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The effect of the trisulfur radical ion on molybdenum transport by hydrothermal fluids

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Knowledge of molybdenum (Mo) speciation under hydrothermal conditions is a key for understanding the formation of porphyry deposits which are the primary source of Mo. Existing experimental and theoretical studies have revealed a complex speciation, solubility and partitioning behavior of Mo in fluid-vapor-melt systems, depending on conditions, with the (hydrogen)molybdate (HMoO_4^- , MoO_4^{2-}) ions and their ion pairs with alkalis in S and Cl-poor fluids [1-3], mixed oxy-chloride species in strongly acidic saline fluids [4, 5], and (hydrogen)sulfide complexes (especially, MoS_4^{2-}) in reduced H_2S -bearing fluids and vapors [6-8]. However, these available data yet remain discrepant and are unable to account for the observed massive transport of Mo in porphyry-related fluids revealed by fluid inclusion analyses demonstrating 100s ppm of Mo (e.g., [9]). A potential missing ligand for Mo may be the recently discovered trisulfur radical ion ($\text{S}_3^{\cdot-}$), which is predicted to be abundant in sulfate-sulfide rich acidic-to-neutral porphyry-like fluids [10]. We performed exploratory experiments of MoS_2 solubility in model sulfate-sulfide- $\text{S}_3^{\cdot-}$ -bearing aqueous solutions at 300°C and 450 bar. We demonstrate that Mo can be efficiently transported by $\text{S}_3^{\cdot-}$ -bearing fluids at concentrations ranging from several 10s ppm to 100s ppm, depending on the fluid pH and redox, whereas the available data on OH-Cl-S complexes cited above predict negligibly small (<100 ppb) Mo concentrations at our conditions. Work is in progress to extend the experiments to wider T-P-composition range of porphyry fluids and to quantitatively assess the role of $\text{S}_3^{\cdot-}$ in Mo transport by geological fluids.

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