

News and Highlights**China's Graphite Resources and the Supply-Demand Situation**

LIU Lian, LIU Zhiqiang, HUANG Min, FEI Hongcai, ZHOU Jian, ZHANG Yuxu and HAO Ziguo*

Chinese Academy of Geological Sciences, China Geological Society, Beijing 100037, China

Graphite is a rare and important nonmetallic mineral. Till 2017, the global graphite resource reserves had exceeded one billion tons, which are mainly distributed in China (0.45 billion tons), Mozambique (0.14 billion tons), Madagascar (0.1 billion tons), Turkey (0.09 billion tons), Brazil (0.07 billion tons), and Tanzania (0.07 billion tons). These six countries include about 92% of the global graphite resource reserves, of which China accounts for about 45% of the world's total resource reserves.

In 2017, China had about 0.368 billion tons of proven resource reserves of crystalline graphite minerals, including 195.3581 million tons in Heilongjiang, accounting for 53.2%, 82.9031 million tons in Inner Mongolia, accounting for 22.6%, 20.9543 million tons in Sichuan, accounting for 5.7%, 19.5622 million tons in Shanxi, accounting for 5.3%, 16.1878 million tons in Shandong, accounting for 4.4%, and other areas accounting for approximately 9%. The total proven resource reserves of cryptocrystalline graphite ores were 0.087 billion tons, including 57.4809 million tons in Inner Mongolia, accounting for 66.3%, 9.5308 million tons in Hunan, accounting for 11%, 8.8590 million tons in Jilin, accounting for 10.2%, 3.8335 million tons in Guangdong, accounting for 4.4%, 3.3174 million tons in Fujian, accounting for 3.8%, and other areas accounting for less than 5%.

The grade of crystalline graphite ores in China varies between 2% and 10%. The diameter of scales was mostly between 0.05 and 1.5 mm, with medium scales. These crystalline graphite ores have a high crystallization degree and low impurity content, which is generally easy to be sorted. The average grade of crystalline graphite ores in Heilongjiang is about 8.56%, of which the average grade of ores in the Jixi area is 4%–10%, with 40%–45% ones with an average scale size of >0.15mm (above 100 mesh); the average ore grade in the Luobei area is 10%, mainly small scale, with most scales of <0.15mm (below 100 mesh). The average grade of the crystalline graphite ores in Inner Mongolia is 2%–5%, which is generally lower than that in Heilongjiang, but the scale is relatively large, with more than 50% with a scale diameter >0.15mm. The

average grade of graphite deposits in Sichuan is mostly distributed between 5% and 7%, with small scales. The average grade of graphite ores in Shanxi is 3%–4%, and the scale diameter is mostly >0.15mm. The average grade of graphite ores in Shandong is 3%–5%, with 40%–60% of large scales.

In 2017, China had proven resource reserves of crystalline graphite minerals up to 36750.43 million tons. The mining recovery rate was 92%, and the recovery rate was 80%. The average yield of large scales (>0.15 mm) in graphite ore concentrate was about 14%. The output of large scales (>0.15mm) in our country is estimated to be 3786.76 million tons in the future, and the remaining small scales (<0.15mm) production is estimated to be 23261.55 million tons.

The grade of China's cryptocrystalline graphite ores varies greatly, lying between 12% and 85%, with an average grade of about 70.8%. The cryptocrystalline graphite ores often have a low impurity content, and can be utilized by only hand selection and grinding powder. In China's graphite deposits, there are few other minerals associated with the graphite, and the comprehensive recovery value is not high.

At present, the world's annual output of graphite has exceeded 1.5 million tons. Among these, China has an annual output of 1.17 million tons, India has an annual output of 0.17 million tons and Brazil has an annual output of 0.08 million tons; these are now the main graphite mining countries in the world. In addition to the traditional graphite mining countries, Mozambique, Tanzania, Australia and other countries have accelerated production expansion in recent years, and are expected to have newly increased production capacity exceeding 0.14 million tons per year.

From 2014 to 2017, the output of crystalline graphite in China was generally stable, and was basically maintained at 60–70 tons per year. The output of cryptocrystalline graphite increased from 0.25 million tons in 2014 to 0.50 million tons in 2017, with an average annual increase of 25% (Table 1).

From 2014 to 2016, China's apparent consumption of graphite was 0.6818 million tons, 6.938 million tons and

* Corresponding author. E-mail: haoziguo@126.com

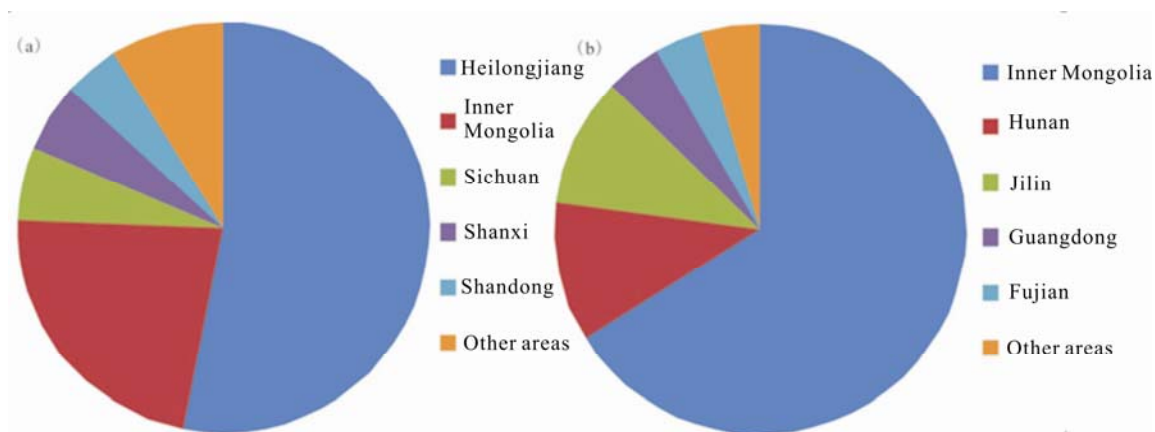


Fig. 1. Distribution of China's graphite resources in 2017.

(a), Distribution of crystalline graphite minerals in China; (b), Distribution of cryptocrystalline graphite ores in China.

5.642 million tons, respectively, which basically maintained a level of 0.60–0.70 million tons per year. In 2017, the apparent consumption increased to 0.9748 million tons, and had an average annual increase of over 10% compared with that in 2014 (Table 2).

At present, China's natural graphite products are mainly used in traditional industries, such as refractories, steelmaking, casting, sealing materials and the pencil industry. However, from the general development trend,

Table 1 China's graphite output during 2014–2016 (minerals, $\times 10^6$ t)

Type	2014	2015	2016	2017
Crystalline	65	66	45	67
Cryptocrystalline	25	20	35	50
Total	90	86	80	117

Table 2 Apparent consumption of China's graphite during 2014–2017 (minerals, $\times 10^6$ t)

Year	2014	2015	2016	2017	Data source
Production	90	86	75	117	China Non-Metallic Minerals Industry Association
Import	6.29	8.45	4.93	14.74	National Custom Information Center
Export	28.11	25.07	23.51	34.26	National Custom Information Center
Apparent consumption	68.18	69.38	56.42	97.48	

Table 3 Comparison of China's graphite consumption structure in 2014 and 2017

Consumption structure	2014	2017
Refractories and steel-making	47%	42%
Batteries, sealing materials, carbon brushes	23%	25%
Lubricants, colloidal graphite, casting	12%	10%
Brake lining, friction material	10%	10%
Pencils	7%	5%
New materials, military industry, nuclear industry, aeronautics and astronautics, etc.	1%	8%

China's iron and steel production capacity has been seriously over surplus. With the continuous adjustment of industrial structure and the extension of refractory material life, and the popularization of low carbon magnesia carbon brick, the demand for graphite in traditional industry will decrease year by year. Spherical graphite, flexible graphite, graphite electrodes, nuclear graphite and other deep-processing products will become a new market direction.

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