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Migration pattern of major elements of the Datang bauxite in WZD area, northern Guizhou province, China

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Migration pattern of major elements of the Datang bauxite in WZD area, northern Guizhou province, China

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Abstract. Sthe research studies the migration pattern of major elements of the bauxite in Datang Syncline, WZD area of the northern part of GuiZhou province through field geological survey, hand specimen observation, and major element analysis and the result shows that Al, Si and Fe all show negative correlation, the enrichment of Al is the result of the massive loss of Si and Fe, the migration pattern of Si and Fe in Datang area is not obvious which means the leaching effect is not sufficient in this area and Si and Fe do not migrate synchronously during mineralizing process.

Keywords: migration; major elements; bauxite; Datang syncline.

1. Introduction

The bauxite resource is rich in the WZD region of northern part of Gui Zhou and many scholars have conducted studies on it (Zhang et al., 2013; Lei et al., 2013; Wang et al., 2013; Yu et al., 2013; Cui et al., 2013; 2014; Du et al., 2013, 2014) and developed a profound understanding on rock mineralogical characteristics, geochemical characteristics, metallogenic environment, genetic mechanism and so on about bauxite in WZD region. Datang syncline is an important part of bauxite. The previous researches often study Datang syncline as a part of WZD and there are relatively a few independent researches about it. This paper selects 4 boreholes of Datang syncline for analysis and test, studies on its principal elements and analyzes its migration pattern and it provides new materials for the study of bauxite in the WZD region of the northern part of Gui Zhou province.

2. Geological background

The bauxite mining area studied in this paper is located in the area of Wuchuan- Zheng,an- Daozhen (WZD) in the northern part of Guizhou province, which belongs to the north part of the carboniferous bauxite metallogenic belt of central Gui Zhou and south Chong Qing and it is made up by Zhengan and Daozhen bauxite belts.The bauxite deposit occurs on the limestone erosion surface of the mud shale and/or upper carboniferous huanglong formation of the lower silurian Korean jiadian group. Its mineralizing period is believed to be the late carboniferous mapingian age and the rock strata of the bauxite ore-bearing rock series are identified as Dazuyuan formation (C_2d).

The bauxite ore deposit is located in the northern part of platform uprise of northern Guzhou Yangtze paraplatform and broken arch. The widely exposed strata in the area include Cambrian system, ordovician system, silurian middle lower system, Permian system and Triassic system and lacks the upper silurian, devonian, lower carboniferous and upper maping formations. Cambrian is distributed in the core of anticline and Triassic is distributed in the core of syncline. The liangshan formation of permian middle system and the upper carboniferous huanglong formation of upper carboniferous at the bottom of the bauxite series are in a spurious contact with the underlying silurian hanjiadian formation. The main lithologies of the ore-bearing strata and the surrounding rock strata are carbonaceous shale, calcareous shale and marl. Bauxite deposits (points), the distribution of the mineralization of yanshan period after NNE to huaxia type syncline fold structure, the control of distributed in chestnut orchard syncline, LuChi syncline, new mould syncline, courtyard syncline, zhang huan creek syncline, taoyuan syncline, DaTang syncline, true syncline, Ann in the field to the (Weng et al., 2013), in this paper, the object of study for Datang syncline of bauxite (Fig. 1).

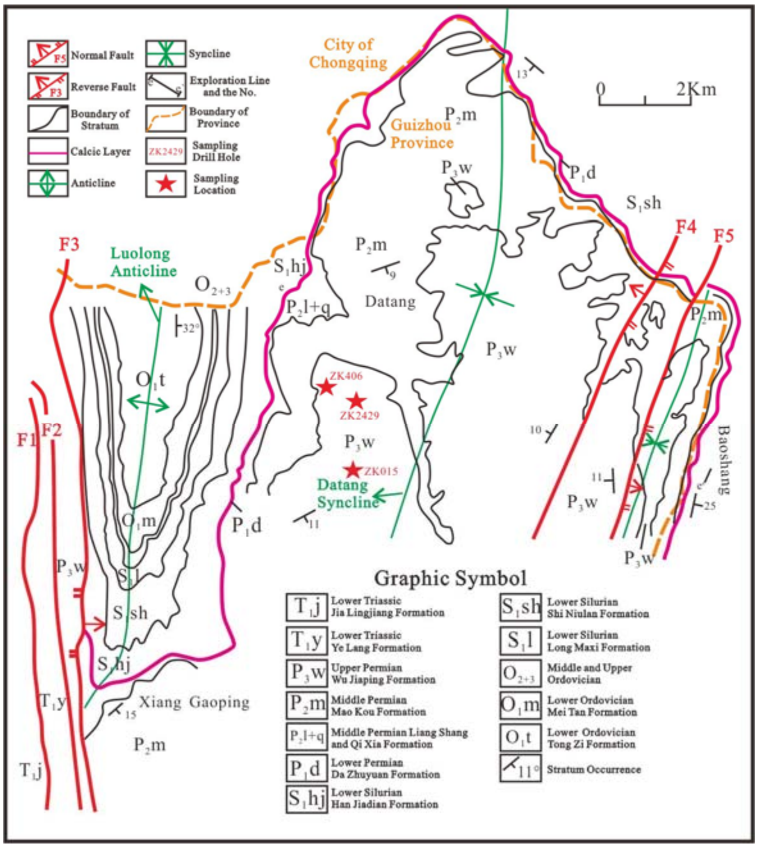

Fig.1 Geological map of the study area

3. Ore features

Similar to other synclines in Wuzhengdao area, the ore of Datang syncline is divided into four types: compact, clastic, semi-earthy and oolitic. The dense ore is grey, dark grey, with micritic structure. The ore has flat and smooth cross section, compact texture, high hardness and weak water-absorbent. Although the mineral composition is still dominated by monohydrated hard bauxite, there are relatively many clay minerals with low grade and non-high grade. The clastic limestone is light grey, and the clastic particles are of different sizes. The composition of minerals include: isophanite, argillaceous clay, iron, silicon, etc. Bean oolitic ore gray is given priority to, oolitic appearance assumes secondary ellipse shape, secondary circle shape, ellipse shape, circular shape, grain size difference is not big, grade has high and low. Semi - earthy ore is pale, light grey and yellow grey, with loose structure, large porosity, high grade and good texture.

Bauxite ore in the exploration area is composed of 23 kinds of minerals. It is dominated by monohydrous hard bauxite, followed by clay mineral, iron mineral, titanium mineral, etc. The above four types of minerals account for over 98% of the total mineral amount (Table 1, Fig. 3).

Table 1. Minerals of Datang bauxite

bauxite	diaspore
clay mineral	hydromica, kaolinite, chlorite, illite
iron minerals	limonite, Hematite, magnetite
tianium minerals	anatase, Rutile, White titanium ore, brookite
zirconium minerals	Zircon, baddeleyite
sulfide mineral	pyrite, pyrrhotite
Other minerals	barite, Tourmaline, xenotime, apatite, epidote, monazite

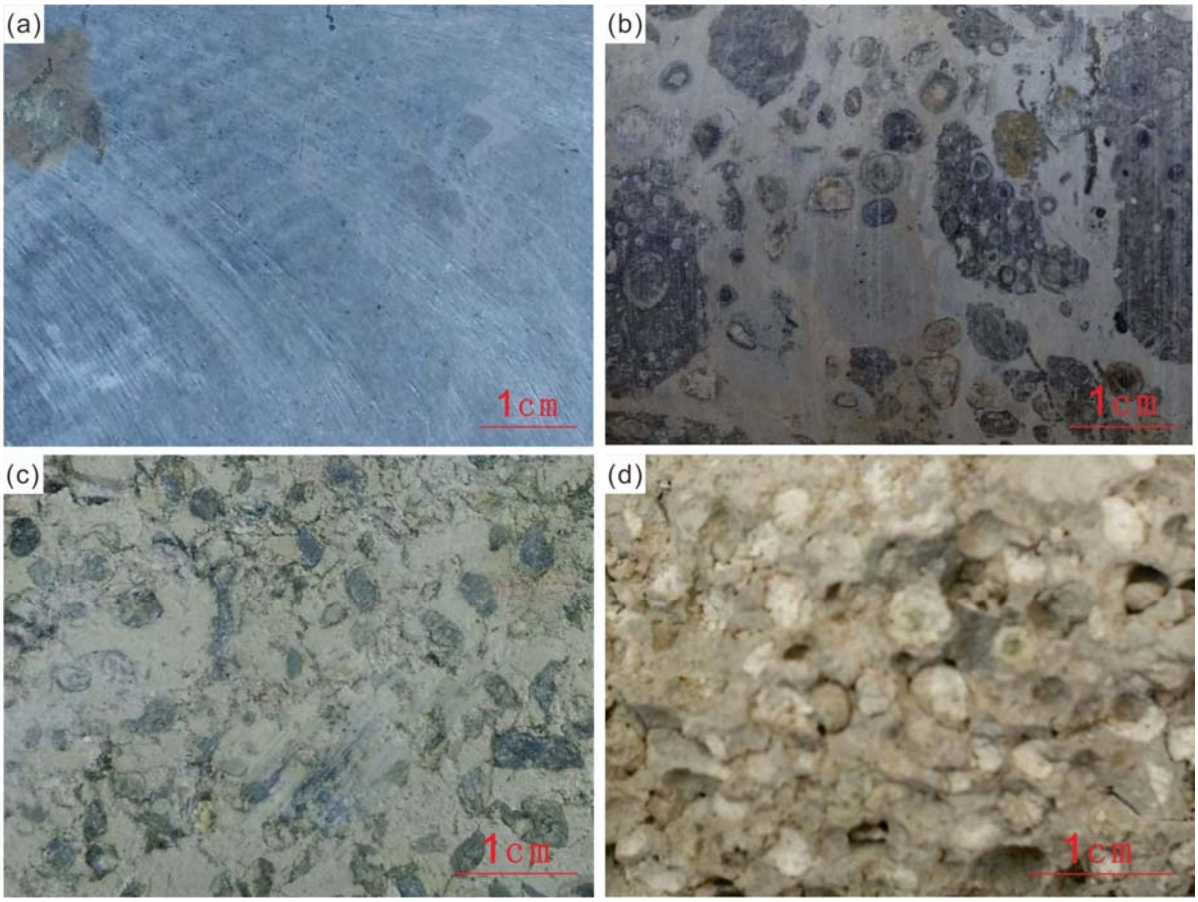

Fig. 2 Charceteristics of Datang bauxite a.massive bauxite; oolitic bauxite; c.clastic bauxite; d.earthy bauxite (Chen, 2017)

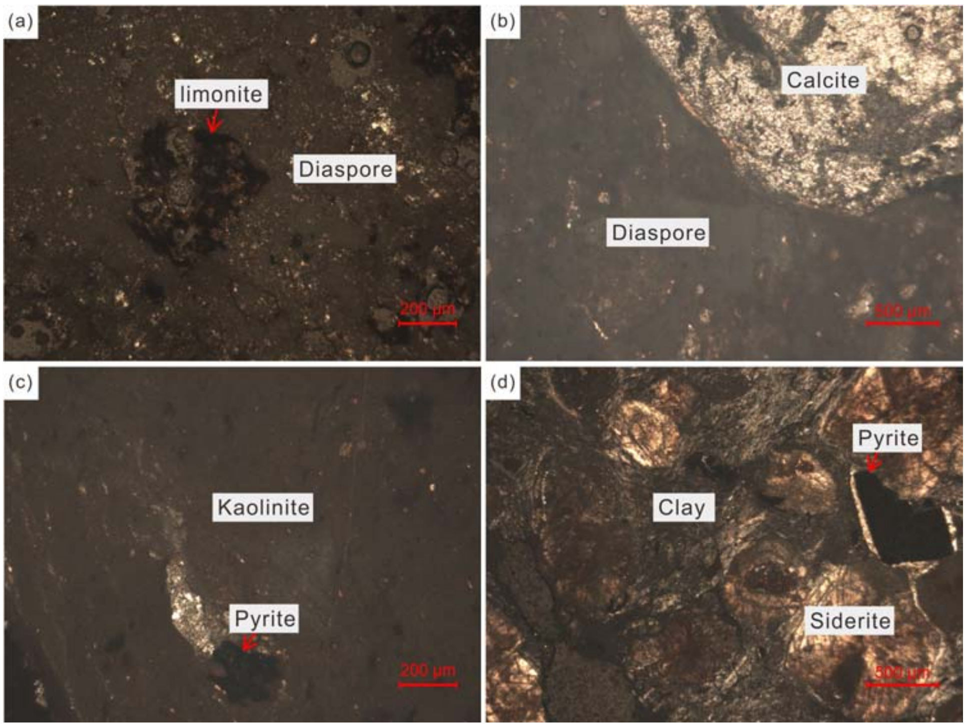

Fig.3 Minerals of the bauxite in Datang syncline

4. Characteristics of major elements

The major elements analysis and test of ZK406, ZK2429 and ZK015 were conducted at bureau of geology and mineral resources of Guizhou. The results are shown in table 2. The migration pattern of principal elements in Datang syncline bauxite mine was studied based on the result of the table 2 combined with ore characteristics and field geological characteristics.

Table 2. Data of the bauxite in Datang syncline

Drills	Number	Describe	Al_2O_3	SiO_2	Fe_2O_3	TiO_2	S	LOI
			10^{-2}	10^{-2}	10^{-2}	10^{-2}	10^{-2}	10^{-2}
ZK402	ZK402-1	bauxite	36.97	43.28	2.30	2.89	1.27	11.54
	ZK402-2	bauxite	36.51	43.45	3.04	2.52	1.94	9.05
	ZK402-3	bauxite	36.15	39.88	4.05	4.41	1.69	12.56
	ZK402-4	bauxite	38.46	43.34	0.98	2.48	0.21	12.48
	ZK402-5	bauxite	38.12	42.61	2.49	1.49	1.34	12.87
	ZK402-6	bauxite	33.16	36.80	15.80	1.41	0.25	7.50
	ZK402-7	bauxite	37.35	41.51	5.44	1.45	0.10	11.02
ZK2429	ZK2429-1	bauxite	58.40	16.76	4.51	2.70	2.31	13.73
	ZK2429-2	bauxite	65.04	10.94	4.84	3.08	0.16	13.45
	ZK2429-3	bauxite	39.94	23.32	18.76	2.39	0.12	10.83
	ZK2429-4	bauxite	36.76	28.88	17.14	2.24	0.41	10.10
	ZK2429-5	bauxite	40.47	19.82	22.41	2.73	0.10	10.04
	ZK2429-6	bauxite	33.81	31.48	16.94	2.36	0.13	10.22
	ZK2429-7	bauxite	32.65	38.84	10.90	2.06	0.55	7.52
ZK015	ZK015-1	bauxite	42.05	33.79	2.94	1.58	0.55	15.50
	ZK015-2	bauxite	37.90	42.01	2.11	1.91	0.82	12.70
	ZK015-3	bauxite	35.30	40.87	5.58	1.44	2.71	8.50

ZK402 is not up to the standard of industrial ore and has low grade. The content of Al_2O_3 does not exceed 40%. The content of Al_2O_3 does not change much at cross-section, there is not high grade bauxite and the lowest value appears at the bottom. The overall content of Al_2O_3 is high without any low value, and the lowest value is up to 36.8%. The lowest value is in sync with the lowest value of Al_2O_3. On the whole, from the top to the bottom of the cross-section, the content of SiO_2 tends to decrease but is not obvious. The content of Fe_2O_3 increased significantly from the top to the bottom of the cross-section. The content of Fe_2O_3 at the bottom is the highest, followed by that at the middle and lower parts. The highest value of Fe_2O_3 is in sync with the low values of Al_2O_3 and SiO_2. The range of variation of Fe_2O_3 is rather large with 16 times of gap.The overall content profile of TiO_2 tends to decrease from the top to the bottom, but the whole is relatively stable with a small gap. The minimum value of TiO_2 is synchronized with that of Al_2O_3 and SiO_2. The change amplitude of S content is expressed, and there is a decreasing trend from the top to the bottom of the cross-section.

ZK2429 structure is relatively rare and high-grade bauxite appears at the top. Al_2O_3 decreases towards the bottom of the cross-section and the lowest value appears at the bottom. From the top to the bottom of the cross-section, the content of SiO_2 shows an increasing trend. The content of SiO_2 at the top ore body is less, while the content of Fe_2O_3 is higher in the middle, the content of the top is lower, followed by the bottom, and the content of iron varies widely. The overall TiO_2 content did not change much and is stable in the cross-section. In addition to a higher content at the top, the content of S in other samples is relatively stable with small variation range.

The sample grade in ZK015 is relatively low, and the content of Al_2O_3 is not up to the industrial grade. The overall content is relatively stable with a slightly decreasing trend. SiO_2 content varies little, and the content of the central sample is the highest. The overall variation of Fe_2O_3 content was not large, and the content of bottom sample was the highest. TiO_2 content did not change much and was stable. The content of S varies greatly and the content of the bottom is higher.

5. The migration pattern of elements

The formation environment of bauxite is small and the mineralizing process of bauxite in the same mining area may be different. The 3 borehole samples from Datang syncline show a rare side, with the top (ZK2429) forming high grade bauxite and no industrial bauxite in the middle and lower part. No industrial ore was formed in the samples of ZK402 and ZK015. ZK402 is located north of ZK2429 and ZK015 is south of ZK2429, showing a decline in grade of bauxite from ZK2429 to the surrounding area. No industrial bauxite ore was formed at the bottom of ZK2429, indicating that the drainage in this area may be poor, and materials such as Si and Fe are overstocked at the bottom, making the content of Al relatively lower. Al_2O_3 is negatively correlated with SiO_2 basically (Fig.4, a), but it is not as obvious as other ores in WZD area, which may indicate that some areas are not sufficiently leached thoroughly. In addition to individual samples, Al_2O_3 and Fe_2O_3 also show a negative correlation (Fig.4, b), and the negative correlation is relatively obvious. The positive correlation between Al_2O_3 and TiO_2 (Fig.4, c) is not obvious. SiO_2 and TiO_2 show a significant positive correlation (Fig. 4, d). The relationship between Fe_2O_3 and TiO_2 is complex and shows a two-directional correlation (Fig.4, e). SiO_2 is positively correlated with Fe_2O_3 (Fig.4, f). In general, the negative correlation between Al_2O_3, Fe_2O_3 and SiO_2 is obvious, indicating that Al enrichment is the loss process of Fe and Si. The correlation between Al_2O_3 and TiO_2 is not obvious. At the same time, industrial ore is located at the top of ore bearing horizon, indicating that bauxite leaching is not sufficient in this region, and it is difficult to form high-grade ore. The negative correlation between Fe_2O_3 and SiO_2 showed that Fe_2O_3 and SiO_2 were not synchronous or consistent migration pattern during mineralizing process.

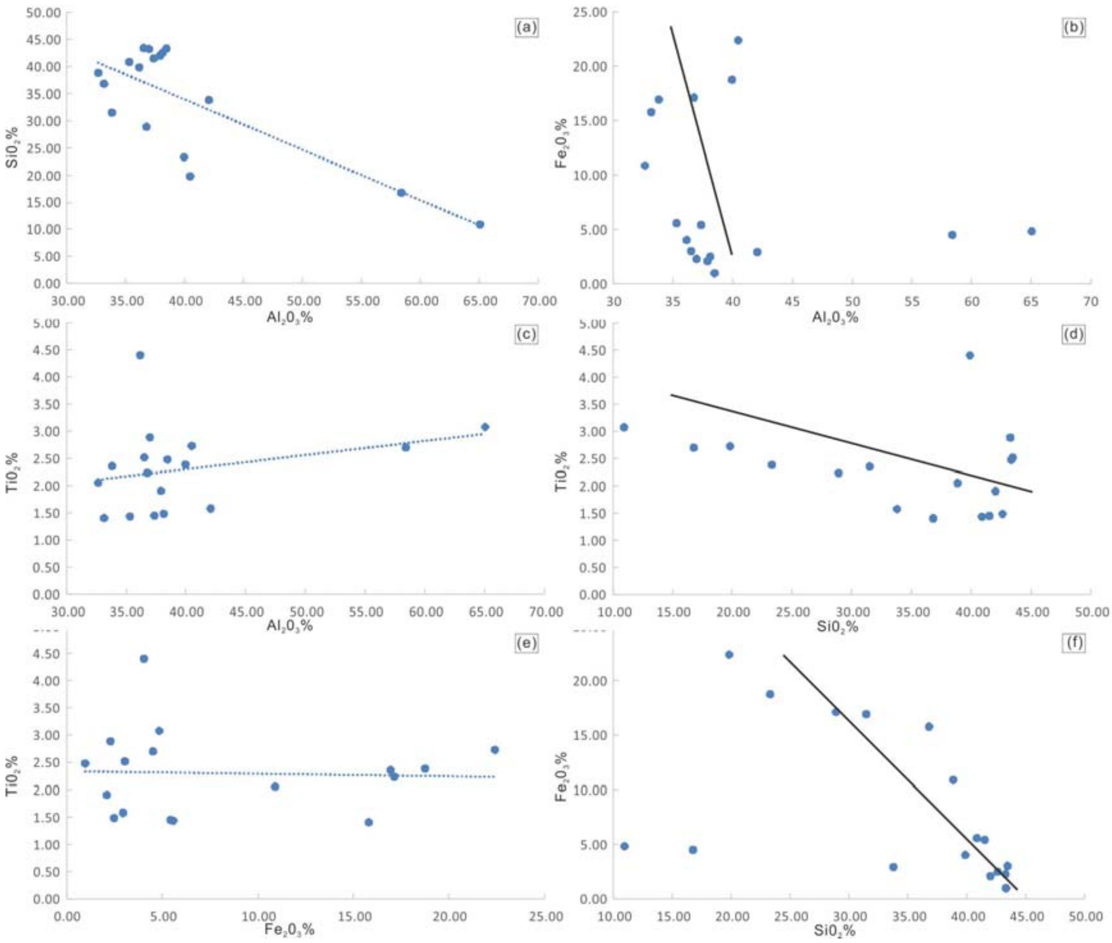

Fig. 4 Correlation of major elements

6. Conclusion

It is concluded as following through the study on principal elements of Datang syncline: 1) Al, Si and Fe all show an obvious negative correlation and the enrichment of Al is the result of the massive loss of Si and Fe; 2) the trend of Si and Fe migration is not obvious, which indicates that bauxite leaching in Datang area is not sufficient.3) Si and Fe do not migrate synchronously during the mineralizing process of bauxite.

Acknowledgements

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