Poly-metamorphism and P-T paths in granulites from eastern Antarctica

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Symplectic coronas, involving orthopyroxene, which replace higher pressure mineral assemblages often have been interpreted as evidence for near-isothermal decompression during the final stages of single collisional tectono-thermal event. However, such decompression textures could form equally well by reheating of (much) older metamorphic protoliths at a higher level in the crust. This dilemma is illustrated by two examples from Eastern Antarctica with well-developed two-stage reaction textures.

1) Magnesium metapelites of probable Archaean age from Forefinger Point, SW Enderby Land, contain high-temperature mineral assemblages orthopyroxene (8-9 wt% Al_2O_3) - sillimanite ± garnet ± quartz ± K-feldspar, formed at 10 ± 1.5 kbar and 950 ± 50°C. These assemblages are overprinted by symplectic and corona reaction textures involving sapphirine, orthopyroxene (6-7 wt% Al_2O_3), cordierite and sometimes spinel at the expense of porphyroblastic garnet or early orthopyroxene-sillimanite. These textures mainly predate the development of coarse biotite at the expense of initial mesoperthite, and the subsequent formation of orthopyroxene (4-6 wt Al_2O_3) - cordierite - plagioclase rinds on the late biotite.

   The early reaction textures indicate decompression from 10 ± 1.5 kbar to 7-8 kbar at high tenperature (T ≈ 900°C), succeeded by biotite formation at significantly lower temperatures (800-850°C) and further decompression to 4.5 ± 1 kbar at 700-800°. The later parts of this P-T evolution can be ascribed to the overprinting and reworking of the Forefinger Point granulites by the later-Proterozoic (*ca.* 1000 Ma) Rayner Complex metamorphism.

2) Garnet in mafic granulites from Sostrene Island, Prydz Bay, East Antarctica, have two-stage symplectic coronas. An outer corona of opx (Mg66) + plag (An94-97) + minor hbl mantles a finer grained inner corona of opx (Mg67) + plag (An95-96) + spl (Mg36). Both symplectites contain minor ilmenite-magnetite intergrowths. The finer grained synplectite also occurs along a fracture cleavage in the garnet. The outer corona originated according to the reaction grt + cpx (±hbl) + SiO_2 = opx + plag, whereas the inner corona formed later, at lower pressure, probably triggered by minor deformation, also resulting in the fracture cleavage in the garnet, by the reaction grt = opx + plag + spl (2). The grossular content of the garnet (X_{grs} = 0.168) is almost exactly that which is required for the stoichiometric breakdown by reaction (2) (calculated X_{grs} = 0.167). Preferred P-T estimates for M1 based on garnet core ($Prp_{40}Alm_{42}Grs_{17}Sps_1$)-matrix opx-cpx-hbl pairs are ca. 10 kbar at 980 °C. The fine-grained symplectite formed at ca. 7 kbar and 850 °C. The enclosing felsic gneisses yield P estimates of between 5 and 7 kbar, which compares with conditions of ca. 6 kbar and 775 °C in the nearby Bolingen Islands. These lower P-T estimates are considered to be representative of widespread 1100 Ma metamorphic event recognized in outcrops along the Prydz Bay coast.

In both occurrences it is believed that the early higher pressure metamorphism may be of Archaean age. The reaction textures could have formed in response to uplift episodes in the Archaean and Proterozoic or may record repeated heated heating, and minor deformation, events at different times and at successively shallower levels in the crust. Radiometric dating of individual mineral assemblages in progress should clarify the tectonic significance of these 'decompression' textures.