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Rövid közlemények

Basement evolution of the Great Hungarian Plain: Variscan, Permo-Triassic and Alpine (Cretaceous) metamorphism

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Összefoglalás

Új geokronológiai vizsgálatok (^{40}Ar-^{39}Ar módszerrel muszkovit, biotit és amfibol szeparátumokon) megerősítik variszkuszi kristályos kőzetek elterjedt jelenlétét az Alföld aljzatában a Villány–Bihari és Békés–Kodrui egységekben egyaránt. Az algyői metamorf aljzat-kiemelkedés ezzel szemben (Sm-Nd módszerrel készült gránát-földpát izokron alapján) permotriász metamorfózist, majd kréta, amfibolit fáciesű felülbélyegzést szenvedett. Metamorf és szerkezeti fejlődése hasonló a Keleti Alpok Ausztroalpi egységébe tartozó Saualpe-Koralpe komplexumhoz. Takaró-maradványként értékelhető.

Introduction

The basement of the Great Hungarian Plain belongs to the Tisza Unit. Its European palaeogeographic affinity was first documented by GÉCZY (1973). FÜLÖP (1994) distinguished three tectonic units on the base of crystalline rock types and Mesozoic sedimentary facies zones: the Mecsek (MU), Villány–Bihar (VBU) and Békés–Codru (BCU) structural units. Eclogites occur in the VBU along a narrow belt (M. TÓTH 1995). This basement was considered to be poly-metamorphic, pre-Variscan and Variscan in age (SZEPESHÁZY 1978, SZEDERKÉNYI 1996). A prograde, Alpine (Cretaceous) very low- to low-grade metamorphism in the Mesozoic basement was first reported by ÁRKAI et al. (1998). Based on K-Ar ages on fine-grained micas separated from basement rocks it also caused retrogression within strongly tectonised crystalline slices.

In this short article new metamorphic petrological and geochronological data from the VBU and BCU units are given. All investigated samples come from logs, because crystalline rocks are covered by Neogene sediments.

Analytical methods

Samples were investigated using petrographic, microscopic and geochronological methods. For ^{40}Ar-^{39}Ar age-determinations coarse-grained biotite and muscovite were separated. Garnet and hornblende used for isotope analyses were hand picked under a binocular microscope. For Ar-Ar age determinations the mineral concentrates were irradiated at the ASTRA 9MW reactor at the Austrian Research Centre at Seibersdorf and KFKI Budapest, and analysed using

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standard procedures with a VG–5400 Fisons Isotopes mass spectrometer. Age calculation was done after corrections for mass discrimination and radioactive decay using the formulas given in DALRYMPLE et al. (1981). J-values are determined with internal laboratory standards. Chemical sample digestion and element separation for the Sm-Nd method follows standard procedures: THÖNI & JAGOUTZ (1992).

New data

The VBU is characterised by the widespread occurrence of kyanite porphyroblasts that are typically overgrown by sillimanite. Andalusite was only found in one log, forming a coarse-grained vein. In the NE part (Álmosd, Földes) prograde assemblages with staurolite and biotite but without kyanite and sillimanite have been found. Ar-Ar plateau ages obtained on coarse-grained micas – interpreted as cooling ages below ca. 400 °C – are about 315 My in the western part. As no older ages are available, these ages indicate a Variscan age for the kyanite and sillimanite-forming imprint of the country rocks of the eclogites. Kyanite followed by sillimanite indicates decompression after the pressure peak. In the NE, younger plateau ages between 308 and 202 My have been found. These ages reflect a later thermal overprint of unknown age.

In the BCU andalusite is the typical Al_2SiO_5 phase. It overlays pre-existing assemblages that contain garnet and staurolite. Ar-Ar plateau ages on coarse-grained muscovites from the andalusite-bearing lithologies indicated ages from 322 to 305 My, indicating metamorphism occurred in the Variscan age.

In the area surrounding Algyő a basement high exists. The crystalline rocks from this area exhibit complex textures. They are characterised by two generations of garnet and staurolite and frequent aggregates of fine-grained kyanite. Based on the microtextures, two medium-grade metamorphic events can be distinguished. During a first, high-temperature/low-pressure (HT/LP) imprint an assemblage of Grt1 + St1 + Bt + And/Sil ? ± Kfp + Pl + Qtz developed. Garnets are poor in large inclusions of biotite and plagioclase. Staurolite occurs as a relic of former big crystals with inclusion-rich rims. K-feldspar forms up to one centimetre-large crystals. Andalusite and sillimanite have been completely replaced but form-relics indicate their former presence. The overprinting event exhibits medium to high-pressure conditions and was accompanied by intense deformation. A second garnet generation (Grt2), rich in tiny inclusions, then developed. It forms rims around pre-existing garnet (Grt1) and individual crystals. Around the staurolite porphyroblasts (St1) fine-grained kyanite and young staurolite (St2) crystallised. Ductile deformation of K-feldspars and kyanite aggregates proves deformation at more than 500 °C.

A Sm-Nd garnet-feldspar isochrone from the Algyő rise yielded a Permian age of 273 ± 7 My. Additional analyses of a leaked garnet and the leachate do not fit exactly to the isochrone. However, all ages that can be calculated between the data points are in the range of 287 to 242 My and indicate a Permian age for the HT/LP event. Five Ar-Ar plateau ages from the Algyő high yielded 90 to 82 My, whereas three disturbed spectra show total gas ages of 76 to 58 My. These ages are in agreement with K-Ar ages (BALOGH in: SZEDERKÉNYI ed. 1996) and prove an Alpine (Cretaceous) metamorphic overprint. In contrast to the remaining part of

the BCU, no overlying Permian sediments are known from the Algyő high. Given all the lithological features described above, the microfabrics as well as the determined age data are very similar to those from the gneiss group in the Austroalpine Saualpe–Koralpe Complex (SKC). The SKC forms an Alpine thrust sheet, which holds a high tectonic position in the eastern part of the Eastern Alps FRANK (1987). Its ductile Cretaceous deformation is related to the exhumation processes, including north to northwest directed thrusting.

Based on seismic, gravity and geothermal data, the Algyő high has been interpreted as a metamorphic core complex (TARI et al. 1999). However, its completely different metamorphic evolution with respect to the underlying rocks and the intense ductile Alpine (Cretaceous) deformation does not suggest this interpretation. Based on the new data the metamorphic rocks of the Algyő high might represent an Alpine thrust sheet.

Conclusions

The new data confirm the widespread distribution of the Variscan crystalline in the VBU and BKU. In contrast, the crystalline rocks of the Algyő basement high in the BKU experienced a medium-grade Permo-Triassic imprint and a medium-grade Alpine (Cretaceous) overprint. Considering the metamorphic and structural evolution it might represent an Alpine thrust sheet. This special metamorphic evolution is similar to that of the Saualpe–Koralpe Complex of the Austroalpine complex.

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References

ÁRKAI, P., BÉRCZI-MAKK, A. & HAJDU, D. 1998: Alpine prograde and retrograde metamorphisms in an overthrusted part of the basement, Great Plain, Pannonian Basin, Eastern Hungary. – *Acta Geol. Hung.* **41**, 179–210.

DALRYMPLE, G. B., ALEXANDER, E. C. LANPHERE, M. A. & KRAKER, G. P. 1981: Irradiation of samples for $^{40}Ar/^{39}Ar$ dating using the Geological Survey TRIGA reactor. – *U. S. Geological Survey Professional Papers* **1176**, 1–55.

FÜLÖP J. 1994: *Magyarország geológiája Paleozoikum II.* – 447 p. Akadémiai Kiadó, Budapest

FRANK, W. 1987: Evolution of the Austroalpine Elements in the Cretaceous. – In: FLÜGEL, H. W., FAUPL P. (Eds): *Geodynamics of the Eastern Alps.* Deuticke, Wien, 379–406.

GÉCZY, B. 1973: Lemeztektonika és paleogeográfia a keletmediterrán mezozóos térségben. – *MTA X. O. K.* **6**, 219–226.

SZEDERKÉNYI, T. 1996: Metamorphic formations and their correlation in the Hungarian part of Tisia Megaunit (Tisia Composite Terrane). – *Acta Mineralogica-Petrologica* **37**, 143–160.

SZEPESHÁZY K. 1978: A Tiszántúl és az Erdélyi-középhegység (Muntii Apuseni) nagyszerkezeti és rétegtani kapcsolatai. – *Általános Földtani Szemle* **12**, 121–198.

TARI, G., DÖVÉNYI, P., DUNKL, I., HORVÁTH, F., LENKEY, L., STEFANESCU, M., SZAFIÁN, P. & TÓTH, T. 1999: Lithospheric structure of the Pannonian basin derived from seismic, gravity and geothermal data. – In: DURAND, B., JOLIVET, L., HORVÁTH, F. & SÉRANNE, M. (Eds): *The Mediterranean Basins: Tertiary Extension within the Alpine Orogene. – Geol. Soc. London Spec. Publ.* **156**, 215–250.

THÖNI, M. & JAGOUTZ, E. 1992: Some new aspects of dating eclogites in orogenic belts: Sm-Nd, Rb-Sr and Pb-Pb isotopic results from the Austroalpine Saualpe and Koralpe type-locality (Carinthia/Styria, SE Austria). – *Geochim. Cosmochim. Acta* **56**, 347–368.

TÓTH, T. M. 1995: Retrograded eclogite in the crystalline basement of Tisza unit, Hungary. – *Acta Min. Petr. Szeged.* **36**, 117–128.