Member Country Report of CHINA

Submitted by

CHINA DELEGATION

(For Agenda Item 3)
GEO-RESOURCES SECTOR

1. MINERAL PROGRAMME

1.1 Summary

In 2011, China carried out 40 programs of mineral investigation and assessment which include 558 projects of mineral potential investigation and assessment, comprehensive research and 85,000 meters drilling.

The budget for the mineral projects was about RMB 2,645 million (about USD 419 million). The geological mapping and mineral potential investigation were carried out in 20 major metallogenetic belts.

China completed the mineral potential assessment of 13 minerals which included iron, aluminum, coal, uranium, copper, lead, zinc, tungsten, tin, gold, rare earth, potash and phosphorus in 2011.

China Geological Survey (CGS), provincial geological surveys, provincial bureaus and departments of geology and mineral resources, and other industry departments of the central government were involved in mineral investigation/prospecting and assessment.

1.2 Annual Progresses Review

1.2.1 Mineral investigation and assessment in major metallogenetic belts

In 2011, China carried out the geological investigation and mineral assessment in 20 major metallogenetic belts.

1. Geological investigation and mineral assessment in Tianshan metallogenetic belts
   The geological investigation and mineral assessment included lead and zinc deposit, copper and iron deposit, copper, lead and zinc deposit, polymetallic ore deposit, iron deposit, zinc and copper deposit, copper and nickel deposit.

2. Geological investigation and mineral assessment in Alertai metallogenetic belts
   The geological investigation and mineral assessment included copper deposit, porphyry copper, molybdenum and gold deposit, iron and copper deposit, and copper and gold deposit.
   The geological investigation and mineral assessment included iron, lead and zinc deposit, copper and polymetallic ore deposit. It also included mineral potential investigation and new airborne magnetic anomaly check.

4. Geological investigation and mineral assessment in Caidamo and its adjacent metallogenetic belts
   The geological investigation and mineral assessment included iron deposit, copper polymetallic ore deposit, and gold deposit.

5. Geological investigation and mineral assessment in Beishan-Qilianshan metallogenetic belts
   The geological investigation and mineral assessment included molybdenum deposit, iron deposit, iron and copper deposit, tungsten polymetallic ore deposit, iron and polymetallic ore deposit, and polymetallic ore deposit.

6. Geological investigation and mineral assessment in Qinling Mountain metallogenetic belts
   The geological investigation and mineral assessment included nonferrous metal deposit, tungsten polymetallic ore deposit, gold deposit, copper deposit, copper and gold deposit.

7. Geological investigation and mineral assessment in Gangdisi metallogenetic belts
   The geological investigation and mineral assessment included copper and molybdenum deposit, copper molybdenum deposit, copper deposit, gold and antimony polymetallic ore deposit.

8. Geological investigation and mineral assessment in Bangonghu-Nujiang metallogenetic belts
   The geological investigation and mineral assessment included copper deposit, copper polymetallic ore deposit, and salt lake resources. It includes the mineral potential investigation and comprehensive research of copper polymetallic ore deposit.

9. Geological investigation and mineral assessment in the border areas of Sichuan-Yunan-Guizhou provinces
   The geological investigation and mineral assessment included iron deposit, lead and zinc deposit, vanadium titanium magnetite deposit, iron and copper deposit, copper, lead and zinc deposit, gold deposit, and bauxite deposit.

10. Geological investigation and mineral assessment in Sanjiang metallogenetic belts of southwest China
    The geological investigation and mineral assessment included lead and zinc deposit, copper, lead and zinc deposit, copper polymetallic deposit, iron and copper deposit, lead and zinc polymetallic deposit gold and antimony polymetallic ore deposit.

11. Geological investigation and mineral assessment in the south area of Daxinganling metallogenetic belts
    The geological investigation and mineral assessment included lead zinc and silver polymetallic ore deposit, iron deposit. It also included mineral potential investigation in the area.
12. Geological investigation and mineral assessment in the north area of Daxinganling metallogenetic belts
   The geological investigation and mineral assessment included iron and copper polymetallic ore deposit, silver polymetallic ore deposit. The mineral potential investigation was also carried out.

13. Geological investigation and mineral assessment in the Daxinganling metallogenetic belts of eastern Liaoning and southern Jilin
   The geological investigation and mineral assessment included copper and zinc deposit, iron deposit. The investigation of potential copper, cobalt, zinc and lead deposit, copper and nickel deposit, and nonferrous metal deposit was carried out too.

14. Geological investigation and mineral assessment in metallogenetic belts of Shansi and Hebei
   The geological investigation and mineral assessment included gold deposit, copper, lead and zinc deposit. It also included iron and bauxite potential investigation.

15. Geological investigation and mineral assessment in the metallogenetic belts of western Henan
   The geological investigation and mineral assessment included bauxite deposit, zinc and silver deposit. It also included mineral potential investigation in the area.

16. Geological investigation and mineral assessment in the metallogenetic belts of middle and lower reaches of the Changjiang River
   It included the investigation of iron and copper deposit, the investigation of potential copper polymetallic ore deposit, copper and iron polymetallic ore deposit, the investigation and assessment of copper and iron polymetallic ore deposit and iron and copper deposit.

17. Geological investigation and mineral assessment in the metallogenetic belts of Wuyishan
   It included the investigation and assessment of copper polymetallic ore deposit and the investigation of potential copper polymetallic ore deposit and other deposits.

18. Geological investigation and mineral assessment in the metallogenetic belts of western Hunan and Hubei
   It included the assessment of potential lead and zinc polymetallic ore deposit, investigation and assessment of lead and zinc deposit, investigation of potential lead and zinc deposit and other deposits.

19. Geological investigation and mineral assessment in the Nanling metallogenetic belts
   It included the prospecting of tin, lead and zinc polymetallic ore deposit, investigation of lead and zinc deposit, manganese deposit, copper, iron, lead and zinc deposit, tin polymetallic ore deposit, and other deposits. It also included investigation and assessment of copper, lead, zinc, tin polymetallic ore deposit, and assessment of tungsten and tin polymetallic ore deposit.
20. Geological investigation and mineral assessment in the Qinhang metallogenetic belts

It included the investigation of copper and gold deposit, copper polymetallic ore deposit, copper, gold and tungsten polymetallic ore deposit, silver, lead and zinc deposit. It also included the investigation and assessment of gold and molybdenum polymetallic ore deposit.

2. ENERGY PROGRAMME

2.1. Summary

In 2011, oil and gas resources in China continued to maintain the rapid development, oil proved reserves 1.342 billion tons, natural gas 722.482 billion cubic meters, and crude oil production continues to maintain 203 million tons, natural gas production 101.2 billion cubic meters.

The new proven geological reserves of coal bed methane was 136.733 billion cubic meters, total proven reserves is 417.64 billion cubic meters.

China carried out the potential assessment and favorable areas of national shale gas resource. China's first horizontal wells of shale gas drilled (Wei 201-H1 well) and test gas which demand production.

China carried out onshore and offshore gas hydrate resources exploration and metallogenic theory and distribution prediction research, the exploration technology research and development, drilling and production technology research and development, testing technology and simulation studies, database construction and strategic research supporting research.

By the end of 2011, China built 2.13 million km of crude oil pipelines, refined oil product pipeline 2.04 million km, and over 5 million meters of natural gas pipelines.

In 2011, 8,704 km-long Second West-East Gas Pipeline was completed, it is the first in China to import overseas gas resources from Turkmenistan. Consisting of one trunk and eight branches, it is connected to the Central Asia-China Gas Pipeline at Horgos in Xinjiang Uygur Autonomous Region, and reaches Shanghai in the east and Guangzhou and Hong Kong in the south. Designing 4,978km long, and 1,219mm-thick trunk can transport 30 billion cubic meters of gas per year.

The overseas M & A activity of China's oil companies concentrated in the deepwater and unconventional shale gas field in 2011. Total 127.48 billion RMB (about USD 20.23 billion) were pull in these fields by the Chinese oil companies, and got interests oil production of 68.99 million tons.

In 2011, China carried out the evaluation of conventional oil and gas resources in the Songliao Basin and Liaohe Depression of Bohai Bay Basin, and oil shale resource evaluation in northeastern regions. The first systematic investigation and evaluation of shale gas resources was conducted through investigation and evaluation of the national oil and gas resources strategy constituency.
The management of oil and gas resources is standardized and orderly, and management tools have constantly improved.

2.2. Annual view of technical programmes/activities

2.2.1 Activities of China National Petroleum Corporation (CNPC)

In 2011, CNPC continued to increase its resources, expand the market. The newly added proven oil and gas were 715.12 million tons and 487.9 billion cubic meters.

In 2011, CNPC produced 107.54 million tons of crude and 75.62 billion cubic meters of natural gas at home. In particular, Daqing continued to produce at the 40 million tons and Changqing produced more than 40 million tons. Overseas projects producing more than 100 million tons of oil equivalent in 2011, of which CNPC’s share was more than 50 million tons.

2.2.2 Exploration

In 2011, domestic exploration resulted in newly proven oil and gas in place of 715.12 million tons and 487.9 billion cubic meters, and proven oil and gas reserves exceeded 1 billion tons of oil equivalent. The newly proven reserves were mainly contained in lithostratigraphic reservoirs and low permeability reservoirs that are deeply buried but feature massive scale and producibility. The oil reserve replacement ratio remained above 100%.

2.2.3 Major Discoveries

New breakthroughs were made in major exploration blocks in Sichuan, Bohai Bay, Qaidam, Ordos, Junggar, and Hailaer basins. Gas exploration in Sichuan Basin identified great potential of the Sinian System. Exploration in the deeply buried hills in Bohai Bay Basin showed favorable prospects. In Ordos Basin, the Lower Palaeozoic strata became a new exploration target. Lithologic reservoirs with abundant reserves were discovered in the Jurassic System in Junggar Basin.

In addition, CNPC made a number of major progresses at Jiyuan and Sulige in Ordos Basin, Tazhong and Tabei in Tarim Basin, Chuanzhong Xujiathe formation in Sichuan Basin, Qibeichenghai block in Bohai Bay Basin, north (oil) and south (natural gas) in Songliao Basin, Jimusaer Sag in Junggar Basin, Kunbei in Qaidam Basin, and Fushan Sag in North Bay Basin.

2.2.4 Crude Oil Production

In 2011, domestic oil and gas production of CNPC reached 167.79 million tons of oil equivalent, up 2.8% year-on-year. In particular, natural gas contributed 36% of the company’s total oil and gas production.

In 2011, CNPC produced 107.54 million tons of crude oil in China, 2% higher than the previous year. Despite the challenges of ultra-high water-cut, Daqing continued to produce at an annual level of 40 million tons, of which more than 13 million was attributable to tertiary recovery represented by polymer flooding and ASP flooding. Attributing to the efficient and massive development of low-permeability reservoirs, Changqing produced more than 40 million tons of oil equivalent, with an average increase of more than 5 million tons for each of
the past four years. In particular, 5.5 million tons of oil was produced from ultra-low-permeability reservoirs.

2.2.5 Natural Gas Development

In 2011, CNPC produced 75.62 billion cubic meters of natural gas domestically, 4.3% more than that in 2010. The gas production of Changqing registered another year of rapid growth in 2011 to 25.8 billion cubic meters. Tarim produced more than 17 billion cubic meters of natural gas. Production capacity building projects in Sulige and Gaoqiao was pushed forward. Sulige has become the largest gas field in China.

2.2 Exploration and Development of Unconventional Oil and Gas

CNPC carried out the exploration and development of CBM, shale gas and other unconventional oil and gas resources. It not only expedites the construction of CBM industrial bases, but also promotes shale gas demonstration projects.

2.2.6 CBM

In 2011, CNPC enhanced CBM production capacity building in Qinshui Basin and the eastern edge of Ordos Basin. CNPC newly proved 78.7 billion cubic meters of CBM, built additional 0.35 bcm/a production capacity, and supplied 420 million cubic meters of commercial CBM. CNPC made a breakthrough in the exploration of low-coal-rank CBM with the discovery of the first medium-to-low-coal-rank CBM field of China in the Baode block on the eastern edge of Ordos Basin. Production test has shown that the block is characterized by early gas show, rapid production increase, thick coal seam, good permeability, and high bottom hole pressure.

2.2.7 Shale Gas

In 2011, CNPC accelerated the building of demonstration zones of shale gas industrialization at Weiyuan-Changning in Sichuan and Zhaotong in Yunnan. CNPC drilled four vertical wells and four horizontal ones, and fractured five of them. Well Wei 201-H1 was completed and fractured, maintaining a daily output of 11,500-13,400 cubic meters. In 150 days of gas testing, it outputted 1.77 million cubic meters of natural gas, and became the first completed horizontal well that began to produce shale gas.

2.3 Activities of SINOPEC

In 2011, SINOPEC continued to implement the resource strategy of “stabilizing reserve and production in eastern region, expanding reserve and production in western areas, accelerating exploration and development in southern blocks, pushing forward offshore exploration and development, making breakthrough in unconventional resource development, depending on technologies and building up upstream strength”. Great efforts were made to increase the hydrocarbon reserves and output in Shengli oilfield complex, Ordos Basin, Tarim Basin, Sichuan Basin, and unconventional resources.
In 2011, SINOPEC focused on exploration in key exploration regions and on intensive exploration in mature fields, such as the Northern rim of Junggar Basin, the western depression in Sichuan Basin, the Northern Slope of Tazhong area in Tarim Basin, Songnan frontier in Songliao Basin and Southeast areas offshore Hainan Island. Exploration for unconventional oil and gas has borne initial results.

SINOPEC has also identified regions in which to build production capacity for coal bed methane.

In the development of crude oil, SINOPEC focused on steady production in eastern China and growth of production in western China and actively promoted technological breakthroughs and tests on horizontal drilling and multi-staged fracturing.

In the development of natural gas, SINOPEC focused on gas projects in the Sichuan Basin and the Ordos Basin.

In 2011, SINOPEC made 5 breakthroughs, 9 important progresses and 4 significant discoveries.

The 5 breakthroughs include exploration successes in:
- shallow strata of the Northern rim of Junggar Basin with a potential of adding 50 million tons of oil reserves in-place;
- the middle and shallow strata of the western depression in Sichuan Basin with a potential of adding trillion cubic meters of gas reserves in-place;
- the Silurian of the northern slope of Tazhong block in Tarim Basin with a potential of adding 100 million tons of oil reserves in-place;
- Songnan frontier in Songliao Basin with a potential of adding 100 million tons of oil reserves in-place; and;
- offshore areas with a potential of adding trillion cubic meters of gas reserves in-place;

The 9 important progresses are made in
- Yuanba block in Sichuan Basin with newly-added measured geological gas reserve of 159.2 billion cubic meters;
- matured areas in Jiyang subbasin in Bohaiwan Basin with a potential of adding 3-level reserves (measured geological reserve, indicated geological reserve and inferred geological reserve) of 300 million tons;
- the Ordovician of Tahe area in Tarim Basin with newly-added measured and indicated geological oil reserves of 170 million tons;
- Western Junggar with a potential of adding measured geological reserve of 47.68 million tons, accumulatively adding 67.39 million tons;
- Southern area in Ordos Basin with a potential of adding a 3-level reserve of 160 million tons;
- Hangjinqi block in Ordos Basin with a potential of adding measured and indicated geological gas reserve of 81.2 billion cubic meters;
- the Ordovician of Yubei block in Tarim Basin with great reserve growth potential;
- Qingdong depression in Bohaiwan Basin with a potential of forming a base for reserve growth, and
- the exploration of unconventional oil and gas with key shale oil and gas blocks and coalbed methane pilot production areas.
The 4 significant oil and gas discoveries are made in
- Wujiaoping Formation of the Permian in Yuanba block in Sichuan Basin;
- marine formation of the Paleozoic in the Lower Yangtze region;
- Triassic of the Luoyi Basin in the south of Northern China and
- Archaeozoic of the Jiyang subasin in Bohaiwan Basin.

In 2011, by implementing delicacy management in its oil field development, SINOPEC operated smoothly according to its annual production plan and achieved positive results in its reservoir evaluation and production capacity building. SINOPEC took full advantage of the oil and gas development technologies to support the production capacity building of its new production zones. The application of matured development technologies and the efforts exerted in practical technology research ensured the quality of its production capacity building for new zones.

The thermal recovery was adopted to accelerate the integration of heavy oil production capacity, enhance the application of engineering technologies in reservoirs and realize the different development of low-permeability reservoirs. Fine characterization of fractured vuggy reservoirs was further strengthened to enhance production capacity building.

SINOPEC also focused on the application of mature production technologies and integration technology innovation to enhance the recovery factor of matured oil fields. SINOPEC studied the distribution of remaining oil in different types of reservoirs and drew up plans for future development. SINOPEC stressed on the research of tight-oil development technologies and achieved initial progress in resource replacement. It carried out basic studies and research for developing tight oil, including geology requirements for well selection, staged fracturing and horizontal well drilling. These work greatly supported the experiments on tight-oil development by laying down a sound foundation for experimental well drillings.

In 2011, SINOPEC completed 2D seismic measurements of 18,583 kilometers and 3D seismic measurement of 11,361 square kilometers and drilled exploration wells with a total footage of 21,741 kilometers in 2011. Proved reserves of oil and gas increased by 411 million barrels of oil equivalent for the year. In 2011, SINOPEC produced 408 million barrels of oil and gas equivalent, and produced 303 million barrels of crude and 517.07 billion cubic meters of natural gas in China.

2.4 Activities of China National Offshore Oil Corporation (CNOOC)

In 2011, CNOOC had net proved reserves of 3.19 billion BOE, including approximately 0.27 billion BOE, and total net oil and gas production of 909,000 BOE per day, including 49,270 BOE per day.

In 2011, CNOOC continued its efforts in exploration and achieved a high record in the amount of investments in exploration, drilling and 3D seismic data collection work. CNOOC’s exploration work has produced fruitful results with a reserve replacement ratio reaching 158%.

In 2011, CNOOC’s exploration made an aggregate of 13 new discoveries and successfully appraised 18 oil and gas structures in offshore China. CNOOC also achieved remarkable results of 3 new discoveries and 2 successfully appraised oil and gas structures overseas.
In 2011, new discoveries were made in core areas mainly included Kenli 9-1, Bozhong 34-3 and Bozhong 34-4 in Bohai as well as Weizhou 12-1S and Weizhou 11-7N in Western South China Sea.

To ensure resource replacement, CNOOC conducted exploration in core areas while continuing to explore new areas and new exploration targets. Regarding exploration activities in new areas and new exploration targets, CNOOC strengthened regional research and basic research activities in 2011. CNOOC mainly focused on certain key technologies, and achieved major breakthroughs in new areas such as shallow lithologic traps with large coverage and high-temperature and high-pressure natural gas. First, drilling works were carried out in Bohai around the Shijiutuo uplift area and lithologic trap structures with successful appraisals for Qinhuangdao 33-2 and Qinhuangdao 33-3, further expanded the scale of this type of oil and gas reservoirs. Secondly, the drilling works of Panyu 10-4W oil and gas structures in Eastern South China Sea revealed significant potential from the shallow formation of the Pearl River Basin. Thirdly, the Dongfang 13-1 middle formation of Yinggehai Basin in Western South China Sea was successfully appraised and resulted in higher trial production. The breakthrough in high-temperature and high-pressure natural gas, in particular, is expected to bring a new chapter of exploration of natural gas to the area. Fourthly, fracturing tests were conducted successfully in the gas reservoir which has low porosity and permeability in East China Sea, creating opportunities for oil and gas reservoirs with low porosity and permeability by bringing a new age of exploration to the area. These achievements have demonstrated the potentials in offshore China and serve as examples for future exploration work in the area. After getting a better understanding of the geological structure in offshore China, CNOOC expects the area to continue to be a major source for its sustainable growth in the future.

In 2011, through carrying out the research on reservoirs, refining water flooding, and enhancing the hourly production rate from oil and gas fields, CNOOC has been able to maintain a steady growth of oil and gas production from the producing fields, realizing a net production of 331.8 million BOE.

In 2011, CNOOC focused on moving ahead with the Lufeng 13-2 adjustment project. The project commenced production at the end of 2011 with a daily peak production volume of 33 thousand BOE. Working with full steam on the regional development model, Weizhou 6-9/6-10 oil fields expected to begin production in 2012.

CNOOC had a heavy-loaded engineering construction program with over 10 new projects under construction in 2011, major projects expected to commence production in 2012 include Panyu 4-2/5-1 adjustment project, Weizhou 6-9/6-10, Yacheng 13-4 and Liuhua 4-1. Other new projects under construction, including Suizhong 36-1 phase II adjustment and Kenli 3-2 regional development, are expected to commence production after 2012.
In 2011, facing with unprecedented challenges in development and production, CNOOC focused on the following areas to offset the production shortfall and accomplished its adjusted annual production target: (1) fully maximizing the production capacity of producing oil and gas fields (2) managing the production of new projects. (3) actively responding to emergencies and collaborating with various parties. (4) minimizing the impact of typhoons. In 2011, CNOOC’s net oil and gas production amounted to 331.8 million BOE.

Overseas development, operations are mainly in Asia, Africa, Oceania, North America and South America. CNOOC has shifted from the traditional oil and gas resources to unconventional oil and gas resources such as shale oil and gas as well as oil sands. Overseas reserves, production and oil and gas sales revenue account for 28.6%, 21.1% and 13.7% of CNOOC’s total reserves, production and oil and gas sales revenue, respectively. In 2011, CNOOC’s overseas development achieved the following: First, expansion of the shale oil and gas business in the U.S. Secondly, expansion of the oil sands business in Canada. Thirdly, tapping into the Alberta Basin, a major basin to be developed in East Africa.

In 2011, CNOOC continued to focus on the R&D of exploration, development and engineering of offshore oil and gas to secure stable growth in reserves and production.

CNOOC has established a number of major projects on key technologies in 2011, mainly focusing on major technology aspects including: new areas and technologies for offshore oil exploration, efficient development and enhancement of oil recovery of offshore oilfield, deepwater oilfield development projects and exploration and development for low porosity and low permeability oil and gas fields.

To provide strong technical support for new discoveries of oil and gas reserves and to maintain and increase oil and gas production, CNOOC increased the research and application of its exploration development technology in 2011. By using the new technology combined with exploration, drilling and testing, CNOOC successfully conducted drilling at the Bozhong 21-2-1 wildcat, the deepest exploratory well in Bohai, at a depth of 5,141 meters with the discovery of natural gas, which substantially expanded the exploration territory of Buried Hill Structure in Bohai. Oil pipeline acidizing technology was first applied to the horizontal wells in the Bohai oilfield, which effectively reduced pollution and improved the production capacity. In the Suizhong 36-1 oilfield, blockage removal technology for horizontal wells has been successfully applied to six production wells, enhancing the osmotic pressure of oil pay with increased yield.

2.5 Coalbed methane activities in China
2.5.1 Activities of China United Coalbed Methane Corporation (CUCBMC)

CUCBMC is a state-operated enterprise which specialized in exploring, developing, utilizing coalbed methane. In 2011, CUCBMC ran 12 exploration projects, which are mainly distribute in Shouyang, Panzhuang, South, North Shizhuang, Qinyuan, Daning, Liulin, Linxing CBM block in Shanxi province, Suzhou and East Panxie CBM block in Anhui province, Enhong CBM block in Yunnan province, Fengcheng CBM block in Jiangxi province. CUCBMC have accomplished the two-dimensional earthquake for about 700 kilometers, 165 vertical wells and a pair of horizontal well, and submitted the proved reserves of 58 billion cubic meters. Also CUCBMC ran 5 developing projects, have finished 750 vertical wells, 8 pairs of horizontal wells, and built flow pipelines for 560 wells and gas transmission pipelines for 17.36 kilometers. In 2011, CUCBMC has made a total production of 400 million cubic meters.
As a national corporation of coalbed methane industry in China, CUCBM is the sponsor and the initiator of “Large Oil-gas Field and Coalbed Methane Developing Special Project” which belongs to “National Science & Technology Major Project, China”. CUCBM is carrying out four programs which are “Gathering-delivering and Monitoring Techniques Research in CBM Field”, “CBM developing Technology research and Equipment development in the Deep Coal Seam”, “CBM Vertical Well Developing Demonstration Project in Southern Qinshui Basin”, “CBM Developing Demonstration Project in the Eastern Margin of Erdos Basin”.

In 2011, CUCBM has accomplished research of the skid-mounted liquefaction equipment with the capacity of 15,000 cubic meters per day and the high efficient dust-removing and water-removing equipment, also acquired the new-type CBM gathering-delivering technique with “Multipoint Access and Flexible Gathering Technique”, CBM nitrogen foam fracturing technology, Double-step horizontal well developing CBM technology, CBM Water-power deep penetrating technology, and also applied the new-type clean fracture fluid in production field. All of the new technologies have promoted the efficiently developing CBM in China.

Up to 2011, CUCBM owns 1,900 wells in total, with proved reserves of 107 billion cubic meters and 1,100 million cubic meters of production capacity per year. By the end of 2015, the proved reserves will reach to 300 billion cubic meters, production capacity will exceeds 5 billion cubic meters per year, and production will be over 4 billion cubic meters per year.

3. GROUNDWATER PROGRAMME

3.1 Summary

In 2011, several hydro-geological projects had been carried out, including the groundwater dynamic investigation and evaluation on main plains/basins in North China, groundwater investigation and safety water supply demonstration in the drought and water-shortage areas as well as endemic areas, groundwater investigation, evaluation and survey in the karst areas of Southwest China, groundwater contamination investigation, evaluation and control, as well as investigation and evaluation on geothermal resources throughout the country.

3.2 Annual Review of Groundwater Activities

3.2.1 Groundwater dynamic investigation and evaluation of main plains/basins in North China

In order to further advance the investigation and evaluation on groundwater dynamic, more than 30 new main regional sections of groundwater automatic monitoring sites were established at the seven main plains/basins in 2011, such as North China Plain, Songneng Plain, Lower Liaohe Plain, Ordos Basin, Yinchuan Plain, Gansu Corridor and Junggar Basin. The investigation and evaluation systems on groundwater dynamic of all plains/basins had been further completed. Since the implementation from 2006, 1:100,000 hydro-geological investigation with 130,000 km² and regional hydrogeology drilling with 33,000 meters had been completed totally; 52 main monitoring sections of regional groundwater with the monitoring area of 670,000 km² had been established; 824 automatic monitoring wells were newly established or recovered. This work will provide an important basis of the monitoring and protection for groundwater contamination and geological environment.
3.2.2 Groundwater investigation and safety water supply demonstration in the drought and water-shortage areas as well as endemic areas

The groundwater investigation and safety water supply demonstration in the endemic areas were carried out by China Geology Survey (CGS) in 2011, including Datong Basin, Hetao Basin, Yinchuan Plain and Sichuan province. The demonstrations on Kaschin-Beck Disease area in Sichuan province had been implemented through the signatures with Ministry of Land and Resources and Sichuan Provincial People's Government in 2008 to solve the drinking safety problems in long-term for the people in Kaschin-Beck Disease area of Aba county. Within three and a half years, total 658 water supply wells were drilled successfully to solve the drinking safety problems for 160,000 Tibetan compatriots in the 27 Kaschin-Beck Disease counties of Sichuan province.

From 2011’s winter to 2012’s spring, some areas of Shandong, Henan, Hebei and Shanxi provinces in China encountered the extreme dry conditions. The Chinese government organized 17 geological survey units to overfulfil their emergency missions of the drilling well for anti-drought in the four above-mentioned provinces. Nearly 10,000 people and more than 1,000 geophysical prospecting and drilling equipments are involved in the activities for the period of more than 70 days. Total 2,349 exploratory boreholes with 333,000 meters and 111% completion rate had been drilled within the working area of 200,000 m², and completed 2,227 wells with 94.7% average well completion percent, and the total water yield reached to 1,165,000m³/day. These water wells solved the problems for the drinking water of more than 2.2 million people and irrigating water of 500,000 acres farmland, and also provided safety guarantee of domestic water in long time for the people in the water-shortage areas.

3.2.3 Karst water evaluation, survey and exploration in Southwest China

1:50,000 hydro-geological surveys with the area of nearly 50,000 km² in 10 typical karst watersheds had been finished by the Project of hydro-geological, environmental geological surveys in the karst areas of Southwest China. Since 2003, total 1:50,000 hydro-geological surveys with the area of 200,000 km² in 89 typical karst watersheds had been completed. Many karst groundwater demonstration projects were established to solve the drinking water problems for more than 1 million people and 500,000 acres of farmland irrigation.

3.2.4 Investigation, assessment and control of groundwater contamination

The investigation and assessment of groundwater contamination in eastern China Plain had been carried out by China Geological Survey(CGS) since 2006. Groundwater evaluation results show that trace organic compounds and heavy metals can be detected in groundwater in Yangtze River Delta and Pearl River Delta, etc., but the detectable rate is low.

The database for groundwater contamination investigation in the main eastern China Plains with total 37 various examination tables, 140,641 record numbers had been established, including original material database and comprehensive results database for the groundwater contamination investigation of North China Plain, Yangtze River Delta region, Huaihe River Basin and Pearl River Delta region. In which, including 4,159,018 effective data items in total, 174 digital results diagrams and 181 single-factor layers.
The contaminated groundwater is difficult to be remediated. In order to protect the valuable groundwater resources, the State Council issued National Contamination Groundwater Prevention Plan in October 2011. According to the Plan, China will invest $5.48 billion to protect and treat the groundwater from 2011 to 2020.

3.2.5 Evaluation and assessment of national geothermal resources

The “Requirements on Evaluation Technology on Shallow Geothermal Energy Investigation” and corresponding technical training as well as report on “Assessment of Nationwide Geothermal Resources Potential” were made by China Geological Survey. For the evaluation of shallow geothermal energy investigation of key cities and the high-temperature geothermal resources investigation along the Qinghai-Tibet Railways, the 1:50,000 hydro-geological mapping with 10,578 km², 1:50,000 hydro-geochemical survey with 341 km² and hydro-geological drilling with 81,913m had been completed. For the evaluation of shallow geothermal energy investigation, the on-site thermal response test, pumping and recharging test as well as geotechnical physical and thermo-physical tests had been carried out in different degrees in 29 cities.

GEO-ENVIRONMENT SECTOR

4. GEO-HAZARDS PROGRAMME

4.1 Summary

12 geo-hazards projects and 35 work projects were totally arranged in 2011 with the funds of RMB128 million therein.

4.2 Annual Review of Groundwater Activities

4.2.1 National geo-hazards investigation and comprehensive study

By the comprehensive summarization for the results of geo-hazards investigation, the Regulations for Landslide, Collapse and Mudslides Disaster Investigation, Regulations for Geo-hazards Exploration in Key Towns and Regulations for Geo-hazards Investigation had been compiled and completed so as to provide basis for the successful implementation of special plans.

The informatization for the details of geo-hazards investigation of 115 counties, and the fast query and statistical analysis for the information and work results of geo-hazards were realized, so as to provide strong supports for the compilation of national geo-hazards prevention plan and regional geo-hazards prevention and mitigation in the Twelfth Five-Year Plan.

By the systematical summarization for the investigation and research results on ground subsidence and ground fissures, the reports on prevention and control situation of national ground subsidence had been compiled and completed, and the “The Third National Ground Subsidence Control Academic Forum” were hosted to significantly improve the ground subsidence prevention and control level of China.
The 1:50,000 geo-hazards investigation in seven counties such as Qinan, Yi County and so on had been completed with the investigating areas of about 5,000 square kilometers. The integration for the details of the geo-hazards investigation had been completed in Yan'an city, Baoji city and Qingjiang River Basin to deeply understood the development characteristics of geo-hazards.

4.2.2 Investigation and evaluation of earth crust stability in major national engineering areas

The geostress survey and real-time monitoring of ground stress for the 600m deep hole system had been carried out in the southeast of Beijing and Pingdu city, Shandong. And two micro-seismic monitoring stations were arranged in Beijing Huangzhuang - Gaoliying fault zone and Sunhe - Nankou fault zone for the first time.

4.2.3 Geo-hazards monitoring and early warning

4.2.3.1 Demonstration on geo-hazards monitoring and early warning in Ailaoshan region

The main works were to carry out the research on the early warning model of the point-like maximum potential degree, field supplementary investigation in the point with recent geo-hazards, inspection and maintenance of geo-hazards monitoring instrument and the maintenance of rain gauge for the geo-hazards. The meteorological early warning of geo-hazards in the flood season and the early warning system and information distribution system, as well as the real-time monitoring work, etc had been carried out. 5 landslide disaster points with the installation of various types of 96 landslide monitors were selected; the installation of 35 automatic telemetering pluviograph had been completed; a set of GIS-based regional rainfall type of early warning and analysis system for landslide and debris flow had been researched and developed, and an early warning and forecasting model had been established to realize the meteorological early warning and forecasting services for the geo-hazards of regional statistical theory and regional dynamics theory.

4.2.3.2 Demonstration for geo-hazards monitoring and early warning in Yaan region

The main works were to carry out the research on the early warning model for the landslide induced by earthquake and the formation mechanism of typical landslide induced by rainfall, the meteorological early warning of geo-hazards in the flood season, the improvement of early warning system and information distribution system, and the real-time monitoring work, etc.

4.2.3.3 Geo-hazards monitoring and early warning in Yan'an city

The main works were to carry out the research on the criterion of regional rainfall, inspection and maintenance for the geo-hazards monitoring instrument in Baota region, and the operation for the geo-hazards monitoring and early warning system in Baota region. The research on rainfall threshold that can resulted in loess slump had been carried out in Yan'an region, and the loess slump disasters induced by rainfall infiltration were researched respectively according to three modes, i.e. the loess slump disaster induced by slow infiltration, loess slump disaster induced by infiltration block, and loess slump disaster induced by infiltration through.
4.2.3.4 Geo-hazards monitoring and early warning in Fengjie county

The main works were to carry out the inspection and maintenance for the urban geo-hazards monitoring instrument, complete the construction tasks of 55 GPS monitoring points, and establish the monitoring network of 5 landslide points.

4.2.3.5 Research and development and demonstration of monitoring techniques for the prevention operated by mass people of geo-hazards

The transmission station of geo-hazards monitoring and early warning, satellite monitoring and warning system, geo-hazards multi-functional alarm, acoustic warning device of debris flow and protective screen warning system of collapse debris flow had been developed and assembled; More than 20,000 units monitoring and warning equipment were produced; The application demonstration on monitoring techniques for the prevention operated by mass people of geo-hazards had been carried out in Sichuan and Yunnan to establish early warning mechanism and management and operation mode; The early warning information distribution and management system for the prevention operated by mass people of geo-hazards had been established and improved in Zhaotong city. Moreover, the knowledge propaganda website on monitoring and warning techniques for the prevention operated by mass people of geo-hazards had been established.

5. ENVIRONMENT GEOLOGY PROGRAMME

5.1 Summary

In 2011, China collected the previous geological investigation data within the working area in the five main coastal economic zones, i.e. Bohai Economic Rim, Yangtze River Delta, Pearl River Delta, Western Taiwan Straits Economic Zone and Beibu Gulf, and the urban agglomeration in the middle reach of the Yangtze River, the compilation of 1: 250,000 geological environment series map of bedrock geology, Quaternary geology, hydrogeology, engineering geology and environmental geology had been completed through combining with the field investigation work. And the proposals on strategy were presented by the analysis of major geological environmental problems to provide geological basis for the regional economic and social development plan.

5.2. Annual Review of Activities

5.2.1 Environmental geological investigation and evaluation of important economic zones and urban agglomeration

The positive results of the specific investigation for the active fault, coastal erosion deposition, karst collapse and other major environmental geological problems had been obtained through the 1:50,000 environmental geological investigation in the Caofeidian, Binhai New Area of Tianjin and other key areas. For example, the investigation of Circum-Bohai Sea Economic Zone provided important basis for the addressing of international ecological town, seawall design, and construction of coastal highways. The investigation for the urban agglomeration in the Western Taiwan Straits Economic Zone and the middle reach of the Yangtze River provided fundamental data for the planning and construction of comprehensive experimental zone in Fuzhou, ground subsidence in Wuhan, prevention and
control of Changsha-Zhuzhou-Xiangtan soil and water contamination, and the emergency water supply in Poyang Lake Economic Zone.

Focused on the promotion for the geological investigation of eight cities such as Chongqing, Fuzhou, Xiamen, Tangshan and so on through combining with the geological investigation of 1:50,000 hydrogeology, engineering geology and environmental geology in key areas. The construction pilots for the three-dimensional geological environmental information system of Wuhan Metropolitan Area and Caofeidian Industrial Zone was completed, thus it provides a technical support platform for the realization of cluster industrialization of the geological data information services. The construction of geological environmental information system in the pilot area of Wuhan Metropolitan Area was completed, a three-dimensional geological model was established with an automatic modeling method. The pilot work for the information system construction of Caofeidian Industrial Zone was completed and the pilot work at science and technology demonstration hall was carried out in the Caofeidian Industrial Zone. At the same time, application of information system in the implementation of the project provides direct technical support for the project.

5. 3 Study on geological investigation for climate change

5.3.1 Evaluation and assessment of national geothermal resources.

The potential estimation for the shallow geothermal energy resources of China was completed, specifically the shallow geothermal energy resources of China are equivalent to 9.5 billion tons of standard coal, the annually available resources are equivalent to 350 million tons of standard coal, and therefore 650 million tons of carbon dioxide emission can be reduced in case of full utilization. According to the evaluation of shallow geothermal energy resources of Tianjin and the work experience in the development and utilization pilot, the evaluation of national shallow geothermal energy resources was completely started in 29 capital cities, and the field work for the evaluation of shallow geothermal energy resources was basically completed in 12 capital cities started in the first batch.

5.3.2 Evaluation and demonstration projects of national carbon dioxide geological storage potential.

The carbon dioxide geological storage potential in deep saline formations, oil fields, gas fields and CBM fields in China, and the atlas for the evaluation on potential and suitability of carbon dioxide geological storage of 165 sedimentary basins was basically compiled. The construction for the demonstration project of Erdos carbon dioxide geological storage was completed by cooperating with Shenhua Group with the safe injection of more than 10,000 tons carbon dioxide, the monitoring system for the migration and escape of carbon dioxide was primarily established to provide demonstration experience for the implementation of carbon dioxide geological storage in China.

5.3.3 Evaluation of nationwide geological carbon sequestration potential.

The total annual karst carbon sequestration with 37 million tons in China were recalculated through the field investigation and monitoring of four types of areas, i.e. the southern karst area, northern karst area, Qinghai-Tibet Plateau karst area and Buried karst area in China, so as to more scientifically and comprehensively reflected the distribution of carbon sequestration in the current karst areas of China. The study on carbon sequestration shown
that the weathering basalt in China had a large potential of carbon sequestration, which can be in line with the level of karst carbon sequestration; and the experimental study found a microbial technology which can significantly accelerate the carbon sequestration of ultrabasic rock tailings, and therefore the technical and economic feasibility for the carbon sequestration of tailings was improved.

5.3.5 Study on geological record of ancient climate changes.

A breakthrough was obtained in the study on high-resolution geological records of ancient climate changes. The time series for the high-resolution monsoon climate change since 1200 years was established according to the stalagmite records, and revealed two times of the drought and cold events of century scale. The sporopollen environmental records with the resolution of 50a for the peat since 2000 was obtained in Miaoning, Sichuan Province in the eastern edge of the Qinghai-Tibet Plateau.

GEO-INFORMATION SECTOR

6. GEO-DATA AND INFORMATION MANAGEMENT PROGRAMME

6.1 Summary

The main objective and task in geo-information work at China Geological Survey (CGS) in 2011 and 2012 are as follows: Pushing forward the ongoing geo-information resource accumulation, enhancing the solid base for geo-information service, and integrating all kinds of geo-information resources with the national geo-database system and to complete the core database of national land and resources in “one map”. Setting up national geo-archive and geo-data service system together with data updating and system maintenance and, producing a series of geo-information products to meet the needs of the country. Upgrading information technology application level, and to realize main procedure informationization of both geological survey and geo-information service in cluster.

6.2. Annual Review of Activities

6.2.1 Geo-information and service

Geo-information work at CGS in 2011 and 2012 has made big progress in capacity building for geo-informatization in the whole procedure of geological survey and national geo-database development, database updating and maintenance. Main achievements are as the followings.

6.2.2 Optimization of general platform of digital geological survey system

Functions of the general base platform of digital geological survey system in CGS has been expanded and optimized. Research on 3-D and multi-dimension geological modeling has also been carried out. Multi-dimension geo-spatial data model and interoperability scheme have been put forward. The swap file layout has been defined and test of multi-dimension geological modeling has been launched.
6.2.3 Geological survey information grid

Geological survey information grid (GSI-GRID) platform has been developed which consist of 17 distributed nodes based on GRID and Cloud GIS and other leading information technology. The platform is the biggest geo-grid of China and can be used to integrate management of mass and heterogeneous spatial data and provide national public geological information services.

6.2.4 Informatization of national geological survey work deployment

CGS Office System has been optimizing and expanded application in several regional centers. Project management system, work deployment assistant system and remote monitoring and control system for field work safety have made stage progress and put in application. The technical framework consisting of service, work deploy, production monitoring and schedule control has been set up and has already promoted cooperation and sharing ability to geo-spatial information within CGS.

6.2.5 Geo-environment early warning system

The general design of functions, system architecture, and security mechanism and so on of geo-environment warning system has been completed. Some modules of data processing have been developed, such as frequency of geo-disaster, rainfall and warning result diagnoses. Test service node has been set up.

6.3. Real time transmission system

Light real time transmission system which is suitable for geological survey has been developed and launched. The system has the ability to transfer video, audio and data to the backbone network of China Geological Survey. The pilot of management service and safety guarantee system for geological survey based on Beidou satellite and IP satellite technology has been done. The system for either truck-based or portable use has been optimized in application.

6.4 Application study on information technology utilization in geological survey

Some key and advanced information technology have been studied for possible application in geological survey, such as Internet of Things for geological survey and achievements management, digital watermarking for intellectual property management, work flow for geological work deployment, 3D grid for geo-earth and so on. A series of tool systems have been developed.

6.5 National geo-database development, updating and maintenance

6.5.1 National geo-database

Development of digital 1:50000 geological map database is still on-going, and 360 sheets digitized, coordinated and put into database in 2011 with a achievement of the total 3079 sheets finished by the end of 2011. National spatial data base of 1:250000 geological maps has been finished which consists of 375 sheets of newly mapped data in which there are 122 sheets in Tibetan plateau. 30079 sheets from 33 measuring areas of aerial images have been...
scanned and the quantity has reached 11TB. Several national databases have been updated, such as work index database, mineral deposits and ore field database, geo-information metadata database and work deployment database of geological survey. A framework of integrated management for the geo-databases has been design.

6.5.2 Core specimen collecting and geological drill-hole database

Some 20 kilometers important core specimens have been collected and scanned in database in 2011. A investigation covered 1219 work units for drill hole information and achieves has been done and around 600000 drill hole has checked up, which has laid a solid information basement for national geological drill hole database development. A trial drill-hole database has also been carried out and about 200 000 meters geological drill data has been collected.

7.2.3 Geo-archive digitalization and geo-literature database

10,000 volumes of geo-archive and 25,000 volumes of geo-literature have been digitalized. The total amounts of digital geo-archive and geo-literature have reached more than 60 000 and 70 000 volumes respectively, which have enhance the ability further of digital and networking service.

6.5.3 National Geo-information service

Integration of national geo-databases and digital geo-archives has been continuously carried out in environmental geology, marine geology, aero-geophysics, underground water, exploration techniques, geo-scientific researches, geo-literatures, geological specimens and so on, In order to insure a steady servicer and digital geo-information production release. Some service-cluster have been built up for test in several provincial organizations and some organizations under the CGS, in which key techniques such as data and information sharing, big data transformation, 3D visualization, etc. have been tested for suitability and reliability. Geo-archive catalogues in China Geological Survey for the services is also cleared up.

6.5.4 Cooperation between CGS and CCOP

China has provided solid support through CGS for CCOP in the field of geo-information especially in the training of CCOP geo-information metadata standard and web-based data managing software CCOP-GIMS, both in Malaysia and Cambodia and also daily software system maintenance in the past 12 months.

CGS has launched a project on Integrated Geophysical Data Processing (IGDP) for CCOP this year as planned, in order to enhance ability building in the field of geo-data management and processing. Software modification and translation into English has been done and user manual is also ready. A training course before the end of this year will be held in China for CCOP and also ASEAN countries.

CGS has also finished the design of an office automation system for CCOP Technical Secretariat as asked, and will start the building up work next year.