The layers were separated and the aqueous layer was extracted with CH_2Cl_2 (2×5 mL). The combined organic layers were dried ($MgSO_4$), filtered, and concentrated in vacuo. Purification by flash chromatography on silica gel (30% EtOAc in hexane) gave the corresponding homoallylic alcohols.

4.4.1. tert-Butyl (2S,3S)-5-benzyl-3-hydroxyhex-5-en-2-ylcarbamate (**22a**)

Yield: 61% (two steps); ds 86:14; TLC: R_f 0.39 (20% EtOAc in hexane); ^{1}H NMR ($CDCl_3$, 300 MHz): δ 1.16 (d, 3H, *J* 7.0 Hz), 1.44 (s, 9H), 2.16 (m, 2H), 2.28 (br s, 1H), 3.33 (d, 1H, *J* 15.0 Hz), 3.41 (d, 1H, *J* 15.4 Hz), 3.64 (m, 2H), 4.82 (br s, 1H), 4.91 (s, 1H), 4.95 (s, 1H), 7.16–7.31 (m, 5H); ^{13}C NMR ($CDCl_3$, 75 MHz): δ 18.6, 28.4, 40.5, 42.9, 49.8, 71.6, 79.1, 114.6, 126.1, 128.2, 128.8, 138.8, 145.3, 155.7; IR (film): ν 3431, 3060, 2978, 2931, 1691, 1497, 1451, 1365, 1169, 1029 cm^{-1}. HRMS (ESI TOF-MS ES$^+$): calcd for $C_{18}H_{28}NO_3$: 306.1991; found: 306.1984.

4.4.2. tert-Butyl (3S,4S)-6-benzyl-4-hydroxy-2-methylhept-6-en-3-ylcarbamate (**22b**)

Yield: 50% (two steps); ds >95:05; TLC: R_f 0.48 (30% EtOAc in hexane); $[\alpha]_D^{20}$ −14.0 (*c* 1.62, CH_2Cl_2); ^{1}H NMR ($CDCl_3$, 300 MHz): δ 0.94 (d, 6H, *J* 7.0 Hz), 1.43 (s, 9H), 1.75–1.85 (m, 2H), 2.16 (d, *J* 6.6 Hz, 2H), 3.12 (apt, 1H, *J* 8.8 Hz), 3.38 (br s, 2H), 3.83 (apt, 1H, *J* 6.2 Hz), 4.78 (br d, 1H, *J* 9.8 Hz), 4.94 (br s, 2H), 7.16–7.31 (m, 5H); ^{13}C NMR ($CDCl_3$, 75 MHz): δ 19.3, 19.7, 28.4, 30.6, 41.4, 43.1, 59.5, 67.9, 78.9, 114.8, 126.1, 128.4, 128.9, 139.0, 145.5, 156.4; IR (film): ν 3439, 3026, 2976, 2929, 2873, 1689, 1497, 1367, 1243, 1171, 1044 cm^{-1}. HRMS (ESI TOF-MS ES$^+$): calcd for $C_{20}H_{32}NO_3$: 334.2382; found: 334.2177.

4.4.3. tert-Butyl (2S,3S)-3-hydroxy-5-methylene-1,6-diphenylhexan-2-ylcarbamate (**22c**)

Yield: 40% (two steps); ds >95:05; TLC: R_f 0.48 (30% EtOAc in hexane); $[\alpha]_D^{20}$ −18.0 (*c* 1.32, CH_2Cl_2); ^{1}H NMR ($CDCl_3$, 300 MHz): δ 1.40 (s, 9H), 2.03 (dd, 1H, *J* 5.3, 8.3 Hz), 2.19 (dd, 1H, *J* 9.1, 9.4 Hz), 2.61 (dd, 1H, *J* 8.3, 13.3 Hz), 2.80 (dd, 1H, *J* 6.5, 13.3 Hz), 3.07 (br s, 1H), 3.19 (br s, 1H), 3.71 (m, 2H), 3.86 (m, 1H), 4.79 (br s, 1H), 4.91 (br d, 1H, *J* 9.9 Hz), 6.96–7.12 (m, 2H), 7.16–7.31 (m, 8H); ^{13}C NMR ($CDCl_3$, 75 MHz): δ 28.5, 39.2, 40.5, 42.9, 53.5, 70.3, 78.9, 115.4, 126.1, 128.3, 129.0, 129.4, 138.7, 139.1, 144.2, 155.4; IR (film): ν 3439, 3055, 2982, 2361, 1707, 1495, 1366, 1265, 1171, 1061, 845, 739 cm^{-1}; HRMS: *m*/*z* calcd for $C_{24}H_{31}NO_3$: 381.2304, found: 290.1804 (M^+−91); Anal. Calcd for $C_{24}H_{31}NO_3$: C, 75.56; H, 8.19; N, 3.67. Found: C, 75.30; H, 8.20; N, 3.63.

4.4.4. tert-Butyl (4S,5S)-7-benzyl-5-hydroxy-2-methyloct-7-en-4-ylcarbamate (**22d**)

Yield: 40% (two steps); ds >95:05; TLC: R_f 0.48 (30% EtOAc in hexane); ^{1}H NMR ($CDCl_3$, 300 MHz): δ 0.91 (d, 3H, *J* 3.2 Hz), 0.92 (d, 3H, *J* 6.6 Hz), 1.30 (m, 1H), 1.43 (s, 9H), 1.60 (m, 1H), 1.92 (m, 1H), 2.18 (m, 2H), 3.35 (d, 1H, *J* 15.0 Hz), 3.40 (d, 1H, *J* 15.0 Hz), 3.57 (m, 1H), 3.65 (m, 1H), 4.64 (br d, 1H, *J* 9.2 Hz), 4.92 (br s, 1H), 4.95 (br s, 1H), 7.16–7.31 (m, 5H); ^{13}C NMR ($CDCl_3$, 75 MHz): δ 22.3, 23.2, 24.9, 28.4, 40.8, 42.0, 43.0, 52.1, 70.6, 79.0, 114.7, 126.3, 128.4, 128.9, 138.9, 145.5, 156.0; IR (film): ν 3439, 3055, 2985, 1707, 1643, 1504, 1265, 1167 cm^{-1}.

*4.4.5. tert-Butyl (2S,3S)-5-benzyl-1-(tert-butyldimethylsilyloxy)-3-hydroxyhex-5-en-2-ylcarbamate (**22e**)*

Yield: 62% (two steps); ds 75:25; TLC: R_f 0.53 (30% EtOAc in hexane); ^{1}H NMR ($CDCl_3$, 300 MHz): δ 0.08 (s, 6H), 0.91 (s, 9H), 1.45 (s, 9H), 2.17 (d, 1H, *J* 6.2 Hz), 2.25 (d, 1H, *J* 6.6 Hz), 3.13 (m, 1H), 3.36 (d, 1H, *J* 15.0 Hz), 3.41 (d, 1H, *J* 15.0 Hz), 3.52 (m, 1H), 3.73 (m, 1H), 3.87 (m, 1H), 4.11 (apt, 1H, J 6.6 Hz), 4.91 (br s, 1H), 4.95 (br s, 1H), 5.14 (d, 1H, *J* 8.8 Hz), 7.18–7.31 (m, 5H); ^{13}C NMR ($CDCl_3$, 75 MHz): δ −5.5, 18.2, 25.9, 28.4, 40.7, 43.0, 53.2, 63.1, 70.6, 79.2, 114.6, 126.1, 128.3, 128.9, 139.1, 145.0, 155.7; IR (film): ν 3443, 3060, 2983, 2960, 2931, 2858, 1707, 1648, 1497, 1367, 1265, 1171, 1087 cm^{-1}.

*4.4.6. tert-Butyl (3S,4S)-6-benzyl-4-hydroxy-1-(methylthio)hept-6-en-3-ylcarbamate (**22f**)*

Yield: 34% (two steps); ds 86:14; TLC: R_f 0.31 (30% EtOAc in hexane); ^{1}H NMR ($CDCl_3$, 300 MHz): δ 1.44 (s, 9H), 1.81 (m, 2H), 2.05–2.19 (m, 2H), 2.10 (s, 3H), 2.50 (m, 2H), 3.34 (d, 1H, *J* 15.4 Hz), 3.41 (d, 1H, *J* 15.4 Hz), 3.59 (m, 1H), 3.69 (m, 1H), 4.79 (br d, 1H, *J* 8.1 Hz), 4.94 (br s, 1H), 4.96 (br s, 1H), 7.17–7.32 (m, 5H); ^{13}C NMR ($CDCl_3$, 75 MHz): δ 15.5, 28.3, 30.8, 32.7, 40.7, 42.9, 53.2, 70.0, 79.3, 115.0, 126.3, 128.5, 128.9, 138.9, 145.3, 156.1; IR (film): ν 3435, 3055, 2982, 2918, 1707, 1498, 1445, 1362, 1265, 1169, 1045 cm^{-1}.

*4.4.7. tert-Butyl (2S,3S)-5-benzyl-1-(tert-butyldiphenylsilyloxy)-3-hydroxyhex-5-en-2-ylcarbamate (**22g**)*

Yield: 58% (two steps); ds >95:5; TLC: R_f 0.45 (30% EtOAc in hexane); $[\alpha]_D^{20}$ +9.5 (*c* 3.01, CH_2Cl_2); ^{1}H NMR ($CDCl_3$, 250 MHz): δ 1.07 (s, 9H), 1.43 (s, 9H), 2.18 (apd, 2H, *J* 5.5 Hz), 2.72 (br s, 1H), 3.34 (d, 1H, *J* 15.0 Hz), 3.37 (d, 1H, *J* 15.0 Hz), 3.62 (m, 1H), 3.73 (m, 2H), 4.12 (m, 1H), 4.91 (br s, 1H), 4.94 (br s, 1H), 5.08 (br d, 1H, *J* 9.0 Hz), 7.16–7.30 (m, 5H), 7.37–7.45 (m, 6H), 7.63–7.66 (m, 4H); ^{13}C NMR ($CDCl_3$, 62.5 MHz): δ 19.2, 26.8, 28.4, 40.1, 42.9, 53.7, 66.0, 69.6, 79.2, 114.8, 126.2, 127.8, 128.4, 129.0, 129.9, 132.8, 135.5, 139.1, 145.1, 155.8; IR (film): ν 3439, 3053, 2932, 2858, 2361, 1711, 1497, 1429, 1367, 1265, 1171, 1113, 897, 823, 739 cm^{-1}. HRMS (ESI TOF-MS ES$^+$): calcd for $C_{34}H_{45}NO_4Si$: 560.3118; found: 560.3107.

*4.4.8. tert-Butyl (2S,3S)-3-hydroxy-5-methyleneoctadecan-2-ylcarbamate (**28a**)*

Yield: 45% (two steps); ds 90:10; TLC: R_f 0.36 (20% EtOAc in hexane); $[\alpha]_D^{20}$ −1.0 (*c* 2.4, CH_2Cl_2); ^{1}H NMR ($CDCl_3$, 250 MHz): δ 0.88 (t, *J* 6.6 Hz, 3H), 1.21 (d, *J* 7.0 Hz, 3H), 1.25 (br s, 19H), 1.41 (m, 2H), 1.45 (s, 9H), 1.65 (m, 2H), 2.02 (t, *J* 7.8 Hz, 2H), 2.12 (dd, *J* 9.6, 13.7 Hz, 1H), 2.24 (dd, *J* 3.0, 13.7 Hz, 1H), 3.61 (m, 2H), 4.78 (m, 2H), 4.83 (br s, 1H), 4.89 (br s, 1H); ^{13}C NMR (C_6D_6, 75 MHz): δ 14.5, 18.9, 23.2, 28.2, 28.6, 29.9, 30.1, 30.3, 32.4, 36.4, 41.7, 50.2, 71.9, 78.7, 112.3, 146.8, 156.9; IR (film): ν 3439, 2924, 2848, 1688, 1504, 1368, 1247, 1171 cm^{-1}; HRMS (ESI TOF-MS ES$^+$): calcd for $C_{24}H_{48}NO_3$: 398.3634; found: 398.3564.

*4.4.9. tert-Butyl (3S,4S)-4-hydroxy-2-methyl-6-methylenenonadecan-3-ylcarbamate (**28b**)*

Yield: 46% (two steps); ds >95:05; TLC: R_f 0.47 (20% EtOAc in hexane); $[\alpha]_D^{20}$ −12.0 (*c* 0.24, CH_2Cl_2); ^{1}H NMR ($CDCl_3$, 300 MHz): δ 0.88 (t, *J* 7.0 Hz, 3H), 0.98 (apt, *J* 7.0 Hz, 6H), 1.26 (br s, 22H), 1.45 (s, 9H), 1.82 (m, 2H), 2.02 (m, 2H), 2.18 (m, 2H), 3.19 (t, *J* 9.0 Hz, 1H), 3.78 (m, 1H), 4.83 (br s, 2H), 4.89 (br s, 1H); ^{13}C NMR ($CDCl_3$, 75 MHz): δ 14.1, 19.4, 19.9, 22.7, 27.7, 28.4, 29.3, 29.5, 29.6, 29.7, 30.8, 31.9, 35.8, 42.0, 59.5, 67.6, 78.9, 112.5, 146.5, 156.5; IR (film): ν 3441, 3079, 2924, 2854, 1688, 1501, 1498, 1370, 1368, 1247, 1173 cm^{-1}.

*4.4.10. tert-Butyl (2S,3S)-3-hydroxy-5-methylene-1-phenyloctadecan-2-ylcarbamate (**28c**)*

Yield: 60% (two steps); ds >95:05; TLC: R_f 0.37 (20% EtOAc in hexane); $[\alpha]_D^{20}$ −3.1 (*c* 3.50, CH_2Cl_2); ^{1}H NMR (C_6D_6, 300 MHz): δ 0.93 (t, *J* 7.0 Hz, 3H), 1.33 (br s, 22H), 1.43 (s, 9H), 1.79 (m, 2H), 2.22 (m, 2H), 2.88 (dd, *J* 8.4, 13.4 Hz, 1H), 3.02 (dd, *J* 7.5, 13.4 Hz, 1H), 3.66 (m, 1H), 4.01 (dd, *J* 7.5, 16.5 Hz, 1H), 4.72 (br s, 1H), 4.78 (br s, 1H), 4.90 (d, *J* 9.3 Hz, 1H), 7.03–7.26 (m, 5H); ^{13}C NMR (C_6D_6, 75 MHz): δ 14.6, 23.4, 28.3, 28.7, 30.0, 30.1, 30.2, 30.4, 32.6, 36.5, 39.8, 42.1, 55.9, 68.7, 79.1, 112.6, 126.8, 128.9, 130.0, 139.4, 146.9, 156.3; IR (film): ν 3439, 3054, 2928, 1693, 1635, 1496, 1453, 1368, 1265, 1169, 897 cm^{-1}; HRMS (ESI TOF-MS ES$^+$): calcd for $C_{30}H_{52}NO_3$: 474.3947; found: 474.3982.

*4.4.11. tert-Butyl (4S,5S)-5-hydroxy-2-methyl-7-methyleneicosan-4-ylcarbamate (**28d**)*

Yield: 42% (two steps); ds >95:05; TLC: R_f 0.62 (20% EtOAc in hexane); $[\alpha]_D^{20}$ −8.0 (*c* 1.70, CH_2Cl_2); ^{1}H NMR ($CDCl_3$, 250 MHz): δ 0.88 (t, *J* 6.9 Hz, 3H), 0.92 (d, *J* 2.7 Hz, 3H), 0.95 (d, *J* 2.7 Hz, 3H), 1.26 (br s, 22H), 1.45 (s, 9H), 1.52 (m, 2H), 1.67 (m, 2H), 2.02 (apt, *J* 7.4 Hz, 2H), 2.20 (m, 2H), 3.65 (m, 2H), 4.67 (br d, *J* 9.8 Hz 1H), 4.83 (br s, 1H), 4.89 (br s, 1H); ^{13}C NMR ($CDCl_3$, 75 MHz): δ 14.0, 22.1, 22.6, 23.1, 24.7, 27.6, 28.3, 29.3, 29.4, 29.6, 31.8, 35.7, 41.4, 42.3, 52.1, 70.3, 77.1, 78.9, 112.4, 156.0; IR (film): ν 3439, 3055, 2926, 2852, 2305, 1693, 1504, 1367, 1270, 1170, 1054, 890 cm^{-1}; HRMS (ESI TOF-MS ES$^+$): calcd for $C_{27}H_{54}NO_2$: 440.4104; found: 440.4051.

*4.4.12. tert-Butyl (2S,3S)-1-(benzyloxy)-3-hydroxy-5-methyleneoctadecan-2-ylcarbamate (**28h**)*

Yield: 50% (two steps); ds 70:30; TLC: R_f 0.46 (20% EtOAc in hexane); ^{1}H NMR ($CDCl_3$, 250 MHz): δ 0.95 (t, 3H, *J* 6.9 Hz), 1.35 (br s, 22H), 1.45 (s, 9H), 2.02 (t, 2H, *J* 7.5 Hz), 2.34 (t, 1H, *J* 6.0 Hz), 2.50–2.57 (m, 1H), 3.44–3.66 (m, 1H), 3.69–3.75 (m, 1H), 3.96–4.21 (m, 2H), 4.85 (br s, 1H), 4.89 (br s, 1H), 4.92 (s, 2H), 5.25 (br d, 1H, *J* 9.2 Hz), 7.13–7.19 (m, 5H); ^{13}C NMR ($CDCl_3$, 125 MHz): δ 14.4, 23.1, 28.1, 28.4, 29.8, 30.1, 32.3, 36.5, 41.1, 41.8, 53.0, 69.9, 72.1, 73.3, 78.9, 105.0, 112.3, 128.3, 128.5, 138.4, 146.6, 156.0; IR (film): ν 3445, 2926, 2854, 2359, 1714, 1504, 1367, 1265, 1170, 1093, 741 cm^{-1}.

4.5. Oxazolidinone formation (general procedure)

A mixture of 60 mg of homoallylic alcohol and 0.2 mL of 1,2-ethanedithiol in 2 mL of trifluoroacetic acid was stirred for 10 min at 0 °C and then for 50 min at rt. The mixture was quenched by the addition of 10 mL of pH 5.0 phosphate buffer, and the organic layer was extracted with Et_2O and dried with $MgSO_4$. To a solution of the amino alcohols (0.213 mmol) in CH_2Cl_2 (1.2 mL) at 0 °C was added slowly a solution of triphosgene (76 mg, 0.256 mmol) in CH_2Cl_2 (1.2 mL). The mixture was stirred for 3 h at rt, diluted with CH_2Cl_2 (10 mL), and washed with satd aq. $NaHCO_3$ (5 mL). The aqueous phase was extracted with CH_2Cl_2 (2×10 mL) and the organic layer dried ($MgSO_4$) and concentrated to provide the crude product, which was purified by flash chromatography (20% EtOAc in hexane).

*4.5.1. (4S,5S)-5-(2-Benzylallyl)-4-isopropyloxazolidin-2-one (**23b**)*

Yield: 45% (two steps); TLC: R_f 0.20 (30% EtOAc in hexane); ^{1}H NMR ($CDCl_3$, 300 MHz): δ 0.83 (d, 3H, *J* 6.8 Hz), 0.88 (d, 3H, *J* 6.7 Hz), 1.64 (m, 1H), 2.22 (dd, 1H, *J* 4.8, 14.8 Hz), 2.40 (dd, 1H, *J* 8.1, 14.8 Hz), 2.65 (m, 1H), 3.17 (apt, 1H, *J* 4.9 Hz), 3.40 (s, 2H), 4.34 (dt, 1H, *J* 4.8, 4.9 Hz), 4.94 (br s, 1H), 4.98 (br s, 1H), 7.17–7.31 (m, 6H).

*4.5.2. (4S,5S)-4-Benzyl-5-(2-benzylprop-2-enyl)-1,3-oxazolidin-2-one (**23c**)*

Yield: 46 mg (70%); R_f 0.52 (50% EtOAc in hexane); ^{1}H NMR ($CDCl_3$, 300 MHz): δ 2.10 (dd, 1H, *J* 14.6, 6.0 Hz), 2.33 (dd, 1H, *J* 14.6, 7.3 Hz), 2.72 (dd, 1H, *J* 13.4, 6.3 Hz), 2.81 (dd, 1H, *J* 13.4, 7.0 Hz), 3.20 (d, 1H, *J* 15.4 Hz), 3.26 (d, 1H, *J* 15.4 Hz), 3.63 (q, 1H, *J* 6.0 Hz), 4.37 (q, 1H, *J* 6.0 Hz), 4.86 (s, 1H), 4.89 (s, 1H), 5.98 (br s, 1H), 7.08–7.33 (m, 10H); ^{13}C NMR ($CDCl_3$, 75 MHz): δ 40.1, 41.4, 43.0, 58.5, 79.9, 115.4, 126.3, 127.1, 128.3, 128.8, 128.9, 135.7, 138.5, 142.9, 158.5; IR (film):

3278, 3068, 3028, 2917, 2852, 1754, 1644, 1600, 1494, 1456, 1389, 1246, 1096, 1013, 902, 735, 703 cm^{-1}; HRMS (ESI TOF-MS ES^+): calcd for $C_{31}H_{49}NO_4Na$: 522.3560; found: 522.3676.

*4.5.3. (4S,5S)-5-(2-Benzylallyl)-4-isobutyloxazolidin-2-one (**23d**)*

Yield: 53% (two steps); TLC: R_f 0.26 (30% EtOAc in hexane); ^1H NMR ($CDCl_3$, 300 MHz): δ 0.89 (d, 3H, *J* 6.2 Hz), 0.91 (d, 3H, *J* 6.2 Hz), 1.23 (m, 1H), 1.45 (dt, 1H, *J* 5.5, 8.8 Hz), 1.59 (m, 1H), 2.25 (dd, 1H, *J* 5.5, 15.0 Hz), 2.42 (dd, 1H, *J* 7.7, 15.0 Hz), 3.40 (s, 2H), 3.48 (dt, 1H, *J* 5.5, 8.8 Hz), 4.22 (dt, 1H, *J* 5.5, 7.7 Hz), 4.95 (br s, 1H), 4.98 (br s, 1H), 6.82 (br s, 1H), 7.17–7.32 (m, 5H); ^{13}C NMR ($CDCl_3$, 75 MHz): δ 21.8, 23.1, 24.9, 40.0, 43.3, 44.3, 55.7, 81.3, 115.4, 126.4, 128.5, 129.0, 138.7, 143.2, 159.0; IR (film): ν 3261, 3057, 2958, 2930, 1751, 1388, 1261, 1076, 1016, 750 cm^{-1}. HRMS (ESI TOF-MS ES^+): calcd for $C_{17}H_{24}NO_2$: 274.3772; found: 274.1772.

*4.5.4. (4S,5S)-tert-Butyl 4-methyl-5-(2-methylenepentadecyl)-2-oxooxazolidine-3-carboxylate (**29a**)*

Yield: 55%; R_f 0.65 (20% EtOAc in hexane); ^1H NMR ($CDCl_3$, 300 MHz): δ 0.87 (t, 3H, *J* 6.9 Hz), 1.25 (br s, 20H), 1.35–1.43 (m, 2H), 1.38 (d, 3H, *J* 7.1 Hz), 1.54 (s, 9H), 1.99–2.08 (m, 2H), 2.26 (dd, 1H, *J* 7.0, 4.5 Hz), 2.46 (dd, 1H, *J* 7.0, 14.5 Hz), 3.96 (dd, 1H, *J* 3.6, 7.0 Hz), 4.16 (dt, 1H, *J* 3.6, 7.0 Hz), 4.81 (br s, 1H), 4.90 (d, 1H, *J* 1.1 Hz); ^{13}C NMR ($CDCl_3$, 75 MHz): δ 14.1, 19.7, 22.7, 27.6, 28.0, 29.6, 29.64, 31.9, 36.2, 40.5, 55.7, 79.6, 83.7, 113.2, 143.4, 149.5, 151.6; IR (film): 2925, 2854, 2366, 1820, 1803, 1725, 1461, 1369, 1259, 1222, 1078, 750 cm^{-1}.

*4.5.5. (4S,5S)-tert-Butyl 4-isopropyl-5-(2-methylenepentadecyl)-2-oxooxazolidine-3-carboxylate (**29b**)*

Yield: 49%; R_f 0.70 (20% EtOAc in hexane); ^1H NMR ($CDCl_3$, 300 MHz): δ 0.60 (d, 3H, *J* 7.0 Hz), 0.70 (d, 3H, *J* 7.0 Hz), 0.92 (t, 3H, *J* 7.0 Hz), 1.33 (br s, 22H), 1.48 (s, 9H), 1.85 (t, 2H, *J* 7.0 Hz), 1.86 (dd, 1H, *J* 7.0, 14.0 Hz), 2.11 (dd, 1H, *J* 7.0, 14.0 Hz), 2.23 (m, 1H), 3.90 (dd, 1H, *J* 2.4, 4.5 Hz), 4.04 (dt, 1H, *J* 2.4, 7.0 Hz), 4.70 (s, 1H), 4.80 (d, 1H, *J* 0.9 Hz); ^{13}C NMR ($CDCl_3$, 75 MHz): δ 14.7, 15.7, 18.0, 23.5, 28.3, 28.4, 29.8, 30.0, 30.2, 30.3, 30.5, 30.6, 32.7, 36.7, 42.2, 63.8, 73.2, 83.4, 114.1, 127.4, 144.3, 151.3, 151.5; IR (film): 2926, 2855, 1815, 1722, 1466, 1371, 1323, 1265, 1160, 1070 cm^{-1}; HRMS (ESI TOF-MS ES^+): calcd for $C_{27}H_{49}NO_4Na$: 474.3559; found: 474.3471.

*4.5.6. (4S,5S)-tert-Butyl 4-benzyl-5-(2-methylenepentadecyl)-2-oxooxazolidine-3-carboxylate (**29c**)*

Yield: 53%; R_f 0.80 (20% EtOAc in hexane); ^1H NMR ($CDCl_3$, 300 MHz): δ 0.80 (t, 3H, *J* 6.9 Hz), 1.17 (br s, 22H), 1.37 (m, 2H), 1.51 (s, 9H), 1.93 (dd, 1H, *J* 8.0, 14.0 Hz), 2.22 (dd, 1H, *J* 6.6, 14.0 Hz), 2.64 (dd, 1H, *J* 10.0, 13.3 Hz), 3.22 (dd, 1H, *J* 3.6, 13.3 Hz), 4.04 (ddd, 1H, *J* 2.3, 3.6, 10.0 Hz), 4.19 (ddd, 1H, *J* 2.34, 6.6, 8.0 Hz), 4.48 (s, 1H), 4.61 (s, 1H), 7.25–7.06 (m, 5H); IR (film): 3055, 2926, 2854, 1815, 1722, 1454, 1323, 1263, 1159, 1072 cm^{-1}; HRMS (ESI TOF-MS ES^+): calcd for $C_{31}H_{49}NO_4Na$: 522.3560, found: 522.3676.

*4.5.7. tert-Butyl 2-benzyl-5-methyl-1H-pyrrole-1-carboxylate (**24**)*

Yield: 19%; TLC: R_f 0.70 (30% EtOAc in hexane). ^1H NMR ($CDCl_3$, 250 MHz): δ 1.45 (s, 9H), 2.40 (s, 3H), 4.17 (s, 2H), 5.67 (dt, 1H, *J* 3.8 Hz), 5.83 (apd, 1H, *J* 1.02 Hz), 7.12–7.28 (m, 5H). ^{13}C NMR ($CDCl_3$, 125 MHz): δ 16.4, 27.8, 35.7, 83.4, 110.1, 111.6, 125.9, 128.2, 128.6, 132.0, 133.6, 140.2, 150.3; IR (film): ν 3066, 3030, 2979, 2930, 1738, 1605, 1535, 1457, 1389, 1329, 1257, 1171, 1120, 1020 cm^{-1}. See Ref. 23.

*4.5.8. tert-Butyl 2-methyl-5-tridecyl-1H-pyrrole-1-carboxylate (**30**)*

Yield: 53%; TLC: R_f 0.62 (20% EtOAc in hexane). ^1H NMR ($CDCl_3$, 250 MHz): δ 0.88 (t, *J* 6.4 Hz, 3H), 1.26 (br s, 20H), 1.57 (m, 2H), 1.59 (s, 9H), 2.37 (s, 3H), 2.76 (t, *J* 7.3 Hz, 2H), 5.80 (s, 2H); ^{13}C NMR ($CDCl_3$, 75 MHz): δ 14.1, 16.5, 22.7, 28.1, 29.3, 29.4, 29.5, 29.6, 29.61, 29.7, 31.9, 83.2, 108.9, 110.1, 131.2, 136.2, 150.5; IR (film): ν 2926, 2852, 1740, 1514, 1462, 1389, 1327, 1254, 1176, 1122, 1028 cm^{-1}.

4.6. Homoallylic alcohol oxidation (general procedure)

To a solution of 0.78 mmol of the corresponding homoallylic alcohol in a mixture of 5 mL of water and 5 mL of ether at rt was added 0.016 mmol of osmium tetroxide. This mixture was stirred for 2 h at rt, then 3.1 mmol of sodium periodate was added and the mixture was stirred for another 24 h. The layers were separated and the aqueous layer was extracted with ether (2×15 mL). The combined organic layer was dried with $MgSO_4$, filtered, and concentrated in vacuo. Yields refer to the unpurified 4-*N*-Boc-amino-3-hydroxy ketones. These 4-*N*-Boc-amino-3-hydroxy ketones are very unstable to flash chromatography and were reduced immediately after preparation. The listed spectroscopic data are for the crude products.

*4.6.1. tert-Butyl (2S,3S)-3-hydroxy-5-oxo-6-phenylhexan-2-ylcarbamate (**8a**)*

TLC: R_f 0.16 (30% EtOAc in hexane); $[\alpha]_D^{20}$ −20.0 (*c* 1.76, CH_2Cl_2); ^1H NMR ($CDCl_3$, 300 MHz): δ 1.17 (d, 3H, *J* 7.0 Hz), 1.44 (s, 9H), 2.66 (m, 2H), 3.60 (m, 1H), 3.71 (s, 2H), 3.96 (m, 1H), 4.84 (d, 1H, *J* 9.2 Hz), 7.16–7.34 (m, 5H); ^{13}C NMR ($CDCl_3$, 75 MHz): δ 18.4, 28.4, 45.8, 49.7, 50.7, 70.3, 79.3, 127.4, 128.6, 129.3, 133.3, 155.7, 209.3; IR (film): ν 3396, 2976, 2931, 1707, 1498, 1367, 1167, 1030 cm^{-1}.

*4.6.2. tert-Butyl (3S,4S)-4-hydroxy-2-methyl-6-oxo-7-phenylheptan-3-ylcarbamate (**8b**)*

TLC: R_f 0.32 (30% EtOAc in hexane); ^1H NMR (C_6D_6, 300 MHz): δ 0.85 (d, 3H, *J* 7.0 Hz), 0.93 (d, 3H, *J* 6.6 Hz), 1.46 (s, 9H), 1.79 (m, 1H), 2.34 (dd, 1H, *J* 2.9, 15.0 Hz), 2.51 (dd, 1H, 9.5, 15.0 Hz), 3.19 (m, 1H), 3.20 (s, 2H), 4.10 (br d, 1H, *J* 8.0 Hz), 4.80 (d, 1H, *J* 10.3 Hz), 6.99–7.12 (m, 5H); ^{13}C NMR (C_6D_6, 75 MHz): δ 19.8, 20.0, 28.6, 30.8, 46.5, 50.5, 59.9, 67.2, 78.6, 127.2, 128.8, 129.7, 134.2, 156.4, 209.0; IR (film): ν 3435, 2974, 2935, 2882, 1705, 1498, 1451, 1367, 1260, 1171, 1040 cm^{-1}.

*4.6.3. tert-Butyl (2S,3S)-3-hydroxy-5-oxo-1,6-diphenylhexan-2-ylcarbamate (**8c**)*

TLC: R_f 0.48 (30% EtOAc in hexane); ^1H NMR ($CDCl_3$, 300 MHz): δ 1.40 (s, 9H), 2.59 (dd, 1H, *J* 2.4, 2.8 Hz), 2.69 (dd, 1H, *J* 2.4, 9.8 Hz), 2.88 (d, 2H, *J* 7.6 Hz), 3.50 (br s, 1H), 3.67 (s, 2H), 3.71 (s, 1H), 3.98 (d, 1H, *J* 9.1 Hz), 4.94 (d, 1H, *J* 9.8 Hz), 7.13–7.36 (m, 10H); ^{13}C NMR ($CDCl_3$, 75 MHz): δ 28.3, 38.4, 45.7, 50.6, 55.3, 66.8, 79.4, 128.4, 129.3, 129.4, 133.3, 138.1, 155.9, 210.1; IR (film): ν 3433, 3055, 2981, 2931, 1707, 1497, 1366, 1265, 1167, 1114 cm^{-1}.

*4.6.4. tert-Butyl (4S,5S)-5-hydroxy-2-methyl-7-oxo-8-phenyloctan-4-ylcarbamate (**8d**)*

TLC: R_f 0.38 (30% EtOAc in hexane); ^1H NMR (C_6D_6, 300 MHz): δ 0.87 (d, 3H, *J* 6.2 Hz), 0.95 (d, 3H, *J* 6.2 Hz), 1.20 (m, 1H), 1.45 (s, 9H), 1.54 (m, 2H), 2.37 (dd, 1H, *J* 3.3, 17.9 Hz), 2.52 (dd, 1H, *J* 8.8, 17.9 Hz), 3.25 (s, 2H), 3.67 (m, 1H), 3.84 (m, 1H), 4.69 (d, 1H, *J* 9.9 Hz), 6.99–7.13 (m, 5H); ^{13}C NMR (C_6D_6, 75 MHz): δ 22.3, 23.3, 25.0, 28.5, 42.0, 46.1, 50.4, 53.2, 69.7, 78.6, 127.2, 128.8, 129.8, 134.3, 156.2, 208.8; IR (film): ν 3435, 3055, 2960, 2874, 1707, 1499, 1368, 1265, 1166 cm^{-1}

*4.6.5. tert-Butyl (3S,4S)-4-hydroxy-1-(methylsulfonyl)-6-oxo-7-phenylheptan-3-ylcarbamate (**8f**)*

Yield: 89%; TLC: R_f 0.35 (60% EtOAc in hexane); ^1H NMR ($CDCl_3$, 300 MHz): δ 1.43 (s, 9H), 1.62 (br s, 1H), 2.15 (m, 2H), 2.65 (m, 2H), 2.90 (s, 3H), 3.09 (apt, 2H, *J* 8.0 Hz), 3.58 (m, 1H), 3.72 (br s, 2H), 4.12 (m, 1H), 4.92 (br d, 1H, *J* 9.5 Hz), 7.17–7.36 (m, 5H); ^{13}C NMR ($CDCl_3$, 75 MHz): δ 25.9, 28.3, 40.7, 45.3, 50.7, 51.9, 52.5, 68.8, 80.0, 127.4, 128.9, 129.4, 133.2, 156.1, 209.5; IR (film): ν 3427, 3061, 2980, 2930, 1707, 1498, 1457, 1267, 1167, 1134 cm^{-1}.

*4.6.6. tert-Butyl (2S,3S)-3-hydroxy-5-oxooctadecan-2-ylcarbamate (**9a**)*

Yield: 92%, TLC: R_f 0.28 (20% EtOAc in hexane); ^{1}H NMR (C_6D_6, 250 MHz): δ 4.79 (d, *J* 8.3 Hz, 1H), 3.60–3.80 (m, 2H), 3.43 (br s, 1H), 2.33 (dd, *J* 9.8, 17.5 Hz, 1H), 2.11 (dd, *J* 2.8, 17.5 Hz, 1H), 1.91 (t, *J* 7.0 Hz, 2H), 1.47 (s, 9H), 1.45 (m, 2H), 1.32 (br s, 20H), 1.10 (d, *J* 6.8 Hz, 3H), 0.92 (t, *J* 6.0 Hz, 3H); ^{13}C NMR (C_6D_6, 75 MHz): δ 211.5, 155.9, 78.7, 70.4, 50.0, 46.4, 44.4, 32.3, 30.8, 30.1, 30.1, 30.1, 29.9, 29.8, 29.4, 29.3, 28.5, 28.3, 27.9, 27.8, 24.1, 23.7, 23.3, 23.1, 21.9, 18.6, 14.3; IR (film): ν 3441, 3020, 2928, 2852, 1705, 1504, 1456, 1367, 1215, 1165 cm^{-1}. HRMS (ESI TOF-MS ES$^+$): calcd for $C_{23}H_{46}NO_4$: 400.3427; found: 400.3280.

*4.6.7. tert-Butyl (3S,4S)-4-hydroxy-2-methyl-6-oxononadecan-3-ylcarbamate (**9b**)*

Yield: 80%; TLC: R_f 0.34 (60% EtOAc in hexane); $[\alpha]_D^{20}$ −28.0 (*c* 1.13, CH_2Cl_2); ^{1}H NMR ($CDCl_3$, 300 MHz): δ 0.92 (t, 3H, *J* 6.5 Hz), 0.93 (d, 3H, *J* 6.7 Hz), 0.99 (d, 3H, *J* 6.7 Hz), 1.12–1.26 (m, 2H), 1.32 (br s, 20H), 1.49 (s, 9H), 1.80–1.93 (m, 3H), 2.23 (dd, 1H, *J* 2.6, 17.8 Hz), 2.46 (dd, 1H, *J* 9.6, 17.8 Hz), 3.27 (apt, 1H, *J* 9.6 Hz), 3.45 (br s, 1H), 4.20 (br d, 1H, *J* 9.6 Hz), 4.90 (br d, 1H, *J* 9.6 Hz); ^{13}C NMR ($CDCl_3$, 75 MHz): δ 14.4, 19.8, 20.0, 23.1, 23.7, 28.5, 29.5, 29.8, 30.0, 30.1, 30.12, 30.14, 30.2, 30.9, 32.3, 43.4, 59.9, 67.1, 78.5, 156.5, 212.2; IR (film): ν 3441, 2926, 2854, 1701, 1501, 1265, 1259, 1170 cm^{-1}. HRMS (ESI TOF-MS ES$^+$): calcd for $C_{25}H_{50}NO_4$: 428.3740; found: 428.3690.

*4.6.8. tert-Butyl (2S,3S)-3-hydroxy-5-oxo-1-phenyloctadecan-2-ylcarbamate (**9c**)*

Yield: 89%; TLC: R_f 0.40 (60% EtOAc in hexane); ^{1}H NMR ($CDCl_3$, 300 MHz): δ 0.92 (t, 3H, *J* 6.9 Hz), 1.11–1.26 (m, 2H), 1.31 (br s, 20H), 1.44 (s, 9H), 1.80 (t, 2H, *J* 7.2 Hz), 2.02 (dd, 1H, *J* 2.1, 17.9 Hz), 2.40 (dd, 1H, *J* 10.0, 17.9 Hz), 2.94 (d, 2H, *J* 7.6 Hz), 3.85 (dd, 2H, *J* 8.3, 17.9 Hz), 4.01 (d, 1H, *J* 9.7 Hz), 5.13 (d, 1H, *J* 9.7 Hz), 7.05–7.29 (m, 5H); ^{13}C NMR ($CDCl_3$, 75 MHz): δ 14.3, 23.0, 28.4, 29.3, 29.7, 29.8, 30.0, 32.2, 38.9, 43.1, 46.1, 55.9, 67.0, 78.8, 126.3, 128.4, 128.5, 129.3, 129.6, 138.8, 155.9, 211.8; IR (film): ν 3445, 3055, 2854, 1699, 1645, 1506, 1265, 1169 cm^{-1}.

*4.6.9. tert-Butyl (4S,5S)-5-hydroxy-2-methyl-7-oxoicosan-4-ylcarbamate (**9d**)*

Yield: 94%; TLC: R_f 0.52 (20% EtOAc in hexane); ^{1}H NMR ($CDCl_3$, 300 MHz): δ 0.92 (t, *J* 6.76 Hz, 3H), 0.93 (d, *J* 6.8 Hz, 3H), 0.99 (d, *J* 6.2 Hz, 3H), 1.32 (br s, 22H), 1.47 (s, 9H), 1.60 (m, 3H), 1.92 (apt, *J* 8.06 Hz, 2H), 2.24 (m, 1H), 2.44 (dd, *J* 9.3, 17.6 Hz, 1H), 3.30 (m, 1H), 3.70 (m, 1H), 3.90 (d, *J* 8.8 Hz, 1H), 4.70 (d, *J* 9.3 Hz, 1H); ^{13}C NMR ($CDCl_3$, 75 MHz): δ 14.3, 22.3, 23.1, 23.3, 23.7, 25.0, 28.5, 29.4, 29.81, 30.07, 30.09, 30.13, 32.3, 42.3, 43.3, 46.4, 52.2, 69.7, 78.6, 156.2, 211.9; IR (film): ν 3445, 3055, 2926, 2858, 1716, 1505, 1469, 1367, 1260, 1171, 1123, 1045 cm^{-1}.

4.7. β-Hydroxyketone reduction (*n*-Bu_3B/$LiBH_4$)

To a solution of 0.60 mmol of tributylborane and 0.41 mmol of the corresponding β-hydroxyketone in 2.5 mL of tetrahydrofuran was bubbled a small amount of air and the solution was stirred at rt for 2 h. Then the mixture was cooled to −78 °C and treated with 0.60 mmol of lithium borohydride. After 4 h the mixture was quenched with a mixture of 4.1 mL of pH 7 phosphate buffer, 6.2 mL of methanol, and 2.5 mL of 30% hydrogen peroxide. This mixture was stirred at rt for 18 h. The organic solvent was evaporated in vacuo and the organic layers were extracted with ether (2×15 mL). The combined organic layer was dried with $MgSO_4$, filtered, and concentrated in vacuo. Purification by flash chromatography (silica gel, 30% EtOAc in hexane) afforded the corresponding 1,3-*syn*-diol.

4.8. β-Hydroxyketone reduction (diethylmethoxyborane/$LiBH_4$)

A solution of 0.25 mL of diethylmethoxyborane and 0.46 g of the corresponding β-hydroxyketone in 18.0 mL of tetrahydrofuran and 3.5 mL of methanol was stirred at −78 °C for 30 min. Then was added 1.8 mL of lithium borohydride solution (2 mol/L). After 2 h the mixture was quenched with a mixture of 4.1 mL of pH 7 phosphate buffer, 6.2 mL of methanol, and 2.5 mL of 25% hydrogen peroxide. This mixture was stirred at rt for 18 h. The organic solvent was evaporated in vacuo and the organic layers were extracted with ether (2×15 mL). The combined organic layer was dried with $MgSO_4$, filtered, and concentrated in vacuo. Purification by flash chromatography (silica gel, 30% EtOAc in hexane) afforded the corresponding 1,3-*syn*-diol.

*4.8.1. tert-Butyl (2S,3S,5S)-3,5-dihydroxy-6-phenylhexan-2-ylcarbamate (**4a**)*

Yield: 89%; ds >95:05; TLC: R_f 0.08 (30% EtOAc in hexane); ^{1}H NMR ($CDCl_3$, 300 MHz): δ 1.17 (d, 3H, *J* 7.0 Hz), 1.45 (s, 9H), 1.67 (apt, 2H, *J* 7.7 Hz), 2.76 (m, 2H), 3.20–3.40 (br s, 2H), 3.67 (m, 1H), 3.78 (m, 1H), 4.10 (m, 1H), 4.85 (m, 1H), 7.16–7.31 (m, 5H); ^{13}C NMR ($CDCl_3$, 75 MHz): δ 18.3, 28.5, 39.5, 44.8, 50.8, 73.5, 75.3, 79.3, 126.6, 128.6, 129.3, 137.5, 156.0. HRMS (ESI TOF-MS ES$^+$): calcd for $C_{17}H_{28}NO_4$: 310.1940; found: 310.1926.

*4.8.2. tert-Butyl (3S,4S,6S)-4,6-dihydroxy-2-methyl-7-phenylheptan-3-ylcarbamate (**4b**)*

Yield: 40%; ds >95:05; TLC: R_f 0.21 (30% EtOAc in hexane); ^{1}H NMR ($CDCl_3$, 300 MHz): δ 0.94 (d, 3H, *J* 6.9 Hz), 0.97 (d, 3H, *J* 6.6 Hz), 1.46 (s, 9H), 1.68 (apdd, 2H, J 2.9, 5.9 Hz), 1.83 (m, 1H), 2.70 (dd, 1H, *J* 8.4, 13.6 Hz), 2.84 (dd, 1H, *J* 4.4, 13.6 Hz), 3.10 (apt, 1H, *J* 9.9 Hz), 4.10 (m, 2H), 4.90 (br d, 1H, *J* 9.9 Hz), 7.18–7.34 (m, 5H); ^{13}C NMR ($CDCl_3$, 75 MHz): δ 19.5, 19.8, 28.4, 30.0, 40.2, 44.8, 60.6, 71.5, 73.8, 79.0, 126.8, 128.7, 129.4, 137.5, 156.7; IR (film): ν 3418, 3057, 2947, 2872, 1713, 1520, 1454, 1367, 1265, 1169, 1045 cm^{-1}.

*4.8.3. tert-Butyl (2S,3S,5S)-3,5-dihydroxy-1,6-diphenylhexan-2-ylcarbamate (**4c**)*

Yield: 69%; ds >95:05; TLC: R_f 0.15 (30% EtOAc in hexane); ^{1}H NMR ($CDCl_3$, 300 MHz): δ 1.43 (s, 9H), 1.59 (m, 1H), 1.74 (m, 1H), 2.64 (m, 3H), 2.72 (dd, 1H, *J* 8.1, 4.4 Hz), 2.84 (d, 2H, *J* 4.4 Hz), 3.68 (m, 1H), 3.82 (d, 1H, *J* 9.8 Hz), 4.02 (m, 1H), 5.01 (br d, 1H, *J* 8.1 Hz), 7.14–7.32 (m, 10H); ^{13}C NMR ($CDCl_3$, 75 MHz): δ 28.5, 38.5, 39.8, 44.8, 56.4, 71.5, 73.7, 79.3, 126.1, 126.7, 128.3, 128.6, 129.3, 137.6, 138.4; IR (film): ν 3343, 3055, 2985, 1655, 1496, 1373, 1265, 1167 cm^{-1}. HRMS (ESI TOF-MS ES$^+$): calcd for $C_{23}H_{32}NO_4$: 386.2253; found: 386.2221.

*4.8.4. tert-Butyl (4S,5S,7S)-5,7-dihydroxy-2-methyl-8-phenyloctan-4-ylcarbamate (**4d**)*

Yield: 60%; ds >95:05; TLC: R_f 0.24 (30% EtOAc in hexane); ^{1}H NMR ($CDCl_3$, 300 MHz): δ 0.91 (d, 6H, *J* 6.6 Hz), 1.29 (m, 1H), 1.45 (s, 9H), 1.65 (m, 3H), 2.70 (dd, 1H, *J* 8.1, 13.6 Hz), 2.81 (dd, 1H, *J* 4.4, 13.6 Hz), 3.04 (br s, 2H), 3.56 (m, 1H), 3.82 (m, 1H), 4.10 (m, 1H), 4.76 (br d, 1H, *J* 9.2 Hz), 7.18–7.33 (m, 5H); ^{13}C NMR ($CDCl_3$, 75 MHz): δ 22.2, 23.1, 24.7, 28.4, 39.5, 41.5, 44.8, 52.9, 73.6, 74.3, 79.1, 126.7, 128.7, 129.4, 137.6, 156.3; IR (film): ν 3435, 3055, 2958, 2870, 1693, 1506, 1451, 1368, 1265, 1169, 1081 cm^{-1}.

*4.8.5. tert-Butyl (2S,3S,5S)-3,5-dihydroxyoctadecan-2-ylcarbamate (**5a**)*

Yield: 48% (two steps); ds 94:06; TLC: R_f 0.10 (20% EtOAc in hexane); white solid (mp 55.1–58.0 °C); $[\alpha]_D^{20}$ −3.0 (*c* 0.84, $CHCl_3$); ^{1}H NMR ($CDCl_3$, 300 MHz): δ 0.88 (t, *J* 6.6 Hz, 3H), 1.19 (d, *J* 6.6 Hz, 3H), 1.26 (br s, 22H), 1.45 (s, 9H), 1.58 (m, 2H), 3.61 (br s, 1H), 3.78 (m, 1H), 3.88 (m, 2H), 4.82 (d, *J* 8.4 Hz, 1H); ^{13}C NMR ($CDCl_3$,

75 MHz): δ 14.1, 18.2, 22.7, 25.3, 28.4, 29.4, 29.6, 29.7, 31.9, 38.4, 40.0, 50.6, 69.5, 79.4, 156.1; IR (film): ν 3435, 2927, 2852, 1691, 1502, 1451, 1367, 1265, 1169, 1022 cm^{-1}.

*4.8.6. tert-Butyl (3S,4S,6S)-4,6-dihydroxy-2-methylnonadecan-3-ylcarbamate (**5b**)*

Yield: 53% (two steps); ds 75:25; TLC: R_f 0.20 (20% EtOAc in hexane); $[\alpha]_D^{20}$ −15.0 (*c* 1.14, CH_2Cl_2); ^1H NMR ($CDCl_3$, 300 MHz): δ 0.88 (t, *J* 6.0 Hz, 3H), 0.95 (m, 6H), 1.25 (br s, 22H), 1.45 (s, 9H), 1.59 (m, 2H), 1.86 (sept, *J* 9.0 Hz, 1H), 3.21 (apt, *J* 9.0 Hz, 1H), 4.20 (dd, *J* 10.0, 18.0 Hz, 1H), 4.60 (dd, *J* 9.0, 12.0 Hz, 1H); ^{13}C NMR ($CDCl_3$, 75 MHz): δ 14.1, 19.4, 20.0, 22.7, 26.6, 27.4, 28.4, 28.7, 29.3, 29.6, 30.4, 31.9, 32.3, 34.6, 36.1, 37.5, 39.3, 59.7, 70.5, 75.1, 79.0, 156.4; IR (film): ν 3445, 2926, 2853, 1693, 1504, 1392, 1301, 1173, 1016 cm^{-1}; HRMS (ESI TOF-MS ES^+): calcd for $C_{25}H_{52}NO_4$: 430.3896; found: 430.3917.

*4.8.7. tert-Butyl (2S,3S,5S)-3,5-dihydroxy-1-phenyloctadecan-2-ylcarbamate (**5c**)*

Yield: 49% (two steps); ds 95:05; TLC: R_f 0.20 (20% EtOAc in hexane); white solid (mp 63.4–66.2 °C); $[\alpha]_D^{20}$ −117.0 (*c* 1.30, CH_2Cl_2); ^1H NMR ($CDCl_3$, 300 MHz): δ 0.87 (t, *J* 6.3 Hz, 3H), 1.24 (br s, 22H), 1.41 (s, 9H), 1.51 (m, 2H), 2.88 (d, *J* 7.2 Hz, 2H), 3.67 (apd, *J* 7.8 Hz, 1H), 3.82 (d, *J* 9.9 Hz, 2H), 5.01 (d, *J* 9.3 Hz, 1H), 7.18–7.31 (m, 5H); ^{13}C NMR ($CDCl_3$, 75 MHz): δ 14.1, 22.7, 25.2, 28.3, 29.3, 29.5, 29.6, 31.9, 38.5, 40.0, 56.5, 71.9, 73.1, 79.3, 126.2, 128.4, 129.4, 138.5, 156.1; IR (film): ν 3435, 3055, 2928, 2858, 1693, 1497, 1451, 1368, 1265, 1169 cm^{-1}; HRMS (ESI TOF-MS ES^+): calcd for $C_{29}H_{52}NO_4$: 478.3896; found: 478.3741.

*4.8.8. tert-Butyl (4S,5S,7S)-5,7-dihydroxy-2-methylicosan-4-ylcarbamate (**5d**)*

Yield: 78% (two steps); ds 70:30; TLC: R_f 0.23 (20% EtOAc in hexane); white solid (mp 60.2–62.7 °C); $[\alpha]_D^{20}$ −4.0 (*c* 1.3, CH_2Cl_2); ^1H NMR ($CDCl_3$, 300 MHz): δ 0.88 (t, *J* 6.9 Hz, 3H), 0.92 (apd, *J* 6.7 Hz, 6H), 1.25 (br s, 22H), 1.44 (s, 9H), 1.50 (m, 3H), 1.59 (m, 2H), 3.01 (br s, 2H), 3.60 (m, 1H), 3.90 (m, 2H), 4.76 (d, *J* 9.7 Hz, 1H); ^{13}C NMR ($CDCl_3$, 75 MHz): δ 14.1, 22.2, 22.7, 23.2, 24.8, 25.3, 28.4, 29.4, 29.6, 29.7, 31.9, 38.5, 39.8, 41.4, 53.1, 73.0, 74.7, 79.2, 156.4; IR (film): ν 3435, 3055, 2852, 1693, 1502, 1368, 1265, 1169, 1045, 913 cm^{-1}; HRMS (ESI TOF-MS ES^+): *m*/*z* calcd for $C_{26}H_{54}NO_4$: 444.4053, found: 444.4015.

4.9. β-Hydroxyketone reduction ($Me_4NBH(OAc)_3$)

Acetic acid (1.0 mL) was added to a stirred suspension of $Me_4NHB(OAc)_3$ (1.58 mmol) in acetonitrile (0.55 mL) at rt. The resulting mixture was stirred for 30 min and then cooled to −40 °C. The corresponding hydroxyketone (0.197 mmol) dissolved in acetonitrile (0.55 mL) was added dropwise. A solution of CSA (0.098 mmol), acetic acid (0.55 mL), and acetonitrile (0.55 mL) was added and the mixture was stirred for 18 h at −22 °C. The reaction was quenched by addition of aqueous sodium bicarbonate solution (10 mL) followed by aqueous potassium tartrate solution (10 mL) and Et_2O (30 mL) stirring vigorously at rt for 3 h. The combined organic phase was dried over $MgSO_4$. The solvent was removed under reduced pressure and the resulting oil was purified by flash chromatography (silica gel 230–400 mesh, using 25% EtOAc in hexane) providing the corresponding 1,3-*anti* aminodiols.

*4.9.1. tert-Butyl (3S,4S,6R)-4,6-dihydroxy-2-methyl-7-phenylheptan-3-ylcarbamate (**6b**)*

Yield: 68%; ds >95:05; TLC: R_f 0.18 (30% EtOAc in hexane); ^1H NMR ($CDCl_3$, 300 MHz): δ 0.92 (d, 3H, *J* 6.7 Hz), 0.97 (d, 3H, *J* 6.7 Hz), 1.43 (s, 9H), 1.57 (m, 1H), 1.82 (m, 2H), 2.80 (d, 1H, *J* 2.1 Hz), 2.86 (d, 1H, *J* 4.0 Hz), 3.16 (apt, 1H, *J* 8.9 Hz), 4.14 (m, 2H), 4.80 (br d, 1H, *J* 9.4 Hz), 7.19–7.32 (m, 5H); ^{13}C NMR ($CDCl_3$, 75 MHz): δ 18.8, 19.9, 28.2, 30.1, 40.2, 43.9, 60.5, 68.3, 70.5, 79.2, 126.6, 128.7, 129.3, 138.2, 156.9; IR (film): ν 3414, 3057, 2945, 2870, 1711, 1496, 1434, 1362, 1265, 1170, 1043, 1021, 902 cm^{-1}. HRMS (ESI TOF-MS ES^+): calcd for $C_{19}H_{32}NO_4$: 338.2331; found: 338.2235.

*4.9.2. tert-Butyl (3S,4S,6R)-4,6-dihydroxy-1-methylsulfonyl-7-phenylheptan-3-ylcarbamate (**6f**)*

Yield: 73%; ds 60:40; TLC: R_f 0.15 (60% EtOAc in hexane); ^1H NMR ($CDCl_3$, 300 MHz): δ 1.43 (s, 9H), 1.61 (br s, 4H), 1.78 (m, 1H), 2.08 (m, 2H), 2.78 (m, 2H), 2.91 (s, 3H), 3.12 (apt, 2H, *J* 7.9 Hz), 3.61 (m, 1H), 4.04 (br d, 1H, *J* 9.2 Hz), 4.11 (m, 1H), 4.99 (d, 1H, *J* 8.8 Hz), 7.18–7.33 (m, 5H); ^{13}C NMR ($CDCl_3$, 75 MHz): δ 25.8, 28.3, 39.3, 40.7, 43.7, 52.0, 53.6, 69.9, 70.3, 79.9, 126.8, 128.8, 129.3, 137.8, 156.8; IR (film): ν 3425, 3055, 2986, 2687, 2307, 1705, 1498, 1421, 1267, 1167, 1022, 964, 897, 784 cm^{-1}.

*4.9.3. tert-Butyl (2S,3S,5R)-3,5-dihydroxyoctadecan-2-ylcarbamate (**7a**)*

Yield: 57%; ds 96:04; TLC: R_f 0.15 (20% EtOAc in hexane); white solid (mp 55.5–56.4 °C); $[\alpha]_D^{20}$ −7.0 (*c* 1.08, CH_2Cl_2); ^1H NMR ($CDCl_3$, 250 MHz): δ 0.88 (t, *J* 6.3 Hz, 3H), 1.18 (d, *J* 7.5 Hz, 3H), 1.15–1.20 (m, 2H), 1.26 (br s, 20H), 1.45 (s, 9H), 1.49–1.579 (m, 2H), 1.69–1.78 (m, 2H), 2.52 (br, 1H), 3.05 (br, 1H), 3.63 (m, 1H), 3.79–3.89 (m, 2H), 4.74 (d, *J* 7.5 Hz, 1H); ^{13}C NMR ($CDCl_3$, 75 MHz): δ 14.1, 22.7, 25.8, 28.3, 29.3, 29.6, 31.9, 37.3, 38.5, 40.1, 56.3, 68.8, 69.5, 79.4, 126.3, 128.4, 129.3, 138.4, 156.4; IR (film): ν 3435, 3049, 2926, 2852, 1687, 1506, 1547, 1265, 1165, 1045 cm^{-1}; HRMS (ESI TOF-MS ES^+): calcd for $C_{29}H_{52}NO_4$: 478.3896; found: 478.3915.

*4.9.4. tert-Butyl (3S,4S,6R)-4,6-dihydroxy-2-methylnonadecan-3-ylcarbamate (**7b**)*

Yield: 42%; ds 95:05; TLC: R_f 0.11 (20% EtOAc in hexane); $[\alpha]_D^{20}$ −11.0 (*c* 2.4, CH_2Cl_2); ^1H NMR ($CDCl_3$, 250 MHz): δ 0.88 (t, *J* 7.0 Hz, 3H), 0.94 (d, *J* 6.5 Hz, 3H), 0.98 (d, *J* 6.5 Hz, 3H), 1.23 (d, *J* 6.5 Hz, 2H), 1.25 (br s, 20H), 1.44 (s, 9H), 1.54–1.57 (m, 2H), 1.80–1.87 (m, 1H), 3.10 (apt, *J* 9.0 Hz, 1H), 3.91–3.97 (m, 2H), 4.07–4.04 (m, 2H), 4.86 (d, *J* 11 Hz, 1H); ^{13}C NMR ($CDCl_3$, 75 MHz): δ 14.1, 19.4, 19.9, 22.7, 24.2, 25.2, 25.3, 28.4, 29.4, 29.6, 29.7, 29.9, 31.9, 38.3, 38.6, 40.5, 44.7, 60.7, 71.9, 73.2, 79.0, 156.7; IR (film): ν 3437, 2926, 2852, 2306, 1693, 1504, 1469, 1367, 1265, 1171, 1045; HRMS (ESI TOF-MS ES^+): calcd for $C_{25}H_{52}NO_4$: 430.3896; found: 430.3927.

*4.9.5. tert-Butyl (2S,3S,5R)-3,5-dihydroxy-1-phenyloctadecan-2-ylcarbamate (**7c**)*

Yield: 40%; ds 90:10; TLC: R_f 0.15 (20% EtOAc in hexane); ^1H NMR ($CDCl_3$, 250 MHz): δ 0.88 (t, 3H, *J* 7.0 Hz), 1.25 (br s, 22H), 1.39 (br s, 11H), 1.77 (m, 1H), 2.88 (d, 3H, *J* 7.5 Hz), 3.72–3.87 (m, 3H), 3.93 (apd, 1H, *J* 9.6 Hz, 1H), 4.96 (d, 1H, *J* 9.5 Hz), 7.21–7.28 (m, 5H); ^{13}C NMR ($CDCl_3$, 75 MHz): δ 14.1, 22.7, 25.8, 28.3, 29.3, 29.6, 31.9, 37.3, 38.5, 40.1, 56.3, 68.8, 69.5, 79.4, 126.3, 128.4, 129.3, 138.4, 156.4; IR (film): ν 3435, 3055, 2928, 2858, 1693, 1497, 1451, 1368, 1265, 1169 cm^{-1}; HRMS (ESI TOF-MS ES^+): calcd for $C_{29}H_{52}NO_4$: 478.3896; found: 478.3915.

*4.9.6. tert-Butyl (4S,5S,7R)-5,7-dihydroxy-2-methylicosan-4-ylcarbamate (**7d**)*

Yield: 42%; ds 92:08; TLC: R_f 0.13 (20% EtOAc in hexane); white solid (mp 99.3–103.0 °C); $[\alpha]_D^{20}$ −2.0 (*c* 0.71, CH_2Cl_2); ^1H NMR ($CDCl_3$, 250 MHz): δ 0.88 (t, *J* 6.6 Hz, 3H), 0.93 (d, *J* 6.6 Hz, 6H), 1.25 (br, 22H), 1.44 (s, 9H), 1.45 (m, 2H), 1.69–1.72 (m, 2H), 2.36 (br, 2H), 3.60 (m, 1H), 3.85–3.88 (m, 2H), 4.68 (d, *J* 9.9 Hz, 1H); ^{13}C NMR ($CDCl_3$, 75 MHz): δ 14.1, 22.1, 22.7, 23.3, 24.8, 25.8, 28.4, 29.3, 29.6, 29.7, 31.9, 37.4, 39.9, 41.5, 53.1, 69.7, 71.2, 79.3, 156.6; IR (film): ν 3437, 2928, 2852, 1707, 1508, 1421, 1361, 1267, 1170, 1045 cm^{-1}; HRMS (ESI TOF-MS ES^+): calcd for $C_{26}H_{54}NO_4$: 444.4053; found: 444.3849.

4.10. Acetonide formation (general procedure)

To a solution of 0.74 mmol of aminodiol in 8 mL of 2,2-dimethoxypropane was added 5 mg of CSA. This mixture was stirred under an argon atmosphere for about 48 h at rt. The layers were separated and the organic layer was washed with satd aq. $NaHCO_3$ and extracted with ether (2×10 mL). The combined organic layer was dried with $MgSO_4$, filtered and concentrated in vacuo. Purification by flash chromatography (silica gel, 30% EtOAc in hexane) afforded the corresponding acetonide.

*4.10.1. tert-Butyl-(S)-1-((4S,6S)-6-benzyl-2,2-dimethyl-1,3-dioxan-4-yl)-methylpropylcarbamate (**25**)*

Yield: 92%; TLC: R_f 0.58 (30% EtOAc in hexane); ^{1}H NMR ($CDCl_3$, 300 MHz): δ 0.90 (d, 3H, *J* 6.6 Hz), 0.93 (d, 3H, *J* 7.0 Hz), 1.30–1.50 (m, 2H), 1.39 (s, 3H), 1.42 (s, 3H), 1.49 (s, 9H), 1.79 (m, 1H), 2.61 (dd, 1H, *J* 7.0, 13.6 Hz), 2.91 (dd, 1H, *J* 5.8, 13.6 Hz), 3.14 (apt, 1H, *J* 9.9 Hz), 4.05 (m, 2H), 4.86 (d, 1H, *J* 9.3 Hz), 7.18–7.31 (m, 5H); ^{13}C NMR ($CDCl_3$, 75 MHz): δ 19.4, 19.5, 28.4, 29.9, 30.3, 33.1, 43.0, 58.9, 67.8, 70.1, 78.8, 98.5, 126.2, 128.2, 129.3, 137.7, 156.3; IR (film): ν 3454, 2974, 2935, 2874, 1716, 1497, 1367, 1255, 1169, 1045 cm^{-1}; HRMS (ESI TOF-MS ES$^+$): calcd for $C_{22}H_{36}NO_4$: 378.2566; found: 378.2498.

*4.10.2. tert-Butyl-(S)-1-((4S,6S)-6-benzyl-2,2-dimethyl-1,3-dioxan-4-yl)-phenylethylcarbamate (**26**)*

Yield: 97%; TLC: R_f 0.48 (30% EtOAc in hexane); ^{1}H NMR ($CDCl_3$, 300 MHz): δ 1.35 (s, 3H), 1.47 (s, 3H), 1.49 (s, 9H), 1.54 (m, 2H), 2.58 (dd, 1H, *J* 7.3, 10.5 Hz), 2.78 (dd, 1H, *J* 9.8, 12.8 Hz), 2.89 (dd, 2H, *J* 5.5, 13.7 Hz), 3.68 (m, 2H), 3.94 (m, 1H), 5.02 (d, 1H, *J* 9.5 Hz), 7.13–7.28 (m, 10H); ^{13}C NMR ($CDCl_3$, 75 MHz): δ 19.8, 28.4, 30.0, 32.6, 38.2, 42.9, 55.2, 66.9, 69.9, 79.2, 98.8, 126.2, 126.3, 128.2, 128.3, 129.3, 129.5, 137.6, 138.4, 155.8.

*4.10.3. tert-Butyl-(S)-1-((4S,6R)-6-benzyl-2,2-dimethyl-1,3-dioxan-4-yl)-ethylpropylcarbamate (**27**)*

Yield: 72%; TLC: R_f 0.48 (30% EtOAc in hexane); ^{1}H NMR ($CDCl_3$, 300 MHz): δ 1.35 (s, 3H), 1.47 (s, 3H), 1.49 (s, 9H), 1.54 (m, 2H), 2.58 (dd, 1H, *J* 7.3, 10.5 Hz), 2.78 (dd, 1H, *J* 9.8, 12.8 Hz), 2.89 (dd, 2H, *J* 5.5, 13.7 Hz), 3.68 (m, 2H), 3.94 (m, 1H), 5.02 (d, 1H, *J* 9.5 Hz), 7.13–7.28 (m, 10H); ^{13}C NMR ($CDCl_3$, 75 MHz): δ 19.4, 24.8, 28.4, 30.8, 35.2, 42.2, 58.6, 65.5, 68.2, 78.8, 100.3, 126.2, 128.0, 129.2, 138.4, 156.8; IR (film): ν 3853, 3736, 3446, 2974, 2930, 2361, 1711, 1624, 1498, 1456, 1367, 1265, 1169, 1047, 941, 741 cm^{-1}.

*4.10.4. tert-Butyl (S)-1-((4S,6S)-2,2-dimethyl-6-tridecyl-1,3-dioxan-4-yl)-2-phenylethylcarbamate (**31**)*

Yield: 97%; TLC: R_f 0.80 (20% EtOAc in hexane); $[\alpha]_D^{20}$ −1.0 (*c* 0.97, CH_2Cl_2); ^{1}H NMR ($CDCl_3$, 300 MHz): δ 0.88 (t, *J* 6.3 Hz, 3H), 1.23 (br s, 22H), 1.35 (s, 3H), 1.43 (s, 3H), 1.45 (s, 9H), 1.59 (br s, 2H), 2.82 (m, 2H), 3.70 (m, 2H), 5.00 (d, *J* 9.3 Hz, 1H), 7.21–7.31 (m, 5H); ^{13}C NMR ($CDCl_3$, 75 MHz): δ 14.1, 19.8, 22.7, 24.9, 28.4, 29.3, 29.5, 29.54, 29.6, 29.7, 30.1, 31.9, 33.2, 36.4, 38.3, 55.3, 67.2, 68.7, 77.2, 79.2, 98.6, 126.3, 128.3, 129.6, 138.5, 155.9; HRMS (ESI TOF-MS ES$^+$): *m*/*z* calcd for $C_{32}H_{56}NO_4$: 518.4209, found: 518.4333.

*4.10.5. tert-Butyl (S)-1-((4S,6R)-2,2-dimethyl-6-tridecyl-1,3-dioxan-4-yl)-3-methylbutylcarbamate (**32**)*

Yield: 87%; TLC: R_f 0.88 (20% EtOAc in hexane); $[\alpha]_D^{20}$ −14.0 (*c* 1.08, CH_2Cl_2); ^{1}H NMR ($CDCl_3$, 250 MHz): δ 0.91 (t, *J* 6.7 Hz, 3H), 0.89 (d, *J* 6.5 Hz, 3H), 0.92 (d, *J* 6.5 Hz, 3H), 1.23 (br, 22H), 1.29 (s, 6H), 1.43 (s, 9H), 1.50–1.53 (m, 2H), 1.57 (br s, 2H), 3.51–3.80 (m, 3H), 4.66 (d, *J* 9.3 Hz, 1H); ^{13}C NMR ($CDCl_3$, 75 MHz): δ 14.1, 22.5, 22.7, 23.0, 24.6, 25.4, 28.4, 29.3, 29.5, 29.6, 29.65, 29.7, 32.0, 35.1, 36.0, 42.0, 51.3, 67.3, 68.0, 77.2, 79.0, 100.3, 156.3; IR (film): ν 2925, 2855, 1718, 1499, 1366, 1275, 1224, 1174 cm^{-1}. HRMS (ESI TOF-MS ES$^+$): calcd for $C_{29}H_{58}NO_4$: 484.4366; found: 484.4251.

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