

## Solubility of silica in the river water and seawater mixing zone

ALLA V. SAVENKO

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

Concentration of dissolved silicon in the river water and seawater mixing zones can be supervised by solubility of silica which is a part of continental runoff suspended matter. Total concentration of the dissolved silicon in equilibrium with  $\text{SiO}_2$  is defined by an equilibrium constant of reaction of silica dissolution  $\text{SiO}_2 + 2\text{H}_2\text{O} = \text{H}_4\text{SiO}_4^0$  ( $K_r^0$ ), a constant of silicon acid dissociation  $K_1^0$ , an activity coefficients of  $\text{H}_4\text{SiO}_4^0$  and  $\text{H}_3\text{SiO}_4^-$  ( $\gamma_0$  and  $\gamma_1$ ), and pH value:

$$[\Sigma\text{Si}] = \frac{K_r^0}{\gamma_0} \left( 1 + \frac{K_1^0 \gamma_0}{a_{\text{H}^+} \gamma_1} \right). \quad (1)$$

The dissociation constants of acids are known, in particular,  $K_1^0$  for a silicon acid at 25°C is equal  $1.3 \times 10^{-10}$ . Values of  $\gamma_1$  can be calculated on one of variants of electrostatic theory of Debay–Huckel. Hence, for the description of solubility of silica according to the equation (1) it is necessary to find  $K_r^0$  and dependence of  $\gamma_0$  on a solution composition.

Experiments on studying solubility of amorphous silica in mixtures of river water with a mineralization of 387 mg/l and seawater with salinity of 35‰ have been carried out for finding of these parameters. Amorphous silica with the water content of 13% and the specific surface area of 584 m<sup>2</sup>/g was used in the experiments. Solubility of not calcinated  $\text{SiO}_2$  sample and the sample calcinated at 900°C was studied. The solid/liquid mass ratio was equal 1 : 200. The exposure time lasted for 3 months at temperature  $22 \pm 1^\circ\text{C}$ .

In the equation (1) there are two unknowns ( $K_r^0$  and  $\gamma_0$ ) for which finding it is necessary to be set by value of one of them. In the beginning it is more convenient to define  $K_r^0$  on the measured total concentration of the dissolved silicon in river water, accepting  $\gamma_0$  in solutions of low mineralizations equal 1.0. According to the experiments, the average  $K_r^0$  value for calcinated and not calcinated silica was equal  $(1.710 \pm 0.005) \times 10^{-3}$ . Further, using the estimated  $K_r^0$  value, activity coefficient of  $\text{H}_4\text{SiO}_4^0$  in river water and seawater mixtures have been calculated. This coefficient nonlinearly increased with an increase of salinity, changing from 1.00 in river water to 1.15 in seawater with salinity of 35‰, and distinctions between two studied  $\text{SiO}_2$  samples on exceeded 1.6%. From here follows, that decrease in equilibrium  $\text{H}_4\text{SiO}_4^0$  concentration in the river water and seawater mixing zone is insignificant and is in a range of 10–15%. Thus at pH < 8 contribution of  $\text{H}_3\text{SiO}_4^-$  in the total content of the dissolved silicon does not exceed 2%.

## B and B isotopic composition of Mariana Trough basalt glasses: Implications for mantle sources

IVAN P. SAVOV<sup>1</sup>, STEVEN B. SHIREY<sup>2</sup>, ERIK H. HAURI<sup>2</sup> AND ALISON M. SHAW<sup>3</sup>

<sup>1</sup>School of Earth & Environment, University of Leeds,

LS2 9JT, UK (\*correspondence i.savov@see.leeds.ac.uk)

<sup>2</sup>DTM, Carnegie Institution of Washington, Washington DC, 20015, USA

<sup>3</sup>WHOI, Woods Hole, MA 02543, USA

We report new B isotope data for fresh basaltic glasses dredged from the Mariana Trough (MT) during the Sonne and TUNES expeditions to the Izu-Bonin Mariana (IBM) region [1]. The samples are backarc volcanic glasses erupted between Latitudes 15°01'N and 22°69'N and Longitudes 144°43'E and 142°45'E. The glasses were studied for B and trace element concentrations by SIMS and for B isotope ratios by the use of combined inter-calibrated Laser-Ablation MC-ICP-MS and SIMS techniques.

The Mariana volcanic arc front samples have elevated B abundances (often >20 ppm) and  $\delta^{11}\text{B}$  ranging between +4 and +6.5 ‰. In contrast, the MT (backarc) volcanic rocks show low B concentrations (~ 2 ppm) and highly variable  $\delta^{11}\text{B}$  values (–12.9 to +7.9 ‰). The measured B isotope values show positive correlations with latitude and with the Pb and Sr isotopic composition.  $\delta^{11}\text{B}$  also correlates well with several key slab fluid tracers such as Ba/Th, B/Nb and B/Be. Based on their REE and HFSE systematics, the described isotope and trace element variations appear to be independent from variations in the degree and style of melting.

Backarc glasses from the Northern MT (north of 20°N) are heavier than fresh MORBs and resemble samples erupted at the Mariana arc. In contrast, the  $\delta^{11}\text{B}$  values of Southern MT glasses are comparable to MORBs and have much lower values than the arc volcanic front even though they are found closer to the arc front than samples from the northern MT. It is possible that a lack of metasomatized mantle domains and/or a denser population of “blobs of refractory mantle” [2] in the southern segments of the Mariana backarc can lead to the observed lighter  $\delta^{11}\text{B}$  signatures. If so, B systematics would support models advocating a depleted mantle source in the southern MT and a more enriched mantle source in the northern MT [3]. We will evaluate new  $\delta^{11}\text{B}$  and radiogenic isotope results in the light of reports of arc parallel mantle flow and recent geochemical, geophysical and thermal structure models for the IBM arc-basin system.

[1] Gribble *et al.* (1998) *J. Petrology* **39**, 125-154. [2] Taylor and Martinez (2003) *EPSL* **210**, 481-497. [3] Pearce *et al.* (2005) *Geochem. Geophys. Geosys.* **6**, 7, 1-27.