Iron isotope signature of Paleoproterozoic banded iron formation from Quadrilátero Ferrífero, Minas Gerais, Brazil

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The iron cycle study provides important insights into the early Earth System evolution history. The Precambrian record is marked by Banded Iron Formation (BIF) occurrences, which are the product of chemical precipitation from seawater, which were subsequently affected by diagenetic and metamorphic processes.

In Central Brazil, the Quadrilátero Ferrífero region comprises a large occurrence of Paleoproterozoic BIF with approximately 7000 km^2, which hosts one of the largest iron ore deposits in the world. Some samples of the Quadrilátero Ferrífero's BIF were used in a preliminary investigation on the iron isotope signature recorded by these deposits.

We have analyzed a suite of samples by MC-ICP-MS using the nickel doping technique. Thirty three analyses of the Milhas hematite standard gave a δ^{57}Fe value of 0.766±0.088‰ (2SD), relative to the IRMM-14 standard. On the USGS BIF reference rock we obtained δ^{57}Fe = 0.903±0.042 (2SE, n=6). Both values agree within uncertainties with previously published values. Our results on the Quadrilatero Ferrifero show large δ^{57}Fe variations, between -1.493± 0.034‰ and -0.061±0.12‰. These different δ^{57}Fe values were obtained for BIF samples which have different mineralogical associations. Samples with the lightests δ^{57}Fe correspond to siliceous BIF whereas all other samples, are BIFs intermingled with carbonates. Such an isotopic range extending towards very light δ^{57}Fe values have only been found in 2.5-2.7 Ga age BIFs, like those of the Quadrilátero Ferrífero.

Biogeochemical characterization of geothermal fluids

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Biogeochemical investigations on deep geothermal fluids are relatively rare, but are of great importance to characterize the geochemical origin of the fluid as well as the potential that biological processes will effect the working reliability of geothermal plants.

To characterize the natural variability in the inventory of dissolved organic carbon (DOC) compounds in geothermal fluids, samples from different geothermal plants in numerous geothermal regions of the world have been screened for the qualitative and quantitative composition of the DOC using size-exclusion chromatography. The characterization of the DOC as well as inorganic anions are valuable to evaluate if microbial processes will be relevant in the geothermal system as the DOC and several inorganic anions like nitrate and sulfate represent potential nutrients for the microbial ecosystem. The changes in composition of the microbial ecosystem in geothermal plants and heat storage systems were also characterized by bacterial membrane phospholipid fatty acids (PLFA) composition.

Here, we will present recent results on the screening of the DOC in selected geothermal fluids from a variety of geothermal plants and heat storage systems as well as the monitoring of fluid chemistry and PLFA composition in heat storage systems present in the North German Basin.

Samples from a solar assisted heat storage located in a quaternary freshwater aquifer in 15 to 30 m depth clearly show that the composition of the microbial ecosystem changes with respect to the seasonal changes of charge and discharge of heat. In wintertime, the PLFA composition of the indigenous microbial community showed an adaptation of the cell membrane during the discharge mode, when temperature decreases from 50 to 13.7°C during time of heat extraction.

One deep heat storage in the North German Basin (1250 m depth) where surplus heat from a gas and steam cogeneration plant is stored in summertime and which is used in wintertime for district heating shows changing PLFA patterns that clearly indicate different composition of the microbial communities on the warm and cold side.