Zhang-Huang Ye, Yi-Ke Li\textsuperscript{*} and Xuan Yang

An Analysis on Chinese Graphite Resource and Its Development Suggestions

\textbf{Abstract:} Graphite has been listed as a strategic mineral resource owing to its superior physical and chemical properties and wide application. China is rich in natural graphite resource, which has the proved reserve of 55 million tons, accounting for 42\% of the global. The output of graphite product made in China rank the first in the world, as well as the largest exporter. However, the structure of domestic consumption is unreasonable, which is oriented by low-end consumption. China’s graphite mining industry is backward in terms of graphite processing technology. Since 1990s, the Chinese graphite industry has experienced the change from prosperity to recession due to the excessive product stock and extreme price disorder. The main reason for the violent change is the rapid expansion of production capacity. It is urgent for us to protect graphite as strategic resources and make scientific development planning.

\textbf{Keywords:} graphite; strategic mineral; resource; suggestions

1 Introduction

Graphite owns many unique physical and chemical properties, including high thermostability, high strength, and good stability. With the development of science and technology, graphite is widely used in all walks of life of modern society as the basic material of high conductivity and high lubrication. Many countries have recognized the strategic value of graphite. For example, the United States and the European Union have listed it as an important strategic mineral resource. China has also realized the importance of graphite and defined it as a strategic mineral product [1].

---

\textit{Zhang-Huang Ye,} Jiangxi Science and Technology Normal University. No. 605, Fenglin Road, Nanchang, Jiangxi. Email: chuckverna@sina.com

\textit{Yi-Ke Li,} Institute of Mineral Resources, CAGS. No. 26, Baiwanzhuang Road, Xicheng district, Beijing. Email: like430@cags.ac.cn

\textit{Xuan Yang,} Institute of Mineral Resources, CAGS. No. 26, Baiwanzhuang Road, Xicheng district, Beijing. Email: 1959634940@qq.com

This work is licensed under the Creative Commons Attribution-NonCommercial-NoDerivs 3.0 License.
2 Abundant Graphite Reserve in China

By 2012, China has ascertained 118 crystalline graphite mining areas and 31 aphanitic graphite mining areas. According to the statistics from the U.S. Geological Survey, the world’s natural graphite reserves are 130 million tons. Among them, the reserve in China have reached 55 million tons accounting for 42 % in the world. Together with Brazil, the two countries account for 87 % of the world (Fig. 1). Global distribution of graphite is highly uneven.

The graphite resource in China has wide distribution, and 20 provinces in China have graphite deposits. Heilongjiang province has the biggest reserve, 64 % of the total, followed by Shandong and Sichuan Province. Abundant graphite reserve in China has established a solid foundation for the development of national economy and defence industry. Nevertheless, the reserve of natural graphite in China shows a decreasing trend in recent years, both crystalline graphite and aphanitic graphite, according to statistics of China Non-Metallic Minerals Industry Association.

![Graphite Reserve Distribution](image)

**Fig. 1:** Global graphite reserve distribution in the year of 2013 (unit: 10,000 tons) Data source: USGS[2]
3 Graphite Production in China

China’s crystalline graphite production was basically showing a steady upward trend, from 220,000 tons in the year of 2000 to 700,000 tons in 2011. However, there was a drop in the year of 2009 and 2012. The production decreased to 480,000 tons in 2009 because of the global financial crisis, compared with the 650,000 tons in 2008. The graphite export decreased in 2012 due to the political and economic environment. Besides, the domestic demand in steel industry declined too. Therefore the crystalline graphite production fell to 470,000 tons in 2012 from 700,000 tons in 2011. Since 2006, the production of aphanitic graphite has always been declining (Fig. 2).

![Graphite Production in China](image)

**Fig. 2:** The graphite production in China in the year of 2000-2012 (Unit: 10,000 tons) Data sources: China Non-Metallic Minerals Industry Association

4 Graphite Consumption in China

The consumption of natural graphite in China fluctuates slightly. Its consumption amount was from 602,700 tons in 2000 to 433,900 tons in 2002, from 433,900 tons in 2002 to 703,400 tons in 2006 then declined to 669,400 tons (Fig. 3).
The domestic graphite structure is characterised by low-end consumption. The main graphite consumption fields in China are refractory materials and steel industry, accounting for 42%. In addition, the proportion used for batteries, fuel cells, expanded graphite and motor brush accounts for about 23%. The above-listed common industrial consumption accounts for about 2/3. Application in lubricants, colloidal graphite and casting accounts for about 12%, brake facing and friction products about 10%, pencils 6%, other new graphite materials, military projects, atomic energy and aerospace only occupy a share of 7% [3].

5 Graphite Mining Industry in China

Although China ranks the top in both the graphite reserve and the output around the world, the graphite mining industry is relatively backward compared with the countries who own the advanced graphite processing technology, such as the United States, Japan and Germany. At present, raw materials and primary processing products predominate in China, and the long-timed problems have been still remaining solved: disorderly mining, low-price export, the environmental destruction.

The domestic demand for aphanitic graphite is less than 500,000 tons, but the actual output is more than 1 million tons, which indicates that less than half of the aphanitic graphite is used for industrial consumption. To clean the stock, manufacturers were trying to dump to the international market at low prices, where the pricing mechanism was seriously distorted. To make matters worse, the aphanitic graphite was even burned, which was a serious waste of graphite resources.

China is the largest exporter of natural graphite in the world. The export of crystalline graphite has expanded to more than 40 countries and regions, accounting for
about half of the total in international market [4]. Since 1990s, the crystalline graphite industry in China has experienced from prosperity to recession. The large new emerging enterprises have led to the rapid excessive expansion of production scale. In the end, the production capacity has brought about the situation of “structural surplus”, which resulted in overstocking and extreme disorder of market price, especially low-medium grade crystalline graphite product. Besides, the unbalanced exploitation has caused the serious resources waste of crystalline graphite. The unauthorized mining of private enterprises had no field investigation, nor mining planning.

6 Suggestions

The governments in the United States, Russia, Britain and Germany limit the graphite mining as a strategic resource because of its importance. Instead, they import low-priced graphite from China and other countries and reserve as strategic materials. Japan, who is lack of graphite resources, imports large quantities of raw materials from China and reserves it at sea. Therefore, it is urgent for China to find out the real situation of graphite resources, to evaluate resource potential, to protect the graphite as a strategic resource, and make a specific development planning.

Acknowledgement: This study was financially supported by the programs (2016ZWH028A–28) and (DD 20160124).

References

[3] Shen Wanci, The situation and development of graphite industry, China non-metallic mineral industry, 2013(2)