Pre-visean nappe structure in the Malé Karpaty Mts. Crystalline basement: Evidence from the geochemical study of metamorphosed basic magmatic and sedimentary rocks

(4 figs)

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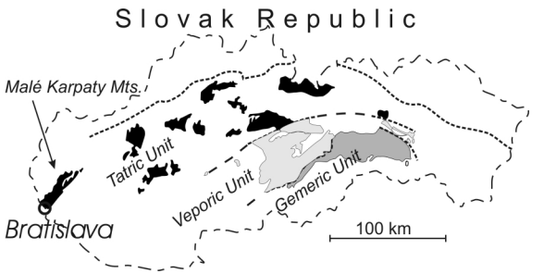
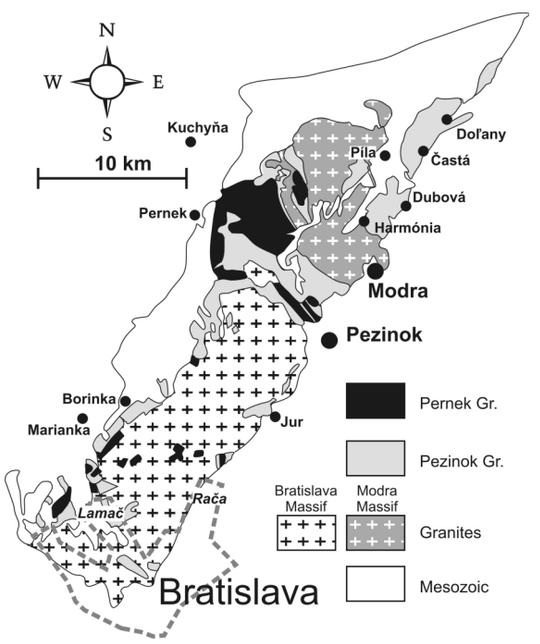
The Malé Karpaty Mts. form the westernmost periphery of the Western Carpathians in the direction of their continuation to the Eastern Alps. They are composed of the Early Palaeozoic crystalline basement and Mesozoic cover.



Although their Early Palaeozoic basement is generally considered as part of the Tatric Unit some differences exists here in comparison to the Tatric basement of other Carpathian mountains: (1) the presence of relatively lower-grade metamorphic rocks, (2) a clearly intrusive relation of the granitoids to the surrounding basement rocks and (3) widespread contact metamorphism. Metamorphosed basic rocks (greenschists to amphibolites) and sedimentary rocks (phyllites to gneisses) are the most widespread rock types of this crystalline basement whereas black shales and limestones are present only sporadically. The basement as a whole was regarded as a single lithostratigraphic unit – the Pezinok-Pernek crystalline complex. Although there were several attempts for more detailed lithostratigraphic division, an integrated picture of geological evolution of this complex has not yet been accomplished.

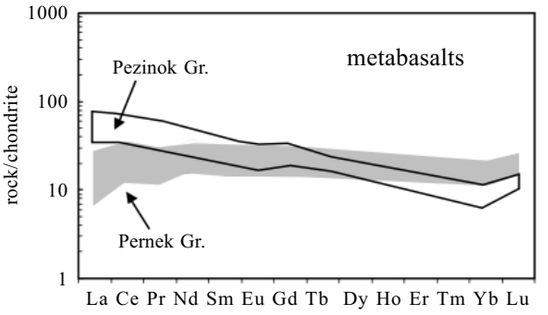


Two different occurrence forms are typical of the metamorphosed basic rocks of the Malé Karpaty Mts. basement: (1) compact blocks or slices associated with black shales and lenses of pyrite ores concentrated into several belts and (2) several small bodies surrounded by metasedimentary rocks. Petrographic variability of these rocks is caused by differences in (1) protolith and (2) metamorphic evolution. Poorly preserved original magmatic structures indicate that effusive basalts, dolerites and gabbros were the protolith of metamorphosed basic rocks from compact blocks and slices, while the isolated small bodies were originally formed by effusive porphyric basalts or basaltic veins. Following petrographic types can be tentatively discerned according to differences in metamorphic evolution: (1) greenstones (greenschists), (2) lower temperature amphibolites, (3) higher temperature amphibolites and (4) hornfelsed amphibolites.

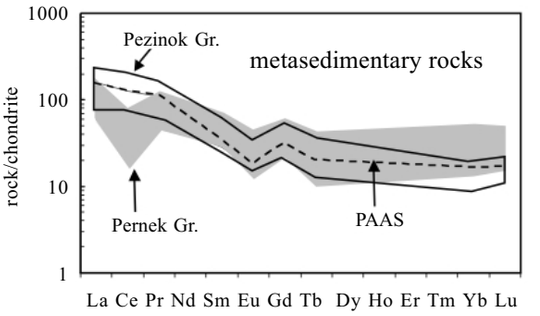
Two different geochemical types of metabasalts have been identified in the Malé Karpaty basement based on immobile trace element distribution. Metabasalts from the compact blocks and slices are close to N-MORB (normal mid-ocean ridge basalt) type. They display typical flat chondrite normalised REE patterns (La_N/Yb_N=0.9–1.4) including typical LREE depletion (La_N/Sm_N=0.7–0.9). Fractionation effects, not metamorphic alteration, is responsible for some variations in rock composition. Metabasalts of isolated bodies are geochemically close to OIT (oceanic island tholeiites) or CT (continental tholeiites) respectively. Their REE patterns are relatively steeply sloping as a result of LREE enrichment (La_N=35.2–74.8) and LREE/HREE fractionation (La_N/Yb_N=4.8- 9.6).

Metamorphosed sedimentary rocks of the Malé Karpaty Mts. basement alike the basic magmatic rocks occur also in two different geological positions. Fine-grained black shales together with black cherts frequently with pyritic impregnation forming thin belts are closely related to the areas formed by metamorphosed basic magmatic rocks. However, sedimentary rocks of the crystal-

line basement build up individual blocks and slices without any basic rocks with only one exception in the Harmónia area. Although metamorphosed psammitic sediments are most widespread alternating metapelitic and metapsammitic layers several mm to cm in thickness are also relatively common. Metapelites locally with organic matter admixture together with small lenses of marble are relatively common in the Harmónia area only. Variability of petrographic types (phyllitic rocks to gneisses) reflects not only original granularity but also variation in metamorphic grade.



Trace elements with limited mobility in weathering, transport and deposition processes (REE, Th, Hf, Sc) and relatively immobile in metamorphic processes were used for geochemical study of metasedimetary rocks. Two types differing in protolith, sedimentary environment and provenance have been found. Black shales occurring in close relation to basic magmatic rocks were formed in deep-water oceanic environment and their fine-grained protolith was probably a mixture of four components: (1) pelagic chert, (2) organic matter, (3) fine-grained terrigenous material and (4) weathered/hydrothermally altered N-MORB-type basalt. Negative Ce-anomaly, $La_N/Yb_N<6$ and Th/Yb<2 are their typical features. Protolith of all other metasedimentary rocks was probably close to immature greywackes of island arc provenance derived from intermediate/acidic magmatic source material. In contrast



to the first type no Ce-anomaly, negative Eu-anomaly (Eu/Eu*=0.6–0.8), La_N/Yb_N=6–15 and Th/Yb=2–9 have been determined in these rocks.

Close space relations of N-MORB-type metabasalts to deep-water oceanic metasedimentary rocks as well as association of CT-type metabasalts with continental sediments of arc provenance argue for existence of two individual rocks complexes in the Malé Karpaty Mts. Early Paleozoic crystalline basement. They were recently referred to as (1) Pernek and (2) Pezinok Groups (Ivan et al., 2001). The Pernek Group is composed of the metamorphosed basalts, dolerites and gabbros together with deep-water oceanic sediments in its upper part. It can be interpreted as incomplete dismembered ophiolite sequence. The Pezinok Group comprising metamorphosed sediments and some metabasalts bodies seems to be represented by fragment of a rift-related basin located probably inboard of the ensialic island arc. The Pezinok Group was paleontologically dated as Devonian in age. Both groups were intruded by granitoid massifs 348±4 Ma old. This fact indicates that the Pezinok and Pernek Groups, which were originally formed in different geodynamic setting, became probably components of nappe structure created due to collisional space shortening in the Pre-Visean time.

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