

***P-T* PATH OF SAPPHIRINE-QUARTZ BEARING GRANULITES, ANÁPOLIS-ITAUCU COMPLEX, CENTRAL BRAZIL.** R. Moraes¹, M. Brown¹, and R. A. Fuck². (1) Laboratory for Crustal Petrology, Department of Geology, University of Maryland, College Park, MD 20742-4211, moraes@geol.umd.edu, (2) Instituto de Geociências, Universidade de Brasília, Brasília, DF, 70910-900, Brazil

Introduction: Ultrahigh-temperature (UHT) metamorphic rocks are formed when extreme temperature conditions ($> 900^{\circ}\text{C}$) are attained within continental crust during regional metamorphism [1]. Determination of peak metamorphic conditions for these rocks with standard geothermobarometers is not an easy task, as commonly post-peak Fe-Mg diffusion hampers calculations. For UHT metamorphism, mineral assemblages and reaction relations used in conjunction with petrogenetic grids are more useful for determination of peak *P-T* and for establishing *P-T* paths. For example, in FMAS system, just sapphirine + quartz coexistence implies $T > 1050^{\circ}\text{C}$. We present data from one outcrop in which two sapphirine-bearing rocks are used to establish UHT conditions and the *P-T* path, using a KFMASH grid.

Geological setting: The Anápolis-Itaúçu Complex is part of the Neoproterozoic Brasília Fold Belt (metamorphic age 633 ± 28 Ma) of central Brazil. It is composed of mafic and felsic granulites and assorted granites. UHT metamorphic assemblages were recognized in four different outcrops. In one of them, UHT metamorphic assemblages occur in two different bulk compositions, quartz poor and quartz rich rocks, and sufficient information can be retrieved to establish peak *P-T* conditions and a reliable *P-T* path for cooling of these rocks, which is taken to be representative for the complex as a whole.

Mineral Assemblages: Mineral assemblages are described based on the succession of observed reaction relations for quartz poor and quartz rich rock. In addition to the separation of the samples into two compositional groups, some reaction relations are strongly controlled by bulk compositional domains that reflect the coarse grain size of the primary mineral assemblage of these rocks.

Sapphirine-bearing quartz poor assemblage. For sapphirine-bearing quartz poor rock, the primary mineral assemblage was orthopyroxene₁ + sillimanite + quartz (sillimanite and quartz are present in small quantities and only as inclusions in garnet) that reacted to form garnet₁ and cordierite₁ porphyroblasts. Garnet₁ reacted with remaining sillimanite producing sapphirine₁ + cordierite₂ + spinel₁ symplectites, then garnet₁ rims were replaced by sapphirine₂ + orthopyroxene₂ + cordierite₃ + spinel₃ symplectites in which the first two minerals are largely dominant.

Subsequently, orthopyroxene₂ + sapphirine₂ symplectites reacted with melt (or K-feldspar) to produce intergrowths of cordierite₄ + spinel₄ + biotite.

Sapphirine-quartz-bearing assemblage. For sapphirine-quartz-bearing rock the primary assemblage was orthopyroxene₁ + quartz + sapphirine that reacted to garnet₁ + cordierite₁. Sapphirine + quartz + garnet₁ reacted to intergrowths of cordierite₂ + sillimanite + spinel. In the next stage, garnet₁ rims were replaced by a corona of orthopyroxene₂ + cordierite₃ ± biotite due to reaction with melt or (K-feldspar). In a nearby outcrop, although no sapphirine is observed, cordierite₂ + sillimanite + spinel is common, which is the typical assemblage developed from quartz + sapphirine + garnet breakdown. Orthopyroxene₂ + cordierite₃ ± biotite in coronae around garnet are also common. Leucosome is widespread, from which we infer that melt promoted further reaction with Fe-Mg phases. Orthopyroxene + cordierite + melt reacted to garnet₂ + biotite₂ and garnet₁ + cordierite₁ reacted to sillimanite + biotite₃.

***P-T* path and peak conditions:** The reaction relations recorded in these rocks developed during a clockwise *P-T* evolution, where sapphirine was produced and consumed in appropriate compositional domains along a near-isothermal decompression stage from ~11 to ~9.5 kbar. The sapphirine + quartz + garnet + spinel + sillimanite + cordierite assemblage, which was stable in both bulk rock compositions, corresponds to the invariant point [Opx - Bt] in the KFMASH model system. This invariant is located at ~1060 °C and ~9.6 kbar [2], and is formed by intersection of the quartz free (coming from low *T* side) and quartz present (coming from high *T* side) reactions; it defines the metamorphic peak conditions. After the metamorphic peak, the rocks followed a near-isobaric cooling stage at *P* less than ~ 9.5 kbar, from ~1060 to ~700 °C, finishing with crystallization of new garnet, sillimanite and biotite due to reaction between Fe-Mg phases and melt. We suggest that melt loss occurred, changing the composition of the reaction volume and preventing total consumption of the UHT assemblages by reaction with melt.

References:

- [1] SL Harley (1998). *Geol. Soc. Spec. Pub.* **138**: 81 - 107. [2] P Bertrand, DJ Ellis & DH Green. 1991. *Contrib. Mineral. Petrol.* **108**: 55 - 71.