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China Mineral Resources

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Foreword

Under the guidance of Xi Jinping Thought on Ecological Civilization, China has continuously promoted the reform of mineral resources management and green development in mining sector. In order to make people at home and abroad who care about and support natural resources conditions understand Chinese policies and reform progress of mineral resources management, the Ministry of Natural Resources (MNR) organized the compilation of the China Mineral Resources (hereinafter referred to as the Report).

This "Report" focuses on new progress since 2022 in the geological and mineral survey and evaluation, mineral resource exploration and development, mine ecological restoration and green mine construction, the new changes in mineral resource policies and regulations, the new measures in mineral resource management, the new situations in scientific and technological innovation, and the new results of the international geological and mineral cooperation.

Till the end of year 2022, a total of 173 kinds of minerals have been discovered in China, including 13 kinds of energy minerals, 59 kinds of metallic minerals, 95 kinds of nonmetallic minerals and 6 kinds of water and gases. A new round of strategic action was comprehensively implemented to make breakthroughs in mineral exploration. The investment in geological exploration of oil and gas, as well as other minerals, in China was doubled in 2022, and 132 new mineral deposits were discovered. In terms of the oil and gas exploration, major breakthroughs have been made in the new bed series, new types and new zones in large oil and gas basins such as Tarim, Dzungaria, Bohai Bay and Sichuan Basin. For the non-oil and gas mineral exploration, significant progress has been achieved in coal, iron, copper, gold, rare earth metals, rare metals, scattered metal, etc.

Basic geological survey work was further improved, and new progress has been made for the survey and evaluation of important mineral resources. The annual evaluation of national

groundwater resources and the survey of storage changes were completed. Basic geological surveys of sea areas, mineral resources surveys and oceanic geological surveys were promoted continuously.

Fixed asset investment in China's mining industry continues to grow, and the output of major mineral products maintain the growth. Significant results have been achieved in ensuring the supply of coal, oil, natural gas and other energy minerals, the self-sufficiency rate has increased, and the energy consumption structure continues to be optimized. The economical, intensive and comprehensive utilization of mineral resources has been steadily advanced.

The *Ecological Restoration of Legacy Mines Action Plan During the "14th Five-Year Plan" Period* was issued, the nationwide inspection of legacy mines was carried out, and the ecological restoration of legacy mines in key river basins and key areas was strengthened, to deploy and implement the first batch of ecological restoration demonstration projects of legacy mines. A sophisticated green exploration standard system has been established, and the annual spot inspections of green mines have been conducted, to promote the construction of green mines with high quality.

The legislation and supervision in the field of mineral resource exploration and development was further strengthened. The revision of the *Mineral Resources Law* was promoted, further standardizing the mining rights transfer transactions and revenue collection management, clarifying matters related to the linkage of new land for mining projects and the reclamation and restoration of existing mining land, relaxing restrictions on comprehensive exploration, mining rights transfer, etc., and simplifying the approval and registration procedures and application requirements.

The National Mineral Resources plan during the "14th Five-Year Plan" period was comprehensively implemented. The supervision and management of geological exploration activities was strengthened, the safe operation of geological exploration enhanced, and the high-quality development of geological exploration units guided and facilitated. Additionally, the review, statistics and quality supervision of mineral resources was strengthened. The transfer of oil and gas exploration blocks was increased, the management of sand and gravel mining standardized, the iron ore supply guaranteed, and the mining rights registration procedures further optimized.

Scientific and technological achievements in the field of mineral resources were remarkable, and a number of important results had been achieved. The implementation of national key

research and development plans and other national science and technology plan projects was actively promoted, and new breakthroughs were made in the theory on regional mineralization and prospecting, and the research and development of key technology and equipment. 3 national standards and 47 industry standards in the field of geology and mineral resources were issued and implemented.

International exchanges and cooperation were carried out in the field of mineral resources through various means, to actively maintain contacts with relevant energy resource countries and international organizations, and the practical cooperation in the field of geology and mineral resources was promoted through international exchange platforms such as the China Mining Conference and Exhibition, to further consolidate friendly cooperative relations.

Statistics in the Report are mainly from the MNR and the National Bureau of Statistics of the People's Republic of China. Statistics from the Hong Kong Special Administration Region, the Macao Special Administrative Region and Taiwan Province are not included in the Report.

Contents

Chapter I
Geological and Mineral Resources Surveys and Evaluations

In 2022, the basic geological survey was further improved, and new progress had been made in basic petroleum geological survey in Qiangtang Basin, Sichuan Basin, etc.; new discoveries were made in solid minerals such as gold and bauxite, and the annual assessment of national groundwater resources in 2022 were completed; basic geological surveys of sea areas, mineral resources surveys, and oceanic geological surveys were promoted continuously.

I. Basic Geological Survey

In 2022, 1 : 50,000 regional geological surveys of nearly 9,600 square kilometers, funded by the central financial funds, were carried out, with a total area of 4.42 million square kilometers. 1 : 50,000 regional geochemical surveys of 16,100 square kilometers were completed, with a total completed area of 2,869,700 square kilometers.

Through the regional geological survey and comprehensive study, the basic geological characteristics of the surveyed areas were identified, and a batch of high-quality basic geological maps and data were provided. New understandings have been obtained in the tectonic evolution of the Tethyan tectonic domain of the Tibetan Plateau, the tectonic deformation events on the northern margin of the Qaidam Basin, the Tianshan-Xingmeng orogenic belt, the super-thick neocrust of the Lhasa terrane of the Tibetan Plateau, the Precambrian continental crust of the Yangtze landmass, and the Ediacaran fossils of Shaanxilithes.

II. Mineral Resources Surveys and Evaluations

1. Geological survey and evaluation of solid minerals

In 2022, 1 : 50,000 mineral geological surveys of 14,000 square kilometers, funded by the central financial funds, were carried out, with a total area of 3.35 million square kilometers. 58 ore-prospecting targets were delineated, and 8 new gold and bauxite deposits were discovered. Important progress was made in the Qianchuiliu and Tengjia Gold Mines in northwest Jiaodong Peninsula, and the inferred gold resources were increased by 19 tons. 4 high-grade iron ore prospecting targets were delineated in Laiwu, Shandong Province, and the 14.5-meter-thick high-grade iron ore deposit was discovered in Shijiaquan target area after the drilling verification, and the inferred resources were more than 4.6 million tons. The inferred resources of bauxite in the Taiyangba area of Daguan, Yunnan Province, more than 10 million tons, and one deposit with large potential was reported.

The potentials of the coal, iron ore, manganese ore, copper, bauxite, lead, zinc, tungsten, tin, etc. were updated. The potential evaluation of titanium, vanadium, cobalt, niobium, tantalum, beryllium, gallium, germanium and etc. was newly carried out.

2. Oil and gas survey and evaluation

New progress was made in the basic geological survey of oil and gas. A breakthrough was made in the oil and gas survey in the northern Qiangtang Basin, with the first discovery of liquid crude oil in the Zangshuangdi 2$^{\#}$ Well. In the Chuanmudi 2$^{\#}$ Well in Muchuan area

of Sichuan Province, 16,800 cubic meters of industrial gas flow per day was discovered, indicating that a breakthrough was made in Triassic oil and gas survey in southwest Sichuan Province.

New progress was also made in Permian shale gas exploration. Strong shale gas indication was found in Dalong Formation and Longtan Formation in Well Xiangshaodi 1# well in central Hunan Province. An important discovery of shale gas was made in the Dalong Formation of Yuwudi 1# Well in the eastern margin of Sichuan Basin.

The national oil and gas resources evaluation during the "14th Five-Year Plan" period has been fully initiated, and the progress of oil and gas exploration and development in corresponding fields has been tracked and analyzed.

3. Geothermal resource survey and evaluation

57 sets of heat flow data were added, to further deepen the understanding of crust-mantle thermal structure and thermal source mechanism in North China - Northeast China. The distribution characteristics and law of geothermal resources in six provinces in the southeast coastal areas were investigated, to deepen the understanding of the relationship between tectonic-thermal effects and the genesis of geothermal resources in the areas.

4. Investigation, evaluation and monitoring of groundwater

The annual evaluation of national groundwater resources reservoir in 2022 were completed. National groundwater storage decreased by 4.43 billion cubic meters from the same period last year, that of the North China Plain increased by 2.86 billion cubic meters, and the quality of groundwater in China was generally stable in the year. The national groundwater strategic reserves was divided for the first time, and 38 key areas for national groundwater strategic reserves were initially designated.

10,171 automatic monitoring stations of the national groundwater monitoring network (natural resources departments) were operated and maintained, and systematic groundwater level measurements were completed for 42,928 sites across the country. The forms and annual changes of groundwater flow fields in major plain basins were mastered, 37 groundwater level

drop-off funnels with an area more than 50 square kilometers were delimited, with a total area of 47,300 square kilometers, mainly distributed in the North China Plain, Huang-Huai Plain and other northern areas.

Feature 1-1 10,000-m "Two Stars" Take 1# Well and Chuanke 1# Well in China Deep Earth Project

10,000-m deep drilling is one of the important indicators to measure the level of engineering technology and equipment of a country or an enterprise.

On May 30, 2023, China's first 10,000-m scientific exploration well, the Deep Earth Take 1# Well, was drilled in the Taklimakan Desert in Xinjiang. With a design depth of 11,100 meters and an expected drilling period of 457 days, the well, shouldering two missions of scientific exploration and oil and gas discovery, was used to deeply explore the interior structure and evolution of the Earth and improve the theory of oil and gas accumulation at a depth of 10,000 m. The drilling of Take 1# Well was faced with world-class exploration problems such as the ultra-high temperature, ultra-high pressure and ultra-high load.

The Deep Earth Chuanke 1# Well, located in the northwest of Sichuan Province, with a design depth of 10,520 meters, and the target layer of the Sinian Dengying Formation, had been drilled in the Nanhua system, and was used to explore the internal structure and evolution of the Earth, and reveal the mechanism of hydrocarbon formation, reserve and accumulation in ancient strata under high temperature and pressure. The well is the first 10,000-m well in the Sichuan Basin and the 10,000-m well in China second to the Deep Earth Take 1# Well. It was drilled in Jiange County, Guangyuan, Sichuan Province on July 20, 2023. The well was deployed in the structural high zone of Jiange-Jiulongshan area, with superior source-reservoir-cap conditions, which is conducive to ultra-deep oil and gas exploration. It is a gas well, with an ultra-depth of 10,520 meters, ultra-high temperature of 224℃, ultra-high pressure of (138 MPa).

III. Marine Geological Survey

1. Basic marine geological survey

The geological surveys for marine areas (4 international standard maps; 1 : 250,000) in the western South Yellow Sea and other key sea areas, covering an area of 64,000 square kilometers, were carried out, the topographic and geomorphic types and divisions of the South Yellow Sea

were determined, the deep structural characteristics of the faults in the east margin of the South Yellow Sea were described, and a series of 20 standard maps were compiled.

The geological surveys for marine areas (2 international standard maps; 1 : 50,000) in the south of Bohai Bay and the Xisha Islands in the South China Sea, covering an area of 900 square kilometers, were completed, a large submarine cave group in the Xisha Sea area was discovered for the first time, and a series of 10 standard maps were compiled. According to the standards of the Global Geoscience Section Committee, the geoscience large-section diagram of the western South China Sea was compiled.

8,150-km airborne gravity and magnetic survey was carried out in the Pearl River Estuary, and a gravity and magnetic anomaly map of continuous land and sea coverage in the Pearl River Estuary was compiled.

2. Marine oil and gas survey

The survey of oil and gas resources in new areas and new strata in the waters under China's jurisdiction was continuously promoted, the potential of oil and gas resources in the South Yellow Sea and the South China Sea was systematically evaluated, to fully learn the distribution of oil and gas resources, and 3 favorable Meso-Paleozoic zones in the Laoshan Uplift of the South Yellow Sea, 8 favorable Cenozoic deep-water zones in the South China Sea, and 17 key targets were delineated.

7 withdrawal blocks in the north of the South China Sea, with an area of about 50,000 square kilometers were systematically evaluated, and 11 exploration blocks with an area of about 17,000 square kilometers were selected and re-set.

3. Deep-sea geological survey

The 12th voyage mission of deep-sea geological survey was completed, a target area of 60,000 square kilometers for exploration of cobalt-rich polymetallic nodules in the Western Pacific Ocean was delineated, and the distribution range of high-grade deep-sea rare earths in this area was initially determined.

The 74th China voyage survey for ocean was successfully carried out, and the area of cobalt-rich crust-containing mining area in the contract area was delineated, with an area about 78 square kilometers.

Chapter II Mineral Resources

Till the end of year 2022, a total of 173 kinds of mineral resources have been discovered in China, including 13 kinds of energy minerals, 59 kinds of metallic minerals, 95 kinds of nonmetallic minerals and 6 kinds of water and gases.

In 2022, reserves of almost 40% of minerals in China increased. Among them, the minerals with substantial reserves growth include copper, lead, zinc, nickel, cobalt, lithium, beryllium, gallium, germanium, fluorite and crystalline graphite.

I. Energy Minerals

Table 2-1 Reserves of Main Energy Minerals in China in 2022

No.	Minerals	Unit	Reserves
1	Coal	Billion tons	207.01
2	Oil	Billion tons	3.81
3	Natural gas	Billion m^3	6569.01
4	Coalbed methane	Billion m^3	365.97
5	Shale gas	Billion m^3	560.56

Note: The data for oil and gas (oil, natural gas, coalbed methane, and shale gas) reserves are remaining proved technically recoverable reserves as per *Classifications for Petroleum Resources and Reserves* (GB/T 19492-2020) and those of other minerals are the total of proved reserves and probable reserves as per *Classifications for Mineral Resources and Mineral Reserves* (GB/T 17766-2020), the same as below.

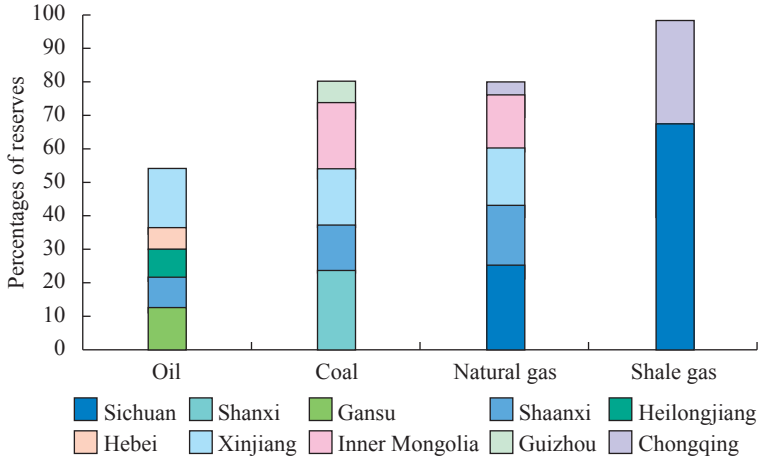

Fig. 2-1 Regional Distribution of Major Energy Mineral Reserves in China

II. Metallic Minerals

Table 2-2 Reserves of Main Metallic Minerals in China in 2022

No.	Minerals	Unit	Reserves
1	Iron ore	Billion tons	16.25
2	Manganese ore	Million tons	275.61
3	Chromite	Million tons	2.79
4	Vanadium	Million tons of V_2O_5	7.34
5	Titanium	Million tons of TiO_2	106.05
6	Copper	Million tons of metal	40.77
7	Lead	Million tons of metal	21.87
8	Zinc	Million tons of metal	46.08
9	Bauxite	Million tons of ore	675.53
10	Nickel	Million tons of metal	4.35
11	Cobalt	Million tons of metal	0.16
12	Tungsten	Million tons of WO_3	3.00
13	Tin	Million tons of metal	1.00
14	Molybdenum	Million tons of metal	5.90
15	Antimony	Million tons of metal	0.67
16	Gold	Tons of metal	3127.46
17	Silver	Tons of metal	70344.21
18	Platinum-group metals	Tons of metal	80.91
19	Strontium	Million tons of celestite	24.57
20	Lithium	Million tons of Li_2O	6.35

III. Nonmetallic Minerals

Table 2-3 Reserves of Main Nonmetallic Minerals in China in 2022

No.	Minerals	Unit	Reserves
1	Magnesite	Million tons of ore	680.12
2	Fluorspar	Million tons of minerals	85.92
3	Refractory clay	Million tons of ore	218.58
4	Pyrite	Million tons of ore	1147.86
5	Phosphorite	Billion tons of ore	3.69
6	Potash	Million tons of KCl	287.89
7	Boron	Million tons of B_2O_3	9.01
8	Sodium salt	Billion tons of NaCl	14.29
9	Mirabilite	Billion tons of Na_2SO_4	1.23
10	Barite	Million tons of ore	107.36
11	Limestone for cement	Billion tons of ore	39.71
12	Glass-making siliceous rock	Billion tons of ore	1.86
13	Gypsum	Billion tons of ore	1.76
14	Kaolin	Million tons of ore	693.45
15	Bentonite	Million tons of ore	171.60
16	Diatomite	Million tons of ore	123.23
17	Veneer granite	Billion m^3	2.26
18	Veneer marble	Billion m^3	0.47
19	Diamond	Kilograms of minerals	183.19
20	Crystalline graphite	Million tons of minerals	81.01
21	Asbestos	Million tons of minerals	7.13
22	Talc	Million tons of ore	60.46
23	Wollastonite	Million tons of ore	40.29

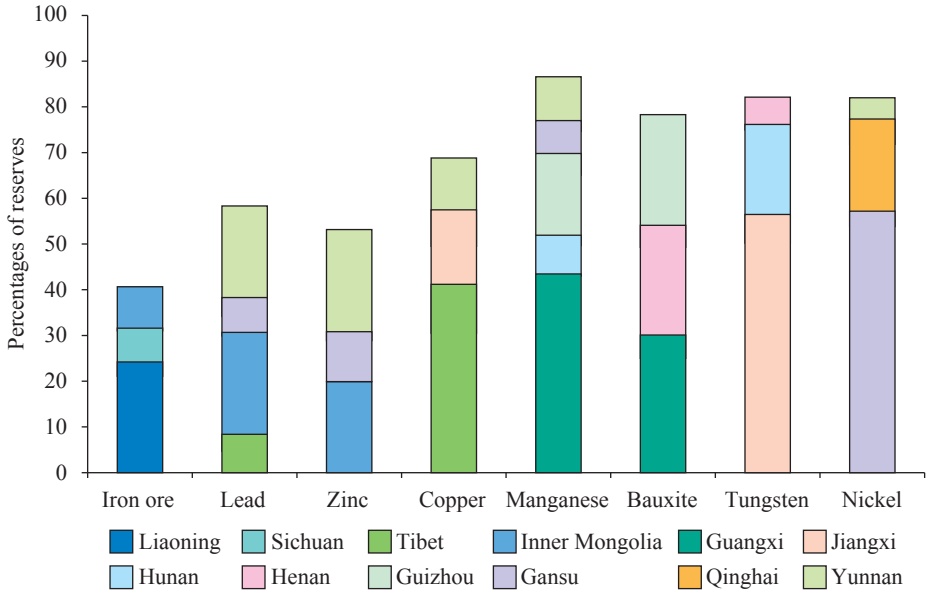

Fig. 2-2 Regional Distribution of Main Metallic Minerals in China

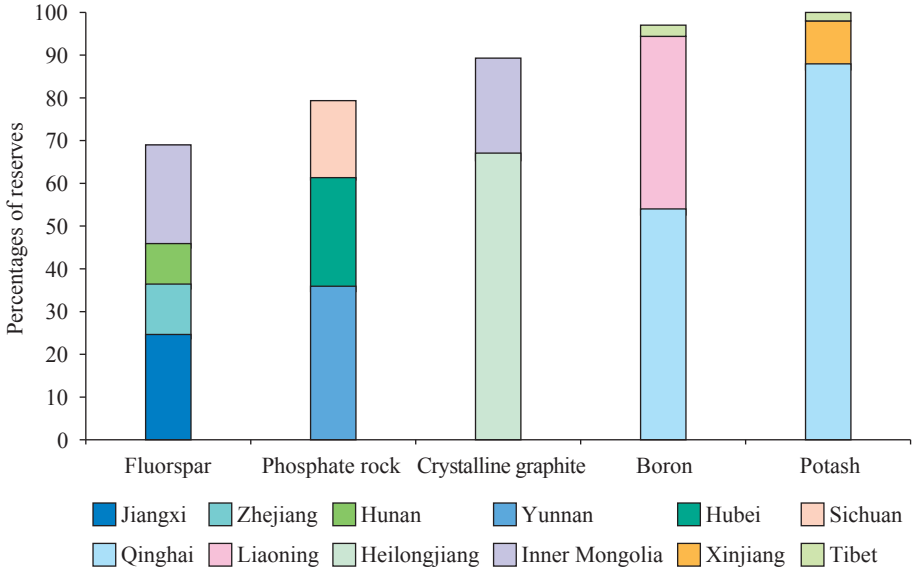

Fig. 2-3 Regional Distribution of Main Nonmetallic Minerals in China

Chapter III Exploration

A new round of strategic action was implemented to make breakthroughs in mineral exploration. The investment in geological exploration of oil and gas, as well as other minerals, was increased in 2022.

In 2022, the oil and gas, and non-oil-gas mineral geological exploration investments achieved growth. In terms of the oil and gas exploration, major breakthroughs had been made in the new strata, new types and new areas in large oil and gas basins such as Tarim, Dzungaria, Bohai Bay and Sichuan Basins. For the non-oil-gas mineral exploration, significant progress had been achieved in the coal, iron, copper, gold mine, "three rare minerals", etc.

I. Investments in Geological Exploration

In 2022, the investments in geological exploration were RMB 101.02 billion in China, up by 3.8% from the previous year. Among them, the investment in oil and gas geological exploration was 82.39 billion yuan, increasing by 3.1%; the investment in geological exploration of non-oil and gas minerals was 18.64 billion yuan, increasing by 7.2% (Fig. 3-1), and achieving the positive growth for two consecutive years.

The oil and gas survey was completed for 2,510 prospecting wells, with a drilling footage of 7.95 million meters, which was reduced by 9.9% and 4.8% respectively, 19,500-km two-dimensional

seismic acquisition was carried out, a year-on-year increase of 51.3%, and three-dimensional seismic acquisition of 47,000 square kilometers was completed, a year-on-year of 24.6%.

Of the investments in geological exploration of non-oil-gas minerals, the mineral exploration was 9.92 billion yuan, accounting for 53.2% of the total, increasing by 15.6%; the basic geological survey 1.86 billion yuan, accounting for 10.0% of the total, increasing by 39.6%; the hydrogeology, environmental geology and geological disaster survey and evaluation 4.54 billion yuan, accounting for 24.4% of the total, decreasing by 1.2%; the geological science, technology and comprehensive study 2.11 billion yuan, accounting for 11.3% of the total, decreasing by 17.6%; the geological data services and informatization were 209 million yuan, accounting for 1.1% of the total, decreasing by 33.5% (Fig. 3-2).

Among the investments in exploration of non-oil-gas minerals, the national financial investments reached RMB 12.62 billion, accounting for 67.7% of the total, including RMB 4.18 billion from the central government, decreased by 0.7% and accounting for 22.4% of the total, and RMB 8.44 billion from local governments, increased by 10.4%, accounting for 45.3% of the total. There was RMB 6.02 billion of social investment, up by 8.8% and accounting for 32.3% of the total (Fig.3-3).

The exploration of non-oil-gas minerals was dominated by the coal (1.65 billion yuan), uranium (1.17 billion yuan), gold (1.07 billion yuan), copper (657 million yuan), lead and zinc (572 million yuan), accounting for 51.8% of the total investment in mineral exploration. Compared with 2021, the minerals with increased input mainly include the phosphorus, tin, molybdenum, coal, etc., while the minerals with reduced input mainly include the graphite, bauxite, potash etc. (Table 3-1).

II. Progress in Oil and Gas Exploration

In 2022, major breakthroughs were made in conventional oil and gas exploration in new strata, new types and new areas in large oil and gas basins such as the Tarim, Junggar, Bohai Bay and Sichuan Basins. New breakthroughs have been made in unconventional oil and gas exploration in new strata and deep layers of shale gas in the Sichuan Basin and its circumferential areas.

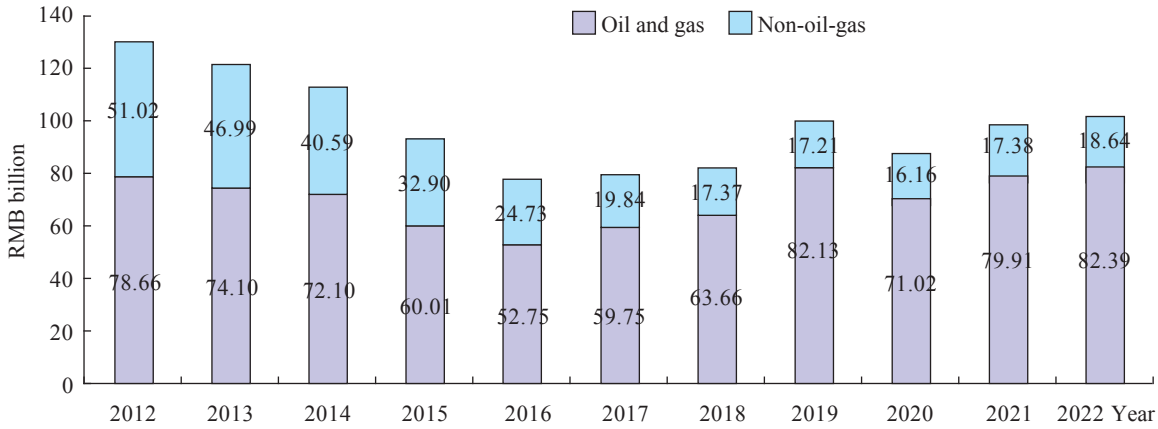

Fig. 3-1 Investment in Geological Exploration in China from 2012 to 2022

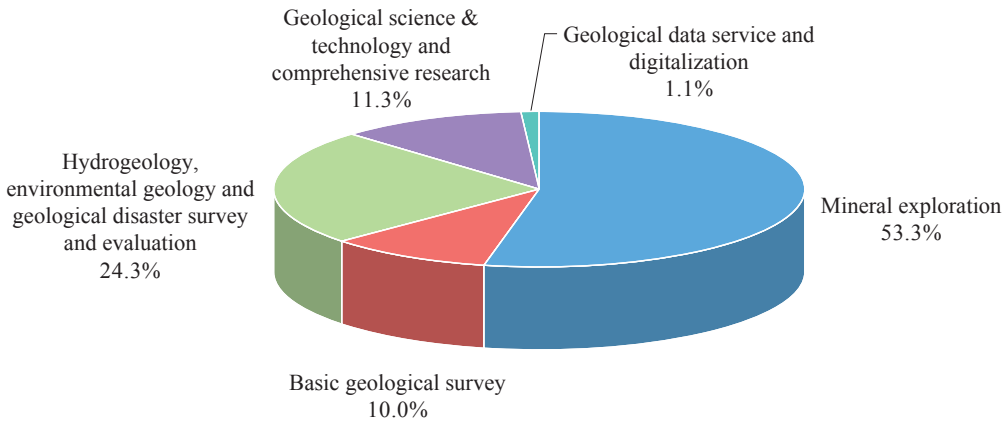

Fig. 3-2 Structure of Investment in Exploration of Non-oil-gas Minerals (by Category)

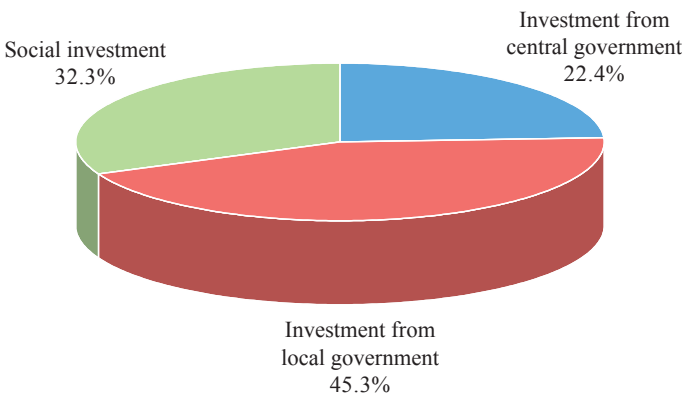

Fig. 3-3 Investment Structure of Non-oil-gas Geological Exploration (by Fund)

Table 3-1 Investments in Exploration of Non-oil-gas Minerals in 2022

Mineral	Investment RMB million	Year-on-year growth / %	Meters drilled million meters	Year-on-year growth/%
Coal	1653	22.5	1.38	6.2
Iron ore	424	-2.3	0.35	0.0
Manganese ore	83	3.7	0.06	50.0
Copper	657	0.3	0.33	0.0
Lead and zinc	572	-3.9	0.38	-36.7
Bauxite	255	-16.1	0.27	-6.9
Nickel	52	15.6	0.05	400.0
Tungsten	148	-6.3	0.10	-33.3
Tin	55	44.7	0.04	0.0
Molybdenum	73	32.7	0.06	20.0
Gold	1071	-1.7	0.68	-10.5
Silver	122	8.9	0.06	-25.0
Phosphorus	288	97.3	0.21	110.0
Graphite	142	-21.1	0.10	-33.3
Potash	84	-17.6	0.04	33.3

New progress has been made in unconventional oil exploration in Ordos Basin, Bohai Bay Basin, Subei Basin and Beibuwan Basin. Moreover, considerable breakthroughs have been achieved in deep coalbed methane exploration in the eastern margin of Ordos Basin.

1. Conventional oil and gas exploration

Breakthroughs had been made in conventional oil and gas exploration in many basins. In the east of Fuman Oilfield and Shunbei Oilfield in Tarim Basin, high-production oil flow was discovered from several wells, and two ultra-deep condensate gas enrichment zones of 100 million tons were delineated. High-production oil flow was obtained through the deep drilling at a depth of 8,000 m in the middle section of the southern margin of Junggar Basin. The high production flow was discovered in the new area of shallow strata of Baoding depression, new strata of deep layers of Yangwuzhai structure and Kuihuadao structure in Bohai Bay Basin. In Hetao Basin, a new target for resources growth of oil and gas in the middle of Linhe depression was delinated. China's first deep-water deep-layer large gas field was discovered in Qiongdongnan Basin. A new exploration area had been opened up in the deep-water Paleogene system in Kaiping Depression of the Pearl River Estuary Basin.

2. Unconventional oil and gas exploration

New breakthroughs had been made in the exploration of shale gas in the shallow Jurassic system of Sichuan Basin and its peripheral Weiyuan Yuxi deep layer, the superficial layer of Puguang gas field, Jingyan-Qianwei Cambrian system, Liangping and Hongxing Permian system, Xinchang complex structure deep layer and Dingshan structure deep layer. The successful exploration of new strata, new types and new areas in unconventional oil of the Ordos Basin, Bohai Bay Basin, Subei Basin and Beibuwan Basin will become an important replacement field for stable oil production in the future. Important breakthroughs had been made in deep coalbed methane exploration in Linxing, Shenfu and other areas in the eastern margin of Ordos Basin.

III. Progress in Non-oil-gas Exploration

In 2022, 132 mineral deposits were newly discovered in China, including 34 large deposits,

51 medium deposits and 47 small deposits. The top 5 minerals in the newly-discovered deposits include the cement limestone (14 deposits), granite for construction (14 deposits), limestone for construction (11 deposits), granite for finishing (9 deposits) and coal (6 deposits).

Staged exploration has been completed in 495 mineral deposits in the country, including 131 general surveys, 255 detailed surveys, and 109 exploration sites. The top 5 mineral deposits subjected to the staged exploration include the limestone for construction (49 deposits), granite for construction (35 deposits), limestone for cement (33 deposits), veneer granite (26 deposits) and coal (18 deposits).

In 2022, important progress was made in a number of strategic minerals such as the gold, lithium and flourspar, among which Xiling Gold Mine, the single gold deposit with the largest resource in China, was discovered in Shandong Province.

Feature 3–1 New Progress of Mineral Exploration Supported by Geological Exploration Fund in 2022

In 2022, the provincial funds invested in geological exploration reached RMB 3.37 billion, including RMB 2.21 billion in mineral exploration, which accounts for 22.2% of the total national investments in non-oil-gas mineral exploration (RMB 9.92 billion) and 41.2% of the national fiscal investments in non-oil-gas mineral exploration (RMB 5.35 billion). 476 mineral exploration projects were implemented, among which gold, coal, geothermal, copper, lead & zinc and lithium exploration took up the largest shares of investment in a descending order.

New discoveries of geological exploration, funded by provincial governments in 2022, were mainly concentrated in construction sand, gold, coal, iron ore, graphite, fluorite, geothermal and other minerals..

With the provincial funds invested in geological exploration, a total of 74 project results were disposed of (RMB 15.59 billion of income from the transfer of prospecting rights) in 2022, including 38 full-investment projects (RMB 7.72 billion of income from the transfer of prospecting rights) and 36 joint investment projects (RMB 7.87 billion of income from the transfer of prospecting rights).

Chapter IV
Development and Utilization

In 2022, fixed-asset investment in China's mining industry continued to grow, and the output of major mineral products maintained the growth, the energy consumption structure was optimized continuously, and the conservation and comprehensive utilization of mineral resources were steadily promoted.

I. Fixed-asset Investment in Mining Industry

Fixed-asset investment in mining industry continued to grow. In 2022, the fixed-asset investment in the mining industry continued the growth trend of the previous year, an increase of 4.5% over the previous year, 0.6 percentage points lower than the growth rate of national fixed-asset investment. In the fixed-asset investment in the mining industry, supported by the policy of ensuring the supply of energy and important commodities for people's livelihood, the investment in coal mining and washing and ferrous metal mining and processing industries increased by 24.4% and 33.3%, respectively. The growth rate of fixed-asset investment in oil and gas extraction, non-ferrous mining and non-metals mining and processing industries was 15.5%, 8.4% and 17.3%, respectively (Fig. 4-1).

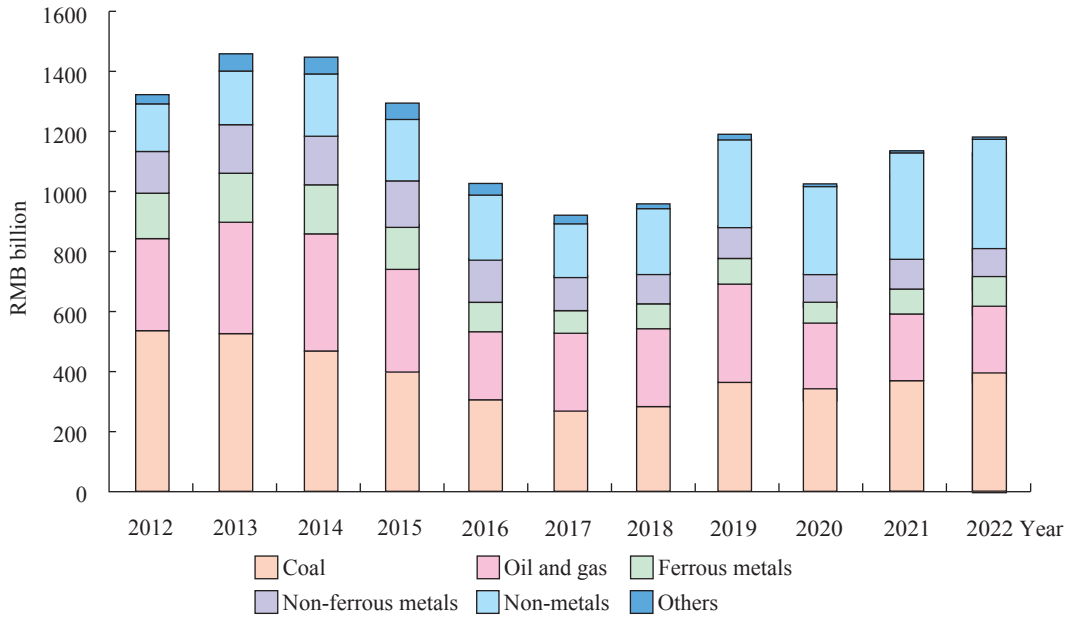

Fig. 4-1 Changes in Fixed-asset Investment in the Mining Industry in China

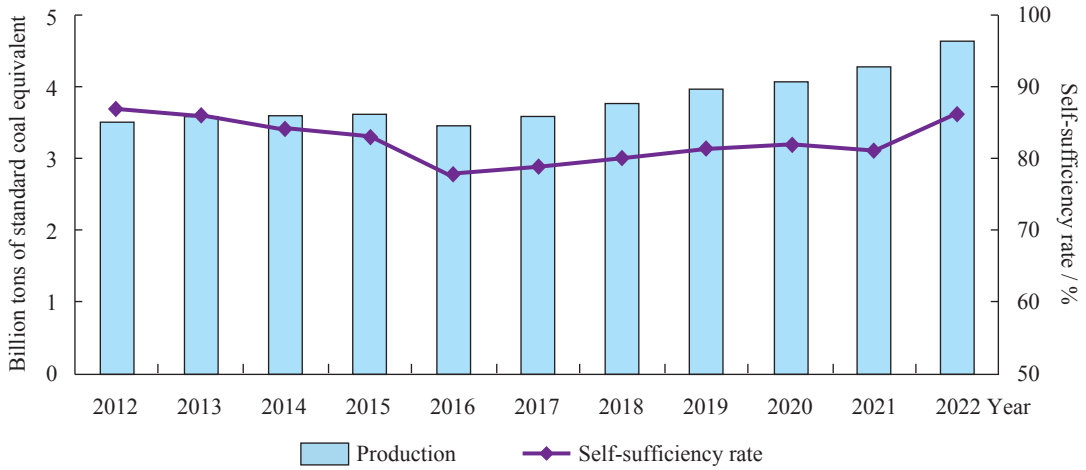

Fig. 4-2 Production of Primary Energy in China

II. Production and Consumption of Mineral Products

1. Energy

Obvious results have been achieved in increasing energy production and guaranteeing stable supply. In 2022, the total primary energy production reached 4.66 billion tons of coal equivalent, an increase of 9.2% over the previous year (Fig. 4-2). In the energy production structure, the coal accounted for 67.4%, the oil accounted for 6.3%, the natural gas accounted for 5.9%, and the non-fossil energy such as hydropower, nuclear power, wind power and solar power accounted for 20.4%. The total energy consumption reached 5.41 billion tons of coal equivalent, an increase of 2.9%. The energy self-sufficiency rate was 86.1%.

China's energy consumption structure was optimized continuously. In 2022, the coal consumption accounted for 56.2% of total primary energy consumption, the oil accounted for 17.9%, the natural gas accounted for 8.4%, and the non-fossil energy such as hydropower, nuclear power, wind power and solar power accounted for 17.5%. Compared with ten years ago, the proportion of coal consumption in energy consumption decreased by 12.3 percentage points, and the proportion of non-fossil energy such as the hydropower, nuclear power, wind power and solar power generation increased by 7.8 percentage points (Fig. 4-3).

In 2022, the coal production was 4.56 billion tons, increasing by 10.5% from the previous year, hitting a record high, while the consumption was 4.44 billion tons, increasing by 4.3%. Crude oil production was 205 million tons, increasing by 2.9% (Fig. 4-4), and maintaining the growth for four consecutive years, and the consumption was 700.0 million tons, decreasing by 3.1%. The natural gas output was 220.11 billion cubic meters, increasing by 6.0%, an increase of more than 10 billion cubic meters for the sixth consecutive year, and the consumption was 372.77 billion cubic meters, decreasing by 1.2%.

2. Metals

In 2022, the iron ore production was 970 million tons, decreasing by 1.0% from the previous year, and the apparent consumption (domestic production + net import) was 1.49 billion tons (60%-grade standard ore); the crude steel production was 1.02 billion tons, decreasing by 1.7% (Fig. 4-5). Among the main nonferrous metallic minerals, the production of copper

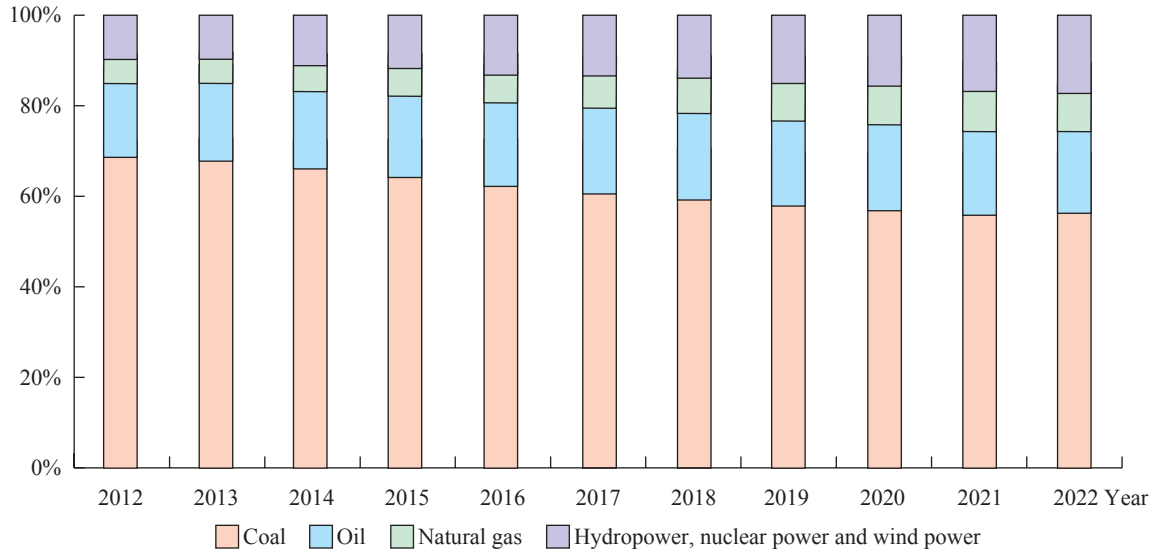

Fig. 4-3 Changes in the Primary Energy Consumption Structure in China

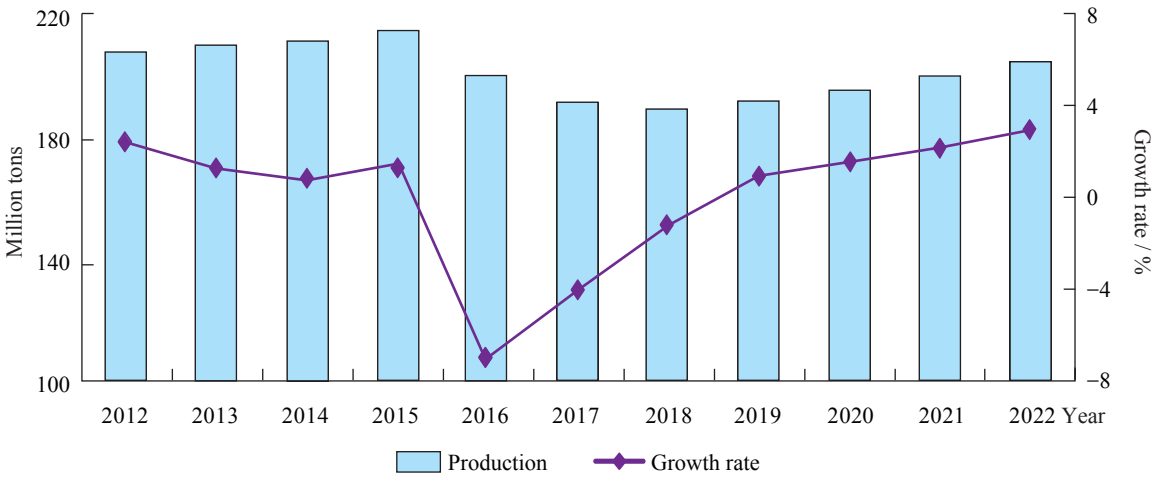

Fig. 4-4 Crude Oil Production and Its Changes in China

concentrates, lead concentrates and zinc concentrates was 1.87 million tons, 1.50 million tons and 3.10 million tons, increased by 5.8%, 0.9% and -1.7% respectively. The output of ten kinds of non-ferrous metals was 67.94 million tons, increased by 4.9%. Among them, the refined copper was 11.06 million tons, an increase of 5.5%; the electrolytic aluminum was 40.21 million tons, an increase of 4.4%.

3. Nonmetals

In 2022, China produced 104.74 million tons of phosphate rocks (30% of P_2O_5), increased by 0.7% over the previous year, and 2.13 billion tons of cement, decreased by 10.5% (Fig. 4-6).

III. Conservation and Comprehensive Utilization of Mineral Resources

1. Establish an evaluation index system for rational exploitation and utilization of mineral resources

On the basis of completing the study and announcement of all the indicators of the mining recovery rate, dressing recovery rate and comprehensive utilization rate (hereinafter referred to as the "three rates") in the operating mines, the study work on the "three rates" standards was carried out, and all mine development and utilization indicators were inspected, and 10 "three rates" standards involving a total of 85 minerals were initially formulated.

2. Update the catalogue of advanced and applicable technologies dynamically

A new round of updating the catalogue of advanced and applicable technologies was deployed and carried out, 317 advanced and applicable technologies for the conservation and comprehensive utilization of mineral resources were selected, and the *Catalogue of Advanced and Applicable Technologies for the Conservation and Comprehensive Utilization of Mineral Resources (2022 Edition)* was issued, covering 46 geological exploration technologies, 82 mining technologies, 56 beneficiation technologies, 58 comprehensive utilization technologies, 30 green and low-carbon technologies and 45 digital and intelligent technologies.

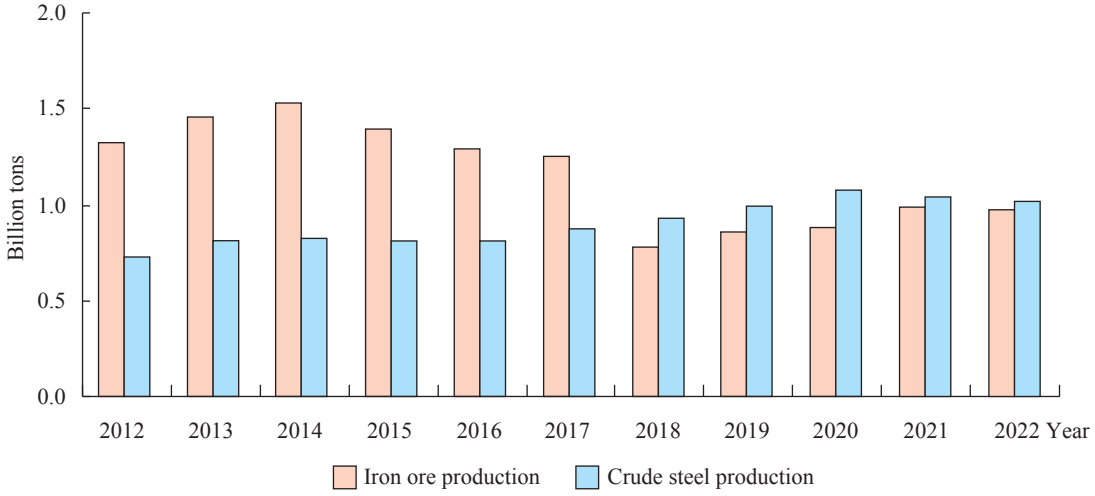

Fig. 4-5 Changes in the Production of Iron Ores and Crude Steels in China

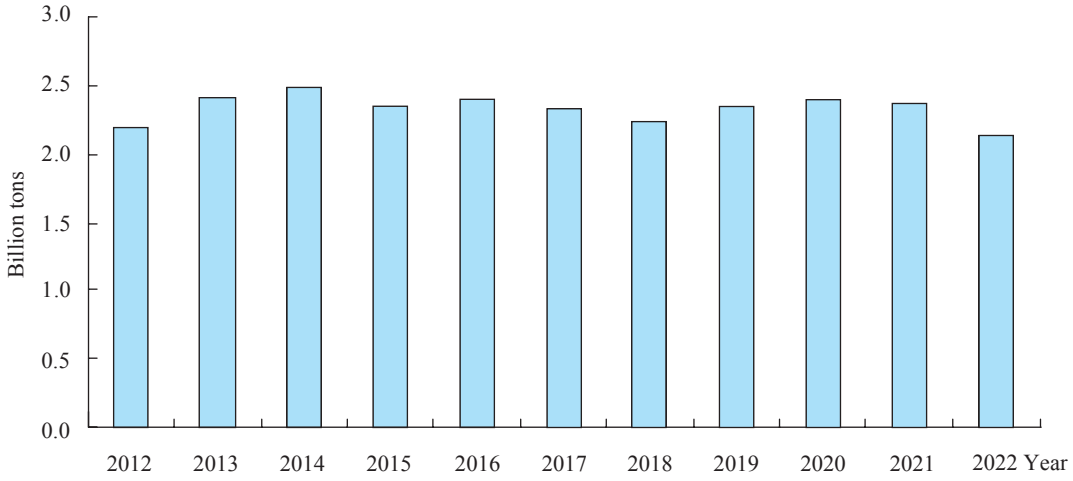

Fig. 4-6 Changes in Cement Production in China

3. Build the economical and intensive demonstration counties (cities) in the fields of mineral resources

An index system for the economical and intensive mineral resources was established, 57 demonstration counties (cities) adopting the economical and intensive utilization of mineral resources were selected and announced in consideration of the economical and intensive use of resources, energy-saving and low-carbon mineral development, ecological restoration and management of mines, intelligent and efficient technology upgrading, and government and public participation.

Feature 4–1 Phased Results Achieved in Expanding Pilot Program for Survey and Evaluation of the Mineral Exploitation and Utilization Level

The establishment of a survey and evaluation system for the level of mineral resources development and utilization is an important task clearly defined in the *Integrated Reform Plan for Promoting Ecological Progress*. On the basis of the original pilots, according to the new situation and new requirements, some provinces (regions) and some mineral species were selected to carry out the whole-process pilot expansion. The type of resources, major mining provinces and regional distribution were taken into account, 10 provinces (autonomous regions) including Hebei and Zhejiang Provinces were determined as pilot areas, of which the pilots were established in the entire Hebei and Shandong Province, and were partially established in counties (cities and districts) of 8 provinces (autonomous regions), including Zhejiang, Anhui, Jiangxi, Henan, Hubei, Sichuan, Gansu and Xinjiang. Pilot minerals include the coal, iron ore, copper, tungsten, molybdenum, gold, fluorite, limestone, potash, and phosphorite, and the pilot program should be launched for above minerals in all operating mines in 2022 according to the actual distribution of resources in the region. A total of 1,278 mines were surveyed, of which 541 were inspected on the spot, and pilot tasks were completed with initial results achieved. Through the pilot program, the survey data quality control system had been explored and established, and the evaluation standards and methods had been verified. In some provinces, the evaluation standards and methods were diversified based on the actual situation, providing practical experience for promoting the construction of the survey and evaluation system for the development and utilization of mineral resources.

Chapter V
Ecological Restoration of Mines and Green Development

The *Ecological Restoration of Legacy Mines Action Plan During the "14th Five-Year Plan" Period* was issued, the nationwide inspection of legacy mines was carried out, and the ecological restoration of legacy mines in key river basins and key areas was strengthened, to deploy and implement the first batch of ecological restoration demonstration projects of legacy mines during "14th Five-Year". A sophisticated green exploration standard system has been established, to constantly optimize the work layout. Annual spot checks of green mines were carried out. Green mine policy documents were issued across the country, to promote green mining construction.

I. Ecological Restoration of Mines

1. Strengthen the role of planning and guidance

The *Ecological Restoration of Legacy Mines Action Plan During the "14th Five-Year Plan" Period* was issued, the diversity and regionality of ecological problems in mines were taken into account, and the national restoration and governance tasks were decomposed and arranged

according to local inventory tasks, regional ecological functions of river basins and territorial spatial planning.

2. Coordinate the implementation of key projects

The principle was followed of highlighting priorities, line-surface combination, guidance by demonstration, and overall promotion. The ecological restoration demonstration projects for abandoned mines were organized and implemented jointly with the Ministry of Finance. 11 demonstration projects for the centralized development zones of mineral resource and the areas with important ecological locations and prominent ecological problems in Fujian, Sichuan, Ningxia, Shandong, Jiangxi, Jiangsu, Guizhou, Xizang, Liaoning, Hebei and Hunan provinces were implemented with cycle of 2022-2024. It is expected that 14,900 hectares will be governed.

3. Strengthen basic support

The legacy mines were inspected nationwide, the situation of abandoned mines, for which the government is liable, were basically ascertained, and a unified national database and task ledger for legacy mines were established, to provide support for the restoration and governance of mines in accordance with local conditions, zones and categories. The survey and evaluation of the ecological damage and pollution of legacy mines in the Yellow River Basin in 9 provinces (autonomous region) along the Yellow River were directed jointly with the Ministry of Ecology and Environment, and the National Forestry and Grassland Administration, the *Technical Plan* was issued, the working base map and technical requirements were unified, to establish a work coordination mechanism, the technical training was carried out, and the daily scheduling and business guidance were strengthened, to ensure the reliable and orderly progress of all work.

4. Improve the standard system

The *Technical Specifications for Remote Sensing Monitoring of Mine Environment*, *Technical Specification for Mine Ecological Restoration Part 1: General Rules* and five special rules for different types of minerals were issued to guide and standardize the implementation of ecological restoration of mines across the country. The research on the index system and

technical methods related to the effective evaluation of mine ecological restoration was organized and carried out, to constantly improve the scientific and technological level of mine ecological restoration.

II. Green Exploration

1. Establish a sophisticated green exploration standard system

The *Quality Management Specifications for Geological Exploration Units* is being revised and improved. The green exploration specifications was proposed for minerals, such as iron ore, manganese ore, chromite and pyrite, and sections on green exploration were added to the Specification for Compilation of Geological Reports on Mineral Exploration. Natural resources authorities in Guizhou, Qinghai, Shandong, Inner Mongolia, Ningxia and other provinces and autonomous regions have developed local (provincial) standards in light of local characteristics.

2. Optimize the work layout continuously

In the process of organizing the implementation of a new round of strategic action for breakthrough in prospecting, all kinds of prospecting areas were fully connected with control lines such as the red line of ecological protection, the minerals related to clean energy and strategic emerging industries were highlighted in mineral exploration, and more exploration technologies were applied with low environmental disturbance. The *Outline of the National Territorial Space Planning (2021-2035)* was actively implemented, and the green exploration was continuously promoted, to minimize the impact of prospecting on the ecological environment.

III. Construction of Green Mines

1. Advance the construction of green mines steadily

The policy documents such as special plans, management measures and implementation plans were issued in areas, to actively promote the construction of green mines. In Liaoning

Province, the *Green Mine Construction Special Plan in Liaoning Province (2021-2025)* was issued; in Zhejiang Province, the "*Green Mine Management Measures in Zhejiang Province*" was released; in Guangxi Zhuang Autonomous Region, the *Notice on Matters Related to the Follow-up Work of "Looking Back" to Improve the Construction Quality of Green Mines* was published; in Gansu Province, the *Implementation Plan for Promoting Green Mine Construction with High Quality in Gansu Province (2021-2025)* was promulgated. In addition, the *Notice of Ordos Municipal People's Government on Strengthening the Supervision of Green Mine Construction* was issued in Ordos, Inner Mongolia, and the *Measures for the Management of Green Mine Construction in Dongying City* was enacted in Dongying, Shandong Province.

By the end of 2022, more than 1,100 national green mines have been constructed.

2. Carry out the annual spot check and verification of green mines

In June 2023, the *Notice of the General Office of the Ministry of Natural Resources on Carrying Out Field Spot Inspection and Verification of Green Mines in 2023* was issued, requiring regular supervision on the basis of "looking back", and inspecting and spot checking the green mines included in the national, provincial, city and county lists in accordance with the relevant requirements of "double random and one open", with the proportion of no less than 20%.

3. Drafting of the *General Rules on Green Mine Evaluation* (open for comment)

Based on the nine industry standards including the *Green Mine Construction Specification of Non-metallic Minerals Industry*, relevant units were organized to draft the *General Rules on Green Mine Evaluation* (open for comments), and opinions are being solicited from relevant ministries and commissions.

Chapter VI
Policies and Regulations on Mineral Resources

The revision of the *Mineral Resources Law* was promoted, further standardizing the mining rights offer transactions and revenue collection management, clarifying matters related to the linkage of new land for mining projects and the reclamation and restoration of existing mining land, relaxing restrictions on comprehensive exploration, mining rights transfer, etc., and simplifying the approval and registration procedures and application requirements.

I. Laws and Regulations

On May 29, 2023, the *Mineral Resources Law (Amendment)* was listed as a bill for initial deliberation according to the *Legislative Work Plan of the Standing Committee of the National People's Congress for the Year 2023*. On May 31, 2023, the *Mineral Resources Law (Revised Draft)* was listed as a bill to be submitted to the Standing Committee of the National People's Congress for deliberation according to the *Legislative Work Plan of the Standing Committee of the National People's Congress for the Year 2023 issued by the General Office of the State Council, PRC.*

II. Rules and Reforms

On November 18, 2022, the *Notice of the Ministry of Natural Resources on the Guarantee of Mining Land* was issued, clarifying the relevant matters related to the new land for mining projects and the reclamation and restoration of the existing mining land. It stipulates that three types of indicators are used to guarantee the land used for mining projects, puts forward five specific measures to establish a mechanism linking the new land used for mining projects with the existing mining land used for reclamation and restoration, and proposes to strengthen the organization, implementation and supervision of the whole process.

On January 3, 2023, the Ministry of Natural Resources revised and issued the *Rules for the Offer and Transaction of Mining Rights*. It is intended to further regulate the offer and transaction of mining rights, ensure that the offer and transaction of mining rights are open, fair and just, and safeguard the rights and interests of the state and the legitimate rights and interests of mining rights holders. The main changes of the newly revised transaction rules are: to optimize the division of responsibilities between the competent department of natural resources and the trading platform; to refine the conditions for the suspension and termination of trading activities; to standardize the work requirements for the change of content after the release of the offer announcement; to strengthen the trading process and relevant time limit requirements; to clearly promote electronic transaction in a comprehensive manner; to improve the liability for breach of contract and credit supervision.

On May 6, 2023, the *Notice of the Ministry of Natural Resources on Further Improving the Registration Management of Mineral Resources Exploration and Exploitation* was issued, which clearly relaxed the restrictions on comprehensive exploration and the transfer of mining rights, and simplified the approval and registration process, and the application requirements.

III. Taxes on Mineral Resources

The *Guiding Opinions of the General Office of the State Council on Further Promoting the Reform of the Financial System below the Provincial Level* clearly states that in areas with uneven distribution of resources between regions, the provincial departments are allowed to participate in the sharing of resource tax revenue at the proportion determined based on factors such as the resource concentration, resource tax revenue scale, and inter-regional balance.

The *Announcement of the Ministry of Finance and the State Taxation Administration on Further Implementing the "Six Local Taxes and Two Fees" Reduction and Exemption Policy for Small and Micro Enterprises* makes it clear that the people's governments of provinces, autonomous regions and municipalities directly under the Central Government may decide to, according to the actual situation of the regions and the needs of macro-control, reduce the resource tax, urban maintenance and construction tax, real estate tax, urban land use tax, stamp duty (excluding stamp duty on securities transactions), cultivated land occupation tax, education fee surcharge, and local education surcharge ("Six Local Taxes and Two Fees") for small-scale VAT taxpayers, small low-profit enterprises and individual industrial and commercial households within the 50% tax range during the execution period from January 1, 2022 to December 31, 2024.

The Ministry of Finance, the Ministry of Natural Resources, and the State Taxation Administration jointly issued the *Measures for the Collection of Revenue from the Offer of Mining Rights*, which improved the collection and management system of revenue from the offer of mining rights, the collection methods of revenue from the offer, the payment and refund, the convergence of old and new policies, and the supervision, and took effect on May 1, 2023. The "*Measures*" provide for two ways of collecting the revenue from the offer of mining rights according to the form of the revenue rate of the offer of mining rights or the form of the offer amount, and adjusts the current "one-time single payment" for most minerals in the offer link to "transaction price + collection year by year at annual rate" for 144 minerals, reduces the proportion of down payments levied in the form of amounts, extends the period of installment payments to the maximum extent, and refines the relevant provisions of market benchmark prices.

In 2022, China's resource tax revenue totaled 338.9 billion yuan, an increase of 48.1 percent over the previous year and accounting for 2.03% of the national tax revenue. The amount of revenue from the offer of exploration and mining rights in 2022 was 223.16 billion yuan.

The *Guiding Opinions of the Ministry of Natural Resources and the Ministry of Finance on the Formulation of the Starting Price Standards for the Transfer Incomes of Mining Rights* was issued and implemented on August 25, 2023, providing guiding opinions on the formulation of the starting price standards for the offer incomes of mining rights of non-oil-gas minerals, oil and gas.

Chapter VII
Mineral Resources Management

The National Mineral Resources Plan during the "14th Five-Year Plan" period was issued and implemented, and databases at all levels was constructed simultaneously; the supervision and management of geological exploration activities was strengthened, the safe operation of geological exploration enhanced, and the high-quality development of geological exploration units guided and facilitated; the review and supervision of mineral & reserves were deepened; the offer of oil and gas exploration blocks was increased, the management of sand and gravel mining standardized, and the iron ore supply was guaranteed, the mining rights registration procedures further streamlined.

I. Mineral Resources Planning

The National Mineral Resources Plan during the "14th Five-Year Plan" period was jointly

issued and implemented by seven departments. The aggregate plans for mineral resources of 31 provinces (autonomous regions and municipalities) and the Xinjiang Production and Construction Corps were all approved by MNR, and issued and implemented by provincial (autonomous regions and municipalities) departments, and more than 2,000 aggregate plans for mineral resources at the city and county levels were compiled nationwide. The construction of mineral resources planning and management systems at the national, provincial, city and county levels has been carried out in an all-round way, and all local authorities and departments have coordinated and cooperated according to the division of responsibilities, and actively supported the implementation of policies, project arrangements, funding guarantee and institutional innovation.

The mineral resources planning databases at all levels were constructed simultaneously, the data entry of provincial mineral resource planning was completed, and the construction of a national unified planning database was promoted, to strengthen the planning integration and coordination, and to facilitate the interconnection, collection and sharing of basic planning information.

The mid-term evaluation of the implementation of the National Mineral Resources Plan during the "14th Five-Year Plan" period was studied and arranged, adhering to the principles of the problem-oriented and demand-oriented combination, overall development and security, based on reality, planning for the future, thus laying a good foundation for the field of mineral resources to make up for weak links, improve weaknesses, consolidate the background, and strengthen advantages.

The draft of the industry standard for approval of the *Technical Regulations for the Preparation of the General Plan for Mineral Resources at the Provincial Level* was publicized, and two industry standard solicitation drafts for the *Mineral Resource Planning Data Quality Inspection and Exchange Specification* and *Specification for Construction of Mineral Resources Planning Databast* were produced.

II. Geological Exploration Management

1. Basic situation of geological exploration sector

In 2022, 431,400 employees served in non-oil-gas geological exploration units in China, an increase of 0.7% over the previous year, of which 173,000 are geological exploration personnel, 85,200 are engineering exploration and construction personnel, 13,800 are mineral development personnel, and 159,500 are other personnel. The total revenue was 394.42 billion yuan, decreasing by 2.6% year-on-year.

2. Supervision and management of geological exploration activities

A national geological exploration industry supervision and service platform was established. The *Letter on Information Filling and Publicity Work of the National Geological Exploration Industry Supervision Service Platform* was issued, and specific requirements were put forward for the information filling and publicity work. The national geological exploration industry supervision service platform operation training video meeting was held, and the information filling and publicity and directory database construction were directed. At present, the regulatory service platform has basically covered state-owned geological exploration units and other geological exploration units, providing basic data for the supervision of geological exploration activities, and playing an important role in the geological exploration industry.

The *Notice of the General Office of the Ministry of Natural Resources on the Supervision and Inspection of Geological Exploration and Geological Disaster Prevention Activities in 2022 by "Random Selection and Public Release"* was issued, and the supervision and inspection work of "Random Selection and Public Release" geological exploration and geological disaster prevention and control activities were organized. A total of 518 units were spot checked, of which 27 units failed to pass the inspection.

3. Safe operation of geological exploration

the *Notice of the General Office of the Ministry of Natural Resources on Operation Safety of the Geological Exploration and Mapping Industry in 2022* was issued, requiring all local authorities to comprehensively investigate potential safety risks and compile a list of potential problems and rectification measures. In 2022, a total of more than 2,000 geological prospecting units were organized to complete self-inspection work on operation safety, and more than 600 geological prospecting units were spot checked, with a proportion of 26%.

III. Mineral Reserves Management

1. Complete the statistics of national mineral resources & reserves

Since the implementation of the new national standards for the classification of mineral resources & reserves, the new and old data had been classified and transformed, the data filling requirements had been standardized, the data joint review procedures had been improved, and a regular quality monitoring mechanism had been established. In 2022, the statistical quality evaluation indicators for mineral resources & reserves were studied and formulated, to standardize the key points of data review, the key inspections and comprehensive assessments of quality control were carried out, the preliminary and joint reviews of data accuracy and comprehensiveness were conducted, and local authorities were urged to verify and improve problems found, further improving the quality of statistical data.

2. Further promote the quality supervision and guidance of mineral resources & reserve review

The working mechanism for quality supervision and guidance of review work has been gradually deepened. The quality supervision and guidance of the review work in 15 provinces (autonomous regions) were completed, and the quality supervision and guidance of the review

at the city and county levels were orderly rolled out by the provincial departments (autonomous regions and municipalities). The implementation of the review and record management reform requirements, new standards and other aspects by provinces (regions and municipalities) was reported for supervision and rectification. Through the national review and record data information service system, the review and record data was collected, to timely grasp the basic situation.

3. Strengthen technical training and exchange

More than 80,000 professional and technical personnel and review experts of geological prospecting units and mining enterprises have been trained, to ensure the implementation of mineral resource & reserve classification and supporting standards. Exchanges and discussions on the national review business were organized and carried out, and specific handling opinions were put forward on important technical issues in the review work.

IV. Mining Rights Management

1. Setting of mining rights

By the end of December 2022, 11,207 exploration rights had been registered nationwide, increased by 9.9%, and the registered area reached 2,671,000 square kilometers, decreased by 0.7% year on year. In addition, a total of 31,025 mining rights were registered nationwide, decreased by 4.6%, and the registered area reached 296,000 square kilometers, increased by 7.2% year on year.

2. Increase the offer of oil and gas exploration blocks

In 7 provinces (autonomous regions), including Xinjiang, Guangxi and Heilongjiang, 42 blocks were successfully listed and transferred, allowing more social funds to flow into the field of oil and gas exploration. Enterprises were urged and guided to speed up the transfer of areas with proven reserves into extraction, a total of 261 oil and gas mining rights were registered in 2022, and enterprises were also urged to accelerate the progress of oil and gas production.

Feature 7–1 Strengthening Iron Ore Security and Standardizing Sand and Gravel Mining Management

The National Development and Reform Commission, PRC was cooperated to supply iron ore, guide local natural resources authorities and iron and steel (iron ore) enterprises to verify the use of ore and land matters involved in domestic key iron ore construction projects, and promote relevant work according to law and regulations. The registration of mining rights for key projects such as the West Anshan Iron Mine of Anshan Iron and Steel Group Corporation was completed and they were officially commenced.

In order to scientifically plan the development layout of sand and gravel resources, improve the policy of sand and gravel supply protection, and promote the green development of sand and gravel resources, on the basis of extensively listening to the opinions of local governments, industry associations, and relevant enterprises, and summarizing typical local practices, MNR issued the *Notice on Standardizing and Improving the Management of Sand and Gravel Mining*, which aims at the main problems and policy blind spots in the development and management of sand and gravel resources.

The document specifies work requirements from several aspects: the scientific planning and development layout, establishment of transfer project database, active implementation of "net mining right" transfer, strict management of sand and gravel used in engineering construction projects, standardization of sand and gravel production generated by non-sand-gravel mines, promotion of green mine construction, and strengthening supervision and law enforcement, and guides local governments to improve the market supply capacity of sand and gravel resources in the whole process, supports the effective promotion of major infrastructure construction projects and standardize the order of sand and gravel resource exploitation.

3. Optimize the mining rights registration procedures and requirements

The *Notice on Further Improving the Registration Administration of Mineral Resources Exploration and Exploitation* was issued, further simplifying and optimizing the procedures and requirements for registration of mining rights, improving the efficiency of handling certificates, and reducing the burden on owners of mining rights. It mainly includes:

(1) Abolishing the restriction on mineral species of comprehensive exploration and clarifying that the change formalities of prospecting mineral species are not required for the comprehensive exploration.

(2) Encouraging nearology ("prospecting near the existing mineral resources"), allowing the mining right owners to directly explore the upper and deep resources, without the need to apply for new registration of prospecting rights.

(3) Relaxing the transfer restrictions, canceling the period limit of transfer of prospecting rights obtained through bidding and auction, and adjusting the limit of 10 years for transferring and holding the agreed mining rights to 5 years.

(4) Allowing to retain the exploration right to continue the exploration, and clarifying that if the mining right cannot be transferred due to reasons other than the mining right owner's own, it can apply for the renewal of the exploration right and continue the exploration work.

(5) The transfer of the exploration right to the mining right needs not to be canceled, and the area of the original exploration right can be changed to continue the exploration, and the restriction that the subject cannot be changed separately is canceled.

(6) Canceling the approval items of the delineation of the mining area, and the transfer of exploration rights to mining rights can be directly applied for new registration.

(7) Streamlining the requirements for mining rights registration application, canceling 9 pre-application requirements, change 2 requirements to obtain through interagency information sharing, and simplifying and adjusting 3 requirements.

(8) Strengthening the supervision and administration of the exploration and mining activities of the owners of mining rights, investigating and punishing violations of laws and regulations according to law, and refusing to register new mining rights if they are included in the list of seriously dishonest subjects.

4. Deepen the reform of mining rights management

The *Opinions of the Ministry of Natural Resources on Several Matters Concerning Deepening the Reform of Mineral Resources Management* was issued, to optimize the approved selling, allowing the deep or upper, surrounding, scattered resource dispersion of the established mining rights, as well as the approved selling of crack area about 300 m between adjacent areas of mining rights granted to the same entity, and encouraging "prospecting on the mine"; to adjust the proportion of deduction area for the extension of exploration rights, changing the deduction base from the area contained in the initial license to the area specified in the exploration license after the extension, and adjusting the deduction ratio from 25% to 20%; to exclude the scope of non-oil-gas resources submitted and the scope of proved geological oil-gas reserves submitted from the deduction base, and promote the exploration; to refine the hydrocarbon exploration and production integration system; to require the letter of guarantee or security deposit in the mining rights transaction, and ensure the smooth competitive transfer of mining rights; to extend the retention period of exploration rights from 2 years to 5 years and reduce service costs.

V. Credit Management for Mining Right Holders

The credit supervision of mining right owners was continuously promoted. First, the publicity of mining exploration and mining information was strengthened, in 2022, 49,872 cases of mining rights was expected to be publicized nationwide, and 49,587 cases were actually publicized, with a publicity rate of 99.4%. Among them, 12,520 prospecting rights should be publicized, 12,466 were actually publicized, with the publicity rate of 99.6%; 37,352 cases of exploitation rights should be publicized, and 37,121 cases were actually publicized, with a publicity rate of 99.4%. Second, the "random selection and public release" spot check was organized, a total of 6,214 mining rights were checked in the year, with the

sampling rate of 12.5%, of which 1,304 prospecting rights were extracted, with the sampling rate of 10.4%; a total of 4,910 exploitation rights were extracted, with a spot check rate of 13.2%. Third, the credit management of mining rights holders was strictly enforced, and a total of 330 mining rights holders were included in the abnormal list of mining rights holders throughout the year, involving 340 mining rights.

VI. Conservation and Management of Paleontological Fossils

The updating of the national paleontological fossil expert database was organized and completed, and 387 paleontological fossil experts were updated; a linkage mechanism between provincial paleontological fossil protection departments was demonstrated, promoted and finally established, and the work related to the inter-ministerial joint meeting on the comprehensive control of national anti-smuggling and the inter-ministerial joint meeting on cultural relics safety was assisted; the preliminary study on the revision of the *Regulations on the Protection of Paleontological Fossils* and the study on evaluation and construction of the regulations on the protection system of paleontological fossils were organized, and the investigation and evaluation of important paleontological fossil sites across the country were carried out constantly; the excavation of paleontological fossils and the approval of their entry and exit were strictly regulated.

Chapter VIII
Geological Data Management and Services

In 2022, the competent departments of natural resources and geological data collection agency at all levels continued to enrich geological data resources, deepen the integrated research, sharing and application of geological data, and improve the service capacity and information construction level of geological data.

I. Geological Data Management

The reform requirements of "streamlining administration and delegating power, improving regulation, and upgrading services" were implemented, constantly strengthening the management of geological data. A total of 6,578 certificates of geological data were issued throughout the year, and 1,308 notices of geological data were issued within the deadline, with the national geological data submission rate reaching 93.7%, an increase of 1 percentage point over 2021.

The clearing of overdue geological data delivery information of mining rights was strengthened, 10 typical cases of failure to submit geological data in accordance with the law were publicized, further strictly clarifying legal provisions, and warning and urging the geological data delivery party to fulfill the obligation of submission in accordance with the law.

The management of coalbed methane geological data was strengthened, the pilot work of coalbed methane geological data management was carried out, and experience for the future rationalization of the national coalbed methane geological data management was accumulated.

The 70 years of struggle in geological data work was reviewed, the results and experience were summarized, and the 50 geological data management agencies and 268 personnels who have performed well in geological data management work were praised.

II. Geological Data Collection

1. Achievements and original geological data

By the end of 2022, the total amount of geological data collected by the geological data collection institutions at the provincial and ministerial levels has reached 935.4 thousand files and 18.71 million pieces. The total amount of original geological data has reached 63.6 thousand files and 3.85 million pieces. In addition, the entrusted units kept a total of 3.41 million files and 10.48 million pieces of original geological data.

2. Physical geological data

By the end of 2022, the geological data collection institutions at the provincial and ministerial levels has stored a total of 3.22 million meters of core, 305.1 thousand bags of

cuttings, 128 thousand pieces of specimens, 360.6 thousand pieces of polished thin section, and 9.94 million bags/bottles of samples. The entrusted units maintained a total of 1.64 million meters of core and 41.79 million bags of cuttings.

III. Geological Data Services

1. Collection service

Geological data collection institutions at the ministerial and provincial levels received a total of 21.5 thousand visits, providing 6.4 million data utilization services, 30.06TB of data replication, and 15.07 million geological data catalogs online. Geological data collection institutions at all levels provided geological data website service visits to 7.65 million. Adhering to the concept of allowing users to "avoid necessary matters", geological data online services were actively provided, and business consulting and borrowing services were provided through the Internet, telephone, mail and other ways.

The disclosure of information on geological data management and services has been promoted in an orderly manner. 1030 delivery voucher information of geological data of prospecting rights were provided to the national e-government information sharing and exchange platform in 2022. A total of 8.2 million case-level and document-level catalogs of geological data from 31 provinces (autonomous regions, municipalities) had been released. 121 thousand pieces of remittance information such as receipt of documents, data prompt, and abnormal list were published.

The National Geological Data Center portal continued to operate, and continuous information sharing services for national geological data resources were actively provided, to meet the needs of society for geological data. The National Digital Core System has achieved data resource aggregation and service efficiency improvement, and has accumulated 1.15 million

drilling data and 3 million catalog data, and promoted the deployment of five offline nodes in provinces, such as Anhui, Hebei, and Henan.

2. Geological cloud service

In 2022, "Geocloud" released five categories of information products, including:

(1) Global geochemical analysis data, global magmatic rock data, international karst geological data, global active fault database, and global boundary stratification database are five global scale geological research data products.

(2) Over 3,800 information products concerning six basic geological and energy mineral survey, including 361 geological survey project results reports, updated geological survey work data, important geological borehole data from 30 thousand wells, geology annals, and the oil and gas geological survey data.

(3) Five geological survey and monitoring information products of hydrogeology, engineering geology and environmental geology include 34 geological environment map systems of China, 10 thousand groundwater monitoring point data, and 890 thousand remote sensing data.

(4) GeositeServer spatial data service publishing software and the geological survey business management big data system, two software products with independent intellectual property rights, were developed.

(5) The new version of "Geocloud APP" was developed and launched.

In 2022, the number of registered users of "Geocloud" reached 110 thousand, and the annual visits were about 5.56 million, with data products viewed more than 8 million times and downloaded 2.62 million times.

Chapter IX
Scientific and Technological Innovations in Mineral Resources

In 2022, the scientific and technological achievements in the field of mineral resources were remarkable, and a number of important results had been achieved. 3 national standards and 47 industrial standards in the field of mineral resources were published and implemented.

I. Technological Milestones in Field of Mineral Resources

The implementation of national key research and development plans and other national science and technology plan projects was actively promoted, and new breakthroughs were made in the basic geological theory, regional mineralization and prospecting theory and the research and development of key technology and equipment.

1. Major improvements

New minerals in nature - Kenorozhdestvenskayaite-(Fe), Wodegongjieite, Nioboixiolite and Changesite-(Y) (new lunar mineral) were discovered.

The coupling ore-forming model of oxygen - uranium - bearing and hydrocarbon - bearing fluids in sandstone type uranium deposits was proposed.

The "body-in-body" mineralization model of rare-metal-bearing pegmatite in the large scale granitic batholith was verified, and the metallogenic model and exploration model of different types of lithium deposits such as Jiajika were built.

A new geodynamic metallogenic model for the continuous parallel occurrence of porphyry copper deposite belt and granite-related tin deposite belt was proposed. The Jiama multiple-center compound metallogenic model and the Juno multiple-stage and multiple-center compound deposit model were built, and the subduction - soft collision porphyry-epithermal metallogenic model and the tectonic-magmatic dome metallogenic model were constructed.

The metallogenic and prospecting model of Jinding lead-zinc-tin deposite concentrated area, the prospecting model of metamorphic sedimentary iron deposites in Tashkurgan area and the new multi-process metallogenic model of granite-type tungsten-niobium-tantalum ore in northern Tibet were put forward.

The tungsten-tin metallogenic model of "five-storey building + basement" was deepened. Two sets of metallogenic systems were constructed and improved, and the ore-controlling model of "three-storey building" structure was built in Liaodong area.

The circulation model of rare earth ore-forming materials in the deep sea was proposed for the first time, the mechanism of extraordinary enrichment of rare earth elements by phosphate components was quantitatively revealed, and the control of submarine topography over the enrichment of rare earth was initially revealed. New understanding of Marine potash mineralization was obtained.

The vertical migration mechanism and stereogeochemical exploration model of elements at large depth of 2000-3000m were established, and the principle and process of elements migrating from large-depth ore bodies to the surface were empirically explained internationally.

The combined detection technology of manganese-bauxite by electromagnetic method was innovated, to guide the discovery of new bauxite occurences.

The pilot machine of photoelectric direct-reading spectrometer on vehicle has been successfully developed, and the chemical assisted sensitization technology of laser denudation mass

spectrometry has been preliminarily established, effectively improving the sensitivity.

The research and development of deep-sea riserless mud recovery circulating drilling technology and equipment has made important progress. The level identification, monitoring and control system of riserless submarine pump lifting system has been established, and the hydraulic model of mud lifting pump has been built.

2. Major achievements

A new lunar geologic chronology was proposed, a hierarchy system of impact crater materials, impact basin formation, rock types and tectonic types was established, and the standards, processes, methods and diagrams for the compilation of geological map of the Moon were formulated, and the world's first 1:2,500,000-scale geologic map of the global Moon was developed.

The ages of multiple sets of impact glass spherules in Chang'e No. 5 lunar soil were obtained, verifying that the impact frequency on the Moon has changed with time over the past 2 billion years.

China's first set of three-axis stabilized platform airborne gravimeter was successfully developed, the "arc-second level" platform stability precision was achieved, and the airborne gravity data processing software was independently developed, making China the third country in the world to break through the 0.6mGal precision.

The chemical impurity removal technology of "acid leaching - calcination - acid leaching" of high-purity quartz in muscovite-bearing pegmatite was developed, to achieve the directional impurity removal of Ca impurity elements in high-purity quartz, and major breakthrough was made in the purification of 4N8 grade quartz.

A high-precision near-deep-seabed detection system was successfully developed and applied, overcoming the multi-target fidelity sampling technology for the first time, and the fidelity samplers for sediment, pore water, and bottom seawater were developed, filling in the gaps in key technologies for in-situ seabed detection and fidelity sampling.

The ultrafine material "fine classification" particle size control technology, ultrafine ilmenite step high intensity magnetic separation preconcentration technology and equipment, ultrafine ilmenite high turbulence concentration and low turbulence flotation recovery technology and

fine flotation equipment were innovated and developed, overcoming the worldwide problem in the industrial recovery of ultrafine ilmenite.

II. Technical Standards in the Field of Mineral Resources

In 2022, 3 national standards and 47 industry standards in the field of mineral resources were issued and implemented.

In order to standardize the sampling work of groundwater, improve the quality of groundwater investigation and sampling, and promote the development of domestic groundwater stratified monitoring technology, two industry standards have been issued and implemented, namely, *Code of Practice for Groundwater Sampling* and *Code of Practice for Continuous Multi-channel Tubes Monitoring Well in Shallow Groundwater*.

In order to meet the study needs of ecological geological survey of iodine and its relationship with human health in China, the *Soil and Stream Sediment - Determination of Iodine and Bromine Decomposition by Sintering Inductively Coupled Plasma Mass Spectrometry* was issued and implemented. Focusing on the actual needs of sample detection of tungsten ore and molybdenum ore, the national standard *Methods for Chemical Analysis of Tungsten Ores and Molybdenum Ores - Part 24: Determination of Germanium Content - Inductively Coupled Plasma Mass Spectrometry* has been issued and implemented.

In response to the analysis and testing needs of a new round of prospecting breakthrough strategic action and ecological geological survey and evaluation, 27 industry standards, including the chemical analysis methods for strontium ore, uranium ore and nickel ore, had been issued and implemented based on the development of modern large-scale analytical instrument testing technology.

The innovation, coordination, green and sustainable development of the geological exploration industry was accelerated, the transformation of technological innovation achievements in geological exploration was promoted, and based on the research and development of new methods and technologies for deep exploration and unconventional energy exploration, nine industry standards, including *Technical Requirements for Aeromagnetic Data Acquisition of Unmanned Aerial Vehicle*, *Code of Practice for*

Magnetotelluric Sounding, and *Code of Practice on the Permafrost Gas Hydrate Drilling Technology,* were published and implemented.

To meet the needs of the geological survey, exploration, evaluation, comprehensive utilization of mineral resources, and dynamic management of reserves, the national standard, *Codes for Indicators and Its Calculation of Comprehensive Utilization Technology of Mineral Resources*, and nine industry standards including the *Specification for Geological Work in Mines, Specification for the Management of Mineral Resources & Reserves in Mines,* and the *Standard of Scale Classification of Mineral Resources & Reserves* were issued and implemented.

III. Technological Innovation Platforms in Field of Mineral Resources

In terms of the national science and technology innovation platform, the construction and operation of the science and technology innovation platform was actively promoted in the field of mineral resources, providing supports for the geological exploration and prospecting breakthroughs, and a national key laboratory was established. The construction of the National Engineering Research Center for Gas Hydrate Exploration and Development was initiated, and 5 national field scientific observation and research stations, including the deep-hole crustal activity in Donghai, Jiangsu province, smoothly passed the evaluation of the Ministry of Science and Technology.

In terms of the Ministry's science and technology platform, 11 engineering technology innovation centers including carbon storage and geological energy storage have been newly approved, covering the research fields of geological and mineral exploration and development, geological disaster prevention and control, and marine mineral resources. The application of 17 field scientific observation and research stations, including the ultra-deep scientific drilling in Songke 2$^{\#}$ Well, was completed.

The relevant science and technology platform has made outstanding achievements in the research and development of key engineering technologies and equipment for "productive test" of natural gas hydrate, experimental grid-connection of hot dry rock in the Gonghe basin of Qinghai Province, and exploration and development of shale gas in the Yangtze River Economic Belt.

Chapter X International Cooperation

International exchanges and cooperations were carried out continuously through various means, contacts with major countries and international organizations actively maintained, and the practical cooperation in the field of geology and mineral resources promoted through international exchange platforms such as the China Mining Conference and Exhibition, friendly cooperative relations further consolidated.

I. Bilateral and Multilateral Cooperation Mechanisms

1. Bilateral cooperation

The practical cooperation with Russia, Mongolia, Chile, Mexico, Saudi Arabia and other countries was actively promoted in the field of geology and minerals, further enhancing cooperative relations in the geoscience study, geological survey, mineral resource development and management, mineral exploration technology and methods, and mining investment.

The ninth meeting of the China-Russia Investment Cooperation Committee was attended. "Strengthen the strategic alignment between the two countries and expand new areas of mining cooperation; deepen bilateral practical cooperation to promote high-quality economic development of the two countries; give play to the role of multilateral mechanisms and build a mining cooperation community" and other cooperation proposals were proposed.

The Memorandum of Understanding on Cooperation in Mineral Resources between China and Mongolia was successfully signed. The two sides was intended to carry out cooperation in the fields of basic geological survey and ecological geological survey, mineral resources study, mineral resources exploration, development and processing.

The second meeting of the Mining Sub-Committee of the China-Chile Intergovernmental Standing Committee was successfully held. MNR and the Ministry of Mining of Chile exchanged views on cooperation in the survey and evaluation of lithium resources and the joint construction of the China-Chile Earth Science Cooperation Center, and relevant mining enterprises introduced investment cases and needs, to promote practical cooperation.

The meeting of the Mining Cooperation Working Group under the China-Mexico High-level Working Group was successfully held. At the meeting, the progress of mineral processing technology and mineral demand of new energy industry were introduced, to promote the Chinese enterprises to invest in Mexico mining industry.

Winning the bid and implementing the Saudi Arabia geological mapping project marked a new step in China-Saudi Arabia geological cooperation.

2. Multilateral cooperation

The DDE Open Science Forum was attended. Besides, the main achievements and contributions in China's national node construction, international geoscience information

standards, international and regional geological mapping cooperation, data-driven magmatic geotectonic study and regional mineral prediction, marginal sea study and climate change were fully displayed.

At the invitation of the United Nations Economic Commission for Europe, a delegation was sent to attend the 13th annual meeting of the United Nations Resource Management Expert Group and deliver a presentation on the meeting, during which bridging documents between the upgraded China's mineral resource & reserves classification standards and the United Nations resource classification framework were reviewed and adopted.

The Global Environment Facility (GEF) "Energy Conservation and Green Low-carbon Promotion Project of China's Phosphorus Chemical Industry" was jointly organized with the United Nations Development Program, promoting the green and low-carbon development of phosphate mines in China and providing China's practical cases for global ecological governance.

II. International Mining Cooperation Platforms

1. China Mining 2022

From September 21 to 23, 2022, the 2022 (24th) China International Mining Conference was successfully held online. The conference, with the theme of "Sustainable mining, for sustainable economic growth", was held through a number of theme forums, special forums and online exhibitions, centering the global mineral supply and demand situation, mining capital market, mineral products trading market and other topics, aiming to build an important platform for promoting international practical cooperation in the mining industry.

2. Lancang-Mekong Geoscience Cooperation Forum

In November 2022, the Third Lancang-Mekong Geoscience Cooperation Forum and China-Asean Geoscience Information Exchange Seminar were held in an "offline + online" manner. The theme of the conference is "Jointly Building a China-Asean geoinformation Big Data Platform to Promote Sustainable Development of Regional Resources and Environment", which was attended by diplomatic envoys of Laos, Cambodia, Myanmar, Thailand and other countries as well as geological and mineral management agencies. During the period, the China-Asean Geoinformation Big Data Platform 1.0 was released, the concept document on the joint construction of the bilateral big data platform was signed, and academic seminars and technical training were carried out in the fields of geoinformatization and geoscience in Southeast Asia.

3. China-Argentina Earth Science Cooperation Center and China-Argentina Seminar on Sustainable Development

In January 2022, the China-Argentina Earth Science Cooperation Center was established. The event was incorporated into the Joint Statement of the People's Republic of China and the Republic of Argentina on Deepening China-Argentina Comprehensive Strategic Partnership as a result of the Argentine President's visit to China. The requirements for practical cooperation in the field of energy and resources proposed in the China-CELAC Joint Action Plan for Cooperation in Key Areas (2022-2024) was implemented, which is conducive to expanding and deepening bilateral cooperation in cutting-edge research in earth sciences, geological surveys, sustainable utilization of natural resources, capacity building and other fields, and supporting and serving the high-quality economic development of the two countries.