Limestone Microstructures and Strain Patterns as Metamorphic Indicators of Low-Temperature Deformation in the Eastern Part of the Bük Mountains (NE Hungary)

Ferenc MÁDAI

University of Miskolc, Dept. of Mineralogy and Petrology, H-3515 Miskolc-Egyetemváros, Hungary

The (North) Bük Parautochton is a major tectonic unit of the Bük Mountains, consisting its central, eastern and northern parts. It is composed of a rock sequence from Middle Carboniferous to Upper Triassic, predominantly of metacarbonates intercalated with metapelites, metapsammites and metavolcanics. The most exposed rock types are platform and basin facies limestones.

The whole sequence was affected by the Alpine dynamothermal metamorphism (e.g. Lelkes-Felvári et al. 1996). This metamorphism in the eastern part of the Bük Ms. reached the green-schist and pumpellyite-actinolite facies, represented first of all with higher anchizonal metasediments (Árkai 2001). The metamorphic grade was determined by mineral assemblages from Paleozoic and Mesozoic metasediments and Middle Triassic metavolcanics, as well as by analytical methods such as ilite crystallinity (IC) data from metapelites and metavolcanics, vitrinite reflectance from metapelites. Based on minerals, occurring in the Upper Triassic meta-basalts, the maximal fluid pressure is estimated for 300 MPa, while the temperature could reach 350°C.

The Mesozoic limestones of the Parautochton are generally neormorphosed and have medium to strong shape preferred orientation (SPO). The macro- and microscopic features show multi-phase deformation. The first, recognizable deformation phase (“early phase” in Németh and Mádai 2003) is characterized by ductile forms and textures, showing cleavage (“main cleavage” in Csontos 1999) and multi-order folding on the macro-scale, SPO and other ductile strain patterns on the micro-scale. Later deformation phases resulted predominantly in brittle deformation in the limestones, however the less competent metapelites and metavolcanics could form ductile strain patterns also in later phases.

Having been an entirely ductile deformation phase, it is believed that the early deformation phase took place during the peak of the Alpine dynamothermal metamorphism (Csontos 1999, Németh and Mádai 2004). The aim of this study is to correlate the available data on metamorphism with the stress-temperature conditions of the most ductile (early) deformation phase, by means of limestone microstructure and strain pattern analyses and interpretation of foreign analogies (Groshong et al. 1984, Ferrill 1991). The investigated strain patterns comprise the type and intensity of crystal preferred orientation (CPO), development of differences. It shows that microporosity in the sample JK1b is relatively large and strongly preferentially oriented, whereas it is significantly lower and less preferred oriented in the sample SNW3. It implies that grain size of rock forming minerals controls amount of microporosity. Also, orientation of microporosity depends mostly on preferred orientation of grain boundaries and somewhat less on orientation of cleavage planes. This study showed that experimental pulse transmission technique is useful tool for visualization of oriented microporosity in 3D and provide important basis for further study of permeability anisotropy through studied rocks.

References


“core and mantle” structures, as well as the width and deformation of mechanical e-twins in large calcite crystals.

The strongest deformation was detected in mylonitized limestones. These rocks occur in shear zones, their texture is characterized by “c-axis fibre type” CPO, that indicates dynamic recrystallization. Relicts of coarse, strongly-twinned crystals (“cores”) flow in these rocks in the broad “mantle” of the dynamically recrystallized matrix.

Out of shear zones, the appearance of “core and mantle” structures is a general feature, too. Here the core corresponds to the strongly-twinned large crystals, while the mantle is a rim of recrystallized calcite grains with d ~ 20–30 μm size. The thickness of the mantle and the deformation style of mechanical twins depend on the intensity of shear strain. During small strain, only twins form in the large crystals, mantle does not develop. Conversely, in strongly-strained limestones a broad mantle develops around the coarse grains, which include curved and recrystallized twins. The microcrystalline matrix of these rocks shows an a-axis fibre type CPO or it lacks CPO that points to the appearance of grain boundary sliding (GBS) as the dominant deformation mechanism. Applying these strain patterns, the shear strain developed during the early deformation phase can be estimated between γ = 0.3–5. The latter value characterizes the shear zones.

The results obtained from strain patterns of the coarse-grained calcite aggregates and mechanical twins in the Eastern Bükk correlates well with metamorphic grade indicators, measured directly in limestones such as Conodont Color Alteration Index (CAI) (Sudar and Kovács in press) and measured in other rock types, using mineral assemblages, IC and vitrinite reflectance data (Lelkes-Felvári et al. 1996). The epizonal metamorphism correlates with strain patterns such as dynamic recrystallization, strongly developed core and mantle structures, curved and recrystallized calcite twins with at least 5 microns width. The anchizonal metamorphism correlates with dynamic recrystallization and GBS, with less-developed core and mantle structures, curved or straight twins with 3–6 microns width.

The Miocene Transpressional Tectonics along the Pieniny Klippen Belt (Zázrivá, Western Carpathians)

František MARKO, Rastislav VOJTKO, Dušan PLAŠIENKA and Ľubomír SLIVA

Department of Geology and Paleontology, Comenius University, Mlynska dolina G, 842 15 Bratislava, Slovak Republic

Meso-Neoalpine tectonic evolution of the Western Carpathians was controlled by long lasting (Upper Cretaceous – recent) squeezing between the North European Platform and promoted the Apulia-Adria microcontinent pushed by the Africa lithospheric plate to the north. It led to the strong dominance of the north-verging tectonic structures within the Outer Western Carpathians (Flysch Belt), where asymmetric accretionary orogenic wedge was created due to the consumption of a quasi-oceanic Peninic (Vahic) crustal slab. Nevertheless, south-verging, high-angle thrusts have already been described in the eastern part of the Pieniny Klippen Belt (Nemčok and Rudinec 1990, Plašienka et al. 1998). The south vergent reverse faulting in studied area has been first suggested by Matějka (1931) in the Medzirozsutce saddle and later accepted in tectonic interpretation of the area (Haťko and Polák 1978). During the last years, we have had an opportunity to study systematically the zone of tectonic junction of the Central and Outer Western Carpathians in the eastern part of the Malá Fatra Mts. and the Kysucké vrchy Mts. From structural analysis supported by detail geological mapping has resulted that the geological structure in tight contact with the Pieniny Klippen Belt zone is really strongly affected by

References


