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METASOMATIC-HYDROTHERMAL PROCESSES ALONG THE CONTACT ZONE OF LOWER CRETACEOUS MAGMATIC SILLS INTRUDED INTO LOWER JURASSIC COAL BEDS AT PÉCS-VASAS, MECSEK MTS., HUNGARY

JÁGER, V.
Department of Mineralogy, Herman Ottó Museum, Kossuth u. 13, H-3525 Miskolc, Hungary
E-mail: jagerviktor@yahoo.co.uk

In the Mecsek Mts. Lower Cretaceous magmatic rock of ankaramite-alkali basalt series intruded in Lower Jurassic paralic coal seams. The coking effects and the fissure networks produced by these magmatics in the coal deposits and their influence on hydrocarbon migration and methane explosions in the coal mines has already been discussed in several papers, but the hydrothermal events caused by these magmatic sills have been barely mentioned yet.

The magmatic sills generally intruded into the coal beds, on the whole concordantly with the coal seams.

A few of the magmatic sills reach 6-7 meter in thickness. The sills bear conspicuous macroscopic features, *i.e.* a network of cooling cracks parallel to the contacts with the coal beds; another network of shorter cracks, perpendicularly to the previous crack system; and directly along the contact a coke zone (up to 1.5 m in thickness) dissected by hexagonal, columnar joints. The change of colour of the sill from dark green through paler tints to whitish and the decrease of size and quantity of the phenocrysts from the centre of the sill towards the contacts are also obvious. The magmatic sills frequently contain cavities within 30-cm distance from the contact; they are often flattened according to the flow direction. Some cavities reach 4-5 cm in diameter. They may contain pyrite, siderite, calcite, quartz, barite and dickite. The largest quartz crystals in the cavities reach 2.5 cm. The crack network of the sills is filled with minerals. These veinlets consist of calcite, quartz, chalcedony, barite, pyrite, and rarely sphalerite crystals up to a few mm in size.

Free-standing calcite, quartz and barite crystals in the veins may reach about 1 cm. It is conspicuous, that the quartz veinlets occur in the sill only within 0.7–1.5-m distance from the contact, depending on the thickness of the sill (within 0.7 m for a 4-meter thick sill and within 1.5 m for a 6.5-meter thick one). In some sills brecciated claystone and coal xenoliths have been observed; in their surroundings there are calcite veins containing euhedral quartz crystals of 1-2 cm length. It is to be noted that on some places euhedral quartz or smoky quartz crystals of about 1-cm length can be found in the fissures of the country rocks (siltstone and sandstone) within 1-2 m distance from the contact.

The origin of hydrothermal minerals found in a 4-meter wide sill that intruded in a coal bed was studied using optical microscopy and SEM-EDS. In the sample, collected from the interior of the sill ***1.7 m from the lower contact***, there are euhedral, 1-2 mm long, sector zoned pyroxene showing violet pleochroism, with a Ti content increasing towards the edges. This pyroxene is rich in Ca and Fe, in some crystals the amount of Cr is also considerable. Moreover, chromian spinel inclusions up to 5 μm are common. Ni-Co-(Fe) sulfide inclusions of a few μm in size have also been found. Ilmenite and rutil inclusions (50–80 μm) are also common. In many cases pyroxene has been calcitized and argillized along the cracks. Fresh kaersutite phenocrysts also occur. Plagioclase shows a labradorite–bytownite composition. The amount of analcime in the rock is considerable. Opaque minerals are ilmenite, titanomagnetite, and pyrite. Some pyrite grains contain galena, barite and Fe-rich sphalerite inclusions up to a few μm. The texture of the rock is microholocrystalline.

1.3 m from the contact only small parts of pyroxene are fresh; it is mainly altered to calcite, clay minerals and iron oxides. Calcite occurs in the matrix, analcime has not been observed. In the rock calcite veins are getting more and more frequent.

90 cm from the contact pyroxene is totally altered to calcite, opal, lussatite, chalcedony, quartz, clay minerals and partly iron oxides. The outline of the pyroxene was preserved, forming a pseudomorphous texture. Calcite and quartz varieties formed due to the alteration of pyroxene fill in crevices and coalescent cavities. Veinlets consisting of rhombohedral, free-grown calcite, chalcedony, free-grown quartz and barite are remarkable. The plagioclase is calcitized more strongly than in the middle of the vein.

50 cm from the contact pyroxene is totally altered to calcite.

At about ***30 cm from the contact*** even the remains of altered phenocrystals are barely visible. The rock consists of calcite, clay minerals, quartz, iron oxides and pyrite. Its texture is microcrystalline, due to the faster cooling. At 30 cm from the contact the mineral-filled cavities are getting more and more frequently. Pyritization is also intensive.

Directly at the contact the magmatic rock is altered to clay minerals and iron oxide. In calcite veinlets found in the aleurolite 2-m from the lower contact of the magmatic sill there are euhedral quartz crystals, 0.5 cm in length.

A rough scenario of mineral formation can be summarised as follows. The intrusion of the magmatic sills suddenly elevated the pressure of aqueous vapour in the country rock. Released volatiles penetrated into the magma (having originally a lower vapour pressure) and formed first gas bubbles, which later dissolved. Volatiles reacted with the minerals crystallizing from the magma. At about 90 cm from the contact silica was released from the altered pyroxene and precipitated as quartz in cavities and veinlets in the sill. CO_2 derived from the coal beds reacted with Ca released from the altered pyroxene and plagioclase to form calcite. In the middle of the sill barite and sphalerite are found as microscopic inclusions in pyrite, but in the veinlets near to the contact they already reach some mm (sphalerite) or 1 cm in size (barite). This fact suggests Ba and Zn mobilization and migration from the country rock into the sill driven by the hydrothermal processes.