



Early Mesozoic metamorphism and tectonic significance of the eastern segment of the Lhasa terrane, south Tibet



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ABSTRACT

The metamorphic belt in the Basongco area, the eastern segment of Lhasa terrane, south Tibet, occurs as the tectonic blocks in Paleozoic sedimentary rocks. The Basongco metamorphic rocks are mainly composed of paragneiss and schist, with minor marble and orthogneiss, and considered previously to be the Precambrian basement of the Lhasa terrane. This study shows that the Basongco metamorphic belt experienced medium-pressure amphibolite-facies metamorphism under the conditions of $T = 640\text{--}705\text{ }^{\circ}\text{C}$ and $P = 6.0\text{--}8.0\text{ kbar}$. The inherited detrital zircon of the metasedimentary rocks yielded widely variable $^{206}\text{Pb}/^{238}\text{U}$ ages ranging from 3105 Ma to 500 Ma, with two main age populations at 1150 Ma and 580 Ma. The magmatic cores of zircons from the orthogneiss constrain the protolith age as ca. 203 Ma. The metamorphic zircons from all rocks yielded the consistent metamorphic ages of 192–204 Ma. The magmatic cores of zircons in the orthogneiss yielded old Hf model ages ($T_{\text{DM2}} = 1.5\text{--}2.1\text{ Ga}$). The magmatic zircons from the mylonitized granite yielded a crystallization age of ca. 198 Ma. These results indicate that the high-grade metamorphic rocks from the Basongco area were formed at early Jurassic and associated with coeval magmatism derived from the thickening crust. The Basongco metamorphic belt, together with the western and coeval Sumdo and Nyainqentanglha metamorphic belts, formed a 400-km-long tectonic unit, indicating that the central segment of the Lhasa terrane experienced the late Paleozoic to early Mesozoic collisional orogeny.

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1. Introduction

The Lhasa terrane located at the south Tibet is bounded by the Yarlung–Zangbo Suture Zone (YZSZ) to the south and the Bangong–Nujiang Suture Zone (BNSZ) to the north (Yin and Harrison, 2000; Zhu et al., 2013; Zhang et al., 2013, and references therein). Previous studies identified that the Lhasa terrane was composed of Precambrian metamorphic basement, Paleozoic–Mesozoic sedimentary rocks and Mesozoic and Cenozoic igneous rocks (e.g., Yin and Harrison, 2000; Pan et al., 2006). Most previous works focused on these magmatic rocks, and the related results provide important constraints on the Mesozoic Andean-type and Cenozoic Himalayan-type orogenies in south Tibet (Pan et al., 2002, 2006; Mo et al., 2003, 2005, 2006, 2007a,b, 2008; Chung et al., 2003, 2005; Liao et al., 2007; Chu et al., 2006; Zhu et al., 2008, 2009a,b; Wen et al., 2008a,b; Ji et al., 2009; Xu et al., 2010a; Zhao et al., 2009; Zhang et al., 2010c; Chen et al., 2012; Zhang et al., 2010a, 2013). However, only a few studies involving

metamorphism of the Lhasa terrane has been carried out (Li et al., 2008; Yang et al., 2007, 2009; Wang et al., 2008, 2009; Booth et al., 2009; Dong et al., 2010a,b, 2011; Guo et al., 2012). Thus, the metamorphism and tectonic significance of the Lhasa terrane remain poorly understanding.

The medium- and high-grade metamorphic rocks occur dominantly in the eastern part of the Lhasa terrane, such as Nam Tso, Nyainqentanglha, Sumdo, Basongco, Linzhi and Bomi areas (Fig. 1). Because many Proterozoic ages were obtained by the traditional dating technologies, these rocks were considered generally to be the Precambrian basement of the Lhasa terrane, termed as the Nyainqentanglha Group, the Linzhi Group or Bomi Group (e.g., Xu et al., 1985; Dewey et al., 1988; Harris et al., 1988). However, recent studies have shown that the protoliths of the Linzhi Group are the Paleozoic to Mesozoic sedimentary rocks, which were metamorphosed during the Mesozoic and Cenozoic (Wang et al., 2008, 2009; Dong et al., 2010a,b, 2012; Zhang et al., 2010a,b). At least part of the metamorphic rocks of the Nyainqentanglha and Sumdo regions were formed during the Permian–Triassic, forming a late Paleozoic to early Mesozoic tectonic belt in the central part of the Lhasa terrane (Li et al., 2008, 2009a,b, 2011; Yang et al., 2009; Dong et al., 2011).

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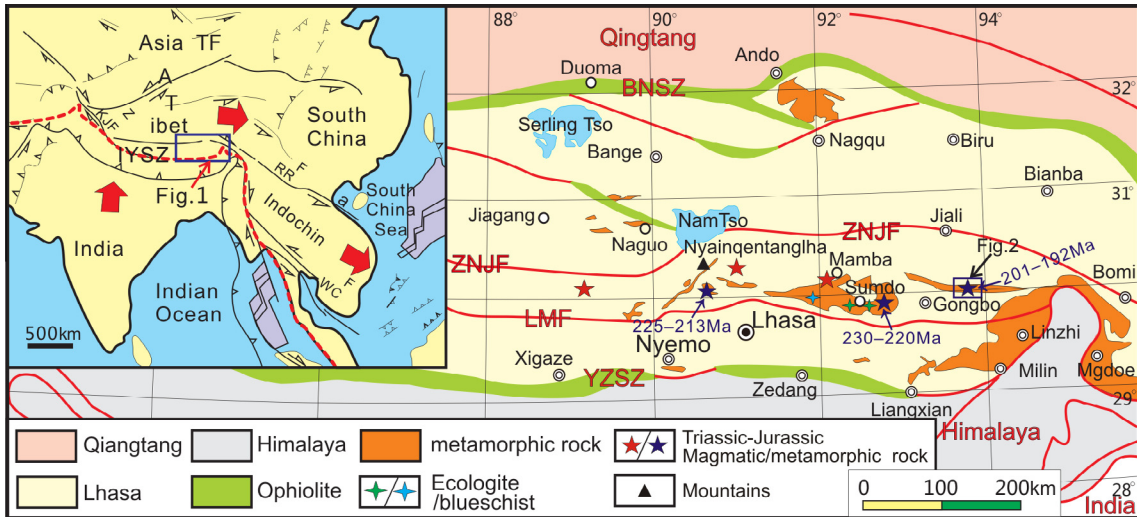


Fig. 1. Simplified geological map of the Lhasa terrane, showing mainly distributions of the high-grade metamorphic rocks, magmatic rocks and the representative locations of the eclogite and blueschist. NBSZ: Bangong–Nujiang Suture Zone; YZSZ: Yarlung–Zangbo Suture Zone; ZNMF: Zhari Nam Tso–Nam Tso–Jiali fault; LMF: Luobadui–Milashan fault.

Available studies considered the Basongco metamorphic belt to be the Mesoproterozoic and Neoproterozoic Nyainqentanglha Group, which was metamorphosed during the late Neoproterozoic (Geologic Survey Institute of Yunnan Province, 2003; Geologic Survey Institute of Xizang Autonomous Region, 2005a,b), but this conclusion is not supported by the reliable geological evidence. In this paper, we report a petrological and geochronological study of the Basongco metamorphic rock. The result shows that the protoliths of the Basongco metamorphic rocks consist mainly of early Paleozoic sedimentary rocks, with minor Mesozoic intrusive rock, and that these rocks experienced early Mesozoic medium-pressure (MP) amphibolite-facies metamorphism. This provides a new insight into the late Paleozoic to early Mesozoic orogeny of the Lhasa terrane.

2. Geological background

Regional geological survey revealed that the metamorphic rocks from the Basongco area, the central-eastern part of the Lhasa terrane, occur as a nearly E–W extending belt with a width of ca. 40 km and length of ca. 120 km (Figs. 1 and 2). The metamorphic belt is mainly composed of gneiss and schist with minor marble. The foliation of metamorphic rocks is nearly east–west striking, with various dipping angles of 25–67°. The Basongco metamorphic belt includes the north and the south belts, with an interval of ca. 5 km (Fig. 2). The north belt consists mainly of various gneisses, with interlayers of marble and schist. The gneisses include biotite–plagioclase gneiss, garnet–two–mica–plagioclase gneiss, two–mica gneiss, and biotite gneiss. This belt contacts with the

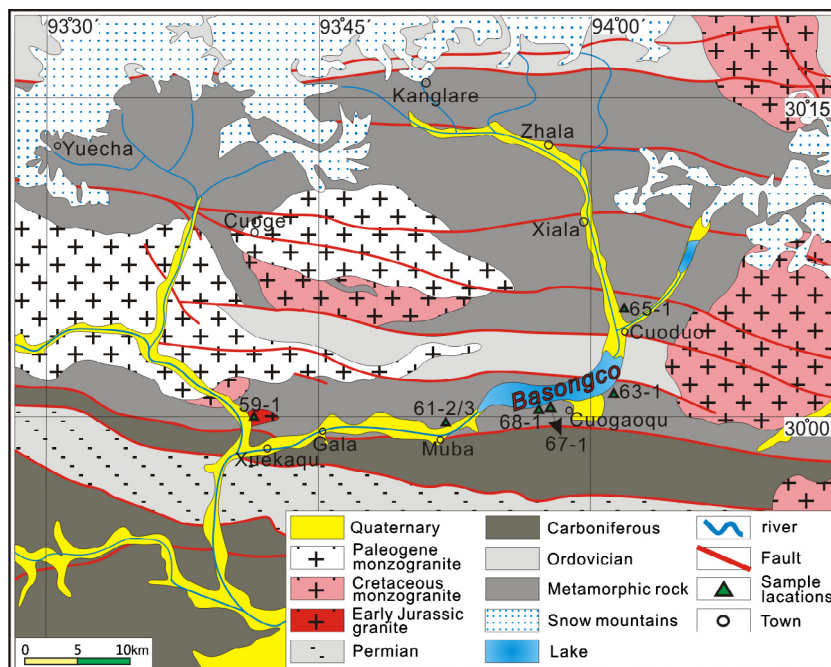


Fig. 2. Simplified geological map of the Basongco metamorphic belt.

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