Supporting Information

A Convergent Approach to the Mitomycin Ring System

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General Methods: All ^{1}H and ^{13}C NMR spectra were recorded on a Brüker DRX-500. Chemical Shifts are reported in ppm relative to $CDCl_3$ peak at 7.24 ppm (^{1}H) or 77.0 ppm (^{13}C). All mass spectroscopy was performed by the Campus Chemical Instruments Center at The Ohio State University on a Micromass Q-TQF2 instrument. Infrared (IR) spectra were recorded on a Perkin-Elmer 1600 FT-IR spectrometer. All reactions unless otherwise specified were run under an inert atmosphere of nitrogen or argon using clean, dried glassware. All solvents were freshly distilled before use. Yields reported refer to isolated material determined to be pure by NMR spectroscopy and thin layer chromatography (TLC) unless specified in the text.

Aldehyde 9. A solution of **8** (587 mg, 2.66 mmol) in CH_2Cl_2 (10 mL) at −78 °C was treated with trimethylsilyl triflate (0.49 mL, 2.7 mmol). The reaction mixture was stirred at −78 °C for 1 h when a solution of **6** (804 mg, 2.70 mmol) in CH_2Cl_2 (2.7 mL) was added. The reaction mixture was stirred at −78 °C for an additional 15 min and was allowed to warm to 25 °C over 2 h. The reaction was quenched by the addition of pH 7 phosphate buffer (10 mL, 1.0 M) and the mixture was extracted with EtOAc (3 × 10 mL). The combined organic extracts were dried by Na_2SO_4, filtered and evaporated in vacuo. Flash chromatography (5 × 20 cm silica, 10% EtOAc/hexane) afforded pure **9** (1.095 g, 96%) as a pale yellow oil: ^{1}H NMR ($CDCl_3$, 500 MHz) δ 9.90-9.67 (br, 1H), 7.45-7.09 (br, 11H), 7.09-6.82 (br, 3H), 5.17-4.85 (br, 4H), 4.73-4.67 (br, 1H), 4.25-4.01 (br, 1H), 3.53-3.02 (br, 2H), 2.11-1.34 (br, 4H); ^{13}C NMR ($CDCl_3$, 125 MHz) δ 199.69, 170.72, 155.45, 141.11, 136.88, 130.86, 128.33, 128.18, 128.00, 127.96, 127.82, 127.64, 127.53, 127.13, 127.00, 126.93, 126.56, 123,53, 121.08, 112.26, 70.15, 66.44, 57.13, 56.18, 46.13, 28.00, 23.24.

Alcohol 10 A solution of **9** (14.8 mg, 0.034 mmol) in THF (1.5 mL) stirring at −78 °C was treated with SuperHydride (1.0 M solution in THF, 0.038 mL, 0.038 mmol). After stirring at −78 °C for 30 min, the reaction mixture was quenched by the addition of pH 7.0 KH_2PO_4/K_2HPO_4

buffer (2 mL, 1.0 M). The mixture was extracted with EtOAc (3 × 3 mL). The organic layer was dried by Na_2SO_4, filtered and evaporated in vacuo. Flash chromatography (0.5 × 10 cm silica, 10% EtOAc/hexane) afforded **10** (14.8 mg, 99%) as a colorless oil: ^{1}H NMR ($CDCl_3$, 500 MHz) δ 7.64-7.56 (br, 1H), 7.43-7.27 (br, 9H), 7.20-7.16 (br, 1H), 6.98-6.93 (br, 1H), 6.93-6.89 (br, 1H), 5.22-5.12 (br, 2H), 5.06-4.97 (br, 2H), 4.50-4.43 (br, 1H), 3.89-3.81 (br, 1H), 3.62-3.54 (br, 1H), 3.52-3.32 (br, 2H), 3.28-3.21 (br, 1H), 1.94-1.64 (br, 3H), 1.55-1.46 (br, 1H); ^{13}C NMR ($CDCl_3$, 125 MHz) δ 157.15, 156.42, 141.04, 136.66, 128.53, 128.23, 128.19, 128.14, 127.99, 127.75, 127.71, 127.56, 127.45, 126.93, 126.87, 126.81, 126.50, 120.57, 111.85, 70.02, 66.98, 63.00, 57.49, 47.47, 43.00, 28.82, 23.28.

Silyl Ether 11. A solution of **10** (403.4 mg, 0.94 mmol) in CH_2Cl_2 (5 mL) was slowly treated with 2,6-lutidine (0.35 mL, 3.0 mmol) at 0 °C followed by the slow addition of triisopropy trifluoromethanesulfonate (0.54 mL, 2.0 mmol). The reaction mixture was stirred at 0 °C for 6 h before satd. aqueous $NaHCO_3$ (5 mL) was added. The mixture was extracted with EtOAc (3 × 10 mL). The organic layer was dried (Na_2SO_4), filtered, and evaporated in vacuo. Flash chromatography (5 × 20 cm silica, 10% EtOAc/hexane) afforded **11** (515.2 mg, 92%) as a colorless oil. Major isomer: ^{1}H NMR ($CDCl_3$, 500 MHz) δ 7.42-7.25 (br, 10H), 7.16-7.08 (br, 2H), 6.91-6.79 (br, 2H), 5.15-4.82 (br, 4H), 4.43-4.23 (br, 1H), 4.11-3.83 (br, 2H), 3.73-3.02 (br, 3H), 1.88-1.46 (br, 4H), 1.02-0.68 (br, 21H); ^{13}C NMR ($CDCl_3$, 125 MHz) δ 157.30, 155.49, 137.39, 137.02, 129.71, 128.43, 128.36, 128.29, 128.20, 127.97, 127.72, 127.64, 127.36, 127.28, 127.22, 127.17, 127.09, 120.83, 112.06, 70.35, 66.56, 65.51, 59.62, 46.43, 28.60, 23.40, 22.57, 17.87, 11.91; IR (neat) ν_{max} 3449.3, 2941.7, 2890.1, 1681.7, 1452.1, 1415.0, 1237.5, 1110.6, 882.5, 751.1, 695.6 cm^{-1}; HRMS (FAB), *m/e* 610.3316 (calcd. for $C_{36}H_{49}O_4NSi$ + Na: 610.3329).

Phenol Amine 12. A solution of **11** (515.2 mg, 0.87 mmol) in methanol (10 mL) was treated with 10% Pd on activated carbon (10 mg, catalytic) at 25 °C. The reaction mixture was stirred 12 h at 25 °C, and was ten filtered and the filtrate was evaporated in vacuo to give pale yellow heavy oil (363 mg, 99%), that was used without further purification: ^{1}H NMR ($CDCl_3$, 500 MHz) δ 7.12-7.06 (app t, 1H, *J* = 7.9 Hz), 6.93-6.86 (m, 2H), 6.78-6.73 (app t, 3H, *J* = 12.2, 6.7 Hz), 4.10-3.96 (m, 2H), 3.48-3.44 (app q, 1H, *J* = 10.3, 3.7 Hz), 3.02-2.90 (m, 1H), 2.80-2.71 (m, 1H), 1.86-1.68 (m, 2H), 1.67-1.58 (m, 1H). 1.56-1.45 (m, 1H), 1.48-0.90 (m, 21H).

Phenyl Triflate 13. A solution of **12** (253.7 mg, 0.70 mmol) in THF (2 mL) at 0 °C was treated slowly with a solution of $NaN(SiMe_3)_2$ (0.6 M in toluene, 1.40 mL, 0.84 mmol). The solution was stirred at 0 °C for 30 min followed by the addition of $PhNTf_2$ (275 mg, 0.77 mmol). The mixture was stirred an additional 1 h at 0 °C and then quenched by the addition of pH 7.0

KH_2PO_4/K_2HPO_4 buffer (1.0 M, 3 mL). The mixture was extracted by EtOAc (3 × 5 mL), and the combined organic extracts were dried (Na_2SO_4), filtered and evaporated in vacuo. Flash chromatography (2 × 20 cm silica, EtOAc) afforded **13** (288 mg, 83%) as a pale yellow oil: ^{1}H NMR ($CDCl_3$, 500 MHz) δ 7.49 (d, J = 7.9 Hz, 1H), 7.32-7.22 (m, 3H), 4.04 (dd, J = 10.4, 5.5 Hz, 1H), 3.94 (dd, J = 9.2, 5.5Hz, 1H), 3.62-3.52 (m, 1H), 3.08-2.98 (m, 2H), 2.98-2.91 (m, 1H), 1.78-1.70 (m, 1H), 1.68-1.58 (m, 2H), 1.28-1.18 (m, 1H), 1.05-0.88 (m, 21H); ^{13}C NMR ($CDCl_3$, 125 MHz) δ 147.90, 135.25, 130.48, 128.01, 127.89, 121.05, 119.10 (q, J = 321 Hz, CF_3), 65.68, 59.90, 46.55, 30.46, 25.61, 25.06, 17.87, 11.84; ^{19}F NMR ($CDCl_3$, 235 MHz, $CFCl_3$ = 0.00 ppm) δ 74.39; IR (film) ν_{max} 2944.6, 2987.1, 2363.4, 1593.5, 1489.9, 1463.1, 1419.5, 1287.5, 1248.6, 1214.0, 1140.6, 1005.9, 889.7, 768.2, 682.7 cm^{-1}; HRMS (FAB), *m/e* 496.2161 (calcd. for $C_{22}H_{36}SO_4F_3SiN$ + H: 496.2164).

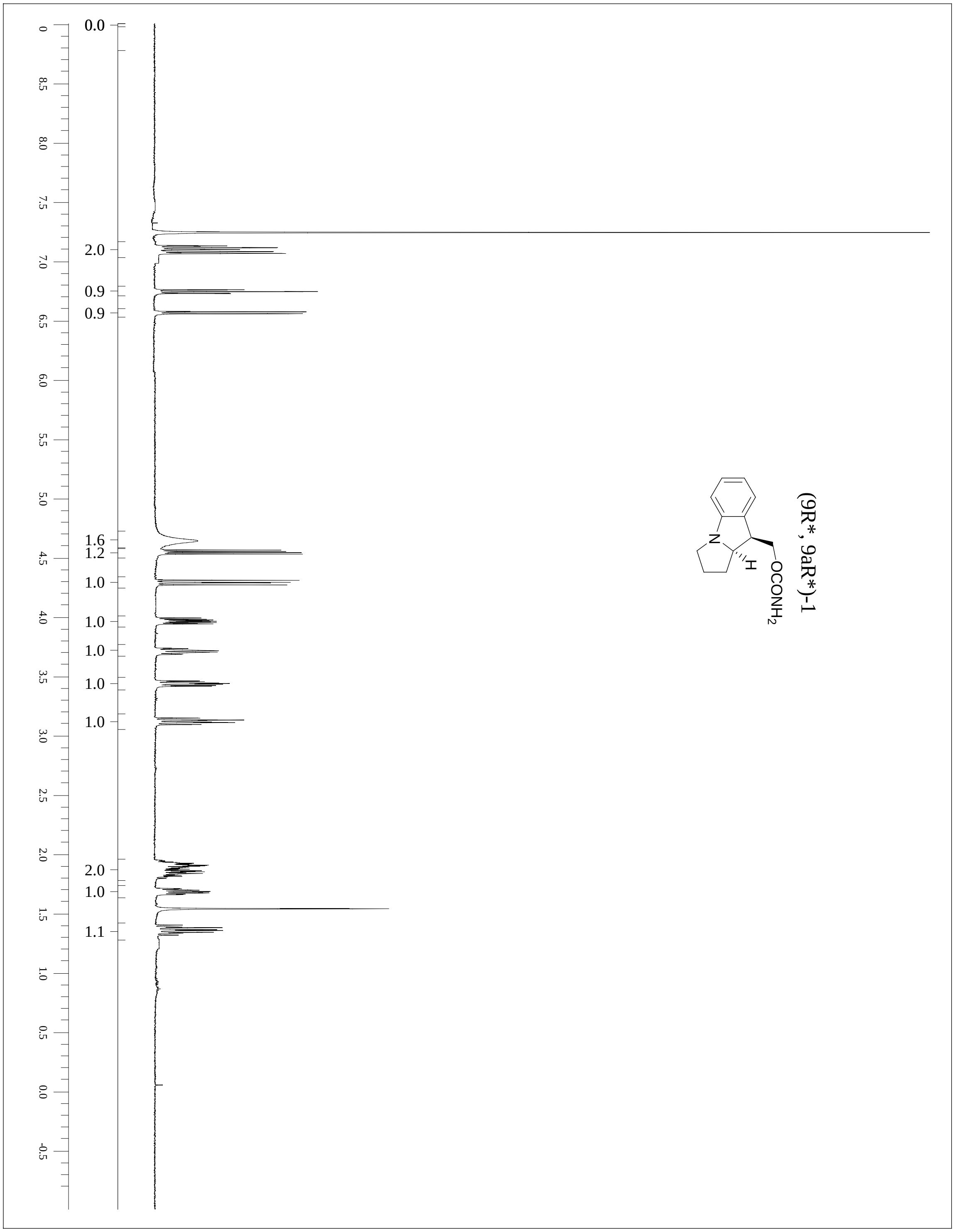
Silylether 14. A vial equipped with a Teflon-lined lid was charged with $Pd(OAc)_2$ (9.0 mg, 0.04 mmol), BINAP (racemic, 31.1 mg, 0.05 mmol) and Cs_2CO_3 (19.5mg, 0.06mmol) was flushed with N_2. A solution of **13** (20 mg, 0.04 mmol) in toluene (0.2 mL) was added and the vial was capped and warmed at 100 °C for 18 h. The reaction mixture was filtered and evaporated in vacuo. The residue was purified by flash chromatography (0.5 × 7 cm silica gel, hexane) to afford **14** (6.1 mg, 44%) as a pale yellow oil. Major isomer: ^{1}H NMR ($CDCl_3$) 7.16-7.08 (m, 2H), 6.75 (app t, J = 7.9 Hz, 1H), 6.58 (d, J = 7.9 Hz, 1H), 4.20 (dd, J = 10.4, 6.1 Hz, 1H), 4.06-4.00 (m, 1H), 3.95 (app t, J = 9.2 Hz, 1H), 3.65 (app dd, J = 14.6, 9.2 Hz, 1H), 3.45 (m, 1H), 3.14 (m, 1H), 1.97-1.82 (m, 2H), 1.82-1.76 (m, 1H), 1.48-1.40 (m, 1H), 1.22-1.05 (m, 21H); ^{13}C NMR ($CDCl_3$, 125 MHz) 155.18, 130.33, 128.01, 124.03, 118.93, 110.48, 69.04, 63.63, 51.75, 45.42, 26.11, 24.96, 18.10, 12.05; IR (film) ν_{max} 2940.9, 2864.7, 2360.1, 1603.7, 1458.1, 1092.2, 881.7, 781.3, 751.7 cm^{-1}; HRMS (FAB), *m/e* 346.2582 (calcd for $C_{21}H_{35}NOSi$ + H: 345.2566).

Pyrrolo[1,2-*a*]indole 15. A solution of **14** (20 mg, 0.058 mmol) in THF (0.58 mL) in a plastic reaction vessel was treated dropwise with dilute HF·pyridine solution (0.18 mL, consisting of: 0.5 mL HF·pyridine (Aldrich) diluted at −20 °C in a plastic bottle under N_2 with 2 mL dry pyridine). The reaction was stirred at 25 °C for 48 h, followed by the addition of cold saturated aqueous $NaHCO_3$ (3 mL). The mixture was extracted with EtOAc (3 × 3 mL) and the combined organic extracts were dried (Na_2SO_4), filtered and evaporated in vacuo. The residue was purified by flash chromatography with silica gel (0.5 × 10 cm silica gel, 33% EtOAc/hexane) to afford **15** (9.1 mg, 83%) as a pale yellow liquid. Major isomer: ^{1}H NMR ($CDCl_3$) 7.17 (app t, J = 7.9 Hz, 1H), 7. 13 (d, J = 7.9 Hz, 1H), 6.80 (app t, J = 7.9 Hz, 1H), 6.63 (d, J = 7.9 Hz, 1H), 4.19 (dd, J = 11.0, 5.5 Hz, 1H), 4.12-4.06 (m, 1H), 3.98 (dd, J = 11.0, 8.5Hz, 1H), 3.67 (app dd, J = 14.7, 8.5 Hz, 1H), 3.50 (m, 1H), 3.17 (m, 1H), 2.02-1.88 (m, 2H), 1.85-1.79 (m, 1H), 1.79-1.68 (br s, 1H, OH), 1.52 (m, 1H); ^{13}C NMR ($CDCl_3$, 125 MHz) 155.05, 129.62, 128.23, 123.85, 119.14, 110.69, 68.76, 62.81, 51.74, 45.01, 26.16, 24.98; HRMS (FAB), *m*/*e* 190.1232 (calcd for $C_{12}H_{15}NO$ + H: 190.1231).

Pyrrolo[1,2-*a*]indole 1. A solution of **15** (44 mg, 0.23 mmol) in dry pyridine (2 mL) was treated with phenyl chloroformate (44 mg, 0.28 mmol) at 0 °C. The reaction mixture was stirred at 25 °C for 18 h before water (2 mL) was added. The mixture was extracted with EtOAc (3 × 5 mL). The combined organic extracts were dried (Na_2SO_4), filtered and evaporated in vacuo. The residue was dissolved in CH_2Cl_2 (2 mL) and was cooled to −40 °C, whereupon liquid NH_3 was added. After refluxing for 6 hours, the reaction mixture was brought to room temperature and the NH_3 was allowed to evaporate. The reaction mixture was diluted with $CHCl_3$ (15 mL) and EtOAc (3 mL), the solution was washed with 4% aqueous NaOH solution (10 mL) and saturated aqueous NaCl (10 mL), and the organic layer was dried (Na_2SO_4). Solvents were removed in vacuo and the residue was purified by flash chromatography (0.5 × 10 cm silica gel, EtOAc) to afford **1** as a mixture of diastereomers as a colorless solid (32 mg, 59%). The major isomer (9*R**,9a*R**)-**1** was isolated by recrystallization (EtOAc). The minor isomer (9*R**,9a*S**)-**1** was isolated by preparative TLC (10 × 20 cm silica PF_{254}, 50 µm, EtOAc).

(9*R**,9a*R**)-**1**: ^{1}H NMR ($CDCl_3$, 500 MHz) δ 7.11 (app t, 1H, *J* = 8.5, 7.9 Hz), 7.07 (d, 1H, *J* = 7.9 Hz), 6.74 (dd, 1H, *J* = 7.9, 7.3 Hz), 6.56 (d, 1H, *J* = 7.9 Hz), 4.64 (br s, 2H, NH_2), 4.55 (dd, 1H, *J* = 6.1, 5.5 Hz, C10-H), 4.29 (dd, 1H, *J* = 8.5, 5.5 Hz, C10-H), 3.96 (ddd, 1H, *J* = 9.8, 8.5, 5.5 Hz, C9a-H), 3.71 (ddd, 1H, *J* = 9.6, 8.5, 6.1 Hz, C9-H), 3.44 (ddd, 1H, *J* = 10.7, 8.8, 3.7 Hz, C3-H), 3.12 (ddd, 1H, *J* = 10.7, 8.5, 7.7 Hz, C3-H), 1.78-1.95 (m, 2H, C2-H), 1.68 (m, 1H, C1-H), 1.36 (m, 1H, C1-H); ^{13}C NMR ($CDCl_3$, 125 MHz) δ 156.58, 154.81, 128.98, 128,41, 124.03, 119.35, 110.76, 68.64, 64.94, 51.80, 41.78, 26.00, 25.07; HRMS (FAB), *m*/*e* 233.1294 (calcd for $C_{13}H_{16}N_2O_2$ + H, 233.1290); IR (film) ν_{max} 2984.5, 1741.4, 1447.8, 1373.7, 1239.8, 1047.1 cm^{-1}.

(9*R**,9a*S**)-**1**: ^{1}H NMR ($CDCl_3$, 500 MHz) δ 7.12 (m, 1H, 2H), 6.75 (app t, 1H, *J* = 7.3 Hz), 6.56 (d, 1H, *J* = 7.9 Hz), 4.60 (br s, 2H, NH_2), 4.23 (dd, 1H, *J* = 10.4, 6.4 Hz, C10-H), 4.13 (dd, 1H, *J* = 11.9, 6.4 Hz, C10-H), 3.71 (ddd, 1H, *J* = 9.5, 6.4, 3.1 Hz, C9a-H), 3.50 (m, 1H, C9-H), 3.40 (m, 1H, C3-H), 3.13 (m, 1H, C3-H), 1.91 (m, 1H, C1-H), 1.84 (m, 2H, C2-H), 1.35 (m, 1H, C1-H); ^{13}C NMR ($CDCl_3$, 125 MHz) δ 156.65, 154.91, 129.60, 128.77, 125.25, 119.40, 111.35, 68.82, 67.82, 51.98, 46.55, 30.83, 25.68.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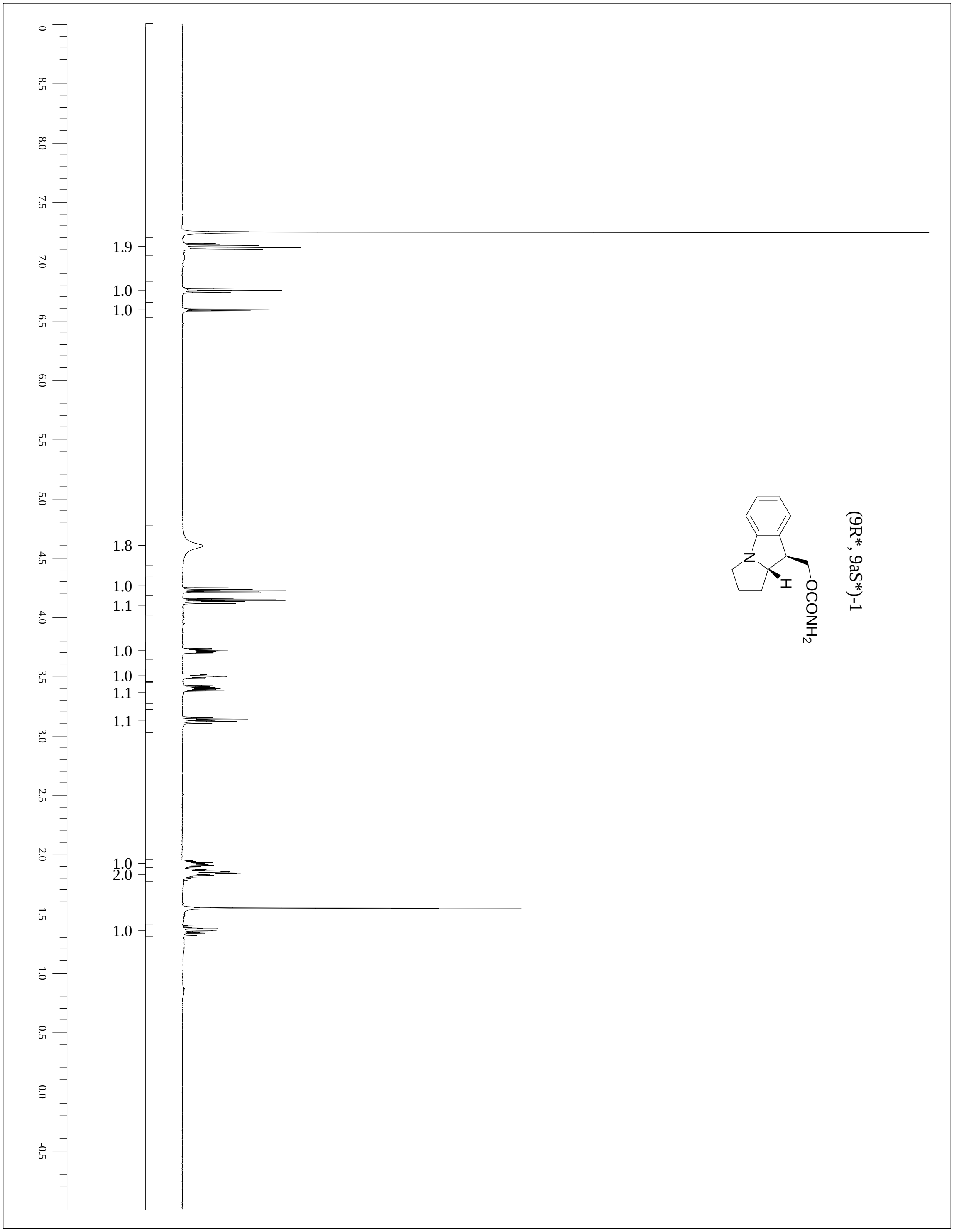
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