The Study of the Fluid Inclusions and Temperature, Pressure Characteristics in the Granite-Type Uranium Deposits in South China

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Abstract: The formation of granite-type uranium deposits is closely related to the physicochemical conditions of ore-forming fluids, which mainly including temperature, pressure, salinity, density, pH, Eh. South China is the most important district of granite-type uranium deposits. It is significant to study the physicochemical conditions of ore-forming fluids during mineralization in order to perfect the metallogenic theory of granite-type uranium deposits. In this study, based on published researches of granite-type uranium deposits in South China, we research the metallogenic temperature and pressure to describe the mechanism of uranium enrichment.

South China, located at the eastern margin of the Eurasia continen, is one of the most important uranium-producing districts in China. It borders the pacific western Ocean to east. It made up of the Yangtze block in the north-west and the Cathaysian block in the southeast (Hu et al., 2008). There is a late Paleozoic and early Mesozoic Qinling-Dabie orogenic belt between the North China block and the Yangtze block in the north of South China, and the Yangtze plate in the west borders Tibet. The granitic batholith is widespread in South China which including Zhuguang, Guidong, Qingzhangshan, Pingtian and Taoshan batholith (Hu et al., 2008). The Zhuguang and Guidong multiple instrusion which formed during the Indosinian and Yanshanian, is the main uranium-producing granite. In South China, based on characteristics of mineralization, granite-type uranium deposits can be divided into two types: silicified zone-type granite uranium deposits and alkali-metasomatic granite uranium deposits. And the later can be classified into two subtypes of major vein-type deposits and minor cataclastic-granite uranium deposits.

Here, we summarize the fluid-inclusion study of the uranium deposits which occurred in Guidong and Zhuguangplution.

The Xiazhuang uranium ore field is a prime example of Guidongplution. The $T_{h\text{-}tot}$ of early fluid inclusions hosted in quartz range from 210 to 416℃ with pressure of 228.9–516.7bar (Chen, 1986; Pan et al., 2007; He, 2017). The main-stage inclusions in quartz, fluorite and carbonate homogenized at temperatures of 90–410℃ with pressure of 25.3–68.7 bar (Chen, 1986; Pan et al., 2007; He, 2017). The late-stage inclusions of fluorite and carbonate homogenized at temperatures of 100–200℃ with pressure of 10.1–20.2 bar (Chen, 1986; Pan et al., 2007; He, 2017).

The Mianhuakeng uranium deposit is a prime example of Zhuguangplution, The $T_{h\text{-}tot}$ of early fluid inclusions hosted in quartz range from 210–415℃ with pressure of 4.5 bar (Chen, et al., 1990; Zhang et al., 2007; Zhang et al., 2009; Zhang et al., 2016). The main-stage inclusions in fluorite and carbonate homogenized at temperatures of 137–354℃ with pressure of 4.7bar (Chen et al., 1990; Zhang et al., 2007; Zhang et al., 2009; Zhang et al., 2016). The late-stage inclusions of quartz, fluorite and carbonate homogenized at temperatures of 96–193℃ with pressure of 7.1 bar (Chen et al., 1990; Zhang et al., 2007; Zhang et al., 2009; Zhang et al., 2016).

Thirty doubly polished thin sections (about 300μm thick) were prepared from quartz,fluorite and carbonate samples associated with different stages at the Mianhuakeng deposit. Microthermometric measurements on the fluid inclusions were carried out using a Linkam THMS 600 progrsmmable heating-freezing stage comnined with an Olympus BX53 microscpoe at the Chengdu University of Technology (CDUT), the detaile process have been described (Zhang et al., 2016). Four types of temperature observations were made in this study including the melting temperature of CO_2 ($T_{m\text{-}CO2}$), final melting temperatures of ice (Tm-ice), final melting temperatures of clathrate (Tm-clath), the total homogenization temperatures (Th-tot). Using Tm -ice, salinities of the H_2O-NaCl (Bodnar, 1993) fluid systems can be calculated. Density and pressure of fluid inclusions were calculated by the Flincor computer program (Brown and Lamb, 1989). The quantity of CO_2-NaCl-H_2O inclusion have been measured is less in Mianhuakeng deposit. The Tm-clath and $T_{m\text{-}CO2}$ weren't calculated.

The $T_{h\text{-}tot}$ of early fluid inclusions hosted in quartz range from 202–279℃ with pressure of 29.1bar. The main-stage inclusions in fluorite and carbonate homogenized at temperatures of 221–246℃ and the pressure of fluorite is 72.6bar. The late-stage inclusions of quartz, fluorite and carbonate homogenized at temperatures of 96–193℃ and the pressure of fluorite is 4.7bar.

(1) The Xiazhuang shows that the temperature of 210–416℃

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is higher than the 100–200℃, and the pressure of 228.9–516.7 bar higher than the 10.1–20.2 bar. The Mianhuakeng shows that the temperature of 210–415℃ is higher than the 96–193℃, and the pressure of 800–1800 bar higher than the 2–98 bar.

(2) Fluid-inclusions study of the xiazhuang and Mianhuakeng uranium deposits in South China indicate that the mineralization were occurred under the environment of high temperature and high pressure to medium and low. And the great fluctuation of pressure may reveal that the decompression degassing process promotes the precipitation of uranium.

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Key words: South China, fluid inclusion, uranium deposit, temperature, pressure

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