

Area-specific URL for geological disposal in China

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- **URL in the world**
- **The concept of area-specific URL**
- **The strategy to develop China's URL by 2020**

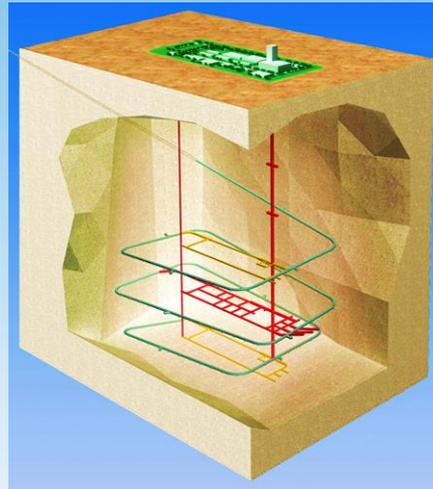


URL is developed for disposal Tech.

site

URL

repository



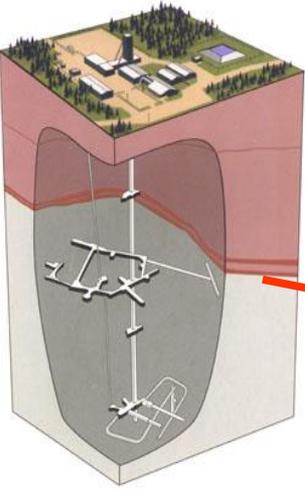
URL is a must step in repository development



France: Bure, Tournemire
Belgium: Mol
Germany: Gorleben
Czech: Josef

Åspö (Sweden)

Sweden



Stripa (Sweden)
Project completed

Korea: KURT



Canada



USA



Kamaishi (Japan)

**Japan:
Kamaishi, Tono
Mizunami, Honorobe**



Grimsel
(Switzerland)

Switzerland



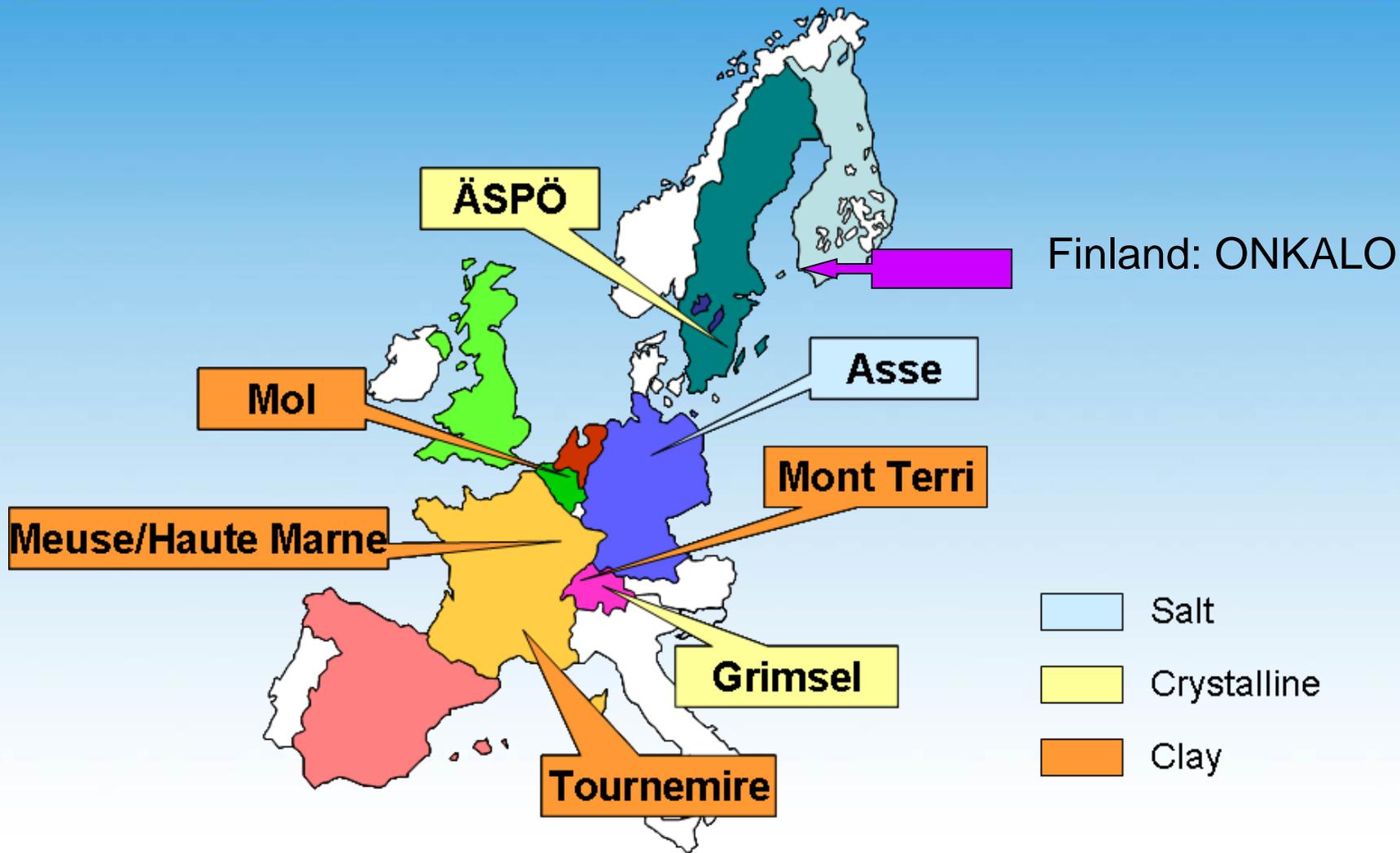
Mont Terri (Switzerland)



**China:
2020**

**26 URLs built in the world
for High-level Radioactive Waste Disposal**

URL in Europe



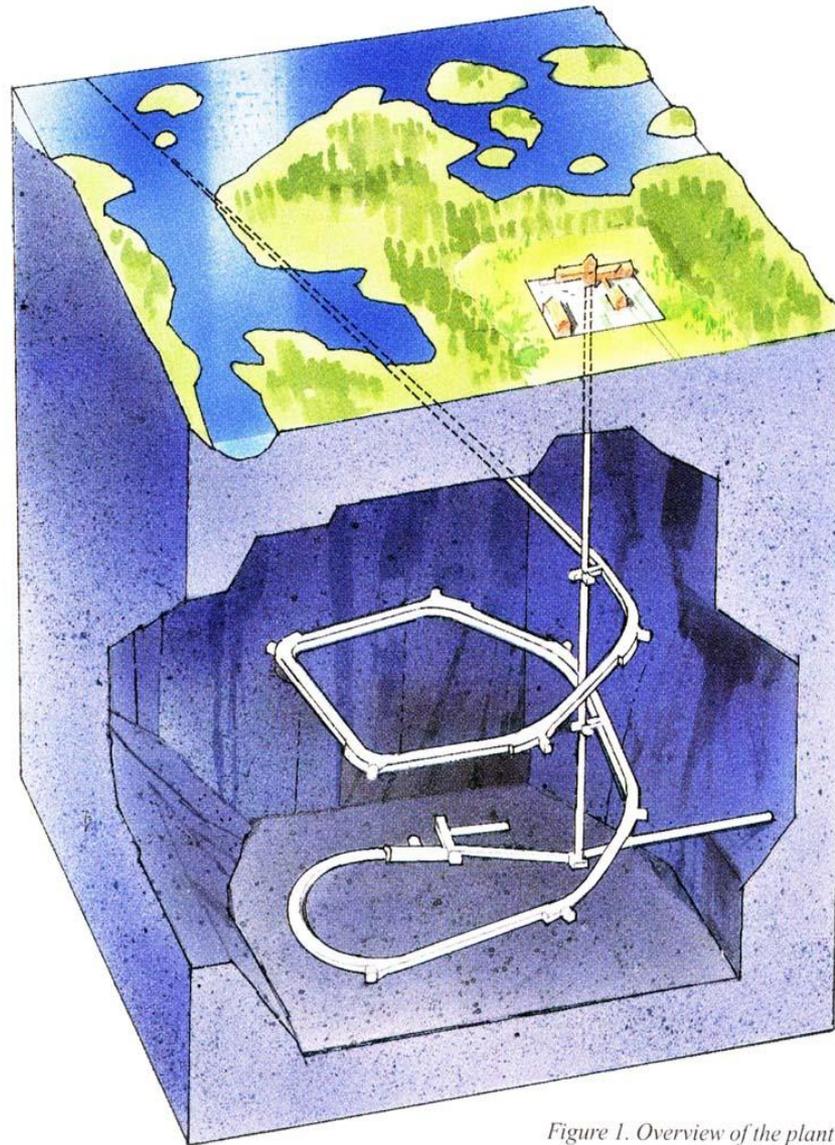


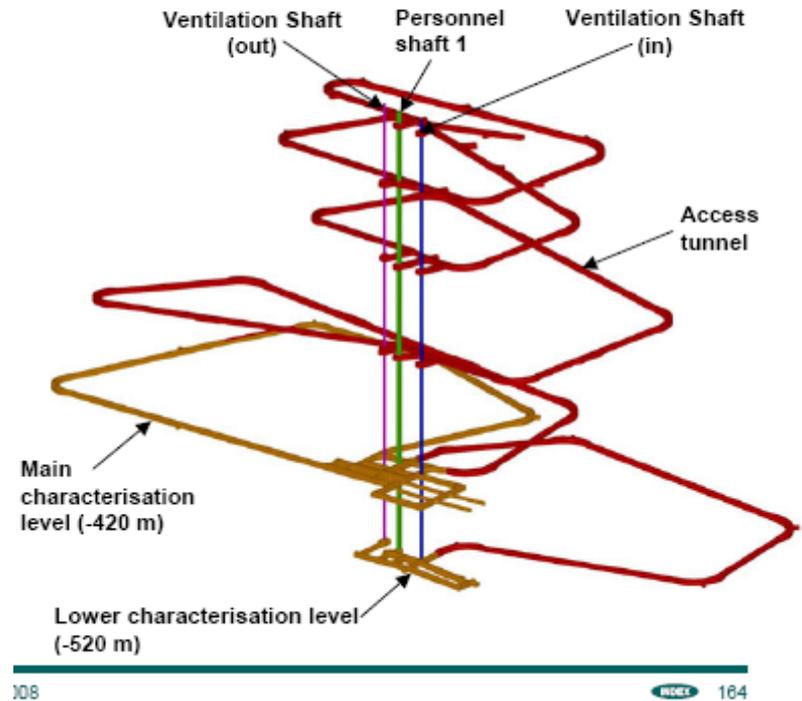
Figure 1. Overview of the plant layout.

Aspo hard rock laboratory in Sweden (from SKB)

ONKALO layout and technical information

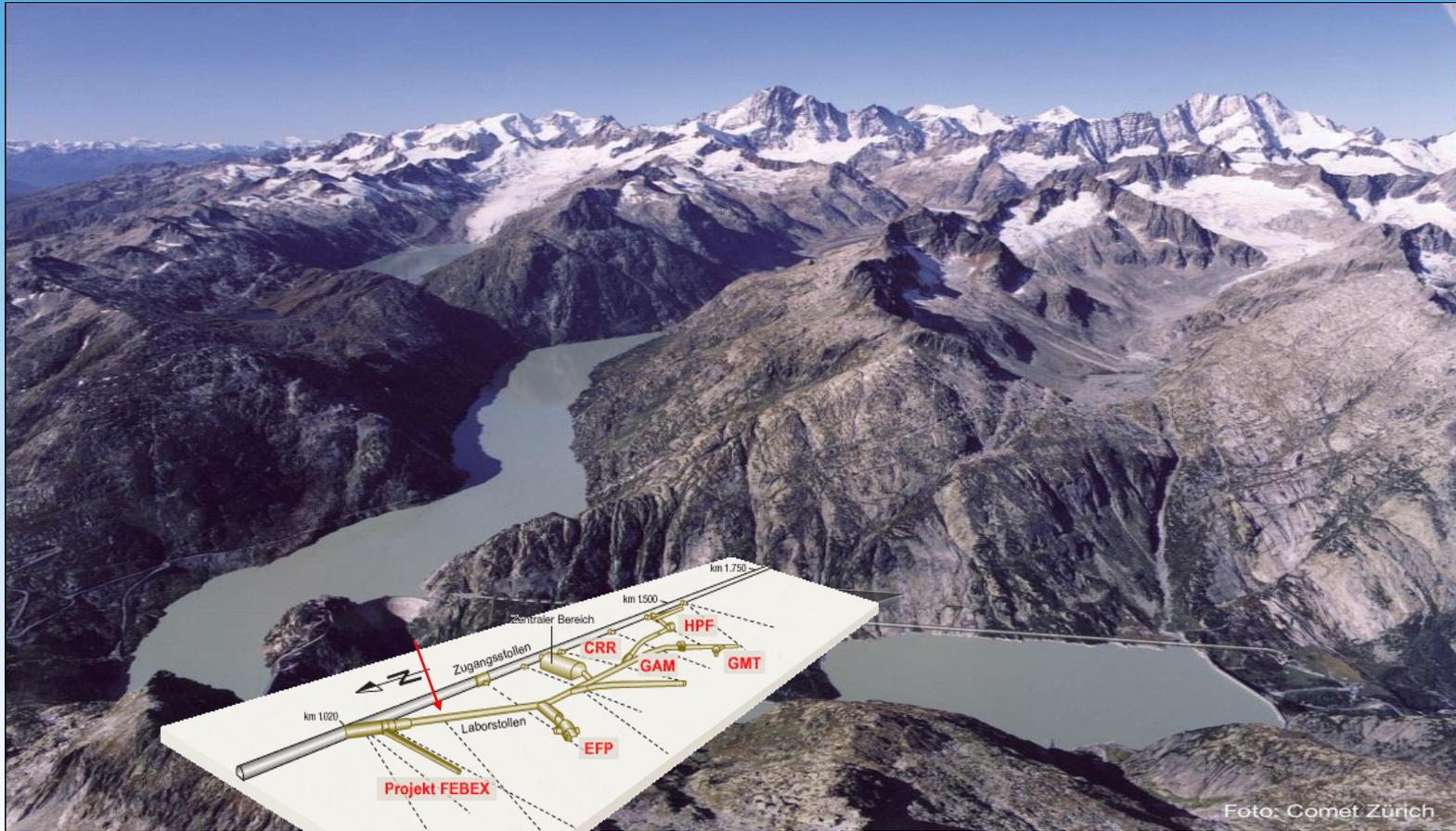
TECHNICAL INFORMATION

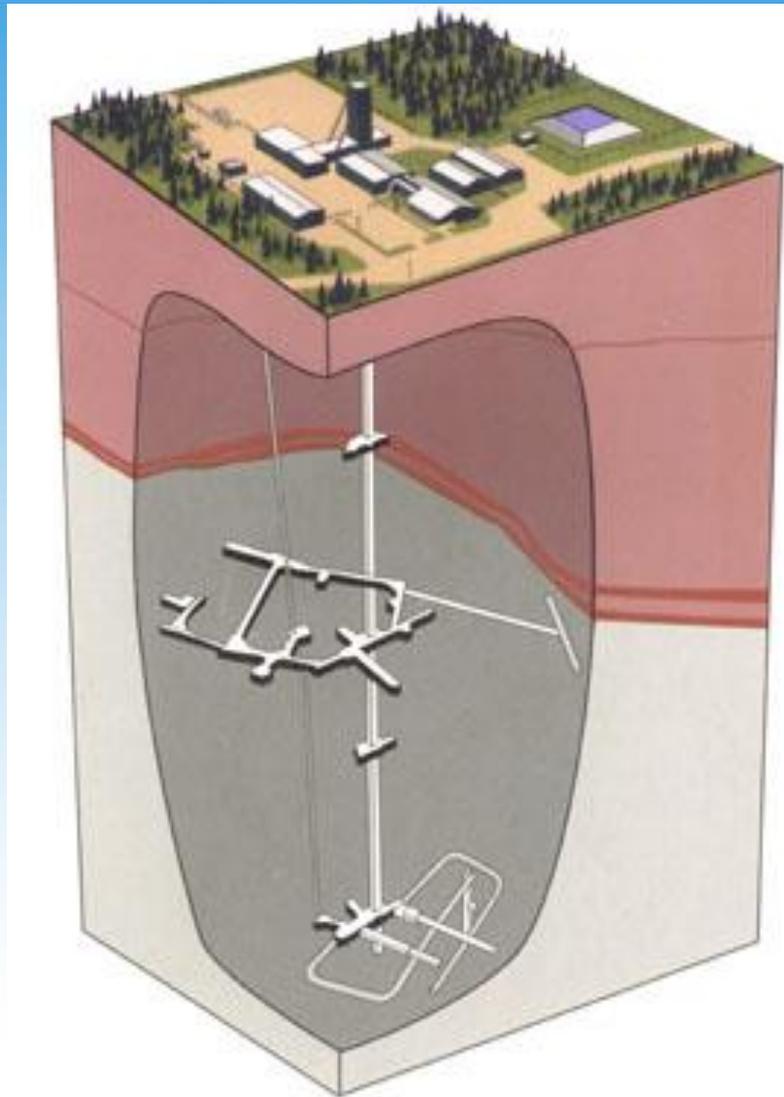
- Excavation volume
365,000 m³
- Access tunnel
 - Length 5.5 km
 - Inclination 1:10
 - Size 5.5 x 6.3 m



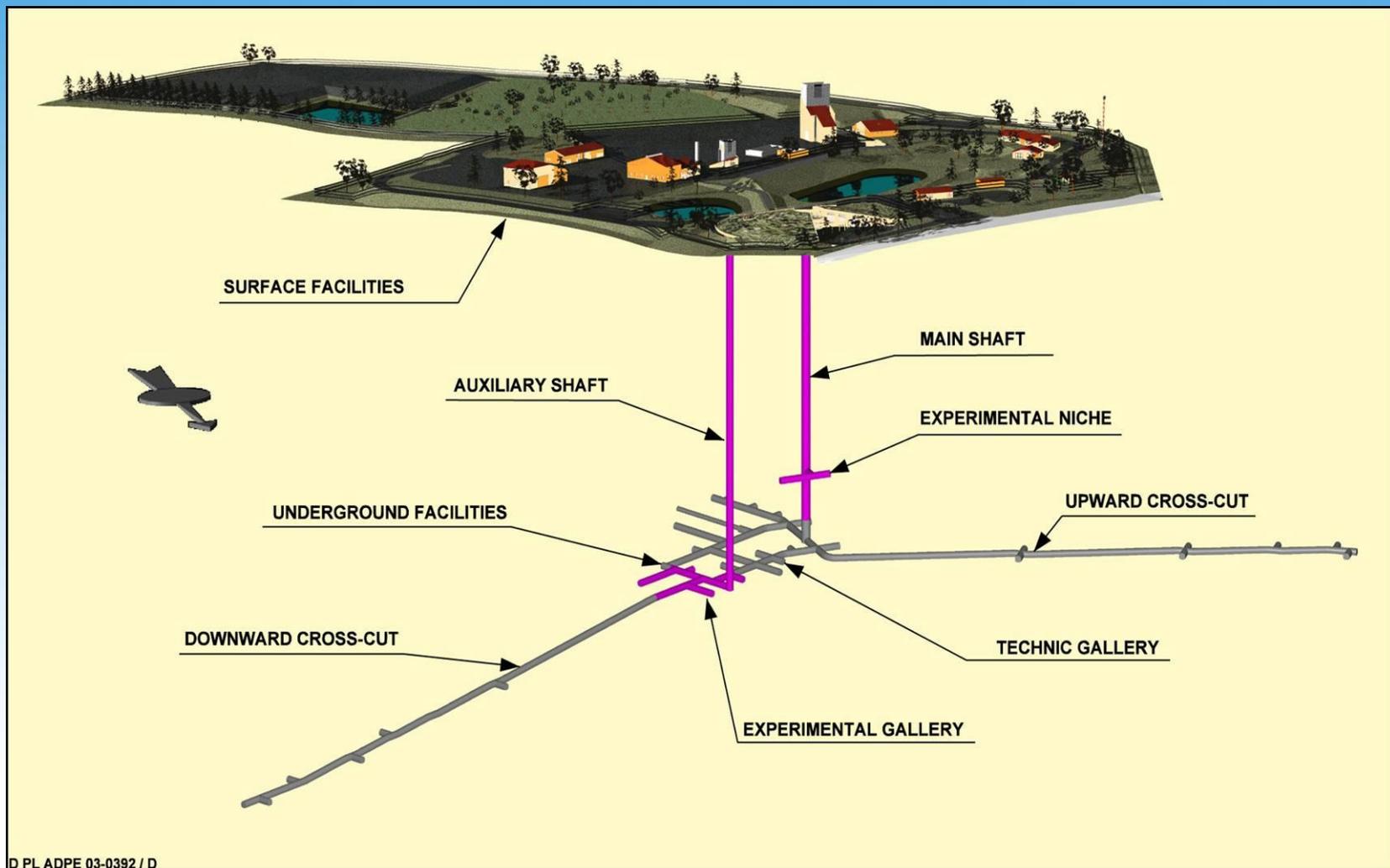
108

INDEX 164



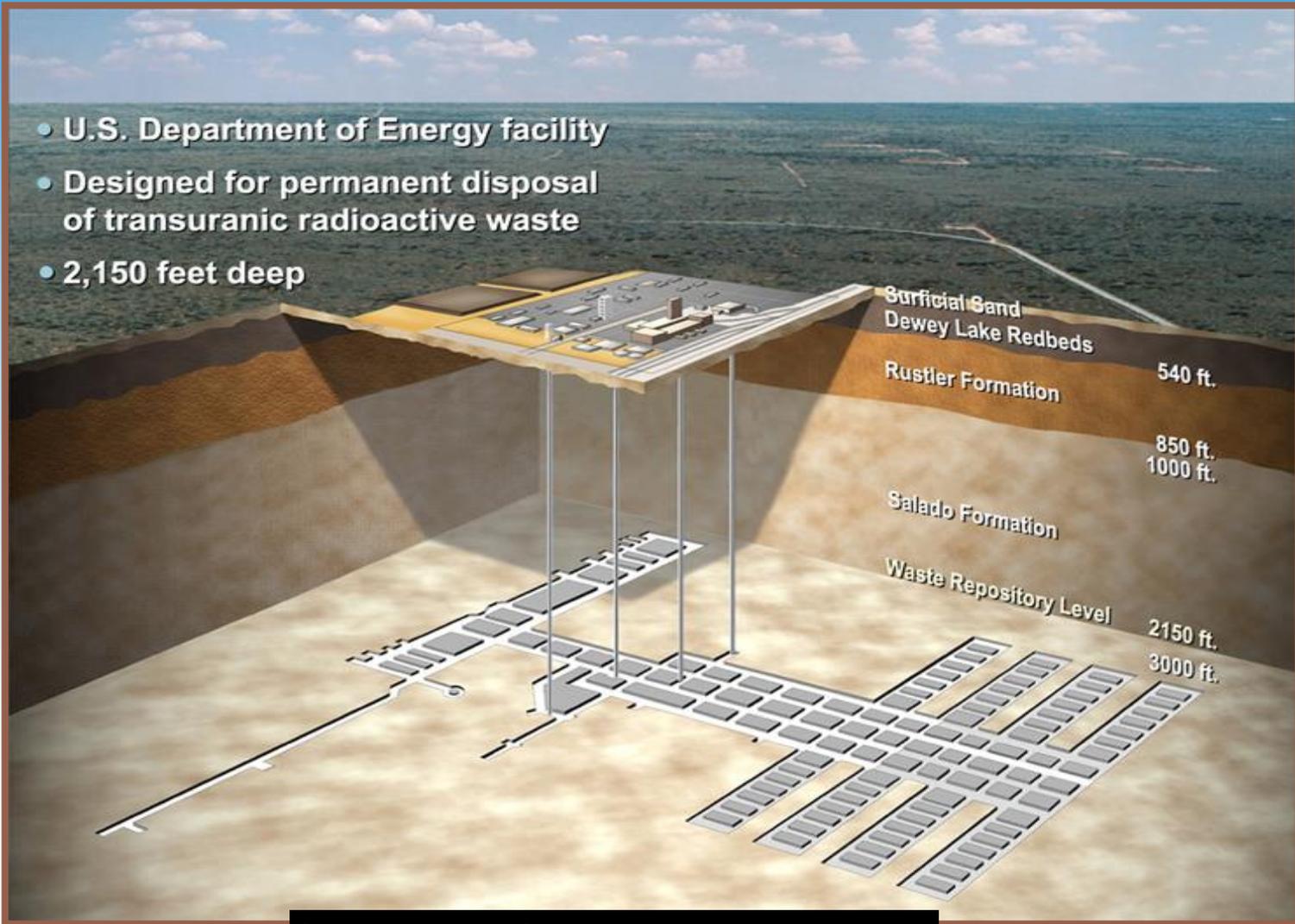


URL in Canada



The BURE URL in France (from ANDRA)

- U.S. Department of Energy facility
- Designed for permanent disposal of transuranic radioactive waste
- 2,150 feet deep



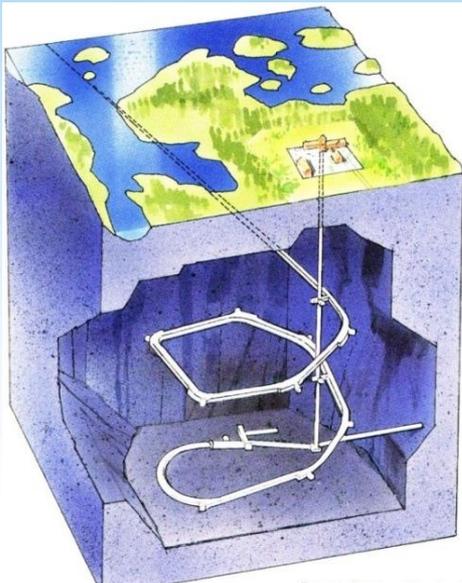
Cutaway View of Subsurface Layout, WIPP Facility

WIPP in USA: host rock: salt

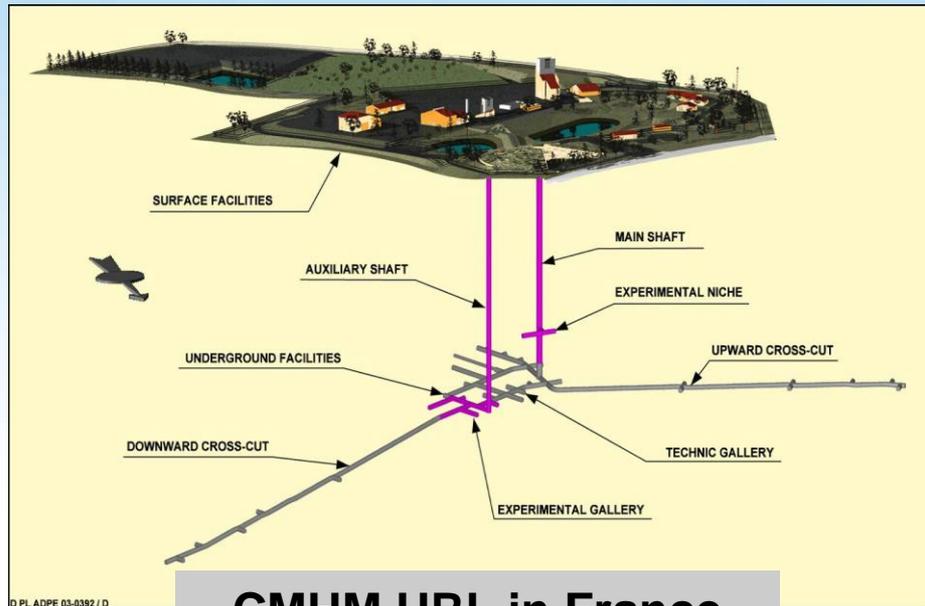
Divided into two classes:

- **Generic URLs:** ASPO, Grismel, Mont Terri, Tournemire...
- **Site-specific URLs:** Meuse/Haute-Marne, ESF, ONKALO.....

no clear line between these two classes.



ASPO URL in Sweden



CMHM URL in France

- Located in various types of host rock, including:
 - **Granite:** Sweden, Finland, Switzerland, India, Japan....
 - **Clay rock:** France, Belgium, Switzerland, Japan
 - **Salt rock:** Germany
 - **Tuff:** USA

Which is the favorable type for repository project?

Not a question with unique answer!



What type of URL in China?

3 options:

- Generic URL?
- Site specific URL?
- An URL between? (or 3rd generation URL)



Option 1: Generic URL

- 1) If a generic URL is constructed, it may not be costly, but will be convenient for scientists to work, for the public to visit.
- 2) However, the experiments in such URL may only be copies of those experiments conducted in other URLs, while the data obtained will only act as references for repository design and safety assessment.
- 3) Although a URL is built, but a site-specific URL must be built in the future repository site, which means such URL is not an appropriate option for China.



Option 2: site-specific URL

Considering the situation in China, it will not be soon for China to determine a final site for geological repository.

Without a site, then a site-specific URL cannot be constructed soon. Thus, this option will delay the establishment of China's URL.



a concept of

“Area-specific URL”

or the 3rd generation of URL



- **URL:** Built at a site within an area that is considered as a potential area for high level radioactive waste repository, or built at a place near the future repository site.
- It acts as a “generic URL”, but also act as a “site-specific URL” to somewhat.



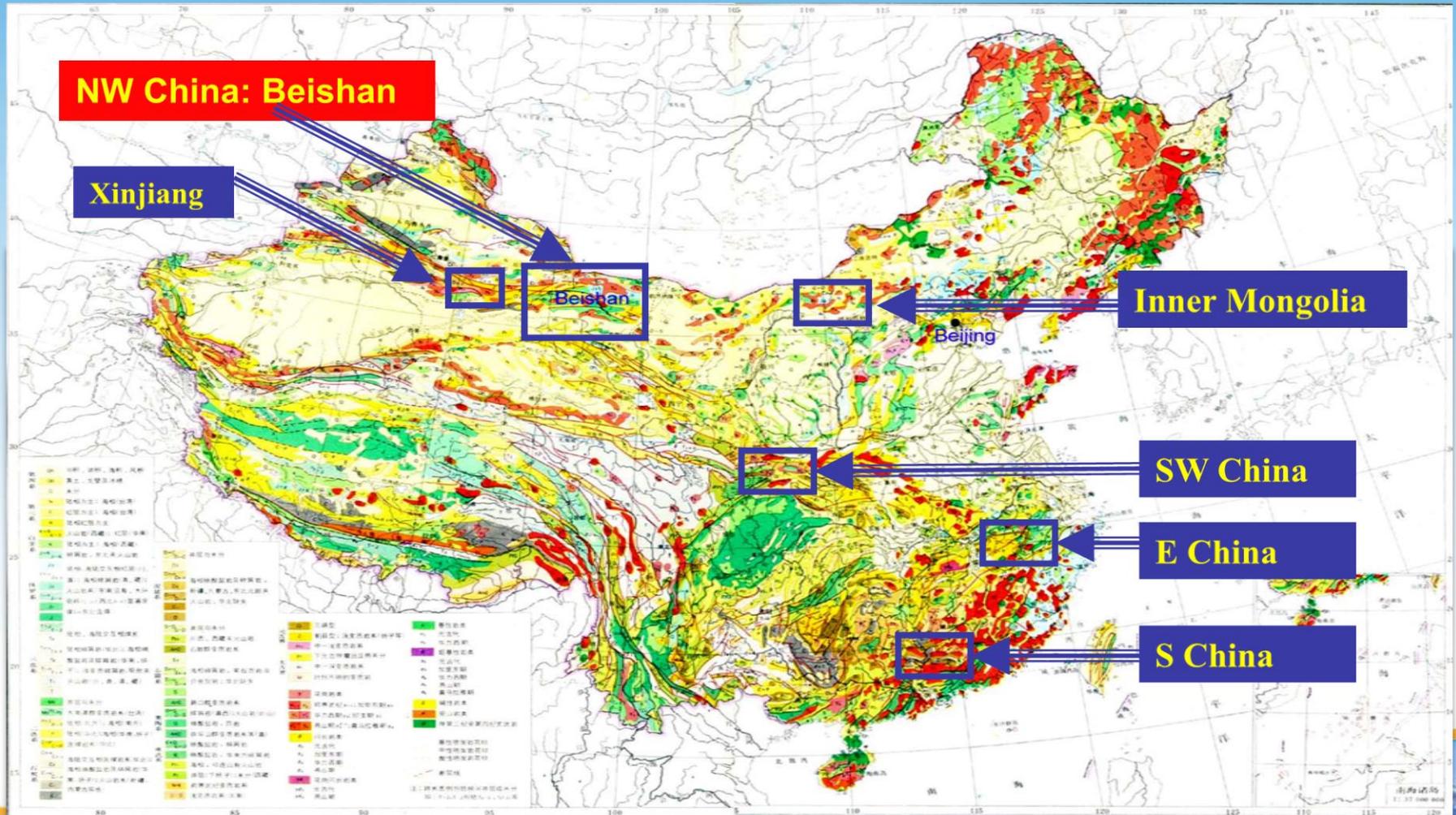
Where to built?

- **Beishan, Gansu,**
- **The first priority site for China's repository**

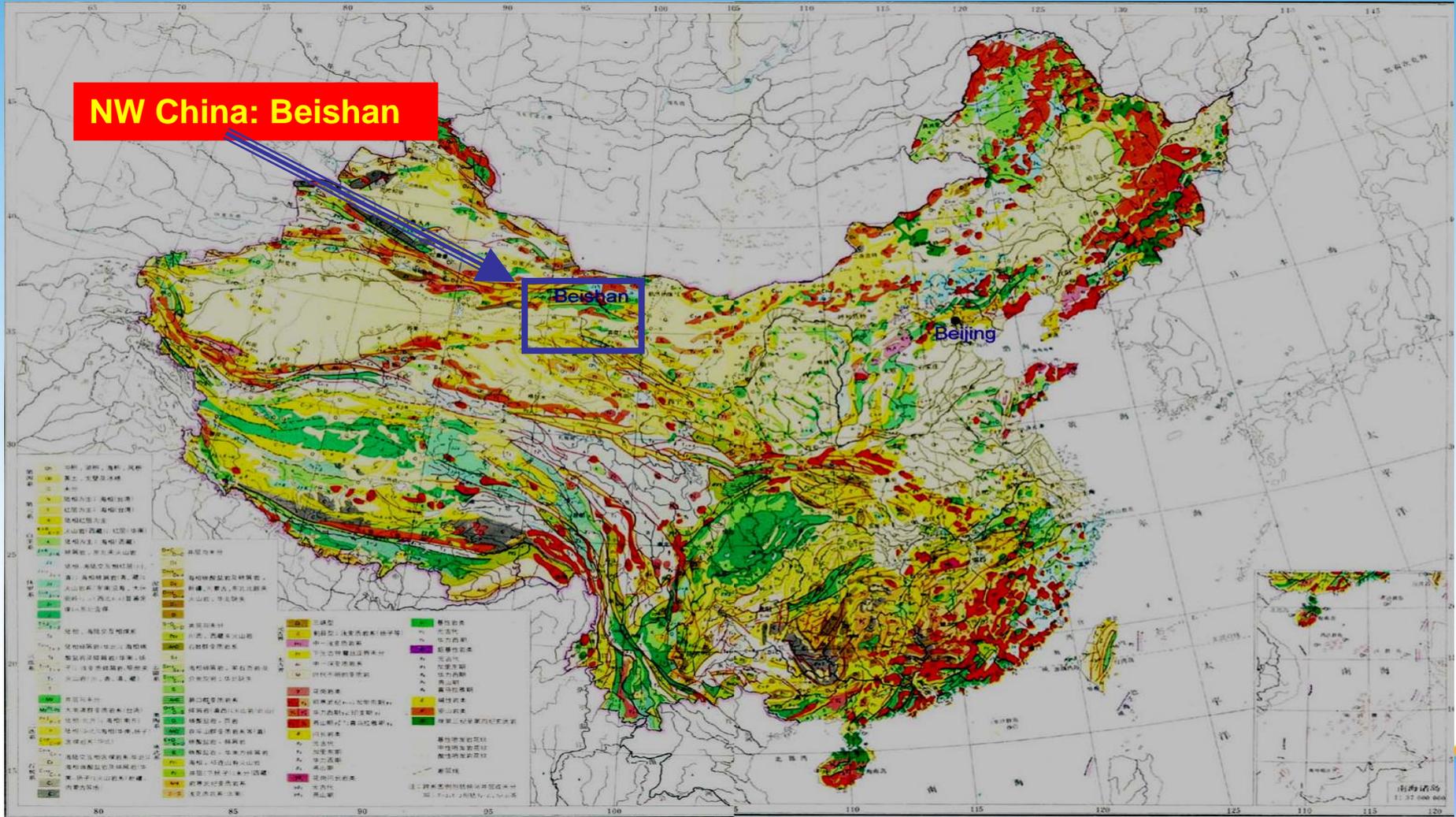


6 regions selected for repository

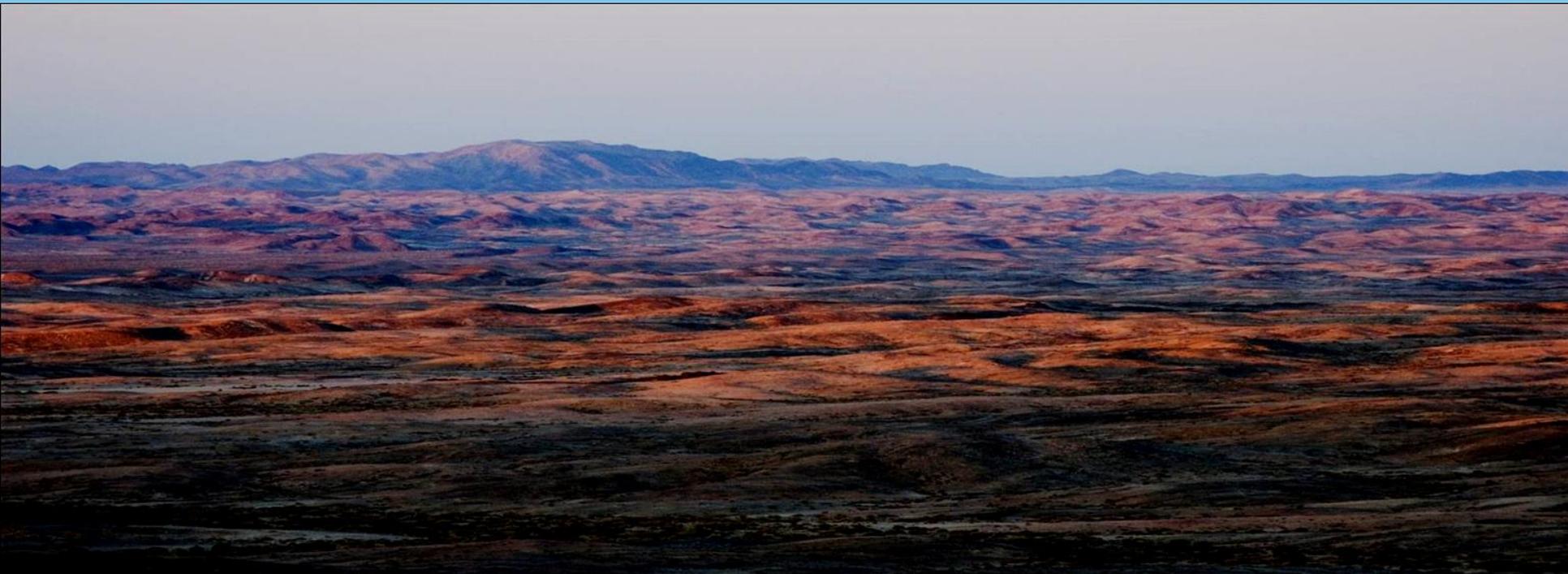
- 1- South China; 2- East China; 3- Southwest China
4- Inner mongolia; 5- Xinjiang; 6- NW China—Beishan area



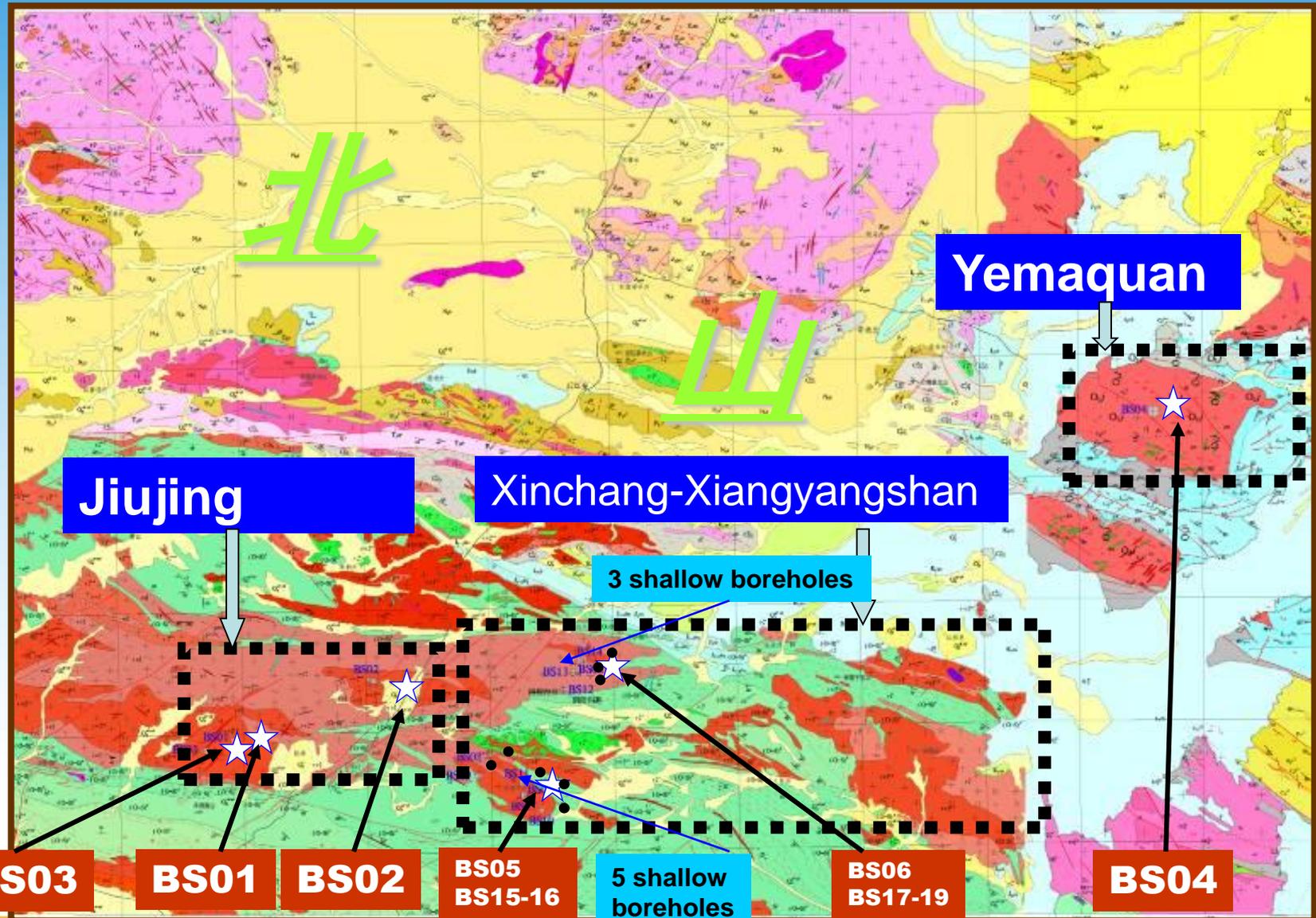
NW China's Beishan area has been selected as the most potential site



Beishan area



21 bore holes drilled in Beishan area since 2000

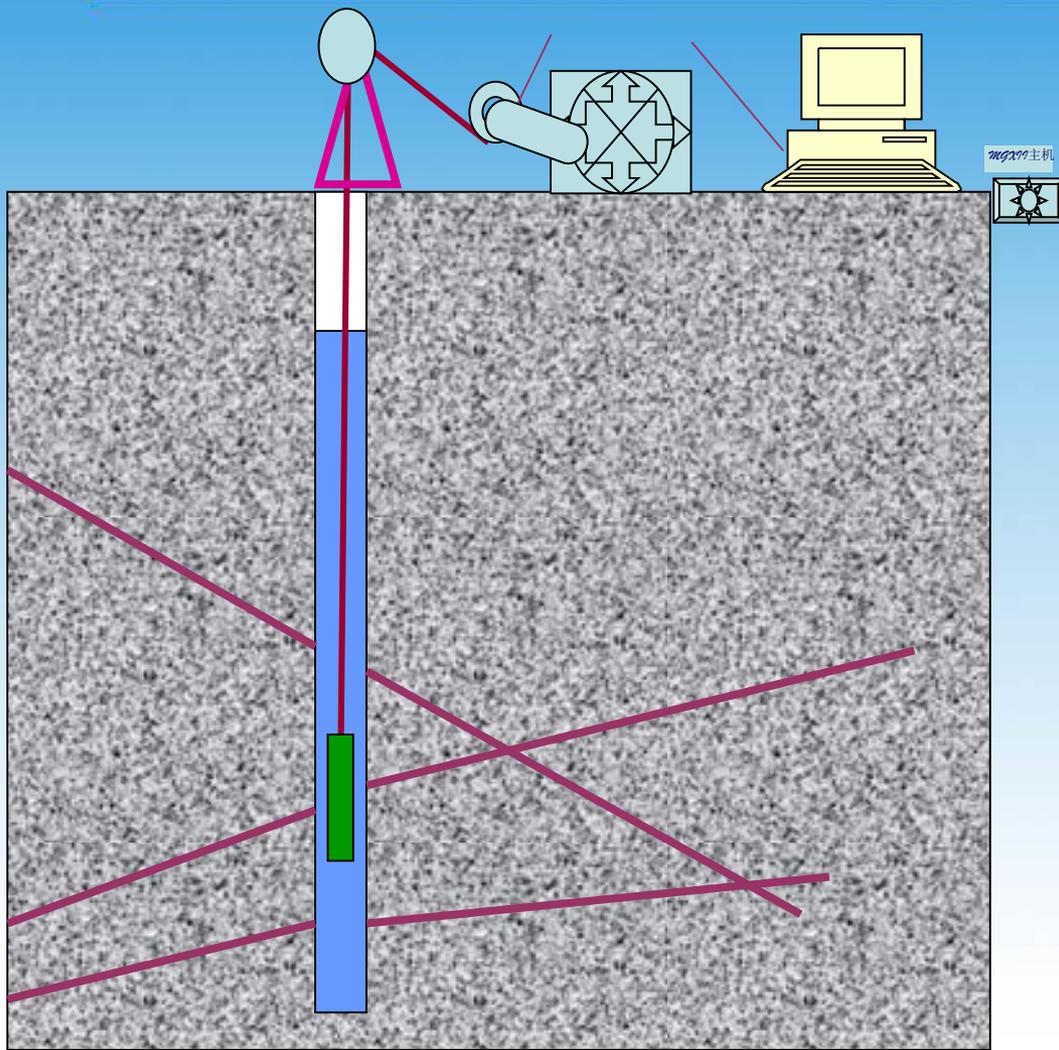


Drilling camp after snow, March 2011

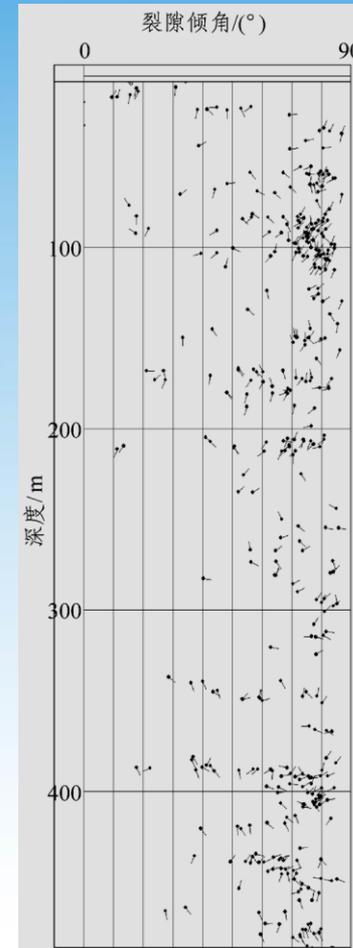
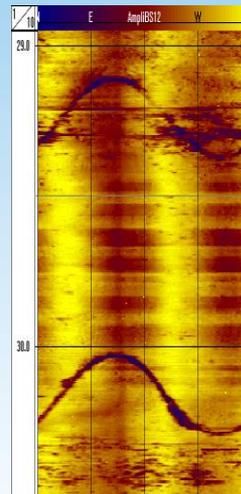


Core samples from BS16



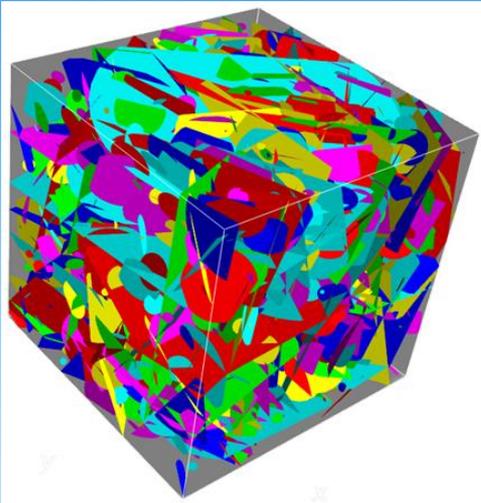


Acoustic borehole televiewer



裂隙随深度分布特征
Fractures Distribution with depth



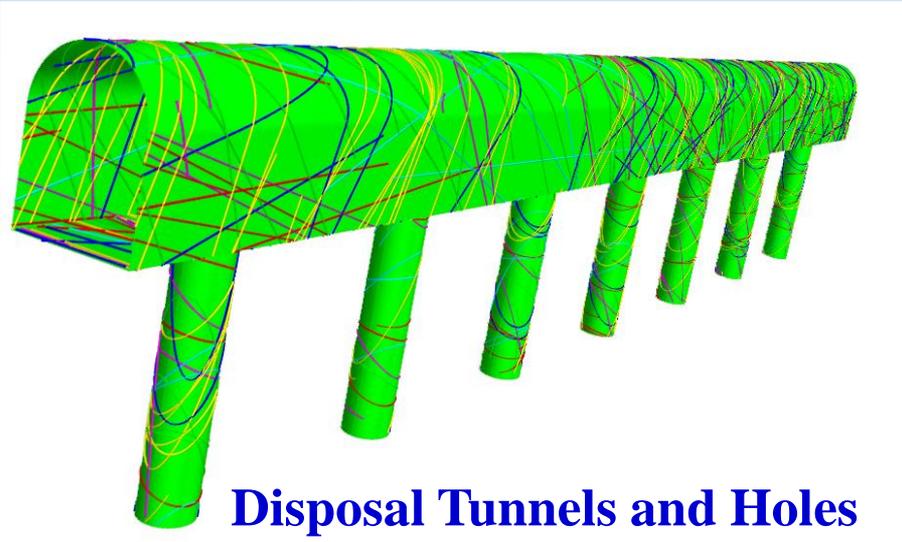
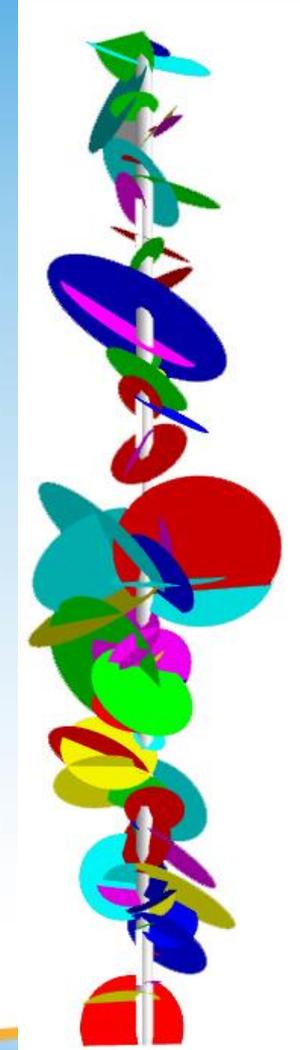


3D DFN



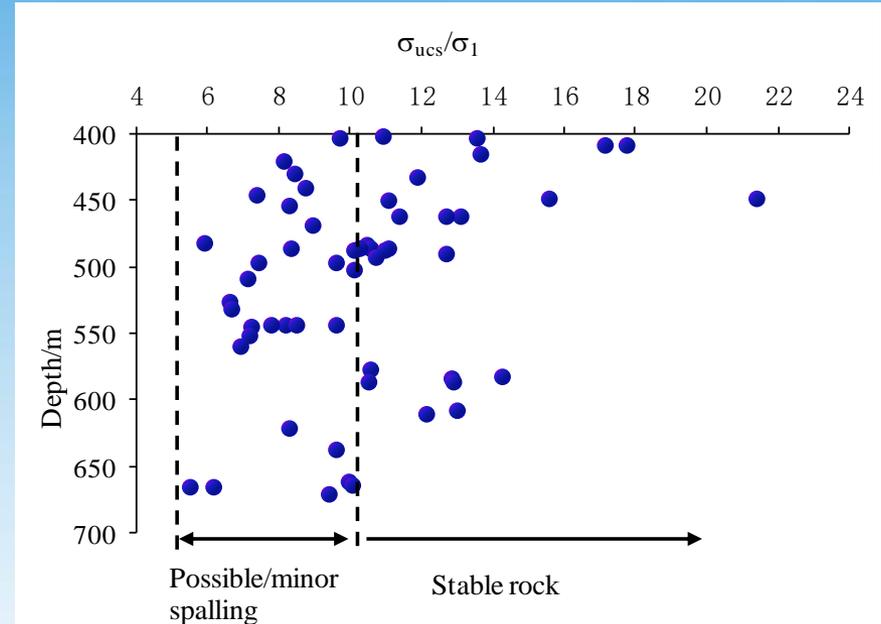
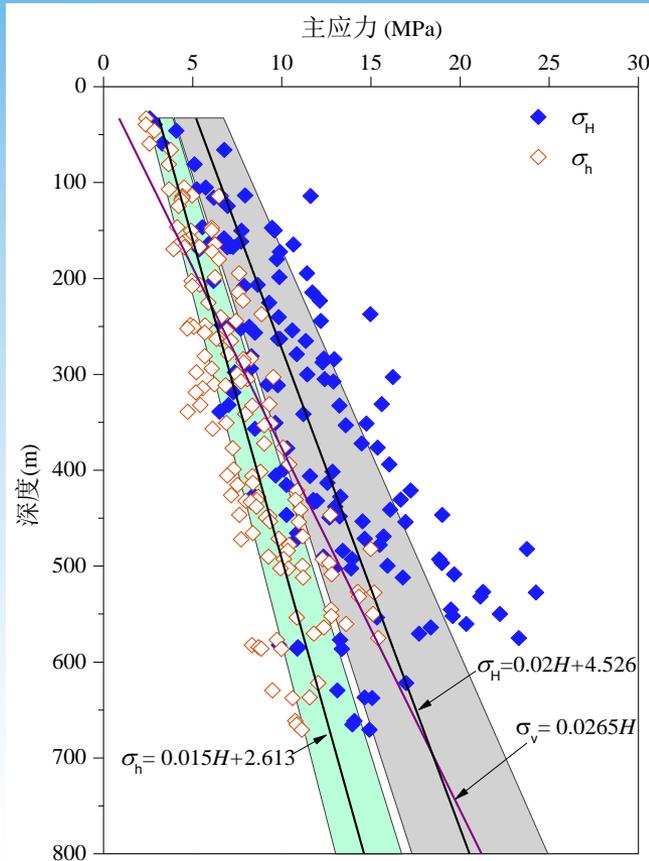
Trace display

Borehole modeling



Disposal Tunnels and Holes

Stress distribution in Beishan area

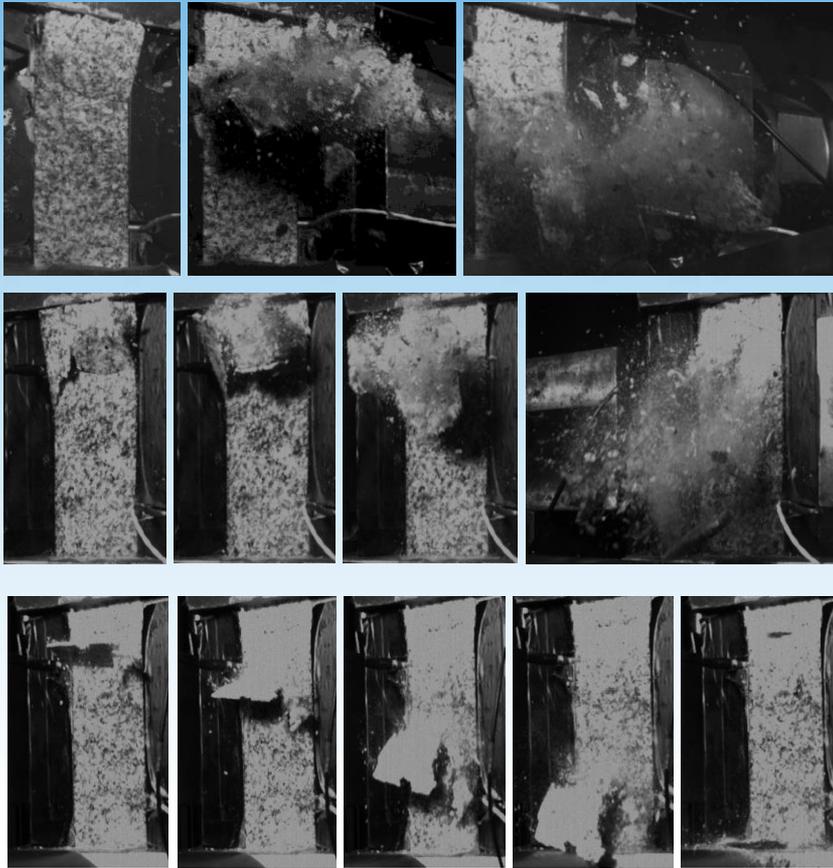


- ✓ The maximum stress is within 25MPa;
- ✓ Relatively low stress level;
- ✓ Ideal for construction.

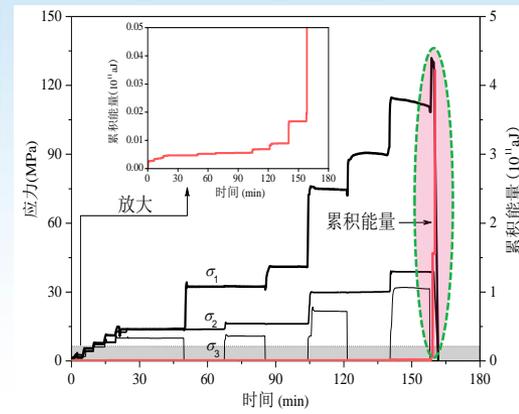
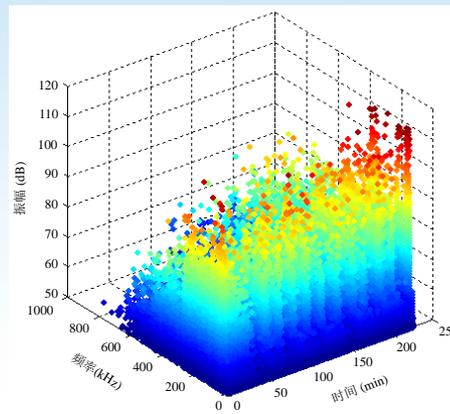
Zhao et al., Engineering Geology, 2013.



Research on rock burst proneness

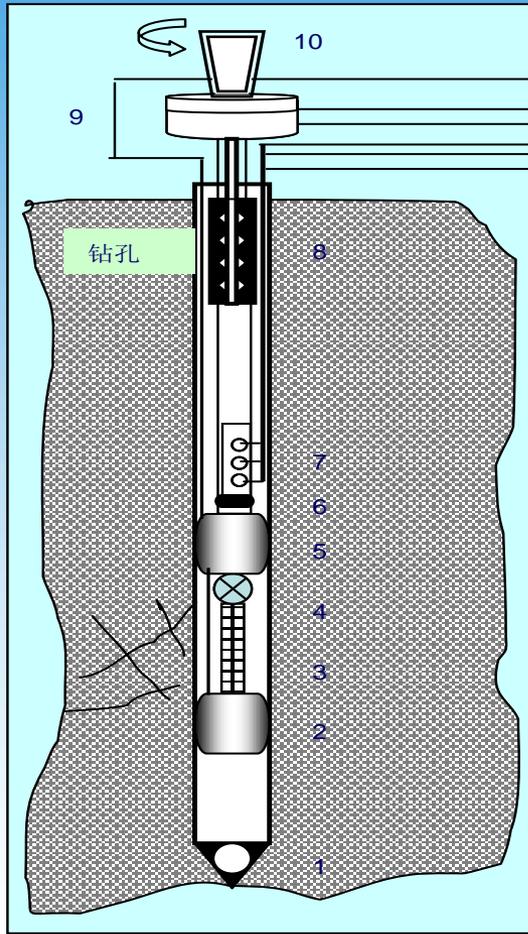


- Based on experimental studies, rockburst of underground excavations in Beishan region (400-600m) will not occur;
- Provides an experimental support for the safety evaluation of underground project.

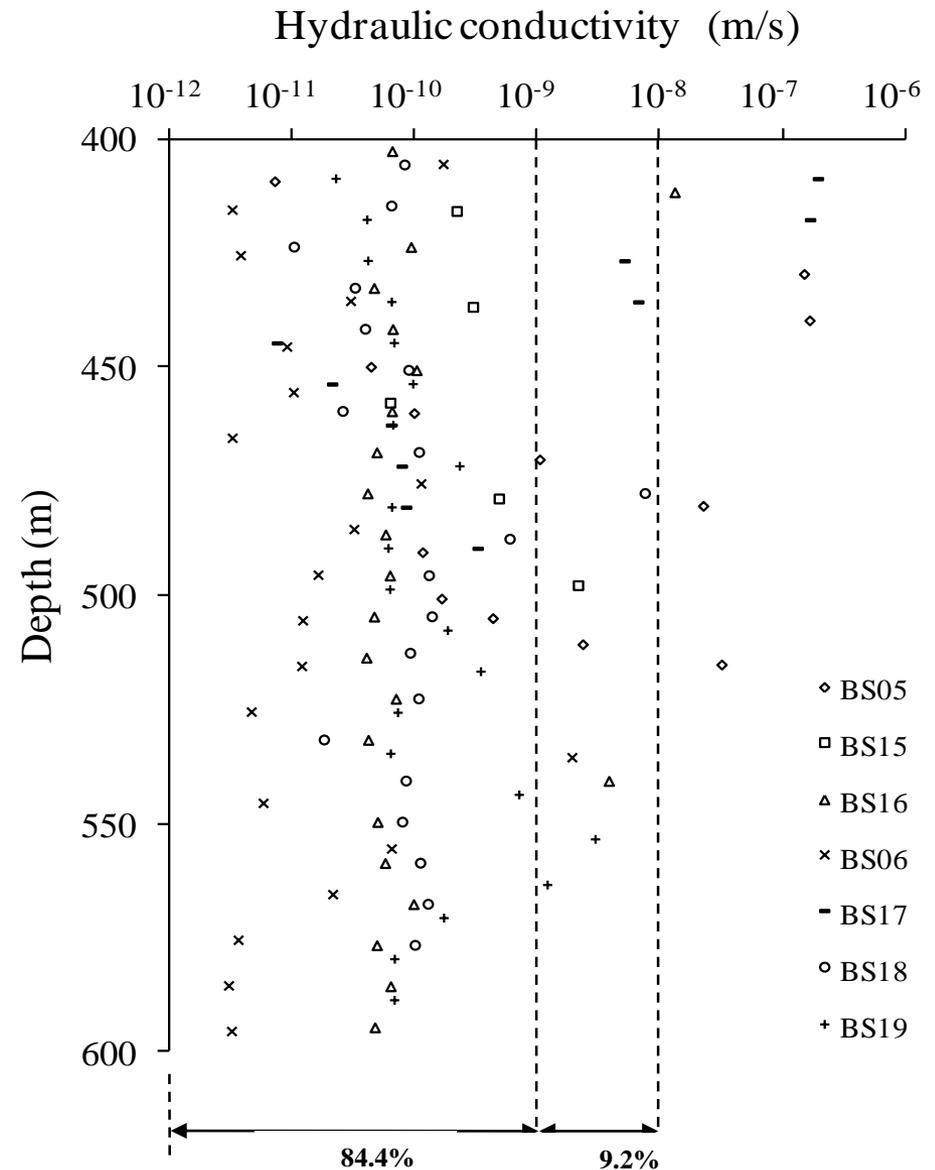


Characteristics

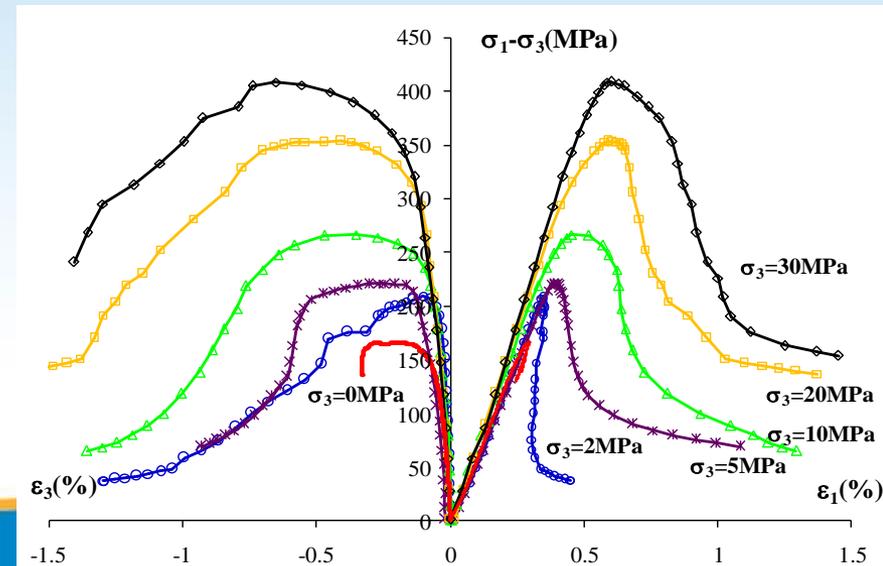
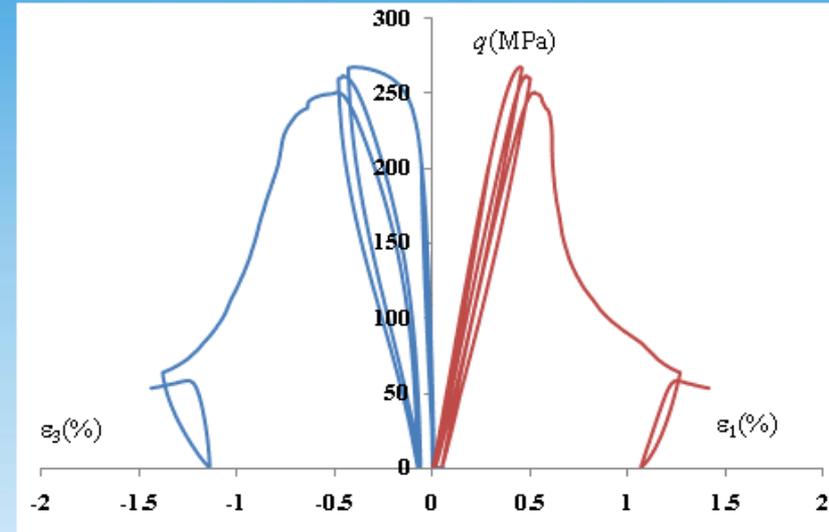
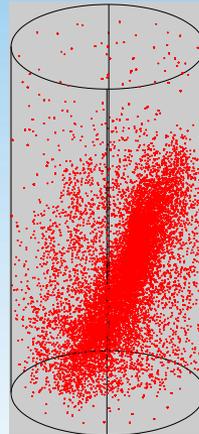




Double packer test system

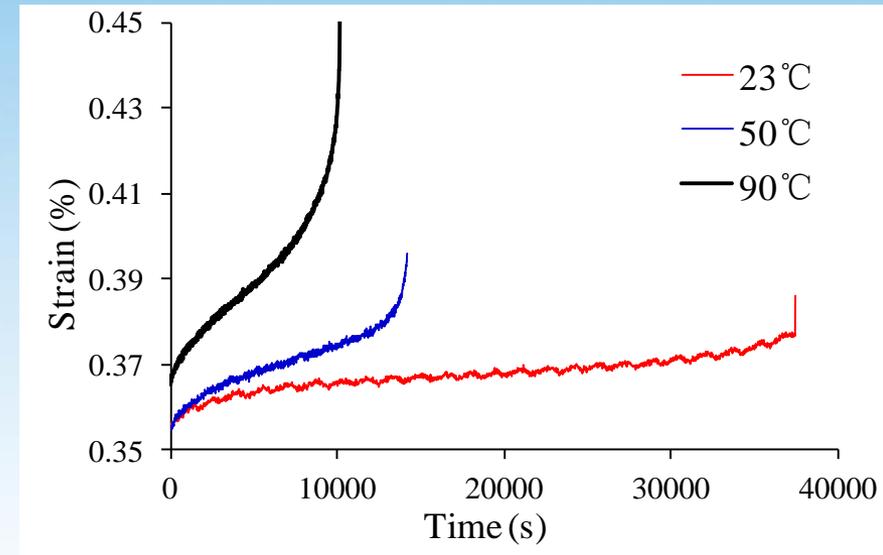
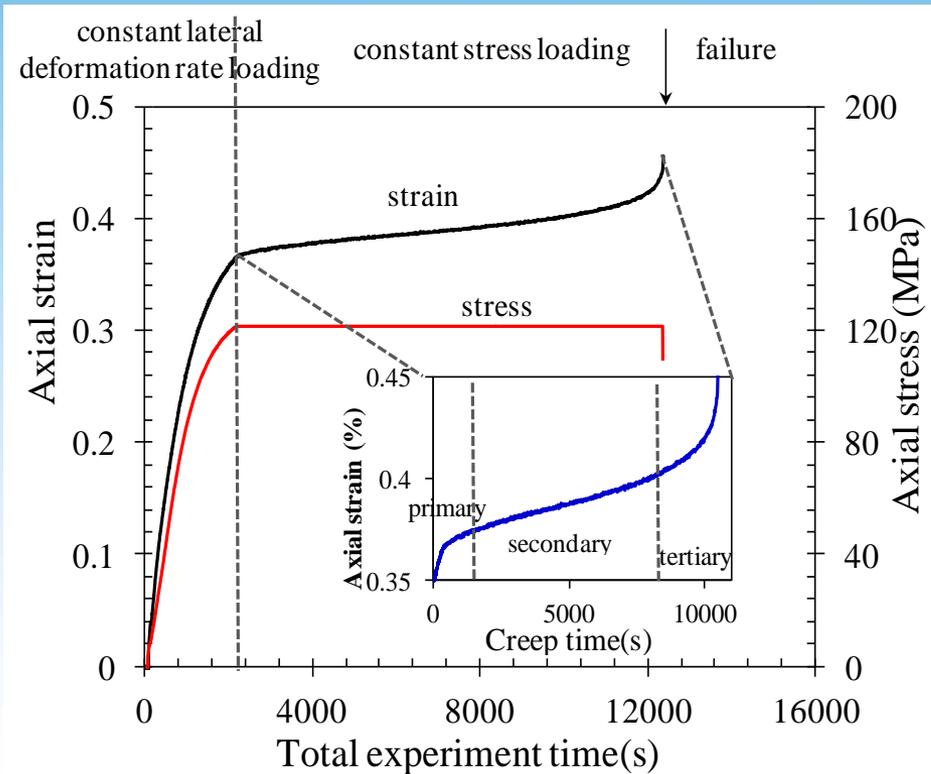


Uniaxial/triaxial compressive test



Chen et al., Int J Rock Mech & Min Sci, 2014;
Chen et al., J. Rock Mech. & Eng., 2011&2012.
Zhao et al., Int J Rock Mech & Min Sci, 2013.

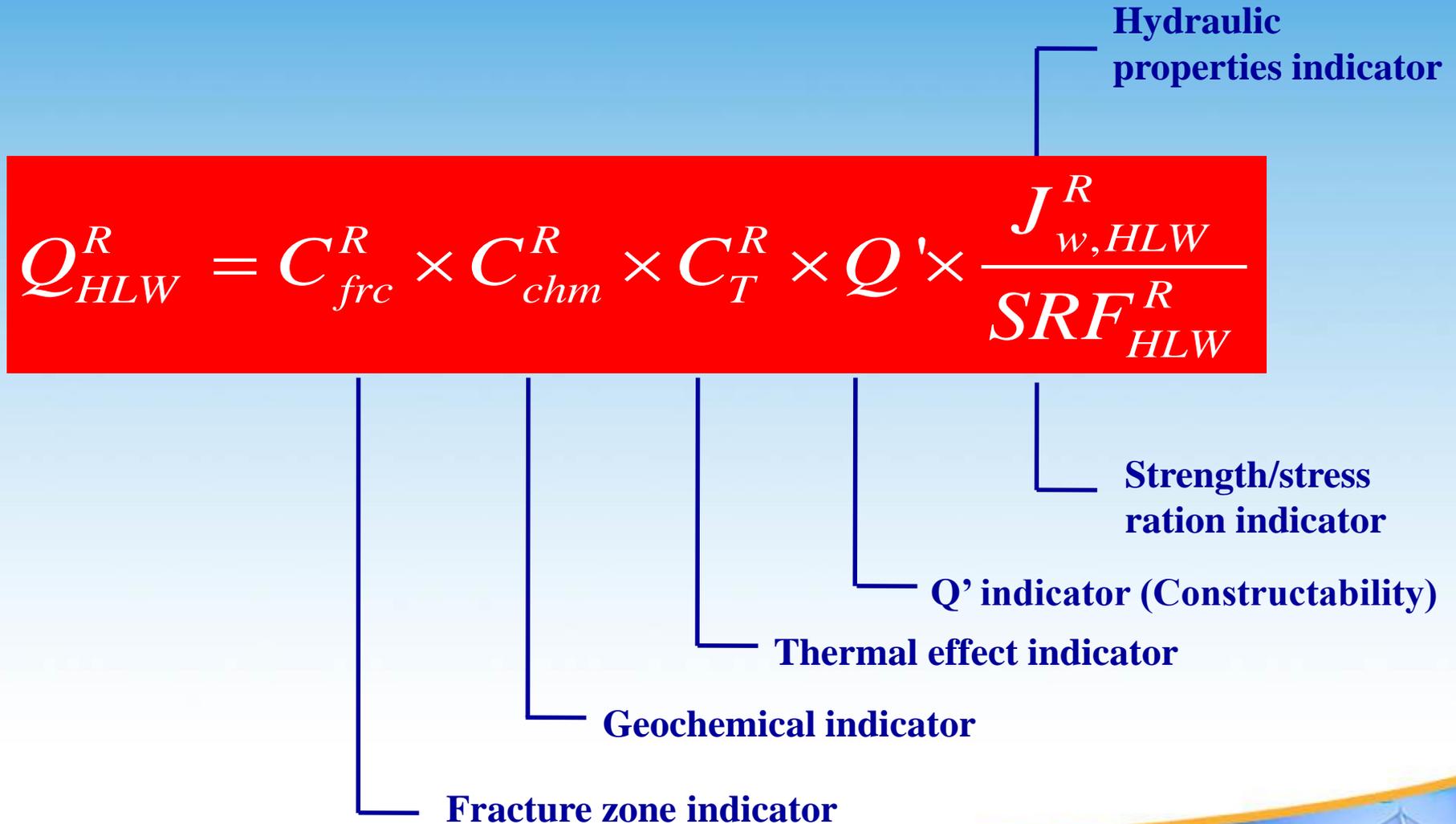
Time-dependent behavior of Beishan granite

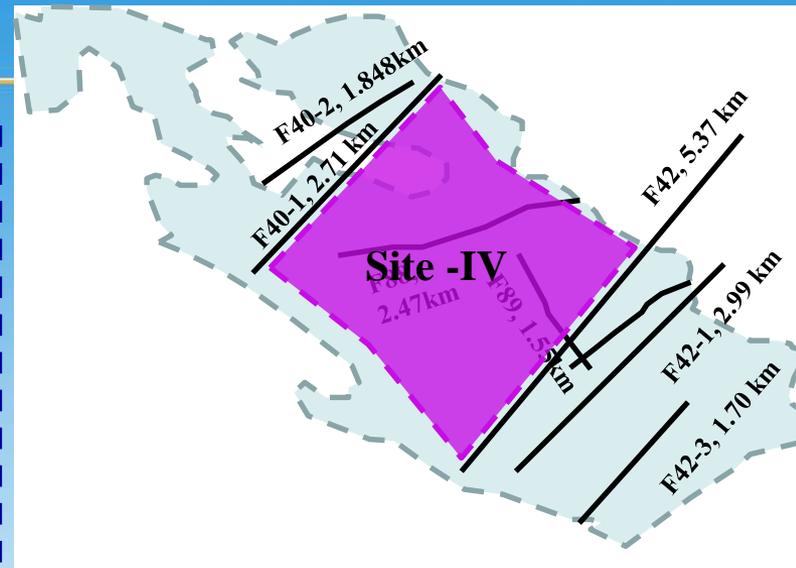
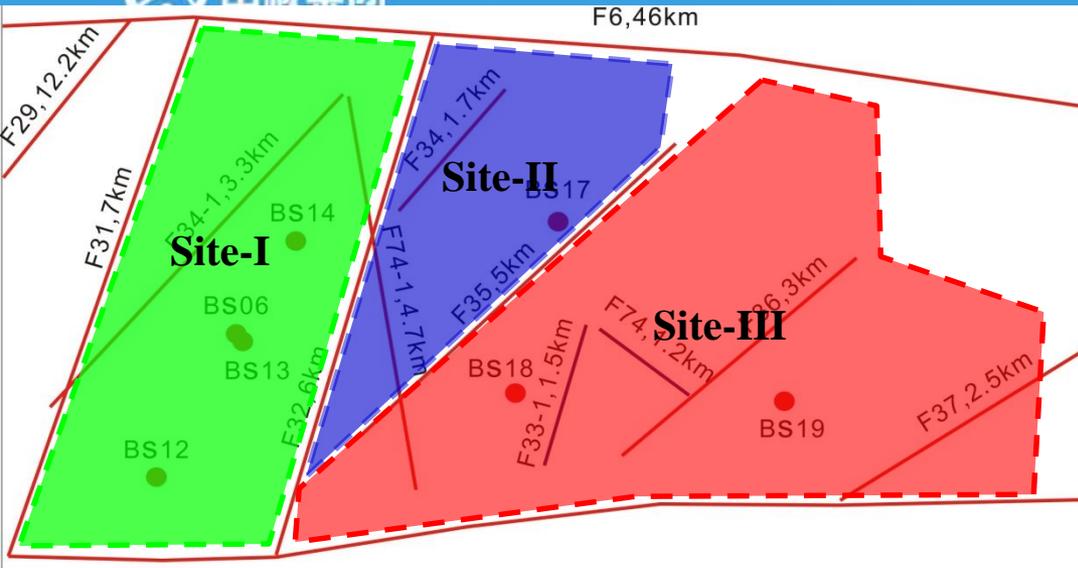


Lin et al., Int .J. Rock Mech. & Min. Sci., 2009.

Chen et al., Mech. Res. Commun. , 2014.







- located in Northwestern China's Gobi desert area
- low population density
- low precipitation : 60--80 mm/a
- high evaporation: 2900-3200 mm/a
- no economical prospect
- no important mineral resources
- convenient transportation
- stable crust
- favorable hydrogeological conditions
- favorable host rock: granite and diorite

**the most potential
area for China's
HLW repository**



Planning of URL in China



An URL.....

- Located at 500m-700m in depth;
- “Area-specific URL” (Wang, 2010)
- Large-sized, and with complete functions,
- Expandable,
- International level,
- Open for International cooperation



● Basic functions:

- Characterization of deep geological environment;
- Implementation of full-scale tests;
- Technology development;
- Demonstration of the disposal technologies;
- International cooperation and Staff training;
- Public acceptance.

● and probably:

- Provide parameters for the repository design, safety assessment,
- **Become a part of the final repository.....**

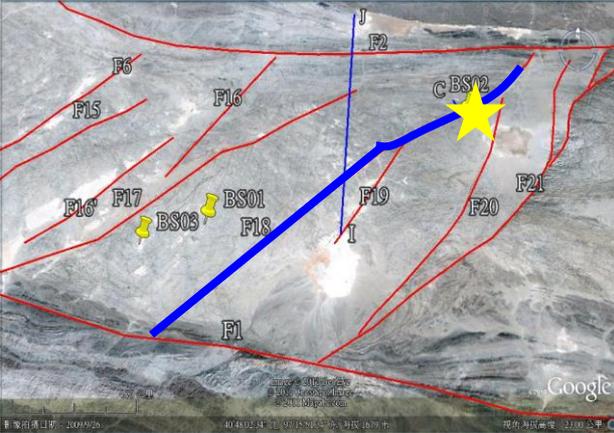


Program I: Basic theoretic and technologic studies

- Design and construction technologies
- Measurement techniques of key parameters
- Security controlling system
- Long-term stability analysis



Underground research facility (-50m)



Ventilation hole

Fracture zone

ramp

Experimental gallery

Experimental gallery

Small scale fracture zone

试验硐室
水仓

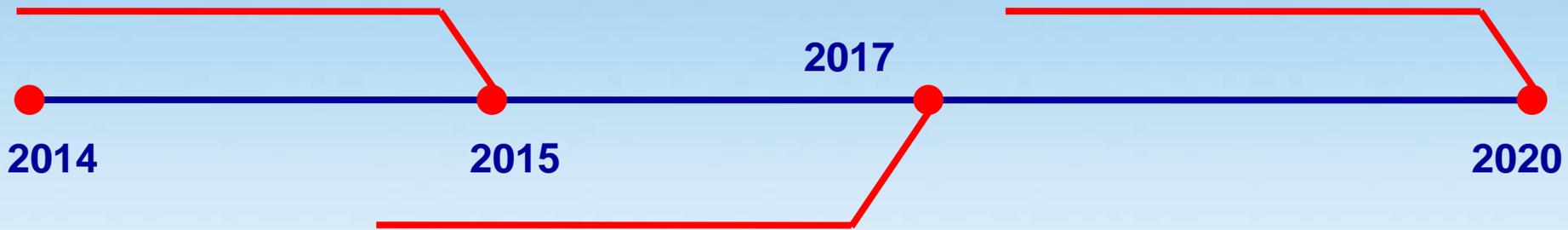


Program I: Basic theoretic and technologic studies

- Design and construction technologies
- Measurement techniques of key parameters
- Security controlling system
- Long-term stability analysis

Program III: URL construction

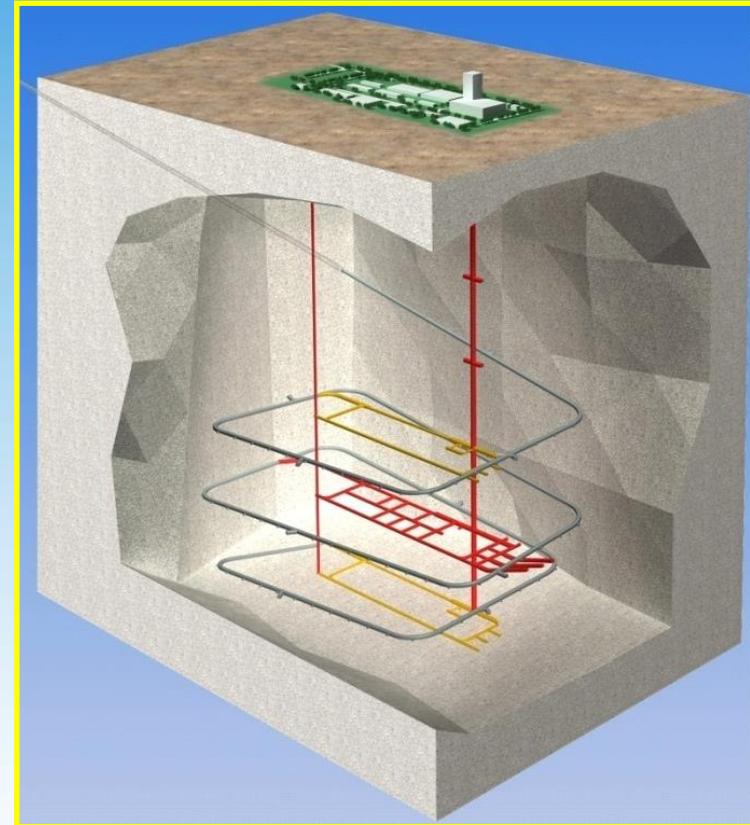
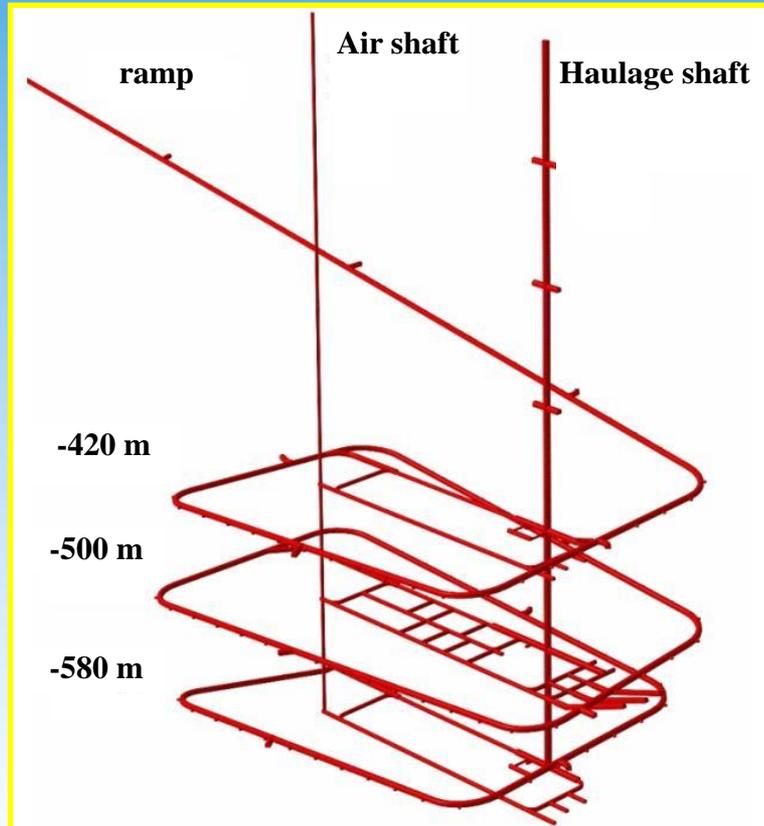
- Surface facilities
- Shaft and access galleries
- Experimental galleries
- Other subsidiary systems



Program II: Pre-studies of URL

- Site selection
- R&D planning in URL
- Structural layout and design
- Design of security controlling system
- Data acquisition and management system





Proposed conceptual design- V

Long-distance ramp and vertical shaft



- The R&D activities will be carried out stage-by-stage
- For the first stage, the attention will be focused on:
 - Investigation of deep geological environment
 - Characterization of host rock
 - Excavation methods
 - Testing of long-term performance of buffer material
 - Data acquisition and management system
- In the future:
 - Nuclide migration tests;
 - Demonstration of disposal technologies
 -



Beishan...





Thanks for your attention !



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