Geophysical Research Abstracts
Vol. 16, EGU2014-14417, 2014
EGU General Assembly 2014

$Fe3+/\Sigma Fe$ ratios of back-arc lavas (East Scotia Basin): new insights into subduction inputs

Thibault Fougeroux (1), Antoine Bezos (1), Christele Guivel (1), Jean-Pierre Lorand (1), Carole La (1), Philip Leat (2), and Christoph Beier (3)

(1) Laboratoire de Planétologie et Géodynamique, CNRS et Université de Nantes, Nantes, France (thibault.fougeroux@univ-nantes.fr), (2) British Antarctic Survey, Madingley, Cambridge , United Kingdom, (3) GeoZentrum Nordbayern,Universität Erlangen Nurnberg, Erlangen, Germany

Back arc basins provide a wide spectrum of chemical compositions ranging from MORB-like to arc-like lavas within the relative simplicity of an oceanic ridge environment. The oxygen fugacity of back-arc basins lavas provides invaluable insights into the redox state of the mantle wedge and its linkages to subduction component inputs.

We present new wet chemical analysis of the Fe3+/ΣFe ratio and H_2O data for 41 East Scotia Ridge (South Atlantic) back arc basin lavas and for 19 MORB lavas (for reference). The Fe3+/ΣFe ratios of East Scotia samples vary from 0.05 to 0.21 (average: 0.13±0.05) compared to 0.04 to 0.12 (average 0.09±0.02) for the MORB samples. We show that fractional crystallization processes do not significantly affect the Fe3+/ΣFe ratio in our sample collection and hence do not correct our data for this effect. The high Fe3+/ΣFe ratios in our arc-like samples therefore reflect higher oxidation states in primary magmas. Along the East Scotia Ridge axis, proxies of subduction inputs such as H8.0 (H_2O data corrected for fractional crystallization) display three arc-like spikes (H8.0> 1.5 wt.%) that are correlated to high Fe3+/ΣFe ratios (0.21, 0.18, and 0.20). MORB-like samples (H8.0<0.3) display Fe3+/ΣFe ratios of 0.08±0.02 that are comparable to MORB values. We propose to study in detail the relationships between the Fe3+/ΣFe and subduction inputs for those three ridge sections.

Previous studies have shown that the northernmost subduction spike, which is mainly represented by segment E2, is characterized by a complex interplay between various subduction inputs and the westward inflow of enriched mantle derived from the Bouvet hotspot. First, we did not find evidence for any influence of the OIB-like enriched mantle on the Fe3+/ΣFe ratios of samples from this area. Second, correlations between the Fe3+/ΣFe and trace element ratios diagnostic of subduction inputs (e.g. Ba/Y, r=0.83) indicate that subduction components are responsible of the high oxidation states of arc-like samples. Detailed study of those later correlations may indicate for this area multiple and sequential inputs of H_2O-rich fluids in the mantle wedge. To the south of this first ridge section, the central spike has the most arc-like influence showing the contribution of H_2O-rich and sediment melts subduction components. The inflow of Bouvet mantle fades to almost no influence. In this section, the Fe3+/ΣFe is strongly and positively correlated to Ba/Y ratios (r=0.85) and shows, for a given Ba/Y ratio, lower Fe3+/ΣFe ratio compared to samples from the northern spike. Finally, samples from the southern spike are characterized, relative to the northern and central spikes, by low mobile element contents for comparable H_2O contents. The Fe3+/ΣFe is also strongly correlated with the Ba/Y ratios (r=0.94) showing, for a given Ba/Y higher Fe3+/ΣFe ratio compared to samples from the northern spike.

East Scotia Fe3+/ΣFe data display three different relationships with subduction components along the back-arc ridge. Despite the large variation of H_2O/[mobile elements] ratios between the three spikes, they all display comparable Fe3+/ΣFe ratios. This strongly suggests that H_2O is the oxidizing agent in this subduction zone.