

The geochemical evolution of clinopyroxene in the Roman Province: A window on decarbonation from wall-rocks to magma

S. MOLLO¹ AND A. VONA²

¹Istituto Nazionale di Geofisica e Vulcanologia, Via di Vigna Murata 605 00143 Rome, Italy (*correspondence: mollo@ingv.it)

²Dipartimento di Scienze, Università degli Studi Roma Tre, L.go San Leonardo Murialdo 1 00146 Rome, Italy

We present results from atmospheric pressure experiments conducted at 1140, 1160 and 1180 °C under the buffering conditions of air, MH and NNO. The starting materials were a shoshonite and a phonotephrite from the Roman Province. These natural samples were doped with variable amounts of CaO and CaO+MgO whose stoichiometric proportions reproduced the assimilation by magmas of calcite and dolomite, respectively.

Results underline that, during magma-carbonate interaction, the oxygen fugacity exerts a primary control on clinopyroxene composition. With increasing fO_2 , the content of Tschermak molecules, i.e., CaAlAlSiO₆, CaFeAlSiO₆, and CaTiAlSiO₆, in clinopyroxene significantly increases at the expenses of hedenbergite and enstatite components.

The compositional variation of clinopyroxene described by our experiments is compared with the chemical analyses of natural crystals found in skarns and lavas at the Roman Province. This comparison provides that the simple ingestion of carbonate by magmas cannot explain the geochemical evolution of clinopyroxene in the Roman Province. At the periphery of magma chamber, the decarbonation reaction proceeds with the highest efficiency producing high CO₂ emissions. This causes extreme oxidizing conditions that, in turn, control the geochemical evolution of clinopyroxene in skarns. However, the oxidative capacity of CO₂ fluxing progressively decreases from the skarn shell to the interior of the magma. Consequently, the chemical analyses of clinopyroxenes found in lavas testify to laterally variable lower redox conditions in the magma chamber.

Lithospheric mantle connection of clinopyroxene inclusions in chromites from the Archean Nuasahi ultramafic-mafic complex (India)

SISIR K. MONDAL^{1*}, SHOJI ARAI², BETCHAIDA D. PAYOT² AND AKIHIRO TAMURA²

¹Department of Geological Sciences, Jadavpur University, Kolkata-700032, India

(*correspondence: sisir.mondal@gmail.com)

²Department of Earth Sciences, Kanazawa University, Kanazawa 920-1192, Japan

The 3.1Ga Nuasahi igneous complex in India is a sill-like layered intrusion within the early Archean greenstone belt of the Singhbhum craton. The igneous complex consists of a lower ultramafic unit (~ 400m thick) containing three chromitite ore bodies and an upper gabbroic unit containing magnetite bands. In between the lower ultramafic unit and the upper gabbro a PGE-rich discordant breccia zone is present. The main rocks of the lower ultramafic unit are orthopyroxenite, harzburgite, dunite and chromitite. Chromites from the massive chromitites contain numerous independent clinopyroxene (cpx) inclusions (> 95% of total inclusion populations) along with tiny phlogopite (<1%). The cpx inclusions are of variable sizes and shapes (rounded, elliptical and euhedral crystals), and in places they mimic the shape of the host chromite grain, and appear as the seed and negative crystals. In addition, few opx and olivine grains are identified in net-textured chromitites. Major element analysis by EPMA confirms that the cpx inclusions are Cr-diopside in composition which suggest a lithospheric mantle origin of the inclusions. Phlogopites are K-rich and compositionally similar to mantle phlogopite. *In situ* trace element analyses by laser ablation ICP-MS show that the chondrite-normalized REE patterns for the cumulus cpx in the upper gabbro and the cpx inclusions in chromites from the massive chromitites from the Nuasahi complex are different. Previous studies showed that the chromitite-bearing sill-like ultramafic-mafic complex in Nuasahi was formed from a boninitic parental magma in a supra-subduction setting. Previous Os isotopic study of the unaltered chromites indicated melt extraction as early as 3.7Ga from a subchondritic Os isotopic source implying derivation from a subcontinental lithospheric mantle. The high-Mg parental magma of the Nuasahi igneous complex may have originated in the deeper parts of the metasomatized lithospheric mantle wedge from where the cpx xenocrysts (along with phlogopite) were collected and transported to the crustal magma chamber where it had been entrapped by the growing chromite crystals.