My most esteemed Friends,

I am deeply indebted to you for all of your great favor by bringing me into my long-cherished dream-kingdom, the Gobi desert and the sand sea with highest sand mountains of the earth - the legendary Utopias. Without your kind support, it will certainly be a pipe-dream, no way through the sands but come into dream with tears! During the forthcoming Chinese Rat-Year, I am writing and thinking of you as an ancient Chinese poem says

of one's close kith and kin redoubled thinking

especially during the festival time with affection

This year we had four teams from the end of July until the end of October, with a Gobi team first and then three camel teams following. The Gobi team follows the Silk Road and the footsteps of Marco Polo to the long-lost '*City of Etzina*' mentioned in his book. We met again the high air temperature up to 45℃(113℉) in the field. We monitor groundwater from many dug wells, boreholes and springs to accumulate long-term variations of hydrochemistry and isotopic contents. We are so happy to find messages left from teams of last years in the monitored borehole of Five-Pagoda at Earthwatch Village in the area of ancient cities. The camel teams ride, walk and drive within the virgin land with megadunes and lakes, and stay with the time-frozen sites of palaeolithic Stone Age in that sand sea. We are stimulated to climb over the *Ever Rest* of sand sea to check the phenomena of wet-megadunes and, to find more lakes which have not been examined. It is also the first time to make vadose (above the water table) water content measurements from various

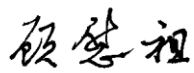
profiles for the highest megadune.

Through our investigation, observation, monitoring and experimentation of the water cycle of Gobi and sand sea during our expeditions, aimed at the historic and modern processes of desertification and its rehabilitation, leads us to an understanding of the water crises of this country that big mistakes for water management have been leading up to the serious desertification in the endorheic region (an area which is closed – i.e. there is no outflow to other water bodies such as the sea) with about 1/3 of the land area of this country. This mistake is still ongoing in our study area. To identify and quantify the strong groundwater recharge source of the sand sea will serve for the water resources disposition for such area. Some aspects of the revival of *O-ge-qin*s, dried depressions named by the Mongolian ancestors, are also found unexpectedly related to climate changes. Our explanation of the fresh spring from the travertine island that recharges the hyper-saline lake was recorded and recently broadcasted by CCTV on its scientific channel.

Full of confidence for realization of our dreams of the study, we have our great backstage boss, Earthwatch and her Angels, talented, warmhearted, charitable, vigorous and valiant volunteers!

Again thanks and best regards from the old bones

Wei-Zu, as ever

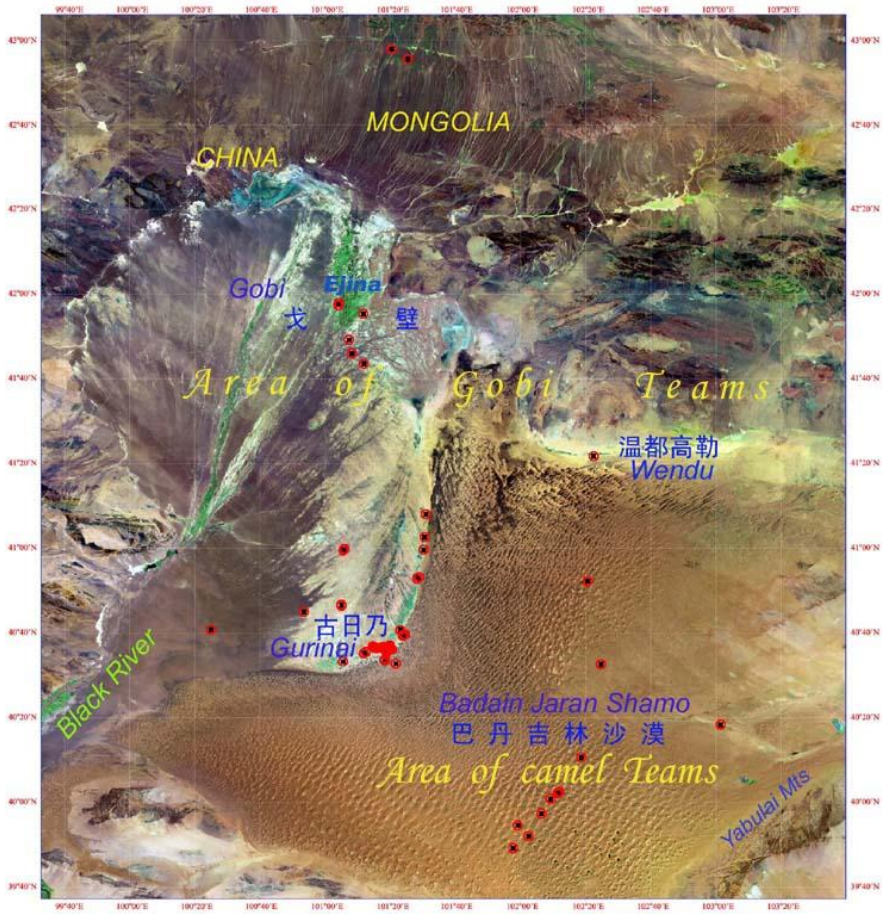


EARTHWATCH INSTITUTE
FINDING SOLUTIONS FOR A SUSTAINABLE FUTURE

EARTHWATCH INSTITUTE ANNUAL FIELD REPORT

Project Title: Inner Mongolia's Lost Water

Date completed: January 6, 2008
Completed by: Wei-Zu Gu
Period covered by this report: July 25 **to** October 24, 2007



Reporting on research objectives

Objective 1. Climate changes

- *Revival of O-ge-qin s*

Six *O-ge-qins*, the so-called dried depressions named by Mongolian ancestors since ancient times, were investigated, new spring(s) were located, measured and sampled hydrochemically (testing chemical characteristics of the water) and isotopically (testing for different forms of chemical elements). We aimed to reveal any climate changes that have happened during recent decades.

- *Fluctuations of lake level*

A reference point fixed on rock is set up for lake water level measurement. Data have been collected several months this year.

- *Old Shorelines*

Old shorelines for several lakes were identified from the different contents of deposit with or without Fe^{3+} (iron ion with positive charge). Organic matter was found simultaneously for dating. Data shows that the ancient lake level was approximately 15 m higher than its present level during about 15 000 BP (before present).

Objective 2. Mechanism of desertification of the Gobi desert

For the Modern process

This year from the data collected for the diminution and disappearance of terminal lakes of endorheic (closed) basins and the simultaneous development of desertification, we found that the mechanism of desertification of such area of about 1/3 land of this country is due mainly to the wrong engineering methods for water management in these regions.

Objective 3. The formation of megadunes

The presence of vadose (above-ground) water is the decisive factor for the formation and maintaining of megadunes. The first set of data for vadose water contents of the highest megadune near Lake Bilutu were measured by Team Five. It is 4.3%V to 5.2%V (V=volume) at its top and less in many profiles on its slope. As measured from the sampled megadunes during last 10 years, it reveals that most of the megadunes are wet.

The origin of the vadose water however maybe threefold: precipitation recharge; collection of the evaporated water vapor from the air; and condensation from the groundwater evaporation within the megadunes.

By dating of the erect standing *calcareous* vegetation (contains calcium carbonate, is "chalky"), we estimate that the megadunes have been kept stagnant at least for 4700 years.

Many outcrops and gravel in valleys reveal the existence of inselburgs (abrupt rock hills that stand alone) within megadunes including the defined 'former' and 'targy' dunes and rock hills, they are sandstone and/or fragment of late Cretaceous to Pliocene, with random distribution.

Objective 4. Evaluation of groundwater system

- *Identification of source waters of Gurinai phreatic (below the water table) groundwater*

Gurinai grassland with an area of about 3000 km^2 had been investigated within several years of Earthwatch expeditions before that area was closed. Due to the gap of data for the evaluation of the groundwater system, supplemental work was made periodically after it was closed for the additional necessary data. Until this year, three source waters for its phreatic (below the water table) groundwater are identified using uranium disequilibrium: local precipitation, Gobi groundwater, and palaeowater. Average compositions of these source waters are then evaluated based on individual record of all sampling points in Gurinai.

- *New work for the Yaburai Mountains*

The Yabulai Mountains, situated to the southeast of the Badan Jaran Shamo, is suggested as one of the possible source areas of groundwater through the Shamo until Gurinai. During Team V this year we stayed in those mountains for three days to investigate any water points. Surprisingly many springs were found in the mountains, some distributed near to the top of the mountains. Waters there were sampled and are in analysis.

Objective 5. The planned water engineering project on the Black River

- The current hydrological-hydrogeological concepts for the water management and regulation of endohreic (closed) river basins are incorrect. Based on such conceptions, the big engineering project on the Black River including the dam and concrete channel for water transportation are incorrect. The "irrigation" system constructed in Ejina Qi that we studied and investigated during Team II this year is also incorrect.

- The current engineering initiatives will create a greater anthropogenic impact on the ecosystem with more serious consequences than that resulted from the historic and, some modern processes. It will be a disaster to the biodiversity of Ejina Basin in the future.

Non-technical summary of results

1. Give an account of the data collected and results (inputs and data) for the period covered by this report, mentioning any emerging trends.

Expeditions in the sand sea are actually the very hard work, as it covers an area of about 49,200 km^2. The number of lakes within the megadune area is still not understood exactly, as we can only cover a small area with ten or more lakes during our expeditions every year. On the 2007 teams, we studied mostly unknown systems, except a few that required repeat observations. The success of the data collection is owed much to the volunteers' activities, e.g., for the recharge spring for an unknown lake, they have to walk round several times the whole lake through reeds or "white needles"; sometimes they have to try to dig holes for water collection, one such record is shown below.

2. How do these data contribute to achieving **conservation impacts?**

The data contributes to our recommendations for a sustainable Badain Jaran Shamo, it also leads to an idea to establish up an "Experimental Biosphere Badain Jaran" including a conservative area of original biosphere and Mongolian culture, we even suggested a protected zone with nauplii farming forbidden, keeping eggs of *Artemia Salina* (brine shrimp) in saline lakes for birds.

4.3 What is/ are the **significance/ benefits** of your research at the following levels?

- Local (to the area of the research site)
  - How to recycle groundwater for use in kitchen and toilet
  - How to irrigate vegetables
  - How to develop green energy to avoid fossil fuels, to diminish CO_2 (carbon dioxide) flux

- National / Regional
  - Change the policy for water resources disposition towards effectiveness and reasonableness for the endohreic (closed) river basins with area of about 1/3 of the land of this country.
  - Avoid making new dams in these areas. Take out some old dams.
  - Improve the strategy of water engineering for long-distance water transportation, especially the so-called "West-Line" program, which may be another mistake.
  - Moving the nomads out from the sand sea may not be good for rehabilitation. The rational carrying capacity of livestock, proper rotation of grazing, and the reasonable population growth in study area may be the correct criteria.

- International
  - For arid zone ecohydrology (how water processes effect ecological processes)
  - For palaeogeography and palaeolimnology (study of past in-land bodies of water that are either natural or man-made)
  - For climate changes
  - For Quaternary archaeology
  - For postgraduate students in these fields

Communication of results

Printed:

Wei-Zu GU, Jia-Ju LU and Y WU. *Identification of groundwater recharge sources by using of ^{234}U excess and ^{34}S for the arid Ejina-Badain Jaran interior basin of Alxa Plateau in Inner Mongolia*. Book of Abstract. International Symposium on Advances in Isotope Hydrology and its Role in Sustainable Water resources Management 2007, Vienna, IAEA

Mass media: broadcast production; film; TV, radio, print (newspaper/ magazine coverage);
Press releases; press conference; interview, article creation; press trip

CCTV Channel 10, Science and Education, a short broadcast film, Gu speaking and volunteers collecting data. Time of broadcasting: December 18: 22:40; December 19: 17:47

Other (Doctoral dissertation):

Zhao Xia, 2007. *Isotopic and hydrogeochemical study on the groundwater recharge sources of Badain Jaran Shamo*. Hohai University. Nanjing.

Educational Opportunities

1. Does your project directly or indirectly involve the following groups in your research topic?

Local communities
Students
Early career scientists
Other groups

Yes, for students

2. Has your project contributed to the completion of Masters' or PhD theses or degrees, or other educational research findings?

Yes, for PhD theses.