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Sulfur isotope fractionation during the reduction of elemental sulfur and thiosulfate by Dethiosulfovibrio spp.

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Thiosulfate and elemental sulfur are typical by-products of the oxidation of dissolved sulfide and important sulfur intermediates in the biogeochemical sulfur cycle of natural sediments where they can be further transformed by microbial or chemical oxidation, reduction, or disproportionation. Due to the often superimposing reaction pathways of the sulfur intermediates in natural environments specific tracers are needed to better resolve the complex microbial and biogeochemical reactions. An important fingerprint for sulfur cycling is provided by the microbial fractionation of the stable sulfur isotopes S-34 and S-32. Proper interpretation of isotope signals in nature, however, is only possible by the calibration with results obtained with pure cultures under defined experimental conditions. In addition, sulfur isotope discrimination may provide informations about specific encymatic biochemical pathways within the bacterial cells.

In this study, we report the results for the discrimination of stable sulfur isotopes S-32 and S-34 during reduction of thiosulfate and elemental sulfur by non-sulfate, but sulfur- and thiosulfate-reducing bacteria which are phylogenetically not related to sulfate-reducing bacteria. Experiments with were conducted at known cell-specific thiosulfate reduction rates. Stable sulfur isotope fractionation was investigated during reduction of thiosulfate and elemental sulfur at 28°C by growing batch cultures of Dethiosulfovibrio marinus WS100 (type strain DSM 12537) and Dethiosulfovibrio russensis (type strain DSM 12538) using citrate as carbon and energy source. The cell-specific reduction rates were 0.3 to 2.4 fmol cell-1 d-1 (thiosulfate) and 31 to 38 fmol cell-1 d-1 (elemental sulphur), respectively. The sulfide produced was depleted in S-34 by 12 per mil compared to total thiosulfate sulfur, close to previous results observed for sulfate-reducing bacteria, indicating that the thiosulfate-reducing mechanism of sulfate reducers is similar to that of the investigated thiosulfate-reducing strains. Elemental sulfur reduction yields sulfide depleted in S-34 and isotope fractionation effects between 1.3 and 5.2 per mil for Dethiosulfovibrio russensis and 1.7 and 5.1 per mil Dethiosulfovibrio marinus, with the smaller fractionation effects observed in the exponential growth phase and enhanced discrimination under conditions of citrate depletion and cell lysis.