ECLOGITE REMNANS ACROSS THE TISIA BLOCK: INDICATION FOR A VARISCAN SUTURE ZONE?

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Abstract: Eclogite relics in MT-MP amphibolite bodies were studied from borecores, which penetrated the Variscan basement of the Pannonian Basin. Among the many HP rock occurrences three type localities are presented (Görcsöny, Jánoshalma, Szeghalom). They suggest similar PT evolution and also exhibit identical structural position being overlain by varieties of HT-MP gneisses. Considering all geochemical and petrological data, the eclogite remnants seem designate a Variscan suture zone.

Key words: Tisia block, Variscan orogeny, eclogite, suture zone

INTRODUCTION

Since the first description of a HP rock from the Hungarian part of the Tisia block (Ravasz-Baranyai, 1969), several new retrograded eclogite samples has appeared. The detailed petrological study of these rocks showed, that an early HP metamorphic event is general throughout the Variscan crystalline basement of the Tisia. We attempt correlating different eclogite localities first within the Tisia block itself, and with different regions of the Bohemian Massif afterwards. Such a correlation procedure may lead us to estimate the real position of the Tisia block prior to its break-off from the European continent during the late Jurassic.

GEOLOGICAL SETTING

The pre-Neogene basement of the Tisia microplate basically consists of metamorphic rocks of pre-Variscan and Variscan age, which at places are covered by various Mesozoic formations. Examinations of the Permian-Mesozoic sedimentary cover show tight relationships between the geological history of Tisia and the south end of the stable European platform. These similarities are reminders of the likely connected evolution of the underlying Variscan metamorphic basement of Tisia and the European Variscan belt. Due to a series of complicated Neogene movements, the

Pannonian Basin subsided. Petrology of the metamorphic rock samples reveals a polymetamorphic evolution throughout the basement, the exact history, however varies from one area to another. The earliest metamorphic event at many places is represented by relic high-pressure mineralogy in MP amphibolites. Eclogite localities align along a SW-NE zone of the Tisia (fig. 1), three of which are presented.

PETOGRAPHY

Görcsöny Ridge

In addition to the eclogite sample described by Ravasz-Baranyai (1969), several eclogite pebbles were found in the basement-covering Neogene conglomerate (Kovács, Lelkes-Felvári pers. comm.). Most samples are retrograded, and only their symplectitic texture, and the relic garnet, rutile and kyanite grains remind to the early HP metamorphism. The key borehole of the area (Baksa-2) penetrated the basement more than a km deep. It contains eclogite remnants in its deepest part defining a lower unit of the basement. Any traces of HP relics are however missing from the upper 800 metres (upper unit). Peak conditions of the eclogite facies event are about 700 °C and 13 kbar (Kovács G., pers. comm.). Conditions of the post-eclogite facies MP-HT overprint are identical in the two parts (650 ± 40 °C, 4.4 ± 0.2 kbar, Árkai et al., 1999), suggesting a syn-metamorphic nappe border within the basement (M Tóth, 2002) (fig. 2a).

Jánoshalma High

One well (JH-U-16) explored HP rocks in the area of the Jánoshalma high. The rock is highly altered; it essentially is made of symplectitic amphibole and plagioclase. In addition rutile and kyanite inclusion bearing garnet, rutile, kyanite and altered clinopyroxene occur as relic phases. In some samples also igneous relic grains were found, garnet occasionally contains orthopyroxene inclusions with clinopyroxene exsolution lamellae in them.

Garnet has an inclusion-free external rim; matrix amphibole is zoned with an increasing Al-content towards the rim suggesting a progressive, post-eclogite facies event. Above the thick eclogite section, high-grade orthogneiss forms the basement, which is the common rock type in the area (fig. 2b). Physical conditions of the MP-HT overprint of the eclogite body and the metamorphism of the gneisses are identical (650-700 °C 5-7 kbar).

Szeghalom high

In the NE part of the Tisia, a series of crystalline highs align, which exhibit an identical structure and metamorphic evolution. Here, garnet-sillimanite gneiss and mica schist stratigraphically overlie a compact amphibolite body. Amphibolite samples generally contain relic textures reminding to an early HP metamorphic event. In most samples plagioclase-amphibole symplectite and corroded garnet with rutile inclusions occur, but also hardly altered eclogite samples were described by M Tóth (1995, 1997). Peak conditions are around 650 °C and 12 kbar. The subsequent cooling and decompression was followed by heating up to 700 °C at 6 kbars as it is suggested by the chemical zoning profiles of the amphibole and garnet grains. This event is identical to that formed the garnet-sillimanite gneiss in the cover, suggesting presence of a syn-metamorphic nappe border within the basement (fig 2c).

GEOCHEMISTRY

Görcsöny Ridge

Not only petrology and metamorphic evolution, but also amphibolite geochemistry differs significantly in the lower and the upper units of the Görcsöny high (M Tóth, 2002). Metaeclogite samples are of a within plate tholeiitic andesite composition, while amphibolite samples of the upper unit were high-Na alkali basalts. The significant difference in amphibolite geochemistry confirms the co-existence of the two tectonic units within the basement of the Görcsöny High.

Szeghalom High

The protolith of most eclogite samples are of a clear MORB character, the composition of most samples reminds to back-arc basin basalts (M Tóth, 1994). The geochemical signal of the overlying paragneiss corresponds well with destructive plate margin sediments (M Tóth et al., 2000).

CONCLUSIONS - GEODYNAMIC CONSEQUENCES

Eclogite remnants of similar characteristics occur along a SW-NE line across the Tisia microplate. They all exhibit an identical metamorphic evolution with an early HP event followed by decompression and a MP-HT overprint. Eclogite bodies in all

localities are overlain by MP-HT gneiss of crustal origin. Geochemical variation of the protolith suggests a back-arc ocean of increasing maturity from SW to NE.

Based on the identical stratigraphic position, the relating protolith and the similar PT evolution of the HP rocks studied, we cannot reject the presence of a Variscan suture zone across the Tisia with the following three-fold scenario (fig. 3.):

1) Formation of oceanic and continental realms with
    a. amphibolites of significantly different geochemical signal (Görcsöny) resulted in significant difference in chemical composition,
    b. granitoid rocks and gabrros (Jánoshalma),
    c. MOR basalt and destructive plate margin sediments (Szeghalom).
2) A subduction-related metamorphic evolution led to high-pressure metamorphism of the oceanic slab, while the continental part was affected by medium pressure metamorphism.
3) Due to reversal in transport direction from subduction to uplift of the lower slice (e.g. following the model of Chemenda et al., 1995), the two units got juxtaposed. Late relaxation of the thermal gradient caused a close-to-isobaric heating of the whole nappe stack.

This tectonometamorphic scheme is compatible with the slab break-off model developed by von Blanckenburg and Davies (1995) for the Alpine evolution of the Central Alps. Slab break-off also was found to be important for the exhumation of eclogite facies rocks throughout the Variscan orogeny (O'Brien, 2000).

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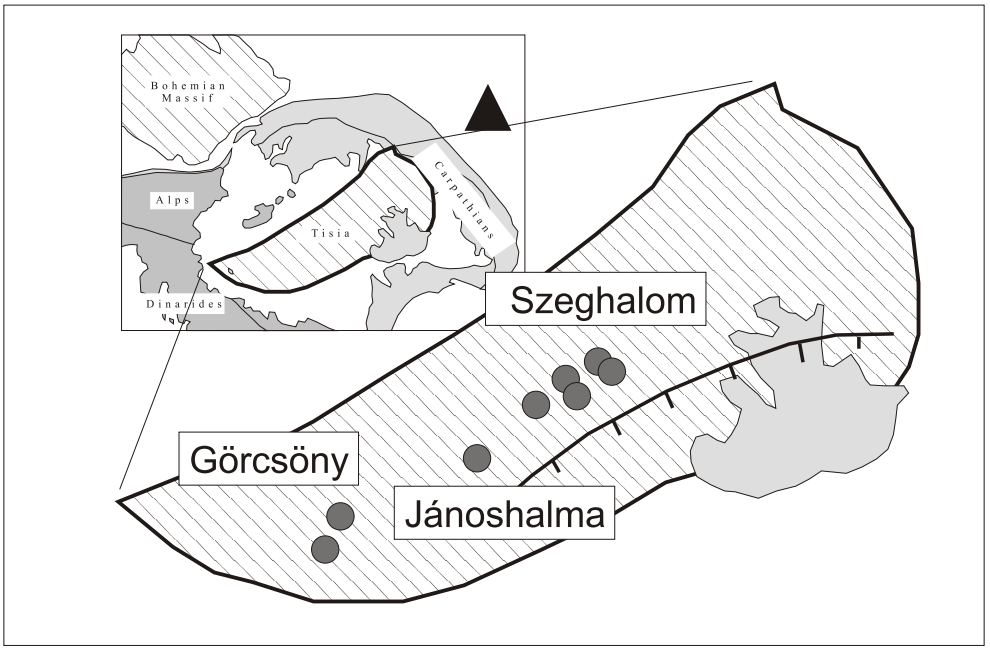
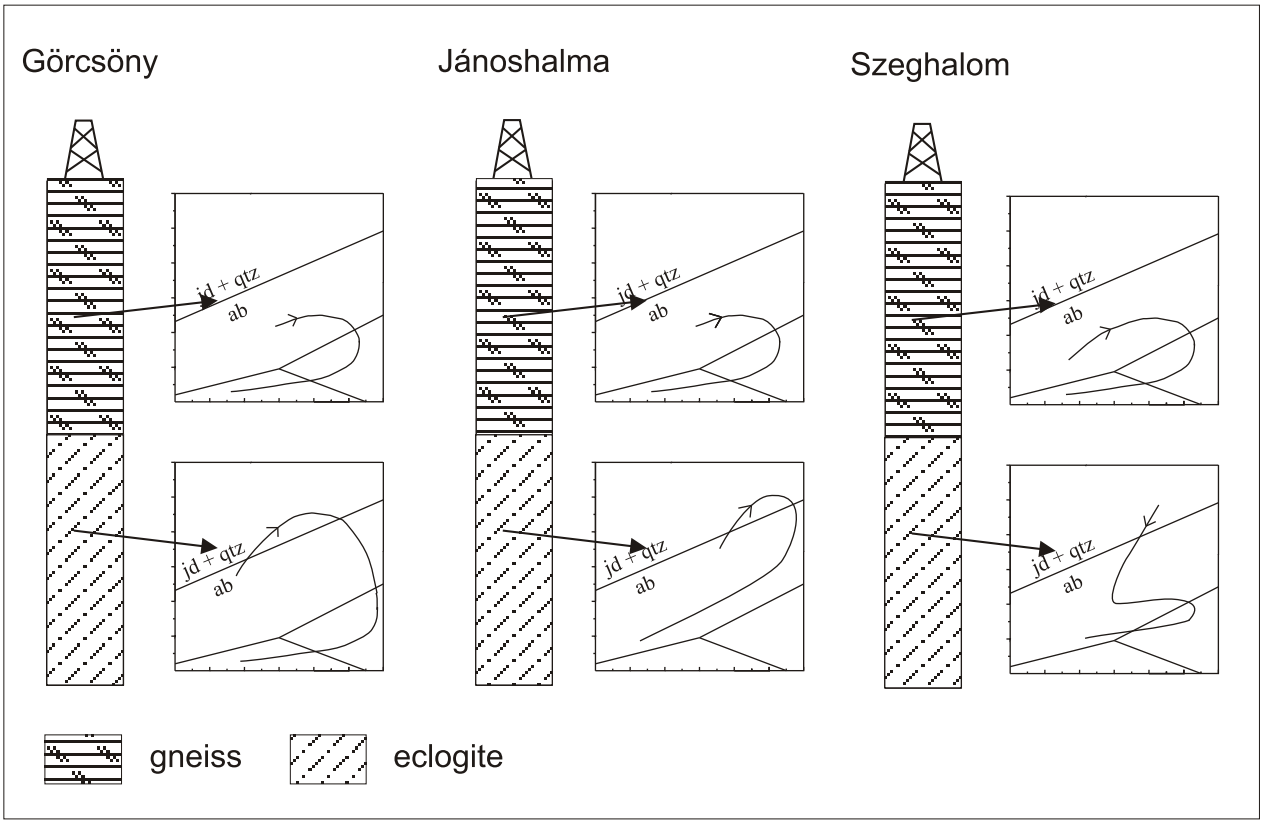
Fig. 1: Eclogite localities in the Hungarian part of the Tisia. Inset: Position of the Tisia plate within the ALCAPA region.

Fig. 2: Sketched stratigraphy and metamorphic PT paths for the studied eclogite and the overlying gneiss bodies.

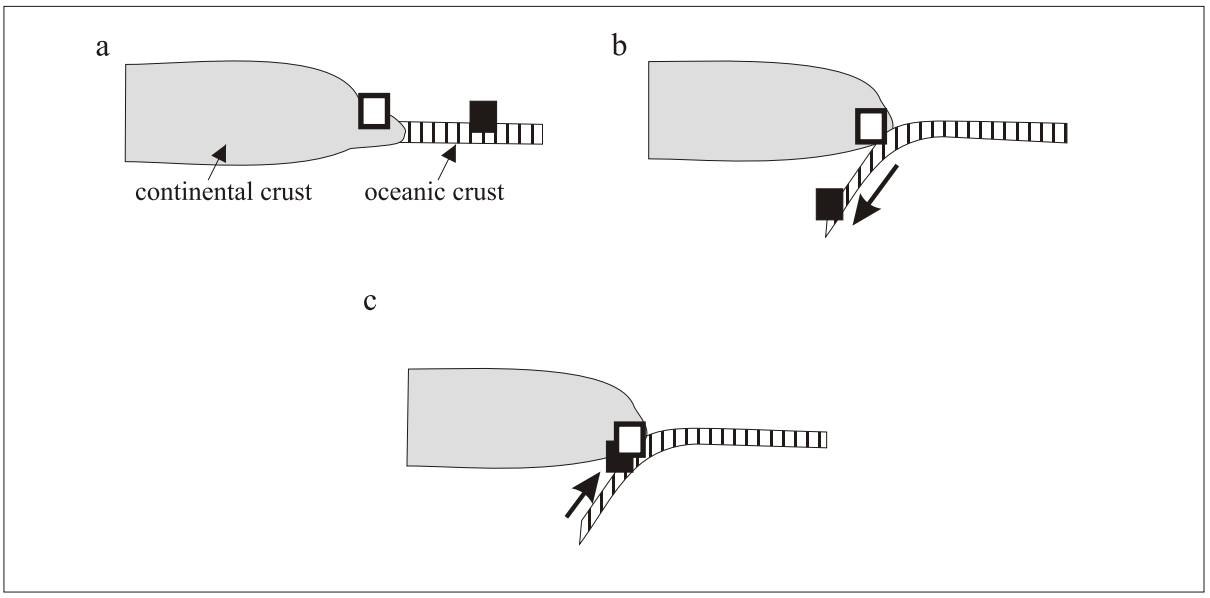
Fig. 3. A possible position of the igneous protoliths of the Görcsöny and the Szeghalom eclogites along an ancient back-arc ocean.

Fig. 4. A common three-fold scenario for modelling the evolution of the Tisia eclogites


Bohemian Massif
Alps
Tisia
Carpathians
Dinarides
Szeghalom
Görcsöny
Jánoshalma



M Tóth, Zachar Fig.2.



M Tóth, Zachar Fig.3.