Pyroclastic stratigraphy of the acid volcaniclastics (2-nd Rupelian phase) near Plazishte (Dzhebel) and Kostino (Kardzhali) villages, Eastern Rhodopes – a comparative study

Стратиграфия на киселите вулканокластити (2-ра Рупелска фаза) при селата Плазище (Джебелско) и Костино (Кърджалийско), Източни Родопи – сравнително изследване

Rositsa Ivanova
Росица Иванова

Geological Institute, Bulgarian Academy of Sciences, 1113 Sofia, Bulgaria; E-mail: rossiv@geology.bas.bg

Key words: Eastern Rhodopes, Paleogene, acid volcaniclastics, eruptive stratigraphy.

The current study was inspired by the discussion raised after the author's presentation (Ivanova et al., 2011) at "Geosciences 2011". The discussion was focused on the reported conclusions that the features of the volcaniclastic section of 2-nd Rupelian acid volcanic phase, occupying the northern parts of Dzhebel depression, imply the existence of source area other than Borovitsa caldera (BC), as it was initially supposed (Yanev, 1981). The questions aroused indicate that further investigations of this topic are needed. To throw some more light on it, the southward extending BC outflow deposits were studied in their larger occurrences (as interpreted in Yanev, 1981; Djourova, Aleksiev, 1990, etc.) near the villages of Zhenda and Kostino as well as to the west of Borovitsa River. The southernmost of them, located to the southeast of the village of Kostino (10 km to the northeast of Kardzhali), was compared with the previously studied section, exposed to the north of Dzhebel.

Borovitsa caldera outflow deposits at near Kostino village. The products of 2-nd acid volcanic phase occupy the topmost 100 m of a hill rising to the east-southeast of Kostino village. The rocks overlie the volcano-terrigeneous formation (Yanev, 2007) interpreted as lateral correlative of the rocks from the 2-nd intermediate volcanic phase. The studied succession could be subdivided into 6 pyroclastic flow deposits associated with ash-cloud units, and 2 ash-fall units (Fig. 1). The pyroclastic flows are massive to diffusely layered, fines-depleted and thus, relatively well sorted. They vary in thickness from 2–3 to over 20 m and contain mainly pumice, ash to fine lapilli in size. Pumice lapilli (up to 1.5 cm) were observed in the lowermost flow unit. They also form a distinct level in the 3-rd flow unit. Dense lava clasts are less abundant, also ash to fine lapilli in size. The larger of them appear as lithics-enriched levels in two of the flows

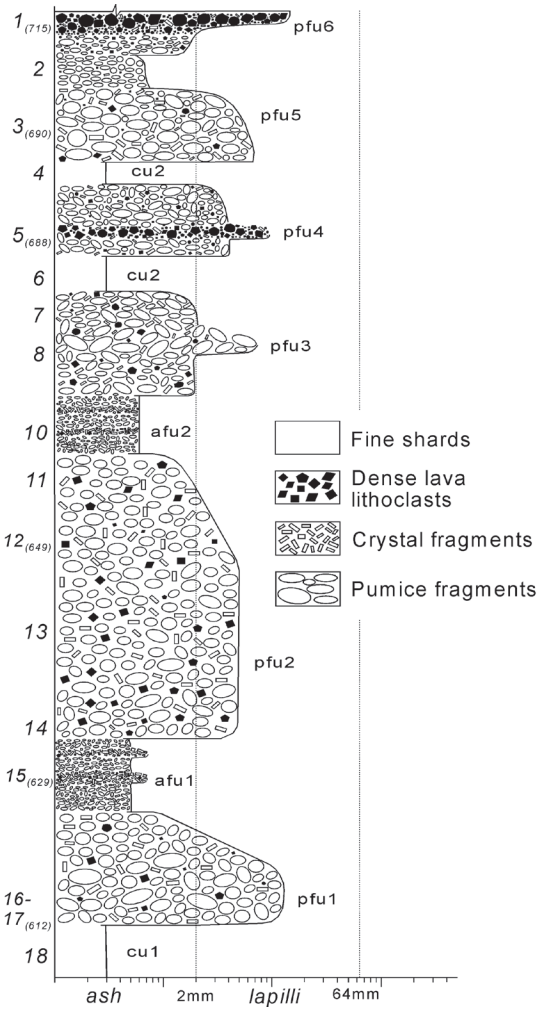

Fig. 1. Stratigraphy (out of scale) and interpretation of the pyroclastic succession of 2-nd acid volcanic phase near Kostino village. Numbers indicate sampled levels; altitude (in m) is given in the brackets; *pfu*, pyroclastic flow units, *afu*, ash-fall units; *cu*, cloud units.

from the upper parts of the section. Crystal clasts are presented by fragments (<1 mm) of plagioclase, biotite, quartz, sanidine, and amphibole. The finest ash, elutriated from the moving flows now can be found as distinctive layers, overlying some of the flow units, and are therefore interpreted as ash-cloud deposits. Aggregation of ash particles and formation of different in shape, size and internal structure accretionary pellets (according to classification proposed by Brown et al., 2012) seem typical of all cloud units. Levels showing distinct layering, resulting from changes in the particle size, were interpreted as ash-falls. They are also pumice dominated. The total thickness of the section is about 80 m.

Regarding the sratigraphy and grain-size characteristics, the section near Kostino seems similar to the succession exposed to the west of Borovitsa River (especially its southernmost parts) that could also be interpreted as an alternation of flow and fall units. Only 3 but very thick (tens of m) and much coarser-grained flow units, accompanied by one relatively thin (~2 m) fall level, also containing ash pellets, was established near Zhenda village, close to the inferred source (BC).

The section of 2-nd acid volcanic phase near Plazishte – common and distinguish features. From the above-reported observations is evident, that over a distance of about 14 km away from the source (from Zhenda to Kostino) the sections change regularly as the thickness of the individual pyroclastic flows deposits decrease, they all get finer-grained and better sorted and the finest ashes tend to become more abundant. Therefore, if the units observed near Kostino had the potential to travel more 19 km further away from the source (and to reach the northern parts of Dzhebel depression), then another significant reduction in both thickness and grain-size (of dense lithics and crystals mainly) of the units should be expected. Indeed, such relatively thin (tens of cm to first m) and very fine-grained levels were identified in the upper parts of the section of the 2-nd acid volcanic phase near the village of Plazishte (Upper mixed packet, Ivanova et al., 2011). They are even finer-grained when compared with the finest ash-cloud levels from near Kostino and, moreover, they also contain ash pellets. Therefore, we can conclude that some levels from the upperparts of the section near Plazishte could be interpreted as more distal correlative of Kostino succession, and BC outflow deposits, respectively.

As regarding pyroclastic flow units, near Plazishte they are 4, as the lower 3 (as each is 8–12 m thick) build the lower half of the section (Lower ignimbrite packet) and the uppermost one is much thinner and associates with ash-fall and epiclastic beds in the upper packet. Besides the apparent discrepancies (e.g. distribution throughout the two sections and thicknesses) between the flow units from Kostino and Plazishte, there is one more piece of evidence indicating a lack of correspondence. As it was mentioned above, the flow units from near Kostino village are depleted in fine ash particles. In contrast, the flow deposits near Plazishte are still rich in fine material, resulting from milling of pumice during movement, now building the matrix between larger clasts. Therefore, the pyroclastic flow units observed near Plazishte village are less evolved (shorter run-out distance), and can not be distal correlatives of the flow units from near Kostino. Thus, they must have been erupted from another source, different from BC. The possible source area, as proposed by Ivanova et al. (2011), is now buried under Dambalak volcano latite lava.

The epiclastic layers, present in the upper packet of Plazishte section, although having no analogue at Kostino, can be interpreted either as distal facies of BC outflow units or a product of later, post-explosive evolution of the newly proposed eruptive center.

Acknowledgments: Some data reported here were collected during the first stages of project NZ-1306 granted by Bulgarian Science Fund. The recent field works have become possible thank to project Min4-K (FFG No. 830 725) granted by Austrian Research Promotion Agency. Yotzo Yanev is kindly thanked for the useful discussions.

References

Brown, R. J., C. Bonadonna, A. J. Durant. 2012. A review of volcanic ash aggregation. – *Physics and Chemistry of the Earth*, *45–46,* 65–78.

Djourova, E., B. Aleksiev. 1990. Zeolitic rocks related to the second acidic Paleogene volcanism to the east of the town of Kaldzhali. – *Geologica Rhodopica, 2*. Aristotl University, Thessaloniki, 279–489.

Ivanova, R., Y. Yanev, E. Vasilieva, L. Machiels, J. Elsen, Tz. Iliev. 2011. Zeolitized volcaniclastics from northern part of Dzhebel depression, E. Rhodopes: stratigraphy, petrography and mineralogy. – In: *Proceedings of National conference "Geosciences 2011"*. Sofia, BGS, 63–64.

Yanev, Y. 1981. The volcanism in Momchilgrad depression and Arda graben-syncline. – In: Harkovska, A., Y. Yanev (Eds). *Paleogene Volcanism in Mesta Graben, Central and Eastern Rhodopes (South Bulgaria)*. Guide-book for work-group 3.4 fieldtrip. Problem commission IX of the Academy of Sciences of the socialist countries. Sofia, 46–55 (in Russian).

Yanev, Y. 2007. Lower Oligocene Dazhdovnitsa Formation (new Formation) in the Eastern Rhodopes: description and volcanological interpretation. – *Rev. Bulg. Geol. Soc., 68*, 1–3, 131–142.