Study of the zeolitic alteration in Petrota Tertiary volcaniclastic rocks, Thrace area, NE Greece

Ioannis Marantos[1], Constantine Michael[2], George Kosharis[2]

[1] IGME, 70 Messogion str, 115 27, Athens, Greece; E-mail: marantos@igme.gr
[2] IGME, Xanthi Branch, 30 Brokoumi str, Xanthi, Greece

Key word: clinoptilolite, K-feldspar, pyroclastic flows, zeolitization, devitrification

Introduction

Detail studies that carried out in the Tertiary pyroclastic rocks in the area of Thrace resulted the localising of several zeolite outcrops (Koshiaris et al., 2002; Marantos, 2004a and reference there in). The Tertiary zeolitized pyroclastics, range in composition from rhyodacitic to andesitic, have been deposited mainly in shallow marine to littoral environment in the form of fall or flow deposits. Clinoptilolite, and mordenite are the most common alteration minerals of the glassy material in the pyroclastic rocks.

In the area of Petrota (fig. 1), mapped in detail, a volcanic center and a tuff-ring have been defined. The Paleogene volcanic activity in the area produced a wide variety of pyroclastic flows, deposited in a shallow marine environment. The pyroclastic deposits are altered to mainly to clinoptilolite (Kirov et al., 1990; Marantos, Perdikatsis, 1994; Stamatakis et al., 1998). In the present study a correlation between deposition environment, deposition mechanism and zeolitization process is attempted.

Methods of study

The studied area was map in a scale of 1:25 000 and part of this in scale 1:5 000. The identification of alteration minerals was carried out by XRD method. Oriented mounts on glass slides of the clay fraction were X-rayed. The identification of the clay minerals was based on the behaviour of its basal reflection upon glycol saturation. The mode of occurrence of alteration minerals was determined by microscopic and SEM observation.

Results

In the Petrota area (Eastern Rhodopes volcanic region) the Paleogene volcanic activity produced a wide variety of pyroclastic flow deposits.

The pyroclastic flows mainly consists of polymictic stratified flow deposits, (coarse-grained/lapilli), intercalated by ignimbritic breccia. Pumice flow tuffs also occur forming a horizon more than 1.5 km in length and up to 100 m in width. The volcanic center is characterized by debris-avalanche deposit in the periphery, with volcanic components rich in K_2O and Na_2O. The volcanic center is filled by polymict conglomerates and sediments.

The volcaniclastic rocks consist of pumice and glass shards, feldspars, quartz, biotite, and muscovite flakes. Fragment of metamorphic and volcanic rocks, usually in the size of lapilli, may also be present in places. Chemical analyses of volcaniclastic rocks are plotted in the fields of dacite, K-rich calc-alkaline dacites, and latite. The phenocrysts of the zeolitized rocks are K-feldspar, quartz, plagioclase, and biotite. The muscovite is also presented. K- Feldspar is a main characteristic mineral in pyroclastic flow deposits. It usually occurs in microscopic crystals outlining glass fragments or filling interstitial pores, (fig. 2a, b). The primary igneous feldspar fragments usually are fresh and the original texture of the rock is well preserved.

The glassy components of the volcaniclastic rocks have been partially altered into zeolites (clinoptilolite and minor mordenite), smectite and cristobalite. Clinoptilolite crystals replace volcanic glass, usually in the form of tabular crystals (fig. 2b).

Discussion

The volcaniclastic rocks in the area of Petrota were mainly deposited as pyroclastic flows in a shallow marine environment.

The glassy components of the volcaniclastic rocks have been partialiy altered to zeolites, smectite and cristobalite. Secondary K-feldspar in microscopic crystals is main mineralogical constituent. The formation of submicroscopic K-feldspar and cristobalite around glass fragments in the pyroclastic flow deposits is a result of devitrification at the cooling stage, while the deposition of the same minerals in pores of the rock is attributed to gas phase-crystallization (Smith 1960a, 1960b; Sheridan, 1970).

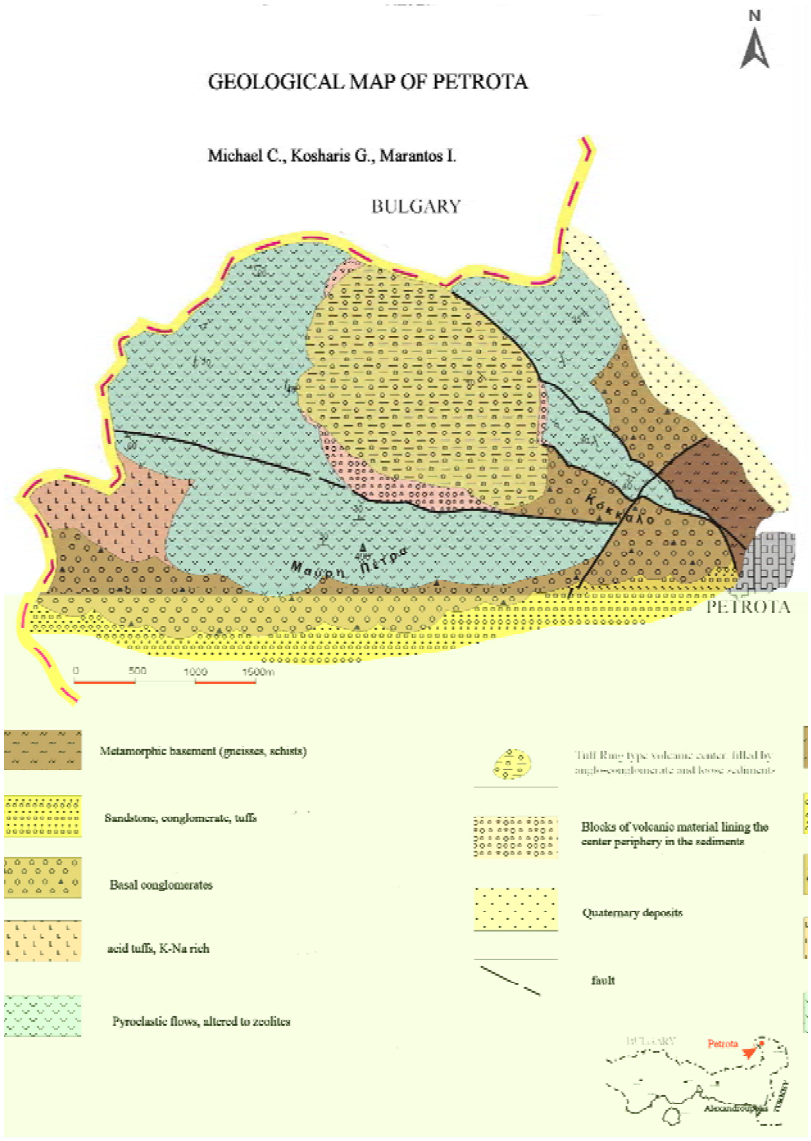


Fig. 1. Geological map of Petrota area

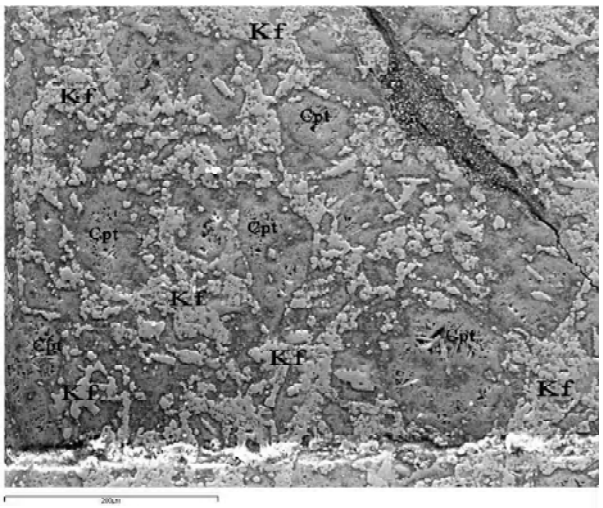


Fig. 2a. Glass altered to clinoptilolite. K-feldspar surrounds glass fragments or precipitate in pores

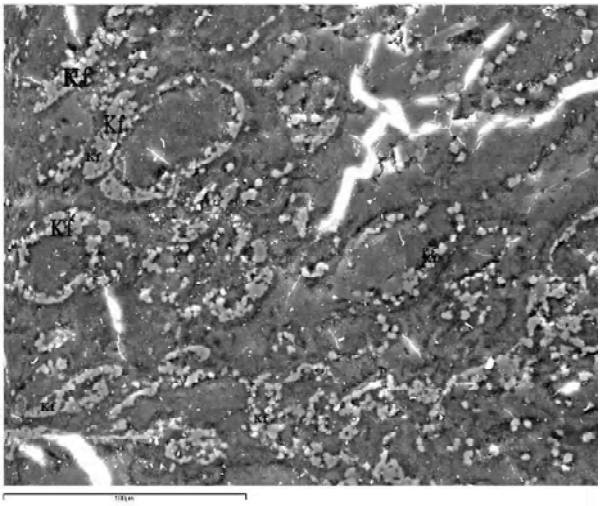


Fig. 2b. K-feldspar lining glass fragments

The formation of zeolites in pyroclastic flows in Thrace area seems to be a fast process, and temperature played critical role (Raynov et al., 1997; Marantos, 2004a; Marantos et al., 2004b). The relatively elevated temperatures due to the deposition of pyroclastic flows in shallow basins raised water temperature supporting a relatively fast zeolitization of volcanic glass (Aleksiev, Djourova, 1975; Aleksiev et al., 1997; Polgari et al., 1997).

References

Aleksiev, B., E. G. Djurova. 1975. On the origin of zeolite rocks. — *C. R. Acad. bulg. Sci., 28*, 517—520.

Aleksiev, B., E. Djourova, Z. Milakovska-Vergilova. 1997. Geology of the Oligocene zeolitic rocks in NE Rhodopes, Bulgaria: A review and new data. — In: Kirov, G., L. Filizova, O. Petrov (Eds.). *Natutal Zeolites – Sofia'95*, 249—262.

Kirov, G., A. Fillipides, A. Tsirambides, R. Tzvetanov, A. Kassoli-Fournaraki. 1990. Zeolite bearing rocks in Petrota area (Eastern Rhodope Massif, Greece). — *Geologica Rhodopica, 2*. Univ. Thessaloniki, 500—511.

Koshiaris, G., I. Marantos, A. Tsirambides., M. G. Stamatakis, A. Kassoli-Fournaraki, A. Filippidis. 2002. In: *Zeolite'02. Guide for the Post-Conference Field Trip to the Zeolite Deposits of Thrace (N. E. Greece),* 24 p.

Marantos, I. 2004a. *Study of the Tertiary Volcanic Rocks Alteration in the Feres Basin of Evros Prefecture, Emphasizing on the Genesis of Zeolites and Their Possible Applications*. — PhD Thesis, Technical University of Crete, 264 p.

Marantos, I., V. Perdikatsis. 1994. Study of mineralogy, dehydration/rehydration, cation exchange capacity of zeolitic tuffs of Petrota-Pentalofos area (Orestias basin), Evros county, NE Greece. — In: *Proceedings of 7th Congress of the Geological Society of Greece, 30*/3, 311—321.

Marantos, I., G. Koshiaris, S. Karantassi, V. Perdikatsis, G. Christidis. 2004b. Preliminary study of altered tertiary volcaniclastic rocks in the area of Asproula, Nea Santa, Rodopi perfecture, Thrace, NE Greece. – *Bull. Geol. Soc. Greece, 36,* 454—463.

Polgari, M., I. Forizs, Z. Mathe, M. Toth, E. Pecsi-Donath. 1997. Geoautoclave-type zeolitization in the Miocene rhyolite tuff, Mecsek Mts, SW Hungary. — In: Kirov, G., L. Filizova, O. Petrov (Eds.). *Natutal Zeolites – Sofia'95*, 227—240.

Raynov N., N. Popov, Y. Yanev, P. Petrova, T. Popova, V. Hristova, R. Atanasova, R. Zankarska. 1997. Geological, mineralogical and technological characteristics of zeolitized (clinoptilolitizied) tuff deposits in the Eastern Rhodopes, Bulgaria. — In: Kirov, G., L. Filizova, O. Petrov (Eds.). *Natutal Zeolites – Sofia'95*, 263—275.

Sheridan, M. F. 1970. Fumarolic mounds and ridges of the Bishop tuffs, California. — *Geol. Soc. Amer. Bull., 81*, 851—868.

Smith, R. L. 1960a. Ash flows. – *Geol. Soc. Amer. Bull., 71*, 795—842.

Smith, R. L. 1960b. Zones and zonal variations in welded ash flows. – *U.S. Geol. Survey Prof. Paper, 354F*, 149—159.

Stamatakis, M., A. Hall, U. Lutat, J. N. Walsh. 1998. Mineralogy, origin and commercial value of the zeolite-rich tuffs in the Petrota – Pentalofos area, Evros county, Greece. – *Estudios Geol., 54*, 3—15.