

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

**NUCLEAR WASTE TECHNICAL REVIEW BOARD
FULL BOARD MEETING**

**SUBJECT: NUMERICAL MODELING OF PROPOSED
YUCCA MOUNTAIN REPOSITORY UNDER
VARIOUS THERMAL LOADS**

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**DENVER, COLORADO
JULY 13-14, 1993**

Thermal Modeling Assumptions

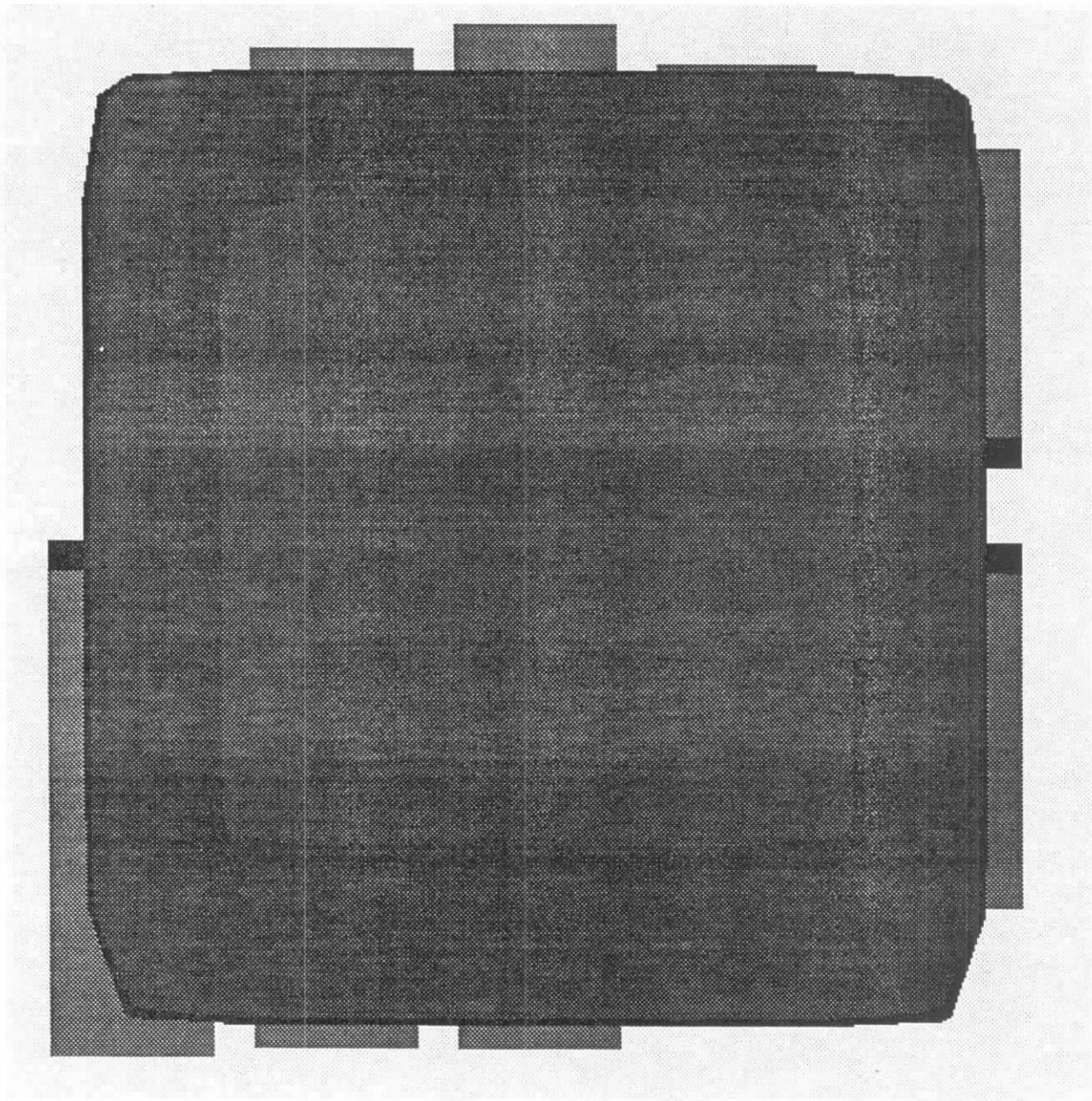
Heat source representations

- Explicit modeling of each waste package
- Areally extensive smeared modeling of heat sources

Material property representations

- Homogeneous
- Homogeneous - layered
- Spatially heterogeneous

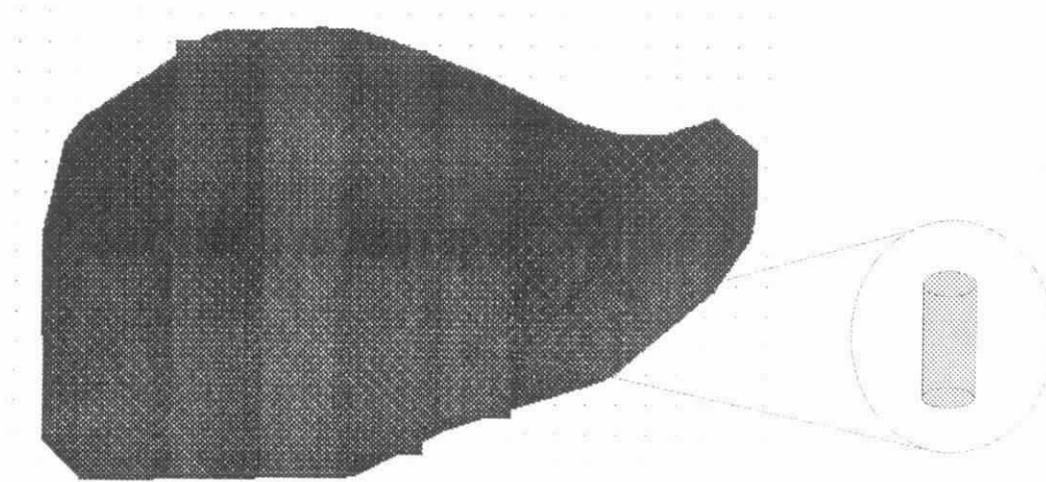
Single Plate Model--95 C Isotherm
80 kW/acre--500 years



Conclusions: Heat Source

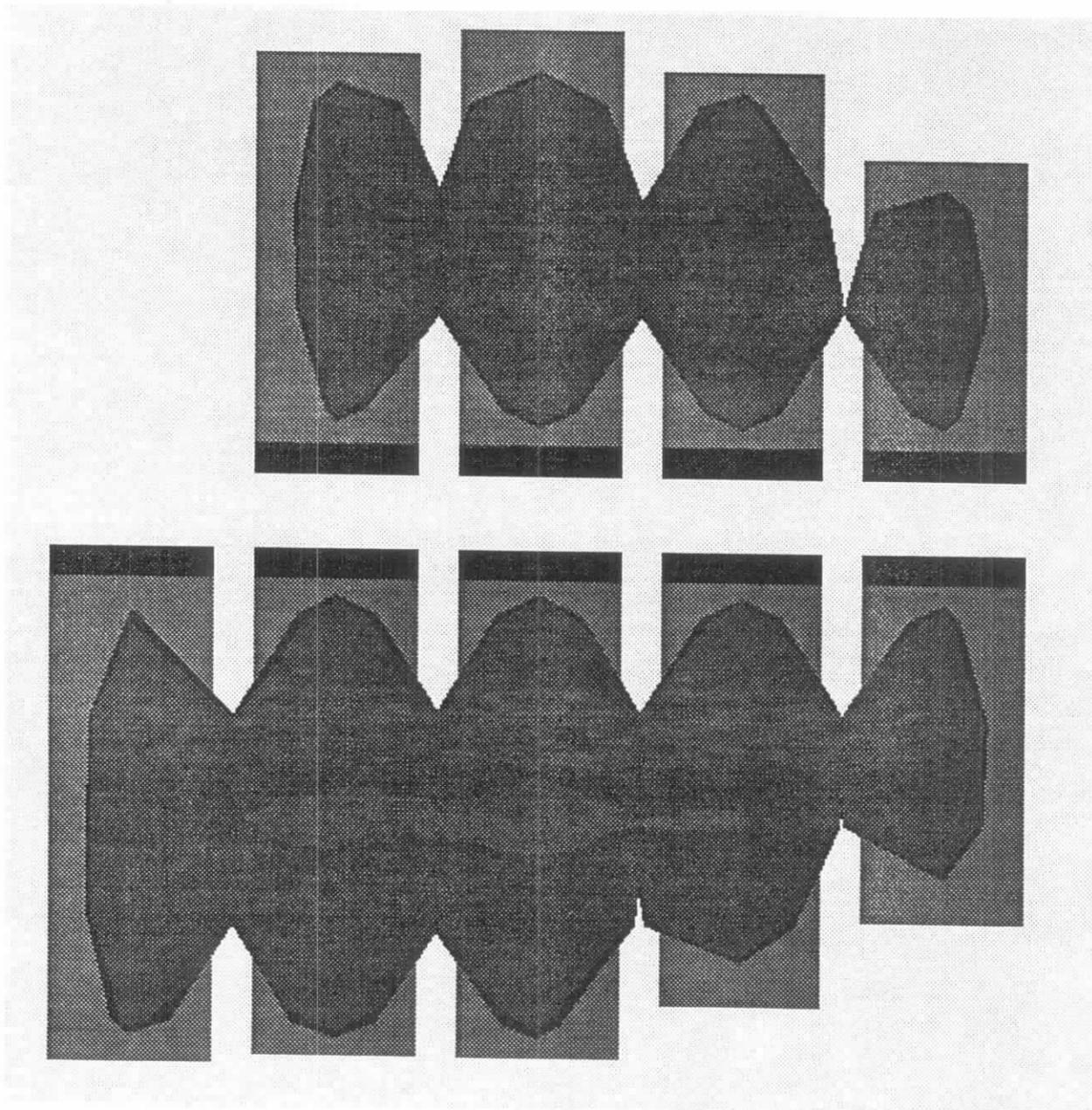
- The geometric distribution of heat-generating waste can impact the spatial and temporal extent of predicted thermal profiles
- No single model can capture the complexities of repository layout and phenomenological coupling
- Conclusions regarding repository thermal response should be based on results from a suite of models

Discrete Source Model

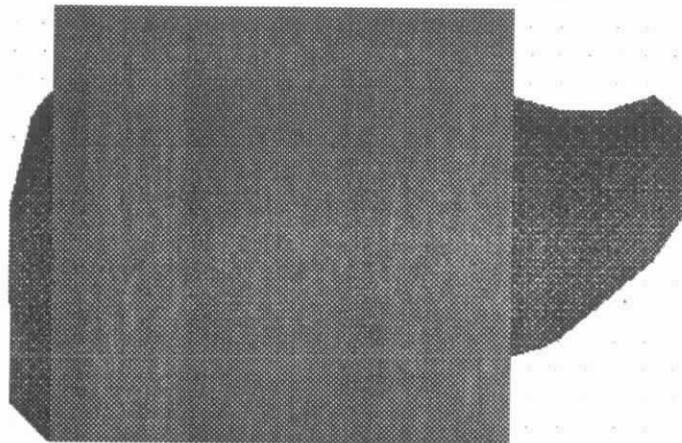


- Analytical heat-conduction in a semi-infinite medium
- Waste packages explicitly modeled as heat-generating right-circular cylinders (31,283 Spent Fuel, 13,500 DHLW)
- Depth of burial = 350 m
- Equivalent initial design-basis APD = 80 kW/acre
- Average waste characteristics: 28.5 years old and 35.4 GWd/MTU

**Discrete Source Model--95 C Isotherm
80 kW/acre--500 years**



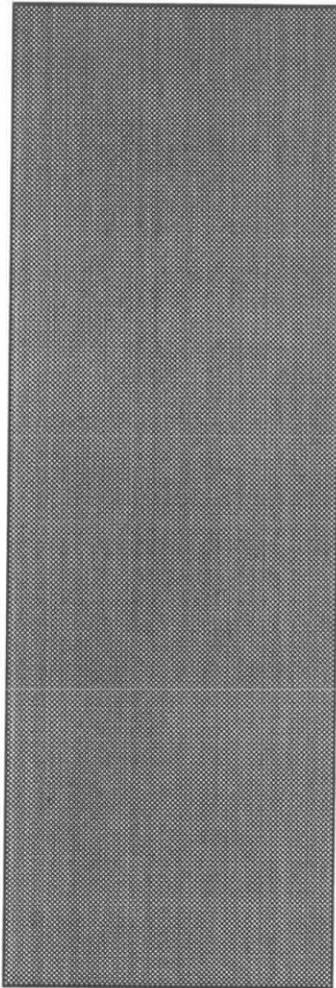
Single Plate Model



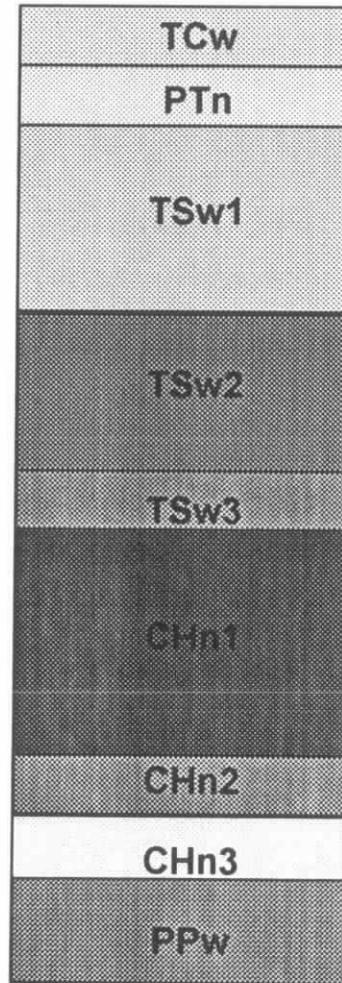
- Analytical heat-conduction in a semi-infinite medium
- Heat-generating waste modeled as single plate
- Depth of burial = 350 m
- Equivalent initial design-basis APD = 80 kW/acre
- Average waste characteristics: 28.5 years old and 35.4 GWd/MTU

Material Properties

Homogeneous



Homogeneous Layered



k (W/mK)

1.73

0.85

1.70

2.10

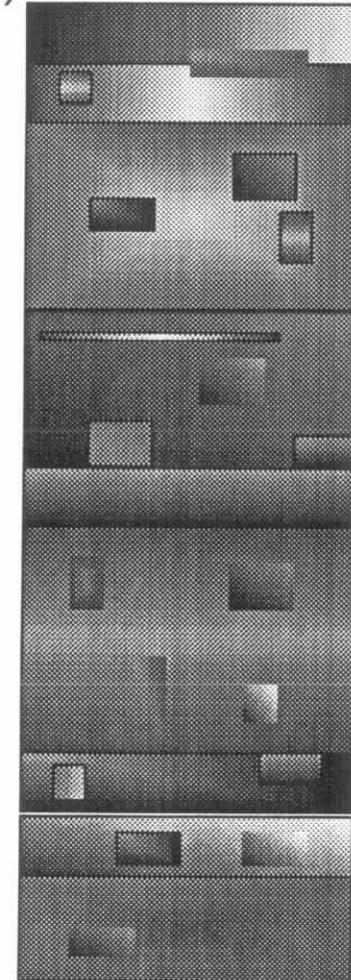
1.28

1.25

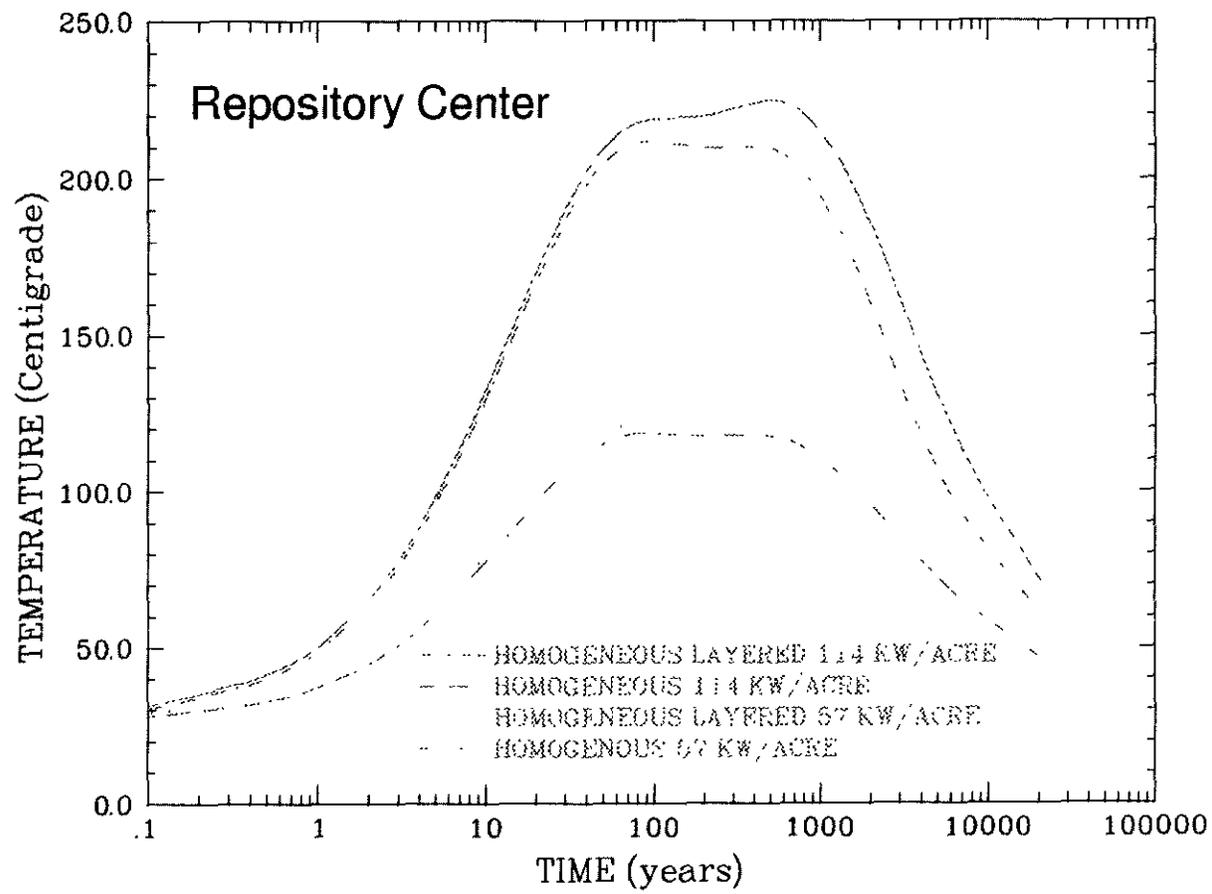
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Spatially Heterogeneous



Comparison of Homogeneous and Layered Material Property Representations



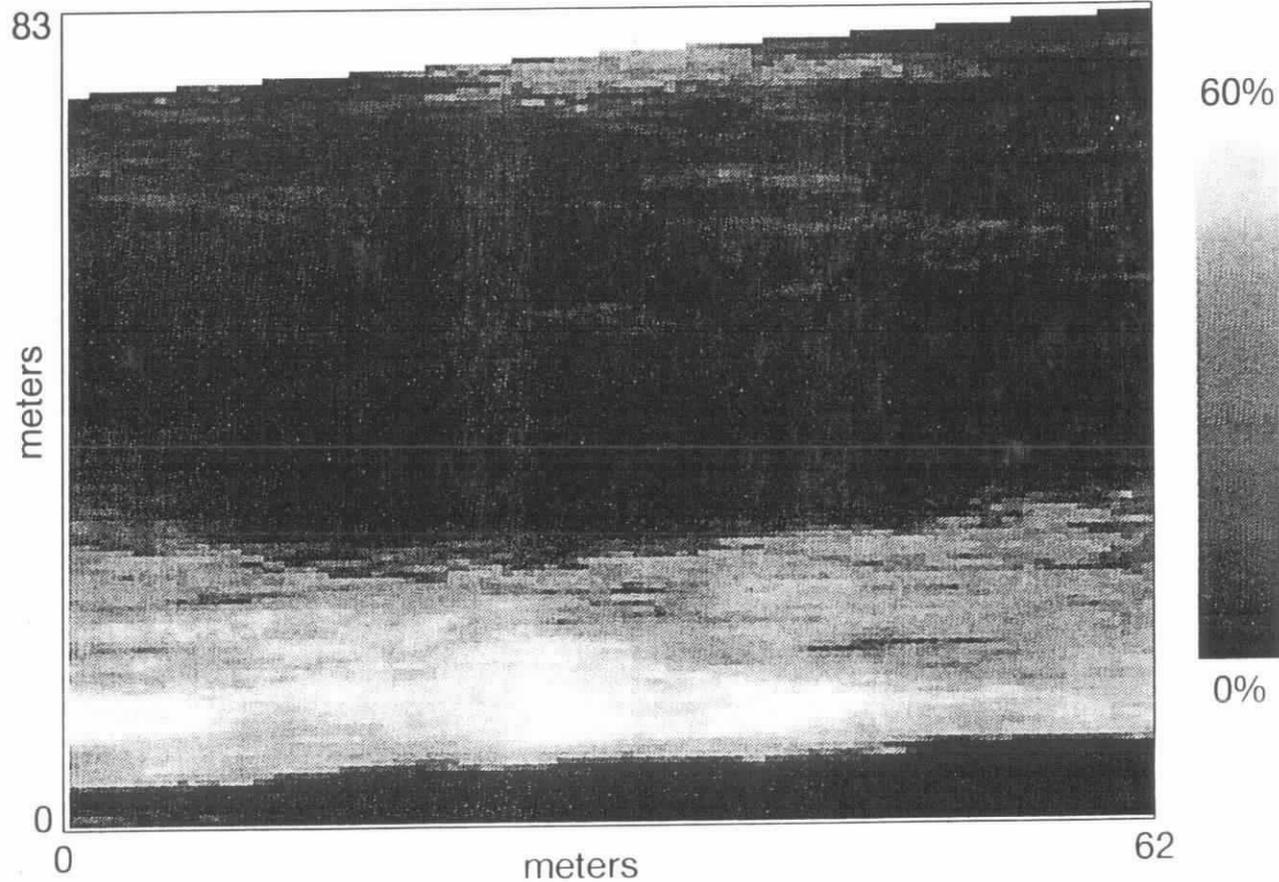
Porosity Simulation

S

N54

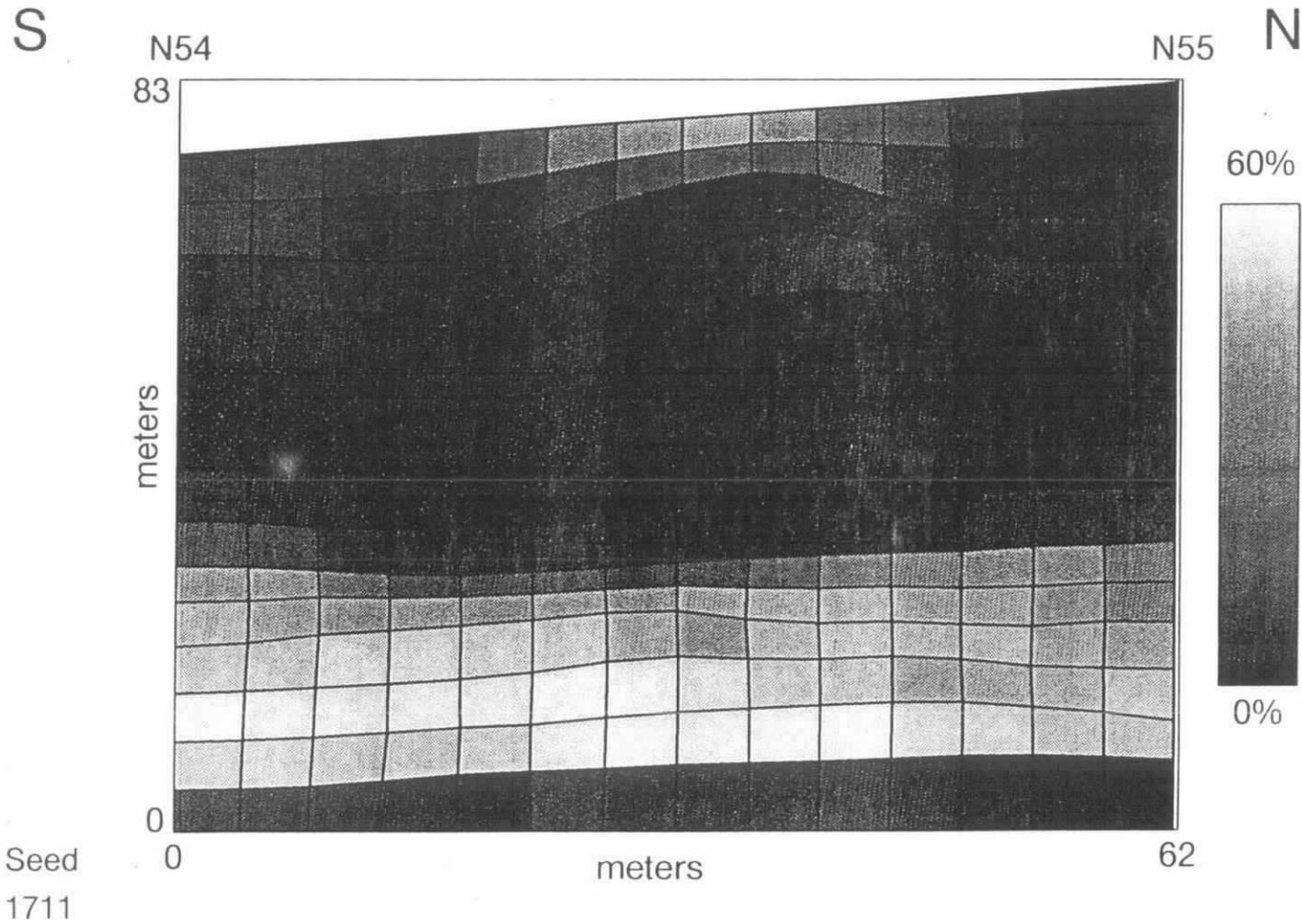
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Seed
1711

Upscaled Porosity Simulation



Conclusions: Material Properties

- How the stratigraphy of the mountain is represented influences temperature predictions
- The impact of spatial heterogeneity on predicted thermal profiles must be assessed as a next step in the repository thermal modeling effort

Conclusions

- Predictions of host rock thermal response are sensitive to assumptions regarding heat source distribution and material property representations
- The lack of extensive site-specific test data is the primary cause of uncertainty in repository thermal modeling