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Rare Earth Elements Characteristic Research of Chahe Copper Deposit at Yuanjiang, Yunnan

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The Chahe copper deposit, a medium-sized deposit, is located in yuanjiang county, Yunnan province. Research on rare earth elements of the ores, can indicate elements enrichment regularity and genesis of deposit effectively. Research on the rare earth elements of country rocks and ores in Chahe copper deposit shows that the distribution patterns of rare earth elements of country rocks is consistent greatly with ores and both of them are characterized by right-sloping type, rich in light rare earth elements and depleted in heavy rare earth elements relatively, with significantly negative anomaly of Eu (Zhang Yuxue et al., 1995). This paper aims, by comparative study of rare earth elements of country rocks, far away from ore body, surrounding rocks of mining area, country rocks of rich ores in mining area and ores, to discuss copper deposit characteristics of rare earth elements and their migration patterns.

1 Mining Area Geological Survey

The Chahe copper deposit is situated in the south of Kangdian floor and the western margin of Yangtze paraplatform. There is a set of medium metamorphic volcanic-sedimentary rocks at the mining area. The copper ore bodies occur in the second unit (Pt_1Ch_2) of the early proterozoic metamorphic rock series in Chahe, Dahongshan Group which is mainly composed of chlorite schist, biotite plagioclase gneiss quartzite, mica quartz schist and lens-like basic volcanic rocks. Morphology of the ore bodies are mainly layered, stratified, lenticular and the host rocks mainly quartzite, mica quartz schist. The ore minerals are mainly chalcopyrite, pyrite, magnetite, etc and the gangue minerals are mainly composed of quartz and calcite.

2 The Sample Description

All the samples are taken from Chahe copper deposit, sample C01 and C03 for country rocks are taken in the mining area, which have no ore minerals developed. Samples C11 and C16-5 are for country rocks of rich ores. The large-grained chalcopyrite can be seen in C11, and small-grained chalcopyrite scatter in C16-5. Samples Yc-1 and Yc-10 are ores, Yc-5 is country rocks far away from the ore bodies.

3 Characteristics of Rare Earth Elements

From table 1, all the samples have limited variation of ΣREE value which is 10.57 ~ 693.93 ug/g (average 170.87 μg/g), with 9.57 ~ 642.68 ug/g LREE, 1.01 ~ 51.25 ug/g HREE, and 6.94～17.86 ratio of LREE/HREE and show obvious enrichment of light rare earth elements, belonging to the LREE-rich type. All the samples show negative anomaly of Eu (δEu is 0.22 ~ 0.96 ug/g) with no obvious anomaly (δCe values is between 0.88 ~ 1.01 ug/g). The contents of rare earth elements and their total contents in country rocks away from the ore body are significantly lower than the country rock of the mining and rich ores, but higher than those in ores. The total rare earth contents in surrounding rocks of rich ore mining area are the highest. Total amount of light rare earth and heavy rare earth has the same rule.

In the hydrothermal process, rare earth elements in rocks can be activated and migrated, but only at high water/rock ratios, the contents of rare earth elements in rocks will be modified largely (Michard，1989), thus, during the modification of Chahe copper deposit by hydrothermal fluids, the reaction of water and rocks in country rocks of mining area and the country rocks of rich ores, under the process of strongly ore-forming hydrothermal fluids, make the county rocks rich in rare earth elements, which are higher than the country rocks far away from the ore body. However the stronger reaction

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Table 1 Contents of the rare earth elements in Chahe copper deposit

Sample	La	Ce	Pr	Nd	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm
C01	18.5	39.8	4.79	18.1	3.38	0.621	3.24	0.581	3.33	0.674	1.9	0.335
C03	25.7	47.3	5.34	20	3.99	1.26	4.11	0.611	2.79	0.535	1.2	0.16
C11	156	304	35.3	126	20	1.38	18.3	2.71	13.3	2.71	7.1	1
C16-5	39	73.8	8.26	30.8	5.56	1.69	7.01	1.22	6.32	1.33	3.45	0.489
Yc-1	7	14.42	1.64	5.04	0.96	0.255	0.59	0.084	0.39	0.071	0.23	0.033
Yc-10	2.31	4.08	0.52	2.04	0.5	0.118	0.38	0.047	0.26	0.047	0.14	0.016
Yc-5	14.06	28.01	3.36	10.95	2.22	0.59	1.98	0.358	2.07	0.421	1.27	0.212

Sample	Yb	Lu	Y	ΣREE	LREE	HREE	LREE /HREE	La_N /Yb_N	δEu	δCe	data sources
C01	1.91	0.23	19.7	97.39	85.19	12.20	6.98	6.95	0.57	1.01	this study
C03	1.05	0.143	11.8	114.19	103.59	10.60	9.77	17.56	0.94	0.94	this study
C11	5.44	0.687	63	693.93	642.68	51.25	12.54	20.57	0.22	0.96	this study
C16-5	2.69	0.406	32	182.03	159.11	22.92	6.94	10.40	0.83	0.96	this study
Yc-1	0.21	0.033	1.61	30.96	29.32	1.64	17.86	23.91	0.96	1.01	(Zhang et al. 1995)
Yc-10	0.1	0.016	1.01	10.57	9.57	1.01	9.51	16.57	0.80	0.88	(Zhang et al. 1995)
Yc-5	1.33	0.2	10.6	67.03	59.19	7.84	7.55	7.58	0.84	0.97	(Zhang et al. 1995)

between the country rock of rich ores and hydrothermal fluids lead the contents of rare earth elements in the country rock of rich ores rich in large amounts of rare earth elements which is significantly higher than the country rocks and the country rocks far away from the ore body. The contents of rare earth elements in ores is the least, which may be caused by numerous loss of rare earth elements as the result of fractionation of rare earth elements during the alteration of REE-bearing minerals in the process of hydrothermalism.

4 Conclusions

Above all, the contents of REE in all samples show obviously right-sloping, belonging to the type of LREE-rich, and Eu perform negative anomaly. In the deposition of stratum, the ore-forming hydrothermal modify the country rocks, causing the contents of rare earth elements in the country rocks higher than the country rocks far away from the ore body. Composition of country rocks and country rocks of rich ore are complicated, while the composition of ore minerals is simple. The distribution patterns of rare earth elements in country rocks and country rocks of rich ores are similar, implying that the ore may inherit the characteristics of rare earth elements of country rocks and country rocks of rich ores. In the process of mineralization, rare earth elements continue to fractionate and result in the decrease of rare earth content.

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