Geochemical Characteristics of Trace Elements of Zoige 510-1 Uranium Deposit, Sichuan Province, China

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1 Introduction

The Zoige uranium ore field in Sichuan province is one of the famous Carbonaceous-siliceous-argillitic rock type uranium deposits of China, in which the 510-1 uranium deposit is the relatively richer, larger-scale and one of the typical and representative deposit (Chen, 2008). In this paper the ore of the deposit and layer of rock have been studied on trace elements of geochemical characteristic systematically. That is to discuss the origin of metallogenic substance of 510-1 uranium deposit.

2 Sampling and Analytical Methods

The 23 ore samples (U>500×10^-6) were collected in the open pit and levels No.2~7 of 510-1 uranium deposit. The 32 rock samples were collected from the rock formations and rock dyke samples in peripheral stratum. The samples were sent to the analytical laboratory of Beijing Research Institute of Uranium Geology and analyzed after the standard analytical method (DZ/T00223—2001). For the determination of trace elements, the HRICP-MS (Finnigan Element I) was used, with an analytical precision is better than 10%.

3 Results and Discussion

The ores of 510-1 Uranium deposit can be divided into two major types, namely, siliceous limestone and siliceous rock type. Statistical analysis of 23 ore samples show that: compared with crust Clark value (Li et al. 1976, the same below) the remarkably enriched elements in ores are U, Mo, Zn, Ni and W and the average contents of each element are U: 5840.8×10^-6; Mo: 98.6×10^-6; Zn: 24239.5×10^-6; Ni: 1176.5×10^-6; W: 11.6×10^-6. The obviously enriched elements are Bi, Pb, V and Y. Besides, the ores are depleted in Be, Ga, Rb, Nb, Ta, Ba and Th.

The host rocks of 510-1 Uranium deposit are mainly siliceous rock, limestone, slate and transitional type--siliceous limestone. Dykes invade into the stratum at later stage are mainly granite porphyry dyke, granodiorite porphyrite dyke and dacite porphyrite dyke. Analysis of 32 wallrock and magmatites dyke samples show that the obviously enriched elements in the siliceous rock are U and Mo. The average contents of each element are 18.0×10^-6, 12.5×10^-6.

The obviously enriched elements in the siliceous limestone are Mo and U. The average contents of each element are 10.0×10^-6, 7.4×10^-6.

The obviously enriched elements in slate are Be and Hf, and the average contents of each element are Be: 10.7×10^-6; Hf: 10.5×10^-6. Relatively enriched elements are W and U. In various kinds of rock samples, the average contain of U in slate is the lowest--only 3.4×10^-6.

The obvious enriched elements are Mo and U in the granodiorite porphyrite dykes, followed by W, Cu, Hf, Cr, V, Zn etc. Some of those average contents are Mo: 44.7×10^-6; U: 26.3×10^-6; W: 8.3×10^-6, Zn: 215.0×10^-6; V: 1125.0×10^-6. Compared with other rocks, W, Mo, V, and Cu have the highest levels in granodiorite porphyrite dykes, Cr and Zn have a certain enrichment in granodiorite porphyrite dykes, while they deficit in other rocks. Only enrichment of U in granite porphyry dykes and the average level is 38.5×10^-6, which has the highest concentration in all types of rocks. The content of U in dacite porphyrite dykes is also relatively higher. The content is 36.3×10^-6. Besides, obviously enriched elements are Mo, W, Hf, V, Pb, while elements of depletion are Co.
From the kinds of enriched trace elements of various rocks, the contents of U in siliceous rock, limestone and a variety magmatic dykes are more than $10 \times 10^{-6}$, which are likely to provide the metallogetic materials—U. Mo is mainly provided by intermediate-acid magmatic rocks and carbonatite, and the source of Zn and Mo is similar considering the content features. The contents of Ni in all kinds of rocks are very low. But compared with other rocks it is higher in granodiorite porphyrite dykes, and it is two to five times higher than siliceous rock, siliceous limestone and limestone. So the source of Ni in ores should be related to granitoid. The characteristics of average content of W in granodiorite porphyrite dykes and dacite porphyrite dykes have higher level similarity with ores compared with other type rocks. In correlation analysis, U merely has significantly positive correlation with W in ores, where the trace elements highly enriched. That is showing a close genetic relationship of the mineralization of U and the enrichment procedure of W (Chen et al. 2013).

The distribution curve approximately divided into two parts according to the trend of development which can be seen from primitive mantle-normalized spider diagram of various kinds of rocks and ores (Fig.1). The allocation models of ore and siliceous rock, siliceous limestone and limestone are more similar while slate and magmatic are even closer which means this mine obviously inherit the microelement characters of sedimentary stone within mineralization process.

4 Conclusions

Based on the distribution geochemical characteristics of trace elements from Zoige 510-1 uranium deposit, it can be concluded: Siliceous rock siliceous limestone and magmatic rocks are closely associated with the source of metallogenic materials; The primary enrichment of U was forming during the sedimentary processes. Magmatic superposition played an important influence on the further enrichment of various elements in later stage, intermediate-acidic magmatic rocks which enriches various trace elements is an important source of multiple ore-forming substance.

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