Ore-magmatic hydrothermal systems of massive sulphide deposits of Southern Urals: Melt and fluid inclusion data

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According to existing models [1], the formation of the volcanogenic massive sulphide (VMS) deposits of the Urals is related to shallow chambers of acidic magma. The ore bodies are hosted by locally altered felsic rocks. All economic VMS deposits are located at some lithostratigraphic levels corresponding to two major and a few local stages of Lower Silurian and Middle Devonian volcanism. Melt inclusions (MI) and high density fluid inclusions (FI) in quartz phenocrysts were studied in 200 samples of dacite, rhyodacite and rhyolite.

Two main types of MI have been discovered: the most widespread devitrified inclusions, and rarely found glasses, some of them contain the ore globules of magnetite and also sulphides, represented by pyrrhotite, pentlandite, chalcopyrite and bornite, defined by electron microprobe. Melting of glasses occurred at 600-720°C, homogenization at 850-1130°C, whereas devitrified inclusions at 750-820°C and 950-1210°C accordingly. MI were analyzed for major elements and F, Cl by electron microprobe and H_2O by secondary ion microprobe. The concentrations of volatiles in the MI are (in wt%) are H_2O up to 6.5, Cl up to 0.28, F up to 0.42 contents; the average content of sulfur is 0.025 wt%.

FI in quartz phenocrysts are round to negative crystal shaped, from 25 to 100 μm, with gas bubbles from 8 to 40 μm. The homogenization of the FI occurred at 124-250°C in liquid phase. The freezing temperatures of FI range from -14 to -37°C. Salinities are from 1.2 to 6.2 wt% NaCl, density of aqueous fluids from 0.80 to 0.94 g/cm^3, calculated pressure from 680 to 850 MPa. Micro-Raman investigation demonstrated a presence of liquid H_2O only. Evaluated by LA-ICP-QMS at GET [2] contents in the magmatic fluid are**:** Cu 0.03-2.1 wt%, Zn 0.008-1.7 wt%, K 0.08-2.0 wt%, Fe 0.1-1.3 wt%, B 40-1600 ppm, Ba 20-2200 ppm, Sn 4-1600, Pb 14-740 ppm, Ag 4-200 ppm, Au 4-8 ppm.

[1] Baranov *et al*. (1988) *Proc. 7th IAGOD Symp,* 449–460. [2] Borisova *et al*. (2010) *Geostand. Geoanal. Res,* **34**, 245–255.

Alterations to nanoparticle associated proteins

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Engineered nanoparticles are often either purposely stabilized with proteins or acquire a protein 'halo' while in geologic or biologic media. The presence of this protein coat is generally thought to stabilize nanoparticles and make them resistant to aggregation and deposition phenomena. Our work has systematically examined the gold nanoparticle/protein interface in an effort to quantify the strength and stability of these interactions and to define the chemical and morphological transformations of the protein coat. Bovine serum albumin (BSA) was chosen as a representative protein and gold nanoparticles serve as a model nanoparticle system. Gold is an ideal model nanoparticle since it can be readily produced as monodisperse suspensions of varying size and variable surface functionality. Furthermore, gold is amenable to a number of surface plasmon enabled spectroscopies that facilitate quantitative evaluation of the protein/gold interface.

This presentation will highlight studies conducted to 1) quantify BSA binding to gold nanoparticle surfaces, 2) evaluate how BSA conformation changes in response to variations in solution chemistry, 3) determine the stability of the BSA coating under flow conditions, and 4) elucidate the chemical and biological reactivity of the BSA coating. These experiments collectively rely upon UV-Vis measurements of changes in the surface plasmon band location and intensity, surface enhanced Raman spectroscopy to evalate changes in BSA conformation and chemistry, and deposition and flow-cell AFM studies that define the stability of the BSA-gold nanoparticle interaction.

The current work has led to an improved understanding of protein/nanoparticle interactions and has helped define the chemical and morphological transformations that surface associated proteins are subject to. The collected results have important implications on the ultimate fate, transport, and toxicity of nanoscale particles released to aquatic environments.