联合国教科文组织一流的国际岩溶研究中心

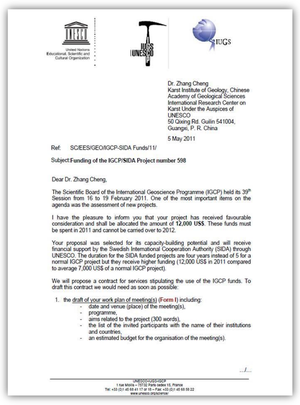
International Research Center on Karst--- A First-Class Research Center under UNESCO

（一）基本情况 Generalities

2008年12月15日，联合国教科文组织国际岩溶研究中心（以下简称“中心”）在中国桂林挂牌成立，它是教科文组织设立的第一个地学类二类研究中心。自成立以来，中心在岩溶水资源开发利用与保护、石漠化治理、应对全球气候变化以及世界自然遗产申报等领域取得了突出成果，同时在地球科学普及、脱贫扶贫、“一带一路”和平共建方面做出了重要贡献。截止2015年，中心共牵头承担了6个国际合作项目，主办和协办国际学术会议11次，举办国际培训班7次，签署合作协议15份，出版专刊2部，在全球建立了39个岩溶碳循环监测站。2013年11月，中心以其突出成果获得了教科文组织评估组的一致好评，顺利通过第一个6年运行评估。

On December 15, 2008, the International Research Center on Karst under the Auspices of UNESCO (hereinafter IRCK) was formally established in Guilin, China. It is the first category II center concerning geosciences. Since the inception of IRCK, it has achieved significant scientific achievements on exploitation, utilization and protection of karst water resource, rocky desertification control, addressing global climate change, as well as application for Global Geoparks and World Natural Heritage sites. Meanwhile, IRCK has contributed great efforts to geoscientific popularization, local poverty alleviation and peaceful joint construction along the *Belt and Road*. Until 2015, IRCK has undertaken 6 international cooperative projects. It has organized and co-organized 11 international symposia, and has successfully organized 7 international training courses. IRCK signed 15 MOUs, and published two Special Editions on Karst. So far, IRCK has set up 39 monitoring stations globally. In November 2013, IRCK successfully passed the first six-year evaluation by the Experts Panel of UNESCO, who agreed that IRCK was an efficient category II center under UNESCO.

牵头开展6个重要国际合作项目
Leading 6 international projects



United Nations Educational, Scientific and Cultural Organization

Dr. Zhang Cheng
Karst Institute of Geology, Chinese Academy of Geological Sciences
International Research Center on Karst Under the Auspices of UNESCO
50 Qixing Rd. Guilin 541004, Guangxi, P. R. China
5 May 2011

Ref. SC/EES/GEO/IGCP-SIDA Funds/11/

Subject:Funding of the IGCP/SIDA Project number 598

Dear Dr. Zhang Cheng,

The Scientific Board of the International Geoscience Programme (IGCP) held its 39th Session from 16 to 19 February 2011. One of the most important items on the agenda was the assessment of new projects.

I have the pleasure to inform you that your project has received favourable consideration and shall be allocated the amount of **12,000 US$**. These funds must be spent in 2011 and cannot be carried over to 2012.

Your proposal was selected for its capacity-building potential and will receive financial support by the Swedish International Cooperation Authority (SIDA) through UNESCO. The duration for the SIDA funded projects are four years instead of 5 for a normal IGCP project but they receive higher funding (12,000 US$ in 2011 compared to average 7,000 US$ of a normal IGCP project).

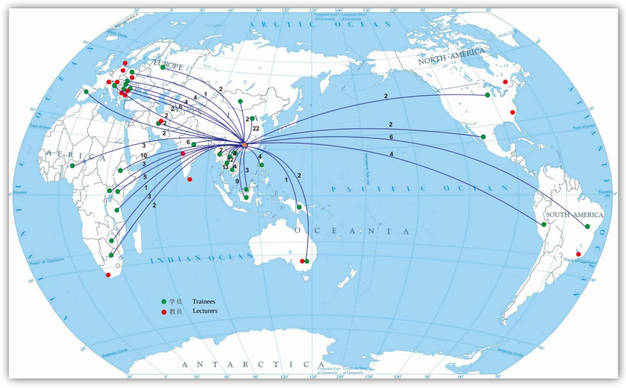
We will propose a contract for services stipulating the use of the IGCP funds. To draft this contract we would need as soon as possible:

1. the draft of your work plan of meeting(s) (Form I) including:
   - date and venue (place) of the meeting(s),
   - programme,
   - aims related to the project (300 words),
   - the list of the invited participants with the name of their institutions and countries,
   - an estimated budget for the organisation of the meeting(s).

IGCP/SIDA598“岩溶系统的环境变化及可持续性-气候变化和人类活动的关系”(2011年-2015)
IGCP/SIDA598
“Environmental Change and Sustainability in Karst Systems: Relations to Climate Change and Anthropogenic Activities” (2011-2015).

举办11次国际学术会议，与40个国家200余名学者进行学术交流
Organized 11 international symposia, conducted academic exchange with more than 200 scientists from 40 countries

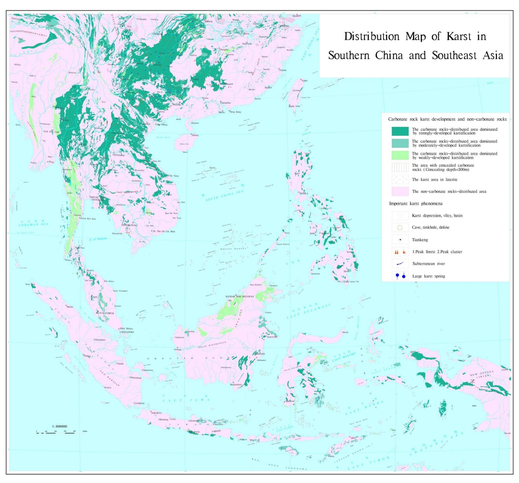
培训33个国家的147名学员
Training 147 trainees from 33 countries

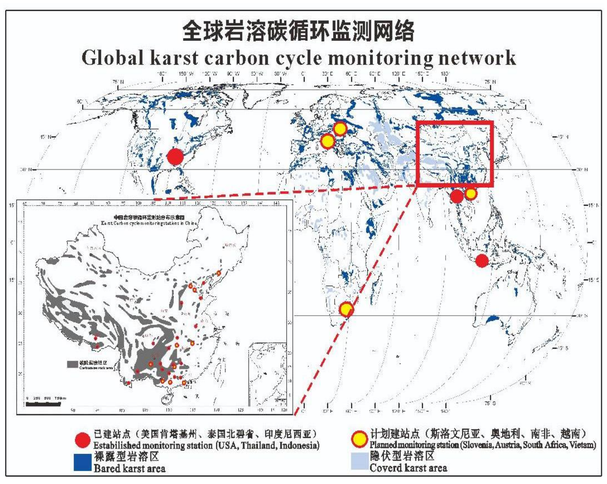


（二）主要成果 Main Achievements

创立了岩溶动力学理论，开辟了应对全球气候变化研究的新途径；创建了独具特色的石漠化治理模式，为岩溶生态修复和精准扶贫做出重要贡献；岩溶水文地质调查研究国际领先，有力保障饮水安全；揭示碳酸盐岩储层古岩溶演变规律，支撑和服务油气勘探；研发世界一流的岩溶塌陷监测预警技术，为重大工程保驾护航；引领岩溶景观和洞穴调查研究，支撑世界遗产保护和地质公园建设。

The theory of Karst Dynamic System leads a new path for addressing global climate change; The rocky desertification treatment models and technology plays an important role for restoring karst ecosystem and alleviating poverty; Results on karst hydrogeological survey provide powerful guarantee for drinking water safety; The truth of paleo-karst evolution in carbonate rock deposit reservoir gives an effective guide for oil and gas exploration; Advanced monitoring and pre-warning technique of karst collapse are safeguard for major constructions; And pioneer investigation and research on karst landscape and caves support world heritage protection and geoparks construction.





“一带一路”沿线编图—中国与东南亚地区岩溶环境系列图编制（2014-2016）
Mapping along *the Belt and Road*---Compilation of serial maps on karst environment geology of China and Southeast Asia (2014-2016).

建立了较为完善的中国岩溶数据库，出版了3部具有国际影响的专著
Useful China Karst Database (Left) and 3 well-known monographs (Right)

（三）研究团队和领军人才 Research Groups and Leading Scientists

袁道先
中国科学院院士，岩溶地质学学科带头人，国际知名岩溶水文地质学专家，岩溶动力学理论创始人，中心第一届学术委员会主任、中心第一届理事会成员
Prof. Yuan Daoxian: Academician of Chinese Academy of Sciences, the leading scientist of karst geology, world famous karst hydrogeologist, initiator of karst dynamics theory, also the 1st AC Director of IRCK and 1 GB Member of IRCK (AC-Academic Committee; GB-Governing Board)

蒋忠诚 研究员
岩溶生态与石漠化治理研究团队带头人，国土资源部岩溶生态系统与石漠化治理重点实验室主任，开拓了岩溶生态学研究
Prof. Jiang Zhongcheng: Leading scientist of the group for karst ecosystem and rocky desertification control. Director of the Key Laboratory on Karst Ecosystem and Rocky Desertification Control under the Ministry of Land and Resources of China. Initiator of karst ecology.

夏日元 研究员
岩溶水资源开发利用研究团队带头人，创建了地下河水循环研究基地
Prof. Xia Riyuan: Leading scientist of the group for exploitation and utilization of karst water resources. Initiator of research base on water cycle of underground river system.

曹建华 研究员
应对全球气候变化研究团队带头人，国际岩溶研究中心常务副主任，制定了碳循环调查技术规程
Prof. Cao Jianhua: Leading scientist of the group for research on addressing global climate change. Executive Deputy Director of IRCK. The author for ***Specification of Carbon Cycle Investigation***.

梁彬 研究员
岩溶油气资源研究团队带头人，开拓了碳酸盐岩油气田古岩溶识别方法研究
Prof. Liang Bin: Leading scientist of the group for karst oil & gas resources research. Initiator of the research on identification of paleo-karst in oil & gas field in carbonate rocks.

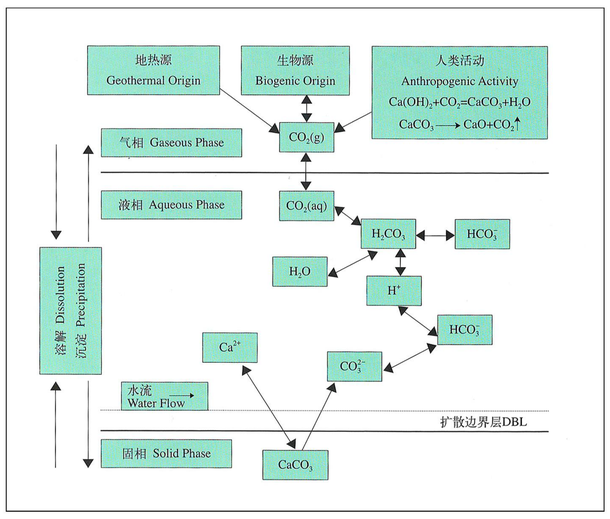
雷明堂 研究员
岩溶塌陷监测预警研究团队带头人，制定了岩溶塌陷调查评价技术规范
Prof. Lei Mingtang: Leading scientist of the group for monitoring and pre-warning of karst collapse. The author for ***Specification of Karst Collapse Investigation and Evaluation***.

陈伟海 研究员
岩溶景观与洞穴研究团队带头人，发展了岩溶景观与洞穴调查评价理论方法体系
Prof. Chen Weihai: Leading scientist of the group for karst landscape and caves research. The developer of theory system on investigation and evaluation of karst landscape and caves.

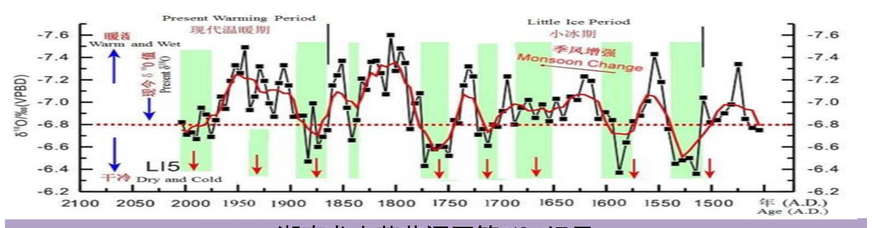
一、创立了岩溶动力学理论，开辟了应对全球气候变化研究的新途径
Theory of Karst Dynamics Lead a New Path for Addressing Global Climate Change

20世纪80年代以来，以袁道先院士为首的科学团队创立了岩溶动力学理论，建立了国际上第一个岩溶动力学重点实验室，率先开展了岩溶动力系统与全球变化研究，揭示了岩溶动力系统对气候变化响应的敏感性，发现了地质过程中短时间尺度的碳汇效应，其碳通量约占森林碳汇的17.65%和土壤碳汇的37.5%，开辟了人工增汇新途径，为国家制定应对气候变化战略提供重要依据，为全球应对气候变化做出突出贡献，实现以年际精度重建石笋气候变化记录和周期性过程，揭示了第四纪以来的极端气候事件及其演变趋势。

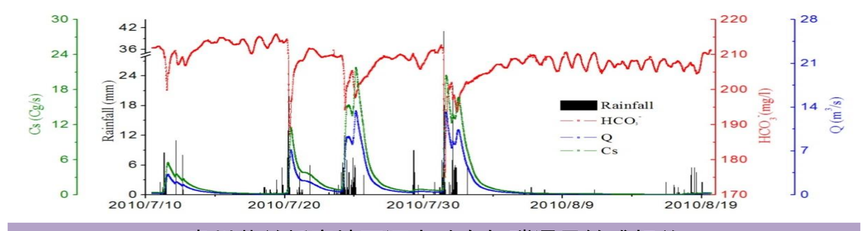
In 1980's, led by Academician Yuan Daoxian, a group of elite scientists created karst dynamic system theory. They established the first key laboratory for karst dynamics all over the world. They are the pioneers for the research on karst dynamic system and global change. Karst dynamic system is sensitive to climate change, and it will result in carbon sink effect for short-time scale. The carbon flux caused by karst dynamic system accounts for 17.65% of that by forest carbon sink and 37.% of that by soil carbon sink. A new path for increasing carbon sink by human intervention was found. All the results from this research have provided important reference for China Government to determine the strategy for addressing climate change. Their efforts contribute a lot to addressing global climate change. The research also fulfilled the precise reconstruction of paleo-climate and its periodical process recorded by stalagmites at inter-annual scale. The extreme climate events and their evolution since the Quaternary were also revealed.



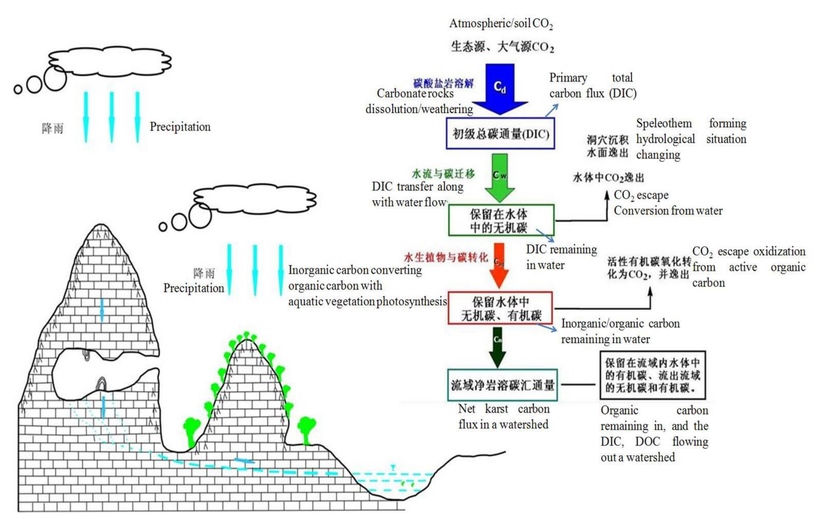
岩溶动力系统结构图
Structure of Karst Dynamic System



湖南龙山莲花洞石笋$\delta^{18}O$记录
$\delta^{18}O$ records of stalagmites in Lianhua Cave, Longshan, Hunan, China



贵州茂兰板寨地下河水动态与碳通量敏感相关
Water dynamics is sensitive to carbon flux, Banzhai Underground River, Maolan, Guizhou, China

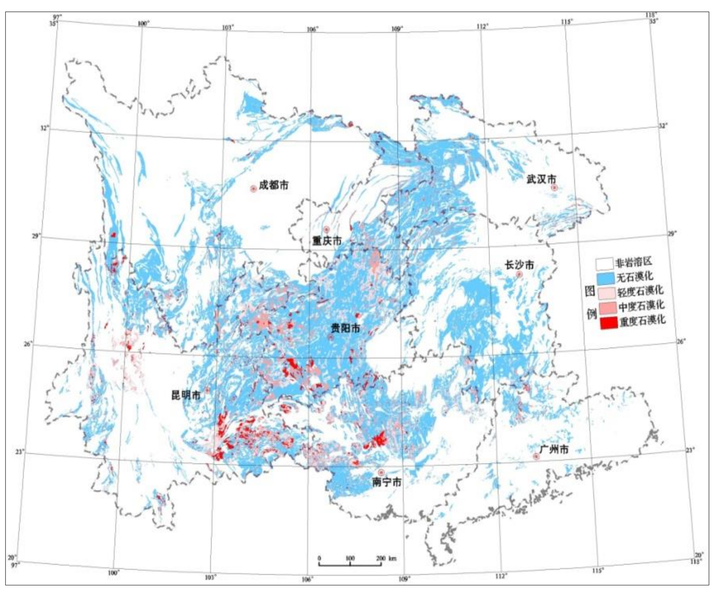


岩溶作用与碳源、碳汇关系框架图
Relationship among karst process, carbon source and carbon sink

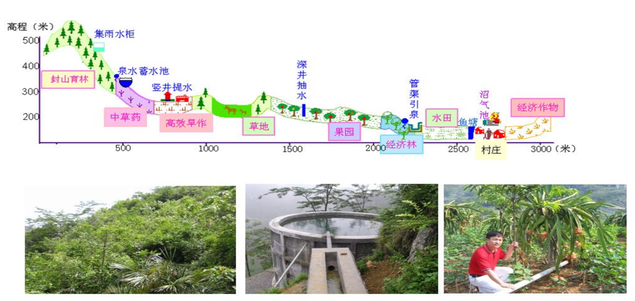
二、创立了独具特色的石漠化治理模式，为岩溶生态修复和精准扶贫做出重要贡献
Models of Rocky Desertification Control-Restore Karst Ecosystem and Alleviate Poverty

20世纪90年代以来，率先阐明岩溶生态系统、石漠化、水土漏失的概念和评价方法，查明我国西南石漠化分布、成因、演变及其危害（石漠化总面积11.35万平方千米），明确了451个石漠化县，为国家8大类型区石漠化治理提供重要技术支撑。兴建了国土资源部岩溶生态系统与石漠化治理重点实验室，建立了广西马山弄拉、平果果化等综合治理示范基地，形成石漠化综合治理模式和技术体系。弄拉成为全国著名的新农村示范屯。果化成为国家石漠化治理示范基地，植被覆盖率由不足10%增加到70%，农民人均年收入由不足500元增加到7000多元，辐射带动周边20多万农民脱贫致富。

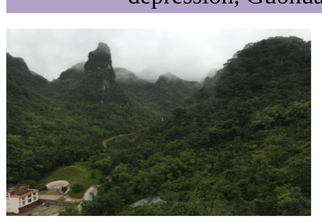
Since 1990s, by leading illustration of the conception and evaluation for karst ecosystem, rocky desertification, and water loss with soil erosion, we have detected the distribution, formation, evolution and damage of rocky desertification (covering an area of 113.5 thousand km^2) in Southwest China. 451 counties were found suffering rocky desertification in this area. Rocky desertification control in 8 types of areas in China is supported by our research. A key laboratory on Karst Ecosystem and Rocky Desertification Control under the Ministry of Land and Resources of China was set up. Research bases for the demonstration of comprehensive control were set up, such as Nongla Base in Mashan, Guohua Base in Pingguo, Guangxi, China. It has also set up a unique comprehensive model and technological system for rocky desertification. Based on our demonstration, Nongla has become a famous example for new countryside in China. Guohua has become a national demonstration base with the coverage rate of vegetation increasing from 10% to 70%, and the annual income of local people increased from less than 500 yuan to more than 7,000 yuan per capita. 200 thousand people around Guohua Base were hence free from poverty.



2014年中国西南岩溶石漠化分布图
Distribution map of Karst Rocky Desertification of Southwest China in 2014

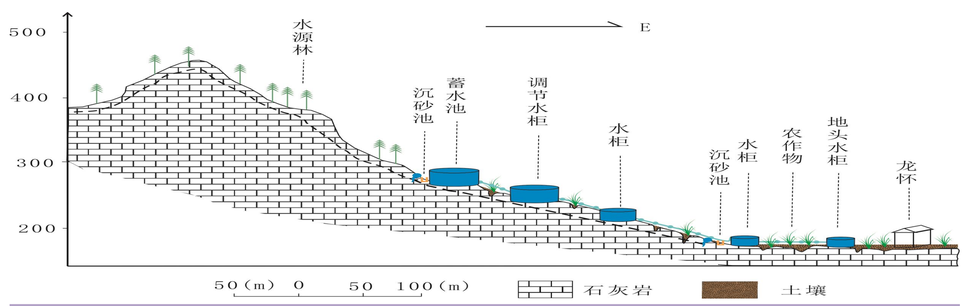


果化峰丛洼地石漠化综合治理模式示意图
Model of karst rocky desertification control in peak-cluster depression, Guohua, Guangxi, China

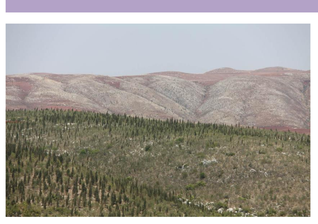


弄拉生态旅游区
Ecological tourism area in Nongla

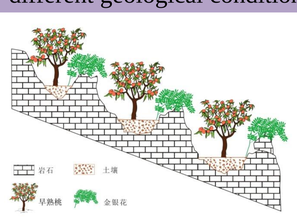
云南鹤庆石漠化景观
Rocky esertification in Heqing, Yunnan



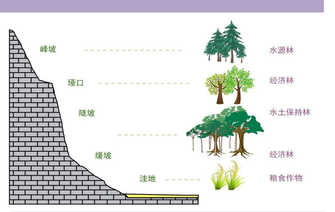
因地制宜的生态调控表层岩溶水利用模式
Model for different utilization of epikarst water with ecological regulation according to different geological conditions



云南省建水石漠化及其生态修复效果比较
Comparison before and after the rocky desertification control of Jianshui County,Yunnan, China



岩溶坡面火龙果与牧草梯化种植模式
Model of planting dragon fruit on karst slopes and planting pasture in terraces



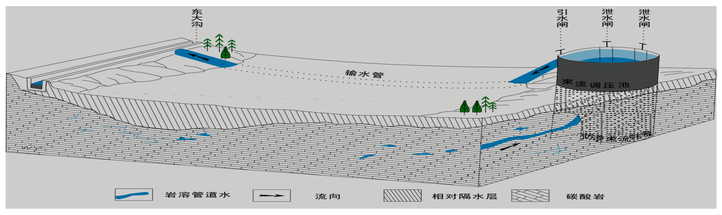
广西马山弄拉峰丛洼地立体生态农业石漠化治理模式
Stereo ecological agricultural model for comprehensive treatment to rocky desertification, Nongla Town, Mashan County, Guangxi, China

三、岩溶水文地质调查研究国际领先，有力保障饮水安全
Results on Karst Hydrogeological Survey Provide Powerful Guarantee for Drinking Water Safety

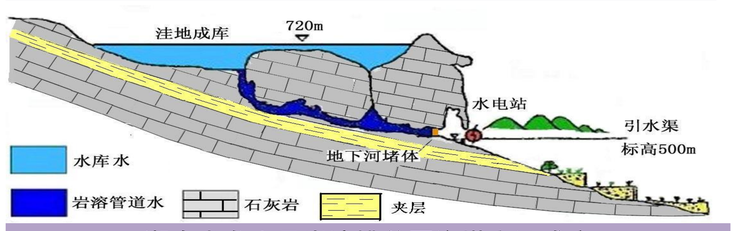
完成中国岩溶区1:25万水文地质调查78万平方千米，组织开展了岩溶区1:5万水文地质调查25万平方千米，查明了3066条岩溶地下河的分布，评价岩溶区地下水资源可开采量达600亿方/每年。组织实施了西南、华北岩溶区应急抗旱找水打井行动，施工探采结合井2300多眼，解决了520万人的干旱缺水问题。主持国际对比（IGCP）513“岩溶含水层与水资源”项目，建立了国土资源部3个岩溶水文地质科学研究基地，创立了“五水”（大气水、地表水、土壤水、表层岩溶水、地下河水）循环模型，有力支撑岩溶水资源合理开发利用。

Hydrogeological conditions of 780 thousand km^2 area were investigated at 1:250,000 scale in karst area of China, and that of 250 thousand km^2 area were investigated at 1:50,000 scale also in karst area. The investigation detected the distribution of 3,066 underground rivers, and found out that the exploitable groundwater resources are up to 60 billion m^3/year. “Emergency wells- drilling for drought resistance” were implemented in southwest and north China, with more than 2,300 wells both for survey and exploitation drilled successfully, which help 5.2 million local residents to solve the problem of water shortage. During the investigation, it has also conducted IGCP 513- “Global study of karst aquifers and water resources”. In addition, 3 research bases for karst hydrogeology under the Ministry of Land and Resources were established. A new mode called as “5 Waters (atmospheric water, surface water, soil water, epikarst water and underground river water)” Mode was created. All these achievements support the utilization of karst water resources powerfully.

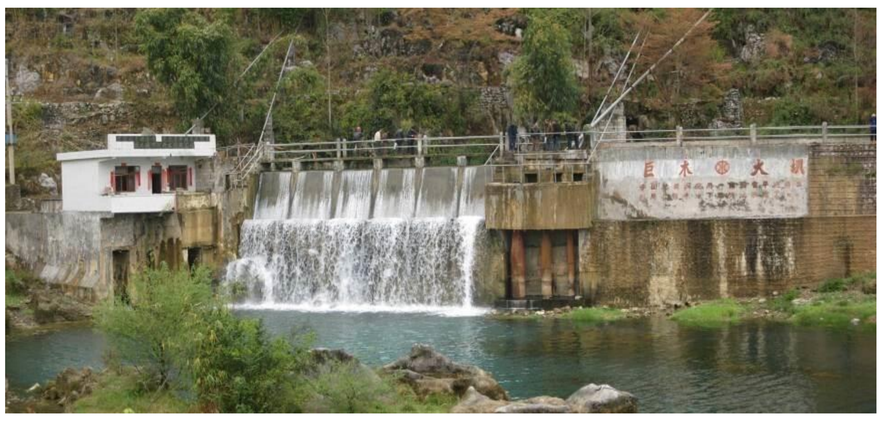
桂林海洋寨底岩溶地下河流域及研究基地立体模型
3D model for Haiyang-Zhaidi Underground River Research Base, Guilin, Guangxi, China



云南省泸西盆地岩溶大泉束流调压壅水开发示范工程
Storing karst spring with water-restriction and pressure-regulation in Pijia Village, Luxi Basin, Yunnan, China



湖南省龙山县岩溶槽谷区洛塔高洼成库
Blocking conduit to form reservoir in high-level depression, Luota, Longshan County, Hunan, China

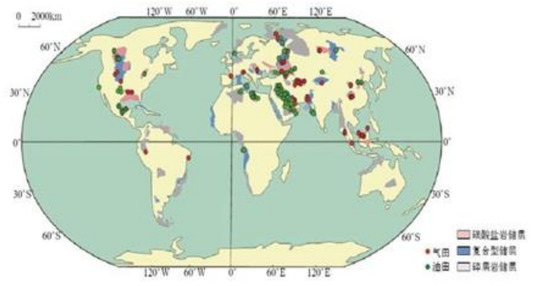


贵州巨木地下河出口筑坝拦蓄地下水，形成库容63万立方米的地下水库，抬高水位20米，建设水电站1座。解决当地5000多人和10000多头大牲畜的饮用水以及6000亩农田灌溉用水问题。
A dam was built up at the outlet of Jumu Underground River, Guizhou, China, which has generated a reservoir with the capacity of 630,000 m^3. The water level was enhanced by 20m, and a hydropower station was established. More than 5,000 local people and over 10,000 large livestock lived on this reservoir, as well as 6,000 mu farmlands were irrigated by this reservoir. (1 mu= 0.067 ha)

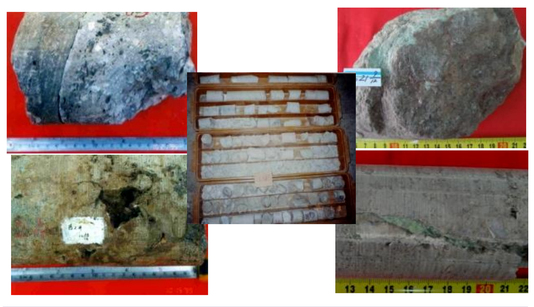
四、揭示碳酸盐岩储层古岩溶演变规律，支撑和服务油气勘探
The Truth of Paleo-karst Evolution in Carbonate Rock Deposit Reservoir -An Effective Guide for Oil and Gas Exploration

掌握了岩溶型油气储层发育与分布规律，建立了塔里木盆地、鄂尔多斯盆地和黄骅坳陷奥陶系古岩溶发育演化模式。特别是塔里木盆地古碳酸盐岩油气储层研究，以埋深5000-6000米的奥陶系古岩溶地貌研究成果为指导，圈定油气总储量达9.17亿吨的岩溶储层，指导部署10多口油气高产井，为塔河油田二次开采增产450万吨提供了技术支撑。

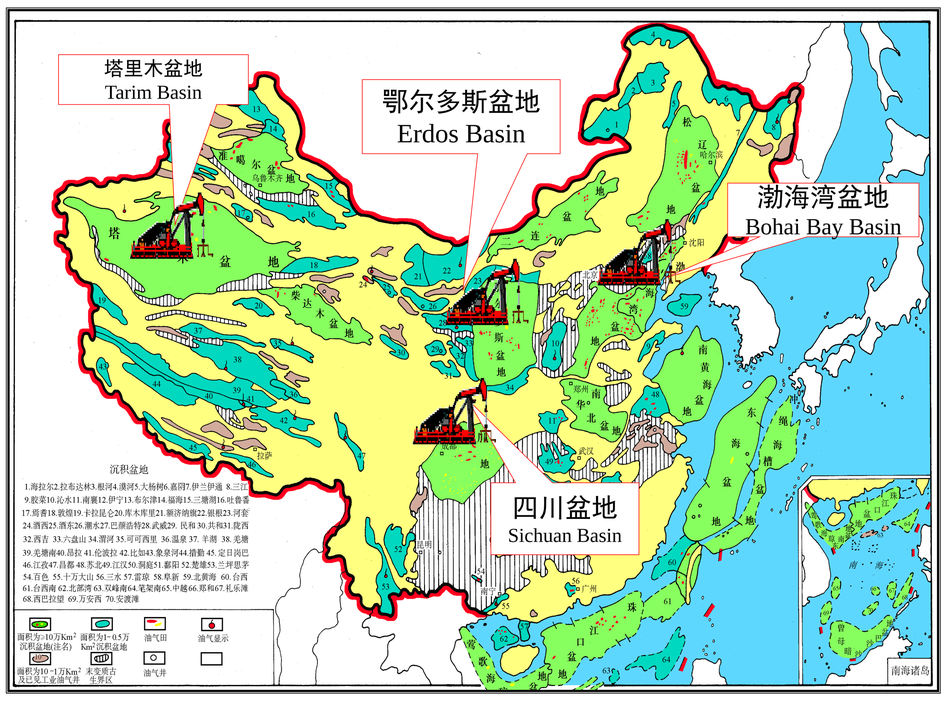
Through our research, we understood the rules for distribution and development of oil and gas reservoir in karst area. Development and evolution models for Ordovician paleo–karst development in Tarim Basin, Erdos Basin and Huanghua Depression were created. Especially, the research on oil and gas reservoir of paleo-carbonate rocks in Tarim Basin has achieved a lot. Based on the research results of Ordovician paleo-karst geomorphology of Tarim Basin buried 5,000-6,000 m deep, it has delineated the karst reservoir with the total reserves up to 917 million tons, and guided to deploy more than 10 oil and gas wells with high yield. It has provided technological support to the re-exploitation of Tahe Oil Field to increase 4.5 million tons of oil .



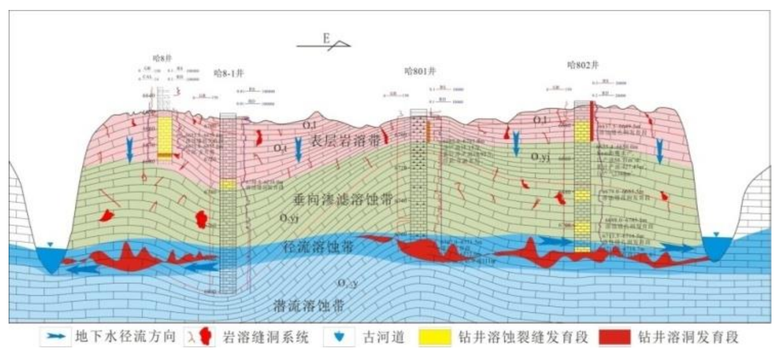
全球碳酸盐岩大油气田地理分布示意图
Geographical distribution of global large oil and gas fields in carbonate rocks



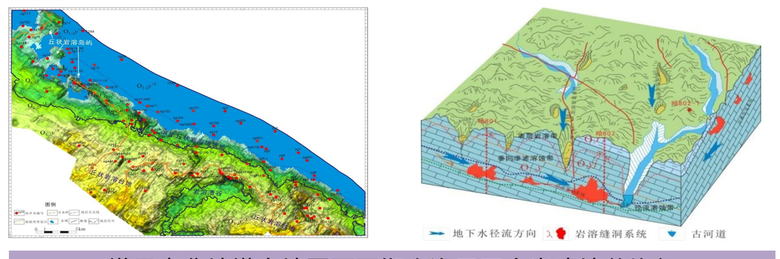
钻井岩心上的古岩溶现象
Paleo-karst phenomenon on cores of borehole



中国碳酸盐岩油气资源分布图
Distribution of oil and gas resources in carbonate rocks in China



岩溶储层地质模型
Geological model for karst reservoir



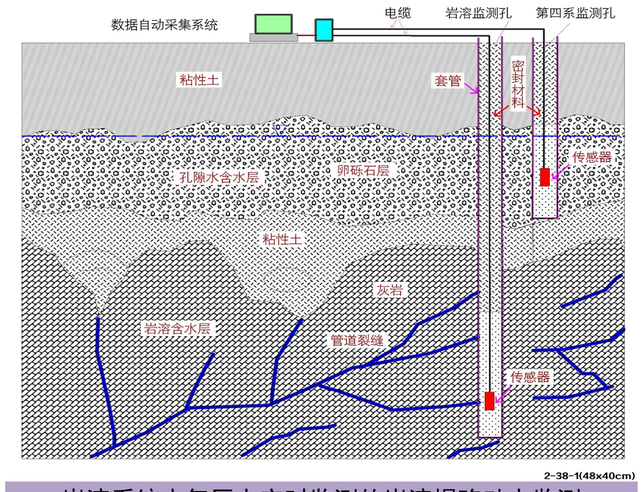
塔里木盆地塔中地区不同期次海平面古岩溶地貌恢复
Recovery of paleo-karst geomorphology during different periods of sea level, Middle Taklimakan Desert, Tarim Basin, China

五、研发世界一流的岩溶塌陷监测预警技术体系，为重大工程保驾护航
Advanced Monitoring and Pre-Warning Technique of Karst Collapse-Safeguard for Major Constructions

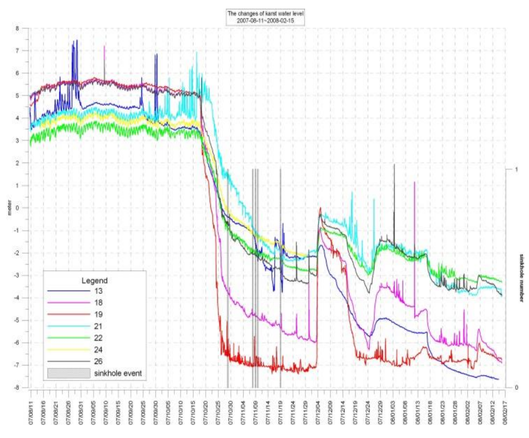
完成岩溶塌陷地质灾害调查3万平方千米，形成了基于地下水动力条件监测、分布式光纤传感监测和地质雷达监测的岩溶塌陷监测预警技术方法体系，实现对岩溶塌陷隐患的风险评估和早期识别定位，建立了室内大型物理试验模型和广州、湖南宁乡等6个岩溶塌陷自动化监测站，为广州岩溶塌陷处置、武广高铁和湘桂高铁岩溶塌陷治理提供了重要支撑服务。

30 thousand km^2 of area was investigated for karst collapse. A new technological system was created for monitoring and pre-warning of karst collapse on the basis of groundwater hydraulics monitoring, and BOTDR and geo-radar technology. It has fulfilled the risk assessment and location of potential karst collapse. Large-scale indoor physical models and 6 automatic monitoring stations set in Guangzhou, Ningxiang of Hunan were established, which have provided great support to the treatment of karst collapse occurred in Guangzhou or along Wuhan-Guangzhou High-Speed Railway and Xiang-Gui High-Speed Railway.

全国岩溶塌陷易发区分布图
Distribution of karst collapse with different risk levels in China



岩溶系统水气压力实时监测的岩溶塌陷动力监测
Karst collapse dynamic monitoring based on real-time observation of karst water hydraulic and barometric pressures



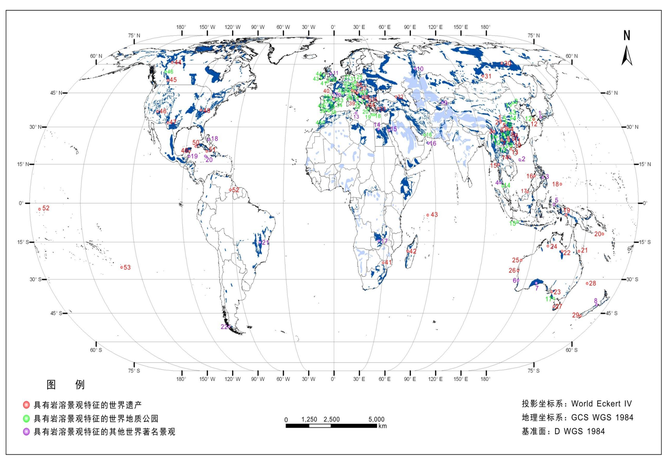
岩溶塌陷动力监测结果
Karst collapse monitoring data

岩溶塌陷物理模型试验
Karst collapse physical modeling experiment

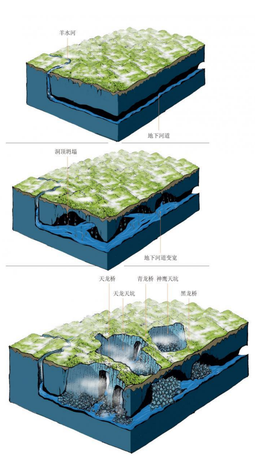
六、引领岩溶景观和洞穴调查研究，支撑世界遗产保护和地质公园建设
Pioneer Investigation and Research on Karst Landscape and Caves-Support for World Heritage Protection and Geopark Construction

建立和完善了岩溶地貌和洞穴演化理论体系。完成重庆武隆、贵州织金洞等20多处世界遗产、地质公园申报，在地质遗迹保护和利用方面做出重要贡献，有效促进了乌蒙山区扶贫攻坚。组织中外10多国联合探洞40余次，探测洞穴2000千米，发展了洞穴探测技术方法。

A theory system for karst landscapes and caves evolution was created and improved. More than 20 sites, including Wulong of Chongqing and Zhijindong Cave of Guizhou, succeeded in application for World Heritage sites and geoparks. Our research has contributed a lot to geoheritages protection and utilization; besides, it has also fostered the poverty alleviation in Wumeng Mountain area. More than 40 times of joint caving with foreign experts from over 10 countries were conducted, with the explored length of cave reaching to 2,000 km. Caving technology was developed and enhanced.

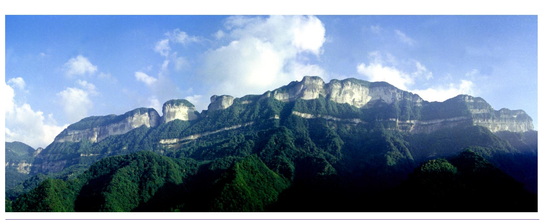


全球岩溶区世界遗产与世界地质公园分布图
Global distribution of karst-related World Heritage Sites and Global Geoparks



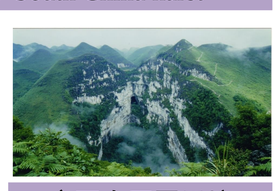
天坑发育模式图
Mode for Tiankeng development

广西桂林喀斯特世界自然遗产
Guilin karst,Guangxi-The world natural heritage of Soutn China karst

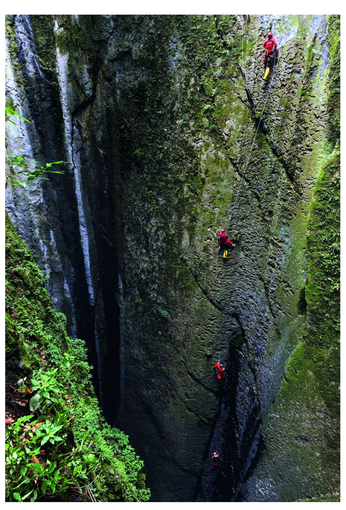


重庆金佛山喀斯特世界自然遗产
Jinfoshan Mountain, Chongqing, The world natural heritage of Soutn China karst

重庆芙蓉洞景观
Furong Cave, Chongqing,China



广西大石围天坑
Dashiwei Tiankeng, Guangxi, China



岩溶竖井探险
Shaft exploration