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The Mesozoic accretionary complex in Northeast China: Evidence for the accretion history of Paleo-Pacific subduction

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ABSTRACT

The Mesozoic accretionary complex in Northeast China, which mainly consists of the Jilin-Heilongjiang high-pressure (HP) metamorphic belt and the Nadanhada accretionary complex, are the key area to understand the Paleo-Pacific subduction-accretion. The Jilin-Heilongjiang HP belt is a HP metamorphic zone between the Jiamusi and Songliao blocks and consists of the Heilongjiang blueschist belt and the Zhangguangcai Complex. Previously published and our new geochronological data indicate that the collision between the Jiamusi and Songliao blocks along the Jilin-Heilongjiang HP belt occurred between 210 and 180 Ma, suggesting that the Jilin-Heilongjiang HP belt is an important unit for characterizing the geodynamic switch from the north-south closure of the Central Asian Orogenic Belt to the onset of westward accretion related to subduction of Paleo-Pacific plate in the Latest Triassic to Early Jurassic. Early Permian igneous rocks with arc affinity in the eastern margin of the Jiamusi Block are more likely related to the Mongol-Okhotsk subduction rather than the Paleo-Pacific subduction or the collision between the Jiamusi and Khanka blocks as previously considered. The Nadanhada accretionary complex lies to the east of the Jiamusi Block, and is composed of the Yuejinshan and Raohe complexes. Compilation of published geochronological data indicate that the Yuejinshan Complex was probably formed between 210 Ma and 180 Ma, similar to ages for the Jilin-Heilongjiang HP belt along the western margin of the Jiamusi-Khanka Block. The Raohe Complex was formed later in the Late Jurassic to Early Cretaceous (170–137 Ma), likely more related to the subduction-accretion of Paleo-Pacific plate. The final accretion in the target area took place in the Early Cretaceous (137–130 Ma).

1. Introduction

The geology of Northeast China and surrounding areas (including Russian Far East, South Korea and central southwest Japan) is characterized by micro-continental blocks amalgamated in the Phanerozoic. In NE China, the terranes are mostly aligned along two major tectonic belts (Fig. 1). The Songliao, Xing'an and Erguna blocks constitutes the western belt, which is consider as a segment of the Central Asian Orogenic Belt (CAOB) and marks the broad collision zone between the North China and Siberia cratons. Mélange, Paleozoic syn-collisional granitoids, and Mesozoic post-collisional A-type granites are widely exposed in the western belt (Wu et al., 2002, 2011; Xiao et al., 2003, 2004a, 2004b; Zhou et al., 2011a, 2011b, 2012; Zhou and Wilde, 2013). The eastern belt includes the Jiamusi, Khanka, Bureya and Nadanhada blocks/terranes in NE China, as well as the Sikhote-Alin Terrane in the Russian Far East and the Japanese islands (Fig. 1). This belt is considered to be related to the subduction of Paleo-Pacific plate. The rock types exposed in this area are characterized by Mesozoic accretionary complexes, large-scale NE-trending granite and volcanic belts, and wrench fault systems (Ren et al., 1999a, 1999b; Wilde et al., 2000, 2003; Wu et al., 2011; Zhou et al., 2009, 2010a, 2010b, 2010c, 2013; Zhou and Wilde, 2013).

The Mesozoic accretionary complex belt in NE China mainly consists of the Jilin-Heilongjiang high-pressure (HP) metamorphic belt and the Nadanhada accretionary complex (the Nadanhada terrane). The Jilin-Heilongjiang HP belt is considered to represent the suture zone between the Jiamusi and Songliao blocks, because of its geological superimposition on the boundary between the two blocks (Fig. 2), and the fact that it has undergone HP metamorphism. The HP metamorphism of this belt is defined by the occurrence of glaucophane and phengite-bearing epidote-blueschist facies rocks with reconstructed HP/LT metamorphic conditions at 320–450 °C and 9–11 kb (Zhou et al., 2009). The Nadanhada terrane, consisting of typical Mesozoic ophiolitic accretionary complex (Zhou et al., 2014), is located to the

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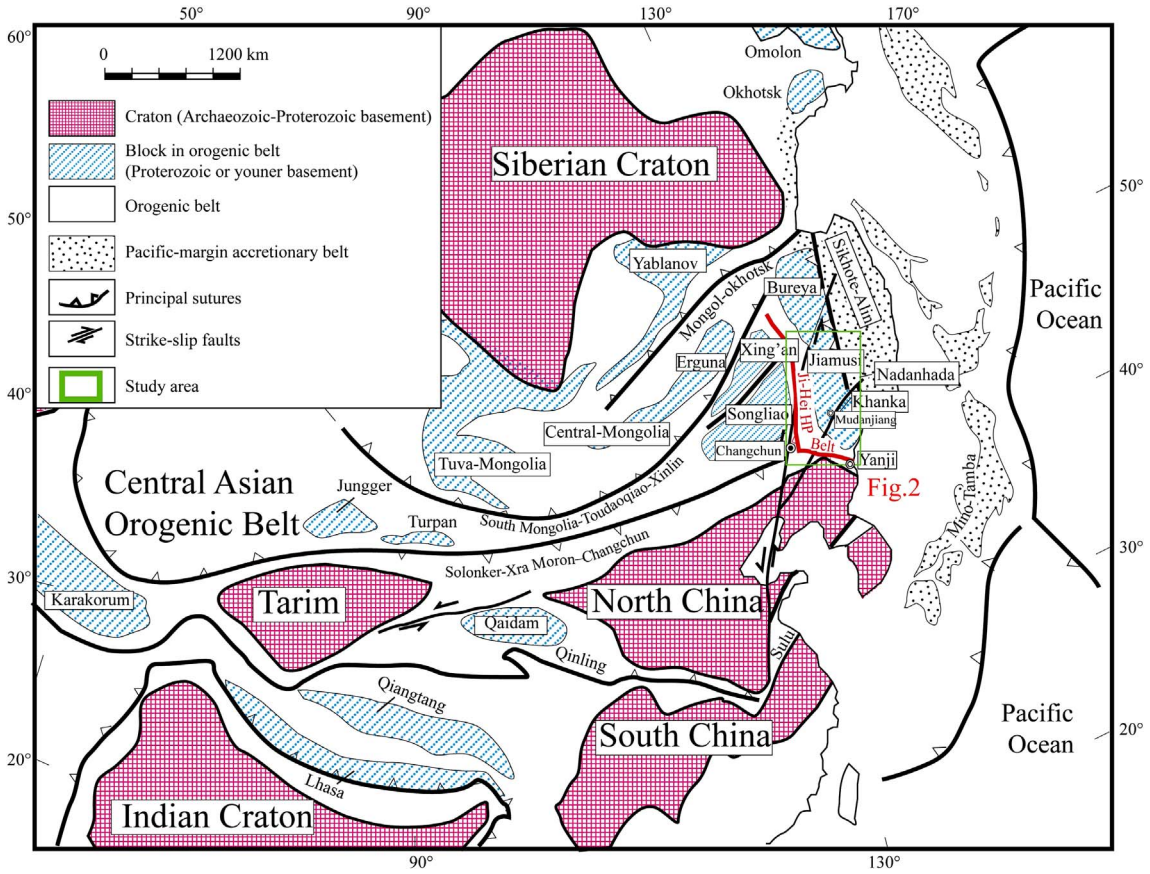

Fig. 1. Tectonic map showing the main subdivisions of central and eastern Asia and location of the study area (modified from Zhou et al., 2009, 2014).

east of the Jiamusi Block at the boundary between the Russian Far East and NE China (Fig. 1). The Nadanhada terrane in NE China, the Sikhote-Alin terrane in the Russian Far East and the Mino-Tamba terrane in central Japan comprise parts of a Mesozoic superterrane originally situated at the northwest margin of the Paleo-Pacific Ocean and continuously accreted to the eastern continental margin of Eurasia in the Mesozoic (Mizutani et al., 1989; Kojima and Mizutani, 1987; Kojima, 1989; Zhang, 1990).

Despite the important role of the Jilin-Heilongjiang HP belt and the Nadanhada terrane in reconstructing the Paleo-Pacific subduction-accretion processes (Zhou et al., 2009, 2014; Zhou and Wilde, 2013), some essential understanding of both belts, such as the protolith nature and tectonic setting of the Mesozoic accretionary complex, still remains controversial. In this paper, we review the Mesozoic accretionary complex in NE China by focusing on three main aspects: (1) the tectonic units of the Mesozoic accretionary complex in NE China, (2) the tectonic setting of the Jilin-Heilongjiang HP belt, and (3) the accretion history of the Nadanhada terrane. These results provide further insights into the tectonic setting of the Mesozoic accretionary complex and thus key information for understanding the processes of Paleo-Pacific subduction-accretion.

2. Geological setting

The geological settings in this review are focused on two regional metamorphic belts, i.e., the Jilin-Heilongjiang HP belt and the Nadanhada terrane, respectively, to the east and southwest of the Jiamusi-Khanka Block (Fig. 1). The Jiamusi Block is traditionally considered an important tectonic unit in the CAOB in NE China (Wilde et al., 2000, 2003). Despite its connection to the Jilin-Heilongjiang HP belt and the Nadanhada terrane, it is also bounded by the Mudanjiang suture zone in the southwest, and the Changchun-Yanji suture zone in the south. The Khanka Massif is separated from the Jiamusi Block by the Dun-Mi Fault and is considered to extend northward into the Jiamusi-Bureya Massif near the NE China-Russian Far East border, and thus has been referred as the Khanka-Jiamusi-Bureya Block (Fig. 1; Wilde et al., 2000, 2003).

The basement rocks of the Jiamusi Block are the Mashan Complex, with predominantly khondalitic metasediments that were originally considered to be Archean–Paleoproterozoic in age. However, SHRIMP zircon U-Pb dating has indicated that the oldest protoliths have Neo- to Mesoprotozoic ages at ~700 Ma, ~900 Ma, ~1050 Ma, ~1300 Ma and 1600 Ma (Wilde et al., 2003) and regional metamorphism occurred at ~500 Ma in the Early Paleozoic (Wilde et al., 2000, 2003; Wilde and Zhou, 2015). The metasediments are intimately associated with deformed granitoids, which were also originally thought to be Archean–Paleoproterozoic in age. Zircon U–Pb dating also has revealed that the granitoids were emplaced between 530 and 515 Ma (Wilde et al., 2000, 2003) and undergone granulite-facies metamorphism at ~500 Ma (Wilde et al., 2000, 2003). In addition, zircon U-Pb dating of most samples from the Mashan Complex in the Jiamusi Block has yielded Grenville ages of 1015 ± 18 to 1189 ± 23 Ma with a concordant population in ~1100 Ma (Wilde et al., 2003).

The Khanka Block mainly consists of Paleozoic to Mesozoic rocks (e.g., Zhou et al., 2010a, 2010b; Zhou and Wilde, 2013; Wilde and Zhou, 2015). The basement rocks in the Chinese part of the Khanka block consist of khondalitic metasediments, marble, graphitic schist and granitic gneiss. They were originally considered to be Precambrian in age during regional mapping (HBGMR, 1993) and were believed to form part of the Mashan 'group' of the adjacent Jiamusi block. However, geochronological work has confirmed their continuity with the Jiamusi Block, with granitic gneisses recording protolith ages of 520–515 Ma and all rocks experiencing high-grade metamorphism at ~500 Ma (Wilde et al., 2000; Zhou et al., 2010a). Detrital zircon U-Pb