Sr, Nd, Pb and Hf isotopic constraints on mantle sources in the Payenia backarc basalts (Mendoza, Argentina)

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The mainly alkaline basalts and trachybasalts from the Payenia volcanic province of southern Mendoza show a great variation in geochemistry ranging from intraplate to arc-backarc compositions. In Pb-Sr-Nd-isotopic space the retroarc and Nevado volcanic field samples form a common trend from the isotopic composition of the Andes transitional southern volcanic zone arc (TSVZ) towards a component with higher Sr and lower Nd-isotopes. This is interpreted as contamination by lithospheric mantle melts due to a sharp decrease in La/Sm, Tb/Yb and incompatible element contents (except Ti) along this trend, making upper crustal contamination unlikely.

The intraplate basalts from the Río Colorado area have lower Pb and Sr and slightly higher Nd-isotopic composition than the Nevado samples and apparently reveal the composition of an astenospheric mantle end-member. The very low Th/Nb, high U/Pb and Ce/Pb of the Río Colorado basalts precludes any significant input from the subduction zone. In Nd-Hf isotopic space they plot at negative $\Delta\varepsilon Hf$ along with FOZO and HIMU-type basalts but the Sr-isotopic values are slightly higher (~0.70355) than these. The Pb-isotopes and trace element patterns are comparable to EM1-type ocean island basalts (OIB) which could suggest that the Río Colorado mantle source is a mixture of FOZO and EM1 material. Even though the trace element patterns are very similar to some Somuncura basalts (another Patagonian hotspot [1, 2]), the Somuncura EM1 end-member is dissimilar in Pb-isotopic space [2]. The presence of recycled crust in the mantle source is supported by the indication that some of the Río Colorado and Payún Matrú basalts are pyroxenite melts as judged by their low Ca, Sc, Mn and MgO and high FeO_T, Ni and SiO_2 compared to peridotite melts.

The high $^{143}Nd/^{144}Nd$ Nevado and retroarc samples have similar εNd to Río Colorado samples but higher εHf and possibly trend towards South Atlantic N-MORB compositions. Furthermore, the major element composition of these lavas is akin to peridotite melts. This suggests that there are two asthenospheric mantle sources beneath the Payenia province: a South Atlantic normal upper mantle and an OIB-type mantle which dominates in the Río Colorado and Payún Matrú regions. The normal upper mantle peridotite is apparently only melted when fluids are added from the subduction zone whereas the OIB mantle melts due to a higher mantle temperature or/and a lower solidus temperature of the pyroxenite components.

[1] Remesal et al. (2002) *Rev. Asoc.Geol. Arg.* **57 (3)**, 260-270. [2] Kay et al. (2007) *Journal of Petrology* **48 (1)**, 43-77.

Melt inclusions as a source of principal geochemical information

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Recent papers [1-5] on the in-situ radiogenic isotope composition of melt inclusions report controversial conclusions on the scale and origin of isotope heterogeneities. In this paper I will review these results focusing mostly on the question: whether melt inclusions can provide the new geochemical information on the origin, composition and scale of mantle heterogeneity?

The study of some 140 olivine hosted melt inclusions from a single lava of Mauna Loa volcano (Hawaii) reveals incredible Sr isotope source heterogeneity: at least 87Sr/86Sr=0.7027-0.7074 (Fig 1) [5]. Based on the 2-sigma criterion we found that 21% of inclusions fall out of the isotopic range of Mauna Loa lavas and 8% fall out of the isotopic range of all Hawaiian Lavas (Fig 1). Most compositionally distinct melts were trapped in high Mg olivine (Fo>86). We show that melt fractions with different compositions were mixed up during olivine crystallization producing typical Mauna Loa lavas. This result indicates unprecedented Sr isotope anomaly in Hawaiian mantle source caused by entrainment of Phanerozoic oceanic crust altered by seawater [5]. It also shows that bulk rocks could easily mask original source heterogeneity, which can be often deciphered ONLY by melt inclusions study.

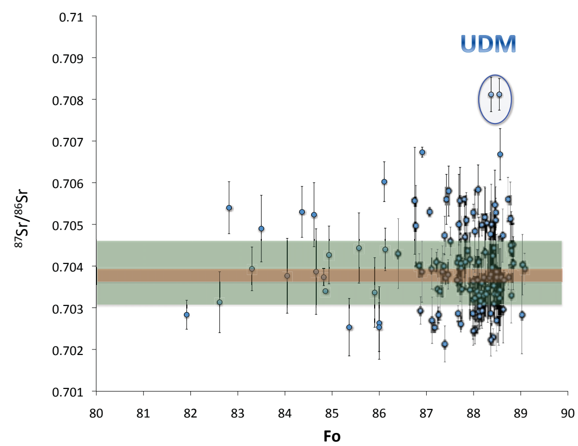

Figure 1: Isotope compositions of melt inclusions in olivine phenocrysts from a single lava sample of Mauna Loa volcano, Hawaii versus composition of host olivine [5]. Narrow (brown) and wider (green) fields manifest composition of all Mauna Loa lavas and all Hawaiian lavas respectively. Error bars: one standard error. Outlined are ultra-depleted melt inclusions (UDM).

[1] E. Saal *et al*., (2005) *EPSL* **240**, 605-620. [2]. M. G. Jackson, S. R. Hart, (2006) *EPSL* **245**, 260-277. [3] J. Maclennan, (2008) *GCA* **72**, 4159-4176. [4] B. Paul *et al*., (2011) *Chemical Geology* **289**, 210-223. [5] A. V. Sobolev, et al (2011), *Nature* **476**, 434-437.