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LA-ICP-MS U-Pb zircon geochronology of the Neoproterozoic igneous rocks from Northern Guangxi, South China: Implications for tectonic evolution

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Abstract

The western end of the Proterozoic Jiangnan orogen is located at the Northern Guangxi, South China. Neoproterozoic granitoids are dominant (>90%) in the area, with ca. 8% being the mafic-ultramafic rocks. The generation of these igneous rocks was previously considered to be related to a mantle plume (or superplume) event that led to the breakup of the Rodinia supercontinent. In this work, we present new laser ablation-ICP-MS U-Pb zircon data for the igneous rocks from Northern Guangxi. The ages for the Zhaigun, Bendong, Dongma, Sanfang and Tianpeng granitic plutons are 835.8 ± 2.5, 822.7 ± 3.8, 824 ± 13, 804.3 ± 5.2 and 794.2 ± 8.1 Ma, respectively, and the Hejiawan layered diabases are 811.5 ± 4.8 Ma. These ages indicate a broad duration of magmatic activities (ca. 35 million years), inconsistent with plume models that predict widespread magmatic eruption and emplacement within period of 1–5 million years. The granitoids in Northern Guangxi are typical S-type granites with high ACNK values (1.10–1.87), and are generally plotted in the collision-related areas in the tectonic discrimination diagrams. They should not be the products of the mantle plume activity. On the contrary, they might be related with the continent–continent collisional orogeny between the Yangtze and Cathysia blocks. A total of eight spot analyses of zircon cores and two from single zircon xenoliths gave early Neoproterozoic ages ranging from ca. 870–950 Ma. These ages might record subduction or collision-related magmatic events during 950–870 Ma in Northern Guangxi. Combined with previous geochronological and geochemical data, our new dating results support post-collisional extension, instead of mantle plume or superplume model, for the genesis of 835–800 Ma granites and mafic rocks in Northern Guangxi. The upwelling of deep mantle due to the detachment of subducted slab and the delamination of the lithosphere might cause partial melting of the continental crust to generate S-type granites. The continent–continent collisional orogenic event along the Jiangnan orogen may have spanned ca. 70 million years from 870 to 800 Ma, and the early Neoproterozoic subduction might last for ca. 130 million years. It is proposed that South China might have been located at the western margin in the Rodinia supercontinent during the period of ca. 870–800 Ma.

Keywords: LA-ICP-MS U-Pb zircon dating; Igneous rocks; Post-collisional; Neoproterozoic; Northern Guangxi of South China

1. Introduction

In the last decade, the Precambrian evolution of South China during the formation and breakup of the Rodinia supercontinent has been a focus of much debate and

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controversy (Evans et al., 2000; Li XH et al., 2003; Li ZX et al., 1995, 1999, 2003, 2004; Zhao and Cawood, 1999; Zheng, 2004; Zhou et al., 2002, 2004; Wang et al., 2004a,b). It was suggested that South China lay between the eastern side of the Australian craton and the western side of Laurentia and might be an important element in the reconstruction of the Rodinia supercontinent (Li et al., 1995). Based on geochronology for the mafic to ultramafic dykes from Northern Guangxi Province of South China and correlations with the Gairdner Dyke Swarm (GDS) in central-southern Australia, Li et al. (1999) proposed that a mantle plume centered beneath South China initiated the rifting of Rodinia at about 820 million years ago. A more comprehensive superplume model was recently proposed by Li ZX et al. (2003, 2004) to explain the breakup of Rodinia. However, the mantle plume hypothesis has been questioned by several authors (Yan et al., 2002; Jiang et al., 2003; Wang et al., 2004a,b; Zhou et al., 2002, 2004).

The Neoproterozoic igneous rocks of South China, especially those distributed along the southeastern margin of the Yangtze Block (or the 'Jiangnan orogen'; Fig. 1a), became the key to understanding the evolution of South China at this time. Two possible explanations for their genesis and tectonic settings are: (1) the coeval and bimodal magmatism was initiated by a mantle plume

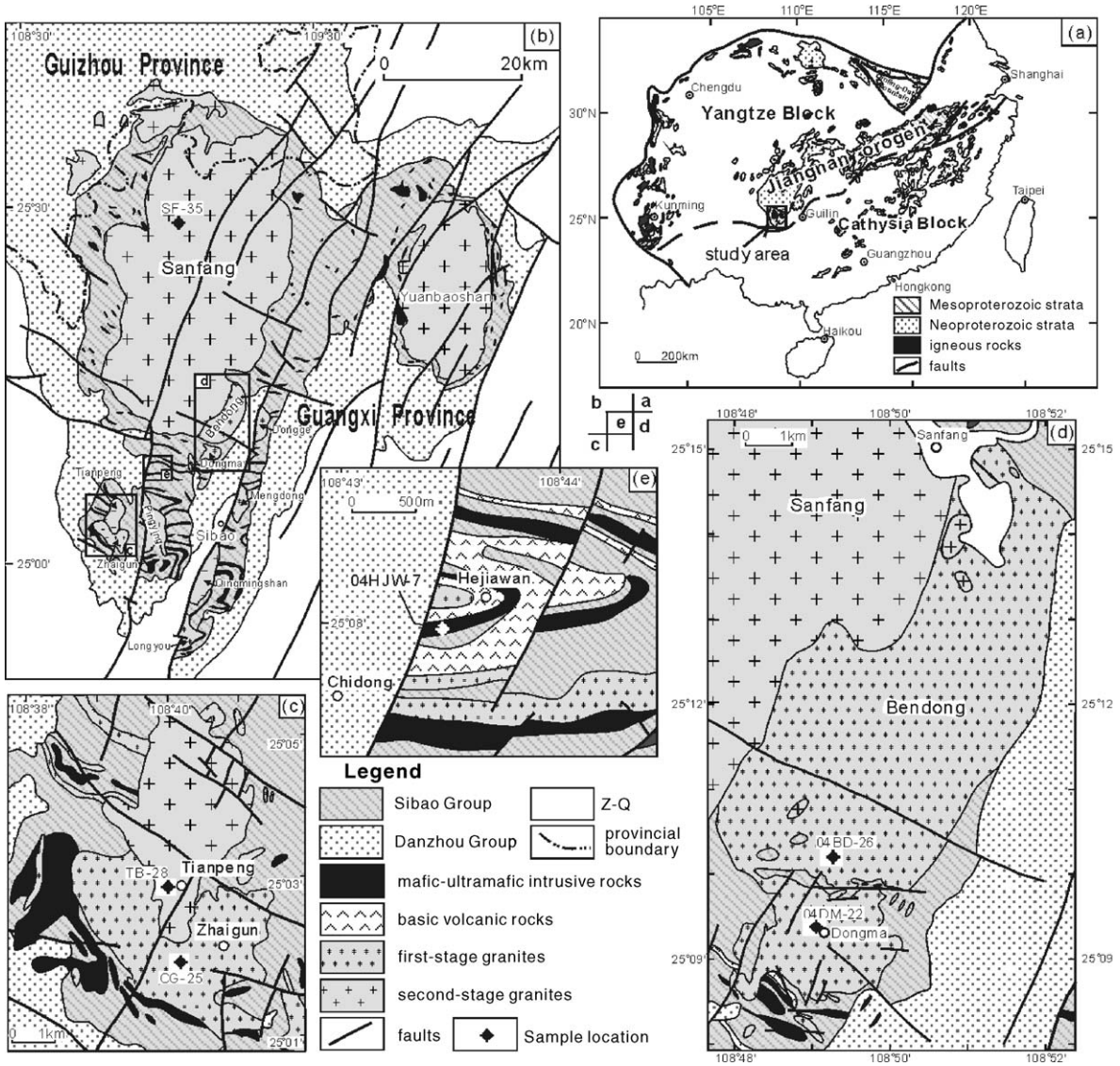

Fig. 1. Geological map of the igneous rocks from Northern Guangxi, South China (modified after GXRGST, 1987, 1995; Chen et al., 1995; Wang, 2000). (a) South China; (b) Northern Guangxi; (c) Tianpeng and Zhaigun plutons; (d) Bendong and Dongma plutons; (e) Hejiawan bedding diabase.