Journal of Structural Geology 37 (2012) 134–149

Contents lists available at SciVerse ScienceDirect

Journal of Structural Geology

journal homepage: www.elsevier.com/locate/jsg

Tectonic setting of the low-grade metamorphic rocks of the Dabie Orogen, central eastern China

Shutong Xu*, Weiping Wu, Yiqun Lu, Dehua Wang

Anhui Institute of Geology, Hefei, Anhui Province 230001, China

ARTICLE INFO

Article history:
Received 2 December 2010
Received in revised form
6 January 2012
Accepted 21 January 2012
Available online 1 February 2012

Keywords:
Dabie Mountains
Forearc basin
Accretionary prism
Oceanic crust

ABSTRACT

The tectonic setting on both the northern and southern sides of the Dabie Mountains reveals that low-grade metamorphic rocks are important constituents produced by the subduction of the oceanic crust prior to collision between the Sino-Korean and Yangtze cratons. The Zhangbaling Group/Mulanshan schist is a pre-Ordovician oceanic crust. The Sujiahe and Xinyang/Foziling Groups are trench sediments of the Ordovician-Devonian age, and constitute an accretionary prism associated with subduction. The Yangshan coal measures/Meishan Group was a forearc basin sediment of Carboniferous age, and was overthrust by the accretionary prism during collision. The Susong Group is composed of passive continental margin sediments of the Yangtze craton. Backarc basin sediments are postulated to be concealed by Mesozoic–Cenozoic sediments to the north of the Dabie Mountains. High-ultrahigh pressure terrains are exotic tectonic slices exhumed from depths, located between low-grade metamorphic rocks, and disturb the integrity of the earlier subduction orogen. Subduction occurred during the Ordovician to Devonian periods, and collision initiated at the beginning of the Permian.

1. Introduction

The Dabie Mountains are one of the best known ultrahigh pressure (UHP) metamorphic terrains of China, and even in the world (Carswell and Compagnoni, 2003). The region has been the subject of considerable international research that has lead to advances in aspects of metamorphism, geochronology, geochemistry, and in particular the discovery of the UHP signature. The most important UHP metamorphic signatures have been found, including coesite at many localities (Xu, 1987; Okay et al., 1989; Wang and Liou, 1991; Wang et al., 1989, 1993; Zhang et al., 1993), microdiamonds at some localities (Xu et al., 1992, 2003, 2005a; Liu et al., 2006), magnetite lamellae in olivine (Zhang et al., 1999), and rod-like apatite, rutile and clino-pyroxene exsolutions in garnet (Xu et al., 2005a). From this evidence, two UHP belts having continental affinity (TG and ECL_2 in Fig. 1) and a high pressure (HP) metamorphic belt of oceanic affinity (ECL_1 in Fig. 1) were identified. However, ECL_1 was once defined as a “Cold eclogite” belt because there were no UHP signatures until the discovery of quartz pseudomorphs after coesite (Li et al., 2004) and clino-zoisite pseudomorphs after lawsonite (Castelli et al., 1998) indicating an oceanic affinity. As yet, no UHP signatures have been found in the western equivalent of the ECL_1. The northernmost UHP belt, TG, has been recognized as having affinity with the lower continental crust of the Yangtze craton (Ma et al., 2000; Zhang et al., 2002).

Extensive isotopic dating of eclogite, mainly Sm–Nd and U–Pb (Li et al., 1996, 1998, 2000; Chavagnac and Jahn, 1996; Chen et al., 2004; Hacker et al., 1998; Liu et al., 2007; Jian et al., 2000) shows positive values of $\varepsilon_{Nd}(t)$ in ECL_1, but negative in ECL_2 and TG, units, and demonstrates that the three HP–UHP metamorphic belts were subducted and exhumed separately at different times. Isotopic ages of the protoliths of most of the blocks and matrix gneisses fall within the range 750–800 Ma (Hacker et al., 1998; Xie et al., 2004). Although great achievements have been made in the Dabie Mountains' research in the last 20 years, there are still some important problems remaining to be solved. These include questions such as where is the remnant of the subducted oceanic crust that exist prior to the collision between the Sino-Korean and Yangtze cratons, what are the tectonic settings of the low-grade metamorphic rocks on both sides of the Dabie Mountains, and where is the suture between the Sino-Korean and Yangtze cratons. These problems are closely related to each other, and the tectonic setting of low-grade metamorphic rocks is crucial. Gao and Liu (1988), Liu et al. (1993, 1995, 1996), Jin et al. (1994) and Ma et al. (1997) successively discovered Paleozoic fossils in some low-grade metamorphic rocks, which together with papers on UHP minerals, geochemistry and geochronology of UHP rocks, laid the ground-work for analyzing the tectonic settings of low-grade

* Corresponding author. Tel./fax: +86 551 4658252.
E-mail address: xushutong@126.com (S. Xu).

0191-8141/$ – see front matter Crown Copyright © 2012 Published by Elsevier Ltd. All rights reserved.
doi:10.1016/j.jsg.2012.01.020

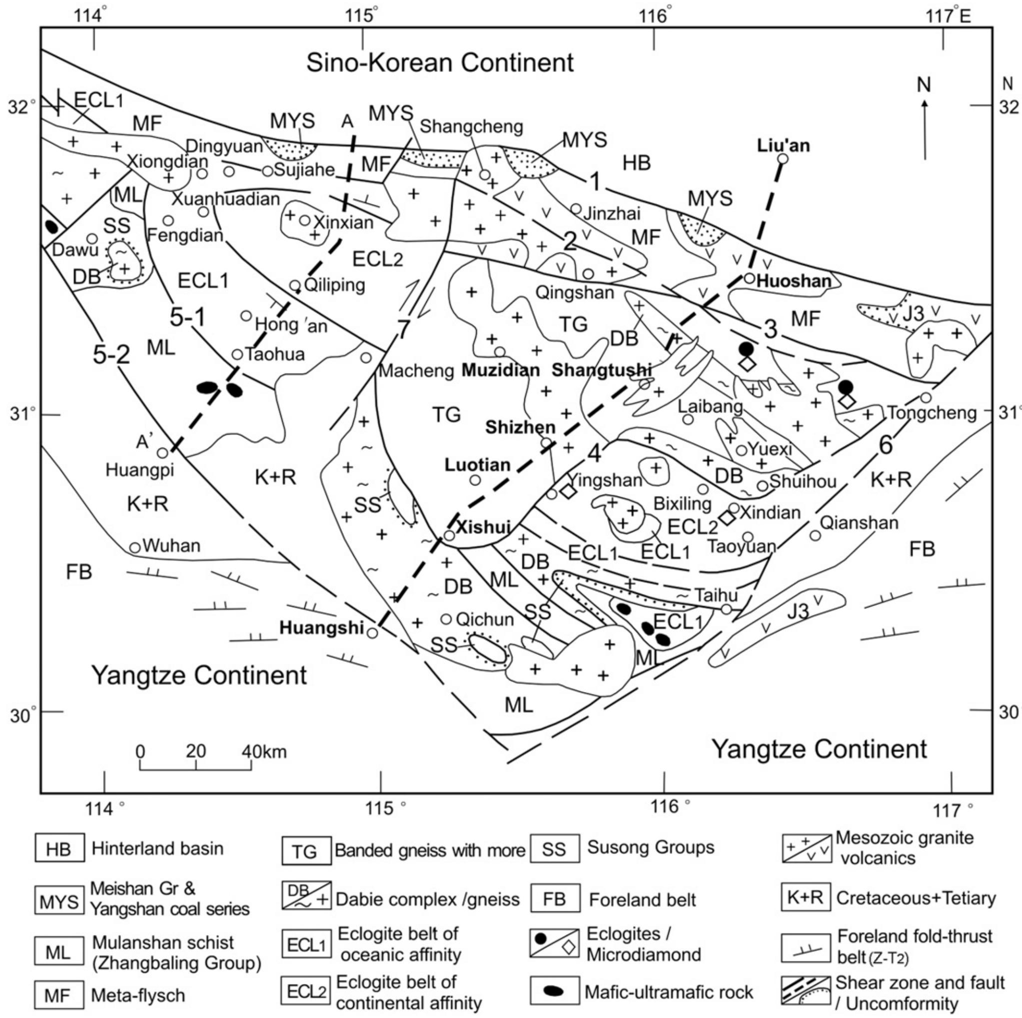

Fig. 1. Geological sketch of the Dabie Mountains (modified after Xu et al., 2005b). A–A′ denotes the line of the geological profile (see Fig. 8). Huangshi–Liu'an denotes the route of the reflection seismic profile (Xu et al., 2008a). All the Mesozoic granitoid is younger than <159 Ma and is in intrusive contact with their country rocks. All the petro-tectonic units are in fault contact with each other, except for the unconformity between SS/DB, and Mesozoic volcanics/MF.

metamorphic rock, which have been poorly understood to date. There are no papers concerning about the tectonic setting of the low-grade metamorphic rocks of the Dabie Mountains, except for some older literatures we cited from the past 20 years. Therefore most geologists are still unclear as to what units are related to subduction, what units were affected by collision event, and how the subduction was transformed to collision. All these questions will prevent one from understanding the location of suture and tectonic evolution of the Dabie Mountains. Some authors discussed the structural elements of the Tongbo orogen to the immediate west of the Dabie orogen recently. Although there is some similarity between the tectonic setting of these elements of the Dabie and Tongbo orogens, they did not focus on the tectonic setting of these structural elements, especially the low-grade metamorphic rocks (Li et al., 2009; Liu et al., 2011). Therefore this discussion of the tectonic setting of low-grade metamorphic rocks in the Dabie Mountains is new research.

2. Geological outline of the Dabie Mountains and neighboring areas

It is known that the Dabie Mountains are a collision orogen between the Sino-Korean and Yangtze cratons. Geological contrast between the two cratons (Table 1) suggests that there should have been an oceanic plate between them during the pre-Ordovician to Carboniferous periods (Table 1), which we term the “Dabie oceanic plate”.

Table 1 is generalized from the Bureau of Geology and Mineral Resources of Anhui Province (1987), Bureau of Geology and Mineral Resources of Henan Province (1989), Department of Geology and Mineral Resources of Henan Province (1997), and the Bureau of Geology and Mineral Resources of Hubei Province (1990).

It shows that the middle Ordovician to early Carboniferous strata in the Sino-Korean craton are absent, whereas all of them are present in the Yangtze craton. Absence of the Middle Ordovician to early Carboniferous strata in the Sino-Korean craton implies that the Sino-Korean craton was uplifted due to subduction of the oceanic crust of the suggested “Dabie oceanic plate” under the Sino-Korean continental plate. Since the Permian (295 Ma), the sediments in the Sino-Korean craton were converted to terrestrial facies in some intercontinental basins, with plenty of plant remnants, such as *Emplectopteridium alatum* (Bureau of Geology and Mineral Resources of Anhui Province, 1997), dating lower (295 Ma) to upper (250 Ma) Permian; it is seemingly caused by further rising of the Sino-Korean continental plate. This means that