MELIATA UNIT – PETROLOGY, GEOCHEMISTRY AND GEOTECTONIC POSITION OF METABASITES

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Abstract: Metabasites, related to the Triassic Meliata oceanic basin, occur along three tectonic zones in the Western Carpathians: the Folkmár zone, the Rožňava zone (Meliata unit, s.s.) and the Bódva valley - Darnó Hill zone. Geochemical and petrographic characteristics of these rocks indicate evidences of a continental rifting volcanism, followed by spreading and formation of oceanic crust of Triassic Meliata-Hallstatt basin. Part of oceanic crust and adjacent continental margin, that underwent blueschist facies metamorphism during Middle Jurassic subduction, was exhumed and occur in the mélange complex of the Meliata unit in the southern part of Gemericum.

Key words: Meliata unit, Mesozoic, metabasites, geochemistry, geotectonic position, Western Carpathians,

Introduction

Mafic rocks, investigated here, occur as tectonic blocks in the mélange complex or form isolated slices together with associated sedimentary rocks that are overthrust on the Paleozoic of the Gemericum. Most of these rocks were studied by mean of metamorphic petrology, but some geochemical data were also obtained from different occurrences of metabasites. Since the metabasites occur in different geological position and have various petrological and geochemical compositions, their origin has been interpreted by different way (Downes et al. 1990; Faryad, 1995; Ivan and Kronome, 1995; Harangi et al., 1996, Hovorka and Spišiak, 1998). This work is aimed to compare petrological and geochemical characteristics of mafic rocks from all up to data investigated localities both in the Slovak

and Hungarian territories and discuss the most important question on origin of mafic rocks with relation to geotectonic position of the Meliata oceanic basin.

Geological position and petrographical varieties of mafic rocks

Tectonic bodies of ophiolites and deep see sediments, representing Triassic-Jurassic Meliata-Hallstatt oceanic basin are known from three tectonic zones in the Inner Western Carpathians both in Slovak and Hungarian territories: (1) the Folkmár and (2) the Rožňava zones bound the northern and southern borders of the Gemericum, respectively and the (3) Bodva valley-Darno Hill zone is situated in the northern part of Hungary. The Folkmár zone (called after type locality at Jaklovce village, near Folkmár) is a suture zone formed by closure of the northern branch of Meliata basin (Kozur and Mock, 1997). It continues from Jaklovce to Dobšina, where serpentinized peridotites occur. Several occurrences of serpentinized peridotites and basaltic rocks with pillow lava structure are present in the Jaklovce and nearby area. Representative rock types are Anisian red pelagic limestones and Ladinian red ribbon radiolarites and red radiolarian shales. Basalts from the Jaklovce locality are massive fine-grained rocks with rarely present amygdaloidals of up to 1 mm in size. In the central parts of some thicker lava flows, and/or subvolcanic bodies may occur also ophitic varieties. They indicate lower greenschist facies mineralogy, but diopsidic augite comparable with clinopyroxene from normal to subalkaline rocks is also observed.

The Meliata unit s.s. (Rožňava zone) is situated along the southern border of the Gemericum and it is characterized by the presence of blueschists, serpentinites and very low-grade sediments that partly overthrust the Paleozoic of the Gemericum. They are mostly tectonically overlain by unmetamorphosed Triassic Silica nappe or by very low-grade metamorphosed Permian-Triassic Turna nappes. Several occurrences of mafic and ultramafic rocks are exposed along the southern margin of the Gemericum unit. In contrast to the Folkmár zone, metabasite underwent blueschist facies metamorphism. Serpentinites of lizardite-chryzotile composition derived from harzburgite, lherzolite and rarely also dunite and form mostly tectonic blocks that are enveloped within very low-grade rocks (Hovorka et al., 1985). Sedimentary rocks of the Meliata unit are characterized by the presence of limestones and dolomites, radiolarites, cherts and different kinds of shales. Biostratigraphical results gave a Late Triassic to Early Jurassic age for their sedimentation (Kozur and Mock, 1997; Mello et al., 1996).

Based on geological position and rocks association, three groups of metabasites are present in Meliata unit. Most metabasites (group 1) form layers and lenses (0.5 x 3 km in

size) within marbles and are exposed in Šugov, Hačava, Bôrka, Štítnik and Radzim localities. They represent primary basalts and basaltic tuffs within carbonatic rocks with small amounts of clastic sediments. Rarely, pillow lava, amygdalous, variolites and ophitic pattern are present. All these rocks underwent blueschist facies metamorphism that reached maximum pressure and temperature of 13 kbar and 460 oC (Faryad, 1995). Middle Jurassic Ar-Ar age was obtained for blueschist facies phengite, which associates with glaucophane, epidote, albite and rarely with garnet and Na-Pyroxene. The group 2 metabasite corresponds to metagabbro and it forms tectonic blocks within Permian evaporite-carbonate sequence of the Turna nappe that is situated between footwall Meliata unit and hanging wall Silica nappe. The metagabbro is characterized by relic igneous Ti-rich richterite which is preserved in relatively coarse grains. Other metamorphic minerals in the rock are phengite, albite, chlorite, titanite and K-feldspar. Metamorphic P-T conditions estimated for metagabbro are 0.8 GPa at 300-330 °C (Faryad et al. in press). *Metabasites associated with micaschists (group 3) occur in Zadiel, R. Bystre and Nižná Slaná localities.* They are free from relic igneous phase was found, only some mica-rich varieties contain a relic muscovite that is rimmed by phengite. Ar-Ar data indicated Variscan (374 Ma) age for muscovite (Faryad and Henjes-Kunst, 1997). These rocks together with garnet hornblende gneiss and amphibolite that also underwent blueschist facies metamorphism are interpreted to represent a pre-blueschist facies basement unit.

The presence of Mesozoic ophiolite in the NE parts of Hungary is known from several borehole as well as form surface (e.g. Darnó Hill). They are usually covered by tertiary sediments or tectonically overlain by Silica Nappe. The dismembered, incomplete ophiolitic sequences are well know from Bódva Valley in the Aggtelek-Rudabánya Mts, Darnó Hill, near village Recsk and from Szarvaskö area in the southwestern Bükk Mountains. Following Kovács et al. (1997) and Csontos (1995) they belong to the innermost tectonic unit of the Western Carpathians. In the Bódva Valley, fragments of serpentinite, metabasalt (MORB) and metagabbro (cm up to few hundred meters in size) are embedded tectonically in a non-metamorphic Permian evaporitic rocks that occur at the base of the Silica Nappe. A Middle Triassic age of magmatism is assumed, based on sporadic biostratigraphical data from radiolarites synchronous with pillow basalts. The metabasites indicate polyphase metamorphism. The first blueschist metamorphism (>8 kbar and ca. 350-500 °C) is assumed to be of a middle Jurassic age, based on analogy with Meliata blueschists. It is characterized by the presence of glaucophane, phengite and chloritoid. The second, greenschist facies metamorphic phase (ca. 4-6 kbar at 350-500 °C) is represented by the assemblage actinolite-chlorite-epidote-albite-quartz. The last

metamorphic event is representative of epidote-amphibolite facies with 4-6 kbar and 500-600 °C.

In the Darnó Hill, mafic rocks are represented by pillow lavas, massive basalts and gabbros of different grain size. They occur as individual blocks and olistolites in the Jurassic olistostrome series with radiolarian fauna. Serpentinites are exposed beneath Miocene conglomerates. The meta-igneous rocks of the Darnó Hill show only prehnite-pumpellyite facies ocean floor hydrothermal metamorphism, while the related sedimentary rocks suffered only diagenetic alterations (Árkai, 1983). The Jurassic Szarvaskö ophiolite complex (not investigated here) consists mostly of a series of ultramafic and mafic rocks that are cross cut by acidic dykes and veins. Surrounding sedimentary rocks are represented by terrigenous deep-water clastics. They indicate metamorphic conditions ranging from zeolite thorough prehnite-pumpellyite to greenschist facies (Árkai, 1983).

Geochemistry and geotectonic implication

Geochemical characteristics of very low-grade metabasites from the Folkmár zone reveal MORB (N-MORB) composition (Fig. 1a, 1b, 1c). This feature corresponds well to pyroxenes composition and chondrite normalized REE patterns, indicating only slight degree of fractionation $(Ce/Yb)_n$ = 1.1-1.7 and $(La/Sm)_n$ = 0.6-0.9) that give them upward convex pattern like those for N-MORB (Faryad et al. in press.). Regarding geochemical composition of mafic rocks and occurrence of serpentinites and radiolartites, the Folkmár zone rocks are the best candidates for uncomplet ophiolite suite.

In contrast to the Folkmár zone the blueschists (group 1), forming layers and lenses in marble from the Rožňava zone have composition transiting between arc-MORB basalts and have high total REE contents with fractionated indexes $(Ce/Yb)_n$ = 2.2-2.5, $(La/Sm)_n$ = 1.3-1.4, Ce_n = 104) (Faryad et al. in press.). The blueschists with marble have no relations with very low-grade metabasites, associated with radiolarites or with serpentinites, forming tectonic blocks and slices, along the Rožňava zone. The metagabbro from Bohúňovo (group 2) with relic richterite have total REE lower than in group 2 blueschists but higher compared to Folkmár zone metabasites.

Geochemically, the Darnó Hills metabasites are comparable with Folkmár zone and that from Bódva valley with group 1 metabasalts from the Rožňava zone. With exception of high Zr contents, MORB character of the Darnó Hill basalts can be assumed from Th-Hf-Ta diagram and from REE distribution (Faryad et al. in press.). Similar to the Folkmár zone, they show horizontal trend of REE pattern with slight degree of fractionation $(Ce/Yb)_n$ = 1.3-1.6 and $(La/Sm)_n$ = 0.8-1.0. Compared to the Darnó Hill, the Bódva valley

metabasites show higher REE contents with $(Ce/Yb)_n$ = 1.7-2.8 and $(La/Sm)_n$ = 1.1-1.3). This suggests different sources for the Bódva valley and Darnó Hills. Pyroxene composition from the Bódva valley metabasites are different from that in the Folkmár zone basaltic rocks and plot in the field of alkaline and peralkaline rocks. Comparred to the Folkmár zone and Darnó Hill metabasites with relatively low Ce_n = 18-28, the Bódva Valley metabasites have higher Ce_n = 64-122 which is close to that in group 1 blueschists in the Rožňava zone. Close relations occur between metagabbro from Bohúňovo and Komiata (Bódva valley). In both cases metagabbro forms tectonic blocks within carbonate-evaporite melange and contain relic richterite or Ti-rich pargasite that is typical for alkaline rocks.

Conclusion

- Trace element compositions and REE distribution from very low-grade metabasites in the Folkmár zone together with serpentinites, radiolarites and cherts are good evidence for uncomplete ophiolite suite.
- Darnó Hill metabasites that accompanied by peridotite, gabbro and dolerite dikes and interpreted as part of ophiolite complex (Harangi et. al, 1996) are comparable with the metabasites from Folkmár zone.
- The uncomplete ophiolite complex, partly exposed at boundary of Western Carpathians and Pannonian block are representative for oceanic crust that was formed by opening of the Meliata Hallstatt oceanic basin between Europe and Africa related blocks during Triassic, probably late Permian.
- Composition of metabasites intercalated in marble from Rožňava zone as well as of metabasites from Bódva valley are not typical for middle ocean ridge basalts. They show composition transitional between MORB-Arc association or within plate basalts and underwent blueschist facies metamorphism.
- Geochemical composition and relic richterite and Ti-rich pargasite in metagabbro blocks suggest a continental rifting igneous activity.
- The presence of older basement rocks with blueschist facies overprint is good evidence for a heterogeneous crust during subduction and closure of the Meliata-Hallstatt oceanic basin.

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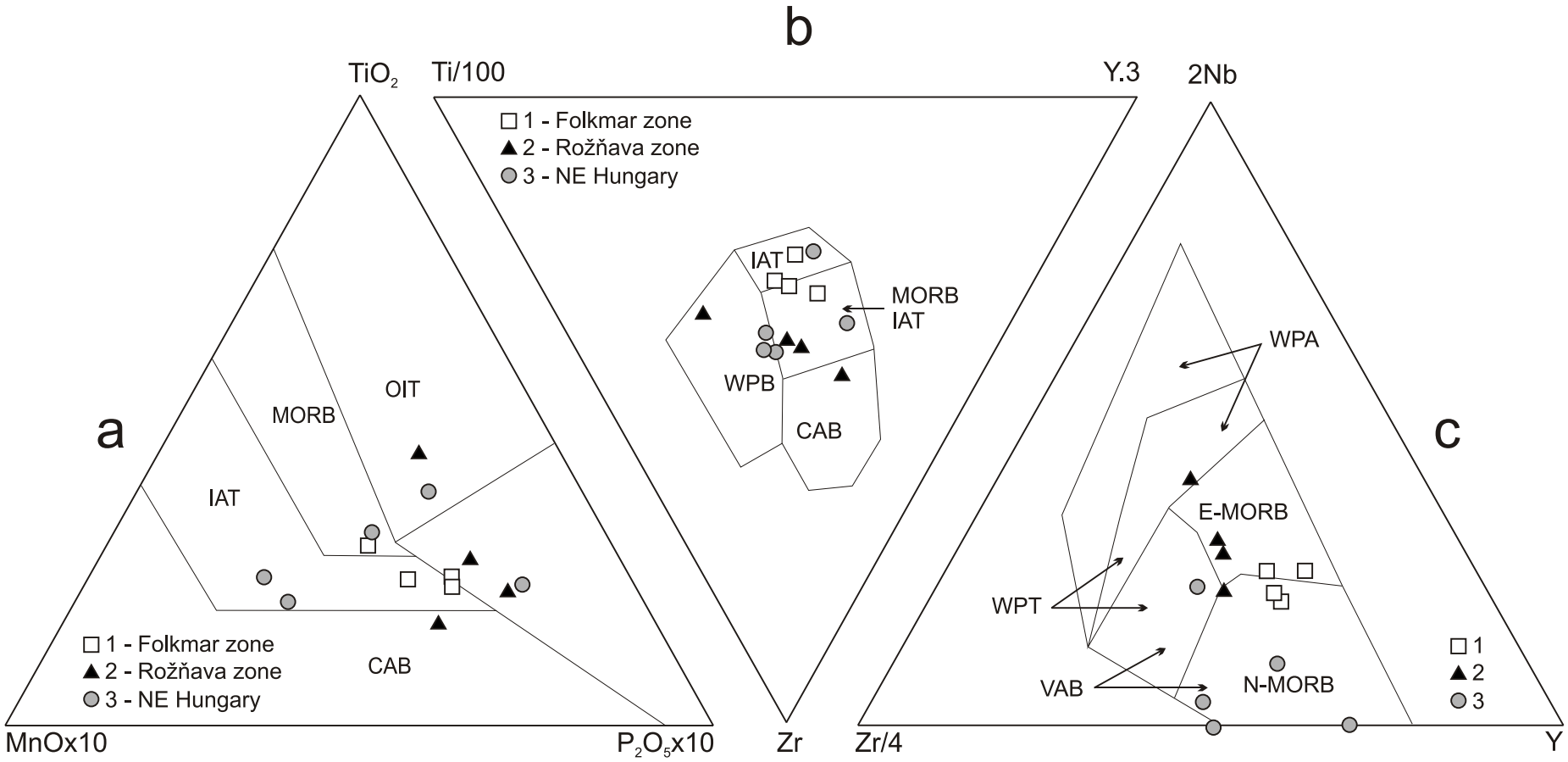
a
b
c
TiO2
Ti/100
Y.3
2Nb
MnOx10
P2O5x10
Zr
Zr/4
Y
1 - Folkmar zone
2 - Rožňava zone
3 - NE Hungary
IAT
MORB
OIT
CAB
MORB
IAT
WPB
CAB
WPA
E-MORB
WPT
VAB
N-MORB
1
2
3