Research Advances

Geochemical Characteristics of the Fluid Inclusions Trapped in Primary Gypsum of the Lop Nor Basin

MA Lichun [1, *], TANG Qingfeng [2], WANG Xin[1] and SUN Xiaohong[1]

1 *MLR Key Laboratory of Metallogeny and Mineral Assessment, Institute of Mineral Resources, CAGS, Beijing 100037, China*

2 *Beijing Centre for Physical & Chemical Analysis, Beijing 100089, China*

Objective

The Lop Nor Basin is a very important Quaternary potash-formation basin in China. It is a typical sulphate-potash brine mine with an average grade of 1.4% (KCl) in underground concentrated brines. It is extraordinary that the reservoir of potassium-rich brines is glauberite stratum rather than halite rock. The anomalous potassium enrichment, advanced in relative early stage of lake evolution (sulphate stage), has attracted much attention in the recent twenty years. Many researchers consider that there may be other source supply besides the Tarim River.

There are gypsum ($CaSO_4 \cdot 2H_2O$), anhydrite ($CaSO_4$), glauberite ($CaSO_4 \cdot Na_2SO_4$), bloedite ($Na_2SO_4 \cdot MgSO_4 \cdot 4H_2O$), halite (NaCl) and polyhalite ($K_2SO_4 \cdot MgSO_4 \cdot 2CaSO_4 \cdot 2H_2O$) in the chemical deposits of the Lop Nor Basin. Petrographic studies are indicative of clear diagenetic overprints and secondary replacement involving glauberite, polyhalite and anhydrite. The gypsum minerals preserve the primary deposits characteristics. Therefore, the fluid inclusions trapped in primary gypsum presents the chemistry of the early lake water from which the gypsum precipitated. This enables us to draw inferences on chemical composition of the early Lop Nor Lake water. The purpose of this research is to identify the composition of the early Lop Nor Lake from ancient gypsum deposits.

Methods

The laser ablation ICP-MS (Inductively Coupled Plasma-Mass Spectromety) method was used to analyze the ion concentration of individual fluid inclusions in gypsum minerals, which allows analysis of major and trace elements with a precision of ~30%. The EQL/EVP computer program was used to model the evaporation of the Tarim River and modern seawater. The simulated evaporation paths show that the ion concentrations in molalities, along with the number of moles of salts precipitated during each evaporation step.

Results

The analysis results are shown in Fig. 1. Red solid symbols represent fluid inclusions trapped in gypsum. Solid curves trace the paths calculated for equilibrium evaporation of the Tarim River water simulated with the EQL/EVP computer program at 25°C. It is inferred that the chemical characteristics and water type of the fluid inclusions trapped in primary gypsum, match closely with gypsum precipitation stage of the Tarim River water, seen in Fig. 1.

Conclusion

It is suggested that the Tarim River is the main inflow water source in the early stage of the Lop Nor lake evolution. No other water source supply is enough to change the water type and chemical characteristics of the

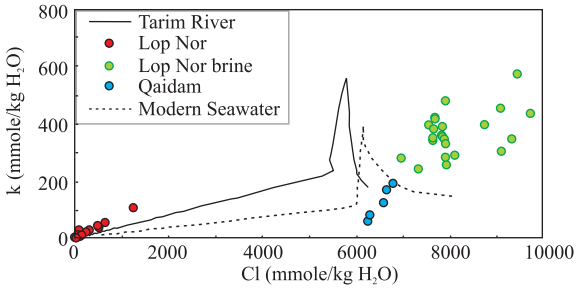

Fig. 1. Chemical analysis of the Quaternary individual fluid inclusions in gypsum from the Lop Nor Basin.

Red solid symbols for Lop Nor represent fluid inclusions trapped in gypsum. Green solid symbols represent underground concentrated brines in the present Lop Nor Basin. Blue solid symbols represent concentrated brines in the present Qaidam Basin. Solid curves trace the paths calculated for equilibrium evaporation of Tarim River water simulated with the EQL/EVP computer program at 25°C. Dashed curves track the evaporation of modern seawater simulated with the EQL/EVP computer program at 25°C.

* Corresponding author. E-mail: lichmafly@gmail.com

dominant inflow water in the early stage of Lop Nor Lake. However, this result does not exclude that there might be other water source supply after the gypsum precipitation stage. Therefore, more fluid inclusion data are needed from other salt minerals precipitated in middle-late stage to figure out the hydrology evolution history of the Lop Nor Basin.

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