A General Approach for Preparing Epidithiodioxopiperazines from Trioxopiperazine Precursors. Enantioselective Total Syntheses of (+)- and (–)-Gliocladine C, (+)-Leptosin D, (+)-T988C, Bionectin A and (+)-Gliocladin A.

Supporting Information Part 1

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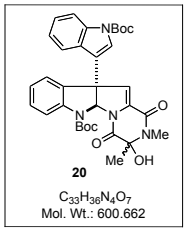
1. General Experimental Details.

General experimental details have been described: *J. Org. Chem.* **2012**, *77*, published online June 26, 2012. When the product was a mixture of isomers and one was predominant, NMR data for only the major isomer is tabulated (unless otherwise noted). When diastereomers were obtained from a reaction, analytical samples of each were obtained by silica gel chromatography (see experimental section for conditions, typically only partial separation was achieved). If conditions could not be found to separate the diastereomers obtained from a reaction, analytical samples of the desired diastereomers were obtained by independently using the separated diastereomers from the previous reaction in the desired reaction. In the tables comparing NMR data for a synthetic product with data reported for the natural product, signals highlighted in red correspond to signals that were reassigned by 2D NMR experiments or are signals that were not reported previously.

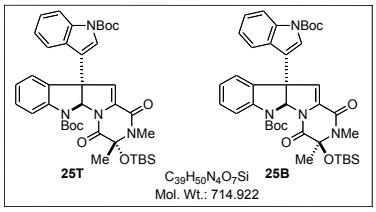
2. Experimental Procedures



Addition of Methylmagnesium Chloride to Trioxopiperazine (+)-17. **Preparation of 20.** A solution of (+)-**17** (270 mg, 0.462 mmol, 98:2 er)[1] in THF (12 mL) was cooled to –78 ºC and methylmagnesium chloride (410 µL, 1.2 mmol, 2.9 M solution in THF) was added dropwise. The reaction was stirred at –78 ºC for 3 h, then AcOH (110 µL) was added, the cooling bath

[1] DeLorbe, J. E.; Jabri, S. Y.; Mennen, S. M.; Overman, L. E.; Zhang, F.-L. *J. Am. Chem. Soc.* **2011**, *133*, 6549–6552.

was removed and the reaction was allowed to warm to room temperature. The solvent was removed under reduced pressure, H_2O (15 mL) was added, and the mixture was extracted with ethyl acetate (3 x 15 mL). The combined organic phases were washed with brine (15 mL), dried (Na_2SO_4), then concentrated to dryness under reduced pressure. The residue was purified by silica gel column chromatography, eluting with hexanes/ethyl acetate (3:1), to afford **20** (238 mg, 86%) as an amorphous colorless solid and a 9:1 mixture of alcohol epimers: ^{1}H NMR (500 MHz, acetone-d_6) δ 8.17 (d, J = 8.3 Hz, 1 H), 7.88 (d, J = 8.1 Hz, 1 H), 7.56 (s, 1 H), 7.36-7.32 (comp, 3 H), 7.13-7.09 (comp, 3 H), 6.83 (s, 1 H), 6.61 (s, 1 H), 5.91 (s, 1 H), 3.03 (s, 3 H), 1.72 (s, 3 H), 1.66 (s, 9 H), 1.55 (s, 9 H); ^{13}C NMR (125 MHz, acetone-d_6) δ 164.7 (C), 156.0 (C), 152.8 (C), 150.2 (C), 143.0 (C), 137.2 (C), 135.1 (C), 134.9 (C), 129.7 (CH), 128.9 (C), 125.8 (CH), 125.3 (CH), 125.1 (CH), 124.7 (CH), 123.7 (CH), 121.4 (C), 120.4 (CH), 118.6 (CH), 118.1 (CH), 116.4 (CH), 86.1 (C), 85.1 (C), 84.7 (CH), 82.8 (C), 58.3 (C), 28.28 (CH_3), 28.27 (CH_3), 27.1 (CH_3), 25.1 (CH_3); IR (film) 3349, 2978, 2930, 1716, 1646, 1453, 1371, 1156 cm^{-1}; TLC R_f 0.40 (1:1 ethyl acetate/hexanes); HRMS (ESI) m/z calcd for $C_{33}H_{36}N_4O_7Na^+$ (M+Na) 623.2482, found 623.2484.

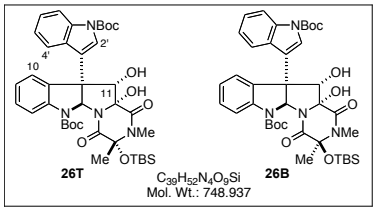


General Procedure for *tert*-Butyldimethylsilyl Protection of the C3 Alcohol. Preparation of 25T and 25B. TBDMSOTf (190 μL, 0.81 mmol) was added dropwise to a 0 ºC solution of **20** (81 mg, 0.14 mmol), DMAP (16 mg, 0.14 mmol), and triethylamine (19 μL, 1.4 mmol) in DMF (1.4 mL). The cold bath was removed, the reaction mixture was stirred at room temperature for 12 h, and ethyl acetate (10 mL) and saturated aq. NH_4Cl (10 mL) were added. The mixture was transferred to a separatory funnel, the layers were separated, and the aqueous phase was further extracted with ethyl acetate (2 x 15 mL). The combined organic extracts were washed with brine (15 mL), dried (Na_2SO_4), and concentrated to dryness under reduced pressure. The crude residue was purified by silica gel column chromatography eluting with hexanes/ethyl acetate (4:1) to afford the title compound **25** (91 mg, 94%) as an amorphous colorless solid and a 3:2 mixture of siloxy epimers. Analytically pure samples of these epimers were obtained by further purification by silica gel column chromatography (toluene/ethyl acetate, 99:1 to 97:3):

Major diastereomer **25T**: ^{1}H NMR (500 MHz, acetone-d_6) δ 8.20 (d, J = 8.4 Hz, 1 H), 7.95 (d, J = 8.2 Hz, 1 H), 7.59 (s, 1 H), 7.40-7.30 (comp, 3 H), 7.20-7.04 (comp, 3 H), 6.80 (s, 1 H), 6.68 (s, 1 H), 3.04 (s, 3 H), 1.77 (s, 3 H), 1.67 (s, 9 H), 1.56 (s, 9 H), 0.89 (s, 9 H), 0.18 (s, 3 H), 0.07 (s, 3 H); ^{13}C NMR (125 MHz, acetone-d_6) δ 164.2 (C), 156.4 (C), 152.7 (C), 150.1 (C), 143.0 (C), 137.2 (C), 134.5 (C), 134.1 (C), 129.8 (CH), 128.8 (C), 125.9 (CH), 125.3 (CH), 125.1 (CH), 125.0 (CH), 123.7 (CH), 121.0 (C), 120.3 (CH), 119.9 (CH), 118.0 (CH), 116.6 (CH), 88.1 (C), 85.1 (C), 84.6 (CH), 83.0 (C), 58.7 (C), 28.28 (CH_3), 28.27 (CH_3), 27.7 (CH_3), 26.7 (CH_3), 26.1 (CH_3), 19.0 (C), –

3.2 (CH_3), –3.5 (CH_3); IR (film) 2977, 2954, 2930, 2857, 1734, 1721, 1703, 1653, 1452, 1372, 1156 cm^{-1}; TLC R_f 0.60 (1:4 ethyl acetate/hexanes); HRMS (ESI) *m/z* calcd for $C_{39}H_{50}N_4O_7SiNa^+$ (M+Na) 737.3347, found 737.3334; $[\alpha]^{21.8}_D$ 33.9, $[\alpha]^{21.8}_{577}$ 33.4, $[\alpha]^{21.8}_{546}$ 35.6, $[\alpha]^{21.8}_{435}$ 30.2 (*c* = 0.70, CH_2Cl_2).

Minor diastereomer **25B**: ^{1}H NMR (500 MHz, acetone-d_6) δ 8.20 (d, *J* = 8.3 Hz, 1 H), 7.87 (d, *J* = 8.0 Hz, 1 H), 7.53 (s, 1 H), 7.40-7.30 (comp, 3 H), 7.20-7.06 (comp, 3 H), 6.86 (s, 1 H), 6.70 (s, 1 H), 3.04 (s, 3 H), 1.79 (s, 3 H), 1.66 (s, 9 H), 1.56 (s, 9 H), 0.79 (s, 9 H), 0.05 (s, 3 H), –0.14 (s, 3 H); ^{13}C NMR (125 MHz, acetone-d_6) δ 163.0 (C), 156.0 (C), 152.6 (C), 150.2 (C), 142.8 (C), 137.2 (C), 135.1 (C), 134.9 (C), 129.7 (CH), 128.9 (C), 125.8 (CH), 125.3 (C), 125.2 (C), 124.8 (C), 123.7 (CH), 121.2 (C), 120.5 (CH), 119.4 (CH), 118.5 (CH), 116.4 (CH), 87.9 (C), 85.1 (C), 85.0 (CH), 82.7 (C), 58.2 (C), 28.28 (CH_3), 28.26 (CH_3), 27.9 (CH_3), 26.4 (CH_3), 26.0(CH_3), 18.8 (C), –3.6 (CH_3), –4.1 (CH_3); IR (film) 2978, 2954, 2931, 2857, 1736, 1717, 1655, 1453, 1372, 1157 cm^{-1}; TLC R_f 0.60 (1:4 ethyl acetate/hexanes); HRMS (ESI) *m/z* calcd for $C_{39}H_{50}N_4O_7SiNa^+$ (M+Na) 737.3347, found 737.3353; $[\alpha]^{22.2}_D$ –74.6, $[\alpha]^{22.2}_{577}$ –81.7, $[\alpha]^{22.3}_{546}$ –97.8, $[\alpha]^{22.5}_{435}$ –233.4 (*c* = 0.80, CH_2Cl_2).



General Procedure for Sharpless Dihydroxylation of the C11-C12 Double Bond. Preparation of 26T and 26B. A flask was charged with AD-mix-α (504 mg), **25** (168 mg, 0.235 mmol, a 3:2 mixture of siloxy epimers), methane sulfonamide (22 mg, 0.235 mmol), and $(DHQ)_2PHAL$ (23 mg, 0.029 mmol) then *t*-BuOH/H_2O/acetone (3:2:1, 6.8 mL) was added, followed by additional K_2OsO_4•$2H_2O$ (22 mg, 0.059 mmol).[2,3] The resulting heterogeneous mixture was stirred vigorously at room temperature for 6 h, the reaction was cooled to 0 ºC and solid Na_2SO_3 (1.4 g) was added, the cold bath was removed, and the mixture was stirred for 1 h at room temperature. Water (8 mL) was added to the reaction mixture, which was transferred to a separatory funnel and extracted with ethyl acetate (3 x 12 mL). The combined organic extracts were washed with brine (10 mL), dried (Na_2SO_4), and concentrated to dryness under reduced pressure. The crude residue was purified by silica gel column chromatography eluting with hexanes/ethyl acetate (4:1) to afford the title compound **26** (142 mg, 81%) as an amorphous colorless solid as a 3:2 mixture of siloxy epimers. Analytically pure samples of the siloxy epimers were obtained by purification using silica gel column chromatography and eluting with toluene/ethyl acetate (95:5):

For compound **26T** irradiation of C11-H leads to NOE signals with C4'–H and C10–H.

For compound **26B** irradiation of C11-H leads to NOE signals with C4'–H, C10–H, and C11-OH.

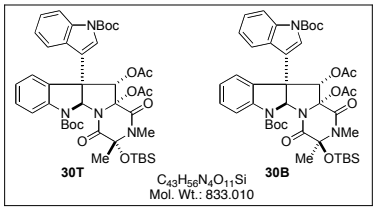
Major diastereomer **26T** (dr ≈14:1): ^{1}H NMR (500 MHz, acetone-d_6) δ 8.14 (d, *J* = 7.7 Hz, 1 H), 8.08 (d, *J* = 7.8 Hz, 1 H), 7.76 (d, *J* = 8.2 Hz, 1 H), 7.68 (d, *J* = 7.6 Hz, 1 H), 7.36-7.20 (comp, 4 H), 7.14 (t, *J* = 7.5 Hz, 1 H),

[2] Hentges, S. G.; Sharpless, K. B. *J. Am. Chem. Soc.* **1980**, *102*, 4263–4265.

[3] Extra K_2OsO_4•$2H_2O$ and $(DHQ)_2PHAL$ were needed in order to consume all starting material.

6.79 (s, 1 H), 5.88 (d, J = 6.4 Hz, 1 H), 5.76 (s, 1 H), 5.26 (d, J = 6.2 Hz, 1 H), 2.91 (s, 3 H), 1.64 (s, 9 H), 1.59-1.54 (comp, 12 H), 0.92 (s, 9 H), 0.28 (s, 6 H); ^{13}C NMR (125 MHz, acetone-d_6) δ 167.7 (C), 167.6 (C), 152.3 (C), 150.1 (C), 141.3 (C), 136.9 (C), 136.4 (C), 130.4 (C), 129.8 (CH), 125.9 (CH), 125.8 (CH), 125.2 (CH), 124.5 (CH), 123.3 (CH), 122.6 (CH), 119.4 (C), 117.5 (CH), 116.0 (CH), 86.9 (C), 85.2 (C), 84.8 (C), 82.2 (C), 81.3 (CH), 77.7 (CH), 58.2 (C), 28.5 (CH_3), 28.3 (CH_3), 27.7 (CH_3), 26.9 (CH_3), 26.2 (CH_3), 18.9 (C), –3.0 (CH_3), –3.4 (CH_3); IR (film) 3396, 2956, 2928, 2851, 1726, 1661, 1371, 1156 cm^{-1}; TLC R_f 0.25 (1:3 ethyl acetate/hexanes); HRMS (ESI) m/z calcd for $C_{39}H_{52}N_4O_9SiNa^+$ (M+Na) 771.3401, found 771.3391.

Minor diastereomer **26B** (dr ≈20:1): ^{1}H NMR (500 MHz, acetone-d_6) δ 8.14 (d, J = 8.0 Hz, 1 H), 8.08 (d, J = 7.5 Hz, 1 H), 7.71 (d, J = 7.5 Hz, 1 H), 7.65 (br s, 1 H), 7.36-7.24 (comp, 3 H), 7.22 (s, 1 H), 7.14 (t, J = 7.5 Hz, 1 H), 6.81 (s, 1 H), 6.00 (br s, 1 H), 5.94 (br s, 1 H), 5.45 (br s, 1 H), 2.86 (s, 3 H), 1.75 (s, 3 H), 1.64 (s, 9 H), 1.57 (s, 9 H), 0.85 (s, 9 H), 0.18 (s, 3 H), –0.15 (s, 3 H); ^{13}C NMR (125 MHz, acetone-d_6) δ 169.8 (C), 165.3 (C), 152.2 (C), 150.1 (C), 141.0 (C), 136.9 (C), 135.9 (C), 130.3 (C), 129.8 (CH), 126.0 (CH), 125.8 (CH), 125.3 (CH), 124.5 (CH), 123.4 (CH), 122.7 (CH), 119.4 (C), 118.1 (CH), 116.0 (CH), 87.4 (C), 86.1 (C), 84.8 (C), 82.4 (C), 80.8 (CH), 76.4 (CH), 58.4 (C), 28.5 (CH_3), 28.3 (CH_3), 27.9 (CH_3), 27.0 (CH_3), 26.5 (CH_3), 19.4 (C), –2.8 (CH_3), –3.5 (CH_3); IR (film) 3379, 2978, 2955, 2931, 2857, 1724, 1656, 1370, 1155 cm^{-1}; TLC R_f 0.25 (1:3 ethyl acetate/hexanes); HRMS (ESI) m/z calcd for $C_{39}H_{52}N_4O_9SiNa^+$ (M+Na) 771.3401, found 771.3395; $[\alpha]^{22.8}_D$ –117.6, $[\alpha]^{22.8}_{577}$ –125.5, $[\alpha]^{22.8}_{546}$ –144.8, $[\alpha]^{22.7}_{435}$ –261.9 (c = 0.65, CH_2Cl_2).

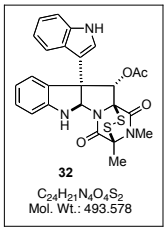


General Procedure for Diacetylation of the C11,C12 Diol. **Preparation of 30T and 30B.** Acetic anhydride (27 μL, 0.28 mmol) was added to a solution of **26** (53 mg, 0.071 mmol), and DMAP (69 mg, 0.57 mmol) in CH_2Cl_2 (3.3 mL). The resulting solution was stirred for 8 h at room temperature, then CH_2Cl_2 (10 mL) was added followed by pH 7 phosphate buffer (5 mL). The reaction mixture was transferred to a separatory funnel, the layers were separated and the aqueous phase was further extracted with CH_2Cl_2 (2 x 10 mL). The combined organic extracts were washed with brine (10 mL), dried (Na_2SO_4), and concentrated to dryness under reduced pressure. The crude residue was purified using silica gel column chromatography eluting with hexanes/ethyl acetate (5:1) to afford the title compound **30** (55 mg, 93%, a 3:2 mixture of siloxy epimers) as an amorphous colorless solid. The yield reported in the Scheme represents the mean of multiple runs. Analytically pure samples of the siloxy epimers were obtained by purification using silica gel column chromatography and eluting with hexanes/ethyl acetate (6:1):

Major diastereomer **30T** (dr ≈14:1): ^{1}H NMR (500 MHz, acetone-d_6) δ 8.15 (d, J = 8.2 Hz, 1 H), 8.02 (d, J = 7.3 Hz, 1 H), 7.84 (d, J = 7.5 Hz, 1 H), 7.77 (br s, 1 H), 7.43–7.33 (comp, 3 H), 7.27 (t, J = 7.6 Hz, 1 H), 7.09 (s, 1 H), 6.64 (s, 1 H), 6.08 (s, 1 H), 2.89 (s, 3 H), 2.35 (s, 3 H,), 1.62 (s, 9 H), 1.53 (s, 3 H), 1.51 (s, 9 H), 1.26 (s, 3 H), 0.91

(s, 9 H), 0.28 (s, 3 H), 0.19 (s, 3 H); ^{13}C NMR (125 MHz, acetone-d_6) δ 169.7 (C), 169.5 (C), 167.1 (C), 161.9 (C), 152.0 (C), 149.9 (C), 141.2 (C), 136.8 (C), 135.3 (C), 130.5 (CH), 129.7 (C), 128.6 (CH), 127.1 (CH), 125.5 (CH), 124.9 (CH), 123.5 (CH), 121.7 (CH), 117.3 (C), 116.9 (C), 116.2 (CH), 87.6 (C), 87.3 (C), 85.2 (C), 82.7 (C), 82.3 (CH), 78.9 (CH), 57.9 (C), 28.6 (CH_3), 28.3 (CH_3), 28.25 (CH_3), 28.17 (CH_3), 26.3 (CH_3), 21.6 (CH_3), 20.2 (CH_3), 19.2 (C), –2.7 (CH_3), –3.2 (CH_3); IR (film) 2978, 2955, 2931, 2857, 1760, 1729, 1686, 1456, 1371, 1225, 1157 cm^{-1}; TLC R_f 0.38 (1:3 ethyl acetate/hexanes); HRMS (ESI) *m/z* calcd for $C_{43}H_{56}N_4O_{11}SiNa^+$ (M+Na) 855.3613, found 855.3604.

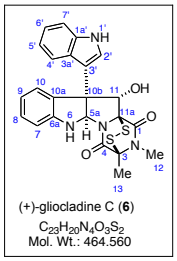
Minor diastereomer **30B** (dr ≈20:1): ^{1}H NMR (500 MHz, acetone-d_6) δ 8.15 (d, J = 8.3 Hz, 1 H), 7.75 (br s, 1 H), 7.70 (d, J = 7.6 Hz, 1 H), 7.55 (d, J = 7.1 Hz, 1 H), 7.43 (s, 1 H), 7.40 (t, J = 7.8 Hz, 1 H), 7.33 (t, J = 7.8 Hz, 1 H), 7.23 (t, J = 7.6 Hz, 1 H), 7.21 (t, J = 7.7 Hz, 1 H), 6.72 (s, 1 H), 6.30 (br s, 1 H), 2.87 (s, 3 H), 2.31 (s, 3 H), 1.74 (s, 3 H), 1.68 (s, 3 H), 1.65 (s, 9 H), 1.53 (s, 9 H), 0.79 (s, 9 H), 0.15 (s, 3 H), –0.13 (s, 3 H); ^{13}C NMR (125 MHz, acetone-d_6) δ 169.7 (C), 169.4 (C), 160.7 (C), 152.2 (C), 150.0 (C), 136.6 (C), 135.2 (broad C), 130.4 (CH), 129.7 (C), 128.0 (CH), 126.6 (broad CH), 125.4 (CH), 125.0 (CH), 123.5 (CH), 121.5 (CH), 118.2 (CH), 117.1 (C), 116.1 (CH), 87.9 (C), 85.1 (C), 82.8 (CH), 77.9 (CH), 64.5 (C), 28.5 (CH_3), 28.4 (CH_3), 28.2 (CH_3), 26.3 (CH_3), 25.1 (CH_3), 21.4 (CH_3), 20.4 (CH_3), 19.1 (C), –2.8 (CH_3), –3.5 (CH_3); IR (film) 2929, 2854, 1729, 1685, 1455, 1370, 1224, 1156 cm^{-1}; TLC R_f 0.30 (1:3 ethyl acetate/hexanes); HRMS (ESI) *m/z* calcd for $C_{43}H_{56}N_4O_{11}SiNa^+$ (M+Na) 855.3613, found 855.3608; $[\alpha]^{23.1}_{D}$ –181.6, $[\alpha]^{23}_{577}$ –191.0, $[\alpha]^{23.1}_{546}$ –219.6, $[\alpha]^{23.1}_{435}$ –393.6 (*c* = 1.20, CH_2Cl_2).



32
$C_{24}H_{21}N_4O_4S_2$
Mol. Wt.: 493.578

Preparation of *O*-Acetylgliocladine C (32). Hydrogen sulfide (bp –60°C, ca. 700 μL) was condensed at –78°C in a pressure tube fitted with a rubber septum. A solution of **30** (44 mg, 0.053 mmol) in CH_2Cl_2 (700 μL) and neat boron trifluoride etherate (65 μL, 0.53 mmol) were added sequentially to the liquid hydrogen sulfide at –78°C. A Teflon screw cap replaced the rubber septum to seal the pressure tube, the cold bath was removed, the reaction mixture was allowed to warm to room temperature with stirring for 2 h. *CAUTION: the sealed tube was maintained behind a blast shield.* The reaction mixture was then cooled to –78°C and the Teflon screw cap was replaced by a rubber septum having a bleed needle connected to a bleach trap. The cooling bath was removed and the resulting colorless suspension was allowed to warm up to room temperature while venting hydrogen sulfide. Upon evaporation of the hydrogen sulfide, the reaction mixture was purged using a nitrogen stream, and the residue was diluted with ethyl acetate (5 mL), transferred to a separatory funnel. and washed with saturated aq. NH_4Cl (5 mL). The aqueous layer was further extracted with ethyl acetate (2 x 8 mL), then the combined organic extracts were washed with brine (5 mL), dried (Na_2SO_4), and concentrated to dryness under reduced pressure. The crude residue was dissolved in MeOH/ethyl acetate (2:1, 3 mL), placed under an oxygen atmosphere, and stirred at room temperature for 12 h. The solvent was removed under reduced pressure

and the crude residue was purified by silica gel column chromatography eluting with CH_2Cl_2/ethyl acetate (97:3) to afford **32** (17 mg, 62%) as an amorphous colorless powder: ^{1}H NMR (500 MHz, acetone-d_6) δ 10.28 (br s, 1 H), 7.88 (d, J = 7.7 Hz, 1 H), 7.63 (d, J = 7.5 Hz, 1 H), 7.41 (d, J = 7.6 Hz, 1 H), 7.14–7.08 (m, 4 H), 6.86 (t, J = 7.3 Hz, 1 H), 6.77 (d, J = 7.9 Hz, 1 H), 6.45 (s, 1 H), 6.40 (s, 1 H), 6.29 (br s, 1 H), 3.01 (s, 3 H), 2.02 (s, 3 H), 1.53 (s, 3 H); ^{13}C NMR (125 MHz, acetone-d_6) δ 169.0 (C), 164.3 (C), 162.9 (C), 149.5 (C), 138.5 (C), 131.0 (C), 130.0 (CH), 127.1 (C), 126.2 (CH), 125.6 (CH), 122.5 (CH), 122.0 (CH), 120.0 (CH), 119.8 (CH), 112.8 (CH), 112.4 (C), 111.1 (CH), 82.3 (CH), 80.0 (CH), 77.0 (C), 75.6 (C), 61.3 (C), 27.5 (CH_3), 20.5 (CH_3), 18.1 (CH_3); IR (film) 3369, 3054, 2981, 2927, 2851, 1756, 1692, 1341, 1216, 1046 cm^{-1}; TLC R_f 0.24 (95:5 CH_2Cl_2/ethyl acetate); HRMS (ESI) *m/z* calcd for $C_{25}H_{22}N_4O_4S_2Na^+$ (M+Na) 529.0980, found 529.0973; $[\alpha]^{23}_D$ +248.8, $[\alpha]^{23}_{577}$ +260.6, $[\alpha]^{23}_{546}$ +300.9, $[\alpha]^{23}_{435}$ +544.1 (c = 0.30, CH_2Cl_2).



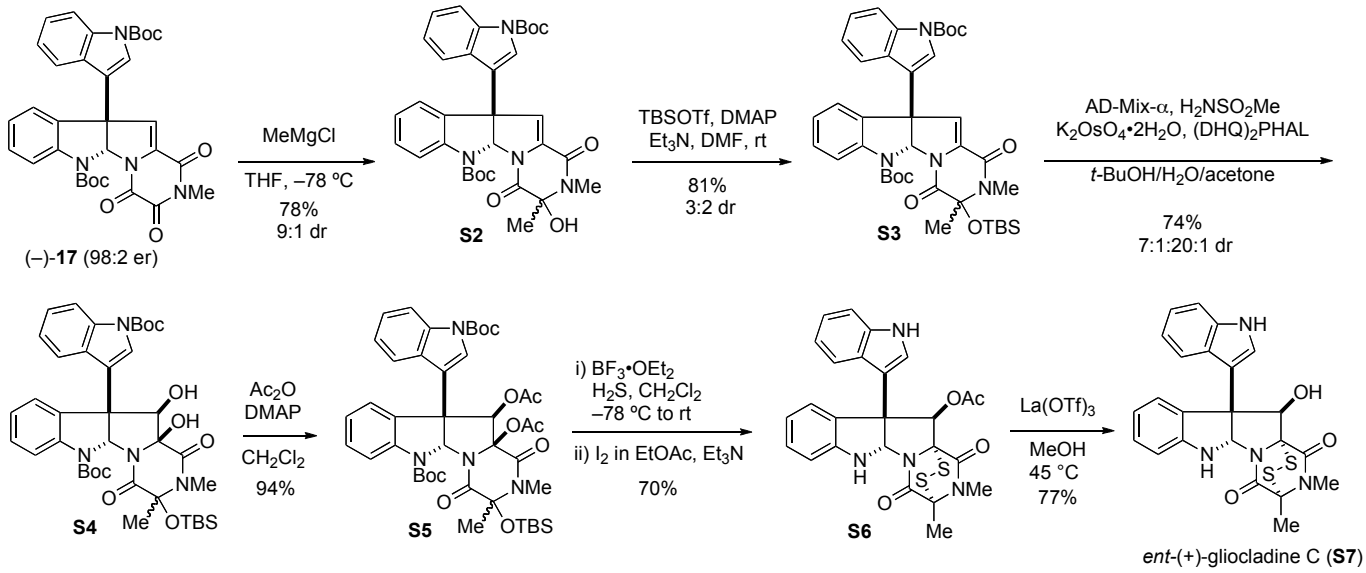
Preparation of (+)-Gliocladine C (6). Lanthanum triflate (90 mg, 0.15 mmol) was added to a solution of **32** (13 mg, 0.026 mmol) in anhydrous MeOH (1 mL) at room temperature. The solution was heated to 40 ºC and maintained at this temperature for 15 h. The reaction was cooled to room temperature and the solvent was removed under reduced pressure. Ethyl acetate (5 mL) was added to the residue, which was subsequently transferred to a separatory funnel containing pH 7 phosphate buffer (5 mL). The layers were separated and the aqueous phase was further extracted with ethyl acetate (2 x 5 mL). The combined organic extracts were washed with brine (5 mL), dried (Na_2SO_4), and concentrated to dryness under reduced pressure. The crude residue was purified by silica gel chromatography eluting with CH_2Cl_2/ethyl acetate (95:5) to afford (+)–gliocladine C (**6**) (9 mg, 75%) as an amorphous colorless powder: ^{1}H NMR (500 MHz, pyridine-d_5) δ 12.1 (s, 1 H), 8.51 (d, J = 7.0 Hz, 1 H), 8.13 (br s, 1 H), 7.82 (d, J = 7.5 Hz, 1 H), 7.76 (s, 1 H), 7.68 (d, J = 2.3 Hz, 1 H), 7.56 (d, J = 7.1 Hz, 1 H), 7.36-7.32 (comp, 2 H), 7.15 (t, J = 7.6 Hz, 1 H), 6.94 (s, 1 H), 6.90 (d, J = 7.8 Hz, 1 H), 6.83 (t, J = 7.4 Hz, 1 H), 6.24 (s, 1 H), 2.94 (s, 3 H), 1.97 (s, 3 H); ^{13}C NMR (125 MHz, pyridine-d_5) δ 166.3 (C), 163.2 (C), 149.1 (C), 138.7 (C), 133.8 (C), 129.4 (CH), 127.2 (C), 124.9 (CH), 122.4 (CH), 122.2 (CH), 119.8 (CH), 119.5 (CH), 116.3 (C), 112.6 (CH), 110.6 (CH), 83.9 (CH), 80.7 (CH), 79.3 (C), 74.9 (C), 62.8 (C), 27.3 (CH_3), 18.2 (CH_3); IR (film) 3396, 3054, 2919, 2360, 1682, 1355, 1265, 1057 cm^{-1}; TLC R_f 0.20 (95:5 CH_2Cl_2/ethyl acetate); HRMS (ESI) *m/z* calcd for $C_{23}H_{20}N_4O_3S_2Na^+$ (M+Na) 487.0875, found 487.0880; $[\alpha]^{23}_D$ +504.9, $[\alpha]^{23}_{577}$ +513.4, $[\alpha]^{23}_{546}$ +612.7, $[\alpha]^{23}_{435}$ +1100.9 (c = 0.47, pyridine).

Literature (500 MHz, pyridine-d_5)		Synthetic **6** (500 MHz, pyridine-d_5)		Δδ
5a	5.98 (s)	5a	6.24 (s)	+0.26
N(6)–H		N(6)–H	7.76 (s)	

7	6.64 (d, J = 8.0)	7	6.90 (d, J = 7.8)	+0.26
8	6.90 (t, J = 7.6)	8	7.15 (t, J = 7.6)	+0.25
9	6.57 (t, J = 7.4)	9	6.83 (t, J = 7.4)	+0.26
10	7.56 (d, J = 7.5)	10	7.82 (d, J = 7.5)	+0.26
11	6.68 (s)	11	6.94 (s)	+0.26
C(11)–OH		C(11)–OH		
12	2.69 (s)	12	2.94 (s)	+0.25
13	1.72 (s)	13	1.97 (s)	+0.25
N(1')–H		N(1')–H	12.10 (s)	
2'	7.49 (s)	2'	7.68 (d, J = 2.3) (COSY)	
4'	8.25 (d, J = 7.1)	4'	8.51 (d, J = 7.0)	+0.26
5'	7.09 (m)	5'	7.35 (m)	+0.26
6'	7.09 (m)	6'	7.35 (m)	+0.26
7'	7.42 (d, J = 7.2)	7'	7.56 (d, J = 7.1)	

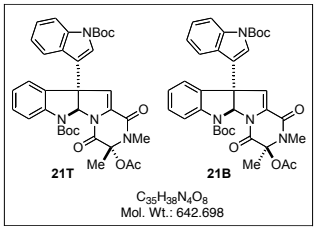
Literature (125 MHz, pyridine-d_5)		Synthetic **6** (125 MHz, pyridine-d_5)		Δδ
1	166.1 (s)	1	166.3 (s)	+0.2
3	74.5 (s)	3	74.9 (s)	+0.4
4	163.0 (s)	4	163.2 (s)	+0.2
5a	83.5 (d)	5a	80.7 (d) (HMQC)	
6a	148.7 (s)	6a	149.1 (s)	+0.4
7	110.5 (d)	7	110.6 (d)	+0.1
8	129.2 (d)	8	129.4 (d)	+0.2
9	119.4 (d)	9	119.5 (d)	+0.1
10	124.6 (d)	10	124.9 (d)	+0.3
10a	133.3 (s)	10a	133.8 (s)	+0.5
10b	62.4 (s)	10b	62.8 (s)	+0.4
11	80.6 (d)	11	83.9 (d) (HMQC)	
11a	78.8 (s)	11a	79.3 (s)	+0.5
12	27.1 (q)	12	27.3 (q)	+0.2
13	17.9 (q)	13	18.2 (q)	+0.3
2'	123.5 (d)	2'	overlapped by Py. (HMQC)	
3'	115.6 (s)	3'	116.3 (s)	+0.7
3'a	126.9 (s)	3'a	127.2 (s)	+0.3
4'	122.0 (d)	4'	122.4 (d)	+0.4
5'	119.6 (d)	5'	119.8 (d)	+0.2
6'	121.9 (d)	6'	122.2 (d)	+0.3
7'	112.3 (d)	7'	112.6 (d)	+0.3
1'a	138.3 (s)	1'a	138.7 (s)	+0.4

Synthesis of *ent*-(+)-Gliocladine C. Starting with (–)-**17** (er = 98:2),[1] *ent*-(+)-Gliocladine C (**S7**) was prepared in identical fashion as summarized in the following scheme.



***ent-O*-Acetyl Gliocladine C (S6)**: a single stereoisomer as an amorphous colorless powder: $[\alpha]^{23}_{D}$ –254.1, $[\alpha]^{23}_{577}$ –267.4, $[\alpha]^{23}_{546}$ –310.1, $[\alpha]^{23}_{435}$ –561.8 (*c* = 0.40, CH_2Cl_2).

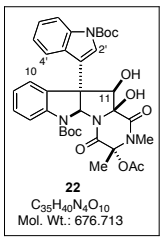
***ent*-(+)-Gliocladine C (S7)**: an amorphous colorless powder that was purified by silica gel column chromatography, eluting with CH_2Cl_2/EtOAc (95:5 to 90:10): $[\alpha]^{23}_{D}$ –489, $[\alpha]^{23}_{577}$ –514, $[\alpha]^{23}_{546}$ –603, $[\alpha]^{23}_{435}$ –1135 (*c* = 0.16, pyridine).



Preparation of Acetates 21T and 21B. Acetic anhydride (66 μL, 0.70 mmol) was added dropwise to a solution of **20** (105 mg, 0.175 mmol) and 4-dimethylaminopyridine (DMAP) (128 mg, 1.05 mmol), in CH_2Cl_2 (6.8 mL). The reaction mixture was stirred at room temperature for 13 h, whereupon CH_2Cl_2 (5 mL) was added, followed by pH 7 phosphate buffer (10 mL). The mixture was transferred to a separatory funnel, the layers were separated, and the aqueous phase was further extracted with CH_2Cl_2 (3 x 10 mL). The combined organic extracts were washed with brine (8 mL), dried (Na_2SO_4), and concentrated to dryness under reduced pressure. The crude residue was purified by silica gel column chromatography eluting with hexanes/EtOAc (3:1 to 1:1) to afford the title compound **21** (102 mg, 91%) as an amorphous colorless solid and a mixture of acetate epimers (9:1 to 3:1). The yield reported in the Scheme represents the mean of multiple runs. Analytically pure samples of these epimers were obtained by purification by silica gel column chromatography and eluting with hexanes/EtOAc (4:1). The relative configurations of **21B** and **21T** were tentatively assigned by their relative polarities. It had previously been observed that the compounds possessing a β-oriented C3-oxy group (*cf.* **25B** and **39B**) were less polar relative to their corresponding diastereomers **25T** and **39T**, as determined using silica gel.

Minor diastereomer **21T**: ^{1}H NMR (500 MHz, acetone-d_6) δ 8.18 (d, J = 8.3 Hz, 1 H), 7.93 (d, J = 8.1 Hz, 1 H), 7.48 (s, 1 H), 7.39–7.30 (comp, 4 H), 7.18–7.11 (comp, 2 H), 6.82 (s, 1 H), 6.52 (s, 1 H), 2.98 (s, 3 H), 2.12 (s, 3 H), 1.87 (s, 3 H), 1.66 (s, 9 H), 1.52 (s, 9 H); ^{13}C NMR (125 MHz, acetone-d_6) δ 171.0 (C), 163.7 (C), 157.1 (C), 152.6 (C), 150.2 (C), 143.0 (C), 137.2 (C), 135.3 (C), 133.5 (C), 129.8 (CH), 128.9 (C), 125.8 (CH), 125.6 (CH), 125.4 (CH), 124.9(CH), 123.8 (CH), 120.9 (CH), 120.7 (C), 119.9 (CH), 117.9 (CH), 116.4 (CH), 88.7 (C), 85.0 (C), 83.8 (CH), 83.0 (C), 58.5 (C), 28.30 (CH_3), 28.26 (CH_3), 27.3 (CH_3), 24.5 (CH_3), 20.7 (CH_3); IR (film) 2976, 2930, 1722, 1716, 1680, 1453, 1371, 1235, 1156 cm^{-1}; TLC R_f 0.35 (1:1 ethyl acetate/hexanes); HRMS (ESI) m/z calcd for $C_{35}H_{38}N_4O_8Na^+$ (M+Na) 655.2587, found 655.2580; $[\alpha]^{23}_D$ –99.0, $[\alpha]^{23}_{577}$ –108.7, $[\alpha]^{23}_{546}$ –129.3, $[\alpha]^{23}_{435}$ –255.1 (c = 0.13, CH_2Cl_2).

Major diastereomer **21B**: ^{1}H NMR (500 MHz, acetone-d_6) δ 8.17 (d, J = 8.3 Hz, 1 H), 7.87 (d, J = 8.0 Hz, 1 H), 7.60 (s, 1 H), 7.36–7.30 (comp, 3 H), 7.13–7.04 (comp, 3 H), 6.81 (s, 1 H), 6.69 (s, 1 H), 2.95 (s, 3 H), 2.00 (s, 3 H), 1.84 (s, 3 H), 1.67 (s, 9 H), 1.55 (s, 9 H); ^{13}C NMR (125 MHz, acetone-d_6) δ 169.8 (C), 161.4 (C), 156.3 (C), 152.8 (C), 150.2 (C), 143.0 (C), 137.2 (C), 134.9 (C), 134.8 (C), 129.6 (CH), 128.8 (C), 125.8 (CH), 125.1 (CH), 125.0 (CH), 124.6 (CH), 123.7 (CH), 121.5 (C), 120.4 (CH), 119.2 (CH), 118.3 (CH), 116.4 (CH), 88.5 (C), 85.2 (CH), 85.1 (C), 82.6 (C), 58.5 (C), 28.34 (CH_3), 28.27 (CH_3), 27.3 (CH_3), 24.7 (CH_3), 20.5 (CH_3); IR (film) 2978, 2930, 1715, 1655, 1453, 1371, 1233, 1156 cm^{-1}; TLC R_f 0.25 (1:1 ethyl acetate/hexanes); HRMS (ESI) m/z calcd for $C_{35}H_{38}N_4O_8Na^+$ (M+Na) 665.2587, found 665.2566; $[\alpha]^{23}_D$ –106.0, $[\alpha]^{23}_{577}$ –114.1, $[\alpha]^{23}_{546}$ –136.0, $[\alpha]^{23}_{435}$ –322.3 (c = 0.20, CH_2Cl_2).

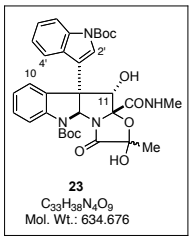


Diol 22. Intermediate **21T** (20 mg, 0.031 mmol) was dihydroxylated using AD-mix-α (200 mg), methane sulfonamide (15 mg, 0.156 mmol), $(DHQ)_2PHAL$ (3 mg, 0.004 mmol), and K_2OsO_4•$2H_2O$ (3 mg, 0.008 mmol) in t-BuOH/H_2O/acetone (3:2:1, 1.0 mL) following the general procedure. The crude residue was purified by silica gel column chromatography eluting with hexanes/ethyl acetate (2:1 to 1:1) to afford the title compound **22** (15 mg, 71%) as an amorphous colorless solid.

For compound **22** irradiation of C11-H leads to NOE signals with C2'–H, C4'–H and C5a–H.

(dr ≈20:1): ^{1}H NMR (500 MHz, acetone-d_6) δ 8.15 (d, J = 8.3 Hz, 1 H), 7.88 (d, J = 8.1 Hz, 1 H), 7.72 (s, 1 H), 7.39 (d, J = 7.5 Hz, 1 H), 7.31 (t, J = 7.6 Hz, 1 H), 7.26 (t, J = 7.5 Hz, 1 H), 7.20 (d, J = 7.9 Hz, 1 H), 7.12 (t, J = 7.5 Hz, 1 H), 6.87 (s, 1 H), 5.16 (d, J = 4.8 Hz, 1 H), 5.08 (s, 1 H), 4.86 (d, J = 4.8 Hz, 1 H), 2.88 (s, 3 H), 2.11 (s, 3 H), 1.82 (s, 3 H), 1.67 (s, 9 H), 1.53 (s, 9 H); ^{13}C NMR (125 MHz, acetone-d_6) δ 170.7 (C), 166.7 (C), 164.5 (C), 152.6 (C), 150.2 (C), 143.9 (C), 137.1 (C), 131.7 (C), 129.1 (CH), 128.2 (CH), 125.6 (CH), 124.7 (CH), 123.7 (CH), 123.1 (C), 122.9 (CH), 120.5 (CH), 116.4 (CH), 115.9 (CH), 87.6 (C), 85.6 (C), 84.9 (C), 82.4 (C), 78.9 (CH), 78.8 (CH), 54.7 (C), 43.5 (CH), 28.6 (CH_3), 28.3 (CH_3), 27.2 (CH_3), 24.3 (CH_3), 20.7 (CH_3); IR (film)

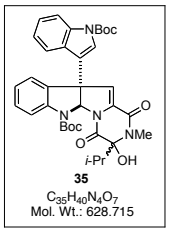
3402, 2980, 2934, 1734, 1713, 1665, 1483, 1454, 1373, 1155, 751 cm^{-1}; HRMS (ESI) *m*/*z* calcd for $C_{35}H_{40}N_4O_{10}Na^+$ (M+Na) 699.2642, found 699.2621.



Formation of 23 from Sharpless Dihydroxylation of 21B. Intermediate **21T** (20 mg, 0.031 mmol) was dihydroxylated using AD-mix-α (200 mg), methane sulfonamide (15 mg, 0.156 mmol), $(DHQ)_2PHAL$ (3 mg, 0.004 mmol), and $K_2OsO_4•2H_2O$ (3 mg, 0.008 mmol) in *t*-BuOH/H_2O/acetone (3:2:1, 1.0 mL) following the general procedure. The crude residue was purified by silica gel column chromatography eluting with hexanes/ethyl acetate (1:1 to 1:2) to afford compound **23** (12 mg, 61%) as an amorphous colorless solid (dr ≈3:2):

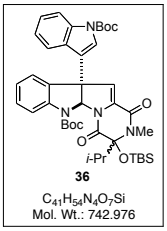
For compound **23** irradiation of C11-H leads to NOE signals with C4'–H, C10–H, and C11-OH.

^{1}H NMR (500 MHz, acetone-d_6) δ 8.18–8.11 (comp, 1 H), 7.90–7.81 (comp, 1 H), 7.79–7.71 (comp, 1 H), 7.52–7.42 (comp, 2 H), 7.37–7.20 (comp, 3.4 H), 7.00–6.92 (comp, 1.6 H), 6.70 (s, 0.4 H), 6.69 (s, 0.6 H), 5.48 (comp, 1 H), 5.00 (m, 0.6 H), 2.18 (d, *J* = 4.8 Hz, 1.2 H), 2.16 (d, *J* = 4.8 Hz, 1.8 H), 1.65 (s, 5.4 H), 1.63 (s, 5.4 H), 1.61 (s, 3.6 H), 1.60 (s, 3.6 H); ^{13}C NMR (125 MHz, acetone-d_6) δ 175.1 (C), 173.5 (C), 168.9 (C), 167.9 (C), 152.3 (C), 150.0 (C), 142.5 (C), 142.4 (C), 137.0 (C), 136.9 (C), 131.7 (C), 131.3 (C), 130.3 (CH), 130.2 (CH), 129.6 (C), 129.4 (C), 127.2 (CH), 127.0 (CH), 125.4 (CH), 125.3 (CH), 124.6 (CH), 124.1 (CH), 124.0 (CH), 123.9 (CH), 123.6 (CH), 123.5 (CH), 122.3 (CH), 122.2 (CH), 121.3 (C), 120.7 (C), 116.5 (CH), 116.1 (CH), 116.0 (CH), 102.4 (C), 101.6 (C), 100.2 (C), 99.4 (C), 84.8 (C), 84.7 (C), 82.8 (C), 82.7 (C), 79.5 (CH), 79.2 (CH), 76.5 (CH), 75.7 (CH), 61.4 (C), 61.3 (C), 43.5 (CH_3), 28.64 (CH_3), 28.62 (CH_3), 28.3 (CH_3), 25.9 (CH_3), 24.1 (CH_3), 23.4 (CH_3); IR (film) 3363, 2979, 2935, 1738, 1703, 1481, 1454, 1373, 1251, 1156, 1096, 751 cm^{-1}; HRMS (ESI) *m*/*z* calcd for $C_{33}H_{38}N_4O_9Na^+$ (M+Na) 657.2537, found 657.2509.



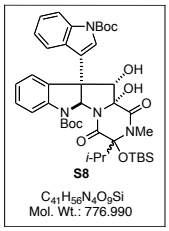
Addition of Isopropylmagnesium bromide to (+)-17. A solution of (+)-**17** (120 mg, 0.205 mmol) in THF (4.1 mL) was cooled to –78 ºC then isopropylmagnesium bromide (713 µL, 0.513 mmol, 0.72 M solution in THF) was added dropwise. The reaction was stirred at –78 ºC for 3 h then AcOH (47 µL) was added, the cooling bath was removed and the reaction was allowed to warm to room temperature. The solvent was removed under reduced pressure then H_2O (10 mL) was added to the concentrate. The aqueous phase was extracted with EtOAc (3 x 12 mL) and the combined organic phases were washed with brine (10 mL), dried (Na_2SO_4), then concentrated to dryness under reduced pressure. The residue was purified by silica gel column chromatography eluting with hexanes/EtOAc (4:1 to 2:1) to afford **35** (106 mg, 83%) as an amorphous colorless solid and about a 1.2:1 mixture of alcohol epimers (data provided for the mixture): ^{1}H NMR (500 MHz, acetone-d_6) δ 8.18 (app d, *J* = 8.3 Hz, 1 H), 7.92–7.88 (comp, 1 H), 7.55 (s,

0.55 H), 7.50 (s, 0.45 H), 7.38–7.29 (comp, 3 H), 7.20–7.05 (comp, 3 H), 6.84 (s, 0.45 H), 6.82 (s, 0.55 H), 6.62–6.60 (comp, 1 H), 5.83 (s, 0.55 H), 5.60 (s, 0.45 H), 3.00 (s, 1.65 H), 2.99 (s, 1.35 H), 2.34 (heptet, J = 6.6 Hz, 0.55 H), 2.19 (heptet, J = 6.8 Hz, 0.45 H), 1.66 (app s, 9 H), 1.56 (s, 4.95 H), 1.55 (s, 4.05 H), 1.11 (d, J = 6.8 Hz, 1.65 H), 0.97–0.93 (comp, 3 H), 0.59 (d, J = 6.8 Hz, 1.35 H); ^{13}C NMR (125 MHz, acetone-d_6) δ 163.9 (C), 163.0 (C), 156.5 (C), 156.4 (C), 152.6 (C), 152.5 (C), 150.1 (C), 142.8 (C), 142.4 (C), 137.09 (C), 137.07 (C), 136.7 (C), 135.0 (C), 134.51 (C), 134.47 (C), 129.7 (CH), 129.6 (CH), 128.8 (C), 128.7 (C), 125.70 (CH), 125.68 (CH), 125.2 (CH), 125.1 (CH), 125.0 (CH), 124.8 (CH), 124.7 (CH), 123.63 (CH), 123.57 (CH), 121.1 (C), 120.9 (C), 120.3 (CH), 120.1 (CH), 118.6 (CH), 118.4 (CH), 117.8 (CH), 116.5 (C), 116.44 (CH), 116.39 (CH), 90.6 (C), 90.4 (C), 85.0 (C), 84.2 (CH), 82.8 (C), 82.7 (C), 58.5 (C), 58.1 (C), 38.0 (CH), 37.9 (CH), 28.17 (CH_3), 28.13 (CH_3), 27.7 (CH_3), 27.4 (CH_3), 17.3 (CH_3), 17.2 (CH_3), 17.1 (CH_3), 16.8 (CH_3); IR (film) 3393, 2975, 2933, 1734, 1720, 1648, 1452, 1371, 1155 cm^{-1}; TLC R_f 0.41 (1:2 ethyl acetate/hexanes); HRMS (ESI) m/z calcd for $C_{35}H_{40}N_4O_7Na^+$ (M+Na) 651.2795, found 651.2784.

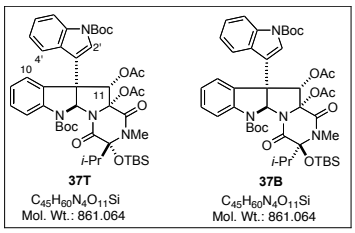


Preparation of Silyl Ether 36. Intermediate **35** (110 mg, 0.175 mmol) was silylated using TBDMSOTf (241 μL, 1.05 mmol), DMAP (21 mg, 0.175 mmol), and triethylamine (244 μL, 1.75 mmol) in DMF (1.8 mL) following the general procedure using a reaction time of 14 h. The crude residue was purified by silica gel column chromatography, eluting with hexanes/EtOAc (6:1) to yield 105 mg (81%) of **36** as an amorphous colorless solid as a 3:2 mixture of siloxy epimers (data provided for mixture): ^{1}H NMR (500 MHz, acetone-d_6) δ 8.20–8.16 (comp, 1 H), 7.92 (d, J = 8.0 Hz, 0.6 H), 7.87 (d, J = 8.1 Hz, 0.4 H), 7.57 (s, 0.4 H), 7.54 (s, 0.6 H), 7.38–7.31 (comp, 3 H), 7.18–7.00 (comp, 3 H), 6.87 (s, 0.4 H), 6.83 (s, 0.6 H), 6.71 (s, 0.4 H), 6.68 (s, 0.6 H), 2.97 (s, 1.8 H), 2.95 (s, 1.2 H), 2.40 (app sept, J = 6.9 Hz, 0.4 H), 2.30 (app sept, J = 6.9 Hz, 0.6 H), 1.67 (s, 9 H), 1.58 (s, 3.6 H), 1.57 (s, 5.4 H), 1.62 (d, J = 6.9 Hz, 1.2 H), 1.04 (d, J = 6.9 Hz, 1.8 H), 0.97 (s, 5.4 H), 0.93–0.90 (comp, 4.8 H), 0.60 (d, J = 6.9 Hz, 1.8 H), 0.21 (s, 1.8 H), 0.11 (s, 1.8 H), 0.03, (s, 1.2 H), –0.10 (s, 1.2 H); ^{13}C NMR (125 MHz, acetone-d_6) δ 162.5 (C), 162.3 (C), 156.14 (C), 156.13 (C), 152.55 (C), 152.54 (C), 150.2 (C), 150.1 (C), 142.8 (C), 142.6 (C), 137.21 (C), 137.19 (C), 135.0 (C), 134.5 (C), 134.3 (C), 134.1 (C), 129.9 (CH), 129.8 (CH), 128.9 (C), 128.8 (C), 125.84 (CH), 125.82 (CH), 125.3 (CH), 125.25 (CH), 125.19 (CH), 125.1 (CH), 125.0 (CH), 124.7 (C), 123.72 (CH), 123.70 (CH), 121.0 (C), 120.8 (C), 120.2 (CH), 120.1 (CH), 119.5 (CH), 119.3 (CH), 118.2 (CH), 117.8 (CH), 116.57 (CH), 116.55 (CH), 92.9 (C), 92.4 (C), 85.1 (C), 84.4 (CH), 82.9 (C), 82.7 (C), 58.32 (C), 58.31 (C), 38.69 (CH), 38.64 (CH), 29.0 (CH_3), 28.9 (CH_3), 28.3 (CH_3), 28.2 (CH_3), 26.5 (CH_3), 26.4 (CH_3), 26.3 (CH_3), 19.3 (C), 19.2 (C), 17.4 (CH_3), 17.2 (CH_3), 16.8 (CH_3), 16.6 (CH_3), –3.1 (CH_3), –3.2 (CH_3), –3.3 (CH_3), –3.6 (CH_3), –3.8 (CH_3); IR (film) 2973,

2931, 2858, 1737, 1719, 1704, 1653, 1451, 1372, 1156 cm^{-1}; TLC R_f 0.75 (1:2 ethyl acetate/hexanes); HRMS (ESI) *m*/*z* calcd for $C_{41}H_{54}N_4O_7SiNa^+$ (M+Na) 765.3660, found 765.3641.



Preparation of Diol S8. **Diol 22.** Intermediate **36** (95 mg, 0.128 mmol, 3:2 mixture of siloxy epimers) was dihydroxylated using AD-mix-α (285 mg), methane sulfonamide (12 mg, 0.128 mmol), $(DHQ)_2PHAL$ (12 mg, 0.016 mmol), and $K_2OsO_4•2H_2O$ (12 mg, 0.032 mmol) in *t*-BuOH/H_2O/acetone (3:2:1, 5 mL) following the general procedure using a reaction time of 15 h. The crude residue was purified by silica gel column chromatography, eluting with hexanes/EtOAc (4:1 to 1:1) to provide siloxy epimers (3:2) 90 mg (90%) of **S8** as a colorless powder. The yield reported in the Scheme represents the mean of multiple runs. Analytical data for mixture: ^{1}H NMR (500 MHz, acetone-d_6) δ 8.20–8.05 (comp, 2 H), 7.85–7.60 (comp, 2 H), 7.38–7.20 (comp, 4 H), 7.19–7.10 (comp, 1 H), 6.76 (app br s, 1 H), 5.92–5.86 (comp, 1 H), 5.80 (br s, 0.4 H), 5.18 (br s, 0.4 H), 5.13 (s, 0.6 H), 2.88 (s, 1.2 H), 2.82 (s, 1.8 H), 2.52 (heptet, *J* = 6.9 Hz, 0.4 H), 2.14 (heptet, *J* = 6.9 Hz, 0.6 H), 1.64–1.62 (comp, 9 H), 1.57–1.55 (comp, 9 H), 1.13 (d, *J* = 6.9 Hz, 1.2 H), 1.07 (d, *J* = 6.9 Hz, 1.2 H), 0.97 (s, 5.4 H), 0.93–0.90 (comp, 5.4 H), 0.35 (s, 1.8 H), 0.20 (s, 1.8 H), 0.07 (d, *J* = 7.0 Hz, 1.8 H), –0.02 (s, 1.2 H), –0.48 (s, 1.2 H); ^{13}C NMR (125 MHz, acetone-d_6) δ 167.2 (C), 166.9 (C), 166.4 (C), 165.6 (C), 152.3 (C), 152.2 (C), 150.0 (C), 141.4 (C), 136.88 (C), 136.85 (C), 130.6 (C), 130.5 (C), 129.7 (CH), 126.3 (CH), 126.1 (CH), 126.0 (CH), 125.2 (CH), 124.39 (CH), 124.35 (CH), 123.37 (CH), 123.31 (CH), 122.7 (CH), 122.5 (CH), 119.4 (C), 119.3 (C), 117.9 (C) (broad), 117.4 (CH), 115.97 (C), 115.95 (CH), 91.6 (C), 91.5 (C), 85.1 (C), 84.9 (C), 84.8 (C), 84.7 (C), 82.1 (C), 81.5 (CH) (broad), 80.8 (CH), 78.2 (CH), 78.1 (CH), 78.0 (CH), 58.0 (C), 57.8 (C) (broad), 38.8 (CH), 38.4 (CH), 29.9 (CH), 28.5 (CH_3), 28.4 (CH_3), 28.3 (CH_3), 28.2 (CH_3), 26.8 (CH_3), 26.3 (CH_3), 19.7 (C), 19.1 (C), 18.3 (CH_3), 17.8 (CH_3), 16.9 (CH_3), 15.8 (CH_3), –3.0 (CH_3), –3.1 (CH_3), –3.6 (CH_3), –4.4 (CH_3); IR (film) 3381, 2976, 2931, 2858, 1727, 1648, 1481, 1455, 1392, 1370, 1156 cm^{-1}; TLC R_f 0.56 (1:2 ethyl acetate/hexanes); HRMS (ESI) *m*/*z* calcd for $C_{41}H_{56}N_4O_9SiNa^+$ (M+Na) 799.3714, found 799.3698.



Preparation of Diacetates 37T and 37B. Intermediate **S8** (90 mg, 0.116 mmol was diacetylated using acetic anhydride (109 μL, 1.16 mmol) and DMAP (213 mg, 1.74 mmol) in CH_2Cl_2 (6.2 mL) following the general procedure using a reaction time of 15 h at room temperature**.** The crude residue was purified using silica gel column chromatography eluting with hexanes/ethyl acetate (6:1) to afford the title compound **37** (90 mg, 91%) as a mixture of siloxy epimers (3:2) as an amorphous colorless solid. The yield reported in the Scheme represents the mean of multiple runs. Analytically pure samples of these epimers were obtained using

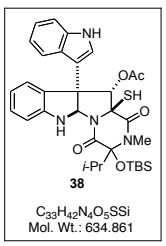
silica gel column chromatography eluting with hexanes/ethyl acetate (6:1). Relative stereochemistry assigned using 1D NOE data.

For **37T** irradiation of C11-H leads to NOE with C10-H and *i*Pr-CH_3.

For **37B** irradiation of C11-H leads to NOE with C4'–H and C10-H.

37T (dr ≈20:1): ^{1}H NMR (500 MHz, acetone-d_6) δ 8.17 (d, J = 8.3 Hz, 1 H), 7.85 (br s, 1 H), 7.72 (d, J = 7.5 Hz, 1 H), 7.58 (br s, 1 H), 7.45–7.40 (comp, 2 H), 7.34 (t, J = 8.0 Hz, 1 H), 7.22 (app t, J = 7.5 Hz, 2 H), 6.48 (br s, 1 H), 5.92 (s, 1 H), 2.87 (s, 3 H), 2.35 (s, 3 H), 2.13 (septet, J = 7.0 Hz, 1 H), 1.75 (s, 3 H), 1.65 (s, 9 H), 1.52 (s, 9 H), 0.95 (s, 9 H), 0.58 (d, J = 6.8 Hz, 3 H), 0.31 (d, J = 7.0 Hz, 3 H), 0.27 (s, 3 H), 0.16 (s, 3 H); ^{13}C NMR (125 MHz, acetone-d_6) δ 169.9 (C), 169.4 (C), 164.2 (C), 161.7 (C), 152.1 (C), 149.9 (C), 141.8 (C), 136.6 (C), 135.7 (C), 130.6 (CH), 129.8 (C), 128.5 (CH), 127.0 (CH), 125.3 (CH), 125.1 (CH), 123.4 (CH), 121.1 (CH), 117.2 (CH), 116.8 (C), 116.1 (CH), 92.0 (C), 86.6 (C), 85.1 (C), 82.9 (CH), 82.7 (C), 79.1 (CH), 57.2 (C), 40.1 (CH), 29.2 (CH_3), 28.29 (CH_3), 28.23 (CH_3), 26.5 (CH_3), 21.5 (CH_3), 20.5 (CH_3), 19.6 (C), 16.9 (CH_3), –2.7 (CH_3), –3.4 (CH_3); IR (film) 2974, 2932, 2858, 1762, 1730, 1679, 1482, 1455, 1371, 1222, 1157 cm^{-1}; TLC R_f 0.42 (1:3 ethyl acetate/hexanes); HRMS (ESI) *m/z* calcd for $C_{45}H_{60}N_4O_{11}SiNa^+$ (M+Na) 883.3926, found 883.3920; $[\alpha]^{23}_D$ –93.5, $[\alpha]^{23}_{577}$ –94.8, $[\alpha]^{23}_{546}$ –112.4, $[\alpha]^{23}_{435}$ –189.8 (c = 0.145, CH_2Cl_2).

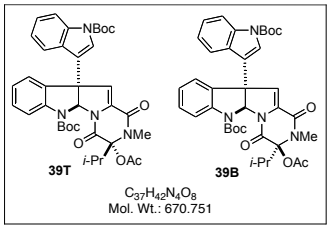
37B (dr ≈20:1): ^{1}H NMR (500 MHz, acetone-d_6, 313 K) δ 8.15 (d, J = 8.0 Hz, 1 H), 7.95 (d, J = 7.5 Hz, 1 H), 7.85 (d, J = 7.5 Hz, 1 H), 7.71 (br s, 1 H), 7.40–7.30 (comp, 3 H), 7.25 (t, J = 7.6 Hz, 1 H), 7.15 (s, 1 H), 7.11 (s, 1 H), 6.78 (s, 1 H), 2.87 (s, 3 H), 2.48 (septet, J = 6.9 Hz, 1 H), 2.27 (s, 3 H), 1.62 (s, 9 H), 1.53 (s, 9 H), 1.43 (s, 3 H), 1.11 (d, J = 6.9 Hz, 3 H), 1.06 (d, J = 6.9 Hz, 3 H), 0.89 (s, 9 H), 0.095 (s, 3 H), –0.41 (s, 3 H); ^{13}C NMR (125 MHz, acetone-d_6, 313 K) δ 169.0 (C), 168.7 (C), 168.3 (C), 168.3 (C), 162.0 (C), 152.1 (C), 150.0 (C), 141.2 (C), 136.9 (C), 130.5 (CH), 129.7 (C), 128.0 (CH), 126.7 (CH), 125.5 (CH), 124.9 (CH), 123.5 (CH), 121.8 (CH), 118.4 (C), 117.2 (C), 116.3 (CH), 92.3 (C), 91.3 (C), 85.3 (C), 83.4 (C), 82.8 (CH), 76.7 (CH), 57.8 (C), 39.1 (CH), 31.4 (CH_3), 28.5 (CH_3), 28.3 (CH_3), 26.9 (CH_3), 21.7 (CH_3), 20.1 (C), 18.2 (CH_3), 17.8 (CH_3), –2.4 (CH_3), –3.9 (CH_3); IR (film) 2976, 2932, 2859, 1767, 1728, 1688, 1481, 1456, 1370, 1221, 1156 cm^{-1}; TLC R_f 0.33 (1:3 ethyl acetate/hexanes); HRMS (ESI) *m/z* calcd for $C_{45}H_{60}N_4O_{11}SiNa^+$ (M+Na) 883.3926, found 883.3931; $[\alpha]^{23}_D$ –88.5, $[\alpha]^{23}_{577}$ –93.0, $[\alpha]^{23}_{546}$ –109.3, $[\alpha]^{23}_{435}$ –198.1 (c = 0.50, CH_2Cl_2).



Sulfur Incorporation Using 37. Hydrogen sulfide (bp –60°C, ca. 150 μL) was condensed at –78°C in a pressure tube fitted with a rubber septum. A solution of **37** (9 mg, 0.010 mmol, 1:1 mixture of siloxy epimers) in CH_2Cl_2 (300 μL), followed by boron trifluoride etherate (14 μL, 0.116 mmol), was added to the liquid hydrogen sulfide. A Teflon screw cap replaced the rubber

septum to seal the pressure tube, the cold bath was removed, the reaction mixture warmed to room temperature, and stirring was continued for 2.5 h. *CAUTION: the sealed tube was maintained behind a blast shield.* The reaction mixture was then cooled to –78°C and the Teflon screw cap was replaced by a rubber septum with a bleed needle connected to a bleach trap. The cooling bath was removed and the resulting colorless suspension was allowed to warm up to room temperature. Upon removal of the hydrogen sulfide, the reaction mixture was dried using a nitrogen stream, diluted with ethyl acetate (6 mL), transferred to a separatory funnel then washed with saturated aq. $NaHCO_3$ (4 mL). The aqueous layer was further extracted with ethyl acetate (2 x 6 mL) then the combined organic extracts were washed with brine (4 mL), dried (Na_2SO_4), and concentrated to dryness under reduced pressure. The crude material was purified using silica gel column chromatography eluting with CH_2Cl_2/ethyl acetate (96:4) to afford **38** (4 mg, 63%) as an amorphous colorless powder as an inseparable mixture of siloxy epimers (10:1).

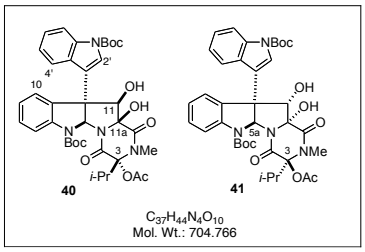
Data for major diastereomer: ^{1}H NMR (500 MHz, acetone-d_6) δ 10.28 (br s, 1 H), 7.73 (d, J = 8.1 Hz, 1 H), 7.60 (d, J = 7.5 Hz, 1 H), 7.39 (d, J = 8.2 Hz, 1 H), 7.15 (t, J = 7.7 Hz, 1 H), 7.13–7.08 (comp, 2 H), 7.01 (t, J = 7.2 Hz, 1 H), 6.87 (t, J = 7.5 Hz, 1 H), 6.72 (d, J = 7.8 Hz, 1 H), 6.71–6.69 (m, 1 H), 6.49 (br s, 1 H), 6.30 (s, 1 H), 3.05 (s, 3 H), 2.66 (heptet, J = 6.8 Hz, 1 H), 1.35 (s, 3 H), 1.08 (d, J = 6.8 Hz, 3 H), 1.04 (s, 9 H), 1.00 (d, J = 6.8 Hz, 2 H), 0.44 (s, 3 H), 0.30 (s, 3 H); ^{13}C NMR (125 MHz, acetone-d_6) δ 168.4 (C), 166.6 (C), 165.3 (C), 150.4 (C), 138.5 (C), 131.4 (C), 130.0 (CH), 126.8 (C), 126.6 (CH), 126.2 (CH), 122.4 (CH), 122.1 (CH), 119.7 (CH), 119.6 (C), 113.8 (C), 112.8 (CH), 110.7 (CH), 91.3 (C), 88.2 (CH), 81.53 (CH), 81.46 (C), 72.6 (C), 59.1 (C), 39.1 (CH), 31.4 (CH_3), 27.1 (CH_3), 20.6 (CH_3), 20.3 (C), 18.7 (CH_3), 17.3 (CH_3), –1.8 (CH_3), –3.1 (CH_3); IR (film) 3344, 2955, 2929, 2857, 2559, 1753, 1686, 1655, 1381, 1217 cm^{-1}; TLC R_f 0.45 (1:2 ethyl acetate/hexanes); HRMS (ESI) m/z calcd for $C_{33}H_{42}N_4O_5SiNa^+$ (M+Na) 657.2543, found 657.2533.



Preparation of Acetates 39. Acetic anhydride (60 μL, 0.636 mmol) was added dropwise to a solution of **35** (100 mg, 0.159 mmol) and DMAP (97 mg, 0.795 mmol), in CH_2Cl_2 (3.2 mL). The reaction mixture was stirred at room temperature for 14 h, whereupon CH_2Cl_2 (5 mL) was added followed by pH 7 phosphate buffer (5 mL). The mixture was transferred to a separatory funnel, the layers were separated, and the aqueous phase was further extracted with CH_2Cl_2 (2 x 5 mL). The combined organic extracts were washed with brine (5 mL), dried (Na_2SO_4), and concentrated to dryness under reduced pressure. The crude residue was purified by silica gel column chromatography eluting with hexanes/EtOAc (3:1) to afford the title compound **39** (102 mg, 95%) as an amorphous colorless solid and a 1.2:1 mixture of acetate epimers. Analytically pure samples of these epimers were obtained by purification using silica gel column chromatography and eluting with hexanes/EtOAc (4:1):

Top diastereomer **39T**: ^{1}H NMR (500 MHz, acetone-d_6) δ 8.18 (d, J = 8.3 Hz, 1 H), 7.90 (d, J = 8.1 Hz, 1 H), 7.49 (s, 1 H), 7.40 (d, J = 7.5 Hz, 1 H), 7.35 (app t, J = 7.9 Hz, 2 H), 7.30 (d, J = 7.9 Hz, 1 H), 7.17 (app t, J = 7.6 Hz, 1 H), 7.14 (app t, J = 7.5 Hz, 1 H), 6.87 (s, 1 H), 6.55 (s, 1 H), 2.93 (s, 3 H), 2.57 (septet, J = 6.9 Hz, 1 H), 2.17 (s, 3 H), 1.66 (s, 9 H), 1.55 (s, 9 H), 1.17 (d, J = 6.9 Hz, 3 H), 0.82 (d, J = 6.9 Hz, 3 H); ^{13}C NMR (125 MHz, acetone-d_6) δ 170.7 (C), 160.9 (C), 157.3 (C), 152.6 (C), 150.2 (C), 142.8 (C), 137.3 (C), 135.0 (C), 133.9 (C), 129.8 (CH), 129.0 (C), 125.8 (CH), 125.6 (CH), 125.1 (CH), 125.0 (CH), 123.9 (CH), 120.9 (C), 120.7 (CH), 119.7 (CH), 117.9 (CH), 116.4 (CH), 92.4 (C), 85.1 (C), 83.7 (CH), 83.0 (C), 58.4 (C), 35.3 (CH), 28.28 (CH_3), 28.25 (CH_3), 27.4 (CH_3), 20.6 (CH_3), 16.8 (CH_3), 16.4 (CH_3); IR (film) 2976, 2931, 1737, 1716, 1674, 1658, 1480, 1453, 1371, 1230, 1156 cm^{-1}; TLC R_f 0.22 (1:3 ethyl acetate/hexanes); HRMS (ESI) m/z calcd for $C_{37}H_{42}N_4O_8Na^+$ (M+Na) 693.2900, found 693.2896; $[\alpha]^{23}_D$ –93.5, $[\alpha]^{23}_{577}$ –101.3, $[\alpha]^{23}_{546}$ –117.8, $[\alpha]^{23}_{435}$ –255.5 (c = 0.16, CH_2Cl_2).

Bottom diastereomer **39B**: ^{1}H NMR (500 MHz, acetone-d_6) δ 8.18 (d, J = 8.4 Hz, 1 H), 7.91 (d, J = 8.2 Hz, 1 H), 7.56 (s, 1 H), 7.37–7.31 (comp, 3 H), 7.15–7.04 (comp, 3 H), 6.82 (s, 1 H), 6.67 (s, 1 H), 2.92 (s, 3 H), 2.55 (septet, J = 6.9 Hz, 1 H), 2.08 (s, 3 H), 1.66 (s, 9 H), 1.54 (s, 9 H), 1.18 (d, J = 6.9 Hz, 3 H), 1.01 (d, J = 6.9 Hz, 3 H); ^{13}C NMR (125 MHz, acetone-d_6) δ 169.7 (C), 159.9 (C), 156.8 (C), 152.7 (C), 150.2 (C), 143.0 (C), 137.2 (C), 134.6 (C), 134.5 (C), 129.7 (CH), 128.8 (C), 125.8 (CH), 125.2 (CH), 125.0 (CH), 124.8 (CH), 123.7 (CH), 121.3 (C), 120.2 (CH), 119.2 (CH), 118.2 (CH), 116.6 (CH), 91.9 (C), 85.1 (C), 84.8 (CH), 82.7 (C), 60.6 (C), 58.7 (C), 36.3 (CH), 28.3 (CH_3), 28.3 (CH_3), 27.8 (CH_3), 20.5 (CH_3), 17.0 (CH_3), 16.5 (CH_3); IR (film) 2975, 2929, 1735, 1718, 1655, 1451, 1370, 1155 cm^{-1}; TLC R_f 0.11 (1:3 ethyl acetate/hexanes); HRMS (ESI) m/z calcd for $C_{37}H_{42}N_4O_8Na^+$ (M+Na) 693.2900, found 693.2891; $[\alpha]^{23}_D$ –80.2, $[\alpha]^{23}_{577}$ –86.3, $[\alpha]^{23}_{546}$ –105.4, $[\alpha]^{23}_{435}$ –258.0 (c = 0.12, CH_2Cl_2).



Diols 40 and 41. Intermediate **39** (120 mg, 0.179 mmol) was dihydroxylated using AD-mix-α (360 mg), methane sulfonamide (17 mg, 0.179 mmol), $(DHQ)_2PHAL$ (17 mg, 0.022 mmol) and $K_2OsO_4•2H_2O$ (16 mg, 0.045 mmol in *t*-BuOH/H_2O/acetone (3:2:1, 6 mL) following the general procedure using a reaction time of 6.5 h. The crude residue was purified by silica gel column chromatography eluting with hexanes/EtOAc (3:1) to afford a 1.2:1.0 mixture of the title compounds **40** and **41** (109 mg, 87%) as an amorphous colorless solid. Analytically pure samples of the acetate epimers were obtained by purification using silica gel column chromatography and eluting with hexane/EtOAc (5:1): Relative configuration established using 1D NOE data.

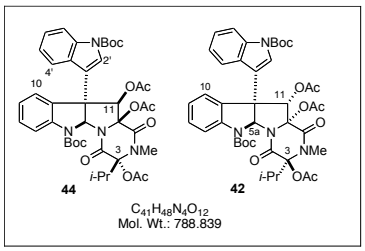
For compound **40** irradiation of C11-H leads to NOE signals with C2'–H and C4'–H, and C5a–H.

For compound **41** irradiation of C11-H leads to NOE signals with C4'–H, C10–H, and C11–OH.

For compound **41** irradiation of C11a-OH hydroxyl proton leads to NOE signals with *i*-Pr-CH and *i*-Pr-CH_3 and C5a–H.

Top diastereomer **40** (dr ≈20:1): ^{1}H NMR (500 MHz, acetone-d_6) δ 8.14 (d, J = 8.3 Hz, 1 H), 7.86 (d, J = 8.1 Hz, 1 H), 7.75 (s, 1 H), 7.36 (d, J = 7.5 Hz, 1 H), 7.29 (app t, J = 7.6 Hz, 1 H), 7.24 (app t, J = 7.5 Hz, 1 H), 7.18 (d, J = 7.9 Hz, 1 H), 7.11 (app t, J = 7.6 Hz, 1 H), 6.99 (s, 1 H), 6.94 (app t, J = 7.5 Hz, 1 H), 5.08 (br s, 1 H), 4.98 (br s, 1 H), 4.70 (br s, 1 H), 2.86 (s, 3 H), 2.51 (septet, J = 6.9 Hz, 1 H), 2.12 (s, 3 H), 1.67 (s, 9 H), 1.57 (s, 9 H), 1.20 (d, J = 6.9 Hz, 3 H), 1.06 (d, J = 6.9 Hz, 3 H); ^{13}C NMR (125 MHz, acetone-d_6) δ 170.8 (C), 167.6 (C), 161.8 (C), 152.7 (C), 150.3 (C), 143.8 (C), 137.1 (C), 131.7 (C), 129.2 (C), 129.1 (CH), 128.2 (CH), 125.6 (CH), 124.4 (CH), 123.7 (CH), 123.4 (C), 122.7 (CH), 120.5 (CH), 116.4 (CH), 115.8 (CH), 92.0 (C), 85.7 (C), 84.9 (C), 82.5 (C), 79.2 (CH), 78.8 (CH), 54.2 (C), 34.9 (C), 28.7 (CH_3), 28.3 (CH_3), 27.5 (CH_3), 20.7 (CH_3), 17.2 (CH_3), 17.0 (CH_3); IR (film) 3446, 2977, 2933, 1727, 1713, 1658, 1483, 1454, 1377, 1156 cm^{-1}; TLC R_f 0.25 (1:1 ethyl acetate/hexanes); HRMS (ESI) *m/z* calcd for $C_{37}H_{44}N_4O_{10}Na^+$ (M+Na) 727.2955, found 727.2947; $[\alpha]^{23}_D$ +88.0, $[\alpha]^{23}_{577}$ +85.0, $[\alpha]^{23}_{546}$ +95.2, $[\alpha]^{23}_{435}$ +171.0 (c = 0.12, CH_2Cl_2).

Bottom diastereomer **41** (dr ≈20:1): ^{1}H NMR (500 MHz, acetone-d_6) δ 8.12 (d, J = 8.2 Hz, 1 H), 8.00 (d, J = 8.0 Hz, 1 H), 7.72 (br d, J = 5.8 Hz, 1 H), 7.59 (d, J = 7.5 Hz, 1 H), 7.31 (s, 1 H), 7.32–7.21 (comp, 3 H), 7.11 (app t, J = 7.5 Hz, 1 H), 6.67 (s, 1 H), 5.85 (br s, 1 H), 5.74 (br s, 1 H), 5.10 (br s, 1 H), 2.76 (s, 3 H), 2.55 (septet, J = 6.9 Hz, 1 H), 1.90 (s, 3 H), 1.63 (s, 9 H), 1.52 (s, 9 H), 1.17 (app t, J = 6.9 Hz, 6 H); ^{13}C NMR (125 MHz, acetone-d_6) δ 169.0 (C), 166.8 (C), 162.2 (C), 152.3 (C), 150.1 (C), 141.5 (C), 136.8 (C), 136.3 (C), 130.7 (C), 129.3 (CH), 126.5 (CH), 125.6 (CH), 125.1 (CH), 124.0 (CH), 123.3 (CH), 122.4 (CH), 119.7 (C), 117.0 (CH), 116.0 (CH), 91.2 (C), 85.1 (C), 84.7 (C), 82.0 (CH), 81.8 (C), 78.7 (CH), 57.5 (C), 43.5 (C), 36.0 (CH), 28.6 (CH_3), 28.2 (CH_3), 20.4 (CH_3), 17.6 (CH_3), 17.4 (CH_3); IR (film) 3388, 2975, 2931, 1728, 1660, 1482, 1455, 1371, 1156 cm^{-1}; TLC R_f 0.20 (1:1 ethyl acetate/hexanes); HRMS (ESI) *m/z* calcd for $C_{37}H_{44}N_4O_{10}Na^+$ (M+Na) 727.2955, found 727.2949; $[\alpha]^{23}_D$ –95.3, $[\alpha]^{23}_{577}$ –103.5, $[\alpha]^{23}_{546}$ –119.9, $[\alpha]^{23}_{435}$ –201.6 (c = 0.13, CH_2Cl_2).

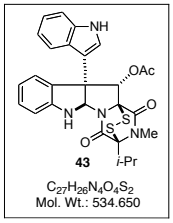


Preparation of Acetates 42 and 44. Intermediate **40/41** (68 mg, 0.0965 mmol, 1.2:1.0 mixture) was diacetylated using acetic anhydride (137 μL, 1.45 mmol) and DMAP (188 mg, 1.54 mmol) in CH_2Cl_2 (5.0 mL) following the general procedure using a reaction time of 14 h at room temperature. The crude residue was purified using silica gel column chromatography eluting with hexane/EtOAc (4:1) to afford

the title compounds **42** and **44** (68 mg, 89%) as amorphous colorless solids. The yield reported in the Scheme is the the mean of dihydroxylation reactions of the separated diastereomers. There were some mixed fractions that could be combined and resubjected to further separate **42** and **34**.

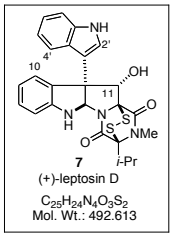
Top diastereomer **44** (dr ≈20:1): ^{1}H NMR (500 MHz, acetone-d_6) δ 8.15–8.10 (comp, 2 H), 7.99 (br d, J = 7.1 Hz, 1 H), 7.36 (app t, J = 8.6 Hz, 1 H), 7.26 (app t, J = 8.3 Hz, 1 H), 7.12 (d, J = 7.6 Hz, 1 H), 7.04–6.93 (comp, 4 H), 6.70 (d, J = 8.0 Hz, 1 H), 2.93 (s, 3 H), 2.66 (heptet, J = 6.9 Hz, 1 H), 2.16 (s, 3 H), 2.12 (s, 3 H), 1.69 (s, 9 H), 1.57 (s, 3 H), 1.54 (s, 9 H), 1.20 (d, J = 6.8 Hz, 3 H), 1.15 (d, J = 6.9 Hz, 3 H); ^{13}C NMR (125 MHz, acetone-d_6) δ 169.5 (C), 169.2 (C), 167.4 (C), 162.5 (C), 160.9 (C), 151.5 (C), 149.2 (C), 143.0 (C), 136.3 (C), 132.0 (C), 129.53 (C), 129.48 (CH), 127.8 (CH), 125.5 (CH), 125.0 (CH), 123.7 (CH), 123.5 (CH), 121.3 (C), 119.9 (CH), 116.3 (CH), 115.2 (CH), 91.4 (C), 86.8 (C), 84.7 (C), 83.1 (C), 81.0 (CH), 75.3 (CH), 54.1 (C), 36.7 (CH), 28.8 (CH_3), 28.7 (CH_3), 28.3 (CH_3), 21.0 (CH_3), 20.8 (CH_3), 20.6 (CH_3), 18.2 (CH_3), 17.4 (CH_3); IR (film) 2976, 2922, 2851, 1767, 1739, 1714, 1687, 1482, 1455, 1374, 1223, 1155 cm^{-1}; TLC R_f 0.54 (1:1 ethyl acetate/hexanes); HRMS (ESI) m/z calcd for $C_{41}H_{48}N_4O_{12}Na^+$ (M+Na) 811.3167, found 811.3174; $[\alpha]^{23}_D$ +84.8, $[\alpha]^{23}_{577}$ +87.0, $[\alpha]^{23}_{546}$ +100.0, $[\alpha]^{23}_{435}$ +179.1 (c = 0.60, CH_2Cl_2).

Bottom diastereomer **42** (dr ≈20:1): ^{1}H NMR (500 MHz, acetone-d_6) δ 8.15 (d, J = 8.3 Hz, 1 H), 7.79 (app d, J = 7.5 Hz, 2 H), 7.68 (br s, 1 H), 7.37–7.32 (comp, 2 H), 7.30 (app t, J = 7.3 Hz, 1 H), 7.23 (s, 1 H), 7.20 (app t, J = 7.5 Hz, 1 H), 6.92 (s, 1 H), 6.75 (s, 1 H), 2.72 (s, 3 H), 2.56 (septet, J = 6.9 Hz, 1 H), 2.28 (s, 3 H), 1.96 (s, 3 H), 1.63 (s, 9 H), 1.50 (s, 3 H), 1.48 (s, 9 H), 1.15 (app d, J = 6.9 Hz, 6 H); ^{13}C NMR (125 MHz, acetone-d_6) δ 169.1 (C), 168.7 (C), 163.7 (C), 162.0 (C), 152.1 (C), 149.9 (C), 141.6 (C), 136.7 (C), 134.1 (C), 130.2 (CH), 129.7 (C), 127.9 (CH), 126.5 (CH), 125.4 (CH), 124.4 (CH), 123.4 (CH), 121.7 (CH), 117.7 (CH), 117.4 (C), 116.2 (CH), 91.4 (C), 90.9 (C), 85.1 (C), 83.9 (CH), 82.2 (C), 76.7 (CH), 57.7 (C), 37.1 (CH), 30.1 (CH_3), 28.5 (CH_3), 28.2 (CH_3), 21.6 (CH_3), 20.23 (CH_3), 20.20 (CH_3), 17.8 (CH_3), 17.4 (CH_3); IR (film) 2977, 2934, 1768, 1721, 1482, 1455, 1369, 1218, 1156 cm^{-1}; TLC R_f 0.44 (1:1 ethyl acetate/hexanes); HRMS (ESI) m/z calcd for $C_{41}H_{48}N_4O_{12}Na^+$ (M+Na) 811.3167, found 811.3173; $[\alpha]^{23}_D$ –90.1, $[\alpha]^{23}_{577}$ –95.4, $[\alpha]^{23}_{546}$ –110.9, $[\alpha]^{23}_{435}$ –209.9 (c = 0.80, CH_2Cl_2).



***O*-Acetyl Leptosin D (43).** Hydrogen sulfide (bp –60°C, ca. 250 μL) was condensed at –78°C in a pressure tube fitted with a rubber septum. A solution of **42** (30 mg, 0.0385 mmol) in CH_2Cl_2 (750 μL), followed by neat boron trifluoride etherate (48 μL, 0.385 mmol), was added to the liquid hydrogen sulfide. A Teflon screw cap replaced the rubber septum to seal the pressure tube, the cold bath was removed, the reaction mixture warmed to room temperature, and stirring was continued for 2 h. *CAUTION: the sealed tube was maintained behind a blast shield*. The reaction mixture was then cooled to –78°C

and the Teflon screw cap was replaced by a rubber septum with a bleed needle connected to a bleach trap. The cooling bath was removed and the resulting colorless suspension was allowed to warm up to room temperature. Upon removal of the hydrogen sulfide, the reaction mixture was dried using a nitrogen stream, diluted with ethyl acetate (5 mL), transferred to a separatory funnel then washed with saturated aq. NH_4Cl (5 mL). The aqueous layer was further extracted with ethyl acetate (2 x 5 mL) then iodine in EtOAc (50 mM, 1.9 mL) was added followed by Et_3N (0.76 mmol, 106 μL). The mixture was stirred at room temperature for 20 min, treated with 10% aq. $Na_2S_2O_3$ (5 mL), then transferred to a separatory funnel. The layers were separated and the aqueous phase was further extracted with EtOAc (2 x 4 mL), the organic layers were combined, washed with sat. aq. NaCl (8 mL), dried (Na_2SO_4) then concentrated to dryness under reduced pressure. The crude material was purified using silica gel column chromatography eluting with CH_2Cl_2/EtOAc (100:0 to 97:3) to afford **43** (14 mg, 70%) as an amorphous colorless powder as a single stereoisomer. ^{1}H NMR (500 MHz, acetone-d_6) δ 10.28 (br s, 1 H), 7.88 (d, J = 7.4 Hz, 1 H), 7.62 (d, J = 7.8 Hz, 1 H), 7.41 (d, J = 7.8 Hz, 1 H), 7.16–7.08 (m, 4 H), 6.86 (app t, J = 7.4 Hz, 1 H), 6.76 (d, J = 7.8 Hz, 1 H), 6.46 (s, 1 H), 6.42 (s, 1 H), 6.28 (br s, 1 H), 3.02 (s, 3 H), 2.77 (heptet, J = 6.9 Hz, 1 H), 1.53 (s, 3 H) 1.44 (app t, J = 6.9 Hz, 6 H); ^{13}C NMR (125 MHz, acetone-d_6) δ 169.1 (C), 165.3 (C), 161.4 (C), 149.5 (C), 138.5 (C), 130.9 (C), 130.1 (CH), 127.1 (C), 126.2 (CH), 125.5 (CH), 122.5 (CH), 122.0 (CH), 120.0 (CH), 119.8 (CH), 112.8 (CH), 112.3 (C), 111.1 (CH), 83.1 (C), 82.4 (CH), 80.2 (CH), 76.6 (C), 61.1 (C), 33.4 (CH), 28.4 (CH_3), 20.6 (CH_3), 18.8 (CH_3), 18.4 (CH_3); IR (film) 3398, 3054, 2973, 2931, 1756, 1684, 1459, 1239, 1217, 1067, 1048, 740 cm^{-1}; TLC R_f 0.62 (9:1 CH_2Cl_2/ethyl acetate); HRMS (ESI) m/z calcd for $C_{27}H_{26}N_4O_4S_2Na^+$ (M+Na) 557.1293, found 557.1271; $[\alpha]^{23}_D$ +221.3, $[\alpha]^{23}_{577}$ +232.9, $[\alpha]^{23}_{546}$ +268.2, $[\alpha]^{23}_{435}$ +489.9 (c = 1.40, CH_2Cl_2).



(+)-Leptosin D (7). Lanthanum triflate (88 mg, 0.149 mmol) and DMAP[4] (0.019 mmol, 2.3 mg) were added to a solution of **43** (10 mg, 0.019 mmol) in anhydrous MeOH (1 mL) at room temperature. The solution was heated to 45 ºC and maintained at this temperature for 2 h. The reaction was cooled to room temperature then EtOAc (3 mL) was added, which was subsequently transferred to a separatory funnel containing sat. aq. NH_4Cl (5 mL). The layers were separated and the aqueous phase was further extracted with EtOAc (2 x 4 mL). The combined organic extracts were washed with H_2O (4 mL), brine (4 mL), dried (Na_2SO_4), then concentrated to dryness under reduced pressure. The crude material was purified by silica gel chromatography eluting with CH_2Cl_2/EtOAc (100:0 to 95:5) to afford (+)–leptosin D (7 mg, 77%) as an amorphous colorless powder. The yield reported in the Scheme represents the mean

[4] The addition of DMAP greatly accelerates deacetylation. However, this reaction can be performed without DMAP by using a reaction time of 16 h.

of multiple runs: ^{1}H NMR (500 MHz, $CDCl_3$) δ 8.03 (br s, 1 H), 7.96 (d, J = 7.7 Hz, 1 H), 7.46 (d, J = 7.5 Hz, 1 H), 7.33 (d, J = 7.3 Hz, 1 H), 7.22–7.12 (comp, 3 H), 7.08 (d, J = 2.5 Hz, 1 H), 6.84 (app t, J = 7.5 Hz, 1 H), 6.73 (d, J = 7.8 Hz, 1 H), 6.35 (s, 1 H), 5.39 (br s, 1 H), 5.37 (s, 1 H), 5.21 (s, 1 H), 3.09 (s, 3 H), 2.72 (septet, J = 6.9 Hz, 1 H), 1.49 (d, J = 6.9 Hz, 3 H), 1.47 (d, J = 6.9 Hz, 3 H); ^{13}C NMR (125 MHz, $CDCl_3$) δ 167.6 (C), 161.3 (C), 147.2 (C), 136.9 (C), 130.8 (C), 129.1 (CH), 126.2 (C), 124.4 (CH), 123.4 (CH), 122.3 (CH), 121.5 (CH), 119.8 (CH), 119.7 (CH), 113.3 (C), 111.5 (CH), 110.6 (CH), 82.5 (CH), 81.3 (CH), 80.4 (C), 76.2 (C), 60.7 (C), 32.4 (CH), 27.8 (CH_3), 18.6 (CH_3), 18.0 (CH_3); IR (film) 3405 2961, 2929, 1681, 1608, 1459, 1339, 1239, 1067, 739 cm^{-1}; TLC R_f 0.55 (9:1 CH_2Cl_2/ethyl acetate); HRMS (ESI) m/z calcd for $C_{25}H_{24}N_4O_3S_2Na^+$ (M+Na) 515.1188, found 515.1179; $[\alpha]^{22.4}_D$ +423.4, $[\alpha]^{22.4}_{577}$ +442.0, $[\alpha]^{22.4}_{546}$ +507.5, $[\alpha]^{22.4}_{435}$ +929.9 (c = 0.225, $CHCl_3$).

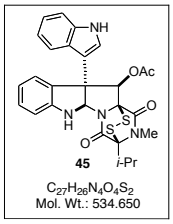
Tabulated ^{1}H NMR spectra of natural (+)-leptosin D and synthetic (+)-leptosin D: *J. Chem. Soc. Perkin Trans. 1* **1994**, 1859–64.

Literature (300 MHz, $CDCl_3$)		Synthetic **7** (500 MHz, $CDCl_3$)		Δδ
5a	6.34 (s)[5]	5a	6.35 (s)	+0.01
N(6)–H	5.40 (br s)[5]	N(6)–H	5.35 (br s)	–0.01
7	6.72 (dd, J = 7.8, 1.0)	7	6.72 (d, J = 7.8)	0
8	7.16 (td, J = 7.8, 1.0)	8	7.15 (t, J = 7.8)	–0.01
9	6.84 (td, J = 7.8, 1.0)	9	6.84 (t, J = 7.4)	0
10	7.45 (dd, J = 7.8 1.0)	10	7.46 (d, J = 7.4)	+0.01
11	5.37 (s)	11	5.37 (s)	0
12	3.08 (s)	12	3.09 (s)	+0.01
13	2.72 (heptet, J = 7.0)	13	2.72 (heptet, J = 6.9)	0
14	1.47 (d, J = 7.0)	14	1.47 (d, J = 6.9)	0
15	1.49 (d, J = 7.0)	15	1.49 (d, J = 6.9)	0
C(11)–OH	5.22 (br s)	C(11)–OH	5.21 (s)	–0.01
N(1')–H	8.01 (br s)	N(1')–H	8.04 (br s)	+0.03
2'	7.02 (d, J = 2.7)	2'	7.08 (d, J = 2.5)	+0.06
4'	7.96 (dd, J = 7.5, 1.0)	4'	7.96 (d, J = 7.7)	0
5'	7.18 (td, J = 7.5, 1.0)	5'	7.18 (t, J = 7.5)	0
6'	7.19 (td, J = 7.5, 1.0)	6'	7.20 (t, J = 7.5)	+0.01
7'	7.30 (dd, J = 7.5, 1.0)	7'	7.33 (d, J = 7.5)	+0.03

Literature (75.4 MHz, $CDCl_3$)		Synthetic **7** (125 MHz, $CDCl_3$)		Δδ
1	167.6 (C)	1	167.6 (C)	0
3	80.5 (CH)	3	80.4 (C)	–0.1
4	161.3 (C)	4	161.3 (C)	0
5a	82.6 (CH)	5a	82.5 (CH)	–0.1
6a	147.2 (C)	6a	147.2 (C)	0

[5] This change in the published data was obtained from a personal communication with Prof. A. Numata

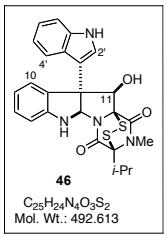
7 8 9 10	110.6 (CH) 129.2 (CH) 119.7 (CH) 124.4 (CH)	7 8 9 10	110.6 (CH) 129.1 (CH) 119.7 (CH) 124.4 (CH)	0 –0.1 0 0
10a	130.9 (C)	10a	130.8 (C)	–0.1
10b	60.7 (C)	10b	60.7 (C)	0
11	81.3 (CH)	11	81.3 (CH)	0
11a	76.2 (C)	11a	76.2 (C)	0
12	27.8 (CH_3)	12	27.8 (CH_3)	0
13	32.4 (CH)	13	32.4 (CH)	0
14	18.7 (CH_3)	14	18.6 (CH_3)	–0.1
15	18.1 (CH_3)	15	18.0 (CH_3)	–0.1
1'a	136.9 (C)	1'a	136.9 (C)	0
2'	123.4 (CH)	2'	123.4 (CH)	0
3'	113.2 (C)	3'	113.3 (C)	+0.1
3'a	126.2 (C)	3'a	126.2 (C)	0
4' 5' 6' 7'	121.5 (CH) 119.8 (CH) 122.3 (CH) 111.5 (CH)	4' 5' 6' 7'	121.5 (CH) 119.8 (CH) 122.3 (CH) 111.5 (CH)	0 0 0 0



C11-*epi*-*O*-Acetyl Leptosin D (45). Hydrogen sulfide (bp –60°C, ca. 150 µL) was condensed at –78°C in a pressure tube fitted with a rubber septum. A solution of **44** (15 mg, 0.019 mmol) in CH_2Cl_2 (600 µL), and boron trifluoride etherate (23 µL, 0.190 mmol), was added sequentially to the liquid hydrogen sulfide. A Teflon screw cap replaced the rubber septum to seal the pressure tube, the cold bath was removed, the reaction mixture warmed to room temperature, and stirring was continued for 2 h *behind a blast shield,* which resulted in a viscous solution. The reaction mixture was then cooled to –78°C and the Teflon screw cap was replaced by a rubber septum with a bleed needle connected to a bleach trap. The cooling bath was removed and the resulting colorless suspension was allowed to warm up to room temperature. Upon removal of the hydrogen sulfide, the reaction mixture was dried using a nitrogen stream, diluted with ethyl acetate (5 mL), transferred to a separatory funnel then washed with saturated aq. NH_4Cl (5 mL). The aqueous layer was further extracted with ethyl acetate (2 x 5 mL) then iodine in EtOAc (50 mM, 0.95 mL) was added followed by Et_3N (0.38 mmol, 53 µL). The mixture was stirred at room temperature for 20 min, treated with 10% aq. $Na_2S_2O_3$ (5 mL), then transferred to a separatory funnel. The layers were separated and the aqueous phase was further extracted with EtOAc (2 x 4 mL), the organic layers were combined, washed with sat. aq. NaCl (8 mL), dried (Na_2SO_4) then concentrated to dryness under reduced pressure. The crude material was purified using silica gel

column chromatography eluting with CH_2Cl_2/EtOAc (100:0 to 97:3) to afford **45** (7 mg, 70%) as an amorphous colorless powder as a single stereoisomer.

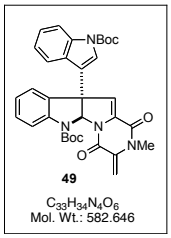
^{1}H NMR (500 MHz, acetone-d_6) δ 10.24 (br s, 1 H), 7.42–7.35 (comp, 4 H), 7.20 (d, J = 7.5 Hz, 1 H), 7.16 (t, J = 7.7 Hz, 1 H), 7.09 (t, J = 7.8 Hz, 1 H), 6.91 (t, J = 7.7 Hz, 1 H), 6.82 (d, J = 7.9 Hz, 1 H), 6.74 (t, J = 7.5 Hz, 1 H), 6.36 (br s, 1 H), 5.95 (d, J = 1.7 Hz, 1 H), 3.04 (s, 3 H), 2.83–2.75 (m, 1 H), 2.10 (s, 3 H) 1.43 (d, J = 6.9 Hz, 3 H), 1.38 (d, J = 6.9 Hz, 3 H); ^{13}C NMR (125 MHz, acetone-d_6) δ 168.5 (C), 166.8 (C), 161.7 (C), 151.0 (C), 138.7 (C), 129.8 (CH), 128.4 (C), 128.1 (CH), 126.5 (C), 124.8 (CH), 122.7 (CH), 120.2 (CH), 120.1 (CH), 119.2 (CH), 115.6 (C), 112.8 (CH), 110.4 (CH), 82.2 (CH), 81.8 (C), 77.46 (C), 77.41 (CH), 59.2 (C), 33.3 (CH), 28.4 (CH_3), 20.6 (CH_3), 18.8 (CH_3), 18.4 (CH_3); IR (film) 3398, 2961, 2926, 1760, 1686, 1459, 1369, 1218, 1070, 741 cm^{-1}; TLC R_f 0.57 (9:1 CH_2Cl_2/ethyl acetate); HRMS (ESI) m/z calcd for $C_{27}H_{26}N_4O_4S_2Na^+$ (M+Na) 557.1293, found 557.1273; $[\alpha]^{22.1}_D$ +209.1, $[\alpha]^{22.1}_{577}$ +214.9, $[\alpha]^{22.1}_{546}$ +246.4, $[\alpha]^{22.2}_{435}$ +437.5 (c = 0.27, $CHCl_3$).



C11-*epi*-Leptosin D (46). Lanthanum triflate (53 mg, 0.090 mmol) and DMAP[4] (0.011 mmol, 1.4 mg) were added to a solution of **45** (6 mg, 0.011 mmol) in anhydrous MeOH (0.75 mL) at room temperature. The solution was heated to 45 ºC and maintained at this temperature for 20 min. The reaction was cooled to room temperature then EtOAc (3 mL) was added, which was subsequently transferred to a separatory funnel containing sat. aq. NH_4Cl (5 mL). The layers were separated and the aqueous phase was further extracted with EtOAc (2 x 4 mL). The combined organic extracts were washed with H_2O (4 mL), brine (4 mL), dried (Na_2SO_4), then concentrated to dryness under reduced pressure. The crude material was purified by silica gel chromatography eluting with CH_2Cl_2/EtOAc (100:0 to 95:5) to afford (+)–leptosin D (4 mg, 80%) as an amorphous colorless powder. ^{1}H NMR (500 MHz, $CDCl_3$) δ 8.10 (br s, 1 H), 7.61 (d, J = 7.4 Hz, 1 H), 7.57 (d, J = 8.1 Hz, 1 H), 7.38 (d, J = 8.1 Hz, 1 H), 7.21 (app t, J = 7.8 Hz, 2 H), 7.14–7.08 (comp, 2 H), 6.86 (t, J = 7.5 Hz, 1 H), 6.76 (d, J = 7.8 Hz, 1 H), 6.07 (br s, 1 H), 5.96 (s, 1 H), 5.33 (br s, 1 H), 3.15 (br s, 1 H) 3.09 (s, 3 H), 2.70 (heptet, J = 6.8 Hz, 1 H), 1.49 (d, J = 6.9 Hz, 3 H), 1.44 (d, J = 6.8 Hz, 3 H); ^{13}C NMR (125 MHz, $CDCl_3$) δ 167.7 (C), 161.6 (C), 148.6 (C), 137.2 (C), 129.0 (CH), 128.1 (CH), 126.9 (C), 124.8 (C), 123.9 (CH), 122.5 (CH), 120.1 (CH), 119.3 (CH), 119.1 (CH), 115.6 (C), 111.8 (CH), 109.7 (CH), 80.1 (C), 79.4 (CH), 77.7 (CH), 77.5 (C), 58.0 (C), 32.4 (CH), 28.0 (CH_3), 18.6 (CH_3), 18.1 (CH_3); IR (film) 3404, 2961, 2925, 1680, 1607, 1458, 1354, 1069, 741 cm^{-1}; TLC R_f 0.33 (9:1 CH_2Cl_2/ethyl acetate); HRMS (ESI) m/z calcd for $C_{25}H_{24}N_4O_3S_2Na^+$ (M+Na) 515.1188, found 515.1182; $[\alpha]^{22.8}_D$ +212.1, $[\alpha]^{23}_{577}$ +217.7 $[\alpha]^{23.1}_{546}$ +237.0, $[\alpha]^{23.1}_{435}$ +415.1 (c = 0.130, $CHCl_3$).

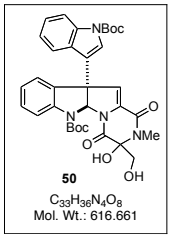
Tabulated ^{1}H NMR spectra of natural (–)-leptosin D-diastereomer and synthetic (+)-leptosin D-diastereomer: *Tetrahedron* **1995**, *51*, 3483–98. (Carbon data not reported).

Literature (300 MHz, $CDCl_3$)		Synthetic **46** (500 MHz, $CDCl_3$)		Δδ
5a	5.94 (s)	5a	5.96 (s)	+0.02
N(6)–H	5.34 (br s)	N(6)–H	5.33 (br s)	–0.01
7	6.77 (dd, J = 7.8, 1.0)	7	6.76 (d, J = 7.8)	–0.01
8	7.20 (td, J = 7.8, 1.0)	8	7.21 (app t, J = 7.8)	+0.01
9	6.85 (td, J = 7.8, 1.0)	9	6.86 (t, J = 7.5)	+0.01
10	7.61 (dd, J = 7.8 1.0)	10	7.61 (d, J = 7.4)	+0.01
11	6.05 (s)	11	6.07 (br s)	+0.02
12	3.08 (s)	12	3.09 (s)	+0.01
13	2.70 (heptet, J = 6.8)	13	2.70 (heptet, J = 6.8)	0
14	1.45 (d, J = 6.8)	14	1.49 (d, J = 6.9)	+0.04
15	1.42 (d, J = 6.8)	15	1.44 (d, J = 6.8)	+0.02
C(11)–OH	3.56 (br s)	C(11)–OH	3.15 (br s)	–0.41
N(1')–H	8.12 (br d, J = 2.7)	N(1')–H	8.01 (br s)	–0.11
2'	7.09 (d, J = 2.7)	2'	7.14–7.08 (comp)	
4'	7.55 (dd, J = 7.5, 1.0)	4'	7.57 (d, J = 7.8)	+0.02
5'	7.08 (td, J = 7.5, 1.0)	5'	7.14–7.08 (comp)	
6'	7.21 (td, J = 7.5, 1.0)	6'	7.21 (app t, J = 7.8)	+0.01
7'	7.36 (dd, J = 7.5, 1.0)	7'	7.38 (d, J = 8.1)	+0.02



Preparation of Dienamide 49. *p*-Toluenesulfonic acid monohydrate (67 mg, 0.352 mmol) was added to a solution of **20** (235 mg, 0.391 mmol) and 4 Å MS (2.8 g) in toluene (8.0 mL). The reaction was stirred at room temperature for 5 h, whereupon H_2O (10 mL) was added. The mixture was transferred to a separatory funnel, the layers were separated, and the aqueous phase was further extracted with EtOAc (3 x 15 mL). The combined organic extracts were washed with brine (15 mL), dried (Na_2SO_4), and concentrated to dryness under reduced pressure. The crude residue was purified by silica gel column chromatography eluting with hexanes/EtOAc (4:1) to afford the title compound **49** (180 mg, 79%) as an amorphous colorless solid. The yield reported in the Scheme represents the mean of multiple runs: ^{1}H NMR (500 MHz, acetone-d_6) δ 8.17 (d, J = 8.4 Hz, 1 H), 7.89 (d, J = 8.1 Hz, 1 H), 7.53 (s, 1 H), 7.38-7.30 (comp, 3 H), 7.22 (d, J = 7.9 Hz, 1 H), 7.11 (app t, J = 7.6 Hz, 2 H), 6.91 (s, 1 H), 6.73 (s, 1 H), 5.72 (d, J = 1.0 Hz, 1 H), 5.04 (d, J = 1.0 Hz, 1 H), 3.22 (s, 3 H), 1.66 (s, 9 H), 1.56 (s, 9 H); ^{13}C NMR (125 MHz, acetone-d_6) δ 155.3 (C), 154.9 (C), 152.7 (C), 150.2 (C), 143.0 (C), 139.6 (C), 137.2 (C), 135.0 (C), 134.5 (C), 129.8 (CH), 128.9 (C), 125.8 (CH), 125.4 (CH), 125.2 (CH), 125.0 (CH), 123.7 (CH), 121.1 (C), 120.6 (CH), 120.2 (CH), 118.2 (CH), 116.4 (CH), 102.3 (CH_2), 85.1 (C), 84.8 (CH), 82.8 (C), 58.4 (C), 29.8 (CH_3), 28.27 (CH_3), 28.25 (CH_3); IR (film) 2926, 2855, 1720, 1698, 1606, 1406, 1374, 1158 cm^{-1}; TLC R_f 0.37 (1:2 ethyl acetate/hexanes); HRMS (ESI) *m*/*z*

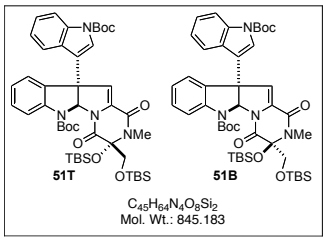
calcd for $C_{33}H_{34}N_4O_6Na^+$ (M+Na) 605.2376, found 605.2370; $[\alpha]^{22.6}_D$ –4.6, $[\alpha]^{22.5}_{577}$ –5.5 $[\alpha]^{22.5}_{546}$ –12.7, $[\alpha]^{22.6}_{435}$ –102.4 (*c* = 0.24, CH_2Cl_2).



Preparation of Diol 50. A flask was charged with AD-mix-α (1.3 g), **49** (130 mg, 0.223 mmol) and methane sulfonamide (42 mg, 0.446 mmol), then *t*-BuOH/H_2O/acetone (3:2:1, 6 mL) was added. The resulting heterogeneous mixture was stirred vigorously at room temperature for 5 h, then the reaction was cooled to 0 ºC and solid Na_2SO_3 (1.5 g) was added, the cold bath was removed and the mixture was stirred for 1 h at room temperature. Water (8 mL) was added to the reaction mixture, which was transferred to a separatory funnel then the aqueous phase was extracted with EtOAc (3 x 12 mL). The combined organic extracts were washed with 1 N NaOH (10 mL), brine (8 mL), dried (Na_2SO_4), and concentrated to dryness under reduced pressure. The crude material was purified using silica gel column chromatography eluting with hexane/EtOAc (1:1 to 1:2) to afford a mixture of the title compounds **50** (114 mg, 83%) as an amorphous colorless solid as a mixture of diastereomers (5:1). The yield reported in the Scheme represents the mean of multiple runs.

Only the top diastereomer (major diastereomer) was completely separated from the diastereomeric mixture using silica gel column chromatography eluting with hexane/EtOAc (1:1 to 1:2).

Top diastereomer: ^{1}H NMR (500 MHz, acetone-d_6) δ 8.17 (d, *J* = 8.3 Hz, 1 H), 7.89 (d, *J* = 8.1 Hz, 1 H), 7.45 (s, 1 H), 7.40 (d, *J* = 7.4 Hz, 1 H), 7.38–7.31 (comp, 2 H), 7.25 (d, *J* = 7.9 Hz, 1 H), 7.16–7.10 (comp, 2 H), 6.84 (s, 1 H), 6.51 (s, 1 H), 6.05 (br s, 1 H), 4.89 (app t, *J* = 5.8 Hz, 1 H), 3.94 (dd, *J* = 10.8, 5.8 Hz, 1 H), 3.77 (dd, *J* = 10.8, 5.8 Hz, 1 H), 2.99 (s, 3 H), 1.65 (s, 9 H), 1.54 (s, 9 H); ^{13}C NMR (125 MHz, acetone-d_6) δ 165.6 (C), 157.2 (C), 152.8 (C), 150.2 (C), 143.0 (C), 137.2 (C), 135.4 (C), 134.4 (C), 129.7 (CH), 128.9 (C), 125.8 (CH), 125.5 (CH), 125.1 (CH), 124.8 (CH), 123.8 (CH), 121.2 (C), 120.7 (CH), 118.8 (CH), 118.1 (CH), 116.4 (CH), 88.5 (C), 85.0 (C), 84.3 (CH), 82.9 (C), 64.8 (CH_2), 58.4 (C), 28.2 (CH_3), 26.7 (CH_3); IR (film) 3373, 2978, 2934, 1716, 1644, 1453, 1374, 1161, 748 cm^{-1}; TLC R_f 0.55 (1:2 ethyl acetate/hexanes); HRMS (ESI) *m*/*z* calcd for $C_{33}H_{36}N_4O_8Na^+$ (M+Na) 639.2431, found 639.2423; $[\alpha]^{21.8}_D$ –58.5, $[\alpha]^{21.8}_{577}$ –63.5 $[\alpha]^{22.2}_{546}$ –75.7, $[\alpha]^{22.3}_{435}$ –177.3 (*c* = 0.70, CH_2Cl_2).



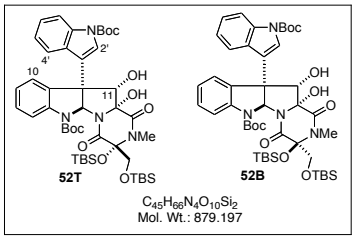
Preparation of Disilylethers 51. TBDMSOTf (620 μL, 2.69 mmol) was added dropwise to a 0 ºC solution of **50** (104 mg, 0.169 mmol), DMAP (23 mg, 0.186 mmol), and triethylamine (470 μL, 3.37 mmol) in DMF (3.4 mL). The cold bath was removed and the reaction mixture was stirred at room temperature for 8 h, whereupon EtOAc

(12 mL) was added followed by saturated aq. NH_4Cl (8 mL). The mixture was transferred to a separatory funnel, the layers were separated, and the aqueous phase was further extracted with EtOAc (2 x 12 mL). The combined organic extracts were washed with brine (10 mL), dried (Na_2SO_4), and concentrated to dryness under reduced pressure. The crude residue was purified by silica gel column chromatography eluting with hexanes/EtOAc (96:4) to afford the title compound **51** (132 mg, 92%) as an amorphous colorless solid and a 1.5:1 mixture of siloxy epimers. The yield reported in the Scheme represents the mean of multiple runs.

Analytically pure samples of these epimers were obtained by purification using Biotage® silica gel column chromatography using a 10 g column and eluting with hexane/EtOAc, 2% to 50% EtOAc over 15 column volumes:

Top diastereomer **51T**: ^{1}H NMR (500 MHz, acetone-d_6) δ 8.18 (d, J = 8.4 Hz, 1 H), 7.91 (d, J = 7.8 Hz, 1 H), 7.54 (s, 1 H), 7.38–7.30 (comp, 3 H), 7.18–7.12 (comp, 2 H), 7.10 (app t, J = 8.5 Hz, 1 H), 6.79 (s, 1 H), 6.69 (s, 1 H), 3.92 (d, J = 9.8 Hz, 1 H), 3.73 (d, J = 9.8 Hz, 1 H), 2.99 (s, 3 H), 1.66 (s, 9 H), 1.56 (s, 9 H), 0.93 (s, 9 H), 0.57 (s, 9 H), 0.23 (s, 3 H), 0.14 (s, 3 H), –0.076 (s, 3 H), –0.18 (s, 3 H); ^{13}C NMR (125 MHz, acetone-d_6) δ 163.2 (C), 156.7 (C), 152.6 (C), 150.2 (C), 143.0 (C), 137.2 (C), 134.6 (C), 134.5 (C), 129.7 (CH), 128.9 (C), 125.8 (CH), 125.17 (CH), 125.15 (CH), 124.8 (CH), 123.7 (CH), 121.3 (C), 120.3 (CH), 119.1 (CH), 118.6 (CH), 116.6 (CH), 90.3 (C), 85.1 (C), 84.9 (CH), 82.7 (C), 66.3 (CH_2), 58.4 (C), 28.3 (CH_3), 28.2 (CH_3), 26.3(CH_3), 25.9 (CH_3), 19.1 (C), 18.3 (C), –3.2 (CH_3), –3.4 (CH_3), –5.67 (CH_3), –5.72 (CH_3); IR (film) 2952, 2928, 2856, 1738, 1720, 1704, 1656, 1453, 1372, 1252, 1156, 833 cm^{-1}; TLC R_f 0.43 (1:4 ethyl acetate/hexanes); HRMS (ESI) m/z calcd for $C_{45}H_{64}N_4O_8Si_2Na^+$ (M+Na) 867.4160, found 867.4163; $[\alpha]^{23}_D$ –31.3, $[\alpha]^{23}_{577}$ –31.5 $[\alpha]^{23}_{546}$ –43.5, $[\alpha]^{23}_{435}$ –124.4 (c = 0.090, CH_2Cl_2).

Bottom diastereomer **51B**: ^{1}H NMR (500 MHz, acetone-d_6) δ 8.20 (d, J = 8.4 Hz, 1 H), 7.89 (d, J = 8.1 Hz, 1 H), 7.57 (s, 1 H), 7.38–7.30 (comp, 3 H), 7.13–7.07 (comp, 2 H), 6.97 (d, J = 8.0 Hz, 1 H), 6.76 (s, 1 H), 6.74 (s, 1 H), 4.02 (dd, J = 9.6 Hz, 1 H), 3.77 (d, J = 9.6 Hz, 1 H), 2.96 (s, 3 H), 1.68 (s, 9 H), 1.57 (s, 9 H), 0.87 (s, 9 H), 0.81 (s, 9 H), 0.075 (s, 3 H), 0.059 (s, 3 H), 0.0087 (s, 3 H), –0.084 (s, 3 H); ^{13}C NMR (125 MHz, acetone-d_6) δ 163.6 (C), 156.7 (C), 152.6 (C), 150.1 (C), 142.9 (C), 137.3 (C), 135.2 (C), 134.8 (C), 129.8 (CH), 128.8 (C), 125.8 (CH), 125.4 (CH), 125.2 (CH), 124.8 (CH), 123.7 (CH), 121.0 (C), 120.2 (CH), 119.1 (CH), 118.4 (CH), 116.5 (CH), 90.0 (C), 85.0 (C), 84.9 (CH), 82.8 (C), 66.2 (CH_2), 58.3 (C), 28.3 (CH_3), 28.2 (CH_3), 27.9 (CH_3), 26.2 (CH_3), 26.1 (CH_3), 18.9 (C), 18.6 (C), –3.6 (CH_3), –3.8 (CH_3), –5.3 (CH_3), –5.4 (CH_3) IR (film) 2952, 2929, 2856, 1736, 1719, 1704, 1655, 1452, 1370, 1252, 1155, 834 cm^{-1}; TLC R_f 0.38 (1:4 ethyl acetate/hexanes); HRMS (ESI) m/z calcd for $C_{45}H_{64}N_4O_8Si_2Na^+$ (M+Na) 867.4160, found 867.4168; $[\alpha]^{23}_D$ –36.4, $[\alpha]^{23}_{577}$ –37.8 $[\alpha]^{23}_{546}$ –47.9, $[\alpha]^{23}_{435}$ –133.0 (c = 0.13, CH_2Cl_2).



Preparation of Diol 52. Intermediate **51** (100 mg, 0.118 mmol) was dihydroxylated using AD-mix-α (500 mg), methane sulfonamide (11 mg, 0.118 mmol), $(DHQ)_2PHAL$ (12 mg, 0.015 mmol), and $K_2OsO_4•2H_2O$ (11 mg, 0.030 mmol) in *t*-BuOH/H_2O/acetone (3:2:1, 4.8 mL) following the general procedure using a reaction time of 16 h. The crude residue was purified by silica gel column chromatography, eluting with hexanes/EtOAc (7:1 to 4:1) to provide siloxy epimers **52** (86 mg, 83%, 1.5:1.0 mixture of siloxy epimers) as a cplorless powder. The yield reported in the Scheme represents the mean of multiple runs. Characterization of the separated **52T** and **52B** was achieved by individually dihydroxylating separated **51T** and **51B**. The yields for individual dihydroxylation of separated **51T** and **51B** was consistent with what was observed for dihydroxylation of the mixture **51.**

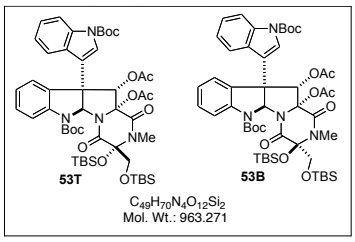
For compound **52T** irradiation of C11-H leads to NOE signals with C4'–H, C10–H, and C11-OH.

For compound **52B** irradiation of C11-H leads to NOE signals with C4'–H and C10–H.

Top diastereomer **52T** (dr ≈20:1): ^{1}H NMR (500 MHz, acetone-d_6) δ 8.12 (d, J = 8.2 Hz, 1 H), 8.01 (d, J = 8.0 Hz, 1 H), 7.78 (br s, 1 H), 7.63 (d, J = 7.5 Hz, 1 H), 7.38 (s, 1 H), 7.34–7.25 (comp, 2 H), 7.22 (app t, J = 7.5 Hz, 1 H), 7.13 (app t, J = 7.5 Hz, 1 H), 6.77 (s, 1 H), 5.85 (s, 1 H), 5.76 (br s, 1 H), 5.11 (d, J = 3.2 Hz, 1 H), 4.17 (d, J = 9.8 Hz, 1 H), 3.70 (d, J = 9.8 Hz, 1 H), 2.95 (s, 3 H), 1.64 (s, 9 H), 1.55 (s, 9 H), 0.92 (s, 9 H), 0.64 (s, 9 H), 0.32 (s, 3 H), 0.29 (s, 3 H), –0.066 (s, 3 H), –0.23 (s, 3 H); ^{13}C NMR (125 MHz, acetone-d_6) δ 168.0 (C), 166.8 (C), 152.4 (C), 150.1 (C), 141.5 (C), 136.85 (C), 136.81 (C), 130.6 (C), 129.7 (CH), 126.4 (CH), 125.6 (CH), 125.1 (CH), 124.5 (CH), 123.3 (CH), 122.4 (CH), 119.6 (C), 118.0 (CH), 116.0 (CH), 88.7 (C), 84.74 (C), 84.66 (C), 82.1 (C), 81.4 (CH), 78.7 (CH), 66.4 (CH_2), 57.5 (C), 28.4 (CH_3), 28.3 (CH_3), 27.2 (CH_3), 26.21 (CH_3), 26.18 (CH_3), 18.9 (C), 18.7 (C), –3.0 (CH_3), –3.5 (CH_3), –5.2 (CH_3), –5.7 (CH_3); IR (film) 3397, 2953, 2930, 2857, 1724, 1658, 1456, 1374, 1161, 835 cm^{-1}; TLC R_f 0.22 (1:4 ethyl acetate/hexanes); HRMS (ESI) *m*/*z* calcd for $C_{45}H_{66}N_4O_{10}Si_2Na^+$ (M+Na) 901.4215, found 901.4210; $[\alpha]^{23}_D$ –68.4, $[\alpha]^{23}_{577}$ –74.2 $[\alpha]^{23}_{546}$ –83.9, $[\alpha]^{23}_{435}$ –135.7 (c = 0.12, CH_2Cl_2).

Bottom diastereomer **52B** (dr ≈20:1): ^{1}H NMR (500 MHz, acetone-d_6) δ 8.14 (d, J = 8.0 Hz, 1 H), 8.12 (d, J = 8.4 Hz, 1 H), 7.72 (br s, 1 H), 7.69 (d, J = 7.5 Hz, 1 H), 7.32 (app t, J = 7.8 Hz, 1 H), 7.31 (app t, J = 7.5 Hz, 1 H), 7.27–7.22 (m, 1 H), 7.25 (s, 1 H), 7.17 (app t, J = 7.5 Hz, 1 H), 6.79 (s, 1 H), 5.72 (s, 1 H), 5.29 (br s, 1 H), 5.22 (d, J = 4.3 Hz, 1 H), 4.14 (d, J = 10.0 Hz, 1 H), 3.89 (d, J = 10.0 Hz, 1 H), 2.92 (s, 3 H), 1.63 (s, 9 H), 1.55 (s, 9 H), 0.98 (s, 9 H), 0.84 (s, 9 H), 0.20 (s, 3 H), 0.17 (s, 3 H), 0.075 (s, 3 H), –0.29 (s, 3 H); ^{13}C NMR (125 MHz, acetone-d_6) δ 167.9 (C), 166.2 (C), 152.2 (C), 150.1 (C), 141.2 (C), 136.9 (C), 136.6 (C), 130.5 (C), 129.7 (CH), 126.3 (CH), 126.0 (CH), 125.2 (CH), 124.6 (CH), 123.3 (CH), 122.5 (CH), 119.5 (C), 118.1 (CH), 116.0 (CH), 89.1 (C), 85.3 (C), 84.7 (C), 82.3 (C), 80.7 (CH), 78.3 (CH), 67.6 (CH_2), 58.2 (C), 28.7 (CH_3), 28.5 (CH_3), 28.2

(CH_3), 26.5 (CH_3), 26.4 (CH_3), 19.4 (C), 19.3 (C), –3.1 (CH_3), –4.0 (CH_3), –5.1 (CH_3), –5.2 (CH_3); IR (film) 3385, 2954, 2930, 2857, 1725, 1655, 1457, 1375, 1256, 1161, 837 cm^{-1}; TLC R_f 0.17 (1:4 ethyl acetate/hexanes); HRMS (ESI) *m/z* calcd for $C_{45}H_{66}N_4O_{10}Si_2Na^+$ (M+Na) 901.4215, found 901.4205; $[\alpha]^{22}_D$ –165.5, $[\alpha]^{23}_{577}$ –170.4 $[\alpha]^{23}_{546}$ –196.1, $[\alpha]^{23}_{435}$ –356.7 (*c* = 0.165, CH_2Cl_2).

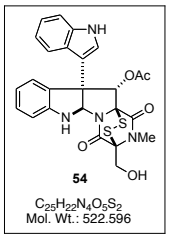


Preparation of Diacetate 53. Intermediate **52** (52 mg, 0.0591 mmol, 1.3:1 mixture of siloxy epimers) was diacetylated using acetic anhydride (100 μL, 1.06 mmol) and DMAP (145 mg, 1.18 mmol) in CH_2Cl_2 (2.4 mL) following the general procedure using a reaction time of 15 h at room temperature. The crude residue was purified using silica gel column chromatography eluting with hexane/EtOAc (5:1) to afford title compounds **53** (54 mg, 96%, 1.3:1.0 mixture of siloxy epimers) as amorphous colorless solids. The yield reported in the Scheme represents the mean of multiple runs. Characterization of separated **53T** and **53B** was achieved by individually diacetylating separated **52T** and **52B**. The yields for individual diacetylation of separated **52T** and **52B** was consistent with what was observed for diacetylation of the mixture **52.**

Top diastereomer **53T** (dr ≈20:1): ^{1}H NMR (500 MHz, $CDCl_3$) δ 8.17 (br s, 1 H), 7.80 (br s, 1 H), 7.75 (d, *J* = 7.5 Hz, 1 H), 7.60 (d, *J* = 8.0 Hz, 1 H), 7.32–7.22 (comp, 3 H), 7.20–7.12 (comp, 2 H), 6.62 (s, 1 H), 6.30 (br s, 1 H), 4.01 (d, *J* = 9.6 Hz, 1 H), 3.52 (d, *J* = 9.6 Hz, 1 H), 2.97 (s, 3 H), 2.24 (s, 3 H), 1.69–1.58 (comp, 9 H), 1.52 (s, 9 H), 0.91 (s, 9 H), 0.67 (s, 9 H), 0.29 (s, 3 H), 0.22 (s, 3 H), –0.15 (s, 3 H), –0.25 (s, 3 H); ^{13}C NMR (125 MHz $CDCl_3$) δ 168.9 (C), 167.6 (C), 162.7 (C), 151.9 (C), 149.4 (C), 140.5 (C), 136.0 (C), 133.9 (C), 129.7 (CH), 129.1 (C), 128.1 (CH), 126.3 (CH), 124.5 (CH), 122.6 (CH), 120.2 (CH), 117.1 (C), 116.3 (C), 115.5 (CH), 88.6 (C), 88.2 (C), 84.3 (C), 82.4 (C), 81.9 (CH), 77.7 (CH), 66.5 (CH_2), 56.3 (C), 29.9 (CH_3), 28.3 (CH_3), 28.2 (CH_3), 26.0 (CH_3), 25.9 (CH_3), 21.7 (CH_3), 20.4 (CH_3), 18.7 (C), 18.4 (C), –2.6 (CH_3), –3.5 (CH_3), –5.6 (CH_3), –5.8 (CH_3); IR (film) 2954, 2930, 2857, 1766, 1727, 1686, 1481, 1374, 1223, 1161, 835 cm^{-1}; TLC R_f 0.79 (1:2 ethyl acetate/hexanes); HRMS (ESI) *m/z* calcd for $C_{49}H_{70}N_4O_{12}Si_2Na^+$ (M+Na) 985.4426, found 985.4427; $[\alpha]^{23}_D$ –73.3, $[\alpha]^{23}_{577}$ –82.3 $[\alpha]^{23}_{546}$ –92.1, $[\alpha]^{23}_{435}$ –165.3 (*c* = 0.53, CH_2Cl_2).

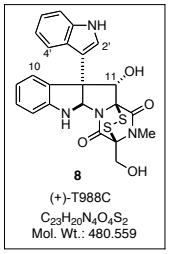
Bottom diastereomer **53B** (dr ≈20:1): ^{1}H NMR (500 MHz, acetone-d_6) δ 8.15 (d, *J* = 8.3 Hz, 1 H), 7.82 (d, *J* = 7.8 Hz, 1 H), 7.81 (d, *J* = 7.3 Hz, 1 H), 7.70 (br s, 1 H), 7.39 (app t, *J* = 7.8 Hz, 1 H), 7.37 (app t, *J* = 7.4 Hz, 1 H), 7.30 (app t, *J* = 8.0 Hz, 1 H), 7.27–7.22 (comp, 2 H), 4.14 (d, *J* = 10.6 Hz, 1 H), 3.98 (d, *J* = 10.6 Hz, 1 H), 2.96 (s, 3 H), 2.30 (s, 3 H), 1.63 (s, 9 H), 1.56–1.48 (comp, 12 H), 0.95 (s, 9 H), 0.85 (s, 9 H), 0.17 (s, 3 H), 0.16 (s, 6 H), –0.17 (s, 3 H); ^{13}C NMR (125 MHz, acetone-d_6) δ 169.1 (C), 168.6 (C), 167.2 (C), 161.6 (C), 152.0 (C), 149.9 (C), 141.2 (C), 136.7 (C), 134.2 (C), 130.5 (CH), 129.6 (C), 128.5 (C), 127.9 (CH), 126.6 (CH), 125.5 (CH), 125.0 (CH), 123.5 (CH), 121.6 (CH), 118.3 (CH), 117.0 (C), 116.3 (CH), 90.2 (C), 89.4 (C), 85.2 (C), 82.9 (CH),

77.0 (CH), 68.6 (CH_2), 57.7 (C), 31.2 (CH_3), 28.4 (CH_3), 28.2 (CH_3), 26.6 (CH_3), 26.4 (CH_3), 21.9 (CH_3), 20.2 (CH_3), 19.6 (C), 19.2 (C), –2.9 (CH_3), –3.6 (CH_3), –5.1 (CH_3); IR (film) 2954, 2930, 2857, 1766, 1726, 1480, 1456, 1374, 1222, 1161, 837 cm^{-1}; TLC R_f 0.73 (1:2 ethyl acetate/hexanes); HRMS (ESI) *m*/*z* calcd for $C_{49}H_{70}N_4O_{12}Si_2Na^+$ (M+Na) 985.4426, found 985.4434; $[\alpha]^{22}_D$ –88.9, $[\alpha]^{23}_{577}$ –94.2 $[\alpha]^{23}_{546}$ –109.1, $[\alpha]^{23}_{435}$ –199.5 (*c* = 1.30, CH_2Cl_2).



***O*-Acetyl T988C (54).** Hydrogen sulfide (bp –60°C, ca. 300 µL) was condensed at –78°C in a pressure tube fitted with a rubber septum. A solution of **53** (38 mg, 0.039 mmol, 1.5:1.0 mixture of siloxy epimers) in CH_2Cl_2 (750 µL), followed by neat boron trifluoride etherate (146 µL, 1.18 mmol), was added to the liquid hydrogen sulfide. A Teflon screw cap replaced the rubber septum to seal the pressure tube, the cold bath was removed, the reaction mixture warmed to room temperature, and stirring was continued for 4.5 h. *CAUTION: the sealed tube was maintained behind a blast shield*. The reaction mixture was then cooled to –78°C and the Teflon screw cap was replaced by a rubber septum with a bleed needle connected to a bleach trap. The cooling bath was removed and the resulting colorless suspension was allowed to warm up to room temperature. Upon removal of the hydrogen sulfide, the reaction mixture was dried using a nitrogen stream, diluted with EtOAc (8 mL), transferred to a separatory funnel then washed with saturated aq. NH_4Cl (6 mL). The aqueous layer was further extracted with EtOAc (2 x 8 mL) then the combined organic extracts were treated with iodine in EtOAc (1.95 mL, 50 mM) and Et_3N (0.78 mmol, 109 µL). The reaction mixture was stirred at room temperature for 25 minutes then excess iodine was quenched by the addition of 10% aqueous Na_2SO_3 (8 mL). The mixture was transferred to a separatory funnel, the layers were separated, then the aqueous layer was further extracted with EtOAc (2 x 4 mL). The combined organics were washed with brine (8 mL), dried (Na_2SO_4), then concentrated to dryness under reduced pressure. The crude material was purified using silica gel column chromatography eluting with CH_2Cl_2/EtOAc (95:5 to 85:15) to afford **54** (14 mg, 70%) as an amorphous colorless powder as a single stereoisomer: ^{1}H NMR (500 MHz, acetone-d_6) δ 10.27 (br s, 1 H), 7.89 (d, *J* = 7.8 Hz, 1 H), 7.63 (d, *J* = 7.4 Hz, 1 H), 7.41 (d, *J* = 8.1 Hz, 1 H), 7.15–7.05 (comp, 4 H), 6.87 (app t, *J* = 7.5 Hz, 1 H), 6.77 (d, *J* = 7.8 Hz, 1 H), 6.46 (s, 1 H), 6.40 (s, 1 H), 6.31 (br s, 1 H), 4.78 (app t, *J* = 6.4 Hz, 1 H), 4.45 (dd, *J* = 12.6, 5.9 Hz, 1 H), 4.37 (dd, *J* = 12.6, 6.9 Hz, 1 H), 3.12 (s, 3 H), 1.54 (s, 3 H); ^{13}C NMR (125 MHz, acetone-d_6) δ 169.0 (C), 164.5 (C), 162.7 (C), 149.5 (C), 138.5 (C), 130.9 (C), 130.2 (CH), 127.1 (C), 126.3 (CH), 125.6 (CH), 122.5 (CH), 122.1 (CH), 120.0 (CH), 119.8 (CH), 112.8 (CH), 112.3 (C), 111.1 (CH), 82.3 (CH), 79.8 (CH), 78.9 (C), 76.8 (C), 61.4 (C), 60.4 (CH_2), 27.8 (CH_3), 20.6 (CH_3); IR (film) 3400, 3053, 2792, 2924, 1753, 1681, 1608, 1459, 1369, 1240, 1221, 1067, 741 cm^{-1}; TLC R_f 0.19 (9:1

CH_2Cl_2/ethyl acetate); HRMS (ESI) *m/z* calcd for $C_{25}H_{22}N_4O_5S_2Na^+$ (M+Na) 545.0930, found 545.0925; $[\alpha]^{22.4}_D$ +220.2, $[\alpha]^{22.4}_{577}$ +231.3, $[\alpha]^{22.2}_{546}$ +260.2, $[\alpha]^{22.4}_{435}$ +451.3 (*c* = 0.215, CH_2Cl_2).



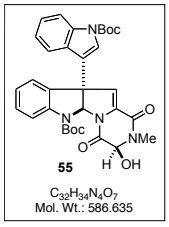
(+)-T988C (8). Lanthanum triflate (80 mg, 0.136 mmol) and DMAP[4] (0.001 mmol, 0.1 mg) were added to a solution of **54** (9 mg, 0.017 mmol) in anhydrous MeOH (1.0 mL) at room temperature. The solution was heated to 45 ºC and maintained at this temperature for 16 h. The reaction was cooled to room temperature then EtOAc (4 mL) was added, which was subsequently transferred to a separatory funnel containing sat. aq. NH_4Cl (3 mL). The layers were separated and the aqueous phase was further extracted with EtOAc (2 x 4 mL). The combined organic extracts were washed with H_2O (4 mL), brine (4 mL), dried (Na_2SO_4), then concentrated to dryness under reduced pressure. The crude material was purified by silica gel chromatography eluting with CH_2Cl_2/EtOAc (95:5 to 85:15) to afford (+)–T988C (**8**) (6 mg, 75%) as an amorphous colorless powder. The yield reported in the Scheme represents the mean of multiple runs. ^{1}H NMR (500 MHz, CD_3OD) δ 7.94 (d, *J* = 7.9 Hz, 1 H), 7.44 (d, *J* = 7.5 Hz, 1 H), 7.31 (d, *J* = 8.0 Hz, 1 H), 7.14 (s, 1 H), 7.09–7.02 (comp, 3 H), 6.71 (app t, *J* = 7.5 Hz, 1 H), 6.65 (d, *J* = 7.8 Hz, 1 H), 6.29 (s, 1 H), 5.47 (s, 1 H), 4.41 (d, *J* = 12.7 Hz, 1 H), 4.28 (d, *J* = 12.7 Hz, 1 H), 3.14 (s, 3 H); ^{13}C NMR (125 MHz, CD_3OD) δ 167.8 (C), 163.7 (C), 149.0 (C), 138.7 (C), 133.2 (C), 129.8 (CH), 127.4 (C), 125.2 (CH), 124.2 (CH), 122.4 (CH), 122.2 (CH), 120.1 (CH), 119.9 (CH), 114.6 (C), 112.4 (CH), 111.1 (CH), 83.7 (CH), 81.5 (CH), 78.6 (C), 78.4 (C), 62.8 (C), 60.2 (CH_2), 27.8 (CH_3); IR (film) 3405, 3053, 2958, 2925, 2853, 1672, 1608, 1458, 1354, 1240, 1059, 793 cm^{-1}; TLC R_f 0.26 (4:1 CH_2Cl_2/ethyl acetate); HRMS (ESI) *m/z* calcd for $C_{23}H_{20}N_4O_4S_2Na^+$ (M+Na) 503.0824, found 503.0826; $[\alpha]^{22.5}_D$ +281.8, $[\alpha]^{23.1}_{577}$ +281.3, $[\alpha]^{23.4}_{546}$ +357.3, $[\alpha]^{23.3}_{435}$ +599.8 (*c* = 0.024, CH_3OH).

Tabulated ^{1}H NMR spectra of natural (+)-T988C and synthetic (+)-T988C: *J. Nat. Prod.* **2004**, *67*, 2090–2092.

Literature (500 MHz, CD_3OD)		Synthetic **8** (500 MHz, CD_3OD)		Δδ
5a	6.29 (s)	5a	6.29 (s)	0
N(6)–H		N(6)–H		
7	6.65 (d, *J* = 7.5)	7	6.65 (d, *J* = 7.8)	0
8	7.04 (m)	8	7.04 (m)	0
9	6.71 (t, *J* = 7.0)	9	6.71 (t, *J* = 7.5)	0
10	7.44 (d, *J* = 8.0)	10	7.44 (d, *J* = 7.5)	0
11	5.46 (s)	11	5.47 (s)	+0.01
C(11)–OH		C(11)–OH		
12	3.14 (s)	12	3.14 (s)	0
13a	4.28 (d, *J* = 12.5)	13a	4.28 (d, *J* = 12.7)	0
13b	4.41 (d, *J* = 12.5)	13b	4.41 (d, *J* = 12.7)	0
N(1')–H		N(1')–H		

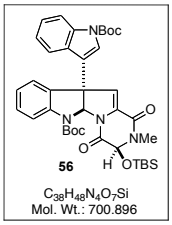
2’	7.14 (br s)	2’	7.14 (s)	
4’	7.93 (d, J = 8.0)	4’	7.94 (d, J = 7.9)	+0.01
5’	7.04 (m)	5’	7.04 (m)	0
6’	7.08 (m)	6’	7.08 (m)	0
7’	7.31 (d, J = 8.0)	7’	7.31 (d, J = 8.0)	0

Literature (125 MHz, CD_3OD)		Synthetic **8** (125 MHz, CD_3OD)		Δδ
1	166.3	1	167.8 (C)	+1.5
3	77.1	3	78.4 (C)	+1.3
4	162.5	4	163.7 (C)	+1.2
5a	82.4	5a	83.7 (CH)	+1.3
6a	148.0	6a	149.0 (C)	+1.0
7	109.8	7	111.1 (CH)	+1.3
8	128.7	8	129.8 (CH)	+1.1
9	118.8	9	120.1 (CH)	+1.3
10	123.9	10	125.2 (CH)	+1.3
10a	132.3	10a	133.2 (C)	+0.9
10b	61.5	10b	62.8 (C)	+1.3
11	80.3	11	81.5 (CH)	+1.2
11a	77.3	11a	78.6 (C)	+1.3
12	26.4	12	27.8 (CH_3)	+1.2
13	58.9	13	60.2 (CH_2)	+1.3
2’	122.9	2’	124.2 (CH)	+1.3
3’	113.5	3’	114.6 (C)	+1.1
3’a	126.1	3’a	127.4 (C)	+1.3
4’	121.0	4’	122.2 (CH)	+1.2
5’	118.7	5’	119.9 (CH)	+1.2
6’	121.1	6’	122.4 (CH)	+1.3
7’	111.1	7’	112.4 (CH)	+1.3
1’a	137.7	1’a	138.7 (C)	+1.0

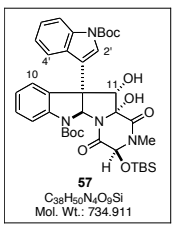


L-selectride reduction of (+)-17. A solution of **17** (180 mg, 0.308 mmol) in THF (6.1 mL) was cooled to –78 ºC then solid L-selectride (462 µL, 0.462 mmol) was added over 10 minutes. The reaction was stirred at –78 ºC for 30 min then AcOH (62 µL, 1.08 mmol) was added stirred for 2 min, the cooling bath was removed and the reaction was allowed to warm to room temperature. Saturated aq. $NaHCO_3$ (8 mL) was added to the reaction then the mixture was extracted with EtOAc (3 x 12 mL) and the combined organic phases were washed with brine (8 mL), dried (Na_2SO_4), then concentrated to dryness under reduced pressure. The residue was purified by silica gel column chromatography eluting with hexanes/EtOAc (2.5:1 to 1:1) to afford **55** (166 mg, 92%) as an amorphous colorless solid and a 14:1

mixture of alcohol epimers. The yield reported in the Scheme represents the mean of multiple runs: ^{1}H NMR (500 MHz, acetone-d_6) δ 8.17 (d, J = 8.3 Hz, 1 H), 7.89 (d, J = 8.3 Hz, 1 H), 7.49 (s, 1 H), 7.39–7.30 (comp, 3 H), 7.17 (d, J = 7.8 Hz, 1 H), 7.14–7.08 (comp, 2 H); 6.82 (s, 1 H), 6.66 (s, 1 H), 6.26 (br d, J = 6.92 Hz, 1 H), 5.20 (br d, J = 5.8 Hz, 1 H), 3.05 (s, 3 H), 1.65 (s, 9 H), 1.54 (s, 9 H); ^{13}C NMR (125 MHz, acetone-d_6) δ 161.9 (C), 156.5 (C), 152.7 (C), 150.2 (C), 142.9 (C), 137.2 (C), 135.3 (C), 134.7 (C), 129.8 (CH), 128.9 (C), 125.8 (CH), 125.4 (CH), 125.1 (CH), 124.8 (CH), 123.7 (CH), 121.3 (C), 120.5 (CH), 119.0 (CH), 118.3 (CH), 116.4 (CH), 85.1 (C), 84.7 (CH), 82.8 (CH), 58.4 (C), 31.0 (CH_3), 28.24 (CH_3), 28.23 (CH_3); IR (film) 3321, 2978, 2932, 1718, 1649, 1478, 1453, 1374, 1158, 747 cm^{-1}; TLC R_f 0.40 (2:1 ethyl acetate/hexanes); HRMS (ESI) m/z calcd for $C_{32}H_{34}N_4O_7Na^+$ (M+Na) 609.2325, found 609.2326; $[\alpha]^{23.1}_D$ –77.2, $[\alpha]^{23.1}_{577}$ –84.9, $[\alpha]^{23.0}_{546}$ –103.8, $[\alpha]^{23.1}_{435}$ –277.6 (c = 0.16, CH_2Cl_2).



Preparation of Silylether 56. Intermediate **55** (150 mg, 0.256 mmol), was silylated using TBDMSOTf (352 μL, 1.53 mmol), DMAP (31 mg, 0.256 mmol), and triethylamine (357 μL, 2.56 mmol) in DMF (2.6 mL) following the general procedure using a reaction time of 13 h. The crude residue was purified by silica gel column chromatography eluting with hexanes/EtOAc (4:1) to afford the title compound **56** (170 mg, 94%) as an amorphous colorless solid and a 14:1 mixture of siloxy epimers. The yield reported in the Scheme represents the mean of multiple runs: ^{1}H NMR (500 MHz, acetone-d_6) δ 8.17 (d, J = 8.4 Hz, 1 H), 7.88 (d, J = 8.1 Hz, 1 H), 7.48 (s, 1 H), 7.39 (d, J = 7.5 Hz, 1 H), 7.38–7.31 (comp, 2 H), 7.22 (d, J = 7.9 Hz, 1 H), 7.17–7.10 (comp, 2 H), 6.82 (s, 1 H), 6.71 (s, 1 H), 5.27 (s, 1 H), 3.03 (s, 3 H), 1.66 (s, 9 H), 1.55 (s, 9 H), 0.79 (s, 9 H), 0.18 (s, 3 H), 0.12 (s, 3 H); ^{13}C NMR (125 MHz, acetone-d_6) δ 161.1 (C), 157.3 (C), 152.5 (C), 150.2 (C), 142.6 (C), 137.2 (C), 135.1 (C), 134.8 (C), 129.7 (CH), 129.0 (C), 125.8 (CH), 125.4 (CH), 125.2 (CH), 124.9 (CH), 123.8 (CH), 121.1 (C), 120.6 (CH), 119.8 (CH), 118.5 (CH), 116.5 (CH), 85.1 (C), 84.5 (CH), 84.1 (CH), 82.7 (C), 58.5 (C), 31.6 (CH_3), 28.25 (CH_3), 28.22 (CH_3), 26.1 (CH_3), 18.9 (C), –4.6 (CH_3), –4.7 (CH_3); IR (film) 2955, 2930, 2857, 1716, 1453, 1370, 1157, 1053, 839, 748 cm^{-1}; TLC R_f 0.54 (1:2 ethyl acetate/hexanes); HRMS (ESI) m/z calcd for $C_{38}H_{48}N_4O_7SiNa^+$ (M+Na) 723.3190, found 723.3195; $[\alpha]^{23.1}_D$ –116.8, $[\alpha]^{23.1}_{577}$ –123.4, $[\alpha]^{23.1}_{546}$ –145.0, $[\alpha]^{23.2}_{435}$ –328.1 (c = 0.20, CH_2Cl_2).

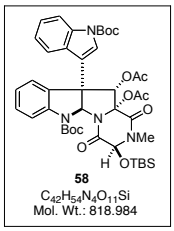


Preparation of Diol 57. Intermediate **56** (150 mg, 0.214 mmol) was dihydroxylated using AD-mix-α (450 mg), methane sulfonamide (20 mg, 0.214 mmol), $(DHQ)_2PHAL$ (21 mg, 0.027 mmol), and K_2OsO_4•$2H_2O$ (20 mg, 0.054 mmol) in t-BuOH/H_2O/acetone (3:2:1, 6.8 mL) following the

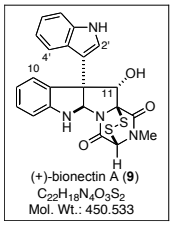
general procedure using a reaction time of 6 h. The crude residue was purified by silica gel column chromatography eluting with hexane/EtOAc (5:1 to 3:1) to afford the title compounds **57** (134 mg, 85%, 20:1 dr) as an amorphous colorless solid. The yield reported in the Scheme represents the mean of multiple runs.

For compound **57** irradiation of C11-H leads to NOE signals with C4'–H and C10–H.

^{1}H NMR (500 MHz, acetone-d_6) δ 8.12 (d, J = 7.9 Hz, 1 H), 8.07 (d, J = 7.9 Hz, 1 H), 7.67 (app d, J = 7.5 Hz, 2 H), 7.36–7.21 (comp, 4 H), 7.08 (app t, J = 7.5 Hz, 1 H), 6.77 (s, 1 H), 5.95 (app br s, 2 H), 5.74 (s, 1 H), 5.48 (s, 1 H), 2.82 (s, 3 H), 1.64 (s, 9 H), 1.58 (s, 9 H), 0.93 (s, 9 H), 0.237 (s, 3 H), 0.232 (s, 3 H); ^{13}C NMR (125 MHz, acetone-d_6) δ 167.7 (C), 166.1 (C), 152.2 (C), 150.0 (C), 140.9 (C), 136.9 (C), 134.7 (C), 130.0 (C), 129.9 (CH), 126.2 (CH), 125.3 (CH), 125.1 (CH), 124.2 (CH), 123.4 (CH), 122.7 (CH), 119.6 (C), 117.6 (CH), 116.0 (CH), 87.4 (C), 84.8 (C), 82.3 (C), 80.7 (CH), 80.6 (CH), 75.2 (CH), 59.0 (C), 29.2 (CH_3), 28.5 (CH_3), 28.3 (CH_3), 26.3 (CH_3), 19.3 (C), –3.8 (CH_3), –4.9 (CH_3); IR (film) 3371, 2957, 2930, 2857, 1724, 1681, 1480, 1455, 1371, 1258, 1156, 1097, 838 cm^{-1}; TLC R_f 0.27 (1:2 ethyl acetate/hexanes); HRMS (ESI) m/z calcd for $C_{38}H_{50}N_4O_9SiNa^+$ (M+Na) 757.3245, found 757.3227; $[\alpha]^{22.9}_D$ –55.1, $[\alpha]^{23.0}_{577}$ –57.4, $[\alpha]^{23.0}_{546}$ –64.3, $[\alpha]^{23.0}_{435}$ –94.9 (c = 0.13, CH_2Cl_2).



Acetylation of 57. Intermediate **57** (60 mg, 0.082 mmol) was diacetylated using acetic anhydride (31 μL, 0.327 mmol) and DMAP (80 mg, 0.653 mmol) in CH_2Cl_2 (4.1 mL) following the general procedure using a reaction time of 6 h at room temperature. The crude residue was purified using silica gel column chromatography eluting with hexane/EtOAc (4:1) to afford the title compounds **58** (65 mg, 97%) as an amorphous colorless solid. The yield reported in the Scheme represents the mean of multiple runs: ^{1}H NMR (500 MHz, acetone-d_6) δ 8.16 (d, J = 8.3 Hz, 1 H), 7.84–7.62 (comp, 3 H), 7.41 (t, J = 7.4 Hz, 1 H), 7.35 (t, J = 7.5 Hz, 1 H), 7.31–7.25 (comp, 2 H), 7.23 (t, J = 7.5 Hz, 1 H), 6.50 (s, 1 H), 5.99 (s, 1 H), 5.14 (s, 1 H), 2.89 (s, 3 H, 2.36 (s, 3 H), 1.67 (s, 3 H), 1.63 (s, 9 H), 1.51 (s, 9 H), 0.83 (s, 9 H), 0.22 (s, 3 H), 0.16 (s, 3 H); ^{13}C NMR (125 MHz, acetone-d_6) δ 171.2 (C), 169.8 (C), 164.8 (C), 162.0 (C), 152.2 (C), 150.0 (C), 141.3 (C), 136.8 (C), 135.7 (C), 130.4 (CH), 129.9 (C), 128.6 (CH), 127.0 (CH), 125.4 (CH), 124.9 (CH), 123.5 (CH), 121.7 (CH), 117.8 (CH), 117.2 (C), 116.2 (CH), 87.2 (C), 85.1 (C), 82.8 (C), 82.4 (CH), 81.7 (CH), 79.2 (CH), 57.6 (C), 30.7 (CH_3), 28.5 (CH_3), 28.3 (CH_3), 26.4 (CH_3), 21.5 (CH_3), 20.4 (CH_3), 19.1 (C), –3.9 (CH_3), –4.7 (CH_3); IR (film) 2976, 2931, 2857, 1727, 1481, 1455, 1370, 1225, 1156, 1081, 839, 750 cm^{-1}; TLC R_f 0.64 (1:2 ethyl acetate/hexanes); HRMS (ESI) m/z calcd for $C_{42}H_{54}N_4O_{11}SiNa^+$ (M+Na) 841.3456, found 841.3447; $[\alpha]^{21.9}_D$ –219.2, $[\alpha]^{22.0}_{577}$ –225.0, $[\alpha]^{22.1}_{546}$ –254.8, $[\alpha]^{22.0}_{435}$ –424.0 (c = 0.10, CH_2Cl_2).



(+)-Bionectin A (9). Hydrogen sulfide (bp –60°C, ca. 100 μL) was condensed at – 78°C in a pressure tube fitted with a rubber septum. A solution of **58** (10 mg, 0.0122 mmol) in CH_2Cl_2 (400 μL), followed by neat boron trifluoride etherate (15 μL, 0.122 mmol), was added to the liquid hydrogen sulfide. A Teflon screw cap replaced the rubber septum to seal the pressure tube, the cold bath was removed, the reaction mixture warmed to room temperature, and stirring was continued for 2 h. *CAUTION: the sealed tube was maintained behind a blast shield*. The reaction mixture was then cooled to –78°C and the Teflon screw cap was replaced by a rubber septum with a bleed needle connected to a bleach trap. The cooling bath was removed and the resulting suspension was allowed to warm up to room temperature. Upon removal of the hydrogen sulfide, the reaction mixture was dried using a nitrogen stream, diluted with EtOAc (5 mL), transferred to a separatory funnel then washed with saturated aq. NH_4Cl (4 mL). The aqueous layer was further extracted with EtOAc (2 x 5 mL) then the organic extracts were combined.[6] The organics were then treated with iodine in EtOAc (0.61 mL, 50 mM) and Et_3N (34 μL, 0.244 mmol). The reaction mixture was stirred at room temperature for 25 minutes then excess iodine was quenched by the addition of 10% aqueous $Na_2S_2O_3$ (4 mL). The mixture was transferred to a separatory funnel, the layers were separated, then the aqueous layer was further extracted with EtOAc (2 x 3 mL). The combined organics were washed with brine (5 mL), dried (Na_2SO_4), then concentrated to dryness under reduced pressure. The crude material was purified by passing through a short plug of silica gel eluting with CH_2Cl_2/EtOAc (85:15) to afford C11-acetylated bionectin A, which was directly treated with $La(OTf)_3$ (43 mg, 0.0732 mmol) and DMAP (3.0 mg, 0.0244) then dissolved in MeOH (1.9 mL). The resulting solution was heated to 34 ºC[7] and stirred at this temperature for 90 min. The reaction was cooled to room temperature then EtOAc (4 mL) was added, which was subsequently transferred to a separatory funnel containing sat. aq. NH_4Cl (3 mL). The layers were separated and the aqueous phase was further extracted with EtOAc (2 x 4 mL). The combined organic extracts were washed with H_2O (4 mL), brine (4 mL), dried (Na_2SO_4), then concentrated to dryness under reduced pressure. The crude material was purified by preparative TLC eluting with $CHCl_3$/MeOH (99:1) to afford (+)–bionectin A (**9**) (2.4 mg, 44%) as an amorphous colorless powder. The yield reported in the Scheme represents the mean of multiple runs.

^{1}H NMR (500 MHz, $CDCl_3$) δ 8.06 (br s), 7.94 (d, J = 7.8 Hz, 1 H), 7.46 (d, J = 7.5 Hz, 1 H), 7.34 (d, J = 8.0 Hz, 1 H), 7.21 (t, J = 7.1 Hz, 1 H), 7.19–7.13 (comp, 2 H), 7.09 (d, J = 2.5 Hz, 1 H), 6.85 (t, J = 7.5 Hz, 1 H), 6.72 (d, J = 7.8 Hz, 1 H), 6.33 (s, 1 H), 5.40 (br s, 1 H), 5.35 (s, 1 H), 5.22 (s, 1 H), 5.20 (s, 1 H), 3.14 (s, 3 H); ^{13}C NMR (125 MHz, $CDCl_3$) δ 165.9 (C), 161.7 (C), 147.1 (C), 136.9 (C), 130.7 (C), 129.2 (CH), 126.1 (C), 124.5 (CH),

[6] Dithiol intermediate **59** could be treated with MeI (50 equiv) and K_2CO_3 (14 equiv) in acetone (0.006 M) for 14 h to afford, after a sat. aq. $NaHCO_3$ work up, compound **61** as a single cis-dithiomethyl isomer in 61% yield.

[7] It is critical that the reaction temperature is maintained between 33 and 35 ºC. If the temperature goes above 35 ºC, the product will begin to decompose, affording significant quantities of 3,3'-biindole

123.3 (CH), 122.4 (CH), 121.4 (CH), 119.9 (CH), 119.8 (CH), 113.2 (C), 111.5 (CH), 110.7 (CH), 82.3 (CH), 80.8 (CH), 67.5 (CH), 61.4 (CH), 31.8 (CH_3); IR (film) 3401, 3052, 2927, 2855, 1677, 1608, 1482, 1458, 1379, 1238, 1093, 901 cm^{-1}; TLC R_f 0.56 (1:2 ethyl acetate/hexanes); HRMS (ESI) *m/z* calcd for $C_{22}H_{18}N_4O_3S_2Na^+$ (M+Na) 473.0718, found 473.0722; $[\alpha]^{23.4}_D$ +405.2, $[\alpha]^{23.4}_{577}$ +419.7, $[\alpha]^{23.5}_{546}$ +480.5, $[\alpha]^{23.2}_{435}$ +878.6 (*c* = 0.12, CH_3OH).

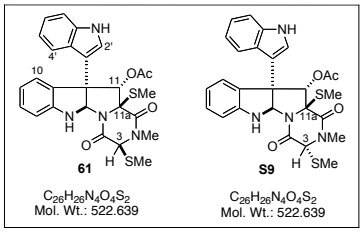
Bionectin A (**9**) (1 mg) was dissolved in $CDCl_3$ (600 µL, passed over K_2CO_3) for NMR analysis. Spectra were obtained before TFA–CD_3OD was added and in succession after 20 µL portions of the 0.022 M solution of TFA–CD_3OD were added (see supporting NMR spectra). No change in the aromatic proton shifts were observed up to the addition of 2.0 equiv of TFA, suggesting the observed difference in the data for synthetic and natural bionectin A does not arise from different protonation states.

Tabulated ^{1}H NMR spectra of natural (+)-bionectin A and synthetic (+)-bionectin A: *J. Nat. Prod.* **2006**, *69*, 1816–19.

Literature (500 MHz, $CDCl_3$)		Synthetic **9** (500 MHz, $CDCl_3$)		Δδ
3	5.19 (s)	3	5.20 (s)	+0.01
5a	6.54 (s)	5a	6.33 (s)	–0.21
N(6)–H	5.63 (s)	N(6)–H	5.40 (br s)	–0.23
7	6.68 (dd, *J* = 7.5, 1.0)	7	6.72 (d, *J* = 7.8)	+0.04
8	7.07 (td, *J* = 7.5, 1.0)	8	7.19–7.13 (comp)	+0.07
9	6.75 (td, *J* = 7.5, 1.0)	9	6.85 (t, *J* = 7.5)	+0.10
10	7.32 (dd, *J* = 7.5, 1.0)	10	7.46 (d, *J* = 7.5)	+0.14
11	5.28 (s)	11	5.35 (s)	+0.07
C(11)–OH		C(11)–OH	5.22 (s)	
12	3.02 (s)	13	3.14 (s)	+0.12
N(1')–H	8.08 (br s)	N(1')–H	8.06 (br s)	–0.02
2'	7.11 (d, *J* = 2.4)	2'	7.09 (d, *J* = 2.5)	–0.02
4'	7.93 (dd, *J* = 7.8, 1.0)	4'	7.94 (d, *J* = 7.8)	+0.01
5'	7.15 (td, *J* = 7.8, 1.0)	5'	7.19–7.13 (comp)	+0.03
6'	7.20 (td, *J* = 7.8, 1.0)	6'	7.21 (t, *J* = 7.1)	+0.01
7'	7.33 (dd, *J* = 7.8, 1.0)	7'	7.34 (d, *J* = 8.0)	+0.01

Literature (75.4 MHz, $CDCl_3$)		Synthetic **9** (125 MHz, $CDCl_3$)		Δδ
1	167.0 (C)	1	165.9 (C)	–1.1
3	70.6 (C)	3	67.5 (C)	–1.1
4	163.1 (C)	4	161.7 (C)	–1.4
5a	83.1 (CH)	5a	82.3 (CH)	–0.8
6a	147.0 (C)	6a	147.1 (C)	+0.1

7 8 9 10	110.5 (CH) 129.3 (CH) 120.3 (CH) 125.3 (CH)	7 8 9 10	110.7 (CH) 129.2 (CH) 119.8 (CH) 124.5 (CH)	+0.2 –0.1 –0.05 –0.08
10a	131.5 (C)	10a	130.7 (C)	–0.8
10b	59.1 (C)	10b	61.4 (C)	+1.3
11	80.1 (CH)	11	80.8 (CH)	+0.7
11a	79.1 (C)	11a	76.7 (C) (HMBC)	–2.4
12	33.1 (CH_3)	12	31.8 (CH_3)	–1.3
1'a	137.1 (C)	1'a	136.9 (C)	–0.2
2'	123.3 (CH)	2'	123.3 (CH)	0
3'	113.6 (C)	3'	113.2 (C)	–0.4
3a'	126.1 (C)	3'a	126.1 (C)	0
4' 5' 6' 7'	121.4 (CH) 120.1 (CH) 122.4 (CH) 111.7 (CH)	4' 5' 6' 7'	121.4 (CH) 119.9 (CH) 122.4 (CH) 111.5 (CH)	0 –0.2 0 –0.2



***O*-Acetyl Bionectin C (61 and S9).** Methanethiol (bp 6°C, ca. 250 µL) was condensed at – 78°C in a pressure tube fitted with a rubber septum. A solution of **58** (30 mg, 0.037 mmol) in CH_2Cl_2 (650 µL), followed by neat boron trifluoride etherate (45 µL, 0.37 mmol), was added to the liquid methanethiol. A Teflon screw cap replaced the rubber septum to seal the pressure tube, the cold bath was removed, the reaction mixture warmed to room temperature, and stirring was continued for 3 h. *CAUTION: the sealed tube was maintained behind a blast shield*. The reaction mixture was then cooled to –78°C and the Teflon screw cap was replaced by a rubber septum with a bleed needle connected to a bleach trap. The cooling bath was removed and the resulting colorless suspension was allowed to warm up to room temperature. Upon removal of methanethiol, the reaction mixture was dried using a nitrogen stream, diluted with EtOAc (6 mL), transferred to a separatory funnel then washed with saturated aq. $NaHCO_3$ (4 mL).[8] The aqueous layer was further extracted with EtOAc (2 x 6 mL) then the combined organics were washed with brine (5 mL), dried (Na_2SO_4), then concentrated to dryness under reduced pressure. The crude material was purified using silica gel column chromatography eluting with CH_2Cl_2/EtOAc (100:0 to 97:3) to afford **61** and **S9** (14 mg, 73%) as an amorphous colorless powder as a cis:trans (2.5:1) mixture of dithiomethyl stereoisomers. Analytically pure samples could be obtained using preparatory TLC purification eluting with CH_2Cl_2/EtOAc (95:5).

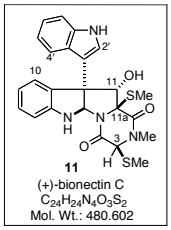
For compound **61** irradiation of C11-H leads to NOE signals with C4'–H, C10–H, and C11a–SMe.

[8] This step destroys the intermediate BF_3 complex.

For compound **S9** irradiation of C11-H leads to NOE signals with C4'–H, C10–H, and C11a–SMe.

61: ^{1}H NMR (500 MHz, acetone-d_6) δ 10.20 (br s, 1 H), 7.64 (d, J = 8.1 Hz, 1 H), 7.58 (d, J = 7.3 Hz, 1 H), 7.38 (d, J = 8.1 Hz, 1 H), 7.12 (t, J = 8.2 Hz, 1 H), 7.10 (t, J = 8.1 Hz, 1 H), 7.05 (d, J = 2.7 H, 1 H), 7.02 (t, J = 7.1 Hz, 1 H), 6.81 (t, J = 7.4 Hz, 1 H), 6.66 (d, J = 7.8 Hz, 1 H), 6.49 (d, J = 1.7 Hz, 1 H), 6.29 (br s, 1 H), 6.25 (s, 1 H), 5.02 (s, 1 H), 3.08 (s, 3 H), 2.43 (s, 3 H), 2.03 (s, 3 H), 1.31 (s, 3 H); ^{13}C NMR (125 MHz, acetone-d_6) δ 168.9 (C), 164.4 (C), 163.9 (C), 150.7 (C), 138.5 (C), 131.5 (C), 129.8 (CH), 127.1 (C), 126.4 (CH), 124.7 (CH), 122.3 (CH), 121.9 (CH), 119.8 (CH), 118.9 (CH), 113.9 (C), 112.8 (CH), 110.3 (CH), 81.2 (CH), 81.1 (CH), 72.6 (C), 67.7 (CH), 59.4 (C), 32.2 (CH_3), 20.5 (CH_3), 17.4 (CH_3), 15.5 (CH_3); IR (film) 3367, 3053, 2921, 2854, 1748, 1667, 1608, 1421, 1395, 1222, 1062, 744 cm^{-1}; TLC R_f 0.27 (9:1 CH_2Cl_2/ethyl acetate); HRMS (ESI) m/z calcd for $C_{26}H_{26}N_4O_4S_2Na^+$ (M+Na) 545.1293, found 545.1293; $[\alpha]^{212.8}_D$ +34.1, $[\alpha]^{22.6}_{577}$ +35.1, $[\alpha]^{22.6}_{546}$ +39.5, $[\alpha]^{22.6}_{435}$ +72.2 (c = 1.25, CH_2Cl_2).

S9: ^{1}H NMR (500 MHz, acetone-d_6) δ 10.21 (br s, 1 H), 7.73 (d, J = 8.0 Hz, 1 H), 7.54 (d, J = 7.4 Hz, 1 H), 7.40 (d, J = 8.1 Hz, 1 H), 7.11 (app t, J = 7.7 Hz, 2 H), 7.06 (d, J = 2.5 Hz, 1 H), 7.05 (t, J = 7.1 Hz, 1 H), 6.81 (t, J = 7.4 Hz, 1 H), 6.63 (d, J = 7.8 Hz, 1 H), 6.46 (br d, J = 2.1 Hz, 1 H), 6.33 (br s, 1 H), 6.07 (s, 1 H), 5.35 (s, 1 H), 3.10 (s, 3 H), 2.33 (s, 3 H), 2.01 (s, 3 H), 1.28 (s, 3 H); ^{13}C NMR (125 MHz, acetone-d_6) δ 168.7 (C), 164.0 (C), 163.6 (C), 151.3 (C), 138.5 (C), 131.4 (C), 129.8 (CH), 127.0 (C), 126.6 (CH), 125.1 (CH), 122.4 (CH), 121.9 (CH), 119.7 (CH), 118.8 (CH), 113.9 (C), 112.9 (CH), 110.1 (CH), 82.6 (CH), 82.4 (CH), 74.6 (C), 67.0 (CH), 60.2 (C), 33.5 (CH_3), 20.3 (CH_3), 15.1 (CH_3), 12.5 (CH_3); IR (film) 3350, 3054, 2922, 2854, 1749, 1661, 1608, 1485, 1417, 1392, 1221, 1073, 743 cm^{-1}; TLC R_f 0.23 (9:1 CH_2Cl_2/ethyl acetate); HRMS (ESI) m/z calcd for $C_{26}H_{26}N_4O_4S_2Na^+$ (M+Na) 545.1293, found 545.1299; $[\alpha]^{21.8}_D$ –22.5, $[\alpha]^{21.9}_{577}$ –24.7, $[\alpha]^{22.0}_{546}$ –28.3, $[\alpha]^{22.0}_{435}$ –58.1 (c = 0.60, CH_2Cl_2



Bionectin C (11). Lanthanum triflate (63 mg, 0.107 mmol) and DMAP (0.0134 mmol, 1.6 mg) were added to a solution of **61**[9] (7 mg, 0.0134 mmol) in anhydrous MeOH (0.75 mL) at room temperature. The solution was heated to 45 ºC and maintained at this temperature for 1 h. A second portion of DMAP (0.0134 mmol, 1.6 mg) in MeOH (0.2 mL) was added and stirring at 45 ºC continued for 5 h. At this stage the reaction was a mixture of starting material, product, and 3,3'-biindole (1.5:1.5:1.0). The reaction was cooled to room temperature then EtOAc (4 mL) was added, which was subsequently transferred to a separatory funnel containing sat. aq. NH_4Cl (3 mL). The layers were separated and the aqueous phase was further extracted with EtOAc (2 x 4 mL). The combined organic extracts were

[9] Using a mixture of **61** and **S9** afforded the same product distribution, because C3-SMe epimerization of **S9** occurs during the reaction.

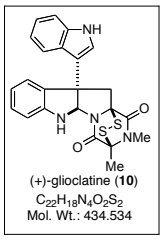
washed with H_2O (4 mL), brine (4 mL), dried (Na_2SO_4), then concentrated to dryness under reduced pressure. The crude material was purified by preparative TLC eluting with hexanes/EtOAc (2.5:1.0) to afford (+)–bionectin C (**11**) (2.3 mg, 35%) as an amorphous colorless powder. ^{1}H NMR (500 MHz, $CDCl_3$) δ 8.05 (br s, 1 H), 7.87 (d, J = 7.8 Hz, 1 H), 7.43 (d, J = 7.2 Hz, 1 H), 7.32 (d, J = 7.6 Hz, 1 H), 7.20 (t, J = 7.5 Hz, 1 H), 7.15 (t, J = 7.5 Hz, 1 H), 7.11 (d, J = 2.4 Hz, 1 H), 7.09 (t, J = 7.8 Hz, 1 H), 6.74 (t, J = 7.4 Hz, 1 H), 6.65 (d, J = 7.7 Hz, 1 H), 6.36 (s, 1 H), 5.32 (br d, J = 2.0 Hz, 1 H), 5.12 (br s, 1 H), 4.61 (s, 1 H), 3.28 (br d, J = 2.0 Hz, 1 H), 3.12 (s, 3 H), 2.48 (s, 3 H), 2.09 (s, 3 H); ^{13}C NMR (125 MHz, $CDCl_3$) δ 164.8 (C), 164.6 (C), 147.4 (C), 136.9 (C), 131.6 (C), 128.7 (CH), 125.8 (C), 123.2 (CH), 122.9 (CH), 122.3 (CH), 121.1 (CH), 119.9 (CH), 119.1 (CH), 114.9 (C), 111.5 (CH), 109.9 (CH), 81.5 (CH), 80.2 (CH), 73.1 (C), 67.6 (CH), 58.9 (C), 32.1 (CH_3), 18.1 (CH_3), 15.4 (CH_3); IR (film) 3365, 3054, 2963, 2922, 1660, 1483, 1427, 1397, 1238, 1087 cm^{-1}; TLC R_f 0.10 (1:1 hexanes/ethyl acetate); HRMS (ESI) *m/z* calcd for $C_{24}H_{24}N_4O_3S_2Na^+$ (M+Na) 503.1187, found 503.1166; $[\alpha]^{23.2}_D$ +266.1, $[\alpha]^{23.4}_{577}$ +279.1, $[\alpha]^{23.4}_{546}$ +316.5, $[\alpha]^{23.2}_{435}$ +599.7 (c = 0.34, CH_3OH).

Tabulated ^{1}H NMR spectra of natural (+)-gliocladin A / (+)-bionectin C and synthetic (+)-gliocladin A: gliocladin A: *Heterocycles* **2004**, *63*, 1123–1129. bionectin C: *J. Nat. Prod.* **2006**, *69*, 1816–1819.

Literature (500 MHz, $CDCl_3$) Gliocladin A		Bionectin C	Synthetic **11** (500 MHz, $CDCl_3$)		Δδ
3	4.60 (s)	4.60 (s)	3	4.61	+0.01
5a	6.35 (s)	6.35 (s)	5a	6.36 (s)	+0.01
N(6)–H	5.12 (br s)	5.12 (s)	N(6)–H	5.12 (br s)	0
7	6.65 (br d, J = 7.8)	6.65 (dd, J = 7.5, 1.0)	7	6.65 (d, J = 7.7)	0
8	7.09 (td, J = 7.8, 1.1)	7.09 (td, J = 7.5, 1.0)	8	7.09 (t, J = 7.8)	0
9	6.73 (td, J = 7.8, 0.9)	6.73 (td, J = 7.5, 1.0)	9	6.74 (t, J = 7.4)	+0.01
10	7.32 (br d, J = 7.8)	7.42 (dd, J = 7.5, 1.0)	10	7.43 (d, J = 7.6)	+0.01
11	5.32 (br d, J = 3.9)	5.32 (s)	11	5.32 (br d, J = 2.0)	0
C(11)–OH	3.28 (d, J = 3.9)		C(11)–OH	3.28 (br d, J = 2.0)	0
12	3.11 (s)	3.11 (s)	12	3.12 (s)	+0.01
3-SMe	2.47 (s)	2.47 (s)	3-SMe	2.48 (s)	+0.01
11a-SMe	2.08 (s)	2.08 (s)	11a-SMe	2.09 (s)	+0.01
N(1')–H	8.04 (br s)	8.06 (br s)	N(1')–H	8.05 (br s)	+0.01
2'	7.11 (d, J = 2.5)	7.11 (d, J = 2.5)	2'	7.11 (d, J = 2.4)	0
4'	7.87 (br d, J = 7.8)	7.87 (dd, J = 7.8, 1.0)	4'	7.87 (d, J = 7.8)	0
5'	7.15 (td, J = 7.8, 1.4)	7.15 (td, J = 7.8, 1.0)	5'	7.15 (t, J = 7.5)	0
6'	7.19 (td, J = 7.8, 1.4)	7.19 (td, J = 7.8, 1.0)	6'	7.20 (t, J = 7.5)	+0.01
7'	7.32 (br d, J = 7.8)	7.32 (dd, J = 7.8, 1.0)	7'	7.32 (d, J = 7.6)	0

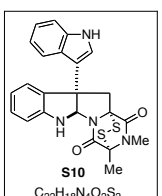
Literature (125 MHz, $CDCl_3$) Gliocladin A		Bionectin C	Synthetic **11** (125 MHz, $CDCl_3$)		Δδ
1	164.6 (C)	164.9 (C)	1	164.6 (C)	0

3	67.59 (CH)	60.8 (CH)	3	67.6 (C)	0
4	164.78 (C)	165.0 (C)	4	164.8 (C)	0
5a	81.55 (CH)	81.8 (CH)	5a	81.5 (CH)	–0.1
6a	147.42 (C)	147.6 (C)	6a	147.4 (C)	0
7	109.89 (CH)	110.1 (CH)	7	109.9 (CH)	0
8	128.74 (CH)	129.0 (CH)	8	128.7 (CH)	–0.1
9	119.10 (CH)	119.3 (CH)	9	119.1 (CH)	0
10	123.21 (CH)	123.5 (CH)	10	123.2 (CH)	0
10a	131.65 (C)	131.9 (C)	10a	131.6 (C)	0
10b	58.94 (C)	59.1 (C)	10b	58.9 (C)	0
11	80.26 (CH)	80.6 (CH)	11	80.2 (CH)	0
11a	73.15 (C)	73.3 (C)	11a	73.1 (C)	0
12	32.13 (CH_3)	32.2 (CH_3)	12	32.1 (CH_3)	0
3-SMe	18.06 (CH_3)	18.2 (CH_3)	3-SMe	18.1 (CH_3)	0
12-SMe	15.42 (CH_3)	15.7 (CH_3)	3-SMe	15.4 (CH_3)	0
1'a	136.91 (C)	137.1 (C)	1'a	136.9 (C)	0
2'	122.91 (CH)	123.3 (CH)	2'	122.9 (CH)	0
3'	114.89 (C)	115.0 (C)	3'	114.9 (C)	0
3'a	125.78 (C)	125.9 (C)	3'a	125.8 (C)	0
4'	121.08 (CH)	121.3 (CH)	4'	121.1 (CH)	0
5'	119.90 (CH)	120.2 (CH)	5'	119.9 (CH)	0
6'	122.34 (CH)	122.6 (CH)	6'	122.3 (CH)	0
7'	111.53 (CH)	111.8 (CH)	7'	111.5 (CH)	0



(+)-glioclatine (**10**)
$C_{22}H_{18}N_4O_2S_2$
Mol. Wt.: 434.534

Glioclatine (10). ^{1}H NMR (500 MHz, pyridine) δ 12.24 (br s, 1 H), 7.97 (d, *J* = 8.0 Hz, 1 H), 7.86 (br s, 1 H), 7.51 (behind solvent), 7.47 (d, *J* = 7.5 Hz, 1 H), 7.45 (br d, *J* = 2.5 Hz, 1 H), 7.28–7.22 (comp, 2 H), 7.11 (t, *J* = 7.6 Hz, 1 H), 6.96 (d, *J* = 7.8 Hz, 1 H), 6.91 (t, *J* = 7.4 Hz, 1 H), 6.48 (s, 1 H), 4.48 (d, *J* = 15.1 Hz, 1 H), 3.48 (d, *J* = 15.1 Hz, 1 H), 3.03 (s, 3 H), 2.01 (s, 3 H); ^{13}C NMR (125 MHz, CD_3OD) δ 167.0 (C), 163.5 (C), 150.2 (behind solvent), 139.2 (C), 134.1 (C), 129.7 (CH), 126.5 (C), 125.0 (CH), 124.0 (behind solvent), 122.7 (CH), 120.4 (CH), 120.3 (CH), 119.7 (CH), 117.9 (C), 113.1 (CH), 110.4 (CH), 84.6 (CH), 75.5 (C), 74.7 (C), 56.5 (C), 45.4 (CH_2), 27.7 (CH_3), 18.5 (CH_3); IR (film) 3350, 3051, 2958, 2924, 2852, 1681, 1608, 1484, 1460, 1349, 1240, 1069 cm^{-1}; TLC R_f 0.18 (1:1 hexanes/ethyl acetate); HRMS (ESI) *m/z* calcd for $C_{23}H_{20}N_4O_2S_2Na^+$ (M+Na) 471.0925, found 471.0929; $[\alpha]^{23.2}_D$ +344.1, $[\alpha]^{23.2}_{577}$ +355.7, $[\alpha]^{23.3}_{546}$ +406.9, $[\alpha]^{23.1}_{435}$ +742.6 (*c* = 0.24, pyridine).



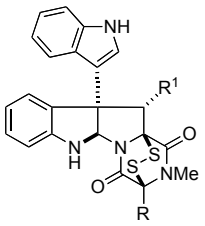
$C_{22}H_{18}N_4O_2S_2$
Mol. Wt.: 434.534

Gliocatine epi-Disulfide (S10). ^{1}H NMR (500 MHz, acetone-d_6) δ 10.29 (br s, 1 H), 7.66 (d, *J* = 8.0 Hz, 1 H), 7.44 (d, *J* = 8.2 Hz, 1 H), 7.23 (d, *J* = 7.4 Hz, 1 H), 7.21 (d, *J* = 2.5 Hz, 1 H), 7.13 (t, *J* = 7.3 Hz, 1 H), 7.11 (t, *J* = 7.5 Hz, 1 H), 7.02 (t, *J* = 7.3 Hz, 1 H), 6.80 (d, *J* = 7.8 Hz, 1 H), 6.75

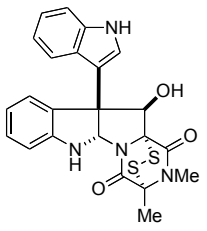
(t, J = 7.5 Hz, 1 H), 6.23 (br s, 1 H), 6.11 (s, 1 H), 3.84 (d, J = 15.3 Hz, 1 H), 3.44 (d, J = 15.3 Hz, 1 H), 2.98 (s, 3 H), 1.98 (s, 3 H); ^{13}C NMR (125 MHz, acetone-d_6) δ 166.7 (C), 164.5 (C), 148.7 (C), 138.9 (C), 133.6 (C), 129.6 (CH), 126.3 (C), 125.2 (CH), 124.5 (CH), 122.7 (CH), 120.18 (CH), 120.16 (CH), 120.11 (CH), 116.9 (C), 113.0 (CH), 111.0 (CH), 84.9 (CH), 75.2 (C), 75.0 (C), 56.9 (C), 44.5 (CH_2), 27.5 (CH_3), 18.3 (CH_3); IR (film) 3358, 2959, 2925, 2854, 1681, 1608, 1459, 1361, 1319, 1106, 1015 cm^{-1}; TLC R_f 0.49 (1:1 hexanes/ethyl acetate); HRMS (ESI) m/z calcd for $C_{23}H_{20}N_4O_2S_2Na^+$ (M+Na) 471.0925, found 471.0910; $[\alpha]^{23.1}_{D}$ –5.0, $[\alpha]^{23.2}_{577}$ –2.8, $[\alpha]^{23.1}_{546}$ –1.3, $[\alpha]^{23.2}_{435}$ +18.2 (c = 0.18, CH_2Cl_2).

Determination of IC_{50} Values Against Invasive Human DU145 Prostate Cancer and A2058 Melanoma cells. Cell viability was determined using a MTS metabolic activity assay as described by the supplier (Promega).[10] Briefly, DU145 prostate cancer and A2058 melanoma cells (5000/well) were seeded in 96-well plates, incubated overnight at 37°C in 5% (v/v) CO_2 and exposed to ETPs in a dose-dependent manner for 48 h. DMSO was used as the vehicle control. Cell viability was determined by tetrazolium conversion to its formazan dye and absorbance was measured at 490 nm using an automated ELISA plate reader. Each experiment was performed in quadruplicate and mean values are reported in Table 1.

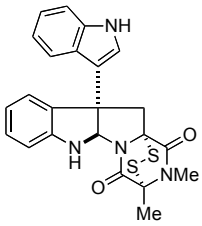
3. Circular Dichroism Data: Obtained using solutions of **6–11**, **S7**, S**10**, and **46** in EtOH (c = 2 x 10^{-4} M).



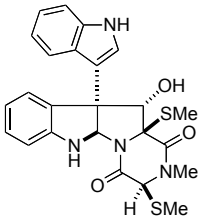
gliocladine C: R = Me, R^1 = OH (**6**)
leptosin D: R = *i*-Pr, R^1 = OH (**7**)
T988C: R = CH_2OH, R^1 = OH (**8**)
bionectin A: R = H, R^1 = OH (**9**)
glioclatine: R = Me, R^1 = H (**10**)



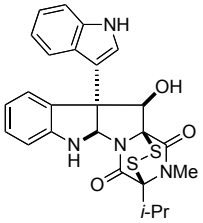
ent-(+)-gliocladine C (**S7**)



S10



bionectin C: R = H (**11**)



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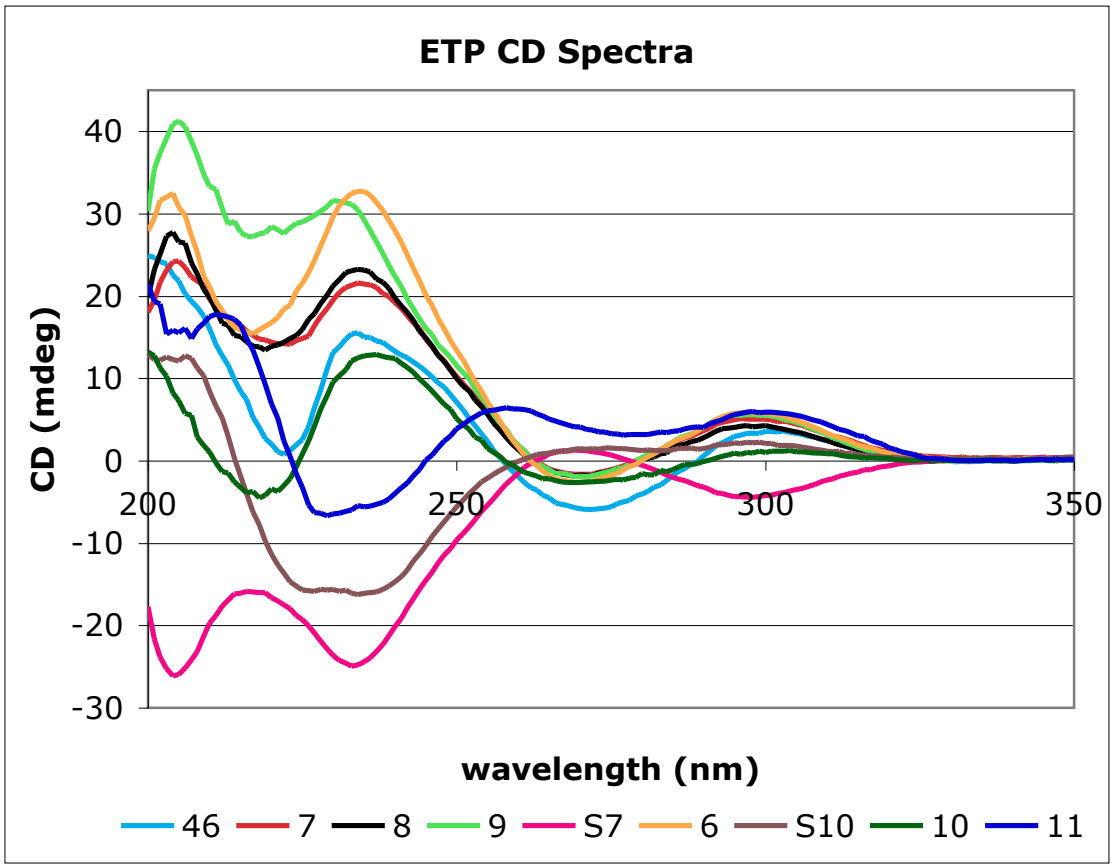
[10] Nam, S.; Williams, A.; Vultur, A.; List, A.; Bhalla, K.; Smith, D.; Lee, F. Y.; Jove, R. *Mol. Cancer Ther.* **2007**, *6*, 1400-1405.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200
250
300
350
wavelength (nm)
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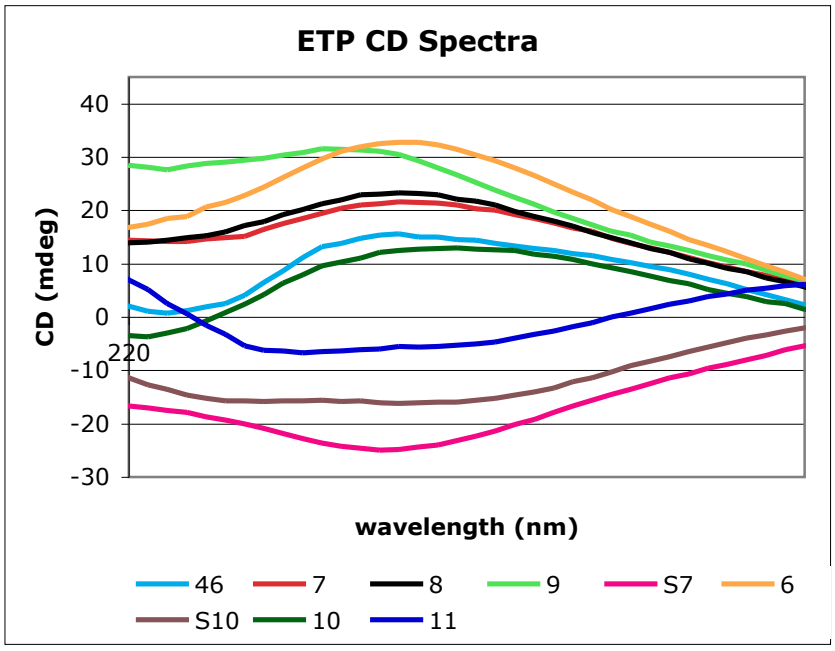
7
8
9
S7
6
S10
10
11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wavelength (nm)
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8
9
S7
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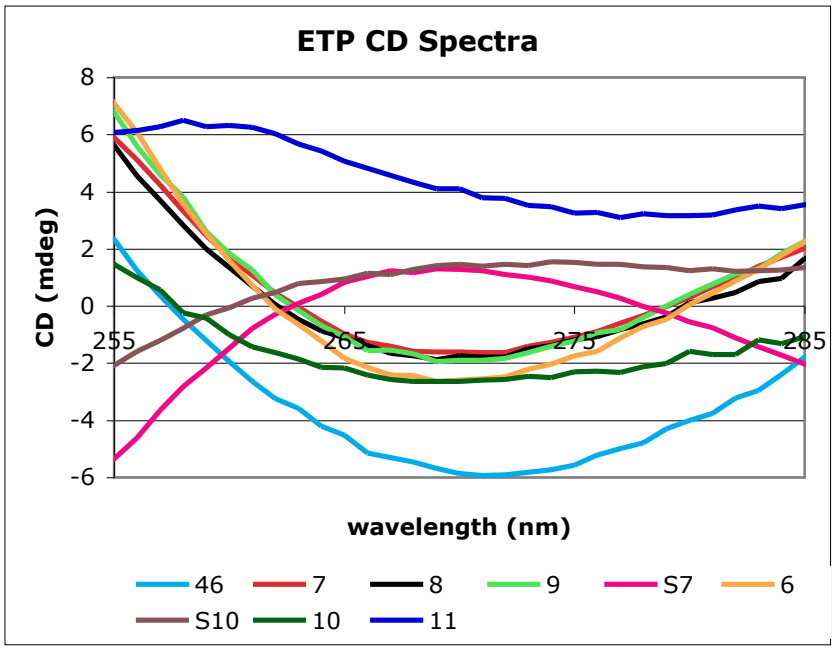
S10
10
11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wavelength (nm)
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7
8
9
S7
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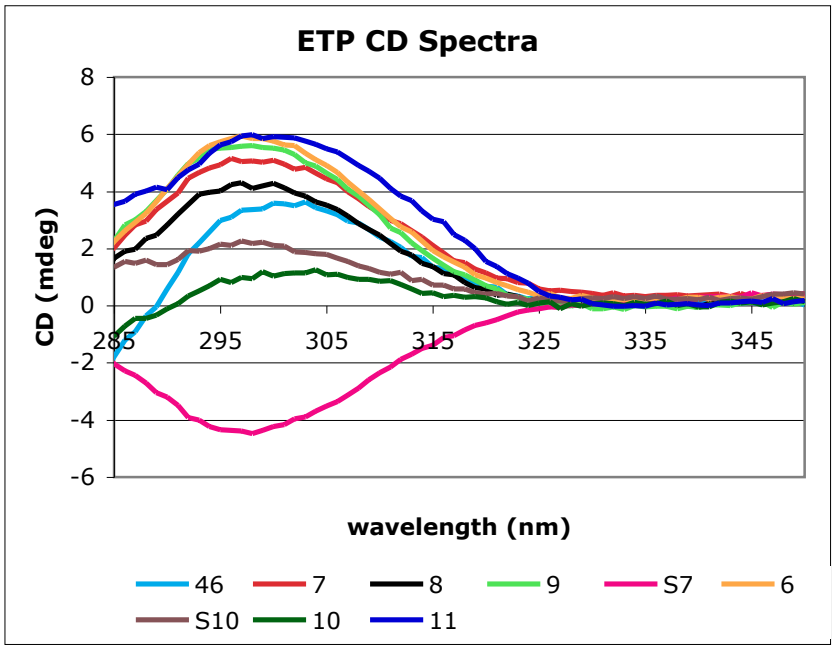
S10
10
11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CD (mdeg)
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-6
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295
305
315
325
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345
wavelength (nm)
46
7
8
9
S7
6
S10
10
11