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Isotopic evidence for sulphur cycling at the Mid-Atlantic Ridge

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Sulphur isotope data for sulfide and sulfate minerals as well as for sulphur in the host rocks from the Logatchev hydrothermal field at 14˚45'N and from the Turtle Pits hydrothermal field at 4˚48'S are presented. The Logatchev hydrothermal field is located in 2900 to 3060 m water depth, hosted by ultramafic rocks, while the Turtle Pits hydrothermal field is situated in 2990 m water depth, hosted by basaltic rocks. Different metal sulphides (chalcopyrite, pyrite, pyrrhotite, various copper sulphides), representing particles from the emanating hydrothermal fluids as well as from sulfide chimneys and mounds from active and inactive black smokers, display sulphur isotope values between +2 and +9 permil, with no significant difference between both hydrothermal sites. However, differences exist between different generations of sulphide precipitates. Based on respective data for other hydrothermal fields from mid-ocean ridges, this sulphur isotope range indicates that sulphur in the hydrothermal fluid and mineral precipitates represents a mixture between mantle sulphur and reduced seawater sulphate. Anhydrite precipitates from hydrothermal chimneys, located inside the sulphide chimneys yielded sulphur isotope values between +17.5 and +20.0 permil. This clearly identifies seawater sulphate as the principal sulphur source. Variable, but generally low abundances of sulphide and sulphate in differently altered mafic and ultramafic rocks point to a complex fluid-rock interaction. Sulphur isotope values for total sulphur range between 0.6 and +18.7 permil, again reflecting a mixing between two principal end-members: seawater sulphate and mantle sulphur.