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Quantitative analysis of volatiles-bearing minerals from mantle xenoliths using Synchrotron Radiation Induced μ-X-Ray Fluorescence (SR-XRF)

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Arc magmas display geochemical specificities including an enrichment in Large Ion Lithophile Elements (LILE) and corresponding depletion in High Field Strengh Elements (HFSE). These unique geochemical features reflect the occurrence in the IAB of a crustal component which traces the contribution of the subducted slab to arc magmatism. Migrating fluids emerging from the subducting lithosphere are supposed to enrich the overlying mantle wedge in volatiles and numerous incompatible elements, like LILE. Interaction between these fluids and mantle parageneses induces the crystallization of metasomatic minerals such as amphibole and phlogopite. These volatiles-bearing minerals are susceptible to incorporate large anions like halogens. Therefore, volatiles and trace elements investigations in these metasomatic minerals may help for a better understanding of volatiles cycling through the Earth reservoirs.

Here we report investigation of hydrous minerals from mantle wedge xenoliths (the Batan island, Philippines). These xenoliths are associated with the youngest pyroclastic deposits of Mt. Iraya, dated at 1480 yr BP. They have been described elsewhere [e.g. 1, 2 3], and only relevant features are reported here. Mantle xenoliths are mostly spinel-bearing harzburgites or dunites. They display porphyroclastic microstructures in which a fine-grained mosaic of olivine and orthopyroxene neoblasts surround larger porphyroclasts. Many xenoliths are characterized by the occurence of cross-cutting networks of veins containing secondary minerals including amphibole and phlogopite. The veins were inferred by [1, 2] to represent a metasomatic event in the mantle wedge.

We used an experimental protocol aimed at analyzing and imaging single minerals using both μPIXE (particle induced X-ray emission, LPS, CEA Saclay) and synchrotron radiation induced X-ray microfluorescence (SR-XRF). SR-XRF measurements were performed at beamline ID22 of the European Synchrotron Research Facility, Grenoble, France. The *in situ* multi-element analytical capability of this technique, together with its high sensitivity and spatial resolution allow determining quantitatively concentrations of major (K, Ca, Ti, Cr, Mn, Fe) and trace elements (V, Co, Ni, Cu, Zn, Br, Rb, Sr, Ce, Ta, Y, Pb) in mineral phases in two xenolith samples. Additional major elements (including Cl and F) were analyzed with a Cameca SX 100 (Camparis, Paris).

SR-XRF data show that Br is detected in mantle amphibole and also in phlogopite. This Br probably originates from recycled fluids expelled from the subducted oceanic crust. These results may contribute to a better understanding of the mantle residence of halogens and will provide information on the role of volatiles-bearing metasomatic phases in the deep fluid recycling processes.

[1] Maury et al; (1992) Nature, 360, 661-663; [2] Schiano et al. (1995) Nature, 377, 595-600; [3] Métrich et al. (1999) EPSL, 167, 1-14.