Thermodynamic properties of copper chloride complexes and copper transport in magmatic hydrthermal solutions

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The equation-of-state parameters and partial molal properties for aqueous copper(I) chloride complexes ($CuCl_{(aq)}$, $CuCl_2^-$, $CuCl_3^{2-}$ and $CuCl_4^{3-}$) have been regressed from experimentally derived log K values derived between 25ºC and 350ºC and vapour-saturated pressure. The results are used to calculate formation constants for a wide range of temperature and pressure (0-1000°C and 1-5000 bar). The reliability of the properties is tested by calculating chalcopyrite solubilities and comparing them with measured values from Seyfried and Ding (1993; 400°C, 500 bars) and Hemley et al. (1992; 300-500°C, 500-2000 bars). The good agreement between the calculated values and the experimental results indicates that our extrapolated thermodynamic properties are reliable at least over these ranges of pressure, temperature and chloride concentration.

The new properties are used to calculate chalcopyrite solubilities under similar conditions of two magmatic-hydrothermal copper deposits: the Starra iron oxide-Au-Cu deposit, Australia; and the Bajo de la Alumbrera porphyry copper deposit, Argentina. In both cases our calculated copper concentrations are consistent with the measured values in inclusions that trapped pre-mineralising and mineralizing fluids. More generally, calculated chalcopyrite solubility at different temperature, pressure, pH, chloride concentrations and oxidation states indicates that hypersaline, neutral-weak acidic, and intermediate-reduced brines can transport thousands of ppm copper at 400ºC and above. Cooling, fluid mixing, boiling and fluid-warter interaction can cause copper deposition in magmatic-hydrothermal environments.

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From fluid inclusion study to genesis of the Anguran ore deposit, NW Iran

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The Anguran Zn-Pb deposits is located within the Urumiah-Dokhtar zone, 120 Km of Zanjan city (47º 20″ E, 36º 40″ N). .It is one of the largest and highest- grade non-sulfide zinc deposits in the word. The data obtained from geothermometric studies of sphalerite and fluorite asociated with zinc-Lead mineralisation at the Anguran mine are compatible with a structurally controlled, sedimentary-hydrotherml origin. Hemogenization and last ice melting temperature of primary fluid inclusion indicate that mineralization taken place over a temperature range 155-165º and salinities of inclusion fluids range 18.63 to 22.38 wt% TDS. We used of a compilation of Th and salinity information from different zinc deposit types, drawing significantly on the summaries of Roedder (1984) together with a wide range of published data (Willkinson, 2001). The main classes of ore deposits occupy broad fields in Th-Salinity space which reflect the basic properties of the fluid involved in their formation and are broadly constrained between the halite saturation curve and the critical curve for pure NaCl solutions. For instance, epithermal deposits are primarily formed from modified, surface- derived fluids that have circulated to a range of depths within the brittle regime of the crust, often in areas of elevated crustal permeability and heat flow. They are therefore typified by low salinity fluids and a range of homogenization temperature that, because of the generally low trapping pressure involved, serve as an approximation of trapping temperature, spanning the typical epithermal range of < 100˚C to 300˚C. It should be emphasis that such field are not sharply determined and that examples exist which do not fall in to the defined ranges; such information should solely be used as a guide and provides for the in experienced worker a feel for the type of data characteristic of different mineralizing systems. However, the data of fluid inclusions shows that Anguran deposit is related to the subsurface activity and the same of irish- type Zn-Pb deposits.

References

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