Stop 2-4 (Day 2). Eclogite, Měděnec
Coordinate N50°25'10.7" E13°06'38.8"

At the locality near Měděnec Village (Fig. 2), we will examine eclogite with a discrete zone that contains atoll garnet formed under eclogite facies conditions. Atoll garnets occur in several localities, but their relations to eclogites lacking atoll garnet are not always clear (Faryad et al., 2010). The presence of atoll garnet is not restricted to a specific rock type but occurs in a variety of metabasites, including quartz-rich types, which probably represent a mixture of mafic rocks and sediments. The eclogite consists of omphacite, garnet, quartz, and small amounts of rutile, amphibole, and albite ± phengite. When different size variabilities are compared, it is found that atoll garnets occur mostly in the fine-grained varieties (see Fig. 7a). The atoll garnets consist of a garnet annulus surrounding quartz and/or amphibole. If the atolls are occupied by quartz, their interfaces are sharp and regular (Fig. 7b) and correlate with crystallographic planes of garnet. On the other hand, where amphibole overgrows the atoll, boundaries with the garnet ring are irregular.

Backscattered electron images and compositional profiles (Figs. 8) from whole garnet grains demonstrate that garnet cores (garnet I) and rims (garnet II) have different compositions. The core I, with idiomorphic outlines, has a higher Ca content and lower Fe content compared with its rim (II (Fig. 8a1). Garnet I shows prograde zoning with a decrease of Mn towards the rim. Figure 8b shows a whole garnet with a dark, Ca-rich core and a peninsula connected to the rim. The peninsula and the rim have similar image contrast and, hence, similar compositions (Fig. 8b1).

Figure 9a shows that the dark, low-Fe zone of garnet has microveins with a similar image contrast to that of the outermost rim of the garnet. These microveins connect garnet core I with the rim, but the core garnet shows a strong compositional gradient at the points of contact between sub-grains with Fe content. Compositional zoning of sub-grains and microveins in garnet I change by substitution of Fe and Mg, while Ca remains almost constant in garnet. Compared with the narrow white veins in the dark rim, sub-grains in the core are separated by wide grey zones and channels with larger Mg contents.

Formation of the atoll garnet is interpreted as resulting from fluid infiltration and element exchange between the garnet core and matrix, a process that was facilitated by temperature increase during eclogite facies metamorphism up to 600 °C/2.4 GPa (Fig. 10). In addition to fluid access, the primary textures, mainly grain size, were also effective for the atoll garnet formation. Small grain fractions with thin rims were easily infiltrated by fluid, which used the short distance for element exchange between core and matrix. The core garnet was gradually dissolved and replaced by new garnet having the same crystallographic orientation as the rim or relics in the core.

If we assume equilibrium of the garnet rim with matrix omphacite, these results suggest that garnet growth continued after the peak of metamorphism, at least in a rock of effectively constant bulk composition. The fact that substantial growth of garnet II happened at a late stage is presumably related to the modification of the local reactive bulk compositions caused by

Metamorphic PT conditions

Temperatures and pressures estimated using the garnet-clinopyroxene Fe-Mg exchange thermometer (Ellis and Green, 1979; Ravna, 2000) and garnet-omphacite-phengite barometer (Ravna and Terry, 2004) are 600–650 °C and 2.5–2.6 GPa. Similar pressures were also obtained for eclogites by Klápová et al. (1998) and for micaschists by Konopásek (2001).

Fig. 6. Estimated PT conditions for Variscan eclogite (E) in the Krušné Hory Complex (E; after Klápová et al. 1998). P indicates PT conditions of Pre-Variscan metamorphic event obtained for the parautochthonous metapelitic rocks (Konopásek 1998).
Fig. 7. Photomicrographs (crossed polarizers) of atoll garnet from eclogite with phengite and amphibole. (a) Contact between two layers with coarse-grained whole and fine-grained atoll garnets; the layers are parallel to foliation in the rock. (b) Present atoll rims with island cores separated by quartz, reflecting crystallographic control of garnet. (c) indicates an omphacite inclusion in the atoll core. (d) Amphibole crystal surrounding the atoll garnets has the same optical orientation as amphibole inside the atoll garnet.

Fig. 8. BSE images and compositional profiles from quartz eclogite (Faryad et al. 2010). Images (a) and (b) show whole garnets with idiomorphic cores (dark, garnet I) along with compositional profiles (a1 and b1). The dotted lines above the pyrope profiles in a1 and b1 indicate $X_{Mg} = Mg/(Mg+Fe)$ ratios in garnet. Note that there is a peninsula in the cores of (b) that has similar image contrast and compositions to that of the garnet rim II. The y axis in the compositional profiles represents the fractional garnet end-member compositions.

The fluid-assisted enlargement of diffusion domains to include previously inaccessible garnet cores.

The common occurrence of Na-Ca amphibole of barroisite composition in the matrix with inclusions of omphacite and garnet in eclogites is good evidence for both pressure and temperature decrease during exhumation of the rocks. The retrograde P-T path crossing the amphibole eclogite/blueschist facies boundary was probably one of the reasons for preservation of eclogite facies minerals and textures in the Krušne Hory eclogite.
Fig. 10. Inferred P-T conditions of atoll garnet in eclogites from the Krušné Hory Complex (Faryad et al. 2010), based on garnet/clinopyroxene thermometry (Ravna 2000; Ai 1994). Maximum pressure conditions are based on data (garnet-omphacite-phengite thermobarometry) from Klápová et al. (1998) and Massonne and Kopp (2005). The P-T path (grey line) is after Massonne and Kopp (2005). Numbers 1–3 correspond to the core (I, 1), the thin zone between the core and rim (2), and the rim or ring (II, 3) of atoll garnet formation (see Fig. 8). Metamorphic facies fields are after Okamoto and Maruyama (1999): BS, blueschist; Law-Ec, lawsonite eclogite; Ep-Ec, epidote eclogite; Amp-Ec, amphibole eclogite.

Fig. 11. Tectonic model and nappe succession of the HP/UHP unit in the Saxothuringian zone after O’Brien 1990; Konopásek and Schulmann 2005. The high-grade units are overthrust by low-grade units.

Tectonic interpretation of the Krušné Hory eclogite

It is generally agreed that Krušné Hory HP/UHP rocks formed during subduction of the Saxothuringian oceanic basin and adjacent crustal units beneath Tepla-Barrandia (Bohemia) and Moldanubia (Fig. 11). A Chemenda et al. (1995)-type model has been widely invoked for exhumation of these rocks. Regarding the present position of granulites and UHP rocks in the Erzge-
birge, this high-grade unit is interpreted as occurring at the bottom of the nappe succession (O’Brien, 2000; Willner et al., 2004 etc.), but an opposite arrangement with an increase of metamorphic conditions from bottom to top has been proposed by Konopásek and Schulman (2005).

References


SCHMÄDICKE E., OKRUSCH M. and SCHMIDT W., 1992. Eclogite-facies rocks in the Saxonian Erzgebirge, Germany: high pressure metamorphism under contrasting P-T con-
