15th International Congress of the Geological Society of Greece
Athens, 22-24 May, 2019 | Harokopio University of Athens, Greece
Bulletin of the Geological Society of Greece, Sp. Pub. 7 Ext. Abs. GSG2019-267

Geological Aspects of the Zeolitic Tuffs of Petrota region, Evros, Northeastern Greece

M. Vavelidis[1], K.Giouri[1], E.Michailidou[1], L.Papadopoulou[1], G. Christidis[2], A. Karetou[1], C.L.Stergiou[1]

(1) Department of Mineralogy-Petrology-Economic Geology, Aristotle University of Thessaloniki, 54124, Thessaloniki, Greece, e-mail: vavelidi@geo.auth.gr
(2) School of Mineral Resources Engineering, Technical University of Crete, 73100, Chania, Greece

Two zones of zeolitictuffs are located approximately 2 km westwards and northwestwards of Petrota village at Evros region, northeastern Greece. During the recent decades several detailed publications have been published on the mineralogy, geochemistry, quality characteristics and applications of these zeolitic tuffs (Kantiranis et al., 2006; Favvas et al., 2016; Filippidis, 2016).The present study is an attempt toreview and also add new data on the geological aspects of the zeolitic tuffs regarding their mineralogical and structural features.

The geological background of the region is composed by Mesozoic phyllites, schists, and gneisses of the Rhodope Massif which are overlaid by Upper Eocene to Oligocene sedimentary series of the Evros molassic basin (Caracciolo et al., 2012, 1978; Kilias et al., 2015). The younger regional stratigraphy includes Pliocene to Quaternary loose conglomerates and alluvial deposits of the Evros and Ardas rivers (Andronopoulos, 1978).

According to Andronopoulos (1978) and Caracciolo et al. (2012) the regional molassic rocks of Upper Eocene age are subdivided as follows (Fig. 1): the lower Komara Series, which mainly consists of conglomerates and coarse-grained sandstones with local intercalations of clays and marls, the middle Pentalofos Sequence of volcano-sedimentary origin, the Upper Sandstone Serieswith fine-grained sandstones and thin clayey intercalations and the younger transgressive limestone. Overlying Oligocene marl limestone and sandstones with marl intercalations constitute the stratigraphy of the molassic basin.

Hydrothermally altered rhyolites and rhyolitic tuffs, as well as polymictic loose breccias and cohesive grit-breccias build up the Pentalofos Sequence (Andronopoulos, 1978; Marantos et al., 2006) (Fig. 1). The rhyolites and the rhyolitic tuffs appear silicified, kaolinitized and locally zeolitized. Their most extensive occurrence is found in the west of Petrota village near the Greek-Bulgarian borders.In addition, rhyolites appear also as small intrusions within the loose breccias formation. According to Ivanova et al. (2000) the Petrota area is located at the southeastern part of the Sheinovets caldera, which mostly extends at the adjacent Bulgaria. According to stratigraphic data, the timeline of the volcanic activity in the Bulgarian part spreads between Priabonian and Rupelian (34.2 to 32.8 Ma), while in the Greek part K/Ar dating of the rhyolites revealed that the volcanic activity continued up to 20.7±1.6 Ma (Ivanova et al., 2000; Barbieri et al., 2001). The loose breccias formation is characterized by large, unconsolidated, angular and unsorted blocks of schists, pegmatites and volcanic material comprising fragments of rhyolites and lava flows. Grits and cobbles of chloritized schist, quartz, lava shards and rhyoliteare located within the cohesive breccias formation. The formation appears in massive, thick-bedded layers of sandstones including thin intercalations, or lenses, of tuffs which are composed byfine clayey-silicic material, kaolinite and layers of zeolitized silicic material. Pyroclastic flows set in a shallow marine environment contributed significantly in the formation of these rocks. In addition, Marantos et al. (2006) report the presence of a tuff-ring volcanic center in the region (Fig. 1).

The spatial distribution of the cohesive grit-breccias formation largely corresponds to the occurrence of the two zones of zeolitic tuffs (Fig. 1). The two zones start at the hilly area near Petrota village and develop towards the west (Kokkalo-Omega) and the northwest (KM-Gazomilos) spreading for 2.5 km and 1.4 km and covering areas of approximately 0.33 km^2 and 0.13 km^2, respectively. Clinoptilolite and mordenite are the two zeolite minerals which are found throughout the two zeolitic zones. Quantitative and qualitative analysis of 31 bulk surface samples from the two zoneswas performed by X-Ray diffraction. According to the results, the presence of clinoptiloliteat the first zone ranges between 54wt%and 80wt%, while at the second zone it ranges between 52wt% to 80wt%. Mordenite was determined in 14 samples ranging from 0.3wt% to 15.3wt%.The mineralogical composition of the samples includes quartz, opal, analcime, biotite, chlorite, smectite, kaolinite, and goethite, while hornblende, sanidine, anorthoclase and plagioclase are also found in the polymictic samples. It should be mentioned that Filippidis and Tsirambides (2012)while summarizing the zeolite presence of the tuffs in the Petrota area, they mention that at Drista location (KM-Gazomilos zone) clinoptilolite-heulandite contents reach up to 95wt%,with an average of 89wt%.

Structurally the zeolitic tuffs appear mostly in gently dipping beds. At the Kokkalo-Omega zone the beds are exposed atthe steep, south-facing,stream area of the hill range running from Petrota village to Omega location as well as along an amphitheatric slope at the northern hillside near Omega (Fig. 1). The zeolitic tuffs appear both as thin beds (<10 cm in width) and as lenses of fine-grained material in coarser-grained beds. The zeolitic beds appear between more massive beds of sandstones (up to 50 cm in width). The general direction of these beds starts as E-W and continues as NNW-SSE, while they dip in average 17°N-NE. Major tectonic feature of the area is a NW-SE trending and SW dipping fault which crosscuts the zone of the zeolitic tuffs. Throughout the KM-Gazomilos zone the development of the zeolitic bedsfollows the morphological gradient of the northeast-facing hill slopes. Thus, significant vertical exposures of zeolitic tuffs are missing from this area. Most of the zeolitic beds exposures can be observed in streams perpendicular to the hill slopes morphology. The zeolitic beds range from less than 10 cm up to 20 cm in width and they are less polymictic than the zeoliticbeds of the Kokkalo-Omega zone. They trend in a SE-NW direction, likewise a major fault which separates this

zone in two parts regarding the dipping of the beds. Consequently the beds of the hilly western part dip in average 45º SW, while these of the plain eastern partdip in average 10ºNE. At the southern part of this zone, near KM location, the beds dip between 58º to 82º SW-SSW. The steeper dipping of the beds at this location is the result of the anticlinal exposure of phyllites which belong to the metamorphic basement of the Rhodope Massif.

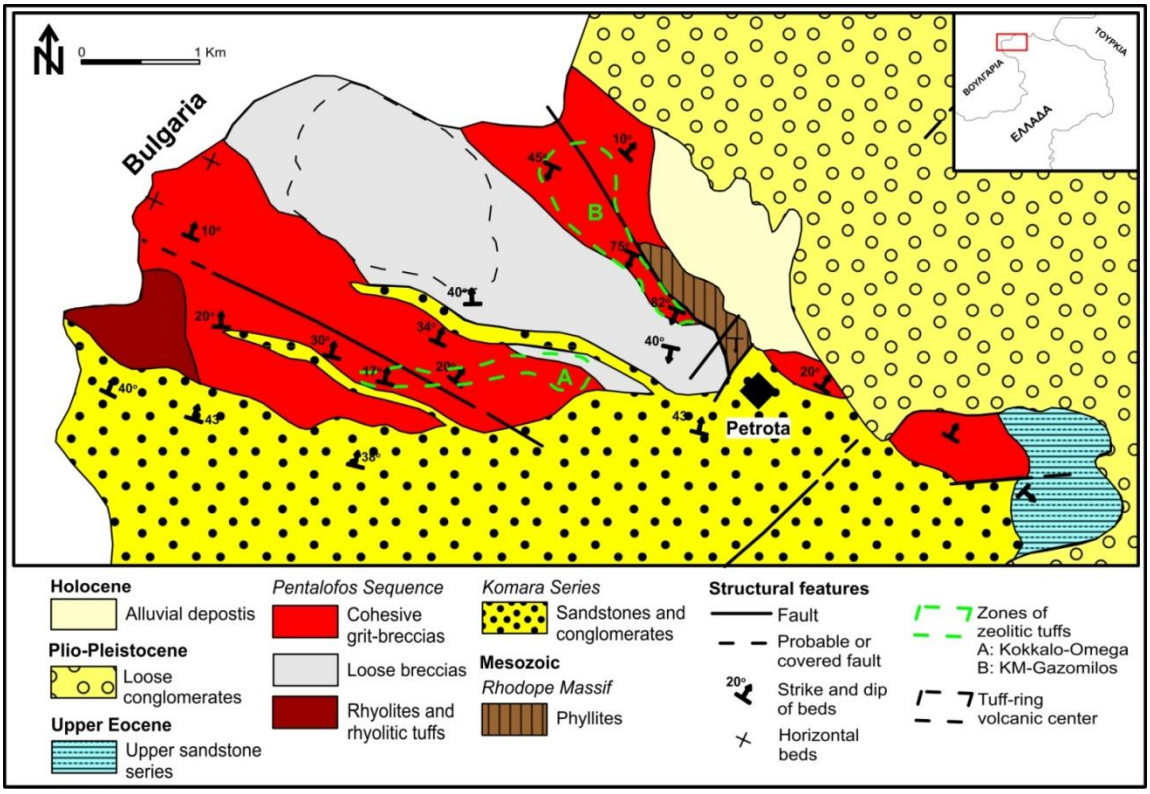

Figure 1. Geological map of the Petrota area, demonstrating the development of the zeolitic tuffs zones and the suggested tuff-ring volcanic center (Andronopoulos, 1978; Marantos et al., 2006).

Acknowledgements

The first author would like to acknowledge Zeolite Petrota Industrial and Commercial S.A. “O Lithoxoos” for their support on field survey logistics.The field survey was carried out at exploration concessions of the company. The School of Mineral Resources Engineering (Technical University of Crete)and MSALabs are acknowledged for their assistance at the analytical research.

References

Andronopoulos B., 1978. Ormenio, Geological Map of Greece 1:50.000. IGME Publications, Athens.

Barbieri, M., Castorina, F., Masi, U., Garbarino, C., Nicoletti, M., Kassoli-Fournaraki, A., Filippidis,Mignardi, S., 2001. Geochemical and isotopic evidence for the origin of rhyolites from Petrota (Northern Thrace, Greece) and geodynamic significance. Chemie Der Erde-geochemistry 61(1), 13-29.

Caracciolo, L., Von Eynatten, H., Tolosana-Delgado, R., Critelli, S., Manetti, P.,Marchev, P., 2012. Petrological, geochemical, and statistical analysis of Eocene–Oligocene sandstones of the Western Thrace Basin, Greece and Bulgaria.Journal of Sedimentary Research 82(7), 482-498.

Favvas, E.P., Tsanaktsidis, C.G., Sapalidis, A.A., Tzilantonis, G.T., Papageorgiou, S.K., Mitropoulos, A.C., 2016. Clinoptilolite, a natural zeolite material: structural characterization and performance evaluation on its dehydration properties of hydrocarbon-based fuels. Microporous and Mesoporous Materials 225, 385-391.

Filippidis, A., 2016. Applications of the Hellenic Natural Zeolite (HENAZE) and specifications of zeolitic tuffs. Bulletin of the Geological Society of Greece 50(4), 1809-1819.

Filippidis, A.,Tsirambides, A., 2012. Quality characteristics of the Greek zeolites, environmental, industrial, agricultural and aquacultural uses of Hellenic natural zeolite: A review. Scientific Annals, School of Geology, Aristotle University of Thessaloniki, Special Volume 101, 125-133 (in Greek with English abstract).

Ivanova, R., Stoykova, K.,Yanev, Y., 2000. Acid pyroclastic rocks from the Sheinovets caldera, Eastern Rhodopes: Lithostratigraphy, characteristics and age. Geochemistry Mineralogy Petrology 37, 47-56.

Kantiranis, N., Chrissafis, C., Filippidis, A., Paraskevopoulos, K.M., 2006. Thermal distinction of HEU-type mineral phases contained in Greek zeolite-rich volcaniclastic tuffs. European Journal of Mineralogy 18(4), 509-516.

Kilias, A.D., Vamvaka, A., Falalakis, G., Sfeikos, A., Papadimitriou, E., Gkarlaouni, C.H., Karakostas, B., 2015. The Mesohellenic Trough and the Paleogene Thrace Basin on the Rhodope Massif, their Structural Evolution and Geotectonic Significance in theHellenides. Journal of Geology and Geosciences 4, 198.

Marantos, I., Michail, C., Koshiaris, G., 2006. Study of the zeolitic alteration in Petrota Tertiary volcaniclastic rocks, Thrace area, NE Greece. Geoscience 124, 126.