



GEOLOGY OF MINERAL DEPOSITS

Review paper

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Chinese mining industry: state of the art review

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Abstract

The territory of the present-day People's Republic of China is rich in mineral and energy resources which stimulate the growth of the extractive industry in the country. China is currently the world leader in the production of 31 commodities (mineral products): molybdenum, tungsten, iron, aluminum, lead, zinc, gold, coal, gypsum, bentonite, and many others. This stimulates the development of the appropriate infrastructure and training of specialists in the mining industry, the development of international links for investment and the exchange of best production practices. The purpose of this work was to study the history of exploration and extraction of natural resources, establish a domestic strategy for the development of the mining and metallurgical sector, and review leading Chinese mining and metallurgical companies. The paper reviewed key domestic processes in China which would affect the domestic and global mining and metallurgical industry. An assessment of natural resource deposits throughout the whole territory of the country was carried out with their brief description, highlighting the prime prospects, and presenting commodity reserves. The paper presents the main challenges for the mining and metallurgical industry to be met in the 14th Five-Year Plan. The development of the industry up to 2025 implies the expansion of extractive capacities with an overall reduction in dependence on imports, enhancing exploration programs, and the reduction of harmful emissions from operating enterprises, etc. Special attention is paid to publicly traded mining and metallurgical companies in China. The leaders in each sector are presented, and their brief economic indicators are given.

Keywords

China, mineral resources, mineral products, provinces, review, extraction, consumption, analysis, yearly data, economy, industry

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ГЕОЛОГИЯ МЕСТОРОЖДЕНИЙ ПОЛЕЗНЫХ ИСКОПАЕМЫХ

Обзорная статья

Обзор современного состояния
горнодобывающей промышленности КитаяА.К. Кирсанов   

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Аннотация

Территория современной Китайской Народной Республики обладает значительными запасами минеральных и энергетических ресурсов, что стимулирует рост добывающей отрасли. На текущий момент Китай является мировым лидером по добыче и производству 31 вида минерально-сырьевых продуктов: молибден, вольфрам, железо, алюминий, свинец, цинк, золото, уголь, гипс, бентонит и многие другие. Данный факт обуславливает развитие соответствующей инфраструктуры и подготовку специалистов в горнодобывающей отрасли, развитие международных связей для инвестиций и обмена передовым производственным опытом. Целью настоящей работы являлись изучение динамики разведки и добычи природных ресурсов, определение внутригосударственной стратегии развития горно-металлургического сектора, анализ передовых китайских горно-металлургических компаний. В представленной работе рассмотрены ключевые внутренние процессы в Китае, которые будут влиять на внутреннюю и мировую горно-металлургическую промышленность. Проведена оценка месторождений природных ресурсов на всей территории государства – дана их краткая



характеристика, выделены наиболее перспективные участки и показаны запасы сырья. Показаны основные задачи для горно-металлургической промышленности, которые должны быть решены в 14-м пятилетнем плане. Развитие отрасли до 2025 г. предполагает наращивание добывающих мощностей с совокупным снижением зависимости от импорта, развитие программы геологоразведки, сокращение вредных выбросов от действующих предприятий и т.д. Отдельное внимание уделено публичным горно-металлургическим компаниям Китая – представлены лидеры в каждом секторе, даны краткие экономические показатели.

Ключевые слова

Китай, минеральные ресурсы, полезные ископаемые, провинции, обзор, добыча, потребление, анализ, данные по годам, экономика, промышленность

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Introduction

Over the past half century, China has made a quantum leap in many economy sectors. The mining sector is no exception. Whereas in the past the country had to import resources and technologies for mining, now it is exporting itself and, in some respects, has even gained effective leverage over the world market.

In 1949, when the 22-year civil war was finally over, the newly formed People's Republic of China was in extreme decline [1]. The consequences of semi-colonialism, civil war, and Japan's occupation of parts of the Chinese territories during World War II had caused enormous economic damage to the country. However, two important factors allowed China to overcome the crisis and develop into an economic superpower.

The first is a good location of the country, encompassing different types of landscapes with diverse mineral deposits. Secondly, the confrontation between the USSR and the U.S., each of which has tried at different times to pull China on its side, helping it to gain technologies and knowledge from both sides of the Iron Curtain.

The history of mining industry of China illustrates very well the historical use of these two factors. Initially, the Soviet government actively assisted in the exploration of new mineral deposits [2]. U.S. then actively helped its businesses in founding U.S.-China joint ventures with transferring new technologies and knowledge on extracting resources [3]. Finally, China itself, having secured its economic independence, went on the offensive, launching an international expansion in resource extraction.

The mining industry is an important source of employment and income for the country, and a significant contributor to the Chinese economy. This paper provides an overview of the Chinese mining industry, including its brief history, current situation, and prospects for future development.

Assessment of natural resource deposits in the territory of China

One of the first acts of cooperation between the USSR and China in the extractive industry was the exploration, production, and refining of oil in 1935–1955. The exploration was carried out mainly in the territory of the Xinjiang Uighur Autonomous Region. Assistance was provided for exploration of other minerals too [4].

To date, China can be described as one of the leading countries in the world mining industry. The country has the world's largest reserves of coal, iron ore, copper, tin, lead, zinc, tungsten, gold, molybdenum, rare earth minerals, etc.

According to the U.S. Geological Survey (USGS), China invested about \$14.4 billion in exploration and \$173 billion in mining in 2019, an increase of 23 % and 24 % from 2018, respectively. In 2019, China ranked first in the world in coal production, fifth in natural gas production and seventh in crude oil production. China was the world's leading producer and consumer of primary energy.

Table 1 shows the reserves of the main mineral products extracted in the territory of the People's Republic of China. The data is for 2020.

Since the country has huge reserves of natural resources, the issue of training specialists for the relevant industries is also urgent.

According to China's National Bureau of Statistics, about 5.3 million people were employed in the mining sector in 2020. This includes personnel engaged in the extraction of coal, crude oil, natural gas, and other mineral products.

In terms of training, many mining industry employees in China receive on-the-job training through internships and other programs offered by employers. There are also a number of mining schools and institutes which offer specialized training in mining and related fields.

The list of key mining institutes (universities) in China include: China University of Mining and



Technologies (Xuzhou, Jiangsu Province), being one of the oldest and most prestigious mining universities in China; Northeastern University: (Shenyang, Liaoning Province); Central South University (Changsha, Hunan Province); China University of Geosciences (campuses in Beijing, Wuhan and other cities); Shandong University of Science and Technology (Qingdao, Shandong Province).

These are just a few examples of many mining institutes and schools in China offering mining education and training.

On the whole, almost all elements of the Mendeleev periodic system are extracted in the country now (Fig. 1). However, the most important mineral products include coal, oil and gas, and rare earth metals [5–8].

Coal is one of the main resources produced in the country. It is used as the main fuel for thermal power plants (60 % of the country's electricity is provided by coal), steel production, and the production of hydrogen (so-called “brown hydrogen” is obtained in the process of coal gasification) [9–13].

Coal is produced in all provinces of the country, but the main deposits are located in the north. The leader in the production is Shanxi province, where up to 50 % of all coal reserves in the country are assumed to be located. Other important coal provinces are Inner Mongolia, Liaoning, Heilongjiang, Hebei, Shandong, and Jilin.

The most common types of coal in the country are lignite and bituminous coal. The first has a low calorific value (up to 7,700 kcal/kg), high moisture content (30 to 70 %), unlimited volatile-matter yield. Bituminous coal has a higher calorific value (7,700–8,800 kcal/kg), up to 10 % moisture content, and a limited volatile-matter yield.

The highest quality type of coal, anthracite, which has calorific value of 8000–8500 kcal/kg, moisture content up to 5 %, and volatile-matter yield up to 14 %, is produced in China in very limited amounts. This requires the government to import it additionally.

The history of coal production in China is shown in Fig. 2.

The main sources of oil, as with coal, are the northern regions of the country. The largest reserves are located in Heilongjiang Province (Daqing oil field), Xinjiang Uygur Autonomous Region (Tarim Basin), Qinghai and Gansu. Individual deposits were found in Sichuan, Henan, Shandong, Liaoning, and Guangdong provinces [14–17].

Most of China's “black gold” deposits can be roughly divided into two types: light high-quality oil and shale oil. The first type (light oil) is refined at refineries, and its production is quite easy. In contrast, shale oil is more difficult to process and extract. In most cases it occurs in deep horizons and requires special technologies for its extraction, such as hydraulic fracturing. Shale oil production is often low-profitable.

Table 1

**Reserves of key minerals and indicators of their extraction
in PRC according to USGS и World Mining Data for 2020**

Metal/Mineral/Natural gas	Reserves		Production volume	
	Mtpa	share in world reserves, %	kt	share in world production, %
Tungsten	1.9	51.4	71.4	81.7
Iron ore	20000	11.1	225.4*	14.8
Gold	2.0	3.7	365.3	11.4
Cobalt	80.0	1.0	2,2	1.7
Lithium	1.5	6.8	28.8	15.5
Copper	26.0	2.9	1.72*	8.3
Molybdenum	8.3	51.8	95.9	33.4
Nickel	2.8	2.9	105.0	4.2
Tin	1100	22.4	94.5	34.1
Fluorspar	42.0	13.1	4.3*	56.7
Natural gas	5.4	n/a	192.5**	4.8
Rare Earth Elements	44.0	36.6	140.0	62.1
Lead	18.0	20.0	1.97	41.5
Talc	82.0	n/a	2.0*	26.2
Uranium	0.25	4.0	2,2	3.9
Zinc	44.0	17.6	4.0*	32.2
Zircon	n/a	n/a	140.0	11.3

* – data in mln t; ** – data in bln m³; n/a – data are not available.



Fig. 1. Mineral map of China

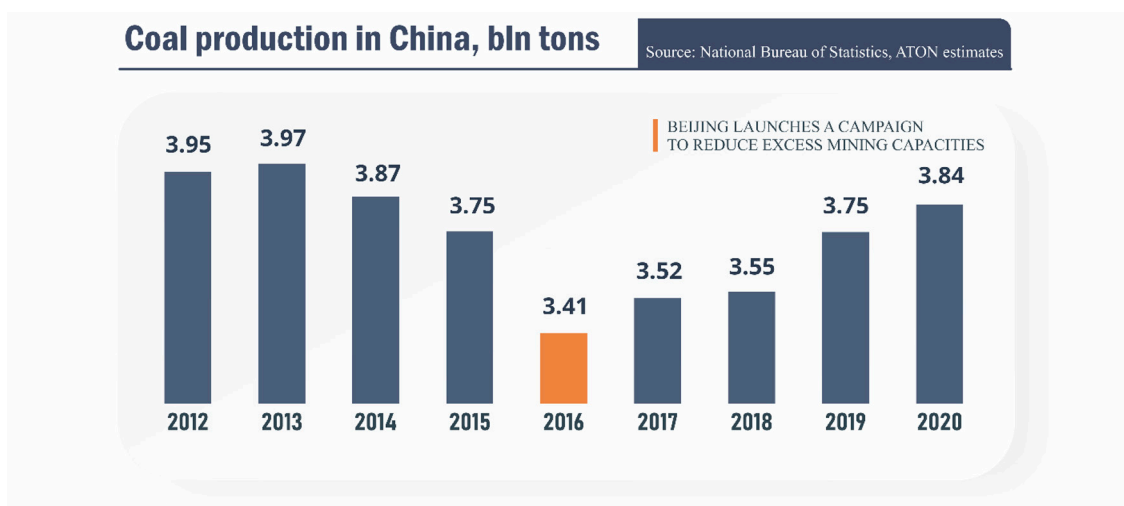


Fig. 2. Coal production history in China



The exploration of natural gas in China has been very underdeveloped for a long time, for which reason the potential of this resource in the country is still unknown. In addition, oil production is often accompanied by the extraction of associated natural gas, such as with Daqing. For this reason, prospecting for natural gas fields for a long time was a low-demand activity. To date, almost half of the explored natural gas reserves belongs to Sichuan Province. Other fields are located in Inner Mongolia, Shanghai, Shaanxi, Hebei, Jiangsu, Zhejiang, and near Hainan Island [18–21].

China has vast iron ore reserves: rich deposits are located in Sichuan, Gansu, Guizhou, Guangdong, and Hainan provinces. Antimony, tungsten, tin, and bauxite reserves are considered to be some of the largest in the world [22]. There are rich deposits of gold and lithium [23–25]. Pyrite explored in Shanxi, Hebei, Shandong, and Liaoning provinces is also one of the most important resources [11].

One more important mineral product are rare-earth elements: 17 metals that are used today in microelectronics, instrumentation, chemical industry, metallurgy, and the nuclear industry. Their peculiarity is that in spite of their occurrence all over the world, they are very rarely found in the form of deposits. This makes their extraction extremely unprofitable, except for some places where their concentration is very high. One such place is Bayan Obo in Inner Mongolia province. This deposit accounts for more than half of the world's rare earth element production and about 70 % of domestic production. According to various estimates, the ore reserves of this deposit are estimated at more than 50 million tons [26–29].

The presence of such a developed mineral resource base also implies a well-developed and up-to-date infrastructure in this sector. The country produces a wide range of mining equipment and machinery, from simple hand tools to modern machinery such as excavators, bulldozers, and cranes. China also has a wide range of options for transporting produced minerals. An extensive network of roads, railroads, and waterways ensures efficient transportation of the extracted resources.

China has a well-developed energy infrastructure with a wide range of energy sources, including coal, oil, gas, and hydroelectric power. The country is investing heavily in research and development to improve the efficiency and safety of its mining operations. All of these factors have enabled China to become one of the world's leading producers of minerals and other natural resources.

Development of mining and metallurgical industry in the country

While the Soviet Union mainly helped China in prospecting, exploration, and primary development of minerals, since the late 1970s the U.S. began actively investing in the creation of joint U.S.-Chinese companies. The basis for such business was laid by Deng Xiaoping, the “father” of modern Chinese economy.

At that time, the country was facing major deficiencies in modern technologies, and Deng Xiaoping found an interesting solution in joint ventures. The essence of the proposal was that foreign investors paired with Chinese investors, in order to create a joint business. Foreigners transferred technologies and provided financing, while the Chinese side provided tax incentives and access to a market of 1.4 billion people. This practice soon spread throughout the country and still exists today.

This strategy gave rise to the rapid growth of many companies. The mining sector was no exception, so when we consider Chinese companies hereinafter, we have to remember that some of them are essentially foreign.

It is also important to remember that, unlike American and European companies, Chinese mining companies have a number of key differences that directly affect their day-to-day operations.

In addition to the creation of joint ventures, a key difference is the great influence of the state on the development strategy of companies. This translates into regulation and “recommendations”. For example, in the 14th Five-Year Plan, covering the period of 2021–2025, there is an entire section devoted to the mining and metallurgical industry (Fig. 3) [30].

14th Five-Year Development Plan: Key Points

- Reduce dependence on imports of iron-containing raw materials (ores);
- Invest in foreign mining assets;
- Launch a new exploration program to discover new mineral deposits;
- Reduce CO₂ emissions through modernizing production facilities;
- Continue consolidation of the steel industry;
- Increase mining capacities;
- Increase the workload of scrap collecting points

Fig. 3. Key points of development of the PRC's mining and metallurgical industry from 2021 to 2025



A more detailed description of the main tasks presented is given below:

Reduce dependence on imports of iron-containing ores. The reason for this task was the critical dependence on Australia, which accounts for 80 % of Chinese imports of these raw materials. However, since 2020, relations between the two countries have become increasingly tense, and the PRC is trying to secure itself ahead of time. It plans to resolve the problem through several steps:

- Launch a new exploration program to discover new deposits.

- Increase the workload of scrap collecting points. The country currently produces just over 1 billion tons of steel per year. With a recycling target of 30 %, the total amount of scrap for recycling would be 300 million tons, which would be 40 % more than 216 million tons recycled in 2019.

- Increase investment in foreign assets. In particular, the government plans to develop up to two world-class iron mines. One of the most likely sites will be the Simandou mine in Guinea (contains about 2 billion tons of high-grade iron ore graded at 65 % Fe).

- Increase domestic production. China ranks 4th in iron ore reserves, but the grade of the resource is quite low which makes it less profitable and also increases CO₂ emissions (the higher grade of iron ore, the easier its processing and the lower total CO₂ emissions per ton of steel) [31].

Reduce harmful emissions. Mining and steel industries are a major source of carbon emissions. In the current conditions, the government demanded to improve the environmental situation by:

- implementing new techniques for carbon capture, use, and storage at new mining facilities, as well as modernization of existing ones;

- increasing the share of renewable energy sources and nuclear power in the structure of energy consumption.

Consolidate the steel sector by merging existing companies and reduce excess steelmaking capacities. China's ongoing gradual consolidation of the steel industry should increase government control over pollution and, in the long term, lead to a reduction in excess capacities. In addition, it will give the major industry players more powerful leverage over leading producers of imported iron ore resources during the negotiations on pricing.

The “recommendations” include silent government regulations. In particular, as of November 6, 2020, it was “recommended” that coal, copper ore, and a number of other commodities no longer be bought from Australia. The main reason was the tense relations between the two countries: Australia was sup-

porting the U.S. in a trade war against China, as well as repeatedly hinting at the guilt of the PRC in the spread of the coronavirus infection COVID-19. In order to understand the scale of the silent regulations, it is enough to cite just a couple of figures: before the embargo, China was the largest importer of Australian commodities, buying up to 60 % of coking coal and 25 % of steam coal, which constituted 21 % of total Australian exports of this commodity. In addition, copper ore and concentrates (which covered 5 % of China's demand), as well as a number of other commodities were banned. A little later the embargo was officially imposed.

Chinese publicly traded mining and metallurgical companies

Another difference is the constant tendency to merge an increasing number of companies, and thus create huge industrial corporations. This often makes it very difficult to judge profitability. Certain subsidiaries are clearly unprofitable, but at the expense of other more profitable ones. In this way the corporation's overall income is almost always in the black. In our case, certain Chinese mining companies are being merged with manufacturing companies. This is particularly evident in the steelmaking sector. Therefore, this paper looks at Chinese companies which belong to two industries simultaneously, mining and metallurgy. This will allow confusion about financial indicators and main characteristics of companies to be avoided.

In absolute terms, the mining and metallurgical industry in China is huge. Its market capitalization is estimated at \$477 billion. Of these, \$197 billion are available to investors in the form of free-floating shares (Fig. 4) [30].

The largest sectors in the industry are steelmaking and coal production, with market capitalizations of \$126 billion and \$98 billion, respectively. They are followed by the precious metals sector, lithium and cobalt production, base metals and aluminum, rare earth elements, etc. [30].

Let's take a closer look at each sector:

Steel sector. Out of 23 public companies, only three are large: Baoshan Iron&Steel (capitalization of \$27 billion), China Steel Corp (\$20 billion) and Inner Mongolia Baotou Steel Union (\$11 billion). Their average EBITDA margin (an analytical indicator of a company's earnings before interest, taxes, depreciation, and amortization) was 9 % in 2020. On the whole, this is at the level of Japan and North America, but lower than in Russia (27 %) and India (23 %). Large dividend payments, despite the debt burden of the sector, should be also noted: the average projected dividend yield is 5 % for 2022, second only to Russia with 10 % [30].

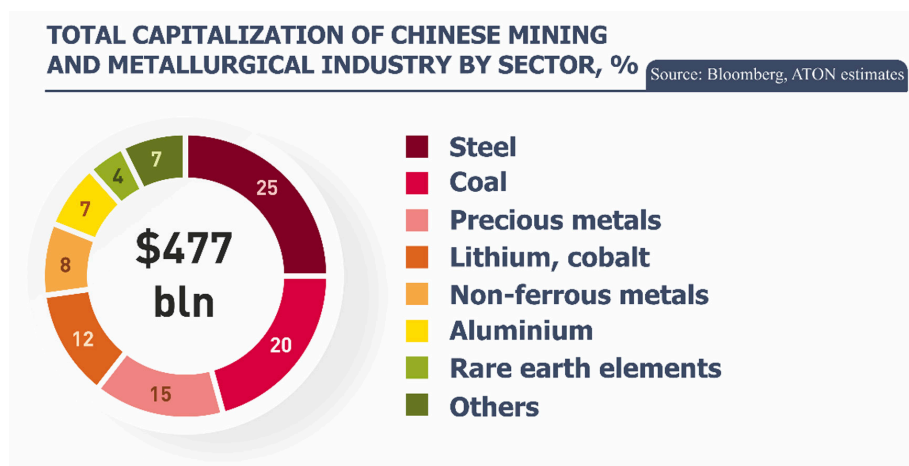


Fig. 4. Total capitalization of Chinese mining and metallurgical industry by sector

It is worth noting that the main iron ore reserves exploited are located north of the Yangtze River and supply neighboring metallurgical plants. However, China has to permanently import raw materials to meet its production needs. Australia accounts for the largest share of Chinese iron ore imports (60 %). This type of resources is not embargoed.

Coal sector. The sector is represented by five companies, four of which are traded on the Shanghai Stock Exchange. The largest of these is China Shenhua Energy. Its capitalization is more than half of the whole sector, \$58 billion. It is followed by Shaanxi Coal and Chemical Industry with a capitalization of \$17.5 billion and China Coal Energy (\$12 billion). The average EBITDA margin in 2020 was 23 %, the highest in whole mining and metallurgical industry. The projected dividend yield in 2022 will be 6 %, also the highest in the industry [30].

A total of 3.9 billion tons of coal were produced by Chinese companies in 2021. This was 2.5 % more than in 2020. The production growth of coal due to the gradual cancellation of quarantine measures and the energy crisis in the EU. The growth rates are expected to be 1.1 %, reaching a production of 4.1 billion tons in 2025. However, due to the government's initiative to decommission obsolete coal extraction facilities [32], the growth rate of coal production will decrease in the near term.

Here we should also note the government's strong regulation of coal production – previously thousands of small mines were established across the country to provide coal for local needs. They account for 40 % of the total domestic production, and most of them are low-margin. However, such an initiative allowed reducing the volumes of coal transportation – the transport network suffered from the excessive load of coal exports from Shanxi Province.

Precious metals sector. It includes six publicly traded companies with a total capitalization of \$70 billion. The largest of these are Zijin Mining (capitalization of \$42 billion), Shandong Gold Mining (\$14 billion) and Zhongjin Gold (\$7 billion), as well as private China National Gold and Zhaojin Gold. The average EBITDA margin in the sector in 2020 was 12 %, against 50 % for global gold producers [30].

Lithium and cobalt production sector. It consists of four publicly traded companies: Tianqi Lithium, Ganfeng Lithium, GME, and Zhejiang Huayou Cobalt. The average EBITDA margin in the sector for 2020 was 21 % [30].

Base metals and aluminium sector. Five base metals producing companies (Jiangxi Copper, Tongling Nonferrous, Chihong Zinc, China Molybdenum, and Tibet Huayu Mining) and four aluminum companies (China Zhongwang, Aluminium Corp, China Hongqiao, and Shandong Nanshan) represent this sector. The total market capitalization of the sector is \$74 billion. The average EBITDA margin in the sector in 2020 was 7 % for the base metals producers (vs. 37 % for global producers) and 21 % for the aluminum producers (higher than that of global producers). This sector has the highest debt burden in the industry [30].

It should be taken into account that many base metal producing companies possess mines for the extraction of ores of cobalt, molybdenum, rare earth elements, etc.

Rare earth elements sector. It includes 34 producers, of which only five can be considered relatively large. The largest of these is China Rare Earth (capitalization of \$11.4 billion), followed by China Northern, Xiamen Tungsten, China Minmetals, and JL Mag. The average EBITDA margin in the sector in 2020 was 10 % [30].



It should be noted that some companies, in addition to mining REE resources, are engaged in production of other products, for instance, lithium, tungsten, potassium, etc.

On the whole, as can be seen, in terms of financial indicators, Chinese companies do not appear very attractive to investors. In most cases, foreign companies, unconstrained by the political plans of a country government, demonstrate a much higher performance (Fig. 5). On the other hand, the government promotes new programs for discovering new mineral deposits and actively encourages increased production.

However, despite the development of Chinese companies and the build-up of efforts to increase the production of minerals, the country is unable independently to satisfy domestic demand. This forces China to permanently import resources from other countries and engage in international expansion.

Trade in minerals

Mineral resources play an important role in China's economic power. Over the past decades, the country has emphasized the development of its own industry, producing all kinds of goods, from bicycles to spacecraft. However, despite numerous domestic mineral reserves, Chinese industry became so large that the country was forced to start importing mineral products from other countries.

According to the World Trade Organization, China's fuel and mineral imports in 2021 were \$789.255 billion, second only to the European Union at \$987.763 billion. In recent years, China, like the EU, has been actively increasing imports (Table 2). The slowdown in 2018–2019 was due to the trade war with the U.S., when both countries imposed customs duties on a number of goods and commodities. The slight decline in 2020 was due to the consequences of coronavirus restrictions.

It is also interesting to note that China actively buys mineral products, but has little to sell. For example, Chinese fuel and mineral exports in 2021 were only \$87.871 billion, ranking only 13th among the largest exporters. However, the upward trend in China's mineral product exports can be seen here too, as well as the drop in 2019 and 2020, for the above reasons.

Key import and export indicators for key mineral products will be presented in more detail below.

Mineral product imports

A noticeable characteristic feature of China's imports of mineral products is that the Chinese importers are looking for suppliers with the lowest prices, not allowing the international political agenda to influence their purchases. Nevertheless, in some cases the country refuses favorable terms if the Communist Party of China “silently” recommends stopping trade with a particular country.

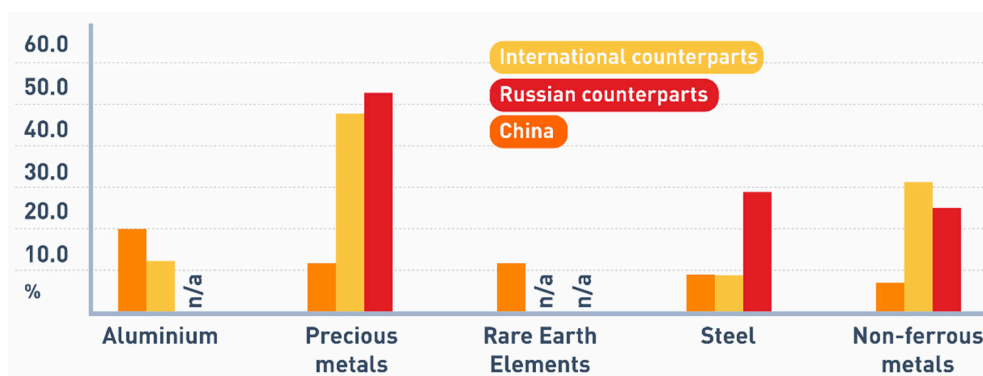


Fig. 5. Average EBITDA margin of some mining and metallurgical sectors in 2020 (comparison of China with global and Russian counterparts)

World leaders in mineral product imports for 2016–2021 (according to World Trade Organization)

Table 2

Region	Amount of mineral product imports by year, \$ billion/year					
	2016	2017	2018	2019	2020	2021
European Union	569.917	716.361	883.131	788.515	573.823	987.763
China	326.216	444.767	560.913	580.577	541.761	789.255
USA	205.737	257.850	300.582	265.652	185.778	307.856
Japan	146.164	184.213	222.842	201.620	151.774	227.103
Germany	117.119	140.207	168.694	157.057	125.779	202.784
India	108.092	148.150	198.755	177.565	123.616	201.546



The main items in the imports of mineral products are coal, crude oil, iron ore, and copper ore (Fig. 6).

Let us now consider these import items in more detail:

Iron ore. Traditionally, the main supplier of iron ore to China was Australia. However, due to the country's U.S.-oriented political course, the Chinese government has in recent years been actively developing supplies from other countries, primarily Brazil. For instance, in the third quarter of 2022, imports from Brazil increased, first of all, because of good weather conditions, allowing increased iron ore production in the country. However, the very price of iron ore is on a permanent decline. Over the same

period, the IODEX index fell 25 percent to \$95.95 (as of September 30, 2022). This is due to the fact that China, acting as one of the main world importers of iron ore, is experiencing a crisis in the real estate market, due to which the demand for steel for construction has fallen.

Copper ore. In this sector, Australia is the main exporter to China. In November 2020, a silent ban on copper ore and coal imports from Australia was imposed due to the Australian government's demand for an international investigation into the origins of COVID-19. In November 2022, after the meeting of the leaders of China and Australia at the G-20 summit, the silent embargo was lifted.

Table 3

World leaders in mineral product exports for 2016–2021
(according to World Trade Organization)

Region	Amount of mineral product exports by year, \$ billion/year					
	2016	2017	2018	2019	2020	2021
European Union	340.330	430.396	510.980	465.947	359.363	589.889
USA	129.247	177.683	238.025	243.141	201.283	305.067
Russia	163.989	209.142	263.390	248.032	171.033	248.868
Australia	112.245	142.277	170.951	184.308	169.108	241.301
UAE	55.423	72.285	132.631	223.881	181.802	233.014
China	50.524	62.657	79.447	78.357	60.493	87.871

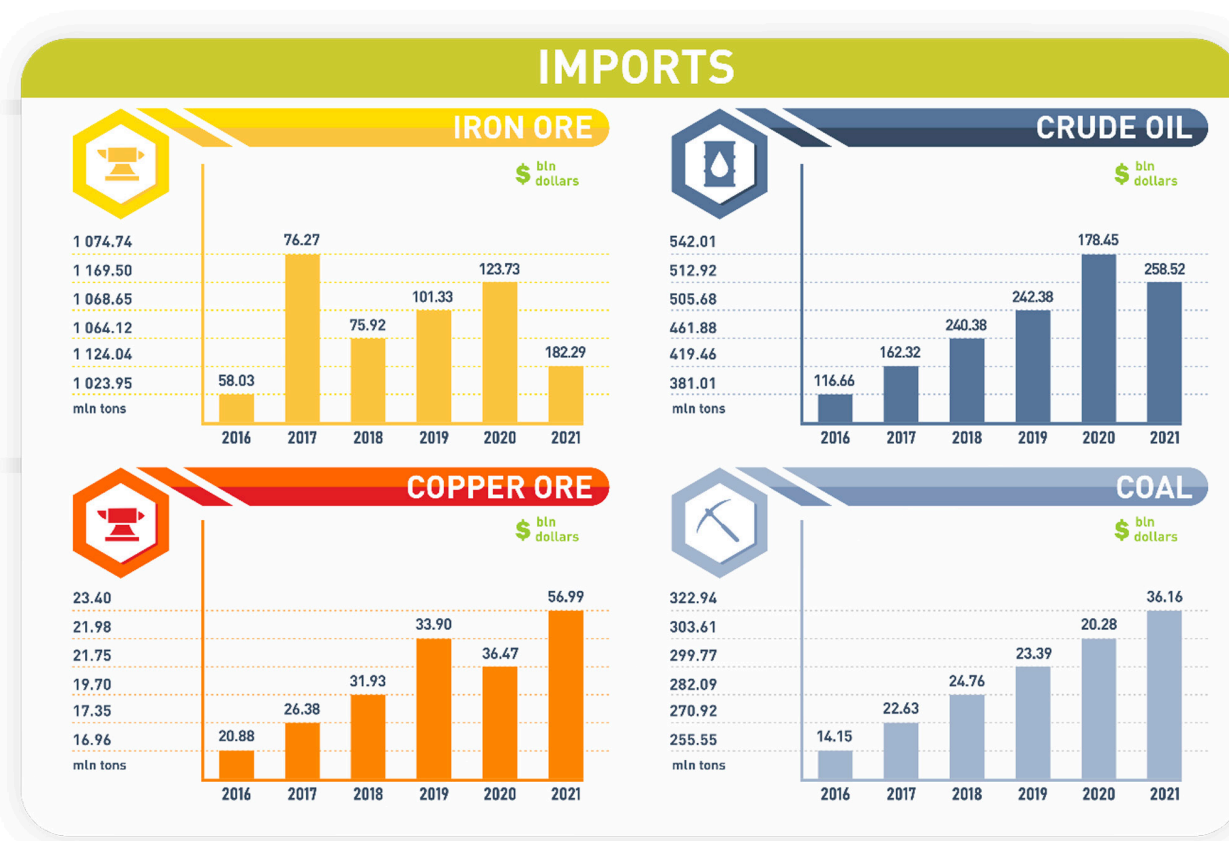


Fig. 6. Imports of major mineral products into China between 2016 and 2021
(according to the National Bureau of Statistics of China and UN Comtrade Database)



Coal. In February 2023, the first two ships carrying coal from Australia arrived in China and several more are en route, thus breaking a two-year embargo. However, on February 16, 2023, the customs office did not let one ship with 12,000 t coal pass. For five days the ship tried to pass customs inspection, but failed to do so. So it had to change its route and deliver coal to Vietnam. The event itself suggests that the Chinese government has not yet fully taken a decision whether to completely lift the embargo on Australia's exports of certain minerals. In addition, China actively is increasing its coal imports from Russia. Due to the EU's and British embargoes on Russian coal, Russia has begun to redirect coal exports to Asia. However, the main problem of the exports is overloaded railways which limits Russia's ability to supply coal.

Crude oil. The main suppliers are Russia and Saudi Arabia. Notice that Russian oil is most often purchased for subsequent resale to Western countries because of international sanctions imposed on Russia, while oil from Saudi Arabia satisfies domestic demand of China.

Export of mineral products

China is one of the world's leading exporters of natural resources with a wide range of minerals, agricultural products, and fossil fuels offered. The coun-

try exports a variety of mineral products and metals, including iron ore, copper, oil, aluminum, and manganese, and is a leading global producer of rare earth elements, which are used in many industries, including electronics, automotive, and renewable energy. Fig. 7 presents some of the main exports.

China exported a total of 6.08 billion tons of mineral products in 2019, including iron ore, copper, aluminum, manganese, and rare earth elements, according to China's National Bureau of Statistics. The iron ore exports account for the largest share of the mineral product exports, with 2.82 billion tons exported in 2019, followed by copper (1.08 billion tons), aluminum (0.72 billion tons), manganese (0.48 billion tons), and rare earth elements (0.35 billion tons).

Over the past few years, China's mineral product exports have been growing steadily. In 2018, China exported 5.9 billion tons of mineral products, and, in 2017, 5.4 billion tons. This increase in the exports was due to a combination of factors, including increased demand from China's trading partners, as well as increased production capacities in the country.

While importing resources, the Chinese government and business are actively trying to expand the number of suppliers, in order to buy minerals at lower prices. In the case of exports, China is actively using

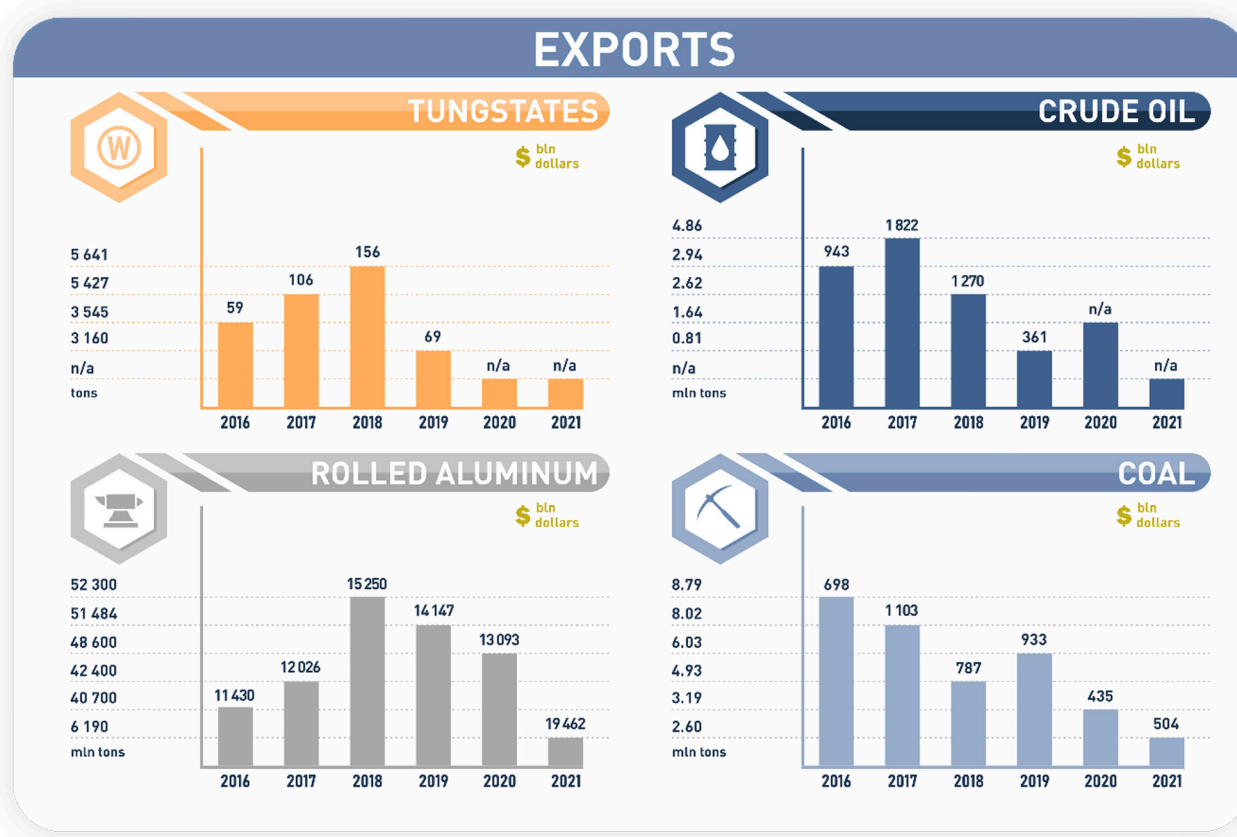


Fig. 7. Exports of major minerals from China between 2016 and 2021 (according to the National Bureau of Statistics of China and UN Comtrade Database)



its influence to raise prices or seek political concessions. For example, in 2010, China reduced its supplies of rare earth elements to Japan amid a scandal with a fishing vessel. In 2019, due to a trade war with the United States, the country threatened to raise duties on the same resources. In December 2021, China even temporarily excluded Lithuania from its customs register, blocking the ability of Lithuanian businesses to clear their goods.

Another feature of the exports is the country's extreme reluctance to sell minerals in their raw form. Instead, China prefers to sell finished products or at least perform primary processing. For example, among the country's largest export items there are no iron, copper, or aluminum ores, but there are pig iron, aluminum, steel, and copper rolled products and downstream products (nails, bolts, etc.). China produces almost 60 % of all types of rare earth elements, but exports beneficiated REE, or metal REE, or even products based on them.

The main country-importers of these mineral products from China are the United States, Japan, South Korea, and the European Union. Some resources are supplied by sea (oil and petroleum products) and some by rail (rare earth elements, coal).

International expansion in exploration and development of old and new mineral deposits

The trade war with the U.S. in 2018, the embargo on Australian resources in 2020, and the preparation of new U.S. sanctions in 2022 have forced the Chinese authorities to think about new threats to current commodity supplies, while the embargo on Russian energy resources forced to start acting in advance.

Since imports could suddenly decline, the Chinese government has begun actively to pursue international expansion, in order to discover new deposits and develop old and new ones. In the first place, preference is given to geographically closest projects. For example, China has actively invested in coal and copper ore mining projects in Mongolia. Moreover, the investment concerns not only companies working directly in these sectors, but also companies involved in the development of transport infrastructure that allows the volume of supply to increase.

Despite increasing tensions with the U.S., Chinese companies are actively cooperating with Western partners, conducting joint exploration of new oil fields in Yellow Sea, South China Sea, Gulf of Tonkin, and Bohai Gulf. Some promising areas fall within the zone of economic interests of Vietnam, North and South Korea, Taiwan.

China is paying special attention to developing countries in Africa and South America. According to a report by the Shanghai University of International Business and Economics, from 2000 to 2019, the PRC invested in 52 of 54 countries on the African continent. The amount of investment has increased from \$210 million to \$47.3 billion. In 2021, the amount of investment was \$49 billion.

However, this figure does not include lending to individual states by Chinese companies. Therefore, it is very difficult to determine how much money has gone into the development of the mining industry. This can only be judged by circumstantial data, such as the growth of trade turnover up to \$254 billion in 2021, and reports on individual investment projects. Such projects include the development of the Simandou iron ore deposit in Guinea. A Chinese company as a part of the Winning Consortium Simandou and Australian-British Rio Tinto have agreed to invest more than \$15 billion in the mine. Part of the money is earmarked for the creation of infrastructure for the convenient export of the resources from the continent.

In addition, there is information about the acquisition of two African gold mining companies Guyana Goldfields and Continental Gold by the Chinese company Zijin Mining. In 2019, Chinese businesses spent a total of \$750 million in buying gold mining assets abroad [30].

In South America, China has become a major trading partner for countries such as Brazil, Peru, Uruguay, and Chile. Most other countries have China in the second place. In exchange for the purchase of commodities, China often offers investments in major infrastructure projects and loans to individual companies for some mining enterprises. The total trade in 2020 was \$315 billion, and the loans to the mining industry were \$2.1 billion [33].

It is especially important to emphasize Venezuela's role in supplying oil to China. The country provides 13 % of China's oil imports (40 % of Venezuela's oil exports).

It should be noted, however, that Chinese mining companies are increasingly facing competition with U.S. companies. In addition to traditional competition in the form of buying-out companies or obtaining licenses, in some situations companies are engaged in "black PR". For example, the Chinese news agency Xinhua in January 2022 published a rebuttal to a report by the British "Guardian" newspaper. The latter reported that two Chinese mining companies, Jinding Mining Zimbabwe and Shanghai Haoyun, were paying low wages and forcing local workers to work overtime.



Conclusion

China has a huge impact on the whole Asian region: the country has the status of an emerging economy and is the world leader in the extraction of a long list of different mineral products.

This study demonstrates the impact of the mining sector on the country's economy. Based on the findings of the review performed in this study, it can be concluded that the prospects of the Chinese mining industry are gradually stabilizing after the COVID-19 pandemic. For instance, following the development of the Chinese economy and the growth of foreign investment, a number of Chinese companies have become widely known in the global mining sector.

In recent years, China has become increasingly dependent on imported natural resources. This is due to a combination of factors, including popula-

tion growth, rapid economic growth, and a shift in the country's energy balance from coal to renewables. As a result, China is now the world's largest net importer of natural resources, with the imports of minerals, agricultural products, and fossil fuels steadily increasing in recent years.

In order to achieve the goals of the 14th Five-Year Plan, China must focus on the more active development of clean energy, including wind power, photovoltaics, hydropower, and nuclear power, carry out structural reform and eliminate obsolete facilities in high energy-intensive industries (steel, petrochemical, and chemical industries).

As a continuation of this study, future work will focus on an in-depth study of each mining sector in the PRC, discussed in this paper, and its detailed review.

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