AMPHIBOLE AS A PROXY OF THE SECULAR VARIATIONS IN PRIMITIVE MAGMAS

Sessa G.[1], Tiepolo M.*[1], Moroni M.[1], Fiorentini M.L.[2], Langone A.[3], Giazzi G.[4], Krotz L.[4], Ferrari E.[1] & Loucks R.R.[2]

[1] Dipartimento di Scienze della Terra "A. Desio", Università di Milano, Italy
[2] Centre for Exploration Targeting, University of Western Australia, Perth, Australia
[3] Istituto di Geoscienze e Georisorse, Consiglio Nazionale delle Ricerche, Pavia, Italy
[4] Thermo Fisher Scientific, Rodano (MI), Italy
Corresponding email: massimo.tiepolo@unimi.it

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In primitive hydrous arc-magmas and under pressure conditions typical of the lower crust calcic amphibole precedes the crystallisation of plagioclase and follows that of olivine, spinel and pyroxene (e.g., Muentener & Ulmer, 2006). Among the early minerals, amphibole is the sole capable to incorporate a large number of petrologically important elements (including Nb, Ta) and volatile elements such as H, Cl and F. In ultramafic igneous rocks amphibole is thus the phase preserving the most complete record of the geochemical signature of the primary magma including its volatile contents.

Hornblendites and amphibole-bearing (typically pyroxenites) ultramafic intrusive rocks occur in most Phanerozoic orogenic belts worldwide. Amphibole-bearing rocks also occur in several Archean komatiites. Hence amphibole may be considered an ideal proxy for monitoring the secular variations in primitive magma composition for a relatively large number of elements including volatiles.

For this purpose we started an ambitious project and selected amphibole-bearing ultramafic igneous rocks from different sites worldwide, form Archean to Phanerozoic in age: komatiites, pyroxenites, hornblendites. Archean samples come from Canadian, Australian and Russian greenstone belts (Abitibi, Agnew-Wiluna, Pechenga), whereas post-Archean samples include mafic and ultramafic rocks from Himalaya (Tibet and Pakistan), Zagros belt (Iran), Ross orogeny (Antarctica), Italian Alps (Ivrea-Verbano zone, Adamello, Bregaglia) and Japan arc. Magmatic sulphides and carbonates may also occur in some amphibole-bearing assemblages suggesting CO_2- and S-bearing primary magmas.

Genetic conditions in most of the samples resulted in amphibole crystallization following olivine, spinel and pyroxene and predating plagioclase. Samples of Archean and Phanerozoic age may show striking similar textural features (like olivine embedded in pyroxene or amphibole oikocrysts).

Preliminary major element analyses on amphibole-bearing assemblages indicate that amphiboles are of igneous origin and in most cases in equilibrium with associated pyroxenes. Amphiboles show relatively restricted major element composition suggesting similar petrogenetic origin, although significant differences exist between Archean and post-Archean amphiboles (e.g., TiO_2 contents). The trace element and volatile content characterization of representative amphiboles by SIMS and LA-ICP-MS is in progress. On selected amphiboles we also determined the S and C contents for a first estimate about the potential for amphibole to influence the deep volatile cycle for C and S.

We shall discuss the first results of this project with emphasis on secular variations marked by key elements and element ratios (e.g., Nb/Ta) for the Earth's evolution.

Muntener, O. & Ulmer, P. (2006): Experimentally derived high-pressure cumulates from hydrous arc magmas and consequences for the seismic velocity structure of lower arc crust. *Geophys. Res. Letters*, **33**, L21308.