–Supplementary Data for-

On the structure of the *Phytophthora* α1 mating hormone: synthesis and comparison of four candidate stereoisomers

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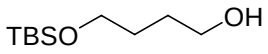
EXPERIMENTAL SECTION

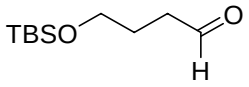
Proton nuclear magnetic resonance (^{1}H NMR) spectra and carbon nuclear magnetic resonance (^{13}C NMR) spectra were recorded on a Bruker WH-300 MHz, an IBM AF-300, an AM-500 spectrometer using deuteriated chloroform as solvent. Signal positions are given as part per million (δ) and were determined relative to the residual proton signal for $CHCl_3$ (7.27 ppm), CD_3OD (3.30 ppm) and the carbon signal for $CDCl_3$ (77.00 ppm), CD_3OD (49.15 ppm). The ^{1}H NMR coupling constants (*J* values) are given in Hz. Spectral content is listed in the according to order: chemical shift (δ), multiplicity, coupling constants (Hz), number of protons. Infrared (IR) spectra were recorded on an IBM IR/32 spectrometer and ran as neat films or chloroform solutions on sodium chloride plates. Low-resolution mass spectra were obtained on a Hewlett Pakard-9000 GC-MS, and high resolution spectra were recorded on a Varian MATCH-5DF instrument.

The reactions were monitored by Thin Layer Chromatography unless otherwise indicated. Visualization of the thin layer chromatograms was accomplished with an ultraviolet light (254 nm), heating the chromatogram after staining with a solution of commercially available (Aldrich Chemical Co., Inc.) anisaldehyde in ethanol, sulfuric acid and acetic acid (5:90:1:1; v/v), phosphomolybdic acid in ethanol (1:4 v/v), or with an aqueous 5% potassium permanganate solution. Conventional flash chromatography was performed with 230-400 mesh silica gel (E. Merck, Silica gel 60). All dry solvents were obtained by refluxing over an appropriate drying agent. Distilled solvents were used immediately or stored over molecular sieves when appropriate. Unless stated otherwise,

all reactions were carried out under an inert atmosphere of dry argon using glassware that had been thoroughly dried in oven.

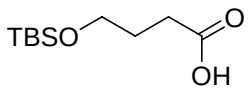


4-(*tert*-Butyldimethylsilyloxy)butan-1-ol. Sodium hydride (60% suspension in mineral oil, 2.2 g, 55.6 mmol) was suspended in dry THF (110 mL) after being washed with hexanes. 1,4-Butanediol (5.0 g, 55.6 mmol) was added to this suspension and the reaction mixture was stirred at room temperature for 45 min during which time a large amount of opaque white precipitate formed. *tert*-Butyldimethylsilyl chloride (8.4 g, 55.6 mmol) was then added and the mixture was further stirred at room temperature for 45 min. The reaction mixture was then diluted with Et_2O and washed with 10% aqueous solution of potassium carbonate. The layers were separated and the aqueous layer was further extracted twice with Et_2O. The combined organic extracts were washed with brine, dried over anhydrous $MgSO_4$, filtered and concentrated under vacuum. Purification by flash column chromatography (SiO_2, 30% ethyl acetate/hexanes) gave 9.6 g (85%) of the desired alcohol as colorless oil: ^{1}H NMR (300 MHz, $CDCl_3$): δ 3.70-3.63 (m, 4H), 2.54 (br s, 1H), 1.71-1.60 (m, 4H), 0.91 (s, 9H), 0.08 (s, 6H).

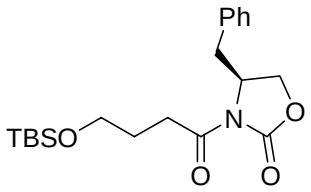


4-(*tert*-Butyldimethylsilanyloxy)butanal. A solution of DMSO (4.9 mL, 68.2 mmol) in DCM (100 mL) was added dropwise to a solution of oxalyl chloride (6.5 mL, 74.4 mmol) in DCM (90 mL) at −78 °C. After 5 min, a solution of starting alcohol (12.7 g, 62.0 mmol) in DCM (80 mL) was added dropwise. The reaction mixture was stirred at −78 °C

for 15 min after which triethylamine (43.7 mL, 310.2 mmol) was added in one portion. The mixture was further stirred at −78 °C for 10 min and then at room temperature for 2 h. The reaction mixture was diluted with DCM, water was added and the layers were separated. The aqueous layer was further extracted twice with DCM. The combined organic extracts were washed with saturated NH_4Cl solution and brine, dried over anhydrous $MgSO_4$ and concentrated under vacuum. Purification by flash column chromatography (SiO_2, 10% ethyl acetate/hexanes) gave 11.3 g (90%) of pure aldehyde as a colorless oil: ^{1}H NMR (300 MHz, $CDCl_3$) δ 9.80 (t, J = 1.8 Hz, 1H), 3.66 (t, J = 6.0 Hz, 2H), 2.51 (td, J = 7.2, 1.8 Hz, 2H), 1.91-1.82 (m, 2H), 0.89 (s, 9H), 0.05 (s, 6H).



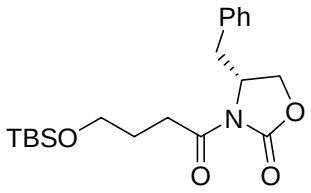
4-(*tert*-Butyldimethylsilyloxy)butanoic acid. NaH_2PO_4•H_2O (1.8 g, 12.9 mmol), 2-methyl-2-butene (2 M in THF, 19 mL, 38.0 mmol) and $NaClO_2$ (1.3 g, 11.5 mmol) were added to a solution of the starting aldehyde (772 mg, 3.8 mmol) in 3:1 *t*-BuOH:H_2O (96 mL) at room temperature. The resulting yellowish green mixture was stirred vigorously at room temperature for 15 h. Most of the reaction solvent was then removed under vacuum. The remaining aqueous portion was diluted with EtOAc and the layers were separated. The Aqueous layer was further extracted three times with EtOAc. The combined organic layers were dried over anhydrous $MgSO_4$ and concentrated under vacuum. Purification by flash chromatography (SiO_2, 20% ethyl acetate/hexanes) afforded 710 mg (86%) of the desired carboxylic acid as a colorless oil: ^{1}H NMR (300 MHz, $CDCl_3$) δ 10.84 (br s, 1H), 3.68 (t, J = 6.0 Hz, 2H), 2.47 (t, J = 7.2 Hz, 2H), 1.90-1.82 (m, 2H), 0.90 (s, 9H), 0.06 (s, 6H).



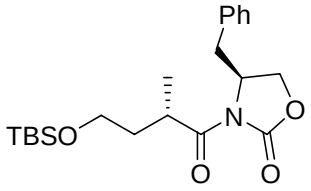
(*S*)-4-Benzyl-3-(4-(*tert*-butyldimethylsilyloxy)butanoyl)oxazolidin-2-one ((*S*)-6).

Triethylamine (6.3 mL, 44.8 mmol) was added dropwise to a solution of the starting carboxylic acid (8.5 g, 38.9 mmol) in diethyl ether (370 mL) and the resulting mixture was stirred at room temperature for 15 min. The reaction mixture was then cooled to 0 °C and ethyl chloroformate (3.8 mL, 38.9 mmol) was added. The mixture was then warmed to room temperature and stirred for 1 h. In a separate flask *n*-BuLi (1.6 M in hexanes, 28.0 mL, 44.8 mmol) was added dropwise to a solution (4*S*)-benzyloxazolidinone (6.9 g, 38.9 mmol) in THF (55 mL) at −78 °C. The oxazolidinone was then transferred dropwise via cannula to the reaction mixture containing the carboxylic acid. The mixture was stirred at −78 °C for 30 min and then at room temperature for 3 h. The reaction was then quenched by addition of saturated NH_4Cl solution, water was added and the layers were separated. The aqueous layer was further extracted twice with Et_2O. The combined organic extracts were washed with brine, dried over $MgSO_4$ and concentrated under vacuum. Purification by flash chromatography (SiO_2, 10% ethyl acetate/hexanes) gave 8.4 g (57%) of pure (***S*)-6** as colorless oil: ^{1}H NMR (300 MHz, $CDCl_3$) δ 7.38-7.28 (m, 3H), 7.24-7.20 (m, 2H), 4.72-4.64 (m, 1H), 4.23-4.14 (m, 2H), 3.71 (t, *J* = 6.2 Hz, 2H), 3.32 (dd, *J* = 3.3, 13.4 Hz, 1H), 3.03 (dd, *J* = 6.8, 7.7 Hz, 2H), 2.77 (dd, *J* = 9.7, 13.3 Hz, 1H), 1.97-1.88 (m, 2H), 0.91 (s, 9H), 0.07 (s, 6H); ^{13}C NMR (75 MHz, $CDCl_3$) δ 173.2, 153.4, 135.3, 129.4, 128.9, 127.3, 66.1, 62.0, 55.2, 37.9, 32.1, 27.2, 25.9, 18.3, −5.4; IR

(neat) 2954, 2928, 1786, 1701, 1388, 1257, 1100, 837 cm^{-1}; EIMS *m/z* 377 $(M)^+$; HRMS $(M)^+$ calcd for $C_{20}H_{31}NO_4Si$, 377.2022; found, 377.2010; $[\alpha]_D^{25}$ +32.32 (*c* 0.95, $CHCl_3$)**.**

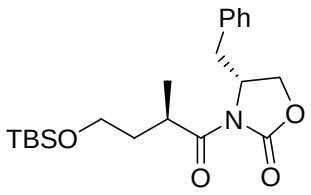


(*R*)-4-Benzyl-3-(4-(*tert*-butyldimethylsilyloxy)butanoyl)oxazolidin-2-one ((*R*)-6). This compound was prepared by reaction of the carboxylic acid with (4*R*)-benzyloxazolidinone according to the procedure described for preparation of **(*S*)-6**. The spectral data was in good accordance to that reported for **(*S*)-6**; $[\alpha]_D^{25}$ −32.84 (*c* 0.81, $CHCl_3$).

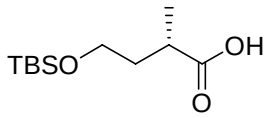


(*S*)-4-Benzyl-3-((*S*)-4-(*tert*-butyldimethylsilyloxy)-2-methylbutanoyl)oxazolidin-2-one ((*S,S*)-7). A solution of oxazolidinone derivative **(*S*)-6** (8.4 g, 22.2 mmol) in THF (30 mL) was added dropwise to a solution of NaHMDS (1.0 M in THF, 31.0 mL, 31.0 mmol) in THF (30 mL) at −78 °C. After 1 h MeI (7.0 mL, 110.8 mmol) was added dropwise and the reaction mixture was further stirred at −78 °C for 3 h. The reaction was then quenched by addition of acetic acid (1.5 mL) and the mixture was warmed to room temperature. The reaction mixture was diluted with EtOAc, water was added and the layers were separated. The aqueous layer was further extracted three times with EtOAc.

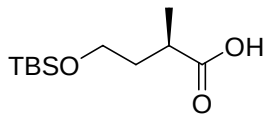
The combined organic extracts were washed with brine, dried over anhydrous $MgSO_4$ and concentrated under vacuum. Purification by flash column chromatography (SiO_2, 10% ethyl acetate/hexanes) afforded 7.5 g (87%) of **(*S*,*S*)-7** as white solid (Mp 51-52 °C): ^{1}H NMR (300 MHz, $CDCl_3$) δ 7.37-7.28 (m, 3H), 7.26-7.20 (m, 2H), 4.71-4.63 (m, 1H), 4.19-4.14 (m, 2H), 3.93-3.81 (m, 1H), 3.72-3.60 (m, 2H), 3.27 (dd, *J* = 3.3, 13.3 Hz, 1H), 2.77 (dd, *J* = 9.6, 13.3 Hz, 1H), 2.11-1.99 (m, 1H), 1.70-1.60 (m, 1H), 1.26 (d, *J* = 6.9 Hz, 3H), 0.88 (s, 9H), 0.03 (s, 6H); ^{13}C NMR (75 MHz, $CDCl_3$) 176.9, 152.9, 135.4, 129.4, 128.9, 127.3, 65.9, 61.0, 55.3, 37.9, 36.0, 34.7, 25.9, 18.3, 17.9, −5.5; IR (thin film); 2953, 2929, 2882, 2856, 1766, 1696, 1462, 1101 cm^{-1}; EIMS *m/z* 391 $(M)^+$; HRMS for $(M)^+$ $C_{21}H_{33}NO_4Si$: calcd. 391.2179; found 391.2160; $[\alpha]_D^{25}$ +59.83 (*c* 0.43, $CHCl_3$).



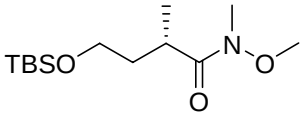
(*R*)-4-Benzyl-3-((*R*)-4-(*tert*-butyldimethylsilyloxy)-2-methylbutanoyl)oxazolidin-2-one ((*R*,*R*)-7). This compound was prepared from **(*R*)-6** in 85% yield according to the procedure described above for preparation of **(*S*,*S*)-7**: Mp 51-52 °C; $[\alpha]_D^{25}$ −60.37 (*c* 0.46, $CHCl_3$); other spectroscopic data was in good accordance to that reported for **(*S*,*S*)-7**.



(*S*)-4-(*tert*-Butyldimethylsilyloxy)-2-methylbutanoic acid. Hydrogen peroxide (30% aqueous solution, 7.1 mL, 62.9 mmol) and LiOH•H_2O (1.3 g, 31.5 mmol) were added to a solution of **(*S,S*)-7** (6.2 g, 15.7 mmol) in THF (37 mL) and water (37 mL) at 0 °C. The reaction mixture was stirred at 0 °C for 3 h. Most of the THF was then evaporated under vacuum and the remaining aqueous portion was extracted four times with DCM. The combined organic extracts were dried over anhydrous $MgSO_4$ and concentrated under vacuum. Purification by flash column chromatography (20-50% ethyl acetate/hexanes) gave 3.5 g (95%) of the pure carboxylic acid as a colorless oil: ^{1}H NMR (500 MHz, $CDCl_3$) δ 10.94 (br s, 1H), 3.77-3.65 (m, 2H), 2.71-2.60 (m, 1H), 2.03-1.91 (m, 1H), 1.70-1.60 (m, 1H), 1.22 (d, J = 7.0 Hz, 3H), 0.90 (s, 9H), 0.07 (s, 6H); ^{13}C NMR (125 MHz, $CDCl_3$) δ 182.7, 60.8, 36.2, 36.0, 25.9, 18.3, 17.0, −5.5; IR (neat) 2930, 2858, 2663, 1713, 1416, 1105, 1006, 882 cm^{-1}; EIMS *m/z* 217 $(M - CH_3)^+$; HRMS $(M - CH_3)^+$ calcd for $C_{10}H_{21}O_3Si$, 217.1260; found, 217.1258; $[\alpha]_D^{25}$ −14.06 (*c* 1.8, $CHCl_3$).

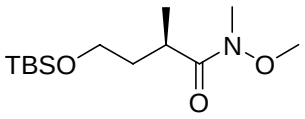


(*R*)-4-(*tert*-Butyldimethylsilyloxy)-2-methylbutanoic acid. This compound was prepared from **(*R,R*)-7** in 95% yield, according to the procedure described above: $[\alpha]_D^{25}$ +13.51 (*c* 1.8, $CHCl_3$); other spectroscopic data was in good accordance to that reported above.



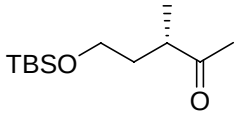
(*S*)-4-(*tert*-Butyldimethylsilyloxy)-*N*-methoxy-*N*,2-dimethylbutanamide.

1,1′-Carbonyldiimidazole (3.9 g, 23.7 mmol) was added in equal portions over a period of 15 min to a solution of above carboxylic acid (3.5 g, 14.9 mmol) in DCM (80 mL) at room temperature. After final addition the reaction mixture was stirred at room temperature for 1 h. *N*,*O*-dimethylhydroxylamine hydrochloride (3.7 g, 37.1 mmol) was then added in one portion and the resulting mixture was stirred overnight. The reaction mixture was then diluted with ether and filtered. The filtrate was diluted with diethyl ether and was washed with 5% aq. citric acid and brine, dried over anhydrous $MgSO_4$ and concentrated under vacuum. Purification by flash chromatography (SiO_2, 20% ethyl acetate/hexanes) gave 3.9 g (95%) of Weinreb amide as a colorless oil: ^{1}H NMR (300 MHz, $CDCl_3$) δ 3.70 (s, 3H), 3.69-3.55 (m, 2H), 3.20 (s, 3H), 3.18-3.06 (m, 1H), 1.99-1.88 (m, 1H), 1.60-1.50 (m, 1H), 1.13 (d, J = 6.9 Hz, 3H), 0.89(s, 9H), 0.04 (s, 6H); ^{13}C NMR (125 MHz, $CDCl_3$) δ 177.8, 61.4, 60.7, 36.5, 32.2, 31.4, 25.9, 18.3, 17.2, −5.40; IR (neat) 2956, 2931, 2857, 1667, 1463, 1255, 1101, 836 cm^{-1}; EIMS *m/z* 260 $(M - CH_3)^+$; HRMS $(M - CH_3)^+$ calcd for $C_{12}H_{26}O_3NSi$, 260.1682; found, 260.1693; $[\alpha]_D^{25}$ +20.60 (*c* 0.03, $CHCl_3$).

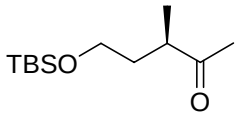


(*R*)-4-(*tert*-Butyldimethylsilyloxy)-*N*-methoxy-*N*,2-dimethylbutanamide.

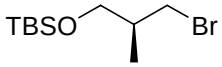
This compound was prepared in 95% yield according to the procedure described above: $[\alpha]_D^{25}$ −21.48 (*c* 2.0, $CHCl_3$); other spectroscopic data was in good accordance to that reported above.



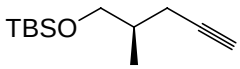
(*S*)-5-(*tert*-Butyldimethylsilyloxy)-3-methylpentan-2-one ((*S*)-4). MeMgBr (3M in ether, 7.0 mL, 20.9 mmol) was added dropwise to a solution of starting Weinreb amide (3.8 g, 13.9 mmol) in dry THF (60 mL) at −78 °C. The reaction mixture was stirred at −78 °C for 1 h and then gradually warmed to 0 °C and stirred for 3.5 h. The reaction was quenched by slow addition of saturated NH_4Cl solution. Water was added and the layers were separated. The aqueous layer was extracted twice with EtOAc. The combined organic extracts were washed with brine, dried over anhydrous $MgSO_4$, and concentrated under vacuum. Purification by flash column chromatography (SiO_2, 5% ethyl acetate/hexanes) gave 2.9 g (91%) of pure ketone **(*S*)-4** as a pale yellow oil: ^{1}H NMR (300 MHz, $CDCl_3$) δ 3.62 (t, *J* = 6.2 Hz, 2H), 2.71 (sextet, *J* = 6.9 Hz, 1H), 2.16 (d, *J* = 0.19 Hz, 3H), 1.97-1.87 (m, 1H), 1.60-1.47 (m, 1H), 1.10 (d, *J* = 7.0 Hz, 3H), 0.89 (s, 9H), 0.04 (s, 6H); ^{13}C NMR (75 MHz, $CDCl_3$) δ 212.5, 60.7, 43.7, 35.7, 28.3, 25.9, 18.8, 16.2, −5.45; IR (neat) 2956, 2930, 2857, 1716, 1472, 1256, 1100, 836 cm^{-1}; EIMS *m/z* 215 $(M - CH_3)^+$; HRMS $(M - H)^+$ calcd for $C_{12}H_{25}O_2Si$, 229.1624; found, 229.1622; $[\alpha]_D^{25}$ +13.21 (*c* 1.20, $CHCl_3$).



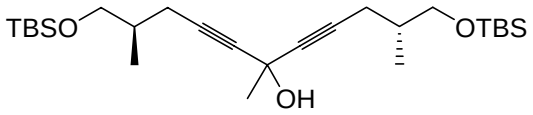
(*R*)-5-(*tert*-Butyldimethylsilyloxy)-3-methylpentan-2-one ((*R*)-4). This compound was prepared in 73% yield from Weinreb amide according to the procedure described for preparation of **(*S*)-4**: $[\alpha]_D^{25}$ −12.97 (*c* 0.61, $CHCl_3$); other spectroscopic data was in good accordance to that reported for **(*S*)-4**.



(*S*)-(3-Bromo-2-methylpropoxy)(*tert*-butyl)dimethylsilane. *tert*-Butyldimethylsilyl chloride (9.0 g, 59.7 mmol) was added to a stirred mixture of (*S*)-3-bromo-2-methylpropan-1-ol (7.30g, 47.7 mmol) and imidazole (8.2 g, 119.4 mmol) in DMF (180 mL). The resulting mixture was stirred at room temperature for 5 h. The reaction was then quenched by addition of saturated NH_4Cl solution. The reaction mixture was diluted with pentanes, water was added and the layers were separated. The aqueous layer was further extracted three times with pentanes. The combined organic extracts were washed with water and brine, dried over anhydrous $MgSO_4$ and concentrated under vacuum. Purification by flash column chromatography (SiO_2, 2% ethyl acetate/hexanes) gave 11.9 g (94%) of pure product as colorless oil: ^{1}H NMR (300 MHz, $CDCl_3$) δ 3.58 (dd, *J* = 5.0, 10.0 Hz, 1H), 3.50 (dd, *J* = 5.3, 9.6 Hz, 1H), 3.49 (dd, *J* = 6.8, 9.9 Hz, 1H), 3.45 (dd, *J* = 5.5, 9.7 Hz, 1H), 2.05-1.93 (m, 1H), 0.99 (d, *J* = 6.8 Hz, 3H), 0.90 (s, 9H), 0.06 (s, 6H).

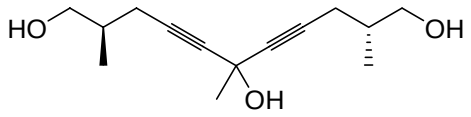


(*R*)-*tert*-Butyldimethyl(2-methylpent-4-ynyloxy)silane ((*R*)-8). A solution of the above bromide (11.5 g, 43.0 mmol) in DMPU (115 mL) was added dropwise to a suspension of lithium acetylide ethylene diamine complex (8.8 g, 86.1 mmol) in THF (230 mL) at 0 °C. The cooling bath was then removed and the reaction mixture was stirred at room temperature for 2 h (the reaction was monitored by GC). The reaction was then quenched by addition of saturated NH_4Cl solution. The resulting mixture was diluted with pentanes, water was added and the layers were separated. The aqueous layer was further extracted three times with pentanes. The combined organic extracts were washed with water and brine, dried over anhydrous $MgSO_4$ and concentrated under vacuum. Purification by flash column chromatography (SiO_2, 2% ethyl acetate/hexanes) gave 5.3 g of alkyne as an inseparable mixture with the elimination product (ratio 9:1 based on 1H NMR spectroscopic analysis): ^{1}H NMR (major product) (300 MHz, $CDCl_3$) δ 3.52 (dd, *J* = 5.5, 9.9 Hz, 1H), 3.47 (dd, *J* = 6.7, 9.9 Hz, 1H), 2.30 (ddd, *J* = 2.7, 5.7, 16.7 Hz, 1H), 2.13 (ddd, *J* = 2.7, 6.9, 16.7 Hz, 1H), 1.95 (dd, *J* = 2.7, 2.7 Hz, 1H), 1.90-1.79 (m, 1H), 0.98 (d, *J* = 6.8 Hz, 3H), 0.90 (s, 9H), 0.06 (s, 6H).



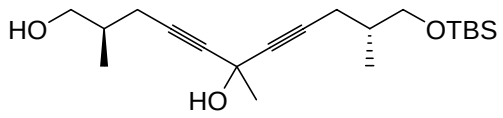
(2*R*,10*R*)-1,11-Bis(*tert*-butyldimethylsilyloxy)-2,6,10-trimethylundeca-4,7-diyn-6-ol ((*R*,*R*)-5). A solution of alkyne **(*R*)-8** (1.2 g, 4.6 mmol) in Et_2O (2.5 mL) was added dropwise to a solution of ethylmagnesium bromide (3 M in ether, 1.3 mL, 3.9 mmol) in Et_2O (2.5 mL). The resulting mixture was heated at reflux temperature for 2 h. The

reaction mixture was then cooled to 0 °C and acetyl chloride (0.1 mL, 1.5 mmol) in THF (0.8 mL) was added dropwise. The resulting mixture was stirred at 0 °C for 1 h and then heated at 45 °C overnight. The reaction mixture was then cooled to room temperature and was quenched by addition of saturated NH_4Cl solution. Water was added and the layers were separated. The aqueous layer was further extracted twice with Et_2O. The combined organic extracts were washed with brine, dried over anhydrous $MgSO_4$ and concentrated under vacuum. Purification by flash chromatography (SiO_2, 8% ethyl acetate/hexanes) gave 650 mg (90%) of pure **(*R*,*R*)-5** as a pale yellow oil: ^{1}H NMR (300 MHz, $CDCl_3$) δ 3.50 (dd, *J* = 5.6, 9.8 Hz, 2H), 3.46 (dd, *J* = 6.6, 9.8 Hz, 2H), 2.36 (br s, 1H), 2.32 (dd, *J* = 5.8, 16.7 Hz, 2H), 2.14 (dd, *J* = 6.8, 16.6 Hz, 2H), 1.89-1.78 (m, 2H), 1.72 (s, 3H), 0.96 (d, *J* = 6.8 Hz, 6H), 0.90 (s, 18H), 0.5 (s, 12H); ^{13}C NMR (75 MHz, $CDCl_3$) δ 83.3, 81.4, 66.8, 60.2, 35.3, 32.5, 25.9, 22.2, 18.3, 16.0, −5.4; IR (neat) 3431, 2956, 2929, 2857, 2244, 1471, 1256, 1096, 837 cm^{-1}; EIMS *m/z* 451 $(M - CH_3)^+$; HRMS $(M - CH_3)^+$ calcd for $C_{25}H_{47}O_3Si_2$, 451.3064; found, 451.3066.



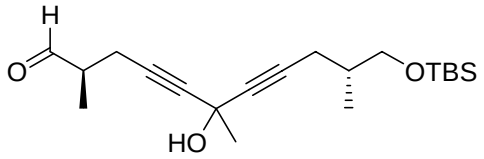
(2*R*,6*R*/*S*,10*R*)-2,6,10-Trimethylundeca-4,7-diyne-1,6,11-triol. TBAF (1 M in THF, 2.4 mL, 2.4 mmol) was added dropwise to a solution of the disilylether **(*R*,*R*)-5** (183 mg, 0.4 mmol) in THF (2.2 mL) at 0 °C. The reaction mixture was stirred at this temperature for 30 min and then at room temperature for 5 h. The reaction was then quenched by addition of saturated aqueous NH_4Cl solution. The reaction mixture was diluted with EtOAc and the layers were separated. The aqueous layer was further extracted three times

with EtOAc. The combined organic layers were dried over anhydrous $MgSO_4$, filtered and concentrated under vacuum. Purification by flash column chromatography (SiO_2, 100% ethyl acetate) gave 91 mg (96%) of the desired triol as a colorless oil:^{1}H NMR (300 MHz, $CDCl_3$) δ 3.92 (br s, 1H), 3.57 (d, *J* = 6.0 Hz, 4H), 2.87 (br s, 2H), 2.30 (dd, *J* = 6.3, 16.8 Hz, 2H), 2.23 (dd, *J* = 6.3, 16.8 Hz, 2H), 1.97-1.82 (m, 2H), 1.71 (s, 3H), 0.98 (d, *J* = 6.6 Hz, 6H); ^{13}C NMR (75 MHz, $CDCl_3$) 83.8, 80.9, 66.7, 59.8, 34.8, 32.2, 22.5, 16.3; IR (neat) 3421, 2961, 2274, 1458 cm^{-1}; EIMS *m/z* 223 $(M - CH_3)^+$; HRMS $(M - CH_3)^+$ calcd for $C_{13}H_{19}O_3$, 223.1334; found 223.1328.



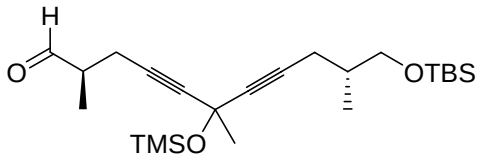
(2*R*,6*R*/*S*,10*R*)-11-(*tert*-Butyldimethylsilyloxy)-2,6,10-trimethylundeca-4,7-diyne-1,6-diol ((*R*,*R*/*S*,*R*)-9). Triethylamine (0.2 mL, 1.5 mmol) and DMAP (4 mg) were added to a solution of the starting triol (332 mg, 1.4 mmol) in DCM (4 mL). The mixture was stirred for 5 min and *tert*-butyldimethylsilyl chloride (236 mg, 1.5 mmol) was added. The resulting mixture was stirred at room temperature for 15 h during which some white precipitate was formed. The reaction was then quenched by the addition of saturated aqueous NH_4Cl solution. The reaction mixture was diluted with Et_2O, water was added and the layers were separated. The aqueous layer was further extracted three times with Et_2O. The combined organic extracts were washed with brine, dried over anhydrous $MgSO_4$, filtered and concentrated under vacuum. The residue was purified by gradient flash column chromatography. First elution with (8% ethyl acetate/hexanes) gave 172 mg (26%) of the bisprotected product **(*R*,*R*)-5**, second elution with (50% ethyl

acetate/hexanes) gave 240 mg (49%) of the desired monoprotected mixture **(*R*,*R*/*S*,*R*)-9** and third elution with (100% ethyl acetates) gave 76 mg (23%) of the recovered triol. Spectroscopic data for **(*R*,*R*/*S*,*R*)-9**: ^{1}H NMR (500 MHz, $CDCl_3$) δ 3.58 (t, *J* = 5.0 Hz, 2H), 3.51 (dd, *J* = 5.5, 10.0 Hz, 1H), 3.47 (dd, *J* = 7.0, 10.0 Hz, 1H), 2.37 (br s, 1H), 2.32 (dd, *J* = 5.5, 16.5 Hz, 1H), 2.31 (dd, *J* = 6.5, 17.0 Hz, 1H), 2.25 (dd, *J* = 6.5, 16.5 Hz, 1H), 2.15 (dd, *J* = 7.0, 17.0 Hz, 1H), 1.95-1.87 (m, 1H), 1.87-1.81 (m, 1H), 1.73 (s, 3H), 1.01 (d, *J* = 6.5 Hz, 3H), 0.97 (d, *J* = 7.0 Hz, 3H), 0.90 (s, 9H), 0.06 (s, 6H); ^{13}C NMR (125 MHz, $CDCl_3$) δ 83.7, 83.0, 81.6, 80.8, 67.0, 66.8, 60.1, 35.2, 35.1, 32.5, 25.9, 22.5, 22.2, 18.3, 16.2, 16.0, −5.4; IR(neat) 3369, 2956, 2929, 2857, 2247, 1471, 1456, 1092 cm^{-1}; EIMS *m/z* 337 $(M - CH_3)^+$; HRMS $(M - CH_3)^+$ calcd for $C_{19}H_{33}O_3Si$, 337.2199; found 337.2204.



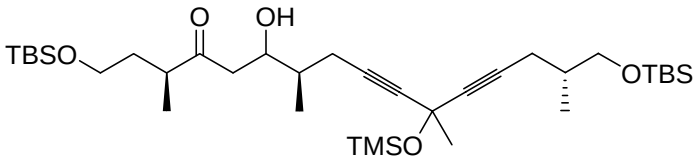
(2*R*,6*R*/*S*,10*R*)-10-((*tert*-Butyldimethylsilyloxy)methyl)-6-hydroxy-2,6 dimethylundeca-4,7-diynal. Dess-Martin periodinane (315 mg, 0.74 mmol) was added to a solution of the starting alcohol mixture **(*R*,*R*/*S*,*R*)-9** (238 mg, 0.68 mmol) and pyridine (0.55 mL, 6.80 mmol) in DCM (108 mL) at 0 °C. The resulting mixture was stirred at 0 °C for 2 h. If the TLC indicated incomplete completion an additional 1 equiv of DMP was added at 0 °C and the reaction was stirred for 1 h. The reaction was then quenched by the addition of a 1:1 mixture of saturated aqueous $NaHCO_3$ solution and saturated aqueous Na_2SO_3 solution (70 mL) and the mixture was stirred until two layers could be seen. The layers were separated and the aqueous layer was further extracted

twice with DCM. The combined organic extracts were then washed with brine, dried over anhydrous $MgSO_4$ and concentrated under vacuum. Flash column chromatography (SiO_2, 20% ethyl acetate/hexanes) gave 193 mg (82%) of the desired aldehyde as a colorless oil: ^{1}H NMR (300 MHz, $CDCl_3$) δ 9.70 (s, 1H), 3.51 (dd, *J* = 5.5, 9.9 Hz, 1H), 3.45 (dd, *J* = 6.7, 9.9 Hz, 1H), 2.60-2.50 (m, 2H), 2.39 (dd, *J* = 9.0, 18.3 Hz, 1H), 2.30 (dd, *J* = 5.7, 16.5 Hz, 1H), 2.13 (dd, *J* = 6.9, 16.8 Hz, 1H), 1.88-1.77 (m, 1H), 1.71 (s, 3H), 1.22 (d, *J* = 6.9 Hz, 3H), 0.95 (d, *J* = 6.9 Hz, 3H), 0.89 (s, 9H), 0.04 (s, 6H); ^{13}C NMR (75 MHz, $CDCl_3$) 203.0, 84.3, 82.8, 81.7, 79.1, 66.7, 60.0, 45.0, 35.1, 32.4, 25.9, 22.1, 19.9, 18.3, 16.0, 13.1, −5.4 ; IR (neat) 3435, 2930, 2857, 2246, 1728, 1462, 1256, 1095 cm^{-1}; EIMS *m/z* 335 $(M - CH_3)^+$; HRMS $(M - CH_3)^+$ calcd for $C_{19}H_{31}O_3Si$, 335.2036; found, 335.2043.



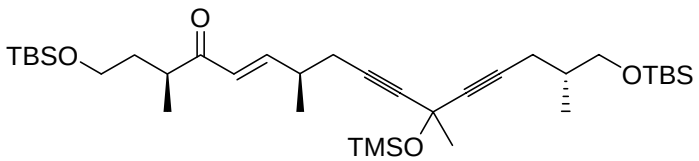
(2*R*,10*R*)-11-(*tert*-Butyldimethylsilyloxy)-2,6,10-trimethyl-6-(trimethylsilyloxy) undeca-4,7-diynal ((*R*,*R*/*S*,*R*)-10). Chlorotrimethylsilane (0.24 mL, 1.63 mmol) was added to a stirred mixture of the tertiary alcohol (190 mg, 0.54 mmol), triethylamine (0.30 mL, 2.17 mmol) and DMAP (6 mg, 0.05 mmol) in DCM (5.60 mL) at room temperature. The reaction mixture was stirred at room temperature for 1 h. The reaction was then quenched by addition of saturated $NaHCO_3$ solution. The mixture was diluted with DCM, water was added and the layers were separated. The aqueous layer was further extracted twice with DCM. The combined organic extracts were washed with brine, dried over anhydrous $MgSO_4$ and concentrated under vacuum. Purification by flash

column chromatography (SiO_2, 5% ethyl acetate/hexanes) gave 200 mg (88%) of the pure aldehyde **(*R*,*R*/*S*,*R*)-10** as a colorless oil: ^{1}H NMR (300 MHz, $CDCl_3$) δ 9.72 (s, 1H), 3.51 (dd, *J* = 6.0, 9.9 Hz, 1H), 3.47 (dd, *J* = 6.6, 9.9 Hz, 1H), 2.65-2.50 (m, 2H), 2.43-2.28 (overlapping dd, 2H), 2.13 (dd, *J* = 6.9 Hz, 16.8 Hz, 1H), 1.93-1.78 (m, 1H), 1.71 (s, 3H), 1.24 (d, *J* = 7.2 Hz, 3H), 0.97 (d, *J* = 6.9 Hz, 3H), 0.90 (s, 9H), 0.23 (s, 9H), 0.05 (s, 6H); ^{13}C NMR (125 MHz, $CDCl_3$) 203.07, 85.16, 83.46, 81.66, 78.81, 66.79, 60.97, 45.09, 35.24, 34.99, 25.90, 22.28, 20.08, 18.28, 16.11, 13.17, 1.57, −5.42; IR (neat) 2958, 2930, 2857, 2241, 1733, 1472, 1463, 843 cm^{-1}; EIMS *m/z* 407 $(M - CH_3)^+$; HRMS $(M - CH_3)^+$ calcd for $C_{22}H_{39}O_3Si_2$, 407.2438; found, 407.2422.



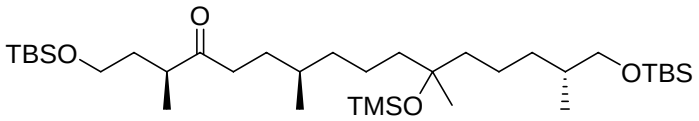
(3*S*,7*R*,15*R*)-1,16-Bis(*tert*-butyldimethylsilyloxy)-6-hydroxy-3,7,11,15-tetramethyl-11-(trimethylsilyloxy)hexadeca-9,12-diyn-4-one. *n*-BuLi (1.6 M in hexanes, 0.30 mL, 0.48 mmol) was added dropwise to a stirring solution of diisopropylamine (0.07 mL, 0.50 mmol) in THF (0.4 mL) at 0 °C. The reaction mixture was stirred at this temperature for 5 min and then cooled to −78 °C. A solution of starting ketone **(*S*)-4** (103.5 mg, 0.45 mmol) in THF (0.4 mL) was added dropwise and the mixture was further stirred at −78 °C for 30 min. A solution of aldehyde **(*R*,*R*/*S*,*R*)-10** (127 mg, 0.30 mmol) in THF (0.4 mL) was then added dropwise and the resulting mixture was stirred at −78 °C for 3.5 h. The reaction was then quenched by addition of saturated NH_4Cl solution and warmed to room temperature. The mixture was diluted with Et_2O, water was added and the layers

were separated. The aqueous layer was further extracted twice with Et_2O. The combined organic extracts were washed with brine, dried over anhydrous $MgSO_4$, and concentrated under vacuum. Purification by flash column chromatography (SiO_2, polarity was gradually increased from 5% ethyl acetate/hexanes to 10% ethyl acetate/hexanes) gave 157 mg (80%) of the desired aldol product as a colorless oil: ^{1}H NMR (300 MHz, $CDCl_3$) δ 4.12-4.00 (m, 0.5H), 3.93-3.80 (m, 0.5H), 3.61 (t, *J* = 6.0 Hz, 2H), 3.47 (d, *J* = 6 Hz, 2H), 3.31-3.14 (m, 1H), 2.81-2.65 (m, 1H), 2.65-2.36 (m, 2H), 2.36-2.05 (m, 3H), 2.00-1.73 (overlapping multiplets, 3H), 1.70 (s, 3H), 1.60-1.45 (m, 1H), 1.09 (d, *J* = 6.9 Hz, 3H), 1.01 (d, *J* = 6.6 Hz, 1.5 H), 1.00 (d, *J* = 6.9 Hz, 1.5H), 0.95 (d, , *J* = 6.6 Hz, 3H), 0.88 (s, 9H), 0.87 (s, 9H), 0.21 (s, 9H), 0.04 (s, 12H); ^{13}C NMR (75 MHz, $CDCl_3$) 216.00, 215.80, 84.23, 84.20, 83.82, 83.74, 81.32, 81.28, 81.23, 81.05, 81.02, 80.99, 70.72, 70.57, 69.77, 69.65, 66.81, 61.05, 60.66, 60.62, 44.94, 44.84, 44.58, 43.64, 43.56, 43.42, 43.40, 37.65, 37.58, 37.52, 35.44, 35.41, 35.38, 35.26, 35.11, 25.91, 22.72, 22.68, 22.31, 21.85, 18.28, 16.28, 16.23, 16.12, 15.80, 15.71, 14.01, 13.97, 1.60, −5.42, IR (neat) 3503, 2955, 2929, 2856, 2240, 1700, 1458 cm^{-1}; EIMS *m/z* 637 $(M - CH_3)^+$; HRMS $(M)^+$ calcd for $C_{35}H_{68}O_5Si_3$, 652.4375; found, 652.4363.



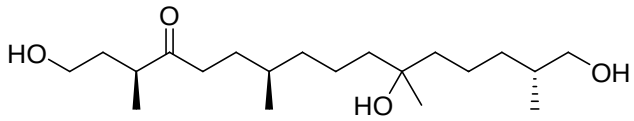
(3*S*,7*R*,15*R*,*E*)-1,16-Bis(*tert*-butyldimethylsilyloxy)-3,7,11,15-tetramethyl-11-(trimethylsilyl-oxy)hexadeca-5-en-9,12-diyn-4-one. Methanesulfonyl chloride (0.03 mL, 0.42 mmol) was added dropwise to a stirring mixture of aldol adduct (139.0 mg, 0.21 mmol) and triethylamine (0.12 mL, 0.84 mmol) in DCM (0.65 mL) at 0 °C. The resulting

mixture was stirred at 0 °C for 30 min and then at room temperature for 12 h. The reaction was quenched by addition of saturated NH_4Cl solution. DCM was added and the layers were separated. The aqueous layer was further extracted twice with DCM. The combined organic extracts were washed with brine, dried over anhydrous $MgSO_4$, filtered and concentrated under vacuum. Purification by flash column chromatography (SiO_2, 10% ethyl acetate/hexanes) gave 110 mg (83%) of the desired enone as a colorless oil: ^{1}H NMR (300 MHz, $CDCl_3$) δ 6.83 (dd, *J* = 6.6, 15.6 Hz, 0.5H), 6.82 (dd, *J* = 7.2, 15.9 Hz, 0.5H), 6.16 (d, *J* = 15.6 Hz, 1H), 3.70-3.55 (m, 2H), 3.49 (d, *J* = 6H, 2H), 3.05-2.90 (m, 1H), 2.63-2.48 (m, 1H), 2.40-2.20 (overlapping dd, 3H), 2.13 (dd, *J* = 6.9, 16.5 Hz, 1H), 2.02-1.88 (m, 1H), 1.88-1.75 (m, 1H), 1.71 (s, 3H), 1.60-1.43 (m, 1H), 1.18 (d, *J* = 6.6 Hz, 3H), 1.11 (d, *J* = 6.9 Hz, 3H), 0.97 (d, *J* = 6.6 Hz, 3H), 0.90 (s, 9H), 0.89 (s, 9H), 0.23 (s, 9H), 0.05 (s, 6H), 0.04 (2X3H); ^{13}C NMR (125 MHz, $CDCl_3$) δ 203.56, 203.52, 149.77, 149.73, 127.92, 127.85 84.91, 83.61, 81.45, 79.66, 66.80, 60.99, 60.63, 40.12, 39.96, 35.90, 35.81. 35.25, 35.11, 25.90, 25.43, 22.30, 18.79, 18.71, 18.25, 16.64, 16.55, 16.11, 1.58, −5.42; IR (neat) 2957, 2926, 2855, 2240, 1699, 1674, 1630, 1463 cm^{-1}; EIMS *m/z* 619 $(M - CH_3)^+$; HRMS $(M - CH_3)^+$ calcd for $C_{34}H_{63}O_4Si_3$, 619.4034; found, 619.4024.



(3*S*,7*R*,15*R*)-1,16-Bis(*tert*-butyldimethylsilyloxy)-3,7,11,15-tetramethyl-11-(trimethylsilyl-oxy)hexadecan-4-one ((*S*,*R*,*R*/*S*,*R*)-3). To a solution of enone (65 mg, 0.10 mmol) in methanol (0.5 mL) was added Pd/C (10% by wt., 5.2mg) and the mixture

was stirred under hydrogen from balloon for 3 h. The reaction mixture was then filtered though a small pad of celite and concentrated under vacuum. Purification by flash column chromatography (SiO_2, 5% ethyl acetate/hexanes) gave 60 mg (91%) of the pure product **(*S*,*R*,*R*/*S*,*R*)-3** as a colorless oil: ^{1}H NMR (500 MHz, $CDCl_3$) 3.64-3.56 (m, 2H), 3.454 (dd, *J* = 6, 10 Hz, 0.5H), 3.450 (dd, *J* = 6.0, 10 Hz, 0.5H), 3.369 (dd, *J* = 6.5, 10 Hz, 0.5H), 3.367 (dd, J = 6.5, 9.5 Hz, 0.5H), 2.75 (sextet, 2H), 2.54-2.39 (m, 2H), 1.94-1.88 (m, 1H), 1.64-1.55 (m, 2H), 1.55-1.46 (m, 1H), 1.45-1.31 (m, 9H), 1.30-1.20 (m, 4H), 1.17 (s, 3H), 1.08 (d, *J* = 7.0 Hz, 3H), 0.90 (s, 9H), 0.89 (s, 9H), 0.89-0.87 (overlapping doublets, 6H), 0.09 (s, 9H), 0.04 (s, 12H); ^{13}C NMR (125 MHz, $CDCl_3$) δ 214.89, 76.18, 68.38, 60.76, 42.76, 42.73, 42.71, 42.69, 42.59, 39.10, 37.41, 35.78, 35.76, 33.72, 32.54, 30.80, 27.44, 27.42, 25.97, 25.92, 21.51, 21.46, 21.41, 19.38, 18.36, 18.27, 16.75, 16.49, 2.69, −5.34, −5.39, −5.41, EIMS *m/z* 629 $(M - CH_3)^+$; HRMS $(M - CH_3)^+$ calcd for $C_{34}H_{73}O_4Si_3$, 629.4817; found, 629.4827.

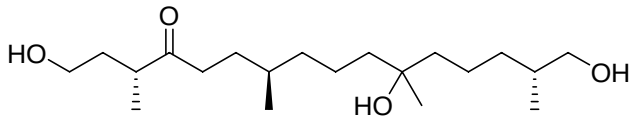


(3*S*,7*R*,11*R*/*S*,15*R*)-1,11,16-trihydroxy-3,7,11,15-tetramethylhexadecan-4-one

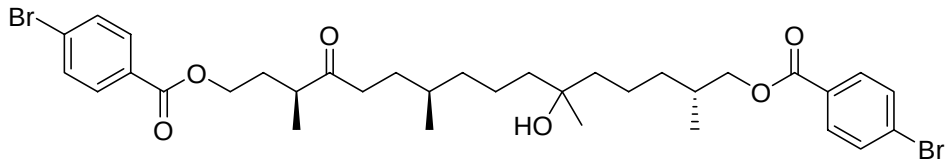
(*S*,*R*,*R*/*S*,*R*)-1. TBAF (1M in THF, 0.64 mL, 0.64 mmol) was added dropwise to a solution of the compound **(*S*,*R*,*R*/*S*,*R*)-3** (60 mg, 0.09 mmol) in THF (10 mL) at 0 °C. The resulting mixture was stirred at 0 °C for 30 min and then at room temperature for 15 h. The reaction was then quenched by the addition of saturated NH_4Cl solution. The reaction mixture was diluted with Et_2O and the layers were separated. The aqueous layer was further extracted three times with Et_2O. The combined organic extracts were dried

over anhydrous $MgSO_4$, filtered and concentrated under vacuum. Purification by flash column chromatography (SiO_2, polarity was gradually increased from 70% ethyl acetate/hexanes - 100%EtOAc) gave 20 mg (65%) of the desired compound **(*S*,*R*,*R*/*S*,*R*)-1** as a colorless oil: ^{1}H NMR (500 MHz, CD_3OD) δ 3.52 (t, *J* = 7.0 Hz, 2H), 3.42 (dd, *J* = 6.0, 11 Hz, 1H), 3.33 (dd, *J* = 6.5, 11 Hz, 1H), 2.77 (sextet, *J* = 6.5 Hz, 1H), 2.61-2.48 (m, 2H), 1.93-1.86 (m, 1H), 1.65-1.26 (m, 16H), 1.13 (s, 3H), 1.08 (d, *J* = 7 Hz, 3H), 1.10-1.05 (m, 1H), 0.91 (d, *J* = 6.5 Hz, 3H), 0.89 (d, *J* = 6.5 Hz, 3H); ^{13}C NMR (125 MHz, $CDCl_3$) δ 217.53, 73.42, 68.50, 60.68, 44.03, 43.07*, 42.96*, 40.02, 38.67, 36.93, 36.90, 36.80*, 35.10, 33.64, 31.80, 26.99*, 22.41*, 19.95, 17.16, 16.95; EIMS *m/z* 326 (M − H_2O)$^+$; HRMS (M − H_2O)$^+$ calcd for $C_{20}H_{38}O_3$, 326.2821; found, 326.2824.

* doublets or multiplets, see expansions and tabulated data



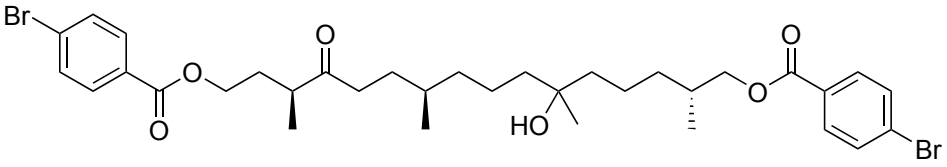
(3*R*,7*R*,11*R*/*S*,15*R*)-1,11,16-trihydroxy-3,7,11,15-tetramethylhexadecan-4-one ((*R*,*R*,*R*/*S*,*R*)-1). This compound was prepared by aldol coupling of the ketone **(*R*)-4** with the aldehyde mixture **(*R*,*R*/*S*,*R*)-10** followed by elimination, hydrogenation and global deprotection as described for the synthesis of **(*S*,*R*,*R*/*S*,*R*)-1**. The NMR data was in good accordance to that reported for **(*S*,*R*,*R*/*S*,*R*)-1**.



Bis-**4-bromobenzoate derivative (*S,R,R*/*S,R*)-2.** 4-bromobenzoyl chloride (36 mg) was added to a solution of the alcohol **(*S,R,R*/*S,R*)-1** (6 mg, 0.02 mmol) in pyridine (2 mL). The resulting mixture was stirred at room temperature for 4 h. The reaction was then quenched by the addition of sat NH_4Cl solution. DCM and water were added and the layers were separated. The aqueous layer was further extracted three times with DCM. The combined organic layers were then washed four times with 10% aqueous CuSO4 solution, dried over saturated $MgSO_4$ solution, filtered and concentrated under vacuum. Purification by flash column chromatography (SiO_2, 20% ethyl acetate/hexanes) gave 9.5 mg (77%) of the desired bis-4-bromobenzoate as colorless oil: ^{1}H NMR (600 MHz, CDCl3) 7.88 (d, 8.4 Hz, 2H), 7.86 (d, 8.4 Hz, 2H), 7.58 (d, 8.4 Hz, 4H), 4.30 (t, *J* = 6.6 Hz, 2H), 4.20 (dd, *J* = 6.0, 10.8 Hz, 1H), 4.10 (dd, *J* = 6.6, 10.2 Hz, 1H), 2.72 (m, 1H), 2.58-2.34 (m, 2H), 2.23-2.14 (m, 1H), 2.00-1.90 (m, 1H), 1.81-1.71 (m, 1H), 1.63-1.54 (m, 1H), 1.53 – 1.20 (m, 14H), 1.16 (d, *J* = 8.4 Hz, 3H), 1.15 (s, 3H), 1.13-1.05 (m, 1H), 1.02 (d, *J* = 7.2 Hz, 3H), 0.83 (d, *J* = 6 Hz, 1.5 H), 0.82 (d, *J* = 6 Hz, 1.5H)); ^{13}C NMR (150 MHz, $CDCl_3$) 213.75*, 165.91, 165.76, 131.74, 131,69, 131.08, 131.06, 129.35, 129.01, 128.12, 127.93, 72.63, 70.04, 63.37, 43.16*, 42.26#, 42.01#, 39.11, 37.37*, 33.99, 32.70, 32.39*, 31.48*, 30.54*, 26.87#, 21.19*, 21.13* 19.35*, 16.9.

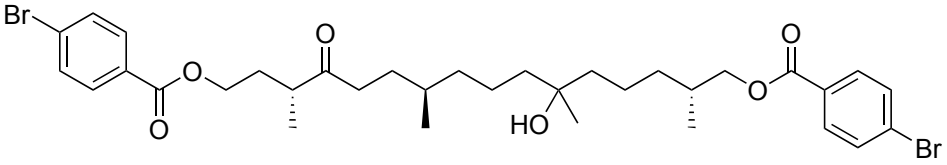
*,# doublets or quadruplets see tabulated data and expansions

***Bis*-4-bromobenzoate derivative (*R,R,R*/*S,R*)-2.** This compound was prepared from **(*R,R,R*/*S,R*)-1** by the procedure described for the synthesis of **(*S,R,R*/*S,R*)-2**. The NMR data was in good accordance to that reported for **(*S,R,R*/*S,R*)-2.**



(*S*,*R*,*R*/*S*,*R*)-2

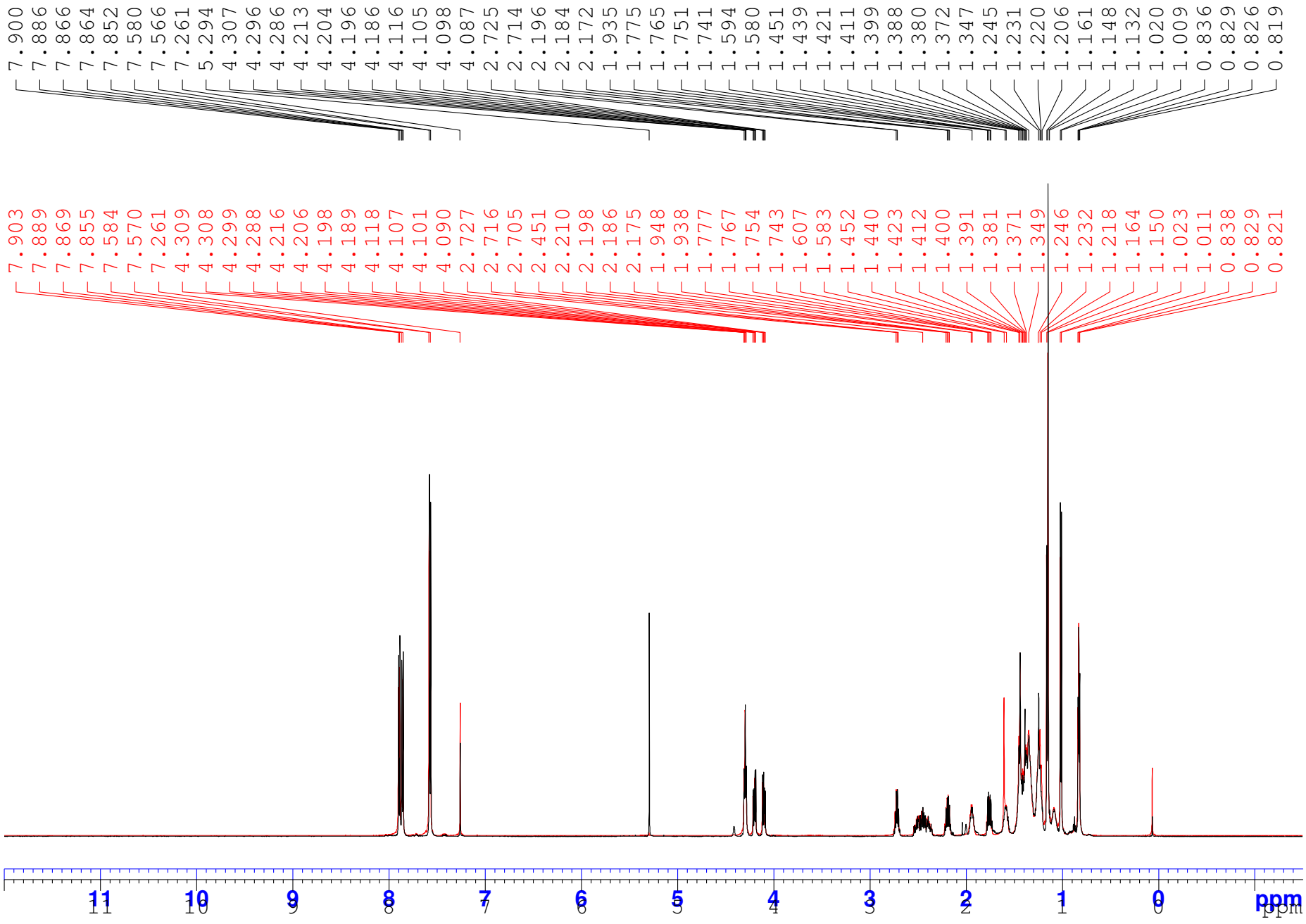
Prepared from **(*S*,*R*,*R*/*S*,*R*)-1**

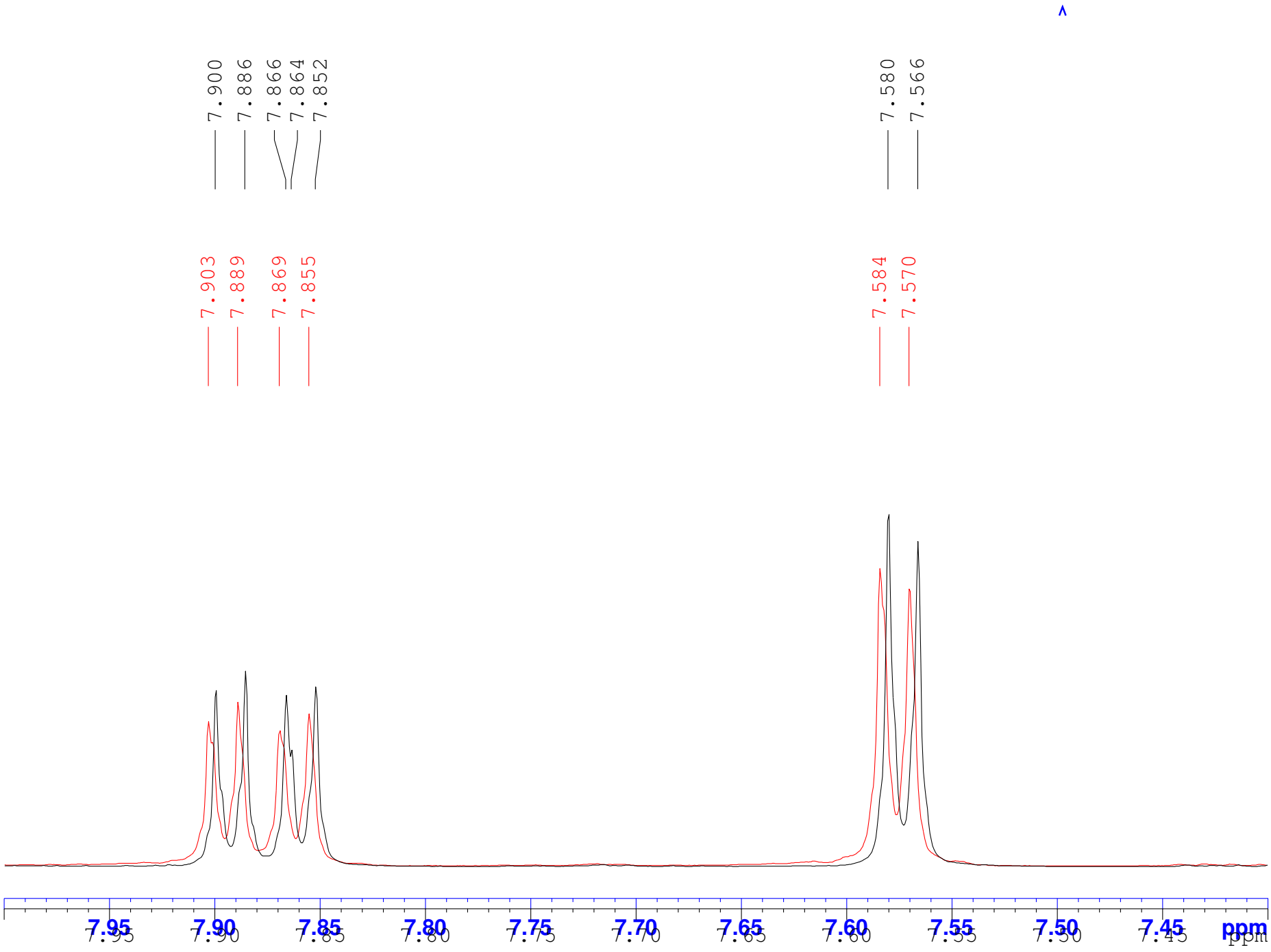


(*R*,*R*,*R*/*S*,*R*)-2

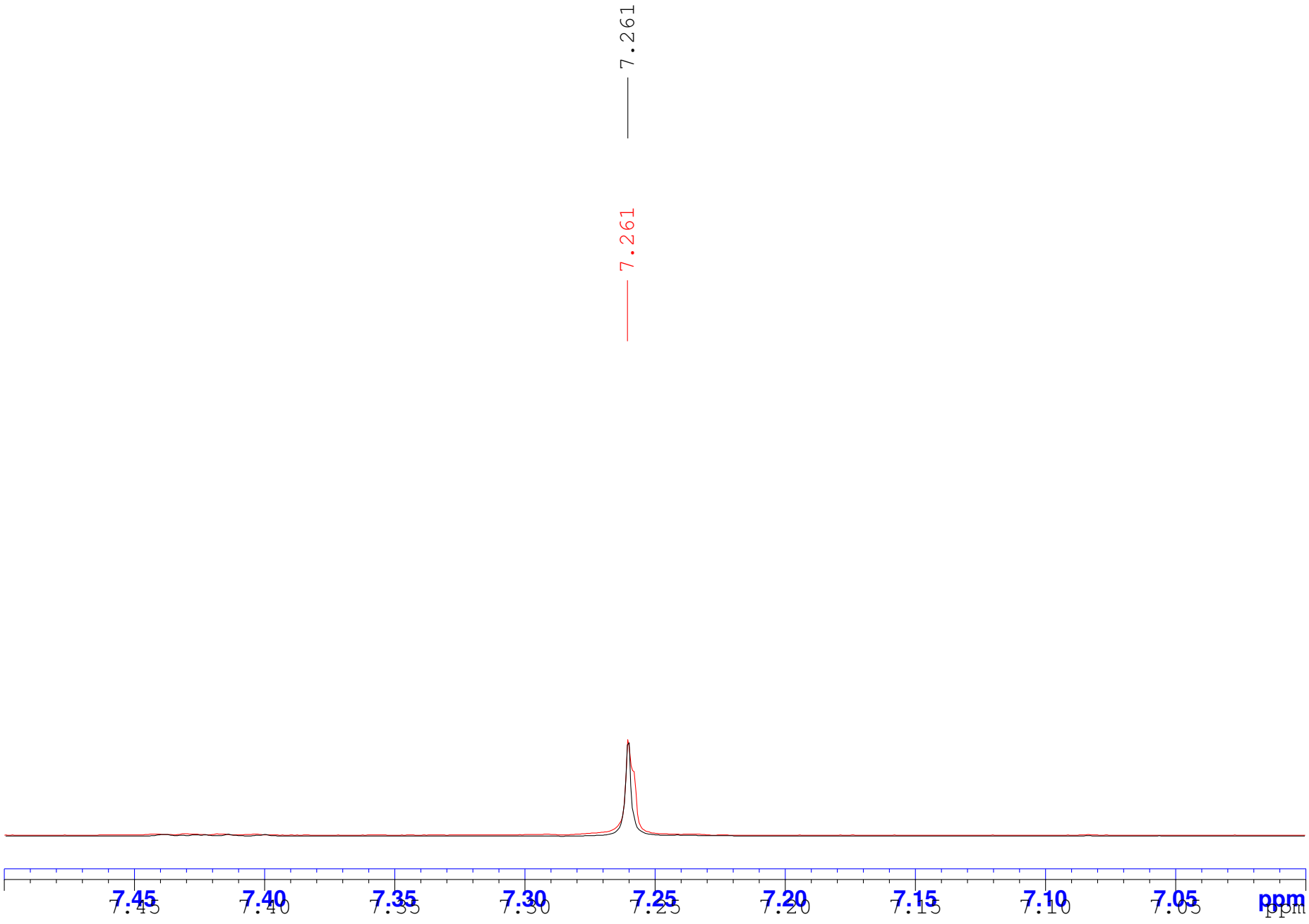
Prepared from **(*R*,*R*,*R*/*S*,*R*)-1**

(R,R,R/S,R)-2 in black, (S,R,R/S,R)-2

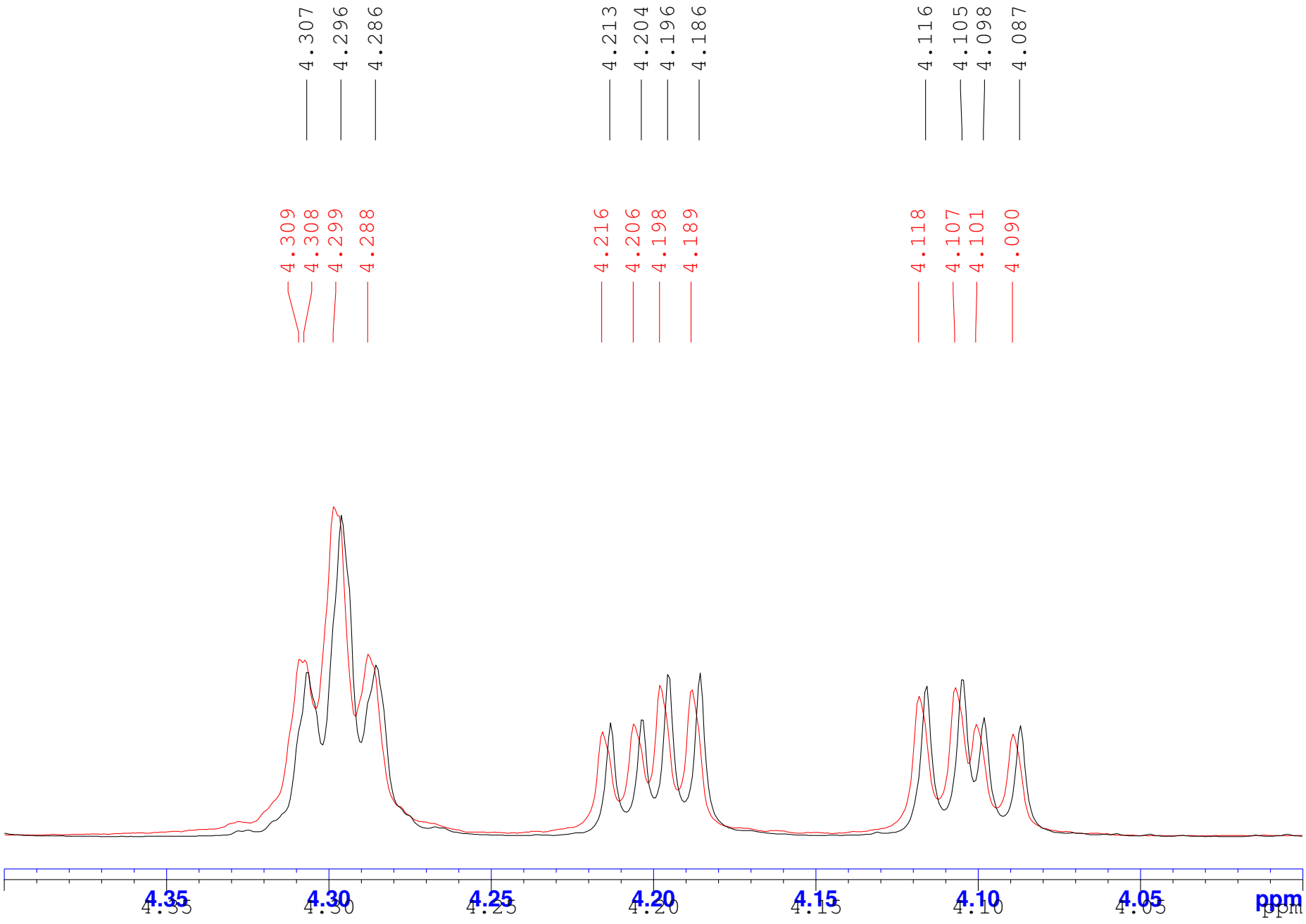



7.900
7.886
7.866
7.864
7.852
7.580
7.566
7.903
7.889
7.869
7.855
7.584
7.570
7.95
7.90
7.85
7.80
7.75
7.70
7.65
7.60
7.55
7.50
7.45
ppm

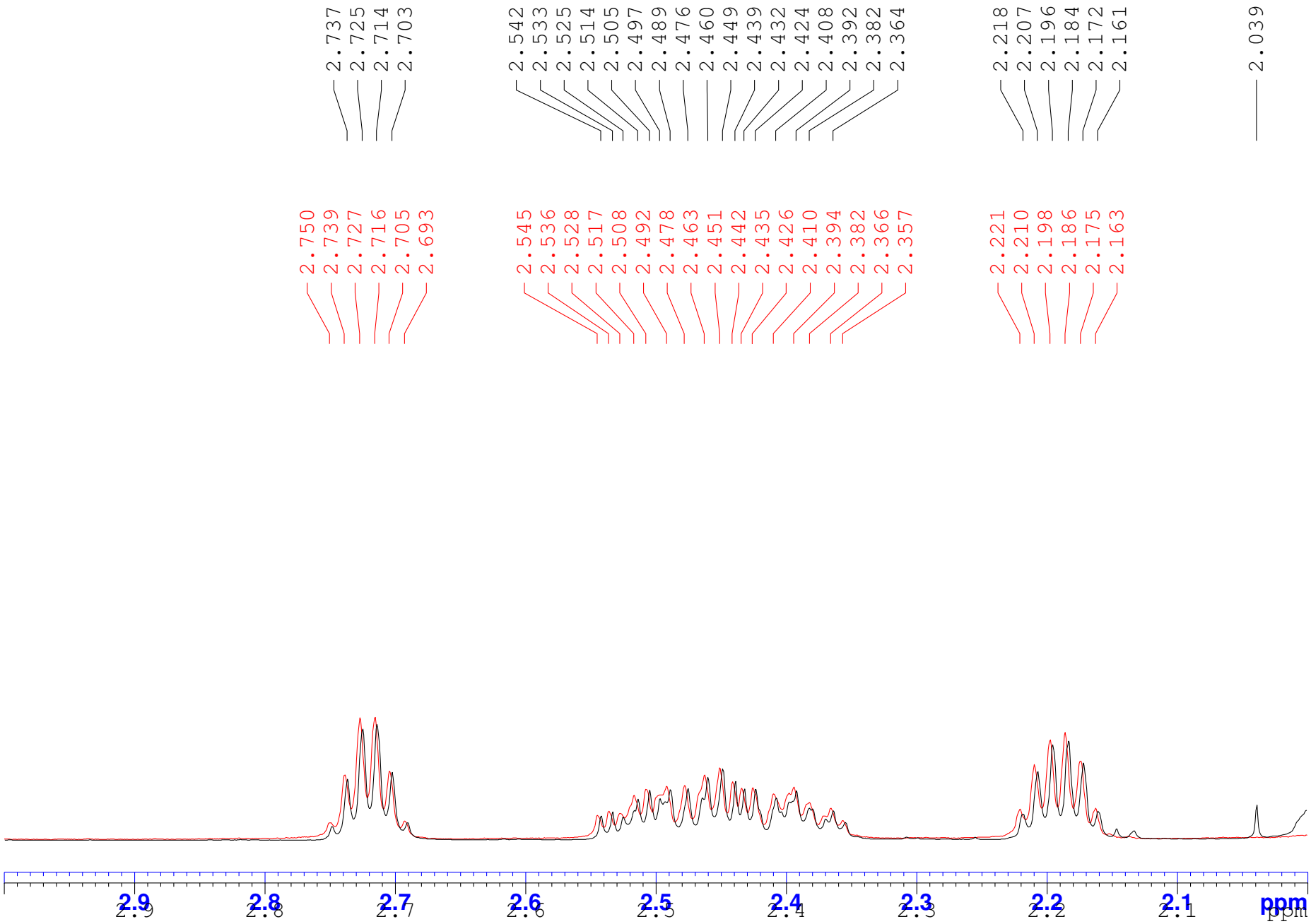
(R,R,R/S,R)-2 in black, (S,R,R/S,R)-2 in red



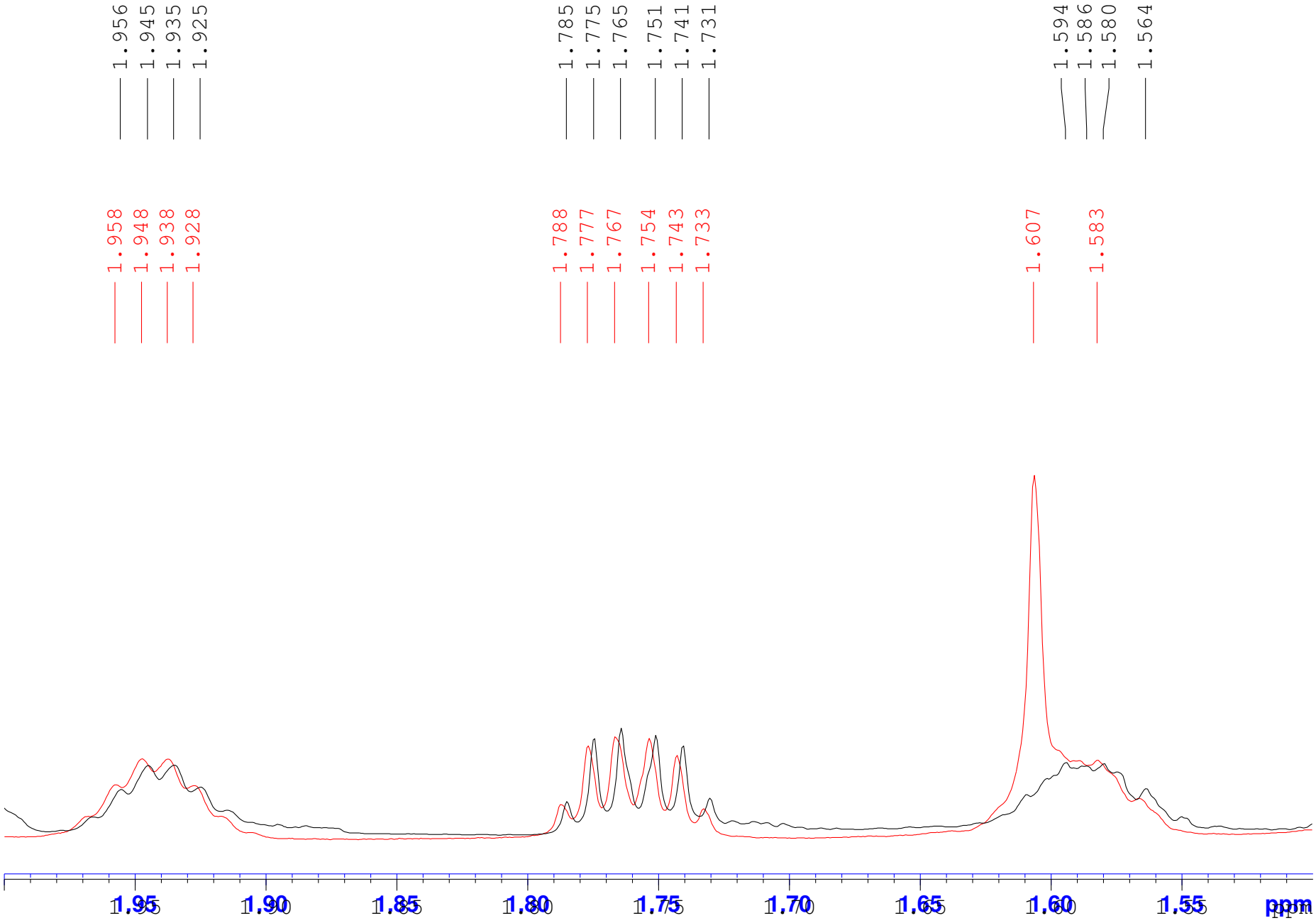
(R,R,R/S,R)-2 in black, (S,R,R/S,R)-2 in red



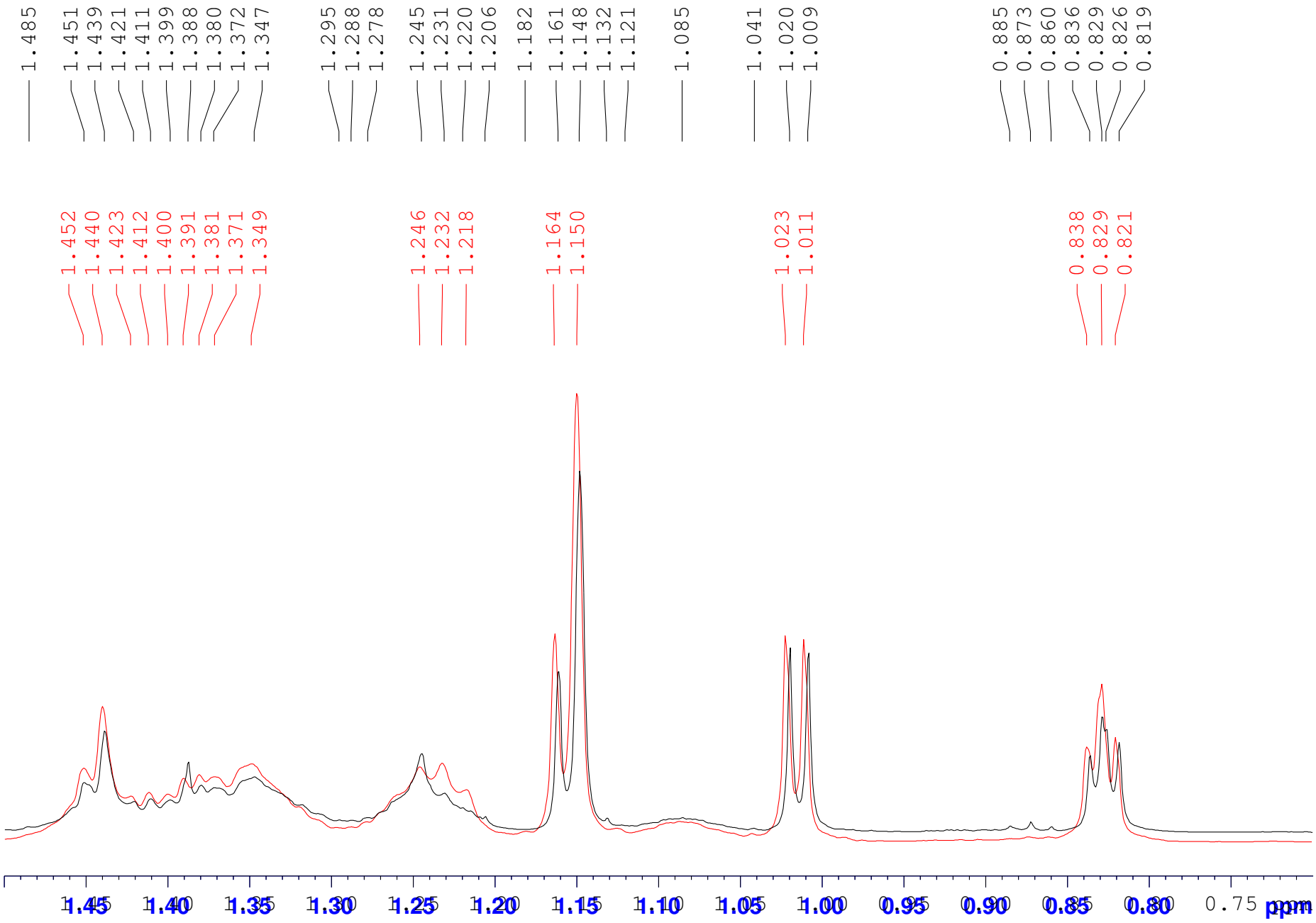
(R,R,R/S,R)-2 in black, (S,R,R/S,R)-2 in red



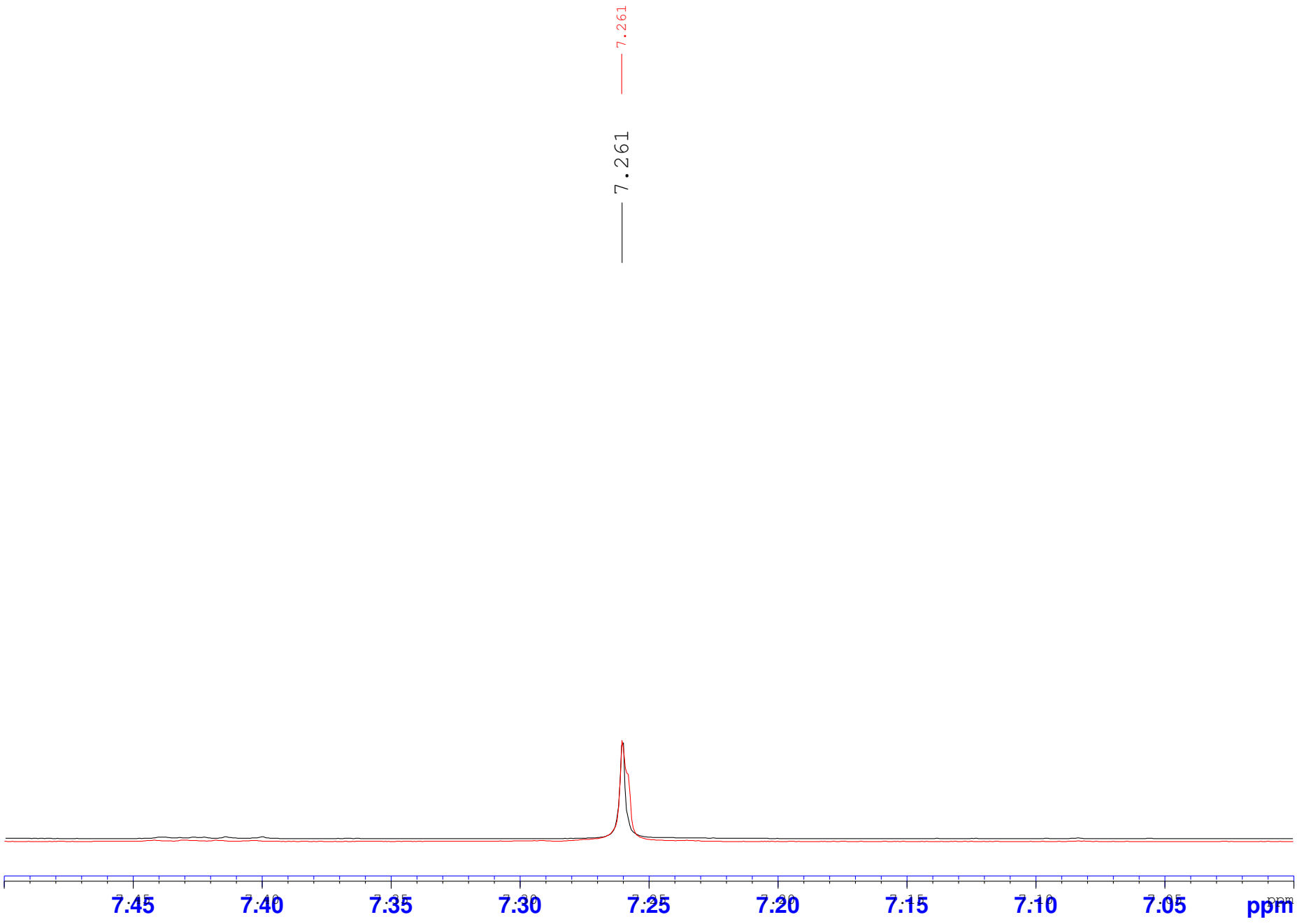
(R,R,R/S,R)-2 in black, (S,R,R/S,R)-2 in red



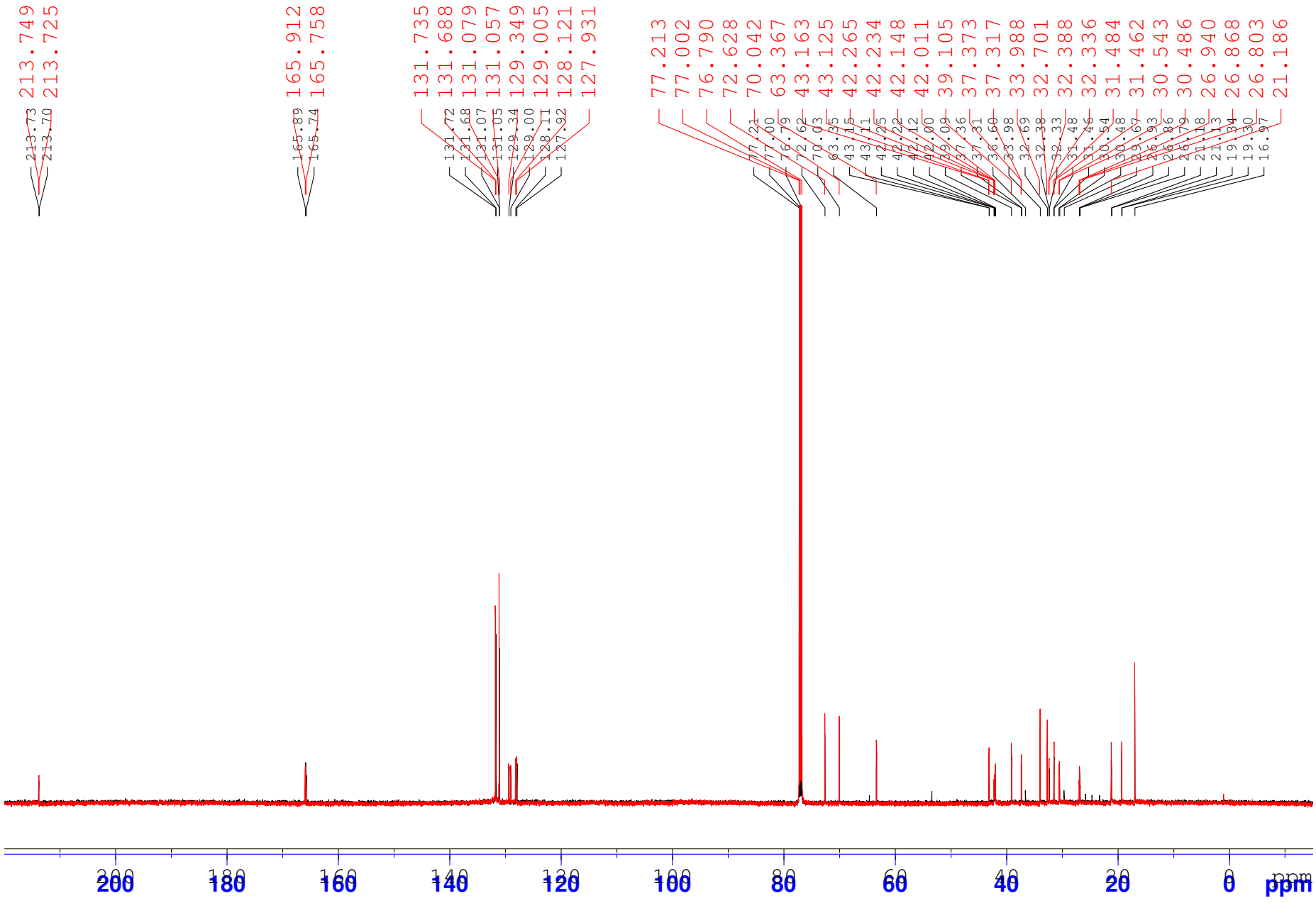
(R,R,R/S,R)-2 in black, (S,R,R/S,R)-2 in red



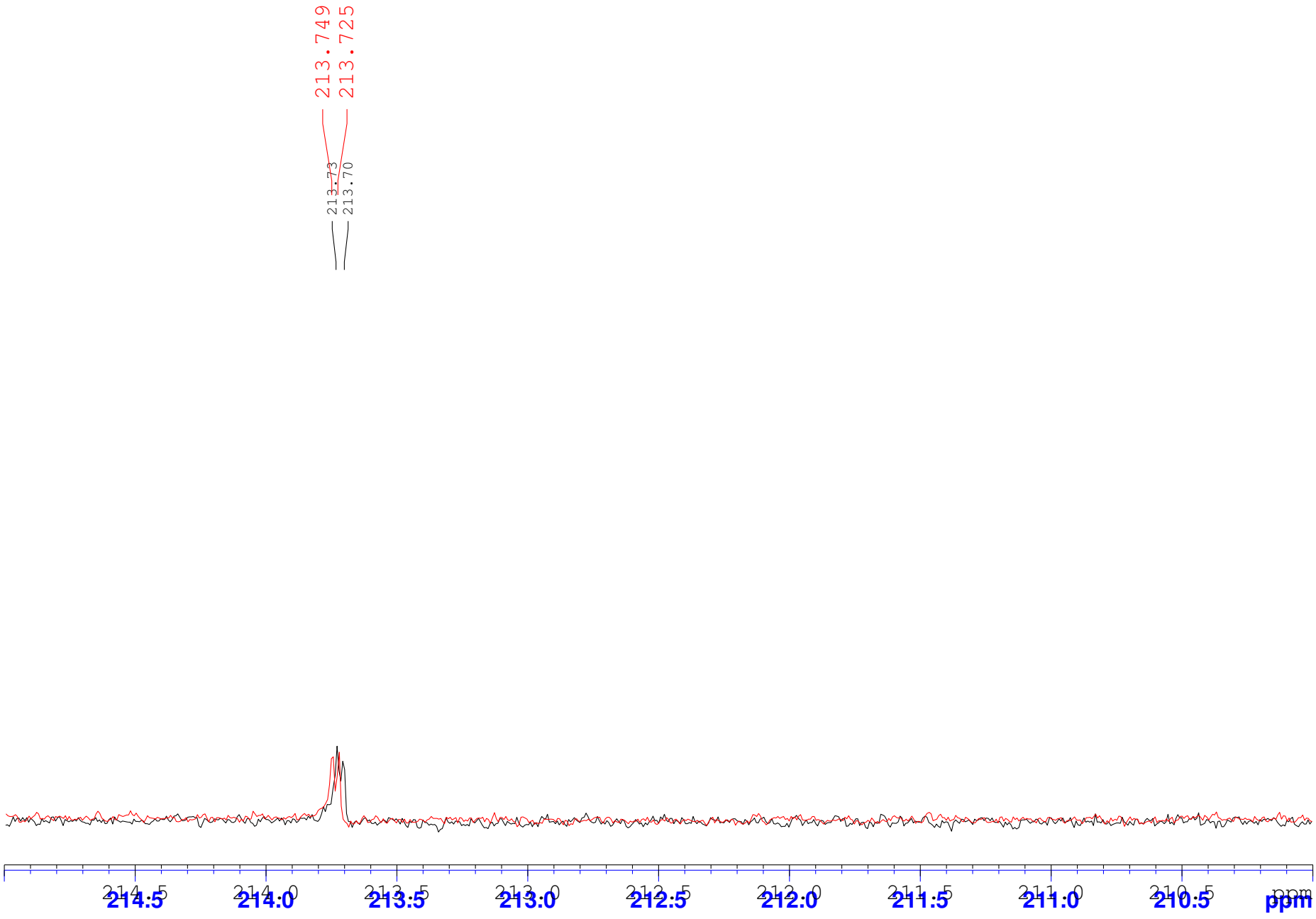
R,R,R/S,R)-2 in black, (S,R,R/S,R)-2 in red



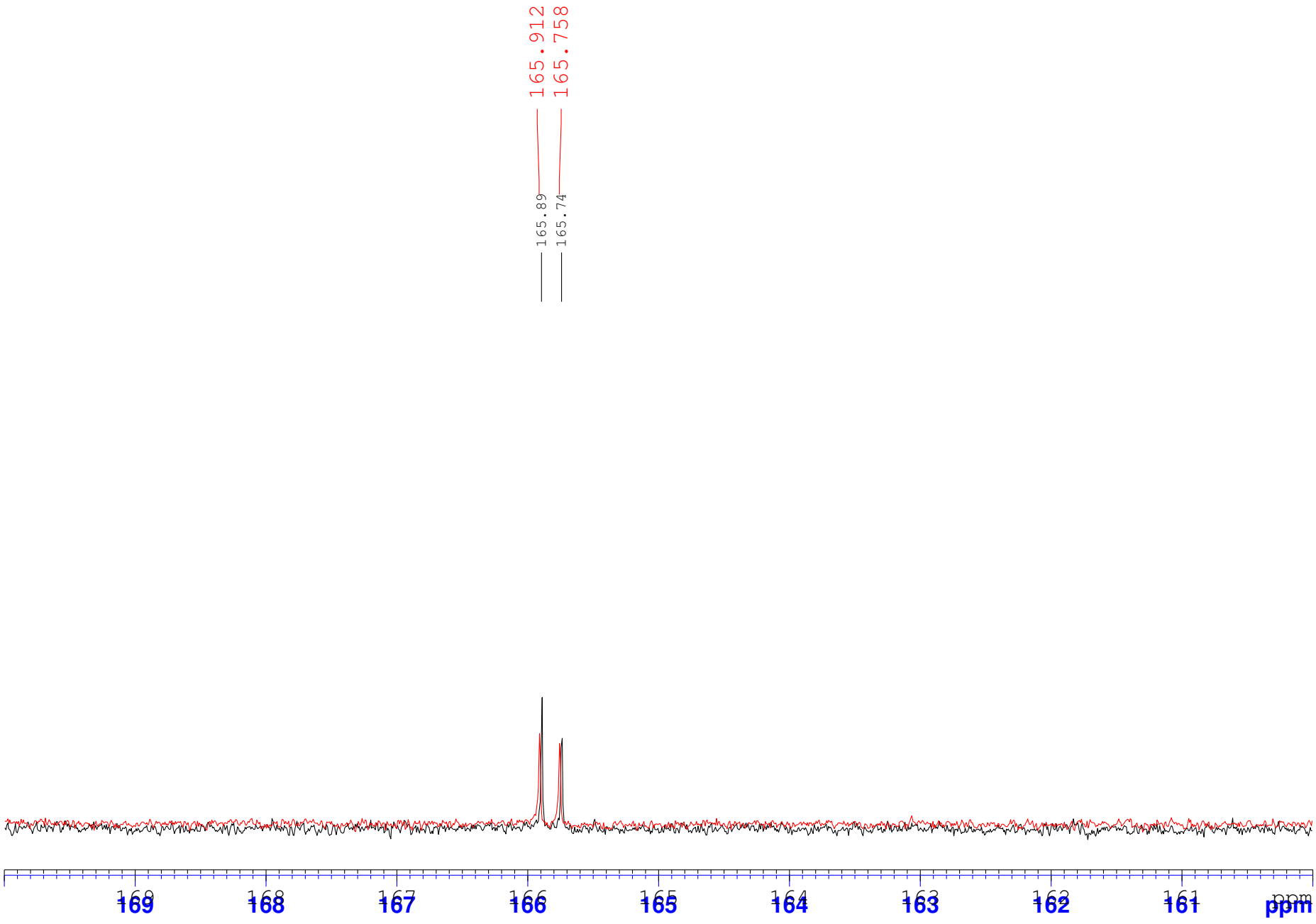
(R,R,R/S,R)-2 in black, (S,R,R/S,R)-2 in red



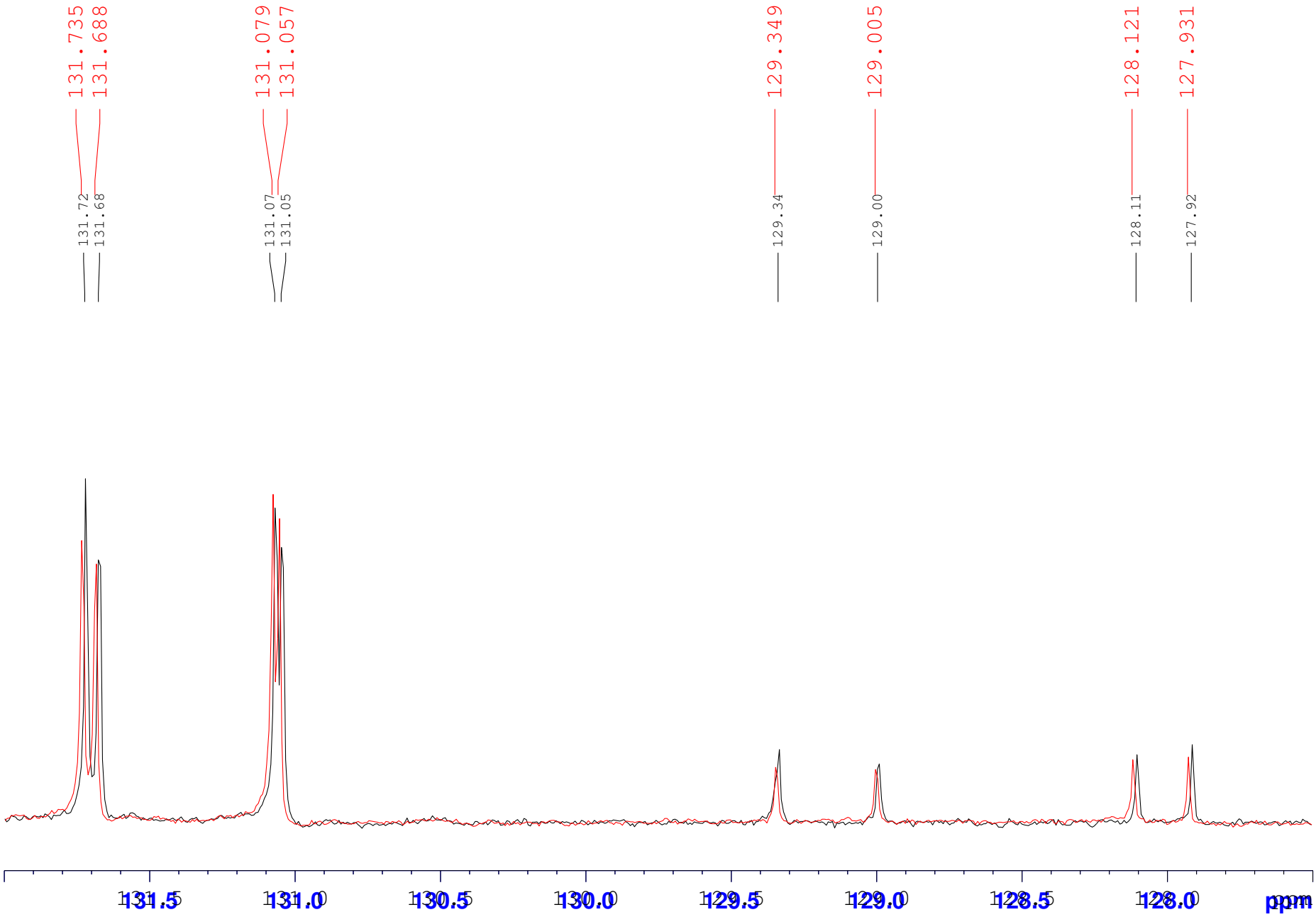
(R,R,R/S,R)-2 in black, (S,R,R/S,R)-2 in red



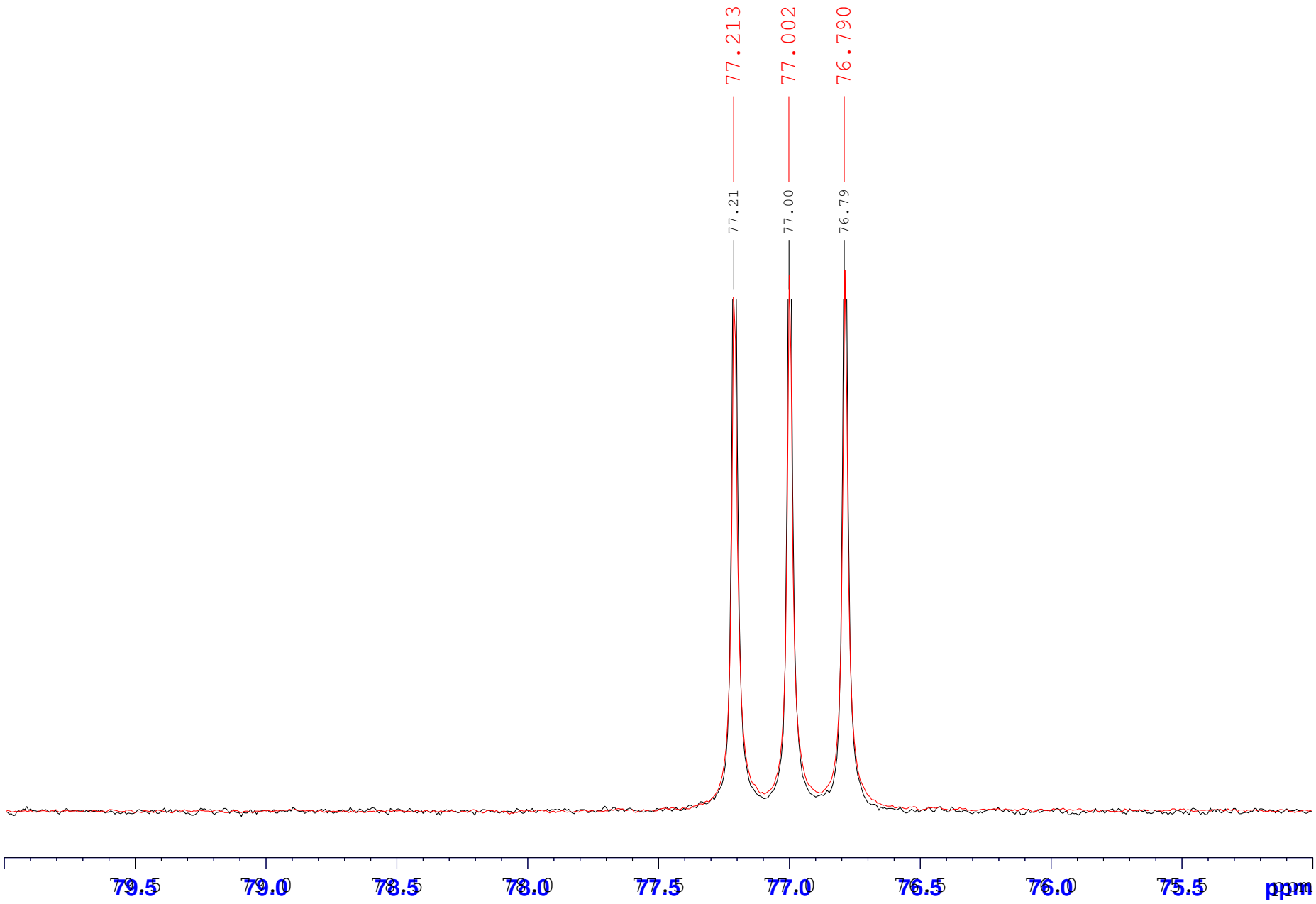
(R,R,R/S,R)-2 in black, (S,R,R/S,R)-2 in red



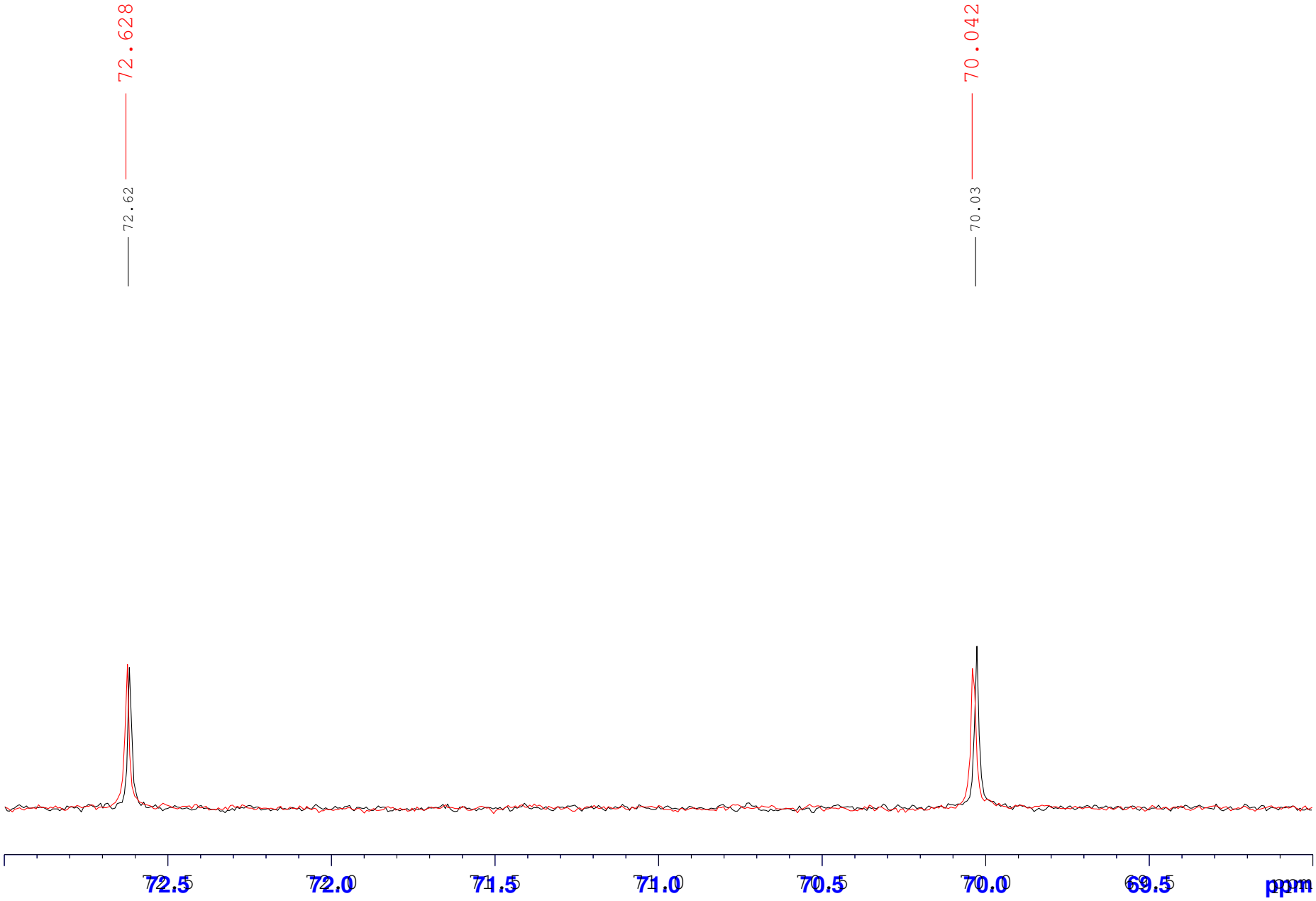
(R,R,R/S,R)-2 in black, (S,R,R/S,R)-2 in red



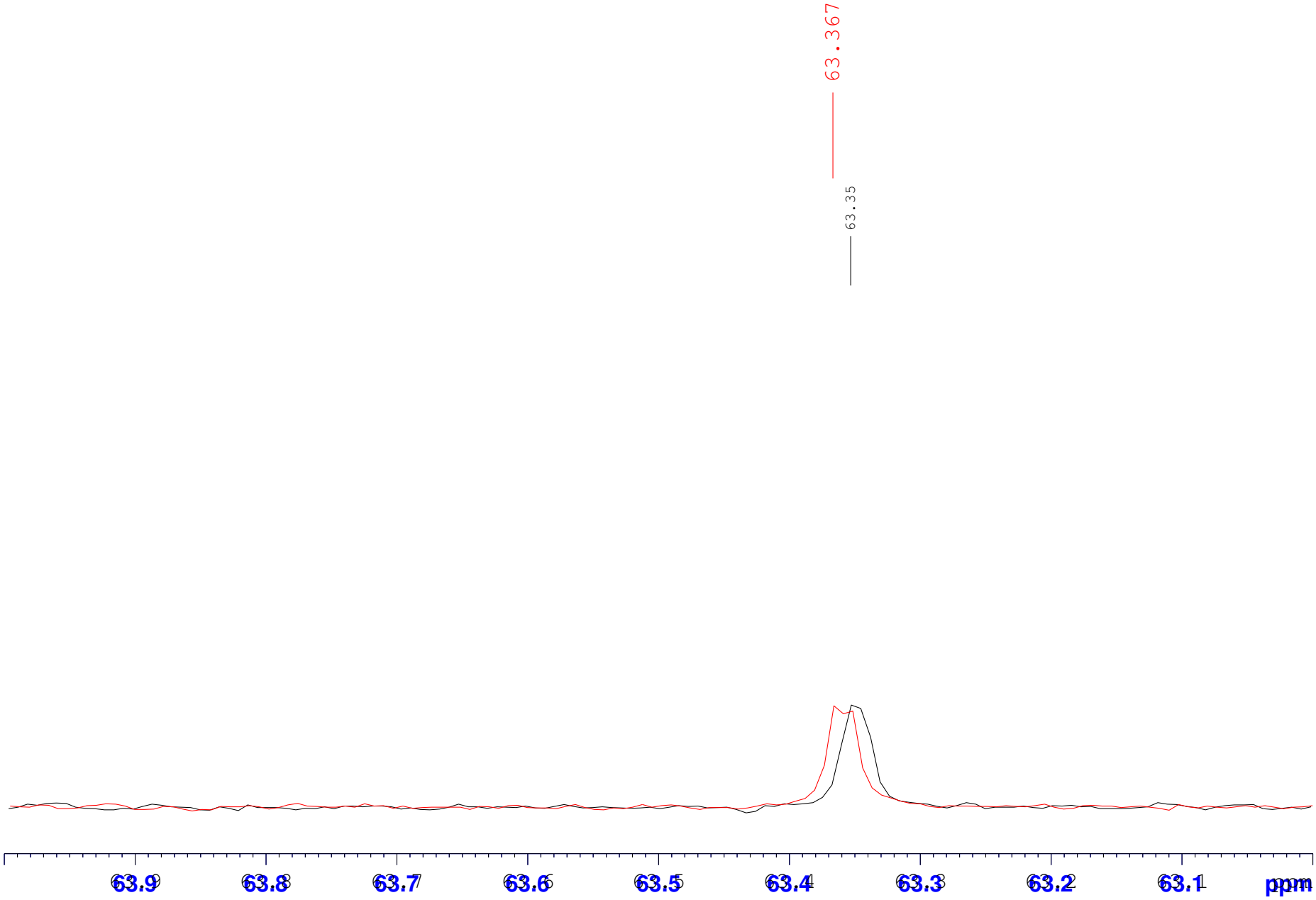
(R,R,R/S,R)-2 in black, (S,R,R/S,R)-2 in red



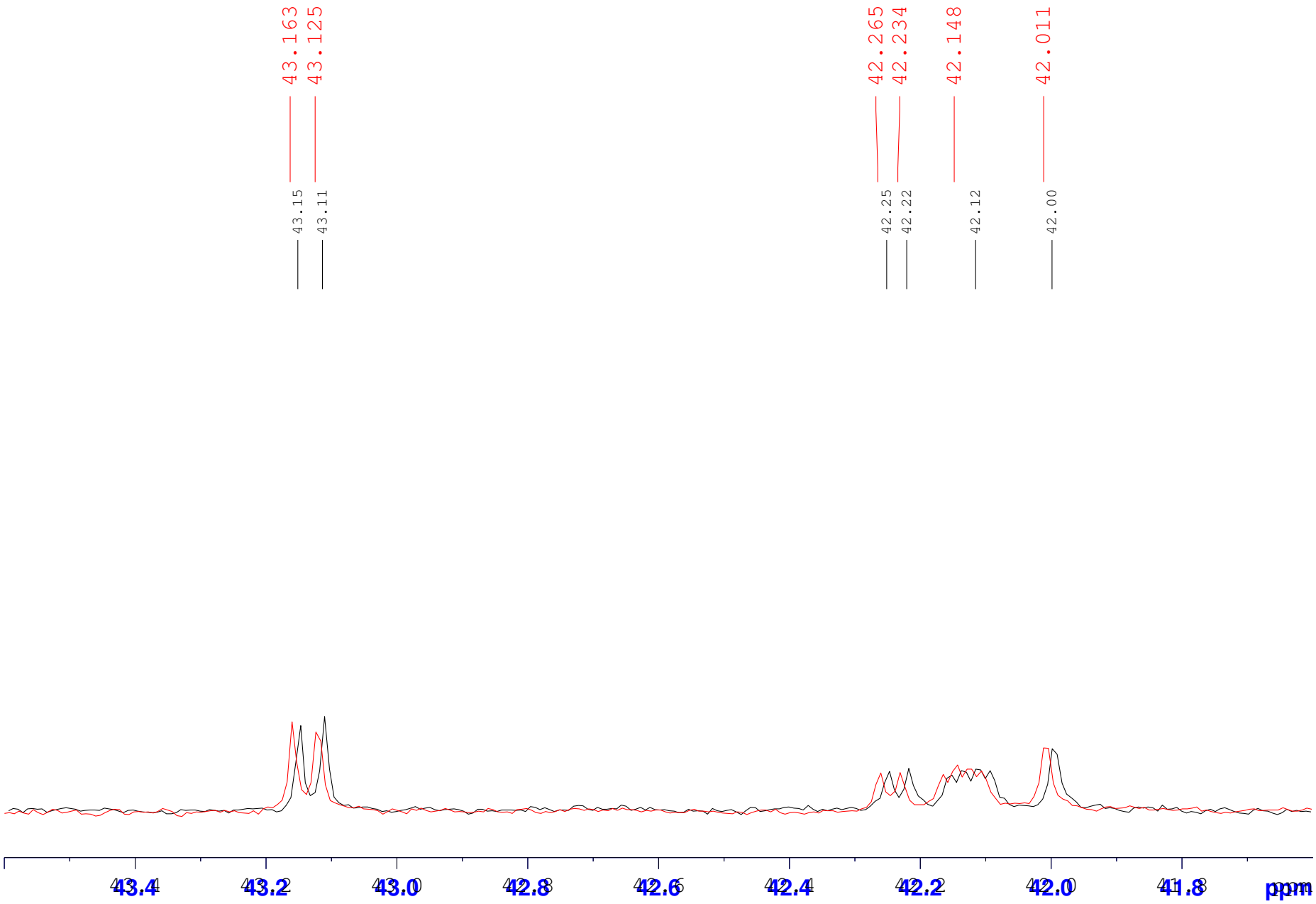
(R,R,R/S,R)-2 in black, (S,R,R/S,R)-2 in red



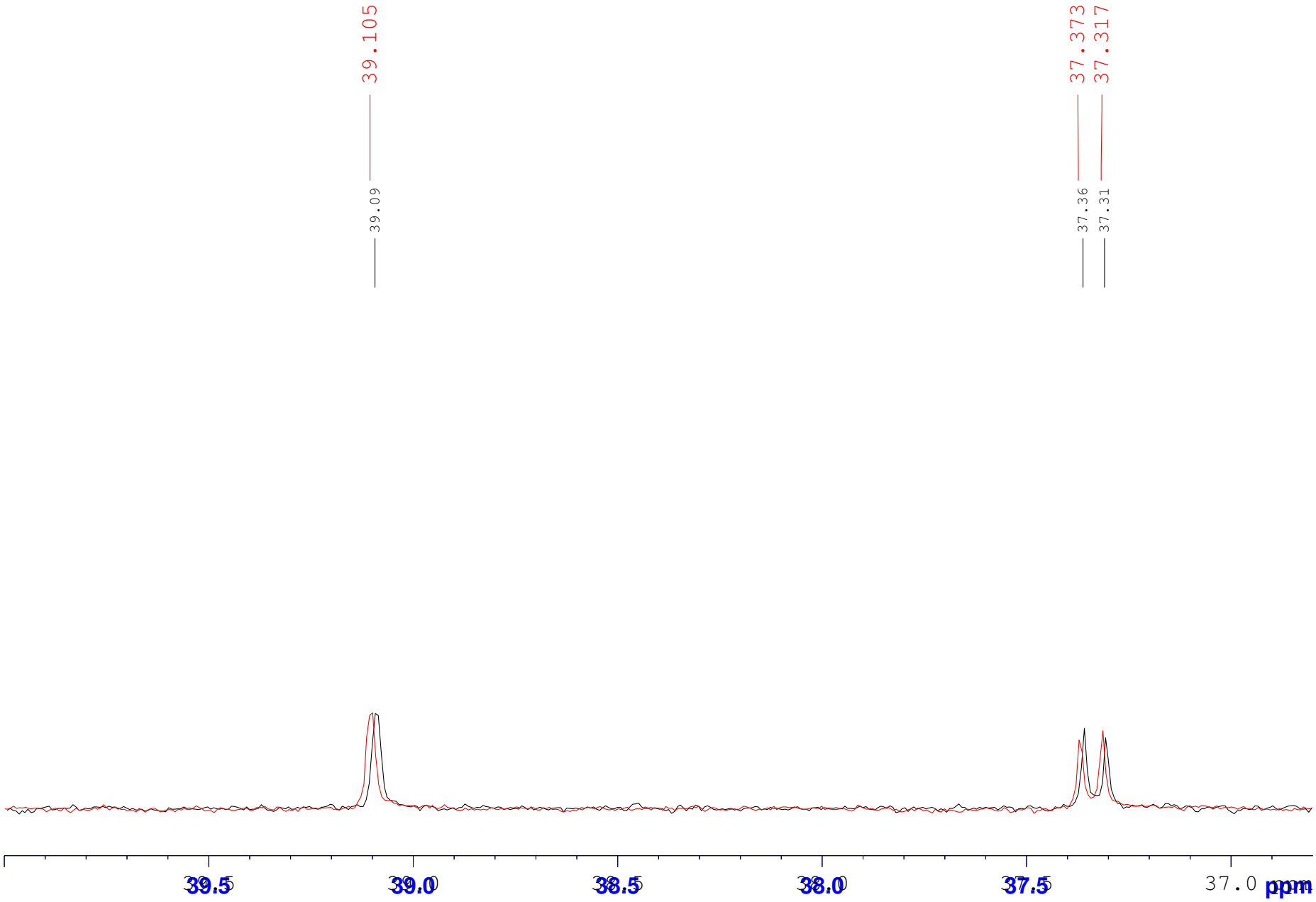
(R,R,R/S,R)-2 in black, (S,R,R/S,R)-2 in red



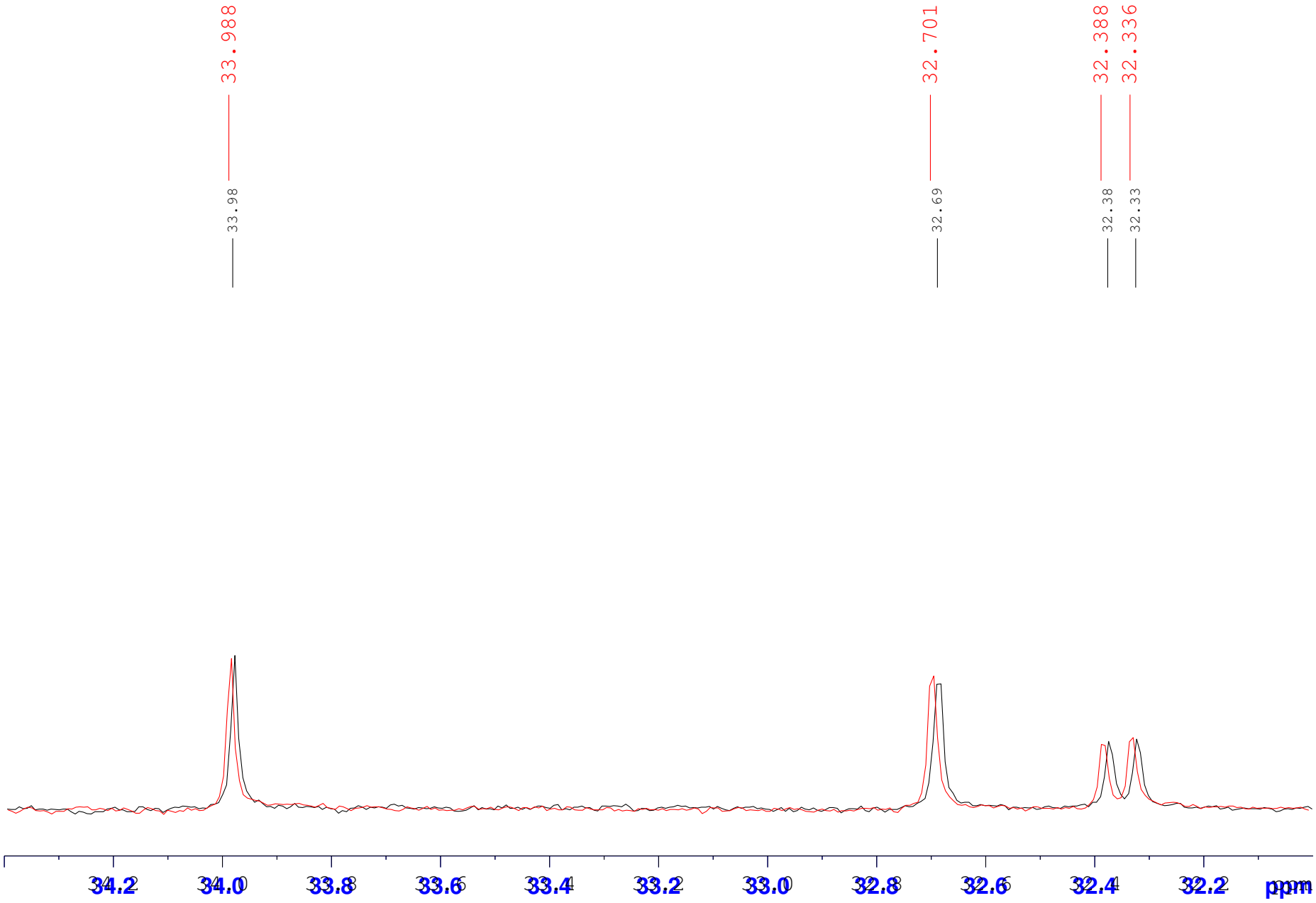
(R,R,R/S,R)-2 in black, (S,R,R/S,R)-2 in red



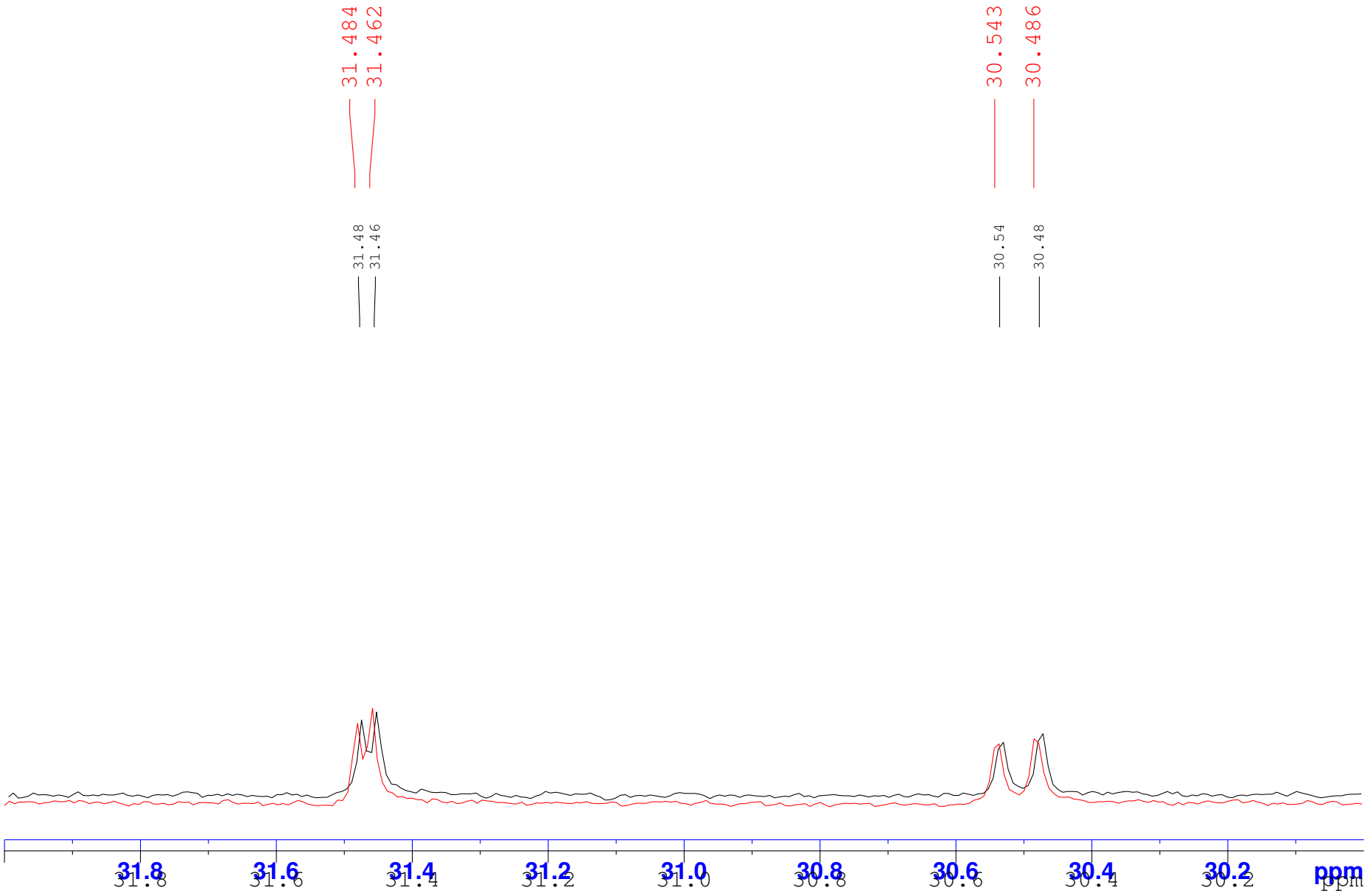
(R,R,R/S,R)-2 in black, (S,R,R/S,R)-2 in red



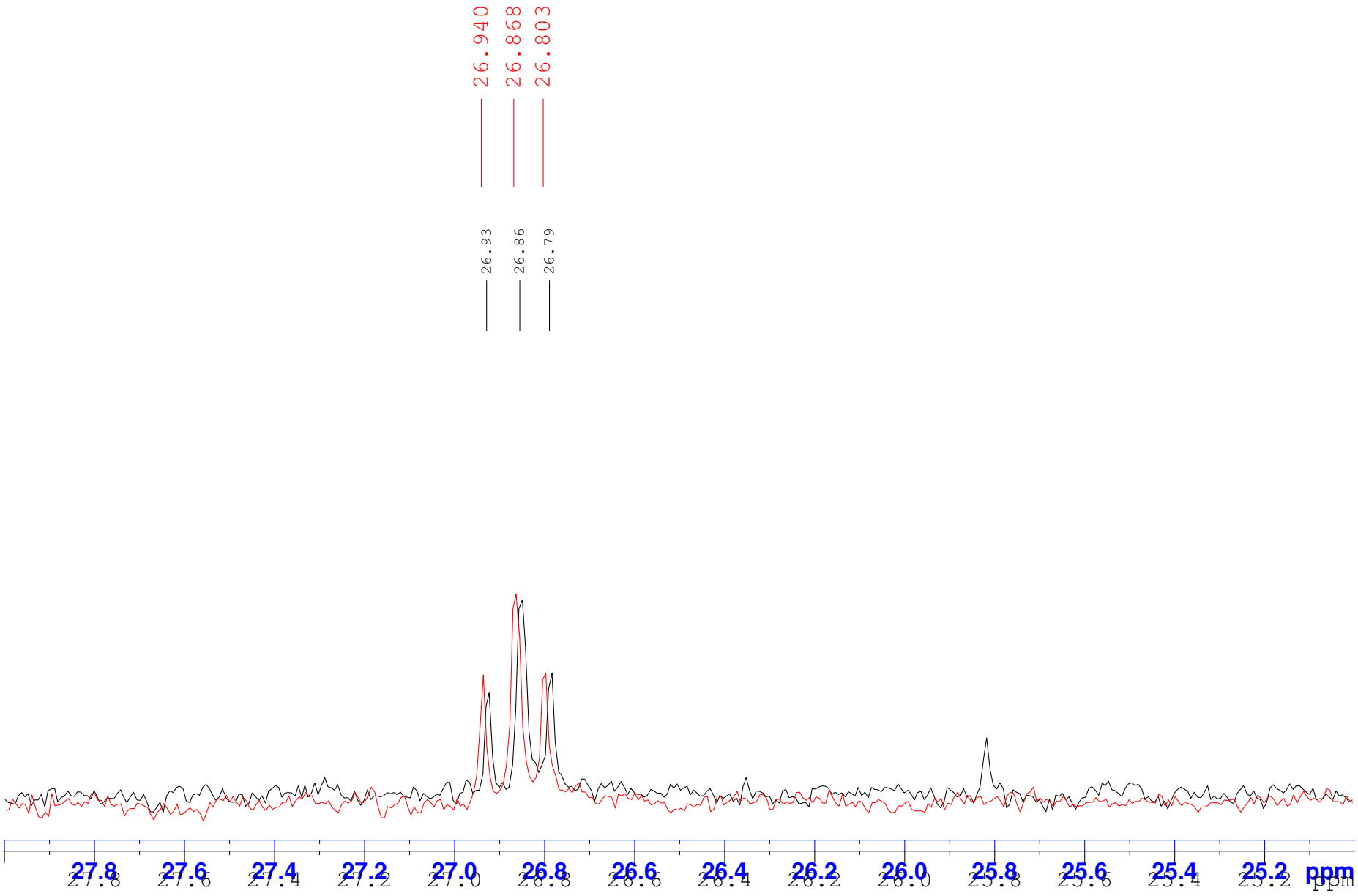
(R,R,R/S,R)-2 in black, (S,R,R/S,R)-2 in red



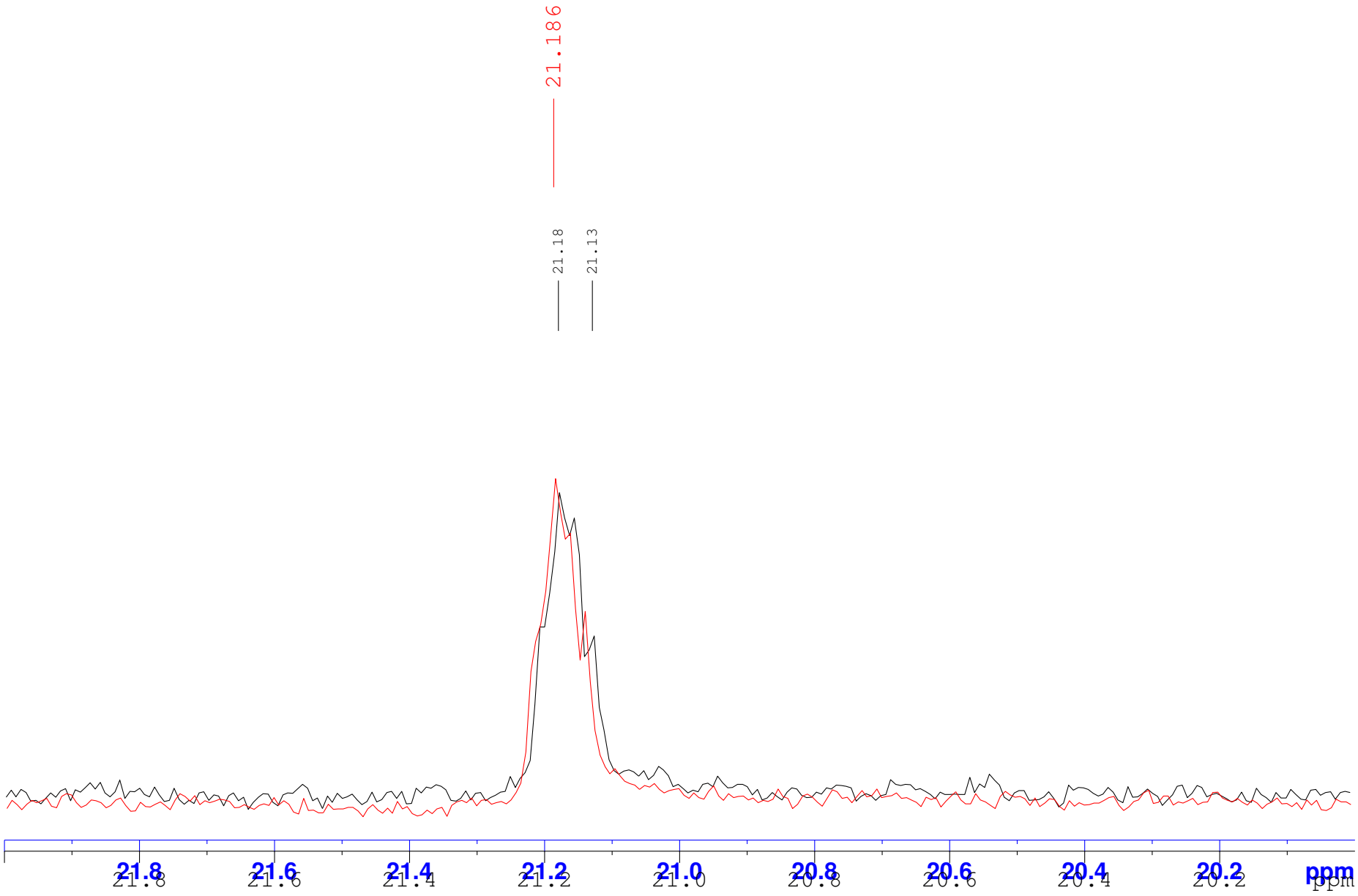
(R,R,R/S,R)-2 in black, (S,R,R/S,R)-2 in red



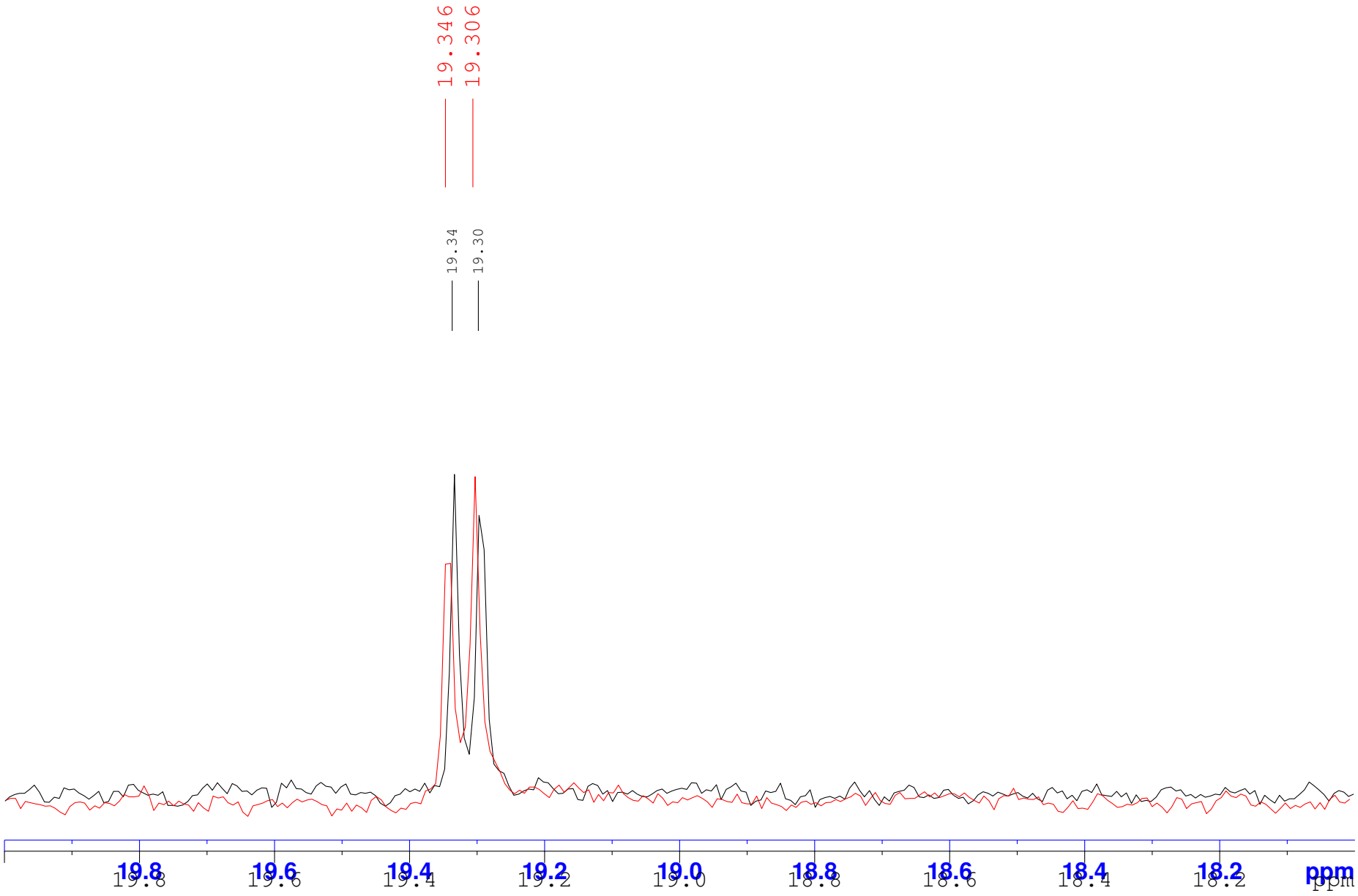
(R,R,R/S,R)-2 in black, (S,R,R/S,R)-2 in red



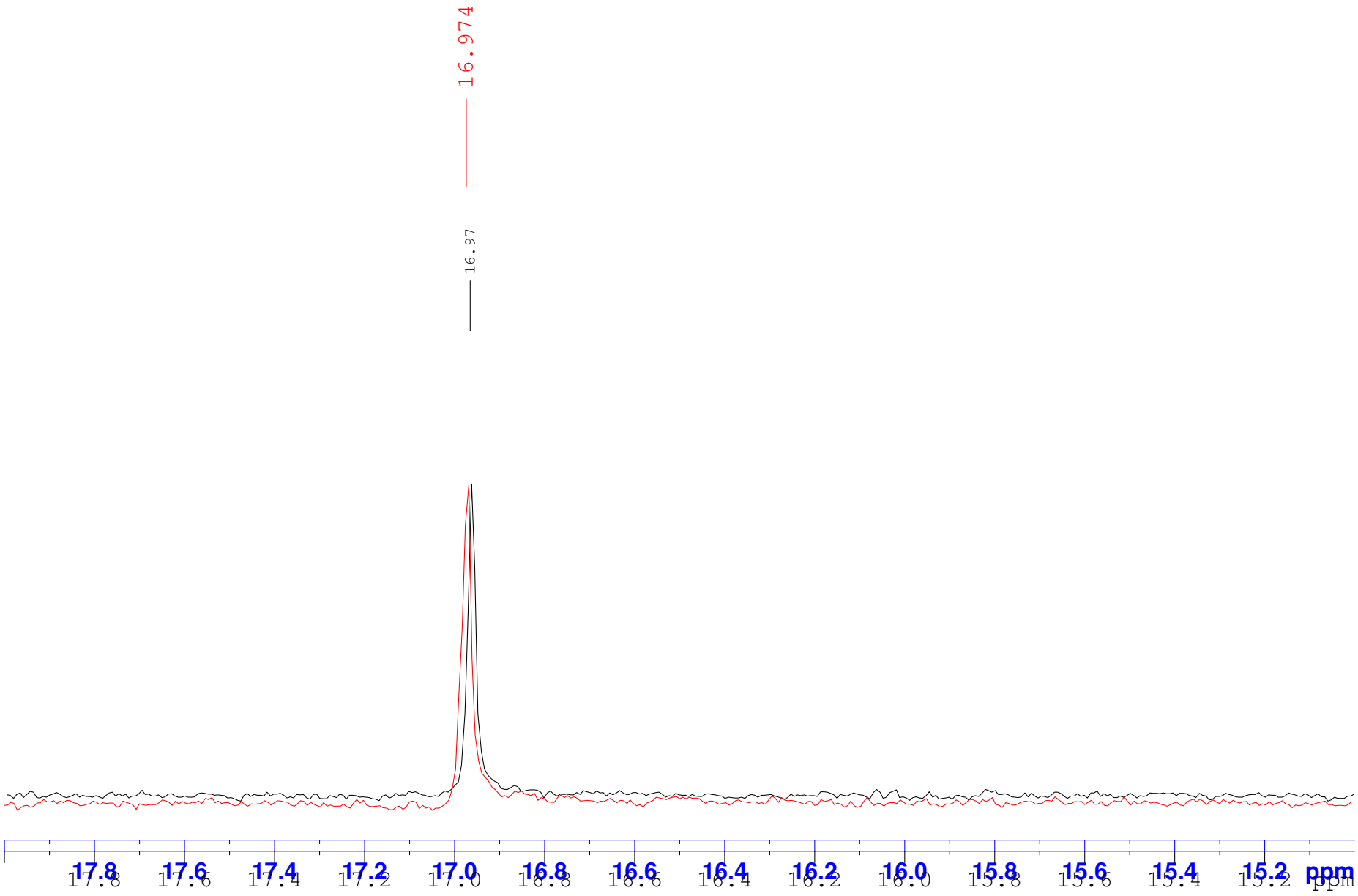
(R,R,R/S,R)-2 in black, (S,R,R/S,R)-2 in red



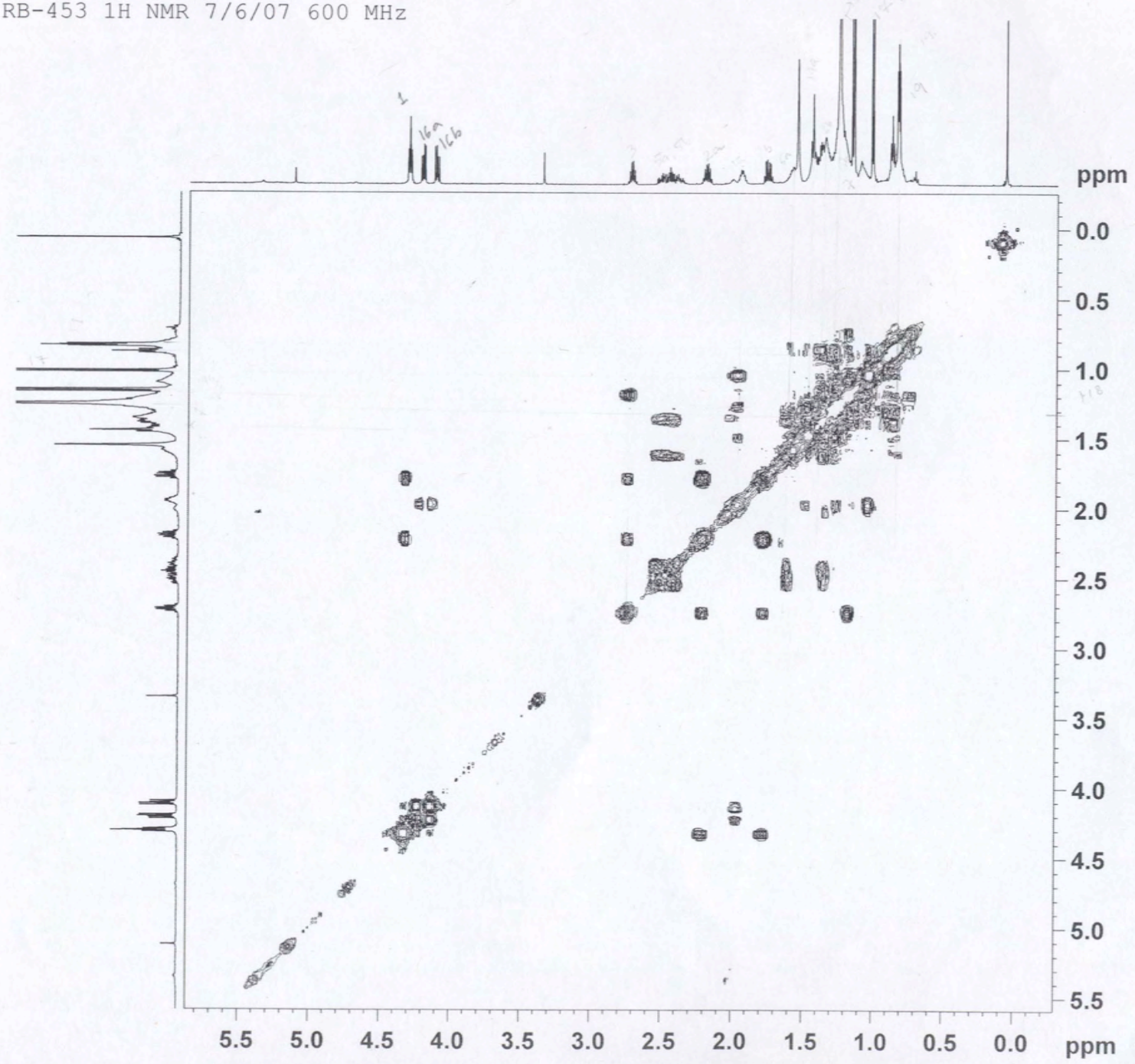
(R,R,R/S,R)-2 in black, (S,R,R/S,R)-2 in red



(R,R,R/S,R)-2 in black, (S,R,R/S,R)-2 in red



RB-453 1H NMR 7/6/07 600 MHz



BRUKER

Current Data Parameters
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EXPNO 3
PROCNO 1

F2 - Acquisition Parameters
Date_ 20070707
Time 11.27
INSTRUM spect
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PULPROG cosygpqf
TD 2048
SOLVENT CDCl3
NS 16
DS 16
SWH 5733.945 Hz
FIDRES 2.799778 Hz
AQ 0.1787228 sec
RG 406.4
DW 87.200 usec
DE 6.00 usec
TE 298.0 K
d0 0.00000300 sec
D1 1.50000000 sec
d13 0.00000400 sec
D16 0.00020000 sec
IN0 0.00017440 sec

======== CHANNEL f1 ========
NUC1 1H
P0 8.12 usec
P1 8.12 usec
PL1 8.00 dB
SFO1 600.8724188 MHz

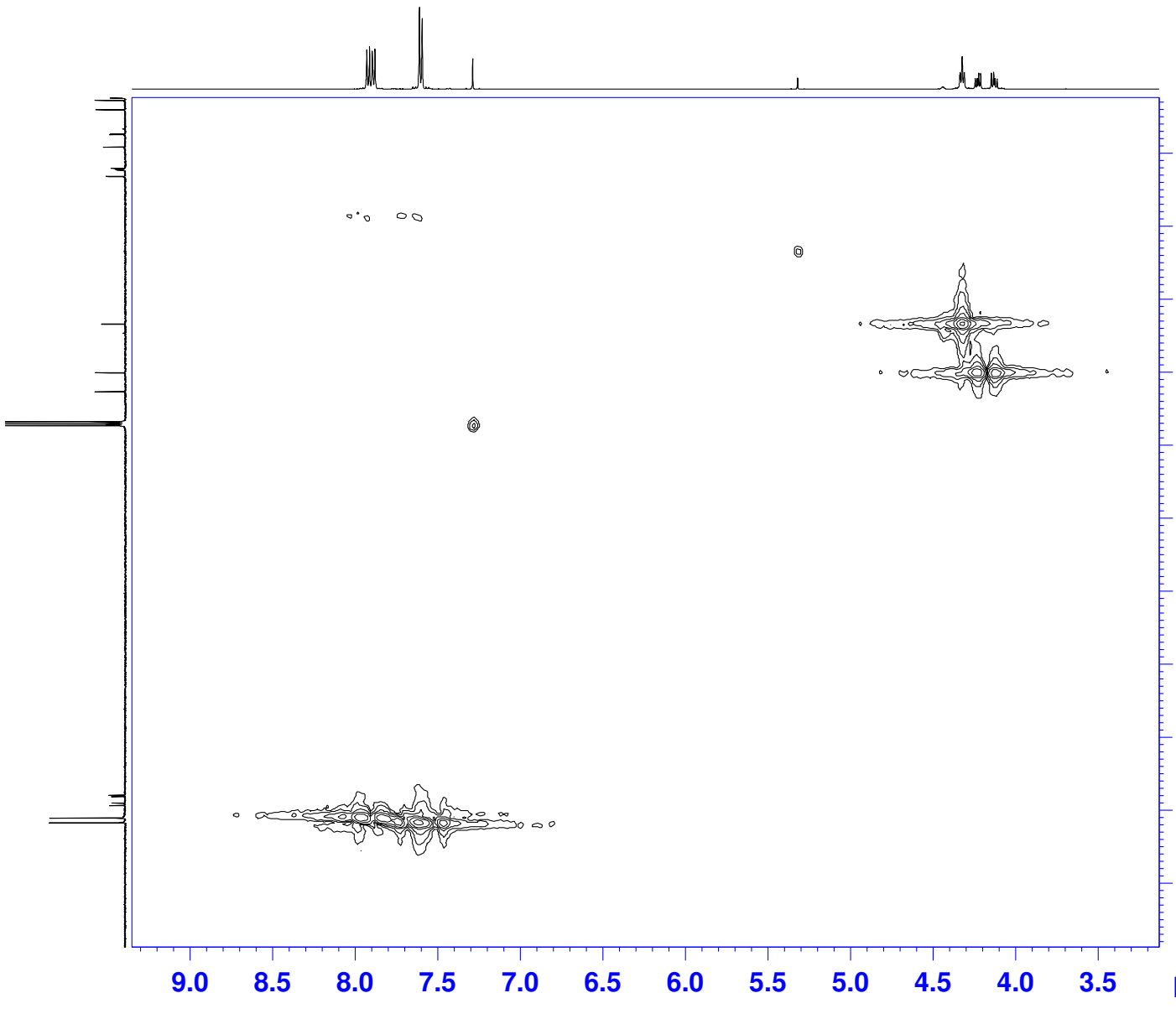
====== GRADIENT CHANNEL =====
GPNAM1 SMSQ10.100
GPNAM2 SMSQ10.100
GPX1 0.00 %
GPX2 0.00 %
GPY1 0.00 %
GPY2 0.00 %
GPZ1 10.00 %
GPZ2 10.00 %
P16 1000.00 usec

F1 - Acquisition parameters
ND0 1
TD 128
SFO1 600.8724 MHz
FIDRES 44.796444 Hz
SW 9.543 ppm
FnMODE QF

F2 - Processing parameters
SI 2048
SF 600.8700000 MHz
WDW SINE
SSB 0
LB 0.00 Hz
GB 0
PC 1.40

F1 - Processing parameters
SI 1024
MC2 QF
SF 600.8700000 MHz
WDW SINE
SSB 0
LB 0.00 Hz
GB 0

(S,R,R/S,R)-2

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PROCNO                 1

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PULPROG         hmqcgpqf
TD                 2048
SOLVENT            CDCl3
NS                    12
DS                    16
SWH           10330.578 Hz
FIDRES         5.044228 Hz
AQ            0.0991732 sec
RG                26008
DW               48.400 usec
DE                6.00 usec
TE               297.2 K
CNST2        145.0000000
d0            0.00000300 sec
D1            2.00000000 sec
d2            0.00344828 sec
d12           0.00002000 sec
d13           0.00000400 sec
D16           0.00020000 sec
DELTA1        0.00222428 sec
IN0           0.00002400 sec

======== CHANNEL f1 ========
NUC1                  1H
P1                 9.30 usec
p2                18.60 usec
PL1                0.00 dB
SFO1        500.1330885 MHz

======== CHANNEL f2 ========
CPDPRG2             garp
NUC2                 13C
P3                17.50 usec
PCPD2            100.00 usec
PL2               -2.00 dB
PL12               13.14 dB
SFO2        125.7672198 MHz

====== GRADIENT CHANNEL =====
GPNAM1        SMSQ10.100
GPNAM2        SMSQ10.100
GPNAM3        SMSQ10.100
GPX1               0.00 %
GPX2               0.00 %
GPX3               0.00 %
GPY1               0.00 %
GPY2               0.00 %
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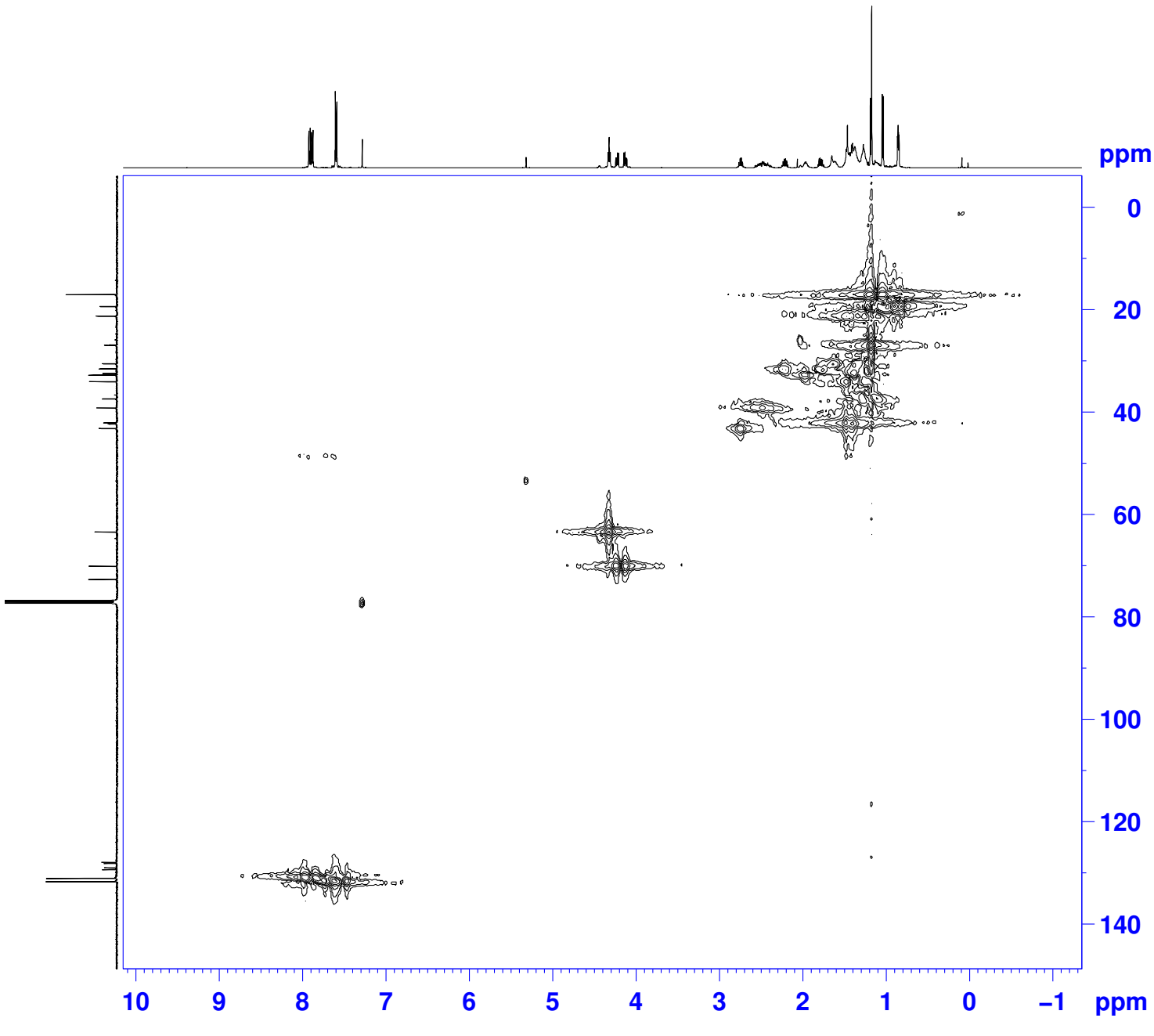
(S,R,R/S,R)-2

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Current Data Parameters
NAME          rb-466-pure
EXPNO                  12
PROCNO                  1

F2 - Acquisition Parameters
Date_            20070820
Time                 8.04
INSTRUM             spect
PROBHD   5 mm Multinucl
PULPROG          hmqcgpqf
TD                   2048
SOLVENT              CDCl3
NS                     12
DS                     16
SWH           10330.578 Hz
FIDRES         5.044228 Hz
AQ             0.0991732 sec
RG                 26008
DW                48.400 usec
DE                 6.00 usec
TE                297.2 K
CNST2        145.0000000
d0             0.00000300 sec
D1             2.00000000 sec
d2             0.00344828 sec
d12            0.00002000 sec
d13            0.00000400 sec
D16            0.00020000 sec
DELTA1         0.00222428 sec
IN0            0.00002400 sec

======== CHANNEL f1 ========
NUC1                  1H
P1                 9.30 usec
p2                18.60 usec
PL1                0.00 dB
SFO1        500.1330885 MHz

======== CHANNEL f2 ========
CPDPRG2             garp
NUC2                 13C
P3                17.50 usec
PCPD2            100.00 usec
PL2               -2.00 dB
PL12               13.14 dB
SFO2        125.7672198 MHz

====== GRADIENT CHANNEL =====
GPNAM1        SMSQ10.100
GPNAM2        SMSQ10.100
GPNAM3        SMSQ10.100
GPX1               0.00 %
GPX2               0.00 %
GPX3               0.00 %
GPY1               0.00 %
GPY2               0.00 %
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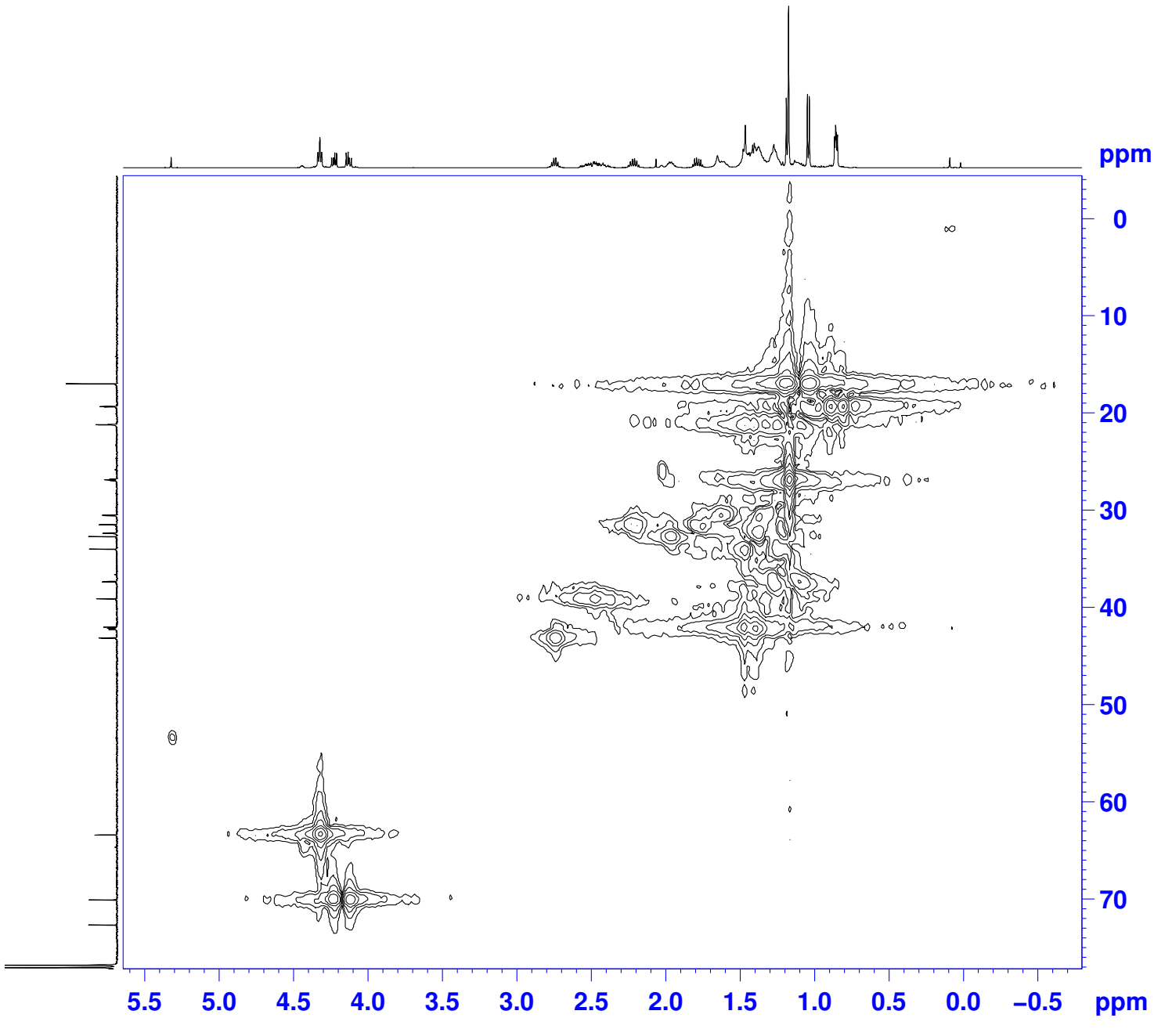
(S,R,R/S,R)-2

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Current Data Parameters
NAME          rb-466-pure
EXPNO                  12
PROCNO                  1

F2 - Acquisition Parameters
Date_            20070820
Time                 8.04
INSTRUM             spect
PROBHD   5 mm Multinucl
PULPROG          hmqcgpqf
TD                   2048
SOLVENT             CDCl3
NS                     12
DS                     16
SWH           10330.578 Hz
FIDRES         5.044228 Hz
AQ             0.0991732 sec
RG                 26008
DW                48.400 usec
DE                 6.00 usec
TE                297.2 K
CNST2        145.0000000
d0            0.00000300 sec
D1            2.00000000 sec
d2            0.00344828 sec
d12           0.00002000 sec
d13           0.00000400 sec
D16           0.00020000 sec
DELTA1        0.00222428 sec
IN0           0.00002400 sec

======== CHANNEL f1 ========
NUC1                1H
P1                9.30 usec
p2               18.60 usec
PL1               0.00 dB
SFO1        500.1330885 MHz

======== CHANNEL f2 ========
CPDPRG2           garp
NUC2                13C
P3               17.50 usec
PCPD2           100.00 usec
PL2              -2.00 dB
PL12              13.14 dB
SFO2        125.7672198 MHz

====== GRADIENT CHANNEL =====
GPNAM1       SMSQ10.100
GPNAM2       SMSQ10.100
GPNAM3       SMSQ10.100
GPX1              0.00 %
GPX2              0.00 %
GPX3              0.00 %
GPY1              0.00 %
GPY2              0.00 %
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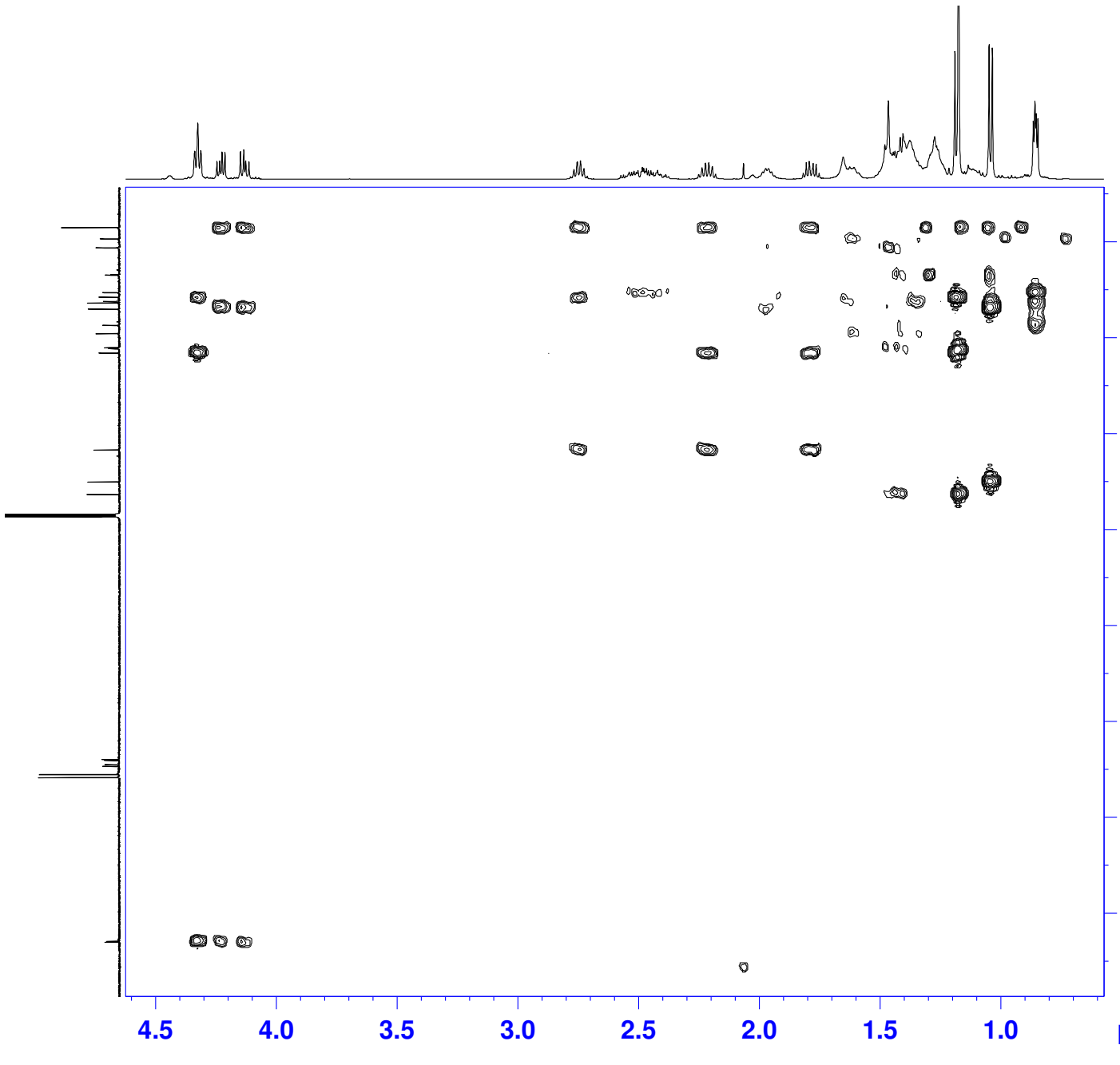
(S,R,R/S,R)-2

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PROCNO                  1

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PULPROG     hmbcgplpndqf
TD                  4096
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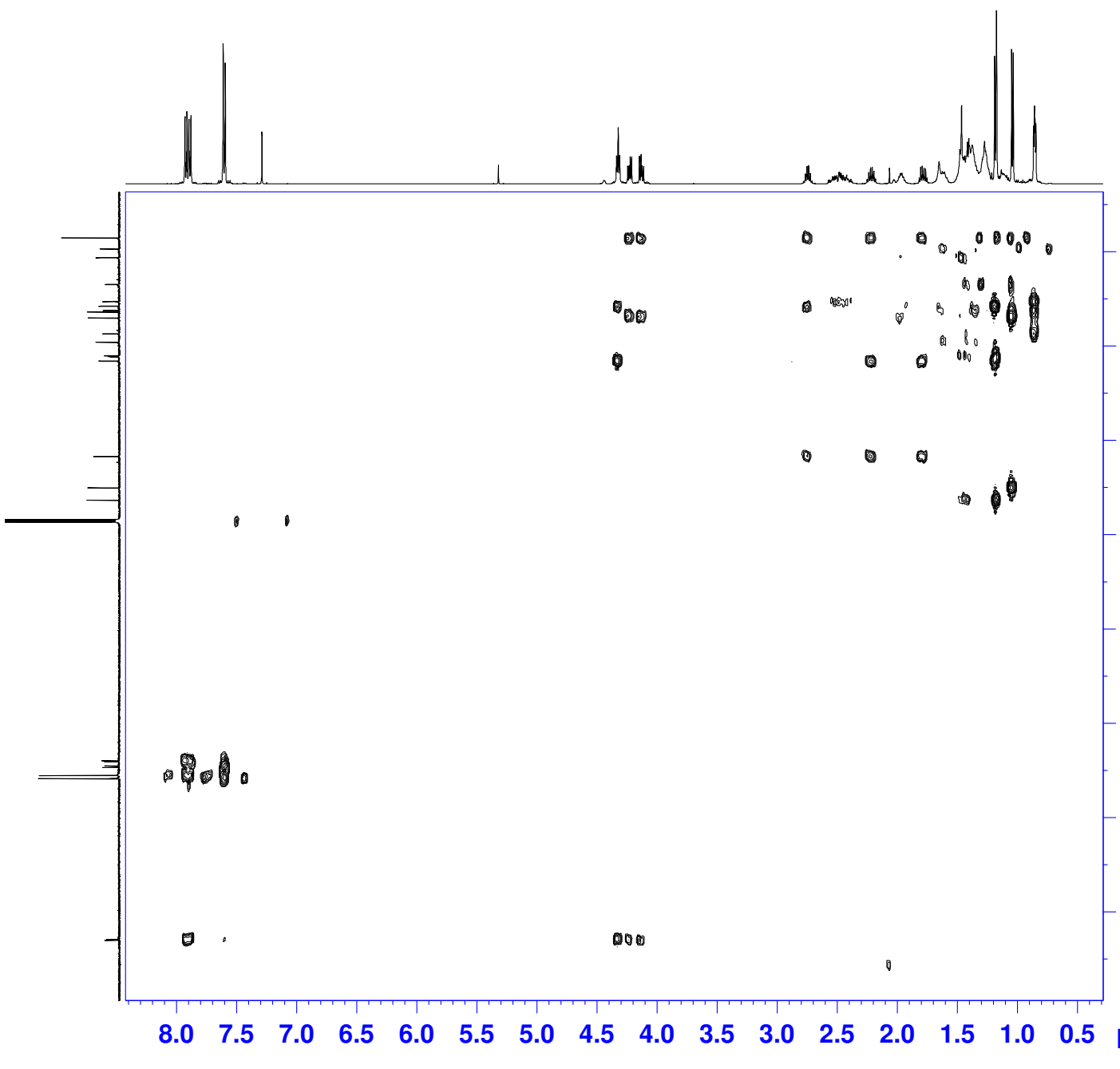
DS                    16
SWH           10330.578 Hz
FIDRES         2.522114 Hz
AQ            0.1982964 sec
RG               9195.2
DW                48.400 usec
DE                 6.00 usec
TE                297.2 K
CNST2        145.0000000
CNST13        10.0000000
d0            0.00000300 sec
D1            1.50000000 sec
d2            0.00344828 sec
d6            0.05000000 sec
D16           0.00020000 sec
IN0           0.00001790 sec

======== CHANNEL f1 ========
NUC1                  1H
P1                 9.30 usec
p2                18.60 usec
PL1                0.00 dB
SFO1        500.1330885 MHz

======== CHANNEL f2 ========
NUC2                 13C
P3                17.50 usec
PL2               -2.00 dB
SFO2        125.7703443 MHz

====== GRADIENT CHANNEL =====
GPNAM1        SMSQ10.100
GPNAM2        SMSQ10.100
GPNAM3        SMSQ10.100
GPX1               0.00 %
GPX2               0.00 %
GPX3               0.00 %
GPY1               0.00 %
GPY2               0.00 %
GPY3               0.00 %
GPZ1              50.00 %
GPZ2              30.00 %
GPZ3              40.10 %
```

(S,R,R/S,R)-2




```
Current Data Parameters
NAME          rb-466-pure
EXPNO                1122
PROCNO                  1

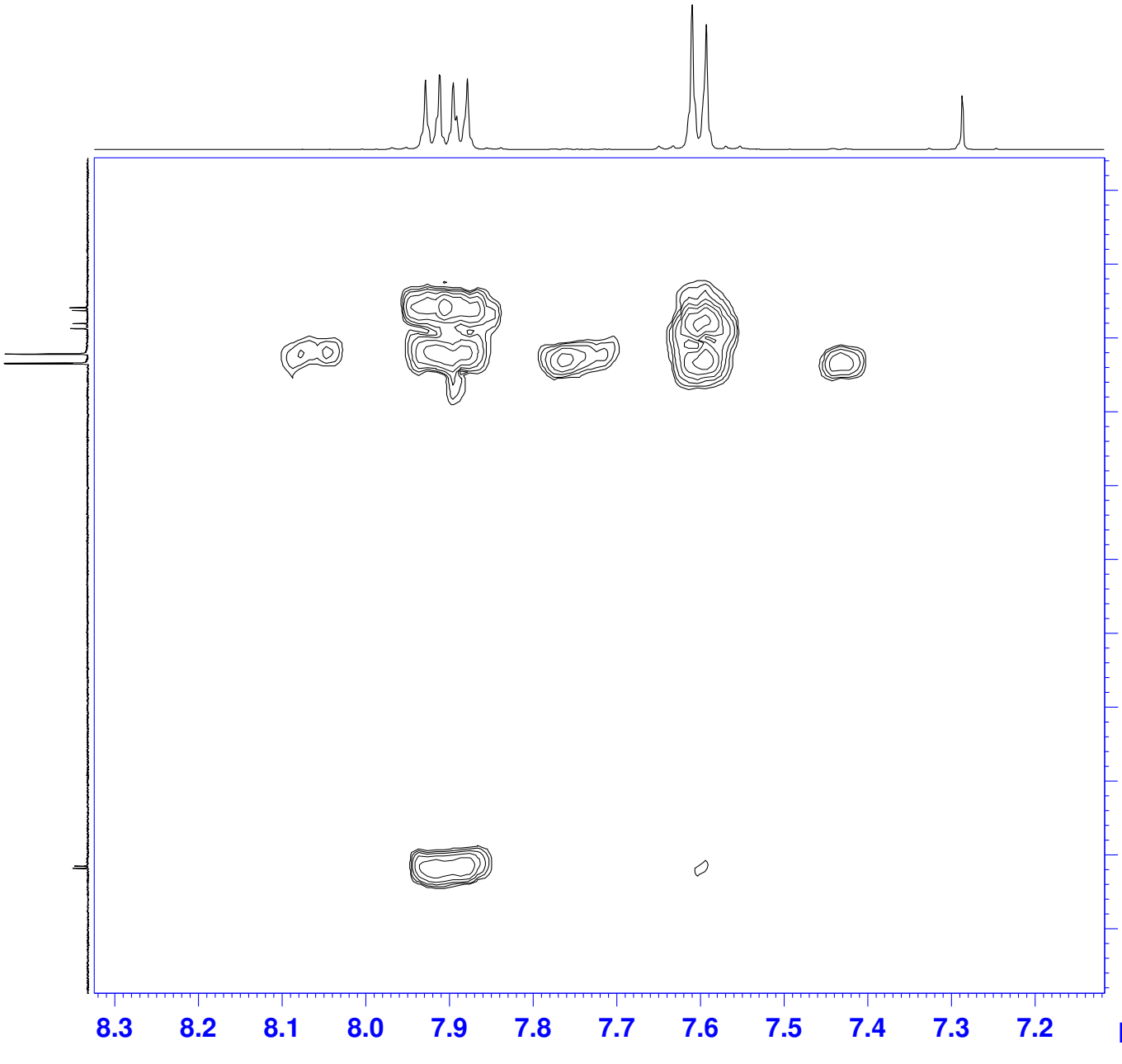
F2 - Acquisition Parameters
Date_             20070819
Time                 13.43
INSTRUM              spect
PROBHD    5 mm Multinucl
PULPROG     hmbcgplpndqf
TD                   4096
SOLVENT              CDCl3
NS                     32
DS                     16
SWH           10330.578 Hz
FIDRES         2.522114 Hz
AQ            0.1982964 sec
RG               9195.2
DW                48.400 usec
DE                 6.00 usec
TE                297.2 K
CNST2        145.0000000
CNST13        10.0000000
d0            0.00000300 sec
D1            1.50000000 sec
d2            0.00344828 sec
d6            0.05000000 sec
D16           0.00020000 sec
IN0           0.00001790 sec

======== CHANNEL f1 ========
NUC1                   1H
P1                   9.30 usec
p2                  18.60 usec
PL1                  0.00 dB
SFO1         500.1330885 MHz

======== CHANNEL f2 ========
NUC2                  13C
P3                  17.50 usec
PL2                 -2.00 dB
SFO2         125.7703443 MHz

====== GRADIENT CHANNEL =====
GPNAM1         SMSQ10.100
GPNAM2         SMSQ10.100
GPNAM3         SMSQ10.100
GPX1                 0.00 %
GPX2                 0.00 %
GPX3                 0.00 %
GPY1                 0.00 %
GPY2                 0.00 %
GPY3                 0.00 %
GPZ1                50.00 %
GPZ2                30.00 %
GPZ3                40.10 %
```

(S,R,R/S,R)-2




```
Current Data Parameters
NAME         rb-466-pure
EXPNO               1122
PROCNO                 1

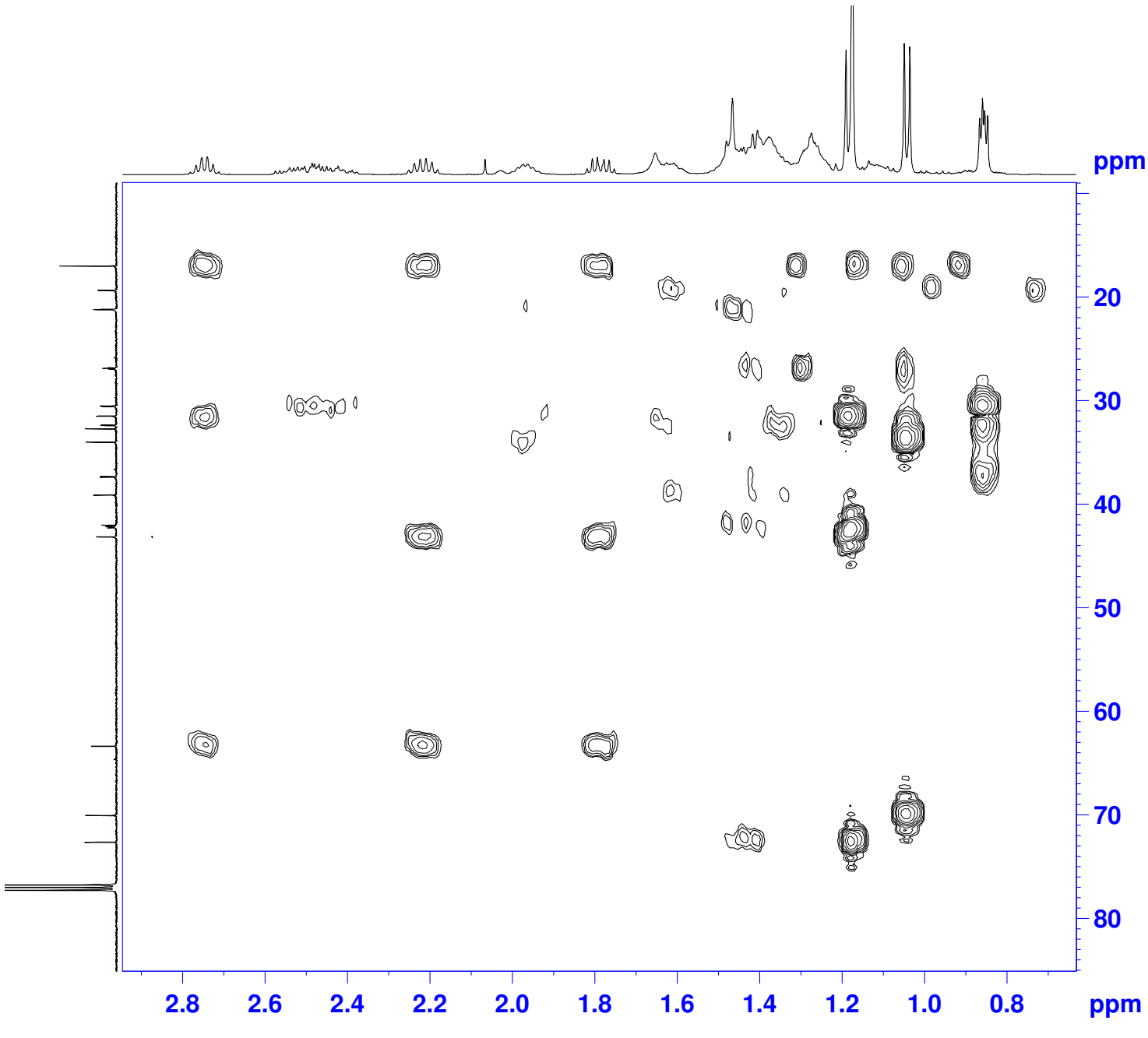
F2 - Acquisition Parameters
Date_           20070819
Time               13.43
INSTRUM            spect
PROBHD   5 mm Multinucl
PULPROG    hmbcgplpndqf
TD                 4096
SOLVENT            CDCl3
NS                   32
DS                   16
SWH          10330.578 Hz
FIDRES        2.522114 Hz
AQ           0.1982964 sec
RG              9195.2
DW                48.400 usec
DE                 6.00 usec
TE                297.2 K
CNST2        145.0000000
CNST13        10.0000000
d0           0.00000300 sec
D1           1.50000000 sec
d2           0.00344828 sec
d6           0.05000000 sec
D16          0.00020000 sec
IN0          0.00001790 sec

======== CHANNEL f1 ========
NUC1                 1H
P1                 9.30 usec
p2                18.60 usec
PL1                0.00 dB
SFO1        500.1330885 MHz

======== CHANNEL f2 ========
NUC2                13C
P3                17.50 usec
PL2               -2.00 dB
SFO2        125.7703443 MHz

====== GRADIENT CHANNEL =====
GPNAM1        SMSQ10.100
GPNAM2        SMSQ10.100
GPNAM3        SMSQ10.100
GPX1               0.00 %
GPX2               0.00 %
GPX3               0.00 %
GPY1               0.00 %
GPY2               0.00 %
GPY3               0.00 %
GPZ1              50.00 %
GPZ2              30.00 %
GPZ3              40.10 %
```

(S,R,R/S,R)-2



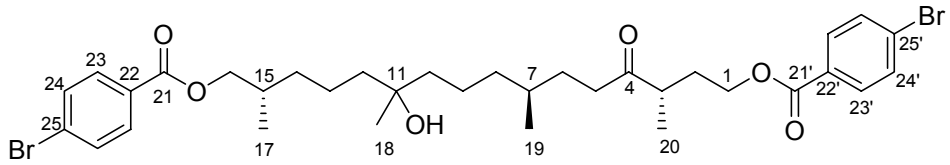

```
Current Data Parameters
NAME          rb-466-pure
EXPNO                1122
PROCNO                  1

F2 - Acquisition Parameters
Date_            20070819
Time                13.43
INSTRUM             spect
PROBHD    5 mm Multinucl
PULPROG     hmbcgplpndqf
TD                  4096
SOLVENT            CDCl3
NS                    32
DS                    16
SWH           10330.578 Hz
FIDRES         2.522114 Hz
AQ            0.1982964 sec
RG               9195.2
DW                48.400 usec
DE                 6.00 usec
TE                297.2 K
CNST2        145.0000000
CNST13        10.0000000
d0            0.00000300 sec
D1            1.50000000 sec
d2            0.00344828 sec
d6            0.05000000 sec
D16           0.00020000 sec
IN0           0.00001790 sec

======== CHANNEL f1 ========
NUC1                  1H
P1                 9.30 usec
p2                18.60 usec
PL1                0.00 dB
SFO1        500.1330885 MHz

======== CHANNEL f2 ========
NUC2                 13C
P3                17.50 usec
PL2               -2.00 dB
SFO2        125.7703443 MHz

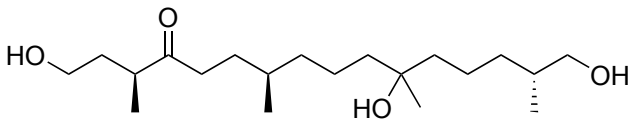
====== GRADIENT CHANNEL =====
GPNAM1        SMSQ10.100
GPNAM2        SMSQ10.100
GPNAM3        SMSQ10.100
GPX1               0.00 %
GPX2               0.00 %
GPX3               0.00 %
GPY1               0.00 %
GPY2               0.00 %
GPY3               0.00 %
GPZ1              50.00 %
GPZ2              30.00 %
GPZ3              40.10 %
```



(S,R,R/S,R)-2

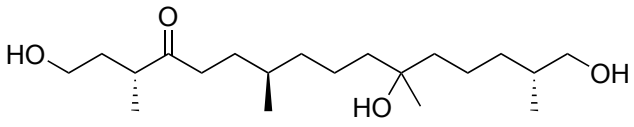
Table:

Carbon Number	13C of (S,R,R/S,R)-2	1H of (S,R,R/S,R)-2	1H Chemical shift of the di-4-bromobenzoate of the natural product
1	72.63	4.30 (t, 6.6 Hz)	4.31 br (t, 6.6 Hz)
2	31.48, 31.46	1.81-1.71 (m), 2.14 (m)	1.77, 2.20 (m)
3	43.16, 43.12	2.72 (m)	2.73 (m)
4	213.75, 213.72	-	-
5	39.11	2.58-2.34 (m)	2.43, 2.49 m
6	30.54, 30.49	1.53 – 1.36 (m)	1.35, 1.59 m
7	32.70	1.53 – 1.36 (m)	1.36 m
8	37.37, 37.32	1.10, 1.26 (m)	1.10, 1.26 m
9	21.19 (m, overlaps with C13)	1.53 – 1.36 (m)	1.30-1.50 m
10	42.26 (m, exchangeable with C 12)	1.53 – 1.36 (m)	1.30-1.50 m
11	72.63	-	-
12	42.15, 42.01 (m, exchangeable with C 10)	1.53 – 1.36 (m)	1.30-1.50 m
13	21.19 (m, overlaps with C9)	1.53 – 1.36 (m)	1.30-1.50 m
14	33.99	1.25 (m), 1.45 (m)	1.24 m, 1.45 m
15	32.39, 32.34	2.04-1.86 (m)	1.95 m
16a	70.04	4.10 (dd, *J* = 6.6, 10.2 Hz)	4.11 (dd, *J* = 10.7, 6.0 Hz)
16b		4.20 (dd, *J* = 6.0, 10.8 Hz)	4.21 dd (10.7, 6.6 Hz)
17	16.97	1.02 (d, 7.2 Hz)	1.03 d (6.6 Hz)
18	26.94, 26.87, 26.80	1.15 (s)	1.15 s
19	19.35, 19.31	0.83 (m)	0.84 m
20	16.97	1.16 (d, 8.4 Hz)	1.17 (d, *J* = 6.6 Hz)
21, 21’	165.91, 165.76	-	-
22, 22’	129.35, 129.01	-	-
23, 23’	131.74, 131.69	7.58 (d, 8.4 Hz)	
24, 24’	131.08, 131.06	7.88 (d, 8.4 Hz) and 7.86 (d, 8.4 Hz)	7.57-7.91 m
25, 25’	128.12, 127.93	-	-



(*S*,*R*,*R*/*S*,*R*)-1

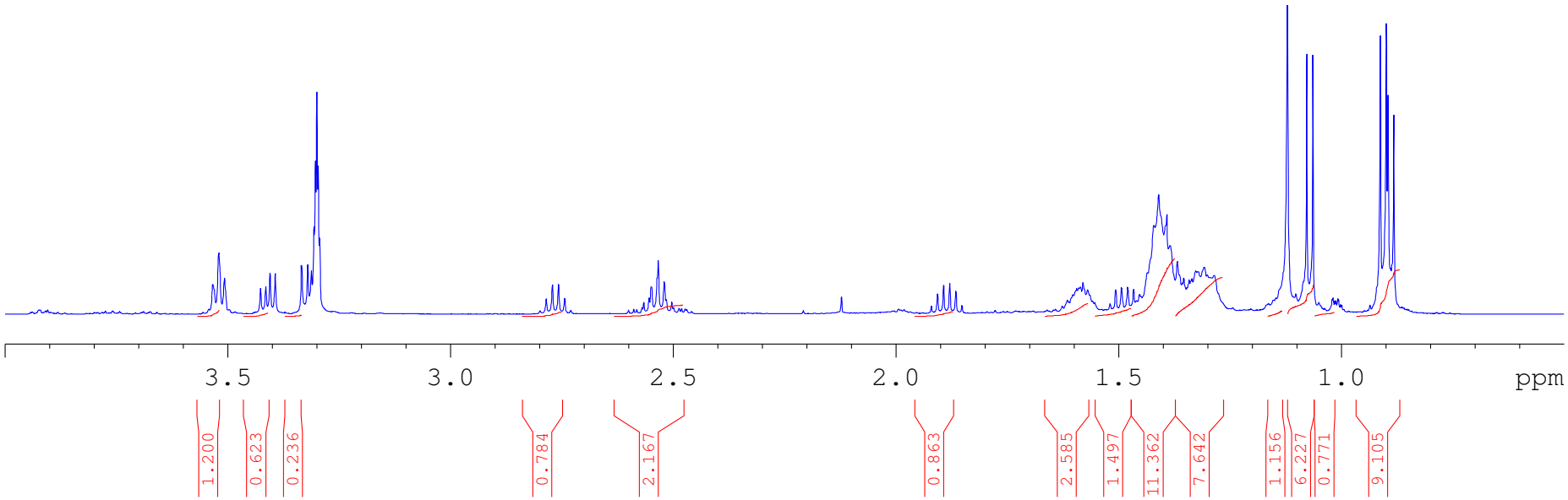
Prepared from **(*S*)-4** and **(*R*,*R*/*S*,*R*)-10**



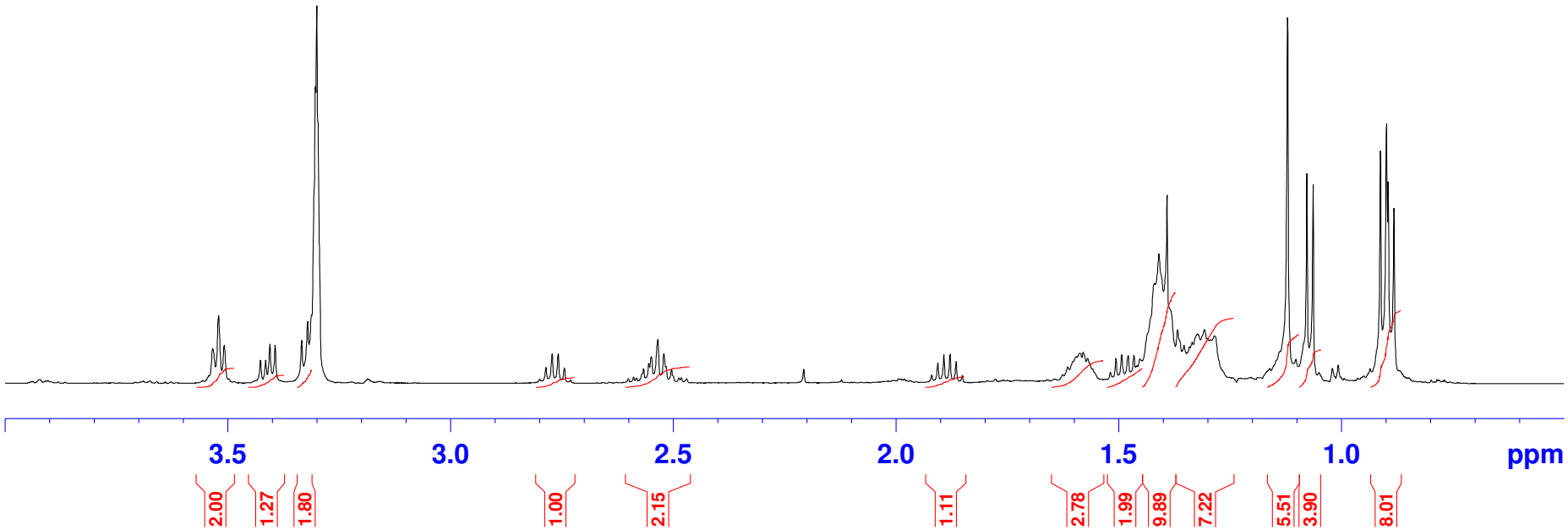
(*R*,*R*,*R*/*S*,*R*)-1

Prepared from **(*R*)-4** and **(*R*,*R*/*S*,*R*)-10**

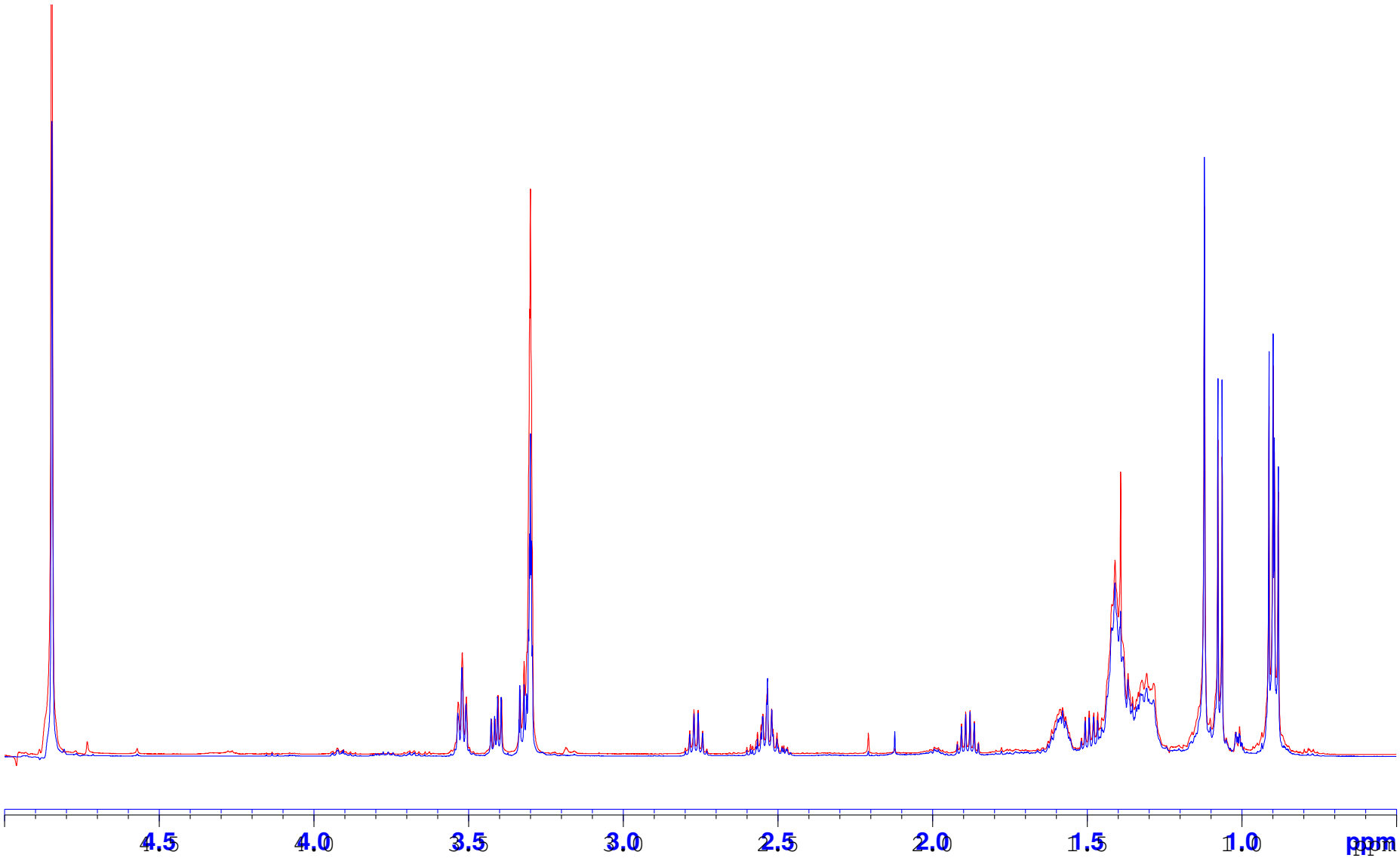
(R,R,R/S,R)-1 in blue



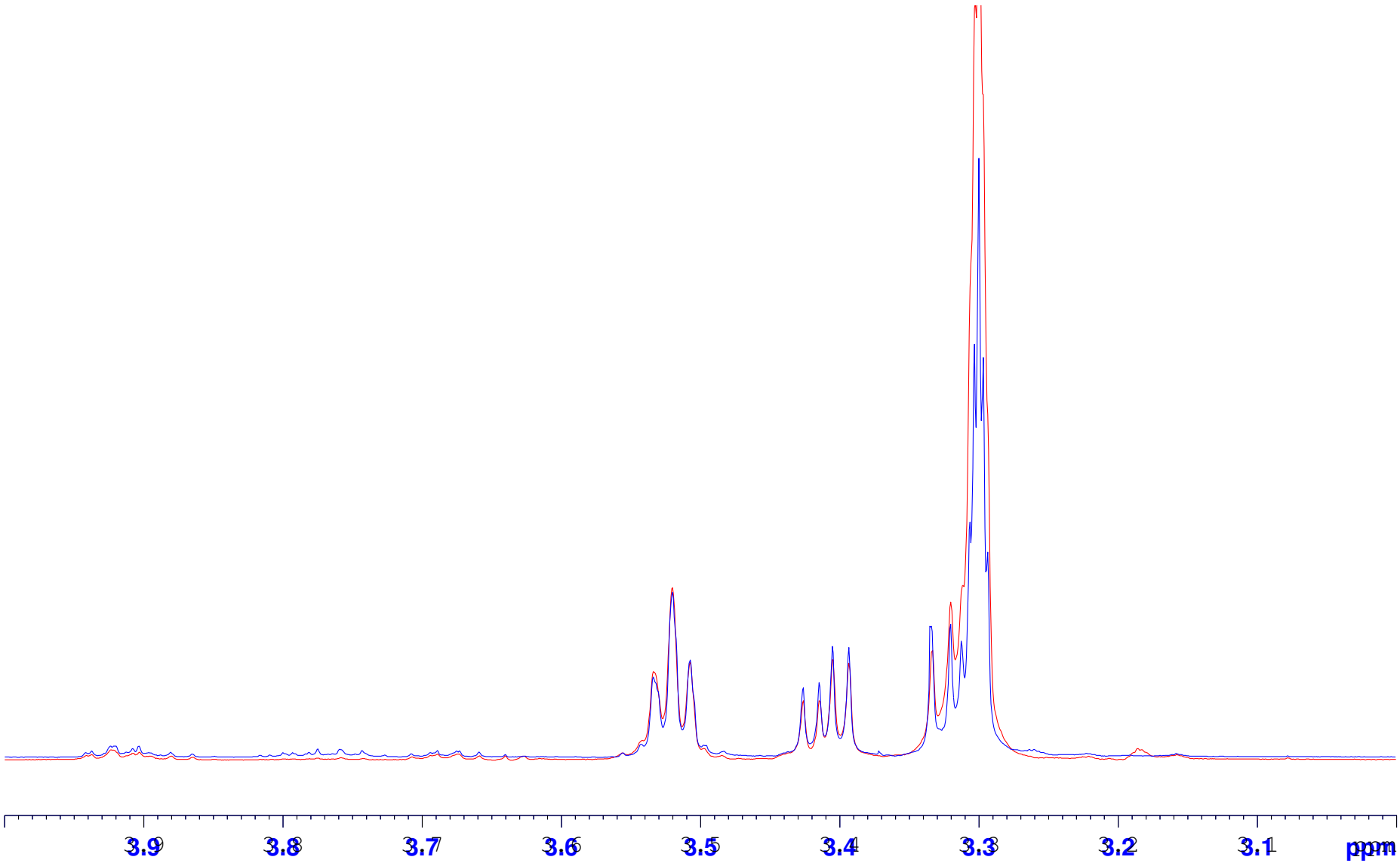
S,R,R/S,R)-1 in black



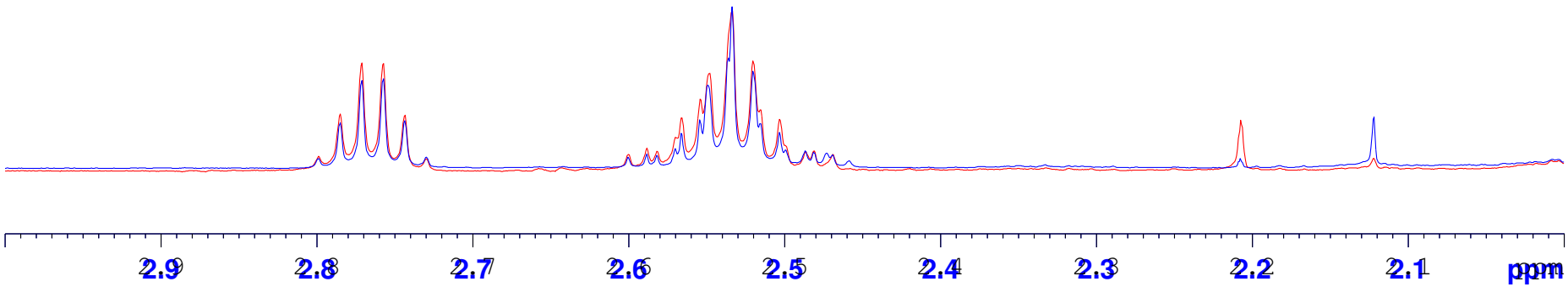
(R,R,R/S,R)-1 in blue
(S,R,R/S,R)-1 in red



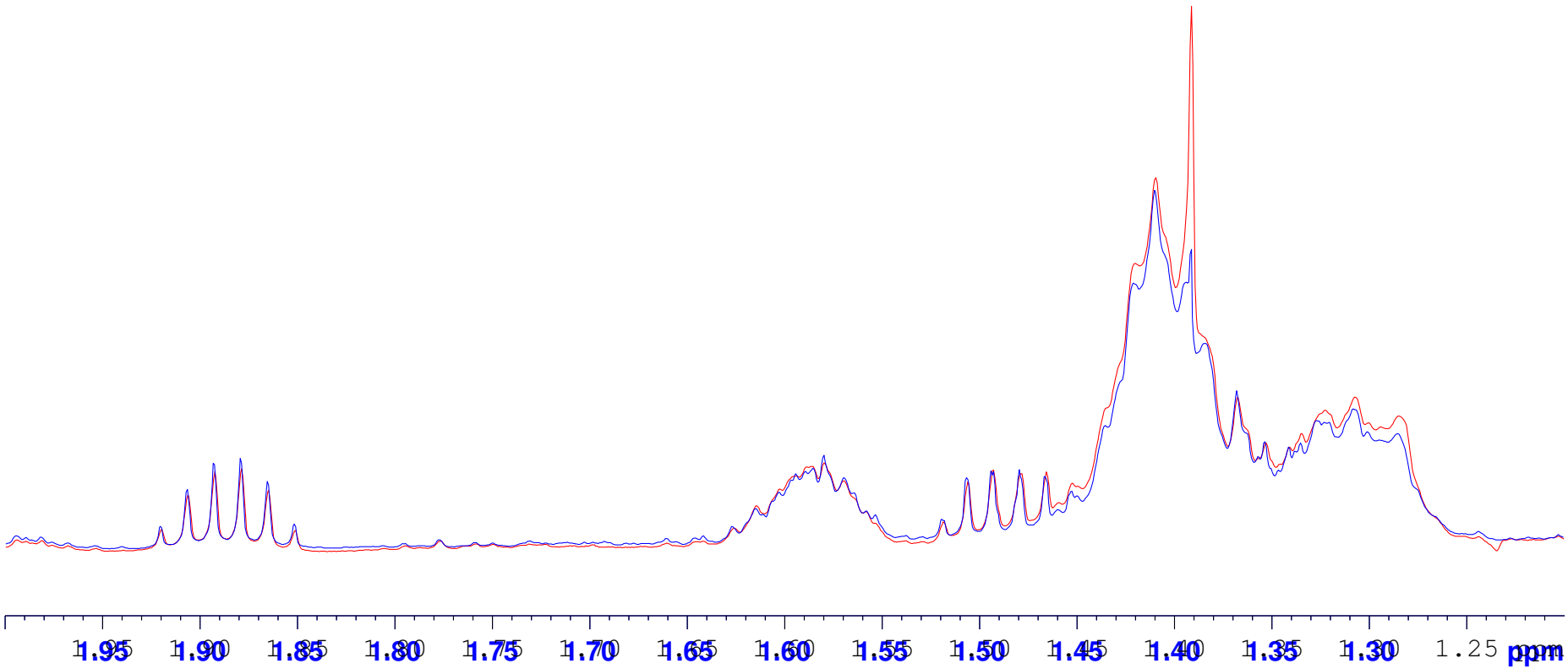
(R,R,R/S,R)-1 in blue
(S,R,R/S,R)-1 in red



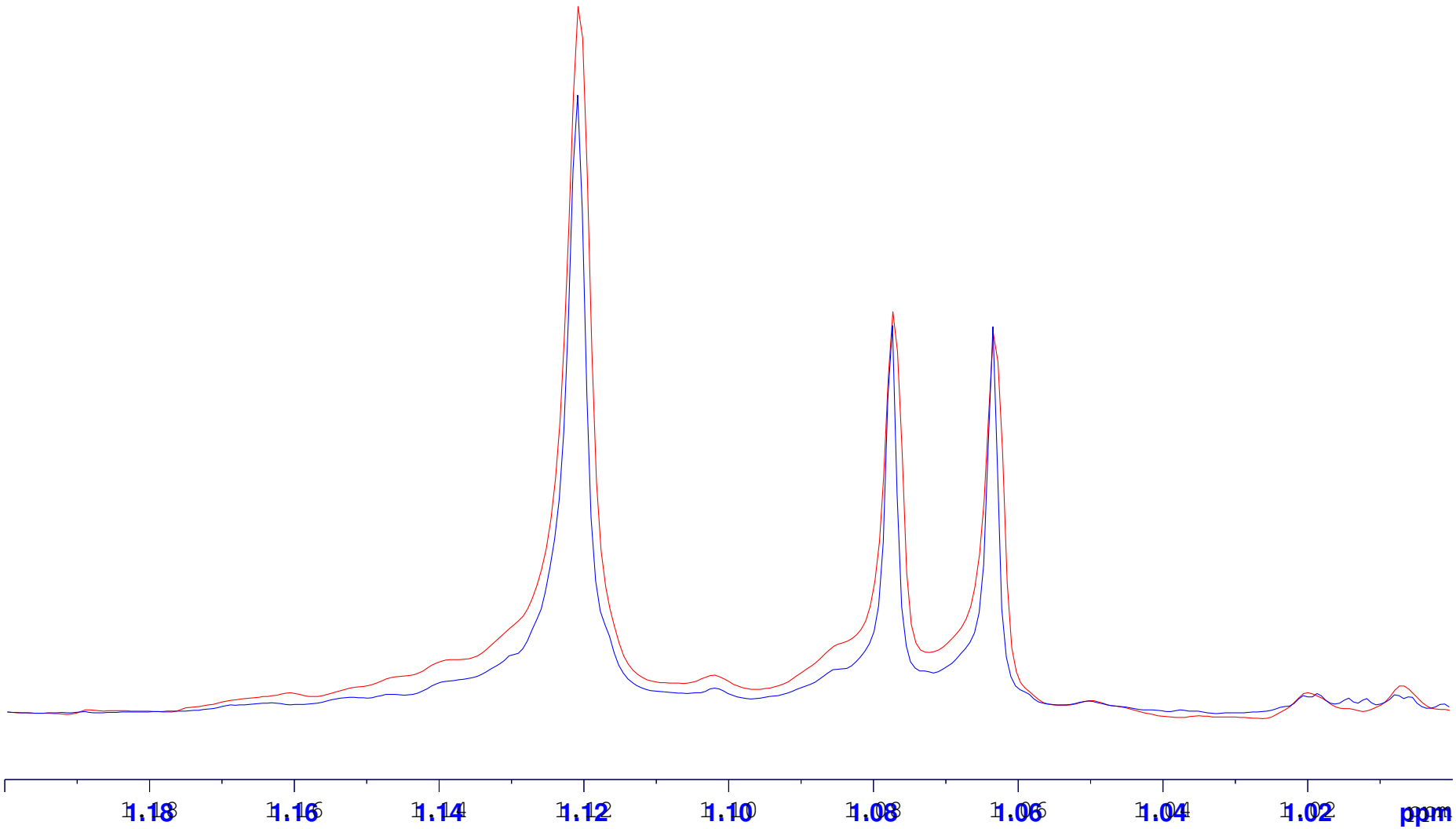
(R,R,R/S,R)-1 in blue
(S,R,R/S,R)-1 in red



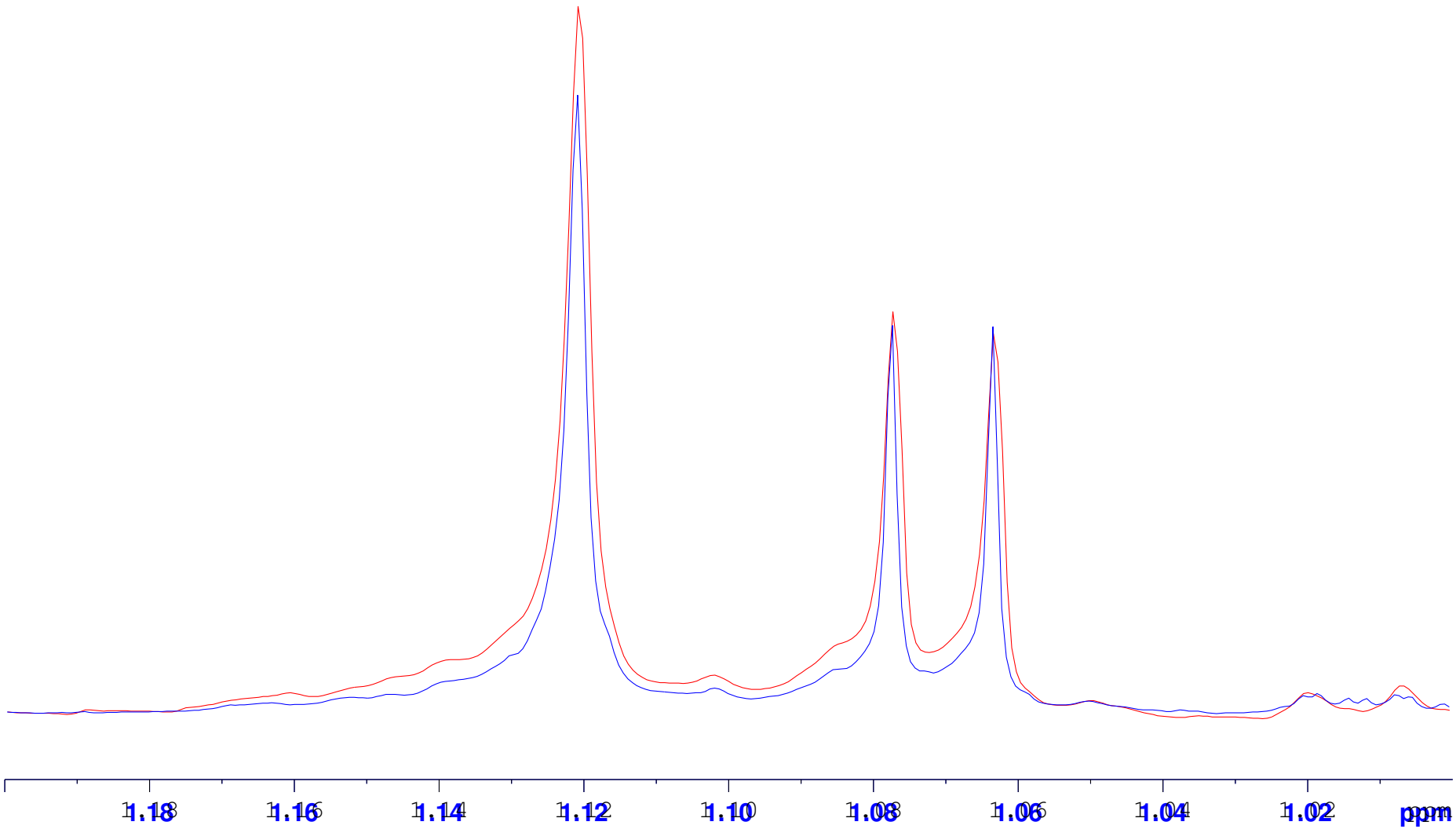
(R,R,R/S,R)-1 in blue
(S,R,R/S,R)-1 in red



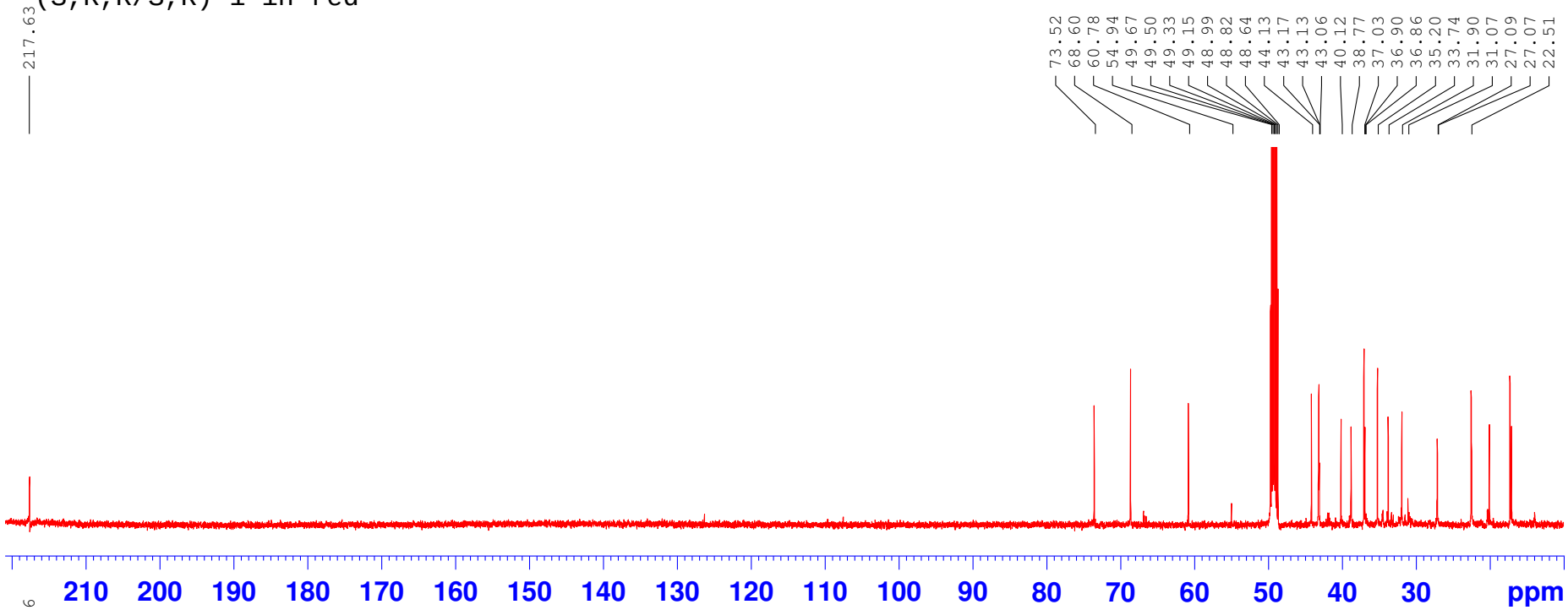
(R,R,R/S,R)-1 in blue
(S,R,R/S,R)-1 in red



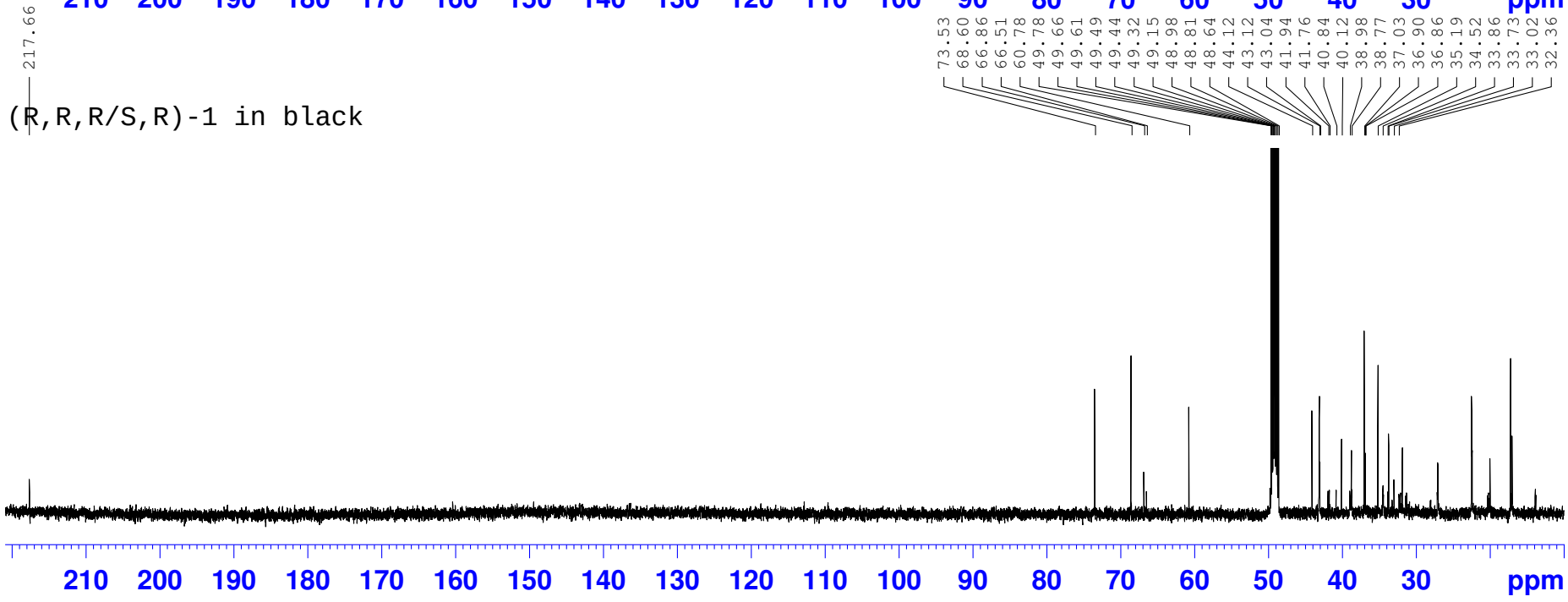
(R,R,R/S,R)-1 in blue
(S,R,R/S,R)-1 in red



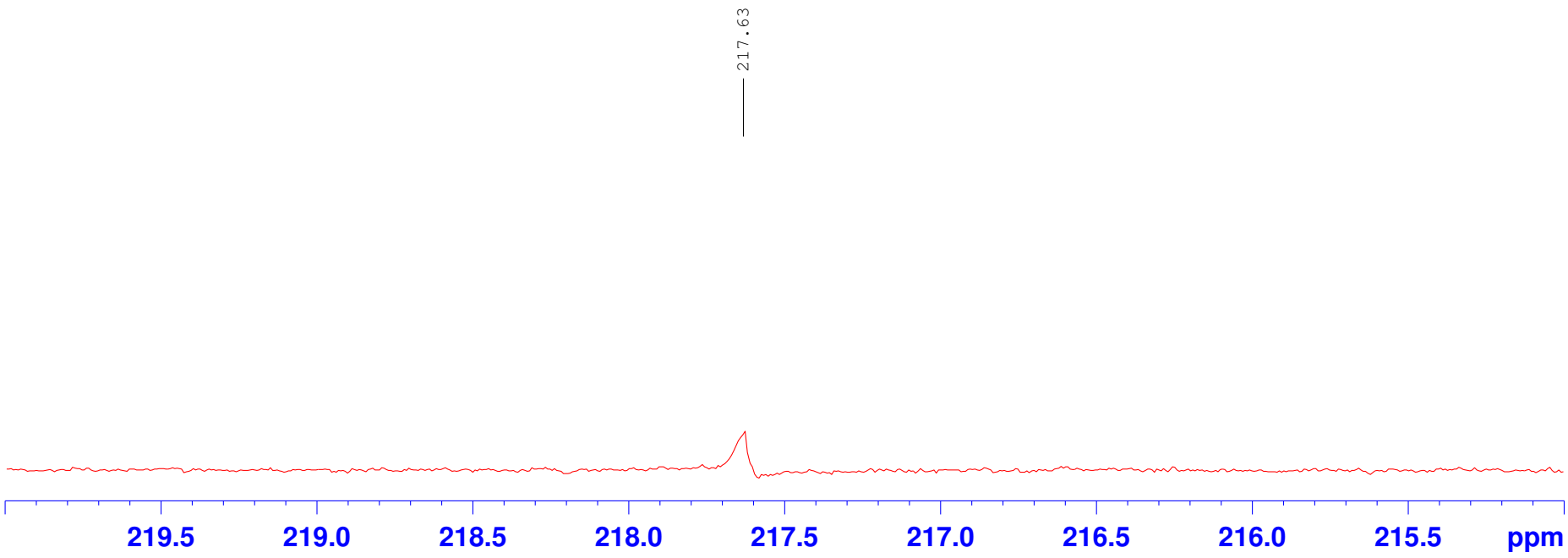
(S,R,R/S,R)-1 in red



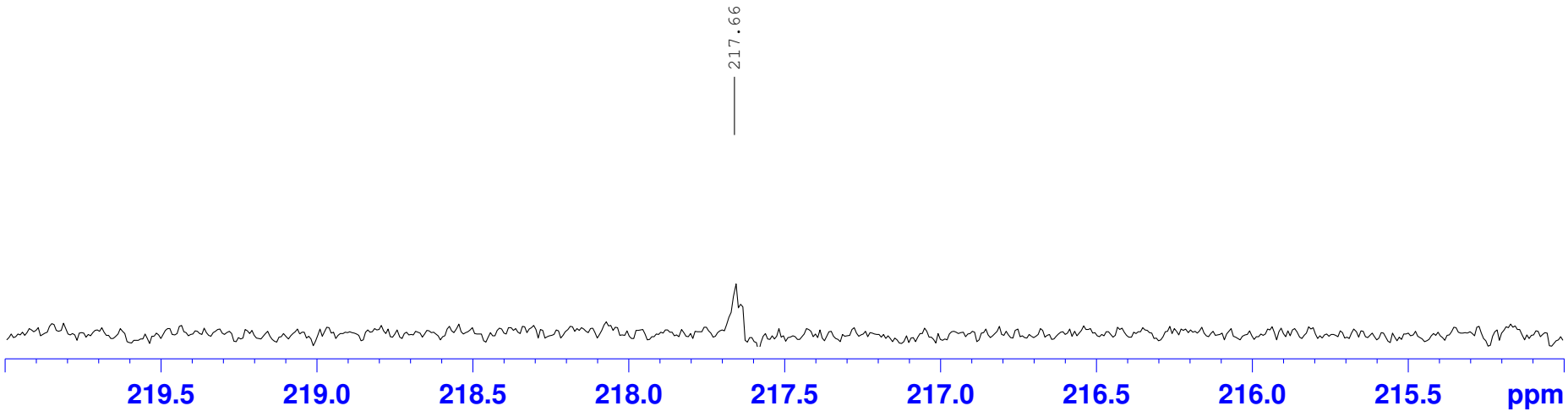
(R,R,R/S,R)-1 in black



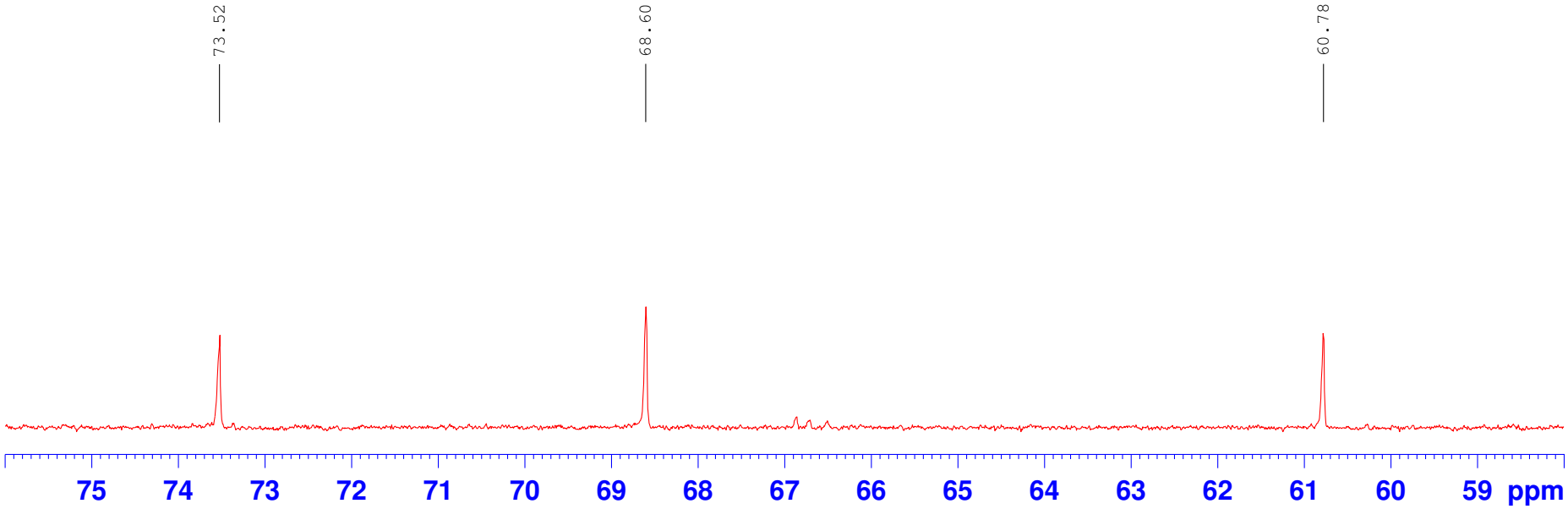
(S,R,R/S,R)-1 in red



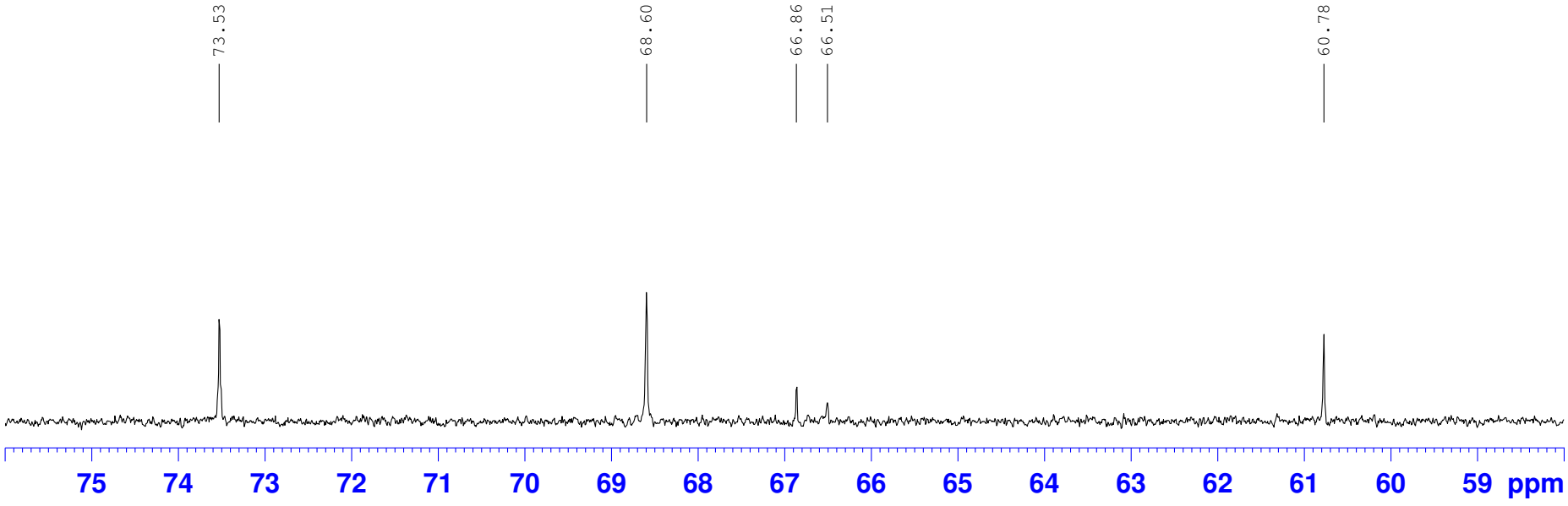
R,R,R/S,R)-1 in black



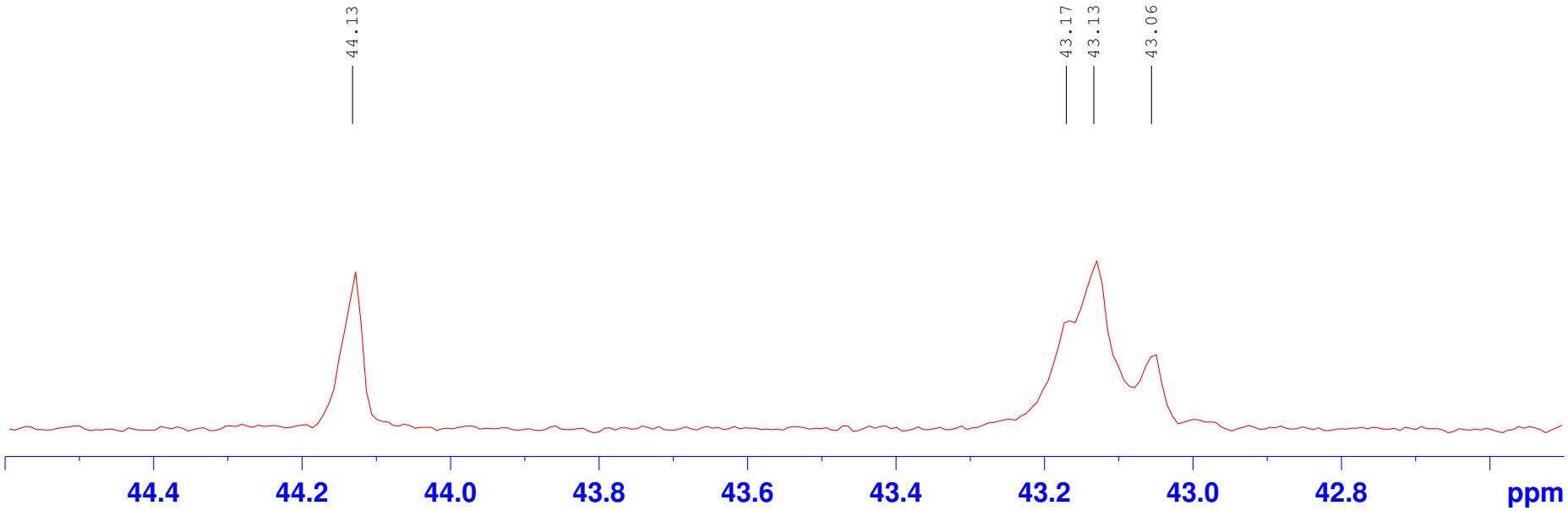
(S,R,R/S,R)-1 in red



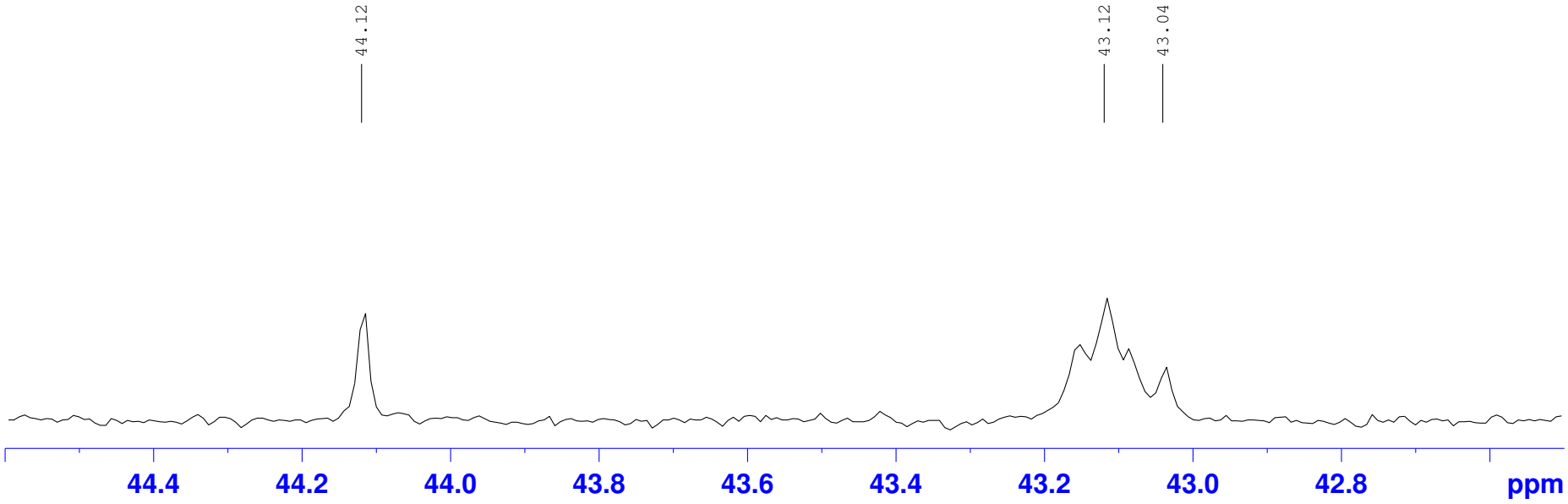
R,R,R/S,R)-1 in black



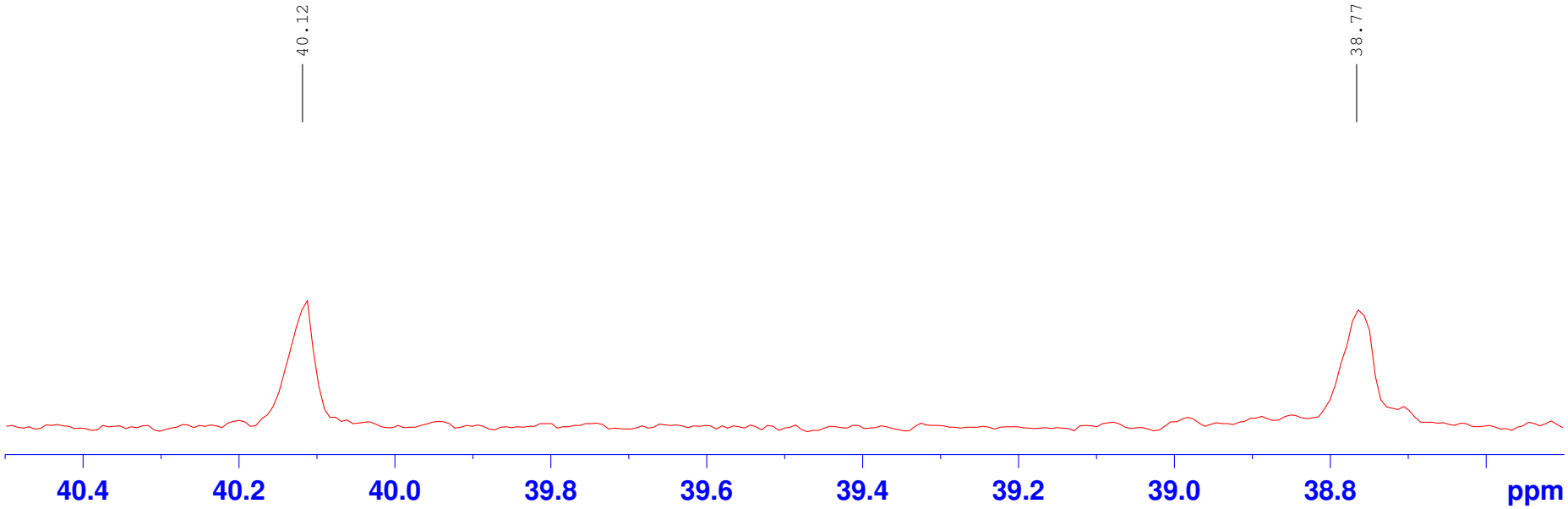
(S,R,R/S,R)-1 in red



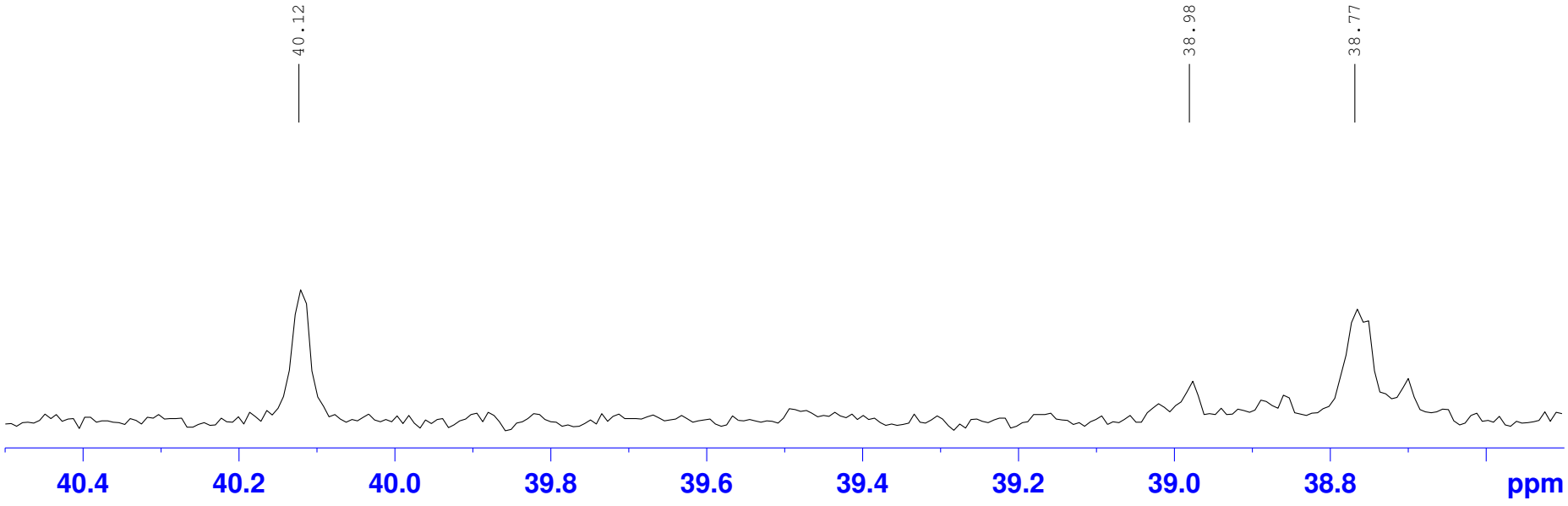
R,R,R/S,R)-1 in black



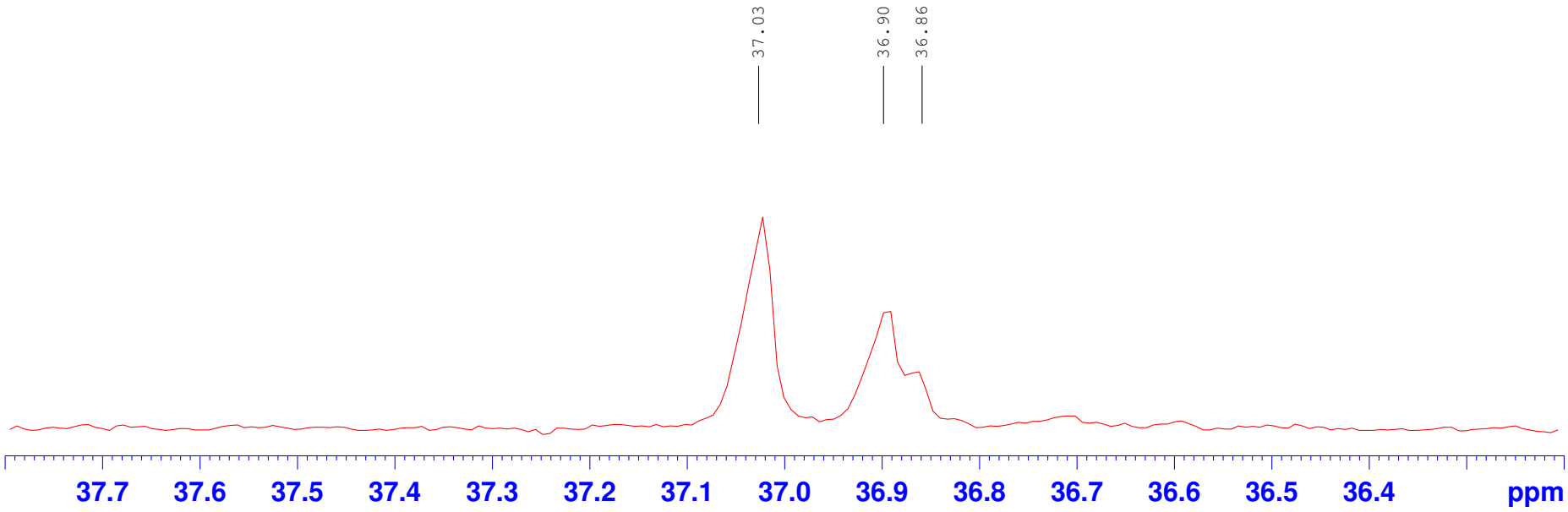
(S,R,R/S,R)-1 in red



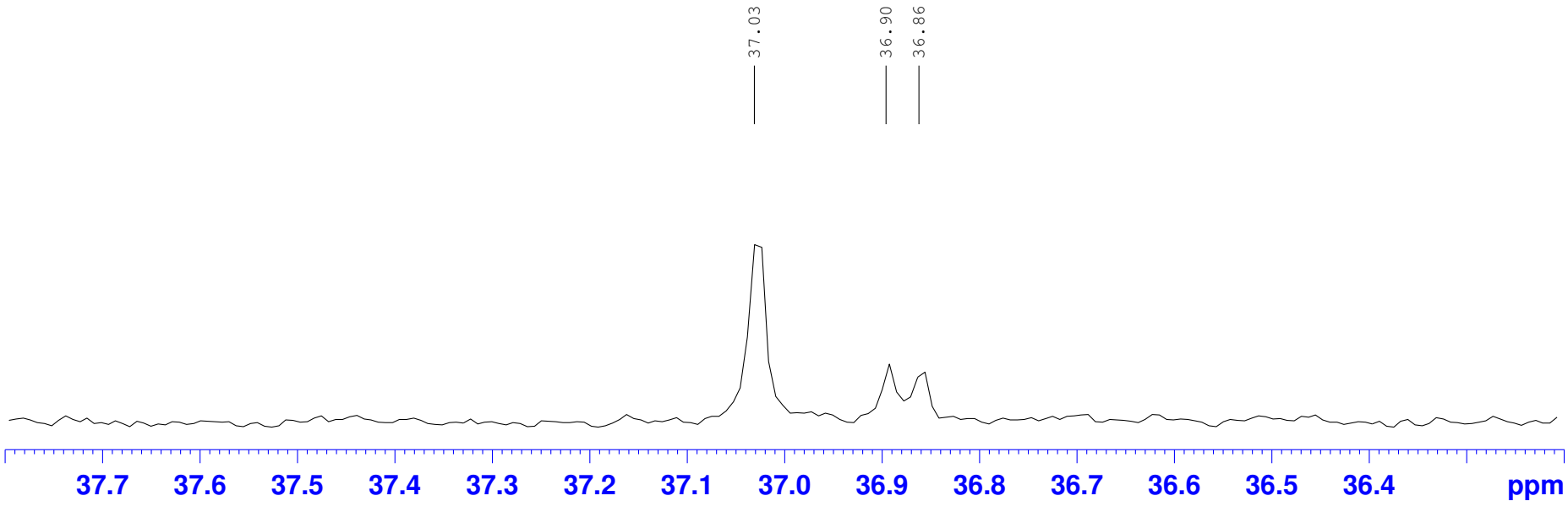
R,R,R/S,R)-1 in black



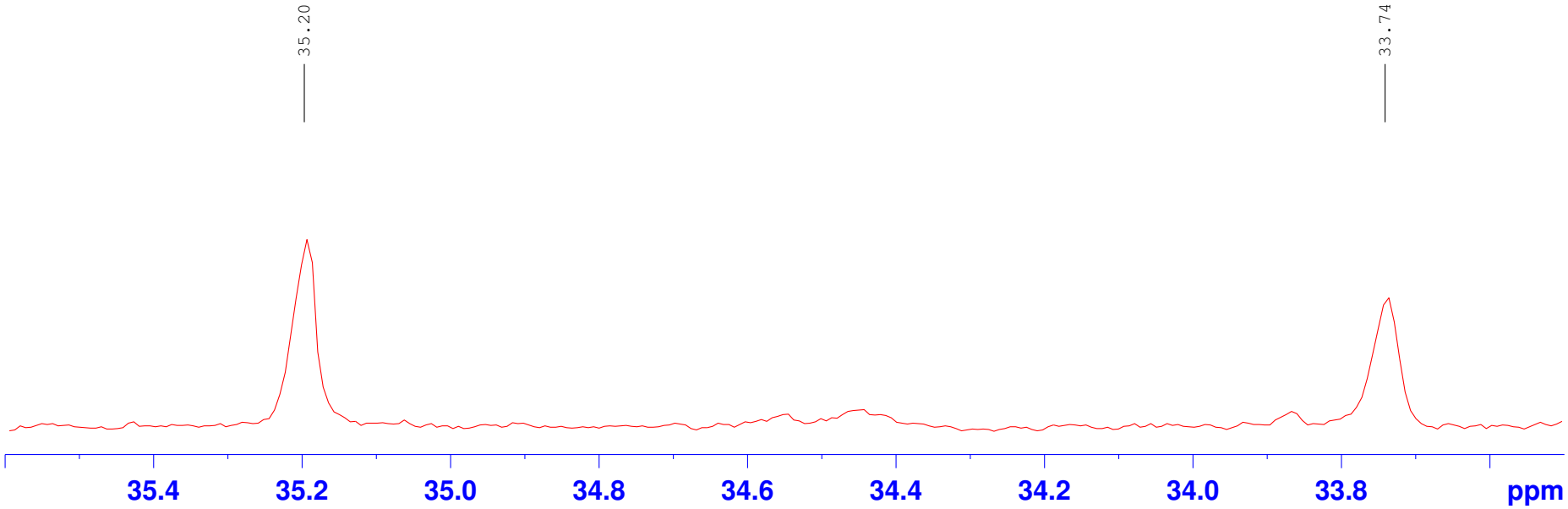
(S,R,R/S,R)-1 in red



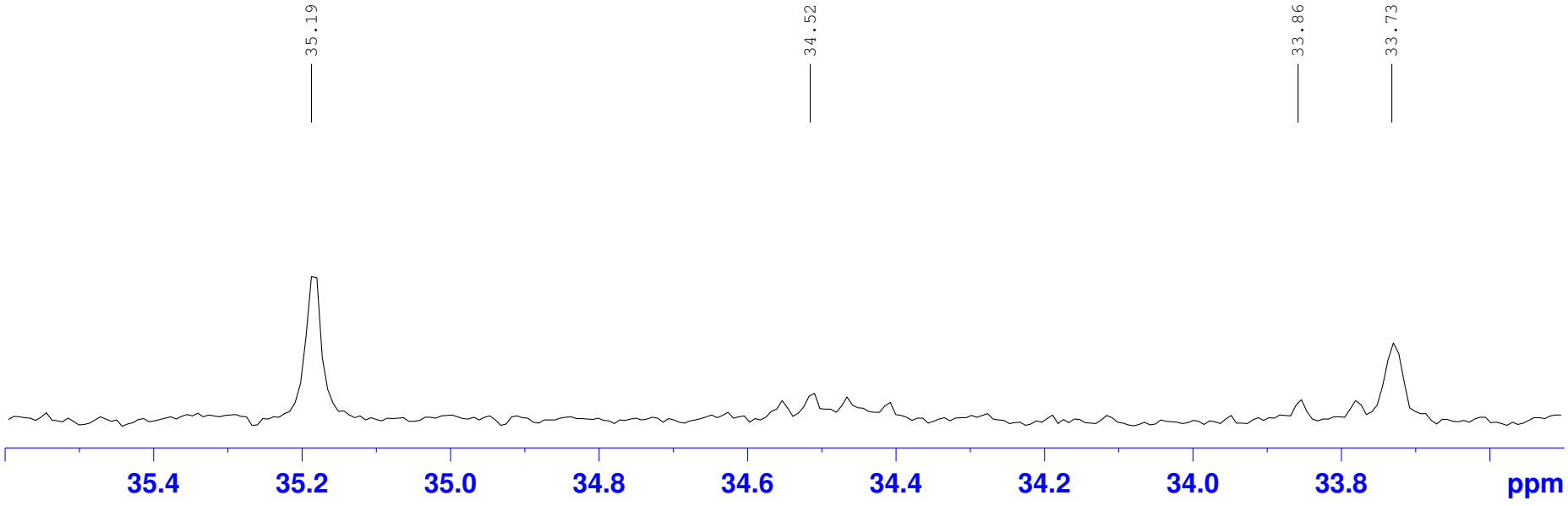
R,R,R/S,R)-1 in black



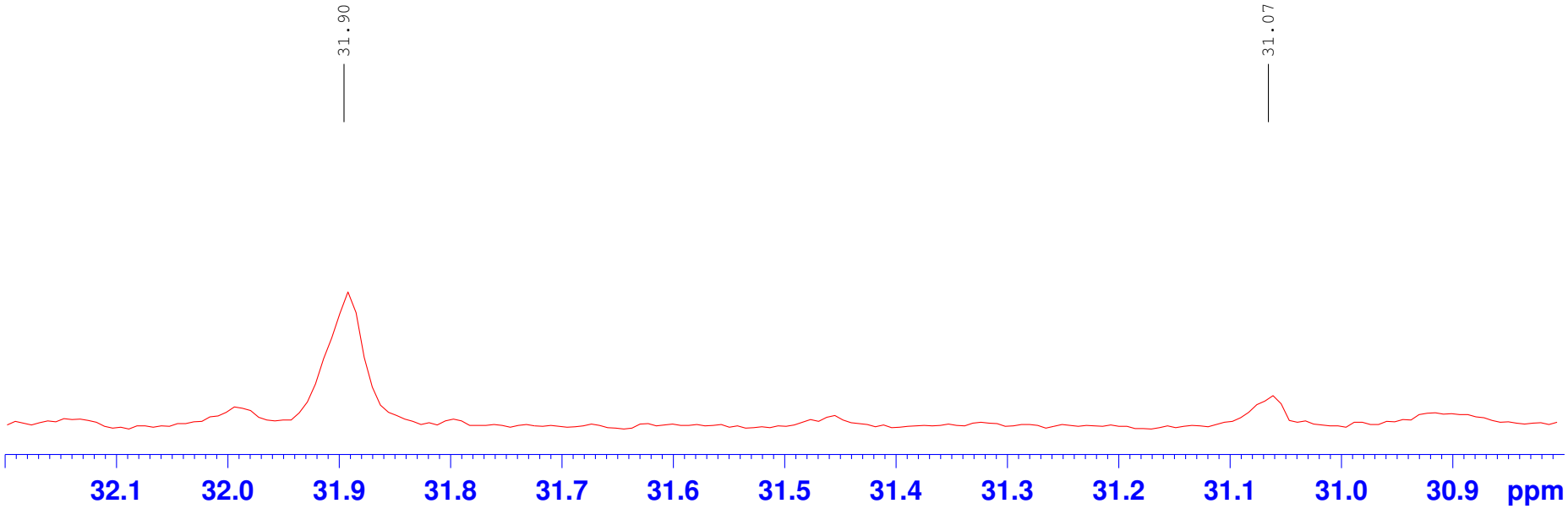
(S,R,R/S,R)-1 in red



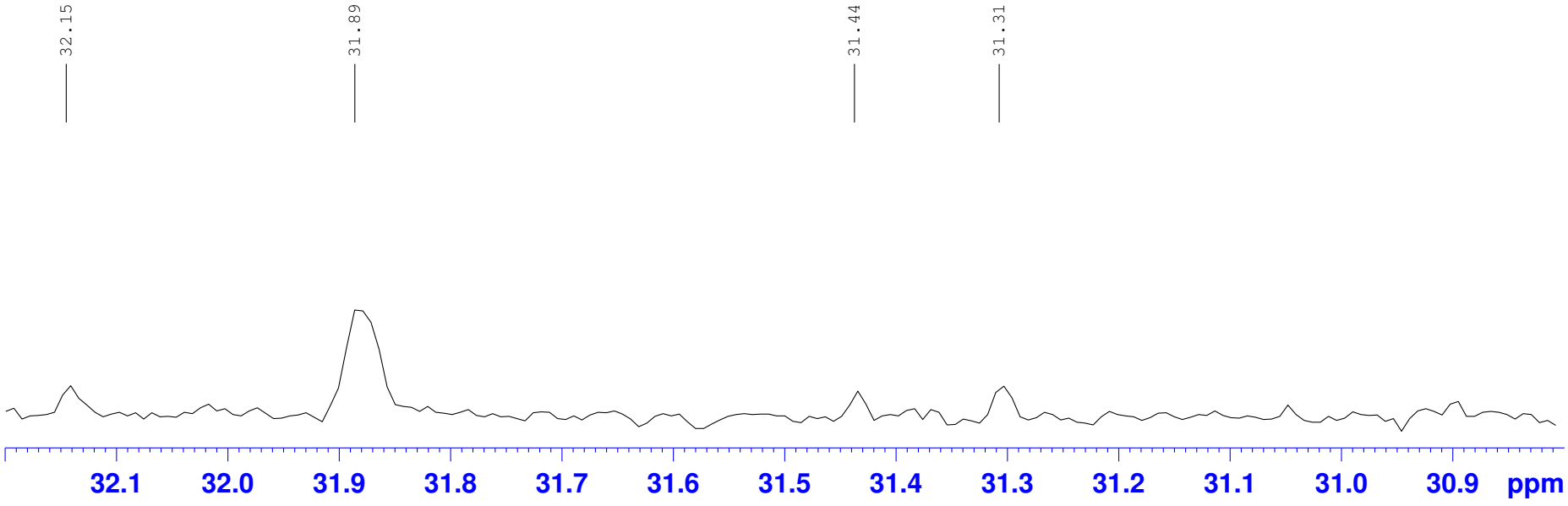
R,R,R/S,R)-1 in black



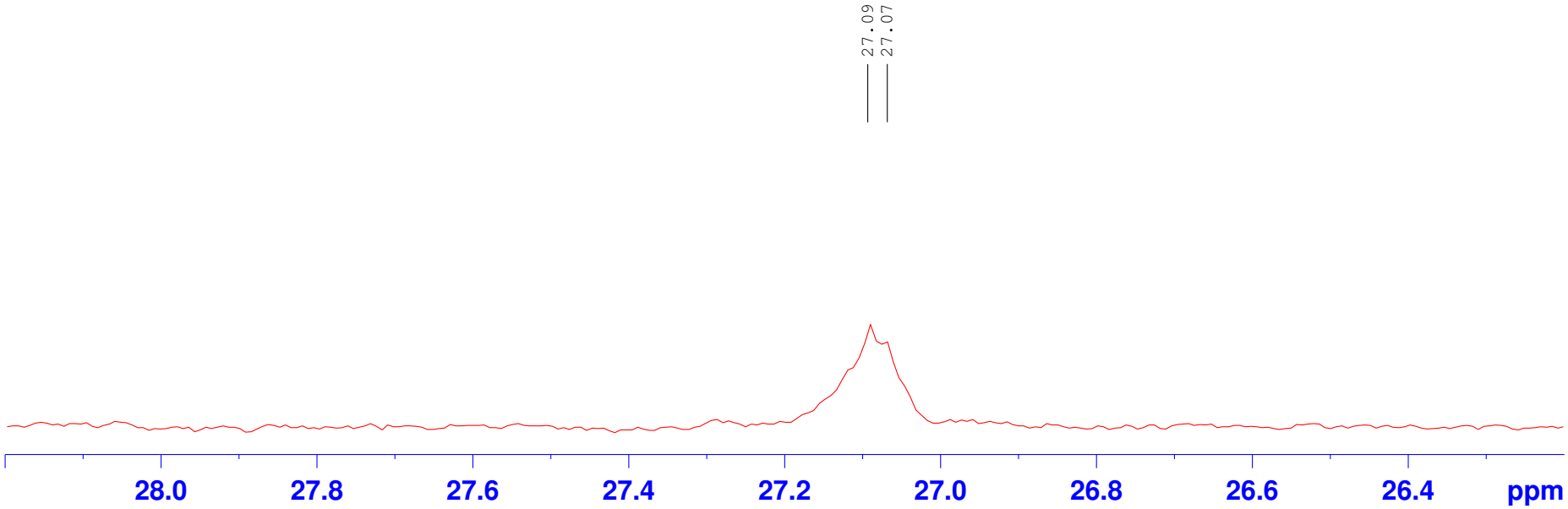
(S,R,R/S,R)-1 in red



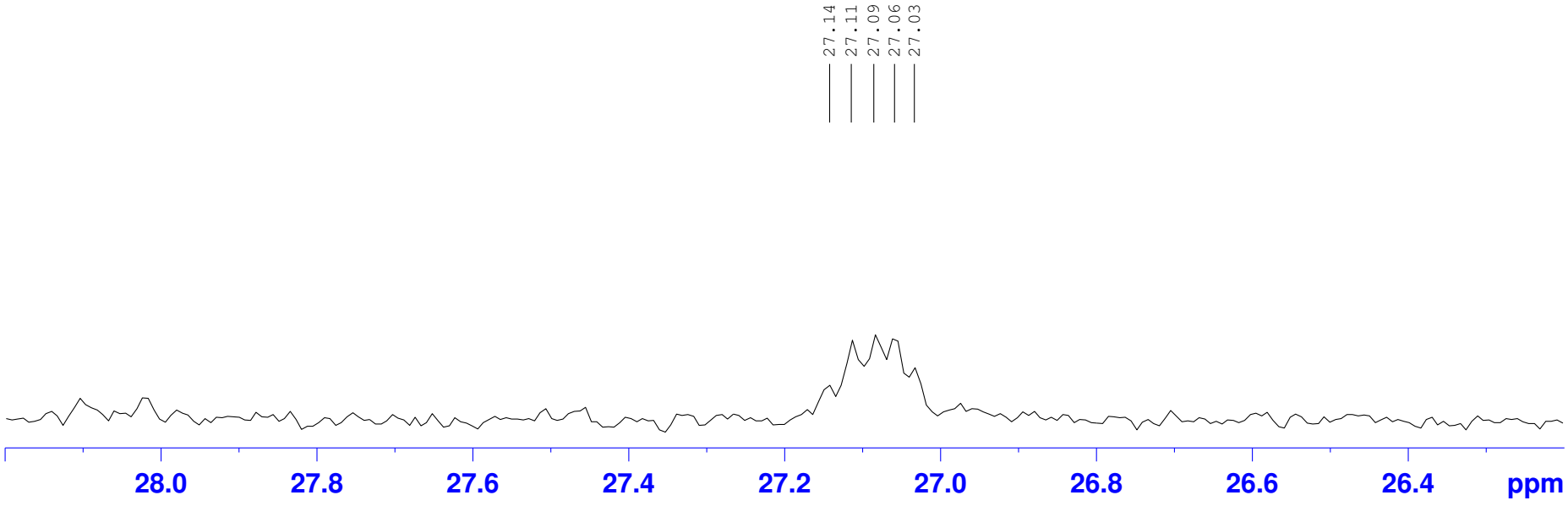
R,R,R/S,R)-1 in black



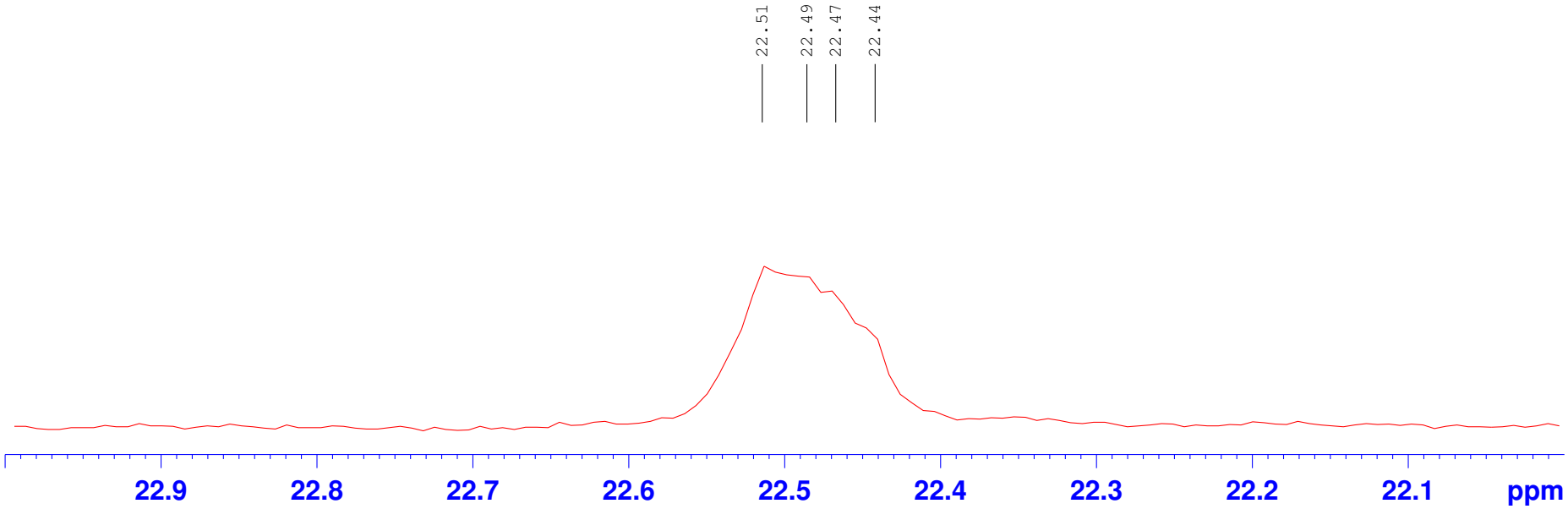
(S,R,R/S,R)-1 in red



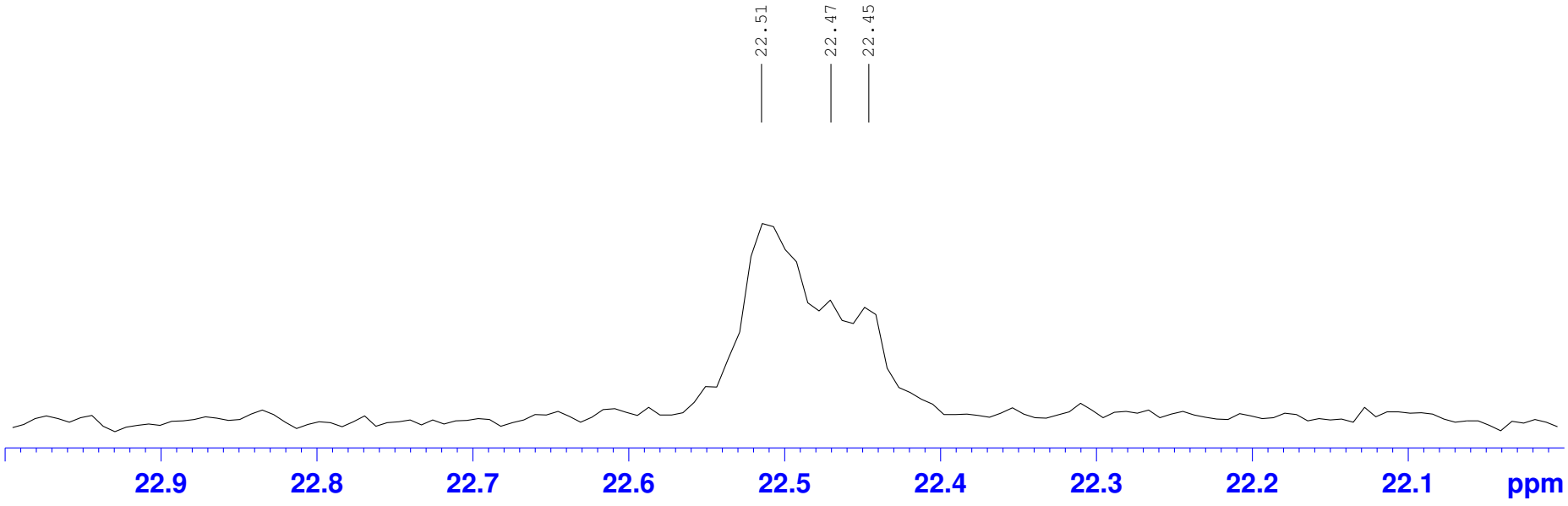
R,R,R/S,R)-1 in black



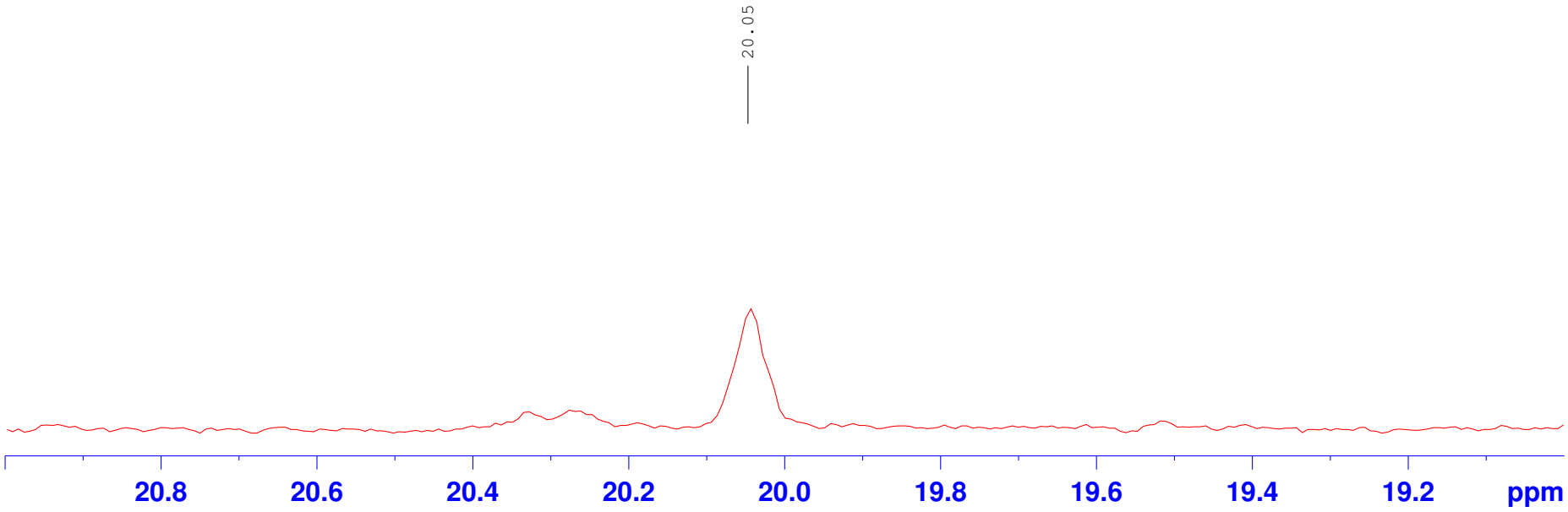
(S,R,R/S,R)-1 in red



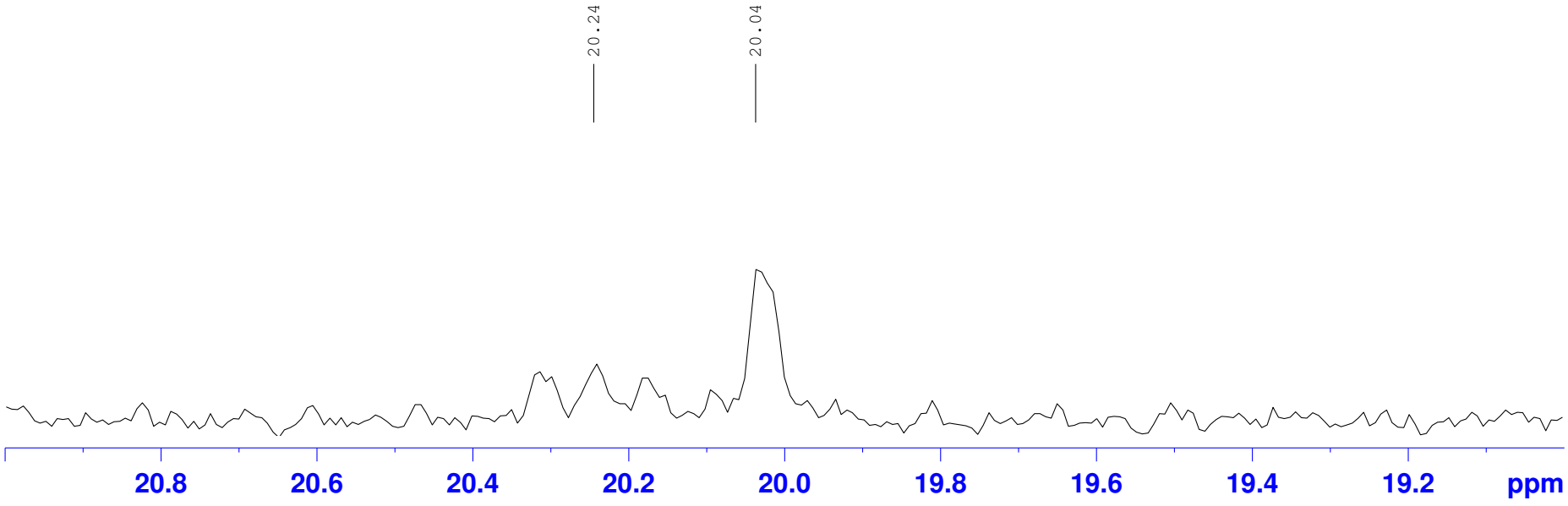
R,R,R/S,R)-1 in black



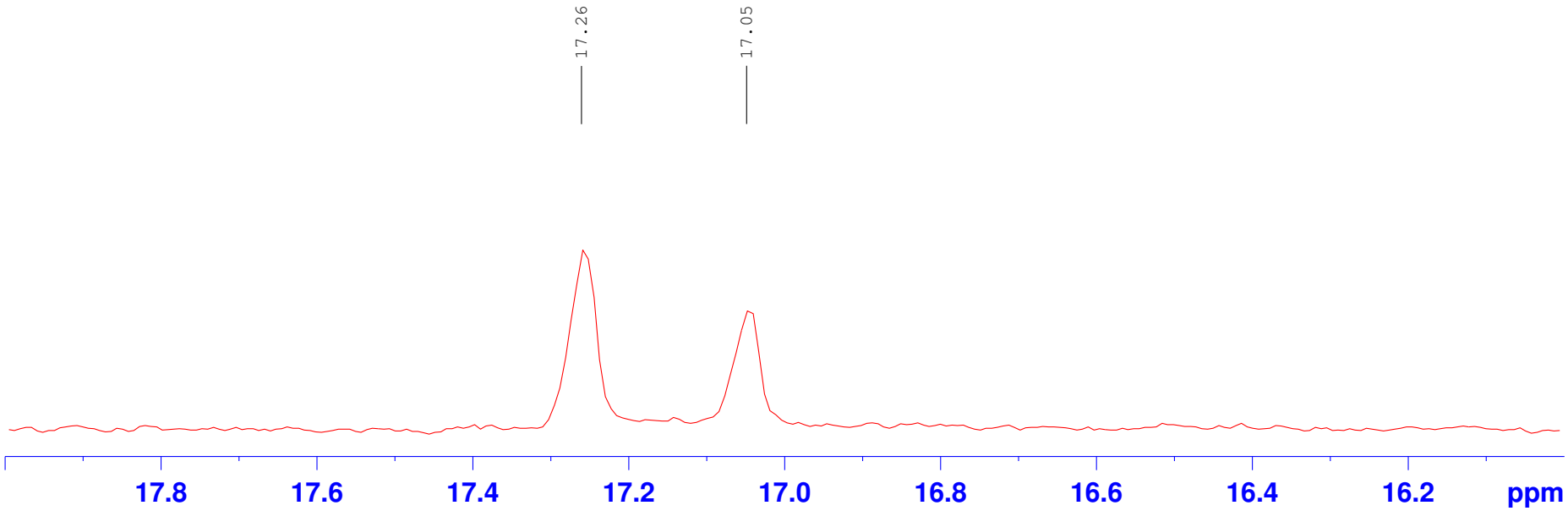
rb-408-pure, re2, MeOD, 500 MHz, NMR 500, 04/16/07



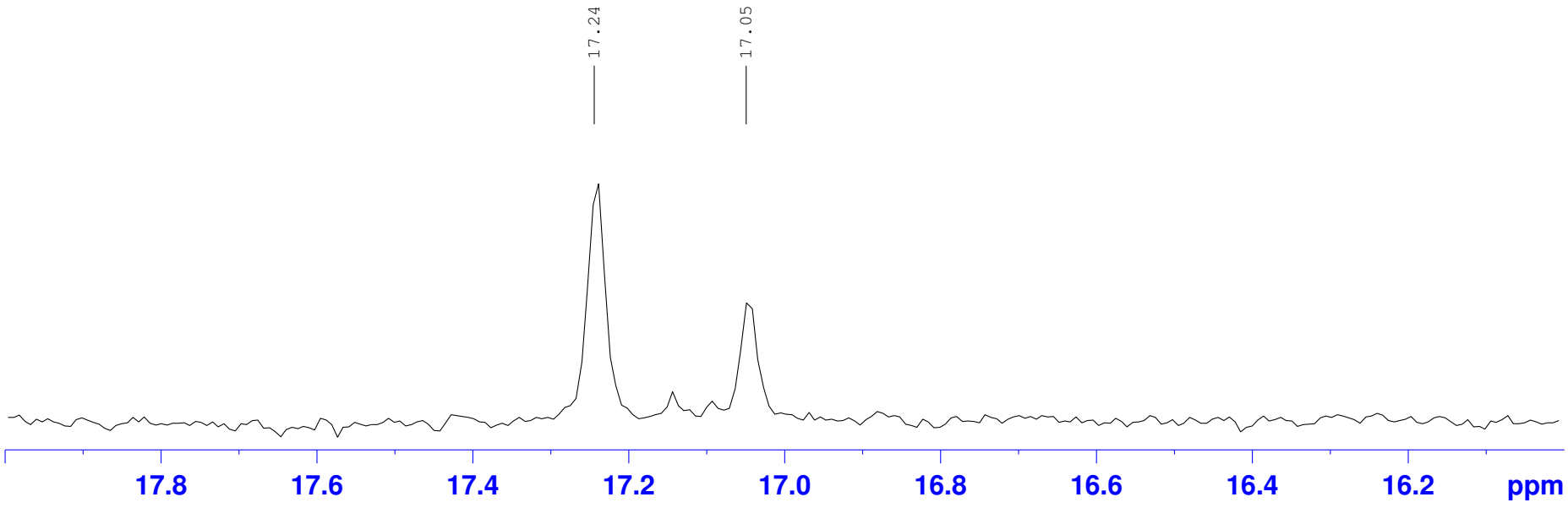
rb-431-pure, re2, MeOD, 500 MHz, NMR 500, 05/19/07



(S,R,R/S,R)-1 in red



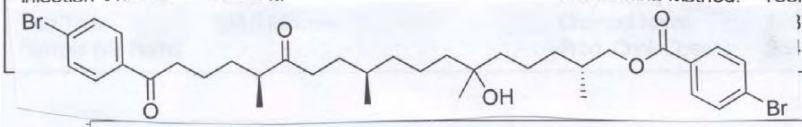
R,R,R/S,R)-1 in black

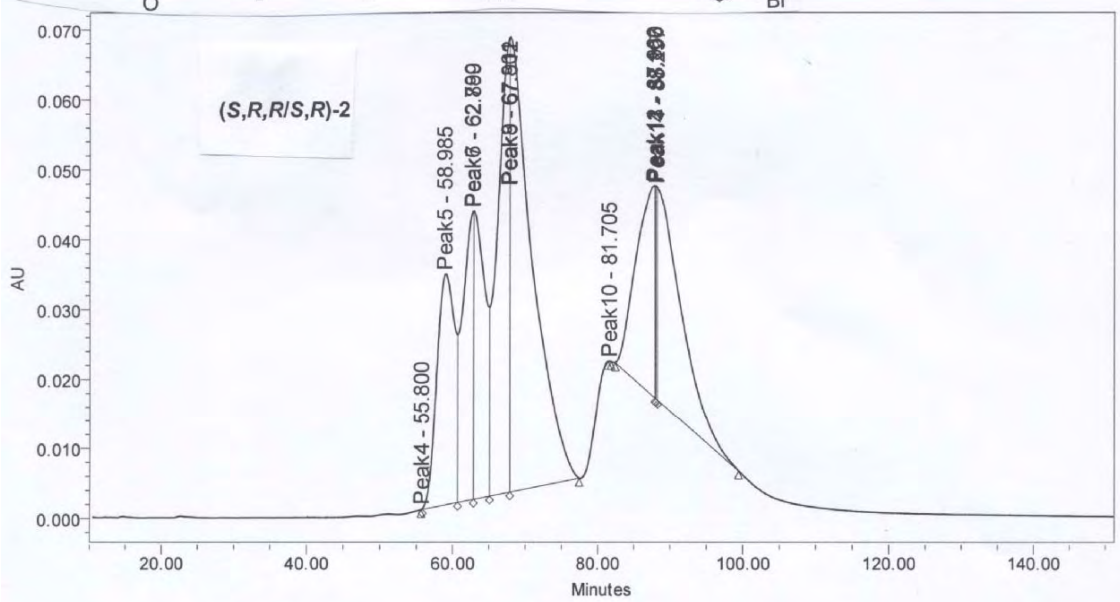


Carbon number	δH (natural) 600 MHz	δc (natural) 600 MHz	δH (**(S,R,R/S,RS)-1**) 500 MHz	δc (**(S,R,R/S,RS)-1**) 500 MHz
1	3.52 br t (6.6)	60.6	3.53 (t, *J* = 6 Hz, 2H)	60.68
2	1.48, 1.88 m	36.7	1.93-185 (m, 1H), 1.65-1.20 (m, 1H)	36.80*
3	2.77 sextet (6.9	44.0	2.78 (sextet, *J* = 7 Hz, 1H)	44.03
4	-	217.6	-	217.53
5	2.53 m	40	2.61-2.49 (m, 2H)	40.02
6	1.35, 1.60 m	31.7	1.65-1.20 (m, 2H)	31.80
7	1.42 m	33.6	1.65-1.20 (m, 1H)	33.64
8	1.13, 1.31 m	38.6	1.65-1.20 (m, 2H)	38.67
9	1.31, 1.41 m	22.3	1.65-1.20 (m, 2H)	22.41*
10	1.41 m	43.0	1.65-1.20 (m, 2H)	43.07*
11	-	73.4	-	73.42
12	1.41 m	43.0	1.65-1.20 (m, 2H)	42.96*
13	1.31, 1.41 m	22.4	1.65-1.20 (m, 2H)	22.41*
14	1.08, 1.42 m	35.1	1.65-1.20 (m, 1H), 1.08 (m, 1H)	35.10
15	1.58 m	36.9	1.65-1.20 (m, 1H)	36.93
16a	3.33 dd (10.8, 4.2)	68.5	3.33 (dd, *J* = 6.5, 10.5 Hz, 1H)	68.50
16b	3.41 dd (10.8, 6.0)		3.42 (dd, *J* = 5.5, 10.5 Hz, 1H)	
17	0.91 d (7.2)	17.1	0.91 (d, *J* = 6.5 Hz, 3H)	17.16
18	1.12 s	26.9	1.13 s (3H)	26.99*
19	0.89 d (6.6)	19.9	0.90 (d, *J* = 6.5 Hz, 3H)	19.95
20	1.07 d (6.6)	16.9	1.08 (d, *J* = 7 Hz, 3H)	16.95

* multiplets

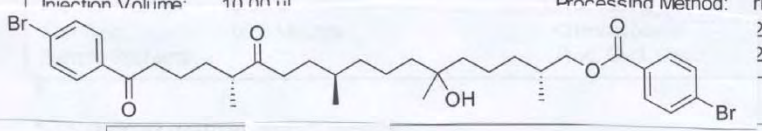
Sample Name:	RB-453-pure -chiral-OD-99:1	Acquired By:	System
Sample Type:	Unknow n	Date Acquired:	7/18/2007 2:26:15 PM
Vial:	1	Acq. Method Set:	reenaNP
Injection #:	1	Date Processed:	7/24/2007 2:57:01 PM
Injection Volume:	10.00 ul	Processing Method:	reena

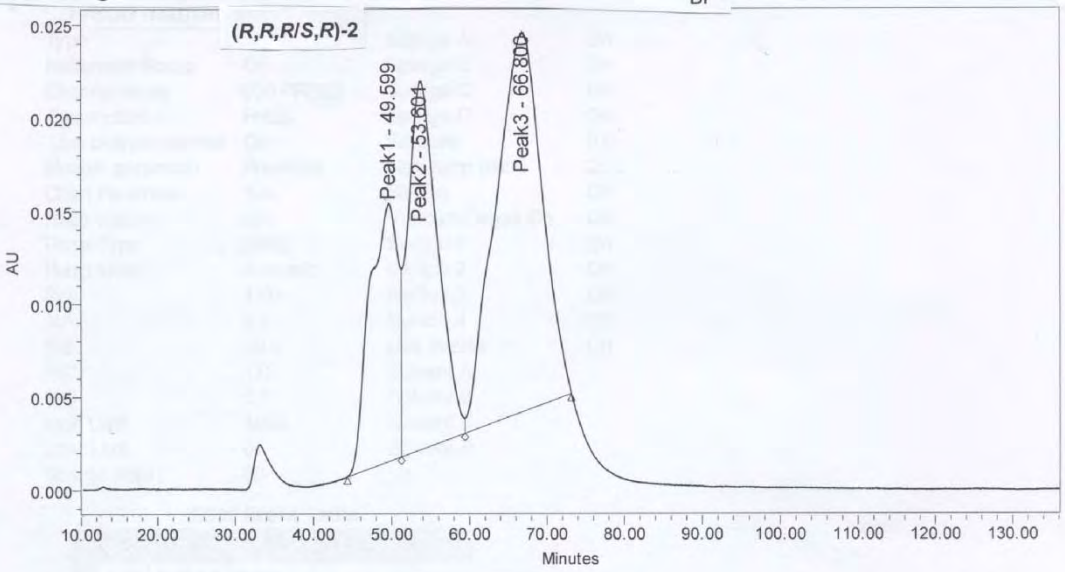




	Peak Name	RT	Area	% Area	Height
1	Peak1	3.852	61944	0.12	2178
2	Peak2	5.138	29461	0.06	1259
3	Peak3	5.834	682713	1.38	22942
4	Peak4	55.800	756	0.00	110
5	Peak5	58.985	5648639	11.40	33130
6	Peak6	62.780	4253426	8.58	41357
7	Peak7	62.899	4570540	9.22	41363
8	Peak8	67.801	7659333	15.45	65057
9	Peak9	67.912	13932911	28.11	65181

Sample Name:	rb-466-pure-1	Acquired By:	System
Sample Type:	Unknow n	Date Acquired:	8/7/2007 1:24:32 PM
Vial:	1	Acq. Method Set:	reenaNP
Injection #:	1	Date Processed:	8/7/2007 5:22:14 PM
Injection Volume:	10.00 µl	Processing Method:	rb466pure1
			2487Channel 1
			254





	Peak Name	RT	Area	% Area	Height
1	Peak1	49.599	3480962	20.12	13872
2	Peak2	53.601	5284846	30.54	19791
3	Peak3	66.800	8538962	49.34	20401