Origin of the seamounts near Futuna Island, SW Pacific

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Futuna Island, located in the SW pacific, is bordered by the North Fiji fracture zone, the active Tonga and Vanuatu subduction zones and associated Lau and North-Fiji back-arc basins, and the currently active Samoan hotspot. A cruise was conducted in August 2010 with the aim to map and sample the oceanic basement near Futuna Island. Bathymetric mapping reveals complex seafloor morphology with multiple areas of numerous seamounts and several very large and isolated caldeiras.

We measured major and trace elements and Pb isotopic ratios on samples collected from dredges or Nautile dives. Lavas collected on the seamount province range from sub-alkaline basalts to trachy-andesites, with SiO_2 content ranging from 45.6 to 60.1 wt%. Lavas exhibit variable La/Yb ratios that define a spatial gradient: north-western lavas are enriched in Light Rare Earth Elements (LREE) compared to Heavy Rare Earth Element (HREE) (La/Yb from 2.2 to 9.9) while south-eastern lavas are depleted in LREE (La/Yb from 0.74 to 1.1). In a Pb isotope diagram, lavas cover a fairly large array ($^{206}Pb/^{204}Pb$ from 18.0 to 19.0) and define a mixing trend. La/Yb and Pb isotopic ratios are positively correlated. We suggest that seamounts near Futuna Island are due to partial melting of an Indian-like mantle that has been variously metasomatised by an enriched end-member composed of Samoan plume material and a component similar to the subducting Louisville ridge basalts. The mixing proportions of end-members are geographically controlled by the infiltration in the mantle of the Samoan plume through the tearing of the Pacific plate at the junction between the Tonga arc and the North-Fiji fracture zone.

Multiple sulfur isotopes in basalts: Chemical geodynamics in the South Atlantic mantle

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Sulfur isotopes have placed significant constraints on past and present external cycle of sulfur. For example, the disappearance of non-zero $\Delta^{33}S$ values in archean sediments at 2.4 Ga show strong evidence for the atmosphere oxygenation [1].

Present day oceanic crust and sediments show a large range of $\delta^{34}S$: from -40‰ to +30‰, mostly between -7‰ and +5‰. The recycling of these crustal components in the mantle source of MORB may thus be identified with sulfur isotopes. Yet, the deep part of the sulfur cycle remains comparatively unconstrained: Only two studies have reported $\delta^{34}S$ of MORB (n=16; $\delta^{34}S_{MORB} = +0.8 \pm 1‰$)[2][3].

Using an improved method allowing quantitative recovery of sulfur from basaltic glasses, we report the first measurements of the four sulfur stable isotopes in 19 MORB from the South Atlantic ridge. The external precision and accuracy are ± 0.01‰, 0.25‰ and 0.20‰ in 2σ for $\Delta^{33}S$, $\delta^{34}S$, and $\Delta^{36}S$ respectively.

$\delta^{34}S$ values of our samples are all negative (mean $\delta^{34}S$ = -0.89 ± 0.6‰, 1σ) except for one sample at +1.1‰. The variability of $\delta^{34}S$ in our dataset is 3‰, which is significantly larger than the analytical precision. This enables us to discuss the $\delta^{34}S$ variability in MORB in terms of a meaningful geological tracer. We suggest than this variability rather reflect source heterogeneity rather than magmatic processes as it is correlated to radiogenic isotopes enrichments.

$\Delta^{33}S$ and $\Delta^{36}S$ of our samples are slightly but significantly non-equal to 0‰ and are of the same sign: -0.025‰ and -0.200‰ respectively (mean values). Both mixing with/within a subducting slab and/or revised terresrial original $\Delta^{33}S$ and $\Delta^{36}S$ could explain this feature. The respective contribution of these two extreme scenarios will be discussed at the conference.

[1] Farquhar *et al*. (2000) *Science* **289**, 256–258. [2] Sakai *et al*. (1983) *GCA* **48** 2433–2441. [3] Chaussidon *et al*. (1991) *Spec. Pub. J.Geochem. Soc*. **3**, 325–337.