DIAGNOSTIC MINERAL ASSEMBLAGES IN DISTINGUISHING GNEISS VARIETIES OF THE GREAT HUNGARIAN PLAIN'S METAMORPHIC BASEMENT

M. TÓTH, T.
Department of Mineralogy, Geochemistry and Petrology, University of Szeged, Szeged, Hungary
E-mail: mtoth@geo.u-szeged.hu

Introduction

The metamorphic basement of the Pannonian Basin is at present covered by several km thick young (Miocene to present) sediments. Consequently, the petrological and structural evolution of the crystalline rocks can be studied essentially using the bore core material. Numerous previous geochronological data prove that the metamorphism in the entire study area is Variscan in age. Nevertheless, seismic interpretations also confirm a complicated Alpine nappe structure inside the metamorphic mass that significantly overwrote the original Variscan structure. During the subsidence of the Pannonian Basin, at places, metamorphic core complexes formed, resulting in a significant vertical disintegration of the basement. Finally, at present, blocks of incompatible metamorphic and post-metamorphic evolutions compose the metamorphic basement.

First, the rock specimens should be classified using their petrographical and microstructural characteristics to define lithostratigraphic units in such a complicated area. These classes should reflect the essential features of the metamorphic rocks; their protolith composition and metamorphic evolution. So, petrographic classification must be based on mineralogical composition and textural information of the rock specimens.

The most typical rock types of the study area are of very simple mineralogy; they are different quartz and feldspar dominated, mica bearing gneiss varieties. To distinguish the major lithological types, essentially, the accessory mineral phases can be used.

Results

Gneiss types with igneous protolith

Gneissose rock specimens at numerous localities contain syn-kinematic amphibole grains besides the common Qz+Pl+Bt assemblage. The consequent lithology is amphibole-biotite gneiss what regularly coincides with massive amphibolite intercalations of Amph+Pl+Ilm±Gt. This assemblage proves a protolith of mafic igneous composition (basalt), while the quartz and biotite rich varieties (amphibole-biotite gneiss) are more of pyroclastic origin. The latter type may also contain small garnet porphyroblasts.

Gneiss varieties without amphibole usually compose of a very simple paragenesis (Qz+Fp+Bt+Ms). The mineralogical indicators of the protolith in these cases are the accessory phases. Zircon and apatite in numerous specimens are of idiomorphic habit suggesting igneous protolith. These samples are classified as orthogneisses. A few feldspar grains in the most orthogneiss samples are myrmekitic and/or exhibit perthitic microtexture.

Two basic types of orthogneiss are common in the study area. One of them occurs only in a well-defined area in the SE part (Algyő metamorphic high). In these samples, epidote and clinozoisite are diagnostic constituents formed along the retrograde pathway substituting the precursor plagioclase. Another orthogneiss type occurs along a SW-NE zone in the middle region of the basement. These samples commonly contain xenocrysts of diverse mineralogy (garnet, amphibole, clinopyroxene). The xenocrysts are always resorbed, showing wavy grain boundaries. Garnet grains of various chemical composition may occur even in a single specimen, some suggesting metapelitic, while others metabasic compositions. Cores of the amphibole xenocrysts are diverse compositions, while their rims are usually in equilibrium with the matrix minerals. This orthogneiss variety regularly contains xenoliths with significantly different compositions. The most common xenoliths are the amphibolite, garnetiferous amphibolite, and numerous eclogite, granulite, serpentinite, and forsterite marble samples occur. Based on all these textural and mineralogical characteristics, the second orthogneiss type samples defines the same lithology.

Gneiss types with sedimentary protolith

Gneiss varieties with the same rock-forming minerals (Qz+Fp+Bt±Ms) above but without idiomorphic accessories are classified as paragneisses. These specimens also lack myrmekitic feldspar grains. Two basic paragneiss types are distinguished based on their mineral compositions.

One of these contains an M1 metamorphic paragenesis with kyanite and garnet overprinted by a second event (M2) with garnet and fibrous sillimanite. This variety is characteristic above the second orthogneiss type following a few tens of metres wide shear zone. Another paragneiss type contains garnet and rutile (±staurolite) in the M1 paragenesis. A second garnet generation and kyanite characterise the M2 assemblage in this case. All M2 grains (including M2 biotite) are tiny in grain size, suggesting intensive nucleation and high heating rate during the second metamorphic event. The increased field gradient during the M2 event possibly coincided with a contact metasomatic overprint proved by post-kinematic tourmaline and apatite grains in this lithology.

Conclusions

Far the most common lithologies of the metamorphic basement of the Pannonian Basin are gneiss varieties of identical rock-forming mineral compositions. All rock types contain quartz, feldspar (both K-feldspar and plagioclase) and biotite with or without muscovite. For the classification of the gneissic rock types, accessory mineral phases are involved.

If the sample contains syn-kinematic amphibole (± garnet) grains, the rock type is amphibole-biotite gneiss. This variety usually occurs intercalated with massive amphibolite along the central SW-NE zone in the middle part of the study area. In the case of felsic composition, the shape of the accessory phases (zircon, apatite) is diagnostic. Orthogneiss varieties contain accessories of idiomorphic habit. One orthogneiss variety contains epidote and clinozoisite (epidote gneiss), while another is characterised by the presence of different xenocrysts (Amp±Gt±Cpx). The epidote gneiss type occurs in a small sub-area in the SE part of the basement, while xenocryst-bearing orthogneiss is the lowermost structural unit of the central SW-NE zone. Two major paragneiss types can be distinguished. One of them characterised by an M1: Gt+Ky, and an M2 Gt+Sil paragenesis is an essential constituent of the central zone. The main feature of the other paragneiss type is the tiny grain size of the M2 Gt+Ky+Bt paragenesis. This lithology occurs exclusively in the SE part of the basement.