



U–Pb and Hf isotopic study of zircons from migmatised amphibolites in the Cathaysia Block: Implications for the early Paleozoic peak tectonothermal event in Southeastern China

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ABSTRACT

Amphibolites occur in a number of localities in the Cathaysia Block, some of them have been migmatized and their protoliths represent basaltic magmas erupted in various tectonic settings. Four migmatized amphibolites were collected from Jiangxi and Fujian Provinces. Cathodo-luminescence images of zircons extracted from the representative amphibolites show unzoned or sector-zoned structure. LA-ICP-MS analysis indicates that most zircons have high Th/U ratios and yield U–Pb zircon ages of 446 ± 5 , 435 ± 2 , 434 ± 4 and 423 ± 2 Ma, respectively. Lu–Hf isotopic analysis on these zircons gives Hf model ages ranging from 900 to 1200 Ma. Based on lithological observations and previously published geochronological data, we interpret that these U–Pb ages record an important tectonothermal event that led to the migmatization. This early Paleozoic (Caledonian) tectonothermal event in the Southeastern China has a great tectonic implication for the evolutionary history of the Cathaysia Block.

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1. Introduction

The basement of the Cathaysia Block is mainly composed of greenschist- to low amphibolite-facies gneisses and amphibolites. These rocks are generally migmatized and assigned to the Paleo- to Meso-proterozoic, some of which may be as old as ~ 2.5 Ga (JXBGMR, 1984; FJBGMR, 1985; Chen and Jahn, 1998; Zhuang et al., 2000). This continental block was possibly amalgamated with the Yangtze Craton in the Neoproterozoic (“Jinningian movement”, Charvet et al., 1996; Wang et al., 2007a, 2008; Li et al., 2008; Zhou et al., 2009; Munteanu et al., in press) and involved in several later tectonic events, including the Late Ordovician–Silurian (“Caledonian”, Shu et al., 1991; Shu, 2006; Ren, 1991; Wang et al., 2007b), Late Permian–Triassic (“Indosinian”, Chen, 1999; Wang et al., 2002, 2005) and Middle Mesozoic (“Yanshanian”, Zhou and Li, 2000; Li et al., 2009) events.

The early Paleozoic (late Ordovician–Silurian) tectonothermal event was characterized by the voluminous Silurian-age granites and migmatites unconformably overlain by the middle-upper Devonian strata (JXBGMR, 1984; FJBGMR, 1985; GDBGMR, 1988). The migmatites

generally have banded structure, and are composed of intermingled leucosome and melanosome components. Veins, micro-folds and irregular pods of silica-rich leucosome occur within foliated dark-colored metamorphic rocks such as gneiss, schist and amphibolite. Because migmatites generally occur in tectonic settings where continental crust is subject to very high temperatures/pressures (Brown, 1994, 2001a,b; Kalsbeek et al., 2001), defining the timing of migmatization is significant for understanding of the nature of the tectonothermal event.

Previous studies on the early Paleozoic tectonothermal event were predominantly focused on granites (Zeng and Liao, 2000; Wu and Zhang, 2003; Lou et al., 2005; Wang et al., 2007b) and some attention was paid to the migmatites with metapelitic protolith (Huang et al., 1994; Zhou, 1997; Chen and Huang, 1994). There is no systematic study on the migmatized amphibolites, although their possible protoliths have been discussed (e.g. Li et al., 1998; Hu and Liu, 2002; Deng, 1997; Yu et al., 1999). In this paper, we present LA-ICP-MS U–Pb zircon dating results for the migmatized amphibolites in the Cathaysia Block to determine the timing of the migmatization process. The geochemical and Lu–Hf isotopic compositions of these rocks were also analysed to study the characteristics of their protoliths. Our data provide new and independent constraints on the migmatization process during the early Paleozoic tectonothermal event in Southeastern China.

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2. Geological background

South China is composed of the Yangtze Block in the northwest and the Cathaysia Block in the southeast. The Precambrian basement of the Cathaysia Block is mainly exposed in an area between the Jiangshan–Shaoxing–Pingxiang and Lishui–Haifeng Faults in NW Fujian and SW Zhejiang Province (Li et al., 2000) (Fig. 1), and is composed of Proterozoic schists, gneisses and migmatites with clastic, volcanic and plutonic rocks as their protoliths (Shu, 2006). The metavolcanic and metasedimentary rocks of varying ages underwent extensive overprinting during subsequent tectonothermal events (Zeng et al., 2008; Xiang et al., 2008). The early Paleozoic overthrust and ductile strike-slip shearing were developed in this area and the kinematic pattern of ductile deformation shows northwest to southeast overthrust in the southeast Wuyi Mountains and south to north overthrust in the north Wuyi Mountains, displaying a flower-shaped structural style (Shu et al., 2008). The amphibolites-bearing Precambrian strata include the Paleoproterozoic Tianjingping Formation and Mayuan Group in NW

Fujian Province, Badu Group in SW Zhejiang Province and Yunkai Group in SW Guangdong Province and Neoproterozoic Zhoutan Group in central Jiangxi Province (JXBGM, 1984; FJBGM, 1985; GDBGMR, 1988; ZJBGM, 1989). Geochemical data show that the protoliths of these amphibolites were basaltic rocks formed in different tectonic environments. The amphibolites in Tianjingping Formation, Mayuan Group and Badu Group are possibly metamorphic products of within plate basalts (Li et al., 1998; Li et al., 2000), the protoliths of the amphibolites in Yunkai Group are thought to be fragments of oceanic floor (Qin et al., 2006), and the protoliths of the amphibolites in Zhoutan Group were basalts probably formed in an island-arc tectonic setting (Hu et al., 1999). Some of these amphibolites have experienced migmatization processes, which are collected for this study including those from the Zhoutan Group in Yiyang County, central Jiangxi Province, Tianjingping Formation in Jianning County, and Mayuan Group in Pucheng County, NW Fujian Province. These migmatized amphibolites, moderate to fine-grained in size, are composed predominantly of hornblende, locally intercalated with the metasedimentary

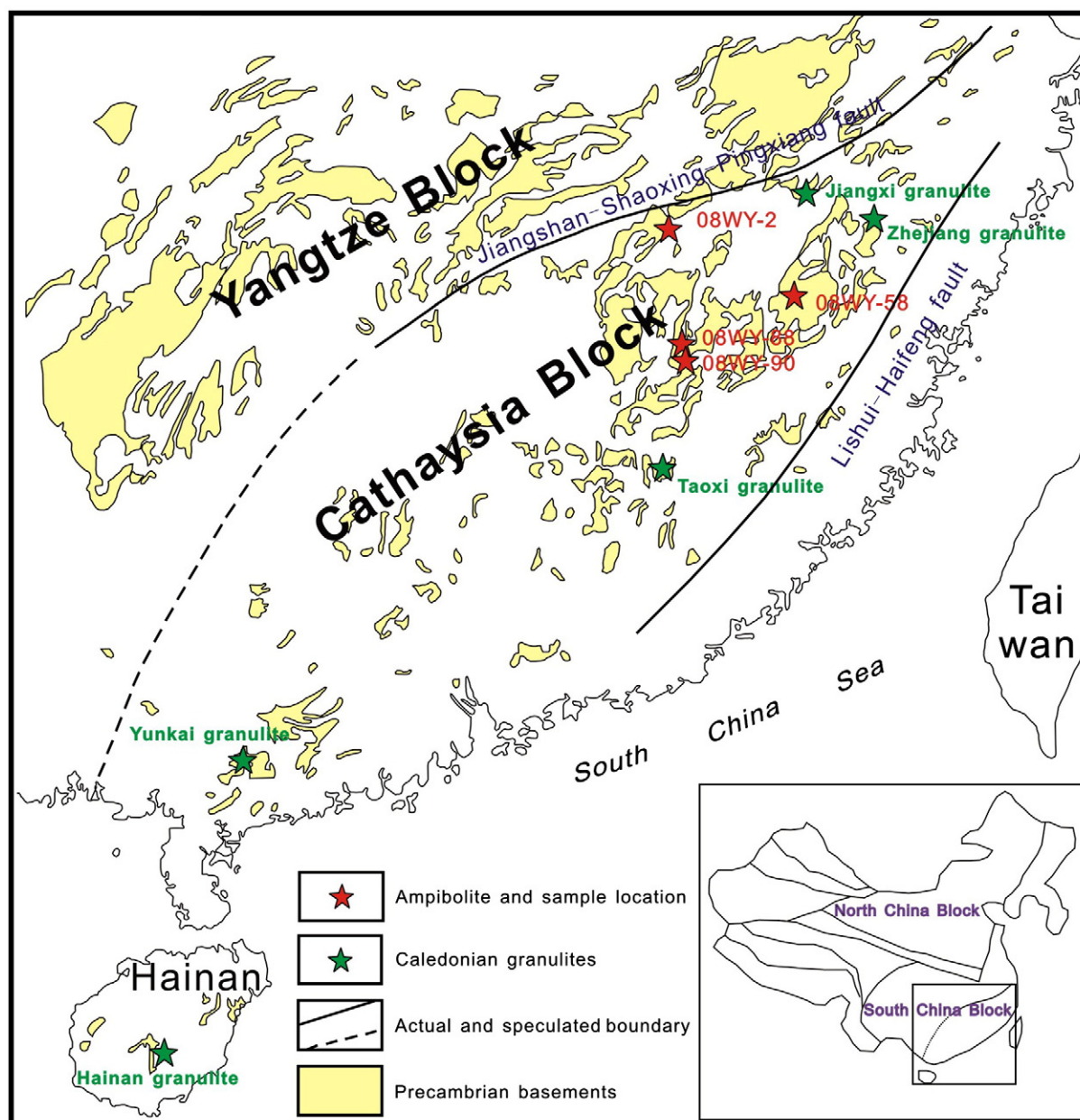


Fig. 1. Simplified geological map of the basement of the Cathaysia Block showing the distribution of the migmatized amphibolites (modified after Yu et al., 2007).

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