

Transcript of Interview with Yuan Daoxian

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Background information:

- The interview was recorded during the workshop “Current Technology in Karst Hydrogeology and Water Resources” at the Southwest University (SWU) of China in Beibei, Chongqing, October 7-14, 2007, organised within the framework of the “China Environmental Health Project” (USAID).
- Date: Friday, 12 October 2007, ca. 14:00 to 15:15; Place: meeting room of Yuan Daoxian at the SWU. Fig. 1 shows a scene of the interview.
- The locations mentioned in the text are shown on the map in Fig. 2.



Fig. 1: Yuan Daoxian during the interview (photo: Chris Groves).

The Interview:

Question: Most of your life, you did research on karst, karst aquifers, karst ecosystems. How did you come to studying karst and to settle on this topic?

Yuan Daoxian: It may trace back to 1957 when I just returned from Tibet. At that time, my job was based in the Bureau of Hydrogeology, Ministry of Geology. After my work in Tibet, the leaders asked me to stay in Beijing to do some office work. My answer was that I would like to go outside, leave Beijing, not stay in Beijing. At that time, Yangtze River authority was lacking geologists. And I was sent to the authority in Wuhan, the capital of Hubei Province, by the Ministry of Geology in support of the authorities. My work there was making plans of hydro-engineering dam siting along Wujiang River, which is one of the main southern tributaries of Yangtze River, flowing through Guizhou Province. It took about three months to walk from the upper reach of Wujiang River down to the lower confluence point with the main stream in Fuling District of Chongqing City (Fig. 2).



Fig. 2: Map of China, indicating all locations mentioned in the interview (map: Wu Yuexia).

I was very impressed by the karst along Wujiang River. There are a lot of gorges, many underground streams, big karst springs along the river. The concern was that underground streams around dam sites may lead to serious leakage problems. So we did a lot of survey of karstic features, such as dolines, caves, springs and so on, to make feasible selection of dam sites and hydropower station. This was the first time I was quite involved in karst, karst research. It took us three months walking in the karst region, 20 km per day, with poor conditions, no highway, no hotel; we lived in farmers' houses. We were a comprehensive team composed of seven people in all, on hydro-engineering, geology, navigation.

After my work in Wujiang, I was appointed the chief of the hydrogeological team in Shandong Province to help them investigate water resources, drill boreholes, to solve water shortage problems caused by the severe drought in 1957. Shandong is a province with a lot of karst. The basic geology is a big dome, the central part is Presinian metamorphic rock, surrounded by Ordovician and Cambrian limestone, which underlies Jinan City, the provincial capital. I was involved two years there, drilling wells in the karst aquifer, building small reservoirs, which were also located in limestone area. That was my second experience in karst.

I worked as a chief hydrogeologist in hydrogeological teams of Yunnan, Guizhou, Guangdong, and Guangxi Province (Fig. 2), affiliated directly to the Ministry of Geology until 1978. And accordingly, my work was almost all related to karst. In 1978, due to the open policy implemented when Deng Xiaoping took his office, the government paid more attention to the scientific research, encouraged learning from outside.

The leader considered I was the pertinent person to be the director of the newly established Institute of Karst Geology because I had much experience with karst regions. But to be honest, at that time my knowledge about karst was very limited, because it was basically

related to practical problems, such as engineering work, water supply, study of aquifers and so on. But nothing like this course [Current Technology in Karst Hydrology and Water Resources], as William B. White talked about the formation of karst landform. I had very limited knowledge. But we had our own terms for karst features according to our understanding. After the opening policy to the outside, the first thing we should do was to learn from outside; what happened, what was the thinking about karst in Europe and America.

So this was what the central government encouraged the scientists to do. My first contact to the outside was a visit to a hydrogeologist from the USGS. His name is Dr. William Back. He is now working at the hydrogeological division of USGS. He is a very active man, has very much large international cooperation. I think the diplomatic relationship between China and USGS then had just been established.

There is a Karst Commission of IAH. Most of the members are from Europe and America; no people from China were involved. That was why Dr. Back was very anxious to find a person to be involved into Karst Commission of IAH. So he, together with Henri Paloc from France, the president of Karst Commission at that time, introduced me to be a member of the commission. My first meeting with Dr. Back was not in the US, but in France in 1981. I was sent by the Chinese government to France to investigate the karst hydrogeology in France. Henri Paloc was my host. He took me on a long trip from the north to the south of France. At the same time, Dr. Back was giving lectures in Barcelona in Spain. He could speak very good Spanish. He came across the border to the south of France, Moulis [Moulis-en-Medoc], and there is an underground laboratory in Moulis. So we first met in Moulis.

Afterwards, Dr. Back visited China with the American scientist delegation. They came to Guilin. We exchanged the relationship and got a cooperation agreement between the USGS and the Ministry of Geology of China. That was my first involvement in the international karstology and karst hydrogeology.

But I was not satisfied with only karst hydrogeology. I also studied karst geomorphology. So I invited... Oh, let me talk about the British delegation. The first visit of British geography delegation from Royal Society was headed by a lady, Marjorie Sweeting from Oxford. We had a very brief meeting in 1977. At that time, I took the office of the institute of karst geology. I thought we should know more about the international idea of karst geomorphology. As the director, I invited Dr. Sweeting to come to Guilin to give a series of lectures about karst landforms. We were very keen on learning the basic terms about karst, as karren, doline, lapiaz, to let more people understand it, together with exchange in field around Guilin. Guilin is a very good site for karst education; every minor feature we learned from her. And now this kind of knowledge is popular in China. One of the important things is we organised a dictionary of karst terminology with the help of Marjorie Sweeting. We also quoted Monroe's USGS publication about the glossary of karst terminology. And we made a comparison with what happened in China, term after term, and got it translated in Chinese. And it was published by the geological publishing house in 1988.

But I was not quite satisfied even with the topography. We should know how it developed; the chemical, the thermodynamic origin. So later, we asked William Back to give a series of lectures about karst hydrochemistry. The content of his lectures were similar with Martin's lecture [Jonathan B. Martin, Florida, gave lectures during the workshop at SWU], just like how to calculate the saturation index. And he gave us very simple software, WATSPEC. We used it in our institute, and started to calculate our calcite and dolomite saturation indexes.

By Bill Back, we kept contact with international science, so the Chinese hydrogeological work was getting more and more involved in the international circle. After many years of my

work in the karst commission of IAH, I also made my contribution by introducing many Chinese karst hydrogeological problems in the international journals, like IAH publications.

There are two events I should mention. One is in 1983 at the 149th Conference of the “triple A-S”, the American Association for the Advancement of Science, at the recommendation of Bill Back. I was invited as a member of the Chinese delegation of the Scientific Society of China to visit the US to attend the 149th session of AAAS in Detroit. Bill Back and I together conveyed a special session at this conference. And the name of it was the “Degradation and Rehabilitation of Fragile Environments: Karst Areas and Desert Margins”. We had two meetings at this session. I made an introduction to the whole of environmental problems and hydrological problems in China as the keynote speech at that session. And Bill Back made an introduction of environmental problems in America. There were a lot of papers. After that, Bill Back gave me a chance to tour around the US, almost all the important karst regions of the US, including New Mexico Cave, Mammoth Cave – this was my first visit to Mammoth Cave, in 1983 –, Florida, Texas, Edward aquifer, almost every most important karst region. So this gave me better understanding of karst in the Europe and in America.

And that is my work, not only to do the practical work, but also to improve our scientific understanding, to catch up the modern situation of the karst study in the world, include all this knowledge to build up our karst institute. The institute is divided into several sections; one is karst geomorphology. And there is karst hydrogeology, and the mechanism of karst formation and water chemistry. This was the first stage, the establishment of this institute.

But the highlight of the institute, I think, it happened in 1988 at the support of the International Association of Hydrogeologists, we had the 21st hydrogeological congress in Guilin. The topic is “Karst Hydrogeology and Karst Environment Protection”. At that time, a lot of people want to know the hydrogeology in China. It was a big congress. More than 500 people attended the congress in Guilin, including many important karst scientists and hydrogeologists. The USA sent the biggest delegation, headed by the director of USGS. Many people from Europe. There were several excursions, let many people understand what happened in China, and what are the main hydrogeological problems in China, according to my understanding.

I organised two discussions, introduced Chinese hydrogeology in two parts; northern China and Southern China. In Southern China, the problems in karst are water shortage, and rock desertification and so on. But in the North, the main problem is the relation between coal mining and the pollution of Ordovician and Cambrian aquifers. There is a lot of discussion about water intrusion in coal mining and pollution of aquifer. So the outside came to understand the problems in Chinese karst; and there is continuous exchange.

The International Union of Speleology and the International Geographical Union also has a Karst Commission. They are all interested in karst in China. With the support of the IAH Karst Commission, we applied for an IGCP [International Geoscience Programme] project. That was the start of my job at the UNESCO-IGCP at the encouragement of karst scientists, especially those in hydrogeology. In 1990, we applied successfully for the first IGCP 299 with the title “Geology, Climate, Hydrology and Karst Formation”. And all the karst friends of the world supported that. And we got better understanding from world comparison.

We used the idea of karst feature complex. There is a debate, this is maybe one of my contributions for the world comparison of karst, for the IGCP 299. It happened in 1981 in Bowling Green, KY [Kentucky, USA]. It was the 8th Congress of UIS [Union Internationale de Spéléologie – International Speleological Union]. There were two papers, one is from Derek Ford, the other was from Joe Jennings from Australia. Derek Ford considered the

pinnacles in the Rocky Mountains as something like tropical karst. So he considered the climatic background is not so reliable. The pinnacle could happen both in the tropical region and also in the Rocky Mountains. But Joe Jennings made a reply: “don’t throw the baby away with the bathwater”! He still considered the climate very important. I think if you considered only one particular karst feature, you cannot make a real comparison about world karst. So for implication, if we cannot find a way out, we only consider such pinnacle is tropical, such cave is subtropical, such is a temperate karst, and etcetera. Maybe some confusion like that example may happen. So I raised up an idea of karst feature complex to match the micro-form and macro-form, to match the surface form and subsurface form, and also the depositional form and the dissolutional form. The name I gave is ‘Karst Feature Complex’. To let people understand that, we took China as an example. In 1991, we had the first meeting of IGCP 299. We made a trip to tropical karst in Guilin for an example, to plateau karst in Guizhou; and to high mountain karst in Tibet; and to Qinling Mountain karst, as the divide between tropical and temperate zone; and then Shandong province, semiarid karst (Fig. 2). IGCP 299 carried out a global karst correlation.

Another important discussion is the involvement of CO₂ in karst processes. There should be some relation with the global warming, greenhouse effect in karst processes. So we had another project, IGCP 379, “Karst Processes and the Global Carbon Cycle”. We tried to get some estimation about the global change, to let karst study be involved in global change study in two ways. One is to estimate the role of karst processes as a CO₂ sink. The second is to use speleological records for paleoenvironment reconstruction. The course in the work started very early, maybe trace back to 1960; some American papers were doing that. During that time in 1990s, such papers were blooming up, a lot of papers do that work all over the continents. And also in China, there are eight institutions to do the speleological work, also in the South West University.

And after that, ecological problems became also important in China, rock desertification, also a problem in the Mediterranean Region and Southeast Asia. We had the third IGCP project about ecological study of karst, IGCP 448, “World Correlation of Karst Geology and Relevant Ecosystems”.

All of them, I think, were related with practical problems which were of worldwide concern. And then we moved to karst aquifers; IGCP 513, “Global Study of Karst Aquifers and Water Resources”. Chris Groves, the leader. At that time, I was not too old. I travelled, contacted, learned from outside. We use such knowledge to solve problems in China, and also feedback to the world.

I will retire, and I am very anxious with young people. Dr. Chris Groves, he is young; comparing with Dr. Bill Back who is several years older than me. I am handing over to young people in China to continue such cooperation. I think the most important job of mine at present time for karst study is to transfer such cooperation to the young generation, such as Dr. Jiang in Chongqing, Dr. Liu in Guilin, and the still younger, like Wu Yuexia. The role of the younger generation is to contact you, continue cooperation, which I pay more attention to at the present time. And not only people in America, also people from Europe, like you, Nico, are very helpful to us.

It is very nice of Chris Groves to initiate the USAID project and to organise the Workshop on Karst Hydrogeology at Southwest University of China, a very good platform for the future cooperation. It is very good that European people are involved, continue our cooperation in several continents together. I think the karst problems still need a longer time to study. There are many new problems and tools, such as vulnerability assessment for water resources. On one hand, karst problems are very complicated. In my understanding about karst aquifers, the

most important thing is heterogeneity, as you mentioned this morning. I have written a special paper, submitted to the IAH. I gave a talk on the heterogeneity of karst aquifers in Turkey. There is also an institute of karst water in Hacettepe University [Turkey]. They have organised international meetings many times.

The problem has not been solved yet: How to estimate, how to exploit karst water resources and how to avoid pollution, basically related to heterogeneity of karst aquifer. So we need a lot of new technology. Caving, tracing, and so on. I am glad to see the tracing technology is very much improved. We are making more effort to do karst water study. What we are concerned more about is to solve many new practical problems. As I mentioned, the 3000 underground streams of Southwest China need to be protected, because the situation is getting worse. That is why I gave a special report to the State Council to call our attention on how to protect them. However, solving such problems is not easy. It needs scientific knowledge and encouraging the local people's participation, and education. At present, I think my important job is to train the young people, to transfer the platform to the younger generation.

We know that you have worked a long time for the education of people in rural areas. Can you tell us a little more about your work in rural areas?

Basically, most of my work in Shandong province, as I mentioned, was in rural areas, to help farmers to get their drinking water, and for irrigation. Especially, I should mention, during the 1960s to 1970 of Cultural Revolution, I was appointed to lead a small team, moved from the chief hydrogeologist to the countryside to help people finding drinking water. Many intellectuals were moved from position of profession. For example, an artist was sent to raise cattle. But I was lucky. I was just asked to go to the rural area to help people to find water.

I moved from the administrative paper work to do more practical work, to do caving, with no SRT [Single Rope Technique], but we do have our rope to guarantee our safety. And I tried to collect methods from experiences of local people to find water. For example, they told us how to identify fish species, and about the relationship between the quantity of fish and cavities in the underground. Because they also fed their cattle in karst mountains, they had much knowledge on which entrance had more possible connections with underground streams. I learned a lot from the farmers. I collected this knowledge and wrote a book summarising all the experiences of the farmers, together with some technologies that the farmers did not know. The English translation of the Chinese book title is "Karst Hydrogeology for Water Supply". The book was published in 1979 and it is well read in schools, university and also geological bureaus in karst regions, as a handbook. Now it is out of print.

Already at the beginning of your talk, you mentioned Tibet, and recently you told us that you just came back from a trip to Tibet. Could you tell us some of your experiences from Tibet?

That's my favourite thing! I went there as a member of engineering team of the State Council in 1955; this is a very high level, but the people were very limited, just 40 people. The affiliation is directly under leadership of the Premier. At that time, the Dalai Lama asked for help from central government with flood problems of Nyang Qu River in Xigaze, western part, and also asked for electrical power for Potala Palace due to the shortage of electricity, to develop local industry. Premier Zhou Enlai asked for a team, including the Ministry of Fuel, and Ministries of Health and Geology, to establish a comprehensive team there. I was very lucky to be involved and was the head of three geologists. I spent three years there, helped dam siting, to build a small hydropower station, to dike along the tributary of Yarlung

Tsangpo River, geological investigations, drilling boreholes. The small power station was only 2000 kW, but enough for the Potala Palace and small towns in Lhasa Region.

So we took this chance to make an overall hydropower resources survey along the Yarlung Tsangpo River. It took me another three months walking along the river, from the middle reach of Yarlung Tsangpo to the border with India. Three months walking 20 km per day. I was impressed by the natural conditions of Tibet. There are gorges, high plateaus with yaks. The social system at that time was cruel, the agricultural slave system. I did see very cruel things; the heads treated slaves very cruelly. There was an agreement between the Dalai Lama and the central government. We could not interfere. The living conditions were also poor.

There happened a serious earthquake in the lower reach of the Yarlung Tsangpo River two years before, in 1952, which damaged the old houses. And so we had to live in the field, with no house, sleep with fire burning all night, keep a person awake in turns in case of an attack from black bear. At the first month, we carried some food, such as rice, flour, transported from the east part of China. When they were finished, we had only barley powder, no vegetables; we had yak meat and yak butter. Quite a different smell, but we had to have that kind of food. But the natural condition is very good. Especially the east part; very good forest. The high plateau is covered by very nice grass, at an elevation of 4000 m above sea level. People there live in tents, built by yak's hair; first woven into rope, and then made into some kind of cloth. They have no fuel, no coal mine. So they burn yak's waste, they dry it, make into fuel. Very precious. They collected it when it was still warm; using their hats. That's 50 years ago.

I returned last year, and this year, for the investigation of glacial melt by global warming. I visited my former working places, the electrical stations were no longer used. Because it is small, it was turned into a granite quarry due to the very low capacity. Now there is very big electrical power station with capacity of 100,000 kW. On the plateau, herdsman have their own houses, some of them are very rich because they cultivate very expensive plants for Chinese medicine. 100,000 RMB [13,500 US\$] is the price for one kilogram of a plant called worm-grass, a root of grass that looks like a worm. Now the condition is much improved. They had motors, small cars. They still use yak waste as fuel, but now more efficiently used. I am very glad to see this.

You have mentioned many environmental problems in China. In western countries, we have the perception that China experiences a big economic boom, but at the same time, there are very severe, or even catastrophic, environmental problems. Could you explain some of the main problems and the measures that need to be taken to solve these problems?

This is one of the problems I work on. Several times, I made suggestions to the central government. One of the most serious problems in southwest China is rock desertification. This is the result of the malpractice in land use. On one hand, the background is fragile, because the soil-forming capacity of limestone is very limited. The limestone dissolves away, very few material remains to make soil. There is the development of underground drainage systems, so there is a shortage of surface water. Also with the strong uplift compared to other karst regions, such as Florida and Mexico – even they have karst features, but the water table is not as deep as in our karst plateau regions –, the geological background is more fragile here than in other karst regions in the world. Also limestone here is older and more compact, comparing with what Dr. Jonathan Martin said about the porous limestone in Florida during this Karst Workshop. So China's karst regions are facing more serious backgrounds for such ecological problems, like rock desertification.

On the other hand, we have a high population pressure, which was caused by uncontrolled population growth 40 years ago when people were encouraged to give birth to more babies, with limited land resources to give enough food. They had to explore and plough very limited land resources, even soil in fissures. More reasonably, we should not grow corn or sweet potatoes in such fissures because once you plough it, the soil become loose and is easily washed away during a storm. With 1.3 billion people, we should solve the problem according to practical conditions to get enough food. Now we should change our way of land use, which I'm also working at.

The central government also takes the issue of rock desertification seriously because of repeated suggestions over more than the last 20 years. So there will be big drive to rehabilitate rock desertification areas in Southwest China.

So the science and technology became more important. Fortunately, we have done some research in the past 10 years. We have some demonstration sites to grow plants, bushes, for both economic and ecological benefit. Some of them can be used as food for animals; some species can be made into medicine; some bushes can grow there without ploughed farmland. I think it may be important to change the land use pattern, to keep a balance between ecology recovery and the economic income. This is still a puzzling problem because the natural condition in southwest China is varied from place to place. One way is not enough, so we should find more ways according to practical conditions to divide the southwest China into several different places.

For hydrologic problems, we also need to differentiate smaller regions, which have certain practical conditions. For example, in some places, where we have very heterogeneous karst aquifers, underground streams could be used. In other places, which I have recently visited in Guizhou province, we find Cambrian dolomite, more like a porous aquifer, in which boreholes could be drilled to get water. The water well completion rate is high, not as in limestone regions. So you should do things according to practical conditions. For hydrogeologists, they should find different ways to solve different kinds of water supply and hydrogeological problems.

On the other hand, we should do more protection! It is very important to prevent the pollution from the countryside, industry and mining activity, and road building. We should make more vulnerability assessments and mapping, from the simplified to the more sophisticated methods, to give the government planners more concise references to protect the environment. Now the pollution of underground streams is really a concern. We have already an environment protection law to forbid any pouring of wastewater into swallow holes, but there are still many cases where they do that.

So education and stronger controls are needed in the future. We should qualify young people, young scientists to continue such effort. Now, the Southwest University base is after my base in Guilin. They are keen on the karst subject. They consider karstology should be the main direction of geography at SWU. Now I take one third of my time here, to establish the karst group here. I came here six years ago. And the project supported by USAID will be of great help to the development of the karst centre here; the technology, personnel, facilities. The condition is improved. Even people from other departments are involved in the course.

You said that international cooperation is very important for your students. Do you have any other advice to your students and to young scientists that work here in South West University and also in Guilin?

I do find that some of them are very good! But I should keep their names as a secret in my mind. I do not tell out who is better, because I should equally educate everybody. But in my mind, some of them are very good. I would pay more attention to them and give them more chances to grow up, but in general, I will educate everybody equally. My standard is not how many high scores he got, but that he or she must be active, with good English and a very good background of chemistry and geography. Especially, they should have good team work abilities and should cooperate well with others. They should be able to give speeches, not be shy, be able to express her- or himself, have good dialogue, and exchanging ability.

Now my challenge is how to retain young people here. Many young people tend to move to the east part. Here is under-developed. Although the central government has already paid more attention to the west, there are still big differences, but the condition is getting improved very quickly. The income is not as high as in the east part, it is a big challenge. We should establish good conditions here to do research, and then maybe some of them will remain here in the future. I think when the “International Research Centre of Karst under the Auspice of UNESCO” (IRCK) will be established in Guilin, we will have more contact and exchange with the outside.

I want to know more about when you were a child with your family, you lived in the east as you told, and then moved to Qing Muguan near Chongqing when the war started. Could you tell more about how that happened?

I first came here during World War II. My father was a principle of a middle school in Shanghai, then got his postgraduate study on education in Japan. At the beginning of World War II, Shanghai was occupied by the Japanese. So we escaped to Zhejiang province, then to Hunan province, then to Guiyang, the capital of Guizhou province. It was a long march as refugees. At that time, my mother gave birth to two children, my older sister is six years older than me. When the war begun, I was just six years old; she was 12. When Shanghai was occupied, my father joined the army to fight against Japan in Henan province. So my sister and I were put into a refugee camp in Wuhan. The central government took care of us, and we moved to Chongqing in 1939.

Afterwards, the central government considered that my father had good experience in education. He was asked to establish a normal university in Hunan province. So we were sent to Hunan. Then my father moved to the university in Guiyang, then to Zhongshan University in Guangdong province. When I was 10 years old in 1943, my father moved to the central university in Chongqing. Then I studied in the middle school affiliated with the central university, which is located in Qing Muguan, the place just outside Jiangjia rongdong, the spring. But all the houses were different, no concrete at that time. Just bamboo walls, put some lime and mud on it, very simple houses. This is a very important place. Houses, the middle school, all moved to the countryside like the Jiangjia rongdong area. Even the ministry of education moved outside the karst valley, because the downtown area was bombed over by Japanese. So they encouraged the ministry to disperse everywhere. Every ministry is along the highway in this region. That's the second time I came to Chongqing to get my middle school education here. When the Japanese surrendered, I moved from Chongqing to Nanjing with the middle school of the central university. Then, I started to learn geology in Nanjing and finished my geology education in 1952 and then worked for the ministry of geology in Beijing until 1958. And after that, I worked mostly in southwest China.

That's my story. It's a pleasure to talk about that.