PETROLOGY OF TITANIAN CLINOHUMITE AND OLIVINE AT THE HIGH-PRESSURE BREAKDOWN OF ANTIGORITE SERPENTINITE TO CHLORITE HARZBURGITE (ALMIREZ ULTRAMAFIC MASSIF, S. SPAIN)

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High-pressure breakdown of antigorite serpentinite to chlorite harzburgite (olivine + orthopyroxene + chlorite) is a significant dehydration reaction in subduction settings. Serpentinite subduction may be a suitable source or sink of significant elements for arc volcanism such as F, Cl, B, Be, Sr, Li, and HFSE. Stabilization of clinohumite during serpentinite dehydration may account for some of these geochemical characteristics (GARRIDO et al., 2005).

Rocks of the Almirez ultramafic massif (Sierra Nevada, Betic Cordillera, S. Spain) record the high-pressure dehydration of antigorite-olivine serpentinite to form chlorite harzburgite. In the field these two rock types are separated by a well defined isograd. Titanian clinohumite (TiCl) and olivine show textural and compositional differences depending on rock type. OH-TiCl occurs in the serpentinite as disseminated grains and in veins. F-OH-TiCl is observed exclusively in the chlorite harzburgite, where it occurs as porphyroblastic grains and within prograde olivine as irregular and lamellar, planar intergrowths at microscopic and submicroscopic scales. Petrological evidence of partial to complete breakdown of TiCl to olivine + ilmenite is preserved in both rock types. Chlorite harzburgite is characterized by a brown pleochroic olivine with abundant oriented microscopic to submicroscopic oxide particles. The mean Ti-content of the brown olivine is 144 ppm. Brown olivine preserves TiCl lamellae that sometimes grade into ghost lamellae outlined by oxide trails. This observation suggests that some of the oxide inclusions in brown olivine are derived from the breakdown of TiCl intergrowths.

Thermodynamic modelling of selected Almirez bulk rock compositions indicates a temperature increase from 635 to 695 °C, at pressures ranging from 1.7 to 2.0 GPa, as the cause for the compositional adjustment of TiCl between the Almirez antigorite serpentinite and chlorite harzburgite. Accordingly, TiCl can be stable in the vicinity of the antigorite serpentinite / chlorite harzburgite phase boundary in some subduction settings. In these circumstances clinohumite-olivine intergrowths in chlorite harzburgite may act as a sink for HFSE, and probably other elements, that are present in mantle-wedge fluids.

Reference

GARRIDO, C.J., LÓPEZ SÁNCHEZ-VIZCAÍNO V., TROMMSDORFF, V , GÓMEZ-PUGNAIRE, M.T ALARD, O., BODINIER, J.L. & GODARD, M. (2005): Enrichment of HFSE in chlorite-harzburgite produced by high-pressure dehydration of antigorite-serpentinite: Implications for subduction magmatism. Geochem Geophys Geosyst, 6:Q01J15, doi:10.1029/2004GC000791