INTEGRATED STRUCTURAL MODEL OF THE YUCCA MOUNTAIN REGION

Chris Fridrich, USGS
OUTCROP MAP OF YUCCA MOUNTAIN REGION
Photo:

Wide-angle view across Crater Flat
Angular unconformity in the late Miocene tuff section in Crater Flat basin
DEFINITIONS

STRUCTURAL DOMAIN:

AN AREA IN WHICH ALL STRUCTURAL CHANGES ARE GRADUAL AND SYSTEMATIC, SUCH THAT THE AREA CONSTITUTES A LOGICAL WHOLE

STRUCTURAL DOMAIN BOUNDARY:

A ZONE ACROSS WHICH AN ABRUPT, FUNDAMENTAL CHANGE OCCURS IN STRUCTURAL STYLE, % EXTENSION, AND/OR TIMING OF DEFORMATION
STRUCTURAL DOMAIN BOUNDARIES
OF THE YUCCA MOUNTAIN REGION
MAJOR FEATURES
OF CRATER FLAT BASIN:

► FAULT PATTERNS: Radial E-W, Curving N-S
► % EXTENSION ↑ S and W;
► LOW % EXTENSION THROUGHOUT
► ASYMMETRY
► ROLLOVER STRUCTURE
► EXTENSION MIGRATED E-W FROM 14-9 Ma

ALL CHANGES GRADATIONAL; ONE DOMAIN
FEATURES OF CRATER FLAT BASIN INDICATING STRIKE-SLIP SHEAR:

- OROFLEXURAL BENDING
- LEFT OBLIQUE SLIPS ON N-TRENDING FAULTS
- SCISSORS FAULTING
- NW-TRENDING RIGHT-SLIP FAULTS
PHOTO:

AEROMAGNETIC SURVEY RESULTS

IN THE CRATER FLAT REGION
3 MAJOR STRUCTURAL FEATURES OF CRATER FLAT BASIN: RANGE-FRONT FAULT, ANTITHETIC FAULTS, AND ZONE OF STRONG DEXTRAL SHEAR ALONG THE SOUTHWESTERN BOUNDARY
## Extensional Evolution of Crater Flat Basin

<table>
<thead>
<tr>
<th>Age</th>
<th>Dir</th>
<th>Rate</th>
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</thead>
<tbody>
<tr>
<td>14-13 Ma</td>
<td>ENE</td>
<td>14</td>
</tr>
<tr>
<td>13-12.5 Ma</td>
<td>N</td>
<td>13</td>
</tr>
<tr>
<td>12.5-11.6 Ma</td>
<td>N</td>
<td>12</td>
</tr>
<tr>
<td>11.45-11.6 Ma</td>
<td>N</td>
<td>11</td>
</tr>
<tr>
<td>~10-11.45 Ma</td>
<td>N</td>
<td>10</td>
</tr>
<tr>
<td>~9-10 Ma</td>
<td>N</td>
<td>9</td>
</tr>
<tr>
<td>~7-9 Ma</td>
<td>NW?</td>
<td>8</td>
</tr>
<tr>
<td>Plio-Quat.</td>
<td>N</td>
<td>7</td>
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</table>

![Diagram showing extensional evolution with arrows and numbers]
FOUR MAPS SHOWING SPATIAL DISTRIBUTION
OF EVIDENT EXTENSIONAL DEFORMATION
FROM 14 TO 11.45 Ma
FOUR MAPS SHOWING SPATIAL DISTRIBUTION
OF EVIDENT EXTENSIONAL DEFORMATION
FROM 11.45 Ma TO PRESENT
MAJOR CONCLUSIONS:

CRATER FLAT IS A HALF-GRABEN

BUT HAS MANY STRIKE-SLIP FEATURES

REGION IS SEGMENTED INTO DOMAINS

EXTENSION IN BELTS MIGRATED TO WEST, 14-9 Ma

FAULTS ACTIVE NOW FORMED AT 12.5 Ma
STRUCTURAL SETTING OF CRATER FLAT BASALTS
PHOTO:

MAP SHOWING DIKES OF NORTHERN YUCCA MOUNTAIN
STRUCTURAL SETTING OF BASALTS IN THE SOUTHWEST NEVADA VOLCANIC FIELD
STRUCTURAL SETTINGS OF BASALTS

(1) CALDERA RING-FRACTURE ZONES

(2) STRIKE-SLIP SHEAR ZONES

(3) EXTENSIONAL STRUCTURES (?)
BASALT CLUSTERS ACTIVE TODAY:

(1) BOTH IN NW-TRENDING RIGHT-LATERAL STRIKE-SLIP SHEAR ZONE(S)

(2) BOTH WERE ACTIVE AT ~10 Ma, ~4 Ma, AND ≤1 Ma

(3) BASALTS OF N YUCCA MTN IN ANOTHER RIGHT-SLIP ZONE, BUT TRIVIAL AND DEAD SINCE 10 Ma
DETACHMENT MODEL OF YUCCA MTN APPARENTLY A FAILED HYPOTHESIS

(1) DIFFICULT TO RECONCILE WITH:
(A) GEOPHYSICAL DATA - CRATER FLAT GRAVITY, AMARGOSA SEISMIC
(B) SEISOMOLOGIC DATA (LITTLE SKULL MTN EARTHQUAKE JUNE 1992)

(2) MODEL FAILS RECENT TESTING:
(A) BARE MTN NOT A LATE UPLIFT
(B) PREDICTED TERT-Pz OFFSET AROUND BARE MTN NOT FOUND
LITTLE SKULL MOUNTAIN AFTERSHOCK PATTERN SHOWS SURFACE FAULTS ARE PLANAR AND EXTEND TO 10-15 km DEPTH (TO THE BRITTLE-DUCTILE TRANSITION)
IMPLICATIONS OF STRUCTURAL MODEL FOR:

SEISMIC HAZARD ASSESSMENT:

- Faults active in the Quaternary formed at \( \sim 12.5 \) Ma; the chances of a new fault forming through the repository are nil.

- Rate of extension has progressively declined since 11.6 Ma; however, activity may rise and fall episodically along with volcanism.

VOLCANIC HAZARD ASSESSMENT:

- Quaternary eruptions have been confined to a narrow zone that does not include the repository area; hence, structural control decreases chance of magmatic disruption.

- Northern Yucca Mountain dike zone has been inactive since 10 Ma; lies in an inactive structural zone.