Dating Early Archean partial melting events: whole-rock versus single grain Re-Os ages in 3.81 Ga chromitites from West Greenland

JUDITH A. COGGON[1*], AMBRE LUGUET[1], PETER W. U. APPEL[2]

[1]Steinmann Institut, Universität Bonn, Bonn, Germany, jude@uni-bonn.de (* presenting author), ambre.luguet@uni-bonn.de
[2]Geological Survey of Denmark and Greenland, Copenhagen, Denmark, pa@geus.dk

Abstract

Large melt depletion events in the mantle are recorded in refractory phases and lithologies by the ^{187}Re-^{187}Os isotope system as rhenium-depletion model ages (T_{RD}). Numerous studies have shown that the peaked distribution of these ages coincides with crustal U-Pb zircon ages providing a record of periodic episodes of significant crustal growth over the last ~3 Ga. However, the frequency of T_{RD} ages preserved decreases with time. In order to detect older events it is necessary to analyse samples that were extracted from the mantle before later events were able to dilute or overprint more ancient signals. A >3.81 Ga chromitite-ultramafic layered body from the Ujaragssuit nunât area of western Greenland provides an ideal target for this study. Peridotites (0.303 – 4.02 ppb Os) display U-shaped PGE patterns (Fig. 1) atypical of partial melt depletion, while chromitites exhibit a gentle decrease in chondrite normalised PGE concentration with increasing incompatibility. Both lithologies show anomalously high Re contents, illustrating significant re-enrichment by one or more post-magmatic events (two late Archean metamorphic events have been suggested [1]). T_{RD} ages for whole-rock peridotites and chromitites are artificially low (483 – 2926 Ma and 2666 – 3250 Ma respectively), a result of the aforementioned Re addition, hence whole-rock model ages are unreliable. We will present a comparison of data from whole-rock samples, leached chromite separates and single grains of Os-bearing minerals. This combined approach will allow us to further constrain the history of the earliest Archean genesis of continental crust, providing information that has so far been inaccessible when considering only whole-rock Re-Os analyses.

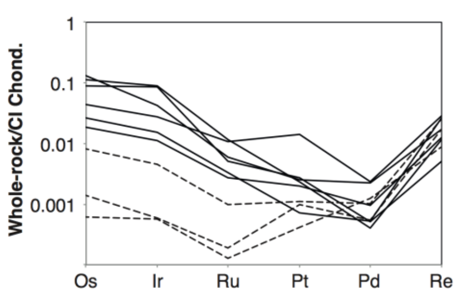

Figure 1: Chondrite [2,3] normalised PGE & Re contents of Ujaragssuit nunât peridotites (dashed) and chromitites (solid).

[1] Rollinson et al. (2002) *Journal of Petrology* **43**, 2143-2170.
[2] Anders & Grevesse (1989) *Geochimica et Cosmochimica Acta* **53**, 197-214. [3] Horan et al. (2009) *Geochimica et Cosmochimica Acta* **73**, 6984-6997.

The CO_2-Vadose project: Numerical simulations coupled with geochemical and geophysical monitoring of CO_2 in the vadose zone

G. COHEN[1], B. GARCIA[2*], C. LOISY[1], P. DELAPLACE[2], F. LARROQUE[1], C. LAVEUF[1], C. MAGNIER[2], V. ROUCHON[2], O. LE ROUX[1], M. FRANCESCHI[1], A. CEREPI[1]

[1]EA 4592 "Géoressources et Environnement",ENSEGID, University of Bordeaux, France, adrian.cerepi@egid-u.bordeaux3.fr
[2]IFP New Energy, Rueil-Malmaison, France, bruno.garcia@ifpen.fr (* presenting author)

The CO_2-Vadose project aims at developing a facility around a cavity, in a former underground limestone quarry, to perform experimental releases of CO_2 under controlled conditions in order to study its migration along the vadose zone and to test near-surface detection techniques. Preliminary modelling carried out with the research code COORES™ permitted to model the extend of the CO_2 plume, at a chosen release rate, the concentrations and flow rates expected at a specific depth, the timing of the migration and of the sampling strategy [1].

Based on the results provided by the preliminary modelling, an array of detection and monitoring tools was deployed. These tools allow the regular surveillance of water and gas compositions and fluxes as well as their samplings, all monitored. Micro-climatic parameters were also recorded by a weather station at the site surface. Geochemical signatures of carbon isotopes, and natural noble gases were also determined after samplings. A baseline, a tracers injection and also a CO_2 migration were performed in this project.

Results show that the natural CO_2 concentration at soil surface is depending of the season but rather homogenous (2.0±1.0% in october 2009 and 1.0±0.7 % in march 2010), and its carbon isotopic signature is constant ($\delta^{13}C_{CO2}$= -18.5±1.0 ‰). Natural noble gases composition at soil surface is equal to atmospheric composition. CO_2 flux is considered as a "normal" flux. Around and in the cavity, same trends were observed [2].

For the tracers injection, modelling results allow us to determine at which time the maximum concentration of Helium and Argon would arrived at soil surface. Experimental results are in good accordance with these previous modelling ones, specially around the cavity but not at soil surface by the fact of the presence of a clay zone just above the top of the cavity.

CO_2 experimental injection was realised in december 2011 with a flow of 2m^3 per hour during 9 hours (18m^3 of CO_2 injected for a cavity with a volume of 9m^3) in order to have a concentration of CO_2 at the top of the cavity equal to the injected CO_2 amount. Monitoring of CO_2 was realised with success from the cavity to the limestone around the cavity and is in good accordance with modelling results considering the clay zone.

[1] C. Laveuf et al. (2010) *International Journal of Greenhouse Gas Control,* submitted.
[2] C. Loisy (2011) *International Journal of Greenhouse Gas Control,* submitted.