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Eclogite facies rocks of the Monotonous unit, clue to Variscan suture in the Moldanubian Zone (Bohemian Massif)

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ABSTRACT

The formation and exhumation of Variscan high- to ultrahigh-pressure metamorphic rocks from the Moldanubian Zone in the Bohemian Massif are the subject of controversy regarding their unclear relationship to possible subduction zones. In this paper we present the results of a petrological study of eclogites that occur together with serpentinites within amphibolite facies gneisses in the Moldanubian Zone, east of the Teplá–Barrandian Block. More than 100 bodies of retrogressed eclogite and serpentinite follow an approximately 250 km long SW–NE trending zone in the central part of the Bohemian Massif. Together with surrounding gneisses, the eclogites share a medium to low-pressure amphibolite facies metamorphism. P–T conditions estimated for the eclogite facies stage indicate a relatively low-temperature geothermal gradient similar to those observed in the Saxothuringian Zone, which occurs north and northwest of the Teplá–Barrandian Block. The presence and distribution of eclogites and comparison of their P–T and age data with HP–UHPM rocks in other units in the Bohemian Massif allow us to constrain the Variscan suture, which straddles the SE of the Teplá–Barrandian Block. The existence of this suture in relation to available geotectonic models and its possible continuation through other allochthonous units along the European Variscan Belt are discussed.

1. Introduction

Definition and localization of suture zones responsible for the formation and/or exhumation of HP–UHPM rocks along old orogenic belts are among the most challenging questions in geological research. This is usually due to poly-metamorphic and poly-deformation histories, where former structures are modified and HP minerals are obliterated by medium- to low-pressure assemblages (Banno et al., 2000; Chopin, 2003; Ernst, 1988; Faryad and Kachlík, 2013; Janák et al., 2009; O'Brien, 1997). To trace the original suture zones, a complex and multi-disciplinary approach, involving geophysical, structural, mineralogical and geochemical methods, is needed. Mineral inclusions and mineral zoning are the best tracers to decipher, whether the rocks have been subjected to subduction or exhumed from mantle depth along the subduction channel (e.g. Liu et al., 2001; Sobolev and Chopin, 1995; Zhang et al., 2006).

The Bohemian Massif is well known for the presence of Variscan eclogite facies and UHPM rocks that are hosted by amphibolite and granulite facies lithologies, respectively. The HP–UHPM rocks are restricted to the Saxothuringian and the Moldanubian Zones which surround the Teplá–Barrandian Block in the core of the Bohemian Massif. Many newly discovered occurrences of HP–UHPM rocks or refinement of PT condition of known localities (Faryad, 2009; Kotková et al., 2011; Medaris et al., 2006; Nakamura et al., 2004; Naemura et al., 2011) help to localize subduction zones or sutures which need to be considered when creating or modifying a geotectonic model for the European Variscan Belt (Franke, 2000; Kroner and Romer, 2010; Linnemann et al., 2010; Matte, 1986; Schulmann et al., 2005, 2009). The Saxothuringian Zone is characterized by the presence of blueschist facies rocks that form a discontinuous belt related to the Teplá Suture at contact with the Teplá–Barrandian Block (Faryad and Kachlík, 2013; Franke, 2000; Mazur and Alexandrowski, 2001). By contrast, the relationship of eclogite facies and UHPM rocks in the Moldanubian Zone to a possible Variscan suture is the subject of discussion and controversy. Some authors (Babuška and Plomerová, 2013; Franke, 2000; Medaris et al., 2006) consider formation of HP–UHPM rocks as the result of closure of the Moldanubian basin that was situated east from the Teplá–Barrandian Blocks. On the other hand, Schulmann et al. (2005, 2009), Lexa et al. (2011) and Guy et al. (2011) assume that the HP–UHPM rocks in the Moldanubian Zone came from the Saxothuringian Zone by underplating the Teplá–Barrandian Block.

In this paper, we present mineral textural relations and maximum P–T conditions reached by eclogites that form lenses and boudins within amphibolite facies gneisses in the Moldanubian Zone. The eclogites record evidence of rapid subduction and exhumation and their occurrence along a SSW–NNE traverse (200 × 50 km) signifies a possible remnant of the Variscan suture zone. The results of this study are combined with the available information about HP–UHPM rocks in the

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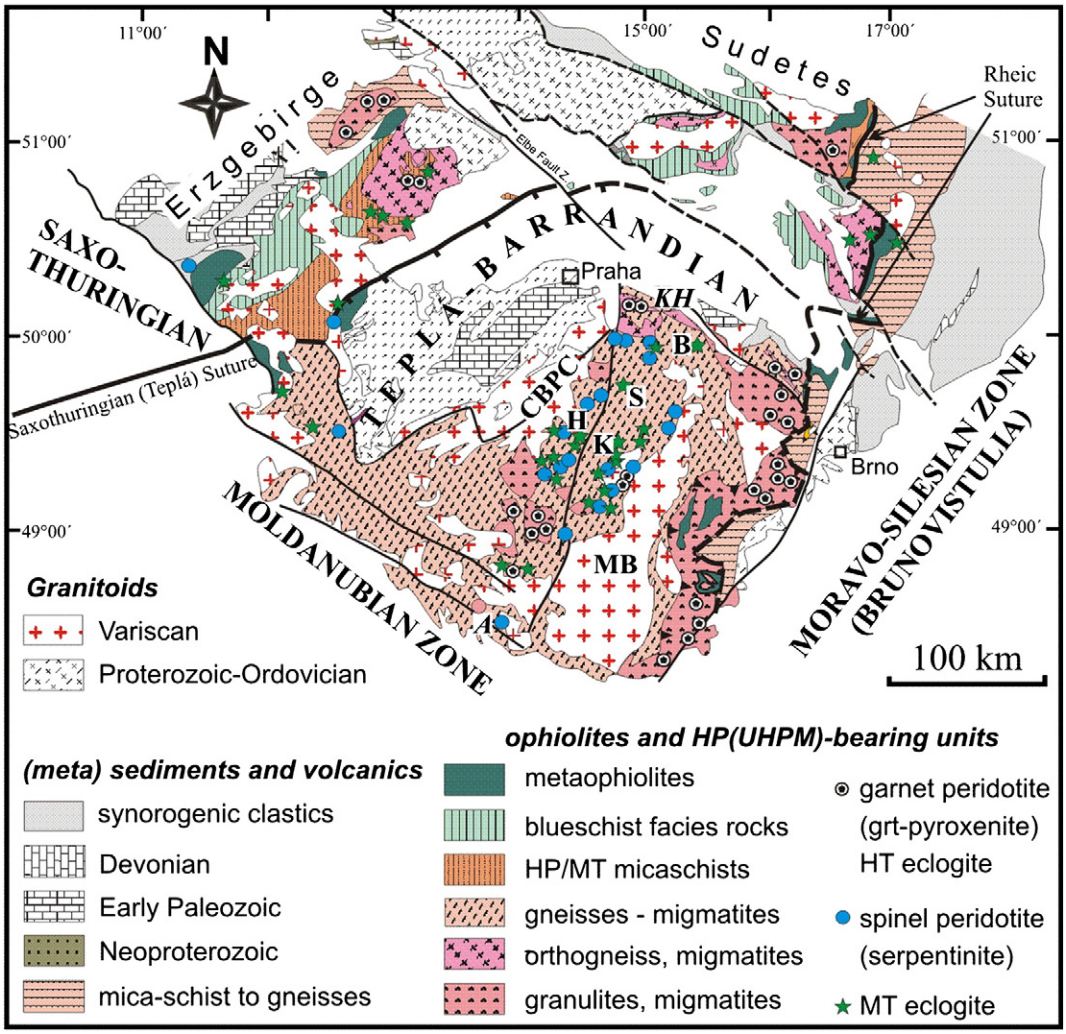

Fig. 1. Simplified geological map of the Bohemian Massif and location of HP–UHPM rocks (Faryad and Kachlík, 2013, compiled from data after Cháb et al., 2007; Franke, 2000; Machart, 1984; Willner et al., 2002). A-Aubach CBPC—Central Bohemian Plutonic Complex, KH-Kutná Hora and MB—Moldanubian Batholith. The studied eclogite localities are: B—Borek, S—Šelmberk, K—Katov and H—Hutě.

Moldanubian Zone to analyze the interplay between petrological data and existing geotectonic models for Variscan Orogeny in the Bohemian Massif.

2. Geological position

The Bohemian Massif represents the easternmost segment of the European Variscan Belt and is formed by two blocks (the Brunovistulian and the Teplá–Barrandian) that are separated or surrounded by two zones (the Moldanubian and the Saxothuringian, Fig. 1). The zones are characterized by the presence of eclogite facies and UHPM rocks that occur as lenses and boudins within amphibolite and granulite facies rocks, while the blocks are free from HP–UHPM rocks. The Saxothuringian Zone occupies the northern part of the Bohemian Massif, including the Erzgebirge in the west and the Sudetes in the east (Fig. 1). In addition to eclogite facies and UHPM rocks, it contains blueschist facies

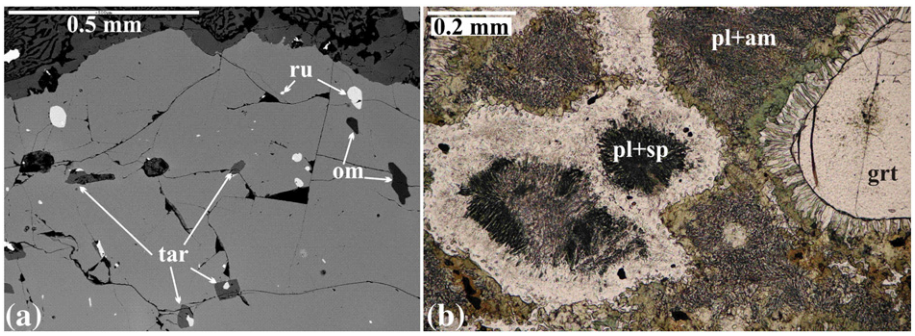

Fig. 2. BSE image (a) of garnet with inclusions of taramite (tar) in the core and omphacite near to the rim (sample 8B-4). Garnet has numerous inclusions of rutile (ru). (b) shows retrogressed eclogite (sample RJB1-11) with symplectite of amphibole (am) + plagioclase (pl) after omphacite and of spinel (sp) + plagioclase after kyanite. Garnet has corona of amphibole and plagioclase.