Supporting Information

Total Synthesis of Brevetoxin B

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Scheme 1: Synthesis of the lactone **6**^a

^a (a) (i) $\text{Ph}_3\text{P}=\text{CHCO}_2\text{Me}$, benzene, rt; (ii) TBAF, THF, rt, 100%; (b) PPTS, CH_2Cl_2 , 0 °C to rt, 92%; (c) H_2 , Pd-C, MeOH, rt, 95%; (d) PPTS, benzene, reflux, 100%.

Scheme 2: Synthesis of the FG Ring Segment **5**^a

^a (a) $\text{Ph}_3\text{P}^+\text{CH}_3\text{Br}^-$, NaHMDS, THF, 0 °C to rt, 93%; (b) TBAF, THF, 40 °C, 91%.

General Methods. All reactions involving air- and/or moisture-sensitive materials were carried out under argon with dry solvents purchased from Wako or Kanto chemicals. On workup, extracts were dried over MgSO_4 . Reactions were monitored by thin-layer chromatography carried out on 0.25 mm Merck silica gel plates (60F-254). Column chromatography was performed with Kanto Chemical silica gel 60N (40-100 mesh, spherical, neutral) or Fuji Silysia silica gel BW-300 (200-400 mesh).

Yields refer to chromatographically and spectroscopically homogeneous materials.

Enol Ether 9. To a mixture of **6** (6.0 g, 20 mmol), PhNTf₂ (14 g, 39 mmol), and DMPU (7.1 mL, 59 mmol) in THF (360 mL) at -78 °C was added KHMDs (99 mL, 49 mmol, 0.5 M in toluene). After stirring for 0.5 h at -78 °C, the reaction was quenched with water. The mixture was extracted with ether, and the organic layer was washed with brine. Concentration and chromatography (hexane/EtOAc, 4:1 containing 1% Et₃N) gave the ketene acetal triflate **7** (8.1 g, 94%). Characterization data of **7** were not collected for lack of stability.

To a mixture of Zn-Cu couple (254 mg, 4.1 mmol) in benzene (3 mL) and DMA (0.2 L) was added methyl (R)-3-hydroxy-2-methylpropionate (0.26 L, 2.1 mmol). The mixture was refluxed for 1 h to give a suspension containing the zinc homoenolate **8**. To the mixture of **8** at room temperature were added a solution of PdCl₂(*o*-Tol₃P)₂ (27 mg, 34 μmol) in benzene (1.5 mL) and a solution of the ketene acetal triflate **7** (300 mg, 0.69 mmol) in benzene (2 mL), successively. After stirring for 13 h at 40 °C, the mixture was quenched with satd K₂CO₃, filtered through a Celite pad, and concentrated. The residue was purified by chromatography (hexane/EtOAc, 10:1 containing 1% Et₃N) to give **9** (228 mg, 85%): colorless needle; mp 88 °C (hexane); *R*_f = 0.26 (hexane/EtOAc, 4:1); [α]_D²¹ +51.9° (c 0.98, CHCl₃); IR (KBr) 1736, 1674 cm⁻¹; ¹H NMR (300 MHz, C₆D₆) δ 7.59-7.56 (m, 2 H), 7.17-7.05 (m, 3 H), 5.28 (s, 1 H), 4.26 (dd, *J* = 10.1, 4.4 Hz, 1 H), 3.57 (ddd, *J* = 9.3, 9.3, 4.5 Hz, 1 H), 3.48-3.41 (m, 2 H), 3.32 (s, 3 H), 3.11 (ddd, *J* = 11.7, 9.0, 4.1 Hz, 1 H), 2.62 (q, *J* = 7.2 Hz, 1 H), 2.32-2.19 (m, 2 H), 2.09-2.03 (m, 2 H), 1.89-1.73 (m, 2 H), 1.03 (s, 3 H), 1.00 (d, *J* = 6.9 Hz, 3 H); ¹³C NMR (75 MHz, C₆D₆) δ 175.6, 151.5, 138.5, 128.9, 128.3, 126.7, 101.8, 97.2, 77.9, 76.3, 72.0, 70.0, 67.3, 51.1, 37.8, 37.5, 37.3, 30.7, 16.5, 15.3; Anal. Calcd for C₂₂H₂₈O₆: C, 68.02; H, 7.27. Found: C, 67.76; H, 7.27.

Alcohol 10. To a solution of **9** (88 mg, 0.23 mmol) in THF (3 mL) was added BH₃·SMe₂ (65 μL, 0.68 mmol) at 0 °C, and the mixture was stirred for 2 h at room temperature. To the mixture were added 1 N NaOH (0.8 mL) and 30% H₂O₂ (0.4 mL) at 0 °C, and the reaction mixture was stirred for 1 h at room temperature. The mixture was diluted with EtOAc, then washed with satd Na₂SO₃ and brine. The organic layer was concentrated to give the corresponding diol which was used for next reaction directly.

To a solution of the diol obtained in CH_2Cl_2 (3 mL) were added 2,6-lutidine (100 μL , 0.86 mmol) and TBSOTf (156 μL , 0.68 mmol). After stirring for 2.5 h at room temperature, the reaction was quenched with MeOH. The mixture was diluted with ether, then washed with water and brine. Concentration and chromatography (hexane/EtOAc, 20:1) gave the corresponding bis-silyl ether (104 mg, 76%): colorless oil; $R_f = 0.24$ (hexane/EtOAc, 10:1); $[\alpha]_D^{23} -41.5^\circ$ (c 1.10, CHCl_3); IR (neat) 2955 cm^{-1} ; ^1H NMR (300 MHz, CDCl_3) δ 7.50-7.47 (m, 2 H), 7.36-7.33 (m, 3 H), 5.52 (s, 1 H), 4.24 (d, $J = 5.7$ Hz, 1 H), 3.71-3.66 (m, 2 H), 3.59-3.42 (m, 3 H), 3.36 (dd, $J = 9.6, 6.3$ Hz, 1 H), 3.26-3.18 (m, 2 H), 2.19 (ddd, $J = 11.7, 3.6, 3.6$ Hz, 1 H), 2.10 (dd, $J = 11.7, 5.1$ Hz, 1 H), 1.90-1.73 (m, 3 H), 1.52 (t, $J = 11.4$ Hz, 1 H), 1.29 (s, 3 H), 1.19 (ddd, $J = 13.8, 9.6, 4.2$ Hz, 1 H), 0.94 (d, $J = 6.6$ Hz, 3 H), 0.89 (s, 9 H), 0.87 (s, 9 H), 0.06 (s, 6 H), 0.04 (s, 6 H); ^{13}C NMR (75 MHz, CDCl_3) δ 137.3, 128.8, 128.1, 126.0, 101.7, 82.6, 78.8, 78.6, 73.9, 70.8, 69.9, 67.5, 66.0, 47.1, 35.9, 32.3, 30.5, 25.9, 25.7, 18.3, 18.2, 17.8, 16.0, -4.2, -4.8, -5.4; HRMS (EI) calcd for $\text{C}_{33}\text{H}_{58}\text{O}_6\text{Si}_2$ (M^+) 606.3769, found 606.3783.

To a solution of the bis-silyl ether (1.43 g, 2.36 mmol) in THF (7 mL) and H_2O (7 mL) at 0°C was added AcOH (21 mL), and the mixture was stirred for 3 h at room temperature. The mixture was diluted with ether, then washed with satd NaHCO_3 three times, water, and brine. Concentration and chromatography (hexane/EtOAc, 20:1 to 2:1) gave **10** (654 mg, 56%, 87 % based on recovery) and unreacted bis-silyl ether (488 mg, 34% recovery): colorless oil; $R_f = 0.23$ (hexane/EtOAc, 4:1); $[\alpha]_D^{24} -38.4^\circ$ (c 0.78, CHCl_3); ^1H NMR (300 MHz, CDCl_3) δ 7.48-7.45 (m, 2 H), 7.38-7.33 (m, 3 H), 5.50 (s, 1 H), 4.22 (dd, $J = 5.7, 2.6$ Hz, 1 H), 3.73-3.65 (m, 2 H), 3.59-3.46 (m, 4 H), 3.30-3.23 (m, 2 H), 2.40 (br, 1 H), 2.19 (ddd, $J = 11.6, 3.9, 3.9$ Hz, 1 H), 2.15 (dd, $J = 11.6, 5.0$ Hz, 1 H), 1.96 (ddd, $J = 12.9, 12.9, 6.6$ Hz, 1 H), 1.85-1.73 (m, 2 H), 1.56-1.45 (m, 2 H), 1.29 (s, 3 H), 0.92 (d, $J = 6.9$ Hz, 3 H), 0.86 (s, 9 H), 0.06 (s, 6 H); ^{13}C NMR (75 MHz, CDCl_3) δ 137.2, 128.9, 128.1, 126.0, 101.7, 81.8, 78.8, 78.3, 73.7, 69.8, 67.2, 66.0, 46.9, 35.4, 32.3, 30.3, 25.6, 17.7, 17.3, 16.0, -4.1, -4.9; HRMS (EI) calcd for $\text{C}_{27}\text{H}_{44}\text{O}_6\text{Si}$ (M^+) 492.2905, found 492.2890.

Carboxylic Acid 4. To a solution of **10** (594 mg, 1.21 mmol) in CH_2Cl_2 (15 mL) and DMSO (2.4 mL) at 0°C were added Et_3N (0.85 mL, 6.05 mmol) and $\text{SO}_3 \cdot \text{pyr}$ (760 mg, 4.8 mmol). After stirring for 1.5 h, the mixture was diluted with Et_2O , then washed with satd NH_4Cl and brine. Concentration

and chromatography (hexane/EtOAc, 6:1) gave the corresponding aldehyde (594 mg, 100%): colorless oil; R_f = 0.40 (hexane/EtOAc, 4:1); ^1H NMR (300 MHz, CDCl_3) δ 9.57 (d, J = 1.8 Hz, 1 H), 7.48-7.45 (m, 2 H), 7.35-7.32 (m, 3 H), 5.49 (s, 1 H), 4.21 (d, J = 5.3 Hz, 1 H), 3.68-3.64 (m, 2 H), 3.56-3.48 (m, 2 H), 3.22-3.13 (m, 2 H), 2.57 (br, 1 H), 2.18-2.07 (m, 3 H), 1.73 (q, J = 11.7 Hz, 1 H), 1.60 (ddd, J = 14.0, 9.7, 3.9 Hz, 1 H), 1.51 (t, J = 11.3 Hz, 1 H), 1.26 (s, 3 H), 1.10 (d, J = 7.0 Hz, 3 H), 0.87 (s, 9 H), 0.07 (s, 6 H).

To a solution of the aldehyde obtained in THF (4 mL), *t*-BuOH (4 mL), H_2O (4 mL), and 2-methyl-2-butene (0.80 mL, 7.50 mmol) were added NaH_2PO_4 (450 mg, 3.75 mmol) and NaClO_2 (339 mg, 3.75 mmol). After stirring at room temperature for 1 h, the mixture was diluted with Et_2O , then washed with water and brine. Concentration and chromatography (hexane/EtOAc, 3:1) gave the carboxylic acid **4** (607 mg, 96%): yellow oil; R_f = 0.26 (hexane/EtOAc, 4:1); ^1H NMR (300 MHz, CDCl_3) δ 7.49-7.46 (m, 2 H), 7.37-7.33 (m, 3 H), 5.50 (s, 1 H), 4.23 (d, J = 5.7 Hz, 1 H), 3.70-3.65 (m, 2 H), 3.56-3.47 (m, 2 H), 3.25-3.20 (m, 2 H), 2.77 (br, 1 H), 2.21 (m, 2 H), 2.10 (dd, J = 11.7, 5.0 Hz, 1 H), 1.75 (q, J = 11.7 Hz, 1H), 1.58-1.39 (m, 3 H), 1.28 (s, 3 H), 1.22 (d, J = 7.1 Hz, 3 H), 0.88 (s, 9 H), 0.07 (s, 6 H); MS (EI) calcd for $\text{C}_{50}\text{H}_{63}\text{O}_{11}$ ($\text{M}^+ - \text{H}$) 840, found 840.

Ester 11. To a solution of **4** (629 mg, 1.24 mmol) and **5** (578 mg, 1.24 mmol) in CH_2Cl_2 (14 mL) were added CSA (86.0 mg, 0.37 mmol), DMAP (45.0 mg, 0.37 mmol), and DCC (1.0 g, 5.0 mmol) in CH_2Cl_2 (6 mL). After refluxing for 15 h, the reaction mixture was filtered through a Celite pad, and washed with hexane. The filtrate was concentrated and purified by chromatography (hexane/EtOAc, 6:1 to 2:1) to give the ester **11** (910 mg, 100% based on recovery) and **5** (160 mg, 28%): colorless oil; R_f = 0.43 (hexane/EtOAc, 4:1); $[\alpha]_D^{22}$ -32.2° (c 0.78, CHCl_3); IR (neat) 1736 cm^{-1} ; ^1H NMR (300 MHz, CDCl_3) δ 7.48-7.45 (m, 2 H), 7.35-7.24 (m 13 H), 5.80 (dd, J = 17.2, 10.8 Hz, 1 H), 5.51 (s, 1 H), 5.25 (d, J = 17.2, 1 H), 5.05 (d, J = 10.8, 1 H), 4.90 (dd, J = 9.7, 5.7 Hz, 1 H), 4.54 (d, J = 11.6, 1 H), 4.42 (s, 2 H), 4.38 (d, J = 11.6 Hz, 1 H), 4.22 (d, J = 5.5 Hz, 1 H), 3.68-3.43 (m, 8 H), 3.19-3.13 (m, 2 H), 2.74 (br, 1 H), 2.18-1.41 (m, 13 H), 1.35 (s, 3 H), 1.27 (s, 3 H), 1.26 (s, 3 H), 1.22 (s, 3 H), 1.15 (d, J = 7.1 Hz, 3 H), 0.86 (s, 9 H), 0.06 (s, 6 H); ^{13}C NMR (75 MHz, CDCl_3) δ 174.7, 143.9, 138.4, 138.3, 137.3, 128.9, 128.1, 127.5, 127.4, 127.3, 126.0, 113.1, 101.7, 81.8, 79.0, 78.5, 77.9, 75.6, 73.8, 73.5,

73.2, 72.9, 70.9, 70.5, 70.3, 69.8, 66.0, 65.9, 47.0, 40.1, 35.9, 31.4, 30.3, 28.0, 25.6, 22.9, 22.5, 19.7, 17.8, 17.1, 16.0, 14.0, -4.2, -4.8; Anal. Calcd for $C_{56}H_{78}O_{11}Si$: C, 70.41; H, 8.23. Found: C, 70.38; H, 8.54.

Alcohol 12. To a mixture of **11** (295 mg, 0.31 mmol) in THF (4 mL) and AcOH (354 μ L, 6.18 mmol) was added TBAF (3.2 mL, 3.20 mmol, 1 M in THF). After stirring for 16 h at 50 °C, the mixture was diluted with EtOAc, then washed with water, satd $NaHCO_3$, and brine. Concentration and chromatography (hexane/EtOAc, 2:1) gave **12** (228 mg, 88%): colorless oil; R_f = 0.50 (hexane/EtOAc, 1:1); $[\alpha]_D^{25}$ -30.9° (c 0.71, $CHCl_3$); IR (neat) 1736 cm^{-1} ; 1H NMR (300 MHz, $CDCl_3$) δ 7.49-7.24 (m, 15 H), 5.80 (dd, J = 17.4, 10.6 Hz, 1 H), 5.51 (s, 1 H), 5.25 (d, J = 17.4 Hz, 1 H), 5.06 (d, J = 10.6 Hz, 1 H), 4.90 (dd, J = 9.3, 5.7 Hz, 1 H), 4.55 (d, J = 11.6 Hz, 1 H), 4.43 (s, 2 H), 4.38 (d, J = 11.6 Hz, 1 H), 4.24 (d, J = 5.5 Hz, 1 H), 3.69-3.47 (m, 8 H), 3.17-3.10 (m, 2 H), 2.81-2.76 (m, 1 H), 2.23-2.13 (m, 4 H), 2.03-1.44 (m, 9 H), 1.37 (s, 3 H), 1.27 (s, 6 H), 1.23 (s, 3 H), 1.18 (d, J = 7.1, 3 H); ^{13}C NMR (75 MHz, $CDCl_3$) δ 175.1, 143.8, 138.3, 138.2, 137.2, 128.9, 128.1, 127.5, 127.4, 125.9, 113.2, 101.7, 81.7, 78.3, 75.5, 73.8, 73.6, 73.2, 72.8, 70.8, 69.8, 69.3, 66.0, 65.8, 60.2, 46.4, 40.0, 35.9, 31.4, 30.2, 27.9, 22.6, 20.9, 19.7, 17.9, 17.1, 15.8, 14.0; Anal. Calcd for $C_{50}H_{64}O_{11}$: C, 71.40; H, 7.67. Found: C, 70.92; H, 7.60.

Allylstannane 14. To a mixture of **11** (228 mg, 0.27 mmol) and γ -methoxyallylstannane **13** (310 mg, 0.86 mmol) in CH_2Cl_2 (3 mL) was added CSA (13 mg, 54.2 μ mol), and the mixture was stirred for 2 h at room temperature. The mixture was quenched with Et_3N , filtered through a short alumina column (EtOAc). Concentration and chromatography (hexane/EtOAc, 4:1 containing 1% Et_3N) gave the corresponding mixed acetal (303 mg, 93%): colorless oil; R_f = 0.31 (hexane/EtOAc, 4:1); IR (neat) 1736 cm^{-1} ; 1H NMR (300 MHz, C_6D_6) δ 7.68-7.65 (m, 2 H), 7.30-7.07 (m, 13 H), 6.08-5.97 (m, 1 H), 5.55-5.46 (m, 1 H), 5.36 (s, 1 H), 5.30-5.25 (m, 1 H), 5.10-5.02 (m, 1 H), 4.48-4.45 (m, 1 H), 4.38-4.32 (m, 4 H), 3.75-3.45 (m, 9 H), 3.21 (s, 1.5 H), 3.18-3.12 (m, 1 H), 3.16 (s, 1.5 H), 3.05-2.95 (m, 1 H), 2.60-2.20 (m, 5 H), 2.10-2.03 (m, 2 H), 1.99-1.80 (m, 4 H), 1.78-1.55 (m, 9 H), 1.52 (s, 3 H), 1.48-1.40 (m, 9 H), 1.35-1.20 (m, 12 H), 1.10-0.80 (m, 15 H); MS (EI) calcd for $C_{62}H_{91}O_{12}Sn$ ($M^+ - C_4H_7$) 1145, found 1145.

To a mixture of the mixed acetal (303 mg, 0.252 mmol) in CH_2Cl_2 (5 mL) at $-20\text{ }^\circ\text{C}$ were added HMDS (1.1 mL, 5.0 mmol) and TMSI (0.54 mL, 3.8 mmol), and the mixture was stirred for 1 h at the same temperature. The reaction mixture was quenched with Et_3N , diluted with ether, then washed with water and brine. Concentration and chromatography (hexane/EtOAc, 8:1 containing 1 % Et_3N) gave **14** (227 mg, 77%): colorless oil; $R_f = 0.40$ (hexane/EtOAc, 4:1); $[\alpha]_D^{26} -26.9^\circ$ (c 0.68, CHCl_3); IR (neat) 1736, 1649 cm^{-1} ; ^1H NMR (300 MHz, C_6D_6) δ 7.67-7.64 (m, 2 H), 7.30-7.06 (m, 13 H), 6.00 (dd, $J = 17.2, 10.8$ Hz, 1 H), 5.70-5.08 (m, 1 H), 5.48 (d, $J = 17.2$ Hz, 1 H), 5.34 (s, 1 H), 5.33-5.29 (m, 1 H), 5.04 (d, $J = 10.8$ Hz, 1 H), 4.70-4.65 (m, 1 H), 4.38-4.17 (m, 3 H), 4.34 (s, 2 H), 3.78-3.25 (m, 8 H), 3.20-3.12 (m, 2 H), 2.88-2.80 (m, 1 H), 2.48-2.00 (m, 6 H), 1.95-1.80 (m, 2 H), 1.75-1.50 (m, 9 H), 1.50-1.30 (m, 15 H), 1.22-1.20 (m, 9 H), 1.07-0.86 (m, 15 H); ^{13}C NMR (75 MHz, CDCl_3) δ 174.3, 144.9, 140.4, 139.4, 138.5, 128.9, 128.4, 128.2, 127.8, 127.5, 126.7, 112.6, 107.3, 101.8, 80.0, 79.6, 79.2, 78.6, 78.5, 77.3, 75.9, 13.9, 13.8, 73.5, 73.1, 71.1, 70.7, 70.1, 66.6, 66.3, 44.6, 40.8, 36.4, 36.1, 31.9, 30.8, 29.7, 29.6, 29.5, 28.8, 28.2, 27.8, 27.5, 24.0, 23.0, 20.2, 17.8, 17.3, 16.0, 14.3, 14.1, 9.7, 9.4, 6.5; Anal. Calcd for $\text{C}_{65}\text{H}_{94}\text{O}_{11}\text{Sn}$: C, 66.72; H, 8.10. Found: C, 66.43; H, 8.34.

α -Acetoxy Ether 15. To a mixture of **14** (79 mg, 68 μmol) in CH_2Cl_2 (2 mL) at $-90\text{ }^\circ\text{C}$ was added DIBAL-H (0.21 mL, 0.2 mmol, 0.95 M in hexane), and the mixture was stirred for 0.5 h at the same temperature. To the resulting mixture were added pyridine (66 μL , 0.81 mmol), DMAP (66 mg, 0.54 mmol) in CH_2Cl_2 (0.5 mL), and Ac_2O (15 μL , 1.6 mmol), and the stirring was continued for 11 h at $-78\text{ }^\circ\text{C}$. The mixture was diluted with ether, then washed with potassium sodium tartrate and brine. Concentration and chromatography (hexane/EtOAc, 8:1 containing 1% Et_3N) gave **15** (12 mg, 15%): colorless oil; ; $R_f = 0.34$ (hexane/EtOAc, 4:1); ^1H NMR (300 MHz, C_6D_6) δ 7.67-7.64 (m, 2 H), 7.30-7.06 (m, 13 H), 6.35-6.25 (m, 2 H), 5.70-5.65 (m, 2 H), 5.40 (s, 1 H), 5.07 (d, $J = 10.8$ Hz, 1 H), 4.68-4.63 (m, 1 H), 4.37-4.20 (m, 3 H), 4.34 (s, 2 H), 3.99-3.92 (m, 1 H), 3.75-3.70 (m, 1 H), 3.65-3.46 (m, 6 H), 3.38-3.10 (m, 3 H), 2.48-2.00 (m, 6 H), 1.95-1.50 (m, 18 H), 1.48-1.35 (m, 12 H), 1.22-0.90 (m, 24 H)

Sulfide 16. To a mixture of **10** (4.12 g, 8.4 mmol) in DMF (70 mL) at $0\text{ }^\circ\text{C}$ were added $(\text{PhS})_2$ (4.00 g, 18 mmol) and Bu_3P (4.60 mL, 18 mmol). After stirring for 2 h at room temperature, the

mixture was diluted with ether, then washed with water and brine. Concentration and chromatography (hexane/EtOAc, 30:1 to 10:1) gave **16** (4.41g, 90%): colorless oil; $R_f = 0.29$ (hexane/EtOAc, 10:1); $[\alpha]_D^{23} -67.1^\circ$ (c 1.00, CHCl_3); IR (neat) 2953 cm^{-1} ; ^1H NMR (300 MHz, CDCl_3) δ 7.44-7.41 (m, 2H), 7.30-7.18 (m, 7H), 7.10-7.05 (m, 1H), 5.46 (s, 1 H), 4.21-4.13 (m, 1 H), 3.64-3.60 (m, 2 H), 3.52-3.36 (m, 2 H), 3.18 (d, $J = 9.7\text{ Hz}$, 1 H), 3.12 (dd, $J = 12.1, 3.8\text{ Hz}$, 1 H), 3.03 (dd, $J = 12.7, 4.6\text{ Hz}$, 1 H), 2.59 (dd, $J = 12.7, 8.2\text{ Hz}$, 1 H), 2.11-2.01 (m, 3 H), 1.83-1.76 (m, 1 H), 1.70 (q, $J = 11.7\text{ Hz}$, 1 H), 1.44 (d, $J = 11.2\text{ Hz}$, 1 H), 1.30 (ddd, $J = 14.2, 9.7, 4.5\text{ Hz}$, 1 H), 1.21 (s, 3 H), 1.01 (d, $J = 6.6\text{ Hz}$, 1 H), 0.81 (s, 9 H), 0.00 (s, 3 H), -0.01 (s, 3 H); ^{13}C NMR (75 MHz, CDCl_3) δ 137.5, 137.4, 129.1, 128.7, 128.7, 128.3, 126.1, 125.5, 101.9, 82.3, 78.9, 78.7, 74.0, 70.6, 70.0, 66.1, 47.1, 40.2, 38.7, 30.5, 29.8, 25.7, 20.5, 17.9, 16.1, -4.0, -4.7; HRMS (ESI TOF) calcd for $\text{C}_{33}\text{H}_{48}\text{O}_5\text{SSiNa}$ ($\text{M}+\text{Na}^+$) 607.2889 found 607.2874.

O,S-Acetal 18. To a mixture of **16** (300 mg, 0.51 mmol) in CCl_4 (6 mL) was added a solution of NCS (0.5 M in CH_2Cl_2 , 1.00 mL, 0.51 mmol), and the mixture was stirred for 0.5 h at room temperature. The resulting solid was filtered off and washed with CCl_4 . The filtrate was concentrated, and the residue was triturated with hexane. The extract was concentrated to give the chlorosulfide **17** which was used for next reaction directly.

To a mixture of **5** (80 mg, 0.17 mmol), DTBMP (0.2 mL, 0.92 mmol), and MS4A (200 mg) in CH_2Cl_2 (7 mL) at -78°C were added AgOTf (220 mg, 0.86 mmol) and a solution of **17** obtained above in CH_2Cl_2 (3 mL). After stirring for 1 h at -10°C , the mixture was filtered through a short silica gel column (ether). Concentration and chromatography (hexane/EtOAc, 15:1 to 10:1 to 4:1) gave **18** (146 mg, 81% from **5**): amorphous solid; $R_f = 0.37$ (hexane/EtOAc, 4:1); $[\alpha]_D^{21} -15.3^\circ$ (c 1.16, CHCl_3); IR (neat) 2953 cm^{-1} ; ^1H NMR (400 MHz, CDCl_3) δ 7.42-7.39 (m, 4 H), 7.28-7.14 (m, 16 H), 5.84 (dd, $J = 17.2, 10.8\text{ Hz}$, 1 H), 5.43 (s, 1 H), 5.18 (dd, $J = 17.2, 1.2\text{ Hz}$, 1 H), 4.93 (dd, $J = 10.8, 1.2\text{ Hz}$, 1 H), 4.85 (d, $J = 3.6\text{ Hz}$, 1 H), 4.45 (d, $J = 11.6\text{ Hz}$, 1 H), 4.32 (s, 2 H), 4.28 (d, $J = 11.6\text{ Hz}$, 1 H), 4.16 (d, $J = 5.6\text{ Hz}$, 1 H), 3.79 (dd, $J = 10.4, 4.8\text{ Hz}$, 1 H), 3.63-3.57 (m, 2 H), 3.51-3.40 (m, 5 H), 3.23 (t, $J = 8.6\text{ Hz}$, 1 H), 3.13 (dd, $J = 12.2, 3.8\text{ Hz}$, 1 H), 3.01 (dd, $J = 12.0, 3.6\text{ Hz}$, 1 H), 2.21-2.03 (m, 5 H), 1.82 (t, $J = 6.8\text{ Hz}$, 2 H), 1.71 (q, $J = 11.6\text{ Hz}$, 1 H), 1.60-1.53 (m, 1 H), 1.50-1.25 (m, 4 H), 1.22 (s,

3 H), 1.21 (s, 3 H), 1.10 (s, 3 H), 1.06 (s, 3 H), 0.99 (d, $J = 6.8$ Hz, 3 H), 0.80 (s, 9 H), 0.00 (s, 3 H), 0.00 (s, 3 H); ^{13}C NMR (100 MHz, CDCl_3) δ 145.1, 138.8, 138.7, 137.6, 136.1, 133.3, 129.2, 129.2, 128.5, 128.5, 127.9, 127.8, 127.7, 127.7, 127.5, 126.3, 112.3, 102.1, 93.4, 83.5, 79.3, 78.9, 78.0, 77.6, 77.3, 74.3, 73.3, 73.3, 71.6, 71.4, 71.3, 70.3, 66.5, 66.3, 47.6, 40.5, 40.4, 36.9, 35.6, 30.9, 26.3, 26.2, 23.4, 20.0, 18.3, 18.0, 17.8, 16.6, -3.8, -4.1; HRMS (ESI TOF) calcd for $\text{C}_{62}\text{H}_{84}\text{O}_{10}\text{SSiNa}$ ($\text{M}+\text{Na}^+$) 1071.5452, found 1071.5526.

Allylstannane 20. To a solution of **18** (2.14 g, 2.04 mmol) in THF (20 mL) was added TBAF (10 mL, 10 mmol, 1 M in THF), and the mixture was stirred for 3 h at room temperature. The mixture was diluted with ether. The mixture was diluted with ether, then washed with water and brine. Concentration gave the crude alcohol **19** which was used for next reaction directly.

To a solution of **19** obtained above and γ -methoxyallylstannane **13** (2.0 g, 6.12 mmol) in CH_2Cl_2 (20 mL) was added CSA (95 mg, 41 μmol), and the mixture was stirred for 1 h at room temperature. The reaction mixture was quenched with Et_3N and filtered through an alumina pad. The filtrate was concentrated and purified by chromatography (hexane/EtOAc, 20:1 to 6:1 containing 1% Et_3N) to give the corresponding mixed acetal as a mixture of diastereoisomers (2.15 g, 81%): colorless oil; $R_f = 0.39$, 0.33 (hexane/EtOAc, 4:1); IR (neat) 2925 cm^{-1} ; ^1H NMR (400 MHz, C_6D_6) δ 7.71-7.66 (m, 4 H), 7.30-6.93 (m, 16 H), 6.41-6.32 (m, 1 H), 5.69-5.64 (m, 1 H), 5.37-5.24 (m, 3 H), 5.17-5.14 (m, 1 H), 4.54-4.48 (m, 1 H), 4.39-4.18 (m, 6 H), 3.75-3.46 (m, 6 H), 3.28-3.15 (m, 6 H), 2.70-2.58 (m, 2 H), 2.22-1.82 (m, 8 H), 1.70-1.51 (m, 14 H), 1.40-1.28 (m, 14 H), 1.22 (m, 3 H), 1.18-1.16 (m, 3 H), 0.96-0.87 (m, 15 H); HRMS (ESI TOF) calcd for $\text{C}_{72}\text{H}_{104}\text{O}_{11}\text{SSnNa}$ ($\text{M}+\text{Na}^+$) 1317.6230, found 1317.6188.

To a stirred solution of the acetal obtained (437 mg, 0.34 mmol) in CH_2Cl_2 (3 mL) at $0\text{ }^\circ\text{C}$ were added HMDS (1.40 mL, 6.74 mmol) and TMSI (0.72 mL, 5.06 mmol). After stirring for 1 h at the same temperature, the reaction mixture was quenched with satd NaHCO_3 , and extracted with ether. The organic layer was washed with satd NaHCO_3 and brine. Concentration and chromatography (hexane/EtOAc, 8:1 containing 1 % Et_3N) gave **20** (358 mg, 84%): colorless oil; $R_f = 0.37$ (hexane/EtOAc, 4:1); $[\alpha]_{\text{D}}^{20} -17.8^\circ$ (c 0.93, CHCl_3); IR (neat) 2925 , 1651 cm^{-1} ; ^1H NMR (400 MHz,

C_6D_6) δ 7.65-7.63 (m, 4 H), 7.28-6.92 (m, 16 H), 6.32 (dd, $J = 17.2, 10.8$ Hz, 1 H), 5.68 (d, $J = 6.4$ Hz, 1 H), 5.63 (dd, $J = 17.2, 2.0$ Hz, 1 H), 5.33 (s, 1 H), 5.20 (d, $J = 4.4$ Hz, 1 H), 5.14 (dd, $J = 10.8, 2.0$ Hz, 1 H), 4.65 (ddd, $J = 8.9, 8.9, 6.4$ Hz, 1 H), 4.37 (d, $J = 11.2$ Hz, 1 H), 4.30 (s, 2 H), 4.23-4.15 (m, 3 H), 3.75-3.38 (m, 7 H), 3.28 (dd, $J = 11.6, 2.8$ Hz, 1 H), 3.20-3.11 (m, 2 H), 2.58-2.47 (m, 2 H), 2.32 (dd, $J = 11.6, 5.2$ Hz, 1 H), 2.21-2.14 (m, 2 H), 2.09-2.02 (m, 3 H), 1.89-1.58 (m, 14 H), 1.52 (s, 3 H), 1.44-1.34 (m, 7 H), 1.29 (s, 3 H), 1.28 (d, $J = 6.4$ Hz, 3 H), 1.20 (s, 3 H), 1.09 (s, 3 H), 1.01-0.92 (m, 13 H); ^{13}C NMR (100 MHz, C_6D_6) δ 145.6, 140.6, 139.4, 139.2, 138.5, 136.4, 133.5, 129.3, 128.9, 128.5, 127.8, 127.6, 127.6, 127.5, 126.7, 111.5, 107.0, 102.0, 93.5, 81.2, 79.7, 79.7, 78.8, 78.3, 78.0, 77.3, 76.7, 73.9, 73.3, 73.2, 71.9, 71.1, 70.3, 66.7, 66.4, 44.9, 40.9, 40.8, 37.1, 35.9, 31.1, 29.9, 29.8, 29.7, 29.7, 29.7, 28.2, 28.0, 27.9, 27.7, 26.6, 24.2, 20.2, 17.8, 17.8, 16.2, 14.2, 14.1, 9.9, 6.7; HRMS (ESI TOF) calcd for $\text{C}_{71}\text{H}_{100}\text{O}_{10}\text{SSnNa}$ ($\text{M}+\text{Na}^+$) 1285.5968, found 1285.5537.

Cyclization of 20. To a mixture of AgOTf (380 mg, 1.48 mmol) and MS4A (300 mg) in CH_2Cl_2 (9 mL) at -78°C was added a solution of **20** (268 mg, 0.21 mmol) in CH_2Cl_2 (3 mL), and the mixture was stirred for 3 h at room temperature. The reaction was quenched with Et_3N and filtered through a short silica gel column (ether). Concentration and chromatography (hexane/EtOAc, 6:1 to 4:1) gave a mixture of **21** and **22** (140 mg, 84%); the ratio of **21** and **22** (78:22) was determined by ^1H NMR spectrum of the mixture. Separation of the mixture gave pure **21** together with **22**, which was still contaminated with small amounts of **21**.

21: amorphous solid; $R_f = 0.18$ (hexane/EtOAc, 4:1); $[\alpha]_D^{21} +4.5^\circ$ (c 0.65, CHCl_3); IR (neat) 2952, 1455 cm^{-1} ; ^1H NMR (400 MHz, C_6D_6) δ 7.58-7.57 (m, 2 H), 7.23-7.04 (m, 13 H), 6.00 (dd, $J = 17.6, 10.8$ Hz, 1 H), 5.48-5.40 (m, 1 H), 5.41 (d, $J = 16.0$ Hz, 1 H), 5.33 (s, 1 H), 5.28 (d, $J = 17.6$ Hz, 1 H), 5.06 (dd, $J = 10.8, 1.2$ Hz, 1 H), 4.96 (d, $J = 10.4$ Hz, 1 H), 4.35 (d, $J = 11.6$ Hz, 1 H), 4.31-4.27 (m, 3 H), 4.18-4.15 (m, 2 H), 4.00-3.94 (m, 1 H), 3.73-3.46 (m, 6 H), 3.36-3.14 (m, 5 H), 2.24-1.81 (m, 10 H), 1.71-1.52 (m, 3 H), 1.36 (s, 3 H), 1.25 (s, 3 H), 1.19 (s, 3 H), 1.16 (s, 3 H), 0.84 (d, $J = 6.4$ Hz, 3 H); ^{13}C NMR (100 MHz, C_6D_6) δ 145.2, 139.0, 138.8, 138.3, 137.7, 127.5, 126.5, 115.0, 113.0, 101.7, 83.7, 82.3, 80.0, 79.4, 78.8, 78.7, 77.9, 77.1, 76.6, 73.9, 73.5, 73.1, 72.9, 72.1, 70.9, 70.1, 66.5, 66.1, 45.5, 40.7, 40.5, 35.1, 31.0, 27.6, 27.3, 22.3, 22.2, 19.8, 17.6, 15.8; HRMS (ESI TOF) calcd for

$C_{53}H_{68}O_{10}Na$ ($M+Na^+$) 887.4710, found 887.4820.

Olefin 25. To a mixture of **21** (690 mg, 0.80 mmol) in benzene (380 mL) was added **23** (328 mg, 0.40 mmol), and the mixture was stirred at 60 °C for 2 h. An additional amount of **23** (984 mg, 1.20 mmol) was added, and the stirring was continued for 11 h. The mixture was filtered through a short silica gel column with ether as an eluent, and the filtrate was concentrated. The residue was purified by chromatography (hexane/EtOAc, 6:1) to give **25** (482 mg, 72%): colorless needle; mp 220 °C (hexane/EtOAc); R_f = 0.25 (hexane/EtOAc, 3:1); $[\alpha]_D^{24} +21.0^\circ$ (c 1.31, $CHCl_3$); IR (neat) 2930, 1454 cm^{-1} ; 1H NMR (400 MHz, $CDCl_3$) δ 7.48-7.46 (m, 2 H), 7.34-7.23 (m, 13 H), 5.72 (d, J = 11.6 Hz, 1 H), 5.60 (d, J = 11.6 Hz, 1 H), 5.48 (s, 1 H), 4.53 (d, J = 12.0 Hz, 1 H), 4.42 (s, 2 H), 4.36 (d, J = 12.0 Hz, 1 H), 4.22-4.17 (m, 2 H), 3.70-3.46 (m, 7 H), 3.35-3.29 (m, 3 H), 3.16 (dd, J = 12.0, 3.2 Hz, 1 H), 3.09 (t, J = 10.0 Hz, 1 H), 2.20-2.03 (m, 4 H), 1.93-1.69 (m, 6 H), 1.61-1.53 (m, 2 H), 1.46 (s, 3 H), 1.43-1.40 (m, 1 H), 1.31 (s, 3 H), 1.22 (s, 3 H), 1.17 (s, 3 H), 1.02 (d, J = 7.2 Hz, 3 H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 139.9, 138.3, 138.3, 137.1, 131.6, 128.9, 128.1, 128.1, 127.5, 127.3, 127.3, 127.3, 126.0, 101.8, 88.7, 86.1, 84.7, 84.0, 83.5, 79.9, 79.3, 78.6, 77.9, 77.0, 74.4, 73.2, 72.9, 72.8, 70.9, 69.9, 66.2, 65.9, 44.6, 40.2, 40.0, 35.2, 33.4, 30.4, 29.2, 22.6, 20.1, 18.0, 17.5, 16.3; HRMS (ESI TOF) calcd for $C_{51}H_{64}O_{10}Na$ ($M + Na^+$) 859.4397, found 859.4359.

Olefin 26. An 86:14 mixture of **21** and **22** (60.6 mg, 70.9 μ mol) in CH_2Cl_2 (9 mL) was added **24** (6.0 mg, 7.1 μ mol), and the mixture was stirred for 17 h at room temperature. The mixture was filtered through a short silica gel column (ether) and concentrated. The residue was purified by chromatography (hexane/EtOAc, 6:1 to 3:1) to give **26** (8.4 mg, 100% from **22**) and unreacted **21** (42 mg, 81%).

26: amorphous solid; R_f = 0.25 (hexane/EtOAc, 3:1); $[\alpha]_D^{21} -16.3^\circ$ (c 0.83, $CHCl_3$); IR (neat) 2951, 1455 cm^{-1} ; 1H NMR (400 MHz, C_6D_6) δ 7.61-7.60 (m, 2 H), 7.24-7.05 (m, 13 H), 6.09 (d, J = 11.6 Hz, 1 H), 5.50 (dd, J = 11.6, 7.4 Hz, 1 H), 5.34 (s, 1 H), 4.58 (dd, J = 11.6, 4.4 Hz, 1 H), 4.33 (d, J = 12.0 Hz, 1 H), 4.26 (s, 2 H), 4.17 (d, J = 12.0 Hz, 1 H), 4.18-4.15 (m, 1 H), 3.69-3.63 (m, 3 H), 3.58 (dd, J = 11.2, 5.2 Hz, 1 H), 3.53-3.44 (m, 4 H), 3.33-3.21 (m, 2 H), 3.10-3.02 (m, 2 H), 2.27-2.23 (m, 2 H), 2.13-2.07 (m, 3 H), 1.99 (t, J = 6.6 Hz, 2 H), 1.94-1.79 (m, 3 H), 1.72 (t, J = 11.6 Hz, 1 H), 1.54 (t, J =

11.6 Hz, 1 H), 1.46 (s, 3 H), 1.37-1.28 (m, 1 H), 1.22 (s, 3 H), 1.10 (s, 3 H), 1.03 (s, 3 H), 0.94 (d, $J = 6.8$ Hz, 3 H); ^{13}C NMR (100 MHz, C_6D_6) δ 143.7, 139.3, 139.2, 138.5, 128.9, 128.5, 128.4, 128.2, 128.1, 127.9, 127.7, 127.7, 127.6, 127.5, 126.7, 123.0, 101.9, 84.0, 83.3, 82.4, 79.5, 78.9, 78.6, 77.5, 77.5, 77.3, 77.1, 74.3, 73.6, 73.1, 72.7, 71.1, 70.3, 66.7, 66.4, 45.4, 40.9, 40.4, 40.2, 36.3, 31.1, 30.5, 23.7, 22.5, 20.3, 17.5, 16.3; HRMS (ESI TOF) calcd for $\text{C}_{51}\text{H}_{64}\text{O}_{10}\text{Na}$ ($\text{M}+\text{Na}^+$) 859.4397, found 859.4496.

Alcohol 27. A solution of **25** in MeOH (2 mL) and CH_2Cl_2 (2 mL) was added CSA (57 mg, 0.25 mmol), and the mixture was stirred for 2 h at room temperature. The reaction mixture was quenched with Et_3N and filtered through a short silica gel column (EtOAc/MeOH, 5:1). The filtrate was concentrated to give the corresponding diol which was used for next reaction directly.

To a solution of the crude diol in CH_2Cl_2 (2 mL) at room temperature were added 2,6-lutidine (0.12 mL, 0.98 mmol) and TBSOTf (0.12 mL, 0.49 mmol). After stirring for 1 h at the same temperature, the reaction was quenched with MeOH. The mixture was diluted with ether, then washed with satd CuSO_4 , satd NaHCO_3 , and brine. Concentration and filtration through a short silica gel column (hexane/EtOAc, 10:1) gave the crude bis-silyl ether which was used for next reaction directly.

A mixture of the bis-silyl ether obtained above, 5% Pd-C (940 mg), and Et_3N (2.4 mL) in EtOAc (40 mL) was stirred for 2 h under H_2 atmosphere. The catalyst was filtered off, and the filtrate was concentrated to give the saturated hexacycle which was used for next reaction.

To a solution of the hexacycle obtained in MeOH (1.2 mL) and CH_2Cl_2 (1.2 mL) at 0°C was added CSA (3.6 mg, 16 μmol). After stirring for 2.5 h at the same temperature, the reaction mixture was quenched with Et_3N and filtered through a short silica gel column (ether). Concentration and chromatography (hexane/EtOAc, 2:1 to 1:1) gave **27** (53.4 mg, 80%): amorphous solid; $R_f = 0.24$ (hexane/EtOAc, 2:1); $[\alpha]_D^{23} +16.8^\circ$ (c 1.00, CHCl_3); IR (neat) 3485, 2952 cm^{-1} ; ^1H NMR (400 MHz, CDCl_3) δ 7.33-7.22 (m, 10 H), 4.53 (d, $J = 11.6$ Hz, 1 H), 4.44 (s, 2 H), 4.36 (d, $J = 11.6$ Hz, 1 H), 3.76-3.72 (m, 1 H), 3.62-3.51 (m, 6 H), 3.47-3.43 (m, 1 H), 3.36-3.29 (m, 2 H), 3.23-3.17 (m, 1 H), 3.09-3.05 (m, 2 H), 2.99 (dd, $J = 12.6, 3.4$ Hz, 1 H), 2.11-2.00 (m, 4 H), 1.99-1.91 (m, 4 H), 1.84-1.75 (m, 3 H), 1.72-1.65 (m, 3 H), 1.58 (t, $J = 11.6$ Hz, 2 H), 1.47 (t, $J = 11.6$ Hz, 1 H), 1.38 (t, $J = 11.6$ Hz,

1 H), 1.28 (s, 3 H), 1.23 (s, 3 H), 1.23 (s, 3 H), 1.17 (s, 3 H), 1.02 (d, $J = 7.2$ Hz, 3 H), 0.85 (s, 9 H), 0.05 (s, 6 H); ^{13}C NMR (100 MHz, CDCl_3) δ 138.5, 138.4, 128.2, 128.2, 127.6, 127.5, 127.4, 127.4, 88.0, 87.4, 85.0, 83.9, 83.7, 79.0, 78.1, 77.9, 74.2, 73.5, 73.3, 73.0, 72.9, 71.0, 67.3, 66.0, 62.6, 45.1, 40.4, 40.3, 38.0, 35.4, 34.2, 33.3, 33.2, 29.5, 28.9, 25.7, 21.6, 20.3, 18.6, 17.9, 17.6, 16.2, -4.1, -4.9; HRMS (ESI TOF) calcd for $\text{C}_{50}\text{H}_{76}\text{O}_{10}\text{SiNa}$ ($\text{M}+\text{Na}^+$) 887.5105, found 887.5132.

Ketone 28. To a mixture of **27** (47 mg, 54 μmol) and MS4A (50 mg) in CH_2Cl_2 (2 mL) were added NMO (38 mg, 0.32 mmol) and TPAP (1 mg, 2.7 μmol), and the mixture was stirred for 1.5 h at room temperature. The mixture was filtered through a short silica gel column and concentrated to give the corresponding aldehyde which was used for next reaction directly.

To a solution of the crude aldehyde obtained in THF (2 mL) at 0 °C was added MeMgI (0.84 M in ether, 0.40 mL, 0.32 mmol). After stirring for 0.5 h at the same temperature, the mixture was quenched with MeOH and filtered through a short silica gel column (ether). The filtrate was concentrated to give the corresponding alcohol which was used for next reaction directly.

To a mixture of the crude alcohol obtained and MS4A (50 mg) in CH_2Cl_2 (2 mL) were added NMO (76 mg, 0.64 mmol) and TPAP (1 mg, 5.4 μmol). After stirring for 2 h at room temperature, the mixture was filtered through a short silica gel column (ether). Concentration and chromatography (hexane/EtOAc, 4:1) gave **28** (43.0 mg, 91%): amorphous solid; $R_f = 0.47$ (hexane/EtOAc, 2:1); $[\alpha]_D^{24} +7.7^\circ$ (c 0.92, CHCl_3); IR (neat) 2951, 1728 cm^{-1} ; ^1H NMR (400 MHz, CDCl_3) δ 7.30-7.22 (m, 10 H), 4.52 (d, $J = 11.6$ Hz, 1 H), 4.44 (s, 2 H), 4.35 (d, $J = 11.6$ Hz, 1 H), 3.89 (d, $J = 9.2$ Hz, 1 H), 3.77 (ddd, $J = 10.0, 10.0, 5.2$ Hz, 1 H), 3.64-3.50 (m, 4 H), 3.36-3.32 (m, 1 H), 3.31 (dd, $J = 12.0, 3.2$ Hz, 1 H), 3.20 (ddd, $J = 11.6, 11.6, 4.0$ Hz, 1 H), 3.11-3.04 (m, 3 H), 2.18 (s, 3 H), 2.12-2.04 (m, 4 H), 2.02-1.87 (m, 3 H), 1.83-1.74 (m, 3 H), 1.72-1.51 (m, 6 H), 1.43-1.33 (m, 1 H), 1.28 (s, 3 H), 1.24 (s, 3 H), 1.23 (s, 3 H), 1.17 (s, 3 H), 1.02 (d, $J = 6.8$ Hz, 3 H), 0.82 (s, 9 H), 0.03 (s, 3 H), -0.01 (s, 3 H); ^{13}C NMR (100 MHz, CDCl_3) δ 205.6, 138.5, 138.4, 128.2, 128.2, 127.6, 127.5, 127.4, 127.4, 88.0, 87.4, 85.1, 84.0, 83.7, 78.6, 78.2, 78.1, 77.9, 77.0, 73.5, 73.3, 73.0, 71.0, 68.5, 66.0, 44.9, 40.4, 40.3, 38.0, 35.4, 34.5, 33.2, 29.5, 28.9, 28.0, 25.7, 21.6, 20.3, 18.6, 17.9, 17.6, 15.9, -4.4, -4.9; HRMS (ESI TOF) calcd for $\text{C}_{51}\text{H}_{76}\text{O}_{10}\text{SiNa}$ ($\text{M} + \text{Na}^+$) 899.5105, found 899.5112.

Diene 29. To a suspension of $\text{Ph}_3\text{P}^+\text{CH}_3\text{Br}^-$ (21 mg, 58 μmol) in THF (0.4 mL) at 0 °C was added NaHMDS (1.0 M in THF, 58 μL , 58 μmol), and the mixture was stirred for 20 min at the same temperature. To the resulting mixture was added a solution of **28** (3.4 mg, 3.9 μmol) in THF (0.6 mL). After stirring for 1 h at room temperature, the reaction mixture was quenched with MeOH and filtered through a short silica gel column (ether). The filtrate was concentrated to give the crude olefin which was used for next reaction directly.

To a solution of the crude olefin obtained above in THF (0.8 mL) at room temperature was added TBAF (1.0 M, 20 μL , 20 μmol), and the mixture was stirred for 3 h at 40 °C. The mixture was filtered through a short silica gel column (ether) and concentrated to give the corresponding alcohol which was used for next reaction directly.

To a suspension of KH (90 mg, 0.78 mmol, 30 %, prewashed with hexane) in THF (0.4 mL) at 0 °C were added allyl bromide (67.0 μL , 0.78 mmol) and the crude alcohol obtained above in THF (0.6 mL). After stirring for 1 h at room temperature, the reaction mixture was quenched with MeOH and filtered through a short silica gel column (ether). Concentration and chromatography (hexane/EtOAc, 20:1 to 2:1) gave **29** (2.8 mg, 90%): amorphous solid; R_f = 0.44 (hexane/EtOAc, 2:1); $[\alpha]_D^{25} +14.3^\circ$ (c 1.48, CHCl_3); IR (neat) 2947 cm^{-1} ; ^1H NMR (400 MHz, CDCl_3) δ 7.30-7.22 (m, 10 H), 5.82 (dddd, J = 17.2, 10.4, 5.8, 5.8 Hz, 1 H), 5.22 (dd, J = 17.2, 1.2 Hz, 1 H), 5.13 (dd, J = 10.4, 1.2 Hz, 1 H), 5.06 (s, 1 H), 4.97 (s, 1 H), 4.52 (d, J = 11.6 Hz, 1 H), 4.44 (s, 2 H), 4.36 (d, J = 11.6 Hz, 1 H), 4.01 (dd, J = 12.6, 5.8 Hz, 1 H), 3.93-3.89 (m, 2 H), 3.64-3.49 (m, 4 H), 3.36-3.26 (m, 3 H), 3.20 (ddd, J = 11.6, 11.6, 4.4 Hz, 1 H), 3.11-2.99 (m, 3 H), 2.23 (dt, J = 11.6, 4.4 Hz, 1 H), 2.11-2.05 (m, 3 H), 2.00-1.89 (m, 3 H), 1.87-1.47 (m, 9 H), 1.74 (s, 3 H), 1.38 (t, J = 11.6 Hz, 1 H), 1.28 (s, 3 H), 1.24 (s, 3 H), 1.23 (s, 3 H), 1.17 (s, 3 H), 1.02 (d, J = 6.8 Hz, 3 H); ^{13}C NMR (100 MHz, CDCl_3) δ 143.0, 138.5, 138.4, 134.7, 128.2, 128.2, 127.6, 127.5, 127.4, 127.4, 117.1, 115.2, 88.0, 87.5, 85.5, 85.0, 83.7, 83.7, 79.0, 78.1, 77.9, 77.0, 76.6, 75.2, 73.5, 73.3, 73.0, 72.7, 71.0, 70.1, 66.0, 45.2, 40.4, 40.3, 38.1, 35.5, 33.3, 30.9, 29.5, 29.0, 21.6, 20.3, 18.6, 18.2, 17.6, 16.0; HRMS (ESI TOF), Calcd for $\text{C}_{49}\text{H}_{68}\text{O}_9\text{Na}$ ($\text{M} + \text{Na}^+$): 823.4761, Found: 823.4682.

Olefin 30. A mixture of **29** (10.6 mg, 13.2 μmol) and **23** (2.2 mg, 2.6 μmol) in CH_2Cl_2 (4 mL)

was stirred for 1.5 h at room temperature. The mixture was filtered through a short silica gel column (ether) and concentrated. The residue was purified by chromatography (hexane/EtOAc, 4:1) to give **30** (10.0 mg, 98%): amorphous solid; $R_f = 0.31$ (hexane/EtOAc, 4:1); ^1H NMR (400 MHz, CDCl_3) δ 7.32-7.24 (m, 10 H), 5.34 (brs, 1 H), 4.54 (d, $J = 11.8$ Hz, 1 H), 4.46 (s, 2 H), 4.37 (d, $J = 11.6$ Hz, 1 H), 4.24 (brd, $J = 16.2$ Hz, 1 H), 4.13 (brd, $J = 16.8$ Hz, 1 H), 3.97 (d, $J = 8.6$ Hz, 1 H), 3.66-3.53 (m, 4 H), 3.36 (dd, $J = 8.3, 5.1$ Hz, 1 H), 3.32 (dd, $J = 11.9, 3.5$ Hz, 1 H), 3.28-3.19 (m, 2 H), 3.14 (dd, $J = 12.4, 3.8$ Hz, 1 H), 3.10-3.06 (m, 2 H), 2.13-2.09 (m, 3 H), 2.01-1.90 (m, 4 H), 1.84-1.60 (m, 8 H), 1.70 (s, 3 H), 1.53 (t, $J = 11.8$ Hz, 1 H), 1.40 (t, $J = 11.5$ Hz, 1 H), 1.30 (s, 3 H), 1.27 (s, 3 H), 1.24 (s, 3 H), 1.19 (s, 3 H), 1.03 (d, $J = 7.1$ Hz, 3 H). The ^1H NMR data of **30** is identical with that reported previously.^{2a,b}

Alcohol 31. Lithium wire (33 mg, 5.0 mmol) was cut into small pieces and added to liquid NH_3 (15 mL) at -78 °C, and the mixture was stirred for 10 min at the same temperature. To the resulting deep blue solution was added a solution **30** (64 mg, 83 μmol) in THF (3 mL). After stirring for 1 min at -78 °C, the reaction was quenched with MeOH-satd NH_4Cl (1:1). The mixture was extracted with EtOAc, and the organic layer was washed with satd NaHCO_3 and brine. The solvent was removed to give the corresponding diol which was used for next reaction directly.

To a solution of the crude diol obtained above in CH_2Cl_2 (8 mL) were added 2,6-lutidine (0.19 mL, 1.66 mmol) and TBSOTf (0.19 mL, 0.83 mmol). After stirring for 0.5 h at room temperature, the mixture was quenched with MeOH and diluted with ether. The mixture was washed with satd CuSO_4 , satd NaHCO_3 , and brine. The solvent was removed to give the corresponding bis-silyl ether which was used for next reaction directly.

To a solution of the bis-silyl ether obtained above in MeOH (3 mL) and CH_2Cl_2 (3 mL) at 0 °C was added CSA (3.8 mg, 17 μmol), and the mixture was stirred for 1.5 h at the same temperature. the reaction mixture was quenched with Et_3N and filtered through a short silica gel column (ether). Concentration and chromatography (hexane/EtOAc, 4:1 to 2:1) gave **31** (52.6 mg, 90%): amorphous solid; $R_f = 0.29$ (hexane/EtOAc, 2:1); $[\alpha]_D^{24} +18.5^\circ$ (c 1.74, CHCl_3); IR (neat) 3510, 2928 cm^{-1} ; ^1H NMR (400 MHz, CDCl_3) δ 5.32 (brs, 1 H), 4.22 (brd, $J = 15.6$ Hz, 1 H), 4.11 (dd, $J = 16.4, 2.4$ Hz, 1

H), 3.94 (d, $J = 7.6$ Hz, 1 H), 3.81-3.75 (m, 3 H), 3.53 (q, $J = 7.6$ Hz, 1 H), 3.35-3.29 (m, 2 H), 3.26-3.15 (m, 2 H), 3.13-3.02 (m, 4 H), 2.11-1.98 (m, 4 H), 1.90-1.58 (m, 12 H), 1.67 (s, 3 H), 1.67 (s, 3 H), 1.48 (t, $J = 11.2$ Hz, 2 H), 1.28 (s, 3 H), 1.26 (s, 3 H), 1.24 (s, 3 H), 1.00 (d, $J = 6.8$ Hz, 3 H), 0.81 (s, 9 H), 0.02 (s, 3 H), 0.01 (s, 3 H); ^{13}C NMR (100 MHz, CDCl_3) δ 134.5, 121.0, 87.9, 87.7, 85.3, 83.9, 83.7, 81.2, 80.3, 78.1, 74.8, 73.9, 73.6, 73.0, 71.8, 69.6, 66.9, 59.4, 45.1, 44.3, 41.5, 38.1, 35.5, 33.3, 31.1, 29.5, 29.0, 25.7, 21.6, 20.3, 18.5, 17.8, 17.2, 16.7, 16.3, -3.9, -4.9; HRMS (ESI TOF) calcd for $\text{C}_{39}\text{H}_{66}\text{O}_9\text{SiNa}$ ($\text{M}+\text{Na}^+$) 729.4374, found 729.4371.

Olefin 2. To a mixture of **31** (60 mg, 85 μmol), NMO (60 mg, 0.51 mmol), and MS4A (50 mg) in CH_2Cl_2 (3.5 mL) was added TPAP (1.5 mg, 4.2 μmol). After stirring for 1 h at room temperature, the mixture was filtered through a short silica gel column (ether) to give the corresponding aldehyde which was used for next reaction directly

To a suspension of $\text{Ph}_3\text{PCH}_3^+\text{Br}^-$ (300 mg, 0.85 mmol) in THF (2.5 mL) at 0 $^\circ\text{C}$ was added NaHMDS (1.0 M in THF, 0.85 mL, 0.85 mmol), and the mixture was stirred for 20 min at the same temperature. To the resulting mixture was added a solution of the crude aldehyde obtained above in THF (3 mL). After stirring for 0.5 h at room temperature, the reaction was quenched with MeOH and diluted with ether. The mixture was washed with water and brine, then concentrated to give the corresponding olefin which was used for next reaction directly.

To a solution of the olefin obtained above in THF (4 mL) was added TBAF (1.0 M, 0.85 mL, 0.85 mmol), and the mixture was stirred for 12 h at 50 $^\circ\text{C}$. The mixture was diluted with ether, then washed with water and brine. Concentration and chromatography (hexane/EtOAc, 10:1 to 2:1) gave **2** (43 mg, 85%): amorphous solid; $R_f = 0.20$ (hexane/EtOAc, 2:1); $[\alpha]_D^{19} +59.5^\circ$ (c 0.93, CHCl_3); IR (neat) 3456, 2930 cm^{-1} ; ^1H NMR (400 MHz, CDCl_3) δ 5.97-5.87 (m, 1 H), 5.31 (brs, 1 H), 5.11-5.07 (m, 2 H), 4.22 (brd, $J = 16.0$ Hz, 1 H), 4.10 (dd, $J = 16.2, 2.2$ Hz, 1 H), 3.94 (d, $J = 8.0$ Hz, 1 H), 3.76 (dd, $J = 11.4, 5.4$ Hz, 1 H), 3.53 (q, $J = 8.0$ Hz, 1 H), 3.34 (dd, $J = 8.2, 5.4$ Hz, 1 H), 3.28-3.15 (m, 3 H), 3.13-3.03 (m, 3 H), 2.36-2.26 (m, 2 H), 2.11-1.93 (m, 5 H), 1.82-1.36 (m, 11 H), 1.67 (s, 3 H), 1.28 (s, 3 H), 1.24 (s, 3 H), 1.21 (s, 3 H), 1.18 (s, 3 H), 1.00 (d, $J = 7.2$ Hz, 3 H); ^{13}C NMR (100 MHz, CDCl_3) δ 134.5, 134.0, 120.9, 118.0, 88.0, 87.5, 85.3, 83.9, 83.8, 80.3, 78.1, 77.9, 74.8, 73.9, 73.6, 73.4, 70.5,

69.6, 66.9, 45.6, 45.1, 44.2, 38.1, 35.5, 33.3, 31.1, 29.5, 28.9, 21.5, 20.3, 18.6, 17.2, 16.5, 16.3; HRMS (ESI TOF) calcd for $C_{34}H_{52}O_8Na$ ($M+Na^+$) 611.3560, found 611.3553.

Alcohol 33. Ozone was passed through a solution of **32** (1.51g, 5.45 mmol) in MeOH (50 mL) at -78 °C until the solution turned blue. After removal of excess ozone with an oxygen stream, the mixture was treated with Me_2S (2.0 mL, 27.3 mmol) and allowed to warm to room temperature with stirring. Concentration gave the crude aldehyde.

To a solution of the aldehyde obtained above in THF (50 mL) and satd NH_4Cl (10 mL) at 0 °C were added allyl bromide (6.0 mL, 65.6 mmol) and Zn powder (4.0 g, 65.6 mmol), and the mixture was stirred vigorously for 3 h at the same temperature. The mixture was quenched with aq K_2CO_3 , and the insoluble material was filtered off through a Celite pad. The filtrate was concentrated and purified by chromatography (hexane/EtOAc, 4:1) to give **33** and its stereoisomer (1.62 g, 93%, $S:R = 2:1$ determined by 1H NMR analysis).

33: colorless needle; mp 146 °C (CH_2Cl_2 /hexane); $R_f = 0.37$ (hexane/EtOAc, 1:1); $[\alpha]_D^{23} +30.8^\circ$ (c 1.00, $CHCl_3$); IR (neat) 3500-3200, 1641 cm^{-1} ; 1H NMR (400 MHz, $CDCl_3$) δ 7.44-7.41 (m, 2 H), 7.32-7.27 (m, 3 H), 5.74 (dddd, $J = 16.4, 10.7, 9.3, 5.4$ Hz, 1 H), 5.45 (s, 1 H), 5.16-5.10 (m, 2 H), 4.13 (dd, $J = 9.6, 4.4$ Hz, 1 H), 3.82 (ddd, $J = 11.6, 4.4, 1.6$ Hz, 1 H), 2.56-2.51 (m, 1 H), 2.25-2.20 (m, 2 H), 1.98 (ddd, $J = 14.0, 9.8, 9.8$ Hz, 1 H), 1.76 (d, $J = 11.2$ Hz, 1 H), 1.20 (s, 3 H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 137.4, 134.8, 128.9, 128.2, 126.1, 119.2, 101.7, 78.8, 77.6, 77.2, 73.6, 69.9, 66.2, 35.8, 33.0, 10.7; HRMS (ESI TOF) calcd for $C_{18}H_{24}O_5Na$ ($M+Na^+$) 320.1624, found 320.1618; Anal. Calcd for $C_{18}H_{24}O_5$: C, 67.48; H, 7.55. Found: C, 67.44; H, 7.65.

Acetate 34. Ozone was passed through a solution of **33** (608 mg, 1.90 mmol) in CH_2Cl_2 (20 mL) at -78 °C until the solution turned blue. After removal of excess ozone with an oxygen stream, the mixture was treated with PPh_3 (1.5 g, 5.70 mmol) and allowed to warm to room temperature with stirring. Concentration and chromatography (CH_2Cl_2 /MeOH, 1:0 to 10:1) gave the crude lactol.

To a solution of the lactol obtained above in CH_2Cl_2 (20 mL) at room temperature were added pyridine (1.5 mL, 19 mmol), Ac_2O (0.9 mL, 9.5 mmol), and DMAP (70 mg, 0.57 mmol). After stirring for 10 h, the mixture was diluted with ether, then washed with satd $CuSO_4$, satd $NaHCO_3$, and

brine. Concentration and chromatography (hexane/EtOAc, 4:1) gave **34** (754 mg, 98%): amorphous solid; R_f = 0.20, 0.26 (hexane/EtOAc, 2:1); IR (neat) 1750 cm^{-1} ; ^1H NMR (400 MHz, CDCl_3) δ 7.47-7.44 (m, 2 H), 7.37-7.30 (m, 3 H), 6.03-5.90 (m, 1 H), 5.5 (s, 1 H), 5.17-5.14 (m, 1 H), 4.21 (dd, J = 10.0, 4.4 Hz, 1 H), 3.97 (dd, J = 12.4, 4.0 Hz, 1 H), 3.71-3.65 (m, 1 H), 3.61-3.55 (m, 1 H), 3.53-3.46 (m, 1 H), 2.27-2.22 (m, 1 H), 2.13-1.85 (m, 3 H), 2.09 (s, 6 H), 1.41 (s, 3 H); HRMS (ESI TOF) calcd for $\text{C}_{21}\text{H}_{26}\text{O}_8\text{Na}$ ($\text{M}+\text{Na}^+$) 429.1525, found 429.1517.

Piv Ester 35. A mixture of **34** (23.4 mg, 0.058 mmol) and $\text{Pd}(\text{OH})_2\text{-C}$ (7 mg) in MeOH (2 mL) was stirred under H_2 atmosphere. After 2 h, the catalyst was filtered off, and the filtrate was concentrated to give the crude diol which was used for next reaction directly.

To a solution of the diol obtained above in CH_2Cl_2 (0.6 mL) were added pyridine (28 μL , 0.35 mmol), PvCl (20 μL , 0.17 mmol), and a catalytic amount of DMAP at room temperature. After stirring for 18 h at $30\text{ }^\circ\text{C}$, additional amounts of pyridine (28 μL , 0.35 mmol), PvCl (20 μL , 0.17 mmol), and a catalytic amount of DMAP were added, and the stirring was continued for further 29 h at $30\text{ }^\circ\text{C}$. The mixture was diluted with ether, then washed with satd CuSO_4 , satd NaHCO_3 , and brine. Concentration and chromatography (hexane/EtOAc, 3:1) gave **35** (24.5 mg, 86%): amorphous solid; R_f = 0.36, 0.30 (hexane/EtOAc, 2:1); IR (neat) 1733 cm^{-1} ; ^1H NMR (400 MHz, CDCl_3) δ 5.97-5.93 (m, 1 H), 5.13-5.12 (m, 1 H), 4.72-4.66 (m, 1 H), 4.22-4.17 (m, 1 H), 3.94-3.88 (m, 1 H), 3.80-3.77 (m, 1 H), 2.30-2.22 (m, 1 H), 2.09-1.99 (m, 7 H), 1.96-1.90 (m, 1 H), 1.67-1.58 (m, 1 H), 1.34 (m, 3 H), 1.15-1.12 (m, 18 H); HRMS (ESI TOF) calcd for $\text{C}_{24}\text{H}_{38}\text{O}_{10}\text{Na}$ ($\text{M}+\text{Na}^+$) 509.2363, found 509.2385.

Acetate 36. To a solution of **35** (370 mg, 0.76 mmol) in CH_3CN (8 mL) at $-20\text{ }^\circ\text{C}$ were added $\text{CH}_2=\text{C}(\text{CH}_2\text{OAc})\text{CH}_2\text{TMS}$ (0.24 mL, 1.14 mmol) and TMSOTf (55 μL , 0.30 mmol), and the mixture was stirred for 0.5 h at $-20\text{ }^\circ\text{C}$. The reaction was quenched with Et_3N , diluted with ether, then washed with satd NaHCO_3 and brine. Concentration and chromatography (hexane/EtOAc, 3:1) gave **36** (384 mg, 93%): colorless oil; R_f = 0.26 (hexane/EtOAc, 2:1); $[\alpha]_D^{16} +46.0^\circ$ (c 0.68, CHCl_3); IR (neat) 1733 cm^{-1} ; ^1H NMR (400 MHz, CDCl_3) δ 5.08-5.06 (m, 1 H), 5.03 (dd, J = 3.2, 3.2 Hz, 1 H), 4.93 (brs, 1 H), 4.69 (ddd, J = 10.0, 10.0, 5.2 Hz, 1 H), 4.53-4.44 (m, 2 H), 4.16 (dd, J = 12.0, 4.8 Hz, 1 H), 4.04-4.00 (m, 1 H), 3.91-3.84 (m, 2 H), 3.77 (ddd, J = 10.0, 5.0, 2.0 Hz, 1 H), 2.78 (dd, J = 14.8, 8.8 Hz, 1 H),

2.29-2.16 (m, 2 H), 2.12-2.07 (m, 1 H), 2.03 (s, 3 H), 2.02 (s, 3 H), 1.56-1.47 (m, 1 H), 1.25 (s, 3 H), 1.13 (s, 9 H), 1.11 (s, 9 H); ^{13}C NMR (100 MHz, CDCl_3) δ 177.8, 176.9, 170.5, 169.7, 141.0, 115.3, 72.7, 71.8, 70.5, 70.4, 66.8, 66.6, 63.6, 62.9, 38.9, 38.8, 36.9, 30.7, 30.1, 27.2, 27.0, 21.3, 20.9, 13.8; HRMS (ESI TOF) calcd for $\text{C}_{28}\text{H}_{44}\text{O}_{10}\text{Na}$ ($\text{M}+\text{Na}^+$) 563.2832, found 563.2876.

Silyl Ether 37. To a mixture of **36** (351 mg, 0.65 mmol) in MeOH (6.5 mL) at 0 °C was added K_2CO_3 (20 mg). After stirring for 2 h at the same temperature, the mixture was neutralized by DOWEX-50W. The resin was filtered off, and the filtrate was concentrated to give the corresponding primary alcohol which was used for next reaction directly.

To a mixture of the alcohol obtained above in DMF (6.5 mL) at room temperature were added imidazole (133 mg, 1.95 mmol) and TBDPSCl (224 mg, 0.78 mmol). After stirring for 1 h at the same temperature, the mixture was quenched with MeOH, diluted with ether, then washed with water and brine. Concentration and chromatography (hexane/EtOAc, 10:1 to 6:1) gave **37** (407 mg, 85%): colorless oil; R_f = 0.20 (hexane/EtOAc, 4:1); $[\alpha]_D^{16} +36.9^\circ$ (c 0.42, CHCl_3); IR (neat) 1733 cm^{-1} ; ^1H NMR (400 MHz, CDCl_3) δ 7.60-7.58 (m, 4 H), 7.37-7.28 (m, 6 H), 5.16 (d, J = 1.6 Hz, 1 H), 4.99 (t, J = 3.2 Hz, 1 H), 4.83 (s, 1 H), 4.66 (ddd, J = 10.4, 10.4, 4.8 Hz, 1 H), 4.13 (dd, J = 12.0, 4.8 Hz, 1 H), 4.08-4.00 (m, 2 H), 3.94-3.86 (m, 2 H), 3.82 (dd, J = 12.0, 4.0 Hz, 1 H), 3.74 (ddd, J = 10.0, 4.8, 2.0 Hz, 1 H), 2.61 (dd, J = 14.0, 8.0 Hz, 1 H), 2.32 (dd, J = 14.0, 7.2 Hz, 1 H), 2.10-2.01 (m, 2), 1.96 (s, 3 H), 1.63 (dd, J = 15.4, 2.0 Hz, 1 H), 1.51-1.43 (m, 1 H), 1.21 (s, 3 H), 1.12 (s, 9 H), 1.10 (s, 9 H), 0.99 (s, 9 H); ^{13}C NMR (100 MHz, CDCl_3) δ 177.9, 176.8, 169.7, 144.9, 135.4, 135.3, 133.4, 129.6, 127.6, 127.5, 111.8, 100.5, 72.7, 71.8, 70.6, 70.5, 66.7, 66.2, 63.5, 62.9, 38.9, 38.7, 36.6, 30.2, 30.1, 27.2, 27.1, 26.9, 21.3, 19.3, 13.8; HRMS (ESI TOF) calcd for $\text{C}_{42}\text{H}_{60}\text{O}_9\text{SiNa}$ ($\text{M}+\text{Na}^+$) 759.3904, found 759.3944.

Acetal 38. To a solution of **37** (407 mg, 0.55 mmol) in MeOH (3 mL) was added K_2CO_3 (30 mg), and the mixture was stirred for 3 h at 40 °C. The mixture was neutralized by DOWEX-50W, and the resin was filtered off. The filtrate was concentrated to give the crude triol which was used for next reaction directly.

To a mixture of the triol obtained above and MS4A (200 mg) in CH_2Cl_2 (5.5 mL) at 0 °C were added *p*-MeOPhCH(OMe)₂ (0.12 mL, 0.72 mmol) and CSA (39 mg, 0.17 mmol). After stirring for 2

h at the same temperature, the reaction was quenched with Et₃N. The mixture was filtered through a short silica gel column, and concentrated to give the alcohol which was used for next reaction directly.

To a solution of the alcohol obtained above in CH₂Cl₂ (5.5 mL) at room temperature were added 2,6-lutidine (0.26 mL, 2.2 mmol) and TBSOTf (0.25 mL, 1.1 mmol). After stirring for 2 h at the same temperature, the mixture was quenched with MeOH and diluted with ether. The mixture was washed with satd CuSO₄, satd NaHCO₃ and brine. Concentration and chromatography (hexane/EtOAc, 10:1) gave **38** (339 mg, 82%): colorless oil; *R_f* = 0.44 (hexane/EtOAc, 4:1); [α]_D¹⁶ +32.6° (c 0.43, CHCl₃); IR (neat) 2929 cm⁻¹; ¹H NMR (400 MHz, CDCl₃) δ 7.64-7.61 (m, 4 H), 7.38-7.30 (m, 8 H), 6.86-6.83 (m, 2 H), 5.41 (s, 1 H), 5.18 (d, *J* = 2.0 Hz, 1 H), 4.88 (s, 1 H), 4.16-4.06 (m, 3 H), 3.99 (dd, *J* = 12.2, 4.1 Hz, 1 H), 3.93-3.86 (m, 1 H), 3.78-3.73 (m, 4 H), 3.64-3.57 (m, 2 H), 3.44-3.91 (m, 1 H), 2.94 (dd, *J* = 14.6, 9.2 Hz, 1 H), 2.26 (dd, *J* = 14.6, 5.2 Hz, 1 H), 2.11 (ddd, *J* = 11.7, 7.6, 4.0 Hz, 1 H), 1.94 (ddd, *J* = 11.0, 4.0, 4.0 Hz, 1 H), 1.66 (ddd, *J* = 12.0, 12.0, 12.0 Hz, 1 H), 1.53 (dd, *J* = 14.6, 2.8 Hz, 1 H), 1.19 (s, 3 H), 1.02 (s, 9 H), 0.87 (s, 9 H), 0.01 (s, 3 H), 0.00 (s, 3 H); ¹³C NMR (100 MHz, CDCl₃) δ 160.0, 146.0, 135.4, 133.6, 130.1, 129.5, 127.6, 127.4, 113.7, 110.9, 101.8, 78.5, 75.4, 72.5, 71.6, 69.9, 37.1, 66.4, 63.6, 55.3, 37.3, 34.5, 30.6, 26.9, 26.0, 19.4, 18.4, 14.6, -4.3, -4.7; HRMS (ESI TOF) calcd for C₄₄H₆₂O₇Si₂Na (M+Na⁺) 781.3932, found 781.3932.

TES ether 39. To a solution of **38** (169 mg, 0.22 mmol) in MeOH (4.4 mL) was added PPTS (28 mg, 0.11 mmol), and the mixture was stirred for 2 h at room temperature. The mixture was quenched with Et₃N, filtered through a short silica gel column, and concentrated to give the corresponding diol which was used next reaction directly.

To a solution of the diol obtained above in benzene (2 mL) and ether (2 mL) at room temperature were added imidazole (22 mg, 0.33 mmol), PPh₃ (87 mg, 0.33 mmol), and I₂ (61 mg, 0.24 mmol). After stirring for 2 h at the same temperature, the reaction mixture was quenched with satd Na₂SO₃, and extracted with ether. The organic layer was washed with satd NaHCO₃ and brine, then concentrated to give the iodide which was used for next reaction directly.

To a mixture of the iodide obtained above in DMSO (2.2 mL) was added NaCN (13 mg, 0.26 mmol). After stirring for 13 h at 50 °C, additional amount of NaCN (7 mg, 0.13 mmol) was added,

and the stirring was continued for further 4 h at 50 °C. The reaction mixture was diluted with ether, then washed with water and brine. Concentration gave the corresponding nitrile which was used for next reaction directly.

To a mixture of the nitrile obtained above in CH₂Cl₂ (2.2 mL) at 0 °C were added 2,6-lutidine (0.1 mL, 0.88 mmol) and TESOTf (0.1 mL, 0.44 mmol). After stirring for 1 h at the same temperature, the mixture was quenched with MeOH and diluted with ether, then washed with water and brine. Concentration and chromatography (hexane/EtOAc, 40:1 to 20:1) gave **39** (147 mg, 86%): colorless oil; R_f = 0.43 (hexane/EtOAc, 4:1); $[\alpha]_D^{16} +76.5^\circ$ (c 0.60, CHCl₃); IR (neat) 2263 cm⁻¹; ¹H NMR (400 MHz, CDCl₃) δ 7.61-7.59 (m, 4 H), 7.37-7.28 (m, 6 H), 5.15 (d, J = 1.6 Hz, 1 H), 4.84 (s, 1 H), 4.08 (s, 1 H), 3.85-3.82 (m, 2 H), 3.76 (t, J = 2.8 Hz, 1 H), 3.55 (ddd, J = 8.8, 8.8, 2.8 Hz, 1 H), 3.30-3.24 (m, 1 H), 2.86 (dd, J = 14.6, 8.8 Hz, 1 H), 2.67 (dd, J = 16.4, 2.8 Hz, 1 H), 2.35-2.26 (m, 2 H), 2.05 (ddd, J = 14.6, 7.4, 2.8 Hz, 1 H), 1.87 (ddd, J = 11.6, 4.4, 4.4 Hz, 1 H), 1.54-1.49 (m, 2 H), 1.13 (s, 3 H), 0.99 (s, 9 H), 0.87 (t, J = 8.0 Hz, 9 H), 0.84 (s, 9 H), 0.52 (q, J = 8.0 Hz, 6 H), 0.04 (s, 3 H), 0.00 (s, 3 H); ¹³C NMR (100 MHz, CDCl₃) δ 145.8, 135.4, 133.6, 129.5, 127.6, 117.7, 110.8, 74.7, 72.1, 71.6, 71.1, 70.9, 66.3, 62.5, 37.3, 34.4, 34.2, 26.9, 26.1, 21.6, 19.4, 18.4, 14.3, 6.8, 5.1, -4.3, -4.5; HRMS (ESI TOF) calcd for C₄₃H₆₉NO₅Si₃Na (M+Na⁺) 786.4381, found 786.4308.

Carboxylic Acid 3. To a mixture of **39** (100 mg, 0.13 mmol) in CH₂Cl₂ (2 mL) at -78 °C was added DIBAL-H (0.95 M in hexane, 0.17 mL, 0.16 mmol). After stirring for 30 min at the same temperature, the mixture was quenched with MeOH, diluted with ether, then washed with aq potassium sodium tartrate and brine. Concentration and chromatography (hexane/EtOAc, 6:1) gave the corresponding aldehyde (94 mg, 94%): colorless oil; R_f = 0.29 (hexane/ether, 5:1); $[\alpha]_D^{16} +64.4^\circ$ (c 0.58, CHCl₃); IR (neat) 1731 cm⁻¹; ¹H NMR (400 MHz, CDCl₃) δ 9.70 (dd, J = 3.2, 1.6 Hz, 1 H), 7.67-7.65 (m, 2 H), 7.43-7.34 (m, 6 H), 5.20 (d, J = 1.6 Hz, 1 H), 4.91 (s, 1 H), 4.14 (s, 2 H), 3.96-3.87 (m, 3 H), 3.75 (m, 1 H), 3.34 (ddd, J = 10.4, 8.8, 4.8 Hz, 1 H), 2.89 (dd, J = 14.8, 8.8 Hz, 1 H), 2.70 (ddd, J = 15.6, 3.2, 1.6 Hz, 1 H), 2.39-2.34 (m, 2 H), 2.10 (ddd, J = 14.8, 7.6, 3.2 Hz, 1 H), 1.61-1.54 (m, 3 H), 1.21 (s, 3 H), 1.06 (s, 9 H), 0.93 (t, J = 7.6 Hz, 9 H), 0.88 (s, 9 H), 0.57 (q, J = 7.6 Hz, 6 H), 0.01 (s, 3 H), 0.00 (s, 3 H); ¹³C NMR (100 MHz, CDCl₃) δ 201.3, 145.9, 135.4, 133.7, 129.5, 127.6, 110.8,

74.2, 72.4, 71.2, 71.1, 71.0, 66.3, 62.7, 46.7, 37.3, 34.8, 34.1, 26.9, 26.0, 19.4, 18.3, 14.4, 6.8, 5.1, -4.4, -4.8; HRMS (ESI TOF) calcd for $C_{43}H_{70}O_6Si_3Na$ ($M+Na^+$) 821.4640, found 821.4642.

To a mixture of the aldehyde obtained above in THF (1 mL), *t*-BuOH (1 mL), and water (1 mL) at 0 °C were added 2-methyl-2-butene (0.63 mL), NaH_2PO_4 (21 mg, 0.18 mmol), and $NaClO_2$ (20 mg, 0.18 mmol). After vigorous stirring for 1 h at the same temperature, the mixture was diluted with ether, then washed with water and brine. Concentration and column chromatography (hexane/EtOAc, 10:1 to 2:1) gave **3** (38 mg, 82%): colorless oil; R_f = 0.20 (hexane/EtOAc, 4:1); $[\alpha]_D^{17} +60.2^\circ$ (c 0.77, $CHCl_3$); IR (neat) 1714 cm^{-1} ; 1H NMR (400 MHz, $CDCl_3$) δ 7.63-7.62 (m, 4 H), 7.39-7.30 (m, 6 H), 5.17 (s, 1 H), 4.86 (s, 1 H), 4.10 (s, 2 H), 3.90-3.79 (m, 3 H), 3.73 (s, 1 H), 3.28 (ddd, J = 10.2, 10.2, 4.4 Hz, 1 H), 2.86 (dd, J = 14.4, 8.8 Hz, 1 H), 2.79 (dd, J = 15.6, 2.8 Hz, 1 H), 2.34-2.27 (m, 2 H), 2.08 (ddd, J = 14.4, 7.6, 3.2 Hz, 1 H), 1.89 (ddd, J = 11.4, 8.8, 8.8 Hz, 1 H), 1.59-1.47 (m, 2 H), 1.27-1.22 (m, 1 H), 1.16 (s, 3 H), 1.02 (s, 9 H), 0.89 (t, J = 7.6 Hz, 9 H), 0.85 (s, 9 H), 0.53 (q, J = 7.6 Hz, 6 H), 0.02 (s, 3 H), 0.00 (s, 3 H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 175.4, 145.9, 135.4, 133.7, 133.6, 129.5, 127.6, 110.8, 74.4, 72.4, 72.1, 71.0, 70.9, 66.3, 62.8, 37.8, 37.3, 34.7, 34.2, 26.9, 26.0, 19.4, 18.3, 14.3, 6.8, 5.1, -4.5, -4.8; HRMS (ESI TOF) calcd for $C_{43}H_{70}O_7Si_3Na$ ($M+Na^+$) 805.4327, found 805.4210.

Ester 40. To a solution of **3** (21.5 mg, 27.4 μ mol) in THF (1.2 mL) were added Et_3N (19 μ L, 0.14 mmol) and 2,4,6-trichlorobenzoyl chloride (17 μ L, 0.11 mmol). After stirring for 1 h at 40 °C, additional amounts of Et_3N (19 μ L, 0.14 mmol) and 2,4,6-trichlorobenzoyl chloride (17 μ L, 0.11 mmol) were added to the reaction mixture. After stirring for 2.5 h, the mixture was concentrated under reduced pressures and diluted with toluene (1.3 mL). To the resulting mixture was added a solution of **2** (16 mg, 27 μ mol) and DMAP (54 mg, 0.44 mmol) in toluene (1.3 mL). After stirring for 1 h at room temperature, the mixture was diluted with EtOAc and filtered through a Celite pad. Concentration and chromatography (hexane/EtOAc, 10:1 to 6:1 to 2:1 to 1:1) gave **40** (29 mg, 94% based on recovery) and **2** (2.7 mg, 17%): amorphous solid; R_f = 0.20 (hexane/EtOAc, 4:1); $[\alpha]_D^{18} +133^\circ$ (c 1.34, $CHCl_3$); IR (neat) $2952, 1743\text{ cm}^{-1}$; 1H NMR (400 MHz, $CDCl_3$) δ 7.66-7.63 (m, 4 H), 7.41-7.32 (m, 6 H), 5.90-5.80 (m, 1 H), 5.32 (brs, 1 H), 5.20 (d, J = 1.6 Hz, 1 H), 5.07 (dd, J = 10.4, 2.0 Hz, 1 H), 5.03-4.96 (m, 2 H), 4.88 (s, 1 H), 4.22 (bd, J = 15.2 Hz, 1 H), 4.13-4.09 (m, 3 H), 3.95 (bd, J

= 8.4 Hz, 1 H), 3.90-3.78 (m, 3 H), 3.69 (s, 1 H), 3.54 (q, J = 8.0 Hz, 1 H), 3.36-3.29 (m, 2 H), 3.27-3.16 (m, 3 H), 3.11 (dd, J = 12.0, 3.6 Hz, 1 H), 3.08-3.04 (m, 2 H), 2.86 (dd, J = 14.6, 8.6 Hz, 1 H), 2.74 (dd, J = 15.2, 1.6 Hz, 1 H), 2.33 (dd, J = 14.8, 5.6 Hz, 1 H), 2.25-2.01 (m, 9 H), 1.90-1.38 (m, 13 H), 1.68 (s, 3 H), 1.28 (s, 3 H), 1.26 (s, 3 H), 1.24 (s, 3 H), 1.24 (s, 3 H), 1.15 (s, 3 H), 1.03 (s, 9 H), 1.01 (d, J = 7.2 Hz, 3 H), 0.90 (t, J = 7.8 Hz, 9 H), 0.86 (s, 9 H), 0.57-0.51 (m, 6 H), 0.00 (s, 3 H), -0.03 (s, 3 H); ^{13}C NMR (100 MHz, CDCl_3) δ 170.2, 145.9, 135.4, 134.5, 133.6, 133.6, 133.0, 129.5, 127.5, 121.0, 118.2, 110.7, 88.0, 87.5, 85.3, 83.9, 83.8, 80.3, 78.0, 77.2, 76.5, 74.8, 74.1, 73.9, 73.9, 73.2, 72.5, 72.2, 71.7, 71.0, 70.8, 69.6, 66.3, 62.8, 45.1, 44.9, 40.7, 38.5, 38.0, 37.4, 35.5, 34.7, 34.1, 33.3, 31.1, 29.5, 28.9, 26.9, 26.1, 26.0, 21.5, 20.1, 19.4, 18.6, 18.3, 17.9, 17.2, 16.3, 14.4, 6.9, 5.1, -4.2, -4.7; HRMS (ESI TOF) calcd for $\text{C}_{77}\text{H}_{120}\text{O}_{14}\text{Si}_3\text{Na}$ ($\text{M}+\text{Na}^+$) 1375.7883, found 1375.7207.

Allylstannane 41. To a solution of **40** in THF (2.5 mL) was added TBAF (1.0 M in THF, 29 μL , 29 μmol) at 0 °C. After stirring for 1.5 h at the same temperature, an additional amount of TBAF (1.0 M in THF, 29 μL , 29 μmol) was added. After stirring for further 1.5 h at the same temperature, the mixture was filtered through a short silica gel column (ether), and concentrated to give the corresponding alcohol which was used for next reaction directly.

To a solution of the crude alcohol obtained and **13** (92 μL , 0.29 mmol) in CH_2Cl_2 (2.5 mL) was added CSA (2.30 mg, 9.72 μmol). After stirring at room temperature for 1 h, the reaction mixture was quenched with Et_3N . The mixture was filtered through a short alumina column (EtOAc) and concentrated. The excess amount of **12** was removed by a short silica gel column (hexane/EtOAc, 1:0 to 6:1 containing 1% Et_3N) to give the corresponding mixed acetal as a mixture of diastereoisomers.

To a stirred solution of the crude acetal obtained in CH_2Cl_2 (2.5 mL) at 0 °C were added HMDS (0.21 mL, 0.99 mmol) and TMSI (0.10 mL, 0.71 mmol). After stirring for 1 h at the same temperature, the reaction mixture was quenched with satd NaHCO_3 and extracted with ether. The organic layer was washed with satd NaHCO_3 and brine. Concentration and chromatography (hexane/EtOAc, 1:0 to 20:1 to 8:1 containing 1 % Et_3N) gave **41** (27 mg, 71%): amorphous solid; R_f = 0.36 (hexane/EtOAc, 4:1); $[\alpha]_D^{19} +71.0^\circ$ (c 1.36, CHCl_3); IR (neat) 2928, 1744, 1651 cm^{-1} ; ^1H NMR (400 MHz, C_6D_6) δ 7.83-7.79 (m, 4 H), 7.28-7.23 (m, 6 H), 6.20-6.10 (m, 1 H), 5.56 (d, J = 6.0 Hz, 1 H), 5.44 (brs, 1 H), 5.38 (dd, J

= 11.8, 5.4 Hz, 1 H), 5.23 (d, J = 15.2 Hz, 1 H), 5.20 (d, J = 10.0 Hz, 1 H), 5.12 (bs, 1 H), 5.02 (bs, 1 H), 4.64 (ddd, J = 8.8, 8.8, 6.0 Hz, 1 H), 4.35-4.31 (m, 3 H), 4.07-3.98 (m, 4 H), 3.91-3.86 (m, 1 H), 3.63 (bs, 1 H), 3.54 (dd, J = 14.4, 7.2 Hz, 1 H), 3.49 (dd, J = 12.2, 3.8 Hz, 1 H), 3.29-3.18 (m, 5 H), 3.12 (dd, J = 12.2, 3.8 Hz, 1 H), 3.08-3.00 (m, 3 H), 2.50-2.23 (m, 8 H), 2.04 (dt, J = 12.0, 3.4 Hz, 1 H), 1.93-1.55 (m, 23 H), 1.76 (s, 3 H), 1.45-1.36 (m, 7 H), 1.37 (s, 3 H), 1.34 (s, 3 H), 1.21 (s, 3 H), 1.19 (s, 9 H), 1.19 (s, 3 H), 1.13 (s, 3 H), 1.00 (s, 9 H), 1.00-0.96 (m, 16 H), 0.20 (s, 3 H), 0.07 (s, 3 H); ^{13}C NMR (100 MHz, C_6D_6) δ 169.7, 146.9, 140.2, 135.9, 135.9, 135.0, 134.1, 134.1, 133.6, 130.0, 128.1, 128.1, 127.9, 121.5, 118.6, 110.9, 107.5, 88.7, 88.4, 85.4, 84.2, 83.4, 80.9, 79.2, 78.2, 76.9, 75.4, 74.8, 74.6, 74.3, 73.5, 73.0, 72.4, 71.4, 70.8, 70.3, 67.0, 63.2, 46.1, 45.6, 41.6, 38.8, 38.5, 37.9, 36.5, 34.6, 33.7, 32.3, 31.9, 30.0, 29.9, 29.8, 29.7, 27.9, 27.2, 26.4, 21.6, 20.5, 19.7, 18.6, 18.5, 18.2, 17.6, 16.4, 14.4, 14.2, 9.6, 6.6, -3.7, -4.4; HRMS (ESI TOF) calcd for $\text{C}_{86}\text{H}_{136}\text{O}_{14}\text{Si}_2\text{SnNa}$ ($\text{M}+\text{Na}^+$) 1591.8412, found 1591.4246.

α -Chloroacetoxy Ether 42. To a solution of **41** (12 mg, 7.7 μmol) in CH_2Cl_2 (1.8 mL) at -78°C was added DIBALH (0.94 M in hexane, 16 μL , 15 μmol), and the mixture was stirred for 3 min at the same temperature. To the resulting mixture were added pyridine (15 μL , 0.18 mmol), DMAP (15 mg, 0.12 mmol) in CH_2Cl_2 (0.6 mL), and $(\text{CH}_2\text{ClCO})_2\text{O}$ (63 mg, 0.37 mmol) in CH_2Cl_2 (0.63 mL). After stirring for 1 h at the same temperature, the mixture was allowed to warm to 0°C and quenched with water. The mixture was extracted with ether, and the organic layer was washed with satd potassium sodium tartrate, satd CuSO_4 , satd NaHCO_3 , and brine. Concentration and chromatography (hexane/EtOAc, 20:1 to 10:1 to 2:1 containing 1 % Et_3N) gave **42** (a mixture of diastereoisomers, 6.6 mg, 68% based on recovery) and **41** (2.7 mg, 22%): colorless oil; R_f = 0.26 (hexane/EtOAc, 4:1); ^1H NMR (400 MHz, C_6D_6) δ 7.83-7.80 (m, 4 H), 7.26-7.23 (m, 6 H), 6.45 (dd, J = 9.2, 2.4 Hz, 1 H), 6.29-6.19 (m, 1 H), 5.59 (d, J = 5.6 Hz, 1 H), 5.46 (brs, 1 H), 5.39 (d, J = 16.8 Hz, 1 H), 5.31 (d, J = 10.0 Hz, 1 H), 5.14 (brs, 1 H), 5.02 (bs, 1 H), 4.63 (ddd, J = 9.2, 9.2, 6.0 Hz, 1 H), 4.32 (brs, 2 H), 4.13-3.86 (m, 6 H), 3.73 (s, 1 H), 3.56-3.47 (m, 2 H), 3.38 (s, 2 H), 3.31-3.18 (m, 5 H), 3.13 (dd, J = 12.0, 4.0 Hz, 1 H), 3.07-3.01 (m, 2 H), 2.65-2.48 (m, 3 H), 2.35-2.20 (m, 5 H), 2.05 (dt, J = 12.0, 3.6 Hz, 1 H), 1.94-1.59 (m, 23 H), 1.76 (s, 3 H), 1.45-1.37 (m, 7 H), 1.43 (s, 3 H), 1.33 (s, 3 H), 1.25 (s, 3

H), 1.25 (s, 3 H), 1.19 (s, 9 H), 1.15 (s, 3 H), 1.03 (s, 9 H), 1.01-0.96 (m, 18 H), 0.27 (s, 3 H), 0.12 (s, 3 H).

Tetraene 43. To a suspension of $\text{MgBr}_2 \cdot \text{OEt}_2$ (25 mg, 97 μmol) in CH_3CN (1.5 mL) was added a solution of **42** (3.2 mg, 1.9 μmol) in CH_3CN (1.5 mL). After stirring for 5 h at 40 °C, the reaction was quenched with Et_3N . The mixture was filtered through a short silica gel column (ether) and concentrated. The residue was purified by chromatography (hexane/EtOAc, 1:0 to 6:1 to 4:1) to give **43** (2.0 mg, 82%): amorphous solid; $R_f = 0.18$ (hexane/EtOAc, 4:1); $[\alpha]_D^{17} +200^\circ$ (c 0.50, CHCl_3); IR (neat) 2927 cm^{-1} ; ^1H NMR (400 MHz, CDCl_3) δ 7.65-7.63 (m, 4 H), 7.40-7.32 (m, 6 H), 5.94-5.83 (m, 2 H), 5.39 (d, $J = 17.6\text{ Hz}$, 1 H), 5.32 (brs, 1 H), 5.27 (d, $J = 10.8\text{ Hz}$, 1 H), 5.19 (d, $J = 2.0\text{ Hz}$, 1 H), 5.07 (d, $J = 11.2\text{ Hz}$, 1 H), 5.02 (d, $J = 17.2\text{ Hz}$, 1 H), 4.88 (s, 1 H), 4.23 (bd, $J = 16.0\text{ Hz}$, 1 H), 4.13-4.05 (m, 3 H), 3.96-3.87 (m, 3 H), 3.74 (s, 1 H), 3.57-3.51 (m, 2 H), 3.45 (dd, $J = 11.2, 5.6\text{ Hz}$, 1 H), 3.34 (dd, $J = 8.4, 5.2\text{ Hz}$, 1 H), 3.27-3.03 (m, 7 H), 2.97-2.90 (m, 2 H), 2.35-2.20 (m, 4 H), 2.15-1.87 (m, 7 H), 1.81-1.61 (m, 7 H), 1.68 (s, 3 H), 1.58-1.34 (m, 7 H), 1.28 (s, 3 H), 1.24 (s, 3 H), 1.20 (s, 3 H), 1.14 (s, 3 H), 1.12 (s, 3 H), 1.03 (s, 9 H), 1.00 (d, $J = 6.8\text{ Hz}$, 3 H), 0.87 (s, 9 H), 0.02 (s, 3 H), 0.01 (s, 3 H); ^{13}C NMR (100 MHz, CDCl_3) δ 146.0, 135.9, 135.4, 134.5, 134.0, 133.6, 133.6, 129.5, 127.6, 121.0, 118.3, 117.8, 110.7, 88.0, 87.6, 85.3, 83.9, 83.8, 81.4, 80.3, 78.2, 78.0, 77.9, 77.4, 77.2, 74.8, 74.7, 73.9, 73.4, 73.3, 72.6, 71.6, 69.6, 69.1, 67.0, 66.3, 63.4, 45.1, 44.5, 43.2, 38.1, 37.8, 37.3, 35.5, 34.4, 33.3, 31.1, 30.8, 29.8, 29.6, 29.3, 28.9, 26.9, 26.0, 21.6, 20.3, 19.3, 18.5, 18.3, 17.8, 17.2, 16.3, 14.5, -4.0, -4.8; HRMS (ESI TOF) calcd for $\text{C}_{74}\text{H}_{110}\text{O}_{13}\text{Si}_2\text{Na}$ ($\text{M}+\text{Na}^+$): 1285.7383, found 1285.7887.

Lactone 45. A mixture of **43** (2.0 mg, 1.58 μmol) and **23** (1.3 mg, 1.58 μmol) in benzene (0.8 mL) was stirred at 40 °C. After 3 h, an additional amount of **23** (0.6 mg, 0.79 μmol) was added, and the stirring was continued for 1.5 h. The mixture was filtered through a short silica gel column (ether) and concentrated to give **44** which was used for next reaction directly.

To a mixture of **44** obtained in benzene (0.8 mL) was added PCC (1.7 mg, 7.9 μmol), and the mixture was stirred at 80 °C. After 3 h, an additional amount of PCC (1.7 mg, 7.9 μmol) was added, and the stirring was continued for 11 h. The reaction mixture was subjected a short silica gel column

(ether). Concentration and chromatography (hexane/EtOAc, 20:1 to 4:1 to 2:1) gave **45** (1.6 mg, 81%): amorphous solid; $R_f = 0.21$ (hexane/EtOAc, 2:1); $[\alpha]_D^{17} +481^\circ$ (c 0.23, CHCl_3); IR (neat) 2929, 1738 cm^{-1} ; ^1H NMR (400 MHz, CDCl_3) δ 7.65-7.63 (m, 4 H), 7.40-7.32 (m, 6 H), 5.80-5.74 (m, 2 H), 5.71 (brs, 1 H), 5.19 (d, $J = 1.6$ Hz, 1 H), 4.87 (s, 1 H), 4.24 (brd, $J = 10.4$ Hz, 1 H), 4.14-4.06 (m, 2 H), 3.99 (dd, $J = 11.4, 4.0$ Hz, 1 H), 3.96 (dt, $J = 10.8, 4.4$ Hz, 1 H), 3.90-3.86 (m, 2 H), 3.80 (dd, $J = 8.8, 3.6$ Hz, 1 H), 3.73 (s, 1 H), 3.53 (dd, $J = 8.8, 3.6$ Hz, 1 H), 3.73 (s, 1 H), 3.53, (dd, $J = 16.0, 8.0$ Hz, 1 H), 3.35-3.21 (m, 6 H), 3.11-3.03 (m, 3 H), 2.93 (dd, $J = 14.6, 9.3$ Hz, 1 H), 2.88-2.81 (m, 1 H), 2.43 (dd, $J = 14.0, 8.0$ Hz, 1 H), 2.34-2.23 (m, 3 H), 2.15-2.07 (m, 4 H), 1.94 (s, 3 H), 1.89-1.36 (m, 15 H), 1.28 (s, 3 H), 1.28 (s, 3 H), 1.27 (s, 3 H), 1.15 (s, 3 H), 1.14 (s, 3 H), 1.03 (s, 9 H), 1.01 (d, $J = 6.8$ Hz, 3 H), 0.86 (s, 9 H), 0.02 (s, 3 H), -0.01 (s, 3 H); ^{13}C NMR (100 MHz, CDCl_3) δ 163.5, 161.0, 146.0, 135.4, 133.6, 129.5, 129.5, 127.6, 126.9, 115.6, 110.7, 88.3, 87.7, 85.5, 83.9, 83.6, 80.0, 79.8, 79.0, 77.9, 77.2, 76.5, 75.0, 74.7, 74.5, 74.0, 74.0, 72.6, 71.5, 69.1, 68.4, 66.3, 63.5, 44.7, 41.2, 39.4, 38.1, 37.7, 37.2, 35.4, 34.3, 33.3, 30.8, 30.4, 30.2, 29.8, 29.6, 29.0, 26.9, 26.1, 22.1, 20.0, 19.3, 18.5, 18.3, 18.2, 17.4, 15.9, 14.5, -4.0, -4.9; HRMS (ESI TOF) calcd for $\text{C}_{72}\text{H}_{104}\text{O}_{14}\text{Si}_2\text{Na}$ ($\text{M}+\text{Na}^+$) 1271.6862, found 1271.6846.

Brevetoxin B (1). To a solution of **45** (1.5 mg, 1.20 μmol) in CH_2Cl_2 (0.5 mL) at 0°C was added $\text{HF}\cdot\text{py}$ (15 μL), and the mixture was stirred for 15 min at the same temperature. The reaction mixture was diluted with EtOAc, then washed with satd NaHCO_3 and brine. Concentration and chromatography ($\text{CH}_3\text{Cl}/\text{MeOH}$, 1:0 to 10:1) gave the corresponding diol which was used for next reaction without further purification

To a mixture of the diol obtained in ether (0.5 mL) was added MnO_2 (5.2 mg, 60 μmol), and the mixture was stirred for 3 h at room temperature. The mixture was filtered through a short silica gel column (EtOAc/MeOH , 10:1), and concentrated. The residue was purified by column chromatography (hexane/EtOAc, 1:1) gave **1** (0.9 mg, 84%): colorless solid; $R_f = 0.40$ (hexane/EtOAc, 1:4); $[\alpha]_D^{20} +123^\circ$ (c 0.09, CH_2Cl_2); IR (neat) 3398, 2925, 1736, 1688 cm^{-1} ; ^1H NMR (400 MHz, CDCl_3) δ 9.51 (s, 1 H), 6.29 (s, 1 H), 6.06 (s, 1 H), 5.76-5.71 (m, 3 H), 4.24 (d, $J = 10.8$ Hz, 1 H), 4.01-3.92 (m, 4 H), 3.86 (dd, $J = 8.8, 2.8$ Hz, 1 H), 3.78 (brs, 1 H), 3.53 (q, $J = 7.2$ Hz, 1 H), 3.41-3.20

(m, 6 H), 3.11-2.99 (m, 4 H), 2.63 (brs, 1 H), 2.44-2.24 (m, 4 H), 2.18-2.06 (m, 4 H), 1.97-1.44 (m, 16 H), 1.94 (s, 3 H), 1.27 (s, 9 H), 1.20 (s, 3 H), 1.15 (s, 3 H), 1.01 (d, $J = 6.8$ Hz, 3 H); ^{13}C NMR (100 MHz, CDCl_3) δ 194.3, 163.3, 161.0, 147.7, 135.9, 135.1, 127.2, 115.6, 88.3, 87.6, 85.5, 84.0, 83.6, 80.2, 79.8, 79.0, 77.9, 77.3, 76.6, 76.2, 75.1, 74.7, 74.7, 74.0, 73.9, 71.5, 71.4, 69.4, 68.4, 63.3, 44.7, 41.3, 39.4, 38.1, 37.6, 35.4, 33.3, 31.9, 31.8, 30.4, 30.1, 29.6, 28.9, 22.0, 20.0, 18.5, 18.2, 17.4, 15.9, 13.9; HRMS (ESI TOF) calcd for $\text{C}_{50}\text{H}_{70}\text{O}_{14}\text{Na}$ ($\text{M}+\text{Na}^+$) 917.4663, found: 917.4594.

Date :	Sun Nov	4 19:06:31 2001
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FILTR	:	3000 Hz
DELAY	:	66.7 usec
DEADT	:	97.2 usec
INVL	:	166.4 usec
TIMES	:	4 times
DUMMY	:	1 times
PD	:	1.5474 sec
ACQTM	:	5452.9552 msec
PREDL	:	10.00000 msec
INITI	:	1000.0000 msec
RESOL	:	0.18 Hz
CPW1	:	5.50 usec
GBNUC	:	1H
OBFRG	:	300.40 MHz
OBSCT	:	131450.00 Hz
RGAIN	:	20
SCANS	:	4 times
SLVNT	:	CDCL3
SPINNING	:	18 Hz
TEMP	:	19.6 C

HT-613

Date : Sun Feb 17 16:09:06 2002
 FileName : .LoadingFID.nmdata
 Comment : HT-613
 SliceHistory :
 EXMODE : non

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 DEADT : 97.2 usec
 INTVL : 166.4 usec
 TIMES : 4 times
 DUMMY : 1 times
 PD : 1.5474 sec
 ACQTM : 5452.5952 msec
 PREDL : 10.00000 msec
 INIWT : 1000.0000 msec
 RESOL : 0.18 Hz
 PW1 : 5.50 usec
 OBNUC : ¹H
 OBFREQ : 300.40 MHz
 OBFREQ : 131150.00 Hz
 OBFREQ : 20
 RGAIN : 4 times
 SCANS : 4 times
 SLVNT : C6D6
 SPINNING : 19 Hz
 TEMP : 22.1 °C

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 PW1 5.8 us
 IRNUC 1H
 CTEMP 23.5 c
 SLVNT CDCl3
 EXREF 0.00 ppm
 BF 0.12 Hz
 RGAIN 8

DFILE \\D62FV71X\c-m-lftf
 COMNT HT-1184
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 EXMOD NON
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 ACQTM 4.096 sec
 PD 2.904 sec
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 IRNUC 1H
 CTEMP 23.7 c
 SLVNT C6D6
 EXREF 7.15 ppm
 BF 0.12 Hz
 RGAIN 9

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 COMNT HT-1196-1
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 OBFIN 10500.0 Hz
 POINT 32768
 FREQU 8000.0 Hz
 SCANS 8
 ACQTM 4.096 sec
 PD 2.904 sec
 PW1 5.8 us
 IRNUC 1H
 CTEMP 22.9 C
 SLVNT C6D6
 EXREF 0.00 ppm
 BF 0.12 Hz
 RGAIN 4

DF IL E C:\共有フォルダ\kyuk
 COMMT HT-1196-2
 DATIM Tue Nov 11 17:22:43
 OBNUC 1H
 EXMND NON
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 OBFIN 10500.0 Hz
 POINT 32768
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 ACQTM 4.096 sec
 PD 2.904 sec
 PW1 5.8 us
 IRNUC 1H
 GTEMP 22.7 c
 SLVNT C6D6
 EXREF 7.15 ppm
 BF 0.12 Hz
 RGAIN 5

DFILE \\D6ZFW71X\c-h-Lftf
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 EXMOD NON
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 OBFIN 10500.0 Hz
 POINT 32768
 FREQU 8000.0 Hz
 SCANS 8
 ACQTM 4.096 sec
 PD 2.904 sec
 PW1 5.8 us
 IRNUC 1H
 CTEMP 26.0 c
 SLVNT CDCL3
 EXREF 7.24 ppm
 BF 0.12 Hz
 RGAIN 10

C:\共有フォルダ\yuk
 DF FILE
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 DATIM Mon Apr 11 20:18:23
 ORNUC 1H
 EXMOD NON
 OBFRQ 399.65 MHz
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 OBFIN 10500.0 Hz
 POINT 32768
 FREQU 8000.0 Hz
 SCANS 8
 ACQTM 4.096 sec
 PD 2.904 sec
 PW1 5.8 us
 TRNUC 1H
 CTEMP 27.1 c
 SLVNT CDCL3
 EXREF 0.00 ppm
 BF 0.12 Hz
 RGAIN 17

C:\共有フォルダ\yuk
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 NON
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 124.00 KHz
 10500.0 Hz
 32768
 8000.0 Hz
 8
 4.096 sec
 2.904 sec
 5.8 us
 1H
 26.9 c
 CDCL3
 7.24 ppm
 0.12 Hz
 8
 RGAIN

DFILE C:\共有フォルダ\yuk
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 DATIM Mon Apr 11 16:19:39
 OBNUC 1H
 EXMOD NON
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 OBFIN 10500.0 Hz
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 SCANS 8
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 PD 2.904 sec
 PW1 5.8 us
 1H
 IRNUC 1H
 CTMP 26.1 c
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 EXREF 0.00 ppm
 BF 0.12 Hz
 RGAIN 12

40

DFILE \\D62FV71X\< n-Lftf
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 EXMOD NON
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 POINT 32768
 FREQU 8000.0 Hz
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 ACQTM 4.096 sec
 PD 2.904 sec
 PW1 5.8 us
 IRNUC 1H
 CTEMP 25.3 C
 SLVNT CDCL3
 EXREF 7.24 ppm
 BF 0.10 Hz
 RGAIN 11

DFILE	\\D6Z\FV71X\K-Lftf
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EXMOD	NON
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OBSET	124.00 KHz
OBPIN	10500.0 Hz
POINT	32768
FREQU	8000.0 Hz
SCANS	80
ACQTM	4.096 sec
PD	2.904 sec
PW1	5.8 us
IRNUC	1H
CTPRP	23.3 c
SLVNT	CDC13
EXREF	7.24 ppm
BF	0.12 Hz
RGAIN	16

Synthetic Brevetoxin B (1)