

CO₂-rich fluid inclusions in ultrahigh-temperature granulites from the Napier Complex, East Antarctica: implications for P-T paths

Toshiaki Tsunogae[1], M SANTOSH[2], Yasuhito Osanai[3], Tsuyoshi Toyoshima[4], Masaaki Owada[5], Tomokazu Hokada[6]

[1] Inst. Geosci., Univ. Tsukuba, [2] Natural Environmental Sci., Kochi Univ, [3] Earth Sci., Okayama Univ., [4] Grad. Sch. Sci. & Tech., Niigata Univ., [5] Dept. Earth Sci., Yamaguchi Univ., [6] National Science Museum

The late-Archean ultrahigh-temperature (UHT) metamorphic rocks of the Napier Complex, East Antarctica, are characterized by the presence of dry mineral assemblages. Available P-T data indicate that granulites from Tonagh and Bunt Islands in the complex equilibrated at peak conditions of ~9 kbar and ~1100C. Textures and mineral reactions preserved by the Tonagh granulites are consistent with an isobaric cooling (IBC) history probably along a counterclockwise P-T path. In contrast, available P-T data for Bunt rocks suggest an isothermal decompression (ITD) history along a clockwise path.

Systematic petrographic and fluid inclusion microthermometric studies on the rocks show the common occurrence of very high-density (primary) carbonic fluid inclusions trapped within various minerals. The melting temperatures of fluids are close to the triple point for pure CO₂. Homogenization of the CO₂ inclusions occurs into the liquid phase at temperatures (Th) in the range of -35.4 to +1.1C. Isochores for the high-density inclusions closely correspond with the peak P-T conditions for the islands. We therefore infer that CO₂ was the dominant fluid species present during the UHT metamorphism in the Napier Complex, and it probably buffered water activity to low levels and stabilized the dry granulite assemblages.

From the systematic variation in densities among different minerals, we are able to reconstruct the exhumation paths of the granulites. In a garnet-granulite from Tonagh Island, Grt-bound CO₂ inclusions show the highest Th (lowest density: 0.96-1.03 g/cm³), whereas inclusions in Qtz show the lowest Th (highest density: 1.05-1.07 g/cm³). This could be a reflection of continuous recrystallization of Qtz along a counterclockwise (IBC) path. In contrast, an Osm-granulite from Bunt Island shows a reverse density-host mineral relation with the lowest Th (highest density: 1.06-1.08 g/cm³) yielded by inclusions in Grt, resulting from recrystallization of Qtz along a clockwise (ITD) path. Our fluid inclusion data would therefore suggest two distinct metamorphic P-T paths for UHT granulites from Tonagh and Bunt Islands.