Total Synthesis of (+)-Superstolide A

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General Experimental Details. All reaction solvents were purified before use. Tetrahydrofuran, dichloromethane, diethyl ether, and toluene were purified by passing through a solvent column composed of activated A-1 alumina. Unless indicated otherwise, all reactions were conducted under an atmosphere of nitrogen using flame-dried or oven-dried (140 °C) glassware. Triethylamine and diisopropylethylamine were dried by distillation over calcium hydride. Acetone was dried by distillation from anhydrous calcium sulfate.

¹H NMR spectra were recorded on commercial instruments at 400 MHz or 500 MHz. ¹³C NMR spectra were recorded at 100 MHz or 125 MHz. The proton signal for residual non-deuterated solvent (δ 7.26 for CHCl₃, 7.16 for C₆H₆) was used as an internal reference for ¹H NMR spectra. For ¹³C NMR spectra, chemical shifts are reported relative to the δ 77.0 resonance of CDCl₃ and 128.0 resonance of C₆D₆. Infrared (IR) spectra were recorded as films on commercial FTIR instrument. Optical rotations were measured on a polarimeter using a quartz cell with 1 mL capacity and a 10 cm path length. Melting points were determined on a hot stage melting point apparatus and are uncorrected. Mass spectra were measured on commercially available instruments.

Analytical thin layer chromatography (TLC) was performed on Kieselgel 60 F_{254} glass plates precoated with a 0.25 mm thickness of silica gel. The TLC plates were visualized with UV light and/or by staining with Hanessian solution (ceric sulfate and ammonium molybdate in aqueous sulfuric acid). Column chromatography was generally performed using Kieselgel 60 (230-400 mesh) silica gel or, when noted, silica gel DavisilTM, grade 645, 60-100 mesh, 150 Å.

Compounds 3-5, 19, 20, 23, 24, 38, 47-49, 54 and SI-6-SI-12 showed a dynamic mixture of conformational isomers and/or Boc rotamers evidenced by doubling of ¹H and ¹³C resonances for many protons and carbons.

Many of the polyene intermediates generated in this work are extremely sensitive to light. Therefore, flasks were covered with aluminum foil whenever possible for intermediates 4, 5, 19, 20, 36b, 43a-b, 47-49 and SI-8 - SI-10.



Diol 10. A solution of salt-free bis(*d*-isopinocampheyl)allyl borane (75 mmol) in Et₂O (100 mL) was cooled to $-105 \,^{\circ}$ C in a diethyl ether/pentane/liquid nitrogen bath. A solution of (4*S*)-2,2-diethyl-1,3-dioxolane-4-acetaldehyde (**9**)¹ (8.49 g, 49.3 mmol) in Et₂O (40 mL) was cooled to $-78 \,^{\circ}$ C and added via cannula over 30 min to the allylboron reagent while maintaining the reaction temperature below $-100 \,^{\circ}$ C. After 1 h more, the reaction was then slowly warmed to $-72 \,^{\circ}$ C over 1.5 h. After the addition of MeOH (6 mL), the reaction was warmed to 0 $^{\circ}$ C. A solution of 2N NaOH (40 mL) and hydrogen peroxide (35% aq, 60 mL) was added dropwise over 30 min. The mixture was stirred for 18 h at room temperature. After extraction of the product with diethyl ether (2 x 200 mL), the combined organic layers were washed with brine, dried over anhydrous MgSO₄, filtered, and concentrated to a crude oil (31.33 g) consisting of the desired allylation product (10:1 d.r.) and isopinocampheol.

The product mixture (~182 mmol total) was dissolved in THF (150 mL) and cooled to 0 °C. Sodium hydride (95% purity, 6.11 g, 254 mmol) was added in portions to control the exothermic release of hydrogen. Methyl iodide (20.4 mL, 327 mmol) was then added and the mixture was gradually warmed to room temperature (the release of hydrogen was controlled by placing of the reaction vessel in an ice bath). After 40 h, the reaction was carefully poured into a 2L-Erlenmeyer flask which contained sat aq NH₄Cl (400 mL) and ice. The mixture was extracted with Et₂O (2 x 300 mL). The combined organic layers were washed with sat. aq. Na₂S₂O₃, brine, dried over anhydrous MgSO₄, filtered, and concentrated to a crude colorless oil (22.80 g).

The crude was dissolved in a mixture of MeOH (40 mL) and 1N HCl (aq) (20 mL). After 40 h, the reaction was poured carefully into an Erlenmeyer flask which contained NaHCO₃ (7.0 g) and then partitioned between brine (30 mL) and EtOAc (100 mL). After separation of the layers, the aqueous phase was extracted once more with EtOAc (100 mL). The combined organic layers were dried over anhydrous MgSO₄, filtered, and concentrated. Purification of the crude product by flash column chromatography (40% EtOAc/hexanes \rightarrow 5% MeOH/EtOAc \rightarrow 15% MeOH/EtOAc) afforded pure **10** (4.22 g, 26.4 mmol, 53% over 3 steps) as a colorless oil: [α]²⁵_D = +65.0° (*c* 1.50, CH₂Cl₂); ⁻¹H NMR (CDCl₃, 400 MHz) δ 5.76 (ddt, *J* = 14.3, 10.6, 7.0 Hz, 1H), 5.13-5.11 (m, 2H), 3.90 (m, 1H), 3.72 (br s, 1H), 3.60 (dd, *J* = 11.1, 3.6 Hz, 1H), 3.55 (m, 1H), 3.47 (dd, *J* = 11.1, 5.9 Hz, 1H), 3.41 (s, 3H), 2.41-2.26 (m, 2H), 2.16 (br s, 1H), 1.69 (ddd, *J* = 14.8, 9.8, 9.3 Hz, 1H), 1.60 (app dt, *J* = 14.8, 3.0 Hz, 1H); ¹³C NMR (CDCl₃, 100 MHz) δ 133.5, 117.7, 80.0, 71.3, 66.4, 56.1, 37.2, 36.5; IR (film) 3391, 3078, 2978,

2933, 2829, 1643, 1418, 1089 cm⁻¹; HRMS (CI, NH₃) m/z for C₈H₁₇O₃ [M+H]⁺ calcd 161.1178, found 161.1174.



Triether 11. A solution of diol 10 (3.76 g, 24.7 mmol) and pyridine (2.70 mL, 33.3 mmol) in CH₂Cl₂ (90 mL) was treated with TrCl (8.27 g, 29.7 mmol). After 16 h, the reaction mixture was poured into sat. aq. NaHCO₃ (200 mL). The aqueous phase was extracted with CH_2Cl_2 (3 x 100 mL). The combined organic layers were washed with sat. aq. Na₂CO₃ (100 mL), dried over anhydrous MgSO₄, filtered, and concentrated to a crude oil (13.88 g). This product was combined with imidazole (3.36 g, 49.4 mmol), 4-(dimethylamino)pyridine (300 mg, 2.47 mmol), and DMF (20 mL). The solution was cooled to 0 °C and treated with TBDPSCl (8.03 mL, 30.9 mmol). The reaction mixture was stirred at room temperature for 21 h and quenched with sat. aq. NaHCO₃ (150 mL). The aqueous phase was extracted with Et₂O (3 x 100 mL). The combined organic layers were washed with water (2 x 150 mL), brine, dried over MgSO₄, filtered, and concentrated. Purification of the crude product by flash column chromatography (2-5% EtOAc/hexanes) afforded 11 (15.7 g, 24.5 mmol, 99%) as a viscous oil: $\left[\alpha\right]_{D}^{25}$ = -11.0° (c 2.10, CH₂Cl₂); ¹H NMR (CDCl₃, 400 MHz) δ 7.63 (m, 4H), 7.44-7.28 (m, 12H), 7.26-7.17 (m, 9H), 5.63 (ddt, J = 13.9, 10.3, 7.0 Hz 1H), 4.97 (m, 1H), 4.92 (m, 1H), 3.98 (m, 1H), 3.21-3.04 (m, 3H), 3.03 (s, 3H), 2.01 (m, 2H), 1.85 (app t, J = 14.0, 6.0 Hz, 1H), 1.70 (app dt, J = 14.0, 6.7 Hz, 1H), 1.05 (s, 9H); ¹³C NMR (CDCl₃, 100 MHz) δ 144.4, 136.3, 136.2, 134.9, 134.5, 134.3, 129.9, 129.7, 129.3, 129.1, 127.9, 127.8, 127.7, 127.1, 117.1, 86.7, 77.2, 70.8, 67.4, 56.2, 38.7, 38.0, 27.4, 19.6; IR (film) 3069, 2930, 2857, 2821, 1960, 1897, 1822, 1640, 1597, 1490, 1472, 1449, 1389, 1361, 1111, 1022 cm⁻¹: HRMS (ESI) m/z for C₄₃H₄₈NaO₃Si [M+Na]⁺ 663.3270, found 663.3274; Anal. calcd for C₄₃H₄₈O₃Si: C, 80.58; H, 7.55. Found: C 80.26; H 7.51.



Aldehyde 12. A solution of 11 (12.7 g, 19.8 mmol) and Sudan III dye in CH_2Cl_2 (119 mL) and MeOH (36 mL) was cooled to -78 °C. Ozone gas was bubbled through the solution until the pink color disappeared (2 h). Triphenylphosphine (8.0 g, 29.7 mmol) was added and the reaction was stirred for 16 h at room temperature. The reaction mixture was poured into 100 mL half-saturated brine and extracted

with CH₂Cl₂ (2 x 100 mL). The combined organic layers were dried over MgSO₄, filtered, and concentrated. Purification of the crude product by flash chromatography (5-10% EtOAc/hexanes) afforded aldehyde **12** (10.09 g, 16.96 mmol, 76%) as a viscous oil: $[\alpha]^{25}_{D} = -14.0^{\circ}$ (*c* 3.10, CH₂Cl₂); ¹H NMR (CDCl₃, 400 MHz) δ 9.50 (dd, *J* = 3.0, 1.8 Hz, 1H), 7.65-7.61 (m, 2H), 7.59-7.56 (m, 2H), 7.47-7.31 (m, 12H), 7.25-7.20 (m, 9H), 3.89 (m, 1H), 3.60 (m, 1H), 3.15 (m, 2H), 3.08 (s, 3H), 2.25 (ddd, *J* = 16.2, 7.9, 3.1 Hz, 1H), 2.14 (ddd, *J* = 16.2, 4.1, 1.8 Hz 1H), 1.91 (app dt, *J* = 14.0, 6.2 Hz, 1H), 1.90 (ddd, *J* = 12.8, 7.3, 5.5 Hz, 1H), 1.05 (s, 9H); ¹³C NMR (CDCl₃, 100 MHz) δ 201.4, 143.9, 135.9, 135.8, 133.8, 133.6, 129.8, 129.6, 128.7, 127.7, 127.5, 126.9, 86.5, 73.1, 69.9, 66.7, 56.2, 48.0, 38.3, 27.0, 19.2; IR (neat) 3056, 2930, 2858, 2822, 2724, 1726, 1590, 1490, 1449, 1428, 1116 cm⁻¹; HRMS (ESI) *m/z* for C₄₂H₄₆NaO₄Si [M+Na]⁺ calcd 665.3063, found 665.3087.



Enoate 13. A solution of ethyl 2-(bis(2,2,2-trifluoroethoxy)phosphoryl)propanoate (11.5 g, 33.4 mmol) and 18-crown-6 (21.0 g, 79.5 mmol) in THF (110 mL) was cooled to -78 °C and treated dropwise over 30 min with a solution of potassium bis(trimethylsilyl)amide (6.33 g, 31.8 mmol) in toluene (64 mL). After an additional 30 min, a solution of aldehyde 12 (10.2 g, 15.9 mmol) in THF (20 mL) was transferred to the reaction mixture via cannula over 1.5 h. After the reaction was stirred an additional 6 h at -78 °C, sat. aq. NH₄Cl (40 mL) was added. The mixture was warmed to 23 °C, and extracted with Et₂O (2 x 100 mL). The combined organic layers were dried over anhydrous MgSO₄, filtered, and concentrated. Purification of the crude product by flash chromatography (10% EtOAc/hexanes) furnished **13** (11.2 g, 15.6 mmol, 98%) as a pale yellow oil: $[\alpha]^{25}_{D} = +6.0^{\circ}$ (*c* 3.40, CH₂Cl₂); ¹H NMR (CDCl₃, 400 MHz) δ 6.61 (m, 4H), 7.43-7.28 (m, 12H), 7.25-7.18 (m, 9H), 5.78 (app td, *J* = 6.6 Hz, 1.4 Hz, 1H), 4.14 (q, J = 7.0 Hz, 2H), 4.08 (m, 1H), 3.21 (m, 1H), 3.18 (dd, J = 9.5, 5.0 Hz, 1H), 3.02 (dd, J = 9.5, 4.5 Hz, 1H)1H), 3.03 (s, 3H), 2.62-2.49 (m, 2H), 1.89 (d, J = 1.3 Hz, 3H), 1.86 (m, 1H), 1.75 (ddd, J = 13.9, 7.5, 5.9 Hz, 1H), 1.28 (t, J = 7.1 Hz, 3H), 1.09 (s, 9H); ¹³C NMR (CDCl₃, 100 MHz) δ 167.8, 144.1, 138.5, 136.0, 135.8, 134.2, 134.0, 129.5, 129.4, 128.7, 128.5, 127.6, 127.5, 127.4, 126.7, 86.3, 70.4, 66.9, 60.0, 55.6, 38.4, 32.9, 27.0, 20.7, 19.3, 14.3; IR (neat) 3054, 2930, 2317, 1960, 1900, 1822, 1732, 1715, 1652. 1645, 1590, 1488, 1455, 1372 cm⁻¹; HRMS (ESI) m/z for C₄₇H₅₄NaO₅Si [M+Na]⁺ calcd 749.3638, found 749.3639.



Alcohol SI-1. Camphorsulfonic acid (0.14 g, 0.61 mmol) was added to a solution of the trityl ether **13** (4.40 g, 6.05 mmol) in EtOH (20 mL)/CH₂Cl₂ (10 mL) at 23 °C. After 36 h, the mixture was poured into an Erlenmeyer flask which contained NaHCO₃ (7 g), filtered, and concentrated. Purification of the crude product by flash chromatography (5-10% EtOAc/hexanes to elute trityl alcohol, then 40% EtOAc/hexanes) afforded the deprotected alcohol **SI-1** (2.84 g, 5.86 mmol, 96%) as a pale yellow oil: $[\alpha]^{25}{}_{D} = +33.0^{\circ}$ (*c* 3.20, CH₂Cl₂); ¹H NMR (CDCl₃, 400 MHz) δ 7.65 (m, 4H), 7.45-7.35 (m, 6H), 5.82 (app dt, *J* = 7.3, 1.5 Hz, 1H), 4.18 (q, *J* = 7.1 Hz, 2H), 3.99 (ddd, *J* = 11.7, 5.9, 4.0 Hz, 1H), 3.56 (m, 1H), 3.50 (d, *J* = 5.6 Hz, 1H), 3.28 (s, 3H), 2.70 (m, 1H), 2.61 (br s, 3 H), 2.55 (ap td, *J* = 15.8, 7.0 Hz, 1H), 1.87 (s, 3H), 1.74 (ddd, *J* = 14.8, 8.5, 3.9 Hz, 1H), 1.64 (ddd, *J* = 14.8, 6.1, 3.1 Hz, 1H), 1.28 (t, *J* = 7.1 Hz, 3H), 1.06 (s, 9H); ¹³C NMR (CDCl₃, 100 MHz) δ 167.7, 137.6, 135.8, 135.7, 133.9, 133.7, 129.8, 127.7, 127.6, 94.4, 76.4, 70.9, 65.4, 60.1, 55.9, 37.7, 32.7, 27.0, 20.8, 19.2, 14.3; IR (neat) 3469 (br), 3072, 2931, 2889, 2858, 1713, 1645, 1590, 1462, 1428, 1373, 1110 cm⁻¹; HRMS (ESI) *m/z* for C₂₈H₄₀NaO₅Si [M+Na]⁺ calcd 507.2543, found 507.2565; *Anal.* calcd for C₂₈H₄₀O₅Si: C, 69.38; H, 8.32. Found: C 69.24; H 8.26.



Aldehyde 14. To a solution of SI-1 (6.60 g, 13.6 mmol) in CH₂Cl₂ (109 mL) was added DMSO (6.80 mL, 95.5 mmol) and diisopropylethylamine (11.9 mL, 68.2 mmol). The mixture was cooled to 0 °C and charged with SO₃•pyridine (6.51 g, 40.9 mmol). After 30 min, sat. aq. NaHCO₃ (50 mL) was added and the aqueous phase was extracted with CH₂Cl₂ (3 x 30 mL). The combined organic layers were washed with brine, dried over Na₂SO₄, filtered and concentrated. Purification of the crude product by flash chromatography (20% EtOAc/hexanes) afforded 14 (6.20 g, 12.8 mmol, 94%) as a viscous oil: $[\alpha]^{25}{}_{D} = +38.3^{\circ}$ (*c* 1.16, CH₂Cl₂); ¹H NMR (CDCl₃, 400 MHz) δ 9.53 (s, 1H), 7.64 (m, 4H), 7.46-7.41 (m, 2H), 7.39-7.34 (m, 4H), 5.85 (tq, *J* = 7.5, 1.4 Hz, 1H), 4.18 (q, *J* = 7.1 Hz, 2H), 4.09 (dd, *J* = 6.4, 2.3 Hz, 1H), 3.71 (m, 1H), 3.30 (s, 3H), 2.80-2.72 (m, 1H), 2.58 (m, 1H), 1.94-1.87 (m, 1H), 1.90 (d, *J* = 1.3 Hz, 3H), 1.69 (ddd, *J* = 14.5, 6.4, 2.7 Hz, 1H), 1.29 (t, *J* = 7.1 Hz, 3H), 1.12 (s, 9H); ¹³C NMR (CDCl₃, 100 MHz) δ 202.4, 167.7, 137.2, 135.7, 135.6, 133.2, 132.7, 130.0, 129.3, 127.8, 127.7, 75.3, 75.2, 60.1, 56.3, 39.0, 32.3, 26.9, 20.8, 19.3, 14.3; IR (neat) 3072, 3050, 2958, 2932, 2894, 2858, 2826, 2713, 1963, 1895,

1825, 1732, 1715, 1648, 1590, 1473, 1463, 1428, 1372, 1228, 1193, 1112 cm⁻¹; HRMS m/z for $C_{28}H_{38}NaO_5Si[M+Na]^+$ calcd 505.2386, found 505.2367.



Allylic Alcohol 7a. To a slurry of anhydrous chromium (II) chloride (15.8 g, 128.6 mmol) in THF (26 mL) was added a solution of 14 (6.20 g, 12.9 mmol) and iodoform (15.2 g, 38.6 mmol) in dioxane (219 mL). The resulting brown suspension was stirred at room temperature for 12 h, then diluted with Et_2O (200 mL) and poured into 200 mL of water. The aqueous phase was extracted with Et_2O (3 x 100 mL). The combined organic layers were washed with brine, dried over MgSO₄, filtered and concentrated. Purification of the crude product by flash chromatography (20-80% CH₂Cl₂-hexanes) afforded iodide SI-2 (6.46 g, 10.6 mmol, 82%) as a yellow oil.

To a -78 °C solution of **SI-2** (6.46 g, 10.6 mmol) in Et₂O (64 mL), was added DIBAL-H (26.6 mL of a 1.0 M solution in hexanes, 26.6 mmol) dropwise. The mixture was allowed to warm up to -20 °C and then quenched with sat. aq. sodium potassium tartrate (Rochelle's salt, 50 mL) and diluted with Et₂O. The mixture was stirred at room temperature for 12 h. The aqueous phase was extracted with Et₂O (3 x 30 mL), dried over anhydrous MgSO₄, filtered and concentrated to provide pure allylic alcohol **7a** (5.83 g, 10.3 mmol, 94%) as a viscous oil: $[\alpha]^{25}{}_{D} = -41.0^{\circ}$ (*c* 3.20, CH₂Cl₂); ¹H NMR (CDCl₃, 400 MHz) δ 7.65-7.60 (m, 4H), 7.45-7.36 (m, 6H), 6.49 (dd, *J* = 14.4, 7.0 Hz, 1H), 5.94 (dd, *J* = 14.1, 1.0 Hz, 1H), 5.17 (app t, *J* = 7.7 Hz, 1H), 4.23 (m, 1H), 3.99 (d, *J* = 11.7 Hz, 1H), 3.92 (d, *J* = 11.7 Hz, 1H), 3.21 (m, 1H), 3.18 (s, 3H), 2.09 (m, 2H), 1.9 (br s, 1H), 1.79 (s, 3H), 1.77 (ddd, *J* = 14.0, 7.4, 5.3 Hz, 1H), 1.49 (ddd, *J* = 14.1, 6.9, 5.0 Hz, 1H), 1.06 (s, 9H); ¹³C NMR (CDCl₃, 100 MHz) δ 148.0, 138.0, 135.9, 135.8, 133.6, 133.3, 129.8, 129.8, 127.6, 123.2, 76.7, 73.7, 61.3, 56.6, 41.2, 31.8, 27.0, 22.1, 19.3; IR (neat) 3435 (br), 3071, 3045, 2931, 2857, 1713, 1606, 1471, 1427, 1111 cm⁻¹; HRMS (ESI) *m/z* for C_{27H37}INaO₃Si [M+Na]⁺ calcd 587.1454, found 587.1462.



Boronic Ester SI-3. A mixture of anhydrous chromium(II) chloride (0.80 g, 6.50 mmol) and lithium iodide (0.16 g, 5.67 mmol) was cooled to 0 °C and suspended in degassed THF (8 mL). A degassed solution of aldehyde 14 (0.39 g, 0.81 mmol) and dichloromethyl pinacol boronate² (0.34 g, 1.6 mmol) in THF (4 mL) was transferred via cannula to the suspension. After 16 h, the dark mixture was poured into water (50 mL) and extracted with diethyl ether (3 x 50 mL). The combined ethereal layers were washed with water (10 mL), dried over MgSO₄, filtered, and concentrated to furnish vinyl boronate **SI-3** (0.45 g, 0.74 mmol, 92%) as a pale yellow oil: $[\alpha]^{25}_{D} = -5.7^{\circ}$ (*c* 4.40, CH₂Cl₂); ¹H NMR (CDCl₃, 400 MHz) δ 7.63 (m, 4H), 7.41-7.30 (m, 6H), 6.57 (dd, J = 17.9, 5.5 Hz, 1H), 5.80 (app td, J = 6.9, 1.2 Hz, 1H), 5.49 (dd, J = 17.9, 11.2 Hz, 1H), 4.38 (m, 1H), 4.16 (q, J = 7.1 Hz, 2H), 3.29 (m, 1H), 3.12 (s, 3H), 2.55 (m, 2H), 1.86 (d, J = 1.3 Hz, 3H), 1.78 (ddd, J = 14.0, 8.2, 5.0 Hz, 1H), 1.47 (ddd, J = 14.0, 7.0, 1.04.3 Hz, 1H), 1.26 (m, 15H), 1.07 (s, 9H); ¹³C NMR (CDCl₃, 125 MHz) δ 167.7. 154.8, 138.3, 135.9, 135.8, 134.1, 133.8, 129.5, 129.4, 128.5, 127.4, 127.3, 83.0, 76.1, 59.5, 55.6, 41.7, 33.1, 27.0, 24.8, 24.7, 24.6, 24.3, 20.7, 19.3, 14.2 [note: the carbon attached to boron was not observed due to guadrupole broadening caused by the ¹¹B nucleus]; IR (film) 3072, 3049, 2978, 2932, 2858, 1715, 1642, 1590, 1472, 1463, 1428, 1371, 1338, 1216, 1145, 1105 cm⁻¹; HRMS (ES) calcd for $C_{35}H_{51}BNaO_6Si [M+Na]^+$ 629.3446, found 629.3459.



Allylic Alcohol 7b. A solution of ethyl ester SI-3 (0.42 g, 0.69 mmol) in diethyl ether (7 mL) was cooled to -78 °C and treated with DIBAL-H (1.0 M in hexanes, 2.08 mL, 2.08 mmol). The dry ice/acetone bath was replaced with an ice bath and the reaction was stirred for an additional 30 min. The reaction was quenched by sequential addition of water (0.3 mL), 2N NaOH (0.6 mL), and water (0.3 mL). After the mixture was stirred for 1 h at 23 °C, the white precipitate was filtered through a pad of Celite. The product was eluted with diethyl ether, dried over MgSO₄, filtered, and concentrated to furnish 7b (0.38 g, 0.67 mmol, 97%) as a transparent oil: $[\alpha]^{25}_{D} = -7.0^{\circ}$ (*c* 2.00, CH₂Cl₂); ¹H NMR (CDCl₃, 400 MHz) δ 7.64 (m, 4H), 7.44-7.31 (m, 6H), 6.57 (dd, *J* = 18.0, 5.5 Hz, 1H), 5.51 (dd, *J* = 18.0, 1.3 Hz, 1H), 5.13 (app t, *J* = 7.7 Hz, 1H), 4.34 (app q, *J* = 5.4 Hz, 1H), 3.96 (dd, *J* = 11.7, 5.3 Hz, 1H), 3.86 (dd, *J* = 11.6, 6.1 Hz, 1H), 3.15 (m, 1H), 3.13 (s, 3H), 2.40 (m, 1H), 2.12-1.95 (m, 2H), 1.80-1.73 (m, 1H), 1.77 (s, 3H), 1.43 (dt, *J* = 14.1, 5.7 Hz, 1H), 1.26 (s, 6H), 1.25 (s, 6H), 1.07 (s, 9H); ¹³C NMR (CDCl₃, 100

MHz) δ 154.7, 138.0, 136.0, 135.9, 134.1, 133.6, 129.7, 129.5, 127.5, 127.4, 123.4, 83.1, 76.7, 72.7, 61.2, 56.6, 41.1, 32.1, 27.1, 24.8, 24.6, 22.3, 19.3; IR (film) 3445 (br), 3072, 3049, 2976, 2932, 2859, 1643, 1472, 1428, 1391, 1371, 1338, 1272, 1146, 1112 cm⁻¹; HRMS (ES) calcd for C₃₃H₄₉BNaO₅Si [M+Na]⁺ 587.3340, found 587.3348.



Allylic Bromide 17. Methane sulfonic anhydride (0.98 g, 5.62 mmol) was added to a cold solution (0 °C) of (2*E*,4*E*)-5-tributylstannyl-2-methylpenta-2,4-dien-1-ol 16³ (1.50 g, 4.32 mmol) and triethylamine (0.90 mL, 6.48 mmol) in CH₂Cl₂ (9 mL). After 15 min, the reaction was diluted with acetone (9 mL) and charged with anhydrous lithium bromide (2.25 g, 25.9 mmol). After the mixture was stirred for 2 h at 23 °C, the solvents were removed *in vacuo*. The concentrate was then rinsed out of the flask and partitioned between sat. aq. NH₄Cl (100 mL) and hexanes (100 mL). The aqueous layer was extracted twice more with hexanes (100 mL). The combined organic layers were dried over Na₂SO₄, filtered, and concentrated to an oil. After trituration with pentane and filtration through a pad of Celite, the filtrate was concentrated to furnish the desired dienylic bromide 17 (1.44 g, 3.20 mmol, 81%) as a yellow oil: ¹H NMR (CDCl₃, 500 MHz) δ 6.71 (dd, *J* = 18.6, 10.3 Hz, 1H), 6.38 Hz (d, *J* = 18.6 Hz, 1H), 6.16 (br d, *J* = 10.4 Hz, 1H), 4.05 (s, 2H), 1.93 (d, *J* = 1.2 Hz, 3H), 1.51 (m, 6H), 1.30 (m, 6H), 0.91 (m, 15H); ¹³C NMR (CDCl₃, 100 MHz) δ 142.1, 137.9, 132.9, 132.2, 42.0, 29.1, 27.3, 15.2, 13.7, 13.6, 9.5; IR (film) 2956, 2925, 2871, 2853, 1558, 1463, 1203, 985 cm⁻¹.

$$\begin{array}{c} Me \\ Bu_3Sn \\ \hline 17 \\ Br \\ 80\% \\ \end{array} \begin{array}{c} PBu_3 \\ MeCN/THF \\ Bu_3Sn \\ \hline 8a \\ \end{array} \begin{array}{c} Me \\ PBu_3 \\ Bu_3Sn \\ \hline 8a \\ \end{array} \begin{array}{c} Me \\ PBu_3 \\ Bu_3Sn \\ \hline 8a \\ \end{array}$$

Phosphonium Salt 8a. A deoxygenated solution of dienyl bromide **17** (1.52 g, 3.71 mmol) in 3:2 MeCN:THF (10 mL) was cooled to -10 °C and treated with tributylphosphine (0.88 mL, 3.52 mmol). The reaction was then warmed to 23 °C over 10 minutes, at which point the solvent was removed first by evaporation under a stream of argon, then *in vacuo*. The oily residue was triturated with pentane and cooled to -20 °C in a freezer. The oily orange solid was collected by filtration through a pad of Celite topped by a layer of sea sand. After removal of the filtrate, the product was dissolved and eluted using CH₂Cl₂ and then concentrated *in vacuo* to provide the phosphonium salt **8a** (1.88 g, 2.88 mmol, 80%) as an oily orange solid: ¹H NMR (CDCl₃/CH₂Cl₂, 500 MHz) δ 6.62 (dd, J = 18.5, 10.2 Hz, 1H), 6.32 (d, J =

18.5 Hz, 1H), 6.12 (m, 1H), 3.52 (d, J = 15.8 Hz, 2H), 2.43 (m, 6H), 1.94 (s, 3H), 1.65-1.37 (m, 18H), 1.31 (m, 6H), 0.93 (m, 9H), 0.87 (m, 15H); ¹³C NMR (CDCl₃, 100 MHz) δ 140.5, 140.4, 137.4, 137.4, 135.7, 135.6, 122.5, 122.3, 30.2, 29.7, 28.6, 28.5, 27.9, 27.5, 27.0, 26.9, 26.7, 26.5, 26.4, 23.8, 23.7, 23.6, 23.5, 23.4, 23.4, 23.3, 23.3, 21.2, 19.1, 18.7, 13.3, 13.2, 13.0, 10.0, 9.1 (*note*: spectrum is not ³¹Pdecoupled); IR (film) 3391, 2958, 2928, 2873, 2181, 1827, 1771, 1633, 1557, 1464, 1456, 1417, 1379, 923 cm⁻¹; HRMS (ES) calcd for C₃₀H₆₂PSn [M–Br]⁺573.3611, found 573.3625.



Trienyl Stannane 19. A solution of azeotropically dried phosphonium salt **8a** (1.11 g, 1.81 mmol) and 18-crown-6 (2.26 g, 8.56 mmol) in THF (12 mL) was cooled to -45 °C and treated with a potassium bis(trimethylsilyl)amide (1.0 M in toluene, 1.77 mL, 1.77 mmol). The dark orange/brown solution was then cooled to -78 °C. A solution of aldehyde 18⁴ (0.474 g, 1.07 mmol) in THF (2 mL) was slowly transferred via cannula to the cooled ylide solution. The reaction was stirred at -78 °C for 10 min, then gradually warmed to −10 °C over 2 h. The mixture was treated with sat. aq. NH₄Cl (20 mL) and extracted with a 1:1 hexanes: diethyl ether (2 x 60 mL). The combined organic extracts were washed with sat. aq. NaHCO₃, then dried over MgSO₄. Filtration of the solution through a pad of basic alumina (diethyl ether as eluant) and concentration of the filtrate furnished the product 19 (0.83 g, 1.04 mmol, 92%, >10:1 E:Z) as a yellow oil. $[\alpha]_{D}^{25} = +9.3^{\circ}$ (c 6.30, CH₂Cl₂); ¹H NMR (CDCl₃, 500 MHz) δ 6.88 (ddd, J = 18.5, 10.6, 2.5 Hz, 1H), 6.26 (d, J = 18.6 Hz, 1H), 6.07 (d, J = 15.7 Hz, 1H), 6.00 (d, J = 10.3 Hz, 1H), 6.00 (d, JHz, 1H), 5.76 (ddd, J = 15.7, 7.1 Hz, 1H), 4.07 and 4.03 (2 d, J = 4.9 Hz, 1H combined), 3.97 (m, 1H), 3.78 (m, 2H), 2.42 (m, 1H), 1.89 (d, J = 1.5 Hz, 3H), 1.76 (m, 1H), 1.56-1.46 (m, 21H), 1.31 (m, 6H), 1.08-1.03 (m, 6H), 0.90 (m, 24H), 0.79 and 0.78 (2 d, J = 6.7 Hz, 3H combined), 0.06 (2 s, 6H); ¹³C NMR (CDCl₃, 125 MHz) & 151.8, 151.5, 143.1, 134.2, 134.2, 134.1, 134.1, 133.5, 133.5, 132.3, 92.7, 79.7, 79.1, 78.0, 77.7, 73.5, 73.4, 54.8, 54.7, 43.8, 35.7, 35.7, 29.2, 29.2, 29.1, 29.0, 28.6, 28.5, 28.3, 27.5, 27.4, 27.3, 27.1, 26.1, 26.1, 25.6, 24.5, 18.6, 18.4, 17.0, 16.9, 13.8, 13.7, 13.2, 12.8, 10.4, 10.3, 10.2, 9.5, -3.8, -3.8, -4.0; IR (film) 2957, 2929, 2856, 1699, 1600, 1388, 1374, 1253, 1105 cm⁻¹; HRMS (ES) calcd for C₄₁H₇₉NNaO₄SiSn [M+Na]⁺ 820.4698, found 820.4706. Anal. Calcd for C₄₁H₇₉NO₄SiSn: C, 61.80; H, 9.99; N 1.76, found: C 61.59; H 10.17; N 1.72.



Trienyl Iodide 20. A solution of trienyl stannane 19 (227 mg, 0.270 mmol) in CH₂Cl₂ (4 mL) was cooled to 0 °C and treated with a solution of iodine (65 mg, 0.26 mmol) in CH₂Cl₂ (1.2 mL). The iodine solution (dark magenta in color) was added dropwise to the reaction (yellow) until the endpoint was just reached (slight orange/purple tint). [Note: Any excess of iodine was found to cause olefin isomerization.] A solution of sat. aq. $Na_2S_2O_3$ (1 mL) was then immediately added, followed by sat. aq. KF (4 mL) and diethyl ether (5 mL). The biphasic mixture was stirred for 1 h and then filtered through a pad of Celite (CH_2Cl_2 as eluant). The aqueous layer was extracted with diethyl ether (2 x10 mL), and the combined organic layers were stirred over MgSO₄ and KF on Celite for 1 h.⁵ Filtration through a pad of basic alumina and concentration furnished pure trienyl iodide 20 (161 mg, 0.250 mmol, 95%) as a bright yellow oil/foam: $[\alpha]_{D}^{25} = +13.0^{\circ} (c \ 1.80, \ CH_2Cl_2);$ ¹H NMR (CDCl₃, 400 MHz) δ 7.37 (ddd, J = 14.1, 11.4, 1.0 Hz, 1H), 6.26 (d, J = 14.1 Hz, 1H), 6.03 (d, J = 16.2 Hz, 1H), 5.90 (d, J = 11.1 Hz, 1H), 5.83 (ddd, J = 15.9, 7.4, 3.5 Hz, 1H), 4.05 and 4.01 (2 d, J = 5.9 Hz, 1H combined), 3.97 and 3.80 (2 m, 1H combined), 3.77 (m, 1H), 2.38 (m, 1H), 1.82 (s, 3H), 1.73 (m, 1H), 1.55 and 1.50 (2 s, 3H combined), 1.48 and 1.46 (2 s, 12H combined), 1.06-1.02 (m, 6H), 0.90 and 0.89 (2 s, 9H combined), 0.79 and 0.78 $(2 \text{ d}, J = 6.8 \text{ Hz}, 3\text{ H combined}), 0.06, 0.05, 0.04, 0.03 (4 \text{ s}, 6\text{H combined}); {}^{13}\text{C NMR} (\text{CDCl}_3, 100 \text{ MHz})$ δ 151.5, 141.8, 135.8, 135.0, 133.0, 128.2, 92.4, 79.5, 78.8, 77.9, 77.6, 77.4, 73.0, 54.4, 43.5, 35.4, 28.2, 28.2, 28.0, 27.1, 25.8, 25.3, 24.2, 18.1, 16.6, 13.5, 12.9, 12.7, 9.9, -4.1, -4.3; IR (film) 2972, 2956, 2929, 2856, 1698, 1462, 1388, 1374, 1253, 1178, 1105 cm⁻¹; HRMS calcd for C₂₉H₅₂INNaO₄Si [M+Na]⁺ 656.2608, found 656.2626.



Enal 5. To a solution of vinyl boronate 7b (0.163 g, 0.289 mmol) and vinyl iodide 20 (0.183 g, 0.289 mmol) in THF (3 mL) was added thallium(I) carbonate (0.34 g, 0.72 mmol) and degassed by three freeze-pump-thaw cycles. An aliquot of degassed water (1 mL) was then added, followed by a solution of Pd(PPh₃)₄ (20.0 mg, 0.017 mmol) in degassed THF (0.4 mL). After 2.5 h, the reaction was complete by TLC (4:1 hexanes:EtOAc). The reaction mixture was filtered through a pad of Celite and eluted with diethyl ether. The resulting filtrate was dried over Na₂SO₄, filtered through a thin layer of basic alumina, and concentrated to afford 22 (0.260 g, 0.27 mmol, 95%) as an orange oil. Attempted purification of samples of 22 by flash column chromatography resulted in decomposition.

A solution of alcohol **22** (0.207 g, 0.219 mmol), DMSO (0.11 mL, 1.5 mmol), and diisopropyl ethylamine (0.17 mL, 0.99 mmol) in CH₂Cl₂ (1 mL) was cooled to 0 °C and SO₃•pyridine (0.105 g, 0.658 mmol) was added. After 40 min, the reaction was quenched with sat. aq. NaHCO₃. The mixture was partitioned between hexanes and half-saturated brine. The hexanes layer was dried over Na₂SO₄, filtered, and concentrated to furnish the enal **5** (0.20 g, 0.21 mmol, 97%) as an orange oil: $[\alpha]^{25}_{D} = -38.0^{\circ}$ (*c* 2.7, CH₂Cl₂); ¹H NMR (CDCl₃, 400 MHz) δ 9.96 (s, 1H), 7.67-7.61 (m, 4H), 7.45-7.32 (m, 6H), 6.40 (m, 2H), 6.14-6.00 (m, 2H), 5.99 (d, *J* = 12.9 Hz, 1H), 5.96 (dd, *J* = 15.1, 10.6 Hz, 1H), 5.75 (app dt, *J* = 15.6, 7.0 Hz, 1H), 5.62 (dd, *J* = 15.1, 7.2 Hz, 1H), 4.33 (m, 1H), 4.07 and 4.06 (2 d, *J* = 5.1 Hz, 1H combined), 3.98 and 3.90 (2 m, 1H combined), 3.78 (m, 1H), 3.33 (m, 1H), 3.17 (s, 3H), 2.58 (m, 2H), 2.42 (m, 1H), 1.87 (m, 1H), 1.86 (s, 3H), 1.75 (m, 4H), 1.60-1.46 (m, 16H), 1.11-1.04 (m, 6H), 1.06 (m, 9H), 0.90 (2 s, 9H combined), 0.77 (m, 6H), 0.07, 0.06, 0.05 and 0.04 (4 s, 6H combined); IR (film) 3072, 2957, 2930, 2857, 2733, 1958, 1816, 1697, 1590, 1472, 1462, 1428, 1388, 1374, 1301, 1255, 1106 cm⁻¹; HRMS calcd for C₅₆H₈₇NNaO₇Si₂ [M+Na]⁺ 964.5919, found 964.5939.



IMDA Cvcloadduct 23. A solution of pentaene 5 (0.20 g, 0.22 mmol) and BHT (one small crystal) in 2,2,2-trifluoroethanol (16 ml, 0.01M) was heated to 70-75 °C for 9 h. The solvent was removed under reduced pressure, affording the crude product as an orange oil ($\geq 6:1:1$ d.s. by ¹H-NMR) which was purified by flash column chromatography on silica gel (10:1 hexanes:EtOAc). The cyclized adduct 23 (0.13 g, 0.14 mmol, 65%) was isolated as a yellow oil. HPLC purification (21 mm column, 91:9 hexanes: EtOAc, r.t. 16.5 min) provided an analytical sample: $\left[\alpha\right]_{D}^{25} = -29.0^{\circ} (c \ 0.60, \ CH_2Cl_2);^{-1}H$ NMR (CDCl₃, 500 MHz) δ 9.42 (d, J = 1.1 Hz, 1H), 7.68 (m, 4H), 7.45-7.35 (m, 6H), 6.04 (br d, J = 10.3 Hz, 1H), 5.97 (d, J = 15.8 Hz, 1H), 5.63 (ddd, J = 15.9, 7.3, 5.9 Hz, 1H), 5.55 (app dt, J = 10.2, 3.6 Hz, 1H), 5.36 (d, J = 10.1 Hz, 1H), 4.02 and 4.00 (2 d, J = 5.5 Hz, 1H), 3.98 and 3.80 (2 m, 1H combined), 3.77 and 3.69 (m, 2H), 3.21 (s, 3H), 3.11 (br d, J = 10.2 Hz, 1H), 2.85 (m, 1H), 2.35 (m, 1H), 2.30 (m, 1H), 2.02 (br d, J = 11.2 Hz, 1H), 1.86 (br d, J = 12.3 Hz, 1H), 1.81 (d, J = 0.7 Hz, 3H), 1.74 (m, 1H), 1.61 (m, 1H), 1.55 and 1.51 (2 s, 3H combined), 1.51 and 1.48 (2 s, 3H combined), 1.48 and 1.47 (2 s, 9H combined), 1.35 (m, 1H), 1.25 (m, 1H), 1.09 (s, 9H), 1.09 and 1.05 (2d, J = 6.1 Hz, 3H combined), 1.02 and 1.01 (2 d, J = 6.8 Hz, 3H), 0.91 (s, 3H), 0.89 and 0.88 (2 s, 9H combined), 0.78 (2 d, J = 6.5 Hz, 3H), 0.06, 0.05, 0.03, 0.03 (4 s, 6H combined); ¹³C NMR (CDCl₃, 100 MHz) & 204.4, 151.8, 151.5, 136.2, 135.7, 134.0, 133.7, 132.7, 129.8, 129.7, 128.3, 127.9, 127.6, 123.9, 92.6, 92.2, 79.7, 79.1, 77.9, 77.7,

77.4, 73.4, 71.2, 55.9, 54.8, 50.4, 43.4, 41.2, 38.2, 37.4, 35.5, 35.2, 29.1, 28.6, 28.5, 28.5, 27.0, 26.1, 25.7, 24.5, 22.8, 19.2, 18.4, 16.9, 13.3, 12.7, 10.2, -3.8, -4.0; IR (film) 3065, 2956, 2931, 2858, 2708, 1725, 1698, 1472, 1428, 1388, 1254, 1178, 1111 cm⁻¹; HRMS (ES) calcd for $C_{56}H_{97}NNaO_7Si_2$ [M+Na]⁺ 964.5919, found 964.5917.



Boronic Ester 24. A solution of aldehyde 23 (52.0 mg, 0.056 mmol) and dichloromethyl pinacol boronate² (23 mg, 0.11 mmol) in THF (1 mL) was degassed by three freeze-pump-thaw cycles. Chromium(II) chloride (54 mg, 0.44 mmol) and lithium iodide (48 mg, 0.36 mmol) were cooled to -78 °C in a dry flask. The THF solution was transferred by cannula to the salts and then warmed to 23 °C. After 18 h, the reaction was diluted with water (10 mL) and diethyl ether (5 mL). The product was extracted with diethyl ether (3 x 20 mL). The combined ethereal layers were washed with brine, dried over MgSO₄, filtered and concentrated to afford 24 (56 mg, 0.055 mmol, 95%) as a yellow oil: $\left[\alpha\right]_{D}^{25} = -42.0^{\circ}$ (c 1.80, CH_2Cl_2); ¹H NMR (CDCl₃, 500 MHz) δ 7.68 (m, 4H), 7.47-7.35 (m, 6H), 6.71 (dd, J = 18.5, 1.9 Hz, 1H), 6.01 (dd, J = 15.7, 2.3 Hz, 1H), 5.96 (d, J = 10.0 Hz, 1H), 5.63-5.57 (m, 2H), 5.40 (dd, J = 5.3, 9.0 Hz, 1H), 5.34 (d, J = 18.6 Hz, 1H), 4.06 and 4.04 (2 d, J = 4.6 Hz, 1H combined), 3.96-3.90 (2 m, 1H combined), 3.77 (m, 1H), 3.66 (m, 1H), 3.18 (2 s, 3H combined), 2.85 (m, 1H), 2.74 (m, 1H), 2.41 (m, 1H), 2.35 (m, 1H), 1.98 (br d, J = 12.0 Hz, 1H), 1.82 (m, 1H), 1.74 (m, 1H), 1.69 (d, J = 3.2 Hz, 3H), 1.56 and 1.51 (2 s, 3H combined), 1.55 (m, 1H), 1.51 and 1.48 (2 s, 3H combined), 1.48 and 1.46 (2 s, 9H combined), 1.31-1.24 (m, 2H), 1.28 (s, 12H), 1.21 and 1.20 (2 s, 9H combined), 1.10 and 1.05 (2 d, J =6.2 Hz, 3H combined), 1.03 (2 d, J = 7.0 Hz, 3H combined), 0.92 (s, 3H), 0.91 (2 s, 9H combined), 0.79 (2 d, J = 6.6 Hz, 3H), 0.06 and 0.05 (2 s, 6H combined); ¹³C NMR (CDCl₃, 100 MHz) δ 160.7, 151.8, 151.5, 135.2, 134.3, 130.5, 129.7, 129.6, 127.6, 127.5, 122.5, 92.6, 92.2, 84.2, 82.8, 77.7, 73.6, 73.3, 71.5, 55.7, 54.8, 44.3, 43.8, 43.6, 42.3, 39.4, 38.8, 36.9, 36.2, 30.3, 29.6, 28.5, 28.5, 27.9, 27.4, 27.0, 26.1, 25.6, 24.7, 24.7, 24.4, 19.2, 18.4, 13.9, 13.3, 12.6, 10.2, -3.7, -4.1 [note: the carbon attached to boron was not observed due to quadrupole broadening caused by the ¹¹B nucleus]; IR (film) 3072, 2978, 2932, 2858, 1698, 1628, 1472, 1428, 1389, 1348, 1326, 1255, 1215, 1146, 1111 cm⁻¹; MS (ES) calcd for $C_{63}H_{100}BNNaO_8Si_2[M+Na]^+$ 1089, found 1089.



Vinyl Iodide 6. A solution of 2-butyn-1-ol (1.81 mL, 24.2 mmol,) in THF (25 mL) at -78 °C was treated with Red-Al (65 wt. % in toluene, 8.0 mL, 27 mmol) dropwise by syringe. The reaction was then warmed to 23 °C and stirred for 18 h. After cooling the mixture back to -78 °C, tributyltin chloride (13.1 mL, 48.4 mmol) was added dropwise by addition funnel. The reaction was then warmed to 23 °C for 1 h and poured into a solution of sodium potassium tartrate (Rochelle's salt, aq). Potassium fluoride (sat. aq.) and diethyl ether were added and the biphasic mixture was stirred for 3 h and then filtered through a pad of Celite. The filtrate was extracted with diethyl ether (2 x 100 mL), and the combined organic layers were stirred over a mixture of MgSO₄ and KF on Celite for 1.5 h. The solids were filtered by flushing the mixture through a pad of basic alumina and the filtrate was concentrated to a transparent oil. Purification of the crude product by flash chromatography (10% EtOAc-hexanes) furnished (*Z*)-3-tributystannyl-2-buten-1-ol (6.24 g, 17.28 mmol, 71%) as a pale oil.

(*Z*)-3-tributystannyl-2-buten-1-ol (1.52 g, 4.31 mmol), DMSO (2.1 mL, 29.4 mmol), and diisopropyl ethylamine (3.31 mL, 18.9 mmol) were dissolved in CH_2Cl_2 (10 mL) and cooled to 0 °C. SO_3 •pyridine (2.01 g, 12.6 mmol) was added in one portion. After 40 min, the reaction was diluted with diethyl ether and sat. aq. sodium bicarbonate. The product was extracted with diethyl ether (3 x 30 mL). The combined organic extracts were washed with half-saturated brine, dried over MgSO₄, filtered, and concentrated to afford enal 27^6 (1.45 g, 4.04 mmol, 96%).

Phosphonate reagent $\mathbf{28}^7$ (0.81 g, 2.58 mmol) was dissolved in THF (3 mL) and cooled to 0 °C. A solution of *n*-BuLi (2.2 M in hexanes, 1.05 mL, 2.31 mmol) was added dropwise and the reaction was warmed to 23 °C for 15 min. After cooling the mixture to 0 °C, a solution of enal **27** (0.31 g, 0.86 mmol) in THF (1 mL) was added dropwise over 5 min. After 20 min, the reaction was complete by TLC (4% EtOAc-hexanes). The solvent was removed under reduced pressure and the crude product was partitioned between diethyl ether and sat. aq. ammonium chloride. The ethereal layer was washed with half-saturated brine, dried over MgSO₄, filtered, and concentrated to afford the vinyl stannane TMSE ester **29** (0.33 g, 0.66 mmol, 77%) as a pale yellow oil

Finally, the vinyl stannane TMSE ester **29** (0.83 g, 1.66 mmol) was dissolved in CH_2Cl_2 (5 mL) and cooled to -78 °C. A solution of iodine (0.40 g, 1.57 mmol) in CH_2Cl_2 (2 mL) was added dropwise by syringe. The mixture was warmed to 0 °C and then quenched with sat. aq. $Na_2S_2O_3$. The reaction was diluted with diethyl ether (6 mL) and sat. aq. potassium fluoride solution. After vigorously stirring the mixture for 1 h, it was filtered through a pad of Celite. The ethereal layer was separated and stirred over MgSO₄ and KF on Celite for 1 h. The mixture was filtered and concentrated to a crude orange oil. The

crude product was purified by flash column chromatography on silica gel (5% Et₂O-hexanes) to furnish the dienyl iodide **6** (0.34 g, 1.01 mmol, 61%) as a pale yellow oil: ¹H NMR (CDCl₃, 500 MHz) δ 7.20 (dd, *J* = 15.4, 10.3 Hz, 1H), 6.15 (dq, *J* = 10.3, 0.5 Hz, 1H), 5.89 (dd, *J* = 15.4, 0.7 Hz, 1H), 4.17 (app d, *J* = 8.5 Hz, 1H), 4.16 (app d, *J* = 8.1 Hz, 1H), 2.58 (s, 3H), 0.95 (app d, *J* = 8.8 Hz, 1H), 0.93 (app d, *J* = 8.1 Hz, 1H), -0.04 (s, 9H); ¹³C NMR (CDCl₃, 100 MHz) δ 166.8, 145.7, 132.7, 123.6, 111.6, 62.7, 34.8, 17.3, -1.4; IR (film) 2954, 2926, 1714, 1631, 1457, 1377, 1314, 1251 1180, 1139, 837 cm⁻¹; HRMS (ES) calcd for C₁₂H₂₃INaO₃ [M+Na+CH₃OH]⁺ 393.0359, found 393.0358.



TMSE Ester 3. A solution of vinyl boronate 24 (53 mg, 0.05 mmol) and vinyl iodide 6 (34 mg, 0.01 mmol) in THF (1 mL) was treated with thalium(I) carbonate (58 mg, 0.12 mmol) and degassed by three freeze-pump-thaw cycles. Water (0.4 mL, degassed) and a solution of Pd(PPh₃)₄ (cat.) in THF (0.2 mL, degassed) were added consecutively to the reaction mixture. After 4.5 h, the reaction was diluted with diethyl ether and filtered through a plug of silica gel. Concentration of the ethereal solution yielded a crude yellow oil which was purified by flash column chromatography on silica gel (5-10% EtOAchexanes) to provided **3** (38.0 mg, 0.033 mmol, 66%) as a bright yellow oil: $[\alpha]_{D}^{25} = +22.0^{\circ}$ (c 0.50, CH₂Cl₂); ¹H NMR (CDCl₃, 400 MHz) δ 7.72 (m, 5H), 7.41 (m, 6H), 6.64 (d, J = 15.8 Hz, 1H), 6.17 (d, J = 15.4 Hz, 1H), 6.03 (m, 2H), 5.98 (d, J = 10.6 Hz, 1H), 5.76 (d, J = 15.7 Hz, 1H), 5.61 (m, 2H), 5.40 (d, J = 11.0 Hz, 1H), 4.25 (app t, J = 8.1 Hz, 1H), 4.24 and 3.96 (2 m, 1H combined), 4.04 (2 d, J = 4.0 Hz, 1H combined), 3.75 (m, 3H), 3.18 (s, 3H), 2.86 (m, 1H), 2.78 (m, 1H), 2.48 (m, 1H), 2.36 (m, 1H), 2.00 (m, 1H), 1.85 (m, 1H), 1.80 (d, J = 3.7 Hz, 3H), 1.73 (m, 2H), 1.67 (s, 3H), 1.54-1.50 (2 s, 3H), 1.48 and 1.47 (2 s, 12H), 1.31 (m, 2H), 1.11-1.03 (m, 17H), 0.90 (s, 12H), 0.77 (m, 3H), 0.06 (s, 15H); ¹³C NMR (CDCl₃, 100 MHz) & 167.7, 151.8, 143.2, 143.0, 139.2, 135.8, 135.4, 134.3, 134.1, 134.0, 132.3, 132.2, 131.5, 131.4, 130.7, 129.8, 129.7, 128.6, 128.4, 127.7, 127.6, 125.4, 122.8, 119.6, 92.6, 92.2, 79.7, 79.1, 77.1, 77.8, 77.6, 73.6, 71.4, 62.4, 55.7, 54.8, 44.9, 43.8, 41.1, 38.8, 36.8, 36.1, 30.1, 29.7, 28.6, 28.5, 28.3, 27.4, 27.0, 26.1, 25.6, 24,5, 21.2, 19.3, 18.5, 17.5, 17.3, 13.9, 13.2, 12.8, 10.2, -1.4, -3.7, -4.0; IR (film) 3065, 2957, 2930, 2884, 2858, 1700, 1616, 1472, 1428, 1389, 1302, 1252, 1163, 1109 cm⁻¹; HRMS calcd for C₆₈H₁₀₇NNaO₈Si₃ [M+Na]⁺ 1172.7202, found 1172.7175.



Boronic Ester 33. To a solution of **7a** (100 mg, 0.180 mmol) in CH₂Cl₂ (2 mL) was added DMSO (90 μ L, 1.26 mmol) and diisopropylethylamine (0.16 mL, 0.90 mmol). The mixture was cooled to 0 °C and charged with SO₃•pyridine (86 mg, 0.54 mmol). After 30 min, sat. aq. NaHCO₃ (50 mL) was added and the aqueous phase was extracted with CH₂Cl₂ (3 x 5 mL). The combined organic layers were washed with brine, dried over Na₂SO₄, filtered and concentrated. The crude product (90 mg, 0.16 mmol, 90%) was used in the next step without further purification: ¹H NMR (400 MHz, CDCl₃) δ 0.96 (s, 1H), 7.65-7.60 (m, 4H), 7.46-7.36 (m, 6H), 6.50 (dd, *J* = 14.4, 6.8 Hz, 1H), 6.37 (tq, *J* = 8.0, 1.4 Hz, 1H), 5.98 (dd, *J* = 14.4, 6.8 Hz, 1H), 4.27 (m, 1H), 3.35 (m, 1H), 3.19 (s, 3H), 2.59 (app t, *J* = 7.0 Hz, 2H), 1.78 (ddd, *J* = 14.0, 8.1, 5.0 Hz, 1H), 1.76 (s, 3H), 1.48 (ddd, *J* = 14.0, 7.0, 4.4 Hz, 1H), 1.06 (s, 9H).

A solution of LiI (385 mg, 2.88 mmol) in degassed THF (4 mL) was added to a suspension of CrCl₂ (708 mg, 5.76 mmol) in degassed THF (7 mL). Then, a solution of aldehyde **32** and boronic ester **15** in degassed THF was added dropwise. The mixture was stirred for 16 h and then quenched with H₂O (20 mL). The aqueous phase was extracted with Et₂O (3 x 20 mL). The combined organic phases were washed with brine, dried over anhydrous Na₂SO₄, filtered and concentrated. Purification of the crude product by flash chromatography (5% EtOAc-hexanes) afforded **33** (368 mg, 0.56 mmol, 78%) as a yellow oil: $[\alpha]^{25}{}_{D} = -40.5^{\circ}$ (*c* 5.20, CHCl₃); ¹H NMR (400 MHz, CDCl₃) δ 7.65-7.60 (m, 4H), 7.44-7.36 (m, 6H), 7.04 (d, *J* = 18.1 Hz, 1H), 6.48 (dd, *J* = 14.4, 7.0 Hz, 1H), 5.91 (dd, *J* = 14.4, 1.0 Hz, 1H), 5.58 (t, *J* = 7.4 Hz, 1H), 5.47 (d, *J* = 18.1 Hz, 1H), 4.25 (m, 1H), 3.27 (m, 1H), 3.17 (s, 3H), 2.32-2.19 (m, 2H), 1.74 (m, 1H), 1.69 (s, 3H), 1.50 (ddd, *J* = 14.0, 7.5, 4.0 Hz, 1H), 1.29 (s, 12H), 1.06 (s, 9H); ¹³C NMR (100 MHz, CDCl₃) δ 154.3, 148.0, 136.8, 135.9, 135.8, 133.7, 133.4, 132.3, 129.8, 129.7, 127.6, 127.5, 83.0, 76.7, 76.5, 73.7, 56.1, 41.6, 32.4, 27.0, 24.8, 19.2, 11.8 [note: the carbon attached to boron was not observed due to quadrupole broadening caused by the ¹¹B nucleus]; IR (neat) 2978, 2857, 1607, 1465, 1426, 1374, 1344, 1267, 1193, 1144, 1111, 998, 965, 847, 823, 738, 705 cm⁻¹; HRMS (ESI) *m/z* for C₃₄H₄₈O₄BISiNa [M + Na]⁺ calcd 709.2357, found 709.2339.



Enyne 45. To a -78 °C solution of trimethylsilyldiazomethane (21.1 mL of a 2.0 M solution in hexanes, 42.2 mmol) was added *n*-BuLi (14.6 mL of a 2.5 M solution in hexanes, 36.6 mmol). After being stirred for 30 min, a solution of **44**⁶ (10.1 g, 28.1 mmol) in THF (56 mL) was added. The mixture was stirred for 1 h at -78 °C, 30 min at 0 °C and then quenched with sat. aq. NHCl₄ (100 mL). The aqueous phase was extracted with Et₂O (3 x 50 mL). The combined organic phases were washed with brine, dried over anhydrous Na₂SO₄, filtered and concentrated. Purification of the crude product by flash chromatography (hexanes + 2% Et₃N) afforded **45** (8.0 g, 22.5 mmol, 80%) as a yellow oil: ¹H NMR (400 MHz, CDCl₃) δ 5.64 (app quint, J = 1.8 Hz, ³ $J_{\text{Sn-H}} = 55.8$ Hz, 1H), 3.14 (app dt, J = 2.0, 0.5 Hz, 1H), 2.14 (dd, J = 1.8, 0.5 Hz, ³ $J_{\text{Sn-H}} = 40.8$ Hz, 1H), 1.53-1.45 (m, 6H), 1.31 (sext, J = 7.3 Hz, 6H), 0.92 (m, 6H), 0.89 (t, J = 7.3 Hz, 9H); ¹³C NMR (100 MHz, CDCl₃) δ 161.6, 117.0, 80.5, 77.2, 29.0 (³ $J_{\text{Sn-C}} = 20.3$ Hz), 27.3 (² $J_{\text{Sn-C}} = 55.6$), 22.9, 13.7, 9.3 (¹ $J_{\text{Sn-C}} = 330.0$ Hz); IR (neat) 3312, 2957, 2926, 2872, 2873, 1463, 1376, 1072, 1013, 970, 874 cm⁻¹; HRMS (GC-CI) *m/z* for H₁₇H₃₃Sn [M + H]⁺ calcd 357.1604, found 357.1567.



Bimetallic Lichpin 36b. To a 0 °C solution of 2,5-dimethyl-2,4-hexadiene (1.4 mL, 9.6 mmol) in THF (0.8 mL) was added BH₃•THF (4.8 mL of a 1.0 M solution in THF, 4.8 mmol) dropwise. The solution was stirred for 3 h at 0 °C and then a solution of **45** (1.42 g, 4.00 mmol) in THF (4 mL) was added dropwise. The reaction mixture was stirred at 0 °C for 1 h and then was allowed to warm to room temperature. Water was added (0.8 mL), the reaction mixture was stirred for 30 min and then treated with an aqueous solution of formaldehyde (0.45 mL of a 37 wt% solution, 6.00 mmol). After being stirred for 1 h, pinacol (567 mg, 4.80 mmol) was added. The reaction mixture was stirred at room temperature for 24 h before water (20 mL) and Et₂O (20 mL) were added. The aqueous phase was extracted with Et₂O (3 x 15 mL) and the combined organic layers were washed with water (2 x 15 mL) and brine, dried over anhydrous Na₂SO₄, filtered and concentrated. Purification of the crude product by flash chromatography (hexanes-15% EtOAc/hexanes) afforded **36b** (970 mg, 2.00 mmol, 50%) as a pale yellow oil: ¹H NMR (400 MHz, CDCl₃) δ 7.40 (dd, *J* = 17.4, 10.6 Hz, 1H), 6.28 (dqd, *J* = 10.8, 2.0, 0.8 Hz, 1H), 5.46 (d, *J* = 17.6 Hz, 1H), 2.08 (d, *J* = 1.6 Hz, ³*J*_{Sn-H} = 46.6 Hz, 3H), 1.55-1.40 (m, 6H), 1.35-1.25 (m, 6H), 1.27 (s, 12H), 0.95-0.89 (m, 6H), 0.88 (t, *J* = 7.4 Hz, 3H); ¹³C NMR (100 MHz, CDCl₃) δ 150.7, 143.3, 141.1,

83.1, 29.1 (${}^{3}J_{Sn-C} = 20.0 \text{ Hz}$), 27.3 (${}^{2}J_{Sn-C} = 53.4$), 24.7, 20.4, 13.7, 9.2 (${}^{1}J_{Sn-C} = 329.0/322.0 \text{ Hz}$), [note: the carbon attached to boron was not observed due to quadrupole broadening caused by the ${}^{11}B$ nucleus]; IR (neat) 2957, 2926, 2872, 2854, 1610, 1572, 1455, 1379, 1354, 1328, 1271, 1146, 990, 971, 850 cm⁻¹; HRMS (ESI) *m/z* for C₂₃H₄₅O₂BSnNa [M + Na]⁺ calcd 507.2435, found 507.2478.



Allylic Bromide SI-4. To a 0 °C solution of 7a (1.00 g, 1.77 mmol) in CH₂Cl₂ (15 mL) was added triethylamine (0.74 mL, 5.31 mmol) followed by a solution of methanesulfonic anhydride (462 mg, 2.65 mmol) in CH_2Cl_2 (3 mL). After being stirred for 15 min, the reaction mixture was diluted with acetone (18 mL) and charged with anhydrous lithium bromide (769 mg, 8.85 mmol). The reaction was stirred for 1 h at room temperature and then quenched with water (15 mL) and extracted with CH₂Cl₂ (3 x 15 mL). The combined organic layers were washed with brine, dried over anhydrous MgSO₄, filtered and concentrated. Then hexanes (30 mL) were added and the mixture was filtered through a pad of Celite. The filtrate was concentrated to furnish the desired allylic bromide SI-4 (1.09 g, 1.74 mmol, 98%) as a colorless oil: $[\alpha]_{D}^{25} = -53.0^{\circ}$ (c 3.82, CHCl₃); ¹H NMR (400 MHz, CDCl₃) δ 7.66-7.60 (m, 4H), 7.46-7.36 (m, 6H), 6.49 (dd, J = 14.4, 7.0 Hz, 1H), 5.93 (dd, J = 14.4, 7.0 Hz, 1H), 5.28 (td, J = 7.3, 1.4 Hz, 1H), 4.25 (m, 1H), 3.88 (d, J = 9.7 Hz, 1H), 3.85 (d, J = 9.7 Hz, 1H), 3.28 (m, 1H), 3.17 (s, 3H), 2.12 (t, J = 6.31 Hz, 1H), 1.82 (d, J = 1.2 Hz, 1H), 1.75 (ddd, J = 14.0, 8.4, 5.1 Hz, 1H), 1.51 (ddd, J = 14.0, 7.3, 1.514.2 Hz, 1H), 1.06 (s, 9H); ¹³C NMR (100 MHz, CDCl₃) δ 148.0, 135.9, 135.8, 133.7, 133.6, 133.4, 129.8, 129.7, 127.63, 127.56, 126.6, 76.8, 76.2, 73.6, 56.2, 41.5, 32.1, 31.7, 27.0, 22.0, 19.3; IR (neat) 3071, 3043, 2931, 2858, 1607, 1471, 1428, 1362, 1205, 1111, 944, 822 cm⁻¹; HRMS (ESI) m/z for $C_{27}H_{36}BrIO_2SiNa [M + Na]^+$ calcd 651.0589, found 651.0573.



Phosphonium Salt 35a. To a 0 °C solution of **SI-4** (1.09 g, 1.74 mmol) in MeCN:THF (3:2, 15 mL) was added tributylphosphine (0.46 mL, 1.86 mmol). After being stirred for 1 h at room temperature the solution was concentrated and the crude product was washed with hexanes (x 3) to remove the excess of tributylphosphine. The phosphonium salt **35a** was obtained as a viscous colorless oil (1.30 g, 1.57 mmol, 89%) and was used without further purification: $[\alpha]^{25}{}_{D} = -31.8^{\circ}$ (c 3.58, CHCl₃); ¹H NMR (400

MHz, CDCl₃) δ 7.62-7.57 (m, 4H), 7.44-7.34 (m, 6H), 6.46 (dd, J = 14.3, 7.1 Hz, 1H), 5.92 (dd, J = 14.4, 0.9 Hz, 1H), 5.38 (m, 1H), 4.24 (m, 1H), 3.38 (m, 1H), 3.25 (m, 1H), 3.14 (s, 3H), 2.46 (m, 6H), 2.11 (m, 1H), 1.19 (s, 3H), 1.77 (ddd, J = 14.0, 8.2, 5.1 Hz, 1H), 1.59-1.39 (m, 13H), 1.05 (s, 9H), 0.96 (t, J = 7.1 Hz); ¹³C NMR (100 MHz, CDCl₃) δ 147.0, 135.1, 135.0, 129.1, 128.6, 128.5, 127.5, 126.9, 126.8, 124.3, 124.3, 124.2, 76.7 (overlapping w/ chloroform), 75.4, 72.9, 55.7, 40.7, 32.4, 26.3, 25.0, 23.3, 23.2, 23.1, 23.0, 19.3, 18.8, 18.5, 12.8 [note: spectrum is not ³¹P decoupled]; IR (neat) 3071, 2956, 2931, 2868, 2459, 2149, 1825, 1463, 1428, 1192, 1111, 822, 752 cm⁻¹; HRMS (ESI) *m/z* for C₃₉H₆₄IO₂PSi [M + H]⁺ calcd 750.3453, found 750.3452.

$$HO \longrightarrow O = 0$$

$$HO$$

Carboxylic Acid 41a. To a 0 °C solution of **40** (0.210 mL, 1.43 mmol) in Et₂O (14 mL) was added a solution of NaOMe (141 mg, 2.60 mmol) in MeOH (2.6 mL). The reaction mixture was stirred for 5 min at this temperature followed by addition of a solution of **39**⁸ (150 mg, 1.30 mmol) in Et₂O (5 mL). The ice bath was removed and the mixture was stirred for 1 h at room temperature. Water (10 mL) was added and the aqueous phase was acidified (pH = 1) with H₂SO₄ (1 M aq.). The organic phase was then washed with sat. aq. K₂CO₃ (3 x 10 mL). The basic aqueous layer was acidified with H₂SO₄ (1 M aq.) and extracted with EtOAc (3 x 10 mL). The combined organic phases were washed with brine, dried over anhydrous Na₂SO₄, filtered and concentrated. The crude product was recrystallized from hexanes to afford the known carboxylic acid **41a**⁹ (195 mg, 1.15 mmol, 88%) as a white solid.



Allylic Alcohol 42a. To a 0 °C solution of 41a (488 mg, 2.87 mmol) in THF (6 mL) was added triethylamine (0.790 mL, 5.74 mmol) followed by ethyl chloroformate (0.400 mL, 3.73 mmol). The reaction mixture was stirred for 1 h at room temperature and then filtered through a pad of Celite and concentrated. The crude product was dissolved in MeOH (15 mL), cooled to -78 °C and NaBH₄ (271 mg, 7.17 mmol) was added in portions. The mixture was stirred for 30 min at this temperature and then carefully quenched with sat. aq. NH₄Cl (10 mL). The aqueous phase was extracted with EtOAc (3 x 20 mL). The combined organic layers were washed with brine, dried over anhydrous Na₂SO₄, filtered and concentrated. Purification of the crude product by flash chromatography (20-50% EtOAc/hexanes) afforded 42a (358 mg, 2.29 mmol, 80%) as a white solid: mp = 45-47 °C; ¹H NMR (400 MHz, CDCl₃) δ 7.56 (dd, *J* = 15.1, 11.8 Hz, 1H), 5.99 (d, *J* = 11.8 Hz, 1H), 5.75 (d, *J* = 15.2 Hz, 1H), 4.27 (s, 2 H), 3.67

(s, 3H), 3.14 (br s, 1H), 1.90 (s, 3H); ¹³C NMR (100 MHz, CDCl₃) δ 167.7, 147.0, 139.4, 125.4, 120.3, 61.6, 51.6, 21.9; IR (neat) 3356, 2946, 1711, 1633, 1603, 1428, 1347, 1307, 1279, 1206, 1148, 1120, 1003, 988, 912, 882 cm⁻¹; HRMS (ESI) *m/z* for C₈H₁₃O₃ [M + H]⁺ calcd 157.0859, found 157.0852



Ester 43a. To a 0 °C solution of 42a (64 mg, 0.41 mmol) in CH₂Cl₂ (4 mL) was added Dess-Martin periodinane (262 mg, 0.62 mmol). The reaction mixture was stirred for 1 h at room temperature and then cooled again to 0 °C. Hexanes were added (4 mL) and the resulting suspension was filtered through a DavisilTM column using a 1:1 Et₂O:hexanes mixture as eluent. The filtrate was concentrated to give aldehyde 37a (54 mg, 0.35 mmol, 85%) as a white solid. Compound 37a was used immediately in the next step to avoid isomerization of the trisubstituted double bond: mp = 82-83 °C; ¹H NMR (400 MHz, CDCl₃) δ 10.37 (s, 3H), 8.13 (dd, *J* = 15.0, 12.4 Hz, 1H), 6.98 (d, *J* = 12.4 Hz, 1 H), 6.08 (d, *J* = 15.0 Hz, 1H), 3.78 (s, 3H), 1.92 (s, 3H); ¹³C NMR (100 MHz, CDCl₃) δ 189.8, 166.5, 141.5, 140.8, 135.7, 126.7, 51.9, 16.8; IR (neat) 2916, 1710, 1663, 1639, 1626, 1597, 1435, 1308, 1291, 1227, 1195, 1006, 984, 920, 856, 719 cm⁻¹.

To a -78 °C solution of **35a** (174 mg, 0.209 mmol), in THF (2 mL) was added NaHDMS (0.54 mL of a 0.50 M solution in THF, freshly prepared, 0.27 mmol). After being stirred for 10 min, a solution of **37a** (38 mg, 0.25 mmol) in THF (0.6 mL) was added. The reaction mixture was allowed to warm up to -10 °C over 2 h and quenched with sat. aq. NH₄Cl (1 mL). The aqueous phase was extracted with EtOAc (3 x 3mL), dried over anhydrous Na₂SO₄, filtered and concentrated. Purification of the crude product by flash chromatography (2 g of DavisilTM pretreated with hexanes+2% of Et₃N, 5% EtOAc as eluent) afforded **43a** (119 mg, 0.17 mmol, 81%) as a colorless oil, which was immediately used in the next reaction: [α]²⁵_D = -22.9° (*c* 2.33, CHCl₃); ¹H NMR (400 MHz, CDCl₃) δ 7.85 (dd, *J* = 15.0, 12.0 Hz, 1H), 7.65-7.60 (m, 4H), 7.44-7.34 (m, 6H), 6.90 (d, *J* = 15.6 Hz, 1H), 6.72 (d, *J* = 15.6 Hz, 1H), 6.49 (dd, *J* = 14.4, 7.0 Hz, 1H), 6.12 (d, *J* = 12.0 Hz, 1H), 5.91 (dd, *J* = 14.4, 1.0 Hz, 1H), 5.86 (d, *J* = 15.0 Hz, 1H), 5.40 (t, *J* = 7.5 Hz, 1H), 4.27 (m, 1H), 3.77 (s, 3H), 3.30 (m, 1H), 3.20 (s, 3H), 2.33 (m, 2H), 2.01 (s, 3H), 1.92 (s, 3H), 1.76 (m, 1H), 1.56 (ddd, *J* = 14.1, 7.5, 3.8 Hz, 1H), 1.06 (s, 9H); ¹³C NMR (100 MHz, CDCl₃) δ 167.9, 148.0, 143.1, 139.3, 135.9, 135.8, 134.2, 133.7, 133.5, 129.80, 129.76, 129.3, 128.9, CDCl₃) δ 167.9, 148.0, 143.1, 139.3, 135.9, 135.8, 134.2, 133.7, 133.5, 129.80, 129.76, 129.3, 128.9, CDCl₃) δ 167.9, 148.0, 143.1, 139.3, 135.9, 135.8, 134.2, 133.7, 133.5, 129.80, 129.76, 129.3, 128.9, CDCl₃) δ 167.9, 148.0, 143.1, 139.3, 135.9, 135.8, 134.2, 133.7, 133.5, 129.80, 129.76, 129.3, 128.9, CDCl₃) δ 167.9, 148.0, 143.1, 139.3, 135.9, 135.8, 134.2, 133.7, 133.5, 129.80, 129.76, 129.3, 128.9, CDCl₃) δ 167.9, 148.0, 143.1, 139.3, 135.9, 135.8, 134.2, 133.7, 133.5, 129.80, 129.76, 129.3, 128.9, CDCl₃) δ 167.9, 148.0, 143.1, 139.3, 135.9, 135.8, 134.2, 133.7, 133.5, 129.80, 129.76, 129.3, 128.9, CDCl₃) δ 167.9, 148.0, 143

127.63, 127.58, 127.2, 124.6, 119.6, 73.8, 56.2, 51.5, 41.7, 31.5, 27.1, 21.2, 20.7, 19.3; IR (neat) 2934, 2857, 1706, 1607, 1434, 1305, 1270, 1226, 1163, 1133, 1108, 976, 949, 908, 823, 732 cm⁻¹; HRMS (ESI) m/z for C₃₅H₄₅IO₄SiNa [M + Na]⁺ calcd 707.2029, found 707.2032.



Aldehyde SI-6. To a 0 °C solution of 46^4 (4.82 g, 14.7 mmol) in THF (103 mL) was added triethylamine (10.2 mL, 73.6 mmol) followed by TESOTF (4.33 mL, 19.1 mmol). The mixture was stirred for 1 h at room temperature and quenched with sat. aq. NaHCO₃ (50 mL). The aqueous phase was extracted with CH₂Cl₂ (3 x 50 mL). The combined organic layers were washed with brine, dried over MgSO₄, filtered and concentrated. Purification of the crude product by flash chromatography (10% EtOAc/hexanes) afforded the protected alcohol SI-5 (5.74 g, 13.0 mmol, 88%) as a colorless oil.

To a -78 °C solution of SI-5 (5.00 g, 11.3 mmol) and Sudan III dye in 4:1 CH₂Cl₂:MeOH (112 mL) was bubbled ozone gas until the pink color of Sudan III disappeared (45 min). Then Ph₃P (3.65 g, 13.6 mmol) was added and the mixture was stirred at room temperature for 3 h. Water (50 mL) was added and the aqueous phase was extracted with CH_2Cl_2 (3 x 30 mL). The combined organic phases were washed with brine, dried over anhydrous Na₂SO₄, filtered and concentrated. Purification of the crude product by flash chromatography (30-80% CH₂Cl₂/hexanes) afforded SI-6 (4.76 g, 10.7 mmol, 95%) as a colorless oil: $[\alpha]_{D}^{25} = +7.6^{\circ}$ (c 2.05, CHCl₃); ¹H NMR (400 MHz, CDCl₃) δ 9.75 and 9.74 (2 d, J = 2.7Hz, 1H combined), 4.34 and 4.30 (2 dd, J = 7.0, 1.9 Hz, 1H combined), 4.01 and 3.84 (2 gd, J = 6.3, 4.8 Hz, 1H combined), 3.79 and 3.76 (2 d, J = 4.7 Hz, 1H, combined), 2.54 (m, 1H), 1.75 (2 qd, J = 6.8, 2.0 Hz, 1H, combined), 1.56 and 1.52 (2 s, 3H combined), 1.52 and 1.48 (2 s, 3H combined), 1.48 and 1.47 (2 s, 9H combined), 1.11 and 1.08 (2 d, J = 6.3 Hz, 3H combined), 1.06 and 1.05 (2 d, J = 7.1 Hz, 3H combined), 0.96 and 0.95 (2 t, J = 7.9 Hz, 9H combined), 0.84 (2 d, J = 6.7 Hz, 3H combined), 0.64 and 0.63 (2 g, J = 7.9 Hz, 6H combined); ¹³C NMR (100 MHz, CDCl₃) δ 204.6, 151.7, 151.3, 93.0, 92.5, 79.8, 79.2, 76.9, 72.4, 72.3, 54.8, 54.7, 51.5, 51.4, 35.9, 35.8, 28.44, 28.36, 28.3, 27.4, 25.5, 24.3, 13.8, 13.1, 11.2, 11.1, 9.43, 9.38, 6.89, 6.88, 5.3; IR (neat) 2978, 2878, 1731, 1698, 1456, 1392, 1302, 1255, 1178, 1109, 1066, 1043, 1012, 869 cm⁻¹; HRMS (ESI) m/z for C₂₃H₄₅NO₅SiNa [M + Na]⁺ calcd 466.2962, found 466.2977.



Vinyl Iodide 38. To a slurry of anhydrous chromium (II) chloride (5.53 g, 4.50 mmol) in THF (9 mL) was added a solution of **SI-6** (2.0 g, 4.5 mmol) and iodoform (5.32 g, 13.5 mmol) in dioxane (76 mL). The resulting brown suspension was stirred at room temperature for 12 h, then diluted with Et₂O (100 mL) and poured into 100 mL of water. The aqueous phase was extracted with Et₂O (3 x 50 mL). The combined organic layers were washed with brine, dried over anhydrous MgSO₄, filtered and concentrated. Purification of the crude product by flash chromatography (20-50% CH₂Cl₂-hexanes) afforded iodide **SI-7** (1.90 g, 4.32 mmol, 96%) as a pale yellow solid.

To a 0 °C solution of **SI-7** (1.85 g, 3.26 mmol) in THF (33 mL) was added TBAF (4.9 mL of a 1.0 M solution in THF freshly prepared, 4.9 mmol). After 1 h at room temperature the solution was quenched with water (15 mL) and diluted with EtOAc (15 mL). The aqueous phase was extracted with EtOAc (3 x 15 mL). The combined organic layers were washed with brine, dried over anhydrous MgSO₄, filtered and concentrated. Purification of the crude product by flash chromatography (5-30% EtOAchexanes) afforded **38** (1.36 g, 3.19 mmol, 95%) as a viscous colorless oil: $[\alpha]^{25}_{D} = +10.9^{\circ}$ (*c* 1.34, CHCl₃); ¹H NMR (400 MHz, CDCl₃) δ 6.53 (2 dd, *J* = 14.4, 8.9 Hz, 1H, combined), 6.13 (2 d, *J* = 14.4 Hz, 1H combined), 4.00 and 3.84 (2 m, 1H), 3.98 (m, 1H), 3.63 (m, 1H), 2.36 and 2.34 (2 quint, *J* = 7.0 Hz, 1H combined), 1.99 (t, *J* = 5.6 Hz, 1H), 1.88 and 1.83 (2 qd, *J* = 6.8, 2.6 Hz, 1H combined), 1.56 and 1.52 (2 s, 3H combined), 1.00 (2 d, *J* = 6.9 Hz, 1H combined), 0.81 and 0.80 (2 d, *J* = 6.4 Hz, 3H combined); ¹³C NMR (100 MHz, CDCl₃) δ 151.7, 151.4, 149.3, 92.8, 92.4, 79.8, 79.2, 77.2, 75.7, 73.2, 73.1, 54.6, 54.5, 44.2, 44.1, 34.1, 34.0, 28.5, 28.4, 28.2, 27.3, 25.2, 24.0, 16.42, 16.36, 13.9, 13.2, 8.9; IR (neat) 3481, 2977, 2937, 2880, 1693, 1455, 1392, 1375, 1253, 1177, 1106, 1059, 1006, 982, 870 cm⁻¹; HRMS (ESI) *m/z* for C₁₈H₃₂INO₄Na [M + Na]⁺ calcd 476.1268 , found 476.1260.



Synthesis of IMDA Cyclization of SI-10: Synthesis of Cycloadduct Adduct 26.¹⁰ To a solution of SI-7 (62 mg, 0.11 mmol) and 36b (82 mg, 0.17 mmol) in anhydrous DMF (1 mL) was added a solution of Pd(CH₃CN)₂Cl₂ (3.0 mg, 0.012 mmol) in DMF (0.2 mL). The resulting brown solution was stirred at room temperature for 16 h. The mixture was diluted with EtOAc (2 mL) and poured into water (2 mL). The organic phase was washed with water (3 x 2 mL) and brine, dried over anhydrous Na₂SO₄, filtered and concentrated. Purification of the crude product by flash chromatography (0-5% EtOAc/CH₂Cl₂) afforded SI-8 (50 mg, 0.079 mmol, 72%) as a pale yellow foam: ¹H NMR (400 MHz, CDCl₃) δ 7.37 (ddd, J = 17.4, 11.2, 1.3 Hz, 1H), 6.09 (d, J = 15.6 Hz, 1H), 6.07 (d, J = 11.0 Hz, 1H), 5.80 (app ddd, J = 15.7, 8.0, 4.1 Hz, 1H), 5.54 (d, J = 17.3 Hz, 1H), 3.97 and 3.80 (2 m, 1H combined), 3.96 and 3.93 (2 m, 1H combined), 3.74 (m, 1H), 2.35 (m, 1H), 1.93 (s, 3H), 1.74 (m, 1H), 1.55 and 1.50 (2 s, 3H combined), 1.50 and 1.47 (2 s, 3H combined), 1.47 and 1.46 (2 s, 9H combined), 1.27 (s, 12H), 1.08 and 1.04 (2 d, J = 6.3 Hz, 3H combined), 0.99 and 0.98 (2 d, J = 6.9 Hz, 3H combined), 0.93 and 0.92 (2 t, J = 8.1 Hz, 9H combined), 0.77 (2 d, J = 6.7 Hz, 3H combined), 0.60-0.53 (m, 6H).

To a solution of **7a** (31.0 mg, 0.055 mmol) and **SI-8** (42.0 mg, 0.066 mmol) in degassed THF:H₂O (3:1) (1 mL, 3 freeze-pump-thaw cycles) was added a solution of Pd(PPh₃)₄ (7 mg, 6 µmol) in THF (0.5 mL) followed by TIOEt (8.0 µL, 0.11 mmol). After 2 h, the reaction was filtered through Celite and poured into water (5 mL). The aqueous phase was extracted with EtOAc (3 x 10 mL). The combined organic layers were washed with brine, dried over anhydrous Na₂SO₄, filtered and concentrated. The crude product was filtered through a short pad of DavisilTM (5% EtOAc + 2% Et₃N) to afford **SI-19** (32 mg, 0.033 mmol, 60%), which was immediately used in the next reaction without further purification: ¹H NMR (400 MHz, CDCl₃) δ 7.68-7.62 (m, 4H), 7.45-7.32 (m, 6H), 6.38 (dd, *J* = 14.2, 11.5 Hz, 1H), 6.13-6.07 (m, 2H), 5.99 (d, *J* = 11.4 Hz, 1H), 5.92 (dd, *J* = 15.0, 10.8 Hz, 1H), 5.71 (ddd, *J* = 15.6, 8.0, 4.2 Hz, 1H), 5.61(dd, *J* = 15.0, 7.3 Hz, 1H), 5.18 (app t, *J* = 7.6 Hz, 1H), 4.32 (m, 1H), 4.00-3.88 (m, 2), 3.95 and

3.80 (2 m, 1H combined), 3.78 (m, 1H), 3.20 (m, 1H), 3.17 (s, 3H), 2.35 (m, 1H), 2.25 (m, 1H), 2.10 (m, 2H), 1.86 (s, 3H), 1.85 (m, 1H), 1.79 (s, 3H), 1.78 (m, 1H), 1.64 (br s, 1H), 1.57 and 1.52 (2 s, 3H combined), 1.52 and 1.49 (2 s, 3H combined), 1.49 and 1.47 (2 s, 9H combined), 1.10 and 1.07 (2 d, J = 6.3 Hz, 3H combined), 1.06 (s, 9H), 1.02 and 1.00 (2 d, J = 6.8 Hz, 3H combined), 0.94 (2 t, J = 7.9 Hz, 9H combined), 0.79 and 0.78 (2 d, J = 6.7 Hz, 3 H), 0.62-0.55 (m, 6H).

To a solution of **SI-9** (32.0 mg, 0.033 mmol) in CH₂Cl₂ (1 mL) was added DMSO (12.0 μ L, 0.165 mmol) and diisopropylethylamine (30.0 μ L, 0.165 mmol). The mixture was cooled to 0 °C and charged with SO₃•pyridine (16.0 mg, 0.099 mmol). After 30 min, sat. aq. NaHCO₃ (2 mL) was added and the aqueous phase was extracted with CH₂Cl₂ (3 x 5 mL). The combined organic layers were washed with brine, dried over Na₂SO₄, filtered and concentrated. Aldehyde **SI-10** (28.0 mg, 0.030 mmol, 90%) was immediately used in the next reaction without further purification: ¹H NMR (CDCl₃, 400 MHz) δ 9.96 (s, 1H), 7.67-7.61 (m, 4H), 7.45-7.32 (m, 6H), 6.43-6.37 (m, 2H), 6.12 (dd, *J* = 14.5, 11.2 Hz, 1H), 6.10 (d, *J* = 15.2 Hz, 1H), 6.01-5.92 (m, 2H), 5.72 (ddd, *J* = 15.6, 8.1, 4.2 Hz, 1H), 5.62 (dd, *J* = 15.0, 7.1 Hz, 1H), 4.35 (m, 1H), 3.99 and 3.80 (2 m, 1H combined), 3.98 and 3.94 (2 d, *J* = 6.3 Hz, 1H combined), 3.72 (m, 1H), 3.34 (m, 1H), 3.17 (s, 3H), 2.58 (m, 2H), 2.36 (m, 1H), 1.90-1.83 (m, 1H), 1.87 (m, 3H), 1.79-1.73 (m, 1H), 1.75 (d, *J* = 1.0 Hz, 3H), 1.58 (m, 1H), 1.01 and 1.07 (2 d, *J* = 6.3 Hz, 3H combined), 1.06 (s, 9H), 1.01 and 1.07 (2 d, 3H combined), 1.06 (s, 9H), 1.01 and 1.07 (2 d, 3H combined), 1.06 (s, 9H), 1.01 and 1.00 (2 d, *J* = 6.8 Hz, 3H combined), 0.95 and 0.94 (2 t, *J* = 7.9 Hz, 9H combined), 0.79 and 0.78 (2 d, *J* = 6.7 Hz, 3H combined), 0.59-0.55 (m, 6H).

A solution of pentaene **SI-10** (28.0 mg, 0.030 mmol) and BHT (one small crystal) in 2,2,2trifluoroethanol (3 ml, 0.01M) was heated to 70-75°C for 9 h. The solvent was removed under reduced pressure, affording the crude product as an orange oil (\geq 6:1:1 d.s. by ¹H-NMR) which was purified by flash column chromatography on silica gel (10-20% EtOAc-hexanes). The cyclized adduct **26** (17.0 mg, 0.018 mmol, 60%) was isolated as a yellow oil: ¹H NMR (CDCl₃, 400 MHz) δ 9.42 (s, 1H), 7.73-7.66 (m, 4H), 7.44-7.35 (m, 6H), 6.05 (br d, J = 10.7 Hz, 1H), 5.98 (d, J = 15.6 Hz, 1H), 5.63-5.53 (m, 2H), 5.38 (br d, J = 10.2 Hz, 1H), 3.98 and 3.81 (2 m, 1H combined), 3.93 and 3.90 (2 d, J = 7.3 Hz, 1H), 3.78-3.69 (m, 2H), 3.21 (s, 3H), 3.12 (m, 1H), 2.85 (tt, J = 11.4, 3.6 Hz, 1H), 3.31 and 3.26 (m, 2H), 2.02 (m, 1H), 1.87 (m, 1H), 1.82 (s, 3H), 1.74 (m, 1H), 1.62 (m, 1H), 1.56 and 1.51 (2 s, 3H combined), 1.51 and 1.48 (2 s, 3H combined), 1.48 and 1.47 (2 s, 9H combined), 1.35-1.25 (m, 2H), 1.10-1.06 (m, 6H), 1.07 (s, 9H), 0.95-0.91 (m, 9H), 0.78 and 0.77 (2 d, J = 6.6 Hz, 3H combined), 0.63-0.53 (m, 6H).



Boronic Ester 47. To a solution of 38 (515 mg, 1.17 mmol) and 36b (850 mg, 1.76 mmol) in anhydrous DMF (10 mL) was added a solution of Pd(CH₃CN)₂Cl₂ (31 mg, 0.12 mmol) in DMF (2 mL). The resulting brown solution was stirred at room temperature for 16 h. The mixture was diluted with EtOAc (12 mL) and poured into water (12 mL). The organic phase was washed with water (3 x 12 mL) and brine, dried over anhydrous Na₂SO₄, filtered and concentrated. Purification of the crude product by flash chromatography (0-5% EtOAc/CH₂Cl₂) afforded 47 (304 mg, 0.585 mmol, 50%) as a pale yellow foam: $[\alpha]^{25}_{D} = -21.7^{\circ}$ (c 0.70, CHCl₃); ¹H NMR (400 MHz, CDCl₃) δ 7.35 (dd, J = 17.4, 11.4 Hz, 1H), 6.22 (d, J = 15.6 Hz, 1H), 6.10 (d, J = 5.6 Hz, 1H), 5.74 (app ddd, J = 15.6, 8.8, 3.2 Hz, 1H), 5.57 (d, J = 15.6 Hz, 1H), 5.57 (d, 17.6 Hz, 1H), 4.04-3.98 and 3.90-3.80 (2 m, 2H combined), 3.64 (tt, J = 8.8, 2.0 Hz, 1H), 2.35 (app sext, J = 7.0 Hz, 1H), 1.94 (s, 3H), 1.87 (m, 1H), 1.77 (dd, J = 9.8, 3.2 Hz, 1H), 1.58 and 1.53 (2 s, 3H) combined), 1.50 and 1.47 (2 s, 3H combined), 1.48 and 1.46 (2 s, 9H combined), 1.13 and 1.09 (2 d, J =6.1 Hz, 3H combined), 1.03 and 1.01 (2 d, J = 6.7 Hz, 3H combined), 0.84 and 0.83 (2 d, J = 6.4 Hz, 3H combined); ¹³C NMR (100 MHz, CDCl₃) & 151.7, 151.4, 145.3, 138.33, 138.29, 135.9, 134.44, 134.42, 132.1, 120.9, 92.6, 92.2, 83.0, 79.7, 79.0, 77.1, 76.9, 73.30, 73.27, 54.6, 54.5, 41.23, 41.21, 33.9, 33.8, 28.5, 28.4, 28.2, 27.3, 24.9, 24.7, 23.7, 17.1, 14.1, 13.8, 13.2, 13.0, 8.6, 8.5; IR (neat) 3468, 2979, 2937, 2885, 1691, 1608, 1579, 1453, 1391, 1376, 1341, 1267, 1174, 1145, 1106, 1057, 969, 869, 852, 738 cm⁻¹; HRMS (ESI) m/z for C₂₉H₅₀BNO₆Na [M + Na]⁺ calcd 542.3629, found 542.3629.



Ester 48. To a solution of 43a (23.0 mg, 0.032 mmol) and 47 (20.0 mg, 0.038 mmol) in degassed THF:H₂O (3:1) (0.4 mL, 3 freeze-pump-thaw cycles) was added a solution of Pd(PPh₃)₄ (7 mg, 6 µmol) in THF (0.2 mL) followed by TlOEt (7.0 µL, 0.01 mmol). After 2 h, the reaction was filtered through Celite and poured into water (2 mL). The aqueous phase was extracted with EtOAc (3 x 5 mL). The combined organic layers were washed with brine, dried over anhydrous Na₂SO₄, filtered and concentrated. The crude product was filtered through a short pad of DavisilTM (5% EtOAc + 2% Et₃N) to afford **48** (20 mg, 0.02 mmol, 62%) which was immediately used in the next reaction: $[\alpha]^{25}_{D} = -131.3^{\circ}$ (*c* 0.70, CHCl₃); ¹H NMR (400 MHz, CDCl₃) δ 7.84 (dd, *J* = 15.0, 12.0 Hz, 1H), 7.66-7.61 (m, 4H), 7.42-

7.30 (m, 6H), 6.88 (d, J = 15.7 Hz, 1H), 6.72 (d, J = 15.6 Hz, 1H), 6.32 (dd, J = 14.6, 11.4 Hz, 1H), 6.21 (d, J = 15.5 Hz, 1H), 6.14-6.08 (m, 2H), 6.00 (d, J = 11.1 Hz, 1H), 5.89 (dd, J = 15.1, 10.7 Hz, 1H), 5.84 (d, J = 15.1 Hz, 1H), 5.65.5.58 (m, 2H), 5.41 (t, J = 7.3 Hz, 1H), 4.35 (m, 1H), 4.06-3.99 and 3.88-3.86 (2 m, 2H combined), 3.76 (s, 3H), 3.31-3.25 (m, 1H), 3.17 (s, 3H), 2.38-2.26 (m, 3H), 2.00 (m, 1H overlapped), 1.99 (s, 3H), 1.91 (s, 3H), 1.91-1.88 (m, 1H overlapped), 1.84 (s, 3H), 1.84-1.80 (m, 2H), 1.58 and 1.54 (2 s, 3H combined), 1.50 and 1.48 (2 s, 3H combined), 1.48 and 1.46 (2 s, 9H combined), 1.13 and 1.10 (2 d, J = 6.3 Hz, 3H combined); 1.05 (s, 9H), 1.02 and 1.01 (2 d, J = 6.7 Hz, 3H combined); 1.30.43 (2 d, J = 6.4 Hz, 3H combined); 1.35.0, 134.9, 134.3, 134.1, 134.0, 132.6, 132.51, 132.48, 131.0, 130.44, 130.42, 129.6, 129.5, 129.4, 128.9, 127.6, 127.5, 127.4, 127.1, 124.4, 119.5, 92.8, 92.4, 79.8, 79.2, 77.24, 77.19, 73.4, 73.3, 72.1, 56.1, 54.72, 54.69, 51.5, 42.5, 41.4, 33.9, 33.8, 31.6, 28.6, 28.5, 28.3, 27.4, 27.1, 25.0, 23.9, 21.2, 20.7, 19.3, 17.3, 17.2, 14.0, 13.3, 12.8, 8.7, 8.6; IR (neat) 3480, 2976, 2935, 1693, 1612, 1454, 1428, 1391, 1376, 1367, 1310, 1265, 1230, 1168, 1133, 1106, 1066, 986, 871, 822, 738, 703 cm⁻¹.



Acid 41b. To a 0 °C solution of 28⁷ (3.20 g, 10.2 mmol) in THF (41 mL) was added *n*-BuLi (3.90 mL of a 2.5 M solution in hexanes, 9.84 mmol). The reaction mixture was stirred for 30 min at this temperature followed by addition of a solution of 39^8 (468 mg, 4.10 mmol) in THF (8 mL). The ice bath was removed and the mixture was stirred for 1 h at room temperature. Water (30 mL) was added and the aqueous phase was acidified (pH = 1) with H₂SO₄ (1 M aq.). The organic phase was then washed with sat. aq. K₂CO₃ (3 x 20 mL). The basic aqueous layer was acidified with H₂SO₄ (1 M aq.) and extracted with EtOAc (3 x 20 mL). The combined organic phases were washed with brine, dried over anhydrous Na₂SO₄, filtered and concentrated. The crude product was recrystallized from hexanes to afford 41b (804 mg, 3.11 mmol, 76%) as a white solid: mp = 77-78 °C; ¹H NMR (400 MHz, CDCl₃) δ 8.18 (dd, *J* = 15.4, 11.7 Hz, 1H), 6.59 (dqd, *J* = 11.7, 1.5, 0.9 Hz, 1H), 6.01 (app dt, *J* = 15.4, 0.8 Hz, 1H), 4.28 (m, 2H), 2.09 (app dt, *J* = 1.4, 0.7 Hz, 3H), 1.05 (m, 2H), 0.06 (s, 9H); ¹³C NMR (100 MHz, CDCl₃) δ 171.9, 166.7, 139.7, 138.1, 133.4, 127.2, 63.0, 21.0, 17.3, -1.48; IR (neat) 2953, 2895, 1706, 1680, 1627, 1597, 1455, 1297, 1250, 1198, 1148, 1118, 1064, 987, 931, 857 cm⁻¹; HRMS (ESI) *m/z* for C₁₂H₂₀O₄SiNa [M + Na]⁺ calcd 279.1023, found 279.1029.



Allylic alcohol 42b. To a 0 °C solution of 41b (800 mg, 3.12 mmol) in THF (12 mL) was added triethylamine (1.70 mL, 12.5 mmol) followed by ethyl chloroformate (0.45 mL, 4.7 mmol). The reaction mixture was stirred for 1 h at room temperature and then filtered through a pad of Celite and concentrated. The crude product was dissolved in MeOH (16 mL), cooled to -78 °C and NaBH₄ (354 mg, 9.36 mmol) was added in portions. The mixture was stirred for 30 min at this temperature and then carefully quenched with sat. aq. NH₄Cl (10 mL). The aqueous phase was extracted with EtOAc (3 x 20 mL). The combined organic layers were washed with brine, dried over anhydrous Na₂SO₄, filtered and concentrated. Purification of the crude product by flash chromatography (20-50% EtOAc/hexanes) afforded **42b** (676 mg, 2.79 mmol, 89%) as a colorless oil: ¹H NMR (400 MHz, CDCl₃) δ 7.59 (dd, *J* = 15.1, 11.8 Hz, 1H), 6.07 (d, *J* = 11.8 Hz, 1H), 5.81 (d, *J* = 15.1 Hz, 1H), 4.37 (d, *J* = 5.5 Hz, 2H), 4.24 (m, 2H), 1.97 (s, 3H), 1.41 (t, *J* = 5.6 Hz, 1H), 1.02 (m, 2H), 0.05 (s, 9 H); ¹³C NMR (100 MHz, CDCl₃) δ 167.5, 146.8, 139.0, 125.4, 120.9, 62.5, 61.4, 21.9, 17.3, -1.5; IR (neat) 3427, 2954, 2898, 1710, 1638, 1612, 1451, 1432, 1379, 1305, 1281, 1154, 981, 860, 838 cm⁻¹; HRMS (ESI) *m/z* for C₁₂H₂₂O₃SiNa [M + Na]⁺ calcd 265.1230, found 265.1230.



Aldehyde 37b. To a 0 °C solution of 42b (200 mg, 0.820 mmol) in CH₂Cl₂ (6 mL) was added Dess-Martin periodinane (525 mg, 1.24 mmol). The reaction mixture was stirred for 1 h at room temperature and then cooled again to 0 °C. Hexanes were added (6 mL) and the resulting suspension was filtered through a DavisilTM column using a 1:1 Et₂O:hexanes mixture as eluent. The filtrate was concentrated to give aldehyde 37b (190 mg, 0.79 mmol, 96%) as a white solid. Compound 37b was used immediately in the next step to avoid isomerization of the trisubstituted double bond: mp = 51-52 °C; ¹H NMR (400 MHz, CDCl₃) δ 9.94 (s, 1H), 8.12 (dd, *J* = 15.1, 12.4 Hz, 1H), 6.22 (br d, *J* = 12.4 Hz, 1H), 5.93 (br d, *J* = 15.1 Hz, 1H), 4.41 (m, 2H), 1.65 (s, 3H), 1.04 (m, 2H), 0.04 (s, 9H); ¹³C NMR (100 MHz, C₆D₆) δ 188.8, 165.9, 141.3, 140.0, 135.9, 127.1, 62.9, 17.5, 16.7, -1.6; IR (neat) 2978, 2878, 1728, 1698, 1456, 1392, 1302, 1255, 1178, 1109, 1066, 1043, 1012, 869 cm⁻¹; HRMS (ESI) *m/z* for C₁₂H₂₀O₃SiNa [M + Na]⁺ calcd 263.1074 , found 263.1061.



Ester 43b. To a -78 °C solution of 35a (200 mg, 0.240 mmol), in THF (2 mL) was added NaHMDS (0.62 mL of a 0.5 M solution in THF, freshly prepared, 0.31 mmol). After being stirred for 10 min, a solution of **37b** (69 mg, 0.29 mmol) in THF (1 mL) was added. The reaction mixture was allowed to warm up to -10 °C over 2 h and quenched with sat. aq. NH₄Cl (1 mL). The aqueous phase was extracted with EtOAc (3 x 3 mL), dried over anhydrous Na₂SO₄, filtered and concentrated. Purification of the crude product by flash chromatography (2 g of DavisilTM pretreated with hexanes + 2% of Et₃N, 5% EtOAc as eluent) afforded 43b (167 mg, 0.21 mmol, 87%) as a colorless oil, which was immediately used in the next reaction: $[\alpha]_{D}^{25} = -17.7^{\circ}$ (c 1.03, CHCl₃); ¹H NMR (400 MHz, C₆D₆) δ 8.27 (dd, J = 15.2, 12.0 Hz, 1H), 7.75-7.68 (m, 4H), 7.25-7.18 (m, 6H), 7.01 (d, J = 15.6 Hz, 1H), 6.74 (d, J = 15.6 Hz, 1H), 6.56 (dd, J = 14.4, 7.2 Hz, 1H), 6.06 (d, J = 14.8 Hz, 1H), 5.95 (dd, J = 14.4, 1.2 Hz, 1H), 5.94 (d, J = 10.4 Hz, 1H), 5.31 (t, J = 7.2 Hz, 1H), 4.39-4.33 (m, 1H), 4.33 (t, J = 8.2 Hz, 2H), 3.22-3.16 (m, 1H), 2.96 (s, 3H), 2.30-2.15 (m, 2H), 1.83 (ddd, J = 14.0, 9.2, 4.8 Hz, 1H), 1.80 (s, 3H), 1.66 (s, 3H), 1.56 (ddd, J = 14.0, 7.6, 3.2 Hz, 1H), 1.35 (s, 9H), 0.95 (t, J = 8.2 Hz, 2H), -0.06 (s, 9H); ¹³C NMR (100 MHz, C₆D₆) δ 167.0, 148.5, 142.5, 138.8, 136.3, 136.2, 134.5, 134.1, 133.8, 130.1, 129.4, 129.0, 128.5, 128.1, 128.0, 127.9, 127.8, 125.0, 121.4, 77.0, 76.9, 74.3, 62.3, 56.0, 42.2, 31.6, 27.2, 21.0, 20.5, 19.5, 17.5, -1.5; IR (neat) 3072, 2953, 2858, 1704, 1614, 1472, 1428, 1380, 1251, 1161, 1130, 977, 949, 836 cm⁻¹; HRMS (ESI) m/z for C₃₉H₅₅IO₄Si₂Na [M + Na]⁺ calcd 793.2576, found 793.2575.

Position	Natural (500 MHz) ¹¹	Synthetic (400 MHz)
1		
2	5.70 d (J = 15.3)	5.70 d (J = 14.9)
3	7.21 dd (J = 15.3, 11.2)	7.21 dd (J = 15.2, 11.0)
4	5.92 d (J = 11.2)	5.91 d (J = 11.0)
5		
6	6.88 d (J = 16.3)	6.87 d (J = 16.4)
7	5.60 d (J = 16.3)	5.60 d (J = 16.4)
8		
9	1.48 m	1.48 m
10	1.45 m, 1.80 m	1.45 m, 1.80 m
11	3.10 m	3.10 m (overlapped)
12	1.31 m, 2.24 br d (J = 10.5)	1.30 m, 2.24 br d (J = 10.5)
13	4.76 br t $(J = 9.8)$	4.77 m
14	2.88 br s	2.89 br s
15	$5.52 \mathrm{dt} (J = 9.8, 3.4)$	$5.52 \mathrm{dt} (J = 10.1, 3.3)$
16	5.68 d (J = 9.8)	5.68 d (J = 9.6)
17	3.10 br d (overlapped)	3.10 m (overlapped)
18	5.78 d (J = 10.8)	5.79 d (J = 10.7)
19		
20	6.29 d (J = 15.3)	6.29 d (J = 15.2)
21	5.32 dd (J = 15.3, 9.8)	5.32 dd (J = 15.2, 9.6)
22	2.71 m	2.71 m
23	4.79 dd (J = 10.5, 2.0)	4.79 d (J = 10.5)
24	1.82 m	1.80 m
25	3.16 dd (J = 10.5, 2.7)	3.16 dd (J = 10.5, 2.4)
26	4.18 m	4.19 m
27		
28	1.96 s	1.97 s
29	1.92 s	1.92 s
30	1.15 s	1.15 s
31		
32	1.77 s	1.77 s
33	1.07 d (J = 6.9)	1.08 d (J = 6.8)
34	0.90 d (J = 6.9)	0.90 d (J = 6.8)
35	1.05 d (J = 6.9)	1.05 d (J = 6.9)
NH	6.22 d (J = 8.8)	6.23 d (J = 8.8)
OCH ₃	3.35 s	3.35 s
CONH ₂	4.66 br s	4.63 br s
OH (25)	3.32 d (overlapped)	3.33 (overlapped)

Comparison of ¹H NMR Data for Synthetic and Natural Superstolide A

Position	Natural (500 MHz) ¹¹	Synthetic (400 MHz)
1	167.0 ^a	169.0
2	121.3	121.3
3	139.2	139.3
4	125.5	125.5
5	142.5	142.6
6	125.8	125.8
7	142.7	142.7
8	40.4	40.4
9	41.3	41.8
10	30.7	30.8
11	77.0 (under $CDCl_3$)	77.0 (under $CDCl_3$)
12	33.7	33.7
13	72.6	72.8
14	36.0	36.0
15	120.3	120.3
16	130.3	130.2
17	42.9	42.9
18	132.2 ^a	133.1
19	132.4	132.4
20	137.1	137.1
21	129.4	129.4
22	40.7	40.9
23	77.0 (under $CDCl_3$)	77.0 (<i>under CDCl</i> ₃)
24	37.5	37.6
25	73.1	73.1
26	45.4	45.5
27	169.7	169.7
28	23.5	23.5
29	20.7	20.7
30	29.7 ^b	31.3
31	156.0	156.1
32	12.0	12.0
33	18.0	18.0
34	8.8	8.8
35	12.7	12.6
NH		
OCH ₃	56.1	56.1
CONH ₂		
OH (25)		

Comparison of ¹³C NMR Data for Synthetic and Natural Superstolide A

a: Appear to have been recorded incorrectly in tabulated data in the isolation paper, as the peaks in the spectra of synthetic and natural superstolide A are in perfect agreement.

b: This peak was misassigned in the isolation paper due to the presence of an impurity at 29.7 ppm. The correct peak was also present at 31.3 ppm in the spectrum of the natural product but was not reported by the isolation authors.

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10. Aldehyde **26** was first synthesized following the sequence shown for its TBS derivative **23**. However, bimetallic linchpin **36b** provided a more reliable route to access intermediate **SI-12**. Boronic ester **SI-10** was found to be more stable than iodide **20** allowing for the synthesis of aldehyde **SI-12** without isomerization of the tetraene fragment.

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