

Carbon and water in Pitcairn and Society hotspots, French Polynesia

CYRIL AUBAUD¹, FRANÇOISE PINEAU¹, MARC JAVOY¹, ROGER HÉKINIAN² AND JEAN-LOUIS CHEMINÉE³

¹ Lab. de Géoch. des Iso. Stables. – I.P.G. Paris – FRANCE
(aubaud@ipgp.jussieu.fr)

² IFREMER, Centre de Brest, Plouzané – FRANCE

³ Obs. Volc. – I. P. G. Paris – FRANCE

It is well established that OIB have different Sr-Nd-Pb isotopic characteristics than MORB. However, carbon and hydrogen isotopic signatures of their sources remain largely unknown.

We analysed 53 volcanic glasses from seamounts in Pitcairn and Society hotspot areas (French-German cruise POLYNAUT) for CO₂, H₂O, δ¹³C and δD by crushing/step-heating/manometry/mass spectrometry techniques for volatiles in vesicles and dissolved in the glass.

Vesicularities of basalts vary from 1.6 to 50 vol%. Concentrations of carbon in vesicles vary by three orders of magnitude (from 0.8 to 870 ppm). Range of δ¹³C of CO₂ in vesicles (from -4.8 to -15.7 ‰) is the largest ever measured for oceanic glasses and extends to very low values. Range of water concentration (from 0 to 1600 ppm) and δD (-28 to -98 ‰) in vesicles is also wide. Concentrations (27 to 35 ppm) and δ¹³C (-10.8 to -15.2‰) of dissolved carbon in the glass are low whereas concentrations (6400 to 9900 ppm) and δD (-50 to -60 ‰) of dissolved water are high in comparison with MORB. Difference between δ¹³C of CO₂ in vesicles and δ¹³C of dissolved carbon is high (from +3.3 to +6.2‰).

The strong correlation between carbon concentration and δ¹³C of CO₂ in vesicles is the result of open system degassing. This is the first time that such a process is shown so evidently in vesicles of oceanic glasses. It confirms that a strong carbon isotopic fractionation (Δ¹³C ≥ +3.5‰) occurs during degassing and leads to very low δ¹³C values which are not the result of contamination or mixing with, for example, a low δ¹³C recycled component. Therefore, all concentration and isotope variations are the result of degassing. Two-stage degassing modelling suggests that distillation is a late stage (edifice and crust) process and is preceded by a large closed system degassing.

Reconstruction of concentrations in magmas before degassing suggests high concentrations of carbon and water (1 wt% for both). It supports the idea that Pitcairn and Society hotspots are enriched in volatiles (both H₂O and CO₂). There is no evidence for carbon isotopic heterogeneity (sources at -4±1‰ similar to sub-oceanic and sub-continental mantles as sampled by MORB and diamonds). However, the reconstructed δD in Pitcairn source is -50‰, significantly higher than depleted MORB (-80‰). Hypotheses of involvement of primordial and/or recycled material to the EM I Pitcairn source will be discussed at the conference.

Origin and migration of atmospheric REE in soils and surface waters

D. AUBERT¹, P. STILLE², A. PROBST³

¹ Ecole et Observatoire des Sciences de la Terre/Centre de Géochimie de la Surface, Strasbourg, France
(daubert@illite.u-strasbg.fr)

² Ecole et Observatoire des Sciences de la Terre/Centre de Géochimie de la Surface, Strasbourg, France
(pstille@illite.u-strasbg.fr)

³ Laboratoire des Mécanismes de Transferts en Géologie, Toulouse, France (aprost@cict.fr)

The aim of this work was to elucidate the origin and the migration of REE in soils and surface waters of a small forested catchment located in the Vosges mountains (France). Particularly, we try to estimate the respective contributions of atmospheric REE inputs and REE released during the weathering in the soils and surface waters using Sr and Nd isotopes.

Rainwater samples are strongly LREE depleted. Compared to urban precipitation collected in Strasbourg, the Vosges rainwater sample is significantly less REE enriched. However, both samples show more or less similar shapes of their REE distribution patterns.

The REE distributions in the spring- and streamwaters from the Vosges catchment are very different from those of the atmospheric solutions. Their Sr and Nd isotopic data suggest that most of the Sr and Nd originate from apatite leaching or dissolution. Soil solutions and soil leachates from the upper soil horizons have REE distribution patterns close to those of lichens and throughfall. Throughfall is slightly more enriched especially in light REE than filtered rainwater probably due to leaching of atmospheric particles deposited on the foliage and also to leaf excretion.

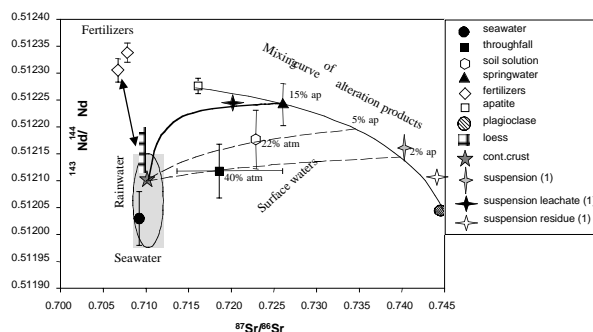


Figure 1: Sr and Nd isotopic compositions of the different samples collected in the Strengbach catchment (Vosges Mountains, France)

Data suggest (Fig. 1) that Sr and Nd isotopes of the soil solutions in the upper soil horizons originate from two different sources: 1. An atmospheric source with fertilizer, dust and seawater components and 2. A source mainly determined by mineral dissolution in the soil. The atmospheric contributions of Sr and Nd to throughfall and soil solution are of 20%-70% and 20%, respectively.