

SUMMARY OF NRC-DOE TECHNICAL EXCHANGE
ON TECTONIC MODELS
November 28-29, 1989
Denver, Colorado

Agenda: See Attachment 1.

List of Attendees: See Attachment 2.

Summary:

On November 28-29, 1989, the U.S. Nuclear Regulatory Commission (NRC) and the U.S. Department of Energy (DOE) conducted a technical exchange about the relationship of DOE's site characterization activities to the evaluation of tectonic models of the Yucca Mountain, Nevada site. The specific objective of the technical exchange was for NRC and DOE to discuss site and regional-scale faulting studies, including integration of field data at both scales, and how the resulting data will be utilized to address alternative tectonic models of Yucca Mountain such as those discussed at the NRC-DOE technical exchange on October 31 and November 1-2, 1989. DOE and DOE contractor representatives presented an approach using the presence or absence of key discriminating geologic characteristics to help determine whether particular tectonic models are plausible alternatives for Yucca Mountain. In that approach the presence or absence of the discriminating characteristics is to be decided on the basis of data gathered during site characterization. Attachment 3 is the example workbook that was used during the discussions to illustrate the approach.

The DOE Study Plan for Evaluating the Location and Recency of Faulting Near Prospective Surface Facilities, which was undergoing detailed technical review by the NRC staff, was discussed as an example of how a particular study is integrated into DOE's overall tectonics program. DOE laid out the studies comprising its tectonics program, and indicated that the Study "Development and Synthesis of Tectonic Models" is intended to be the main vehicle for integrating and coordinating its program.

Both NRC and DOE considered that useful discussion took place concerning the relationship of site characterization activities to the evaluation of alternative tectonic models of Yucca Mountain. However, NRC indicated that it had expected more charts, maps, and other data to be available for discussion at this exchange. The State of Nevada, which also participated in the exchange, expressed its disappointment that more of the United States Geological Survey principal investigators involved in the DOE tectonics program were not available to discuss their activities.

FULL TEXT ASCII SCAN

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DRAFT AGENDA

DOE-NRC TECHNICAL EXCHANGE ON TECTONIC MODELSDATE: NOVEMBER 28-29, 1989¹

DENVER, COLORADO

- PURPOSE:** To discuss both site-area and regional-scale faulting studies including integration of field data at both scales and how resulting data will address questions relating to alternative tectonic models.
- SCOPE:** This technical exchange will concentrate on that portion of the site characterization program pertinent to identification and evaluation of alternative tectonic models. In a narrower sense, it will focus on some examples of DOE studies planned to evaluate various tectonic models of the Yucca Mountain Site. The agenda below covers faulting studies at both site and regional scales, and allows time for discussions of how field data will address alternative tectonic models as well as the interrelationships between site-area and regional-scale studies.

NOVEMBER 28, 1989

Agenda TopicsDiscussion Leader

- | | |
|---|-------------------------|
| o Introduction/Background | DOE/NRC/State of Nevada |
| o Site Area Faulting Field Studies | Rick Spengler, USGS |
| Field Mapping,
Trenching,
Geophysical Surveys, and
Drilling | |
| o Regional Faulting Field Studies | Ken Fox, USGS |
| Field Mapping,
Geophysical Surveys, and
Use of other available data | |

NOVEMBER 29, 1989

- o Carryover from November 28
- o Discussion of how site specific field data will address tectonic models

Technical Models

11/28-29/89

31 people

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**DOE-USGS-NRC TECHNICAL EXCHANGE ON TECTONIC MODELS
November 28-29, 1989**

**NO QUATERNARY
EXTENSIONAL AXIS
BELOW CRATER FLAT**

**QUATERNARY
EXTENSIONAL AXIS
BELOW CRATER FLAT**

REGIONAL WRENCH

Calderas
(Crater Flat)

Regional Low-angle
Extensional fault

Planar Normal Fault

Local Low-angle Extensional Fault

Local Low-angle Extensional Fault and Wrench Fault

En Echelon Faults over Wrench Fault

DOB-USGS-NRC TECHNICAL EXCHANGE ON TECTONIC MODELS
November 28-29, 1989

Discriminator

Credible Models for Quaternary Tectonism

No Quaternary extensional axis in upper crust below Crater Flat (Extensional axis lies to west in D.V.-P.V. area)	Quaternary extensional axis lies below Crater Flat (i.e., Crater Flat is post-Crater Flat tuff extensional basin)		Regional Wrench Fault		
Regional detachment extends eastward to or beyond Y.M.	No detachment below YM-CF; Syn-Crater Flat Tuff caldera(s) (caldera model)	Planar Normal Fault (Basin & Range)	Local detachment	Wrench Fault concealed below detachment (Hardyman model for Central W.L.)	Echelon Fts. over deep basement shear zone (Lake Basin-Huntley model)
Stratigraphic features of Crater Flat Tuff suggest source is below Crater Flat					
Low-angle extensional faults present below Y.M.					
Quaternary faults at Y.M. (and vicinity?) are listric to low-angle ext. flt. at depth					
Contemporary stress pattern suggest decoupling of upper plate(s) from lower					

Discriminator

Credible Models for Quaternary Tectonism (cont.)

No Quaternary extensional axis in upper crust below Crater Flat (Extensional axis lies to west in D.V.-P.V. area)	Quaternary extensional axis lies below Crater Flat (i.e., Crater Flat is post-Crater Flat tuff extensional basin)			Regional Wrench Fault	
Regional detachment extends eastward to or beyond Y.M.	No detachment below YM-CF; Syn-Crater Flat Tuff caldera(s) (caldera model)	Planar Normal Fault (Basin & Range)	Local detachment	Wrench Fault concealed below detachment (Hardyman model for Central W.L.)	Echelon Flts. over deep basement shear zone (Lake Basin-Huntley model)

Low-angle extensional faults below D.V.-P.V. extend eastward to or beyond Y.M.

Low-angle extensional faults extending eastward from D.V.-P.V. are Quaternary

Wrench fault projects below Y.M.-C.F.

Wrench fault projecting below Y.M.-C.F. is Quaternary

Contemporary stress-pattern suggests active couple (wrench)

Discriminator

Credible Models for Quaternary Tectonism (cont.)

No Quaternary extensional axis in upper crust below Crater Flat (Extensional axis lies to west in D.V.-P.V. area)	Quaternary extensional axis lies below Crater Flat (i.e., Crater Flat is post-Crater Flat tuff extensional basin)			Regional Wrench Fault	
Regional detachment extends eastward to or beyond Y.M.	No detachment below YM-CF; Syn-Crater Flat Tuff caldera(s) (caldera model)	Planar Normal Fault (Basin & Range)	Local detachment	Wrench Fault concealed below detachment (Hardyman model for Central W.L.)	Echelon Flts. over deep basement shear zone (Lake Basin-Huntley model)

Quat. Flting
coeval on many
faults (as at
Cedar Mtn.)

Extension driven
by local shear
couple

Extension driven
by mantle-
lower crustal
convection

Quat. Flting &
basaltic Volcanism
are correlated

Basaltic volc.
at C.F. is
response to
local extension

Rate of flting
increasing
through Quat.

ACTIVITY

DISCRIMINATOR

**STRATIGRAPHIC FEATURES OF THE
CRATER FLAT TUFF SUGGEST A SOURCE
BELOW CRATER FLAT**

YES

NO

**strat studies
of host rock
8.3.1.4.2.1.1**

**mapping of zonal
features
8.3.1.4.2.2.1**

**eval. postulated
detachment faults
8.3.1.17.4.5.2**

**magnetic properties
and stratigraphic
corr.8.3.1.4.2.1.5**

ACTIVITY**DISCRIMINATOR**

**LOW-ANGLE EXTENSIONAL FAULTS ARE
PRESENT BENEATH YUCCA MOUNTAIN**

TERT PZ-TERT PZ NONE

**Borehole
geophysics
8.3.1.4.2.1.4**

**borehole
eval.
of faults
8.3.1.4.2.2.3**

**Detachment
faulting
8.3.1.17.4.5**

**Tectonic
models
8.3.1.17.4.12.1**

**Stress field
studies
8.3.1.17.4.8.1
8.3.1.17.4.8.2**

**gravity of
site area
8.3.1.17.4.7.2**

**paleomag
studies
8.3.1.4.1.5**

ACTIVITY

DISCRIMINATOR

**QUATERNARY FAULTS AT YM
(AND VICINITY) ARE LISTRIC TO
A LOW-ANGLE EXT. FLT. AT DEPTH**

to PZ-TERT

YES

to Deeper level

NO

**Gravity map
8.3.1.17.4.7.1**

**borehole
geophysics
8.3.1.4..2.1.3**

**Borehole
eval. of
faults
8.3.1.4.2.2.3**

**subsurface
strat. studies
8.3.1.4.2.1.1**

**Mapping of
shaft
8.3.1.4.2.2.4**

**geologic
map
8.3.1.4.2.2.1**

**MidWay
valley
trenching
8.3.1.17.4.3.2**

Activity

Discriminator

Contemporary stress pattern suggests
decoupling of upper plate(s) from lower

Yes

No

Evaluate present stress
field within the site-
area (8.3.1.17.4.8.1)

Evaluate and test
shallow borehole
hydrofrac and
triaxial strain
recovery methods for
the determination
of in-situ stress
(8.3.1.17.4.8.2)

Monitor current
seismicity
(8.3.1.17.4.1.2)

Activity

Discriminator

Low-angle extensional faults below D.V.-
P.V. extend eastward to or beyond Y.M.

Yes

No

Conduct and evaluate
deep geophysical surveys
in an east-west tran-
sect crossing the
Furnace Creek fault
zone, Yucca Mountain,
and the Walker Lane
(8.3.1.17.4.3.1)

Evaluate postulated
detachment faults in
the Beatty-Bare
Mountain area
(8.3.1.17.4.5.2)

Evaluate the age of
detachment faults
using radiometric
ages (8.3.1.17.4.5.5)

Evaluate tectonic
processes and tectonic
stability at the site
(8.3.1.17.4.12.1)

Activity

Discriminator

**Low-angle extensional faults extending-
eastward from D.V.-P.V. are Quaternary**

Yes

No

Evaluate postulated
detachment faults in
the Beatty-Bare
Mountain area
(8.3.1.17.4.5.2)

Evaluate the age of
detachment faults
using radiometric
ages (8.3.1.17.4.5.5)

Evaluate Quaternary
faults within 100 km of
Yucca Mountain
(8.3.1.17.4.3.2)

Activity

Discriminator

Wrench fault projects below Y.M.-C.F.

Yes

No

Conduct and evaluate deep geophysical surveys in an east-west transect crossing the Furnace Creek fault zone, Yucca Mountain, and the Walker Lane (8.3.1.17.4.3.1)

Evaluate intermediate depth (2 to 3 km) reflection and refraction methods and plan potential application of these methods within the site area (8.3.1.17.4.7.1)

Detailed gravity survey of the site-area (8.3.1.17.4.7.2)

Detailed aeromagnetic survey of the site area (8.3.1.17.4.7.3)

Evaluate tectonic processes and tectonic stability at the site (8.3.1.17.4.12.1)

Activity

Discriminator

Wrench fault projecting below Y.M.-C.F.
is Quaternary

Yes

No

Evaluate Quaternary
faults within 100 km of
Yucca Mountain
(8.3.1.17.4.3.2)

Activity

Discriminator

**Contemporary stress-pattern suggests
active couple (wrench)**

Yes

No

**Evaluate present stress
field within the site-
area (8.3.1.17.4.8.1)**

**Evaluate and test
shallow borehole
hydrofrac and
triaxial strain
recovery methods for
the determination
of in-situ stress
(8.3.1.17.4.8.2)**

**Monitor current
seismicity
(8.3.1.17.4.1.2)**

Activity

Discriminator

Quaternary faulting coeval on many faults
(as at Cedar Mountain)

Yes

No

Evaluate age and
recurrence of movement
on suspected and known
Quaternary faults
(8.3.1.17.4.6.2)

Evaluate Quaternary
faults within 100 km of
Yucca Mountain
(8.3.1.17.4.3.2)

Conduct exploratory
trenching in Midway
Valley (8.3.1.17.4.2.2)

Evaluate the Stagecoach
Road fault system
(8.3.1.17.4.4.3)

Activity

Discriminator

Extension driven by local shear couple

Yes

No

Evaluate Quaternary
faults within 100 km of
Yucca Mountain
(8.3.1.17.4.3.2)

Evaluate structural
domains and characterize
the Yucca Mountain
region with respect to
regional patterns of
faults and fractures
(8.3.1.17.4.3.5)

Activity

Discriminator

Extension driven by mantle-lower crustal
convection

Yes

No

Heat flow at Yucca
Mountain and evaluation
of regional ambient heat
flow anomalies
(8.3.1.8.5.2.3))

Activity

Discriminator

Quaternary faulting and basaltic volcanism
are correlated

Yes

No

Evaluate age and
recurrence of movement
on suspected and known
Quaternary faults
(8.3.1.17.4.6.2)

Evaluate Quaternary
faults within 100 km of
Yucca Mountain
(8.3.1.17.4.3.2)

Conduct exploratory
trenching in Midway
Valley (8.3.1.17.4.2.2)

Evaluate the Stagecoach
Road fault system
(8.3.1.17.4.4.3)

Geochronology studies
(of volcanic features)
(8.3.1.8.5.1.2)

Field geologic studies
(of volcanic features)
(8.3.1.8.5.1.3)

Activity

Discriminator

**Rate of faulting increasing through
Quaternary**

Yes

No

Evaluate age and
recurrence of movement
on suspected and known
Quaternary faults
(8.3.1.17.4.6.2)

Evaluate Quaternary
faults within 100 km of
Yucca Mountain
(8.3.1.17.4.3.2)

Conduct exploratory
trenching in Midway
Valley (8.3.1.17.4.2.2)

Evaluate the Stagecoach
Road fault system
(8.3.1.17.4.4.3)