PETROLOGY OF VARISCAN GRANITOIDS IN TISIA COMPOSITE TERRANE (BÉKÉSIA TERRANE - SE HUNGARY)

E. PÁL-MOLNÁR and G. KOVÁCS

Department of Mineralogy, Geochemistry and Petrology, University of Szeged; H-6701 Szeged, P. O. Box 651, Hungary

Abstract: The aim of the research was the petrological study of granitoid rocks located in the axis zone of the crystalline domes (Deszk-Ferencszállás-Makó-Mezõhegyes-Battonya) of the Békésia Terrane - Tisia Composite Terrain (SE Hungary). The studied samples (alkali granite, syeno- monzogranite and granodiorite) are S-type, subalkaline, calc-alkaline rocks of prealuminous character. Concerning their tectonical origin, the crustal granites were formed by continental collisions.

Key words: granite; crystalline basement; Pannonian Basin

Introduction

The present geology and the tectonical setting of the Carpathian Basin (Pannonian Basin) and that of Hungary (Figure 1A) is a result of a compound, multi-step evolution of geological structures. The greatest proportion of the Pre-Neogene basement of the Pannonian Basin is built up by two Alpine megatectonic units, namely, the Pelsoian Composite Terrain in the North (comprising the Southern part of the ALCAPA Composite Terrain), and the Tisia Terrain in the South (Kovács et al., 2000).

The crystalline mass of the Tisia Composite Terrain is characterised by granitoid ranges and anticline wings of middle and high grade metamorphites. This paper presents the results of the petrological analyses on the granitoid rocks located in the characteristic uplifts of the basement (Deszk-Ferencszállás-Makó - ADMF High, and Pusztaföldvár-Battonya - PB High) of the Békésia Terrain – Tisia Composite Terrain (Figure 1B, 1C).

Geological setting

The Tisia Composite Terrain (Figure 1B) comprises the crystalline basement of South Hungary, East Croatia, North Yugoslavia and that of the Western part of Transylvania (Romania). As a consequence of the fact that at the present the basement is covered by Miocene-Pliocene sediments at a depth of 300-6500 m, its structure and petrology can only be investigated with geophysical methods and borehole samples. The seismic research of the past decades has shown that during the Neogene the Pannonian Basin has gone under a complex tectonic evolution, that has principally modified the original Variscan structures of the area (Tari et al., 1999; Csontos and Nagymarosi, 1999). As an independent unit the Tisia Composite Terrain existed from the Late Cretaceous, when its rotation began, till the Early Miocene. Concerning the territory of Hungary it involves three large Variscan Terrains (Slavonia-Dravia Terrain, Kunságia Terrain and Békésia Terrain), all of which are covered by an Alpine overstep sequence. From the beginning of the Late Triassic up to the Early Cretaceous a characteristic separation is recorded by sedimentary successions. Although, these units thrusted, and formed nappe zones during the Middle-Late Cretaceous, sometimes lateral transitions were detected as well (Kovács et al., 2000). The areas of interest (Figure 1B) are situated within the Békésia Terrain, that is the part of the Békés-Codru Alpine Zone. The name Békésia Terrain is only applied to the Hungarian part of the basement, since detailed comparative investigations of the Codru Zone in Romania are still missing. The Békésia Terrain can be divided into four units: Kelebia Unit, Csongrád Unit, Battonya Unit and the Sarkadkeresztúr Unit.

The borders of the Csongrád Unit are the following: the northern front of the South Hungarian Nappe Belt in the north, the Ásotthalom-Bordány Depression in the west, the so called Makói Trench in the east, towards the south it stretches to the Vajdaság, where its border is formed by the northern front of the Biharia Nappe System (Kemeneci-Čanovič, 1997). According to Szederkényi (1984), the main phase of the unit's polimetamorphism was a 350-330 Ma Barrow type event with a temperature of 500-570 ºC and a pressure of 6-8 Kb. This was followed by a Variscan late kinematic, T = 590-620 ºC, P= 2,8-3,9 Kb event 330-270 Ma ago, which resulted in the formation of andalusite in higher grade schists, and the development of small sized granite bodies, that were significantly homogenised due to a certain upward compression (Deszk, Ferencszállás), in the migmatite zone. This second phase was accompanied by a stronger shear along the cleavage planes, and the formation of blastomilonite in lower grade crystalline schists. The granite samples studied in this research are originating from approximately 2500 m below the surface (Figure 1C).

The Battonya Unit effectively is a 15-25 km long and 10-15 km wide body with a round shaped layout, forming a flat anticline that is covered by Miocene and Pannonian strata. Its borders are: the front of the South Hungarian Nappe Belt in the north, the Makói Trench in the west, the Békési Basin in the east, and it stretches till the northern front line of the Biharia Nappe in Romania. The average depth of the Hungarian section below the surface is 1000-1500 m (Figure 1C), though, in the outskirts of Pitvaros and Kunágota and in Kevermes it can be detected in a 2000 m depth. At Battonya-Mezõhegyes the magma of the abyssical plutonic body was slightly compressed upwards due to an “in situ” melting in the late, kinematic phase of the Variscan Orogenesis. As a result of this, it developed a slight contact zone (Szederkényi, 1984).

According to Buda (1996), the granitoid rock is a biotite muscovite granodiorite, containing crystalline schist inclusions, that did not granitizate.

Petrology and geochemistry of the granitoid rocks from Pusztaföldvár-Battonya (PB) High and Algyő-Deszk-Ferencszállás-Makó (ADFM) High

The granitoid samples of PB High (Figure 1C) are mainly of light grey, greenish grey colour. Most them have a holocrystalline, inequigranular texture, some samples are of equigranular texture. The macroscopic components of the studied granites are quartz, potassium feldspar, plagioclase feldspar, mica (the later can be ±biotite or ±muscovite). The usual size of the main rock forming grains falls between 1-3 mm, therefore, the studied rocks can be considered medium-granular. Subordinately, the rocks can be of bimodal composition, i.e. in a fine-grained matrix phenocrysts are placed, which is probably developed due to tectonic effects. In case of some samples, based on the ordered setting of mica, features of textural orientation can be observed, too.

Primarily, the samples are solid and compact rocks, however, this state can be modified by weathering and tectonical effects. As a result of weathering the feldspars form fine dust, while the biotite is chloriticised. Carbonate and limonitic veins penetrate the rocks.

During the microscopic analyses the most important textural characteristics and the volumetric percentage were examined in terms of the main rock forming minerals, the accessory and the secondary minerals. On the basis of their textures, the studied granitoid rocks can be classified in the following five groups: rocks of medium-grained, inequigranular, hypidiomorphic-granular texture; rocks of coarse-grained, hypidiomorphic-granular texture; rocks of medium-grained, equigranular, hypidiomorphic-granular texture; rocks with textural orientation; rocks with tectonised texture.

Concerning the mineral composition and texture of the rocks, significant differences cannot be detected. On the basis of their composition, the rocks can be considered of similar character. The main rock forming minerals of the studied samples are: quartz ± orthoclase + microcline + plagioclase feldspar (albite-oligoclase) ± biotite + muscovite.

The rocks mentioned above has been modified to a smaller or larger extent (chloritisation, sericitisation, or rarely saussiritisation). As a result of these transformations the following secondary components appeared: chlorite, sericite, carbonate, epidote, leucoxene, limonite and opaque components.

The colour of the ADMF High granitoid rocks (Figure 1C) is mainly light grey, subordinately pale rose-colour. Their texture is mostly holocrystalline, medium-grained inequigranular and equigranular. Based on the situation of mica, in some places the studied rocks are characterised by a preferred orientation in their texture. The major rock forming minerals are quartz, potassium feldspar, plagioclase feldspar and mica (biotite, muscovite).

On the basis of their textures, the studied rocks can be classified in the following groups: (i) rocks of medium-grained, inequigranular, hypidiomorphic-granular texture; (ii) meta-granitoid rocks of medium-grained, inequigranular texture with preferred orientation; (iii) gneisses.

Concerning the mineral composition and texture of the rocks, significant differences cannot be recorded. On the basis of their composition, the rocks can be considered of similar character. The main rock forming minerals of the studied samples are: quartz + microcline ± orthoclase + plagioclase feldspar + biotite + muscovite.

Affected by deformations, the main rock forming minerals change. Quartz grains show undulatory extinction and a lots of subgrains consist of the recrystallised ones. Polysynthetic twins of plagiclase feldspar are wavy. The micas are kink-banded.

On the basis of modal measurements, the studied rocks fall in four different fields: alkali feldspar granite, syeno- and monzogranite, and grandiorite.

On the basis of the geochemical examinations the studied samples are subalkaline, calc-alkaline rocks of prealuminous character. The differentiational index of the rocks of PB High and ADFM High varies between 74-91 and 87-91, respectively. Concerning their tectonical origin, the crustal granites were formed by continental collisions. On the basis of their material, the granitoids are of S-type (korund-norm > 1; the quartz-norm content of granites is high; Na/K < 1; Na_2O < 3.2 %wt, K_2O > 5 %wt, Al/(Na+K+Ca/2 > 1.1).

References

BUDA, GY. (1996): Correlation of Variscan granitoids occuring in Central Europe. Acta Miner. Petr. Szeged, 37, Suppl., 24.

CSONTOS, L. NAGYMAROSI, A. (1999): Late Miocene inversion versus extension in the Pannonian Basin. Tübinger Geowissenschaftliche Arbeiten, Series A, 52, 132.

KEMENCI, R., CANOVIC, M. (1997): Geologic setting of the Pre-Tertiary basement in Vojvodina. Part I: The Tisza Megaunit of North Vojvodina. Acta Geol. Hung., 40/1. 1-36.

KOVÁCS, S., HASS, J., BUDA, GY., NAGYMAROSY, A., SZEDERKÉNYI, T., ÁRKAI, P., CSÁSZÁR, G. (2000): Tectonostratigraphic terranes in the pre-Neogene basement of the Hungarian part of the Pannonian area. Acta Geologica Hungarica, Vol. 43/3, 225-328.

SZEDERKÉNYI, T. (1984): Az alföld kristályos aljzata és földtani kapcsolati (Crystalline basement and geological relations of the Great Plain). D.Sc. Thesis. MTA Library, Budapest, (in Hungarian).

SZEDERKÉNYI, T. (1996): Metamorphic formations and their correlation in the Hungarian part of the Tisza Megaunit (Tisa Composite Terrane). Acta Miner., Petr. Szeged, 37, 143-160.

Tari, G., Dövényi, P., Dunkl, I., Horváth, F., Lenkey, L., Stefanescu, M., Szafián, P., Tóth, T. (1999): Lihospheric structure of Pannonian basin derived from seismic, gravity and geothermal data. In The Mediterranean Basins: Tertiary Extension within the Alpine Orogen, Durand B, Jolivet L, Horváth F,Sérane M (eds). Geological Society: London. Special Publication, 156, 215-250.

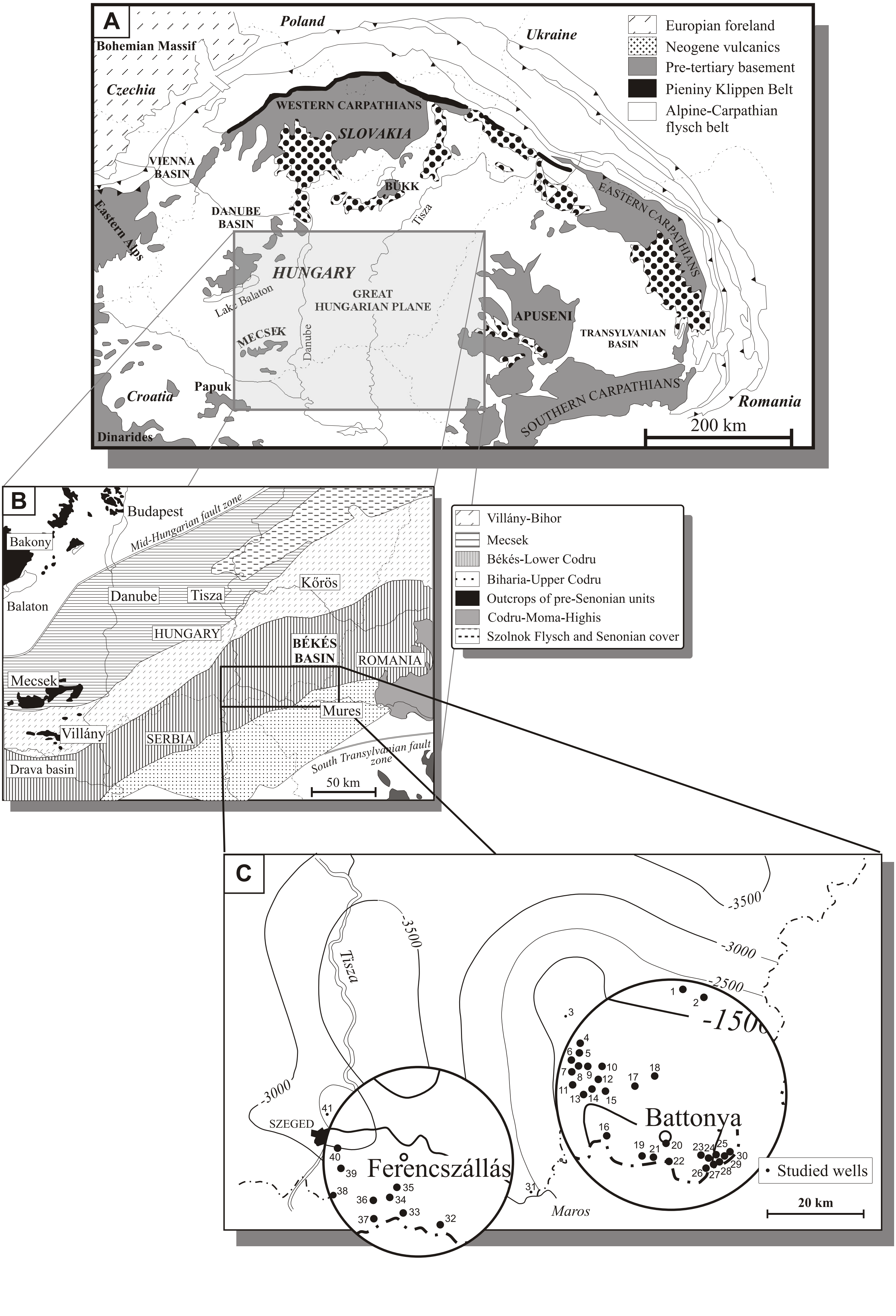
Fig. 1.

Simplified geological map of the Pannonian basin and of the study area

A. Simplified geological map of the Alpine-Carpathian-Pannonian System with location of the study area

B. Geological sketch map of Tisia Composite Terrain with location of a detailed topographic map

C. Topographical map of the Pre-Neogene basement of Csongrád and Battonya Unit. The dots indicated with numbers show the boreholes in which the granitoid rocks were exposed in the above mentioned Units.



A
Europian foreland
Neogene vulcanics
Pre-tertiary basement
Pieniny Klippen Belt
Alpine-Carpathian flysch belt
Poland
Ukraine
Bohemian Massif
Czechia
WESTERN CARPATHIANS
SLOVAKIA
VIENNA BASIN
DANUBE BASIN
BÜKK
Tisza
EASTERN CARPATHIANS
Eastern Alps
HUNGARY
Lake Balaton
GREAT HUNGARIAN PLANE
MECSEK
Danube
APUSENI
TRANSYLVANIAN BASIN
Croatia
Papuk
SOUTHERN CARPATHIANS
Romania
Dinarides
200 km
B
Budapest
Mid-Hungarian fault zone
Bakony
Balaton
Danube
Tisza
Kőrös
HUNGARY
BÉKÉS BASIN
ROMANIA
Mecsek
Mures
Villány
SERBIA
South Transylvanian fault zone
Drava basin
50 km
Villány-Bihor
Mecsek
Békés-Lower Codru
Biharia-Upper Codru
Outcrops of pre-Senonian units
Codru-Moma-Highis
Szolnok Flysch and Senonian cover
C
-3500
-3000
-2500
-1500
Tisza
SZEGED
Ferencszállás
Battonya
Maros
Studied wells
20 km