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Deformation history inferred from magnetic fabric in the southwestern Okcheon metamorphic belt, Korea

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Abstract

Magnetic fabric and rock-magnetic studies have been carried out for the non-fossiliferous, low- to medium-grade metasedimentary rocks in the southwestern part of the Okcheon metamorphic belt (OMB). Two major metamorphic events in the study area were previously recognized: regional metamorphism (M_1) in the late Carboniferous to early Permian and contact metamorphism (M_2) due to the intrusion of granite in the middle Jurassic. The metamorphic grade of the study area increases from the biotite zone in southeast through the garnet zone to the staurolite zone towards the northwest. Magnetic fabrics of the study area are generally well defined and can be characterized according to the metamorphic zones. Magnetic foliation is the dominant magnetic fabric in the biotite zone, while magnetic lineation prevails in both garnet and staurolite zones. We interpret the metamorphism-related deformation history of the study area based on magnetic fabrics, magnetic mineralogy and previously reported metamorphic evolution as follows. Penetrative NW-dipping cleavage, represented by magnetic foliation, was formed in the study area by prevailing NW–SE shortening event during the M_1 regional metamorphism in the late Carboniferous–early Permian. This shortening event is interpreted to be associated with the collisional event between the North and South China blocks. Cleavages dipping steeply to the southeast in the staurolite zone are attributed to the pressure exerted from the intrusion of Jurassic granite in the northwestern area.

Keywords: Anisotropy of magnetic susceptibility; Metamorphism-related deformation; Magnetic mineralogy; Okcheon metamorphic belt

1. Introduction

The Okcheon belt is a fold-and-thrust belt running diagonally (SW–NE) across the Korean Peninsula, and it divides the peninsula into the Gyeonggi massif and the Yeongnam massif (Fig. 1a). In recent years, the Okcheon belt has been a key place in formulating the tectonic framework of the Korean Peninsula and East Asia, because the Okcheon belt is regarded as a candidate for a possible eastern extension of the Qinling–Dabie–Sulu belt, the suture zone between the North China (Sino–Korean) and the South

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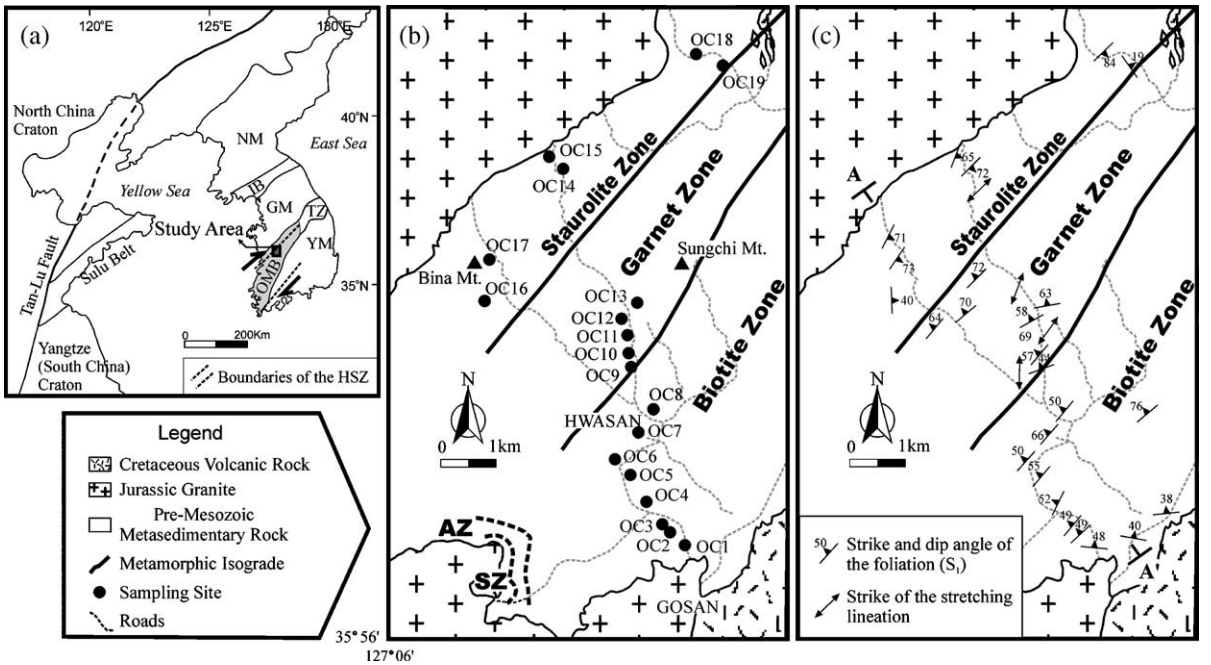

Fig. 1. The simplified tectonic map (a) of East Asia (after Ree et al., 2001) and the metamorphic maps (after Oh et al., 1995b) of the southwestern part of the Okcheon metamorphic belt (OMB) showing (b) the locations of the sampling sites and (c) the petrofabrics data observed in the field. The Okcheon belt is divided into the OMB to the southwest and the Taebaeksan zone (TZ) to the northeast. NM, Nangrim massif; GM, Gyeonggi massif; YM, Yeongnam massif; IB, Imjingang belt; HSZ, Honam shear zone. AZ, Andalusite zone; SZ, Sillimanite zone. The dotted lines in (a) are boundaries of the Honam shear zone proposed by Yanai et al. (1985).

China (Yangtze) blocks (Cluzel et al., 1990, 1991; Oh et al., 1999). However, any direct evidence for the subduction or ultrahigh pressure metamorphism (e.g. ophiolite suite and eclogite) has not been found. Yin and Nie (1993) proposed that the indentation of the South China block into the North China block caused both the left lateral Tan–Lu fault in east central China and the right lateral Honam shear zone within the Okcheon belt (Fig. 1a). There have been efforts to demonstrate the role of the Okcheon belt during the collisional event in East Asia, but it is still controversial whether the Okcheon belt is a suture zone (Oh et al., 1999) or a transform fault (Yin and Nie, 1993; Ernst and Liou, 1995; Ree et al., 2001). In spite of its importance, structural settings and tectonic evolution of the Okcheon belt have not been established clearly due to severe deformation of rocks and overprinted structures related to Mesozoic plutonism. Since structural analyses have been performed mainly for the central and northeastern parts of the Okcheon belt, more structural data from the southwestern part of the Okcheon belt is needed to shed light on the tectonic evolution of the Korean Peninsula.

Information on the petrofabrics of rocks and metamorphic petrology are important in the interpretation of deformational history in metamorphic belts. Anisotropy of magnetic susceptibility (AMS) studies have been widely used to describe the petrofabric of deformed metamorphic rocks, since the principal magnetic susceptibility axes can represent the principal directions of the strain ellipsoid in deformed rocks (e.g. Graham, 1954; Hrouda, 1982; Borradaile, 1988). AMS is generally regarded as an effective method in weakly deformed areas where the strain markers were poorly developed or conventional strain methods cannot be applied (Hrouda, 1982). The validity of the magnetic fabric method for even highly deformed and metamorphosed rocks has been shown in many previous studies (e.g. Rathore et al., 1983; Zhou et al., 2002), because the anisotropies of rocks are difficult to measure quantitatively in the field and determination