Geophysical Research Abstracts
Vol. 14, EGU2012-7627, 2012
EGU General Assembly 2012

Aquifer-specific Rare Earth Element patterns in groundwater of the Thuringian basin, Germany

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The Thuringian basin is the major geological structural unit in the federal state of Thuringia, Germany. It consists of sandstones, limestones, clays, gypsum and salts, that were deposited from the Upper Permian until the Lower Jurassic (approximately 250 to 180 million years ago). The largest deposits are Buntsandstein, Muschelkalk and Keuper, all of Triassic age. Important aquifers are located in the Buntsandstein formations, which are cropping out widespread in the southeastern part and the northeastern part of the basin. These aquifers contain large resources of drinking water for the region.
The hydrochemical properties of the groundwater with special emphasis on Rare Earth Elements (REE) are the main focus of this study. To investigate possible interactions between aquifers in the Buntsandstein with aquifers in adjoining formations, waters from Zechstein and Muschelkalk are considered, additionally.
Since the REE in water in many case are originated from the minerals of the host rocks, REE fractionation pattern could provide information regarding the lithology of the solid aquifer material (Möller, 2002). Furthermore, interaction processes between solid and liquid phases or complexation in the water phase could be identified by REE fractionations (Ingri et al., 2000). Nevertheless, waters in circumneutral pH conditions could feature many different fractionation patterns (Johannesson & Zhou, 1997) making the interpretation difficult. Due to very low concentrations of REE in water at neutral pH condition, an enrichment procedure is necessary prior to REE determination by inductively coupled plasma mass spectroscopy (ICP-MS). The used method is based on the procedure of Shabani et al. (1990) and yields enrichment factors of about 500.
REE fractionation patterns were determined for different water types such as Na-Cl type originating from Zechstein, Ca-Mg-HCO_3-SO4 and Ca-SO4 from Buntsandstein or Ca-HCO_3 from Muschelkalk aquifers. The patterns are specific for the different aquifers, representing local hydrochemical conditions. Furthermore, also regional prevailing features could be identified, representing processes which occur on a larger scale. On base of these results, continuative investigations on particular processes in the rock-water interaction will be carried out.
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