

## Place, role and significance of the propylites in Bulgaria

*Ivan Velinov*

Independently of the wide development of the medium and low temperature hydrothermal alterations of the Upper Cretaceous and Tertiary volcanics in the Srednogorie and Rhodope zone, their terminological designation and use are too various. Typical cases in this respect are the propylites. Very often their classical determination given in 1868 by Rithoffen (Русинов, 1972) as hydrothermal alteration of andesites and dacites preceding the gold-silver ore mineralization is neglected. Especially for Bulgaria, a similar destiny have had the results obtained by Lewien (1933). For a long time they were insufficiently rationally used in our geological practice where terms "strong", "medium" and "weakly" altered volcanics are used frequently instead of the proposed by the same author three main types of propylitization — carbonate, chlorite and sulphide (pyritic) type. The evolution of the opinions of Strashimir Dimitrov (Димитров, 1961) about the sense of the term "propylitization" is quite interesting. In 1936 he considered the hydrothermal alterations of the Upper Cretaceous andesites in the Srednogorie zone as a result of a "deep autometamorphosis". He connected to this process also the origin of ore mineralization of native copper, some deposits of copper sulphides and manganese ores. In 1946 S. Dimitrov used the term "propylitization" and considered it as dominantly zeolitic, chloritic and pyritic. In 1955 he mentioned a "greenschist facies" metamorphism that had developed in submarine conditions.

In the beginning of the 60s specialized studies on the different types hydrothermal alterations of the volcanics in the Srednogorie and Eastern Rhodope zone had started with the purposeful support of Strashimir Dimitrov. The influence of Наковник (1954) who determined the propylites as products of hydrothermal alter-

ations chiefly of basic and medium acid rocks was very strong. He considered them as complexes comprising albite, adular, amphibole (uralite or actinolite), epidote, chlorite, rutile, carbonate, sericite, quartz and pyrite and asserted the idea for five mineralogical facies, characteristic with more or less equilibrium associations: amphibole-epidote, epidote-chlorite, chlorite-carbonate, sericite-carbonate and quartz-sericite. The assertion that every outside previous facies is earlier than every subsequent telescoping it inside facies is significant too.

The influence of the ideas by Коржинский (1955) is important too. According to him, propylitization is a greenschist alteration of volcanic rocks of different age. It is not connected to the single intrusions and is explained by the effect of fluids related to the fields of postvolcanic magmatic activity.

The later studies of the alterations of volcanics (including propylites) follow the same trend. Diaspore containing quartzites from the Eastern Rhodopes were described for the first time by Рашков (1962). Радонова (1962, 1969, 1970, 1973) submits several papers on the origin of the secondary quartzites from Panagurishte and Spahievo ore regions. Ушев et al. (1962) studied the propylitic type alterations, accompanying the copper-porphyry ores from Medet. A comparison between alterations of volcanics from the Central and Western Srednogorie zone is done for the first time and the idea about the uniform zone development of the facies, modelling the secondary quartzites and their periphery zones of propylitization, is introduced. A considerable contribution to the understanding of these processes, especially in mineralogical and petrological aspect have the works by Кунов (1986) etc.

The next stage, continuing nowadays, is based as on the new interpretation of the older data

connected to the essence of the processes: uralitization (Димитров, 1951), zeolitization (Kostov, 1969), pumpelyite-prehnite-epidote mineralization with native copper (Велинов, Пунев, 1972), as to those from theoretical and experimental modelling (Velinov, Kanazirski, 1990; Каназирски, Велинов, 1997).

The major conclusions related to the propylitization and the formation of the propylite type rocks concern the following:

1. Hydrothermal alterations of basic and mainly medium acid volcanic rocks formed in subaqueous conditions are relatively poor studied. In Srednogorie zone (the villages of Klisoura, Golyama Rakovitsa etc.) the hydrothermal alterations, connected to the formation of iron-manganese ores, must not be referred to the greenschist, propylite type according to their mineralogical composition. They occur in the periphery zones of acid leaching and associate mainly with low temperature quartz. Any connection between the secondary minerals (mountmorillonite, chlorite-mountmorillonite, seladonite, chlorite and analcim) determined by Банушев (1997) and a certain type ore mineralization is not established thus they are not referred to the propylites.

2. In respect to the particular examples in Bulgaria, the development of the theoretical concepts about the hydrothermal alterations of volcanics, high- and low sulphidation type epithermal mineralizations and those connected to the native copper (type "Michigan"), the following idea about the medium temperature propylites is launched. Middle temperature hydrothermal altered volcanic rocks have a local character and during their formation they overprint on the submarine — dominantly chlorite-mountmorillonite ( $\pm$  seladonite) formations. They are in emphatic connection to the tectonic ruptures and often coincide with the fracture-controlled type of zeolitization (Kostov, 1969). Principal minerals are chlorite, carbonate, quartz, pyrite ( $\pm$  epidote, actinolite, sericite and albite). The vein type zeolitization and adularization (for instance deposit Madzharovo) thrust on the propylitised volcanics. These propylites are characteristic with the typical kinetic mineralogical associations resulting in the undoubted cases of telescoping. They are connected mostly to the disseminated type pyrite and less polymetallic and copper-sulphide mineralizations.

An important feature of this type propylites in Bulgaria is a relatively weak development of albitization and the absence of emphasized metasomatic zonation.

3. The established epidote-uralite type contact and hydrothermal altered volcanic rocks mainly with medium composition are referred to high temperature propylites. This is made with certain conventionality due to the absence of characteristic ore concentrations in them. This approach contradicts ideas of Коржинский (1955) about their contact nature, but fully corresponds to those by Русинов (1989), who considers them as propylite formation. According to that author it shows similar features with some hornfelses and is represented by biotite, epidote-actinolite and  $\pm$  albite-chlorite facies. It is formed at depth of 1,5 km,  $P < 1$  KB and  $T < 720-740^\circ\text{C}$ . Sulphide-cassiterite ores are found in the biotite zones and gold ores — in epidote-chlorite zones.

In contrast to data by Русинов (1989) this type propylites in Bulgaria is characteristic with two important features: associated with uralite plagioclase is basic (An — 60-80%) and considered by Винклер (1969) as antagonistic minerals actinolite and prehnite occur together (Велинов, Пунев, 1972).

On the basis of data obtained after studies of the alterations accompanying the native copper in USA and those from the Srednogorie volcanic zone in Bulgaria, "Michigan type" propylitization is proposed. Typomorphic minerals for it are pumpelyite, prehnite and epidote. Not only the examples from the nature, but the considerations of Kostov (Костов, 1971) about unification of these minerals in a classification group, led to such proposal. The discussed by Каназирски, Велинов (1997) paragenetical relations between them are additional arguments for such interpretation.

Ore mineralization of "Michigan type" is characteristic by low sulfur and oxygen potential contrary to the other types propylites and propylitised volcanic rocks. As a result of that native copper, native silver and  $\pm$  native zinc are deposited.

4. After a theoretical modeling (Velinov, Kanazirski, 1990; Каназирски, 1996) the third type propylites (Наковник, 1964; Creasey, 1959; Радонова, Велинов, 1974; Ушев et al., 1962; Кунов, 1986, etc.) is considered as outside zones of secondary quartzites. Propylites around potassium-silicate and quartz-sericite metasomatites should be referred to this type. Corresponding to the secondary hydrothermal mineralization, they respond to the five propylite facies determined by Наконник (1954) for different geological conditions. They are characteristic with typical pseudomorphoses on the primary rock forming minerals and high pyrite

amount (up  $\approx$  10%). In many cases both with the secondary quartzites, they are indicators for prospecting and exploration of epithermal (gold-silver), copper and copper-molibdene porphyry ores.

Discussed propylites have not only mineralogical-petrographical but metallogenical importance. Their modern investigation facilitates the solution of problem about "tops" and "bottoms" (Sillitoe, 1973) of important hydrothermal deposits.

## References

- Creasey, S. 1959. — *Econ. Geology*, 54, 3; 351-373.
- Kostov, I. 1969. — *N. Jb. Miner. Abh.*, 111, 3; 264-278.
- Lewien, E. 1933. — *Untersuchung der Enargit-Kupferkieslagerstätte bei Bôta-Panagjurische und Beitrag zur Petrographic der Sredna-Gora in Bulgarien. Dissertation*, Aachen; 36 p.
- Sillitoe, R. H. 1973. — *Econ. Geology*, 68, 1; 799-815.
- Velinov, I., Kanazirski, M. 1990. — *Geologica Balc.*, 20, 3; 59-71.
- Банушев, Б. 1997. — Автореферат на дисертация за получаване на научната степен „доктор“. С.; 54 с.
- Велинов, И., Пунев, Л. 1972. — *Изв. Геол. инст., сер. геохим., минерал. и петрогр.*, 21; 91-109.
- Ванклер, Г. 1969. — *Генезис метаморфических пород*. М., Мир; 248 с.
- Димитров, Стр. 1951. — *Изв. Геол., Геогр. и Хим. инст.*, 1; 63-82.
- Димитров, Стр. 1961. — *Научни трудове*. С., БАН, 1, 2; 379 с., 376 с.
- Каназирски, М. 1996. — Автореферат на дисертация за получаване на научната степен „доктор на геологическите науки“. С.; 79 с.
- Каназирски, М., Велинов, И. 1997. — *Геохим., минерал. и петрол.*, 32; 35-45.
- Коржинский, Д. С. 1955. — В: *Основные проблемы в учении о магматогенных рудных месторождениях*, М., АН СССР; 335-456.
- Костов, И. 1971. — *Минералогия*. М., Мир; 584 с.
- Кунов, А. 1986. — Автореферат на дисертация за получаване на научната степен „кандидат на геолого-минералогическите науки“. С.; 36 с.
- Наковник, Н. И. 1954. — *Зап. ВМО*, LXXXIII, 2; 85-94.
- Наковник, Н. И. 1964. — *Вторичные кварциты СССР и связанные с ними месторождения полезных ископаемых*. М., Недра; 339 с.
- Радонова, Т. 1962. — *Труд. геол. Бълг., сер. геох. и пол. изкоп.*, 3; 93-128.
- Радонова, Т. 1969. — *Геол. рудн. месторожд.*, 11, 2; 53-63.
- Радонова, Т. 1970. — *Изв. Геол. инст., сер. геохим., минерал. и петрогр.*, 19; 179-187.
- Радонова, Т. 1973. — *Изв. Геол. инст., сер. геохим., минерал. и петрогр.*, 22; 141-161.
- Радонова, Т., Велинов, И. 1974. — В: *Метасоматизм и рудообразование*. М., Недра; 60-69.
- Рашков, Р. 1962. — *Сп. Бълг. геол. д-во*, 23, 3; 263-274.
- Русинов, В. Л. 1972. — *Геологические и физикохимические закономерности пропилитизации*. М., Наука; 204 с.
- Русинов, В. Л. 1989. — *Метасоматические процессы в вулканических толщах*. М., Наука; 214 с.
- Ушев, А., Маринова-Чипчакова, С., Ангелков, К. 1962. — *Прин. геол. Бълг.*, 1; 67-147.