

Application of LSC Techniques in Environmental Radiochemistry Research in China

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Outlines

- ❖ **Nuclear Industry in China**
- ❖ **Radioactive Waste Disposal in China**
- ❖ **HLW Disposal in China**
- ❖ **Application of LSC Techniques in Environmental Radiochemistry Research in China**

Nuclear Industry in China

- ❖ China's Nuclear Industry started from 1955**
- ❖ The first Nuclear Weapon Test, 1964**
- ❖ The first Hydrogen Bomb Test, 1967**
- ❖ The first Submarine , 1971**
- ❖ The first Nuclear Power Plant, 1991**
- ❖ The first Aircraft Carrier, 2012**



Nuclear Industry in China

- ❖ **Currently, China's total net electrical capacity, 32 GW, 37 reactors.**
- ❖ **Nuclear electricity production is 200kGW·h, 3.6%.**
- ❖ **In the middle of this century, the total net electrical capacity, 100 GW?**
- ❖ **Nuclear accidents with nuclear power plants must be taken into consideration.**

Environmental Radiochemistry Research in China

- ❖ Environmental radiochemistry research in China started in 1980th ;**
- ❖ Currently focused on remediation of decommissioned nuclear facilities, radioactive waste disposal;**
- ❖ Low & Intermediate level radioactive wastes are disposed regionally with near surface disposal facilities;**
- ❖ High level radioactive wastes will be disposed in geological repositories.**

HLW Disposal in China

❖ Site selection--History

- **1986: Site selection started**
- **1989: Six regions selected for high level radioactive waste repository**
- **1990: Sub-area selection in Beishan area, Northwest China's Gansu province**
- **2000: Systematical site characterization in Northwest China's Beishan area**
- **2000/2012: Focused at Beishan Area, one site Policy (Following YM Model)**



HLW Disposal in China

❖ Discussions:

- **2005, 25 member “Expert Group” headed by Mr. PAN Ziqiang, an academician of Chinese Academy of Engineering, Chairman of the Committee of Science & Technology of the China National Nuclear Corporation (CNNC), and the President of Chinese Radiation Protection Society (CRPS);**
- **Nominated by the Chinese Atomic Energy Agency (CAEA)**



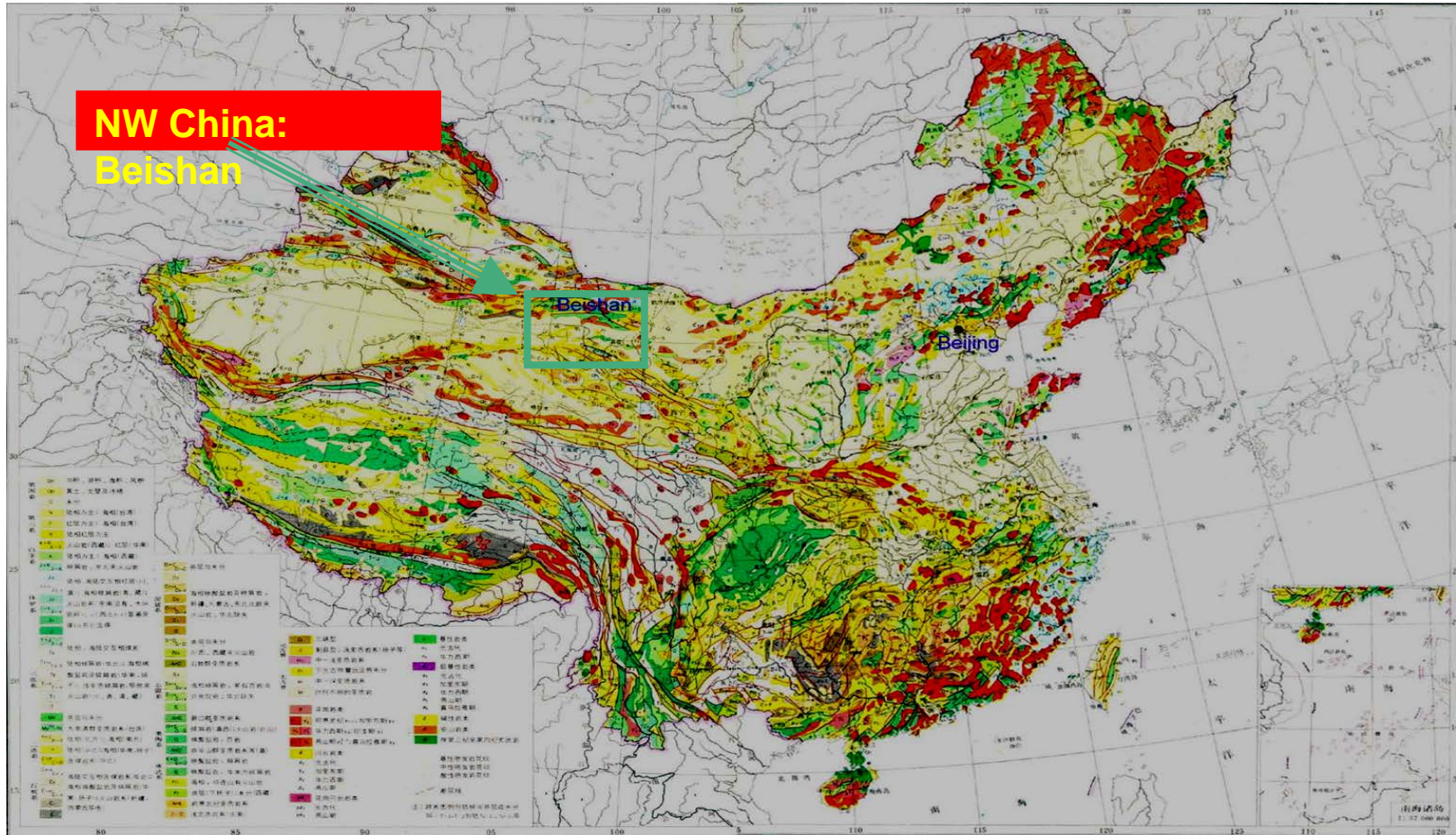
HLW Disposal in China

❖ Host Rock Selection Disagreement:

- CHILRAWD should be a government decided project just like that in USA when the US government decided the Yucca Mountain Project;
 - **Since China is a developing country, it is difficult for the government to support scientists to carry out large amount of research activities for the selection of different potential disposal sites.**
- CHILRAWD must a science-driven project, the selection of the potential disposal site must be based on science;
 - **Necessary large amount of basic research must be carried out before the site is selected.**



Beishan: the most potential site





HLW Disposal in China

❖ Beishan Site:

- From the beginning of the 21 century, China's geologists have for more than 15 years been carrying out geologic survey and mapping work at Beishan, Gansu Province.
- They have drilled several boreholes of 400 to 700 meters deep and obtained various granite core samples.
- Geochemists and radio-chemists have been performing basic research on the geochemical and radiochemical properties of the groundwater and the granite.
- Dozens of millions of RMB has been spent in Beishan area.



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❖ Beishan Site:

- the average annual precipitation is about 60 mm;
- the average annual evaporation is about 3,000 mm;
- groundwater level at around 500 m from the surface;
- the properties of the granite is acceptable as a host rock .

❖ An important point:

these data are complete and sufficiently scientifically documented to allow the Chinese government to make decisions to construct a geologic repository at Beishan?

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❖ Yucca Mountain Lesson:

The Yucca Mountain Project was shelved in 2010;

- Chinese scientists and decision makers understand that one site policy is very dangerous!

❖ More sites need to be investigated:

- In 2012, some other programs were approved to investigate more sites in China for the potential geologic repository.



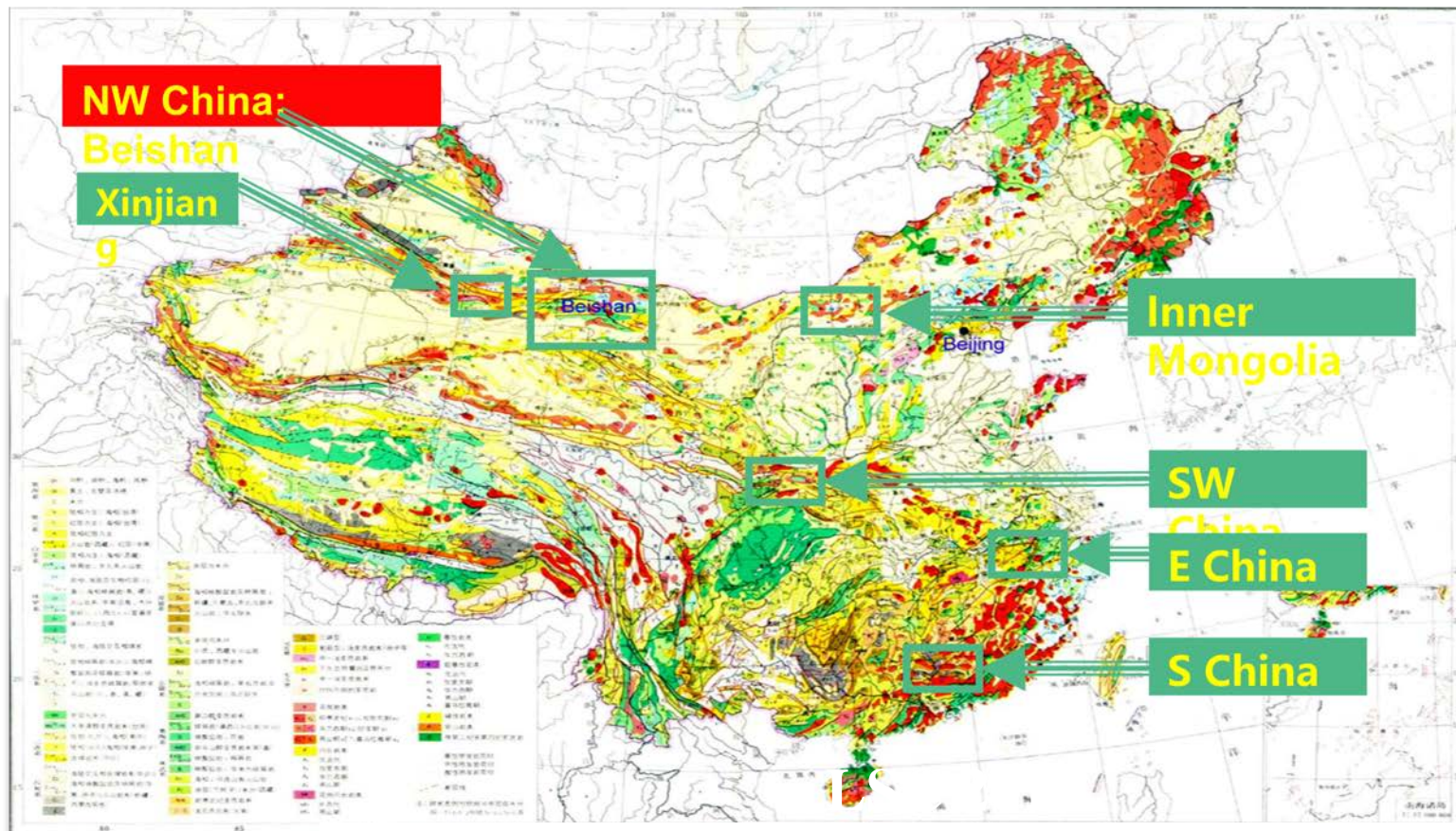
HLW Disposal in China

- ❖ **New Strategy:**
- ❖ **12 sites are selected and investigated again;**
- ❖ **comparison of the 12 sites, in terms of including human activities, transportation, environmental protection, land use, social impact and public acceptance, geology, hydrogeology, future changes, geochemistry, engineering and construction conditions;**
- ❖ **3 sites has been selected for pre-safety assessment;**
- ❖ **finally one site will be selected for the repository;**
- ❖ **The host rock includes granite and clay.**



6 regions selected for repository

1 - South China; 2 - East China; 3 - Southwest China;
4 - Inner Mongolia; 5 - Xinjiang; 6- NW China — Beishan area



Application of LSC Techniques

- ❖ **Safety Assessment for the potential geologic repository needs many data;**
- ❖ **The migration of radionuclides in groundwater systems, the migration of radionuclides in surface soils, the transfer of radionuclides in ecosystems...;**
- ❖ **To understand the migration of radionuclides in groundwater systems, it is very important to understand the behaviors of some key radionuclides;**



Application of LSC Techniques

- ❖ **Tracing method is a powerful technique to obtain the groundwater flow field;**
- ❖ **Radionuclides ^3H , ^{36}Cl , ^{99}Tc can be used as tracers at very low concentrations;**
- ❖ **The accurate determination of the concentration of these radionuclides needs badly the LSC technique;**
- ❖ **This LSC technique to determine the low concentration of β emitting radionuclides actually will be widely used in China in the area of environmental Radiochemistry in the following 20 years.**

Research Activities at PKU

- ❖ **Diffusion of Radionuclides in Beishan Granite;**
- ❖ **Molecular Dynamics Modeling of Uranyl Ions on the Clay/Water Interface;**
- ❖ **Development of Speciation Analysis Code, CHEMSPEC;**
- ❖ **Synthesis of Uranyl Crystals;**
- ❖ **Redox Behavior of Radionuclides in Beishan Groundwater.**

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THANK YOU!

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