ORIGIN AND EVOLUTION OF THE HIGH-PRESSURE META-IGNEOUS ASSEMBLAGE NEAR ST. MICHALIS, SYROS, GREECE

Andrei Sinitsin
Department of Geology
Amherst College

Metamorphic rocks of the island of Syros in the Cyclades, a group of Greek islands located in the southern Aegean, are the product of the Alpine Orogeny (Smith & Woodcock, 1982). They are assumed to have been metamorphosed through northward-directed under-thrusting of the Apulian microplate beneath Eurasia (Avigad & Garfunkel, 1991). This subduction may have begun as early as the Triassic (Brocker & Enders, 1998). Although Syros is mostly composed of a thick pelitic schist-marble succession, several meta-igneous bodies exhibiting blueschist/eclogite facies mineralogy are embedded in the northern, central, and western parts of the island (Okrusch & Brocker, 1990).

This study concentrates on the geochemistry and history of the diverse high-pressure, low-temperature, meta-igneous rocks in the complex located near the village of St. Michalis, in the northeastern corner of Syros. This assemblage includes (from most to least abundant) epidote-omphacite metagabbros, garnet-glaucophane blueschists, garnet-clinopyroxene rocks, gneiss, meta-breccia, serpentinite melange, and a small felsic body thought to be a jadeitite. Most of these rocks appear to form large coherent meta-igneous bodies, but some also occur as tectonic blocks in melange zones. The entire assemblage appears to be tectonically separate from the marble-schist succesion (Okrusch & Brocker, 1990). The diversity of rock types in the assemblage suggests that there might also be fault surfaces within it, separating blocks that may have been juxtaposed either during subduction or exhumation.

Chemical analyses of major, minor, trace, and rare earth elements composing these rocks have been obtained for eighteen of the samples in an attempt to constrain the origin and petrogenetic history of the St. Michalis assemblage. Are these meta-igneous rocks genetically related or were they assembled from completely separate protoliths prior to or during the subduction? The results of the analyses suggest that the three major meta-igneous rock groups in the assemblage – metagabbros, blueschists, and clinopyroxene-garnet rock – had three chemically different separate source magmas. These data also imply that major differences in mineralogy among rock types are most likely the result of chemical differences. In addition, chemical analyses of meta-breccia samples indicate that these rocks are more likely to be tectonic in origin rather than intrusive. Breccia samples are very similar to either garnet-clinopyroxene rocks or epidote-garnet-glaucophane blueschists. None of the samples, however, have compositions like those of metagabbros, as would be expected if the breccia were intrusive in origin; also, in the field metagabbro is found only at the edges of the meta-breccia bodies. This suggests that metagabbro was emplaced subsequent to tectonic formation of the meta-breccia bodies.

In addition, mineral composition data were gathered on the SEM/EDS (Scanning Electron Microscope/Energy Dispersive Spectrometer) in order to characterize any differences in mineral compositions among different rock types. These data will also be used to constrain the metamorphic evolution of these meta-igneous rocks, especially the conditions of the high-pressure, low-temperature metamorphism. Two of garnet-clinopyroxene rocks, for example, (samples 10A and 15C) contain garnet/paragonite/quartz/albite, which makes them excellent candidates for geothermobarometry as albite – jadeite + quartz and paragonite – jadeite + quartz + kyanite reactions can be used to constrain a range of possible pressures. In addition, a garnet-clinopyroxene geothermometer can be applied to these two samples in order to constrain the temperature at which these rocks underwent metamorphism. Preliminary results suggest that these rocks and probably the whole assemblage experienced high-pressure low-temperature metamorphic conditions similar to the accepted peak values of 15-18 kilobars and 500 degrees Celsius (Avigad &Garfunkel, 1991).