Microbial uranium mineralization and hydrocarbon oxidation in the Qianjia-dian deposit, NE China

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Braided rive facies sandstone - hosted tabular uranium deposit has recently been found in the Lower Cretaceous Yaojia Formation in the Qianjiadian deposit, the Kailu basin, NE China. The mineralization consists mainly of pitchblende (UO_x, x=2.16 to 2.7) and small amount of brannerite (UTi_2O_6). U-Pb dating shows the main U-mineralization took place at about 53±3Ma during the early Himalayan orogeny, when the basin was uplifted and petroleum was up-migrated from the Upper Jurassic lacustrine source rock through faults. Subsequenbtly, part of the U ore was re-mobilized and re-precipitated at about 7±0 Ma during the late Himalayan orogeny. Uranium ore occurs as cement or adsorbed on plant debris, but no correlation occurs between TOC and U content. Some of the pitchblende is intimately intergrown with ore-stage colloidal pyrite, Fe dolomite and calcite, indicating coprecipitation. Ore-stage pyrite shows replacement of barite, and has $\delta^{34}S$ values from -31.4 to -47.1‰ (n=5), suggesting an origin from bacterial sulfate reduction. Fe dolomite/calcite cements have an average content of 4% (n=139) and show $\delta^{13}C$ from -1.3 to -21.7‰ with an average of -6.4‰ (n=10), indicating part of carbon was derived from petroleum oxidation. The host sandstone contains adsorbed petroleum and oil inclusions with adsorbed methane up to 5530μl/kg. GC data from oil inclusions and adsorbed oils show the existence of unresolved complex mixtures, and significant amounts of demethylated hopanes and tricyclic terpanes. These lines of evidence indicate petroleum was likely oxidized by sulfate reducing bacteria (SRB) simultaneously with reduction of sulfates to sulfides, causing direct or indirect reduction of U(VI) to U(IV) and thus supplying some of the carbon in the carbonates. This suggestion is partially supported by the low-temperature diagenetic environment (<50°C). However, U(VI) pre-concentration by adsorption and subsequent inorganic reduction is likely to be less significant than direct reduction of U(VI) by SRB in the Qianjiadian deposit. This is because ore-stage solution is non-acidic, as indicated by digenetic mineral assemblage pyrite, Fe-dolomite, calcite and pitchblende and lack of marcasite precipitation and carbonate dissolution in the host sandstone. The proposal that direct reduction of U(VI) to U(IV) by SRB is supported by recent finding of mineralized microorganisms in the Dongsheng deposit, NW China (Cai *et al*., 2007).

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References

Cai, C.F., *et al*. (2007) *Chem. Geol.* **236**, 167-179.

Sm-Nd and Rb-Sr isotopic ages of adamellite body from the Longquan in the south of Zhejiang, China

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The adamellite body lies in the south of Zhejiang Province, China. The sampling location lie at Badou Group of Lower Proterozoic of Longquan area.

Analytical Method

Analysis of Rb-Sr abundances and their isotope compositions were performed on an automated multi-channel mass spectrometer VG 354 at Center of Modern Analysis, Nanjing University. $^{87}Sr/^{86}Sr$ = 0.710224±6 (2σ) for NBS987 standard. $^{43}Nd/^{144}Nd$ = 0.512465±6 (2σ) for BCR-1 standard.

Discussion of Results

The age of Rb-Sr isochron for the adamellite body from Badou Group area. is 665.5±21Ma and initial $^{87}Sr/^{86}Sr$ ratio is 0.74175±92. Sm-Nd isotope age of the whole rock-mineral internal for the adamellite body rock .is 2059± 52Ma. The isotopic age of the whole rock-mineral internal Sm-Nd isochron for the adamellite body from Badou Group of Lower Proterozoic of Longquan area is 2059±52Ma and initial εNd(t) is -1.97∽-2.46.

Conclusion

Rb-Sr age of the the adamellite body whole-rock and mineral samples reflects the age of this intrusion after the disturbation of the subsequent geological processes. Sm-Nd age of the the adamellite body whole-rock and mineral samples is consided as the emplacement age of the adamellite body and indicates that the earliest activity of granitic-magma in Zhejiang. In combination with the geological evidence and geochemical date,it is believed that the adamellite body belong to a S-type [1] or transformation-type granite. It was formed by partial melting of the crustal materials mainly of sedimentary constituents. T^{Nd}_{DM} of 5 whole rock-mineral samples is about 2600-2700Ma.

Reference

[1] McCulloch MT *et al*. (1982). *Earth Planet. Sci. Letter*, **58**:51-64.