SPHALERITE INDICATIONS IN THE AGGTELEK MTS

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Abstract
The results of the base metal exploration at Rudabánya indicate a stratiform zinc-lead mineralization in the Lower Triassic siliciclastic rocks. This observation induced the assumption of a mineralized horizon in the Silicikum stratigraphic unit beyond the area of the Rudabánya complex, polymetallic deposit. The resampling of stored drill cores from the mapping boreholes of the Aggtelek Mts revealed sulphide enrichments and the presence of sphalerite along the Jósva Valley.

1. Introduction
The Rotaqua Kft. runs an exploration at the abandoned open-cast and underground iron ore mine of Rudabánya since 2006 in cooperation with the Institute of Mineralogy and Geology of the University of Miskolc. The licence refers to base metals, iron ore and precious metals. The siderite deposit and its gossan cap are well known to contain variable copper minerals [1]. The 10–100 m scale siderite blocks are embedded in calcareous siltstone (‘clay marl’), and the rims of these blocks are mineralized with barite and considerable amount of base metal sulfides [2]. The exploration aimed these bodies originally, but the ongoing evaluation of gained structural, lithological and geochemical observations during the mapping, sampling and assaying program revealed a stratiform mineralization of sphalerite and galena bound to the siliciclastic country rock of the carbonate blocks [3].

This stratiform mineralization, overprinted by all later mineralization and deformation events, may have formed as a sedimentary exhalative deposit in a restricted basin during the Early Triassic period, independent from the subsequent metasomatic sideritization. Therefore there is a possibility that this paragenesis can also be found on other localities of the same stratigraphic horizon of the Silicikum Unit containing the Rudabánya Ore Bearing Complex.

The drill cores of several mapping drillholes from the Aggtelek area are stored at the Rákócziibánya core deposit of the Hungarian Geological Institute. As these were not drilled for ore exploration, there was no assay of base metals, and no record of observed sphalerite or galena. The aim of our study was to search for mineralized intervals in drillholes transecting the Lower Triassic part of the Silicikum.

2. Geological setting
The name Silicikum refers to an alpine Triassic succession distributed in the Aggtelek-Rudabánya Mts in Hungary and in adjacent mountainous areas in Slovakia [4]. It starts with Permian evaporite (anhydrite and black shale, Perkupa Evaporite F). The Lower Triassic comprises a transgressive succession of littoral sandstone and siltstone (Bódvaszilas
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Sandstone F), shallow water marl (Szin Marl F.) and laminar or nodular limestone (Szinpetri Limestone F). The Anisian rocks are dark, euxinic facies, thick-bedded or massive limestone and dolomite (Gutenstein F) followed by light gray, platform facies limestone and dolomite (Steinalm F). In the further Middle and Upper Triassic part of the succession carbonate platforms and reefs (Wetterstein and Dachstein F) of some 100 m thickness alternating with basin facies rocks (e.g. Pöttschen Limestone F, Hallstatt Limestone F, etc.) were developed.

This assemblage occurs here in the Silica Nappe. Evaporite beds acted as décollement horizon during the nappe emplacement. This basal layer also contains blocks of serpentinized basic volcanic rocks from the Meliatikum. The nappe forms km-scale gentle folds with E-W oriented axes. Synclines are characterized by karstified areas formed over thick Wetterstein Limestone and Dolomite. Anticlines expose the Lower Triassic siliciclastic rocks; the drainage system of the Jósva and Ménes Valleys follows the anticlinal crests to the east. An imbricate structure of these anticlines was indicated by some drillholes with repeated incomplete sections of the succession of the Silicikum.

The Silica Nappe is bordered by the Darnó Zone in the southeast, a some km wide strike-slip fault zone of some 10 km displacement in sinistral sense during the Miocene, but its activity spans the whole Cenozoic time [5, 6] The Rudabánya deposit is situated in this zone and the Martonyi siderite deposit with the same paragenesis cca. 15 km NE from Rudabánya is probably a displaced part of the same mineralized rock body. However there is another small zinc-lead deposit known in the Silicikum in the western continuation of the Ménes Valley Anticline in Slovakia, at Pelsőcardó [Ardovo] [7]. This small ore body is bound to Gutenstein carbonate, and after the exhaustion of sulfide resources smithsonite ore was exploited up to the first part of the 20th century.

3. Observations and results

As a first step drillholes with recorded transecting of Lower Triassic strata were chosen and displayed from the accessible store. Our study was restricted to the sulfide or any Zn-bearing mineral content of the cores, lithology was recorded at sulfide enrichments only. Neogene cover was not studied.

As experience in Rudabánya has shown, sphalerite of the stratiform mineralization is hard to distinguish from other dark, fine-grained minerals. For the detection of Zn-bearing minerals zinc-zap was used [8]. Two composites have to be sprayed on the mineral surface:

- A: 3% potassium-ferricyanide solved in water (yellow)
- B: 3% oxalic acid and 0,5% diethylaniline solved in 1% hydrochloric acid (clear)

It reacts with smithsonite, hydrocinkite, hemimorphite and saucnite, forming bright scarlet stains, with sphalerite the reaction is weaker. Fe sulfide minerals, primarily pyrite, cause dark blue color. Other minerals do not react with the zap. Cores were tested with this zap in some dm intervals or in some cases continuously.

**Drillhole Szin-1 (1646 m).** This is one of the deep structural exploration drillholes, located at the mouth of the Jósva Valley.

The 150–170 m interval is the lower part of the Szin Marl Formation lying over Bódvaszilas Sandstone. The greenish gray, laminar marl contains several dm-scale intervals
of crumbled material, giving blue reaction color. At 165 m white sulfate coating was formed due to the weathering of sulfide minerals during the storage of the cores.

In the Bódvaszilas Sandstone Formation down to 435 m some quartzite veins contain pyrite. The lowermost part is siltstone lying over anhydrite (Perkupa Evaporite F) with pyrite enrichment and sulfate coating. The top 5 m of the anhydrite is penetrated by quartzite veins with pyrite, giving blue reaction color.

In the 435–465 m interval stylolitic limestone was found. At the bottom of this interval a 1 dm thick sparry calcite vein was found surrounded by a net of veinlets, containing mm-thick dark veinlets of sphalerite (Figure 2). The reaction color was intensive red. Another vein at 440 m also reacted with red color, but it was weaker. Underlying rock was anhydrite again with pyrite nests.

The 465–1660 m interval the transected assemblage comprises alternating anhydrite, gypsum, serpentinite, metabasalt, limestone, marl, siltstone and sandstone, including the rock material of the covering formations, probably a thickened mélange in the core of the Jósva Valley Anticline. Calcite or quartzite veins, the serpentinite and the metabasalt often contains pyrite enrichments, other sulfide minerals were not found.

**Drillhole Szinpetri-1 (139 m).** The drillhole explored gray, compact limestone and marl with mm-scale calcite veins (Szinpetri Limestone F). Some veins also contained dark material (sulfide minerals). Three veins at 79, 83.5 and 92.5 m gave red reaction color, indicating the presence of Zn-bearing minerals; in several other cases the reaction color was blue.

**Drillhole Bódvaszilas-11 (111 m).** The drillhole transected alternating shale, siltstone and sandstone (Bódvaszilas Sandstone F) with cm thick sulfide rich veins in the 72–74.5 m interval, giving both red and blue reaction colors. On the bottom section, from 106 m there was dolomite with rust stains.

**Drillhole Jósvafő-2 (85 m).** Marl with a thin red clay bed at the bottom was transected down to 25 m, lying over anhydrite. Intensive red reaction color was observed in the anhydrite under the contact. From 42.5 m to the bottom limestone was explored with iron oxide veins only.

The drillholes Jósvafő-3 and Szögliget-3 were also tested without positive reaction.
Our observations proved the presence of sphalerite mineralization in four drillholes, three located along Jósva Valley and one in the Ménès Valley Anticline. However the mineralization was vein type and bound to limestone or anhidrite, resembling rather to the Pelsőcardó deposit than to the stratiform ore of Rudabánya. The lower part of the Szin Marl Formation in the drillhole Szin-1, the only drillhole transecting an undisturbed succession of the Szin Marl lying over Bódvaszilas Sandstone, proved to contain sulfide-rich intervals. Still there is a possibility, that there are local sphalerite and galena enrichments in this horizon and this may be the source of the carbonate hosted sphalerite indications.
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