3.4.P10

Geochemistry of platinum group elements in the Jinshan gold deposit, Jiangxi Province, China

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Based on the development and application of ICP-MS technology, the geochemistry of the platinum-group elements (PGE) is used in the studies of crystallization differentiation, partial melting, magma evolution, and fluid-rock interactions. Different distribution patterns and characteristics of PGE were recognized and hence used as indicators of different material sources and geodynamic settings [1, 2].

The Jinshan gold deposit is located in well-known Dexing Cu-Au ore field of East China, and is hosted in a ductile shear zone[3]. The PGE from deformed wall rocks and ore bodies were analysed. Result shows that all kinds of rocks are richer in PGE comparing to the continental crust. In the figure of primary mantle-normalized PGE distribution, the phyllitic wall rocks, ore-hosting mylonite and ultra-mylonites, and gold-bearing quartz veins all show similar patterns. The total PGE concentrations decrease from carbonaceous phyllite, through mylonite, to gold-bearing quartz vein, together with a gradual decreasing of Pd/Pt and Pt/Ir ratios. Pd concentrations show strong negative correlation to Au concentrations (r=-0.9443), whereas Pt has no obvious correlation with Ir. The data indicate that Pd group elements and Ir group elements have similar geochemical behavior during fluid flow, while differentiation existed within the Pd group elements. Barnes et al (1985) considered it related to the hydrothermal alteration, which might affect the migration of Pd group elements [4]. Generally speaking, the geochemistry of PGE indicates that the ore-forming material of the Jinshan gold deposit was from the phyllitic wall rock. This is also in accordance with the studies on REE and isotope geochemistry of the deposit.

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3.4.P11

Thermodynamics of hydrothermal two-phase flow of H_2O-NaCl fluids

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Modeling the simultaneous two-phase (liquid+vapour) flow in hydrothermal systems has so far been limited to pure water models. While liquid+vapour coexistence in pure water terminates at the critical point at 374°C and 22 MPa, many deep fluids are water-salt mixtures with a liquid+vapour coexistence field that extends to much higher temperatures and pressures. With our new equation of state for H_2O-NaCl fluids, we have been able to carry out realistic hydrothermal two-phase fluid flow simulations in this system [1].

The phase diagram topology implies a number of possible changes of fluid state as a consequence of changes in pressure, temperature and composition. For example, a single phase fluid may split into a liquid+vapour mixture upon depressurization, heating, or mixing with a fluid of different salinity, and can drastically increase or decrease its volume. In addition to the correct phase diagram topology and thermodynamic properties (density, enthalpy, heat capacity, etc.) of the individual fluid phases, an accurate and numerically stable representation of these processes in fluid flow modeling requires the (isothermal or adiabatic) compressibility, the thermal and "chemical" expansivities, and – depending on the simulation algorithm – the isobaric heat capacity of the fluid or fluid mixture.

The calculation of these properties is non-trivial. For example, the compressibility of a liquid+vapour mixture is neither given by the sum of the compressibilities of the individual phases nor is it even roughly approximated by the vapour compressibility. Thermodynamically, it is in fact infinitely high because vapour can condense into the liquid upon pressurization. In a real system with fluid in a porous medium, however, infinite compressibility is an inadequate concept because mass and heat balance effects limit the amount of vapour that can condense. We present formulations that correctly describe the compressibility of a liquid+vapour mixture of the pure H_2O or mixed H_2O-NaCl system as well as other bulk mixture properties relevant for fluid flow simulations.

Example simulations of hydrothermal two-phase fluid flow demonstrate the importance of these parameters and are discussed with respect to the maximum temperature and/or salinity of hydrothermal fluid flow.

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