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ORIGIN OF SOME MINERALS FROM THE CRYISTALLINE BASEMENT OF SZEGHALOM, EAST HUNGARY

T. M. TÓTH

Department of Mineralogy, Geochemistry and Petrology, József Attila University*

ABSTRACT

There are some minerals having unknown origin in the joints of the cryistalline basement at Szeghalom. The origin of them may have been attached either to a postvolcanic effect or a very low grade metamorphism. Based on mineralogical and geochemical investigations as well as tectonic considerations the priority of Laramian progressive metamorphism is proved.

INTRODUCTION

Hydrocarbon reservoirs, belonging to the Szeghalom Unit of crystalline basement of the Great Hungarian Plain have become very important for a few years in Hungary. These metamorphic rocks are strongly fractured and covered by undisturbed Neogene basin sediments. They consist mostly of gneisses, amphibolites and mica-schists. A fairly large part of the joints are filled by some unknown origin minerals, like zeolites, calcite and pyrite. The development of these minerals can be attributed to a very low grade metamorphism, perhaps some kind of postvolcanic effect, or sedimentary (diagenetic) events. It would be very important to know the real conditions of their origin, because these processes could involve certain changes in the permeability, porosity and other rock-physical features. The aim of this paper is to solve these problems, and giving an accaptable age of origination. The examined rock samples were collected from 9 boreholes (*Fig. 1*). In addition the description of 3 further borholes were utilized.

A REVIEW OF THE CRYSTALLINE BASEMENT AT SZEGHALOM

Szeghalom Unit can be found in the area of so called Biharian Autochton, at the northern border of the Hungarian part of Codru Nappe system. The rocks of the unit had suffered polymetamorphic effects. The first important event was a Barrow type, medium grade metamorphism (about 320—330 My ago) (SZEDERKÉNYI 1984). The main rock types related this effect are amphibolite, amphibole gneiss, biotite gneiss and biotite mica schist. Gneisses and mica schists have a sedimentary origin, like everywhere in Tisza Unit.

* H—6701 Szeged, P.O.Box. 651, Hungary

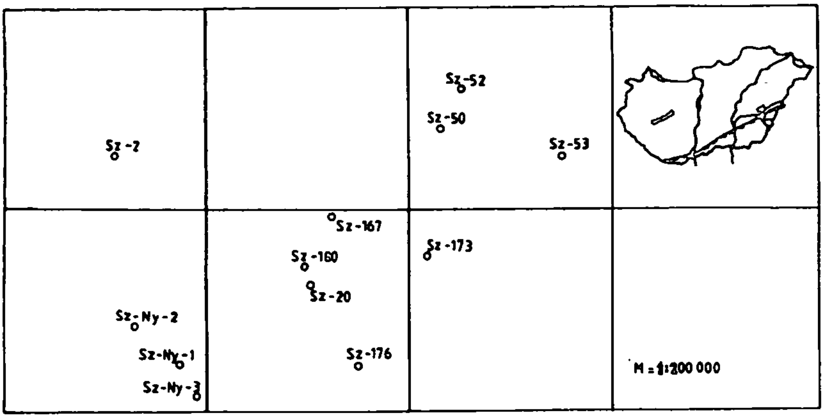

Fig. 1. The map of examined boreholes

During and after Variscan orogenesis a cosiderable portion of metamorphites was eroded, due to the fast uplifting. This elevation was attached of course to retrograde effects.

The third metamorphic event in the unit took place during the Alpine orogenesis; first of all in its Laramian phase. The maximum grade of this metamorphism can be characterized by greenschist facies, without any conspicuous alteration of the medium grade older metamorphic rocks.

After the Upper Cretaceous epoch this area was covered by the sea. The period of the transgression is not known exactly, but based on palinological data it can be ranged between Upper Cretaceous and Lower Miocene.

Several other important features of the rocks originated from the examinated boreholes are also observed, as followes:

— The main rock types are gneiss and mica schist with few intercalated amphibolites.

— The directions of the joints are about vertical, without any movement along them. The most of them are filled by intact minerals (without renewal). That is why the joint system is regarded to be a result of a single tectonic event.

— The joints don't continue in the overlying Paleogene and younger clastic basin sediment cover, at all. So, the tectonic effect must have followed by the erosion, which may have ranged between Upper Cretaceous and Lower Miocene.

— The joints are filled up with different minerals showing possibility of a hydrothermal origin. The recognized paragenesis is chlorite, illite, two habits of calcite, laumontite, pyrite and quartz.

MINERALOGICAL STUDY OF THE VEINLETS

I could not find any unexpected minerals neither with X-ray diffraction nor with infrared spectroscopy. However the listed minerals can offer several kind of suggestions about the origin.

The succession of minerals seems to be fix. The most important one from the wall-rock of the joint is illite —calcite — laumontite — pyrite. Some component from the succession may sometimes be missing. E.g. illite may has been replaced by chlorite. One can seldom find pyrite — laumontite — pyrite and quartz —

calcite — quartz paragenesis, too. But the first one seems to be widespread, thus the origin of the minerals must have attributed to the same effect.

All zeolites examined by X-ray diffraction or infrared spectroscopy turned out to be laumontite. (*Fig. 2.* and *3*). So the mineralization must have been attached to a postvolcanic effect or a very low grade metamorphism, because other environments where zeolites can be found, have been ruled out by paleogeogprahic setting, or there doesn't originate any laumontite. (MUMPTON 1981). The stability area of laumontite shows, that the real temperature of mineralization must have been between 150 and 280 °C. (*Fig. 4.* COOMBS 1959).

Fig. 2. IR spectra of laumontite

Pyrites, having a hydrothermal origin always contain characteristic trace elements, like Ni, Cu, Co, Zn, Au, Ag, Pb and As. Measuring of the abundance of these elements in the pyrites can be found in Szeghalom, it showed the absence or very low level of them, suggesting a not magmatic origin. Trace elements in the grey calcites are represented by Fe and Mn only, which have not any indicator roles.

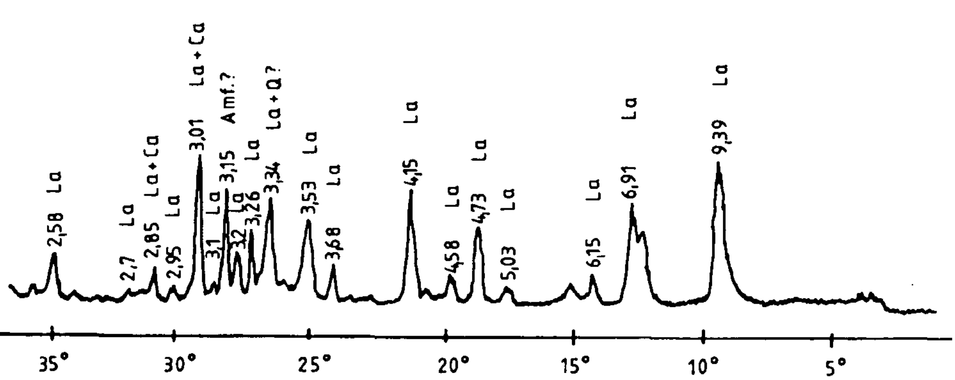

Fig. 3. X-ray spectra of laumontite
La — laumontite; Ca — calcite; Q — quartz; Amf — amphibole

Using crystallographic characters of the calcite and quartz it was tried to specify their forming temperature. There have been two types of calcite in the

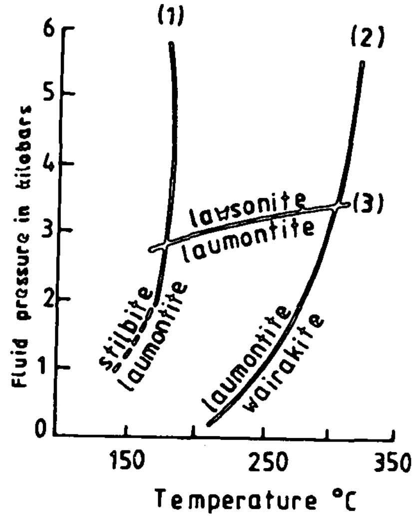

Fig. 4. The stability area of laumontite (after COOMBS 1959)

paragenesis: a romboeder habit and a lamellar one. Together with the characteristic shape of the quartz crystalls they suggest that the temperature of the origin may have been located into the upper levels of the hydrothermal interval, i.e. 200—280 °C.

THE POSSIBLE TERM OF THE ORIGIN

As one could see before, the origination of the joint system must have preceded the mineralization. It may have been linked either with nappe movements, had taken place during the Upper Cretaceous, or with the Neogene pull-apart movements.

There are some boreholes in the so called "Bihar Autochtonous Group" where Jurassic and Cretaceous sediments lie under the crystalline rocks, e.g. Endrőd-7, Füzesgyarmat-7, and -9 boreholes about 10 kilometres far from the Szeghalom Unit. These patterns suggest, that the "autochton" was in motion, and it took part in the Alpine nappe movements. So this phase must have had an effect on the metamorphic rocks of the Szeghalom Unit.

The main tectonic character of the Pannonian basin is determined by strike-slipe type faults during the Miocene. But the joint system of the basement at Szeghalom couldn't be followed in the neogene sediments. So, the tectonic effect, produced the fissures preceded the Miocene, sometimes Pre-Lower Miocene sedimentation, like other parts of the Hungarian Plain (HORVÁTH *et al.* 1988). So, the most possible age of the joint system may be Upper Cretaceous in relation to the Laramian phase of Alpine orogenesis.

CONCLUSION

The joint system of the metamorphic rocks at Szeghalom is filled up by minerals related to an exact paragenesis, which consists usually of illite, calcite, laumontite and pyrite. The precipitation of the minerals can be attached to a single phase after origination of the joint system, the temperature of it may have been located between 200 and 280 °C. Based on abundance of trace elements all magmatic effect may be ruled out with no doubt. The acceptable age of origination is probably the Laramian phase of Alpine orogenesis. So the proper reason of mineralization was the very low grade metamorphism and fracturing followed by a hydrothermal front related to the Laramian phase.

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