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BACTERIOGENIC ORE FORMATION IN BLEIBERG-TYPE DEPOSITS

by

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We present new microscopic and analytical evidence in favour of bacteriogenic ore formation at Bleiberg. This should be viewed against the background of previous work, which is summarised below.

Negative sulphur isotope values of sulphide ores of Bleiberg and other Alpine Pb-Zn deposits have been interpreted by SCHROLL et.al. [1] as products of bacteriogenic reduction of sulphate in Triassic seawater. The finegrained texture of zinc sulphides and the presence of framboids, especially in stratiform mineralisations have been used as indicators for bacteriogenic metal deposition. This has, however, not been generally accepted and negative sulphur isotope values have traditionally been attributed to abiogenic processes [2].

Microthermometry of some sphalerite and fluorite samples from Bleiberg and Mezica, Slovenia, gave formation temperatures in excess of 100°C, which exclude bacteriogenic processes [3]. The Mississippi Valley type (MVT) model was then postulated for the genesis of ore deposits in the Alpine Trias. This involved epigenetic metal supply during subsidence at the time of the Alpine orogeny. However, thermal reduction of sulphate sulphur can only result in heavier sulphur, i.e. positive isotopic values - a feature observed in MVT deposits.

Bacteriogenic sulphate reduction (BRS) in mineralisations with sedimentary textures can be reconciled only with a model involving ore deposition which is coeval with the stratigraphic age of the host sediments [4].
To clarify this problem, we selected ore samples of finegrained sulphide associations from Bleiberg and from other occurrences within the Camian and Anisian sediments, such as Topla, Slovenia. These have been investigated microscopically, by scanning electron microscopy (SEM), by electron microprobe and by RAMAN spectroscopy. Measurements of sulphur valence by microprobe have also been performed. In reflected light samples of the stratiform Cardita mineralisation reveal microtextures of peloids. These represent relicts of bacteria which have also been identified in carbonate hosted mineralisations in Ireland, Belgium and Poland [5].

These sphalerite peloids show a ZnS core with 30–50 mm diameter. The rim is made up by pyrite, oxisulphide and an outer layer (10 - 20 mm) of ZnS. Sphalerite recrystallisation is widespread. Sulphur valences of the oxisulphides vary considerably from sulphide to thiosulphate; this is considered indicative for bacterial sulphur reduction. In addition, Zn-calcite peloids have been observed which are mantled by ZnS. Their core reveals large elongate or circular textures which can be interpreted as individual fossil bacteria.

Syndiagenetic textures have been described from the Cardita mineralisation at Bleiberg [6]; our data and observations now provide definite proof for syndiagenetic Pb-Zn mineralisation in the Alpine Trias. The giant carbonate hosted deposit of Navan, Ireland, occurs in Lower Carboniferous rocks and carries 9 mt Zn+Pb. It has recently been ascribed to the activity of sulphate reducing bacteria: "No bacteria, no ore deposit" [7]. This discovery is considered an extraordinary coincidence and provides additional support for our concept.

Bacteriogenic sulphate reduction (BSR) takes place below ~80°C and plays a significant role in Pb-Zn mineralisation in the alpine Trias and in the economically important deposits of the Lower Carboniferous in Ireland. The latter do, however, occur in tectonically undisturbed platform sediments while deposits of the Bleiberg type have been affected by deep subsidence during Alpine orogeny. Thus, bacteriogenic mineralisations co-exist with products of epigenesis and redeposition. The combined application of gas chromatography and isotopic methods will provide better understanding of the links between carbohydrates, ores and the thermal evolution of mineralised sequences. Examples for the distinction between bacteriogenic and thermally overprinted organogenic sediments components have been presented by MACHEL [8].

The response of carbohydrates in ores and rocks to different thermal regimes has also been elucidated [9]. Carbohydrate and isotope data from Topla, Slovenia, support synsedimentary, bacteriogenic origin for sphalerite ores [10].

This contribution reports first results of a working group which owes its existence to the support of the Raw Materials Commission of the Austrian Academy of Science.

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