



U.S. Department of Energy
Office of Civilian Radioactive Waste Management

Framework for Volcanic Hazard Analysis at Yucca Mountain

Presented to:

Nuclear Waste Technical Review Board

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Management and Operating Contractor

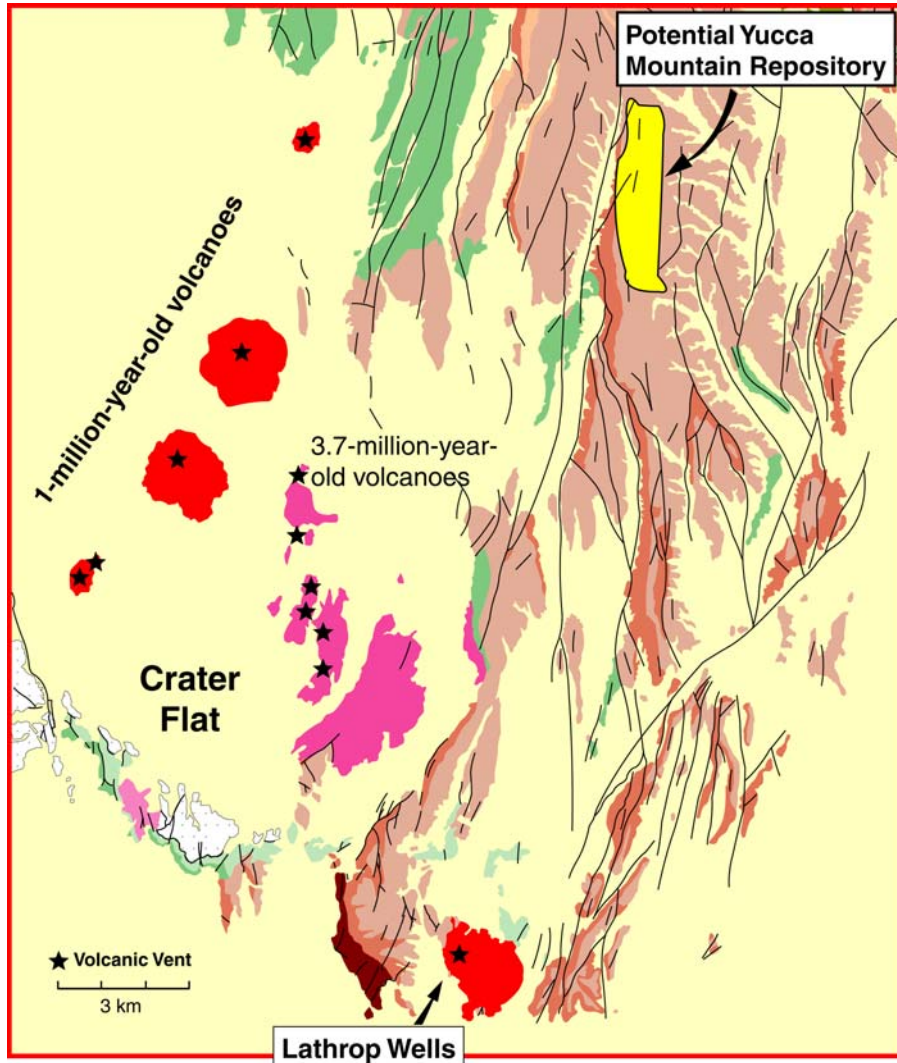
August 1, 2000

YUCCA
MOUNTAIN
PROJECT

Purpose

- **Provide an overview of the volcanic history of the Yucca Mountain region and the history of volcanism studies**
- **Provide a sense of the type of site characterization information that was considered by the expert panel during the PVHA**

Distribution of Volcanoes near Yucca Mountain



Why is volcanism an issue?

- Six Quaternary basaltic volcanoes within 20 km of the repository site
- Recurrence interval of volcanic episodes is ~ 300,000 years during the Quaternary
- Youngest volcano dated at ~75 ka

Timeline of DOE Volcanism Studies

Phase 1 (1978-1986):

- Regional characterization of basaltic volcanism
- Development of probabilistic approach to hazard analysis

Phase 2 (1987-1996):

- Focused characterization of post-Miocene volcanism nearest Yucca Mountain
- Initiation of Consequence Studies
- Reduction in uncertainty of age of youngest volcanic center through use of multiple geochronology methods
- Development and sensitivity analysis of alternative probability models
- PVHA expert elicitation

Timeline of DOE Volcanism Studies

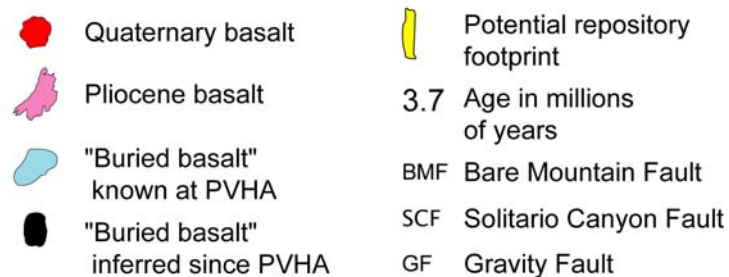
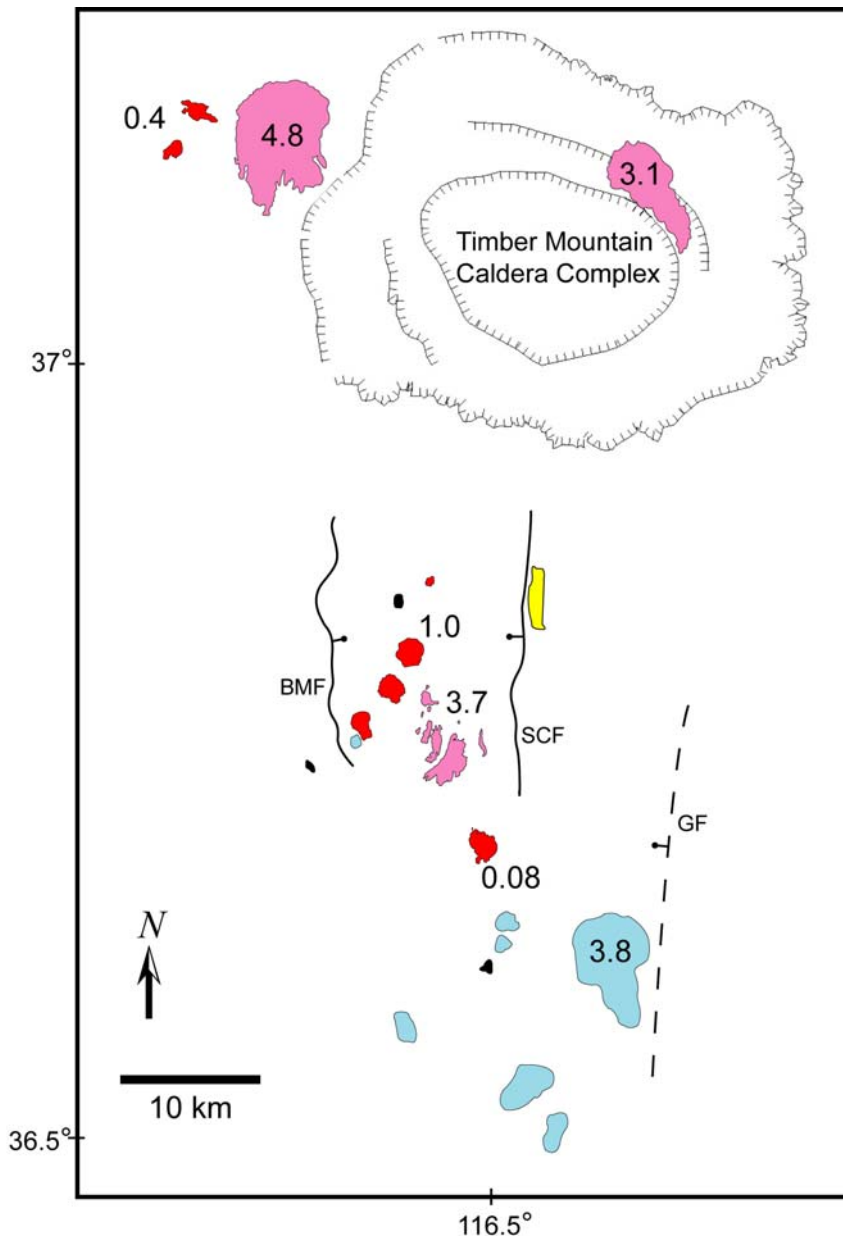
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Post-PVHA

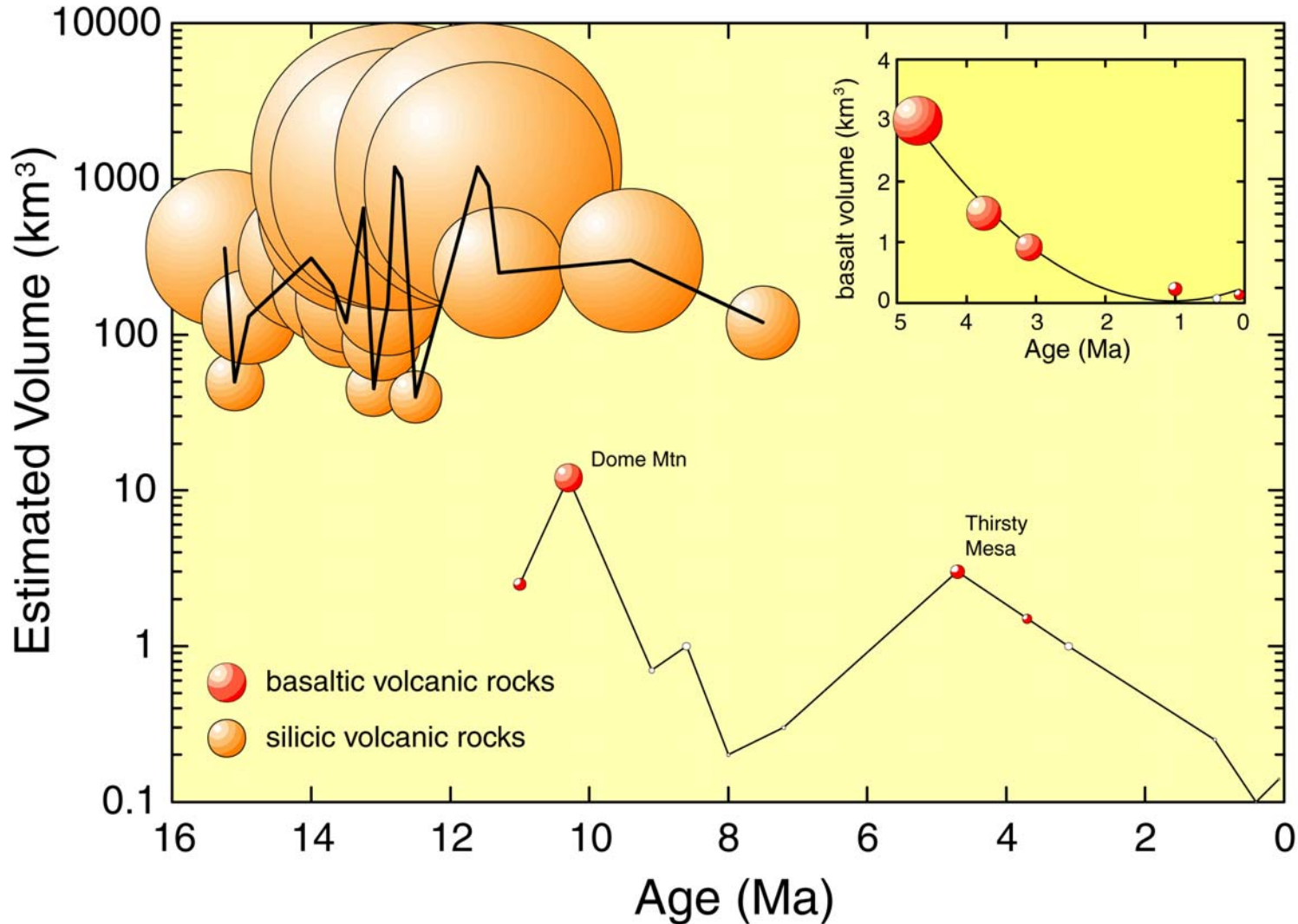
- **Sensitivity analyses of PVHA results in light of post-PVHA data and interpretations**
- **AMR feeds to Disruptive Events PMR**

Quaternary and Pliocene Volcanism in the Yucca Mountain Region

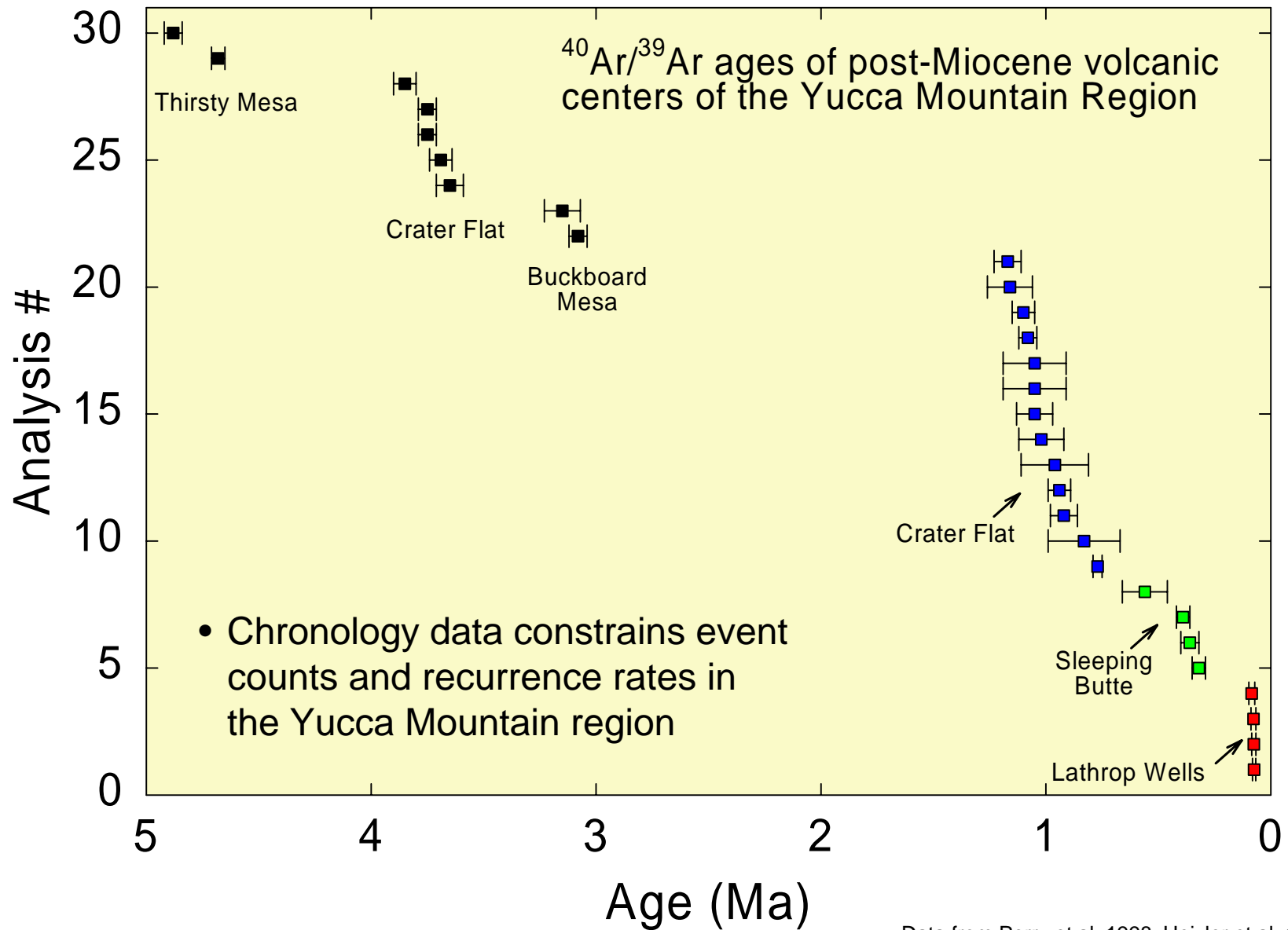
- Probability models based on known volcanic/tectonic record
- Silicic volcanism has not occurred since 7-8 Ma and is not an issue
- Past patterns of basaltic volcanism are basis for estimating probability of future repository disruption
- Volcanic record includes presence of inferred and known buried basalt centers



Age vs Volume of Volcanic Events in the SW Nevada Volcanic Field

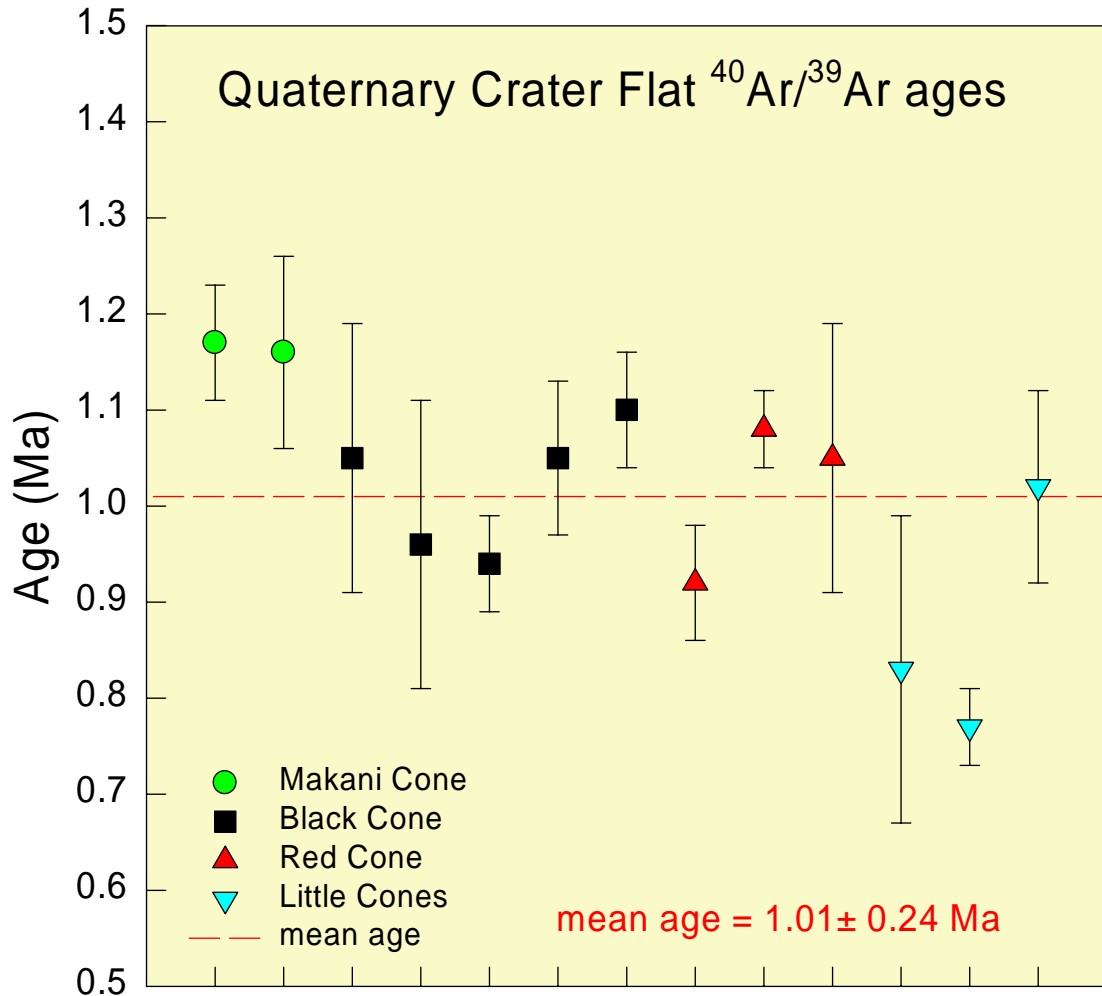


Data from Sawyer et al. 1994, Crowe et al. 1995



Data from Perry et al. 1998, Heizler et al. 1999

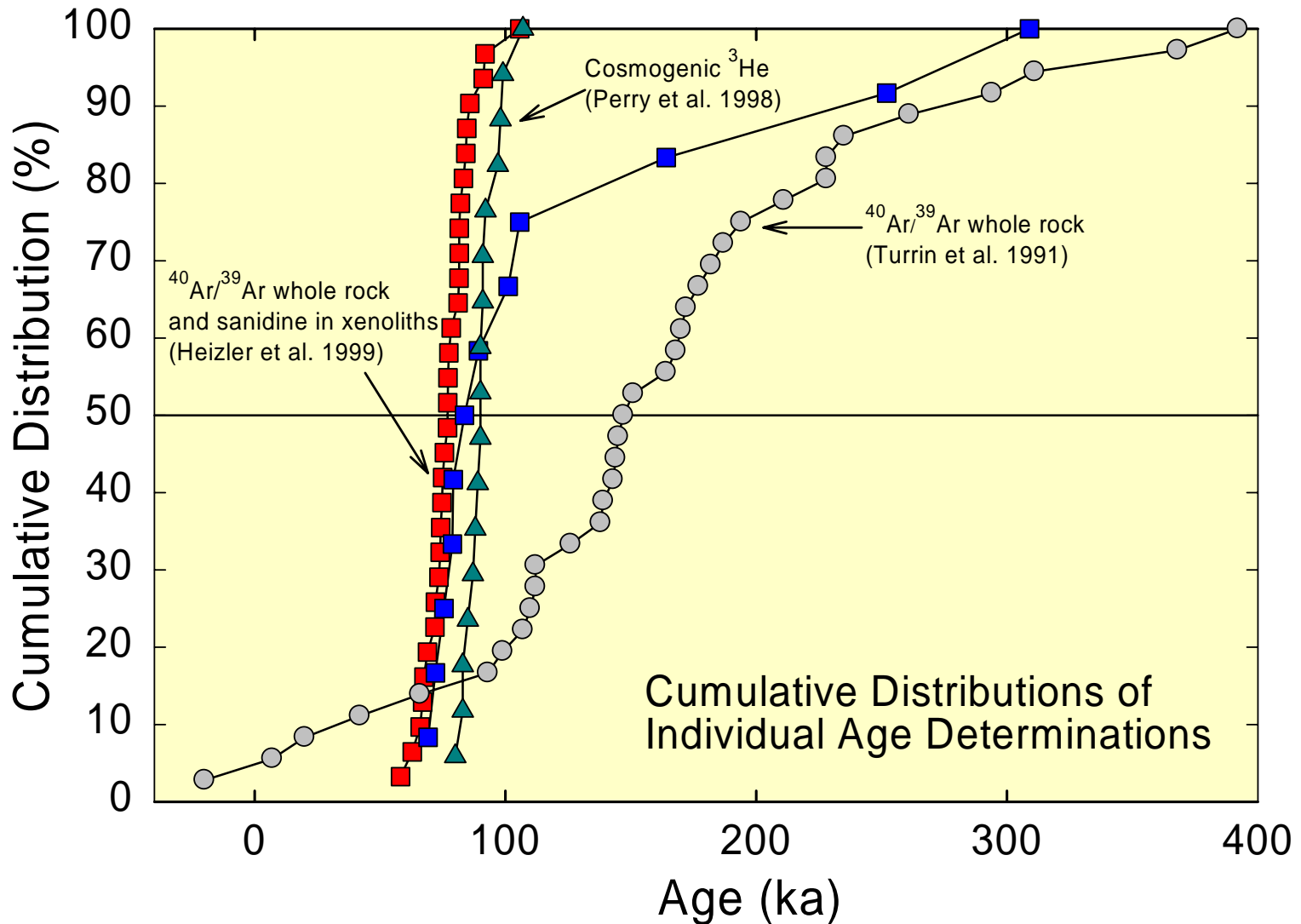
Age Interpretations



Ages within a single volcanic “episode” are uncertain, allowing for multiple interpretations of event counts

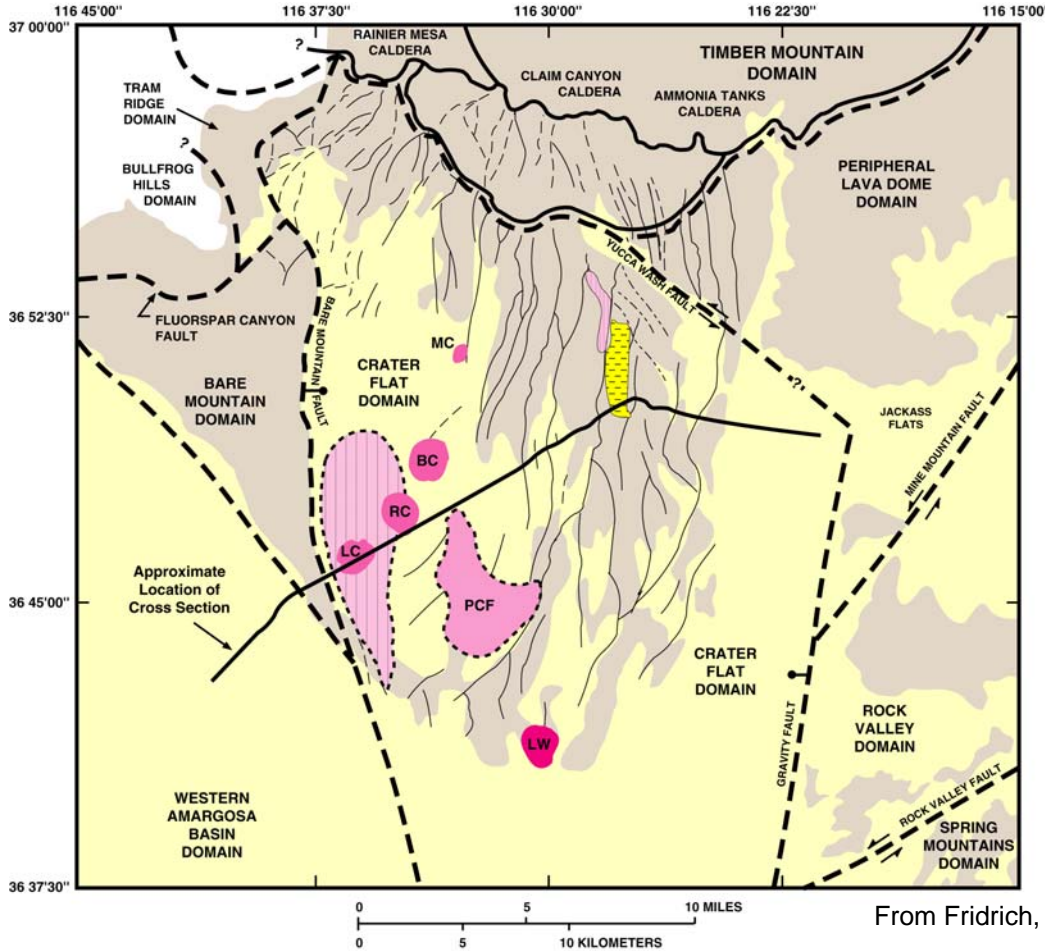
Data from Perry et al. 1998

Age of the Lathrop Wells Volcano



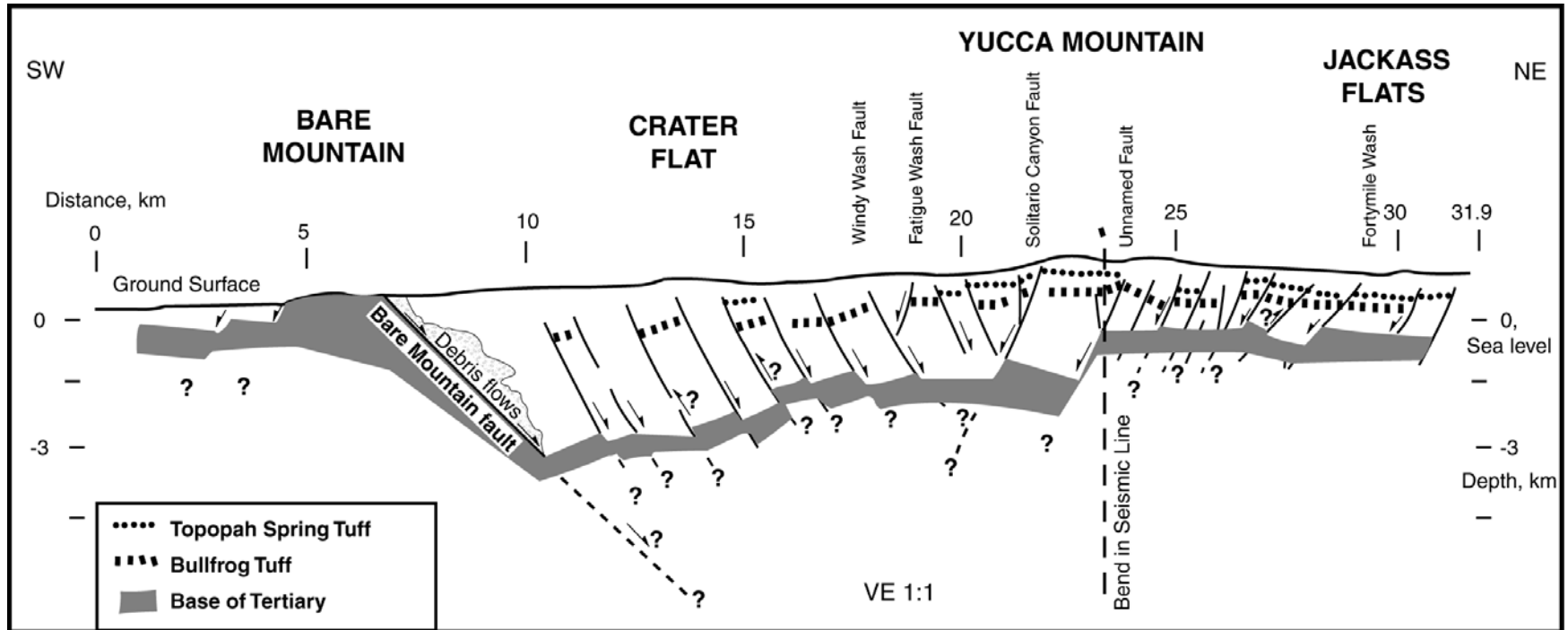
Crater Flat Structural Domain

Yucca Mountain and Crater Flat lie within the same structural domain, but different portions of the domain have experienced different amounts of extension



- Caldera margin
- - - Right-slip faults
- - - East dipping normal faults
- - - West dipping normal faults
- Bedrock/alluvium
- - - Buried contact
- - - Local structural domain boundary, queried where uncertain
- Approximate Repository footprint (EDA II)
- 70 ka basalt
- 0.9 Ma basalt
- 3.7 Ma basalt
- 10.5-11.3 Ma basalt

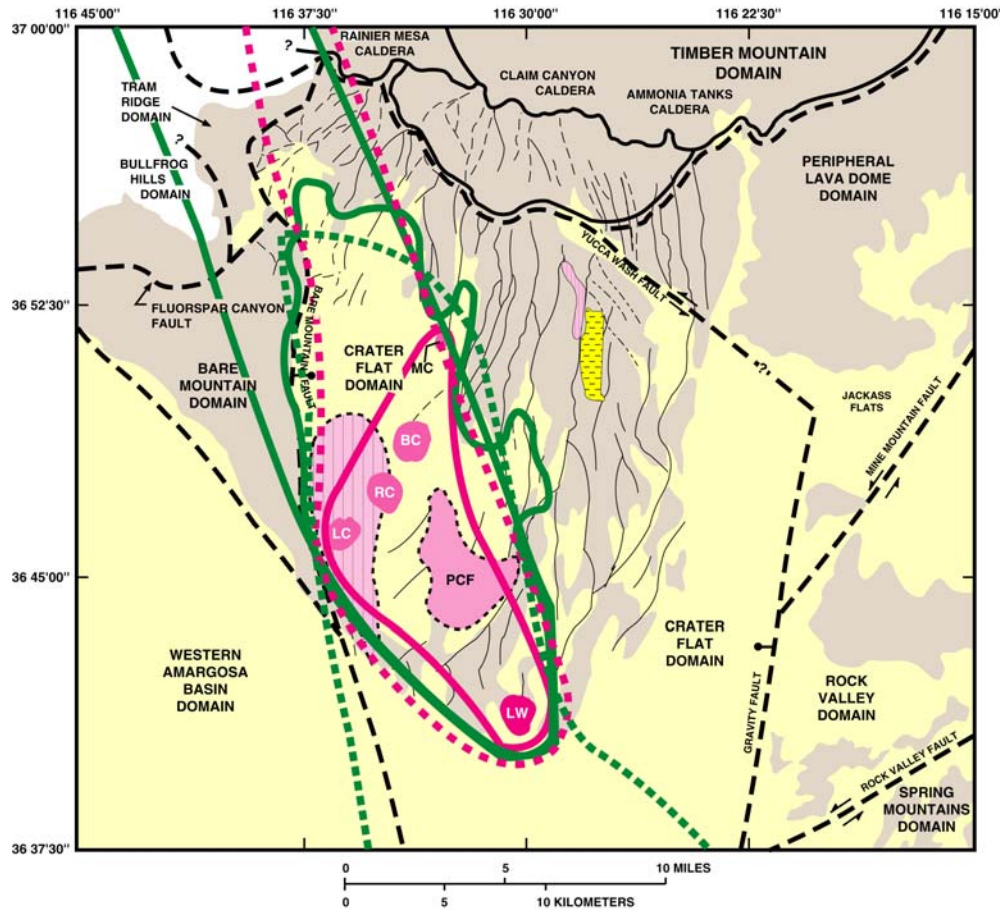
Interpretation of Crater Flat Domain Subsurface Structure from Seismic Reflection Data



From Brocher et al. 1998

Relationship between Volcanism, Crater Flat Structural Domain, and Example Volcanic Source Zones from PVHA

- Volcanic source zones are consistent with past patterns of basaltic volcanism and current understanding of domain tectonics



PVHA SOURCE ZONE BOUNDARIES NEAR YUCCA MOUNTAIN THAT ENCLOSE AREAS OF RELATIVELY HIGH VOLCANIC EVENT FREQUENCY



Why a PVHA Expert Elicitation after 15+ Years of Intense Data Collection and Analysis?

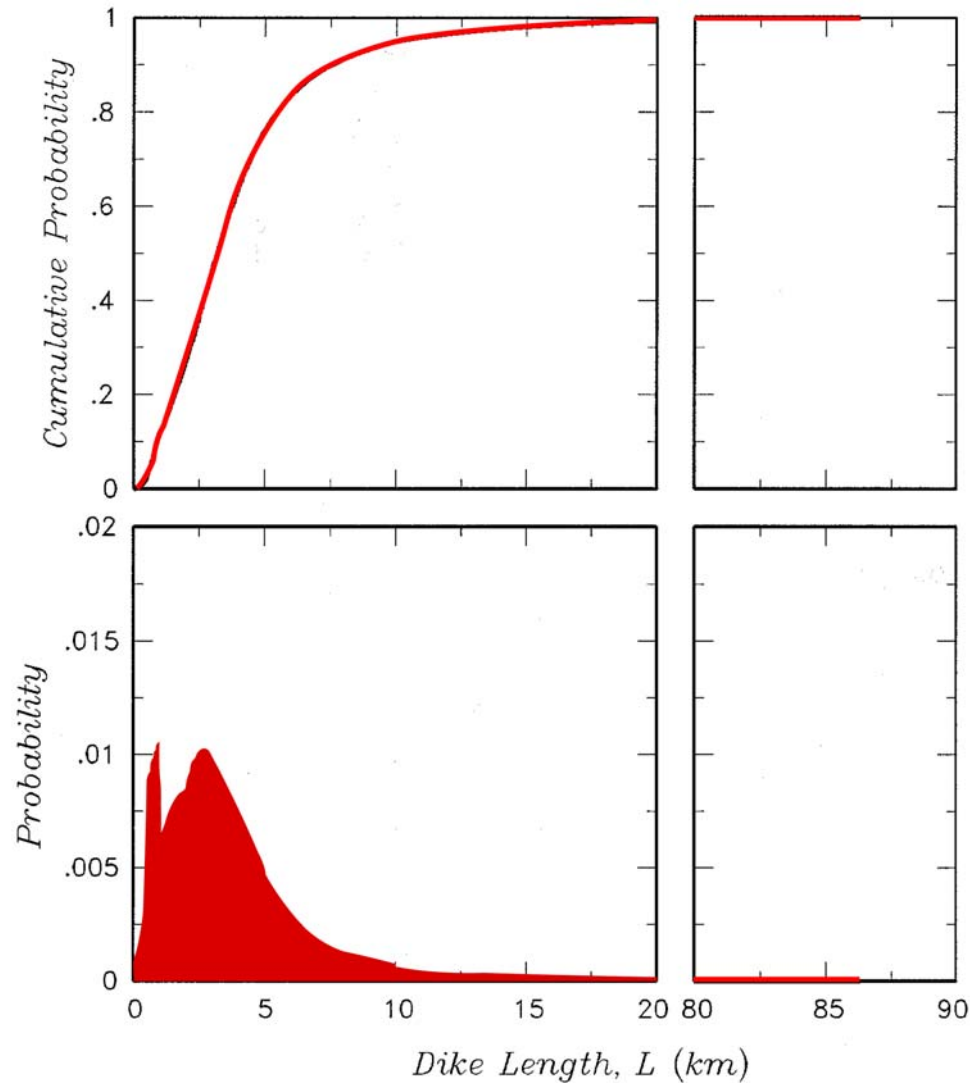
- **DOE approach emphasized a suite of permissible alternative probability models, all equally weighted with no attempt at discriminating between permissible models**
- **Disagreements among scientists over modeling methods and model parameters created difficulty in reaching resolution on probability issues**

Why a PVHA Expert Elicitation after 15+ Years of Intense Data Collection and Analysis?

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- **Sparse record of volcanism and incomplete understanding of magmatic and tectonic processes tended to fuel disagreements**
- **The PVHA was convened to provide an independent assessment of the probability of volcanic disruption of the proposed repository, as well as the uncertainty of the probability models and of the parameter values used in the models**

Example of Parameter Value Uncertainty: Dike Length



Comparison of PVHA Results with pre-and post-PVHA Results

