Eclogite-facies relics and inferred ultrahigh-pressure metamorphism in the North Dabie Complex, central-eastern China

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ABSTRACT

Mineral assemblages and microstructures of a newly identified (retrogressed) eclogite (sensu lato) in the North Dabie Complex (NDC), central-eastern China, indicate early very high-pressure metamorphic relics preserved in a dominant amphibolite-facies host, where no eclogite (sensu stricto) has been positively identified before. The investigated eclogitic rock shows distinct multistage recrystallization, with granulite- and amphibolite-facies assemblages overprinting eclogite-facies relics. The minimum temperature for the eclogite-facies metamorphism is estimated to be ~800–820 °C. A spectacular microstructure of oriented quartz needles (~2–20 µm wide, ~5–200 µm long) in matrix Ca-Na clinopyroxene implies the prior existence of a non-stoichiometric “supersilicic” omphacite stabilized at ultrahigh-pressure (UHP, ≥25 kbar) conditions, although no coesite or coesite pseudomorphs have been found in the samples. The absence of coesite may be due to the lack of free silica at UHP conditions or the consumption of silica during retrograde reactions. The inferred UHP conditions metamorphism is further supported by Sm-Nd ages that are equivalent to Triassic metamorphic ages from UHP eclogites in the southeastern Dabie Mountains. This finding expands the UHP terrane northward about 50 km; spatial distribution of subduction/collision-related UHP rocks includes parts of the NDC.

INTRODUCTION

The widely confirmed presence of coesite and possible microdiamond from eclogites and other metamorphosed crustal rocks in the Dabie Mountains has demonstrated that a sizable segment of ancient continental crust was subducted to ultrahigh-pressure (UHP, ≥25 kbar) conditions along the tectonic boundary between the Sino-Korean and Yangtze cratons in Triassic time (see reviews by Hacker et al. 1996; Liou et al. 1996). Metamorphic rocks with evidence of UHP conditions have been reported from the southeastern Dabie Mountains where an UHP unit is well exposed, but the full spatial extent of UHP rocks in the Dabie Mountains is unknown. This study focuses on eclogite-facies relics and inferred UHP metamorphism in the North Dabie Complex (NDC; see Fig. 1 in Jahn et al. 1999), where no high-pressure metamorphism or eclogite (sensu stricto) has been identified previously. This finding expands the UHP terrane northward about 50 km and provides a basis to re-evaluate previous tectonic interpretations.

According to Koons and Thompson (1985), quartzofeldspathic rocks in exhumed terranes are more susceptible to retrogression than mafic rocks because of kinetic reasons. Therefore, it should not be easy to find high-pressure relics from the NDC, which is dominated by granitoid gneisses, even if it were once metamorphosed at high pressures. The possible occurrence of UHP metamorphism in the NDC had been implied by several authors (Wang and Liou 1991; Li et al. 1993; Okay et al. 1993); on the other hand, interpretations that do not invoke high-pressure events in the NDC seem to have been favored recently (Zhai et al. 1994; Hacker et al. 1995; Zhang et al. 1996). However, Hacker et al. (1998) speculated that some metamorphosed ultramafic bodies in the NDC might represent parts of the northern limb of an orogen-scale antiform that was closer to the southern Dabie area than it is today. To solve this problem, six samples of garnet-clinopyroxene metabasite from the NDC were investigated in this study. A variety of textures, such as mineral inclusions, exsolution lamellae, kelyphites, mineral replacements, and chemical zoning, represent a succession of changing physical and fluid conditions, allowing us to reconstruct metamorphic P-T-time path(s) to evaluate and revise existing tectonic models.

GEOLoGIC SETTING, SAMPLE OCCURRENCE, AND WHOLE-ROCK COMPOSITION

The Dabie orogenic belt has been divided into several units on the basis of different rock types and their metamorphic P-T conditions (see review by Liou et al. 1996 and references therein). The North Dabie Complex (NDC) occupies the northern half of the Dabie Mountains and consists predominantly of variably deformed, monzonitic to granitic Cretaceous plutons intruding amphibolite-facies (ortho)gneisses and rare, sparsely exposed granulites, marbles, and ultramafic slices (see Fig. 1 in Jahn et al. 1999). The Cretaceous plutonic suite extends throughout the Dabie Mountains, intruding most of the other major rocks. Eclogite (s.s.) previously has not been positively identified from the NDC, whereas characteristic UHP minerals, including coesite and possible microdiamond, have been reported from scattered occurrences in metamorphosed crustal protoliths of the eclogite units in the south. The NDC has been interpreted as a Paleozoic