State of Nevada
Presentation to the
Technical Review Board

Subject: **Active Tectonics of the Yucca Mountain Region**

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Main Points

- Yucca Mountain and its Geological Context

- Regional Seismicity and the Potential for Temporal and Spatial Clustering

- Mechanisms of Modern Deformation in the Southern Great Basin

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Conclusions

Yucca Mountain is part of an active geological system whose components are inextricably linked to each other.

In order to better understand (and anticipate) geological processes at Yucca Mountain we need to better understand the system as a whole.

Any interpretation of Yucca Mountain must be consistent with that of the region.

We must be certain that probabalistic analyses are provided with a thorough and an as-complete-as-possible database.

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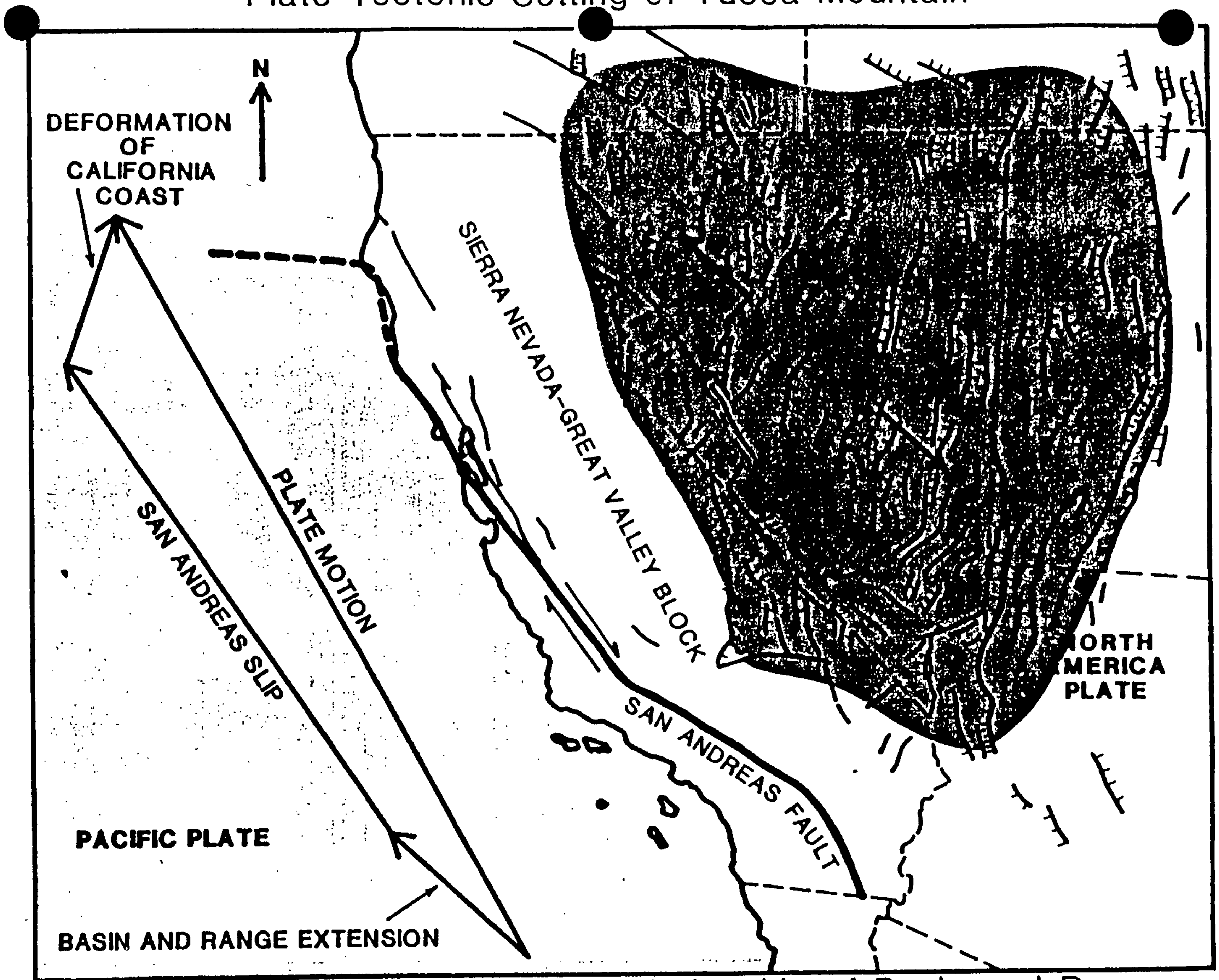
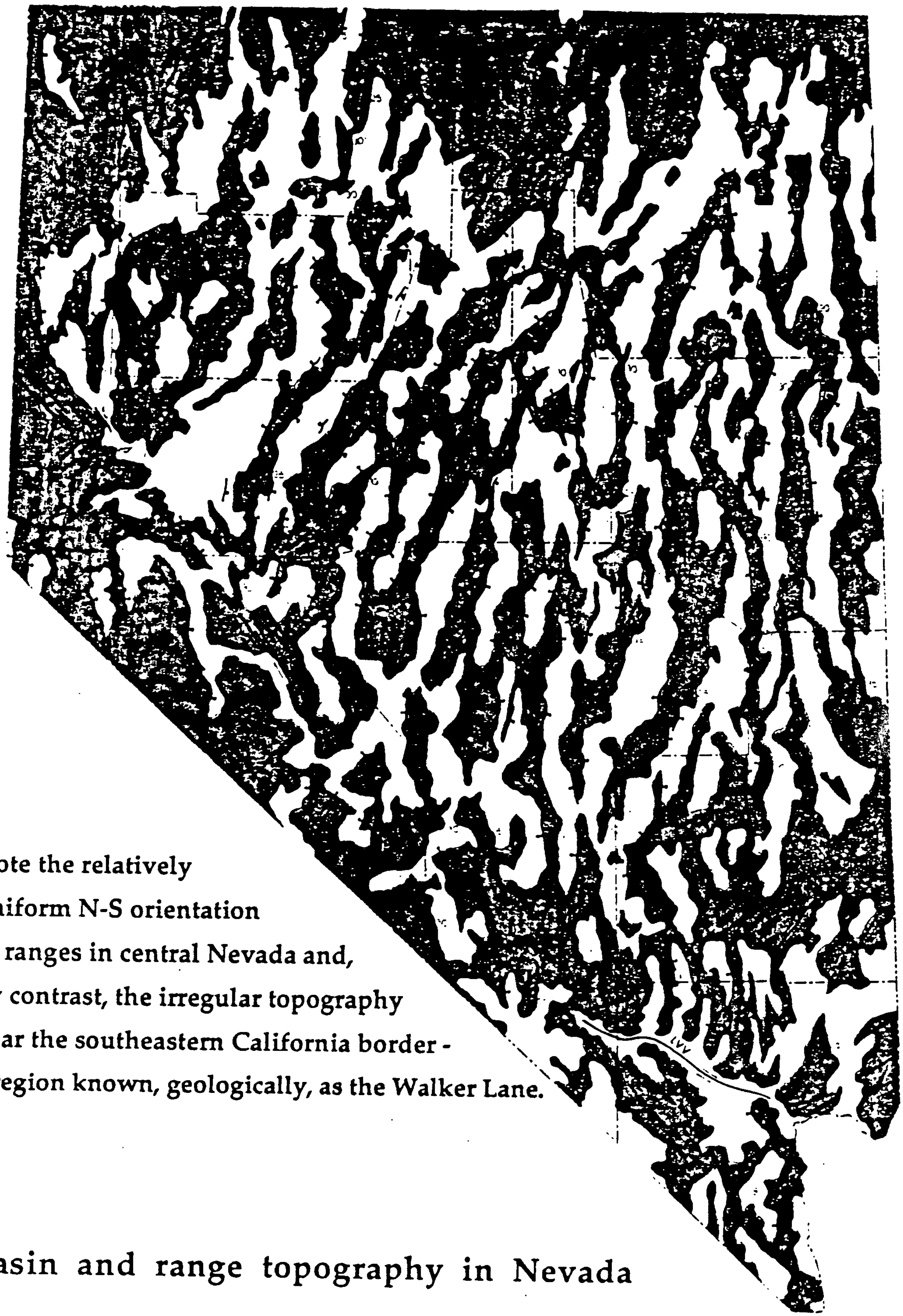
Plate Tectonic Setting of Yucca Mountain



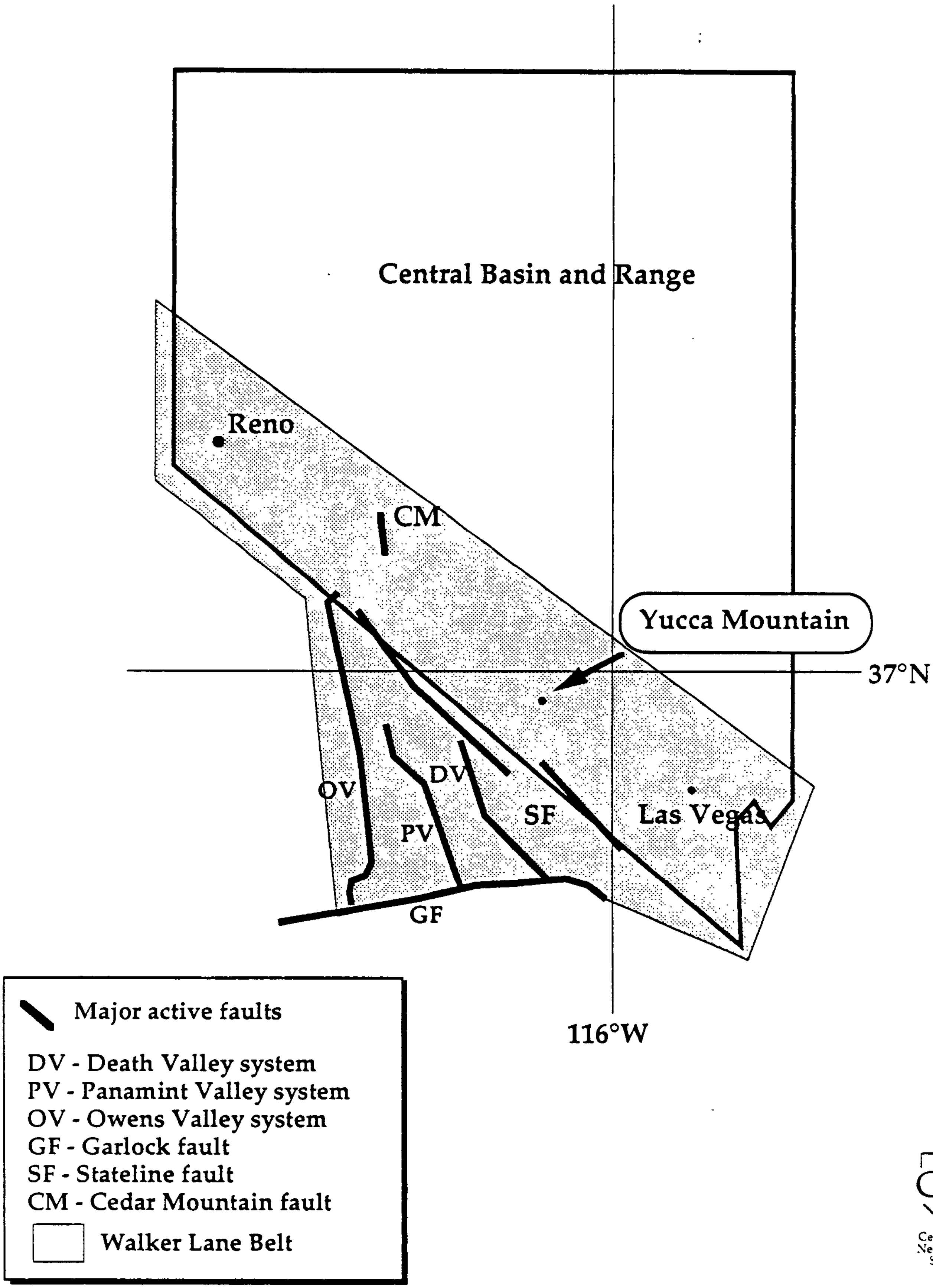
Velocity vector diagram shows relationship of Basin and Range deformation to that of the western USA



Note the relatively uniform N-S orientation of ranges in central Nevada and, by contrast, the irregular topography near the southeastern California border - a region known, geologically, as the Walker Lane.

Basin and range topography in Nevada

Walker Lane Belt and Major Active Faults in the Southern Great Basin



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Regional Seismicity and the potential for spatial and temporal clustering

Seismicity and modern deformation in the Yucca Mountain region affects the following features:

- ground water flow
- mineral resource potential
- volcanic eruptive processes
- strong ground motions during seismic events
- ground deformation due to blind faults

In order to evaluate the seismicity that will directly affect Yucca Mountain we need to evaluate the potential for both spatial and temporal clustering of seismic events in the region - we need to understand how the region has been responding to extension during the past tens of thousands of years.

No amount of probabalistic analysis will yield an appropriate seismic hazard map if the data base is fundamentally inadequate.

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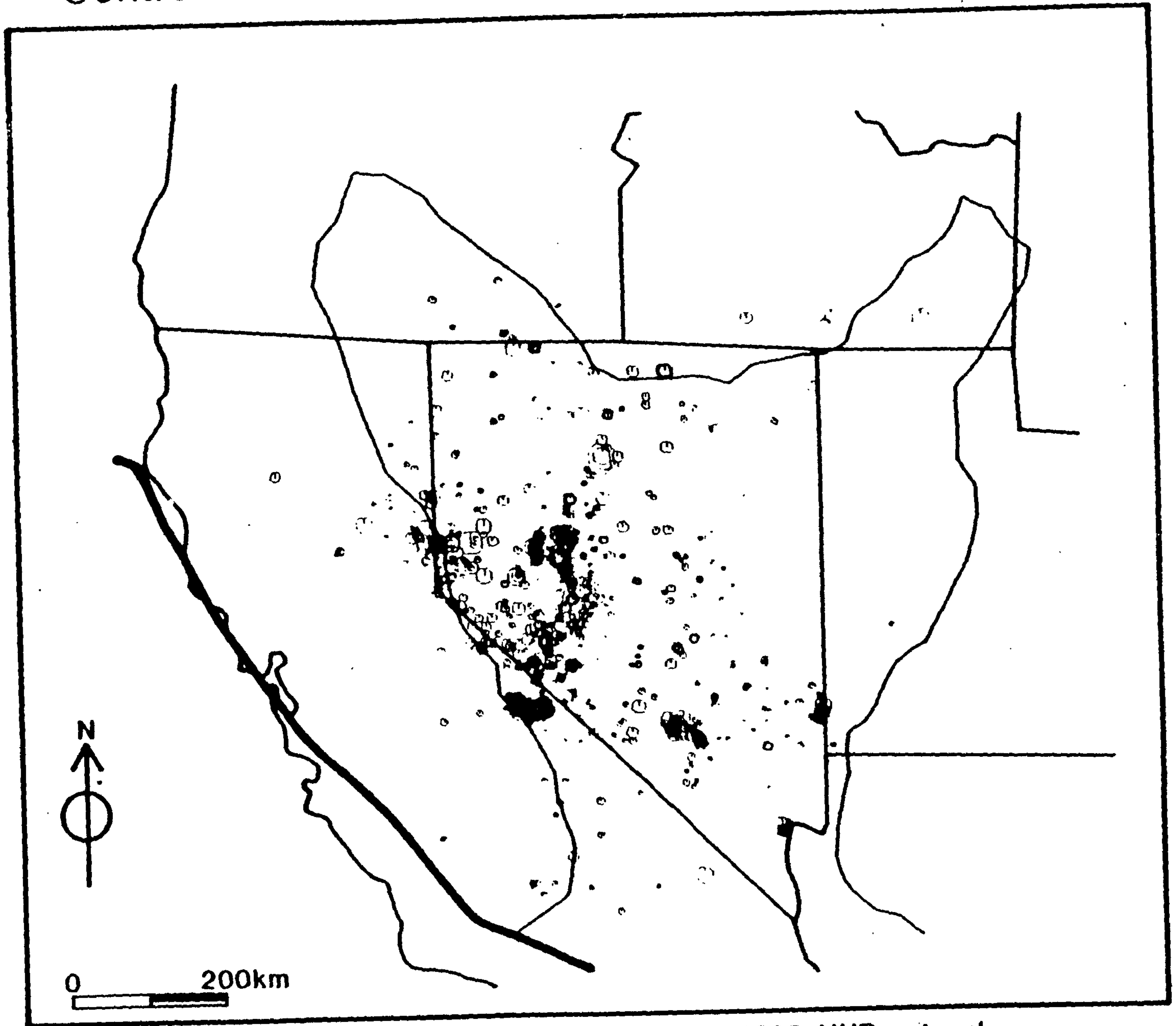
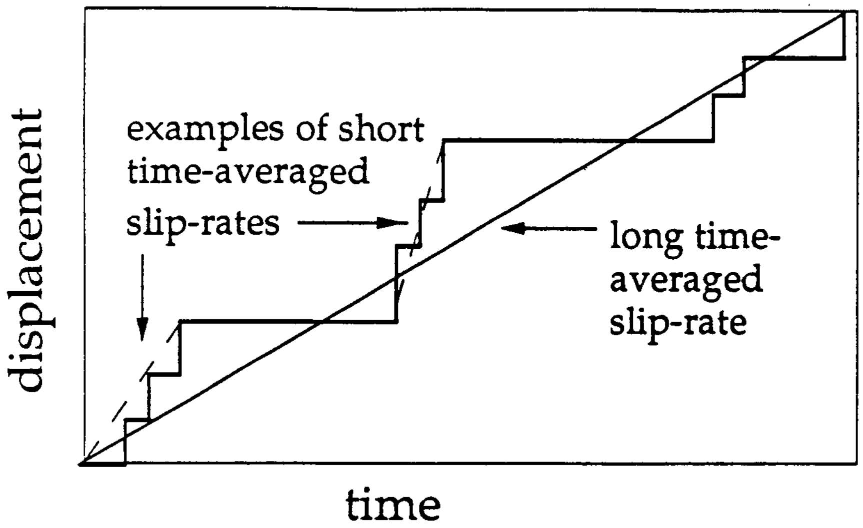
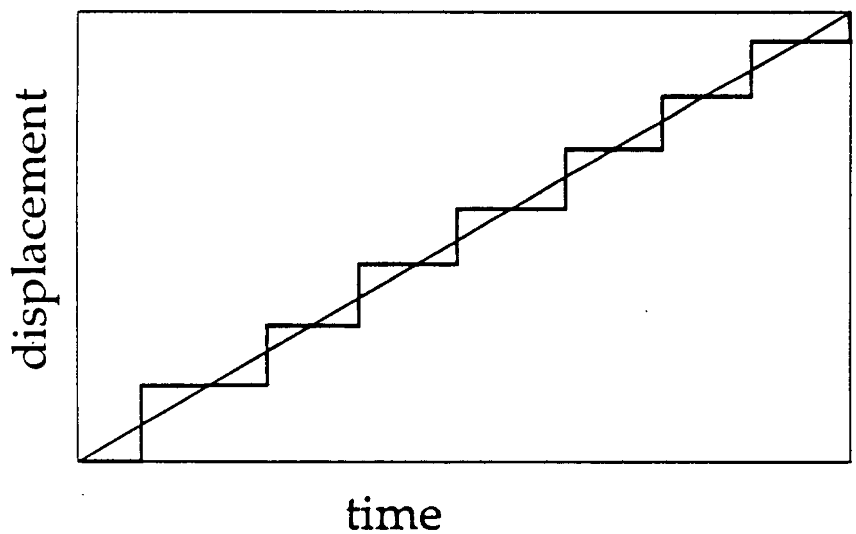
Central and Northern Nevada Seismicity, 1852-1988



Earthquakes greater than M 4.0 1852 to 1988. UNR cat. only.



Temporal
Clustering



Temporal
Regularity

Schematic illustration of temporal clustering versus temporal regularity during seismic deformation. Note that apparent slip-rate depends on the sampled time-interval.

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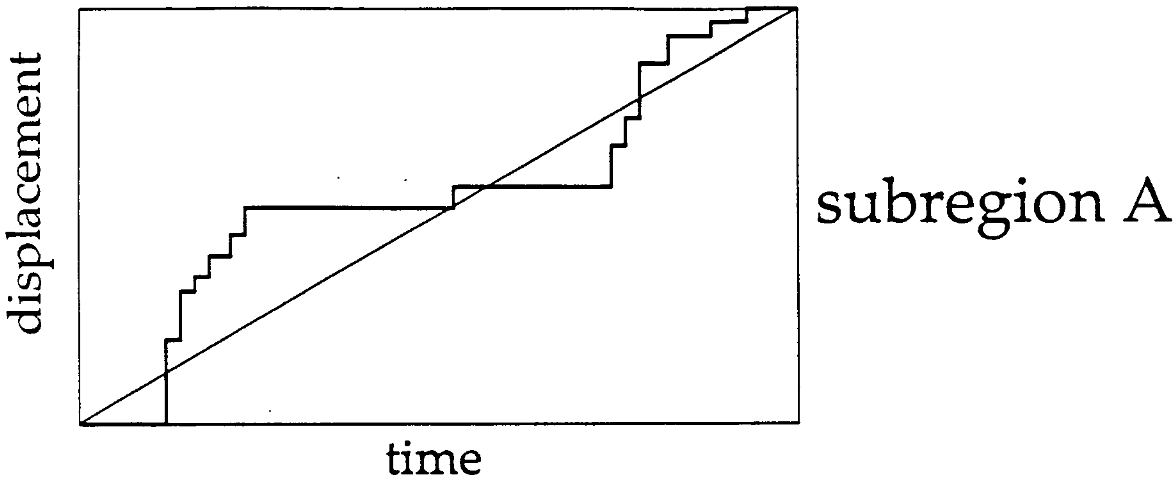
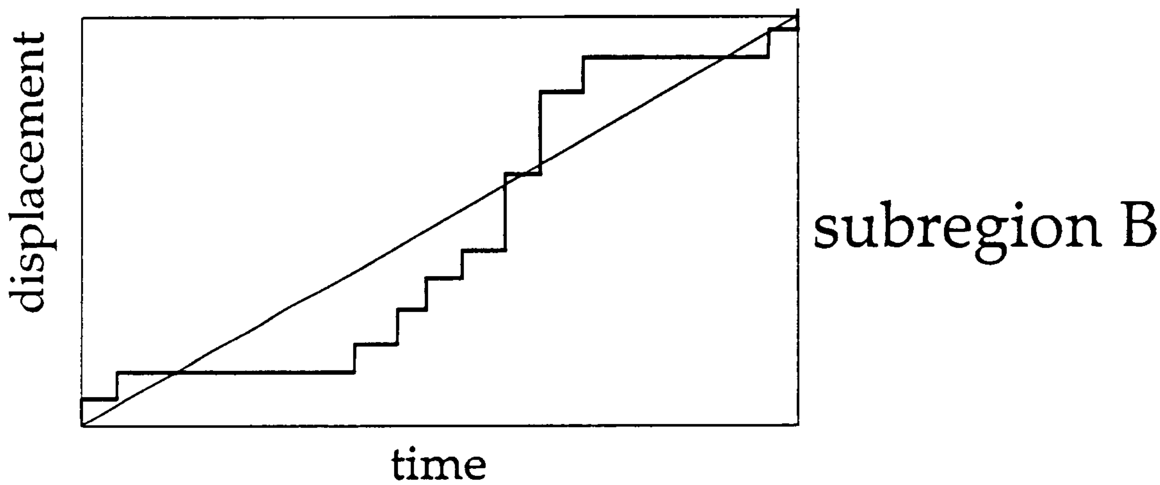
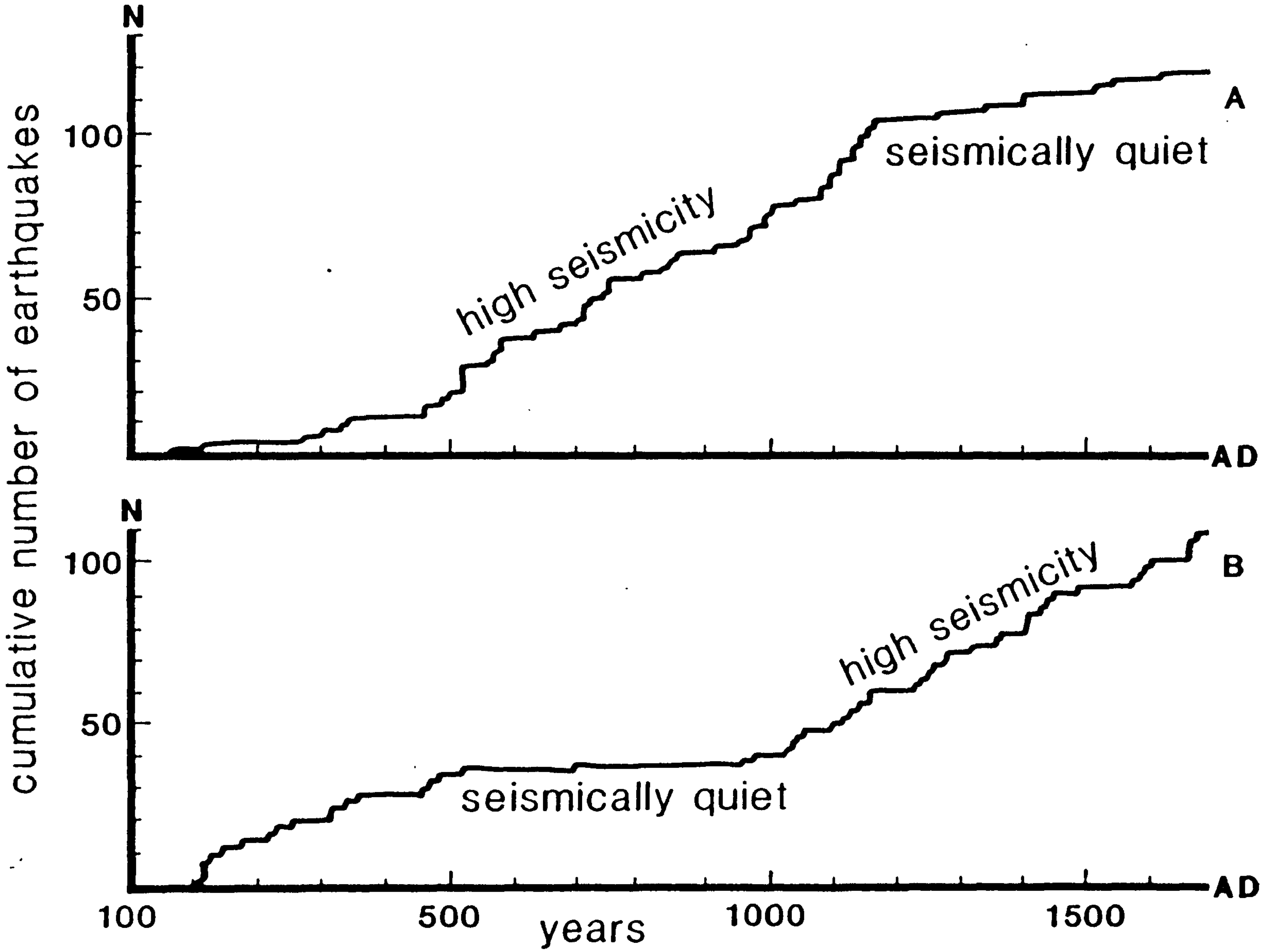




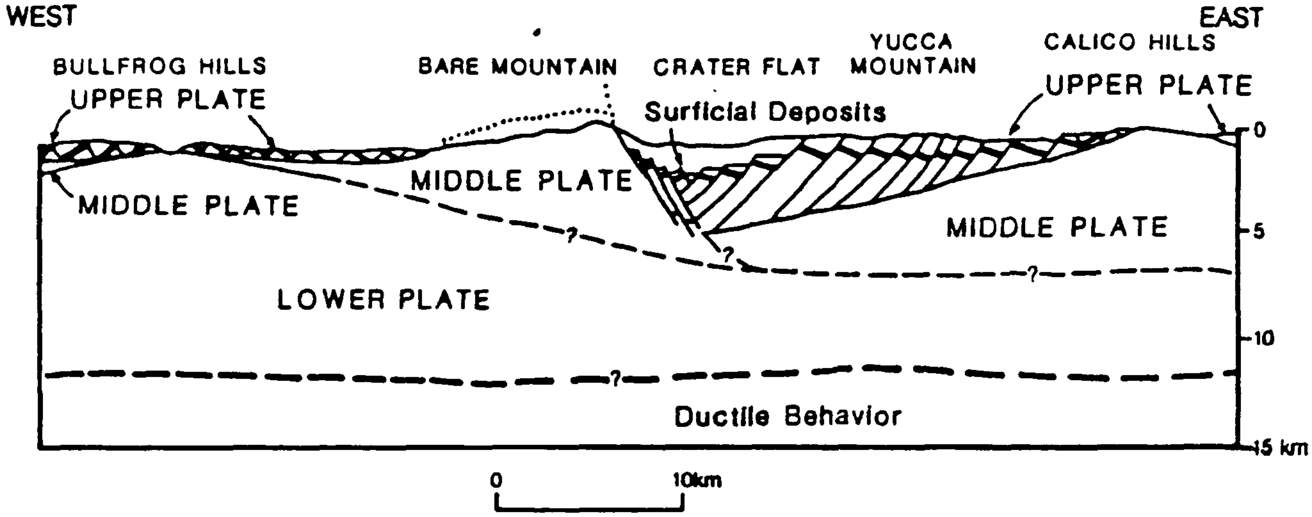
Schematic illustration of spatial and temporal clustering in two subregions within one larger region.

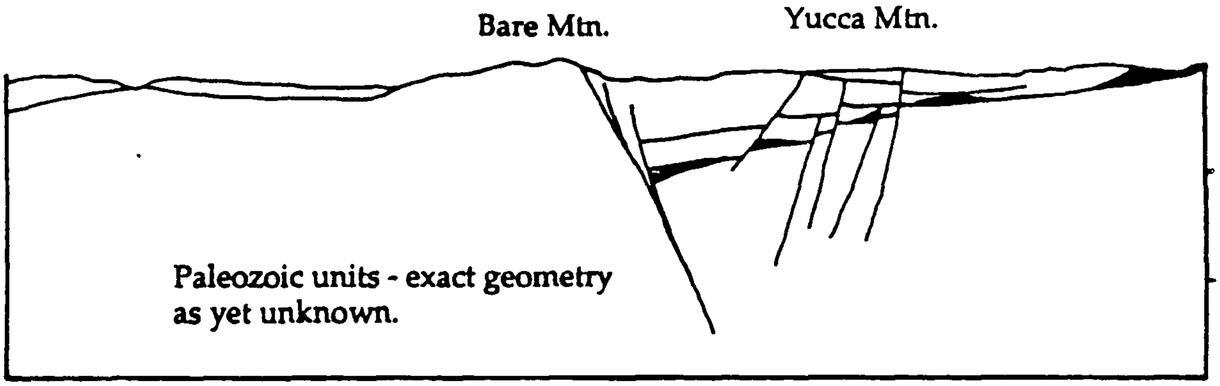
"Consequently, it is simply not logical to ignore the possibility that all of our observations may be for a quiescent period in the seismic activity of a region. . .this is the chief reason why statistics based on short period data alone do not provide a reliable assessment of earthquake hazard."
Ambraseys, 1989, Geophys. Journ. v96, p.314.

SEISMIC ACTIVITY IN ADJACENT REGIONS IN AN INTRA-CONTINENTAL SETTING



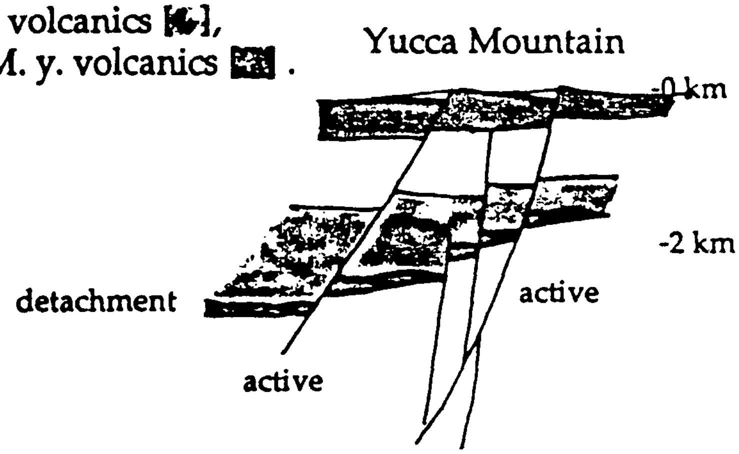
Two cross-sections of the Yucca Mountain region: top one by USGS, bottom one by Center for Neotectonic Studies, UNR.





Key to enlargement only: Pre-13.5 M.y. volcanics [ ], 13.5 - 11 M. y. volcanics, [ ], post-11.5 M. y. volcanics [ ]. Sediments < 2 M. y.,

Cross-sections are schematic only.

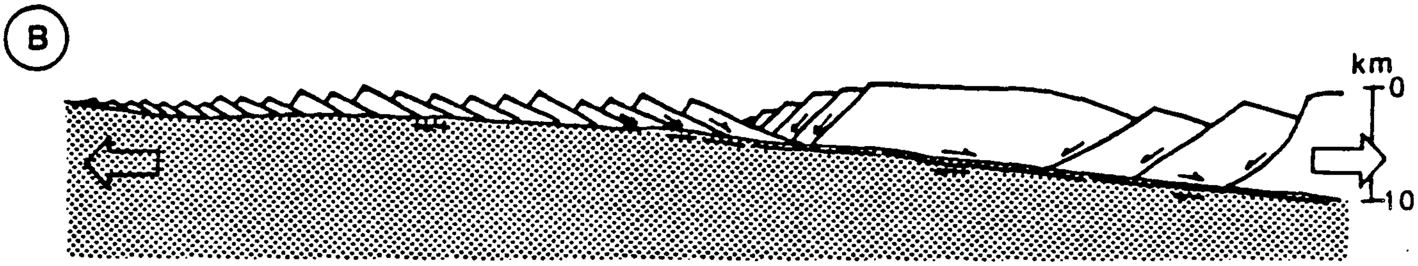


Enlargement of region above, showing three generations of extensional faulting and displacement of volcanic units and older detachment.

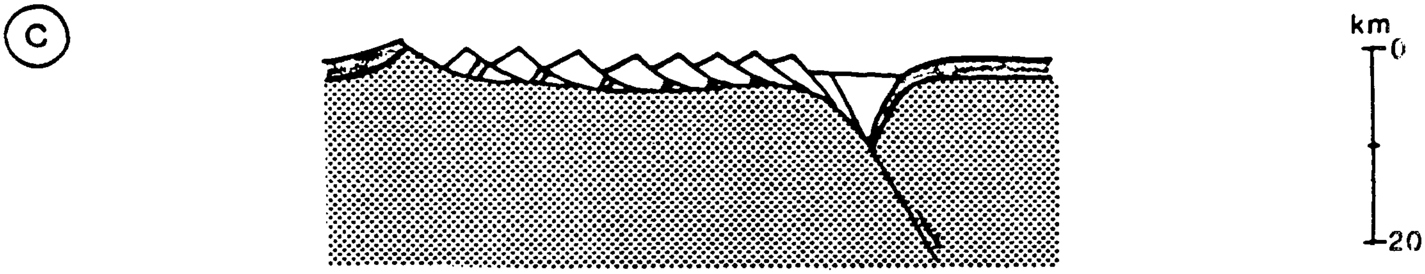
<u>Significant differences between cross-sections:</u>

- we include more realistic fault geometry, and show the potential distribution of Lower Paleozoic (aquifer) units.
- we include three generations of faulting indicated by field evidence.
- we show one subhorizontal detachment, as opposed to three, for which there is good evidence.

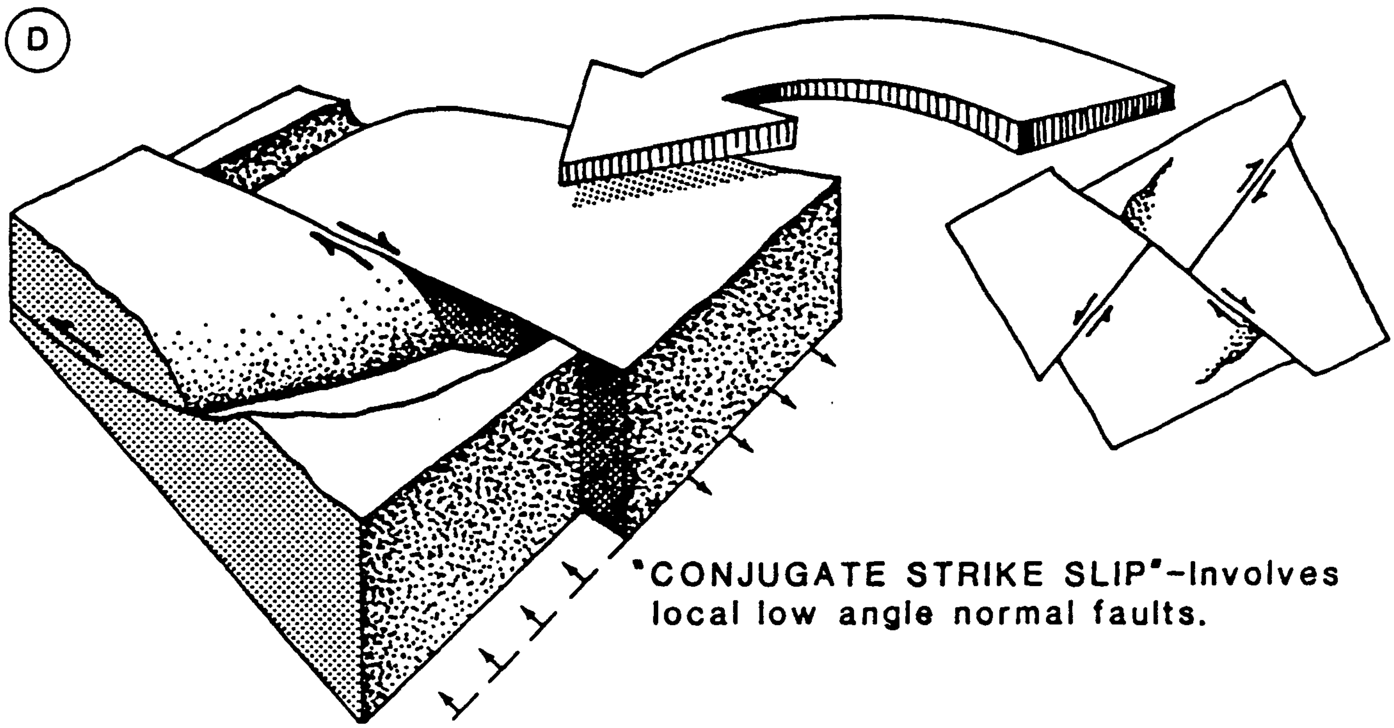
"PURE SHEAR"-Uniform stretching through crust.



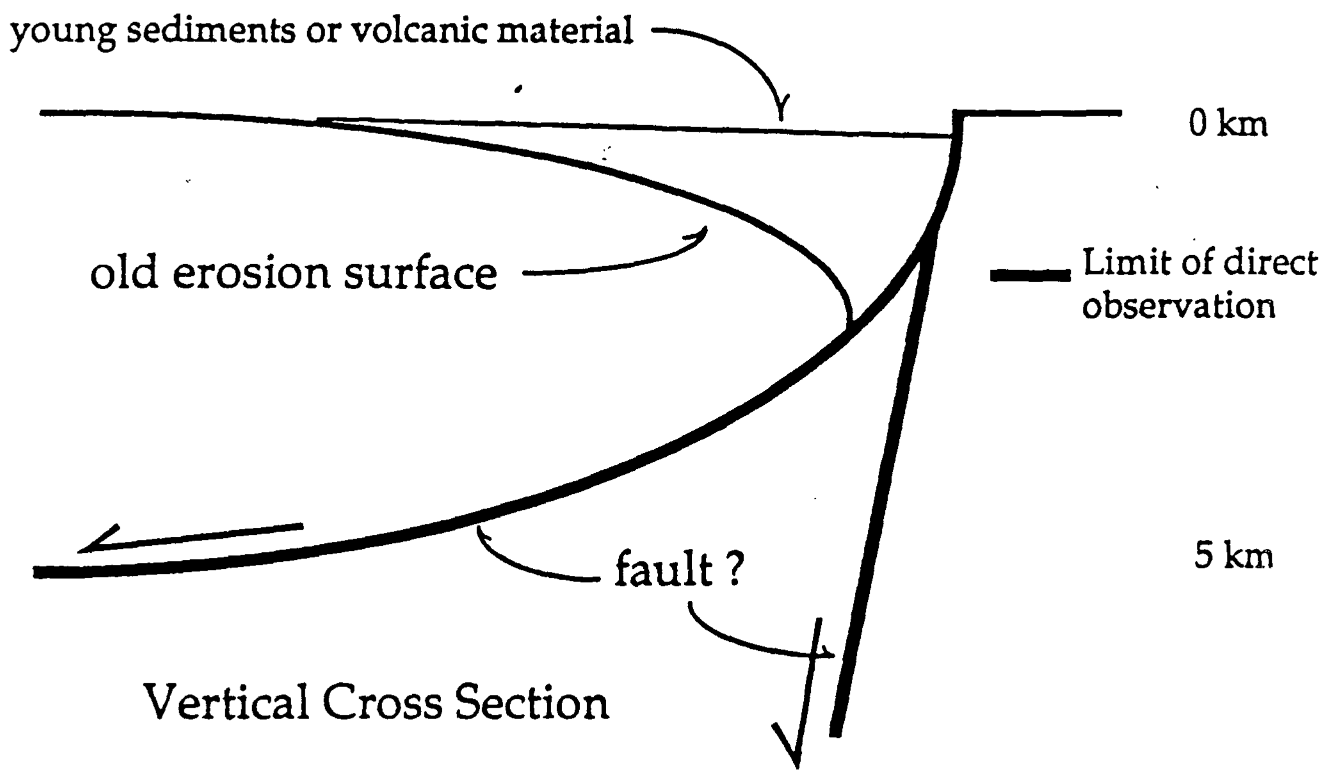
"SIMPLE SHEAR"-Non uniform stretching through crust involves significant low angle detachment.



"ROLLING HINGE"-High angle fault is stranded as inactive "detachment".



"CONJUGATE STRIKE SLIP"-Involves local low angle normal faults.



Vertical Cross Section

<u>Subsurface Fault Geometry</u> -

- planar to seismogenic depths (10 - 15 km)
- curved and flattening to relatively shallow depths (5 km)

(In the latter model, the curvature is a function of the style of deformation in the hanging wall, HW.)

Conclusions

In order to accurately anticipate the geological processes at Yucca Mountain over the next 10,000 years, we need to understand the geological system of which the proposed respository site is but a component.

This requires both detailed regional and site specific studies.

Geological research in this region is continually breaking new ground, much of it represents new concepts, and in this sense the various hypotheses proposed require particularly careful evaluation.

Probabalistic analyses will ultimately yield the engineering parameters for any repository design - we must be certain that the database from which these analyses are derived are as complete as possible.