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# An enigmatic source of hematitic carbonate beds containing vast amounts of iron oxidizers in a paleozoic metamorphic complex, South Hungary, Geresd-Hills, Ófalu.

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Near the village of Ófalu, in the Geresd Hills, South Hungary, within the „Mecsekalja tectonic belt", low and intermediate grade paleozoic metamorphic complex (phyllite, gneiss) contains vein-like hematitic carbonate beds, up to 30 cm in thickness. The carbonate mineral is calcite. These hematitic carbonate beds cross-cut the foliation of the phyllite, and show no signs of any metamorphic alteration. In the studied section the red carbonate beds are associated with a vein system filled with multiple generations of vein carbonates(Dabi et al., 2011). The red carbonate beds contain a vaste number of twisted stalks of the iron oxidizing taxon of Gallionella. Rarely in some siliceous parts, Leptothrix-like microbial fossils can be found and these beds also contain numerous unidentifiable, hematitic foraminifers. According to ICP-AES measurements, the hematitic carbonate beds contains 8 % Fe, 0.86 % Mn and 0.12 % Ba. XRD and Raman measurements proved that the iron phase is hematite. The SEM observations revealed that the bacterial microfossils and foraminifers are built up of micron-submicron sized pseudohexagonal platy hematite. The bacterial microfossils of the Gallionella iron oxidizer are very well preserved and reaches about 80 $\mu$m length and about 2-3 $\mu$m width.

The above observations raise the following issues: 1. how did these non metamorphic hematitic-carbonatic beds get inside into the metamorphic complex?, 2. what is the age of the formation of these beds?, and 3. what was the source of the iron? If we consider that the hematitic beds contain foraminifers and iron oxidizing bacteria, and no signs of metamorphic alteration nor foliations can be observed in these beds, the only answer for the first question is that the formations are fractures filled with lime-mud, i.e. neptunian dykes, which penetrated into the cracks of the phyllite. The presence of foraminifers and the geotectonic situation of the unit imply marine origin. Considering that these beds are neptunian dykes, their age must be younger than the paleozoic metamorphic event. They must be older than the Early Cretaceous dyke emplacement in the region, based on cross-cutting relation with limonite stained calcite veins, related to the volcanic activity (Dabi et al., 2011)

In this region (Tisza-megaunit) continental rift-related alkali basaltic submarine volcanism was widespread during the Early Cretaceous epoch, when hypabyssal basaltic bodies (intrusive pillow basalts) intruded into unconsolidated sediments. Along these magmatic bodies low temperature hydrothermal circulation of seawater hydrolyzed basaltic glass and mafic minerals, and huge amount of Fe(II) was released and got into the lime mud that was saturated with anaerobic water, where iron oxidizing microorganisms thrived (Jáger et al., 2012).We propose a very similar paleoenvironmental model for Ófalu occurence, where low temperature, reductive iron-rich hydrothermal fluids penetrated soft sediments and contributed to the flourishing of iron-oxidizers. Due to subsequent tectonic events, these iron-rich sediments got into the fissures of the Ófalu metamorphic complex. This model is strenghtened by some borehole and outcrops where the Lower Cretaceous interpillow sediments and hyaloclastites rich in iron oxydes and intrusive pillow basalt can be found close to our investigated section. (Hetényi et al., 1976)

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