Hydrogeology and Environmental Geology Issues in Karst of China under Global Climate Change

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1. Chinese Leaders’ Concern on Karst Problems

1.1 Xi Jinping’s Talk on “the Forum of Economical Development in the Upper Reach of Yangtze River”, Chongqing, January, 2016

1.2 Karst problems mentioned in the Central Government 2016 Report made by former Premier Li Keqiang

2. Karst related Projects approved by the National Science foundation of China

3. The Hydrogeology and Environmental Geology Issues in Karst of China
Water tanks were dried in drought

Local people get drinking water from karst windows

In the 2008 drought, former premier Wen Jiabao said in Yunnan that there are “water shortage, water excess, and water pollution problems in south China Karst”
On March 10, 2016, in a talk with the Qinghai delegation for the National People’s Congress, he emphasized the importance of putting into implementation the plan of major ecological protection zones.

“We should put the recovery of the ecological system of Yangtze River at an overwhelm position”, “We should work together for great protection, and not great development. Our first choice is to harness the soil erosion and rock desertification problems in karst regions”
“To enhance the rehabilitation of rock desertification regions” is included in the section of ecological rehabilitation.
2. Government’s Funding for Scientific Research in the Field of Ecology and Environmental Problems

(1) On Feb. 22, 2016, The Ministry of Science and Technology delivered the Guideline of Funding for 6 fields, including: Key technologies for deep sea research; water resources; the protection and rehabilitation of typical fragile ecosystems; deep earth resources exploration; green construction; and public security.

(2) On March 7, 2016, The MOST delivered guideline for funding 9 more key fields, including Agricultural pollution; Big data & cloud calculation; global change and countermeasures.
Major projects for rehabilitation and protection of Fragile Ecological Systems” supported by MOST

1. Monitoring
2. NE China Wetland
3. Wind Dust, North China
4. Loess Plateau
5. Qinghai-Tibet Plateau
6. Upper & Middle Reach of Yangtze Basin
   (1) Southwest ecological security patterns and their evolution
   (2) Southwest hydropower development ecological protection and recovery
   (3) Rehabilitation of Rock Desertification Areas
7. Urbanization & Eastern Coast Area
8. Ecological Security System
   (1) Endangered species
   (2) World Heritage
   (3) Ecological Resources Budget
3. The Funding of karst-related projects from the NNSFC in 2015

100 projects were approved for funding from the Earth Science Division. That includes:
- 16 projects for karst ecology;
- 14 projects for karst carbon sink;
- 14 projects for paleoclimate records from speleothem;
- and 7 for karst hydrology.

The institutions receiving support include:
- China University of Geosciences (Wuhan), 10 projects;
- The Institute of Karst Geology, 6 projects;
- The Institute of Geochemistry, 6 projects;
- China University of Geosciences (Beijing), 5 projects;
- Southwest University, 3 projects;
- Guizhou Normal University, 3 projects;
- Guilin University of Technology, 3 projects.

The total number of support received by the 7 frontier institutions is only 36 projects, showing great scatterly.
16 Issues are summarized for discussion:

1. The conflicts between major ecological protection zones and development (e.g. central Guizhou; North Guangdong);
2. The areal pollution problems brought about by the general Mineral-Land-Water resources distribution framework, such as “water below land” in South China, and “water below coal” in North China, and the way to solve such problems;
3. New problems happened in South China’s rock desertification rehabilitation areas, such as: obstacles following continuous plantation; species invasion; water, soil side effects of Eucaliptus plantation; water quality problems of water tank and its relation with epikarst zone;
4. Distributed parameter discharge and hydrochemical models for typical karst hydrological system in South China;
5. The stability of carbon sink in karst processes (the Rane Curl question);
6. A comparable Paleomonson climate field for extreme event reconstructed from high resolution speleothem records;
7. Change in the flow field of regional karst hydrological systems induced by traffic (tunnelling), mining and hydroelectric (reservoir) construction;
16 Issues are summarized for discussion:

(8) Karst water quality problems induced by damping in dolines, injection of waste water in sinkholes and traffic construction (gas stations) in karst regions;
(9) Pollution events on karst groundwater systems and prevention measures;
(10) The prediction and prevention of karst collapse events;
(11) The hydrological functions of karst forests: to regulate water resources? Or to increase evaporation?
(13) The origin of high CO₂ concentration (up to 8000 ppm) in the atmosphere of Xueyu Cave, Fengdu, Chongqing and the mechanism of its regular change over years;
(14) Scientific problems remained in some world heritage sites of South China Karst, such as: the origin of allogenic gravels in the caves of Jinfo Mountain; the origin of Furong Cave system;
(15) The origin of 6000 m deep caves;
(16) The formation mechanism of long cave systems in the silicate rocks of Gondwana land.
4. Hydrogeology and Environmental Geology Issues in Karst of China

(1) The conflicts between the protection of major ecological functioning zones and Development (e.g. Central Guizhou, North Guangdong)

Tail water dam of Phosphate mining in Central Guizhou

Tail water of Dabaoshan mineral Deposit, N.Guangdong
4. Hydrogeology and Environmental Geology Issues in Karst of China

(2) Areal pollution problems brought about by the general Land-Water-Mineral deposits relationship of “coal on top and water below” in North China, and “land on top and water below” in South China, and way out!

A sketch profile of Mengzi-Kaiyuan-Nanpan River (upper reach of Pearl river)

Typical profiles in North China showing the relationship between Coal measures of Permo-Carboniferous and karst aquifers of Cambrian-Ordovician
But karst aquifers in north China enjoy a more stable discharge because of bigger recharge area, and better regulation function, such as the Shentou Karst Spring of Shanxi province.

The discharge of Shentou spring showing an approximate 10 years of time lag from precipitation.
(3) New problems following the rehabilitation of Rock desert in southwest China: Slop land; Continuous Cropping obstacle; Species Invasion (紫荆泽兰 Ageratina adenophora, 肿胀菊 Tithonia diversifolia, 黄花厥明 Cassia surattensis 等); soil moisture problems of Eucaliptus; Stone terraced land or Bioterraced land(生物篱)? Relationship between water tank and Epikarst水柜水质及与表层岩溶带关系

Slop land along Nanpang river (upper rach of Pearl river)

广西弄那峰从洼地植被

四川宁南生物篱

贵州金沙水柜 (2008)
(4) Distributed parameter models (hydrological & hydrochemical) for typical karst system in South China

(5) The Stability of carbon sink in Karst processes (debate raised by Rane Curl)

AAPB (Aerobic Anoxygenic Phototrophic Bacteria)
好氧不产氧光合异氧菌) can transfer HCO$_3^-$ into RDOC
陆地淡水中有 AAPB, RDOC 吗?

张莹：汇？通量？“中国岩溶”2015年第6期
4. Hydrogeology and Environmental Geology Issues in Karst of China

(6) High Resolution paleoclimate records from speleothem, and the reconstruction of comparable paleomonsoon field in extreme climate event

McDermont: Europe (2011)  
Hai Cheng: global(2012)  
Tan Ming: China(2009)
Paleoclimatic field in Europe from speleothem records

Oral talk from Frank McDermont (Dublin University) 2011.6.18, Birmingham (Published on Global and Planetary Change, 2011, 275-287)
Paleomonsoon field in China from speleothem records (Tang Ming, Quaternary Research (Sept. 2009))
A Global Synthesis from Speleothem records (Hai Cheng) Climate Dynamic (2012)

通过东亚,中东,地中海,南北美,28处石笋资料,揭示几个冰期终止点的空间变化。
A Holocene Monsoon field in the bordering area between Hunan, Hubei, Chongqing and Guizhou (Yin Jianjun, 2013)
(7) Change of Karst Hydrological Flowfield following Traffic (Tunneling), Mining, and Hydroelectric (reservoir) construction in Karst regions

Dewatering along A tunnel on the Yunnan-Lao Railway
The flow fields of Niangziguan Karst Spring, Shangxi, from 1982 (green) to 2004 (brown)

新问题：老煤矿闭井后对岩溶含水层的污染
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(8) Karst water pollution induced by damping in dolines, injection of waste water in sinkholes, and oil stations in karst areas, (高速公路加油站影响)
Waste floating on the outlet of Lianzhou underground stream, Guangdong
Karst Dolines are used as Waste water pond, Pingguo Bauxite Ore Deposit, Guangxi
A karst aquifer of Upper Devonian is filled by mud after a doline is used as tailwater pond, Beishan Limonite Ore, Huanjiang, Guangxi.
The Pengshuidong underground stream, Songmin County, Yunnan was polluted by waste disposal from A Phosphate Manufactory (2008.2.21).
(10) Karst Collapse Event Karst Collapses in Liangwu Village, Zhangmu, Guixian, Guangxi, 1963

1. 爆破点
2. 1963年良吴村找水爆破引发的岩溶塌陷点
3. 土层中的裂缝
4. 最初的塌陷区
5. 2-3月后塌陷延伸区
6. 石灰岩露头
(11) Hydrological Function of Karst Forest: Water conservancy? or to increase evaporation?

云南邱北桉树 (Eucalyptus, sp)
种植情况：速生，但需大量水份和养份：澳大利亚观测
One piece of Eucalyptus tree can evaporate 200 liters water/day
4. Hydrogeology and Environmental Geology Issues in Karst of China

(12) The hydrological behaviour of Dolomite:
- Pore water? fissure water? karst water; or an impermeable bed?

广西临桂西二塘，石炭系大埔白云岩露头（示小溶洞）

美国纽约州泥盆系白云岩（D.H.Zenger, Dolomitization, 1982, P.359，上图比例尺1mm, 下图2mm）
(13) The origin of high CO₂ concentration in Xueyu Cave, Fengdu, Chongqing, and mechanism of its regular change
4. Hydrogeology and Environmental Geology Issues in Karst of China

(1) Issues remained in World Heritage site of South China Karst

(1) The origin of Quartzite Gravels In a cave 2200m asl Chongqing

石膏花的来源 (CaSO₄): 硫的来源：三叠系地层? 盆地油田? 如美国新墨西哥州Carlsbad
4. Hydrogeology and Environmental Geology Issues in Karst of China

(15) The origin of Karst 6000m deep Paleokarst? Or other mechanism of Formation?

引自：汪泽成，赵文智等，四川盆地构造层序与天然气勘探，P.193,地质出版社，2002
在埋深5918-5945.86处有溶蚀孔洞，P.192

The Formation environment and mechanism of big cave systems in Silicates in Gondwana land:

Factor of TIME? Or special atmospheric contents of Gondwana land in Geological history? (In a geochemical modelling for the formation of Proterozoic Hematite in NE China, Zhu Xiaoqin suggests a high content of HCL in the paleo-Atmosphere.)
Thank you very much for your attention!