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Origin and evolution of the Tengchong block, southeastern margin of the Tibetan Plateau: Zircon U–Pb and Lu–Hf isotopic evidence from the (meta-) sedimentary rocks and intrusions

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ABSTRACT

U–Pb ages and Hf isotopic data from detrital zircons of Gaoligongshan metamorphic complex and the Carboniferous Menghong Group and igneous zircons from intrusions constrain the origin, tectonic affinity (East Gondwana), crustal evolution processes, and the properties of regional high-grade metamorphic rocks in the Tengchong block of southeastern China. Three granites intruded into the Tengchong block at ~72 Ma, ~114 Ma and ~122 Ma. Detrital zircons range in age from Archean to Late Ordovician for both the Carboniferous Menghong Group and the Gaoligongshan metamorphic complex. Analyses for these two units yield similar age clusters at ~2.5 Ga, ~1.6 Ga, ~1.17 Ga, ~0.95 Ga, and ~0.65–0.5 Ga as well as parallel Hf isotopic distributions. The protolith of the studied Gaoligongshan complex in the Tengchong block should deposit in the Late Paleozoic. Detrital zircon age distribution patterns of the Carboniferous Menghong Group and the Gaoligongshan complex show dominant younger Grenvillian age peaks at ~0.95 Ga, indicating the strong paleogeographic connection of the Tengchong block with the Indian margin. The Hf isotopic comparison of both detrital and igneous dated-zircon shows that the Tengchong block can be represented by the post-Archean Indian continental margin. After 250 Ma, the intensive magma events affected the region and considerable juvenile material accreted to the crust of the Tengchong block.

1. Introduction

Present-day East and Southeast Asia are the result of >400 million years of continental dispersion from Gondwana and plate tectonic convergence, collision and accretion (Sengör and Natal'in, 1996; Yin and Harrison, 2000; Metcalfe, 2013). The Tibetan Plateau and its southeastern margin provide a natural laboratory to study plate collision, the formation of the suture zones and orogenic processes (Yin and Harrison, 2000; Hall, 2009; Zhang et al., 2008, 2012). They comprise a heterogeneous collage of continental blocks, subduction–accretionary complexes related to the successive closure of Tethys, and ocean islands (Metcalfe, 2013). The Tengchong block is one of the important members as it preserves robust records of tectonomagmatic evolution reflecting continental breakup, subduction, collision, and post-collisional processes.

As one fragment of the disintegrated Gondwana, the Tengchong block in the southwest margin of Western Yunnan, China, is regarded as the northern continuation of the Sibumasu terrane (Fig. 1). Although the tectonic evolution (Wopfner, 1996; Zhong, 1998), magmatism (Liu et al., 2009; Huang et al., 2013; Wang et al., 2013; Ma et al., 2014) and metallogenesis (Mao, 1988; Hou and Guo, 1991; Hou et al., 2007a) of the Tengchong block were studied, some fundamental issues such as the origin and tectonic affinity with East Gondwana (Cawood et al., 2013; Zhang et al., 2013; Li et al., 2014), crustal evolution (i.e., accretion and/or reworking) processes (Chen et al., 2007; Xu et al., 2012) and the existence of the Precambrian basement (Zhong, 1998; Song et al., 2010; Li et al., 2013) are still debated.

The Carboniferous Menghong Group is the largest Paleozoic clastic sedimentary cover in the Tengchong block documenting key information on the origin and tectonic affinity (Li et al., 2014); however, useful zircon U–Pb and/or Hf data for provenance studies are limited. The paleoposition study that based on detrital zircons recovered from two sediments in the north to middle part of the Tengchong block will be compromised by feature that detrital zircon tend to deposit near the source area (Li et al., 2011, 2014). Therefore, more samples from a larger region of this block should be studied to get a robust result. Furthermore, as an important component, the widespread Gaoligongshan metamorphic complex in the Tengchong, Baoshan, and Gongshan blocks were once regarded as the Precambrian basement of these blocks

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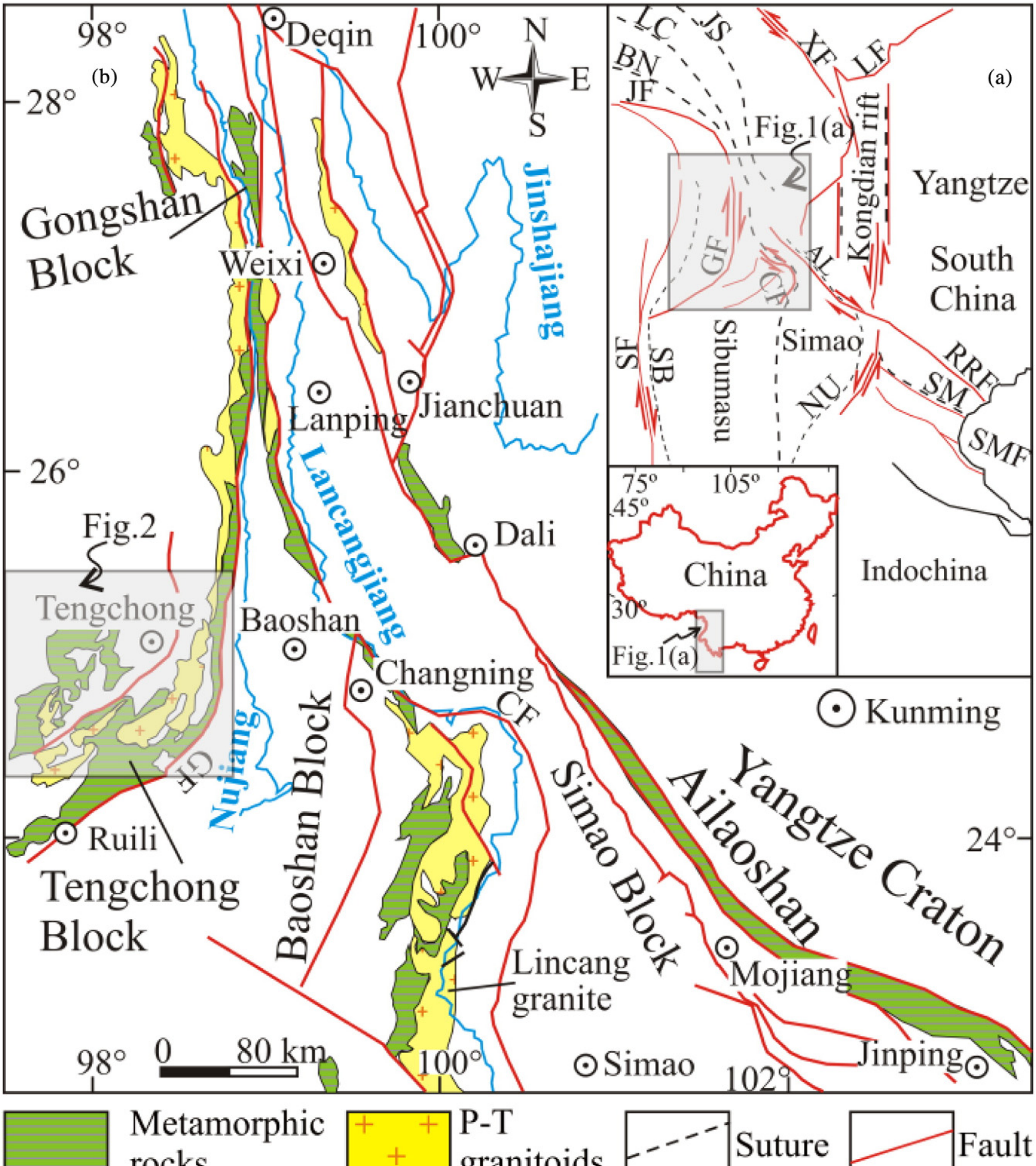

Fig. 1. Schematic map showing major tectonic units. (a) Tectonic outline of Southeast Asia (adpoted from Lin et al., 2012). Additional abbreviations are: BN: Bangong–Nujiang suture, LC: Lancangjiang suture, JS: Jinshajaing suture, AL: Ailaoshan suture, SM: Song Ma suture, NU: Nan–Uttaradit suture, SB: Shan Boundary suture, XF: Xianshuihe Fault, LF: Longmenshan Fault, JF: Jaili Fault, CF: Chongshan Fault, RRF: Red River Fault, SF: Sagaing Fault, GF: Gaoligong Fault, SMF: Song Ma Fault. The western Qiangtang and Lhasa blocks in the Tibetan Plateau lies both sides to the Bangong–Nujiang suture to the northwest corner of the map. (b) Tectonic map of southwest China, showing the major tectonic unit and location of the study areas (modified from Wang et al., 2010; Li et al., 2015).

before dispersion from Gondwana; nevertheless, this concept was challenged based on recent geochronology studies (e.g., Song et al., 2010). Moreover, even the formation age of the protolith of the Gaoligong complex in Tengchong remains unclear.

In situ analyses of Hf isotopes on dated zircons provide information about the nature of the periodic igneous activities, and they are relatively immune to subsequent tectono-thermal events that could largely compromise the whole rock Sr–Nd isotopic analyses (Kröner et al., 2014). Therefore, the combination of U–Pb ages and Hf isotopic compositions of both detrital and magmatic zircon crystals for a given block can effectively reveal the regional crustal preservation and evolution.

In this paper, we present new zircon U–Pb and Hf isotopic data on representative Gaoligongshan complex, Carboniferous Menghong Group, and granitoids from the Tengchong block. These data, together