

Mineralogical and textural study of manganese oxides and oxi-hydroxides in the Úrkút manganese ore deposit, Hungary

Máté Zs. Leskó, Boglárka A. Topa

Eötvös Loránd University, Budapest, Hungary (lmate89@gmail.com)

During the Toarcian anoxic event manganese rich strata were deposited Europe-wide. One of the largest known manganese accumulations of this horizon is the Úrkút deposit (Bakony Mountains, Transdanubian Range (TR), Hungary). The formation of the TR was part of the evolution of the Mesozoic Tethys Ocean system. In the Triassic extensive carbonate platforms were formed (Dachstein Limestone Formation). In the Jurassic, the carbonate platforms were dissected by extensional tectonics and they became drowned. The limited extension of the intraplatform basins thus formed resulted in a strong lateral variation of Jurassic sedimentation in the TR (Galácz & Vörös, 1972). Accordingly, the Úrkút Manganese Ore Formation, with its 40 meter maximum thickness, is only of a few kms lateral extension. There are two types of ore in the Úrkút manganese deposit: carbonatic and oxidic. The geological section we studied in the mine represents a transition between these types: the several meters thick, well bedded, predominantly carbonate ore alternates with oxidic layers. The current research was focussed on the lowermost manganese-oxide-rich layers, not studied in detail so far. These layers, occurring immediately above the footwall of the section, show massive, macroscopically unlayered texture. The formation of these black ("oxidic") layers has been assumed to be the result of the postdiagenetic pyrite oxidation related remobilization of the manganese. However, details of that process have never been revealed, neither mineralogically, nor geochemically.

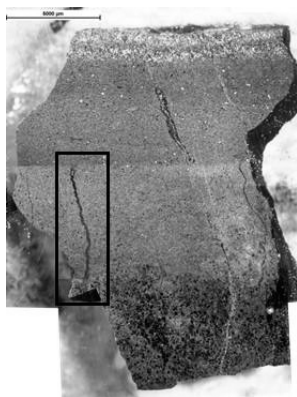


Fig. 1.: Oxidic manganese layer (oriented), consisting four different, mm-sized sublayers. The position of the veinlet shown in Fig. 2 is marked. Scale bar: 5 mm. Stereomicrograph.

Our aim was to map, down to the micrometer size range, the texture-related mineralogical features of these macroscopically homogeneous layers, in order to find potential traces of the prediagenetic, diagenetic and postdiagenetic processes at the boundary of the limestone footwall and the ore body. In our study we combined stereo and polarized reflected light microscopy, X-ray powder diffraction (XRD), scanning electron microscopy (SEM), X-ray microanalysis (SEM-EDX) and Raman-spectroscopy. It is the first time that oxidic manganese mineral phases, known before from bulk phase analyses only, can be connected to particular

microtextural features. From among the four mineral phases identified, cryptomelane and manganite dominate, while hollandite and a fourth phase, not identified till now, are present in subordinate amounts. Cryptomelane is fine-grained ($\leq 1 \mu\text{m}$). Texturally it is present either as cavity filling matrix or as round-shaped aggregates/pellets?, up to 100–200 μm in diameter, mostly around detrital mica crystals. As to manganite two different euhedral crystal generations could be distinguished. Few μm thin, 40–60 μm wide platy manganite crystals form loose masses in separate sublayers (e.g. the uppermost sublayer in Fig. 1), or they are present as co-precipitates with cryptomelane in veinlets, syngenetic with the manganese oxide sublayer formation (Fig. 2). The other manganite generation, stubby crystals of around 50 μm , fills post-sublayer-formation veins (e.g. the large vein crossing all sublayers in Fig. 1). Former works regarded manganite as "secondary, postgenetic" phase in the system. That matches our stubby crystal veins, but the textural position of the platy crystals needs additional explanation.

It is worth mentioning, that the two minerals (manganite and cryptomelane) represent not only two distinct species, but also two different oxidation states of manganese (Mn^{4+} , Mn^{3+}), suggesting that geochemical parameters might have changed during the formation of these manganese oxides at the bottom of the profile.

Pseudomorphic replacement of carbonate bioclasts by different oxidic manganese minerals was also observed (e.g. in the lowermost sublayer in Fig. 1). That process, being fabric-selective (preserving even the finest, μm -sized textural details of the fossils), must have been slow, probably not an aggressive dissolution-re-precipitation type one.

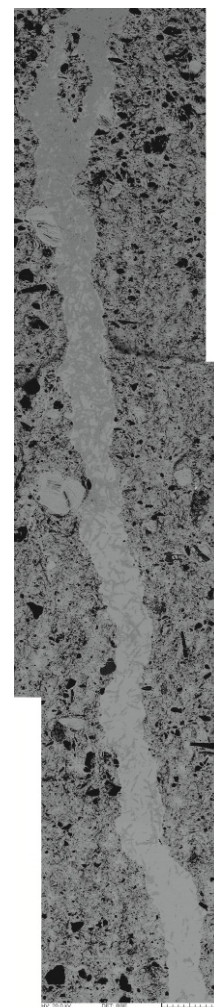
Detailed analysis of the texture and mineral composition of the oxidic sublayers, the replacement processes and the different veinlet generations show, that the formation of these massive bottom manganese oxide layers at the bottom of the deposit of Úrkút requires a more complex interpretation than it was suggested earlier.

Fig. 2. Details of the veinlet marked in Fig. 1.

From bottom up: pure massive cryptomelane (brighter matrix) changes gradually to manganite (darker laths and at the top – pure darker matrix).

The veinlet does not cross the sublayer border.

BSE image.



Galácz, A., Vörös, A. (1972): *Föld Közl.*, 102: 122–135.