Metamorphic Zonality of the Jeseník Amphibolite Massif and its Influence on Deformation of Amphibolites during Folding

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The studied area is situated at the north-eastern margin of the Bohemian Massif, at the northern termination of the Desná dome of Silesicum. The Desná dome consists of the crystalline pre-Variscan basement and its Devonian metasedimentary and metavolcanic envelope. All lithologies are strongly influenced by the Variscan orogenic event. The studied metabasites belong to Devonian volcanites which form the western part of the Devonian envelope of the Desná crystalline basement. From the geochemical point of view, the majority of the metabasites of the Jeseník amphibolite massif have a composition of ocean tholeiites (Souček 1981) which are related to the Devonian rifting of the eastern part of Brunia (Schulmann and Gayer 2000). The aim of this work is to investigate relationships between variations of micro- and macro-structural patterns and the degree of metamorphism across the Desná dome.

The metamorphism is considered as polyphase and metamorphic grade increases from the E to the W. Schulmann and Gayer (2000) distinguished two main Variscan metamorphic events – – M_2 and M_3, superimposed on the pre-Variscan M_1 metamorphic assemblage in basement lithologies. The earlier Variscan metamorphism M_2 is of Barrovian type and is present in the entire Desná dome, whereas the M_3 event is of HT/LP type, related to the thermal influence of the Žulová pluton in the western part of the studied area. Amphibolites of the lower epidote-amphibolite facies are present at the eastern margin of the Jeseník amphibolite massif while rocks of higher amphibolite facies related to M3 stage occur at the contact with the Žulová pluton in the W. Typical assemblage of the lower grade amphibolites is oligoclase + hbl + act + ep ± chl ± bt ± qtz ± ttn ± ilm ± ap ± cal, the mineral assemblage of the middle grade amphibolites is oligoclase – andesine + hbl ± ep ± bt ± cpx ± qtz ± cal ± ttn ± ilm ± ± ap and the mineral assemblage of the highest conditions attained in the sillimanite zone is andesine – bytownite + hbl ± ± ep ± cpx ± qtz ± cal ± ttn ± ilm. The clinopyroxene is present mainly in the calcite-rich layers parallel to metamorphic foliation.

Hornblende – plagioclase thermometry (Holland and Blundy 1994) and themobaromter of (Plyusnina 1982) were applied to estimate metamorphic temperatures and pressures of metamorphism The first metamorphic event M_2 reached the temperature of 630–680 °C. The pressures did not exceed 7 kbar. The second event M_3, which overprinted M_2 in the W, reached the temperature of 720–750 °C and pressure of 3–4 kbar.

All the lithologies are strongly influenced by the Variscan polyphase deformation defined by Schulmann and Gayer (2000). The investigated folds were formed during the second phase of the Variscan deformation D_3. The classification by Ramsay (1967) and the harmonic analysis by Hudleston (1973) were used to class the folds into groups basing on their morphology. The macroscopic shapes strongly vary across the Jeseník amphibolite massif. The fold shapes at the lower grade rocks belong to the classes 1A, 1B and 1C (Ramsay 1967) and they appear in the field of chevron folds (Hudleston 1973). The fold shapes often approach to sine waves and they seem to be controlled mostly by the rock anisotropy, which is defined by the foliation and by the arrangement of grains of amphiboles. However, the fold shapes in the western part of the massif belong to the 1C and 3A class and they vary from chevron folds to parabolas. Important feature is the occurrence of cuspate and lobate folds which implies strong influence of increasing temperature generated by the M_3 HT/LP contact metamorphism, which controls the mechanical behaviour of the rock.

The microscopic pattern of distribution and character of the grains within the folds varies with increasing metamorphic grade as well. The difference between the size and the orientation of amphiboles and plagioclases in the lower grade rocks is quite important and the mechanical behaviour of the rock during folding in a microscopic scale is ruled mostly by the shape and size of amphibole grains. On the contrary, the size and shape of amphiboles and plagioclases become more similar in the higher grade rocks and the mechanical properties of the rock during folding are defined by both minerals in nearly same way.

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