The solubility of gold in water-hydrogen sulphide vapours

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Although the formation of high-suphidation epithermal deposits of Au has generally been attributed to hydrothermal mobilization of ore components by saline aqueous liquid, pressure-temperature conditions favour the domination of vapour over liquid in these magmatic hydrothermal ore-forming systems. In view of this and the longevity of many magmatic-hydrothermal systems, it is reasonable to consider the possibility, that vapour rather than liquid may be the principal ore fluid for high-sulphidation epithermal deposits. To test this hypothesis, we have experimentally investigated the solubility of gold in H_2O-H_2S gas mixtures. The speciation and stability of gold species were evaluated in gas-only system at temperatures from 300 to 400 °C and pressures up to 265 bar, with hydrogen fugacity constrained by the reaction $H_2+S=H_2S$. Results of the experiments demonstrate that Au can be dissolved in significant concentrations in aqueous vapours. As the fugacity of gold increases with the fugacity of H_2S (in both pure H_2S gas and H_2O-H_2S mixtures), it follows that formation of stable volatile sulphide species and their solvation by H_2S ($AuS(H_2S)_n$) control the solubility of gold in the gas phase. Moreover, as the solubility of Au in the vapour phase increases with the fugacity of H_2O, it also follows that gold solubility is enhanced by formation of species hydrated by H_2O molecules, $AuS(H_2O)_m$. These results provide strong evidence that H_2S plays an important role in the vapour transport of gold.

The relative importance of solvation/hydration of sulphide and chloride complexes was assesed for vapours of composition similar to those of natural low-density magmatic-hydrothermal fluids. As these vapours are mostly water rich, gold will be transported in the vapour dominantly as hydrated gold complexes. The data on the stoichiometry and stability of gold species presented in this study represent an important contribution to our knowledge of the chemical properties of volatile metal species. Equally important, they permit accurate modeling of vapour-related processes involved in the mobilization, transport and deposition of gold in magmatic hydrothermal systems, notably those of epithermal environments.

Water resources issues in the basin of transboundary Selenga river

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According to the United Nations, in the world is more than 260 rivers belonging by several states. Within their basins it is formed about 80 % of a world river flow and lives about 40 % of a world's population [1].

The Selenga river basin is located in the centre of the Euroasian continent, in a zone of a world watershed of Arctic and Pacific oceans basins and closed basin of the Central Asia. In the landscape relation the Selenga river basin is situated in contact area of taiga and steppe natural zones that predetermines development in this territory the natural environment, which is characterised by a high level of a biological variety and hypersensibility to external influences.

The intergovernmental border divides the Selenga river basin into 2 inadequate parts: its prevailing top part is situated in the territory of Mongolia, bottom – in the Russian Federation. The river Selenga – the main inflow of lake Baikal, the importance and uniqueness of which natural characteristics are recognised by the world community as object of the World natural heritage of UNESCO and are legislatively fixed only at the Russian level. Now the Russian-Mongolian relations in the field of protection of water resources are regulated on the basis of the intergovernmental Agreement for protection and use of transboundary waters (1995).

In a boundary control point in 1992-2008 years Fe, Cu, Zn, phenols and nitrogen were constantly marked above permitted standard content. The greatest values of concentration of polluting substances are marked in 1997, 2001, 2002, 2004 years. Thus in separate years presence of pesticides and mercury was fixed, which are according to the Russian requirements is inadmissible for lake Baikal basin. In 2010 for the lake Baikal the government of the Russian Federation enters even more rigid acceptable exposure standards.

The basic sources of pollution are treatment facilities of big cities of Mongolia and Republic of Buryatia (Russian federation) (Ulaanbaator, Darkhan, Erdenet, Ulan-Ude, Gusinoozersk, Zakamensk), and also the mining enterprises (especially gold mining) in Selenga river basin.

[1] Danilov-Danilyan, 2006.