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

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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 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 opatic 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 calcalkali 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 calcalkali andesitic to rhyolitic with medium to high K-content. The composition of the vitreous cementing material is also changing (61–79% SiO₂ and 0.54–5.05% K₂O), 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 rhyolitic 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 rhyolitic 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.

Tectonics of the Orava — Nowy Targ Basin

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The analysis of gravity and geoelectrical data within the Orava — Nowy Targ Basin has been carried out to recognize the structural style of the basin. The geophysical data interpretation allow the faults in the basement of the basin to be traced and correlated with some faults previously detected on the surface close to the Orava — Nowy Targ Basin. From the examination of the faults pattern two major fault systems can be identified within the basin. Two distinct depressions surrounded by these faults and separated by the basement elevation in the vicinity of Rogoźnik and Ludźmierz have been detected.

The oldest system consist of faults which are parallel or
The Late Jurassic to Miocene dynamics of the Polish part of Outer Carpathian Basins and its regional implications

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The Late Jurassic to Early Neogene tectonic evolution of the Polish part of Outer Carpathian fold-and-thrust flysch belt was a subject of the research. The flysch sequences in Poland are divided into several tectonic and facies units related to primal basins/sub-basins; Magura, Dukla, Fore-Dukla, Silesian, Subsilesian and Skole units were analysed here. Outwards of flysch belt basin the European platform Peri-Tethyan basins developed, including Polish Trough and its southern prolongation, of which tectonic relations with northern Tethyan realm are in question.

Synthetic 1-D sections of the basin-fill for individual zones of flysch belt sub-basins were reconstructed and backstripped in order to calculate tectonic component of the basement vertical movements. The results are highly dependent on palaeobathymetry estimations. For the Polish Trough maps of subsidence rates were constructed, and correlation of the main tectonic events between Outer Carpathians and European plate (Polish Trough) were analysed. Subsidence pattern is consistent the across analysed part of Outer Carpathians (less certain for Magura basin) suggesting common mechanisms controlling subsidence and uplift of basins/sub-basins. For the Late Jurassic to Maastrichtian main tectonic events of the norden Tethyan realm (Outer Carpathians) and southern Peri-Tethyan realm (Polish Trough) correlate in time, while for the Neogene only very limited correlation is observed. During Oxfrodian time, the major tectonic event took place across the southern prolongation of the Polish Trough, which significantly increased in rate towards the Outer Carpathian basins. Together with extensional/transensional major tectonic event in the Inner Carpathians it allows to suggest that the Outer Carpathian basins were affected by extensional tectonic regime at that time.

For the Tithonian to beginning of Early Cretaceous, an extensional event is recorded for Silesian (and possibly Dukla) units, followed by thermal cooling subsidence pattern throughout the remaining part of the Early Cretaceous. Decreasing deposition rates convince regional thermal sag mechanism, affecting source area as well. Since the Turonian-Coniacian until Maastrichtian-Paleocene, an uplift of basins took place (not certain for Magura basin), which was coeval in time with the Inner Carpathian collision and folding. The uplift is interpreted as being a result of change in tectonic regime into compressional one. This is also coeval with suggested here beginning of inversion processes of the Polish Trough, recorded by very minor subsidence and/or uplift of former main depocentre, as well as development of marginal depocentres on both flanks of the Polish Trough. Therefore, it is suggested that dynamic processes taking place in the Tethyan realm (the northern Inner and Outer Carpathians) and in the southern Peri-Tethyan realm (Polish Trough) at that time were part of common geodynamic frame controlled by transmission of compressional stresses from the collision zone of the Inner Carpathians. Renovation of subsidence since the Paleocene and lasting until Middle-Late Eocene times, could be related to an isostatic rebound after previous uplift, although thermal cooling after the Late Jurassic/Early Cretaceous extension might be of some contribution as well. During Late Eocene to Early Oligocene times prominent uplift took place, followed by minor subsidence. This uplift, having the general plate convergence background, is interpreted here to be a reaction to compressional stress development and a shift of locus of shortening to the north. Its final relocation and creation of main detachment surfaces resulted in stress relaxation and limited subsidence, therefore, the Late Oligocene-Early Miocene basin would developed on top of undergoing initial thrusting flysch sequences. Further continuation of shortening introduced orogenic processes into the Outer Carpathians.