# MULTI-STAGE CARBONIFEROUS-ALPINE HIGH-P METAMORPHISM IN NORTHERN SAMOS (GREECE): EVIDENCE FROM GARNET ZONING AND INCLUSIONS

FEENSTRA, A. [1], PETRAKAKIS, K. [2] & RHEDE, D. [1]

[1]GeoForschungsZentrum Potsdam, Department 4, Telegrafenberg, 14473 Potsdam, Germany.
[2]Institut für Geologische Wissenschaften, Geozentrum Universität Wien, Althanstraße 14, 1090, Wien, Austria
e-mail: feenstra *at* gfz-potsdam.de

The island of Samos occupies a transitional position between the Attic-Cycladic-Metamorphic-Complex (ACMC) in the Aegean Sea and the Menderes-Complex in SW-Turkey. Like the ACMC rocks, the Samos rocks have experienced an early Alpine high-P, low-T metamorphism (M1) followed by a late Alpine, medium-P, greenschist-grade event (M2). The latter is related to the emplacement of the blueschist facies rocks into higher crustal levels.

Porphyroblastic garnet schists from northern Samos, however, show also evidence of an older higher temperature metamorphism. Large Fe-rich garnets, ranging up to 1.5 cm in diameter and displaying an internal foliation discordant with that in the matrix, have developed thin (0.1 - 0.8 mm) discontinuous rims strongly enriched in Ca (20 - 26 mole% grossular component). Most garnet cores show a growth-zoning with Mn, Ca and Y highest in the core, whereas Mg, Fe and Mg # increase towards the rims; some garnet cores are fairly homogeneous. The thin Ca-rich rims, which are locally resorbed (most probably during the M2 event) compare in composition to a second generation of small (< 1 - 2 mm) garnets in the matrix. Textures and element partitioning indicate that the second garnet generation and the Ca-rich rims of the large garnets are in equilibrium with typical M1-minerals such as chloritoid and phengite (Si = 6.6 - 6.85 and (Fe + Mg) = 0.8 - 1.0 atoms / 22 O). Typical inclusions in garnet cores are: white K-mica compositionally matching high-T muscovite (Si = 6.02 - 6.15 and (Fe + Mg) = 0.25 - 0.36 atoms / 22 O; Ti = 0.8 - 1.2 wt%; Ba = 0.20 - 0.45 wt%); F-rich apatite; monazite; irregular intergrowths of white K-Na micas + albite + quartz, probably a replacement product of K-Na feldspar. Monazite inclusions appear to be confined to the marginal parts of the garnet cores which are also characterized by elevated Y contents. Electron microprobe U-Th-Pb dating of monazite inclusions yielded ages in the range 220 - 320 Ma. Alpine monazite occurring in the matrix or in late veinlets crosscutting garnet could not be dated by the EMP method owing to its low Pb contents.

The various types of relict minerals included and the rather „flat" chemical zoning of the large garnets suggests that they formed at middle amphibolite-facies conditions. Detailed EMP work failed to detect significant element diffusion between the pre-Alpine cores and the Ca-rich Alpine overgrowths, which is in accord with the comparitively low temperatures prevailing during Alpine metamorphism. Amphibolite facies conditions have been documented in the "Variscan" basement rocks exposed as lowest unit of the ACMC on some Cycladic islands. It is tempting, therefore, to correlate the garnet rocks described from N-Samos with these occurrences. In general, the present study demonstrates that high-T muscovite, apatite and monazite trapped in garnet may survive a subsequent low-T, high-P metamorphism (≈500 °C, ≈20 kbar). Thus such inclusions may provide important petrogenetic information on the early metamorphic history of rocks.