PROSPECTING FOR LARGE TRIHYDROXY BAUXITE DEPOSITS IN CHINA: THINKING AND PERSPECTIVE①

Chen Guoda②

Central South University of Technology, Changsha 410083, China

ABSTRACT

Large trihydroxy bauxite deposit was once considered unavailable in China. With the prospecting thinking of diwa theory, the author has drawn a contrary conclusion. From the view of the law of progression with transformation between mobile and stable regions and the metallogenic specialization of tectonic elements, he reveals the principal reason why the known bauxite deposits in China are mostly of monohydroxide type, and acquires the way of searching for trihydroxide bauxite deposits. He considers that the residual-mobility period of the diwa stage in the crustal development in South China pocesses tectonic conditions favourable to the formation of bauxite deposits of this type. He believes that the Cenozoic structural sublayer of the residual-mobility period of the diwa stage developed on the carbonate rock of the Paleozoic platformal structural layer is the preferrential target of prospecting. With this thinking and many years of efforts, we have gained preliminary achievements and have discovered Guigang-type latee-ritic trihydroxied bauxite deposits in Guangxi. In future, by extension and analogy of the thinking, we are likely to find large, high-grade bauxite deposits in its vicinity and to discover weathering-type bauxite deposits with other parent rocks.

Key words: trihydroxide bauxite deposit, law of progression, mobile and stable regions, progressive ore formation, prospecting thinking, diwa theory

1 INTRODUCTION

China abounds with bauxite rather abundantly, however, they are mostly monohydroxy, accounting for 97%, and those with the ratio of aluminium to silicon larger than 7 make up only 17%, while easily dressed and fusible trihydroxy bauxite forms only a few small ore deposits, such as those located in Zhangpu and Longhai, Fujian Province, and in Qiongshan, Wenchang, etc Hainan Province. In addition, trihydroxy bauxite is also locally present in monohydroxy bauxite deposits in Pingguo, Guangxi, and other places.

Geologists have done much in prospecting for gibbsite deposits. But little advance has been made in several decades. Afterwards, little attention was paid to them, and a consensus gradually held that in China there was no possibility of finding large trihydroxy bauxite deposits.

Since the publication of the first paper of diwa (geodepression) or activated tectonics theory[1], examples of "Activated Regions" on

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②Professor, academician

the Chinese platform with special reference to the 'Cathaysia' problem, the author probed into this topic following new thinking, and made a preliminary analysis in 1960[2]. In recent years the theory of progressive ore formation, an important constituent of the diwa theory, has been revitalized and improved due to the efforts of geologists. This has made the author think deeply and further define the way of searching for large trihydroxy bauxite deposits. In 1983, we drafted a paper entitled "Trends in Prospecting for Gibbsite Resources in China" and made a proposal concerning renewal of prospecting for this type of ore deposit. In August 1984 the author delivered a report on "Geological Basis for Prospecting for Trihydroxy Bauxite Deposits in China". Finally we got financial support and began field geological investigation and prospecting.

In May 1987 Chen Shiyi found for the first time a lateritic trihydroxy bauxide deposit according to the diwa theory. Then in a common effort of other colleagues of the university and the №. 273 team, the same type of ore deposit was discovered in neighbouring areas. At the same time advances have been made in the fields of dressing, smelting and comperhensive utilization. And then an enlarge exploitation and utilization circuit test was made out. This achievement received the appraisal of experts① . The ore deposit was considered as a new type of economically valuable mineral deposit.

In order to better play the guiding role of theory in future mineral prospecting, it is necessary to sum up past experience from mineral prospecting, and to systematically track the thinking and basis in searching for this deposit.

2 CHARACTERISTICS, GENESIS AND TECTONIC CONDITIONS FOR THE FORMATION OF GUIGANG TYPE TRIHYDROXY BAUXITE DEPOSITS

2.1 *Characteristics and Genesis*

According to references[3, 9], the characteristic traits and genesis of the bauxite deposits and the basis for determining ore types are as follows.

2.1.1 Distribution Features, Geomorphological Environment and Geologcal Foundation

The bauxite deposits are distributed in more than ten counties in a zone from Nanning to Yulin, especially in Guigang, Hengxian and Binyang. Geomorphologically they occur in a transition zone between dome-shaped medium-low mountains extending from Dayao to Daming and a karst plain lying south of them. Ore beds occur on the gentle slope of the lowest table (specific height 10—30m). The geological foundation consists of the mid-Devonian Youjiang and Donggangling Formations overlain by the upper Devonian and Carboniferous. The Youjiang Formation is composed of sandstone and shale in the lower part and dolomite and limestone in the upper part. The Donggangling Formation consists chiefly of dolomite interbedded with limestone.

2.1.2 Attitude of Orebodies

Orebodies occur mostly in laterite overlying the middle Devonian and locally also in

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laterite overlying the upper Devonian and Carboniferous. They have a plane-like distribution, with a thickness of 2—3 m and up to 13 m. Laterite passes downwards mostly into limestone. The ancient erosion surface dips at angles of 5°—15°, and the area with dip angles of 5°— 8° has the highest grade. The ore-bearing laterite may be divided, in descending order, into four beds.

The upper laterite bed is dark red, loose, laterite soil with even tone. It has a low humidity, without any debris, and locally contains a small amount of alumino-ferric nodules. The principal minerals of this bed are goethite, kaolinite, gibbsite and quartz, and the subordinate minerals, hematite and illite. A thin layer of humid material bed is on the top of this bed with badly grown plant.

The bauxite-bearing bed consists of laterite and ore, loosely cemented. In overall features, it is similar to the upper laterite, but lower in iron content, the bed shows downwards yellow and red-yellow colour with downwards increasing tone . Ore scattered in the laterite as pisolitic or oolitic nodules has an appearance somewhat like a sphere ellipsoid or an irregular tumour and honey-comb and is commonly enclosed by a ferric crust yellow brown to dark brown colour. In the interior of the noduled there are white and yellowish patches and mottles. Generally speaking the ore with more light coloured patches, smooth surface, brown colour and circular or elliptical form contains more gibbsite nodules range in diameter from less than 1 mm to more than 2 m and generally 1—20 cm. The principal minerals include goethite and gibbsite, and the subordinate minerals, Kaolinite, hematite, lithiophorite, illite and anatase.

The lower laterite bed consists of spotted laterite in the upper part and purplish-red clay in the lower part. The former is not homogeneous in tone, poorly cemented and composed of red clay and a small amount of alumo-ferric and manganese nodules, which decrease downwards. The latter is homogeneous in tone, well cemented and has a high stickability and humidity. The principal minerals include illite, kaolinite and goethite, and the subordinate minerals, gibbsite, quartz, hematite and anatase. The bed is about 0.3—3m thick.

The partly-weathered bedrock consists of grey and yellow clay containing fragments of limestone, dolomite, marl and shale weathered in varying degrees, and residual bedding may be locally presented. The principal minerals include calcite, illite and quartz, and the subordinate minerals, goethite, dolomite and kaolinite. In some places the bed is missing, and the lower laterite bed lies directly on the fresh bedrock. The bed is about 0—10m thick.

The boundary between the upper laterite and thebauxite bearing bed is very sharp, but the boundaries between the other beds are usually transitional.

2.1.3 Structure of Orebodies and Features of Ore

No bedding is observed in orebodies, but residual bedrock can frequently be found. Ore is gravel-shaped. Gravels have different sizes and mixed accumulate, with the greatest one being 1— 2 m in diameter. The outer part of the gravels consists of ferric crust, while the inner part consists of gibbsite, hematite and goethite.

2. 1. 4 Composition.

As seen in Guigang, the ore deposit consists chiefly of gibbsite, goethite, hematite, kaolinite, quartz and anatase. Ore potential is 1400kg / m^3. The ore contains 24—39% Al_2O_3, 4— 12% SiO_2, 35— 50% Fe_2O_3 and 2— 3% TiO_2. X-ray powder diffraction, chemical analysis and digestion residue indicate that effective Al_2O_3 in ore accounts for 50—80% of total Al_2O_3 and active silicon, 30— 60% of $TSiO_2$. Therefore, by using the Bayer process, the actual ratio of aluminum to silicon is over 6— 8. The preliminary and expanded experiments indicate that the ore deposit has the advantage of comprehensive utilization and high economical value.

2. 1. 5 Ore Genesis

From the discussion it can be seen that this type of bauxited deposit is lateritic. It is a product of lateritization of rock in ore-forming materials in the favourable climate, e. g. in a tropical or subtropical zone with sufficient rainfall and appropriate temperature. Physicochemical weathering has leached alkaline and alkaline earth metals and most of silicon from the parent rock and left residue composed mostly of aluminium, iron silicates titanium oxides and hydroxides. In a geomorphological environment favourable to preservation they remain present ore deposit.

2. 1. 6 Structural Horizon

The Guigang type trihydroxy bauxide deposit occurs in the minor structural layer (Neogene and Quaternary) of the late half of residual-mobility period structural sublayer (Cenozoic) of the diwa structural layer (Mesozoic and Cenozoic).

2. 2 *Tectonic Setting, Material Base and Historical Background*

The ore deposit occurs in the Nanning-Yulin arcuate diwa-type basin (geodepression), southern Jiangxi-Guangxi diwa system, SE China diwa region. The basin is bounded on the north by the Dayao and Damming geodome-type mountain and southern Xuefeng geodome system, and on the southeast of Zhejiang-Guangdong geodome system. Judged by the fact that the ore bed passes gradually into the spotted laterite formed in the middle and late Pleistocene, the ore deposit may have been formed in the late Pleistocene to Holocene, i. e. in the latter half of the residual mobility period of the diwa stage when crustal movements became rather weak.

The material base and background for the formation of the Guigang-type bauxite deposit may be interpreted as follows. The layer exposed in the transition zone between the northern margin of the Nanning-Yulin diwa basin (geodepression) and the Dayao Daming geodome mountain is the platform structural layer composed of the Paleozoic and characterized by the development of limestone and dolomite. It was formed prior to the mid-Mesozoic at the platform stage of the crustal development. The ore deposit was developed on it as a base, which provided material for ore formation by weathering.

3 THE THINKING BY WHICH THE GUIGANG-TYPE TRIHYDROXY BAUXITE DEPOSIT WAS FOUND

The discovery of Guigang type trihydroxy bauxite deposit is the result of exploration by a new thinking. At first we paid attention to the metallogenic specialization of tectonic elements according to the law of progression with transformation between mobile and stable regions; then we analysed the principal cause why the known bauxite deposits in China are mostly monohydroxy, and thus we concluded that there is the possibility of finding large trihydroxy bauxite deposits in the study area and then we know how to find them. The concrete contents include the following points.

3.1 *Relation of Bauxite Ore and Tectonic Setting*

In the search for trihydroxy bauxite it is necessary to reveal the favourable tectonic setting in. This is because diwa theory metallogeny suggests that different tectonic elements have their own metallogenic specialization, and ores bauxite have no exception. In the tectonic classification of mineral deposits, diwa theory has smashed the yoke of the traditional notion"either geosyncline or platform", and distinguished, according to China's geological and metallogenic features, three tectonic types, i. e. the diwa (geodepression) type in addition to the previously known geosynclinal and platform types.

Trihydroxy bauxite deposits are mainly of laterite type, formed by lateritization. Besides they may be sedimentary in origin, formed mostly by transportation of ore deposits of weathered origin by running water. The tectonic condition necessary for formation of laterite-type bauxite deposits is a relatively stable tectonic regime. The reasons are as follows: In light of the conditions of ore formation in this tectonic setting, crustal movements are weak or relatively weak, upwarping and downwarping are slow or relatively slow, geomorphological contrast is small and relief is low, thus favouring the prolonged, protracted and thorough operation of weathering with the formation of a wide and thick crust for the preservation of ore; low relief favours the preservation of a weathering crust formed in an area with a gentle slope and prevents it from being destroyed by running water. Moreover, in this tectonic setting, terrestrial heat flow is low and magmatic activity is weak. As a result, gibbsite may not be influenced by high earth temperature and experienced dehydration and metamorphism, converting itself into diaspore.

According to the law of progression with transformation between mobile and stable regions, tectonic regimes of any nature and type sometimes possess conditions favourable to the formation of trihydroxy bauxite deposits. Provided it has a material source and appropriate climatic and geomorphological conditions, this type of bauxite deposit will surely be formed. In a geosynclinal region, important bauxite deposits occur mainly in marine sediments deposited in the early period of its development. However, this tectonic element is a mobile region, in which terrestrial heat flow is generally produced by high and infense folding, magmatism and metamorphism caused by orogenic movements taking place in the period of geosynclinal inversion (middle or maximum mobility period of geosynclinal development). Under their influence ore is metamorphosed into a diaspore.

The platform region is a stable region. In the process of its formation and development, terrestrial heat flow is low; crustal movements are gentle, mainly slow up and down movements affecting a large area, and intense folding, magmatism and metamorphism are absent. Therefore, bauxite deposits are of trihydroxy type, little affected by metamorphism. In the platform region geomorphological contrast is generally weak, characterized by a flat, open and gently undulating plain or peneplain, and thus bauxite deposits are widespread, of persistent thickness and large tonnage.

The diwa region, similar to the geosyncline, is also a mobile region. Therefore, bauxite deposits formed in the early (i. e. initial-mobility) period of its development may have been affected and reworked in the middle period by high earth temperature and folding, faulting, magmatism and metamorphism caused by intense orogeny. But bauxite deposits formed in the late (residual-mobility) period can still keep their original features, and trihydroxy bauxite deposits may be formed. Let us further consider the climatic and geomorphological conditions. The early half of the residual-mobility period of diwa development, when the maximum-mobility period has just passed, still sees sharp tectono-geomorphological contrast. At that time, high geodome mountains acting as a screen prevent diwa basins, albeit high in temperature, from getting sufficient rainfall, and enhance the accumulation of red beds only, which are unfavourable to the occurrence of trihydroxy bauxite deposits. On the other hand, the earth's steep surface is also an unfavourable condition. But the circumstances changed in the latter half of the residual-mobility period. At that time earth temperature lowered further, crustal movements weakened, geomorphological contrast was reduced further, and diwa basins might have a suitable geomorphological environment. If climate is favorable, trihydroxy bauxite deposits may easily be formed.

From this discussion it becomes apparent that among the three tectonic elements the platform region is the preferred site in the search for trihydroxy bauxite deposits.

3.2 *Influence of China's Crustal Evolution on the Bauxite Deposits*

According to the geosynclinal platform theory, most part of China, especially its eastern area, is under a platform regime at the present stage. Bauxite deposits within this broad area must belong to the trihydroxy type. But this does not agree with the facts we discussed above. What is the reason?

In applying the diwa theory to restudying the history of China's crustal evolution, some may believe that during the Paleozoic, its eastern part, actually changed at different times from the geosynclinal into the platform stage, forming finally the broad "Chinese Platform" and by the mid-Mesozoic its different parts had undergone successive activation and transformed themselves into activated[1] or diwa[2,10] regions. In accordance with the time of birth and difference in historical background, these include Northeast China, North China, Central China, Yunnan-Guizhou, Western Yunnan and Southeast China diwa regions.

This transformation in the history of China's crustal evolution had an important influence upon bauxite deposits formed in the original "Chinese Patform". This is because the diwa region is a mobile region, where terrestrial heat flow is high and crustal movements in the Paleozoic were originally composed of gibbsite, but affected by high heat flow and intense folding, magmatism and metamorphism taking place in the maximum-mobility period of diwa development; for this reason, they could not help being mostly or even wholly reworked and converted into diaspore. Clearly the reason why the bauxite deposits of China belong to monohydroxy type is closely related to the transformation of tectonic elements.

3. 3 *Modelling on the Conversion Relation of Aluminium Ore Types to the Transformation of Tectonic Settings*

The conversion relation of the known platform-type trihyroxy bauxite deposits into those of monohydroxy type to the transfromation of tectonic settings was interpreted by the author from a metallogenic view[2]. Experimetnts[11,13] indicate that gibbsite, when heated and dehydrated, could indeed undergo phase transformation, and be converted into diaspore. After the discovery of the Guigang bauxite deposit, Fan Faming[14] took samples from the ore deposit for similar modelling, which gives a convincing argument in favour of the above view.

Fan's sample for modelling is gibbsite from Daliling, Menggong and Guigang . In the process of modelling, with the rise in temperature, aluminous minerals change along the order: gibbsite → boehmite → diaspore → corundum. Fan drew the following conclusions: (1) The major factor affecting this transformation is temperature. Below 100℃ gibbsite does not change, but when temperature rises to 150℃ , a great amount of gibbsite is converted into boehmite, and part of it into diaspore. When temperature reaches 300℃ , gibbsite disappears, and boehmite decreases, but diaspore increases sharply and a small amount of corundum appears. (2) Gibbsite undergoes dehydration and transformation along the above order at appropriate temperatures , whether it is in a dry environment or soaked in water. (3) In the process of Gibbsite's conversion into diaspore, goethite is also dehydrated into hematite, but kaolinite, anatase and rutile do not change.

It is well known that values of terrestrial heat flow in the platform region are far lower than those in mobile (e. g. diwa) region. The former are generally 1 HFU, while the latter, >1 HFU or>2HFU and even up to 2.5 HFU. As the earth temperature and geothermal gradient in the platform region vary little, trihydroxy bauxite deposits occurring in it have rarely been converted into those of monohydroxy type despite of deep burial and rise in temperature, even if they are overlain by several thousand meters of sediments. In western Henan Province, according to Fan, platform-type bauxite deposits occur in the mid-Carboniferous platform structural layer overlain by 2462—4965m of sediments. At the present the area is in the residual-mobility period of the diwa stage, with the geothermal gradient being 3. 78℃ / 100m. The geothermal gradient at the platform stage was presumably lower than that. Even if we take the higher value as a standard for calcuation, the bauxite deposits after formation were only influenced by temperatures of 95℃—189℃. As compared with Fan's modelling, gibbsite in the bauxite deposits also cannot be converted into diaspore , since the actual temperatures must be lower.

Fan's modelling can prove the following points. (1) Diaspore can be converted from gibbsite due to the rise of temperature. (2) The platform type bauxite deposits were originally trihydroxy in type, but the areas in which they occur changed into diwa regions, and thus they were mostly converted into monohydroxy in type.

3. 4 *Diwa Regions in South China during the Residual-mobility Period are the Prospects for Trihydroxy Bauxite Deposits*

In the eyes of the history of tectono-metallogenic development, platform type bauxite deposits were originally of large trihydroxy type. But platform regions in China were activated in mid-Mesozoic time and became diwa regions, and only three small platforms, the Yishan, Sichuan and Songliao, remain. Not only were platform type bauxite deposits within the limits of diwa regions mostly dehydrated into monohydroxy type, but bauxite deposits in the three small residual platforms were also more or less affected and are no longer of trihydroxy type, Therefore, the platform structural layer is not a promising object for searching large trihydroxy bauxite deposit.

Nevertheless, the diwa structural layer is well-developed in China and spreads widely in diwa basins of various diwa regions. The diwa regions in South China in particular, have favourable conditions for ore formation.

3. 4. 1 Tectonic Conditions

The history of crustal development in the area indicates that when it entered the late half of the residual-mobility period (Neogene to Quaternary) of the diwa stage, the maximum-mobility period (middle and late Mesozoic) of diwa development had passed as a major orogeny (Yanshanian movement) had ended long ago; structural disturbance was more gentle than in the early half of the residual mobility period (Paleogene), and the crust experienced a relatively long, stable period thus providing conditions for protracted and persistent weathering and ore formation.

3. 4. 2 Climatic Conditions

Climates are important for the formation of trihydroxy bauxite deposits. As discussed above, a diwa region, being in the maximum-mobility period of development, is characterized by alternation between high geodome mountains and deep diwa basins. In the early half of the residual-mobility period, high mountains stand still and their screening role is obvious. As a result, diwa basins, though high in temperature, lack in rainfall, receive generally only red beds without trihydroxy bauxite. But in the latter half of the residual-mobility period, mountains were eroded and lowered and regional climatic conditions also played a role, thus providing a basis for the search for trihydroxy bauxite deposits.

In terms of climatic zones occupied by the provinces of China the area which is favourable to the occurrence of lateritic bauxite is an EW zone lying approximately south of the line Lhasa–Zhongqing–Yueyang–Liujiang–Hangzhou, i. e. , latitude 30° N. This zone is located mostly within the limits of the present subtropical and tropical zones. Its western segment consisting of south Xizang (Tibet), west Sichuan and northwest Yunnan has a high topography, low temperature and small rainfall due to recent tectonic uplifting. But the other regions have an annual average temperature ranging from 16—18.5℃ to 19—25℃ (Guangdong), with the highest monthly average temperature reaching 23—28℃ (Guangxi) and even 30—40℃ (Hunan), and the annual average rainfall ranging from 1100mm to 2800mm (Guangxi). The latter half of the residual-mobility period of the development of the diwa regions in this zone includes the Neogene and Quaternary. Available data indicate that the geographical net of latitudes and longitudes and climatic zones at that time differed little from the present ones. Moreover, the western segment was not uplifted as high as it is today, and thus temperature at that time was higher. Therefore, it can be inferred that this period, except for the ice age, witnessed overall climatic conditions similar to those of the present, which were more favourable to bauxite formation. Thus, the zone, especially the part lying south of latitude 23 ° N, was suitable for the formation of trihydroxy bauxite.

3. 4. 3 Sources of Material

The sources of material for bauxite formation in South China may be derrived all kinds of rocks, such as igneous, sedimentary and metamorphic rocks. Within the limits of the above favourable climatic zone, in addition to Cenozoic basalt as the parent rock for the Zhangpu-type, and Pengai-type trihydroxy bauxite, there is upper Paleozoic carbonate rock as the most common potential parent rock. Many large bauxite deposits in the world are known to have been derived from carbonate rock. This is because the rock is rich in aluminium, permeable and favorable for the formation of weathering-type bauxite deposits. For example, trihydroxy bauxite deposits of Jamaica have been interpreted as the products of weathering of white limestone on the island

South China in the Paleozoic was in a platform regime, in which topography was characterized by a peneplain with low relief and broad basins. At that time sea water flooded the area from the southwest. As a result, a vast ancient sea basin emerged in most of Yunnan, Guangdong and Hunan Provinces, in which Devonian to Permo-Carboniferous carbonate rock was deposited. It is widespread and can provide ore-forming material in large quantity, and thus the area can be regarded as a preferential region.

3. 4. 4 Geomorphological Conditions

These are important conditions for the formation of weathering-type bauxite deposits. As discussed above, the diwa region is a mobile region, in which geomorphological contrast is sharp, especially in the maximum mobility period, and washing by running water is intense. These conditions are unfavourable for the formation of weathering-type ore deposits. But in the residual-mobility period, when the major orogeny passed, with weakening of tectonic movements, geomorphological contrast was mostly reduced. In the late half of the residual-mobility period, land surfaces with gentle slopes increased, on which weathering-type ore deposits might develop. Particular importance is the transition zone between the steep land surfaces of geodome mountains and diwa basins, where a definte slope favours leaching and desilication and where the slope is so gentle as to prevent the resultant ore from being washed away and to guarantee its protracted accumulation to form an ore deposit.

3. 4. 5 Geothermal Conditions

As the diwa region is a mobile region, it is characterized by high terrestrial heat flow values, especially in the maximum-mobility period. This is unfavourable for the preservation of trihydroxy bauxite deposits. But when it developed into the early half of the residual mobility period , heat flow began to decrease. When the late half of the residual-mobility period came ,heat flow further decreaes, and magmatism also becomes scarce, marked only by Neogene and Quaternary volcanism in a few places of the area. This has created a favourable condition for preservation of gibbsite, preventing it from being converted into diaspore through dehydration at high temperatures. Moreover, weathering-type ore deposits formed at that time are not overlain, by thin sediments, and the chance of the overlayment being reworked by earth temperatures is almost equal to zero. From the discussion we can draw the following conclusion. In searching for large trihydroxy bauxite deposits in Chinese territory emphasis should be put on the weathering crust, belonging to the minor structural layer of the diwa stage. This weathering crust which underlain by a potential parent rock, the upper Paleozoic carbonate rock of the platform-structural layer can be found on land surfaces with gentle slopes in the diwa regions in South China lying at present in subtropical and tropical zones.

4 SUGGESTIONS FOR PROSPECTING TRIHYDROXY BAUXITE DEPOSITS IN SOUTH CHINA

4. 1 *Trends in the Search for Large, Rich Bauxite Deposits of Guigang type*

Since 1987 , the Guigang-type bauxite deposits, only 2—3m and up to 13 m thick at most, have been found. Although they have a high tonnage, they are not concentrated and have a low grade (24—30% Al_2O_3) with a high iron content (35—50% Fe_2O_3)

In future, more attention should be paid on larger bauxite deposits with substantial thickness and concentrated resources and on ore shoots with a high grade and little impurities (iron and silicon). Such bauxite deposits are expected to be found in the following two sites. 1) Within a relatively depressed area in a karst zone with ore-forming conditions, which has a thick weathering crust and has experienced thorough leaching. 2) The depressed area adjacent to a weathering-type bauxite deposit, e. g. limestone sink and solution cave, where a new rich bauxite deposit may be laid down through a short-distance transportation of the weathering-type bauxite deposit. As a result of transportation and selection, silicon and iron contents may further decrease while gibbsite increases, and a thick ore bed may be concentrated in a small area.

The author has observed an example in Yugoslavia. At Jajce, Sarajevo, there is a Cenozoic trihtydroxy bauxite deposit, whose tectonic setting is also a diwa region (the Yugoslavia diwa region). It was formed in the residual-mobility period of the diwa stage (Neogene to Quaternary). Its parent rock is upper Paleozoic carbonate rock, which experienced weathering to form a lateritic bauxite deposit. But high tonnage high grade orebodies occur in limestone sinks. An orebody in exploitation lies in a 200m long and 150m wide limestone sink, with an ore grade of more than 40%. Its main ore-forming material was derived from transportation of an adjacent weathering-type bauxite by running water. This example can be used as reference in our search for large, rich bauxite deposits.

4. 2 *Trend in the Search for Guigang or Other Types of Trihydroxy Bauxite Deposits in Neighborhood*

Guigang-type bauxite is known to occur only in SE China diwa region, notably in Guigang, Hengxian and Binyang Counties. Moreover, besides the explored reserves the forecasted prospective reserves only amount to one hundred million tons. Therefore, it is urgent to carry out prospecting for more bauxite reserves in surrounding areas

Available information indicates that in

the appropriate climatic zones in South China, owing to the wide distribution of the Upper Paleozoic platform structural layer, carbonate rock as a source for Guigang-type or other type trihydroxy bauxite deposits, including the middle and upper Devonian, e.g. the Youjiang (D_1^1) and Donggangling (D_2^1) formations or their equivalents, and the Carboniferous, is still plentiful and crops out widely. Examples include the middle and upper Devonian to Permian in Hunan the upper Carboniferons to lower Permian in southern Jiangxi province and the middle and upper Devonian to lower Permian in Guangdong. Areas of exposure of limestone in these strata may be selected as promising regions. Emphasis should be put on laterite beds in zones with a gentle slope and favourable geomorphological conditions on the margin of a diwa basin, at the foot of a geodome mountain, on a solution peneplain and in a karst depression with limestone exposed. In these zones one should take samples for analysis. When a trihydroxy bauxite deposit is found, attention also should be put on the search for high tonnage, high grade bauxite deposits in the adjacent limestone sinks and caves.

4.3 *Trend in the Search for Weathering-Type Bauxite Deposits Resulted from Other Kind of Rocks in Southern China*

As discussed above, many rock types can be used as parent rocks for lateritic bauxite deposits. Under appropriate geomorphological conditions, various aluminium-rich igneous and sedimentary rocks of different regimes and older crustal-evolution stages may develop through lateritization in the late half of the residual-mobility period of the diwa stage into trihydroxy bauxite deposits. Available information indicates that among these rocks the widely exposed are as follows.

4.3.1 Igneous Rocks-Eruptive and Intrusive

Generally speaking, basalt is the most common parent rock for bauxite. Many large trihydroxy bauxite deposits in the world are the products of weathering of basalt. For example, the Ayekoye, Dabola and Tuge bauxite deposits of Guinea and the Minitap bauxite deposit of Cameroon occur in the products of weathering of basic lava. This is also true of the Gujarat bauxite deposit in India. In South China, apart from Neogene to Quaternary basalt in Fujian and Hainan, the SE China diwa region, is known to host bauxite deposits, Cenozoic basalt in other places such as Guangdong, Hunan, Zhejiang and Jiangxi provinces probably also host bauxite deposits. In addition, in the favourable climatic zones of Hunan, Guizhou and Sichuan, Permian basalt has a wide distribution and thus merits our attention.

Finally, granitoid, diorite and nepheline syenite are also common parent rocks for trihydroxy bauxite deposits in the world, for example, in Kalimantan, Indonesia, and in Arkansas, USA. In the diwa regions of South China, granite crops out widely. In addition to Indoinian-Yanshanian granite of the initial and maximum-mobility periods of the diwa stage there is Caledonian (including minor Hercynian) granite (a small part of which has been metamorphosed). They had the possibility to evolve into trihydroxy bauxite deposits in the late half of the residual-mobility period of the diwa stage.

Trihydroxy bauxite deposits with intermediate-acid volcanics such as liparite and tuff as parent rocks are also seen outside China. For example, bauxite of Jamaica has been interpreted as being derived from volcanic ash. In South China, especially in the provinces along the coast, Mesozoic-Cenozoic liparite and tuff are also widespread and worthy of exploration

4. 3. 2 Sedimentary Rocks

Types of sedimentary rocks used for sources of bauxite are also plentiful. In South China, in addition to the widespread carbonate rock referred to above, there is also aluminium rich-fine-clastic rock, e. g. arkose, siltstone and mudstone. Examples include the Wepa bauxite deposit in Australia resulting from weathering of Tertiary arkose and sandy claystone and the Gouge bauxite deposit closely related to weathering of Cretaceous arkose, claystone and siltstone. In South China these rocks are also widespread and merits our attention.

4. 3. 3 Metamorphic Rocks

On examples outside China, metamorphic rocks also may be important sources of weathering type-bauxite deposits, e. g. gneiss, schist, phyllite, metabasalt and metagranite. The examples include the bauxite deposits Trombetas in Brasil, the Coast Plain in Guyana, the Buckchs in Surinam, the Darling in Australia, the Orissa and Andhra, in India. In South China attention should be put on the exposure of metamorphic rocks in the Proterozoic (partly Upper Archean) pre-geosynclinal (crystalline basement) and lower Paleozoic geosynclinal (folded basement) structural layers, as seen in favourable climatic zones, as Fujian, Zhejiang, Guangdong and Hainan provinces and in the Xuefeng and Yunkai mountains.

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