ISRM

THE FUTURE OF ROCK MECHANICS

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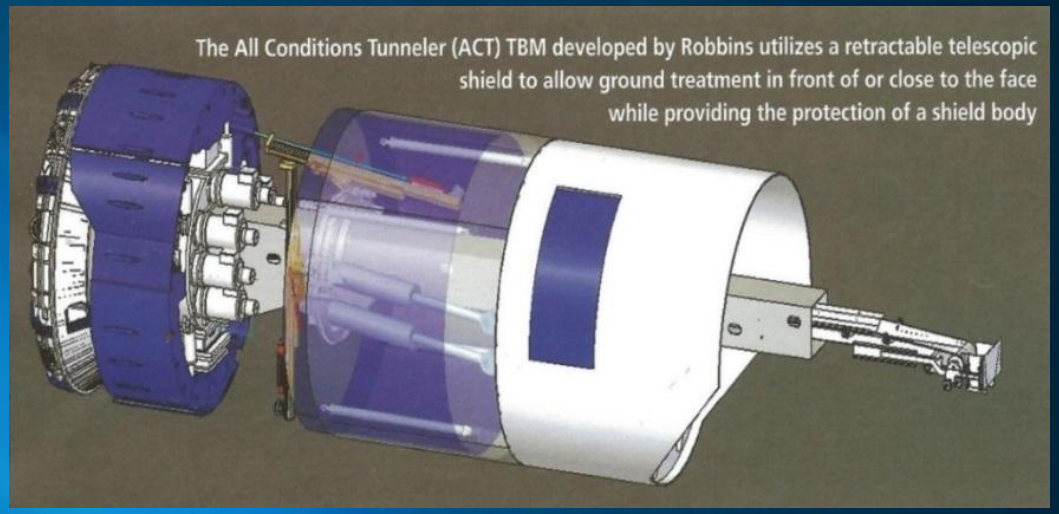
CHALLENGE AREAS IN ROCK MECHANICS & ROCK ENGINEERING

- Urban projects - transport tunneling, roads, underground parking, flood water gallery …
- Large scale ground & underground projects
- New technologies and innovations in rock excavation
- Geohazards due to anthropogenic intervention
- Landslides (rock slides, rock falls, mud flows, avalanches) in both urban and moutainous areas
- Deep excavation: ground mining, tunnelling, sea mining
- Clean energies

CHALLENGES
New technologies – Tunnelling

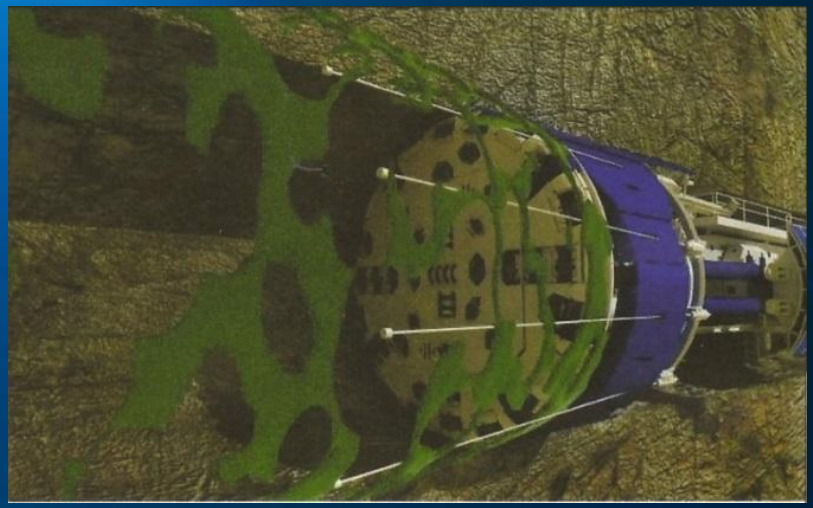
Improvements in TBM machines due to advances in mechanical/hydraulic/ electronic engineering and heavy machinery



(ROBBINS (Willis, 2012

NOW ➡ Retractable telescopic shield to allow ground treatment in front or close to the face while providing the protection of a shield body

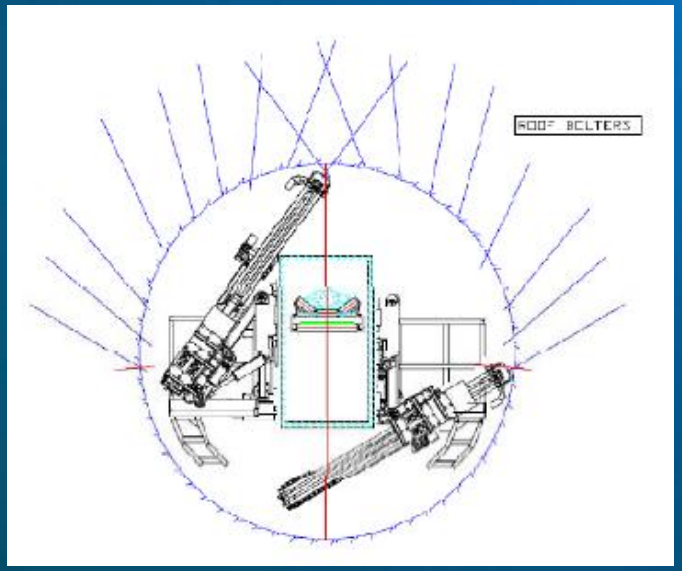
NEAR FUTURE ➡ Progress expected in operations and machine-innovations

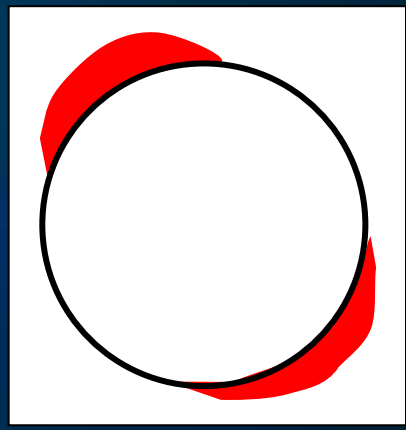


CHALLENGES
TBM tunnelling

- Rock sqeezing
- Rock burst
- Improvement of rock reinforcement
- Complicated geological conditions

Single shielded TBM jammed in squeezing ground (Ramoni 2012)





CHALLENGES
New technologies – Grouting

NEED ➡ more efficient pre-injection techniques for water sealing and ground stabilisation

NOW ➡ these needs are acknowledged by TBM manufacturers!

NEAR FUTURE ➡ High Progress is expected in this area (ROBBINS Willis, 2012).

CHALLENGES
Engineering & Natural Slopes

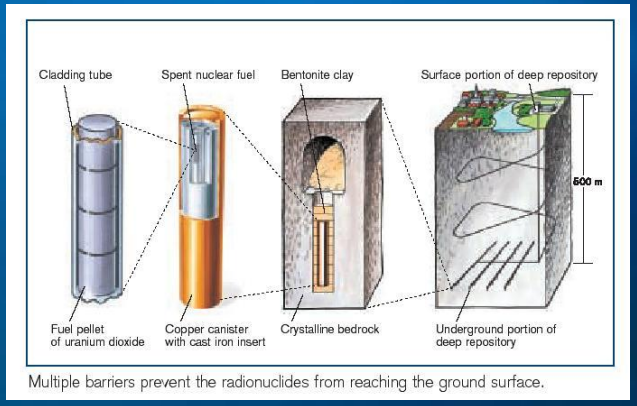
- Risk analysis
- Realistic modelling
- Intelligent monitoring technology

Mudflow in Rio de Janeiro, Brazil, 2011 – >500 deaths

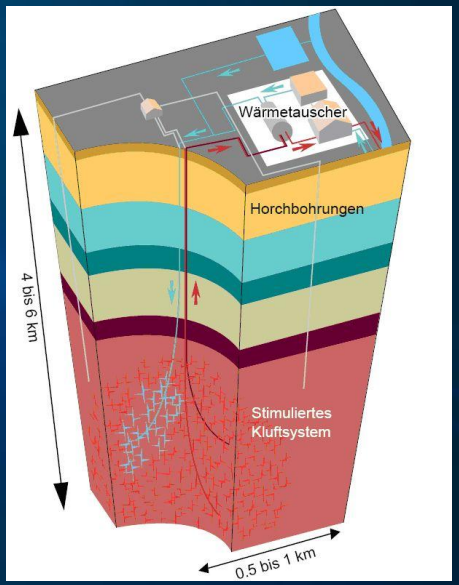
Landslides 24 June 2017 in Maoxian, China. 8 Mm3, > 1 km slide height, 2.5 km H-displ. > 120 deaths, 62 houses buried. Village built after 2008 Wenchun earthquake (8.2 Mn)

CHALLENGES
Clean Energies

- Hydropower: environmental issues, large caverns, water tunnels
- Nuclear power: radioactive waste repositories, underground plant
- Deep geothermal energy: drilling efficiency, drill bit life
- Storage of hydrocarbons
- Storage of CO2

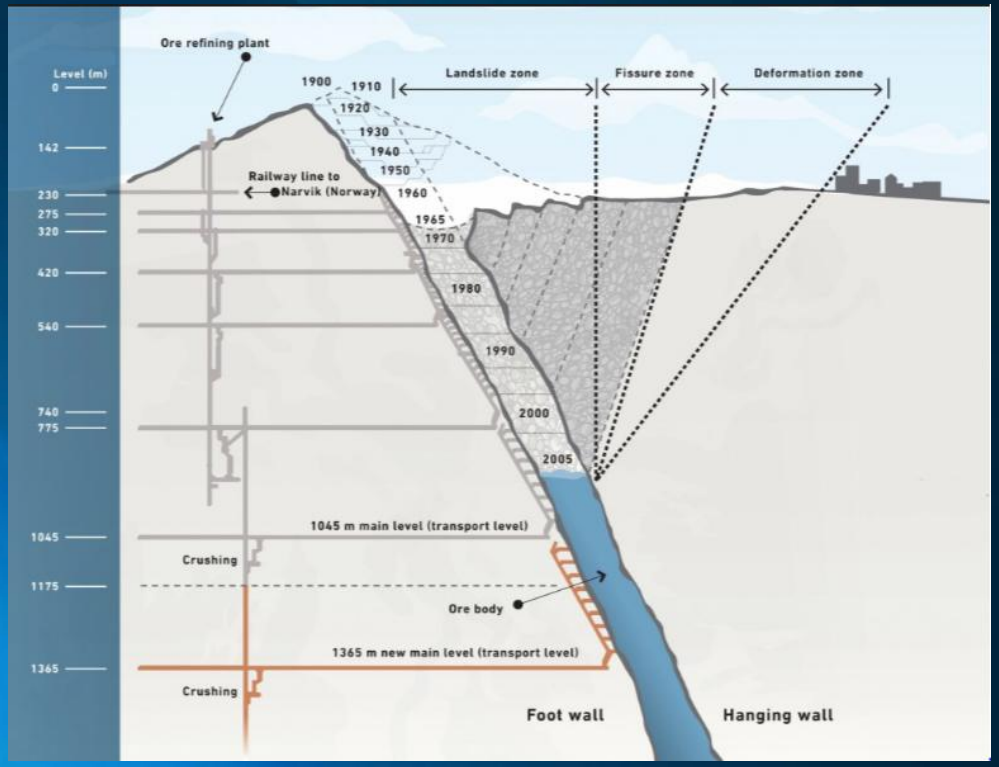


Multiple barriers prevent the radionuclides from reaching the ground surface.



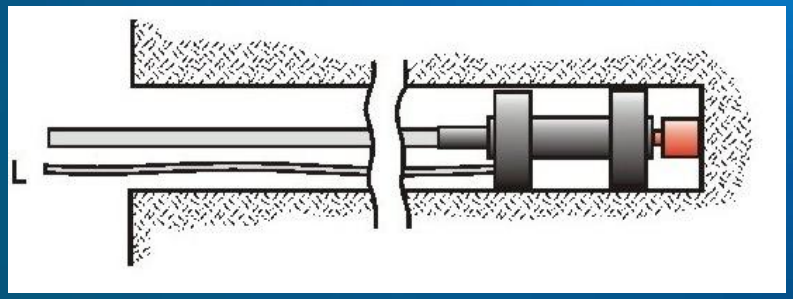
CHALLENGES
Deep Mining

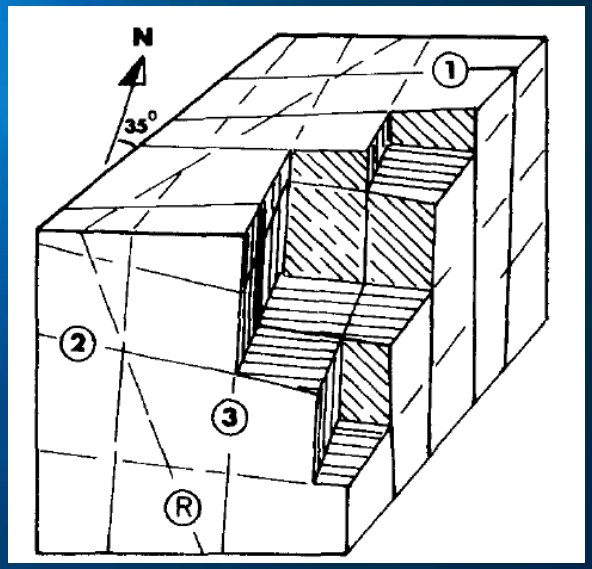
- High ground pressure – rock burst, squeezing
- High temperature
- Ventilation



CHALLENGES
Other issues

- In situ rock stresses: measurements and evaluations
- Permeability
- 3D visualization of rock discontiuities and weakness zones
- Physical and mechanical anisotropies in rock masses
- Realistic estimation of the rock mass quality





SUMMARY

- Rock burst and rock squeezing in TBM tunnels
- Challenges of rock reinforcement in TBM tunnels
- High ground pressure in deep mines
- New technologies in grouting
- Engineering and natural slopes: risk analysis, intelligent and real-time monitoring
- Clean energies: underground hydropower caverns, effective deep geothermal drilling, safe nuclear waste repositories and underground nucler power plant, CO2 storage
- Realistical estimation of rock mass quality
- Rock discontinuities and weakness zone
- Measurements and estimation of in situ rock stresses

International collaborations are extremely important to solve the issues

We need ISRM to reach the goals!

Thank you!