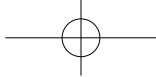


2015 Annual ***REPORT***

CHINESE ACADEMY OF GEOLOGICAL SCIENCES

Geological Publishing House

· Beijing ·



SUMMARY

This Annual Report documents the work of the Chinese Academy of Geological Sciences in major aspects of 2015, covering management and supporting services in science and technology, representative research achievements, construction of key laboratories, international collaboration and exchanges, graduate education, academic publications, and systematically outlines the advances of the Academy in development in the year 2015.

The present work can serve as reference for those who are working and studying in the field of earth sciences or dealing with scientific and technological management as regards land and resources, and also for teachers and students engaged in relevant fields at colleges and universities.

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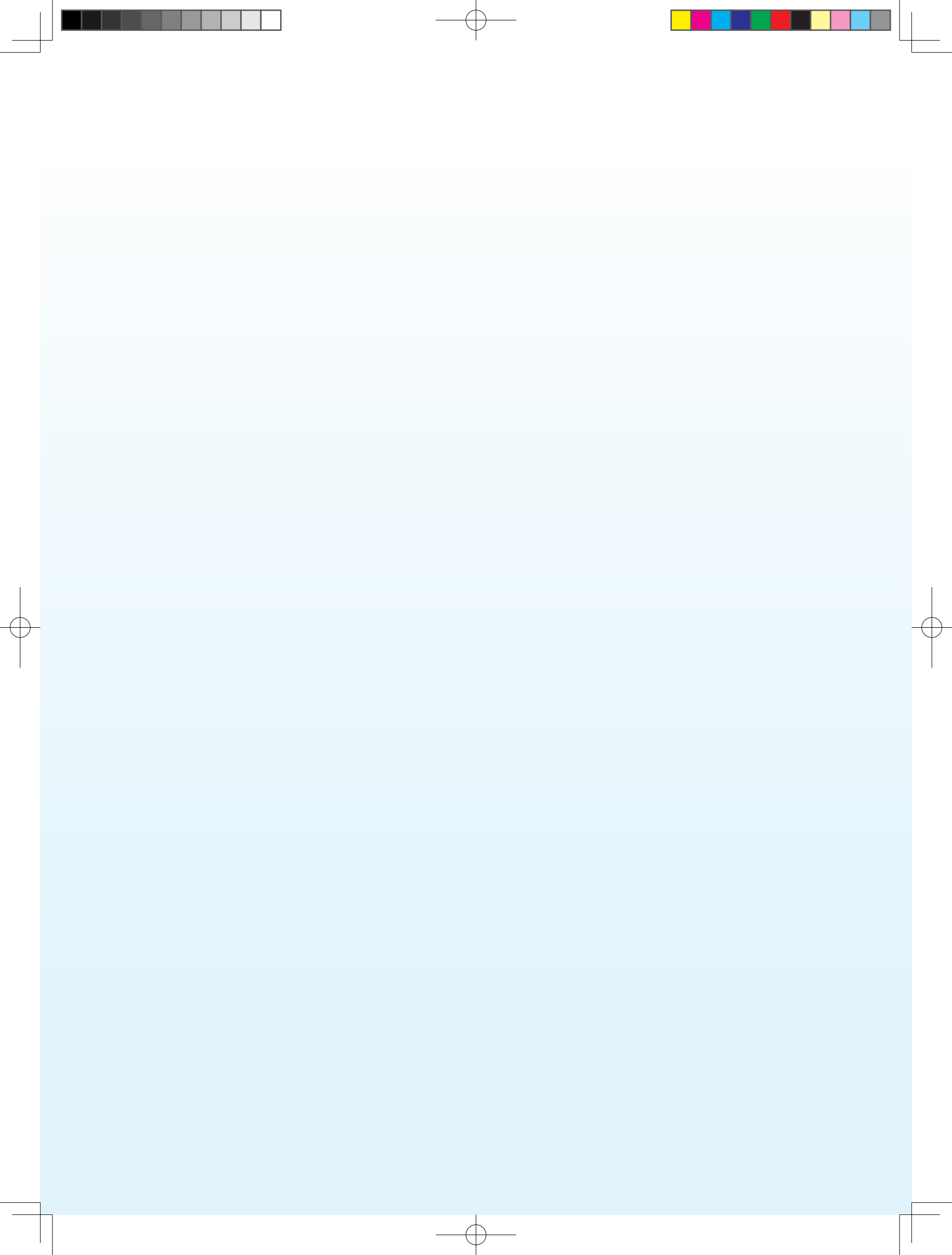
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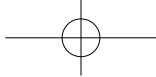
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Preface

In 2015, all members of the Academy earnestly studied and followed the spirit of the central government, executed the decisions and steps of the Ministry of Land and Resources (MLR) and the China Geological Survey (CGS) and carried out the campaign to build understanding of the “Three Self-Disciplines and Three Self-Integrities” to promote the innovative development of geological science and technology. Notable progress was made in all its work. Several areas merit special mention in this annual report.

Firstly, fruitful achievements were made in geological surveys and researches.

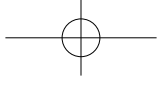
Altogether 1465 projects of various types were carried out with a total expenditure of 982 million yuan in 2015, of which 185 million yuan came from national science and technology projects, 674 million yuan from the CGS, and 56 million yuan from other funding sources. The Academy headquarters organized and carried out 2 geological survey programs, 12 projects and 82 second-tier projects, as well as 95 projects supported by the National Natural Science Foundation of China with a total financial fund of 49.11 million yuan.

In 2015, 1034 scientific papers were published, including 378 SCI-indexed papers, 76 EI-indexed papers and 497 papers from China’s core periodicals in addition to 19 monographs. 15 projects were awarded National Invention Patents, 27 received National Patents for Utility Models and 11 were awarded software copyrights. Researchers of the Academy received 3 first prizes and 4 second prizes of the Science and Technology Awards from the MLR, and 2 other provincial and ministerial prizes. 6 research achievements were reviewed as Top 10 Geological Scientific and Technological Advances of 2015 by the CGS and CAGS, and 2 were selected as projects in a list of Top 10 Geological Science and Technology Advances of 2015 by the Geological Society of China (GSC).

Secondly, new advances were achieved in key scientific research projects.

Two 973-projects, “Continental convergence and metallogeny in southern Tibetan plateau” and “Research of metallogenesis and prediction of potash salt resources” were officially concluded after passing the final review.

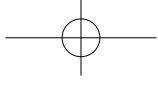
The project “Metallogenetic mechanism of the iron-rich deposits in China and prospecting prediction”, ongoing 863-projects focusing on development of large instruments and equipments, important projects supported by foundation proceeded smoothly. A number of geological maps were published, including 1:2,000,000 geological maps, 1:2,500,000 Lunar Geological Map and Digital



Granite Map of Asia was compiled. The geodynamic model of the India-Eurasian continent collision and the new metallogenic model of Qinghai-Tibet Plateau were established. A breakthrough was made in the metallogenic theory of marine potash resources of land massifs, and targets and prospective areas for potash deposits were located, the work guided potash exploration in the south-central Jiangling depression. The first high-resolution 3-D crust and lithosphere structure map of Antarctic plate (both continent and sea areas) was finished, which deepened the geological research in the Antarctic region. The first standard sample of $^{143}\text{Nd}/^{144}\text{Nd}$ in China was prepared and a work guideline of 1:50,000 corresponding regional geological survey was completed. Significant technological progresses were achieved in many research projects such as the development of UAV aeromagnetic survey system, seismic exploration, comprehensive geophysical prospecting of oil and gas resources, land quality geochemical survey and evaluation, and soil remediation.

Thirdly, important results were obtained in supporting mineral exploration and serving national construction.

A breakthrough was made in ore prospecting in the Bangong-Nujiang metallogenic belt, the largest porphyry-epithermal copper deposit of China with reserves of 10 million tons was identified in southern Tiegelong, Tibet and its predicted resources is over 15 million tons. Gyabjekain in Sichuan Province where the superlarge spodumene deposit was explored is expected to be a world-class spodumene resources base. A large-sized buried porphyry-skarn iron-copper deposit was discovered in eastern Junggar, Xinjiang. Following the principle of “focusing on both oil and potash exploration”, 889 million tons of prospective potassium chloride resources and nearly 10 trillion tons of potassium oxide resources were discovered in six prospective areas such as the Qaidam Basin, Lanping-Simao Basin and Tarim Basin. Progress was made in the investigation and evaluation of oil and gas resources of the Qaidam Basin, new series of strata were identified in shale gas investigation in southern China. Seismic and non-seismic methods were jointly applied to find new oil and gas fields in the surroundings of the Song-liao Basin. High-temperature steam of 205°C was drilled in comai county near the Qinghai-Tibet Railway, which has the highest temperature compared with other places at the same depth in China and the potential power generation capacity is estimated at 110 megawatts. The first scientific drilling of hot dry rock in China had a headway of over 3120 meters in Longhai City, Zhangzhou of Fujian. *China's Groundwater Quality and Pollution Investigation Report* was completed, which provided important technical support for drafting the “Action Plan for Water Pollution Prevention” of the State Council and conducting enforcement and supervision of the “Water Pollution Prevention and Control Law” of the Standing Committee of the NPC of China. *The Report on Chinese Arable Land Geochemical Research* (2015) was issued, which is of far-reaching significance in making a scientific conclusion for the overall geochemical status of farmland of the country. The following investigations and researches have been intensified: karst and geohydrological study, global climate change, carbon circulation and carbon sink effect, as well as investigation, application and service regarding karst collapse. The Academy



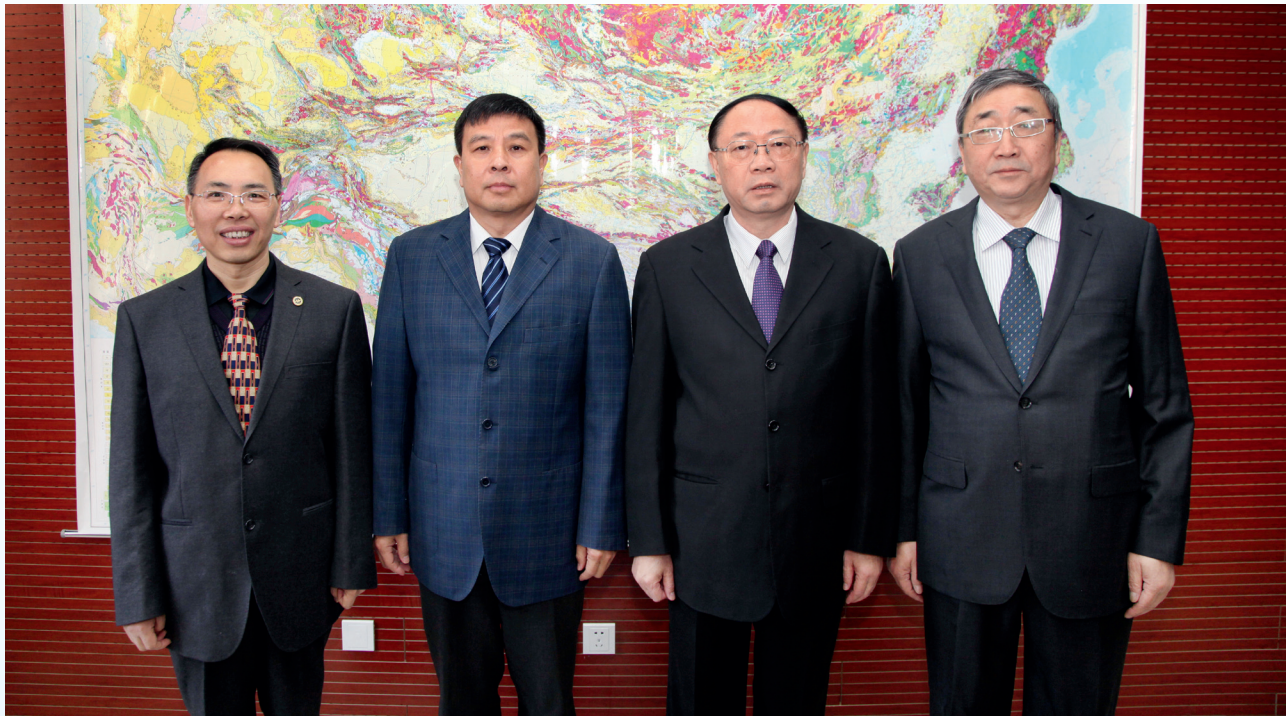
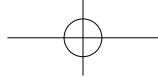
obtained preliminary results in cooperation with the Geological Exploration Bureau of Zhejiang Province, Geological Mineral Exploration and Development Bureau of Jiangxi Province, Shenzhen Geological Bureau and other geological organizations through joint projects, setting up working stations for academicians. The Academy conducted investigation of geological hazards and typical geological landscapes in Yanjin County, Yunnan Province, pushed forward construction of the Wumeng Canyon Geopark and worked out a plan for preventing geological hazards. Poverty alleviation work of the Academy was well evaluated by the MLR and CGS, as well as the local governments.

Fourthly, human resource development was fully promoted and achieved a new level of excellence.

Prof. Gao Rui was elected as an academician of the Chinese Academy of Sciences. Before this, nobody else from the CAGS had been awarded this title in the past decade. Prof. Zhu Lixin, Jiang Zhongcheng and Wang Guiling were elected as foreign members of Russian Academy of Natural Science. Prof. Tang Juxing received the title of National Excellent Worker; Prof. Shi Jiansheng was awarded the title of National Excellent S&T Worker. Prof. Hou Zengqian won the Li Siguang Geological Science Prize in its 14th conferment. Prof. Zeng Lingsen received the T.K. Huang's Young Geological Scientist Prize in the 7th conferment of this prize. Prof. Cheng Hangxin had the title of Excellent Worker of all sectors related to land and resources of the country. Prof. Wang Wenlei was chosen by the National Program for Recruiting 100 Overseas Top-notch Young Specialists. Dr. Zhai Qingguo received funds from the National Natural Science Foundation for Outstanding Youth. Dr. Zhang Yuxu had a title of Leading Talents in the National Press and Publication Industry in the fourth conferment. Prof. Tang Juxing was chosen as a scientist among the first round of outstanding geological talents of the CGS. Prof. Wang Denghong and 5 other geologists were identified as outstanding geological scientists of the CGS. Prof. Chen Xuanhua and 5 other researchers were among the second round of leading scientific and technological scientists selected by the Development and Cultivating Program of the CGS. Dr. Li Zhonghai and 4 other leading young researchers were chosen by the Nurturing Program for Outstanding Scientific and Technological Young Talented Scientists. The scientific and technological innovation group of geochemical mapping was selected to become one of the Cultivation Program of Scientific and Technological Innovation Teams. The CAGS for the first time invited 2 senior visiting scholars from both China and overseas, further progress was made in the graduate and postdoctoral education of the Academy.

Fifthly, the scientific and technological infrastructure was greatly strengthened.

The construction of the new research facility for geological projects of the CAGS started in July 2015 and so far an amount of 200 million yuan has been appropriated. The construction has been proceeding smoothly and the facility is planned to go into operation at the end of 2016. Construction of other experimental and research base facilities including the Xiamen Base, Guilin Karst Base and Beijing SHRIMP Center Base got under way. The building of the Experiment and Research Center for



Wang Xiaolie (2nd R), Vice President of the CGS, Executive Vice President of the CAGS; Zhu Lixin (2nd L), Executive Vice President; Wang Ruijiang (1st R), Wu Zhenhan (1st L), Vice Presidents of the CAGS

Geophysical and Geochemical Methods and Techniques was reviewed and accepted by the relevant governmental organizations. Preparatory work of the construction of the State Laboratory of Natural Resources and Energy Safety proceeded steadily. The mechanism for the “1+6” and “8+6” geological survey cooperation was intensified. The Centre for Deep Exploration under the CGS and CAGS was established in June 2015. The CAGS reorganized the Strategic Research Center for Global Mineral Resources and smoothly carried out the construction of the International Research Center on Karst, the International Center for Global-scale Geochemistry and other international cooperation platforms. The Academy has actively built a sharing platform for large scientific and research instruments and equipment, and its website construction and information and service platform were operated effectively and stably. A number of academic journals sponsored by the Academy won the title of the Highest International Impact Academic Journals of China. *Journal of Geomechanics* and *Carsologica Sinica* were included in the China’s core journals. *Acta Geologica Sinica* (Chinese edition) will be included by the EI after 2016.

The year 2016 is the first year of the 13th Five-Year Plan of China, and a “year of scientific and technological innovation” of the CGS and CAGS. It is also a crucial year in carrying out reform of



systems and mechanisms and comprehensively advancing geological science and technology innovation. We will focus on the main task of reforming systems and mechanisms, give full play to the integrated strength of scientific and technological innovation and intensify the supporting and guiding services of scientific and technological innovation. We will take reform as an opportunity, innovation as a drive, development as the goal and demand as the guidance to propose new initiatives in establishing new systems and mechanisms, make breakthroughs in scientific and technological innovation, make progress in cultivating talented professionals, take another stride forward in the construction of research facilities and platforms, and open up new prospects in integrating geological survey and scientific research, so as to lay a solid foundation for a good start of the 13th Five-Year Plan and greeting the 60th anniversary of the founding of the Chinese Academy of Geological Sciences.

Wang Xiaolie

Vice President of the CGS, Executive Vice President of the CAGS

Zhu Lixin

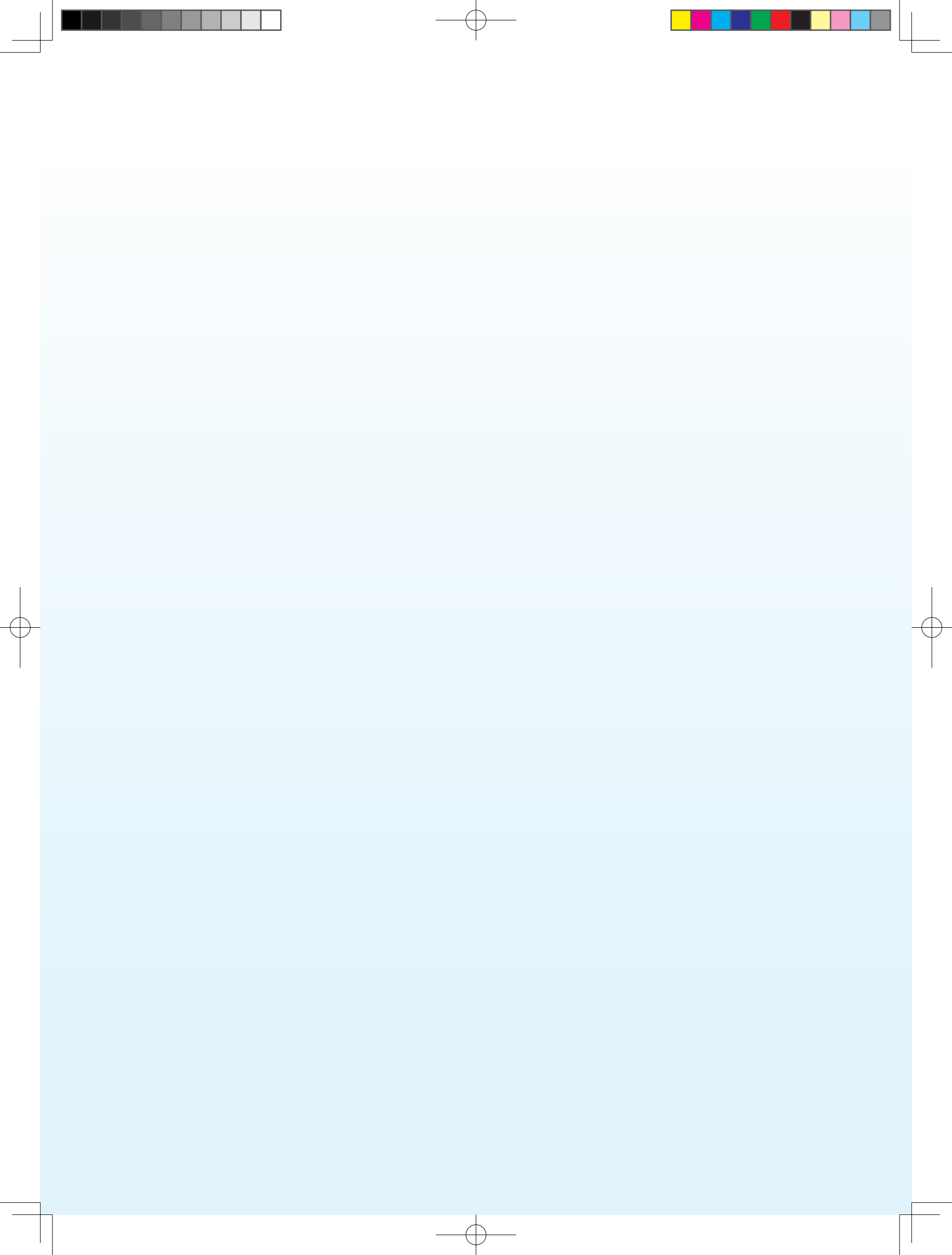
Executive Vice President

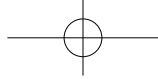
Wang Ruijiang

Vice President

Wu Zhenhan

Vice President





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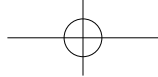
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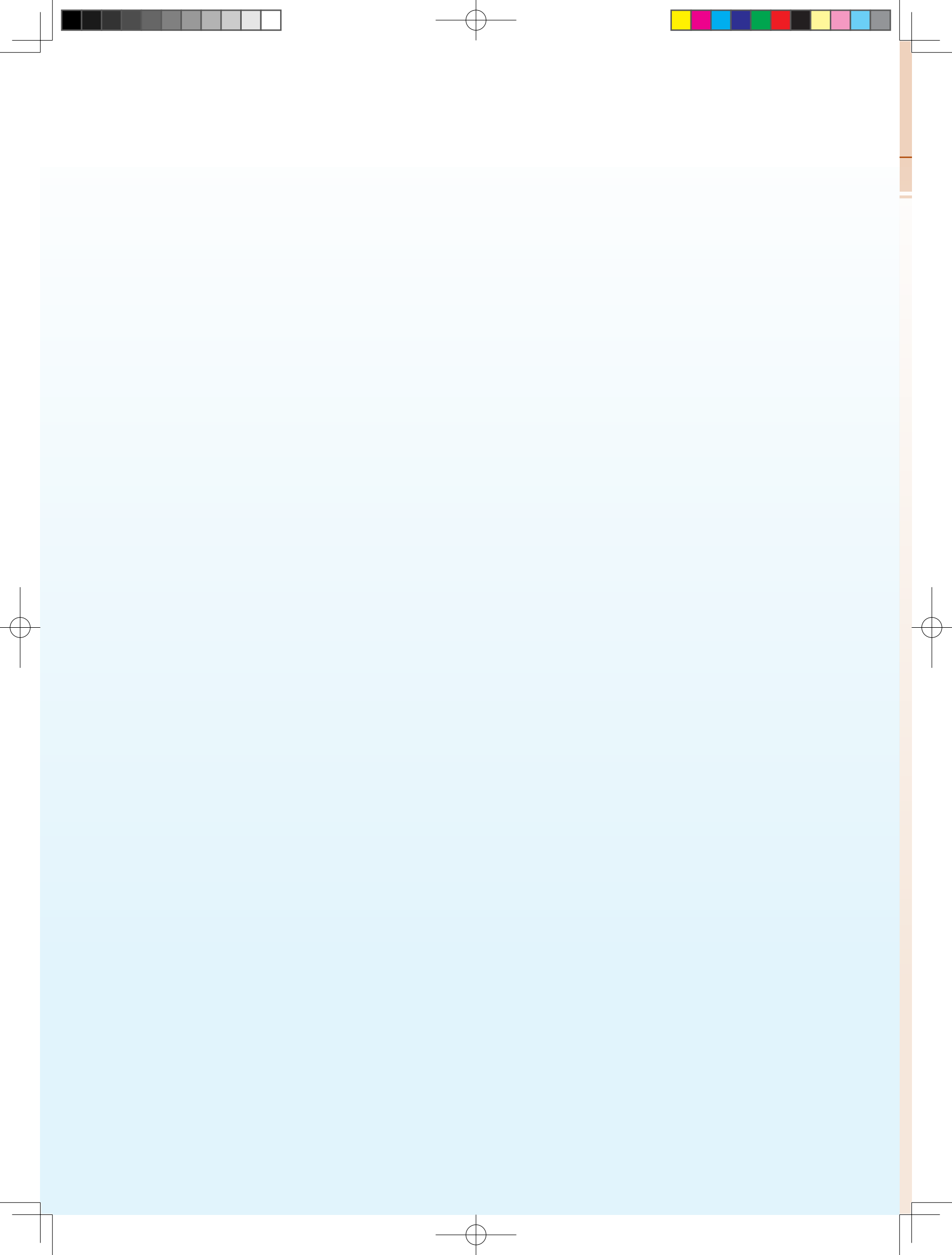


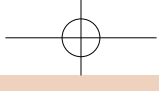
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Chapter I Reform and Development

1.1 Drawing up the Program Blueprint for the Reform of System and Mechanism

In the light of relevant requirements of the annual work plan of the CGS, the leading group for the reform of geological scientific and technological system and a group for drafting the reform plan were formed. The two groups conducted investigation and study at the Chinese Academy of Sciences, Chinese Academy of Forestry Sciences, China Academy of Chinese Medical Sciences and Fudan University. They completed an investigative report on optimizing systems and mechanisms of scientific and technological institutions and colleges, and worked out the “Plan for the Reform of Scientific and Technological System and Mechanism of the CGS”, which was submitted to the leading group of the MLR after consulting the MST.



A discussion on promoting the reform of geological scientific and technological system and mechanism arranged by the CAGS on April 23, 2015

1.2 Carefully Working Out the Plan for the Construction of the State Laboratory of Natural Resources and Energy Safety

According to the instruction of the MLR and CGS, the Academy organized experienced and key personnel to gather and to sort out related information and major scientific problems in both China and foreign countries, to solicit significant and cutting-edge research directions, and to conduct field investigations and seminar discussions. A preparatory plan for the construction of the State Laboratory Natural Resources and Energy Safety was submitted to the MST and the Department of Science, Technology and International Cooperation, MLR after making repeated corrections and improvements on the draft plan.



1.3 Vigorously Promoting Integration of Scientific Research and Geological Survey

Leaders of the Academy and affiliated institutions and centers along with related experts went to the local geological survey centers of the six Large Regions, made investigation and held meetings on cooperation as regards formulating and carrying out geological surveys and research projects, establishing laboratories and training graduates and postdoctoral students. They organized discussions

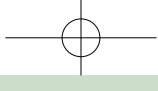


A symposium on the integration of geological survey and scientific research held in Shandong on July 16-17, 2015

and on-site meetings to exchange opinions on the integration of geological survey and scientific research. Special symposiums were arranged on such subjects as orogeny and metallogeny in western China, mineral prospecting in the old industrial bases in northeastern China and modern geological mapping. The Beijing SHRIMP Center built its remote shared workstation (the eleventh one in the world) at the Xi'an Center of the CGS, so as to deepen the "1+6" and "8+6" cooperation mechanisms of linking geological survey and geological research.

1.4 Taking Part in Drafting Suggestions and Programs for Major Research Projects

The Academy organized experts to propose suggestions for the key R&D tasks that would be given high priority in the R&D plan of the 13th Five-Year Plan. Among those projects, "Exploration and exploitation of deep geological resources" was already accepted. The Academy assisted the CGS to work out the program for the development of geological science and technology in the 13th Five-Year Plan period, the international geological cooperation plan and program for the development of geological science, and initiated the formulation of the program for the development of science and technology of the CAGS during the 13th Five-Year Plan period. Besides, the Academy participated in the work of enacting some regulations of the MLR such as the "Interim Measure of the Ministry of Land and Resources for Promoting the Industrial Application of Scientific and Technological Advances".



Chapter II Human Resources and Finance

2.1 Human Resources

The personnel at the CAGS consist of permanent employees (active and retired) and non-permanent employees. Among 2753 permanent positions, 1000 are for not-for-profit public research. By the end of 2015, the actual number of staff was 3645, including 1927 full-time and 1718 retired. Among those who are full-time, 1573 have bachelor's degrees or higher, 1166 have master's or higher degrees. There were 1572 technical professionals, including 14 academicians of the Chinese Academy of Sciences or Chinese Academy of Engineering, 329 research fellows and professor-rank senior engineers, 374 associate research fellows and senior engineers, 586 and 273 researchers with middle and junior professional titles, respectively. Among the professionals, 586 have a doctor's degree, 509 have a master's degree, 331 have bachelor's degrees and 146 received junior college education or below. The Academy now has a contingent of high-caliber talents with Ph.D and master's degrees as the main force possessing strong innovative competitiveness.

In 2015, 1 researcher was selected as a leading young scientist in science and technology innovation by the Promotion Program for Innovation Professionals of the MST, 1 chosen by the National Program for Recruiting 1000 Overseas Top-notch Specialists, and 13 scientists by the National Program for Nurturing and Attracting 100-1000-10000 Talents. 4 received research funds from the National Natural Science Foundation of China for outstanding young scientists, 17 were selected by the Program for Cultivating Leading Talents in Science and Technology of the MLR, 20 by the Program for Cultivating Outstanding Young Talents in Science and Technology of the MLR, 11 research groups were named Science and Technology Innovation Teams by the MLR.

Profile of the newly elected academician

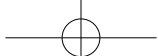
Gao Rui, research fellow of the Institute of Geology, CAGS, was elected academician of the Chinese Academy of Sciences in November 2015, whose major academic achievements and contributions are introduced below. He has long been engaged in geophysical and deep structure, made systematic and creative contributions with international influence on the study of deep-seated structure and structural deformation geneses of the Qinghai-Tibet Plateau and the continental lithosphere in other regions based on deep seismic reflection profiles. He and his team members have completed a survey of deep seismic profiles as long as 7000 km and made a significant contribution to the deep seismic reflection study of China.



Gao Rui in the field work

2.2 Annual Income and Expenditure

In 2015, the actual income of the Academy was 1.95 billion yuan, with a decrease of 9.18% from 2014. The Academy appropriated 86.90 million yuan for purchasing 32 sets of large experimental instruments and equipments. The total expenditure was 1.67 billion yuan.



Chapter III Research Institutions and Major Scientific and Technological Achievements

3.1 CAGS Headquarters

The CAGS Headquarters comprises the following 12 functional divisions and departments: General Office, Division of Science and Technology, Geological Survey Department, Division of Labs Administration and GeoAnalysis, Division of Economic Administration, Division of International Cooperation, Division of Personnel (Division of Production Security), Division of Planning and Finance, Division of Party-People Relation, Division of Supervision and Auditing, Infrastructural Department (Office of Experimental Base for Geological Project) and the Graduate School; 3 administrative centers: Information Center, Administration Center for Retired Staff in Beijing, Logistic Service Center; and 3 research departments: Chinese Geoparks Network, Center for Deep Exploration and Division of Qinghai-Tibet Plateau Research.

Attached to the Headquarters of the CAGS are the following international and national geoscientific organizations and offices: the Secretariat of the IUGS, the Secretariat of the National Commission on China International Program in Earth Science, the World Data Center (WDC) for Geology in China, the Geoheritage Office of the IUGS, the Office of the GSC, the Secretariat of the Li Siguang Geological Science Foundation, the Office of the National Commission on Stratigraphy, the Office of Key Laboratories and Field Scientific Observation and Research Bases of the MLR.

Major Research Achievements

SinoProbe Program

SinoProbe program was in the final stage of the first phase. This program is dedicated to building a three-dimensional probing technology adaptable to the characteristics of deep earth in China and promoting the discovery of major scientific findings, so that China could be a strong country in deep probing technology. Researchers have found a series of significant clues for strategic mineral exploration from the program, and did significant work in data sharing and application of research results. Concrete R&D of the 5,000-ton press was taken up. The CCD-SK was proceeding smoothly and the 10,000m drilling



rig, Crust No.1, was operating normally. Special issues on 3-D probing of deep resources were published in noted Chinese and international journals such as *Chinese Journal of Geophysics* and *Journal of Asia Earth Sciences*.



Special issues on SinoProbe in geoscientific journals



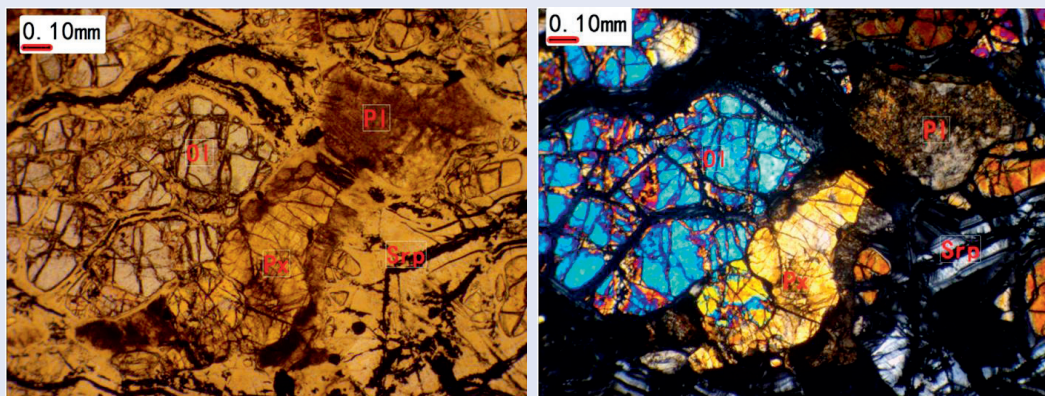
Inaugural meeting of the Centre for Deep Exploration under the CGS and CAGS

Study of Diversity of Geological Heritage Resources

A major investigation project of geological relics in China, completed its work, which proposed the guideline framework for protection and utilization of the diversity geological relics of China, so as to provide a related reference and guideline for departments of land and resources at different levels.

Progress in the Study of Moon and Mars Geoscientific Probing

① Determination of the boundary of mare basalt based on the boundaries of three mare rock types and the prominent elevation difference between mares and terrains; ② Establishment of the 150-order lunar gravity field based on the latest GRAIL data of the US; ③ Compilation of lunar surface age map based



Clinopyroxene olivine observed at the Liuyuan Experiment Ground of Lunar Basalt

on lunar surface roughness; ④ Identification of minerals and lithologies based on typical impact craters. The Symposium on Geosciences in Lunar and Deep Space Exploration was held, and the suggestion for the top-level design of deep space exploration of the MLR was drafted and submitted to the CGS.

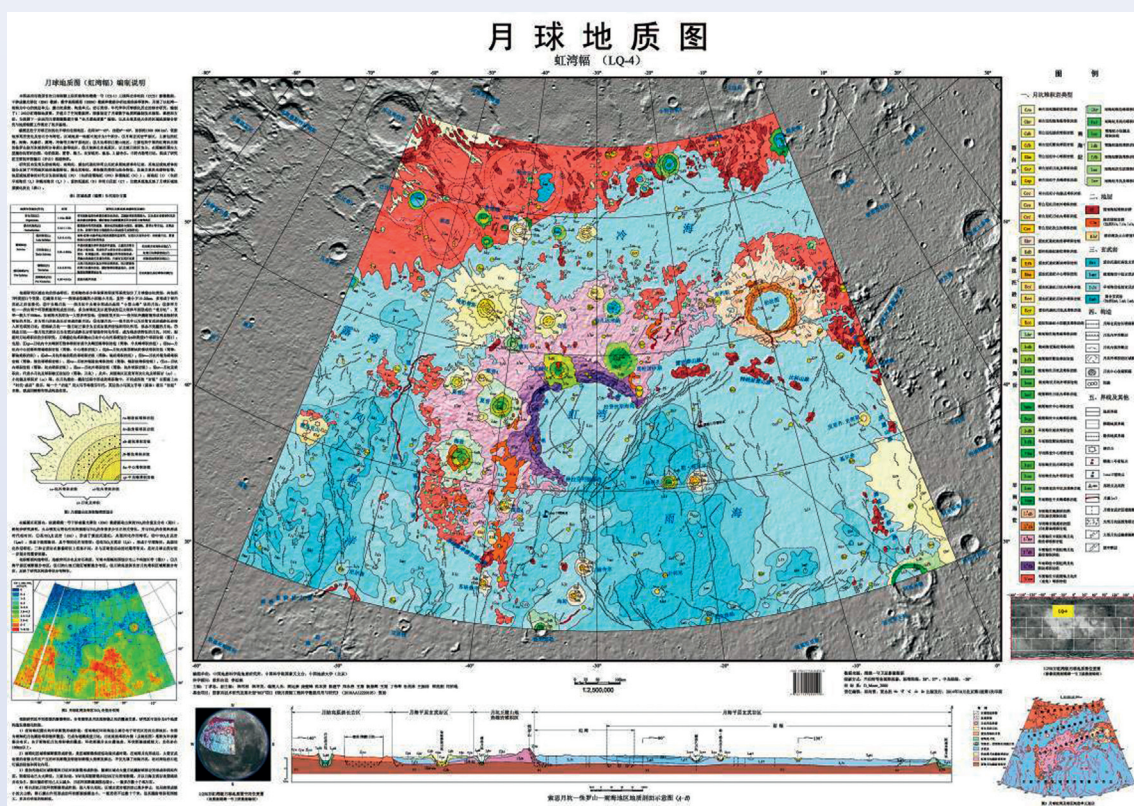
3.2 Institute of Geology, CAGS

Institute of Geology has 6 administrative departments, 11 research divisions, 1 State-level S&T infrastructural platform, and 4 ministerial key laboratories. The National Commission of Geological Mapping, Stratigraphic and Paleontological Center of the CGS, Three-dimensional Geological Survey and Research Center, CGS, academic journal *Petrologica et Mineralogica* and 7 academic organizations are affiliated with this institute.

Major Research Achievements

Numerous Results in Regional Geology and Comprehensive Mapping

Publication of the 1:2,500,000 Lunar Geological Map (Sinus Iridum Quadrangle), *Volume of Geology* of 20 provinces (autonomous regions), 1:5,000,000 Moho Depth Map of Continental Crust of China, and Serial Basic Oil and Gas Geological Maps of China.

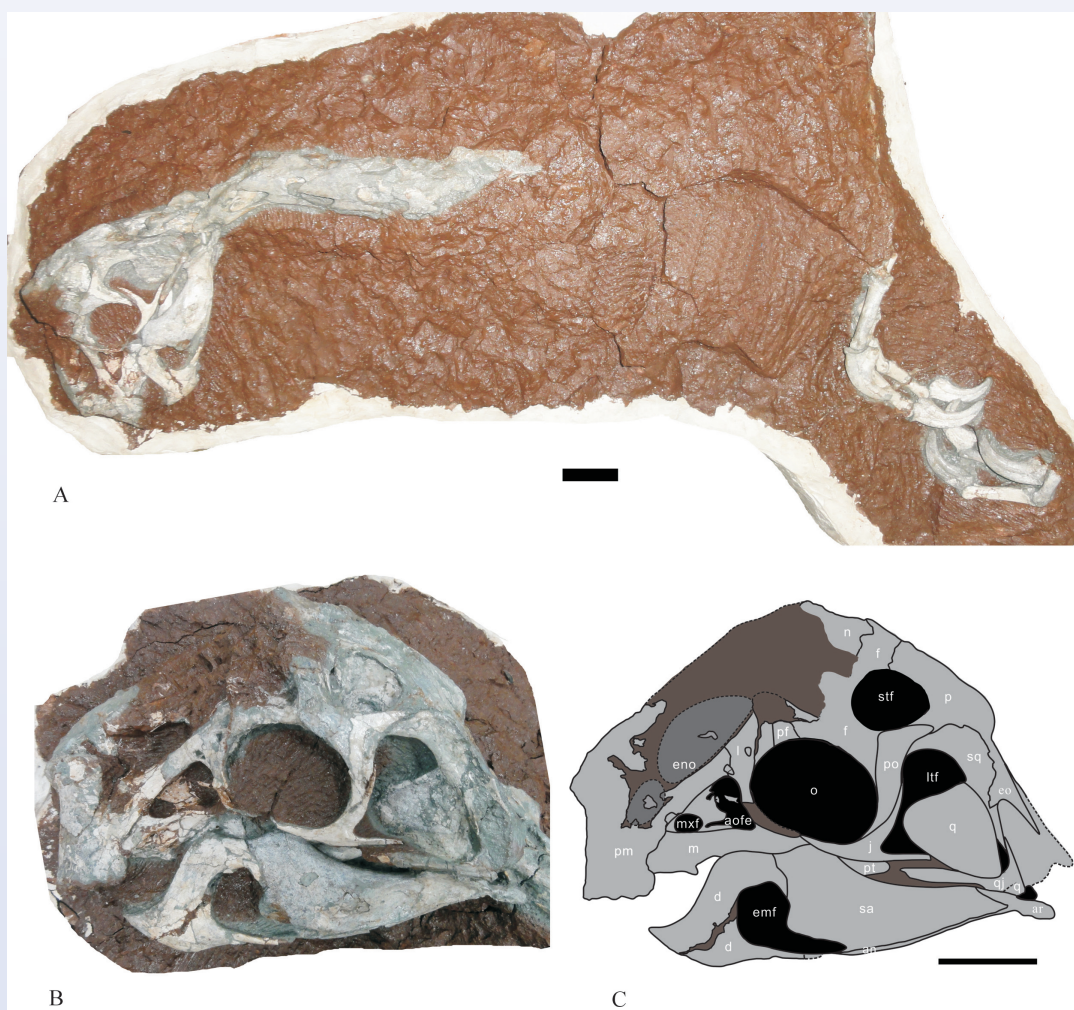


1:2,500,000 Lunar geological map (Sinus Iridum Quadrangle)

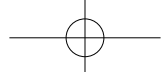


New findings in Stratigraphic and Paleontologic Researches

A new oviraptorid dinosaur, *Huanansaurus ganzhouensis*, was discovered in Late Cretaceous strata in the Ganzhou area, Jiangxi Province; *Zhenyuanlong suni* in the Early Cretaceous Strata in western Liaoning Province; *Orientognathus chaoyangensis* in western Liaoning Province, which is the first pterosaur specimen in the Late Jurassic in this area were reported. These significant discoveries have provided important references and bases for some open paleontologic questions about the evolution of oviraptorid dinosaurs, evolution of *Dromaeosaurus* and birds feathers. Especially a concept of Ganzhou dinosaurian fauna was proposed based on establishing new genera and species, which is of guiding significance in systematic evolution of paleontologic species, paleogeographic distribution and comparison with other fauna in the study area.



The holotype of *Huanansaurus ganzhouensis*



New Understandings in the Study of Metamorphic Geology

The southeastern boundary of the North China craton was ascertained; 1 : 5,000,000 Metamorphic Geological Map of China was compiled and four metamorphic processes were proposed: old craton metamorphic process, orogenic metamorphic process, deep-burial metamorphic process and oceanic bottom metamorphic process. Pilot project of 1 : 50,000 regional geological investigation mapping of Paleoproterozoic structural belts in the North China craton was completed.

New Advance Made in the Research of Granite

Convergence and divergence framework of Mesozoic Asian continent was put forth, providing a basis for studying the tectonic evolution of Asia, especially the process of convergence of landmasses. Nd and Hf isotopic mapping of Qinling granite revealed that deep compositions zoning control mineralization zoning.

Substantial Results Yielded in Researches of the Qinghai-Tibet Plateau

A new type of ophiolite diamond was suggested based on the research of diamond found in the Yarlung-Zangbo suture; a new idea about deep genesis and material recycling of chromite was proposed; Gangdese magmatic arc granulite-facies metamorphism and I-type and S-type granite magmatism formed due to large-scale heating in the lower crust found in the southern Lhasa terrane are regarded to be the sole record of the composition of the lower crust in the Qinghai-Tibet Plateau; The “curve-decoupling” model around the eastern structural node on the southeastern margin of the Qinghai-Tibet Plateau was established; the Wenchuan earthquake deep drilling discovered different deforming processes of the Yingxiu-Beichuan and Anxian-Guanxian fault zones.

Breakthroughs in Ore Prospecting Supported by the Results of Resources and Energy Researches

The continent porphyry copper ore-forming model was improved, which explains that the southern and northern Lhasa terranes have new lower-crust arc terranes to form island arc porphyry Cu-Au deposits, and collisional porphyry Cu-Mo deposits are formed in the new lower crust due to underplating of arc magma; a new type of gold deposits, magmatic gold deposit was identified in Inner Mongolia; researchers thought that the pre-accumulation of gold in the process of magmatism might be an important prerequisite of many magmatic-hydrothermal gold deposits, and that super large magmatic carbonatite REE deposits are likely the product of deep circulation of oceanic crust sediments; this research showed that the ore-forming material of the Bayan Obo deposit came from the mantle instead of multiple resources; comprehensive study of the Pb-Zn deposits in the SSZ belt hosted in carbonate rock of the Zagros orogen in Iran revealed the existence of Si-rich MVT deposits in thrust and nape structures.

Rapid Development of Isotope Analytic Techniques

The advances in this area include the first standard sample for Nd isotopic ratio ($^{143}\text{Nd}/^{144}\text{Nd}$) analysis,



Certificate of the standard sample
for Nd isotopic ratio analysis

received the national certificate. The source condition for zircon (U-Th)/He standard material has been determined; the first accurate quantitative solution method in the world for whole-rock REE research of carbonate has been established; the first single-grain zircon (U-Th)/He dating laboratory in China has been set up and put into use.

Significant Progress in Deep Geophysical Probe

The wide-frequency seismic profile of the northeastern margin of the Qinghai-Tibet Plateau revealed that the North China lithosphere was subducted underneath the Qilian orogenic belt, providing new evidence for the southward subduction of the Asian lithosphere; GPS data, geological and geophysical surveys proved that the Longriba fault is the west-most boundary of the Yangtze block and a new model was proposed, showing that Longmenshan Mt. on the eastern margin of the Qinghai-Tibet Plateau responds to the India-Eurasia collision by way of high-angle thrusting; MT-probing discovered that the middle and lower crust of the Da Hinggan Mountains is composed of relatively soft heated material and the lower crust experienced detachment and delamination.

Development of 3-D Geological Survey Technology

The trial projects of 3-D geological survey established 25 geological models, which have different dimensions and reflect different geological problems, worked out the general survey procedure of geological survey of our country, and developed modeling software and a management system of research results for 3-D geological survey, which have China's independent intellectual property rights.

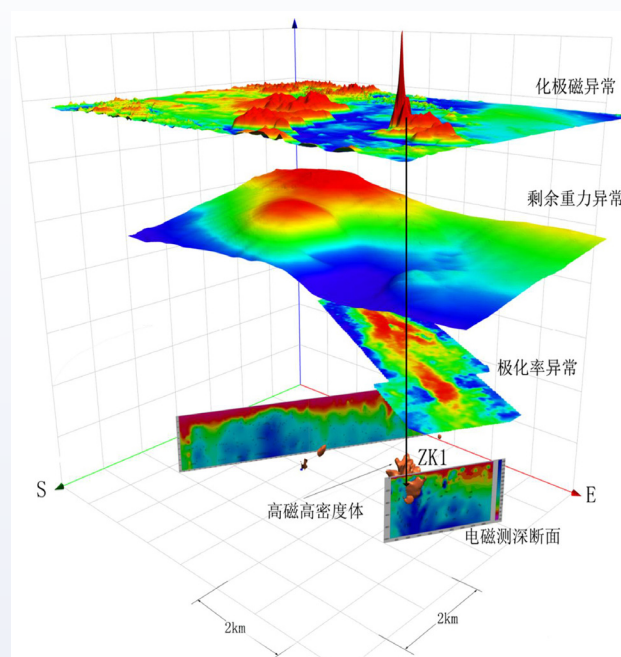
3.3 Institute of Mineral Resources, CAGS

The Institute of Mineral Resources has 10 research divisions (centers), 8 functional divisions and 1 Achievement Transformation Center, 2 ministerial key laboratories. Affiliated with the Institute are Commission on Deposit Geology of the GSC and Commission on Mineralogy of the Chinese Society of Mineralogy, Petrology and Geochemistry. Academic journal *Mineral Deposits* is sponsored by this institute.

Major Research Achievements

Great Progress Made in the Study of Metallogenic Theory and Mineral Prospecting with Package Exploration in the Duolong Area, Tibet

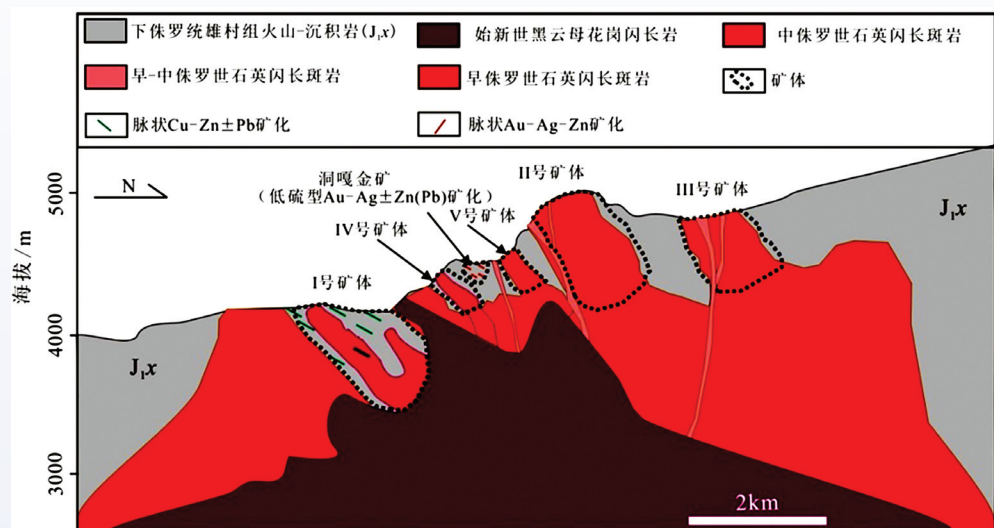
Mineral prediction was carried out in the deep and peripheries of the mining district, breakthroughs were achieved in the Duolong area of Tibet in the past two years. It is found that high-sulfide epithermal Cu (Au, Ag) deposits and deep porphyry Cu-Au deposits in this area are occurred.



The ore-formation model of concealed porphyry-skarn Cu deposits in the eastern Junggar cover area in Xinjiang

Good Results Obtained in both Scientific Research and Mineral Exploration in Xiongcun Village and Nanmulin Basin in Tibet

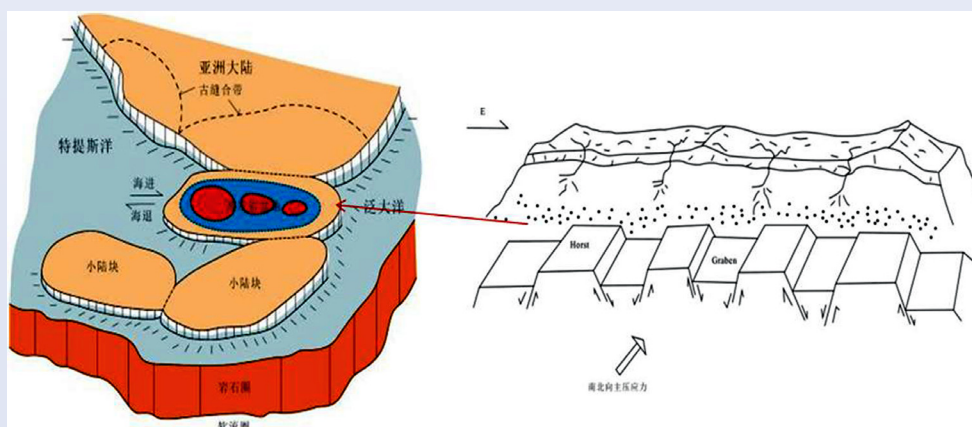
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The metallogenic model of the porphyry-low sulfide epithermal ore-forming system in Xiongcu Village, Tibet

A Breakthrough in the Metallogenic Theory of Marine Potash Deposits in Landmasses of China and Prediction of Target Areas

The study revealed the “structure-provenance-weather” coupling mechanism for the formation of marine potash deposits in landmasses and further put forward the formation model of potash deposits of small landmasses in the east Tethyan domain; the absolute age and the ore-forming age of the potash deposit of the Mengyejing Formation of the Simao basin were obtained for the first time, which provided a new thought and scientific basis for correctly understanding the metallogenic regularity and exploration of the potash deposits in the Simao basin; research showed that brine of the Triassic old salt lake of the Sichuan Basin was already concentrated into separating potash salt, so



A sketch showing the for mation process of collision of small land blocks-secondary basins-lake chain system

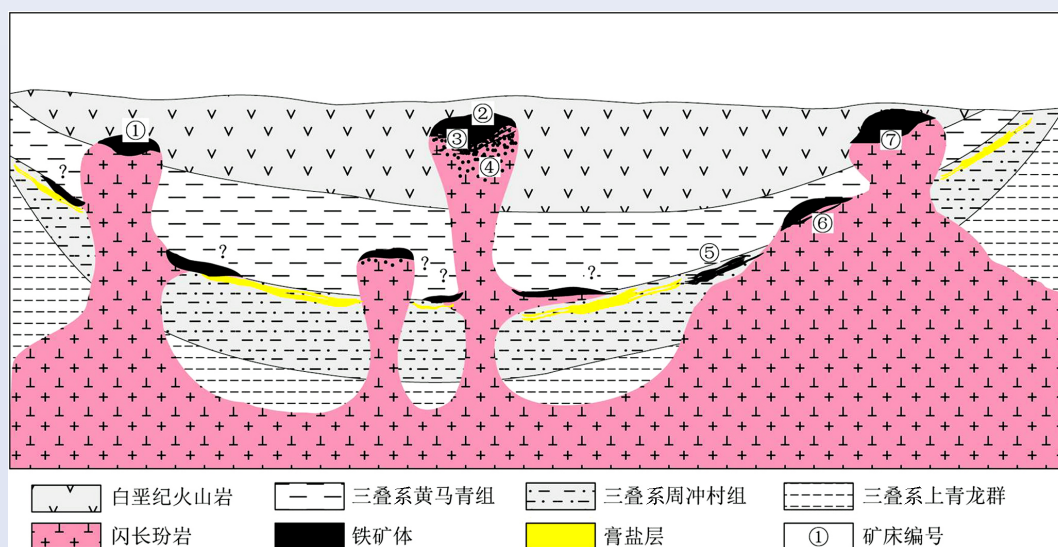
that a long-disputed basic scientific problem about potash prospecting in Triassic strata in the Sichuan Basin was solved, which provided a basic theoretic basis for further research of potash formation and prospecting in the Sichuan Basin. The abundant data and information can be used as an important guidance for planning potash exploration in related basins. Guided by metallogenic theory of potash deposits related to rift, package exploration in the south-central part of the Jiangling depression was carried out and potash-rich brine was drilled by the Jinhui Co., Ltd. to make a breakthrough in potash prospecting.

Significant Progress in Simultaneous Prospecting of both Potash and Gas

The research indicated a great potential and optimistic prospect in prospecting for upper Paleozoic marine-continent argillutite gas resources in the Ordos Basin and moreover for Ordovician salt gas resources. The new W-type “double-bottom pan” model of potash formation presented a scientific basis and clear target for further potash salt exploration. New findings were discovered through Well Zhenjia-I in argillutite gas-bearing series in the upper Paleozoic Carboniferous-Permian marine-continent facies Benxi-Taiyuan Formation and Shanxi Formation, which shows good prospects of the Ordos Basin and is favorable for marine-continent facies shale gas prospecting of our country to make breakthroughs.

Research on the Effect of Oxidized Barrier of Gypseous Salt Beds in Iron Ore Porphyrite Skarn Type

Systematic researches were conducted in the Ningwu and Luzong porphyrite iron ore and Daye and Hanxing skarn iron ore and the work established a three-in-all metallogenic model of porphyrite-skarn iron-pyrite-gypsum deposits to promote the metallogenic theory of porphyrite iron and skarn iron; the



Effect of gypseous salt bed, a new explanation of the Ningwu iron ore deposit model



“two-storey building” metallogenic model of porphyrite iron ore shows that ore magma-skarn rich iron ore bodies (Daye style iron deposits) occur at the contact of deep rock bodies and gypsum beds in the Ningwu and Luzong basins, the sizes may be larger than the “narrowly conceived” porphyrite iron deposits hosted in shallow volcanoes and sub-volcanoes, which have been evidenced by the latest mineral prospecting practice.

Comprehensive Research of Iron-polymetallic Deposits Related to Volcanic and Intrusive Rocks in Northern Xinjiang

The iron-polymetallic deposits in the study area have 3 metallogenic backgrounds, 4 genetic types and 5 metallogenic events related to magmatic eruption and intrusion. Application of Re-Os dating analysis for magnetite solved the difficult problem about the accurate dating of the iron deposits in the study area, indicating that multi-stage and superposed mineralization might be the main cause responsible for the complex composition of ore-forming elements, the study made assessment for multipurpose utilization of paragenic/associated elements, which provided a basis for finding out control factors in the exploration of iron-polymetallic deposits in northern Xinjiang. 14 target areas were outlined and three 1:500,000 and 1:250,000 metallogenic regularity and mineral prediction maps were completed.

Discussion of Paragenesis and Separation Mechanism of Elements from Skarn Metallic Deposits and Application — a Case Study of the Southeast Hubei Province

The study proposed paragenesis and separation mechanism of Cu and Fe, and Cu and W in skarn metallic deposits. The study shows that deep layers of the known skarn iron deposits have potential for skarn copper and iron ore. A metallogenic model was established, showing the skarn gold ore and the peripheral disseminated gold and silver ore in the surrounding areas have the same metallogenic system. This enriched the metallogenic theory of skarn ore deposits and opened more prospecting opportunities. The study also revealed that the surrounding areas of the ore-forming belts of porphyry-skarn ore deposits in the middle and lower valleys of the Yangtze River have potential for far-end disseminated Au and Ag deposits.

Comprehensive Research on Guaranteed Capacity for Energy and Resources During 2020—2030 in China

Based on the research results of single-ore guarantee capacity of energy and analysis of energy situations of China and foreign countries, systematic research of supply capacity, shortage of supply and demand, guarantee capacity and foreign availability of China in the coming 15 years was conducted and related countermeasures and suggestions were proposed: ① Deepening energy system reform and releasing efficiency of system; ② vigorously developing coal-producing gas and oil to guarantee energy safety and promoting industrial upgrading; ③ actively developing nuclear energy and optimizing energy structure; ④ implementing and improving policies for non-conventional energy exploration; ⑤ speeding up the

construction of oil and gas pipeline networks and emergency response systems of energy;
⑥ carrying out a large number of energy projects.

Subduction of the Lower Crust of India: Zircon Hf-O and Whole-rock Li Isotopic Evidence of Cenozoic Potassic-ultrapotassic Volcanic Rocks on Tibet

The research revealed that the Potassic-ultrapotassic and Mg-rich potassic volcanic rocks in Tibet originated from partial melting of subcontinental lithospheric mantle and were metasomatized at varying ratios by the lower crust of India, which was subducted towards and beneath the Lhasa block in the early and middle Miocene. A Genetic models of Potassic-ultrapotassic and Mg-rich potassic volcanic rocks were proposed.

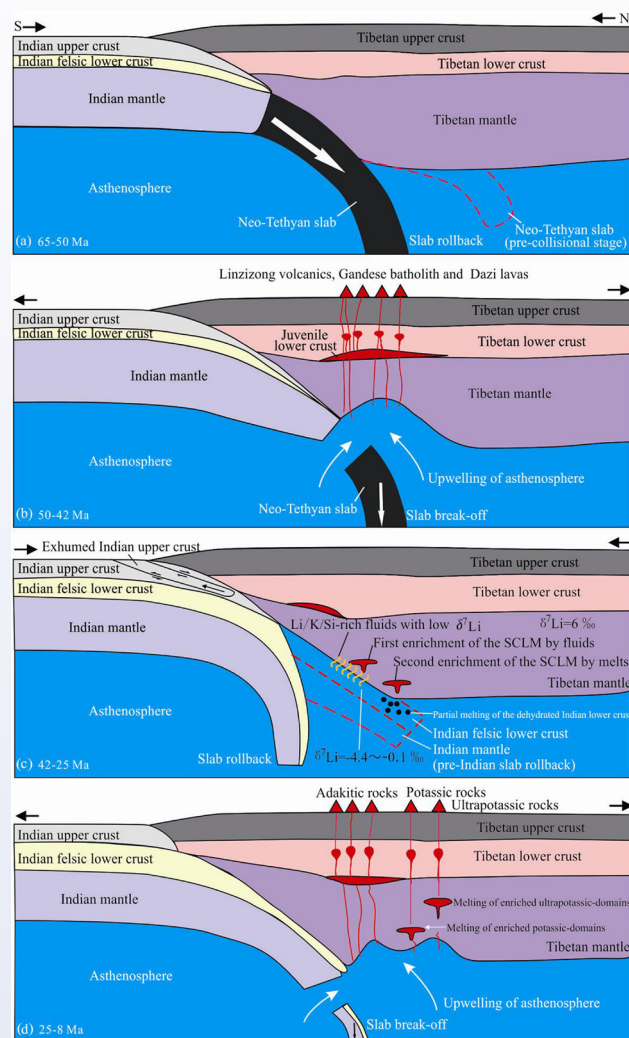
3.4 Institute of Geomechanics, CAGS

By the end of 2015, the institute had 197 employees, including 108 with doctoral degrees, 44 with senior professional titles and 56 with associate senior professional titles. The institute have 8 research divisions, 5 functional divisions and 2 public-service departments; 2 ministerial key laboratories, 2 field scientific observation and research bases, 1 CGS key laboratory, 1 CGS administrative center and 2 CAGS key laboratories.

Major Research Achievements

Early Neoproterozoic Diabase Sills in the Liaodong Peninsula and Regional Uplift of the Southeast Part of the North China Craton

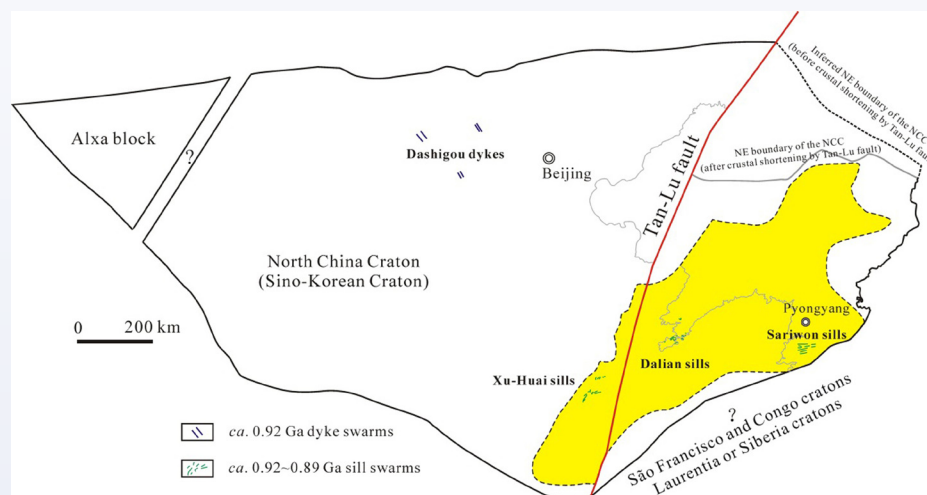
Considerable diabase intruded in Neoproterozoic sedimentary strata of the Liaodong Peninsula, emplacement ages of 920 to 890 Ma was confirmed through zircon U-Pb and baddeleyite Pb-Pb dating technique, it was considered for a long time as diabase sills intruded in Triassic strata. The study



A sketch showing the structural model of diagenesis of potash-super potash volcanic rock in the Lhasa block



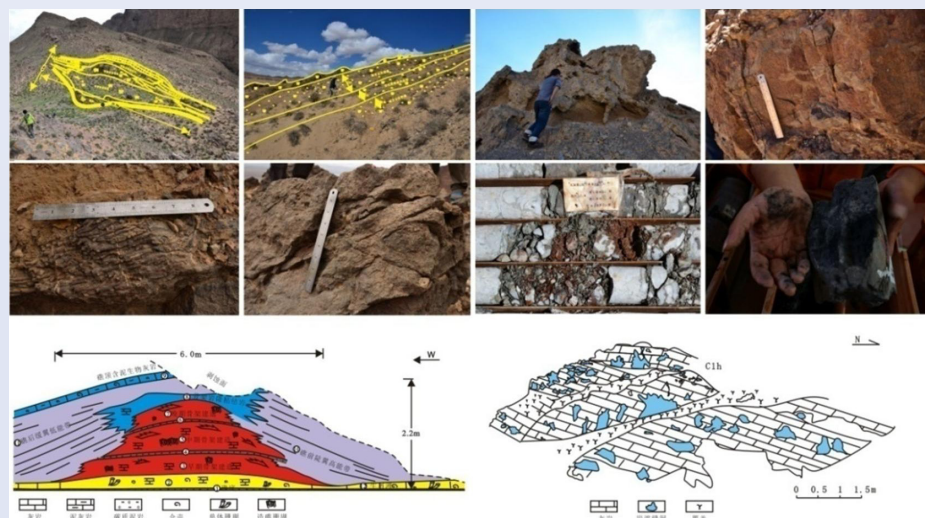
showed that this extensively distributed diabase sills and associated regional uplift are related to the dismembering of the Rodinia super continent in the east part of the North China craton. The result of this research was released in *Precambrian Research*.



A sketch showing the spatial distribution of diabase sill (929 to 890 Ma) in the eastern part of the North China (China-Korea) craton (allowing for the influence of the left-hand strike-slipping process of the Tanlu fault)

Research of Qaidam Basin

Several suites of marine hydrocarbon source rock were found in Sinian-Carboniferous strata of the Qaidam Basin, which are favorable for hydrocarbon formation. There develop two suites of hydrocarbon source rock from Sinian Quanjia Group to lower Paleozoic in the Oulongbuluke area on the northern margin of the Qaidam Basin. Bioherms and paleokarst were found in the Carboniferous Stratum, which can provide sufficient space for hydrocarbon reservoirs.



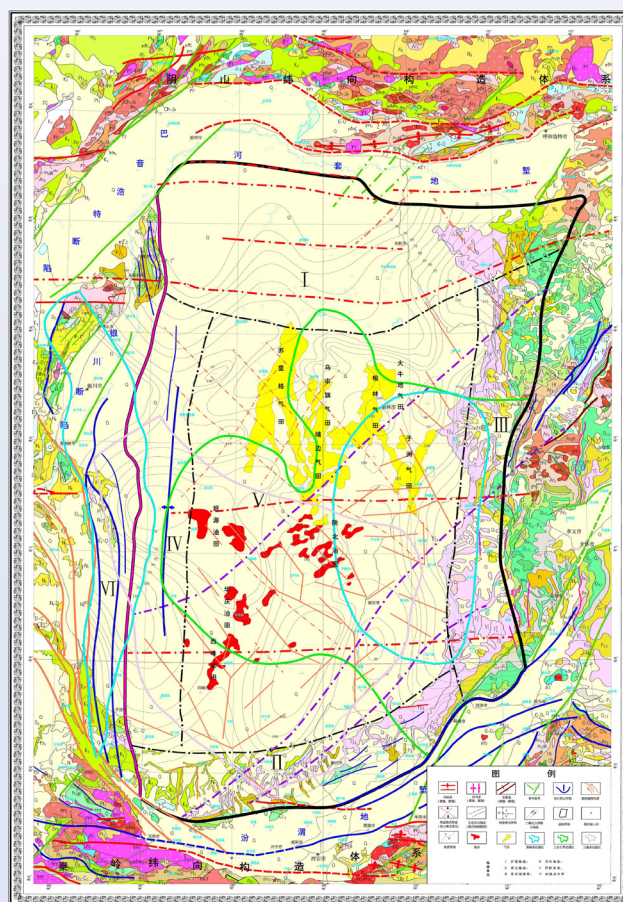
Characteristics and distribution of Carboniferous bioherms and paleokarst in eastern Qaidam Basin

Early Structural Deformation on the Northern Margin of the Altun Mts. and Mineral Prediction of Gold-polymetallic Ore Deposits

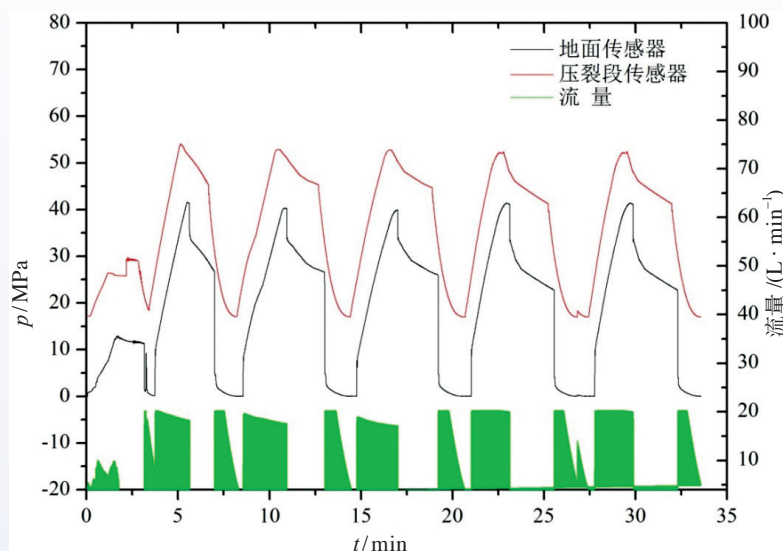
The study proved that the northern margin of the Altun Mts. and the North Qilian Mts. are in the same structural belt and have good mineralization potential. The magmatism in the middle Neoproterozoic in the West China plate, where this structural belt lies, is closely related to the dismembering event of the Rodinia subcontinent. The study discovered a rock body with an age of 1.93 Ga and direct evidence of 2.0 to 1.8 Ga thermal event of the Paleoproterozoic on the northern margin of the Altun Mts., which is of great importance to research into the structural evolution of the Tarim plate. The formation age of the brittle-ductile shear zone on the northern margin of the Altun Mts. and its geodynamic background were ascertained by the study. The age is between Early Ordovician and early Late Jurassic, which is coincident with that of the closure of the north Altun Ocean. Its geodynamic background is the oblique collision and convergence of the Tarim plate and Azhong landmass. A 600m long Cu mineralization belt with favorable prospect was found around the Hongliugou area on the northern margin of the Altun Mts.

New Advance Made in the Research of Oil Control of Structural System in Central and Eastern China

The prototype of Paleozoic basin controlled by the ancient structural system and its superposing (composite) history were reconstructed for the first time. The research discussed characteristics of basin-control and oil-gas-control source areas oil-gas-control belts in structural systems. Some new models of oil-control structures were established or improved and specific favorable structural positions were located. The research summarized the general rule of oil-gas-control distribution in structural systems. Classification and evaluation of favorable regions and belts were conducted based on formation conditions of oil-gas reservoirs, especially oil-control distribution of structural regularities, and target areas for oil-gas prospecting were proposed.



Structural system map of the Odors Basin and adjacent regions



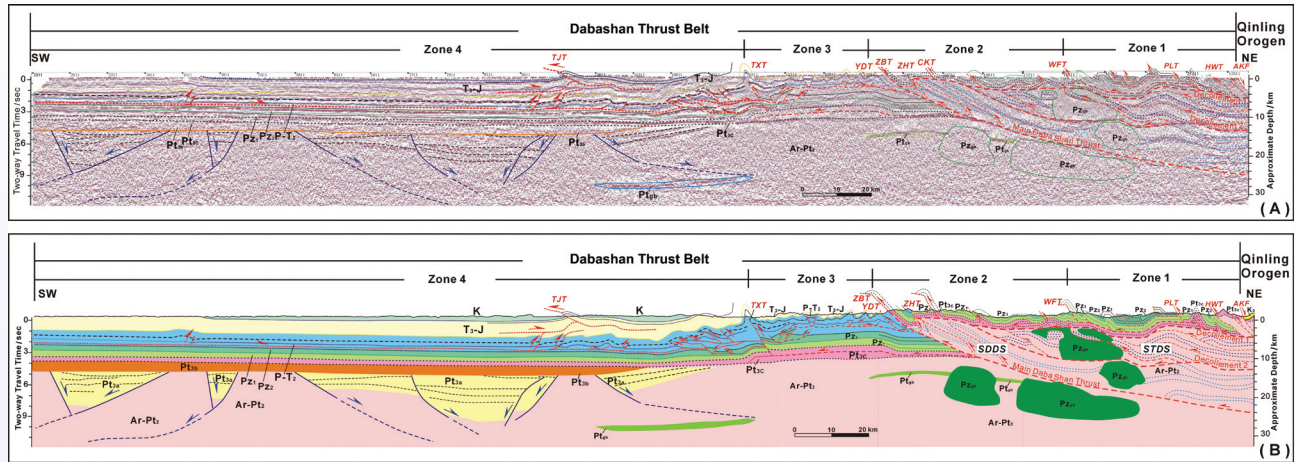
Stress measurement at a depth of 1698 m of Well Yidi-II with the hydraulic fracturing technique

Breakthroughs Made in the Application of Crustal Stress Measurement to the Investigation and Assessment of Shale Gas Resources

In consideration of practical needs for crustal stress measurement in the exploration and development of shale gas resources, researchers continuously improved the capacity of crustal stress measurement and completed tests with the hydraulic fracturing technique at a number of measurement points in Well Yidi-II (depths of 588-1698 m), yielding strengths and directions of the in-situ crustal stress of the borehole. The measurements served as basis data for the exploration of natural gas, tight sandstone gas and shale gas in the Zigui basin and Wulingshan area. Meanwhile, a breakthrough was made in applying the hydraulic fracturing technique at large depths of small-caliber wells. The test depth is the largest to date in China according to released reports.

Explanation of the Deep Reflection Seismic Profile of the Dabashan Structural Belt and Research of Balanced Geological Section

The research completed the explanation of the deep reflection seismic profile of the Dabashan structural belt, and found out the deep crustal and lithospheric structure of the Dabashan Mountains. The balanced geological section delineates the fine deformation of the upper and middle crust of the Dabashan Mountains, indicating a decrease of >130 km of the inner deformation, which was strong enough for the transformation of the mafic lower crust on the northern margin of the South China plate from granulite to eclogite facies and thus the density and weight would increase to bring about slab pull which is a key to continuous continent-continent convergence of the South China and North China plates. The report on the research results can be found in *Tectonics*.



(A) Deep reflection seismic profile of the Dabashan structural belt and (B) sketch diagram of fine deformation of the upper and middle crust

Antarctic Geological Investigation

① Natural seismic observation revealed high-precision 3-D deep structure of the crust and mantle of the Antarctic continent and adjacent sea areas. ② The researchers sorted out the data of mineral resources and did assessment and analysis for key mineralized areas. ③ Analysis was conducted for the formation conditions and favorable zones of oil and gas resources on the marginal areas of Antarctica. ④ Potential evaluation of major fishery resources around Antarctica was done. ⑤ Potential evaluation of microbial resources of the Antarctic continent and adjacent seas was done, which identified a series of new species, new genera and new products. ⑥ Investigation of geological and mineral resources was conducted based on Australian airborne network and logistic guarantee in the North Prince Charles Mountains, Mount Tremblant, Vestfold Hills and Windermere Islands, which are far from the Zhongshan Research Station of China. Geological and mineral resources investigations were carried out in cooperation with Chilean scientists in the Antarctic Peninsula and South Shetland Islands. The researchers identified metamorphic process from the blueschist facies to the green schist faces in the Smith Island, which providing a lithological constraint on the accretional process of the cold subduction zone.



Field investigation on blueschist at the Smith Island of the South Shetland Islands (the 31st Chinese Antarctic expedition in January 2015)



3.5 Institute of Hydrogeology and Environmental Geology, CAGS

By the end of 2015, the institute had 540 permanent employees, including 316 active and 224 retired staff; 1 academician of the Chinese Academy of Engineering, 2 members of the Russian Academy of Natural Sciences, 8 doctorate supervisors and 3 scientists with the special government allowances. Among the employed staff, 57 were at administrative posts, 248 at professional and technical posts, and 11 at logistic posts. 40 researchers and scientists had senior professional titles, 49 had associate senior professional titles and 126 had middle professional titles. The institute had 8 administrative divisions, 16 research and business divisions and 3 logistic support departments. Affiliated with the institute are the China National Commission of the International Association of Hydrogeologists, Commission on Hydrogeology, Commission on Geothermal Resources and Commission on Agricultural Geology of the GSC, Investigation Center of Geothermal Resources of the CGS, and the Mineral Water Product Quality Supervision and Inspection Office of Hebei Province.

Major Research Achievements

Investigative Report on Groundwater Quality and Pollution of China

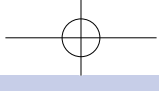
This report indicated that one third of the groundwater of our country can be sources for direct drinking, one third is for drinkable water after treatment and the other one third cannot be used for drinking. The report basically covers the quality, formation and evolution regularity of groundwater and major types and distribution of groundwater pollution in China, and provides a basis for drafting other relevant regulations of the country.

Geothermal Resources in China

This report, in terms of annals and records for the first time, presents systematic and comprehensive description of China's geothermal spots and representative geothermal boreholes. This book incorporates the data of 2767 representative geothermal points of hot springs (groups) and systematically expounds the occurrence background, distribution, characteristics and quantity of the geothermal resources in China. It describes the factual situation of the development and utilization of geothermal resources of our country and the exploitation and research level in this aspect, so this report is of significance as a historic material.



Distribution of hot springs and geothermal wells of China
(After 《2015 Annual Report》 Chinese Version)



Key Technology and Demonstration Project of Groundwater Recharge in Typical Areas of the North China Plain

Taking the Gaocheng District of Shijiazhuang City as a typical case, a demonstration project was completed for automatic groundwater monitoring. The project developed and summarized a set of high-efficiency recharge system and a key technique of block-preventing treatment; a three-tiered groundwater numerical simulation and coupling model and a groundwater management system were established. The project summarized the types, major patterns and sub-patterns of artificial recharge of regional groundwater.

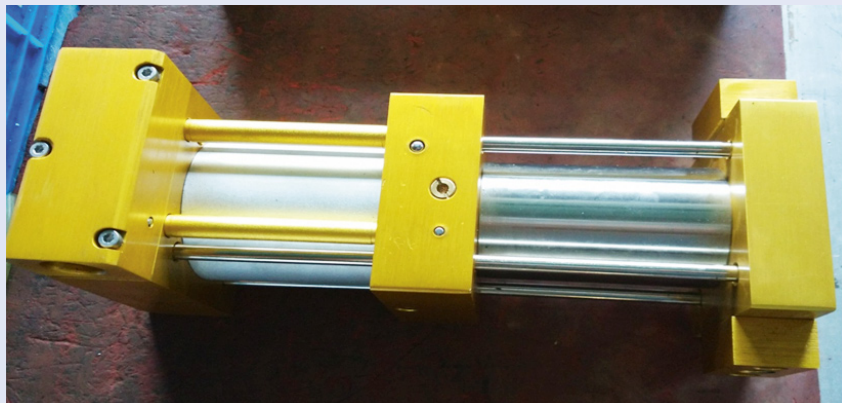
A panoramic view of the demonstration project of groundwater recharge



Radionuclide Dating and Sampling Device of Groundwater Radioactive Inert Gases

A device for radionuclide dating and sampling of groundwater radioactive inert gases operated under positive pressure was developed, which can effectively avoid atmospheric pollution during sampling and is potable and convenient to use.

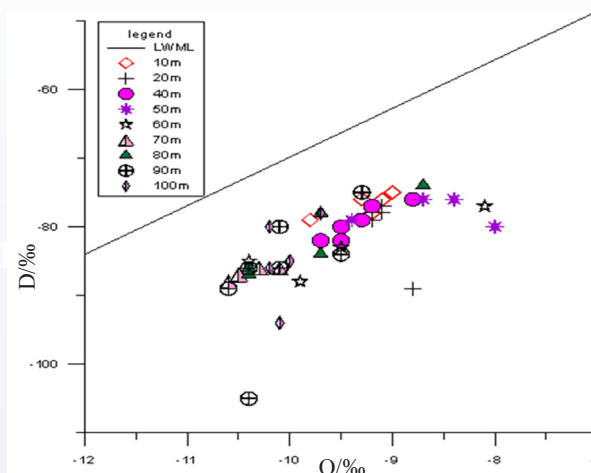
Water-driving pressure pump



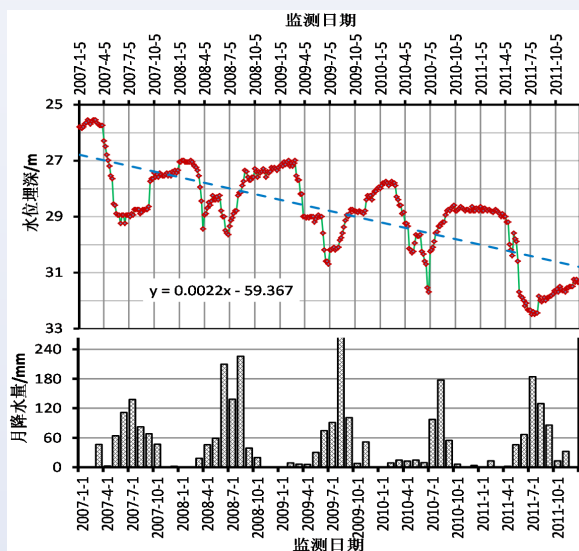


Influence of Reverse Osmosis in Weakly Osmotic Layers on Salt Migration in Groundwater

Taking all usable cores of the 110m deep drill hole of the Hengshui experiment site as the study object, this research conducted analysis of isotopic and water mechanical features of clay water and did a test for distinguishing rainwater percolation and downward migration of salt by means of characteristic differentiation. In consideration of different features between squeezed water from clay and porous water, researches found out the migration traces and interactive relationships of groundwater in aquifers.



A diagram showing isotopic characteristics



A diagram showing fluctuation of groundwater table and precipitation since 2007 in typical agricultural areas of North China

Identification of Interactive Threshold of Precipitation Variation and Intensity of Irrigation Water Utilization

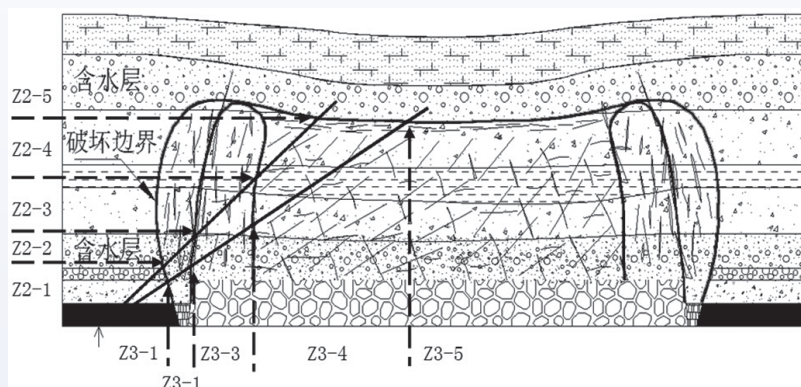
The fluctuation of the shallow groundwater in agricultural areas of North China is characterized by rising at a “cm/d” order (>1.0 cm/d) during the main irrigation period while falling at a “mm/d” order (<1.0 cm/d) during the non-irrigation period. Such features are closely related to precipitation and precipitation distribution within a year. Large-scale intensive tapping of groundwater in agricultural areas is the dynamic cause of the drop of groundwater table at an order of “cm/d”, and large thick vadose zones (≥ 15 m) are an important condition of the rising of shallow groundwater at a “cm/d” order in agricultural areas.

Study of Mechanism for the Influence of Structural Variation of Aquifers Driven by Group Coal Mining on Regional Water Circulation

The study focused on structural and thickness variation of aquifers while coal mining; proposed the formula for determining thicknesses of variation aquifers based on identification of key confining beds, calculation of free space height and comparison of free space and maximum deflection; reclassified the overlying aquifers of goafs, defined the range of variation aquifers as the water-table sudden-drop zone and the layers above variation aquifers as the water-table fluctuation zone. Permeability and dynamic

regularity of the water-table sudden-drop zone and water-table fluctuation zone were also studied, the influence of coal mining on structural variation, water table and water pressure of aquifers were analyzed in Changye Basin.

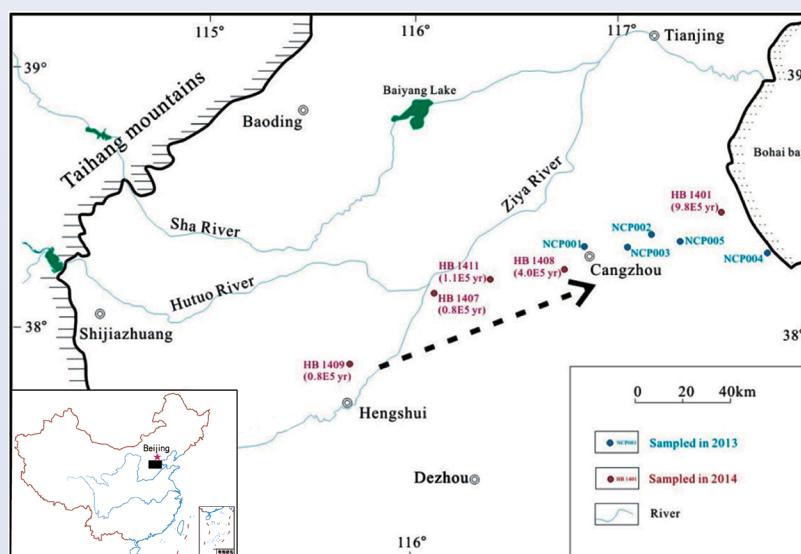
A sketch showing structural variation of the aquifer on coal roof



Dating of Ancient Groundwater of Confined Aquifers in the Coastal Areas of the North China Plain

The research team for the first time collected ^{81}Kr gas samples from deep confined aquifers in the coastal areas of the North China Plain, the dating result indicated that the ages of part of groundwater samples are as old as 1 Ma (far older than the upper limit with the ^{14}C dating method), showing that the deep groundwater of this area is attributed to “non-renewable” resources with very low renewal rate. This is quite different from the result obtained with the conventional ^{14}C method. Therefore, it is necessary to do reevaluation of the resources attributes and renewable rate of the groundwater here.

A diagram showing the groundwater sampling site and ^{81}Kr age
(After 《2015 Annual Report》 Chinese Version)





3.6 Institute of Geophysical and Geochemical Exploration, CAGS

By the end of 2015, the Institute of Geophysical and Geochemical Exploration (IGGE) had 371 employees, 280 of which were professional technicians, including 1 academician of Chinese Academy of Sciences, 69 with senior professional titles, 59 with associate senior professional titles, 38 with doctorate degrees, 119 with master's degrees. The institute had 7 functional departments and offices, 4 service departments, 11 research divisions, and 1 company. The UNESCO Global Scale Geochemical International Research Center (under construction), National Modern Geology Exploration Engineering Technology Research Center, 1 ministry-level geochemical exploration supervision and inspection center, 2 ministry-level key open laboratories, 1 geologic survey service center, and 1 academy-level key laboratory were IGGE-based. Associated with the institute were the Commission on Exploration Geochemistry, Commission on Geophysical Prospecting and Commission on Non-Destructive Inspection of Pile Foundation of the GSC, and the Geological Exploration Technical Subcommittee of the China National Technical Committee for Standardization of Land and Resources. The IGGE is entitled to grant master's degree of geodetection and information technology.

Major Research Achievements

A Report on Arable Land Geochemical Research of China (2015)

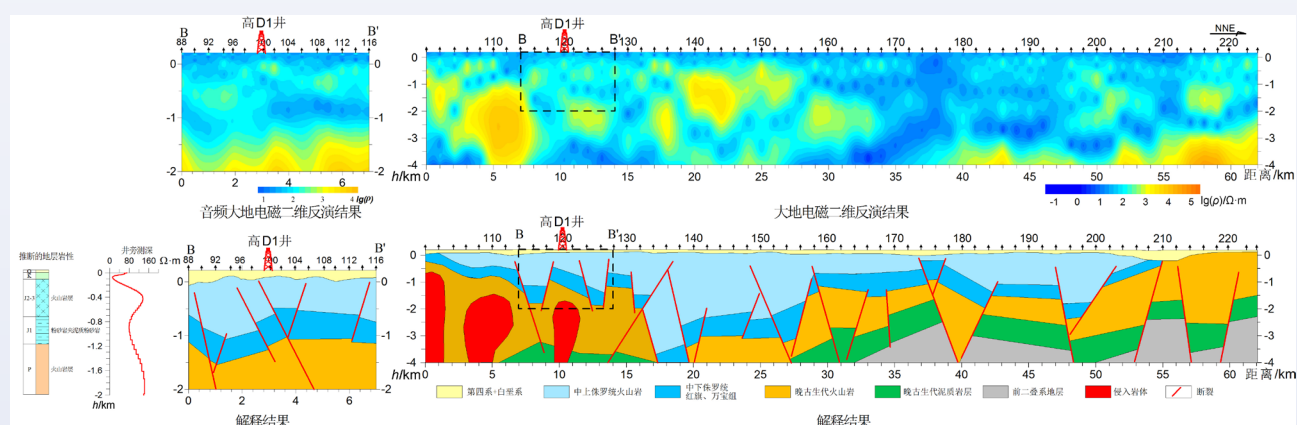
For the first time, we systemically verified the geochemical situation of the land in China and briefly summarized the research results of land quality in the past 15 years. We formally issued *A Report on Arable Land Geochemical Research of China (2015)* on June 25, 2015, which presented significant assessments on the geochemical situation of the arable land throughout China.



Distributions of selenium-rich green land in various areas
(After 《2015 Annual Report》 Chinese Version)

Geophysical Investigation of Oil and Gas Resources on the West Margin of the Songliao Basin

New progress was made in the physical investigation of oil and gas in the Songliao basin. By means of the non-seismic geophysical comprehensive geological survey, we found three sags in volcanic rocks under the cover area, which were verified by the "high ZK1 hole" conducted by the Shenyang Geological Survey Center of the CGS. Combustible gas was discovered under the thick layer of volcanic rocks at a depth of 862.55 m. The interpretation model for the division of Mesozoic and late Paleozoic strata of deep geological structure was built, providing a basis for the research of deep structure of the major faults on the west margin of the Songliao basin and the control factors on the formation of the basin, and also a strong technical support to oil and gas geological survey on the western margin of the Songliao basin.



2-D inversion and interpretation results of the sounding WT-3 in the Gaoliban area

Breakthroughs Made in the Research of Geochemical Theory for Deep Mineral Exploration

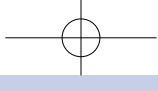
Studies found that multi-attribute geochemical anomalies exist in the metallogenic system of hydrothermal nonferrous metals, and the researchers put forward the multidimensional anomalous system, which is a basic applied geochemical mineral exploration theory for the prediction of deep ore deposits. Using negative anomalies of elements, we could define the boundary of the hydrothermal mineralization system effectively. At the same time, we also developed the three-dimensional anomaly structure model and visualization system, realized geochemical anomaly structure modeling and visualization analysis, and constructed the mineral resource potential evaluation method on the basis of the principle of multidimensional anomaly system. In Jiaojia Gold Mine, West Shandong province, from micro pores in thermal magnetic components of the soil, we found gold pure metallic particles with dozens to hundreds nanometers in diameter, which provided microscopic evidence for effectiveness and mechanism of the analysis. Completed the "integration processing system of medium to large scale



Anti-interference Seismic Detection Technology for Deep Metallic Ore is Getting Mature

Figure 1 consists of two main parts. The left part is a seismic profile showing a cross-section of the study area. The vertical axis represents depth in kilometers (h/km), ranging from 0 to 1.65. The horizontal axis represents distance in kilometers, ranging from 0 to 500. A red-shaded area indicates a fault zone. The right part is a stratigraphic column with layers numbered 1 to 22. The vertical axis represents depth in meters (m), ranging from 0 to 1500. The column shows the lithology of each layer, including 辉长岩 (Gabbro), 辉长闪长岩 (Gabbro-diorite), 闪长岩 (Diorite), and 闪长角闪岩 (Diorite amphibolite). The column also includes a column for '岩性描述' (Lithology description) and a column for '柱状图' (Columnar diagram).

26



3.7 Institute of Karst Geology, CAGS

By the end of 2015, the Institute of Karst Geology had 215 active employees, including 1 academician of the Chinese Academy of Sciences, 34 with senior professional titles, 45 with associate professional titles, 141 with doctor's and master's degrees. The institute had 8 functional departments, 9 research divisions (centers), 2 ministerial key laboratories and 1 key laboratory under the CGS.

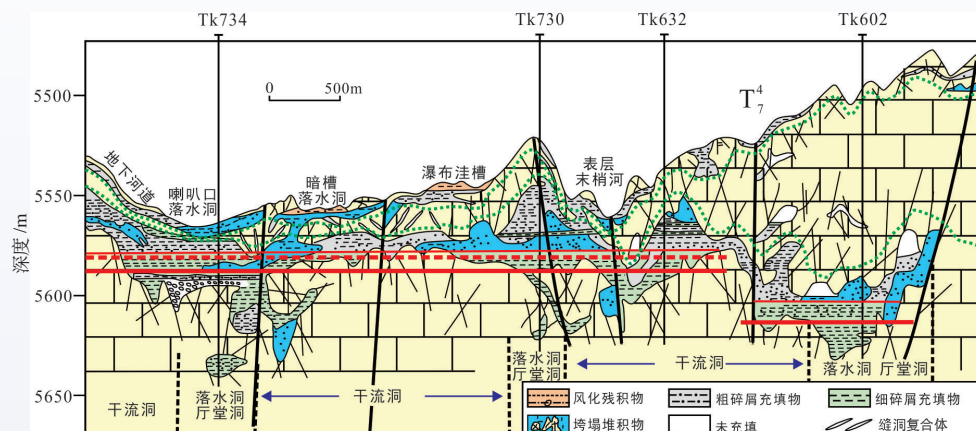
Major Research Achievements

Study on the Technologies of Water and Soil Conservation in Karst Peak-cluster Depressions

Researchers built the Guohua demonstration site of comprehensive control of karst rocky desertification in Pingguo County, Guangxi; carried out scientific and technological experiments and controlled demonstrations for water and soil shortage and local dweller poverty; innovated on water and soil leakage theories, investigation and evaluation of approaches and water-soil joint treatment models; and developed the compound storage and transferring ecological control technologies of epikarst water in rocky desertification areas, landscape ecological technologies of land consolidation under various environments of water and soil leakage, and technologies of karst soil pitaya planting and production management. The technologies for karst soil pitaya planting and production management include: karst soil improvement and fertility cultivation technique, pitaya and night blooming cereus grafting technique, grafting seedling technique, pitaya grafting and pollinating technique, pitaya pollen storage and preservation technique, pitaya flower and fruit retention technique. All these techniques have been popularized and used in more than 20 counties and cities. These scientific research achievements were released in numerous reports by various media such as CCTV, Guangxi TV, Science and Technology Daily, Guangxi Daily and China Land and Resources News.

Study on Karst Fissure-Cavern Filling Process and Mechanism under Surface and near Surface Conditions

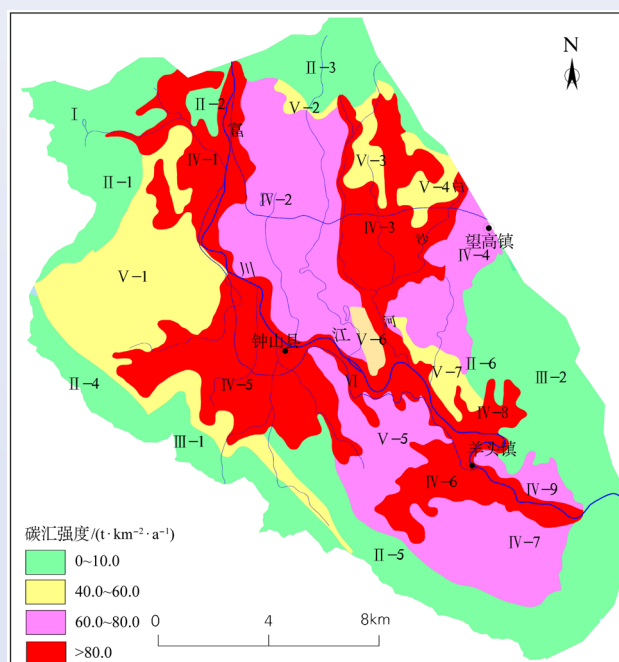
The study revealed the formation mechanism of the carbonate fissure-cavern system in the Tahe oilfield, established fissure-cavern system filling patterns in various karst zones, and identified the relationship between the paleokarst distribution and oil-gas accumulation. The research results were successfully applied in the secondary development of the Tahe oilfield of Sinopec North-West, with a 5% increase of oil recovery, and also in the exploration and production of carbonate reservoirs of CNPC Tarim oilfield company to enhance the oil well completion ratio.



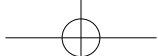
Filling patterns of the paleokarst fissure-cavern system in the Tahe oilfield

Geological Investigation and Comprehensive Evaluation for Addressing Global Climate Change

Investigations of the karst basin in Zhongshan County, Hezhou City, Guangxi were carried out and the carbon sequestration of the basin was estimated by using the hydrochemical equilibrium-runoff method. The results showed that in the Zhongshan karst basin, 2.32×10^4 t/a CO_2 was consumed from air/soil due to rock dissolution and weathering, and its carbon sink capacity, constrained by the geological and hydrogeological conditions, was shown to be high in the middle and low in all sides. The extraction and analysis method fit for AAPB in karst water was firstly made to study the stability of karst geological carbon sink. The results showed that there existed AAPB in the Maocun karst underground river. It was proved by the ^{14}C labeling experiment that the microbial carbon flux accounted for 0.2% of the total inorganic carbon in the outlet of the Maocun underground river under light conditions. The aragonite stalagmite LHD1 from the Lianhua Cave in Xiangxi, Hunan Province was studied for the reconstruction of local drought-flood variation in the past 500 years with an average resolution of 1.5 years. By comparing the stalagmite records with relevant historical documents, it was found that the stalagmite $\delta^{18}\text{O}$ records indicated the local drought-flood variation accurately. To study the



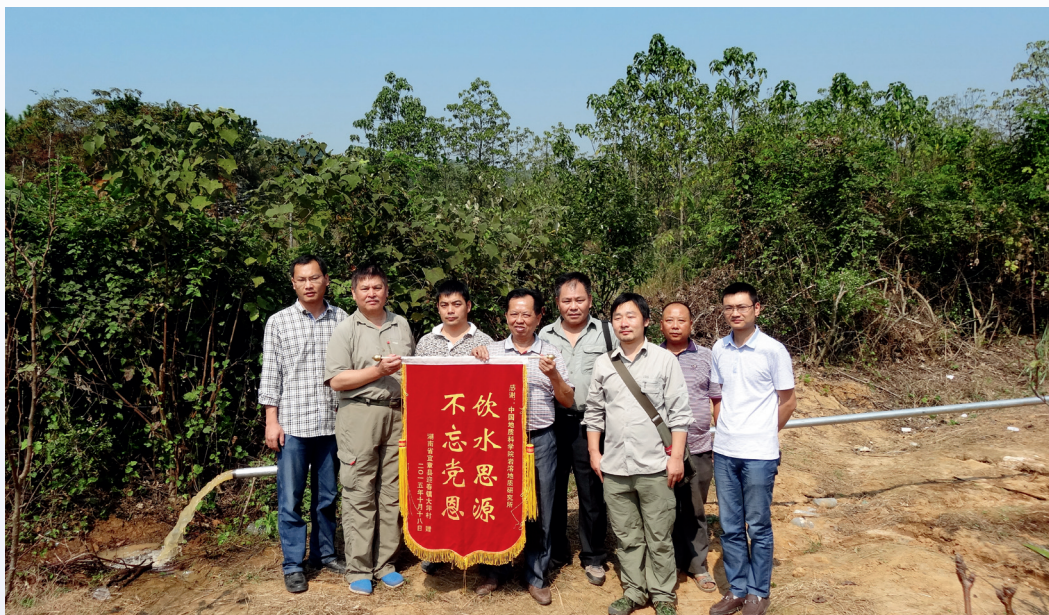
Geological carbon sink capacity of the Zhongshan basin



regional differences between the Medieval warm period and the Little Ice Age, 13 lake sediments, 7 cave sediments and 7 peat study sites in China monsoon region were selected for a comprehensive integration, and a preliminary investigation was conducted on the regional dry-wet distribution and evolution of China monsoon region during the Medieval warm period and the Little Ice Age. Besides, in 2015, the geological investigation information system for addressing the global climate change was developed, the construction standards and technical requirements for geological carbon sink and geological data banks were improved, 17 papers in Chinese core journals and 2 papers in SCI were published.

Hydrogeological and Environment Geological Survey of Key Karst Drainage Areas in South Hunan Province and North Guangdong Province

The hydrogeological and environment geological investigations were conducted in key karst drainage areas in south Hunan Province and north Guangdong Province, with a total investigating area of 2,300 km², including 91 karst springs and 23 underground rivers. Comparing with the survey at a scale of 1:200,000, 65 new karst springs and 6 underground rivers were found, and the records of 3 underground rivers were revised, thus enhancing the accuracy of investigation. Besides, the regional hydrogeological conditions were found out, the controlling factors and regulations of the development of underground rivers and karst springs were analyzed. The development of underground rivers was controlled by tectonism, lithology and regional hydrological network conditions, so that many underground rivers developed in Devonian and Carboniferous mid-thick bedded limestone and dolomitic limestone. And karst springs mostly developed along the strata contact zones, faults, terrain cuts and fold structures. Meanwhile, the aquifer, cover strata, heat resource and water resource of 12 medium-low-temperature and natural-discharging hot springs were investigated and sampled for isotopic analyses. After a basic investigation of 55 drought-hit villages and townships, 25 boreholes for both exploration and production and 16 wells were constructed, which contributed to a total water yield of 4,500m³ per day, and succeeded in providing drinking water for nearly 50,000 local people, which acquires good social benefits as well. The water-shortage areas are mainly distributed in the northwest and south-center of the studied region. The drought is related to both the strong karst development and the groundwater pollution caused by mining. The types of groundwater pollution sources mainly include mineral processing, mining, small farms, scattered small workshops, household waste and intensively distributed landfills, and the pollution forms are excessive levels of heavy metal content. There is slight rocky desertification in this study area, with an incidence of rocky desertification of 8.91%. The trends in rocky desertification evolution basically remain unchanged but partially varying.

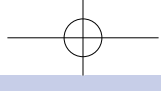


Water flowing from the constructed borehole for both exploration and mining

Hydrogeological and Environment Geological Survey in the Wumeng Mountain Area

The investigation at the scale of 1 : 50,000 completed the following three tasks:

- ① After the hydrogeological investigation of over 4000 square kilometers in the Wumeng Mountain area, 9 standard 1 : 50,000 maps were completed. More than 300 karst springs and underground river outlets were investigated. They had a total discharge of 400,000 tons per day. The distribution of these groundwater resources of more than 70,000,000 tons per year were investigated, and suggestions for regional water resources development and utilization were put forward, serving as a solid technical support in hydrogeology for the economic and social development of the Wumeng Mountain area.
- ② 29 wells were constructed for both exploration and production, as well as 6 groundwater development demonstration sites. They had a water yield of over 6000 tons per day, providing drinking water for more than 70,000 local people. It benefited both domestic and industrial water uses, and avoided the possible relocation of local markets and schools, embodying the Party's great care for the local government and people.
- ③ Key geological landscapes in the area of Zhaotong, Yunnan Province were investigated, which led to new discoveries of a great number of geological heritage landscape resources, such as the largest Tiankeng group in Yunan province, large-scale non-gravitational water deposit caves and contiguous cluster of cascade waterfalls. Moreover, timely transformation of research results was conducted for helping the poverty-stricken counties apply for the establishment of geoparks. It thus set out a path for sustainable development of the local economy driven by the possible geological tourism resources.



Well pumping test

Investigation and Dynamic Evaluation of Typical Karst Underground Rivers in Southwest China

Researchers worked on a systematic summary and submitted integrated reports of the new techniques, new theories and karst water exploring and using experiments in the hydrogeological and environmental geological survey projects since 2003. They revised and compiled 1:500,000 synthetic karst hydrogeological maps for 6 provinces or regions (municipality), i.e., Yunnan, Guizhou, Guangxi, Hunan, Hubei and Chongqing. They compiled a 1:50,000 hydrogeological remote sensing image interpretation map and the rocky desertification distribution map for the Nandong karst underground river in Yunnan Province. Based on field experiment and dynamic analysis, they established the evaluation method for underground river capacity in extreme heterogeneous conditions and the calculation method for the amount of water resources in the condition of anthropogenic activities. They better understood the applicability of MODFLOW and CFP module for the evaluation of water resources of karst underground rivers due to the application and comparison of numerical evaluation models, thus learning more from the theories of Darcy-Weisbach equation based on tracing testing and hydraulic dynamic field analyzing. They confirmed that the head loss in completely saturated underground rivers is controlled by pressure conduction. The research results, including new theoretical understandings and viewpoints, were published in *Environmental Earth Sciences* (SCI), *Transactions of the Chinese Society of Agricultural Machinery* (EI), *Carsologica Sinica* and other journals. 12 papers were published in 2015.



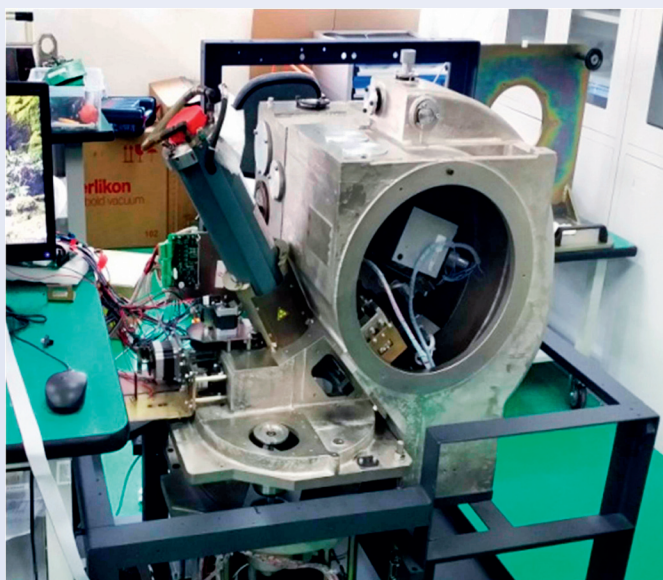
3.8 National Research Center for GeoAnalysis (NRCGA)

By the end of 2015, the NRCGA had 130 employees, of which 33 had doctorates, 40 received master's degrees, 37 completed regular university courses and 20 received junior college education or below. Among the researchers and technicians, 22 had senior professional titles, 30 had associate professional titles, 55 had middle professional titles and 23 had junior professional titles. The NRCGA had 7 functional divisions and offices, 7 research divisions, 1 ministerial key laboratory, 2 key laboratories under the CGS and CAGS respectively, and 1 CGS administrative center. The Commission on Rock and Mineral Analysis of the GSC, the Branch of Geology and Mineral Resources of the Chinese Society for Measurement, the Mineral Resources Analysis Subcommittee of the China National Technical Committee on Standardization of Land and Resources are affiliated with the NRCGA.

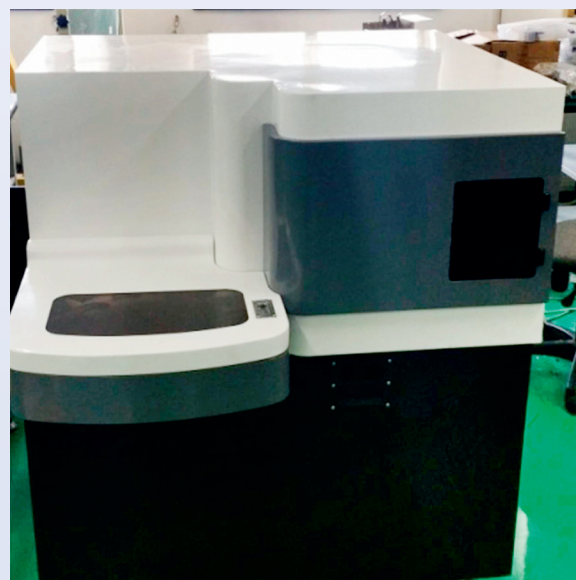
Major Research Achievements

R&D and Industrialization of the Spectrum Composite X-ray Fluorescence Spectrometer

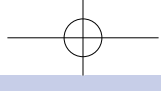
The research group manufactured main components of 2 prototypes of the instrument, now is in assembly and testing. The group also completed 12 projects, including new products, new materials, new processes, new equipment and computer software. 4 utility model patents were obtained (ZL 201520104703.9, ZL 201520154409.9, ZL 201520098279.1, ZL 2015200010289.5) and 4 papers in scientific core journals were published.



Internal view of the prototype



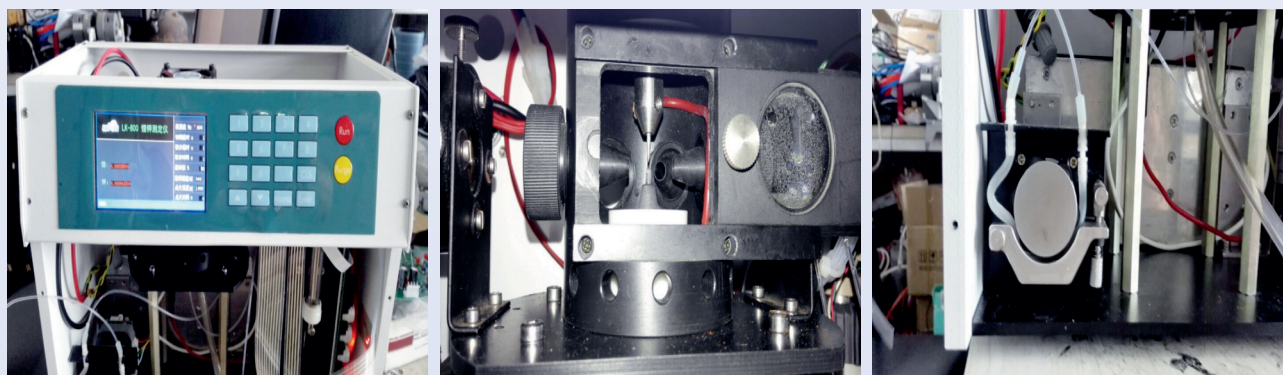
Appearance of the experimental prototype



Capability and Scope of the On-site Analysis in Integrated Exploration Area Expanded

Based on energy dispersive X-ray fluorescence (EDXRF) and atomic absorption spectroscopy (AAS) technology, the research group established and supplemented an on-site laboratory in Qimantag in Qinghai. The field data provided much information for the deployment of on-site geological work, and the field unit gave a high rating on the instrument.

Based on EDXRF construction of the containerized site laboratory and demonstration were completed in the iron-copper-cobalt mine in eastern Liaoning metallogenic belt, the anomalous area outlined by the on-site data is consistent with the ore body on the local geological section map. The field laboratory analysis capability was expanded to uranium, rare earth ions (the total amount) and potassium cuttings and drilling mud. The EDXRF analytic method was developed and is capable of covering analyses at the exploration site for important minerals such as iron, copper, lead, zinc, nickel, manganese, uranium, molybdenum, tungsten, bauxite, and ionic rare earths. In 2015, application demonstration was conducted in potash drilling site in Hubei and the rare earth mine in Ganzhou. The field data analysis indicates that the mud field data and the total rare earth concentration are consistent with laboratory results. Portable real-time field drilling fluid analysis laboratory established based on small gas mass spectrometers is able to conduct simultaneously online analysis for multiple components of CH_4 , CO_2 , H_2 , He etc. in drilling mud gas. Based on the liquid cathode glow discharge (SCGD) principle, 3 Li-K analyzer prototypes with the CCD detector (345-1015 nm) were successfully developed, which is capable of simultaneous analysis of Li, K, Rb, Cs, and other elements. Practical application test was conducted for mineral water, spodumene and other samples, and the test data is consistent with the known values. The instrument is light in weight, small in size, and has low power consumption, no need for other auxiliary combustion gas, so it has very good prospects for field application.



Li-K analyzer



Information Management of Geological Analysis Technical Standards and Informatization and Widespread Application of Remote Real-time Monitoring of Groundwater

The independently developed “information management system for standard methods of geological analysis” and “information management system for standard materials of geological analysis” have been applied to 20 laboratories. The two software systems greatly improved the efficiency and accuracy of data processing, which will promote the implementation of two basic standards: “Technical specification of standard methods of geological analysis” and “Technical specification of reference material research of geological analysis”.

The research project proposed the idea for remote real-time monitoring of groundwater quality control and the working mechanism for remote real-time monitoring of groundwater organic analysis. The independently developed “Quality monitoring expert system V1.0 for the test of groundwater samples throughout China” has realized remote real-time monitoring for the quality of organic analysis of groundwater samples, so as to ensure comparability of the analytic data of groundwater collected at different times and on different sites.

Significant Progress in Rapid Detection Technology of Multi-indicator Organic Pollutants in Groundwater Survey

The research group used gas chromatography-mass spectrometry, liquid chromatography-triple quadrupole mass spectrometer and other advanced new organic analysis techniques to enhance sensitivity of analysis and address a number of problems like polar organic pollutants detection, simultaneous analysis of co-elution detection; established 7 rapid analytic methods for simultaneous determination of multiple indicators, such as 94 kinds of non-polar and weak polar pesticides in groundwater, 44 kinds of strong polar pesticides in groundwater, 110 kinds of chemical, organic pollutants and 54 volatile organic pollutants, so as to meet the urgent needs of the groundwater investigation in China and to provide technical support to carry out a new round of comprehensive investigation of aquifers in the country.

Technical Support of the Hydrocarbon Geochemical Experiment Test Technology to Hydrocarbon Geological Survey Project

An experimental test technique system was established for evaluation and research of hydrocarbon source rocks in the Qiangtang basin. In order to improve the analysis and test quality of samples in hydrocarbon investigation, a quality management organization of experiment and testing in hydrocarbon geological investigation was established, and a relevant general plan was worked out by the Center for Hydrocarbon Resources Investigation, CGS. An investigation on the general condition and examination of the capacity of related laboratories was conducted and corresponding experiments, research were carried out for the quality control method of analysis and testing for chemical indicators of major hydrocarbon source rocks.

Chapter IV Major Awards for Scientific and Technological Achievements

In 2015, the CAGS won 3 first prizes and 4 second prizes of the MLR Award for Science and Technology, and 2 other provincial and ministerial awards. Two research achievements, “Three-dimensional tectonic framework of Antarctic lithosphere is first unveiled” and “Comprehensive study of groundwater safeguard capacity of major grain production regions in China”, were listed in Top 10 Geological Scientific and Technological Advances of 2015 by the GSC.

MLR Awards for Science and Technology in 2015

Research project	Investigation organizations	Principal investigators	Award
Groundwater Pollution Investigation & Assessment and Key Technologies in the North-China Plain	Institute of Hydrogeology and Environmental Geology, CAGS; Hebei Provincial Geological Environmental Monitoring Institute; Henan Institute of Geological Survey; Shandong Institute of Geological Survey; Beijing Institute of Geological Survey; Tianjin Institute of Geological Survey; Tianjin Center of China Geological Survey; and National Research Center for Geo-Analysis	Zhang Zhaoji, Fei Yuhong, Luo Guozhong, Yang lizhi, Zhang Liansheng, Lin Jian, Wang Lanhua, Ma Zhen, Qian Yong, Li Yasong, Qi Jixiang, Wang Suming, Zhang Lizhong, Zhang Yilong, Wang Zhao	First Prize
Correlative Study of the Spatial-temporal Evolution and Tectonic Setting of Granitic Magmatism of the Major Orogens in China and Asia	Institute of Geology, Chinese Academy of Geological Sciences	Wang Tao, Tong Ying, Wu Cailai, Wang Xiaoxia, Zhang Lei, Guo Lei, Xie Caifu, Li Zhipei, Zhang Hongrui, Han Baofu, Mao Jianren, Li Shan, Hong Dawei, Zhang Jianjun, Wang Yanbin	First Prize
Comprehensive Information Prediction Method Based on Metallogenic Series Theory Importont	Institute of Mineral Resources, CAGS; Geological Mineral Exploration Bureau of Xinjiang Uygur Autonomous Region; Xi'an Center, CGS; China University of Geosciences (Beijing)	Xiao Keyan, Tang Juxing, Wang Denghong, Li Wenyuan, Feng Jing, Chen Yongqing, Deng Gang, Chen Gang, Ding Jianhua, Sun Li, Li Nan, Lou Debo, Yin Jiangning, Cong Yuan, Zheng Wenbao	First Prize



Continued

Research project	Investigation organizations	Principal investigators	Award
Metamorphism and Tectonic Evolution of the Southern Tibetan Plateau	Institute of Geology, CAGS	Zhang Zeming, Dong Xin, Xiang Hua, Lin Yanhao, Ding Huixia, Wang Jinli, Liu Feng, He Zhenyu, Wang Wei	Second Prize
High-depth Multifunctional Electromagnetic Detection Technology and System Integration	Institute of Geophysical and Geochemical Exploration, CAGS; Central South University; Chengdu University of Technology; Jilin University	Lin Pinrong, Zheng Caijun, Shi Fusheng, Wu Wenli, Chen Xiaodong, Tang Jingtian, Wang Xuben, Li Tonglin, Li Yong, Li Jianhua	Second Prize
Natural Gas Hydrate IN-SITU Geochemical Exploration System	Institute of Mineral Resources, CAGS; Zhejiang University; Guangzhou Marine Geological Survey	Gu Yumin, Pan Yiwen, Zhao Jinhua, Hu Bo, Gao Lei, Zheng Hao, Tao Jun, Xia Meisheng, Chen Chunliang, Li Yunda	Second Prize

4.1 First Prizes of the MLR Award for Science and Technology

Groundwater Pollution Investigation & Assessment and Key Technologies in the North China Plain

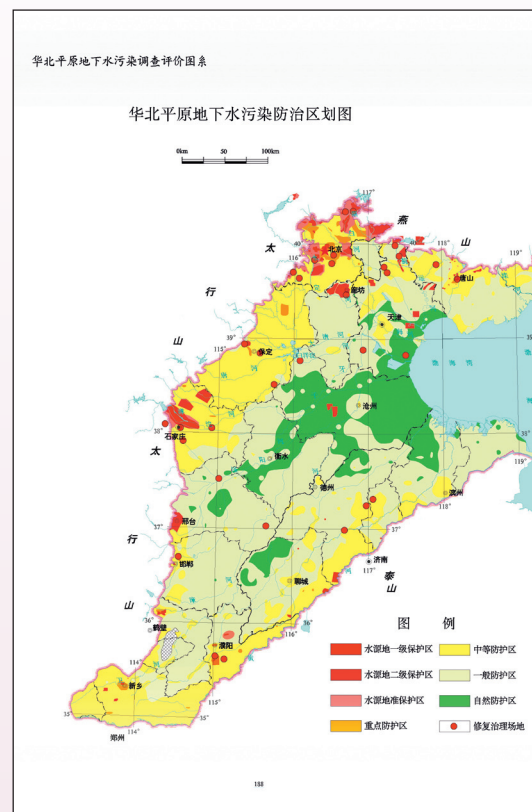
Principal Investigators: Zhang Zhaoji, Fei Yuhong, Luo Guozhong, Yang lizhi, Zhang Liansheng, Lin Jian, Wang Lanhua, Ma Zhen, Qian Yong, Li Yasong, Qi Jixiang, Wang Suming, Zhang Lizhong, Zhang Yilong, Wang Zhao

PI Organizations: Institute of Hydrogeology and Environmental Geology, CAGS; Hebei Provincial Geological Environmental Monitoring Institute; Henan Institute of Geological Survey; Shandong Institute of Geological Survey; Beijing Institute of Geological Survey; Tianjin Institute of Geological Survey; Tianjin Center of China Geological Survey; and National Research Center for Geo-Analysis

Achievements of the project:

Affiliated with the program of “National Groundwater Investigation and Assessment”, the project of “Groundwater Pollution Investigation & Assessment and Key Technologies in the North China Plain” has made breakthroughs on groundwater pollution investigation and assessment in the past 5 years, involving more than 120 researchers from 14 organizations with a total fund of 74,000,000 yuan. Based on local conditions, the research team has developed particular sampling tools for organic pollutants, a remote monitoring system of groundwater test and an information system of groundwater pollution investigation and assessment, integrating the whole process of groundwater pollution investigation, sampling, test and data management. The project has created new methods of groundwater quality

assessment and improved the quantitative analysis system of groundwater pollution risks zoning. On the basis of abundant field data and tests, the researchers conducted systematic and comprehensive analysis of groundwater quality and pollution in the North China Plain, indicating that the groundwater quality is subject to the primary geological environment, and the main pollution sources come from agricultural diffused pollution, sewage rivers and industrial parks. They made a suitability appraisal for the first time for 232 centralized water supply sources and 3154 separate water supply sources, established the information system for groundwater quality, set up the pollution risk assessment method and carried out zoning for the groundwater pollution prevention and treatment, providing an important basis for pollution control in the North China Plain. A report on groundwater pollution and suggestions in the North China Plain was submitted, winning high comments from the then Premier Wen Jiabao. *The Groundwater Pollution Prevention and Treatment Plans in the North China Plain* has been the first of its kind after the promulgation of *National Groundwater Pollution Prevention and Treatment Plan*, an important step for addressing aggravating groundwater pollution issues. The *Atlas of Land & Resources and Environmental Geology in Beijing-Tianjin-Hebei* has scientifically facilitated the integration between Beijing, Tianjin and Hebei. The article *Regional Groundwater Pollution Investigation and Assessment* has been cited by one report entitled *China Hopes to Address Pollution* on the official website of *Nature* in June 2013, illustrating the groundwater pollution in the North China Plain.



Regionalization of pollution prevention

Correlative Study of the Space-time Evolution and Tectonic Setting of Granitic Magma of the Major Orogens in China and Asia

Principal Investigators: Wang Tao, Tong Ying, Wu Cailai, Wang Xiaoxia, Zhang Lei, Guo Lei, Xie Caifu, Li Zhipei, Zhang Hongrui, Han Baofu, Mao Jianren, Li Shan, Hong Dawei, Zhang Jianjun, Wang Yanbin

PI Organization: Institute of Geology, CAGS

Achievements of the project:

Massive granitoids occur in China and Asia, attracting more attention in the world. The project focused on comparative studies of the granitoids from the important orogenic belts in China and Asia based on the mapping of the International Geological Map of Asia, which was funded by the Chinese Geological

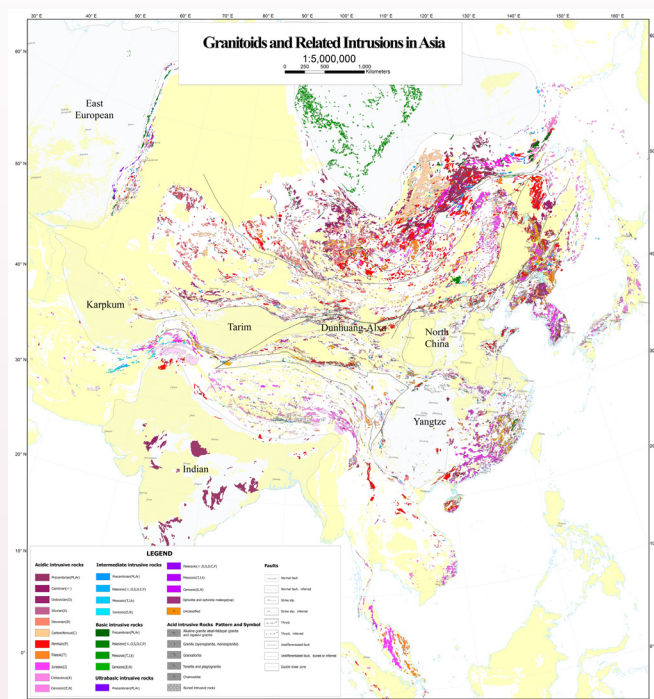


Survey projects, National Natural Science Foundation and National Basic Research Program of China (973 Program). The major results are as follows:

(1) This research project compiled digital maps of granitoids in Asia; from the perspective of China and Asia, made a preliminary summary of the spatial and temporal distribution of granitoids in the Central Asian orogenic belt, the Central China belt, and the Tethys and West Pacific belt. From the viewpoint of continent accumulation and separation, we sketched out the basic tectono-magmatic evolution framework of China and Asia.

(2) Based on a large number of new data and previously published data, by way of comparing the granitoids in domestic and adjacent foreign areas. Researchers of the project reconstructed the granitic geochronology framework of some important orogenic belts, and solved tectonic evolution and regional crustal deformation problems of a number of important orogenic belts. Granitic tectonic dynamics was put forward and enhanced.

(3) Isotopic mapping of granitoids was used to reveal crustal growth modes and determine the composition of the deep crust, and explored a new approach to the comprehensive research of tectonic study and geochemical characters of granitoids.



1 : 5 M Granitoids and related Intrusions in Asia

Comprehensive Information Prediction Method Based on Important Metallogenic Series Theory

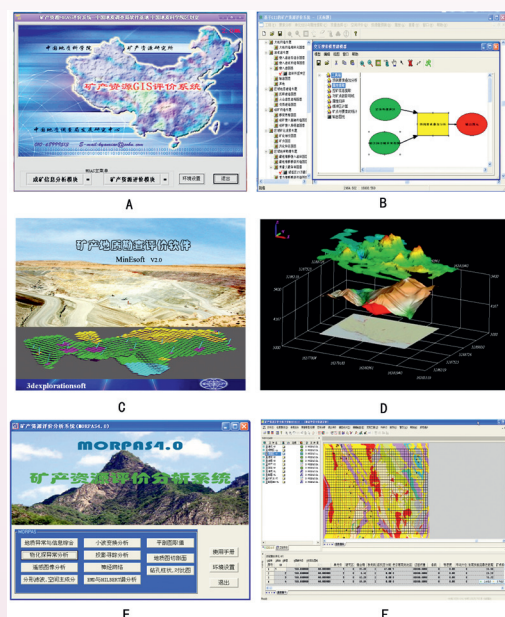
Principal Investigators: Xiao Keyan, Tang Juxing, Wang Denghong, Li Wenyuan, Feng Jing, Chen Yongqing, Deng Gang, Chen Gang, Ding Jianhua, Sun Li, Li Nan, Lou Debo, Yin Jiangning, Cong Yuan, Zheng Wenbao

PI Organizations: Institute of Mineral Resources, CAGS; Geological Mineral Exploration Bureau of Xinjiang Uygur Autonomous Region; Xi'an Center, CGS; China University of Geosciences (Beijing)

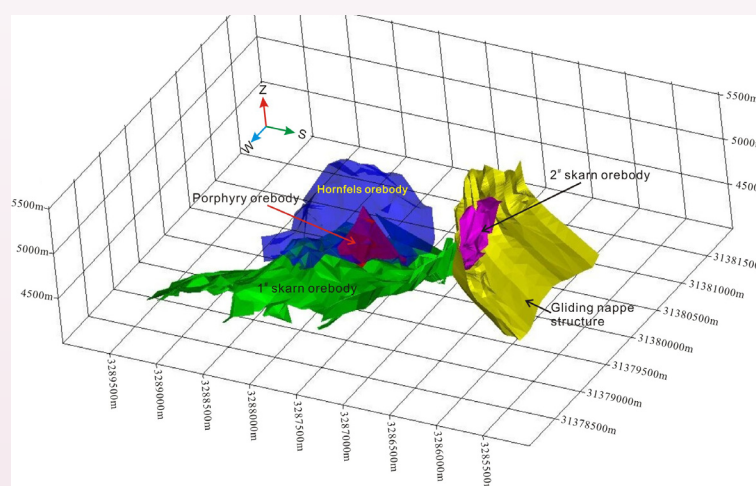
Achievements of the Project:

① The project created a mineral assessment method system suitable for western China and its core contents are as follows: (a) the comprehensive information prediction method based on the metallogenic series theory, (b) the prognosis model guiding→comprehensive information locating→3D software

platform estimating, (c) independent target layer spatial information, (d) the 3D prospecting model and 3D cubic quantitative prognosis. ② We developed and upgraded three sets of software: MRAS, MinEsoft and MORPAS. ③ We applied the developed technique and method in four metallogenic belts (Gangdise, East Tianshan, Qin-Qi-Kun and southwest Sanjiang belts), delineated 354 target areas with good results in deep prospecting.



Software of mineral prediction



The 3D prediction model (Jiama)

4.2 Second Prizes of the MLR Award for Science and Technology

Metamorphism and Tectonic Evolution of the Southern Tibetan Plateau

Principal Investigators: Zhang Zeming, Dong Xin, Xiang Hua, Lin Yanhao, Ding Huixia, Wang Jinli, Liu Feng, He Zhenyu, Wang Wei

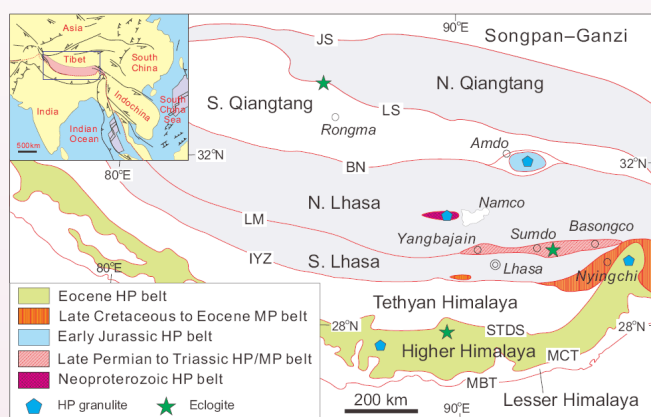
PI Organization: Institute of Geology, CAGS

Achievements of the Project:

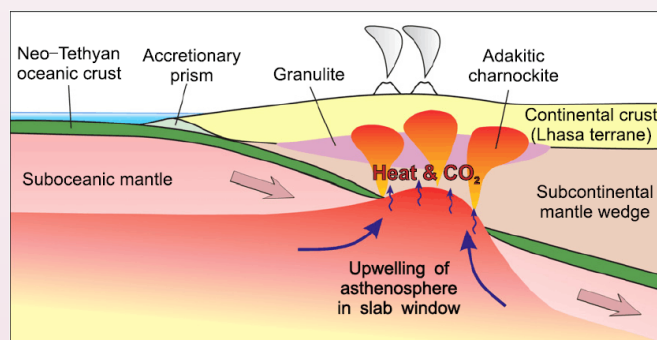
① The Neoproterozoic HP metamorphic rocks located in the North Lhasa terrane witnessed the origin and old tectonic evolution of Lhasa terrane. ② The Triassic MP metamorphic belt in the central of the Lhasa terrane recorded the collision of the North and South Lhasa terranes. ③ The researches on Amdo terrane contributed to the terrane compositions and attribution of the southern Tibetan Plateau. ④ Late Cretaceous Gangdese charnockite proved the Neo-Tethyan mid-ocean ridge subduction. ⑤ Late Devonian granite firstly reported in the South Lhasa terrane, providing important information for the Paleozoic orogeny of the northern margin of the Gondwana. ⑥ The Nyingchi complex represented the exposed lower crust of the Gangdese magmatic arc, suggesting the crustal growth during arc accretion.



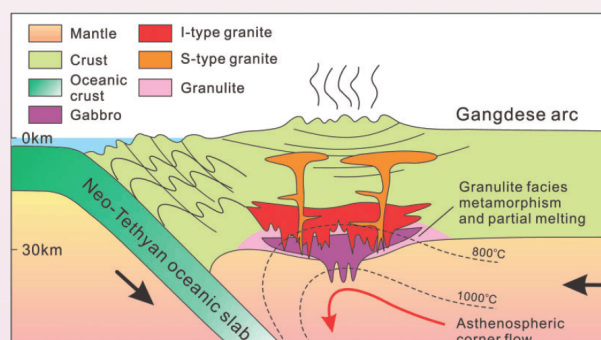
⑦ The compositions and multiple-reworking of the High Himalaya crystalline sequence provided important constraints on the formation and evolution of India. ⑧ Himalaya orogenic belt underwent long-lived HP/HT granulite-facies metamorphism and associated anatexis. ⑨ We constructed a tectonic evolutionary model of the Lhasa terrane since the Neoproterozoic.



A sketch showing the metamorphism of the Lhasa terrane BN—Bangong-Nujiang suture zone, IYZ—India-Yarlung Zangbo suture zone, JS—Jinsha Jiamg suture zone, LM—Luobadui-Milashan fault, LS—Longmucuo-Shuanghu suture zone, MBT—Main boundary thrust, MCT—Main central thrust, STDS—The south Tibetan detachment system



The tectonic model for the subduction of Neo-Tethys mid-ocean ridge



The Paleocene tectonic model for the southeastern Gangdese arc

High-depth Multifunctional Electromagnetic Detection Technology and System Integration

Principal Investigators: Lin Pinrong, Zheng Caijun, Shi Fusheng, Wu Wenli, Chen Xiaodong, Tang Jingtian, Wang Xuben, Li Tonglin, Li Yong, Li Jianhua

PI Organizations: Institute of Geophysical and Geochemical Exploration, CAGS; Central South University; Chengdu University of Technology; Jilin University

Achievements of the Project:

The high-depth multifunctional electromagnetic detection system has been developed successfully. With the adoption of the high precision GPS mixed with steady crystal synchronization technology, the wireless data relay and double 24 AD large dynamic conversion technology, and the generator excitation surge current technology, the project realized distributed detection of high power electromagnetic

emission and high precision synchronous measurement. Meanwhile, an electromagnetic parameter data information processing technology was developed by digital filter technology, the related frequency selective technology and the synchronous overlap technology. Based on the study of the electromagnetic method for 2-D and 3-D inversion modeling under the condition of terrains, the electromagnetic method inversion interpreting software was developed. By carrying out the area test and application of the self-developed system, the project not only obtained the corresponding known ore body anomalies, but also discovered new prospecting clues, and the results obtained significant test application effect. During the implementation of the project, 25 papers were published, including 6 SCI-indexed and EI-indexed papers. 2 invention patents and 7 software copyrights were obtained. Meanwhile, 17 doctoral and 18 graduate students finished their courses.



Distributed receiver



High-power transmitter

Natural Gas Hydrate IN-SITU Geochemical Exploration System

Principal Investigators: Gu Yumin, Pan Yiwen, Zhao Jinhua, Hu Bo, Gao Lei, Zheng Hao, Tao Jun, Xia Meisheng, Chen Chunliang, Li Yunda

PI Organizations: Institute of Mineral Resources, CAGS; Zhejiang University; Guangzhou Marine Geological Survey

Achievements of the Project:

(1) The “visual in-situ multi-parameter online detection system” developed by this project adopts the towed and multi-parameter sensors to conduct integrated detection. It is a towing body carrying sensors that are more than that of any other towing bodies in the big-depth towed detection in China, which provided a new technological means for fast exploration of marine gas hydrates.



(2) Integrated in-situ detection technology of underwater video and photography realized in-situ geochemical exploration and real-time visual observation of submarine geomorphologic landscape, comprehensive detection of the distribution of biological population and other geological characteristics, which has greatly improved accuracy of determining ore prospecting markers.

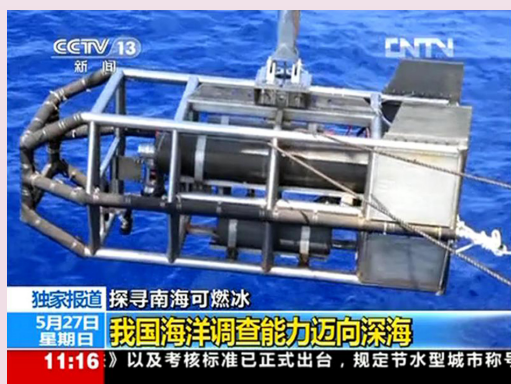
(3) There are nine multi-parameter in-situ detection sensors applicable for CH_4 , H_2S , CO_2 , Eh (oxidation-reduction potential), DO (dissolved oxygen), pH and CTD (conductance, temperature, depth). Multiple parameters can be detected by means of a single operation and successful tracking of mineralization anomalies can be done with high efficiency.

(4) The in-situ detection technique overcomes the problem of data distortion caused by the change of temperature and pressure during the migration of the sample.

(5) This technique has such advantages as high work efficiency and low manufacturing and operating cost, especially suitable for a wide range of exploration, prospecting target areas. It is the front-end exploration means of ROV (remote operated vehicle), AUV (autonomous underwater vehicle) and manned submersibles and other large high-precision operating systems, which optimized the work flow of ocean expedition.

(6) The results can be applied to natural gas hydrate and other ocean resources exploration, and also to underwater structures exploration, sea area environmental protection and other areas, it has broadened application prospects and social and economic benefits.

(7) The achievements in the big-depth detection equipment development and breakthroughs in a number of key technologies, including remote sensing and control technology, multi-parameter data fusion technology, deep water electricity supply, real-time data transmission technology, in-situ detection sensor resistance to high pressure, corrosion resistance, high precision detection electrode packaging technology, they have improved our independent research and development of ocean detection equipment, have promoted ocean exploration equipment of the independent intellectual property rights, and thus is of great significance.



The in-situ geochemical exploration system is operated in South China Sea



Chapter V Top 10 Geological Scientific and Technological Advances

The top 10 geological scientific and technological advances in 2015 were selected from 48 submitted research projects by 38 academicians and experts from the MLR, MST, ME, CAS, NNSFC, CUG (Beijing) and announced on the reviewing conference held by the MLR and CGS on December 23-24, 2015.

These achievements forcefully demonstrate the significant progress of geological investigation and geoscientific study throughout China, fully embody the capability and level of the scientific innovation and industrial application of geological investigation work. Six projects of the top 10 advances were coordinated and carried out by the CAGS, which are detailed below.

MLR Awards for Science and Technology

Ser. No.	Research project	Principal investigation organizations	Project coordinator
1	Discovery of the First Giant Porphyry-epithermal Cu (Au-Ag) Deposit in China	Institute of Mineral Resources, CAGS; No. 5 Geological Team of Tibet Bureau of Geological Exploration; Chinalco Resources Corporation, Chengdu University of Technology; Institute of Geomechanics, CAGS	Tang Jüxing
2	Three-dimensional Tectonic Framework of Antarctic Lithosphere is Unveiled	Institute of Geomechanics, CAGS	An Meijian, Douglas Wiens (US), Zhao Yue, Feng Mei
3	The Release of the Report on Cultivated Land Geochemical Situation in China	Institute of Geophysical and Geochemical Exploration, CAGS, and others	Cheng Hangxin
4	Research on Rocky Desertification and its Comprehensive Control of Karst Areas in Southwest China	Institute of Karst Geology, CAGS; China Aero Geophysical Survey and Remote Sensing Center for Land and Resources, CGS; Guangxi Institute of Botany, CAS	Jiang Zhongcheng, Ma Zulu



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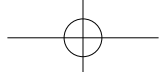
Ser. No.	Research project	Principal investigation organizations	Project coordinator
5	Innovating evaluation methodology of groundwater safeguard capacity serves for the national food security strategy	Institute of Hydrogeology and Environmental Geology, CAGS; China Agricultural University; Airborne Survey and Remote Sensing Center of Nuclear Industry	Zhang Guanghui, Tian Yanliang
6	The new discoveries in study of the feathered dinosaurs and pterosaurs	Institute of Geology, CAGS; Henan Geological Museum	Lü Junchang

5.1 Discovery of the First Giant Porphyry-Epithermal Cu (Au-Ag) Deposit in China

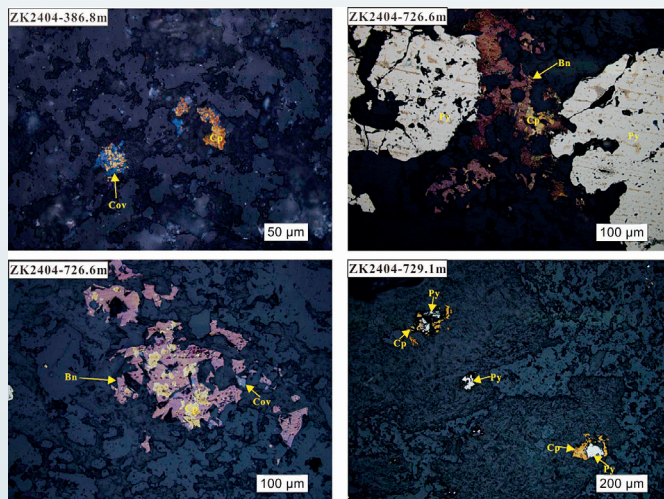
The team led by Prof. Tang Jüxing at the Institute of Mineral Resources, CAGS, spent three years and made a breakthrough in the exploration of the Duolong mineral district, Ngari Prefecture, North Tibet, where the working conditions were extremely terrible. The research was supported by the funds from geological survey, exploration companies and national non-profit research projects. The team studied the geological background in the Duolong mineral district and found out the metellogenic regularity and resource potential. The team believed that the main exploration target was high-sulfidation epithermal-porphyry deposits, and proposed that the epithermal ore bodies at the near-surface of Tiegelongnan formed above porphyry ore bodies at depth. A series of rapid exploration and assessment techniques were developed for the exploration model of porphyry-epithermal deposits. The discovery of porphyry-epithermal ore bodies diversifies the metallogenetic series in Tibet. Teams from China Resources



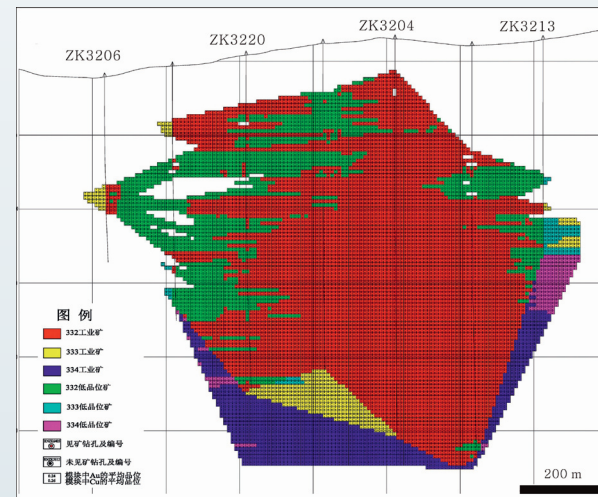
A photograph of the Tiegelongnan porphyry-epithermal Cu(Au) deposit in Tibet



Corporation and Tibet Bureau of Geological Exploration assess that the Tiegelongnan Cu (Au-Ag) deposit has a reservoir of 10.98 million tons with Cu grade of 0.53%. The prospecting Cu resource is over 15 million tons. The Tiegelongnan Cu (Au-Ag) deposit is the first super-large high-sulfidation epithermal-porphyry deposit in Tibet. This breakthrough opens a new prospecting direction in Tibet. The three-year practice has cultivated a novel team, which is good at solid mineral exploration and evaluation in the important metellogenic belts in Tibet. One member of the team was awarded the Li Siguang Scholar, one got the honor of National Advanced Worker in 2015, one was selected into the Young People Plan in 2015 and the fourth one received the Silver-Hammer Award of the Geological Youth Science and Technology Award.



Mineralization characteristics, mineral assemblages, ore textures and structures of the Tiegelongnan deposit
Bn—bornite; Cp—copper; Cov—covellite; Py—pyrite



The profile model of Cu grade interpolation on the 32 line of the Tiegelongnan deposit

5.2 Three-dimensional Tectonic Framework of Antarctic Lithosphere is Unveiled

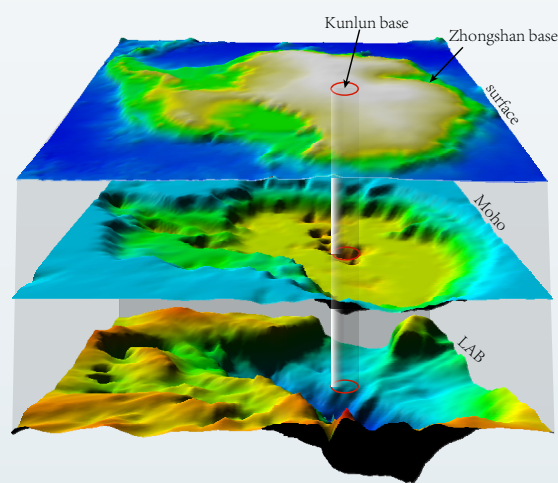
After several years efforts on data analyses and methodology development, An Meijian, Douglas Wiens (USA), Zhao Yue et al., from Institute of Geomechanics, CAGS retrieved high-resolution 3-D lithospheric structure for the whole Antarctic plate using new seismic data collected by geologists from the USA, China and other countries in the Antarctic inland, which has extremely cold weather and harsh conditions. This work is part of the international seismic survey of the flagship project in the fourth International Polar Year. From the 3-D model, they identified the general tectonic framework of Antarctica and obtained some new results about the geological evolution of Antarctica and Gondwana. For example, remnant of 10-Ma-years-ago subduction slab was found under the Antarctic Peninsula.



Evidences support that the east Antarctic Mountain Ranges is the suture formed when Gondwana supercontinent was finally amalgamated. These findings are helpful to understand the evolution of Antarctica, especially on the Gondwana amalgamation and break-up. The main research results were published in *Journal of Geophysical Research*.



The Chinese seismic station at the Kunlun base, in the highest point of Antarctica



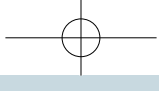
Three-dimensional lithospheric structure of the Antarctic plate
LAB—Lithosphere-Asthenosphere Boundary

5.3 The Release of the Report on Cultivated Land Geochemical Situation in China

This investigation systemically verified the geochemical situation of the land within China and briefly summarized the research results of land quality in the past 15 years. We have also formally issued the *Reports on Chinese Arable Land Geochemical Research* (2015) on June 25th, 2015, and made significant assessments on the geochemical situation of national arable land. Among the 1.386 billion mu lands studied, there is a selenium-rich green land area of 52.44 million mu, heavy metal pollution-free land area of 1.272 billion mu, as well as 34.88 million mu in heavy pollution. What is more, obvious organic decline has also been seen in northeastern China, acidification and salinization are getting worse and worse in south China and north China. We formulated a series of technological standards, such

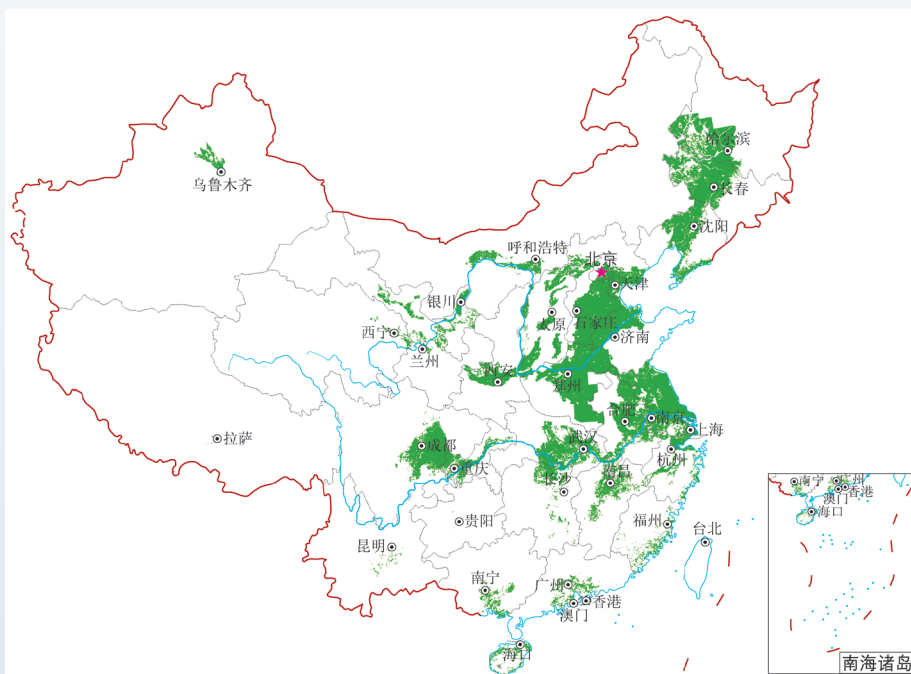


News about the report on the land geochemical investigation of China was released on CCTV



as those for geochemical research evaluation, monitoring and warning on land quality, accelerated the establishment and development of eco-geochemical theory and subjects, realized innovation in the original geochemical exploration theory and made great achievements in technology. The Report has been listed in the “Top 10 Geological Scientific and Technological Advances of 2015” supported by the CGS and CAGS.

Distribution of heavy metal pollution-free land in China
(After 《2015 Annual Report》
Chinese Version)



5.4 Research on Rocky Desertification and Its Comprehensive Control of Karst Areas in Southwest China

Under the auspices of the national science-technology support plan and geological survey projects, Prof. Jiang Zhongcheng, Ma Zulu and their team from the Institute of Karst Geology, CGS, along with China Aero Geophysical Survey and Remote Sensing Center for Land and Resources, CGS and Guangxi Institute of Botany, CAS, innovated the water-soil leakage theory and comprehensive control mode of water in rocky desertification areas. They developed technical methods for remote sensing investigation, field monitoring and evaluation of rocky desertification, clarified the progress and problems in comprehensive treatment of rocky desertification of the country since the beginning of the 21st century, and put forward a proposal for the second-phase comprehensive treatment. They carried out experiments of comprehensive treatment of rocky desertification in Guohua Town, Guangxi, and created the ecological control technique of storage-diversion recombination of epi-karst water in rocky desertification areas, landscape ecological land consolidation technology in different water-soil leakage environments and the technology for planting pitaya, from cultivation to management, on



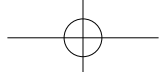
karst soil. There is 50,000 m³ karst water to be developed and utilized every year. 8000 mu of land was arranged for preventing leakage of soil and water with positive effect. They used native plant pitaya flower to pollinate dragon fruit in nearly ten thousand acres of land. Multipurpose utilization of karst water guaranteed the safety of drinking water of local residents. The problem of water-soil leakage was radically solved. Ecological production of dragon fruit in rocky desertification areas has realized a transformation from experiment and demonstration to industrial application, which has enabled about 200,000 farmers around the demonstration areas to cast off poverty and created a direct economic benefit of more than 200 million yuan. The project team published over 70 papers and 2 monographs, applied for 6 patents and registered 3 trademarks about dragon fruit. One researcher was selected by the MLR as the leading talent in science and technology, one was selected by the MLR as the outstanding young talent in science and technology and one was selected as the outstanding young talent of the Guangxi Autonomous Region. The team of rocky desertification research and their achievements and effects have produced significant repercussions at home and abroad.



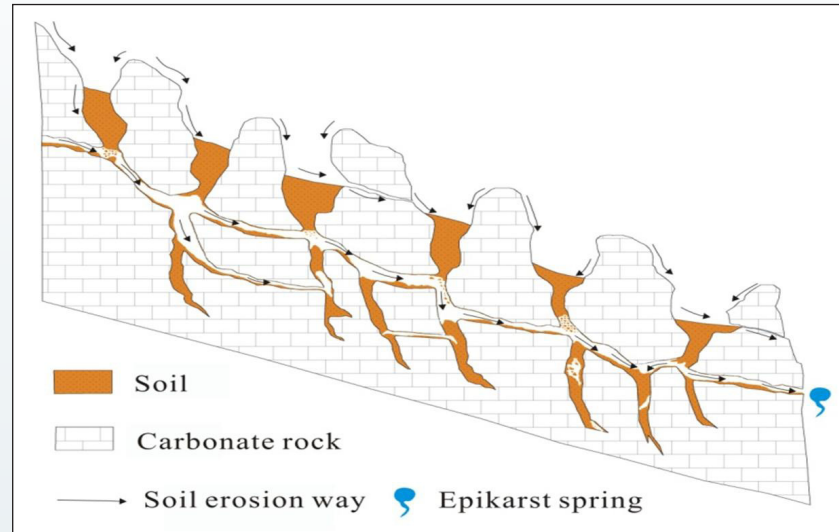
Rocky desertification and soil erosion in the Nandong ground river basin, Yunnan Province



Effect of landscape ecological land consolidation in a rocky desertification-control demonstration area of Guohua Town, Pingguo County, Guangxi



A schematic diagram showing soil and water leakage process in a karst peak cluster depression



5.5 Innovating Evaluation Methodology of Groundwater Safeguard Capacity Serves for the National Food Security Strategy

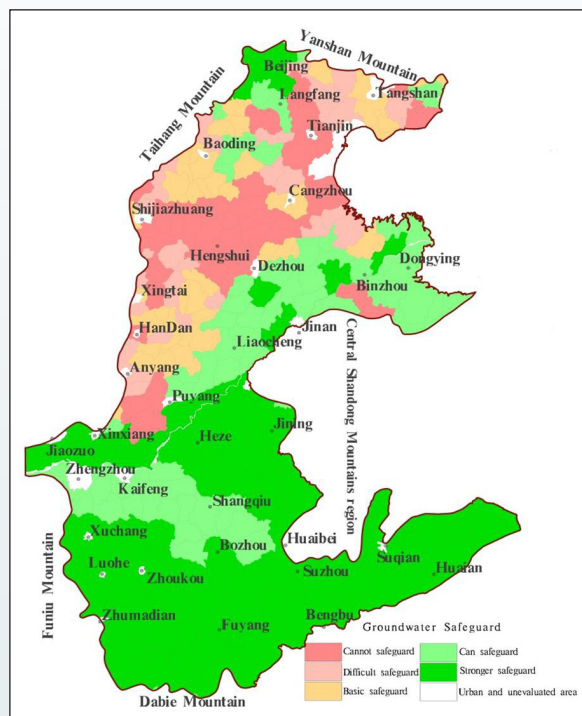
Prof. Zhang Guanghui and his research team from the Institute of Hydrogeology and Environmental Geology, CAGS, have achieved great advances in geological survey and research. The study was supported by the geological survey project in cooperation with China Agricultural University and Airborne Survey and Remote Sensing Center of Nuclear Industry. Aiming at the national requirement of the food security strategy and innovating on the key technologies, the project ascertained the spatial pattern of national major grain production regions, the density distribution of wells and drains, the structure of the crops planting intensity and the irrigated dependence level on groundwater in northeast China, the Huang-Huai-Hai plain and the Yangtze river basin. Meanwhile, the research achievements revealed the laws of sharp decline and sluggish rise of shallow groundwater level in groundwater overdraft regions. Based on the research of the relationship among agricultural irrigation water, precipitation, crops planting intensity and interactive mechanism between the surface hydrology and the status of the water resource, Prof. Zhang and his research team created the evaluation methodology of groundwater safeguard capacity, which is suitable for the main grain production regions in China and first clarified the condition of groundwater safeguard capacity on the national grain producing areas. The research results which provided a great scientific basis for the national food security strategy and proposed a theoretic foundation to overcome agricultural groundwater over-pumping indicated clearly that the important approach for relaxing over-exploitation of groundwater is to regulate and adjust the agricultural planting structure reasonably. Furthermore, the research expanded and developed the evaluation theory and methodology of regional groundwater assessment in China. In implementing the project, a sci-tech innovation team engaged in groundwater resources assessment, development and utilization was formed. In this research team, one scientist was accepted as a leading talent issued by



the MLR, one won the prize given to outstanding young and middle-aged specialists with significant contributions issued by Hebei Province and the T.K. Huang's Geologic Science and Technology Prize, and one was awarded May 4th Youth Medal of Hebei Province.



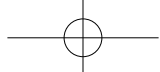
Field survey and monitoring in the major grain production region of the Huang-Huai-Hai Plain



The groundwater safeguard capacity distribution of the major grain production region in the Huang-Huai-Hai Plain

5.6 The New Discoveries in Study of the Feathered Dinosaurs and Pterosaurs

The research group led by Prof. Lü Junchang from the Institute of Geology, CAGS, cooperated with Henan Geological Museum and University of Edinburgh, UK, which was funded by the National Natural Science Foundation of China and the China Geological Survey, discovered a new oviraptorid dinosaur, *Huanansaurus ganzhouensis*, from the Late Cretaceous deposits in Ganzhou, Jiangxi provinces. This new oviraptorid dinosaur provides new insight into the craniofacial evolution of oviraptorosaurid dinosaurs, paleogeographical distribution and paleoecological environments. The newly discovered *Zhenyuanlong suni* from the Early Cretaceous of west Liaoning Province is a large, short-armed, winged dromaeosaurid dinosaur. It provides the first evidence of feather morphologies and distribution in a short-armed dromaeosaurid dinosaur. The discovery of *Zhenyuanlong* also provides important evidence for the study of the diversity, origin of feathers and flight of Liaoning dromaeosaurid dinosaurs. *Orientognathus chaoyangensis* is the first Late Jurassic pterosaur in western Liaoning and it is the largest rhamphorhynchinae pterosaur. The discovery of *Orientognathus* not only fills the temporal gap between the Middle Jurassic and Early Cretaceous pterosaur faunas of China, but also plays an important role in the understanding of radiation evolution of rhamphorhynchids from the Late Jurassic.



The above-mentioned important discoveries provide a key role in our understanding of controversial and difficult issues such as the evolution of oviraptorid dinosaurs, the feather evolution in dromaeosaurid dinosaurs and the origin of bird feathers. In particular, the Ganzhou Dinosaurian Fauna is named based on the new taxon.

The science and technology innovation team for dinosaur research, geological survey, excavation and repair has been educated during the project implementation process.

Artist's conceptualization of *Huanansaurus ganzhouensis* (drawn by Zhao Chuang)



The holotype of *Zhenyuanlong suni*



Artist's conceptualization of *Orientognathus chaoyangensis* (drawn by Zhao Chuang)



Chapter VII Key Laboratories and Scientific and Technological Research Platforms

Key laboratories and scientific and technological research platforms play a critical role in science and technology innovation of the CAGS. These labs and platforms are major vehicles for building and developing research disciplines and also important grounds to attract, train and support exceptionally talented and innovative professionals in science and technology.

By the end of 2015, there were 2 international and 3 national scientific and technological platforms at the CAGS, 14 key laboratories affiliated to the MLR, 5 key laboratories to the CGS, and 9 under the CAGS. In addition, there were 5 popular science bases and 4 ministerial testing centers of the MLR, 11 professional centers under the CGS, 15 field observatories set up by the MLR, and the Experimental Base for Geological Projects of the CAGS (under construction).

In 2015, all the laboratories and science and technological platforms yielded substantial scientific and research achievements, organized varieties of academic exchanges. Numerous scientific professionals were trained and the scientific and research level of the Academy was significantly improved, which has strengthened the scientific and technological innovation capacity of the Academy.

International platforms

Ser. No.	Laboratory Name	Supporting Institution	Director
1	International Research Center on Karst under the Auspices of UNESCO	Institute of Karst Geology, CAGS	Liu Tongliang
2	International Centre on Global-scale Geochemistry under the Auspices of UNESCO	Institute of Geophysical and Geochemical Exploration, CAGS	Peng Xuanming

National platforms

Ser. No.	Laboratory Name	Supporting Institution	Director
1	Beijing SHRIMP Center	Institute of Geology, CAGS	Liu Dunyi

Continued

Ser. No.	Laboratory Name	Supporting Institution	Director
2	National Center for Geological Exploration Technology	Institute of Geophysical and Geochemical Exploration, CAGS	Peng Xuanming
3	National Center for International Research on Karst Dynamic System and Global Change	Institute of Karst Geology, CAGS	Liu Tongliang

MLR Key Laboratories

Ser. No.	Laboratory Name	Supporting Institution	Director
1	MLR Key Laboratory of Continental Dynamics	Institute of Geology, CAGS	Xu Zhiqin
2	MLR Key Laboratory of Isotope Geology		Zhu Xiangkun
3	MLR Key Laboratory of Stratigraphy and Paleontology		Ji Zhansheng
4	MLR Key Laboratory of Earthprobe and Geodynamics		Gao Rui
5	MLR Key Laboratory of Metallogeny and Mineral Resource Assessment	Institute of Mineral Resources, CAGS	Mao Jingwen
6	MLR Key Laboratory of Salt Lake Resources and Environment		Zheng Mianping
7	MLR Key Laboratory of Neotectonic Movement and Geohazard	Institute of Geomechanics, CAGS	Zhang Yongshuang
8	MLR Key Laboratory of Paleomagnetism and Paleostucture Reconstruction		Sun Zhiming
9	MLR Key Laboratory of Eco-geochemistry	National Research Center for GeoAnalysis	Zhuang Yuxun
10	MLR Key Laboratory of Groundwater Science and Engineering	Institute of Hydrogeology and Environmental Geology, CAGS	Chen Zongyu
11	MLR Key Laboratory Geochemical Survey Technology	Institute of Geophysical and Geochemical Exploration, CAGS	Wang Xueqiu
12	MLR Key Laboratory of Geophysical Electromagnetic Exploration Technology		Fang Hui
13	MLR Key Laboratory of Karst Ecosystem and Treatment of Rocky	Institute of Karst Geology, CAGS	Jiang Zhongcheng
14	MLR Key Laboratory of Karst Dynamics		Yuan Daoxian

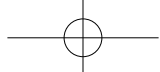


CGS and CAGS Key Laboratories

Ser. No.	Laboratory Name	Supporting Institution	Director
1	Key Laboratory of In-situ Stress Measurement and Monitoring, CGS (CAGS)	Institute of Geomechanics, CAGS	Chen Qunce
2	Key Laboratory of Shale Oil and Gas Geological Survey, CAGS		Wang Zongxiu
3	Key Laboratory of Re-Os Isotope Geochemistry, CAGS	National Research Center for GeoAnalysis	Qu Wenjun
4	Key Laboratory for Element Microzone and Morphological Analysis, CGS (CAGS)		Zhan Xiuchun
5	Key Laboratory of Groundwater Remediation, CGS (CAGS)	Institute of Hydrogeology and Environmental Geology, CAGS	Han Zhantao
6	Key Laboratory of Quaternary Chronology and Environment Evolution, CAGS		Zhao Hua
7	Key Laboratory of Geochemical Cycling of Carbon and Mercury in the Earth's Critical Zone, CGS (CAGS)	Institute of Geophysical and Geochemical Exploration, CAGS	Cheng Hangxin
8	Key Laboratory of Karst Collapse Prevention, CGS (CAGS)	Institute of Karst Geology, CAGS	Lei Mingtang
9	Key Laboratory of 3D Exploration for Ore District, CAGS & HFUT	Institute of Mineral Resources, CAGS; Hefei University of Technology	Lü Qingtian

CGS Professional Centers

Ser. No.	Center Name	Supporting Institution
1	National Geological Mapping Research Center	Institute of Geology, CAGS
2	Center for Stratigraphy and Paleontology, CGS	
3	Three-dimensional Geological Survey and Research Center, CGS	
4	Research Center of Continental Dynamics, CGS	
5	Geological Research Center on Global Climate Change, CGS	Institute of Karst Geology, CAGS
6	Research Center on Metallogenic Regularity and Prognosis of Mineral Resources, CGS	Institute of Mineral Resources, CAGS
7	Centre of Deep Exploration, CGS	CAGS (Headquarters)
8	Geothermal Survey and Research Center, CGS	Institute of Hydrogeology and Environmental Geology, CAGS
9	Research Center on Neotectonic and Crust Stability, CGS	Institute of Geomechanics, CAGS



Continued

Ser. No.	Center Name	Supporting Institution
10	Research Center of Geochemical Survey and Assessment on Land Quality, CGS	Institute of Geophysical and Geochemical Exploration, CAGS
11	Research Center for Geoanalysis Standards, CGS	National Research Center for GeoAnalysis

Popular Science Outreach of MLR

Ser. No.	Name	Supporting Institution	Recommending Organization
1	Kasrt Geology Museum of China	Institute of Karst Geology, CAGS	China Geological Survey (CGS)
2	Li Siguang (J.S. LEE) Memorial Hall	Institute of Geomechanics, CAGS	
3	Groundwater Science and Engineering Experimental Site	Institute of Hydrogeology and Environmental Geology, CAGS	
4	Scientific Observation Station for Potash Research and Resources Utilization of Lop Nor Salt Lake	Institute of Mineral Resources, CAGS	
5	MLR Key Laboratory of Salt Lake Resources and Environment		

Quality Monitoring and Test Centers of MLR

Ser. No.	Name	Monitoring and Test Scope	Undertaken by
1	National Research Center for GeoAnalysis	Nonferrous and ferrous metallic, rare and scattered metallic, noble metallic, nonmetallic ores, energy mineral resources and products; ecological and geochemical environment, groundwater, mineral water, sea water	National Research Center for GeoAnalysis
2	Supervision and Analysis Center for Groundwater Mineral water and Environment, MLR	Groundwater, surface water, mineral water and products, hydrogeochemical environment, mining geo-environment and agricultural geologic environment; Quaternary geological environment, engineering geology and environment	Institute of Hydrogeology and Environmental Geology, CAGS
3	Control and Supervision Center of Geochemical Exploration, MLR	Iron ore, manganese ore, chromite, copper ore, lead ore, zinc ore, polymetallic ore, vanadium titano-magnetite, etc.	Institute of Geophysical and Geochemical Exploration, CAGS
4	Supervision and Testing Centre for Karst Geology and Resources, MLR	Karst geology, ecological and geochemical environment, mining geo-environment and agricultural geologic environment, karst groundwater, mineral water, metal and nonmetals, physical properties of rock and soil test	Institute of Karst Geology, CAGS

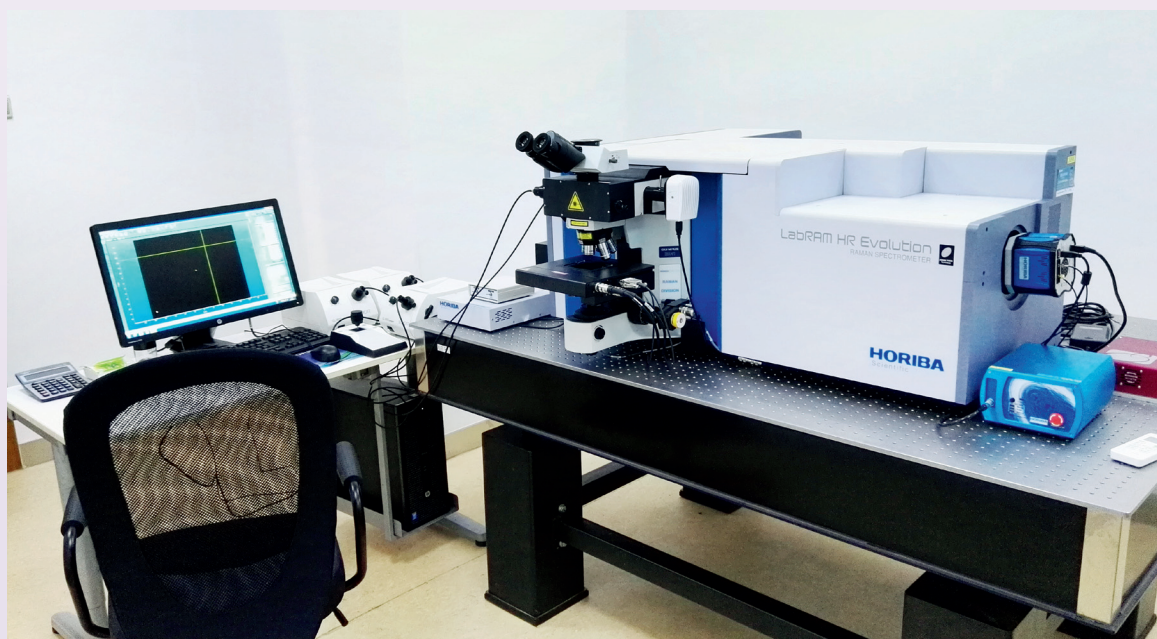


6.1 National Science and Research Platforms

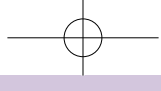
The Beijing SHRIMP Centre (National Science and Technology Infrastructure)

The Beijing SHRIMP Centre is one of the National Science and Technology Infrastructures, jointly recognized by the Ministry of Science and Technology and the Ministry of Finance. It is incorporated into the Institute of Geology, Chinese Academy of Geological Sciences (CAGS) in Beijing. The major objectives of the Centre are to provide high-quality geochronological and cosmochronological data; to develop new techniques for SHRIMP dating and mineral geochemistry; to undertake research in Precambrian geochronology and crustal evolution and the composition (especially the studies of the formation and early history of the solar system and the earth), in evolution of the Phanerozoic orogenic belts in Central and Eastern Asia, in the geological timescale and in the age of large and special mineral deposition. Furthermore, the development of new scientific instruments is also an important objective of the Centre.

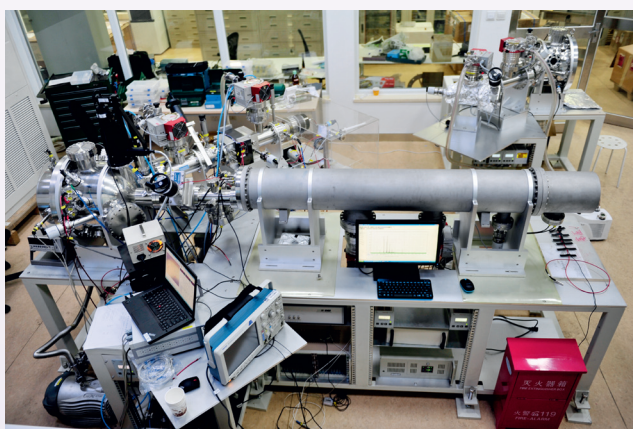
The two SHRIMP instruments of the Centre kept high productivity in 2015. The total machine time for U-Pb dating and stable isotopes measurements was 9816.50 hours. A high resolution laser microscopic confocal Raman spectrometer, HORIBA LabRAM HR Evolution, was installed and accepted successfully at the Beijing SHRIMP New Lab Building in August of 2015. The spectrometer was introduced to investigate the influences on accuracy and reliability of isotopic dating caused by the metamict of zircon.



High resolution laser microscopic confocal Raman spectrometer, HORIBA LabRAM HR Evolution



The Special-funded Program on National Key Scientific Instruments and Equipment Development—“New Models of TOF-SIMS (Time of Flight Secondary Ion Mass Spectrometer) for Isotope Geology”, which is undertaken by the Beijing SHRIMP Centre, made important progress in 2015. The machining of all components and the assemblage of two sets of TOF-SIMS instruments were completed successfully. Now the two instruments are under testing and performance optimization. The diameters of oxygen and cesium primary ion beams are approaching 5 μm and 3 μm , respectively. The mass resolution is 14000 when $m/q=122$.



Two units of TOF-SIMS developed by the technical team of the Centre (assemblage was completed and testing is in progress)

Mr. Zhong Ziran, member of the Leading Party Group of the MLR, President of the CGS, inspected the Beijing SHRIMP Centre on June 29, 2015 and made an important speech at the Centre. Mr. Wang Xiaolie, member of the Leading Party Group of the CGS, and member of the Leading Group of the Institute of Geology, CAGS also participated in the inspection.

Zhong Ziran inspected the Research and Development Centre of Large Mass Spectrometer in the Beijing SHRIMP Centre





In 2015, the Centre and IPRCC successfully organized two academic events, the Short Course “Precambrian Surface Processes” and the International Field Excursion in Daqingshan Area, Inner Mongolia, which played an important role in training young geologists and promoting the performance of China’s research work in Precambrian geology.



2015 Short course—Precambrian Surface Processes

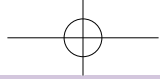


International field excursion in the Daqingshan area

National Modern Geology Exploration Engineering Technology Research Center

National Modern Geology Exploration Engineering Technology Research Center (hereinafter, the Center) was demonstrated by the former Experts Committee of State Scientific and Technological Commission on November 28, 1993. On March 18, 1994 the former State Scientific and Technological Commission approved The Plan of Tasks and officially began to establish the center. In April, 1998 the former Assessment Center of State Scientific and Technological Commission officially accepted and put the center into operation up to now. Due to good operation of the center, it has been listed in the reconstruction plan of the National Engineering Technology Research Center by the Ministry of Science and Technology and received further support.

The relationship between the center and the support units can be described as “one institution, two designations”. Now the main research direction and content of the center is carrying out research & development of technology innovation and transformation, application of scientific and technological achievements on major national needs for management and protection of land and mineral resources, important research areas and technological development directions such as geophysics and geochemistry, etc.



Major research achievements

(1) The survey results of airborne geophysical prospecting support breakthroughs of resource exploration.

The Center has taken charge of the development of CH-3 Medium UAV Global Airborne Geophysical Measurement System. This system provides new technical support and service means for basic geological surveys and carries out the widespread aeromagnetic survey on major oil and gas basins such as Tarim Basin. And the first spectacle of this system attracted high attention and reports from the news media such as CCTV in 2015 China Mining. With the use of UAV airborne geophysical prospecting technology, Wuhan Geological Survey Center signed an agreement of cooperating assistance project for Liberia Mineral Resources Exploration with the Ministry of Commerce. Now science researchers have gone to Liberia to carry out early-stage work, which achieves developing international energy and resource prospecting with the use of more mature UAV airborne geophysical prospecting technology.



CH-3 medium UAV global airborne geophysical measurement system

(2) Promoting the upgrade of equipment and the transformation of scientific and technological achievements.

The center developed carbon analyzer and corollary equipment, transformed and upgraded fully-automated Zeeman Mercury Analyzer, flame-proof Radio Wave Tunnel Scenograph, new fully-



automated double-channel Gas-generation Atomic Fluorescence Spectroscopy, metal mine radio wave CT system and so on. The world-leading new fully-automated double-channel Gas-generation Atomic Fluorescence Spectroscopy obtained 22 National Utility Model Patents. At the time, the Center sold 6 sets of XGY-1011A Atomic Fluorescence Spectrophotometer, 18 sets of Atomic Fluorescence Spectroscopy and one set of WKY-7 Tunnel Scenograph to the Republic of Angola.

(3) Promoting standardization of geochemical sample analytic methods.

The Center completed the standardization of 76 elements analytic methods of survey sample and developed the standard text manuscript of 58 analytic methods. The Center established the LA-HR-ICP-MS method with fusion sample preparation to detect 49 elements such as niobium, tantalum, zirconium, hafnium, rare earth element by solving spectral interference and studying element fraction effect quantitative evaluation. The oil & gas chemical prospecting soil reference materials preparation enters into the stage of fixed value analysis. The Center supports the IGEO infrastructure project in Angola, successfully completed the training of theoretical knowledge and operating practice to 25 laboratory technicians from Angola, and pushed forward the internationalization of the geochemical analysis technology of China. With the steady progress of geochemical reference materials preparation, the Center developed 7 soil, 10 stream sediment, 6 rock and 17 Au reference materials. Besides, the Center produced and prepared reference materials samples amounting to 64,000 pieces of 960 units and 625 external issuers, and hence supervised samples analysis quality effectively for more than 900 batches. In 2015, the Center signed 1200 reference materials.



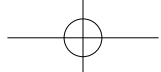
New fully-automated double-channel Gas-generation Atomic Fluorescence Spectroscopy



Graduation ceremony for trainees from Angola



International communication map



National Center for International Research on Karst Dynamic System and Global Change

This is a State-level international research center, which is supported by the Institute of Karst Geology, CAGS and the International Research Center on Karst under the UNESCO. It was approved by the MST in 2013. Through international cooperation, this research center is able to share the latest information and research results in the world through their access to international scientific and technical resources.

The researchers are to strive to make innovative results in the following topics: evolution regularity of karst dynamic system and influence of karst process on global carbon circulation and carbon sink effect, high-precision stalagmite paleoclimate records, management of karst water-bearing beds of extreme climate events and the response of fragile karst ecological system to global change, especially countermeasures to such problems as resources and environment in karst regions of the developing countries.

6.2 MLR Key Laboratories

MLR Key Laboratory of Continental Dynamics

From the viewpoint of the global tectonic outlook and by means of field investigation, deep geophysical probe, continental scientific drilling, isotopic geochemical tracing and long-term observation of deep boreholes, guided by the continental dynamic theory and based on relevant high-tech means, this key laboratory is dedicated to conducting multidisciplinary comprehensive studies of composition, structure, behavior, dynamic evolution and deep driving mechanisms of the continent; exploring and solving key scientific problems about the structure and dynamics of the Chinese (Asian) continent; establishing the theoretical system on continental structure and dynamics; promoting the development of solid earth's science; improving the public-welfare geological investigation and serving national benefits and social needs as regards resources, energy and hazard alleviation of the country.

The lab and the Institute of Geology jointly organized 2015 Academic Symposium of Project IGCP-649, and 106 experts and young scientists attended the symposium and field investigation. 97 research papers were published, including 52 in SCI-indexed journals.

Major research achievements

Establishment of the concept “the Qinghai-Tibet Plateau—a plateau of orogeny”; reconstruction of the Tethyan system and structural framework of the Qinghai-Tibet Plateau; discovery of in-situ diamond and deep-mantle mineral groups in Neo-Tethyan ophiolite; new mechanism of the subduction of the Neo-Tethyan ocean basin, and early magmatism of the India-Asia collision and its effect on exhumation of the Himalayan Mts.; new mechanism of the escape of materials on the southeastern margin of the plateau—curving and decoupling of the crust; a new metallogenic model related to collision and orogeny of the Qinghai-Tibet Plateau; discovery of subduction-type, collision-type and intracontinent-type



gneiss domes in the plateau; structural setting and mechanism of the strong Wenchuan earthquake on the eastern margin of the Qinghai-Tibet Plateau; numerical simulation of the India-Asia collision process.



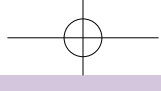
The 2015 Science Popularization Demonstration Base opened to teachers and students of the Beijing Bayi High School in summer vacation

MLR Key Laboratory of Isotope Geology

The MLR Key Laboratory of Isotope Geology adheres to the following research directions: basic theory of isotopic geology, including isotopic geochronology and isotopic geochemistry, measurement technology and its application to solving crucial geological problems concerning resources, environment and ecology.

In 2015, the lab undertook 2 special projects of the “973” programs, 1 project supported by the National Natural Science Foundation of China, 8 by the funds for young geologists (one of them was completed), 2 projects by other financial funds, 3 projects supported by the CGS, 5 special public-welfare research projects (one was completed with good evaluation), and 4 projects supported by the basic research funds. 19 research papers were published with the lab as the first author (7 papers in overseas SCI-indexed journals, 8 in Chinese SCI-indexed journals and 8 in the core periodicals of China).

Professor Nicolas Beukes from University of Johannesburg of South Africa visited the lab and delivered a report “Metallogenesis of iron and manganese of the Precambrian”. Professor Des Patterson and other American scientists and experts in isotopic thermochronology visited the lab and had discussion on the technology of in-situ zircon (U-Th) dating of laser microzones. Dr. Tian Yuntao was invited from University College London as guest researcher to jointly conduct and develop the in-situ (U-Th)/He dating method of laser microzones.



Major research achievements

Successful preparation of the first standard sample for Nd isotopic ratio ($^{143}\text{Nd}/^{144}\text{Nd}$) analysis, which received the national certificate; determination of the source condition for zircon U-Th standard material; establishment of the first accurate quantitative solution method in the world for whole-rock REE research of carbonate; establishment of the first single-grain zircon (U-Th/He) dating laboratory in China; reformation of relevant laboratories.

MLR Key Laboratory of Stratigraphy and Paleontology

This key laboratory is supported by the Institute of Geology, CAGS and addresses the following major research tasks: basing the lab on the frontier of earth sciences and the demands of social development, developing important basic theories on stratigraphy and paleontology, solving crucial stratigraphic and paleontologic problems in land and resources investigation, developing new and improving existing technical and method systems, conducting research covering early life evolution, biologic and geological environment changes, and dating and correlation of major strata.

Our lab aims to meet the national demands and needs of the earth science frontiers, to develop and innovate stratigraphic and paleontologic theories, to solve problems of key strata in land and resources survey, to establish and perfect new technologies and methods of stratigraphic and paleontologic studies. We carry out studies on the early life, the evolution of important faunas, geological environment changes, the division and correlation of major stratigraphic units, etc. In recent years, researchers in our lab have made outstanding achievements in the studies of the origin, evolution and extinction of important biota, especially those related to early life, important vertebrate fossil research, stratigraphic standard of China, establishment of standard sections and outcrops, the stratigraphic framework of important metallogenic belts, orogenic belts, tectonic belts, peri-Gondwana stratigraphic studies of the Qinghai-Tibet plateau and its adjacent areas, and compilation of the protection list of the national key and important fossils.

In 2015, Yao Jianxin, researcher of the lab, worked together with the National Commission on Stratigraphy to release the new edition of Stratigraphic Chart of China. Researcher Lü Junchang discovered the New Oviraptorid Dinosaur *Huanansaurus ganzhouensis* from the Late Cretaceous of Southern China, which was published in Science Reports sponsored by the British Nature Publishing



Conference celebrating the 30th Anniversary of the Commission on Isotopic Geology, GSC and Symposium on the Application of Isotopic Geology



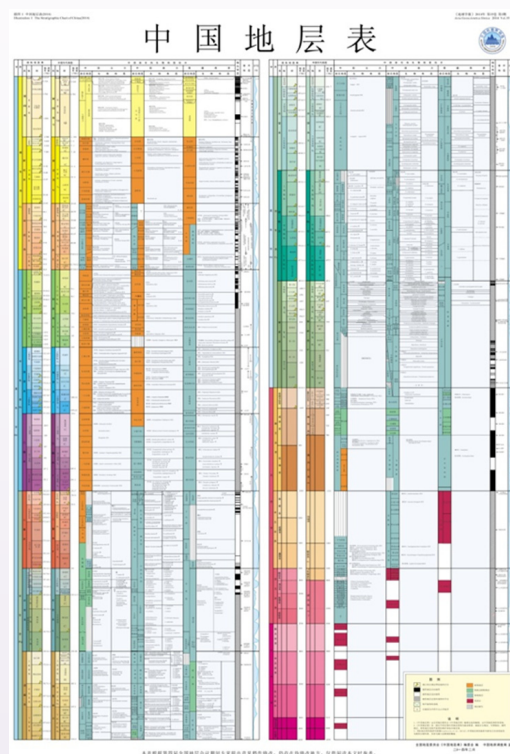
Group. In addition, significant results were obtained by researchers of the lab, such as Jin Xiaochi and Dr. Huang Hao in the research of paleographic reconstruction of the Fusulinids Fauna in Baoshan Block, Liu Pengju and Tang Feng in the research of the Ediacaran Fauna, Dr Wang Xuri in the research on birds, Dr. Wu Zhenjie in the research of Ordovician marine red layer, Dr. Peng Nan in the research on the sediment source of the Laiyang Group, Dr. Zong Pu in the research of the relationship between the atmospheric oxygen levels and the biodiversity.

MLR Key Laboratory of Earthprobe and Geodynamics

The laboratory focuses its research work on the development of deep probing techniques, detection of the earth's deep structure and dynamics, so as to provide scientific support to resources prospecting, prevention and control of disasters and innovation of geoscientific theories. It is distinctive and superior that the laboratory applies integrated deep probing technology to explore fine and detailed deep structure of important structural elements and metallogenic areas and builds 3-D models delineating the structure and dynamics of the earth from the surface down to the mantle. MLR Key Laboratory of Earthprobe and Geodynamics has been focusing on the studies of continental lithospheric structures, tectonics and geodynamics, as well as deep processes for ore forming. Under this research goal, we have built a system of deep probing that is primarily centered on the deep seismic reflection studies and have an innovative team who undertook major national research projects. So far, we have completed a total of more than 8000 km seismic reflection profiles. The results have contributed greatly to understanding deep continental structures of China. Currently, we are undertaking 10 projects supported by the National Natural Science Foundation of China, including 1 Major Program, 2 Key Programs and 7 General Programs, as well as multiple projects supported by Land and Resources Survey.

In 2015, we published a total of 17 papers in academic journals. Among them, 16 papers are indexed by SCI and 1 paper is indexed by EI. We have obtained the first prize awarded on Land and Resource of Science and Technology. In addition, a number of important scientific findings were achieved, including:

(1) A dense broadband seismic profile reveals persistent underthrusting of the mantle lithosphere beneath the Qilian orogen, which provides new evidence for the subduction of Euro-Asian plate beneath the Tibetan Plateau (Zhuo Ye, Rui Gao et al., 2015).



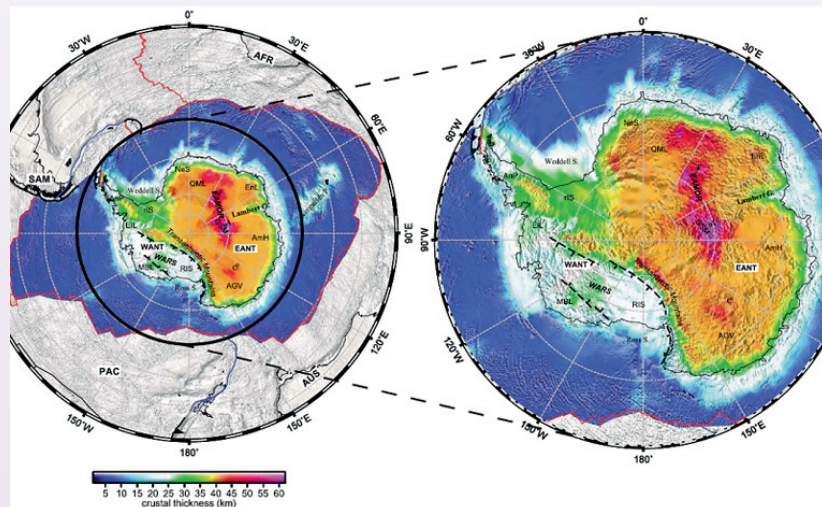
Stratigraphic Chart of China

(2) The new deep seismic reflection indicates that the Longriba fault zone, instead of the Longmen Shan fault zone, marks the western edge of the Yangtze crustal block in eastern Tibet (Guo X.Y., Gao R. et al., 2015).

(3) The seismic observations in Antarctica by China-US cooperation constructed a 3-D crustal and lithospheric seismic model for the entire Antarctic Plate for the first time (Meijian An et al., 2015).

Our laboratory insists on the spirit of “OPEN, Go OUT, and Bring IN”. The influence of our laboratory has been strengthened more by frequent co-operations with other institutes and universities at home and abroad.

The lab director, Prof. Gao Rui, was elected as Academician of the Chinese Academy of Sciences in 2015.



Crustal thickness (Moho discontinuity) map of the Antarctic plate



Academician Gao Rui discusses with Prof. Fenglin Niu at Rice University about the seismic full waveform inversion



MLR Key Laboratory of Metallogeny and Mineral Resource Assessment

Centering around country's goals and economic and social demands, the lab is dedicated to the following research fields: ore-forming process and background, metallogenic theories; regional metallogenic patterns and theories, assessment and planning of potential regional mineral resources; important problems and new techniques and methods for the investigation and assessment of mineral resources; typical cases in the exploration of large-scale ore deposits; strategic research of mineral resources.

The Academic Committee Conference was held on May 7, 2015, concluding that the lab was distinctive in the strategy and regional planning of mineral resources and strong in mineral exploration, resources assessment and studying of metallogenic regularity. Dr. Mao Jingwen, director of the lab, and his colleagues have paid several visits to some universities and labs to conduct exchanges about lab construction and talent cultivation, such as the National Key Laboratory of Geological Process and Mineral Resources of China University of Geosciences (Wuhan) and the National Key Laboratory of Metallogenic Mechanism of Endogenic Metallic Deposits of Nanjing University.



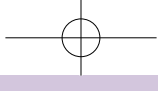
Academic Committee Conference of the laboratory



An investigation at the National Key Laboratory of Geological Process and Mineral Resources



An investigation at the National Key Laboratory of Metallogenic Mechanism of Endogenic Metallic Deposits



The lab organized the Symposium on the Mineral Resources in the Silk Road Economic Belt. Over 100 geologists and graduates from institutes and universities attended the symposium and had discussion and exchanges on important problems about exploration and research of mineral resources of major ore-forming belts in the Silk Road economic belt, especially Ural-Mongolia, Tethys, East and West Tianshan, Altai and Middle Asian Orogeny.



Symposium on the Mineral Resources in the Silk Road Economic Belt

In 2015, the lab published 115 research papers, including 70 SCI-indexed papers and 3 monographs, and received 3 invention patents, 1 first and 2 second prizes of the Scientific and Technological Award of the MLR. Research Fellow Wang Denghong was awarded titles by the CGS for outstanding geological talents.

Major research achievements

Significant results were obtained in applying metallogenic theories to guide ore prospecting, and a major breakthrough was made in mineral exploration in the Bannu ore-forming belt in Tibet. It was estimated that copper resources of the Duolong ore-concentrated area could be up to 20 million tons and expected to be the 25th superlarge base of copper resources in the world. Wang Denghong and his team undertook the project of “Strategic investigation of ‘three-rare’ resources of China” and established a metallogenic model for the Gyabjeka orefield based on the research of geological features and metallogenic regularity of the orefield, discovered 9 Li-mineralized pegmatite veins (X01-X09) with X03 having 643100 tons of lithium oxide. Prof. Zheng Mianping and his team carried out investigation on a large number of oil-well cores and records and combined multidisciplinary prospecting techniques in six favorable areas of potash resources in the Qaidam, Lanping-Simao, Tarim, Ordos, Sichuan and Jiangnan basins. Major progress was made in mineral exploration for shallow covering areas and a large buried porphyry-skarn iron-copper deposit was verified by drilling in Layikeleke of the eastern Junggar basin.

MLR Key Laboratory of Salt Lake Resources and Environment

The main research directions of the lab are mineralogenic regularities of salt deposits, theoretical and



methodological study of assessment and multipurpose utilization of salt resources, salt lake environment and global change, agriculture, ecology and health related to salt lakes.

As the only platform in China for the study of salt resources and environment, the lab is equipped with a number of advanced analytic instruments and has applied effective techniques and methods to rapid measurement, analysis and test, so as to provide a host of analytic data and strong support to scientific research related to prospecting of potash resources.

In 2015, the lab undertook 22 projects, including 8 projects funded by the National Natural Science Foundation of China and 3 “973” programs. 33 papers were published, including 5 papers in international SCI-indexed journals, 5 in Chinese SCI-indexed journals, 5 in EI-indexed journals, 15 in the core journals. The lab won 2 awards in 2015 and 2 scientists of the lab have positions at the International Society for Salt Lake Research.

The lab actively conducted academic exchanges both internationally and domestically. Prof. Zheng Mianping presented the keynote report at the 2015 World Potash Conference; organized science popularization activities in universities and colleges, gave lectures and spread knowledge and results of salt lakes research. The Center on Research and Development of Salt Lakes and Geothermal Water Resources, CAGS, undertook the 218th S&R Forum of the Chinese Academy of Engineering — “Symposium of Young and Middle-aged Scientists Engaged in Salt Engineering Science and Technology”, attracting over a hundred scientists and researchers.



Academician Zheng Mianping presents the keynote report at the 2015 World Potash Conference

MLR Key Laboratory of Neotectonic Movement and Geohazard

The laboratory focuses on the following researches: neotectonics mobile faults; seismic geology, engineering geological effect of mobile faults, formation mechanisms and hazard formation models of catastrophic geological hazards; theories and methods for prediction and evaluation of severe geological hazards, establishment of technical exchange platforms and research bases of active structure and

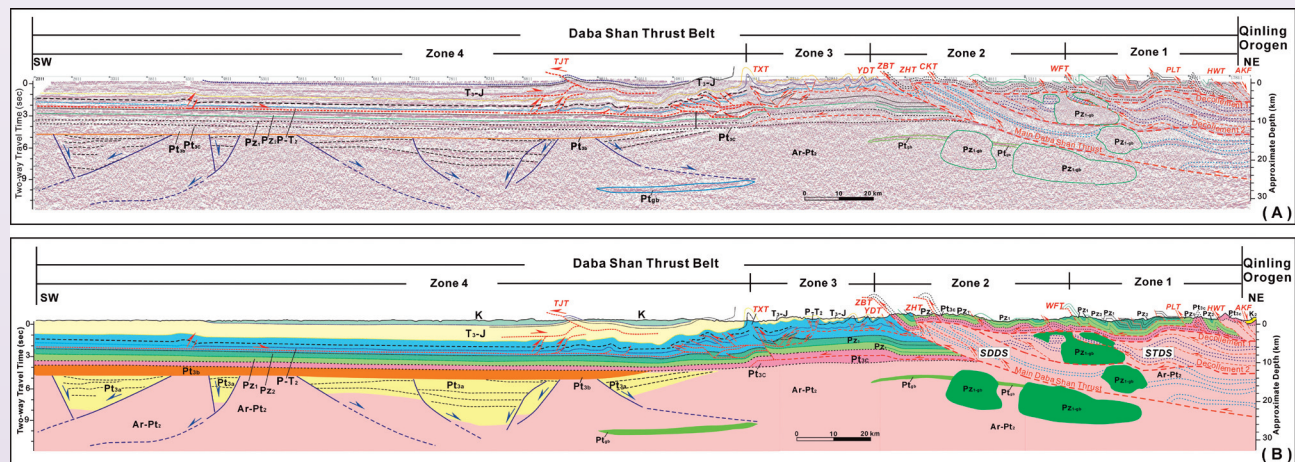
mitigation and prevention of geological hazards, so as to propose policy-making bases and technical support to the national strategy for fighting and alleviating natural disasters. The lab has established a hazard formation model of neotectonics—tectonic geomorphology—active fault—seismic geology—present tectonic stress field—regional crustal stability—major geological disasters and risk-control system research platform.

In 2015, the lab had 68 staffs, including researchers, lab assistants, administrative personnel, master and doctoral students, as well as 5 doctorate fellows working at the post-doctorate research station; undertook 26 projects and published 108 research papers, including 68 papers in SCI/EI-indexed journals, 33 in core journals, and 2 monographs; received 1 Invention Patent, 1 National Utility Model Patents and 2 software copyrights. Researchers of the lab participated in over 60 academic symposiums and the lab invited foreign and Chinese experts to conduct academic exchanges and organized various symposiums and discussions.

Major research achievements

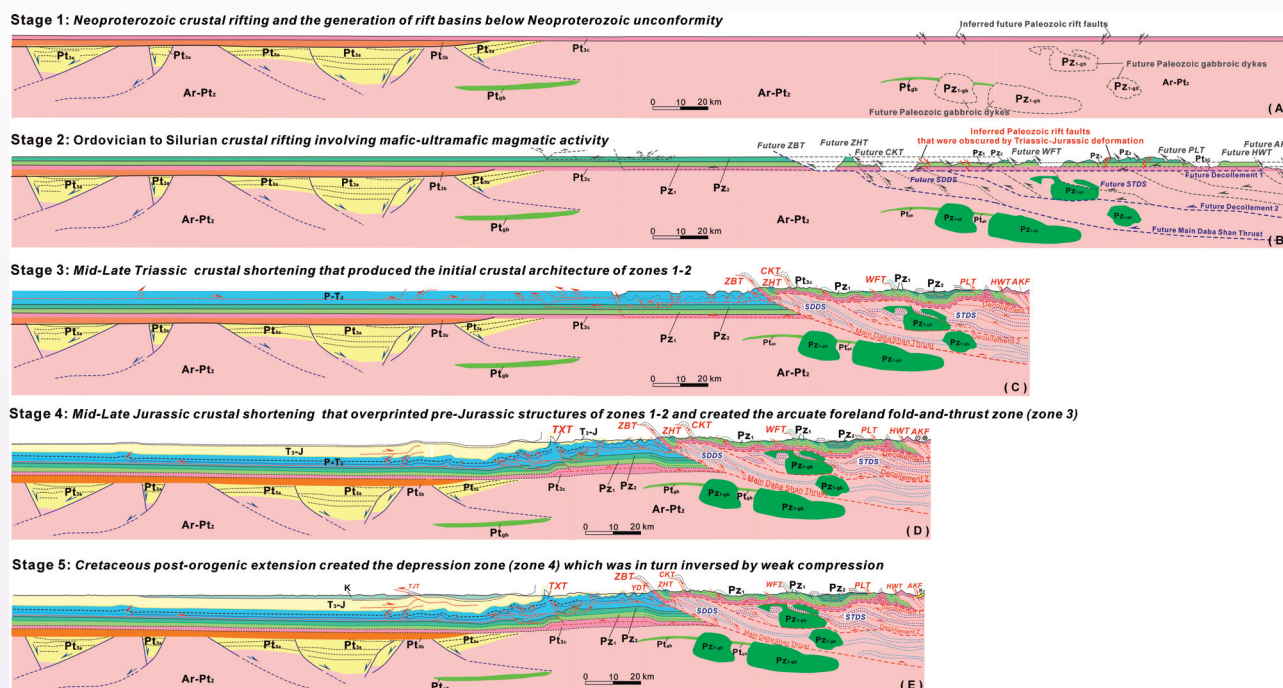
(1) New insights into crustal tectonics and evolution of the Dabashan thrust belt from the reflection seismology and balanced cross-section:

(a) The deformation in the North Dabashan is characterized by intense ductile shearing and tight folding at surface and duplex thrusting at depth. The South Dabashan exhibits thin-skinned thrusts and folds at surface, genetically accommodated by multiple detachment faulting at depth.



Interpretation of deep reflection seismic profile (A) and the deformation mode in the middle and upper crust (B) in the Dabashan structure belt

(b) The Dabashan thrust belt underwent a five-stage tectono-magmatic evolution during the Neoproterozoic-Mesozoic period.



Five-stage tectono-magmatic evolution of the Dabashan structural belt during the Neoproterozoic-Mesozoic period.

(2) Analysis of the activity of the Xianshuihe fault and geological hazards investigation, as well as assessment of susceptibility, were done. On this basis, a suggestion was proposed for improving the Sichuan-Tibet Railway in Litang County and adopted by the designing institute.

(3) Regional risk assessment of earthquake-triggered landslides was performed in the North-South fault area, as well as a local-scale risk assessment under different earthquake probabilities in Tianshui. The outcomes could provide references of geological safety for land use in mountainous cities.

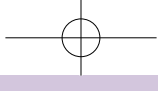
(4) The reorganized J.S.Lee Memorial Hall was opened to the public since September 2015.

MLR Key Laboratory of Paleomagnetism and Paleotectonic Reconstruction

The Paleomagnetic Laboratory is the first paleomagnetic laboratory created under the guidance of Professor Li Siguang in 1963 and was approved by the CAGS in 2008. In 2012, the MLR approved the Key Laboratory of Paleomagnetism and Paleotectonic Reconstruction.

Laboratory research: Mr. Li Siguang inherited and carried forward the theory of geomechanics, application of paleomagnetism method, combining with field geology, geophysics, geochemistry as a interdisciplinary means to continue in-depth study of ancient tectonic reconstructions, remodeling of the ancient environment, typical magnetic formations dating and other basic geological problems.

The lab held the academic annual meeting in January 2016, presided over by Wang Xisheng and Sun Zhiming. Yang Zhenyu, director of the laboratory, gave a report on the progress of the work in 2015.



The main results achieved in 2015 include:

- (1) Mesozoic paleomagnetic results of the Longmenshan tectonic belt and their constraints on the rotating structure of the Sichuan Basin.
- (2) Paleomagnetism of Paleogene sedimentary strata of the Sichuan-Yunnan block on the southeastern margin of the Qinghai-Tibetan Plateau and its tectonic significance.
- (3) Paleomagnetic results of Carboniferous strata in the Qaidam block and their paleogeographic significance.



Field investigation

MLR Key Laboratory of Eco-geochemistry

Major research achievements

- (1) Rare Earth Mine Environmental Remediation Technology.

The research group focused on the study of the enrichment patterns of scandium in various mineral elements, and the relationship of basic-ultrabasic rocks with alteration, ore, mineralized zone, and proposed a prospecting direction of scandium deposits, as further search for new resources and a guideline for effective use of scandium in mine tailings. 6 standard materials of rare earth element speciation in soil were developed in accordance with the National technical specification for the first-class standard materials.

- (2) A Breakthrough Made in Applying Geochemical Engineering Technique to the Remediation of Contaminated Soils in Ionic Rare Earth Mines.

Starting with the Zudong abandoned mine repair base, the group established a relatively stable and efficient mining repair field experiment platform. The vegetation in the repair area has been restored,



which reduced soil erosion in the mining area. The indicators after (such as pH, ammonia nitrogen) were all maintained at normal levels, and the repair effectively fixed ammonia nitrogen, heavy metals and rare earth elements, and controlled their downstream migration speed while mining residual ammonia nitrogen could be used as “recycling” resources.

(3) Comprehensive Achievements Scored in Organic Ecogeochemical Studies.

Taking the Yangtze River Delta region as a typical case, organic geochemical survey and evaluation of land were carried out, which improved the comprehensive survey and evaluation of agricultural soil, irrigation water, air, crops and other media. *Farmland Organic Geochemical Survey and Evaluation Methods* was worked out to provide support for the improvement of investigation and assessment of land quality and geochemical monitoring methods and techniques, and to provide a showcase for the implementation of land organic geochemical survey tasks of the industry.

Academic Rewards and Geostandards

(1) “Pollution Investigation and Evaluation of Key Technology Research of Groundwater in the North China plain” won the First Prize of 2015 annual Land and Resources of Science and Technology Award (ranking No. 12).

(2) “National Standard traceability System Optimization and Capacity Building” won the second prize of the Science and Technology Award by National Bureau of Quality Supervision and Inspection and Quarantine (ranking No. 2).

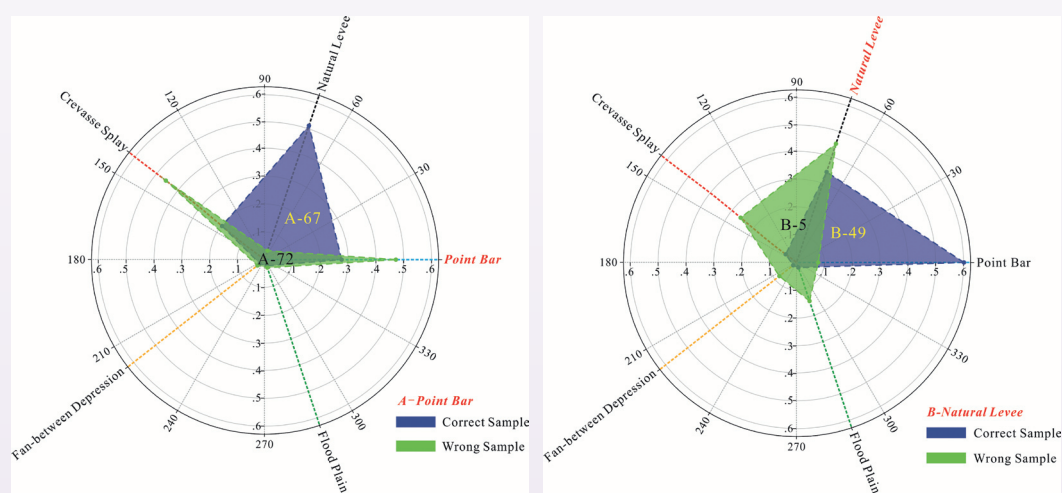
(3) Standard name: Requirements on Quality Control Technology of Sample Analysis for Groundwater Pollution Investigation and Evaluation (standard number: DD 2014-15).



An REE mine (left) and its scenery nine months after environment remediation (right)

MLR Key Laboratory of Groundwater Sciences and Engineering

The laboratory is dedicated to addressing the country's pressing needs of sustainable utilization of groundwater through conducting the cutting-edge basic research and innovations with respect to circular evolution and sustainability of groundwater. The lab also boosts domestic and international cooperation, fosters an environment favorable to innovative talents, provides strong scientific and technical support to safe utilization of regional groundwater and to solve problems related to land resources and environment.



Quantitative identification of sedimentary microfacies

MLR Key Laboratory Geochemical Survey Technology

The supporting institute of Geochemical Survey Technology Key Laboratory of the MLR is the Institute of Geophysical and Geochemical Exploration of the CAGS. The research directions of the Laboratory are baseline and change research for global geochemistry, deep-penetrating geochemical prospecting theory and technology research and geochemical mapping technology research. This team won the title of the Innovation Team of the MLR.

Academic Activities

The Laboratory held 6 national and international academic exchanges and training classes in 2015, hosted and participated in 4 international geochemical mapping technology training courses with more than 160 trainees coming from over 30 countries, which not only improved trainees' skill, but also achieved technological output and win-win cooperation. The Laboratory held a geochemical prospecting technology research discussion and a global geochemical mapping discussion.

Major Achievements

(1) On the basis of nano-scale metals discovered in recent years, the Laboratory further confirms that



nano crystals have the crystal shape (most in hexagon) and lattice diffraction, and directly proves that nano-scale crystals are produced by endogenic mineralization. So the Laboratory obtained a complete evidence chain about nano geochemical transport.

(2) Major progress was achieved in drawing of a global geochemical map and integration of research achievements. The Laboratory researched and developed a global geochemical map, the Chemistry Earth Platform, which is like the Google Earth. This platform collected geochemical data from about 40 countries, and covers an area of 32 million km². These data occupy 22% of the global land area.

(3) A substantial breakthrough was made in serving the society, which supports enterprises that go abroad for resources exploration. The Laboratory surveyed 10 metallogenic elements and over 500 prospecting potential areas. 14 of the surveyed geochemical anomalies became the basis of the plan “Open Toward the North—Mineral Exploration Areas of the Major Metallogenic Belts in Mongolia” of the Geological Survey Institute of Inner Mongolia. The exploration right of 3 anomalies was gained by Inner Mongolia Ferrous Geological Mining Industry (Group) Co., LLC.

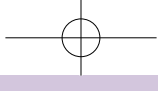
(4) The Laboratory published 43 papers including 5 SCI papers, and cultivated 1 Latin America outstanding young researcher, 2 post-doctorates, 6 doctors and 3 masters.



Researcher Wang Xueqiu discusses with visiting scholar Adrian Perez Avila of the China-Latin America Technology Exchange Plan

MLR Key Laboratory of Geophysical Electromagnetic Exploration Technology

The Key Laboratory of Geophysical Electromagnetic Technology of the MLR focuses on airborne electromagnetic survey, ground electromagnetic survey, down-hole electromagnetic survey, diverse information processing of electromagnetic survey, and other basic researches, and provides technical support for undertaking basic, public-minded and strategic research of national geological survey. The supporting institute of this laboratory is the Institute of Geophysical and Geochemical Exploration of the CAGS.



Academic Activities

The Laboratory invited international experts to present one special academic report, organized 7 symposiums or training classes for discussion and exchanges about key technological problems, achievements, techniques and methods with over 200 participants. 50 researchers of the laboratory participated in 15 domestic technical exchanges and 2 international academic conferences. The laboratory arranged visits and academic exchanges for over 50 foreign scholars.

Major Achievements

(1) The airborne geophysical prospecting on the scale of 1 : 50,000 in the Hunan section of the Qinhang ore belt obtained high quality data (airborne magnetic/airborne radioactive) of geophysical prospecting, screened out 1343 aeromagnetic anomalies, 329 airborne gamma-ray spectrometry anomalies, and discovered 8 ore occurrences and mineralized spots. the airborne geophysical comprehensive lithology structure diagram was compiled. And the laboratory predicted potential prospecting areas and prospecting target areas of multi-metals and radioactive uranium, and surveyed 40 potential areas and 52 target areas.

(2) The Laboratory conducted intensive research on technologies of magnetic core, coil winding and magnetic feedback, and developed the frequency domain inductive magnetic field sensor IGGE-30 and IGGE-80, which attained the world's most advanced standard and can totally replace American ZONGE'S ANT/6, Canadian Phoenix's AMTC-30 and MTC-80 inductive magnetic sensor to match Chinese instruments.



Two magnetic sensors

MLR Key Laboratory of Karst Ecosystem and Treatment of Rocky

In 2015, the laboratory undertook 38 projects, 4 of which were state science and technology support programs and 5 were Funded by National Natural Science Foundation of China. Major progress was achieved in fragile ecosystem restoration in rocky desertification areas, investigation and evaluation of groundwater pollution, and also in hydrogeology and engineering geology. We published 25 articles, and 3 were cited by SCI or EI.

The laboratory actively carried out academic exchanges. We invited professors of Nanjing Institute of Geography and Limnology to give us special lectures. 8 researchers of the lab attended 6 domestic and international academic conferences. The lab carried out four open projects, and each subject turned over



the interim summary; organized four conferences, including the Lab Academic Committee Meeting, Academician Forum of Rock Desertification Integrated Management in Karst Areas and the acceptance conference of the Lab.

On December 31 2015, the acceptance conference was held. The panel listened to the report of our Lab and asked questions. Finally, we had 94 scores and passed the acceptance successfully, and the Lab was officially established.

国土资源部岩溶生态系统与石漠化治理重点实验室2015年学术委员会会议



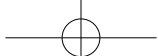
A group photo of attendees of the 2015 annual academic conference



A meeting of laboratory acceptance



Plaque-unveiling ceremony of the laboratory



MLR Key Laboratory of Karst Dynamics

The key Laboratory of Karst Dynamic is among the first groups of key labs set up by the MLR in 2004, also the key member of the International Research Center on Karst (IRCK) under the auspices of UNESCO and National Center for International Research of Ministry of Science and Technology. Based on the IRCK and guided by the systematic geosciences, the lab takes advantage of the geographic feature and international influence of China and is dedicated to the following tasks: improving the karst geodynamic theory, establishing a laboratory and experimental platform, training high-rank researchers, making contributions to fulfilling the goals of the lab, conducting researches on the response of karst dynamic system to the global change, so as to provide scientific and technological support for solving ecological and environmental problems and making scientific and technological innovation in land and resources management in karst regions.

In 2015, the KDL was chosen as the advanced group in international technology and international cooperation during the “Twelfth Five-year Plan” of China.

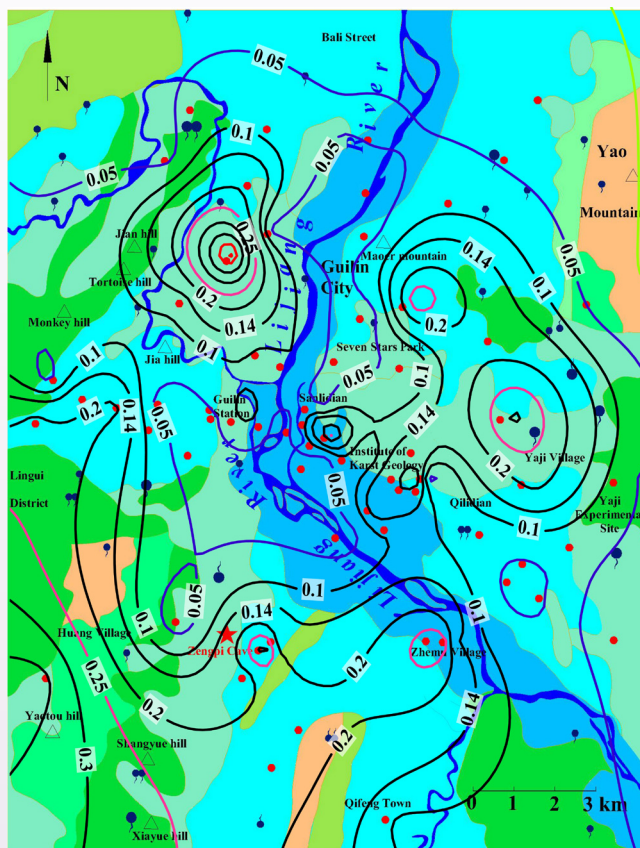
This year, researchers of the KDL attended 30 international exchanges and domestic exchanges, finished 3 geological surveys for research abroad, organized one international conference and one domestic conference, undertook 58 geological survey projects, applied for four national natural science funds and one China scholarship fund, published 64 academic papers, including 18 SCI papers, and gained 5 patents of utility models.

Major Achievements

In northwest Yunnan, the high-resolution cave stalagmite recording during the Mid-Holocene was from 6270 aBP to 4185 aBP. It showed three stepwise evolution stages on the centennial scale. With gradual weakening of the intensity of southwest monsoon, there were three arid and cold events, and the vegetation showed positive evolution process by a self-regulatory mechanism.

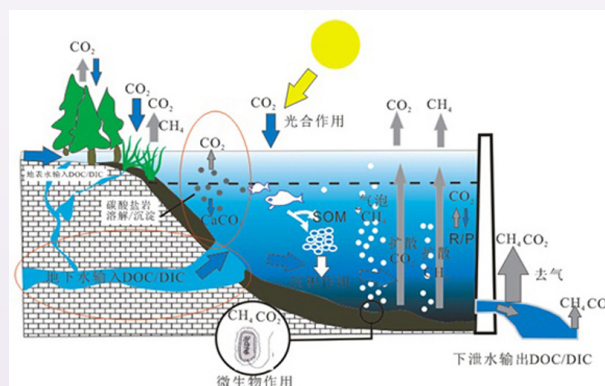
According to the analysis of sequence of groundwater level changes at 65 monitoring stations from 1987 to 1990 in Guilin, and the response data of water level in boreholes, which were recorded near Zhenpiyan with 15 minutes for one record, researchers calculated the change range of the specific yield of amplitude zone in groundwater, and then ascertained the spatial distribution of specific yield.

According to the research results of transaction flux of greenhouse gases between water and gas interface in summer of reservoirs under different geological backgrounds, the discharge of greenhouse gases from the water out of a reservoir are larger than that from the water in the reservoir. It is worthwhile to pay attention to how to control the discharge of CO₂ and CH₄ of greenhouse gases from the water out of reservoirs. Meanwhile, the CO₂ transaction flux of reservoir recharged by karst water are obviously higher than that recharged by non-karst water under the situation of no amount of organic matter covered by soil and plants.



Distribution map of water supply in Guilin City

In 2015, *the IRCK in First 6 Years* (in both Chinese and English) was successfully published by the Science Press, which was written by the IRCK under the Auspices of UNESCO, the Institute of Karst Geology, CAGS and the Ministry of Science and Technology/Key Laboratory of Karst Dynamic, MLR.



Generation mechanism of greenhouse gases in karst reservoir and discharge route



Establishment of the international monitoring station on karst carbon sink in the WANG BA DAN Spring of Thailand



Thematic symposium on geological investigation and research of global climate change organized by KDL, MLR

6.3 CGS and CAGS Key Laboratories

Key Laboratory of In-situ Stress Measurement and Monitoring, CGS (CAGS)

The laboratory is supported by the Institute of Geomechanics and focuses on the following research areas: developing basic theories, test techniques and methods regarding crustal and structural stress fields, as well as related instruments and equipment; extending applications of crustal stress and lithological mechanics to structural deformation, endodynamic disasters and metallogeny, so as to provide technical support to basic research of geodynamics, exploitation of natural resources, prediction and early warning of geological hazards.

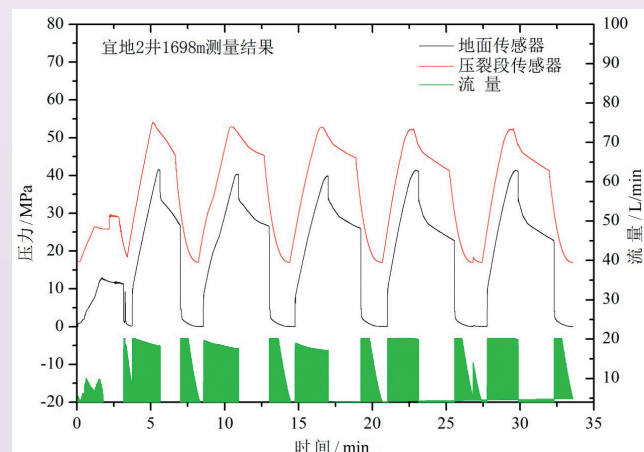
In 2015, the laboratory had 24 researchers and one guest researcher; undertook 30 projects and published 24 research papers, including 14 SCI/EI-indexed papers; received 3 National Utility Model Patents; organized or participated in 8 international or domestic academic exchange conferences.

Major Research Achievements

① The laboratory for calibration of stress measurement was established and put into operation. Physical simulation was conducted for bidirectional loading of large-sized rock samples and laboratory measurement of crustal stress. ② The laboratory made investigation on the crustal stress sites in shale oil areas in South China; completed in-situ stress measurement in Well Yidi-II and obtained stress data of shale oil-bearing beds at a depth of 1698 m, which made a breakthrough in applying the hydraulic fracturing technique at large depths of small-caliber wells. The test depth is the largest to date in China according to released reports. ③ Based on the ocean guarantee project, the lab carried out crustal stress investigation and evaluation of crustal stability in Bohai Sea strait and Qiongzhou strait, which provided basic data for the construction of related projects. ④ The analytic system of stress monitoring data was developed.



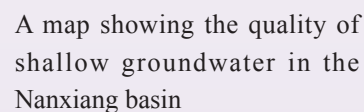
Laboratory for calibration of stress measurement



Stress measurement at a depth of 1698 m of Well Yidi-II with the hydraulic fracturing technique



The laboratory adheres to the research direction of “groundwater pollution mechanism and remediation” and focuses on the following research tasks: in view of the weak basis of China in the control and remediation of groundwater pollution and poor application of related remediation technology, and strong public and market demands, the lab focuses on the development and application of groundwater remediation technology through applications of innovative research and application results from abroad. At present, a research system has been established, with pollutant migration mechanism, geological microbiology and nanotechnology of remediation as the predominant research direction and characterized by integrated development in the research features of soil and groundwater contamination mechanism, contamination remediation methods, field investigation and in-situ mediation technology application, groundwater pollution prevention and regionalization.



Based on in-situ micro-analysis and speciation analysis techniques including LA-ICPMS, μ -XRF/ μ -SRXRF, LIBS, HPLC/GC-ICPMS, SR-XAFS/XANES, the lab's research activities have been focused on development and application for elemental concentration, distribution of major and trace elements, and also focused on the study of elemental speciation, migration and transformation of samples in typical mining districts based on element morphology, in order to provide technical support for mineral

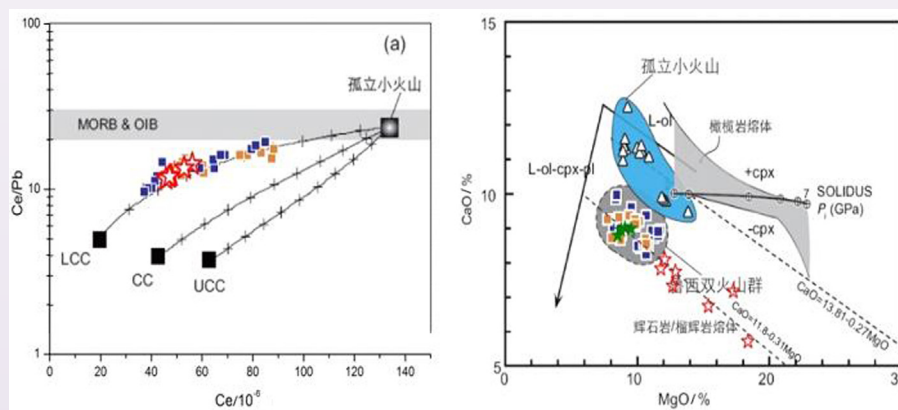
prospecting, multipurpose utilization and ecological research.

Academic Achievements

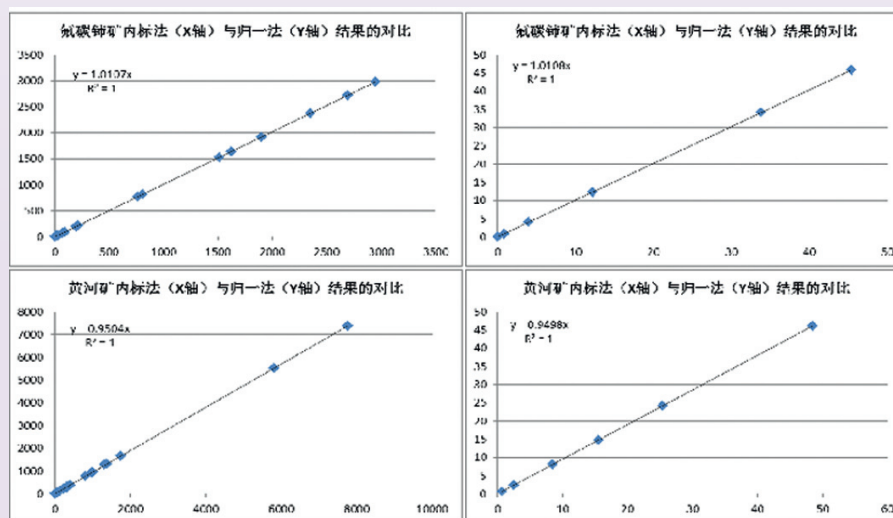
(1) LA-ICPMS analytic methods

In 2015, the group of LA-ICPMS prepared a series of synthetic fluid inclusions in quartz analog calibration samples. A quantitative analytic method for mineral melt inclusions was established. The EPMA and in-situ LA-ICP-MS were applied to analyzing mineral inclusions in zircon U-Pb dating standard “Temora”, and both methods showed good consistency of major and trace elements. The rare earth carbonate minerals fluorine LA-ICPMS internal standard method and analytic method normalization were established. The methods are suitable for simultaneous determination of 50 elements including rare earth elements, comparing with the result using the internal standard method, the deviation of the results was less than 5%, while the analysis efficiency was greatly improved and the costs significantly reduced; prepared three alternative sulphide mineral micro calibration material using co-precipitation powder tablet method to carry out homogeneity and stability analysis.

LA-ICPMS data of the melt inclusions from olivine phenocrysts of Linqu basalt in comparison with the data released in previous literature (blue data points for the LA-ICPMS measurements)



LA-ICP MS internal standard calibration and normalization calibration of high REE minerals (each data point denotes an element; left: trace elements, 10^{-6} ; right: major elements, 10^{-2})





(2) In-situ XRF analysis

Instrument optimization: 1) The new X-ray tube was used to increase the space for microscope adjusting; 2) the minimum spot was decreased from 45 to 19 μm to enable areal scan of small-sized samples; 3) the X-ray pipe mounting bracket was improved so that the incident X-ray is adjustable at three angles (30° , 45° , 60°); 4) replacement of sample fixations to effectively reduce the experimental background. The method is suitable for multi-element in-situ analysis and provides abundant information for the study of element distribution characteristics. The lab established the SR-XRF analytic method for cadmium in rice.

(3) HPLC / GC-ICP MS technique combined with morphological analysis

Based on MSMS techniques, distribution and morphological analytic method was established for analyzing cadmium in plants, including UPLC-ESIMS and SEC-HPLC-ICPMS analytic methods for phytochelatins (PCn). The separation and detection methods for analyzing different forms of arsenic were improved, including ① three kinds of organic forms of arsenic separation and detection methods for ASA, ROX, NPAA; ② six kinds of arsenic speciation simultaneous separation and detection methods for AsC, AsB, As^{3+} , DMA, MMA, As^{5+} ; ③ seven kinds of arsenic speciation simultaneous separation and detection methods for AsB, As^{3+} , DMA, MMA, As^{5+} , ASA, NPAA. The establishment of the series of sample analytic method facilitates the qualitative and quantitative detection of arsenic in various species. The analytic method for iodine speciation analysis in soil samples was established.

Equipment and Technical Support

The laboratory provided equipment and technical support to many scientific institutions and universities, including the Institute of Mineral Resources and Institute of Geology of the CAGS, China University of Geosciences (Beijing, Wuhan), Guangzhou Institute of Geochemistry, Chinese Academy of Sciences and University of Hong Kong. The mineral types of samples include silicate minerals like zircon, garnet, sulfide minerals like pyrite, chalcopyrite, oxide minerals and tungstate minerals.

Key Laboratory of Geochemical Cycling of Carbon and Mercury in the Earth's Critical Zone, CGS (CAGS)

The laboratory is on the grounds of the Institute of Geophysical and Geochemical Exploration of the CAGS. The research direction of the lab is studying the geochemical behavior and transport process of carbon and mercury under natural effect and in man-made interference process, ascertaining transport flux and control factors of various cycling processes in the earth's critical zone, evaluating the ecological effect in the geochemical cycling process of carbon and mercury, carrying out research on soil carbon pool and carbon sequestration potential as well as geochemical evaluation on land quality in major farming zone, and providing scientific support for the rational utilization of land and environmental protection.

Academic Achievements

The laboratory convened the Checking and Accepting Meeting of the Laboratory Establishment. The attendees of this meeting were experts from the MLR, CAGS, China University of Geosciences (Beijing) and leaders and laboratory personnel from the Institute of Geophysical and Geochemical Exploration.

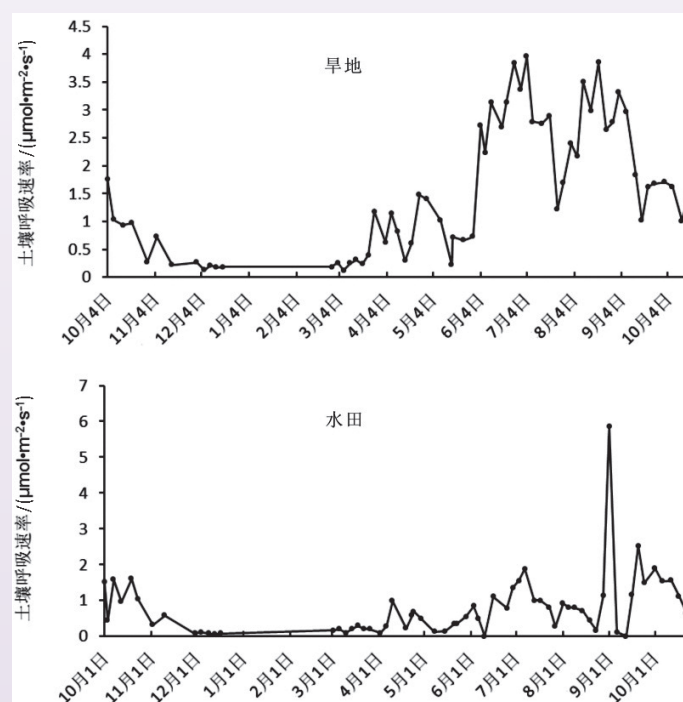
The experts team agreed to check and accept the achievements and ranked the achievements as class A, 2015.

Major Achievements in 2015

(1) Soil Carbon Respiration Monitoring in Heilongjiang Province

The lab carried out monitoring and research work on the change of soil carbon source and sink in farmland after reclamation from wet land in three rivers region Heilongjiang province. The soil types monitored include boggy soil and meadow soil. The land utilization types monitored include unused land, paddy field and dry farmland.

The soil carbon respiration monitoring work acquired more than 4700 sets of dynamic and static soil respiration monitoring data through November, 2015. Daily variation data show that the humidity, biological species and quantity of the soil changes little in a day and that temperature is the most important element which influences the soil respiration rate. Monthly variation data show that the obvious seasonal difference caused by climate leads to the seasonal change of the soil respiration. In addition, the different land utilization types influenced the soil respiration. Because of flood in July and August, the maximum of carbon respiration of water field occurs in September after the water is drianed, while maximum of carbon respiration of farmland occurs in July and August.



Comparison of monthly soil carbon respiration data between farmland and water field

(2) Mercury exchange flux monitoring

The lab completed the mercury exchange flux monitoring in soil-atmosphere interface in Hebei farmland and established the method of estimating mercury emission flux in accordance with the linear



relation between monitoring data and meteorological data. According to the monitoring data since 2012, the annual exchange flux in the Yangtze River Delta was a positive value in the main and the overall performance was characterized by emission, while that of the three provinces in northeast China was negative in the main and the overall performance was sedimentation. The emission and sedimentation situation of Shandong and Hebei provinces fell between the above two cases. All of this shows the tight relation between the latitude and annual mercury exchange flux at the soil-atmosphere interface.

Key Laboratory of Karst Collapse Prevention, CGS (CAGS)

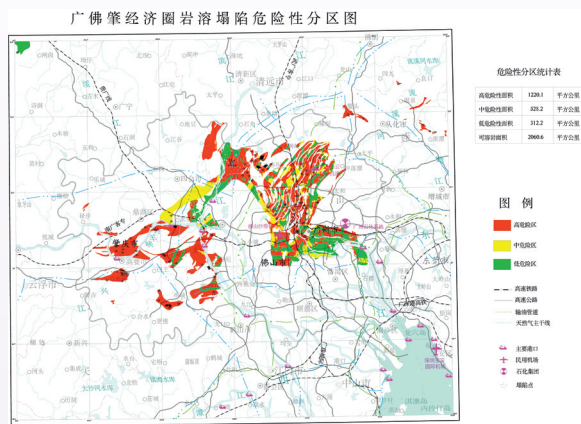
The research areas of the lab are as follows: investigation and risk assessment of karst collapse, formation process and influence factors of karst collapse, monitoring technique of potential sinkhole, karst collapse prevention and sinkhole remediation. Supported by Chinese Academy of Geological Sciences, the Key Laboratory of Karst Collapse Prevention was founded in 2012 in the Institute of Karst Geology. In April 2015, the Lab passed the acceptance test organized by the Chinese Academy of Geological Sciences.

In 2015, the Lab carried out research and application work around five research areas. Nineteen projects were successfully completed, among which six projects were funded by the NSFC, three projects funded by the CGS, and one project supported by local governments. Four papers by the research group were published and two field experimental sites were improved and constructed, among which the research site for karst geological hazard in Guangzhou was officially established in December.

The main academic activities in 2015 include inviting visiting research fellows to return to give lectures, organizing experience exchanges on karst collapse investigation techniques on the 1:50,000 scale, organizing the Key Lab Academic Committee Meeting, attending the Annual Symposium of Engineering Geology.

Main research achievements

- (1) The current status, distribution and development trend of karst collapse in China were summarized.
- (2) Risk assessment of karst collapse in the City Belt of Guangzhou, Foshan and Zhaoqing was made.
- (3) The results of an experimental study of monitoring the process of sinkhole collapse using Brillouin Optical Time Domain Reflectometry (BOTDR) technology demonstrated that the positions of the peak strain in optical fibers correspond well to the areas of maximum disturbance and soil void formation. Time series of optical fiber strain analysis exhibit the progress of horizontal disturbance in soil.
- (4) Monitoring methodology based on dynamic monitoring and optical fiber sensor monitoring was formed, which will provide important guarantee for dynamic parameter capture, mechanism recognizing and development criteria.



Risk assessment of karst collapse in the City Belt of Guangzhou, Foshan and Zhaoqing



Academic committee meeting of the laboratory

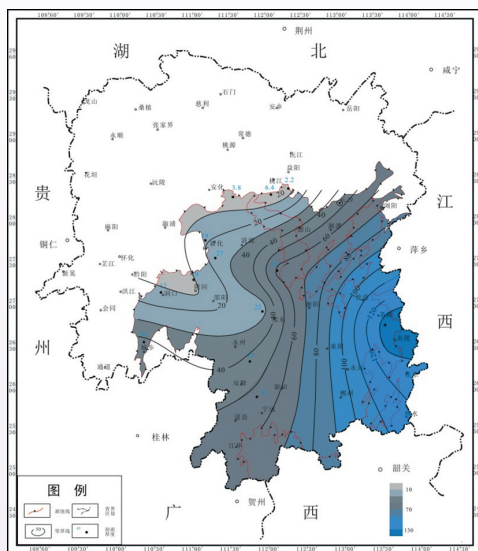
Key Laboratory of Shale Oil and Gas Geological Survey, CAGS

The lab does research in the following areas: Around on the development strategy of China in prospecting for unconventional oil and gas resources, taking shale gas as the stress, applying the geomechanic theory to analyze factors and conditions of shale gas accumulation; applying in-situ stress measurement, hydraulic fracturing, lithological mechanics and micro-seismic network to conduct research of structural deformation and structural evolution, stress field measurement, development and application of lithological mechanics, fracture prediction and reservoir evaluation; research of shale gas accumulation mechanisms and resources evaluation; establishment of the shale gas evaluation system; making efforts to build a scientific research base of investigation and evaluation of shale gas resources with Chinese characteristics.

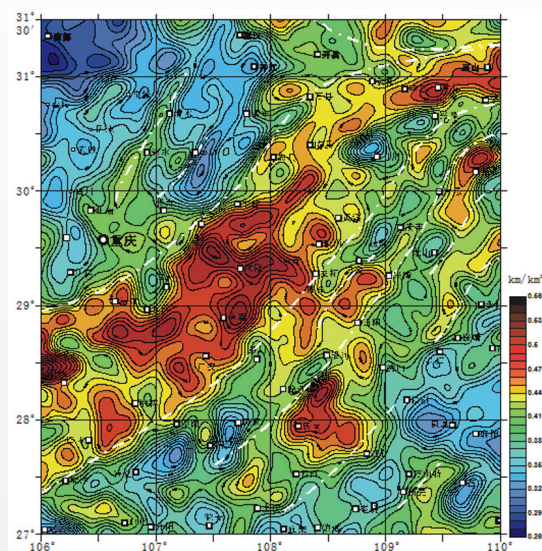
In 2015, the laboratory undertook and participated in 7 projects and published 25 scientific papers, including 11 SCI-indexed and 2 EI-indexed papers, in addition to 1 monograph; organized 16 academic exchanges or symposiums and the academic annual conference. The lab had 19 staff members, including researchers and lab assistants, and one guest academician, they were professionals in petroleum geology, structural geology, petrology and other related disciplines.

Main research achievements

- (1) A suite of new strata favorable for high-quality shale gas was found for the first time in Central Hunan Province and a prospective stratigraphic series of shale gas resources was found for the first time in the Middle Ordovician Yanxi Formation in the Central Hunan area on the southeast side of Xuefeng Mountain.
- (2) Research and data explanation showed that the Daba Arc and the NE-EW striking Wuling Arcuate Structure in East Sichuan were formed in a uniform deformation field and the related fractured system also was developed synchronously.

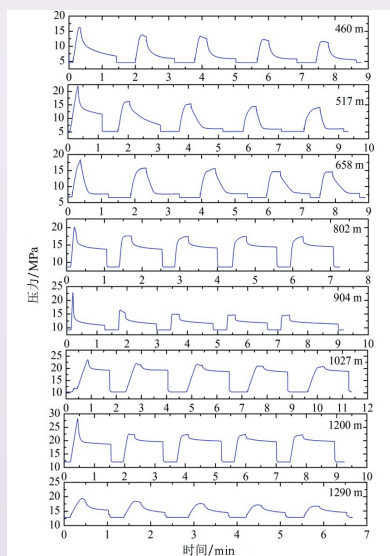


Contour map of shale thickness of the Yanxi Formation

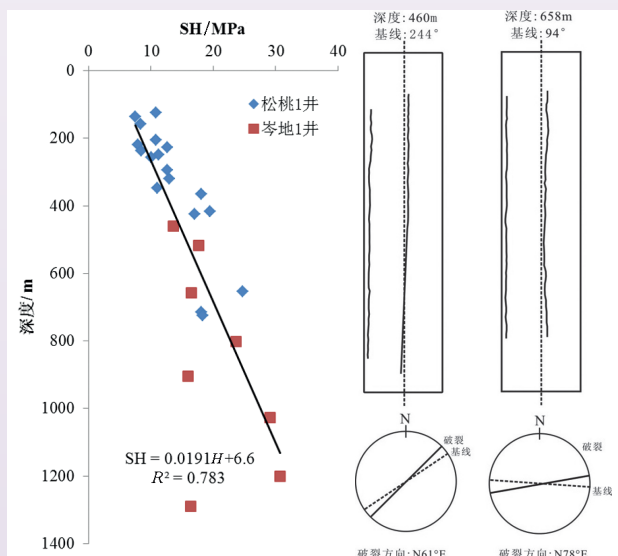


Contour map of density distribution of fracturing lines of the Wuling depression (lines with white dots denote the boundaries of density classification)

(3) The lab completed crustal stress measurement at 8 drill holes and applied the numerical simulation method to analyzing distribution characteristics of the stress field of shale oil-bearing beds in South China.

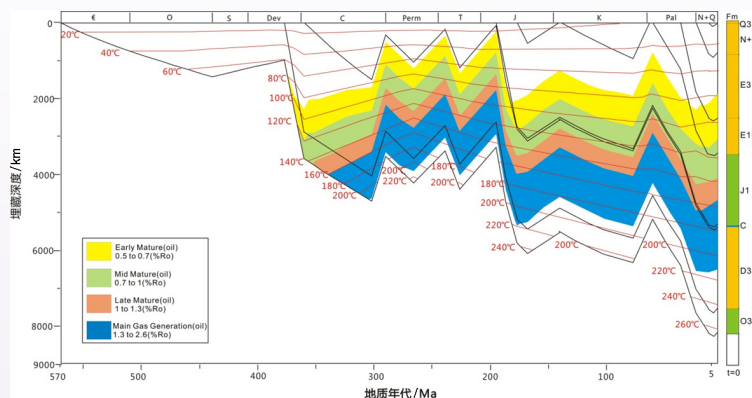


Stress measurement in Well Cendi-I with the hydraulic fracturing technique

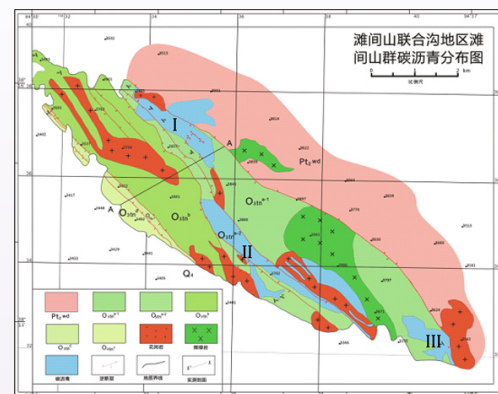


Intensity and direction of the maximum horizontal principal stress in Well Cendi-I

(4) Investigation was conducted on distribution characteristics and genesis of anthraxolite found in some strata of the Tanjianshan Group of the Qaidam basin.



The burial-mature process of hydrocarbon source rock of the Tanjianshan Group



Distribution of hydrocarbon source rock of the Tanjianshan Group

Key Laboratory of Re-Os Isotope Geochemistry, CAGS

The lab focuses on developing Re-Os isotope theory, conducting research on key techniques and standard materials, promoting applications and providing a scientific basis for dating of ore-formation epochs and tracing of material origins. The lab has created a series of Re-Os isotope experiment methods for different samples, such as molybdenite, pyrite and arsenopyrite, developed several primary reference materials, and dated hundreds of metallic mineral deposits at home and abroad, which have solved the long-term unsolvable problems of direct dating of deposits; established a series of mass spectrometric methods and data processing procedures suitable to various geological samples; widened the application scope of Re-Os isotopic dating technique with the emphasis placed on the analysis of geological samples with high content of organic matter; extended the application to crude oil, graphite, bitumen, and organic-rich limestone, which provides isotope chronological constraints on the formation and destruction of oil reservoirs, regional metamorphism, and sedimentary rock diagenesis. The major three research tasks were supported by the National Natural Science Foundation of China.

Academic Achievements

(1) Conduct methodological research, and reinforce the technical basis for the application of Re-Os isotopic system

Standard methods of Re-Os isotopic dating for molybdenite samples were established, and the direct distillation process was improved. The lab compiled the draft instruction of standard methods of molybdenite Re-Os isotope dating of ICP-MS. A new thermal ionization mass spectrometer (Triton Plus) matching method was developed and improved. High-precision (pg-ng level) Os isotopic analytic methods were established. The analytic methods are on the world-class level in terms of the whole process Os blank and the instrument sensitivity.

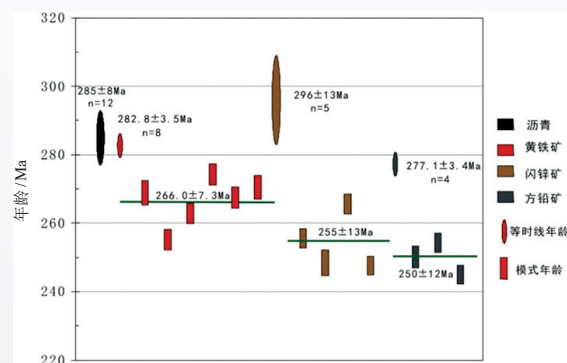


(2) Expand the application of Re-Os isotope analysis

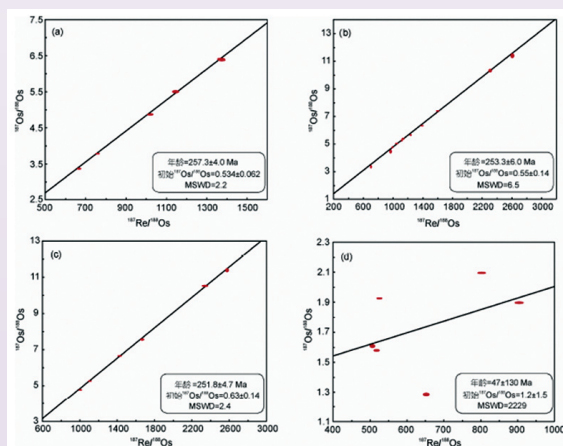
(a) Re-Os isotope dating was conducted for pyrite, galena, sphalerite, and asphalt related with mineralization in the Chipu Lead-zinc Deposit in Sichuan, which yielded the model ages and isochron ages of the three minerals and asphalt. The Re-Os dating analysis was done for the asphalt, sphalerite and pyrite in Huayuan-Phoenix lead-zinc Mine, which expanded the application scope of this analysis and played an important role in the study of Re-Os isotope in chronology of lead and zinc.

(b) We analyzed limestone samples from the “golden spike” section on the Changxing Permian-Triassic boundary in Zhejiang Province, and obtained the Re-Os isochron ages that coincide with the zircon U-Pb ages. Research showed that the Re-Os isotope analysis can be used to directly determine the ages of limestone strata and provides an effective means for determining the absolute ages of chemical sedimentary strata.

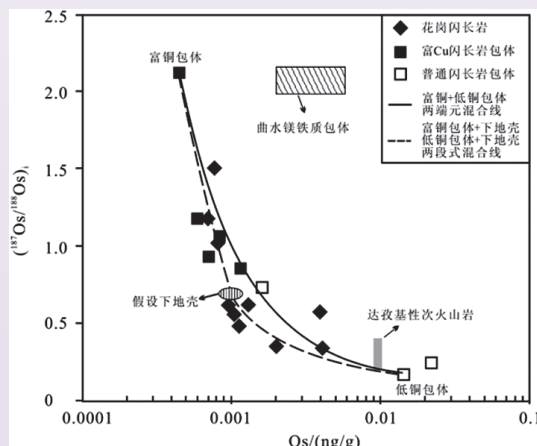
(c) Re-Os isotope analysis was conducted on granodiorite and copper-rich/poor copper diorite enclave samples in the Qulong porphyry deposit of Tibet. The result indicated that ordinary diorite xenoliths and copper-rich diorite xenoliths have significantly different Os isotopic compositions. The work opened up a new area for the Re-Os isotope analysis in the research of medium-acidic magmatic origin and evolution.



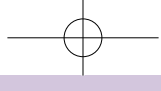
Re-Os model ages and isochron ages of asphalt, pyrite, sphalerite and galena in the Chipu lead-zinc deposit in Sichuan



Re-Os isotope isochron ages of the Permian-Triassic “golden spike” rock (Meishan section)



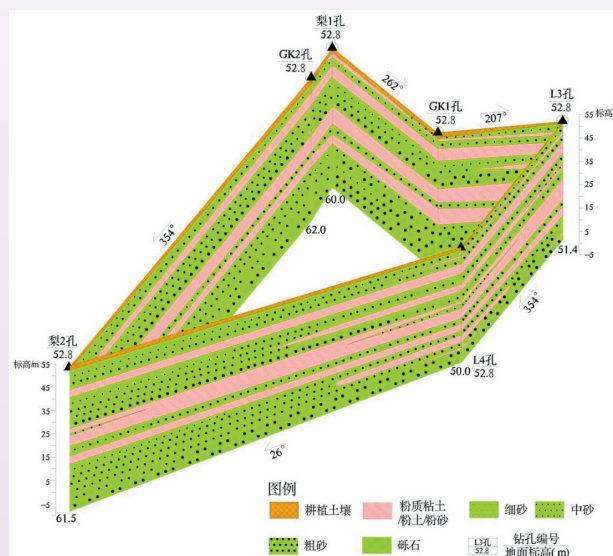
Os isotope analysis of granodiorite and diorite enclaves in Qulong, Tibet



Key Laboratory of Quaternary Chronology and Environment Evolution, CAGS

The lab focuses its research on the geological records of climate and environmental evolution since the Quaternary. Aiming at important problems regarding Quaternary chronology and climate-hydrological environment evolution process, the lab conducts research to reveal the time series of paleoclimate and paleoenvironment evolution in different rudimentary environments and at different temporal scales since the Quaternary, especially late Quaternary, by improving and developing the Quaternary dating technique and analytic technique of paleoclimatic environmental indexes, so as to forecast future weather and the change tendency of hydrological environment and provide a basis for the study of global changes and rational utilization of regional ground water resources.

In 2015, the lab undertook and participated in 12 scientific and research projects, and published 13 academic papers, including 7 SCI-indexed papers. One Ph.D fellow was enrolled in the lab and 4 students with Master's degree were graduated. The lab invited senior researchers from other institutions to present 7 academic reports. Researchers of the lab actively participated in academic activities both abroad and at home, including 27 academic symposiums, and 3 researchers attended the INQUA conference held at Japan. The lab carried out the "Research on the condition of groundwater recharge systems in typical areas of the North China Plain—A study of aquifer structure", supported by the MLR for public-welfare projects. This research, taking the region along the Hutuo River in northern Gaocheng of the Shijiazhuang area as the study area, analyzed the regularity of spatial distribution of aquifers and aquifuges by means of integrated approaches such as investigation, drilling, geophysical exploration and experiments, as well as principles in sedimentology and high-resolution sequence stratigraphy, and compiled a 3-D stratigraphic shallow structure map of the study area.



3-D stratigraphic structure of the recharge experiment ground

GAGS & HFUT Key Laboratory of 3D Exploration for Ore District

The laboratory focuses on the study of geological processes and 3-D structure of major ore-forming belts, stereoscopic sounding and 3-D models in ore-concentrated areas, regional metallogenic systems and regularities, and deep mineral exploration techniques and methods.

In 2015, the lab undertook and participated in 68 projects with total funds of 150 million yuan, including



1 “973” program, 1 “863” program and projects supported by the National Natural Science Foundation of China and other funding sources. The lab published 106 research papers, including 20 in international SCI-indexed journals, 21 in Chinese SCI-indexed journals and 1 EI-indexed paper, as well as 10 presentations for academic symposiums.

At the academic committee conference of the lab held at Hefei University of Technology on March 15, 2015, the members discussed the plan for the lab construction. On July 3, the lab co-organized a symposium on deep mineral investigation and new technology for ore prospecting.

Researchers of the lab were invited to give reports at two high-caliber national academic conferences, undertook 3 major research projects. The lab invited renowned foreign experts, including Profs. Li Yaoguo and Franco Pirajno, to visit the lab, have academic exchanges and give lectures.

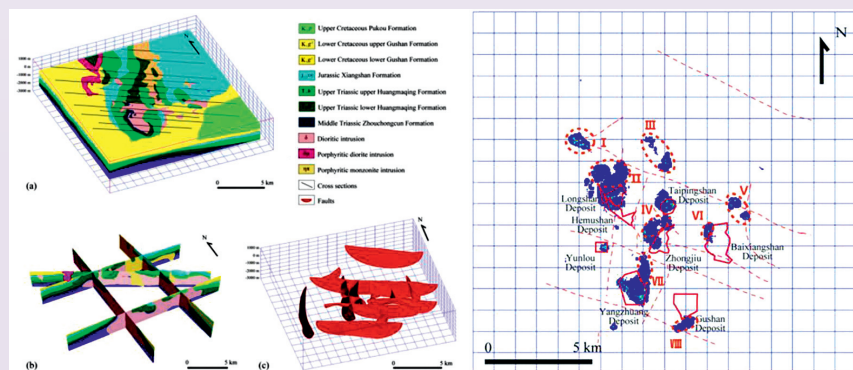
Main research achievements

(1) Deep comprehensive geophysical exploration and research were carried out in the Gebi overburden area of Xinjiang and found large-scale shallow buried porphyry and skarn, which was considered to be a superlarge copper deposit; buried mineralized porphyry bodies were verified and a new target of buried porphyry iron ore was outlined in the Ladong area; a large target area of buried graphite belt was identified, which was inferred to be a large to superlarge graphite deposit; a buried sedimentary titanomagnetite deposit was targeted.

(2) Wide-band seismic probing and research were conducted in the Qinghai-Tibet Plateau. Researchers proposed a new model for continental collision and the structural evolution of the Gangdese ore-forming belt. A study of the



Field site and experiment instruments



Results of the research on 3-D prognosis of mineral deposits

upper mantle structure in the Qaidam and Qilianshan areas was conducted, rejecting the previous conclusion of long-distance southward subduction of the Asian plate lithosphere from Qaidam or the southern margin of the Alxia block. The study concluded that the Moho of the Qilian Mts. is slightly domed without “mountain root” structure and proposed a new structural evolution model of the Kunlun Mts., Qaidam basin and Qilian Mts.



Chapter VII International Collaboration and Academic Exchanges

In 2015, altogether 282 CAGS geoscientists went overseas and 346 foreign geoscientists were invited to CAGS to carry out dynamic academic exchanges and cooperation. 184 international cooperation and exchange opportunities were realized, including 122 for Chinese scientists and engineers travelling overseas and 62 for inviting experts from abroad to participate in relevant projects in China.

7.1 Attending International Conferences in Foreign Countries

The 4th Asia-Pacific Geoparks Network Symposium

On September 16—20, 2015, Prof. Wang Xiaolie, Party Committee Secretary and Vice President of the CAGS and Director of the Chinese Geoparks Network, led a Chinese delegation to attend the 4th Symposium on Asia-Pacific Geoparks Network held at the Sanin Coast Geopark of Japan, during which academic reports and exchanges, as well as a geoparks exhibition were organized. On the sidelines of the Symposium, a briefing was held on the global geoparks in China. Prof. Long Changxing, member of the Global Geoparks Network Bureau, and Prof. Jin Xiaochi were invited to be present at the conferences of the Advisory Committee of the Asia-Pacific Geoparks Network and the Global Geoparks Network.



A delegation from the CAGS attending the 4th Symposium on Asia-Pacific Geoparks Network



Officials of UNESCO and some of the delegates of the CAGS pose for a photograph



Bureau. During the conferences, Dunhuang of Gansu Province and Zhijindong of Guizhou Province were listed in the UNESCO Global Geoparks Directory Network after a review and vote of the Global Geoparks Network Bureau.

The 8th World Chinese Geological Congress

On June 14—18, 2015, Prof. Meng Xianlai, Executive Vice President of the GSC, and Zhu Lixin, Secretary General of the GSC, headed a delegation to attend the 8th World Chinese Geological Congress. Invited by the Congress, Prof. Meng Xianlai delivered a presentation entitled “Development and Prospects of Contemporary Geosciences in China”. Prof. Zhu Lixin attended the session of Petrology, Mineralogy and Geochemistry and presented a special lecture titled “Application of Multidimensional System in Mineral Exploration”.



Prof. Meng Xianlai delivered a lecture on the Congress



Prof. Zhu Lixin presented an academic report



Visiting the Institute of Earth Sciences, Academia Sinica of Taiwan, China

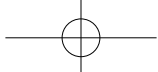
7.2 Major International Scientific and Technological Cooperation Projects

Bilateral Cooperation Project

In accordance with the cooperation program of “Correlation Study on the Permian LIPs in Emeishan of China and Siberia of Russia”, the delegation of the CAGS went to central Aldan in southern Yakutia of Siberia, Russia in late August, 2015 to make field geological investigation at a gold-uranium deposit. During the investigation, they researched Mesozoic magmatism of central Siberia and geological features and metallogenic regularities of other related gold and uranium deposits.



Geologists from the delegation pose for a group photo during a field geological investigation at the Siberian Mine



Field geological investigation at a gold-uranium deposit in central Yakutia, Aldan in Siberia



China-Germany Joint Field Geological Courses

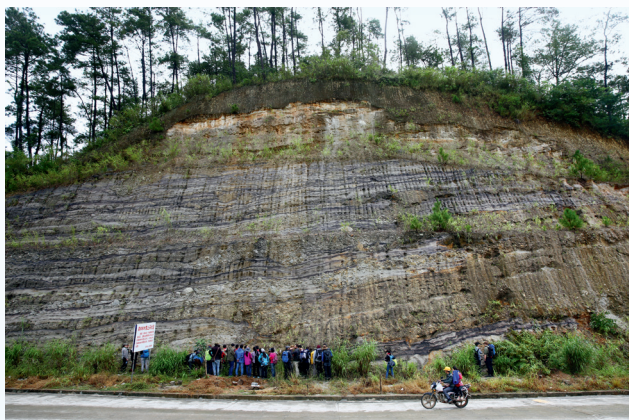
On October 8—20, 2015, according to the “Agreement of Cooperation between Chinese Academy of Geological Sciences and University of Potsdam, Germany” and invited by the Academy, Prof. Roland Oberhänsli, President of the IUGS, headed 17 teachers and students from Germany and about 30 supervisors and graduates from the CAGS to take joint field geological courses of 13 days in Yunnan Province. They had a field trip from Tengchong, Baoshan, Dali to Luoping, traversing several structural elements from west to east, including the Tengchong block, Baoshan block, Lanping-Simao block, western side of margin of the Yangtze block and western South China folded zone. The field practice involved volcanic petrology, new structural and mobile structural, regional tectonics, sedimentary and metamorphic rock, ductile shear deformation, magmatic and sedimentary metallogensis, vertebrate fauna and paleontology.



Chinese and German teachers and students in the field



Field practice in the Beiya gold deposit



Field work on fluvial and lacustrine stratigraphic sections of the Mangpeng Formation in the Tengchong Basin



President Roland Oberhänsli gave a lecture in field class

Third-phase Work of the Five-country Cooperation Project

The 13th work conference of the five-country (China, Russia, Mongolia, Kazakhstan and South Korea) cooperation project was held on 13—15 October, 2015 at Chimkent, Kazakhstan. Participants in the conference discussed and reviewed the work involving the progress in making geophysical maps, geochemical map series and maps of accretional and collisional structure and related metallogenesis; comprehensive study of GGTs; Mesozoic structure, magmatism and metallogeny in eastern Asia; analysis of potential metallogenic areas and synopses of related geological, structural and metallogenic regularity maps. The five parties agreed to continue the set research task based on the overall arrangement. It was planned to publish a special volume of their research results in *Asian Earth Sciences*.

7.3 Attending International Academic Conferences held in China

The first work conference of IGCP-649 “Diamonds and Recycled Mantle”

On 6 August, 2015, the initial workshop on IGCP-649 “Diamonds and Recycled Mantle-Ophiolite and Related High-Pressure Rocks in the Qilian Mountain” was held in Xining, Qinghai Province, which was attended by over 100 geologists in the field of the Qilianshan orogeny and ophiolite. Twelve experts gave their academic reports. Academic exchanges were conducted at the conference regarding the progress of the study on the geneses of global ophiolite mantle peridotite and anomalous



Field investigation in the Qilianshan area



mantle minerals from chromite, and diagenic and metallogenic process of HP low-temperature metamorphic rock, ophiolite and island-arc volcanics in the Qilianshan area. Scientists also discussed ophiolite and high-pressure and super high-pressure metamorphic rock, and related mineralization in the Qilianshan area and other different structural belts in the world. Besides, 4-day post-conference field geological investigation was arranged on lawsonite-bearing blue schist, eclogite, ophiolite and island-arc volcanics in the Qilianshan area.



Academic symposium of IGCP-649



A group photo of attendees of the symposium

The First Sino-German Workshop on Seismic Rupture and Faulting

From October 31 to November 6, 2015, the First Sino-German Workshop on Seismic Rupture and Faulting was held in Chengdu, Sichuan Province, which was sponsored by the Sino-German Center for Science Promotion. About 100 renowned experts and young scientists from China, Germany, Japan and other countries and regions participated in the workshop. 31 experts and scholars presented academic reports. The foreign reports covered such topics as lithological and mineralogical analysis of seismic faults, dating of ancient seismic events, fluid-rock interactive mechanism and physical simulating



A Group photo of participants of the Workshop



Field investigation in the long-term monitoring site of the Wenchuan scientific drilling WFS-2



calculation of faulting; the reports given by Chinese experts covered faulting mechanism of the Qinghai-Tibet Plateau and adjacent regions, simulation of seismic faults, microscopic analysis and magnetic study of fault rock, and distribution and drilling monitoring of surface rupture belts. After the workshop, the geologists visited field outcrops of the Yingxiu-Beichuan coseismic surface rupture, the old Beichuan earthquake site, the wenchuan earthquake museum and the storehouse of deep scientific drilling cores.

The First China-Russia International Meeting on CAOB and IGCP592 Workshop

On September 23—25, 2015, the First China-Russia International Meeting on CAOB and IGCP592 Workshop was held in Beijing. Prof. Wang Xiaolie gave a speech at the opening ceremony and over 130 experts and scholars engaged in the study of the Central Asian orogeny attended the meeting. They came from 9 countries, including China, Russia, Mongolia, Canada, Germany and Australia. 34 scientists presented academic reports on the latest progress in the research of Precambrian basement, magmatic evolution, crustal growth, deep probing, mineral exploration and Quaternary. The scientists discussed the formation and evolution of the Central Asian orogeny and regional metallogenic regularity. After the meeting a 3-day field trip “From Craton to Orogenic Belts” was arranged.



The First China-Russia International Meeting on CAOB and IGCP592 Workshop

Symposium on Karst and Environmental Geological Mapping in China and ASEAN Countries

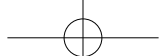
On November 4, 2015, the Symposium on Karst and Environmental Geological Mapping in China and ASEAN Countries was held in Nanning, Guangxi, more than 40 experts and scholars from 9 countries,



A group photo of experts attending the Symposium



Members of the research project exchange their ideas on the maps under compilation



namely China, Cambodia, Indonesia, Laos, Malaysia, Burma, the Philippines, Thailand and Vietnam participated in the conference. Their academic reports focused on karst development, karst distribution and geological environment protection. Intensive discussion was conducted on prominent issues that the ASEAN is faced with, such as geological environment, measures for geological environment protection and the plan for further cooperation.

The Second Asian Trans-Disciplinary Karst Conference

The Second Asian Trans-Disciplinary Karst Conference was held at Lichuan, Hubei Province on November 6—8, 2015. Over 180 scientists in karst-related fields attended the conference. They came from 22 countries and regions in Asia and Europe. Some 50 experts presented special academic reports and all the participants made exchanges on the achievements of karst research and field investigation in the world, especially in the Asian region, including paperless cave measurement technology, cave exploration nail climbing technology, cave photography etc. On the sidelines of the Conference there were training courses and seminars on cave exploration technologies and field investigation in the Tenglongdong, Sanlongmen and Yulongdong caves.



A group photo of participants attending the Symposium



Geologists make field investigation in the Tenglongdong Cave

7.4 Construction of the Category II Centers of the UNESCO

International Research Center on Karst (IRCK)

(1) Implementation of China-Slovenia Intergovernmental Scientific and Technological Cooperation Project

The Academy organized and implemented the scientific and technological cooperation project “Correlation Study on Karstification and Carbon Sink Effect under China’s Monsoon Climate and Slovenia’s Subcontinental Climate” and scientists of both parties did sampling and correlative test of karst intensity in different lithologies and land utilization cases, and carried out hydrogeological investigation and hydrochemical analysis of the tributaries and headstream of the Sava River. Data



monitoring, tracer test and placing of dissolution test pieces were done in the reaches of the Lihe River and Chaotianhe River.

(2) The 6th China-Italy Joint Cave Expedition

Cooperating with the Italian Speleological Society, the Academy organized the 6th China-Italy Joint Cave Exploration Trip (13 days) at the field experimental base at Maocun in Lingchuan County, Guilin City, Guangxi.

(3) Memorandum of Understanding between the Institute of Karst Geology, CAGS/IRCK under the auspices of UNESCO and Water Research Commission of South Africa

In light of the memorandum of understanding, the Institute of Geology, CAGS planned to conduct in-depth cooperation research in cooperative of the South African Water Resources Research Council on several subjects, including water resources utilization and management of karst aquifers.

(4) The 7th IRCK Training Course

On September 21, 2015, the 7th International Training Course with the training topics of “Karst Landscape, Geopark, Natural Heritage, Environmental and Geological Mapping and Data Mining” was held simultaneously with the China-ASEAN Exposition at Nanning, Guangxi. There were 38 trainees coming from 20 countries, including 25 foreign students from 19 countries such as Thailand, South Africa, Slovenia and Australia. Among them 13 came from countries along the “One-Belt-One-Road” region. The class was organized by the Institute of Karst Geology, CAGS and the IRCK, and co-organized by organizations and departments of the Guangxi Zhuang Autonomous Region, and offices and centers affiliated with the UNESCO, as well as the Chinese Geoparks Network.



Cave experts discuss interesting topics



A group photo at the opening ceremony of the international training course



Academician Yuan Daoxian delivered an opening speech



Trainees of the class make field investigation in the Fengshan Global Geopark in Guangxi

The International Centre on Global-scale Geochemistry under the Auspices of UNESCO

The International Centre on Global-scale Geochemistry under the auspices of the UNESCO was based on the Institute of Geophysical and Geochemical Exploration, CAGS. The suggestion of its establishment was submitted in February 2010 and approved by the 37 Session of General Conference of the UNESCO in November 2013, and was finally authorized by the State Council of China in September 2015.

7.5 Routine Work of the Permanent Secretariat of the IUGS

Based on the Memorandum of Understanding signed by the MLR and the IUGS, the CAGS continued to take up the routine work of the Permanent Secretariat of the IUGS, operated and participated in the Bureau Meeting and the 68th Executive Committee Meeting held in Vancouver, Canada on January 27—29, 2015, and Bureau Meetings of the IUGS held in Cape Town, South Africa on May 23—31 and in Jixian County, Tianjin City on October 21—26, respectively. Active preparation was proceeding for the 69th Executive Committee Meeting, the Bureau Meeting taking place during the 35th International Geological Congress, and the Council Meeting of the IUGS. Guided by the Executive Committee and Executive Bureau of the IUGS, the Permanent Secretariat smoothly dealt with routine work related to subordinate commissions, special committees, special working groups and associated organizations of the IUGS, so that all scientific programs under the IUGS were successfully implemented.



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A group photo of participants of the 68th Executive Committee Meeting of the IUGS



The 68th Executive Committee Meeting of the IUGS



Members of the Executive Bureau of the IUGS observing the Jixian Section in Tianjin



The booth of the USGS at the Annual Meeting of the Geological Society of America



7.6 Scientists of the CAGS Holding Posts in International Academic Organizations

Name	Academic Organization or International Journal	Position	Term
Cao Jianhua	Commission on Karst Geology, International Association of Hydrogeologists (IAH)	Member	Since 2009
Ding Tiping	Inorganic Chemistry Division, International Union of Pure and Applied Chemistry (IUPAC)	Titular Member	2012—2017
Dong Shuwen	International Union of Geological Sciences (IUGS)	Treasurer	2012—2016
	Akademie Gemeinnütziger Wissenschaften zu Erfurt	Member	Since 2011
	Geological Society of America (GSA)	Honorary Fellow	Since 2013
He Shiyi	Commission on Karst Geology, IAH	Member	Since 2009
Hou Chuntang	International Consortium on Geo-Disaster Reduction	International Advisor	Since 2014
Hou Zengqian	Resources Geology	Senior Editorial Board Member	Since 2009
	Society of Economic Geologists (SEG)	Regional Vice-president, Lecturer	Since 2014
Ji Qiang	Asia Dinosaur Association	Vice President and Secretary General	Since 2013
Jiang Guanghui	Commission on Karst Geology, IAH	Vice President	Since 2010
Jin Xiaochi	Subcommission on Carboniferous Stratigraphy, International Commission on Stratigraphy (ICS)	Voting Member	2004—2016
	Scientific Board of the International Geoscience Programme (IGCP), UNESCO	Member	2009—2016
	Subcommission on South and East Asia, Commission for the Geological Map of the World (CGMW)	Deputy Secretary General	Since 2010
	Global Geoparks Network (GGN) Bureau	Member	Since 2013
Jiang Zhongcheng	Russian Academy of Natural Sciences	Foreign member	Since 2015
Kong Fanjing	International Society for Salt Lake Research (ISSLR)	Member-at-large	2012—2014
Liu Pengju	Subcommission on Ediacaran Stratigraphy, ICS	Corresponding Member	2012—2016
Liu Shoujie	Gondwana Research	Associate Editor-in-Chief	Since 2013
Liu Xiaochun	<i>Journal of Metamorphic Geology</i>	Editorial Board Member	Since 2013
Long Changxing	Global Geoparks Network (GGN) Bureau, UNESCO	Member	Since 2010



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Continued

Name	Academic Organization or International Journal	Position	Term
Luo Liqiang	<i>X-Ray Spectrometry</i>	Associate Editor-in-Chief	Since 2003
	<i>Journal of Radioanalytical and Nuclear Chemistry</i>	Associate Editor-in-Chief	Since 2006
Lü Junchang	Asia Dinosaur Association	Deputy Secretary General	Since 2013
Mao Jingwen	International Association of the Genesis of Ore Deposits (IAGOD)	President	2012—2016
	Society of Economic Geologists	Council member	2013—2016
	Society for Geology Applied to Mineral Deposits (SGA)	Council member	2013—2016
	<i>Ore Geology Reviews</i>	Associate Editor-in-Chief	Since 2002
	<i>Journal of Geochemical Exploration</i>	Associate Editor-in-Chief	Since 2014
Nie Fengjun	<i>Resource Geology</i>	Senior Editorial Board Member	Since 2007
	Scientific Board of the International Geoscience Programme (IGCP), UNESCO	Member	2009—2016
Pei Rongfu	Commission on Paragenesis, IAGOD	Officer	Since 1995
Ren Jishun	Commission for the Geological Map of the World (CGMW)	Vice President	Since 2004
Shi Jiansheng	Russian Academy of Natural Sciences	Foreign member	Since 2011
Shi Jusong	Committee on Neotectonics and Geohazard, International Association for Engineering Geology and the Environment (IAEG)	Deputy Secretary General	Since 2008
	International Consortium on Geo-disaster Reduction	Assistant to the President	Since 2014
Sun Ping	<i>Landslides</i>	Editorial Board Member	Since 2009
	International Consortium on Geo-Disaster Reduction	Life member	Since 2014
Wang Guiling	Russian Academy of Natural Sciences	Foreign member	Since 2015
Wang Jun	Commission on Management and Application of Geoscience Information, IUGS	Observer	Since 2010
Wang Wei	Permanent Secretariat of the International Union of Geological Sciences	Director	Since 2013
Wang Xueqiu	Association of Applied Geochemists (AAG)	Regional Councilor	Since 2004
	Task Group on Global Geochemical Baselines (TGGGB), IUGS	Co-Leader	Since 2008
	<i>Geostandards and Geoanalytical Research</i>	Editorial Board Member	Since 2012

Continued

Name	Academic Organization or International Journal	Position	Term
Wu Shuren	Committee on Neotectonics and Geohazard, IAEG	Member	Since 2008
Xie Xuejin	<i>Geochemistry Exploration-Environment-Analysis</i>	Editorial Board Member	Since 2004
	<i>Journal of Geochemical Exploration</i>	Editorial Board Member	Since 1999
Xu Zhiqin	Academy of Sciences for the Developing World	Member	Since 2007
Yang Jingsui	Geological Society of America (GSA)	Fellow	Since 2011
	Mineralogical Society of America (MSA)	Fellow	Since 2009
	<i>VESTNIK OF MSTU (Scientific Journal of Murmansk State Technical University)</i>	Editorial Board Member	Since 2015
Yao Jianxin	Subcommission on Triassic Stratigraphy, ICS	Corresponding Member	Since 2011
Yin Chongyu	Subcommission on Ediacaran Stratigraphy, ICS	Voting Member	2012—2016
Yin Ming	<i>Journal of Geostandards and Geoanalysis</i>	Editorial Board Member	Since 2006
Yuan Daoxian	Commission on Karst Geology, IAH	Member	Since 1988
Zhao Yue	Standing Scientific Group on Geosciences, Scientific Committee on Antarctic Research	Delegate	Since 2002
	Committee on Neotectonics and Geohazard, International Association for Engineering Geology and the Environment (IAEG)	Member	Since 2008
Zhang Cheng	Commission on Karst Geology, International Association of Hydrogeologists (IAH)	Member	Since 2009
	International Geological Correlation Program (IGCP)	Member	Since 2013
Zhang Fawang	Russian Academy of Natural Sciences	Foreign member	Since 2012
Zhang Ronghua	<i>International Journal of Material Science</i>	Editor	Since 2006
	Commission on Industrial Minerals and Rocks, IAGOD	Vice Chairman	Since 1994
Zhang Yongshuang	Committee on Neotectonics and Geohazard, International Association for Engineering Geology and the Environment (IAEG)	Secretary General	Since 2008
Zhang Zeming	<i>Gondwana Research</i>	Associate Editor-in-Chief	Since 2011
Zheng Mianping	International Society for Salt Lake Research (ISSLR)	President	2014—2017
Zhu Lixin	Russian Academy of Natural Sciences	Foreign member	Since 2015
Zhu Xiangkun	Commission on Isotopic Abundances and Atomic Weights	Titular Member	2010—2016



Chapter VIII Graduate Education and Postdoctoral Work

Graduate and postdoctoral education of the CAGS assumes the task of cultivating high-caliber geoscientific professionals for the country, the MLR and CGS. The CAGS recruits graduates and postdoctoral students in the following five first-class subjects: geology, geological resources and geological engineering, chemistry, geophysics and mining engineering. It's the only unit under the MLR that is authorized to offer doctoral degrees and to run postdoctoral research programs.

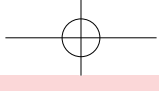
8.1 Directions of Graduate Education

In 2015, the CAGS recruited graduates of 8 doctorate authorized specialties and 11 master degree authorized specialties.

① analytic chemistry, ② solid-earth physics, ③ mineralogy, petrology, study of mineral deposits, ④ geochemistry, ⑤ paleontology and stratigraphy, ⑥ Structural geology, ⑦ Quaternary geology, ⑧ mineral resources prospecting and exploration, ⑨ earth probing and information technology, ⑩ geological engineering, ⑪ mineral processing engineering.



Field geological class in Yunnan Province attended by teachers and students from Germany headed by Prof. Roland Oberhänsli of University Potsdam, president of the IUGS, and graduates and teachers from the CAGS



8.2 Graduates Recruited in 2015

In 2015, 35 Ph.D candidates and 40 master students were enrolled. 9 Ph.D candidates were jointly trained by the Academy and Peking University, 10 Ph.D candidates by the CAGS and China University of Geosciences (Beijing) and 10 Ph.D candidates by the CAGS and China University of Geosciences (Wuhan). 40 master students were jointly trained by the Academy and China University of Geosciences (Beijing).

Graduates of the CAGS enrolled in 2015

Specialty	Number of graduates to be recruited			
	Doctor	Master	Doctor by joint training	Master by joint training
Analytic chemistry	—	2	—	0
Solid-earth physics	—	2	—	0
Mineralogy, petrology, study of mineral deposit	5	14	10	6
Geochemistry	6	3	0	8
Paleontology and stratigraphy	2	3	3	1
Structural geology	9	7	6	4
Quaternary geology	0	1	1	0
Mineral resources prospecting and exploration	4	0	1	0
Earth probing and information technology	2	1	1	0
Geological engineering	7	7	7	1
Mineral processing engineering	—	0	—	0
Geological engineering (for specialty degree)	—	—	—	20
Total	35	40	29	40

Field training courses in the Luanchuan Molybdenum Mine, Henan Province

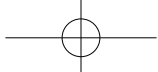




Spring fun games of 2015



The 6th Autumn sports meeting



8.3 Academic Degrees Conferred on Graduates in 2015

In 2015, 34 doctorate fellows, including 8 by joint training, and 61 master students, including 35 by joint training, finished their courses. Among these students, 30 were conferred Ph.Ds. 8 received Ph.D of China University of Geosciences (Beijing). 26 students received master's degrees and 35 had master's degrees of China University of Geosciences (Beijing). 95 graduates, as the first authors, published 217 research papers in Chinese and international academic journals, including 41 SCI-indexed papers (18 in international SCI-index journals) and 17 EI-indexed papers. The quality of graduates training work was significantly improved and remarkable progress was made in the graduate education of the Academy.

Graduates of the CAGS who finished school in 2015

Specialty	Number of graduates				Number of graduates with degrees			
	Doctor	Doctor by joint training	Master	Master by joint training	Doctor	Doctor by joint training	Master	Master by joint training
Analytic chemistry	—	—	2	0	—	—	2	0
Solid-earth physics	—	—	2	0	—	—	2	0
Mineralogy, petrology, study of mineral deposit	9	1	7	17	9	1	7	17
Geochemistry	3	0	4	1	3	0	4	1
Paleontology and stratigraphy	2	0	1	0	2	0	1	0
Tectonic geology	7	3	3	2	9	3	3	2
Quaternary geology	1	0	0	0	1	0	0	0
Mineral reconnaissance and exploration	0	2	1	2	0	2	1	2
Earth probing and information technology	1	0	0	0	1	0	0	0
Geological engineering	3	2	5	13	5	2	5	13
Mineral processing engineering	—	—	1	0	—	—	1	0
Total	26	8	26	35	30	8	26	35



Academician Li Tingdong, director of the Academic Degrees Committee, CAGS confers a degree on a student



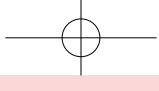
A group photo of graduates at the graduation ceremony of 2015

8.4 Awards

Zhu Qiaoqiao and 7 other graduates and Li Yun and another graduate jointly trained by the CAGS and other universities were granted the national scholarships of 2015. Li Qiang and 4 other graduates received the Cheng Yuqi Award for Outstanding Degree Theses. Hu Qiaoqing and 4 other graduates won the Cheng Yuqi Award for Outstanding Graduates. 4 students received outstanding graduate awards issued by Beijing Municipality. 7 students were chosen as outstanding graduates of the Academy and 33 graduates received the honorary title of “Merit Student”.

Chen Yuqi Award for Outstanding Degree Theses in 2015

Title of thesis	Author	Supervisor
Metallogenesis of Iron Polymetallic Deposits in Altay, Xinjiang	Li Qiang	Yang Fuquan
Seismic Faulting Mechanisms in the Wenchuan Earthquake Fault Zone	Wang Huan	Xu Zhiqin Li Haibing
Dynamic Changes of Lakes in the Tibetan Plateau and Inner Mongolia–Xinjiang Lake Area and Their Response to Climate Fluctuation in the Past Forty Years	Yan Lijuan	Zheng Mianping
Minerals, Alteration and Fluid Characteristics Research of the Rongna (southern Tiegelong) High-sulfidation Epithermal-porphyry Cu(Au) Deposit, Tibet	Yang Chao	Tang Juxing
Mineral Magnetic Characteristics and Paleoenvironmental Implications for Xiarinur Lake sediments in the Hunshandake Sandy Land, Inner Mongolia, since the Last Deglaciation	Tang Ling	Wang Xisheng



Li Haiqing, leader of the CGS, confers awards on outstanding graduates



Academician Zhao Wenjin confers Cheng Yuqi Award for Outstanding Graduates



Leaders of the CGS confer titles of “Merit Student” on graduates

8.5 Postdoctorate Program

In 2015, 38 researchers were enrolled in the postdoctorate program, among whom 22 engaged in geology and 16 in geological resources and geological engineering. 1 was supported by the 2015 Hong Kong Scholar Program and 1 was recruited jointly by the Academy and the postdoctoral program. As of December, 2015, 125 postdoctoral fellows worked in the postdoctorate program, with an average age of 32. Among them, 20 postdoctorate fellows finished their research programs, of whom 8 remained in the institutions running the research program, 8 joined other organizations and 4 returned to their original units.

In 2015, 16 postdoctoral students received financial assistance from the National Natural Science Foundation of China, 5 were supported by the Chinese Postdoctorate Science Foundation and 9 received special research funds from relevant institutes. They published 132 scientific papers, including 32 SCI-indexed and EI-indexed papers.

Chapter IX Major Activities in 2015

9.1 CAGS Work Conference of 2015

On January 29, 2015, the Academy held the 2015 Work Conference in Beijing. The Conference pointed out that we should constantly play the leading and supporting role of scientific and technological innovation, identify our correct position as for how to meet the demands of the country, and make the Academy more competitive while providing public services and more vigorous while carrying out reform and innovation. The Academy proposed the focal points and the general principle of its work in 2015 as follows: implementing the innovation-driven strategy and strengthening innovation of system and mechanism, promoting innovation projects of geological science and technology and cultivating high-rank professionals; building platforms for integrating geological survey and geological research, combining industry, academia, research and application together, and expanding international cooperation and exchange; intensifying the management and service system, strengthening ranks of the officials, stepping up efforts to improve Party conduct and integrity, and advancing cultural and ethical progress; guaranteeing the safety of energy and resources, guiding and supporting mineral exploration to make breakthroughs; serving social and economic development and promoting ecologic progress.



CAGS Work Conference of 2015



A group discussion at the Conference

9.2 Symposium of the CAGS on Party Conduct and Integrity

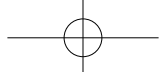
On April 23, 2015, a symposium on Party Conduct and Integrity was held at the Academy, which focused on better managing the funds of projects and improving the work style of the Party. After the symposium, Party Secretary Wang Xiaolie and legal representatives of the Academy-affiliated institutes, centers, laboratories and departments signed respective responsibility agreements on improving Party conduct and promoting integrity in 2015.



The Symposium on Party Conduct and Integrity



Signing the responsibility agreement on improving Party Conduct and Integrity



9.3 Solid Steps Taken to Promote Strategic Cooperation of Industries, Academia, Research Institutions and Enterprises

On February 3, 2015, Prof. Xu Zongwei, President of Hefei University of Technology, and his colleagues visited the Academy. Discussion was arranged between the two parties on how to deepen their cooperation in 2015 and ensuing years on the basis of the previous strategic cooperation.



A meeting on future cooperation and exchanges between the CAGS and Hefei University of Technology



A discussion on scientific and technological cooperation between the CAGS and the Geological Exploration Bureau of Zhejiang Province

On May 12, 2015, a symposium was held between the CAGS and the Geological Exploration Bureau of Zhejiang Province to discuss their science and technology cooperation. The two sides confirmed the initial progress in their practical cooperation, had intensive discussions and reached consensus on such issues as future cooperation, talent exchanges, joint establishment of work stations for Academicians, opening and sharing of key laboratories and training of professionals.

On April 15, 2015, Prof. Wang Yanxin, President of China University of Geosciences (Wuhan) and his



party visited the Academy to deal with science and technology cooperation and relevant work. The two sides gave an account of the major work they were taking up, discussed problems concerning their common interests and reached consensus on a series of problems: firstly, jointly applying for establishing the Collaborative Innovation Center on Deep Geological Processes and Resource-Environment Effects, which is coordinated by China University of Geosciences (Wuhan); secondly, jointly building the world-class High-temperature and High-pressure Laboratory; thirdly, making joint effort to submit a proposal to set up the National Key Laboratory on Karst Dynamics as early as possible; and fourthly, exploring new approaches to cultivating talents.

On October 9, 2015, Miao Zhuang director of the Geological Exploration Bureau of Jiangxi Province and his colleagues paid a visit to the CAGS for the purpose of discussing the cooperation between the two parties with respect to geological survey and scientific research. Both sides agreed that there would be vast potential in future cooperation, they would closely follow the “One Belt One Road” and “Yangtze River Economic Belt” strategic plans to extend their cooperation and exchanges, intensify application of innovation projects, more closely cooperate with each other in new technology, method, equipment and field, promote the combination of industry, academia, research and application, and strengthen technical exchanges and training of talents, especially young and middle-aged professionals.



A discussion on science and technology cooperation between the CAGS and China University of Geosciences (Wuhan)



An official talk on scientific and technological cooperation between the CAGS and the Geological Exploration Bureau of Jiangxi Province



The CAGS was honored by the Organizing Office of the National Science and Technology Week



Academician Xu Zhiqin gives a presentation "Life and the Earth"

9.4 Activities to Popularize Scientific Knowledge

In 2015, "Proposals to the Science Popularization Work of the Chinese Academy of the Geological Sciences (2015-2020)" was promulgated. A series of relevant activities were organized by the Academy with extensive social influence, such as the "World Earth Day" and "Science and Technology Week", which received commendation from the MLR and MTS. Popular science lectures were arranged such as "A Song to Our Mother, Earth: Life and the Earth" presented by Academician Xu Zhiqin and "Listen to Academicians, Care about the Earth and Go into Campuses" given by Academician Zhao Wenjin on Earth Day. The Academy and the No.1 Primary School of Ruoqiang County in Xinjiang jointly launched a classroom of earth sciences popularization. The State Key Laboratory of Continental Tectonics and Dynamics was opened to the public. Three books compiled by scientists from the Academy were selected as excellent popular science readings of 2015 by the MLR.



Academician Zhao Wenjin presents a lecture at the High School Affiliated to Renmin University of China



9.5 Academic Seminar on Massive 8.1 M_s Earthquake in Nepal

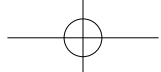
A massive 8.1 M_s earthquake hit Nepal on April 25, 2015 with the hypocenter at depth of 20 km. On April 29, the Academy arranged an academic seminar regarding this event, scientists discussed and exchanged ideas on related academic topics. Li Haibing, Peng Hua and Wu Zhenhan expounded the triggering structure of the earthquake and its influence on the adjacent areas, real-time monitoring of crustal stress measurement stations of China, focal mechanism and the comparison between this quake and the Wenchuan earthquake. They put forward many significant scientific problems.



Academician Chen Yuntai attending the seminar



Academic exchanges at the seminar



9.6 Symposium on Mineral Exploration in Old Industrial Bases of Northeast China

On August 24-25, 2015, organized by the CAGS and the Shenyang Center of the CGS, the Symposium on Mineral Exploration in Old Industrial Bases of Northeast China was held at Shenyang. 17 academic papers were presented at the symposium, covering regional structure and deep processes, energy and solid mineral resources, important metallogenic belts, areas of package mineral exploration and old mines, and geophysical and geochemical exploration techniques. Academicians, experts and all participants had lively discussion on major problems in mineral prospecting in Northeast China, national science and technology programs, the industry-academia-research chain of geological research and survey projects, and integration of geological survey and scientific research. Many consensuses were reached at the symposium, such as major tasks of every Center of the CGS, integration mechanism of geological survey and research, jointly submitting proposals of national science and technology programs, propelling the development of academic disciplines in terms of carrying out research tasks, sticking to definite research directions, and keeping the contingent of researchers and workers stable, as well as the main goal, regional geological structure and other important problems related to mineral prospecting in Northeast China.



Symposium on Mineral Exploration in Old Industrial Bases of Northeast China



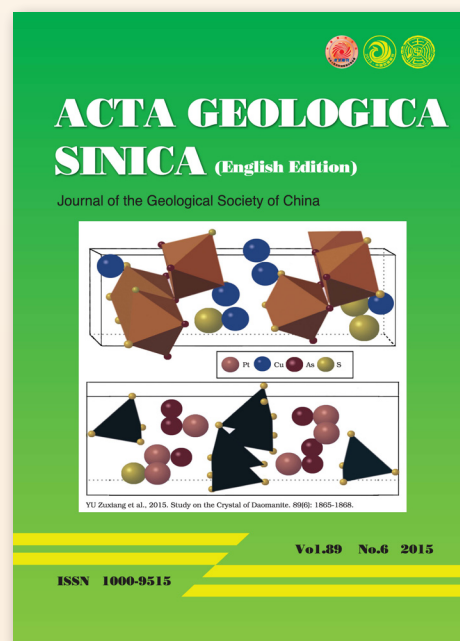
Chapter X Academic Publications

In 2015, 1034 research papers and 19 monographs written by scientists of the Academy were published, including 378 SCI-indexed (up 64.89% from 2014) and 76 EI-indexed papers, and 497 papers in China's core journals.

The Chinese Academy of Geological Sciences and the Geological Society of China sponsor 10 academic journals, including *Acta Geologica Sinica* (English edition) (indexed by SCI), *Acta Geologica Sinica* (Chinese edition) (indexed by IE), *Acta Geoscientica Sinica*, *Mineral Deposits*, *Geological Review*, *Carsologica Sinica*, *Rock and Mineral Analysis* (indexed by CA), *Acta Petrologica et Mineralogica*, *Journal of Geomechanics* (China's core journal), and *Journal of Groundwater Science and Engineering* (English edition).

In 2015, the website of geoscientific journals of China (<http://www.geojournals.cn/>) was heavily visited and accommodated more professional periodicals than any other geoscientific website in China. The website attracted extensive attention of overseas researchers from more than 10 countries, such as the US, Canada, Germany, Australia, Japan and Mongolia. The website has overcome significant language barriers to gain more and more attention from foreign countries.

ACTA GEOLOGICA SINICA (English edition) is sponsored by the GSC and started publication in 1922 under its former name *Bulletin of the Geological Society of China*. It is one of the scientific periodicals with a long history in China. The present editor-in-chief is Academician Shu Degan from Northwest University, China and the journal's Editorial Board has 56 Chinese members and 24 overseas members, as well as 1995 Chinese experts and 580 Wiley-Blackwell experts engaged in websites and databases. The journal has been praised several times by the MST, Publicity Department of the Communist Party of China (PDCPC) and General Administration of Press and Publication (GAPP). It was chosen into the China Scientific Periodical Array in 2001. During 2006—2012, the magazine received financial aid from the Project of A-category Outstanding Periodicals of the



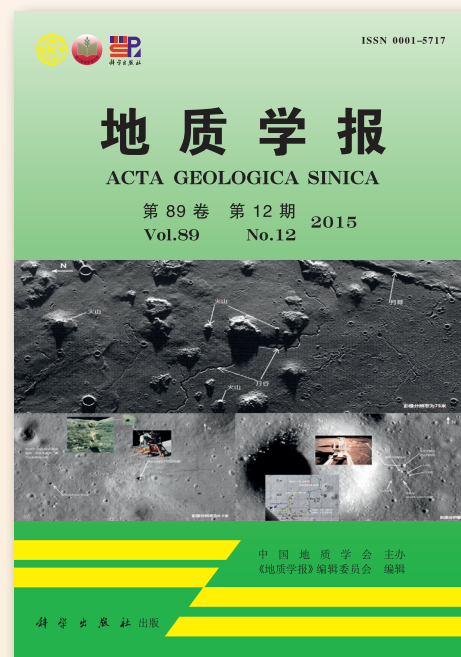
CAST. The journal received financial support from the “Special Funds for Key Academic Periodicals” of China National Natural Science Foundation during 2010—2011. The journal has received the first award of the Project for Enhancing International Impact of China STM Journals during 2012—2015, issued by the Ministry of Finance and the CAST with a fund of 2 million yuan a year. In recent years, notable progress has been made in magazine internationalization and the journal was chosen as the source item by more than 10 famous index references, digests and databases, including the *Science Citation Index* (SCI) and *Chemical Abstracts* (CA) of the Institute of Science Information of the US. This journal won the title of the Highest International Impact Academic Journals of China from 2012 to 2015. It was chosen as one of the “Top 100 Newspapers and Magazines” by the State Administration of Press, Publication, Radio, Film and Television in 2013. This journal was evaluated as high-quality printing matter in 2014 by the Beijing Quality Supervision Department. All the above results from long-term efforts in international construction of scientific periodicals, and marks high quality and a new level for the journal.

In 2014, *Acta Geologica Sinica* (English edition) had an impact factor of 1.682 and the number of citations was 2705. Papers carried in this journal are comparable in terms of academic level with international academic media of the same kind. In 2015, it published 6 issues (1956 pages in total), carrying 132 scientific papers and 12 newsletters among 310 received papers. Among all published papers, 93% were those supported by various funds and 21% were from overseas, such as Korea, India, South Africa, Malaysia, Iran and Russia, so as to extend international influence of this journal.

Website: <http://www.geojournals.cn/dzxbcn/ch/index.aspx/> (in China)

<http://onlinelibrary.wiley.com/doi/10.1111/acgs.2014.88.issue-5/issuetoc> (in other countries)

ACTA GEOLOGICA SINICA (Chinese edition) is sponsored by the GSC. Its predecessor was *Bulletin of the Geological Society of China*, one of the earliest scientific periodicals in China. With Academician Mo Xuanxue from the CAGS as editor-in-chief, *Acta Geologica Sinica* is dedicated to reporting the latest and most significant achievements in theoretical and basic research, as well as new techniques and methods of the geological community of China. *Acta Geologica Sinica* was chosen as the source item by a number of index references both at home and abroad. It was indexed by *EI* and included in *Zoological Record of Thomson Reuters*, *Biological Abstracts*, *BIOSIS Previews* and *Scopus*. The journal has been praised several times by the MST, PDCPC and GAPP and was selected into the China Scientific Periodical Array in 2001. In 2005, it won the National Journal Award. During 2006—2015





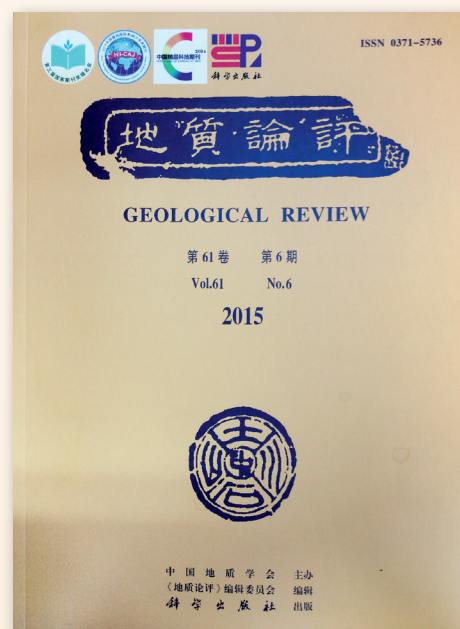
the journal received financial aid from the Project of B-category Outstanding Periodicals of the CAST. It was included in the list of the Highest International Impact Academic Journals of China since 2012. It was chosen as one of the “Top 100 Journals of China” in 2014.

In 2015, 183 scientific papers (2500 pages in total) were published in *Acta Geologica Sinica* (Chinese edition), 98% of the papers receiving financial aid from various funds and more than half of them financially supported by major research projects, such as Project 973 and the National Natural Science Foundation of China, so as to present a significant platform for demonstrating scientific and technological achievements of China. In 2015, in cooperation with the Commission on Youth Work, Commission on Isotope Geology under the GSC, Project IGCP/SIDA-600 and the research group of “Metallogenic Regularity of Marine Potash Deposits on the Chinese Continent” under Project 973, 4 special issues were published (Nos. 3, 9, 10 and 11), which promoted the development of scientific research. The impact factor of the journal was 1.435, the total number of citations was 4,491, and the overall evaluation reached a score of 65.4 in 2014. These figures ranked sixth, second and second respectively among all the geoscientific journals of China. *Acta Geologica Sinica* (Chinese edition) has long drawn the attention of numerous contributors with a large number of papers received while it has a high rate of rejection, indicating an ample source of scientific papers to attract the readers of this journal.

Website: <http://www.geojournals.cn/dzxb/ch/index.aspx>

GEOLOGICAL REVIEW is sponsored by the GSC and started publication in 1936. The journal has long seen its mission as stimulating scientific debate and discussion as well as encouraging the exchange of ideas and research discoveries. The design for the four Chinese characters meaning “Geological Review” on the cover has its upper right and lower left rims chipped, implying that the territory of North China and Southwest China was encroached upon by invaders at the moment when *Geological Review* was born. This design has been used ever since, expressing the worry of Chinese geologists for the fate of their country. *Geological Review* is a bimonthly journal with the following distinctive features: Discussing, Commenting, Explicating and Reporting. Academician Yang Wencai from the Institute of Geology, CAGS is the editor-in-chief.

Geological Review is among China’s core journals. The journal received the National Journal Award, Best Scientific Journal Award and the title of Double-Award Periodicals by the MST, PDCPC and GAPP. It has been indexed by a large number of Chinese index systems. According to statistics released

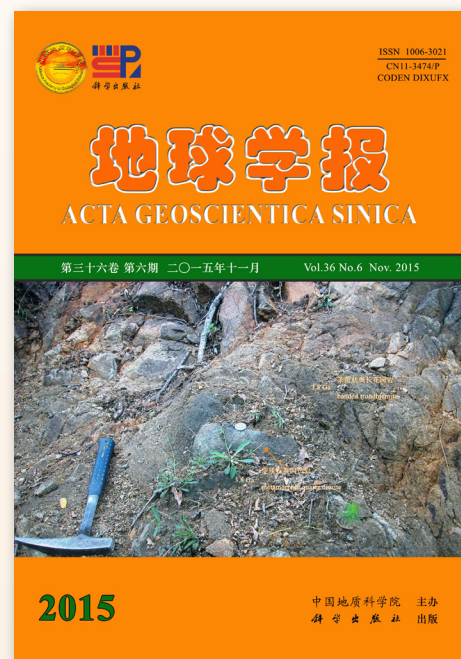


by the ISTIC, the impact factor and the total number of citations were both in the front rank of the Chinese journals. *Geological Review* was chosen into the Project of Outstanding S&T Journals of the CAST in 2006, and appraised as a journal among the Top-notch Academic Journals of 100 Categories by the ISTIC in 2009. It was included in the list of the Highest International Impact Academic Journals of China in 2012. In 2015, 376 papers were received and 128 scientific papers were published in addition to more than 10 news releases. The impact factor was 1.155 in 2015 and the total number of citations was 2772. The overall evaluation had a score of 66.9, ranking fifth among all geoscientific periodicals in China.

Website: <http://www.geojournals.cn/georev/ch/index.aspx>

ACTA GEOSCIENTICA SINICA is a bimonthly journal sponsored by the CAGS and published by the Science Press. It is among China's core scientific journals, national core journals of natural science and national Chinese core journals. It is a source periodical for the statistics of Chinese scientific papers, a journal included in the database of outstanding S&T journals of China and a source item of the core CSCD. It was selected as the journal in the first batch of Outstanding S&T Journals of China. *Acta Geoscientica Sinica* ranks among the periodicals that have the total number of SCI cites higher than 100. This journal was included in famous foreign index systems, such as *Engineering Index* of the US, Russia's digest magazine *Реферативный журнал*, *CA*, *CSA* and *GeoRef* of the US, *IC* of Poland, *ISI Web of Knowledge* of the US, *JST* of Japan, *Scopus* of Holland, *UIPD* of the US and *Zoological Record*. It was indexed by EI in 2013 and 2014. During 2012—2014, the journal was included in the Highest International Impact Academic Journals of China for three consecutive years. *Acta Geoscientica Sinica* was evaluated as a journal among the RCCSE Authoritative Academic Journals of China in 2015 and received the High Quality Award of Periodicals of 2015 issued by the Science Press. In 2014, the total number of cites was 1992 and the core impact factor was 1.596, ranking 59th among the 2383 core periodicals in China.

As an important window for showing a fine academic image of the CAGS, *Acta Geoscientica Sinica* is dedicated to fully reporting academic achievements and overall competitiveness of the CAGS in scientific research. In 2015, *Geological Review* published 6 papers reporting the Top 10 Geological Scientific and Technological Advances of the CGS and CAGS in 2014 in addition to related pictures and stories. This journal published 6 issues (812 pages) in 2015, carrying 84 scientific papers and 22 various newsletters. The electronic version of the journal was available, and the full texts can be freely reviewed

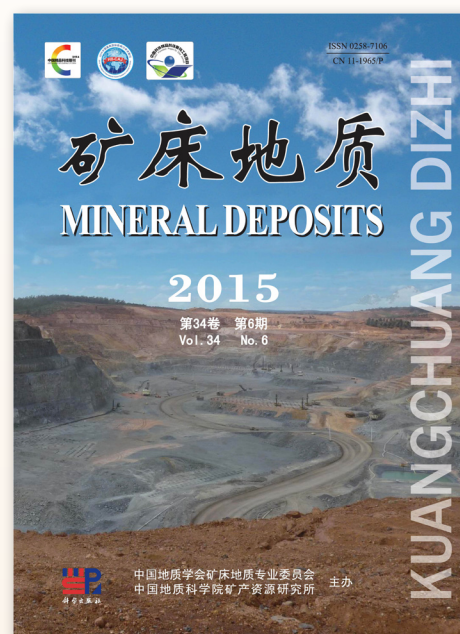




and downloaded on its website.

Website: <http://www.cagsbulletin.com>

MINERAL DEPOSITS is sponsored by the Commission on Deposit Geology of the GSC and the Institute of Mineral Resources, CAGS. It is a bimonthly journal and began publication in 1982. This journal is the only periodical in China that covers the latest achievements in the study of mineral deposits, including geological characteristics of ore deposits, relevant research results and new techniques and methods in lithology, mineralogy and geochemistry. *Mineral Deposits* was indexed by such index references and databases as *Chemical Abstracts*, *CSA Technology Research Database*, Russia's digest magazine *Реферативный журнал*, *CNKI*, *CSCD* and *CJFD*, *Digital Periodicals: Paper Database*, *Digital Periodicals: Citation Database*, *China Geological Digest*, *National Press Index Database* (natural science and technology), *Nonferrous Metallic Abstract* and *China Science Abstracts*.



In 2015, 82 scientific papers from among 293 submitted papers were published in *Mineral Deposits*. The journal has maintained a high number of papers reporting national funded research projects compared with other scientific periodicals in China. The impact factor was 1.46 in 2014, taking the 6th place among the journals in earth science and the 78th place among 2383 core scientific periodicals in China. The total number of cites was 2579. *Mineral Deposits* received financial aid from the Project of Outstanding Periodicals of the CAST. The Editorial Board of the journal completed the annual plan of “Improving Academic Quality of Periodicals—*Mineral Deposits*” and took part in Project “Pacemaker 5000—Top Academic Papers in China Fine S&T Periodicals”. According to the CSTPCD, 2 scientific papers published in this journal in 2014 were recommended to be listed in the database. In 2015, *Mineral Deposits* was again awarded the title of the Highest International Impact Academic Journal of China and the website received a click rate of nearly 6.5 million.

Website: <http://www.kcdz.ac.cn/ch/index.aspx>

ACTA PETROLOGICA ET MINERALOGICA is sponsored jointly by the Commission on Lithology and Commission on Mineralogy of the GSC, and the Institute of Geology, CAGS. It started publication in 1982 and was changed to a bimonthly journal in 2005. Hou Zengqian, research fellow of the Institute of Geology, CAGS, assumes editor-in-chief of the journal. *Acta Petrologica et Mineralogica* mainly covers basic theories and applications of branches and disciplines of lithology and mineralogy, as

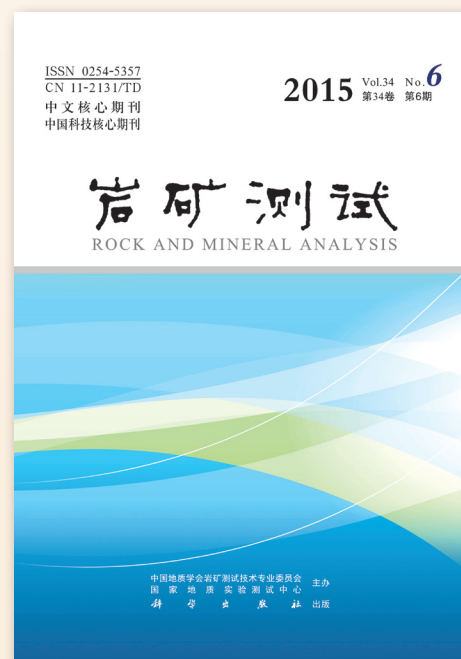
well as innovative and comprehensive research results, and new methods for rock and mineral test and analysis. *Acta Petrologica et Mineralogica* is the source item of a number of index systems and digests in both China and abroad, and is included in various Chinese databases such as the *National Press Index Database* (natural science and technology), *China Geological Literature Database System*, *China Geological Digest*, *China Geological Digest* (English edition), *China Chemistry and Chemical Engineering Digest*, *CSTPC*, *CSCD*, *CAJCED*, *CSTPD*, as well as website *CEPS* of Taiwan, *AJ*, *BIG*, *CA*, *GEOREF* and *CSA* of foreign countries.

Acta Petrologica et Mineralogica published 88 scientific papers (1014 pages) in 2015. Its website had a click rate of over 2.83 million, indicating high attraction to the geoscientific community. In 2014, the journal had an impact factor of 0.695, the total number of citations of 1138 and a non-self-citing rate of 0.91, showing high ranking among the journals of the same scientific field.

Website: [http:// www.yskw.ac.cn/](http://www.yskw.ac.cn/)

ROCK AND MINERAL ANALYSIS is sponsored by the Commission on Rock and Mineral Analysis of the GSC and the National Research Center for GeoAnalysis. The journal started publication in 1982. This is the only scientific periodical in China that is related to geoanalysis and reflects the level of geoanalysis of China.

The journal has closely followed up hot topics and development trends of geoscientific research in China and abroad with releasing high-level research achievements in geology and geoanalysis as its major goal. It has reported basic, forward-looking and innovative research results in geology and related fields, so as to provide support to technical progress of geoanalysis and test technology. In recent years, the journal has paid great attention to research results and important innovation of various analytic and test techniques, and therefore significantly improved its academic quality, reference value and international recognition. *Rock and Mineral Analysis* received the High Quality Award of Periodicals of 2015 issued by the Science Press. It was chosen





into the RCCSE Authoritative Academic Journals of China and included in almost 20 index systems, such as *CA*, *Reader's Digest*, *CSA* and *UIPD*, *EBSCO* and *Analytic Abstracts*, *Chinese CSCD*, *CNKI*, *CJFD*, *Digital Periodicals of Wanfang Data*, and so on.

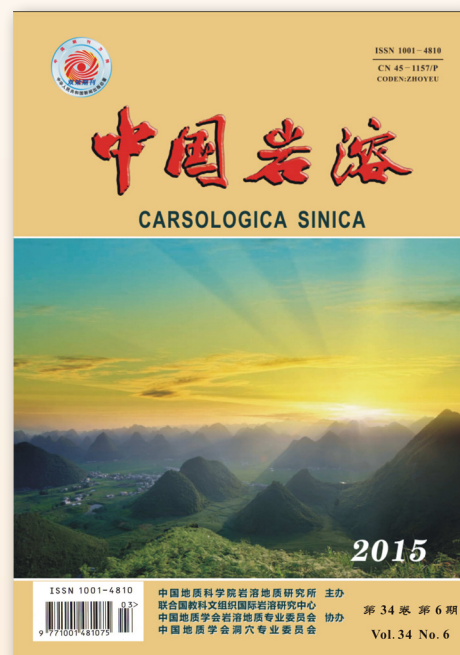
Meetings of paper reviewing and author training classes were arranged periodically in order to help authors improve their paper writing ability and guarantee high quality and readability of the papers. The editorial board has paid attention to academic innovation and tried to meet various requirements of the readers. In 2015, the journal published 104 research papers (724 pages) with a rejection rate of 50%, covering research results of key projects of the MST, projects supported by the National Science Foundation of China, Special Public-welfare Research Projects of the MLR, projects related to geological surveys in China and supported by other funds of the geological industry.

In 2014, the journal had an impact factor of 1.064 and the total number of citations was 1289. Its website received a click rate of over 480,000.

Website: www.ykcs.ac.cn/ykcs/ch/index.aspx

CARSOLOGICA SINICA started publication in 1982 and is a quarterly journal. This is the only academic periodical regarding karst geology published in China. It is sponsored by the CAGS and managed by the Institute of Karst Geology, CAGS, and co-managed by the International Karst Research Center of the UNESCO and the Commission on Karst and Commission on Caves of the GSC. It is among China's core periodicals and scientific and technological periodicals, and is included in the CSCD. *Carsologica Sinica* has been appraised several times as a fine periodical in Guangxi Zhuang Autonomous Region, and selected as a journal among the "Double-effects Periodicals" in the China Periodical Array. It has been indexed or included by a number of world-famous references and databases such as *CA*, *GeoRef* and *CSA* of the US, *JST* of Japan, *IC* of Poland, and *UIPD*, *Database Gale* and the *Library of Congress* of the US, as well as *CSTPCD* and *CJFD* of China.

In the over 30 years since it began publication, *Carsologica Sinica* has been closely linked to the national economic construction and reported the latest research achievements in karst science. While promoting the development of karst science in China, the journal has provided strong technological support to the economic construction of karst regions. The composite compact factor was 0.865 and the comprehensive compact index was 0.602 in 2015.



Carsologica Sinica changed from a quarterly periodical to a bimonthly one and published 6 issues in 2015, carrying 86 scientific papers (648 pages), which covered mainly current academic hot topics and difficult problems in economic and social construction in karst areas, and showed high academic and application values.

Website: <http://zgyr.karst.ac.cn/ch/index.aspx>

JOURNAL of GEOMECHANICS began publication in 1995 and is sponsored by the Institute of Geomechanics, CAGS. The journal serves as a window to reflect research achievements in geomechanics with the aim of carrying forward Li Siguang's academic thought and pursuing reality, innovation and development. *Journal of Geomechanics* mainly covers the trends and results of cutting edge and theoretical research in crustal movement, continental geological tectonics and dynamic mechanisms, as well as exploration of mineral resources, investigation and prevention of geological hazards, and regularities of environmental changes.

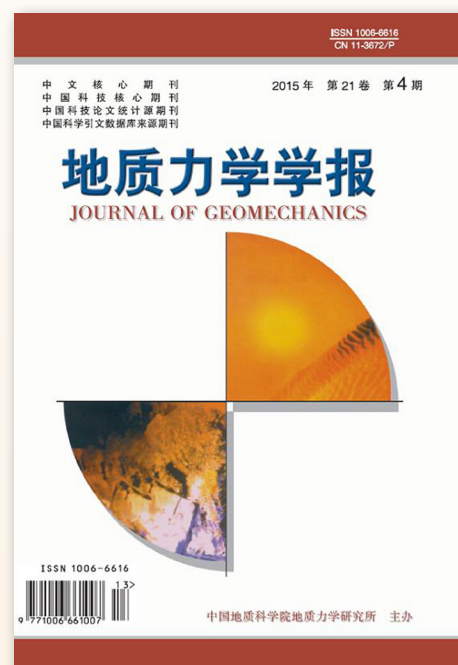
It is a source periodical for the statistics of Chinese scientific and technological papers, a source item of the comprehensive evaluation database of Chinese academic journals, the *Chinese Citation Database of Scientific and Technological Papers*, and *CAJCED* of the CNKI; and is included in the *Digital Periodicals of Wanfang Data*, *CSTPD*, *Chinese Core Periodicals (Evaluation) Database* and *CJFD* of the CNKI.

In 2015, based on the agreement "COAJ" between this journal and China Science Journal Publishing Co., Ltd., full text of all published papers of the journal are timely uploaded to www.eesciencep.org of the CSPM. *Journal of Geomechanics* was included in the "geological core journals" in 2015, indicating the constantly improved quality of the journal. The comprehensive evaluation index of the journal ranked 16th among 35 geological periodicals and 4th among the 17 geomechanic periodicals.

Altogether 57 research papers (554 pages) were published in 2015. The electronic version of the journal was available, and the full texts can be freely reviewed and downloaded on its website.

Website: <http://journal.geomech.ac.cn/ch/index.aspx>

JOURNAL OF GROUNDWATER SCIENCE AND ENGINEERING (English edition), supported by the Institute of Hydrological and Environmental Geology, CAGS, is an integrated academic quarterly periodical of natural science. It started publication in April 2013. The journal receives all high-





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quality manuscripts regarding the following research fields: hydrogeology, environment geology, groundwater resource, agriculture and groundwater, groundwater resource and ecology, groundwater and geological environment, groundwater recycling, groundwater pollution, exploitation and utilization of groundwater, standard methods of hydrogeology, information science of groundwater, and climate changes and groundwater.

In 2015, the journal published 39 research papers (374 pages) and was included in one of the six world largest databases, *Russian Digest*, so that *Journal of Groundwater Science and Engineering* greatly raised its international influence and the level of hydrogeological research of China is internationally recognized. This journal was also chosen as a periodical in the *GeoRef*.

Website: <http://gwse.iheg.org.cn>

