U.S. DEPARTMENT OF ENERGY
OFFICE OF CIVILIAN RADIOACTIVE WASTE MANAGEMENT

PRESENTATION TO THE NUCLEAR WASTE TECHNICAL REVIEW BOARD

SUBJECT: EFFECTS OF REPOSITORY DEVELOPMENT

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PRESENTER'S TITLE AND ORGANIZATION: TECHNICAL AREA LEADER,
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REGISTRY HOTEL, DENVER, COLORADO
JUNE 25-27, 1991

Emphasis of Presentation

- Update of overview presented December 11-12, 1989 Information
- Disturbed Zone Characterization
- Repository/emplacement effects-design options

Update

- Physical Effects of WP Emplacement on the Environment
  - Advances in hydrologic & chemical understanding
- Laboratory and Field Evidence for Physical and Chemical Effects

Summary 1989

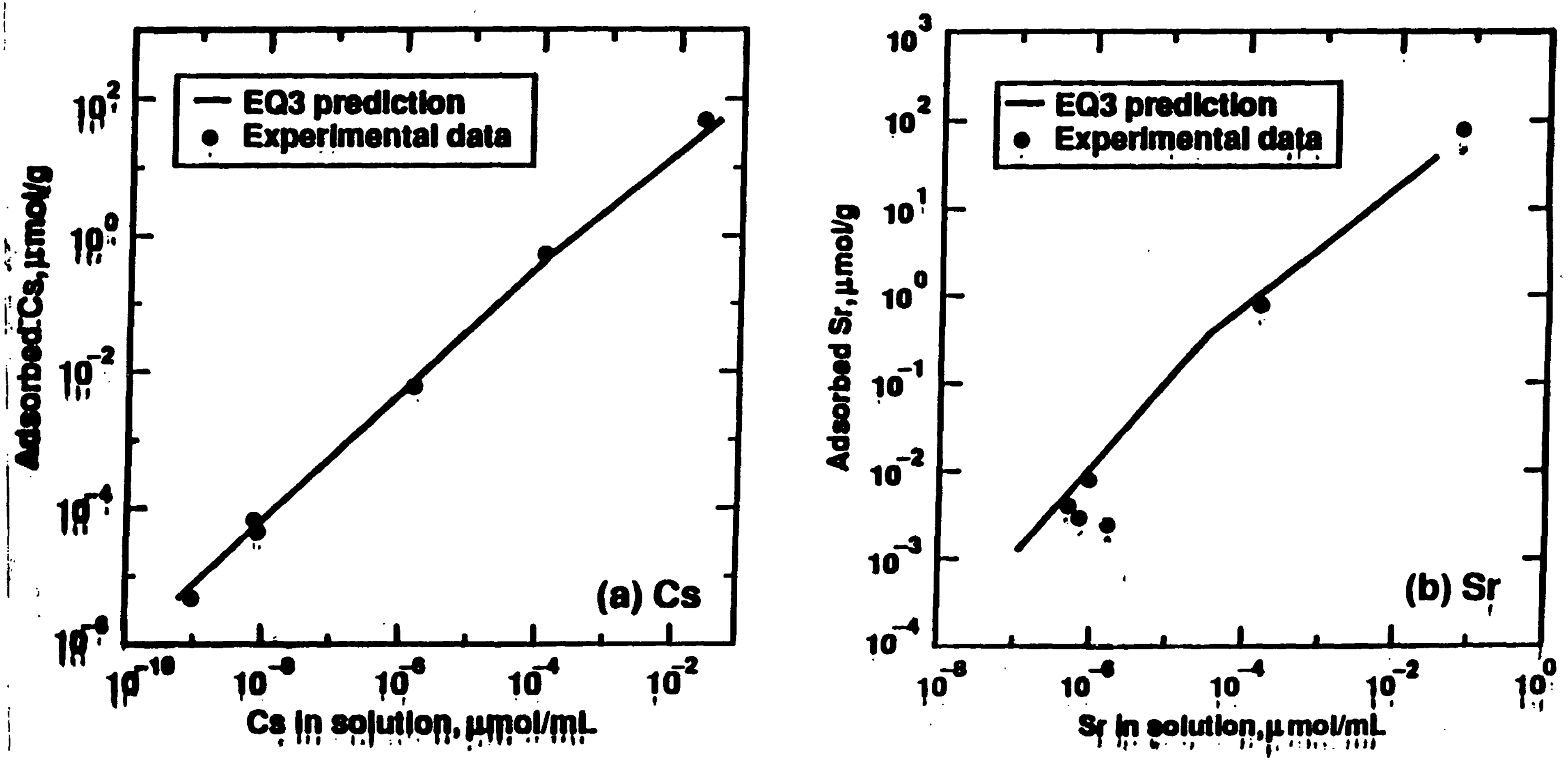
- Modeling Activities successfully describe hydrological, ...& geochemical bahavior of a range of laboratory and field systems
- Comparisons between model predictions, and laboratory and field studies identify important data and model needs
- Future work will concentrate on these areas, and on model validation

Rock-Water Interaction

Rock	Water	Conditions
Topopah Spring Tuff	J-13 concentrated	90-350°C
devitrified	J-13	~100 bars
Vitric	distilled	60-304 days
zeolitized		

- Aqueous SiO_2 activity plays key role in paragenesis of secondary minerals
- Diagenetic sequence of minerals & textures at Yucca Mountain are reproduced in experiments
- Zeolites produced contain cation compositions in fair agreement with ion exchange model added to EQ3/6

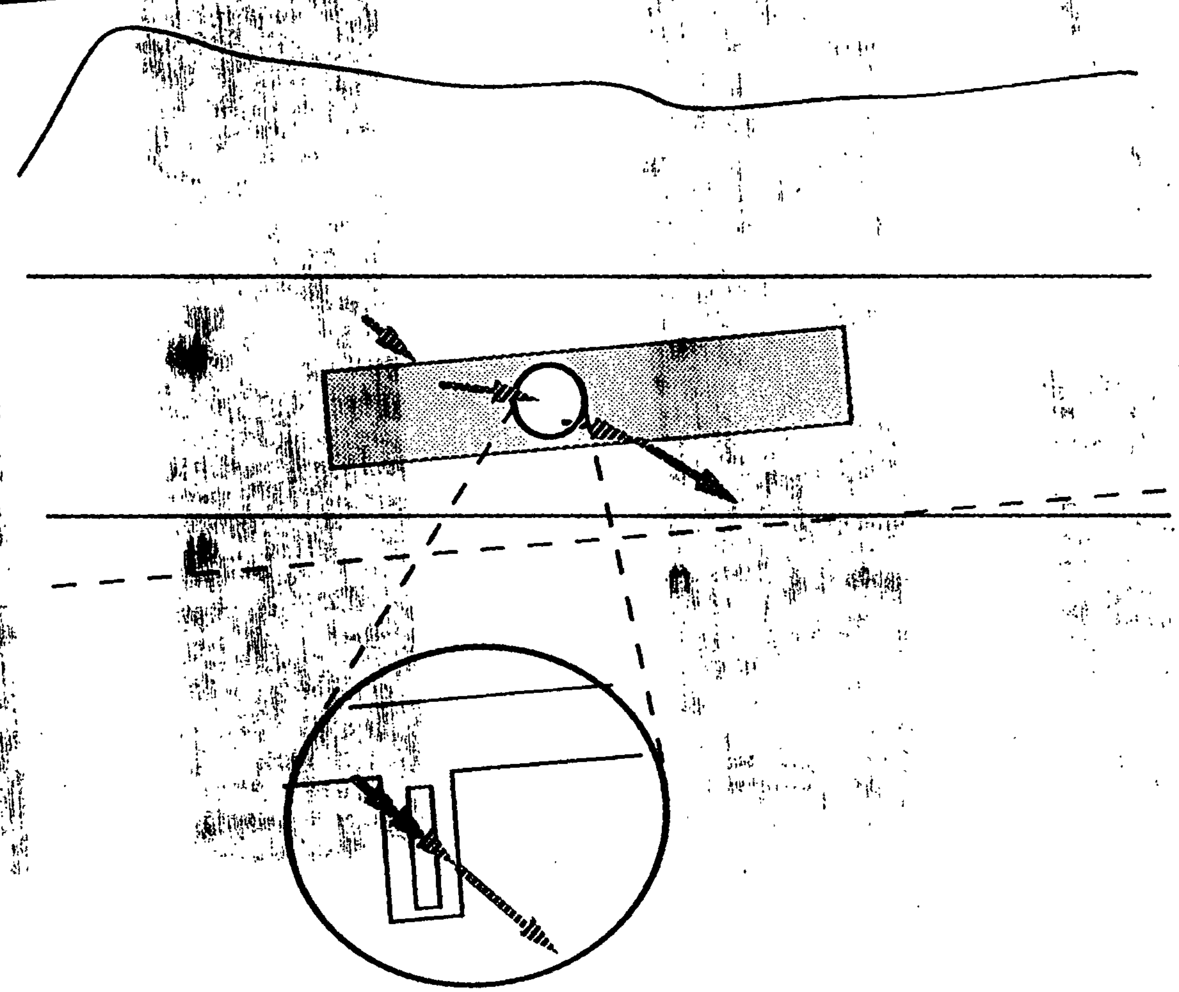
Cation-exchange modeling examples: Comparison of predicted with experimental isotherms



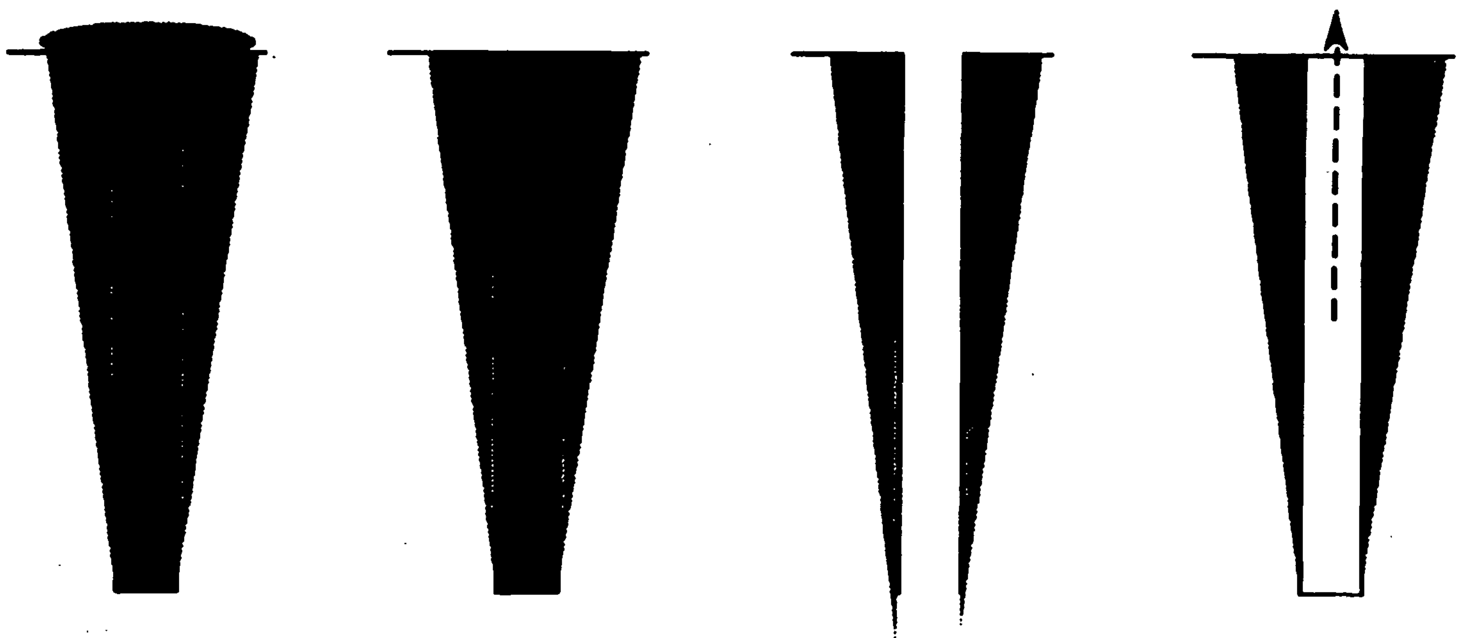
Characterization of Altered (Disturbed) Zone

- Disturbed zone is a significant portion of the rock
- DZ is important to WP Performance
- DZ influences the Source Term

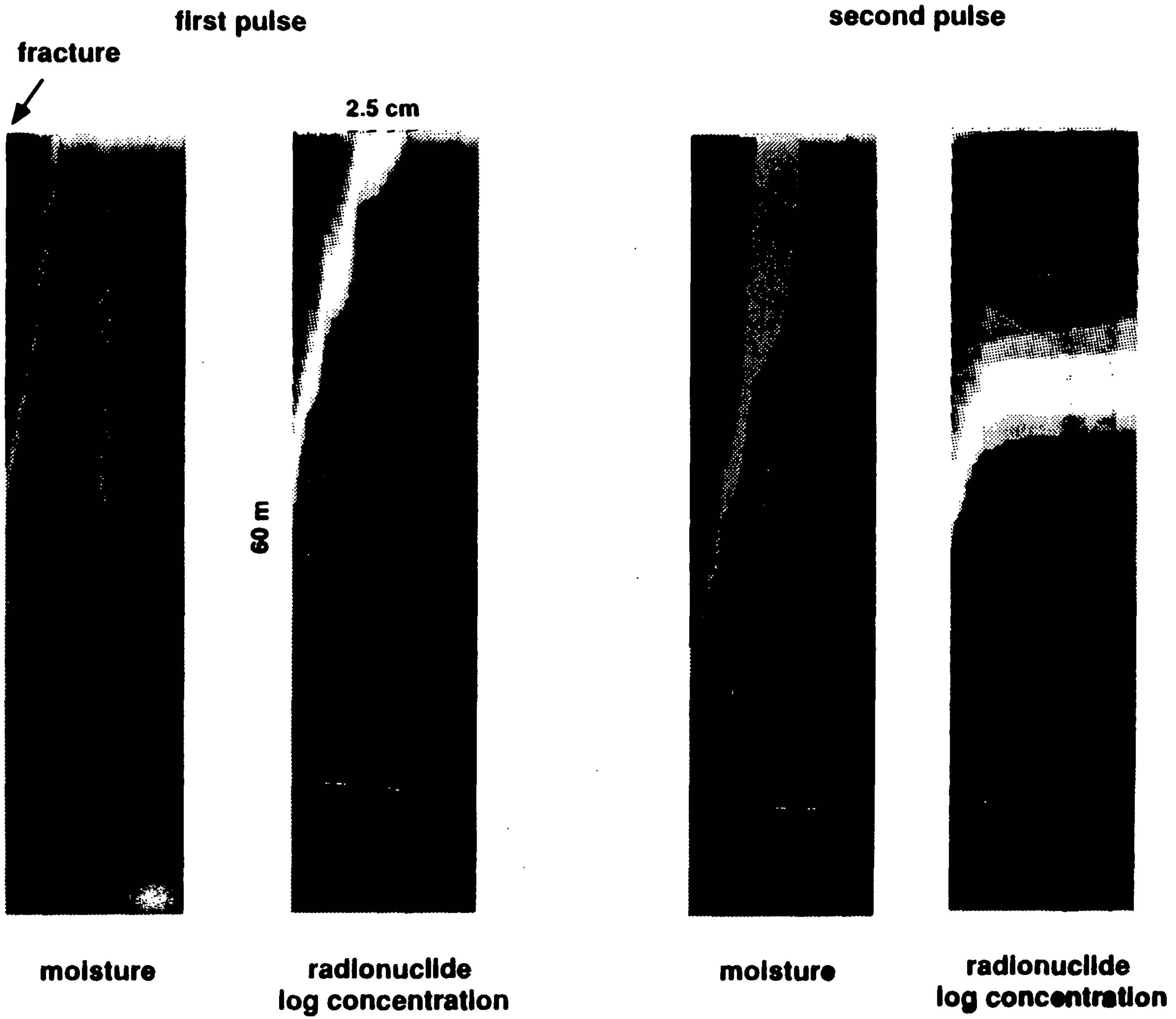
Interactions & radionuclide releases and transport mechanisms



Movement of Water in Fractures



2 hour contaminated pulse followed after 30 days by a 4 hour clean pulse



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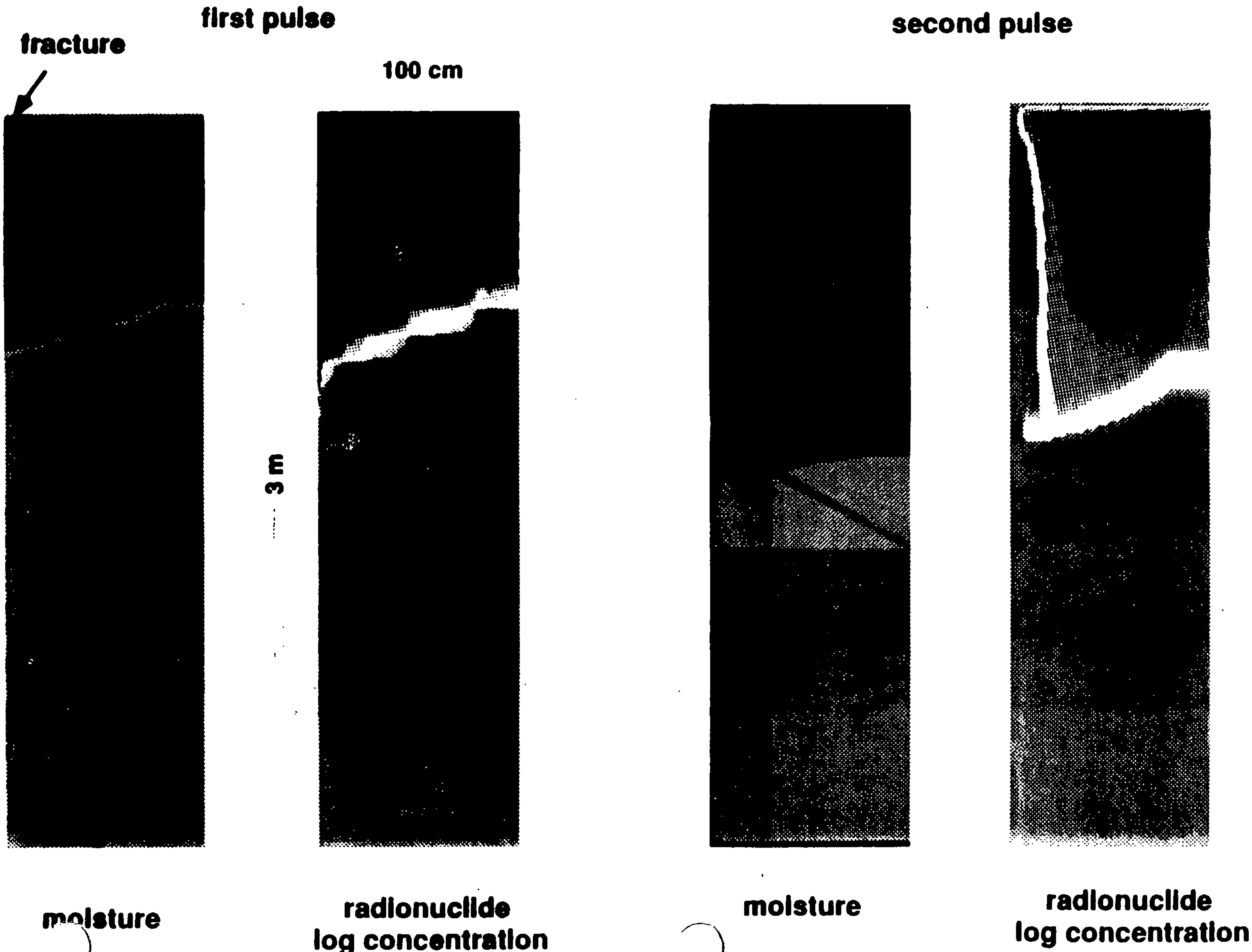
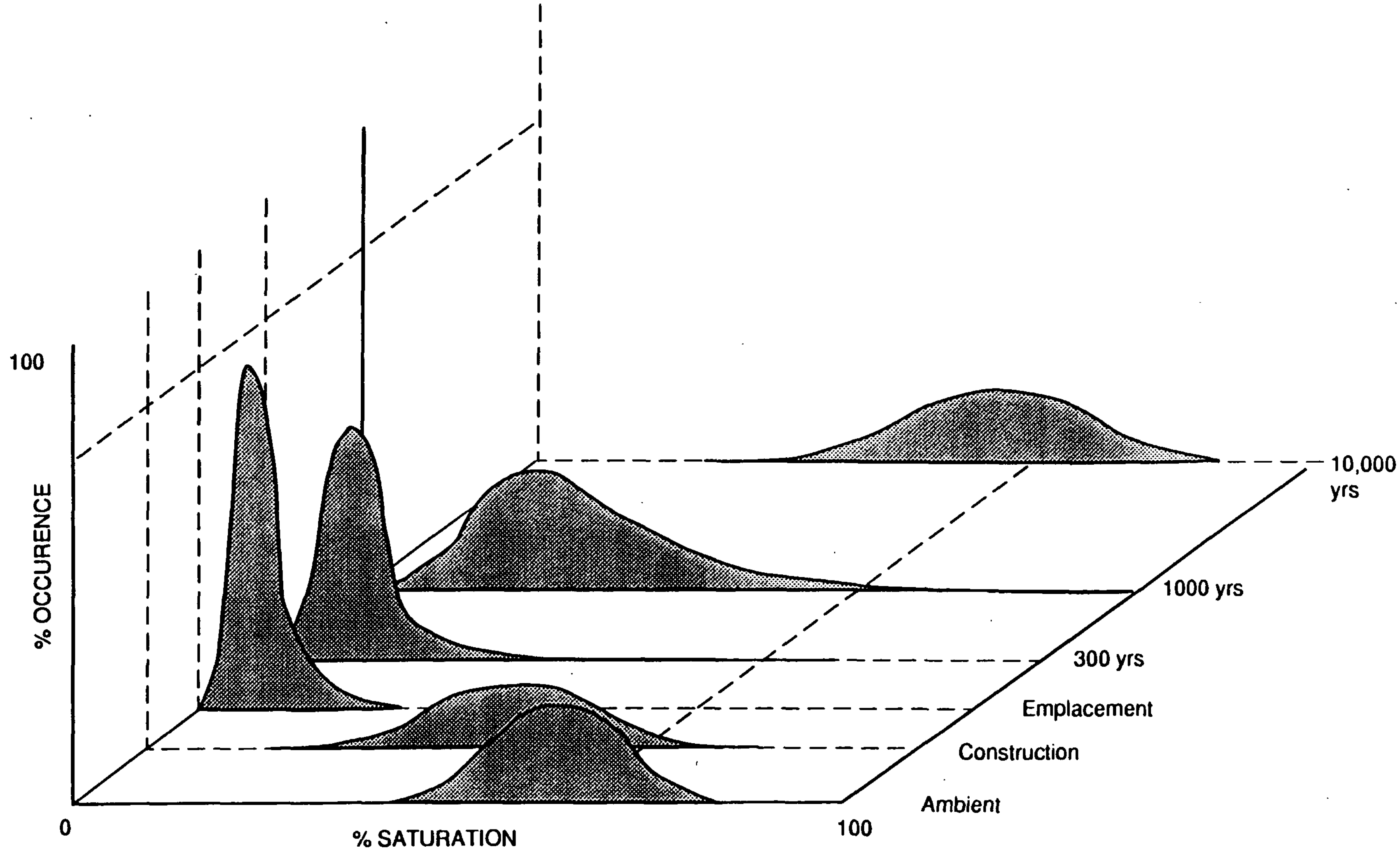
Permeability increased by 1000 ---- diffusion dominated by imbibition



Effects of repository development and waste emplacement

Saturation of Rock around SF Boreholes an example of changing environment with time



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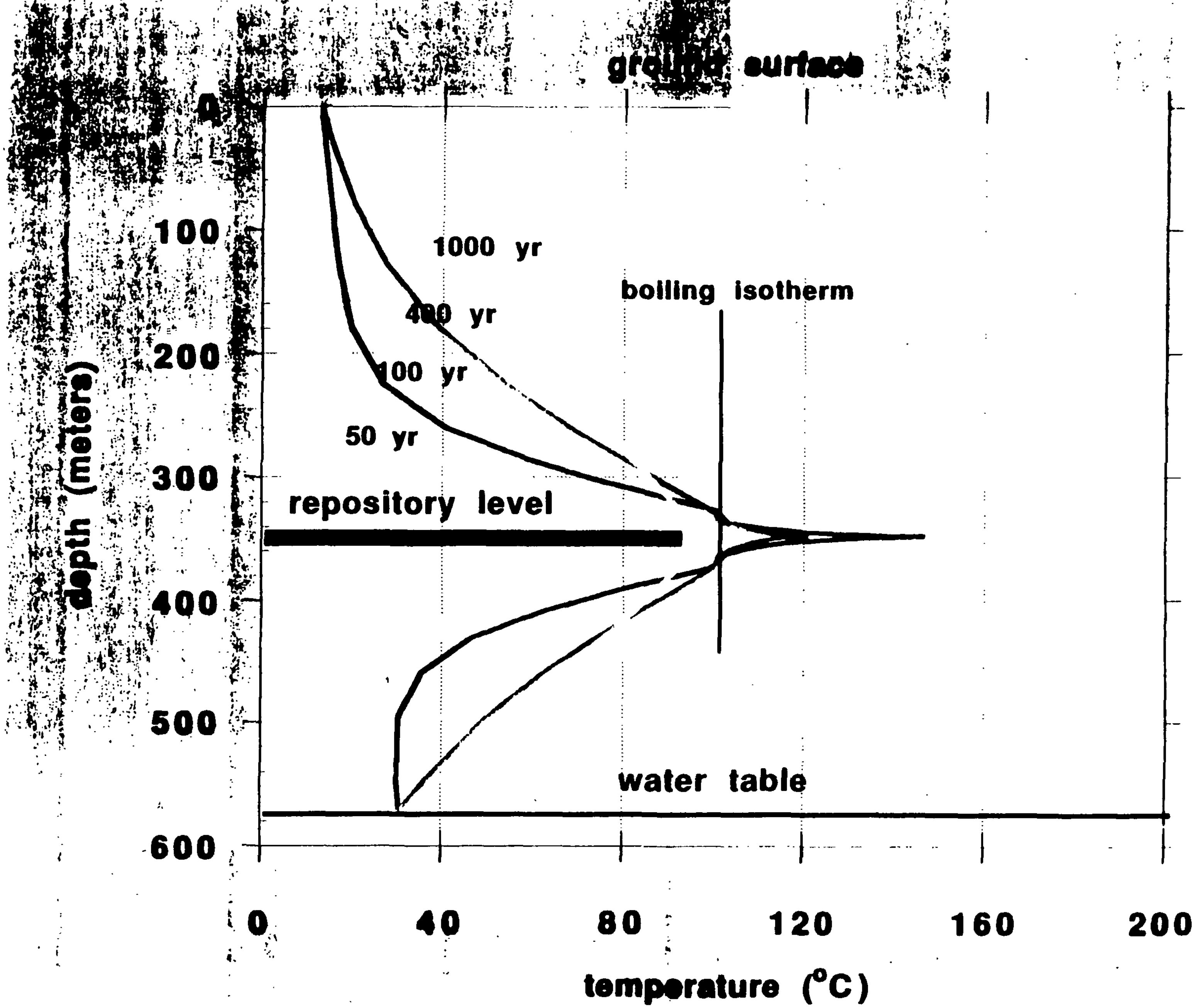
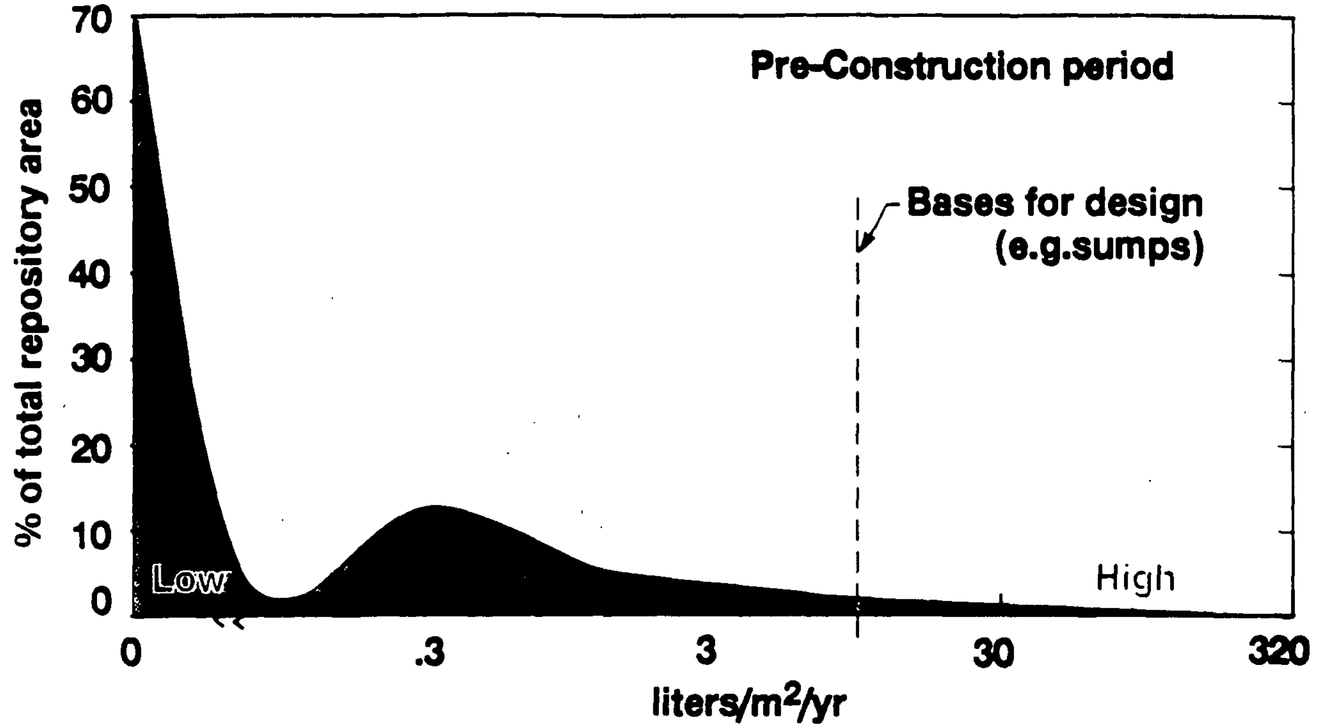
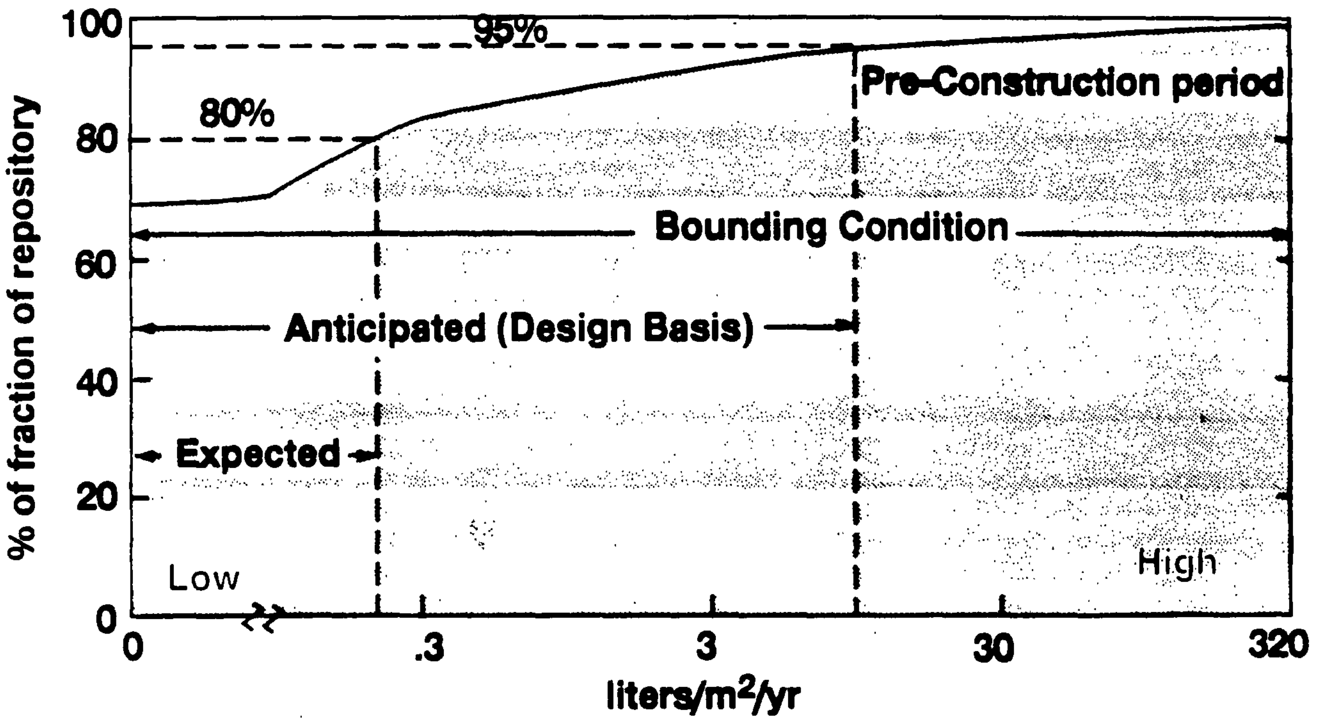
Vertical Temperature Profiles



Hydrology scientific output developed for design and performance assessment: water quantity





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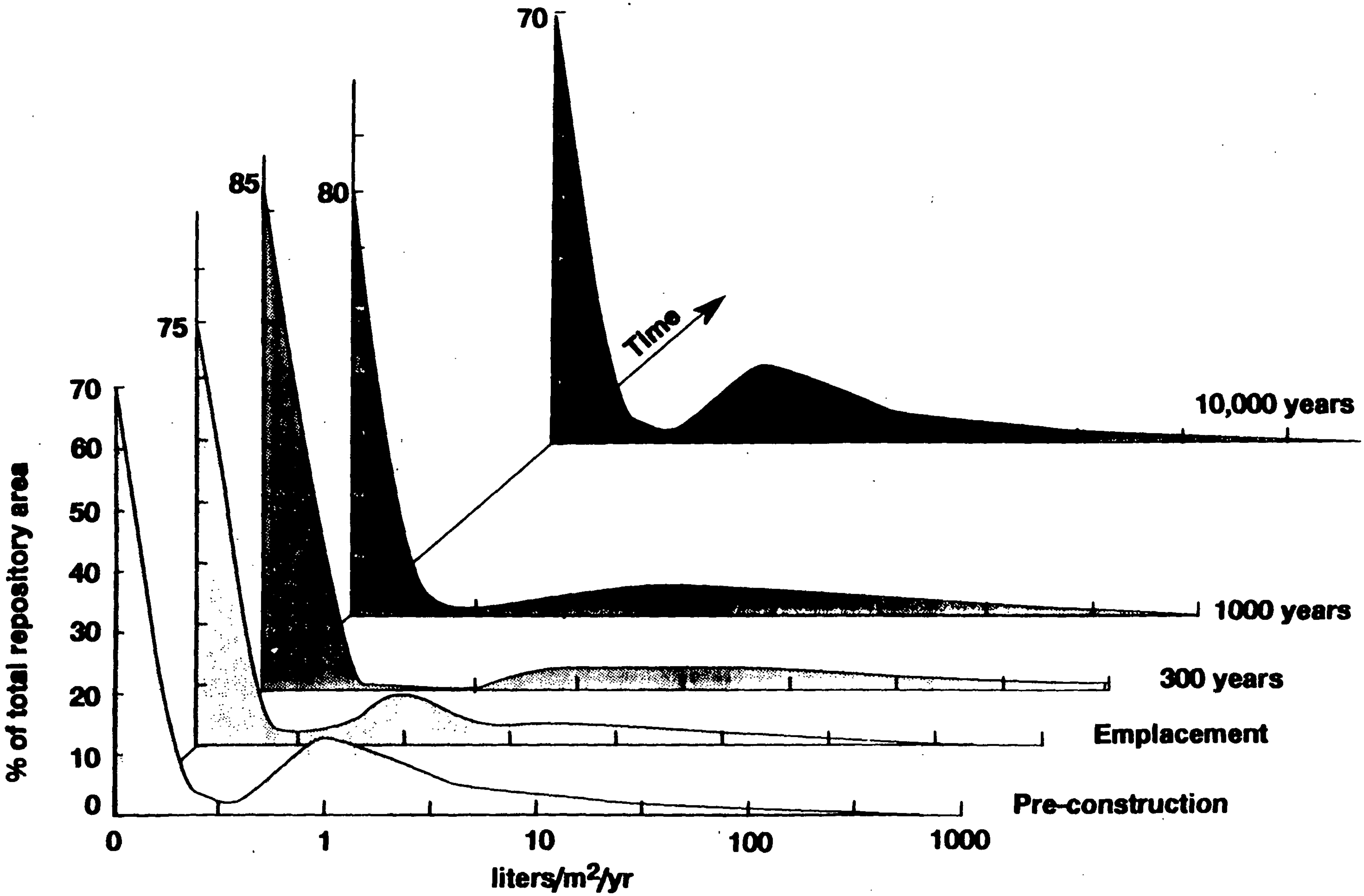
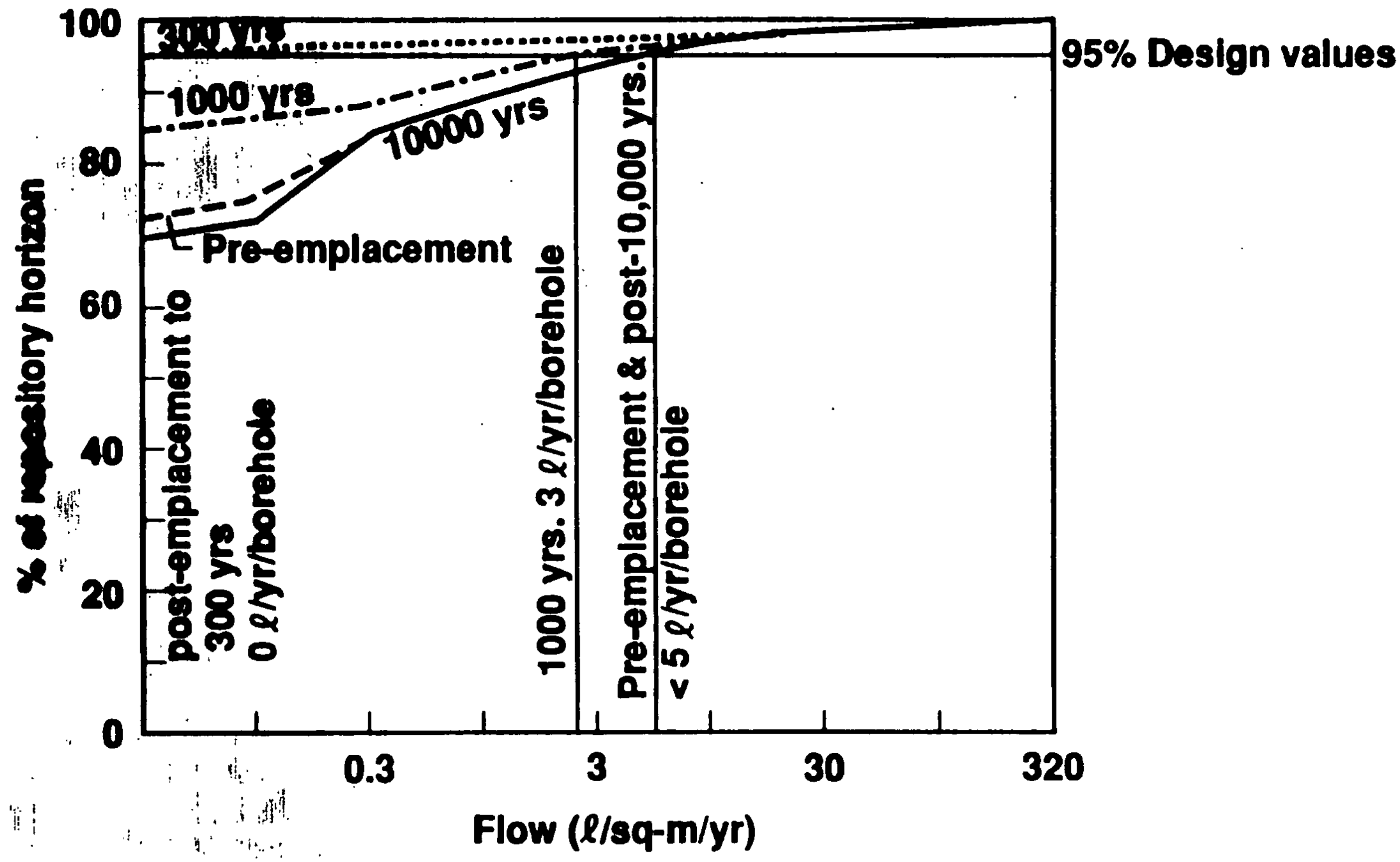
Hydrology scientific output developed for design & performance assessment: water quantity



Cumulative flow volumes



Conclusions

Preliminary Design Bases:

Pre-emplacement	< 5 ℓ/yr/borehole
Post-emplacement (≈ 5 yrs) to 300 yrs	0 ℓ/yr/borehole
300-1000 yrs	0 to < 3 ℓ/yr/borehole
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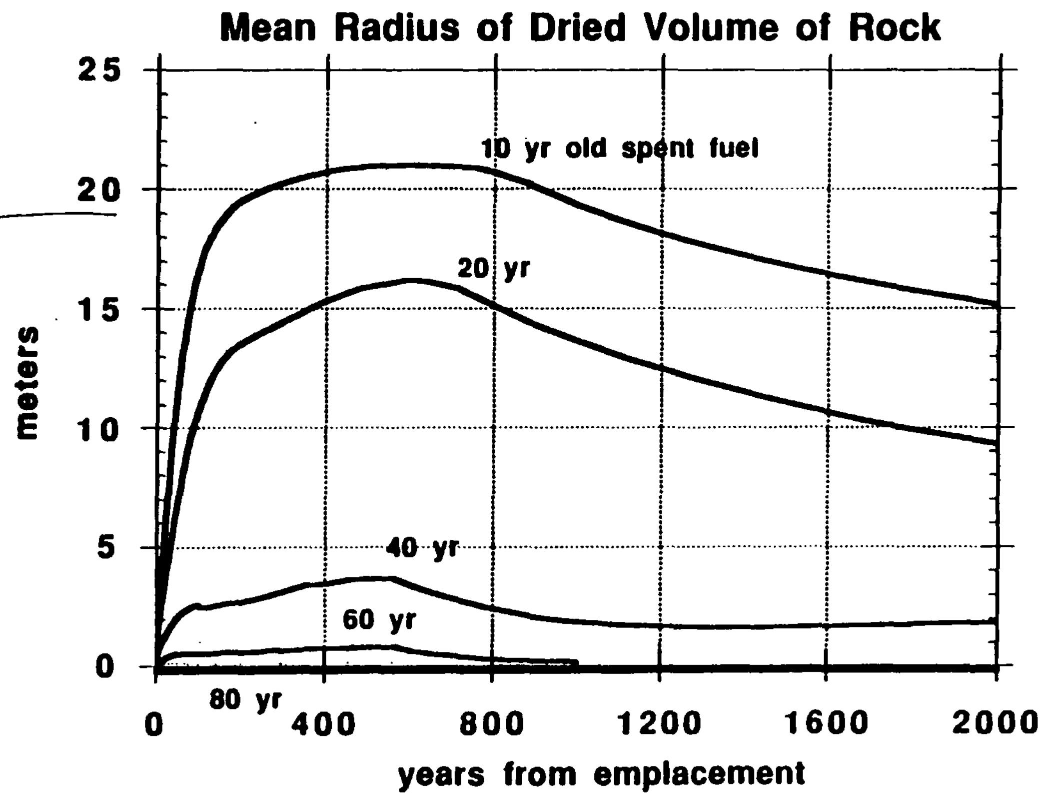
Initial Power Densities for Various Ages of Spent Fuel

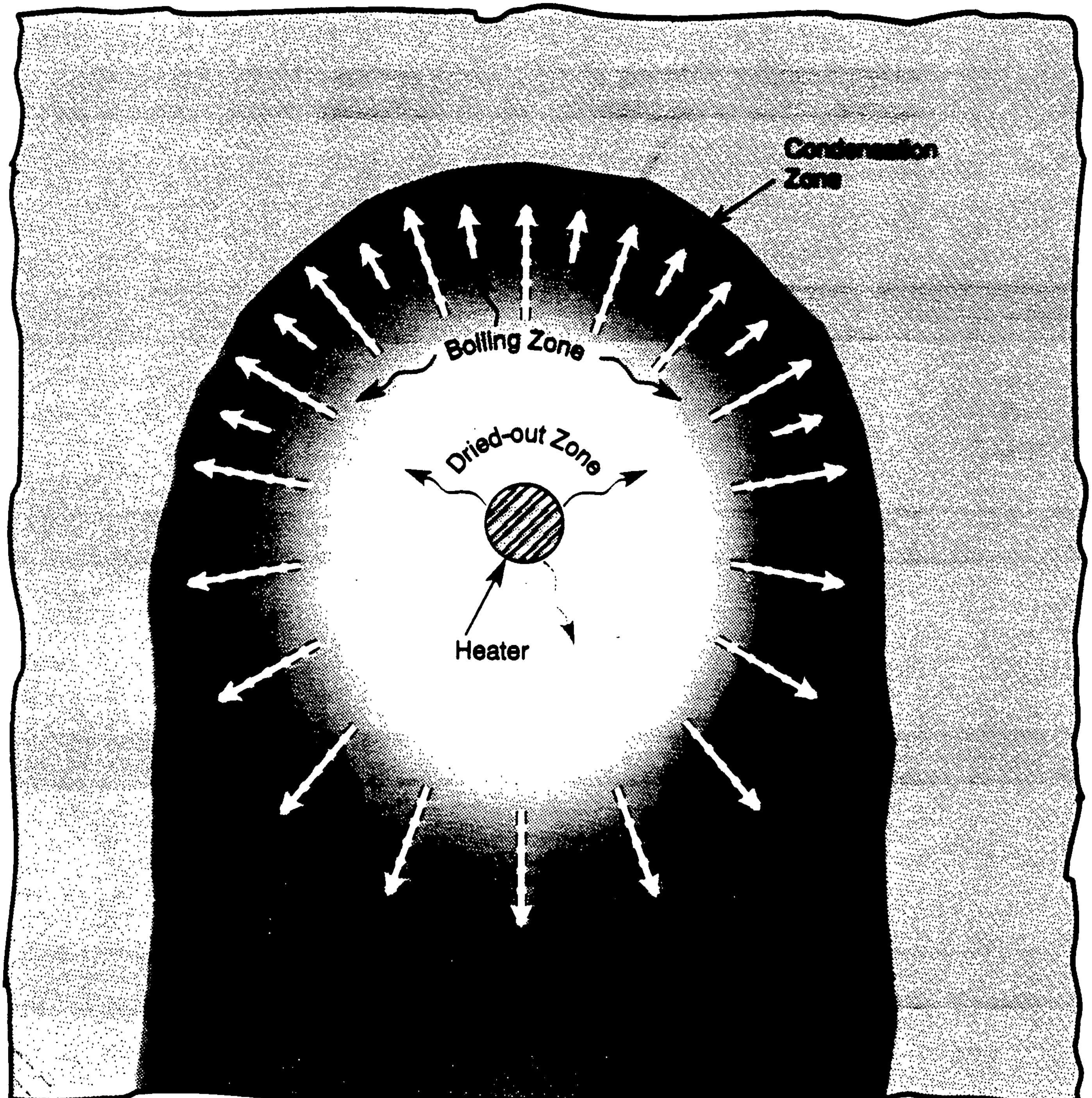
age (years)	10	20	40	60	80
LAPD (kW/acre)	73	56	39	29	23
APD (kW/acre)	60	46	32	24	19

based on spacing of 15 feet for vertical emplacement according to SCP-CDR

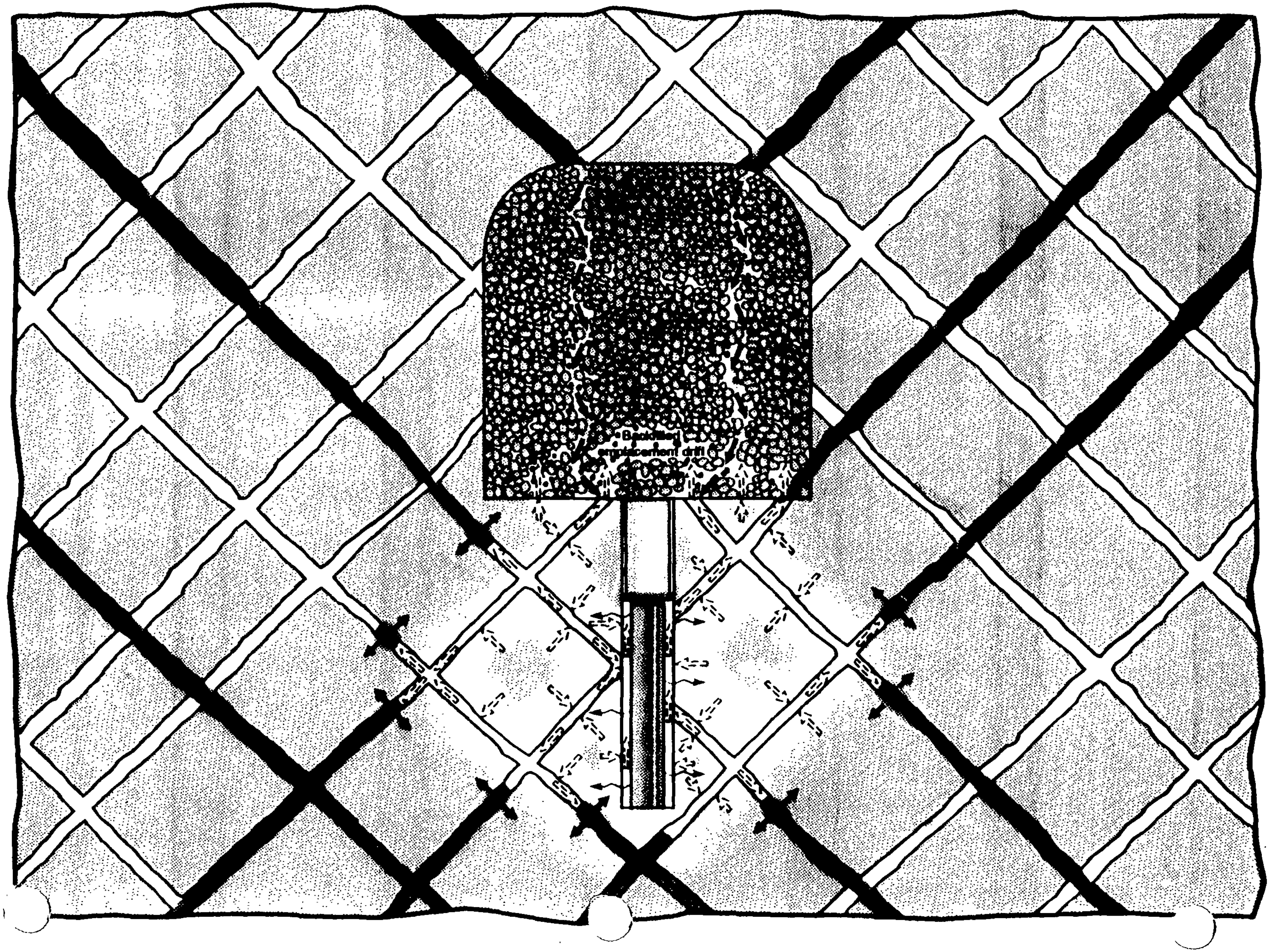
Mean radius of dry-out volume per emplacement drift is dependent on the age of the spent fuel at time of emplacement



The fracture system sheds condensate due to a combination of: (1) vapor flow away from the heat source and (2) gravity-driven liquid flow

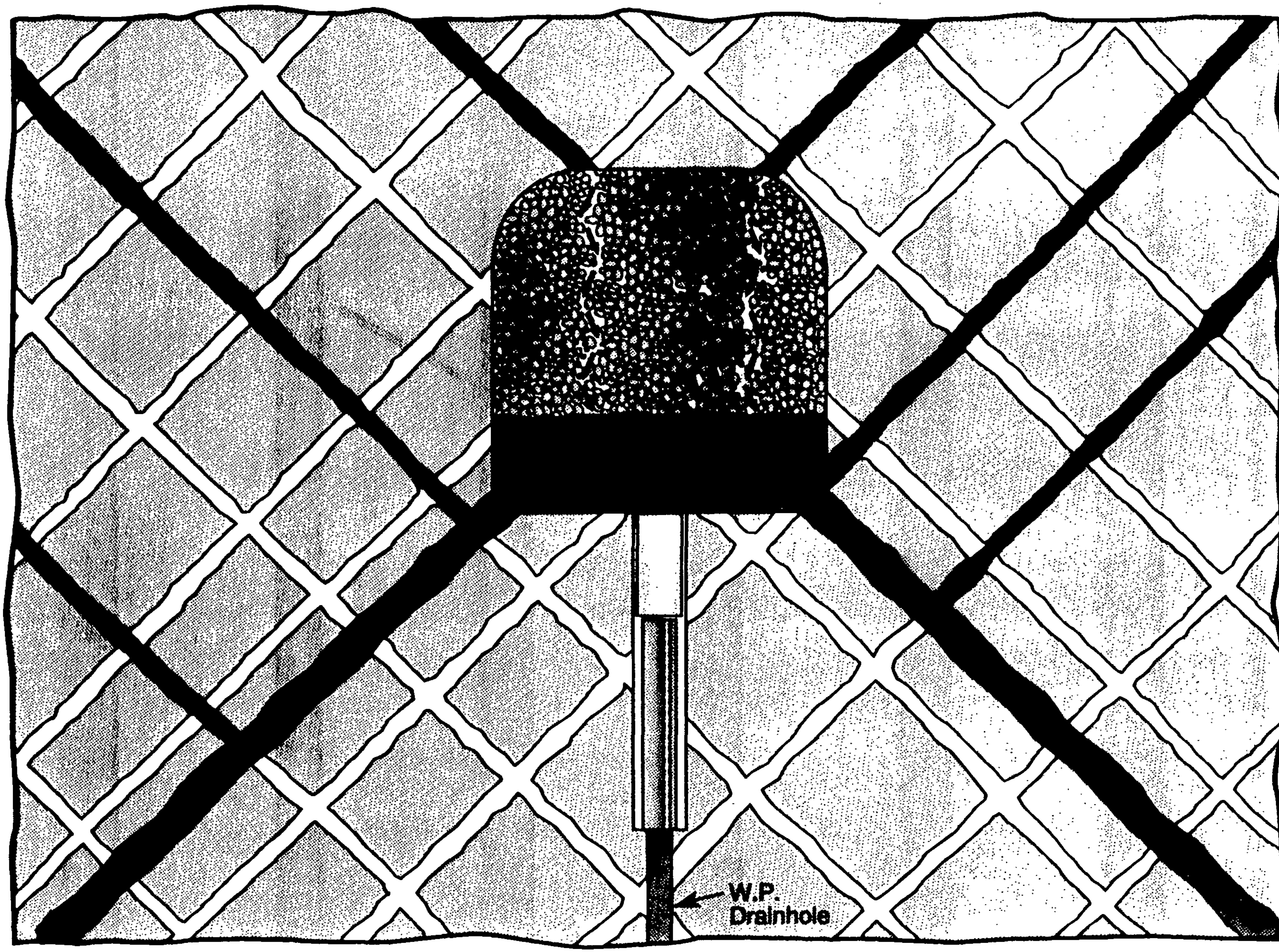


Under hydrothermally perturbed conditions, boiling will mitigate episodic fracture flow from reaching the waste package (for up to 1000 years for a repository heat loading rate of 57 *kw/acre*) (Buscheck and Nitao, 1991)



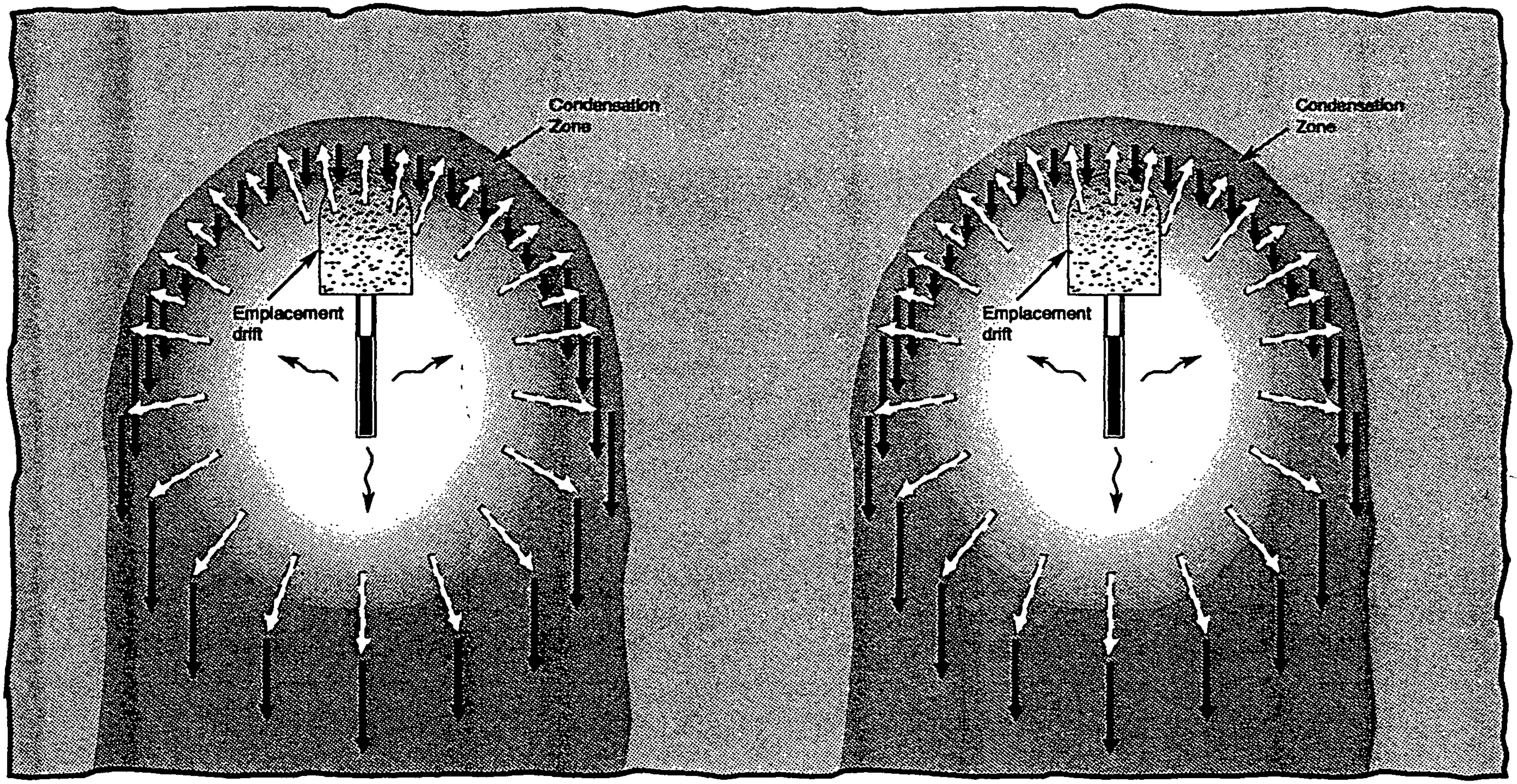
ES-TB-7 (4-20-91) IL

Engineered backfill with high moisture sorbing material (e.g. crushed nonwelded PTn tuff) will mitigate episodic fracture flow from reaching the waste package (Buscheck and Nitao, 1991)



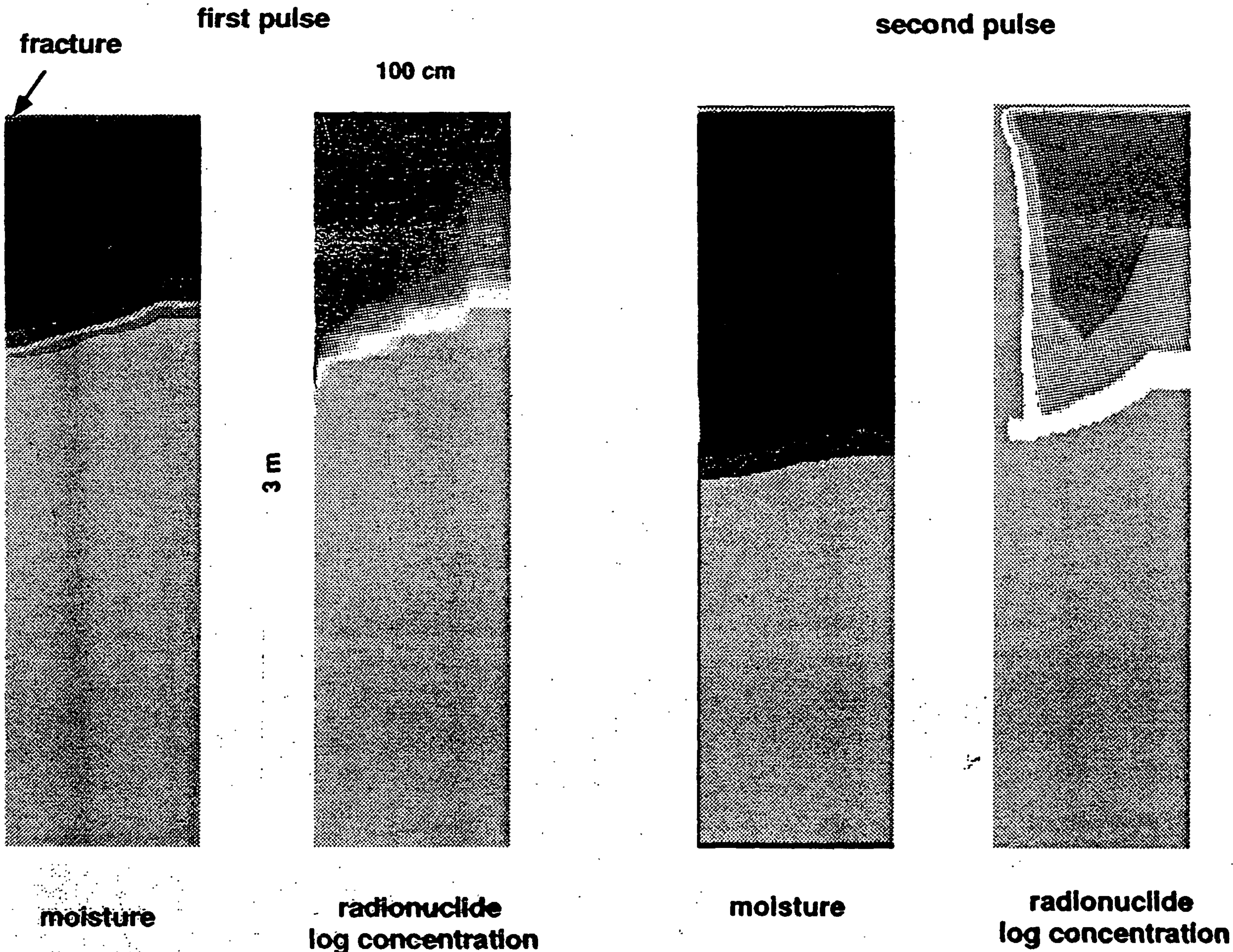
ES-TB-10 (4-20-91) IL

A "hydrothermal umbrella" is established along each of the emplacement drifts due to condensate being shed off of the sides of the boiling zone



[illegible]hour contaminated pulse followed aft[illegible]0 days by a 4 hour clean pulse

Permeability increased by 1000 ---- diffusion dominated by imbibition

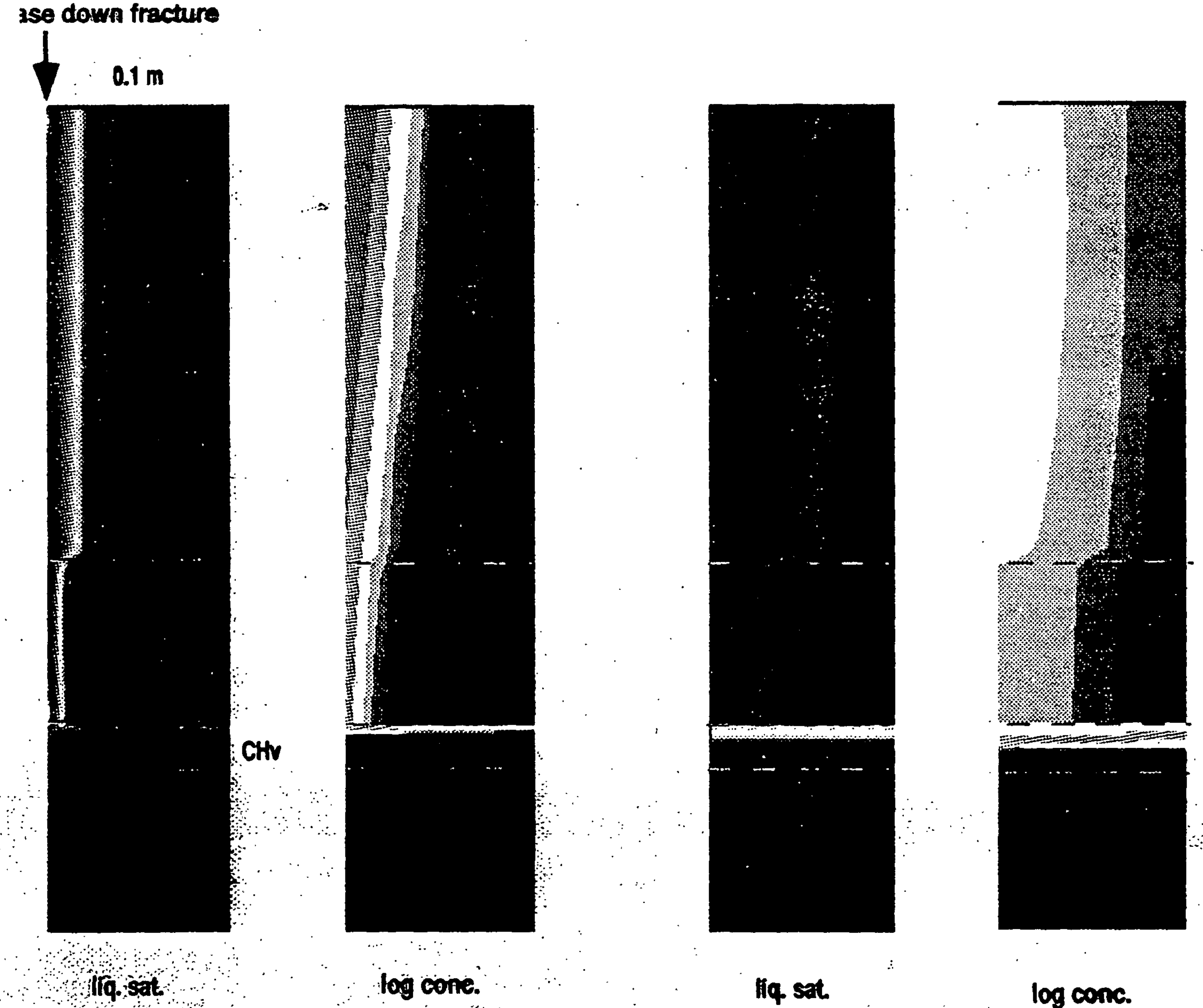


day 4

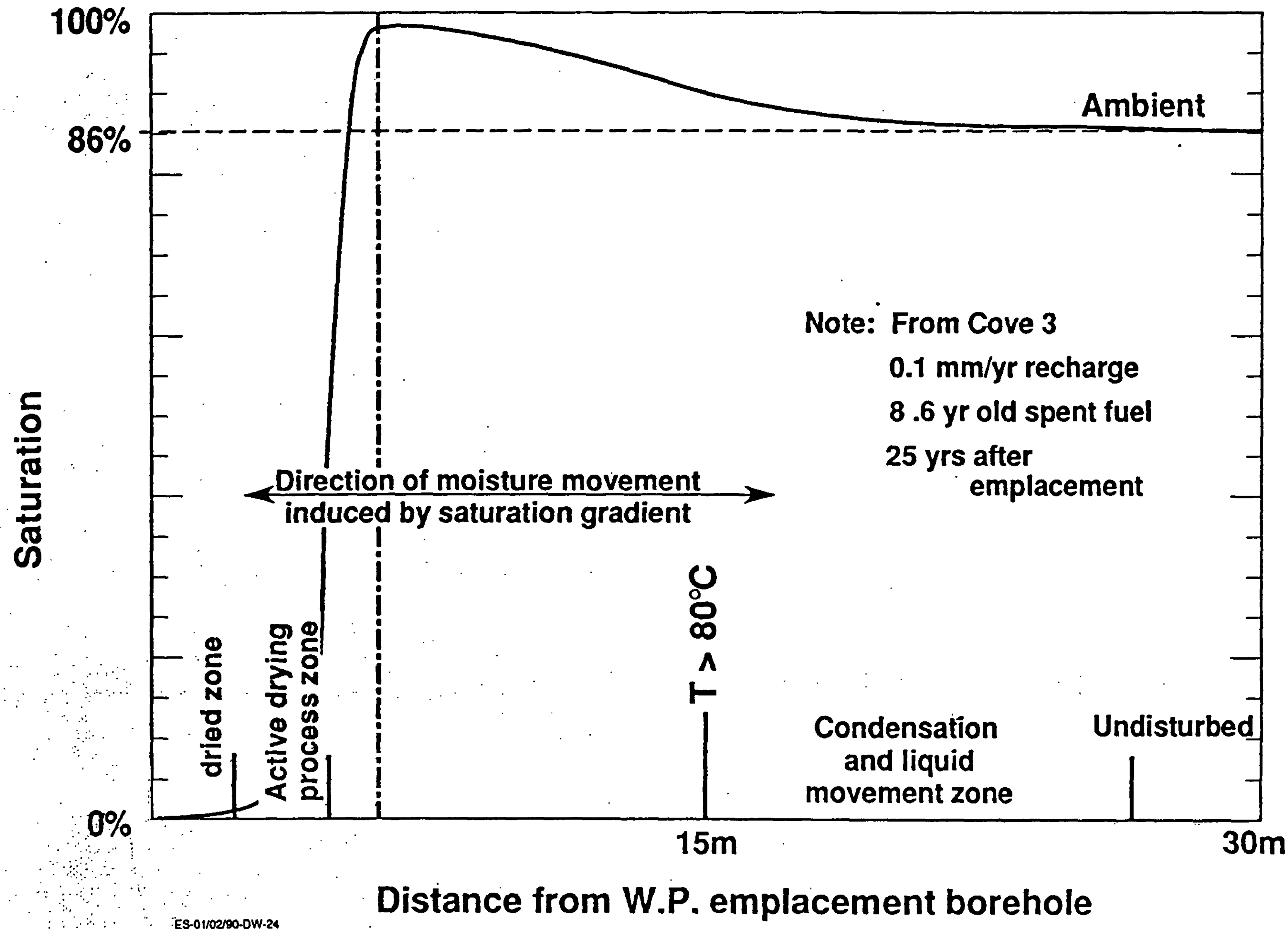
end of 4 day release

day 30

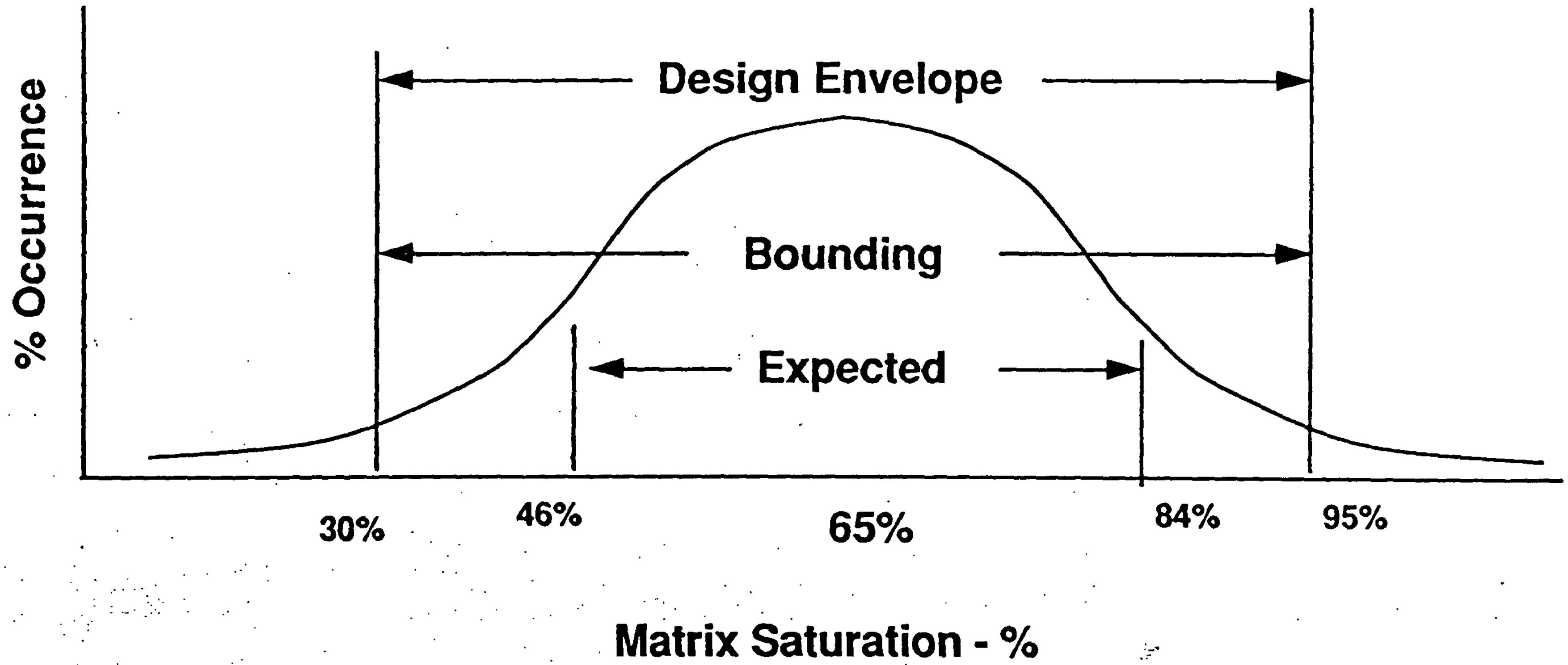
after 4 days of release, 4 more days of clean stream, and 12 days of rest



Post-emplacement Saturation Conditions around borehole of typical Spent Fuel Canister

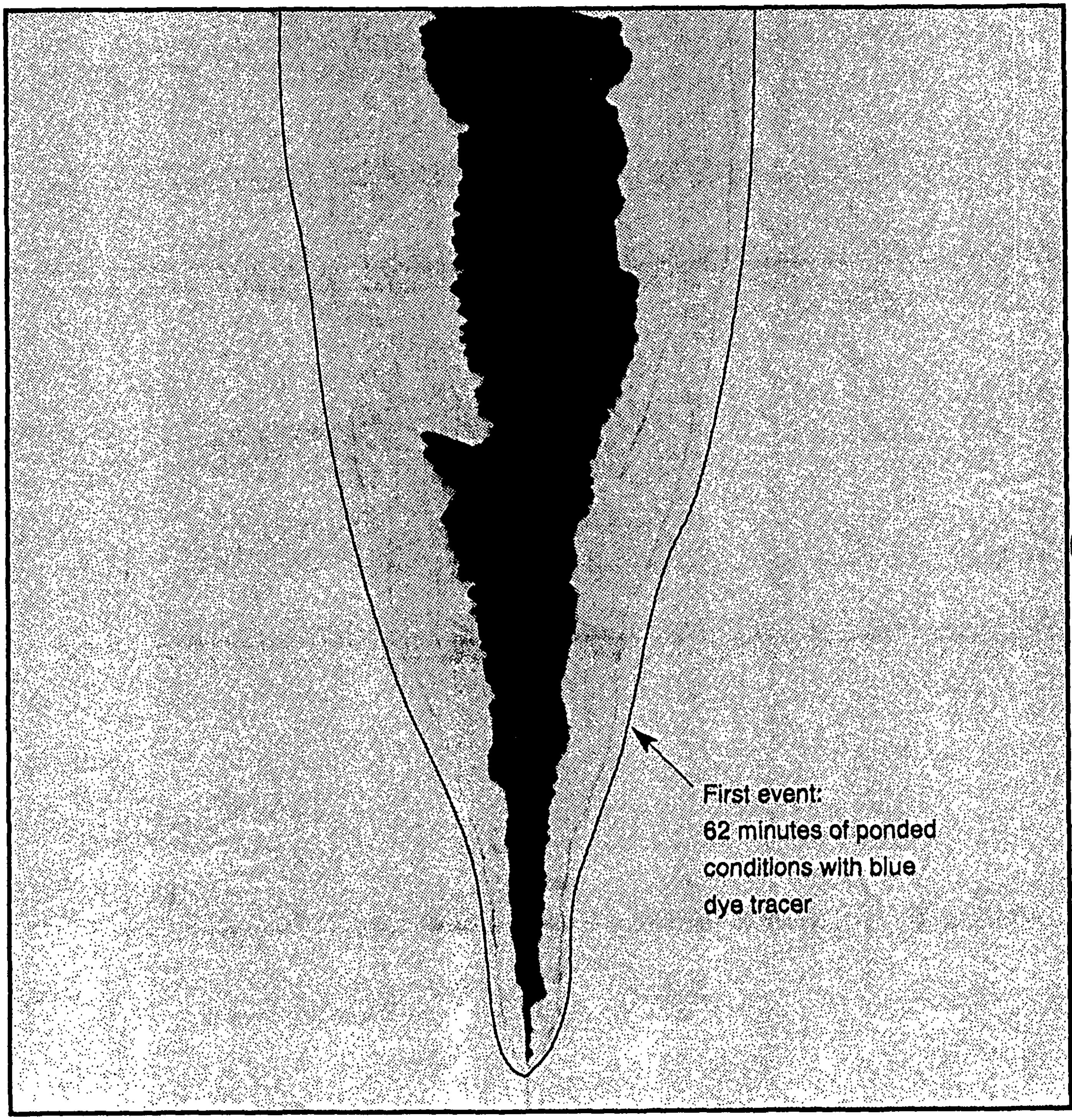


Yucca Mountain Matrix Saturation conditions as Currently Understood



Prototype experiment of fracture-matrix flow

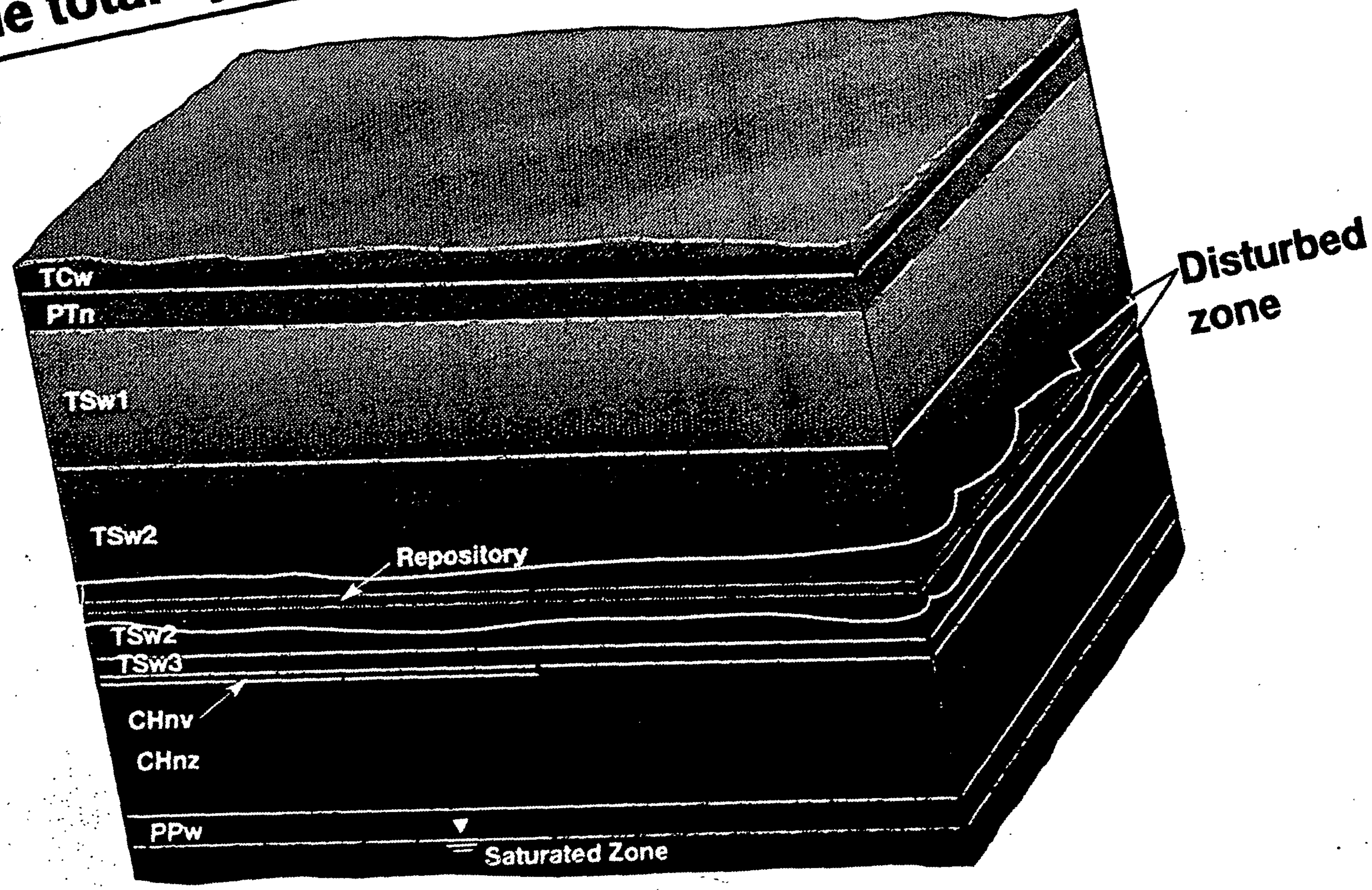
First episodic event: wetting front after 62 minutes of ponded conditions using blue dye tracer



Characterization of Altered (Disturbed) Zone

- Disturbed zone is a significant portion of the rock
- DZ is important to WP Performance
- DZ influences the Source Term

The disturbed zone is an important component of the total system



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