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SHRIMP U–Pb zircon ages of pyroclastic rocks in the Bansong Group, Taebaeksan Basin, South Korea and their implication for the Mesozoic tectonics

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Abstract

The Bansong Group (Daedong Supergroup) in the Korean peninsula has long been considered to be an important time marker for two well-known orogenies, in that it was deposited after the Songnim orogeny (Permian–Triassic collision of the North and South China blocks) but was deformed during the Early to Middle Jurassic Daebo tectonic event. Here we present a new interpretation on the origin of the Bansong Group and associated faults on the basis of structural and geochronological data. SHRIMP (Sensitive High-Resolution Ion MicroProbe) U–Pb zircon age determination of two felsic pyroclastic rocks from the Bansong Group formed in the foreland basin of the Gongsuweon thrust in the Taebaeksan Basin yielded ages of 186.3±1.5 and 187.2±1.5 Ma, respectively, indicating the deposition of the Bansong Group during the late Early Jurassic. Inherited zircon component indicates ca. 1.9 Ga source material for the volcanic rocks, agreeing with known basement ages.

The Bansong Group represents syntectonic sedimentation during the late Early Jurassic in a compressional regime. During the Daebo tectonic event, the northeast-trending regional folds and thrusts including the Deokpori (Gakdong) and Gongsuweon thrusts with a southeast vergence developed in the Taebaeksan Basin. This is ascribed to deformation in a continental-arc setting due to the northwesterly orthogonal convergence of the Izanagi plate on the Asiatic margin, which occurred immediately after the juxtaposition of the Taebaeksan Basin against the Okcheon Basin in the late stage of the Songnim orogeny. Thus, the Deokpori thrust is not a continental transform fault between the North and South China blocks, but an "intracontinental" thrust that developed after their juxtaposition.

Keywords: Bansong Group; SHRIMP U–Pb zircon age; Deokpori thrust; Gongsuweon thrust; Mesozoic tectonics

1. Introduction

The Late Triassic to Early Jurassic (?) Daedong Supergroup of Korea has been known to unconformably overlie the late Paleozoic to Early Triassic sequence (Pyeongan Supergroup), and be unconformably overlain by the Late Jurassic to Early Cretaceous sequence (Jaseong Group). Consequently, the Daedong Supergroup has been used classically as a key sequence defining the Middle Triassic Songnim orogeny and Middle Jurassic Daebo 'orogeny' of Korea. (e.g. Kobayashi, 1953; Lee, 1987). The supergroup consists of siliciclastic molasse-type deposits formed in small-scale non-marine basins scattered across the Korean peninsula (Fig. 1), and contains pyroclastic rocks in some of the basins. Cluzel (1992) interpreted the Daedong Supergroup as being deposited in half-grabens or pull-apart basins formed by right-lateral movement of northeast-striking transcurrent shear zones during the late stages of the Middle Triassic Indosinian tectonic event (corresponding to the Songnim orogeny) when the North and South China cratons were juxtaposed. Despite the importance of the Daedong Supergroup for understanding the nature and timing of Mesozoic tectonic events, there have been few studies of its sedimentology and basin-forming tectonics, and no isotopic age determinations of its pyroclastic rocks have been conducted.

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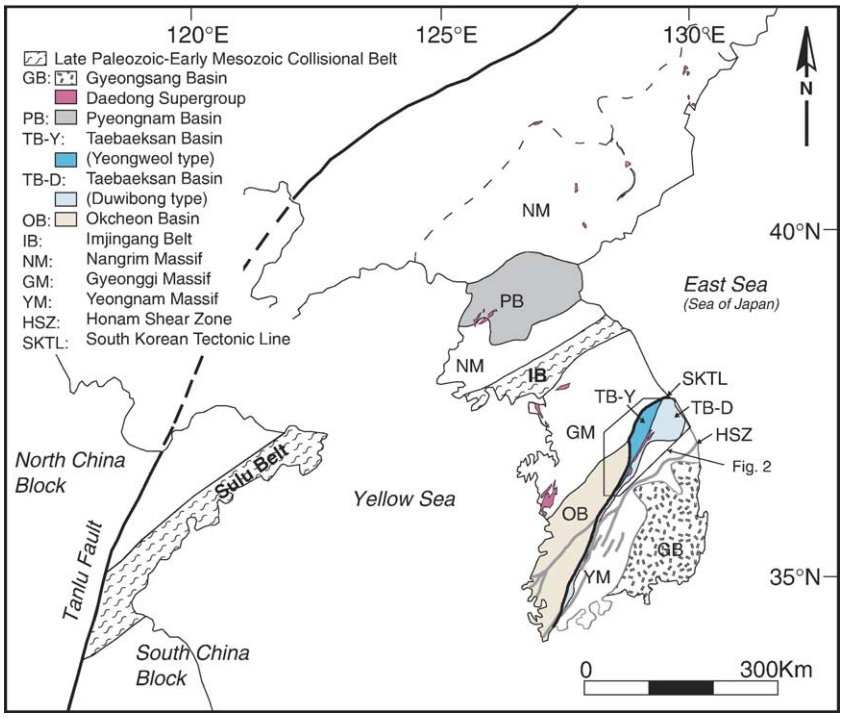

Fig. 1. Distribution of the Daedong Supergroup within the Korean peninsula.

In this paper, we redress this with a detailed study and SHRIMP (Sensitive High-Resolution Ion MicroProbe) U–Pb zircon dating of the part of the Daedong Supergroup (Bansong Group) in the Taebaeksan basin of the Okcheon belt. The Bansong Group consists of conglomerate, pyroclastic rocks, sandstone and shale (Fig. 2), and occurs in the footwall sides of major thrusts (Deokpori and Gongsuweon thrusts). Although the age of the Bansong Group has been considered to be the Late Triassic to Early Jurassic (e.g. Kobayashi, 1953; Reedman and Um, 1975; Chun et al., 1994), or more recently the Late Triassic to Jurassic (Chun, 2004) based on plant fossils, its precise age is still controversial. Using our new zircon U–Pb age determinations of the pyroclastic rocks, and structural data of the formation and the adjacent sequences in the eastern Yeongweol area, we reevaluate the Mesozoic tectonics of the Korean peninsula.

2. Geological background

The Korean peninsula is composed of three Precambrian massifs and two Phanerozoic mobile belts (Fig. 1). The Precambrian basements are, from north to south, the Nangrim, Gyeonggi and Yeongnam massifs, which consist mainly of high-grade gneisses and schists. The Imjingang belt, between the Nangrim and Gyeonggi massifs, is an east–northeast-trending fold-and-thrust belt, composed of a Silurian to Carboniferous sequence separated by unconformity from the Proterozoic basement rocks. The Okcheon belt, between the Gyeonggi and Yeongnam massifs, is a northeast-trending fold-and-thrust belt, which can be divided into the Okcheon Basin to the southwest and the Taebaeksan Basin to the northeast (Chough et al., 2000; Ree et al., 2001). The Okcheon Basin consists of nonfossiliferous, low- to medium-grade metasedimentary and metavolcanic rocks (Okcheon complex). There is, as yet, no consensus on the depositional age of the metasedimentary rocks of this basin, although Sm–Nd mineral and U–Pb zircon ages of the associated metavolcanic rocks suggest that the sequence formed prior to the Late Proterozoic (Kwon and Lan, 1991; Lee et al., 1998). In contrast, the Taebaeksan Basin includes fossiliferous, weakly metamorphosed sedimentary rocks of the early Paleozoic (Joseon Supergroup), late Paleozoic to early Mesozoic (Pyeongan Supergroup) and the middle Mesozoic (Daedong Supergroup). A sedimentary basin equivalent to the Taebaeksan basin, the Pyeongnam Basin, also occurs within the Nangrim massif of North Korea. The Cretaceous Gyeongsang Basin (non-marine sedimentary rocks and volcanics) occurs on the Yeongnam massif. All these crustal provinces were extensively intruded by Mesozoic granitoids formed mainly by continental-arc magmatism (Chough et al., 2000; Sagong et al., 2005).

Recent tectonic models have suggested that the Imjingang belt is an eastern extension of the Permian–Triassic Qinling–Dabie–Sulu collision belt between the North and South China blocks (Hsü et al., 1990; Cluzel et al., 1991; Yin and Nie, 1993; Ree et al., 1996). Ree et al. (2001) interpreted that the Gyeonggi massif and the Okcheon Basin belonging to the South China block were juxtaposed against the Yeongnam massif and the Taebaeksan Basin of the North China block along a continental transform fault during the late stage of the Permian–Triassic continent–continent collision. Chough et al. (2000) referred to the continental transform fault as the South Korean Tectonic Line. However, this tectonic model may need some modification to reconcile the recent finding of trace of ultramafic lenses and possibly high-pressure metabasites