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The solubility of gallium oxide in vapor and two-phase fluid filtration in hydrothermal systems

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The solubility of gallium and aluminum oxides in gas phase in the system Ga_2O_3 (Al_2O_3)-HCl-H_2O was studied at 150-350ºC and pressure up to saturated vapor. The concentration of gallium increases with the increasing of HCl pressure. The formulae of gallium gaseous specie was determined as $GaOHCl_2$. The constant of gallium oxide solubility reaction was calculated at 150, 200, 250, 300 and 350ºC. The concentration of aluminum in gas phase is insignificant in the same conditions. The possibility of gallium transportation in gas phase with small quantity of Al allow to divide this elements in hydrothermal processes with gas phase. The Ga/Al ratio in muscovite can be used as the indicator of gas phase separation and condensation. This indicator was not considered in the geochemical literature earlier. The separation of gas and liquid phases was determined in Akchatau (Kazahstan) and Spokoinoe (Russia) greisen W deposit by carbon isotope fractionation of carbon dioxide in fluid inclusion. The important feature of both ore mains is heterogenization and boiling of ore-forming fluids. Greisen ore bodies are formed as a result of strongly focused solution flow in the T-P gradient fields. It is possible to divide ore bodies of Akchatau in two types: muscovite and quartz. Muscovite type veins are thin and have small metasyntactic zone. Quartz type veins are localized in fault with large vertical extent (500 m) and content the large quantity of wolframite. These veins formed in condition of significant pressure decreasing from 2.5 to 0.5 kbar with fluid boiling. Gas and liquid phase separation specifies the vertical zonality of quartz type veins. The gas phase with the high gallium concentration is separated from a flow of liquid phase. Liquid phase react with the granites forming greisen metasomatites. Condensation of the gas phase in upper parts of massive produces the increasing of Ga/Al ratio in muscovite 3-5 times more, then in granites and bottom part of vein (from $2{\cdot}10^{-4}$ to $8{\cdot}10^{-4}$ mass ratio). The muscovite type veins has no separation between gas and liquid due to there thickness and small pressure gradient. There is no difference in Ga/Al ratio in muscovite from this veins. The Spokoinoe deposit is classified by mineralized dome type. The heterogenization of fluid occurs in H_2O-CO_2 system for water phase and carbon dioxide with temperature decreasing. Two-phase flow is separated in granite, forming greisen metosomatites. The Ga/Al ratio in rock increase up to 3 times to the upper part of metasomatitic zone. The Ga/Al ratio in muscovite can be applied for other hydrothermal systems for geochemical indicator of gas phase separation and condensation zone determination.

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