OIB type basic volcanism in the Early Palaeozoic of the Gemeric Unit (Inner Western Carpathians): Evidence for the generation in the extensional back-arc setting

(1 fig.)

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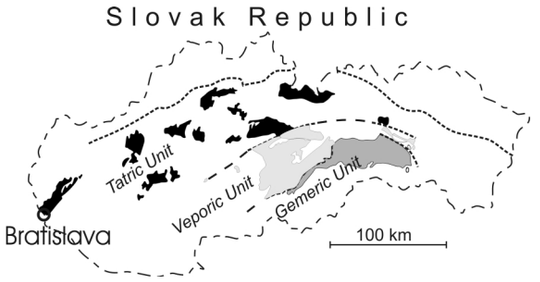
Early Palaeozoic of the Gemeric Unit is composed of several litostratigraphic subunits, which can be divided into two groups: (1) low-grade metamorphosed volcanosedimentary complexes (Štós Formation, Gelnica Group, Smrečinka Formation and Rakovec Group) and (2) high-grade metamorphosed Klátov Group – retrogressed and partly migmatized complex probably of the lower crustal origin (Ivan, 1996). OIB (oceanic island basalt) type volcanism is related to the Gelnica and Rakovec Groups – the most widespread subunits on the recent surface. The present-day position of both groups is tectonic – they form several nappes (or slices) in the nappe pile of the Gemeric Unit.



The Gelnica Group (Ordovician/Silurian) is mainly composed of flysch sedimentary sequences and redeposited acid volcaniclastic rocks. Small amounts of closely associated black shales, cherts and allodapic carbonates are also commonly present. Calc-alkaline volcanic and volcaniclastic rocks of ryolitic, less dacitic composition dominate among metamorphosed eruptive rocks in the Gelnica Group. Volcaniclastic rocks are the most widespread, effusive varieties building up to almost 1% of the Gelnica Group (Ivanička et al., 1989).

Metamorphosed basalt bodies mostly in the form of conformably oriented lenses reaching few hundred metres in length are concentrated into three discontinuous belts in the northern, central and southern parts of the Gelnica Group. Three different geochemical types of basalts have been identified here. OIB-type basalts occur in all three belts whereas basalts with CAB (calc-alkaline basalt) and BABB (back-arc basin basalt) signatures have been found in the northern belt only (Ivan, 1994). Except the northern belt, all other OIB-type basalts of the Gelnica Group probably crystallized in subvolcanic conditions. Polyphase metamorphic alteration of the Gelnica Group did not exceed greenschist facies conditions.

The Rakovec Group was originally composed mainly of basaltic pillow lavas and sheet flows, which were sporadically intercallated by the thin layers of dacitic and rhyolitic rocks or pelitic sediments. Laminated basaltic volcaniclastic rocks together with pelitic sediments dominated in the upper part of the group. Small bodies of basic subvolcanic rocks locally penetrated the volcanic sequence. Magmatic structures of the volcanic and subvolcanic rocks are well preserved despite the metamorphic alteration. All basaltic rocks in the Rakovec Group display OIB signature. Volcanic rocks of the Rakovec Group underwent a multi-stage low-grade metamorphism reaching medium- to high-pressure peak conditions. The age of the Rakovec Group is poorly constrained – no direct geochronological data exist. The intercalation of volcanogenic sandstones and acid volcaniclastics fully identical with those in the Gelnica Group could indicate a possible coeval evolution of both groups in the lateral position.

Petrography of the OIB-type volcanic rocks in the Gelnica and Rakovec Groups is rather similar except some differences in the metamorphic mineral assemblages. Aphyric or porphyric magmatic textures were typical of the effusive basalts of the Rakovec Group. Augitic clinopyroxene and/or plagioclase phenocrysts (up to 2 or 1 cm resp.) and rarely also clinopyroxenes in ophitic matrix are locally preserved in porphyric basalts. Coarse-grained porphyric basalts, dolerites, gabbroic rocks and pyroxene-rich cumulates were formed in a subvolcanic environment. Clinopyroxene in the form of rare relics is only preserved magmatic mineral (Ivan, 1997). Metamorphosed basic volcanics originally with doleritic or gabbro-doleritic textures dominate in the Gelnica Group. Rare fine-grained effusive ophitic basalts and picrite with cumulate texture have also been found.

Despite of the identical OIB signature of basalts of the Rakovec and Gelnica Groups there are some geochemical variations not only between basic volcanic rocks of both groups in but also within each group. Metabasalts of the Rakovec Fm. are geochemically close to typical E-MORB/OIT with relatively steep REE patterns (La_N/Yb_N=2.9–7.6, La_N=27–190), which are almost parallel (La_N/Yb_N= 4–6) in the case of effusive basalts. Distinctly evolved negative Eu anomalies have only been found

in the subvolcanic types with tendency to CT (continental tholeiite) signature. Variations in concentrations of SiO_2, MgO, TiO_2, Cr, Sc and total REE as well as widespread porphyric and sometimes also cumulate textures indicate an extensive clinopyroxene and/or olivine, plagioclase and ilmenite fractionation. The metabasalts of the Gelnica Group display similar geochemical features including REE patterns (La_N/Yb_N=3.3–6.7; La_N=40.1–89.5) although some variations exist in relation to their position in the group. Almost identical rocks to the Rakovec Group have been found in the central of the three belts, other ones are rather close to the CT type. Plagioclase and olivine fractionated during magmatic evolution of all these rocks. Small positive or more distinct negative (Eu/Eu*= 0.6–0.7) Eu-anomalies are relatively common in metabasalts from the central and southern belts.

Trace element distribution in the OIB-type basic volcanic rocks of the Rakovec and Gelnica Groups support the idea of their common origin and generation by partial melting of an enriched mantle source. Volcanism was probably related to the opening of an extensional basin in the supra-subduction zone setting. The Gelnica and Rakovec Groups represent two preserved small relics of this basin.

As follows from the lithology of the Gelnica Group this group was probably deposited in the deep-water environment where turbidity currents and other types of gravity currents and sliding transported calc-alkaline volcaniclastic and detrital material by submarine channels from the magmatic arc to the base of continental slope forming submarine fans. The domination of the acid volcanic material reflects an evolved stage of the magmatic arc accompanied by initiation of rifting and forming of extensional back-arc basins. OIB-type metabasalts are probably related to the incipient stage of the opening of such basin penetrating its volcanic arc faced marginal deposits. The shift in composition from E-MORB/OIT to CT signature might have been caused by contamination during the magma evolution still in the continental crust environment. Occurrence of basalts with the BABB signature in the northern part of the Gelnica Group might be interpreted as a result of the progressive evolution of back-arc rifting from incipient to immature stages.

The strong domination of basaltic rocks in the lithology of the Rakovec Group and their almost uniform E-MORB/OIT geochemical signature support the interpretation of this group as a relic of the seafloor of a back-arc basin in the initial stage of its evolution, which was probably formed on the strongly attenuated continental crust. Basaltic magma underwent intensive mineral fractionation partly also in shallow magma chambers. During further geological evolution the Rakovec Group was involved in the subduction zone and recrystallized in the medium to high-pressure conditions, but the age of this event remains still unknown.

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