Genesis of the exhalative iron ore occurrence of the Darnó Hill (NE Hungary)

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The Darnó Unit (in northeastern Hungary) is the uppermost nappe of the Bükk Unit, which has a rather complex geological structure in the Pannonian Basin. It fundamentally consist of Paleozoic, Triassic and Jurassic igneous and sedimentary blocks, related to different evolutionary stages (i.e. advanced rifting and back-arc-basin opening) of the Neotethys, which are found in an accretionary mélange complex (Kiss *et al.*, 2010 and references therein). The studied iron ore occurrence is found in one of the Triassic sedimentary blocks of this unit. It was described and last time intensively studied by Kiss (1958). By that time, there were many unclear questions about the geology of the area, which resulted in the uncertainty about the genesis of the mineralization. In the last decade, intensive research resulted in the above mentioned widely accepted model for the geology of the Darnó Hill area (Kovács *et al*., 2010 and references therein). That is why the re-examination of the indication can provide important new information and also answer some unclear questions.

The studied samples were collected at the northern part of the Darnó Hill, and they are mainly composed of quartz and hematite. In the studied locality, hematite containing siliceous sedimentary rocks and coarser grained quartz and hematite containing rocks of most likely hydrothermal origin were also found. The former type is assumed to be the host rock of the mineralization. In the latter type, the hematite may form crystals up to 100 µm in size, and appears sometimes as thin plates, the habit of which suggests crystallization from warm hydrothermal solutions. However, at some places, the hematite can be found as fine-grained crystals, too, which may refer to lower formation temperatures. The syngenetic quartz is mainly massive, but in small cavities (0.5-1cm) sometimes idiomorphic crystals of 0.5 mm in length also occur. Polarization microscopic study revealed the presence of prehnite, while the EPMA study proved the occurrence of minor amounts of manganese-oxide, barite and apatite, together with the above mentioned minerals. The EPMA analyses have shown, that the hematite is rather rich in trace elements; it contains 3.5-4.5 w% Al_2O_3, ~0.1 w% TiO_2, V_2O_3, MgO, 0.05 w% MnO and 0.01 w% ZnO, too. Based on the textural features, the paragenetic order can be established, so first the hematite crystallised, followed by the prehnite, while quartz was continuously present in the system.

Bulk chemical analyses have shown some characteristic features, e.g. Fe>>Mn, or the typically low Ni-Co-Cu-Cr content. These characteristics are typical, when iron ore is the result of not exclusively sedimentary processes (Bonatti *et al.*, 1972; Bonström *et al.*, 1979), thus supports the submarine hydrothermal origin.

The quartz, which is cogenetic with the supposedly hydrothermal hematite, contains rarely small primary (5-10µm), two-phased (liquid and vapour) fluid inclusions with 5 to 10% vapour content. The minimum formation temperatures (i.e. the homogenisation temperatures) show a wide dispersion (70 to 155°C), which can be explained by the rapid cooling of the hydrothermal system. Furthermore the measured salinities (~4 NaCl equiv. wt%) suggest that the fluid was slightly enriched in salts as compared to sea water.

Based on these data, a sedimentary exhalative (SEDEX) origin is supposed for the studied indication. It can be classified to the magmatic origin type, volcanics- to sediment-hosted iron deposit subtype according to the taxonomy of Dill (2010). However, it fits well to the geological model of the Darnó Unit, as SEDEX deposits may typically form in the (advanced) rifting stage.

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