Geophysical Research Abstracts
Vol. 16, EGU2014-4308, 2014
EGU General Assembly 2014

The ophiolite of the Eohellenic nappe in the island of Skyros, Greece: Geotectonic environment of formation and metamorphic conditions inferred by mineralogical and geochemical data

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The island of Skyros is located in the Sporades-Aegean region. It includes an ophiolitic mélange sequence consisting of serpentinites, gabbroic and doleritic rocks, and also lavas which mostly appear in massive form, but in rare cases as deformed pillows. The ophiolitic mélange sequence also includes rodingites, ophicalcites, as well as radiolarites. This formation belongs to the Eohellenic tectonic nappe, which encompasses marbles, sandstones and schists and was emplaced onto the Pelagonian Zone during Early Cretaceous [1, 2].

Serpentinites were most likely formed after serpentinization of harzburgitic protoliths and consist of serpentine, bastite, spinel and magnetite. The chemistry of spinels (TiO_2=0.14-0.25 wt.%, $Al2O_3$=35.1-35.21 wt.%, Cr#=37.38-38.87), shows that the harzburgitic protoliths plausibly resemble back-arc basin peridotites [3]. Gabbros and dolerites present mostly subophitic textures, between the hornblende/clinopyroxene and plagioclase grains. Based upon their petrography and on their mineral chemistry hornblendes have been distinguished into magmatic and metamorphic hornblendes, with the first occurring mostly in gabbroic rocks. Magmatic hornblendes exhibit relatively high TiO_2 (1.42-1.62 wt.%), $Al2O_3$ (5.11-5.86 wt.%) and Na2O (1.01-1.09 wt.%) contents, with their presence implying that the magma was at least to some degree hydrous. Lavas are tholeiitic basalts with relatively high FeOt≈12 wt.% and low K2O and Th contents, consisting mostly albite, altered clinopyroxene and devitrified glass. Tectonomagmatic discrimination diagrams [4, 5] illustrate that the studied gabbros and lavas of Skyros are most likely associated with SSZ processes.

Gabbroic rocks, subvolcanic dolerites and lavas have been subjected to greenschist/subgreenschist metamorphic processes, as confirmed by the presence of secondary amphiboles (metamorphic hornblende, actinolite/tremolite), epidote, pumpellyite and chlorite in all of the studied samples. On the other hand, the occurrence of rodingites and ophicalcites clearly point to interaction of the gabbroic rocks and serpentinites with hydrothermal fluids, which most probably took place during the stage of exhumation and tectonic emplacement. Ophicalcites contain serpentine, calcite, magnetite, as well as rare pyroxene and spinel. Rodingites on their behalf include hydroandradite (Alm0.00Adr61.33-67.43Grs28.25-35.18Prp0.10-2.49Sps0.00-0.33Uv0.41-2.75), vesuvianite (MgO=2.78-3.33 wt.%; TiO_2=0.02-0.59 wt.%) diopside neoblasts (En48.53-49.89Wo47.56-48.10Fs2.32-3.33; Mg#=93.96-96.28), chlorite and also accessory prehnite. Some small-sized Cr-bearing hydrogarnet crystals ($Cr2O_3$=10.34 wt.%) were most likely formed at the expense of spinel. The types of hydrogarnet and vesuvianite crystals are highly indicative for the involvement of subduction-related fluids during the formation of the rodingites [6].

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