EXPERIMENTAL STUDY AND THERMODYNAMIC CALCULATION OF COPPER GAS TRANSPORT ON II VOLCANIC CONE OF TOLBACHIK

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Modern ore-forming at fumaroles activity of volcanoes is drawn with attention as process where there is a gas conduction of mining components. One of such objects is II cone Tolbachik eruptions (BTTI). Here during 30 years there is a deposition sublimates, containing minerals of copper. Now activity of gas yields has dropped, but temperatures up to 400°C nevertheless are fixed. Conduction of copper to a gas phase at magmatic temperatures is well studied, but at middle temperatures process the factors supervising transport, are not investigated. In the present work results of experimental, natural and theoretical research of processes of conduction of copper in a gas phase are resulted.

During a field season of 2005 on II cone BTTI samples of gas and condensate from fumaroles with temperature from 60 up to 400°C have been taken. At 400°C deposition of copper minerals is not observed, the most plentiful copper mineralization is noted at 220°C. In all cases gas precipitates out very dry, that complicates reception of a condensate. For selection of the condensate we used the micro-compressor which pumped over gas through a column with silica gel and teflon tubes cooled by boiling butane (the method is offered to M.E.Zelensky). During selection through the certain time terms the gas current was measured, the weight of water is found on increase in weight of columns and tubules. After selection of a tubule were hermetically closed.

Water content does not depend on temperature of a gas yield and makes 0.03 g/dm^3 of gas. The basic gas components are air gases - nitrogen and oxygen, the contents of acid gases low and can be estimated only on composition of condensates.

For an estimation of an opportunity of gas conduction of copper experiments by a method of a stream with use as gas-carrier of air and nitrogen are carried out. Samples of natural sublimates and chloride of copper (I) were exposed to disolution at 350 and 400°C. In gas-carrier the fixed amount of hydrogen chloride and sulphur dioxide was added. Results have shown that evaporation of copper to a gas phase occurs only in the reduction conditions (nitrogen at presence SO_2). At presence of oxygen transportation of copper is low.

On the basis of natural and experimental data thermodynamic model of II cone BTTI (fig.1) is constructed. Air filtrates through permeable breeds ash cone in a zone hot breeds where there is an interaction to the slag, resulting in removal of oxygen and mixture with magma fluid, adding acid gases.

Thermodynamic calculations have shown, that under these conditions cuprous compounds prevail: Cu_3Cl_3 (g). Over absence of magmatic gas at low fugacity of HCl dominates CuOH (g). At cooling magmatic gas there is a reduction of concentration of copper in a gas phase (fig.2) and nantokite (CuCl) precipitate. The temperature of deposition depends on concentration of copper in a gas phase. In model saturation of cuprite is calculated, but in the nature it is improbable. The mole ratio of copper in a condensate from fumaroles with temperature 400°C makes $5 \cdot 10^{-7}$ below saturation on chloride of copper at this temperature. Precipitation of nantokite from gas according to calculations has good agreement at 200-250°C.

At displacement of volcanic gases to air there is an oxidation and deposition of chlorides and hydrooxichlorides coppers (II). In the reduction environment at cooling cuprite and nantokite are formed.

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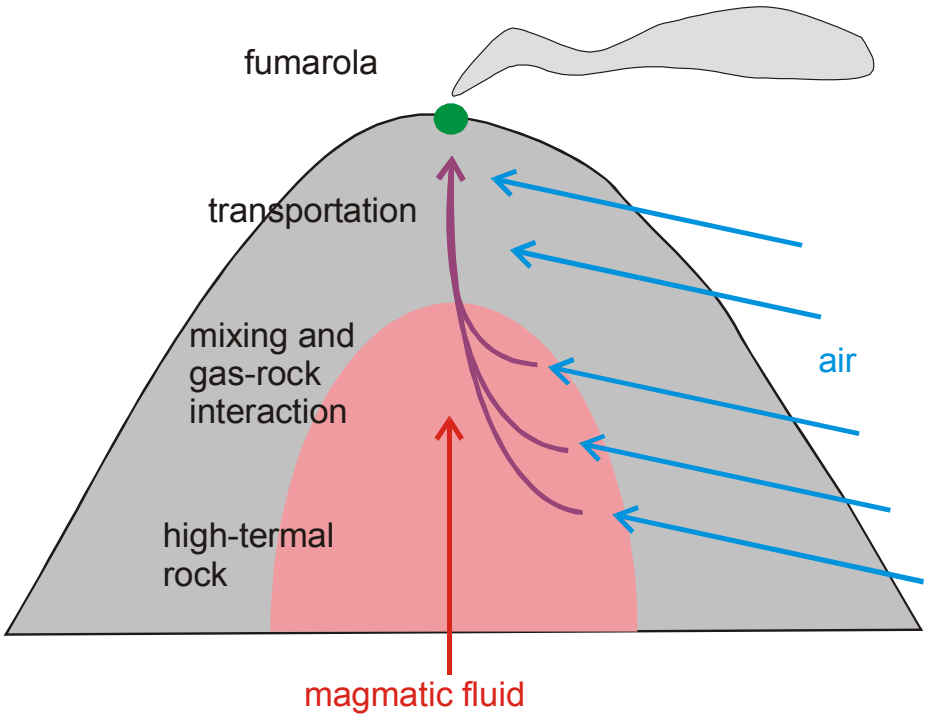

Fig. 1. Schem of II cone hydrothermal system.

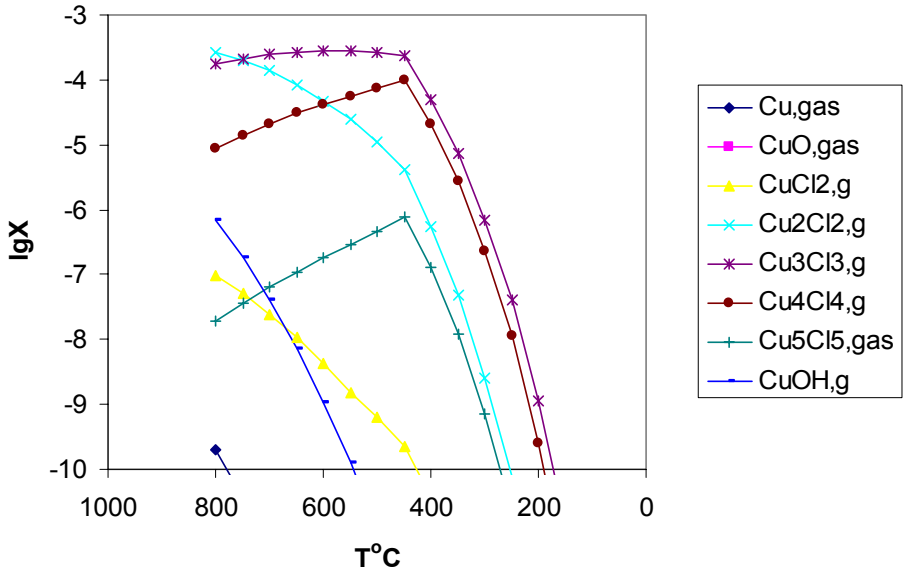

Fig. 2. Result of cooling model calculation: cupper speciation in gas

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