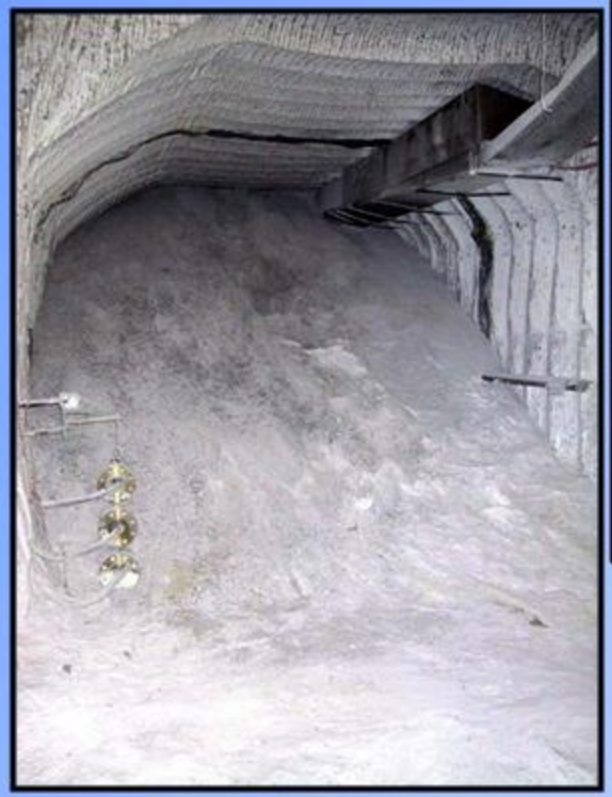
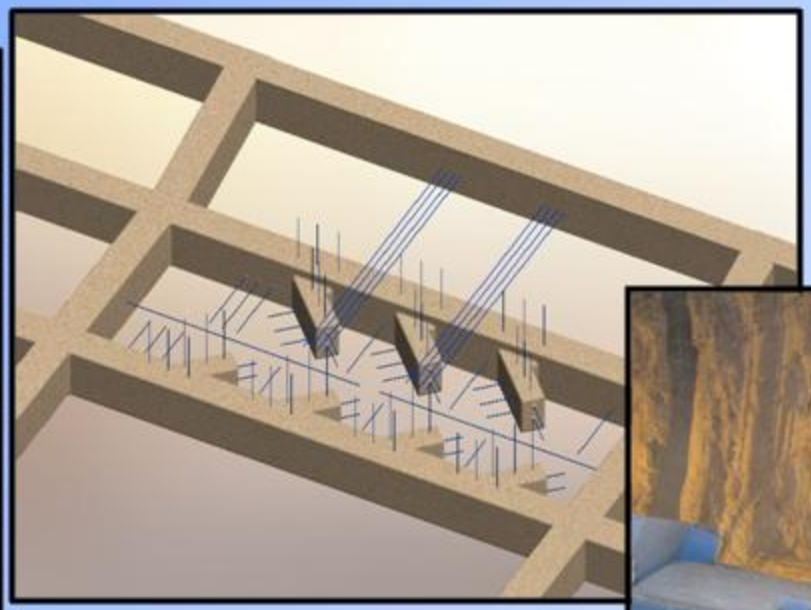
SALT DISPOSAL INVESTIGATIONS

(with a field scale heater test at WIPP)





DOE Carlsbad Field Office

Doug Weaver – Los Alamos National Laboratory

Agenda – Overview of SDI Thermal Test

- SDI Proposal Overview
- Plans for an In Situ Heater Test
  - Basis for the test layout
  - What the test will look like
  - What the test will look like in WIPP
  - Why conduct the test in WIPP?
  - Expectations of the test
- Test Schedule and Key Milestones
- Mining Sequence and Schedule

What is the SDI Proposal?

- A science-based exploration for the disposal of heat-generating nuclear waste in salt consisting of:
  - laboratory testing
  - modeling efforts
  - an underground field test at WIPP

- Directly tests a disposal arrangement for heat-generating waste

- Builds upon past experiences – thermal tests at WIPP, Kansas, Louisiana, and Germany

Salt is an Ideal Disposal Medium

- The concept of disposal of heat generating nuclear waste in salt has been considered viable for many years because salt ...

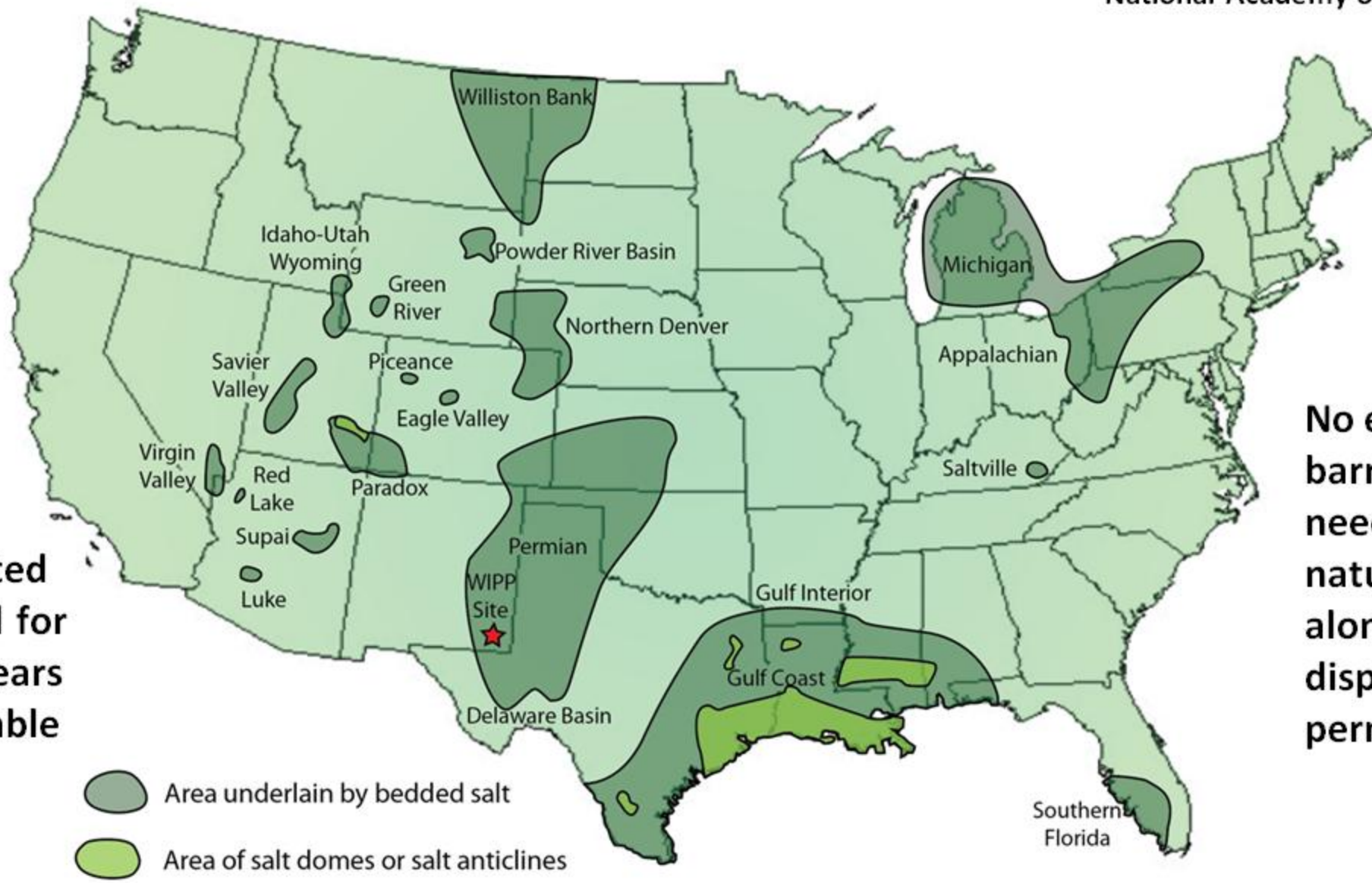
  - Can be mined easily
  - Is essentially impermeable
  - Is self-healing
  - Has been stable for millions of years
  - Has relatively high thermal conductivity
  - Presents many potential sites
  - Has plastic creep deformation that can positively affect encapsulation under thermal conditions

Salt is an Ideal Disposal Medium

There is a wide geographic distribution of salt with many potential sites.

"The great advantage is that no water can pass through salt. Fractures are self healing…."

National Academy of Sciences, 1957



Salt has existed underground for millions of years and has a stable geology.

No engineered barriers are needed – the natural barrier alone makes disposal in salt permanent.

Salt at great depth 'flows.' It will encapsulate waste and isolate it from the surface for eons.

Why Do We Need These SDI Tests?

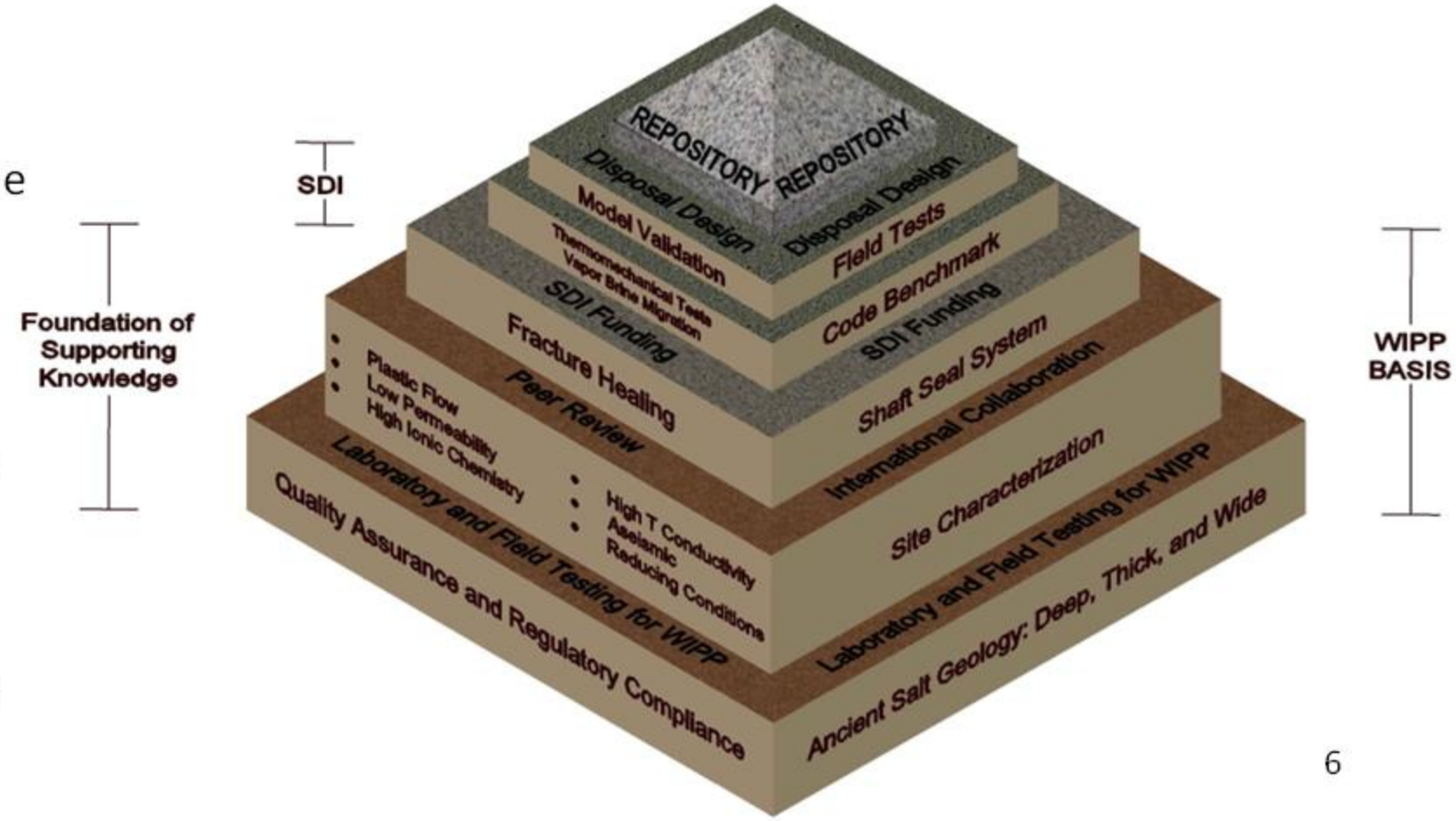
- Salt repository studies and operations have demonstrated that TRU waste can be safely disposed of in salt. As shown in the figure below, there is a substantial foundation of knowledge associated with salt
- More information is needed regarding the disposal of higher temperature waste in salt
- There are things we don't know about salt at higher temperatures (lab and field work)

Salt creep and reconsolidation

Brine and vapor migration

Radionuclide solubility and transport

- This proposed research will fill these information gaps in current knowledge related to the behavior of salt at high temperatures
- This research will form the technical foundation for design, operation, coupled process modeling, and performance assessment of future salt repositories for heat-generating nuclear waste

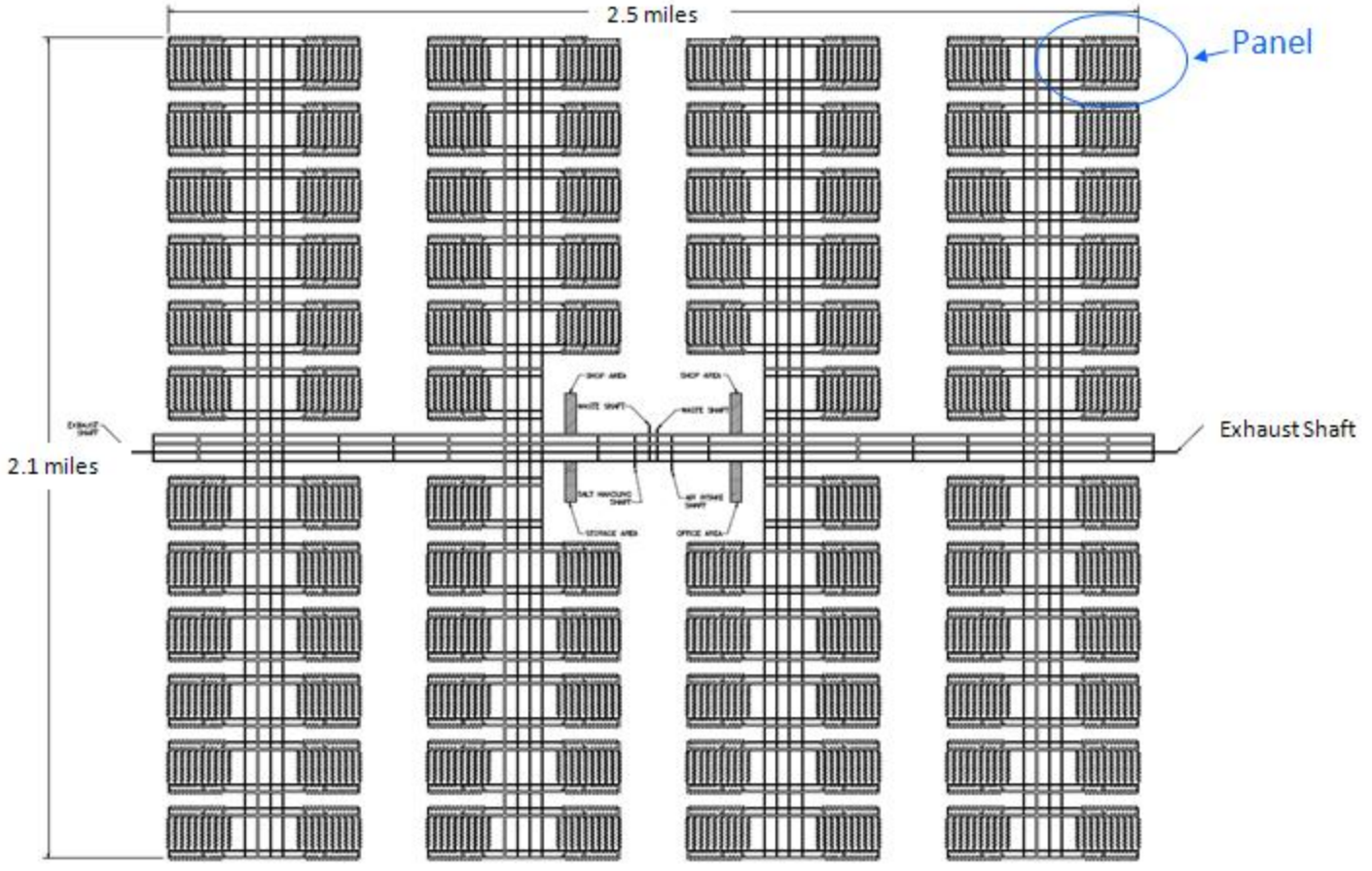


Why a Field Test?

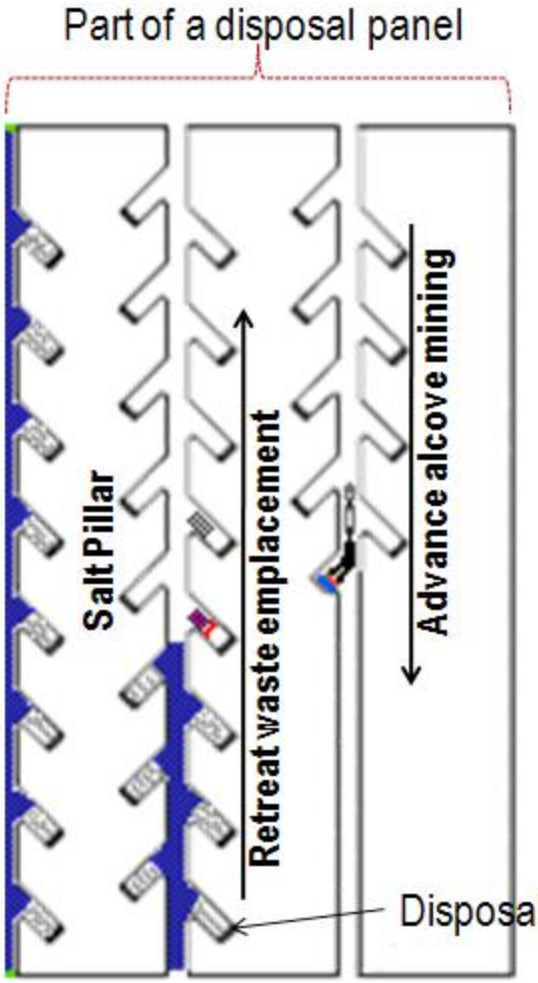
- The field test will provide a direct proof-of-principal demonstration of the alcove waste-disposal concept for heat generating waste
- Past field heater tests, many at WIPP, have provided significant benefit to our knowledge of salt behavior but not to the extent, quality control, or most importantly, the rigorous integration of thermal, mechanical, hydrologic, and geochemical processes necessary to model, and ultimately license, a deep geological repository for HLW in salt
- This test will push the envelope in terms of heat load and the average bulk salt temperature (it will run hotter than previous field experiments including those at Yucca Mountain conducted explicitly for spent fuel HLW)
- Advanced computer modeling and data gathering techniques of today are vastly superior to those used 25 years ago
- Regulatory and technical rigor (QA) is necessary to form defensible conclusions

*Photo from Asse Tests - Germany's Waste Disposal & Research Program

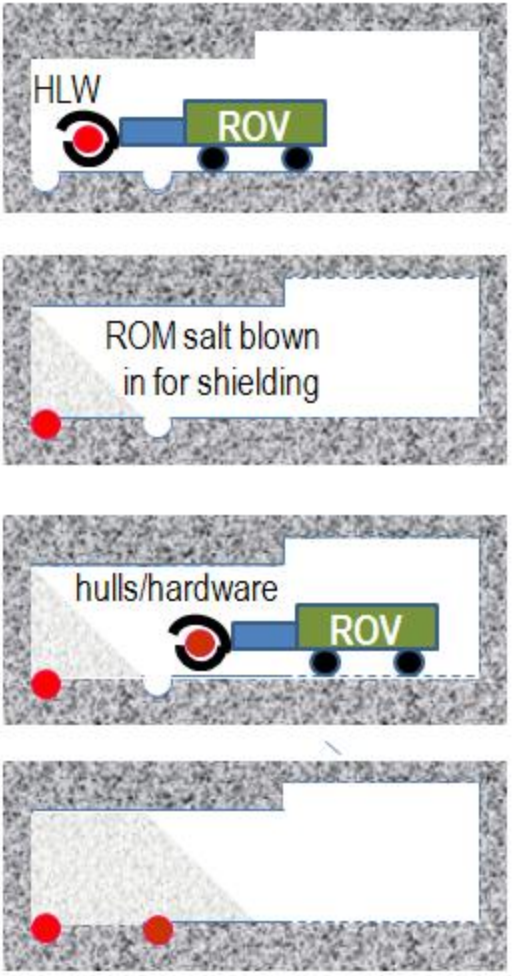
Basis for the Field Test Layout: Generic Salt Repository Concept – Underground Footprint



Generic Salt Repository Emplacement Concept

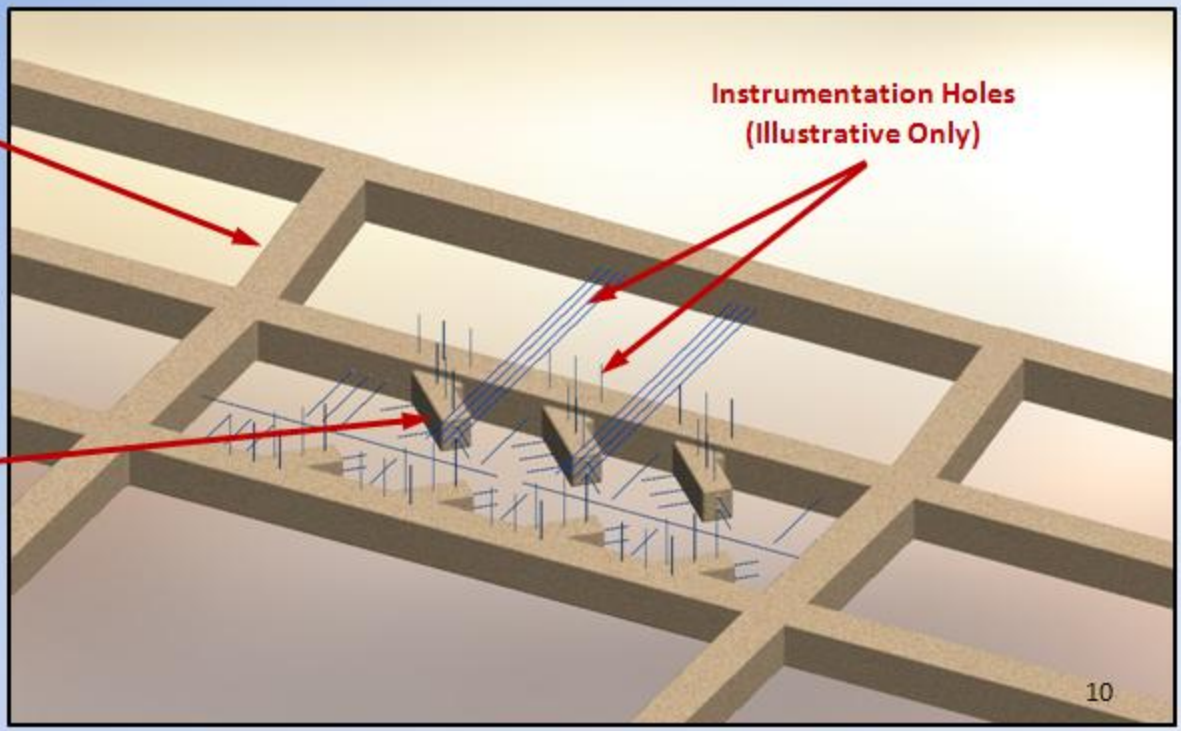


- 6 m deep alcoves
- Angled entries
- Mining and waste emplacement in adjoining rooms
- All waste all in a single disposal concept



What Will the Field Test Look Like?

- The test design is modeled after a proof-of-principle layout and operational strategy for a repository in salt
- The design consists of an array of alcoves with access and ventilation drifts
- Boreholes will be drilled to contain monitoring instrumentation



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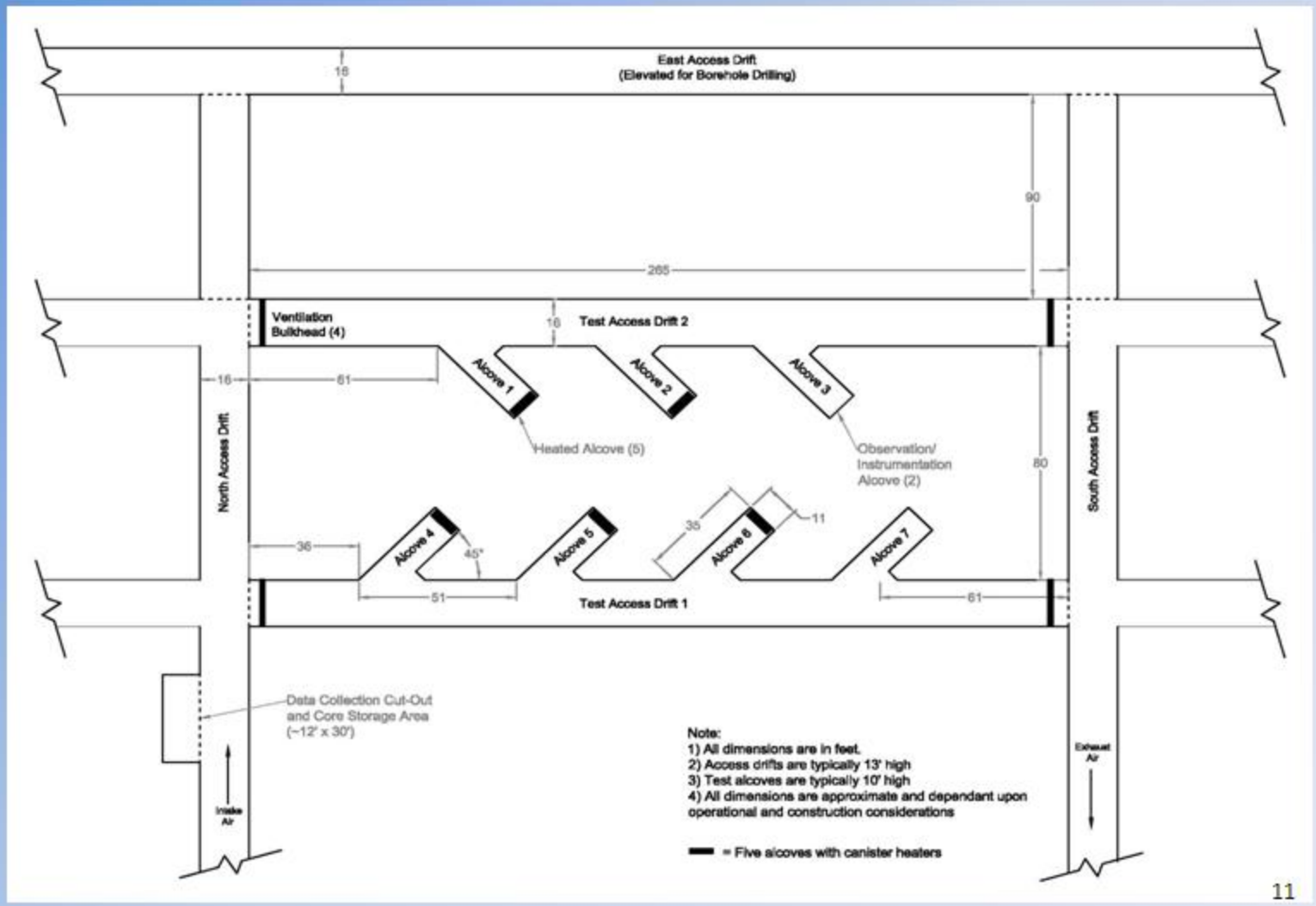
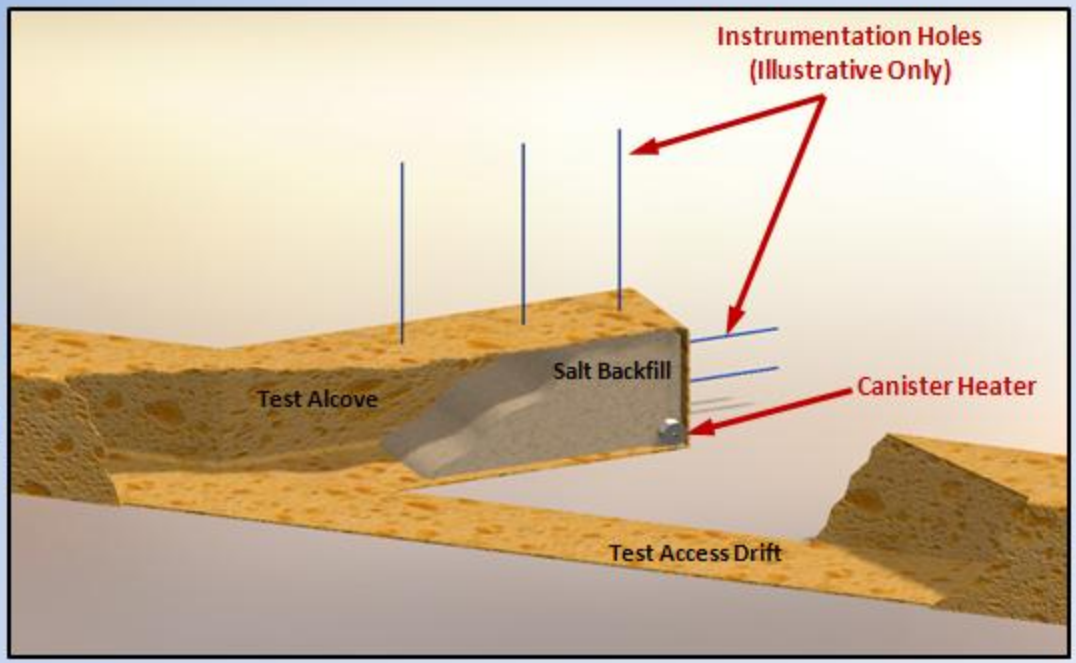


What Will the Field Test Look Like?

- Electrical heaters placed in the back of the alcoves are used to simulate waste packages
- This thermal loading will produce temperatures in excess of 160°C in the nearby undisturbed salt (temperatures well above other existing salt data and beyond temperatures achieved in the Drift Scale Heater Test at Yucca Mountain)
- The alcoves will be instrumented to measure:
  - water movement
  - temperature
  - deformation
  - alcove closure
  - crushed salt pressure
  - ventilation conditions
- Two years heating (planned)
- Two years cooling
- Post-test forensics will confirm measured data



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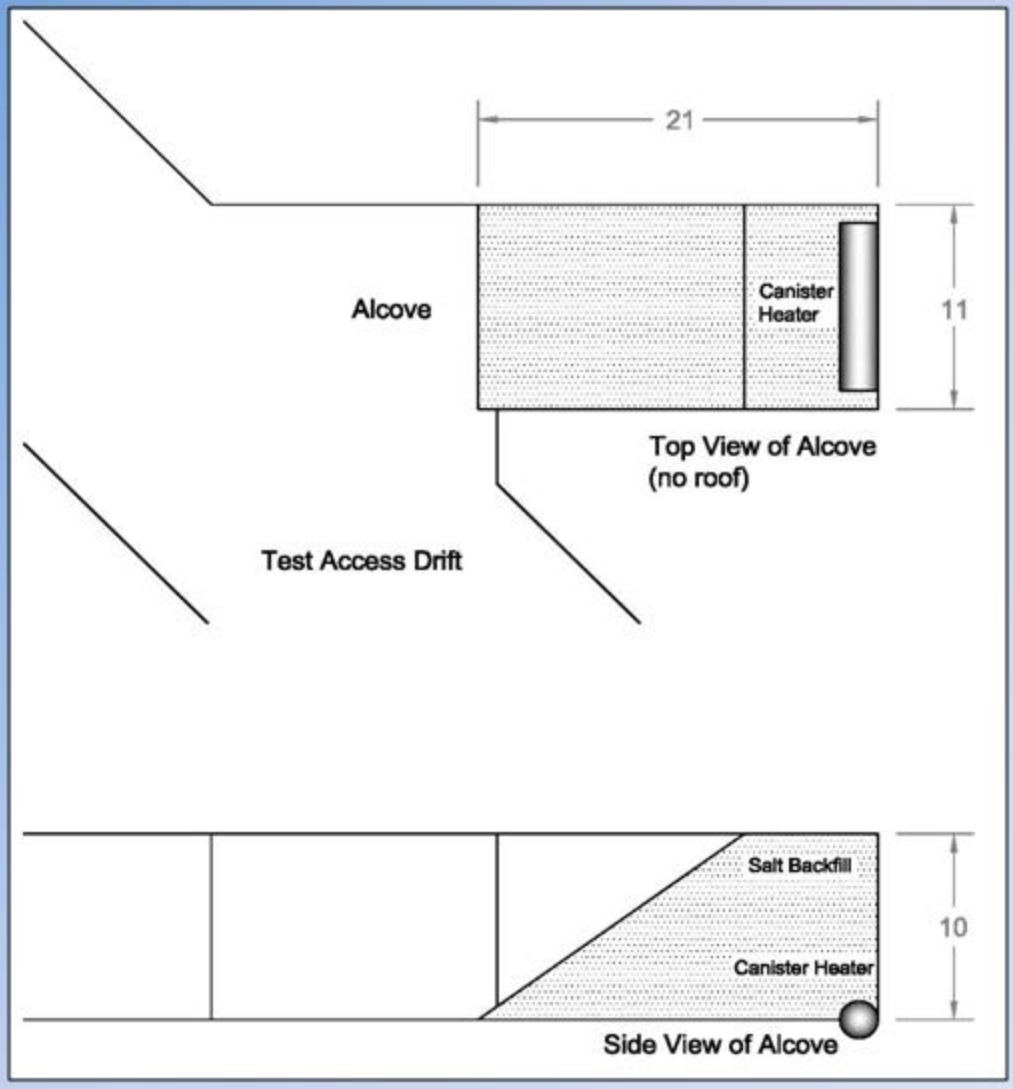
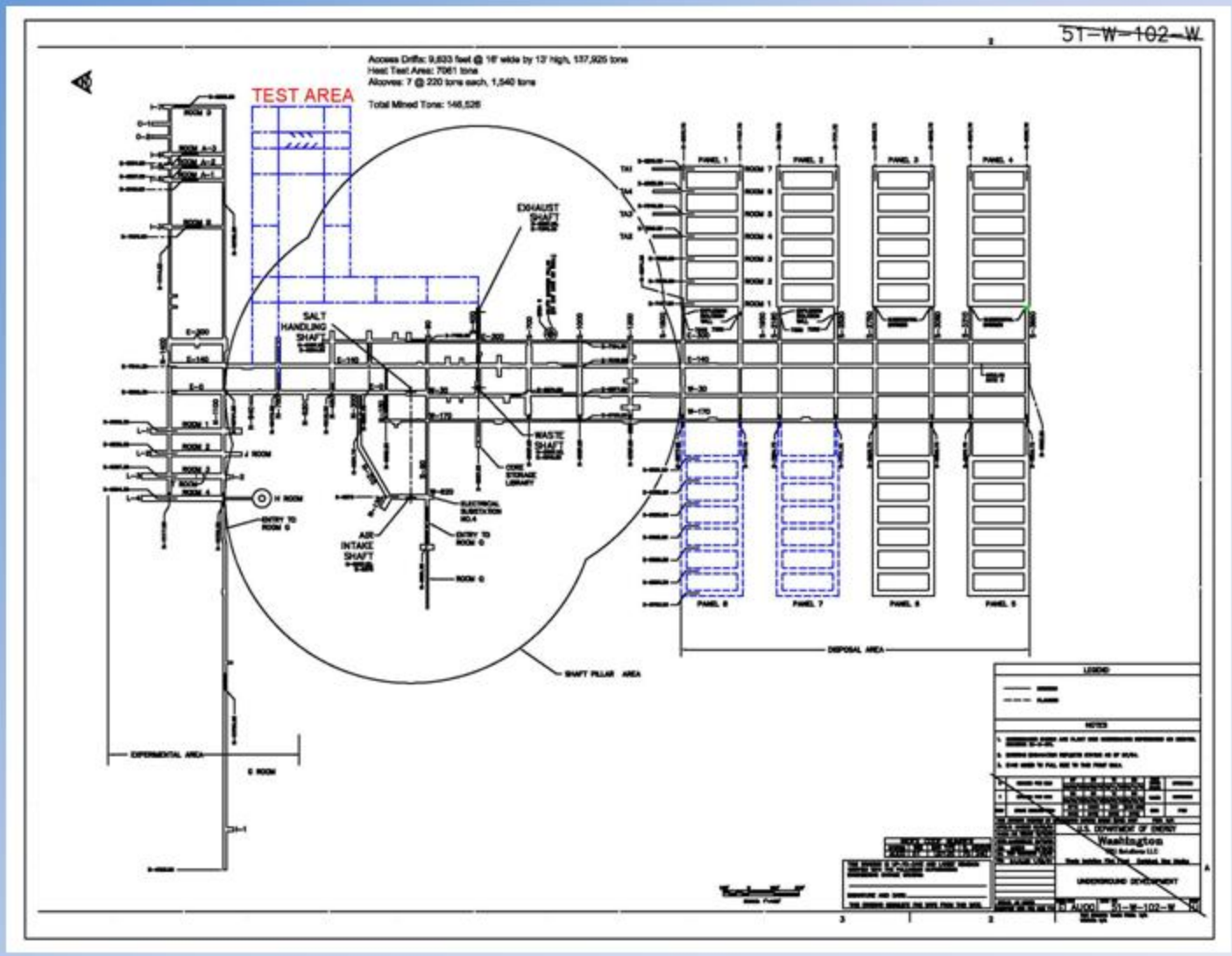


What Will the Field Test Look Like in WIPP?



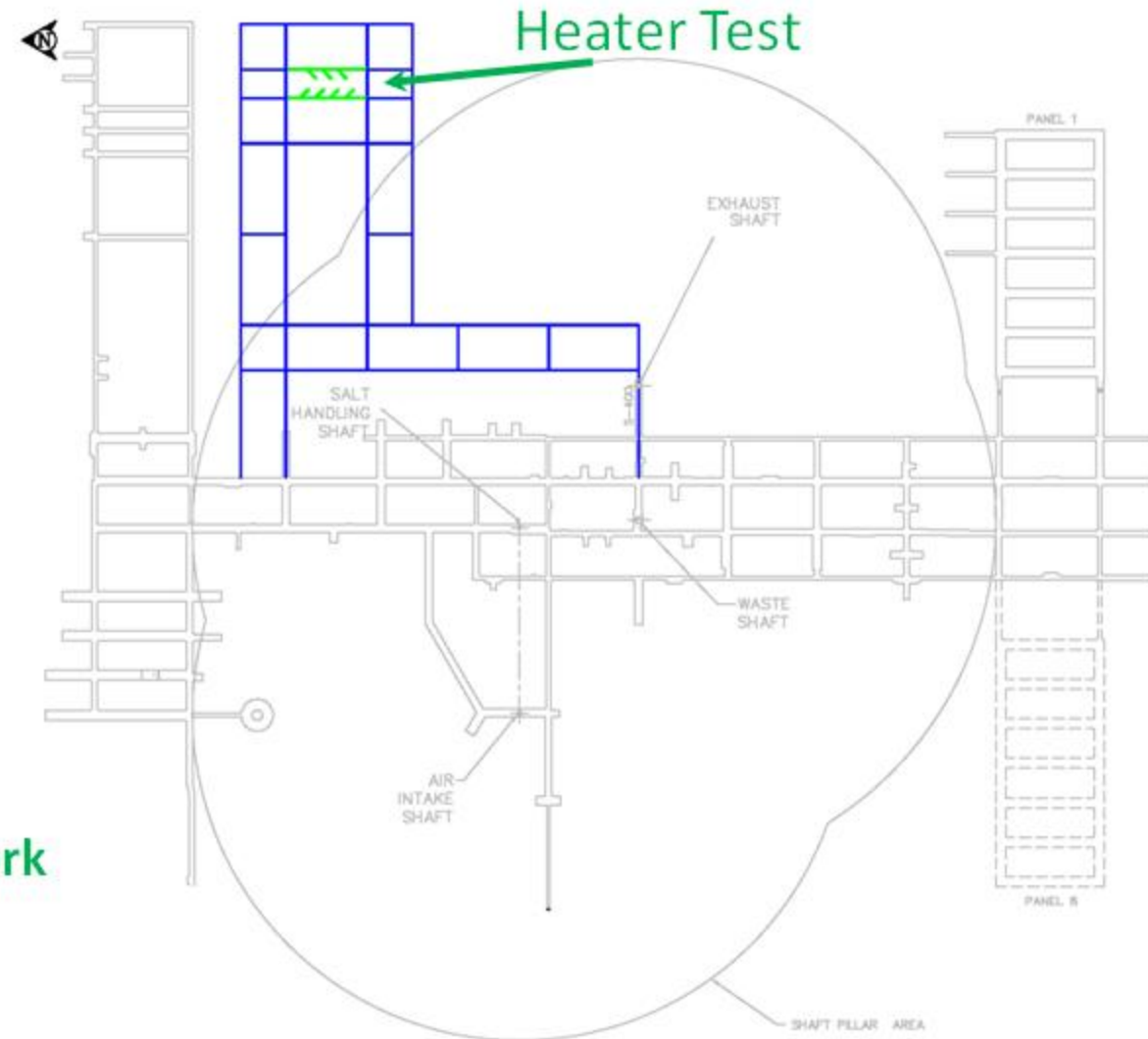
Why Conduct the Field Test at WIPP?

Order of magnitude cost, and significant schedule savings, will be realized by conducting the field test at WIPP.

This test can begin, and be completed, years sooner and tens of millions of dollars cheaper than at a location without underground access, support infrastructure, and resident skilled labor and scientific resources.

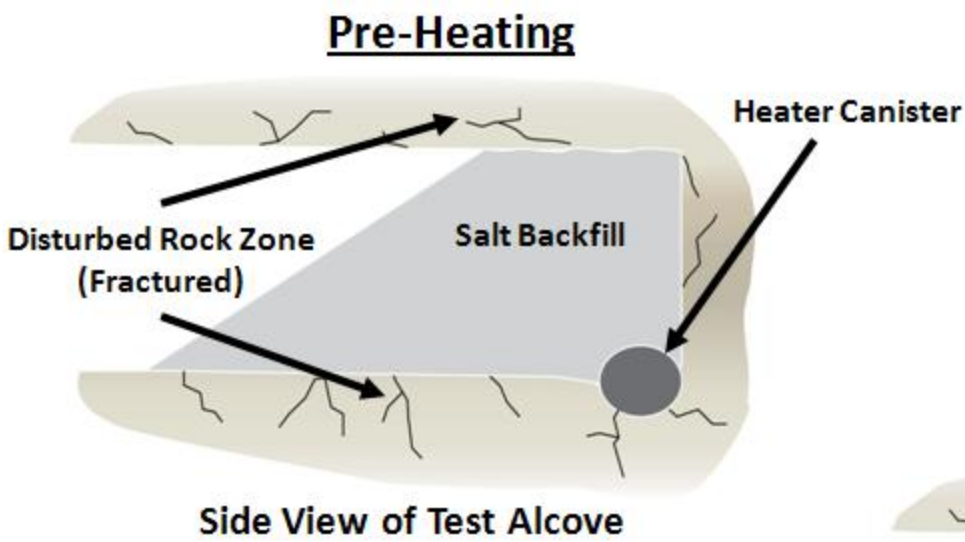
Advantages of using WIPP:

- existing trained workforce
- mining infrastructure
- construction equipment
- MSHA Qualification
- QA Program
- Data more readily transferable to other potential salt sites

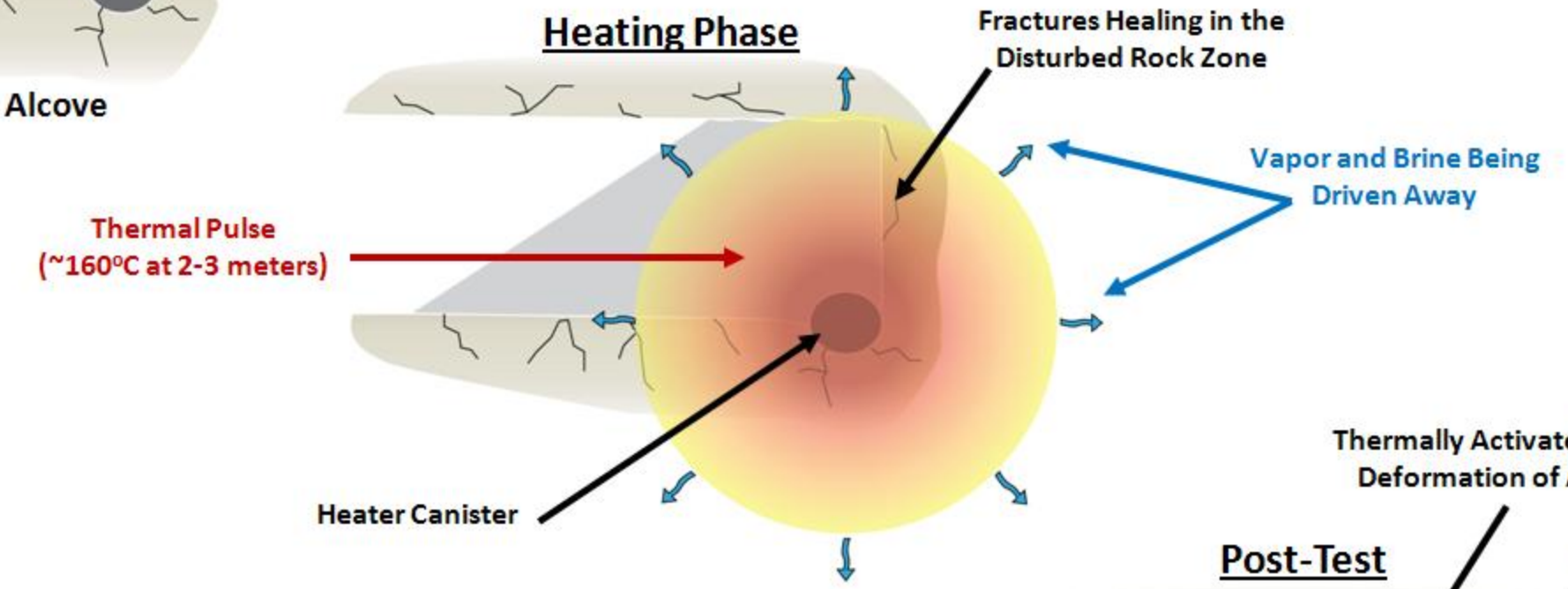


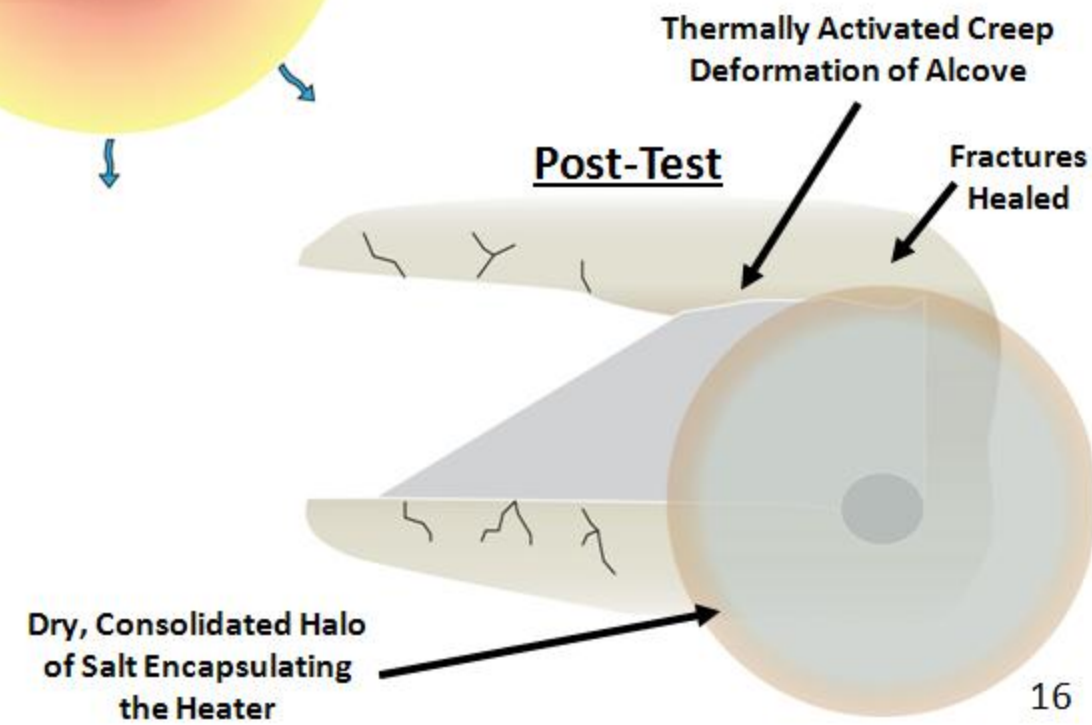
- **Staff is trained and available**
- **WIPP mining schedule accommodates this work**
- **Fast test start**
- **Less overall cost**

Expectations of the Field Test



In this series of simple illustrations, a side view of a test alcove is shown. The heater is on the floor at the back of the alcove. The alcove is heated for at least two years.



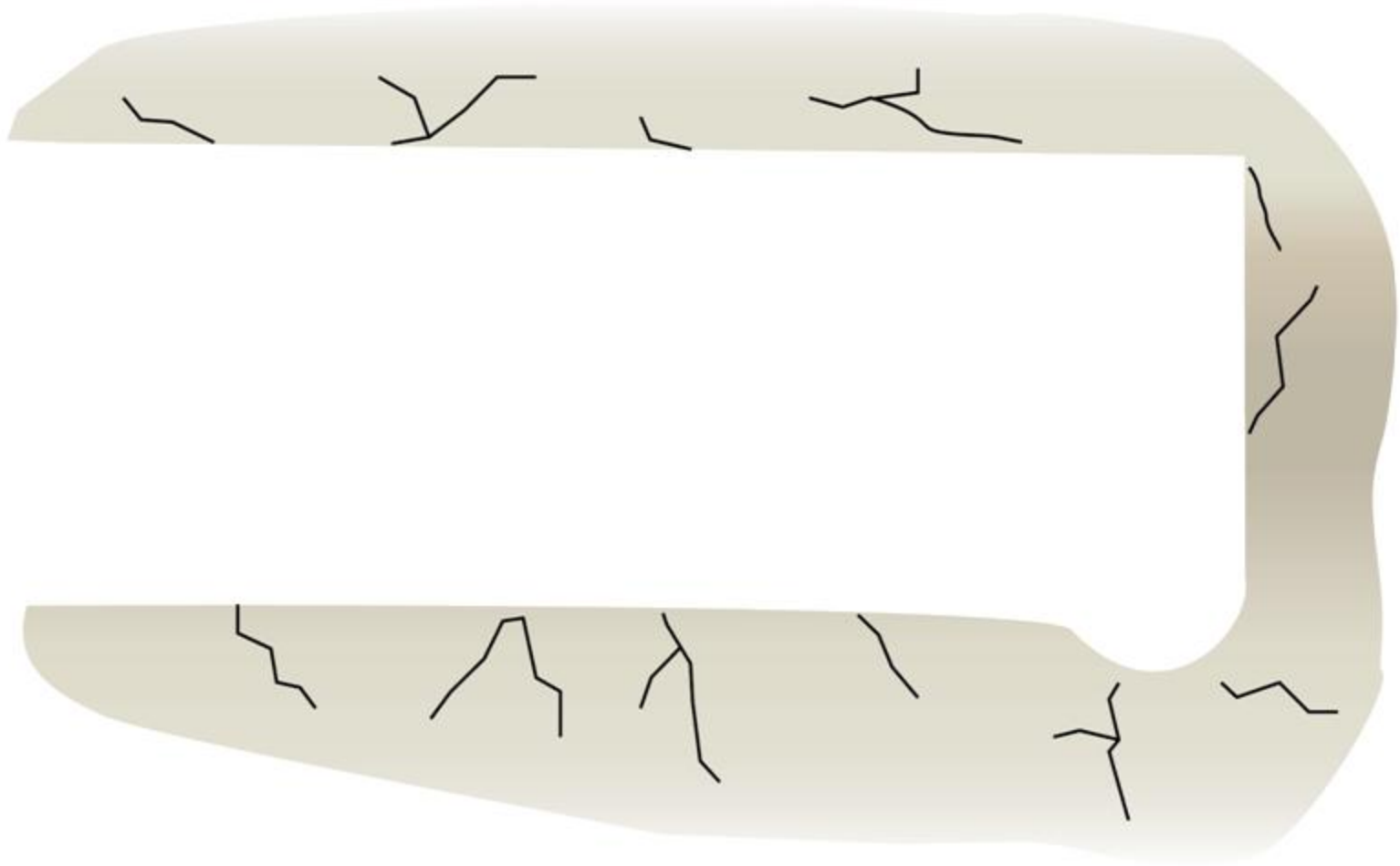


Data is collected throughout the test period, and at the completion, post test forensics will be conducted to prove a dry, consolidated halo of salt has formed around the package, encapsulating it permanently.

Expectations of the Field Test

Pristine Intact Salt

Expectations of the Field Test



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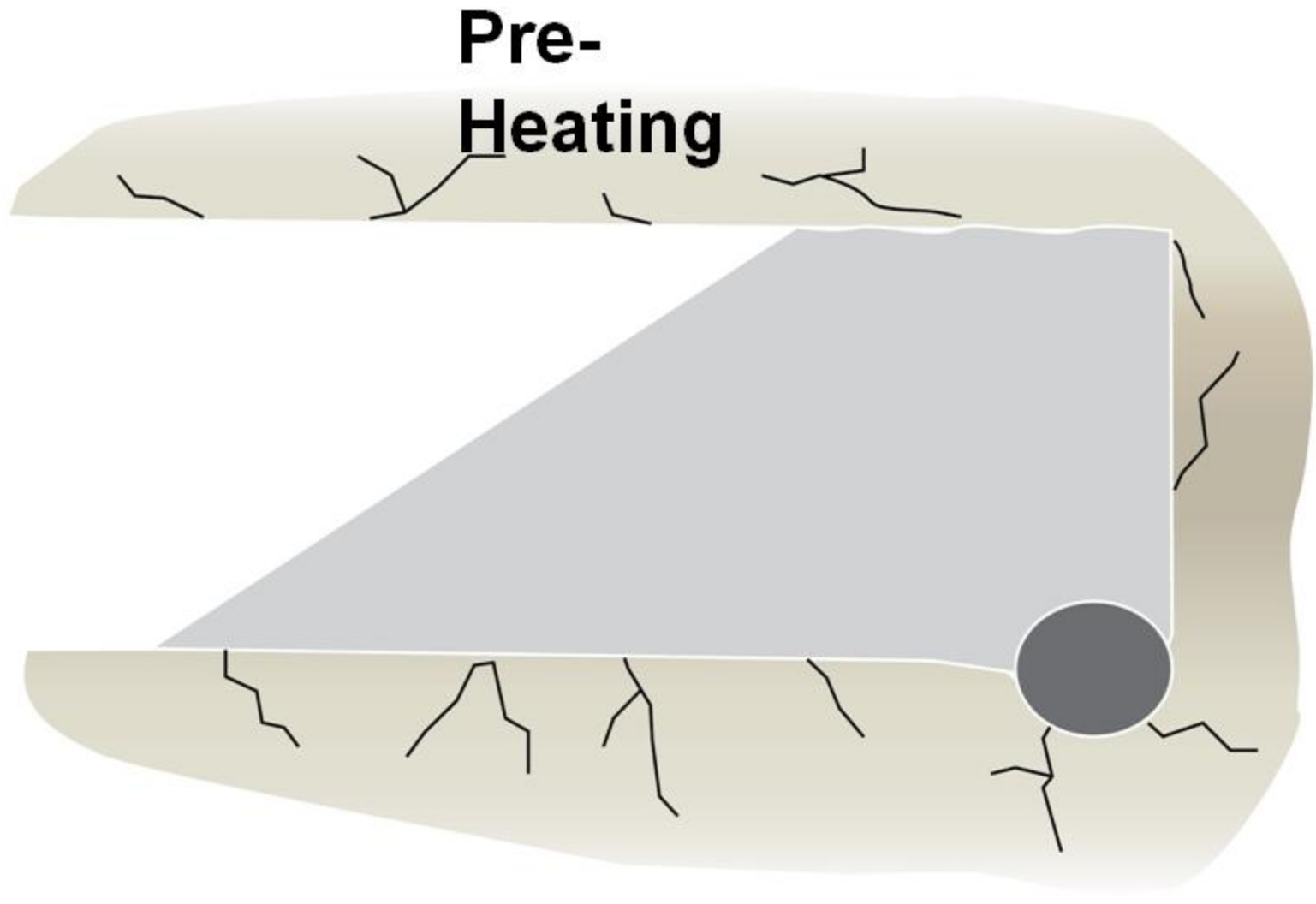

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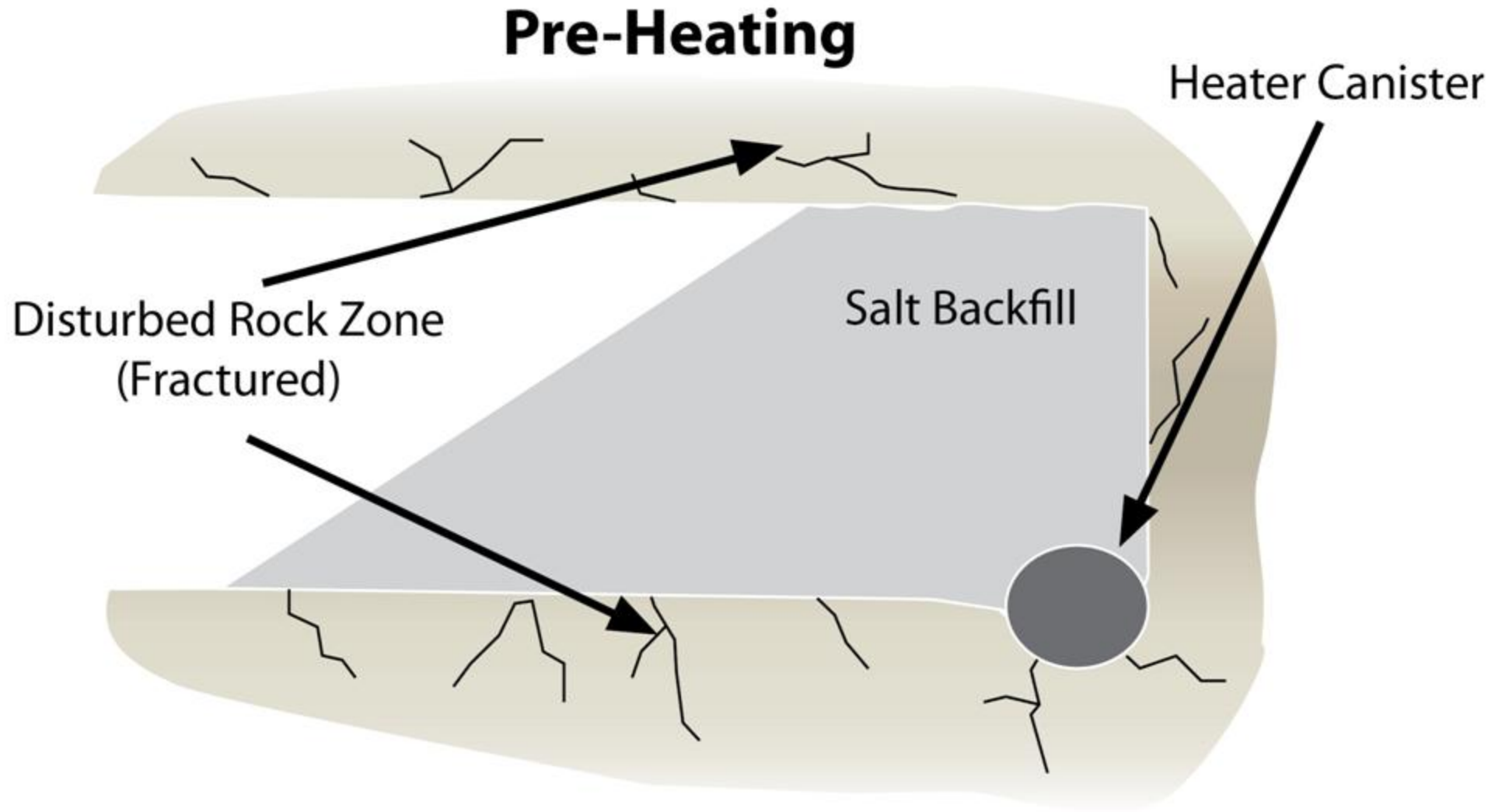
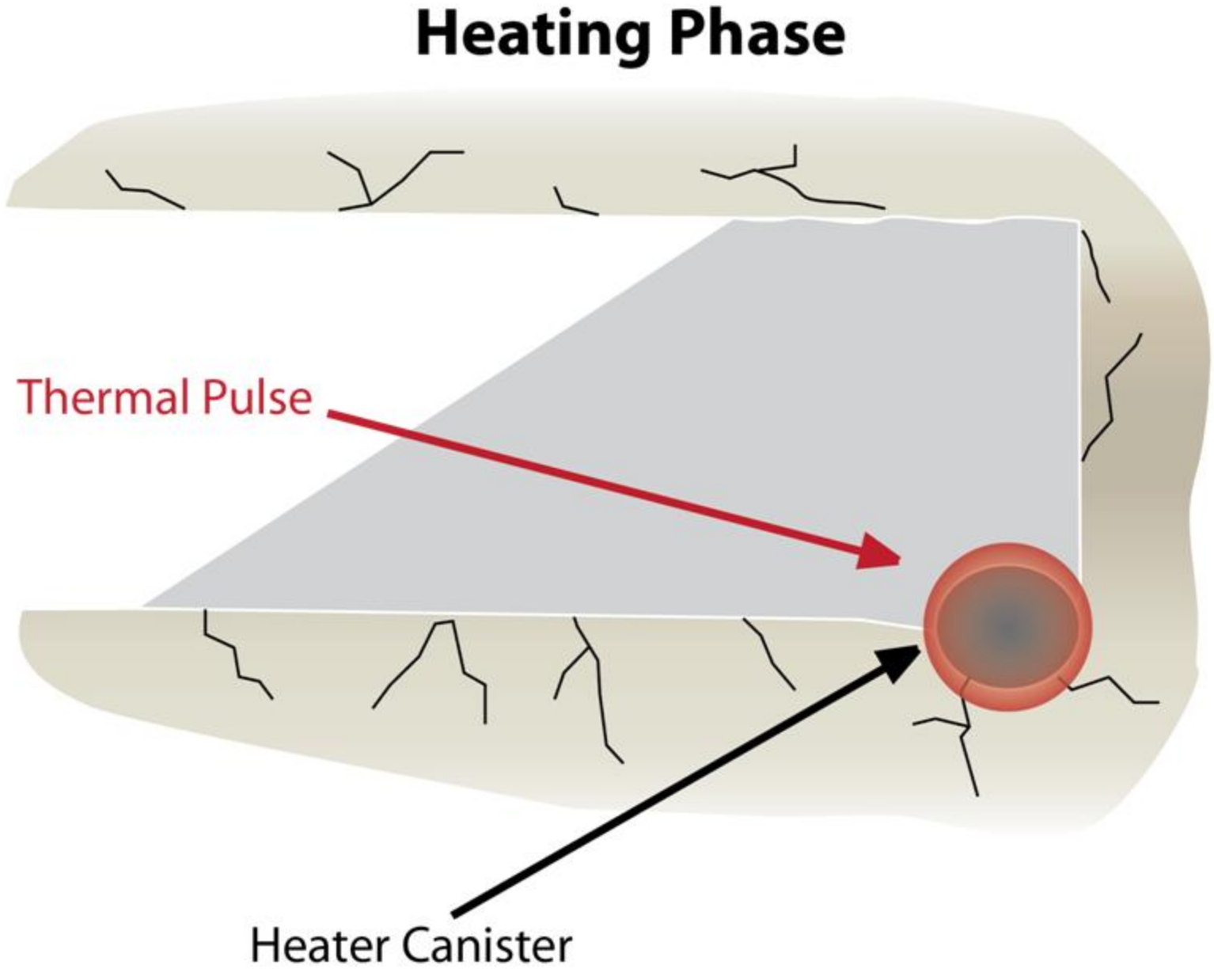


Side View of Test Alcove

Expectations of the Field Test



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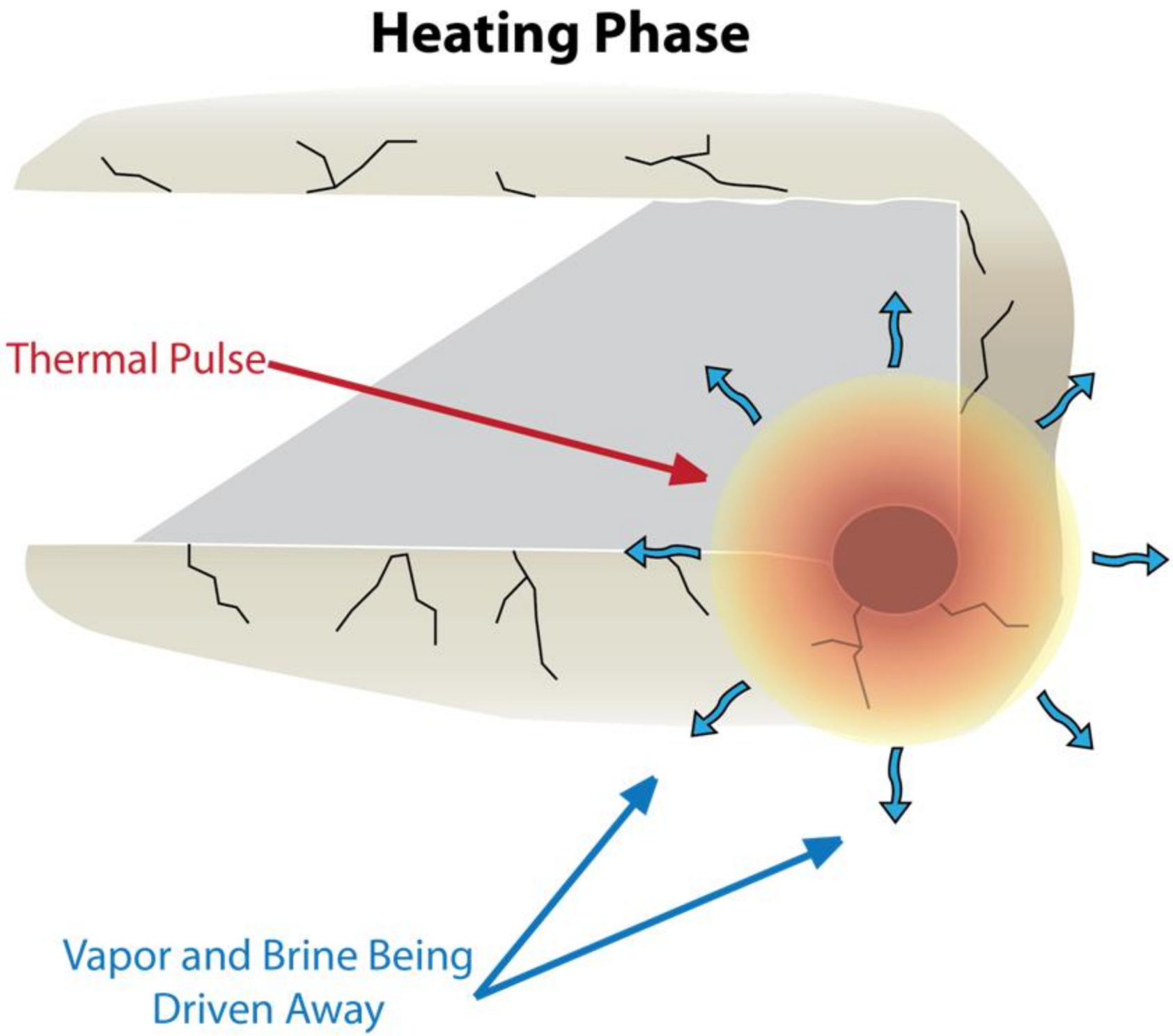

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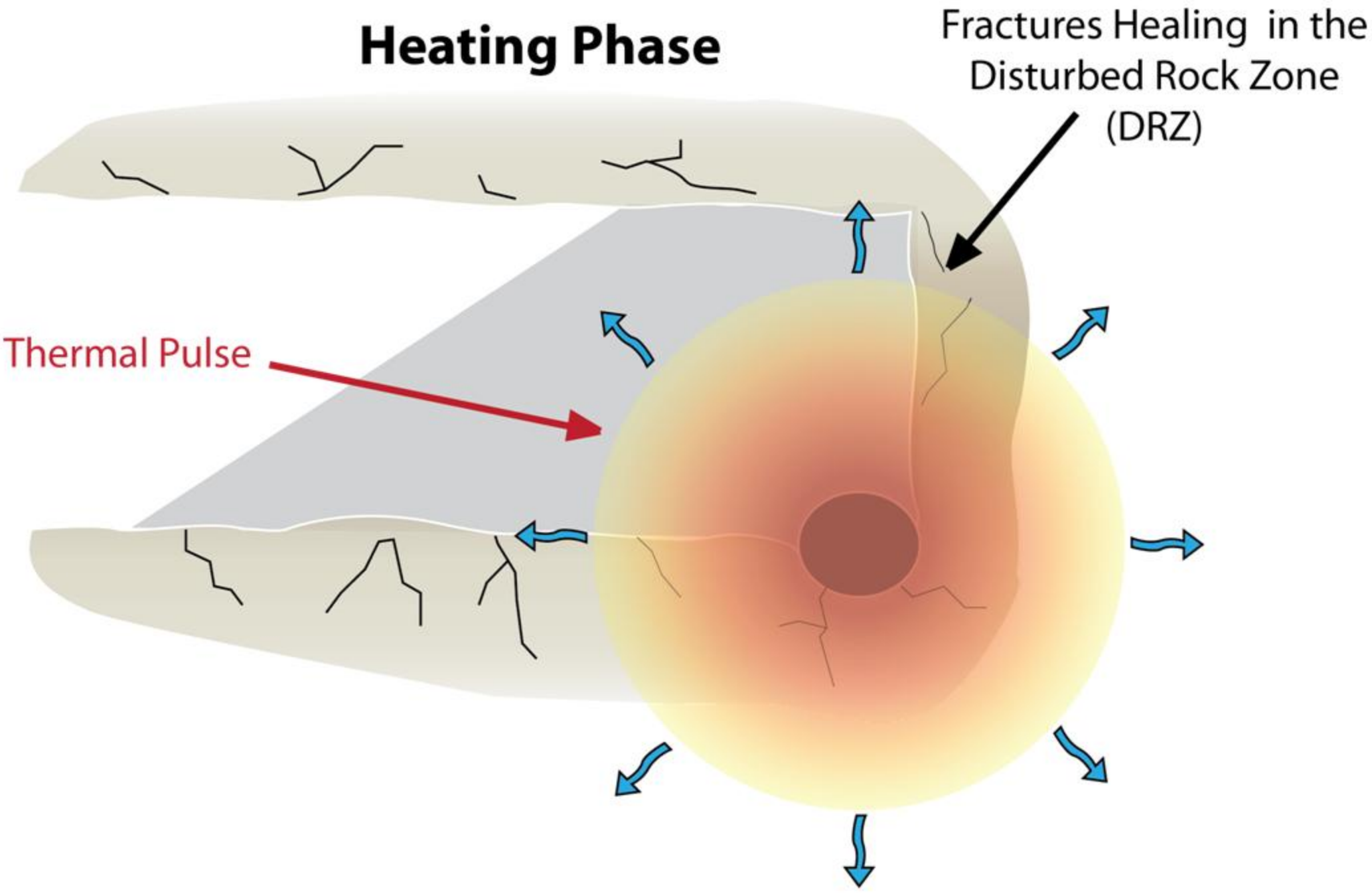

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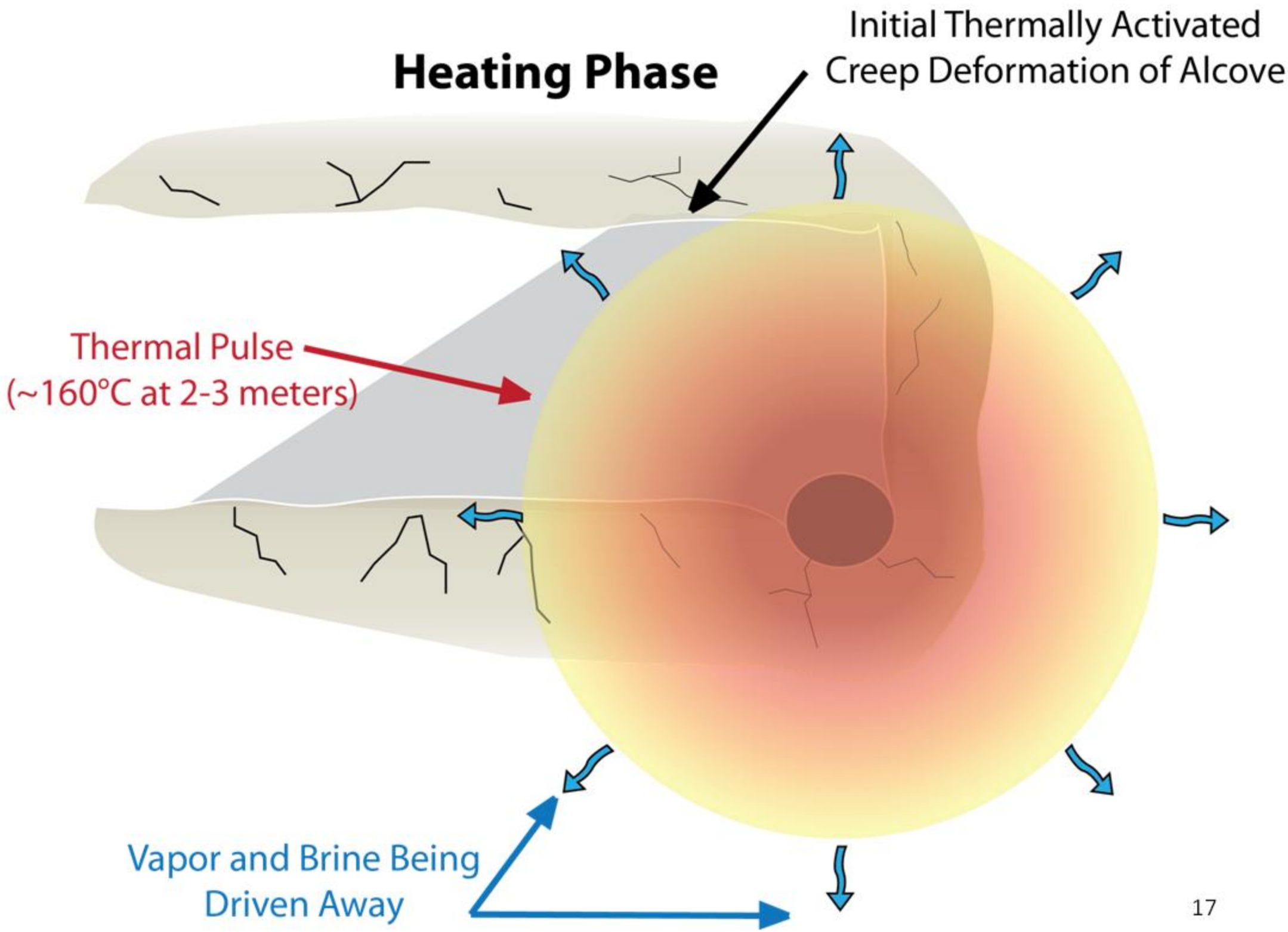

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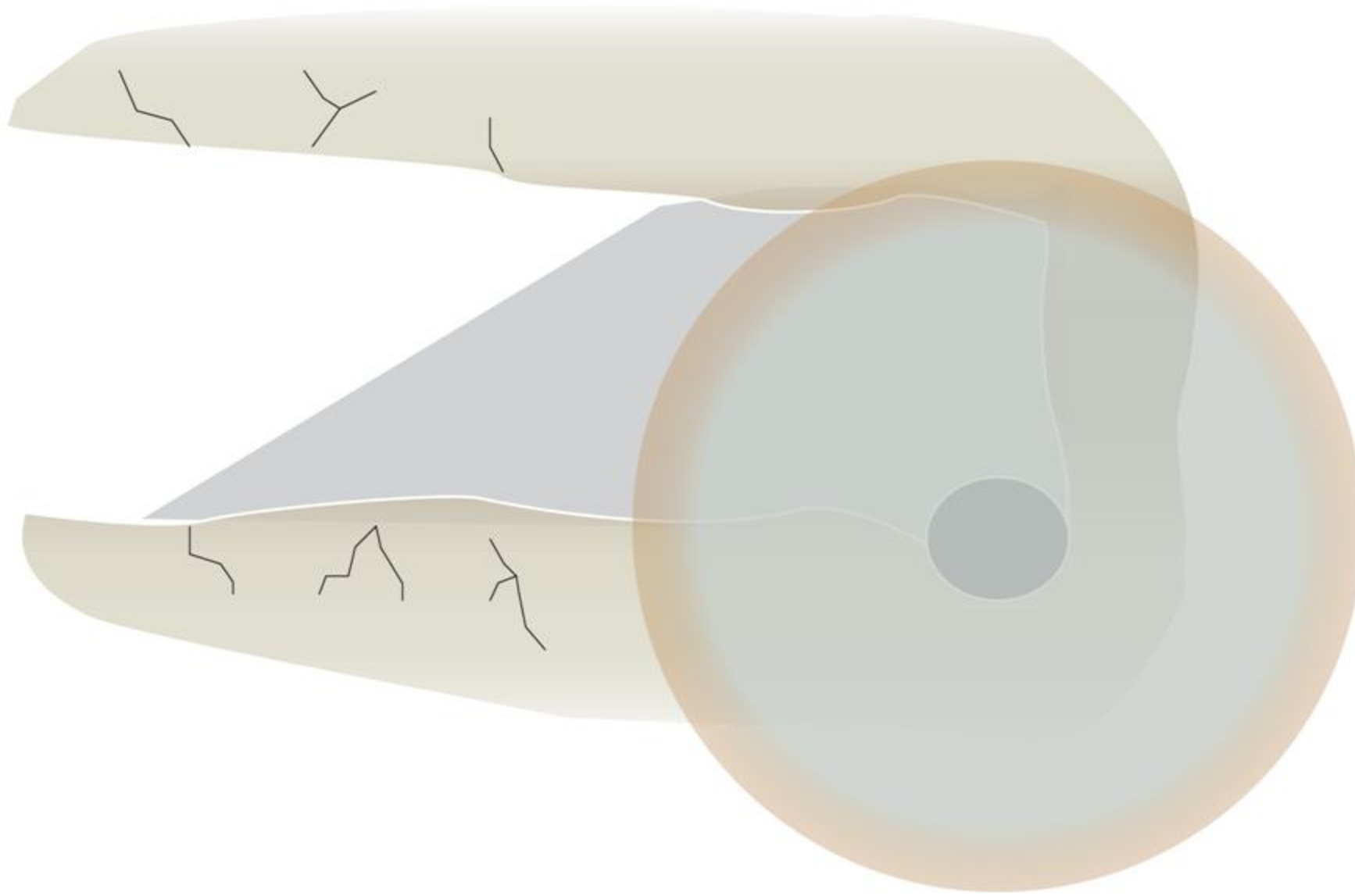

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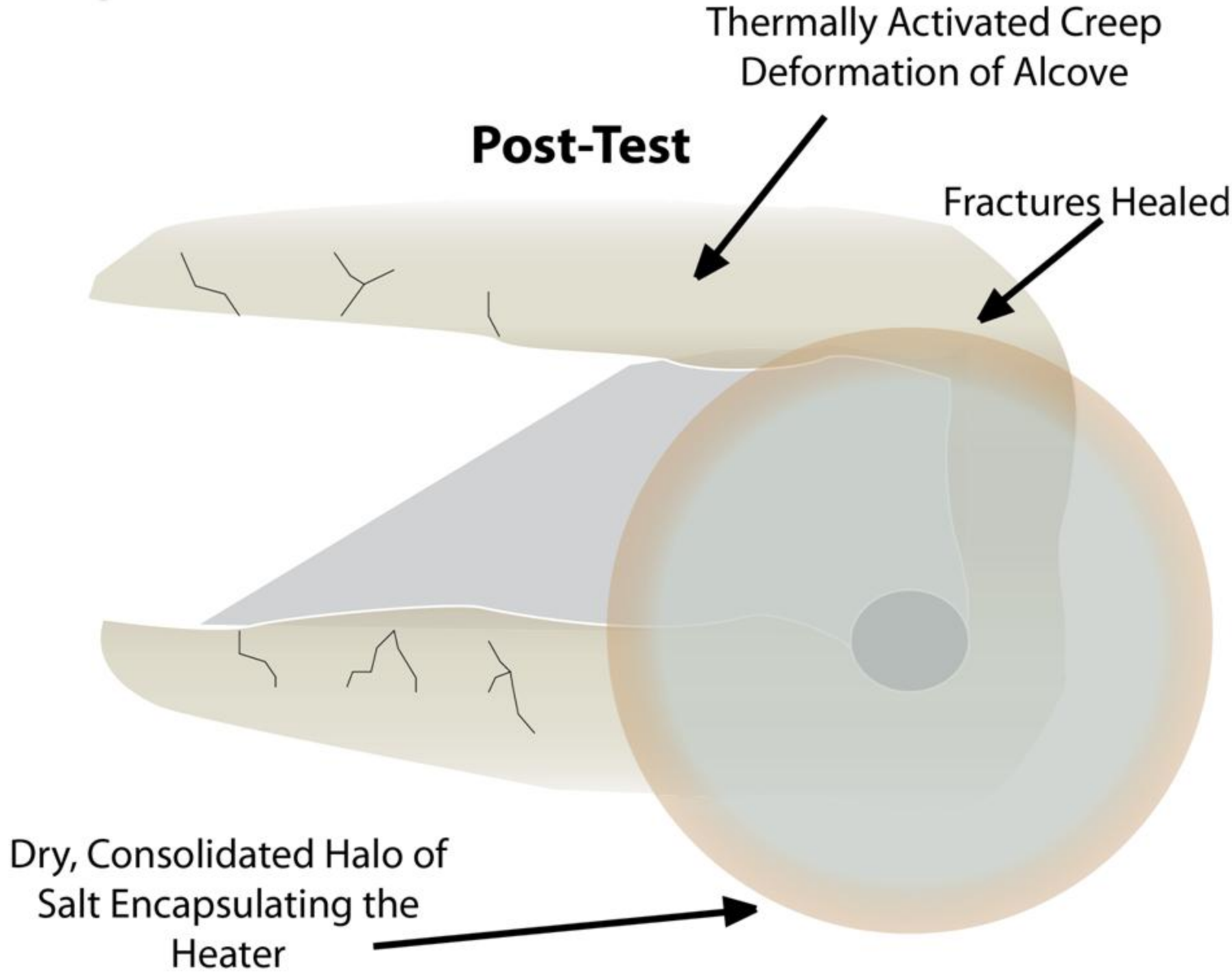

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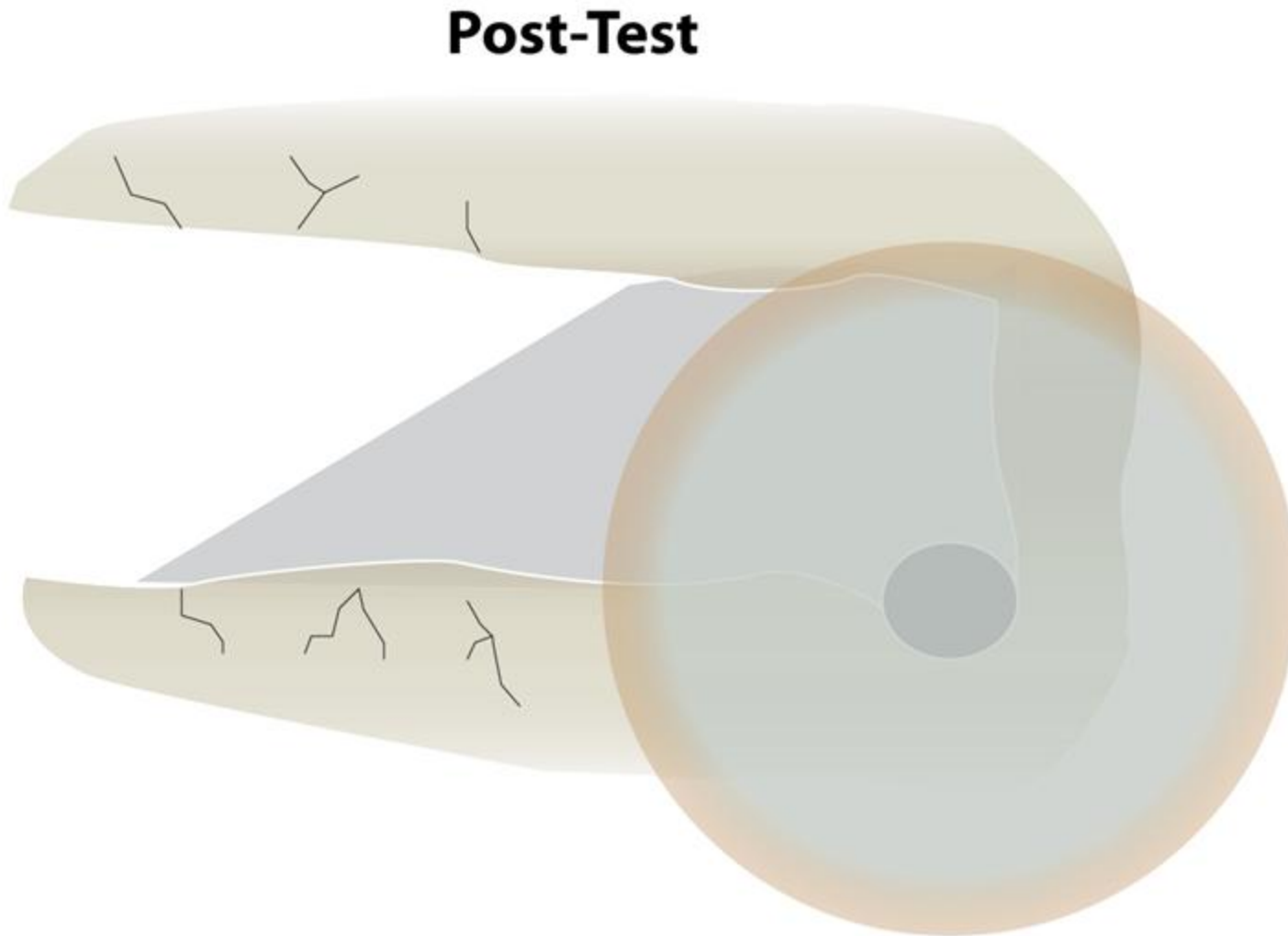
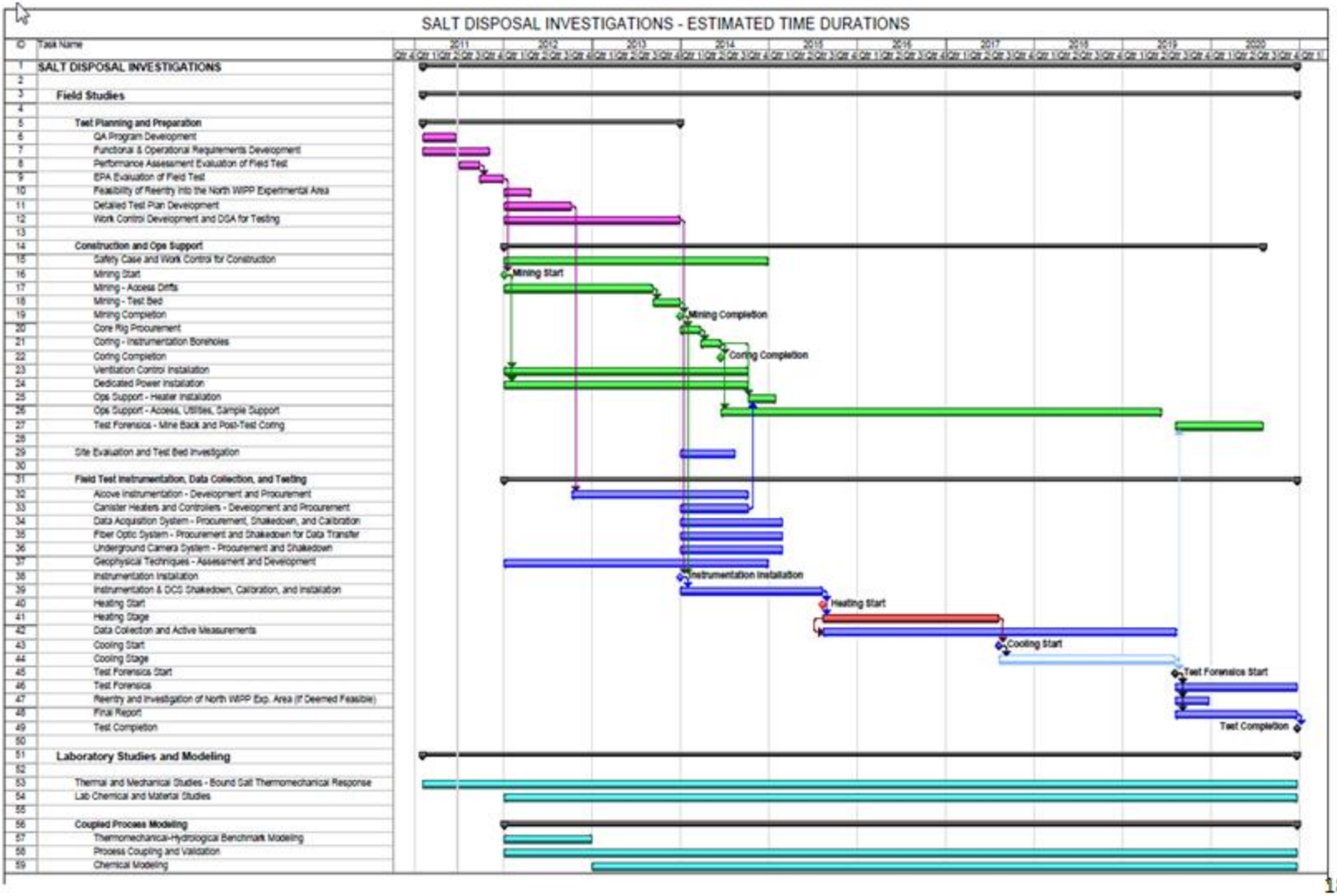


Data will be collected throughout the test period, and at the completion, post test forensics will be conducted to prove the theory that a dry, consolidated halo of salt will form around the package, encapsulating it permanently.

Mining and Test Schedule (planned)



Key Milestones (planned)

FY12

Develop and review the detailed field test plan
Begin mining the underground access drifts to the test bed location
Begin developing and specifying test instrumentation and geophysics

FY13

Procure test equipment and instrumentation
Complete mining of the underground access drifts
Mine the test bed

FY14

Core instrumentation boreholes
Install instrumentation, data collection and fiber optic communication equipment

FY15

Heating Start: Planned two year duration

Outyears

Begin Cool down period in FY17/18
Post-test forensics, mine-back and post-test coring in FY 19 and FY 20
Complete the final test and data reports
Develop calibrated, coupled TM(H) model

Mining Sequence and Schedule

Schedule:

Panel 7 completion = 1st week of September

Phase I duration = 28 wks
Total duration = 84 wks

Mine Day shift (7 days) and back shift (M-Th)

Sequence:

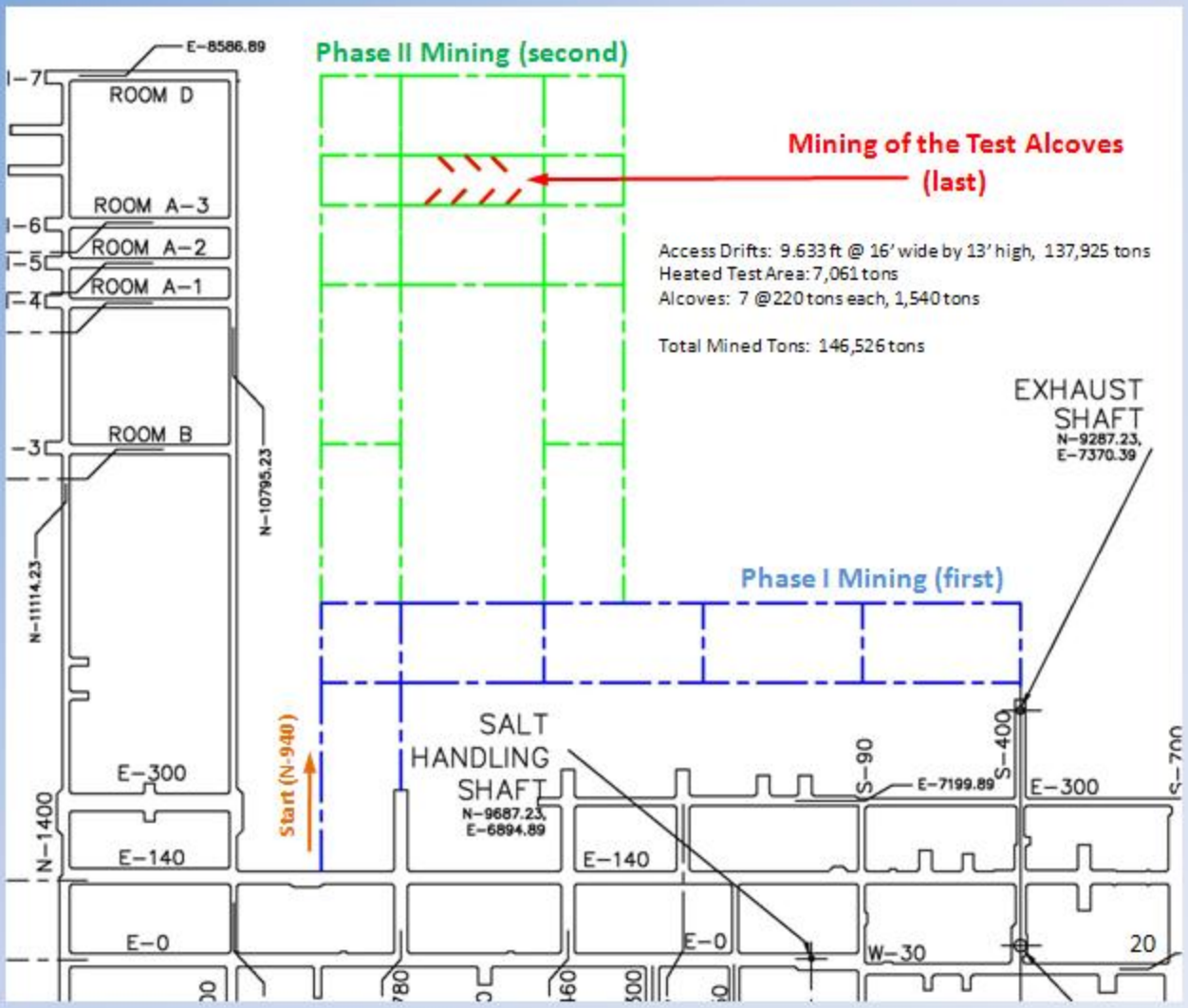
Start at N-940 and complete a ventilation loop back to N-780.

Work south to tie into the Exhaust Shaft.

Two drives (top bench, then remove floor). Set up regulators and control ventilation before tying into the exhaust shaft.

Mine Phase II, probably two headings.

Complete test alcoves as needed for coring and instrumentation.



Up Next …

- Overview of SDI PCN
- Impacts of SDI on WIPP operations
- Impacts of SDI on long-term performance

- Issues/Questions