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Application of Mossbauer spectroscopy in investigation of wall rock alteration at uranium deposit

Pitchblende as the micro/cryptocrystalline uraninite, normally UO_{2+x} , is common U^{4+} mineral species, and is the main ore mineral in the hydrothermal U deposits. Pitchblende always contains certain amount U^{6+} in the formula of UO_{2+x} , where x reaches the maximum value as 0.25. The investigation shows that the mineral composition varies as the lodes formed at different stages and changes outwards from the center of the lode. It also indicates that sulfur/ H_2S and the ferrous minerals may play an important role as a reducer in the deposition of the pitchblende from uraniferous solution where the uranium migrates mainly in the form of various U^{6+} compounds. So, the pitchblende deposition is considered to be a reduction – oxidation process between U^{6+} -bearing solution and the rock as diabase is enriched in ferrous minerals.

In general, the iron-bearing minerals with different valence charge are macroscopically distinguished by their colors. However, it is quite different when the iron-bearing minerals are in small amount and highly dispersed, such as the wall rock alteration. In such a circumstance, Mossbauer spectroscopy is of great advantages compared to other methods because of its sensitivity for the iron containing minerals.

Samples were collected from different zones (the pitchblende lode, the chloritized alteration zone and the weakly altered diabase) at a uranium deposit (Fig. 1). Fig. 2 shows the spectra of these samples. Based on the Mossbauer spectroscopy, the main iron mineral in the lode is pyrite, and in the altered zone there is less pyrite relative to that in the lode. There are more original minerals in weakly altered diabase zone. The difference among these three zones originates from the difference of rock alteration. The alteration decreases according to the increase of distance to the center of the lode, from pyritization to chloritization gradually. The ratio of pyrite decreases with increasing distance to the lode center, while altered ripidolite is most abundant in the altered zone of chloritization.

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