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Triassic three-stage collision in the Paleo-Tethys: Constraints from magmatism in the Jiangda–Deqen–Weixi continental margin arc, SW China ☆

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ABSTRACT

Triassic volcanic rocks in the Jiangda–Deqen–Weixi continental margin arc (DWCA) in the Sanjiang area of SW China formed as a result of the closure of the Paleo-Tethys and associated continental collision, and are therefore important for reconstructing the evolution of the Paleo-Tethys. Representative samples of rhyolite and basalt from the Jijiading–Luchun–Yezhi area yield weighted mean $^{206}Pb/^{238}U$ ages of 245–249 Ma and 245 Ma, respectively, and exhibit the features of bimodal volcanic rocks. The mafic rocks are enriched in large ion lithophile elements (e.g., Rb, Ba, U), are depleted in high field strength elements (e.g., Nb, Ta, Ti), and have low $\varepsilon_{Nd}(t)$ values (−3.55 to −3.69) and high initial $^{87}Sr/^{86}Sr$ values (0.70788–0.70804). The mafic rocks were formed by partial melting of an enriched lithospheric mantle source that had been metasomatized by fluids derived from subducted sediments. The felsic rocks are characterized by high K_2O (K_2O/Na_2O = 2.16–71.33) and A/CNK (>1.1), and low Mg# (20–45) and $\varepsilon_{Nd}(t)$ values (−9.61 to −10.66), with zircon $\varepsilon_{Hf}(t)$ values of −8.1 to −16.6. Their old Nd model ages are similar to those of ancient Yangtze basement, indicating that they formed by partial melting of this ancient crust as a result of underplating by basaltic magma. We suggest that the bimodal volcanic rocks in the DWCA formed in an extensional setting as a result of slab break-off during a margin of arc–continent collision. The present results, combined with previous data, reveal three stages of collision in the Paleo-Tethys: early collision convergence (~255–250 Ma), syn-collision extension (249–237 Ma), and late collision orogenesis (236–212 Ma).

1. Introduction

The Jinsha River orogenic belt in the Sanjiang area of SW China forms part of the giant Paleo-Tethys orogenic belt. It lies in the transitional area between the Tibetan Plateau and the Yangtze Block (Fig. 1a, b) (Wang et al., 2002a; Pan et al., 2012; C.M. Wang et al., 2013; L.Q. Wang et al., 2013). This orogen comprises a series of N–S trending, ophiolite-decorated suture zones and flanking magmatic belts that constitute the dominant geological feature of the region (Zi et al., 2013). The western part of the Jinsha River orogenic belt comprises the Changdu–Simao Block (Fig. 1a, b) (Wang et al., 2002a). The eastern margin of the belt is bounded by the Jinsha River, immediately to the east of which lies the Zhongzan–Zhongdian Block, which split from the western margin of the Yangtze Block. Previous biostratigraphic and geochronological studies of the Jinsha River ophiolite sequence indicate that the Jinsha River Ocean opened during the Early Devonian–Carboniferous, and started to be subducted during the Permian (Li et al., 2010; Pan et al., 2012; Zi et al., 2012b; L.Q. Wang et al., 2013). The Triassic volcanics and sediments in the DWCA are unconformably overlain by Upper Triassic foreland-basin molasse, indicating that the Paleo-Tethys closed along the Jinsha River suture during the Late Triassic (Pan et al., 2012; L.Q. Wang et al., 2013). However, the precise timings of, and the processes involved in, the arc–continent or continent–continent collisions during the evolution of the Paleo-Tethys remain controversial. Some researchers have suggested that the Jinsha River Ocean slab continued to subduct during the Late Triassic, based on studies of the Haxiu quartz diorite and the Yushu volcanic rocks (Chen et al., 2005; Yang et al., 2012). Other investigators have proposed a post-collision extensional tectonic setting in the DWCA during the Early Triassic (Wang et al., 2011; Zhang et al., 2011). Most recently, Zi et al. (2012a, 2013) suggested that the initial collision of the Jinsha River suture zone took place during the Early Triassic.

The Jiangda–Deqen–Weixi continental margin arc (DWCA) in the northern Jinsha River suture zone contains Triassic volcanic rocks and

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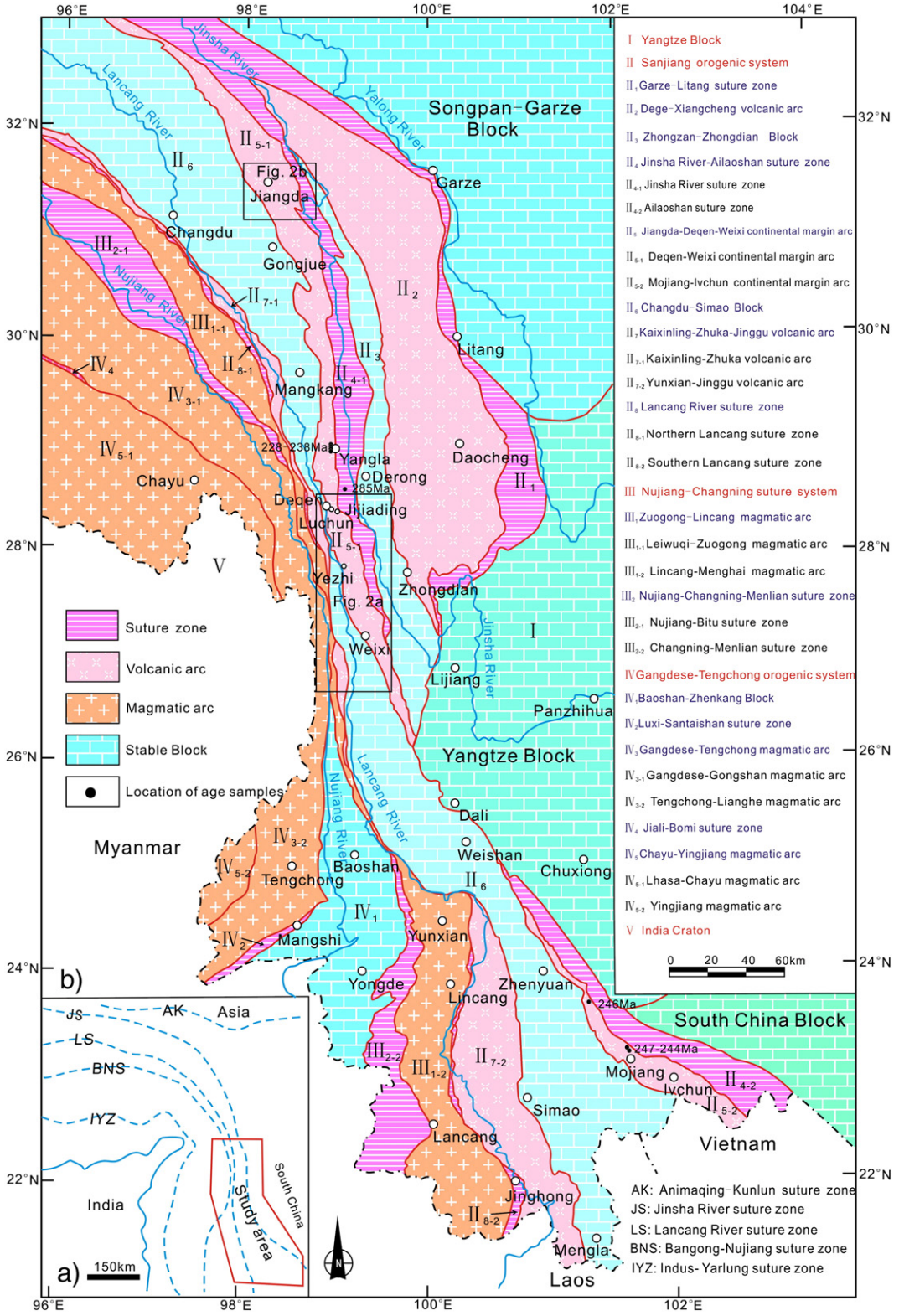

Fig. 1. Geological map showing (a) the tectonic framework and (b) a simplified geological map of the Sanjiang Orogen and surrounding areas (modified from Deng et al., 2012). Radiometric ages of the Triassic magmatic bodies in the Jinsha River–Ailaoshan belt are marked.
Data are from Jian et al. (2008), Wang et al. (2010), Liu et al. (2011), and J.J. Zhu et al. (2011).

a granitic basement that extend for several thousand kilometers, forming an important tectonic–magmatic belt in the Sanjiang area. These magmatic rocks are generally regarded as resulting from arc–continent collision of Paleo-Tethys, and are therefore important in understanding and reconstructing the processes that took place during orogenesis and collision in the Sanjiang area following the closure of