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Detrital zircon geochronology and Nd isotope geochemistry of the basal succession of the Taebaeksan Basin, South Korea: Implications for the Gondwana linkage of the Sino-Korean (North China) block during the Neoproterozoic–early Cambrian

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ABSTRACT

The paleogeographic configuration of continental blocks around East Gondwana during the Neoproterozoic–early Cambrian is controversial. This study reports the U–Pb ages of detrital zircons and Nd isotopic composition of the Neoproterozoic–early Cambrian succession developed on the Precambrian basement in South Korea, which formed the southeastern portion of the Sino-Korean block (SKB) in its present configuration. Three stratigraphic units are addressed in this study: the Neoproterozoic Jangsan, early Cambrian Myeonsan, and early–middle Cambrian Myobong Formations. Both the Jangsan (white to pink quartz sandstone) and Myeonsan (dark gray ilmenite-rich sandstone/shale) formations are barren and are unconformably and conformably overlain, respectively, by the dark gray, fossiliferous fine-grained Myobong Formations. The Jangsan and Myeonsan Formations contain zircons with Archean–Paleoproterozoic ages, indicative of detritus derived from the local Precambrian basement. In contrast, the Myobong Formation is dominated by Mesoproterozoic to Neoproterozoic zircons, which are not represented in the local Precambrian basement. The Sm–Nd model ages of the Myobong Formation are younger than those of the underlying strata, indicative of significant changes in provenance during the deposition of this formation. Comparison with coeval sediment having Gondwana signatures in the southern margin of the SKB and the Tethyan Himalayan terrane strongly suggests that the Myobong Formation was derived from orogens in East Gondwana. The results of this study reveal that the timing of the Myobong Formation deposition marks the onset of a sedimentation episode on the southeastern margin of the SKB, which was related to the emergence of a vast source province in East Gondwana, possibly aided by the Cambrian transgression onto the SKB. In comparison with the published literature, we argue for the paleogeographic continuity of the SKB with the northern margin of East Gondwana, possibly between northwestern Australia and northeastern India during the Neoproterozoic–early Cambrian.

1. Introduction

The Sino-Korean block (SKB; also called the North China block) is one of the major crustal blocks in East Asia, and the Korean Peninsula forms the southeastern margin of the SKB (in present-day coordinates). Magmatic and metamorphic events that occurred at ~2.5 Ga and 2.0–1.8 Ga have been widely reported within the SKB comprising North China and the Korean Peninsula (Sagong et al., 2003; Zhao et al., 2010 and references therein). During the Cambrian, the SKB was a stable equatorial to subequatorial craton (Meng et al., 1997; Lee and Lee, 2003). The early Paleozoic stratigraphy of the Korean Peninsula shows close similarity to that of North China; thus, the Korean Peninsula and North China cratons are regarded to have experienced similar geological processes during the early Paleozoic (Chough et al., 2000; Kim et al., 2001; Kwon et al., 2006). The paleogeographic position of the SKB during the Neoproterozoic–Cambrian is controversial, partly because of the lack of appropriate sediment provenance information. Most paleogeographic reconstructions are based on faunal similarities and paleomagnetism. The close faunal similarity between the SKB and Australia during the Cambrian (Shergold, 1988 and references therein) led to placement of the SKB in close proximity to Australia. However, whether the SKB was attached to Gondwana during the early Paleozoic is still debated (Metcalfe, 2006; McKenzie et al., 2011; Cocks and Torsvik, 2013; Burrett et al., 2014). The SKB has long been considered as an isolated outboard terrane off the northern shelf of Australia. The SKB has even

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been placed as an outboard terrane along the eastern coast of Australia facing the paleo-Pacific Ocean (Li and Powell, 2001). Based on detrital zircon U–Pb ages, McKenzie et al. (2011) were the first to suggest that during the Cambrian, the SKB was tectonically attached to the northern margin of East Gondwana. However, different views have been proposed in more recent studies by Cocks and Torsvik (2013), Xu et al. (2013), and Burrett et al. (2014), who placed the SKB as an isolated terrane off the northern Gondwanan margin (Fig. 1).

Furthermore, some paleogeographic models regarded the southern part of the Korean Peninsula as part of the South China block (SCB), following the viewpoint (i.e., Oh et al., 2005, 2006) that the collision belt between the SKB and SCB in China (the Dabie and Sulu belts) can be extended eastward to the Korean Peninsula. This viewpoint is mainly based on studies of high-grade metamorphic and igneous rocks in the central part of the Korean Peninsula, which yield radiometric ages comparable to the timing of the Chinese collisional belt. However, the eastward extension of the Chinese collisional belt into the Korean Peninsula has not yet been established, and various tectonic relationships between the Korean Peninsula and the two Chinese blocks (the SKB and SCB) have been proposed (refer to Chang and Zhao, 2012 for recent summary and discussion). Among the three Precambrian tectonic blocks that make up the Korean Peninsula, i.e., from north to south the Nangrim, Gyeonggi, and Yeongnam massifs (Fig. 2), the Precambrian geology of the Nangrim and Yeongnam massifs and paleontology and stratigraphy of the Paleozoic–early Mesozoic succession of both massifs are known to correlate well with those of North China (Chough et al., 2000; Kim et al., 2001; Sagong et al., 2003 and references therein). These similarities indicate that both the Nangrim and Yeongnam massifs were part of the SKB; however, the tectonic affinity of the Gyeonggi Massif remains controversial.

This study reports the laser ablation inductively coupled mass spectrometry (LA-ICP-MS) zircon U–Pb ages and Nd isotopic compositions from the Neoproterozoic–early Cambrian strata of the Taebaeksan Basin, which is developed on the Yeongnam Massif, Korea (Fig. 2). The results of this study are used to constrain the placement of the SKB with respect to Gondwana and contribute significantly to the resolution of the regional paleogeography during the Neoproterozoic–early Cambrian.

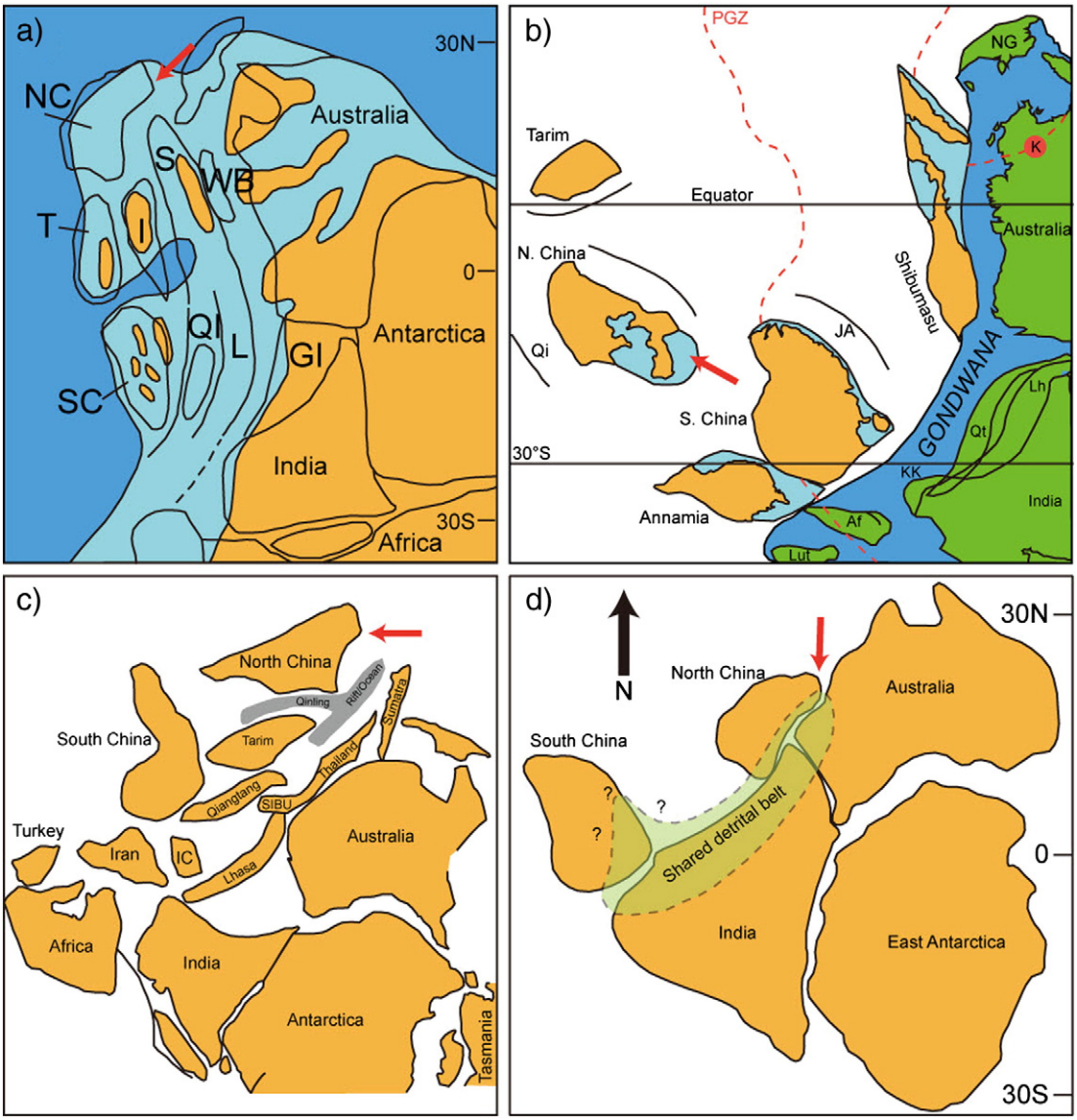

Fig. 1. Selected paleogeographic reconstructions of East Gondwana during the early Paleozoic. (a) Cambro–Ordovician (Metcalfe, 2006), (b) early Cambrian (Burrett et al., 2014), (c) Middle Cambrian (Cocks and Torsvik, 2013), and (d) latest Cambrian (McKenzie et al., 2011). The location of the Korean Peninsula in the Sino-Korean block is marked by an arrow.