The Wet but Dry Mantle

A. HALIMULATI[1], O. ALARD[1,2], S. DEMOUCHY[2] AND SUZANNE.Y. O'REILLY[1]

[1]CCFS, Dept. Earth & Environmental Sciences, Macquarie University, Australia. halimulati.ananuer@mq.edu.au
[2]Géosciences Montpellier, CNRS, France

The terms "wet" or "hydrous" mantle are commonly used in the literature and refer to modally metasomatised mantle bearing amphibole, phlogopite . In recent years, the community has focussed on the nominally anhydrous minerals (NAMs) and not so much on the nominally hydrous phases (NHMs). Only few studies have investigated the effect of NHMs on the content and bulk distribution of H_2O in metasomatised mantle assemblages. Here, three xenolith suites (alkali-basalt hosted) containing varying modes of amphibole (up to 30%) have been investigated; two from the French Massif Central (MCF), and one from the Newer Volcanic Province (Australia; BM-GN suite). We used a range of analytical methods to quantify the concentration and distribution of water and water-derived species both at whole-rock and at the mineral scales, including: elemental analyser (EA), fourier transform infra-red spectrocopy (FTIR) and thermal gravitation analysis (TGA). The relationship between bulk water content (EA) and amphibole is not straight-forward. MCF suites show a rough positive correlation. This is not observed for the BM-GN suite, which shows a positive correlation with CO_2. Recomputed bulk Hydrogen concentrations from FTIR are independent from amphibole abundances and are typical of a "dry" lithospheric mantle. In contrast, well-defined negative and positive correlations are found between hydrogen in NAMs and olivine, opx and cpx abundances, respectively. The partitioning of H_2O between co-existing NAMs does not seems to be affected either.

BM-GN and MCF amphiboles show different geochemical characteristics: contrasted REE fractionations ($(Sm/Yb)_{PM}$: (0.8-8.8 vs. 0.8-3.7) and $(La/Sm)_{PM}$: (1.1-5.0 vs. 0.1-27)); prominent positive vs negative Nb-Ta; and marked negative vs no U-Th anomalies, relative to Ce, for BM-GN vs MCF, respectively. Their dissimilarity in chemical composition relates to different metasomatic events and agents that contain different volatile abundances. For instance, TGA shows a strong CO_2 signal for BM-GN but weak or no signal for FMC amphiboles. Therefore, we conclude that (1) the occurrence of amphibole in the mantle assemblage does not imply that coexsisting NAMs have high or saturated H_2O content, this holds true for large amounts of amphibole (30%), and (2) mantle amphiboles may host significant amounts of CO_2.