The modelling of copper-lead interrelations in the mineral-forming environment of low-temperature hydrothermal deposits

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The work aims to determine the place of fahlores in low-temperature (below 300°C) systems of base metal (lead-zinc) deposits, which are world-wide and consists of considerable volume of the base metals of the world. Fahlores are often accompanied the base metal ores. Since the precipitation of fahlores are sensitive to mineral-forming conditions, they can indicate the mineral-forming conditions of the ore-forming systems. The modelling has been done with CHILLER software package (Reed, 1982), created to count chemical equilibria between solids, liquids and gases at the temperatures of 25-300°C. The modelling solutions was saturated with quartz, adularia, muscovite, pyrite and sphalerite.

It is established that the balance of Cu and Pb concentrations is important for precipitation of fahlore and Pb minerals. So, stability of galena and boulangerite are marked with the balance of Pb and Cu contents in the solutions. Decreasing Pb content leads to fahlore precipitation. The intermediate boundary between boulangerite and tetrahedrite stability fields not exist: they are divided by stability field of only bournonite. The temperature level of bournonite stability is decreased with decreasing of Pb concentration. Galena and fahlore coexist only in temperature interval of ~5°C, with stability of tetrahedrite with a little increment of Pb over Cu. Top temperature level of tetrahedrite is parallel to the scale of Pb concentration.

The investigations of the concentrations of dissolved complexes of Cu and Pb show about with equalisation $C_{Pb}=C_{Cu}$ (C – concentration) their balance is abruptly altered accordingly to the scheme: $Cu(HS)_2^-+Pb^{2+}\Leftrightarrow Pb(HS)_2+Cu^+$; $2CuCl+Pb^{2+}\Leftrightarrow PbCl_2+2Cu^+$ and similar. Accordingly, the increasing Pb content leads to increment of the precipitating bournonite, which connects Cu. With $C_{Pb}=C_{Cu}$ the decreasing Cu content leads to instability of fahlores, and Pb enters into Sb-enriched sulfosalt – boulangerite (or, with higher temperature, with the domination of thiostibite complexes, in galena). The process has a place in opposite way with increasing Cu concentration.

Thus, the formation of fahlore in the low-temperature deposits indicates instability (at least metastability) of galena, with the excess of Cu concentration (activity) over Pb content (activity).

MC-ICP-MS determination of isotopic fractionation of cadmium in simple aquatic food chains

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Recent developments in the field of mass spectrometry, coupling inductively-coupled plasmas with multiple detectors has opened the possibility to explore biological fractionation of heavy elements. One element that has the potential to fractionate as a result of food chain processing is cadmium. Cadmium is of particular interest because of the large mass spread in usable isotopes (110 to 114 AMU) and because of its environmental and toxicological significance. Until recently, it was quite difficult to measure Cd isotope ratios on large numbers of samples rapidly and with high precision. However, the development of multicollector ICP-MS instruments has changed this.

The major difficulty in obtaining good precision for Cd isotope ratios in biological samples is the presence of large concentrations of matrix elements in digested material. Of particular concern is the isobaric overlap of ^{114}Sn on ^{114}Cd. We will present a simple method for matrix removal that enables us to rapidly measure Cd isotope ratios in a variety of tissues with very high precision. The technique, using Eichrom Ln ion exchange resin, is capable of producing an essentially matrix-free sample in a few minutes. The method can be run in batch mode to process several samples at once. This paper will present data on changes in isotope ratios observed in simple aquatic food chains consisting of phytoplankton, zooplankton and benthic macroinvertbrates. Two systems will be compared: one, maintained in the laboratory, in which initial isotopic composition of Cd was altered, and one, with a similar food chain, in which samples have been collected from a lake.