

Experimental modeling of strontium coprecipitation with CaCO₃ in the river water – seawater mixing zone

A. V. SAVENKO

Department of Geology, Moscow M.V. Lomonosov State University, Moscow, Russia (Alla_Savenko@rambler.ru)

Introduction

The process of strontium coprecipitation with CaCO₃ is the less investigated factor among the factors, which control strontium migration in the river water – seawater mixing zone. There are a lot of references for strontium distribution coefficients in biogenic and chemogenic carbonates, but the data relate to either seawater or fresh water. With respect to the fact we have provided an experimental modeling of strontium coprecipitation with calcium carbonate from solutions of variable salinity, which simulate water of river mouths.

Results of the Experiments

Two series of experiments has been provided to simulate interaction between river runoff and the Ocean water or the Caspian Sea water, respectively. When processing the results we have accounted for the effect of dissolved solids present in solutions (mainly the magnesium ions). The value of strontium distribution coefficient between CaCO₃ and solutions, which simulate water of river mouths, ($\lambda_{Sr} = (Sr/Ca)_{solid} / (Sr/Ca)_{solution}$) decreases from 0.91 in fresh water down to 0.72 in water of the northern Caspian Sea with salinity of 11.8 ‰, and down to 0.53 in seawater with salinity of 35 ‰.

Discussion of Results

The analysis of references gives a ground to conclude that chemogenic formation of CaCO₃ acts the minor effect (no more several percents) on dissolved calcium runoff in river mouths within the arid zone. We assume that values of strontium distribution coefficient range 0.8–0.9 under salinity of 2–5 ‰, corresponding to the highest oversaturation with respect to calcium carbonate. The Sr/Ca mass ratio in water of river mouths within the arid zone is not higher than 0.005–0.008 under salinity of 2–5 ‰. Hence the removal of dissolved strontium by coprecipitation with chemogenic CaCO₃, which originates within the river water – seawater mixing zone, is likely to undervalue limits of analytical precision, and it affects insignificantly transformation of chemical strontium runoff. Besides that formation of autochthonous CaCO₃ in river mouths may be accompanied with poor fractioning between Ca and Sr. On the contrary, carbonate formation from seawater constitutes the major factor of removal in geochemical balance of these elements in the Ocean. Carbonate formation from seawater is responsible for increase of Sr/Ca ratio in seawater compared with Sr/Ca ratio in river runoff.

This work is financially supported by Russian Fond of Fundamental Investigations (project 01–05–64852).

Geochemistry of Serpentinites from the S.Chamorro Seamount, ODP Leg 195, Site 1200, Mariana Forearc- Implications For Recycling at Subduction Zones

I.P.SAVOV¹, J.G.RYAN¹, L.CHAN², MASSIMO D'ANTONIO³, M.MOTLL⁴, P.FRYER⁴ AND ODP LEG 195 SCI.PARTY

¹University of South Florida, Tampa, Florida, USA (isavov1@luna.cas.usf.edu)

²Louisiana State University, Baton Rouge, LA, USA

³Università "Federico II" di Napoli, Naples, Italy

⁴SOEST/ Univ. Hawaii, Honolulu, HI, USA

Several holes drilled at the summit and on the flanks of the actively South Chamorro Seamount during ODP Leg 195 at Site 1200 in the Mariana forearc. Recovered lithologies are mostly serpentinitized harzburgite and dunite clasts in a matrix of serpentine mud. As with the Conical Seamount (ODP Leg 125), the presence of blueschist facies clasts and unusual porefluid chemistries point to slab devolatilization as the source of fluids triggering serpentinite formation and buoyancy-driven expulsion in the Mariana forearc. The serpentinites have ⁸⁷Sr/⁸⁶Sr of 0.70551, decreasing steadily to 0.70469 with increasing core depth. The ultramafic protoliths suffered high degrees (~20%) of melt extraction prior to serpentinization, as evidenced by the absence of clinopyroxene, low bulk-rock Ca and Al contents and REE abundances (at 0.0001–0.001 x CI levels) with U-shaped patterns that are comparable to those of boninites.

B, As, Cs, and other "fluid-mobile" elements (FMEs) in both serpentinite muds and clasts are enriched by several orders of magnitude, relative to the mantle. Li, Rb, K, Sb and Sr are also elevated, while Be, Th, U and the HFSE appear to be essentially immobile. Li isotope ratios in porefluids are substantially elevated relative to seawater ($\delta^7\text{Li} \approx 42\text{‰}$) and to serpentinite muds ($\delta^7\text{Li} \approx +6\text{‰}$ in Leg 125 summit samples). As Li is elevated in serpentinite muds and clasts, it is likely that like B, Li is initially enriched in forearc fluids. The high $\delta^7\text{Li}$ of residual fluids probably result from a Rayleigh-type fractionation process due to the extensive removal of Li from porefluids into serpentine. The final $\delta^7\text{Li}$ in the fluid depends on the initial $\delta^7\text{Li}$, $\alpha_{7/6\text{Li}}^{\text{fluid/serpentine}}$, the fraction of fluid Li removed, and the temperature of the reaction.

Serpentinization at the slab-mantle interface serves as an outflux for highly volatile components such as H₂O, B, As, Cs and Sb. This shallow fluid- mobile element flux also appears to strongly fractionate the isotopes of B and Li contributing to the high Li and B isotopic ratios of seawater, and reducing the mean $\delta^7\text{Li}$ and $\delta^{11}\text{B}$ of the slab as it travels to greater depths.