**IGCP project short title:** Environmental Change and Sustainability in Karst Systems

**Duration:** 2011 — 2014

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Date of submission of report: Dec.15 2012  
Signature of project leader(s):  
Zhang Cheng, Chris Groves
Please use the following headlines to report the present status and scientific achievements of your project (write N/A where not applicable) and explain abbreviations you use in your report.

1. **Website address(es) related to the project**
   
   Website1: [http://igcpkarst.com](http://igcpkarst.com) Main website specially designed for IGCP/SIDA 598 project hosted by Hoffman Environmental Research Institute, WKU, USA
   
   Website2: [http://www.irck.edu.cn](http://www.irck.edu.cn) This is the website for the International Research Center on Karst Under the Auspice of UNESCO, Guilin, China
   
   Website3: [http://www.karst.edu.cn](http://www.karst.edu.cn) This is the website for Karst Dynamics Laboratory, MLR, China, also for previous four karst related IGCP projects
   
   Website4: [http://www.wku.edu/hoffman](http://www.wku.edu/hoffman) website for Hoffman Environmental Research Institute, Department of Geology and Geography, Western Kentucky University, USA
   
   Website5: [http://karstfieldstudies.com/](http://karstfieldstudies.com/) website for the WKU/Mammoth Cave National Park Karst Field Studies Program

2. **Summary of major past achievements of the project**
   

   A summary of the major past accomplishments of IGCP 598 and the previous IGCP Karst projects was published this year as an invited contribution:
   

   These ideas were emphasized during the 40th anniversary celebration of IGCP held in Paris in February, which was attended by several IGCP 598 co-leaders and members of China working group including Professors Zhang Cheng, Jin Xiaochi, and Nie Fengjun. Professor Zhang gave a presentation “Climate Change, Water Resources and Water Environment.”

3. **Achievements of the project this year only**

   3.1. **List of countries involved in the project (please *indicate the countries active this year)**

   *Actively engaged participants in 2012 came from 28 countries.*

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3.2. General scientific achievements and social benefits

(1) Karst carbon sink potential and climate change. Chinese and American scientists continued to develop collaboration in establishing a standard methodology for high-resolution carbon sink monitoring with an initial pair of reference sites being established at the Maocun Basin in China’s Guangxi Autonomous Region and Lost River Cave in Kentucky USA. The American team made two visits to Maocun in 2012, and Chinese team visited Kentucky. The equipment and procedures have been designed and monitoring at both sites will begin in early 2013. Studies are simultaneously underway by IGCP 598 affiliated scientists in several to understand how aquatic vegetation utilizing HCO$_3^-$ as a carbon source is karst surface river systems may influence measurements of the relevant carbon sinks.

(2) Karst aquifer/landscape systems and processes. Greg Heath reported on conditions and processes within South Africa related to karst development in the dolomite rocks of the 2.6 billion year old Transvaal Supergroup. In South Africa significant environmental challenges exist, especially with regard to catastrophic sinkhole development. On Slovakia’s Jasovská plateau, the easternmost plateau in the Slovak Karst, Alena Petrvalska and her colleagues, as there are no settlements, were surprised to find found anthropogenic forms—lime pits—because generally there are no settlements in that area due to water scarcity. The lime pits are very similar to forms karst – dolines.

(3) Karst watersheds sustainable protection. In additional US/Chinese cooperation in December a US team visited the fluorescence lab for groundwater dye tracing at Chongqing’s Southwest University that had originally been established by US scientists during IGCP 513, and gave several presentations about relevant methods for groundwater protection. Tim Slattery is leading an effort to understand and find solutions to karst water-related environmental problems caused by urban development in Bowling Green, Kentucky USA. Vitor Moura and Brazilian colleagues studied monitoring procedures for management and protection of caves in Brazil and identified aquatic cave fauna from the Serra do Ramalho. Yang Riu and Liu Zaihua evaluated hydrogeochemical characteristics of surface water, spring and groundwater in the Gaoping basin, Guizhou. The waters of the Jeita spring of Lebanon, a water supply for Beruit, are being threatened with pollution sources and a multi agency effort is underway to understand and identify solutions to these challenges.

(4) Environmental change records in karst systems. Gilman Ouellette and Jason Polk are developing a high-resolution reconstruction of Late Holocene precipitation and climate variability on the island of Barbados from multiple speleothems. Proxy climate records from speleothem stable oxygen isotope records combined with high-resolution uranium-series dating are being used to address water resource issues in Caribbean island karst aquifers. Jason Polk is conducting additional work on drought and storm event impacts in the Caribbean on karst water resources in Belize using cave deposits.

3.3. List of meetings with approximate attendance and number of countries

IGC Congress, Australia, August 2012

The IGC Congress is the each four-year meeting of the International Union of Geological
This was the primary business meeting of IGCP598 in 2012 and had an IGCP/SIDA 598- sponsored session, over 50 participants from 9 countries (USA, Germany, China, Australia, Romania, Russia, Spain, Indonesia, Vietnam) attended the session:

29.2 Karst: processes, environments and paleoenvironmental records (IGCP/SIDA 598)

This topic includes (1) fundamental research on karst geology, hydrogeology and geochemistry and monitoring techniques; (2) factors impacting karst development and their changes; (3) carbonate rock dissolution and carbon sequestration, carbonate deposition and (paleoenvironmental) environmental and climatic records in tufa, travertine and stalagmites; (4) karst hydrogeology, water resources exploration, and management; (5) karst ecosystems, fragility, human impacts and environmental rehabilitation; (6) karst landscape and caves: natural heritage sites, Geoparks and educational sites.

IAH Congress, Canada, September 2012

This congress served as the main 2012 business venue for IGCP 598's partner team the Karst Commission of the IAH, and there is some overlap in the membership. There were six-karst water related sessions, each appropriate to IGCP 598, and a field excursion "Karst of the Niagara Peninsula.” The technical sessions were:

2-1 Karst Aquifers, Environmental Problems and Global Change
moderators: Derek Ford (Canada), Liu Zaihua (China)

2-2 Characterization and Management of Karst Aquifers
moderators: Nico Goldscheider (Germany), Barbara Mahler (USA), Geary Schindel (USA)

2-3 Modeling Karst Aquifer Systems
moderators: Neven Kresic (USA), Nicolas Massei (France)

2-4 Topics in General Karst Hydrogeology
moderators: Stephen Worthington (Canada), Nadine Goeppert (Germany), Jiang Guanghui (China)

2-5 Artificial Tracers and Environmental Isotopes to Understand and Quantify Water Flow-paths and Pollutant Transport in Karst Aquifers
Maloszewski (Germany), Przemyslaw Wachniew (Poland), Ralf Benischke (Austria)

IGCP 598 Business Meeting, Guilin China December

A business meeting was held in Guilin after the 2012 IGCP training course, attended by five of the Project’s co-leaders (Professors Zhang, Yuan, Groves, Novarro, and Knez) as well as other participants from several countries in Guilin at the time. The year's activities and plans for 2013 were discussed and evaluated.

3.4. Educational, training or capacity building activities

In its 32nd year, Western Kentucky University offered its Karst Field Studies Program in collaboration with Mammoth Cave National Park Kentucky USA. Five courses were offered in June 2012, including 1) Cave Archaeology 2) Cave Survey and Cartography, 3) Techniques for Groundwater Investigations in Karst Terrains, 4) Exploration of Mammoth Cave, and 5) Karst Hydrogeology of the Ozarks. Over forty students from the United States, Costa Rica, Canada, and elsewhere participated in the week long workshops, with surveys at the end showing that students throughout found the courses beneficial.

The International Training Course on Karst and Hydrogeochemistry, co-sponsored by the
Form V

International Research Center on Karst (IRCK) under the Auspices of UNESCO, Southwest University, UNESCO Beijing and the IGCP/SIDA 598 project “Environmental Change and Sustainability in Karst Systems: Relations to Climate Change and Anthropogenic Activities”, was held from November 25 to December 6, 2012. 21 geo-environmental researchers and managers from 12 countries (Brazil, Ethiopia, India, Indonesia, Slovak, Romania, Thailand, Vietnam, Hungary, Kenya, Malaysia and Bangladesh) participated and 16 karst experts from 4 countries (China, Spain, US, Slovenia) were invited as instructors.

3.5. Participation of scientists from developing countries.

Based on World Bank atlas method criteria, participants included those from three countries with "low-income" (Ethiopia, Kenya and Bangladesh) three countries with “lower-middle income” economies (India, Indonesia, and Vietnam) and four countries with “upper-middle income” economies (Brazil, Romania, Thailand, Malaysia) had an active part in this Project by attending IGCP-related Symposia or training courses.

3.6. List of most important publications (including maps)

At least ten relevant peer reviewed papers were published by IGCP 598 participants, these two are listed from that list due to report length constraints.


3.7. Activities involving other IGCP projects, UNESCO, IUGS or others

Representatives from International Research Center on Karst, UNESCO (IRCK) were invited to participate the Fourth Regional Consultation on Groundwater Governance, devoted to the Asia and Pacific region, was organized by the UNESCO Beijing Office, in Shijiazhuang, China, from 3 to 5 December 2012. IRCK and IGCP/SIDA 598 will take this opportunity to be involved actively in the implementation of the project “Groundwater Governance: A Framework for Action” that the UNESCO International Hydrological Programme (IHP), the Global Environment Facility (GEF), the Food and Agriculture and thus strengthen cooperation between IRCK, IGCP/SIDA 598 and IHP.

We continue active interactions with the International Association of Hydrogeologists (IAH) and the Union Internationale de Spéléologie’s (UIS) Commission on Karst Hydrogeology and Speleogenesis.

4. Activities planned

4.1. General goals

Karst systems are an important water source, with an 25% of the world’s population relaying on karst water. Karst landscapes record past environmental change and are highly vulnerable to environmental change. Sustainable use of karst water requires an understanding of how hydrological processes respond to climatic and hydrogeological conditions, especially to extreme droughts and floods, Symposia and training courses will bring together researchers involved in IGCP/SIDA Project 598 and others to focus on the impacts of environmental change on karst systems and the sustainability of karst systems.
4.2. Tentative list of specific meetings and field trips (please list the participating countries)

(1) International Congress of Speleology
A working group meeting and field seminar will be in Brno Czech Republic during the 16th International Congress of Speleology, 21-28 July. Web: http://www.speleo2013.com

(2) Guilin, China, April 11-15, 2013
International Symposium on Karst Water under Global Change Pressure, co-organized by Karst Commission of IAH, IRCK and IGCP/SIDA 598 will be held on 11-15 April, 2013, in Guilin, China. The website for the meeting is at http://iskw.karst.edu.cn/.

(3) Guilin, China, November 19-30, 2013
IRCK 2013 International Training Course on karst hydrogeology, co-sponsored by International Research Center on Karst and IGCP/SIDA 598 will be held on 19-30 November, 2013 in Guilin, China. Around 20 young karst scientists will be involved in the course.

(4) Kentucky, USA, June 2013
Karst Field Studies Program as a collaboration between Western Kentucky University and Mammoth Cave National Park. Five courses will be offered in karst resources topics, and We expect about 50 people to participate. IGCP/SIDA funds will be used for a scholarship to subsidize travel and course fees for a student in the program.

5. Project funding requested: $12,000 from IGCP and SIDA
IGCP/SIDA 598 funds for the year 2013 will be mainly used for participants involved in the activities listed below: Conference sessions and principal business meeting at the International Congress of Speleology, Brno; Conference Guilin April, Karst Field Studies program and Huilin Karst training course, including activated for African scientists. Less than 10% of the allocation will be used for routine work of project secretariat.

6. Request for extension, on-extended-term-status, or intention to propose successor project: N/A

7. Financial statement ($10,500 USD only)
Karst Field Studies ($1,000). The IGCP/SIDA 598 funds were used to pay the faculty salary for Dr. Bob Lerch, instructor of the course "Karst Hydrology of the Ozarks."
IGCP/SIDA 598 session of 34th IGC ($3,500) and karst related sessions of 39th IAH ($2,000). Total $5,500 of IGCP/SIDA 598 funds was used to support registration fee or partial international transportation of five participants from Iran, Romania, Thailand, China.
The IRCK International Training Course ($3,000). $1,000 of IGCP/SIDA 598 funds was used for local transportation for the field trips, $2,000 was used to support partial international transportation of two participants from Ethiopia, and one from Kenya.
$1000 (9.5%) was used for secretariat (newsletter printing and mailing postage, etc.)

8. Attach any information you may consider relevant

1. A Note with regard to funding provided to the project by the Swedish International Development Cooperation Agency (SIDA). SIDA added funding for the strong capacity building element of the project, with directions to especially strengthen capacity development in Africa, the Arab countries, and Iran. To this end, Professor Ezzat Raeisi from Shiraz University, Iran participated as an IGCP/SIDA 598 co-leader in 2012. We used funds ($3,000) to support training of African scientists during the Karst Training Course in Guilin including local transportation and direct travel expenses for three participants (two from Ethiopia and one from Kenya). Professor Raeisi (Iran) was upportederas an invited speaker for the Australia IGC conference. Anticipating activities for 2013, we have received a request for karst-related training from scientists from the Saudi Geological Survey, a PhD student of Professor Raeisi has been approved for Iranian government funding to work at the WKU Hoffman Institute for six months, and we anticipate providing funds for African trainees to participate in the 2013 Guilin karst training course.