

Modeling of possible limits for Sr values in Early Proterozoic waters of continental flow (the Baltic shield)

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Continental chemical weathering, as a reason for changing the Sr isotope ratio in seawater was examined only qualitatively. The composition of drainage waters and river waters is fully caused by the interaction of climate and rocks, which form a drainage basin, thus the changing of the composition of the upper continental crust and atmosphere through time should affect the composition of the drainage waters and continental flow in general.

The profiles of continental weathering are widely found in all stratigraphic levels in Karelia. Some of these profiles were examined and by means of mathematical modeling the amount of main elements and isotopic values of Sr were reconstructed in drainage waters of these profiles. Mathematical models are based on the Rb-Sr isotope data for the most ancient weathering profile at the Baltic shield – 2.8 Ga [1], and geochemical data for a number of Proterozoic weathering profiles. The $^{87}\text{Sr}/^{86}\text{Sr}$ ratio at the granite source was calculated relative to their age, according to the measured contemporary value 0.70391, with the $^{87}\text{Rb}/^{86}\text{Sr}$ contemporary ratio 0.0736. The results of the models are shown in picture 1.

The majority of published data concerning the isotopic value of Sr, including data for the Tulomozerskaya formation of the Baltic Shield [2], are shown at picture 1 and most of them are inside calculated levels of $^{87}\text{Sr}/^{86}\text{Sr}$. Thus, the calculated values of the isotope composition of Sr can indicate possible limits for the continental flow in Early Precambrian time.

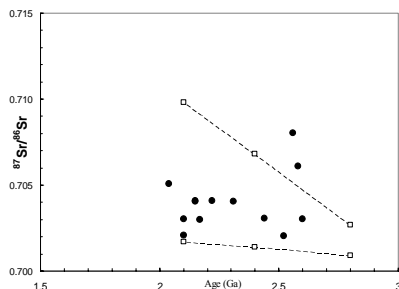


Figure 1: Limits of possible variation of Sr isotope ratios in continental flow. Lines – limits of $^{87}\text{Sr}/^{86}\text{Sr}$, black spheres – the analyses of carbonates [2].

[1] Matrenichev *et al.* (2005) *Reports of Russian Academy of Science* **400** (1), 83-87 (in Russian). [2] Bekker *et al.* (2003) *American Journal of Science* **303**, 865-904.

CarbFix - CO₂ sequestration in basaltic rock: Chemistry of the rocks and waters at the injection site, Hellsheidi, SW-Iceland

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Storage of CO₂ as solid Ca, Mg, and Fe carbonates in basaltic rocks may provide a long-lasting solution for reduction of industrial CO₂ emissions. Here, we report on the chemical composition, crystallinity of the rocks, their alteration and water chemistry at the targeted field site for injection of CO₂-charged waters, the Þrengsli, Hellsheidi area SW-Iceland.

The stratigraphy of the injection rocks consists of basaltic glass formations (hyaloclastite formations) and crystalline lava flows. Whole rock chemical analysis from drill cuttings of the boreholes, show that the overall chemical composition spans the picrite to tholeiite rock types, with relatively low Si content. The dissolution rate of natural glasses increases with decreasing silica content [1]. Thus the rocks below 400 m are reactive due to the low silica content and will readily react with the proposed CO₂-charged injection waters.

The water chemistry of the injection site show two different groundwater systems. The upper groundwater system spans from 0 – 400 m depth. The pH is around 8 and temperatures range from 8 – 12°C. It has more dissolved Ca, Mg, Cl and O₂, but lower Si, Fe, B and Al compared to the deeper ground water system. The deeper system spans from 400 – 800 m depth and is the targeted injection system. The pH range from 8,5 – 9,6 and temperatures from 20 – 30°C. The concentration of toxic metals, like Al, As, Cr, Hg and Pb are all below limits for EU drinking water standards.

PhreeqC was used for modelling the results. The percent error for charge balance was on average 2%. The calculated saturation index for secondary minerals show that the deeper system is saturated with respect to calcite, but undersaturated with respect to Fe-Mg carbonates. It is oversaturated with respect to calcium rich zeolites and clays, such as heulandite, stilbite, mesolite, chabazite and smectite. The upper system shows similar results, but is undersaturated with respect to calcite and Fe-Mg carbonates. This is in concert with the observed spatial distribution of the secondary minerals found in the drill cuttings of the boreholes.

[1] Wolff-Boenisch *et al.* (2004) *GCA* **68**, 4843-4858.