

The solubility of gold in H₂S vapor

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Although there is extensive evidence that magmatic vapors are capable of transporting high concentrations of some ore metals, modeling of the processes responsible for ore deposition is severely limited by the paucity of data on the solubility and speciation of metals in the vapour phase. As complexes with HS⁻ and H₂S are the principal forms of dissolved gold in aqueous liquids and H₂S partitions strongly into the vapor phase of hydrothermal systems, it is likely that gaseous H₂S is important in promoting the volatile transport of gold. In this paper, we report the results of the first of a series of experimental studies designed to investigate the solubility of gold in H₂S-bearing water vapor.

This first study examines the solubility of gold wire in H₂S gas. The experiments were conducted in titanium alloy autoclaves at 300 to 400°C and pressures up to 230 bars. The total pressure was assumed to be equal to the pressure of H₂S gas and was calculated from the PVT properties of this gas. The redox potential was controlled by the S/H₂S pair. At the end of an experiment, the autoclaves were quenched and Au condensed on the walls of the vessel was dissolved in aqua regia. The solubility of Au in H₂S gas was calculated from its concentration in this acid. The results of our experiments indicate that the solubility of Au in H₂S increases with both temperature and *f*H₂S, reaching a concentration of 95 ppb at 400°C. Based on the *f*H₂S dependency, we propose that the species controlling the solubility of Au in H₂S gas has the form AuS·(H₂S)_{*n*} or AuHS·(H₂S)_{*n*} with a solvation number between 1 and 2 at 300-400°C. The equilibrium constants for the reactions controlling formation of these two species are *log K* = -11.1 ± 0.2 at 300°C (both species), -10.7 ± 0.3 and -10.5 ± 0.3 at 350°C, and -10.6 ± 0.2 and -10.4 ± 0.2 at 400°C, respectively.

Results of this study and preliminary experiments in the Au-H₂S-H₂O system, which yielded even higher Au solubilities, provide evidence that H₂S may play a major role in dissolving Au in hydrothermal vapor, something which may be key to understanding the genesis of porphyry and epithermal gold deposits.

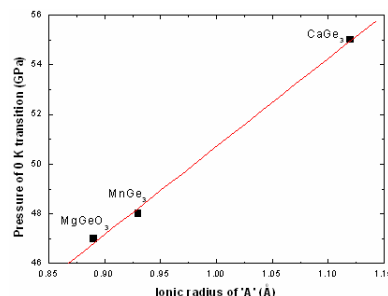
Influence of 'A' cation ionic-radius on the structure and bulk modulus of ABO₃ perovskite and postperovskite

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Recently, high-pressure experiments and theoretical calculations demonstrate that (Mg,Fe)SiO₃ postperovskite is the predominant mineral in the lowermost mantle called the D'' layer, and phase transition from perovskite (Pv) to postperovskite (PPv) has significant geophysical implications for the nature of the D'' layer (Hirose 2006). The available experimental data of bulk modulus and 0 K transition pressure from Pv to PPv were investigated for ABO₃ perovskite and postperovskite, it was found that a linear relationships between the radius of 'A' cation and bulk modulus exists in ABO₃ Pv and PPv. The bulk modulus decreased linearly with increasing the radius of 'A' cation. On the other hand, there is also a positive linear relation between the 'A' cation ionic radius and the 0 K transition pressure for germinates perovskite, which indicates the transition pressure increasing linearly with the increasing the radius of 'A' cation, so the transformation into postperovskite phase becomes more difficult with the large ionic radii of 'A' cation in ABO₃ perovskite (see Fig.). As the phase transitions from Pv to PPv is due to the distortion of BO₆ octahedra in Pv, our results suggest that the ionic radius of 'A' cation probably play an very important role on the structure and the phase transformation of ABO₃ compounds.



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References

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