

## New tool for the direct isotopic dating of PGM ( $^{190}\text{Pt}$ - $^4\text{He}$ method): new constructions on the timing of Pt mineralization in Kondyor and Galmoenan massifs, Russian Far East

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New  $^{190}\text{Pt}$ - $^4\text{He}$  method of isotope geochronology for the native minerals of platinum is based on the  $\alpha$ -decay of  $^{190}\text{Pt}$  isotope. Radiogenic helium in crystal structures of native metals tends to form atomic clusters that appear as nanoscale “bubbles”. Therefore the stability of  $^{190}\text{Pt}$ - $^4\text{He}$  isotope system in native minerals of platinum is rather high [1].

By the novel  $^{190}\text{Pt}$ - $^4\text{He}$  method we have determined age of Pt>Ir fluid-metamorphogenic, Pt>Os magmatogenic-fluid-metasomatic, and Pt magmatogenic-fluid-metasomatic types of platinum mineralization of alkaline-ultramafic massifs Kondyor (Aldanian Shield, Russia) and gabbro-dunite-pyroxenite Galmoenan massif (Koryak-Kamchatka belt, Russia).

Obtained age of isoferroplatinum for Pt>Ir fluid-metamorphogenic, and Pt>Os magmatogenic-fluid-metasomatic types of platinum mineralization of Galmoenan massif is  $63 \pm 3$  Ma (average from 10 samples). The data are in good agreement with relevant geological observations. Obtained age of isoferroplatinum for Pt>Ir fluid-metamorphogenic, and Pt magmatogenic-fluid-metasomatic types of platinum mineralization of Kondyor massif is  $123 \pm 6$  Ma (average from 20 samples). The data are also in excellent agreement with relevant geological observations and other existing geochronological determinations. Noteworthy that the age of Pt>Ir fluid-metamorphogenic and Pt>Os magmatogenic-fluid-metasomatic types of platinum mineralization doesn't have any significant discrepancy.

Conducted  $^{190}\text{Pt}$ - $^4\text{He}$  dating experiments also let us to separate a new young type of Pt mineralization on the Kondyor massif.  $^{190}\text{Pt}$ - $^4\text{He}$  ages for fine cubic crystals of isoferroplatinum turned out to be around 8 Ma. The same young age for these crystals was also obtained by the independent  $^{190}\text{Pt}$ - $^{186}\text{Os}$  method. These data may indicate formation of these Pt minerals under surface conditions.

[1] Shukolyukov (2012) *Petrology*, **20.6.**, 491-505

## Barium stable isotope fractionation during diffusion through silica hydrogel: Experimental determination of kinetic isotope effects at low temperatures

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Only very few studies have so far focussed on barium (Ba) stable isotope fractionation in nature. Many questions thus still remain regarding the direction and extent of isotope fractionation in physical and (bio)geochemical reactions. To date, experimental studies of Ba isotope fractionation are limited to precipitation of Ba-carbonates and -sulphates [1,2] and adsorption of Ba onto Mn-oxides and clay minerals [3].

Here, we investigated Ba isotope fractionation during diffusion of Ba through a silica hydrogel. The gel was prepared in 15 cm long glass U-tubes. A concentration gradient was established by applying a  $\text{BaCl}_2$  solution (0.1 and 1.0 mol/l, respectively) on one side of the gel and deionised water on the other side. Diffusion experiments were run at two different temperatures (10 and 25°C) over 2, 6, 12, 20 and 27 days, respectively.

The rates of Ba diffusion through the silica hydrogel correlate positively with initial  $\text{BaCl}_2$  concentration and temperature. Ba isotope fractionation, however, appears to be independent from both boundary conditions. Initially, diffused Ba was found to be fractionated by as much as -2.2‰ in  $\delta^{137/134}\text{Ba}$  relative to the  $\text{BaCl}_2$  stock solution. With continuing duration of the experiments, the  $\delta^{137/134}\text{Ba}$  values increased rapidly to about -0.6‰ after 27 days. We hypothesise that initial kinetic isotope fractionation caused by Ba diffusion switched to a later control via adsorption of Ba onto the silica hydrogel. Our experiments thus show that fractionation of Ba isotopes of more than 2‰ in  $\delta^{137/134}\text{Ba}$  (~0.7‰/amu) are possible under experimental conditions and that the light Ba isotopes are favoured substantially during Ba diffusion through an aqueous medium.

[1] von Allmen *et al.* (2010) *Chem Geol* **277**, 70-77. [2] Böttcher *et al.* (2012) *Isot En Health Stud* **48**, 457-463. [3] Böttcher *et al.* (2012) *Mineral Mag* **76**, 1495.