Petrology and geochemistry of the Miocene ignimbritic volcanism of the southern foreground of the Bükk Mountains (Hungary)

Teréz Póka[1], Tibor Zelenka[2], Alexandru Szakács[3], Ioan Seghedi[3] & Géza Nagy[1]

[1]*Laboratory for Geochemical Research, Hungarian Academy of Sciences, Budapest, Hungary*
[2]*Hungarian Geological Survey, MGSZ, Budapest, Hungary*
[3]*Institutul Geologic al Romaniei, Bucuresti, Romania*

The reambulatory investigation of the Miocene ignimbritic volcanic sequence of the southern foreground of the Bükk Mountains has become opportune since it was not studied so far by means of modern integrated petrological-geochemical and geophysical methods on the one hand, and this area is the most complete formation of this sequence in the surface, on the other. The petrological and geochemical investigations, together with the K/Ar and paleomagnetic age determinations aim at the knowledge of magma genesis of the formation and the relationships with the megatectonic evolution.

Each of these three characteristic explosive volcanic horizons developed within a relatively short geological time, and they represent the volcanic formation of greatest extension and volume in the region of the Pannonian basin (it is six times greater than the andesitic sequence).

The *lower ignimbrite horizon* is built up by pumice tuff, more or less welded ignimbrites, phreatomagmatic sequences and by redeposited tuffs. Only biotite occurs as mafic component, it is however often opacitic and chloritized. In addition to the often zoned plagioclase of oligoclase composition, sanidine always occurs. Magnetite and zircon are frequent accessories. Pumice and vitroclasts are frequent in different size and forms. Occasionally, subsequent clay mineralization and zeolitization can be observed.

The counter-clockwise rotation of 80–90° is characteristic of the lower horizon. Field and borehole observations relate to two main explosion phases of the lower tuff horizon: 20.7–19.0 my and 19.3–17.8 my, respectively. Based on the main elements the lower horizon is a typical calc-alkali rhyolitic magma type of high K–content. The distributions of REE and incompatible trace elements are close to the average of the continental Earth's crust, according to the enrichment of LREE to that of the acid lower crust. This probabilizes the existence of the granulitic lower crust.

The geological age of the *middle ignimbrite horizon* is 16.3–17.0 my. Its composition is peculiarly bimodal: the andesitogenic and rhyolitogenic clastics and textural elements are mingled not only with a sequence but also within one rock type, as well. The chemistry of the given rock type is defined by their quantitative proportions. The chemistry of this horizon changes from calc alkali andesitic to rhyolitic with medium to high K-content. The composition of the vitreous cementing material is also changing (61–79 % SiO_2 and 0.54–5.05% K_2O), but is predominantly dacitic.

Hypersthene, rarely biotite, green and brown amphibole represent the mafic ingredients. In this horizon the strongly welded ignimbrite formation is much more frequent. This prevents the weathering, thus fresh mafic components are more frequent. The incompatible trace elements and REE distributions are transitional between those characteristic of the continental Earth's crust and of the andesitogenic magmas. The LREE content is lower than in the lower horizon, while the HREE display a second maximum. This means that subsequently to the explosion of the most acid crustal part (lower rhyolite tuff horizon), a more basic material remained and the andesitic magma (the activity of which was most intense just in the Badenian) was mixed with the acid melt in crustal magma chambers.

The upper rhyolite tuff horizon (of Sarmatian age, 13.6 my, can be characterized by rotation of 0°) is usually unwelded and often of phreatomagmatic formation. Its composition is purely potassium-rich rhyolitic. Biotite is the main mafic component (hypersthene occurs rarely). Nevertheless, the distributions of incompatible trace elements and REE is similar rather to the middle horizon and this relates to the fact that the acid magma molten from the lower crust depleted the material in LREE.

In the course of the investigation of the ignimbrite sequence the discrete petrological-geochemical character of each horizons as well as the paleomagnetic data allowed the suitable interpretation of the K/Ar age data indicating wider time intervals.