

# Sandia National Laboratories

## Carlsbad Programs Group

SAND2008-1308P



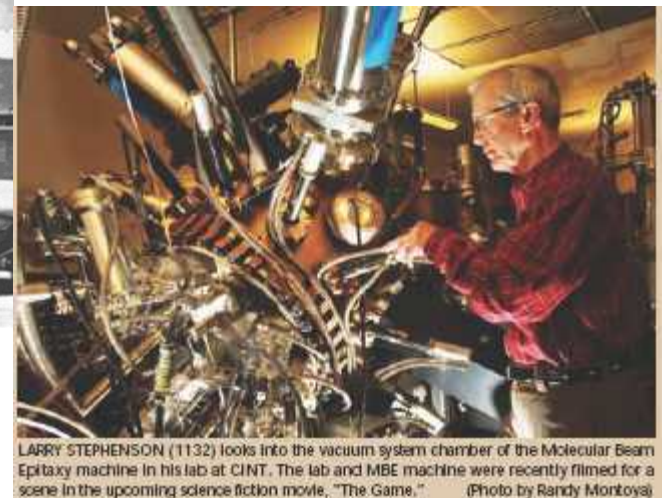
**“In my opinion, you have  
an opportunity to render an  
exceptional service in the national interest”**

**HS Truman – May 18th 1949**

**WIPP Public Outreach**  
**Chad Twitchell**  
**MA, PMP**  
**February 2008**



**SAND2008-1308P**



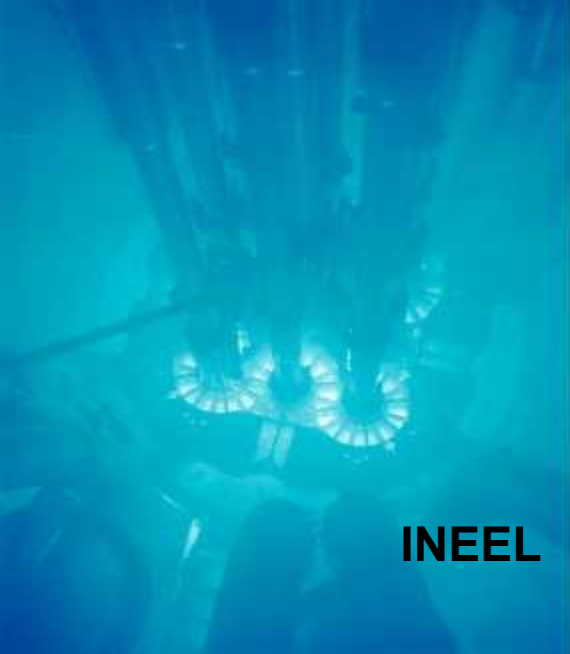
LARRY STEPHENSON (1132) looks into the vacuum system chamber of the Molecular Beam Epitaxy machine in his lab at CINT. The lab and MBE machine were recently filmed for a scene in the upcoming science fiction movie, "The Game." (Photo by Randy Montoya)



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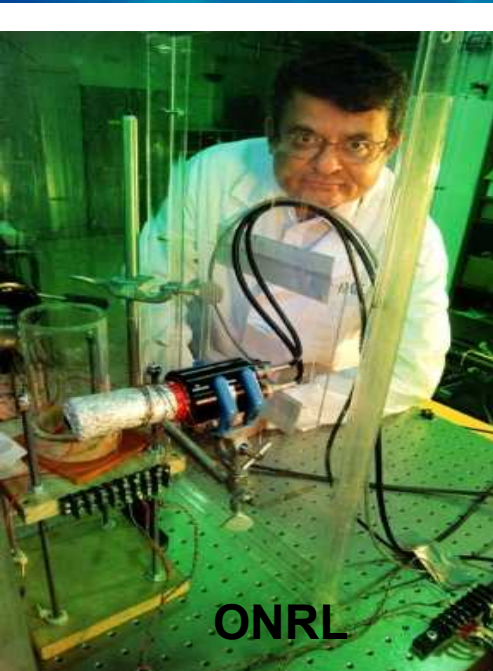
**INEEL**



**LANL**



**PNNL**



**ONRL**



**LLNL**



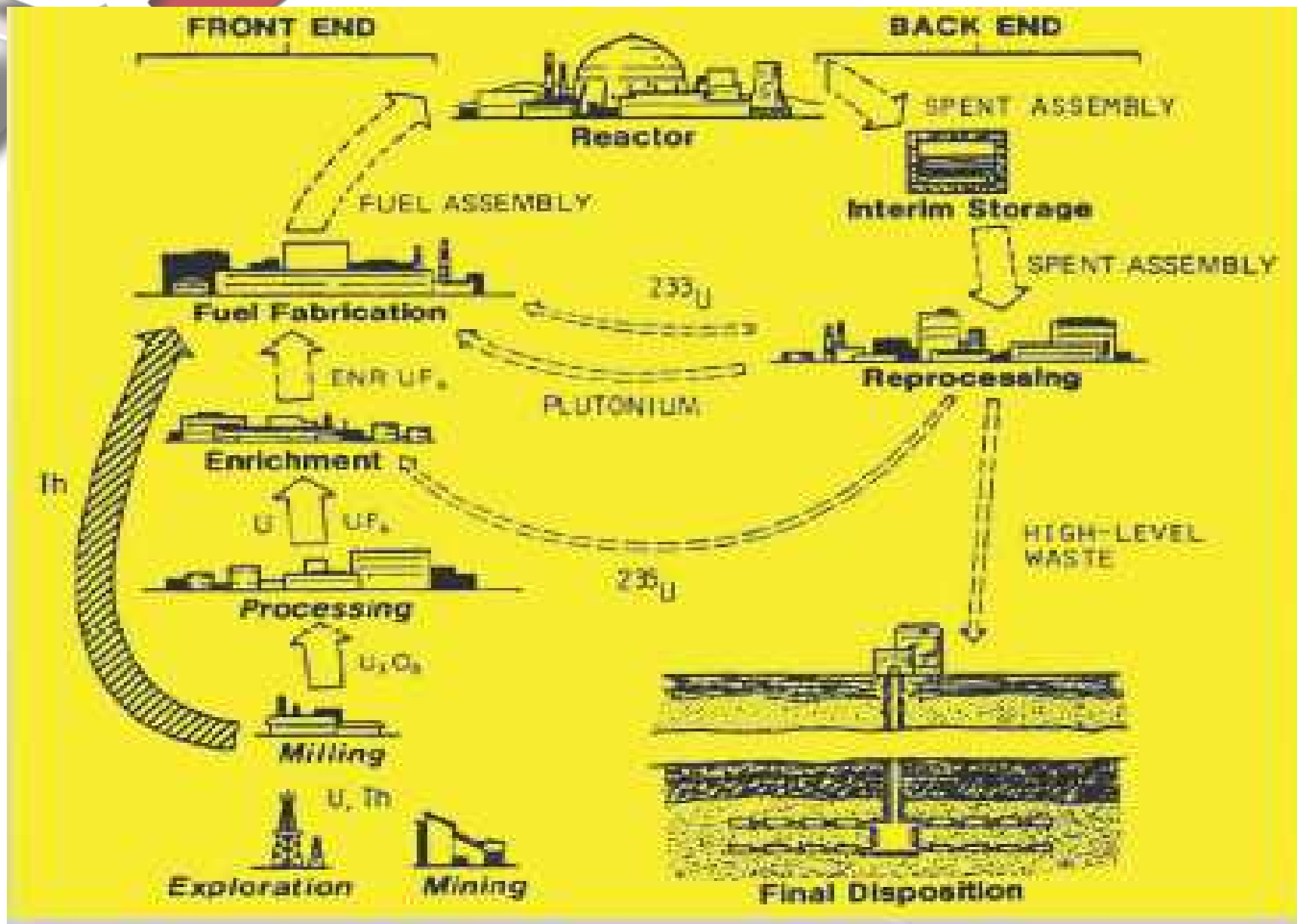
**Rocky Flats**



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**Sandia  
National  
Laboratories**



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# What does a science advisor do?

## Safety Assessment for the WIPP

- Numerical modeling of the behavior of the system shows
  - Essentially no 10,000-yr releases from undisturbed performance
  - Releases that might result from human intrusion (assumed to be a drilling accident) are within EPA limits
- Analyses include broad uncertainty in natural and engineered systems
- Performance is most sensitive to assumptions about future human actions



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# Map of Salt Deposits in U.S.

## TRU Timeline

**1942:**

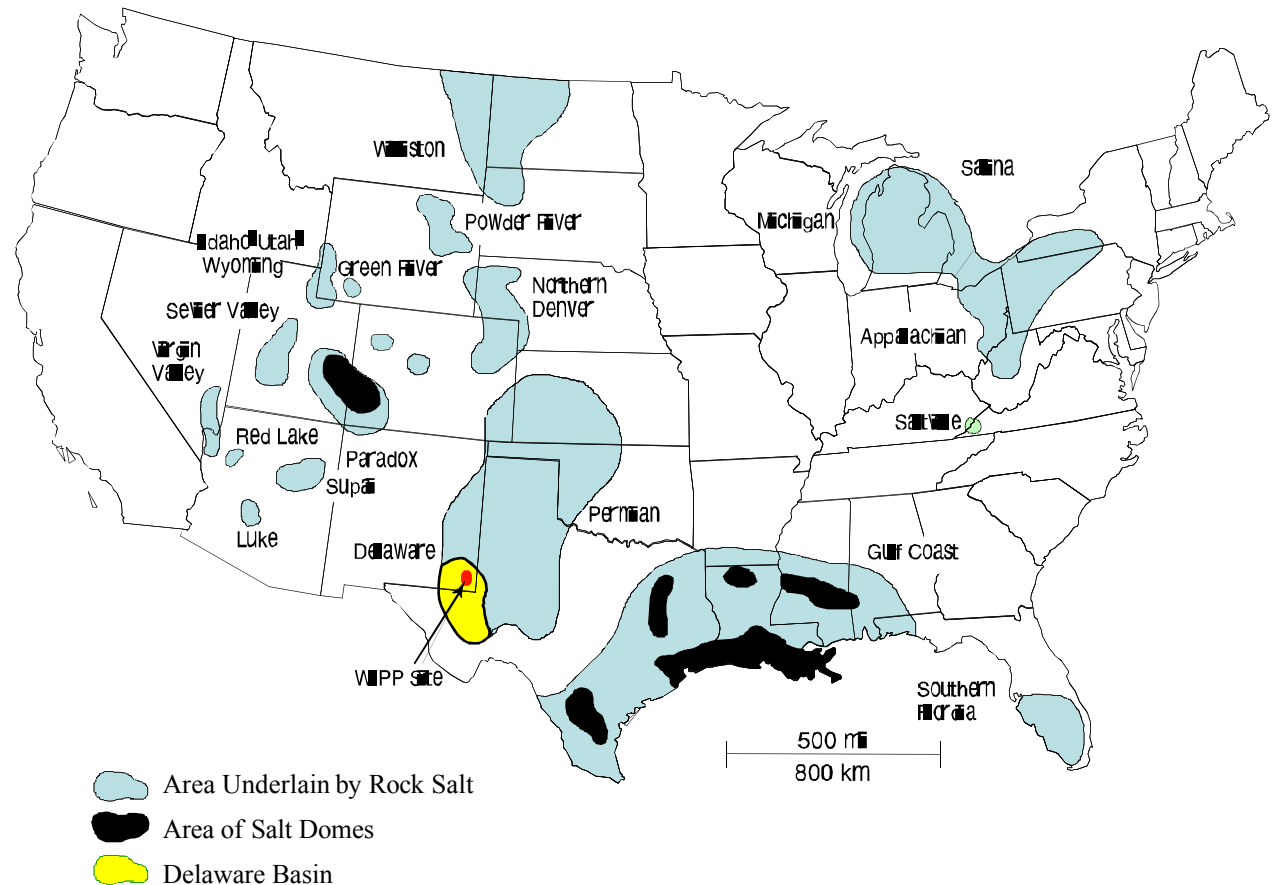
LANL chosen as site to build first nuclear bomb

**1957:**

NAS recommended salt for permanent underground disposal

**1973:**

NM chosen as potential disposal site

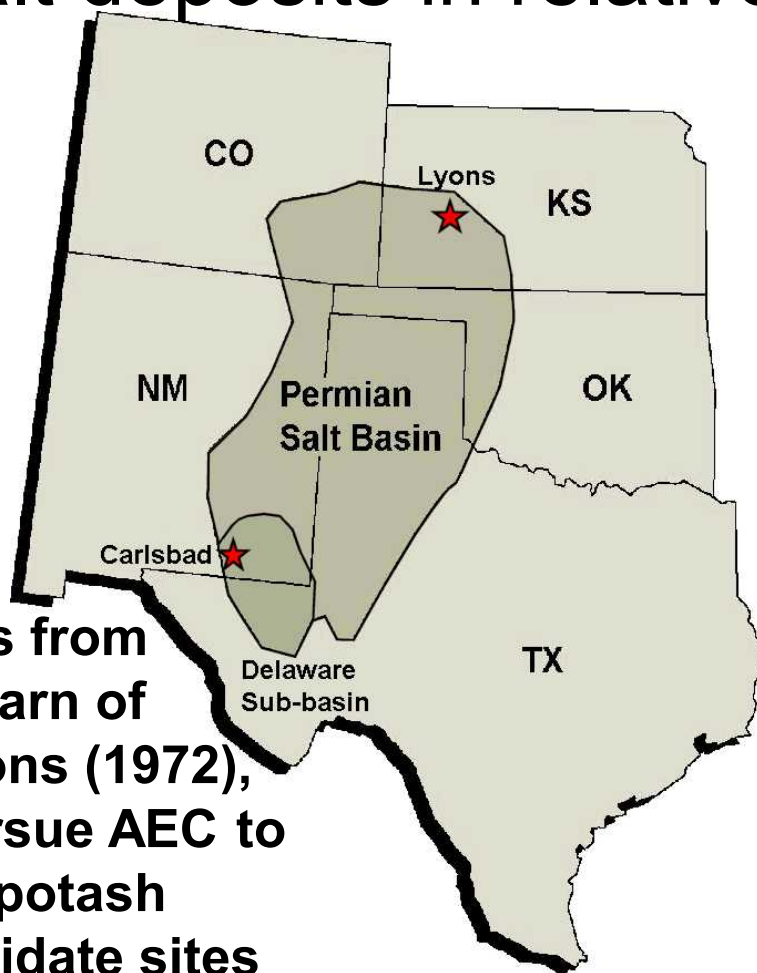


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Initial candidate sites are soon focused on bedded salt deposits in relatively remote areas

**1968-1971  
Project Salt  
Vault near  
Lyons Kansas**



**The Lyons site became politically troubled very quickly**

**Local politicians from Carlsbad, NM learn of problems at Lyons (1972), and actively pursue AEC to explore nearby potash district for candidate sites**

**Delaware Basin turns out to be deepest and thickest, but nearby oil production and potash mining still make site selection controversial**



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# West-East Geologic Cross Section of Delaware Basin

**1981:**  
First shaft completed

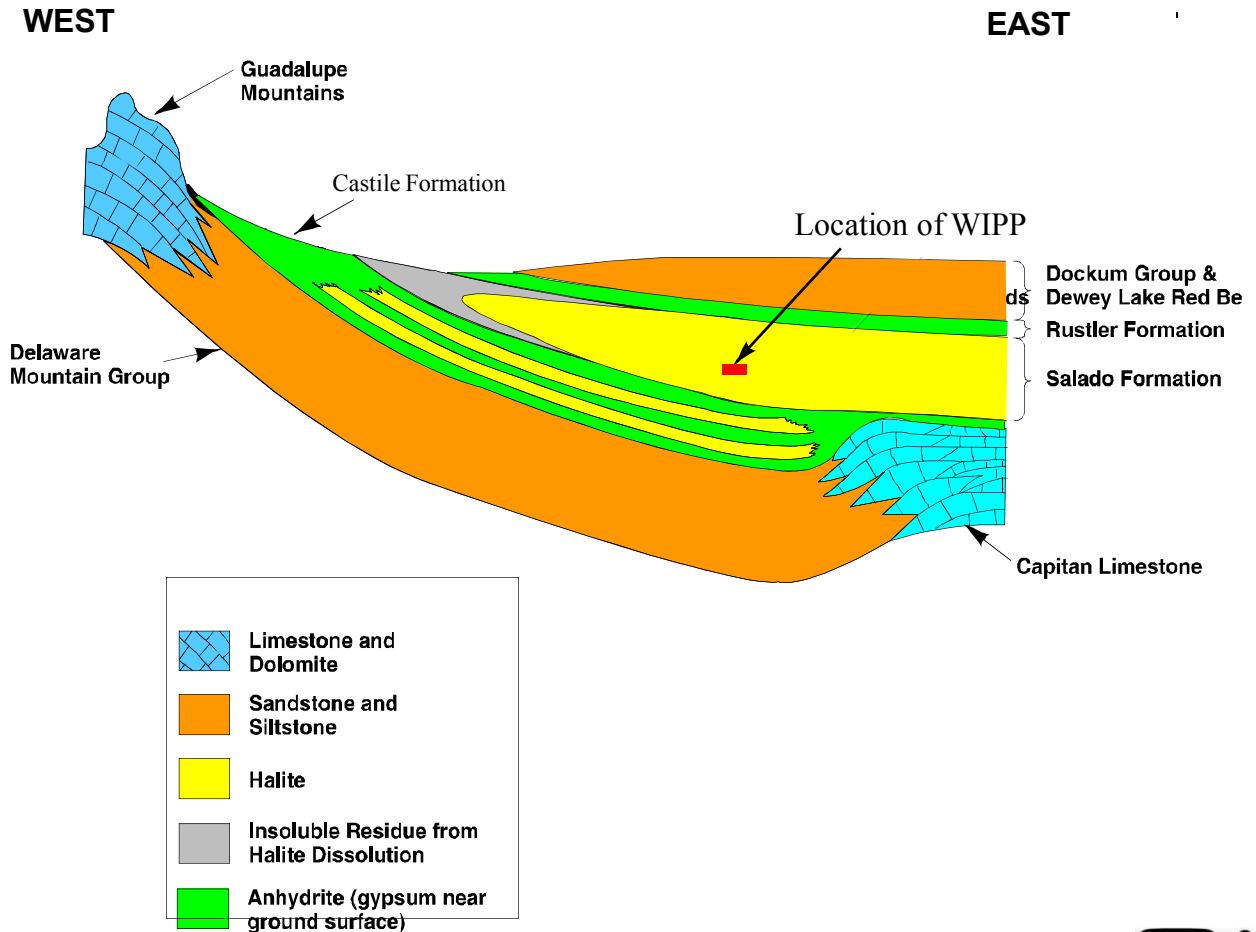
**1996:**  
CCA submitted to EPA

**1998:**  
WIPP certified by EPA

**1999:**  
First waste shipment received

**2004:**  
First recertification

**2007:**  
Begin RH disposal

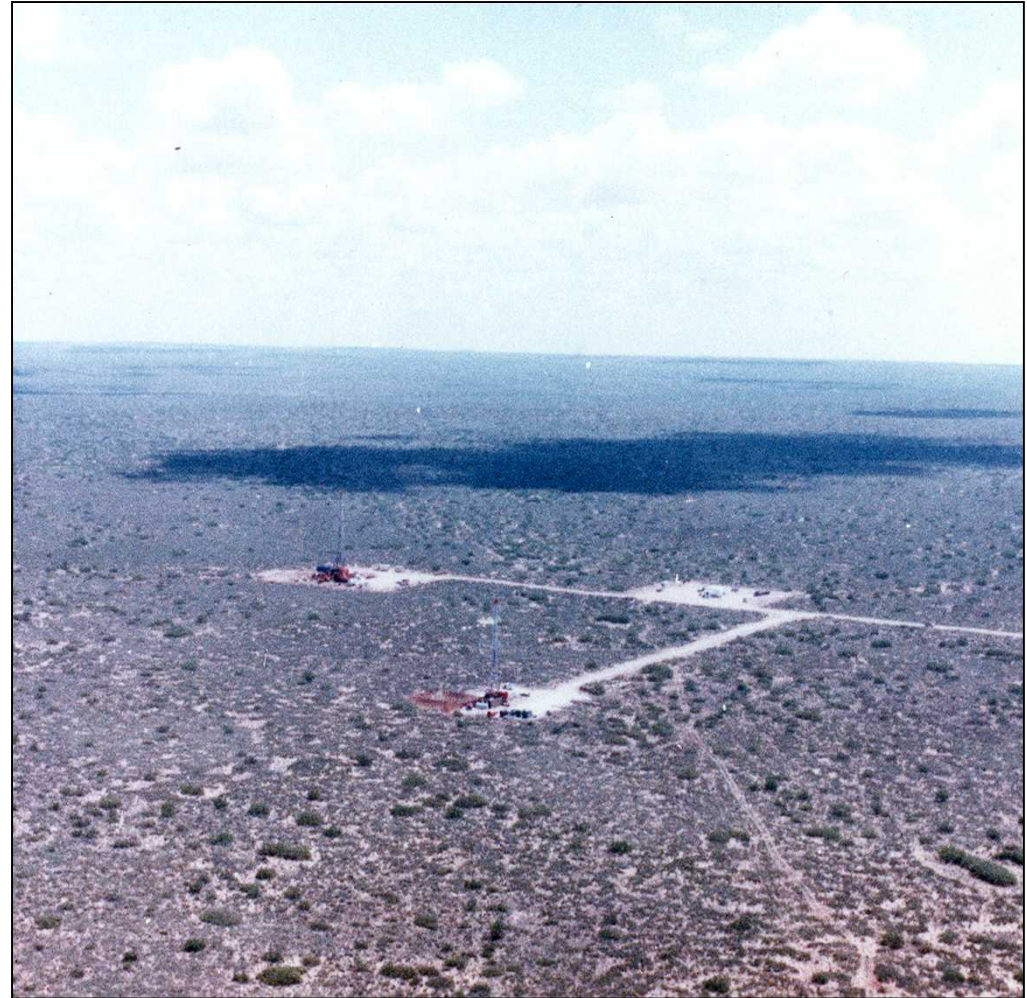


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# Bedded Salt Was Chosen for the Siting of the US Defense Nuclear Wastes

- Salt can be mined easily
- Salt is plastic
- Salt is essentially impermeable
- Fractures in salt are self healing
- Salt has existed underground for millions of years
- Salt has a relatively high thermal conductivity
- Wide geographic distribution (many potential sites)



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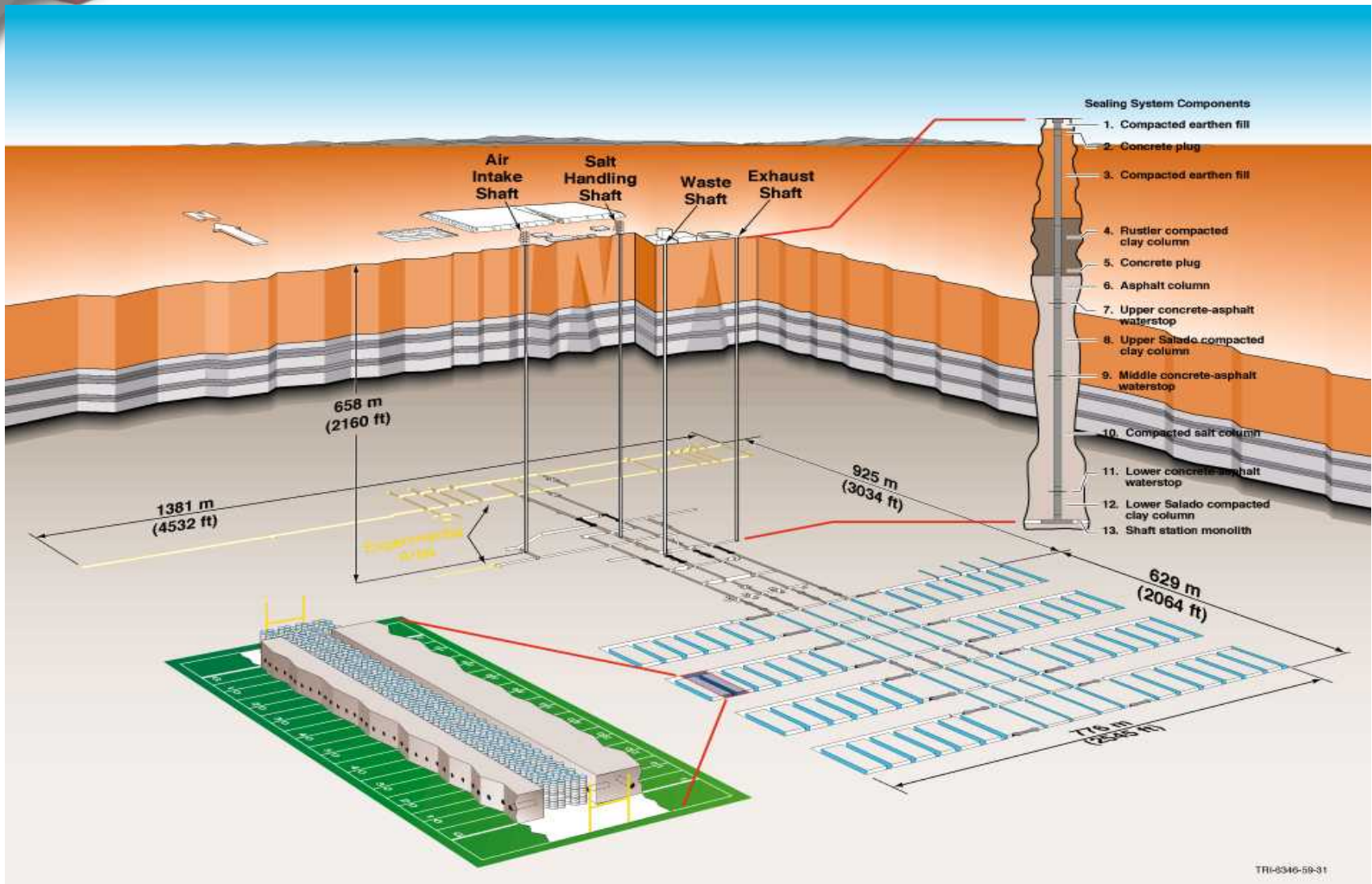
# The WIPP Site



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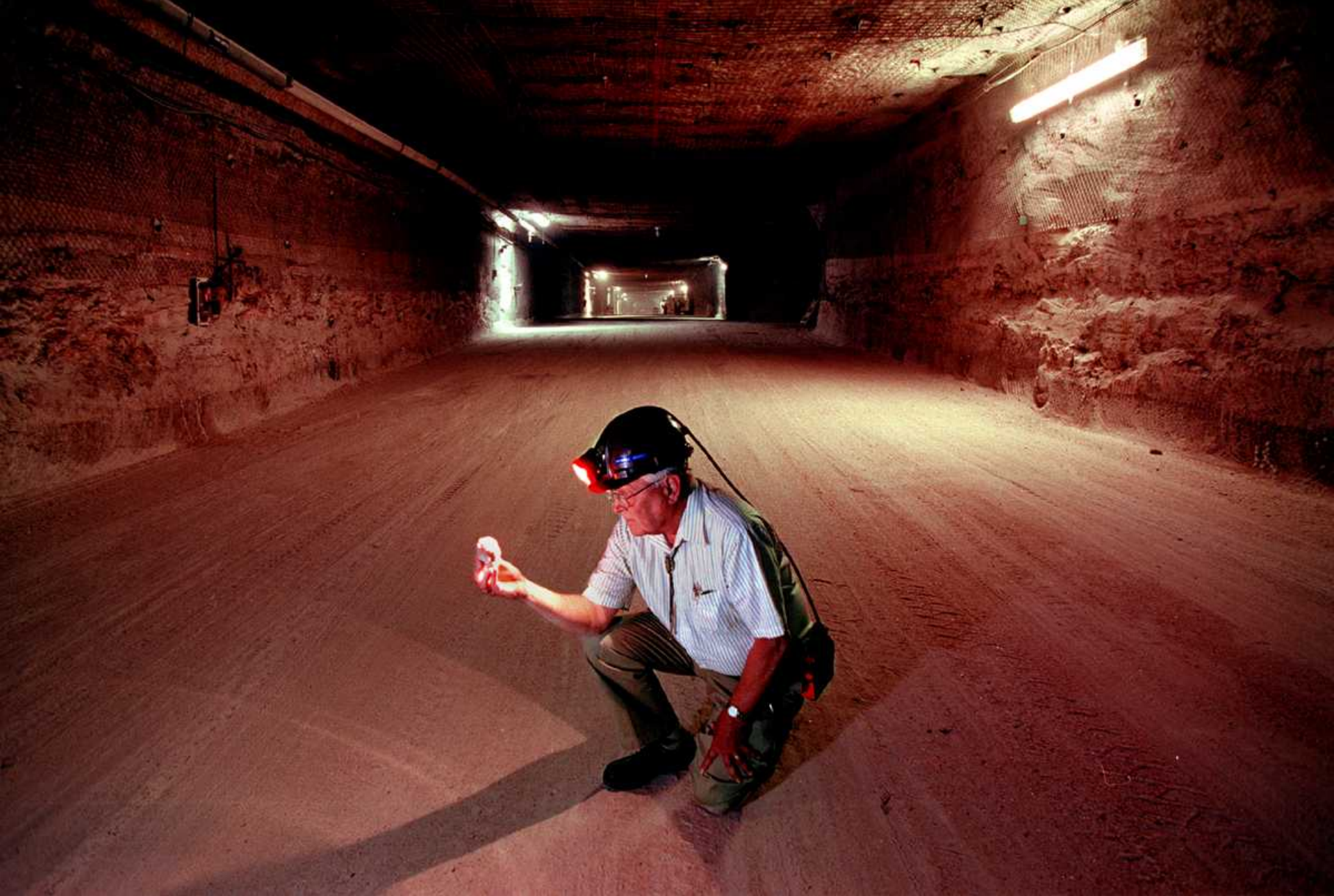
# WIPP Underground Layout



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# What can happen over 10,000 years?

- What if
  - someone drilled into the WIPP....
  - and hit an underground water pocket....
  - and the water corroded the iron in the waste drums....
  - and bacteria consumed waste materials....
  - and the repository became pressurized....
  - and then someone else drilled into the WIPP?



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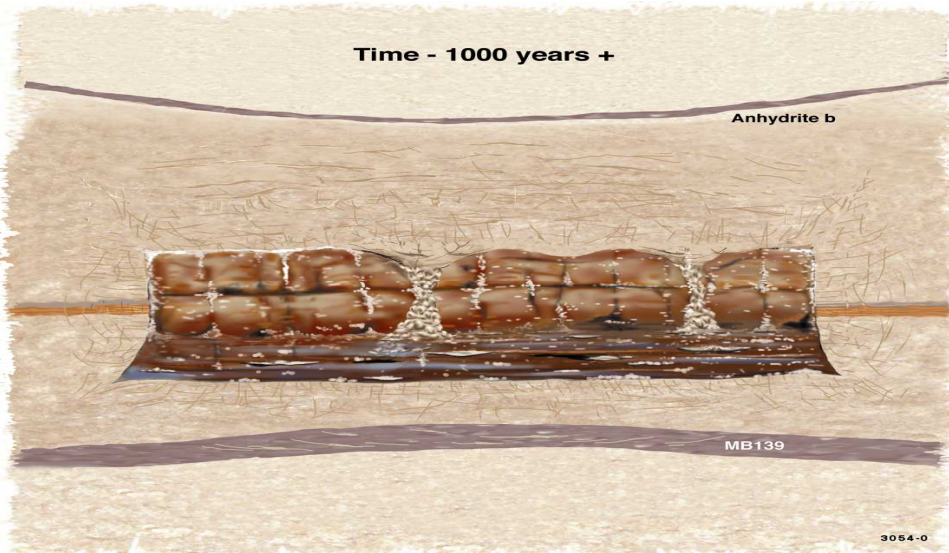
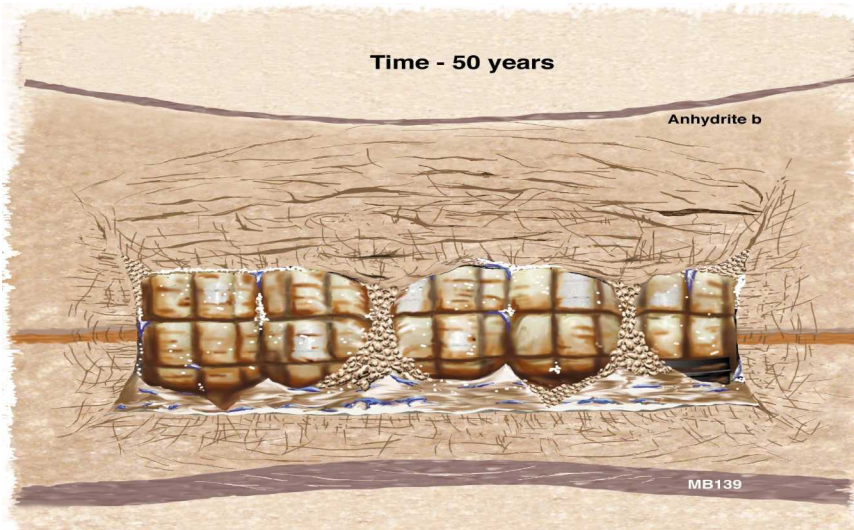
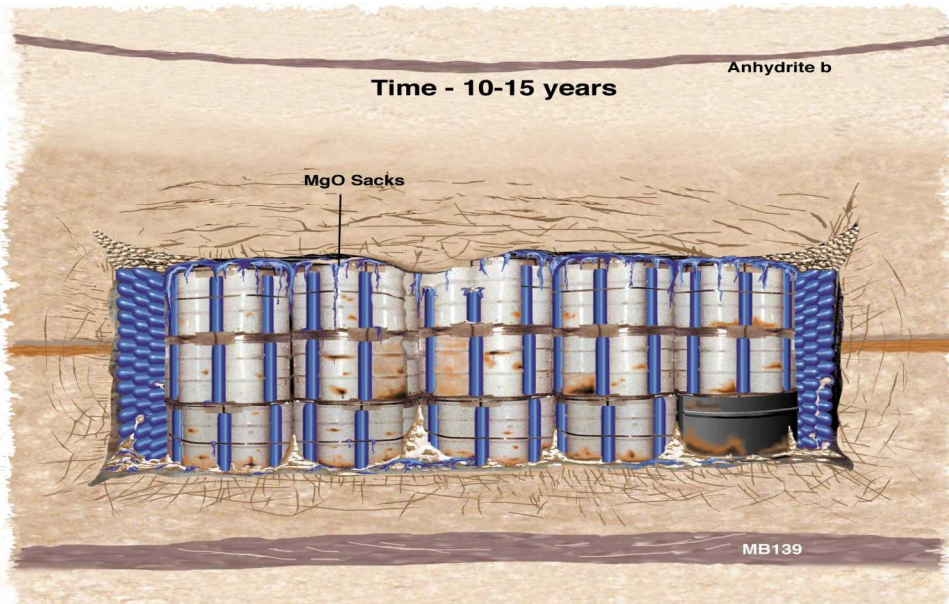
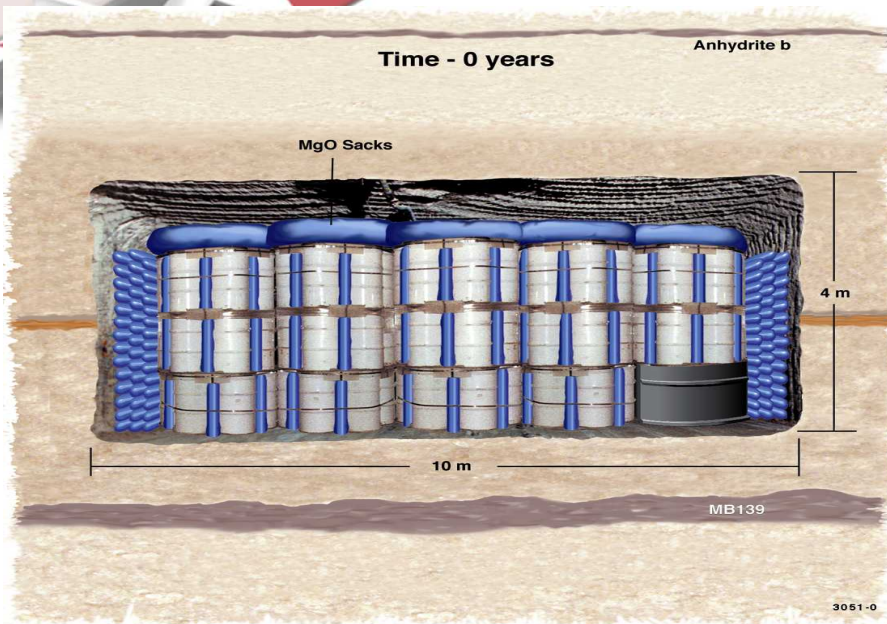




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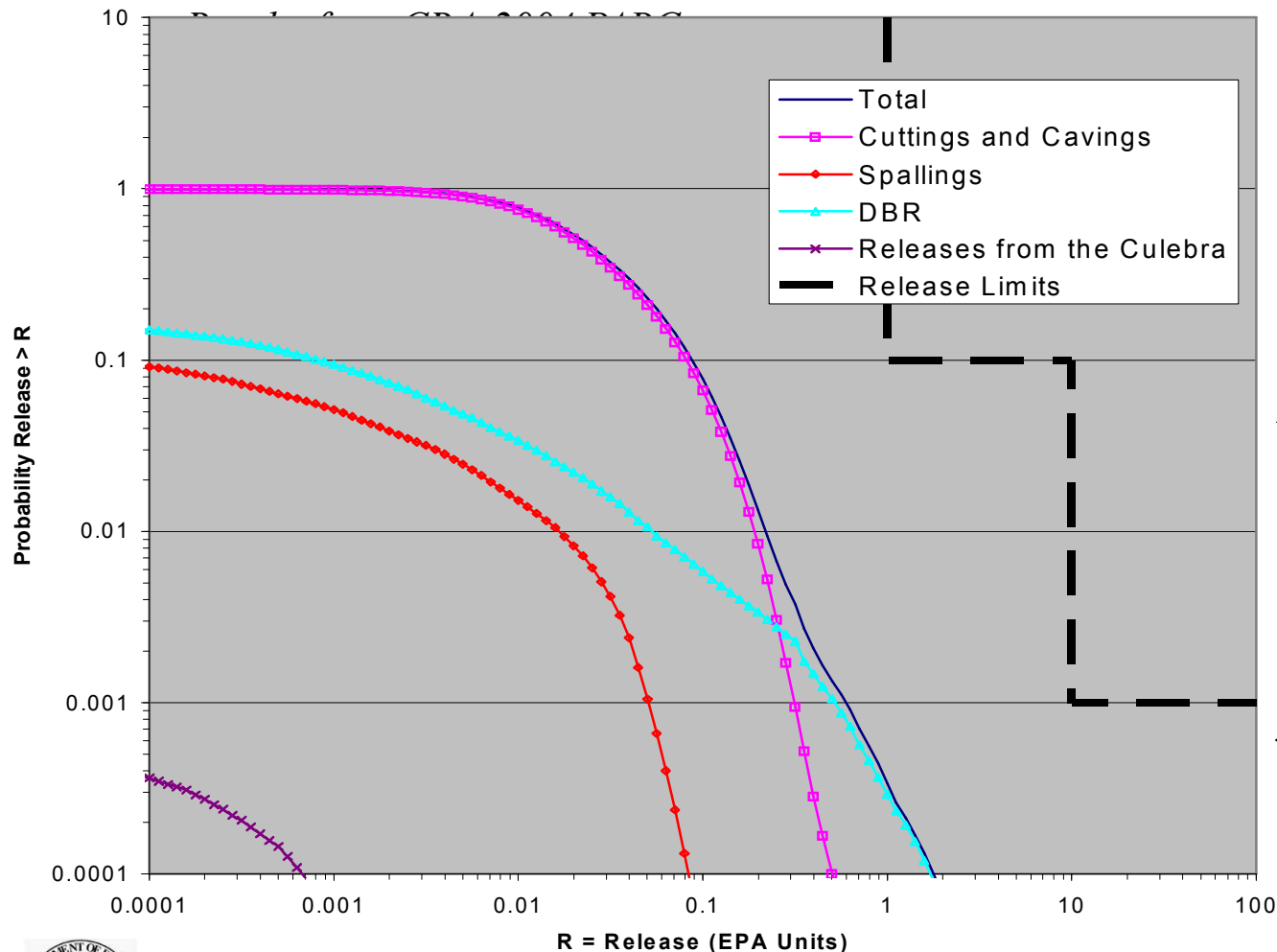


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# Demonstration of Compliance



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2901-0



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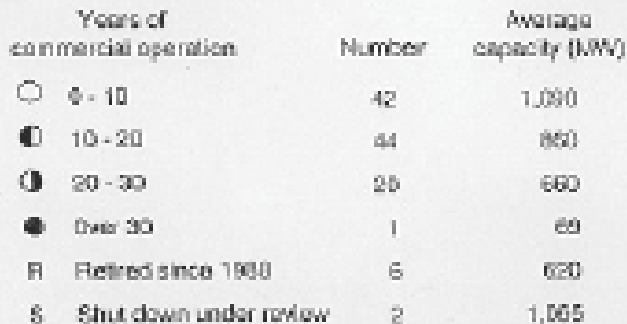
# What of the future?

- The commercial nuclear waste problem...
- Other types of waste (besides TRU) that need a disposal path...
- Many other countries turning to Nuclear Energy as a power solution. They have a waste management problem and need help....
- Great people in technical disciplines to help give:
- *Exceptional service in the national (and international) interest.*



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“Well, that’s the end of the story, and it’s  
also the end of the album.  
So good night.”

- Harry Nilsson, The Point 1971



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# Backup slides



# Perspectives on Nuclear Weapons

- “...I think a strong case can be made ...that when we look back on the past sixty years, the true recipient of the Nobel Peace Prize ironically ought to be nuclear weapons.
- ..Nuclear weapons prevent wars.
- Michael Wheeler: Nuclear Weapons: The American Experience during the Cold war, Nov 2, 1999. It is a paraphrase of a quote by Elspeth Rostow. See also John E. Mueller “The Remnants of War” pg. 164. Cornell University Press 2004 online at: <http://books.google.com/books?id=Zx5Q-JzDQr4C&printsec=frontcover#PPA165.M1>. Ref: Kenneth Waltz “thank our nuclear blessings” ibid.
- Ref: [http://www.boston.com/news/globe/ideas/articles/2005/03/20/give\\_nukes\\_a\\_chance/](http://www.boston.com/news/globe/ideas/articles/2005/03/20/give_nukes_a_chance/). Interview with Kenneth Waltz, Adjunct Professor at Columbia University.



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# What do we need right now?

- Performance Assessment and Rock Mechanics department
  - Geo-Mechanics
  - Time Domain Electromagnetic (TDEM)
  - Continuum Mechanics
  - Constitutive equations on material behavior with an emphasis on geological material
- Repository Investigations department
  - Laboratory Technician
  - Geo Chemistry experimentation related to Iron chemistry
  - Magnesium Oxide (MgO) testing and experiments.



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# What would you do?

- A geomechanical modeler supports analyses of the mechanical behavior of the underground repository. ...expected to develop conceptual models and numerical codes to represent the geomechanical behavior of the repository. ... will develop constitutive models for the system and implement models in Sandia developed geomechanics codes.
- ... must have demonstrated excellence in the technical field, excellent oral and written communications skills and demonstrated interpersonal skills including teamwork and communication. ...reside in Carlsbad, NM.
- The position requires an advanced degree (M.S. or Ph.D.) in rock mechanics, geomechanics, engineering mechanics or closely related discipline. A background in constitutive model development and implementation and proficiency with finite element modeling is required. Experience with finite element numerical methods, geophysics, the petroleum industry, and high performance computing environments is desirable.



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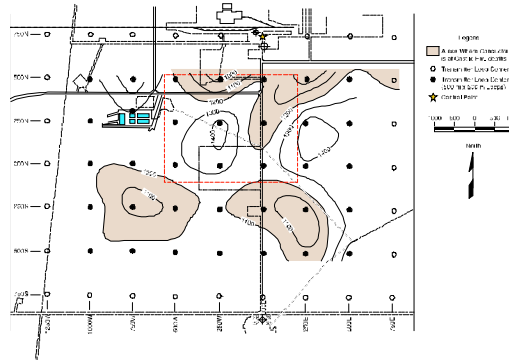
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# WIPP Site Characterization



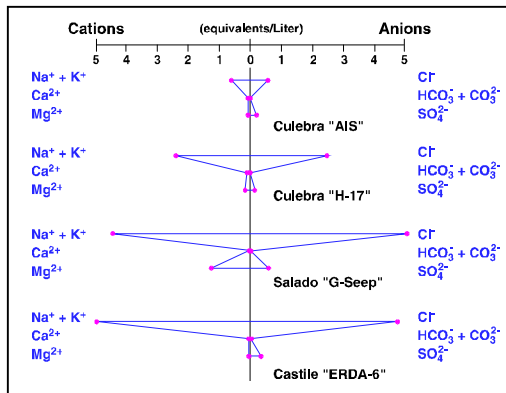
Geologic studies



Geophysical surveys



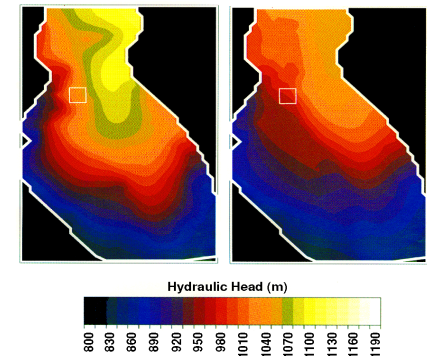
Hydrologic testing



Geochemical sampling and analysis



Geomechanical testing



Numerical modeling

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# Geologic Studies



**Geologic mapping**



**Surface-based geologic drilling, coring, & geophysical logging**

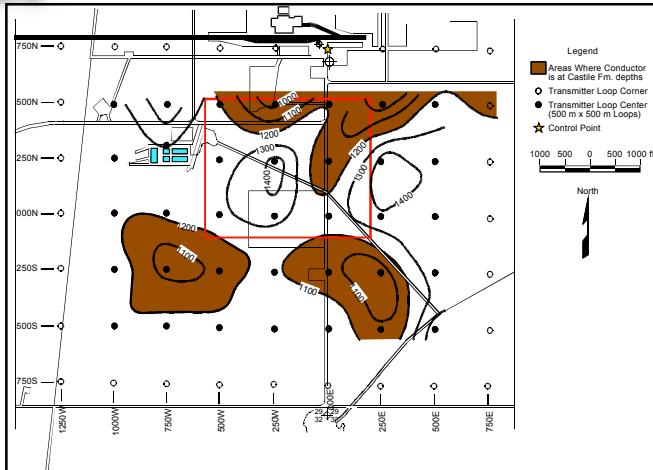


**Geologic mapping of air intake shaft**

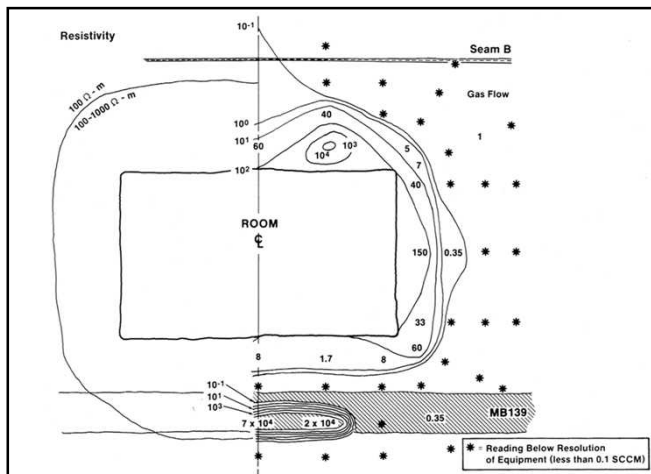


**Horizontal core from air intake shaft**

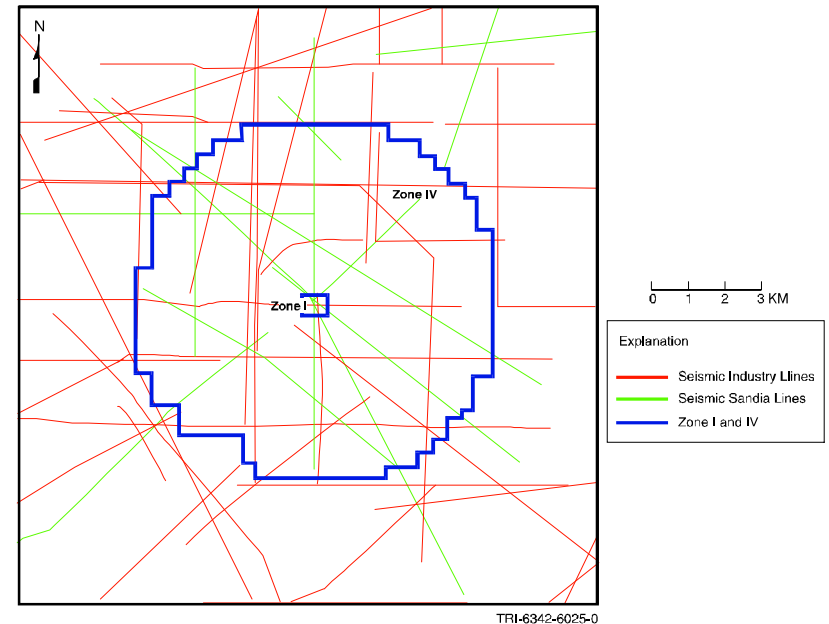
# Geophysical Surveys



**Time domain electromagnetic imaging of deep pressurized brine accumulations**

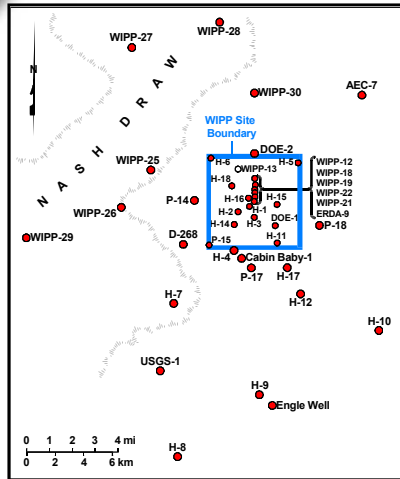


**Electrical resistivity and gas injection test characterization of disturbed rock zone**

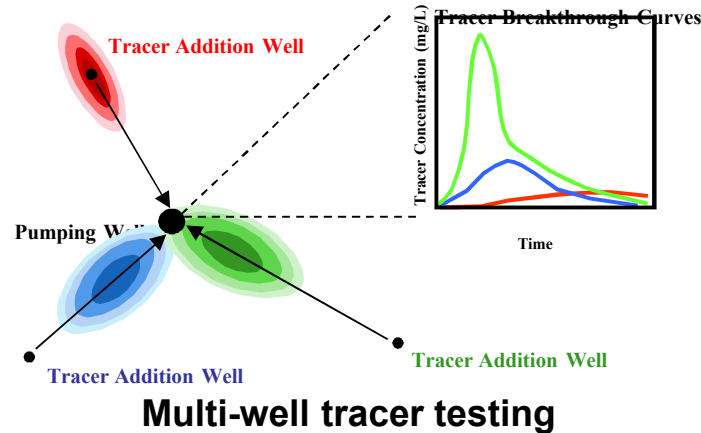


**Seismic surveys for mapping of deeply buried geologic structures**

# Hydrologic Testing



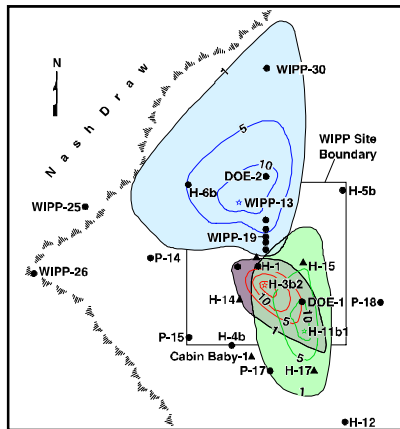
Location of hydrologic test holes



Multi-well tracer testing



Measurement of 2-phase properties of low permeability rock



Hydraulic head drawdowns from large scale pumping tests



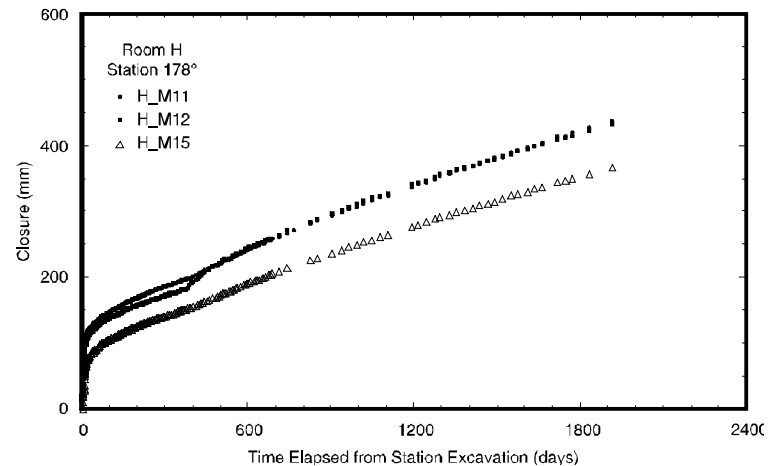
# Geoche



# Geomechanical Testing



**Measurement of creep closure in cylindrical tunnel**



**Creep closure data for a rectangular tunnel**



**Axisymmetric pillar test**

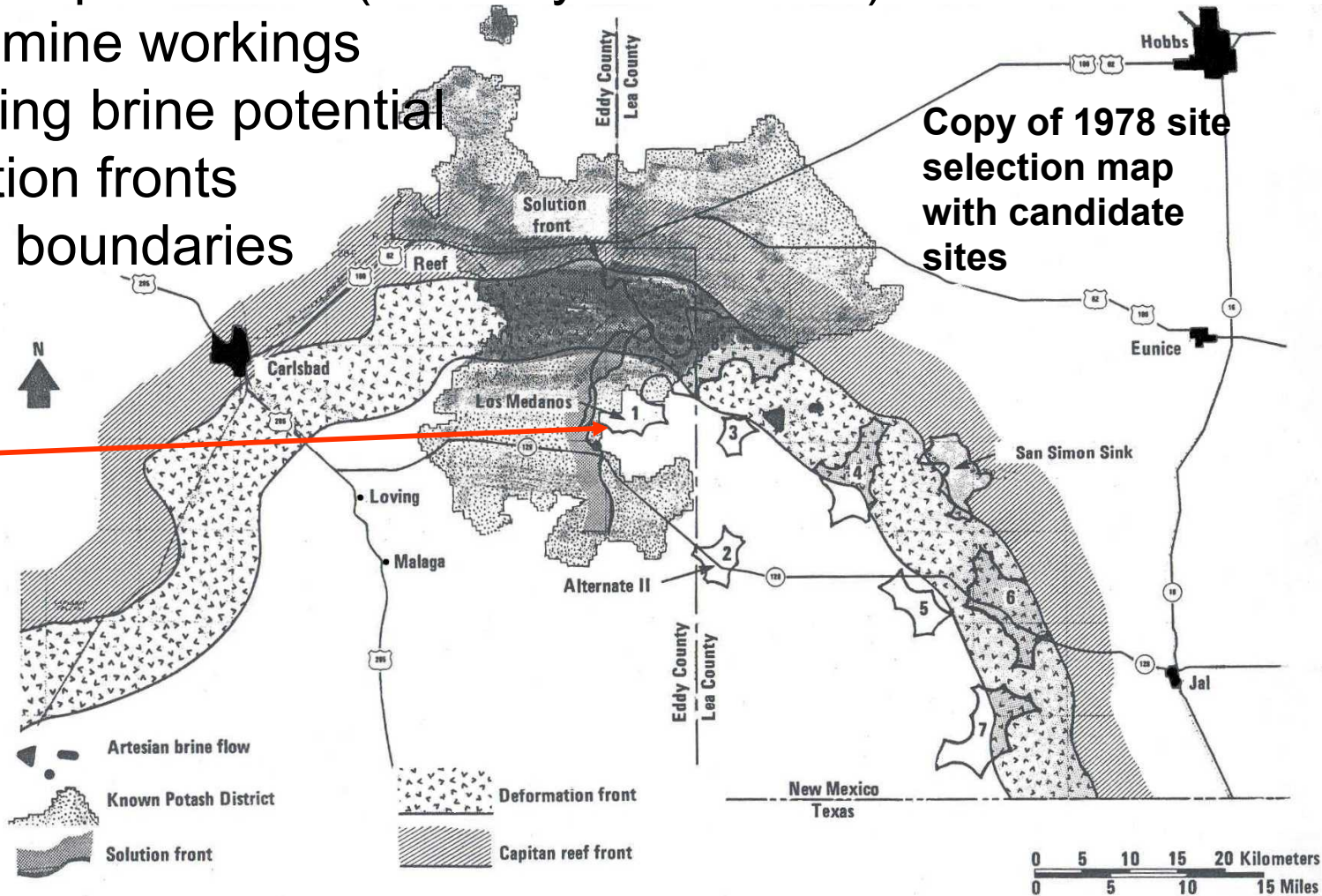


**Measurement of creep deformation in the rock mechanics laboratory**

# Site Selection Constraints

- Nearby oil production (arbitrary 2-mile limit)
- Nearby mine workings
- Underlying brine potential
- Dissolution fronts
- Political boundaries

Final site selection (Los Medanos) only after several nearby changes and consideration of county line



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# What does a science advisor do?

- Studies and analyzes the natural setting of the WIPP prior to waste placement
- Describes repository behavior after waste placement
- Predicts repository behavior over a 10,000 year period with computer simulations in order to demonstrate compliance of the WIPP with environmental regulations



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