Monazite ages from carbonatites and high-grade assemblages along the Kambam Fault (Southern Granulite Terrane, South India)

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ABSTRACT

Monazite ages from carbonatites and high-grade assemblages exposed along a significant linear belt within the Southern Granulite Terrane of India termed the Kambam fault were obtained in thin section (in situ) using an ion microprobe. X-ray maps for Ce and Th were acquired in larger monazites to decipher the significance of the ages of individual spots within grains. The Kambam carbonatite contains large (millimeter-sized) apatite rimmed by ~10 μm thick bands of monazite. Monazite commonly appears as a lower-Th, late-stage mineral in carbonatites, and bands surrounding apatite are interpreted as products of metasomatism, rather than exsolution. The age of a Kambam carbonatite monazite band is 715 ± 42 Ma (Th-Pb, ±1σ), but monazite filling cracks within the apatite is ~300 m.y. younger (405 ± 5 Ma). The younger monazite grains are in contact with quartz, a mineral thought to be an indicator of subsolidus alteration in carbonatites. The age of the monazite rim is similar to ages of several carbonatites located 50–400 km further north, and chemical analyses show that this sample displays chemical trends similar to the other complexes (e.g., Y/Ho, Ce/Pb, REE, and HFSE patterns). The mid-Neoproterozoic event is recorded in garnet-bearing assemblages ~20 km west of the Kambam fault (733 ± 15 Ma) and garnet-bearing enclaves within Southern Granulite Terrane charnockites (701 ± 26 Ma; 786 ± 84 Ma). The results show that monazite can crystallize during metasomatism and be useful in deciphering fluid processes occurring at deeper crustal levels. The Kambam fault, which records over 300 million years of monazite growth, should be considered a major boundary in reconstructions of Gondwana.

Keywords: Carbonatite, geochronology, ion microprobe, monazite, Southern Granulite Terrane

INTRODUCTION AND GEOLOGIC BACKGROUND

Central to our understanding of Earth’s geologic, biological, and climatological history is knowledge of the assembly and dispersal of supercontinents. Large-scale structures identified in India’s Southern Granulite Terrane are speculated to extend onto other continents (e.g., Miller et al. 1996) and the region is ideal for developing models for the configuration and the evolution of supercontinents, particularly Gondwana. The Southern Granulite Terrane exposes charnockites, anorthosites, banded iron formations, carbonatites, pyroxene- and garnet-bearing granulites, pelitic gneisses, and calc-granulites (e.g., Mohan and Windley 1993; Janardhan and Anto 1997; Satish-Kumar and Santosh 1998; Sriramguru et al. 2002; Ghosh et al. 2004; Sajeev et al. 2004, 2006). These igneous and high-grade metamorphic rocks are considered windows into the lower to middle crust (e.g., Santosh 2003; Ajayakumar et al. 2006). Constraining the geochronologic and tectonic evolution of the Southern Granulite Terrane permits a better understanding of the petrologic evolution of these lithologies and the assembly of Gondwana overall (see Meert 2003).

The Southern Granulite Terrane is located south of the Fermor Line (Fermor 1936), which is considered the equivalent of the orthopyroxene isograd. The terrane is further divided into “northern” and “southern” blocks by the Palghat Cauvery Shear Zone (PCSZ) (Fig. 1) (e.g., Drury and Holt 1980; Drury et al. 1984; Harris et al. 1994; Yoshida et al. 1996; Jain et al. 2003; Santosh et al. 2003, 2004; John et al. 2005; Mishra et al. 2006). Some investigators consider the Southern Granulite Terrane to be located south of the PCSZ, which leads to confusion (e.g., Santosh 1996). The east-west-trending PCSZ is a right-lateral strike-slip fault, collision zone, and/or terrane boundary (Drury et al. 1984; Harris et al. 1994; Ghosh et al. et al. 2004; Senki and Kriegsman 2005; Chetty and Bhaskar Rao 2006; Shimpo et al. 2006; Rao and Prasad 2006). Many models for the construction of Gondwana use the PCSZ as a piercing point to link continental fragments. The structure may be the same as the Angavo Shear Zone in Madagascar (Yoshida et al. 1996; Ghosh et al. 2004), and/or divide the Rayner and Lutzow-Holm complexes in Antarctica (Harris et al. 1994; John et al. 2005). However, some investigators have suggested minor amounts of displacement along the structure (Ghosh et al. 2004).

This study focuses on the Madurai Block, located within the southern block, south of the PCSZ and north of the Anchankovil Shear Zone (Fig. 1) (e.g., Santosh 1996; Mohan and Jayananda...