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Research Advances

A New Type of REE Deposit Found in Clay Rock at the Top of the Permian Emeishan Basalt in the Yunnan-Guizhou Area

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Objective

A set of REE-rich clay rocks is formed at the top of the Emeishan basalt in the eastern Yunnan-Western Guizhou area, accompanied by Nb, Zr, Ga. It is a new type of REE deposit and has great resource potential. This paper introduces its metallogenic conditions and element occurrence states, discusses the genetic mechanism.

Methods

Through the 1:500 petrographic section measurement, thin section identification, X-ray diffraction analysis, etc., the occurrence state of REE is ascertained. Taking the top boundary of Emeishan basalt as the isochronal surface, the sedimentary microfacies of the ore-bearing strata are divided and compared, and the ore-forming geological conditions are summarized. Combined the geochemical analysis of elements, the genetic mechanism is discussed.

Results

The REE-rich clay rock at the bottom of the Permian Xuanwei Formation has good continuity. It is widely distributed in the area from the Zhaotong-Xuanwei-Qujing in Yunnan to the Hezhang-Liupanshui in western Guizhou. The ore-bearing layer is 2~16 meters thick and has the highest grade in the area of Zhenjue-Chahe town in Weining County. Vertically, from bottom to top, the ore beds can be divided into several sub-beds, almond-shaped basalt (Fig. 1d) — magenta iron-bearing tuffaceous clay rock (Fig. 1e)—light gray tuff clay rock—off-white bauxite clay rock (Fig. 1f) —Gray-green silty clay rock (Fig. 1h) —light gray siltstone (Fig. 1g) with a small amount of carbonaceous clay rock (Fig. 1a), and grayish white clay rock in the middle has the highest REE content (Fig. 1b).

The REE-rich clay rock strata are layered, with horizontal bedding, block bedding, meanwhile, there are lots of conglomerates and bottom eroding of river can be seen on several sections. The sedimentary environment is the deltaic plain. The REE content is closely related to the alluvial plain. In the same period, there was no REE anomaly in the Longtan Formation, which is marine-terrigenous facies, in the east of Hezhang-Liupanshui. Restricted by the paleogeographic environment, REE anomalies only occur in the eastern Yunnan-Western Guizhou area.

The highest ΣREE in the ore beds is 16000 ppm, with an average of 1500 ppm, associated with Niobium (Nb_2O_5 average 322.01 ppm, maximum 2846.84 ppm), zirconium (Zr_2O average 907.71 ppm, up to 8199.82 ppm), gallium (Ga average 47.38 ppm, maximum 162 ppm). Useful elements are dominated by kaolinite (83%), with a small amount of halloysite (2%), hydromica, β-quartzes, and chlorite (1%), light rare earth elements are strongly enriehed（88.51%）, exists in isomorphism (80%) and ion-adsorption (20%).

The LREE / HREE of the ore-bearing section is between 3.96-10.70, with an average of 7.15, δEu is between 0.35-0.90, average 0.65, δCe is between 0.75-1.54, average 1.11 (Fig. 1c). This mine is different from the other major REE deposits in the world, and its properties are similar to the iron-REE deposit (Fig. 1i). REE distribution pattern showing light REE enrichment, has an overall right-dip shape, it is similar to the Iron-REE deposits and the Emeishan basalts in the area (Fig. 1j).

Conclusion

The REE-Nb-Zr-Ga clay rock in the Yunnan-Guizhou area contains typical minerals derived from basalt and volcanic ash. The REE distribution pattern is inherited from the basalt. The genetic mechanism may be that, after the basalt weathering and erosion, it is transported to the alluvial plain between the volcanic depressions, and deposited with the volcanic ash. Under the weathering and leaching, REEs are gradually resolved and adsorbed in kaolinite mudstone (Yang et al., 2008), or entering into the lattice of minerals as isomorphism, form the REE-rich layer.

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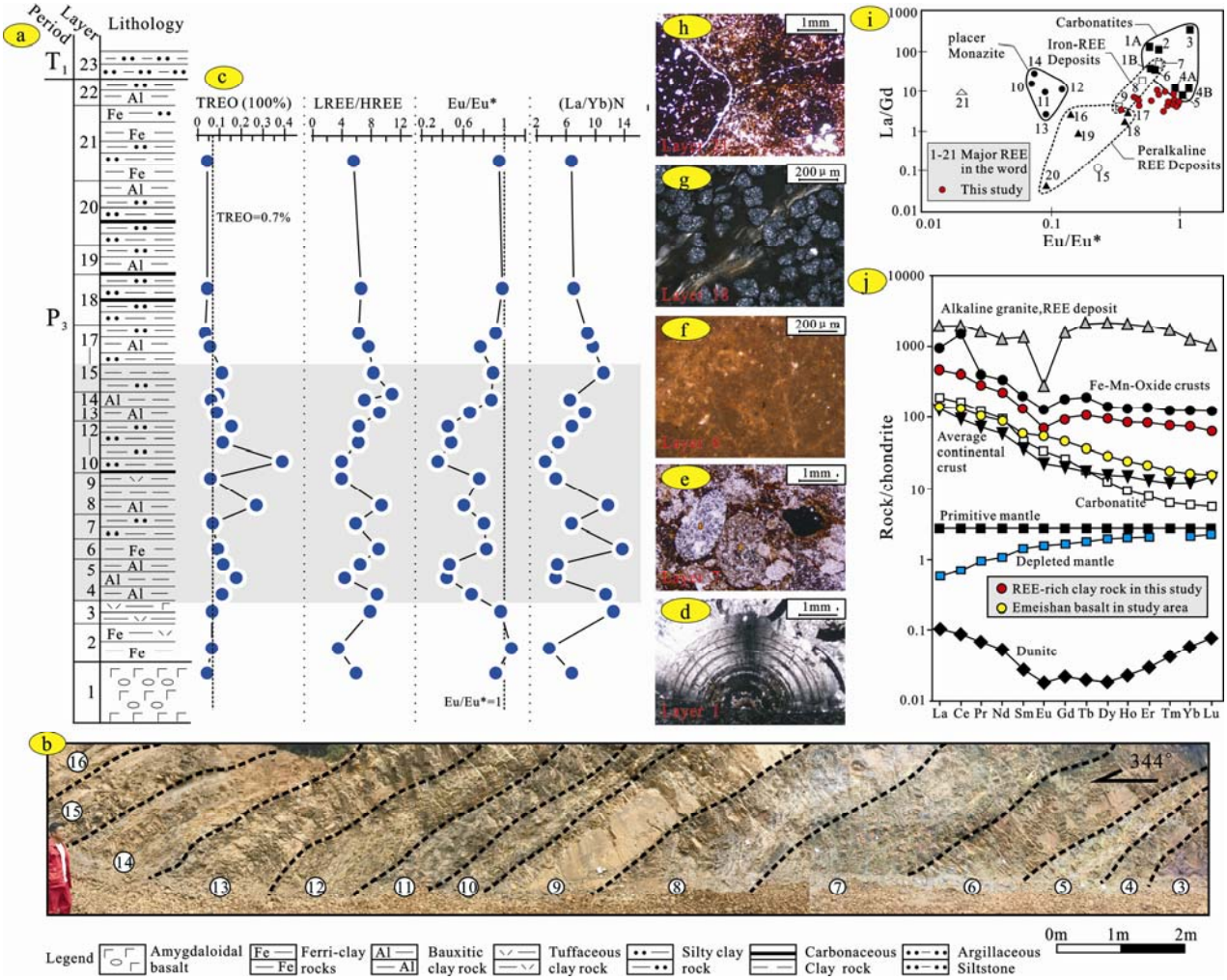


Fig. 1. Photographs, ore types and typical parameters of REE-rich clay rock in Northwest Guizhoun (I-after Castor et al., 2006; J - after Sindern, 2017)

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