In Situ Measurement of Permeability in the Vicinity of Faulted Nonwelded Bishop Tuff

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Nonwelded Basal Bishop Tuff

Location

Rhyolitic nonwelded basal Bishop Tuff, erupted from the Long Valley Caldera (755 4 ka) in eastern California, is exposed in northern Owens Valley, north of Bishop, California, USA

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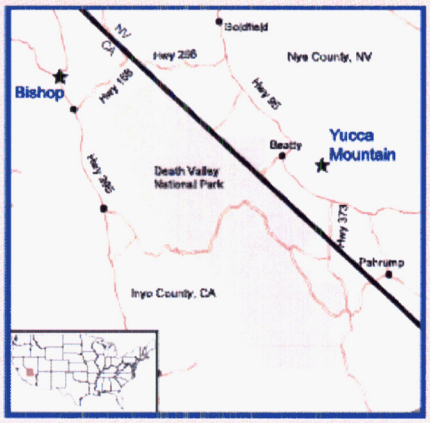


Outcrop analyses and hydrologic tests by Fedors et al. (2001) suggest that the Bishop Tuff is a suitable analog for the Paintbrush Tuff--a unit overlying the proposed high-level waste repository at Yucca Mountain.

The nonwelded Bishop Tuff includes matrix-supported massive ignimbrites and clast-supported bedded deposits. Fluid flow is likely to be influenced by a combination of host rock properties and the presence of deformation features like open fractures, mineralized fractures, and fault zones with comminuted fault rocks and clays.

Nonwelded Basal Bishop Tuff

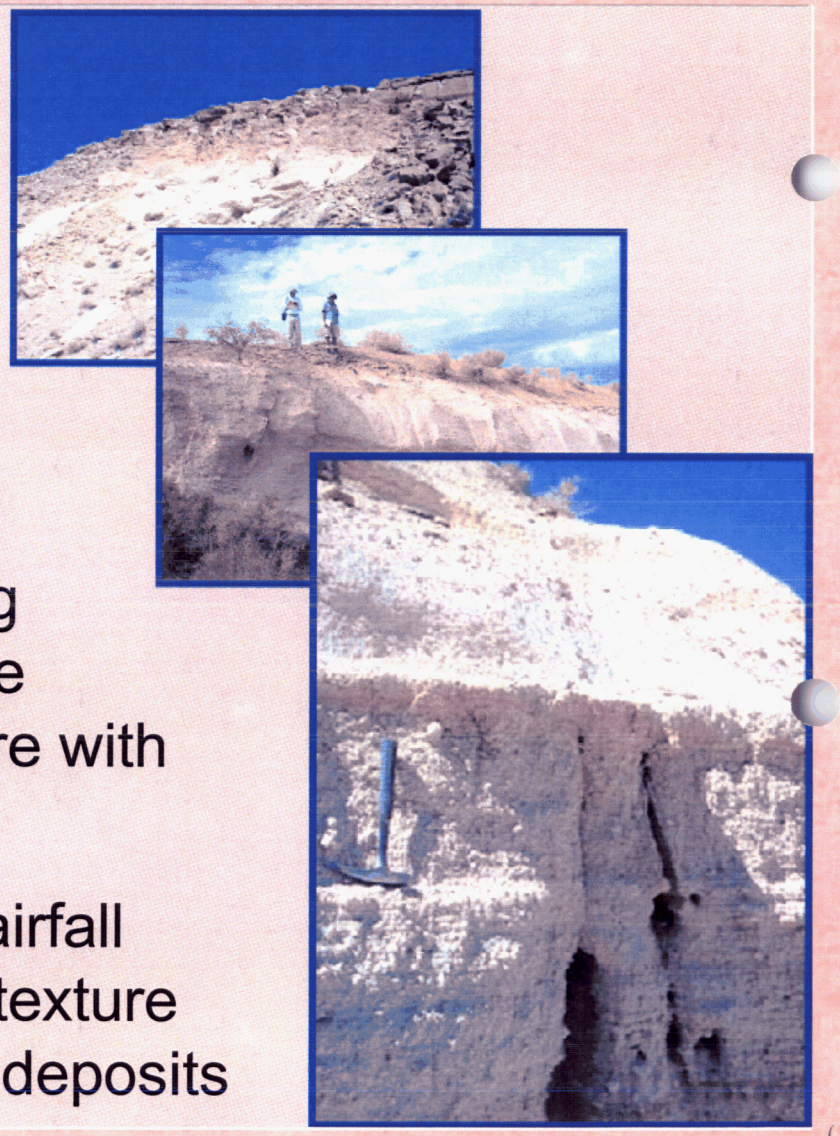
Stratigraphic Section

Unit D, densely-welded tuff capping the Volcanic Tableland

Unit C, massive ignimbrite, moderately welded, grades to densely welded at the top

Unit B, moderately-welded grading to nonwelded at bottom of massive ignimbrite, matrix-supported texture with lithic and pumice fragments

Unit A, pumice-rich, well-bedded airfall deposits; pumice clast-supported texture and locally finely-laminated surge deposits



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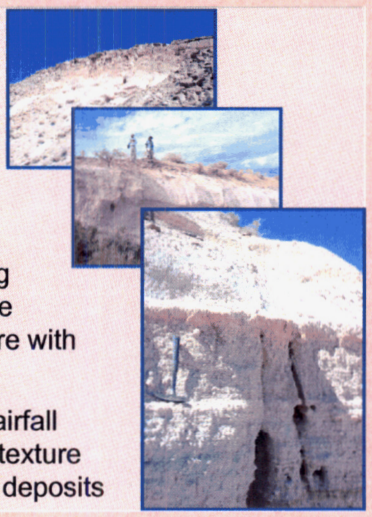


Unit D, Figure 1

Unit C, Figure 1

Unit B, Figure 1, 2, and top of 3

Unit A, Bottom of Figure 3 and Crossing Faults Figures

Why study the permeability of nonwelded tuffs?

The nonwelded tuff units at Yucca Mountain (YM), the site of the proposed high-level radioactive waste repository, play a prominent role in determining spatial and temporal distribution of flux at the potential repository horizon.

The nonwelded Paintbrush Tuff (PTn) unit, which overlies the repository horizon, is assumed to spatially and temporally dampen episodic infiltration pulses moving downward through the moderately welded tuffs of the Tiva Canyon Unit;

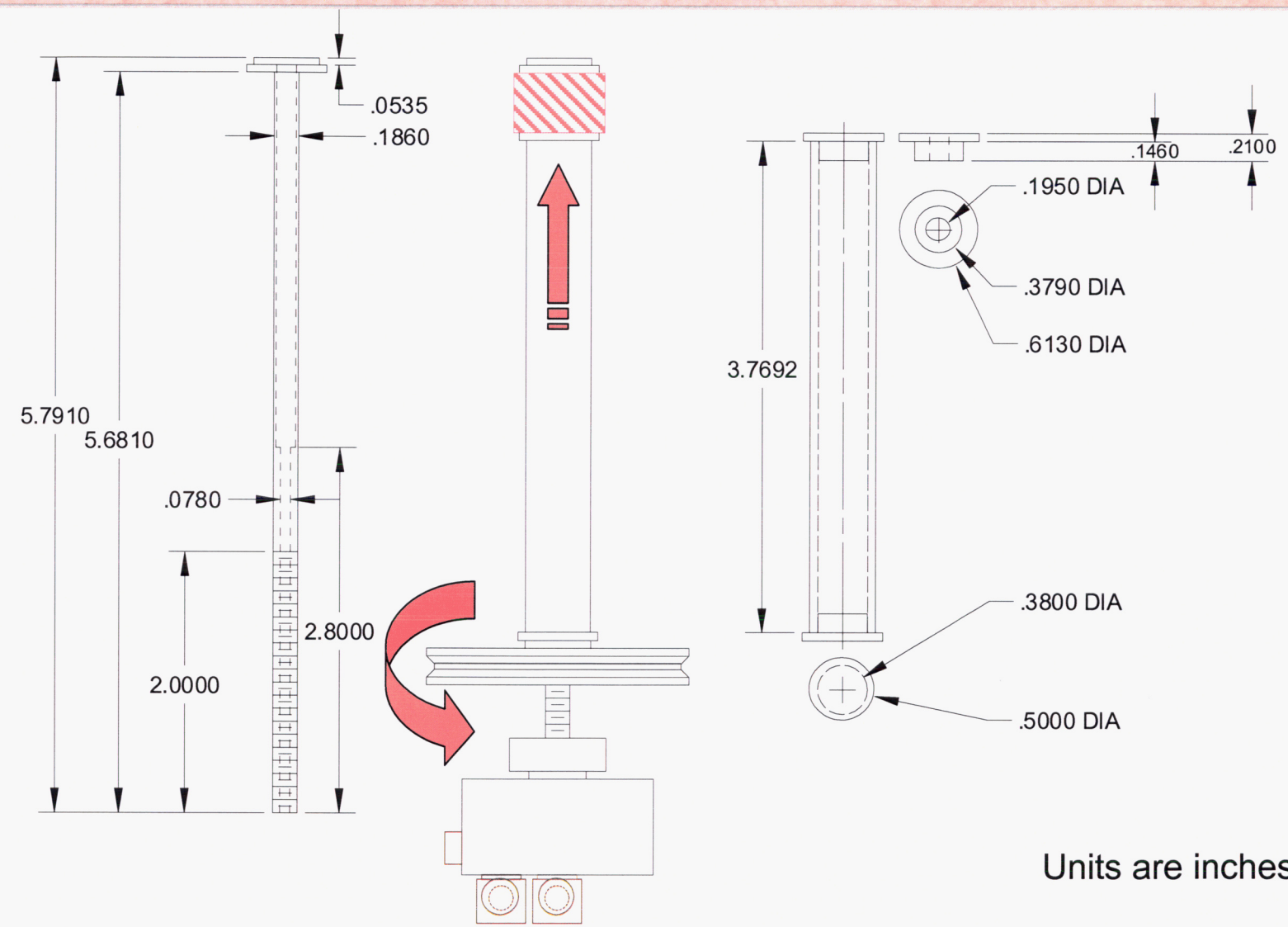
Numerical model simulations (CRWMS M&O, 2000) show that a porous, permeable nonwelded tuff matrix (PTn) may attenuate rapid, transient fracture flow from the moderately welded Tiva Canyon tuff; hence, a steady-state assumption is often made for unsaturated flow through the fractured tuffs of YM

Nonwelded Basal Bishop Tuff

Structure

- Simple deformation history characterized by extension, which was accommodated by normal faulting.
- Faulting:
  - Chalk Cove: Normal fault juxtaposing poorly-welded massive tuff and silty lacustrine deposits (8.7 m vertical offset)
  - Crucifix/Crossing Faults: Crossing conjugate normal faults in laminated airfall tuffs with basal surge deposits; 7 m vertical offset)
- Fractures:
  - Fracture density increases with degree of welding
  - Fractures evident in nonwelded massive ignimbrite and in finely laminated basal surge deposits

Minipermeametry:
Small-Drillhole Minipermeameter Probe



Units are inches

Minipermeametry:
Small-Drillhole Minipermeameter System

- Release nitrogen gas into porous medium through an expandable tip seal packer
- Measure steady-state gas flow rate at associated injection pressure
- Use knowledge of the above variables and the system geometry in a form of Darcy's law to solve for permeability