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Geochronology, petrogenesis and tectonic significance of the Jitang granitic pluton in eastern Tibet, SW China

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ABSTRACT

The Jitang granitic pluton, which is situated in the southern margin of the North Qiangtang block in eastern Tibet, may provide critical information about the source and derivation of the North Qiangtang block during Gondwana breakup and dispersion. In this paper we report relevant data such as zircon U–Pb age, whole-rock major and trace element abundances, and Sr–Nd isotopes for the Jitang pluton. The major rock types of the pluton are granodiorite and biotite granite. Whole-rock major element data reveal that the Jitang pluton is a peraluminous S-type granitic pluton. The U–Pb age of zircons from the pluton is 219.1 ± 1.7 Ma, which is ~10 Ma younger than the age of high-pressure metamorphism in the Longmu Co–Shuanghu collisional suture between the North and South Qiangtang blocks. The Jitang granitoids show pronounced negative Ba–Eu–Sr anomalies, high initial $^{87}Sr/^{86}Sr$ ratios from 0.7266 to 0.7389 and low $\varepsilon_{Nd}(t)$ values for from −11.1 to −13.2, which are remarkably similar to the gneisses and meta-sedimentary rocks from the Indian craton as well as the North Qiangtang block. The results from this study indicate that the Jitang granitoids formed by melts derived from a crustal source with Sr–Nd isotopic compositions similar to those of the Indian cratonic crust. We concur with the previous interpretation based on detrital zircon records that the North Qiangtang block was derived from the Indian Gondwana.

1. Introduction

The Sanjiang (Jinshajiang, Lancangjiang and Nujiang) region in eastern Tibet and Yunnan province is a collage of Gondwana-derived micro-continents, Paleozoic arc terranes and the remnants of Tethys oceans (Deng et al., 2013; Metcalfe, 2013; Yin and Harrison, 2000; Zhu et al., 2013). The different continental blocks are separated by sub-parallel suture zones stretching over 1000 km from Tibet to Yunnan, SW China (Fig. 1a). Among all of the micro-continental blocks in this region, the derivation of the Simao and North Qiangtang blocks is most enigmatic. Some researchers have suggested that the two micro-continental blocks were derived from the South China block based on Permian bio-strata correlation (Metcalfe, 2002, 2013; Zhang et al., 2013). Other researchers have proposed that they were derived from the Indian Gondwana based on detrital zircon records (He et al., 2011; Pullen et al., 2008; Usuki et al., 2012; Wang et al., 2013; Zhu et al., 2013). Triassic granitoids within the Simao and North Qiangtang blocks such as the Lincang batholith and the Jitang pluton may provide important information about the derivation of the micro-continental blocks during Gondwana breakup and dispersion, because different crustal sources commonly have different trace element and Sr–Nd isotope signatures. For this purpose we have carried out an integrated geochronological, petrological and geochemical study of the Jitang granite pluton which occurs in the southern margin of the North Qiangtang block, eastern Tibet (Fig. 1b).

2. Geological background

Abundant granitoids including the Jitang pluton and the Lincang batholith occur along the Longmu Co–Shuanghu collisional suture between the North and South Qiangtang blocks in eastern Tibet and along the Changning–Menglian collisional suture between the Simao and Baoshan blocks in Yunnan province, respectively (Fig. 1b). There is a general consensus that the micro-continental blocks on the south or west side of these sutures were derived from the Australian Gondwana (Deng et al., 2013; Metcalfe, 2013; Zhu et al., 2013). The micro-continental blocks on the north or east side of the sutures may have been derived from the Indian Gondwana (He et al., 2011; Pullen et al., 2008; Usuki et al., 2012; Zhu et al., 2013) or from the South China block (Metcalfe, 2002, 2013; Zhang et al., 2013).

Available geochronological data show that most of the granitic plutons in the Simao and North Qiangtang blocks are contemporaneous, with ages varying between 210 and 230 Ma. For examples, the Rongma granite pluton along the western segment of the Longmu Co–Shuanghu suture has an Ar–Ar age of ~215 Ma (Liu et al., 2011), the Dongdashan

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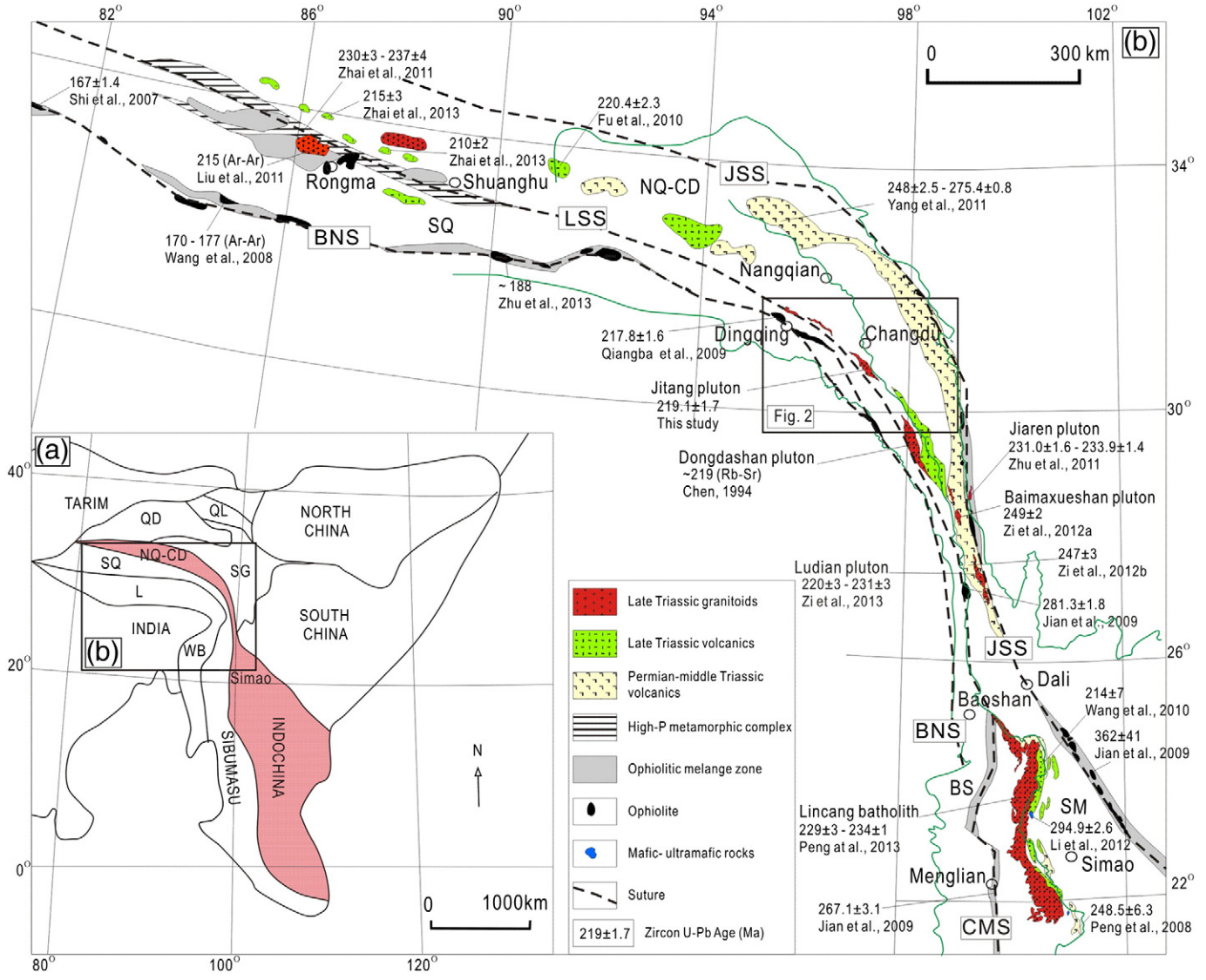

Fig. 1. Continental blocks of SE Asia (a) and simplified geological map of eastern Tibet and Sanjiang region (b) (modified from Li et al., 2012; Deng et al., 2013; Zhu et al., 2013. The ages are from Fu et al., 2010; Jian et al., 2009 ; Qiangba et al., 2009; Shi, 2007; Wang et al., 2008; Wang et al., 2010; Zhai et al., 2013; Zhu et al., 2011; Zi et al., 2013; etc. as showing in the figure). Sutures: *JSS*, Jinshajiang suture; *LSS*, Longmu Co–Shuanghu suture; *CMS*, Changning–Menglian suture; *BNS*, Bangong–Nujiang suture. Continental blocks: *NQ*, North Qiangtang; *SM*, Simao; *SQ*, South Qiangtang; *BS*, Baoshan; *WB*, West Burma; *L*, Lhasa; *SG*, Songpan Ganzi; *QD*, Qaidam; *QL*, Qilian.

granitic pluton along the eastern segment of the Longmu Co–Shuanghu suture has a Rb–Sr isochron age of ~219 Ma (Chen et al., 1994), the Lincang batholith along the Changning–Menglian suture zone has zircon U–Pb ages from ~210 to ~230 Ma (Dong et al., 2013; Peng et al., 2006, 2013). Abundant granitoids with slightly older ages occur along the Jinshajiang suture to the east (Fig. 1b). For examples, the zircon U–Pb ages of the Baimaxueshan and Ludian granitic plutons along the Jinshajiang suture are 249 ± 2 Ma (Zi et al., 2012a) and 247 ± 3 Ma (Zi et al., 2012b), respectively. The Baimaxueshan pluton is a I-type granite pluton with moderate initial $^{87}Sr/^{86}Sr$ ratios from 0.710 to 0.711 and $\varepsilon_{Nd}(t)$ values from −8 to −9.5 (Zi et al., 2012a). In contrast, the younger Lincang batholith is an S-type granite pluton with much higher initial $^{87}Sr/^{86}Sr$ ratios from 0.724 to 0.741 and slightly lower $\varepsilon_{Nd}(t)$ values from −11 to −14 (Hennig et al., 2009; Peng et al., 2013).

The Jitang pluton is located in the eastern segment of the Longmu Co–Shuanghu suture in the Changdu region. In this region, Proterozoic meta-sedimentary rocks including gneissic rocks of the Jitang group are present along the suture (Fig. 2). They are overlain by Triassic volcanic rocks, which in turn are overlain by younger sedimentary rocks. During the India–Asia collision in the past 65 Ma, the Changdu region had undergone strong shearing and over-thrusting (Burchfiel and Chen, 2012; Yin and Harrison, 2000). Small Cenozoic granitic porphyry bodies are present close to the suture, farther to the north within the North Qiangtang block (Bi et al., 2009; Liang et al., 2009).

The middle segment of the Longmu Co–Shuanghu suture near Rongma is marked by a prominent high-P metamorphic belt (Fig. 1b). The U–Pb ages of zircons from the eclogites of this belt are between 230 and 237 Ma (Zhai et al., 2011). These ages are thought to represent the timing of continental collision between the South and North Qiangtang blocks (Zhai et al., 2011). The $^{40}Ar/^{39}Ar$ age of phengite from the high-P metamorphic belt is ~220 Ma (Zhai et al., 2011). This age is interpreted to represent the cooling event associated with crustal uplift in the region (Zhai et al., 2011).

3. Geology and petrography

The Jitang granite pluton is situated in the west side of Lancangjiang (Lancang River), ~3 km west of Jitang township, Changdu city (Fig. 2). The exposure of this pluton is about 70 km long and 2–10 km wide. The overall strike of the pluton is NNW. The immediate country rocks of the pluton belong to the Proterozoic Jitang group which is composed