

## Peering into the Cradle of Life: Multiple sulfur isotopes reveal insights into environmental conditions and early sulfur metabolism some 3.5 Ga

A. MONTINARO<sup>1\*</sup>, H. STRAUSS<sup>1</sup>, P. MASON<sup>2</sup>  
AND A. GALIĆ<sup>2</sup>

<sup>1</sup>Westfälische Wilhelms-Universität Münster, Münster,  
Germany (\*correspondance:amont\_01@uni-muenster.de)

<sup>2</sup>Utrecht University, Utrecht, The Netherlands

Multiple sulfur isotopes have been used successfully for constraining Earth's early sulfur cycle, prevailing overall environmental and redox conditions in particular, as well as for tracing life on Earth. ICDP project "Peering into the Cradle of Life" aims at investigating the environmental conditions that existed when life emerged and evolved on our planet. Samples stem from the Barberton Greenstone Belt in South Africa (3.55–3.23 Ga), one of the oldest well preserved rock successions from the earliest part of Earth history. This study centers on core BARB5, comprising carbonaceous shale, interbedded sandstone and conglomerate and volcanoclastic rocks from the middle Mapepe Formation of the Fig Tree Group. Total sulfur abundance ranges between 0.01 and 3.03 wt.% and total carbon abundances between 0.15 and 10.29 wt.%. The carbonaceous shale displays  $\delta^{34}\text{S}$  values between -0.99 and 3.33‰; volcanoclastic rocks between -6.57 and 2.32‰; sandstone and conglomerate between 0.37 and 3.44‰. Similar to the  $\delta^{34}\text{S}$  values,  $\Delta^{33}\text{S}$  values are different for each lithofacies. Samples from the carbonaceous shale yielded a range between 0.41 and 2.33‰; volcanoclastic rocks between -0.32 and 0.20‰; sandstone and conglomerate between 0.14 and 0.61‰. Some preliminary conclusions can be drawn. Each lithofacies is characterized by a different isotopic composition. Clearly,  $\Delta^{33}\text{S}$  values in carbonaceous shale reflect mass-independent isotope fractionation, hence an atmospheric signature. In contrast, volcanoclastic rocks display rather small  $\Delta^{33}\text{S}$  values but substantial variability in  $\delta^{34}\text{S}$ , that could reflect solely mass-dependent isotopic fractionation, hence a terrestrial signature. However, alternatives have been proposed.

## THEREDA – Thermodynamic Reference Database

HELGE C. MOOG<sup>1</sup> AND FRANK BOK<sup>2</sup>

<sup>1</sup>Gesellschaft für Anlagen- und Reaktorsicherheit (GRS) mbH,  
Theodor-Heuss-Straße 4, 38122 Braunschweig, Germany,  
helge.moog@grs.de

<sup>2</sup>Helmholtz-Zentrum Dresden-Rossendorf e.V., Institute of  
Resource Ecology, Surface Processes Division (FWOG),  
Bautzner Landstraße 400, 01328 Dresden (Germany),  
f.bok@hzdr.de

THEREDA was founded by five institutions in Germany and Switzerland. Our main objectives are

- To ensure that equilibrium calculations for nuclear disposal issues are consistent among different institutions
- To save basic thermodynamic data in a way which renders them usable on a long term
- To have a technical platform which facilitates the decentralized editing of data
- To provide users with ready-to-use parameter files for the most widely used geochemical codes
- To make sure that each datum can be traced back to its original source
- To classify the entered data in order to inform the user about the quality of the data and hence his calculations

Following these objectives THEREDA has evolved into a web-based platform for a common thermodynamic database. The main focus lies on providing a database for high-saline systems. However, some efforts have been made to design THEREDA as flexible as possible for future demands, as necessity arises, namely: other models for the aqueous solution, non ideal gas and solid phases, etc.

Backbone of the whole database is a Pitzer-consistent set of phase constituents along with equilibrium constants and Pitzer coefficients for the basic hexary system Na-K-Mg-Ca-Cl-SO<sub>4</sub>-H<sub>2</sub>O. The set is at present being extended to be valid for temperatures between 120 and 200°C, depending on the particular system. At the same time data are added to extend the database for polythermal, in parts even polybaric equilibria with HCO<sub>3</sub><sup>-</sup>/CO<sub>2</sub>(g).

Consistently to the above mentioned backbone, other joint members of THEREDA collaborate to extend the database for actinides, activation- and fission products, and heavy metals. Another string of endeavour is targeted towards geothermal applications.

The THEREDA team welcomes colleagues from other database projects to discuss or collaborate on specific subjects of common interest.