Australian Government

Geoscience Australia

National In Situ Leach Uranium Mining Best Practice Guide: Groundwaters, Residues and Radiation Protection

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GEOSCIENCE AUSTRALIA

Australian Government's Uranium Policy

- Uranium mines will be approved subject to world best practice environment & safety standards
  - But what is world best practice for uranium mining?

➔Need for national guidelines

Addressing this need

- In April 2009, Australian Government's Department of Resources, Energy and Tourism commissioned Geoscience Australia to prepare a:

National in situ leach uranium mining best practice guide

- GA's roles in Australian Government include technical advice on mineral and energy resources, mining and related matters

National in situ leach uranium mining best practice guide

The draft guide for public comment has been completed. It comprises:

- **Introductory discussion**
  - **What is meant by world best practice**
  - **General principles for mining in Australia**
  - **Description of in situ leach uranium mining**
- **ISL specific guidelines and approaches**
  - **Site characterisation and baseline environmental description**
  - **Description of the proposed mine operations**
- **More detailed guidance on best practice mining and regulation**

National in situ leach uranium mining best practice guide

- **Communicates Australian Government's expectations for ISL mining**
  - **Developed to inform high level consideration of ISL mining proposals by providing information on approaches to regulation, planning, operation and mine closure**
- **Focuses on groundwaters, residue disposal and radiation protection**

  = Key issues for ISL mines

General principles and approaches

- There is no universal template for ‘world best practice’ ISL uranium mining
  - The operational and regulatory practices and procedures need to be best for the characteristics of the particular site
  - ‘World best practice’ ➔ ‘Best practice’

Best Practice Environmental Management in Mining (2002)

- *……. best practice is not fixed in space or time. A best practice technique at one mine may not be suitable at a similar mine elsewhere……Continual improvement may be driven by changes in legislative requirements, public expectations, corporate thinking, or by development of new and improved technology*

Best Practice Radiation Protection and Radioactive Waste Management in Mining and Mineral Processing

- **National Code of Practice and Safety Guide applies**
  - **Adopts the IAEA's principle that the magnitude of the individual radiation doses, and the number of people exposed are kept As Low As Reasonably Achievable taking account of economic and social factors (ALARA principle)**
- **Integrated into mine planning, operation and closure**

General best practice principles and approaches for mining

- Outcome-based regulation
  - Rather than a prescriptive approach
  - Involves a continuing, integrated process from initial planning to closure of mine
- Basis for planning and approval of a best practice uranium mining project is a comprehensive characterisation of the geological and environmental setting

General best practice principles and approaches for mining

- Environmental outcomes are set by the regulators
  - Through a process involving the mining company and the interested public
  - Involves consideration of all potential risks

  ➔ SOCIAL LICENCE TO OPERATE
- Operators are responsible for achievement of agreed outcomes
  - Can be prosecuted for failure

General best practice principles and approaches for mining

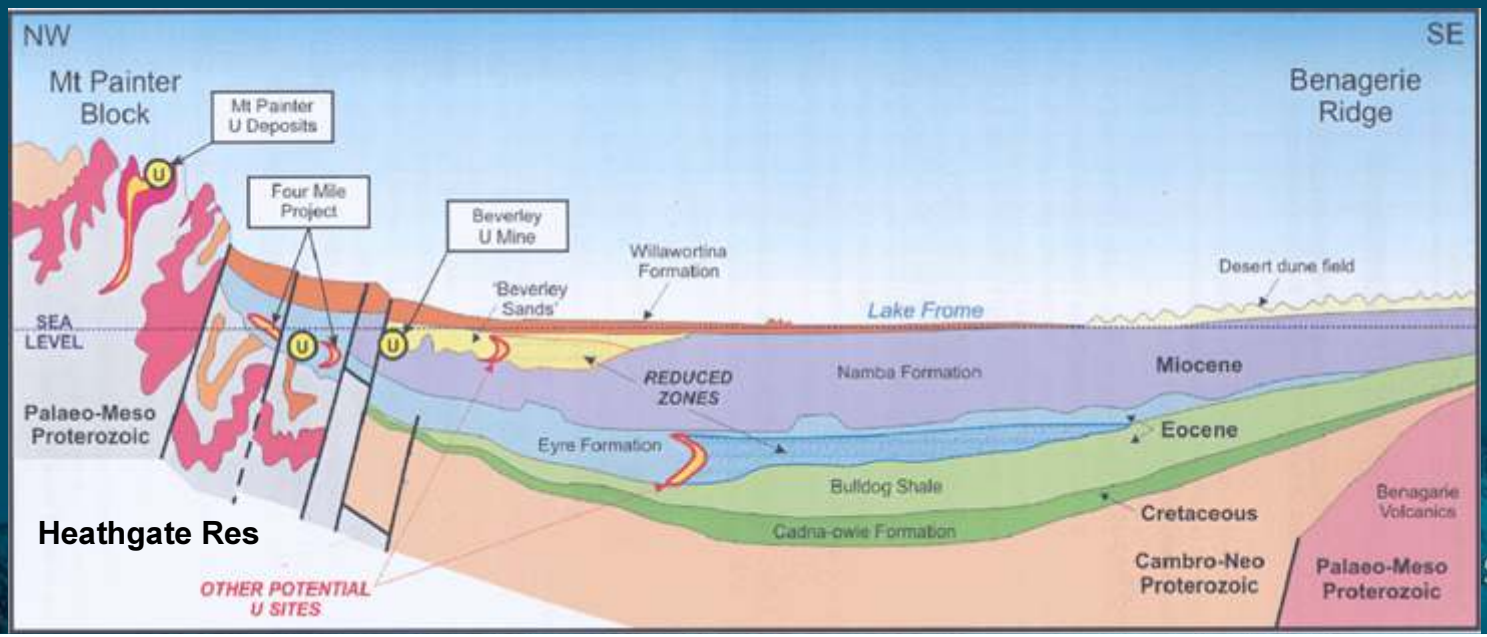
- Operators must meet performance standards set by government regulators
  - Expected to pursue continual improvement throughout the mine life
- Rigorous monitoring programs are required to demonstrate progress and identify problems

General best practice principles and approaches for mining

- Governments are not to be left with any liabilities after mining ceases
  - Rehabilitation security bond has to be lodged and amount reviewed regularly
- All decision-making and performance assessments are to be transparent

Turning more specifically to best practice ISL uranium mining

- **The main potential impacts of ISL mining are on aquifers**
  - **Assessment of these impacts relies on a full understanding of the hydrological/hydrogeological aspects of the proposed project, and the current and potential uses of groundwaters**

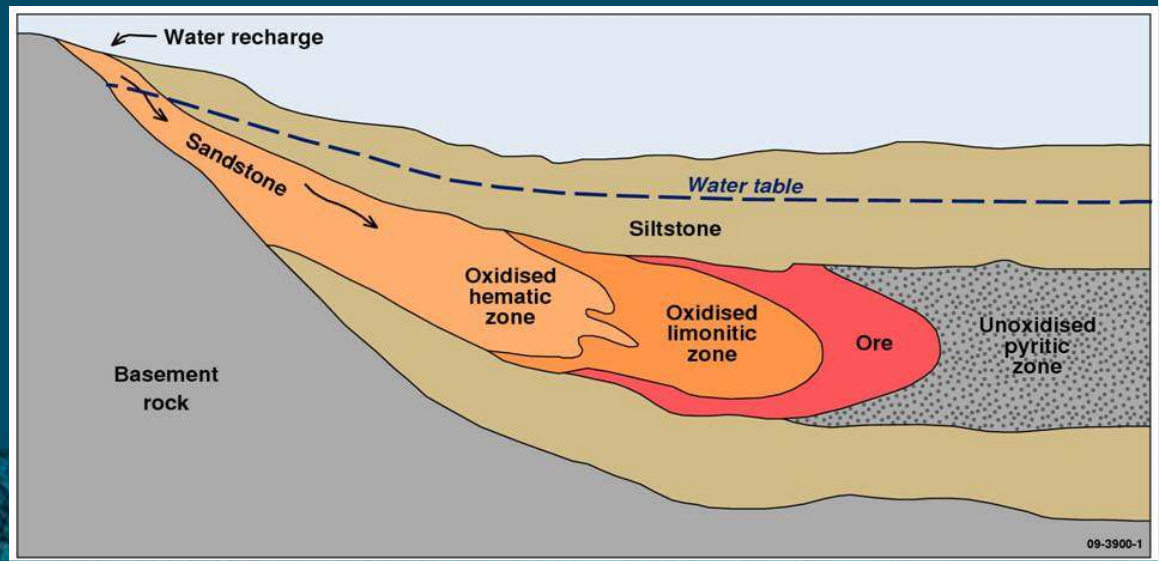


ISL best practice guidelines and approaches

- Hydrogeological features of the mineralised aquifer constrain
  - Nature of the mining solution
    - Acid or alkaline
  - Best option for uranium recovery
    - Ion exchange or solvent extraction (higher salinity)
  - Extent and distribution of monitoring wells
  - Options for disposal of residues
  - Groundwater rehabilitation requirements

ISL best practice guidelines and approaches

- ISL uranium mining should be planned and conducted so as not to compromise the “use categories” of groundwaters down flow from the mine and in other aquifers in the area
  - Use categories = stock watering, agricultural, ecosystem maintenance, potable



ISL best practice guidelines and approaches

- ISL mining produces liquid residues comprising mainly
  - Bleed stream from wellfield operations
  - Plant wash down waters
- Best option for disposal of liquid residues will be decided by the impact assessment process

ISL best practice guidelines and approaches

- Options for residue disposal
  - Injection into deep aquifer with poor quality groundwater
  - Injection into 'mined-out' areas of host aquifer
    - May require treatment before disposal to ensure no impacts beyond specified distance from the mine
  - Surface evaporation of liquid wastes
    - Shallow burial of residual low level radioactive precipitates
    - Need to ensure this does not contaminate shallow aquifers

ISL best practice guidelines and approaches

- Mine closure, decommissioning and rehabilitation plan should come into effect as soon as practicable after the completion of mining in each area of a lease
  - Risk-based closure planning process
  - Development and updating will be iterative between the company and regulatory authorities
  - Where the groundwater down flow has potential uses, or its quality is uncertain, remediation of residual mining solutions will normally be required

ISL best practice guidelines and approaches

- Rigorous monitoring of groundwater pressures and chemistry is to be conducted for all aquifers in the area
  - Verify integrity of confining strata
  - Provide effective early warning of any excursions of mining solutions or injected liquid residues

ISL best practice guidelines and approaches

- **Relinquishment of lease after mining ceases:**
  - **For the regulator to relieve the company of responsibilities for environmental management of the site, the groundwater should be returned to its pre-mining use category**
    - **Stock watering, agricultural, ecosystem support, potable**
  - **In the case of a "no use" category, natural attenuation should be established to be progressing at a satisfactory rate**

Completing the national ISL uranium mining best practice guide

- Public comments on the draft Guide are being addressed
- Any significant feed back from IAEA and Uranium Group will be taken into account
- National Guide will need to be approved by Federal and State Resources and Environment Ministers

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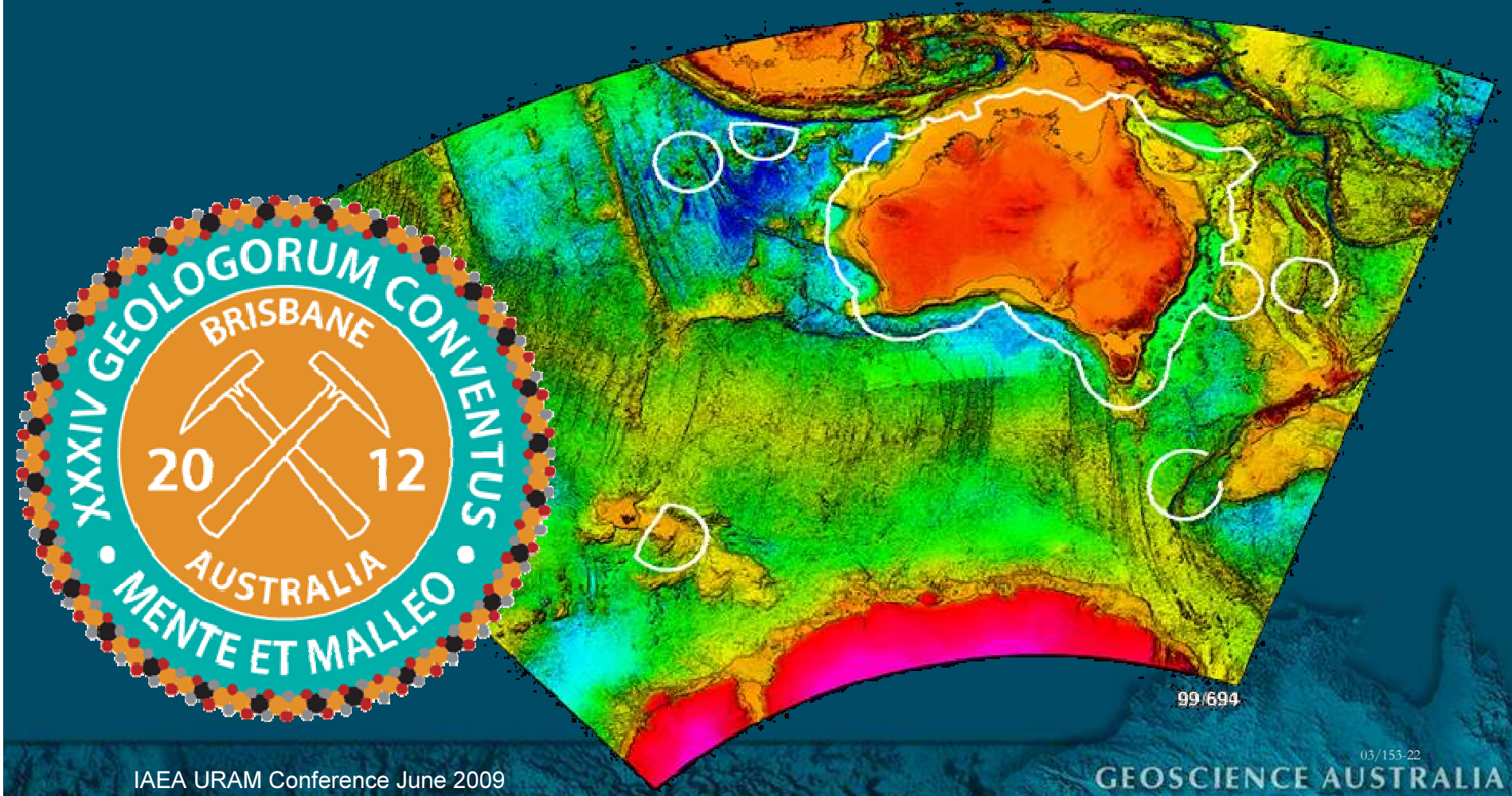
GA is playing a lead role

Strong minerals and energy program



THANK YOU

Why ISL?

- Uranium production by in situ leach (ISL) techniques has been increasing internationally
  - >27% of world's total U production in 2007
  - Used for uranium deposits in sandstone aquifers
  - In Australia
    - Existing ISL Mine = Beverley
    - Proposed mines
      - Honeymoon (SA) to begin production 2010
      - Beverley Four Mile (SA) under formal consideration
    - Others prospects under evaluation: Oban (SA), Goulds Dam (SA) Manyingee and Bennetts Well (WA)

Sandstone deposits in Australia

- In Australia, most sandstone deposits are:
  - Geologically young
  - In regions with relatively low relief, saline groundwaters and low population densities