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Metamorphic evolution of pelitic–semipelitic granulites in the Kon Tum massif (south-central Vietnam)

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ABSTRACT

Pelitic and semipelitic anatectic granulites form one of the major lithological units in Kan Nack complex of the Kon Tum massif (in south-central Vietnam), which comprises HT metamorphic and magmatic rocks including granulites and charnockites is classically regarded as the older part of the Gondwana-derived Indosinia terrain. Metamorphic evolution study of pelitic granulite, the most abundant among granulites exposed in this massif, facilitates to understand that tectonic setting take place during the Indosinian time. The paragenetic assemblages, mineral chemistry, thermobarometry and P–T evolution path of pelitic–semipelitic granulites from Kon Tum massif has been studied in detail. Petrographic feature demonstrates that the pelitic granulite experienced prograde history, from pregranulitic conditions in the amphibolite facies up to the peak granulitic assemblages. Successive prograde reactions led to the temperature-climax giving rise to assemblages with cordierite-hercynite and cordierite-hercynite-K-feldspar. Then, as attested by the mineralogic association occurring in cordieritic coronas, these rocks have been affected by retrograde conditions coeval with a decrease of the pressure. Thermobarometic results show that the highest temperature obtained by ksp/pl thermometry is 850 °C and the highest pressure obtained by GASP (Garnet Alumino-Silicate Plagioclase) is 7.8 kbar. The obtained clockwise P–T evolution path involving heating decompression, then nearly isothermal decompression and nearly isobar cooling conditions shows that high temperature–low pressure metamorphism of the studied pelitic anatectic granulites of Kan Nack complex occurred possibly in extensional setting during the Indosinian orogeny of 260–240 Ma in age.

1. Introduction

The Indosinian orogeny in late Permian and Triassic times (Fromaget, 1941) is the expression of the collision of different Gondwana-derived continental terrains (Indosinia, Sibumasu, and South China), after narrowing and suturing of different branches of the Paleotethys (Metcalfe, 1996; Lepvrier et al., 2004). The south-central area of Vietnam territory which corresponds to the Kon Tum massif (Fig. 1A) exposes widespread high temperature crystalline rocks subdivided into four lithological units: granulitic facies Kan Nack complex in the south-east; amphibolitic facies Ngoc Linh complex in central; greenschists-amphibolite facies Kham Duc complex in the north and – greeschists-amphibolite Sa Thay (Dien Binh) complex in the west, which is commonly regarded as an old and stable Precambrian basement (Phan Cu Tien et al., 1989). Because of the occurrence of high-temperature metasedimentary and igneous series comprising granulites and charnockites, this massif has classically been interpreted as a fragment of Gondwana, equivalent in age to the same facies rocks which are exposed in southern India and Antarctica (Katz, 1993). However, recent isotopic data show that the Kon Tum basement was affected by Permo-Triasic tectono-metamorphic event (Tran Ngoc Nam et al., 2001; Nagy et al., 2001; Osanai et al., 2001; Maluski et al., 2005).

There is now a broad recognition of the variety of P–T paths and tectonic settings to be found in granulite-facies terrains. It was firstly assumed that granulitic rocks in orogenic belts typically experienced a crustal thickening (England and Richardson, 1977). Some models were proposed to account for type of retrograde path such as: metamorphism in extensional terrains (Sandiford and Powell, 1986) or in terrains heated by the addition of voluminous magmas (Bohlen, 1987). When parts of the prograde history (isobaric heating) could be detected, it suggests that magmatic

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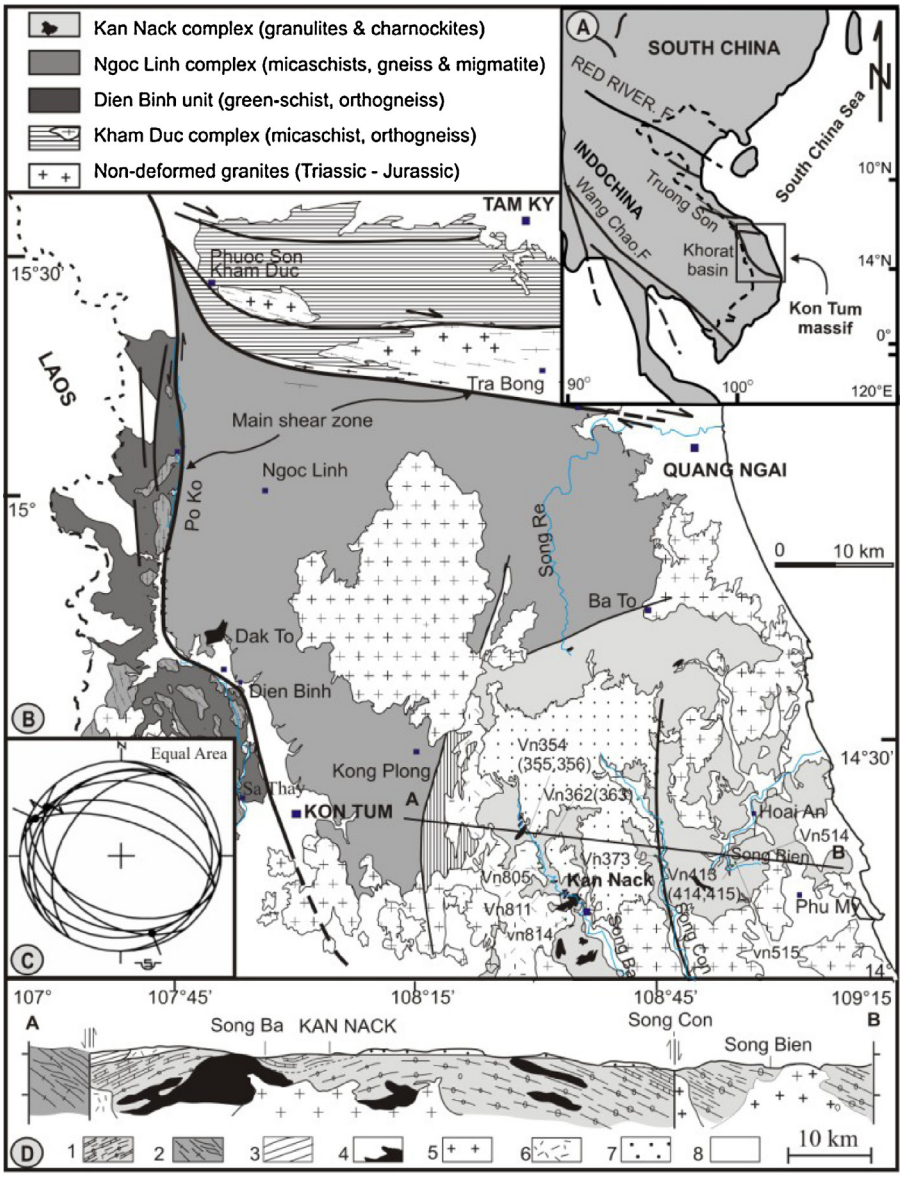

Fig. 1. (A) Location of the Kon Tum massif; (B) geological sketch map of the Kon Tum Massif and more detail of the Kan Nack complex (modified after Phan Cu Tien et al., 1989); (C) folliation data from the Kan Nack complex (along the Song Ba and the Song Bien reiver); (D) Interpretative section of the Kan Nack complex [1. granulites; 2. gneiss, micaschists (the Ngoc Linh Complex: Metamorphic cover of the Kan Nack Complex); 3. Paleozoic sediment; 4. charnockites; 5. Undeformed granites (Late Triassic and Cretaceous); 6. Cenozoic basalts; 7. Mesozoic sediments; 8. quaternary sediments], Vn811 sample location.

accretion had played an important role in heat advection (Sandiford and Powell, 1986).

Previous studies have given an idea of the global evolution of the area, but the diversity in protolith of granulites from different places obtained by previous works (Osanai et al., 2004) show that the thermo-tectonic setting of the Kon Tum massif is more complicated in detail. Moreover, the large exposure of pelitic and semipelitic anatectic granulites (granulite leucosomes) in the Kon Tum basement which is important to understand tectono-metamorphic setting, which has not been studied in detail. The question therefore has to be asked, is the metamorphic P–T path of metapelitic granulitic leucosomes observed in the Kan Nack complex a single isothermal decompression and decompression cooling path or does it reflect a prograde (decompression heating) and isothermal decompression? So, detailed petrogenetic data are needed to constrain tectono-metamorphic evolution of this area.

In the this paper, we present here detailed petrography, mineral assemblage, and mineral chemistry of the Kan Nack pelitic granulites in order to understand the metamorphic history through reaction textures observed combining with P–T trajectory and thermobarometric calculations. This data will be interpreted in the light of previous works (geochronology data) in order to discuss more about the thermo-tectonic evolution of the Kon Tum massif and its role during the Indosinian orogenic evolution.

2. Geological setting of the Kon Tum massif and the Kan Nack complex

The studied area (Kon Tum massif) is located in south-central Vietnam (Fig. 1A). The Kon Tum massif exposes a large scale of crystalline rocks. It consists of mainly metasediments and orthogneisses, which were metamorphosed in amphibolitic and granulitic facies (Phan Cu Tien et al., 1989). This metamorphic basement is covered from place to place by Paleozoic-Mesozoic sediments or even directly by Neogene to Quaternary lava flows (Lee et al., 1998), and intruded by undeformed Jurassic-Triassic