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Triassic collision in the Paleo-Tethys Ocean constrained by volcanic activity in SW China

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ABSTRACT

A suite of collision-related Triassic volcanic rocks cropping out within the Jinshajiang–Ailaoshan orogenic belt in SW China offers insights into closure of the Paleo-Tethys and associated terrane/continent collision. Combined geochemical and Sr–Nd isotopic data for samples from the Jinshajiang segment demonstrate that the lower part of the volcanic suite is dominated by high-Si rhyolites (the Pantiange Formation) derived through crustal anatexis; whereas the upper units (the Cuiyibi Formation) are characterized by basalts alternating with intermediate-felsic lavas that share similar Sr–Nd isotopic signatures, and may have originated from partial melting of subduction-enriched lithospheric mantle. SHRIMP U–Pb analyses on zircons yield ages of 247–246 Ma for the rhyolites of the Pantiange Formation, and ages ranging from ca. 245 Ma to 237 Ma for the basaltic and intermediate-felsic samples from the overlying Cuiyibi Formation. These data, integrated with other geologic evidence (e.g., stratigraphic record), suggest an Early-Middle Triassic timing of terrane–continent collision along the Jinshajiang and Ailaoshan sutures with the 247–246 Ma Pantiange high-Si rhyolites representing the early magmatic products generated by this event. The development of the 245–237 Ma bimodal volcanism was associated with subsidence and deep-marine sedimentation. We interpret this as reflective of an extensional setting within an evolving collisional orogen, probably related to oblique convergence along the collisional zone. Triassic volcanic rocks with similar geochemical signatures and ages have been identified along the >1000 km length of the Jinshajiang–Ailaoshan suture zone. The Indochina block to the south of the suture records 250–240 Ma tectonothermal activity. Taken together, these relationships suggest that initial collision and amalgamation of the Qamdo–Simao terrane (Indochina) with the Yangtze Block (South China) along the Jinshajiang–Ailaoshan and Song Ma sutures probably took place in the Early Triassic following consumption of the Paleo-Tethys Ocean.

1. Introduction

The Jinshajiang–Ailaoshan orogenic belt in SW China constitutes an important part of the expansive Tethyan–Himalayan domain (Allegre et al., 1984; Boulin, 1991; Sengor, 1981, 1987; Zhong, 2000). The belt contains ophiolitic mélange zones and fringing volcanic belts that extend from northeastern Tibet to peninsular Indochina (Mo et al., 1993). The sutures marked by ophiolite mélange represent an ancient plate boundary that separated the Yangtze Block of South China from micro-continental blocks (e.g., Qamdo–Simao and Indochina) within the Paleo-Tethys archipelagic ocean. Previous biostratigraphic and geochronological studies on the Jinshajiang and Ailaoshan ophiolite sequences have revealed that this branch of the Paleo-Tethys opened and spread from the Late Devonian to Early Carboniferous (Metcalfe, 1998, 2006; Pan et al., 2003; Wang et al., 2000; Zhong, 2000), with closure and associated subduction zone magmatism during the Early to Late Permian (Jian et al., 2009b; Zi et al., 2012a).

Unraveling the timing and geometry of the Jinshajiang–Ailaoshan suture is hindered by structural overprinting and displacement caused by younger deformation related to the Tertiary indention of India into Eurasia, and a lack of knowledge of the tempo-spatial pattern of collision-related magmatism. Closure of the Paleo-Tethys Ocean along the Jinshajiang–Ailaoshan suture has generally been assumed to have occurred in the Late Triassic, on the basis of an angular unconformity at the base of the Upper Triassic sequence (Pan et al., 2003; Wang et al., 2000). Nevertheless, prior to the Late Triassic (Carnian–Norian) unconformity, there exists an earlier unconformity between the uppermost Paleozoic and Triassic strata (BGMRY, 1990). Data from the Jinshajiang–Ailaoshan

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orogenic belt and the adjoining areas reveal the prevalence of tectonic or magmatic activity during the Early Triassic, for example: volcanic rocks from Deqen in the Jinshajiang segment and Lvchun in the Ailaoshan segment yielded zircon ages of 249–247 Ma (Liu et al., 2011 and Wang et al., 2011); an Early-Middle Triassic tectonothermal event (culminating at 250–240 Ma) recorded by the basement rocks in the Truong Son belt and Kontum Massif of Vietnam is interpreted to represent a synchronous, oblique collision of Indochina with both the Sibumasu terrane and South China Block (Carter et al., 2001; Lepvrier et al., 2004; Lepvrier et al., 2008).

Here we report on the Triassic volcanic rocks associated with the Jinshajiang segment of the Paleo-Tethys suture and associated continental collision. The results provide robust constraints on the age, nature and genesis of these rocks which, in combination with evidence from the contemporaneous sedimentation, deformation and metamorphism, enable us to better understand their geodynamic setting and tectonic

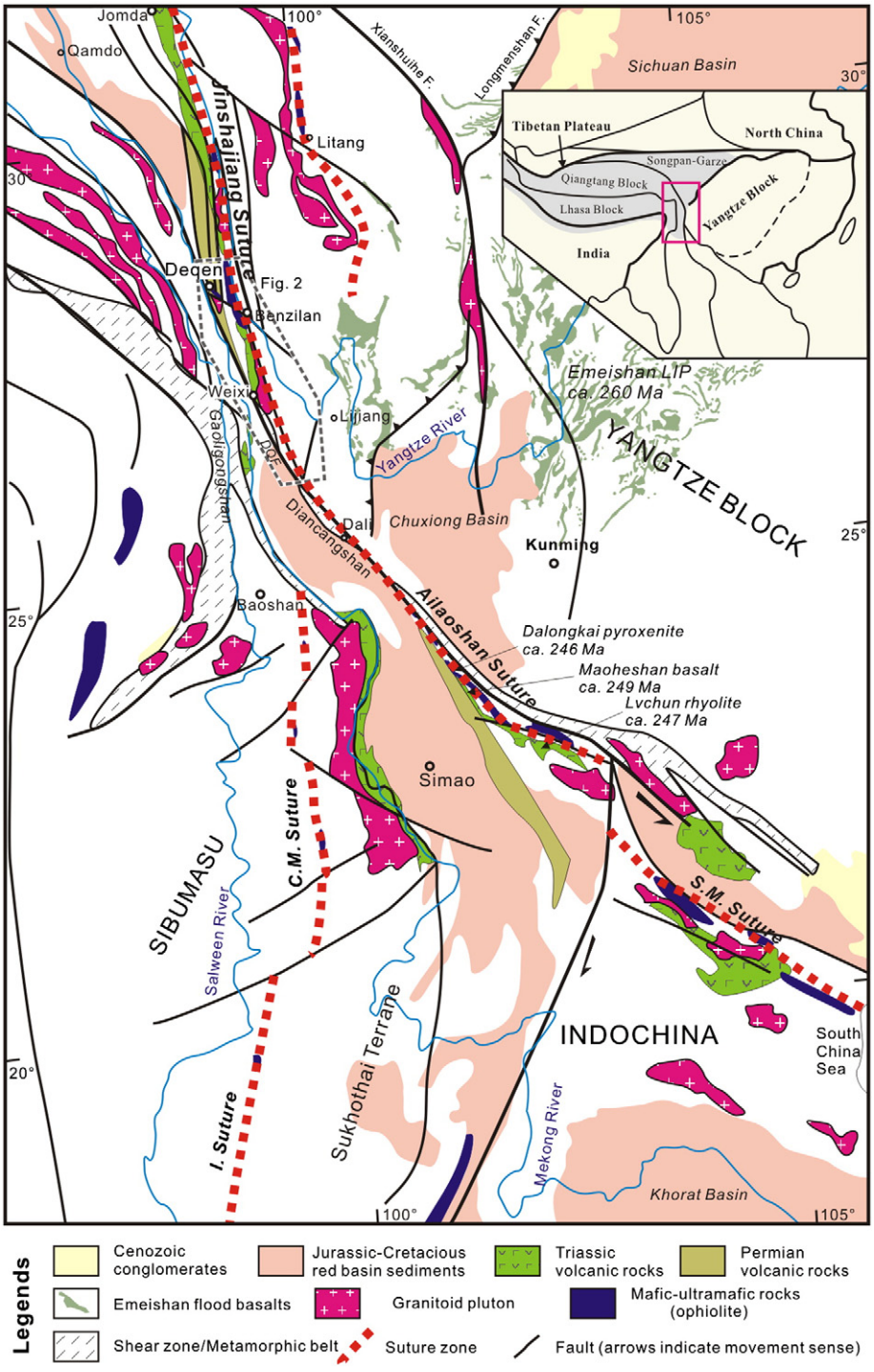

Fig. 1. Simplified geological map of the Sanjiang Orogen and surrounding areas. The Jinshajiang Suture, Ailaoshan Suture and S.M. Suture (Song Ma Suture) are considered to be contiguous and mark the boundaries between the Yangtze Block and Qamdo–Simao and Indochina blocks. Radiometric ages of the Triassic magmatic bodies in the Ailaoshan belt are marked, data source: Dalongkai pyroxenite from Jian et al. (2009b), Maoheshan basalt and Lvchun rhyolite from Liu et al. (2011). Other sutures representing the remnants of Paleo-Tethys are also indicated, including G.L. Suture (Garze–Litang Suture), C.M. Suture (Changning–Menglian Suture) and I. Suture (Inthanon Suture).