

Volumetric properties of multi-electrolyte aqueous solutions at elevated temperatures and pressures

D. ZEZIN¹, T. DRIESNER² AND C. SANCHEZ-VALLE³

¹(denis.zezin@erdw.ethz.ch),

²(thomas.driesner@erdw.ethz.ch.)

³(carmen.sanchez@erdw.ethz.ch)

Aqueous solutions play a vital role for many geological processes in various environments, such as geothermal and magmatic hydrothermal settings or sedimentary basins. In order to perform a detailed geochemical modeling to describe these processes quantitatively, one needs accurate thermodynamic data for all constituents, with aqueous fluid being the essential part of a system. The fluids are typically multi-electrolyte aqueous solutions of a wide range of salinity predominantly comprising chlorides and sulfates of alkali and alkali earth metals. However, the thermodynamic properties of such solutions have remained largely unstudied at elevated temperatures and at pressures above the vapor pressure saturation curve, affecting the accuracy of geochemical modeling at geologically relevant conditions.

We present the results of an experimental study of the volumetric data of multicomponent electrolyte solutions over a wide range of temperatures, pressures, and compositions. This study provides the volumetric properties of aqueous solutions containing binary mixtures of chlorides and sulfates of Na, K, Ca and Mg at temperatures up to 250 °C and pressures up to 70 MPa for ionic strengths up to 12 molal. A vibrating-tube densimeter was used to measure the relative density of aqueous solutions with respect to pure water. The mean apparent molar volume of the electrolyte mixture, calculated from the experimental data, was used for evaluation of the partial molar volume of dissolved components and limiting partial molar volume of these solutes. The obtained data were used for direct evaluation of the pressure dependence on water-rock equilibrium, e.g., anhydrite dissolution and Na-K-(Ca) geothermometry reactions. Such experimental data may also provide important information about the structure of a solution and ionic interactions occurring in aqueous liquids.

The presented experimental data will be employed for the parameterization of thermodynamic models describing the properties of aqueous mixtures of electrolytes. The results of this study will find use in hydrothermal and geothermal fluid-related modeling, petroleum and geothermal reservoir engineering, processing and utilization of industrial brines and CO₂.

Mineralogical evidence of high-fluoride oxidizing fluid in Baiyanghe U-Be-Mo Deposit, Xinjiang, China

CHENGJIANG ZHANG¹, WANG GUO^{1,2}, SONG HAO¹, CHEN FENXIONG² AND WANG BAOQUN²

¹ Chengdu University of Technology, Chengdu 610059, China

(*Correspondence: zcj@cdut.edu.cn)² Geologic Party No. 216, CNNC, Urumqi 830011, China

Baiyanghe uranium-beryllium-molybdenum deposit, located in the western of Xuemisitan volcanic rock belt, is formed in late Palaeozoic mature island-arc environment, the north marginal active belt of Junggar. According to incomplete statistics, the unique similar to this deposit is the Spor uranium-beryllium deposit in Utah, USA, and the elements combination in Spor are U-Be-F, while Baiyanghe deposit are U-Be-Mo-F.

In space, there is both overlap and separation phenomenon exist in uranium-beryllium-molybdenum ore bodies. There are mainly three kinds of spatial relations: Firstly, the uranium-beryllium-molybdenum ore bodies are coincided basically with the space or roughly consistent; Secondly, the single uranium ore body without beryllium and molybdenum; Thirdly, the beryllium and molybdenum ore bodies without uranium.

This type of ore deposits are associated with high silicon-rich fluorine acidic volcanic rocks, and the ore-forming fluid derive from the fluorine-rich gas-liquid containing molybdenum, beryllium and uranium from the immiscibility of the later volcanic magmatism[1,2]. The migration of the three elements in fluid are in various complex forms, such as fluoride, beryllium fluoride complex, carbonate complex, uranyl ions carbonate, the fluoro carbonate of uranium, uranyl ions molybdenum acid radical. Thus, the volatile, such as F and CO₂, play an important role in the migration and precipitation of uranium, beryllium and molybdenum.

The sulfide mineral are rare in Baiyanghe deposit, and the vast oxide minerals, such as hematite, manganite, pyrolusite, indicate that the ore-forming fluid are oxidizing fluid properties. At the late ore-forming stage, there are small amounts of sulfide mineral, such as pyrite, gellenite and molybdenite.

This work is supported financially by the National Natural Scientific Foundation of China (Grants No. 41272100).

[1]Mark D B et al. (2002) Reviews in Mineralogy and Geochemistry 50, 591-691. [2] Greta M E et al.(2002) International Journal of Coal Geology 55, 47-58.