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# Problems and Countermeasures of Rare Earth Industry in China

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## Abstract
Rare earth elements are applied extensively in various industries, especially in the hi-tech and military fields. China has various and abundant deposits in rare earth resources. Since the end of the 20th century, China has been No.1 in both the production and exportation of rare earth products in the world. However, there are many rare earth problems in China, such as very low mining industry concentration, backward mining technology, disordered mining administration, low export price, difficult transformation of export policy, serious smuggling and decreasing storage. China's comparative advantages in rare earth resources are gradually in decline and even in a danger of losing. As for rare earth elements China should integrate and standardize the disordered mining industry, extend the domestic supply chain, try to match the domestic industry policies with international trade policy, and improve the system of strategic storage.

**Key words:** Rare earth; Export control; Smuggling; Strategic storage

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## INTRODUCTION
Rare earth elements (REEs) are applied extensively in various industries such as agricultural, metallurgical, petrochemical, glass-ceramic, medical treatment and textile industries. It is even more important that REEs are used widely in the new technological fields of information, biology, new materials, new energy, space and ocean, and play a key role in the core part of various high-tech weapons. REEs are very important to national and economic security. It is difficult to discover other resources available to substitute REEs.

According to the U.S. Geological Survey, based on the proportions of discovered extractable rare earth reserve out of the world's total, China ranks No. 1 with 36%, followed by Russia (19%), the U.S. (13%), Australia (5%) and India (3%). What is more noticeable is that China takes 97% of the world total supply, while the U.S., Russia and Australia have no production and exportation (Salazar, & McNutt, Marcia, 2011).

However, there has been a loosen exploitation, less efficient utilization and immoderate exportation of REEs for quiet a long time in China, which results in the rapid decrease of deposit of REEs, severe competition of numbers of enterprises, lowering price of REEs and seriously pollution problems. At the very beginning of the 21 century, China started to strengthen the regulation and integration of the REEs industry, and tighten restriction over REEs exports. The importers of rare earth products mainly from the U.S., the EU and Japan began to fight against the export restriction policy of China violently. The volume of smuggling of REEs in China is growing. China has been trying hard to solve these problems.

## 1. MINING PROBLEMS OF RARE EARTH RESOURCES

### 1.1 Very Low Concentration of Mining Industry

The characteristics of rare earth mining industry in China are small, scattered, and overneeded. It is difficult to develop scale economy advantage and industry advantage. In 2010 there were more than 170 smelting and separating companies, while only 5 of them had the capacity to handle 5000 tons 0f rare earth oxide per year. Most of them could only handle 1000-2000 tons (Wang, 2001).

Ganzhou Mine of Jiangxi in the south and Baiyunebo mine in Baotou city of Inner Mongolia in the north are large mines just integrated with scale economy effect. However, the other small rare earth mining companies scattering all over the country have greatly weakened the competitive power of these two mines. Basically the competition of the entire rare earth industry is in the state of low-quality, inefficiency and disorder.

### 1.2 Backward Mining Techniques Accompanying Serious Ecological Environment Destruction

In China the mining technical means of rare earth are very backward. Some small and medium-sized companies only skim the upper rich layer of rare earth minerals with original rough equipments or tools. The rate of mineral mining recovery is very low.

At present, the average recovery rate of rare earth resources of the state-owned mines is 60%, whereas that of the individual mines is less than 40%, and that of most of the illegal mines is only 5%. Baiyunebo Mine in Baotou, the largest REEs mine in China, has exploited 12.5 million tons rare earth recourses totally ever since it began to exploit minerals with industrialized methods. However, the actually utilized REEs minerals only amount to 1.2 million tons or so. The utilization rate is less than 10%, and more than 9 million tons left have been dumped into the tailing dam (Wang, 2001).

There are typical rich deposits of ionic rare earth ore (called heavy REEs) in southern China, which are rare in the world. The heavy REEs are wasted more seriously while being mined. Extraction of REEs requires large amount of land resources, and it often results in widespread vegetation destruction, soil erosion and other bad ecological pollution. The waste water and gas emitted have water and atmosphere polluted seriously. Numbers of rare earth companies are developing at the cost of excessive consumption of resources, destruction of ecological environment and serious pollution to a certain degree.

### 1.3 Distorted Administration Over the Mining

The administration of rare earth mining industry has always been a big problem to the central government because the phenomena of out-of-control administration, irregular examination and approval, and illegal exploitation are quite common.

Firstly, there are interest conflicts between the national government and local governments in terms of REEs mining. The national government, based on a long-term strategic perspective, tends to make detailed mining plans to restrict the exploitation of REEs; while local governments often run in the opposite direction for the benefit of local economy and even of individuals. As for the mining plan and management of resources,the division of mineral property rights between the national government and local governments is not clear. The overlapped supervision responsibilities bring about disordered administration.

Secondly, most rare earth resources are deposited in remote mountainous areas, while most of the administrating and managing agencies are in cities. It is quite difficult to regulate and supervise the mining of REEs. Driven by tremendous interests, many small and medium-sized companies seize the loopholes in administration and skillfully skirt round the regulations, and disorderly dig rare earth ores as much as they can, ignoring national regulations and restrictions.

Thirdly, there are responsibility conflicts among the administrators of REEs minerals. The administrators have their rights and responsibilities unclearly divided and always pass the buck to the others, which lead to the absence of regulation.

## 2. UTILIZING PROBLEMS OF RARE EARTH ELEMENTS

The supply chain for rare earth elements generally consist of mining, separating, refining, alloying, and manufacturing. The value rate of ore concentrate, new materials and devices is 1:50:500, with the added value rising outstandingly (Humphries, 2010).

China has been at the lowest point of the international rare earth supply chain, concentrating in mining, separating and refining. China has the most advanced technology of extraction and separation, but is quite backward in the technology of alloying and manufacturing compared with the advanced industrialized countries such as Japan, the U.S. and France.

REEs in China are mainly utilized in traditional fields, and less than 50% of REEs have been used in high and new technological fields. Most of the rare earth products are permanent magnet materials, luminescent materials, hydrogen storage materials and polishing powder, which are primary, low value added products but with extremely high environmental cost. In comparison, the proportions of REEs used in high and new technological field in the U.S. and Japan are 77% and 90% separately of the total amount of utilization (Wang, 2001).

China separates large amount of REEs and exports them at relative low price to some industrialized countries to support their production of hi-tech and high value-

added advices and practical commodities. At the same time, China imports these hi-tech and high value-added rare earth products by paying tens or hundreds of times of the exporting price. The rare earth industry in China has over-supplied raw materials and inadequate capacity of developing hi-tech and new materials, and mainly lives on selling raw materials.

## 3. EXPORTING PROBLEMS OF RARE EARTH PRODUCTS

In the 1970s and 1980s, the Mountain Pass mine in California of the U.S. produced over 70 percent of the world's supply of REEs (Bourzac, 2010). The U.S. used to be the biggest producer and exporter of REEs in the world. At the end of the 1990s, China became the major producer of REEs instead of the U.S. based on its low cost advantage. Ever since, China has been the major contributor in both production and exportation of REEs to the world. However, the advantage in the export volume of REEs has not brought China matched benefits. Low international price, difficult policy transformation and rampant smuggling are the main problems faced by the exportation of REEs in China.

### 3.1 Deteriorating Terms of Trade

China has no power to regulate the supply and demand of REEs in the international market, and is faced with the shortage of pricing power and the deteriorating terms of trade. In the period of 1973-1980, the total amount of rare earth exports was 150 tons[1]. From 1990 to 2005, the amount of rare earth exports increased by nearly 10 times, but the average price was depressed to 64% of the original price (Chen, 2010). In 1995-2005, the rare earth industry in China suffered a loss of 10 billion US dollars caused by low pricing exports. For example, cerium oxide with 99.9% purity was once sold very cheaply at 18 yuan per kilogram (Wang, 2001).

The international market price of REEs has been decreasing in the long term mainly because rare earth ores have been mined in a disordered pattern, rare earth companies have been competing excessively and foreign importers are more powerful in negotiation to press down the prices. Quite often foreign importers negotiate with many exporters of China simultaneously in order to cause more severe price competition and reach low purchasing price.

### 3.2 Difficult Export Policy Transformation

China has been faced with great barriers in export policy transformation since it began to strengthen the regulation over rare earth exports and put forward some relevant policies.

At the beginning of the 21 century, China started the transformation of export policies from encouraging REE exports to controlling. In 2005 China began to cancel export rebate policy on rare earth smelting separation products (Wang, 2001). In November 2006, China started to impose tariffs of 15-25% on rare earth exports, and list rare earth raw ore and 41 kinds of rare earth products in the catalogue of prohibited commodities in processing trade (Fang, 2010). The total amount of quotas is decreasing year by year.

On the road of the transformation of rare earth export policy from encouraging to controlling China has met many difficulties mainly caused by violent rejections from the importers, such as the U.S., Japan and the EU, with a trade dispute request to the WTO on June 23 of 2009 against China's export control on nine kinds of raw materials[2], and another trade dispute request to the WTO on March 13, 2012 against China's export restrictions on rare earth, tungsten and molybdenum[3].

### 3.3 Serious Smuggling

The smuggling of rare earth products in China has been increasing violently, mainly because there is a weaker demand, looser regulation and lower price in the domestic market than those in the international market as for the REEs supplied by China. The export of REEs through normal channels is 50,000 tons in 2009, and the smuggling of REEs is over 20,000 tons. The smuggling takes about 40% of the normal exports. In comparison with 2008, the amount of smuggled REEs grew by 10%. The smugglers go around export regulation, and pay less or no export tariffs by camouflaging products, making false declaration, making use of loopholes in tariff descriptions, and even colluding with customs officials.

China's REEs smuggled mainly flow into Japan, followed by South Korea, the U.S. and some European countries[4]. A large number of rare earth smuggling results in the leaching out of valuable resources at very low price, and offsets China's export control policy effect.

## 4. RESERVING PROBLEMS OF RARE EARTH ELEMENTS

After all, rare earth is non-renewable resource. Along with the extensive mining, excessive waste and large

[1]On the Development of Rare Earth Industry of China in the Past 60 Years: Achievements and Expectation. http://www.qqthj.com/ 2011-01-17. Global ferroalloy network.
[2]WTO maintains the adjudication that China's restrictions on the exports of 9 raw materials violate WTO rules [EB/OL]. http://www.sina.com.cn. 2012-01-31.
[3]China's rare earth exports will be investigated by the WTO [EB/OL].
[4]About 40% of China's rare earth has been smuggled oversea and rare earth alloy has been detoured export quotas [EB/OL]. http://www.mofcom.gov.cn/aarticle/o/dh/201010/20101007175872.html.

amount of exports, rare earth reserve in China is declining rapidly, and its proportion out of the world's total is shrinking quickly. The comparative advantage of China has been discounted heavily. In 2011, China only holds 23% of the world's reserves of rare earths, but still takes 90% of the world's supply[5]. Early in 1992 when Deng Xiaoping visited southern China, China took 80% of the world's reserves. Within less than 20 years the proportion decreased from 80% to 23% (Wang, 2001).

Rare earth reserves of China have been decreasing rapidly, while the international and domestic demands are increasing promptly. With the development of modern industry, national defense and hi-tech, the world demand per year for rare earth elements is growing up from 134 thousand tons in 2009 to 180 thousand tons in 2012, increasing by more than 10% yearly (Humphries, 2010). Thus it can be seen that China should pay more attention to the strategic status of REEs, cut the volume of production and exportation, and increase the strategic storage. If not, China will be forced to import large amount of rare earth raw ore and products at higher price in the near future.

## 5. COUNTERMEASURES TO SOLVE RARE EARTH PROBLEMS

Above all, due to the extensive exploitation and laissez faire exports, China has its REE reserves declining rapidly and with the danger of exhausting during the 21st century. It is even worse that, though it enjoys comparative advantage in the holding of rare earths, China does not have the power of pricing and is in a lack of international speaking right. Facing the unfair trade pattern, China can do nothing but to sell large amounts of precious REEs at very low price for exchanging of small amount of expensive hi-tech products. China's terms of trade is deteriorating. Soon after starting to control the export of REEs instead of encouraging, China has been fought against drastically by some large importing and consuming economies such the U.S., EU and Japan. No matter how, China must insist the transformation of export policy, fully recognize the strategic status of rare earth, try to match domestic policies with international ones, and control the exploitation, utilization, strategic reserve and exportation of REEs.

### 5.1 Integrate and Standardize the Mining Industry

To integrate and standardize the disordered mining industry, it is important to set up and support a few giant rare earth enterprises with large scale of production and huge processing competitiveness. By expanding scale and increasing market share, these giants can strengthen their competitiveness.

In the Rare Earth Industry Development Plan Revised Draft (2009-2015) by the Ministry of Industry and Information Technology, Baogang Rare Earth, China Minmetals and Jiangxi Copper are singled out as the leading rare earth enterprises of China. In 2012, the system of China rare earth industry has been set up, which is composed of Baotou light rare earth mine in Inner Mongolia, Liangshan light rare earth mine in Sichuan, and the southern heavy rare earth mine in the five southern provinces represented by Ganzhou in Jiangxi province. The three production bases are supported by mining, refining, and separating technology and a complete industrial system of equipment manufacturing, material processing and applying [11]. In April 2012, China Rare Earth Industry Association came into being.

The framework has been set up, but China needs to improve the industry and section policies, straighten out the administration system, and enforce the supervision. The administration of the integrated market of rare earth will be based on the principle of national ownership. Mineral Resources Law of the People's Republic of China stipulates that the mineral resources on-ground and under-ground belong to the nation, only the State Council and the superior territory agencies have the examination and approval authorities of mining, and one mining license is only related with one mining spot[6]. The administration responsibilities of the central and local governments should be divided rationally so as to improve the efficiency of management.

Under the national strict control, rare earth mining licenses should be issued more carefully, mining prohibition should be imposed on the scattered, disordered and small mining companies, and environmental protection should be strengthened. It is urgent to raise the environmental accessing threshold of the mining industry, raise the requirements for monitoring and controlling pollutant emission, and strive to solve the pollution problems about drinking water, atmosphere, soil and sea, which are closely related with people's livelihood.

### 5.2 Extend the Domestic Supply Chain

Most of the rare earth products exported from China is primary ones, which are raw materials or half-finished products with low value added, mainly because the industry chain in the domestic market of China is very short and most of the rare earth companies lack advanced technology to separate, purify or deep-process rare earth.

An overall management of rare earth supply chain should be preceded. China should develop integrated governance, boost the upgrading of industrial structure

[5]The State Council Information Office of China. Conditions and policies of China's rare earth[R]. People's Publishing House. 2012(6). Pp.4,12,22.
[6]Mineral Resources Law of China. http://www.mlr.gov.cn/zwgk/flfg/kczyflfg/200406/t20040625_292.htm.

and promote healthy development of strategic emerging industries, encourage large enterprises to increase investment in R&D by offering financial support to them so as to improve their capability of mining and smelting, to increase the technological contents in processing and to raise their efficiency of utilizing rare earth elements.

At present the leading enterprises, such as Baogang Rare Earth, China Minmetals and Jiangxi Copper, have been put more money in R&D to stimulate technical innovations. However, it will take a long time to raise their capability to make deeper processing of REEs.

In recent years, China has been constructing actively a fare and open environment for investment in order to encourage foreigners to invest in the recycling and reusing of waste and old products, and high-end application of rare earth industry. In 2012, there are 38 wholly-owned enterprises and joint ventures investing in rare earth industry in China, mainly from the U.S., Germany, France, Canada and Japan. In China, most of the rare earth projects of deep processing, new materials and application are accomplished by foreign enterprises.

While strengthening international cooperation, China should enforce the protection of the strategically important rare earth elements, and carefully choose foreign investment. Foreign investors are forbidden to set up rare earth mine enterprises within the border of China, that is, they are not allowed to step into rare earth mining and primary processing.

In addition China should screw up its legislation and refine its customs tariff descriptions in order to prevent foreign investors to make simple deep processing of rare earth raw materials and then have them exported.

### 5.3 Try to Match Domestic Industry Policies wth International Trade Policy

According to the natural resource protection exception clause i.e. article XX (g) of the GATT, China should regulate its domestic rare earth industry as strictly as regulating its export of rare earth elements[7]. It is an inalienable right of a country to restrict exports of strategic resources. In the premise of ensuring its national and industrial security, China has the right to gradually strengthen the export restrictions on REEs, take over the pricing right gradually, change the unfair trade patterns, and exchange rare earth for technology step-by-step.

While improving measures of rare earth export control, China should pay attention to the linkage between domestic industry policies and foreign trade policies so as to reduce trade frictions and political sensitivity, enhance the conformity with WTO rules, and strengthen China's distributing and pricing power in international rare earth market. In addition to reduce total export volume of REEs, China should restrict the exports of raw rare earth ores, primarily processed products, and encourage the exports of deep processed, high value-added products.

As for the smuggling of REEs, China should take greater efforts to support the General Administration of Customs with money, talents and equipments. Provide specific funds for more advanced, more specialized testing equipments such as chromatograph inspectors. Train qualified talents just for the special inspection and set up an agency to provide authoritative inspection report for the best. Greater attention should be paid to detecting the declared exports of rare earth products which are easy to be smuggled. Companies which exchanged rare earth export quotas illegally, make false declaration or bribe custom officials, especially the custom officials who are involved in smuggling, must be heavily punished, sentenced heavily and give criminal sanctions.

### 5.4 Improve the System of Strategic Rare Earth Storage

Establishing and perfecting the storage system of REEs is good to improve the relationship between the supply and demand of REEs, lead market price reasonably and meet the need of safeguarding national economic security and protecting its national defense sustainably. China should improve its storage system, and learn from the developed economies, such as the U.S., Japan and the EU to protectively exploit and systematically store rare earths.

China has formulated the framework of strategic rare earth storage system, and singled out eleven national rare earth sites, in which certain amount of rare earth resources under-ground and rare earth products will be stored as national reserves[7].

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