Geophysical Research Abstracts,
Vol. 11, EGU2009-10797-2, 2009
EGU General Assembly 2009

The Mesozoic Larissa Ophicalcite-Serpentinite Association in Eastern Thessaly, Greece: Mineralogical, Geochemical and Isotopic Constraints for Rocks Formed in an Ocean-Continent Transition Setting

V. Melfos (1), A. Magganas (2), P. Voudouris (2), and M. Kati (2)

(1) Aristotle University of Thessaloniki, Mineralogy, Petrology, Economic Geology, Thessaloniki, Greece (melfosv@otenet.gr), (2) Department of Mineralogy and Petrology, Faculty of Geology and Geoenvironment, University of Athens, Ilissia, Greece

The ophicalcite breccias and serpentinites occurring at the Chasanbali Hill in the Larissa area, Central Greece, the former well known as building and decorative materials from ancient times, comprise part of the Eohellenic nappe, which overthrusts the Pelagonian Zone, a Mesozoic continental fragment of Gondwana. The ophicalcite breccias are enveloped by imbricated serpentinites that overlie amphibolites and greenschists and structurally underlie crystalline limestones of the Upper Cretaceous age. Though the breccias have suffered hydrothermal and/or low grade metamorphism, most of their original sedimentary structures and mineralogical and chemical features are relatively well preserved. A preponderance of large serpentinite together with few carbonate clasts, set in fine grained serpentinite-carbonate matrix, are the constituents of the breccias. A small number of larger marble olistoliths are also found intercalated among the ophicalcites. It is important that some of various dispersed clasts, which are composed of gneissic rocks, granite together with a few fossiliferous carbonates, as well as the olistoliths, are considered as belonging to the Pelagonian continental basement. Additionally, the breccias have been deposited by resedimentation processes, mostly as rockfalls and sediment gravity flows, in a submarine environment.

The ophicalcite breccias present large variations in the proportions of serpentinic to carbonate material, ranging from pure serpentinite breccias to ophicalcite with abundant carbonate clasts. The carbonate is represented exclusively by calcite and the serpentine by antigorite and subordinate lizardite and chrysotile. Chromian magnetite, magnetite, hematite and chromite are minor constituents, while tremolite, epidote, chlorite, talc and millerite are found in trace amounts. Microprobe mineral analyses showed that there are no significant variations in the chemical composition of the serpentines of the ophicalcite. The oxide totals are generally below the ideal, which may reflect extra water either held in micropores or present in addition to stoichiometric hydroxyl water. Major- and trace-element whole-rock analyses of the ophicalcite reveal a high precipitation of CaO (26.39 to 31.00 wt%), which is related to the hydrothermal carbonate incorporation in the rock. These data show that the calcitization of the serpentinite involved extensive changes in the bulk composition due to the large amounts of $CaCO_3$ addition. Furthermore, the negative correlation between MgO and CaO and the positive correlation between MgO and SiO_2 reveal an analogous behavior of Mg and Si in the alteration process.

For the purposes of our isotopic study, five types of carbonate have been distinguished: 1) early veins, 2) clasts, 3) matrix fabrics and cavity fillings, 4) late veins, and 5) olistolithic blocks. The results arising from all the ophicalcite carbonate types, apart from the blocks, show a small range of carbon and oxygen isotope values ($\delta^{13}C$ = +0.81 to +3.31 ‰ and $\delta^{18}O$ = –12.84 to –15.19 ‰), demonstrating a relative homogeneity. These isotopic compositions contrast with those of calcite in the carbonate blocks, which are isotopically heavier ($\delta^{13}C$ = +2.74 to +2.84 ‰ and $\delta^{18}O$ = –4.61 to –4.77‰). The depleted oxygen isotope values of the calcite in the clasts, matrix and veins of the ophicalcite carbonates are likely related to higher precipitation temperatures relative to the marine precipitation of the carbonate blocks. It is probable that the ophicalcite carbonates were exposured to hot fluids on the deep sea floor and were in equilibrium with seawater at 90 to 110°C, as is indicated by the calcite-water fractionation equation of Kim and O'Neil (1997).

The above described geological, petrological, geochemical and isotopic characteristics suggest that the Larissa ophicalcite-serpentinite association has been generated in an ocean-continent transition zone, where the litho-

spheric mantle was exhumed in the oceanic floor. This unusual setting presents many similarities with the ophicalcites and related rocks found in the Iberia Abyssal Plain and Tasna area in the Alps (Milliken et al. 1996; Manatschal et al. 2006). Moreover, the depositional and physicochemical conditions of the formation are analogous to those deduced for the recently discovered active, low temperature hydrothermal field of the Lost City in the Mid-Atlantic Ridge (Kelley et al. 2007).

References

Kelley D.S., Früh-Green G.L., Karson J.A., Ludwig K.A. (2007). The Lost City Hydrothermal Field Revisited, Oceanography, 20, 90-99.

Kim S-T, O'Neil JR (1997). Equilibrium and nonequilibrium oxygen isotope effects in synthetic carbonates. Geochim Cosmochim Acta, 61, 3461-3475.

Manatschal G., Engstrom A., Desmurs L, Schaltegger U., Cosca M., Muntener O. and Bernoulli D. (2006). What is the tectono-metamorphic evolution of continental break-up?: The example of the Tasna Ocean-Continent Transition. J. Struct. Geology, 28, 1849- 1869.

Milliken K.L., Lynch F.L. and Seifert K.E. (1996). Marine weathering of serpentinites and serpentinite breccias, Sites 897 and 899, Iberia Abyssal Plain. In: Whitmarsh, R.B., Sawyer, D.S., Klaus, A., and Masson, D.G. (Ed.), Proceedings of the Ocean Drilling Program, Scientific Results, Vol. 149, 529-540.