

Analysis on metallogenic environment of the Fuxing bauxite in Zunyi area, northern Guizhou, China

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Abstract. The ore-forming environment of Fuxing bauxite in the Zunyi area of northern Guizhou Province was analyzed by field geological survey, hand specimen observation and geochemical analysis. The results show that the sedimentary environment of Fuxing bauxite is a continental lake or marsh environment, and the sedimentary environment is reduced Environment, but the leaching process is an acidic oxidizing environment; Al has a good positive correlation with Ti, and Al has a negative correlation with Si and Fe; ore-bearing rock is formed in a strong acidic environment. Fe rapidly migrates to the bottom, but leaching when it is insufficient, Si does not have time to migrate, so that the Fe content in the ore is low but the ore grade is still low.

Keywords: bauxite; metallogenic environment; major elements; Zunyi area.

1. Introduction

The Zunyi area in northern Guizhou is an important metallogenic belt of the bauxite deposit in Guizhou. The Carboniferous-Permian area formed abundant bauxite resources. The predecessors have done a lot of research on bauxite in the area (Liu et al., 1990; Gao et al., 1992; Yin et al., 2011; Weng et al., 2011; Liu Ping, 2012; Du et al., 2013; Wang et al., 2013; Zhang et al., 2013; Cui et al., 2013; Liu Youping, 2015, 2016). Previous studies on Zunyi bauxite are relatively rich, but the research objects are not Fuxing bauxite, and the research on Fuxing bauxite is relatively weak. Fuxing bauxite has been exploited for many years and is of great economic value. In this paper, Fuxing bauxite is studied by means of field geological survey, hand specimen observation and geochemical analysis, and the metallogenic environment of the bauxite is analyzed. It has certain guiding significance for future exploration of the bauxite in this area and enriches the bauxite research materials in Zunyi area.

2. Geological background

The bauxite mine in Zunyi is located on the Yangtze platform and is connected to the Wuzheng bauxite metallogenic belt to the north. The exposed strata in this area are mainly Cambrian-Triassic, and the bauxite ore-bearing rock series is the nine-furnace group of the Carboniferous System (Liu et al., 1990; Gao et al., 1992), and the thickness is about 0 to 10 meters. The overlying layer is the black mud shale of the Liangshan Formation or the limestone of the Qixia Formation, and the overlay is dolomite in the Cambrian Lou Shan Guan Formation or dolomite of Ordovician Tongzi Formation. The regional strata are exposed as the Cambrian Loushanguan Formation, the Permian Liangshan-Qixia Formation, and the



nine-furnace group of the Carboniferous System(Fig.1). The entire stratum is distributed at a 75° direction with an inclination of about 15°.

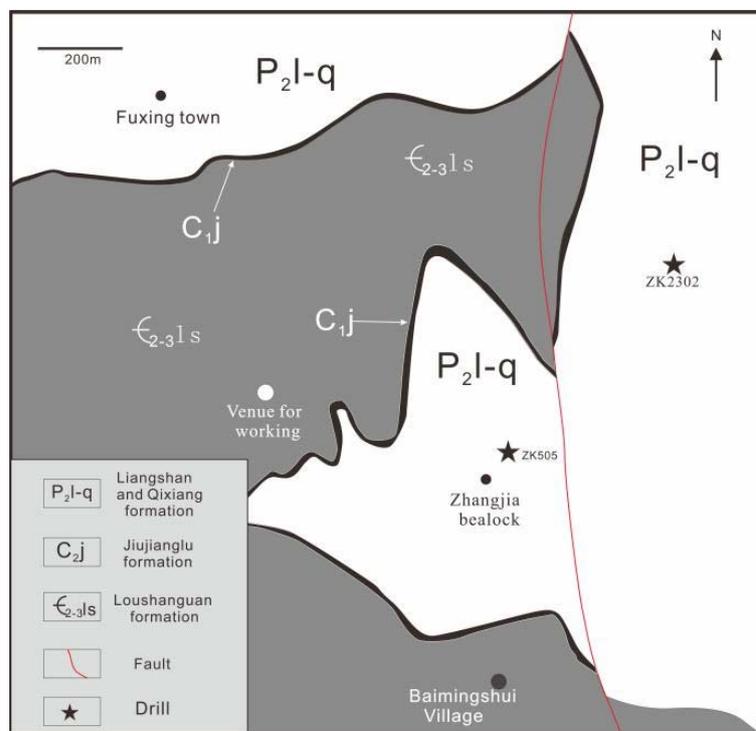


Fig.1 Geology map of Fuxing area

3. Analysis test

Table 1. Major elements of Fuxing bauxite

Number	Stratum	Lithology	Al ₂ O ₃	SiO ₂	Fe ₂ O ₃	TiO ₂	S	LOI
			10 ⁻²	10 ⁻²	10 ⁻²	10 ⁻²	10 ⁻²	10 ⁻²
ZK2302-1	P ₂ l	black shale	11.73	22.54	15.13	0.470	4.14	15.18
ZK2302-2	C ₁ jj	gray massive bauxite	37.42	44.26	0.472	1.24	0.122	7.26
ZK2302-3	C ₁ jj	gray clastic bauxite	44.93	36.91	0.717	1.63	0.168	8.54
ZK2302-4	C ₁ jj	gray massive bauxite	51.88	29.84	0.450	2.13	0.083	9.85
ZK2302-5	C ₁ jj	gray massive bauxite	39.99	42.42	0.377	1.64	<0.05	8.53
ZK2302-6	C ₁ jj	gray massive bauxite	38.41	43.78	0.638	1.58	0.130	10.23
ZK2302-7	C ₁ jj	light green clay	11.96	41.32	16.53	0.366	8.73	17.14
ZK2302-8	ε ₂₋₃ ls	gray dolomite	1.25	3.37	10.86	0.030	3.18	24.38
ZK505-1	P ₂ l	black shale	11.45	50.02	3.55	0.634	1.04	13.84
ZK505-2	C ₁ jj	light gray massive bauxite	20.61	39.46	7.87	0.938	2.82	16.54
ZK505-3	C ₁ jj	gray massive bauxite	38.14	41.49	0.698	1.55	0.162	13.22
ZK505-4	C ₁ jj	light gray clastic bauxite	40.83	41.84	0.374	1.63	0.053	11.66
ZK505-5	C ₁ jj	gray massive bauxite	38.80	43.89	0.491	1.62	<0.05	13.84
ZK505-6	C ₁ jj	gray clastic bauxite	36.00	44.39	1.95	1.35	0.503	13.04
ZK505-7	C ₁ jj	gray massive bauxite	4.73	81.52	4.50	0.164	2.45	4.71
ZK505-8	C ₁ jj	gray massive bauxite	6.09	63.89	9.75	0.164	5.76	11.23
ZK505-9	ε ₂₋₃ ls	gray dolomite	2.55	5.43	5.16	0.051	1.17	34.55

A total of 17 samples from boreholes ZK2302 and ZK505 in southeastern Fuxing mining area (Fig. 1, table 1), were sent to Langfang City China Railway Geophysical Prospecting Co., Ltd. for analysis and test, and the major elements data were obtained. The test standard is based on GB/T 14506.28-2010 Silicic acid. Salt rock chemical analysis method. ZK2302 sample numbers are ZK2302-1 to ZK2302-8, and ZK505 sample numbers are ZK505-1 to ZK505-9. The sampling sequence is from top to bottom of the ore-bearing rock section.

4. Distribution characteristics of ore bodies

Fuxing bauxite is composed of dense bauxite, clastic bauxite, braided bauxite, and earthy bauxite (Fig. 2). The main ore is composed of a brittle bauxite and crumb-like bauxite (Fig. 2, b) and a transitional type between earthy ore and vermicular ore. The dense ore content is low and the grade is low. High-grade ore has black ore and light gray ore (two kinds, the rest of the ore color is between light gray and black). The Fuxing bauxite is not layered, the shape varies, mostly funnel-shaped, the specific shape is determined by the underlying depression. The thickness and grade change of the ore body are relatively large, and the stable extension range of the ore body is generally not more than 50m.



Fig.2 characteristics of ore bodies a.massive bauxite b. clastic bauxite

5. Element migration rule

The test results show that (Table 1), the Al content of bauxite in ZK2302 is not high overall, and the Al content is close to or exceeds the boundary grade, and the variation range is large. The middle and upper Al content is higher, and the bottom Al content is lower, which is similar to the Al content of the bauxite ore-bearing rock series in the Wuzheng area of northern Guizhou. The bottom sample has a low Al content of only 11.96%, which is not a bauxite but belongs to clay rock and has a high iron content. The overall Si content is about 40%, and the lowest Si content is synchronous with the highest Al content, but the highest Si content and the lowest Al value do not occur at the same time. The Fe content was lower overall, except for the higher content of the bottom, the other layer content was lower, indicating that a strong iron discharge occurred in the borehole. The overall Ti content does not change much, and there is a tendency to decrease toward the bottom. The change in S content is not large and the content at the bottom is extremely high.

In ZK505, the Al content is not high overall, and there are fewer layers with Al content of more than 40%. The Al content of the two samples at the bottom is very low, which may be due to the mixing of the bottom dolomite in the test. In addition to the bottom layer, the remaining content of Al is relatively stable, and the top is low, only 20%. The Si content is generally high and stable at around 40%. The Fe content is generally stable and the top content is the highest. The Ti content is generally stable except the bottom. The S content is higher than ZK2302, and the bottom is higher than the upper middle portion.

On the whole, Al has a negative correlation with Si and Fe in boreholes (Fig. 3, a, b), but the three are not completely synchronized. The bauxite in the borehole is basically less than the industrial grade because the Si content is too high. The Fe content in the borehole is low, and it does not occupy a

dominant position in the ore, and does not affect the bauxite grade. Si has a positive correlation with Fe (Fig. 3, f), but the correlation is not obvious, which indicates that the migration of Si and Fe is not synchronous. Al is positively correlated with Ti and has a high degree of correlation (Fig. 3, c). Both of them remain relatively stable during the formation of bauxite. Ti is negatively correlated with Si (Fig. 3, d), indicating that Ti is relatively enriched and Si is lost during the formation of bauxite. Ti has a weak negative correlation with Fe (Fig. 3, e), indicating that Ti and Al are similar in nature.

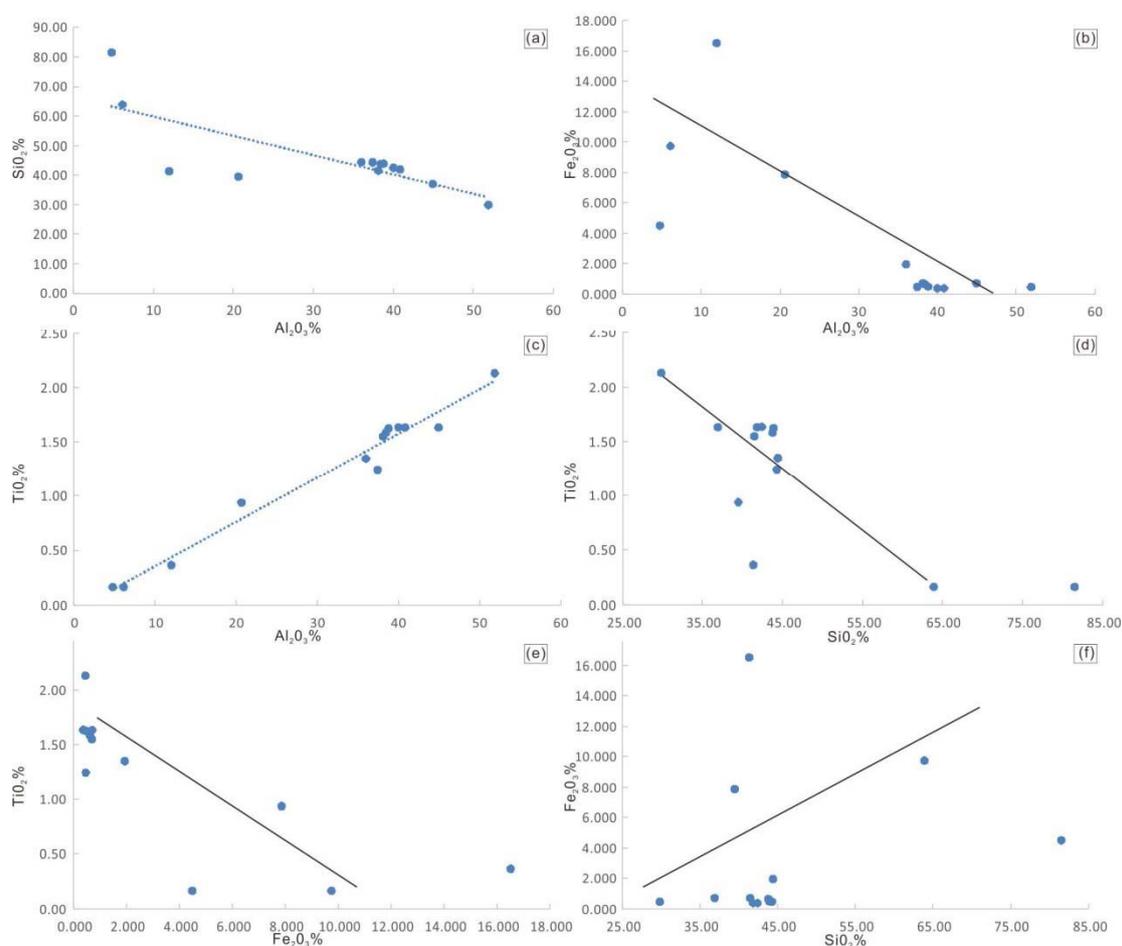


Fig.3 Plots diagrams of major elements

6. Metallogenic environment

The main minerals of Zunyi Fuxing Bauxite are composed of diaspore and clay minerals, and a thicker pyrite layer appears at the bottom. The shape of the ore body is irregular and the whole is karst funnel. No strong hydrodynamic signs were found in bauxite, and the ore was gray-black in its entirety, indicating that bauxite was deposited in a reducing environment. The presence of light gray clastic bauxite indicates that the formation of the Zunyi Fuxing bauxite has undergone leaching as well, and the formation of high grade ore is the result of leaching under oxidative conditions. There is a large amount of pyrite at the bottom of the Zunyi bauxite mine. The formation of pyrite is the result of the downward migration of iron.

The main role of bauxite is to refine alumina. To form an industrial ore for refining alumina, sufficient desilicization and iron removal must occur during the mineralization process to make the relative enrichment of Al and finally form high-grade bauxite ore. The major element characteristics of the bauxite mine indicate that the migration of Al, Si and Fe is not synchronous, and the correlation between Al and Ti is high. Al and Ti remain relatively stable during mineralization and have certain

source significance. The content of Fe in Fuxing bauxite mine is very low, but the grade of bauxite in the selected borehole is not high, mainly due to the high Si content, and the Si content is too high, which affects the ratio of aluminum to silicon of bauxite. So that many layers can not meet the standard of alumina ore, and can only be sold as tile materials. This indicates that in the process of Fuxing bauxite mineralization, Fe element migrates downward under acidic conditions and finally precipitates pyrite at the bottom, the thicker pyrite layer at the bottom of Fuxing bauxite (partial boreholes can reach industrial utilization standards) is formed accordingly, but in the process of Fe migration, Si does not synchronize or quasi-synchronous migration, so that the Fe content in the ore layer is reduced, but the Si content is too high to reach the ore standard for producing alumina. Why under acidic conditions, Fe migrates to the bottom to form pyrite and Si does not migrate a lot. This probably because Fe is easier to migrate under acidic conditions, and Fe migrates downward under leaching, But because of the lack of leaching time, the migration of Fe and Si is not synchronized, and Fe migrates to the bottom to form pyrite, but Si is relatively enriched and eventually fails to form high-grade ore.

Generally speaking, the Fuxing bauxite is a karst-type bauxite of terrestrial genesis. The leaching is exposed many times but the leaching degree varies greatly in different regions. So the quality of bauxite ore and its ore body varies greatly. Fuxing bauxite should be formed in lake-marsh environment, and the area where the leaching function is fully developed forms the high-grade bauxite ore and the industrial pyrite layer at the bottom. But In the area where the leaching effect is insufficient, because the ore-forming environment has high organic matter content and strong acidic conditions. Fe still migrates downward to form a pyrite layer, but Si does not migrate in large quantities, so it is easy to form low-grade ore.

7. Conclusion

Through research, we have the following conclusions: 1) Fuxing bauxite is similar to bauxite in other areas of Zunyi, which is formed in the continental lake and marsh environment, the sedimentary environment is the reducing environment, but the leaching process is acidic oxidizing environment; 2) Al and Ti have good positive correlation and can be used to indicate the source, and Al has a negative correlation with Si and Fe. However, the migration between Si and Fe is not synchronous, and the negative correlation between Al and Si and Fe is not particularly obvious. 3) Fuxing bauxite ZK2302 and ZK505 have lower Fe content but the ore grade is still low, which may be due to insufficient leaching under strong acidic conditions, Fe rapidly migrates and precipitates but Si does not have enough time to migrate in large quantities.

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