New geochemical data, further supporting hydrothermal contribution to the formation of the Úrkút Mn-ore, Hungary

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At the mining area near Úrkút mineral exploitation has been going on from 1925, although production is continuously declining in the last decades because of the diminishing market demand.

The Úrkút deposit is located in the Bakony Mountains, in the Transdanubian Central Range zone. The geologic framework of the deposit is determined by the surrounding Triassic platform carbonates. Both the formation environment, the size and the depth of the deposit is controlled by fault systems in these carbonates. Plastic deformation also played a significant role in the structural evolution of the mountains. In the middle Jurassic rifting of the carbonate platform resulted in uneven bottom topography that limited the oceanic circulation and led to the development of anoxic conditions. The accumulation of manganese is strongly connected to this Toarcian Oceanic Anoxic Event. The fluctuation of the redox boundary was a necessary factor in the precipitation of manganese minerals. According to $\delta^{13}C$ isotope values, Mn-carbonate ore was formed from a precursor Mn-oxide ore during diagenesis (Polgári *et al.*, 1991).

This deposit is a black shale-hosted Mn-carbonate ore. Its areal extension is ca. 10 km^2. The thickness of the whole black shale sequence is about 40 m which hosts the maximum 10-12 m thick Main Ore Bed and the thin Ore Bed II.

The ore itself comprises alternating clay marl - carbonate marl laminae. It consists of micritic carbonates (mainly rodochrosite), clay minerals (celadonite), goethite and small amounts of quartz and apatite.

The underground mine at Úrkút is one of our important prospects in the ongoing Critical Elements project at the University of Miskolc, Hungary. In this study we provide new data on the elemental composition of the Úrkút carbonatic manganese ore and the associated formations.

Up to date, we have received the chemical data of 59 samples. 31 samples are Mn-carbonate ore, 10 of them are black shale, 8 of them are manganese clay, 4 of them are underlying limestone, 3 of them are Eplény Limestone, 2 of them are Cservár Flintstone and one sample is an oxidic manganese nodule.

The data of the Mn-carbonate ores show that the different colour-types of these ores have different chemical and mineralogical composition.

The total rare earth elements (REE) concentration is on the average 1.4 times the Clark value (ΣREE: 266 ppm). The Post Archaean Australian Shale (PAAS, thought to represent upper continental average concentration) normalized REE-diagram (Fig. 1.) shows that all Mn-carbonate ore samples show positive Ce-anomaly. This anomaly is probably due to the anoxic conditions prevailing during sedimentation and diagenesis. We found 3 brown banded Mn-carbonate ore samples that have strong positive Eu-anomaly. This, together with the high Ba-concentration may refer to more intensive hydrothermal contribution in this type.

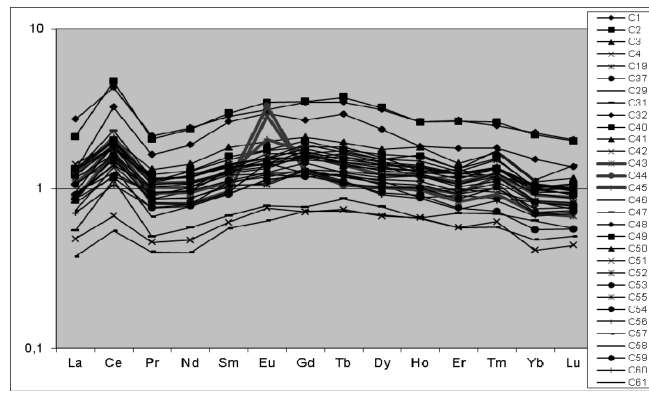

Figure 1. The PAAS normalized diagram of the Mn-carbonate ores

Co is present in relatively high concentrations. According to SEM investigations (Polgári *et al.*, 2000) Co appears in small sulfide mineral grains (cattierite, Co-Ni- and Co-Ni-Fe-sulfides). Its concentration is between 71 and 2601 ppm, averaging 330 ppm that equals 28 times the clark value (if we do not count with the outstanding 2601 ppm value, the deviation is 175 ppm). The highest concentration of Co is found in the reddish brown ore.

Our final goal is to give additional value to the existing manganese ore with the help of gaining knowledge from the rare elements in it. With an appropriate hydrometallurgic method we can extract REEs and Co as a byproduct from Mn-carbonate ores.

Polgári, M., Okita, P.M., Hein, J.R. (1991): J Sedim Petrol, 61/3: 384-393.

Polgári, M., Szabó, Z., Szederkényi, T. (2000): Manganese ores in Hungary (in Hungarian with English summary). Regional Comm Hung Acad Sci, Szeged, 652 p.

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