1 Introduction

The volcanic-type uranium deposits located in Xiangshan basin were generally first detected by radiometric methods in 1950s. In recent years, uranium mineralization has been detected by drilling at a depth of several hundred meters, over where there are no significant radiometric responses can be measured on ground surface. The main problem, however, is how to acquire the weak information aroused by the deep-buried uranium orebodies with geochemical techniques.

The electrogeochemical extraction (CHIM) was invented in the former Soviet Union in 1970s. The first detailed paper describing the theoretical principles and the field techniques method, together with some practical results, was published by Ryss Yu.S. and Goldberg I.S. (1973). It is based on the migration of ions in an electric field (Leinz et al., 1998) and it has been proved a kind of effective method to locate concealed mineral deposits, especially for Cu, Pb, Zn, Au and Ag deposits. Ions gathered by the collectors are derived from both the secondary haloes near the surface and ionic haloes from the deep orebodies (Luo Xiangrong, 2008). The IGGE group state that CHIM may be used in exploration for Pb, Zn, Cu, Ni, Au, Ag, Sn, U, and oil and gas with an “effective detection depth of hundreds of meters” (Liu, 1991). Experiment carried out by Alekseev et al. (1978) and Goldberg I. S. (1998) shown that the common velocities of U migration, in an electrolyte and using an applied electric current, were in order of 0.5 cm/h.

2 Material and Methods

2.1 The CHIM procedures in field

The electrodes are made of graphite rod and in a length of 15 cm. Electrodes coated by absorbent materials containing electrolyte compose the element collectors, which are buried underground at a depth of 40 to 60 cm. The distance between the positive and negative electrode is 100 cm. The ground around the electrodes should be wet by the addition of 15% HNO₃. The voltage of the artificial applied DC power is 9V. Fig. 1 shows the CHIM results over NTS U deposit in Xiangshan basin. The host rock is present in form of porphyroclastic rhyolite in Upper Ehuling formation, covered by overburden which mainly consists of weathered rocks and soils. Rhyodacite in Upper Daguding formation is underlying the host rock and there is a clear interface between them. There are 31 element collectors buried underground and the distance between measurement points is 20 m. After 48 hours, the element collectors are taken out and sent to laboratory for analyzing.

2.2 Analytic methods and results

The concentrations of elements in the collectors are determined by ICP-MS. There are three layers of uranium mineralization occurring at depth of 100 m, 200 m and 400 m, separately. The main ore body is intersected by boreholes at a depth of 400 m. The U ore body is manifested as a clear U CHIM anomaly of U detected directly above (Fig. 1b). The typical response to uranium mineralization appears to be peak anomalies. The anomaly of U is approximately 100 m wide, with an intensity up to 5.6 μg of U with a background of 1.6 to 2.8 μg of U. For the purpose of comparison, the result of the analysis of the soil for U is also shown (Fig. 1a). Typically, ‘total’ U element content is difficult to show the anomalies.

3 Conclusions and Discussions

Filed work presented in this paper has demonstrated the effectiveness of electrogeochemical CHIM extraction in exploration for concealed uranium orebodies buried at a depth of more than 400 m. It is confirmed that the form of mobile U can migrate over large distances, which makes it
possible to detect the CHIM anomalies of U on ground. The comparison of CHIM and conventional soil geochemical results showed that the CHIM anomalies of U are very distinct over the U orebodies, while the soil geochemical anomalies cannot show obviously. The CHIM method has been proved useful in exploration for volcanic-type uranium deposits. This approach also has potential in the exploration for other kinds of uranium deposits. In addition, there are many challenges and questions including determining the suitable conditions for different kinds of minerals, mechanisms of the electrogeochemical migration of U.

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References


Fig. 1. CHIM traverse over HYB U deposit: (a) soil; (b) CHIM.  
1—overburden; 2—main U ore bodies; 3—faults; 4—U ore veinlets; 5—boreholes; 6—porphyroclastic rhyolite in Upper Ehuln formation; 7—ryholite in Upper Daguding formation; 8—CHIM columnar section; 9—CHIM profile(averaged).