Oxygen fugacity and chemical potentials as determinant factors in constraining the metamorphic evolution of subducted rodingites and enclosing ultramafic rocks.

Casta López (1), Vicente López Sánchez-Vizcaíno (1), Claudio Marchesi (2,3), María Teresa Gómez-Pugnaire (2,3), Carlos J. Garrido (3), Antonio Jabaloy-Sánchez (4), and José Alberto Padrón-Navarta (5) (1) Universidad de Jaén, Campus Científico-Tecnológico de Linares, Geología, Linares, Spain (claborda@ujaen.es), (2) Departamento de Mineralogía y Petrología, Universidad de Granada, Granada, Spain, (3) Instituto Andaluz de Ciencias de la Tierra, CSIC-Universidad de Granada, Armilla (Granada), Spain, (4) Departamento de Geodinámica, Universidad de Granada, Granada, Spain, (5) Géosciences Montpellier, UMR 5243, CNRS-Université de Montpellier, Montpellier, France

Rodingites are Ca-, Al-enriched and Si-undersaturated rocks formed from mafic precursors enclosed in peridotites. Formation of both rodingites and serpentinites occurs simultaneously during serpentinization. Therefore, rodingites are common rocks associated with serpentinites in exhumed terrains, which experienced subduction and HP metamorphism. However, uncertainties remain about the factors that constrain the diverse mineral associations occurring in meta-rodin-gites as well as their response to devolatilization and redox reactions during subduction. In the Cerro del Almirez ultramafic massif (S-Spain) meta-rodin-gite bodies are enclosed both in Atg-serpentinite and Chl-harzburgite, which are separated by a transitional zone that represents the front of prograde serpentinite dehydration during subduction. Different types of meta-rodin-gites are found associated with these two ultramafic lithologies: Grandite-meta-rodin-gite (type 1) within Atg-serpentinite, Epidote-meta-rodin-gite (type 2) within both of them, especially in the vicinity of the dehydration front, and Pyralspite-meta-rodin-gite (type 3) within Chl-harzburgite. Type 1 consists of garnet, chlorite and clinopyroxene with minor titanite, magnetite and ilmenite. Several garnet generations are found within this meta-rodin-gite type: Grt1 (Ti-rich hydrogrossular, 78-90 wt% grossular), Grt2 (6-20 wt% pyralspite, 80-93 wt% grandite), and Grt3 (Ti-rich grandite, 38-40 wt% andradite). Type 2 meta-rodin-gite consists of epidote and clinopyroxene with minor titanite, garnet and chlorite. It appears partially transforming type 1 rocks within Atg-serpentinite and its amount increases gradually towards the dehydration front. Just across this front, in the Chl-harzburgite domain, all meta-rodin-gite types are type 2. Type 3 meta-rodin-gite overgrew type 2 assemblages and consists of garnet (Grt4, 38-50 wt% almandine, 12-31% pyrope, 17-35% grossular), epidote, clinopyroxene, amphibole, chlorite, titanite and rutile. All meta-rodin-gite types underwent a retrograde partial amphibolitization, more pronounced in types 2 and 3. Meta-rodin-gite bodies are surrounded by a bimetasomatic reaction rim consisting, from the rodingite body to the enclosing ultramafic rock, of Chl-blackwall (chlorite+clinopyroxene+titanite), Chl-diopsidite (clinopyroxene+ chlorite) and Chl-Olivine-diopsidite (olivine+clinopyroxene,+chlorite± antigorite). In this study we present a phase relationships thermodynamic model for the rodingites metamorphic evolution. In type 1, Grt1 represents the relic low-grade rodingitic association (T < 260°C, P < 7 Kbar). Grt2 and Grt3 grew sequentially during subduction-linked prograde metamorphism (T < 630°C, P = 7-16 Kbar). Grt2 and Grt3 grew sequentially during subduction-linked prograde metamorphism (T < 630°C, P = 7-16 Kbar), just before their transformation to epidote-meta-rodin-gite and antigorite breakdown during the enclosing serpentinite. Metamorphic peak is marked by the maximum pyrope content (30 wt%) in Grt4 (type 3 meta-rodin-gite) at ~670°C and P < 16 Kbar. Oxygen fugacity variation was a crucial factor to stabilize the observed mineral assemblages and their chemistry both in meta-rodin-gites and ultramafic rocks. LogfO² ranged from -45 to -38 in Grt1 stability conditions and increased progressively up to -13 to -10 during the formation of Grt2 and Grt3 and epidote-meta-rodin-gite. Chemical potentials gradients between meta-rodin-gites and ultramafic rocks also concur to explain the observed transformations. Diffusion was catalyzed by fluids released during the prograde dehydration breakdown of the enclosing Atg-serpentinite to Chl-harzburgite. Type 1 to type 2 transformation was the result of decreasing μCaO (< -703 kJ) and increasing μSiO² (-857.5 to -852 kJ). Transformation of Type 2 to type 3 was also enhanced by a decrease in μCaO.