Xenoliths of various metamorphic evolutions in the Déva orthogneiss (Tisza block, Hungary)

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Introduction

Variscan basement of the Tisza block is a composite of different terrains, which got juxtaposed during subsequent tectonic events from the Palaeozoic ages up to present. A large portion of the basement is formed by diverse orthogneiss types, which, based on current petrological studies, are thought to represent identical origin in different localities. In this presentation significance of xenoliths and xenocrysts of the gneiss is focused on.

Geological setting

Several occurrences of orthogneiss exposed by hydrocarbon exploratory drillings proved the existence of a WSW-ENE ranging Déva orthogneiss zone in the Variscan basement of the central Tisza block (M Tóth, Zachar, this volume). Although at different localities Déva orthogneiss shows peculiarities, in general its mineralogy, texture, geochemistry and P-T-t constraints are identical. In addition to the well-developed polygonal quartz/feldspar matrix of the two-mica gneiss, also presence of euhedral accessory phases (zircon, apatite, ortite) remind to the intrusive origin of the rock. Feldspar usually is myrmekitic throughout the study area. Geochemically, each analysed sample owns a peraluminous character, the original intrusion possibly was of granodiorite composition. Based on their main characteristics, presence of diverse xenoliths and xenocrysts Déva gneiss is well distinguishable from other gneiss types of the Tisza complex.

Petrography

Xenoliths

Déva gneiss is rather homogeneous in both mineralogical and textural features throughout the study area. It however contains xenoliths of significantly different lithology:

Ultramafic xenoliths usually consist essentially of amphibole and clinopyroxene grains with a significant amount of olivine. Feldspar and quartz are missing. These rocks are altered to carbonate minerals and serpentine. Among the various mafic xenoliths *amphibolite* is the most common variety. It contains the common paragenesis of amphibole, plagioclase, chlorite and quartz. Some amphibolite types also contain garnet as a frequent accessory phase. Presence of relict igneous pyroxene is common in some samples. In addition to MP amphibolites, also *eclogite* xenoliths occur in the Déva gneiss. In a fine grained symplectite garnet, kyanite, clinopyroxene, zoizite and rutile remind the early HP metamorphism. In most cases garnet contains all the other phases as inclusions. Rock types with felsic chemical composition usually do not form xenoliths in the studied orthogneiss. The only exception is a *felsic granulite* sample, which consist basically of garnet, plagioclase, K-feldspar, kyanite and rutile.

Xenocrysts

In addition to the presence of rock fragments in the studied orthogneiss, also single mineral grains of a strange habit remind exotic origin. The most common of these xenocrysts is *amphibole*, which usually forms large tabular crystals, in certain cases with clinopyroxene, garnet and olivine inclusions. The arrangement of the amphibole grains shows no orientation. They are „floating" in the polygonal quartz/feldspar matrix of the gneiss. Amphibole is always resorbed with irregular grain boundaries. In several samples, small grains showing the same optical orientation remind of a previous large crystal. Also the presence of *feldspar megacrysts* is common. The lense-shaped grains show no orientation and are sitting in the polygonal texture of the orthogneiss. They consist mainly of large deformed plagioclase, but K-feldspar occurs too. The poikilitic porphyroblasts are rich in mica, quartz and in some cases garnet and rare rutile inclusions. The following inclusion parageneses can be distinguished in feldspar: biotite, muscovite; biotite, muscovite, garnet; biotite, muscovite, rutile, garnet. Although inclusions are oriented inside the feldspar grains, the host minerals do not show any arrangement in the gneiss. *Sillimanite* occurs only in a few cases in coarse-grained pockets of muscovite. Occurrence of resorbed *garnet* grains with S-shaped inclusion trail is rather common in the polygonal texture of feldspar and quartz of the orthogneiss.

Geochemistry

Bulk rock, trace element as well as REE composition suggest MORB character for all mafic xenolith varieties, independently of the diverse mineralogy. Ultramafic rock fragments are usually highly altered, but show a typical ultramafic composition with $Cr > 1500$ ppm, $Ni > 700$ ppm.

Mineral chemistry, thermobarometry

Most xenoliths of the Déva orthogneiss lack mineral parageneses or at least mineral pairs that can be suitable for thermobarometric calculations. The only set of samples that can serve reliable PT data are the different metabasic rocks; amphibolite and eclogite. In amphibolite samples amphibole, plagioclase (± garnet) equilibria were used. For eclogite samples reconstruction of more complex PT evolution paths was also possible.

Conclusions

According to the above results, one can recognize that during uplift to shallower crustal levels, the original intrusion of the Déva orthogneiss sampled various rock types of different metamorphic evolution. Based on their compositions, the different xenoliths and xenochrysts can be divided into three main categories: ultramafic, mafic and felsic types.

Olivine-, garnet- and clinopyroxene-bearing ultramafic xenoliths should be of mantle origin. Mafic rocks with HP relics represent pieces of a deeply subducted oceanic slab, while those of MP amphibolite compositions are of the same protolith, which reached only a shallower depth.

All felsic xenoliths and xenocrysts are thought to represent portions of the metamorphosed accretionary prism. The felsic granulite xenolith formed in the lowest level of the prism that was subducted with the oceanic crust to a depth requisite for garnet, kyanite and rutile formation. Distinct S1 inclusion parageneses of the feldspar xenocrysts represents different metamorphic PT, suggesting various depths of formation from the same sedimentary precursor material. Rutile- and garnet-bearing ones were situated in lower levels of the prism since these minerals imply relatively high metamorphic pressure. High T metamorphism, probably caused by mantle derived magmas, induced growth of feldspar and sillimanite grains, thus feldspar could encircle the pre-existing S1 parageneses. We consider the inclusion-rich feldspar blasts and sillimanite xenocrysts were constituents of the melting metasedimentary rock and at present are restites in the host orthogneiss. Inclusion trails could preserve their original S1 foliation also during rotation in the melt.

Déva gneiss contains xenoliths and xenocrysts of significantly diverse lithology and metamorphic evolution. All xenolith types represent different portions of the subducting oceanic slab and diverse levels of the accretionary prism. The original intrusion of the Déva orthogneiss possibly sampled the melange of basic rocks of the oceanic crust (amphibolite and eclogite), metasedimentary rocks of cratonic origin (felsic granulite xenolith, sillimanite and feldspar megacryst xenocrysts) and of mantle origin (olivine, garnet and pyroxene xenoliths) that was emplaced in and near the subduction trench.