SUBDUCTION-RELATED VOLCANISM IN THE SW TISIA AND ITS GEODYNAMIC CONSEQUENCES

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Abstract: Subvolcanic bodies from the Villány Mts. (Tisia plate, SW Hungary) were studied. Based on petrological and geochemical features, these rocks differ significantly from the widespread alkali basalt of the Mecsek Mts., and are more similar to the Upper Cretaceous arc-related volcanic rocks of Northern Croatia.

Key words: mafic dyke, Tisia, subduction

INTRODUCTION

Although igneous rocks do not play an important role in the Villány Mts. (SW Hungary, fig. 1.), the sparse mafic dykes and sills (Fig. 1) carry specific information about the late Cretaceous evolution of the southern part of the Tisia block as well as about the geodynamics of the southern margin of the Thetys. Previous studies on the petrology of several of these subvolcanic bodies show a significant difference from the mafic rocks of the Mecsek Mts. (Nédli, M Tóth, 1999), which are widespread in the whole area.

GEOLOGICAL BACKGROUND

During the Mesozoic Both Mecsek and Villány Mts. were parts of the Southern European craton representing the northern margin of the Tethys. Mesozoic mafic dykes occur sporadically in the Villány, some of which crosscut aptian-albanian limestones. Petrographically they are alkali basalts containing ultramafic spinel/plagioclase lherzolit xenoliths of upper mantle origin (Nédli, M.Tóth, 1999). K/Ar radiometric data of the host basalt vary between 64 Ma and 76 Ma (Molnár, Szederkényi 1996).

Early-Cretaceous alkaline volcanic rocks of intraplate origin occur in the Mecsek unit along a SW-NE 200-km long and 50-km wide zone (Harangi et al., 1996). They mainly intruded into Early Jurassic sedimentary sequences, K/Ar radiometric data indicate a paroxysm between 135 and 100 Ma (Harangi, Árva-Sós 1993).

Pamic (1997, 2000) described rocks of an Upper Cretaceous bimodal basalt-rhyolite suite from the southern part of the Pannonian Basin (Slavonia). K/Ar radiometric data indicate an 62-72 Ma age for the basalts. Their source rock was amphibole lherzolite of the metasomatized upper mantle wedge. Geological and geodynamical data suggest that the Slavonian basalt-rhyolite association formed due to Alpine subduction processes in the Dinaridic Thetys (Tari, Pamic 1998, Pamic 1997, 2000).

PETROGRAPHY

Mafic sills and dykes of the Villány generally exhibit a fine-grained pyroxene-dominated matrix, which contains partially or totally altered phenocrysts of olivine and clinopyroxene as well as felsic and ultramafic xenocrysts and round-shaped ocelli. In some cases olivine grains enclose minute inclusions of spinel and orthopyroxene. The 1-20 mm large quartz xenocrysts are resorbed and in general are surrounded by a thin (10-30 microns) glassy inner rim and an external corona of clinopyroxene crystals of a radial arrangement. Most ocelli consist of an anhedral calcite core surrounded by a complex rim of silicate and oxide minerals; amphibole with tiny zircon inclusions; Fe-Ti-oxide phases and apatite needles are settled in a plagioclase-rich groundmass. Ocelli usually have a sharp contact with the groundmass, while occasionally matrix pyroxene grains of tangential alignment rim them.

GEOCHEMISTRY

Each Villány basalt sample studied shows a similar trend on the primitive mantle normalized spidergram, which however is rather different from the typical Mecsek basalt trend (fig. 2.). All curves are steeply sloping with a distinct LILE and LREE enrichment, a significant depletion in Nb, Sr and in the HFS elements. In contrast, the Mecsek Mts. basalts (Harangi 1993) exhibit a more flat curve and display only a weak LILE and LREE enrichment, and a positive Nb anomaly.

DISCUSSION

Following the classification scheme of Foley (1984), the ocelli in question are very similar to his type II globular structures. Their formation can be explained by segregation of a late-stage melt into bubbles after much of the groundmass had crystallized. The high amount of the ocelli in each sill proves the high volatile content of the primary magmas. The presence of accidental felsic xenocrysts in alkali basalts indicates the contamination of crustal material by the ascending melt (Luhr et al. 1995; Watson 1982; etc.). Magmas of intraplate tectonic setting carry crustal xenocrysts

during the early stage of the extension, but they tend to contain mantle xenoliths during the mature stage (Luhr et al. 1995). Dykes and sills studied represent various steps of this succession.

The distribution of the HFS elements (Zr, Nb, Y, Ti and Hf) indicates a within plate (WP) origin of the Villány dykes and sills on each plot used (fig. 3.). The samples exhibit a trend slightly distinct from both that is typical for the basalts in the Mecsek Mts. (Harangi, 1993) and that represent Slavonian basalts (Pamic, 2000). On all of these plots the Villány Mts. basalts are situated in a transitional position between the Lower Cretaceous MOR related basalt-phonolite suite of the Mecsek (Harangi 1993) and the Upper Cretaceous subduction related basalt-rhyolite suite of Slavonia (Pamic 2000).

The most significant discriminating factors between the three basaltic suites are the different behaviour of LREE and Nb. That is why trace element ratios like La/Nb can be used to reveal relationships between the different basaltic series in the southern part of the Tisia and to distinguish their source regions as well as melting characteristics. La/Nb ratio is rather high for all Villány basalts (La/Nb>1). The similarly high values (La/Nb=1-4) of the Slavonian Upper Creteceous alkali basalt suite was explained by Pamic (2000) as being generated by partial melting of the metasomatized lherzolite of the upper mantle wedge. In the MOR related alkali basalts of the Mecsek Mts. this ratio is significantly lower (La/Nb<0.8) (Harangi 1993).

Considering all petrographic and geochemical data, the evolution of the Villány dykes and sills is significantly different from the Lower Cretaceous basalts of the Mecsek Mts, where the absence of mantle xenoliths and a positive Nb-anomaly is characteristic. The Villány subvolcanic bodies are more similar petrologically to the Upper Cretaceous basalts of Slavonia, which formed in relation with the Alpine subduction processes in the Dinaridic Thetys (fig. 4.). This magmatic arc can be correlated with recent back-arc basins and in base of seismic data it is probably that units of the northermost Dinarides, may be blocks of the Late Cretaceous magmatic-sedimentary complex, are thrust onto the South Pannonian Basin (Tari, Pamic 1998, Pamic 2000).

References

Foley, S. F. 1984. Liquid immiscibility and melt segregation in alkaline lamprophyres from Labrador. Lithos, 17: 127-137.

Harangi, Sz. (1993). A Mecsek hegység alsókréta vulkáni közetei (Lower Cretaceous volcanic rocks in the Mecsek Mts.). – PhD theses, ELTE, Budapest (in Hungarian)

Harangi, Sz., Árváné Sós, E. 1993. A Mecsek hegység alsókréta vulkáni közetei I. Ásvány- és kőzettan. (Early Cretaceous volcanic rocks of the Mecsek Mountains (South Hungary) I. Mineralogy and petrology). Földt. Közl. 123/2: 129-165. (in Hungarian with English summary)

Luhr, J. F. et al. 1995. Crustal contamination in early basin-and-range hawaiites of the Los Encinos Volcanic Field, central Mexico. Contrib. Mineral. Petrol. 118: 321-339.

Molnár, S., Szederkényi, T. 1996. Subvolcanic basaltic dyke from Beremend, Southeast Transdanubia, Hungary. Acta Min.-Petr. 37: 181-187.

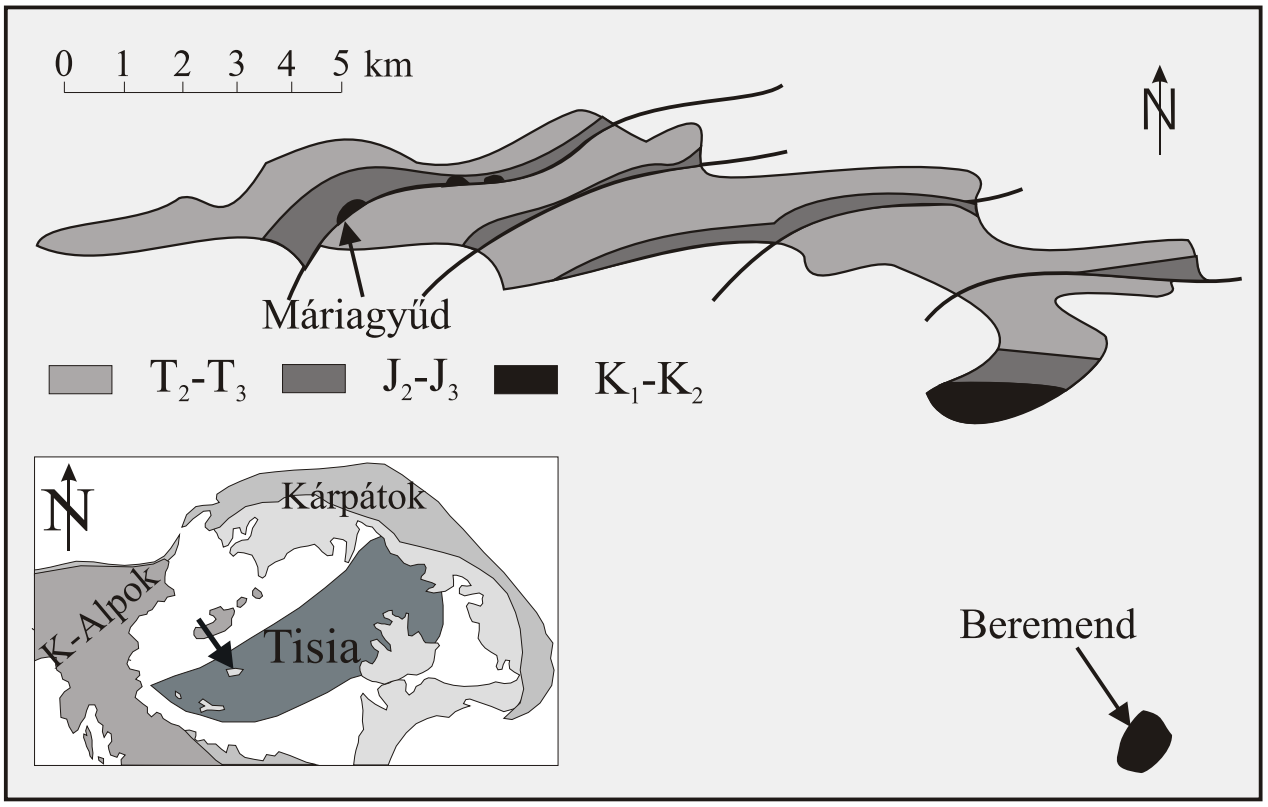
Nédli, Zs., M.Tóth, T. 1999. Mantle xenolith in the mafic dyke at Beremend, Villány Mts., SW Hungary. Acta Min.-Petr. 40: 97-104.
Pamic, J. et al. 2000. Geochemistry and geodynamics of a Late Cretaceous bimodal volcanic association from the southern part of the Pannonian Basin in Slavonija (Northern Croatia). Mineralogy and Petrology 68: 271-296.
Tari, V., Pamic, J. 1998. Geodynamic evolution of the northern Dinarides and the southern part of the Pannonian Basin. Tectonophysics 297: 269-281.
Watson, B. 1982. Basalt contamination by continental crust: some experiments and models. Contrib. Mineral. Petrol. 80: 73-87.

Fig. 1. Geological sketch map of the Villány Mts. Inset: Position of the Villány Mts. In the ALCAPA region.

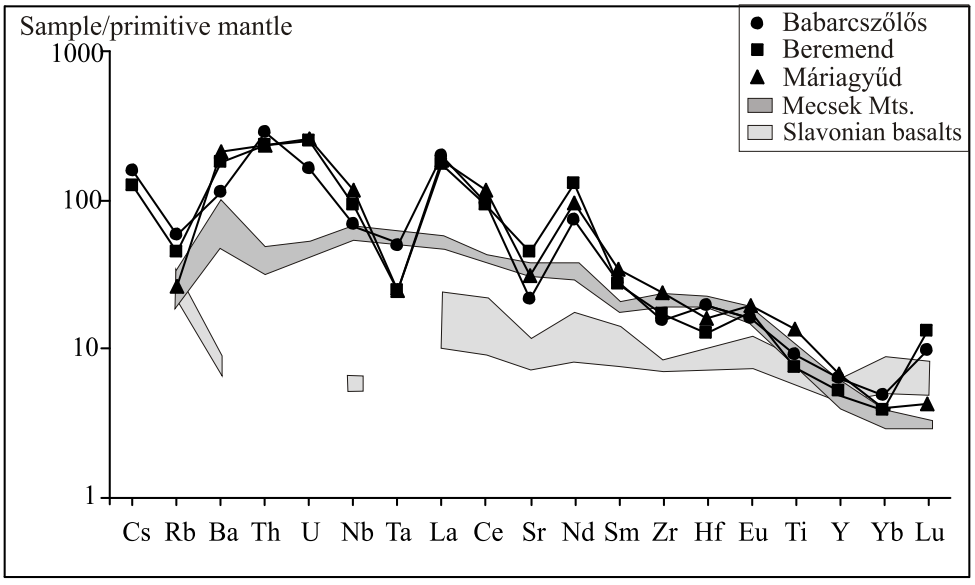
Fig. 2. Primitive mantle normalized spidergram for the Mecsek, Villány and the Slavonia basalts

Fig. 3. Selected geochemical plots for discriminating Mecsek and Villány basalts. Grey area shows the field of the typical Mecsek basalts.

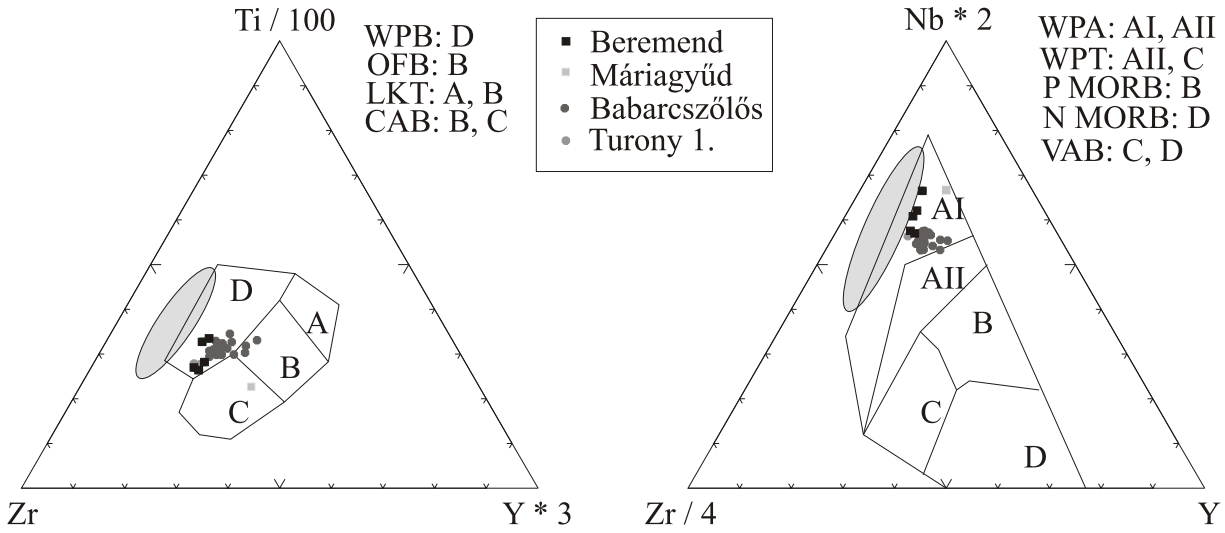
Fig. 4. Early Cretaceous stage of the evolution of the northern part of the Dinaridic Tethys (after Pamic, 2000).



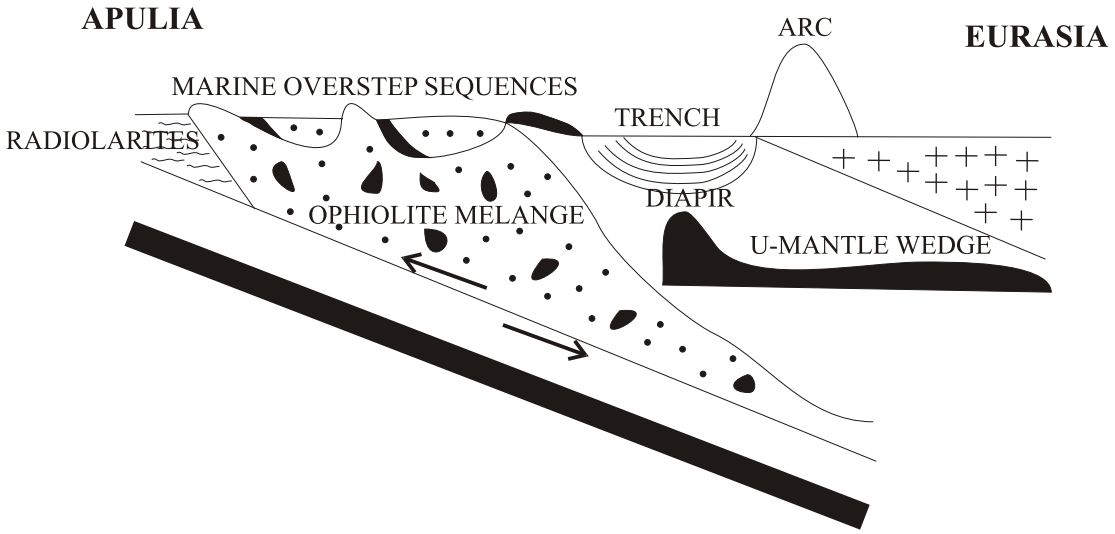
Nédli, M Tóth Fig. 1..



Nédli, M Tóth Fig.2.



Nédli, M Tóth Fig.3.



Nédli, M Tóth Fig.4.