Study of Physicochemical Conditions for 510-1 Uranium Deposit Mineralization in Zoige, Sichuan Province, China

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1 Introduction

Sichuan Zoige Uranium Field is one of the well-known carbonaceous-siliceous-argillaceous rock type uranium deposits in the orefields. It is not only characterized by large scale and rich grade, but also centralized distribution and a variety of associated metallic elements available for utilization, thus attracting much attention of geologists (Chen Youliang, 2004, 2008). 510-1 uranium deposit is a typical deposit in the area. Among the ore mineral associations of the deposit, the common pitchblende-pyrite-calcite-quartz indicates the hydrothermal minerals calcite, quartz and pyrite are closely related to uranium mineralization (Chen Youliang, 2012). In this paper, the fluid inclusions in the hydrothermal calcite and quartz veins in this uranium deposit are analyzed from the perspective of petrography and thermometry to reveal the physicochemical conditions for the formation of metallogenic fluid.

2 Samples and Analysis Methods

The samples in this experiment were collected at open pits and 2 to 7 levels orebody in 510-1 uranium deposit, including quartz and calcite samples at different stages. Firstly both sides of each sample were polished into wafers with the thickness of 0.2–0.3 mm. Then, after mineralography and fluid inclusion petrography observation, the representative inclusions were analyzed from the perspective of microthermometry (temperature measurement with microscope and salinity measurement of fluid inclusions in quartz and calcite were respectively carried out by means of homogenization method and freezing method). Analysis of temperature measurement of fluid inclusions with microscope was conducted with a LINKAM THMS600 Hot/Cold Stage at the Beijing Research Institute of Uranium Geology. The temperature range is from -196 to +600°C. The laboratory temperature and humidity at the time of measurement were measured 22°C and 40%.

3 Analysis Results and Conclusions

With the help of the polarizing microscope (with single plane), it is found out that a lot of native or false secondary fluid inclusions were developed in quartz and calcite samples. These fluid inclusions are mostly clustered and banded, occasionally scattered. They are colorless, gray or dark gray. Most of them are in regular shape, with size ranging from a few microns to tens of microns and gas-liquid ratio generally between 5% and 30%. The homogenous phase is the liquid phase.

Among the 369 groups of data of inclusions were measured during this analysis, 325 groups are effective. According to the analysis of experimental results (see Fig.1), the range of homogenization temperature of the fluid inclusions of pre-ore quartz is from 201°C to 394°C with the average of 319°C; its salinity is 3.71~10.48 wt% NaCl eqv with the average of 6.98 wt% NaCl eqv. while the range of homogenization temperature of the fluid inclusion of main-ore quartz is from 139°C~426°C with the average of 284°C; the corresponding salinity is 2.90~10.49 wt% NaCl eqv with the average of 7.11 wt% NaCl eqv. The range of homogenization temperature of the fluid inclusions of pre-ore calcite is 93~314°C with the average of 194°C; the corresponding salinity is 1.40~8.41 wt% NaCl eqv with the average of 4.50 wt% NaCl eqv; while the homogenization temperature of the fluid inclusions of main-ore calcite is distributed between 91°C~317°C with the average of 160°C; the corresponding salinity is 0.88~8.95 wt% NaCl eqv, an average of 4.15 wt% NaCl eqv. By comparing the results of the above analysis, it is discovered that the homogenization temperature of fluid inclusions in the deposit from the pre-

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ore period to the main-ore period presents an obvious tendency of decrease, and that fluid inclusions in this deposit were formed under the conditions of medium and low temperature and low salinity.

According to the mathematical model fitting formula calculate the density of the fluid inclusions (Liu Bin, 1999), based on the known homogeneous temperature and salinity, comprehensive analysis shows that the density range of the fluid inclusions in quartz is 0.51~0.97g/cm$^3$ with the average of 0.76g/cm$^3$; the density range of fluid inclusions in calcite is 0.71~1.02g/cm$^3$ with the average of 0.90g/cm$^3$. The corresponding pressure value can be calculated with the isochoric formulae for NaCl–H$_2$O fluid inclusions (Liu Bin, 1987). Pursuant to that, the formation pressure range of fluid inclusions is 4.2~30.4MPa, and corresponding to the depth of mineralization estimated with lithostatic pressure formula is approximately 159~1149m (rock density: 2.7g/cm$^3$), indicating that the metallogenic fluid was formed under the conditions of low pressure and low depth.

In summary, the metallogenic fluid of 510-1 uranium deposit in zoige uranium oreifield are characterized by medium and low temperature, low salinity and low-density, and this deposit formed at low pressure and low depth is a typical epithermal deposit.

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References


