IOP Conference Series: Earth and Environmental Science

PAPER • **OPEN ACCESS**

Characteristics and migration rules of major elements of the bauxite in Meitan-Fenggang area, northern Guizhou, China

To cite this article: Junfeng Luo *et al* 2019 *IOP Conf. Ser.: Earth Environ. Sci.* **384** 012132

IOP Conf. Series: Earth and Environmental Science **384** (2019) 012132 doi:10.1088/1755-1315/384/1/012132

Characteristics and migration rules of major elements of the bauxite in Meitan-Fenggang area, northern Guizhou, China

Junfeng Luo*, Zhaoyang Wu, Jiao Tang, Daoguo Zeng

Institute of geology and deposit exploration, Nonferrous metals and nuclear industry geological exploration bureau of Guizhou, Guiyang 550005, Guizhou, China

*Corresponding author e -mail: 363964899@qq.com

Abstract: The following results were obtained by analyzing the major elementss of bauxite in the Meitan-Fenggang area: 1) There is a correlation between Al, Si, Fe and Ti elements, and Al is negatively correlated with Si and Fe, Al and Ti have positive correlation, Si is negatively correlated with Fe and Ti; 2) Al, Si and Fe have a downward migration trend, and the migration of Si and Fe to the bottom is the key to the formation of high-grade bauxite; 3) The migration of Fe Al, Si is not completely synchronized, but However, the higher the Al content, the stronger the correlation between the samples Al, Si, and Fe.

Key words: Major elements, Bauxite, Migration Rules, Meitan-Fenggang area.

1. Introduction

The northern part of Guizhou contains rich bauxite resources. It was mainly divided into two parts: Wuchuan-Zheng'an-Daozhen bauxite mine, bauxite mine in Zunyi area, and many experts have done a lot of research on bauxite mines in these two areas. They had great results (Du et al., 2013;Weng et al., 2013; Gu et al., 2013; Wang et al., 2013; Zhang et al., 2013; Zhao et al., 2013; Cui et al., 2013; Lei et al.,2013; Liu et al., 2016; Liu et al., 2018; Jin et al., 2018)and had comprehensive understanding of the metallogenic mechanism of bauxite deposits in these two areas. In the past, the Meitan-Fenggang area was considered as the boundary of Wuchuan-Zhengbauxite deposit in northern Guizhou. The potential of bauxite resources is insufficient. However, recent exploration has shown that there are certain bauxite resources in the Meitan-Fenggang area, and there are few studies on this part of bauxite resources. In this paper, the Meitan-Fenggang area is systematically sampled and analyzed by field geological survey. The characteristics of major elementss of bauxite deposits in this area are studied, which provides basic information for the study of the metallogenic mechanism of bauxite deposits in Meitan-Fenggang area.

2. Geological Background

The study area is located in Fengle District of Wuchuan-Fenggang Counties. It is about 4KM from Wuchuan County in the north and 30KM from Fenggang County in the south (Fig.1, a). The elevation in the exploration area is generally 800-1100 m, the highest is 1421 m (Liudinggai Mountain of Fengleshan River in Wuchuan), the lowest is 540 m (the junction of the northernmost end of the exploration area and Fengle River), and the maximum relative elevation difference is 881 m, generally

150-450 M. The terrain is undulating, with shallow-medium cut, low-mountain-middle-altitude narrow valley topography. The carbonate rock series in the area are widely distributed, and the Karst landforms such as the dark river, caves, funnels, solitary peaks and stone forests are developed. The main rivers belong to the Wujiang River system.

The geotectonic location of the exploration area is located in the Yangzi ancient block (I-level tectonic unit), the north Guizhou Tailong (II-level tectonic unit) Zunyi arch (class III structural unit), the north and east tectonic deformation zone of Fenggang, belonging to the Upper Yangtze Mountain - Daba Mountain (Luyuan Depression) Fe-Cu-Pb-Zn-Mn-P bauxite metallogenic belt.From the old to the new, the exposed strata in the area are mainly Cambrian, Ordovician, Silurian, Carboniferous, Permian and Triassic. The Quaternary is scattered and not integrated in the strata of each era. Upper and middle Silurian and Devonian are missed. The lithology is dominated by marine carbonate rocks, followed by clastic rocks dominated by clay rocks. The area has undergone many tectonic movements, characterized by folds and faults. Its main structure consists of a series of NNE-trending synclines, anticlines and compressive-torsional faults, and NW-SE-trending tensional faults.The distribution of bauxite is mostly controlled by the Yanshanian NNE to the Xinhuaxia syncline after mineralization. There is no magmatic activity in the area. Among them, the Permian Zhonglian Liangshan Formation (P_2l) is a bauxite ore-bearing rock series, and the top plate is the Permian Zhongtong Qixia Formation (P_2q) formation stratum, and the bottom plate is mostly the Silurian Hanjiadian group ($S_{1-2}hj$). The mud rock is locally composed of the Carboniferous Zhonglong Huanglong Formation (C_2hn) limestone. The exploration area is characterized by the excavation, distribution and ore-controlling nature of the ore-bearing rock series. It is roughly divided into three syncline structural areas, namely the Wuchuan complex slant, the Yongxing syncline and the Yachuan syncline structure.

The ore body is present in the middle, upper and top of the aluminum-bearing rock series of the Liangshan Formation (P_2l), which is layered, layered and lenticular (Fig.1, b). The ore body is produced in a single oblique layer, which is consistent with the occurrence of the ore-bearing layer Liangshan Formation (P_2l), and its occurrence is also related to the underlying strata Hanjiadian Formation ($S_{1-2}hj$) and the Upper Permian Permian system. The Qixia Formation and the Maokou Formation (P_2q+m) were basically consistent. The southern and central forms are 10-110°∠7-24°, and the northern form is 300-330°∠8-12°. The thickness of the ore-bearing rock series and the thickness of the ore body are unstable or discontinuous, and the regularity is poor.

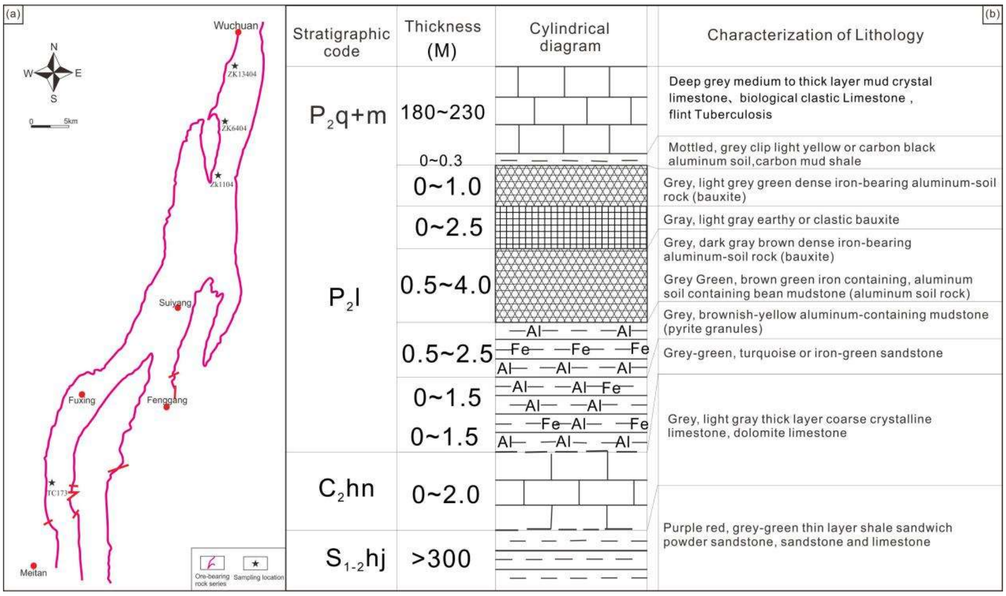

Fig.1 Location of the study area and histogram

IOP Conf. Series: Earth and Environmental Science **384** (2019) 012132 doi:10.1088/1755-1315/384/1/012132

3. Ore Characteristics

Consistent with the type of ore in the Wuzhengdao area, the ore can be classified into dense, clastic, semi-soil, and soybean meal according to natural types (Weng et al., 2013; Du et al., 2013). The ore structure is dominated by a dense structure, followed by a soil-like, semi-soil-like structure and a clastic structure, with occasional bean-like and braided structures (Fig. 2). Dense ore: The main ore type of the mine is gray, dark gray, muddy structure, and the content of debris is generally <5%. The minerals in the ore are evenly distributed. Soil-semi-soily, clastic ore: The minerals in the ore are loosely powdery and semi-powdered. It is the main ore type in the oxidation zone. The clastic shape is characterized by irregular arrangement of crystals, granules or soybean granules constituting the ore, no obvious directionality and stratification. Bean-like, scorpion-like structure: The minerals in the ore are in the form of beans, mites, and a small amount of cement between the soybean meal. This type of ore is less common in this area.

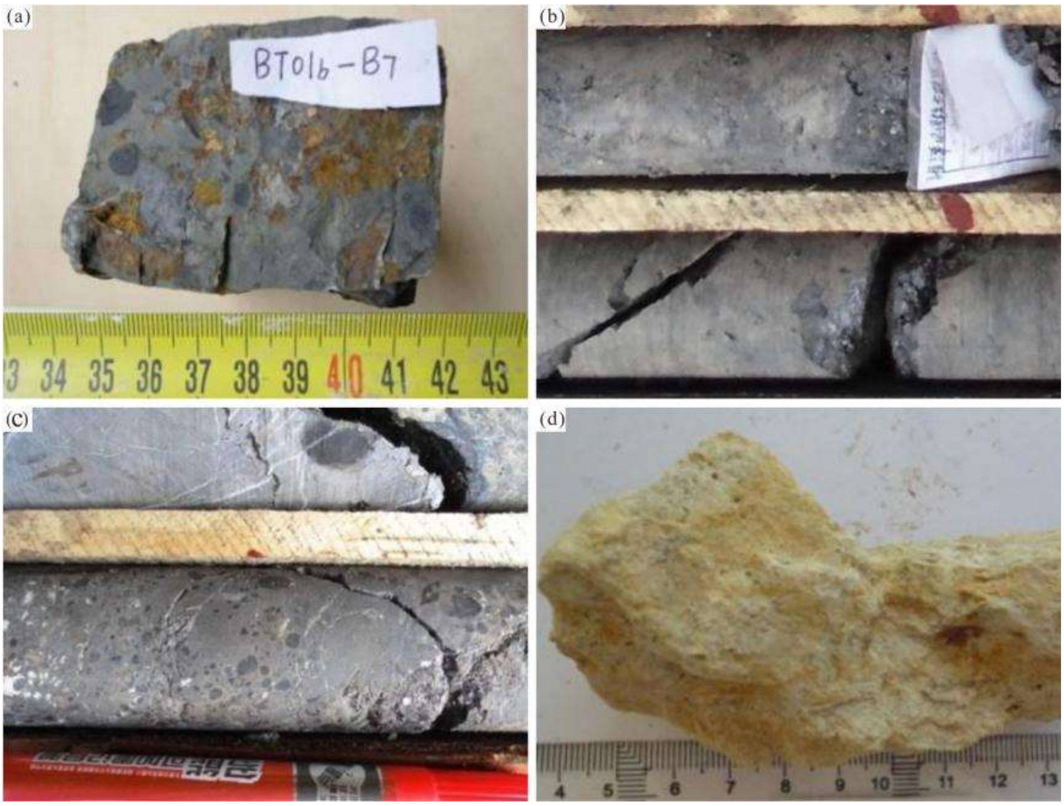

Fig.2 Nature types of the bauxite ore

4. Characteristics of Major Elements

From the north to the south of the study area, three boreholes were selected, and 29 samples of one trench were analyzed for major elements. The results are shown in Table 1.

Table 1. Major elements Data of the bauxite in Meitan-Fenggang area

Numeber	Code	Al_203	SiO_2	Fe_20_3	TiO_2	S	Loss	A/S
1	ZK13404-1	34.23	35.60	4.86	3.49	3.00	16.81	0.96
2	ZK13404-2	31.83	28.24	14.14	3.29	10.88	19.62	1.13
3	ZK13404-3	41.18	26.87	8.28	3.61	6.04	17.57	1.54
4	ZK13404-4	53.72	10.16	12.57	3.22	8.60	16.82	5.29
5	ZK13404-5	43.58	29.80	4.57	2.29	2.20	16.01	1.46
6	ZK13404-6	28.81	34.18	12.43	1.30	9.93	15.21	0.84
7	ZK13404-7	27.98	44.30	6.14	1.07	0.81	8.35	0.63
8	ZK13404-8	25.58	44.30	9.78	1.01	0.11	8.05	0.58
9	ZK6404-1	22.67	9.18	34.29	1.76	15.40	15.48	2.47
10	ZK6404-2	26.22	12.70	25.28	1.84	0.22	15.46	2.06
11	ZK6404-3	27.85	13.12	26.71	1.88	0.44	14.20	2.12
12	ZK6404-4	38.00	12.48	24.14	2.18	0.24	13.34	3.04
13	ZK6404-5	64.13	7.06	7.86	2.48	5.66	15.64	9.08
14	ZK6404-6	35.73	12.06	24.00	1.75	0.04	13.31	2.96
15	ZK6404-7	25.98	20.79	36.86	1.30	0.03	9.94	1.25
16	ZK6404-8	32.29	36.26	13.00	1.34	0.04	11.05	0.89
17	ZK6404-9	34.38	39.64	5.00	2.36	3.60	16.41	0.87
18	ZK6404-10	32.03	36.38	12.86	1.44	0.04	10.60	0.88
19	ZK6404-11	30.55	35.58	15.71	1.32	0.04	9.24	0.86
20	ZK6404-12	25.49	31.73	25.50	1.16	0.03	8.08	0.80
21	ZK6404-13	19.56	54.40	9.14	0.81	0.04	7.00	0.36
22	ZK1104-1	53.12	11.72	17.00	2.47	0.04	12.34	4.53
23	ZK1104-2	25.56	43.14	10.14	0.89	0.23	7.78	0.59
24	ZK1104-3	24.64	41.86	13.71	0.82	0.04	7.73	0.59
25	TC173-1	34.04	42.16	4.57	1.35	0.09	9.14	0.81
26	TC173-2	34.61	38.34	7.57	1.67	0.16	14.12	0.90
27	TC173-3	43.89	34.30	0.86	2.12	0.09	15.00	1.28
28	TC173-4	63.23	10.56	2.86	3.16	0.09	15.62	5.99
29	TC173-5	39.43	32.34	7.64	4.06	0.09	12.73	1.22

4.1. Characteristics of Major Elements

The overall grade of ZK13404 sample is low. Only sample No. 4 is close to the industrial grade. The Al content is higher than the lower part and the bottom grade is the lowest. The whole content is from top to bottom. The Al content first rises and then decreases, which indicates that the Al element has the trend of moving down. In ZK13404, the top and bottom of Si are higher and the middle part is lower, indicating that Si has a downward migration tendency, and the bottom Si content is significantly higher than the upper middle part, indicating that the Si enrichment trend is strong. The change of Fe is more complicated, and the overall trend is from top to bottom, but the higher values are in the middle. The Ti content tends to decrease from the top to the bottom, the Ti content in the middle and upper parts is higher, the Ti content in the bottom is lower, and the lowest value is the bottom-most sample. The content of S has a two-stage characteristic, the top content is high, the position near the middle is sharply decreased, and then it rises to a larger value, and then decreases sharply toward the bottom.

ZK6404 is located in the middle of the study area and has a large thickness of ore-bearing rock series. The content of Al in the middle is higher, the content of Al in the top and bottom is lower, and the content of Al increases at first and then decreases. The middle ZK6404-5 exceeds the industrial grade and reaches the standard of industrial deposits. The content of Si increases from the top to the bottom, the content of Si in the middle is the lowest, and the lowest value of Si appears in synchronization with the highest value of Al. Fe varies greatly, and the whole can be divided into three sections, 1-5, 6-9, 10-13. The three sections show a decreasing trend internally, but the No. 12 sample in the 10-13 section shows the highest value of this section. The lowest value of Fe does not coincide with the high value of Al and the lowest value of Si. The overall content of Ti does not change much, and the content to the bottom decreases. The higher value of Ti occurs in synchronization with the low value of Fe. The S content in the sample changes greatly, the highest value is 70 times different from the lowest value, and the higher value of S occurs synchronously with the low value of Fe.

ZK1104 is located in the lower middle of the study area, and the thickness of the ore-bearing rock series is small. None of the samples reaches the industrial grade, and the Al content is the highest at the top, close to the industrial grade, and gradually decreases from the top to the bottom. The top of the Si is the lowest and increases to the bottom. The overall Fe content does not change much, and the highest value of Fe occurs synchronously with the lowest value of Si. The Ti top sample is much higher than the lower two samples. The middle content of S is the highest, and the difference between the top sample and the top sample and the middle sample is large.

TC173 is located in the lower part of the study area, from the top to the middle and lower parts, the Al content increases, the bottom Al content reduces, and the No. 4 sample reaches the industrial grade. From the top to the bottom, the Si content has a decreasing trend, and the Si minimum value coincides with the highest Al value. The overall Fe content does not change much, and the lower value of Fe is substantially synchronous with the higher value of Al. The overall Ti content does not change much, and the bottom sample shows a peak. The overall content of S does not change much.

4.2. Correlation Analysis of Major Elements

According to the major elements data, the correlation trend graph of the major elementss is compiled (Fig. 3). Correlation analysis showed that Al and Si were negatively correlated (Fig. 3, a), but the correlation of some samples was not obvious, and the overall negative correlation trend became obvious with the increase of Al content. Al and Fe also have a negative correlation (Fig. 3, b). The correlation of some samples is not obvious, and the overall trend becomes obvious with the increase of Al content. Al has a positive correlation with Ti (Fig. 3, c), and the trend is more obvious. Fe has a negative correlation with Si (Fig. 3, d), and the overall trend is more obvious except for some samples. Ti is negatively correlated with Fe (Fig. 3, e), but the trend is not particularly obvious. Ti is also negatively correlated with Si (Fig. 3, f), similar to Fe, and the trend is not particularly noticeable. There is a significant correlation between the elements of Al, Si, Fe and Ti as a whole, and the correlation of a small number of samples is not particularly obvious.

IOP Conf. Series: Earth and Environmental Science **384** (2019) 012132 doi:10.1088/1755-1315/384/1/012132

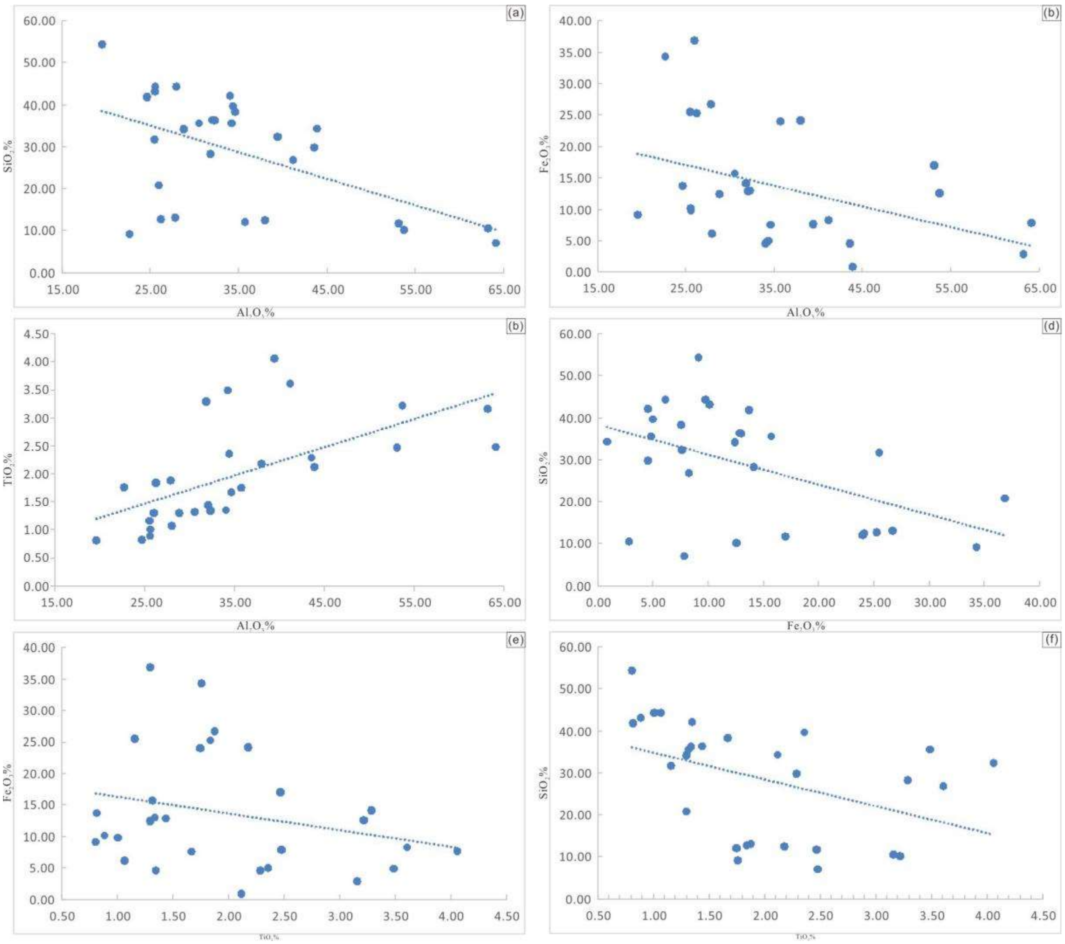

Fig.3 Correlation map of major elements

5. Discussion

The characteristics of the major elementss in the study area indicate that Al, Si, Fe and Ti migrated during the mineralization of bauxite. In the Meitan-Fenggang area, the grade of bauxite is generally low, but some areas have reached industrial grade and have certain development and utilization value. There is a correlation between the elements of Al, Si, Fe and Ti. The content of Al in the middle is higher, the content in the top and bottom is lower, and the content of Si, Fe and Ti in the profile also changes. The regular variation of the content of Al, Si, Fe and Ti in the vertical section indicates that the four elements migrated vertically in the process of bauxite mineralization. The four elements have certain migration ability, and Ti is rich in the upper part. Set, Al is enriched in the middle, and the characteristics of Si and Fe enrichment in the lower part are more obvious, indicating that the migration ability is Si/Fe>Al>Ti.

The higher the Al content as a whole, the more obvious the correlation between Al, Si, Fe and Ti. The correlation of some samples is not obvious because the accepted mineralization transformation is not strong and the element content is close to clay. The more intense the ore-forming process, the higher the Al content, the more intense the migration of Si and Fe. This indicates that the formation of the Meitan-Fenggang bauxite is a process of intense vertical migration of Si and Fe. According to the metallogenic regularity of sedimentary bauxite, whether Si and Fe can migrate violently depends mainly on the paleogeographic environment, and paleogeography controls the formation of high quality bauxite.

IOP Conf. Series: Earth and Environmental Science **384** (2019) 012132 doi:10.1088/1755-1315/384/1/012132

6. Summary

The comprehensive study of the major elementss shows that: 1) the overall Al content of the Tantan-Fenggang bauxite is low, but it has certain development and utilization value; 2) Except for some samples, the overall Al is negatively correlated with Si and Fe. There is a positive correlation between Ti and Ti; 3) Si has a negative correlation with Fe and Ti, and Fe is also negatively correlated with Ti; 3) Al, Si, Fe, and Ti migrate along the profile in the process of mineralization. The migration ability of Si/Fe is strong. In the migration ability of Al, the migration ability of Ti is the weakest. 4) Migration to the middle part of the ore-bearing rock series, the Al element is also lost during the mineralization process, but due to Si, The intense migration of Fe to the bottom causes the Al content in the middle to become high-grade bauxite; 5) The key factor for the formation of high-grade bauxite in the Meitan-Fenggang area is whether the paleogeographic environment can make Si, Fe migrates violently toward the bottom.

References

[1] Du Yuansheng, Zhou Qi, Jin Zhong-guo, Lin Wenlin. Adcances in basic geology and metallogenic regularity study of bauxite in Wuchuan-Zheng,an- Daozhen area, northern Guizhou, China. Geological Science and Technonlogy Information, 2013,32(1):1-6.

[2] Weng, Shen-fu, Lei Zhi-yuan, Cheng Qiang, Xiong Xing, Pan Zhonghua. A correlation of sedimentary facies and bauxite ore grade of the Wuchuan- Zheng,an-Daozhen bauxitic belt, northern Guizhou province. Geological Science and Technology Information, 2013, 32(1):19-22.

[3] Gu Jing, Huang Zhilong, Fan Hongpeng, Jin Zhongguo, Yan Zaifei, Zhang Jiawei. Mineralogy, geochemistry, and genesis of lateritic bauxite deposits in the Wuchuan-Zheng,an-Daozhen area, Northern Guizhou province, China. Journal of Geochemical exploration, 2013a,130:44-59.

[4] Wang Xiaomei, Jiao Yangquan, Du Yuansheng, Lin Wenli, Wu Liqun. Rare earth element geochemistry of bauxite in Wuchuan-Zheng,an-Daozhen area, northern Guizhou province. Geological Science and Technology Information, 2013, 32(1): 27-33.

[5] Zhang Yinghua, Lin Wenlin, Wu Hui, Zhang Yanan. Geochemistry of varied type ores of northern Guizhou bauxite and its implication for mineralization. Geological Science and Technology Information, 2013, 32(1):71-79.

[6] Cui Tao, Jiao Yangquan, Du Yuansheng, Yu Wenchao, Ji Bo, Lei Zhiyuan, Weng Shenfu, Jin Zhong-guo, He Xiu-lin. Analysis on paleosalinity of sedimentary environment of bauxite in northern Guizhou. Geology Science and Technology Information, 2013,32(1):46-51.

[7] Lei Zhiyuan, Weng Shengfu, Cheng Qiang, Xiong Xing, Pan Zhonghua, He Xiulin, Cheng Hai. Lithofacies paleogeography of the Dazhuyuan age, early Permian in the Wuchuan-Zheng,an-Daozhen area, northern Guizhou Province and its implication for bauxitisation. Geological Science and Technology Information, 2013, 32(1):8-12.

[8] Liu Youping, Cheng Guofan, Zhou Wenlong, Cui Tao, Long Han-sheng. Division of bauxite mineralization area(belt) in Guizhou province. Geological Science and Technonlogy Information, 2016, 35(3):128-132.

[9] Liu Chensheng, Jin Zhongguo, Guo Jianhua. Effect of sea level change on enrichment and mineralization of bauxite-takeing Qianbei bauxite for example. The Chinese Journal of Nonferrous Metals, 2018, 28(5): 985-993.

[10] Jin Zhongguo, Zhou Lin, Zhang li, Zheng Ming-hong, Han Ying. Metallogenic and Prospecting Models of Bauxite in Wuchuan-Zheng’an-Daozhen Area, Guizhou Province.Acta Sedimentologica Sinica, 2018, 36(5):914-926.