Geophysical Research Abstracts
Vol. 13, EGU2011-8296, 2011
EGU General Assembly 2011

Chemical composition of oceanic basalts near Futuna Island, SW Pacific

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The Horne archipelago, composed of Futuna and Alofi Islands, is located in the SW pacific, NE of Fiji islands. The complex evolution of the Australian – Pacific boundary left the Futuna region in an intricate geological context. The islands are bordered by the North Fiji fracture zone, the active Tonga-Kermadec subduction zone and the associated Lau and North-Fiji back-arc basins. In addition to these features, the currently active Samoan plume is located in the North-East of the Futuna region.

An expedition was conducted in August and September 2010 with the aim to map and sample the oceanic basement around the Horne archipelago. Precise bathymetric mapping reveals a complex seafloor morphology with various volcanic features: two spreading ridges (the Futuna spreading center and the newly discovered "Alofi spreading ridge"), volcanic activity associated to a transform fault, multiple areas of numerous and isolated seamounts and finally several very large and isolated caldeira. All these volcanic features were sampled thanks to dredges and Nautile dives.

Here we present chemical data obtained on more then 150 samples that were collected during the cruise. Samples are very fresh with Loss On Ignition below 2% for most samples. The studied lavas range from basalts and basanites to andesites, with SiO2 and MgO contents ranging from 41.0 to 60.1 wt% and 1.94 to 14.6 wt% respectively. Most lavas are in the sub-alkaline field in a TAS diagram. However, lavas from the northern part of the Futuna spreading ridge have an alkaline signature with Na2O +K2O contents ranging from 2.66 to 4.07 wt%.

Trace elements were measured on samples from the Futuna and Alofi spreading ridges. All Futuna ridge lavas are enriched in Light Rare Earth Elements (LREE) relative to Heavy Rare Earth Element (HREE). Inversely, lavas from the Alofi ridge have depleted or flat REE patterns.

Using High Field Strength Elements, we can constrain the chemical context in which the basalts formed. Excess of Nb and Ta relative to the REE are observed in all samples from the Futuna spreading ridge and some samples of the Alofi spreading ridge. The Nb/La ratio normalized to primitive mantle of these samples range from 1.17 to 1.39, values comparable to those reported for the Samoan islands but significantly different from values reported for Mid-Ocean Ridge Basalts or Back-Arc Basalts. This may suggest that an interaction between a lithospheric depleted mantle and a deep mantle material occurs. Previous studies have suggested that Samoan plume material have penetrated beneath some Lau Basin spreading centres thanks to the tearing of the Pacific Plate at the junction between the Tonga subduction zone and the transforming North-Fiji fracture zone. Our results suggest that the Samoan hotspot influence reaches Futuna and Alofi spreading centers. More trace element and isotopic data will soon allow us to confirm and map the extent of the Samoan signature in the Futuna region.