Some Petrographic Evidences for Multiphase Deformation of Ultrabasic Rocks from the Sowie Góry Gneiss Block (NE Bohemian Massif)

Piotr GUNIA

Institute of Geological Sciences, Uniwersity of Wrocław, pl. M.Borna 9, 50-204 Wrocław, Poland

Ultrabasic rocks from the Góry Sowie block (NE edge of the Bohemian Massif) form small, lense-like or plate-shaped tectonic bodies within gneisses, in many places accompanied by amphibolites or granulites. Most of them are strongly foliated and surrounded by metamorphic rims composed of talc-actinolite schists. The other groups of ultrabasites represent larger units bordered by steep faults (Przygórze and Roztocznik units). Results of petrologic studies indicate, that these rocks represent primary harzburgites and lherzolites, whilst pyroxenites occur only in small amounts. All primary peridotites underwent strong serpentinization producing mesh, hourglass, cellular, banded, interpenetrating, interlocking and mylonitic structures of serpentinites. Some petrological features of the Sowie Góry ultrabasites suggest their similarities to tectonic peridotites from the lowest members of ophiolitic suites occurring in the surroundings of the Sowie Góry gneiss block (Gunia and Szczepański, 1994; Gunia, 1997; Dubińska et al., 1999; Bylina et al., 2001).

Three types of deformation structures can be recognized after detailed petrographic examinations of thin sections. They probably reflect different events in petrogenetic history of ultrabasites connected with 1) high-temperature plastic flow in the solid state, 2) folding during the late stages of gneiss deformation, and 3) brittle deformation after solidification.

The first group of microstructures is difficult to interpret because studied samples were strongly serpentinized. Consequently, the identifiable relict structures are marked only by presence of the characteristic systems of magnetite microspherules. In some places, sets of microspherules occupy isolated areas, which resemble microstructures typical of high-temperature deformation of primary peridotites. Serpentinites from Kamionki most often show characteristic "cellular" or polygonal structures. Sometimes, these polygons contain larger opaque grains situated in the triple point juctions. Other example of pristine high-temperature microstructures can be interpreted as porphyroblasts, when large serpentine pseudomorphs replacing olivine are surrounded by fine-grained matrix. In other cases, parallel – oriented assemblages of the flattened or lenticular pseudomorphs after olivine or pyroxene also are present. Such phenomena can be indicative for relics of penetrative structures produced by the high-temperature flow of asthenosphere in the seafloor spreading centres (Nicolas et al., 1980). Nevertheless, the origin of these structures due to high temperature recrystallization of olivines in continental micromylonitic zones (Buiskool-Toxopeus, 1977) is also possible.

The second group of deformation structures reflects folding of metamorphic layering (foliation) widespread in many of the Sowie Góry serpentinite bodies. Results of structural observations carried out in the area between Jugowska and Woliborska Passes in the Central Range of the Góry Sowie Mts indicate that elongation of larger serpentinite lenses (W-E or NW-SE oriented) is consistent with the main structural trend in the surrounding gneisses. Additionally, some serpentinite bodies, which have well – preserved foliation are locally folded in chevron or isoclinal microfolds with axial planes dipping at the medium angle to the ESE (Gunia and Szczepanski, 1994). The shape of these folds and their orientation are comparable with the D5 stage of deformation in the Sowie Góry gneisses (according to scheme by Żelaźniewicz, 1987). The foliated serpentinites from the Korczak hill (near Jugowska Pass) exhibit characteristic banded structure composed of thin, glassy-like, alternating lizardite-chryzotile layers containing small amounts of magnetite microspherules. Ultrabasic rocks from Chmielina hill near Nowa Bielawa have foliation defined by presence of alternating amphibolitic (primary pyroxenites?) bands and slightly serpentinized peridotite layers up to 5 cm in thickness.

The brittle deformation events in serpentinites are documented by presence of fissures and joints filled with secondary asbestos veins, cutting metamorphic layering of the foliated serpentinites. These strucutres can be well – observed in the southern part of the Sowie Mts (Przygórze Unit). After detailed microscopic examination three different systems of serpentine veins were ascertained. All of them obliterated the primary structure of serpentinite, commonly rich in bastites after pyroxene. The obtained results indicate that secondary serpentine veins differ in morphology of their serpentine components. The oldest system of veins seems to be composed of fibrous serpentine, whereas the younger systems shows "serrated" or glassy appearance of serpentine individuals.

The second generation of brittle deformation structures is known from ultrabasic rocks occurring along the contact zone between the Fore-Sudetic Block and mylonitic rocks of the Niemcza Shear Zone. Serpentinites from this locality (Gilów) are characterized by mylonitic structure composed of very small, shattered flakes of antigorite intergrown with long needles of tremolite-actinolite amphibole and worm-like or ameboidal-shaped chromian spinels. The microscale mylonitic zones in these specimens are also filled with cloudy assemblages containing flakes of talc and frequent magnetite microspherules. The occurrence of these brittle structures suggests that they likely originated during the continental episode of structural evolution of serpentinized peridotites.

Summing up, the deformation microstructures preserved in the Sowie Góry serpentinites exhibit some features characteristic of different events in their petrogenetic history. They are correlated with: (1) mantle-related processes, (2) folding after the main metamorphic event and (3) later brittle deformation. Elucidation of relationships between described microstructures and the structural evolution of adjacent gneisses requires further studies which are currently in progress.

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The Record of Thermal and Shock Metamorphism in Selected H Chondrites

Jakub HALODA and Patricie TÝCOVÁ

Department of geochemistry, Faculty of Science, Charles University, Prague, Albertov 6, 12843, Czech Republic

Chondritic meteorites of H chemical class belong to an ordinary chondrite compositional group. They represent chemically primitive and less modified material formed by condensation from a cooling solar nebula, occurring about 4.5 billion years ago. H chondrites originated in the surroundings of protoplanets by aglomeration of small bodies of chondritic composition. Furthermore, these parent-bodies experienced the processes of thermal metamorphism. The heat source was probably the decay of short-lived radionuclides (^{26}Al, ^{53}Fe). The experienced metamorphic P-T conditions were 300–950 °C and less than 1.5 kbar, related to the stratification and size of the parent-body (200–400 km in diameter). It is possible to simulate the P-T conditions of formation and to estimate the physical properties of parent-bodies by studying the metamorphic record affecting distinct H chondrites

Chemical classification of ordinary chondrites is based on the oxidation state (the presence of Fe in silicates). Petrological classification is defined by grades of metamorphism in chondrites (type 3–6) based on observable textural and mineralogical changes (from the individual mineral grains and chondrule recrystallization, chemical and mineralogical equilibration of primary components, devitrification and recrystallization of glass to form feldspar (> 500 °C), chondrule-matrix integration, to partial melting and formation of primitive achondrites). Mineral assemblage of H chondrites contains silicate minerals (cpx, opx, ol, plg and glass), reduced metal (the Fe-Ni alloy) and sulphides (troilite – FeS). Present accessory minerals are chromite, chlorapatite and merrillite.

The effects of thermal metamorphism were studied on three selected H chondrite samples of distinct petrological type, after the accomplishment of classification: 1) H3 chondrite from the Libyan desert, less affected, 2) H4 chondrite of unknown origin, 3) observed fall – Morávka (H5) meteorite (Fig. 1). The polished sections were made and studied using optical and electron microscopy. All chemical analyses were obtained using electron microprobe CamScan S4 with EDX analytical system Link ISIS 300 (Laboratory of electron microanalysis, Faculty of Science, Charles University in Prague) and the data were processed by the ZAF method. Structural identification of several phases was realized by measuring on the FTIR spectrometer Magna-IR 760 E.S.P. (Laboratory of specialized polymers, Faculty of Science). The record of thermal metamorphism was stud-

Fig. 1. Classification diagram for ordinary chondrites of Bearley & Jones (1998), with the three studied samples falling in the field of H chondrites.