

Appearance of smectite and its relation to the Úrkút manganese deposit, Bakony Mountains, Transdanubian Range, Hungary

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The Úrkút manganese deposit, including also the mineralization in the Eplény area, is one of the largest manganese ore accumulations, which relates to the Toarcian Oceanic Anoxic Event (T-OAE). After nearly 100 years of mining, the remaining ore is more than 50 Mt. The deposit has been the focus of scientific investigations since the 1950s, and therefore a lot of information is available. However our knowledge is far from complete; for example, the source of the manganese, the ore-forming processes (volcanic/hydrothermal/hydrogenetic), or the proto-ore formation are not clarified. To be able to identify the local environmental factors that caused the Mn-ore accumulation in Úrkút, not only at the deposit but also at other locations in the Transdanubian Range, must be studied comparatively.

We investigated the boundary between the ore containing strata and the footwall, and the underlying beds in Úrkút and also in different outcrops within the same stratigraphic position in the Transdanubian Range (Lókút Bakony Mts., Tölgyhát-Quarry Gerecse Mts.) that relate to the T-OAE as well. The study of the orebody's footwall is essential, because there are some unique geological features (smectite appearance and local Si enrichment), which appear only below the Úrkút deposit in the whole Transdanubian Range. The aim of this study was to recognize the local geological factors, which allowed the ore accumulation at Úrkút, but it did not effect other parts of the Transdanubian Range. During our research, SEM-EDX/WDX, XRF, XRD, and oriented clay mineral XRD study techniques were used. We investigated seven boreholes, which cover most parts of the Úrkút deposit. The focus of this current study was on the footwall, to identify where and from which point the smectite generating processes took place.

Our results show that the unique clay mineral content (smectite), which has been shown to be characteristic of the ore deposit, also is a characteristic feature in the entire footwall directly below the deposit. Smectite was found in every sample of the footwall. The deepest smectite appearance was at 14 m (Borehole U-178) below the T-OAE, which was our stratigraphically lowest sample. The evidence indicates that the unique geological features below the orebody (smectite and Si enrichment) and the same clay mineral content within the deposit could have been created by the same local processes. Our geochemical results show that in the whole Transdanubian Range, the eH sensitive elements (Mn, Co, Ni, Cr,) are enriched in the Toarcian strata, but only at Úrkút could the manganese have accumulated in an economically important amount. This shows that there should be an important local enrichment factor.

Based on our observations, the most probable genetic model for the Mn ore formation is alteration of fresh oceanic crust to provide a source of manganese and related elements. They were transported by anoxic bottom waters, where precipitation and deposition happened when these waters were mixed with oxic waters due to an upwelling.