AMERICAN ASSOCIATION OF CIVIL ENGINEERS
SUU ENGINEERING WEEK BANQUET
FEBRUARY 25, 1999

Slide 1: Title Slide

- o present results of first year of study of HF
- o partially funded by a NEHRP grant through the USGS
- o cooperative project with the AZGS

Slide 2: Worldwide Plate Boundaries

- o present world view first and then progressively work toward the HF
- o discuss kinds of plate movement, consequences, "Ring of Fire"

Slide 3: Western United States Tectonic Setting

- o relative motion of the NA and Pacific plates causes extension
- o pulling apart motion has created the Basin & Range Province and earthquakes
- o zones of greatest earthquake activity are at the edges of B&R (Wasatch & Hurricane faults)
- o Intermountain Seismic Belt - zone of increased earthquake activity w/in the NA Plate

Slide 4: ISB Superimposed on State Boundaries

- o Southern Utah is in ISB
- o historic earthquakes in ISB - 1992 St George M 5.8 event not shown.

Slide 5: Utah Earthquake Map

- o earthquakes centered in a narrow north-south zone - the ISB
- o Utah has ~700 earthquakes/yr; the vast majority too small to be felt

Slide 6: Quaternary Fault Map of Utah

- o Why does Utah have so many earthquakes? Because there are ~150 known potentially active faults in the state.
- o Active fault: a fault that is capable of producing a damaging earthquake within a time frame of interest to humankind.

Slide 7: Kinds of Faults

- o discuss, also mention reverse faults\

Slide 8: Small normal fault in New Mexico

Slide 9: Wasatch Fault at Mouth of Little Cottonwood Canyon

- o large active fault with prominent scarps providing evidence for numerous geologically young surface faulting earthquakes.
- o define scarp

Slide 10: Footwall of Wasatch Fault

- o footwall of Wasatch fault in bedrock, note slickenlines and polished surfaces

Slide 11: Seismic Risk Map of the United States

- o risk map not a hazard map, so southern Utah would be more prominent now
- o shows distribution of seismic risk in the US - note southern Utah
- o not as high as California, not even as high as the Wasatch Front, but still significant.

NOW MOVING TO THE HURRICANE FAULT

Slide 12: Active Faults and Historical Earthquakes in SW Utah & NW Arizona

- o shows earthquakes of M4 and >
- o numerous active faults in region
- o our study focused on the HF because it shows greatest evidence for recent activity
- o 250 km long extending from Cedar City to Peach Springs. AZ
- o major down-to-the-west normal fault with hundreds of meters (thousands of feet) of net slip

Slide 13: View of the Hurricane Cliffs

- o Hurricane Cliff represent the trace of the HF and are in fact a fault (line) scarp
- o mention satellite imagery

Slide 14: Exposure of Hurricane Fault in town of Hurricane

- o located directly behind a home and business in the most rapidly developing part of Hurricane

Slide 15: Home Destroyed by Springdale Landslide - 1992

- o why worry about earthquakes in southern Utah - because we have them and they have done significant damage in historical time
- o discuss cause/significance of Springdale landslide

Slide 16: Second Home Destroyed by Springdale Landslide

Slide 17: Goals of Study

- o discuss and explain briefly

Slide 18: Paleoseismic Investigation

- o define paleoseismology
- o discuss what paleoseismic studies can tell us
- o briefly explain elements of the study; trenches, age dates, soils, scarp profiles, etc.

Slide 19: Map of Hurricane Fault Study Sites

- o Geologic and paleoseismologic tour of the Hurricane fault
- o starting at north point out and briefly discuss each study site

Slide 20: Shurtz Creek Air Photo

- o discuss location and site characteristics - scarps and age of deposits
- o single large scarp - multiple scarp sites just to north and south

Slide 21: Shurtz Creek Scarp

- o best developed scarp on Hurricane fault in Utah

Slide 22: Shurtz Creek Scarp Profile

- o discuss reason for profiling fault scarps
- o multiple event scarp representing at least x meters of net slip
- o discuss age of displaced surface

Slide 23: Murie Creek Air Photo

- o discuss location and site characteristics - single and multiple-event scarps
- o over turned bedrock

Slide 24: Murie Creek Multiple-Event Scarp

- o large scarp in background
- o crew profiling scarp

Slide 25: Murie Creek Alluvial Fan Scarp Profile

- o evidence for a single surface faulting event
- o likely the youngest (most recent) event at the north end of the Hurricane fault

Slide 26: Murie Creek Colluvial Apron Scarp Profile

- o clearly a multiple-event scarp, but downdropped surface is buried by young alluvium
- o net slip measured here is a minimum number

Slide 27: Deadmans Hollow Air Photo

- o basalt lava flow displaced ~336 meters (1100 ft)
- o Ar/Ar age dates on basalt at top of ridge give average age of 0.86 myr
- o slip rate of 0.39 mm/yr for past 0.86 myr - compare to Wasatch fault

Slide 28: Anderson Junction Site Air Photo

- o basalt flow displaced more than 400 meters (1300 ft) across the fault
- o basalts at top and bottom of cliff are chemically identical
- o still waiting for age dates fro laboratory

Slide 29: Basalt Cascade Air Photo

o discuss location and geology of site
o still waiting for age dates here
o discuss relation between end of cascade and present valley floor

Slide 30: Basalt Cascade from the Ground

Slide 31: Cottonwood Canyon Site from the Air
o point out different sized scarps in deposits of different ages - single and multiple events
o discuss reason why scarp is so far from the cliff face

Slide 32: Cottonwood Canyon Scarp Profiles
o show different amounts of displacement across scarps in deposits of different ages

Slide 33: Cottonwood Canyon Trenches
o excavated trenches across the small and medium sized scarps

Slide 34: Large Trench Across Medium Scarp
o gives a sense of the scale of the project

Slide 35: Colluvial Wedge Slide
o explain colluvial wedges and reason for trenching
o number of events, timing of events, size of events - if lucky

Slide 36: Logging Cottonwood Canyon Trench
o note bedrock in fault contact with scarp colluvium
o looking for colluvial wedges and buried soils

Slide 37: Cottonwood Canyon Trench Log
o dry, desert environment precluded soil development making age dating impossible
o documented 60 cm of surface faulting in MRE in deposits dated at 5-10 kyr based on soil profile development
o based on displacement, estimate magnitude of MRE as ~ M 6.6

Slide 38: Study Results Summary
o point out likelihood of fault segmentation

Slide 39: Cartoon

STUDY RESULTS

1. The Hurricane fault has produced recurrent late Quaternary (past 100 kyrs) surface faulting earthquakes in southwestern Utah and northwestern Arizona.

2. The most recent surface faulting earthquake (MRE) occurred 5-10 kyr ago near the Utah/Arizona border and probably 5-12 kyr ago near Cedar City.

3. The MRE in Arizona had an estimated magnitude of 6.6. The magnitude of the MRE near Cedar City is presently unknown.

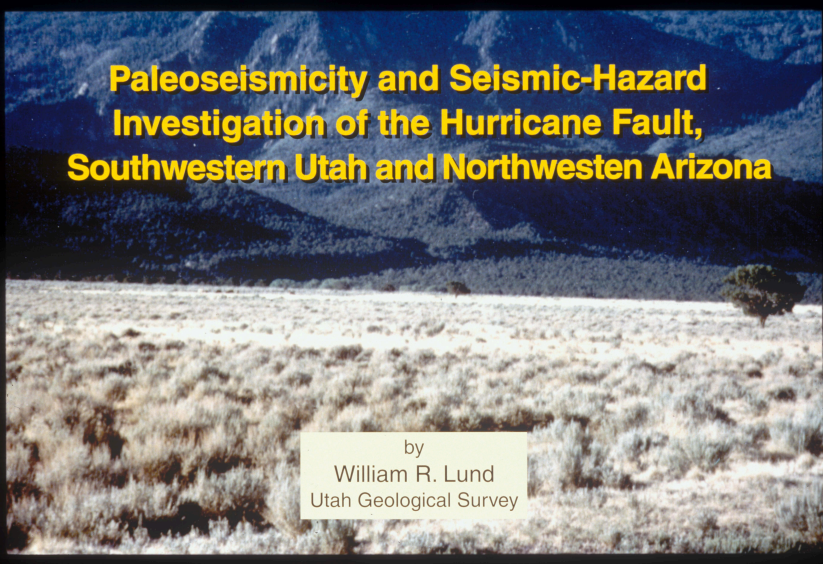
4. Differences in the abundance, type, and preservation of scarps along the fault suggest variations in slip rate and indicate that the Hurricane fault likely consists of multiple earthquake segments.

5. Argon isotope age dates from a basalt flow displaced across the fault at Deadmans Hollow indicate a slip rate of 0.39 mm/yr for the past 85 kyr.

Results Slide

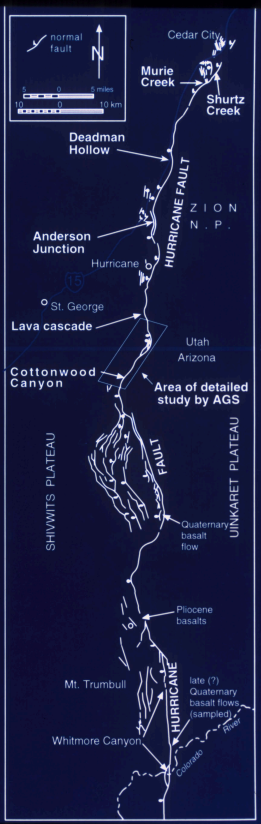
7.33 x 11

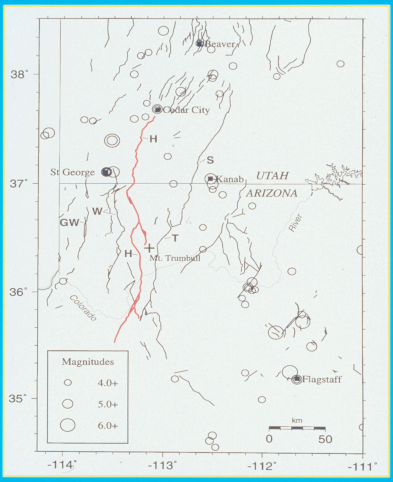
Paleoseismicity and Seismic-Hazard Investigation of the Hurricane Fault, Southwestern Utah and Northwesten Arizona



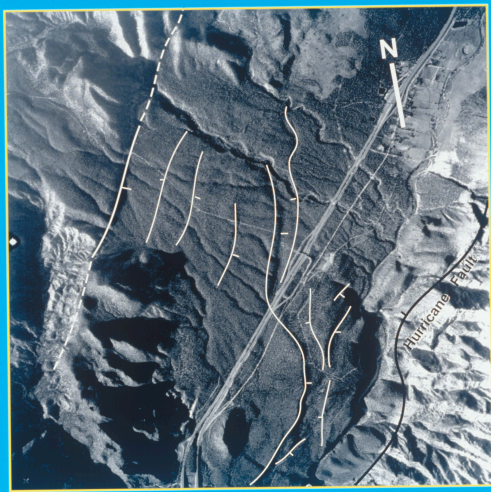
by
William R. Lund
Utah Geological Survey

Hurricane fault and subsidiary structures in southwestern Utah and northwestern Arizona. Key study sites and basalt flows sampled for radiometric dating are shown.

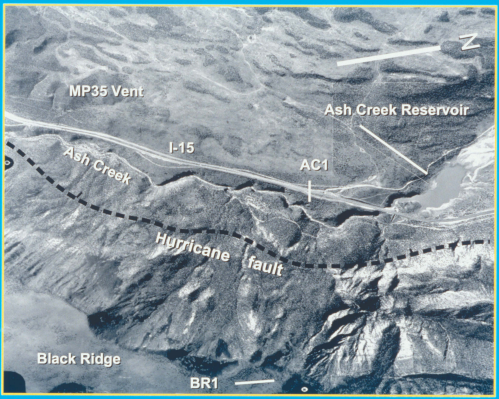




Quaternary faults and historical earthquakes in southwestern Utah and northwestern Arizona. H=Hurricane fault, W=Washington fault, GW=Grand Wash fault, S=Sevier fault, T=Toroweap fault



Oblique aerial view of the Hurricane fault (black) and antithetic and sympathetic faults (white) at the south end of the Ash Creek graben near Anderson Junction.



Oblique aerial view of the Pintura volcanic center showing the location of the MP35 vent and $^{40}Ar/^{39}Ar$ isotopic age sample locations BR1 and AC1. Ages: BR1 = 0.84 myr; AC1 = 0.88 myr.

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