U-Th-Pa-Ra constraints on mantle wedge metasomatism and melting beneath Volcán Llaima

O. REUBI[1,2], B. BOURDON[1], J. KOORNNEEF[1], S. ACIEGO[1], M.A. DUNGAN[2], D. SELLÉS[3] AND C. LANGMUIR[3]

[1]Institute for Isotope Geochemistry and Mineral Resources, ETH Zurich, Switzerland (olivier.reubi@erdw.ethz.ch)
[2]University of Geneva, Earth Sciences, Switzerland
[3]Harvard University, Earth and Planetary Sciences, USA

Volcán Llaima, Chile is one of the most active volcanoes in South America. Since 1640, six major effusive eruptions have produced basaltic to basaltic andesitic (~51-55 wt% SiO_2) lavas. Trace element signatures of these magmas show little evidence for crustal contamination and point toward a relatively homogenous and depleted mantle source. This provides an ideal case to constrain slab-derived mantle metasomatic and melting processes beneath arc volcanoes on the basis of U-series systematics.

Llaima magmas display ^{226}Ra and ^{238}U excesses that fall on the "slab fluid contribution" end of the regional ^{238}U/^{230}Th vs. ^{226}Ra /^{230}Th trend defined by Sigmarsson *et al*. [1]. Yet Llaima samples show no correlation between these two activity ratios, and only ^{238}U excesses correlate with Ba/Th. This suggests that although the overall extent of ^{226}Ra excesses may be imprinted by addition of slab-derived fluid, a second order process is likely to affect ^{226}Ra-^{230}Th disequilibrium. The samples display ubiquitous but variable ^{231}Pa excesses that are distinctly higher than the values predicted by the coupled ^{231}Pa-^{235}U vs. subduction rate model of Huang and Lundstrom [2]. The measured variability in (^{231}Pa/^{235}U) excess also indicates that the mechanism controlling ^{231}Pa excesses can produce significant variations beneath a single volcano on short time scales. A striking feature of our data is the positive correlation between (^{231}Pa/^{235}U), (^{238}U/^{230}Th), Ba/Th and Ce/Th. This suggests a link between mantle wedge enrichment and melting processes, however the positive correlation between ^{231}Pa-^{235}U and ^{238}U-^{230}Th systems precludes a direct relationship between the amount of slab fluid and degree (and rate) of partial melting and requires a more complex scenario.

[1] Sigmarsson *et al.* (2002) *Earth Planet. Sci. Lett.* **196**, 189-196. [2] Huang & Lundstrom (2007) Geology **35**, 1007-1010.

Multiple sulfur istotope measurements from the 2.4 Ga old Seidorechka Formation

M. REUSCHEL[1]*, H. STRAUSS[1], A. LEPLAND[2], V.A. MELEZHIK[2,] P. CARTIGNY[3] AND A.J. KAUFMANN[4]

[1]Westfaelische Wilhelms Universitaet, Corrensstrasse 24, 48153 Muenster, Germany (*correspondence: marlene.reuschel@uni-muenster.de)
[2]Geological Survey of Norway, Leiv Eiriksons vei 39 N-7491 Trondheim, Norway
[3]Institut de Physique du Globe de Paris, 4 Place Jussieu, 75251 Paris, France
[4]University of Maryland, College Park, Maryland 20742, USA

Mass independent fractionated (MIF) sulfur isotope data in Archean and earliest Paleoproterozoic rocks are considered to provide evidence for an anoxic atmosphere [1, 2]. The disappearence of large magnitude MIF is thought to occur between 2.32 and 2.47 [3, 4]. The ca. 2.4 Ga old Seidorechka Sedimentary Formation within the Imadra Varzuga Greenstone Belt may thus capture the oxygenation of Earth's surface environments. In this study 42 siliciclastic and carbonate samples were collected from outcrops or selected from the FAR DEEP drillcore. All were analyzed for δ^{34}S and half were selected for Δ^{33}S and Δ^{36}S measurement.

Both the drillcore and outcrop samples reveal comparable temporal variations in δ^{34}S, but the lower part of the drillcore appears condensed or partly eroded. δ^{34}S ranges between +3.3 and -15.1‰ with distinct temporal variations. These variations coincide with a change in lithology from siliciclastic to carbonate facies preserved in the drillcore. In the outcrop no stratigraphic trend is discernible.

Δ^{33}S measurements display variations between -0.47 to +0.06‰ with only two measurements yielding a positive Δ^{33}S value. A Δ^{36}S/Δ^{33}S crossplot for all samples displays a slope of -1.1, which is characteristic for Archean sediments. However, temporal variations in Δ^{33}S are discernible.

[1] Farquha *et al*. (2000) *Science* **289**, 756-758. [2] Pavlov & Kasting (2002) *Astrobiology* **2**, 27-41. [3] Bekker *et al*. (2004) *Nature* **472**, 117-120. [4] Guo *et al*. (in press) *Geology*.