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Research paper

Sedimentology, provenance and geochronology of the Miocene Qiuwu Formation: Implication for the uplift history of Southern Tibet

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ABSTRACT

Located on the south of the Gangdese, the Qiuwu Formation has traditionally been considered as Eocene coal-bearing clastic sediments consisting of sandstone, mudstone and conglomerate, unconformably on top of Gangdese batholith. However, its precise age and depositional environment remain ambiguous. Here, we present a newly measured stratigraphic section near the Ngamring County, western Xigaze. Detrital zircon U–Pb ages were also applied to trace the provenance of sediments and to constrain the maximum depositional age of the Qiuwu Formation. Sedimentary facies analyses indicate subaqueous fan and alluvial fan depositional environments. Clast composition of the conglomerate is dominated by magmatic rocks at the lower part, while chert and mafic detritus occur in the upper part, suggesting a southern source. Sandstone modal analyses indicate that the compositions of quartz, feldspar and lithic grains changed from transitional arc to dissected arc, implying the unroofing of the Gangdese arc. Detrital zircon U–Pb ages of the Qiuwu Formation are compared with those from Gangdese magmatic rocks and Yarlung-Zangbo ophiolites, suggesting that the Gangdese arc is a main source of the Qiuwu detritus and that the southern source played a role during the later stage. The major peak of detrital zircon ages is at 45–55 Ma, which corresponds to Linzizong volcanic rocks in southern Gangdese arc. The weighted mean age of the five youngest zircons from the lower part of the section is 21.0 ± 2.2 Ma, suggesting that the Qiuwu Formation was deposited in early Miocene, coeval with other conglomerates exposed along the southern margin of Gangdese. Combining new observations with previously published data, we propose that the provenance of the Qiuwu Formation had shifted from a single northern source to double sources from both the north and the south. Activities of Great Counter Thrust were primarily responsible for the shift by making the south area a high elevation to provide sediments for the Qiuwu Formation.

1. Introduction

The Yarlung–Zangbo suture zone in the southern Tibetan Plateau not only preserves information of the Neo-Tethyan evolution, but also provides details of the India–Asia collision and the uplift history of the Tibetan Plateau and Himalayas (Aitchison et al., 2011; Wang et al., 2012; Dai et al., 2013a). In general, the Yarlung–Zangbo ophiolite, Xigaze forearc basin, and Gangdese magmatic arc (Fig. 1) are related to the evolution of Neo-Tethys and the India–Asia collision, while the late Cenozoic sedimentary basins within this suture zone provide a unique archive of uplift history.

The Liuqu and Kailas basins, both narrow and strike-parallel, are the most representative late Cenozoic sedimentary basins. The Liuqu basin is located in the south of the central Yarlung–Zangbo ophiolite, and is filled with Paleogene Liuqu conglomerate (Davis et al., 2002; Wang et al., 2010; Li et al., 2015a), containing abundant red chert cobbles, ultramafic–mafic cobbles, as well as quartz–arenite, litharenite, phyllite and slate. Davis et al. (2002) proposed that the Liuqu conglomerate probably formed during

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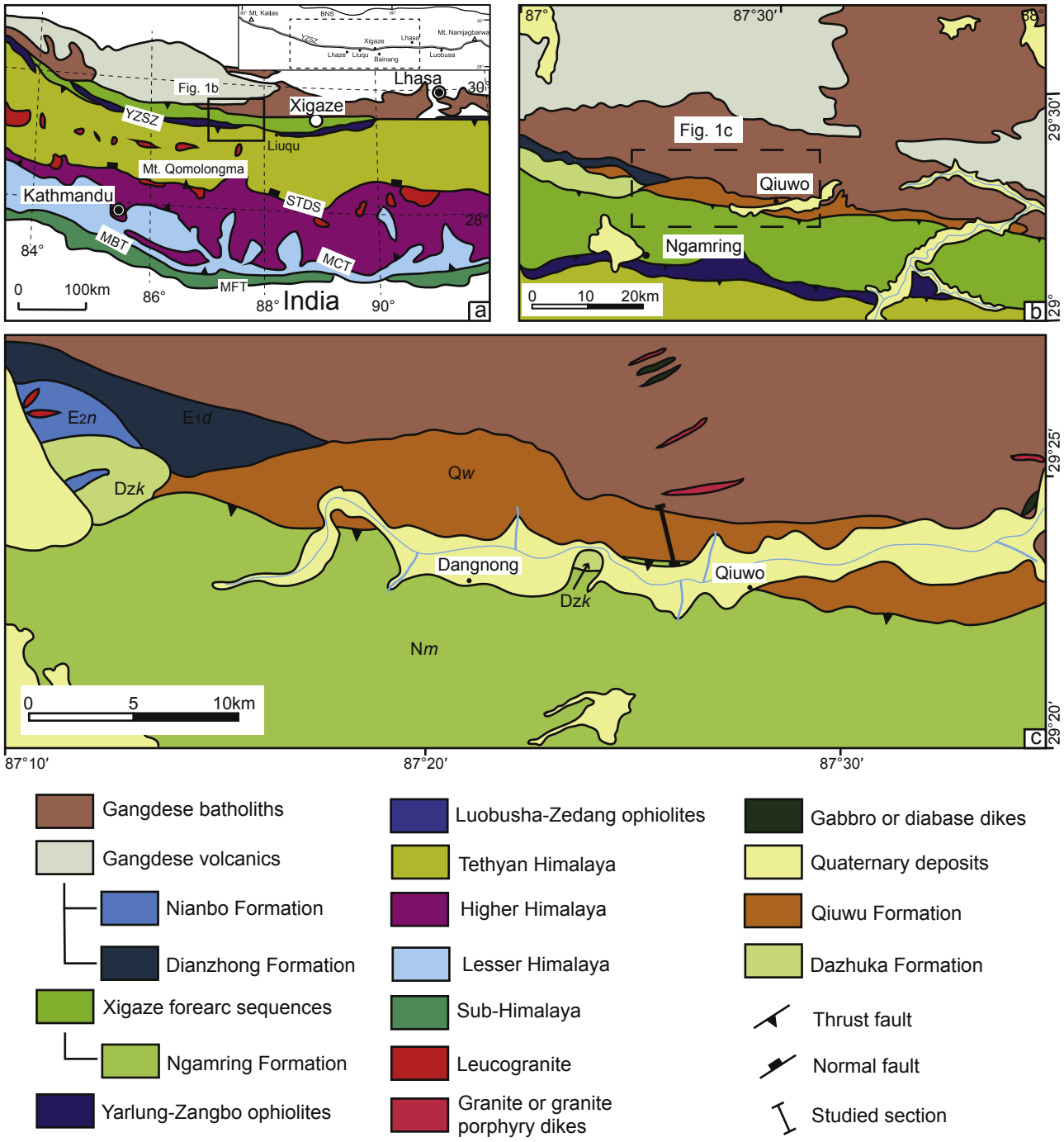

Figure 1. (a) Simplified geological map of the Himalaya and southern Tibet, modified after Wang et al. (2013). BNS = Bangong-Nujing suturse; YZSZ = Yarlung-Zangbo suture zone; STDZ = South Tibet Detachment Zone; MCT = Main Central Thrust; MBT = Main Boundary Thrust; MFT = Main Frontal Thrust. (b) Geological sketch map of the Ngamring area, southern Tibet, modified after a scale of 1:1,500,000 geologic map (Pan et al., 2004). (c) Detailed geological map of the studied area, modified after a scale of 1:250,000 geologic map resulted from regional geological survey, showing location of measured sections (black bold segment). E_2n = Nianbo Formation; E_1d = Dianzhong Formation; Qw = Qiuwu Formation; Dzk = Dazhuka Formation; Nm = Ngamring Formation.

the collision between an intra-oceanic arc and the Indian continental margin. However, subsequent studies indicate that the Liuqu conglomerate contains clasts originated from both the Langjiexue Group and Tethyan Himalayan sediments to its south, as well as the sediments within the Xigaze forearc basin and the ophiolite to its north (Wang et al., 2010; Li et al., 2015a). Particularly, Li et al. (2015a) suggested that the Liuqu conglomerate preserved the post-collision erosion in the Indus–Yarlung suture zone. The Kailas basin is characterized by the Kailas conglomerate (Aitchison et al., 2002; DeCelles et al., 2011), which crops out along the entire Yarlung–Zangbo suture zone, stretching from the Kailas Mountain in the west to Namjagbarwa Mountain in the east. The Kailas conglomerate is referred to different stratigraphic names in different areas, such as Kailas, Qiuwu, Dazhuka and Luobusa