Member Country Report of CHINA

Submitted by

Chinese Delegation

(For Agenda Item 3)
1. OUTREACH

1.1. Summary

Along with the industrialization, informationization, urbanization and agricultural modernization of China, geological work deployment and main targets of China in 2018-2019 has focused on the security of national energy, mineral, water and other strategic resources, ecological civilization, geohazards prevention and mitigation, natural resources management, and the Belt and Road Initiative. Geological Survey (CGS) promoted the reform of regional geological survey with overall consideration of land and sea and with technique innovation. And a series of important original achievements, and breakthrough have been made in energy resources survey, ecological development, modernization of marine geological survey, geoscience information release with new technology and international cooperation and data and knowledge sharing.

1.2. Annual Review of Individual Technical Activities

1.2.1 Progress on Basic Geological Survey

Reform of regional survey by taking various measures, and achieving remarkable results has been promoted since 2018 in CGS, and marine geological survey has also been strengthening and research capability’s been improved.

(1) At the sector of basic geological mapping, national 1:1000,000 regional geological survey of land and sea areas have been fully covered, the national 1:250,000, 1:200,000 regional geological survey of land areas have been nearly accomplished full coverage, the national 1:250,000 regional geological survey of sea areas have been covered 2.25×105 km2, the national 1:50,000 regional geological survey have been accomplished 44% of the onshore areas. Understanding of basic geology has been further improved.

(2) On the promotion of innovation of the Earth System Science, four key issues as geological background and condition, deep earth constrains on natural resources, surface action and multi-circle and system evolution and resource-environment effects were aimed and major work has been deployed.

For targeting geological background survey of natural resources, survey work conducted over six geological and geomorphological units. For example, the basin-mountain unit in western China for energy and mineral resources, and eastern plain and mountain series unit for regional development strategy and ecological civilization, geological measures are mainly the collection of geophysical and geochemical remote data and identification of
the composition, structure and evolution of the crust surface, and solution to the key problems restricting natural resources and ecological environment.

For targeting investigation of deep constraints on natural resources, four resource and energy bases are drafted. They are northwest basin-mountain junction zone, Songliao basin and its peripheral areas, Gangdise-Himalaya and south China. Main tasks on these bases are to reveal the crustal structure and attributes of important orogenic belts and basins, and to establish a deep geological framework and deep processes in the mainland of China.

Three typical and key geological corridors are targeted for surface action and systematic evolution, including Yellow River and Yangtze River corridor belts and eastern Paleo-climate corridor belt. Geological survey tasks have been to identify the surface processes in typical areas and to establish the tectonic framework, sedimentary filling process and environmental evolution response of the late Cenozoic in mainland China.

Basic geological survey of multi-circle synergistic evolution has also conducted with establishment of digital earth with big data as the core of geosciences, construction of geological framework in different scales, and evolution of earth system during the reconstruction of geo-history

(3) Construction of a modern regional survey technical method and standard system to improve the efficiency and ability of field mapping. These includes Technical Requirements for Regional Geological Survey (1:50 000) (DD2019-01), and Guidelines for Mapping Methods of Different Geological and Geomorphological Areas.

(4) Science and technical innovation supporting surveys have been focused on new stratigraphic hydrocarbon in northern new area, southern China shale gas and geothermal field in north China.

Innovation of basic geoscience theory in 2018 has achieved a batch of original theoretical understandings in 2018. The distribution and age of the oldest rocks in North China Craton are determined, and the age and evolution of the oldest continents in China are determined. And it is proposed that the initiation time of Yangtze block is consistent with the global plate tectonic. Great changes in environment and biology have been discovered and recognized in the process of earth evolution.

While in new stratigraphic hydrocarbon in northern new areas, five basins with different basement properties in Xingmeng orogenic belt are divided. The sedimentary systems and assemblages of basins with different basement types, the development and preservation conditions of source rocks are different. And the basement properties of carboniferous-Permian basins in the Central Asian orogenic belt and its adjacent areas can be divided into five types: Precambrian block, early Paleozoic-Devonian island arc, early Paleozoic-Devonian accretion wedge, residual ocean and complex basement.

For southern China shale gas, the gas-bearing regularity of the graptolite belt is determined, the favorable facies zones for the development of high-quality shale are delicately divided, and a new understanding of the northward migration of the foreland uplift area is put forward, which controls the northward migration of the favorable facies
zones for shale gas exploration and provides a geological basis for the exploration and deployment of shale gas.

And the study of bedrock and Neo-tectonic activities for geothermal field in north China is focusing on solving the problems of geothermal reservoirs and occurrence conditions. Geological maps of bedrock and the division maps of Cenozoic tectonic units in North China Plain are compiled to highlight the thermal reservoirs such as Wumishan and Majiagou Formations, providing basic support for confirming the target layers for deep geothermal resources exploration.

(5) Marine geological series map of China Seas based on 1:1 million measured data have been compiled, and a number of original achievements have been obtained.

Supporting the determination of the strata system of Mesozoic-Cenozoic at east China and adjacent areas, a unified integrated stratigraphic division of land and sea was carried out which were divided into three mega-stratigraphic regions, eight stratigraphic regions and twelve sub-stratigraphic zones.

Geotectonic framework of east Asian continental margin maybe reshaped with the new understanding of geological units and characteristics, faults, magmatism, thickness of continental and oceanic crust.

Supporting oil and gas prospect, 3D synthetic marine survey technologies are developed, especially in aero geophysical survey, hydrological and hydrodynamic survey, marine geophysical survey. And cross profile for China seas has been constructed and the geotectonic framework was established with integrated interpretation technology for gravity-magnetism-seismic.

Supporting the "Blue Land" ecological civilization, evolutionary models for different river delta since the Holocene has been established, and heavy metal pollution level in five estuaries haves been evaluated.

(6) Geological survey for Poverty Alleviation. Totally 498 relevant geological maps have been compiled in southern Jiangxi, including 112 high magnetic anomalies and 201 geochemical anomalies, 21 new metal ore (chemical) sites, 22 non-metallic ore sites and 3 energy minerals, and 5 new fossil sites, providing basic geological information for the poverty alleviation areas in southern Jiangxi.

1.2.2 Progress on Mineral Resource Survey

Major breakthrough of survey on shale gas in the Yangtze river economic belt, shale oil survey in Songliao basin were made and major progress of oil and gas survey in new stratigraphic units in the green field in north China. In the mineral sector, new progress on survey of bulk and scarce ccommodities and strategic mineral resources were also achieved. Reform and transformation of technical standards upgrade has advanced much as well.

(1) New progress has been achieved on survey of oil and gas resources since 2018 by CGS include survey on shale gas in the Yangtze river economic belt, shale oil survey in
CGS continuously conducted shale gas survey to develop new pattern of exploitation of shale gas along the Yangtze river economic belt, which was extended from the upper region to the middle and lower regions of the Yangtze river.

At the upper Yangtze region, Anye No.1 well in Zunyi, Guizhou province, yields stable and productive industrial gas > 100,000 cubic meters daily, leading to historic transition from traditional basin-focused exploration to orogenic belt-oriented exploration. And new discoveries of shale gas from Yunyongdi No.1 well, Qiandongdi No.3 well, and Xingfu No.1 well.

At the middle Yangtze region, great potential of exploration, providing basis for shale gas exploration in the middle-lower Yangtze river economic belt. Three strata in the Yichang region have obtained high productive shale gas flow, marking a breakthrough of the survey of shale gas. Estimation of geological reservation of 116.8 billion m$^3$, supporting construction basis of 10 billion m$^3$ annual production.

At the lower Yangtze region, discovery has been made in shale gas, tight gas, coal bed methane, and shale oil in Permian marine-continental transitional facies in well Gangdi 1, Xuanchen, Anhui province.

In survey of new stratigraphic units in the green field in north China, CGS has Identified 15 favorable oil and gas prospects in new stratigraphic units and new regions as the strategically primary target for the next step. Oil and gas flow obtained in the new region of Yin’e, Qaidam, and Junggar basins. And with the utilization of two-dimensional seismic join processing technique, oil-gas survey made progress in deep level in the Tarim basin.

(2) There are some 10 new and significant progress on survey of bulk and scarce commodities in China 2018, including surveys of potash deposit, major exploration breakthrough of Mn mineralization in south China series(Tongren, Guizhou province), discovery in new region and new stratigraphic units in the Maerkansu Mn deposit in Xijiang, exploration breakthrough of Chengkou Mn deposit in Chongqing, important progress in the deep part of Weilasituo Li-Sn polymetallic deposit in Inner Mongolia, discovery of Xiaolonghe Sn deposit and phosphorite mineralization in Dianxiogn region of Yunnan province, new discoveries of gold deposits in Jiaodong, Cu mineralization in the thick covered area of the Huili-huidong ore district in Sichuan, and progress on ore prospecting in integrated exploration areas.

(3) New progress made in the geological survey of strategic mineral resources, include the survey of Li resources in southern Xinjiang and western Sichuan provinces, survey of Sc and REE resources in Nayong, Guizhou Province, and Tengchong, Yunnan Province, and the survey of rare metals at the Baishawo district in the Lianyunshan region of Hunan province. And also in the survey for fluorite deposit in western Fujian and southern Jiangxi provinces.
(4) Upgrading of technical standards of the survey for mineral resources

Development and publishing of technique requirement of solid mineral geological survey (1:50000) is made in 2018 to promote transformation and upgrading of the survey following the fundamental transition of CGS in recent years, which emphasize the consideration and integration of geological potential, technical and economic feasibility, environmental implication, and emphasizing green survey. A new way of mapping by a combination of metallogenies, controlling factors of ore-forming, pre-studies, the mineralization theme, and with evaluation system of mineral resource potential is established, and also a new way to express and show research results: geological and mineral resource map (1:50000), metallogenetic map, prospecting map, comprehensive map of resource and environment.

1.2.3 Progress on Hydrogeology and Environmental Geology Survey

CGS planned hydraulic engineering geological work around the overall improvement of the ability and level of supporting natural resource management and ecological civilization construction since 2018.

(1) To support national urbanization strategy, CGS conducted urban geological surveys in Xiongan New Area, Beijing city sub-center, Hainan free trade zone (freeport), and some other regions. And also carried out coastal zone geo-environment investigations.

CGS has compiled China geothermal energy report (2018) and held Tianjin international geothermal symposium in 2018. Geothermal exploration is on important part in urban geological survey in 2018,

Wells drilled in high-capacity geothermal areas outlet water temperature reached more than 100 ° C in Xiong’an, Zhangcheng area and Tianjin Dongli district. Geothermal resources have been evaluated and thermal storage structure of Xiong’an is delineated.

(2) In the sector of disasters prevention and mitigation, 1:50000 Geological hazard survey has achieved 13, 250 km² in 2018. Geological survey projects for location of active fault belts and in-situ stress monitoring are deployed, as well as geo-hazards investigation in mountainous and hilly areas, and in loess regions.

(3) In supporting ecological civilization, demonstration areas are studied with eco-geological survey, several geological culture villages, three districts and one center in Hainan has been developed.

(4) To support natural resources management of the new ministry, CGS completed the compilation of the atlas of natural resources of China, and conducted projects on geological heritages, groundwater monitoring, evaluation of carrying capacity of resources and environment and suitability of land space, geochemical survey of land quality, and mining environment monitoring in 2018.

CGS have completed a total of 2.55 million square kilometers of land quality geochemical survey with a scale of 1:250,000 up to 2018, and pollution-free selenium-rich land...
prospect area of 173,000 km² is delineated. CGS has also provided technical support for detailed investigation of soil pollution status on agricultural lands.

While for mine environmental monitoring, CGS guided the preparation of remote sensing interpretation maps of land destroy in the country and 31 provinces, and the unified technical requirements for geological environment investigation and monitoring of mines were also issued and put in application.

(5) Significant progress has been made also in coastal zone and wet land surveys. Compilation of the atlases of resources and environment of China's national coastal zone and sub-provincial coastal zone is completed in 2019, and construction and monitoring network as part of the global monitoring network for wetland functions is completed as well. Temporal and spatial variation characteristics of land use in the coastal zone of the Yangtze River Delta is studied since 2018. The division of sedimentary strata since the Neogene in the South Yellow Sea in China was completed, further confirming the Quaternary bottom boundary of the continental shelf of the South Yellow Sea and the main stratigraphic boundaries in the Quaternary.

1.2.4 Main oil companies’ activities on exploration and production

In 2018, the full-year additions to proven oil and gas in place were 633.16 million tons and 584.6 billion cubic meters respectively by China National Petroleum Corporation (CNPC). The company produced 101.02 million tons of crude oil for the full year, thanks to heightened measures for improving production management at mature fields and boosting capacity at new projects. The company’s full-year gas output surged to an all-time high of 109.4 billion cubic meters, with the shale gas output increased by 41.2%, as a result of capacity expansion in key gas producing areas, such as shale gas blocks in Southwest Oilfield. And Sinopec pressed ahead with high efficiency exploration and profit-oriented development in 2018. Measures were taken to accelerate the formation of an integrated value chain of natural gas business including production, supply, storage and marketing and continuously reduce cost and expenditure on all fronts. Tangible results were achieved in maintaining oil production, increasing gas output and reducing cost.

(1) Exploration and Production of CNPC

- Exploration

The company’s exploration efforts in 2018 have proved fruitful. Focusing on risk exploration, we made more investments and efforts in new areas and new fields, leading to new discoveries at multiple basins, strata and spots. Meanwhile, a cost-effective and fine exploration approach was adopted in mature areas, increasing the ratio of high-quality, large-scale, uncompartmentalized reserves that are more developable and upgradable. Unconventional resources have taken a larger share in the newly added reserves and gradually become an important alternative source of reserve expansion. The full-year increment to proven oil in place and gas in place are 633.16 million tons and 584.6 billion cubic meters respectively.

- Major discoveries

Risk exploration in Tarim Basin achieved big breakthrough that a new gas-bearing structural belt in Qiulitage was found.
High yield oil and gas flows were obtained at a number of exploratory wells in Bayan-Hetao Basin.

Significant progress was made in natural gas exploration in Sichuan Basin, include the identification of new gas-bearing volcanic strata in the western part and high yield gas flows from exploratory wells in the eastern part.

Lithologic reservoirs are identified in the Shawan Sag, Junggar Basin.

Table1 Reserves and operating data (Domestic) in CNPC

<table>
<thead>
<tr>
<th></th>
<th>2018</th>
<th>2017</th>
<th>2016</th>
</tr>
</thead>
<tbody>
<tr>
<td>Newly proven oil in place (mmt)</td>
<td>633.16</td>
<td>659.45</td>
<td>649.29</td>
</tr>
<tr>
<td>Newly proven gas in place (bcm)</td>
<td>584.6</td>
<td>569.8</td>
<td>541.9</td>
</tr>
<tr>
<td>Exploration wells</td>
<td>1,803</td>
<td>1,773</td>
<td>1,656</td>
</tr>
</tbody>
</table>

- **Development and Production**

With an emphasis on both ramping up production in new fields and stabilizing production in mature fields, the company produced 101.02 million tons of crude oil in 2018, and produced 109.4 billion cubic meters natural gas.

- **Exploration and Development of Unconventional Oil and Gas**

The company’s exploration efforts in unconventional hydrocarbon such as shale oil and gas, tight oil and gas and CBM delivered important results in 2018. Unconventional hydrocarbon, as an important alternative source of energy, are accounting for an increasingly larger share in our newly added proven reserves. The construction of unconventional hydrocarbon projects has gathered pace. A number of important producing blocks and pilot testing bases have taken shape as unconventional oil and gas production continues to grow.

We produced 4.26 billion cubic meters of shale gas in 2018, jumping 41.2% year-on-year. Shale gas exploration breakthroughs in the southern part of the Sichuan Basin provide a meaningful example for mining shale gas from depths of over 4,000 meters.

In Junggar Basin, tight oil production capacity is growing rapidly on a large scale across the Jimasar Sag.

- **Technical innovation on oil and gas exploration & geology**

Key techniques for exploration and evaluation of non-marine shale oil/ tight oil in China Significat headway has been made in continental shale oil exploration, facilitating exploration breakthroughs and production hikes in Junggar Basin, Bohai Bay Basin and Ordos Basin.

The theories and techniques for natural gas exploration and evaluation for deep marine carbonate rocks in China. The theories on how gas reservoirs were formed and exploratory evaluation technologies have been developed for deep marine carbonate rocks. It paves the way for the deep marine carbonates in the northwestern part of Sichuan to become a new candidate for strategic reserve replacement in Sichuan Basin.
(2) Sinopec petroleum exploration and production in 2018

Sinopec reinforced preliminary exploration in frontier areas and strengthened integrated detailed evaluation in mature fields, which led to new discoveries in Tarim, Yin’e and Sichuan basins. The Company’s newly added proved reserves in China reached 458.2 million barrels of oil equivalent, with crude oil reserve replacement ratio at 131.7%.

- **Crude oil production**
  
The company made a full-fledged push to build profitable production capacity, deepen the structural adjustment of mature fields, reduce natural decline rate and ensure steady production.

- **Natural gas production**
  
Sinopec constantly pushed forward capacity building in Hangjinqi of Neimongol, the eastern slope of west Sichuan Depression and Weirong shale gas fields. Sinopec optimised production and distribution and promoted a coordinated growth along the value chain. The Company’s production of oil and gas reached 451.46 million barrels of oil equivalent, with domestic crude production registering 248.93 million barrels and natural gas production totaling 977.32 billion cubic feet, up by 7.1%.

- **R&D sector**
  
with the emphasis on reinforcing innovation-driven strategy, Sinopec accomplished notable results in R&D, deepened reform of R&D mechanism and pushed ahead with efforts in key and new technologies. In upstream segment, further advancement in evaluation technology of buried hill bedrock and deep carbonate reservoir and fracturing technology of deep shale gas field brought the breakthroughs in the exploration of Guaizihu Depression in Yin’e Basin and new series of strata in Maokou Formation in Yuanba area as well as the discovery of Weirong deep shale gas field. The pilot test of 185℃ high temperature measurement while drilling was successfully conducted in the ultra-deep well in Shunbei.

- **Activities in 2019**
  
by fully implementing the action plan of redoubling efforts in oil and gas exploration and production, Sinopec will advance high-efficiency exploration, continuously increase
proved reserves and expand resource base. In crude oil development, more efforts will be made in promoting the capacity building of the Tahe Oilfield, making technological breakthrough for undeveloped oil-bearing reservoirs, improving refined reservoir characterization of mature fields in order to increase reserve development rate and recovery rate. In natural gas development, Sinopec will accelerate the production capacity construction of key projects, optimise the system of natural gas production, supply, storage and marketing as well as the market layout so as to foster coordinated development of the whole business value chain. In 2019, Sinopec plans to produce 288 million barrels of crude oil, among which overseas production will be 39 million barrels, and 1,019.1 billion cubic feet of natural gas.

Summary of operation for Exploration and Production

<table>
<thead>
<tr>
<th>Items</th>
<th>2018</th>
<th>2017</th>
<th>2016</th>
<th>Change from 2017 to 2018(%)</th>
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<tbody>
<tr>
<td>Oil and gas production (mmbbls)</td>
<td>451.46</td>
<td>448.79</td>
<td>431.79</td>
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<tr>
<td>Crude oil production (mmbbls)</td>
<td>298.51</td>
<td>293.66</td>
<td>303.51</td>
<td>(1.6)</td>
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<td>China</td>
<td>248.93</td>
<td>248.88</td>
<td>253.15</td>
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<tr>
<td>Overseas</td>
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<td>44.78</td>
<td>50.36</td>
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<tr>
<td>Natural gas production (bcf)</td>
<td>577.32</td>
<td>912.30</td>
<td>766.12</td>
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Crude oil and natural Gas Reserves

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<th>Items</th>
<th>Crude oil reserves (mmbbls)</th>
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<td>31 December 18</td>
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<tr>
<td>Proved reserves</td>
<td>1,666</td>
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<tr>
<td>Proved developed reserves</td>
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<td>China</td>
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<td>Consolidated subsidiaries</td>
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<td>Shengli</td>
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<td>Shengli</td>
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<td>Others</td>
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<td>Overseas</td>
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<td>Equity accounted entities</td>
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<table>
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<tr>
<th>Items</th>
<th>Natural gas reserves (bcf)</th>
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<tr>
<td></td>
<td>31 December 18</td>
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<tr>
<td>Proved reserves</td>
<td>6,807</td>
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<td>Proved developed reserves</td>
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<td>China</td>
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<td>Consolidated subsidiaries</td>
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<td>Puguang</td>
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<td>Fuling</td>
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<td>Overseas</td>
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<td>Equity accounted entities</td>
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<td>Fuling</td>
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<td>Others</td>
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Exploration and Production Activities
1.3. Proposed Future Activities

Continue to enhance geochemical mapping cooperation with the member countries of CCOP, including the five countries have being carried out and other countries, such like Thailand, Myanmar and Malaysia.
2. COOPERATION AND PARTNERSHIP

2.1. Summary
Dozens of activities on international cooperation and partnership of CGS have taken place with successful organization, and fruitful results and great achievements have been made, which were mostly within CCOP or under the umbrella of CCOP.

2.2. Annual Review of Individual Technical Activities

2.2.1 CCOP Geochemical Baseline Mapping Project

The project is supported by China Geological Survey in finance and technique for the member countries of CCOP. The key points of the Project are to build capacity by sharing with China's world-leading geochemical mapping experiences and methodology and provide geochemical data and maps applying in mineral exploration and environmental monitoring. From 2011, five bilateral cooperation geochemical mapping projects are being carried out between China and Laos, PNG, Indonesia, Cambodia, and Mongolia. During the year, China Geological Survey, the Ministry of Natural Resources of the People’s Republic of China, and Department of Geology and Minerals, the Ministry of Energy and Mines, Lao People’s Democratic Republic completed the Cooperation Project of Low-density Geochemical Mapping of Laos and gained satisfied results.

Bilateral Cooperation Geochemical Mapping: The Cooperation Project of Low-density Geochemical Mapping of Laos has been carried out since 2014. A total of 146 catchment sediment samples from 73 sites for global-scale geochemical baselines and 1904 stream sediment samples for national-scale geochemical mapping were collected across the whole of Laos (approx. 180,000 km²). During the year, cooperation parties completed the final report, generated 76 maps for global geochemical baselines, generated 69 maps for national-scale geochemical mapping and delineated more than 10 prospecting areas. The cooperation results provided important basic data for mineral resource evaluation and environmental monitoring for Laos. During the year, two young geologists were supported by China Geological Survey to visit China for one month to learn how to generate geochemical maps.

Geologists from CGS and DGM take part in the field work (left) and Laos national-scale geochemical map of Hg (right)
2.2.2 China-ASEAN cross-border geological mapping in key tectonic belts of Thailand, Myanmar, and Malaysia

From June 24 to July 31, 2018, Chengdu Center visited Thailand, Malaysia and Myanmar to carry out field research on China-ASEAN cross-border geological mapping in key tectonic belts of Thailand, Myanmar, and Malaysia.

Form a joint field survey team with Malaysia Geoscience and Minerals Bureau to carry out the field research in Bentong Raub Suture Zone, Malaysia. The China-Myanmar joint project team carried out field researches in key tectonic zones such as Mogok metamorphic zone in Myanmar and typical deposits such as Dongzhibang Iron Mine.

2.2.3 GEOSEA Conference and joint field survey in Viet Nam

CGS staff visit the general administration of geology and mineral resources of Viet Nam from October 1 to October 30, 2018 to carry out field geological survey of cross-border metallogenic belts. The delegation visited the General Department of Geology and Mineral Resources of Viet Nam three times, exchanged views on field visits and discussed the further cooperation direction; The geological personnel of Chengdu Center have surveyed 7 typical deposits and 2 important metallogenic belts, and collected relevant samples, laying a foundation for further comparative researches on cross-border mineralization. During the period, the delegation also participated in the Fifteenth Congress on Geology, Mineral and Energy Resources of Southeast Asia (GEOSEA XV) and made an oral report of English, receiving good reputation from the experts.

2.2.4 Visit Laos Geological and Mineral Division and carry out field work of China-Laos cooperation project

From October 21, 2018 to November 29, 2018, four of Chengdu Center visited Laos to implement the “Agreement on Cooperation Projects of Geochemical Mapping of Laos” signed between China Geological Survey and the Laos Geological and Mineral Resources Division in August 2017. Chengdu Center worked with West-Panzhihua Geological Team of Sichuan Bureau of Geology and Mineral Resources, Comprehensive Survey brigade of the Exploration Unit of North China Geological Exploration Bureau and technicians of Laos to carry out field geological geochemical mapping, with an area of 2,000km².

Handing over of achievements and field work photos to Laos.
2.2.5 Visit the Philippines to participate in the 11th ASOMM+3 Mining Cooperation Consultation Meeting

On 5 to 7 December 2018, the Ministry of Natural Resources sent a delegation to participate in the negotiations, and Chengdu Center deployed one representative to participate as one of the members of the delegation. The Chinese delegation made a report on the achievements and contributions made by China under the framework of ASEAN+3 mining cooperation over the past one year, and introduced the cooperation framework for 2019; It detailed the completion and effectiveness of China Geological Survey in 2018 around the ASEAN+3 annual target task, and made specific deployment of the 2019 work plan. Besides, Chengdu Center has made detailed action plans in the fields of talent training, ASEAN Mining Cooperation Forum, comparative researches on cross-border geology and compilation.

2.2.6 Visit Laos to carry out geological geochemical mapping

From April 10 to May 19, 2019, four of Chengdu Center visited Laos to complete the investigation of Chinese mining enterprises in Laos, understand their needs and achieve precise services; Collect relevant information of Laos mining investment in a comprehensive manner; Complete the field geological survey of the typical deposits in Luangprabang; Complete the route survey in mapping area, and preliminarily determine the mapping unit.

2.2.7 Visit Myanmar and Malaysia to carry out geological survey of tungsten-stin metallogenic belt in Tanintharyi and -Malaysia Peninsula

24.7 On June 26 to August 24, 2019, 7 of Chengdu Center visited Myanmar and Malaysia to carry out geological survey of tungsten-tin metallogenic belt in Tanintharyi and -Malaysia Peninsula Exchanged views with the Myanmar Geological and Mineral Exploration Bureau and signed the summary of the cooperation discussion; The joint project team of China-Myanmar carried out field geological research on the typical deposits of Mawchi-Tanintharyi metallogenic belt; Communicate with Chinese-invested enterprises to understand their needs; Cooperated and exchanged with Malaysia Minerals and Geosciences Bureau and Malaysia Mining Federation, and signed the summary of cooperation discussion with Malaysia Mineral and Geoscience Bureau; The joint project team of China and Malaysia carried out field geological research work on the typical deposits along Bentong Raub Suture Zone in Malaysia.

2.2.8 International seminar on geohazard prevention and mitigation with the title of Science and technology - the solution to the improved response capacity to geohazard.

Hosted by China Geological Survey, the seminar was successfully held in Lanzhou, China from June 22 to 24. Total of 50 participants from both CCOP member countries and collaborating countries including China, Thailand, Malaysia, Germany and France joined this seminar. The seminar successfully enhances the communication among CCOP member countries in geohazard prevention and mitigation, and helped to improve national capacity to resist geohazard.
This seminar provided a good opportunity for both CCOP member countries and collaborating countries to communicate and share the successful practices and experiences in geohazard prevention and mitigation, and will further promote the further scientific cooperation and improvement of capability to geohazard control in these countries.

2.2.9 Workshop & Training Courses on Marine Geoscience Capacity Building and Geohazards Reduction and Prevention

The Workshop & Training Courses on Marine Geoscience Capacity Building and Geohazards Reduction and Prevention of China-ASEAN-CCOP in Guangzhou in August 2018 was successfully conducted. The training course was focused on the three scientific fields, eg. Coastal environmental research and disaster mitigation, deep structure of the China-ASEAN area research, sea-land compilation of geoscience map series. The representatives of the ASEAN countries have systematically learned the theory and technology of the geological environment of the coastal zone and the geological mapping.

2.2.10 Geosciences Week for Lancang-Mekong Cooperation Countries

From 23 to 31 March 2019, the 2nd Geosciences Week for Lancang-Mekong Cooperation Countries organized by the China Geological Survey and hosted by Chengdu Geological Survey Center was successfully held in Beijing. A total of 88 representatives from the subordinated organizations of China Geological Survey and five countries in Lancang-Mekong region attended the meeting. During the Cooperation Week, China Geological Survey hosted 3 forums and 1 round table conference and reached a consensus on the co-construction of the "China-ASEAN Geosciences Cooperation Center" and the implementation scheme for the cross-border geological comparison and compilation of the Lancang-Mekong River.
2.2.11 Establishment of "China-ASEAN Geosciences Cooperation Center"

On November 15, 2018, senior officials of mineral departments from China, Cambodia, Indonesia, Laos, Malaysia, Myanmar, the Philippines, Thailand and Vietnam presented the inauguration ceremony for the “China-ASEAN Geoscience Cooperation Center” during the 9th China-ASEAN Mining Cooperation Forum in Nanning of China, which has marked a new milestone in geoscience cooperation between China and ASEAN member states.

2.2.12 China-ASEAN Geoscience Cooperation Seminar

On November 15, 2018, the "China-ASEAN Geoscience Cooperation Seminar" hosted by Chengdu Center was held at Nanning Convention and Exhibition Center. Nearly 150 participants attended the seminar, including around 60 foreign guests from ASEAN countries. The seminar does not only represent a demonstration of the achievements of the geological and mineral sectors in the field of geoscience cooperation, but also an opportunity for a wide range of exchanges and cooperation.

2.2.13 Progress of cooperation between China and Cambodia

From 2018 to 2019, QIMG of CGS continued to strengthen its cooperation with Cambodia in Marine Geology and made important progress. From October to December 2018, four young scholars from General Department of Ministry Resources of Cambodia(GDMR) were invited to China to have technical training. China and Cambodia have jointly compiled a coastal Geo-environment atlas of Kampong Som Bay and drafted the survey results report.

2.2.14 CNPC Joint E&P in China

China National Petroleum Corporation(CNPC) has been working with international partners including Shell and Total in E&P activities in China around low-permeability reservoirs, heavy oil, shallow-water reservoirs, sour gas, high-temperature and high pressure gas reservoirs, CBM and shale gas, etc. The company’s foreign cooperation E&P projects have made new breakthroughs. These projects produced for the first time more than 10 million tons of oil equivalent for the full year, i.e. 10.12 million tons, including 2.39 million tons of crude oil and 9.7 billion cubic meters of natural gas. As of 2018, the company had 34 joint E&P projects in operation.
2.2.15 Progress of cooperation between China and Myanmar

From October to December 2018, three young teachers from Yangon University of Myanmar were invited to China for a three-month technical training. QIMG has arranged more than 10 technical lectures for them. During this period, QIMG has conducted in-depth collaborative research with teachers of Yangon University. Yangtze River Delta in China and the Irrawaddy River Delta in Myanmar are basically identified as case study areas of coastal zone, and discussed the detailed work plan of joint geological drilling investigation between China and Myanmar in 2019.

Geological sampling of 100 stations at three profiles of the Indo-Burma Range was carried out jointly with Myanmar team. More than 300 samples were sampled. Samples were analyzed and tested at UK lab. Testing data for all samples may be available by the end of 2019. Some data analysis work has been carried out.

2.2.16 Progress of cooperation between China and Thailand

In October 2018, China and Thailand have exchanged the cooperation modes, contents and the detailed signatures of the cooperation agreement. In August 2019, the two sides held in-depth discussions on cooperation plans and future cooperation areas of “Agreement on Cooperative Project of Marine Geoscience Map Compilation and Coastal Geohazards between China Geological Survey, China and the Department of Mineral Resources Ministry of Natural Resources and Environment, Thailand”. Preliminary agreed areas of cooperation include (1) Marine Geoscience map compilation, (2) Coastal erosion and geohazards case study, (3) Coastal wetland survey and research, (4) Personnel exchange and technical discussion.

2.2.17 Progress of cooperation between China and Malaysian

In November 2018, QIMG and Bureau of Mineral Geology of Malaysian exchanged opinions on cooperation in marine geology field. The Malaysian side stated that it would actively promote the integration of China-Malaysia marine geoscience and technology cooperation into the MOU. Preliminary cooperation areas include: marine geological mapping, coastal geological hazard monitoring, beach erosion and monitoring, Geological Park construction. In addition, Jointly with scientists of PetroNAS, the interpretation of seismic data in the Java Sea has been carried out, and two papers have been jointly completed and submitted.

2.2.18 Progress of cooperation between China and Vietnam

On the basis of the Sino-Vietnamese cooperation project" Comparative study of Holocene Sedimentary Evolution of the Yangtze River Delta and the Red River Delta", experts from both sides of the China and Vietnam jointly carried out various forms of cooperation activities including technical training courses, joint field investigation, personnel exchanges and postgraduate training and so on. Personnel exchanges reached 15 batches, totally 72 people. This has greatly enhanced the understanding and friendship between the two sides. This project has set a good example for China-Vietnam cooperation in low sensitive areas and laid a solid foundation for China-Vietnam cooperation in marine geoscience.
Major collaboration researched including geomorphological evolution of the deltas and neighboring continental shelves, late Pleistocene–Holocene sequence stratigraphy, changes in coastlines during the Holocene and the relevant controlling factors, characteristics of superficial sediment in the submarine river deltas and neighboring continental shelves, sediment dynamics surveys and numerical simulations of the estuaries and continental shelves, and investigation of the impacts of global changes and human activities during the Holocene, and particularly, over the past century, on the development and evolution of the river deltas.

2.2.19 Land and resources and environmental protection planning project with Laos
Geological map, town classification map, major land resources and population density maps are drafted.

2.2.20 Cambodia National Mining Industry Promotion Conference
On November 16, 2018, the "Cambodia National Mining Industry Promotion Conference" hosted by the Chengdu Geological Survey Center and the State Administration of Mineral Resources of Cambodia was successfully held in Nanning International Convention and Exhibition Center, with more than 150 participants from both sides attending. This special promotion conference not only shows the current research status in the field of geoscience in Cambodia, the policies of investment in mining industry and the development direction, but also promotes the exchanges and practical cooperation between the two sides in the field of geoscience.

2.3. Assistance Required from CCOP in Support of Future Activities
CCOP can provide help to promote cooperation between China and the member countries of CCOP in geochemical mapping.

3. KNOWLEDGE ENHANCEMENT AND SHARING
Activities for enhancing capabilities with area of focus - geo-hazards prediction and mitigation, environmental geology, water resources integrated management, energy and mineral resources sustainable development and geo-information.

3.1. Summary
China Geological Survey has been continuously conducted several regional cooperation projects in knowledge enhancement and sharing in 2018 in CCOP region. Typical activities are digital geological mapping (DGM), integrated geological data processing (IGDP) and cross border geoscience map compilation.

3.2. Annual Review of Individual Technical Activities
3.2.1 Capacity-building: Training course on geochemical mapping and environmental geochemical investigation for development countries which included the member countries of CCOP took place in Peking and Langfang, China in October 2018.
3.2.2 Technical Training Course on Geological Disasters for Countries along the Bangladesh-China-India-Myanmar Economic Corridor

On November 14 to 29, 2018, the Asia Regional Special Cooperation Fund of the Ministry of Foreign Affairs of “Technical Training Course on Geological Disasters for Countries along the Bangladesh-China-India-Myanmar Economic Corridor” hosted by Chengdu Geological Survey Center of China Geological Survey was held in Nanning and Chengdu. 29 officials and technicians in geological sector from 9 countries of Southeast Asia and South Asia were present. This training received good reputations from participants of Southeast Asian and South Asian countries. This training course will help accelerate the further development of bilateral and multilateral cooperation between China and Southeast Asian and South Asian countries in the field of geoscience, improve the technical level of geological science and technology personnel in South-East Asia and South Asia.

3.2.3 Integrated Geosciences Data Processing (IGDP) capacity building for CCOP member countries.

(1) IGDP capacity building for CCOP member countries.

The 2nd workshop of CCOP-CGS IGDP project phase II (IGDP-II2) was held in Guangzhou, China on 17-19 July 2018, which is funded by China Geological Survey (CGS), and hosted by Guangzhou Marine Geological Survey. There were 26 participants from Cambodia, China, Indonesia, Japan, Lao PDR, Malaysia, Philippines, Thailand attended this training.

(2) CCOP-CGS-IGDP project meeting in Busan in October 2018

The IGDP project phase II meeting was held in Busan, Republic of Korea, on 30 October 2018, as part of the 54th CCOP Annual Session. 15 participants from Cambodia, China, Indonesia, Japan, Lao PDR, Malaysia, Philippines and Thailand presented output of the project in 2018 and discussed next step work of the project.

(3) The 3rd China-ASEAN-CCOP IGDP training courses sponsored and supported by China Geological Survey (CGS) was held in Nanning, China on Nov.17-18, 2018. More than 20 officials, technicians and university students from Cambodia, Myanmar, and Indonesia participated in this 2-day training course.

(4) The 3rd workshop of CCOP-CGS IGDP project workshop was held in Qingdao, China on 18-22 September 2019, hosted by China Geological Survey. There were 28 participants from Cambodia, China, Indonesia, Japan, Korea, Lao PDR, Malaysia, Mongolia, Myanmar, Papua New Guinea, Philippines, Thailand and Viet Nam attended this workshop and training. Practical use training of RGIS-IGDP software was conducted and geophysical compilation work and techniques were discussed, and a short-term work plan was drafted.
3.2.4 Digital geological mapping (DGM) technology for field geological survey and mineral exploration.

(1) DGM training in Malaysia 2018

An 8-day training course on DGM including 5 days indoor trainings and 3 days field practices was conducted by CGS on 8-15 Oct. 2018 in Kota Kinabalu, Malaysia. 50 professionals from 6 different organizations under the mineral and geological science of Malaysia and 4 universities participated this training course. Geological mapping along 1 profile was completed during the field practice and another 1 test sheet of draft geological map was finished.

(2) DGM training courses in Myanmar 2018

The 8-day training course on DGM was conducted by CGS on 8-16 Dec. 2018 in Naypyidaw, Myanmar. 75 professionals from geological survey and mineral exploration bureaus of the Myanmar ministry of natural resources and environment protection and 4 mineral exploration companies participated.

(3) DGM training in Brazil

Invited by the geological survey of Brazil, the CGS DGM group delivered a successful training course on digital field geological mapping technology on 26-30 Nov. 2018. There were 15 professionals from geology and mineral, land, data analysis and geo-information divisions attend the training and discussion. Digital mapping technology are introduced and related new development toward an intelligent space frame were discussed. Geobank of Brazil were also presented at the discussion.

3.2.5 Training courses on satellite remote sensing technology and application

A training course on this purpose was held on 19-26 November 2018 in Bangkok, Thailand by CGS. 30 trainees from the department of mineral resources, land development department, geo-Informatics and space technology development agency, Chiang Mai university and Chulalogkorn University of Thailand participated. Training courses include remote sensing frontier, theories, methodologies as well as application cases. This training was conducted as the following action of the seminar on remote
sensing technology and application in resources and environment for Lancang-Mekong cooperation countries held on 19-24 Mar. 2018 in Beijing, China.

3.2.6: Training of International Students
Chengdu Geological Survey Center, in cooperation with China University of Geosciences, has cultivated 205 international students in the field of geoscience, geological survey, mineral resources evaluation and test analysis in ASEAN countries in 2019, including 41 undergraduate students, 112 masters, 51 doctors and 1 post-doctor.

3.3. Proposed Future Activities

3.4. Assistance Required from CCOP in Support of Future Activities
CCOP TS should help to complete the geophysical compilation in a short time period for the CCOP-CGS IGDP project.
CGS suggested to set up a joint training base at CCOP TS building office for effective training and efficient practice of advanced geological survey technology, with the help of DMR.

3.5. Assistance Offered to CCOP/Other Member Countries in Support of Future Activities
To improve the technologies and knowledge sharing in geochemical mapping, regional mineral assessment, geoscience data integration and data processing for mineral exploration and environmental protection through training courses within CCOP member countries.

4. DATA AND INFORMATION
4.1. Summary
CGS has promoted the deep integration of big data, cloud computing, artificial intelligence and geological work since 208, in order to speed up geological survey transformation to demand-orientation, the ways of geological work, data service and management, and work efficiency. Measures taken included Building up of a distributed national geological big-data center, promoting efficient application of cloud computing on the GeoCloud platform, promoting artificial intelligence of the full process of geological survey and development of geological information product system.

4.2. Annual Review of Individual Technical Activities
4.2.1 A milestone: online geological survey is fully carried out for the first time.
A cloud working space for field geologists is developed. They can easily access geological data and information for field work preparation. During field survey, they can obtain geoscience knowledge, historical data and professional information support anytime and anywhere through intelligent terminals; field data collection can be uploaded to and stored on GeoCloud. Online geological data analysis and output can be fulfilled on
GeoCloud with provided professional software and mining tools, thus building a complete service chain from field investigation to office work. In 2019, the overall 464 geological survey projects are developed on GeoCloud, promoting a new leap in geological survey work mode.

4.2.2 Leading direction: several pilot intelligent geological survey projects are on the way.

Geologists may encounter inevitable professional, safety and quality problems in the field. While in GeoCloud environment, they can obtain professional support from the cloud anytime and anywhere. Through rapid identification of rock formations, they can obtain specific services such as rock names, geological age, origins, associated mapping units and related profiles. The “GeoCloud” intelligent meteorological disaster warning service ensures the meteorological disaster warning information to be pushed to the field personnel in real time to ensure field safety. Intelligent application technologies such as multi-space data AI model construction and deep mining of unstructured data, assist in the geological survey process of pre-study, comprehensive analysis, predictive evaluation, and mapping. Based on cloud online massive data and intelligent risk identification model and the quality risk of geological survey projects, the new scheme is explored for upgrading management mode. The newly developed intelligent search realizes one-click acquisition of massive data in the cloud. GeoCloud aims to build a powerful geological brain, and provide a new generation of intelligent engines for protecting the earth, managing the homeland, and supporting green and sustainable development.

4.2.3 Improve both Quality and Quantity: Expanding and Upgrading Data Products and Infrastructure.

The mass data product resources of GeoCloud are steadily updated. More than 7,000 authoritative resource and environment products have been released, including geologic maps, technical methods and standards, publications, software, popular geoscience readings, and equipment. 96 core databases and 1150 data services under 10 categories with all majors and at various scales in the China Geological Survey are fully shared. The cloud infrastructure continues to expand, and the storage capacity, memory space, and computing level are upgraded in an orderly manner. The quality of GeoCloud data products has been comprehensively improved, the overall data review and rectification of the data products on the cloud have been completed, and the portal functions have been upgraded. Therefore, the Geological Cloud is improved in both “construction” and “service”, as well as in “quality” and “volume”.

4.2.4 Breakthrough in Services: precisely Serving the National Strategy and Economic and Social Development.

China Geological Survey has deeply investigated in massive results data and stock data resources, and carefully researched and developed more than 13,000 special geological information products to provide accurate services to the society.
4.3. Proposed Future Activities

4.3.1 Under CCOP framework, the MCs, CCs and Cos jointly compile the book on coastal erosion geohazards monitoring, including coastal erosion monitoring system construction, coastal erosion situation and case studies of coastal erosion of different countries.

4.3.2 Under CCOP framework, the MCs, CCs and Cos jointly carry out cooperation research of Global Earth Observation on Asian Delta and Estuary Corresponding to Anthropogenic Impacts and Climate Changes.

4.4. Assistance Required from CCOP in Support of Future Activities

We suggest CCOP set up a CCOP Marine Geoscience Research Center in Qingdao. This Center will be directed by CCOP and mainly financially supported by Qingdao Institute of Marine Geology, CGS, based on the campus of Qingdao National Laboratory of Marine Science and Technology, and will serve as a platform for joint research and exchange for scientists from CCOP member countries. The center will provide ten visiting places for CCOP member countries each year, and provide free accommodation and food for the visitors. The center will provide marine seismic data 2D/3D and research facilities for the visitors for free. The center will organize one CCOP marine geoscience conference each year.