

Se/Te ratios in different geological samples and its potential application as paleo redox proxy

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Previous investigations had shown, that with concentrations of up to >200 ppm and a mean concentration of 46 ppm, Te is the most enriched element in hydrogenetic marine ferromanganese crusts. Assuming an average earth's crustal Te concentration between 1 and 10 ppb, the mean enrichment factor of Te in marine Fe-Mn crusts is about 46000 or 4600, respectively which is significantly higher compared to other highly enriched elements such as Co, Mo, Bi, and Tl. Unlike Te the chemically similar element Se is not enriched in Fe-Mn crusts to this extent. Our ongoing investigations indicate that Te is selectively sequestered from seawater by the crusts via a surface oxidization process. This process, based upon the oxidization of Te(IV) to Te(VI) on the Fe-Mn oxide surface was also examined by sorption experiments and verified by X-ray fine structure measurements. The sorption experiments showed, that Te(IV) in general sorbs distinctively faster than Te(VI) on fully oxidized Mn and Fe oxide surfaces, but slower on a diagenetic manganese nodule with todorokite (crystalline $\text{MnO}_{1.79}$). After sorption of Te(VI), all Te was found to be Te(VI) on Mn oxides (MnO_2) whereas the Te in sorption experiments with FeOOH mostly remained in the oxidation state IV. In the analyzed ferromanganese crusts a major part of the Te occurs as Te(VI). One question is, whether the proposed oxidative enrichment of Te is also of relevance in other geological systems and if the ratio between Te and Se can be used to describe paleo redox conditions. The analyzed evaporites, magmatic rocks and sediments do not show a Te/Se ratio that differs significantly from the Earth's crustal values. In marine Mn-Fe oxides, Se/Te ratios decrease significantly from Baltic Sea Fe-Mn crusts over diagenetic Mn nodules to hydrogenetic Fe-Mn crusts, which could be related to the growth rate and/or the redox conditions during formation.

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Abs. No. **115**
Meeting: **DMG 2008**
submitted by: **Schirmer, Thomas**
email: **t.schirmer@jacobs-**
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date: **0000-00-00**
Req. presentation: **Vortrag**
Req. session: **S09**