-SUPPORTING INFORMATION FOR-

Radical [3+2]-Annulation of Divinylcyclopropanes: Synthesis of Complex Meloscine Analogs

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EXPERIMENTAL PROCEDURES and CHARACTERIZATION DATA

General Information: Chemicals and solvents were purchased from commercial suppliers and used as received, except as follows. Dichloromethane, THF, ether, and toluene were dried by passing through an activated alumina column, unless otherwise indicated. All reactions were carried out under an inert atmosphere of dry argon unless otherwise indicated.

All reactions were followed by TLC, LCMS, or ^{1}H NMR spectroscopy. TLC visualizations were performed by illumination with a UV lamp (254 nm), in combination with staining with a solution of phosphomolybdic acid in ethanol, or a solution of anisaldehyde in ethanol, and heating. All flash chromatography was performed with 230-400 mesh silica gel purchased from Sorbent Technologies or by CombiFlash system (Teledyne ISCO).

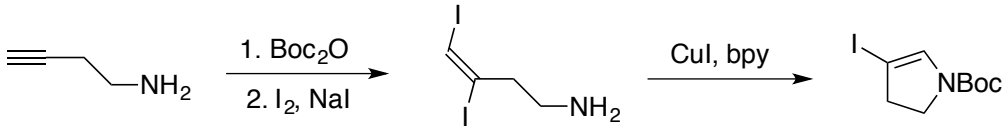
^{1}H NMR spectra were recorded on Bruker Avance instruments at 300, 400, 500, 600 and 700 MHz with deuterated chloroform as solvent, unless otherwise indicated. ^{13}C NMR spectra were measured on Bruker Avance instruments at 75, 100, 125, and 150 MHz. The chemical shifts in spectra were measured in parts per million (ppm) on the delta (δ) scale relative to the resonance of the solvent peak ($CDCl_3$: ^{1}H = 7.27 ppm, ^{13}C = 77.0 ppm). Unless otherwise noted, NMR spectra were recorded at 293 K.

IR spectra were recorded on a Nicolet Avatar 360 FTIR spectrometer or an Identity IR-ATR spectrometer and ran neat or as thin films on sodium chloride plates. Mass spectra were obtained on Fisons Autospec high-resolution magnetic sector mass spectrometer or a Micromass Q-ToF Ultima mass spectrometer. LCMS-high resolution LC/MS analyses were completed on a Thermo Scientific Exactive spectrometer with purities determined using an Agilent Technologies 385-ELSD

using MeCN/H_2O with 0.1% formic acid.

N-Boc-2,3-dihydropyrrole **13a**, *N*-Boc-2,3-dihydro-2*H*-pyridine **13b**, and *N*-Boc-2,3,4,5-tetrahydroazepine **13c** were purchased from Sigma-Aldrich. Vinyl iodide **10b** was prepared in two steps from **13b** using known procedures.[1] Arylboronic ester **8** was purchased from Boron Molecular Inc. Procedures and spectral data for compounds **1a**, **2a**, **4**, **5**, **6**, **7**, **10a, 14a,** and **19a** were previously reported.[2]

Preparation of vinyl iodide 10a from 4-amino-1-butyne:



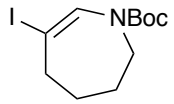
10a

***N*-Boc protection of 4-amino-1-butyne**: A solution of 4-amino-1-butyne (2.70 g, 39.07 mmol) in diethyl ether (ACS reagent grade; 150 mL) at −78 °C was treated with Boc_2O (9.39 g, 42.98 mmol) and the reaction mixture was stirred at this temperature for 2 h. A saturated aqueous $NaHCO_3$ solution was added, and the biphasic mixture was stirred vigorously at room temperature for 10 min. The aqueous layer was extracted by diethyl ether, and the combined organic layer was dried over $MgSO_4$ and concentrated *in vacuo*. The resulting crude (*E*)-3,4-diiodobut-3-en-1-amine (6.6 g) was directly used for the next reaction.

Diiodination of (*E*)-3,4-diiodobut-3-en-1-amine: To a stirred solution of (*E*)-3,4-diiodobut-3-en-1-amine (6.6 g, 39.07 mmol) in dichloromethane (150 mL) was sequentially added NaI (17.57 g, 117.20 mmol) and I_2 (11.90, 46.88 mmol). The reaction mixture was stirred in dark for 12 h, before a saturated aqueous solution of $Na_2S_2O_3$ was added. After vigorous stirring for 10 min, the biphasic mixture was transferred into a separatory funnel. The aqueous layer was extracted with

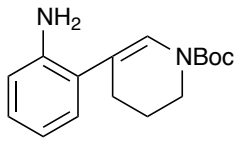
dichloromethane, and the combined organic layers was dried over $MgSO_4$, and concentrated *in vacuo*. The crude (*E*)-3,4-diiodobut-3-en-1-amine (15.5 g) appeared as a yellow oil and was directly subjected to the next reaction without purification.

Copper-mediated 5-*endo-trig* cyclization of (*E*)-3,4-diiodobut-3-en-1-amine: The crude (*E*)-3,4-diiodobut-3-en-1-amine (8.20 g, 19.39 mmol; based on a hypothetical 100% yield of the diiodination reaction) was dissolved in toluene (300 mL), followed by addition of K_3PO_4 (12.35 g, 58.17 mmol), 2,2'-bipyridyl (3.03 g, 19.39 mmol), CuI (1.85 g, 9.70 mmol), and water (0.3 mL). The reaction mixture was refluxed for 48 h, before it was cooled to room temperature, filtered through a pad of celite and concentrated. The residue was pre-absorbed onto silica gel and purified by flash chromatography (30% EtOAc/hexanes) to give **10a** (3.50 g, 61% over two steps; with >90% purity).

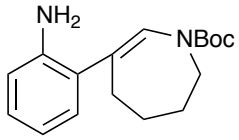


***tert*-Butyl 6-iodo-2,3,4,5-tetrahydro-1*H*-azepine-1-carboxylate (10c)**: Sodium methoxide (0.55 g, 10.10 mmol) was added to a stirred solution of *tert*-butyl 2,3,4,5-tetrahydro-1*H*-azepine-1-carboxylate **13c** (1.0 g, 5.10 mmol) in MeOH (20 mL). An ICl solution (1 M in CH_2Cl_2, 5.60 mL) was added dropwise, and the mixture was stirred for 30 min after the completion of addition. The reaction was quenched with a saturated aqueous $Na_2S_2O_3$ solution, and the aqueous layer was extracted with Et_2O. The combined organic layers were washed with brine, dried over $MgSO_4$, and concentrated *in vacuo*. The crude 1-methoxy-2-iodo-tetrahydroazepine product was dissolved in toluene (75 mL), and the solution was heated at 130 °C. TFA (30 μL) was then added in one portion, and the reaction mixture was heated at this temperature for 10 min, during which time the colorless reaction mixture turned dark

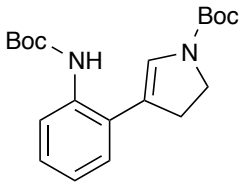
red. The reaction mixture was cooled to room temperature and neutralized with triethylamine (the reaction mixture turned yellow). The solvent was evaporated, and the residue was purified by flash chromatography (silica gel, 10% EtOAc/hexanes) to provide **10c** (1.1 g, 74%) as a colorless oil, as a 2:1 ratio of *N*-Boc rotamers: FTIR (thin film, $CHCl_3$) 2976, 2932, 1706, 1628, 1390, 1348, 1250, 1161, 976 cm^{-1}; ^1H NMR (500 MHz, $CDCl_3$) δ major rotamer: 6.96 (s, 1H); minor rotamer: 7.10 (s, 1H); overlapping resonance: 3.66 (m, 2H), 2.77-2.75 (m, 2H), 1.78-1.74 (m, 4H), 1.48 (s, 9H); HRMS (TOF ES) *m/z* calcd for $C_{11}H_{19}NO_2I$ $[M]^+$ 324.0461, found 324.0469. This product contained minor, inseparable impurities, and was submitted to the subsequent Suzuki-coupling reaction without further purification.



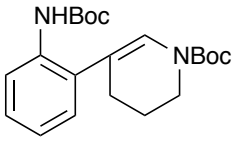
***tert*-Butyl 5-(2-aminophenyl)-3,4-dihydropyridine-1(2*H*)-carboxylate (14b)**: Suzuki coupling of vinyl iodide **10b** (1.02 g, 3.20 mmol) and 2-aminophenyl pinacolboronate **8** (0.86 g, 3.90 mmol) in the manner of **14a**[2], followed by flash chromatography purification (silica gel, 30% EtOAc/hexanes), afforded **14b** (brown oil, 0.67 g, 76%) as a mixture of *N*-Boc rotamers: FTIR (thin film, $CHCl_3$) 3450, 3361, 2976, 2932, 1697, 1650, 1615, 1493, 1452, 1390, 1367, 1311, 1253, 1162, 1116, 749 cm^{-1}; ^1H NMR (400 MHz, $CDCl_3$) δ 7.09-7.05 (m, 2H), 6.90 (s, 1H), 6.77-6.73 (m, 2H), 3.81 (br s, 2H), 3.65 (m, 2H), 2.33 (t, J = 6.5 Hz, 2H), 1.49 (s, 9H); ^{13}C NMR (125 MHz, $CDCl_3$) δ 152.8, 152.4, 143.9, 143.8, 129.8, 129.6, 127.8, 127.7, 124.9, 124.5, 118.5, 115.9, 115.5, 115.2, 80.9, 80.7, 42.4, 41.3, 28.4, 26.2, 25.9, 22.1, 22.0; HRMS (TOF ES) *m/z* calcd for $C_{16}H_{23}N_2O_2$ $[M+H]^+$ 275.1760, found 275.1747.



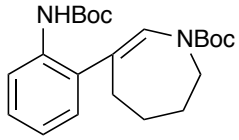
***tert*-Butyl 6-(2-aminophenyl)-2,3,4,5-tetrahydro-1*H*-azepine-1-carboxylate (14c)**: Suzuki coupling of vinyl iodide **10c** (1.05 g, 3.25 mmol) and 2-aminophenyl pinacolboronate **8** (0.86 g, 3.90 mmol) in the manner of **14a**[2], followed by flash chromatography purification (silica gel, 30% EtOAc/hexanes), afforded **14c** (0.73 g, 78%) as a brown oil, in a 1:1 mixture of *N*-Boc rotamers: FTIR (thin film, $CHCl_3$) 3462, 3361, 2976, 2931, 2860, 1697, 1647, 1616, 1493, 1452, 1393, 1367, 1306, 1241, 1161, 1117, 749 cm^{-1}; ^1H NMR (500 MHz, $CDCl_3$) δ 7.07-7.02 (m, 2H), 6.75-6.71 (m, 2H), 6.55 (m, 1H), 3.74 (t, J = 6.0 Hz, 2H), 2.49 (m, 2H), 1.85 (m, 4H), 1.49 (s, 9H); ^{13}C NMR (125 MHz, $CDCl_3$) δ 153.9, 143.2, 130.7, 129.6, 129.1, 127.9, 126.7, 118.5, 115.6, 80.6, 46.9, 31.9, 28.4, 28.3, 25.0; HRMS (TOF ES) *m/z* calcd for $C_{17}H_{25}N_2O_2$ $[M+H]^+$ 289.1916', found 289.1925.



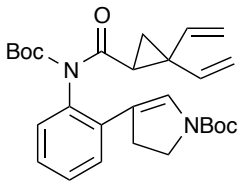
***tert*-Butyl 4-(2-((*tert*-butoxycarbonyl)amino)phenyl)-2,3-dihydro-1*H*-pyrrole-1-carboxylate (15a)**: A mixture of aniline **14a** (510 mg, 1.96 mmol), $LiClO_4$ (42 mg, 0.39 mmol), and Boc_2O (869 mg, 3.92 mmol) in CH_2Cl_2 (25 mL) was stirred at room temperature for 12 h. The remaining solid in the reaction mixture was filtered off, and the solvent was evaporated. The residue was purified by flash chromatography (silica gel, 15% EtOAc/hexanes) to provide **15a** (664 mg, 94%) as a brown oil, with a minor amount of inseparable impurities.



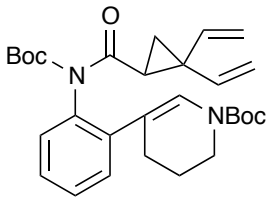
***tert*-Butyl 5-(2-(*tert*-butoxycarbonylamino)phenyl)-3,4-dihydropyridine-1(2*H*)-carboxylate (15b)**: A mixture of $LiClO_4$ (7 mg, 0.068 mmol), aniline **14b** (94 mg, 0.34 mmol), and Boc_2O (82 mg, 0.38 mmol) in CH_2Cl_2 (3 mL) was stirred at room temperature for 12 h. The solvent was evaporated, and the residue was purified by flash chromatography (silica gel, 15% EtOAc/hexanes) to give **15b** (123 mg, 97%) as a colorless oil, that was a mixture of multiple rotamers (see supporting information for ^{1}H NMR and ^{13}C NMR spectra): FTIR (thin film, $CHCl_3$) 3418, 2977, 2932, 1704, 1650, 1514, 1447, 1386, 1367, 1312, 1252, 1159, 754 cm^{-1}; HRMS (TOF ES) *m/z* calcd for $C_{21}H_{30}N_2O_4Na$ $[M+Na]^+$ 397.2103, found 397.2097.



***tert*-Butyl 6-(2-(*tert*-butoxycarbonylamino)phenyl)-2,3,4,5-tetrahydro-1*H*-azepine-1-carboxylate (15c)**: *N*-Boc protection of aniline **14c** (100 mg, 0.35 mmol) in the manner of **15b**, followed by flash chromatography (silica gel, 15% EtOAc/hexanes), provided **15c** (125 mg, 94%) as a colorless oil, that was a mixture of multiple rotamers (see supporting information for ^{1}H NMR and ^{13}C NMR spectra): FTIR (thin film, $CHCl_3$) 3414, 2977, 2931, 1703, 1513, 1481, 1448, 1389, 1367, 1246, 1160, 753 cm^{-1}; HRMS (TOF ES) *m/z* calcd for $C_{22}H_{33}N_2O_4$ $[M+H]^+$ 389.2440, found 389.2459.

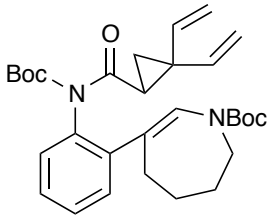


***tert*-Butyl 4-(2-(*N*-(*tert*-butoxycarbonyl)-2,2-divinylcyclopropane-carboxamido)phenyl)-2,3-dihydro-1*H*-pyrrole-1-carboxylate (16a)**: The Ghosez reagent (80 μL, 0.61 mmol) was added to a solution of acid **9a** (84 mg, 0.61 mmol) in toluene (2 mL), and the mixture was stirred at room temperature for 2 h. A KHMDS solution (0.5 M in toluene, 0.97 mL) was slowly added to a solution of **15a** (172 mg, 0.406 mmol) in THF (5 mL) at 0 °C. After 30 min, a fresh solution of acid chloride **9** (0.61 mmol, in 2 mL of toluene), prepared from acid **9** and Ghosez reagent, was slowly added. The reaction mixture was then stirred at room temperature for 12 h, before it was partitioned between H_2O and diethyl ether. The aqueous layer was extracted with diethyl ether, and the combined organic layer was dried with $MgSO_4$ and concentrated *in vacuo*. The residue was purified by flash chromatography (silica gel, 15% EtOAc/hexanes) to provide **16a** (152 mg, 69%) as a colorless oil, as a mixture of multiple rotamers (see supporting information for ^{1}H NMR and ^{13}C NMR spectra): FTIR (thin film, $CHCl_3$) 2977, 2931, 1732, 1700, 1451, 1408, 1368, 1299, 1253, 1156, 1128, 896, 757 cm^{-1}; HRMS (TOF ES) *m/z* calcd for $C_{28}H_{36}N_2O_5Na$ $[M+Na]^+$ 503.2522, found 503.2519.

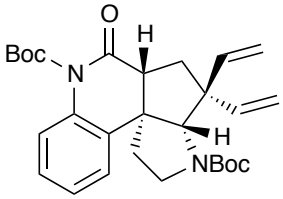


***tert*-Butyl 5-(2-(*N*-(*tert*-butoxycarbonyl)-2,2-divinylcyclopropanecarboxamido) phenyl)-3,4-dihydropyridine-1(2*H*)-carboxylate (16b)**: Acid chloride **9** (0.22 mmol in 2 mL of toluene) was prepared from acid **9a** (30 mg, 0.22 mmol) and Ghosez reagent (29 μL, 0.22 mmol). In a separate flask, a NaHMDS solution (1 M in THF, 131 μL) was added dropwise to a solution of **15b** (41 mg, 0.11 mmol) in THF (2 mL) at −78 °C. After 30 min, the above mentioned acid chloride solution was added

dropwise at this temperature. The reaction mixture was slowly warmed to room temperature and stirred for 1 h. The reaction was quenched with water, and the mixture was extracted with diethyl ether. The combined organic layer was dried over $MgSO_4$ and concentrated *in vacuo*. The crude product was purified by flash chromatography (silica gel, 15% EtOAc/hexanes) to provide **16b** (24 mg, 83%) as a colorless oil, as a mixture of multiple rotamers (see supporting information for ^{1}H NMR and ^{13}C NMR spectra): FTIR (thin film, $CHCl_3$) 3086, 2978, 2933, 1733, 1702, 1649, 1386, 1298, 1254, 1160, 1119, 895, 759 cm^{-1}; HRMS (TOF ES) *m/z* calcd for $C_{29}H_{38}N_2O_5Na$ $[M+Na]^+$, 517.2678, found 517.2673.

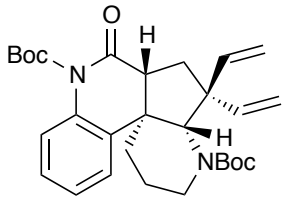


***tert*-Butyl 6-(2-(*N*-(*tert*-butoxycarbonyl)-2,2-divinylcyclopropanecarboxamido) phenyl)-2,3,4,5-tetrahydro-1*H*-azepine-1-carboxylate (16c)**: Acylation of **15c** (62 mg, 0.16 mmol) was in the manner of **16b**, followed by flash chromatography (silica gel, 15% EtOAc/hexanes), provided **16c** (51 mg, 63%) as a colorless oil, as a mixture of multiple rotamers and contained minor, inseparable impurities (see supporting information for ^{1}H NMR spectrum): FTIR (thin film, $CHCl_3$) 2978, 2932, 1733, 1701, 1647, 1391, 1368, 1300, 1251, 1158, 757 cm^{-1}; HRMS (TOF ES) *m/z* calcd for $C_{30}H_{40}N_2O_5Na$ $[M+Na]^+$ 531.2835, found 531.2816.



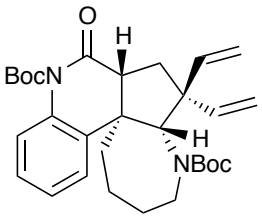
(3a*R*,5a*R*,11b*R*)-Di-*tert*-butyl 6-oxo-4,4-divinyl-4,5,5a,6-tetrahydro-1*H*-pyrrolo[3',2':2,3]cyclopenta[1,2-*c*]quinoline-3,7(2*H*,3a*H*)-dicarboxylate (17a):

A solution of AIBN (18 mg, 0.108 mmol) and Bu_3SnH (116 μL, 0.448 mmol) in toluene (6 mL) was added via syringe pump to a solution of *bis*-carbamate **16a** (104 mg, 0.216 mmol) in refluxing toluene (9 mL) over a period of 4 h. The reaction mixture was cooled to room temperature, and the solvent was evaporated. The residue was purified by flash chromatography (silica gel, 15% EtOAc/hexanes) to provide **17a** (55 mg, 53%) as a colorless oil, as a 1.5:1 mixture of rotamers: FTIR (thin film, $CHCl_3$) 2976, 2928, 1698, 1454, 1392, 1368, 1249, 1150 cm^{-1}; ^1H NMR (400 MHz, $CDCl_3$) δ major rotamer: 6.00 (dd, *J* = 17.6, 10.8 Hz, 1H), 5.91 (dd, *J* = 17.2, 10.8 Hz, 1H), 4.32 (s, 1H), 2.87 (dd, *J* = 12.4, 8.0 Hz, 1H), 2.33 (t, *J* = 13.2 Hz, 1H), 1.54 (s, 9H); minor rotamer: 6.09 (dd, *J* = 17.6, 10.8 Hz, 1H), 5.95 (dd, *J* = 17.6, 10.8 Hz, 1H), 4.47 (s, 1H), 2.92 (dd, *J* = 12.4, 8.0 Hz, 1H), 2.37 (t, *J* = 13.2 Hz, 1H), 1.51 (s, 9H); overlapping signals: 7.29-7.25 (m, 1H), 7.12 (t, *J* = 7.6 Hz, 1H), 7.06-6.97 (m, 2H), 5.17-5.04 (m, 4H), 3.55-3.34 (m, 2H), 2.23-2.13 (m, 2H), 1.70-1.65 (m, 1H), 1.62 (s, 9H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 169.8, 169.5, 154.5, 154.0, 152.0, 151.9, 144.2, 143.4, 140.6, 140.5, 136.7, 135.0, 134.8, 127.7, 127.6, 124.7, 123.1, 122.8, 119.1, 119.0, 114.2, 113.5, 112.0, 85.2, 85.1, 80.5, 79.9, 77.6, 71.8, 71.5, 54.9, 54.5, 54.0, 53.9, 46.6, 46.4, 45.4, 45.3, 31.6, 30.6, 28.6, 28.5, 28.0, 27.8, 23.5, 22.7; HRMS (TOF ES) *m/z* calcd for $C_{28}H_{36}N_2O_5Na$ $[M+Na]^+$, 503.2522, found 503.2540.



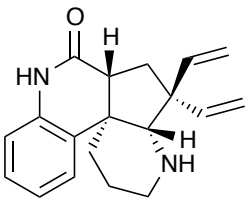
(4a*S*,6a*R*,12b*R*)-Di-*tert*-butyl 7-oxo-5,5-divinyl-2,3,5,6,6a,7-hexahydropyrido-[3',2':2,3]cyclopenta[1,2-*c*]quinoline-4,8(1*H*,4a*H*)-dicarboxylate (17b): A solution of AIBN (4 mg, 0.026 mmol) and Bu_3SnH (1 M in cyclohexane, 129 μL, 0.129 mmol) in toluene (3 mL) was added via syringe pump to a solution of **16b** (32 mg,

0.065 mmol) in refluxing toluene (8 mL) over a period of 4 h. The reaction mixture was cooled to room temperature, and the solvent was evaporated. The residue was partitioned between acetonitrile and hexanes. The acetonitrile layer was washed with hexanes and then concentrated *in vacuo*. The crude product was purified by flash chromatography (silica gel, 15% EtOAc/hexanes) to provide the title compound **17b** (15 mg, 52%, contained minor, inseparable impurities) as a colorless oil, in a 2:1 mixture of *N*-Boc rotamers: FTIR (thin film, $CHCl_3$) 2978, 2934, 1733, 1694, 1392, 1368, 1278, 1253, 1151, 915, 848, 758 cm^{-1}; ^1H NMR (400 MHz, $CDCl_3$) δ major rotamer: 7.10 (t, *J* = 7.2 Hz, 1H), 7.01 (d, *J* = 7.2 Hz, 1H), 6.09 (dd, *J* = 17.2, 10.2 Hz, 1H), 5.92 (dd, *J* = 17.6, 10.8 Hz, 1H), 5.25 (d, *J* = 17.2 Hz, 1H), 5.22 (d, *J* = 10.4 Hz, 1H), 4.94 (d, *J* = 17.2 Hz, 1H), 4.89 (d, *J* = 10.4 Hz, 1H), 4.63 (s, 1H), 4.20-4.16 (m, 1H), 2.52 (t, *J* = 12.8 Hz, 1H), 2.06 (dd, *J* = 13.2, 6.0 Hz, 1H), 1.52 (s, 9H); minor rotamer: 7.09 (t, *J* = 7.2 Hz, 1H), 6.97 (d, *J* = 7.2 Hz, 1H), 6.28 (dd, *J* = 17.2, 10.2 Hz, 1H), 5.89 (dd, *J* = 17.6, 10.8 Hz, 1H), 5.19 (d, *J* = 17.2 Hz, 1H), 5.15 (d, *J* = 10.8 Hz, 1H), 4.79 (s, 1H), 4.02-3.98 (m, 1H), 2.42 (t, *J* = 12.8 Hz, 1H), 2.20 (dd, *J* = 13.2, 6.0 Hz, 1H), 1.52 (s, 9H); overlapping resonance: 7.28-7.22 (m, 1H), 7.21-7.15 (m, 1H), 2.94-2.81 (m, 2H), 1.62 (s, 9H), 1.59-1.54 (m, 3H). This product was directly subjected to the next reaction without further purification.



(5a*S*,7a*R*,13b*R*)-Di-*tert*-butyl 8-oxo-6,6-divinyl-3,4,6,7,7a,8-hexahydro-1*H*-azepino[3',2':2,3]cyclopenta[1,2-*c*]quinoline-5,9(2*H*,5a*H*)-dicarboxylate (17c): Radical annulation of divinylcyclopropane **16c** (41 mg, 0.081 mmol) in the manner of **17b**, followed by flash chromatography purification (silica gel, 15% EtOAc/hexanes),

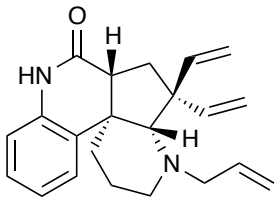
provided **17c** (15 mg, 35%) as a colorless oil, as a 1:1 mixture of *N*-Boc rotamers: FTIR (thin film, $CHCl_3$) 2976, 2929, 1688, 1421, 1368, 1278, 1249, 1149 cm^{-1}; ^1H NMR (500 MHz, $CDCl_3$) δ 7.40-7.35 (m, 1H), 7.28-7.22 (m, 1H), 7.15-7.11 (m, 1H), 7.02, 6.97 (d, *J* = 8.0 Hz, 1H), 5.94, 5.88 (dd, *J* = 17.5, 10.5 Hz, 1H), 5.85, 5.80 (dd, *J* = 17.5, 10.5 Hz, 1H), 5.39-4.92 (m, 3H), 3.93, 3.65 (d, *J* = 15.0 Hz, 1H), 3.14, 3.12 (d, *J* = 15.0 Hz, 1H), 2.87, 2.84 (dd, *J* = 8.0, 5.0 Hz, 1H), 2.45, 2.39 (t, *J* = 13.0 Hz, 1H), 2.12, 2.08 (dd, *J* = 8.0, 5.0 Hz, 1H), 1.92-1.80 (m, 2H), 1.63 (m, 9H), 1.57-1.56 (m, 9H), 1.59-1.41 (m, 3H), 0.90 (m, 1H); ^{13}C NMR (125 MHz, $CDCl_3$) δ 169.9, 169.8, 156.0, 155.3, 152.2, 152.0, 146.1, 146.0, 141.8, 141.2, 137.1, 136.7, 136.4, 136.2, 127.3, 127.1, 126.1, 125.3, 124.6, 124.1, 119.3, 119.0, 113.6, 113.1, 112.1, 110.9, 85.0, 84.9, 80.7, 80.0, 68.3, 66.5, 54.3, 53.8, 51.6, 51.1, 48.8, 48.7, 43.3, 42.5, 30.5, 28.6, 28.5, 27.8, 25.9, 25.5, 25.3, 24.6, 23.5, 18.5, 18.1; HRMS (TOF ES) *m/z* calcd for $C_{30}H_{40}N_2O_5Na$ $[M+Na]^+$, 531.2835, found 531.2854.



(4a*S*,6a*R*,12b*R*)-5,5-Divinyl-1,2,3,4,4a,5,6,6a-octahydropyrido[3',2':2,3]-cyclopenta[1,2-*c*]quinolin-7(8*H*)-one (18b): Crude *bis*-carbamate **17b** (15 mg) was dissolved in a mixed solvent of CH_2Cl_2/TFA (10:1, 3 mL), and the reaction mixture was stirred at room temperature for 4 h. The solvent was evaporated and the residue was redissolved in CH_2Cl_2. This solution was washed with 1 M NaOH aqueous solution, dried over $MgSO_4$, and concentrated *in vacuo*. The resulting residue was purified by flash chromatography (silica gel, 40% EtOAc/CH_2Cl_2) to provide **18b** (7 mg, 35% over 2 steps) as a colorless oil: FTIR (thin film, $CHCl_3$) 3218, 3079, 2934, 2859, 1682, 1475, 1396, 1304, 1254, 912, 758, 735 cm^{-1}; ^1H NMR (400 MHz, $CDCl_3$)

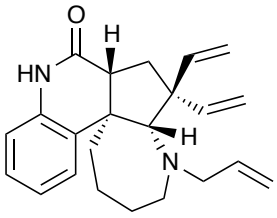
δ 8.19 (br s, 1H), 7.84 (d, *J* = 7.6 Hz, 1H), 7.20 (td, *J* = 7.6, 1.6 Hz, 1H), 7.07 (td, *J* = 7.6, 1.6 Hz, 1H), 6.87 (d, *J* = 7.6 Hz, 1H), 6.32 (dd, *J* = 17.6, 10.8 Hz, 1H), 5.88 (dd, *J* = 17.6, 10.8 Hz, 1H), 5.24 (d, *J* = 16.8 Hz, 1H), 5.21 (d, *J* = 10.4 Hz, 1H), 4.98 (d, *J* = 16.4 Hz, 1H), 4.94 (d, *J* = 10.4 Hz, 1H), 3.64 (s, 1H), 2.94 (td, *J* = 11.6, 4.0 Hz, 1H), 2.86-2.83 (m, 1H), 2.75 (dd, *J* = 12.8, 6.4 Hz, 1H), 2.48 (t, *J* = 13.2 Hz, 1H), 2.12 (dd, *J* = 12.4, 6.4 Hz, 1H), 1.59 (td, *J* = 11.6, 4.0 Hz, 1H), 1.52-1.47 (m, 1H), 1.45-1.35 (m, 2H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 172.1, 146.1, 142.6, 136.6, 134.5, 127.2, 126.4, 122.8, 116.2, 113.7, 110.4, 67.2, 54.2, 47.2, 44.1, 41.8, 30.7, 25.0, 20.4; HRMS (TOF ES) *m/z* calcd for $C_{19}H_{23}N_2O$ $[M+H]^+$ 295.1810, found 295.1805.

A sample for X-ray crystallography analysis was prepared by slow evaporation crystallization technique. A test tube (13 mL) was charged with a solution of amine **18b** (2 mg) in ethyl acetate (3 mL). After 72 h, a small crystal was found on the wall of this tube.



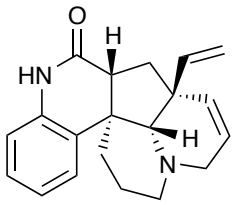
(4a*S*,6a*R*,12b*R*)-4-Allyl-5,5-divinyl-1,2,3,4,4a,5,6,6a-octahydropyrido[3',2':2,3]-cyclopenta[1,2-*c*]quinolin-7(8*H*)-one (19b): Free amine **18b** (15 mg, 0.030 mmol) was dissolved in CH_3CN (5 mL), followed by addition of K_2CO_3 (25 mg, 0.18 mmol) and allyl bromide (13 μL, 0.18 mmol). The reaction mixture was stirred at 45 °C for 12 h. The reaction mixture was diluted with CH_2Cl_2 (20 mL), washed with water, dried over $MgSO_4$, and concentrated *in vacuo*. The residue was purified by flash chromatography (silica gel, 50% EtOAc/hexanes) to afford **19b** (8 mg, 73%) as a light yellow oil. Alternatively, free amine obtained by TFA treatment of bis-Boc compound

17b can be allylated in the manner previously described[2] that gave a 59% yield of **19b** for this two step process: FTIR (thin film, $CHCl_3$) 3236, 3080, 2922, 2851, 1684, 1474, 1393, 1302, 1253, 914, 758 cm^{-1}; ^1H NMR (500 MHz, $CDCl_3$) δ 7.92 (d, *J* = 8.0 Hz, 1H), 7.51 (br s, 1H), 7.18 (td, *J* = 8.0, 1.5 Hz, 1H), 7.34 (t, *J* = 8.0 Hz, 1H), 6.80 (d, *J* = 8.0 Hz, 1H), 6.45 (dd, *J* = 17.5, 10.5 Hz, 1H), 6.11 (dd, *J* = 17.5, 10.5 Hz, 1H), 5.95-5.87 (m, 1H), 5.31-5.14 (m, 4H), 4.98 (d, *J* = 17.5 Hz, 1H), 4.93 (d, *J* = 10.5 Hz, 1H), 3.71 (dd, *J* = 14.5, 5.5 Hz, 1H), 3.63 (s, 1H), 3.51 (dd, *J* = 14.5, 7.0 Hz, 1H), 3.11-3.06 (m, 1H), 2.76 (dd, *J* = 12.5, 6.0 Hz, 1H), 2.76 (m, 1H), 2.55 (t, *J* = 13.0 Hz, 1H), 2.00 (dd, *J* = 13.5, 6.5 Hz, 1H), 1.72-1.65 (m, 1H), 1.46-1.42 (m, 3H); ^{13}C NMR (125 MHz, $CDCl_3$) δ 171.8, 147.2, 143.3, 136.9, 136.5, 134.6, 127.1, 126.7, 122.7, 116.4, 115.8, 113.3, 109.9, 73.9, 57.7, 55.7, 47.0, 45.6, 44.8, 30.8, 24.1, 21.0; HRMS (TOF ES) *m/z* calcd for $C_{22}H_{27}N_2O$ $[M+H]^+$ 335.2123, found 335.2127.

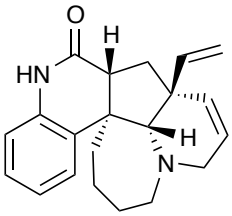


(5a*S*,7a*R*,13b*R*)-5-Allyl-6,6-divinyl-2,3,4,5,5a,6,7,7a-octahydro-1*H*azepino-[3',2':2,3]-cyclopenta[1,2-*c*]quinolin-8(9*H*)-one (19c): *N*-Boc deprotection of *bis*-carbamate **17c** (23 mg, 0.045 mmol) and allylation in the manner previously described[2] gave **19c** (12 mg, 76%) as a light yellow oil after purification by flash chromatography (silica gel, 50% EtOAc/hexanes): FTIR (thin film, $CHCl_3$) 3239, 3081, 2925, 2861, 1682, 1472, 1401, 759 cm^{-1}; ^1H NMR (400 MHz, $CDCl_3$) δ 7.76 (d, *J* = 7.2 Hz, 1H), 7.44 (br s, 1H), 7.21 (t, *J* = 7.6 Hz, 1H), 7.07 (t, *J* = 7.6 Hz, 1H), 6.79 (d, *J* = 7.6 Hz, 1H), 6.43 (dd, *J* = 17.6, 10.8 Hz, 1H), 6.02 (dd, *J* = 17.2, 10.4 Hz, 1H), 5.99 (m, 1H), 5.26-5.14 (m, 4H), 4.98 (d, *J* = 17.2 Hz, 1H), 4.90 (d, *J* = 10.8 Hz, 1H), 3.72 (m, 1H), 3.69 (s, 1H), 3.61 (dd, *J* = 10.4, 6.4 Hz, 1H), 3.37 (t, *J* = 12.4 Hz, 1H),

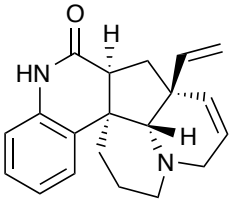
2.81 (dd, *J* = 13.2, 6.0 Hz, 1H), 2.51 (t, *J* = 13.2 Hz, 1H), 2.00 (dd, *J* = 12.8, 6.0 Hz, 1H), 1.90 (t, *J* = 12.8 Hz, 1H), 1.47-0.86 (m, 5H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 172.3, 147.8, 143.2, 137.6, 136.3, 134.3, 127.2, 126.6, 122.8, 116.5, 116.0, 112.4, 109.9, 79.3, 61.8, 54.4, 50.8, 48.2, 47.0, 30.0, 27.4, 25.2, 21.0; HRMS (TOF ES) *m/z* calcd for $C_{23}H_{29}N_2O$ $[M+H]^+$ 349.2280, found 349.2276.



(6b*R*,6b^1*S*,13a*S*,14a*R*)-13a-Vinyl-6b^1,7,8,9,11,13a,14,14a-octahydroquinolizino-[1',9':2,3,4]cyclopenta[1,2-*c*]quinolin-1(2*H*)-one (2b): Hoveyda-Grubbs II catalyst (1 mg, 0.0018 mmol) was added to a solution of triene **19b** (6 mg, 0.018 mmol) in toluene (4 mL). The reaction mixture was heated at 80 °C for 12 h. The solvent was evaporated, and the residue was purified by flash chromatography (silica gel, 5% MeOH/CH_2Cl_2, with 0.5% Et_3N) to provide **2b** (6 mg, 73%) as a white, amorphous powder: FTIR (thin film, $CHCl_3$) 3411, 2927, 1684, 1474, 1399, 1302, 758, 726 cm^{-1}; ^{1}H NMR (600 MHz, $CDCl_3$) δ 7.53 (d, *J* = 7.2 Hz, 1H), 7.38 (br s, 1H), 7.20 (t, *J* = 7.2 Hz, 1H), 7.07 (t, *J* = 7.2 Hz, 1H), 6.81 (d, *J* = 7.8 Hz, 1H), 5.95-5.92 (m, 1H), 5.87 (d, *J* = 9.6 Hz, 1H), 5.69 (dd, *J* = 17.4, 10.8 Hz, 1H), 4.99 (d, *J* = 17.4 Hz, 1H), 4.89 (d, *J* = 10.8 Hz, 1H), 3.56 (s, 1H), 3.22-3.16 (m, 2H), 2.92 (dd, *J* = 12.6, 4.8 Hz, 1H), 2.78 (td, *J* = 10.2, 4.8 Hz, 1H), 2.64-2.62 (m, 1H), 2.21 (dd, *J* = 12.6, 4.8 Hz, 1H), 2.04 (t, *J* = 12.6 Hz, 1H), 1.57-1.39 (m, 4H); ^{13}C NMR (175 MHz, $CDCl_3$) δ 171.9, 144.8, 136.5, 135.1, 133.0, 127.2, 125.6, 122.9, 116.3, 110.7, 68.9, 51.1, 49.2, 48.4, 47.5, 45.7, 31.3, 25.5, 19.5; HRMS (TOF ES) *m/z* calcd for $C_{20}H_{23}N_2O$ $[M+H]^+$ 307.1810, found 307.1809.

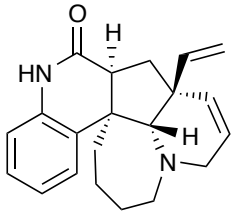


(6b*R*,6b^1*S*,13a*S*,14a*R*)-13a-Vinyl-2,6b^1,7,8,9,10,11,13a,14,14a-decahydro-1*H*-2,10a-diazabenzo[*c*]cyclohepta[*ef*]fluoren-1-one (2c): Ring-closing metathesis of triene **19c** (11 mg, 0.032 mmol) in the manner of **2b**, followed by flash chromatography purification (silica gel, 4% MeOH/CH_2Cl_2 with 0.5% Et_3N) provided **2c** (8 mg, 76%) as a white, amorphous powder: FTIR (thin film, $CHCl_3$) 3391, 2989, 2927, 1685, 1474, 1401, 1158, 805, 756, 728 cm^{-1}; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.64 (d, *J* = 7.5 Hz, 1H), 7.61 (s, 1H), 7.20 (t, *J* = 7.5 Hz, 1H), 7.09 (t, *J* = 7.5 Hz, 1H), 6.83 (d, *J* = 7.5 Hz, 1H), 5.94-5.90 (m, 1H), 5.69 (dd, *J* = 17.5, 10.5 Hz, 1H), 5.65 (d, *J* = 17.5 Hz, 1H), 5.02 (d, *J* = 17.5 Hz, 1H), 4.97 (d, *J* = 10.5 Hz, 1H), 3.58 (s, 1H), 3.18 (m, 2H), 3.15 (dd, *J* = 11.5, 7.0 Hz, 1H), 3.01 (t, *J* = 13.0 Hz, 1H), 2.80 (d, *J* = 14.0 Hz, 1H), 2.23 (t, *J* = 13.0 Hz, 1H), 2.08 (t, *J* = 6.0 Hz, 1H), 1.75 (dd, *J* = 7.0, 6.0 Hz, 1H), 1.47-1.44 (m, 2H), 0.91-0.83 (m, 1H); ^{13}C NMR (175 MHz, $CDCl_3$) δ 172.6, 145.4, 136.9, 135.3, 131.6, 127.1, 126.9, 124.8, 122.4, 117.0, 112.4, 73.8, 58.0, 54.7, 53.0, 51.7, 50.9, 30.9, 29.6, 26.8, 24.5; HRMS (TOF ES) *m/z* calcd for $C_{21}H_{25}N_2O$ $[M+H]^+$321.1967, found 321.1973.



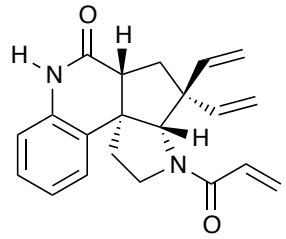
(6b*R*,6b^1*S*,13a*S*,14a*S*)-13a-Vinyl-6b^1,7,8,9,11,13a,14,14a-octahydroquinolizino-[1',9':2,3,4]cyclopenta[1,2-*c*]quinolin-1(2*H*)-one (1b): Epimerization of pentacycle **2b** (4.6 mg, 0.015 mmol) by potassium *tert*-butoxide (3.0 mg, 0.03 mmol) in the manner of meloscine **1**[2], followed by flash chromatography purification (silica gel,

3% MeOH/CH_2Cl_2 with 0.5% Et_3N), provided **1b** (4.0 mg, 82%) as an amorphous powder: FTIR (thin film, $CHCl_3$) 3420, 1649, 1387, 1159 cm^{-1}; ^1H NMR (700 MHz, $CDCl_3$) δ 7.51 (br s, 1H), 7.31 (d, *J* = 7.7 Hz, 1H), 7.13 (t, *J* = 7.7 Hz, 1H), 6.98 (t, *J* = 7.7 Hz, 1H), 6.65 (d, *J* = 7.7 Hz, 1H), 5.79 (dd, *J* = 9.1, 5.6 Hz, 1H), 5.36 (d, *J* = 9.8 Hz, 1H), 5.20 (dd, *J* = 17.5, 10.5 Hz, 1H), 4.66 (d, *J* = 17.5 Hz, 1H), 4.46 (d, *J* = 11.2 Hz, 1H), 3.70 (t, *J* = 9.8 Hz, 1H), 3.14 (dd, *J* = 16.1, 5.6 Hz, 1H), 2.95 (s, 1H), 2.92 (d, *J* = 11.2 Hz, 1H), 2.82 (d, *J* = 16.1 Hz, 1H), 2.46 (dd, *J* = 14.0, 11.9 Hz, 1H), 2.28 (t, *J* = 11.9 Hz, 1H), 2.05 (dd, *J* = 14.0, 9.1 Hz, 1H), 1.95-1.93 (m, 2H); ^{13}C NMR (175 MHz, $CDCl_3$) δ 171.6, 143.2, 135.0, 132.4, 127.9, 127.7, 127.6, 127.1, 123.9, 115.2, 112.7, 82.5, 56.8, 53.0, 51.0, 48.1, 46.9, 43.4, 42.2, 31.0; HRMS (TOF ES) *m/z* calcd for $C_{20}H_{23}N_2O$ $[M+H]^+$ 307.1810, found 307.1807.

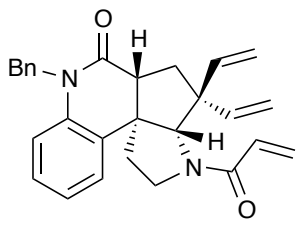


(6b*R*,6b^1*S*,13a*S*,14a*S*)-13a-Vinyl-2,6b^1,7,8,9,10,11,13a,14,14a-decahydro-1*H*-2,10a-diazabenzo[*c*]cyclohepta[*ef*]fluoren-1-one (1c): Epimerization of pentacycle **2c** (4.0 mg, 0.012 mmol) by potassium *tert*-butoxide (2.8 mg, 0.025 mmol) in the manner of meloscine **1**[2], followed by flash chromatography purification (silica gel, 3% MeOH/CH_2Cl_2 with 0.5% Et_3N), provided **1c** (3.5 mg, 84%) as an amorphous powder: FTIR (thin film, $CHCl_3$) 3400, 2925, 1674, 1481, 1395, 1157 cm^{-1}; ^1H NMR (700 MHz, $CDCl_3$) δ 8.03 (br s, 1H), 7.61 (d, *J* = 7.7 Hz, 1H), 7.20 (t, *J* = 7.7 Hz, 1H), 7.12 (t, *J* = 7.7 Hz, 1H), 6.77 (d, *J* = 7.7 Hz, 1H), 6.09 (dd, *J* = 9.8, 4.2 Hz, 1H), 5.79 (dd, *J* = 16.8, 10.5 Hz, 1H), 5.51 (d, *J* = 10.5 Hz, 1H), 4.97 (d, *J* = 16.8 Hz, 1H), 4.94 (d, *J* = 9.8 Hz, 1H), 4.01 (s, 1H), 3.86 (d, *J* = 17.5 Hz, 1H), 3.46 (d, *J* = 14.7 Hz, 1H), 3.14-3.10 (m, 2H), 2.82 (dd, *J* = 13.3, 4.9 Hz, 1H), 2.10-2.07 (m, 1H), 1.80 (dd,

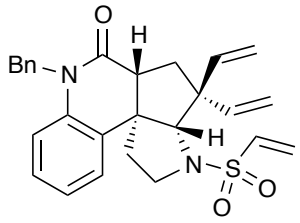
J = 13.3, 4.9 Hz, 1H), 1.76 (d, *J* = 13.3 Hz, 1H), 1.70-1.66 (m, 2H), 1.60 (m, 1H), 1.50 (m, 2H); ^{13}C NMR (175 MHz, $CDCl_3$) δ 171.8, 144.7, 134.9, 130.1, 129.5, 128.5, 127.4, 126.7, 122.8, 116.1, 112.9, 75.2, 57.4, 57.0, 52.2, 49.3, 44.7, 40.0, 36.5, 27.0, 23.3; HRMS (TOF ES) *m/z* calcd for $C_{21}H_{25}N_2O$ $[M+H]^+$ 321.1967, found 321.1977.



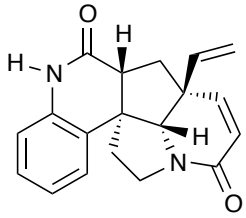
(3a*S*,5a*R*,11b*R*)-3-Acryloyl-4,4-divinyl-2,3,3a,4,5,5a-hexahydro-1*H*-pyrrolo[3',2':2,3]cyclopenta[1,2-*c*]quinolin-6(7*H*)-one (23): The crude mixture **18a** (28.0 mg) was dissolved in CH_2Cl_2 (5.0 mL). Pyridine (18.0 μL, 0.223 mmol) and acryloyl chloride (18.0 μL, 0.216 mmol) were added at 0 ºC. The reaction mixture was stirred at 0 ºC for 1 h. The reaction mixture was diluted with CH_2Cl_2 (10 mL) and washed with water, dried ($MgSO_4$), filtered and concentrated. The residue was filtered using silica gel plug (20% EtOAc/CH_2Cl_2) to provide **23** (22.0 mg, 53%) in a 2.7:1 mixture of amide rotamers: ^{1}H NMR (300 MHz, $CDCl_3$) δ major rotamer: 8.31 (s, 1H), 6.19 (dd, *J* = 17.4, 10.8 Hz, 1H), 4.85 (s, 1H); minor rotamer: 8.34 (s, 1H), 6.07 (dd, *J* = 17.4, 10.5 Hz, 1H), 4.55 (s, 1H); overlapping signals: 7.26-7.20 (m, 1H), 7.04-6.91 (m, 3H), 6.50 (d, *J* = 6.3 Hz, 2H), 5.93-5.74 (m, 2H), 5.24-5.05 (m, 4H), 3.72-3.51 (m, 2H), 3.03-2.95 (m, 1H), 2.53-2.13 (m, 3H); HRMS (TOF ES) *m/z* calcd for $C_{21}H_{23}N_2O_2$ $[M+H]^+$ 335.1754, found 335.1743.



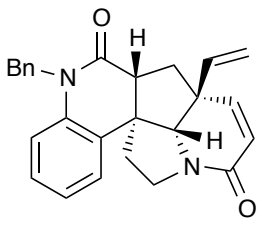
(3a*S*,5a*R*,11b*R*)-3-Acryloyl-7-benzyl-4,4-divinyl-2,3,3a,4,5,5a-hexahydro-1*H*-pyrrolo[3',2':2,3]cyclopenta[1,2-*c*]quinolin-6(7*H*)-one (24a): Carbamate **7** (27 mg, 0.057 mmol) was dissolved a mixed CH_2Cl_2/TFA (10:1, 2 mL). The reaction mixture was stirred at room temperature for 4 h, before the solvent was evaporated. The residue was redissolved in CH_2Cl_2 and washed with an aqueous NaOH solution (1 M). The solution was dried over $MgSO_4$ and the volume was reduced to 2 mL. Pyridine (19 μL, 0.23 mmol) and acryloyl chloride (19 μL, 0.114 mmol) were added at 0 °C. The reaction mixture was then stirred at room temperature for 2 h. It was diluted with CH_2Cl_2, washed with an aqueous $CuSO_4$ solution, dried over $MgSO_4$, and concentrated *in vacuo*. The residue was purified by flash chromatography (silica gel, 30% EtOAc/CH_2Cl_2) to provide **24a** (23 mg, 94%) as a colorless oil, as a 2:1 mixture of amide rotamers: ^{1}H NMR (400 MHz, $CDCl_3$) δ major rotamer: 6.21 (dd, *J* = 17.6, 10.8 Hz, 1H), 5.89 (dd, *J* = 17.6, 10.8 Hz, 1H), 4.86 (s, 1H), 3.09 (dd, *J* = 12.0, 6.4 Hz, 1H), 2.48 (t, *J* = 13.2 Hz, 1H); minor rotamer: 6.08 (dd, *J* = 17.6, 10.8 Hz, 1H), 5.85 (dd, *J* = 17.6, 10.8 Hz, 1H), 4.55 (s, 1H), 3.07 (dd, *J* = 12.0, 6.4 Hz, 1H), 2.59 (t, *J* = 13.2 Hz, 1H); overlapping resonance: 7.34-7.16 (m, 6H), 7.05-6.92 (m, 3H), 6.52-6.49 (m, 2H), 5.79-5.75 (m, 1H), 5.39-5.00 (m, 6H), 3.71-3.51 (m, 2H), 2.36-2.18 (m, 2H), 1.65-1.60 (m, 1H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 170.9, 170.4, 164.8, 164.6, 144.2, 143.4, 140.5, 139.4, 139.1, 137.9, 137.0, 136.9, 134.5, 134.4, 129.1, 128.8, 128.7, 128.2, 128.1, 127.9, 127.8, 127.4, 127.3, 126.9, 126.8, 125.3, 123.5, 123.4, 122.9, 122.5, 116.9, 116.8, 115.8, 113.5, 113.2, 112.2, 72.0, 71.5, 55.3, 54.6, 53.9, 52.8, 46.3, 46.2, 45.8, 45.7, 45.6, 45.5, 33.2, 31.6, 30.2, 21.5; HRMS (TOF ES) *m/z* calcd for $C_{28}H_{29}N_2O_2$ $[M+H]^+$ 425.2229, found 425.2213.



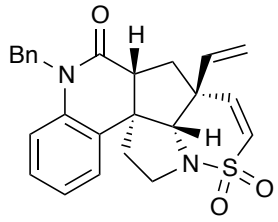
(3a*S*,5a*R*,11b*R*)-7-Benzyl-4,4-divinyl-3-(vinylsulfonyl)-2,3,3a,4,5,5a-hexahydro-1*H*-pyrrolo[3',2':2,3]cyclopenta[1,2-*c*]quinolin-6(7*H*)-one (24b): Carbamate **7** (31 mg, 0.065 mmol) was dissolved a mixed CH_2Cl_2/TFA (10:1, 2 mL). The reaction mixture was stirred at room temperature for 4 h, before the solvent was evaporated. The residue was redissolved in CH_2Cl_2 and washed with an aqueous NaOH solution (1 M). The solution was dried over $MgSO_4$, and the volume was reduced to 2 mL. Collidine (43 μL, 0.324 mmol) and 2-chloroethanesulfonyl chloride (14 μL, 0.129 mmol) were added at 0 °C. The reaction mixture was then stirred at room temperature for 12 h. It was diluted with CH_2Cl_2, washed with an aqueous NH_4Cl solution, dried over $MgSO_4$, and concentrated *in vacuo*. The residue was purified by flash chromatography (silica gel, 50% EtOAc/CH_2Cl_2) to provide **24b** (8 mg, 30%) as a colorless oil: FTIR (thin film, $CHCl_3$) 3061, 2925, 1684, 1603, 1492, 1455, 1385, 1346, 1213, 1149, 1029, 980, 920, 735 cm^{-1}; ^1H NMR (400 MHz, $CDCl_3$) δ 7.33-7.17 (m, 7H), 7.07-7.02 (m, 2H), 6.64 (dd, *J* = 16.8, 10.0 Hz, 1H), 6.35 (d, *J* = 16.8 Hz, 1H), 6.14 (dd, *J* = 17.6, 10.8 Hz, 1H), 6.05 (d, *J* = 10.0 Hz, 1H), 5.96 (dd, *J* = 17.6, 10.8 Hz, 1H), 5.35 (d, *J* = 16.0 Hz, 1H), 5.21-5.11 (m, 4H), 4.99 (s, *J* = 16.0 Hz, 1H), 4.63 (s, 1H), 3.33-3.29 (m, 2H), 3.00 (dd, *J* = 12.4, 6.4 Hz, 1H), 2.39-2.20 (m, 3H), 1.63-1.56 (m, 1H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 170.7, 143.2, 141.4, 139.0, 136.9, 135.2, 134.6, 128.8, 128.0, 127.8, 127.4, 126.9, 123.4, 123.0, 116.9, 113.8, 113.2, 72.5, 54.7, 54.5, 46.6, 46.3, 46.0, 32.3, 31.0; HRMS (TOF ES) *m/z* calcd for $C_{27}H_{29}N_2O_3S$ $[M+H]^+$ 461.1899, found 461.1879.



(6b*R*,6b^1*S*,12a*S*,13a*R*)-12a-Vinyl-6b^1,7,8,12a,13,13a-hexahydro-1*H*-indolizino[1',8':2,3,4]cyclopenta[1,2-*c*]quinoline-1,10(2*H*)-dione (25): Hoveyda-Grubbs II catalyst (8.00 mg, 0.012 mmol) was added to a solution of triene **23** (41.0 mg, 0.12 mmol) in toluene (16.8 mL) and the reaction mixture was stirred at 85 ºC for 12 h. Another portion of Hoveyda-Grubbs II catalyst (4.00 mg, 0.0062 mmol) was added and stirred for 6 h. The solvent was evaporated and the residue was purified by flash chromatography (silica gel, 4% MeOH/CH_2Cl_2 with 0.5% Et_3N) to provide **25** (24.3 mg, 65%) as a brown solid in addition to recovered starting material (7.00 mg, 17%): mp 252-253 ºC (decomposed); FTIR (thin film, CH_2Cl_2) 3221, 2924, 1691, 1659, 1601, 1471, 1256 cm^{-1}; ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.60 (br s, 1H), 7.24 (d, *J* = 8.4 Hz, 2H), 7.07 (t, *J* = 6.8 Hz, 1H), 6.99 (d, *J* = 7.6 Hz, 1H), 6.29 (d, *J* = 9.6 Hz, 1H), 5.95 (d, *J* = 10.0 Hz, 1H), 5.78 (dd, *J* = 17.6, 10.8 Hz, 1H), 5.24 (d, *J* = 10.8 Hz, 1H), 5.12 (d, *J* = 17.6 Hz, 1H), 4.58 (s, 1H), 4.32 (dd, *J* = 11.6, 6.8 Hz, 1H), 3.02-2.95 (m, 2H), 2.18 (dd, *J* = 12.0, 4.8 Hz, 1H), 2.00 (t, *J* = 12.8 Hz, 1H), 1.89 (td, *J* = 12.4, 7.2 Hz, 1H), 1.64 (dd, *J* = 12.4, 4.8 Hz, 1H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 171.1, 160.7, 142.6, 141.1, 137.2, 133.9, 127.8, 123.1, 122.2, 122.0, 117.3, 117.1, 65.8, 56.3, 48.2, 47.9, 43.4, 36.3, 33.1; HRMS (ESI) *m/z* calcd for $C_{19}H_{19}N_2O_2$ $[M+H]^+$ 307.1441, found 307.1436.

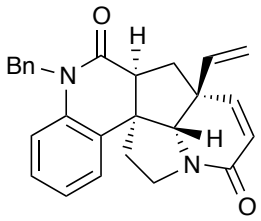


(6b*R*,6b^1*S*,12a*S*,13a*R*)-2-Benzyl-12a-vinyl-6b^1,7,8,12a,13,13a-hexahydro-1*H*-indolizino[1',8':2,3,4]cyclopenta[1,2-*c*]quinoline-1,10(2*H*)-dione (26a): Acrylamide **24a** (12 mg, 0.028 mmol) was dissolved in toluene (5 mL), and Hoveyda-Grubbs II catalyst (2 mg, 0.0028 mmol) was added. The reaction mixture was stirred at 80 °C for 8 h, and another portion of Hoveyda-Grubbs II catalyst (2 mg, 0.0028 mmol) was added. After 4 h, the solvent was evaporated, and the residue was purified by flash chromatography (silica gel, 5% MeOH/CH_2Cl_2, with 0.5% Et_3N) to provide **26a** (9 mg, 84%) as a light brown oil: FTIR (thin film, $CHCl_3$) 2928, 1686, 1663, 1603, 1453, 1391, 1255, 753, 733 cm^{-1}; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.34-7.31 (m, 2H), 7.26-7.19 (m, 5H), 7.09 (d, *J* = 7.5 Hz, 1H), 7.05 (t, *J* = 7.5 Hz, 1H), 6.30 (d, *J* = 10.0 Hz, 1H), 5.94 (d, *J* = 10.0 Hz, 1H), 5.80 (dd, *J* = 17.5, 10.5 Hz, 1H), 5.33 (d, *J* = 16.0 Hz, 1H), 5.25 (d, *J* = 11.0 Hz, 1H), 5.14 (d, *J* = 17.5 Hz, 1H), 5.00 (d, *J* = 17.0 Hz, 1H), 4.60 (s, 1H), 4.31 (dd, *J* = 12.0, 7.0 Hz, 1H), 3.07 (dd, *J* = 13.0, 5.0 Hz, 1H), 2.96 (td, *J* = 12.5, 5.0 Hz, 1H), 2.24 (dd, *J* = 12.5, 5.0 Hz, 1H), 2.07 (t, *J* = 12.5 Hz, 1H), 1.89 (td, *J* = 12.5, 7.0 Hz, 1H), 1.50 (dd, *J* = 12.0, 5.0 Hz, 1H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 170.0, 160.7, 142.7, 141.3, 139.7, 137.0, 136.0, 128.8, 127.7, 127.4, 127.0, 123.1, 122.1, 121.8, 117.4, 117.3, 66.3, 55.8, 48.3, 48.2, 46.3, 43.6, 36.2, 34.1; HRMS (TOF ES) *m/z* calcd for $C_{26}H_{25}N_2O_2$ $[M+H]^+$ 397.1916, found 397.1909.



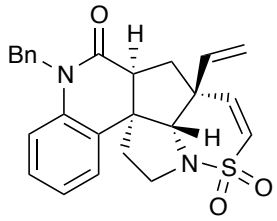
(6b*R*,6b^1*S*,11a*S*,12a*R*)-2-Benzyl-11a-vinyl-6b^1,7,8,11a,12,12a-hexahydro-9-thia-2,8a-diazabenzo[*c*]cyclopenta[*ef*]fluoren-1(2*H*)-one 9,9-dioxide (26b): Ring-closing metathesis of vinylsulfonamide **24b** (8 mg, 0.017 mmol) in the manner of **26a**, followed by flash chromatography purification (silica gel, 2% MeOH/CH_2Cl_2

with 0.5% Et_3N) provided **26b** (6 mg, 74%) as a colorless oil: FTIR (thin film, $CHCl_3$) 3059, 2921, 1683, 1602, 1492, 1455, 1390, 1339, 1158, 758, 734 cm^{-1}; ^1H NMR (400 MHz, $CDCl_3$) δ 7.39 (d, *J* = 7.2 Hz, 1H), 7.35-7.31 (m, 2H), 7.27-7.20 (m, 4H), 7.11 (d, *J* = 7.6 Hz, 1H), 7.03 (d, *J* = 8.0 Hz, 1H), 6.61 (d, *J* = 10.8 Hz, 1H), 6.39 (d, *J* = 10.8 Hz, 1H), 5.85 (dd, *J* = 17.2, 10.4 Hz, 1H), 5.34 (m, 2H), 5.28 (d, *J* = 10.4 Hz, 1H), 5.03 (d, *J* = 16.0 Hz, 1H), 4.76 (s, 1H), 3.65 (td, *J* = 9.6, 4.8 Hz, 1H), 3.35 (q, *J* = 9.6 Hz, 1H), 3.16 (dd, *J* = 13.2, 5.6 Hz, 1H), 2.50 (dd, *J* = 13.2, 6.0 Hz, 1H), 2.23 (ddd, *J* = 13.6, 8.8, 4.8 Hz, 1H), 2.05 (t, *J* = 13.2 Hz, 1H), 1.85 (dt, *J* = 13.2, 8.0 Hz, 1H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 169.8, 143.0, 140.6, 138.7, 136.8, 134.9, 128.8, 127.4, 126.8, 124.0, 123.5, 122.9, 117.0, 116.5; HRMS (TOF ES) *m/z* calcd for $C_{25}H_{25}N_2O_3S$ $[M+H]^+$ 433.1586, found 433.1606.



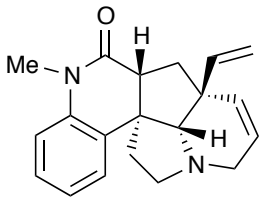
(6b*R*,6b^1*S*,12a*S*,13a*S*)-2-Benzyl-12a-vinyl-6b^1,7,8,12a,13,13a-hexahydro-1*H*-indolizino[1',8':2,3,4]cyclopenta[1,2-*c*]quinoline-1,10(2*H*)-dione (27a): Epimerization of *N*-Bn-10-oxoepimeloscine **26a** (2.5 mg, 0.0063 mmol) by potassium *tert*-butoxide (1.4 mg, 0.013 mmol) in the manner of meloscine **1**[2], followed by flash chromatography purification (silica gel, 7% MeOH/CH_2Cl_2 with 0.5% Et_3N), provided **27a** (1.8 mg, 86%) as a thin film: FTIR (thin film, $CHCl_3$) 2924, 1666, 1601, 1497, 1456, 1384, 1322, 923, 756, 730 cm^{-1}; ^1H NMR (400 MHz, $CDCl_3$) δ 7.35-7.30 (m, 4H), 7.22-7.16 (m, 3H), 7.08 (td, *J* = 7.6, 1.2 Hz, 1H), 6.94 (dd, *J* = 8.0, 0.8 Hz, 1H), 6.35 (d, *J* = 9.6 Hz, 1H), 5.96 (d, *J* = 9.6 Hz, 1H), 5.49 (d, *J* = 17.6 Hz, 1H), 5.46 (dd, *J* = 17.2, 10.4 Hz, 1H), 4.94 (d, *J* = 17.6 Hz, 2H), 4.91 (d, *J* = 10.6 Hz, 1H), 4.48 (s, 1H), 4.06 (dt, *J* = 12.8, 8.4 Hz, 1H), 3.68 (ddd, *J* = 13.6, 10.4, 3.6 Hz,

1H), 3.22 (t, *J* = 10.0 Hz, 1H), 2.55 (dd, *J* = 13.6, 9.6 Hz, 1H), 2.39 (ddd, *J* = 13.2, 8.8, 4.0 Hz, 1H), 2.27 (dd, *J* = 13.6, 10.8 Hz, 1H), 2.07 (ddd, *J* = 13.6, 10.4, 8.0 Hz, 1H); ^{13}C NMR (150 MHz, $CDCl_3$) δ 169.3, 162.0, 143.6, 143.2, 138.2, 136.7, 128.9, 128.7, 127.3, 127.0, 126.3, 124.8, 123.8, 122.4, 116.2, 115.2, 57.3, 49.3, 47.5, 46.1, 45.4, 43.7, 36.3, 29.7; HRMS (TOF ES) *m/z* calcd for $C_{26}H_{25}N_2O_2$ $[M+H]^+$ 397.1916, found 397.1935.

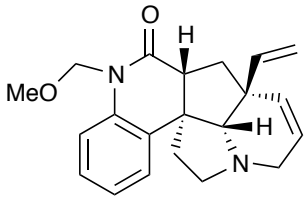


(6b*R*,6b^1*S*,11a*S*,12a*S*)-2-Benzyl-11a-vinyl-6b^1,7,8,11a,12,12a-hexahydro-9-thia-2,8a-diazabenzo[*c*]cyclopenta[*ef*]fluoren-1(2*H*)-one 9,9-dioxide (27b): Epimerization of sulfonamide **26b** (3.5 mg, 0.0081 mmol) by potassium *tert*-butoxide (1.8 mg, 0.016 mmol) in the manner of meloscine **1**[2], followed by flash chromatography purification (silica gel, 3% MeOH/CH_2Cl_2 with 0.5% Et_3N), provided **27b** (3.0 mg, 84%) as a thin film: FTIR (thin film, $CHCl_3$) 2955, 2918, 2851, 1666, 1600, 1498, 1454, 1386, 1337, 1162 cm^{-1}; ^{1}H NMR (600 MHz, $CDCl_3$) δ 7.47 (d, *J* = 7.8 Hz, 1H), 7.33 (t, *J* = 7.8 Hz, 2H), 7.27-7.25 (m, 1H), 7.19-7.16 (m, 3H), 7.13 (t, *J* = 7.8 Hz, 1H), 6.93 (d, *J* = 7.8 Hz, 1H), 6.80 (d, *J* = 10.8 Hz, 1H), 6.35 (d, *J* = 10.8 Hz, 1H), 5.96 (dd, *J* = 17.4, 10.2 Hz, 1H), 5.48 (d, *J* = 16.2 Hz, 1H), 5.10 (d, *J* = 10.2 Hz, 1H), 5.06 (d, *J* = 16.8 Hz, 1H), 4.99 (d, *J* = 17.4 Hz, 1H), 4.76 (s, 1H), 3.82 (dd, *J* = 9.6, 7.2 Hz, 1H), 3.31 (ddd, *J* = 12.0, 10.2, 5.4 Hz, 1H), 2.97 (dd, *J* = 12.6, 6.6 Hz, 1H), 2.32 (t, *J* = 12.6 Hz, 1H), 2.28 (dd, *J* = 12.6, 6.6 Hz, 1H), 2.16 (dd, *J* = 13.2, 5.4 Hz, 1H), 2.06 (td, *J* = 12.6, 7.2 Hz, 1H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 168.4, 144.8, 140.9, 137.0, 136.3, 129.0, 128.9, 128.8, 127.5, 127.4, 126.2, 126.1, 124.4, 116.0, 115.9, 80.2, 58.5, 50.1, 48.5, 47.6, 46.0, 42.3, 37.7; HRMS (TOF

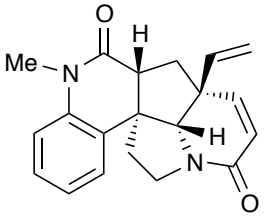
ES) *m/z* calcd for $C_{25}H_{25}N_2O_3S$ $[M+H]^+$ 433.1586, found 433.1599.



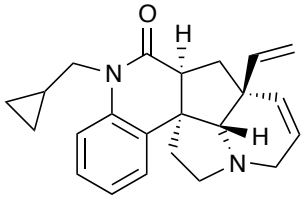
(6b*R*,6b^1*S*,12a*S*,13a*R*)-2-Methyl-12a-vinyl-2,6b^1,7,8,10,12a,13,13a-octahydro-1*H*-indolizino[1',8':2,3,4]cyclopenta[1,2-*c*]quinolin-1-one (28): To a solution of epimeloscine **2a** (10.0 mg, 0.034 mmol) in THF (2.2 mL) was added KHMDS (14.4 mg, 0.068 mmol) at 0 ºC. After 40 min, methyl iodide (7.0 μL, 0.110 mmol) was added and the reaction mixture was stirred at room temperature for 4 h. The reaction was quenched with water and extracted with diethyl ether. The combined organic layers were dried over $MgSO_4$ and concentrated. The residue was purified by flash chromatography (silica gel, 5% MeOH/CH_2Cl_2) to afford **28** (4.60 mg, 44%) as colorless oil: FTIR (thin film, CH_2Cl_2) 2921, 2846, 1679, 1457, 1381, 1325 cm^{-1}; ^1H NMR (500 MHz, $CDCl_3$) δ 7.36 (dd, *J* = 7.2, 1.5 Hz, 1H), 7.25 (td, *J* = 8.0, 1.5 Hz, 1H), 7.07 (td, *J* = 7.5, 1.0 Hz, 1H), 7.03 (dd, *J* = 8.0, 1.0 Hz, 1H), 5.82 (dd, *J* = 10.0, 2.0 Hz, 1H), 5.74-5.69 (m, 2H), 5.00 (dd, *J* = 17.5, 0.5 Hz, 1H), 4.98 (dd, *J* = 11.0, 0.5 Hz, 1H), 3.93 (s, 1H), 3.63 (dt, *J* = 17.5, 2.0 Hz, 1H), 3.37 (s, 3H), 3.27 (dd, *J* = 17.5, 5.0 Hz, 1H), 3.03 (q, *J* = 8.5 Hz, 1H), 2.95-2.91 (m, 2H), 2.20 (dd, *J* = 12.5, 5.0 Hz, 1H), 2.09 (ddd, *J* = 13.5, 8.5, 1.5 Hz, 1H), 1.81 (ddd, *J* = 19.5, 10.5, 19.0 Hz, 1H), 1.74 (t, *J* = 12.5 Hz, 1H); ^{13}C NMR (125 MHz, $CDCl_3$) δ 171.5, 144.8, 140.0, 137.9, 131.3, 127.0, 123.4, 122.3, 121.1, 115.8, 112.3, 72.0, 54.8, 52.0, 48.3, 46.0, 45.0, 35.3, 35.0, 29.5; HRMS (ESI) *m/z* calcd for $C_{20}H_{23}N_2O$ $[M+H]^+$ 307.1805, found 307.1804.



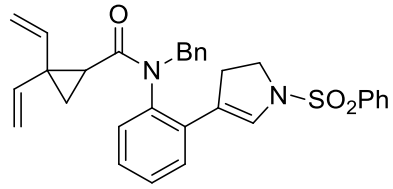
(6b*R*,6b^1*S*,12a*S*,13a*R*)-2-(Methoxymethyl)-12a-vinyl-2,6b^1,7,8,10,12a,13,13a-octahydro-1*H*-indolizino[1',8':2,3,4]cyclopenta[1,2-*c*]quinolin-1-one (29): To a solution of epimeloscine **2a** (16.0 mg, 0.055 mmol) in THF (3.6 mL) was added KHMDS (23.0 mg, 0.109 mmol) at 0 ºC. After 40 min, chloromethyl methyl ether (14.0 μL, 0.17 mmol) was added and the reaction mixture was stirred at room temperature for 2 h. The reaction mixture was stirred at 55 ºC for 1.5 h. The reaction was quenched with water and extracted with diethyl ether. The combined organic layers were dried over $MgSO_4$ and concentrated. The residue was purified by flash chromatography (silica gel, 5% MeOH/ CH_2Cl_2) to afford **29** (9.90 mg, 54%) as a colorless oil: FTIR (thin film, CH_2Cl_2) 2926, 2848, 1691, 1455, 1381, 1088 cm^{-1}; ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.42 (d, *J* = 7.0 Hz, 1H), 7.34 (dd, *J* = 8.0, 1.0 Hz, 1H), 7.24 (td, *J* = 7.5, 1.5 Hz, 1H), 7.11 (td, *J* = 7.5, 1.0 Hz, 1H), 5.84 (dd, *J* = 10.0, 2.0 Hz, 1H), 5.75-5.69 (m, 3H), 5.02 (d, *J* = 13.0 Hz, 1H), 4.99 (d, *J* = 6.0 Hz, 1H), 4.94 (d, *J* = 10.5 Hz, 1H), 3.98 (s, 1H), 3.67 (d, *J* = 17.5 Hz, 1H), 3.41 (s, 3H), 3.29 (dd, *J* = 17.5, 5.0 Hz, 1H), 3.08-2.97 (m, 3H), 2.06 (dd, *J* = 12.5, 5.0 Hz, 1H), 2.07 (ddd, *J* = 12.5, 8.0, 1.0 Hz, 1H), 1.90-1.84 (m, 1H), 1.76 (t, *J* = 13.0 Hz, 1H); ^{13}C NMR (125 MHz, $CDCl_3$) δ 172.3, 144.4, 138.9 137.5, 131.2, 127.3, 124.2, 122.5, 120.7, 116.9, 112.6, 73.9, 71.9, 56.2, 55.0, 52.0, 48.4, 45.9, 45.1, 35.3, 34.9; HRMS (ESI) *m/z* calcd for $C_{21}H_{25}N_2O_2$ $[M+H]^+$ 337.1911, found 337.1908.



(6b*R*,6b^1*S*,12a*S*,13a*R*)-2-Methyl-12a-vinyl-6b^1,7,8,12a,13,13a-hexahydro-1*H*-indolizino[1',8':2,3,4]cyclopenta[1,2-*c*]quinoline-1,10(2*H*)-dione (30): To a solution of amide **25** (24.0 mg, 0.0783 mmol) in THF (5.0 mL) was added KHMDS (49.5 mg, 0.236 mmol) at 0 ºC. After 40 min, methyl iodide (26.0 μL, 0.40 mmol) was added and the reaction mixture was stirred at room temperature for 3.5 h. The reaction was quenched with water and extracted with diethyl ether. The combined organic layers dried over $MgSO_4$ and concentrated. The residue was purified by flash chromatography (silica gel, 2% MeOH/ CH_2Cl_2 with 0.5% Et_3N) to provide **30** (15.3 mg, 61%) as a brown solid: mp 165-166 ºC (decomposed); FTIR (thin film, CH_2Cl_2) 2930, 1659, 1597, 1457, 1366 cm^{-1}; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.35 (m, 2H), 7.12 (td, *J* = 7.6, 1.2 Hz, 1H), 7.04 (dd, *J* = 8.0, 0.8 Hz 1H), 6.31 (d, *J* = 9.6 Hz, 1H), 5.92 (d, *J* = 10.0 Hz, 1H), 5.43 (dd, *J* = 17.6, 10.8 Hz, 1H), 4.90 (d, *J* = 17.6 Hz, 1H), 4.89 (d, *J* = 10.4 Hz, 1H), 4.43 (s, 1H), 4.01 (ddd, *J* = 12.8, 8.8, 8.0 Hz, 1H), 3.64 (ddd, *J* = 12.8, 10.4, 4.0 Hz, 1H), 3.40 (s, 3H), 3.10 (t, *J* = 9.6 Hz, 1H), 2.44 (dd, *J* = 13.6, 9.6 Hz, 1H), 2.32 (ddd, *J* = 13.6, 8.8, 3.6 Hz, 1H), 2.16 (dd, *J* = 14.0, 10.4 Hz, 1H), 2.03 (ddd, *J* = 13.6, 10.0, 7.6 Hz, 1H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 168.9, 161.9, 143.7, 143.0, 138.9, 128.7, 126.9, 124.7, 123.6, 122.3, 115.2, 115.1, 77.2, 56.9, 49.2, 47.4, 44.9, 43.6, 36.5, 29.6; HRMS (ESI) *m/z* calcd for $C_{20}H_{21}N_2O_2$ $[M+H]^+$ 321.1598, found 312.1596.

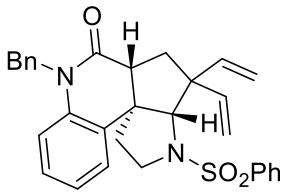


(6b*R*,6b^1*S*,12a*S*,13a*S*)-2-(Cyclopropylmethyl)-12a-vinyl-2,6b^1,7,8,10,12a,13,13a-octahydro-1*H*-indolizino[1',8':2,3,4]cyclopenta[1,2-*c*]quinolin-1-one (31): To a solution of meloscine, **1a** (14.0 mg, 0.048 mmol) in THF (3.0 mL) was added KHMDS (30.2 mg, 0.14 mmol) at 0 ºC. After 40 min, (bromomethyl)cyclopropane (15.0 μL, 0.15 mmol) was added and the reaction mixture was stirred at room temperature for 15 h. The reaction mixture was stirred at 45 ºC for 48 h. The reaction was quenched with water and extracted with diethyl ether. The combined organic layers dried over $MgSO_4$ and concentrated. The residue was purified by flash chromatography (silica gel, 4% MeOH/CH_2Cl_2 with 0.5% Et_3N) to provide **31** (12.7 mg, 77%) as a colorless oil: FTIR (thin film, CH_2Cl_2) 2923, 1663, 1597, 1451, 1379 cm^{-1}; ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.47 (d, *J* = 6.5 Hz, 1H), 7.25 (td, *J* = 7.5, 1.5 Hz, 1H), 7.13 (dd, *J* = 8.5, 1.0 Hz, 1H), 7.10 (td, *J* = 8.0, 1.0 Hz, 1H), 6.08 (ddd, *J* = 10.0, 5.5, 2.5 Hz, 1H), 5.76 (dd, *J* = 10.0, 2.5 Hz, 1H), 5.54 (dd, *J* = 17.0, 10.5 Hz, 1H), 4.90 (dd, *J* = 17.5, 1.0 Hz, 1H), 4.78 (dd, *J* = 10.5, 1.0 Hz, 1H), 4.03 (dd, *J* = 14.5, 6.5 Hz, 1H), 3.84 (dd, *J* = 14.5, 6.5 Hz, 1H), 3.74 (s, 1H), 3.27 (dd, *J* = 16.0, 5.5 Hz, 1H), 3.20-3.15 (m, 2H), 2.97 (dd, *J* = 11.0, 7.0 Hz, 1H), 2.91 (td, *J* = 9.0, 3.0 Hz, 1H), 2.19 (dd, *J* = 12.5, 7.5 Hz, 1H), 2.06 (ddd, *J* = 12.5, 6.0, 3.0 Hz, 1H), 2.04-2.00 (m, 1H), 1.90 (dt, *J* = 12.5, 8.0 Hz, 1H), 1.23-1.12 (m, 1H), 0.52-0.42 (m, 4H); ^{13}C NMR (125 MHz, $CDCl_3$) δ 171.2, 143.6, 137.5, 132.9, 129.1, 128.2, 127.6, 127.5, 123.3, 114.9, 112.1, 81.9, 56.5, 52.8, 50.4, 47.4, 45.9, 45.3, 43.7, 40.5, 9.6, 4.0, 3.7; HRMS (ESI) *m/z* calcd for $C_{23}H_{27}N_2O$ $[M+H]^+$ 347.2118, found 347.2109.



***N*–Benzyl–*N*–(2–(1–(phenylsulfonyl)–4,5–dihydro–1*H*–pyrrol–3–yl)phenyl)–2,2–divinylcyclopropanecarboxamide (C):** Ghosez reagent (41 μL, 0.31 mmol) was added to a stirring solution of 2,2-divinylcyclopropanecarboxylic acid[2] **9a** in CH_2Cl_2 (2 mL) at 0 °C. This mixture was stirred for 1 h and then cannulated to a stirred solution of *N*-benzyl-2-(1-(phenylsulfonyl)-4,5-dihydro-1*H*-pyrrol-3-yl)aniline[3] (80 mg, 0.20 mmol) and pyridine (25 μL, 0.31 mmol) in CH_2Cl_2 (2 mL). This solution was stirred for 2 hours at room temperature. Aqueous $KHCO_3$ was added and the aqueous layer was extracted with EtOAc. The combined organic layer was washed with brine, dried over $MgSO_4$, filtered and concentrated. The residue was purified by flash chromatography (20% EtOAc/hexanes) to give **C** (95 mg, 91%) as a colorless oil. ^{1}H NMR (500 MHz, $CDCl_3$) 4:1 mixture of rotamers: δ major rotamer: 7.87 (d, *J* = 7.5 Hz, 2H), 7.01 (td, *J* = 7.5 Hz, 2.0 Hz, 1H), 6.80 (s, 1H), 6.52 (d, *J* = 7.0 Hz, 1H), 6.86 (dd, *J* = 17.5 Hz, 11.0 Hz, 1H), 5.62 (dd, *J* = 17.5 Hz, 11.0 Hz, 1H), 5.46 (d, *J* = 14.0 Hz, 1H), 5.13 (dd, *J* = 11.0 Hz, 1.0 Hz, 1H), 5.08 (dd, *J* = 17.0 Hz, 1.0 Hz, 1H), 4.74 (dd, *J* = 9.0 Hz, 1.0 Hz, 1H), 4.40 (dd, *J* = 17.0 Hz, 1.0 Hz, 1H), 1.79 (dd, 7.0 Hz, 5.0 Hz, 1H), 1.51 (dd, *J* = 7.5 Hz, 5.5 Hz, 1H), 1.06 (dd, *J* = 8.0 Hz, 5.0 Hz, 1H); minor rotamer: 7.13 (dd, *J* = 7.5 Hz, 2.0 Hz, 1H), 6.71 (s, 1H), 6.66 (d, *J* = 8.0 Hz, 1H), 6.01 (dd, *J* = 17.5 Hz, 10.5 Hz, 1H), 5.72 (dd, *J* = 17.0 Hz, 10.0 Hz, 1H), 5.54 (d, *J* = 14.0 Hz, 1H), 5.07 (dd, *J* = 10.5 Hz, 1.0 Hz, 1H), 5.02 (dd, *J* = 17.5 Hz, 1.0 Hz, 1H), 4.79 (dd, *J* = 10.5 Hz, 1.0 Hz, 1H), 4.43 (dd, *J* 17.0 Hz, 1.0 Hz, 1H), 1.68 (dd, *J* = 7.0 Hz, 4.5 Hz, 1H), 1.12 (dd, *J* = 8.0 Hz, 4.5 Hz, 1H); overlapping peaks: 7.62–7.54 (m, 4H), 7.27–7.22 (m, 2H), 7.21–7.19 (m, 4H), 7.08–7.07 (m, 2H),

3.70–3.51 (m, 4H), 3.00–2.90 (m, 1H), 2.82–2.75 (m, 1H); ^{13}C NMR (125 MHz, $CDCl_3$) 4:1 mixture of rotamers: δ 169.6, 169.1, 138.6, 138.3, 137.8, 137.7, 137.1, 136.9, 136.8, 136.2, 135.5, 133.1, 132.7, 131.9, 131.6, 131.2, 129.2, 129.1, 129.0, 129.0, 128.8, 128.4, 128.3, 128.2, 128.1, 128.0, 127.6, 127.5, 127.4, 127.3, 127.2, 126.8, 126.7, 120.9, 120.5, 115.7, 114.4, 114.3, 51.2, 50.8, 47.2, 35.3, 33.9, 31.9, 31.8, 29.7, 27.6, 20.5, 18.9; MS (LC-MS) *m/z* calcd for $C_{31}H_{31}N_2O_3S$ $[M+H]^+$ 511, found 511.



7–Benzyl–3–(phenylsulfonyl)–4,4–divinyl–2,3,3a,4,5,5a–hexahydro–1*H*–pyrrolo[3',2':2,3]cyclopenta[1,2–c]quinolin–6(7*H*)–one (D): A solution of Bu_3SnH (53 μL, 0.20 mmol), AIBN (16 mg, 0.10 mmol) in benzene (1.0 mL, degassed by Ar sparge) was added by syringe pump over 90 min to anilide **C** (50 mg, 0.10 mmol) in refluxing benzene (9 mL, degassed by Ar sparge). The solution was concentrated and the crude residue was purified by flash chromatography (20% EtOAc/hexanes) to give **D** (29 mg, 58%) as a colorless oil. FTIR (thin film, CH_2Cl_2) 2923, 1684, 1602, 1454, 1351, 1165, 1097 cm^{-1}; ^{1}H NMR (500 MHz, $CDCl_3$) δ 8.03 (d, *J* = 7.5 Hz, 2H), 7.78 (t, *J* = 7.5 Hz, 1H), 7.68 (t, *J* = Hz, 2H), 7.33–7.31 (m, 3H), 7.27 (d, *J* = 7.5 Hz, 1H), 7.24 (d, *J* = 7.0 Hz, 2H), 7.07 (t, *J* = 8.0 Hz, 1H), 6.97 (d, *J* = 8.0 Hz, 1H), 6.51 (t, *J* = 7.5 Hz, 1H), 6.42 (dd, *J* = 17.0 Hz, 11.5 Hz, 1H), 6.10 (dd, *J* = 17.0 Hz, 11.5 Hz, 1H), 5.75 (d, *J* = 7.5 Hz, 1H), 5.29 (d, *J* = 16.0 Hz, 1H), 5.24–5.16 (m, 4H), 5.03 (d, *J* = 16.0 Hz, 1H), 4.32 (s, 1H), 3.54 (t, *J* = 8.5 Hz, 1H), 3.14 (ddd, *J* = 15.5 Hz, 9.5 Hz, 6.5 Hz, 1H), 2.97 (dd, *J* = 13.0 Hz, 6.5 Hz, 1H), 2.44 (t, *J* = 15.0 Hz, 1H), 2.33 (dd, *J* = 13.5 Hz, 6.0 Hz, 1H), 2.23 (td, *J* = 12.0 Hz, 7.5 Hz, 1H), 1.46 (dd, *J* = 12.5 Hz, 6.0

Hz, 1H); ^{13}C NMR (125 MHz, $CDCl_3$) δ 170.5, 143.5, 141.5, 138.8, 138.0, 136.8, 134.3, 133.0, 129.4, 128.7, 127.9 127.6, 127.3, 126.9, 122.9, 122.6, 116.7, 113.2, 112.4, 72.9, 55.1, 54.2, 47.5, 46.0, 45.6, 31.6, 30.4; HRMS (ESI) *m/z* calcd for $C_{31}H_{31}N_2O_3S$ $[M+H]^+$ 511.2055, found 511.2063.

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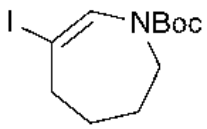
1. Kiewel, K.; Luo, Z. S.; Sulikowski, G. A. *Org. Lett.* **2005**, *7*, 5163-5165.
2. Zhang, H.; Curran, D.P. *J. Am. Chem. Soc*. **2011**, *133*, 10376-10378.
3. Zhang, H.; Hay, E. B.; Geib, S. J.; Curran, D. P., *J. Am. Chem. Soc*. **2013**, ASAP, **DOI:** 10.1021/ja408387d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NBoc

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1.485
0.509
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9.23
0.357
1.96
3.92
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8
7
6
5
4
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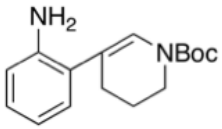
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NBoc

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2.333
2.320
1.975
1.490
0.778
1.42
2
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8
7
6
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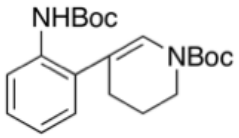
0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NBoc

14b

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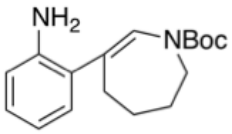
NH2
NBoc

14c

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2.493
2.484
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1.490
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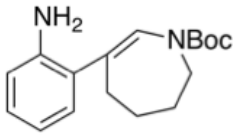
NH2
NBoc

14c

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28.404
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ppm
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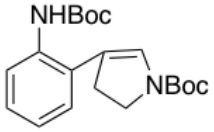
NHBoc
NBoc

15a

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6.525
6.516
6.491
3.904
3.885
3.868
2.996
2.979
2.963
1.536
1.518
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0.87
0.826
1.95
7.99
0.98
1.09
0.797
2.1
6.19
9
8
7
6
5
4
3
2
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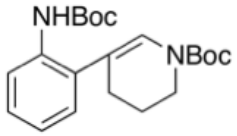
NHBoc
NBoc

15b

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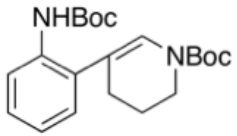
NHBoc
NBoc

15b

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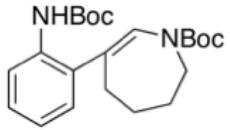
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NBoc

15c

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6.503
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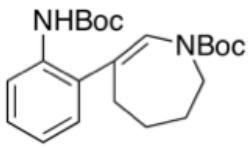
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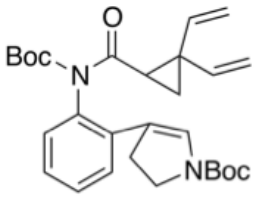
Boc
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16a

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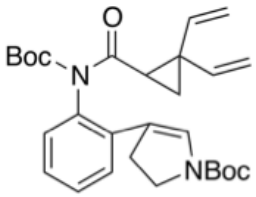
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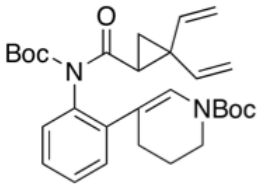
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16b

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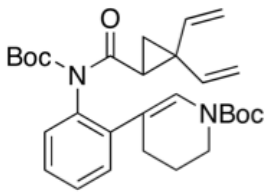
O
Boc
N
NBoc

16b

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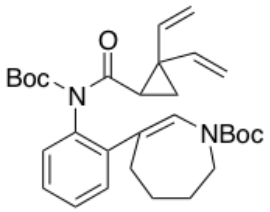
Boc
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NBoc

16c

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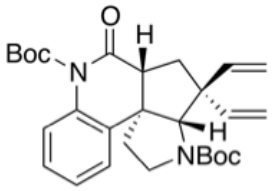
O
H
Boc
N
H
NBoc

17a

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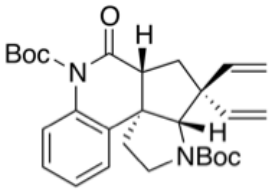

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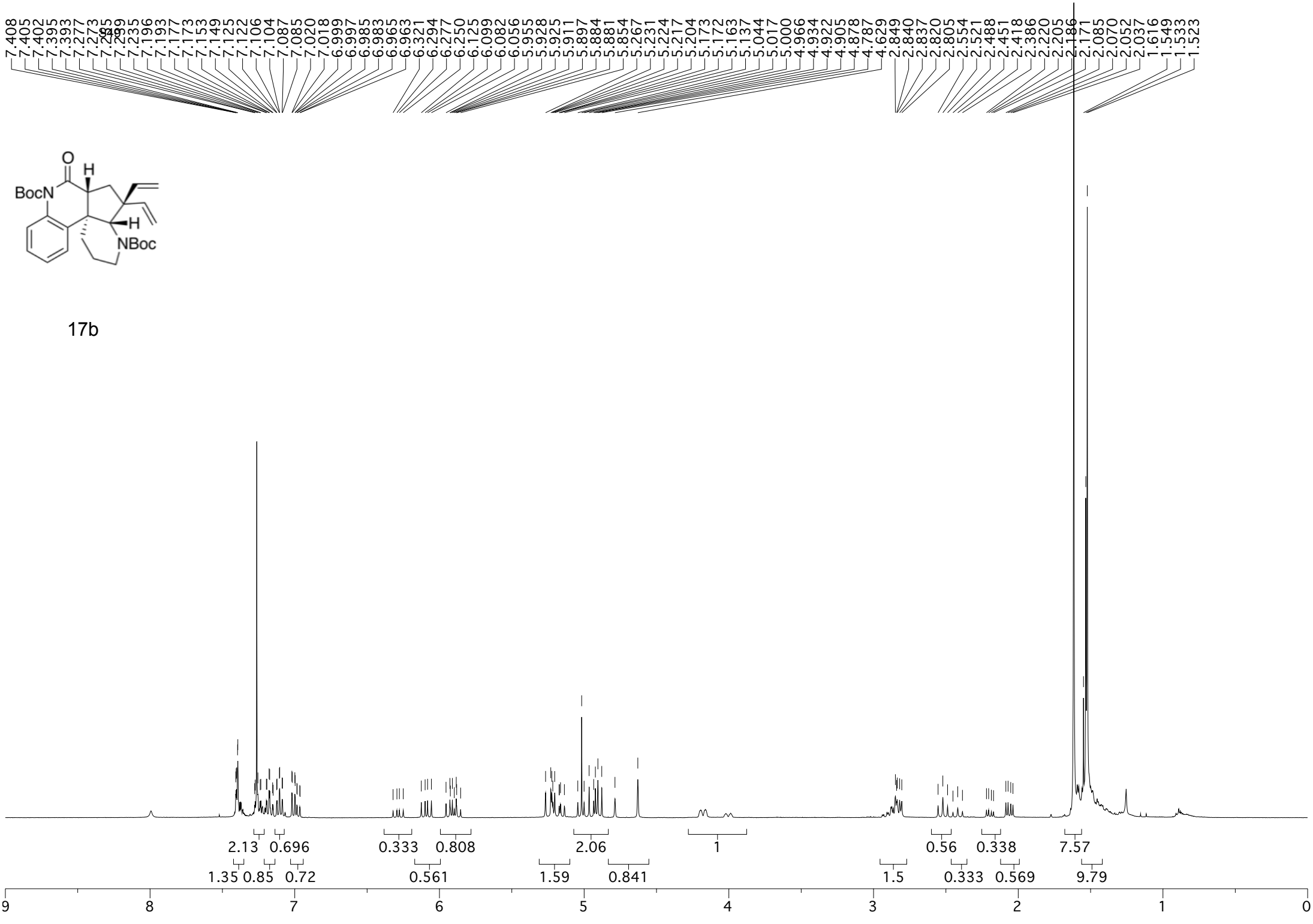
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H
BocN
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NBoc
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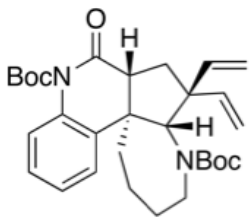
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BocN
H
NBoc

17c

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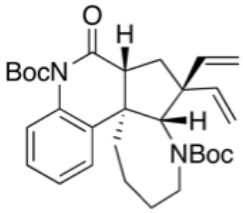

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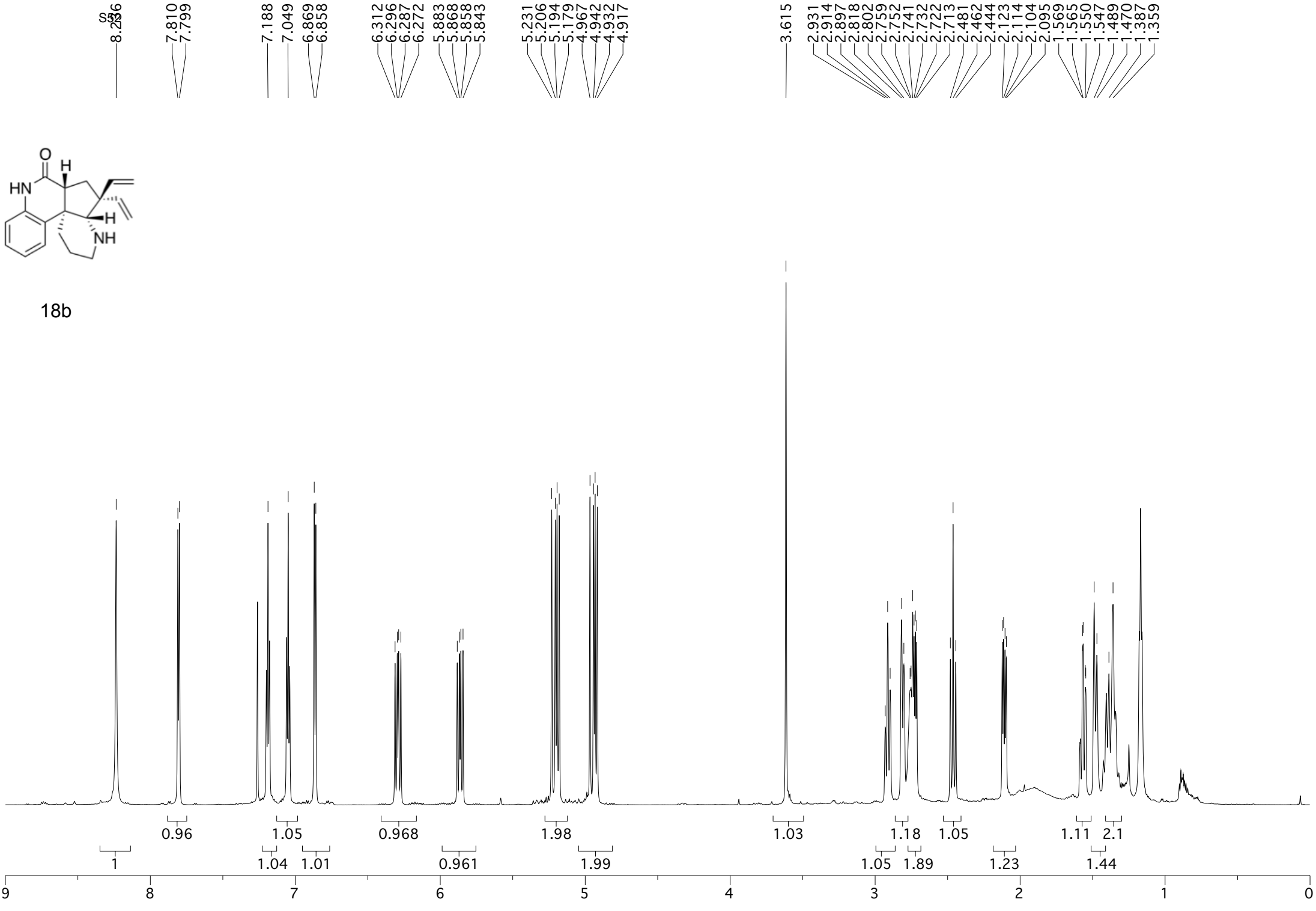
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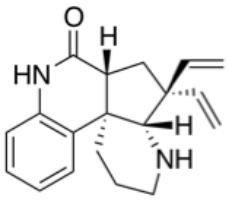
O
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18b

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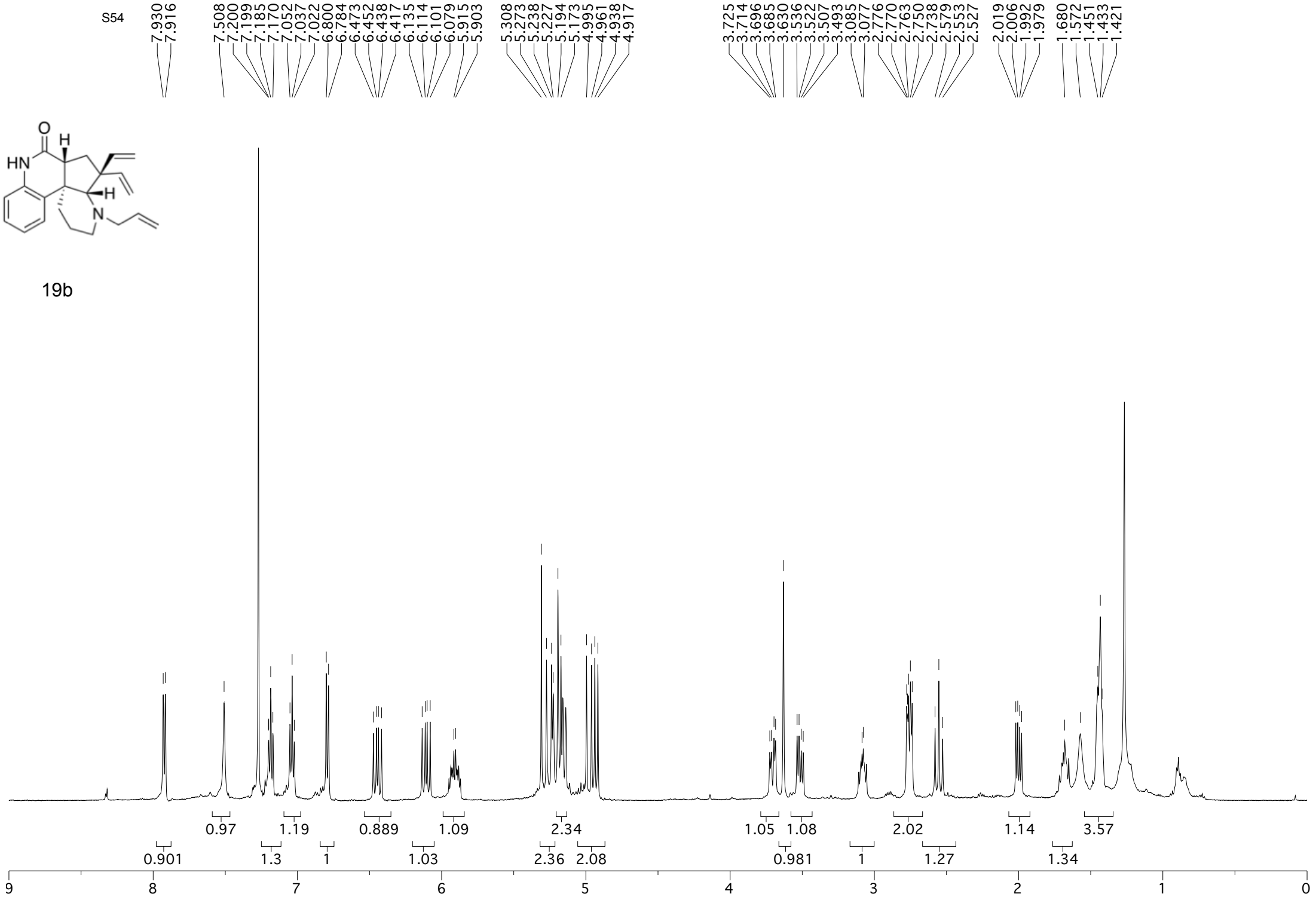
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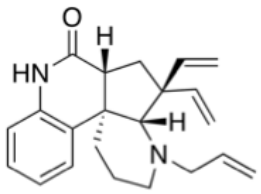
O
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19b

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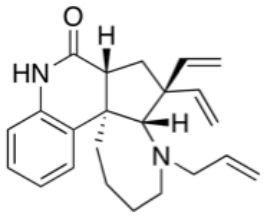
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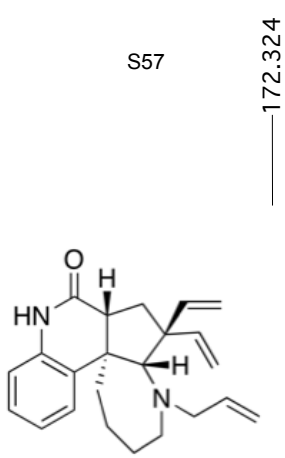
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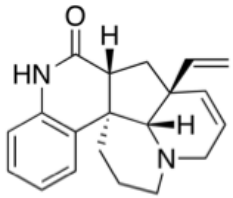
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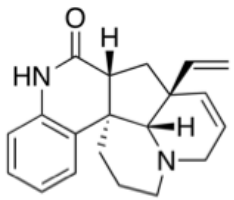
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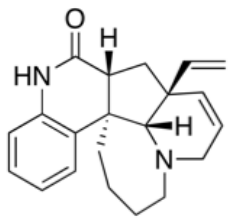
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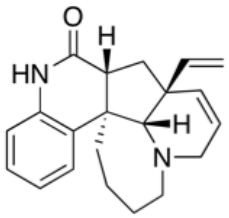
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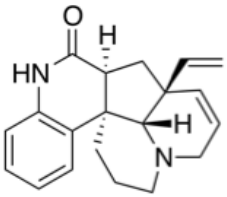
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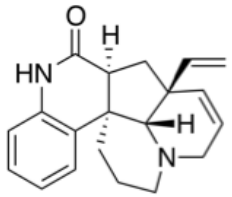
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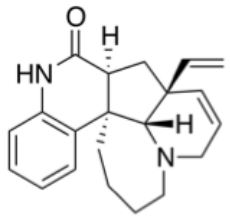
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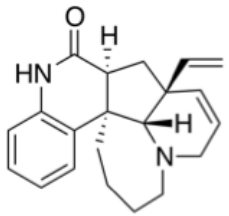
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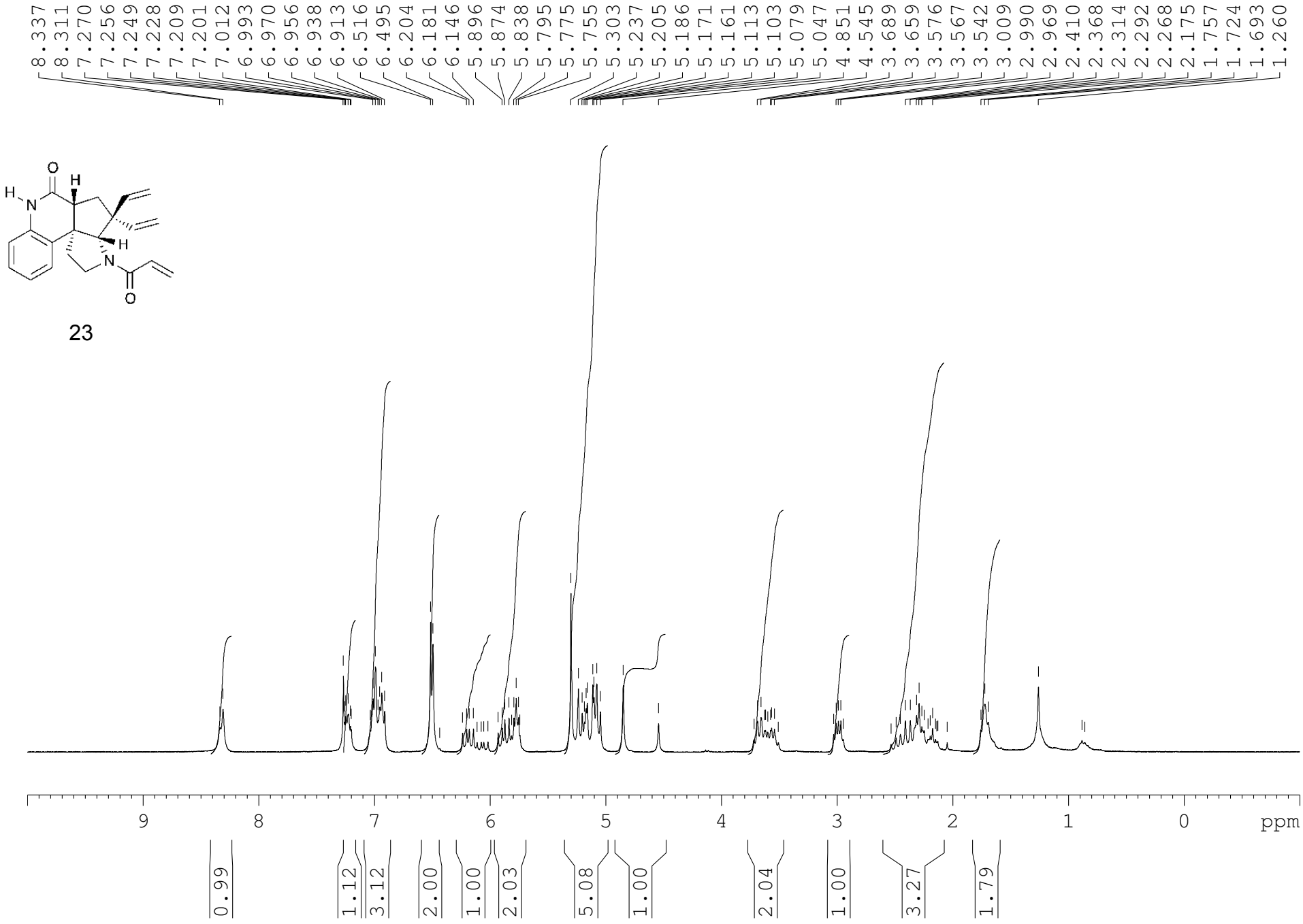
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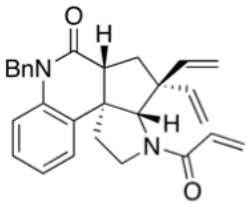
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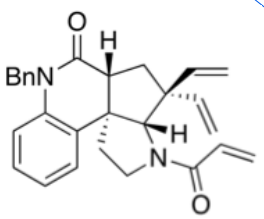
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24a

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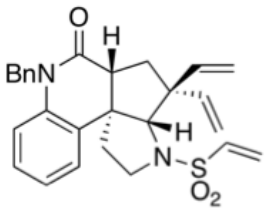
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24b

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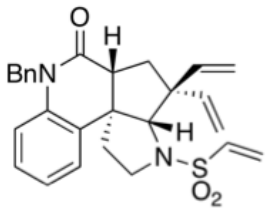
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24b

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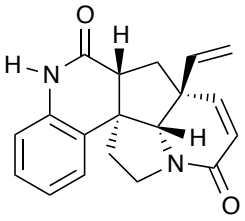

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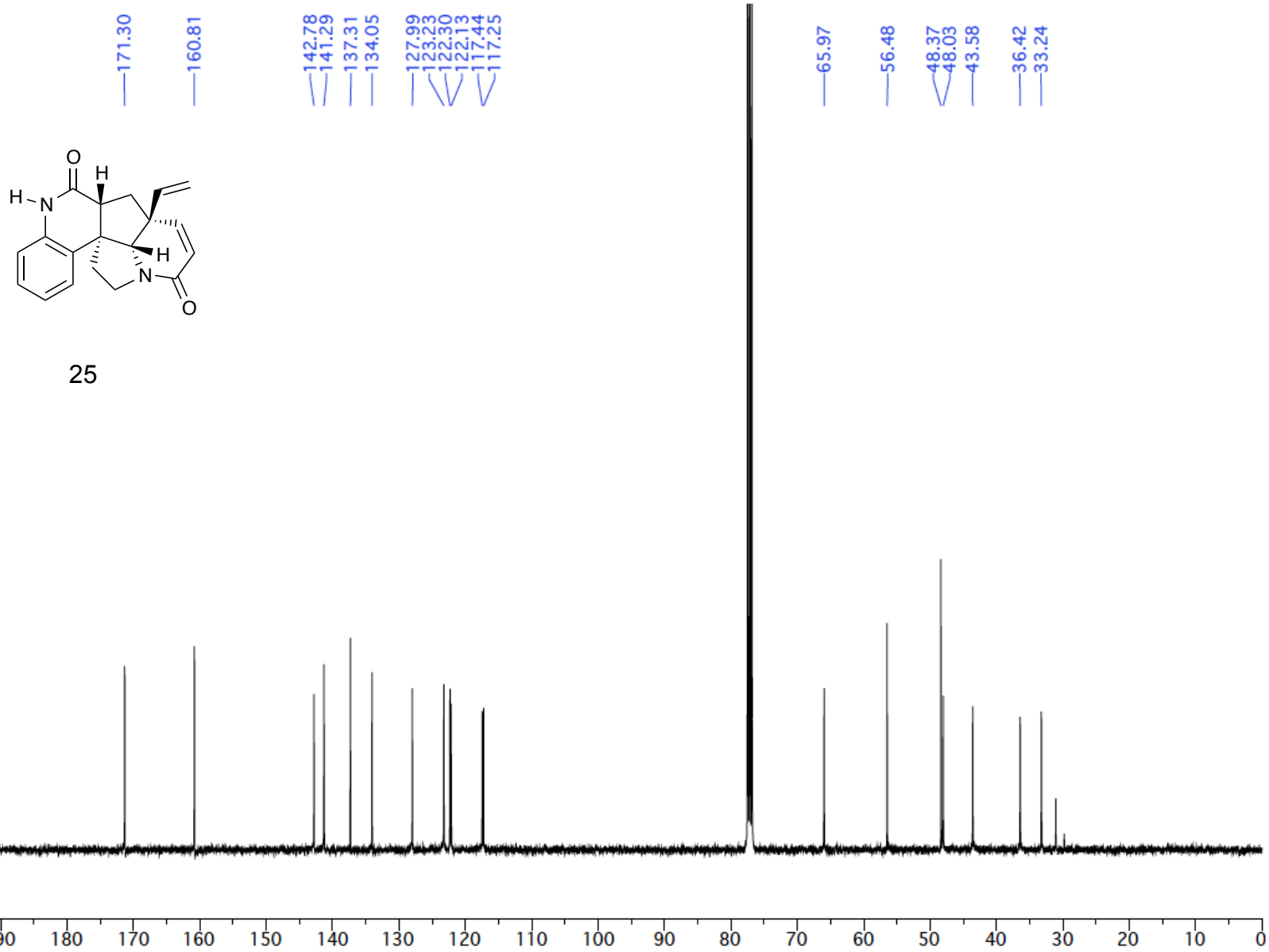
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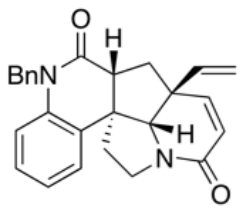
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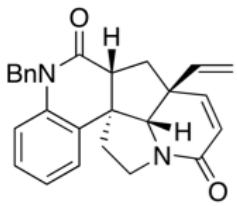
0.868
1
0.94
0.887
0.917
1.09
1.19
9
8
7
6
5
4
3
2
1
0



26a

169.991
160.681
142.744
141.352
139.699
136.995
136.003
128.751
127.680
127.384
127.031
123.058
122.147
121.761
117.441
117.295
66.252
55.842
48.251
46.314
43.591
36.155
34.053

ppm
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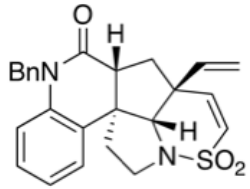
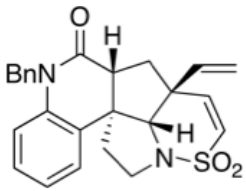
100
50
0


O
H
BnN
H
N
SO2

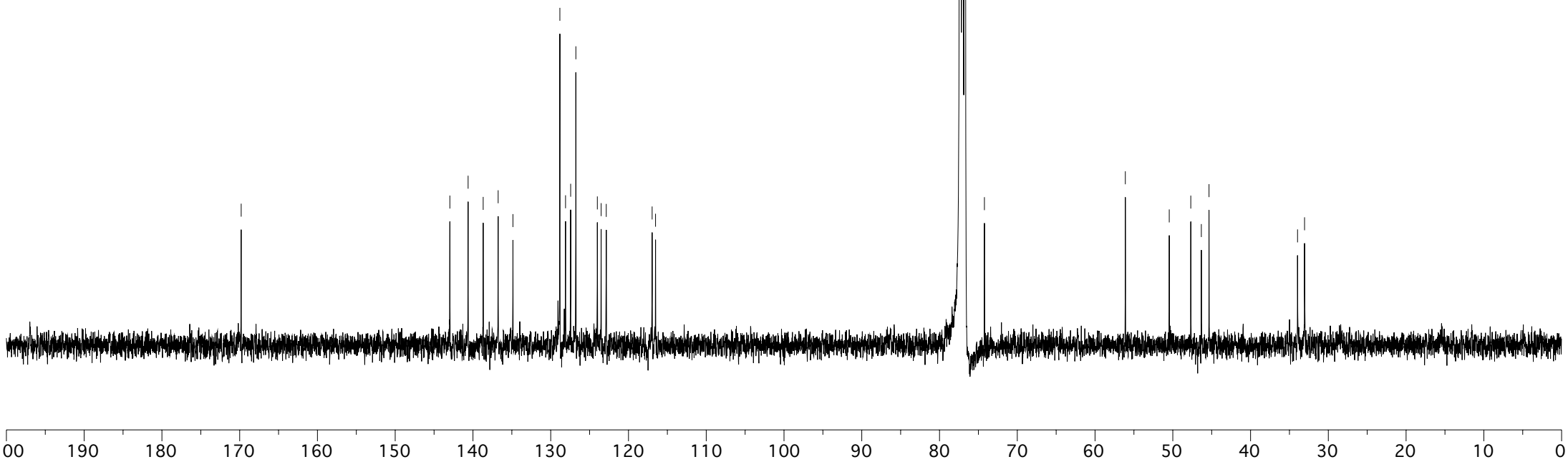
26b

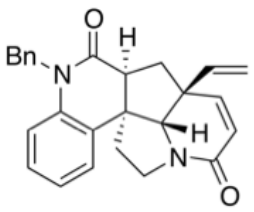
7.401
7.400
7.383
7.333
7.314
7.285
7.267
7.251
7.233
7.216
7.125
7.106
7.044
7.024
6.623
6.596
6.405
6.378
5.881
5.855
5.838
5.812
5.366
5.323
5.298
5.272
5.050
4.755
3.641
3.356
3.336
3.183
3.169
3.151
3.137
2.521
2.506
2.488
2.473
2.225
2.082
2.050
2.017
1.862
1.829
0.9
0.862
0.863
0.977
0.896
0.977
0.967
1
9.28
0.904
0.869
2.72
0.901
0.889
0.897
1.07
9
8
7
6
5
4
3
2
1
0

169.806
142.970
140.623
138.685
136.760
134.860
128.823
128.095
127.437
126.766
124.005
123.514
122.858
116.958
116.521
74.226
56.105
50.457
47.688
46.330
45.343
33.958
33.057



26b




O
H
Bn
N
H
N
O

27a

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7.322
7.316
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7.200
7.101
7.099
7.082
7.080
6.955
6.953
6.935
6.360
6.336
5.974
5.950
5.510
5.491
5.465
5.448
5.421
4.968
4.924
4.898
4.477
4.071
4.060
4.051
4.040
4.019
3.685
3.676
3.670
3.243
3.218
3.194
2.583
2.560
2.549
2.525
2.393
2.301
2.274
2.267
2.240
2.056
2.048
2.028
2.96
0.862
0.916
2.76
0.92
0.932
0.917
1.18
9.33
1
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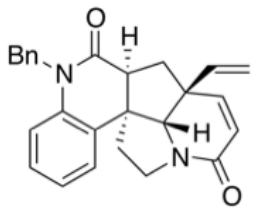
0.985
0.812
1.17
9
8
7
6
5
4
3
2
1
0


O
H
Bn
N
H
N
O

27a

169.274
161.966
143.587
143.168
138.214
136.681
128.889
128.670
127.303
126.991
126.288
124.756
123.750
122.357
116.158
115.241
57.247
49.278
47.464
46.125
45.366
43.676
36.331
29.708
00
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180
170
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150
140
130
120
110
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80
70
60
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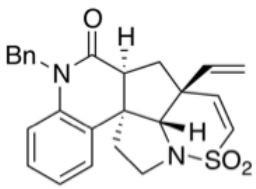
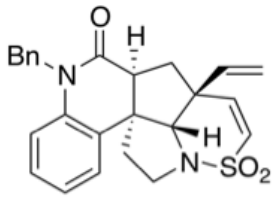
40
30
20
10
0


O
H
Bn
N
H
N
SO2

27b

7.487
7.476
7.474
7.356
7.344
7.331
7.275
7.205
7.192
7.178
7.176
7.153
7.141
6.946
6.932
6.824
6.806
6.375
6.357
5.996
5.978
5.967
5.949
5.504
5.477
5.320
5.116
5.098
5.081
5.052
5.019
4.990
4.769
3.844
3.831
3.828
3.815
3.337
3.329
3.326
3.320
3.317
3.310
2.999
2.988
2.978
2.967
2.330
2.309
2.303
2.292
2.169
2.160
2.078
2.065
2.05
1.02
1
0.944
1.96
1
1.06
1.74
1.25
0.894
4.36
1.04
0.908
0.683
0.962
0.945
0.907
1.11
9
8
7
6
5
4
3
2
1
0



27b

168.354
144.835
140.897
137.024
136.277
129.013
128.944
128.758
127.544
127.381
126.146
126.113
124.436
116.022
115.932
80.223
58.489
50.059
48.545
47.552
45.982
42.281
37.656

ppm
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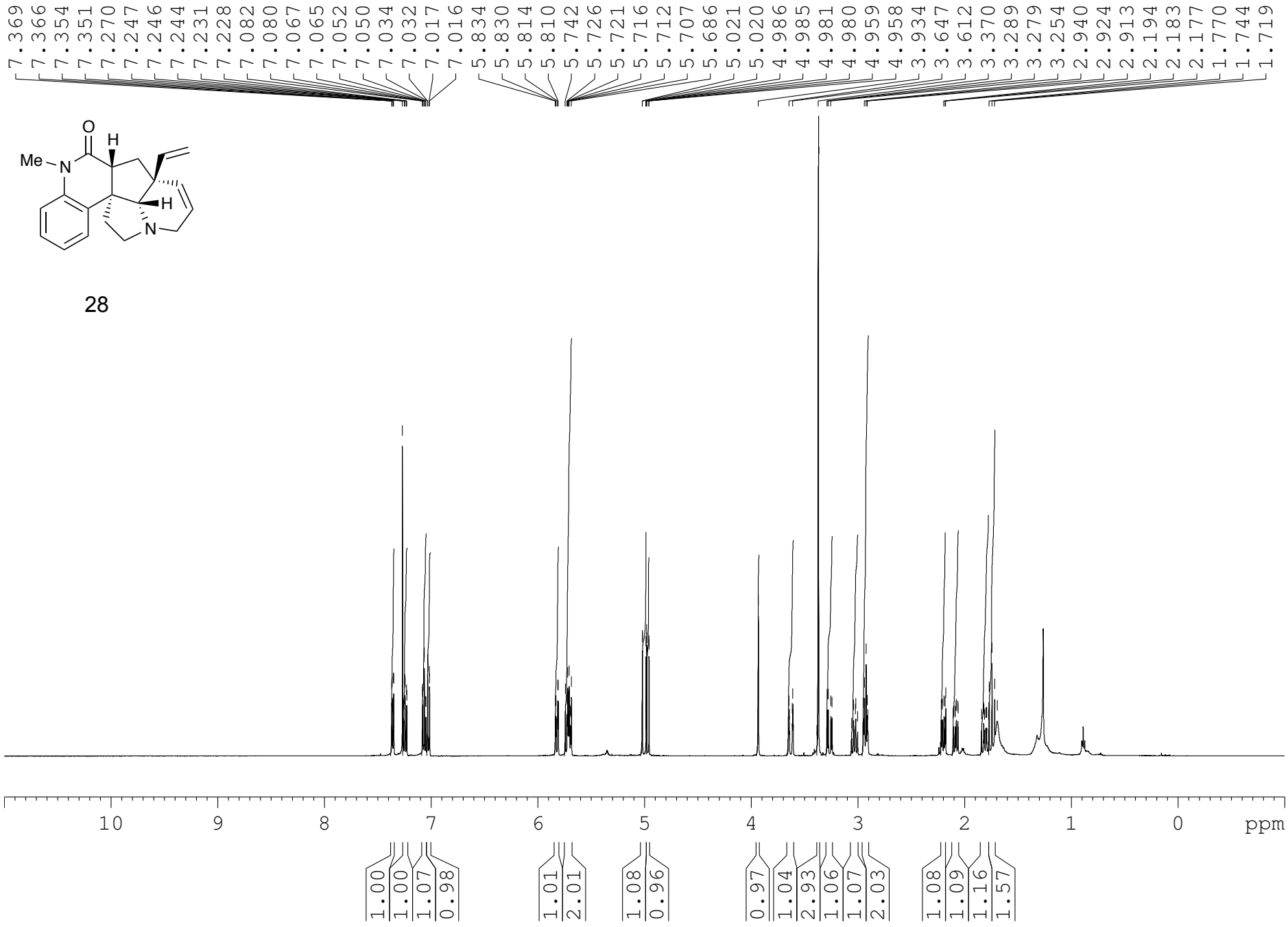
100
50
0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7.270
7.247
7.246
7.244
7.231
7.228
7.082
7.080
7.067
7.065
7.052
7.050
7.034
7.032
7.017
7.016
5.834
5.830
5.814
5.810
5.742
5.726
5.721
5.716
5.712
5.707
5.686
5.021
5.020
4.986
4.985
4.981
4.980
4.959
4.958
3.934
3.647
3.612
3.370
3.289
3.279
3.254
2.940
2.924
2.913
2.194
2.183
2.177
1.770
1.744
1.719
O
H
Me
N
H
N
28
10
9
8
7
6
5
4
3
2
1
0
ppm
1.00
1.00
1.07
0.98
1.01
2.01
1.08
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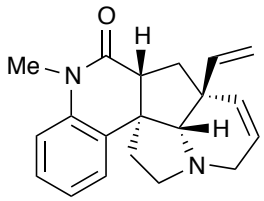
0.97
1.04
2.93
1.06
1.07
2.03
1.08
1.09
1.16
1.57


O
H
Me
N
H
N

28

171.51
144.83
140.02
137.94
131.29
126.97
123.38
122.35
121.08
115.78
112.28
72.00
54.78
51.99
48.29
45.99
45.02
35.34
35.02
29.71
00
190
180
170
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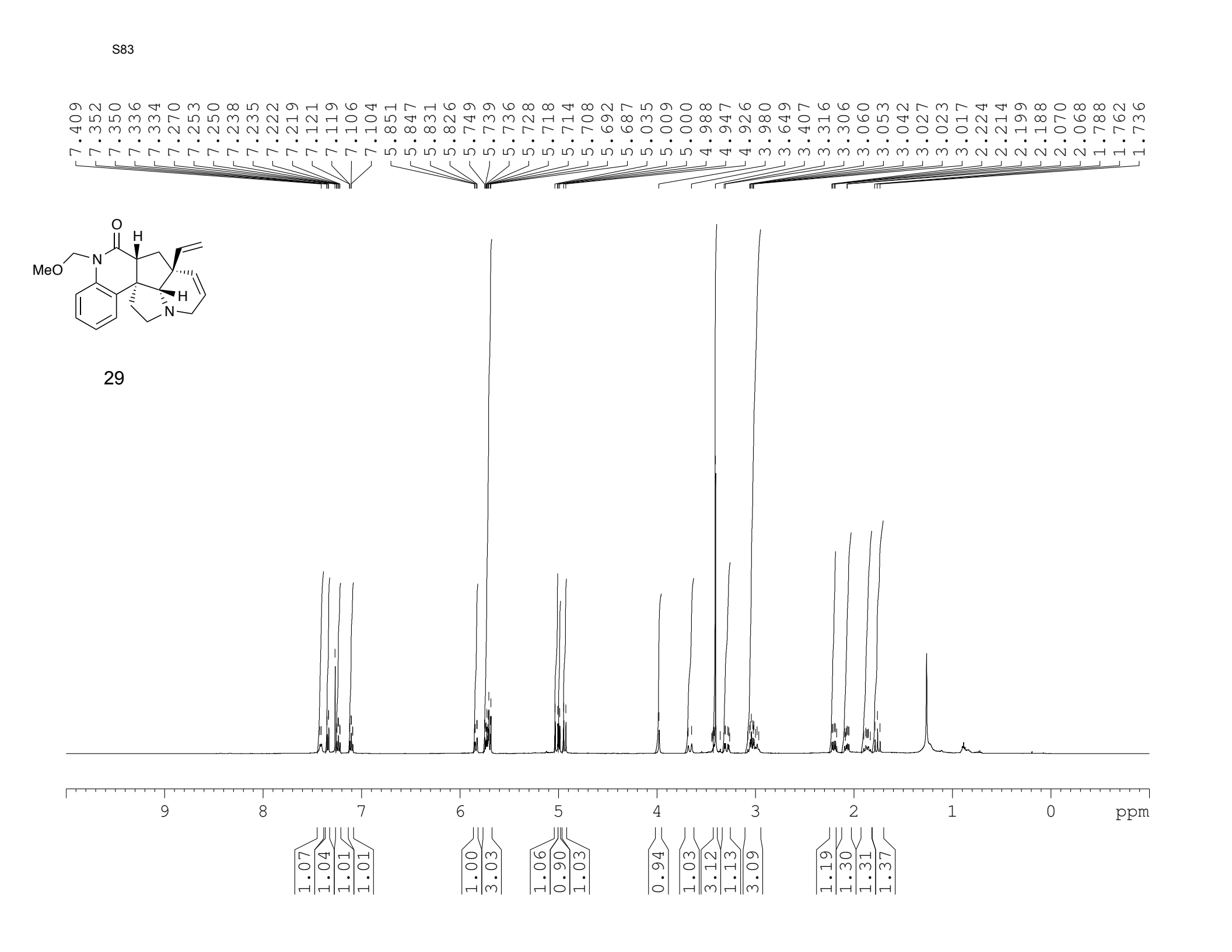
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0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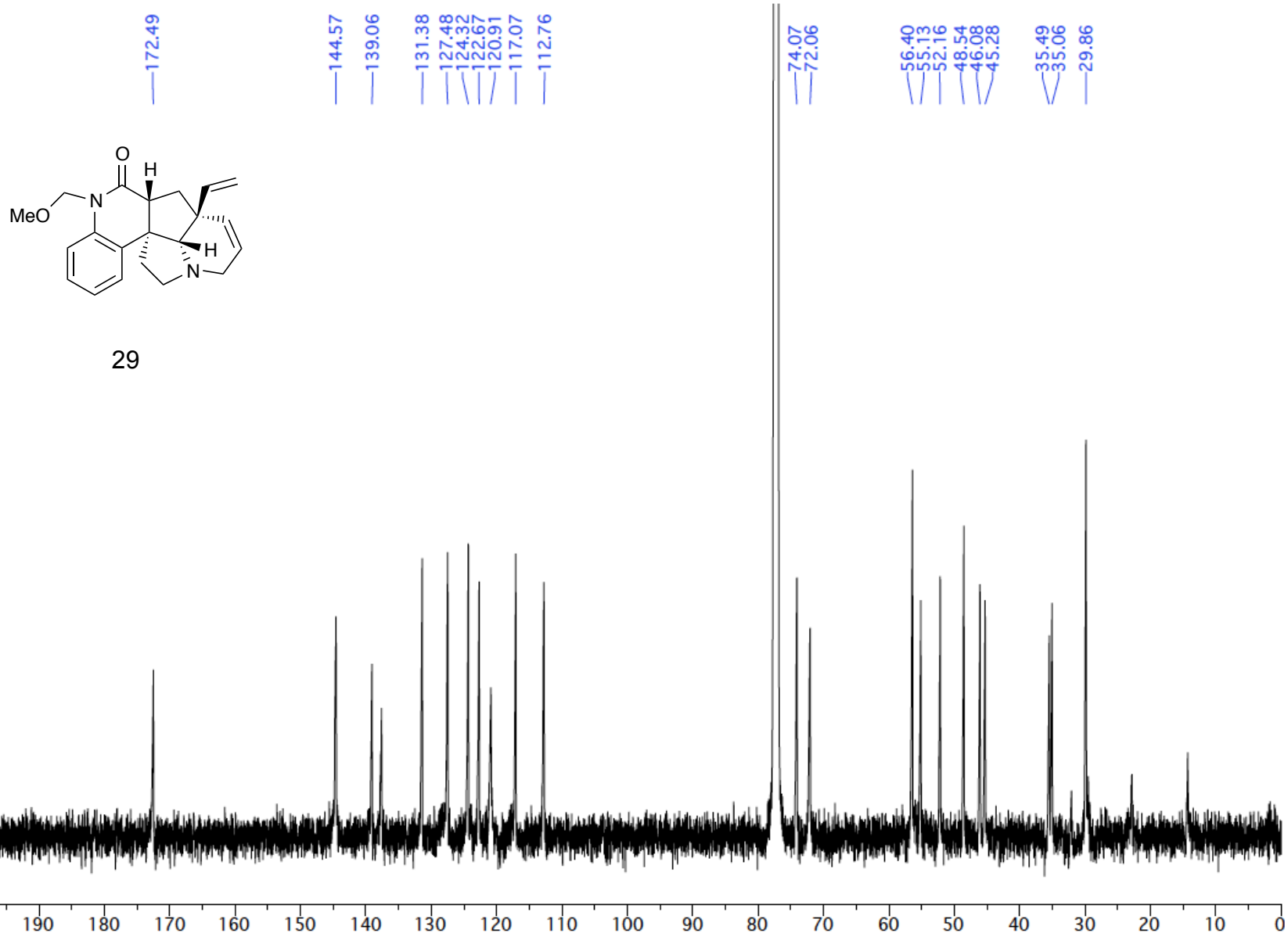
7.270
7.253
7.250
7.238
7.235
7.222
7.219
7.121
7.119
7.106
7.104
5.851
5.847
5.831
5.826
5.749
5.739
5.736
5.728
5.718
5.714
5.708
5.692
5.687
5.035
5.009
5.000
4.988
4.947
4.926
3.980
3.649
3.407
3.316
3.306
3.060
3.053
3.042
3.027
3.023
3.017
2.224
2.214
2.199
2.188
2.070
2.068
1.788
1.762
1.736
O
H
N
MeO
H
N
29
9
8
7
6
5
4
3
2
1
0
ppm
1.07
1.04
1.01
1.01
1.00
3.03
1.06
0.90
1.03
0.94
1.03
3.12
1.13
3.09
1.19
1.30
1.31
1.37


172.49
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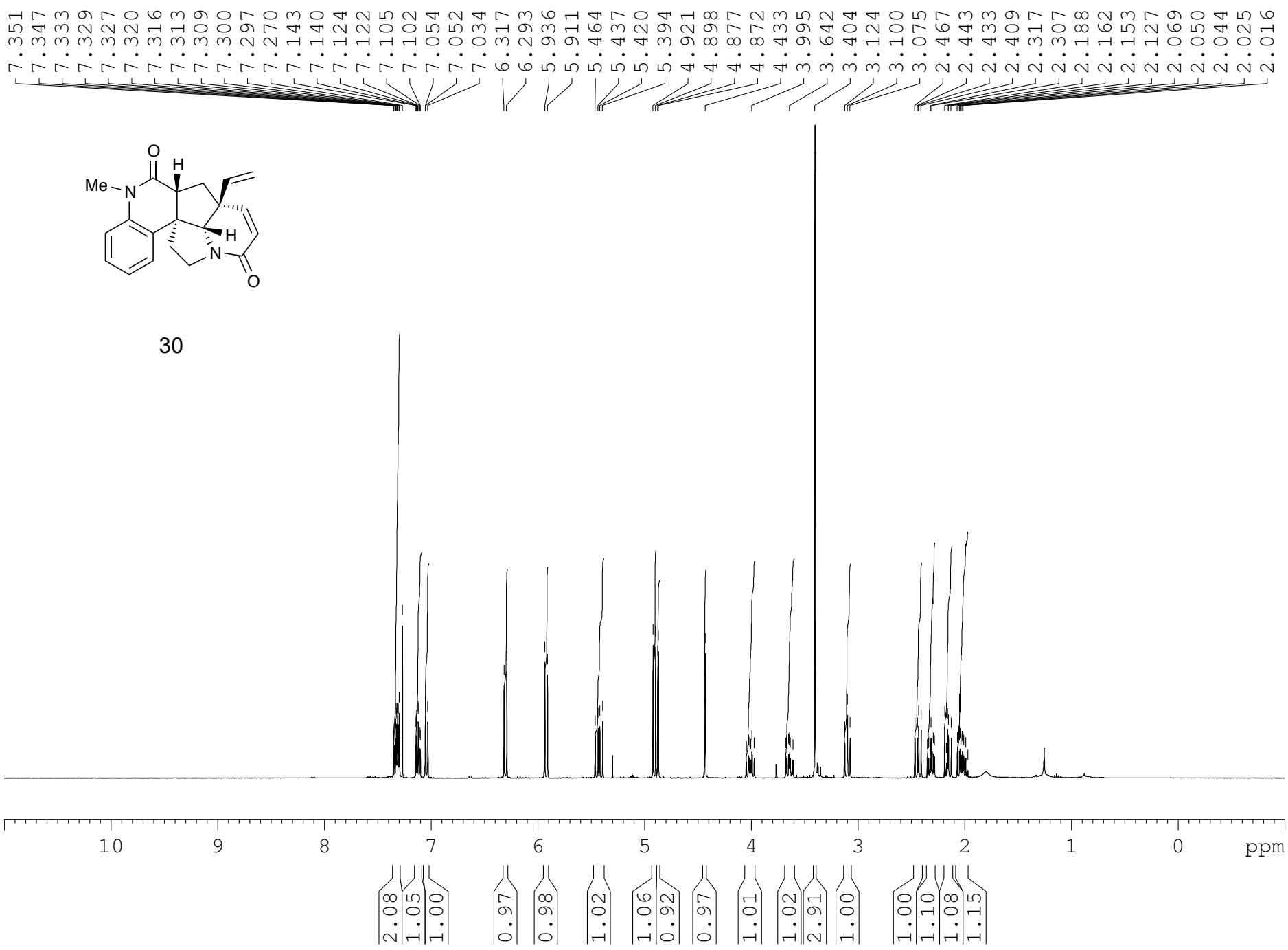
139.06
131.38
127.48
124.32
122.67
120.91
117.07
112.76
74.07
72.06
56.40
55.13
52.16
48.54
46.08
45.28
35.49
35.06
29.86
O
H
N
MeO
H
N
00
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0

29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7.329
7.327
7.320
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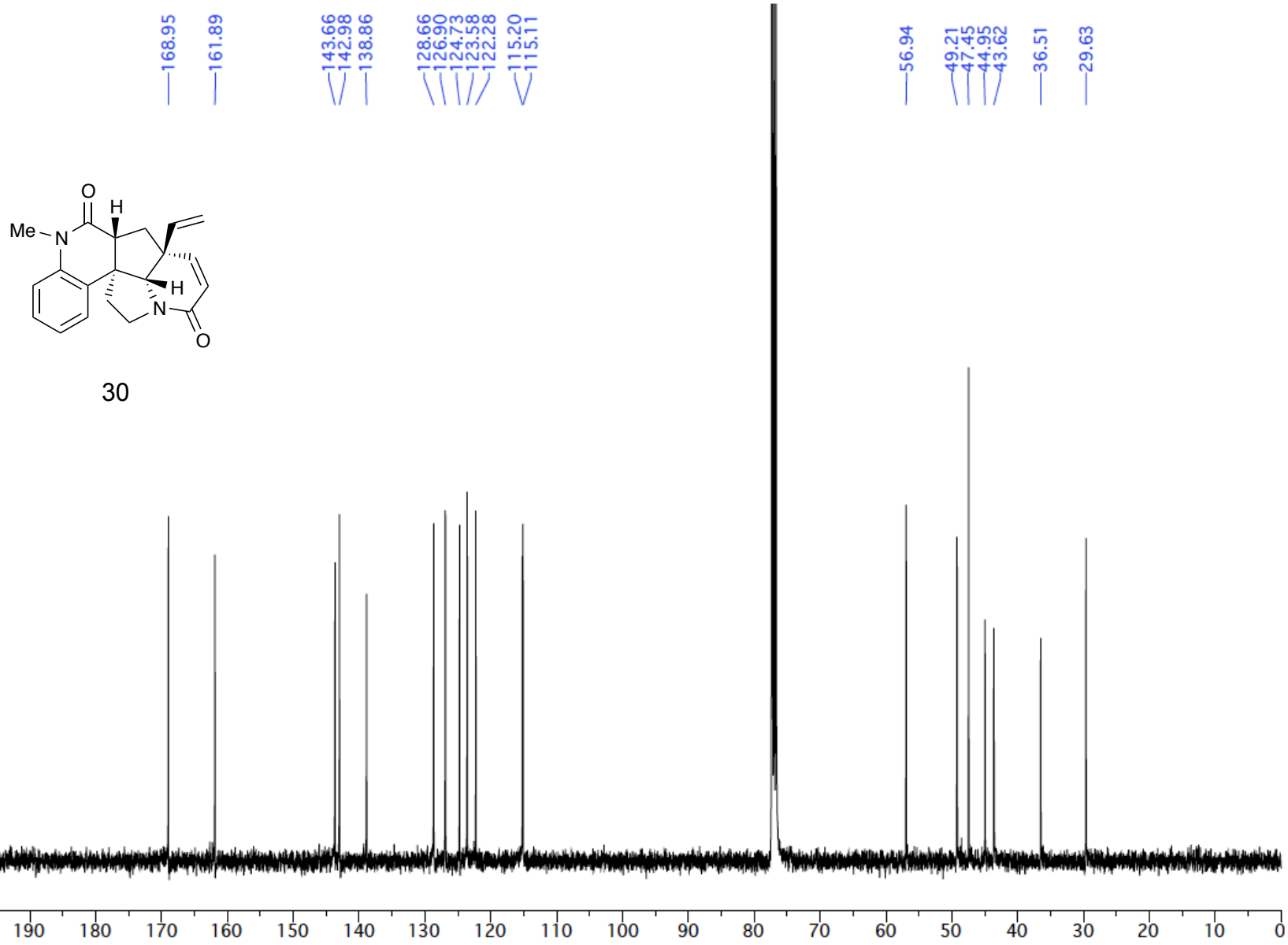
7.313
7.309
7.300
7.297
7.270
7.143
7.140
7.124
7.122
7.105
7.102
7.054
7.052
7.034
6.317
6.293
5.936
5.911
5.464
5.437
5.420
5.394
4.921
4.898
4.877
4.872
4.433
3.995
3.642
3.404
3.124
3.100
3.075
2.467
2.443
2.433
2.409
2.317
2.307
2.188
2.162
2.153
2.127
2.069
2.050
2.044
2.025
2.016
O
H
Me
N
H
N
O
30
10
9
8
7
6
5
4
3
2
1
0
ppm
2.08
1.05
1.00
0.97
0.98
1.02
1.06
0.92
0.97
1.01
1.02
2.91
1.00
1.00
1.10
1.08
1.15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142.98
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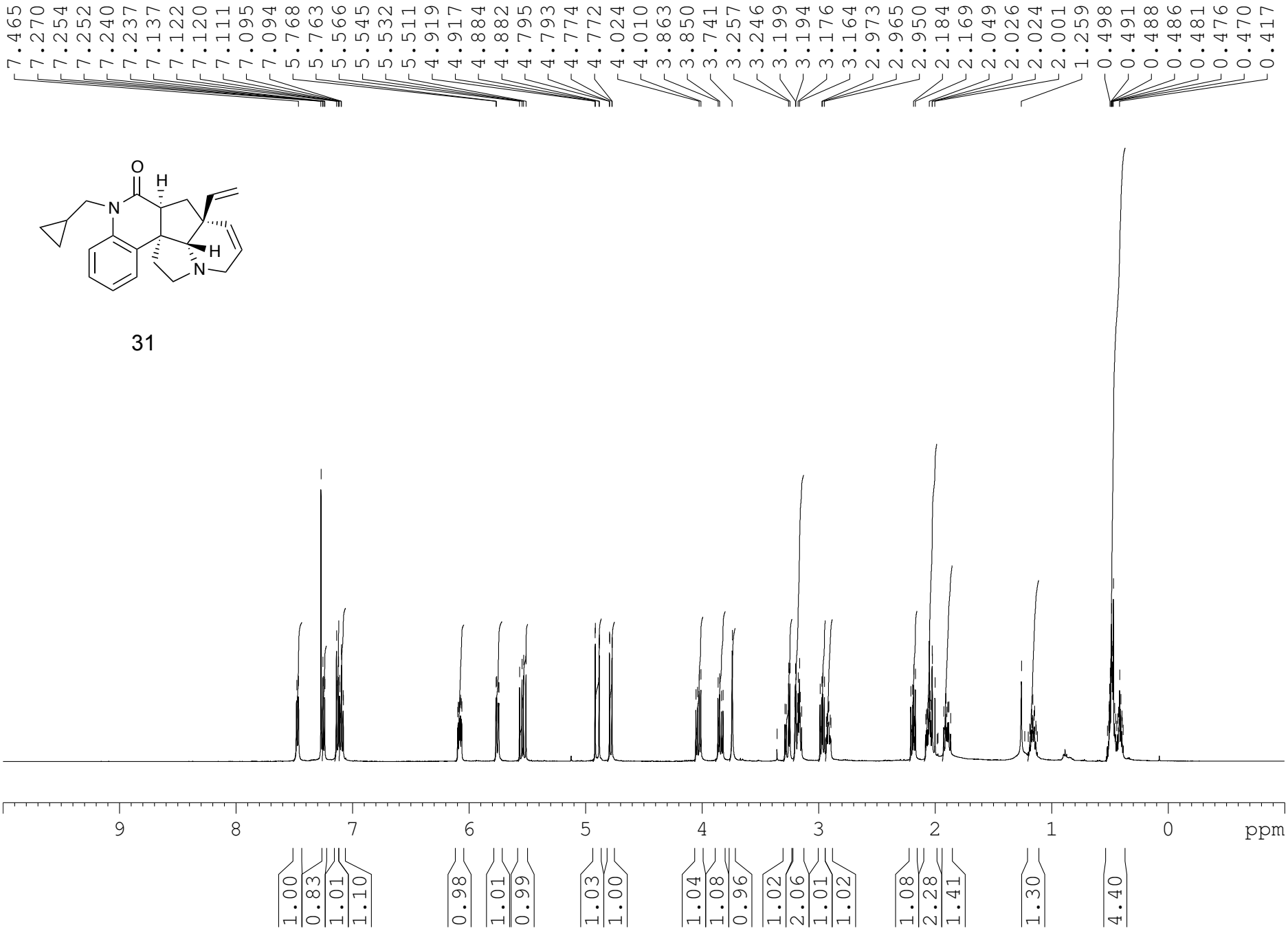
128.66
126.90
124.73
123.58
122.28
115.20
115.11
56.94
49.21
47.45
44.95
43.62
36.51
29.63
O
H
Me
N
H
N
O
00
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0

30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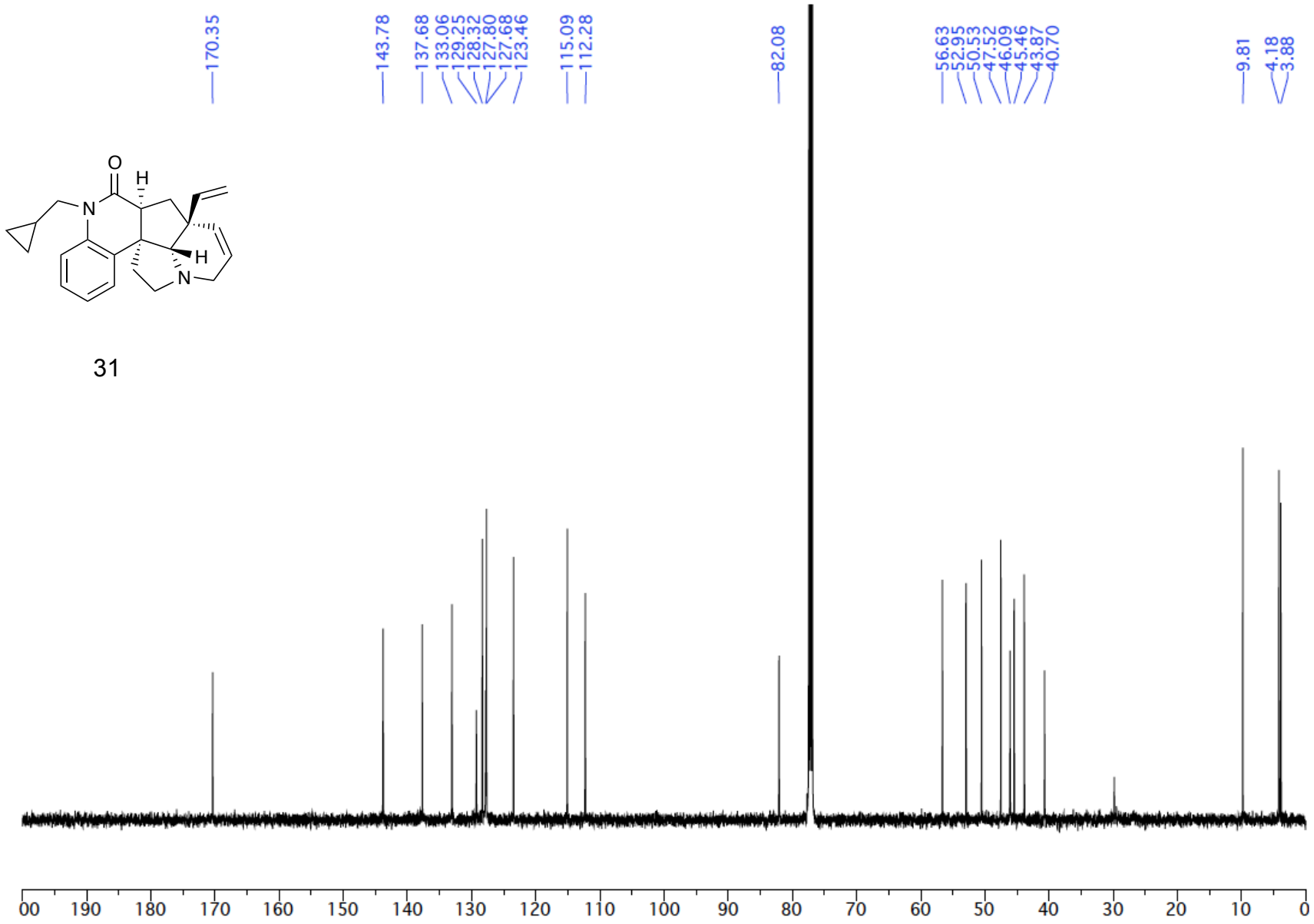
7.254
7.252
7.240
7.237
7.137
7.122
7.120
7.111
7.095
7.094
5.768
5.763
5.566
5.545
5.532
5.511
4.919
4.917
4.884
4.882
4.795
4.793
4.774
4.772
4.024
4.010
3.863
3.850
3.741
3.257
3.246
3.199
3.194
3.176
3.164
2.973
2.965
2.950
2.184
2.169
2.049
2.026
2.024
2.001
1.259
0.498
0.491
0.488
0.486
0.481
0.476
0.470
0.417
O
H
N
H
N
9
8
7
6
5
4
3
2
1
0
ppm
1.00
0.83
1.01
1.10
0.98
1.01
0.99
1.03
1.00
1.04
1.08
0.96
1.02
2.06
1.01
1.02
1.08
2.28
1.41
1.30
4.40

31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133.06
129.25
128.32
127.80
127.68
123.46
115.09
112.28
82.08
56.63
52.95
50.53
47.52
46.09
45.46
43.87
40.70
9.81
4.18
3.88
O
H
N
H
N
00
190
180
170
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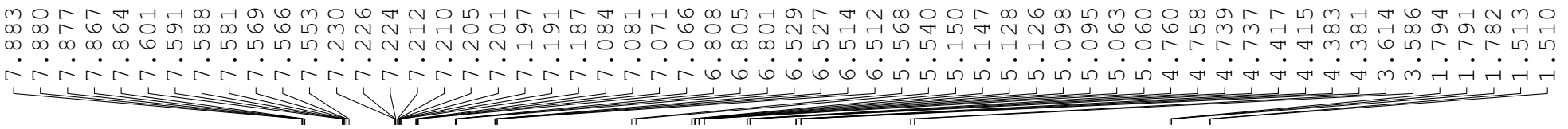
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0

31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7.588
7.581
7.569
7.566
7.553
7.230
7.226
7.224
7.212
7.210
7.205
7.201
7.197
7.191
7.187
7.084
7.081
7.071
7.066
6.808
6.805
6.801
6.529
6.527
6.514
6.512
5.568
5.540
5.150
5.147
5.128
5.126
5.098
5.095
5.063
5.060
4.760
4.758
4.739
4.737
4.417
4.415
4.383
4.381
3.614
3.586
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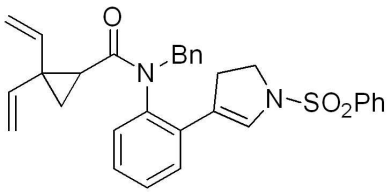
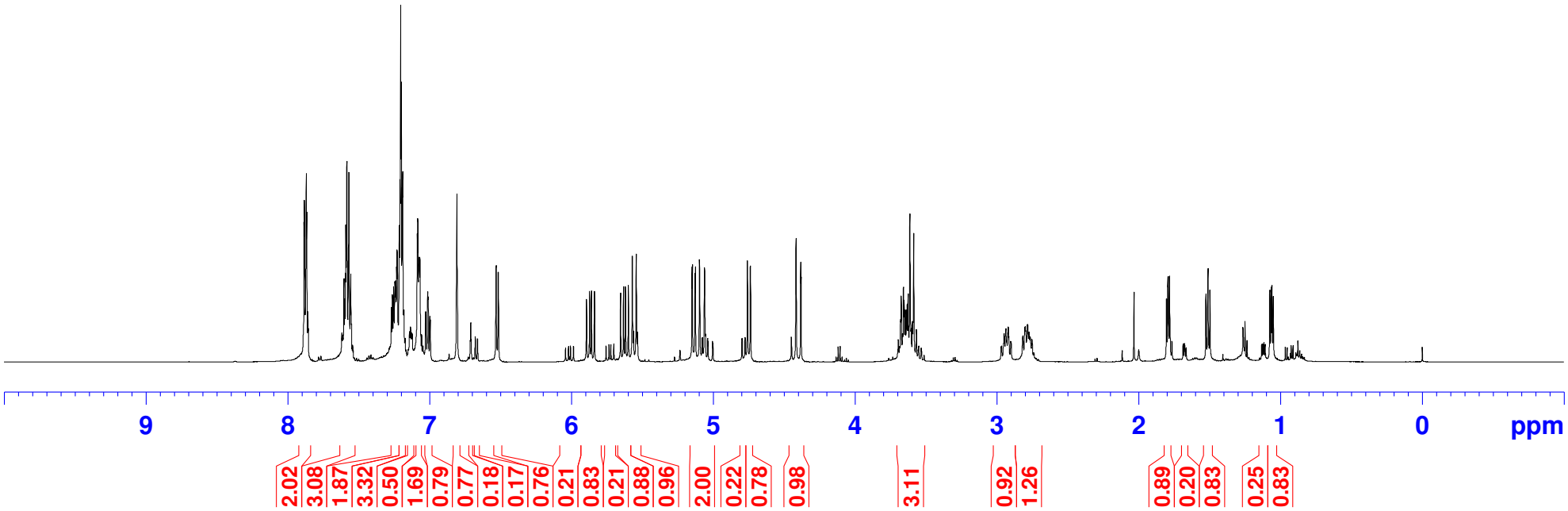
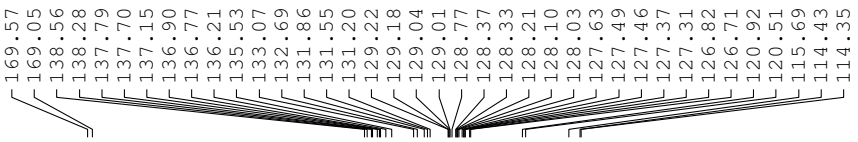
1.791
1.782
1.513
1.510


O
N
Bn
N
SO2Ph

C


9
8
7
6
5
4
3
2
1
0
ppm
2.02
3.08
1.87
3.32
0.50
1.69
0.79
0.77
0.18
0.17
0.76
0.21
0.83
0.21
0.88
0.96
2.00
0.22
0.78
0.98
3.11
0.92
1.26
0.89
0.20
0.83
0.25
0.83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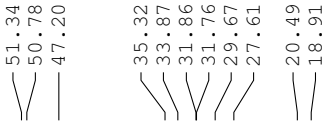
137.70
137.15
136.90
136.77
136.21
135.53
133.07
132.69
131.86
131.55
131.20
129.22
129.18
129.04
129.01
128.77
128.37
128.33
128.21
128.10
128.03
127.63
127.49
127.46
127.37
127.31
126.82
126.71
120.92
120.51
115.69
114.43
114.35


51.34
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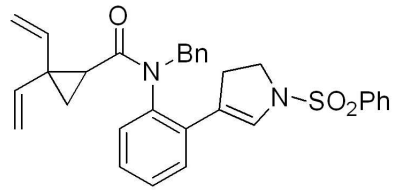
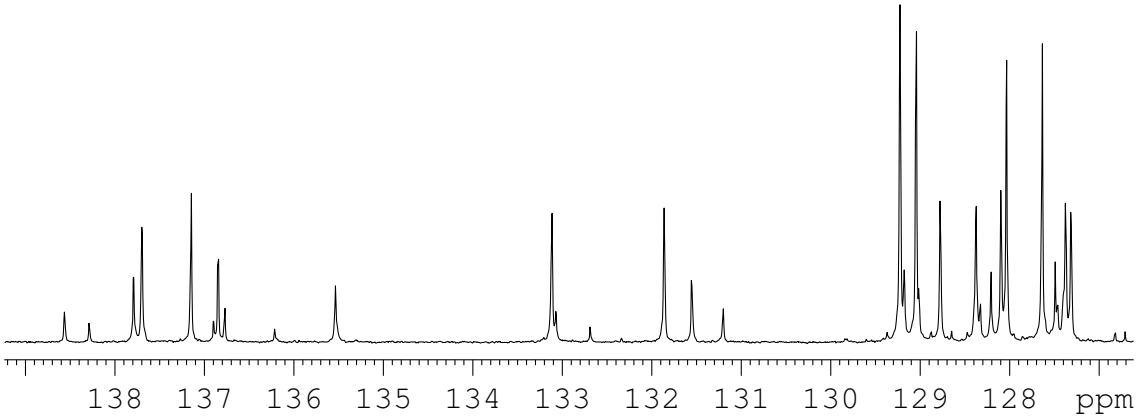
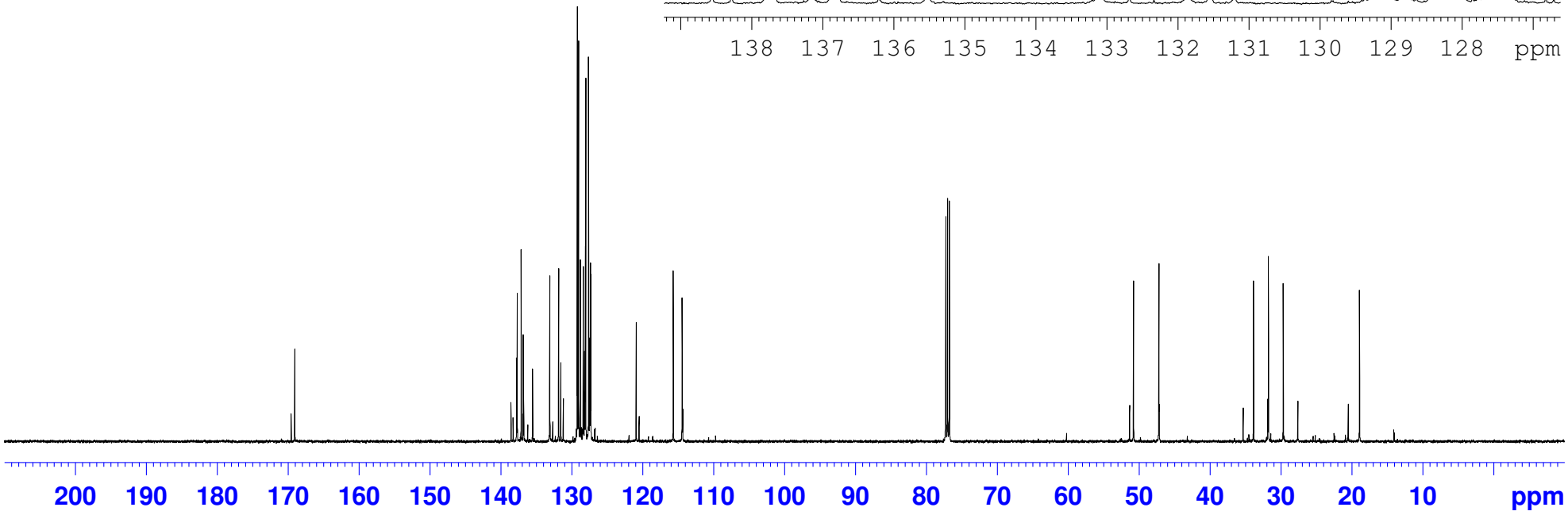
47.20
35.32
33.87
31.86
31.76
29.67
27.61
20.49
18.91

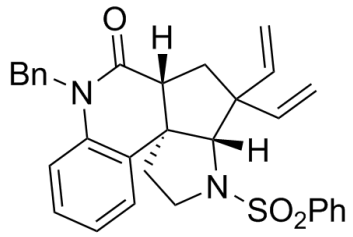

O
N
Bn
N
SO2Ph

C

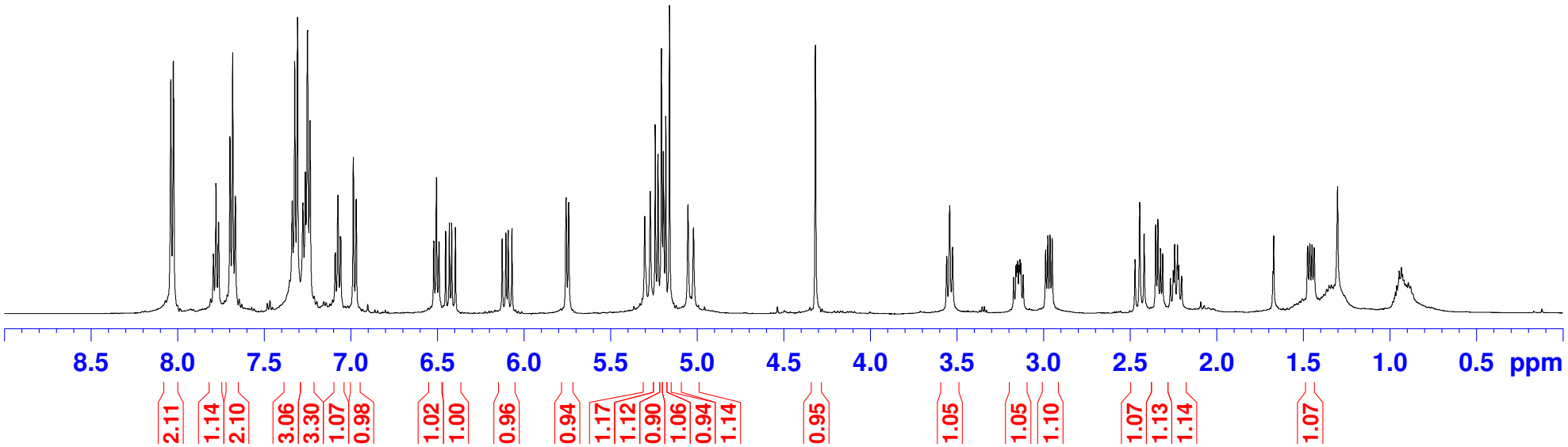

138
137
136
135
134
133
132
131
130
129
128
ppm

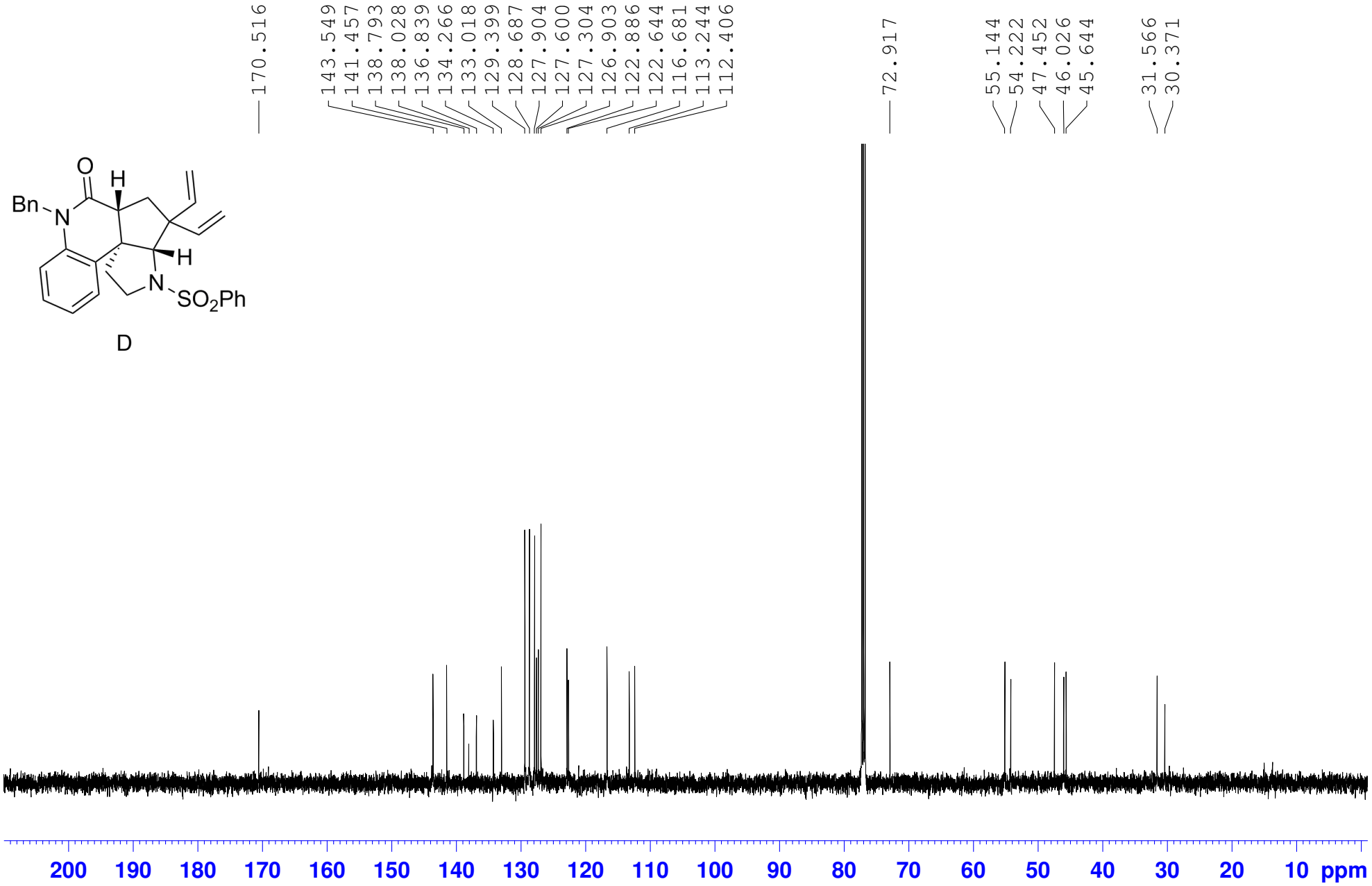

200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
ppm

8.037 8.023 7.776 7.761 7.695 7.680 7.665 7.336 7.322 7.305 7.274 7.260 7.248 7.233 7.072 7.058 7.056 6.983 6.967 6.520 6.505 6.491 6.453 6.431 6.418 6.396 6.126 6.105 6.091 6.070 5.756 5.741 5.303 5.271 5.242 5.226 5.207 5.195 5.181 5.160 5.053 5.021 4.317 3.542 3.525 2.975 2.962 2.950 2.445 2.419 2.352 2.340 2.243 2.227 1.474 1.462 1.449 1.302



D

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141.457
138.793
138.028
136.839
134.266
133.018
129.399
128.687
127.904
127.600
127.304
126.903
122.886
122.644
116.681
113.244
112.406
72.917
55.144
54.222
47.452
46.026
45.644
31.566
30.371
O
H
Bn
N
H
N
SO2Ph
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
ppm

D

	MW (g/mol)	clogP	PSA (Å^2)
meloscine, **1a**	292.4	2.2	42.1
epimeloscine, **2a**	292.4	2.3	41.7
2b	306.4	2.8	42.0
2c	320.4	3.1	40.6
1b	306.4	2.7	39.3
1c	320.4	3.0	40.6
25	306.4	2.4	69.4
26a	396.5	4.2	53.4
26b	432.5	3.4	64.9
27a	396.5	4.1	53.5
27b	432.5	3.3	64.8
28	306.4	2.6	31.0
29	336.4	2.4	37.0
30	320.4	2.5	55.4
31	346.5	3.6	29.0

Supplementary Table 1. Calculated physical properties.