# Characterization of Fractures at the Nopal I Site and Comparison to Fracture Characteristics of Yucca Mountain, Nevada

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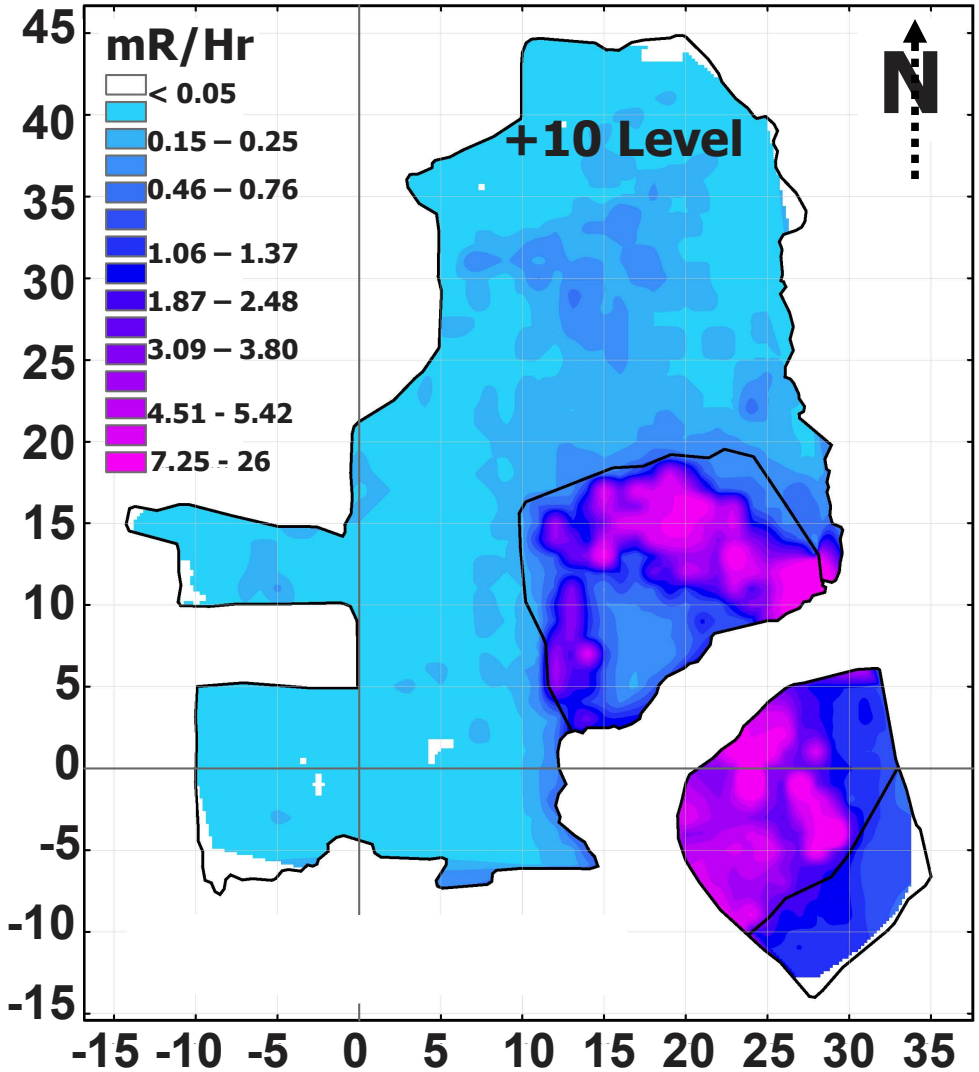
# Outline

- Introduction – overview of past work
- Fracture characteristics at
  - Nopal I site, Chihuahua, Mexico
  - Yucca Mountain, Nevada
- Use of fracture characterization information
- Summary

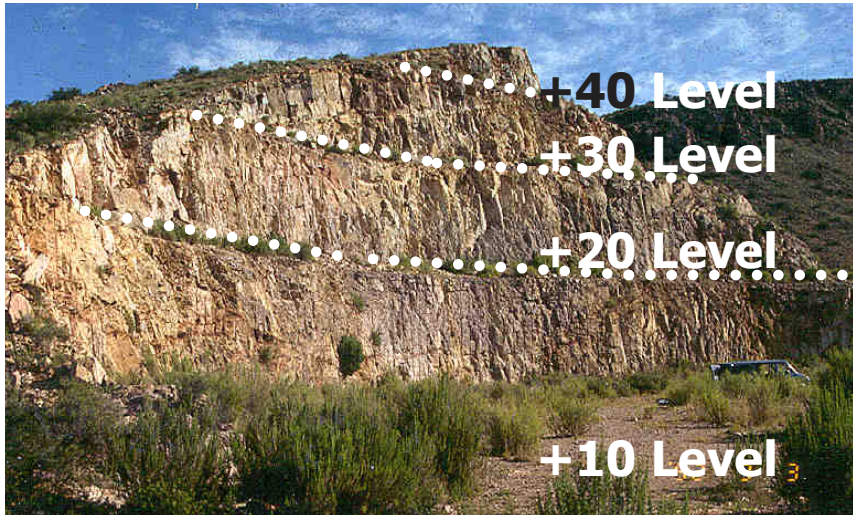
# Overview of Past Fracture Characterization Efforts

- Cleared benches
- Grid developed
- Mapped at 1:25 scale
- Contact gamma survey
- Investigated uranium transport and retention at micron to meter scale on cleared benches (Pearcy et al., 1995)

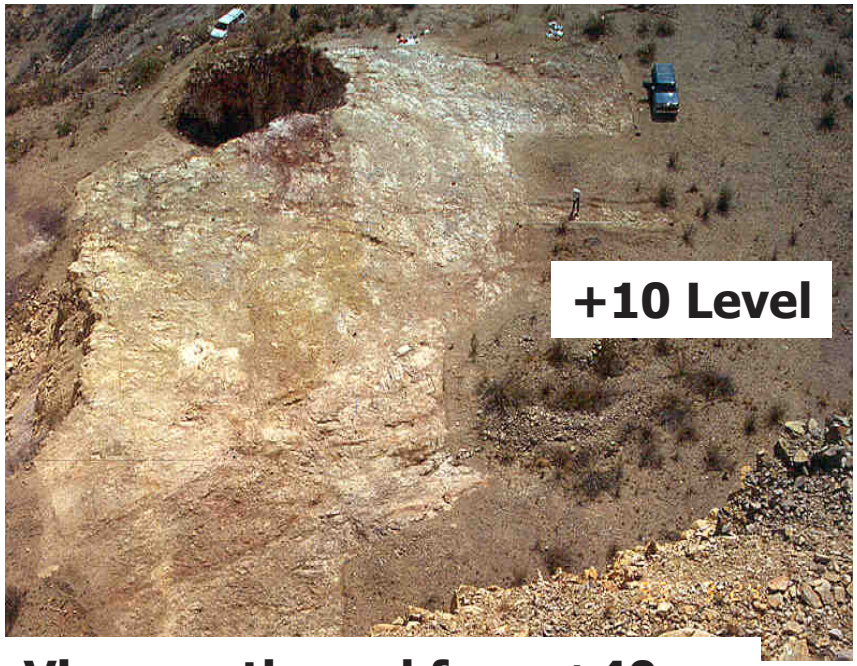
# Gamma Intensity Mapped onto Metric Grid



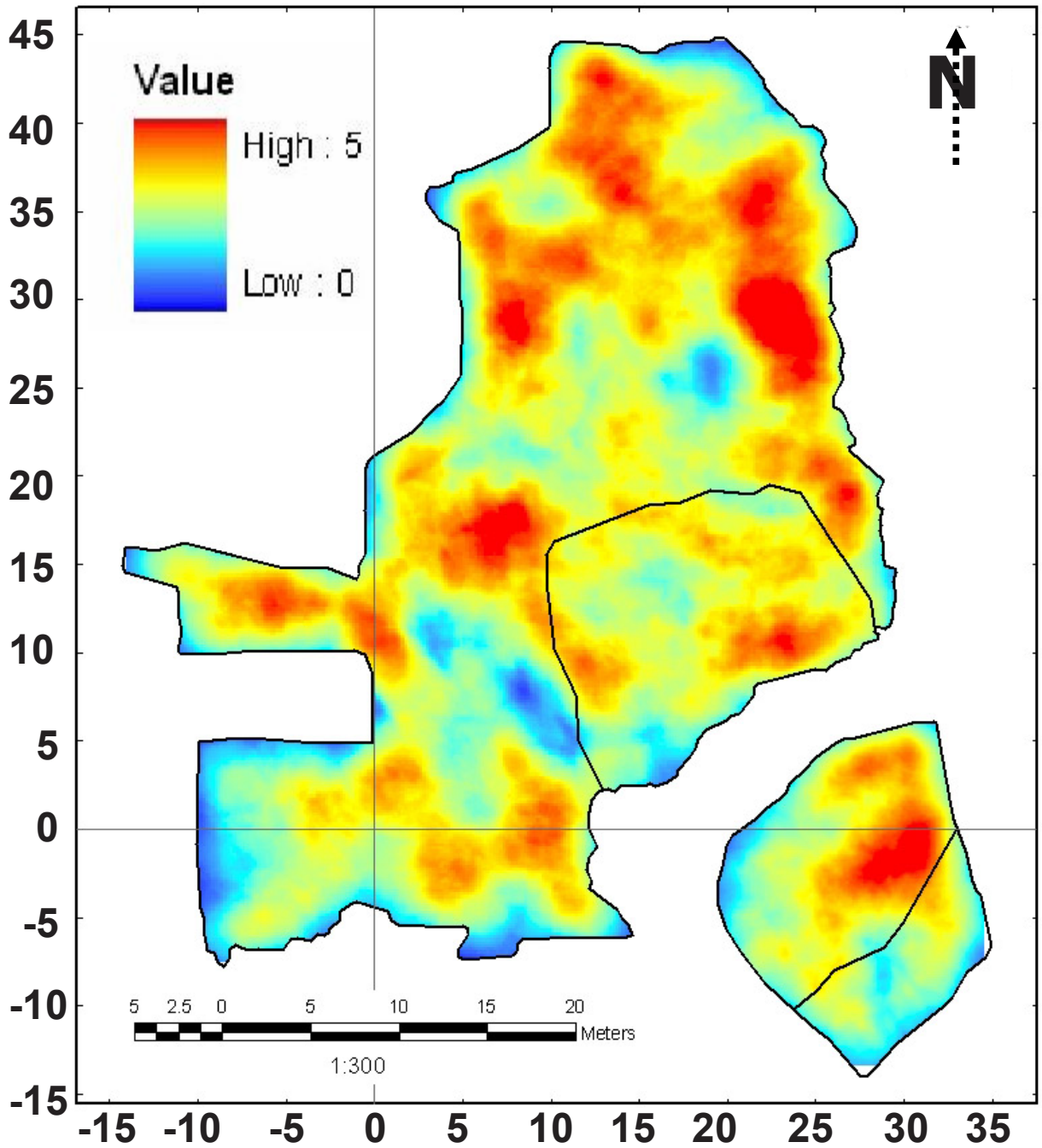

**Meters**



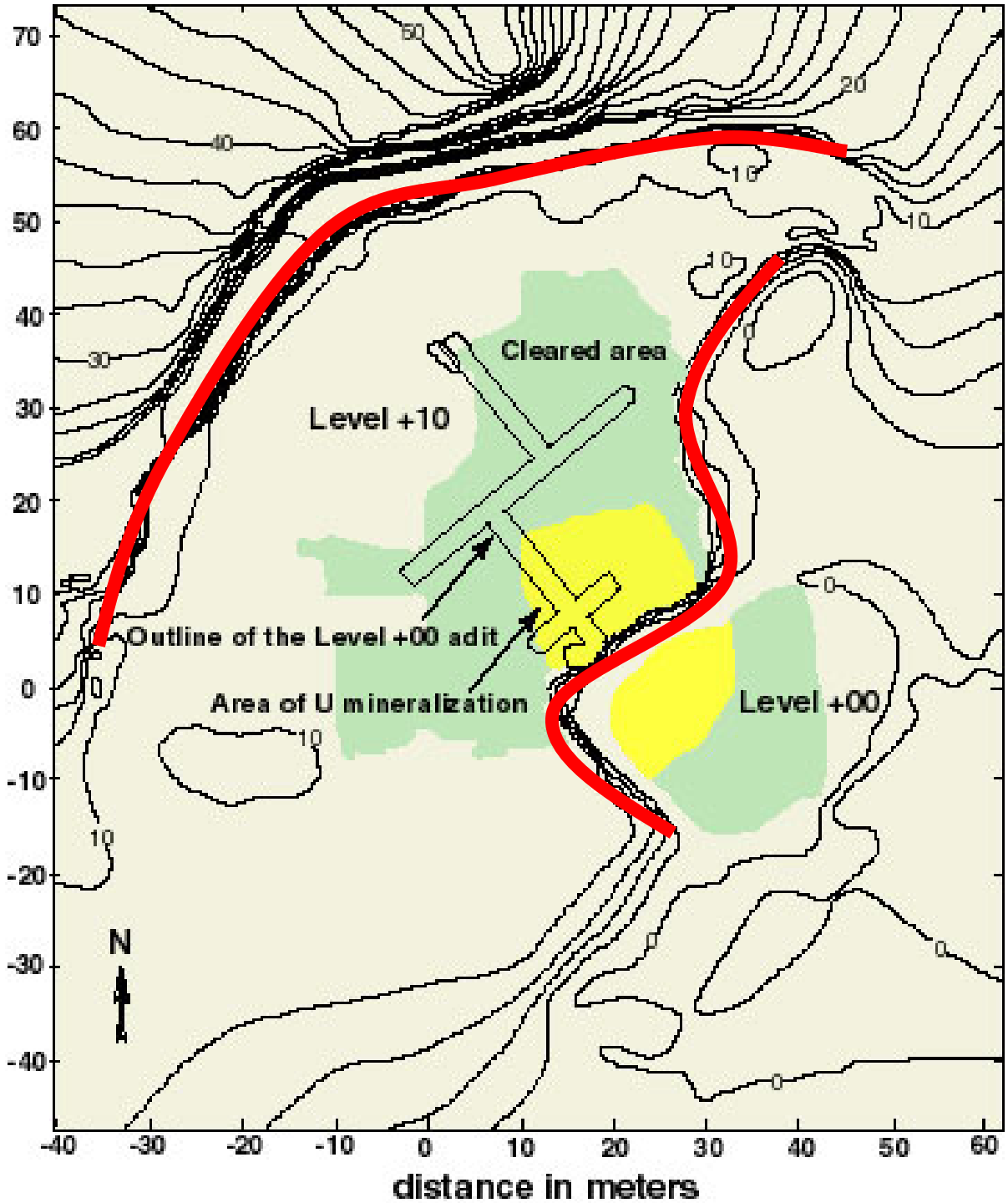

**View from +10 level up towards mapped 10 m high vertical walls**




**View southward from +40 level down to +0 level**

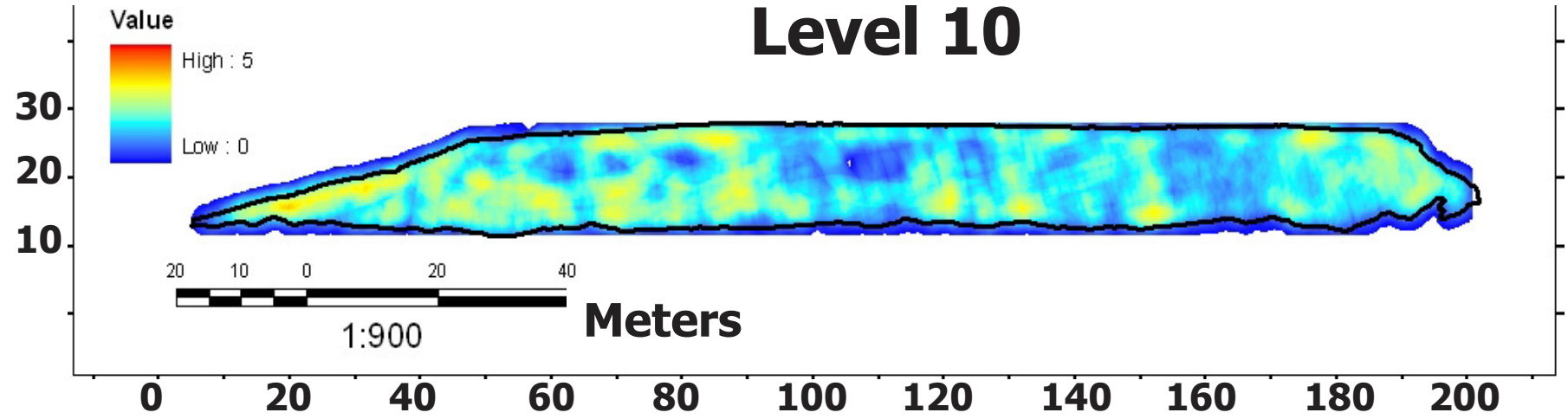


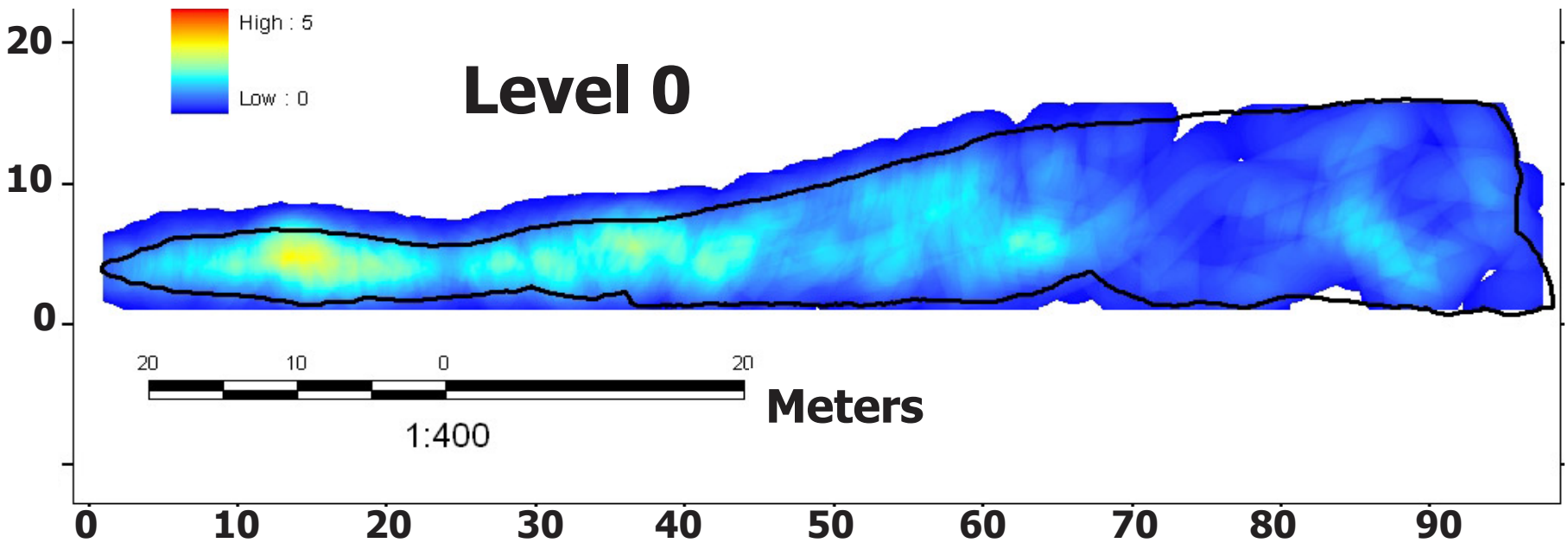

# Fracture Density ($m/m^2$) on Level +10 and Level +0 Mapped onto Metric Grid



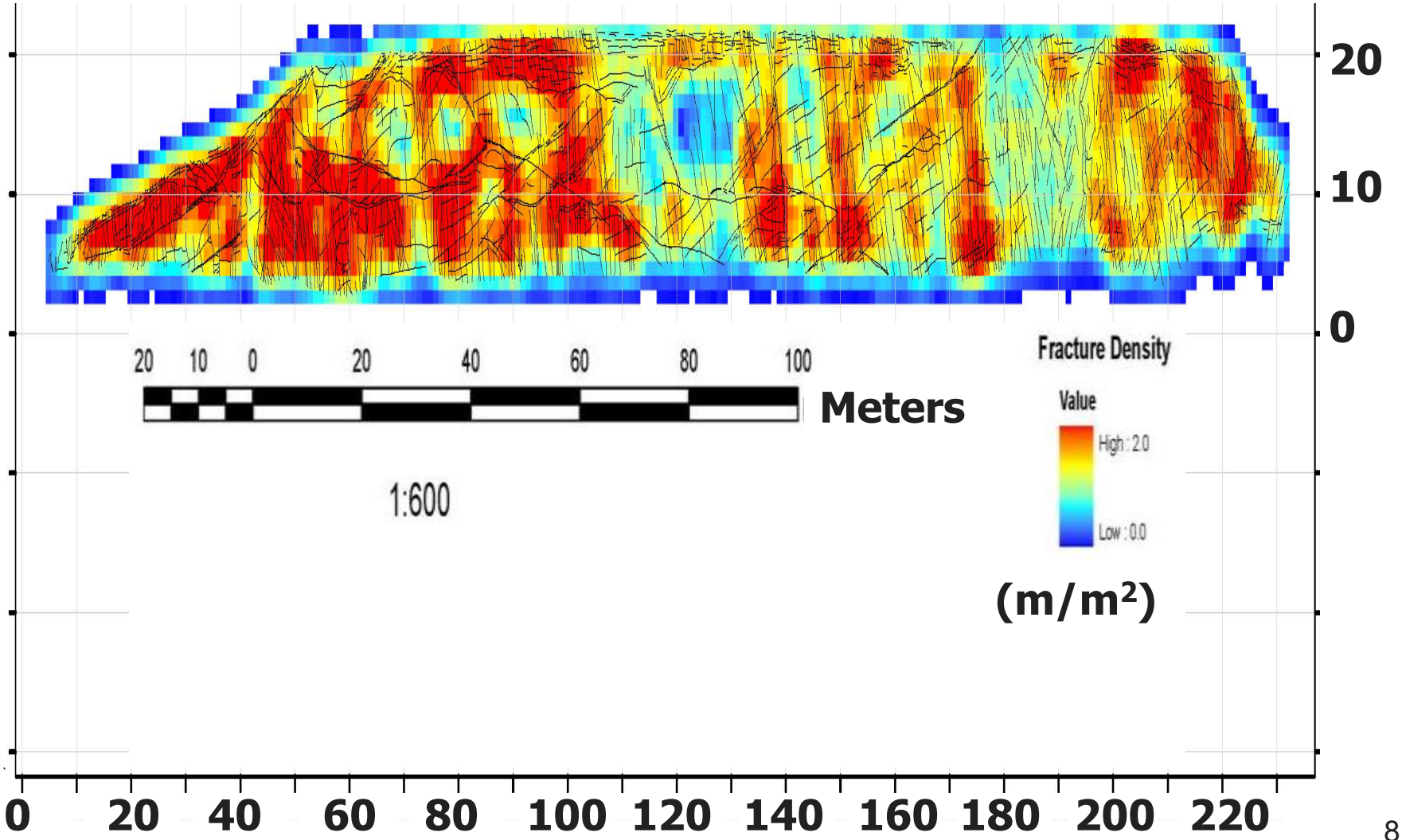

# Topographic Map of Nopal I Deposit Showing Orientation of Vertical Walls in Next Slides

# Fracture Density on Walls ($m/m^2$)



# Fractures and Fracture Density on +10 Wall



# Summary of Nopal I Fracture Characteristics

- Fracture density ranges from ~0.4 – ~6.0 $m/m^2$ for cleared benches and from ~0.4 – ~2.0 $m/m^2$ for vertical walls
- Fractal dimension of fracture pattern on cleared benches is 1.8
- Fracture-frequency-density fractal dimension is 2.4 and fracture-length-density fractal dimension is 2.6

# Summary of Yucca Mountain Fracture Characteristics

- **Middle non-lithophysal Topopah Spring Tuff**
  - **Fractal dimension of fracture pattern is 1.7 (Barton et al., 1993)**
  - **Fracture density ranges from 0.8 – 2.5 $m/m^2$ for Cross Drift, determined from full-periphery geologic mapping data (Smart et al., 2005, in review)**
- **Total of 3 sets of fractures, with one sub-horizontal set under-sampled**

# Using Fracture Characterization Data

- U.S. Department of Energy (DOE)
  - Constrain models of drift degradation
  - Understand seepage experiments
  - Distribution of mineralized fractures
    - Support for active fracture model
    - Support for estimates of deep percolation
- U.S. Nuclear Regulatory Commission
  - Independently assess DOE efforts
  - Better understand potential contaminant transport processes

# Summary

- NRC intensively mapped Nopal I site to understand importance of transport processes
- Fracture characteristics for welded non-lithophysal units at Yucca Mountain and Nopal I are broadly similar
- Use of fracture information is critically dependent on correcting data for orientation bias
- Potential to further use Nopal I fracture characterization information to better understand processes at Yucca Mountain

# Disclaimer

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