

First Total Synthesis of *trans*- and *cis*-Resorcyclide: Remarkable Hydrogen-Bond-Controlled, Stereospecific Ring Closing Metathesis

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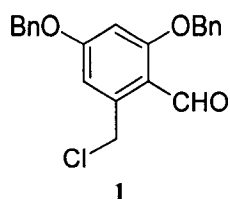
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SUPPORTING INFORMATION

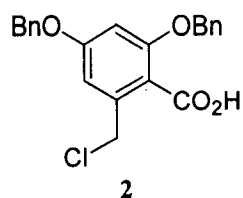
General methods. All reactions were carried out under anhydrous conditions and argon atmosphere using dry, freshly distilled solvents, unless otherwise noted. Tetrahydrofuran (THF) was distilled from sodium/benzophenone and dichloromethane (CH_2Cl_2) from CaH. Yields refer to chromatographically and spectroscopically (^1H NMR) homogeneous materials, unless otherwise stated. All reagents were purchased at highest commercial quality and used without further purification, unless otherwise stated. All reactions were monitored by thin-layer chromatography (TLC) carried out on 0.25 mm Merck silica gel plates (60 F₂₅₄) using UV light as visualizing agent and ethanolic phosphomolybdic acid, *p*-anisaldehyde solution and heat as developing agents. Merck silica gel (60, particle size 0.040-0.063 mm) was used for flash column chromatography. NMR spectra were recorded on Bruker AMX-500 or AC-250 instruments. The following abbreviations were used to explain NMR signal multiplicities: s = singlet, d = doublet, q = quartet, m = multiplet, ddd = doublet of doublet of doublets, dt = doublet of triplets, br = broad. IR spectra were recorded on Nicolet Magna system 550 FT-IR instruments. Optical rotations were recorded on a Perkin-Elmer 241 polarimeter. High resolution mass spectra (HRMS) were recorded on a VG ZAB-ZSE mass spectrometer under fast atom bombardment (FAB) conditions and matrix-assisted (MALDI-FTMS) mass spectra were recorded on a PerSeptive Biosystems Voyager IonSpect mass spectrometer.

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Benzyl chloride (1): Phosphorus oxychloride (6 mL, 65.7 mmol) was added drop-wise, over 10 min period, to DMF (10 mL, 124.8 mmol) under argon, at 0 °C. The ice-bath was removed and the solution was further stirred vigorously for 20 min. A solution of 3,5-dibenzoyloxybenzyl alcohol (5.00 g, 15.6 mmol) in DMF (2 mL) was then added via cannula and the reaction mixture was heated to 90 °C for 3 h. Upon completion it was allowed to cool to ambient temperature and ice-water (150 mL) was added. The pH was neutralized by addition of an aqueous solution of NaOH (2*N*; 100 mL) and the mixture was further stirred for 1.5 h at 25 °C. The resulting precipitate was filtered, washed with cool water (3 x 25 mL) and dried under reduced pressure to afford **1** as white solid (5.14 g, 90%).

R_f = 0.35 (Hexanes / AcOEt 8:2); FTIR (neat): $\tilde{\nu}$ = 3090, 3069, 3035, 1676, 1600, 1575, 1440, 1323, 1154, 739, 681 cm⁻¹; ¹H NMR (250 MHz, CDCl₃, 25 °C): δ = 10.55 (s, 1H; CH=O), 7.45 – 7.34 (m, 10H; OCH₂ArH), 6.88 (d, J = 2.2 Hz, 1H; ArH), 6.59 (d, J = 2.2 Hz, 1H; ArH), 5.13 (s, 4H; OCH₂Ph), 5.07 (s, 2H; CH₂Cl); ¹³C NMR (62.9 MHz, CDCl₃, 25 °C): δ = 190.0, 164.0, 161.8, 142.8, 135.5, 128.5, 127.3, 127.2, 116.0, 108.8, 99.2, 70.8, 70.3, 45.0.

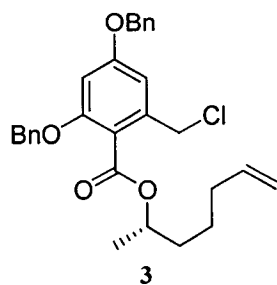


Benzoic acid (2): To a stirred solution of benzaldehyde **1** (1.70 g, 4.63 mmol) in acetone / DMSO (50 mL : 20mL) was added an aqueous solution of sulfamic acid (765 mg, 7.88 mmol in 15 mL of water). The mixture was cooled to 0 °C and then an aqueous solution of sodium chlorite (810 mg, 7.17 mmol in 35 mL of water) was slowly added. The reaction mixture was stirred at 0 °C for 30 min and after completion, was extracted with ethyl acetate (3 x 50 mL). The combined organic

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layers were washed with water (2 x 30 mL) and brine (30 mL), dried over anhydrous Na_2SO_4 and concentrated under reduced pressure to afford **2** as white solid (1.68 g, 95%), which was used in the next step without any further purification.

R_f = 0.35 (Hexanes / AcOEt / AcOH 7:3:0.1); FTIR (KBr): $\tilde{\nu}$ = 3524, 3443, 3295, 3029, 2886, 2675, 2575, 1689, 1603, 1310, 1171, 1046, 828, 738, 701 cm^{-1} ; ^1H NMR (250 MHz, CDCl_3 , 25 $^\circ\text{C}$): δ = 7.45 – 7.34 (m, 10H; OCH_2ArH), 6.92 (d, J = 2.2 Hz, 1H; ArH), 6.64 (d, J = 2.2 Hz, 1H; ArH), 5.16 (s, 2H; OCH_2Ph), 5.10 (s, 2H; OCH_2Ph), 4.97 (s, 2H; CH_2Cl); ^{13}C NMR (62.9 MHz, CDCl_3 , 25 $^\circ\text{C}$): δ = 167.8, 161.8, 158.8, 142.1, 135.7, 134.9, 128.8, 128.7, 128.6, 128.4, 127.6, 127.4, 112.2, 109.5, 100.8, 71.9, 70.4, 44.9; HRMS (MALDI – FTMS) calcd for $\text{C}_{22}\text{H}_{19}\text{ClO}_4$ ($[\text{M}+\text{Na}]^+$): 405.0864; found 405.0869.



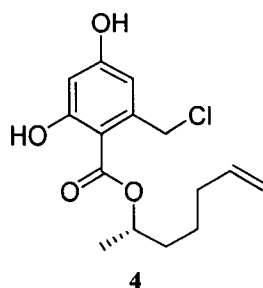
Ester (3): A solution of DIAD (0.095 mL, 0.46 mmol) in benzene (0.2 mL) was treated with $\text{P}(2\text{-furyl})_3$ (110 mg, 0.46 mmol) under argon and stirred at 25 $^\circ\text{C}$ for 5 min. A solution of (*R*)-Hept-6-enol^[1] (40 mg, 0.35 mmol) in benzene (0.7 mL) was then added and the mixture was stirred for 5 min. Benzoic acid **2** was added and the reaction mixture was stirred for further 10 min. The solvent was removed *in vacuo* and the residue was subjected to flash chromatography (SiO_2 , Hexanes / AcOEt 98:2) to afford **3** as colorless oil (122 mg, 73%).

R_f = 0.45 (Hexanes / AcOEt 9:1); $[\alpha]_D^{25}$ = + 17.4 (c = 1.39 in CHCl_3); FTIR (neat): $\tilde{\nu}$ = 3068, 3035, 2977, 2936, 2868, 1713, 1605, 1456, 1436, 1377, 1331, 1287, 1168, 1038, 910, 836, 737, 699 cm^{-1} ; ^1H NMR (250 MHz, CDCl_3 , 25 $^\circ\text{C}$): δ = 7.44

¹ Lee, C. W.; Crubbs, R. H. *J. Org. Chem.* **2001**, *66*, 7155–7158.

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– 7.32 (m, 10H; OCH₂ArH), 6.66 (d, *J* = 2.2 Hz, 1H; ArH), 6.55 (d, *J* = 2.2 Hz, 1H; ArH), 5.73 (ddt, *J* = 16.7, 10.4, 6.3 Hz, 1H; CH=CH₂), 5.25 – 5.10 (m, 1H; CHCH₃), 5.05 (s, 2H; OCH₂Ph), 5.04 (s, 2H; OCH₂Ph), 5.02 – 4.88 (m, 2H; CH=CH₂), 4.61 (s, 2H; CH₂Cl), 2.07 – 1.92 (m, 2H; CH₂CH=CH₂), 1.76 – 1.34 (m, 4H; CH₂CH₂), 1.25 (d, *J* = 6.3 Hz, 3H; CH₃); ¹³C NMR (62.9 MHz, CDCl₃, 25 °C): δ = 166.7, 160.6, 157.5, 138.5, 137.5, 128.7, 128.5, 128.2, 128.0, 127.5, 127.4, 117.2, 114.6, 107.5, 100.9, 72.3, 70.7, 70.3, 43.5, 35.3, 33.4, 24.6, 19.8; HRMS (MALDI – FTMS) calcd for C₂₉H₃₁ClO₄ ([M+Na]⁺): 501.1803; found 501.1816.



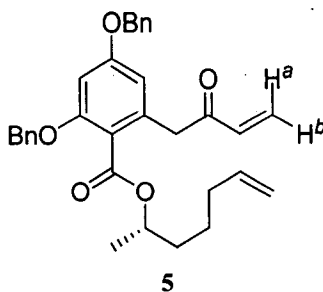
Resorcynol (4): To a solution of dibenzyl ether **3** (62.5 mg, 0.13 mmol) in DCM (3 mL) was added thioanisole (0.2 mL) under argon and the mixture was cooled to -78 °C. A solution of BBr₃ (1M; 0.29 mL), was then added drop-wise over 15 min period. The reaction was quenched with MeOH (0.1 mL) and an aqueous solution of HCl (1N, 2 mL) was added. The crude mixture was extracted with AcOEt (2 x 5 mL) and the combined organic layers were washed with water (2 mL) and brine (2 mL), dried over anhydrous Na₂SO₄ and concentrated under reduced pressure. The crude product was purified by flash column chromatography (SiO₂, Hexane / EtOAc 93:7) to afford **4** as colorless oil (33 mg, 85%).

*R*_f = 0.35 (Hexanes / AcOEt 8:2); [*α*]_D²⁵ = + 42.3 (*c* = 2.29 in CHCl₃); FTIR (neat):

$\tilde{\nu}$ = 3386, 3078, 2980, 2936, 2864, 1652, 1620, 1454, 1359, 1319, 1264, 1170, 1117, 914, 852, 729, 643 cm⁻¹; ¹H NMR (250 MHz, CDCl₃, 25 °C): δ = 12.00 (s, 1H; OH), 6.51 (d, *J* = 2.2 Hz, 1H; ArH), 6.41 (d, *J* = 2.2 Hz, 1H; ArH), 5.79 (ddt, *J* = 16.7, 10.1, 6.7 Hz, 1H; CH=CH₂), 5.35 – 5.20 (m, 1H; CHCH₃), 5.08 – 4.93 (m, 2H; CH=CH₂), 4.83 (AB_q, *J* = 11.3 Hz, 2H; CH₂Cl), 2.16 – 2.04 (m, 2H;

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$\text{CH}_2\text{CH}=\text{CH}_2$), 1.92 – 1.44 (m, 4H; CH_2CH_2), 1.41 (d, $J = 6.3$ Hz, 3H; CH_3); ^{13}C NMR (62.9 MHz, CDCl_3 , 25 °C): $\delta = 170.2, 165.5, 160.5, 141.5, 138.2, 115.0, 111.6, 104.7, 103.9, 73.5, 46.2, 35.2, 33.4, 24.7, 19.8$; ESI – MS calcd for $\text{C}_{15}\text{H}_{19}\text{ClO}_4$ ($[\text{M}+\text{Na}]^+$): 321.0864; found 321.1.



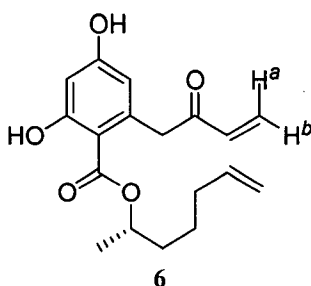
Enone (5): To a solution of benzyl chloride **3** (122 mg, 0.25 mmol) in HMPA (1 mL) that was previously bubbled with CO for 10 min, $\text{Pd}(\text{PPh}_3)_4$ (14.9 mg, 13 μmol) and $\text{P}(2\text{-furyl})_3$ (6.0 mg, 25 μmol) were sequentially added and the mixture was stirred for 5 min, at 25 °C under CO atmosphere. Tributyl(vinyl)tin (80 μL , 0.27 mmol) was then added and the reaction was heated at 80 °C for 2 h, after which time Pd black precipitated. After extraction of the crude mixture with Et_2O (2 x 5 mL), the combined organic layers were washed with water (3 x 2 mL) and brine (2 mL), dried over anhydrous Na_2SO_4 and concentrated under reduced pressure. The crude product was purified by flash column chromatography (SiO_2 , Hexane / EtOAc 9:1) to afford **5** as colorless oil (60 mg, 47%) along with recovered **3** (32 mg, 26%).

$R_f = 0.40$ (Hexanes / AcOEt 8:2); $[\alpha]_D^{25} = +10.8$ ($c = 1.55$ in CHCl_3); FTIR (neat):

$\tilde{\nu} = 3066, 3033, 2930, 2857, 1711, 1604, 1457, 1436, 1380, 1276, 1165, 1074, 1041, 913, 830, 739, 698 \text{ cm}^{-1}$; ^1H NMR (250 MHz, CDCl_3 , 25 °C): $\delta = 7.44 - 7.31$ (m, 10H; OCH_2ArH), 6.53 (d, $J = 2.2$ Hz, 1H; ArH), 6.43 (dd, $J = 17.5, 10.0$ Hz, 1H; $\text{C}(=\text{O})\text{CH}=\text{CH}_a\text{H}$), 6.40 (d, $J = 2.2$ Hz, 1H; ArH), 6.29 (dd, $J = 17.5, 1.9$ Hz, 1H; $\text{C}(=\text{O})\text{CH}=\text{CH}_b\text{H}$), 5.79 (dd, $J = 10.0, 1.9$ Hz, 1H; $\text{C}(=\text{O})\text{CH}=\text{CH}_2$), 5.71 (ddt, $J = 16.7, 10.1, 6.7$ Hz, 1H; $\text{CH}_2\text{CH}=\text{CH}_2$), 5.15 – 5.00 (m, 1H; CHCH_3), 5.03 (s, 2H; OCH_2Ph), 5.02 (s, 2H; OCH_2Ph), 5.00 – 4.87 (m, 2H; $\text{CH}_2\text{CH}=\text{CH}_2$), 3.90 (s, 2H; $\text{CH}_2\text{C}(=\text{O})$), 2.04 – 1.89 (m, 2H; $\text{CH}_2\text{CH}=\text{CH}_2$), 1.71 – 1.25 (m, 4H; CH_2CH_2),

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1.19 (d, $J = 6.3$ Hz, 3H; CH_3); ^{13}C NMR (62.9 MHz, CDCl_3 , 25 °C): $\delta = 196.6$, 167.5, 160.5, 157.7, 138.5, 136.3, 135.3, 128.9, 128.6, 128.4, 128.1, 128.0, 127.5, 127.5, 117.8, 114.6, 108.2, 99.7, 72.0, 70.6, 70.1, 45.2, 35.3, 33.4, 24.6, 19.8; HRMS (MALDI – FTMS) calcd for $\text{C}_{32}\text{H}_{34}\text{O}_5$ ($[\text{M}+\text{Na}]^+$): 521.2298; found 521.2315.



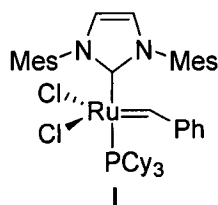
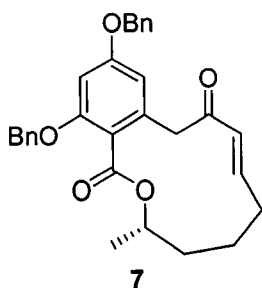
Enone (6): To a solution of benzyl chloride **4** (33 mg, 0.1105 mmol) in HMPA (0.5 mL) that was previously bubbled with CO for 10 min, $\text{Pd}(\text{PPh}_3)_4$ (6.4 mg, 5.5 μmol) and $\text{P}(2\text{-furyl})_3$ (2.6 mg, 11.2 μmol) were sequentially added and the mixture was stirred for 5 min, at 25 °C under CO atmosphere. Tributyl(vinyl)tin (35 μL , 0.1215 mmol) was then added and the reaction was heated at 80 °C for 1.5 h, after which time Pd black precipitated. After extraction of the crude mixture with Et_2O (2 x 3 mL), the combined organic layers were washed with water (3 x 1.5 mL) and brine (1.5 mL), dried over anhydrous Na_2SO_4 and concentrated under reduced pressure. The crude product was purified by flash column chromatography (SiO_2 , Hexane / AcOEt 83:17) to afford **6** as colorless oil (26 mg, 74%).

$R_f = 0.30$ (Hexanes / AcOEt 7:3); $[\alpha]_D^{25} = + 34.8$ ($c = 1.89$ in CHCl_3); FTIR (neat):

$\tilde{\nu} = 3367, 2981, 2934, 2862, 1696, 1653, 1617, 1456, 1399, 1318, 1264, 1173, 1109, 850, 805 \text{ cm}^{-1}$; ^1H NMR (250 MHz, CDCl_3 , 25 °C): $\delta = 11.89$ (s, 1H, OH), 6.46 (dd, $J = 17.5, 9.3$ Hz, 1H, $\text{C}(=\text{O})\text{CH}=\text{CH}_a\text{H}$), 6.34 (dd, $J = 17.5, 1.9$ Hz, 1H, $\text{C}(=\text{O})\text{CH}=\text{CH}_b\text{H}$), 6.29 (d, $J = 2.6$ Hz, 1H, ArH), 6.01 (d, $J = 2.6$ Hz, 1H, ArH), 5.91 (dd, $J = 9.7, 1.9$ Hz, 1H, $\text{C}(=\text{O})\text{CH}=\text{CH}_2$), 5.76 (ddt, $J = 16.7, 10.1, 6.7$ Hz, 1H, $\text{CH}_2\text{CH}=\text{CH}_2$), 5.24 – 5.10 (m, 1H, CHCH_3), 5.05 – 4.92 (m, 2H, $\text{CH}_2\text{CH}=\text{CH}_2$), 4.14 (ABq, $J = 17.9$ Hz, 2H, $\text{CH}_2\text{C}(=\text{O})$), 2.10 – 1.98 (m, 2H,

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$\text{CH}_2\text{CH}=\text{CH}_2$), 1.72 – 1.29 (m, 4H, CH_2CH_2), 1.22 (d, $J = 6.3$ Hz, 3H, CH_3); ^{13}C NMR (62.9 MHz, CDCl_3 , 25 °C): $\delta = 198.2, 170.3, 165.5, 161.0, 138.3, 138.1, 135.5, 129.2, 115.0, 113.1, 105.7, 103.1, 72.8, 48.7, 35.2, 33.3, 24.8, 19.9$; HRMS (MALDI – FTMS) calcd for $\text{C}_{18}\text{H}_{22}\text{O}_5$ ($[\text{M}+\text{Na}]^+$): 341.1359; found 341.1356.

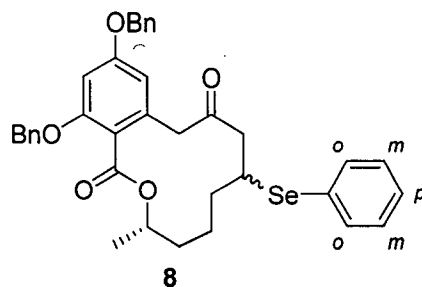


Dibenzyl *trans*-Resorcylic diene (7): To a solution of diene **5** (30 mg, 0.0602 mmol) in DCM (40 mL, dilution 1 mM), catalyst **I** (1.1 mg, 0.12 μmol) was added under argon and the mixture was heated to reflux. The reaction was quenched after 30 min by addition of ethylvinyl ether (50 μL) and concentrated under reduced pressure. The crude product was purified by flash column chromatography (SiO_2 , Hexane / AcOEt 85:15) to afford **7** as white foam (18.8 mg, 67%).

$R_f = 0.20$ (Hexanes / AcOEt 8:2); $[\alpha]_D^{25} = +37.6$ ($c = 0.80$ in CHCl_3); FTIR (neat):

$\tilde{\nu} = 3067, 3034, 2975, 2934, 2873, 1715, 1696, 1602, 1456, 1453, 1379, 1288, 1165, 1064, 740 \text{ cm}^{-1}$; ^1H NMR (250 MHz, CDCl_3 , 25 °C): $\delta = 7.44 - 7.31$ (m, 10H; OCH_2ArH), 6.91 (ddd, $J = 16.0, 9.3, 5.6$ Hz, 1H; $=\text{CHCH}_2$), 6.66 (d, $J = 2.2$ Hz, 1H; ArH), 6.49 (d, $J = 2.2$ Hz, 1H; ArH), 5.94 (dt, $J = 16.4, 1.1$ Hz, 1H; C(=O)CH=), 5.19 – 5.07 (m, 1H; CHCH_3), 5.04 (s, 2H; OCH_2Ph), 4.99 (s, 1H; OCH_2Ph), 4.98 (s, 1H; OCH_2Ph), 4.62 (d, $J = 11.9$ Hz, 1H; $\text{CH}_2\text{C(=O)}$), 3.30 (d, $J = 11.9$ Hz, 1H; $\text{CH}_2\text{C(=O)}$), 2.40 – 2.14 (m, 2H; $\text{CH}_2\text{CH}=\text{CH}_2$), 1.92 – 1.57 (m, 4H; CH_2CH_2), 1.12 (d, $J = 6.3$ Hz, 3H; CH_3); ^{13}C NMR (62.9 MHz, CDCl_3 , 25 °C): $\delta = 199.0, 160.6, 157.5, 150.1, 134.8, 130.9, 128.6, 128.4, 128.1, 128.0, 127.7, 117.9, 107.8, 99.7, 72.3, 70.6, 70.2, 42.8, 34.1, 31.3, 24.7, 20.2$; HRMS (MALDI – FTMS) calcd for $\text{C}_{30}\text{H}_{30}\text{O}_5$ ($[\text{M}+\text{H}]^+$): 471.2166; found 471.2177.

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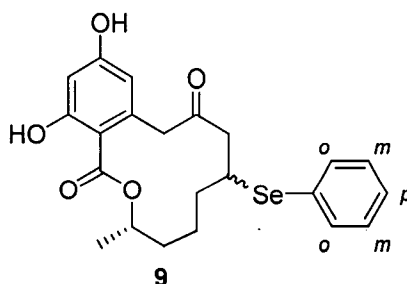


Selenide (8): To a stirred solution of diphenyl diselenide (29 mg, 0.1633 mmol) in EtOH (0.9 mL), NaBH₄ (21 mg, 0.5384 mmol) was added at 0 °C under argon. When the solution became colorless and clear (after 5 min), AcOH (40 µL, 0.6994 mmol) and a solution of enone **7** (19.0 mg, 0.0404 mmol) in THF (1.2 mL) were successively added and the reaction mixture was stirred for 10 min at room temperature. After extraction of the crude mixture with AcOEt (2 x 5 mL), the combined organic layers were washed with water (4 mL) and brine (3 mL), dried over anhydrous Na₂SO₄ and concentrated under reduced pressure. The crude product was purified by flash column chromatography (SiO₂, Hexane / AcOEt 9:1) to afford **8** as white foam (21.3 mg, 84%), (mixture of diastereoisomers, ratio 1:1).

R_f = 0.40 (Hexanes / AcOEt 8:2); FTIR (neat): $\tilde{\nu}$ = 3065, 3034, 2930, 2871, 1718, 1605, 1436, 1284, 1166, 1091, 1039, 739, 697 cm⁻¹; ¹H NMR (250 MHz, CDCl₃, 25 °C): δ = 7.60 – 7.50 (m, 4H; SeArH_o), 7.43 – 7.32 (m, 20H; OCH₂ArH), 7.31 – 7.25 (m, 6H; SeArH_mH_p), 6.53 (d, J = 2.2 Hz, 2H; ArH), 6.38 (d, J = 2.2 Hz, 1H; ArH), 6.34 (d, J = 2.2 Hz, 1H; ArH), 5.31 – 5.09 (m, 2H; CHCH₃), 5.05 – 4.99 (m, 8H; OCH₂Ph), 4.11 (d, J = 17.9 Hz, 1H, CHHC(=O)), 4.09 (d, J = 16.9 Hz, 1H; CHHC(=O)), 4.00 – 3.85 (m, 1H; CHSePh), 4.81 – 3.65 (m, 1H; CHSePh), 3.52 (d, J = 17.9 Hz, 1H; CHHC(=O)), 3.47 (d, J = 16.9 Hz, 1H; CHHC(=O)), 3.03 – 2.53 (m, 4H; CH₂CH₂CHSePh), 1.90 – 1.46 (m, 8H; CH₂CH₂), 1.16 (d, J = 6.3 Hz, 3H, CH₃), 1.14 (d, J = 6.3 Hz, 3H, CH₃); ¹³C NMR (62.9 MHz, CDCl₃, 25 °C): δ = 205.8, 205.6, 168.0, 167.5, 160.5, 160.3, 157.7, 156.9, 136.4, 136.3, 135.1, 133.9, 133.8, 133.2, 129.2, 128.6, 128.4, 128.2, 128.1, 127.9, 127.6, 127.5, 127.3, 118.3, 117.8, 113.1, 109.1, 99.9, 99.6, 73.5, 72.2, 71.7, 70.6, 70.4, 70.2, 48.8, 48.7, 48.2, 46.7, 38.6, 37.3, 34.2, 34.0, 32.9, 32.3, 29.7, 23.3, 20.9, 20.7,

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19.4; HRMS (ESI pos.) calcd for $C_{36}H_{36}O_5Se$ ($[M+H]^+$): 629.1806; found 629.1800.

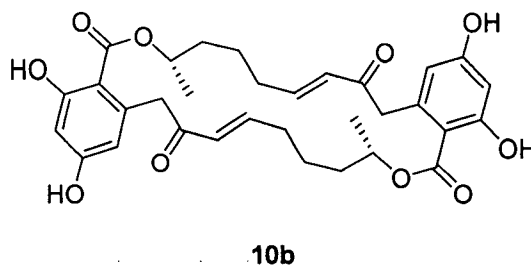
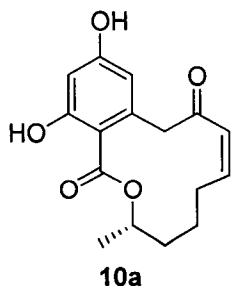


Dihydroxy selenide (9): To a solution of dibenzyl ether **8** (17.3 mg, 0.0276 mmol) in DCM (2 mL) was added thioanisole (50 μ L) under argon and the mixture was cooled to -78°C . A solution of BBr_3 (1M; 60 μ L) was added and the reaction mixture was stirred for 30 min. The reaction was quenched with MeOH (0.1 mL) and the crude mixture was extracted with AcOEt (2 x 3 mL). The combined organic layers were washed with water (2 mL) and brine (1.5 mL), dried over anhydrous Na_2SO_4 and concentrated under reduced pressure. The crude product was purified by flash column chromatography (SiO_2 , Hexane / AcOEt 8:2) to afford **9** as colorless oil (8.8 mg, 72%), (mixture of diastereoisomers (A or B), ratio 1:1).

R_f = 0.25 (Hexanes / AcOEt 7:3); FTIR (neat): $\tilde{\nu}$ = 3369, 2926, 2856, 1710, 1647, 1621, 1456, 1315, 1261, 1100, 743 cm^{-1} ; ^1H NMR (250 MHz, $CDCl_3$, 25°C): δ = 12.02 (s, 1H; OH, (A)), 11.70 (s, 1H; OH, (B)), 7.64 – 7.57 (m, 2H; SeArH_o, (B)), 7.57 – 7.50 (m, 2H; SeArH_o, (A)), 7.39 – 7.30 (m, 6H; SeArH_mH_p, (A+B)), 6.31 (d, J = 2.6 Hz, 1H; ArH, (A or B)), 6.01 (d, J = 2.6 Hz, 1H; ArH, (A or B)), 5.32 – 5.18 (m, 1H; CHCH₃, (A)), 5.06 – 4.90 (m, 1H; CHCH₃, (B)), 4.73 (d, J = 18.2 Hz, 1H; CHHC(=O), (B)), 4.52 (d, J = 18.6 Hz, 1H; CHHC(=O), (A)), 4.20 – 3.99 (m, 1H; CHSePh, (A)), 3.95 – 3.79 (m, 1H; CHSePh, (B)), 3.66 (d, J = 18.6 Hz, 1H; CHHC(=O), (A)), 3.41 (d, J = 18.2 Hz, 1H; CHHC(=O), (B)), 3.05 – 2.58 (m, 4H; CH₂CH₂CHSePh, (A+B)), 1.88 – 1.40 (m, 8H; CH₂CH₂, (A+B)), 1.33 (d, J = 6.0 Hz, 3H; CH₃, (B)), 1.27 (d, J = 6.0 Hz, 3H; CH₃, (A)); ^{13}C NMR (62.9 MHz, $CDCl_3$, 25°C): δ = 206.7, 205.7, 170.9, 165.4, 160.4, 138.0, 135.3, 133.7,

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129.3, 128.5, 128.3, 128.2, 127.5, 112.7, 112.3, 103.0, 75.2, 72.4, 51.8, 51.0, 49.2, 48.5, 36.8, 35.6, 33.4, 32.4, 31.8, 29.7, 23.1, 21.0, 20.6, 18.3.



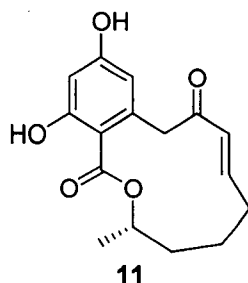
cis-Resorcyllide (10a) and dimmer (10b): To a refluxing (80 °C) solution of diene **6** (26 mg, 0.0817 mmol) in CCl₃CH₃ (150 mL, dilution 0.54 mM), catalyst **I** (2.2 mg, 0.24 μmol) was added under argon. The reaction was quenched after 1 h by addition of ethylvinyl ether (100 μL) and concentrated under reduced pressure. The crude product was purified by flash column chromatography (SiO₂, Hexane / AcOEt 8:2) to afford **10a** (9.5 mg, 40%) and **10b** (6.9 mg, 29%) as white solids.

10a: R_f = 0.35 (Hexanes / AcOEt 6:4); $[\alpha]_D^{25} = +2.7$ ($c = 0.26$ in MeOH); FTIR (KBr): $\tilde{\nu} = 3390, 2988, 2967, 2927, 2862, 1679, 1645, 1604, 1446, 1398, 1314, 1267, 1161, 1104, 1052, 850, 815, 790, 736$ cm⁻¹; ¹H NMR (250 MHz, CD₃OD, 25 °C): $\delta = 6.50$ (dt, $J = 11.8, 1.5$ Hz, 1H; C(=O)CH=), 6.25 (d, $J = 2.5$ Hz, 1H; ArH), 6.16 (d, $J = 2.5$ Hz, 1H; ArH), 5.81 (ddd, $J = 11.8, 9.9, 5.7$ Hz, 1H; =CHCH₂), 5.09 – 4.96 (m, 1H; CHCH₃), 4.57 (d, $J = 18.5$ Hz, 1H; CHHC(=O)), 3.65 (d, $J = 18.5$ Hz, 1H; CHHC(=O)), 2.62 – 2.41 (m, 1H; CH₂CH=CH₂), 2.30 – 2.14 (m, 1H; CH₂CH=CH₂), 1.94 – 1.77 (m, 1H; CH(-CH₃)CH₂CHH), 1.75 – 1.57 (m, 3H; CH(-CH₃)CH₂CHH), 1.28 (d, $J = 6.1$ Hz, 3H; CH₃); ¹H NMR (500 MHz, (CD₃)₂CO, 25 °C): $\delta = 12.01$ (s, 1H; OH), 9.25 (br s, 1H; OH), 6.50 (dt, $J = 11.9, 1.4$ Hz, 1H; C(=O)CH=), 6.32 (d, $J = 2.3$ Hz, 1H; ArH), 6.25 (d, $J = 2.3$ Hz, 1H; ArH), 5.77 (ddd, $J = 11.9, 10.1, 6.0$ Hz, 1H; =CHCH₂), 5.05 – 4.97 (m, 1H; CHCH₃), 4.58 (d, $J = 18.3$ Hz, 1H; CHHC(=O)), 3.69 (d, $J = 18.3$ Hz, 1H; CHHC(=O)), 2.58 – 2.47 (m, 1H; CHHCH=CH₂), 2.20 – 2.12 (m, 1H;

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CHHCH=CH₂), 1.93 – 1.82 (m, 1H; CH(-CH₃)CH₂CHH), 1.72 – 1.61 (m, 3H; CH(-CH₃)CH₂CHH), 1.28 (d, *J* = 6.0 Hz, 3H; CH₃); ¹³C NMR (62.9 MHz, CD₃OD, 25 °C): δ = 204.7, 172.8, 167.1, 164.1, 140.1, 139.9, 132.8, 114.0, 106.2, 103.0, 76.9, 51.5, 32.2, 27.6, 26.4, 21.5; HRMS (MALDI – FTMS) calcd for C₁₆H₁₈O₅ ([M+H]⁺): 291.1227; found 291.1231.

10b: ¹H NMR (500 MHz, (CD₃)₂CO, 25 °C): δ = 11.95 (s, 2H; OH), 9.22 (br s, 2H; OH), 7.05 – 6.93 (m, 2H; =CHCH₂), 6.34 – 6.23 (m, 6H; ArH, C(=O)CH=), 5.33 – 5.23 (m, 2H; OCH(-CH₃)CH₂), 4.23 (AB_q, *J* = 17.9 Hz, 4H; CH₂C(=O)), 2.44 – 2.33 (m, 2H; CH₂CH=CH₂), 2.33 – 2.22 (m, 2H; CH₂CH=CH₂) 1.74 – 1.51 (m, 8H; CH₂CH₂), 1.27 (d, *J* = 6.4 Hz, 6H; CH₃); HRMS (ESI pos.) calcd for C₃₂H₃₆O₁₀ ([M+H]⁺): 581.2387; found 581.2377.



trans-Resorcyllide (11): To a stirred solution of selenide **9** (4.2 mg, 0.0034 mmol) and AcOH (0.5 μL) in THF (1.5 mL), an aqueous solution of H₂O₂ (30%; 2.7 μL, 0.0237 mmol) diluted in additional H₂O (0.5 mL), was added drop-wise at 0 °C. After 1 h the reaction mixture was quenched with saturated NaHCO₃ (50 μL), extracted with Et₂O (2 x 1.5 mL) and the combined organic layers were washed with water (0.5 mL) and brine (0.5 mL), dried over anhydrous Na₂SO₄ and concentrated under reduced pressure. The crude product was purified by flash column chromatography (SiO₂, Hexane / AcOEt 75:25) to afford **11** as colorless solid (2.4 mg, 90%).

*R*_f = 0.24 (Hexanes / AcOEt 6:4); [*α*]_D²⁵ = + 46.9 (*c* = 0.66 in MeOH); FTIR (KBr): $\tilde{\nu}$ = 3445, 2961, 2930, 2860, 1704, 1651, 1627, 1455, 1267, 1171, 846, 681, 544 cm⁻¹; ¹H NMR (250 MHz, CD₃OD, 25 °C): δ = 6.95 (ddd, *J* = 16.0, 8.4, 6.1 Hz, 1H;

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=CHCH₂), 6.31 (d, *J* = 2.3 Hz, 1H; ArH), 6.22 (d, *J* = 2.3 Hz; 1H, ArH), 5.94 (dt, *J* = 16.0, 1.1 Hz, 1H; C(=O)CH=), 5.19 – 5.07 (m, 1H; CHCH₃), 4.43 (d, *J* = 12.6 Hz, 1H; CHHC(=O)), 3.32 (d, *J* = 12.6 Hz, 1H; CHHC(=O)), 2.36 – 2.22 (m, 2H; CH₂CH=CH₂), 1.99 – 1.60 (m, 4H; CH₂CH₂), 1.35 (d, *J* = 6.1 Hz, 3H; CH₃); ¹H NMR (500 MHz, (CD₃)₂CO, 25 °C): δ = 9.19 (br s, 1H; OH), 8.80 (br s, 1H; OH), 6.90 (ddd, *J* = 16.0, 8.2, 6.0 Hz, 1H; =CHCH₂), 6.42 (d, *J* = 2.3 Hz, 1H; ArH), 6.36 (d, *J* = 2.3 Hz; 1H, ArH), 5.93 (dt, *J* = 16.5, 1.4 Hz, 1H; C(=O)CH=), 5.24 – 5.15 (m, 1H; CHCH₃), 4.31 (d, *J* = 12.8 Hz, 1H; CHHC(=O)), 3.51 (d, *J* = 12.8 Hz, 1H; CHHC(=O)), 2.36 – 2.21 (m, 2H; CH₂CH=CH₂), 2.01 – 1.95 (m, 1H; CH(-CH₃)CH₂CHH), 1.88 – 1.75 (m, 2H; CH(-CH₃)CHHCHH), 1.75 – 1.64 (m, 1H; CH(-CH₃)CHHCH₂), 1.36 (d, *J* = 6.4 Hz, 3H; CH₃); ¹³C NMR (62.9 MHz, CD₃OD, 25 °C): δ = 201.8, 171.1, 161.1, 158.9, 152.1, 136.4, 131.3, 114.8, 110.4, 102.6, 73.7, 44.2, 35.0, 32.6, 25.5, 20.7; HRMS (ESI pos.) calcd for C₁₆H₁₈O₅ ([M+H]⁺): 291.1227; found 291.1227.