Voluminous outburst of silicic low $\delta^{18}O$ magma in NE-Iceland inferred from zircon $\delta^{18}O$ and U-Pb geochronology

BERG S. E.[12]*, TROLL, V. R.[2], RIISHUUS, M. S.[1], BURCHARDT, S.[2], DEEGAN, F. M.[23] AND HARRIS, C.[4]

[1] Nordic Volcanological Center, Reykjavik, Iceland (*sylvia@hi.is)

[2]Dept. of Earth Science, CEMPEG, Uppsala University, Sweden

[3]Laboratory for Isotope Geology, Swedish Museum of Natural History, SE-104 05 Stockholm, Sweden

[4]Dept. of Geological Sciences, University of Cape Town, Rondebosch, South Africa

The Borgarfjörður Eystri area in NE-Iceland represents the second-most voluminous outcrop of silicic eruptive rocks in Iceland and is a superb locality to unravel bimodal volcanism (c.f. "Bunsen-Daly" compositional gap), which has struck petrologists as abnormal for this tectonic setting for decades. Several explanations have been proposed; closed system fractional crystallisation, partial melting of hydrothermally altered crust, or partial melting of an underlying fragment of old continental or oceanic crust. To contribute to a solution to this issue we focus on zircon to unravel the origin, timing and evolution of voluminous evolved rhyolites in the Neogene silicic volcano complexes in the greater Borgarfjörður Eystri area. We report zircon U-Pb geochronology and $\delta^{18}O$ values measured by SIMS, and on whole rock $\delta^{18}O$ values of felsic and intermediate units from Dyrfjöll and Breiðavik central volcanoes. With this new dataset we are able to decipher timing, primary magmatic processes, as well as contamination and/or post emplacement alteration. Zircon U-Pb ages of key units reveal prolonged silicic activity represented by several rhyolite flows as the systems were gradually building up (from 13.42 ± 0.15 to 12.79 ± 0.15 Ma), followed by explosive caldera forming volcanism in the Breiðavik and Dyrfjöll centres (12.44 ± 0.27 and 12.40 ± 0.19 Ma). The lifetime of these volcanic centres ended abruptly with eruption of a dacite flow at 12.26 ± 0.33 Ma and younger basaltic volcanism. Zircon $\delta^{18}O$ values range from 1.1 to 4.7 ‰ (n = 179), corresponding to $\delta^{18}O_{(magma)}$ values of 3.3 to 6.0 ‰. These data imply significant contamination by hydrothermally altered crust. Whole rock $\delta^{18}O$ values ranging from 2.9 to 18.5, confirm contamination by hydrothermally altered material but also indicate the influence of low-temperature alteration in some samples. We propose a relatively short, though violent, eruptive episode of the Borgarfjörður Eystri volcanoes, with voluminous and explosive outbursts of felsic volcanics from a low $\delta^{18}O$ magma source, likely spanning 1 M.yrs. in total duration.

Pyroxenites and the construction of oceanic arc roots

J. BERGER[1], R. CABY[2] AND J-P. BURG[1]

[1]Geological Institute, ETH Zurich, 8092 Zurich, Switzerland (julien.berger@erdw.ethz.ch)

[2]Géosciences Montpellier, Université de Montpellier II, 34095 Montpellier, France

Pyroxenites are a major component of arc roots. They bear important information on the igneous and metamorphic evolution of arcs. In the Jijal and Sapat complexes of the Cretaceous Kohistan oceanic arc (Himalaya, Pakistan), pyroxenites formed by reactive flow of basalts within residual mantle peridotites [1,2]. In the Talkeetna Jurassic arc (Alaska), pyroxenites are high-pressure fractionation products of primitive hydrous basalts [3].

The Neoproterozoic Amalaoulaou oceanic arc root (Gourma belt, West Africa) exposes dykes of spinel and garnet pyroxenites cutting across interlayered garnet granulites and plagioclase pyroxenites [4]. Spinel pyroxenites were crystallized at about 1.0 GPa. Isobaric cooling down to 850-900 ºC induced the formation of garnet around spinel. In the vicinty of the pyroxenite dykes, lower crustal gabbros were partially molten leading to the formation of garnet granulites and garnet-clinopyroxene-rutile residues.

Spinel pyroxenites were fractionated from a primitive hydrous basalt (Mg# ~ 60-70). Calculated equilibrium liquids are similar to melt-like hornblende gabbros forming the middle to lower crust of the Amalaoulaou arc. One peculiar orthopyroxene-rich spinel pyroxenite found as a xenolith within the garnet granulites shows high Mg# and Cr content but high incompatible elements contents (LREE, Zr, Nb). It is interpreted as a product of melt-peridotite reaction before the intrusion of the garnet granulite precursor.

The strong planar-linear, high-temperature fabric of spinel pyroxenites in dykes is oblique to layering and metamorphic foliation of garnet granulites. These dykes are representing magma paths where the primitive mantle-derived basalt differentiated en-route by segregation of pyroxene and spinel. The Kohistan and Amalaoulaou complexes do not display a thick sequence of cumulate pyroxenites. Instead, scattered cumulate pyroxenites resulted from fractionation and/or melt-rock reaction in dykes or channels.

[1] Garrido *et al*. (2007) *Geology* **35**, 683-86. [2] Bouilhol *et al*. (2009) *Lithos* **107**, 17-37 [3] Greene *et al*. (2006) *J. Pet*. **47**, 1051-93. [4] Berger *et al*. (2011) *Comtrib. Min. Pet*. **162**, 773-96.

DOI:10.1180/minmag.2013.077.5.2
www.minersoc.org