Sediment Hosted Zn-Pb-Cu Mineralization in Siliciclastic Rocks from Moravosilesian Paleozoic: Fault Controlled Mineralizing Fluids Derived from Evaporated Seawater

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The post–Variscan vein mineralisation is disseminated at the eastern border of the Bohemian Massif mainly in the Nízký Jeseník Upland and Upper Silesian Basin. Hydrothermal veins are hosted by Lower Carboniferous greywackes, siltstones, shales and conglomerates and Upper Carboniferous sandstones. In the larger area, the results of hydrothermal activity of post-Variscan age also comprise the large Mississippi Valley-type deposits in Poland (Silesia-Cracow Zn-Pb district).

Study of the region indicate a fluid flow through the Paleozoic rocks likely in a NW-SE direction, which could correlate with the concept of a major control exerted by the fault systems in the area. Evidence comes from a study of stable isotopes and fluid inclusions. The fluid transport towards the NE correlates with a decrease of the homogenization temperature and salinity in fluid inclusions and an increase of oxygen isotopic values in carbonates.

The O and C stable isotope compositions of dolomites are characterized by $\delta^{18}O$ values from −14.9 to −7.7 ‰ and $\delta^{13}C$ values from −5.6 to +2 ‰ PDB. Homogenization temperatures regionally decrease from 147° to 64 °C and salinities from 26.8 to 19.6 wt.% eq. NaCl. Eutectic temperature within the range from –43.7° to –63.4°C represents H_2O-NaCl-$CaCl_2$ type of enclosed fluids. Calculated isotopic compositions of oxygen (Zheng 1999) and carbon (Ohmoto and Rye 1979) of parent fluids provide average values in the range from −0.7 to +2.7 ‰ SMOW and from −10.6 to −4 ‰ PDB. Important decrease of $\delta^{13}C$ values in fluids is apparently evoked by the interaction with the organic matter.

In several samples were the fluid inclusions analyzed for their values of Na, Cl, K, Li, Br by the crush-leach technique. Molar ratios of Cl/Na ranging from 2.3 to 2.6, ratios of Cl/Br vary between 230 and 400. Total dissolved solution ranges from 196 to 268 g/l. These values could represent basinal brines with H_2O-NaCl-$CaCl_2$ type of fluids. The relative concentrations of potassium (molar ratio K/Cl ranges between 0.0133 and 0.0409) and lithium (molar ratio Li/Cl varies between 0.0007 and 0.0017) further indicate that the fluids interacted with siliciclastic rocks. These type of the interaction between the rock and the fluid flow is more typical for the mineralization of Upper Silesian Basin. Na/Br, Cl/Br and Na/Cl ratios suggest a major contribution of an evaporitic brine as a source for the high salinity. A log Br vs. log Cl plot for these brines shows that the fluids all plot to the right of the seawater evaporation trajectory. Increased Br concentrations could result from recrystallization of halite or from interaction with organic matter. From this plot is also evident mixing between a bittern brine and probably meteoric waters (varying between 0 and 20 %).

Microthermometric and crush-leach analyses of fluid inclusions are very similar with Silesia-Cracow MVT district. Low temperature and high saline fluids are probably adherent to same fluid flow along NW-SE and NE-SW faults which represent main migration pathways for hydrothermal fluids. Mineralizing fluids could have been driven by a dilatational pump mechanism (Heijlen et al. 2003), or gravity-driven flow model (Leach et al. 1996). We suggest that fluids may have migrated from the Carpathian foredeep.

Age of this mineralization is dated to the Early Cretaceous (Heijlen et al. 2003) or Middle Tertiary (Symons et al. 1995, Leach et al. 1996).

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References

HEIJLEN W., MUCHEZ Ph., BANKS D. A., SCHNEIDER J., KUCHA H. and KEPPENS E., 2003. Carbonate-Hosted Zn-Pb deposits in Upper Silesia, Poland: Origin and evolution of mineralizing fluids and constraints on genetic models. *Econ. Geol.*, 98: 911-932.

LEACH D.L., VIETS J.G., KOZLOWSKI A. and KIBITLEWSKI S., 1996. Geology, geochemistry, and genesis of the Silesia-Cracow zinc-lead district, southern Poland. *Society of Economic Geologists Special Publication*, 4: 144-170.

OHMOTO H. and RYE R.O., 1979. Isotope of sulfur and carbon. In: H.L. BARNES (Editor), Geochemistry of Hydrothermal deposits, John Wiley & Sons, pp. 509-567.

SYMONS D.T.A., SANGSTER D.F. and LEACH D.L., 1995. A Tertiary age from paleomagnetism for Mississipi Valley-type zinc-lead mineralisation in Upper Silesia, Poland. *Econ. Geol.*, 90: 782-794.

ZHENG Y. F., 1999. Oxygen isotope fractionation in carbonate and sulfate minerals. *Geochem. J.*, 33: 109-126.