Electronic supplementary information for 3-hydroxypyrrolidines from epoxysulfonamides and dimethylsulfoxonium methylide

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(I) General Directions

All reactions were conducted in flame-dried glassware under an atmosphere of argon. THF was distilled under an atmosphere of argon from sodium benzophenone ketyl, while CH_2Cl_2 was degassed and dried over alumina under nitrogen.[1] Column chromatography was carried out on Kieselgel 60 (40−63 μm) silica gel. Petrol refers to the fraction of petroleum ether boiling between 30 and 40 °C. Melting points were recorded on a Kofler hot block. IR spectra were recorded as thin films or KBr discs, using a 1750 FTIR spectrophotometer. ^{1}H and ^{13}C NMR spectra were recorded at 25 °C in $CDCl_3$, using DPX400, AV400 or AMX500 spectrometers. Data are expressed as chemical shifts in parts per million (ppm) relative to residual $CHCl_3$ (^{1}H δ 7.27) or

(1) Pangborn, A. B.; Giardello, M. A.; Grubbs, R. H.; Rosen, R. K.; Timmers, F. J. *Organometallics* **1996**, *15*, 1518–1520.

$CDCl_3$ (^{13}C δ 77.0) as the internal standard on the δ scale. The multiplicity of each signal is designated by the following abbreviations; s, singlet; d, doublet; t, triplet; q, quartet; quint, quintet; br, broad singlet. Coupling constants *J* are given in Hz. Mass spectra were obtained from the EPSRC National Mass Spectrometry Service Centre, University of Wales, Swansea with a Micromass ZAB-E instrument, or 900 XLT high resolution double focusing mass spectrometer with tandem ion trap. Alternatively they were recorded in-house using a VG Mass Lab TRIO1 or Micromass platform APCI spectrometer using chemical ionization (CI) or electrospray ionization (ESI) techniques.

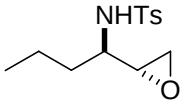
(II) Procedures and data for epoxysulfonamide preparation

General Procedure A. Aza-Payne rearrangement of *N*-Ts 2-aziridinemethanols to epoxysulfonamides.[2]

A suspension of KH (4 equiv) in THF was cooled to −78 °C and a solution of the appropriate *N*-Ts 2-aziridinemethanol (1 equiv) in THF was added dropwise. The reaction was warmed to 0 °C over 5 min and left to stir at this temperature for 2 h. The reaction was carefully quenched with sat. aq. NH_4Cl solution (30 mL) and the organic layer separated. The aqueous layer was extracted with Et_2O (3 x 30 mL); the combined organic layers were dried ($MgSO_4$) and solvent evaporated *in vacuo*. The residue was purified by column chromatography (Et_2O/petrol) to give the corresponding epoxysulfonamide.

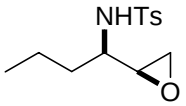
(2) Ibuka, T.; Nakai, K.; Habashita, H.; Hotta, Y.; Otaka, A.; Tamamura, H.; Fujii, N.; Mimura, N.; Miwa, Y.; Taga, T.; Chounan, Y.; Yamamoto, Y. *J. Org. Chem.* **1995**, *60*, 2044−2058.

4-Methyl-*N*-[(*R**)-1-((*R**)-oxiran-2-yl)butyl]benzenesulfonamide *anti*-**7a**



Following general procedure A, the addition of *trans*-(3-propyl-1-tosylaziridin-2-yl)methanol[3] (600 mg, 2.23 mmol) in THF (18 mL) to KH (30% w/w, 1.19 g, 8.91 mmol) in THF (18 mL) gave after work-up and column chromatography (50% Et_2O in petrol) *anti-epoxide* **7a** (550 mg, 92%) as a colorless oil, which solidified on standing; R_f 0.16 (50% Et_2O in petrol); mp 55−57 °C; IR (neat)/cm^{-1} 3278br, 2961m, 2874m, 1599w, 1455m, 1328s, 1160s, 1093m; ^{1}H NMR (400 MHz) δ 7.76 (d, *J* = 8, 2H), 7.30 (d, *J* = 8, 2H), 5.11 (d, *J* = 7.5, 1H), 2.97−2.94 (m, 1H), 2.78 (ddd, *J* = 6.5, 3.5, 3, 1H), 2.61 (dd, *J* = 4.5, 3.5, 1H), 2.52 (dd, *J* = 4.5, 3, 1H), 2.43 (s, 3H), 1.61−1.10 (m, 4H), 0.78 (t, *J* = 7, 3H); ^{13}C NMR (100 MHz) δ 143.5, 137.8, 129.6, 127.1, 55.1, 53.9, 46.7, 34.5, 21.5, 18.2, 13.6; MS *m*/*z* (CI) 287 (M+NH_4^+, 100), 271 (18), 270 (12), 189 (17), 52 (24); HRMS calcd for $C_{13}H_{20}NO_3S$ (M+H^+) 270.1164, found 270.1161.

4-Methyl-*N*-[(*R**)-1-((*S**)-oxiran-2-yl)butyl]benzenesulfonamide *syn*-**7a**



Following general procedure A, the addition of *cis*-(3-propyl-1-tosylaziridin-2-yl)methanol[3] (500 mg, 1.86 mmol) in THF (15 mL) to KH (30% w/w, 993 mg, 7.43 mmol) in THF (15 mL) gave after work-up and column chromatography (50% Et_2O in petrol) *syn-epoxide* **7a** (400 mg, 80%) as a white solid; R_f 0.16 (50% Et_2O in petrol); mp 98−99 °C; IR (KBr)/cm^{-1} 3244br, 2964m, 2863m, 1597m, 1431m, 1329s, 1152s, 1094s; ^{1}H NMR (400 MHz) δ 7.75 (d, *J* = 8, 2H), 7.30 (d, *J* = 8, 2H), 4.55 (d, *J* = 9, 1H), 3.53−3.48 (m, 1H), 2.96 (ddd, *J* = 5, 4, 2.5, 1H), 2.66 (dd, *J* = 4.5, 4, 1H), 2.60 (dd, *J* = 4.5, 2.5, 1H), 2.43 (s, 3H), 1.58−1.19 (m, 4H), 0.81 (t, *J* = 7, 3H); ^{13}C NMR (100 MHz) δ 143.4, 138.2, 129.6, 126.9, 53.5, 52.5, 44.4, 35.7, 21.5, 18.5, 13.7; MS *m*/*z* (CI) 287 (M+NH_4^+, 100), 271 (35), 189 (18), 72 (88); HRMS calcd for $C_{13}H_{23}N_2O_3S$ (M+NH_4^+) 287.1429, found 287.1424.

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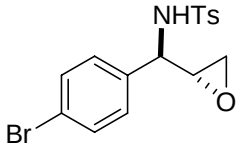
(3) Jeong, J. U.; Tao, B.; Sagasser, I.; Henniges, H.; Sharpless, K. B. *J. Am. Chem. Soc.* **1998**, *120*, 6844−6845.

4-Methyl-*N*-[(*R**)-(4-bromophenyl) ((*R**)-oxiran-2-yl)methyl]benzenesulfonamide **7e**



To a mixture of (*E*)-3-(4-bromophenyl)-2-propen-1-ol [4] (1.10 g, 5.16 mmol) and anhydrous chloramine-T (1.30 g, 5.68 mmol) in MeCN (60 mL) was added PTAB (196 mg, 0.52 mmol) at rt. After stirring for 16 h, the mixture was filtered and the solvent evaporated *in vacuo*. Purification of the residue by column chromatography (50% Et_2O in petrol) gave *trans*-[3-(4-bromophenyl)-1-tosylaziridin-2-yl]methanol (1.34 g, 68%) as a colorless oil; R_f 0.21 (50% Et_2O in petrol); IR (neat)/cm^{-1} 3521br, 3064m, 3039m, 2950m, 2885w, 1598m, 1497m, 1456m, 1323s, 1161s, 1088m; ^1H NMR (400 MHz) δ 7.82 (d, *J* = 8, 2H), 7.39 (d, *J* = 8, 2H), 7.30 (d, *J* = 8, 2H), 7.02 (d, *J* = 8, 2H), 4.32−4.28 (m, 1H), 4.18−4.14 (m, 1H), 3.98 (d, *J* = 4, 1H), 3.12−3.18 (m, 2H), 2.42 (s, 3H); ^{13}C NMR (100 MHz) δ 144.6, 136.8, 133.7, 131.8, 129.8, 128.1, 127.1, 122.4, 60.4, 54.7, 45.6, 21.7; MS *m*/*z* (ESI) 382 ($M+H^+$, 100); HRMS calcd for $C_{16}H_{17}BrNO_3S$ ($M+H^+$) 382.0113, found 382.0105.

Following general procedure A, the addition of *trans*-(3-(4-bromophenyl)-1-tosylaziridin-2-yl)methanol (370 mg, 0.97 mmol) in THF (8 mL) to KH (30% w/w, 517 mg, 3.88 mmol) in THF (8 mL) gave after work-up and column chromatography (50% Et_2O in petrol) *anti-epoxide* **7e** (290 mg, 78%) as a white solid; R_f 0.19 (50% Et_2O in petrol); mp 113−114 °C; IR (KBr)/cm^{-1} 3263s, 2960m, 2898m, 1599m, 1490m, 1445m, 1330s, 1164s, 1093m, 1074m; ^1H NMR (400 MHz) δ 7.56 (d, *J* = 8, 2H), 7.32 (d, *J* = 8.5, 2H), 7.18 (d, *J* = 8, 2H), 6.98 (d, *J* = 8.5, 2H), 5.29 (d, *J* = 6.5, 1H), 4.39 (dd, *J* = 6.5, 5, 1H), 3.21−3.18 (m, 1H), 2.70 (dd, *J* = 4, 1H), 2.41−2.35 (m, 4H); ^{13}C NMR (100 MHz) δ 143.7, 137.0, 134.9, 131.6, 129.5, 129.2, 127.1, 122.4, 57.5, 53.6, 45.5, 21.6; MS *m*/*z* (ESI) 382 ($M+H^+$, 100); HRMS calcd for $C_{16}H_{17}BrNO_3S$ ($M+H^+$) 382.0113, found 382.0103.

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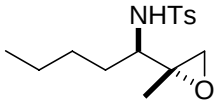
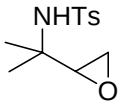
[4] Hammond, M. L.; Zambias, R. A.; Chang, M. N.; Jensen, N. P.; McDonald, J.; Thompson, K.; Boulton, D. A.; Kopka, I. E.; Hand, K. M.; Opas, E. E.; Luell, S.; Bach, T.; Davies, P.; MacIntyre, D. E.; Bonney, R. J.; Humes, J. L. *J. Med. Chem*. **1990**, *33*, 908−918.

4-Methyl-*N*-[(*R**)-1-((*R**)-2-methyloxiran-2-yl)pentyl]-benzenesulfonamide **7f**



Following general procedure A (except reaction left at rt for 24 h), the addition of (*E*)-(3-butyl-2-methyl-1-tosylaziridin-2-yl)methanol[3, 5] (140 mg, 0.47 mmol) in THF (4 mL) to KH (30% w/w, 251 mg, 1.88 mmol) in THF (4 mL) gave after work-up and column chromatography (20%→40% Et_2O in petrol) *epoxide* **7f** (112 mg, 80%) as a colorless oil, which solidified on standing; mp 71–73 °C; R_f 0.19 (50% Et_2O in petrol); IR (KBr)/cm^{-1} 3257br, 2926s, 2868m, 1598m, 1497m, 1431m, 1399m, 1326s, 1163s, 1095m; ^1H NMR (400 MHz) δ 7.75 (d, *J* = 8, 2H), 7.30 (d, *J* = 8, 2H), 5.25 (d, *J* = 10, 1H), 2.83–2.77 (m, 1H), 2.66 (d, *J* = 4.5, 1H), 2.48 (d, *J* = 4.5, 1H), 2.43 (s, 3H), 1.64–1.57 (m, 1H), 1.42–1.31 (m, 1H), 1.21 (s, 3H), 1.20–0.99 (m, 4H), 0.76 (t, *J* = 7, 3H); ^{13}C NMR (100 MHz) δ 145.6, 137.6, 129.6, 127.1, 58.6, 57.7, 54.7, 31.1, 27.6, 22.2, 21.5, 16.1, 13.8; MS *m*/*z* (ESI) 296 ($M-H^-$, 100); HRMS calcd for $C_{15}H_{22}NO_3S$ ($M-H^-$) 296.1322, found 296.1314.

4-Methyl-*N*-(2-(oxiran-2-yl)propan-2-yl)benzenesulfonamide **7g**



Following general procedure A, the addition (3,3-dimethyl-1-tosylazirin-2-yl)methanol[3] (255 mg, 1.00 mmol) in THF (8 mL) to KH (30% w/w, 533 mg, 4.00 mmol) in THF (8 mL) gave after work-up and column chromatography (50% Et_2O in petrol) *epoxide* **7g** (160 mg, 63%) as a white solid; mp 74–75 °C; R_f 0.19 (50% Et_2O in petrol); IR (KBr)/cm^{-1} 3276br, 2983m, 1599m, 1324s, 1152s, 1094s; ^1H NMR (400 MHz) δ 7.77 (d, *J* = 8, 2H), 7.29 (d, *J* = 8, 2H), 4.75 (s, 1H), 2.91 (dd, *J* = 4, 2.5, 1H), 2.74 (dd, *J* = 4, 2.5, 1H), 2.68 (dd, *J* = 4, 4, 1H), 2.43 (s, 3H), 1.23 (s, 3H), 1.22 (s, 3H); ^{13}C NMR (100 MHz) δ 143.2, 140.1, 129.6, 127.0, 58.4, 54.8, 44.6, 25.0, 23.4, 21.5; MS *m*/*z* (ESI) 278 ($M+Na^+$, 100); HRMS calcd for $C_{12}H_{17}NNaO_3S$ ($M+Na^+$) 278.0827, found 278.0826.

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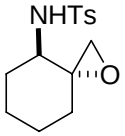
(5) White, J. D.; Takabe, K.; Prisbylla, M. P. *J. Org. Chem*. **1985**, *50*, 5233–5244.

4-Methyl-*N*-[(3*R**,4*R**)-1-oxaspiro[2.5]octan-4-yl]benzenesulfonamide *anti*-**9b**

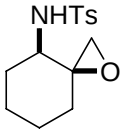


To a mixture of cyclohexenyl-1-methanol [6] (820 mg, 7.32 mmol) and anhydrous chloramine-T (1.80 g, 8.10 mmol) in MeCN (100 mL) was added PTAB (275 mg, 0.73 mmol) at rt. After stirring for 16 h, the mixture was filtered and the solvent evaporated *in vacuo*. Purification of the residue by column chromatography (50% Et_2O in petrol) gave (7-tosyl-7-azabicyclo[4.1.0]heptan-1-yl)methanol (1.60 g, 78%) as a colorless oil; R_f 0.20 (50% Et_2O in petrol); IR (KBr)/cm^{-1} 3519br, 2940m, 1598m, 1439m, 1329m, 1303s, 1150s, 1090s; ^{1}H NMR (400 MHz) δ 7.83 (d, *J* = 8, 2H), 7.33 (d, *J* = 8, 2H), 4.05−4.02 (m, 2H), 3.25 (dd, *J* = 5, 1, 1H), 3.04−3.00 (m, 1H), 2.45 (s, 3H), 2.27 (ddd, *J* = 15, 6, 6, 1H), 1.83−1.76 (m, 2H), 1.69−1.62 (m, 1H), 1.42−1.18 (m, 4H); ^{13}C NMR (100 MHz) δ 143.8, 138.2, 129.6, 126.8, 65.9, 56.4, 45.4, 27.4, 22.8, 21.6, 19.7, 19.3; MS *m*/*z* (CI) 282 ($M+H^+$, 80), 264 (40), 252 (30), 189 (100), 155 (38), 128 (50), 108 (55), 91 (30); HRMS calcd for $C_{14}H_{20}NO_3S$ ($M+H^+$) 282.1164, found 282.1154.

Following general procedure A, the addition of (7-tosyl-7-azabicyclo[4.1.0]heptan-1-yl)methanol (230 mg, 0.82 mmol) in THF (7 mL) to KH (30% w/w, 437 mg, 3.28 mmol) in THF (7 mL) gave after work-up and column chromatography (50% Et_2O in petrol) *anti-epoxide* **9b** (210 mg, 91%) as a colorless oil; R_f 0.19 (50% Et_2O in petrol); IR (neat)/cm^{-1} 3201br, 3069m, 2939s, 1597m, 1452m, 1329s, 1288m, 1160s, 1094s; ^{1}H NMR (400 MHz) δ 7.75 (d, *J* = 8, 2H), 7.29 (d, *J* = 8, 2H), 5.42 (d, *J* = 6, 1H), 3.04−2.99 (m, 1H), 2.66 (d, *J* = 4.5, 1H), 2.44 (d, *J* = 4.5, 1H), 2.42 (s, 3H), 1.92−1.85 (m, 1H), 1.74−1.33 (m, 7H); ^{13}C NMR (100 MHz) δ 143.5, 137.3, 129.7, 127.1, 59.4, 54.6, 51.8, 31.0, 30.6, 23.8, 21.6, 21.5; MS *m*/*z* (CI) 282 ($M+H^+$, 65), 252 (30), 189 (40), 128 (100), 112 (45), 110 (50), 98 (55); HRMS calcd for $C_{14}H_{20}NO_3S$ ($M+H^+$) 282.1164, found 282.1154.

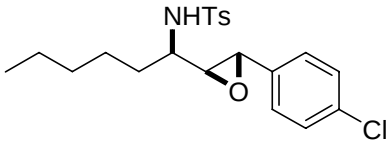
(6) Kimura, M.; Shimizu, M.; Tanaka, S.; Tamaru, Y. *Tetrahedron* **2005**, *61*, 3709−3718.

4-Methyl-*N*-[(3*R**,4*S**)-1-oxaspiro[2.5]octan-4-yl]benzenesulfonamide *syn*-**9b**



To a solution of 4-methyl-*N*-(2-methylenecyclohexyl)benzenesulfonamide[7] (145 mg, 0.55 mmol) in CH_2Cl_2 (5.5 mL) was added $NaHCO_3$ (92 mg, 1.09 mmol) and *m*CPBA (188 mg, 1.09 mmol) and the reaction mixture was then stirred at rt for 24 h. The reaction mixture was washed with sat. aq. Na_2SO_3 solution (2 x 20 mL) and then sat. aq. Na_2CO_3 solution (2 x 20 mL). The organic layer was dried ($MgSO_4$) and solvent evaporated *in vacuo*. Analysis of the ^{1}H NMR of the crude reaction mixture revealed *d.r.* = 96:4. The residue was purified by column chromatography (30%→50% Et_2O in petrol) to give only the *syn*-isomer of *epoxide* **9b** (119 mg, 77%) as a white solid; mp 140−142 °C; R_f 0.15 (50% Et_2O in petrol); IR (KBr)/cm^{-1} 3201br, 3069w, 2939s, 1598m, 1450m, 1328m, 1288m, 1162s, 1092; ^{1}H NMR (400 MHz) δ 7.72 (d, *J* = 8, 2H), 7.27 (d, *J* = 8, 2H), 4.85 (d, *J* = 10, 1H), 3.49 (ddd, *J* = 11.5, 10, 4.5, 1H), 2.75 (d, *J* = 4.5, 1H), 2.45 (d, *J* = 4.5, 1H), 2.40 (s, 3H), 1.85−1.21 (m, 8H); ^{13}C NMR (100 MHz) δ 143.2, 138.5, 129.7, 126.7, 59.6, 52.4, 51.0, 32.8, 32.1, 24.7, 22.9, 21.5; MS *m*/*z* (CI) 282 (M+H$^+$, 30), 252 (15), 189 (28), 128 (100), 112 (70), 110 (73), 98 (95); HRMS calcd for $C_{14}H_{20}NO_3S$ (M+H$^+$) 282.1164, found 282.1160.

N-[(*R**)-1-((2*S**,3*S**)-3-(4-Chlorophenyl)oxiran-2-yl)hexyl]-4-methyl-benzenesulfonamide **11**



To a solution of 4-methyl-*N*-(1-octen-3-yl)benzenesulfonamide[7] (200 mg, 0.71 mmol) and 4-chlorostyrene (1.48 g, 10.7 mmol) in CH_2Cl_2 (7 mL) was added Grubbs' 2nd generation catalyst (17 mg, 20 μmol). The reaction was heated to reflux for 12 h then cooled and filtered through a short silica plug. The solvent was evaporated *in vacuo* and the residue was purified by column chromatography (20%→50% Et_2O in petrol) to give (*E*)-*N*-[1-(4-chlorophenyl)-1-octen-3-yl]-4-methylbenzenesulfonamide (231 mg,

(7) Hodgson, D. M.; Fleming, M. J.; Stanway, S. J. *Org. Lett*. **2005**, 7, 3295–3298.

83%, *E*:*Z*>95:5 by ^{1}H NMR analysis of isomeric vinylic protons in the δ 6.50−5.50 region) as a colorless oil, which solidified on standing; mp 99−100 °C; R_f 0.19 (30% Et_2O in petrol); IR (neat)/cm^{-1} 3268br, 2924s, 2858s, 1597w, 1491m, 1318m, 1161s, 1091m; ^{1}H NMR (400 MHz) δ 7.75 (d, *J* = 8, 2H), 7.19 (d, *J* = 8.5, 2H), 7.16 (d, *J* = 8, 2H), 7.01 (d, *J* = 8.5, 2H), 6.15 (d, *J* = 15.5, 1H), 5.71 (dd, *J* = 15.5, 8, 1H), 5.31 (d, *J* = 8, 1H), 3.89 (quint, *J* = 8, 1H), 2.29 (s, 3H), 1.60−1.45 (m, 2H), 1.32−1.14 (m, 6H), 0.82 (t, *J* = 8, 3H); ^{13}C NMR (100 MHz) δ 143.2, 138.2, 134.9, 133.1, 129.9, 129.9, 129.5, 128.5, 127.5, 127.3, 56.4, 35.7, 31.3, 25.1, 22.4, 21.4, 14.0; MS *m*/*z* (ESI) 414 (M+Na$^+$, 100); HRMS calcd for $C_{21}H_{26}ClNNaO_2S$ (M+Na$^+$) 414.1270, found 414.1275.

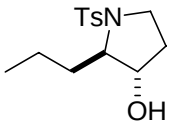
To a solution of (*E*)-*N*-[1-(4-chlorophenyl)-1-octen-3-yl]-4-methylbenzenesulfonamide (200 mg, 0.51 mmol) in CH_2Cl_2 (5 mL) was added $NaHCO_3$ (86 mg, 1.02 mmol) and *m*CPBA (176 mg, 1.02 mmol) and the reaction was then stirred at rt for 24 h. The reaction mixture was washed with sat. aq. Na_2SO_3 solution (2 x 15 mL) and then sat. aq. Na_2CO_3 solution (2 x 15 mL). The organic layer was dried ($MgSO_4$) and solvent evaporated *in vacuo*. The residue was purified by column chromatography (40% Et_2O in petrol) to give *epoxide* **11** (154 mg, 74%, *d.r.* = 65:35 by ^{1}H NMR analysis of isomeric N-*H* protons in the δ 5.50−4.50 region). Further purification by column chromatography (20% Et_2O in petrol) gave partial separation of the major *syn* diastereoisomer of *epoxide* **11** (58 mg, 28%) as a colorless oil which solidified on standing; mp 119−120 °C; R_f 0.24 (30% Et_2O in petrol); IR (KBr)/cm^{-1} 3281br, 2926s, 1599w, 1495m, 1427m, 1318m, 1160m, 1089m; ^{1}H NMR (400 MHz) δ 7.78 (d, *J* = 8, 2H), 7.32 (d, *J* = 8.5, 2H), 7.27 (d, *J* = 8, 2H), 7.04 (d, *J* = 8.5, 2H), 4.79 (d, *J* = 9, 1H), 3.69 (d, *J* = 2, 1H), 3.65 (dtd, *J* = 9, 8, 2.5, 1H), 2.92 (dd, *J* = 2.5, 2, 1H), 2.45 (s, 3H), 1.63−1.43 (m, 2H), 1.28−1.08 (m, 6H), 0.81 (t, *J* = 8, 3H); ^{13}C NMR (100 MHz) δ 143.5, 138.1, 135.0, 134.0, 129.8, 128.6, 127.0, 126.9, 63.9, 55.1, 52.3, 33.4, 31.4, 25.0, 22.4, 21.5, 13.9; MS *m*/*z* (ESI) 430 (M+Na$^+$, 100); HRMS calcd for $C_{21}H_{26}ClNNaO_3S$ (M+Na$^+$) 430.1220, found 430.1214.

(III) General procedure and data for 3-hydroxypyrrolidines

General Procedure B. Synthesis of 3-hydroxypyrrolidines from epoxysulfonamides.

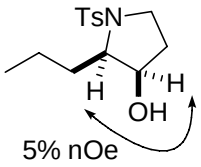
*n*BuLi (3.3 equiv) was added dropwise to a stirred suspension of trimethylsulfoxonium iodide (3 equiv) in THF at −78 °C and stirred at this temperature for 15 min and then at 0 °C for 15 min. The solution was recooled to −78 °C and a solution of the epoxysulfonamide (1 equiv) in THF and then DMPU (20 equiv) were added dropwise. The reaction was warmed to rt over 5 min and then refluxed for 2 h. After quenching with 5% aq. NH_4Cl solution (10 mL) and dilution with EtOAc (10 mL), the layers were separated. The aqueous layer was extracted with EtOAc (3 x 20 mL); the combined organic layers were dried ($MgSO_4$), and solvent was evaporated *in vacuo*. The residue was purified by column chromatography (petrol/Et_2O) to give the corresponding 3-hydroxypyrrolidine.

(2*R**,3*S**)-2-Propyl-1-tosylpyrrolidin-3-ol *trans*-**8a**



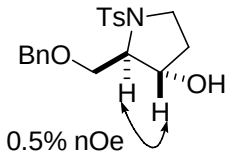
Following general procedure B, the addition of *anti*-epoxysulfonamide **7a** (50 mg, 0.19 mmol) in THF (0.5 mL) and then DMPU (0.45 mL, 3.74 mmol) to dimethylsulfoxonium methylide [prepared from *n*BuLi (1.6 M in hexanes; 0.38 mL, 0.61 mmol) and trimethylsulfoxonium iodide (123 mg, 0.56 mmol) in THF (1.4 mL)] gave after work-up and column chromatography (60% Et_2O in petrol) *trans-pyrrolidinol* **8a** (45 mg, 86%) as a colorless oil; R_f 0.18 (70% Et_2O in petrol); IR (neat)/cm^{-1} 3510br, 2960s, 1599s, 1494s, 1336s, 1156s; ^1H NMR (400 MHz) δ 7.74 (d, *J* = 8, 2H), 7.31 (d, *J* = 8, 2H), 4.05 (d, *J* = 3, 1H), 3.49−3.44 (m, 2H), 3.24 (ddd, *J* = 10.5, 9.5, 7, 1H), 2.41 (s, 3H), 2.06−1.97 (m, 1H), 1.77−1.67 (m, 3H), 1.50−1.33 (m, 2H), 1.26 (br, 1H), 0.94 (t, *J* = 7, 3H); ^{13}C NMR (100 MHz) δ 143.4, 134.2, 129.5, 127.7, 74.8, 69.1, 46.2, 37.3, 32.4, 21.5, 19.5, 14.0; MS *m*/*z* (CI) 301 ($M+NH_4^+$, 100), 284 (68), 130 (50), 48 (33), 86 (29), 72 (30); HRMS calcd for $C_{14}H_{25}N_2O_3S$ ($M+NH_4^+$) 301.1586, found 301.1577.

(2*R**,3*R**)-2-Propyl-1-tosylpyrrolidin-3-ol *cis*-**8a**



Following general procedure B, the addition of *syn*-epoxysulfonamide **7a** (50 mg, 0.19 mmol) in THF (0.5 mL) and then DMPU (0.45 mL, 3.74 mmol) to dimethylsulfoxonium methylide [prepared from *n*BuLi (1.6 M in hexanes; 0.38 mL, 0.61 mmol) and trimethylsulfoxonium iodide (123 mg, 0.56 mmol) in THF (1.4 mL)] gave after work-up and column chromatography (60% Et_2O in petrol) *cis-pyrrolidinol* **8a** (44 mg, 83%) as a colorless oil, which solidified on standing; mp 97–98 °C; R_f 0.18 (70% Et_2O in petrol); IR (KBr)/cm^{-1} 3484br, 2959m, 1597m, 1457m, 1327m, 1156m, 1090m; ^1H NMR (400 MHz) δ 7.71 (d, *J* = 8, 2H), 7.31 (d, *J* = 8, 2H), 4.06 (dddd, *J* = 10, 8, 5, 5, 1H), 3.54–3.39 (m, 3H), 2.43 (s, 3H), 1.92–1.83 (m, 1H), 1.79–1.68 (m, 2H), 1.61–1.51 (m, 2H), 1.43 (app. sextet, *J* = 7, 2H), 0.98 (t, *J* = 7, 3H); ^{13}C NMR (100 MHz) δ 143.4, 134.8, 129.7, 127.4, 71.7, 63.9, 46.3, 32.5, 31.5, 21.5, 19.6, 14.3; MS *m*/*z* (ESI) 306 ($M+Na^+$, 45), 284 (100); HRMS calcd for $C_{14}H_{21}NNaO_3S$ ($M+Na^+$) 306.1140, found 306.1137.

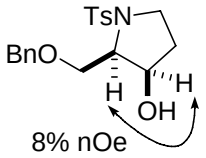
(2*R**,3*S**)-2-(Benzyloxymethyl)-1-tosylpyrrolidin-3-ol *trans*-**8b**



Following general procedure B, the addition of *N*-[(*R**)-2-(benzyloxy)-1-(*S**)-(oxiran-2-yl)ethyl]-4-methylbenzenesulfonamide (*anti*-**7b**)[2,3] (50 mg, 0.14 mmol) in THF (0.5 mL) and then DMPU (0.35 mL, 2.91 mmol) to dimethylsulfoxonium methylide [prepared from *n*BuLi (1.6 M in hexanes; 0.30 mL, 0.48 mmol) and trimethylsulfoxonium iodide (95 mg, 0.43 mmol) in THF (1 mL)] gave after work-up and column chromatography (70% Et_2O in petrol) *trans-pyrrolidinol* **8b** (39 mg, 74%) as a colorless oil; R_f 0.18 (70% Et_2O in petrol); IR (neat)/cm^{-1} 3223br, 3038w, 2932s, 1598s, 1454m, 1346m, 1162m; ^1H NMR (400 MHz) δ 7.74 (d, *J* = 8, 2H), 7.39–7.30 (m, 7H), 4.56 (dd, *J* = 18.5, 12, 2H), 4.32 (s, 1H), 3.88 (dd, *J* = 9.5, 4, 1H), 3.54–3.40 (m, 3H), 3.26

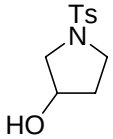
(ddd, *J* = 16.5, 10, 7, 1H), 2.42 (s, 3H), 2.06−2.01 (m, 1H), 1.69−1.64 (m, 1H), 1.40 (br, 1H); ^{13}C NMR (100 MHz) δ 143.6, 137.9, 133.5, 129.6, 128.5, 127.9, 127.8, 127.7, 74.1, 73.6, 72.1, 67.3, 46.8, 31.9, 21.6; MS *m*/*z* (CI) 362 (M+H$^+$, 100); HRMS calcd for $C_{19}H_{23}NNaO_4S$ (M+Na$^+$) 384.1245, found 384.1240.

(2*R**,3*R**)-2-(Benzyloxymethyl)-1-tosylpyrrolidin-3-ol *cis*-**8b**



Following general procedure B, the addition of *N*-[(*R**)-2-(benzyloxy)-1-(*S**)-(oxiran-2-yl)ethyl]-4-methylbenzenesulfonamide (*syn*-**7b**)[2,3] (50 mg, 0.14 mmol) in THF (0.5 mL) and then DMPU (0.35 mL, 2.91 mmol) to dimethylsulfoxonium methylide [prepared from *n*BuLi (1.6 M in hexanes; 0.30 mL, 0.48 mmol) and trimethylsulfoxonium iodide (95 mg, 0.43 mmol) in THF (1 mL)] gave after work-up and column chromatography (70% Et_2O in petrol) *cis-pyrrolidinol* **8b** (40 mg, 76%) as a colorless oil; R_f 0.18 (70% Et_2O in petrol); IR (neat)/cm^{-1} 3223br, 3031w, 2926s, 1598s, 1454m, 1337m, 1160m; ^{1}H NMR (400 MHz) δ 7.70 (d, *J* = 8, 2H), 7.40−7.30 (m, 7H), 4.57 (s, 2H), 4.12 (app. quint, *J* = 5.5, 1H), 4.01 (dd, *J* = 9.5, 4, 1H), 3.90 (dd, *J* = 9.5, 7.5, 1H), 3.68 (ddd, *J* = 7.5, 5.5, 4, 1H), 3.54 (dt, *J* = 13, 5.5, 1H), 3.28 (dt, *J* = 13, 5.5, 1H), 2.95 (d, *J* = 5.5, 1H), 2.43 (s, 3H), 1.82 (dq, *J* = 12, 5.5, 1H), 1.55 (dq, *J* = 12, 5.5, 1H); ^{13}C NMR (100 MHz) δ 143.7, 137.4, 134.1, 129.8, 128.6, 128.1, 127.9, 127.5, 73.9, 72.7, 70.2, 61.2, 46.8, 32.9, 21.5; MS *m*/*z* (ESI) 384 (M+Na$^+$, 100), 362 (18); HRMS calcd for $C_{19}H_{23}NNaO_4S$ (M+Na$^+$) 384.1245, found 384.1255.

1-Tosylpyrrolidin-3-ol[8] **8c**

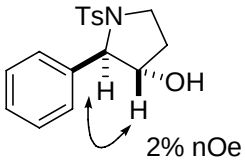


Following general procedure B, the addition of 4-methyl-*N*-(oxiran-2-ylmethyl)benzenesulfonamide (**7c**)[2,3] (60 mg, 0.26 mmol) in THF (0.6 mL) and then DMPU (0.63 mL, 5.24 mmol) to dimethylsulfoxonium methylide [prepared from *n*BuLi

(8) Spectra and physical properties matched commercially available material (Aldrich, cat. no. 53,215−0).

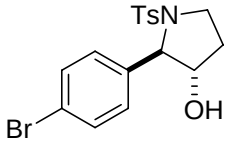
(1.6 M in hexanes; 0.55 mL, 0.88 mmol) and trimethylsulfoxonium iodide (174 mg, 0.79 mmol) in THF (2 mL)] gave after work-up and column chromatography (35% EtOAc in petrol) *pyrrolidinol* **8c** (46 mg, 72%) as a colorless oil, which solidified on standing; mp 60−61 °C (lit[8] 61−65 °C); R_f 0.18 (35% EtOAc in petrol); IR (neat)/cm^{-1} 3486br, 2948m, 1597m, 1446m, 1326s, 1161s, 1090s; ^{1}H NMR (400 MHz) δ 7.71 (d, *J* = 8, 2H), 7.32 (d, *J* = 8, 2H), 4.37−4.34 (m, 1H), 3.38−3.33 (m, 3H), 3.23 (ddd, *J* = 11, 2.5, 1.5, 1H), 2.42 (s, 3H), 1.23 (br, 1H), 1.92−1.82 (m, 2H); ^{13}C NMR (100 MHz) δ 143.6, 133.5, 129.7, 127.6, 70.6, 56.0, 46.0, 34.1, 21.5; MS *m*/*z* (ESI) 264 (M+Na$^+$, 100); HRMS calcd for $C_{11}H_{15}NNaO_3S$ (M+Na$^+$) 264.0670, found 264.0668.

(2*R**,3*S**)-2-Phenyl-1-tosylpyrrolidin-3-ol **8d**



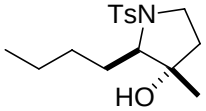
Following general procedure B, the addition of 4-methyl-*N*-[(*R**,*R**)-oxiran-2-yl(phenyl)methyl]benzenesulfonamide (**7d**)[2,3] (40 mg, 0.13 mmol) in THF (0.5 mL) and then DMPU (0.32 mL, 2.66 mmol) to dimethylsulfoxonium methylide [prepared from *n*BuLi (1.6 M in hexanes; 0.27 mL, 0.43 mmol) and trimethylsulfoxonium iodide (87 mg, 0.40 mmol) in THF (0.8 mL)] gave after work-up and column chromatography (70% Et_2O in petrol) *pyrrolidinol* **8d** (37 mg, 88%) as a white solid; mp 137−138 °C; R_f 0.17 (70% Et_2O in petrol); IR (KBr)/cm^{-1} 3514br, 2949m, 1598m, 1451m, 1328s, 1254w, 1155s, 1091m; ^{1}H NMR (400 MHz) δ 7.73 (d, *J* = 8, 2H), 7.33−7.25 (m, 7H), 4.68 (s, 1H), 4.11 (br, 1H), 3.69 (ddd, *J* = 10, 9, 2, 1H), 3.48 (ddd, *J* = 10, 7, 6.5, 1H), 2.41 (s, 3H), 2.03−1.84 (m, 2H), 1.74−1.69 (m, 1H); ^{13}C NMR (100 MHz) δ 143.5, 139.9, 134.4, 129.6, 128.5, 127.7, 127.4, 126.2, 78.7, 71.9, 46.8, 31.2, 21.6; MS *m*/*z* (ESI) 340 (M+Na$^+$, 100); HRMS calcd for $C_{17}H_{19}NNaO_3S$ (M+Na$^+$) 340.0983, found 340.0978.

(2*R**, 3*S**)-2-(4-Bromophenyl)-1-tosylpyrrolidin-3-ol **8e**



Following general procedure B, the addition of *anti*-epoxysulfonamide **7e** (50 mg, 0.13 mmol) in THF (0.5 mL) and then DMPU (0.31 mL, 2.66 mmol) to dimethylsulfoxonium methylide [prepared from *n*BuLi (1.6 M in hexanes; 0.27 mL, 0.43 mmol) and trimethylsulfoxonium iodide (86 mg, 0.39 mmol) in THF (0.8 mL)] gave after work-up and column chromatography (35% EtOAc in petrol) *pyrrolidinol* **8e** (43 mg, 82%) as a white solid; mp 143−144 °C; R_f 0.20 (35% EtOAc in petrol); IR (KBr)/cm^{-1} 3510s, 2942m, 2875w, 1540w, 1488m, 1445w, 1403m, 1330s, 1253w, 1157s, 1093m, 1008 m; ^{1}H NMR (400 MHz) δ 7.72 (d, *J* = 8, 2H), 7.43 (d, *J* = 8, 2H), 7.29 (d, *J* = 8, 2H), 7.21 (d, *J* = 8, 2H), 4.61 (s, 1H), 4.09−4.07 (m, 1H), 3.68 (ddd, *J* = 10, 9, 2, 1H), 3.48 (ddd, *J* = 10, 7, 6.5, 1H), 2.42 (s, 3H), 2.00−1.91 (m, 2H), 1.76−1.69 (m, 1H); ^{13}C NMR (100 MHz) δ 143.8 139.1, 134.1, 131.6, 129.7, 128.0, 127.7, 121.4, 84.4, 71.3, 46.8, 31.3, 21.6; MS *m*/*z* (ESI) 396 (M+H$^+$, 100); HRMS calcd for $C_{17}H_{19}BrNO_3S$ (M+H$^+$) 396.0269, found 396.0268.

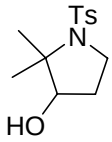
(2*R**,3*S**)-2-Butyl-3-methyl-1-tosylpyrrolidin-3-ol **8f**



Following general procedure B, the addition of epoxysulfonamide **7f** (50 mg, 0.17 mmol) in THF (0.7 mL) and then DMPU (0.40 mL, 3.33 mmol) to dimethylsulfoxonium methylide [prepared from *n*BuLi (1.6 M in hexanes; 0.34 mL, 0.54 mmol) and trimethylsulfoxonium iodide (111 mg, 0.50 mmol) in THF (1 mL)] gave after work-up and column chromatography (70% Et_2O in petrol) *pyrrolidinol* **8f** (42 mg, 80%) as a colorless oil; R_f 0.19 (70% Et_2O in petrol); IR (neat)/cm^{-1} 3508br, 2957s, 1599m, 1455m, 1329s, 1157s; ^{1}H NMR (400 MHz) δ 7.74 (d, *J* = 8, 2H), 7.29 (d, *J* = 8, 2H), 3.45 (dd, *J* = 6.5, 6, 1H), 3.39 (ddd, *J* = 10, 8, 1.5, 1H), 3.25 (ddd, *J* = 10, 7.5, 7, 1H), 2.40 (s, 3H), 1.88 (ddd, *J* = 13, 7.5, 1.5, 1H), 1.70 (ddd, *J* = 13, 8, 7.5, 1H), 1.59−1.28 (m, 7H), 1.24 (s, 3H), 0.91 (t, *J* = 7, 3H); ^{13}C NMR (100 MHz) δ 143.4, 134.6, 129.5, 127.9, 79.7, 70.8,

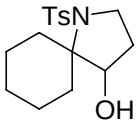
45.8, 37.6, 33.8, 28.1, 22.9, 22.6, 21.5, 14.0; MS *m*/*z* (ESI+) 334 ($M+Na^+$, 100); HRMS calcd for $C_{16}H_{25}NNaO_3S$ ($M+Na^+$) 334.1453, found 334.1441.

2, 2-Dimethyl-1-tosylpyrrolidin-3-ol **8g**



Following general procedure B, the addition of epoxysulfonamide **7g** (50 mg, 0.20 mmol) in THF (0.5 mL) and then DMPU (0.47 mmol, 3.91 mmol) to dimethylsulfoxonium methylide [prepared from *n*BuLi (1.6 M in hexanes; 0.41 mL, 0.65 mmol) and trimethylsulfoxonium iodide (130 mg, 0.59 mmol) in THF (1.5 mL)] gave after work-up and column chromatography (35% EtOAc in petrol) *pyrrolidinol* **8g** (38 mg, 72%) as a white solid; mp 114−115 °C; R_f 0.16 (35% EtOAc in petrol); IR (KBr)/cm^{-1} 3440br, 2982m, 1597m, 1331s, 1155s, 1111m; ^1H NMR (400 MHz) δ 7.70 (d, *J* = 8, 2H), 7.26 (d, *J* = 8, 2H), 3.80 (dd, *J* = 5.5, 5.5, 2H), 3.47 (ddd, *J* = 8.5, 7, 6.5, 1H), 3.39 (ddd, *J* = 8.5, 6, 5.5, 1H), 2.40 (s, 3H), 2.24 (br, 1H) 2.10 (dddd, *J* = 8, 7, 6, 5.5, 1H), 1.76 (dddd, *J* = 8, 6.5, 5.5, 5.5, 1H), 1.36 (s, 3H), 1.31 (s, 3H); ^{13}C NMR (100 MHz) δ 142.8, 138.5, 129.5, 127.0, 79.8, 67.1, 45.5, 29.9, 26.8, 21.5, 21.1; MS *m*/*z* (ESI) 292 ($M+Na^+$, 100); HRMS calcd for $C_{13}H_{19}NNaO_3S$ ($M+Na^+$) 292.0983, found 292.0977.

2,2-Cyclohexyl-1-tosylpyrrolidin-3-ol **10a**

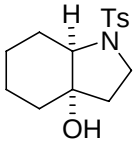


Following general procedure B, the addition of 4-methyl-*N*-(1-(oxiran-2-yl)cyclohexyl)benzenesulfonamide (**9a**)[9] (50 mg, 0.17 mmol) in THF (0.5 mL) and then DMPU (0.41 mL, 3.40 mmol) to dimethylsulfoxonium methylide [prepared from *n*BuLi (1.6 M in hexanes; 0.35 mL, 0.56 mmol) and trimethylsulfoxonium iodide (112 mg, 0.51 mmol) in THF (1.2 mL)] gave after work-up and column chromatography (70% Et_2O in

(9) Moulines, J.; Charpentier, P.; Bats, J. P.; Nuhrich, A.; Lamidey, A. M. *Tetrahedron Lett*. **1992**, *33*, 487−490.

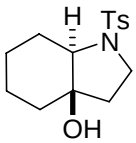
petrol) *pyrrolidinol* **10a** (43 mg, 81%) as a colorless oil, which solidified on standing; mp 94–95 °C; R_f 0.19 (70% Et_2O in petrol); IR (KBr)/cm^{-1} 3501br, 2939m, 2863m, 1599w, 1454m, 1325m, 1154s, 1092s; ^{1}H NMR (400 MHz) δ 7.72 (d, *J* = 8, 2H), 7.23 (d, *J* = 8, 2H), 4.35 (br, 1H), 3.66 (ddd, *J* = 9, 9, 2, 1H), 3.47 (ddd, *J* = 9, 6.5, 6, 1H), 2.38 (s, 3H), 2.27–2.04 (m, 3H), 1.89–1.52 (m, 7H), 1.37–1.14 (m, 3H); ^{13}C NMR (100 MHz) δ 142.4, 139.3, 129.3, 126.7, 73.7, 72.8, 46.7, 36.0, 30.8, 29.6, 24.9, 24.8, 24.5, 21.4; MS *m*/*z* (ESI) 332 (M+Na^+, 90), 310 (100); HRMS calcd for $C_{16}H_{23}NNaO_3S$ (M+Na^+) 332.1296, found 332.1299.

(3aR*, 7aS*)-1-Tosyl-octahydro-1H-indol-3a-ol *cis*-**10b**



Following general procedure B, the addition of *anti*-epoxysulfonamide **9b** (110 mg, 0.39 mmol) in THF (1.9 mL) and then DMPU (0.94 mL, 7.80 mmol) to dimethylsulfoxonium methylide [prepared from *n*BuLi (1.6 M in hexanes; 0.80 mL, 1.28 mmol) and trimethylsulfoxonium iodide (257 mg, 1.17 mmol) in THF (2 mL)] gave after work-up and column chromatography (35% EtOAc in petrol) *cis-pyrrolidinol* **10b** (80 mg, 69%) as a colorless oil; R_f 0.18 (35% EtOAc in petrol); IR (neat)/cm^{-1} 3501br, 2975s, 2927s, 1599s, 1454m, 1336m, 1156s, 1094m; ^{1}H NMR (400 MHz) δ 7.75 (d, *J* = 8, 2H), 7.30 (d, *J* = 8, 2H), 3.50 (ddd, *J* = 9, 8, 7, 1H), 3.38–3.31 (m, 2H), 2.41 (s, 3H), 2.20–2.11 (m, 2H), 1.93 (d, *J* = 13, 1H), 1.67–1.47 (m, 4H), 1.42–1.19 (m, 3H); ^{13}C NMR (100 MHz) δ 143.2, 135.1, 129.5, 127.5, 66.9, 45.3, 35.2, 34.0, 33.2, 23.5, 23.0, 21.5; MS *m*/*z* (ESI) 296 (M+H^+, 100); HRMS calcd for $C_{15}H_{22}NO_3S$ (M+H^+) 296.1320, found 296.1318.

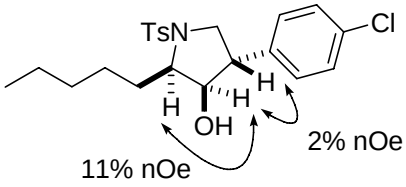
(3a*R**,7a*R**)-1-Tosyl-octahydro-1H-indol-3a-ol *trans*-**10b**



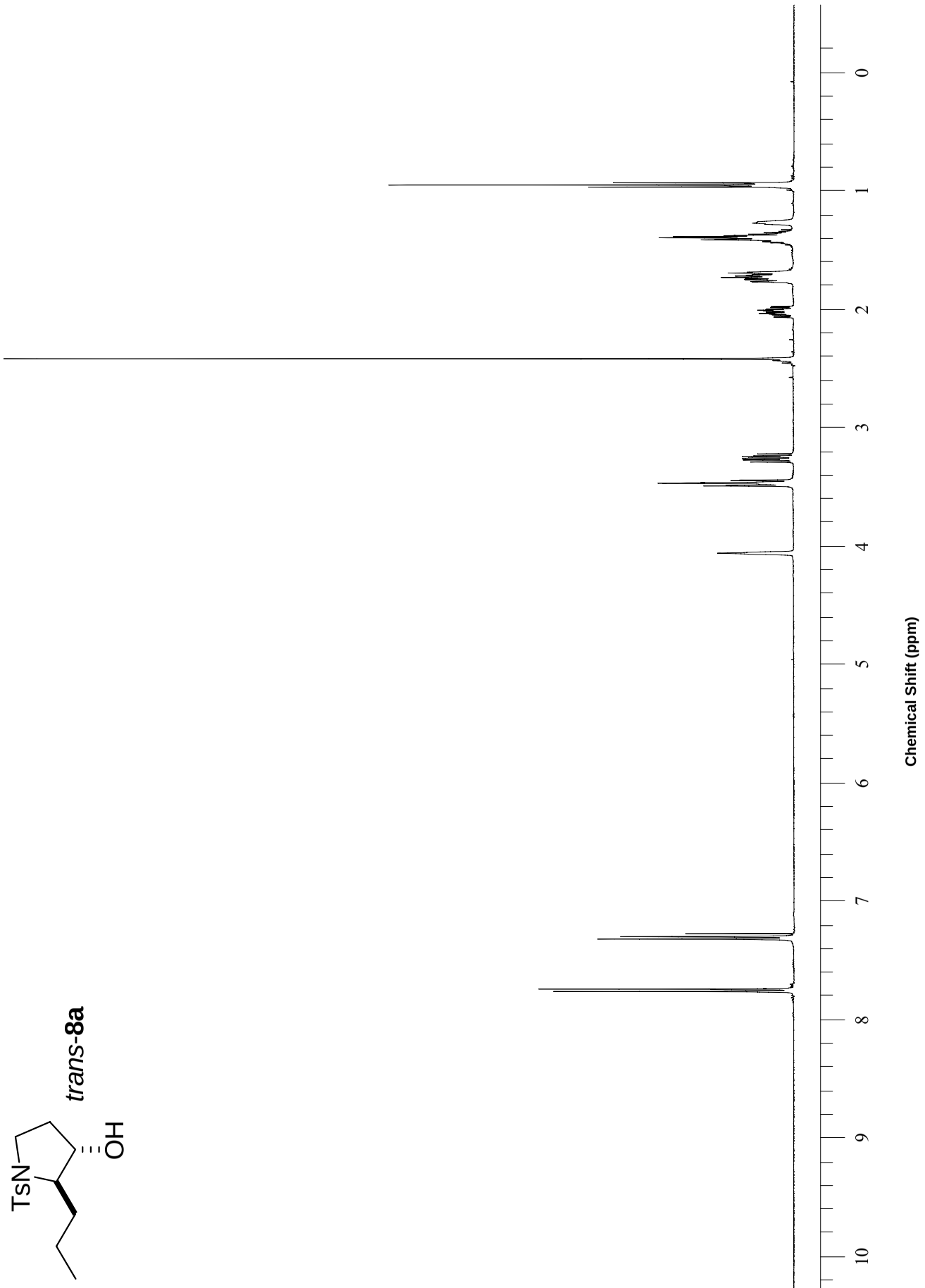
Following general procedure B, the addition of *syn*-epoxysulfonamide **9b** (130 mg, 0.46 mmol) in THF (1.6 mL) and then DMPU (1.11 mL, 9.20 mmol) to dimethylsulfoxonium methylide [prepared from *n*BuLi (1.6 M in hexanes; 0.95 mL, 1.52 mmol) and trimethylsulfoxonium iodide (304 mg, 1.38 mmol) in THF (3 mL)] gave

after work-up and column chromatography (70% Et_2O in petrol) *trans-pyrrolidinol* **10b** (90 mg, 66%) as a colorless oil, which solidified on standing; mp 121−122 °C; R_f 0.19 (70% Et_2O in petrol); IR (KBr)/cm^{-1} 3501br, 2975s, 2925s, 1599m, 1451m, 1331m, 1154s, 1091m; ^1H NMR (500 MHz) δ 7.70 (d, *J* = 8, 2H), 7.35 (d, *J* = 8, 2H), 3.59 (ddd, *J* = 10.5, 10, 2, 1H), 3.20 (ddd, *J* = 10.5, 10, 2, 1H), 2.46 (s, 3H), 2.43 (dd, *J* = 12, 4, 1H), 2.34−2.30 (m, 1H), 1.97−1.59 (m, 6H), 1.50−1.38 (m, 2H), 1.21−1.18 (m, 2H); ^{13}C NMR (125 MHz) δ 143.6, 133.1, 129.7, 127.7, 76.3, 66.6, 46.4, 36.1, 34.1, 25.8, 23.9, 21.6, 20.1; MS *m*/*z* (ESI) 294 ($M-H^+$, 100), 255 (10), 239 (15), 170 (15); HRMS calcd for $C_{15}H_{20}NO_3S$ ($M-H^+$) 294.1164, found 294.1164.

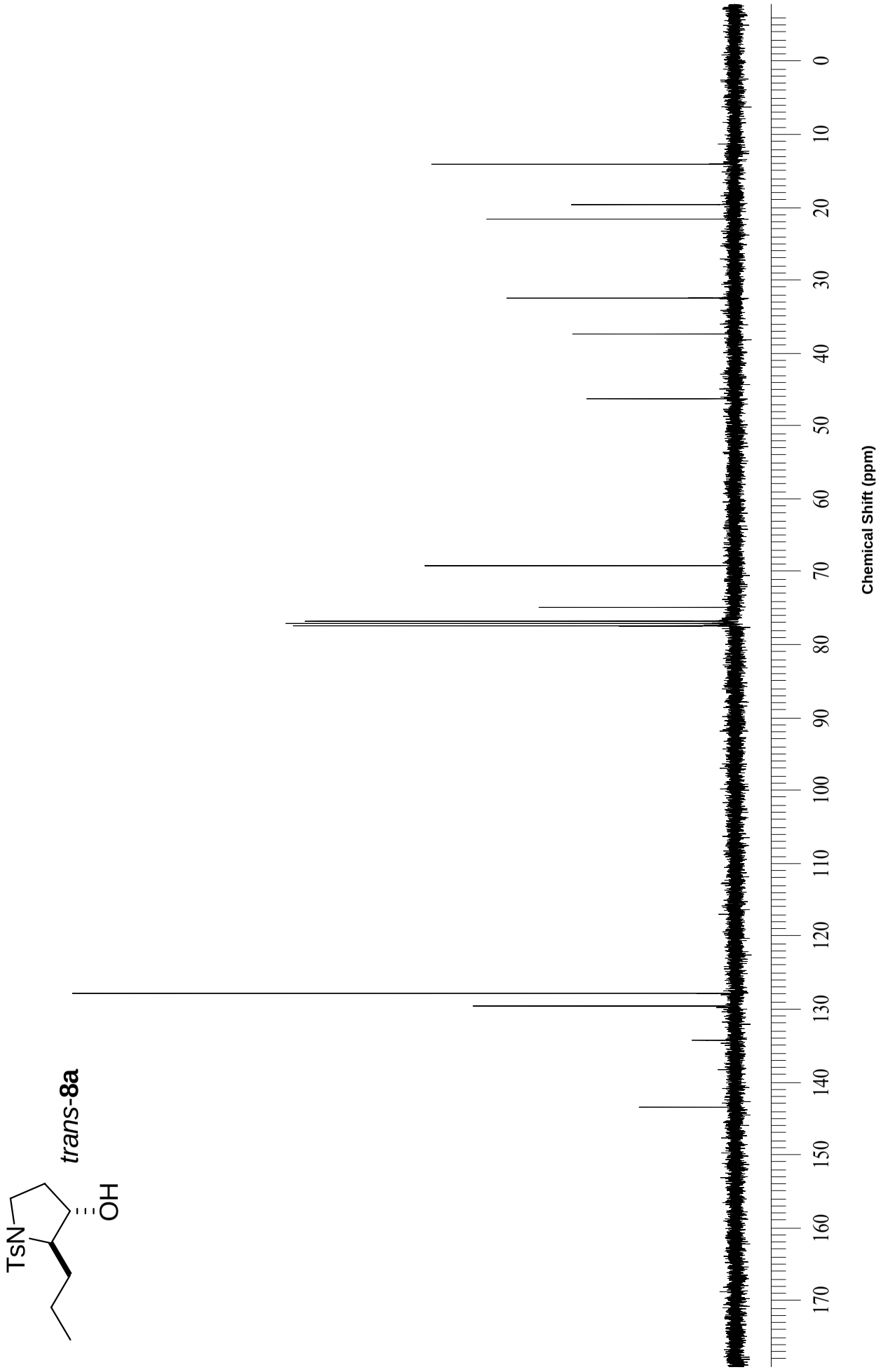
(2*R**,3*R**,4*S**)-4-(4-Chlorophenyl)-2-pentyl-1-tosylpyrrolidin-3-ol **12**



Following general procedure B, the addition of *syn*-epoxysulfonamide **11** (50 mg, 0.12 mmol) in THF (0.5 mL) and then DMPU (0.30 mL, 2.5 mmol) to dimethylsulfoxonium methylide [prepared from *n*BuLi (1.6 M in hexanes; 0.25 mL, 0.40 mmol) and trimethylsulfoxonium iodide (81 mg, 0.37 mmol) in THF (0.7 mL)] gave after work-up and column chromatography (40% Et_2O in petrol) *pyrrolidinol* **12** (40 mg, 77%) as a colorless oil; R_f 0.20 (40% Et_2O in petrol); IR (neat)/cm^{-1} 3499br, 2955s, 2927s, 1598m, 1494m, 1340m, 1161s, 1094m; ^1H NMR (500 MHz) δ 7.74 (d, *J* = 8, 2H), 7.34 (d, *J* = 8, 2H), 7.22 (d, *J* = 8.5, 2H), 6.88 (d, *J* = 8.5, 2H), 3.88 (ddd, *J* = 7, 6.5, 6, 1H), 3.80−3.75 (m, 2H), 3.26−3.20 (m, 2H), 2.48 (s, 3H), 1.83−1.26 (m, 9H), 0.92 (t, *J* = 8, 3H); ^{13}C NMR (125 MHz) δ 143.8, 137.0, 134.9, 133.3, 129.8, 129.0, 128.8, 127.5, 77.3, 62.3, 51.3, 48.8, 32.0, 29.5, 25.8, 22.6, 21.6, 14.1; HRMS calcd for $C_{22}H_{29}ClNO_3S$ ($M+H^+$) 422.1557, found 422.1550.



trans-**8a**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OH
trans-8a
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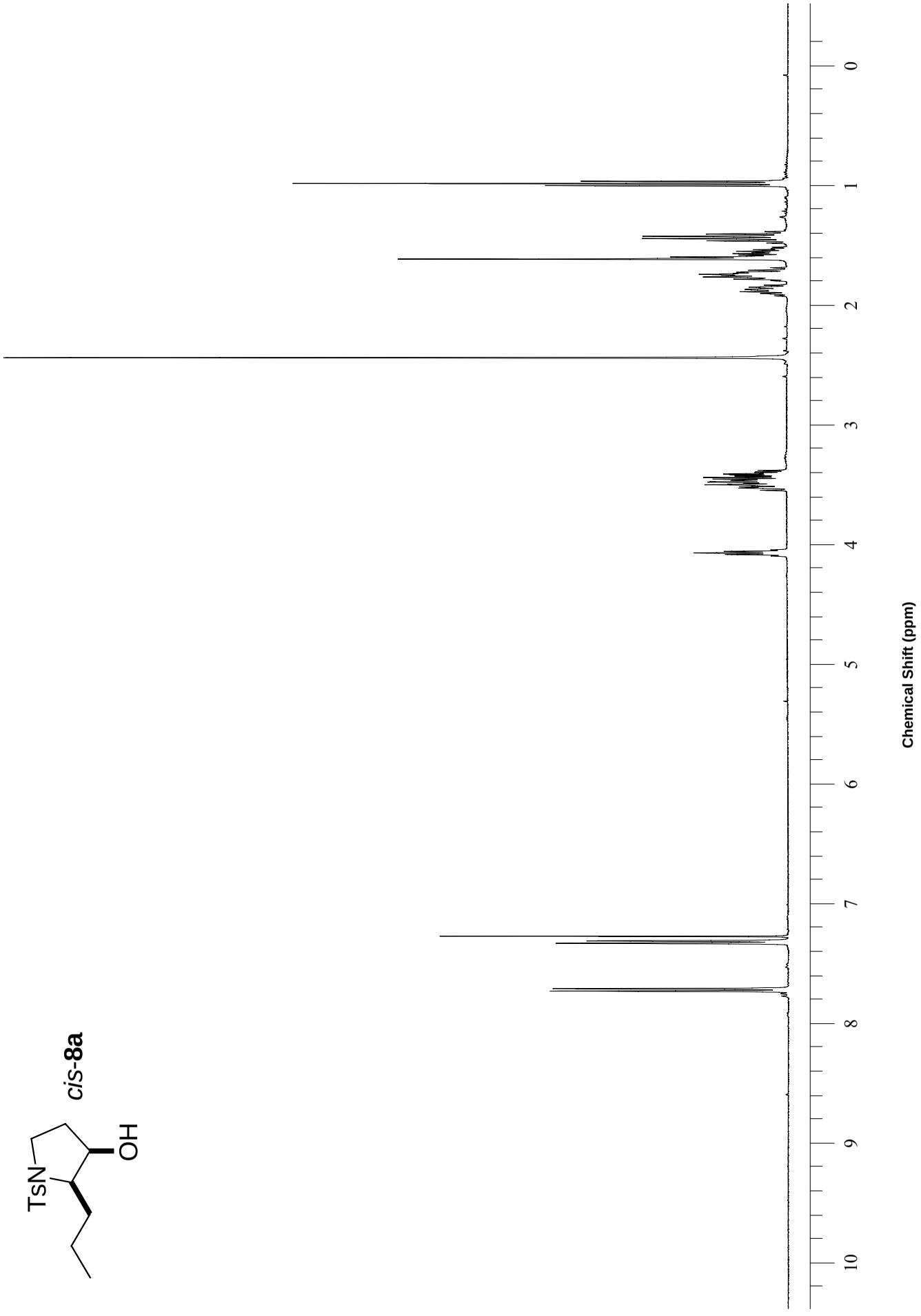
140
150
160
170


cis-8a
TsN
OH
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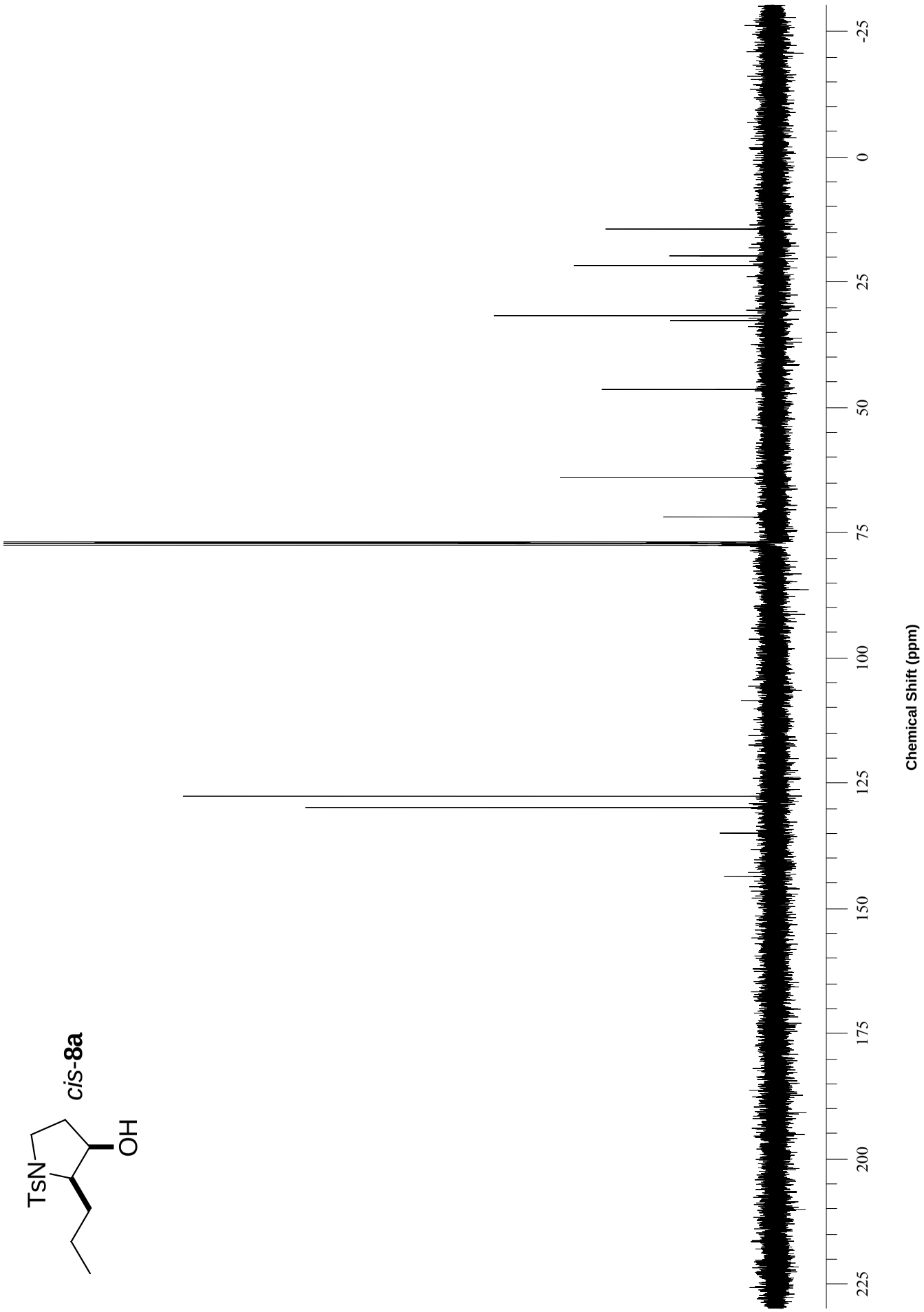
8
9
10
Chemical Shift (ppm)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100
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150
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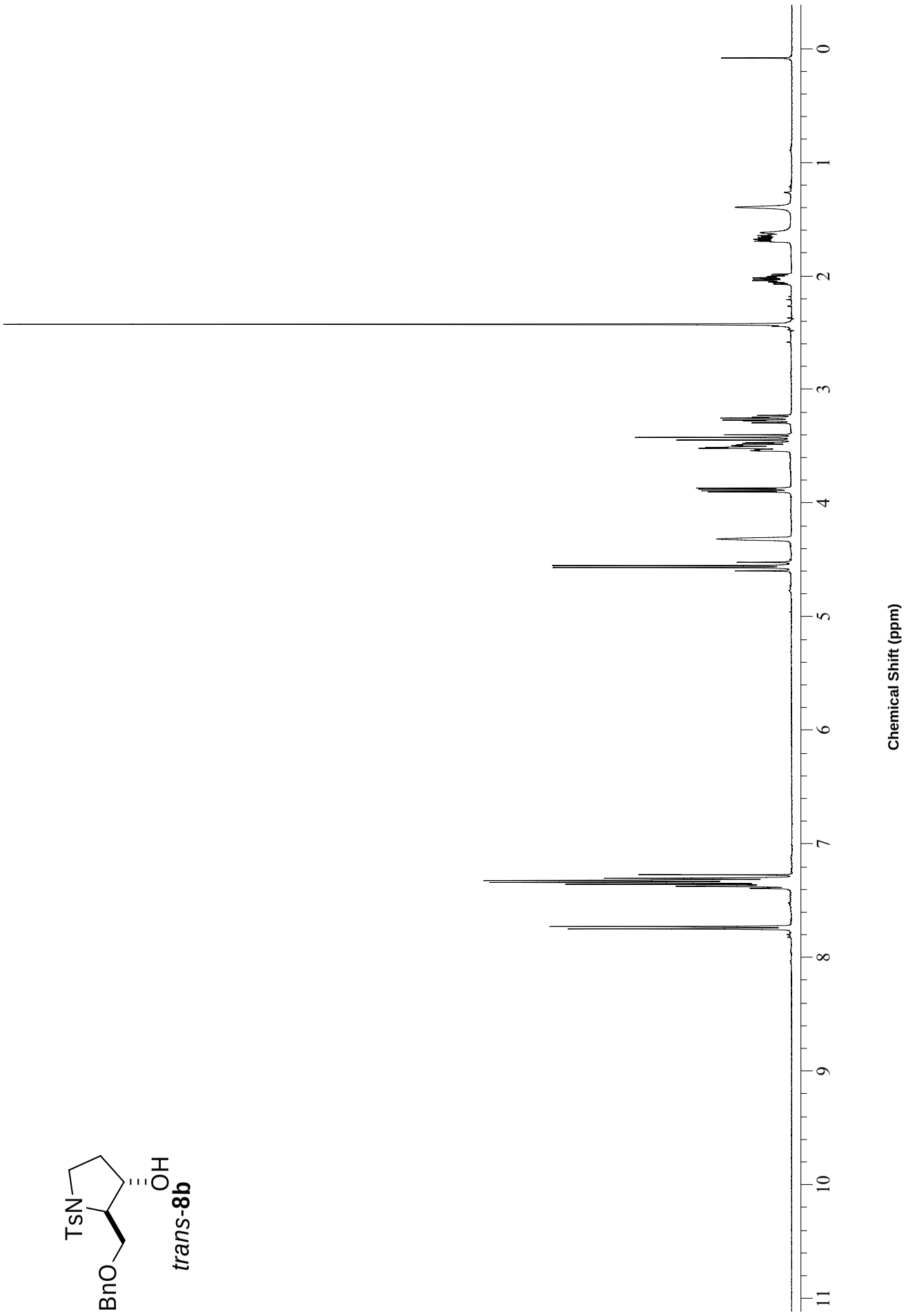
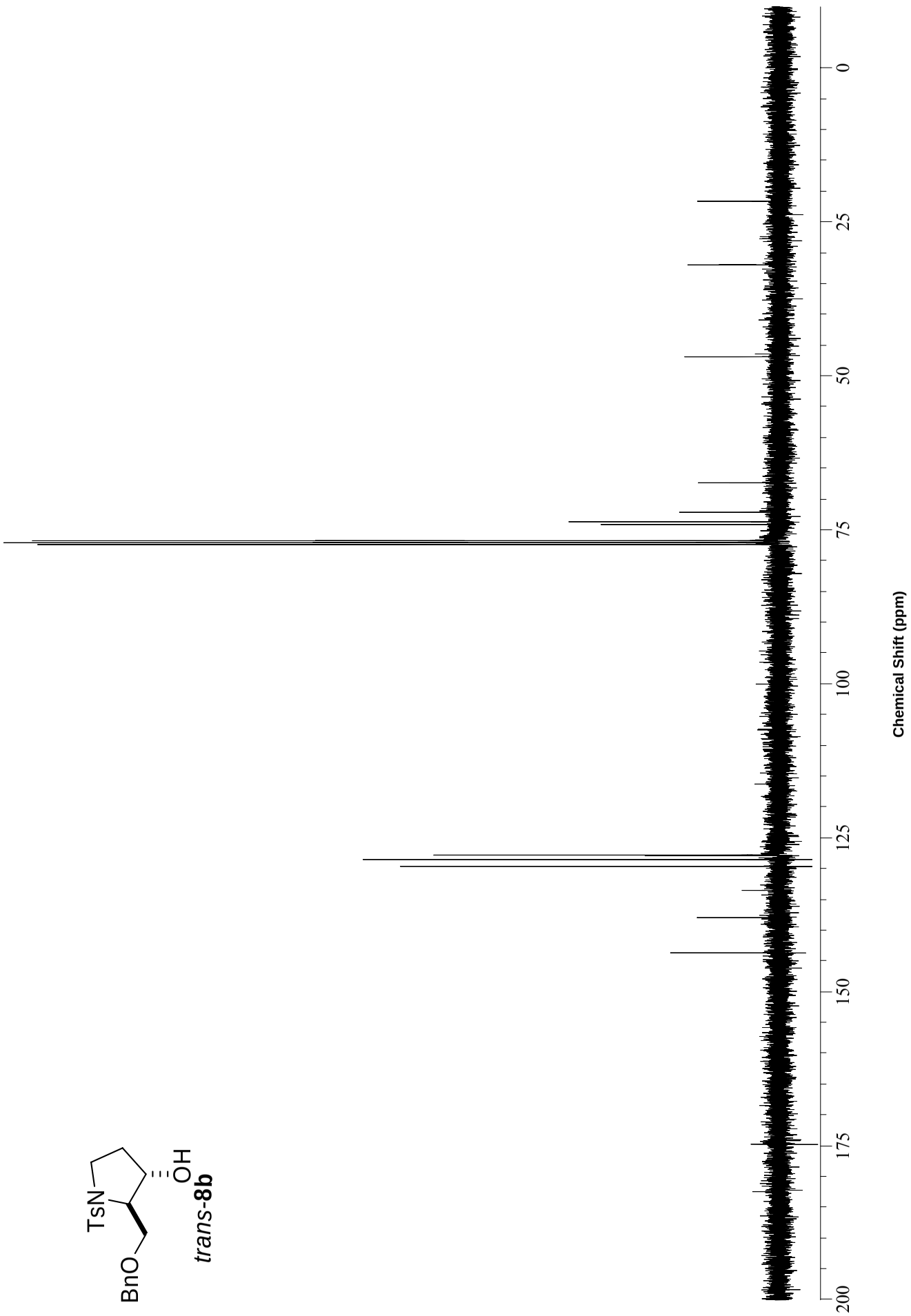
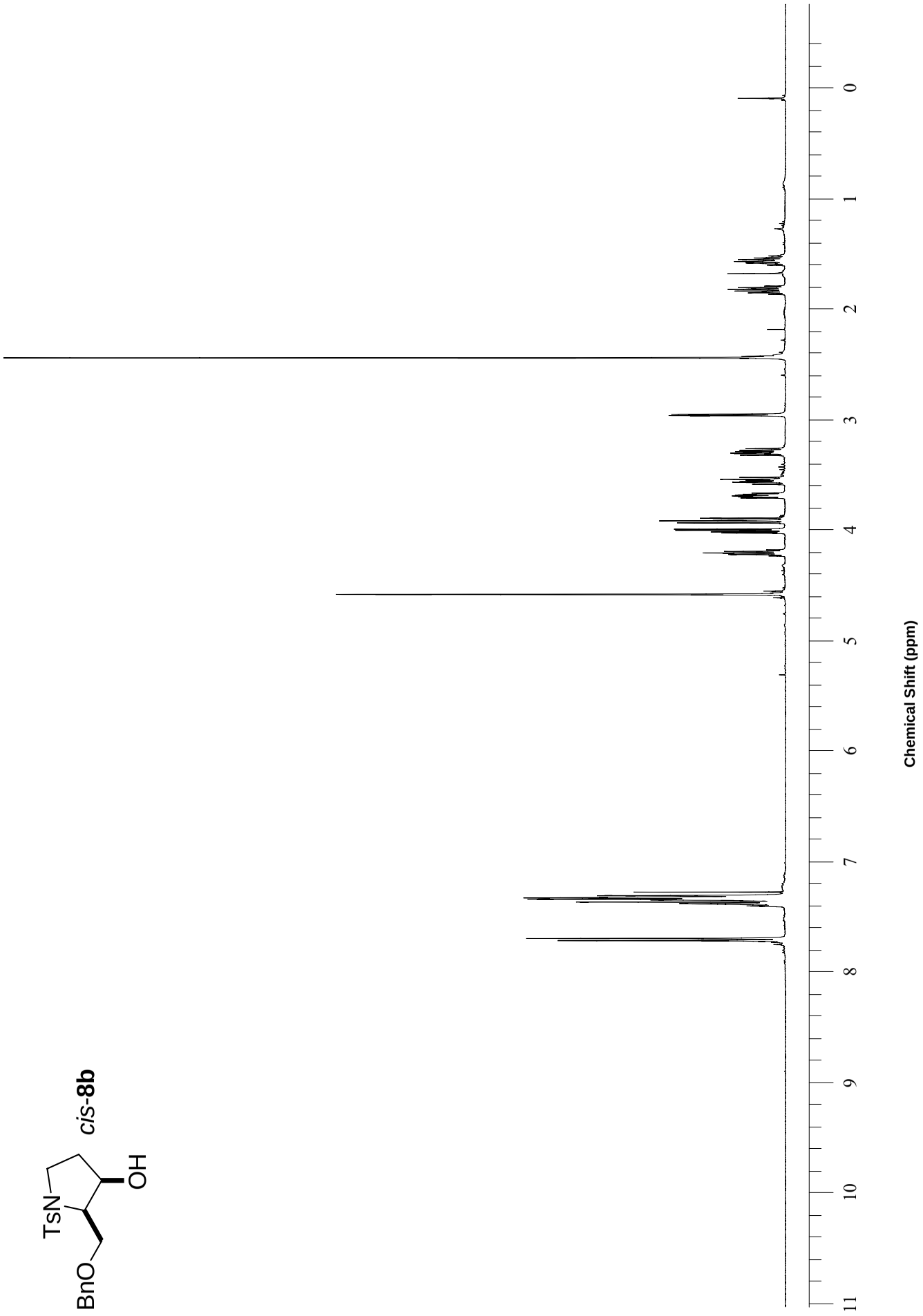
200
225
Chemical Shift (ppm)



trans-**8b**



trans-**8b**


cis-8b
TsN
OH
BnO
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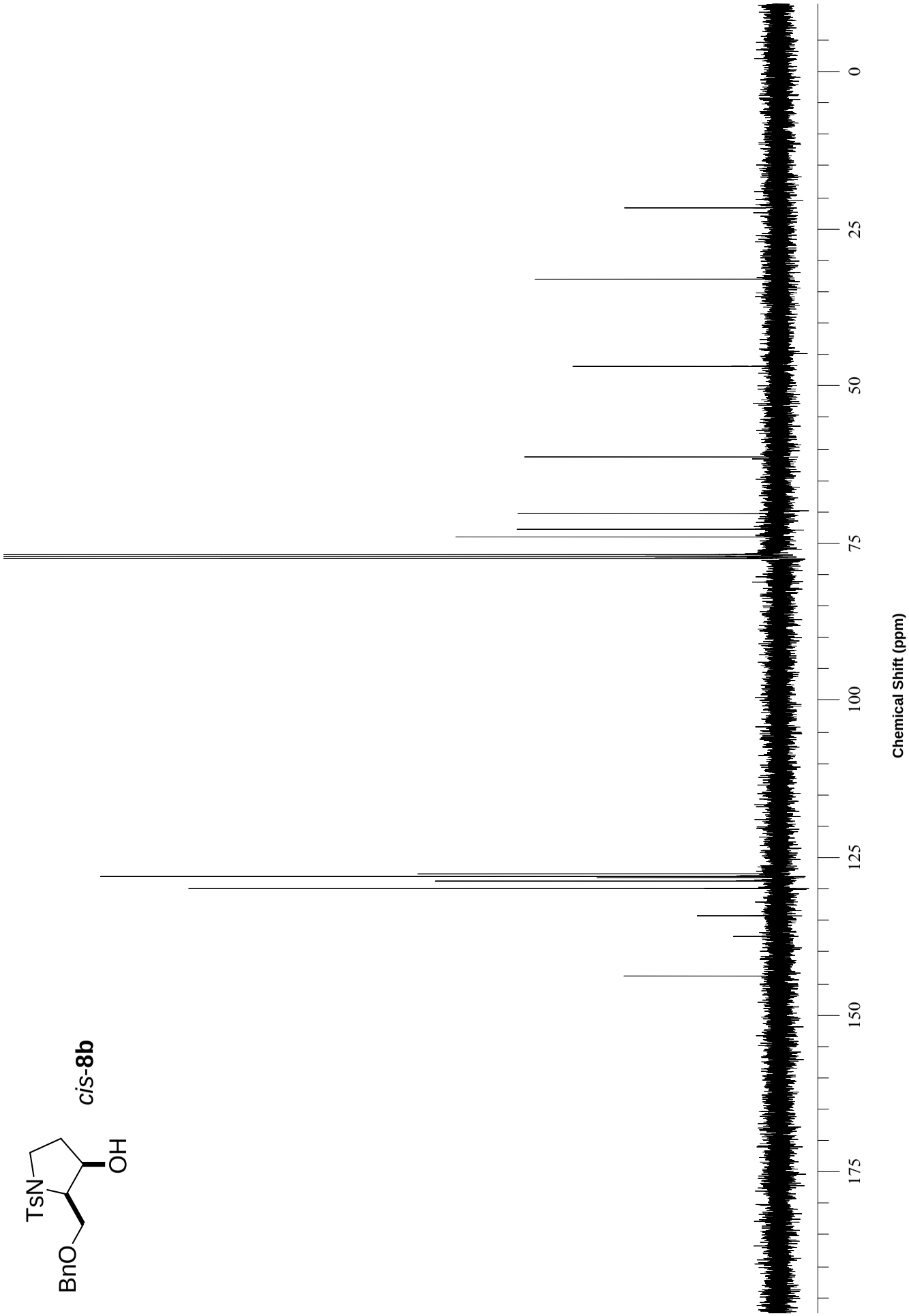
6
7
8
9
10
11


cis-8b
TsN
OH
BnO
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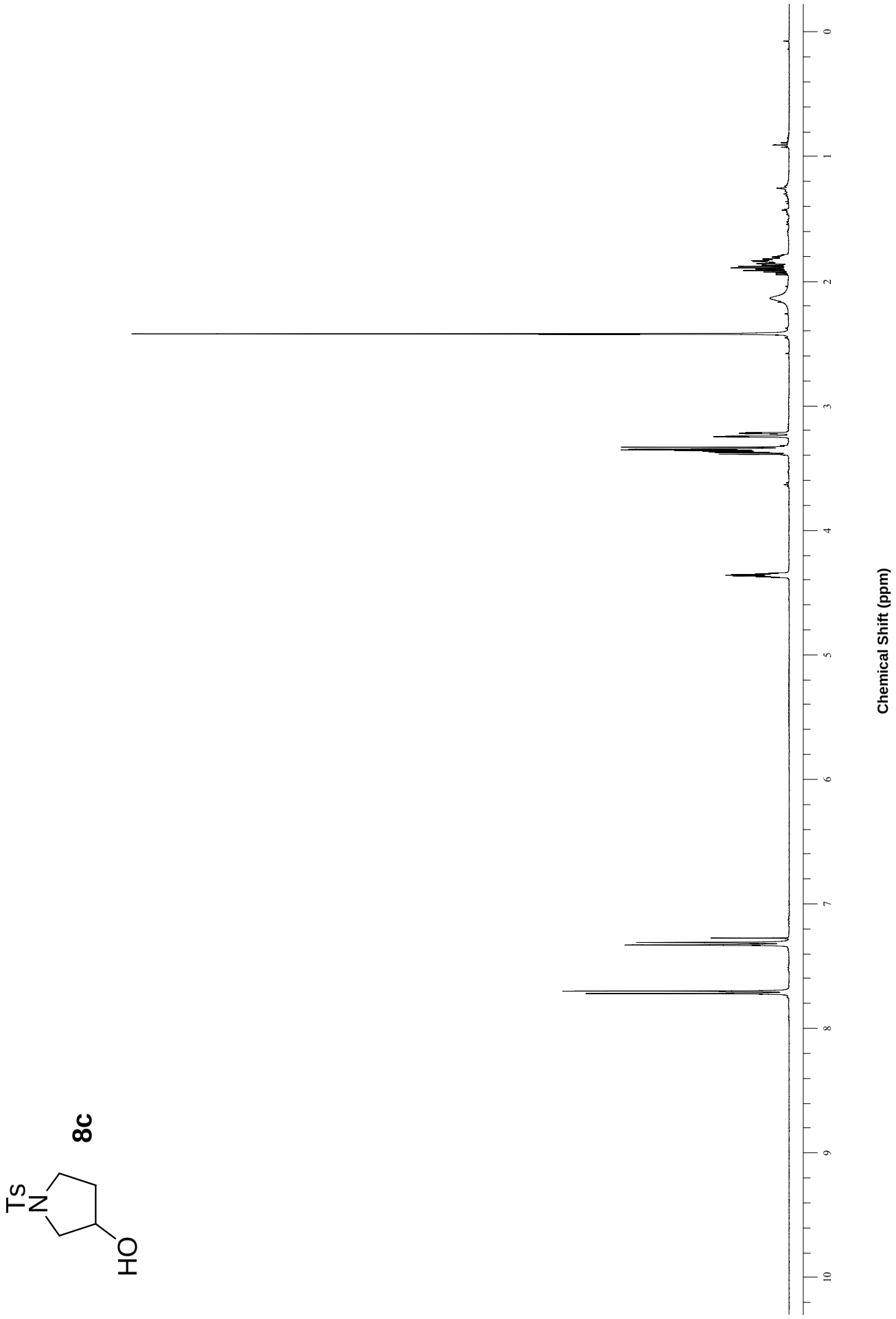
50
75
100
125
150
175
Chemical Shift (ppm)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Ts
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HO
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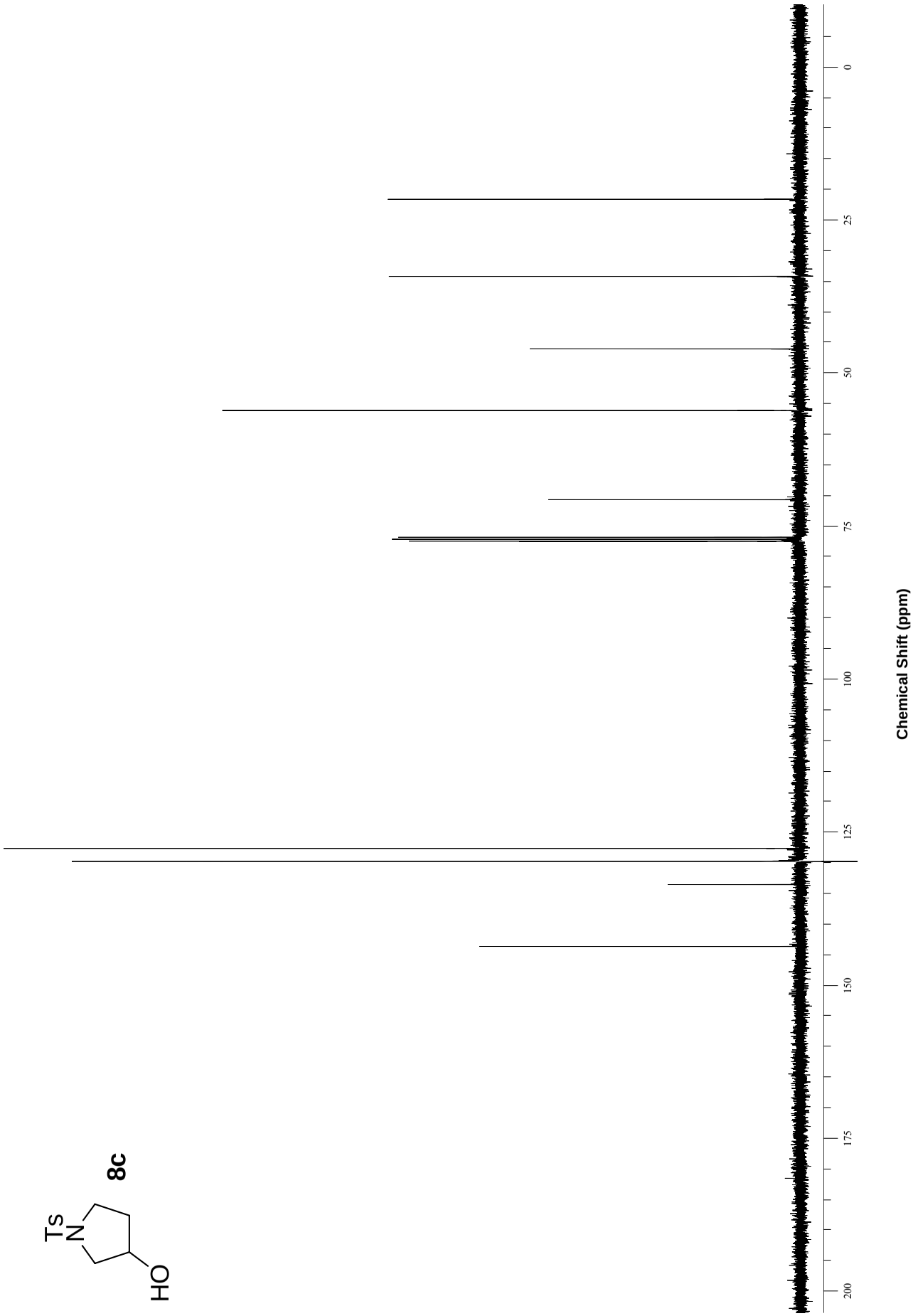
5
6
7
8
9
10
Chemical Shift (ppm)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Ts
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HO
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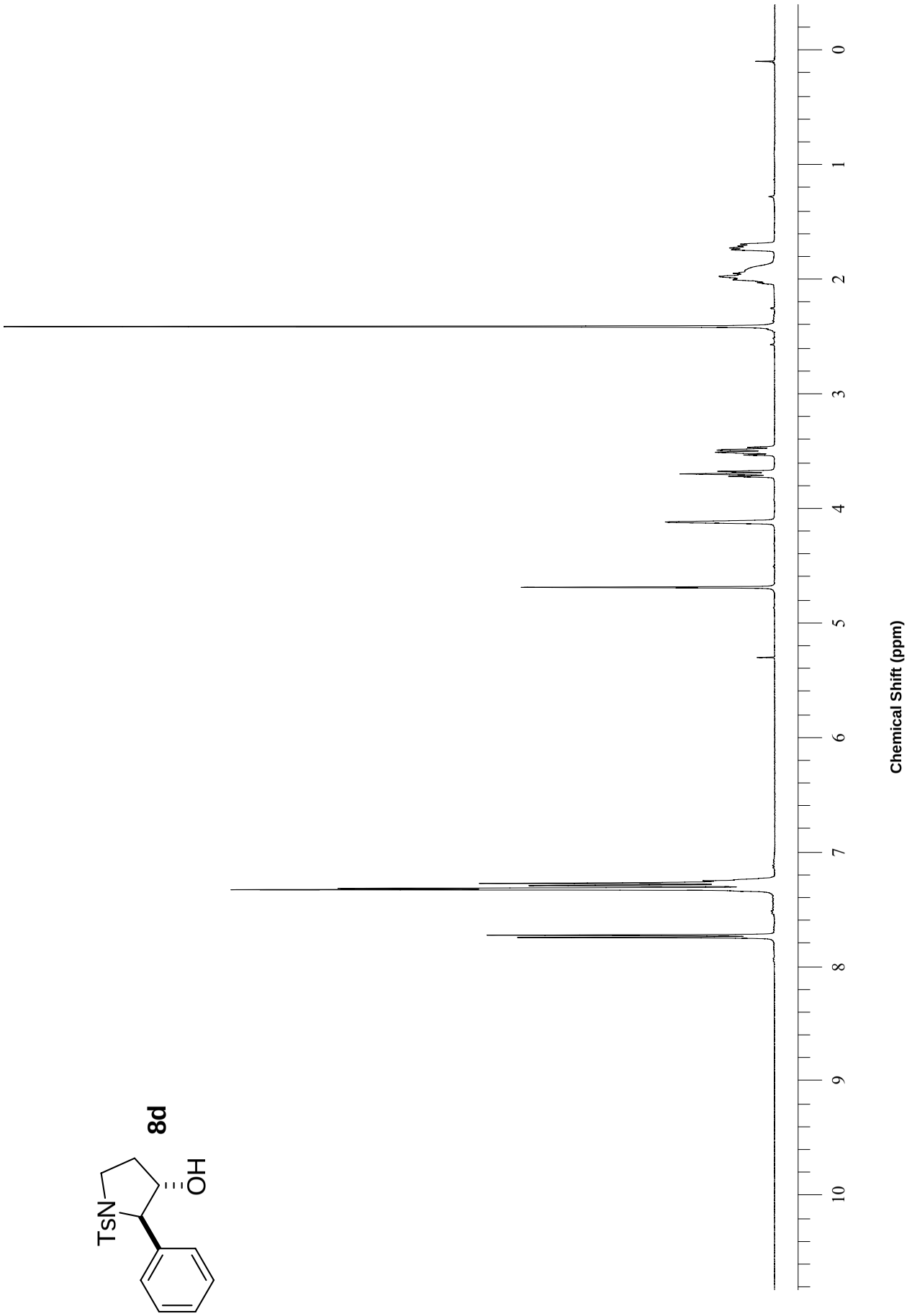
Chemical Shift (ppm)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TsN
OH
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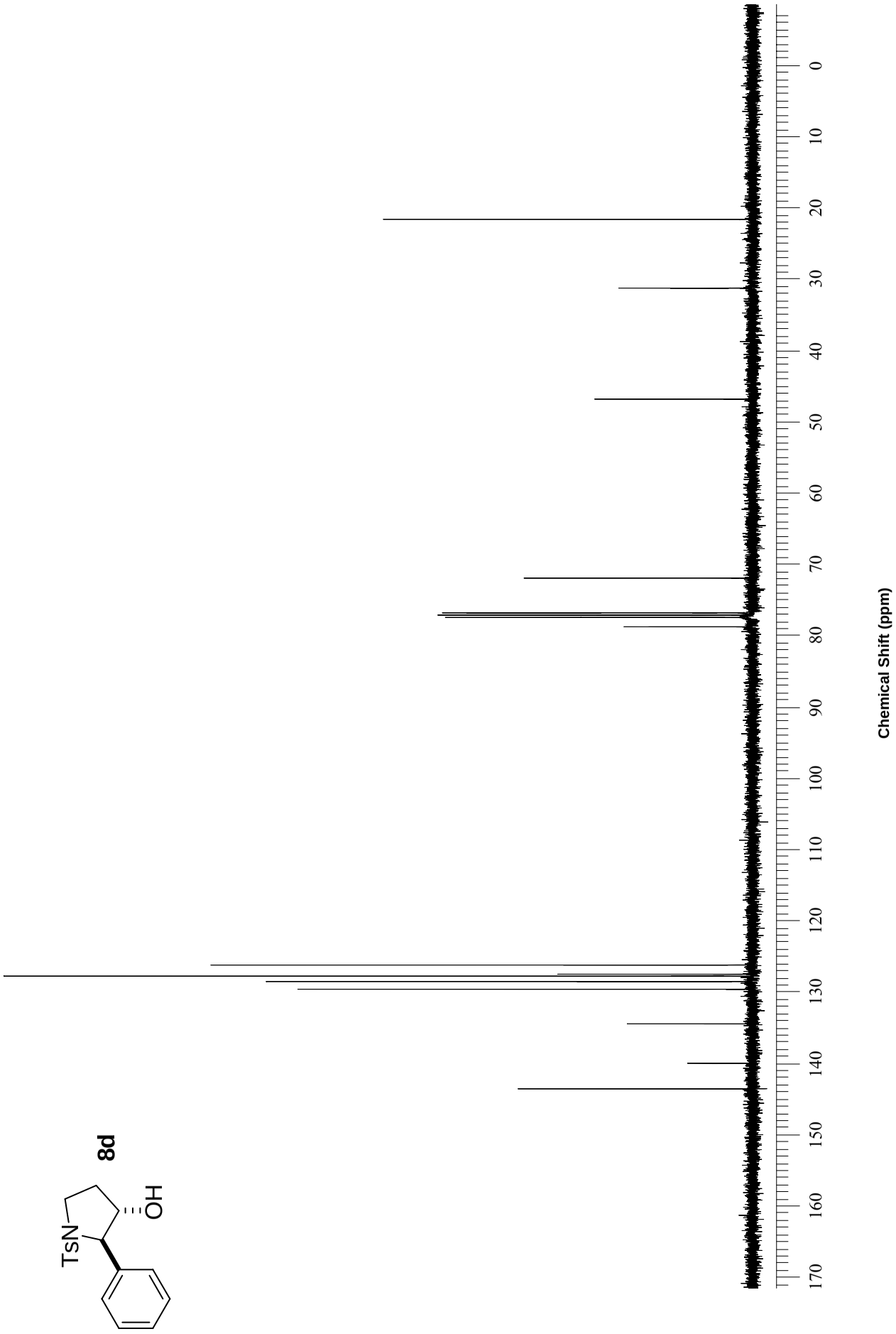
5
6
7
8
9
10
Chemical Shift (ppm)


8d
TsN
OH
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110
120
130
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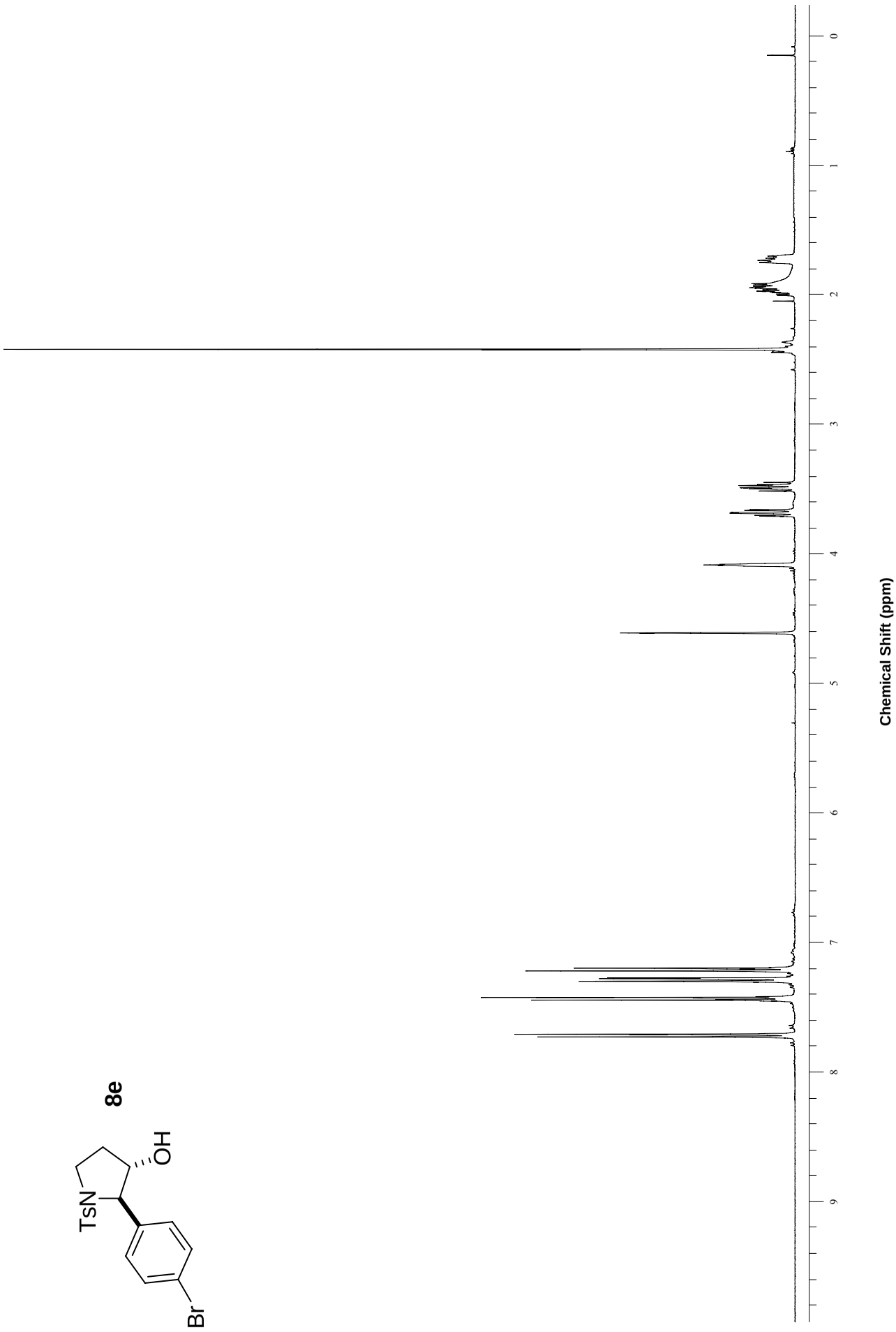
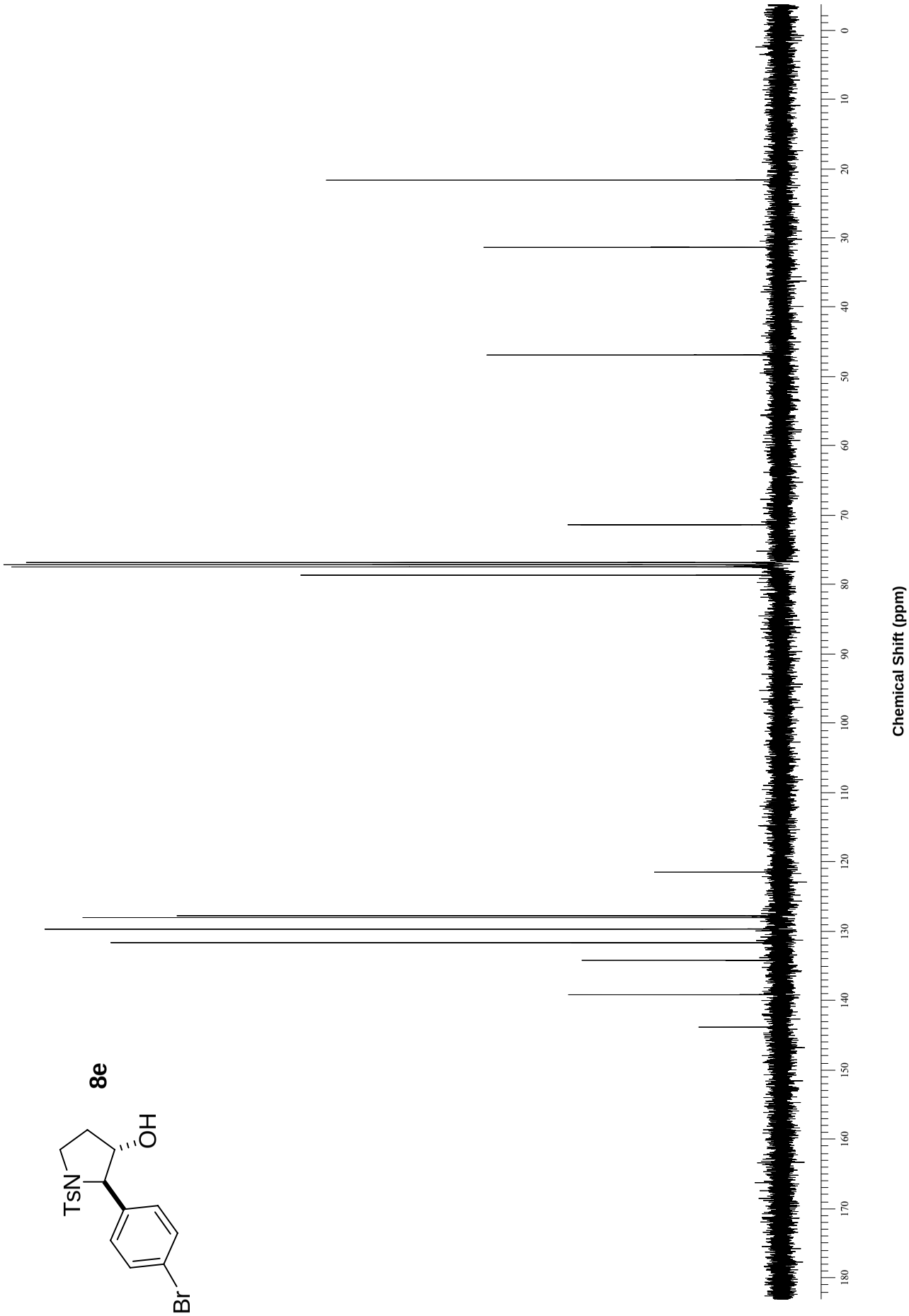
150
160
170
Chemical Shift (ppm)


8e
OH
TsN
Br
Chemical Shift (ppm)


8e
TsN
OH
Br
Chemical Shift (ppm)
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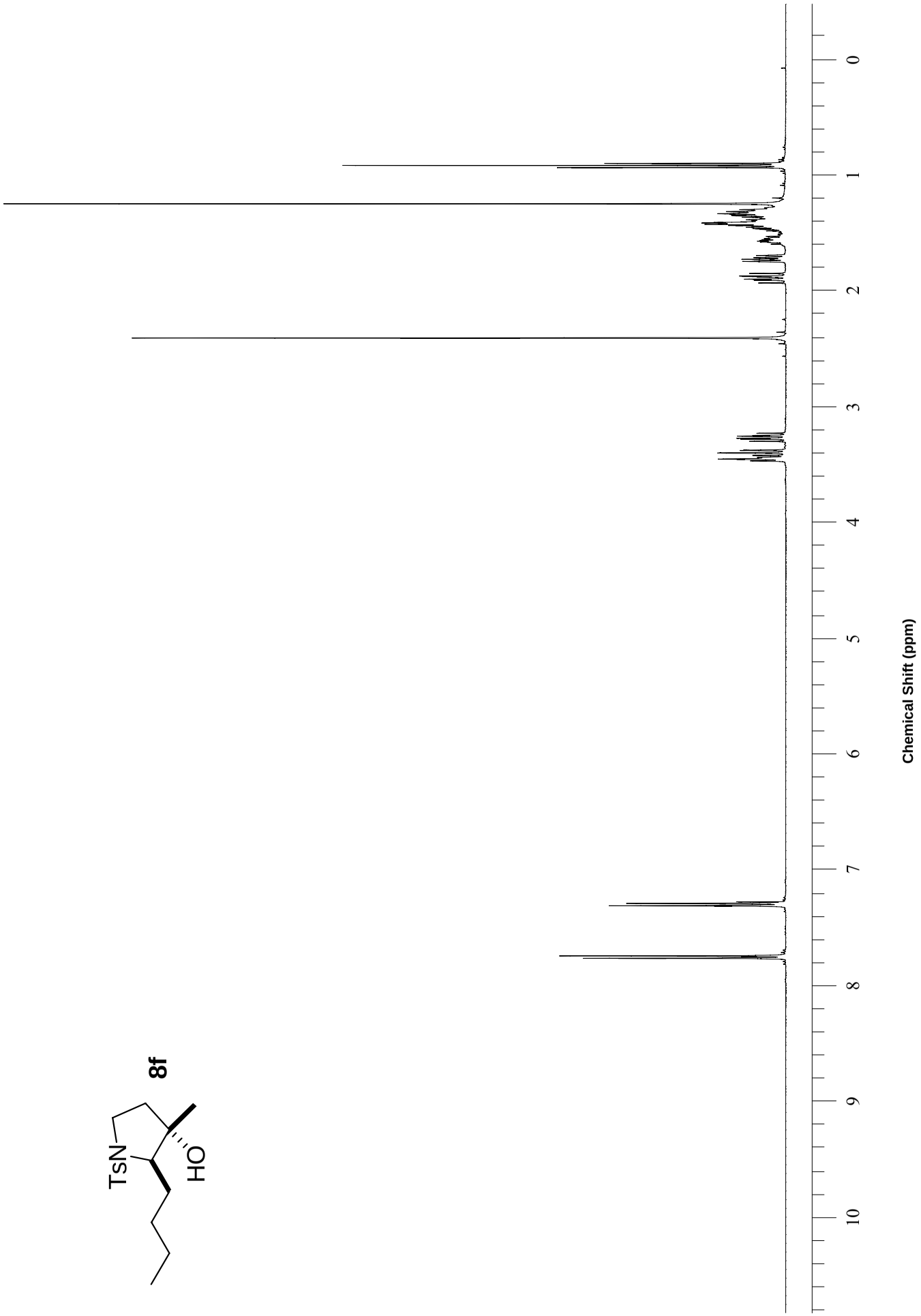
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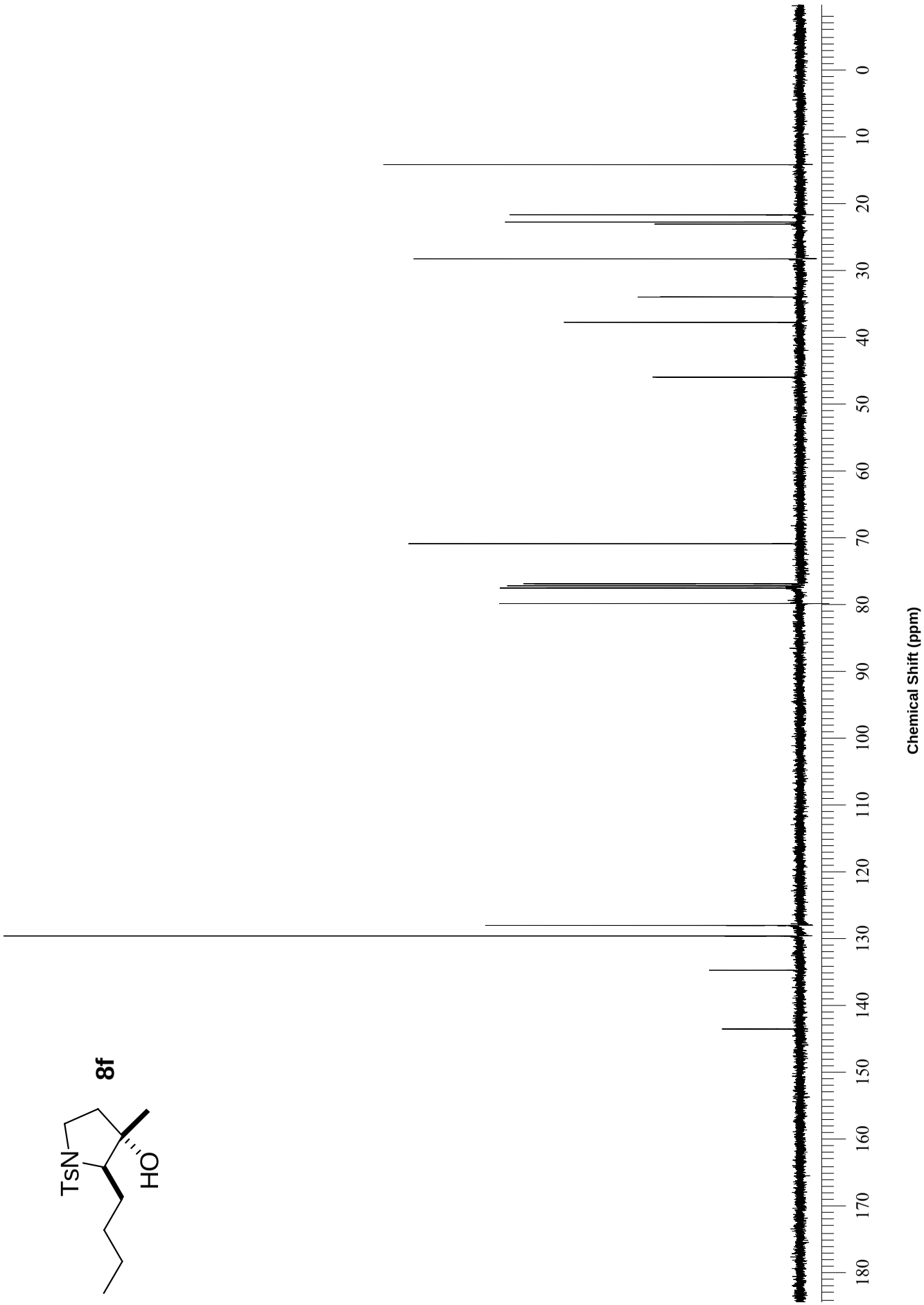
Chemical Shift (ppm)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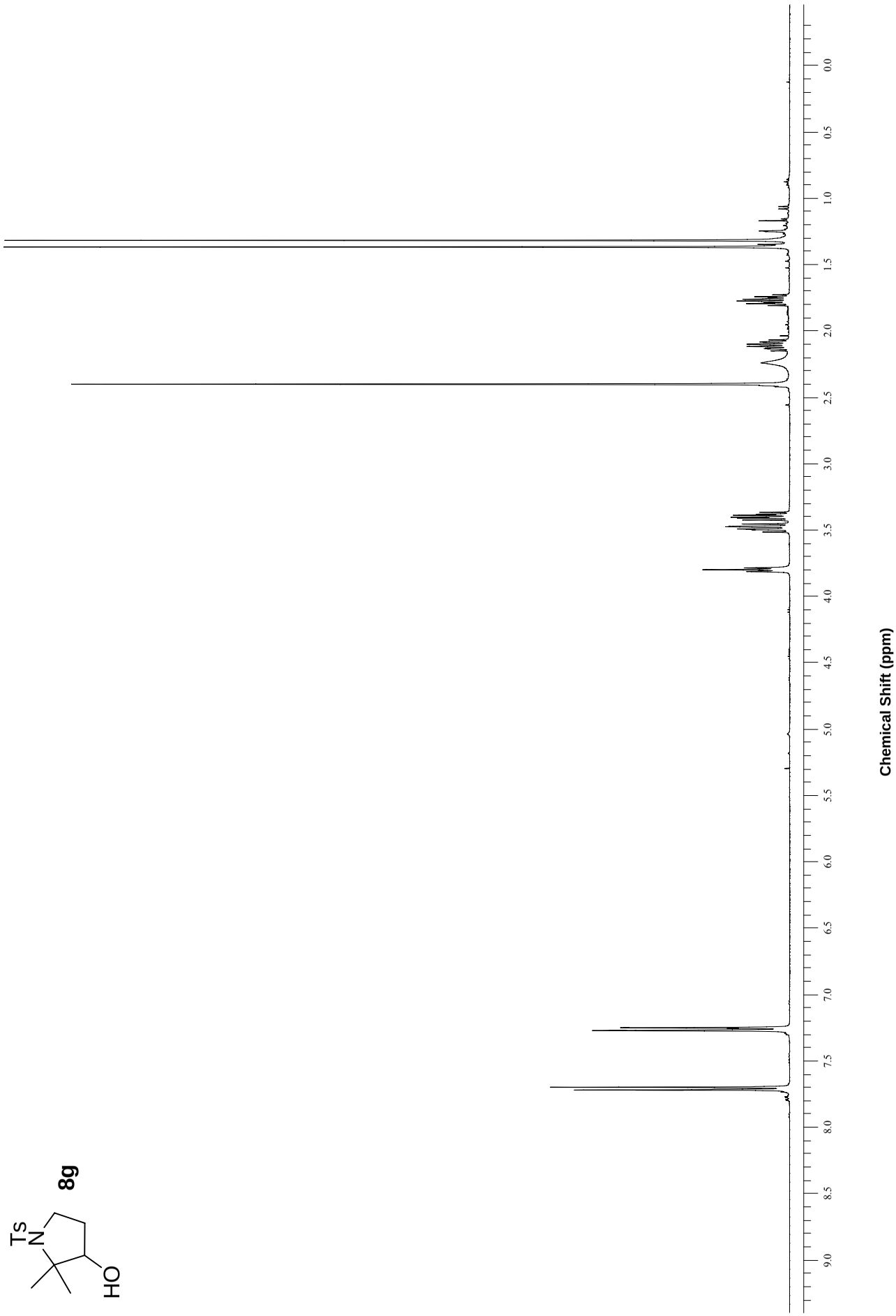
Chemical Shift (ppm)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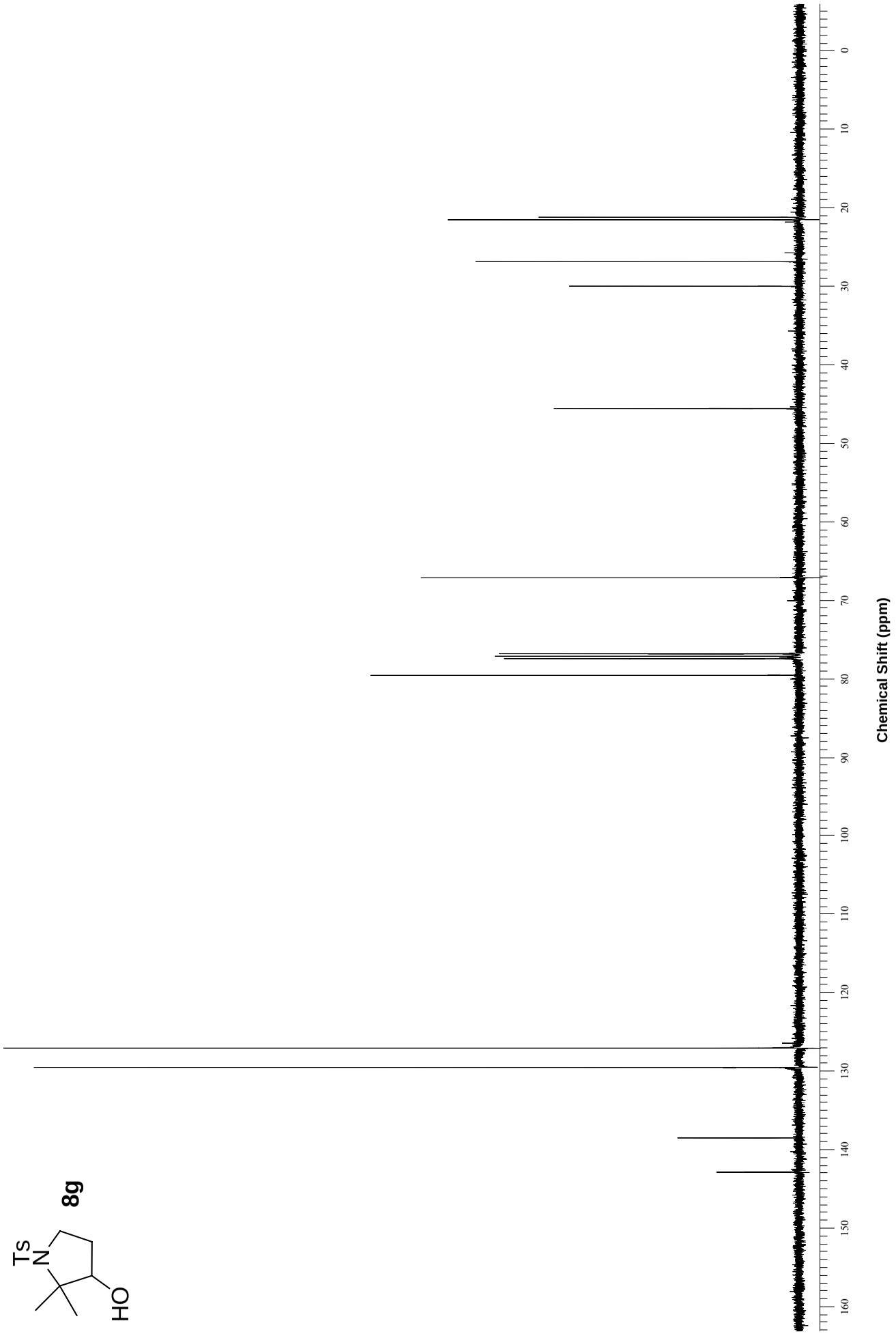
8g
Ts
N
HO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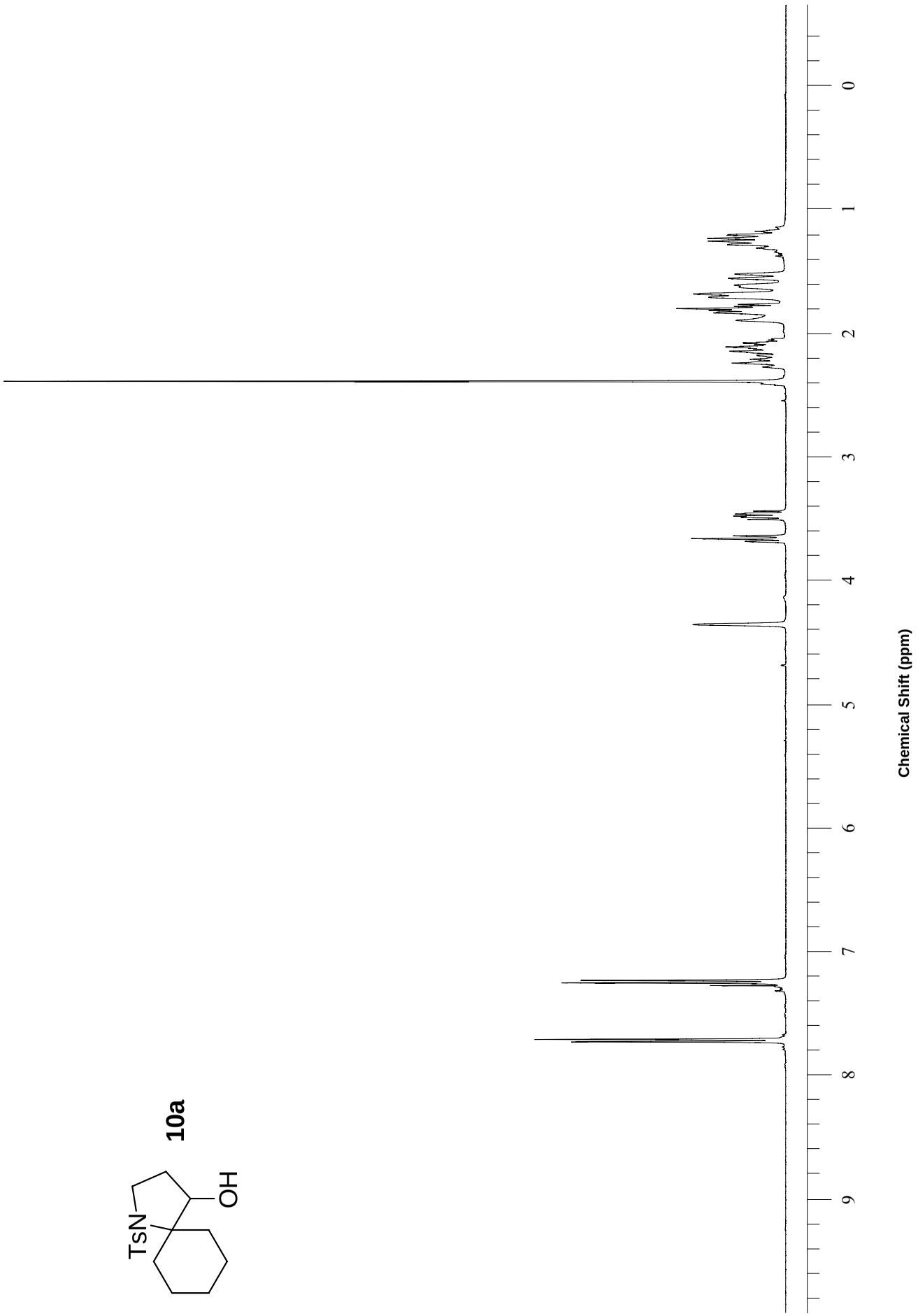
Chemical Shift (ppm)


10a
TsN
OH
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2
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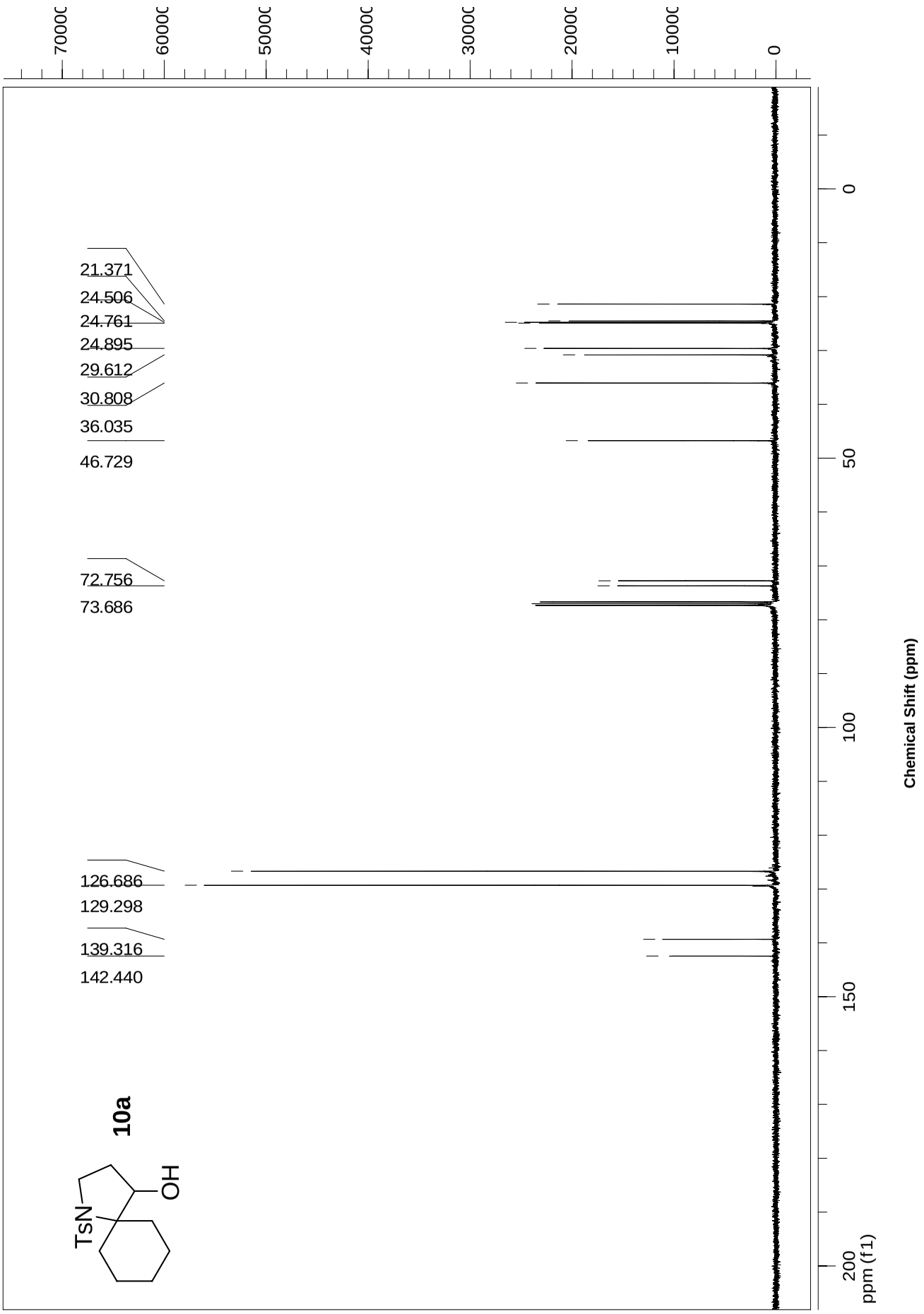
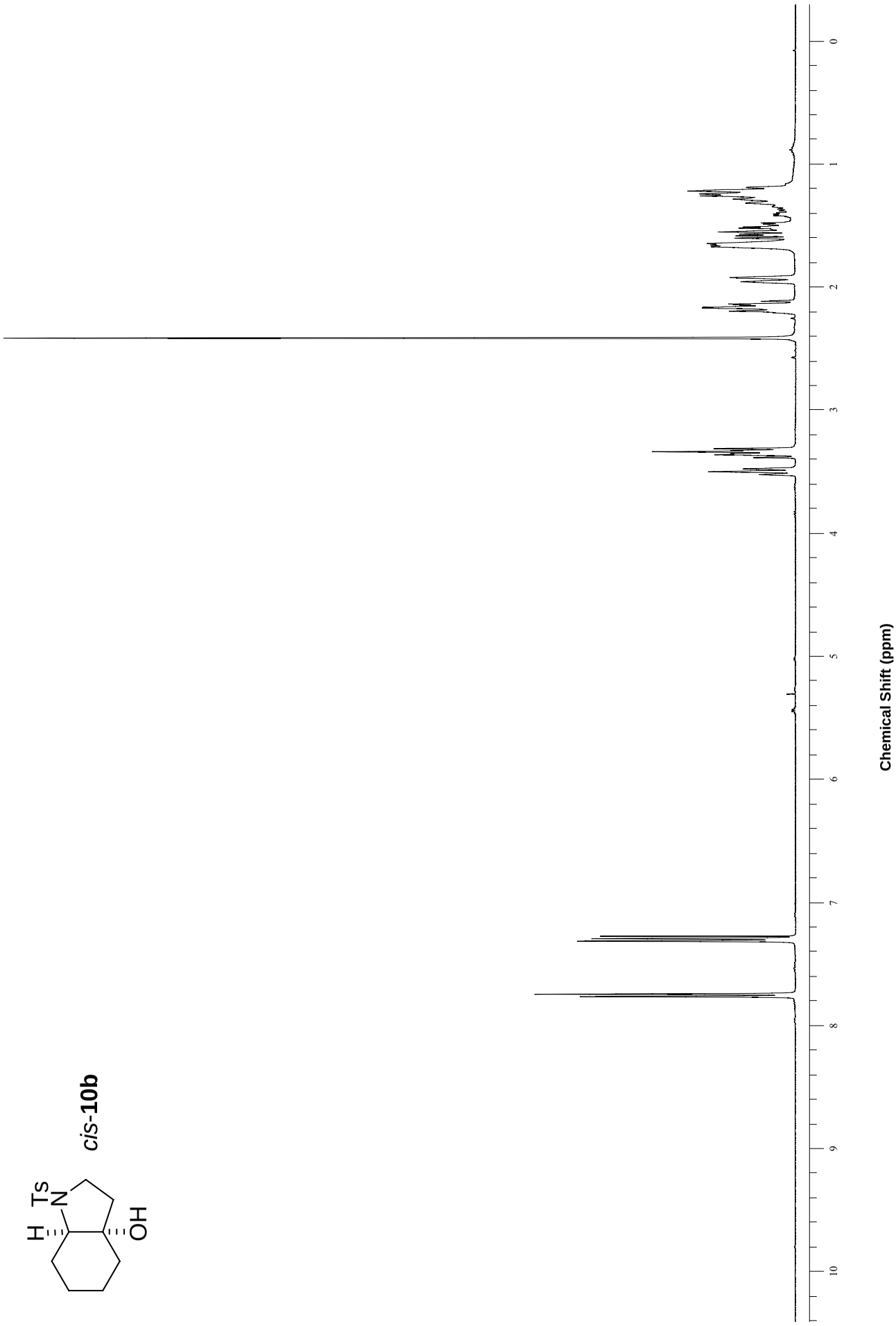
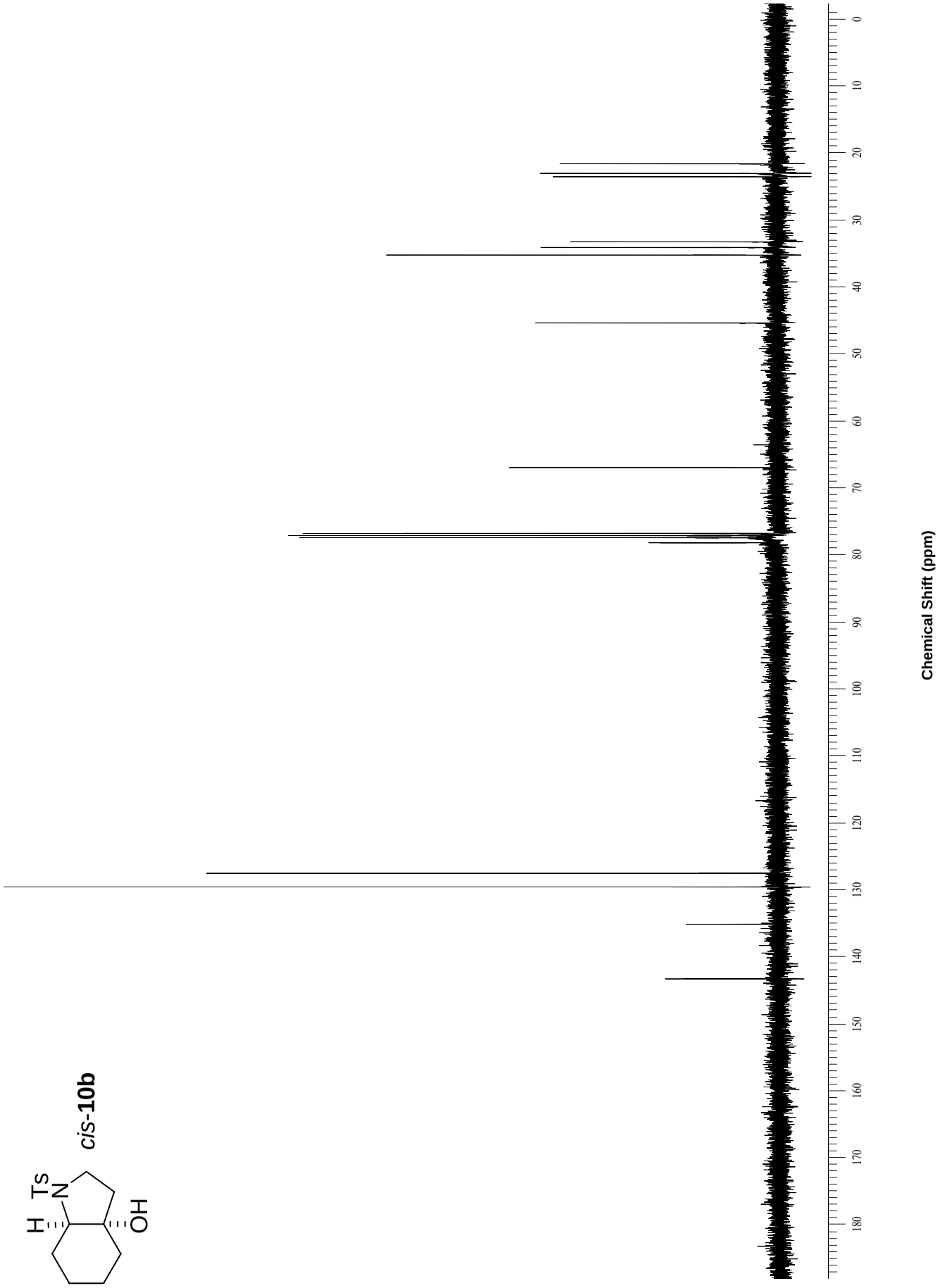
4
5
6
7
8
9
Chemical Shift (ppm)





cis-**10b**


Chemical Shift (ppm)
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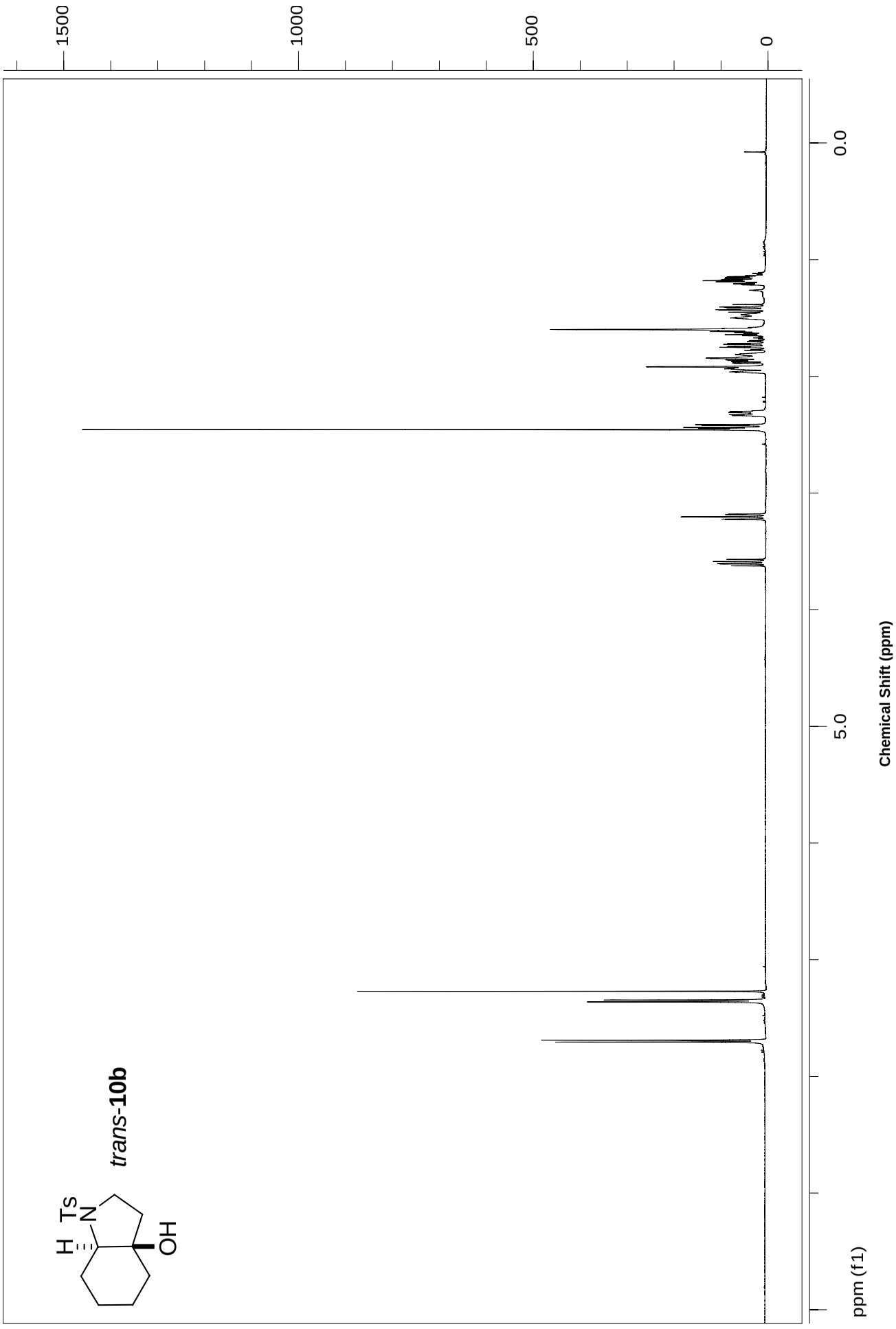
170
180
H
Ts
N
OH

cis-**10b**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1000
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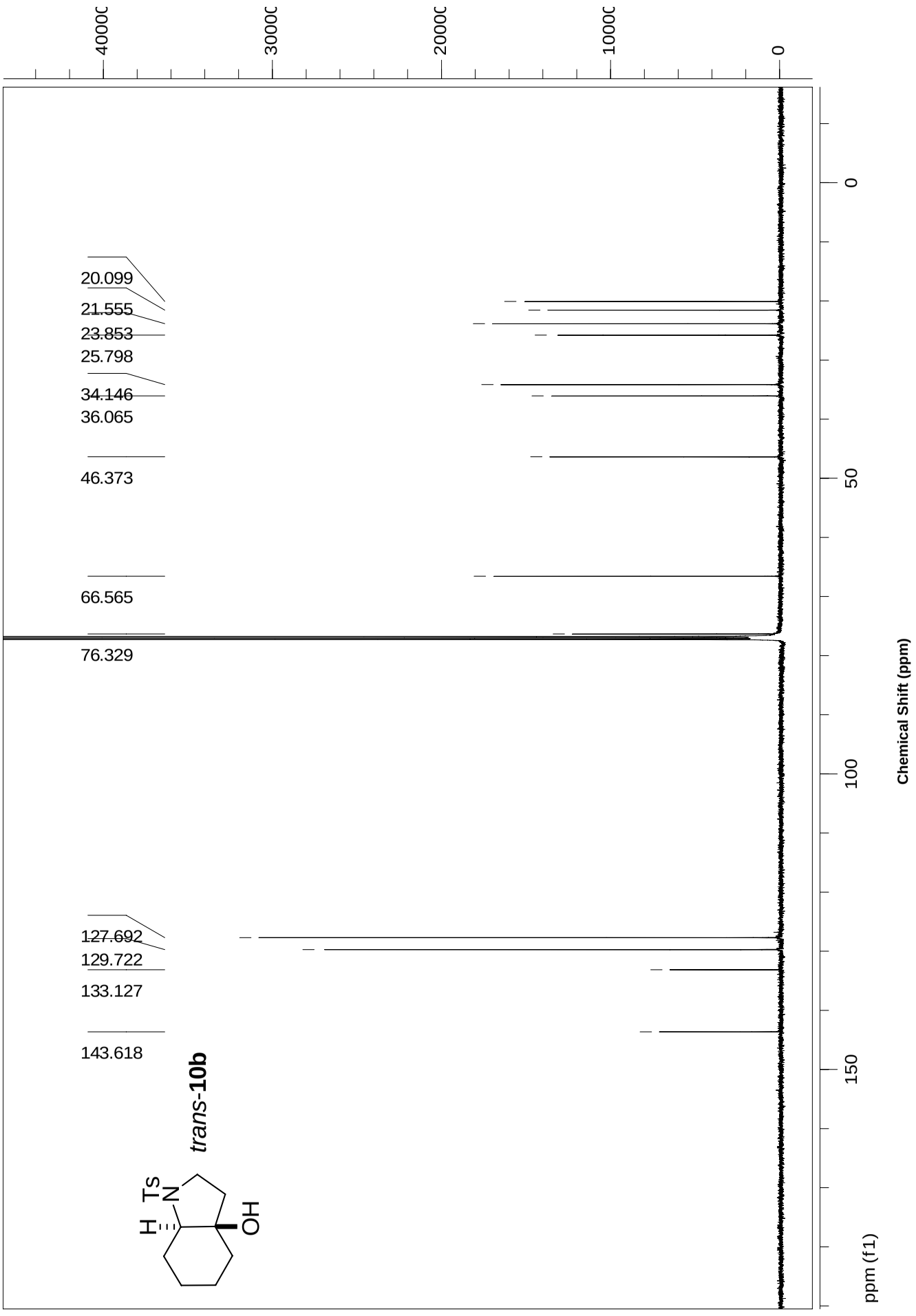
Chemical Shift (ppm)
ppm (f1)
trans-10b
H
Ts
N
OH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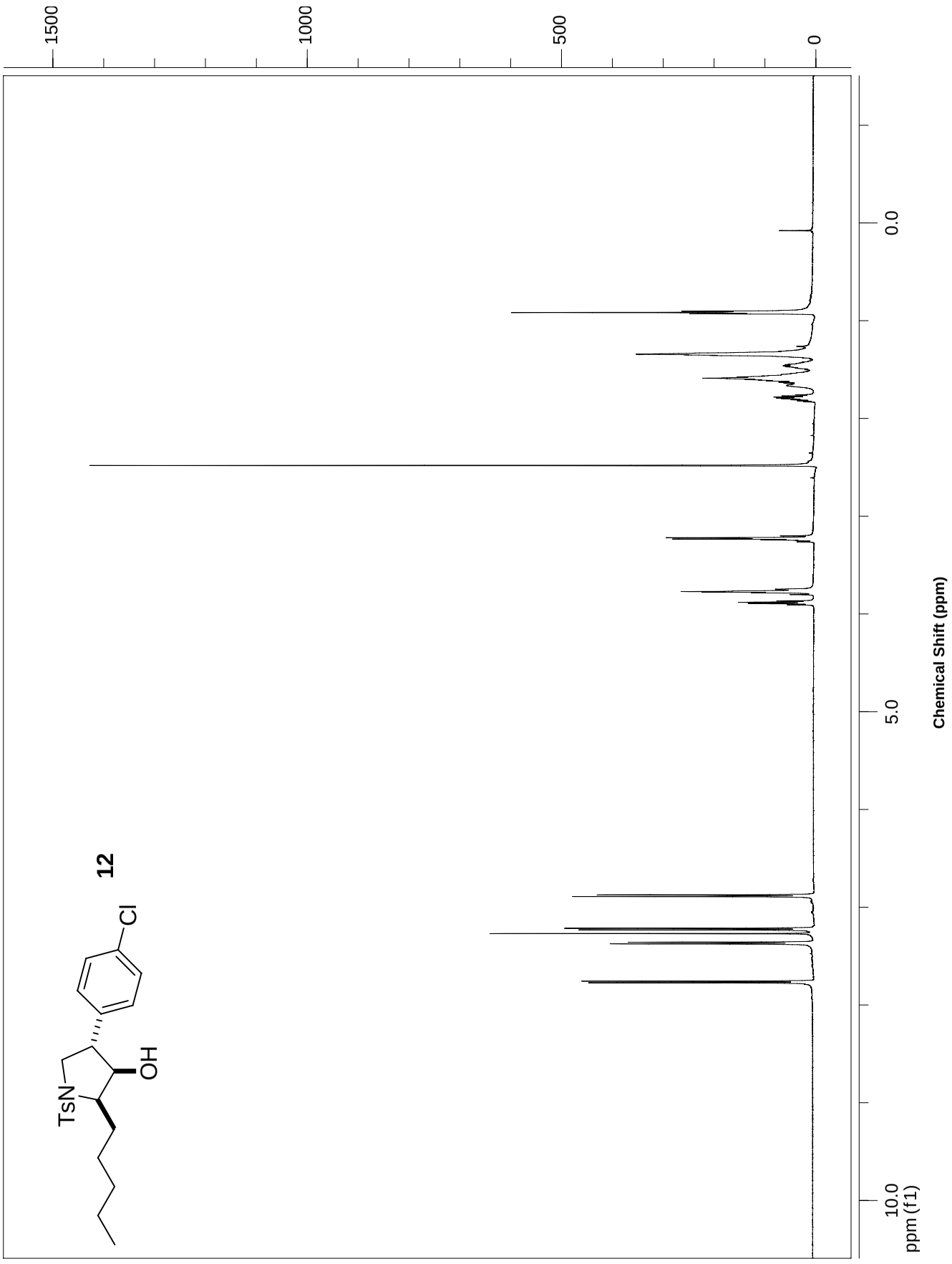
100
150
ppm (f1)
Chemical Shift (ppm)
trans-10b
Ts
N
H
OH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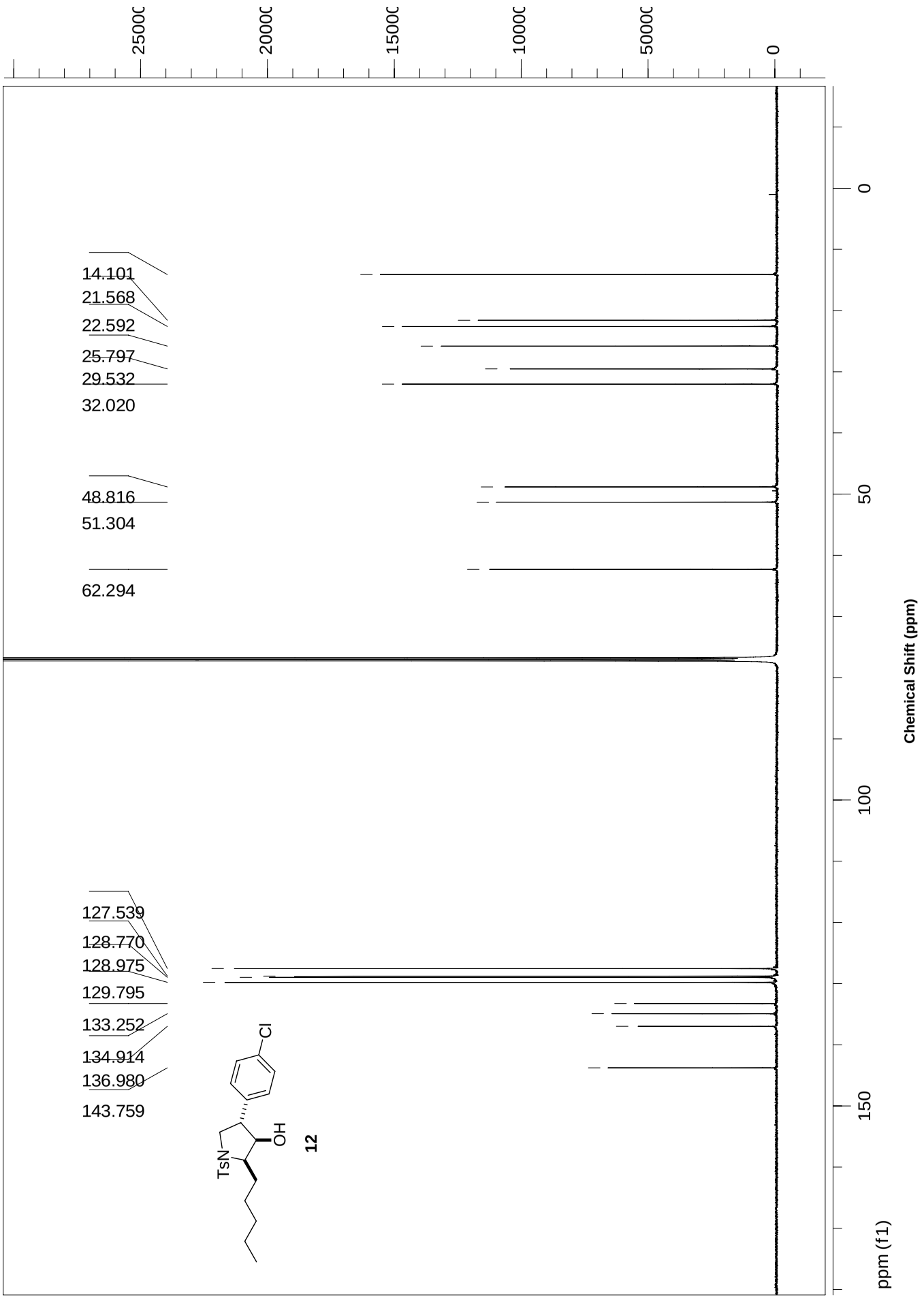
ppm (f1)
Chemical Shift (ppm)
12
Cl
OH
TsN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133.252
134.914
136.980
143.759
Cl
OH
TsN
12
Chemical Shift (ppm)
ppm (f1)