SEDEX deposits in the Graz Paleozoic - investigations to the exploration potential with the Arzberg deposit as calibration region

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1. INTRODUCTION

The sedimentary exhalative (=SEDEX) deposits of the Graz Paleozoic carry raw materials that have been important for basic supply for a long time **(Pb, Zn and Ag)**, as well as raw materials **(barite, Co, In, Sb and Ge)** that have been put on the list of **critical raw materials** by the European Commission (EUROPEAN COMMISSION, 2020). Furthermore, they have elevated contents of Cu, Ni and Sn and low contents of Cd, Ge and Tl. Of the Paleozoic units of the Eastern Alps, these deposits constitute the most important ore district on non-ferrous metals. On a global scale, SEDEX mineralizations are among the largest non-ferrous metal occurrences, containing >50% of the world's resources for zinc and lead and carrying a number of other important minor elements (for example Co, In, Sb and Ge) in addition to silver (Large, 1980; Melcher & Onuk, 2019).
Arzberg and its surroundings were sites of mining for silver, lead and zinc for about 680 documented years. After several closures and restarts, mining was terminated in 1927. Since then, there has been repeated research work as well as an exploration phase with drilling activity in the 1970s to 1980s (Weber, 1990). The results of these investigations are to be built upon in this project.

The deposits of the former mining districts in the Graz Paleozoic are well described, however, the focus was put on the ore occurrences themselves. A **detailed investigation of the spatial extent and composition of the wall rock alterations formed during the mineralization process** is missing. However, these alterations are an essential tool for exploration of SEDEX mineralizations and are recorded and characterized in this project. The definition and application of **proximity indicators from geochemical and mineralogical data** can provide evidence of hidden ore occurrences.
As a further prospecting method, the **investigation of stream and mine waters and their respective sediments in and around a deposit** is used. Not only in the case of the Graz Paleozoic such a detailed survey, which considers all indicative measuring factors, is missing. This investigation is carried out for at least the Arzberg test area in this project.

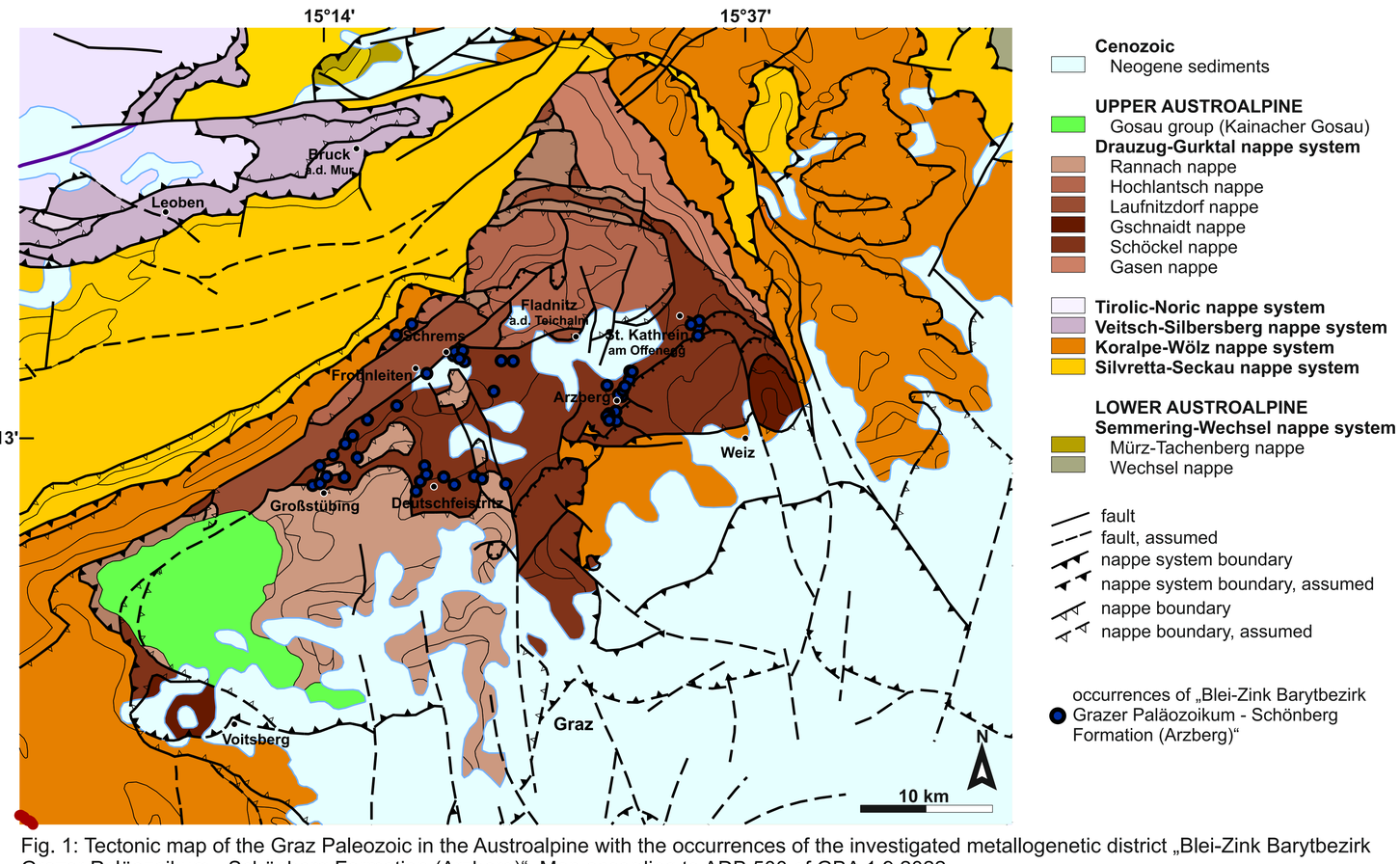

Fig. 1: Tectonic map of the Graz Paleozoic in the Austroalpine with the occurrences of the investigated metallogenetic district „Blei-Zink Barytbezirk Grazer Paläozoikum - Schönberg Formation (Arzberg)“. Map according to ADB 500 of GBA 1.9.2022.

In summary, this project, **supported by the „Initiative GBA-Forschungspartnerschaften Mineralrohstoffe - MRI“**, aims to **calibrate and define prospectivity indicators for lead-zinc deposits in the Graz Paleozoic**. These could also be transferable to SEDEX deposits in other areas.

2. SEDEX deposits in the Graz Paleozoic

The lead-zinc deposits in the Graz Paleozoic form the most important ore district on non-ferrous metals in Paleozoic units of the Eastern Alps. They constitute the metallogenetic district **"Blei-Zink-Barytbezirk Grazer Paläozoikum - Schönberg Formation (Arzberg)"** and belong to the Drauzug-Gurktal nappe system (Fig. 1) (Schmid et al., 2004; Melcher & Onuk, 2018). Host rocks are polyphase deformed, greenschist facies metasediments (often black shale) and metavolcanites (Greenschist) of the Schönberg Formation (Flügel, 2000), which are placed in the Upper Silurian to Lower Devonian (Weber, 1990; Gasser et al., 2010).

The mineralisation occurs in 2 to 3 sulfide- or baryte-dominated „Lager“ (Fig. 2 & 3) (Weber, 1990; Feichter, 2005). **Main minerals** are: Galena, Sphalerite, Pyrite, Pyrrhotite. **Associated minerals** are Chalcopyrite, Arsenopyrite, Freibergite, Marcasite, Pyrargyrite, Tetradymite, Cobaltite, Ullmannite, Breithauptite and rare minerals (e.g. Auer, 2010; Auer, 2020), e.g. Harmotome (Bojar & Taucher, 1997) and Alstonite (Bernhard & Schachinger, 2012).

Fig. 2: Folded ore mineralization of the „Hangendlager“ (“Mariahilfstollen“, Arzberg)

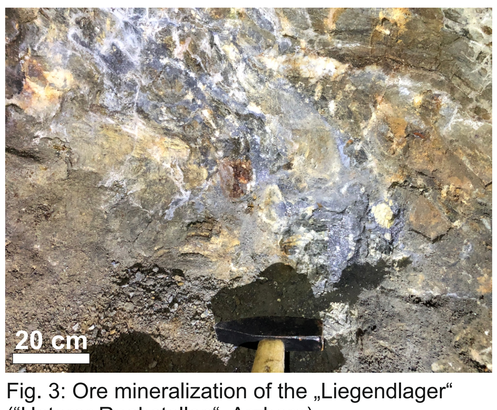

Fig. 3: Ore mineralization of the „Liegendlager“ (“Unterer Raabstollen“, Arzberg)

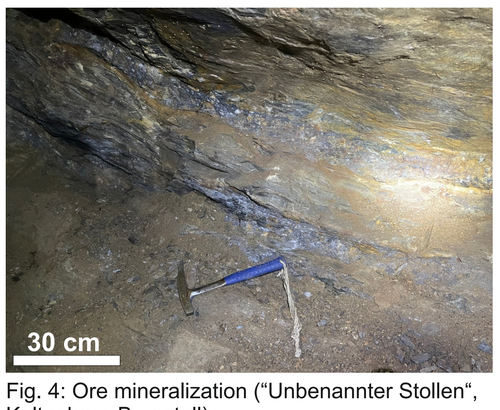

Fig. 4: Ore mineralization (“Unbenannter Stollen“, Kaltenberg-Burgstall)

3. PROJECT GOALS

Assessment of the **exploration potential for SEDEX deposits in the Graz Paleozoic**

- Investigation of **stream and mine waters** and their respective **sediments** in and around a deposit (**identification of geochemical anomalies**)
- Detailed investigation of the spatial extent and composition of wall rock alteration formed during the mineralization process (= **hydrothermal alteration phenomena**)
- Definition and application of **proximity indicators** from geochemical and mineralogical data (= element zonation around the mineralization)

4. CURRENT WORK

- Systematic search for literature, geological maps and for geophysical and geochemical datasets
- Sampling of stream sediments and waters around Arzberg finished
- Major + trace element chemistry analysis of the stream water samples from around Arzberg finished
- Sampling of ore and host rocks of one old mine in the mining district „Kaltenberg-Burgstall“ (Fig. 4) and one in the mining district „Peggau-Taschen“ finished
- Radiometric measurements in Arzberg upper and lower „Raabstollen“ galleries

5. NEXT STEPS

- Compilation and harmonization of geological maps
- Major + trace element chemistry analysis of the stream sediment samples from around Arzberg
- Sampling and major + trace element chemistry analysis of the mine sediments and waters inside the Arzberg mine
- Interpretation of the hydrogeochemistry analysis
- Sampling and analysis of ore and host rocks of the other accessible old mines, e.g. Arzberg, Kaltenberg-Burgstall
- Analysis of some drill cores from the drilling activity in the 1970s to 1980s (Weber, 1990)
- Discussion, general breakdown and presentation of results

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