parallel to the macroscopic foliation. In the upper sheet, most of the magmatic amphiboles and plagioclases are recrystallized forming monomineral bands of 0.1 – 1 cm in size. The plagioclase-plagioclase grain boundaries are strongly serrated, while the amphibole-amphibole boundaries are mostly straight and equilibrated.

The quantitative microstructural analysis shows in the lower gabbro sheet an important increase in shape preferred orientation (SPO) of amphiboles and slight increase of SPO of plagioclase with increasing deformation. Both minerals achieve higher aspect ratio but they do not exhibit change in grain size distribution with increasing strain intensity. On the contrary, the SPO in the upper gabbro sheet as well as the aspect ratio of amphiboles slightly decrease with increasing deformation, whereas these parameters in plagioclases remain unchanged. Moreover, the grain size of amphibole decreases, while that of plagioclase increases with progressive deformation.The electron backscatter diffraction (EBSD) measurements of crystal preferred orientation (CPO) reveal similar trends for both metagabbro sheets. Amphibole is marked by a relatively strong CPO already at lower deformation intensities, whereas plagioclase displays very weak CPO. With progressive deformation, the CPO of amphibole further strengthens and becomes entirely random for plagioclase.

The quantitative microstructural analysis and the EBSD study suggest that the deformation on a microscale changes depending on temperature and degree of deformation. In the lower sheet, the magmatic grains of amphibole firstly rotate to the easy slip direction, which is represented by the (100)[001] glide system oriented parallel to the foliation and lineation. When this orientation is achieved, the dislocation creep on (100)[001] takes place together with activation of (110)[001] weak cleavage planes inducing a strong rock anisotropy at high deformation intensities. Plagioclase recrystallizes mostly by fracturing and nucleation of new grains occurring in the highly strained zones and to limited extent by mechanism of subgrain rotation. At high strains, the deformation mechanism switches to grain boundary diffusion creep, which is a grain-size sensitive process resulting in a random CPO. In the upper sheet, most of the longest axes of magmatic amphiboles are already oriented parallel to the foliation, and the predominant (100)[001] glide is active. Moreover, the dislocation glide is accompanied by chemically induced grain boundary migration, which is manifested by different composition of the new and old grains. On the contrary, the plagioclase recrystallizes by subgrain rotation mechanism. At the later stages, the dominant recrystallization mechanism is grain boundary migration, which is either chemically or strain induced. It is indicated by strongly serrated plagioclase-plagioclase grain boundaries as well as by important differences in the plagioclase compositions. The processes described above result in strong anisotropy of the whole rock.

Petrography and Succession of Granitoids from the Southern Part of the Strzelin Crystalline Massif (SW Poland) – Preliminary Data

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The Strzelin crystalline massif is located in the eastern part of the Fore-Sudetic Block c. 40 km SE of Wrocław, SW Poland. The unit consists of gneisses (Upper Proterozoic – Cambrian), older schist series (Precambrian or Lower Paleozoic) and younger schist series corresponding to Lower–Middle Devonian quartzites of the Jegłowa Member (Oberc-Dziedzic, 1999). Metamorphic rocks are intruded by Variscan granitoids. Oberc-Dziedzic (1991, 1999) documented three episodes of granitoid emplacement into metamorphic rocks represented by intrusions of tonalite and quartz diorite, biotite granite and two-mica granite. The biotite granite was dated at 347 ± 12 Ma and the two-mica granite yielded the age of 330 ± 6 Ma (Oberc-Dziedzic et al., 1996). According to Oberc-Dziedzic (1991, 1999), small bodies of granodiorite in the southern part of the massif may represent an onset of magmatic activity. Nevertheless, this has not been proved yet.

This paper focuses on granitoids encountered in boreholes (B-1, B-2, W-1, De-1) drilled in the SE part of the massif. Five varieties of granitoids were identified in the investigated drill cores: granodiorites and subordinate biotite tonalites, fine-grained biotite-hornblende tonalites, medium-grained biotite-hornblende tonalites and two-mica granites. Non-plutonic rocks in the drill cores are gneisses (fragments of the metamorphic envelope of the granitoids). Granitoids form small intrusive bodies, mainly compound dykes a few metres to several centimetres thick. Thin dykes mainly follow foliation in gneisses whereas thick ones are discordant. Some granitoids were emplaced into shear zones. Only scarce alteration is observed on contact between granitoids and their envelope. A fine-grained rim of granodiorite 1 cm thick impoverished in biotite occurs at the contact.

Granodiorites are coarse- to medium-grained, locally porphyritic, with parallel alignment of biotite flakes. Both plagioclase and K-feldspar exhibit zonal structures. Granodiorites also consist of quartz, whereas zircon and apatite are accessories.

Biotite tonalites are fine-grained, with parallel alignment of biotite and plagioclase. Plagioclase porphyrocrysts occur in fine-grained matrix consisting of plagioclase, biotite and quartz. The porphyrocrysts are characterized by strongly serecitized cores and recovered mantles. Clusters of several biotite blades are recognizable with unaided eye, fine flakes of biotite are also present.

Fine-grained biotite-hornblende tonalites comprise two varieties: dark and light. The dark tonalite is rich in hornblende, apatite and titanite, which are not common in the light one. Both varieties contain plagioclase and quartz. Biotite and hornblende occur as aggregates. Contact between the two varieties is abrupt but embayed and irregular. Dykes of the light tonalite penetrate into the dark variety.

Medium-grained biotite-hornblende tonalites consist of plagioclase, hornblende, biotite, and quartz. Apatite and zircon are accesories. Aggregates are formed by hornblende surrounded by biotite. Two varieties of plagioclase are present: (1) large grains, up to 2 mm in size, characterized by complex zoning, and (2) small, scarcely zoned grains in the matrix, up to 0.5 mm in size.

Granites are fine-grained and consist of quartz, K-feldspar, plagioclase, muscovite and biotite. Apatite and zircon are accesories.

Biotite tonalites occur as rounded and angular enclaves in the granodiorites. Outer parts of the tonalite enclaves crystallized rapidly due to cooling. One centemetre thick chilled margins of non-porphyritic tonalite were formed around the enclaves. Such a relationship between the granodiorite and biotite tonalite indicates that the former one is older and both rocks can be referred to as a compound dyke sensu Fernandez and Barbarin (1991). The contacts between the granodiorites and biotite-hornblende tonalites were absent in the investigated drill cores. Mutual relationships between these rocks cannot be therefore determined. Granites are the youngest rock type, which crosscuts all other rocks in the form of dykes a few metres to several centimetres thick.

The analysis of borehole material allowed the discrimination of three distinct episodes of magmatic activity: the granodiorite injection, followed by tonalite and granite injections.

References

FERNANDEZ A.N. and BARBARIN B., 1991. Relative rheology of coeval mafic and felsic magmas: Nature of resulting interaction processes and shape and mineral fabrics of mafic microgranular enclaves. Elsevier, Amsterdam, pp. 263-275.

OBERC-DZIEDZIC T., 1991. Pozycja geologiczna granitoidów strzelińskich. *Acta Univer. Wratisl. 1375, Prace Geol.-Miner.*, 29: 295-324.

OBERC-DZIEDZIC T., 1999. The geology of the Strzelin granitoids (Fore-Sudetic Block, SW Poland). *Miner. Soc of Poland*, 14: 22-31.

OBERC-DZIEDZIC T., PIN C., DUTHOU J.L. and COUTURIE J.P., 1996. Age and origin of the Strzelin granitoids (Fore-Sudetic Block, Poland): ^{87}Rb/^{86}Sr data. *Neues Jahrbuch für Mineralogie, Abh.*, 171: 187-198.

Deep Structure and Geodynamics of the Carpathian Lithosphere Based on Geophysical Study

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Geophysical methods are the most important tool for the study of lithosphere and reconstruction of the geodynamic development of the Western Carpathians. Therefore, a complex geophysical interpretation of deep-seated structures confronted with the results obtained from other geophysical and geological disciplines can contribute to better understanding of the evolution of the Carpathian orogen structural pattern. The study of lithosphere is based mainly on application of deep-range geophysical methods, such as seismic refraction and reflection profiling, seismology, gravimetry, magnetotellurics, geothermics and magnetometry.

Integrated geophysical modeling was used for the specification of the lithosphere thickness map in the Carpathian region. This approach combines the surface heat flow, free-air (Bouguer) anomalies and topography (local isostasy) to determine the continental lithospheric thermal structure along transects running across the Western Carpathians, the Polish Platform, the Bohemian Massif and the Pannonian Basin. Beneath the central and eastern segments of the Western Carpathians, the thickness of the lithosphere increases to a maximum of 140–150 km. We interpret the lithospheric thickening as a small remnant of a subducted slab. Unlike the central and eastern segments of the Western Carpathians, a clear lithospheric thickening is not compatible with the data in the western segment of the Western Carpathians. The differences in lithospheric thickness in these two segments of the Western Carpathians can be explained by a different geodynamic evolution of these areas. Based on a critical analysis of earlier models, a new interpolation of