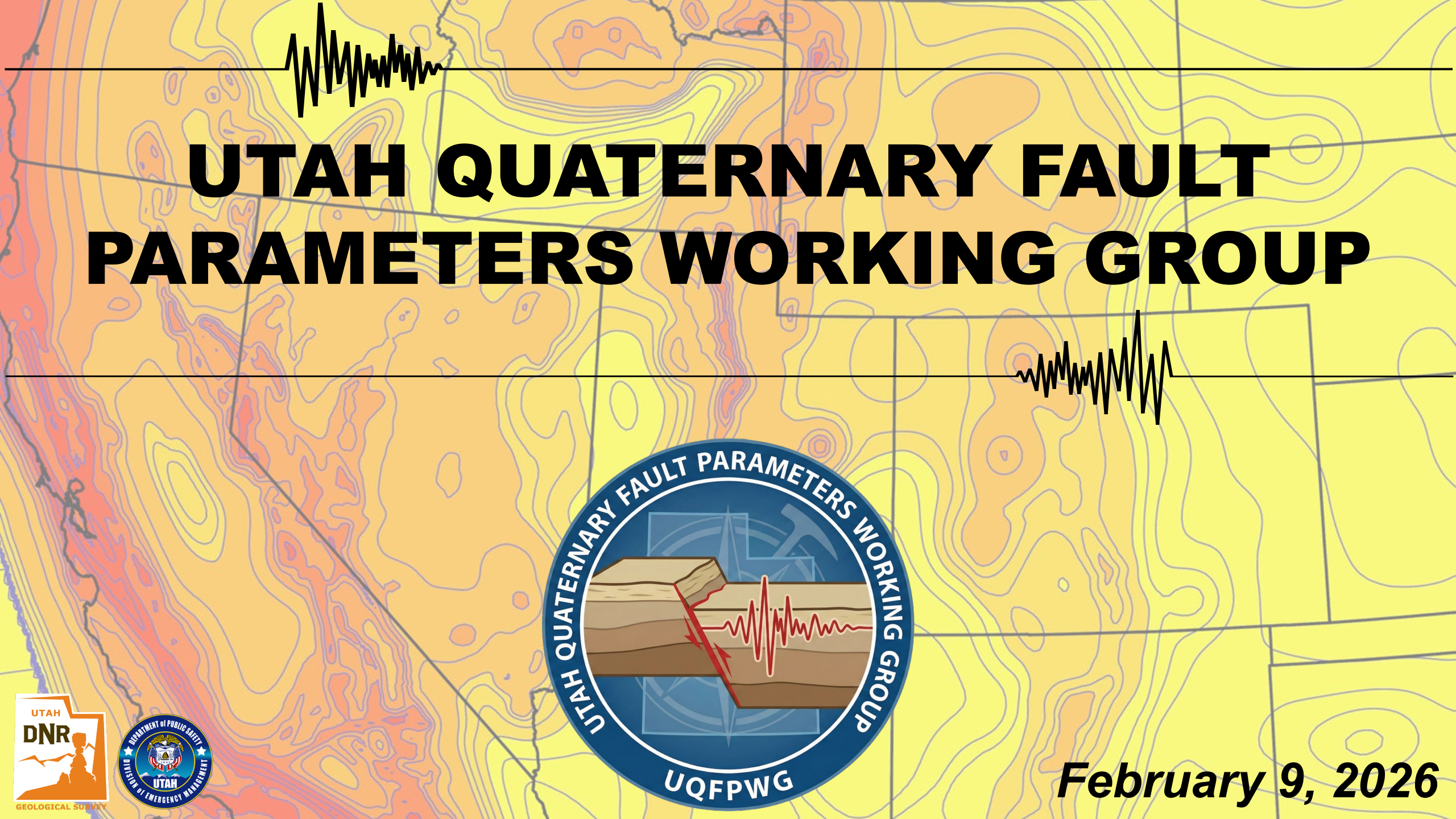
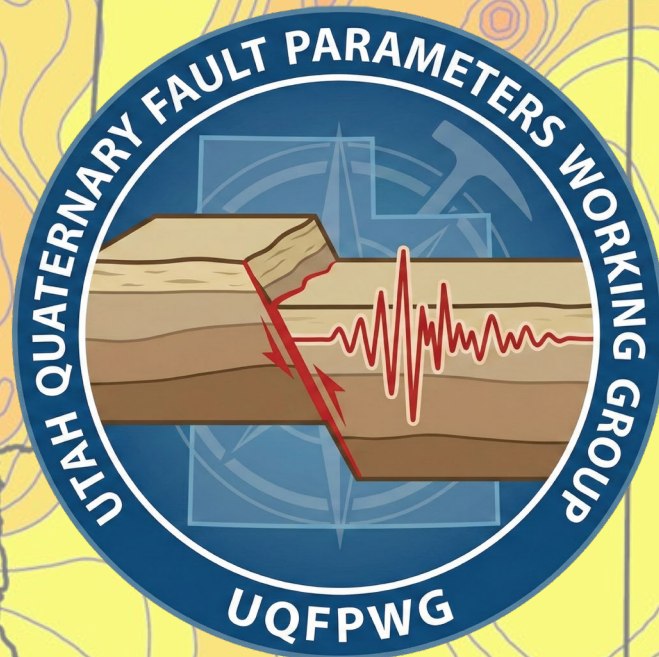




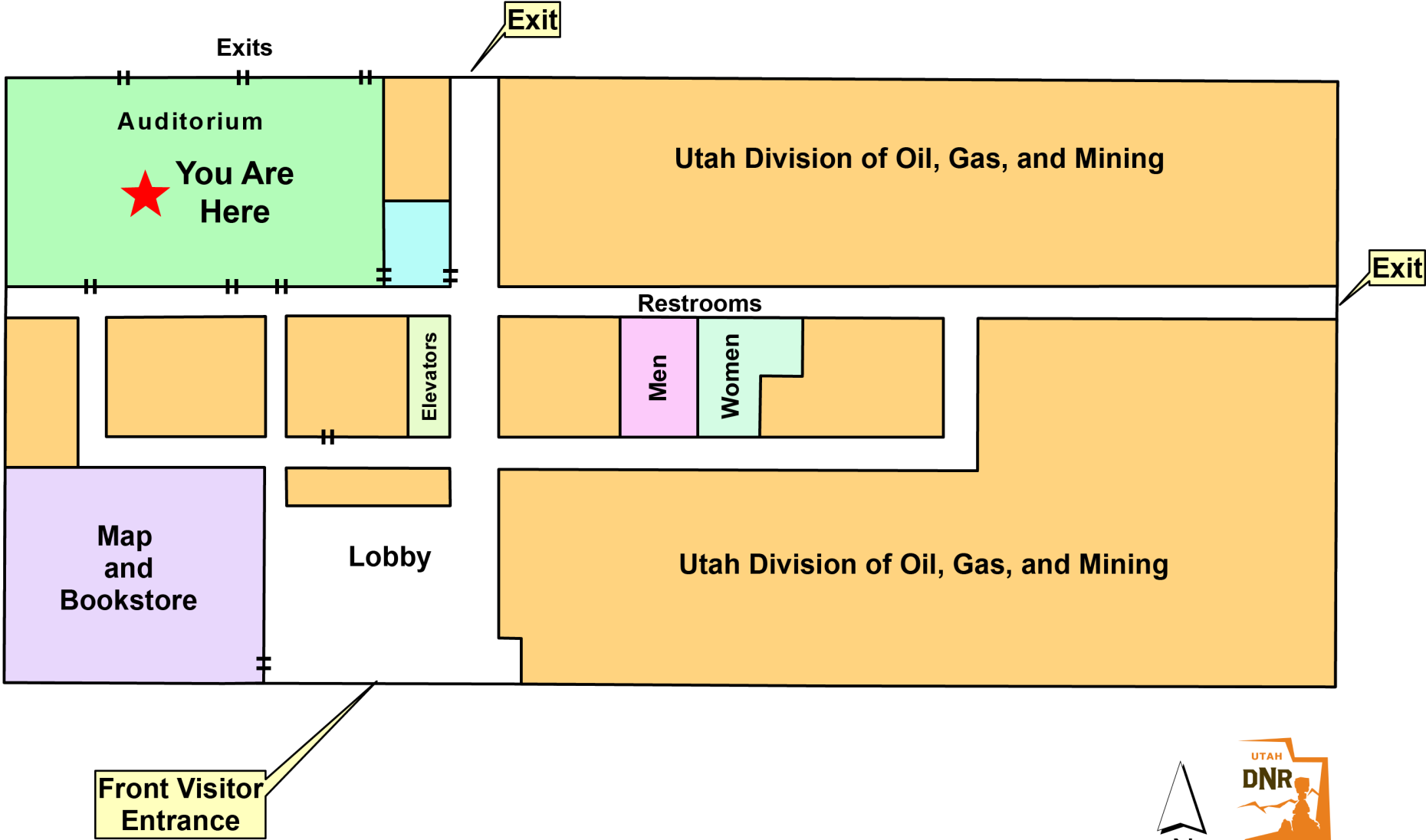
UTAH QUATERNARY FAULT PARAMETERS WORKING GROUP



February 9, 2026



Utah DNR 1st Floor Map



Presenters

- Speaker Timer in front of you to keep things on track!
 - We do have plenty of time in the agenda for discussion and Q/A.
- Meeting is being recorded
- Talk to me if you don't want the recording of your talk publicly available – we can remove it
- Make sure to stay in front of the podium so the mic's pick up your voice for virtual attendees to hear
- Q/A – Mics on each table are muted, if you'd like to ask a question, **please use the mic and press the button to unmute before you talk**
 - We also have handheld mics to pass around for QA
- Virtual Attendees Q/A – Please put your questions into the meeting chat – we will read them in order at the end of talks.
- Virtual Attendees – **PLEASE KEEP YOUR MICS MUTED DURING TALKS!**

Virtual Attendance/ Google Meet Guide

- Please keep your microphone muted during talks
- Put Q/A in the meeting chat – we will read them in order after presentations



Adam Hiscock

2:02 PM | gee-xsxn-ivh

Mute/Unmute Mic

Video On/Off

Share Screen

Reactions

Raise Hand

Leave Meeting

View Participants

Open Chat

In-call messages

Let participants send messages

Continuous chat is OFF

Messages won't be saved when the call ends. You can pin a message to make it visible for people who join later.

No chat messages yet

Send a message

Choose what to share with meet.google.com

The site will be able to see the contents of your screen

Chrome Tab

Window

Entire Screen


Meet - qag-mfij-xnq - ...


UQFPWG26_TitleSlides...


Gmail - Rachel Adam - ...


Google Calendar - State...


AIH_UtahEQGeo_Updat...


Downloads and 3 more...

 Also share all audio outputs ☐

Share

Cancel

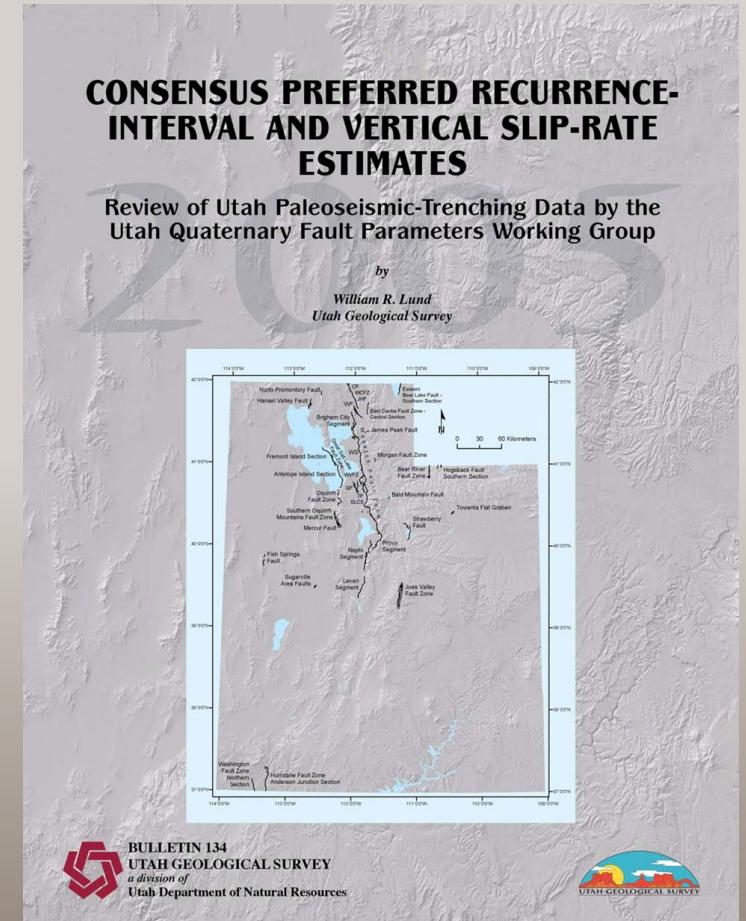
Choose Window to Share

Screen Sharing Selection

Adam Hiscock

UQFPWG History and Purpose

- Began in 2004 by developing consensus slip-rate and recurrence-interval data for all faults with paleoseismic data in Utah (UGS B-134, Lund, 2005).
- Group developed an initial priority list of Utah Quaternary faults requiring additional study, list updated annually and incorporated into the annual USGS Earthquake Hazards Program External Research Support funding announcements.
- Review ongoing paleoseismic, earthquake timing, and fault characterization studies ongoing in Utah with the goal of maintaining and updating consensus slip-rate recurrence intervals.
- Group is dependent on the active involvement of researchers (academic, government, etc), consultants, and the public.



2025 UQFPWG Review

- **Adam Hiscock (UGS)** – Welcome and Introduction
- **Chris DuRoss (USGS)** – U.S. Geological Survey, Earthquake Hazards Program, External Grants Updates
- **Chris DuRoss (USGS)** – Working Group on Utah Earthquake Probabilities, Paleoseismology Subgroup Update
- **Alex Hatem (USGS)** – Working Group on Utah Earthquake Probabilities, Modeling Subgroup Update
- **Robert Givler, Christopher Bloszies, and John Baldwin (Lettis Consultants International)** – Updated Paleoseismic Data for Recent Events on the Weber Segment of the Wasatch Fault Zone at the East Layton Site, Layton Utah
- **Robert Givler, Christopher Bloszies, and John Baldwin (Lettis Consultants International)** – Paleoseismic and Geologic Constraints on the Location and Timing of Surface Faulting along the Provo Segment of the Wasatch Fault Zone in Orem, Utah
- **Nathan Toke (Utah Valley University)** – Examining the Spatial Variability of Uplift Along the Wasatch Fault and Adjacent Basin and Range Normal Faults Using Normalized Channel Steepness (Ksn) and Mountain Front Sinuosity (MFS)
- **HyeJeong Kim and Fan-Chi Lin (University of Utah)** – Towards an Improved Salt Lake Valley Community Velocity Model Through Seismic and Gravity Joint Inversion, Final Results

2025 UQFPWG Review

- ***Srisharan Shreedharan and Alexis Ault (Utah State University)*** – Characterizing the Frictional Strength, Stability, and Fabric Evolution of the Wasatch Fault Zone Through Laboratory Experiments
- ***Grasshopper Anderston-Merritt and Michelle Cooke (University of Massachusetts Amherst)*** – Simulating the Evolution of Stress over the Past 7 ka along the Wasatch Fault System in Utah
- ***Adam Hiscock and Rachel Adam (UGS)*** – Utah Quaternary Fault Mapping Updates
- ***Adam Hiscock (UGS)*** – sUAS-based Lidar for Fault Mapping
- ***Adam Hiscock (UGS)*** – Utah Seismic Safety Commission (USSC) Update

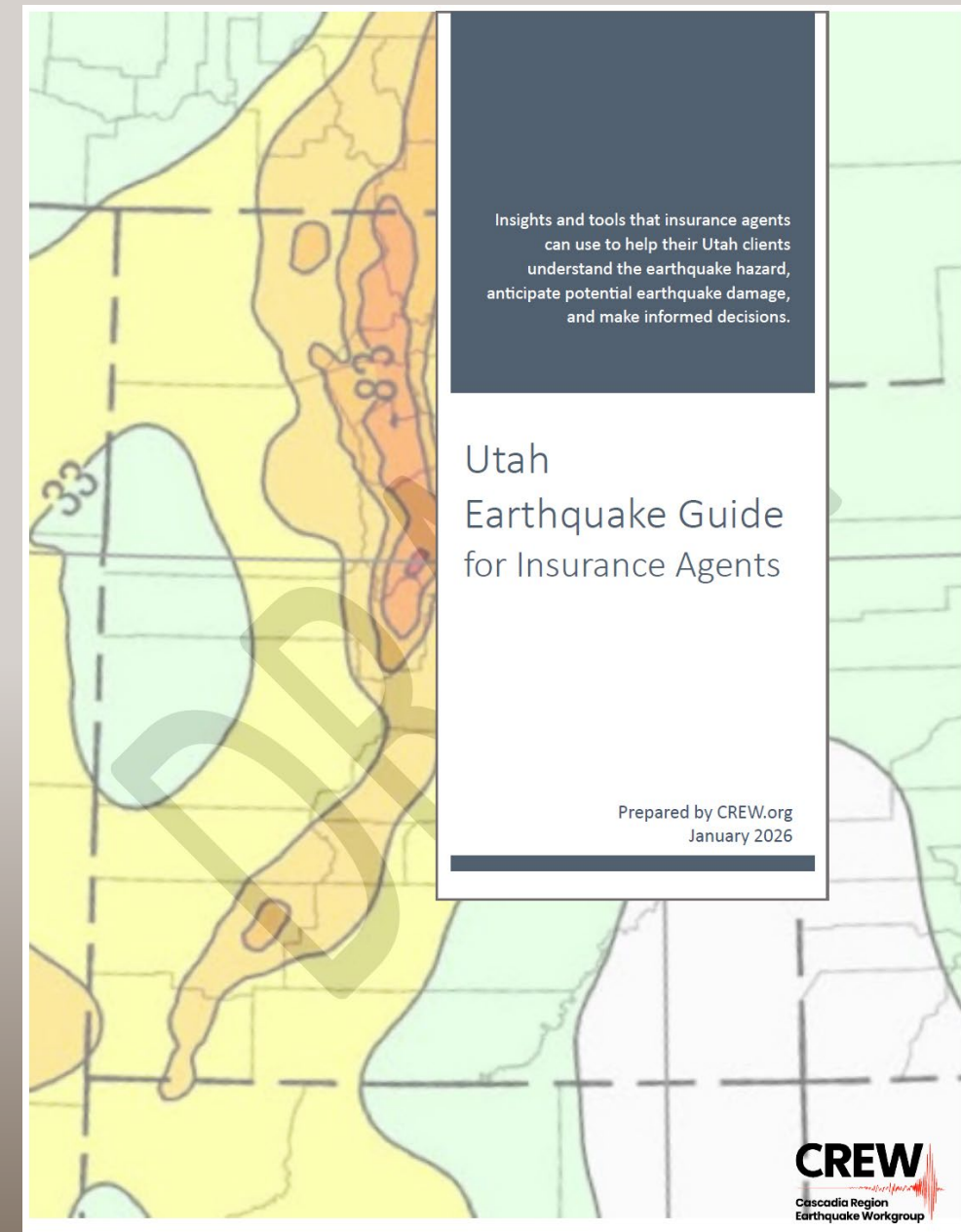
Utah Updates

- EERI Utah Chapter – Starting up in 2026!
 - Kickstarted by Brent Maxfield, Structural Engineer, LDS Church
 - Board Members:
 - Brent Maxfield – Structural Engineer, Special Projects Department, LDS Church
 - Jordan Terry – Structural Engineer, FFKR
 - Jerod Johnson – Structural Engineer, Reaveley Engineers
 - Brady Cox – Geotechnical Engineer, Utah State University
 - Bill Perkins – Geotechnical Engineer, Shannon and Wilson
 - Adam Hiscock – Project Geologist, Utah Geological Survey
 - Lisa Sun – Law Professor, BYU Law School



Utah Updates

- Utah Earthquake Guide for Insurance Agents
 - Prepared by Cascadia Region Earthquake Workgroup (CREW) with funding from FEMA & NEHRP
 - Based on versions CREW has produced for other Basin and Range States
 - Still in draft form, expected to be out soon
 - Valuable resource for Insurance agents in Utah!



Utah Updates

- Putting Down Roots in Earthquake Country – Now available as a fully interactive, digital webapp!
- Acknowledgements:
 - UGS's Web Services Team (Rachel Willmore, Mackenzie Cope, and Jackie DeWolfe)
 - Funding from Utah Division of Emergency Management
- <https://roots.geology.utah.gov/>



UTAH GEOLOGICAL SURVEY

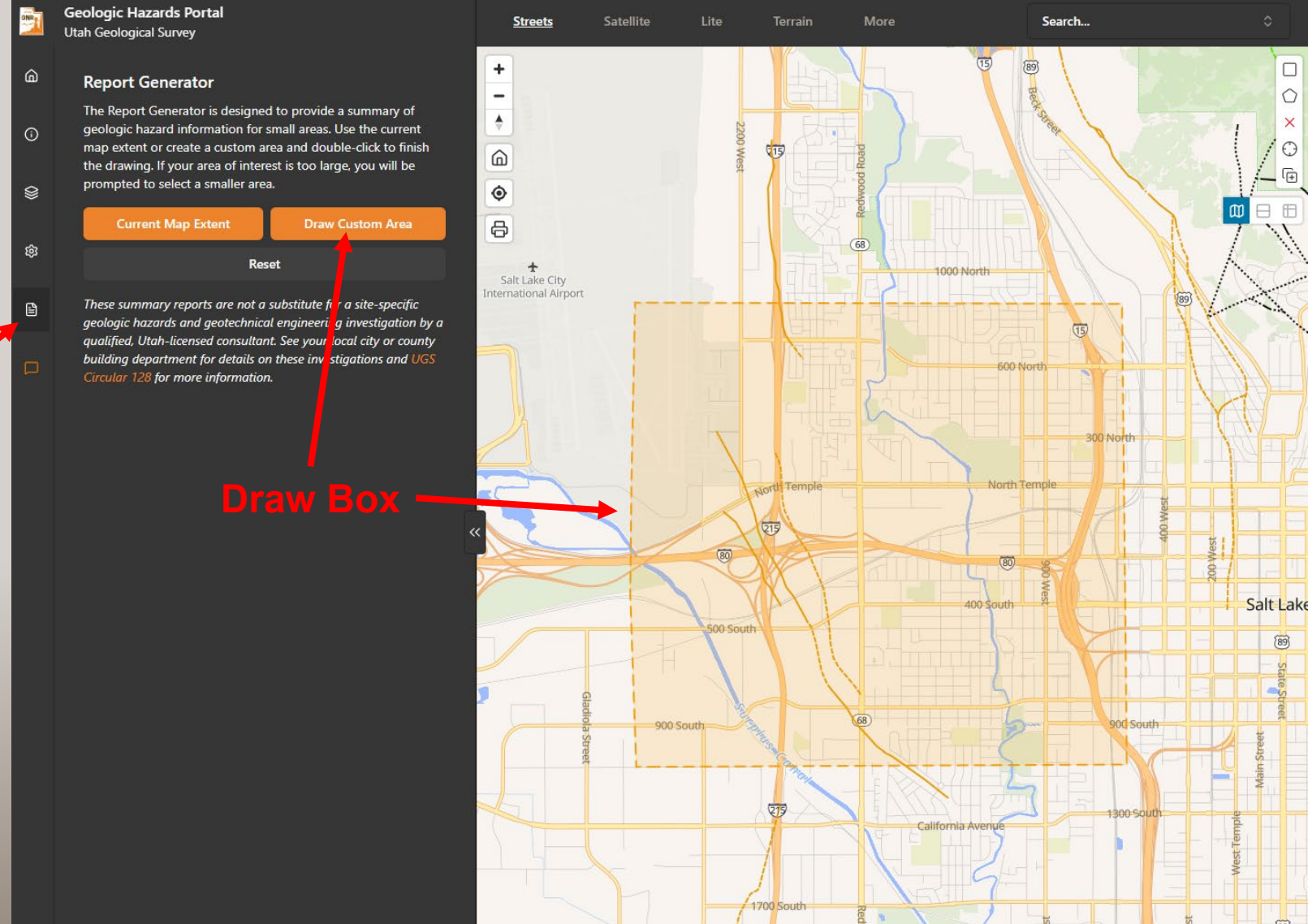
A screenshot of a web browser displaying the 'Putting Down Roots in Earthquake Country' web application. The browser's address bar shows 'roots.geology.utah.gov'. The page features a large header image of a mountain range with the title 'Putting Down Roots In EARTHQUAKE COUNTRY'. Below the header, there is a section titled 'Utah is Earthquake Country' with a paragraph explaining the risk and a link to 'EXPLORE THE TOPICS'. This section includes three interactive cards: 'WHY SHOULD I CARE?', 'WHY SHOULD I PREPARE?', and 'WHAT SHOULD I DO?'. Further down, a text block states: 'There is more than a 50 percent chance that a major earthquake will happen along the Wasatch Front in the next 50 years.' This is followed by a photograph of a damaged brick building and a paragraph about the importance of preparedness. A 'GLOSSARY' button is visible in the bottom right corner.

Utah Geologic Hazards Portal New Reporting Tool

- New Geologic Hazard Reporting tool – live at the end of this week

**Report
Generator**

Draw Box



<https://hazards.geology.utah.gov>



Cover



Summary



Earthquake



Other Resources



Share



Print

endorsement or recommendation by the Utah Geological Survey.

Report Summary

Geologic hazards affect many areas in Utah, and if not properly addressed, can negatively impact life safety, health, property, and the state's economy. These hazards are geologic conditions that present a risk to life or of substantial loss or damage of real property, and are generally within five categories: landslide, earthquake (including seismic ground shaking and liquefaction), flooding, problem soil and rock, and volcanic hazards (volcanic hazards are not currently mapped in Utah due to the long recurrence interval). Although many geologic hazards are not life threatening, they are often costly when not recognized and properly accommodated and mitigated in project planning and design, and may result in additional, significant construction and/or future maintenance costs, and, potentially, injury or death.

However, we can live and deal with geologic hazards by understanding what they are, where they exist, and how to effectively mitigate them. Detailed geologic hazard mapping is available for limited areas and for specific hazards in Utah, and additional mapping is ongoing. This report presents geologic hazard data extracted from the Utah Geologic Hazards Database of current geologic hazard mapping by the UGS for part of Utah and from other sources at the date and time indicated on the cover page. For each of the major geologic hazard categories (earthquake, landslide, flooding, and problem soil and rock) mapped in Utah, a summary page describes the hazard category and the individual types of hazards within that category. Following the summary are details for each mapped hazard type with a brief description of that hazard type, a map of your area of interest and the mapped hazard susceptibility, a brief discussion on the susceptibility rankings and their meaning, and a list of references and other information for that hazard type. **The absence of data does not imply that no geologic hazard or hazards exist.** Additional geologic hazard mapping is on-going and will be added to the database as it is finalized.

Mapped Geologic Hazards

Earthquake

- Surface-Fault-Rupture Hazard Special-Study Zones
- Earthquake Ground Shaking - Statewide

This database is updated when new geologic hazard mapping is published by the UGS, usually in urban areas using 7.5-minute quadrangles as comprehensive geologic hazard map sets. If mapping is not available for your area of interest at the time this report is created, check the UGS website for updates or contact us at (801) 537-3300 or <https://geology.utah.gov/about-us/ask-a-geologist>.

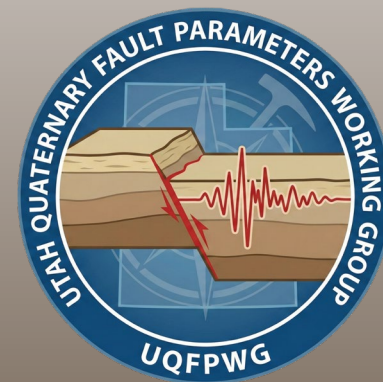
Earthquake

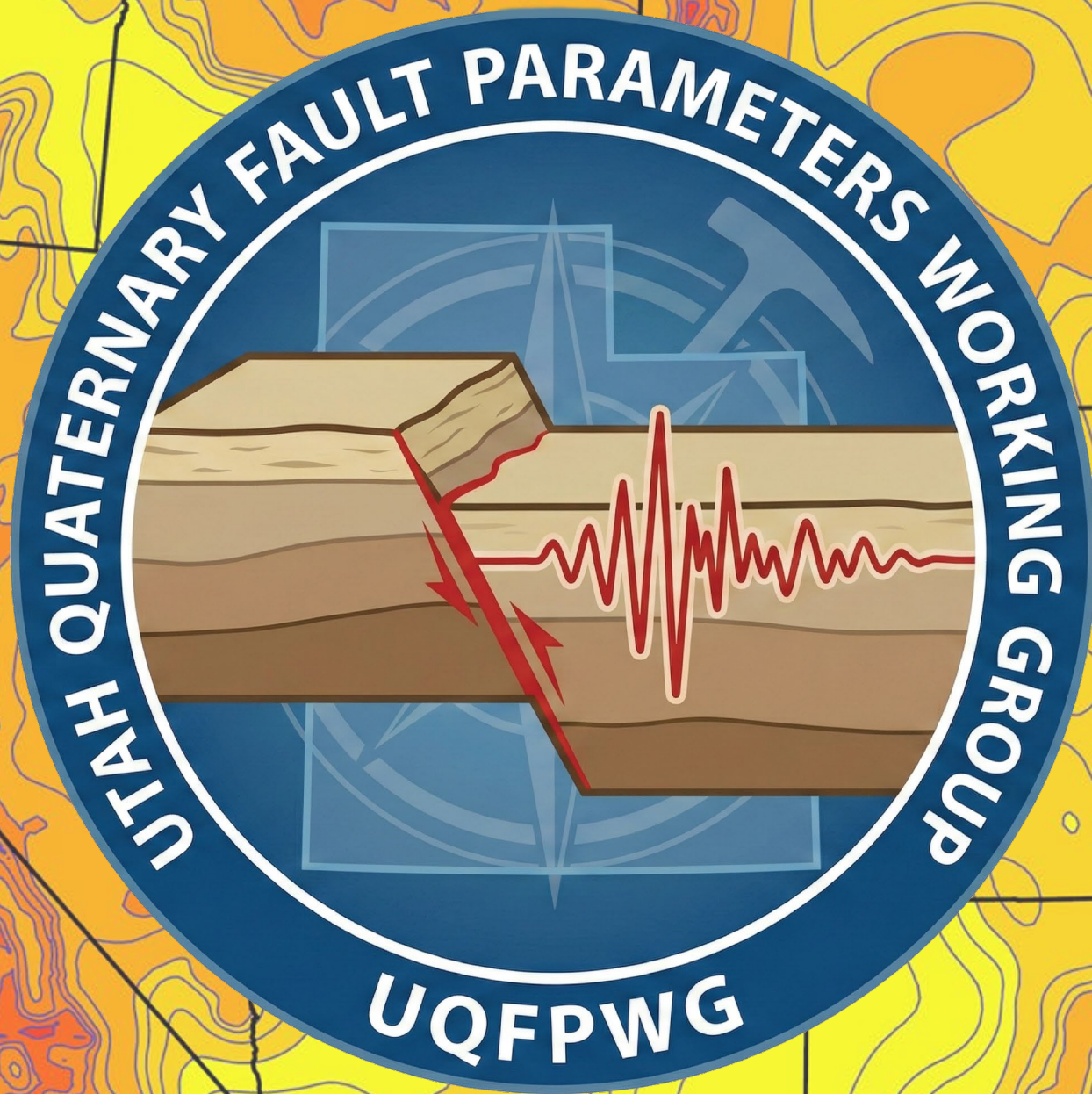
Utah has experienced 16 earthquakes greater than magnitude (M) 5.5 since pioneer settlement in 1847. Paleoseismic investigations of Utah's faults indicate a long geologic history of repeated large earthquakes of M6.5 and greater. Utah is in the western part of the North American plate in a tectonically extending province referred to as the Basin and Range. Also, many small earthquakes in east-central Utah are induced by underground coal mining. Large, damaging earthquakes in Utah are likely to occur in the Intermountain Seismic Belt (ISB), an area of high seismicity that generally extends north-south through the center of the state (essentially following Interstate 15), where there are many hazardous faults capable of producing earthquakes. However, areas outside the ISB also experience earthquakes. Moderate to large earthquakes (generally M6 and greater) can injure or even kill people and cause substantial damage to buildings, roads, bridges, and utilities. The Utah Earthquakes (1850 to 2016) and Quaternary Fault Map (<https://ugspub.nr.utah.gov/publications/maps/m-277.pdf>) shows earthquakes known to have occurred within and surrounding Utah, along with mapped Quaternary faults (those with movement in the past 2.6 million years) considered to be earthquake sources. The University of Utah Seismograph Stations (<https://quake.utah.edu/>) website shows recent earthquakes and additional information about earthquakes in Utah.

Hazard Type	Description



- 8:00 Refreshments and Coffee
- 8:30 Welcome, Overview of Meeting, and Review of Previous Years' Activities: *Adam I. Hiscock, Utah Geological Survey (UGS)*
- 8:45 Update on the U.S. Geological Survey (USGS) External Grants Program and Topics Across the Intermountain West Region: *Chris DuRoss, U.S. Geological Survey (USGS) Geologic Hazards Science Center*
Update on the January 22, 2026 M4.7 Bear River Fault Zone Earthquake: *Chris DuRoss, USGS*
- 9:05 Working Group on Utah Earthquake Probabilities 2 Update: *Ivan Wong (Lettis Consultants International)*
- 9:20 Utah Geological Survey Aerial Imagery database update: *Steve Bowman (UGS)*
- 9:35 Southern Utah Quaternary Fault updates: *Tyler Knudsen (UGS)*
- 9:55 Break (20 minutes)
- 10:15 Northern Utah Quaternary Fault Mapping updates: *Rachel N. Adam (UGS)*
- 10:35 Duchesne-Pleasant Valley Fault/Soldier Creek Dam updates: *Ellen Lamont (U.S. Bureau of Reclamation)*
- 11:05 How does Inherited Deformation Control the Frictional Behavior of the Wasatch Fault? Insights from Friction Experiments and Microstructural Analyses of the Farmington Canyon Complex: *Lindsey Broderick (Utah State University)*
- 11:35 Lunch
- 1:00 Technical Presentations (continued):
- 1:00 Dip Angles of Mountain-Front Facets Encode Long-Term Slip Rates Along the Wasatch Normal Fault, USA: *Scott McCoy (University of Nevada Reno)*
- 1:30 Bedrock Offset Across the Wasatch Fault in Salt Lake City, Utah, from Teleseismic Converted Phases and its Geologic Implications: *Jim Pechmann (University of Utah Seismograph Stations)*
- 2:00 Break (20 minutes)
- 2:20 Virginia Street Fault updates: *Adam McKean (UGS)*
- 2:35 Utah Quaternary Fault Database scheduled updates: *Adam Hiscock (UGS)*
- 2:50 Utah Earthquake Action Alliance (UEAA) update: *Matthew Morriss (UGS)*
- 3:05 Break (15 minutes)
- 3:20 Group Discussion Time/Working Group 2026 Fault Investigation Priorities Discussion
- 5:00 Adjourn (may be earlier)





2025 UQFPWG Priorities

- Acquire new slip-rate and other paleoseismic data for faults lacking sufficient data and have ongoing or completed lidar fault mapping projects:
 - East and West Cache fault zones (Cache Valley regional faults)
 - Data gaps in paleoseismic records for the five central segments of the Wasatch fault zone (Brigham City, Weber, Salt Lake City, Provo, and Nephi segments)
 - Oquirrh and Southern Oquirrh Mountains fault zones (Tooele/Rush Valley faults)
 - Washington, Hurricane, and Sevier fault zones (Southern Utah regional faults)
- Use recently acquired lidar data to more accurately map fault traces. Specifically:
 - Faults in rural areas of western Utah (Escalante Desert, Sevier Desert, Pilot Valley, Tintic Valley, Skull Valley, Hansel Valley, Beaver Basin, Scipio Valley)
 - Basin and Range – Colorado Plateau Transition faults (Thousand Lake fault, Paunsaugunt fault, Joes Valley faults, etc.)
 - Faults that cross zones of critical infrastructure across Utah

2025 UQFPWG Priorities

- Use geophysical methods to improve subsurface models of basins along the Wasatch fault, including the densely populated Provo, Salt Lake, and Weber basins.
 - Improve 3D Basin structural models using gravity data, well data, and seismic data
 - Community velocity model input improvements
 - Use geophysical methods to better model and study listric faults
- Opportunistic trenching sites – Funding for dating samples left over from other projects that have been stored and would be useful.
- Great Salt Lake and Utah Lake faults – Improve upon previous work to better map and characterize these faults using new methods and techniques.
- Slip-rate data for Quaternary faults in Utah included in the [2023 USGS National Seismic Hazard Maps \(NSHM\) Update](#) – Slip-rates needed for many of these faults for the next NSHM update.

2025 UQFPWG Priority Faults

- **Acquire new slip-rate and other paleoseismic data for faults lacking sufficient data and have ongoing or completed lidar fault mapping projects:**
 - East and West Cache fault zones (Cache Valley regional faults)
 - Data gaps in paleoseismic records for the five central segments of the Wasatch fault zone (Brigham City, Weber, Salt Lake City, Provo, and Nephi segments)
 - Oquirrh and Southern Oquirrh Mountains fault zones (Tooele/Rush Valley faults)
 - Washington, Hurricane, and Sevier fault zones (Southern Utah regional faults)
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 - Basin and Range – Colorado Plateau Transition faults (Thousand Lake fault, Paunsaugunt fault, Joes Valley faults, etc.)
 - Faults that cross zones of critical infrastructure across Utah
- **Use geophysical methods to improve subsurface models of basins along the Wasatch fault, including the densely populated Provo, Salt Lake, and Weber basins.**
 - Improve 3D Basin structural models using gravity data, well data, and seismic data
 - Community velocity model input improvements
 - Use geophysical methods to better model and study listric faults
- **Opportunistic trenching sites – Funding for dating samples left over from other projects that have been stored and would be useful.**
- **Great Salt Lake and Utah Lake faults – Improve upon previous work to better map and characterize these faults using new methods and techniques.**
- **Slip-rate data for Quaternary faults in Utah included in the 2023 USGS National Seismic Hazard Maps (NSHM) Update – Slip-rates needed for many of these faults for the next NSHM update.**

UQFPWG – Priority Faults Discussion

Potential faults to add:

- Salt-tectonic related faulting?
- Southern Utah/Rural Area faults:
 - Thousand Lake Mountain fault
 - Paunsaugunt (already on list)
- Listric faults? Listric WFZ? – category about dips and earthquake processes
- Slip rates for faults with no slip rate data
- Faults in NSHM – develop/collect paleoseismic data – need rate info!
- What are the next faults in Utah we can start thinking about time dependent modeling for?
- Secondary faulting on the WFZ and regional faults

Intermountain West (IMW) Update

2026 Utah Quaternary Fault Parameters Working Group
2026 Basin and Range Province Earthquake Working Group

Christopher DuRoss

USGS IMW Regional Coordinator, cduross@usgs.gov



This information is preliminary and is subject to revision. It is being provided to meet the need for timely best science. The information is provided on the condition that neither the U.S. Geological Survey nor the U.S. Government shall be held liable for any damages resulting from the authorized or unauthorized use of the information.

USGS Earthquake Geology Project (& collaborators)



Alex
Hattem



Rich
Briggs

Joe
Powell

Harrison
Gray

Cassie
Hannagan



Chris
DuRoss



Sylvia
Nicovich



Nadine
Reitman



Jessie
Thompson
Jobe



Emerson
Lynch



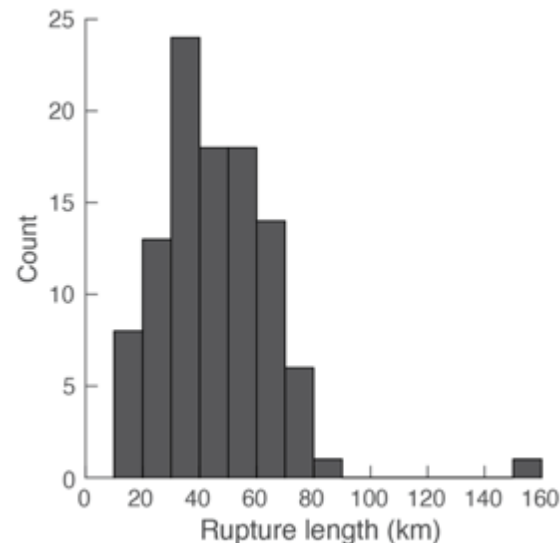
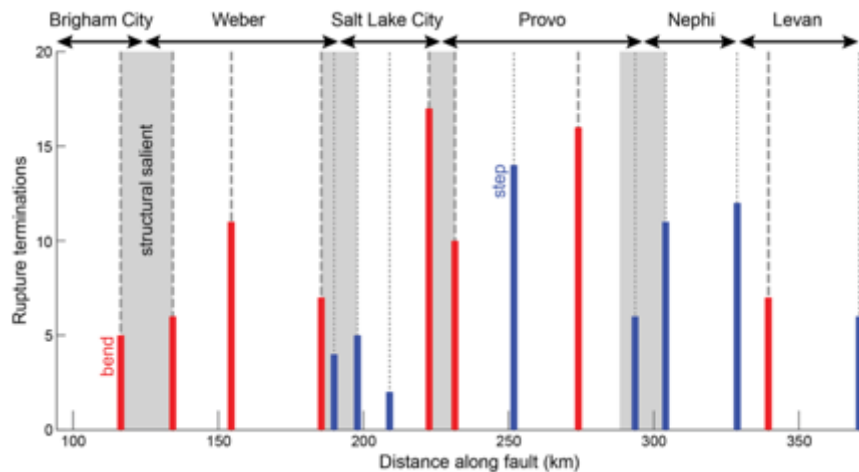
Rupture Forecasts & Hazard Modeling

USGS National Seismic Hazard Model

- Time-dependent earthquake rate probabilities using date of last earthquake (DOLE)

Working Group on Utah Earthquake Probabilities (WGUEP)

- Wasatch fault paleoseismic rupture models
- Wasatch Front rupture rates using inversion framework



 science for a changing world

ScienceBase-Catalog Communities More Help

ScienceBase Catalog → USGS Data Release P... → Date of Last Earthqua...

Date of Last Earthquake (DOLE) compilation for use in time-dependent seismic hazard analyses, version 1.0

Dates

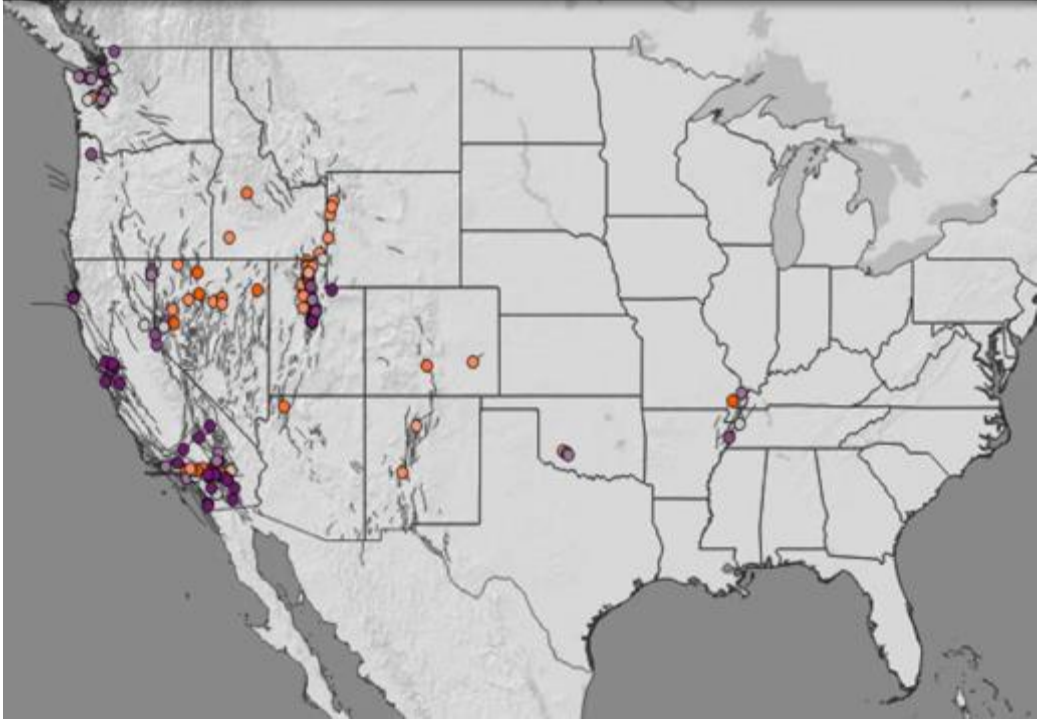
Last Update : 2024-08-30
Publication Date : 2024-11-04

Citation

Hatem, A.E., Thompson Jobe, J.A., Briggs, R.W., Tan, M., Scharer, K.M., Hecker, S.M., DuRoss, C.B., and Lynch, E.M., 2024, Date of Last Earthquake (DOLE) compilation for use in time-dependent seismic hazard analyses, version 1.0: U.S. Geological Survey data release, doi.org/10.5066/P142CQAB.

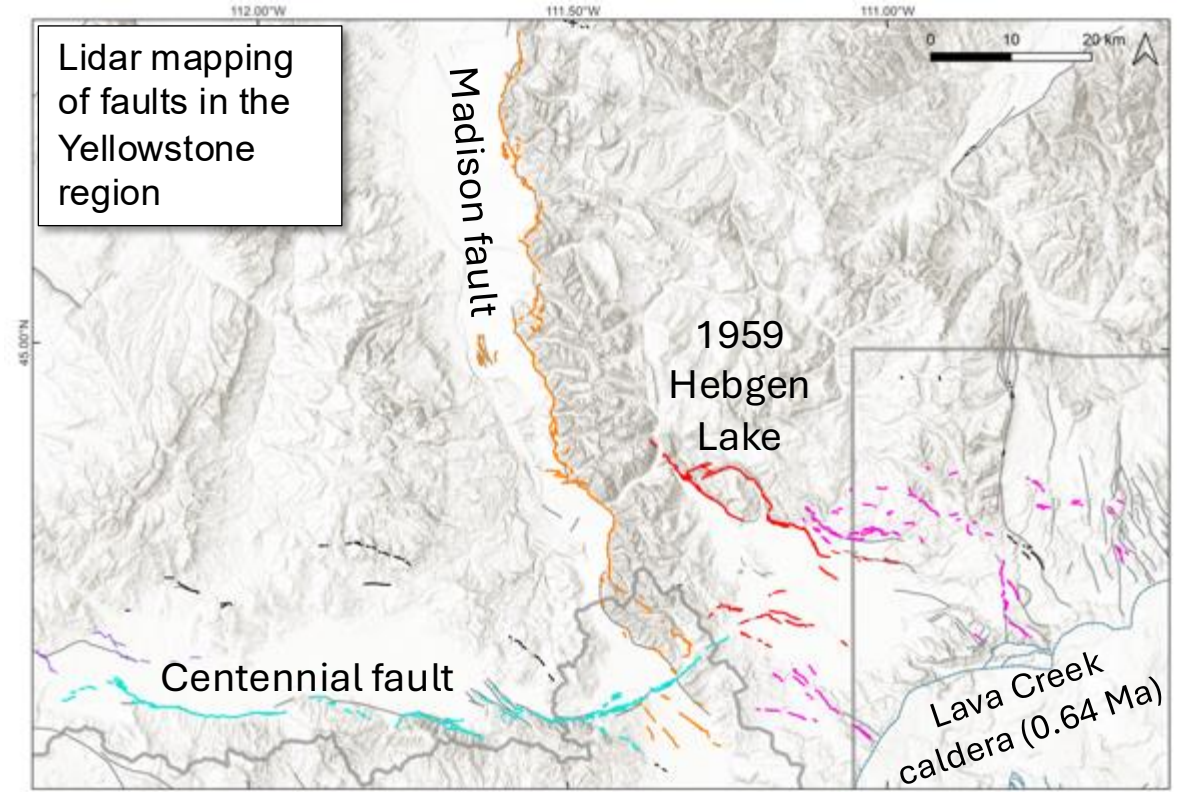
Summary

This Data Release contains two compilations provide information on the date of the last known earthquake in the U.S. where available (conterminous U.S. and Alaska). There are two spatial datasets with different feature geometries — line features ("HistDOLE_v1") and ("PaleoDOLE_v1"). The line features describe surface ruptures constrained by historical or near-historical observations (c. 1850). The describe paleoseismic observations of the most recent earthquake at a study location. These compilations support future developments in seismic hazard analysis.



Paleoseismic Research & Fault Characterization

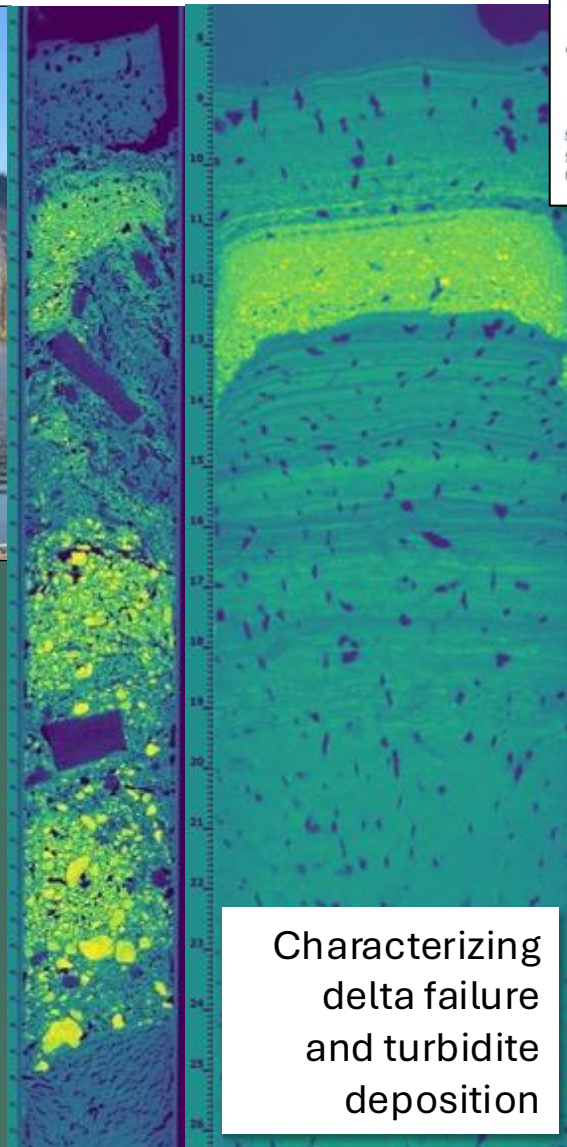
- Trench across the Gore Range fault, Colorado (Hatem)
- Fault mapping and geochronology in the central Rio Grande Rift (Thompson Jobe)
- Fault characterization and paleoseismic trenching (pending) in the Yellowstone region (Nicovich, DuRoss)



Lacustrine Paleoseismology

- Improve our understanding of how IMW lakes record evidence of strong earthquake shaking

Stanley Lake, Idaho



Characterizing
delta failure
and turbidite
deposition

Geophysical Research Letters

RESEARCH LETTER
10.1029/2024GL110889

Key Points:

- Sediment cores from Henrys Lake record ground shaking produced from the 1959 M7.3 Hebgen Lake earthquake
- Henrys Lake sediment cores do not record shaking-induced sedimentation from ~4.7 ka until 1959
- Lacustrine sediments in shallow, low-relief, intraplate basins can record earthquake shaking

Supporting Information:

Supporting Information may be found in the online version of this article.

Shallow Lake, Strong Shake: Record of Seismically Triggered Lacustrine Sedimentation From the 1959 M7.3 Hebgen Lake Earthquake Within Henrys Lake, Idaho

Sylvia R. Nicovich¹, Christopher B. DuRoss¹, Jessica A. Thompson Jobe¹, Jessica R. Rodysill², Richard W. Briggs¹, Alexandra E. Hatem¹, Madeleine M. Tan¹, Yann Gavillot³, Noah S. Lindberg¹, Laura E. Strickland⁴, and Jason S. Padgett⁵

¹U.S. Geological Survey, Geological Hazards Science Center, Golden, CO, USA, ²U.S. Geological Survey, Florence Bascom Geoscience Center, Reston, VA, USA, ³Montana Bureau of Mines and Geology, Montana Tech University, Butte, MT, USA, ⁴U.S. Geological Survey, Geosciences and Environmental Change Science Center, Denver Federal Center, Denver, CO, USA, ⁵U.S. Geological Survey, Pacific Coastal Marine Science Center, Santa Cruz, CA, USA

Abstract We investigate a shallow lake basin for western North America. Henrys Lake, Idaho is an atyp shallow depth (~7 m) and low relief ($\leq 2^\circ$ slopes). Hen

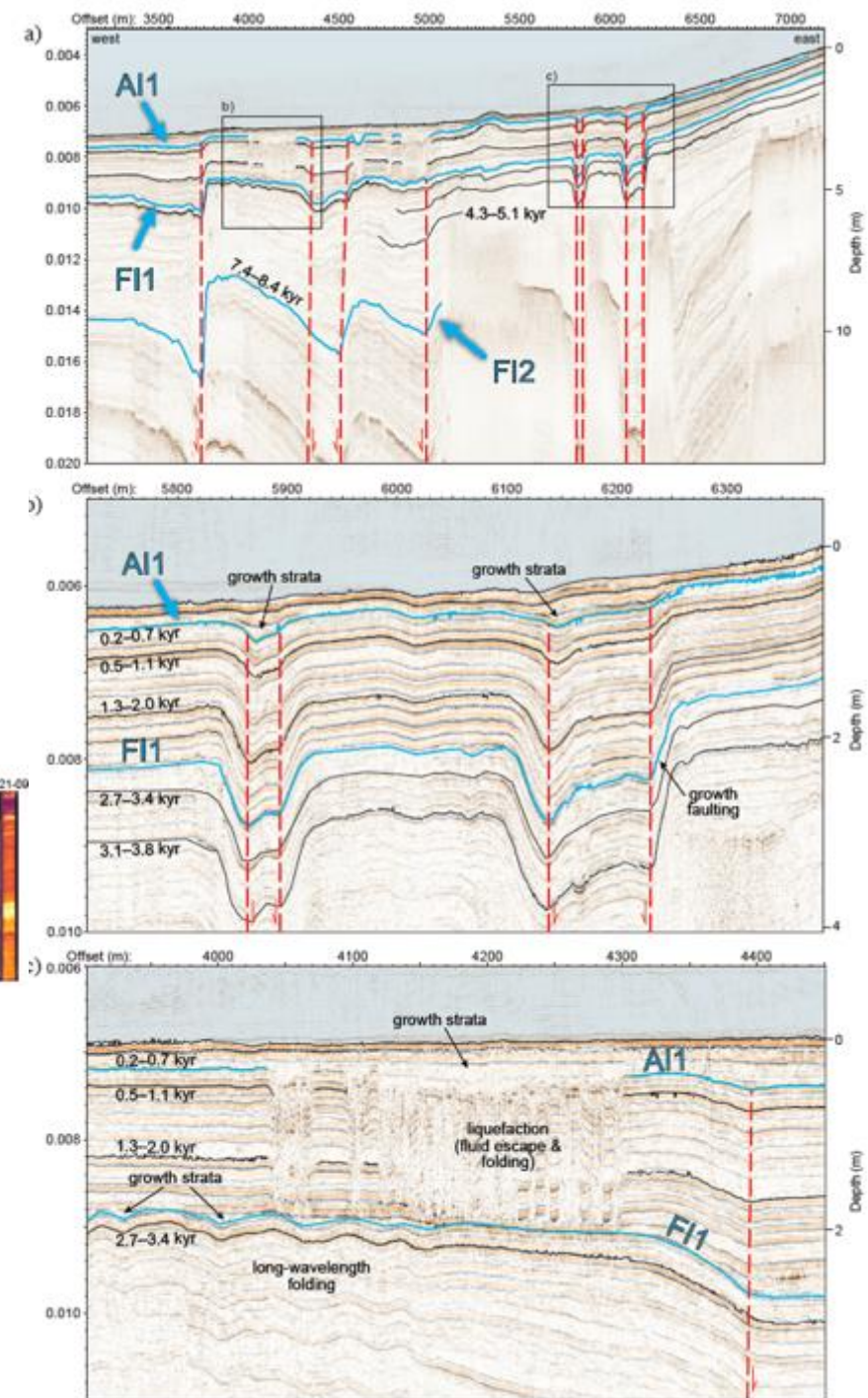
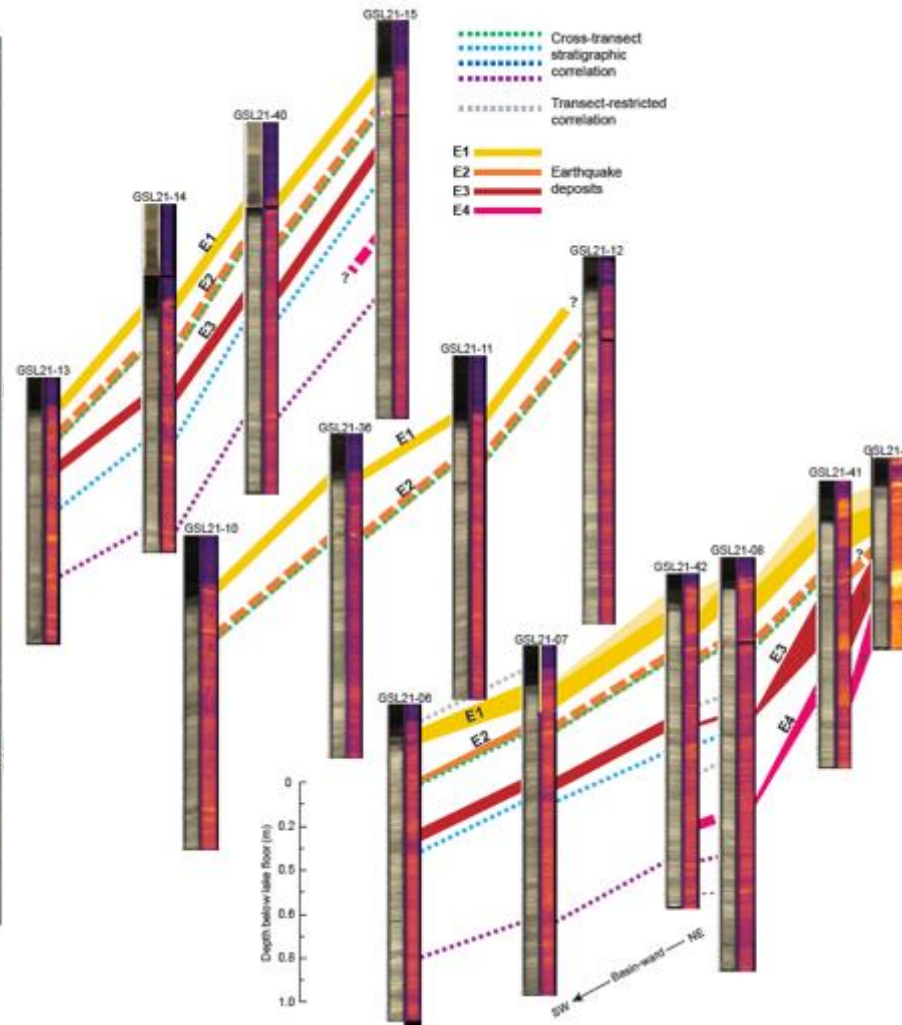
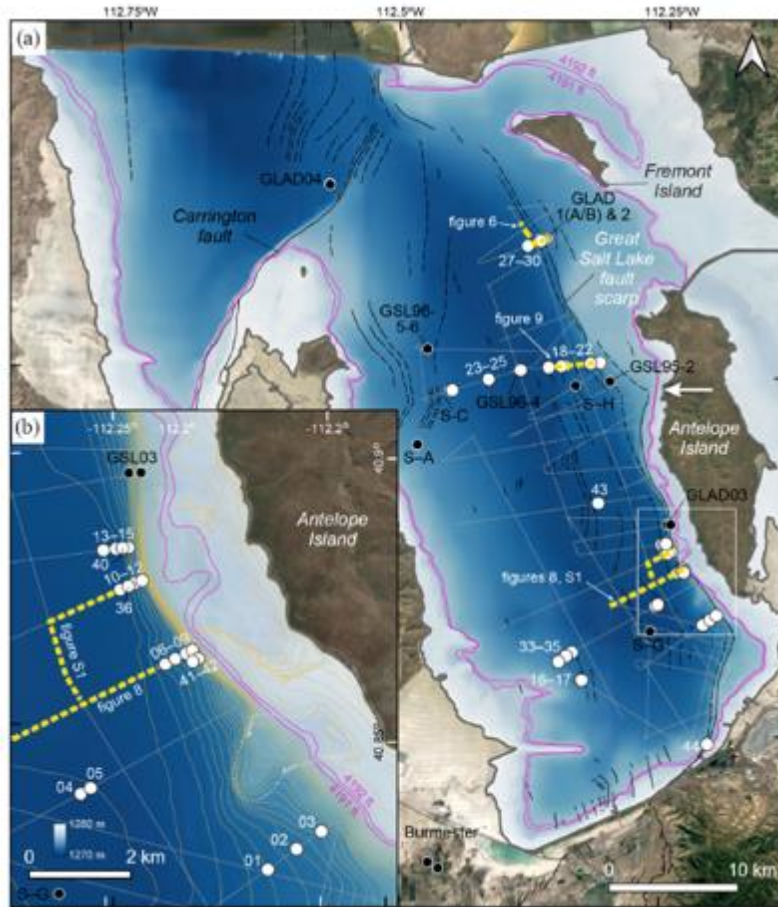
Nicovich et al. (2024)



Exploring shaking-related disturbance of lake
sediments near the 1959 Hebgen Lake EQ

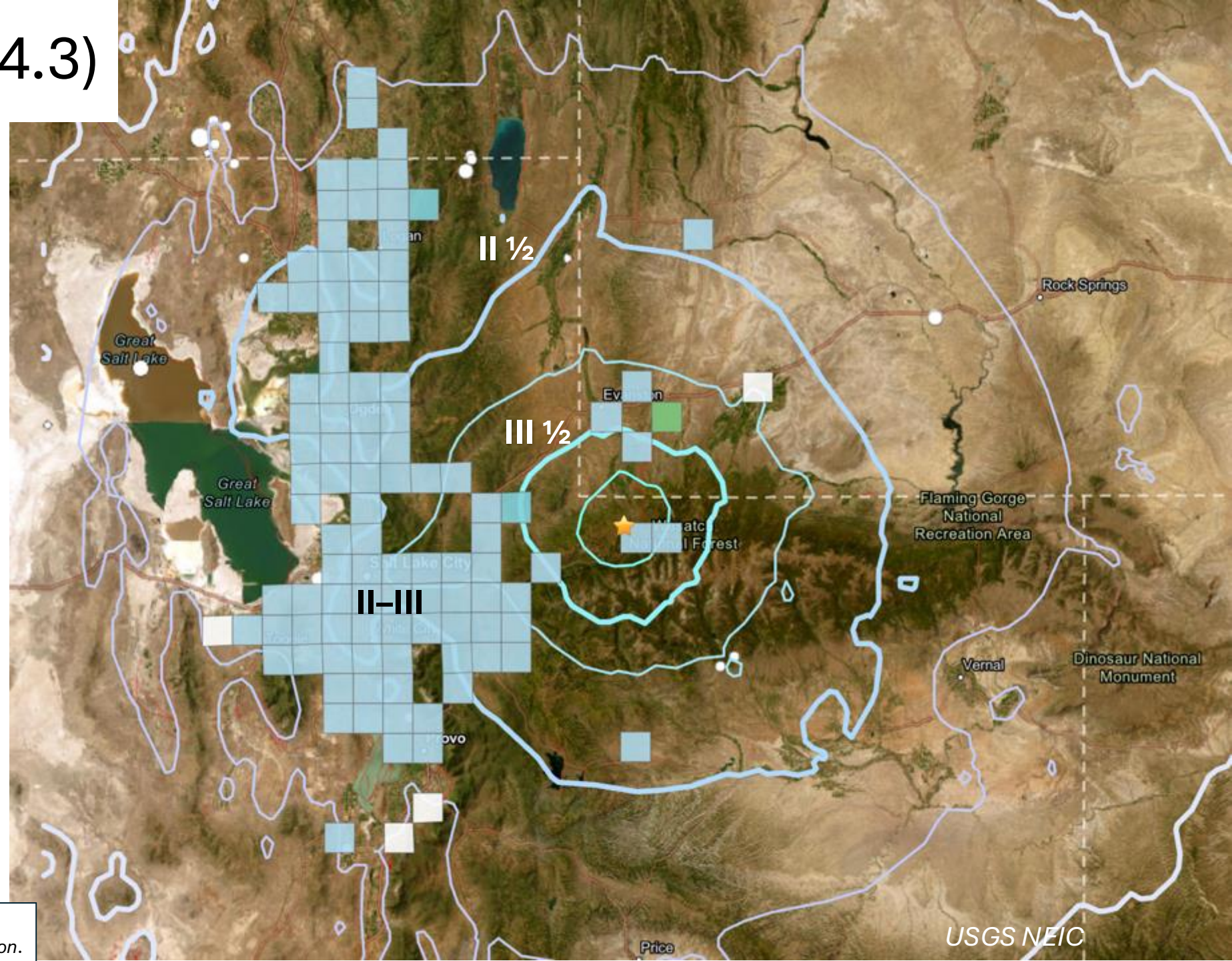
Great Salt Lake Paleoseismology

Exploring the acoustic and sedimentary archive of Wasatch Front earthquakes in the Great Salt Lake (GSAB, in review)



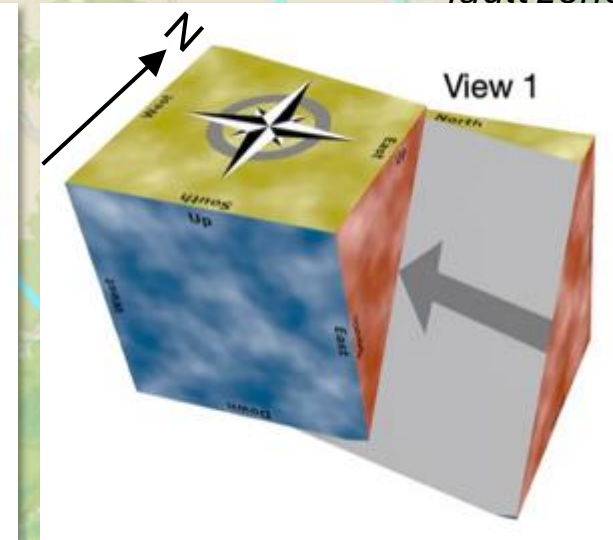
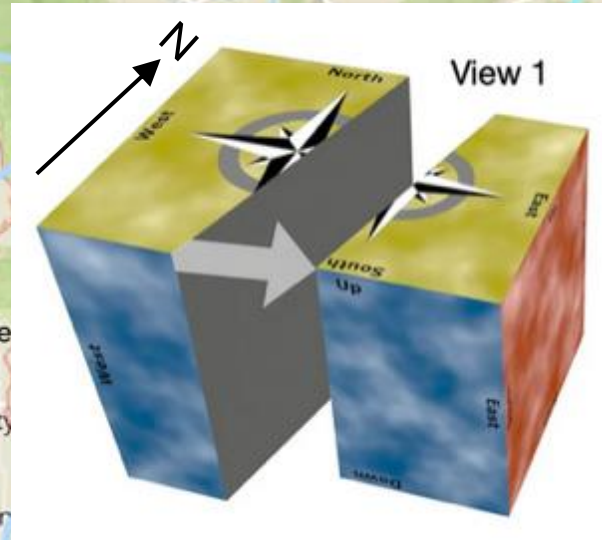
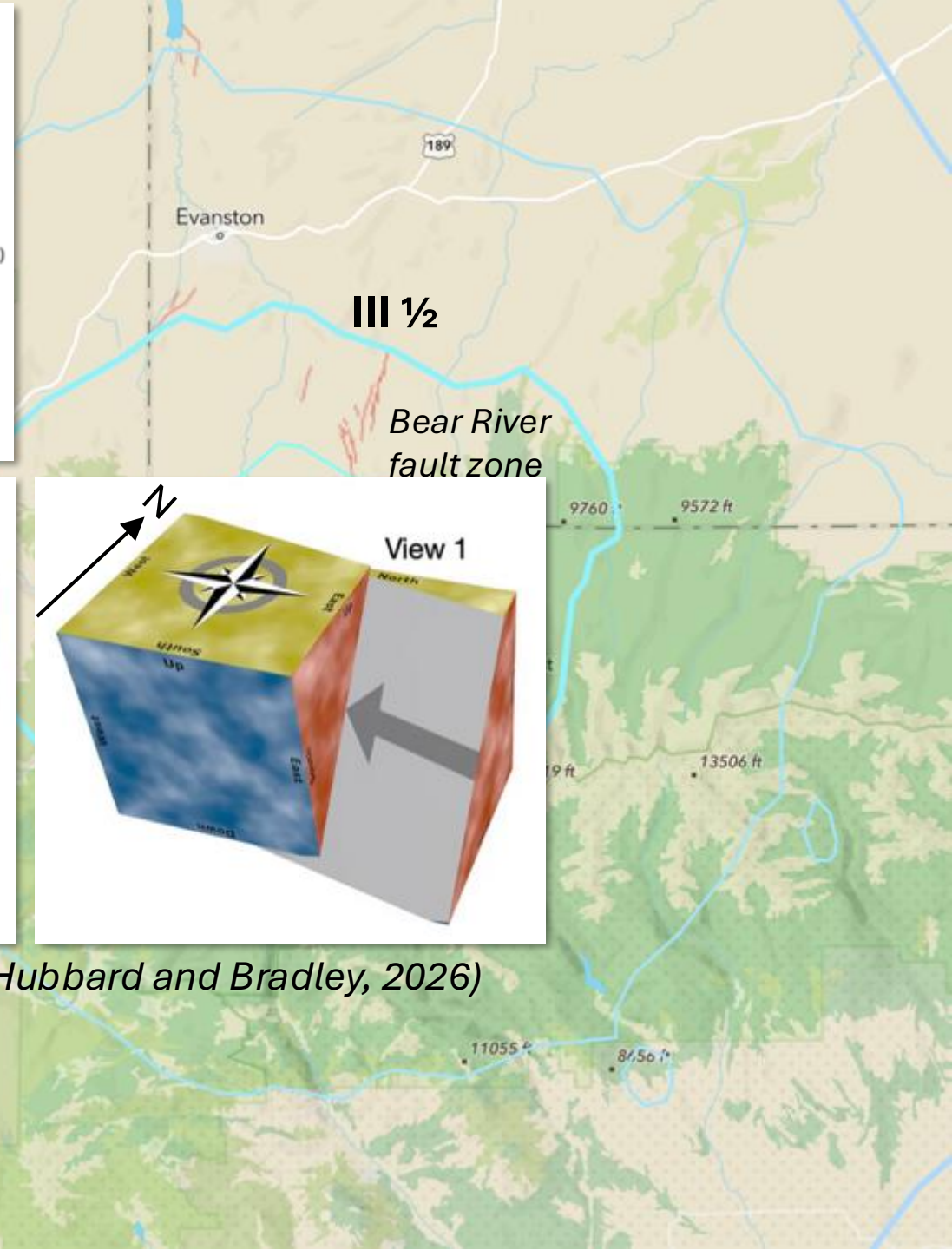
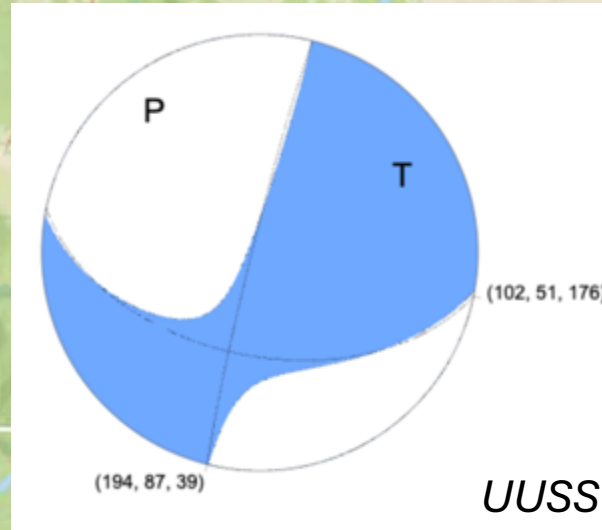
2026 M_L 4.7 (M_W 4.3)

- January 22, 2026, 7:49a
- ~17 km deep earthquake about 40 km south of Evanston
- Weak shaking (MMI ~II–III) recorded along the Wasatch Front (~4.3k responses)
- 15 aftershocks (as of Jan 27)



2026 M_L 4.7

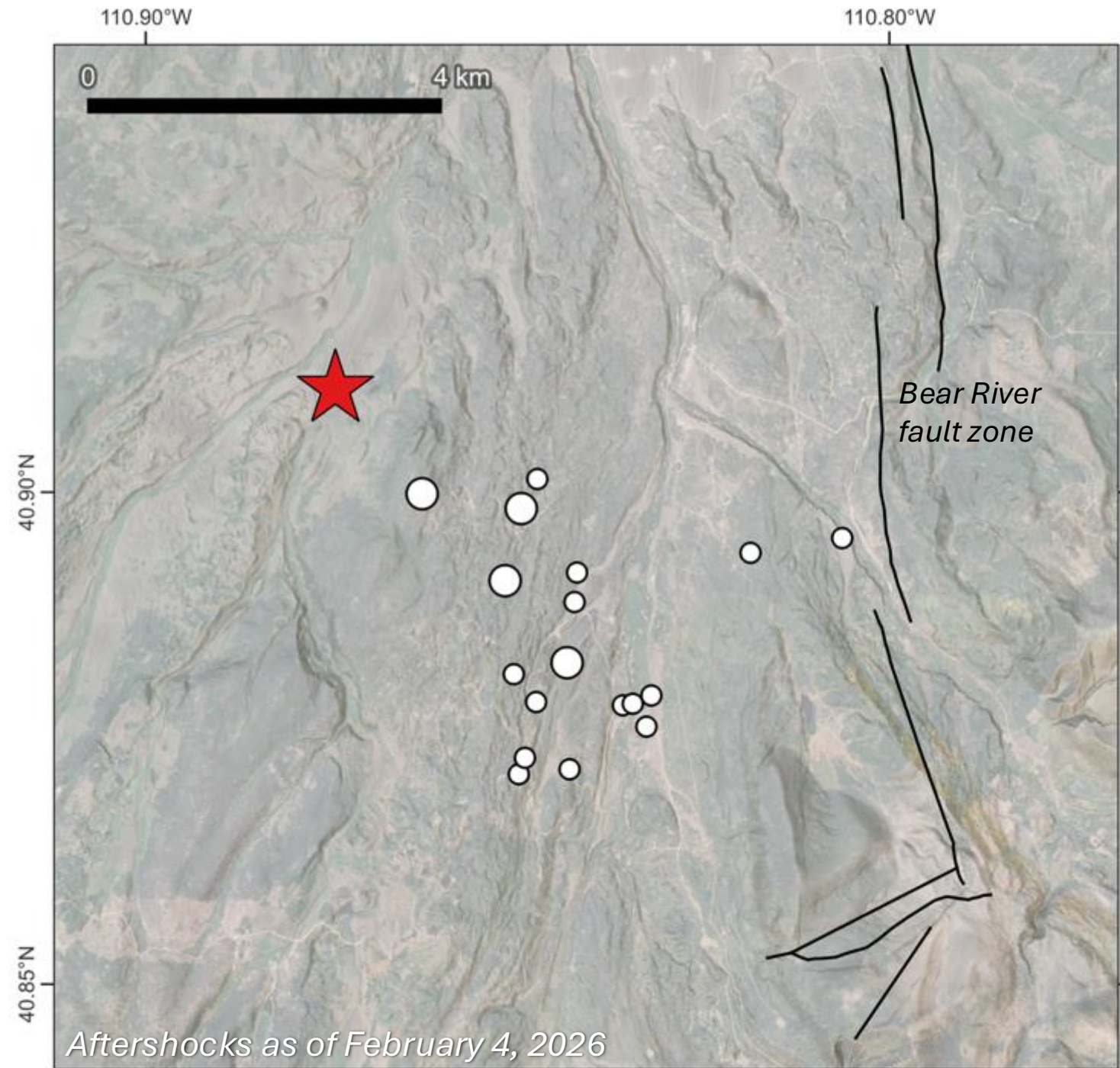
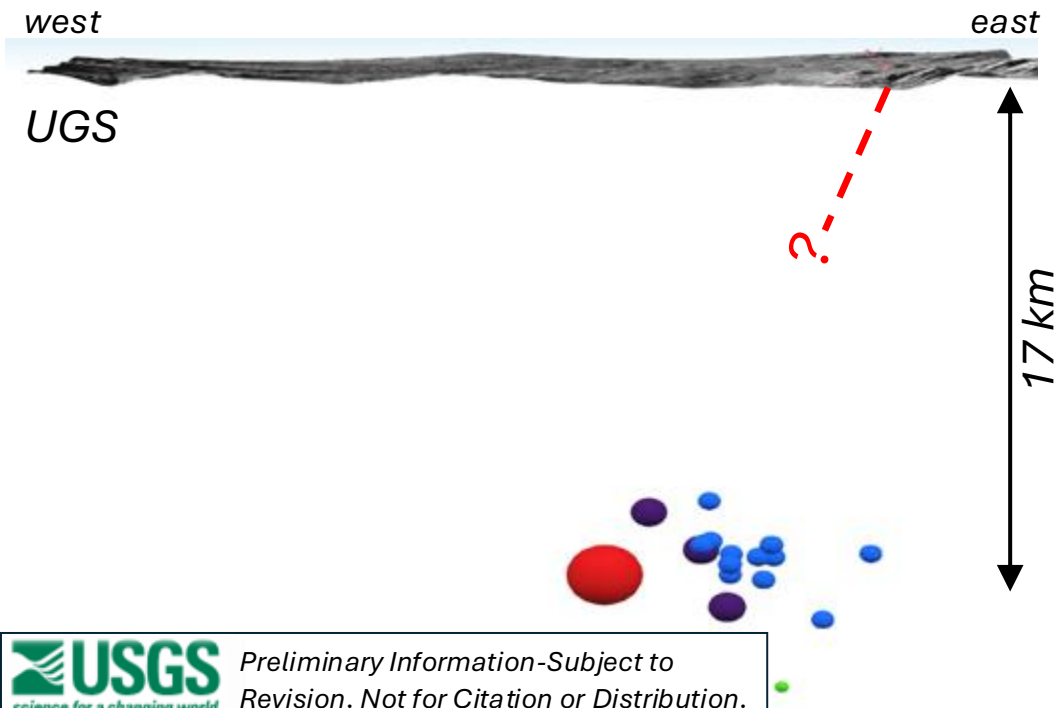
- North of the Uinta Mountains and close to southern terminus of the Bear River fault zone
- Moment tensor nodal planes:
 - Steeply dipping ~N-S fault with LL and down-to-east slip
 - Moderately dipping ~E-W fault with RL slip



Earthquake Insights (Hubbard and Bradley, 2026)

Aftershocks

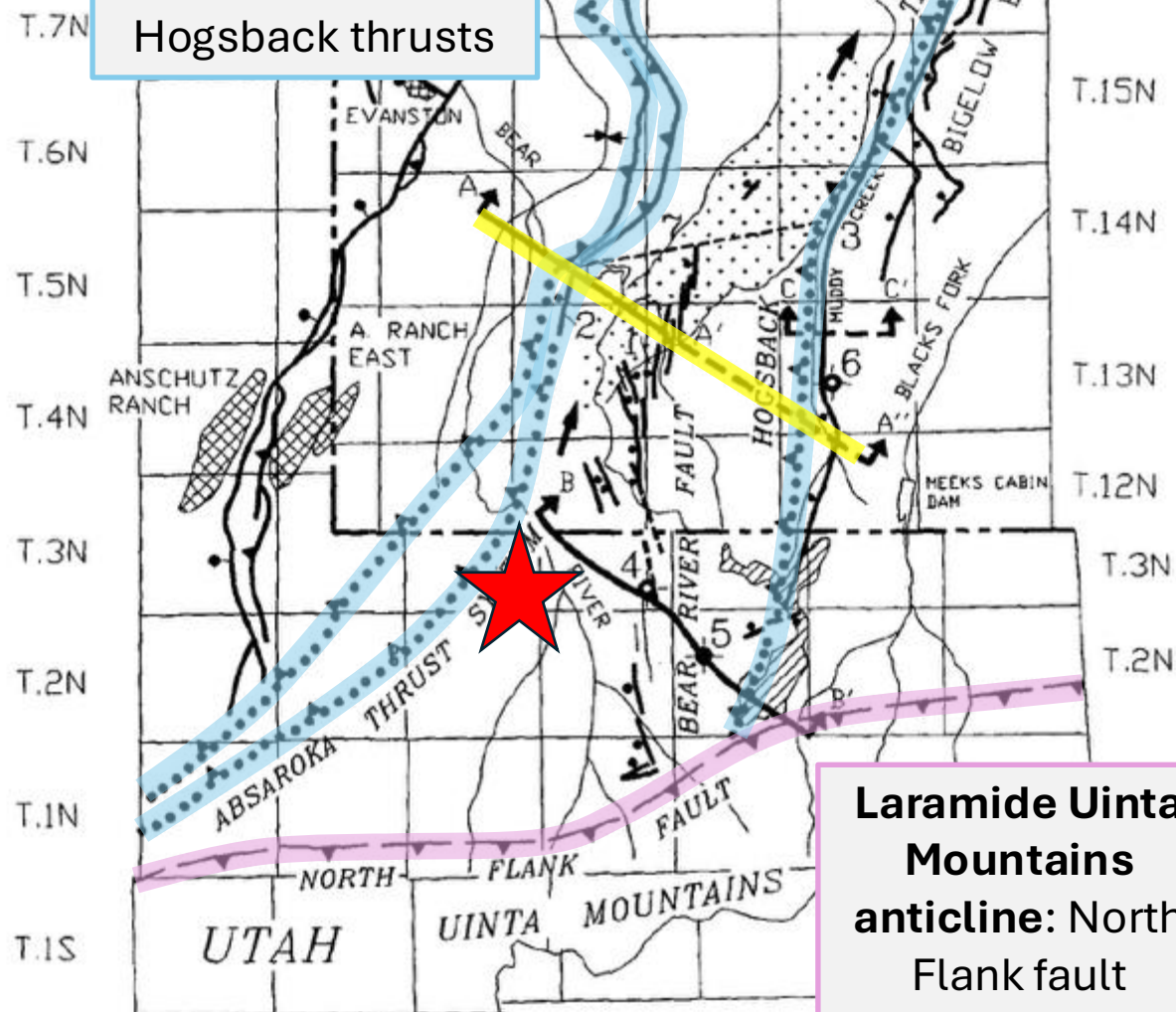
- Approximate N–S alignment supports the N–S nodal plane
- ~15–18 km deep and not along an obvious plane



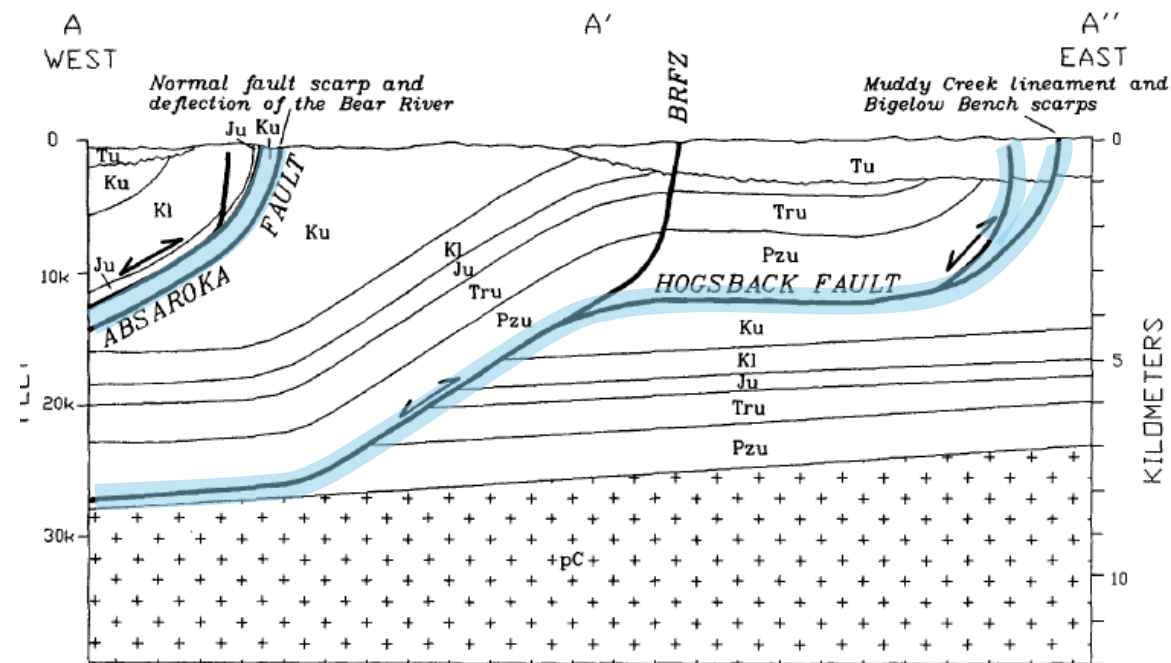
R.120W R.119W R.118W R.117W R.116W

West (1993)

Cordilleran thrust belt: Absaroka & Hogsback thrusts



Laramide Uinta Mountains anticline: North Flank fault



EXPLANATION

- Tu TERTIARY ROCKS
- Ku UPPER CRETACEOUS ROCKS
- Kl LOWER CRETACEOUS ROCKS

- Ju JURASSIC ROCKS
- Tru TRIASSIC ROCKS
- Pzu PALEOZOIC ROCKS

- +pC+ PRECAMBRIAN ROCKS

Slip arrow showing initial reverse slip and subsequent normal slip.

NORTH



0 5 10 15
MILES

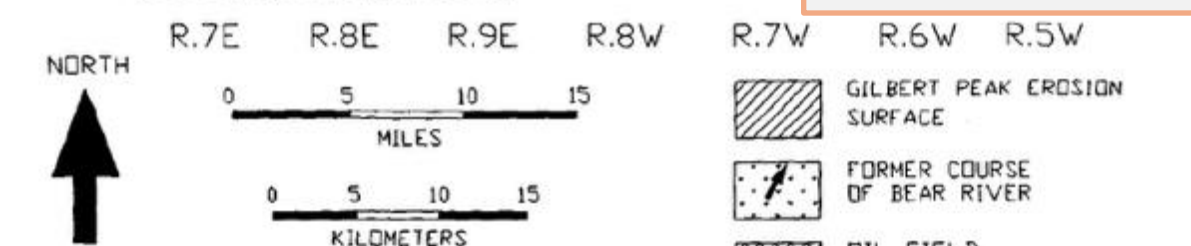
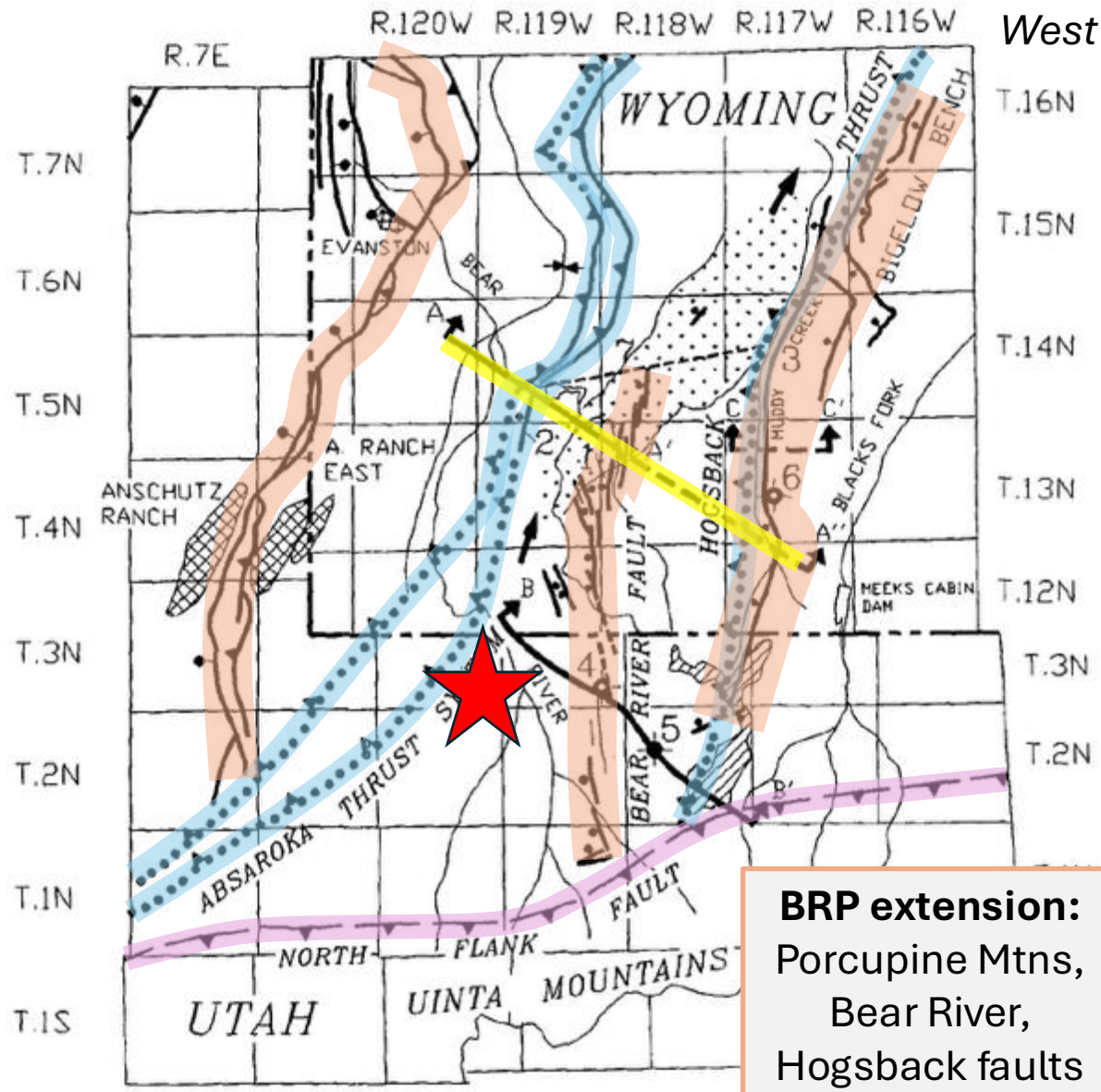
0 5 10 15
KILOMETERS

GILBERT PEAK EROSION SURFACE

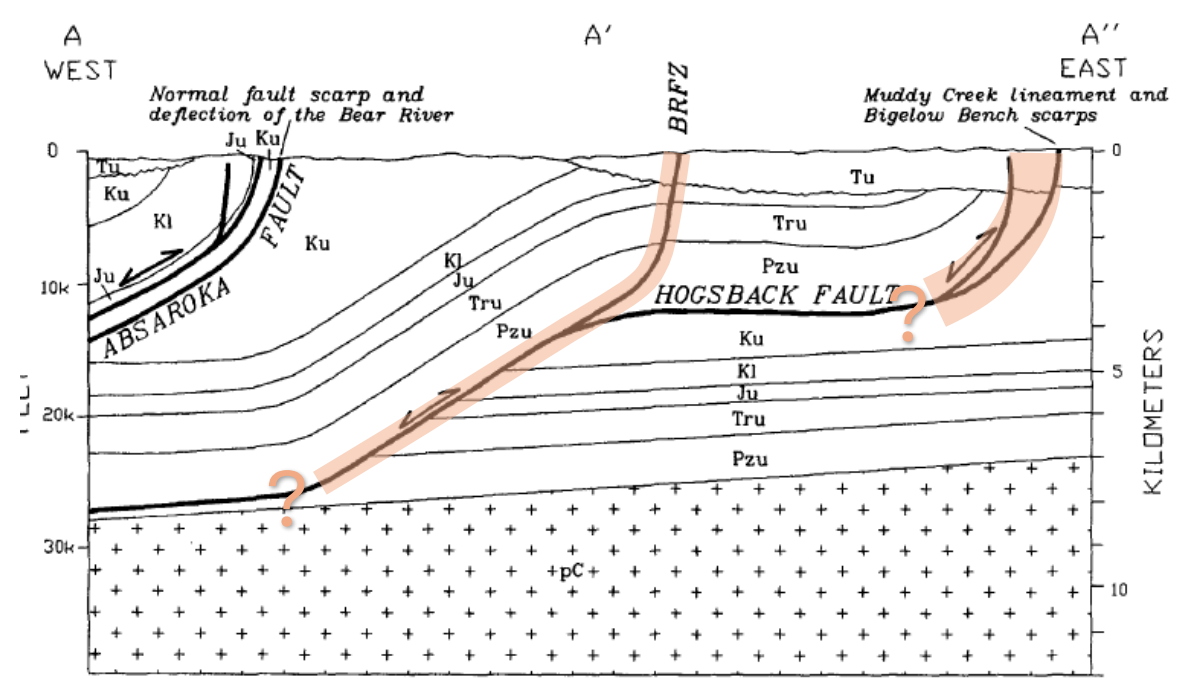
FORMER COURSE OF BEAR RIVER



Preliminary Information-Subject to Revision. Not for Citation or Distribution.



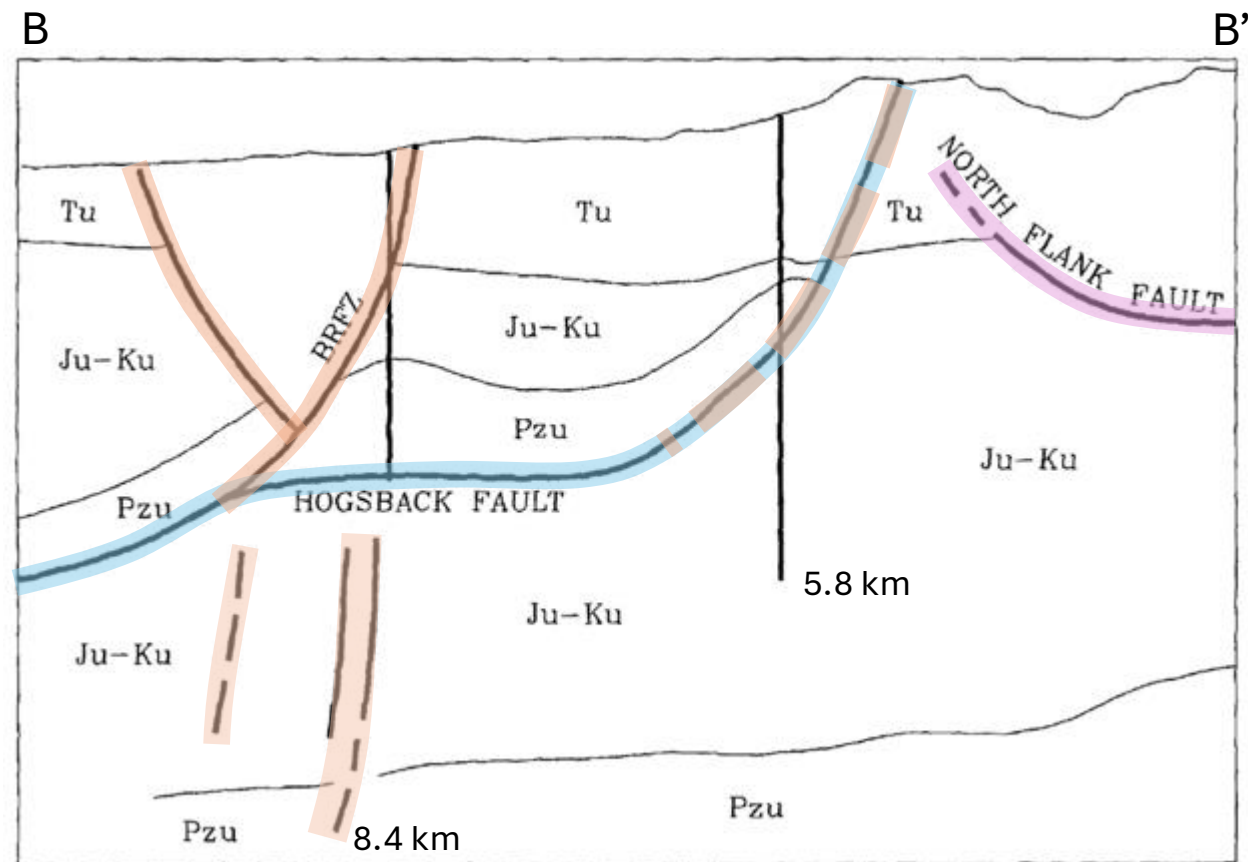
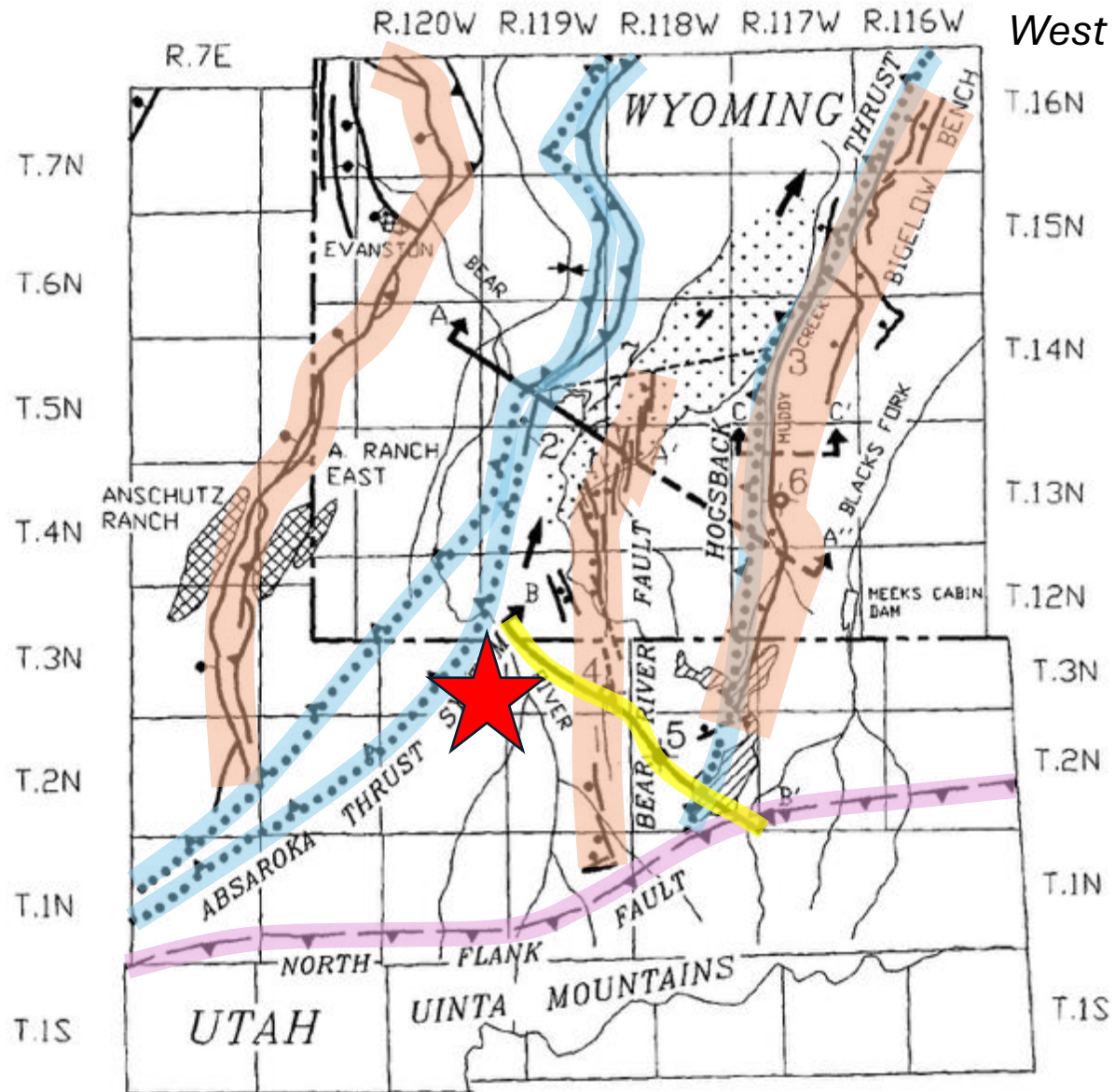
West (1993)



EXPLANATION

Tu	TERTIARY ROCKS	Ju	JURASSIC ROCKS	+ pC +	PRECAMBRIAN ROCKS
Ku	UPPER CRETACEOUS ROCKS	Tru	TRIASSIC ROCKS		
Kl	LOWER CRETACEOUS ROCKS	Pzu	PALEOZOIC ROCKS		

↗ Slip arrow showing initial reverse slip and subsequent normal slip.



West (1993)

NORTH



0 5 10 15
MILES

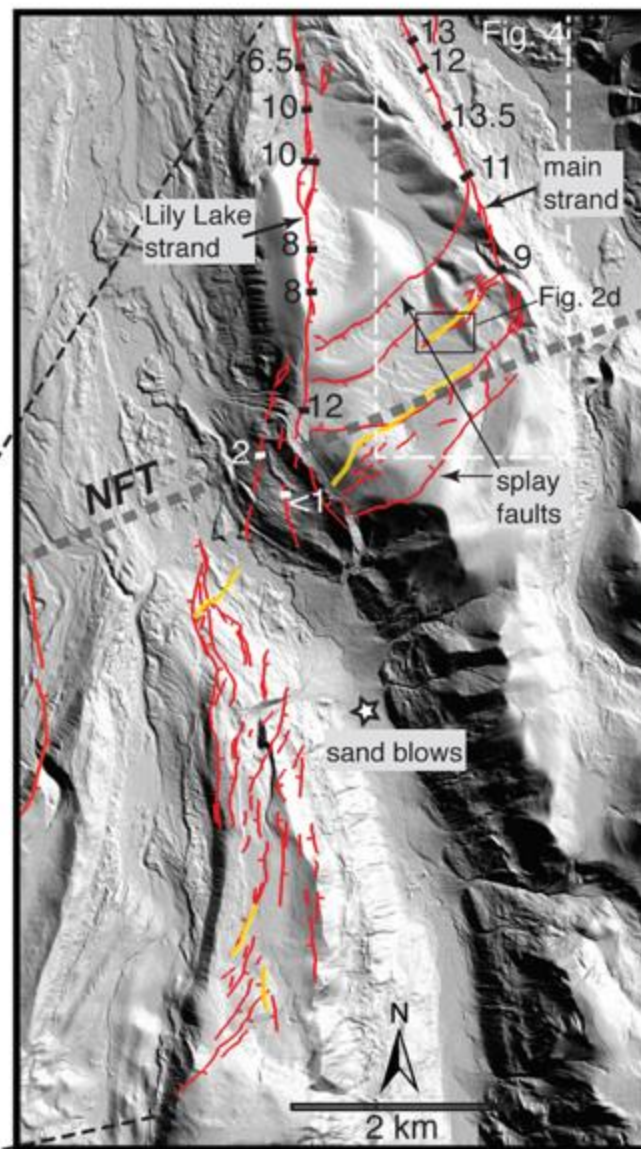
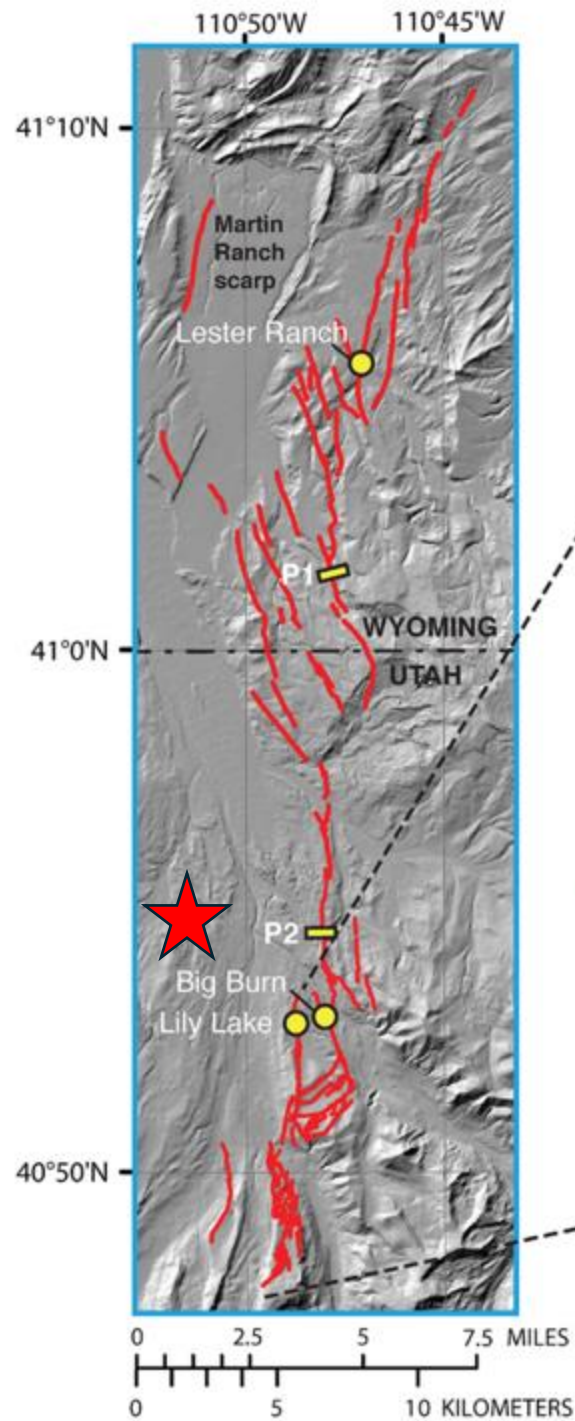
0 5 10 15
KILOMETERS

GILBERT PEAK EROSION SURFACE

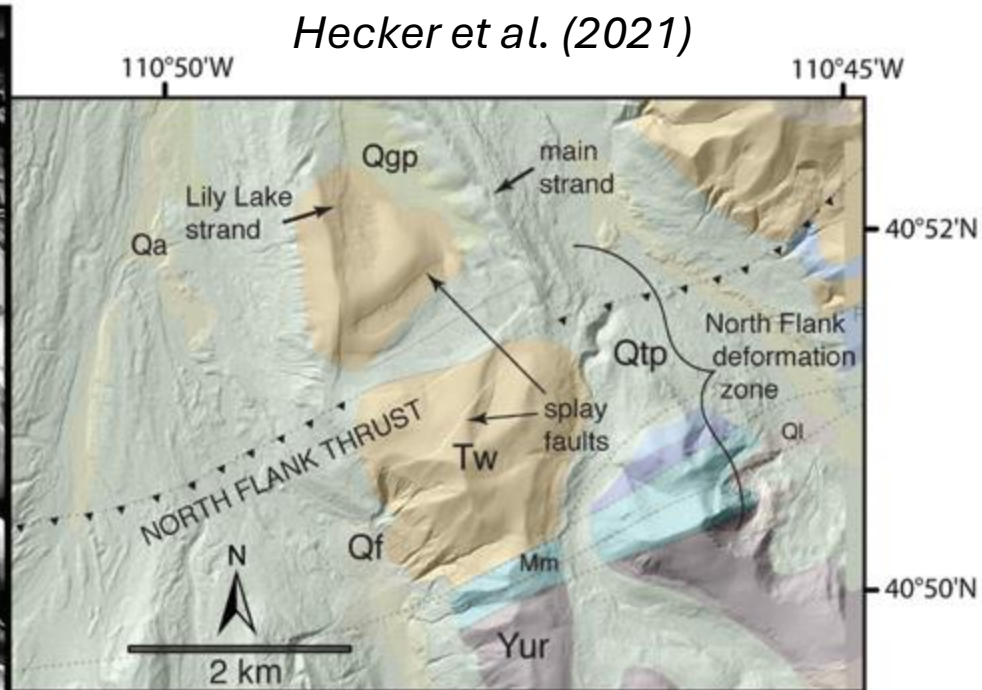
FORMER COURSE OF BEAR RIVER



Preliminary Information-Subject to Revision. Not for Citation or Distribution.



(b)

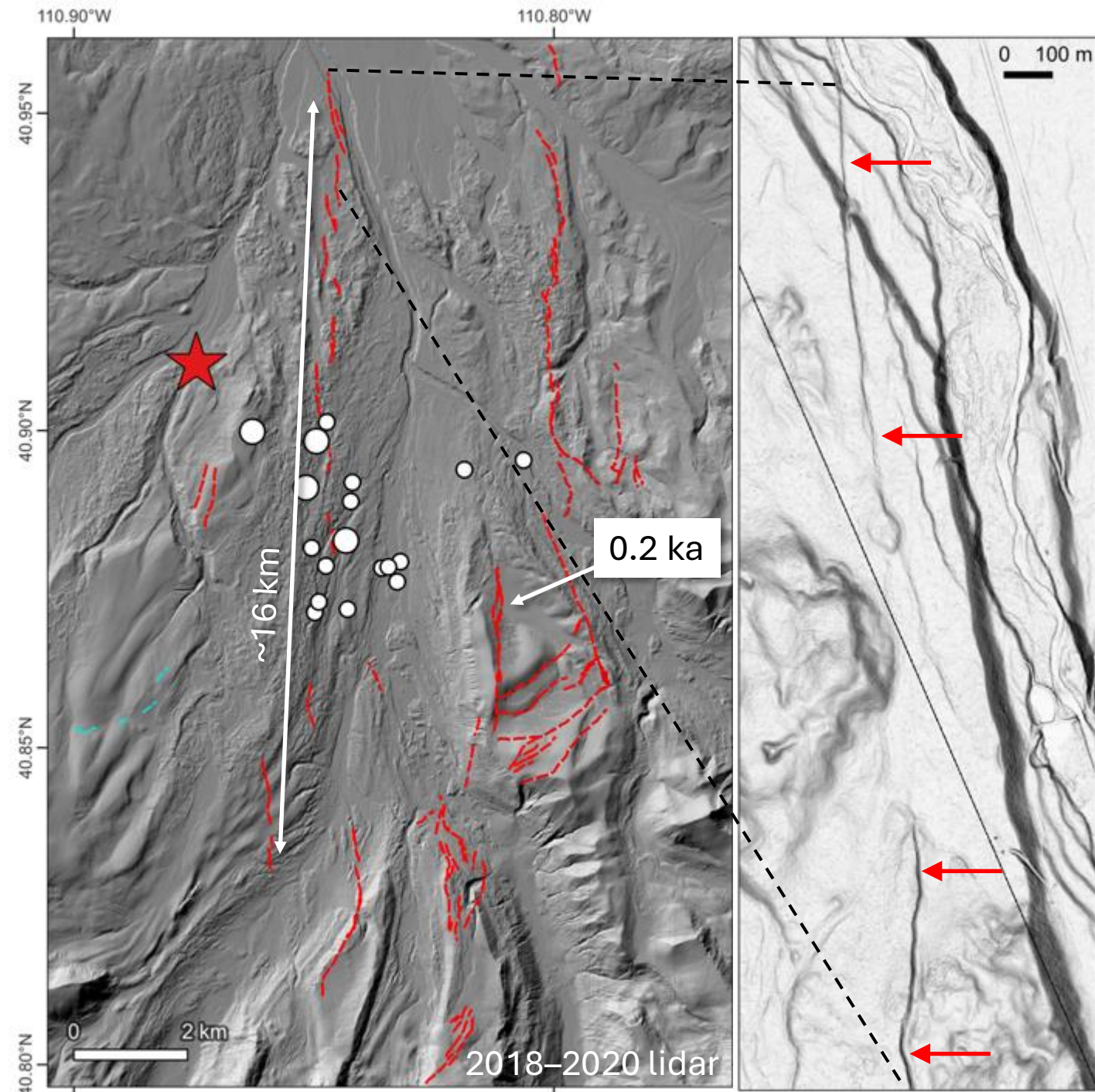


(c)

Bear Creek earthquake history

~4.6 ka, ~3.4 ka: 25–34 km with 2.5–2.9 m average displacement

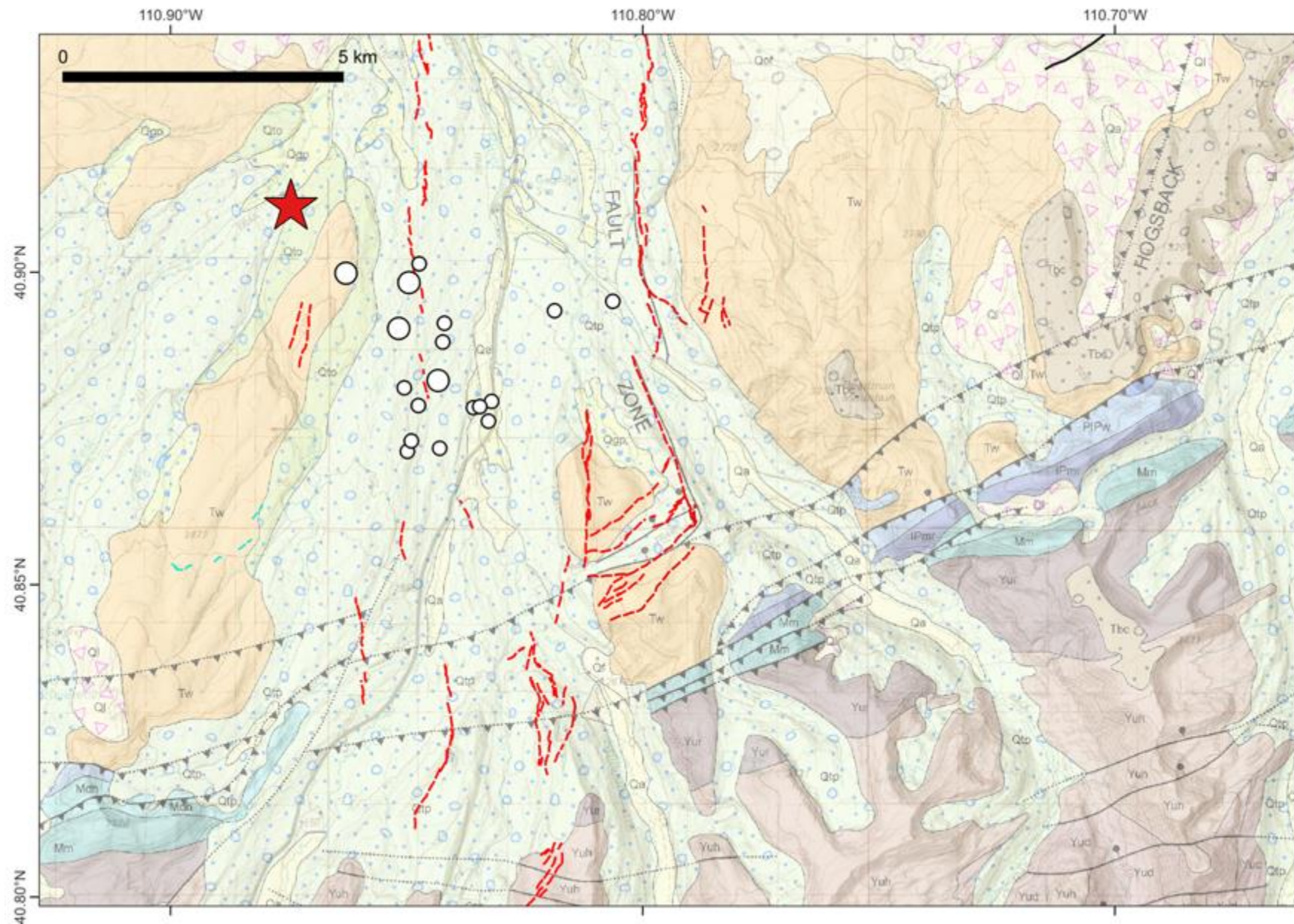
~0.2 ka: partial rupture with minor slip



- Mainshock and aftershock epicenters are ~4–6 km west BRFZ primary trace.
- Overlap spatially with newly mapped zone of hanging-wall (antithetic?) fault scarps:
 - ~4 km west of the BRFZ
 - ~N–S trending
 - East facing
 - ≥ 16 km long

Did the M4.7 occur on the BRFZ?

- ❑ Mainshock and aftershock epicenters overlap with complex BRFZ surface traces
- ❑ Aftershock seismicity and secondary scarps consistent with steep N–S nodal plane
- ❑ Steeply dipping faults beneath the Hogsback thrust (West, 1993), could be BRFZ or a separate buried structure
- ❑ Hypocentral depth (17 km) is >2x BRFZ depth in West (1993)
- ❑ BRFZ slip requires dip $\geq 71^\circ$, conflicting with West (1993) cross sections
- ❑ Oblique slip more consistent with separate rather than antithetic fault slip?



Bryant (2010)

USGS External Grants

FY25 – All Regions/Topics

- 125 proposals: **\$10M** (1yr), ~\$257k (2yr)
- Funding: **\$3.59M** (1yr), \$80.6k (2yr)

FY25 – IMW

- 14 proposals (2 collaborative): **\$882k** (1yr) (no 2yr)
- Funding: **\$274k** (5 proposals; 2 collaborative)
- ~**8%** of External Grants portfolio

Funded FY25 Proposals

- Quaternary Slip Rates and Surface Geometry on the East Gallatin-Reese Creek Fault System, Yellowstone National Park [MT/WY] [Collaborative]
- Seismic Sources and Ground Shaking in the Reno [NV] Basin
- Seismic Hazard in Las Vegas [NV] Assessed with Passive Seismics and Machine Learning [Collaborative]

USGS External Grants

FY26 – All Regions/Topics

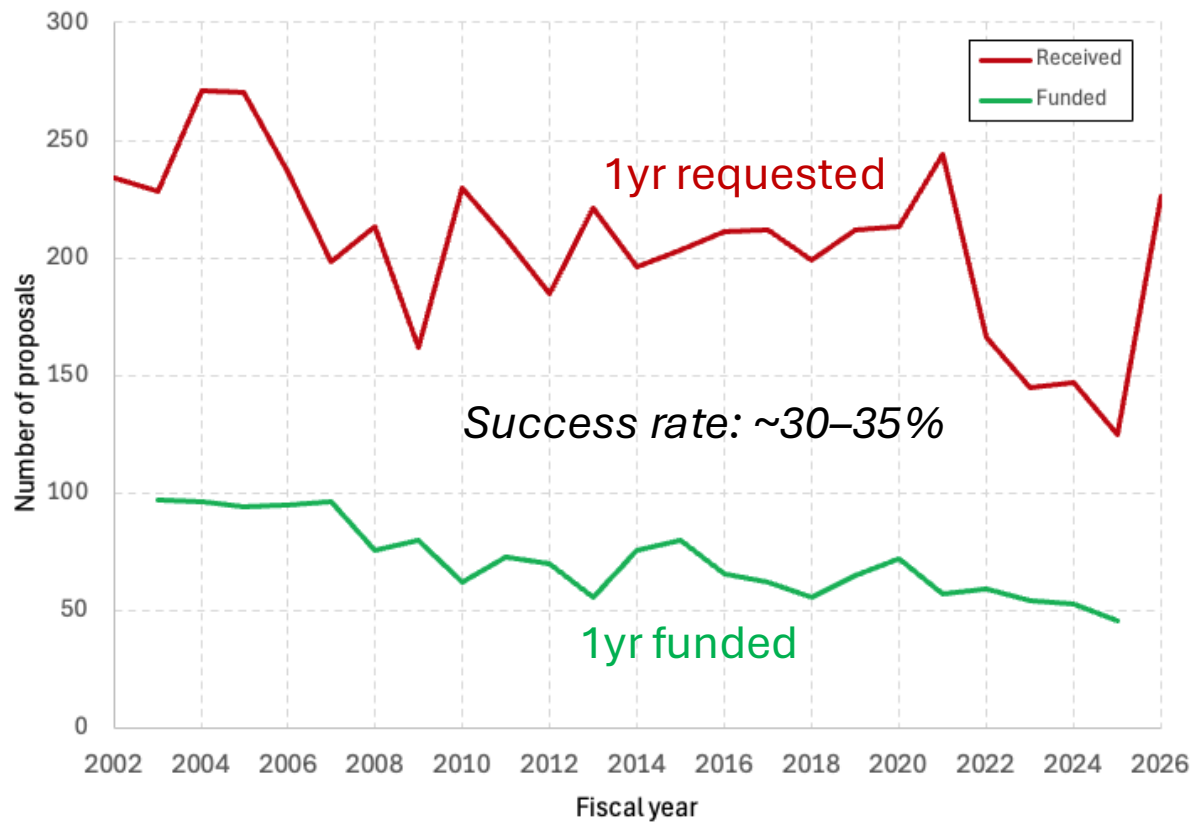
- 226 proposals: **\$18.6M** (1yr), \$1.7M (2yr)

FY26 – IMW

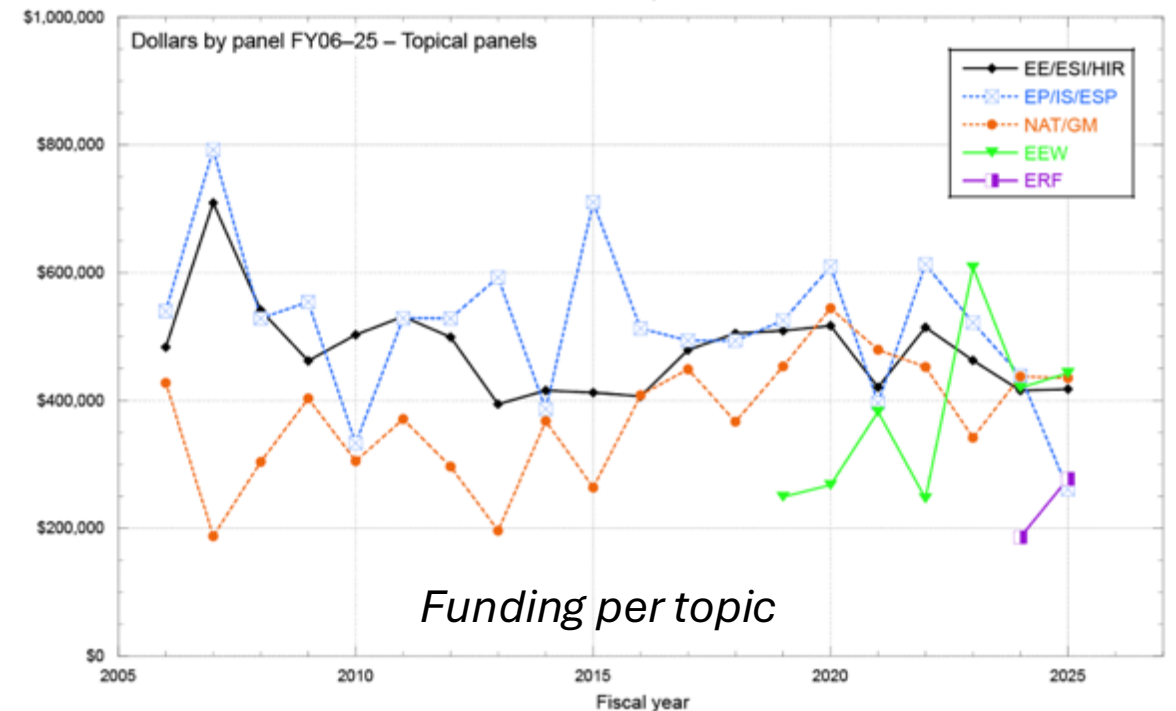
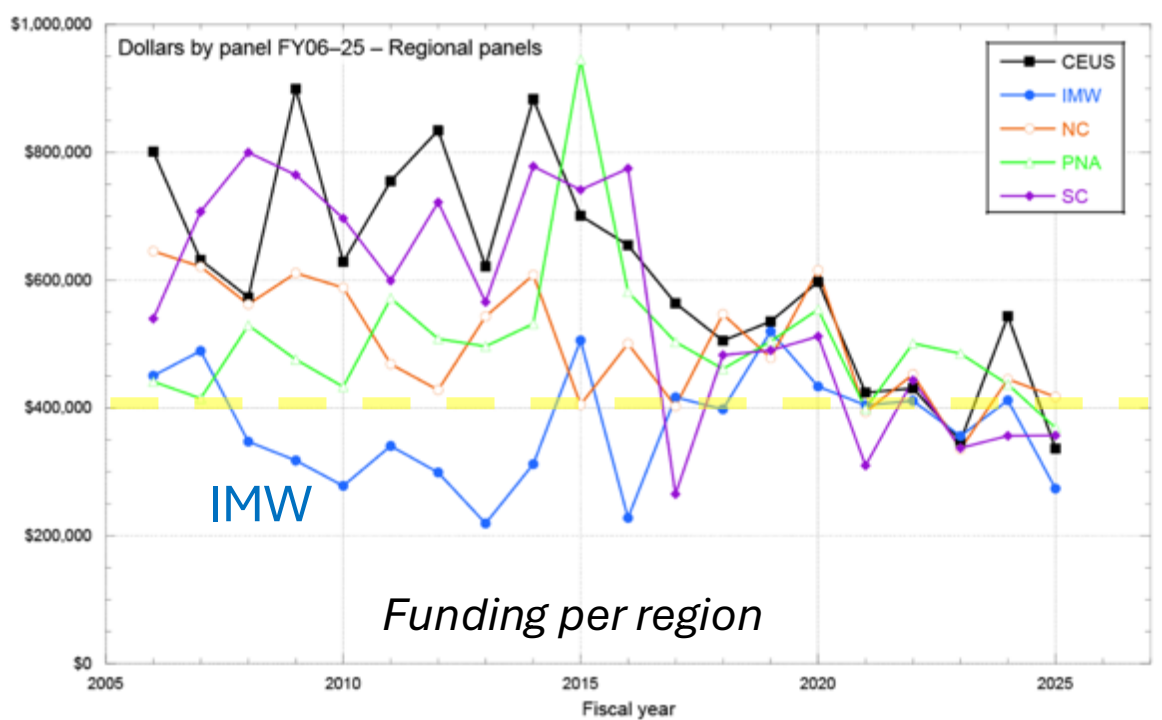
- 23 proposals (6 collaborative): **\$1.6M** (1yr), \$93k (2yr)
- FY26 proposals recommended for funding (11 proposals; 4 collaborative) are in Hold status due to delayed appropriations
- Funding updates to PIs expected in February–March

External Grants Trends

All Regions/Topics (since 2002)



Proposals received and funded FY02–FY26



External Grants FY27

- Notice of FY27 funding opportunity (NOFO) in March
- Research Priorities included in NOFO (no substantial changes to IMW priorities)
- Submit your 1- or 2-yr proposals by late May
- Panel review meeting in late summer
- Reach out to me if you're interested in serving on a panel

FY27 NOFO will be available at www.grants.gov

For more information:

- **IMW Priorities:** Chris DuRoss (cduross@usgs.gov)
- **Proposal submissions and grant extensions:** Jill Franks (jfranks@usgs.gov)
- **General info:** <https://www.usgs.gov/programs/earthquake-hazards/science/external-grants-overview>

2025 IMW Priority Faults

- Community-driven fault and regional priorities to guide USGS EHP Research Priorities

USGS
science for a changing world

ScienceBase-Catalog Communities Help Log in

ScienceBase Catalog → USGS Data Release Products → Priority Faults for Improving ...

Priority Faults for Improving Seismic Hazard Models in the Intermountain West Region

View

Dates

Release Date : 2025
Publication Date : 2025-03-12

Citation

DuRoss, C.B., 2025, Priority faults for improving seismic hazard models in the Intermountain West region: U.S. Geological Survey data release, <https://doi.org/10.5066/P13XVWR7>.

Summary

Abstract
This data release includes a list of high-priority hazardous faults and associated spatial data (regional polygons and buffered fault traces) for the Intermountain West (IMW) region of the United States. These are the top five faults or regions of concern per IMW state, based on the 2025 (version 1.0) meeting of the Basin and Range Province Earthquake Working Group. In general, the list includes important, understudied faults where additional research would help to improve regional earthquake rupture forecasts and hazard modeling, reduce earthquake risk, and expand our knowledge of earthquake processes in the IMW region. This information will be used to guide IMW-specific priorities for research included in the USGS Earthquake Hazards Program external research priorities.

Disclaimer: This database has been approved for release by the U.S. Geological Survey (USGS). Although this database has been subjected to rigorous review and is substantially complete, the USGS reserves the right to revise the data pursuant to further analysis and review. Furthermore, the database is released on condition that neither the USGS nor the U.S. Government shall be held liable for any damages resulting from its authorized or unauthorized use. Any use of trade, firm, or product names is for descriptive purposes only and does not imply endorsement by the U.S. Government.

Map »



Spatial Services

ScienceBase WMS :
<https://www.sciencebase.gov/catalog>

Communities

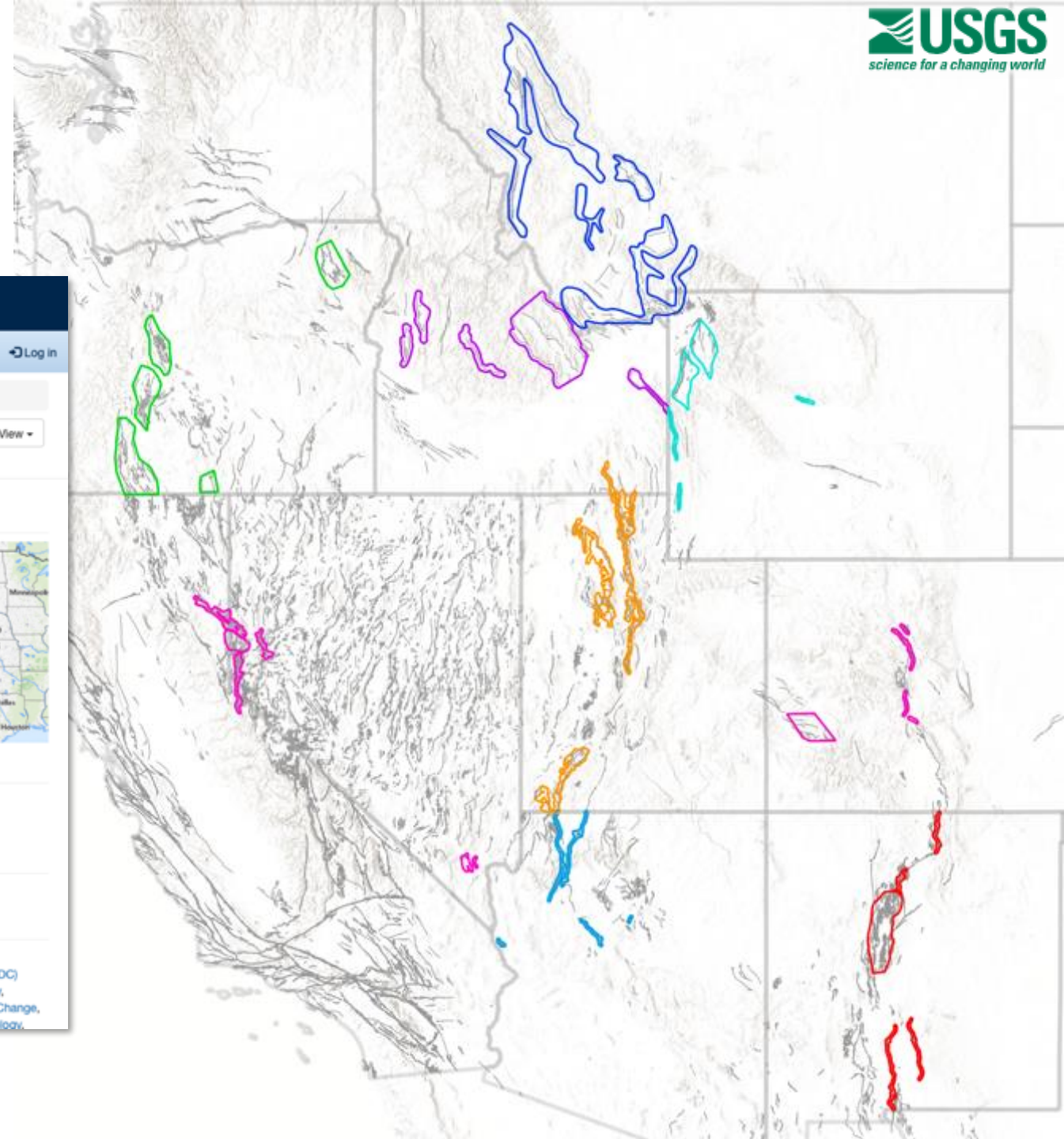
• USGS Data Release Products

Tags

Categories : Data
Harvest Set : USGS Science Data Catalog (SDC)
Scientific Topic Keyword : Geography, Morphology, Geophysics, Land Use Change, Remote Sensing, Sedimentology, Seismology.

<https://doi.org/10.5066/P13XVWR7>

Version 2 (2026 if needed after BRPEWG)



Working Group on Utah Earthquake Probabilities 2 (WGUEP2) Progress Report

**Ivan Wong, Alex Hatem, Patricia Thomas, Chris DuRoss,
Adam Hiscock, Emily Kleber, Greg McDonald, Jim Pechmann, Mark
Petersen, and David Schwartz**

2026 Utah Quaternary Fault Parameters Working Group

9 February 2026

WGUEP

- The WGUEP was a three-year study (stretched to six years) funded by the USGS through NEHRP external grants to the UGS and URS Corporation from 2009 to 2012.
- The WGUEP forecast was released to the public and published in 2016.
- WGUEP2 is funded for two years by NEHRP through grants to LCI and UGS.



WGUEP2

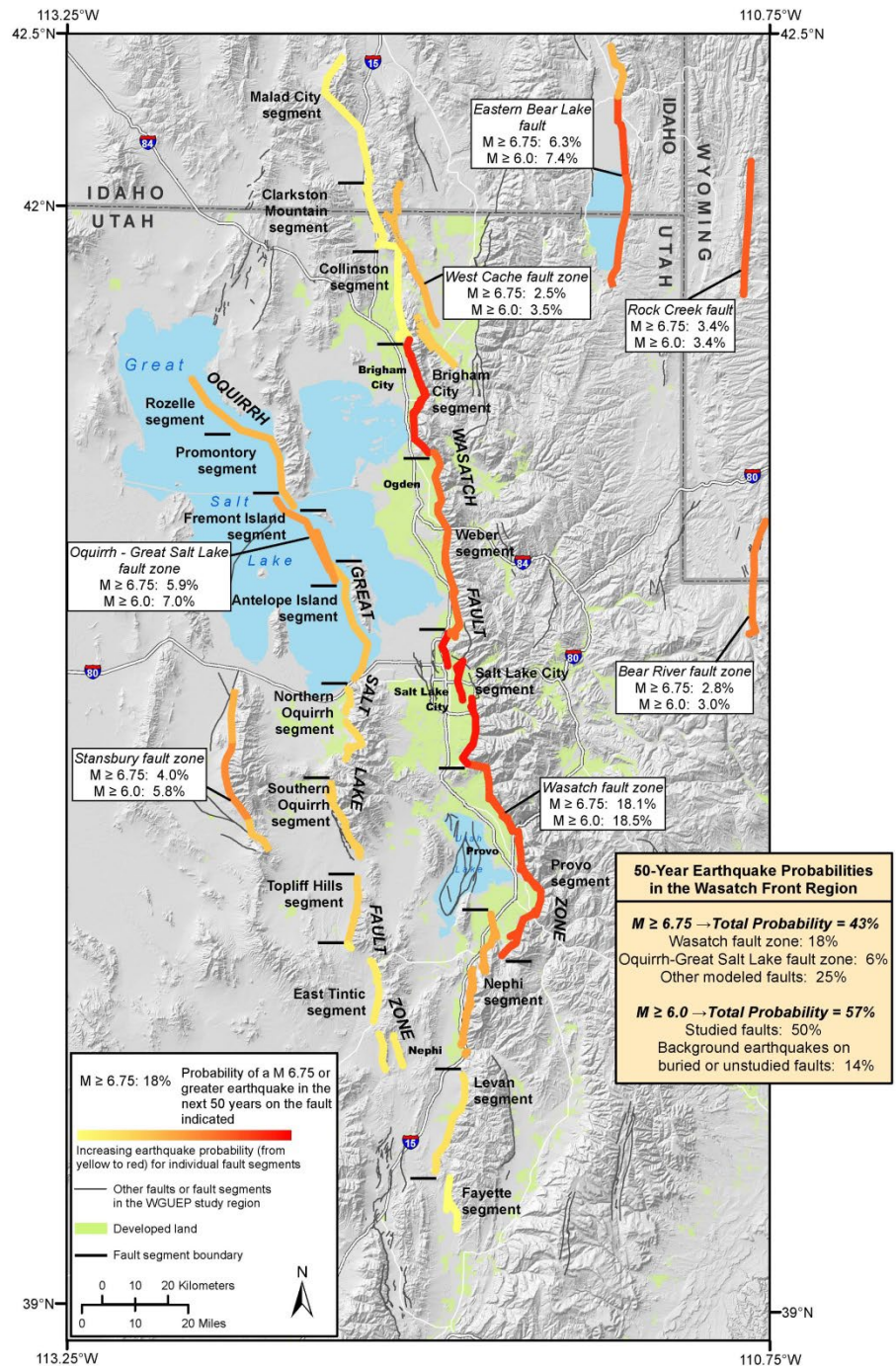
Ivan Wong, LCI (Chair)
Emily Kleber, UGS (Co-Chair)
Chris DuRoss, USGS
Alex Hatem, USGS
Adam Hiscock, UGS
Greg McDonald, UGS
Jim Pechmann, UU
Mark Petersen, USGS (emeritus)
David Schwartz, USGS (emeritus)
Patricia Thomas, LCI



WGUEP Objectives

- The WGUEP calculated the probability of moderate to large earthquakes ($M \geq 5.0$) in the Wasatch Front region for a range of intervals varying from annually to 100 years.
- Time-dependent and time-independent earthquake probabilities that were estimated are:
 1. Segment-specific for the 5 central segments of the Wasatch fault.
 2. Total for the Wasatch fault central segments and the whole fault including the end segments.
 3. Segment-specific and fault-specific for the Oquirrh-Great Salt Lake fault.
 4. Time-independent fault-specific for all other faults in the Wasatch Front.
 5. Time-independent for background earthquakes (M 5.0 to 6.75).
 6. Total for the Wasatch Front region.

50-Year Probabilities for $M \geq 6.75$ and 6.0 2014-2063



Schedule

17 May 2024	Kickoff Meeting	Conference Call
18-19 September 2024	Workshop #1 Paleorupture Model	In-Person
13-14 November 2024	Workshop #2 UCERF3, Paleorupture Models, and Deformation Models	In-Person
12-13 March 2025	Workshop #3 Preliminary Inversion Results	In-Person
24 April 2025	Deformation Models & Misfits	Conference Call
11 Jun 2025	Deformation Models & Misfits	Conference Call
25 Jun 2025	Deformation Models & Misfits and Preliminary Time-Dependent Results	Conference Call
18 July 2025	Deformation Models	Conference Call
8 Sep 2025	Preliminary Inversions Results & Deformation Models & Weights	Conference Call
17 Sep 2025	Poisson Probabilities	Conference Call

- Goal is to complete by January 2027 with public release of the publication.

WGUEP1 Full “Other Modeled Faults” List

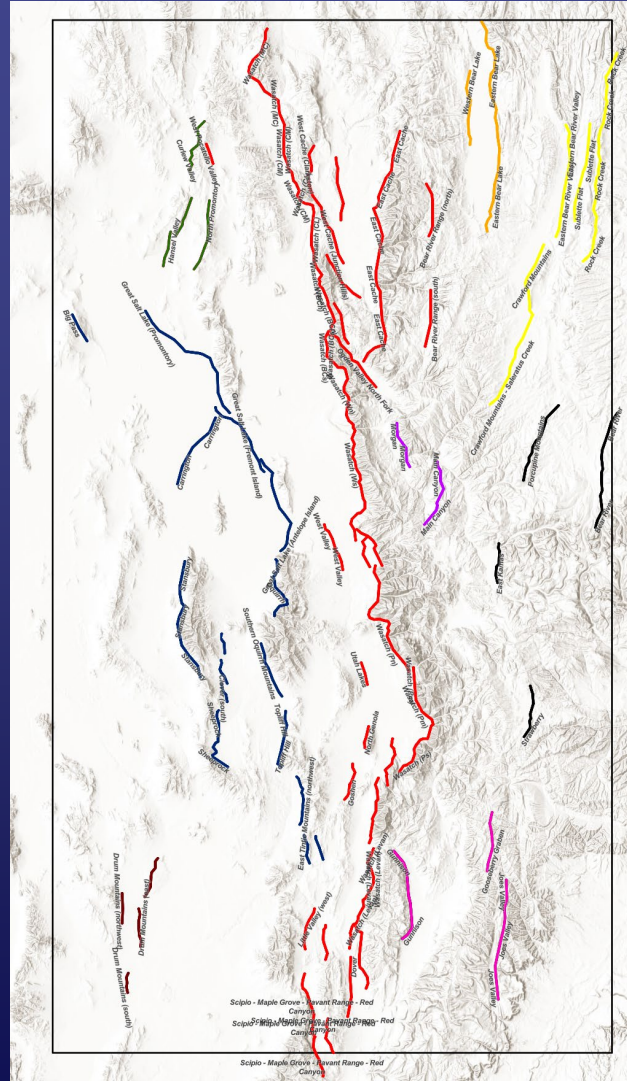
- **These are additional faults modeled for EQ probabilities**
- **Wasatch and Oquirrh-Great Salt Lake Fault Zones included as the primary structures in WGUEP2.**

- Bear River fault zone
- Carrington fault
- Crater Bench fault and
- Crawford Mountains (west side) fault
- Curlew Valley faults
- Drum Mountains fault zone
- East Cache fault zone
 - Northern section
 - Central section
 - Southern section
 - Broadmouth Canyon faults
 - James Peak fault
- East Dayton – Oxford faults
- Eastern Bear Lake fault
 - Northern section
 - Central section
 - Southern section
- Gunnison fault
- Hansel Valley fault,
- Hansel Mountains (east side) faults
- Hansel Valley (valley floor) faults
- Joes Valley fault zone (combined)
- Little Valley faults
- Main Canyon fault
- Maple Grove faults
- Morgan fault
- North Promontory fault
- Porcupine Mountain fault
- Pavant Range fault
- Red Canyon fault scarps
- Rock Creek fault
- Scipio fault zone
- Scipio Valley faults.
- Skull Valley (mid valley) faults
- Snow Lake graben
- Stansbury fault
 - Northern segment
 - Central segment
 - Southern segment
- Stinking Springs fault
- Strawberry fault
- Utah Lake faults
- West Cache fault zone
 - Clarkston fault
 - Junction Hills fault
 - Wellsville fault
- West Valley fault zone
 - Taylorsville fault
 - Granger fault
- Western Bear Lake fault

WGUEP2 new “Other Modeled Faults”

- New faults added for WGUEP2
 - Mostly faults included in NSHM23 or faults with new/additional slip rate data since WGUEP1
- Bear River Range (north/south)
 - Big Pass fault
 - Clover (north/south)
 - Crawford Mountains
 - Dayton-Oxford
 - Eastern Bear River Valley fault
 - Gooseberry graben faults
 - Long Ridge (northwest side) fault
 - Long Ridge (west side) fault
 - Mantua area faults
 - Ogden Valley North Fork fault
 - Rock Creek fault
 - Ryckman Creek fault
 - Saleratus Creek fault
 - Sheeprock fault zone
 - Sheeprock Mountains fault
 - Sublette Flat fault

All modeled faults in WGUEP2



Geodetic Deformation Models

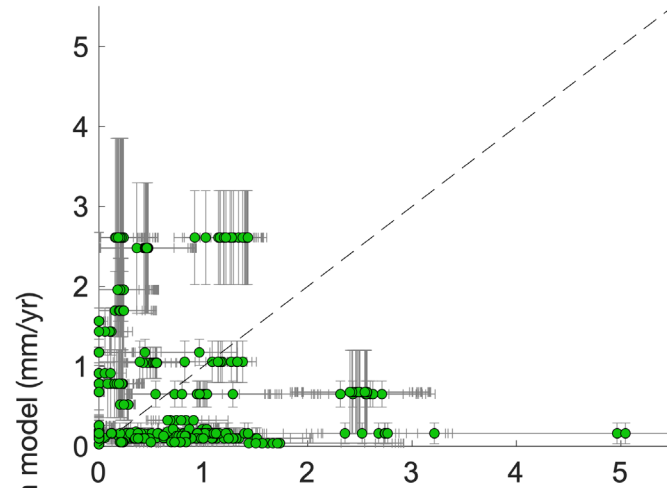
- The 2023 NSHM considered five deformation models for the western U.S.: four geodetic inversion models with geologic constraints and one model which is basically a geologic model (Hatem et al., 2022). The four geodetic models were Pollitz, Evans, Zeng, and Shen-Bird.
- These models were evaluated to assess if they should be included and weighted in WGUEP2.

GPS Data Misfits: Wasatch Front Region

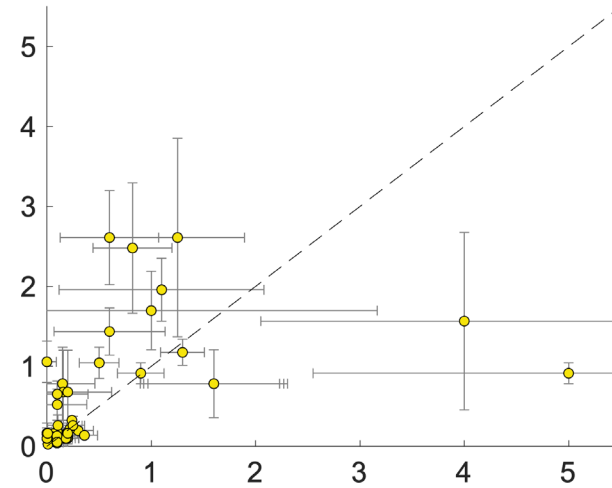
Model Developer Model Type	Median Misfit Vector Amp (mm/yr)	RMS Misfit Vector Amp (mm/yr)
Evans Block	0.7	0.8
Pollitz Viscoelastic fault-based	1.5	1.6
Shen-Bird Dislocation fault-based	0.4	0.6
Zeng Dislocation fault-based	0.6	0.7

Geodetic vs. geologic deformation model comparisons

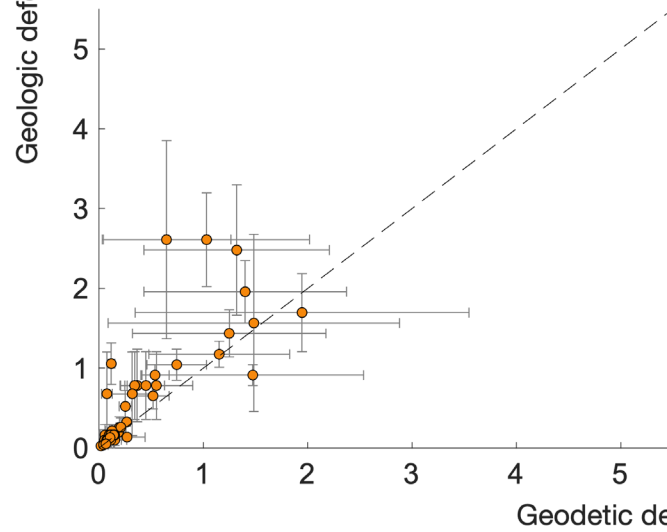
Evans



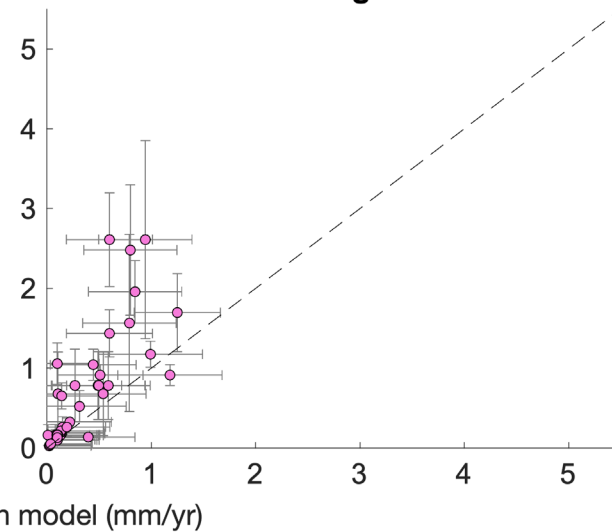
Pollitz



ShenBird



Zeng



Fault Slip Rate Comparisons, WGUEP2 Region

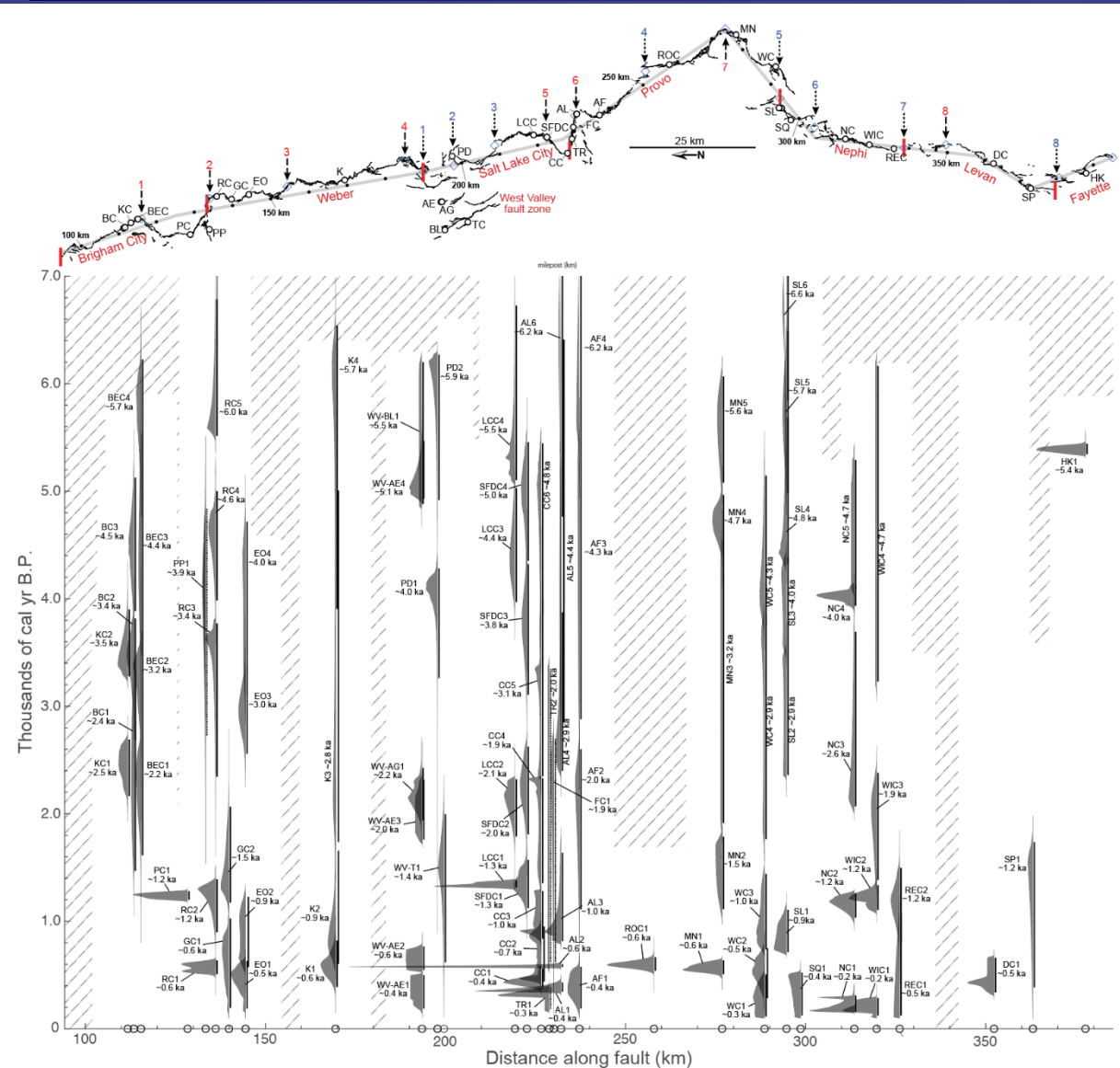
Estimating Slip Rates Based on Geologic and Geodetic Data

- Faults slip rates were based on four categories based on the quality of the geologic and geodetic data. Weights were subjectively assigned to each category to estimate the slip rate distribution for each fault. Only the Hatem (geologic), Zeng, and Shen-Bird models were considered.
- Good geologic and good geodetic data: 0.7, 0.15, 0.15
- Good geologic and bad geodetic data: 0.86, 0.07, 0.07
- Bad geologic and good geodetic data: 0.44, 0.28, 0.28
- Bad geologic and bad geodetic data: 0.56, 0.22, 0.22

Wasatch Fault Zone Paleoseismic Data

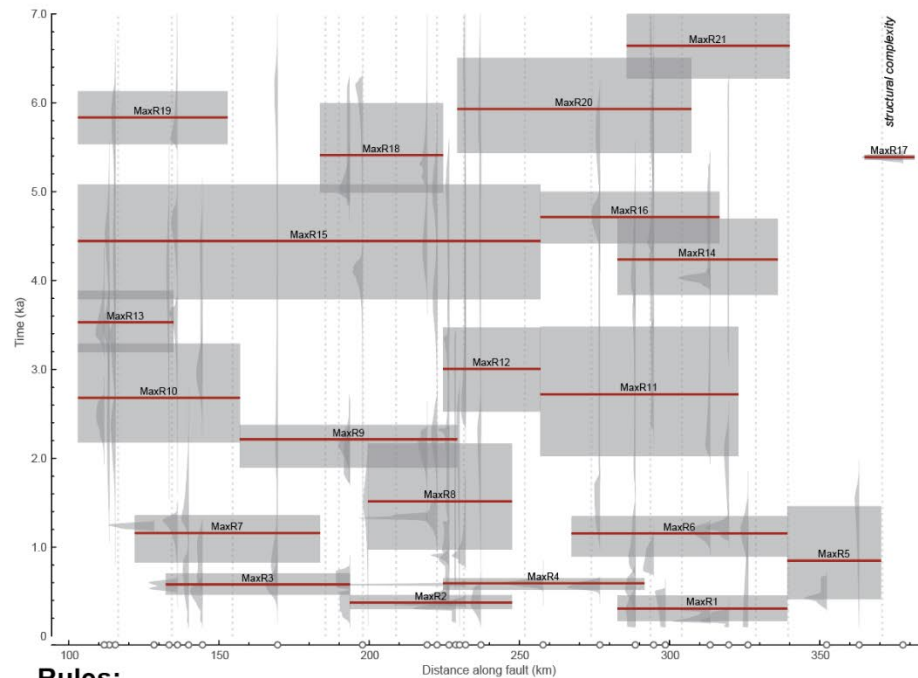
- Four rupture models constructed using geometric complexities and 87 earthquakes from 28 sites along the fault:

1. Longest ruptures (Maximum)
2. Shortest ruptures (Minimum)
3. Longest ruptures, using structural and timing data (Structural)
4. Segmented



Paleoseismic Rupture Models

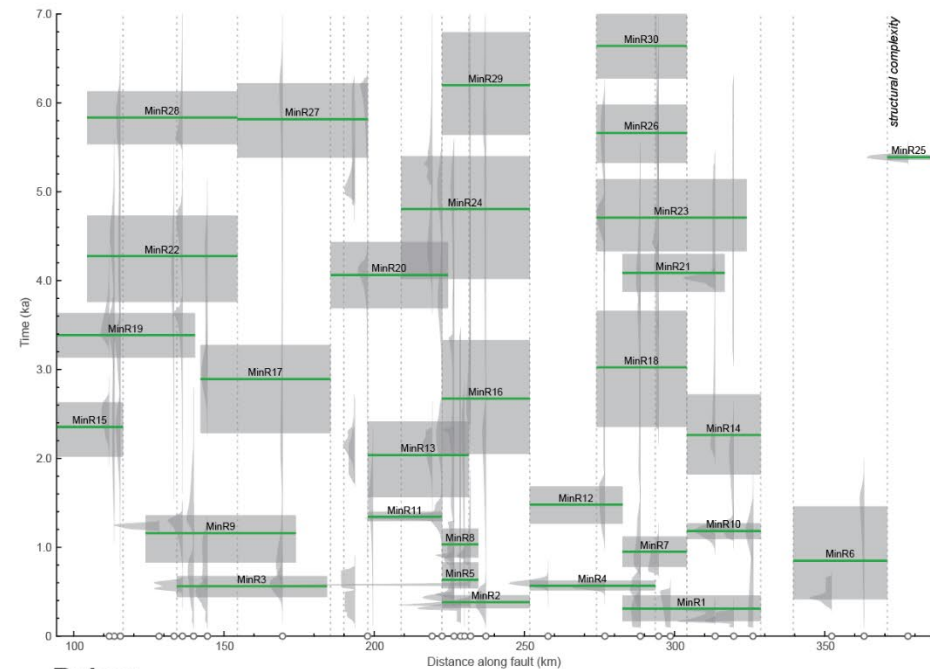
Maximum-length model – longest-possible ruptures (n=21)



Rules:

1. No length limit
2. Rupture termination between paleoseismic sites

Minimum-length model – most spatially limited ruptures (≤ 50 km long; n=30)

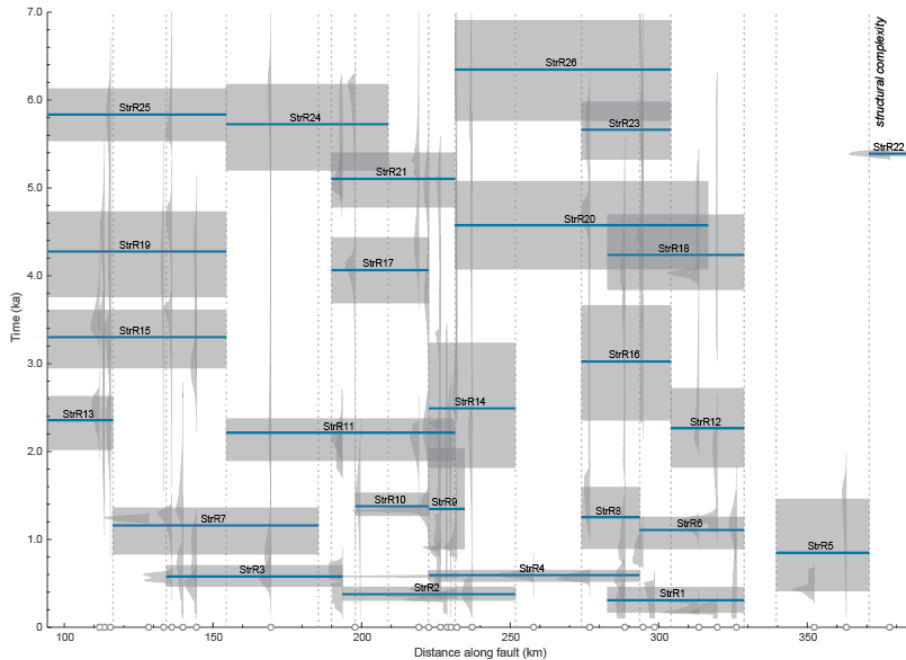


Rules:

1. Ruptures limited to ≤ 50 km
2. Rupture termination at structural complexities (8 steps and 8 bends)

Paleoseismic Rupture Models

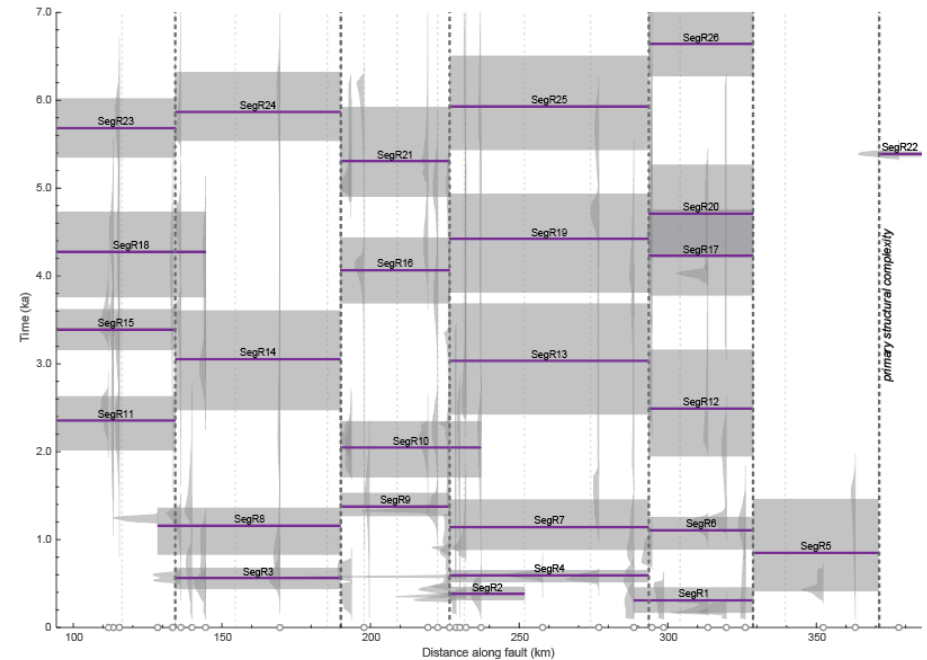
Structural model – similar to maximum-length model, but with ruptures trimmed or extended to geometric complexities (n=26)



Rules: Like Maximum model, but:

1. No length limit
2. Subdivision of some ruptures based on temporal overlap of earthquake-timing PDFs
3. Rupture termination at structural complexities (8 steps and 8

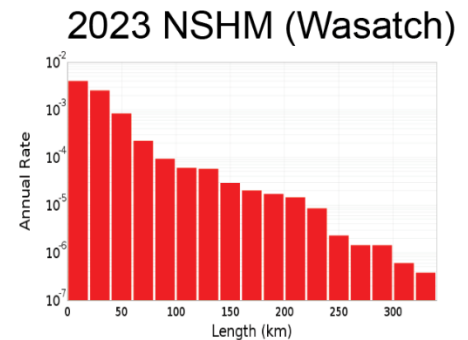
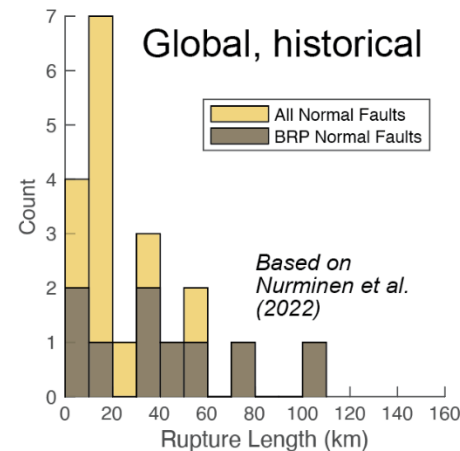
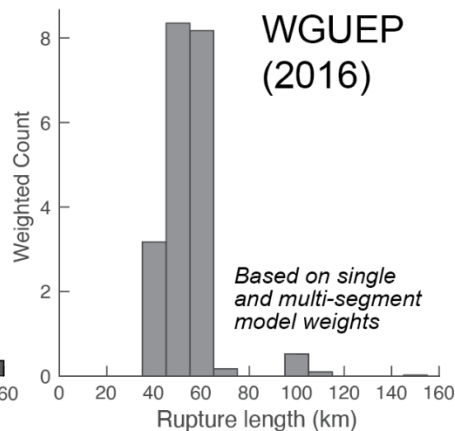
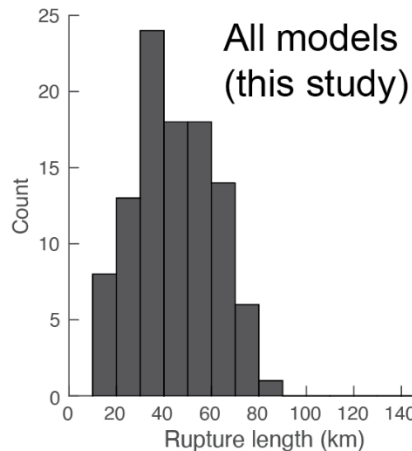
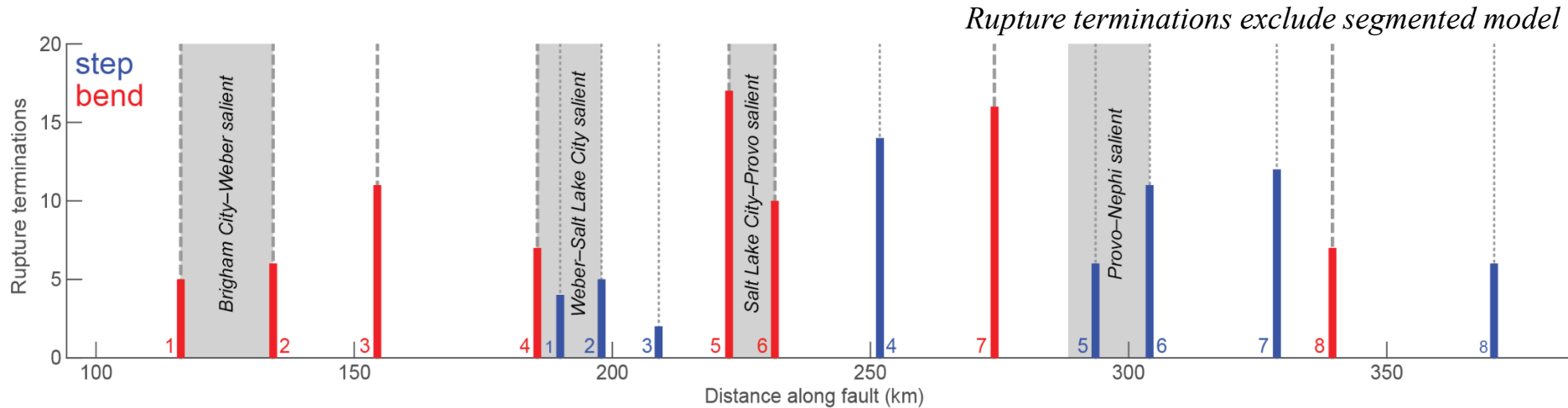
Segmented model – ruptures that are largely restricted to the most prominent structural complexities along strike (n=26)



Rules:

1. Ruptures restricted to primary segments (overlapping PDFs = segment ruptures)
2. Spillover rupture where supported by paleoseismic data
3. Rupture termination at primary complexities (6 segment

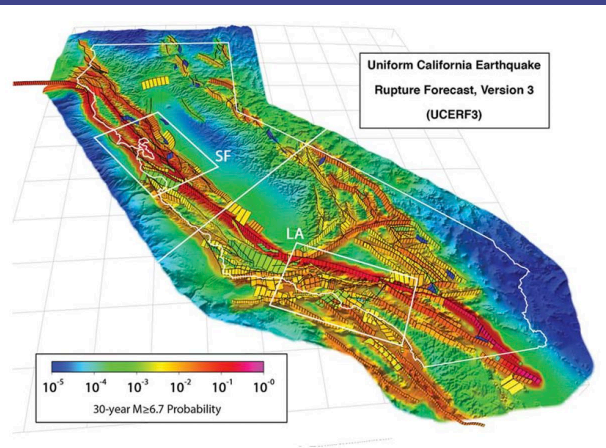
Wasatch Fault Zone Summary



➤ 103 ruptures: 12–154 km long (mean 44 km), many crossing typical segmentation points

➤ M_W : ~6.7–7.3

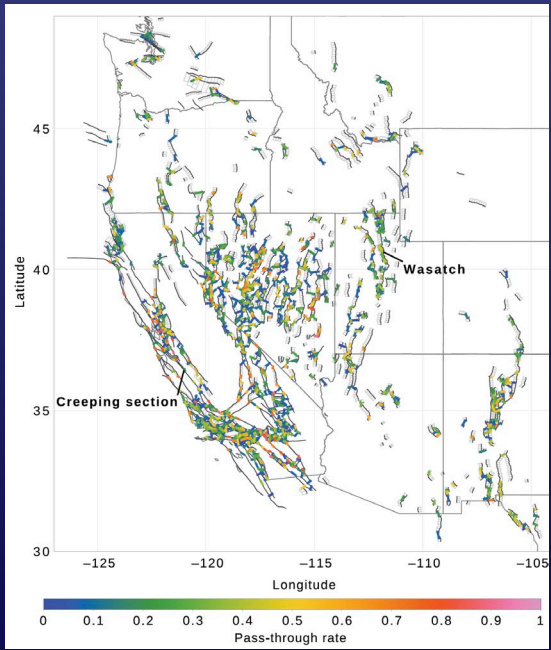
➤ Mean recurrence: ~1.3–1.4 kyr



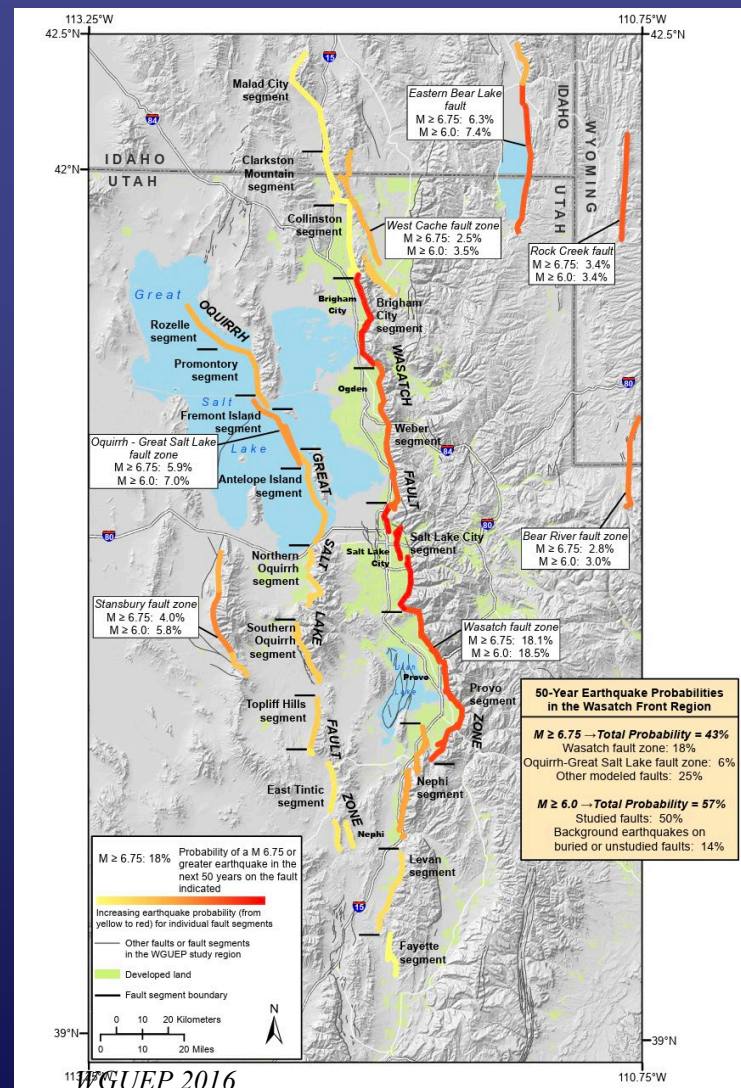
Adding multi-fault ruptures to Wasatch front time-dependent forecast



Field et al 2015



Milner and Field, 2023



Models run *Intended to emulate paleorupture models as best as possible*

1. Maximum Length

- 150 km max rupture length
- “Low” segmentation

2. Minimum Length

- 40 or 50 km max rupture length
- “High” segmentation

3. Structural Timing

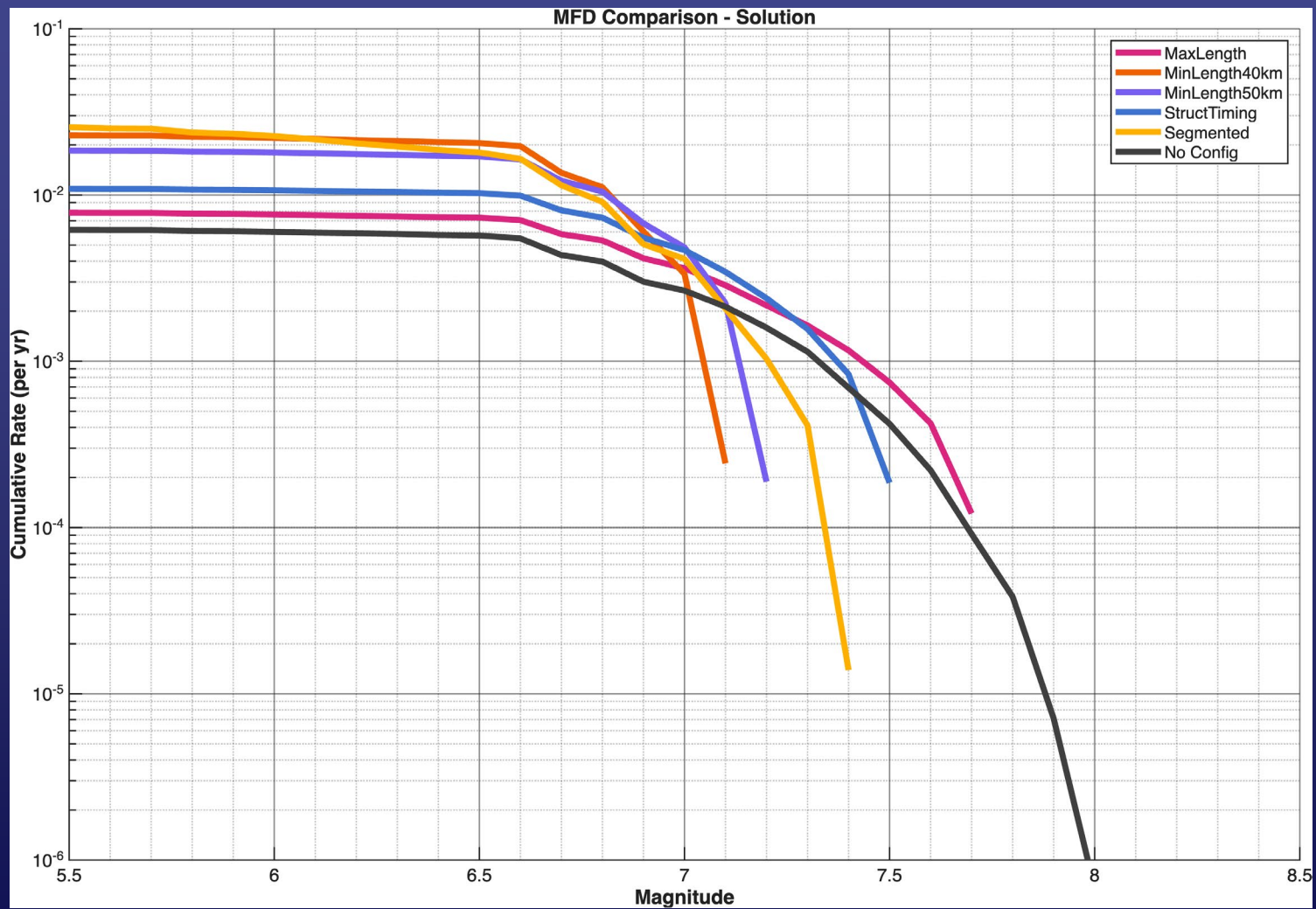
- 100 km max rupture length
- “Mid” segmentation
- Overfit paleoseismic data

4. Segmented

- Fully segmented at inferred long-term boundaries

All models use:

- Paleoseismic recurrence as an inversion constraint.
- Weighted geodetic & geologic slip rates.
- Semi-continuous Wasatch geometry to minimize downdip gaps along strike.
- NSHM23 generalized inversion parameters and plausibility filters (except for rupture length).



Probabilistic Forecast

- Poisson Probabilities
 - Rupture
 - Subsection (subsections are small pieces of faults)
 - Segment (“Classic 10 segments of WFZ”)
 - Total Wasatch
- Time Dependent Calculations for Wasatch Fault
 - Approach
 - COVs
 - Date of Last Event – Paleoseismic rupture models
 - Results (Rupture, Subsection, Segment, Total Wasatch)
- Remaining Issues
 - Implement unknown DOLE approach
 - Extend to all other sources

Poisson Probabilities

- Rupture Probabilities – directly calculated from rupture rates (inversion output)
- Subsection Probabilities – calculated from segment rates, which are sum of rates of all ruptures that include subsection
- Segment probabilities – includes all ruptures that rupture any part of the segment (“participation probabilities”)
- Total Wasatch fault – directly from the total rate of all ruptures

Utah Aerial Imagery Database Update

Where we are today and what remains.

Steve D. Bowman, Ph.D., P.E., P.G.
Senior Scientist/Chief Administrative Officer



Aerial Imagery Background

Aerial Imagery (air photos and similar) are used in nearly every UGS applied research project, and by consultants, local governments, and the public for land use planning and development, environmental projects, land boundary disputes, recreational planning, and other uses.

2008-2021: Utah Aerial Imagery Collection

(<https://geodata.geology.utah.gov/imagery>)

+2021: Utah Aerial Imagery Database

(<https://imagery.geology.utah.gov>)

Sorting air photos in the UGS Collection (Keith: former student intern)



Database Summary

- Includes air photos and related aerial project materials from 1935 to the present within the Utah Area of Interest (AOI).
 - Utah AOI: Utah, plus a 0.2-degree buffer to ensure stereo coverage, and includes special projects outside the AOI, such as the Wasatch fault zone low-sun-angle photos.
 - Index Sheets
 - Camera and Lens Calibration Reports
 - Orthophotos, Photomaps, and Image Mosaics
 - Lidar Intensity Images
 - Project Reports and Related Materials



Current Database Summary

- 181,382 Air Photos
- 228,273 Air Photos Linked from the U.S. Geological Survey EarthExplorer System
- 2167 Orthophotos, Photomaps, and Image Mosaics
 - 82,520 APFO Images (AAA, CSS, PMA, ASCS, and SCS): ~88% Complete
 - 49,861 USFS Images: ~52% Complete
 - 167,601 USGS Images: Nearly All Complete
- 126,534 Lidar Intensity Images
- 6496 Aerial Index Sheets
- 6151 Camera and Lens Calibration Reports
- 745 Aerial Project and Related Documents
- 5 Imagery Related Videos

Also Includes Imagery From:

- UGS (all)
- UDOT (all known)
- BLM (nearly all)
- NPS (nearly all)

Total: 552,090 items within 2459 aerial projects.

2025 Usage: 12,867,812 page views.

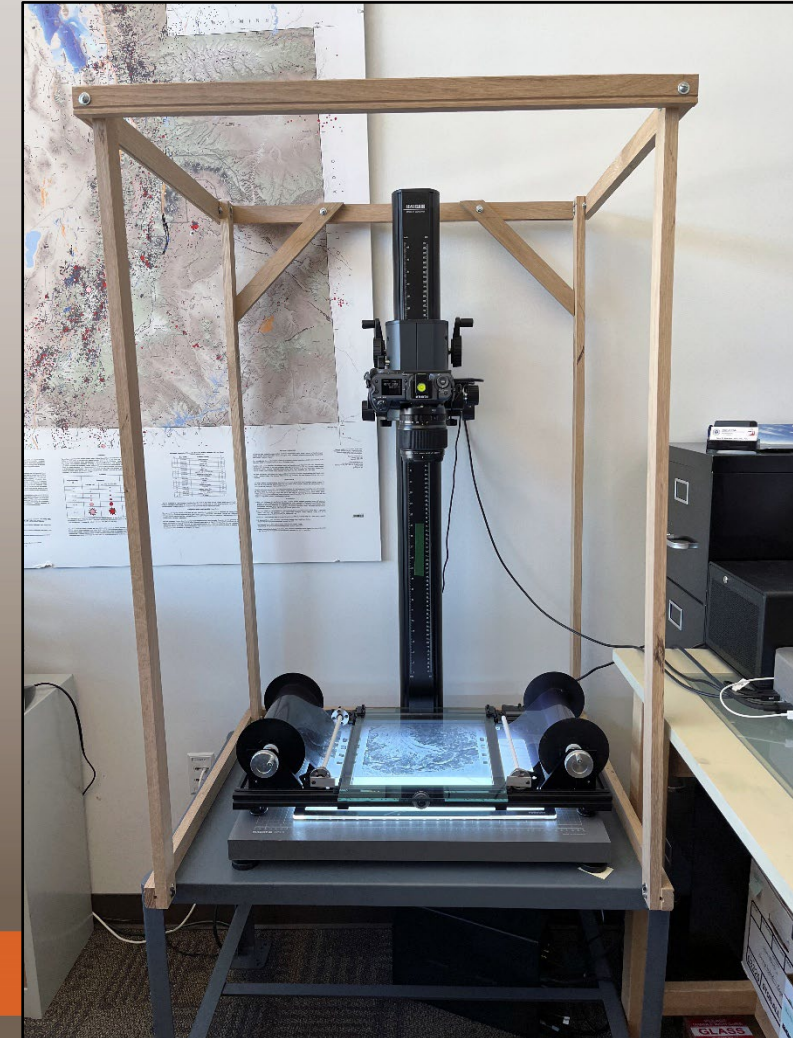


Current Work

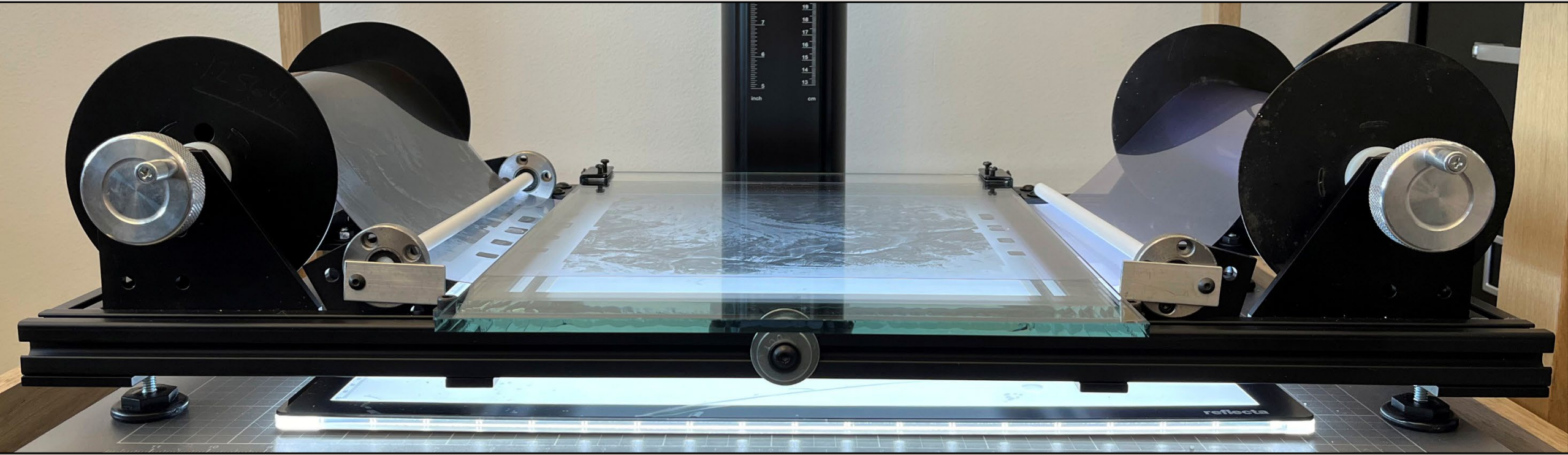
The UGS is currently digitizing 1930s to 1970s Army Air Force (AAF), U.S. Air Force (USAF), and U.S. Navy (USN) aerial imagery acquired as part of photoreconnaissance training missions in the Utah Area of Interest at the National Archives and Records Administration (NARA) Archives II facility in College Park, Maryland.

Imagery includes vertical and oblique images.

- One of the first images digitized shows an area near Gunnison, Colorado, from an aerial film roll showing oblique views of Utah airports in 1943.



Current Work



Aerial film rolls up to 6" diameter and 10" wide are digitized using specially developed equipment that includes a Fuji 400MP medium-format digital camera producing 16-bit, 1800 dpi images. The raw DNG images are converted to TIF images and processed using a custom Python Jupyter Notebook running in Jupyter Lab on an Apple Mac Studio computer (about 100 pages of code).





UGS Aerial Film Digitization Station Image File Processing, v3.0

Dr. Steve D. Bowman, P.E., P.G.
December 17, 2025

Introduction

This Python Jupyter Notebook (runs in Jupyter Lab) processes camera raw image files from a FujiFilm GFX100 medium format digital camera (<https://www.fujifilm-x.com/en-us/products/cameras/gfx100>; 16 image files per shot using the Pixel Shift, 400 MP high resolution mode) and DNG files resulting from processing those files in the FujiFilm Pixel Shift Combiner software (<https://www.fujifilm-x.com/en-us/products/software/pixel-shift-combiner>) as part of the Utah Geological Survey (UGS; <https://geology.utah.gov>) aerial roll film digitization hardware. Camera raw (RAF) and the combined digital negative (DNG) files are saved by the FujiFilm software to the external Thunderbolt connected storage array at the paths defined in Step 1A (that also are the same as set in the FujiFilm software), along with all of the processed files created by this notebook. Additional information on this notebook is available in Appendix 11 of the *Utah Aerial Imagery Database Manual* and the *Utah Aerial Imagery Database* is available at <https://imagery.geology.utah.gov>.

Version 3.0 Changes

Version 3.0 brings several new and enhanced features, including fixes for use on Microsoft Windows, several new fiducial mark templates, updated descriptions and documentation on processing steps, information display on the current Conda Python environment in Step 1B, the ability to create custom fiducial mark template image files automatically in Step 1G, parallel processing of images when using darktable in Step 3 that significantly improves performance, improved automatic crop calculations in Step 4, the capability to handle text data strips as one or multiple long lines and improved returned OCR text processing in Step 6, and file transfers with progress reporting in Step 8.

NOTE: Due to the addition of the ipynbname and joblib external Python modules, if this notebook has previously been run, the notebook will need to be restarted on the first run using *Run*; *Restart Kernel*, *Run All Cells* selection.

Steps 1A to 1H to Setup the Processing Environment

- Step 1A: Set the Processing Variables
- Step 1B: Import the Required Python Modules and Setup Logging
- Step 1C: Check for the Required Dependencies
- Step 1D: Define the Python Functions Used in the Processing
- Step 1E: Create the Needed Folders on the Storage Array, if Needed
- Step 1F: Define the Image Text Strip Bounding Boxes for OCR
- Step 1G: Create Custom Fiducial Mark Template Image (SFM) Files
- Step 1H: Determine the Notebook Runtime Available and Aerial Image Number to Process

Steps 1A to 1H involve setting up the aerial image workflow processing environment. In Step 1A, processing parameters are set via named variables and must be reviewed before each notebook run to determine if they are still correct.

In Step 1B, the required Python (>= v3.11) modules are imported for later use in other steps. These modules may be automatically installed by the notebook or can be installed before running this notebook in the Anaconda Navigator or miniconda environment used to run this notebook or installed via 'pip' in a Python-enabled terminal session associated with the Python environment this notebook is run in. Required modules beyond the base Python modules, include the CRAFT text detector, easyOCR, ImageIQ, imutils, ipynbname, joblib, Matplotlib, multi-template matching, onnx, onnx runtime, NumPy, OpenCV, OpenPvXL,

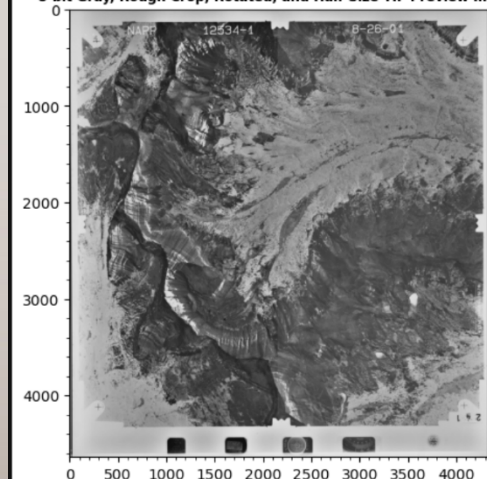
STEP 1F: DEFINE THE AERIAL IMAGE TOP TEXT STRIP BOUNDING BOXES FOR OPTICAL CHARACTER RECOGNITION (OCR)

Available Memory: 49.75 GB
2 Image Text Strip Styles Have Been Defined in Step 1A.

---Processing #1 of 2 Aerial Image Text Strip Styles-----

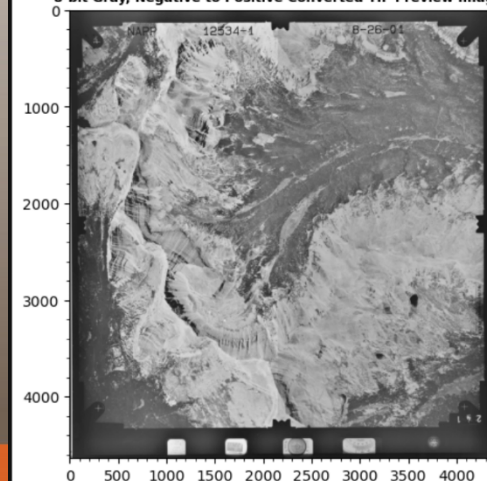
Number of Text Area Bounding Boxes: 3
Using the First Camera Raw DNG Image (_DSF0225.DNG) for OCR Bounding Box Selections.
Converting the DNG Image to a TIF Image with darktable (may take several minutes to process):
102.4884 [export_job] exported to '/Volumes/data1/Calibration/DSF0225_OCRbbox.tif'
Initial TIF Image (W x H): 23264 x 17448 pixels
ImageMagick Crop Parameter: 18546x17318+3608+130
Converting to 8-bit, Rough Cropping, Rotating, and Reducing by 50% the Converted TIF Image -90 Degrees (DSF0225_OCRbbox.tif):
/Volumes/data1/Calibration/DSF0225_OCRbbox.tif
TIFF 9273x8659=>4330x4637 8-bit Gray 19.1624MiB 0.100u 0:00.067

8-bit Gray, Rough Crop, Rotated, and Half-Size TIF Preview Image

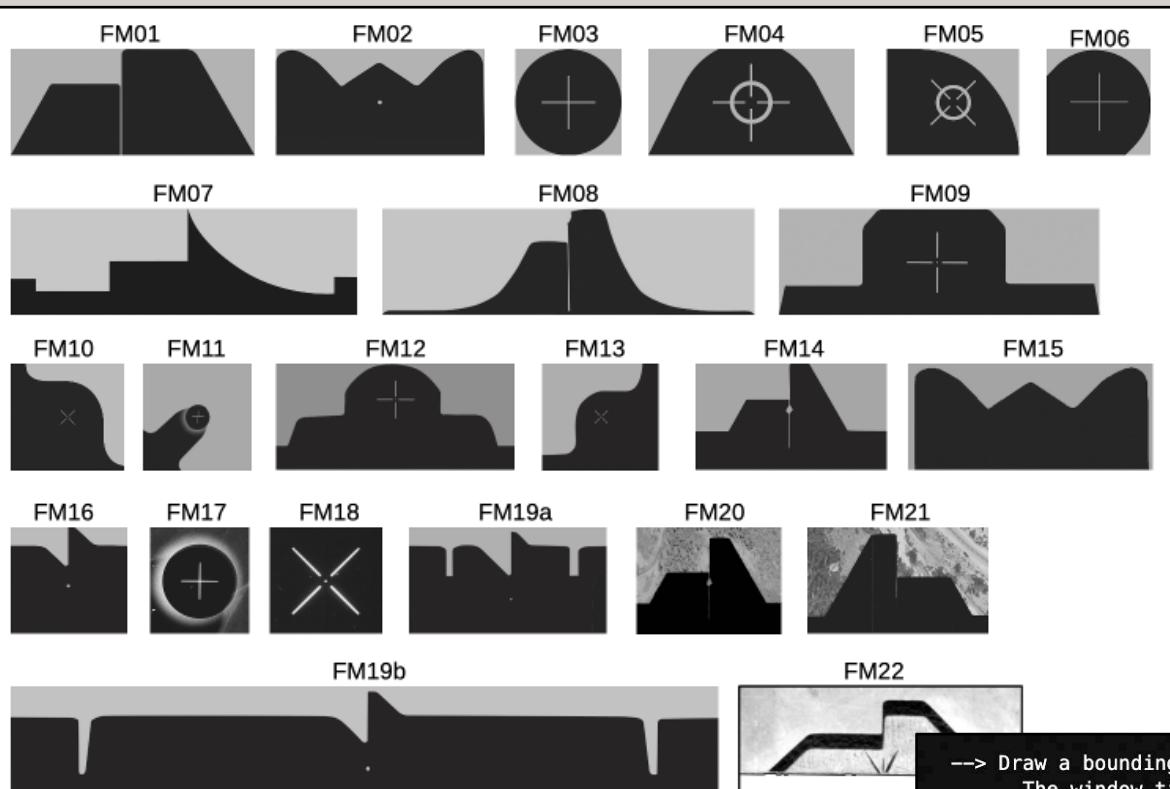


Converting from a Negative to a Positive TIF Image (DSF0225_OCRbbox.tif):
/Volumes/data1/Calibration/DSF0225_OCRbbox.tif
TIFF 4330x4637 4330x4637+0+0 8-bit Grayscale Gray 19.1624MiB 0.040u 0:00.055
<Figure size 640x480 with 0 Axes>

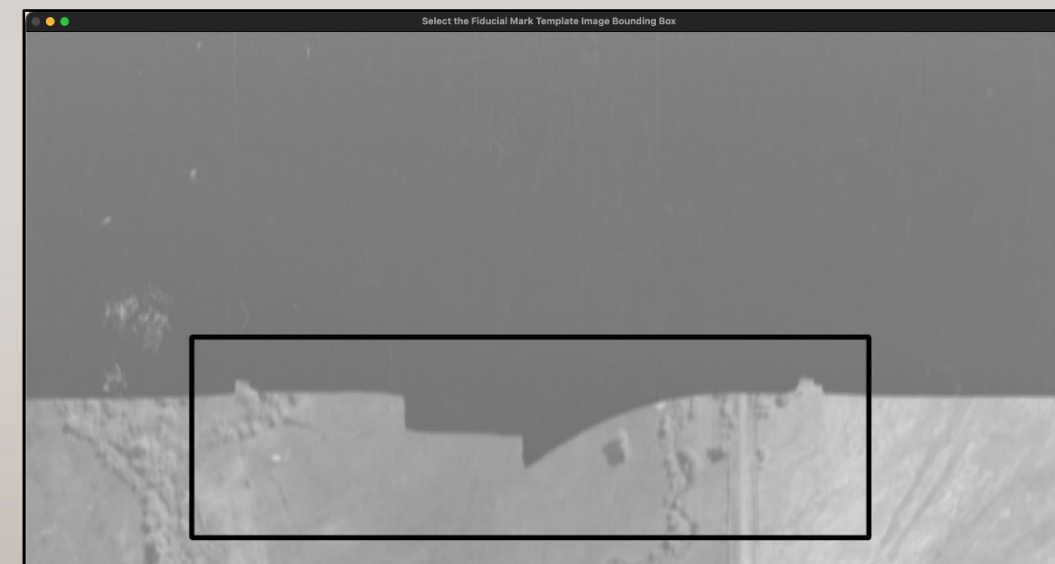
8-bit Gray, Negative to Positive Converted TIF Preview Image



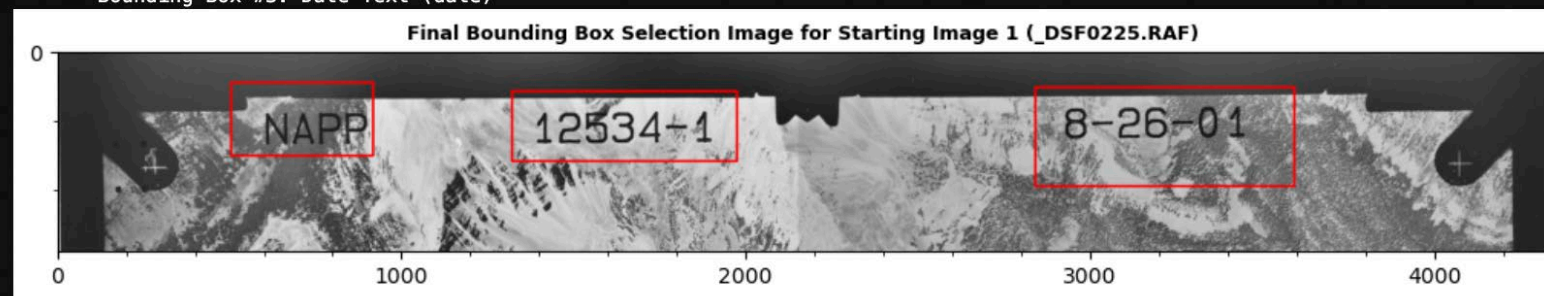
Loading the DSF0225_OCRbbox.tif Bounding Box Preview Image:
Image (H x V): 4637 x 4330 pixels
Cropping Off the Lower 80% of the Image:
Image (H x V): 579 x 4330 pixels



Current Work



--> Draw a bounding box on the displayed image by left clicking the upper left corner and dragging to the lower right corner.
 The window title will display which text bounding box you are to select.
 Press the 'Q' or 'ESC' key when complete with that box, then continue until all text bounding boxes have been selected.
 Aerial Image Style for Starting Image (_DSF0225.DNG) Contains 3 Bounding Boxes
 Bounding Box #1: Frame Text (frame)
 Bounding Box #2: Other Text Not Including the Date Text (id)
 Bounding Box #3: Date Text (date)



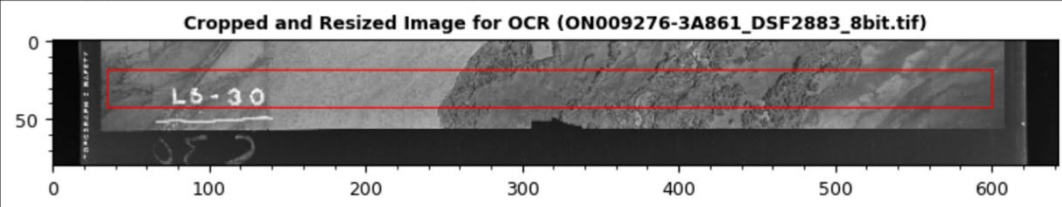
Saving the Bounding Box Image as a JPEG File:
 /Volumes/data1/Logs/DSF0225_OCRbbox.jpg

1) ULx: [1318, 503, 2837], ULy: [117, 92, 106], LRx: [1971, 915, 3589], and LRy: [319, 303, 391]
 Deleting the Bounding Box TIF Image File (/Volumes/data1/Calibration/DSF0225_OCRbbox.tif):
 Done


```

--Processing TIF Image 2 of 2: ON009276-3A861_DSF2883_8bit.tif-----
Determining the Image NARA Can ID and SPOT ID:
  NARA Can ID: ON009276 and SPOT ID: 3A861
Loading the Preview TIF Image for Processing:
  Image (H x V): 8672 x 8724 pixels with 3 Channels
Cropping the Image to Only Use the Bottom 20% of the Image: Success
Creating the ClearText Image:
  Image (H x V): 1084 x 8724 pixels
Inverting the ClearText Image: Success
Cropped/Resized Image (H x V): 80 x 643 pixels

```



```

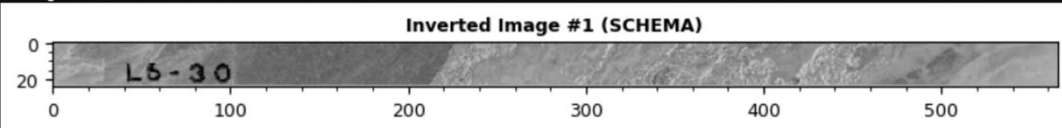
Converting the BGR Color Image to Greyscale for OCR: Success
Inverting the Image: Success
Aerial Image OCR Text Bounding Box #1 (SCHEMA) Text Area:

```

```

ATTEMPT 1: Using the Inverted Image:
<Figure size 640x480 with 0 Axes>

```



```

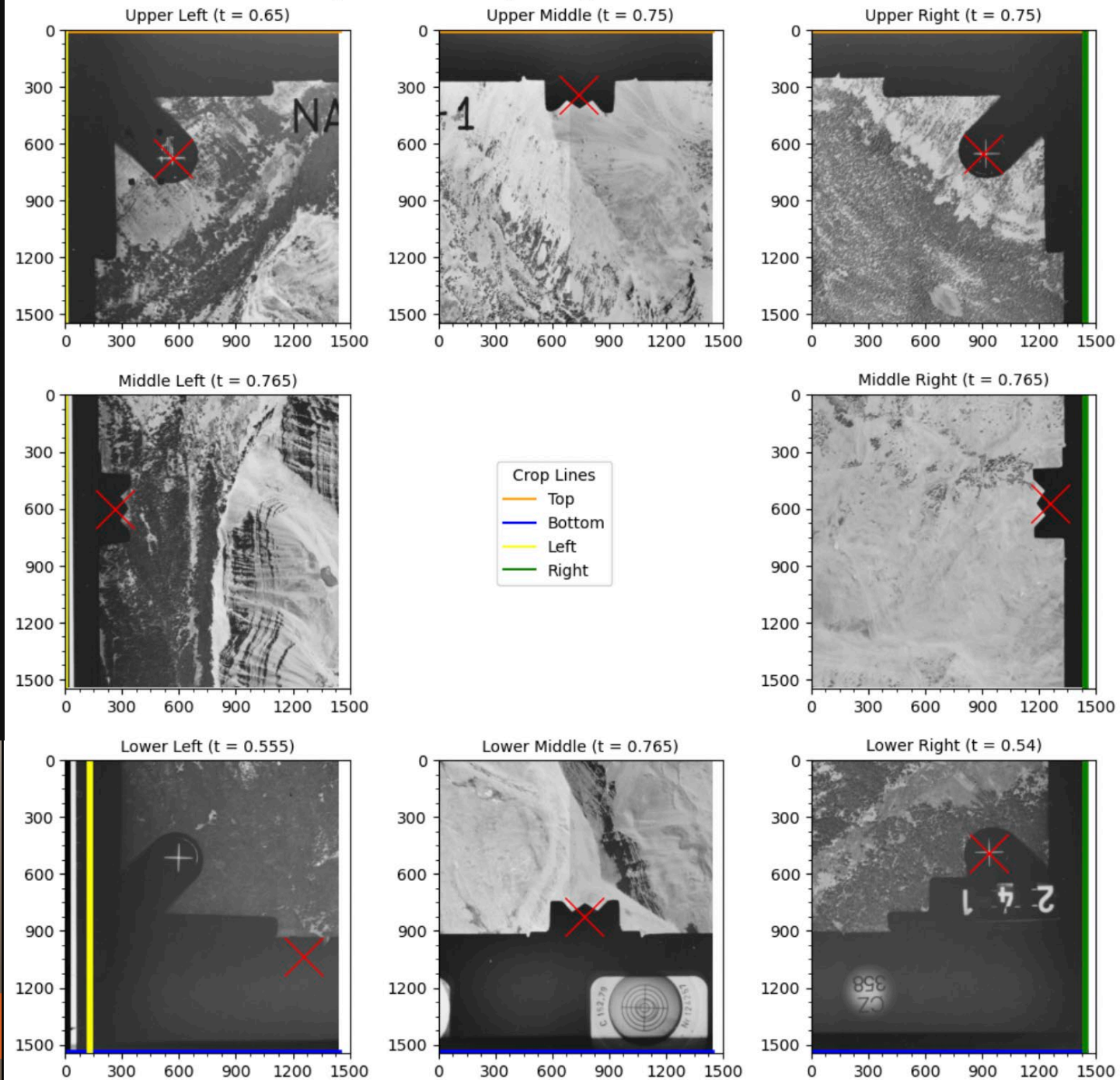
Performing Optical Character Recognition (OCR) on the Image:
Tesseract OCR Results: WARNING: No text found.
easyOCR Results: [([39, 9], [103, 9], [103, 25], [39, 25]), 'L6-30', 0.6013473341763818)]
Processed Schema Results: 60.1% Confidence
Result: L6-30
Defined Schema #2 and Returned Text Values: 2 / 2
Text: ['L6', '30']
Flightline: L6 --> 6
Frame: 30 --> 30

```



UTAH GEOLOGICAL SURVEY

Image TestID1-TestSPOT1_DSF0225_8bit.tif Fuducial Mark Results



Future Aerial Imagery Additions

Many aerial images are awaiting metadata creation, so they can be added to the database.

- Post-1955 Soil Conservation Service and related agencies
- U.S. Forest Service
- Miscellaneous other aerial projects





Questions and Discussion

Society can prepare for and deal with geologic hazards.



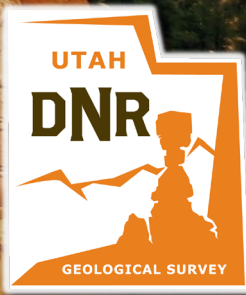
UTAH GEOLOGICAL SURVEY



12-Mile Landslide, Sanpete County

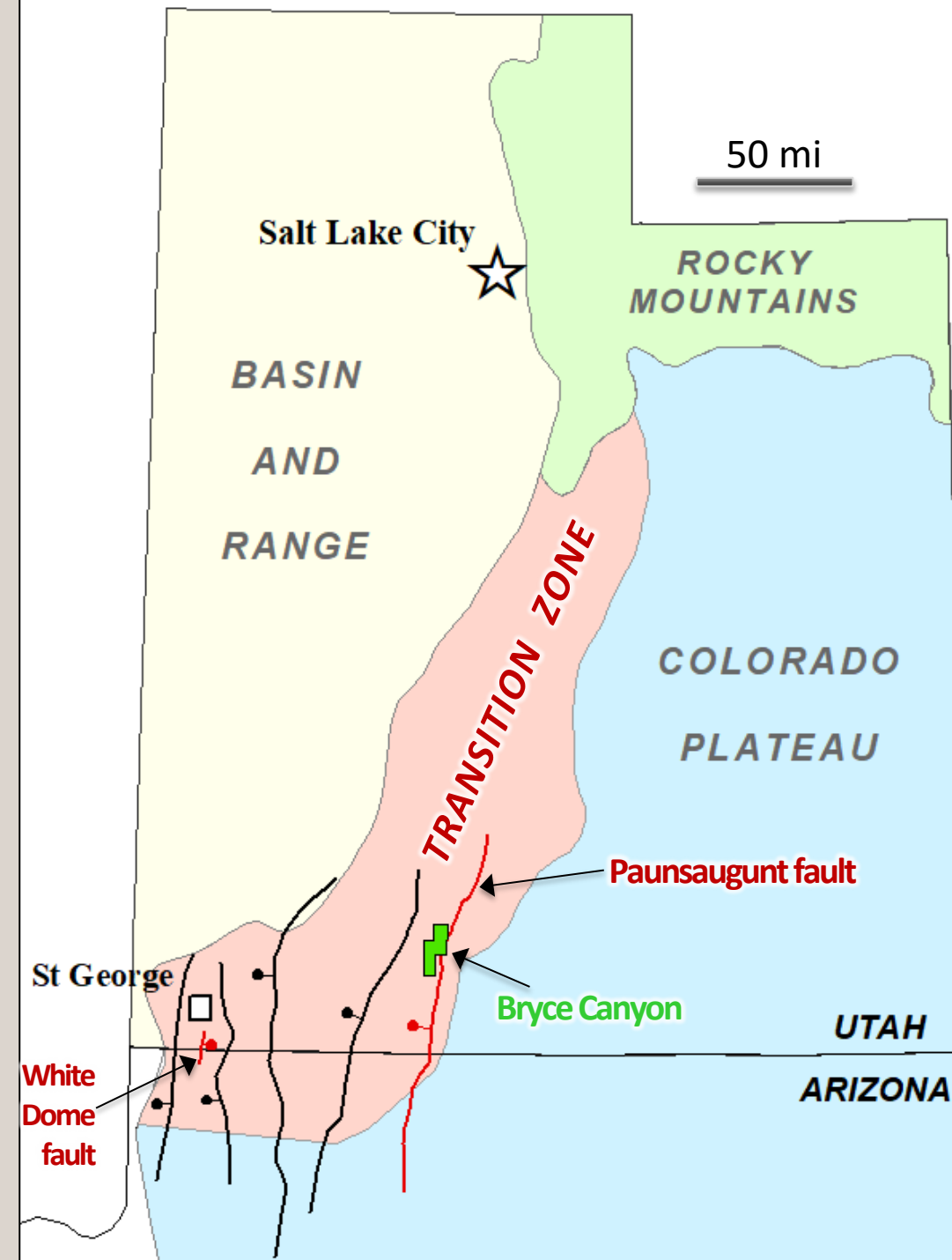
Southern Utah Quaternary Faults Updates

Tyler Knudsen, Utah Geological Survey



Outline/Setting

- **Transition Zone**
- **White Dome fault**
 - Newly discovered fault in rapidly developing St. George
 - Chance discovery by local consultants
- **Paunsaugunt fault**
 - Mostly missing from the Quaternary fault databases
 - New geologic-hazards mapping (Bryce Canyon) reveals new evidence for Quaternary rupture



White Dome Fault

- St. George among fastest growing metro areas in U.S.
- January 2025—Landmark conducts a geotechnical investigation on parcel with proposed church building
 - Standard test pits for soil characterization, depth to bedrock, etc.
 - Encountered folded/faulted bedrock, despite typical gentle dips in area



White Dome Fault

*Hugo Angeles,
Landmark Testing
& Engineering*



White Dome Fault

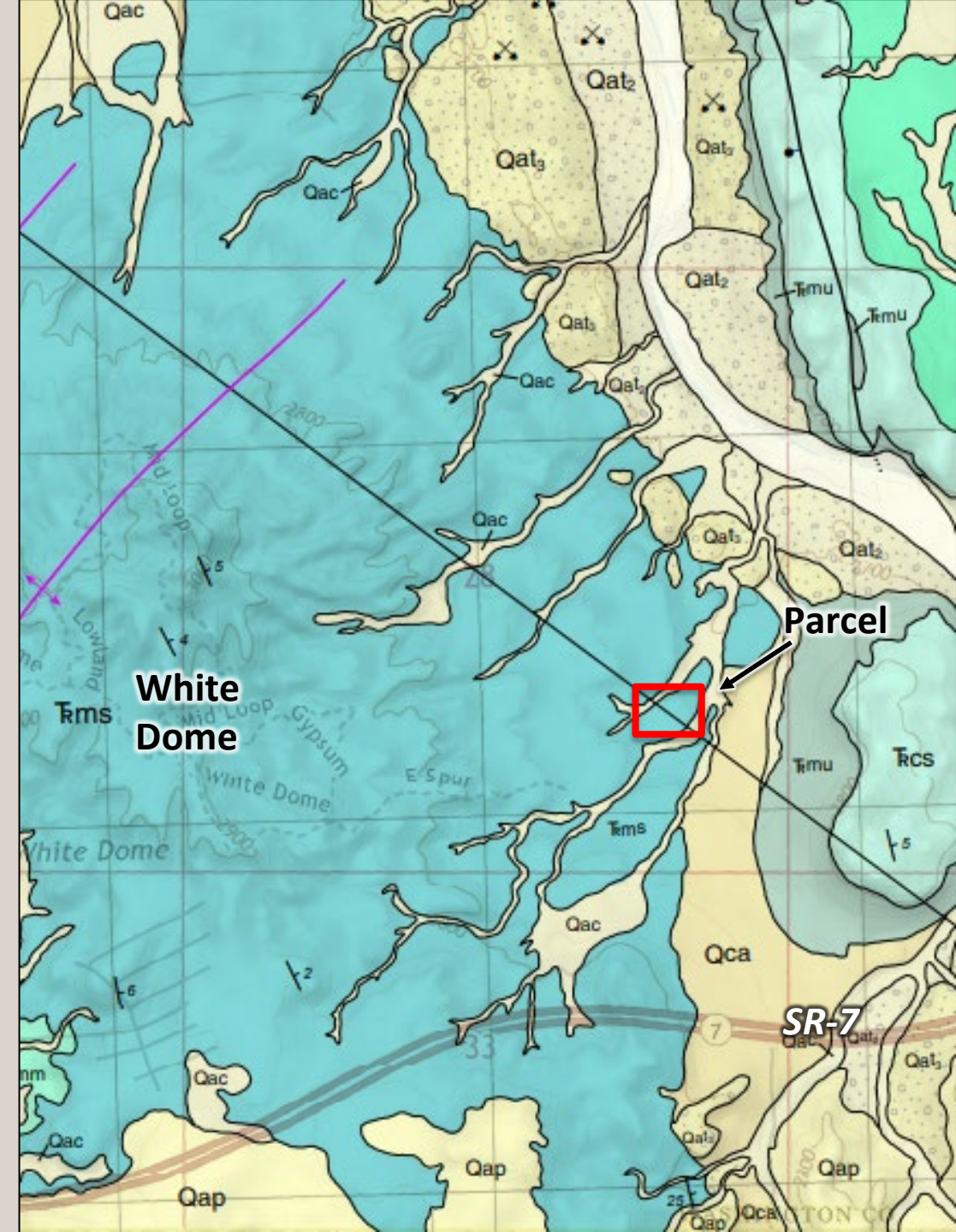
➤ UGS visit (January 2025)

- Wide zone of folded/faulted Triassic bedrock, fault gouge, sand-filled fissures
- Normal, east-dipping, 10s to 100s ft displacement
- No obvious scarp
- Unconsolidated surficial units involved?, suspected Q fault



White Dome Fault

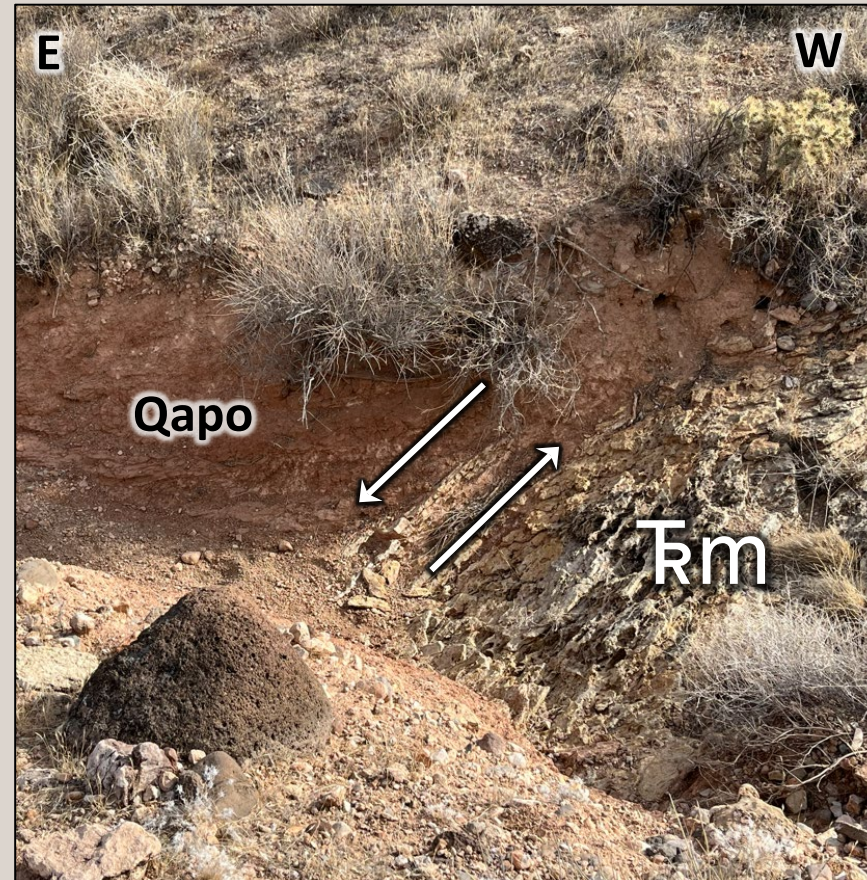
- No faults mapped on geologic maps or Q-fault databases



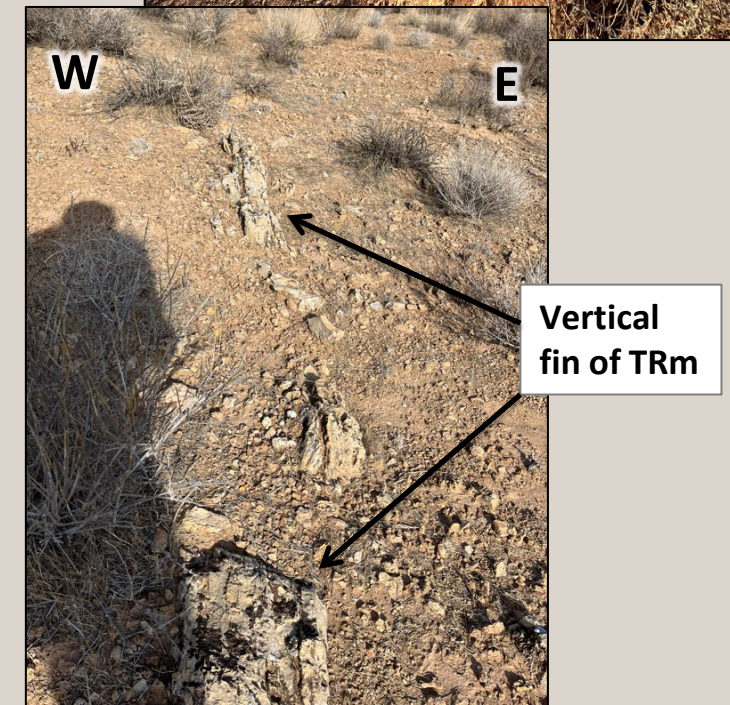
*St. George 7.5' Quad
(Hayden and Willis, 2022)*

White Dome Fault

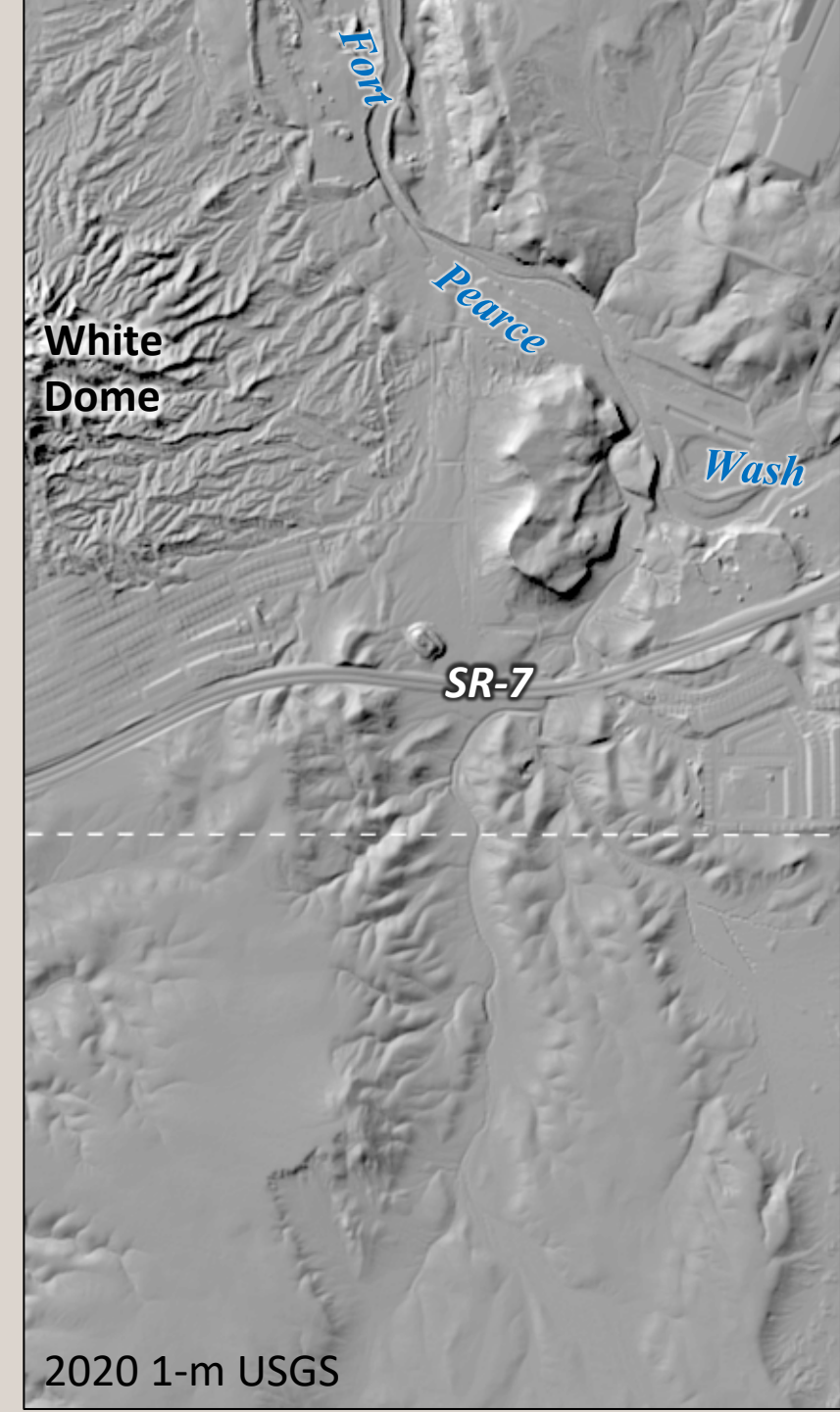
- Reconnaissance mapping to investigate extent/age relations



Arizona



Vertical fin of TRm



White Dome Fault

Surface Fault Rupture Hazards Evaluation

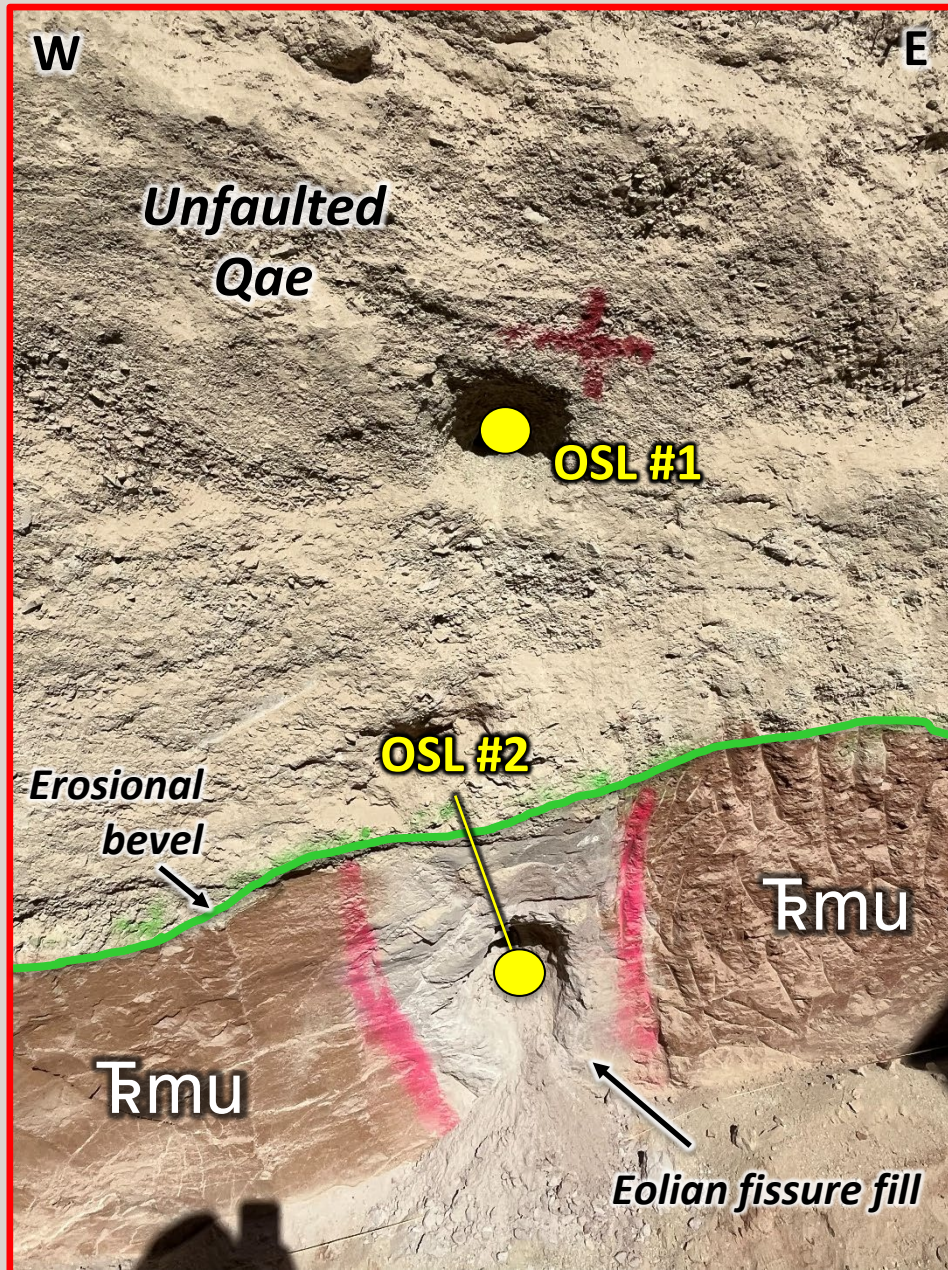
- February 2025: Landmark subcontracts with **Western Geologic (Bill Black)** for surface-rupture investigation
 - 4 trenches excavated and logged
 - 20-80' wide graben
 - No definitive unconsolidated deposits involved (not sheared)
 - No colluvial wedges
 - Wide fissure filled with eolian sand
 - 2 OSL samples collected by UGS



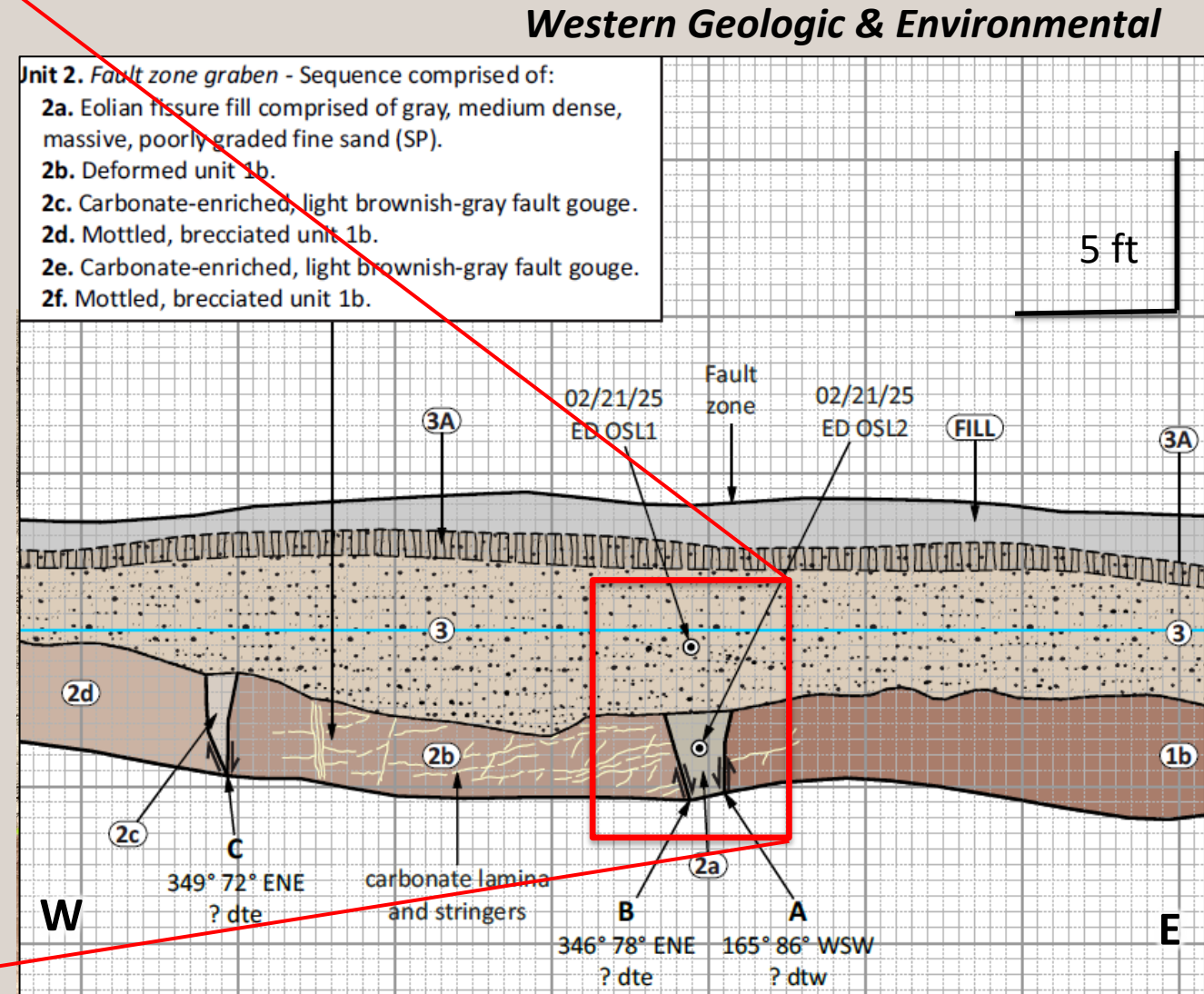
Bill Black & Hugo Angeles photos



White Dome Fault – Surface Fault Rupture Hazards Evaluation



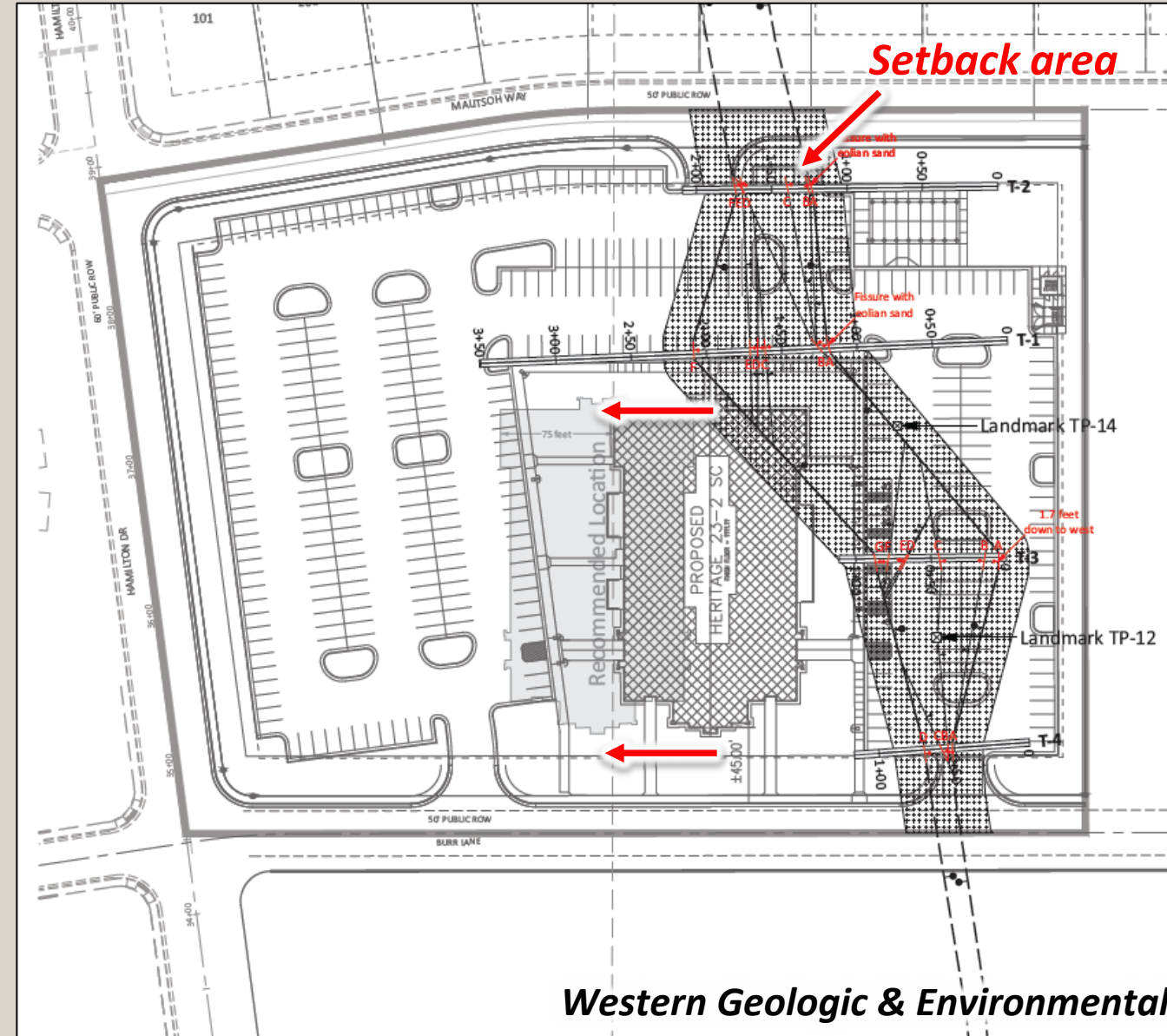
- 2 OSL samples collected from trench #2



White Dome Fault: Surface-Faulting-Hazard Evaluation

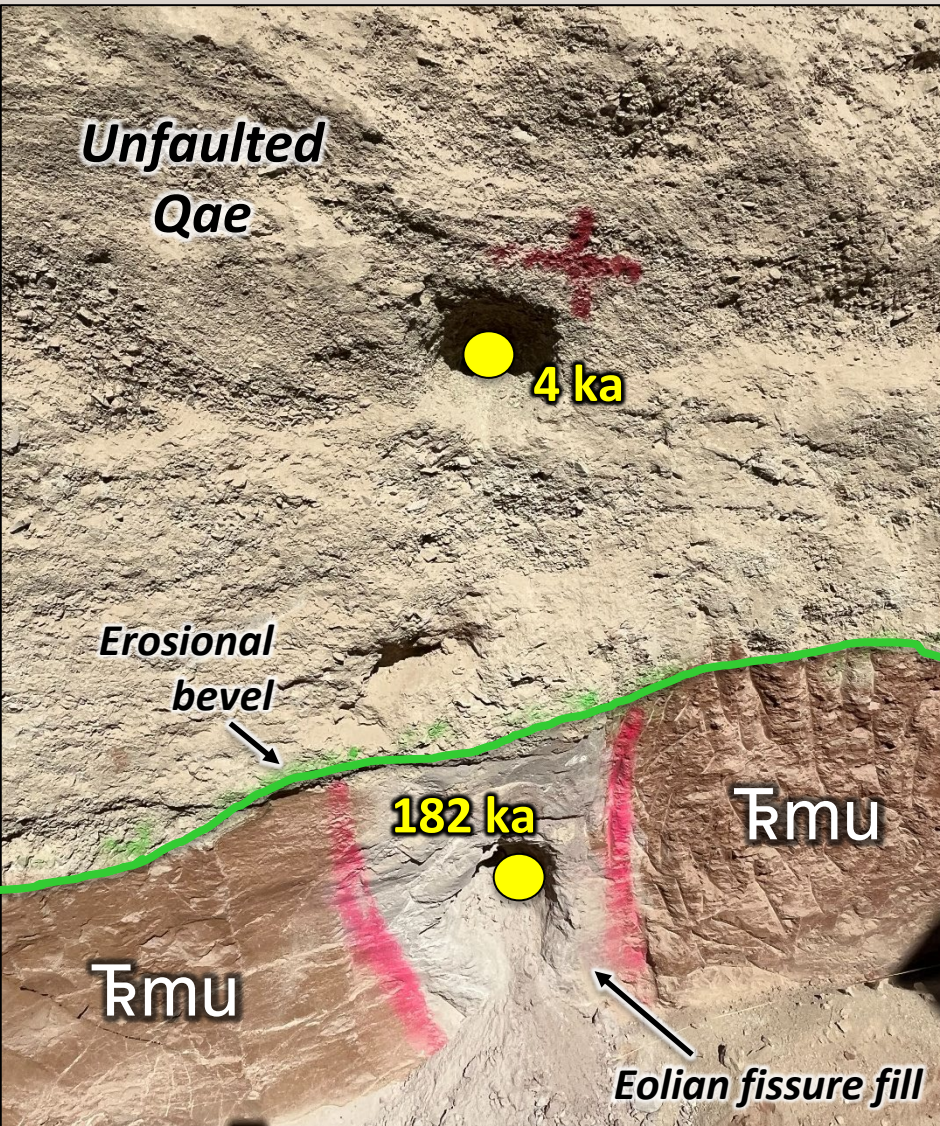
Based on trenching results:

- MRE likely >15 ka, but treated as Holocene fault due to uncertainty
- Setbacks created using *UGS Circular 128 Guidelines (Lund et al. 2020)*
- Structure shifted 80 ft west



White Dome Fault – OSL Ages

➤ May 2025



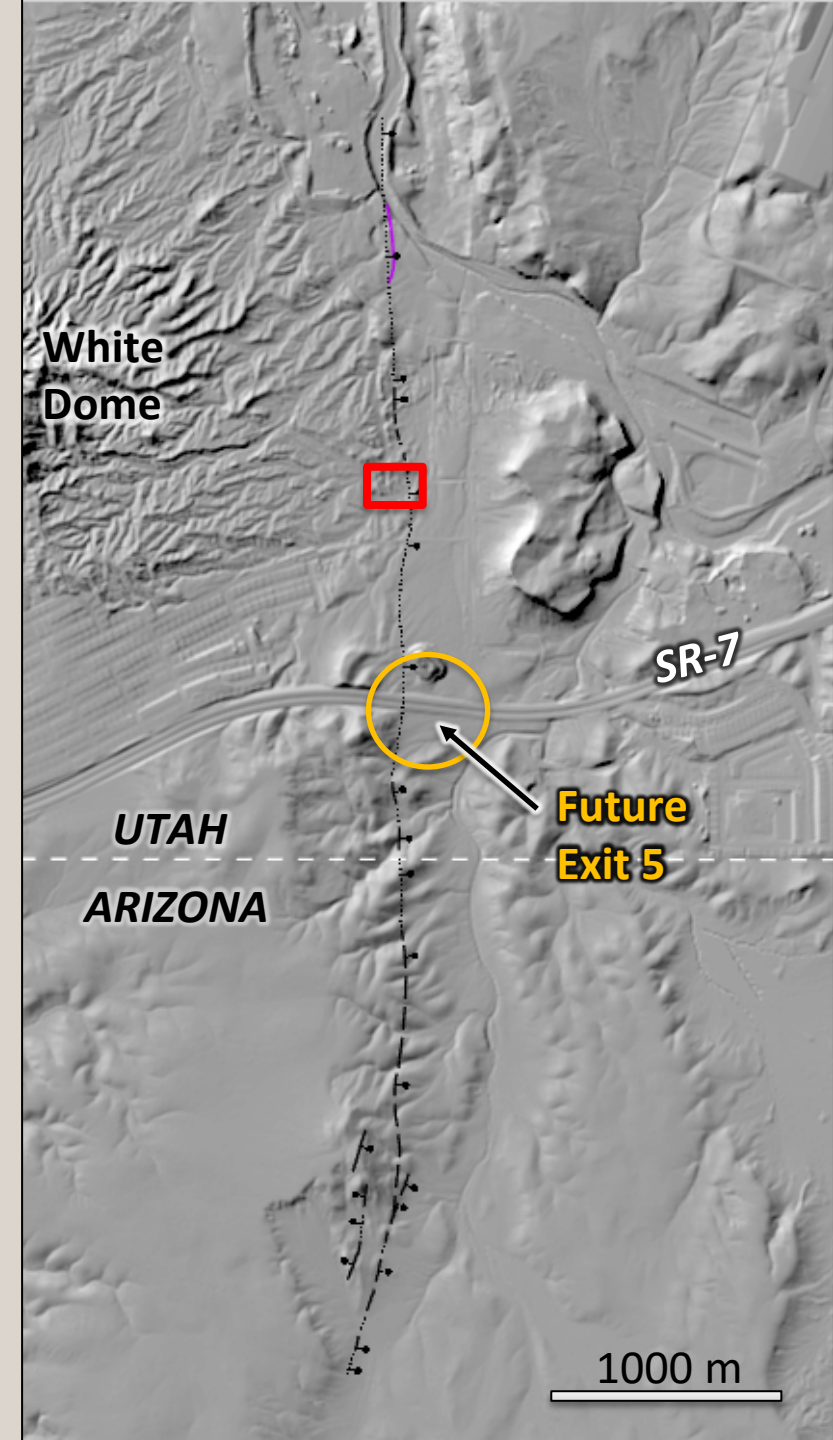
➤ Utah DOT plans to add Exit 5 (raised interchange) to SR-7

➤ **Rosenberg Associates, Gerhart Cole** fund OSL samples analyzed by **Desert Research Institute (Dr. Kathleen Rodriguez)**

OSL 1: 4.07 ± 0.48 ka

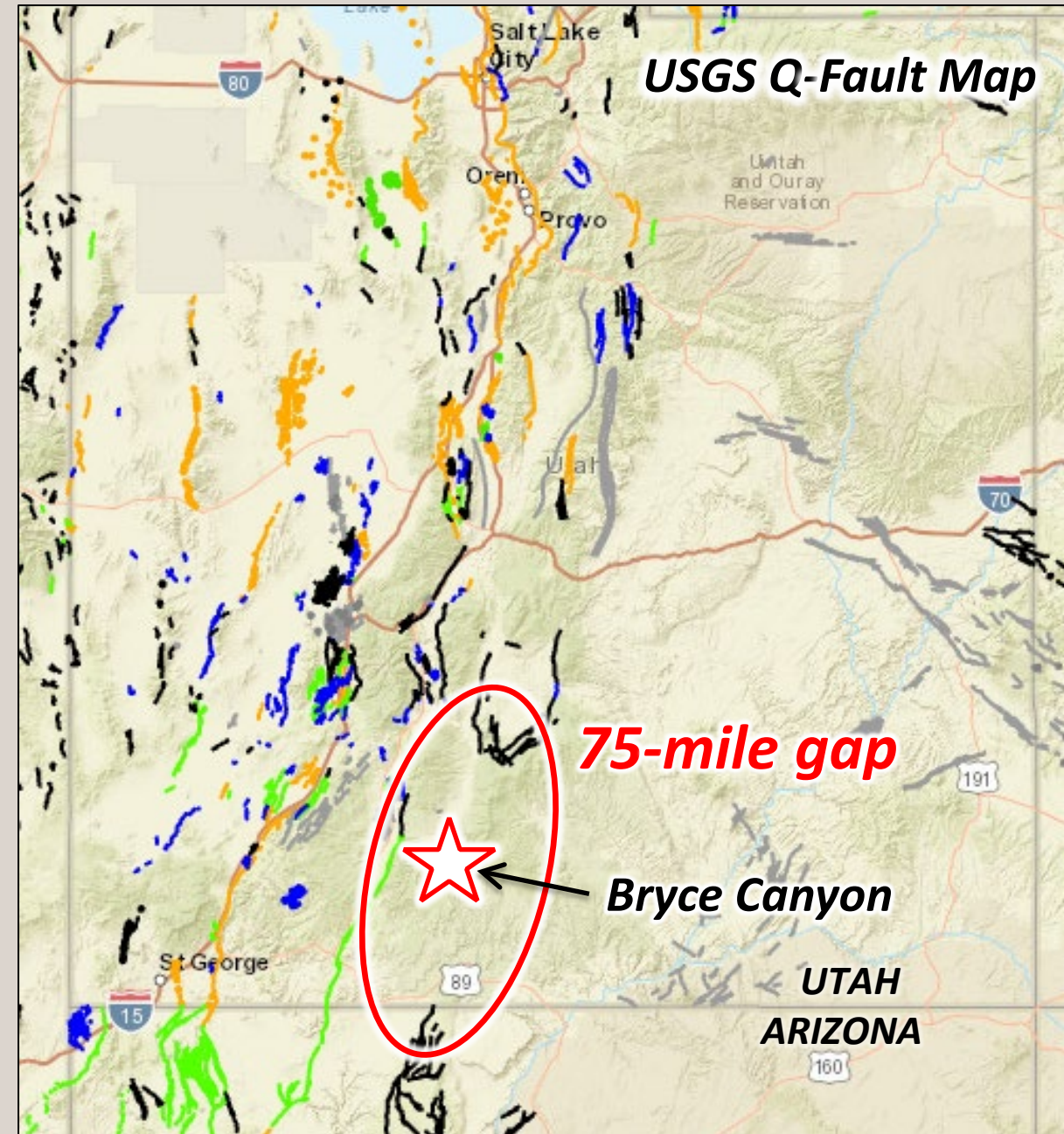
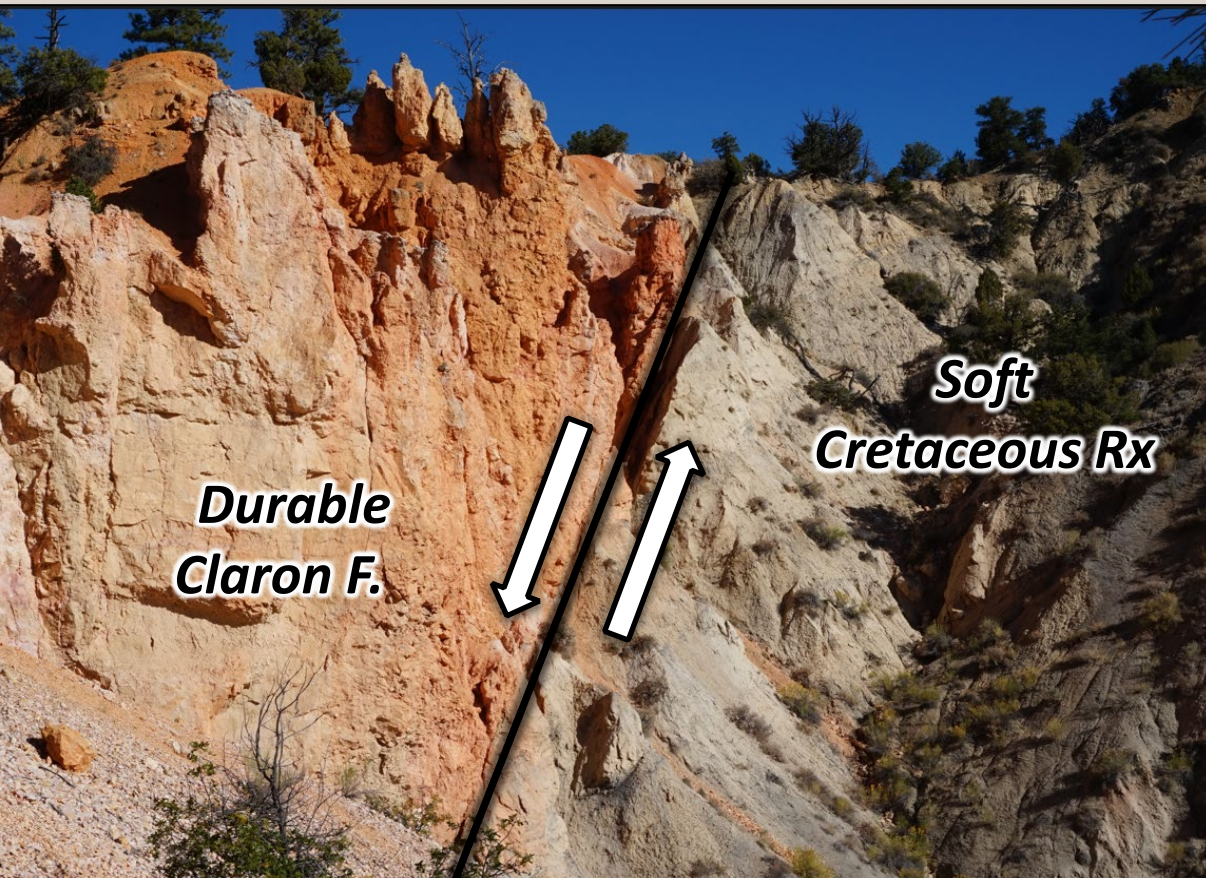
OSL 2: 182 ± 18.6 ka

➤ Likely a mid Pleistocene active fault (low hazard for UDOT)



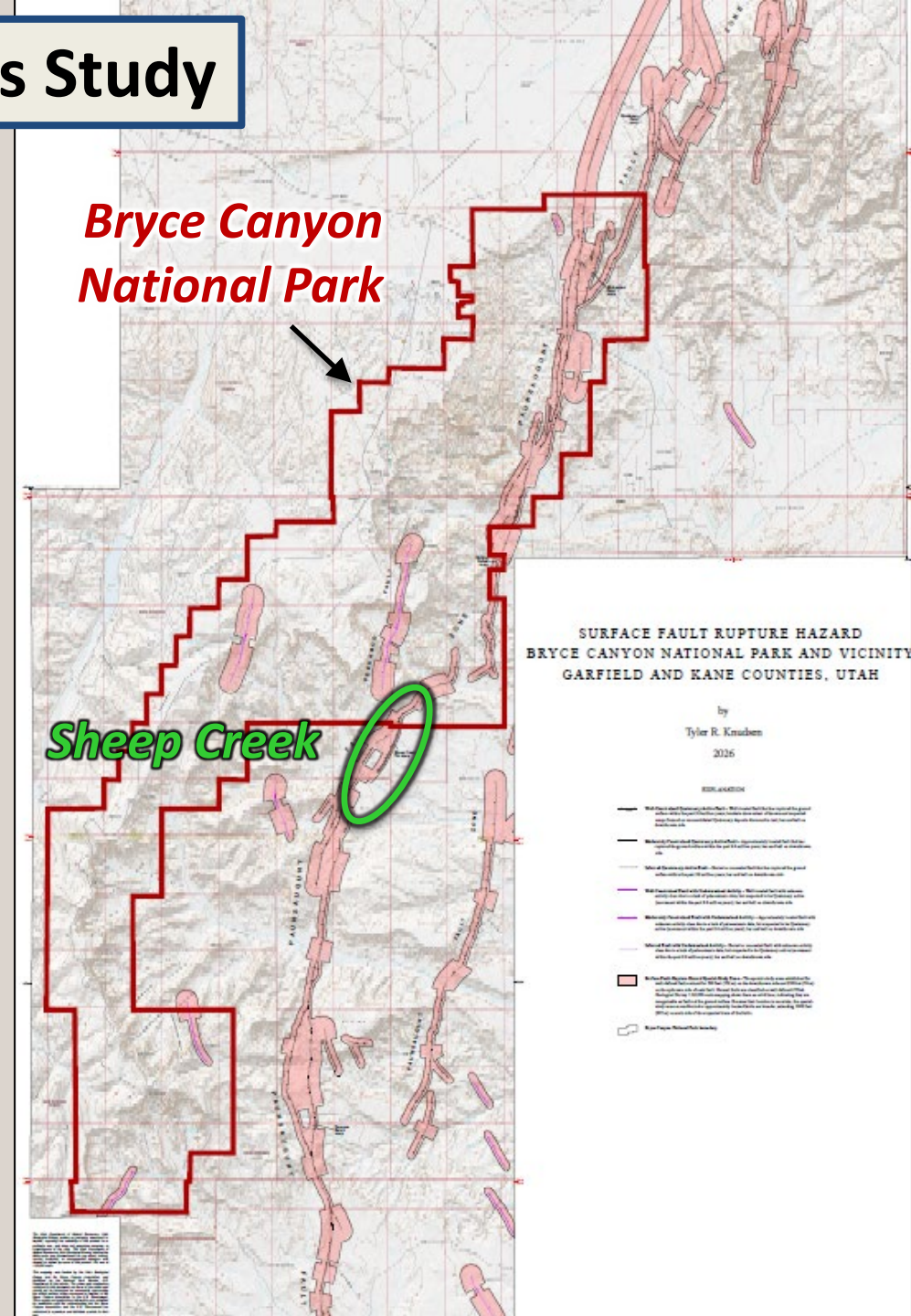
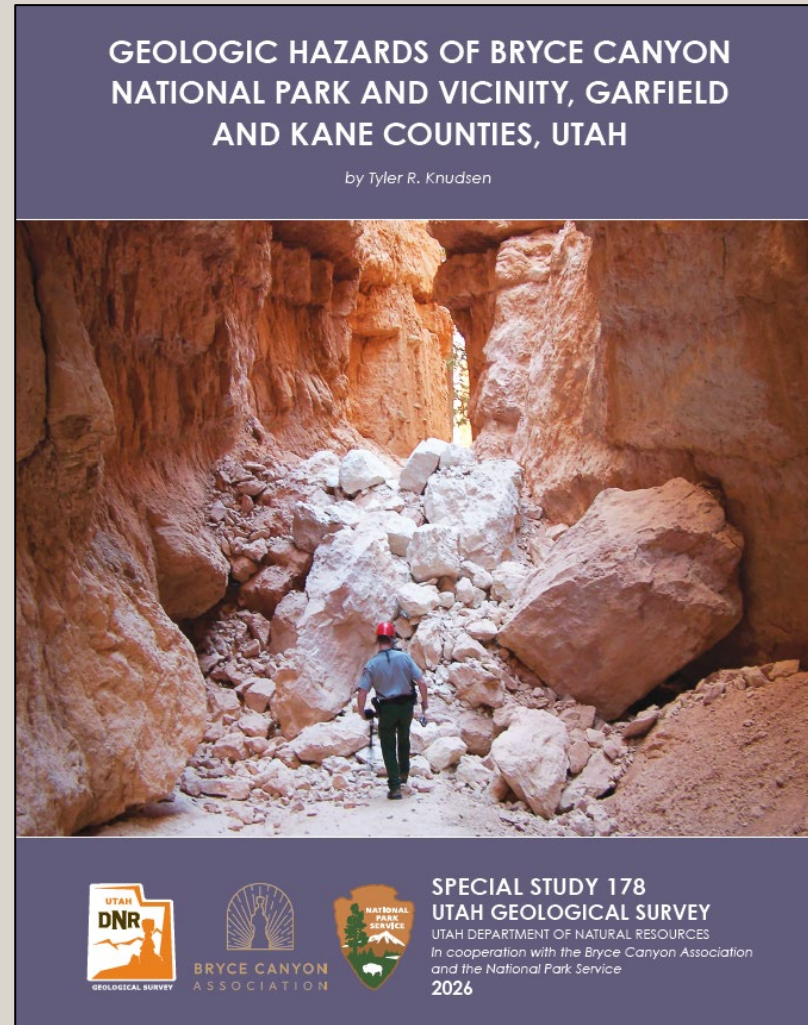
Paunsaugunt Fault –Bryce Canyon NP

- Down-to-west Paunsaugunt fault
- Appears on geologic maps, not Q-fault maps
- Obsequent (inverted) fault scarp indicates very slow slip rates



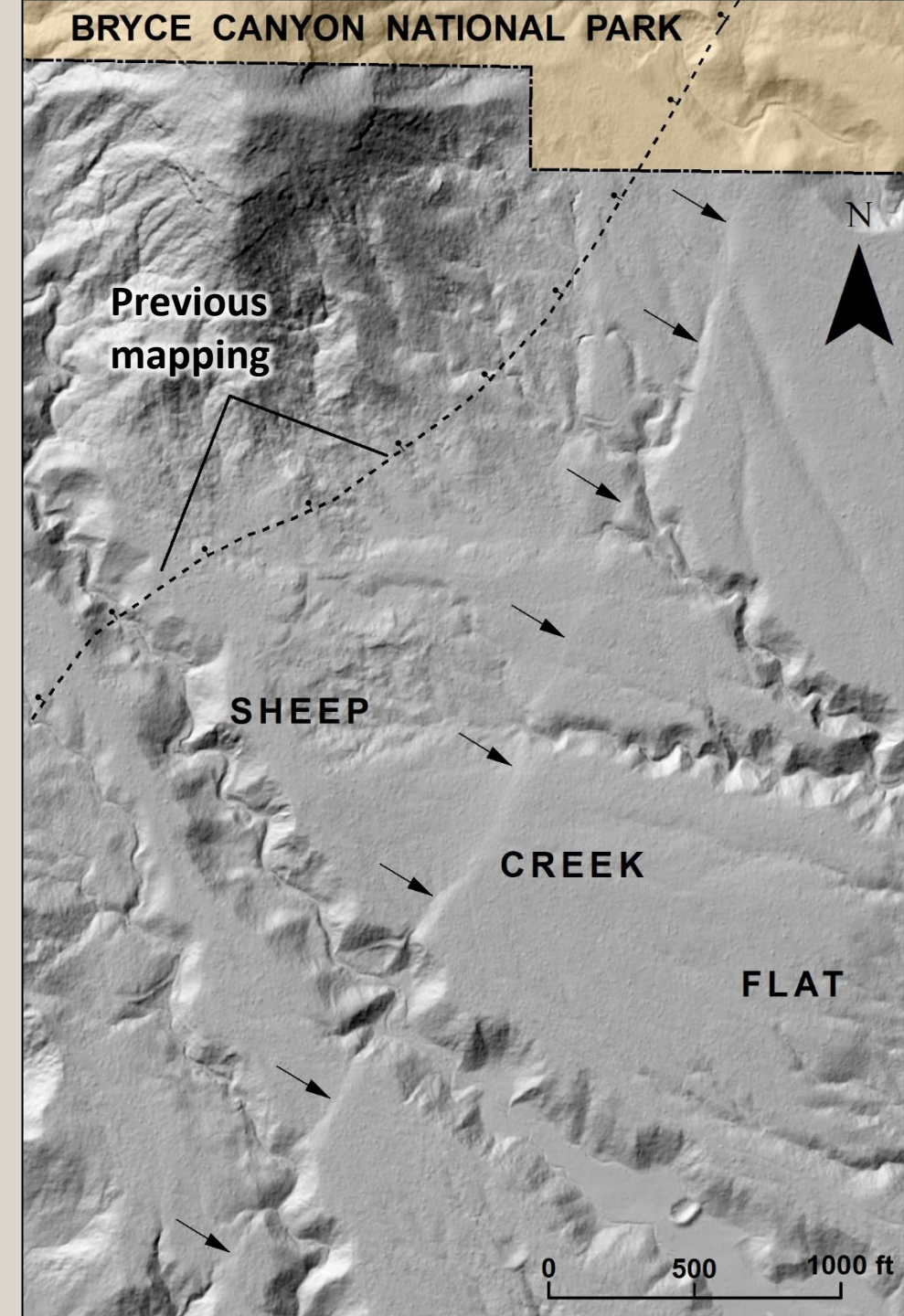
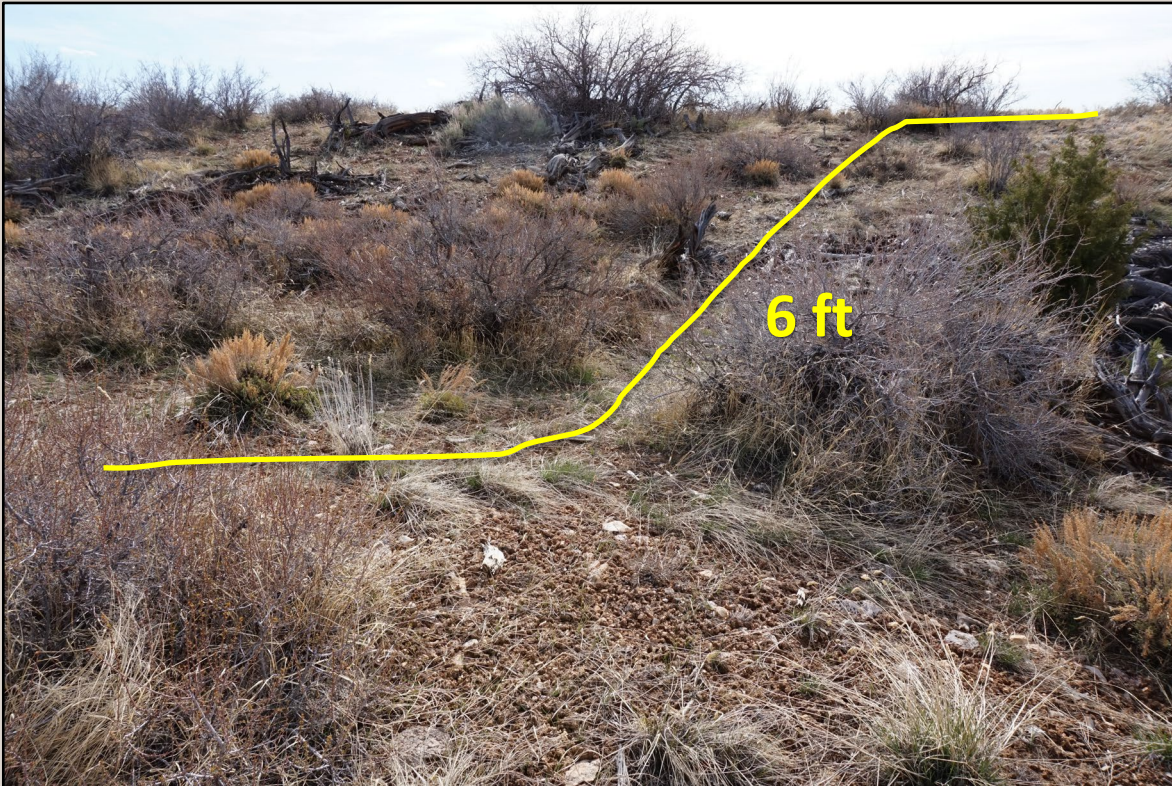
Paunsaugunt Fault—Bryce Canyon GeoHazards Study

- 265-square-mile study area (25 mi of fault)
 - 14 hazards mapped, including surface-fault rupture
 - 5 Q-scarps identified
 - Sheep Creek Flat
- GEOLOGIC HAZARDS OF BRYCE CANYON
NATIONAL PARK AND VICINITY, GARFIELD
AND KANE COUNTIES, UTAH



Paunsaugunt Fault – Sheep Creek Flat Scarp

- Displaced middle to late Pleistocene(?) pediment
- Nearly 1-mile long and about 6 feet high
- Poorly preserved, subdued
- Recently added to Q-fault database (partial)



Next Steps

➤ White Dome fault

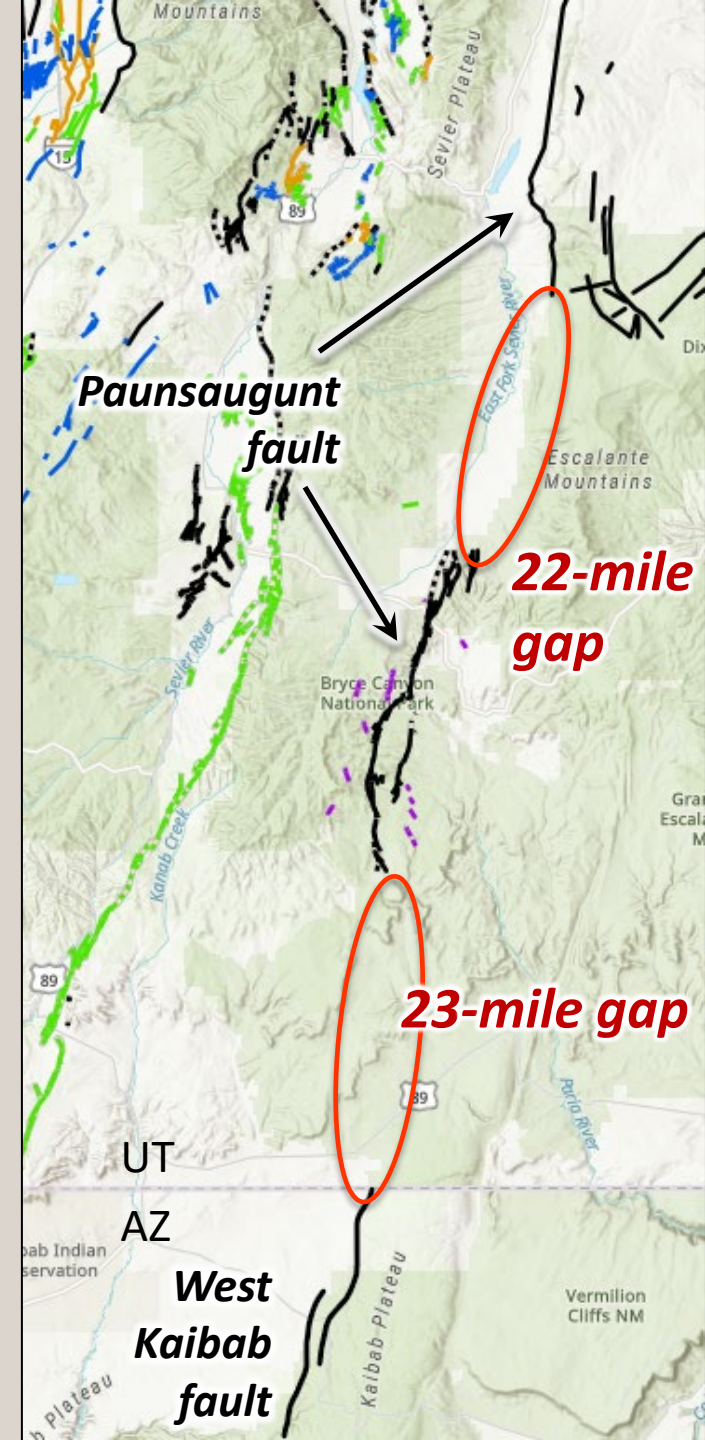
- Improve mapping (differentiating scarps from river terraces)
- Southern extension into Arizona?

➤ Paunsaugunt fault

- Complete mapping in Utah of this major regional structure
- Further constrain age of MRE (trenching, OSL)

Thanks to: Landmark Testing & Engineering, Western Geologic, Rosenberg Associates, Gerhart-Cole, DRI Luminescence Lab, Bryce Canyon Association, Bryce Canyon National Park

Questions? tylerknudsen@utah.gov



QUATERNARY FAULT MAPPING UPDATES - SKULL VALLEY & PAHVANT VALLEY, UT

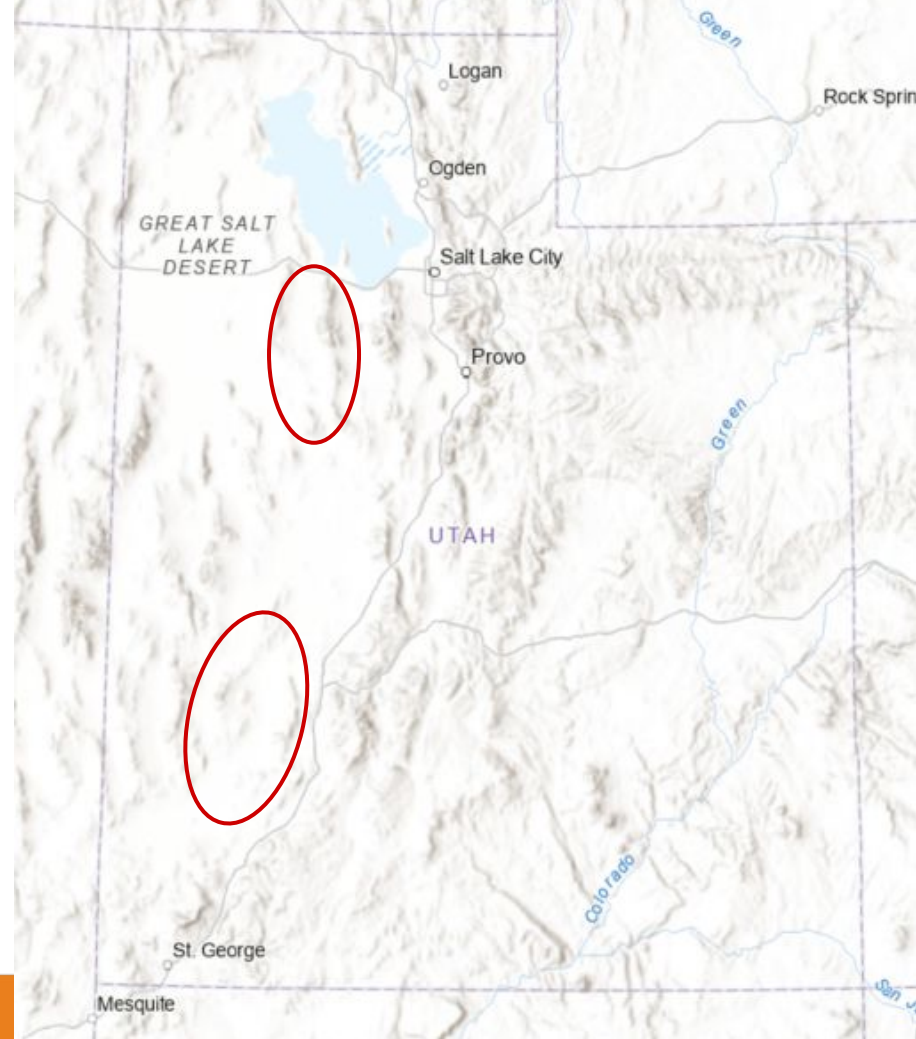
Rachel N. Adam
Utah Geological Survey Hazards Program



GEOLOGICAL SURVEY

Objectives

- With newly acquired lidar data, quaternary faults that were previously mapped either in the field or with coarser data are remapped
- More accurate fault placements and newly identified traces are critical to mitigating damage from hazardous geologic events
- The updated fault traces will be added to the UGS's Geologic Hazards Portal for internal use and for public access

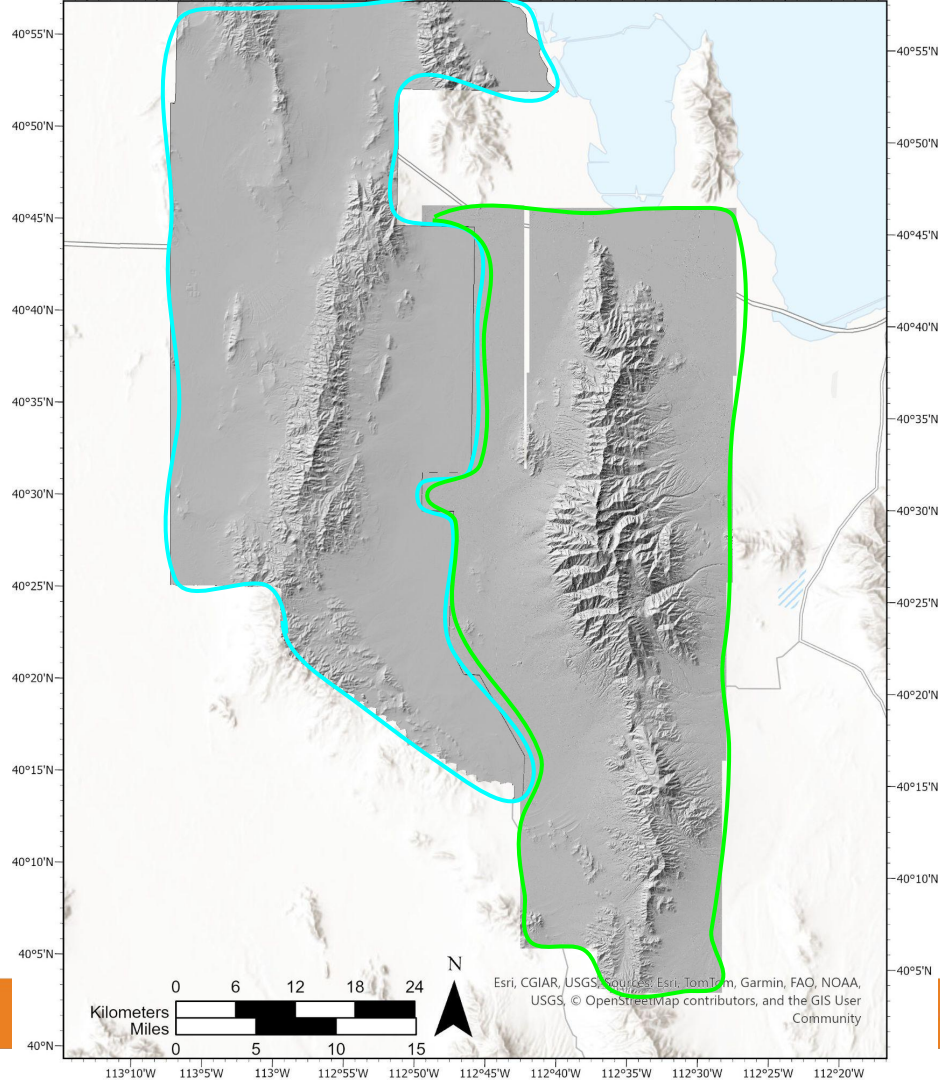


Skull Valley Fault Mapping Updates

- East side of the valley has been concluded
- West side is in progress with newly released lidar of the area



Utah Geological Survey



Skull Valley (East Side)

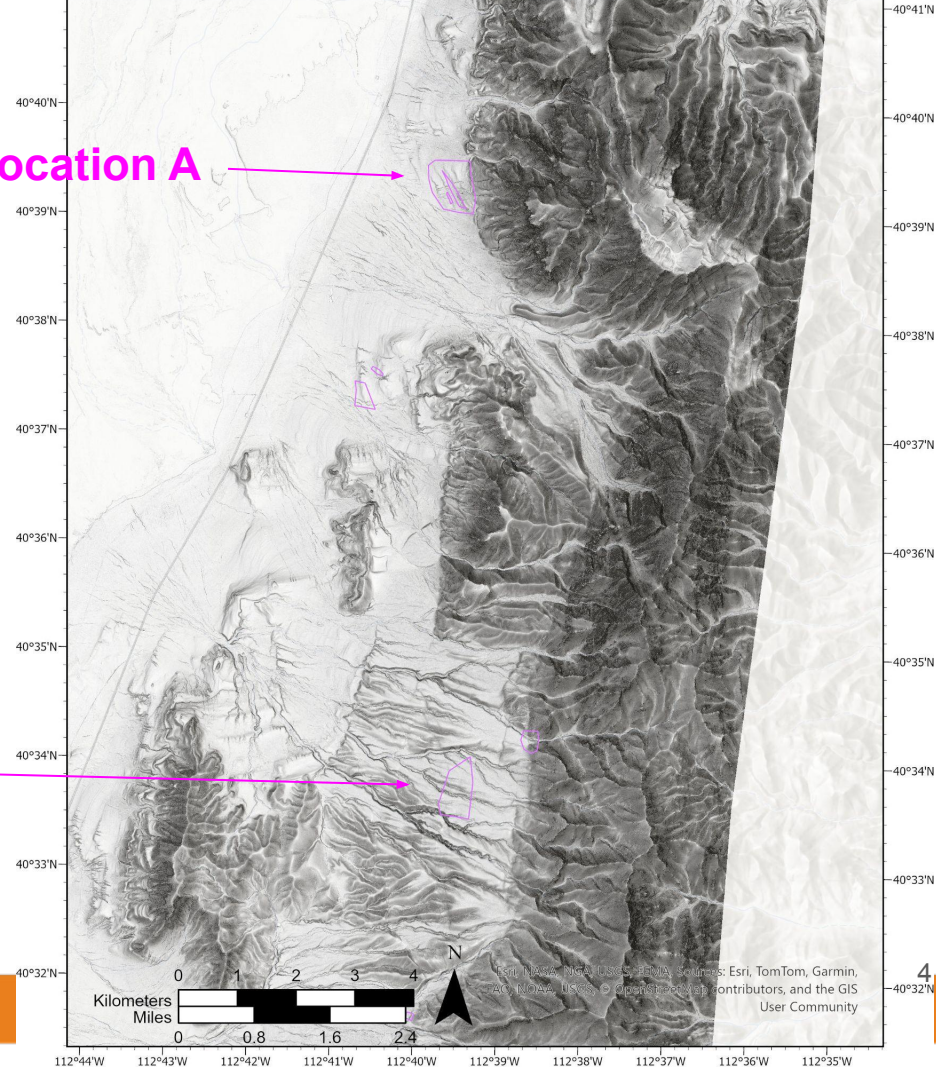
- Field checked locations A, B, and (see figure)
- Found new traces and adjusted mapping constraint on several traces

Location B

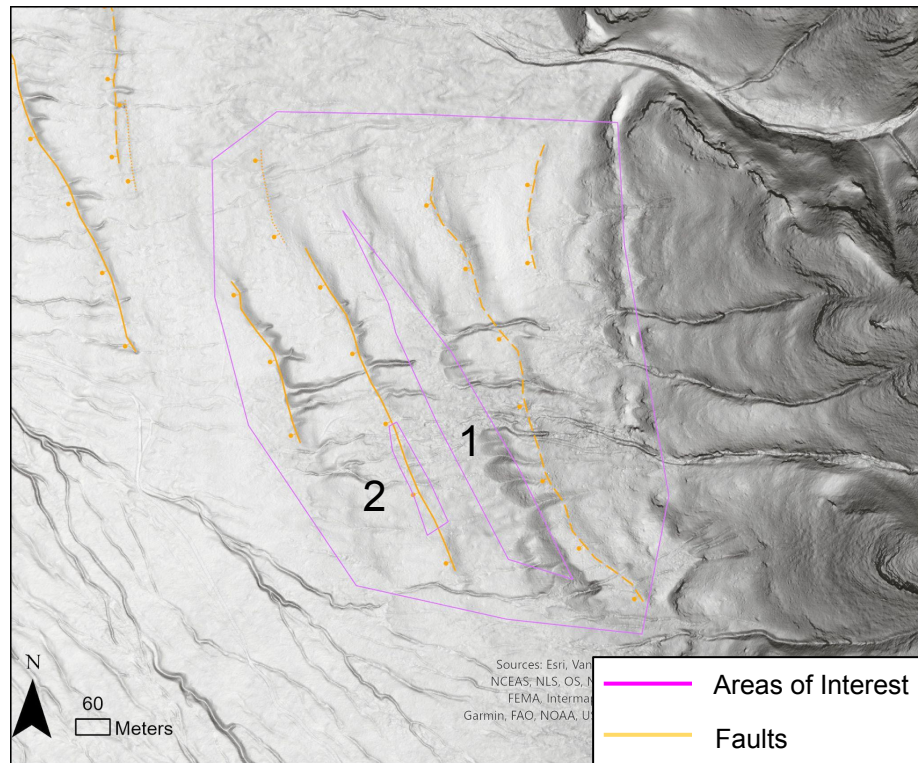
Location A



Utah Geological Survey

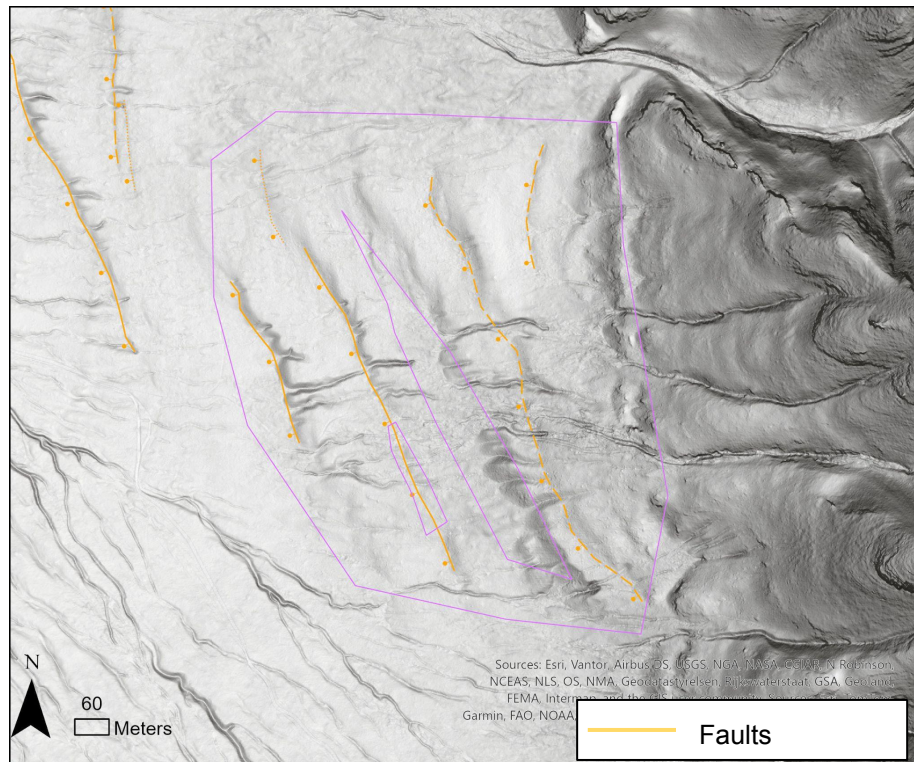


Skull Valley (East Side) - Location A



- 1) Check shoreline for adjacent faults
- 2) Check constraints

Skull Valley (East Side) - Location A

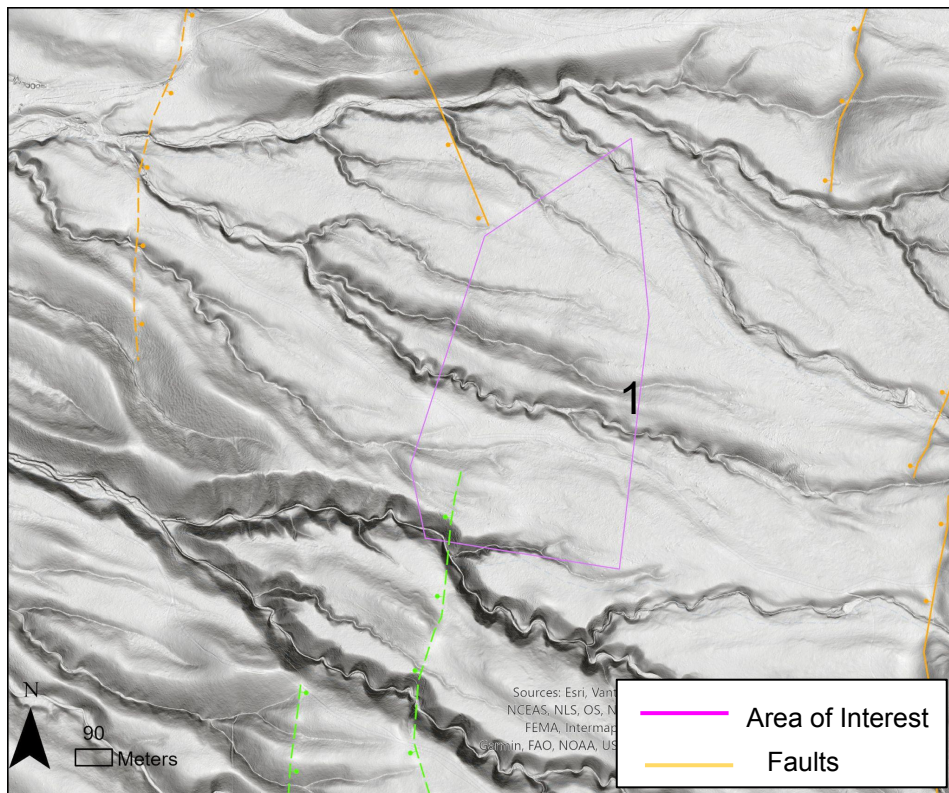


1) Added fault 2) Changed from well constrained to inferred

Utah Geological Survey

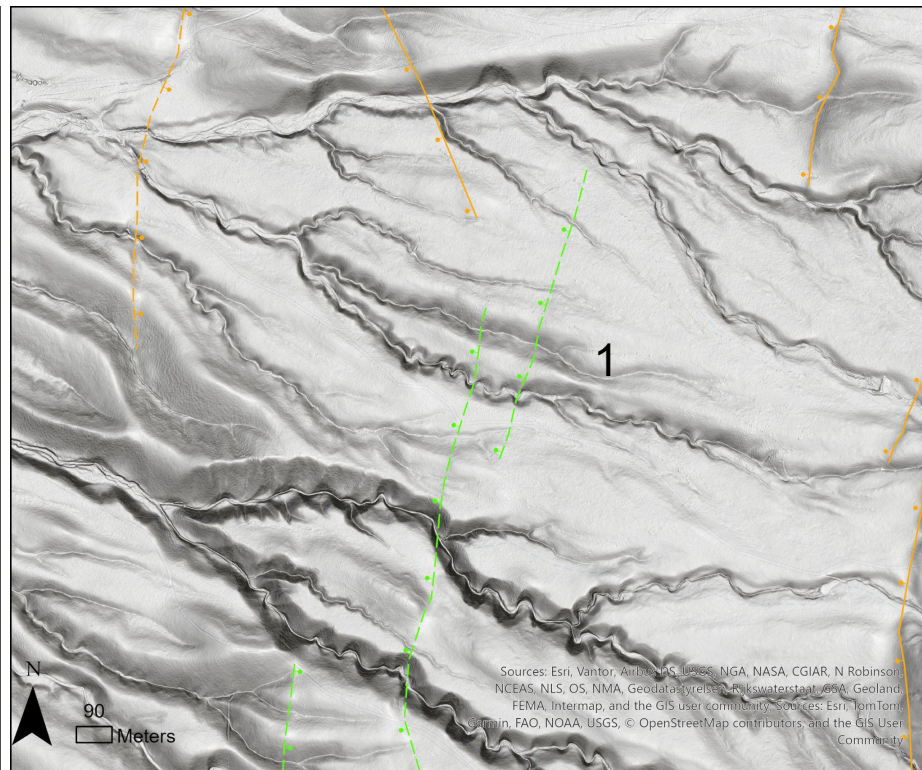
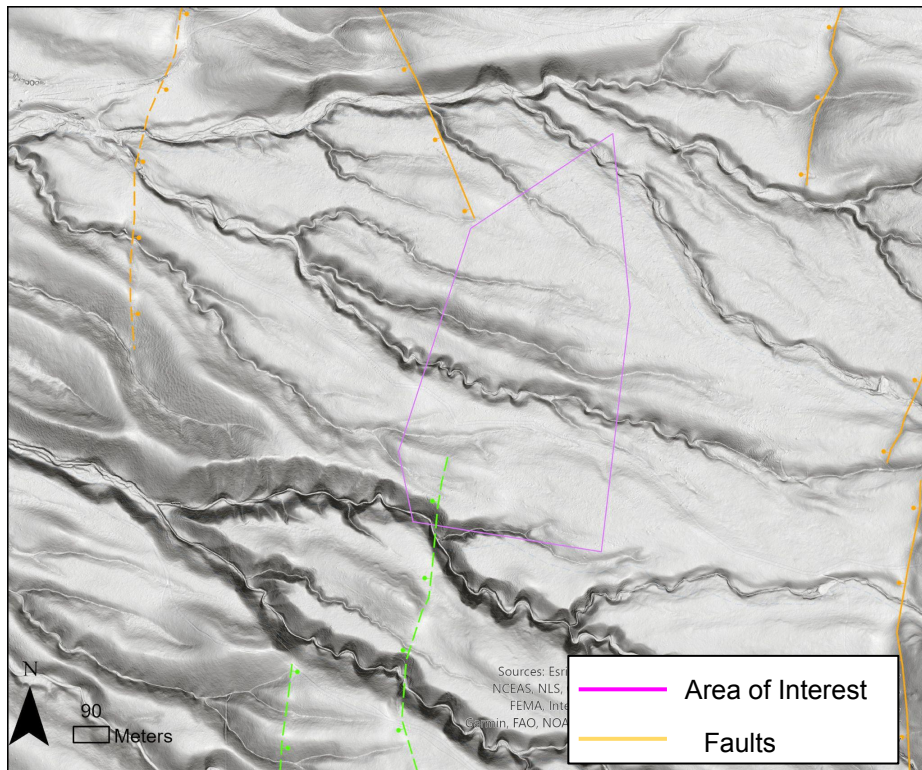
geology.utah.gov

Skull Valley (East Side) - Location B



1) Check for new traces

Skull Valley (East Side) - Location B

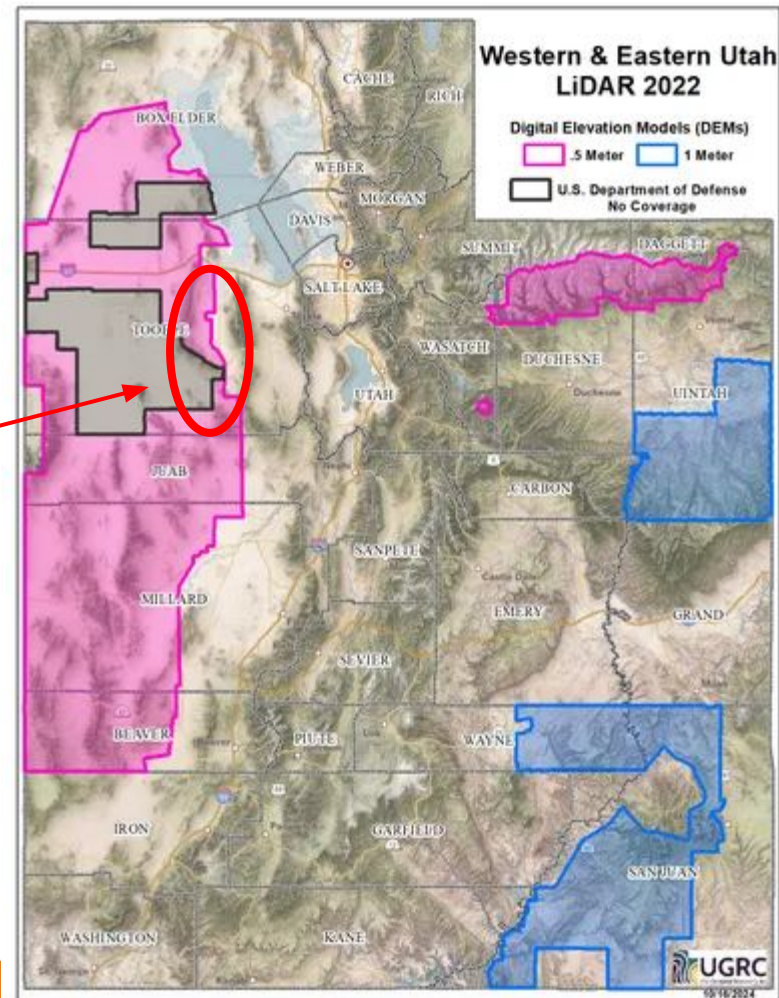


1) Added traces

Skull Valley (West Side)

- 0.5 meter lidar captures in 2022 covers the western half of Skull Valley, Utah
- Precursory mapping shows less faults than the Eastern half of the valley

Lidar used for
Skull Valley

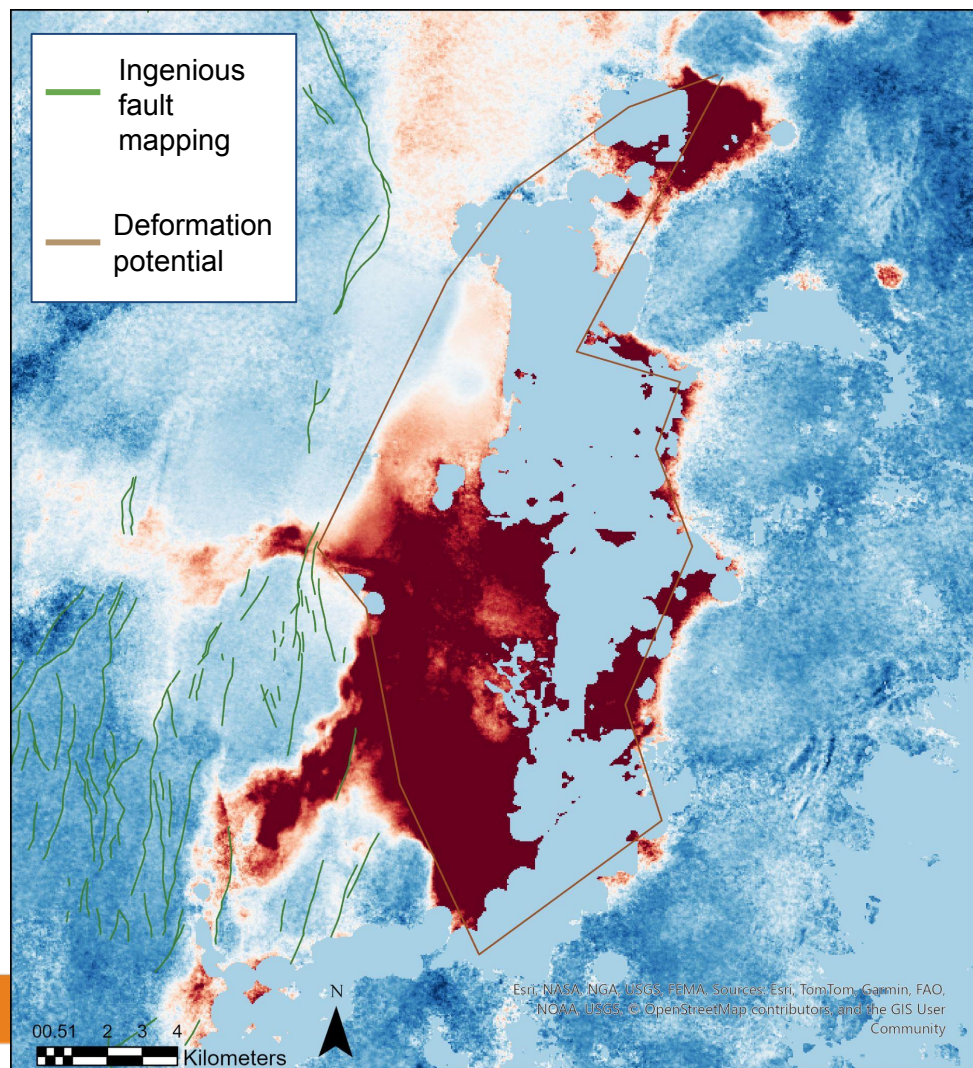


Fissure and Fault Mapping in Pahvant Valley

- Under a grant to scope the state for ground subsidence as a result of groundwater depletion
- Fissures pose a hazard to surrounding infrastructure
- InSAR data highlights the boundaries of subsidence and can indicate location of fissures and fault lines



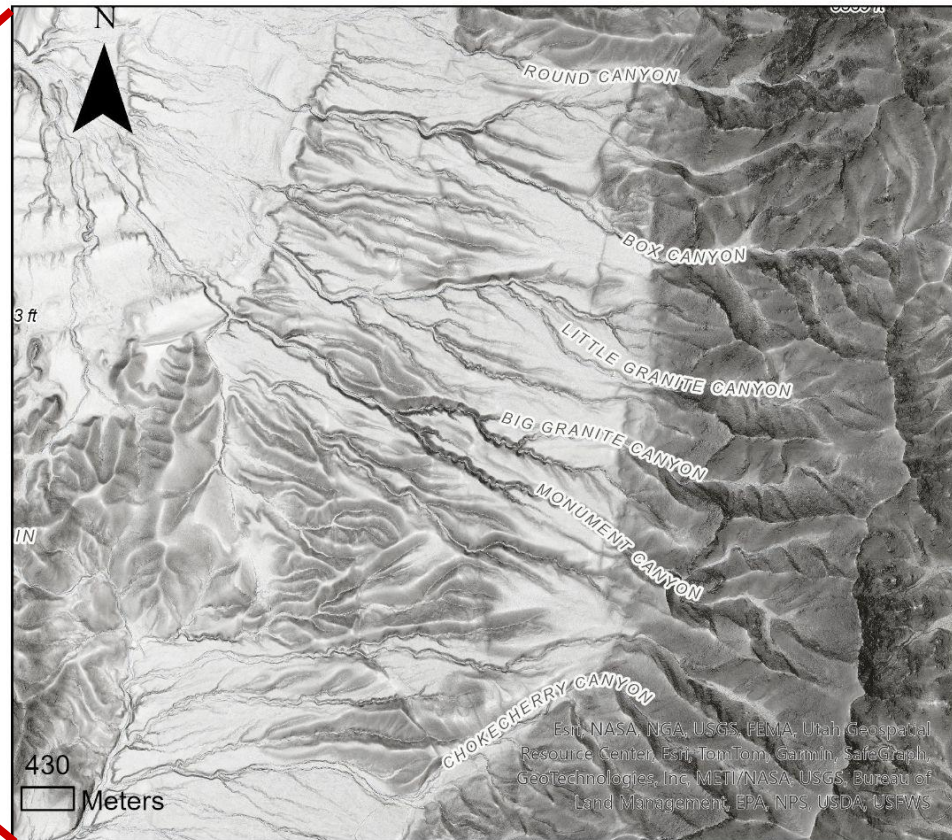
Utah Geological Survey

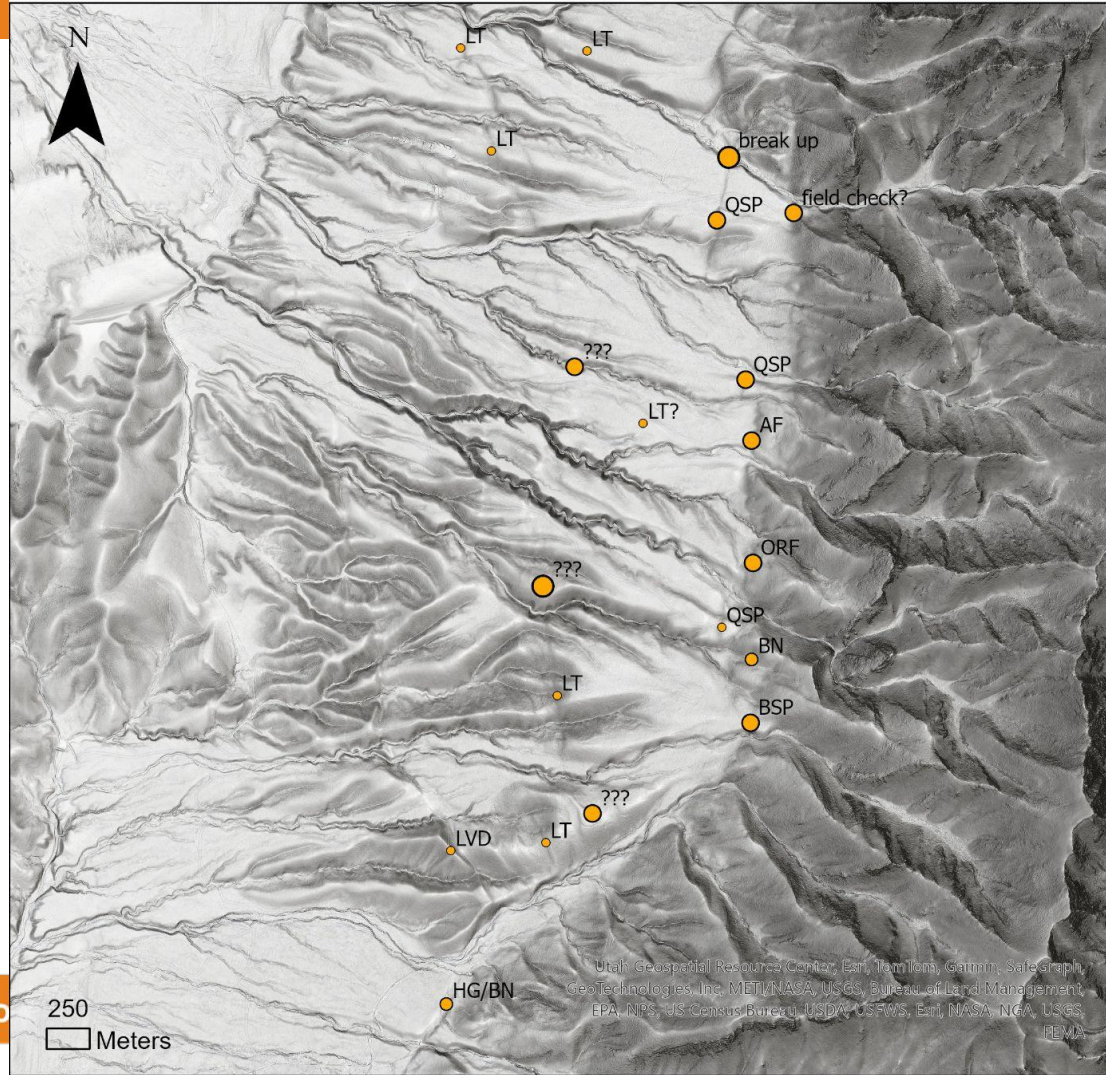


Standardizing the Quaternary Fault Mapping Process

- Often, multiple fault mappers can be working in the same area, but have differing final fault locations
- When peer reviewing work, we often only have the final fault lines from each other, without easy-to-read documentation of the mapper's thought process behind their decision making
- To help the process of mapping Quaternary faults and make it easier to disseminate information and compare maps, we are trying to implement the Geomorphic Indicator Ranking System (GIR) from Adam et al. (2025) to match the schema and style of mapping at the Utah Geological Survey

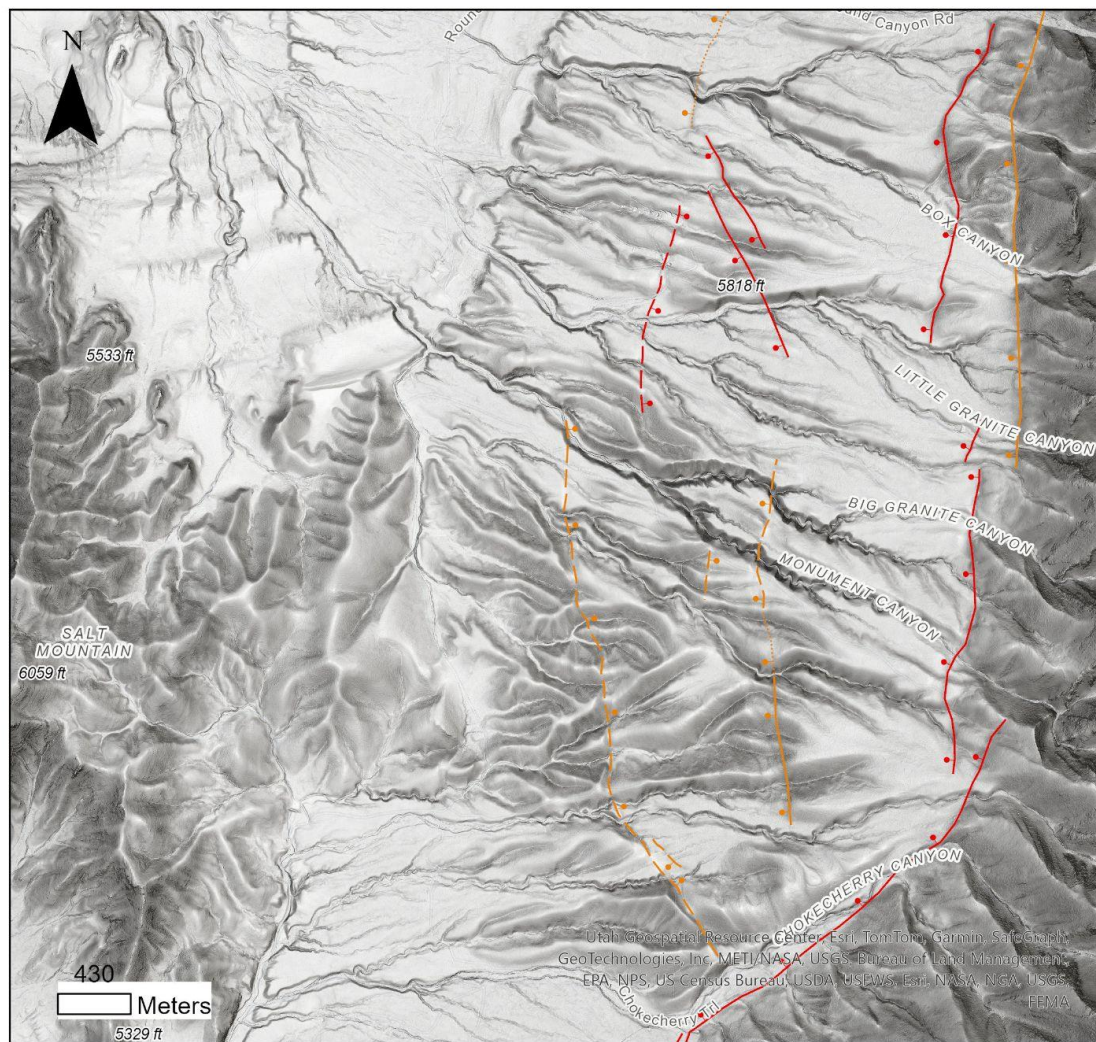






Utah Geo

geology.utah.gov



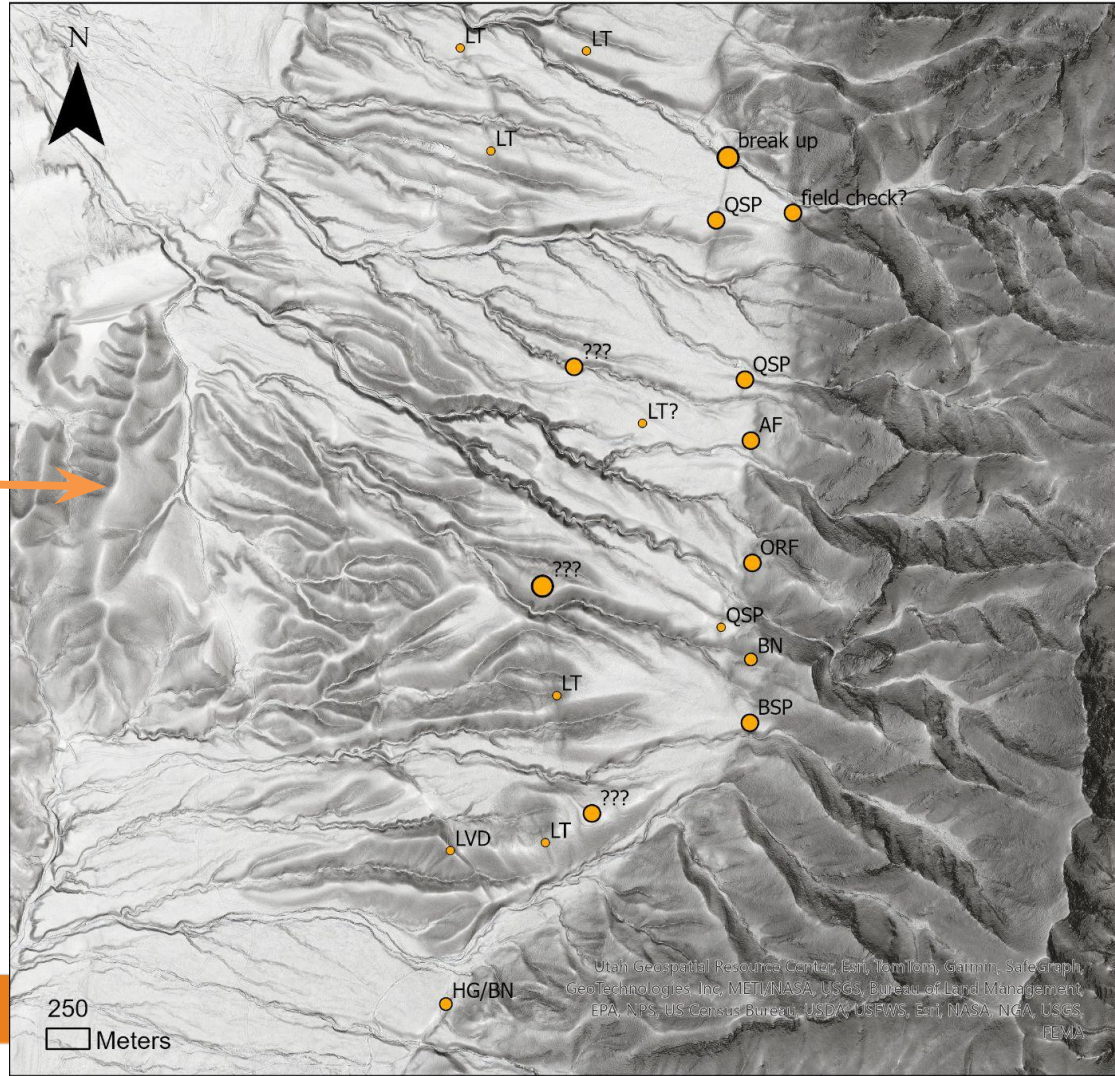
Utah Geo

geology.utah.gov

SYMBOL	FEATURE
AF	Cut offset/ alluvial fan
BN	Bench
BSP	Bedrock scarp
HG	Horst/graben
LT	Lineament in topography
LVD	Linear valley/drainage
QSP	Quaternary scarp
ORF	Oversteepened rangefront



Utah Geological Survey



Future Work

- Finish mapping the remaining western half of Skull Valley
- Continue mapping fissures in tandem with Quaternary faults in Pahvant Valley
- The quaternary faults for the new area will be remapped and updated in the UGS Geologic Hazards Portal
- Continue developing the GIR process for UGS mapping

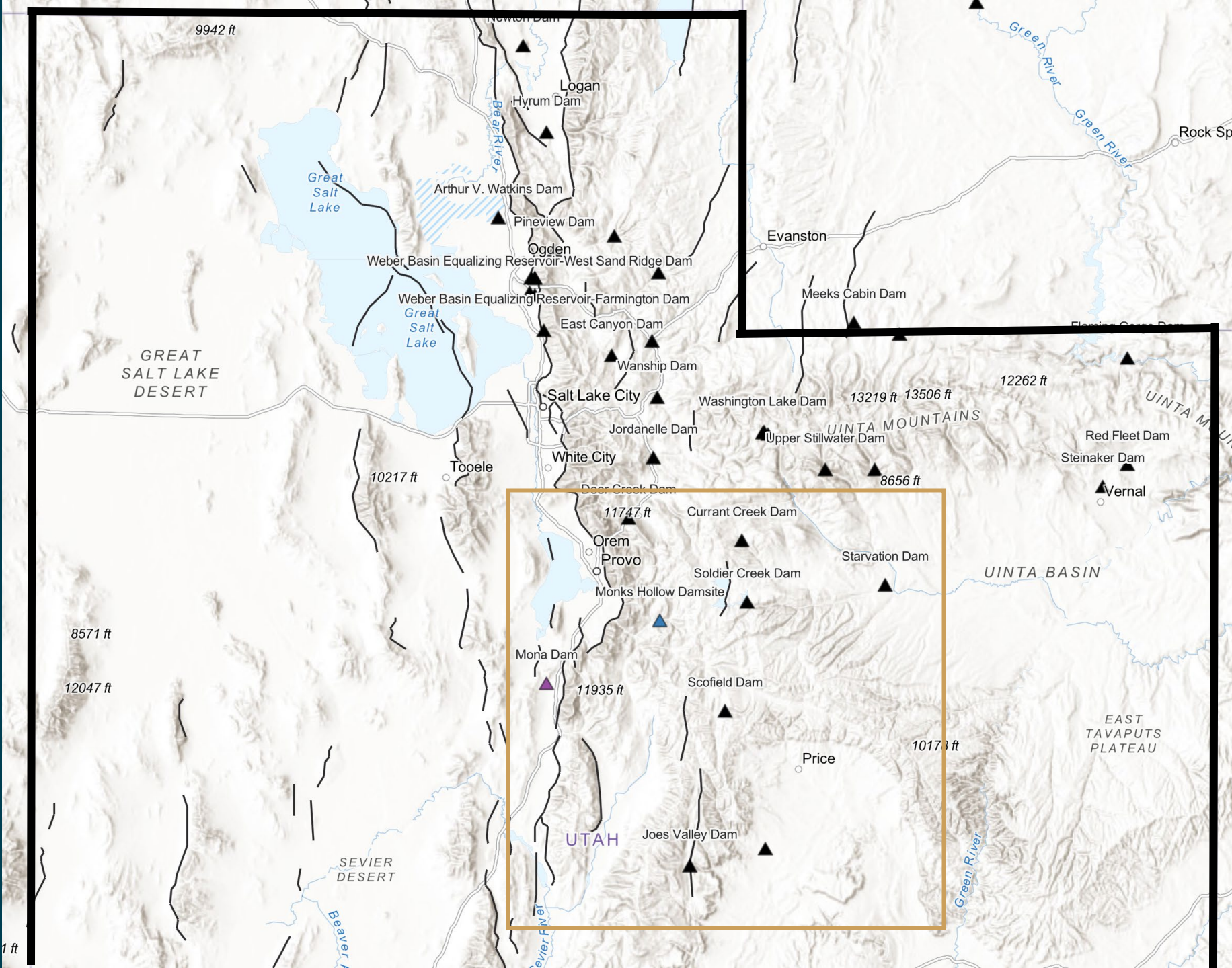


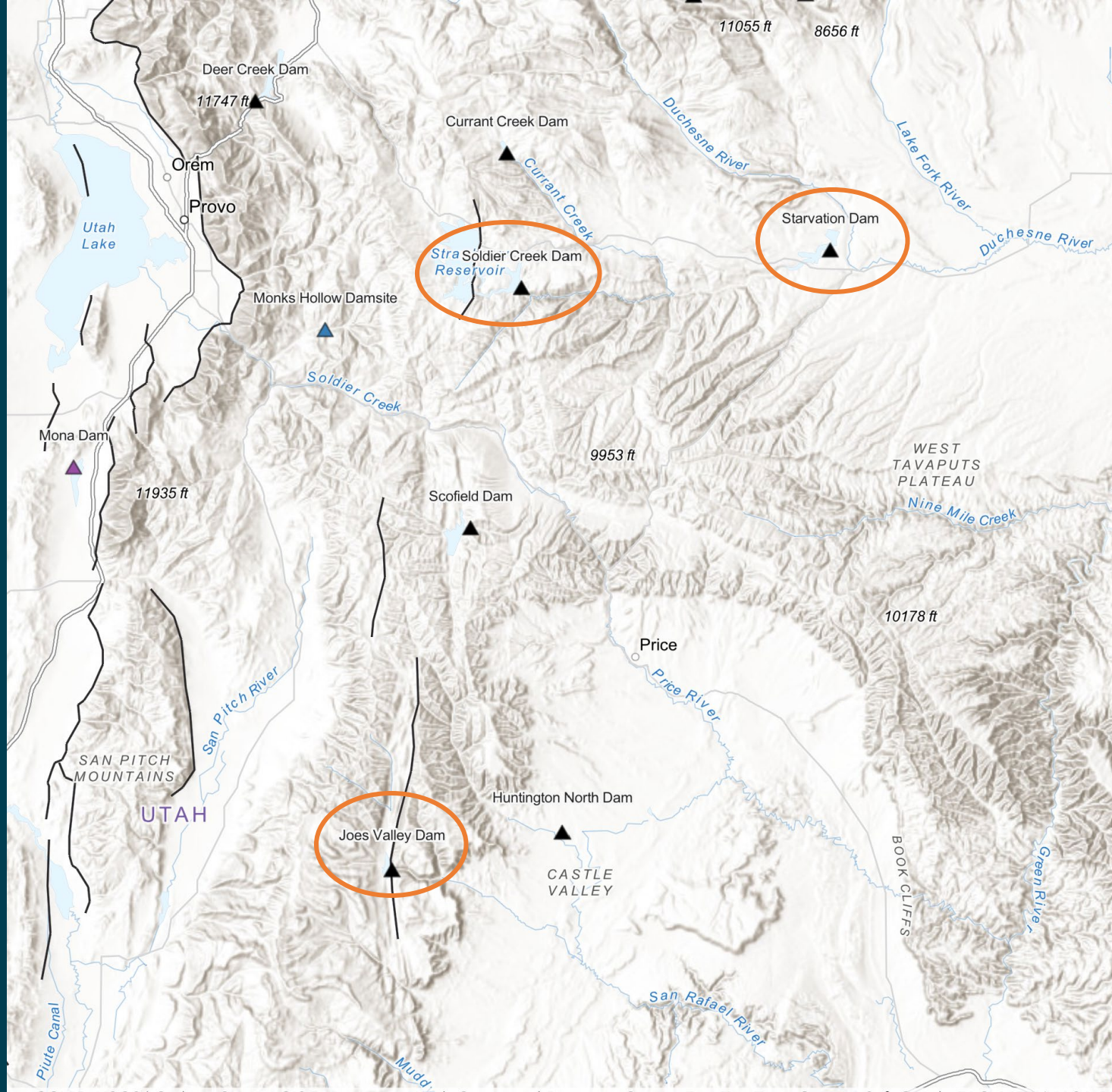


— BUREAU OF —
RECLAMATION

Updates from the Bureau of Reclamation

Presented by Ellen Lamont on behalf of
Seismology and Geomorphology Group







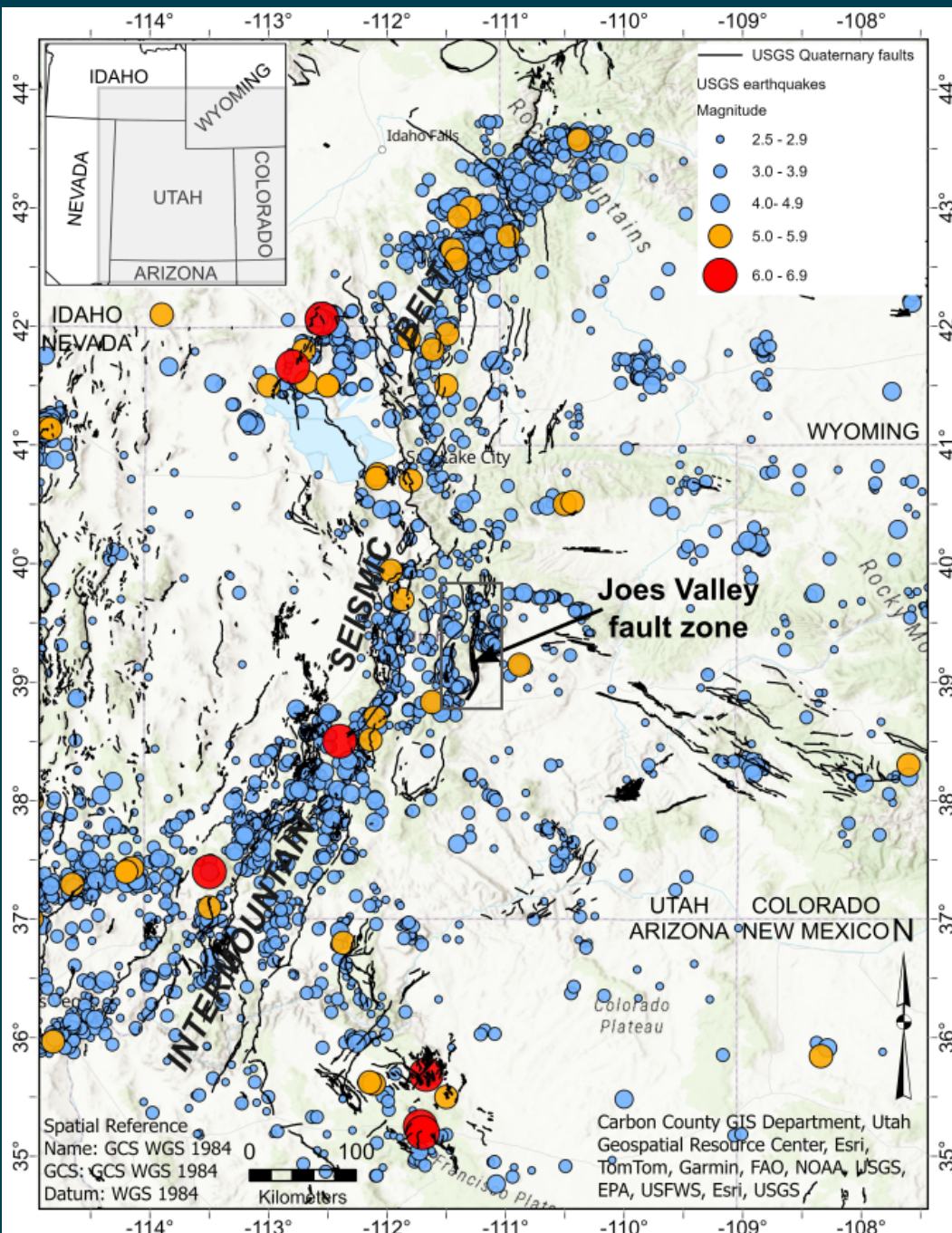
— BUREAU OF —
RECLAMATION

Joes Valley Fault

Contributors: Lucy Piety, Julia Howe, Joanna Redwine, Chris Wood, Ralph Klinger, Kirstyn Cataldo, Silvia Nicovich, Glenda Besana-Ostman, Ryan Levinson, and Kris Hornsby (all formerly in the Seismology and Geomorphology Group, Bureau of Reclamation, Denver), Colin Chupik (Seismology and Geomorphology Group, Bureau of Reclamation, Denver), and Harrison Gray (USGS, Luminescence Dating Laboratory, Denver)

Study of the Joes Valley fault, central Utah

Joes Valley fault zone is in central Utah at the eastern edge of the Intermountain seismic belt (left). The fault zone is located between the Basin and Range to the west and the Colorado Plateau to the east. The northern 2/3 of the fault zone crosses the Wasatch Plateau. The southern 1/3 is along the southeast margin of the Wasatch Plateau at its junction with Castle Valley.



Our study was done between 2017 and 2020 and was funded by the Bureau of Reclamation and based in part on an evaluation of previous work on the Joes Valley fault zone by Jim McCalpin (Geo-Haz Consulting) in 2013 (Evaluation of the Quaternary history of the Joes Valley fault zone, Huntington North Dam, Utah; https://geology.utah.gov/docs/pdf/UQFPWG-2014_Presentations.pdf).



Study of the Joes Valley Fault

The study included four main parts:

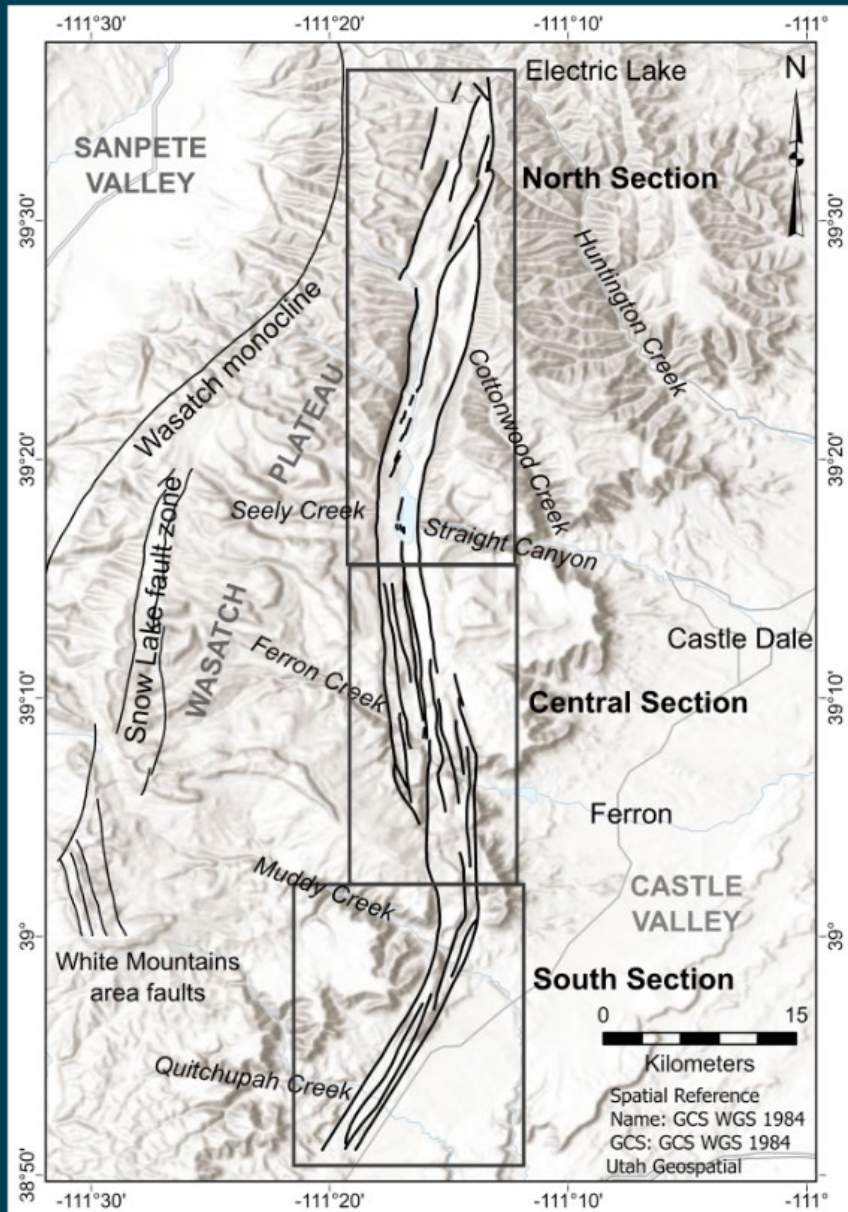
- Geomorphic evaluation using lidar acquired by the Bureau of Reclamation,
- Excavation and interpretation of seven paleoseismic trenches across scarps on the north and south Joes Valley fault zone
- Interpretation of 13 2D seismic reflection lines across the Joes Valley fault zone (John Arestad (Excel Geophysical Services and International Reservoir Technologies) combined with well and surface geology by Dave List (Excel Geophysical Services and David List Consulting)
- Compilation and interpretation of contemporary stress data (Steve Sturm (303 PetrolImages))

The primary goal of the study was to constrain the timing of any surface ruptures on the Joes Valley fault zone.

A main resource for our study was the detailed evaluation of the Joes Valley fault zone in the 1980s by Lucy Foley and others (Foley, L.L., Martin, Jr., R.A., and Sullivan, J.T., 1986, Seismotectonic study for Joes Valley, Scofield, and Huntington North Dams, Emery County and Scofield Projects, Utah: Bureau of Reclamation Seismotectonic Report No. 86-7, 132 p. (<https://geology.utah.gov/library/>))

This presentation is a brief summary of the geomorphic evaluation and paleoseismic trenches

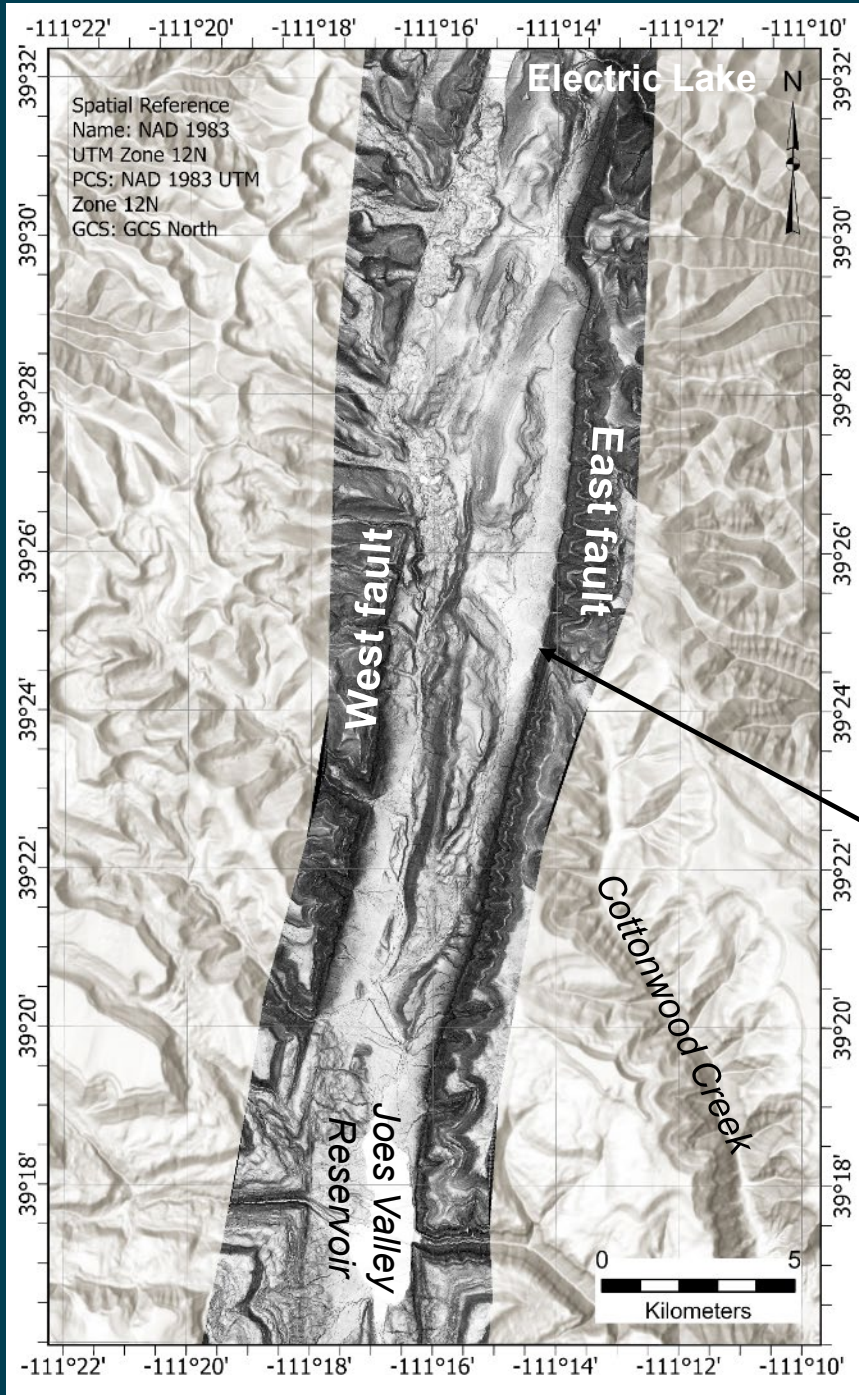
Geomorphic Mapping and Interpretation of Paleoseismic Trenches



We subdivide the Joes Valley fault zone into North, Central, and South sections for discussion purposes based on changes in strike and expression of the fault traces

- Geomorphic mapping of scarps and lineaments was done on all three sections
- Five paleoseismic trenches were excavated at four localities on the North section
- Two paleoseismic trenches were excavated at two localities on the South section
- Although the Central section has scarps and lineaments, the sites were not accessible for trench excavations

Faults shown are from the USGS Quaternary fault and fold database



North Section: Geomorphic Expression

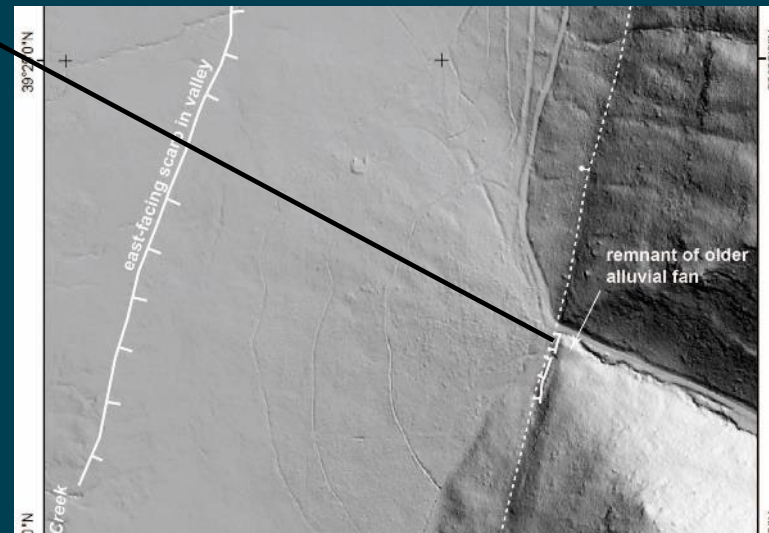
- The 38 km-long section between Electric Lake and just south of Joes Valley Reservoir
- Approximately coincides with Joes Valley
- Includes linear ridges (Bald Mtn, Bald Ridge, Middle Mtn)
- Includes intervening valleys (Scad, Upper Joes Valley, Staker)
- Evidence for drainage changes

West fault

- Three en echelon traces
- Traces overlap by 1-6 km
- Glacial till and outwash are offset and overlap traces
- Lineaments through Quaternary deposits and rock

Faults within Joes Valley

- Along linear ridges and intervening valleys



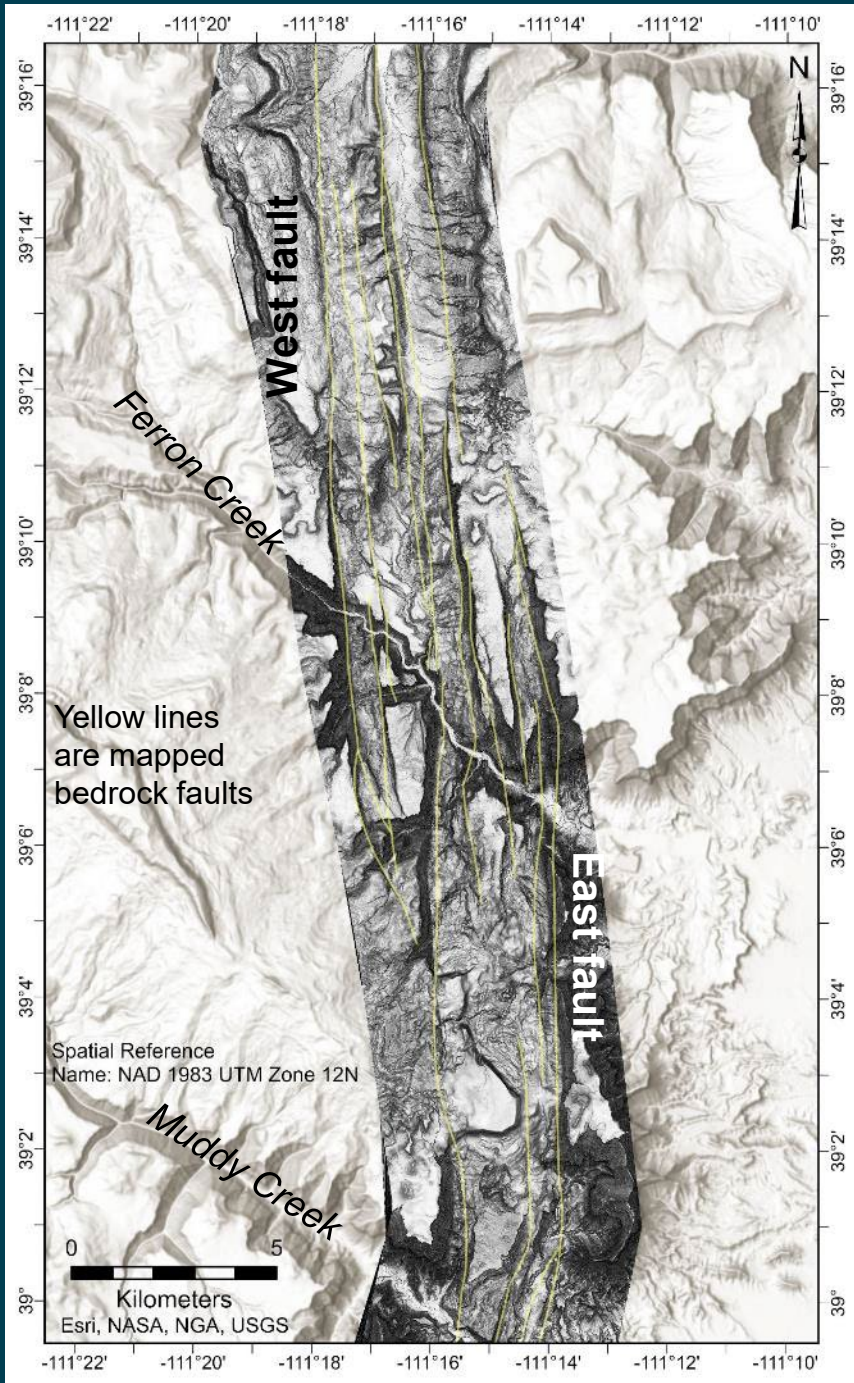
East fault

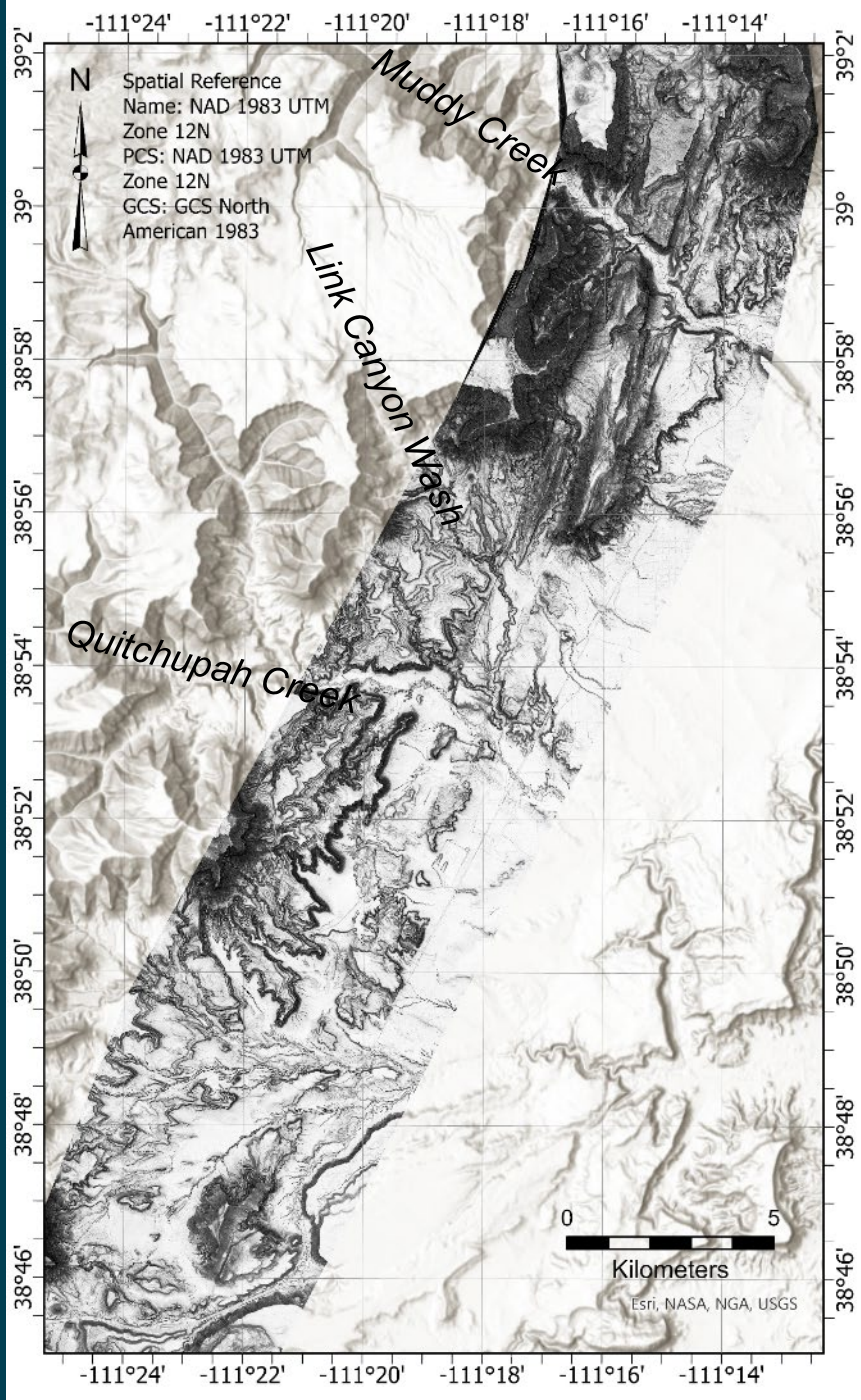
- Mostly along the base of a steep, west-facing rock escarpment
- At least four drainages have scarps that truncate alluvial deposits (example at left)
- Large alluvial fans preserved west of the fault

Cottonwood Creek (at left) has a scarp that truncates a bouldery alluvial deposit at the East fault

Central Section: Geomorphic Expression

- The 25 km-long section between Joes Valley Reservoir and about 5 km north of Ferron Canyon
- Fault zone includes several subparallel north- or north-northwest-striking faults that cut across bedrock mesas at several elevations; no overall valley morphology
- Faults bound a series of generally linear ridges and the intervening valleys
- Near Ferron Creek, the fault zone has a more complex pattern of ridges and valleys created by multiple, overlapping branching faults, and the fault zone overall steps left
- Complex zones of mass-wasting deposits throughout this section
- No paleoseismic trenches were excavated across this section

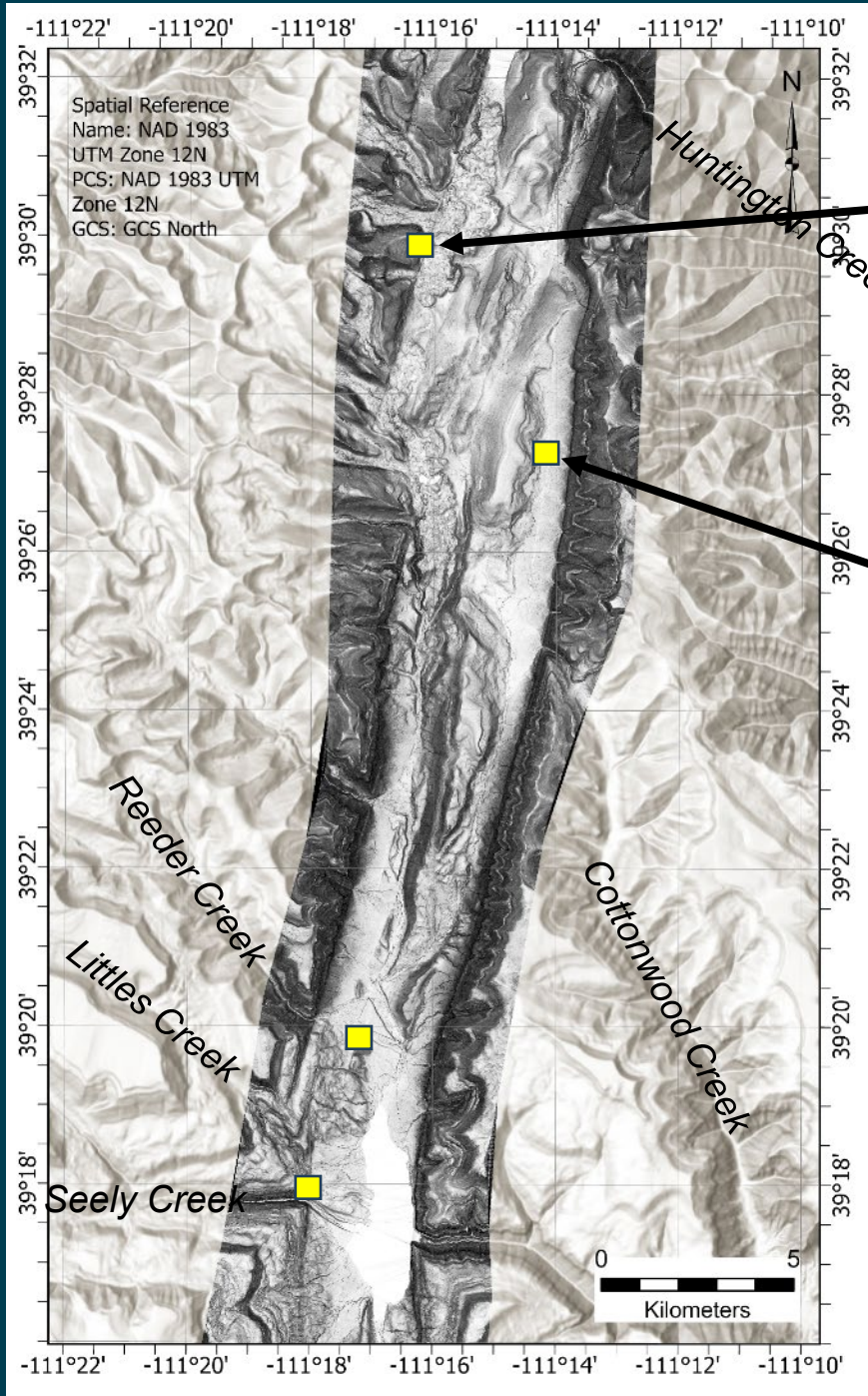




South Section: Geomorphic Expression

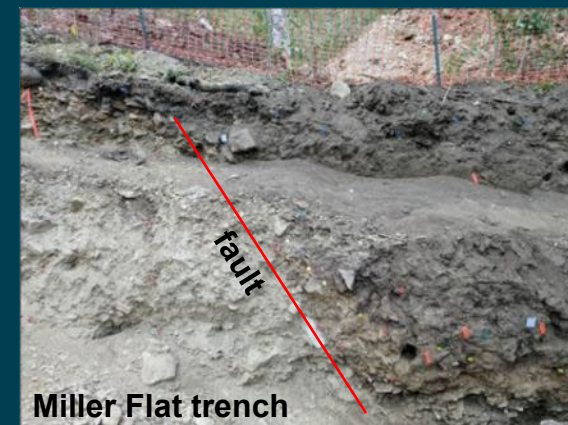
- The 22 km-long, northeast-striking section between the high mesas north of Muddy Creek and south of Quitchupah Creek
- Composed of multiple, overlapping faults
- Bedrock maps show Quaternary alluvium displaced against rock along parts of the section south of Link Canyon Wash
- This section is along the southeast edge of the Wasatch Plateau
- No topographic valley is associated with this section
- Two subsections divided at Link Canyon Wash
 - North of Link Canyon Wash, the South section is characterized by linear mesa and valleys; scarps on alluvial fans in places
 - South of Link Canyon Wash, the South section is marked by an abrupt change from incised highlands to the west and incised lowlands to the east; scarps at drainages; the east fault has little topographic expression

North Section: Paleoseismic Trenches



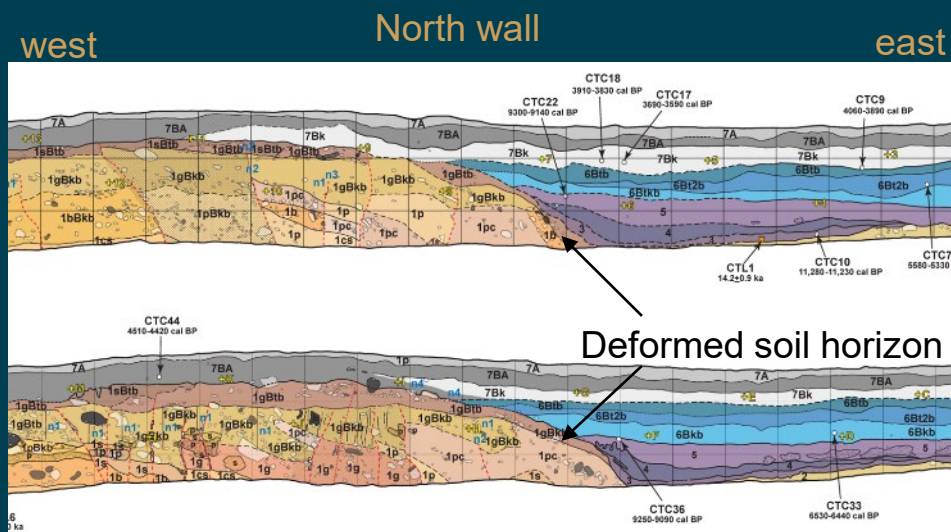
Miller Flat trenches

- On an east-facing scarp on the west fault
- Fault zone exposed
- Interpret three surface ruptures since about 12-13 ka



Christmas Tree trench

- On an east-facing scarp on a fault within Joes Valley
- No fault zone exposed; zone of deformation
- Interpret two to four surface ruptures since about 15 ka

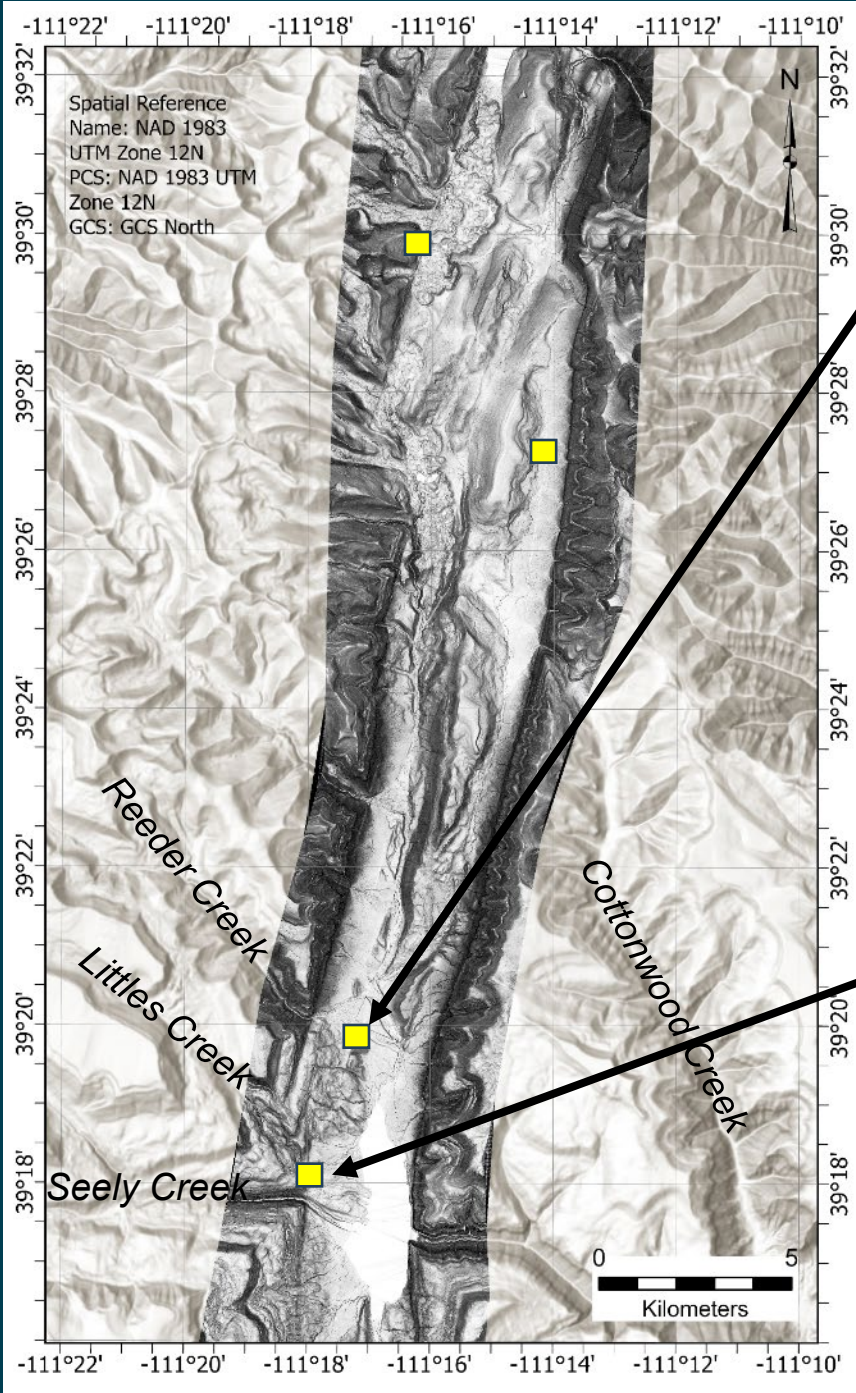


Log of part of Christmas Tree trench

Gravelly alluvial-fan deposits with a well-developed soil (brown)

Silt and clay deposited by drainages ponded against the scarp

North Section: Paleoseismic Trenches



Reeder Creek trench

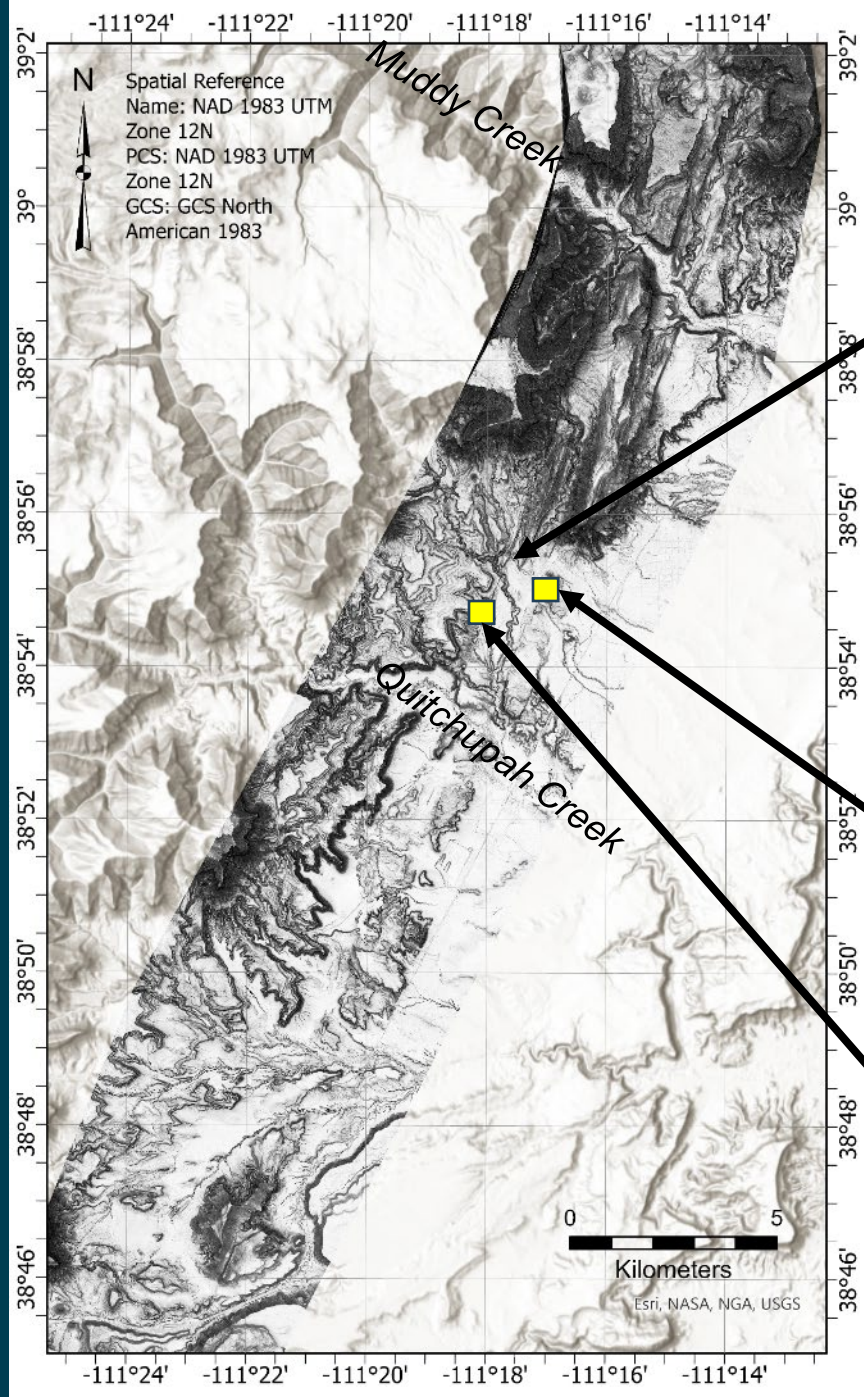
- On a west-facing scarp in Joes Valley ~0.5 km from the west fault
- Fault zone and deformation exposed
- Interpret two surface ruptures since about 6.5 ka



Littles Creek trench

- On an east-facing scarp on the west fault
- Fault zone exposed
- Interpret three surface ruptures since about 29 ka

South Section: Paleoseismic Trenches



Link Canyon Basin trench

- Fault zone and deformation exposed
- Interpret two surface ruptures since about 11 ka

Link Canyon West trench

- Fault zone exposed
- Interpret four surface ruptures since about 16 ka

Link Canyon West trench

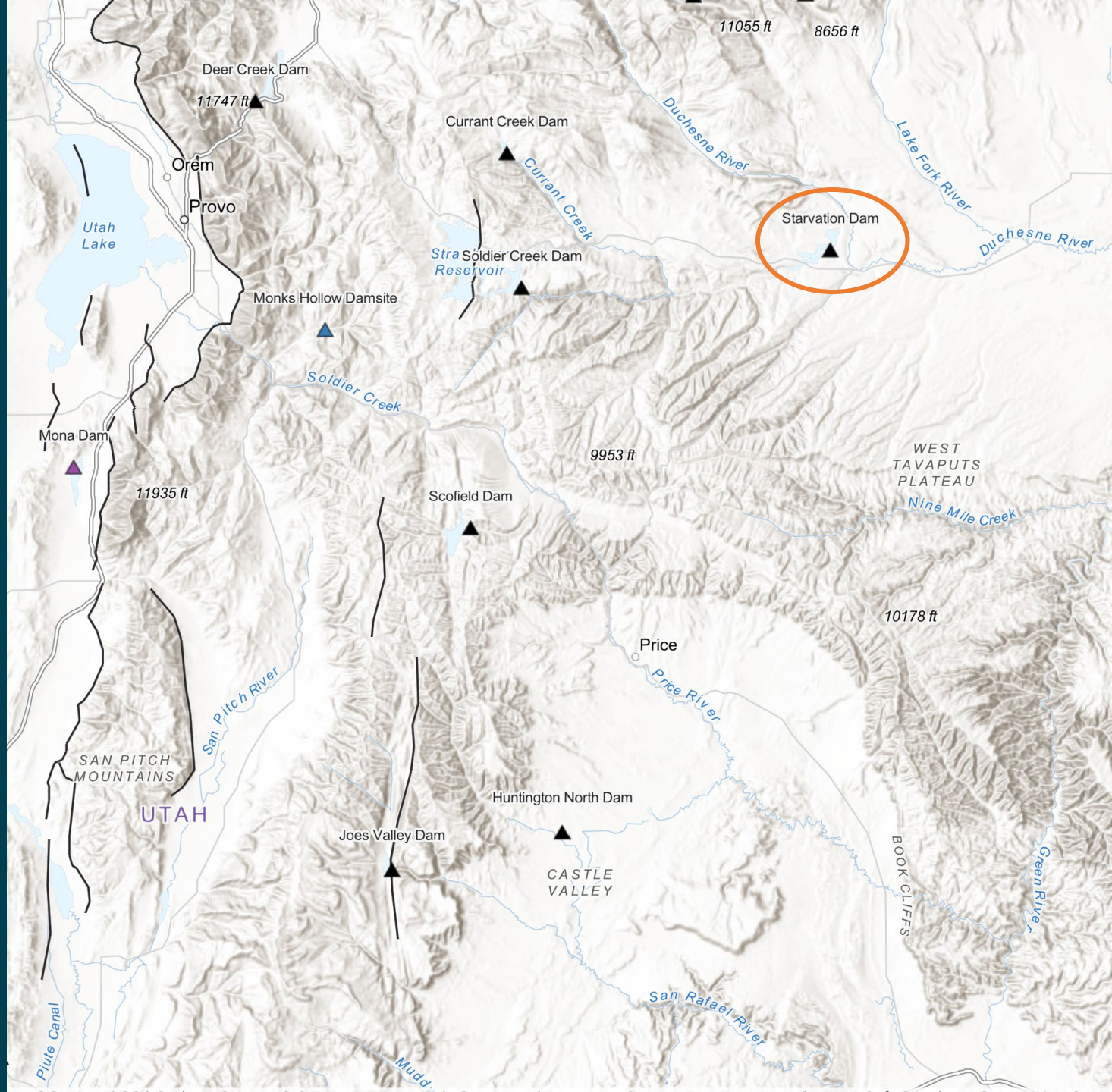


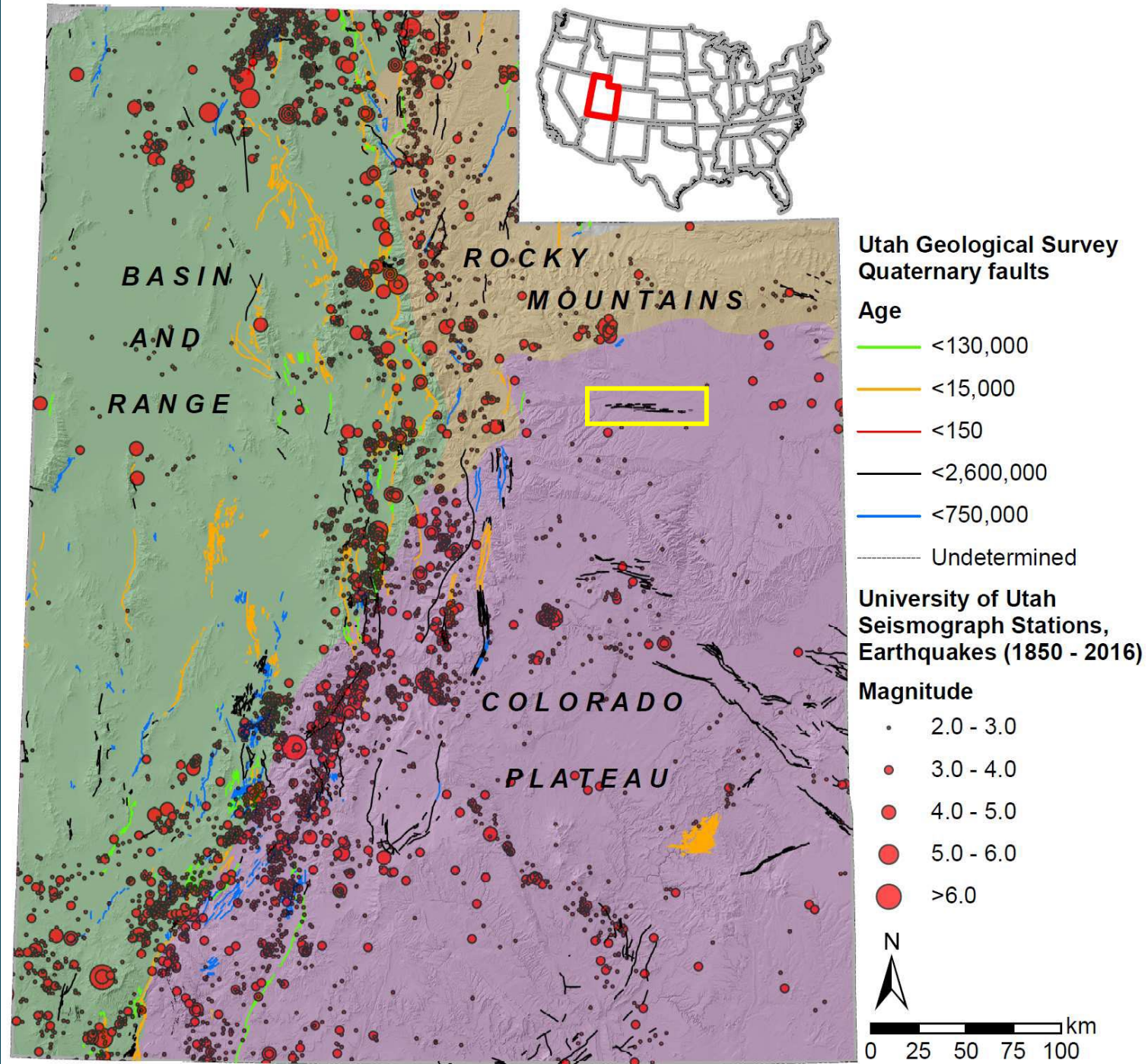


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Duchesne-Pleasant Valley Fault Zone

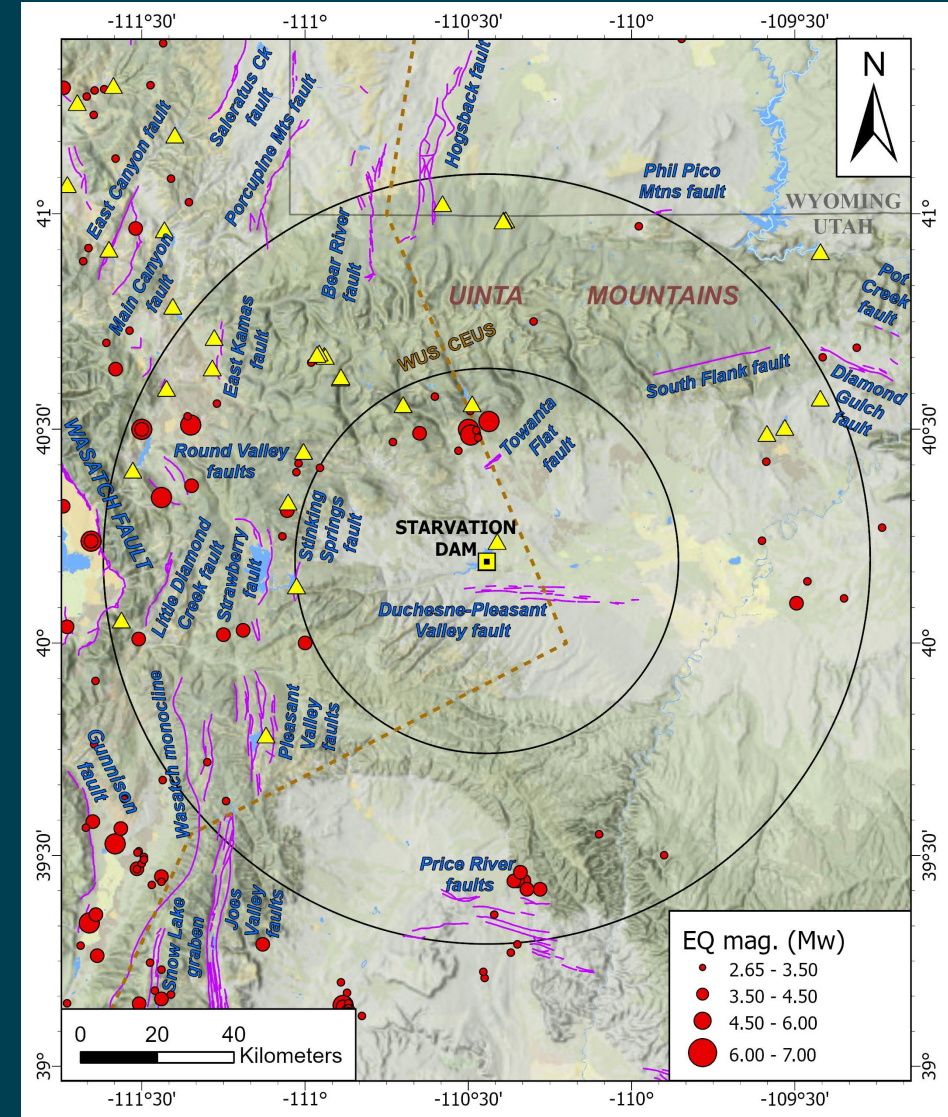
J. Howe and R. Klinger – Reclamation (former)

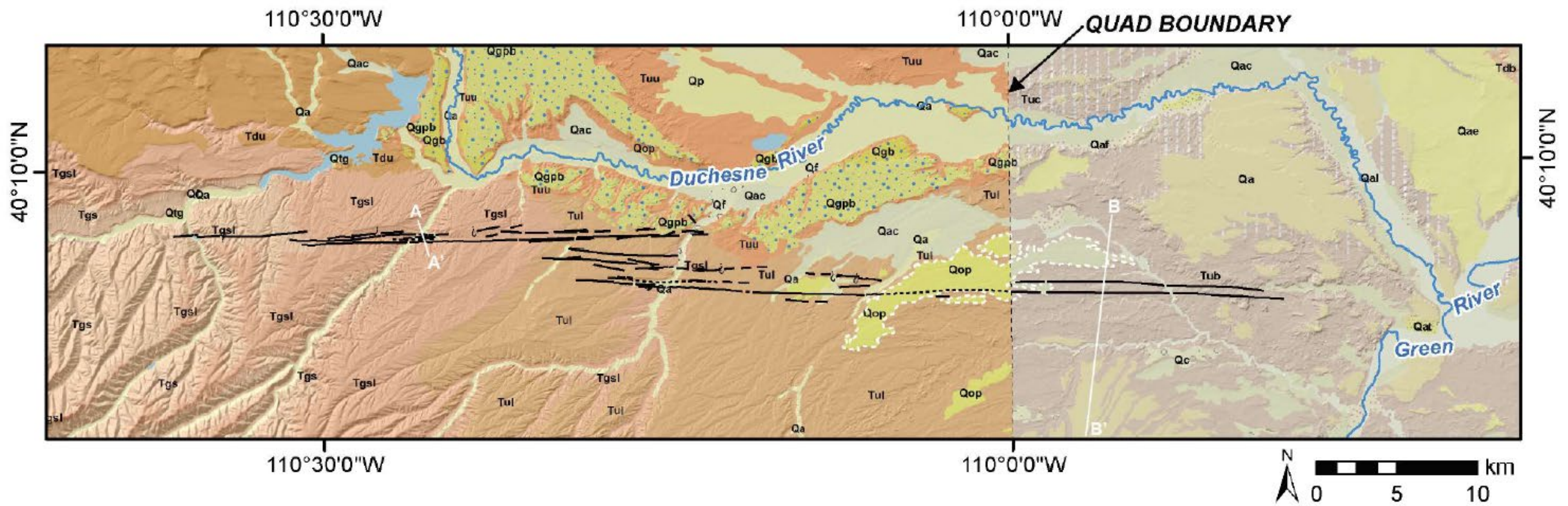




Seismic hazard studies in northeast Utah

- BOR dams in/near the Uinta Mountains
- Minimal historic seismicity, few Quaternary-active faults
- Duchesne-Pleasant Valley fault zone (DFZ) is within 50 km of five dams
 - Quaternary active based on morphology and offsets of Q deposits (Howe and Klinger, 2021)





DFZ
Sprinkel (2021, personal communication)

- Well-located
- - - Approximately located
- - - Approximately located, queried
- Concealed
- - - - - Uncertain

Geologic Units
Duchesne and Kings Peak 30' x 60' Quads
Bryant (2010)

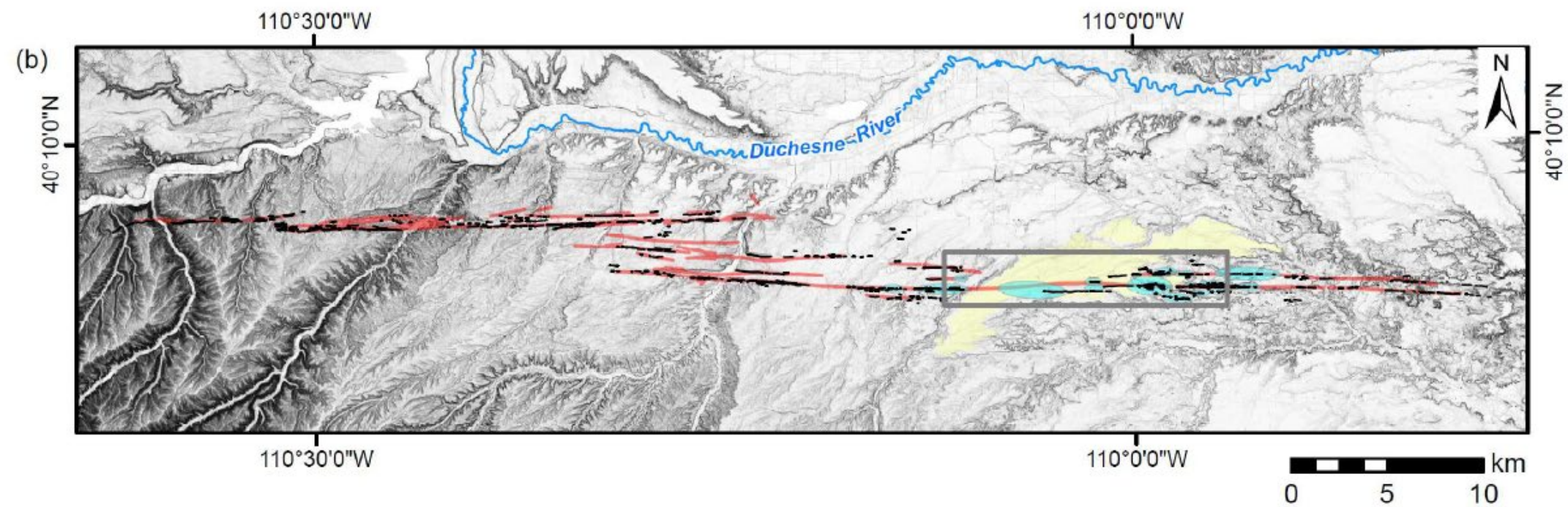
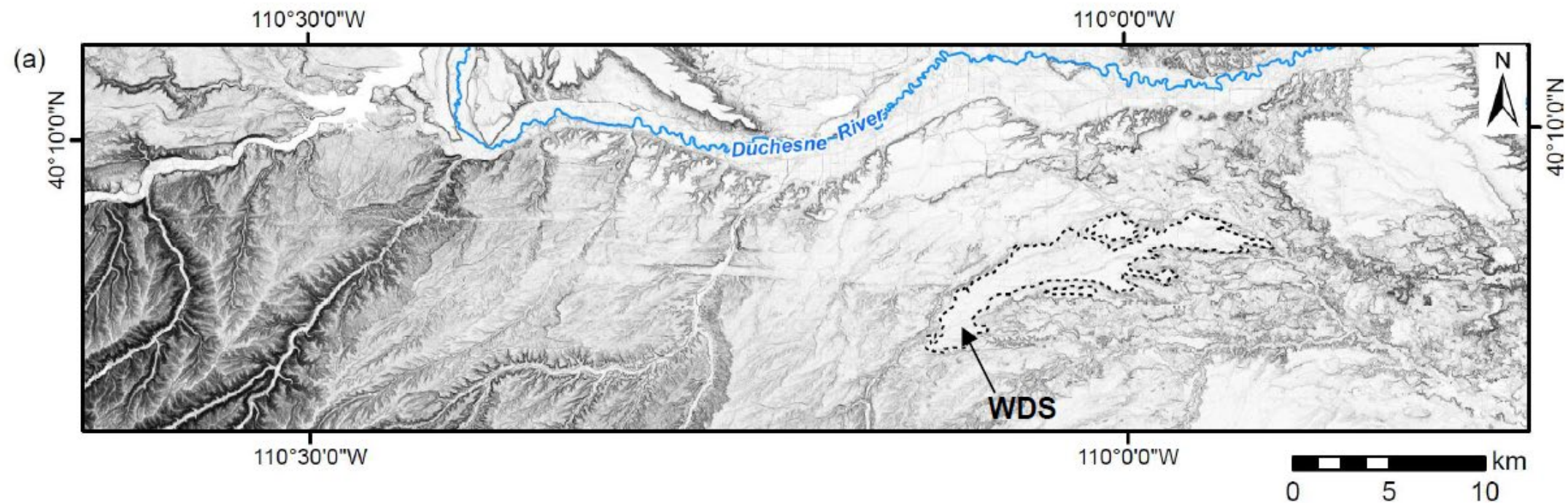
- Qac Alluvium and colluvium
- Qa Alluvium
- Qp Pediment deposits
- Qf Alluvial- and debris-fan deposits
- Qtg Terrace gravels
- Qop Older pediment deposits
- Qgb Glacial outwash deposits of Bull Lake age
- Qgpb Glacial outwash deposits of pre-Bull Lake age
- QTg Gravel

- Tdu Duchesne River Formation (undivided)
- Tuu Upper member of the Uinta Formation
- Tul Lower member of the Uinta Formation
- Tgsl Sandstone and limestone facies of the Green River Formation
- Tgss Sandstone facies of the Green River Formation
- Tgs Saline facies of the Green River Formation
- Water

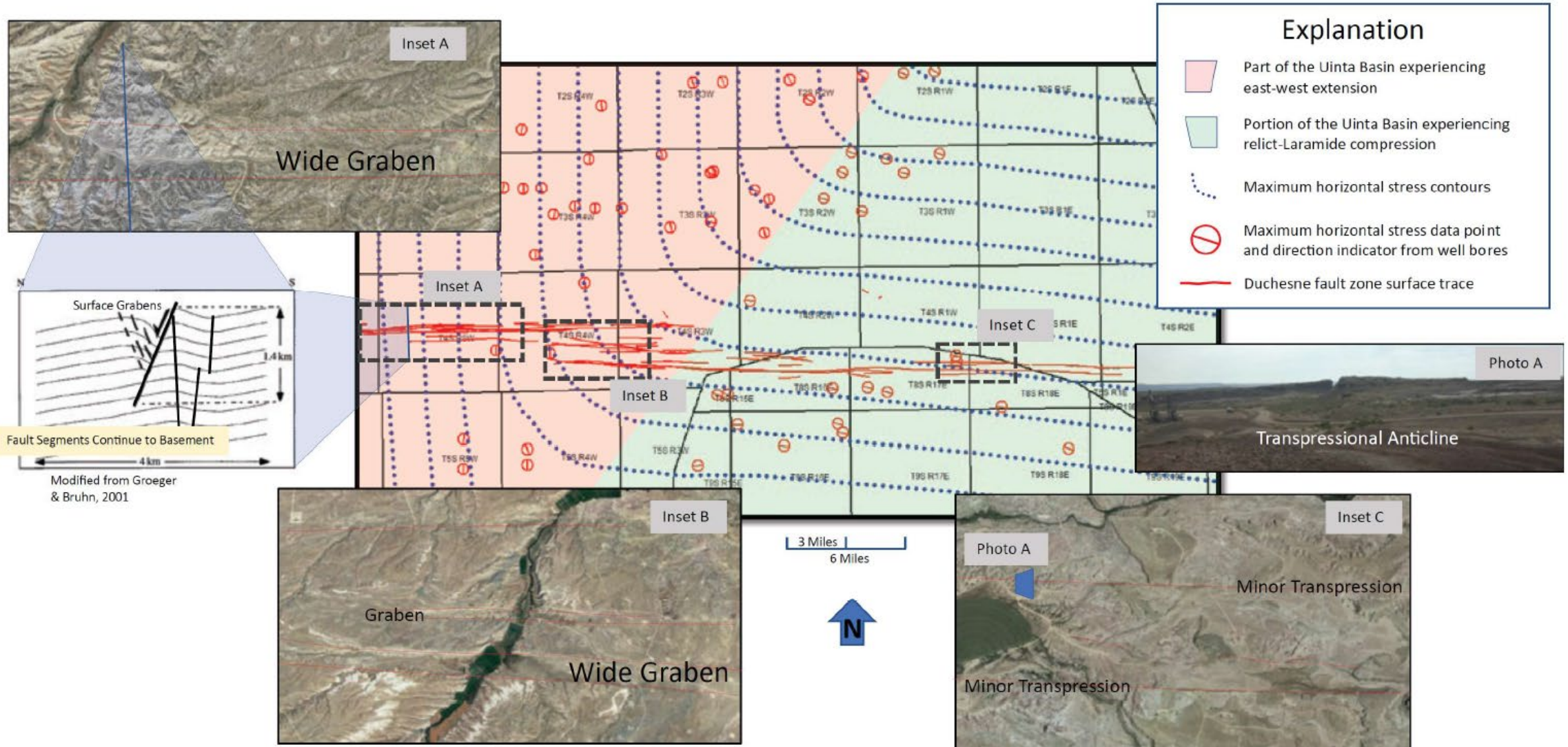
Geologic Units
Vernal 30' x 60' Quad
Sprinkel (2007)

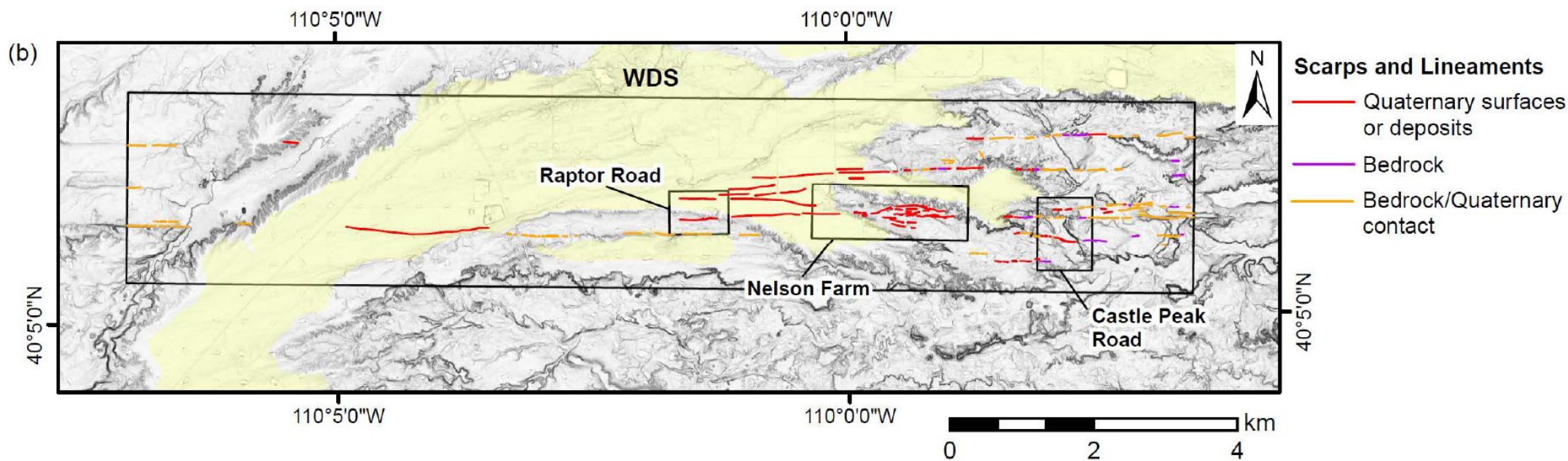
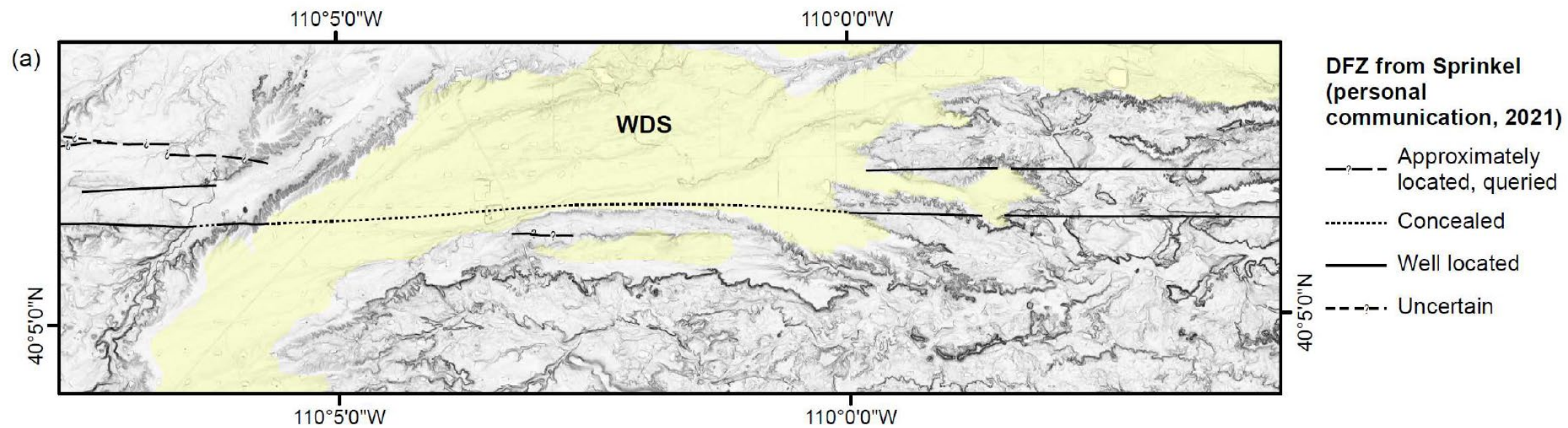
- Qal Flood-plain and channel alluvium
- Qa Piedmont and basin alluvium, undivided
- Qat Terrace deposits
- Qaf Alluvial-fan deposits
- Qac Mixed alluvium and colluvium
- Qae Mixed alluvium and eolian deposits
- Qc Colluvium
- Tdb Brennan basin member of Duchesne River Formation
- Tuc Member C of Uinta Formation
- Tub Member B of Uinta Formation

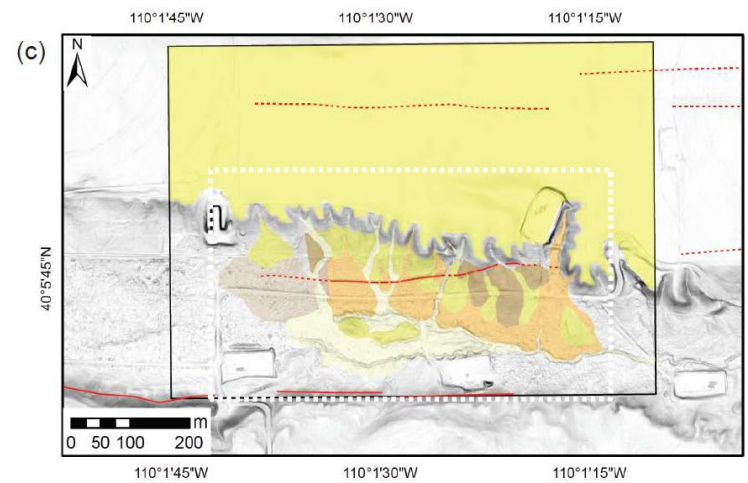
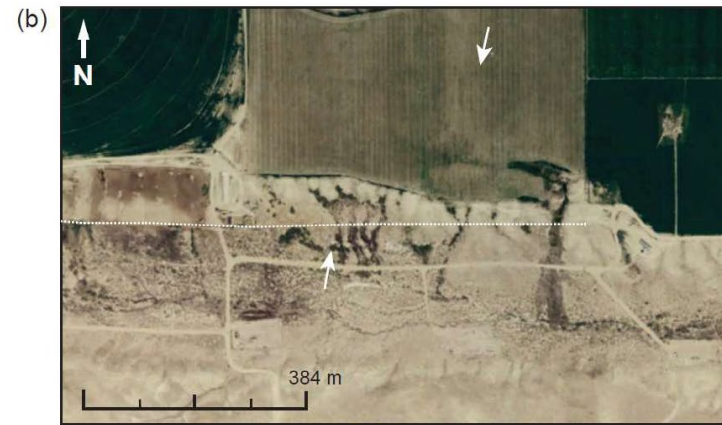
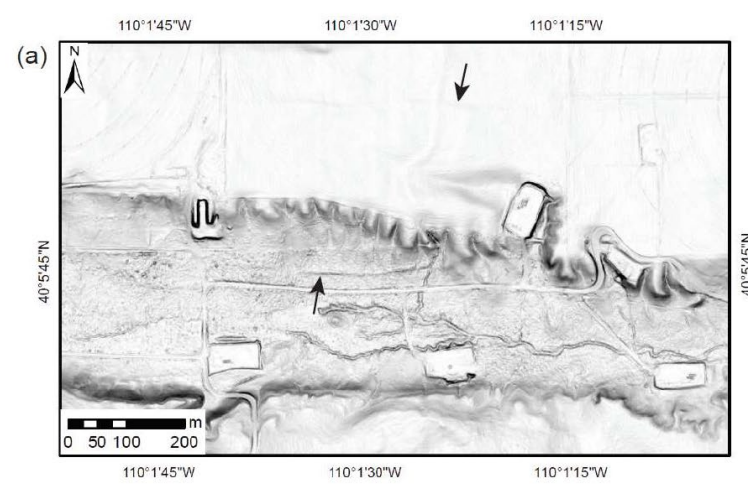
Mapping by D. Sprinkel, UGS



West and east fault segments have differing geometries







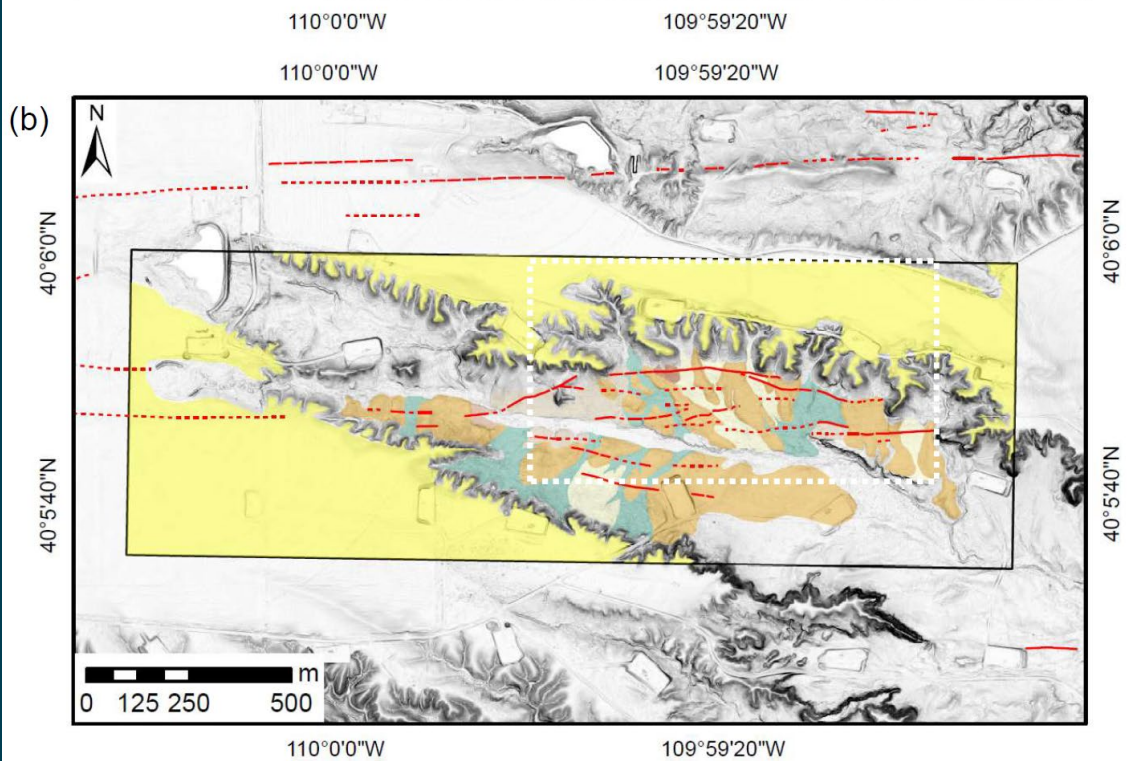
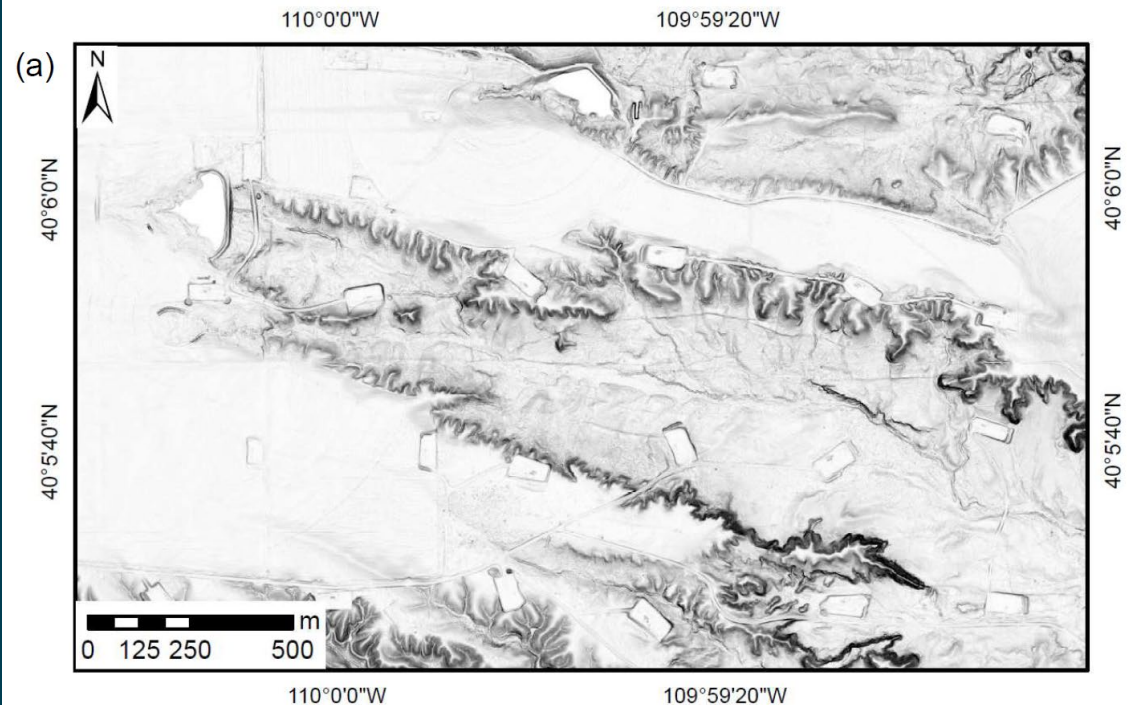
Scarp or Lineament Expression

- Strong
- - - Moderate
- · · Weak

Quaternary Units

- Qal4 Alluvium (youngest)
- Qc Colluvium
- Qt Terrace deposits
- Qal3 Alluvium (intermediate)
- Qal2 Alluvium (intermediate)
- Qal1 Alluvium (oldest)
- Qop Older pediment deposits





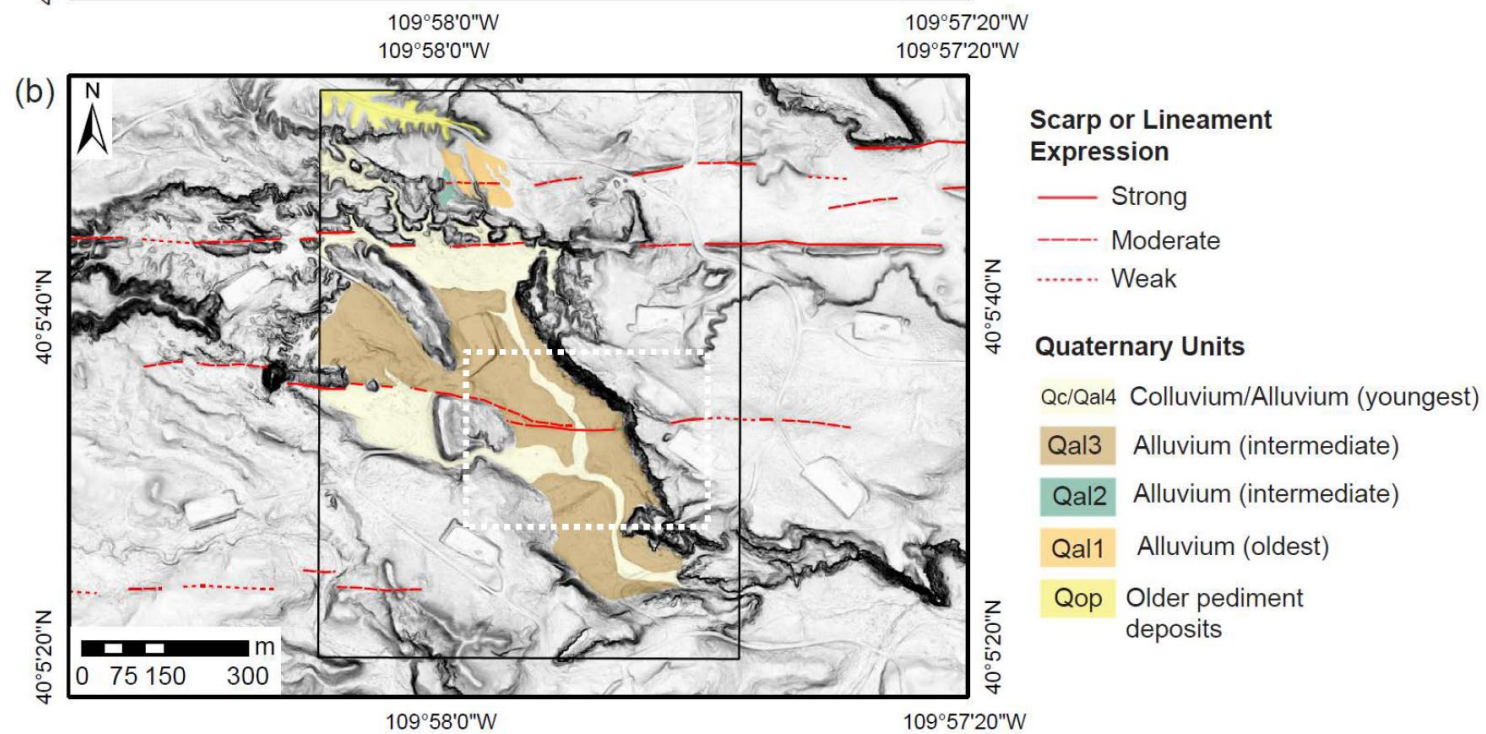
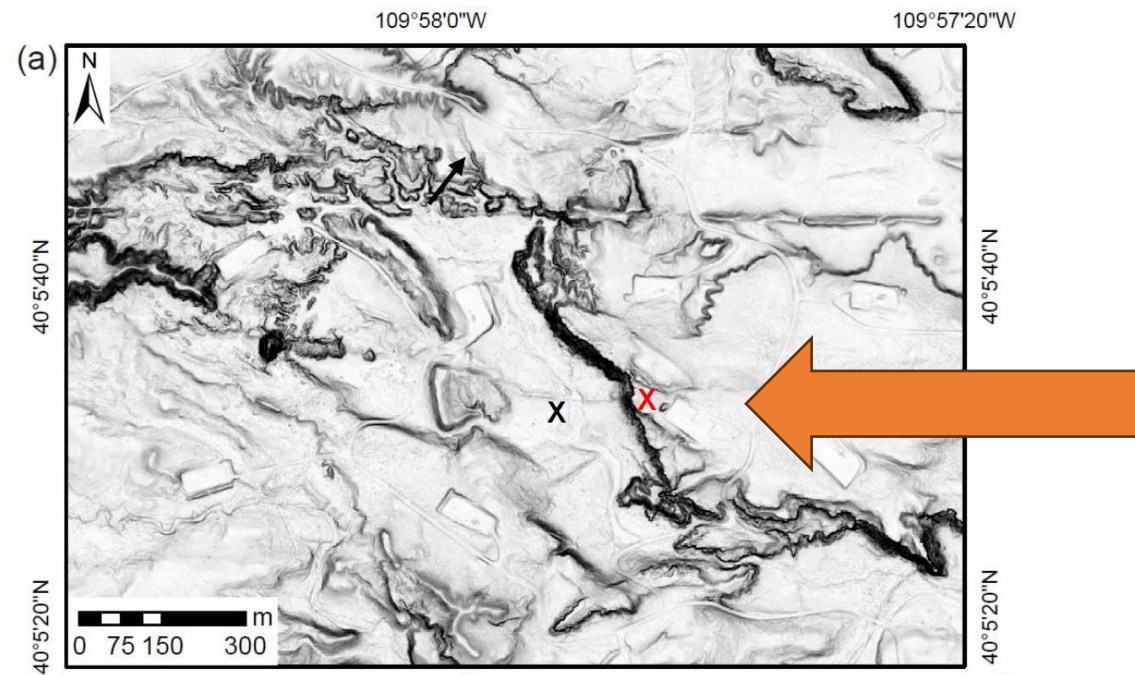
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- Qal2 Alluvium (intermediate)
- Qt Terrace deposits
- Qal1 Alluvium (oldest)
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(a)



(b)

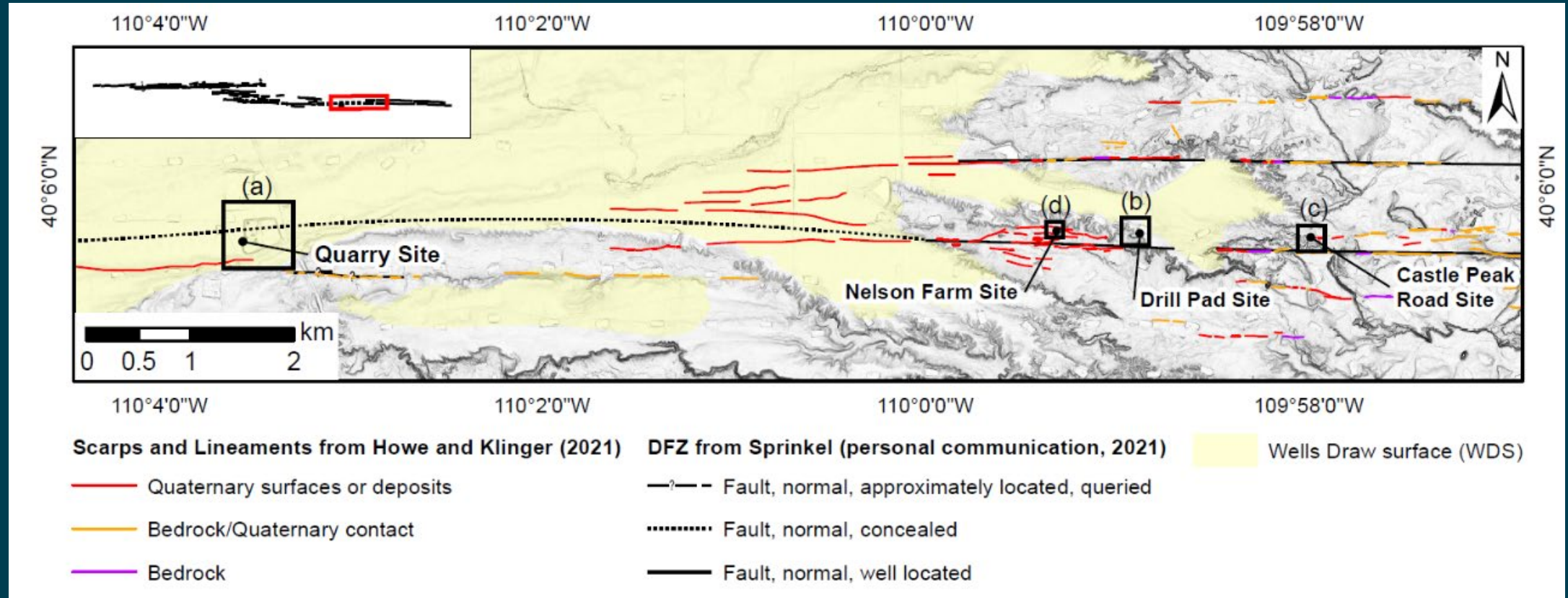


The Duchesne-Pleasant Valley fault zone

- Differing stress and geometries of west and east segments
- East segment offsets Quaternary sediments
- The fault is poorly exposed and was not trenched
 - Outcrops and pits exposing fluvial sediments and loess sampled for OSL
 - Faulting likely pre-dates loess deposition

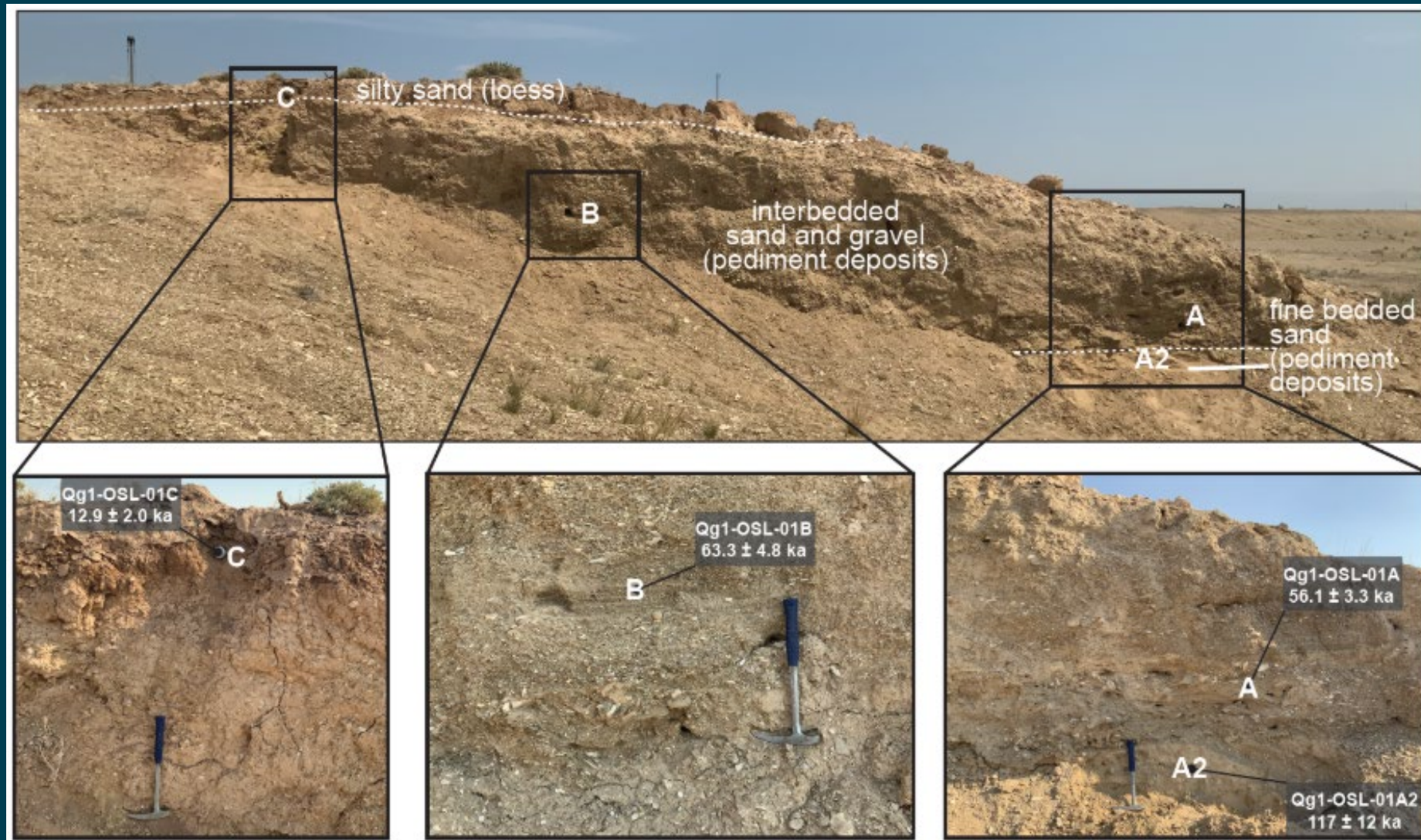


Stratigraphic observations

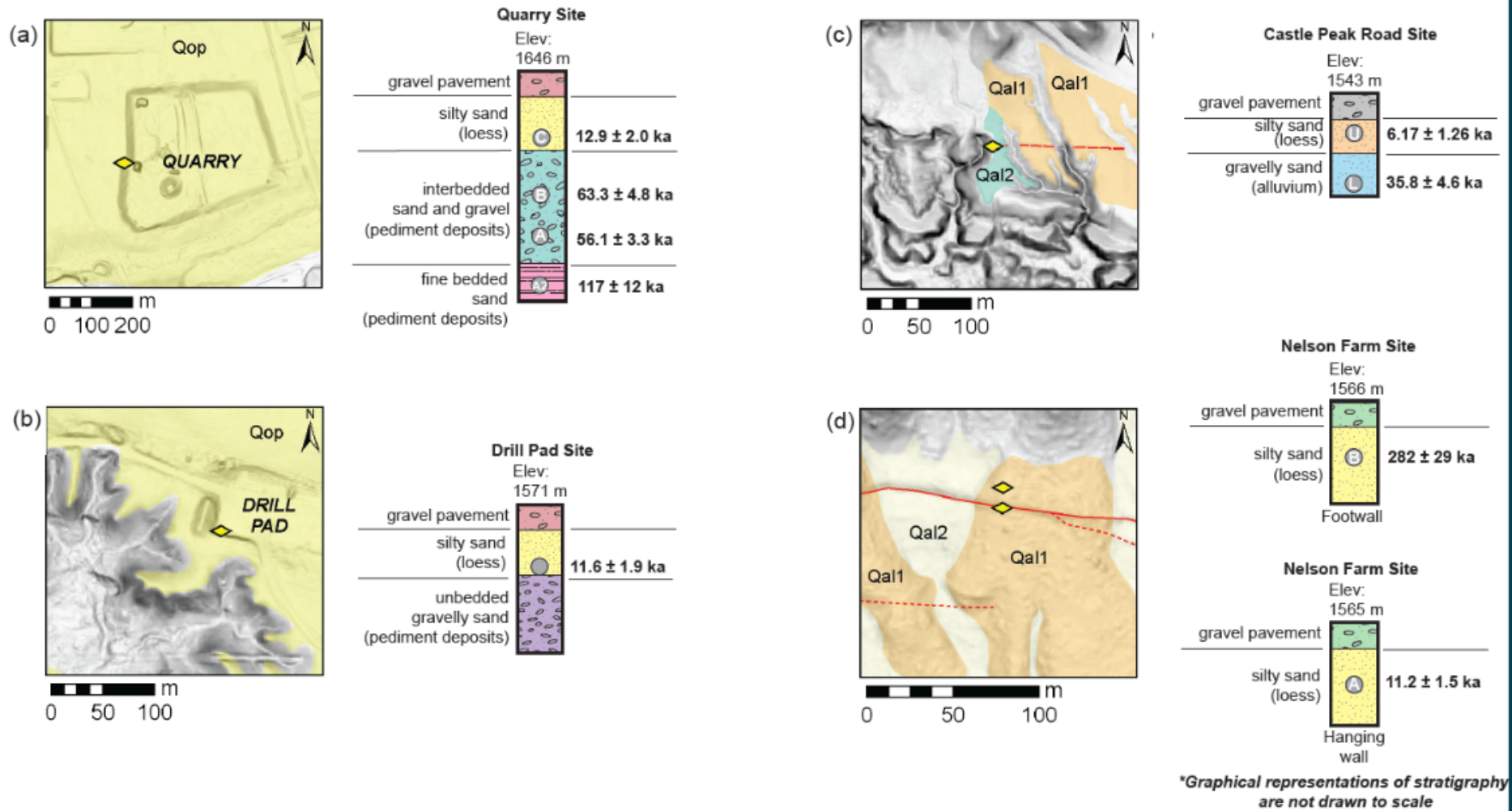


"WDS" is the oldest Quaternary feature offset by the fault
Younger fluvial surfaces are faulted at Nelson Farm and Castle Peak Rd





Stratigraphic observations



DFZ study – summary

- Fluvial sediments with loess cover form the youngest faulted surfaces
- OSL ages of faulted fluvial sediment are 36-63 ka
- The DFZ is slow, with recurrence intervals likely >10 kyr
- Additional work is needed to improve fault characterization
 - Better defined stratigraphic relationships of Q deposits and the fault

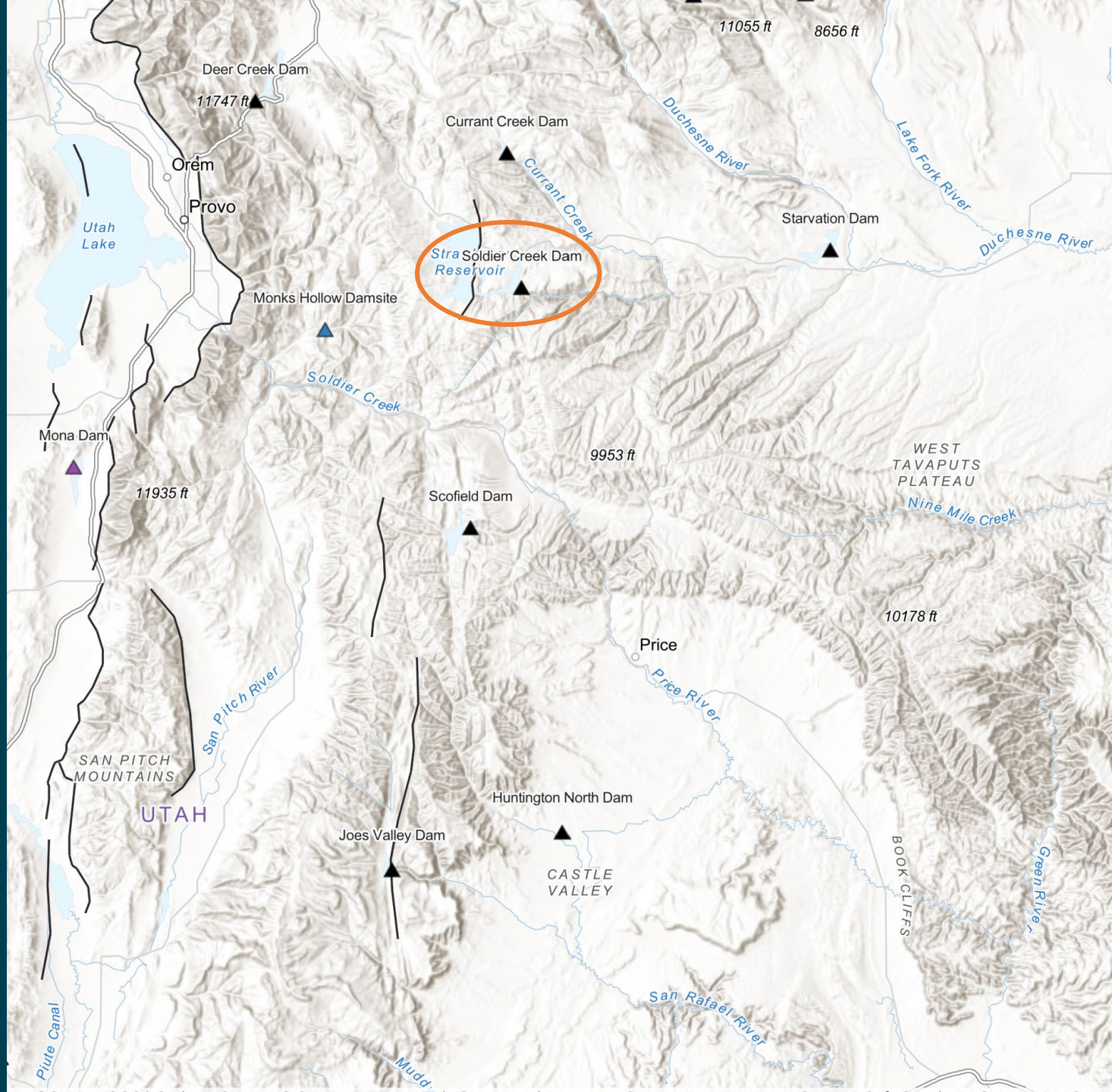


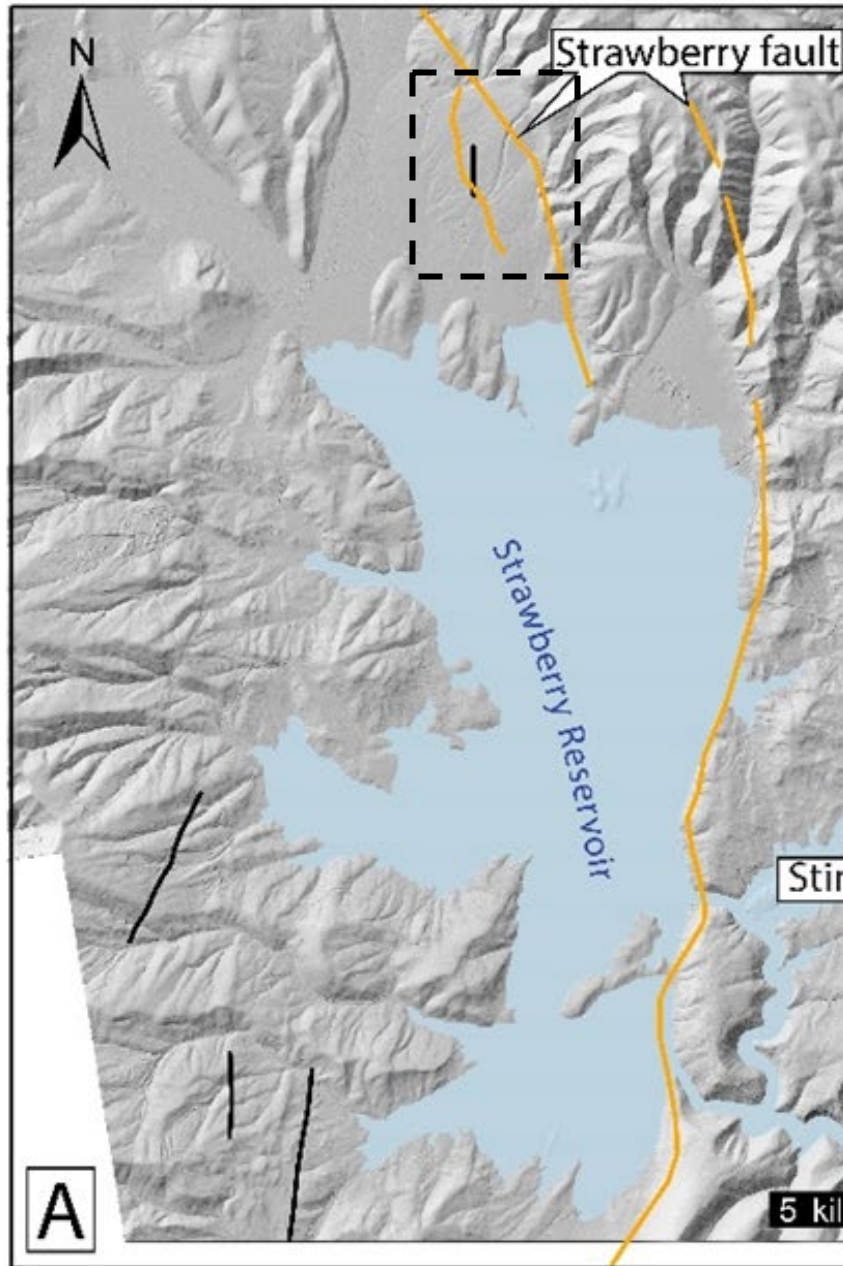


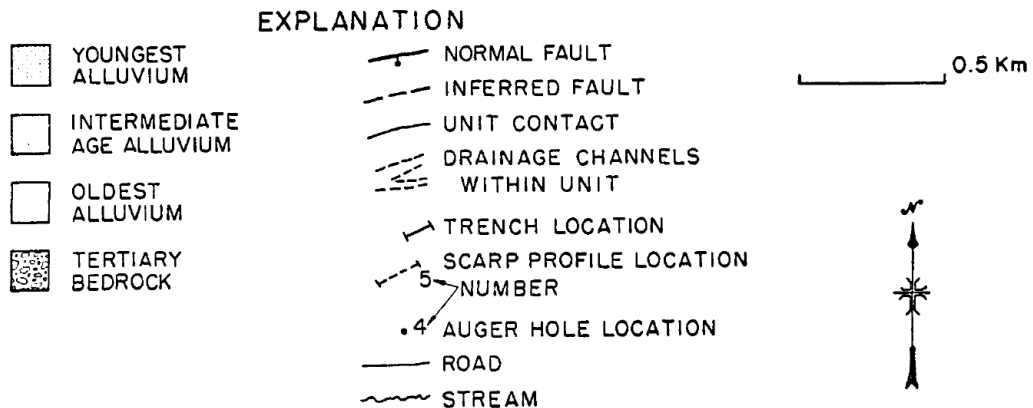
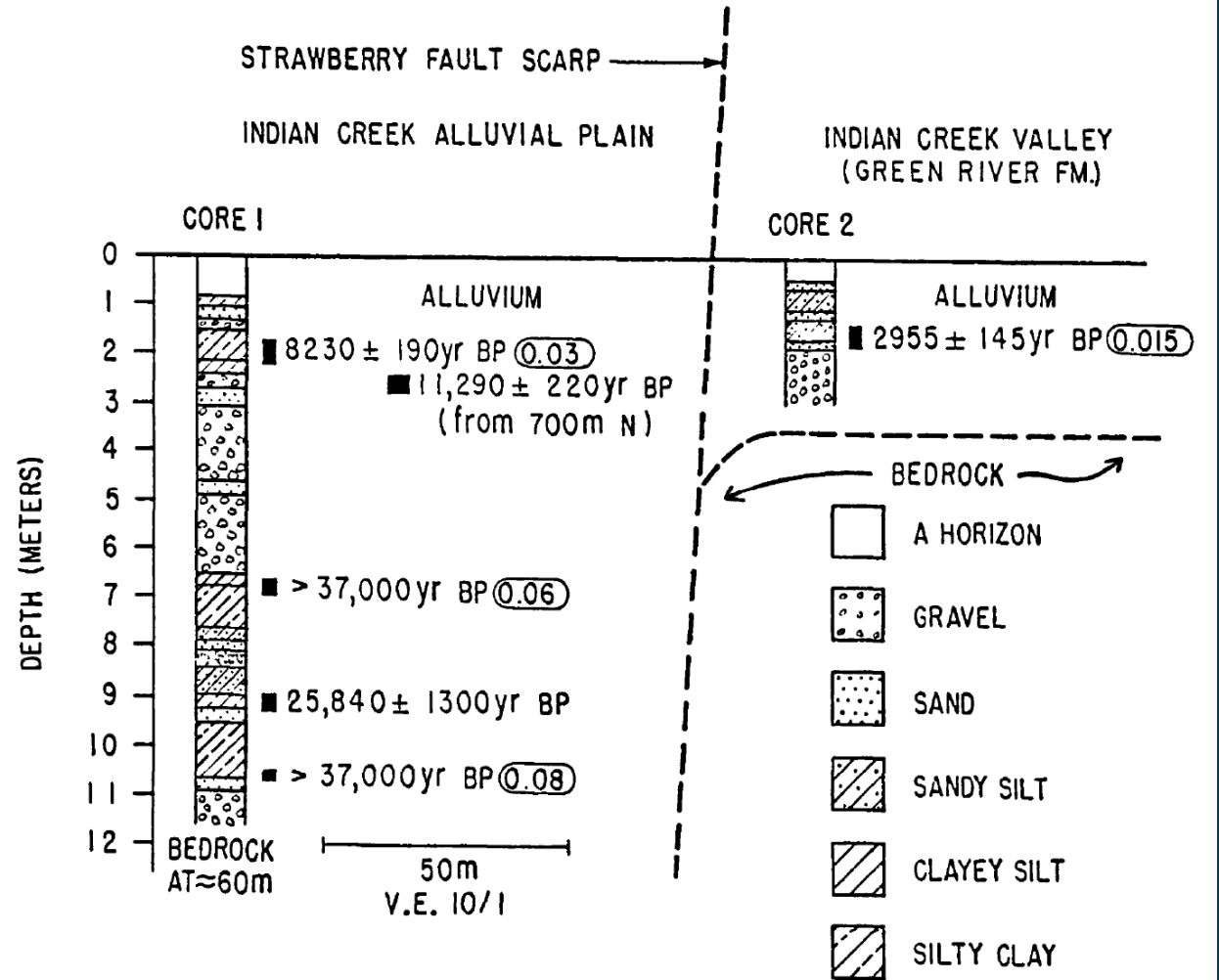
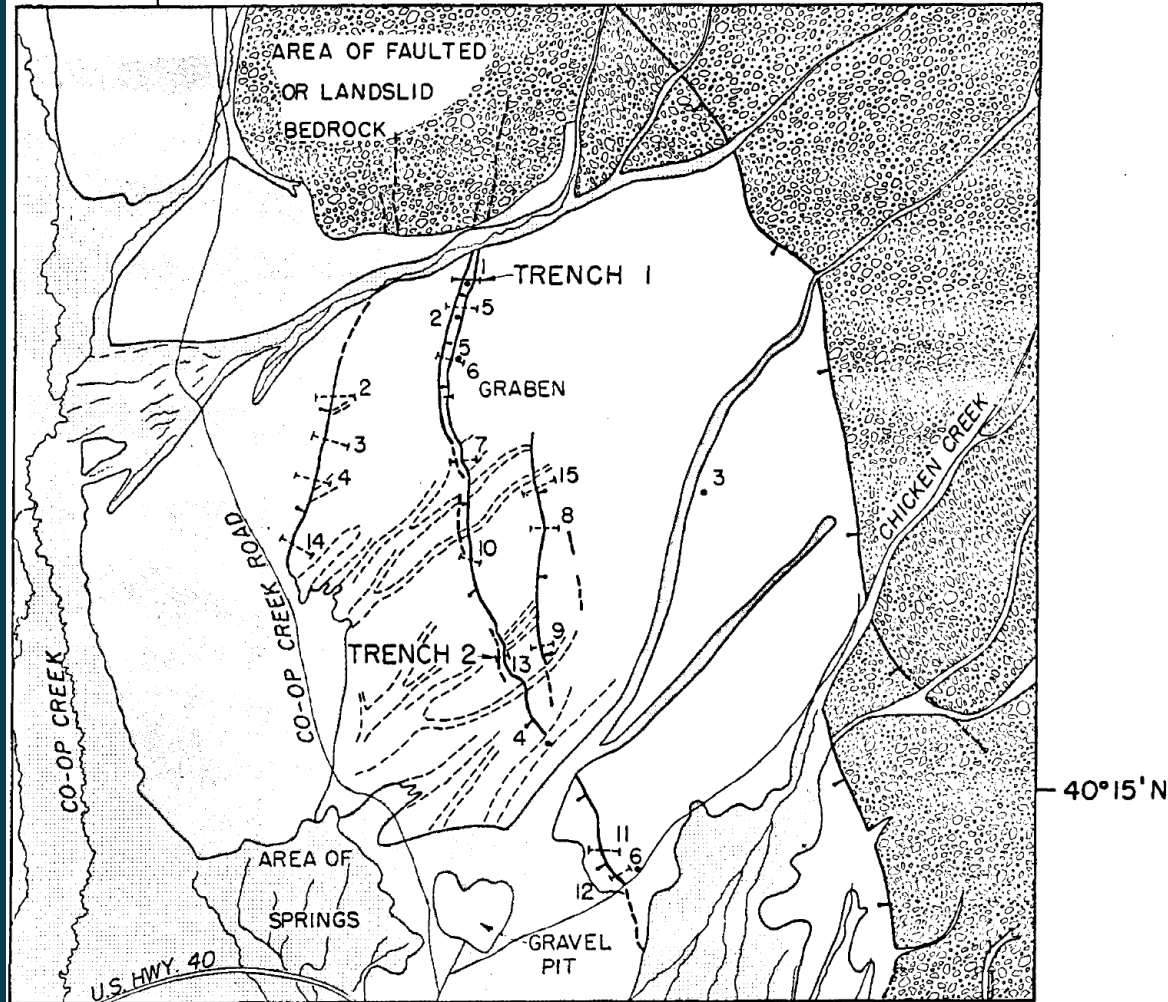
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Strawberry, Soldier Springs & Stinking Springs Faults

Future Work - TBD

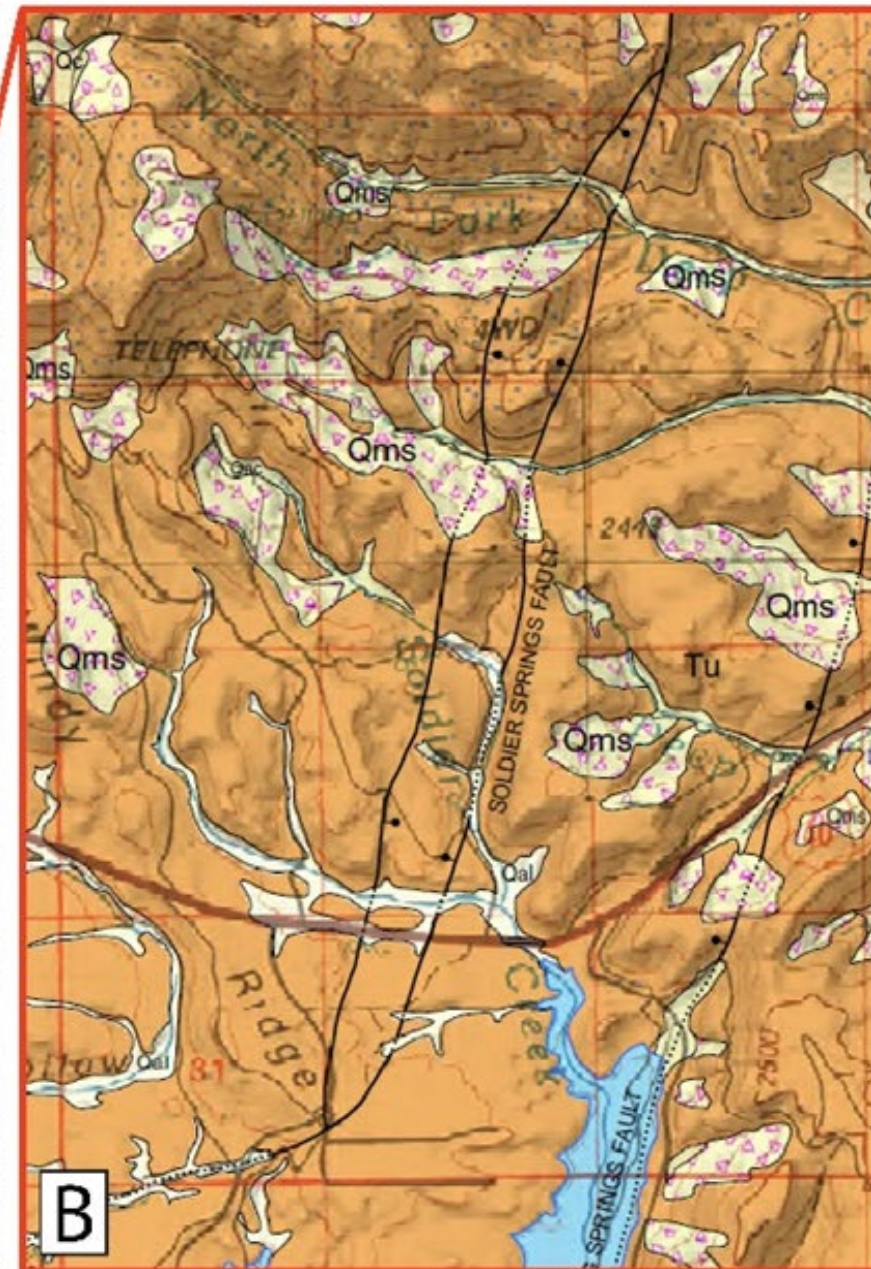
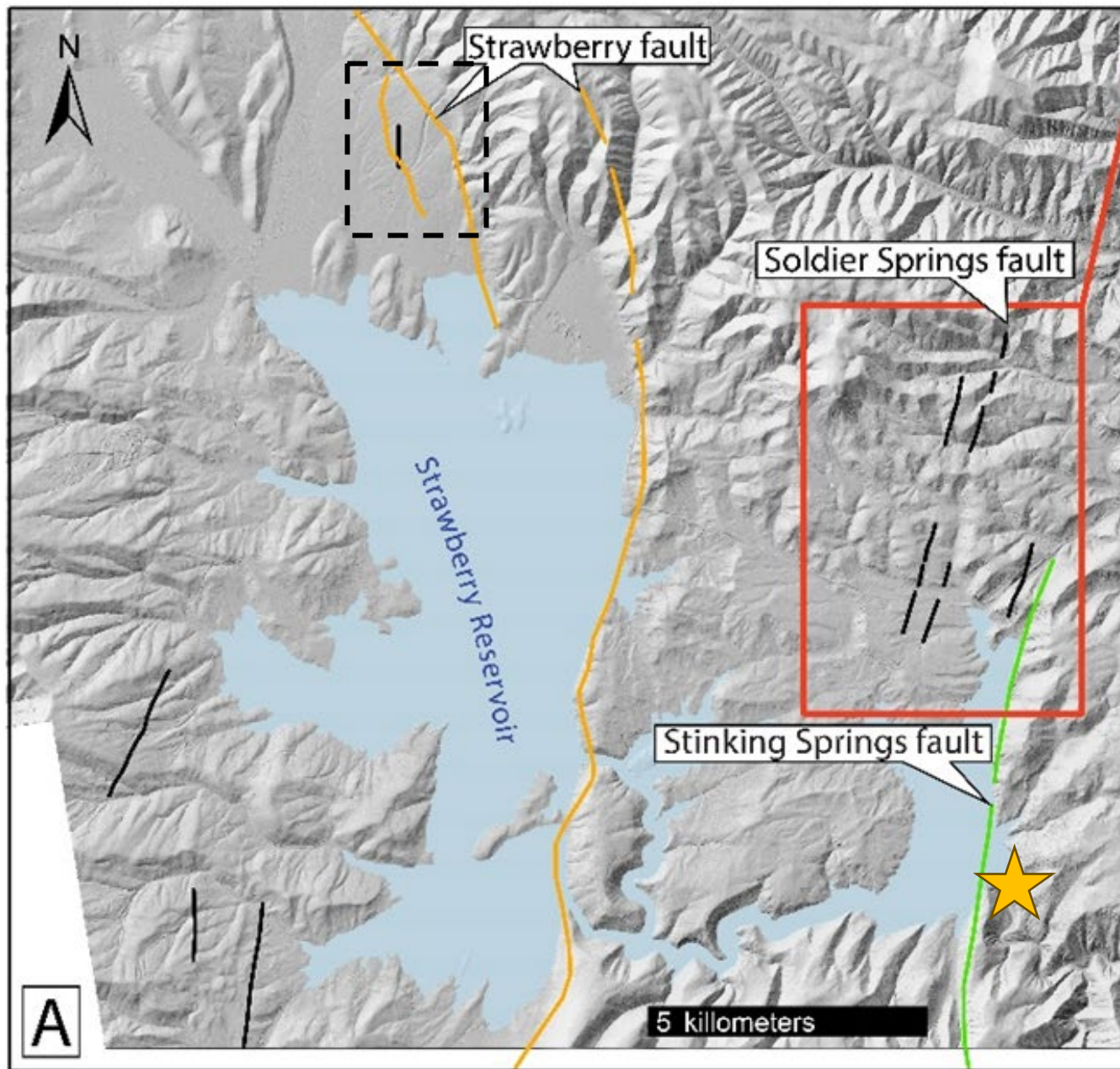




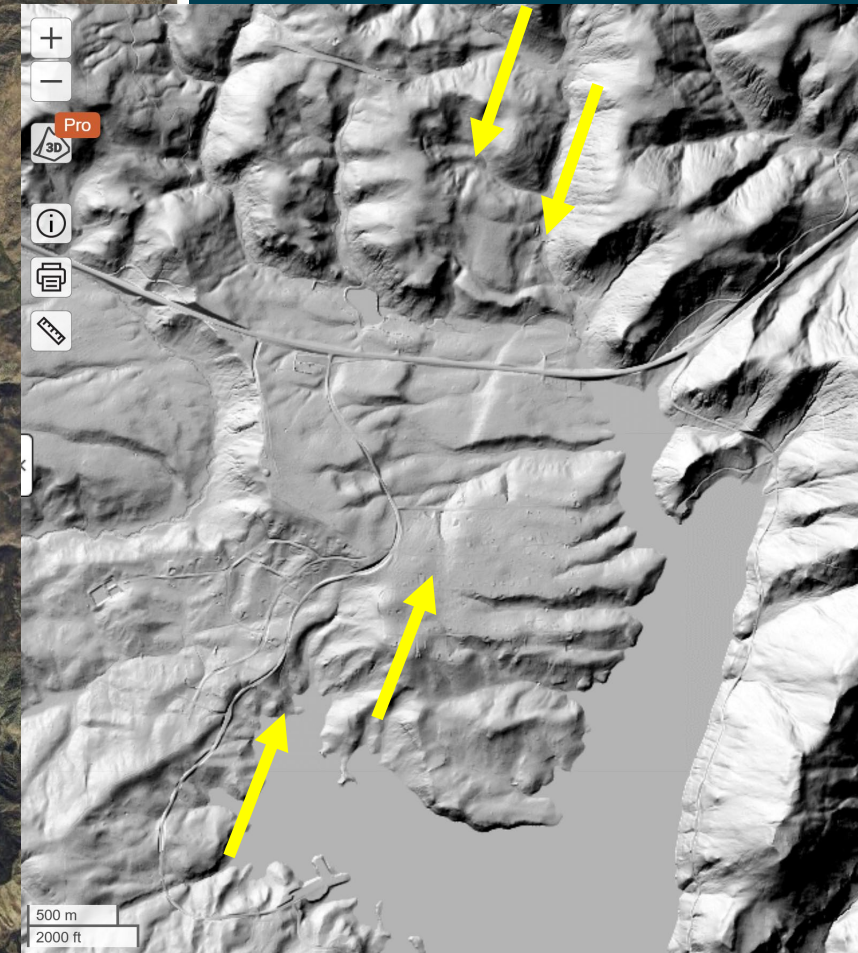
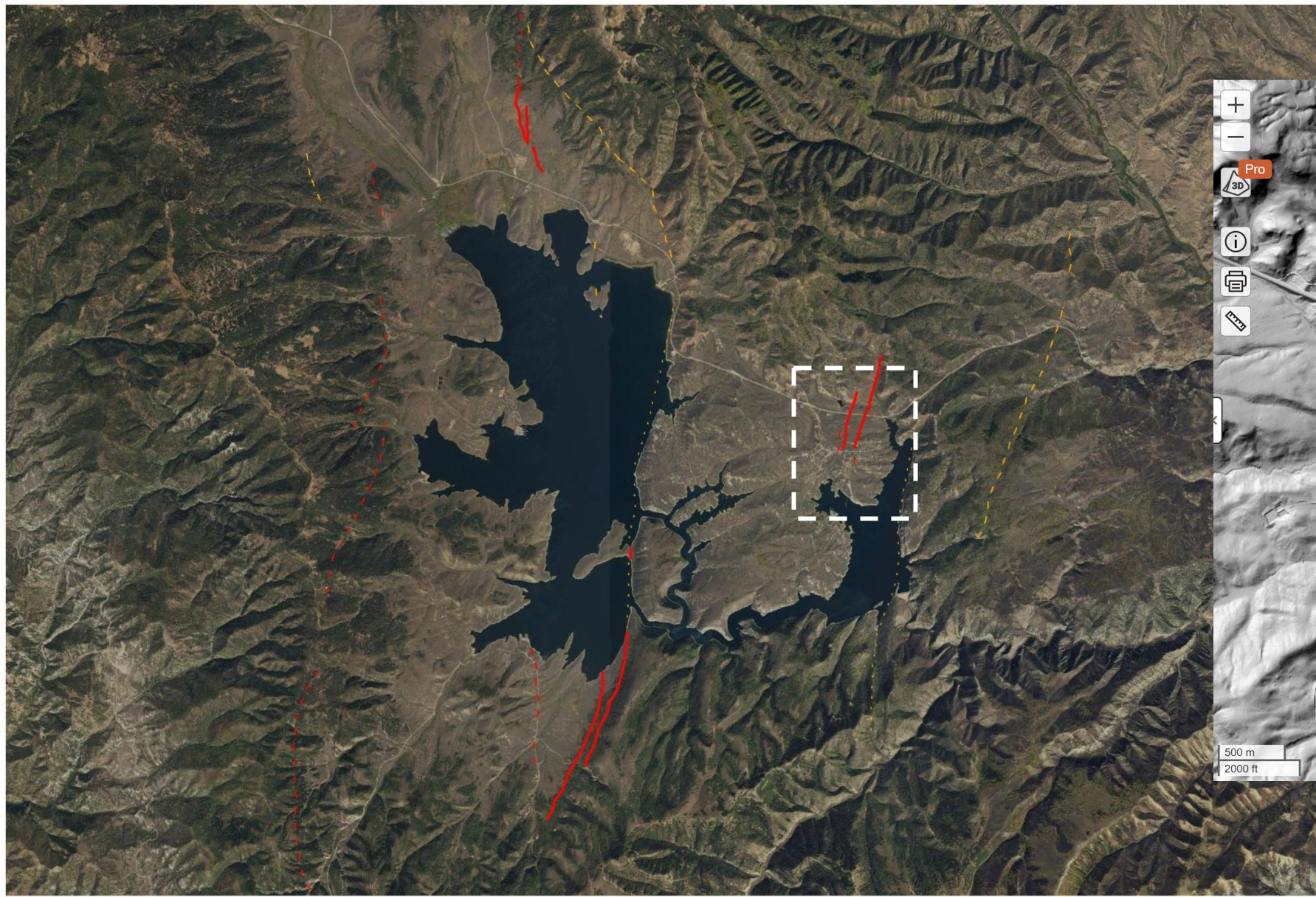


Coop Creek Scarps – Nelson and Martin, 1982

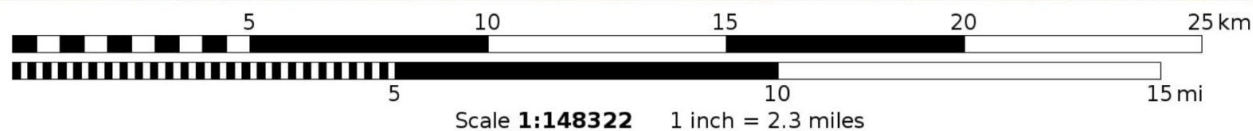




Soldier Springs Graben



Mercator Projection
WGS84
UTM Zone 12T
 CALTOPO



MN
10.4°



Ellen Lamont, Geologist
Bureau of Reclamation
Elamont@usbr.gov



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How does inherited deformation control the frictional behavior of the Wasatch Fault?

Lindsey Broderick, Srisharan Shreedharan,
Alexis Ault, Kate Murdock



G24AP00253



S.J. & Jessie E. Quinney
College of Agriculture & Natural Resources
UtahStateUniversity

Photo: Rocky Alps on
summitpost.org

Frictional and microstructural evidence for a weak Wasatch fault zone

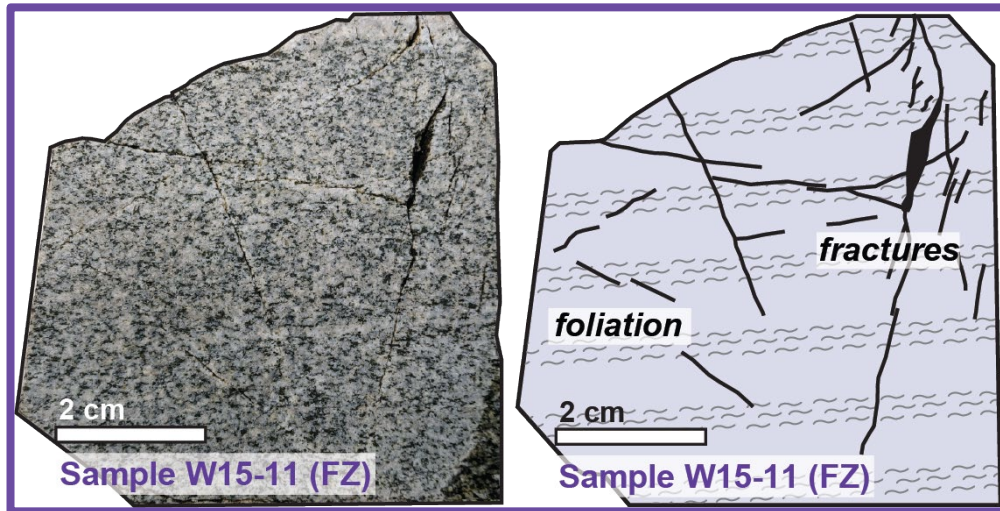
Srisharan Shreedharan*, Alexis K. Ault, and Jordan Jensen

Department of Geosciences, Utah State University, Logan, Utah 84322, USA

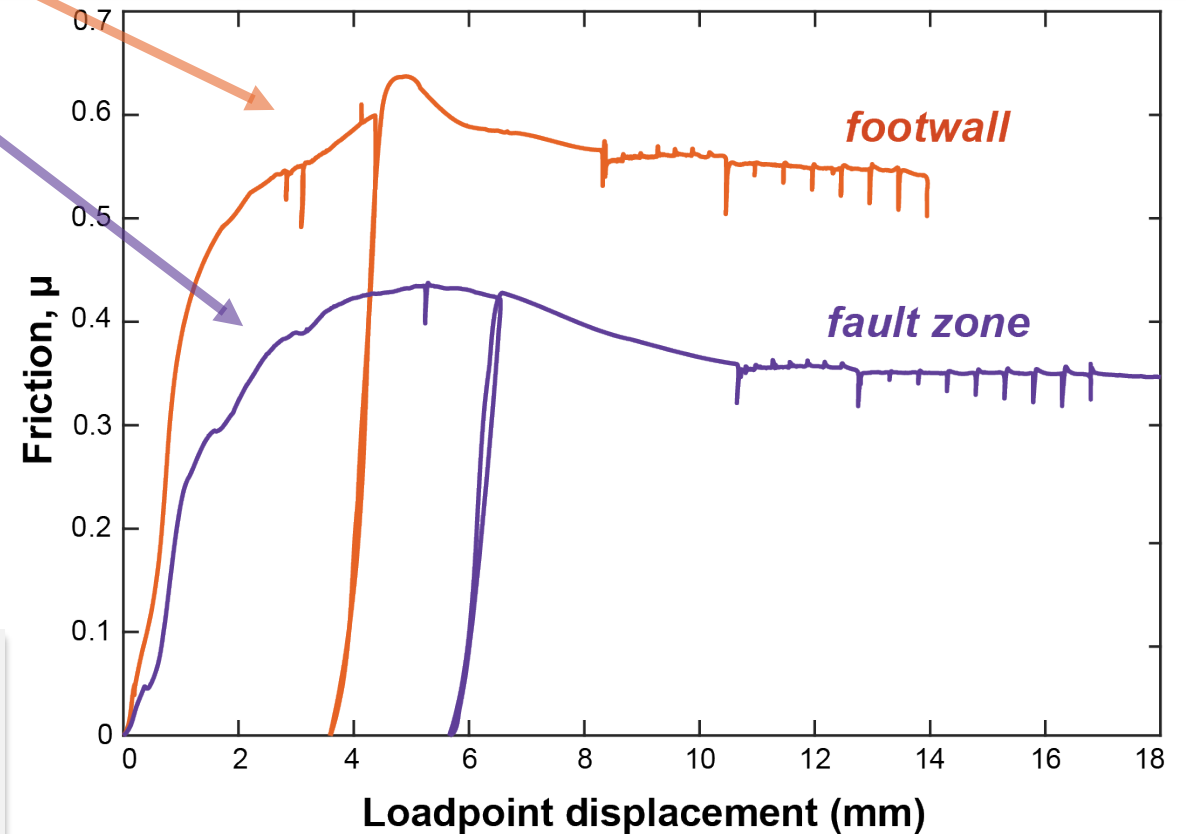


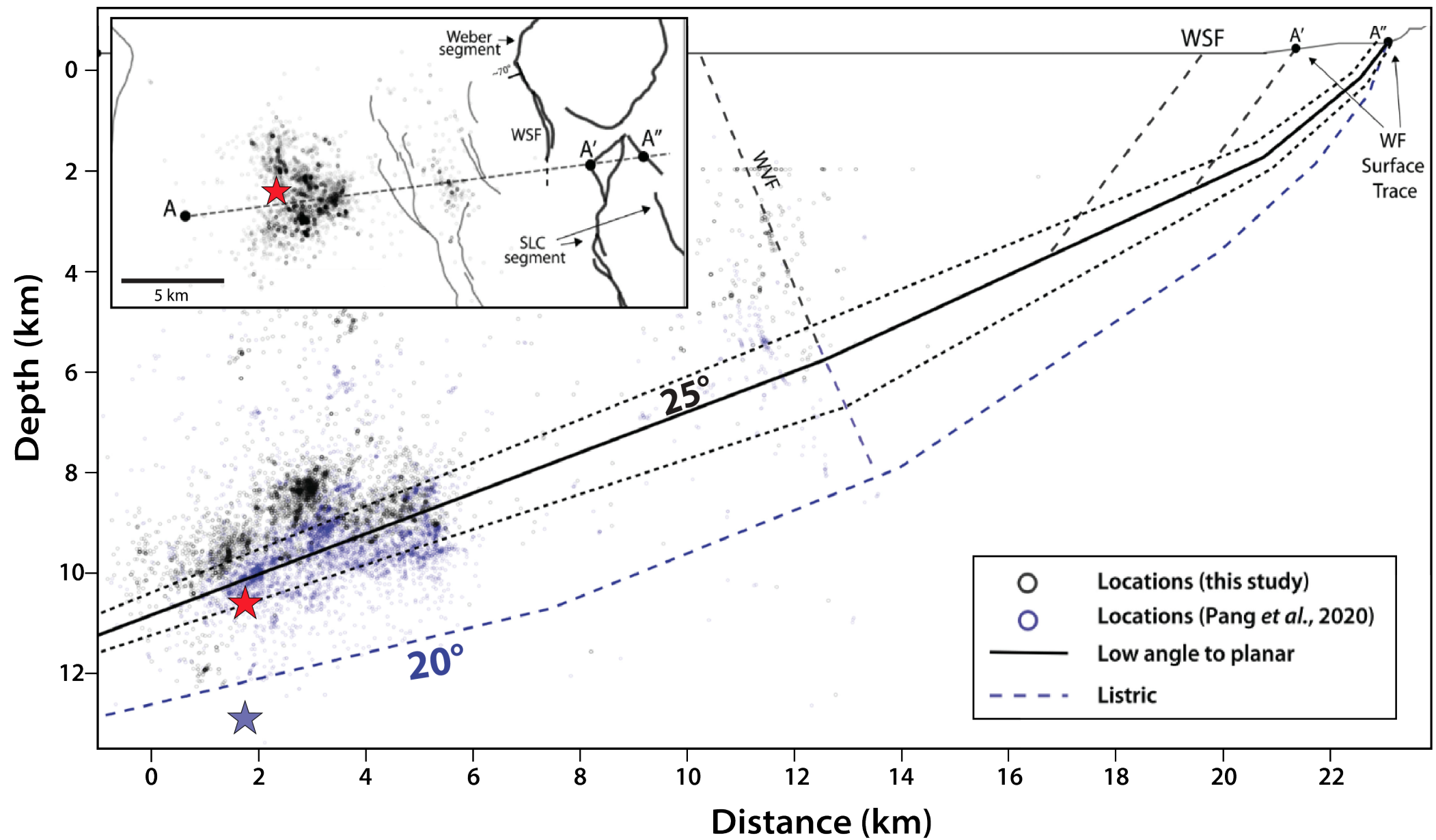
less pre-existing
deformation,
higher friction

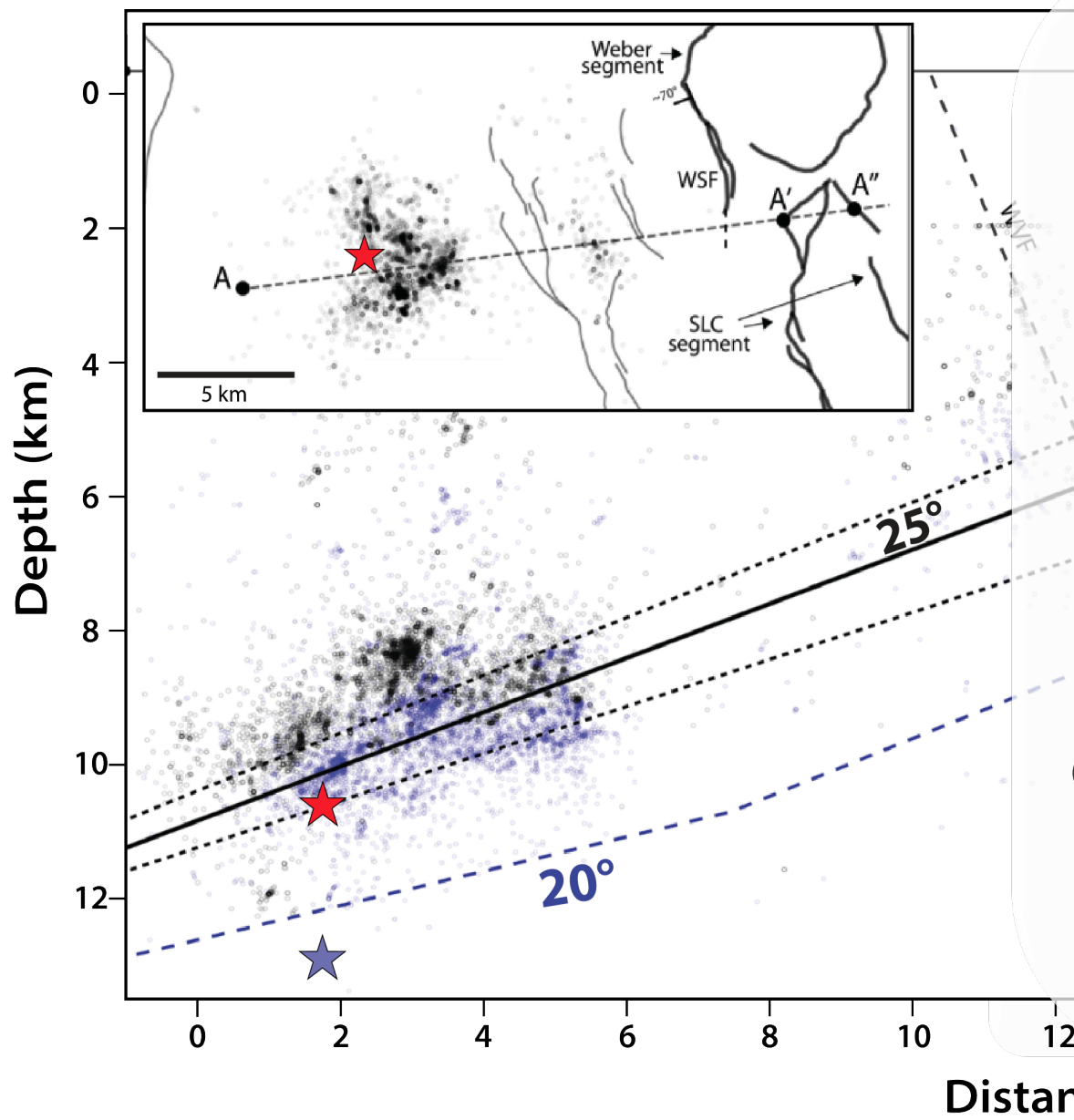
more pre-existing
deformation, lower friction



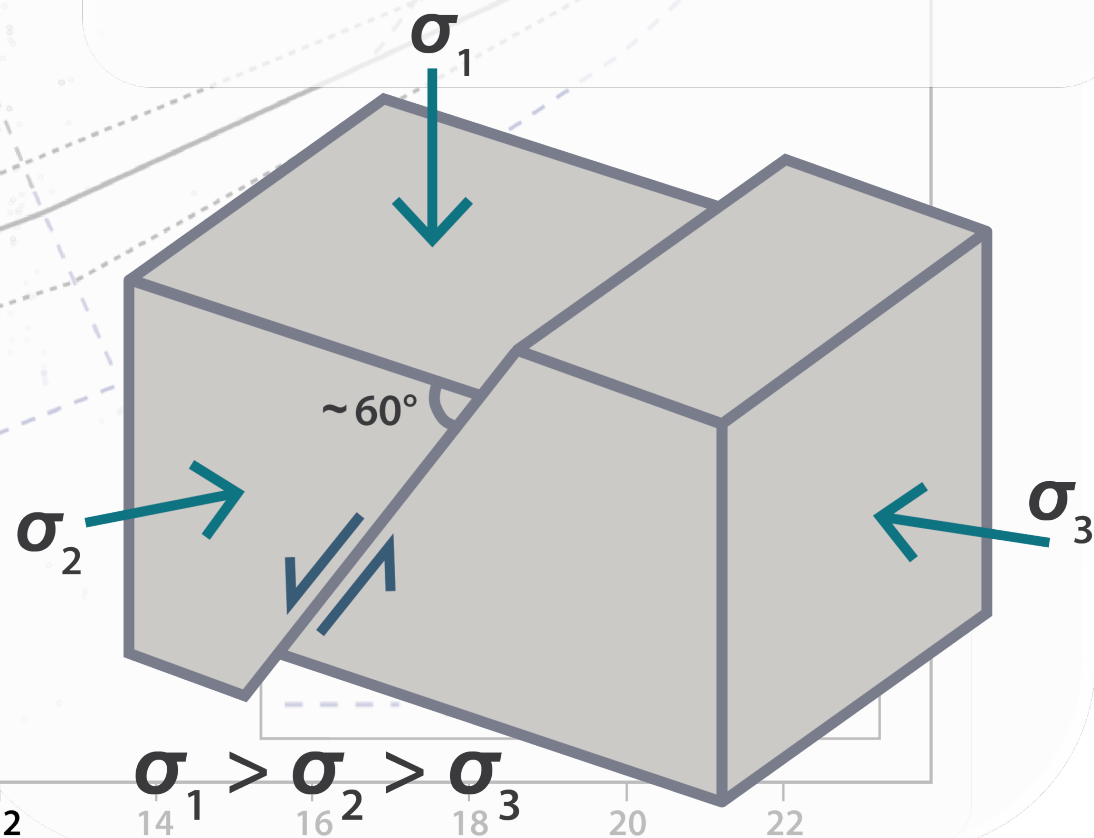
The ductile fabric in the fault zone sample is exploited during friction experiments resulting in low friction

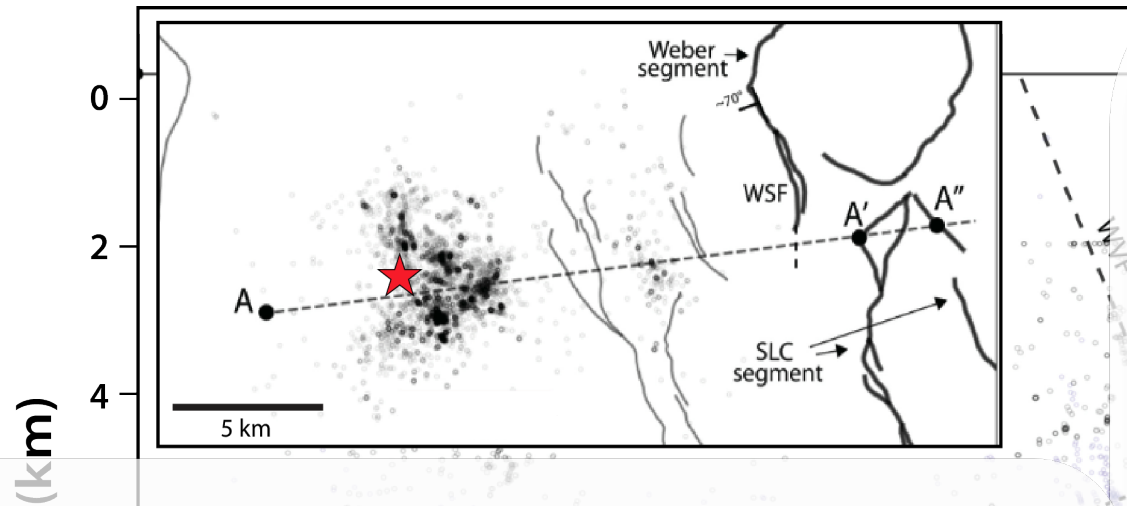






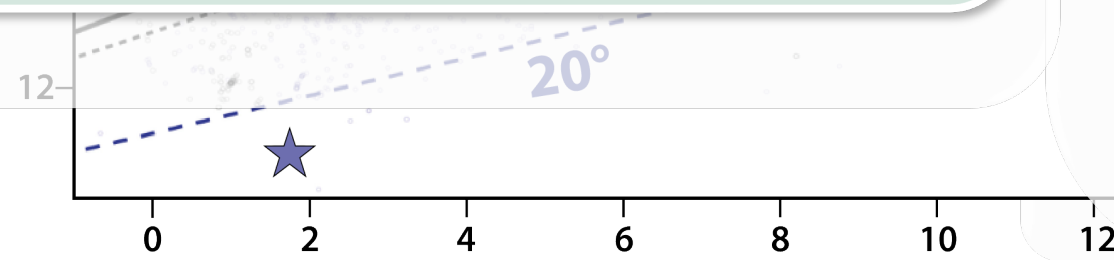
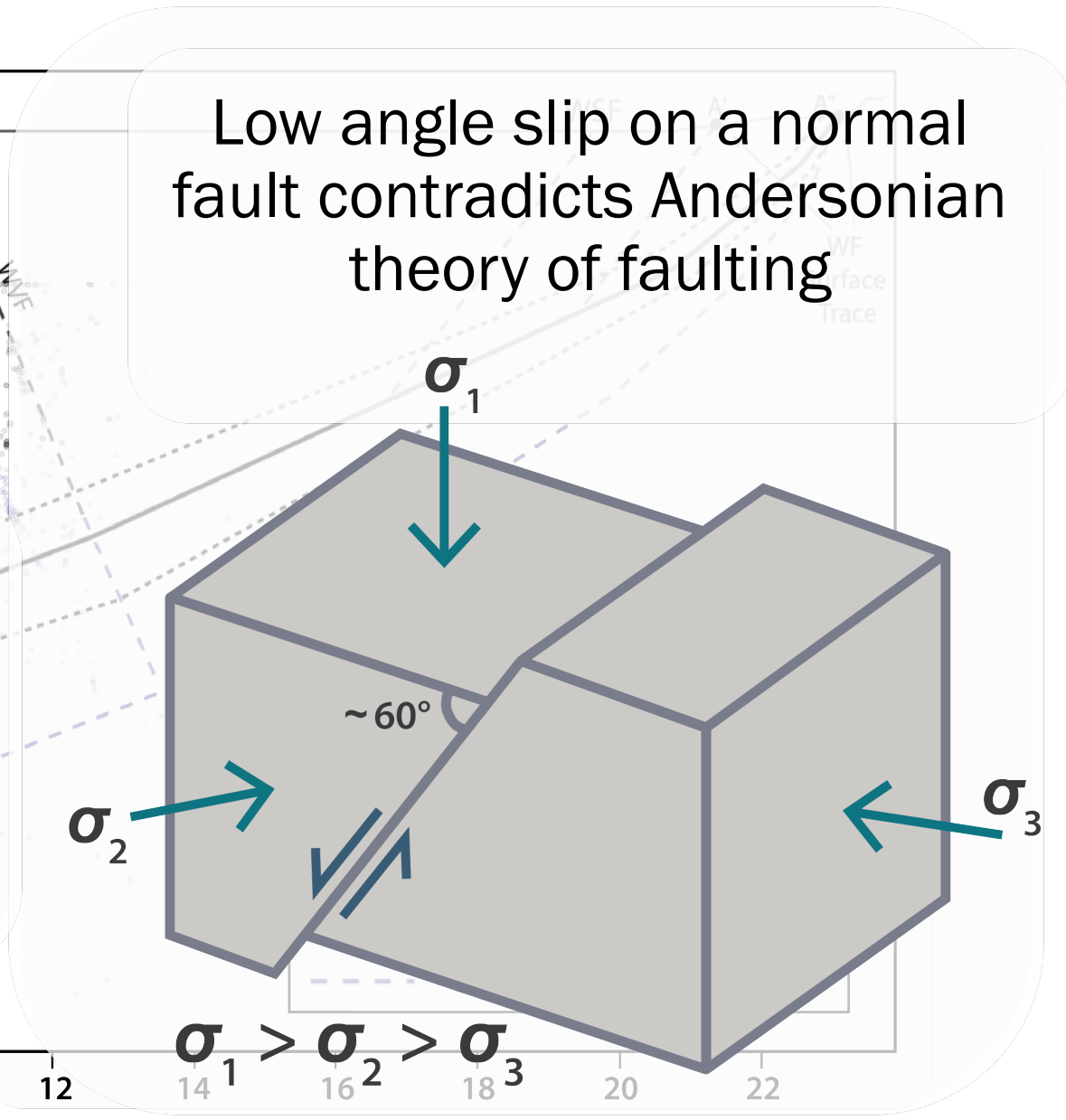
Low angle slip on a normal fault contradicts Andersonian theory of faulting





Low angle slip on a normal fault contradicts Andersonian theory of faulting

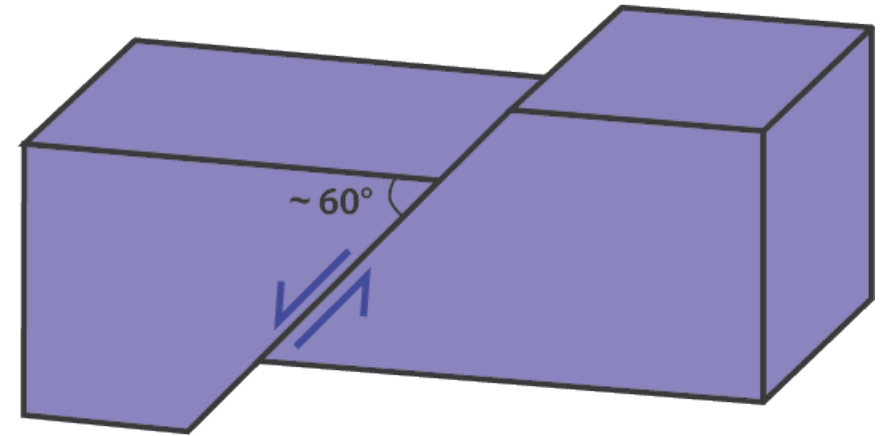
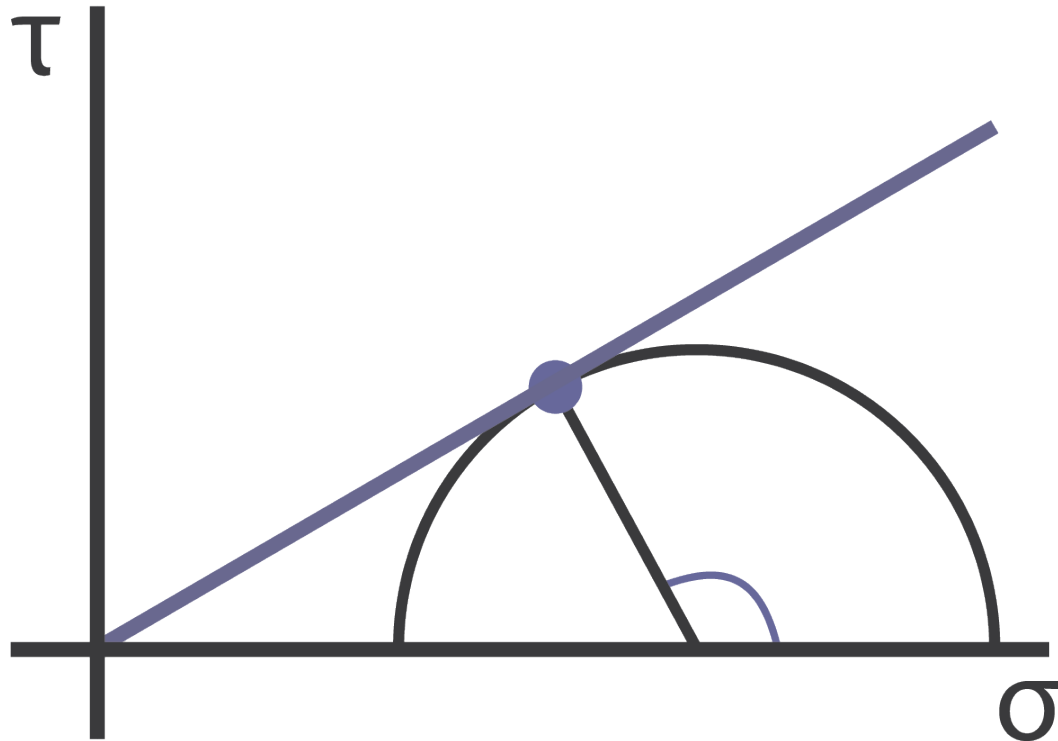
What is the frictional behavior of the Wasatch Fault and is it conducive to low angle slip?



Distance (km)

failure envelope: $\tau = \mu * \sigma_n$

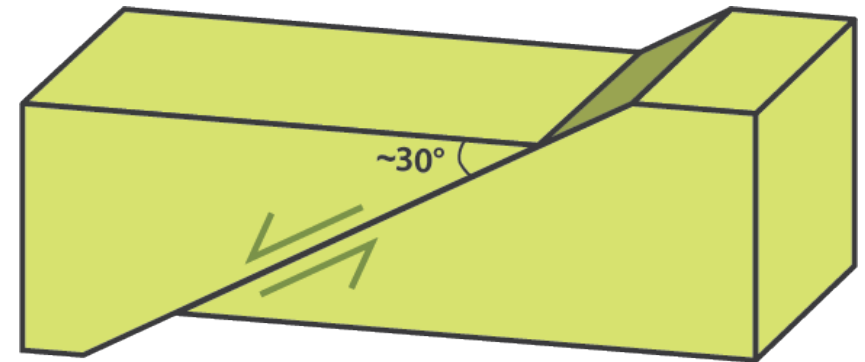
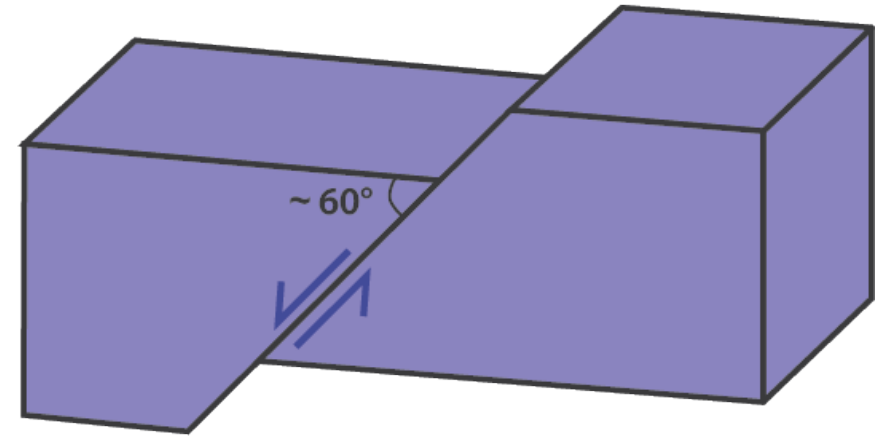
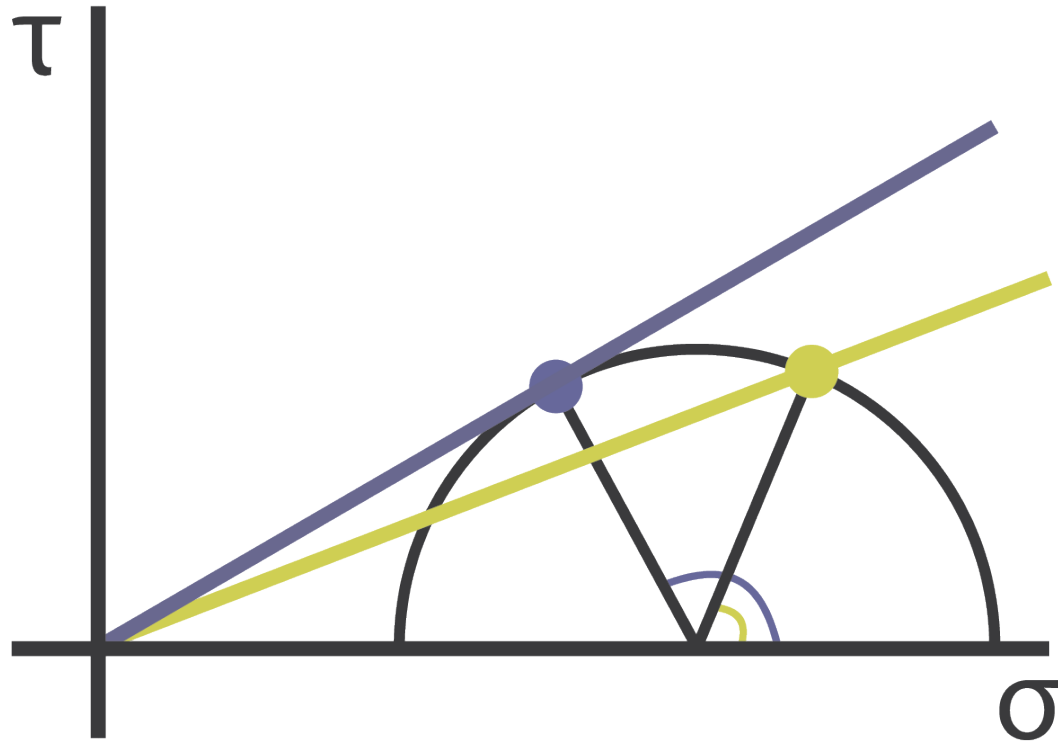
shear strength = friction * normal stress



A normal fault must be sufficiently weak to nucleate earthquakes at low angles

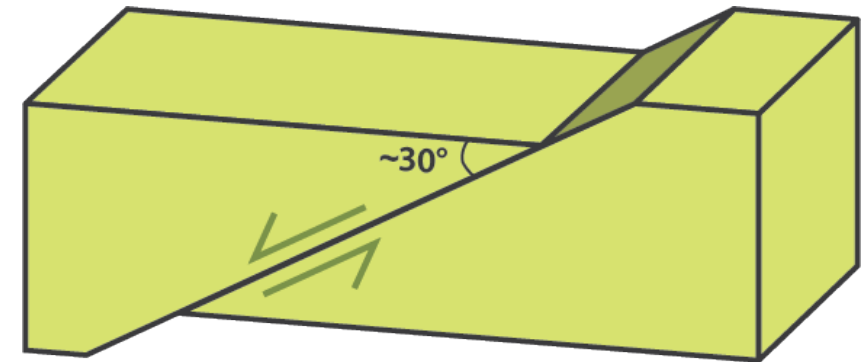
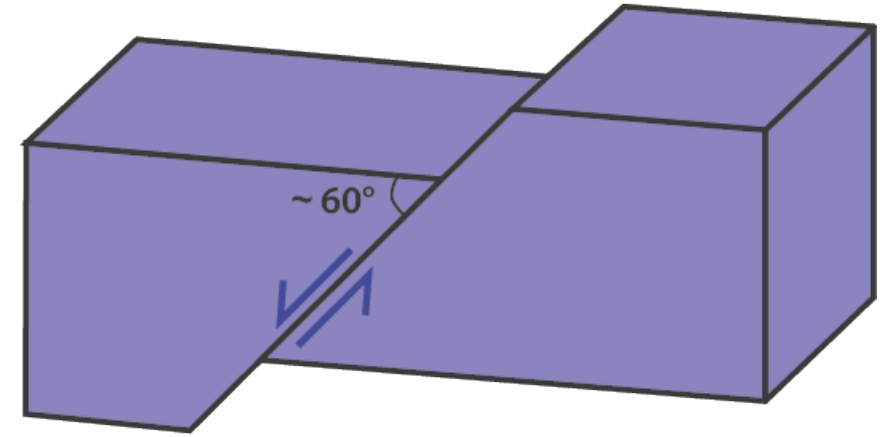
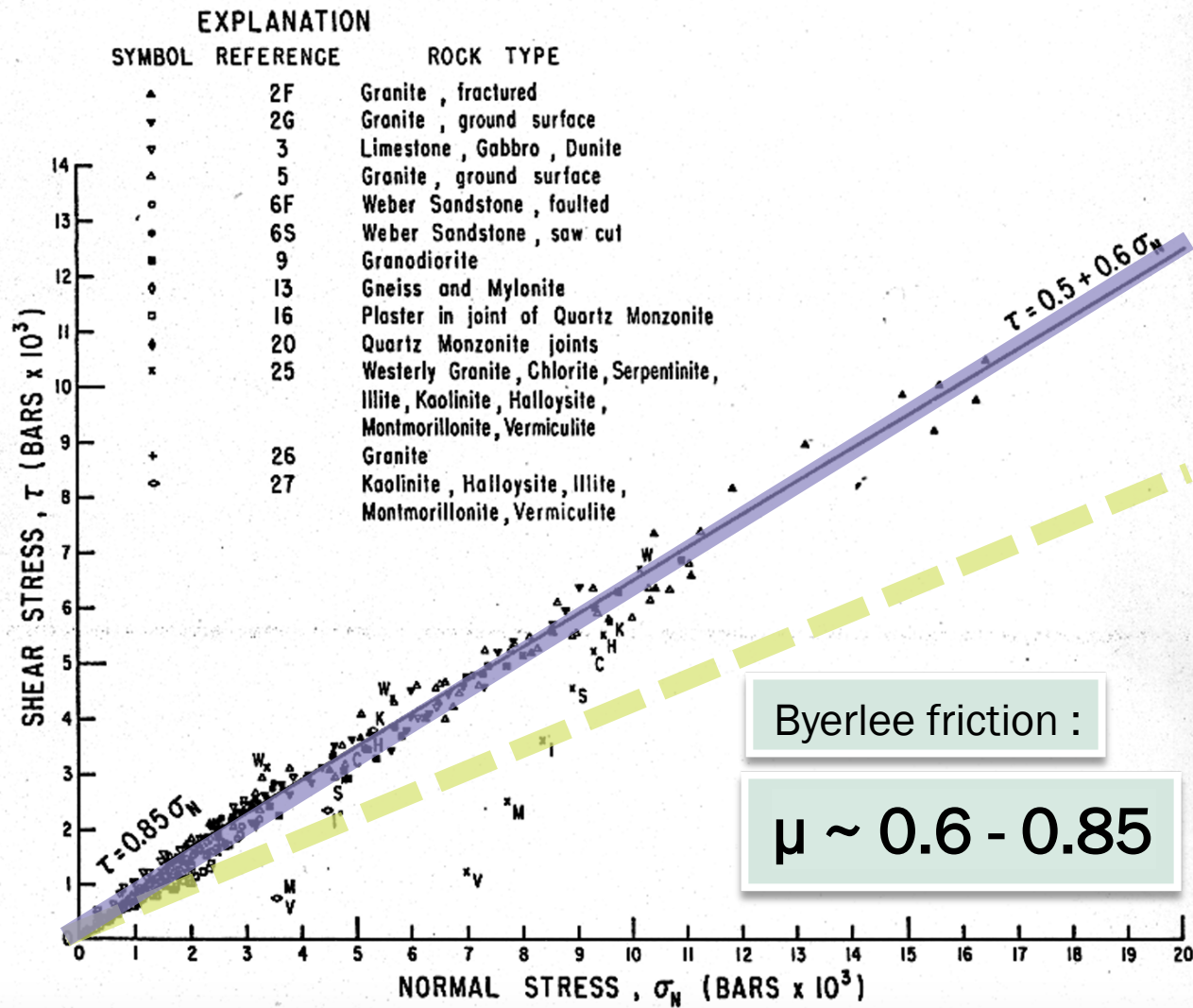
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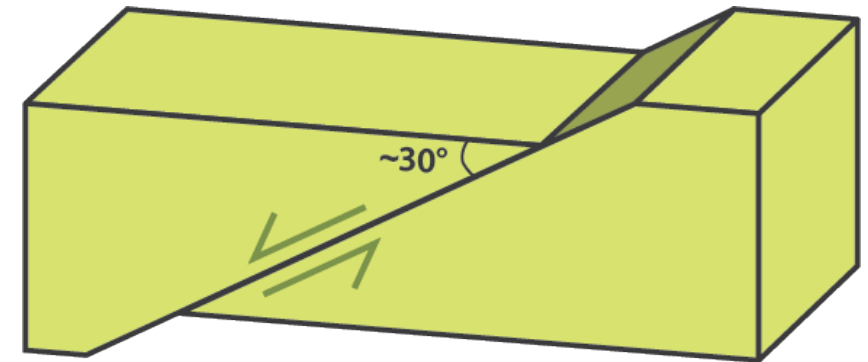
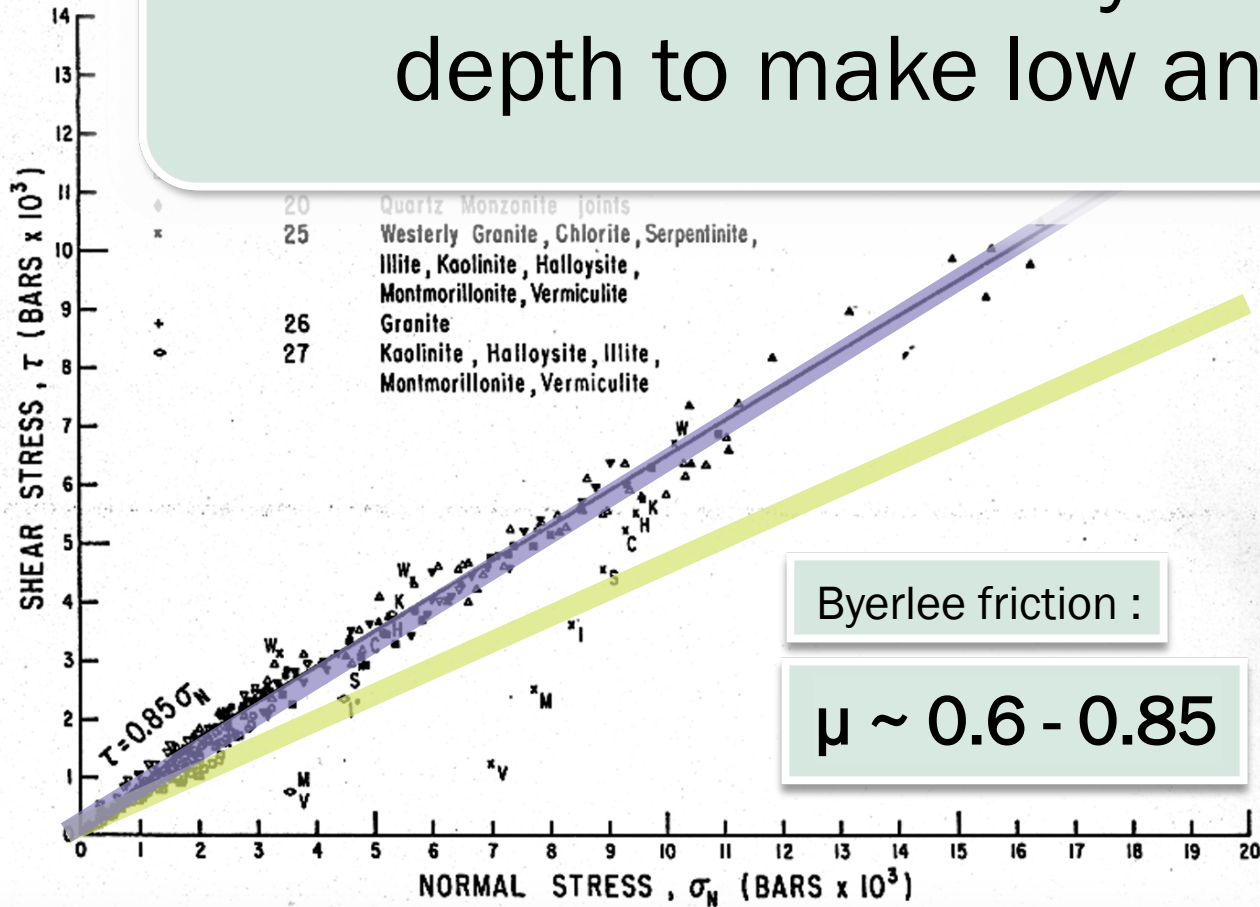
A normal fault must be sufficiently weak to nucleate earthquakes at low angles

MAXIMUM FRICTION



MAXIMUM FRICTION

What could frictionally weaken the Wasatch at depth to make low angle slip possible?



What could frictionally weaken the Wasatch at depth to make low angle slip possible?

friction
experiments

+

microstructural
analyses

We test this using a similar approach on an expanded set of samples and expanded experimental protocol



Exhumed footwall damage zone of the Wasatch Fault in the Farmington Canyon Complex in the Brigham City segment





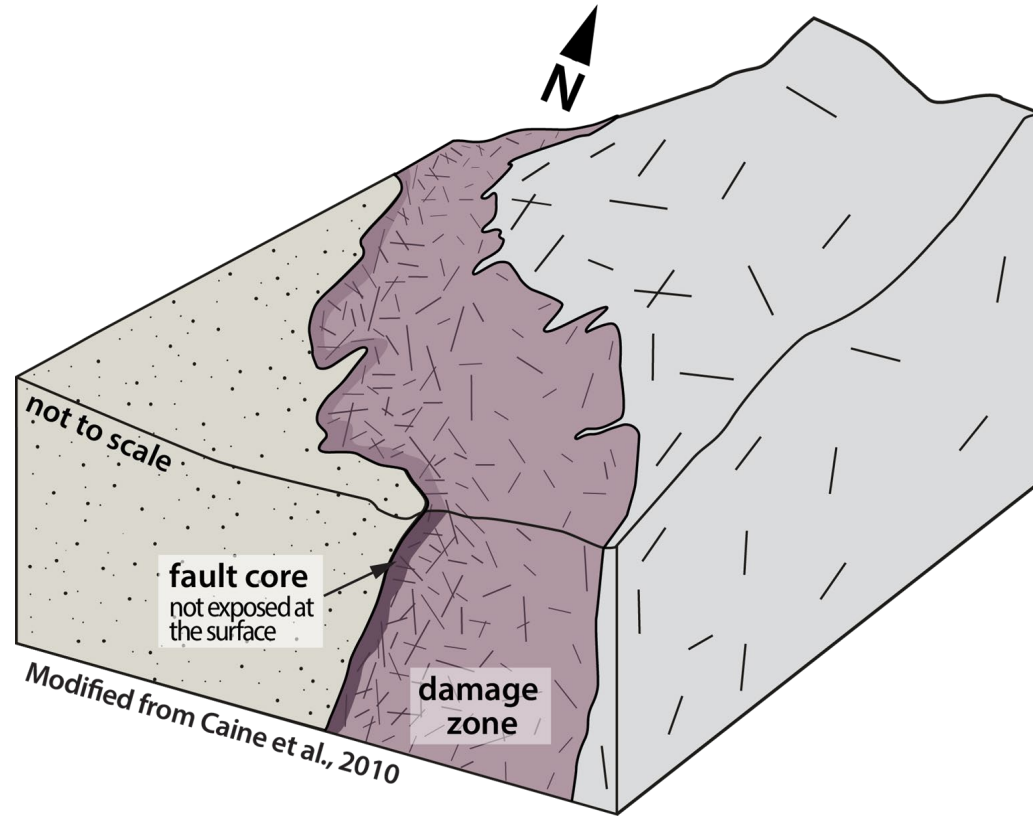
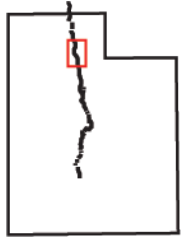
strong ductile fabric

fine grain size

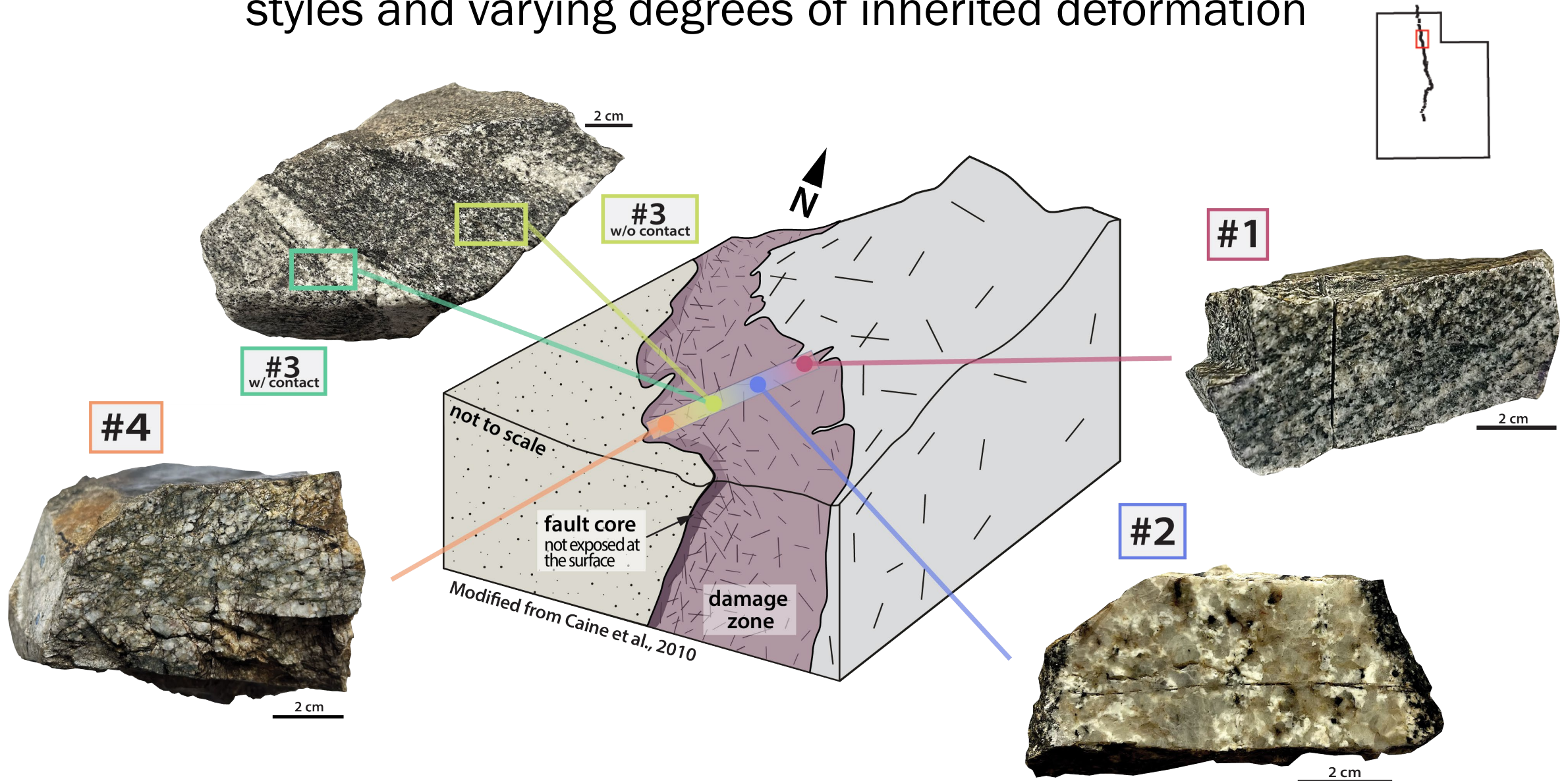
brittle fractures

Exhumed footwall damage zone of the Wasatch Fault in the Farmington Canyon Complex in the Brigham City segment

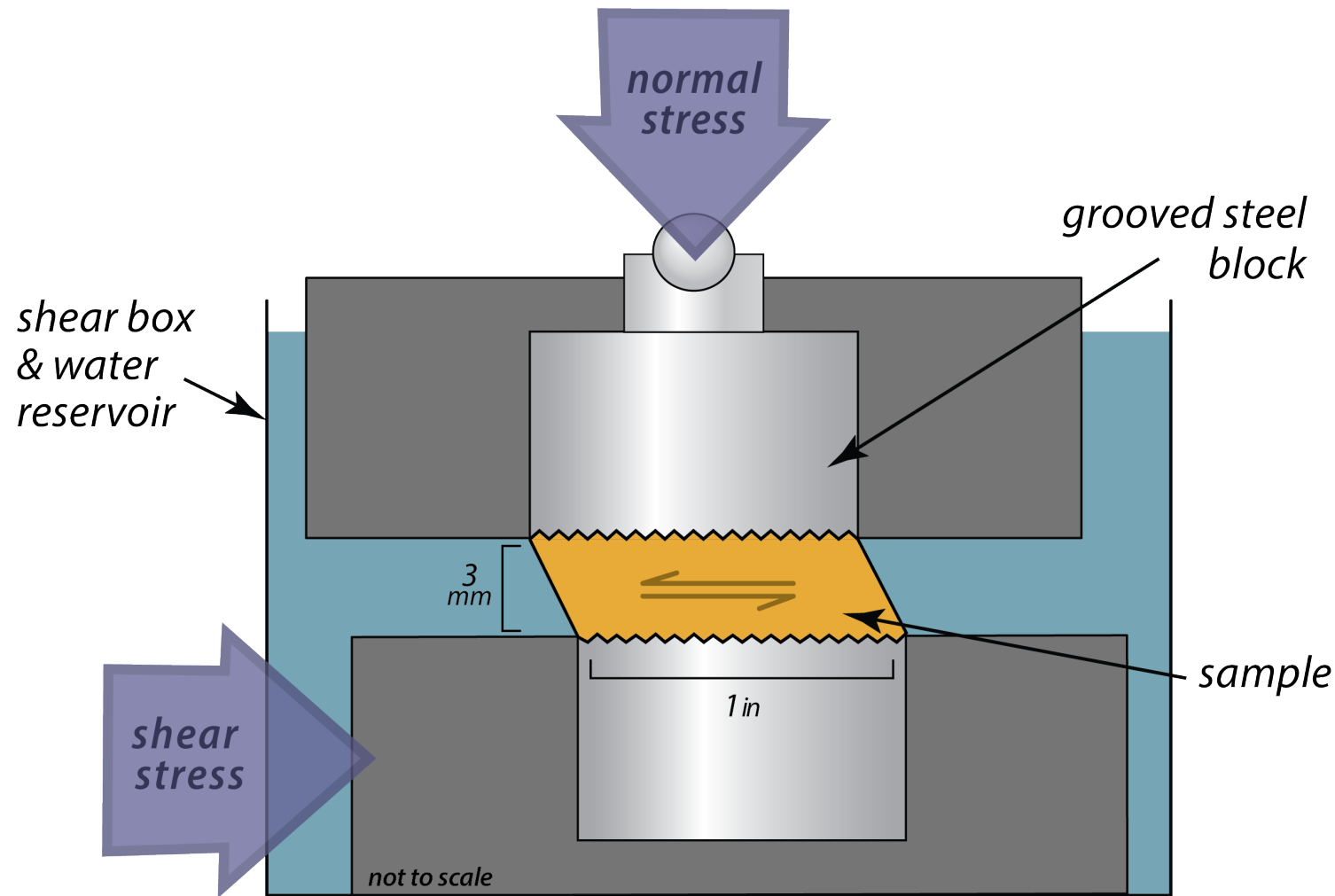
Sampled in a transect through the damage zone to access a range of styles and varying degrees of inherited deformation



Sampled in a transect through the damage zone to access a range of styles and varying degrees of inherited deformation



Friction deformation experiments shear samples to quantify frictional behaviors



experiment conditions:

15 MPa normal stress

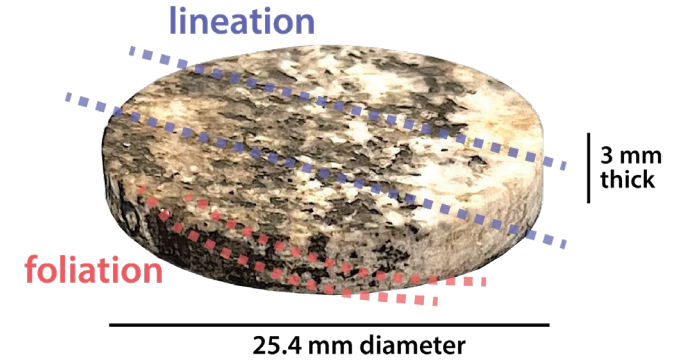
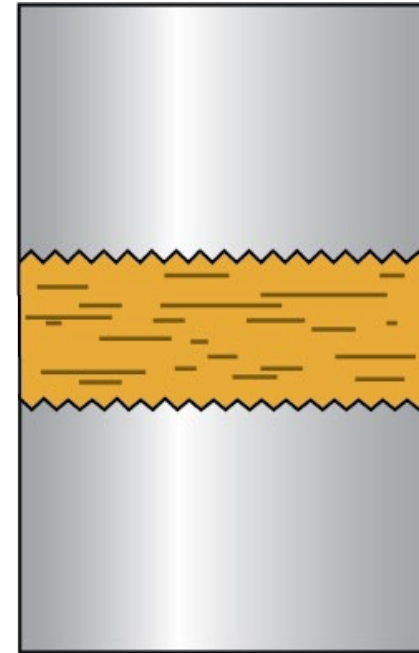
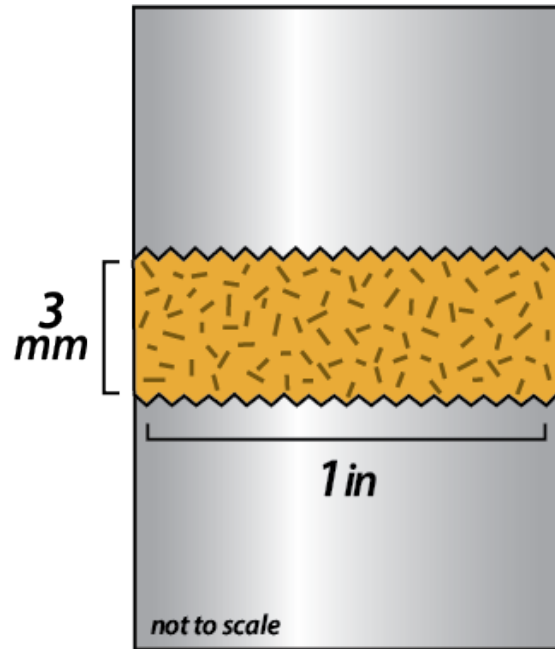
DI water saturated

room temperature

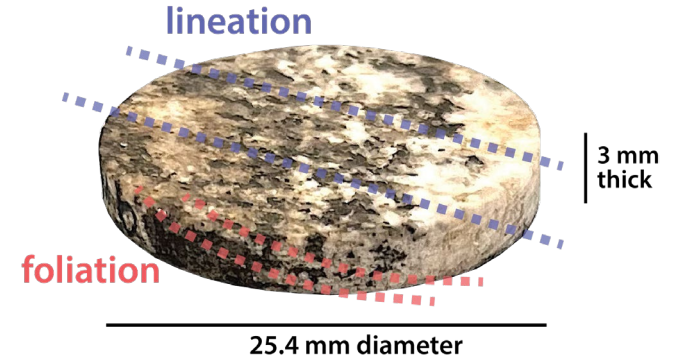
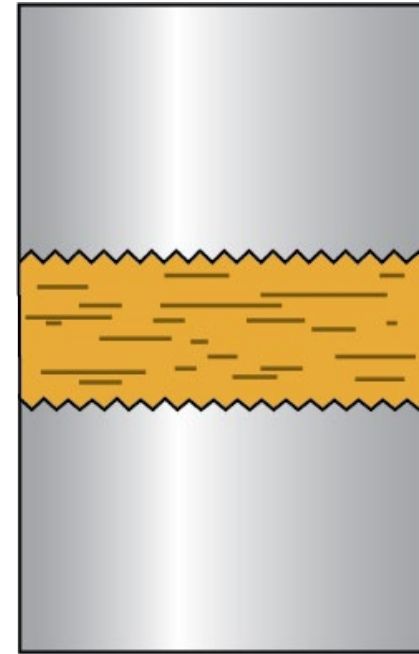
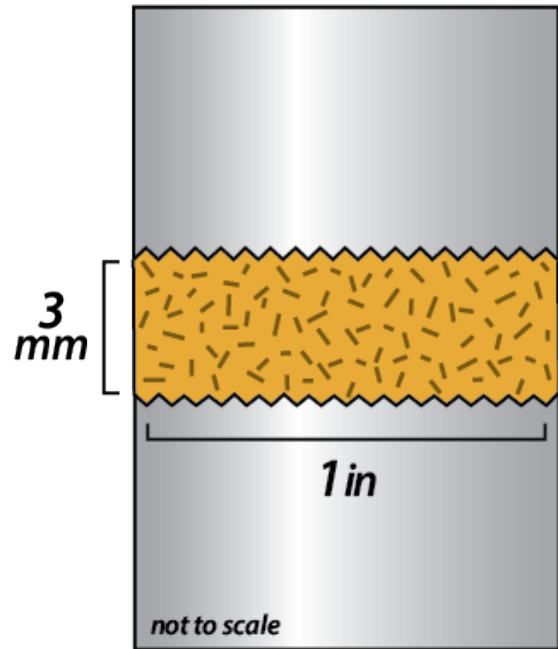
1-10 $\mu\text{m/s}$ displacement rate

PT conditions in the seismogenic zone reduce frictional strength

Comparing powder to wafer isolates the influence of inherited deformation on friction

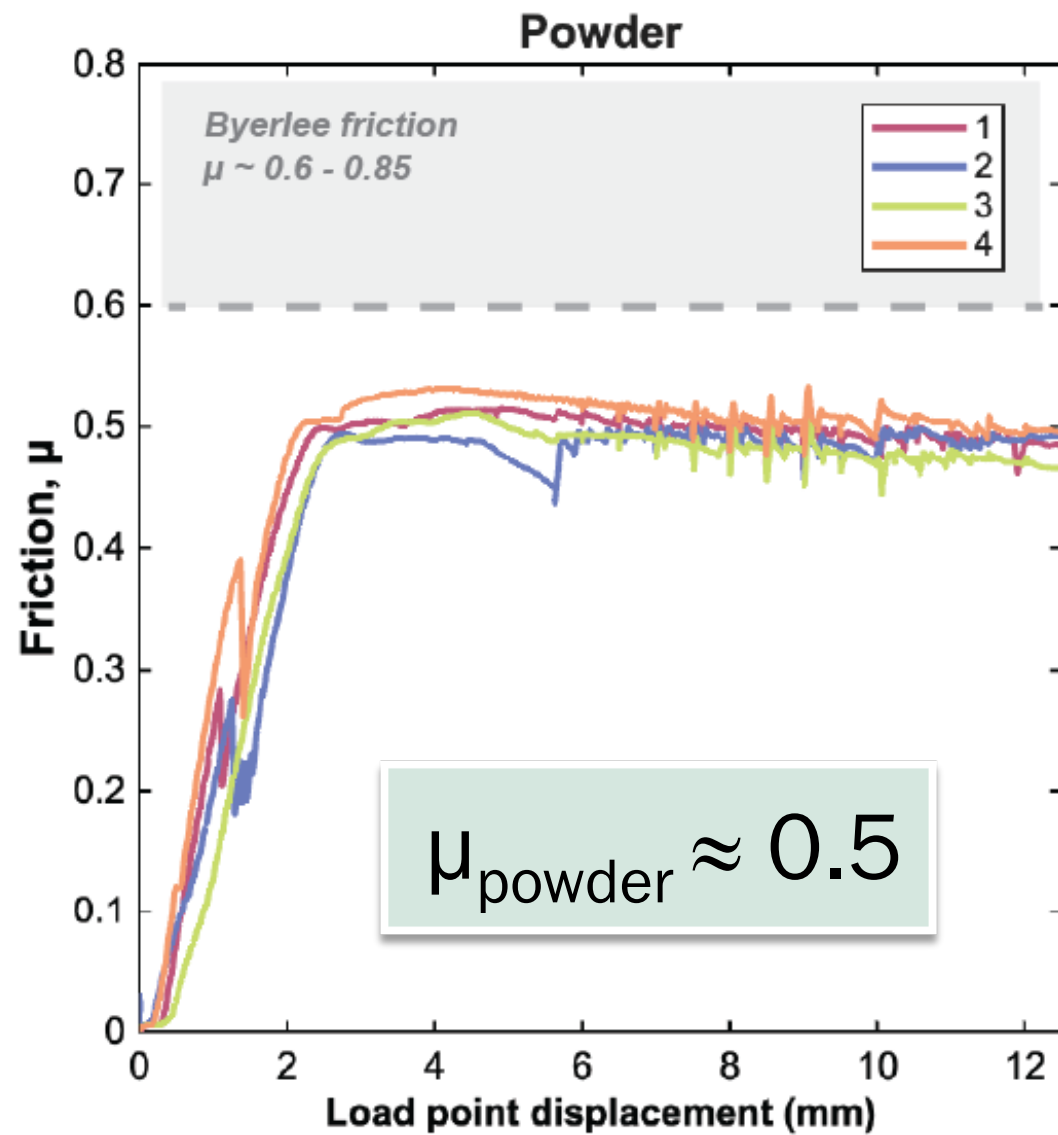


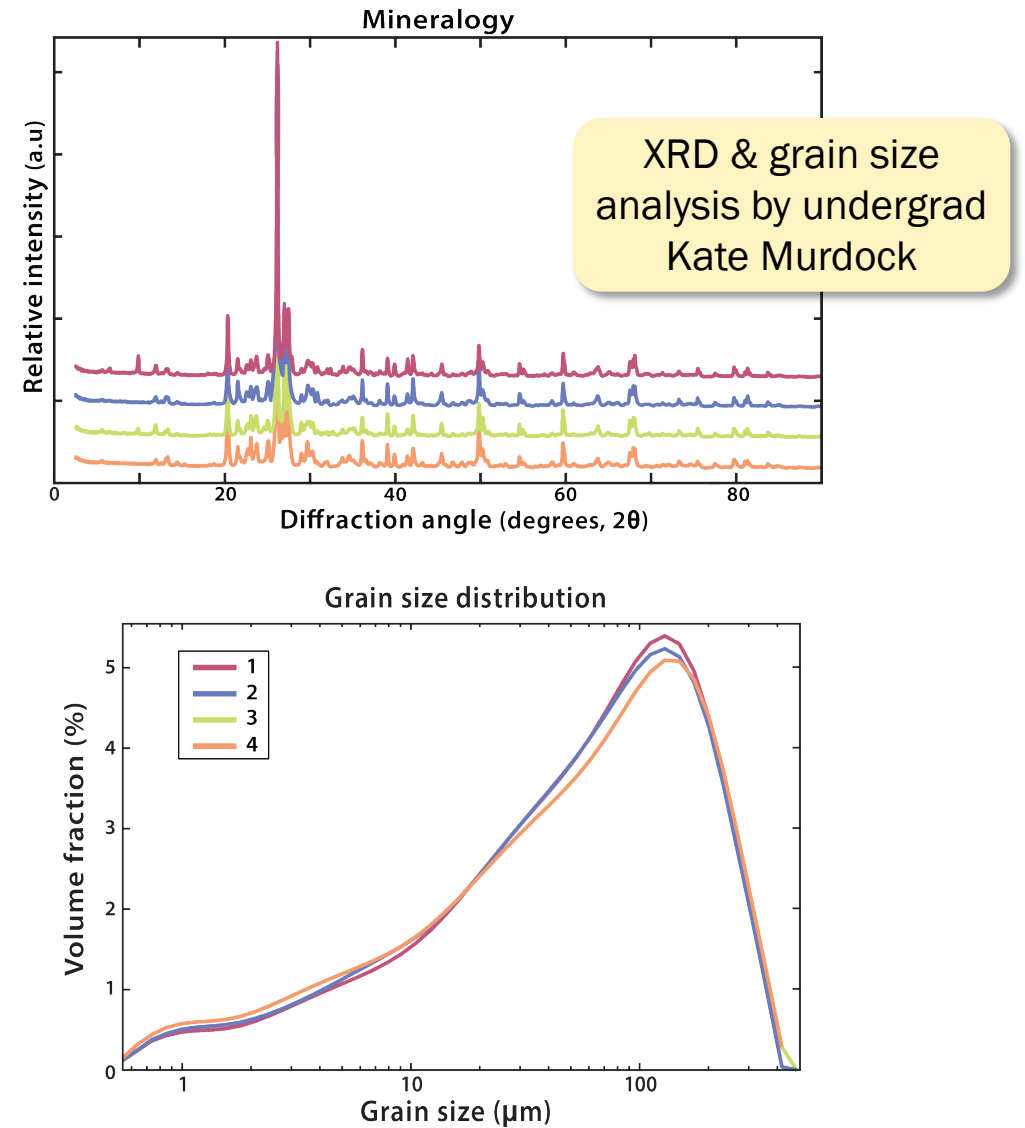
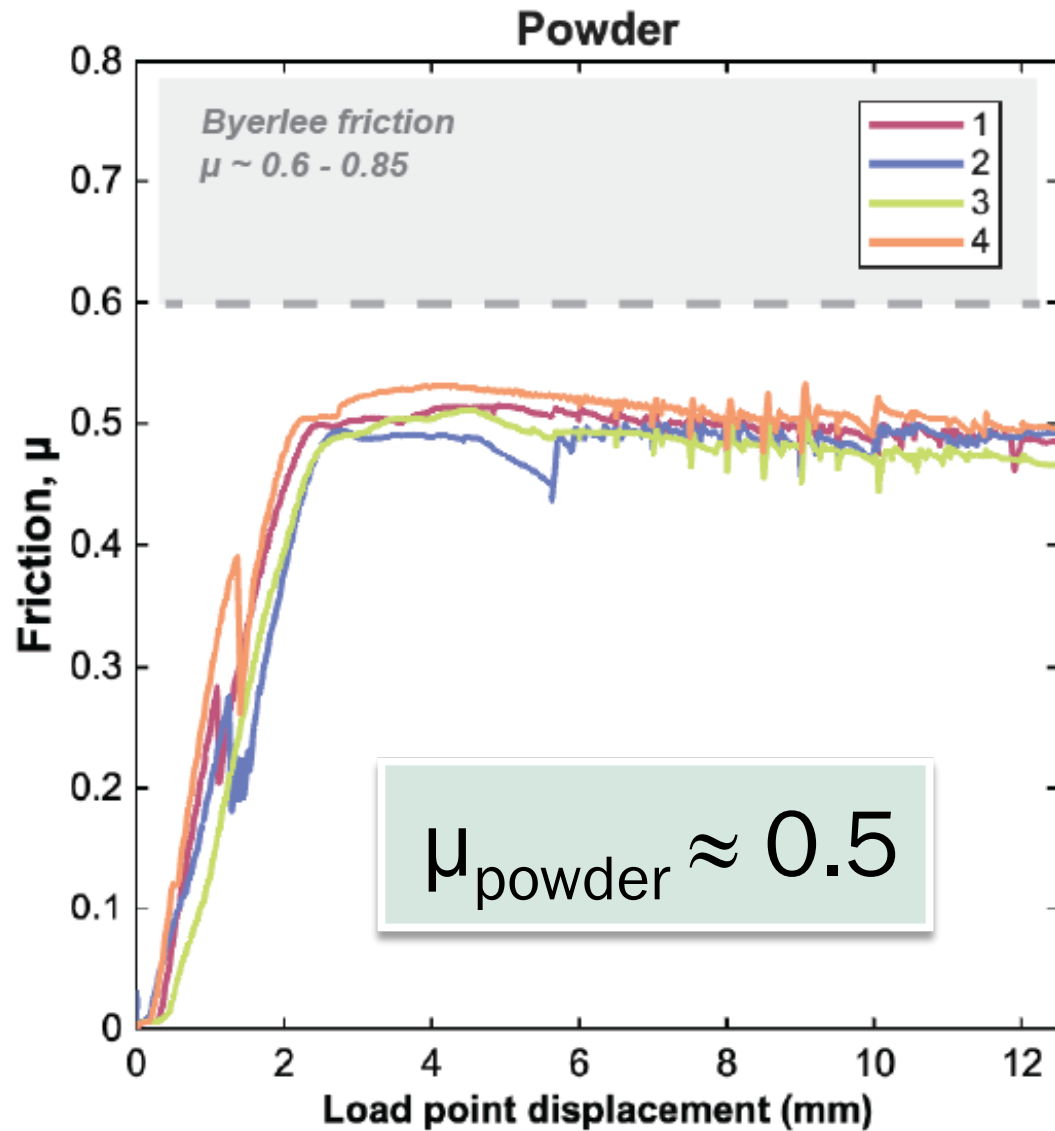
Comparing powder to wafer isolates the influence of inherited deformation on friction



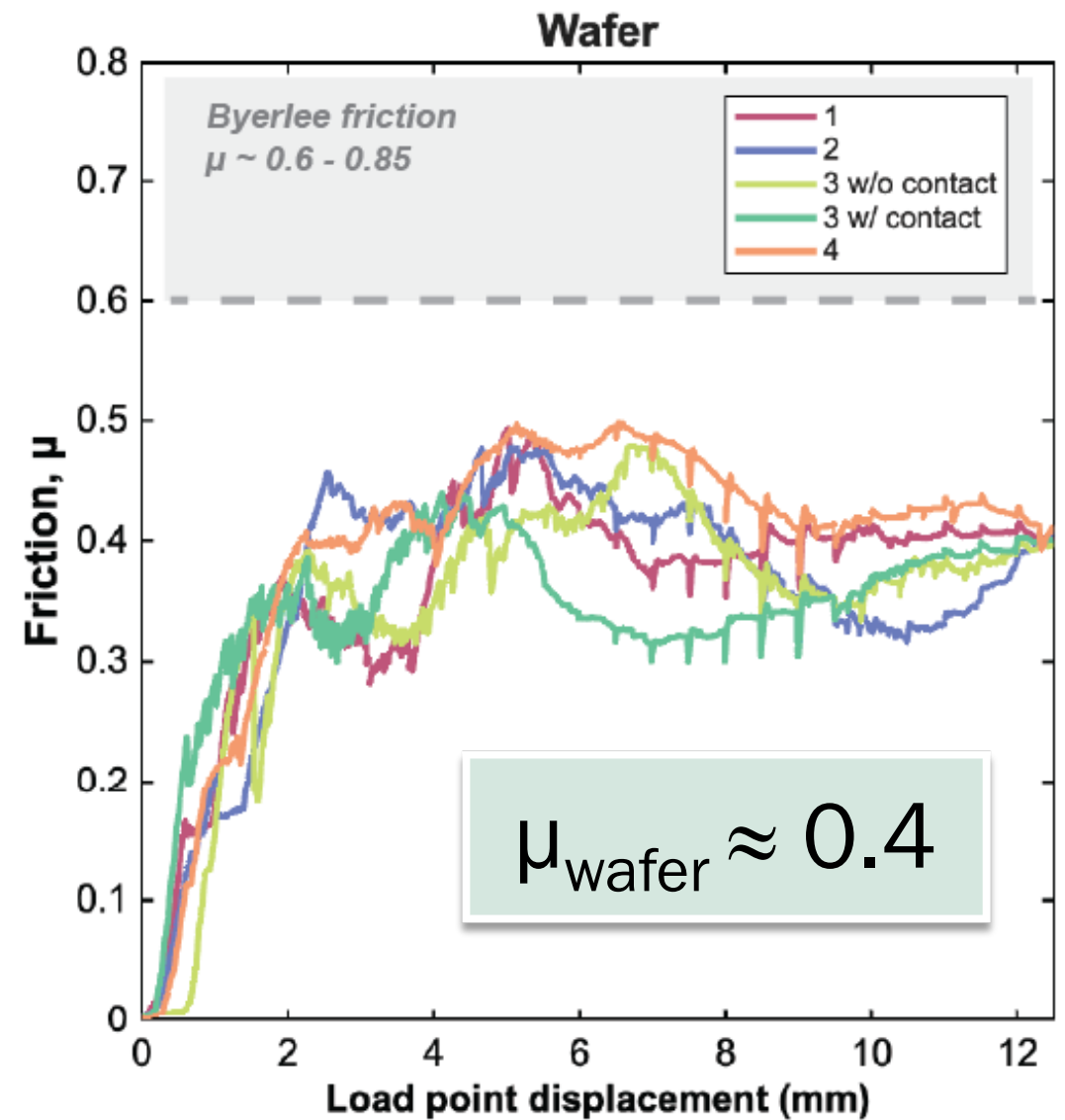
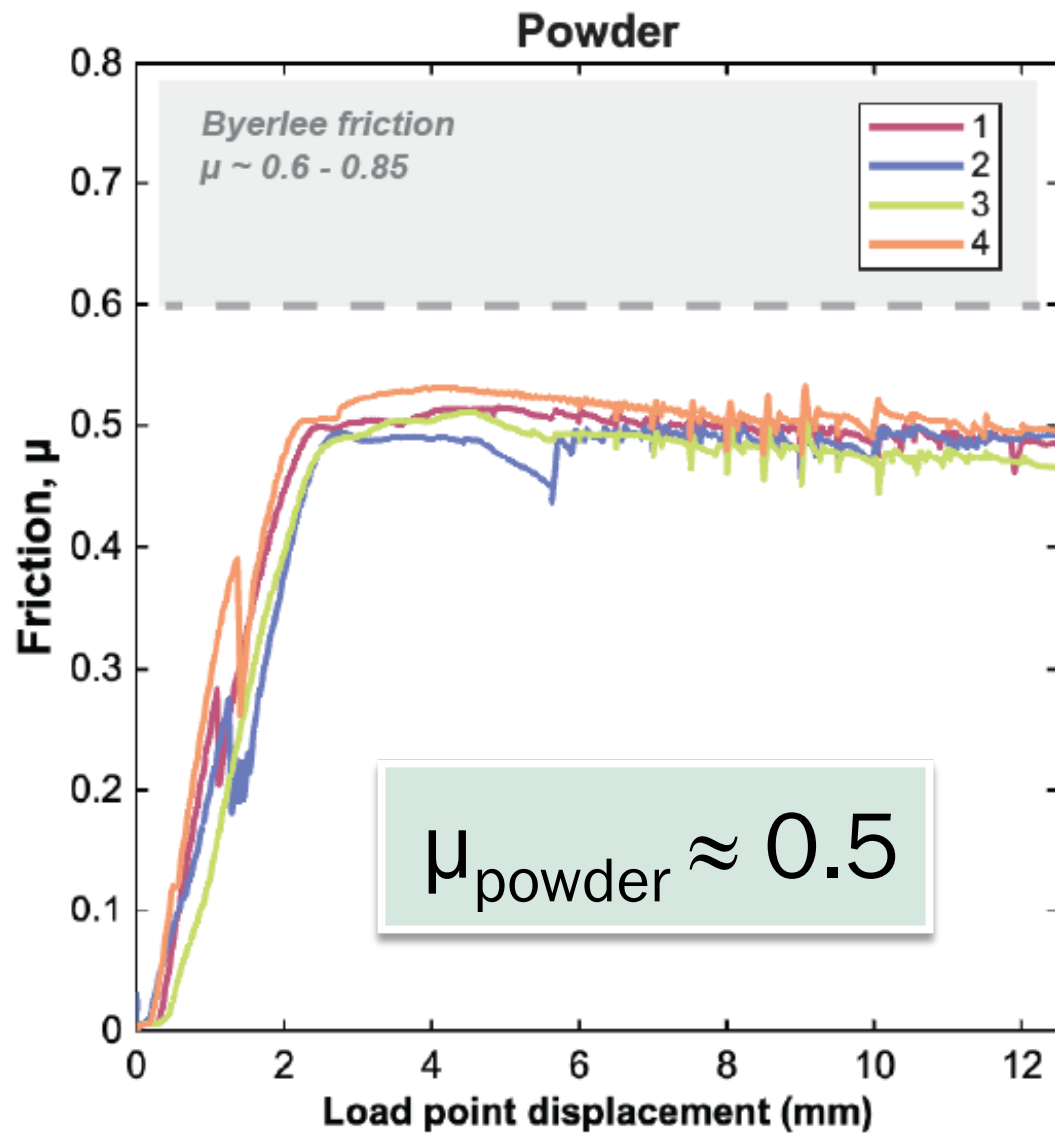
$$\mu_{\text{powder}} \approx f(\text{mineralogy})$$

$$\mu_{\text{wafer}} \approx f(\text{mineralogy} + \text{inherited deformation})$$

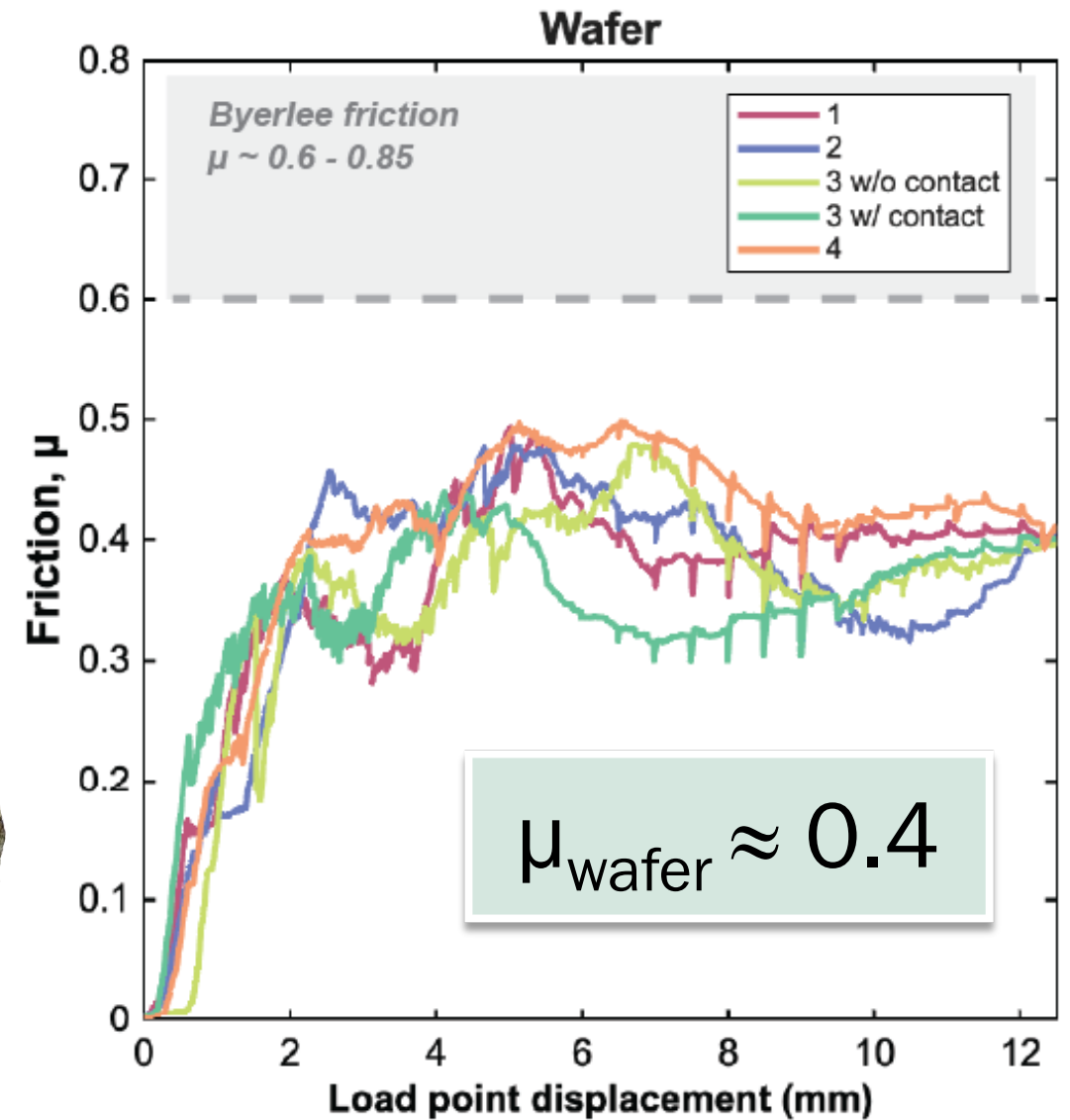
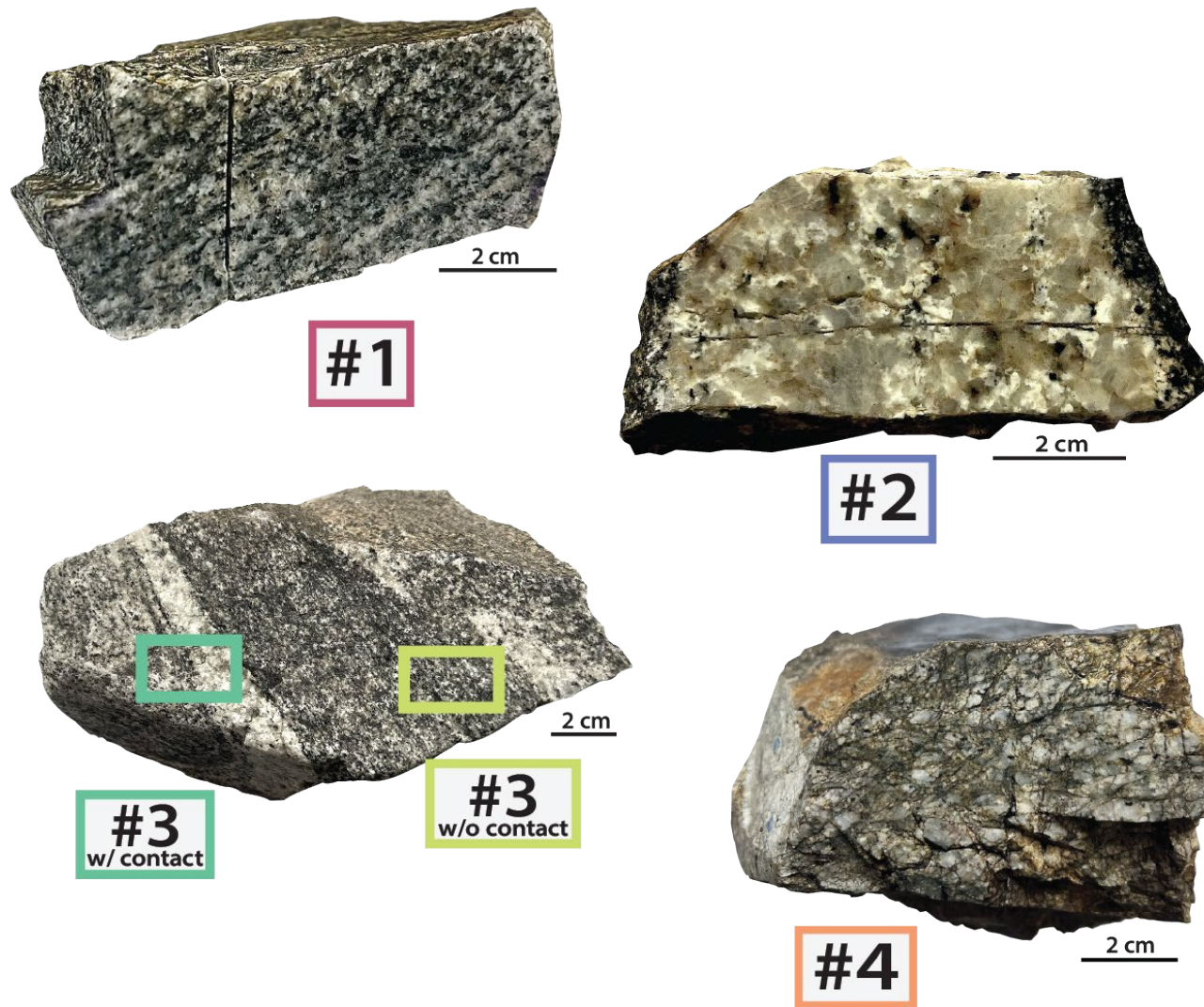




Little variation in friction between powder samples is a result of consistent grain size and mineralogy

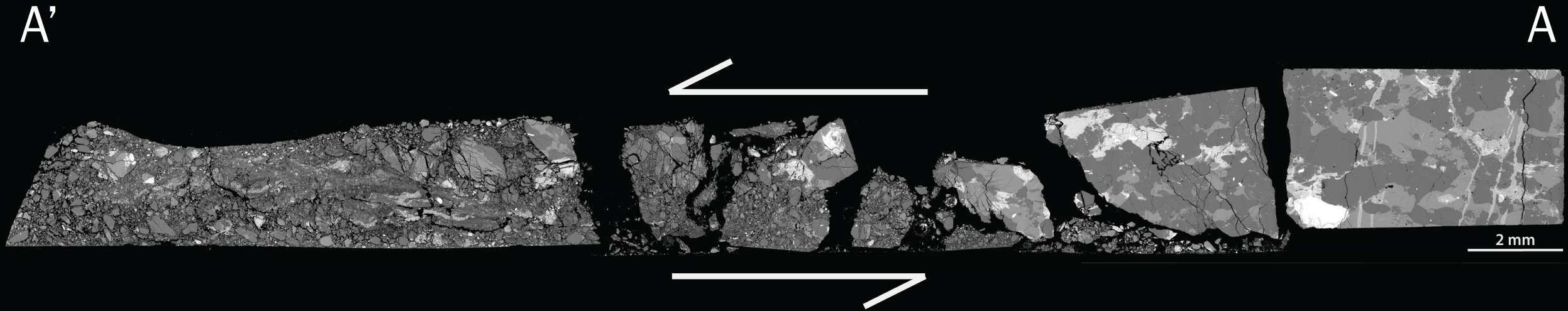
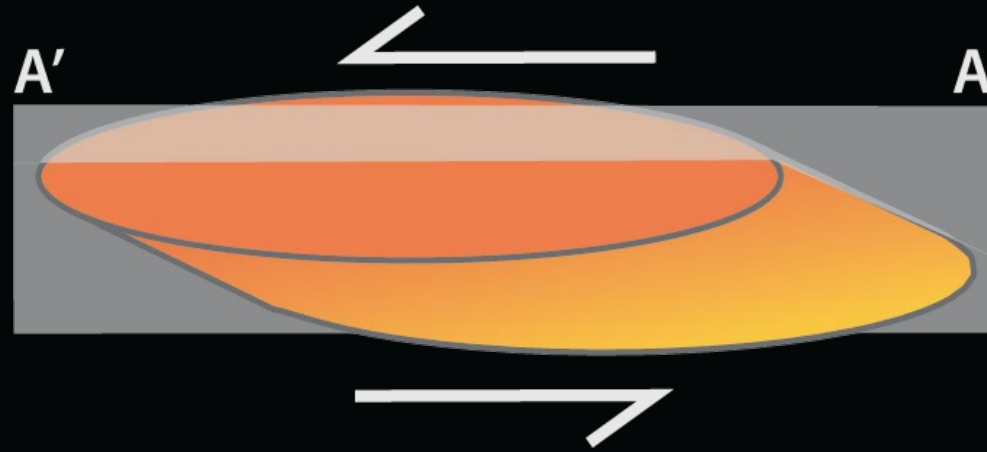


$$\mu_{\text{powder}} > \mu_{\text{wafer}}$$



Inherited deformation effects the evolution of friction but not friction at 12.5 mm

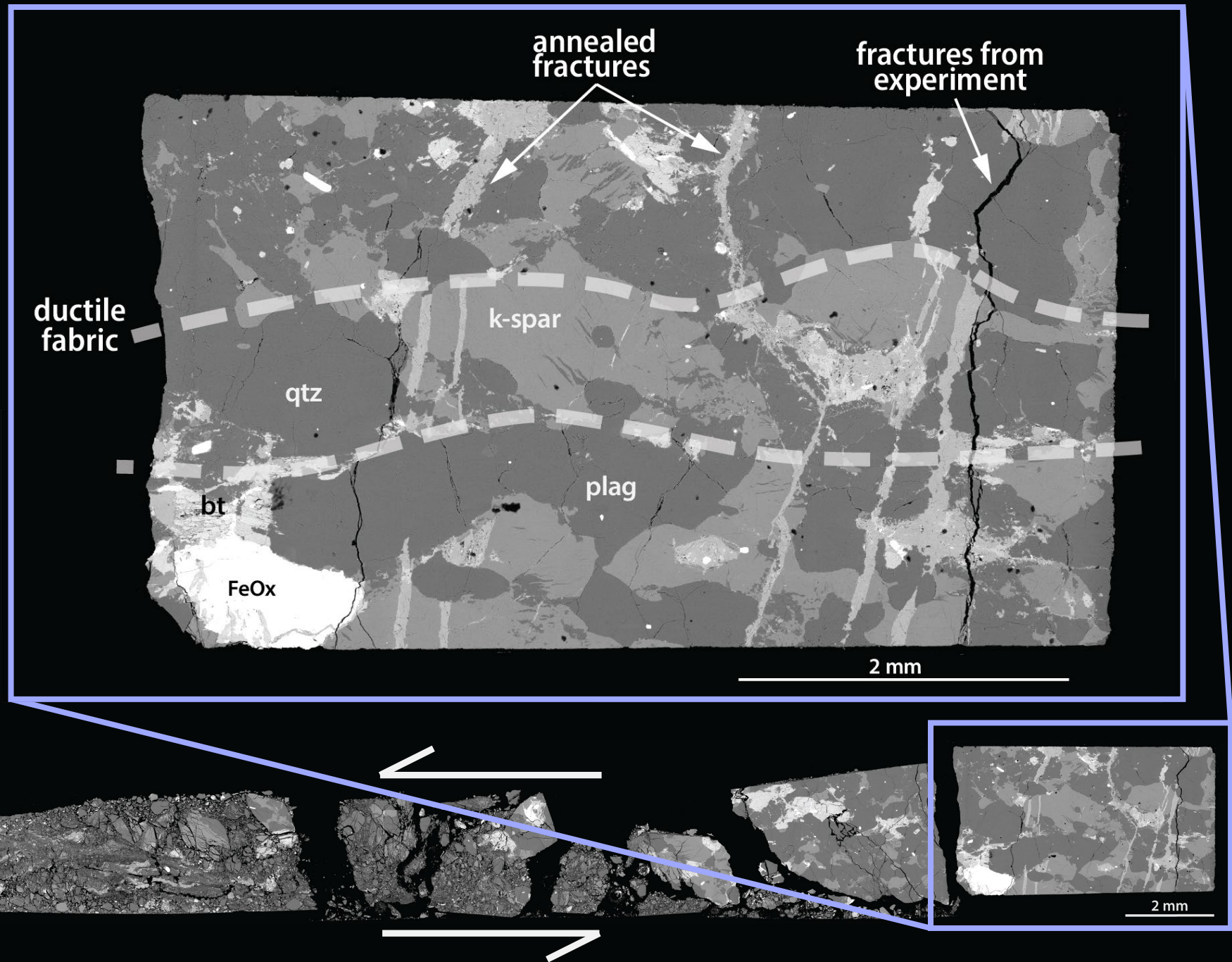
wafer :



wafer :

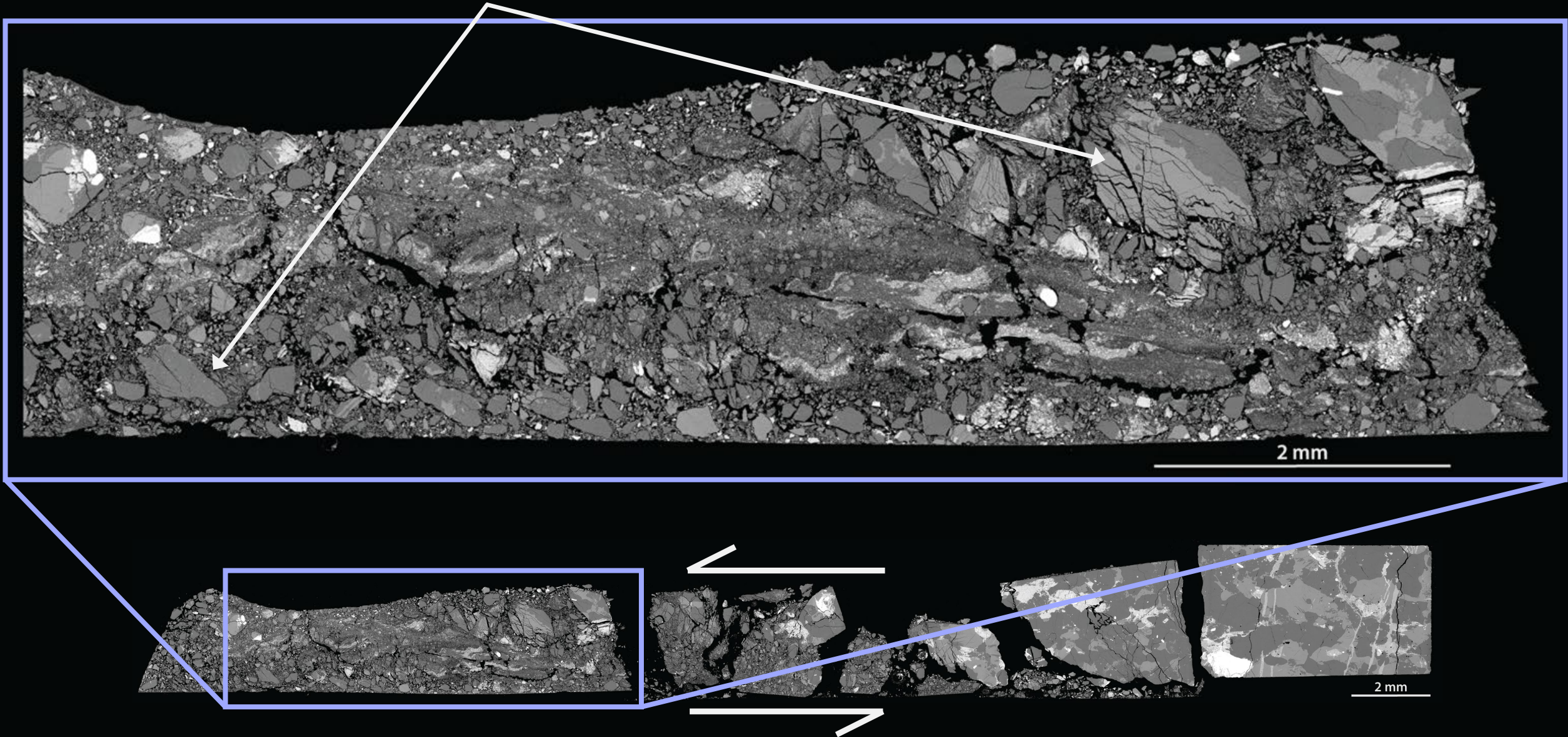
*this minimally
deformed section
shows pre-existing
deformation*

*pre-existing
fabric seeds
experimentally
developed
shear fabric*



wafer :

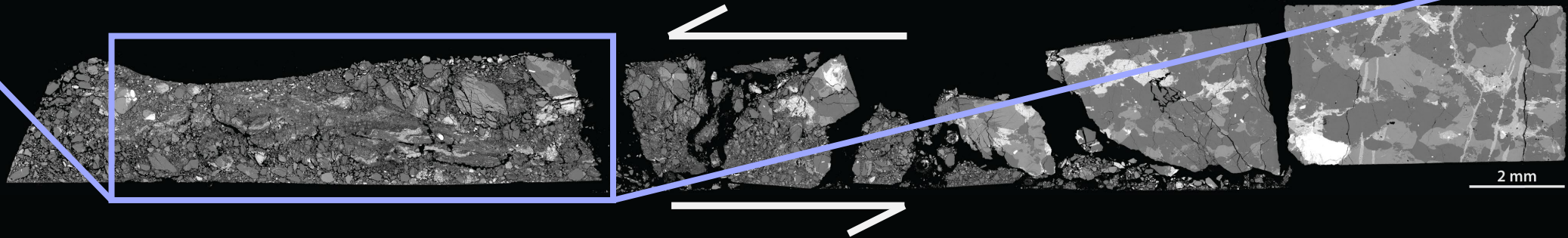
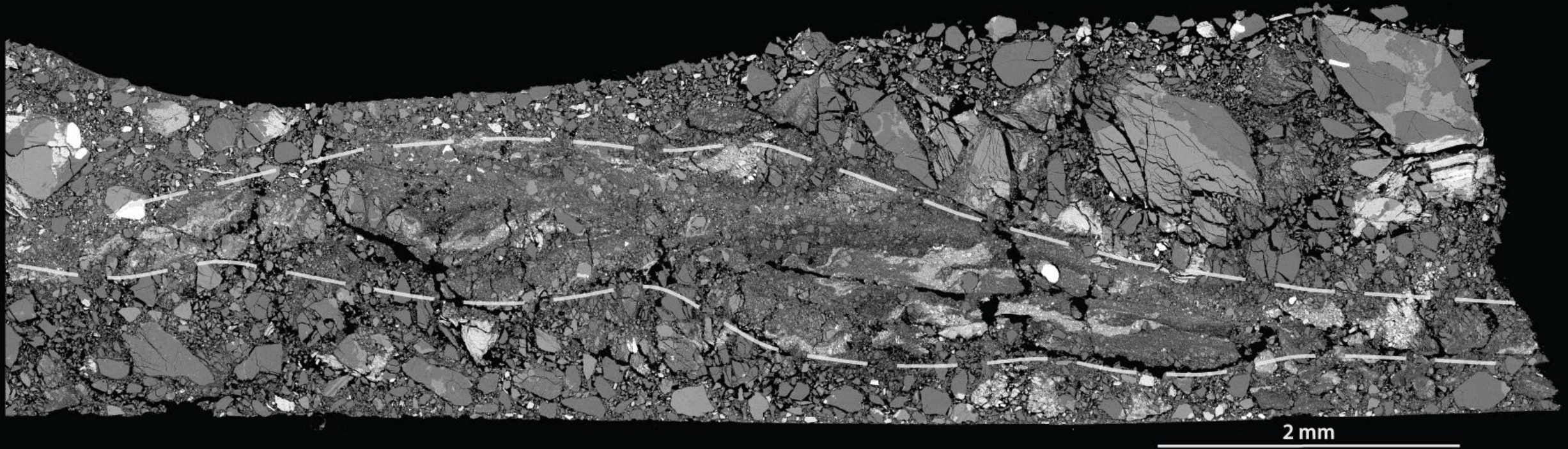
*large grains oriented
with shear direction*



wafer :

*large grains oriented
with shear direction*

*intense grain
size reduction*

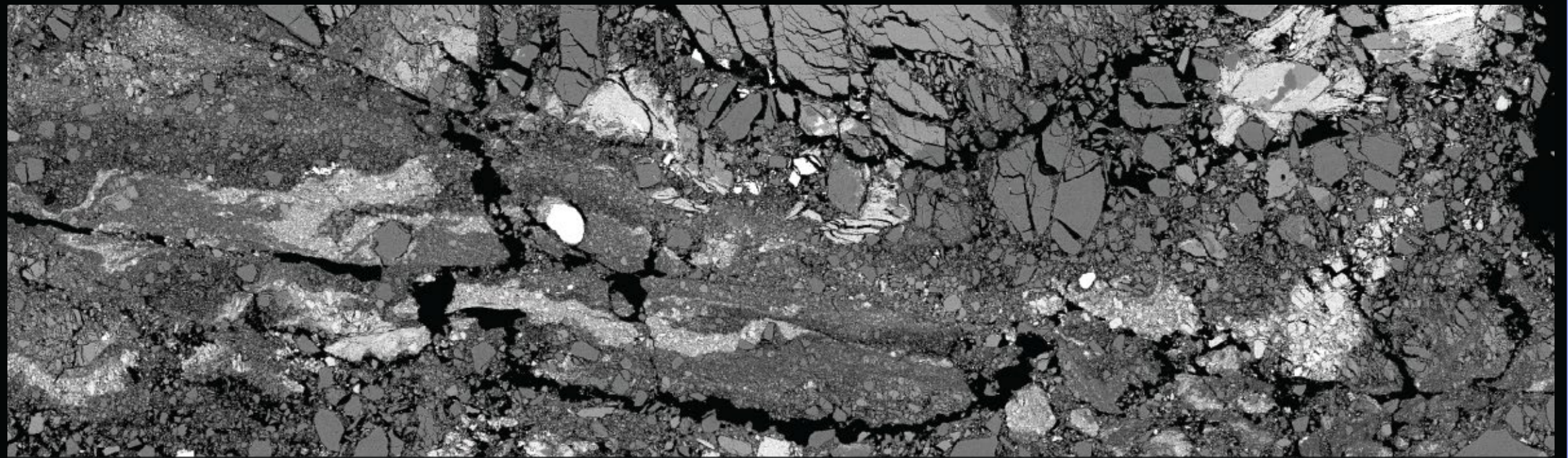


wafer :

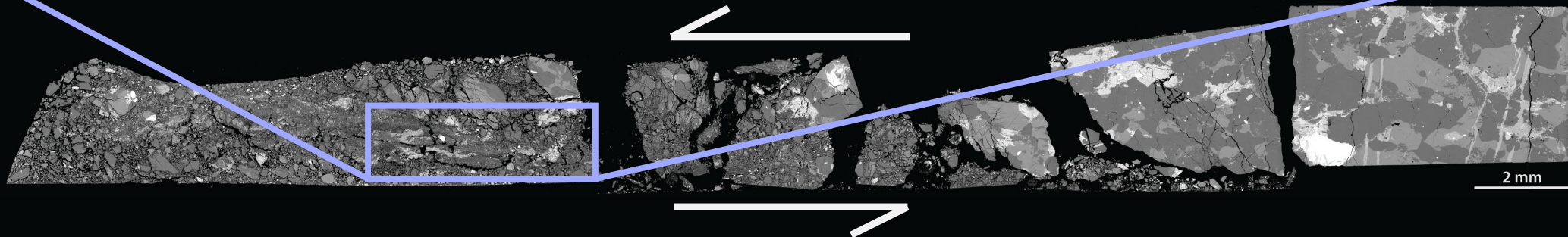
*large grains oriented
with shear direction*

*intense grain
size reduction*

*displacement localized on
discrete slip surfaces*



2 mm



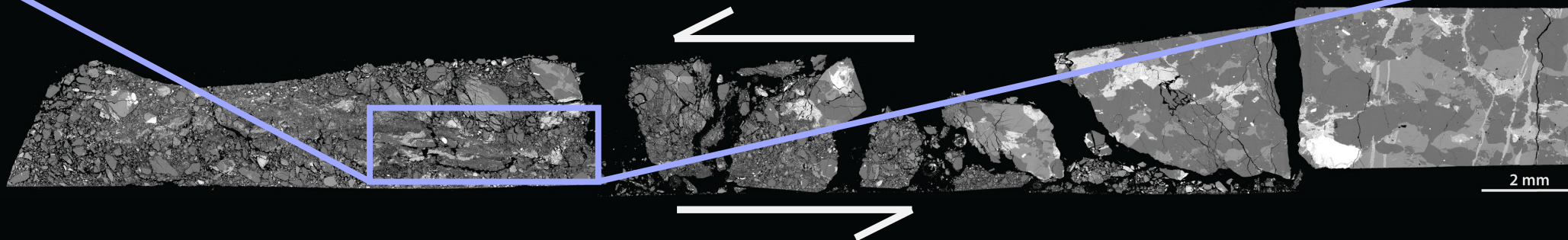
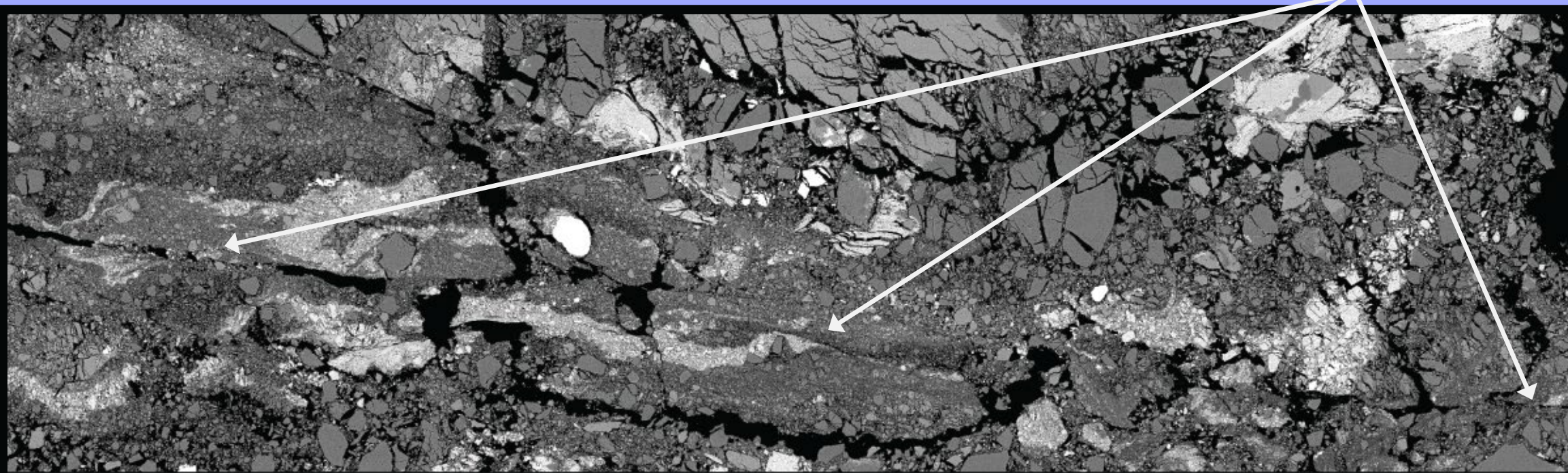
2 mm

wafer :

*large grains oriented
with shear direction*

*intense grain
size reduction*

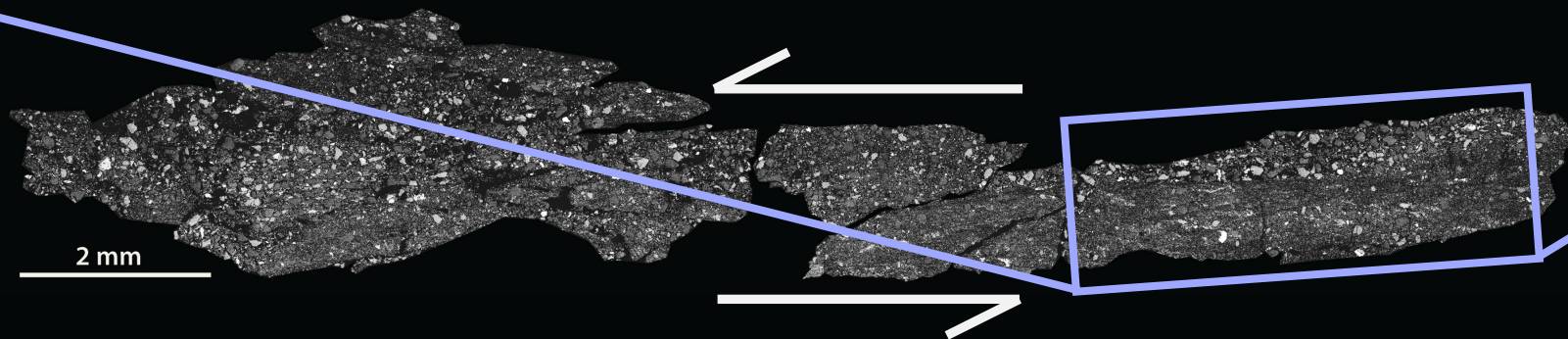
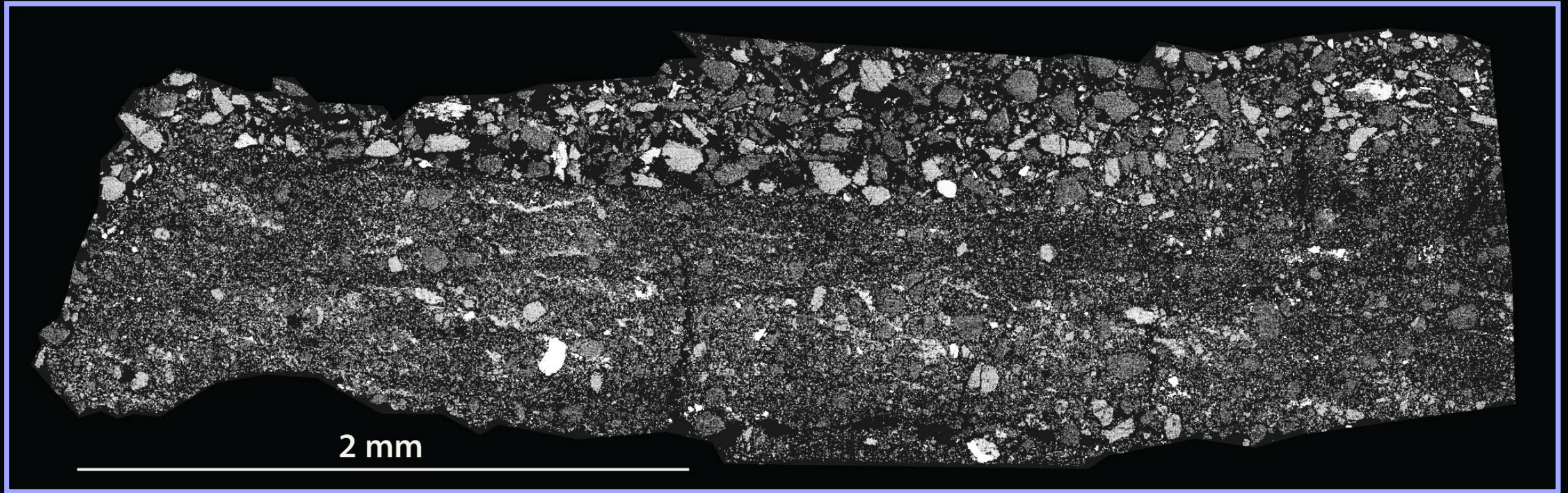
*displacement localized on
discrete slip surfaces*



powder :

*moderate grain
size reduction*

*distributed
deformation*

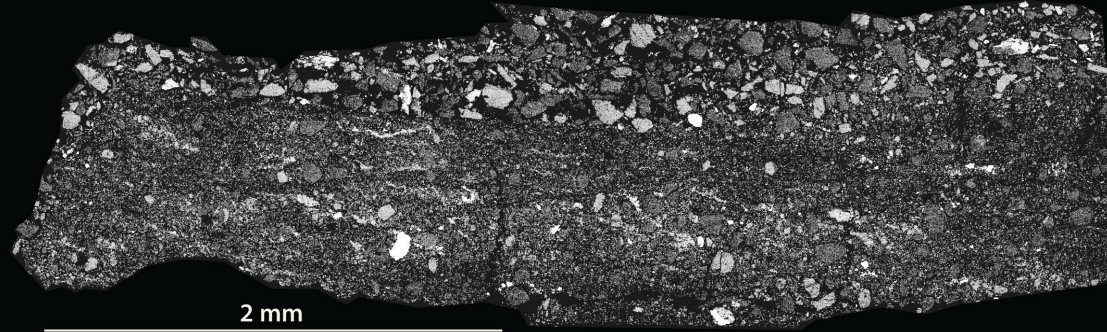


powder :

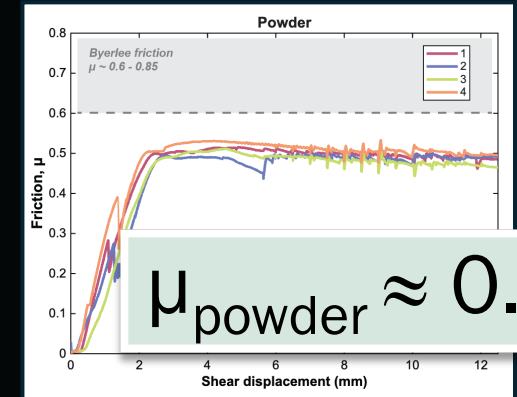
no inherited deformation



distributed deformation

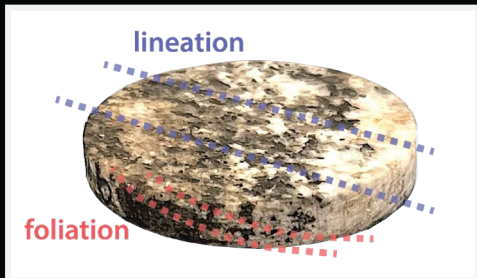


higher friction



wafer :

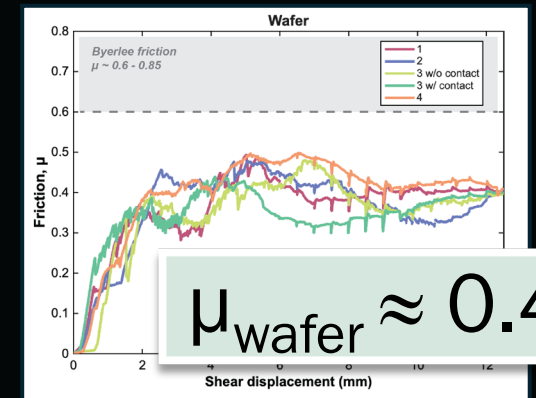
inherited deformation



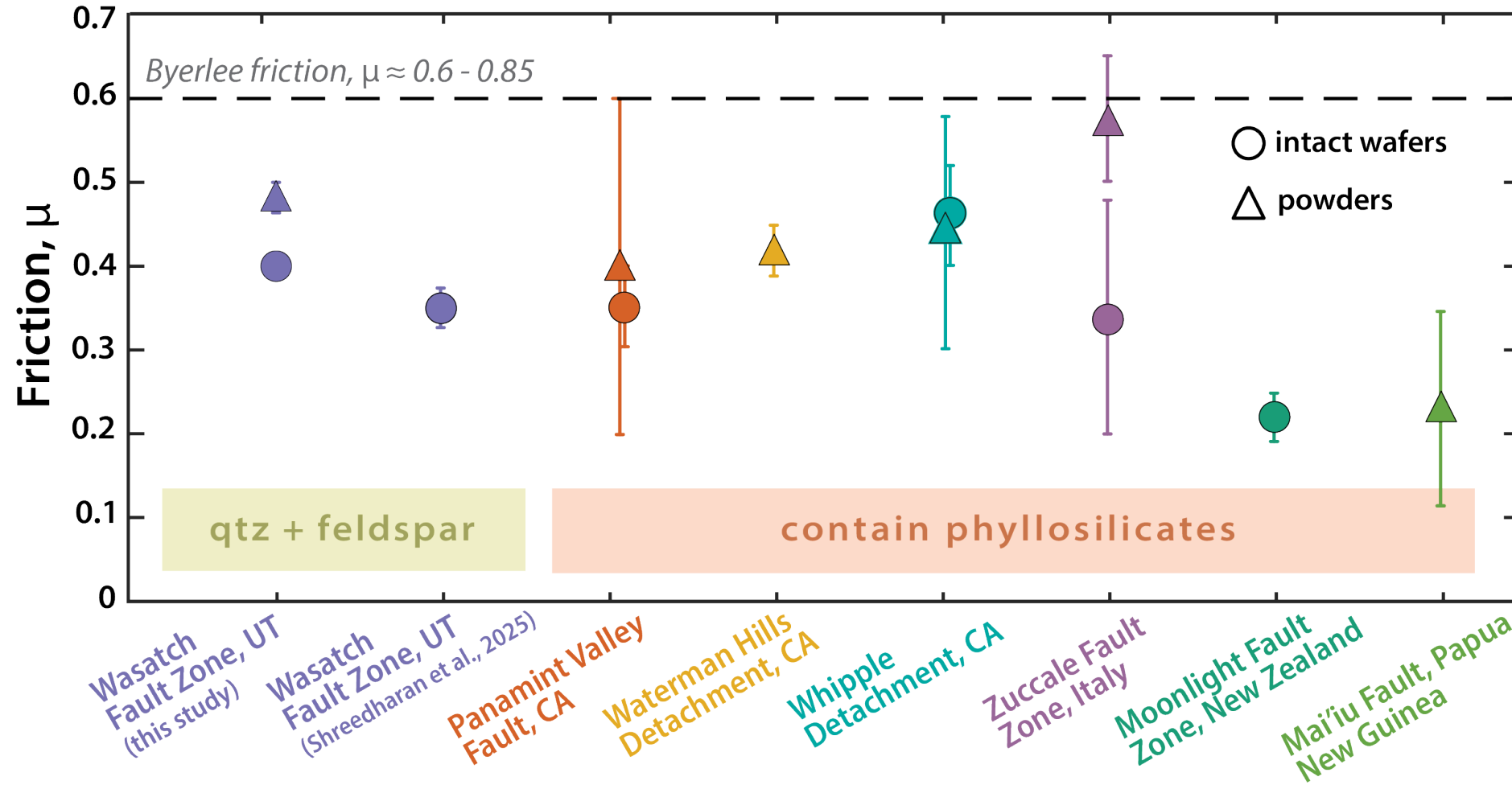
localized deformation



lower friction



Low frictional strength is consistent with other misoriented faults



Key takeaways

Inherited deformation seeds shear localization and frictional weakening.

Our results are maximum values; seismogenic PT conditions would further reduce frictional strength.

Implications for USGS Intermountain West priorities

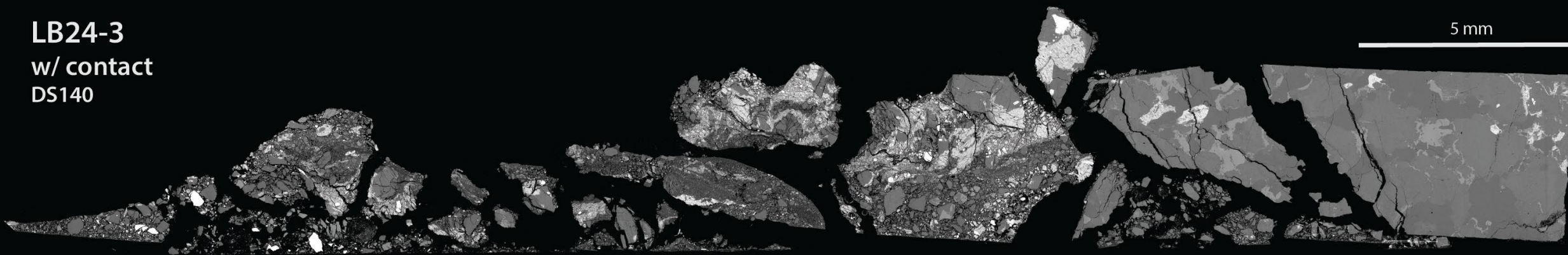
We provide the first experimental constraints on the low-velocity *in-situ* frictional behavior of Wasatch fault zone rocks.

Our results show spontaneous fault reactivation is possible even at low angles on the Wasatch fault.

These data contribute important inputs for physics-based earthquake simulators (e.g., RSQSim) and forecasting models.

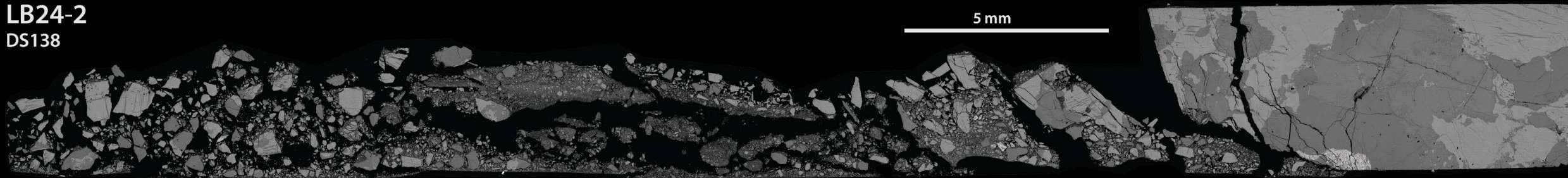
LB24-3
w/ contact
DS140

5 mm

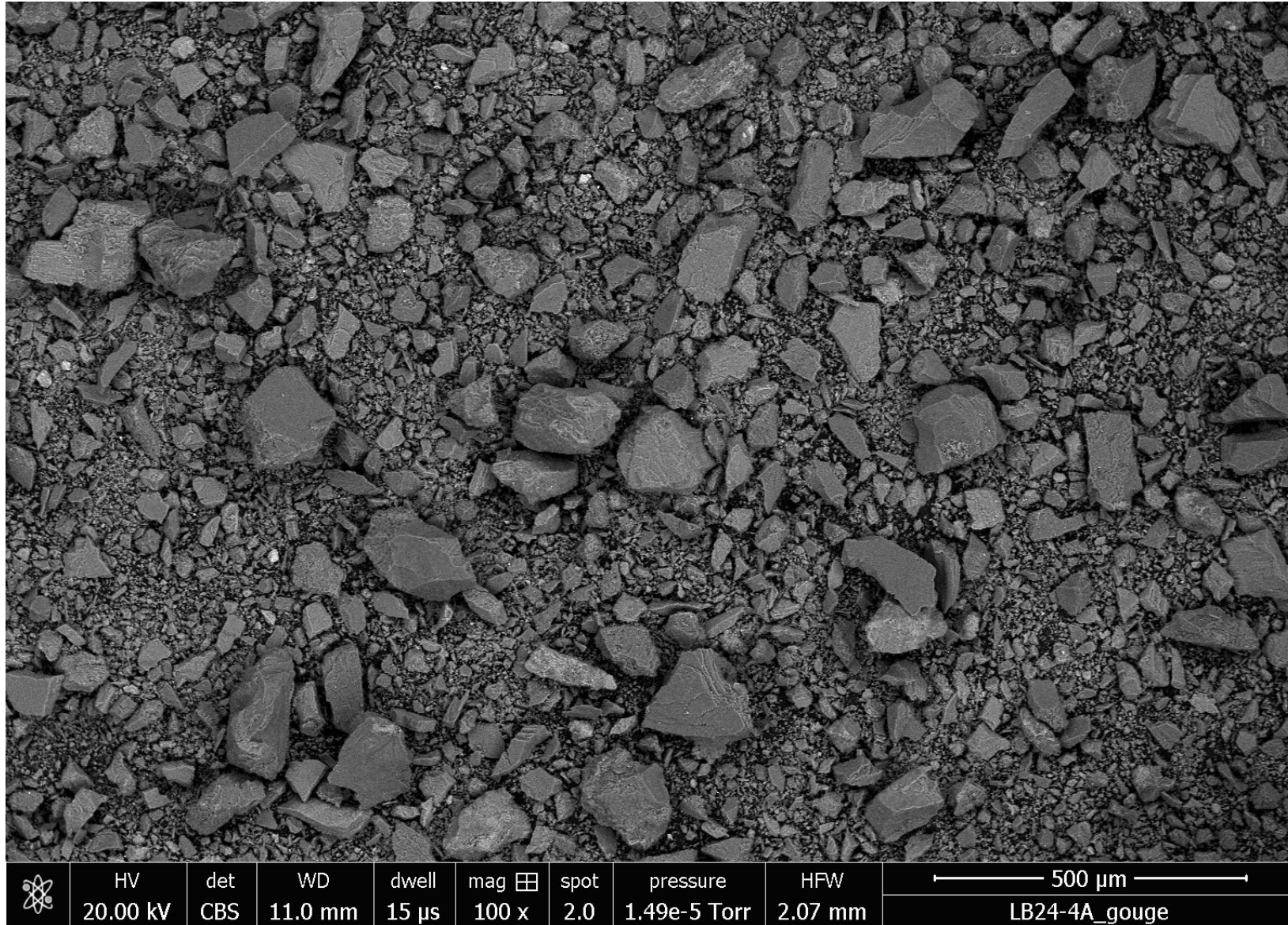


LB24-2
DS138

5 mm



#4 powder pre-experiment





Dip Angles of Mountain-Front Facets Encode Long-Term Slip Rates Along the Wasatch Normal Fault.

Scott McCoy, Ben Mason, Will Struble
Department of Geological Sciences
and Engineering
University of Nevada

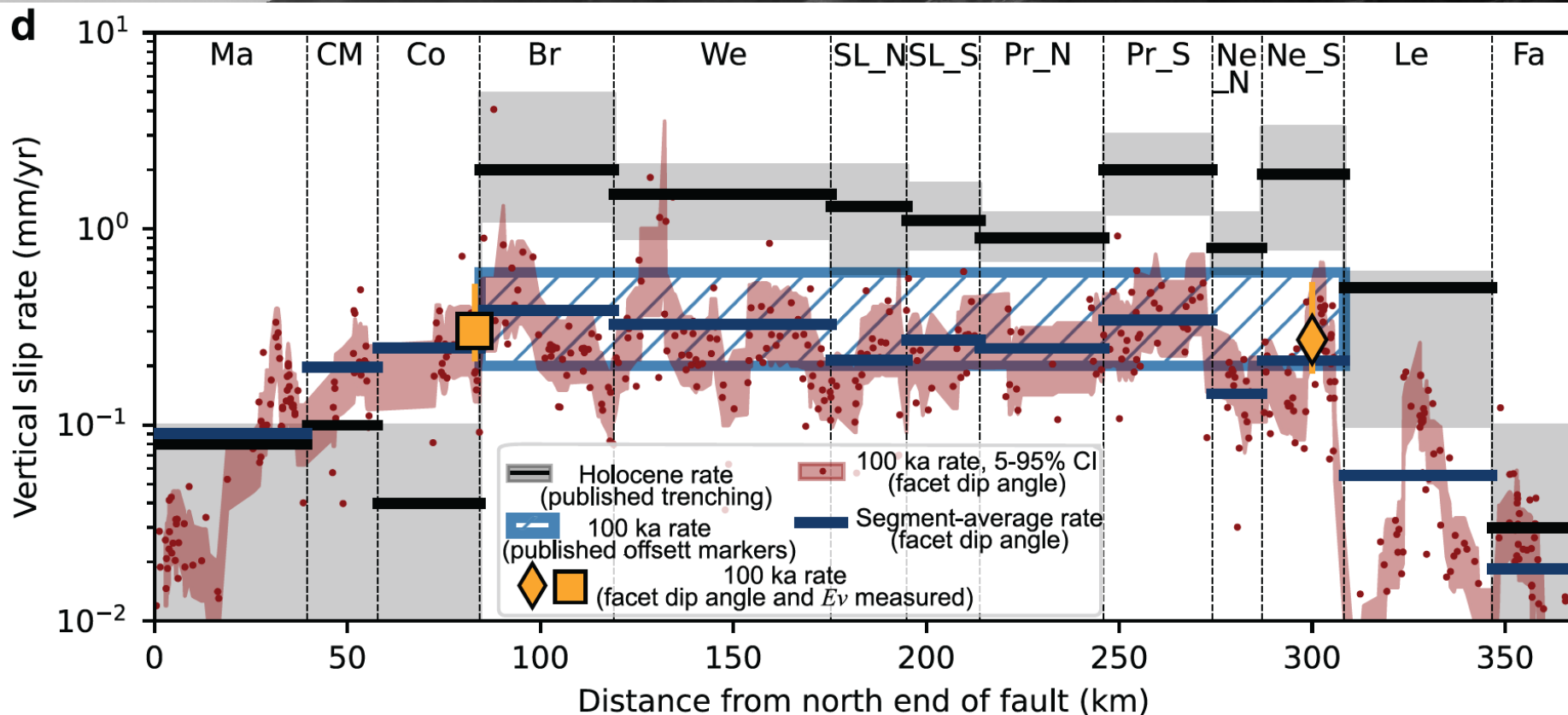
Dan Hobley, Greg Tucker
CIRES and Department of Geological
Sciences
University of Colorado at Boulder

Dip Angles of Mountain-Front Facets Encode Long-Term Slip Rates Along the Wasatch Normal Fault, USA

Key Points:

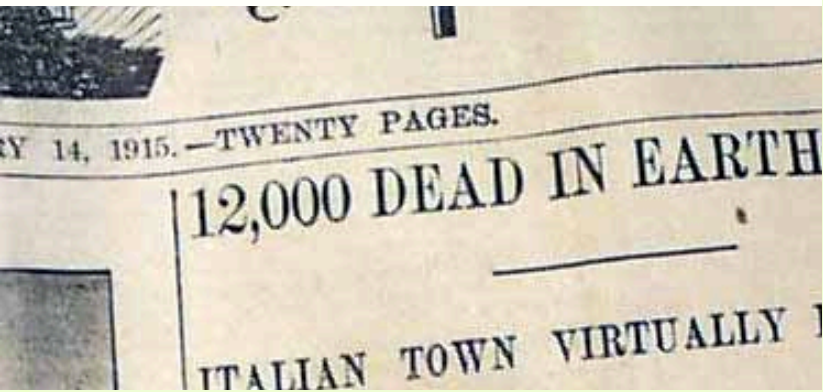
- Relative variations in fault slip rate along surface traces of normal faults

William T. Struble¹ , Scott W. McCoy² , Gregory E. Tucker³ , Daniel E. J. Hobley³ , Laura C. Gregory⁴ , and Henry B. Mason²



Do facets record long-term slip rates?

Long term slip rate sets seismic hazard



ed as evidence of this.
The Turks are still
factor in the war in t
army near the fronti
casus is reported to
stand, and further
the Turks have oc
100 miles east of th
which offers a bas
againat the south
Russia.
To the western

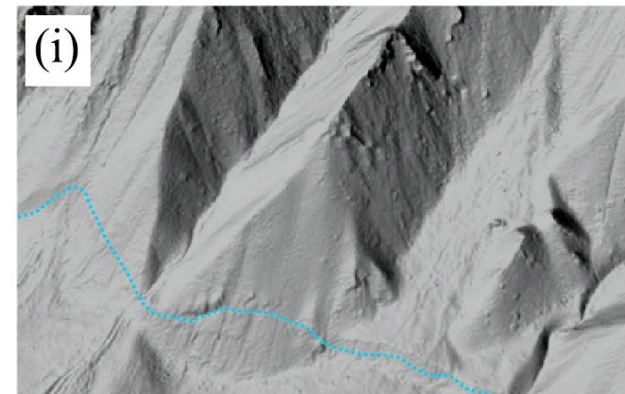
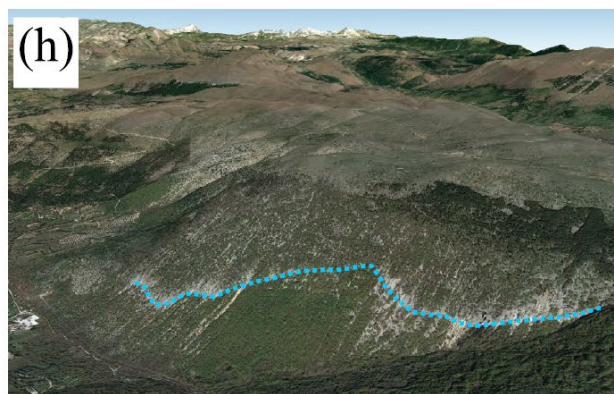
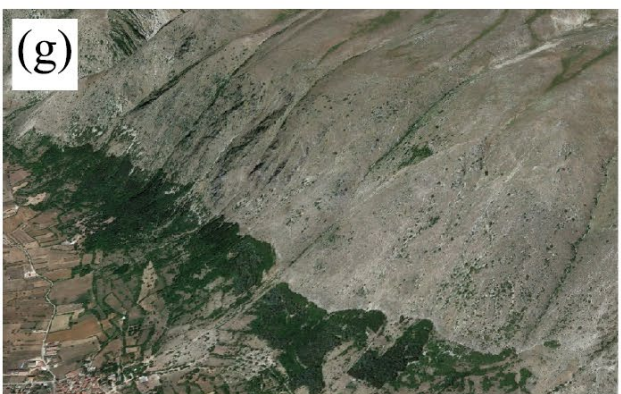
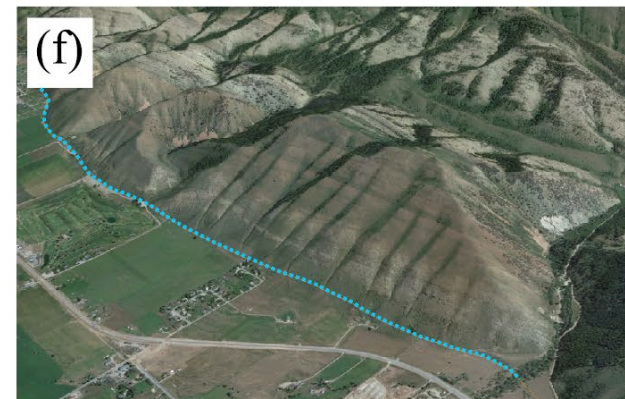
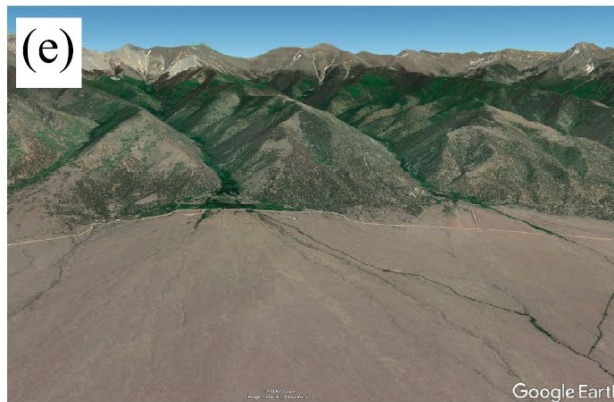
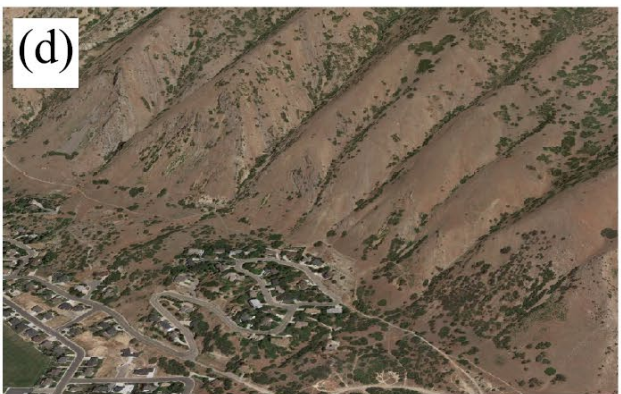
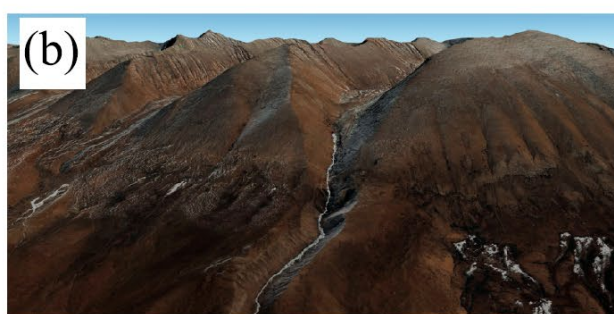
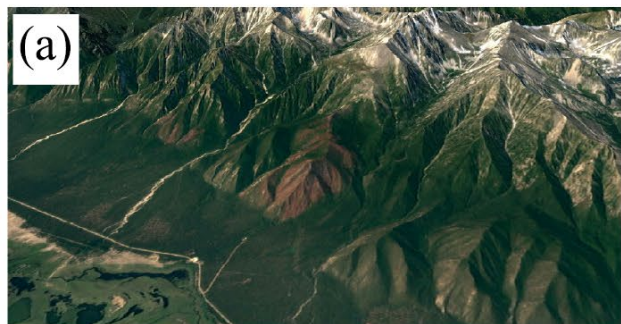
A snippet of text from a newspaper, likely a continuation of the article about the earthquake. The text is partially cut off on the right side.

But representative slip rate measurements spanning multiple earthquake cycles are rare on moderate to slow slip rate faults

General observations of normal-fault facets:

The footwalls of active normal faults are often decorated with facet slopes - semi-planar, dipping slopes that rise up out of the fault trace

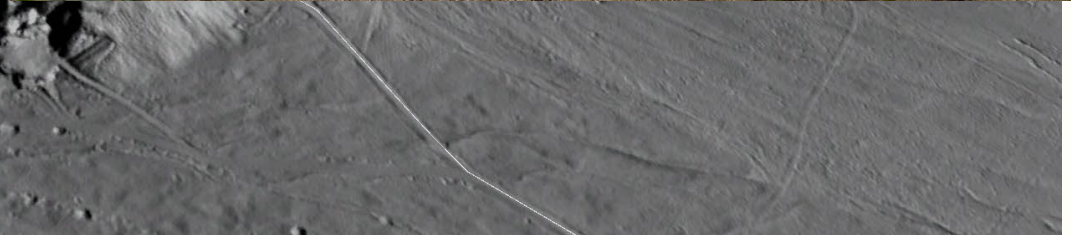
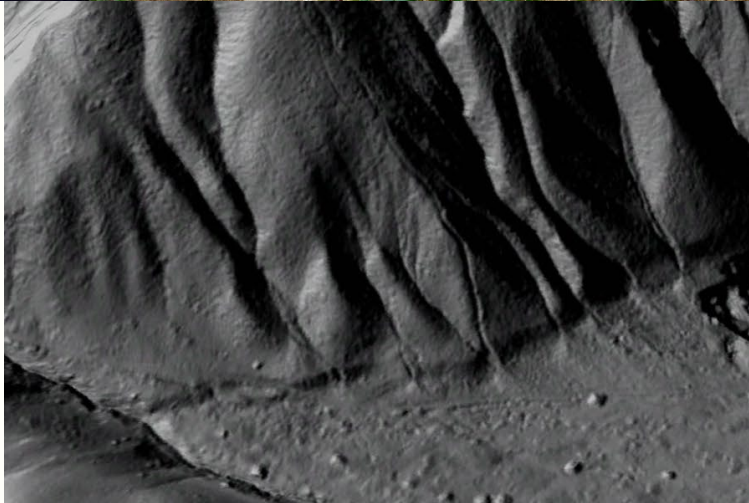
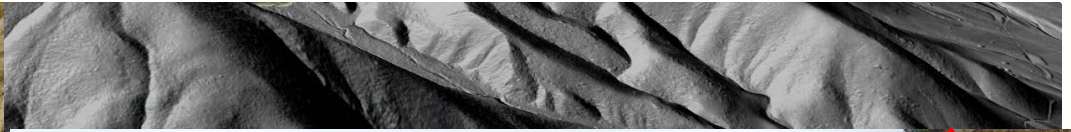




Facet slopes are made of bedrock, or bedrock thinly mantled by regolith



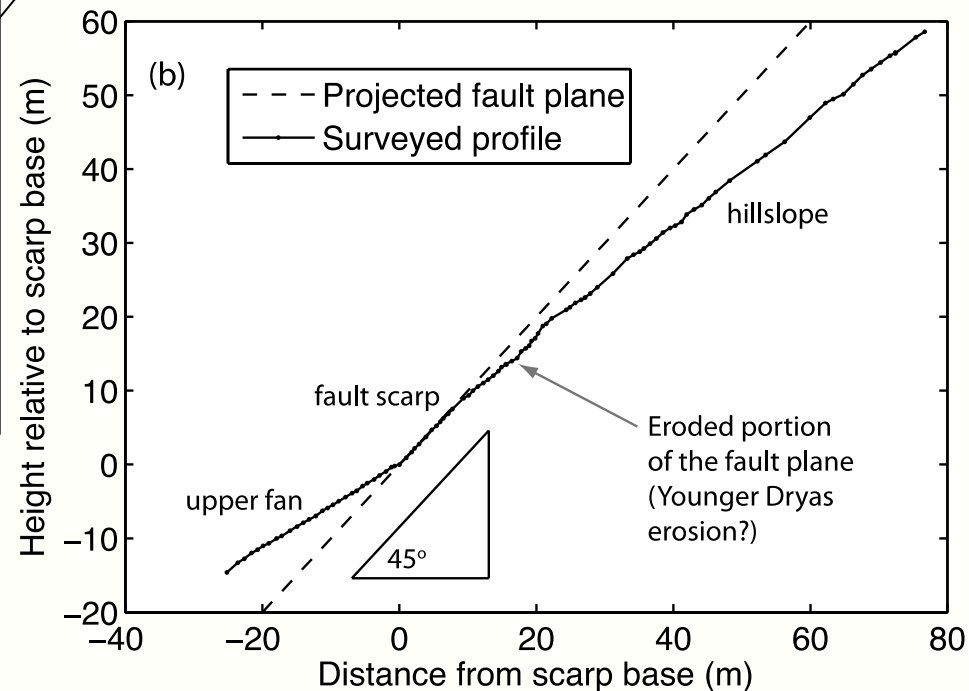
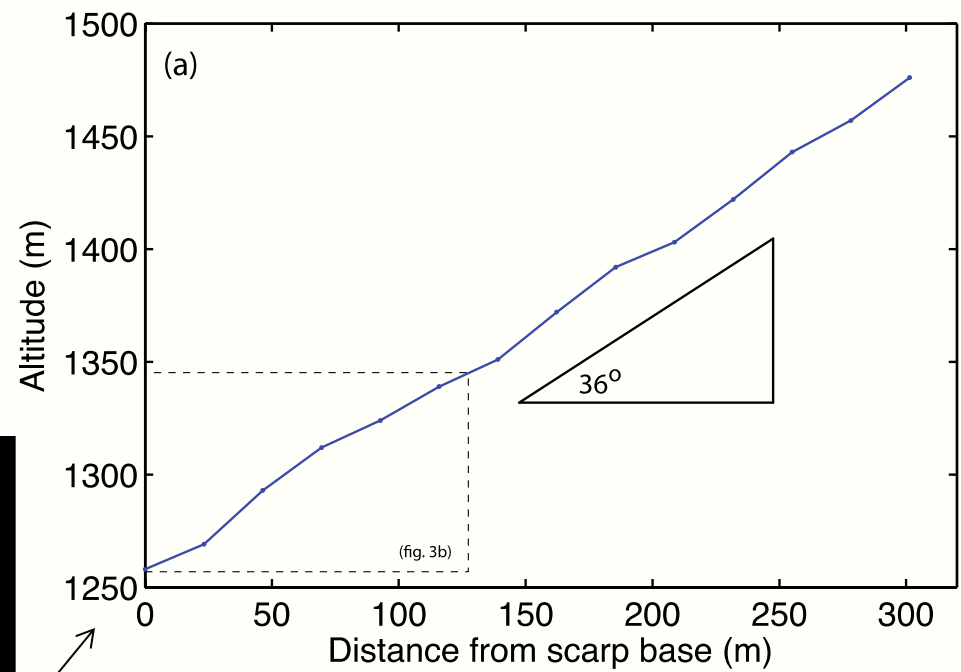
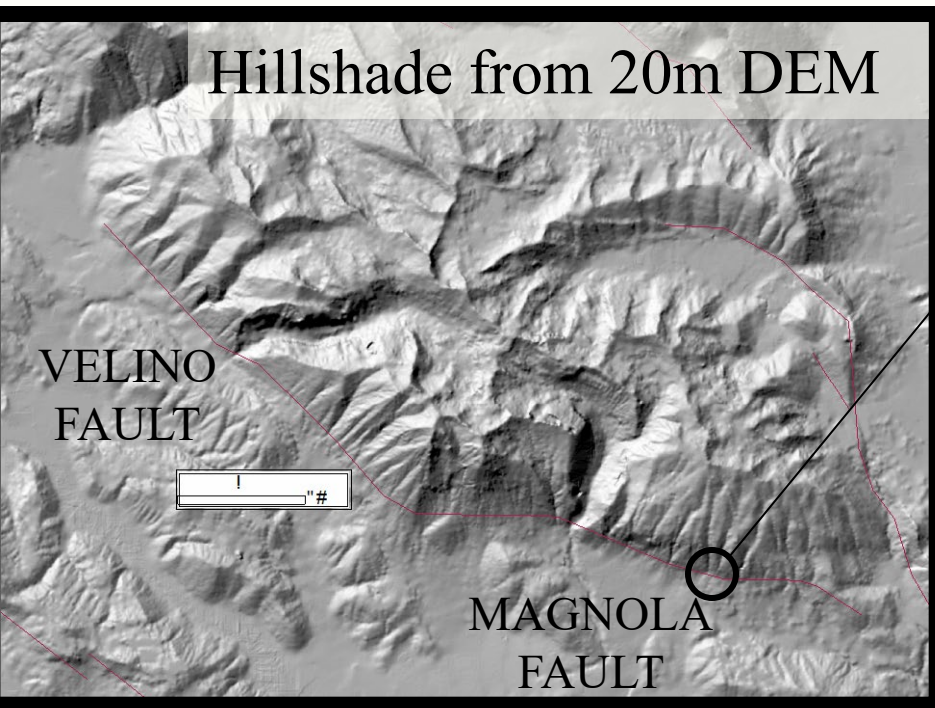
Facet slopes are less steep than the fault plane and bedrock fault scarp from which they grow

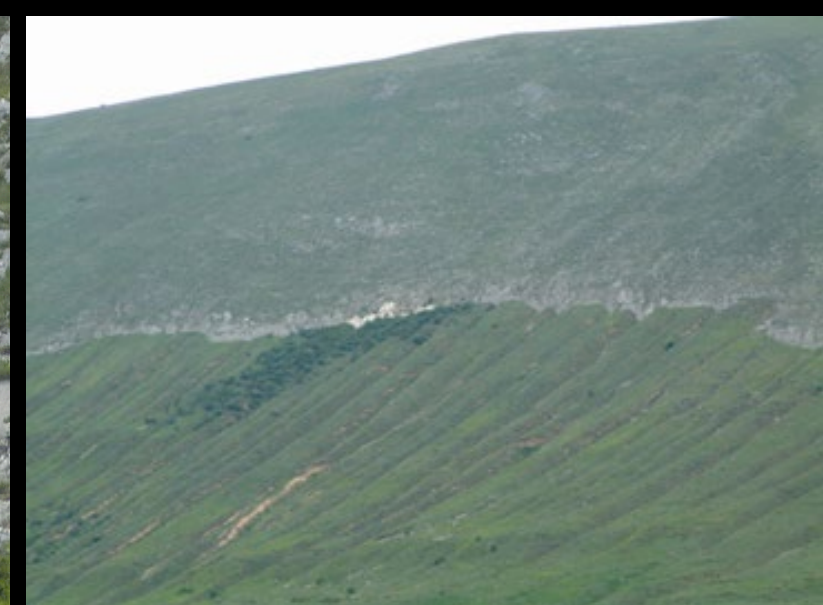


Facet slopes are less steep than the fault plane and bedrock fault scarp from which they grow



Hillslope facets above scarps are less steep than the fault plane



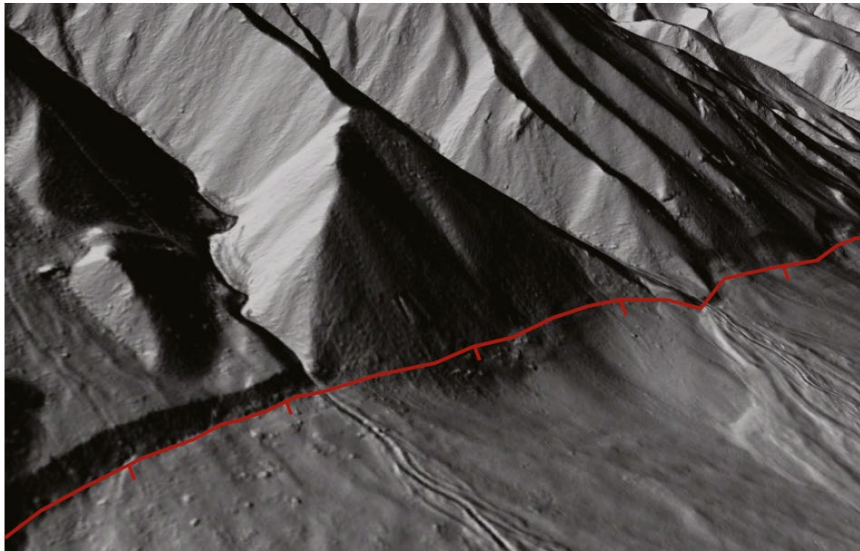
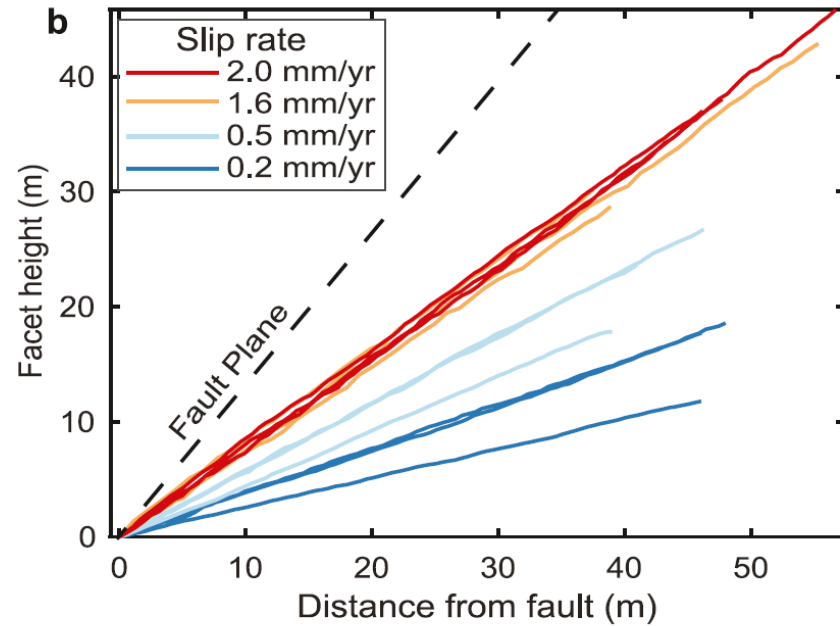


BEDROCK FAULT SCARPS IN CENTRAL ITALY

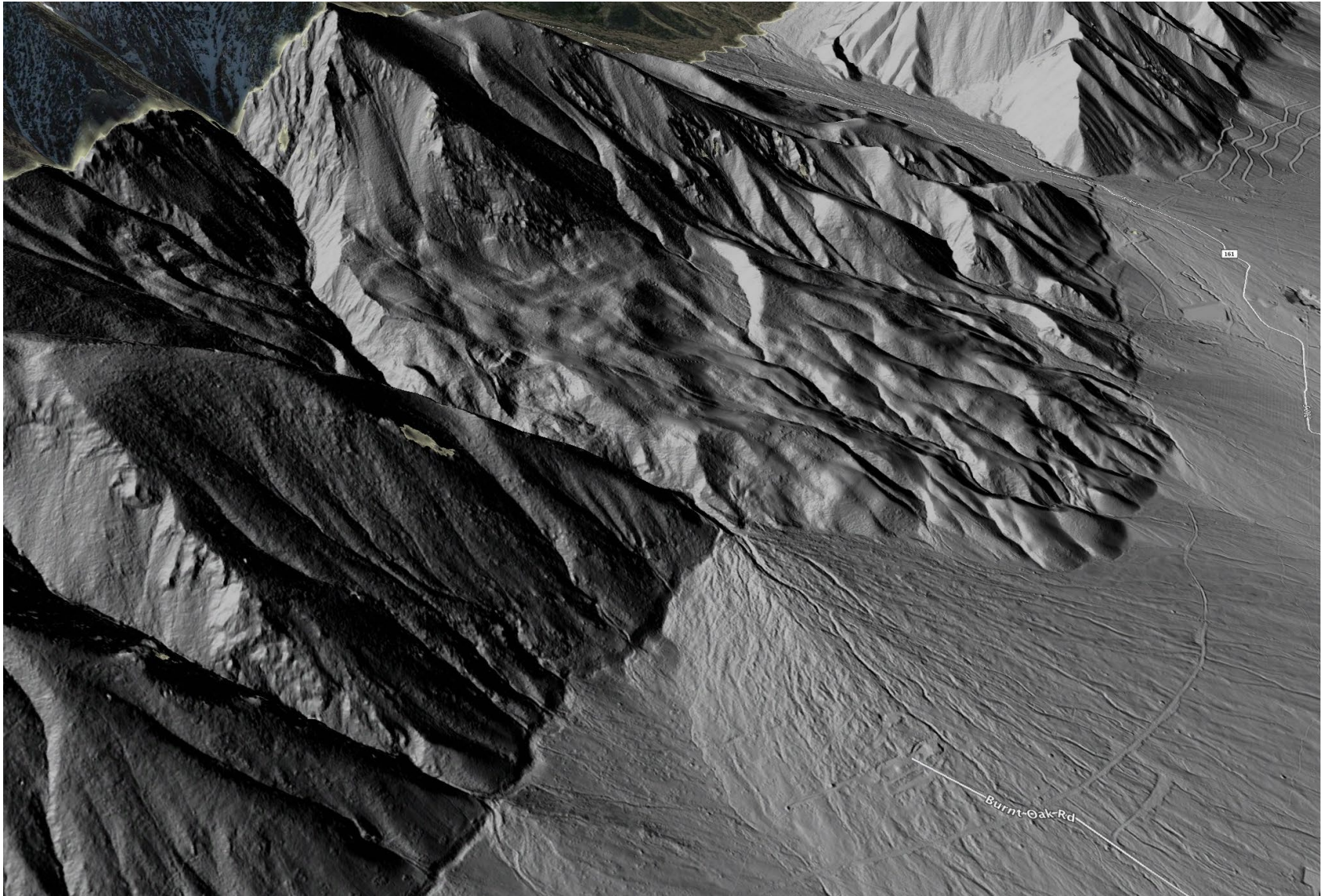
What sets facet inclination?

Rock strength and deep seated
landsliding ?

- Easy way to make a planar slope
- But NO evidence for pervasive landslides
- Observe large variation in facet inclination



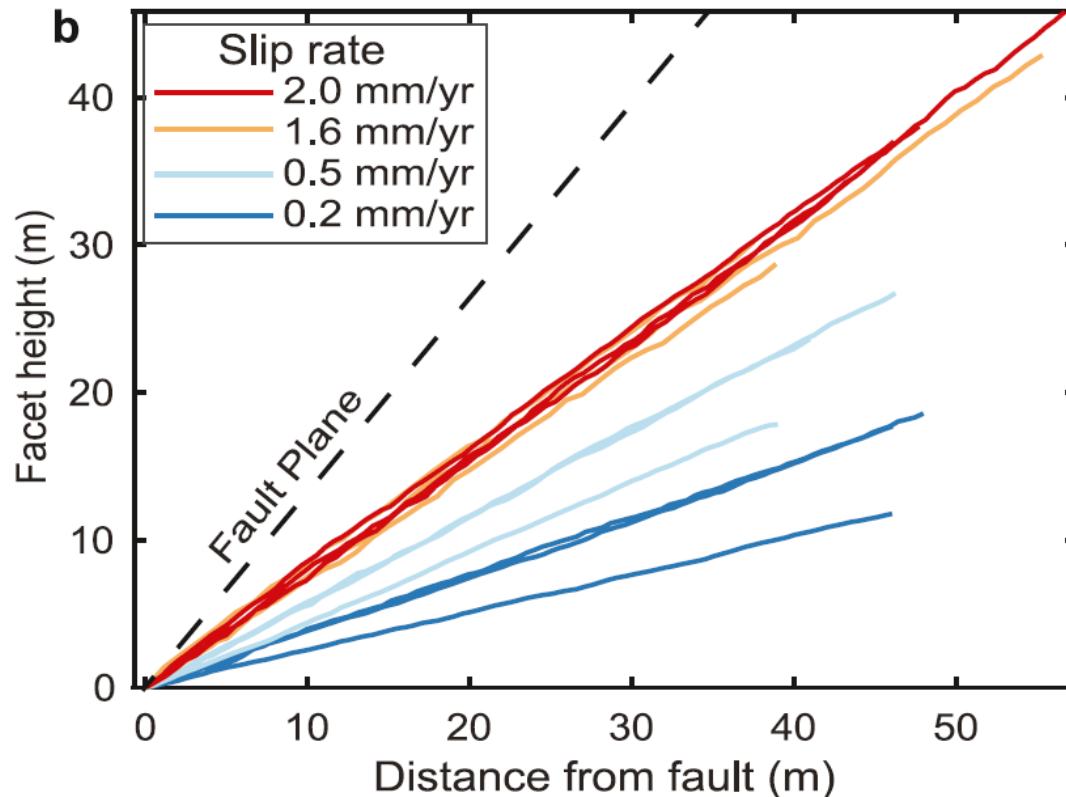
If landslides were predominant mode of sediment transport, facet-slope gradients would be uniform along strike of the fault and equal to the threshold slope angle set by bedrock strength



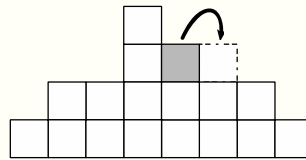
Alternative conceptual model

Facet inclination set by a **balance** between **facet erosion rate** and fault **slip rate**

- If erosion is uniform, also makes a planar slope



Particle-based model of facet slope evolution



ALGORITHM:

Pick random location (“disturbance event”)

If rock at surface

 Weathers to regolith with probability P_w

If regolith

 Repeat

 Pick direction at random

 Hop with probability P

 Re-evaluate P

 Until grain comes to rest or exits

SLOW SLIP

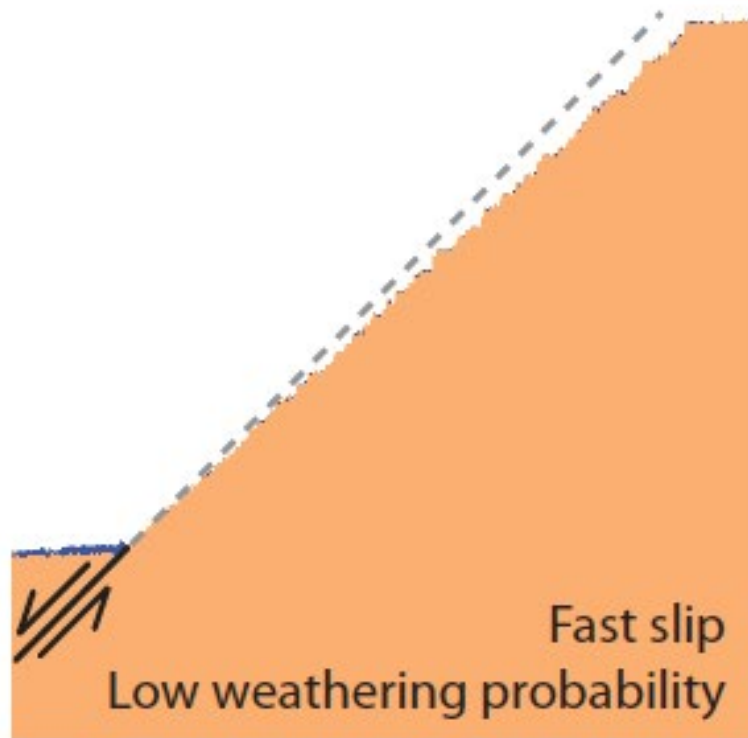
Slow slip, slow weathering -> low erosion rate



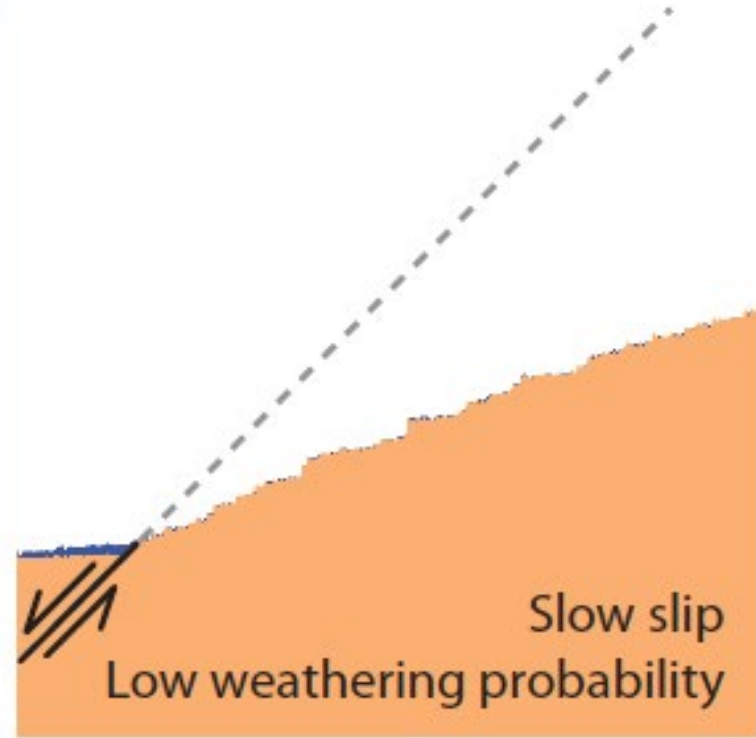
Fast slip, slow weathering $\rightarrow$ low erosion rate



Fast slip
slow weathering ->
low erosion rate



Slow slip
slow weathering ->
low erosion rate

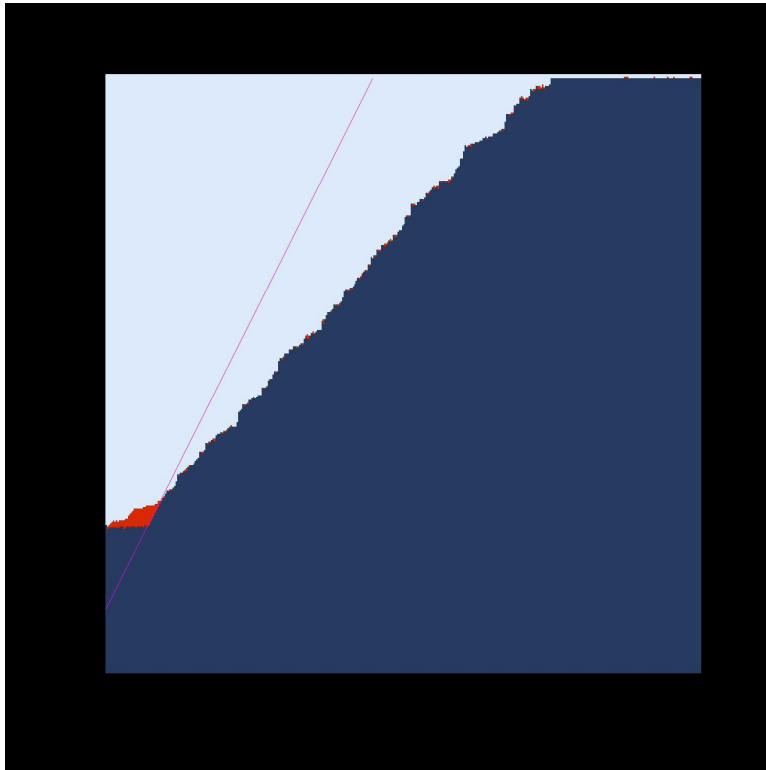


Decreasing slip rate decreases facet slope

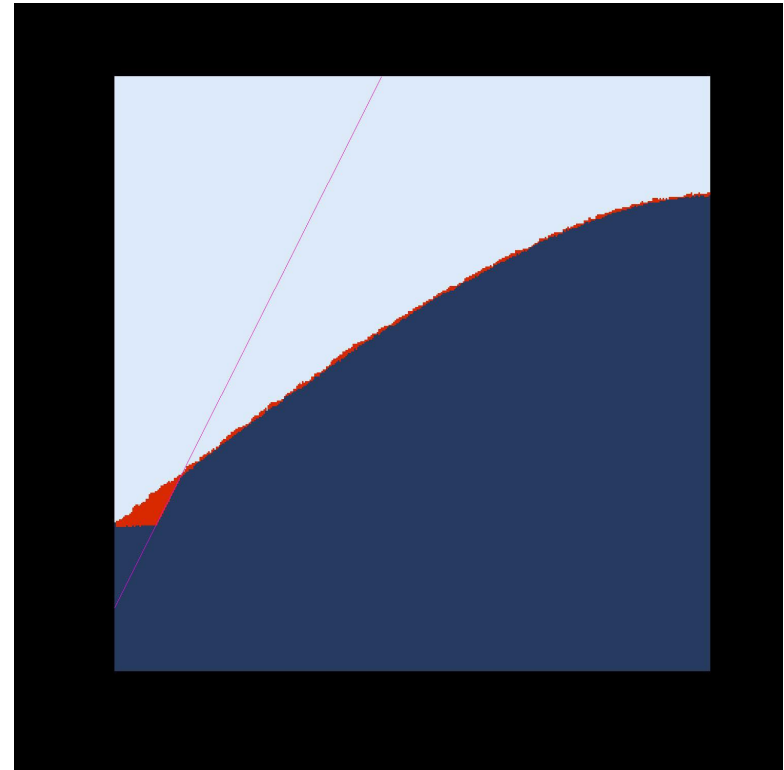
Fast slip, Fast weathering -> Fast erosion rate



Fast slip
slow weathering ->
low erosion rate



Fast slip
fast weathering ->
fast erosion rate

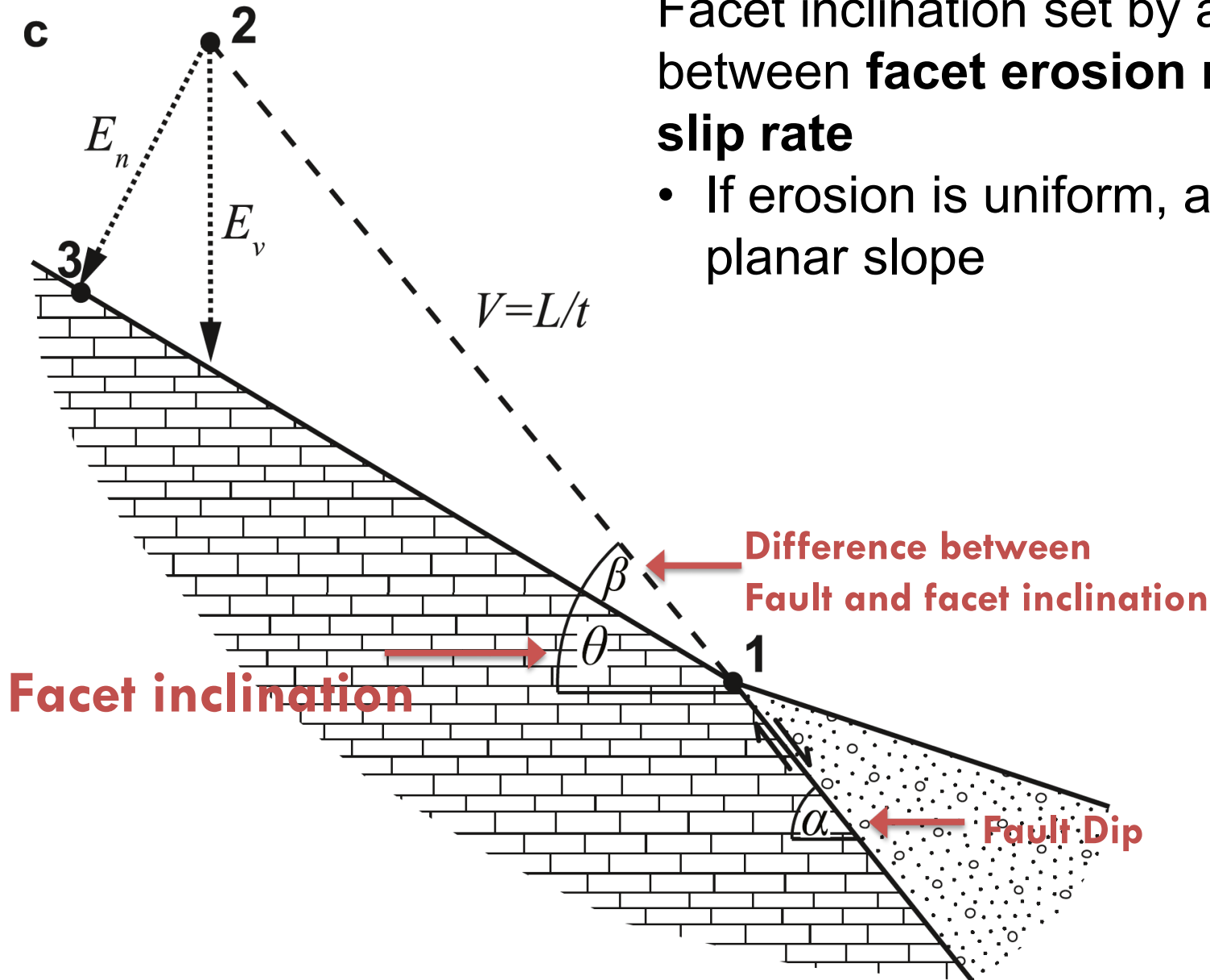


Increasing erosion rate decreases facet slope

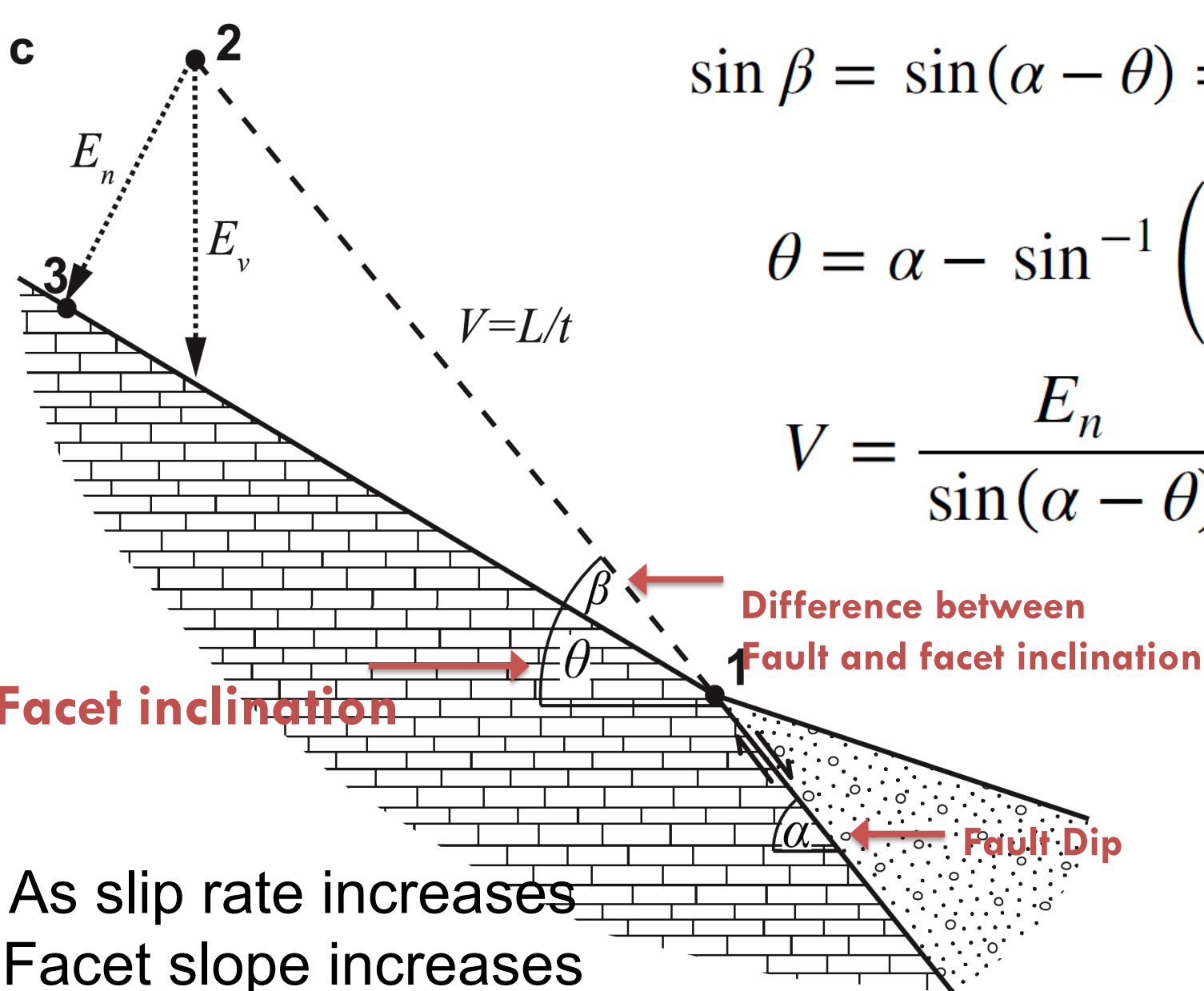
Geometric Facet Evolution Model

Facet inclination set by a **balance** between **facet erosion rate** and fault **slip rate**

- If erosion is uniform, also makes a planar slope

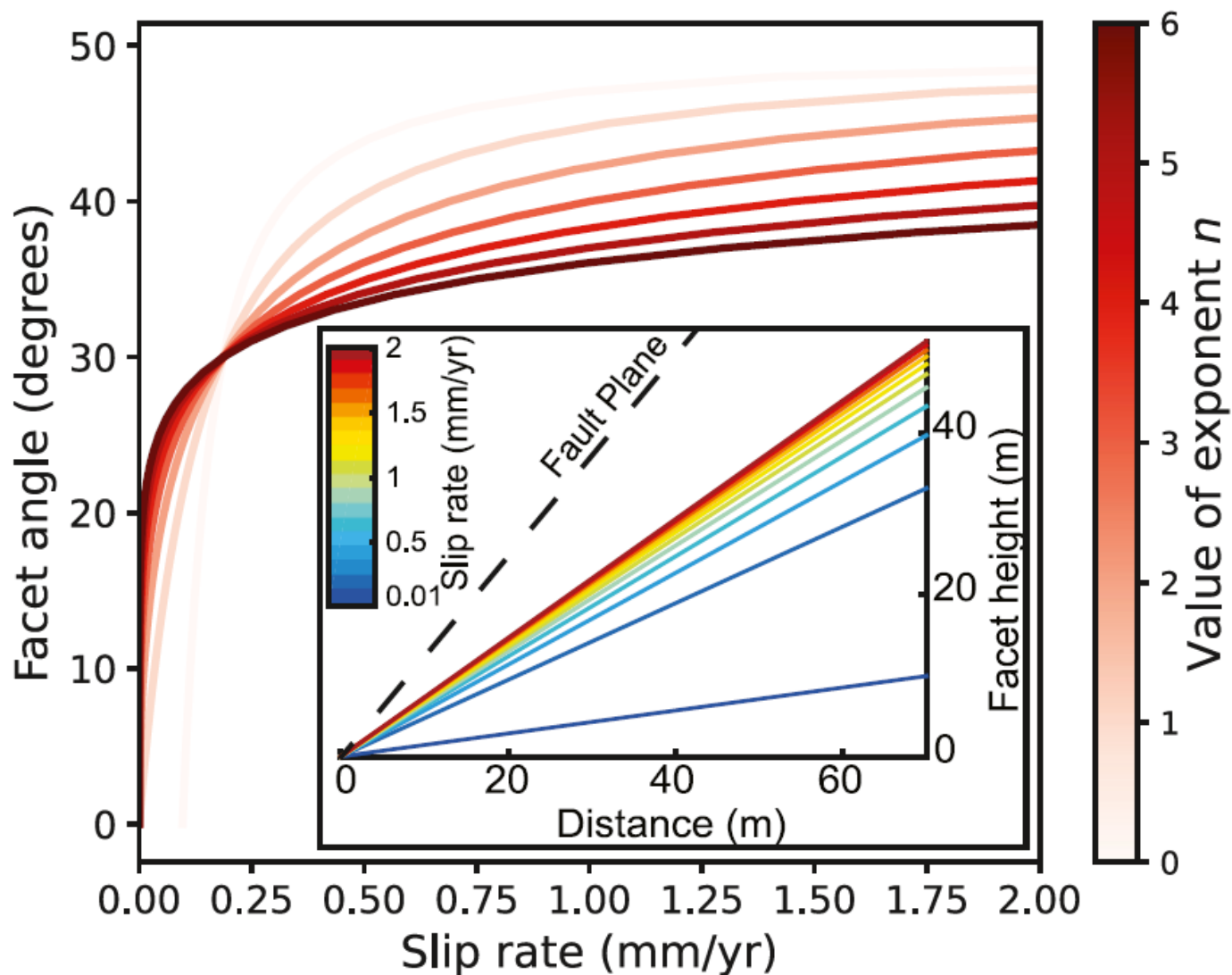


Geometric Facet Evolution Model

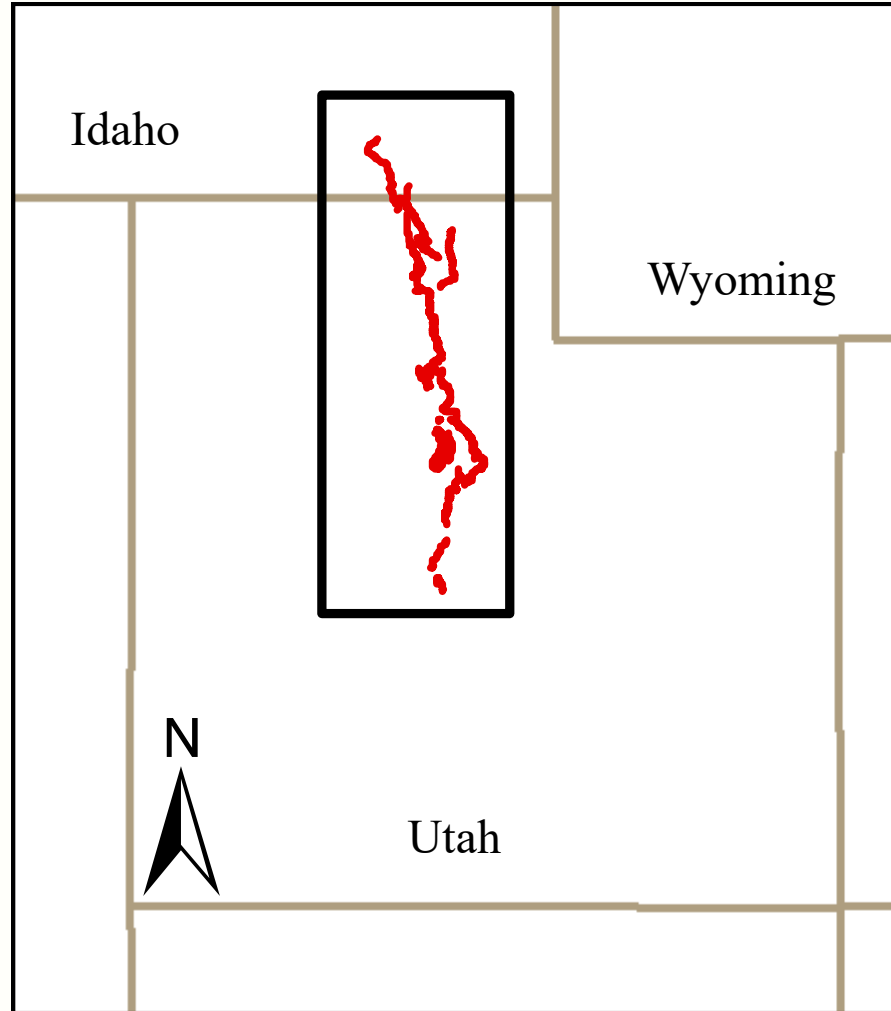


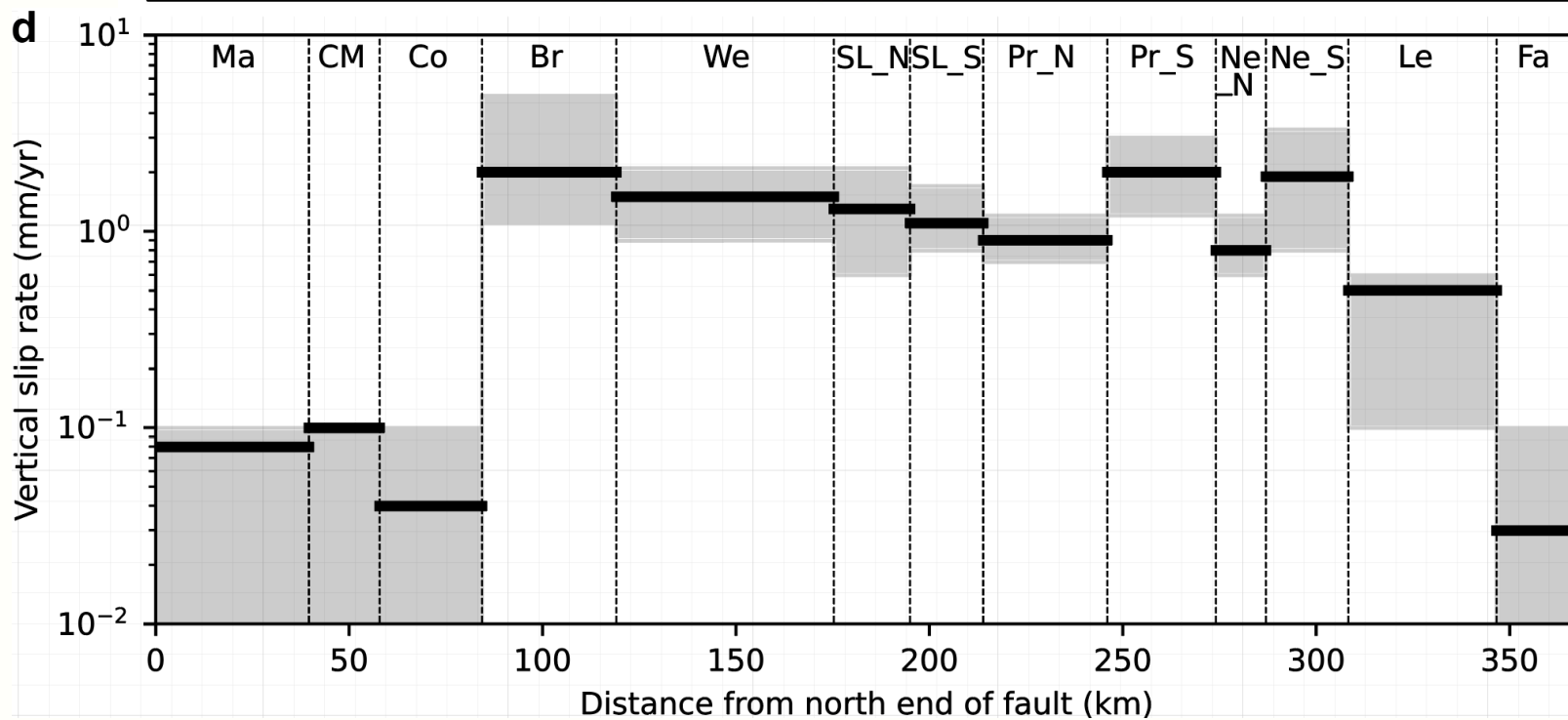
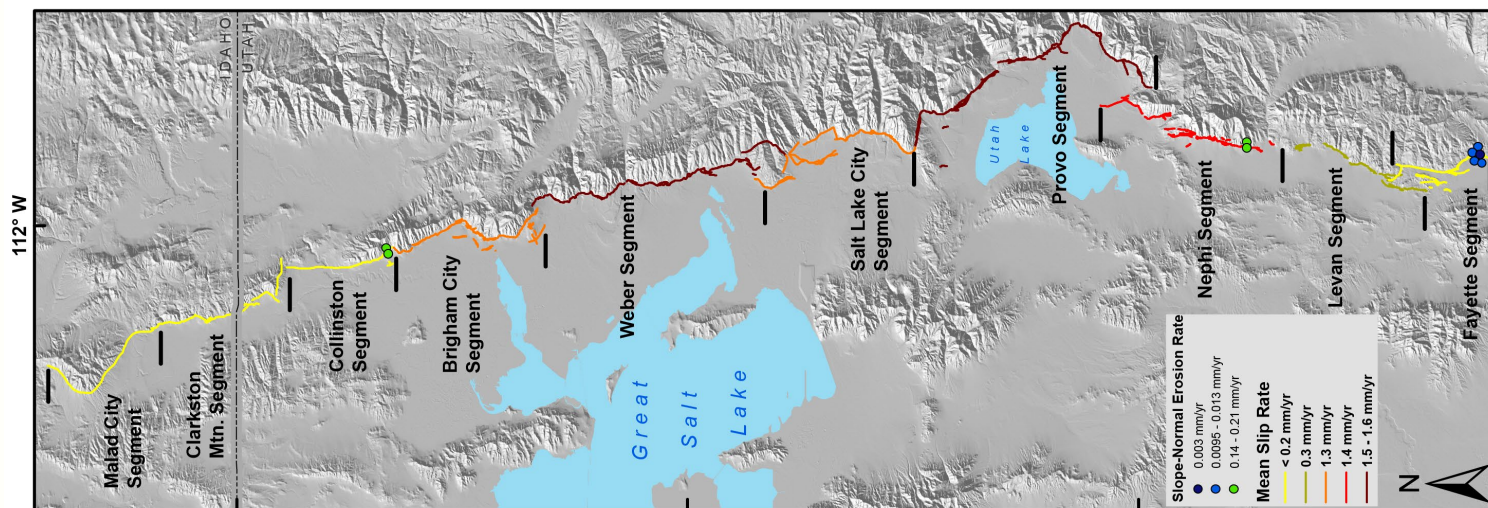
$$E_v = kS^n = k(\tan \theta)^n$$

$$V = \frac{k(\tan \theta)^n \cos \theta}{\sin(\alpha - \theta)}$$

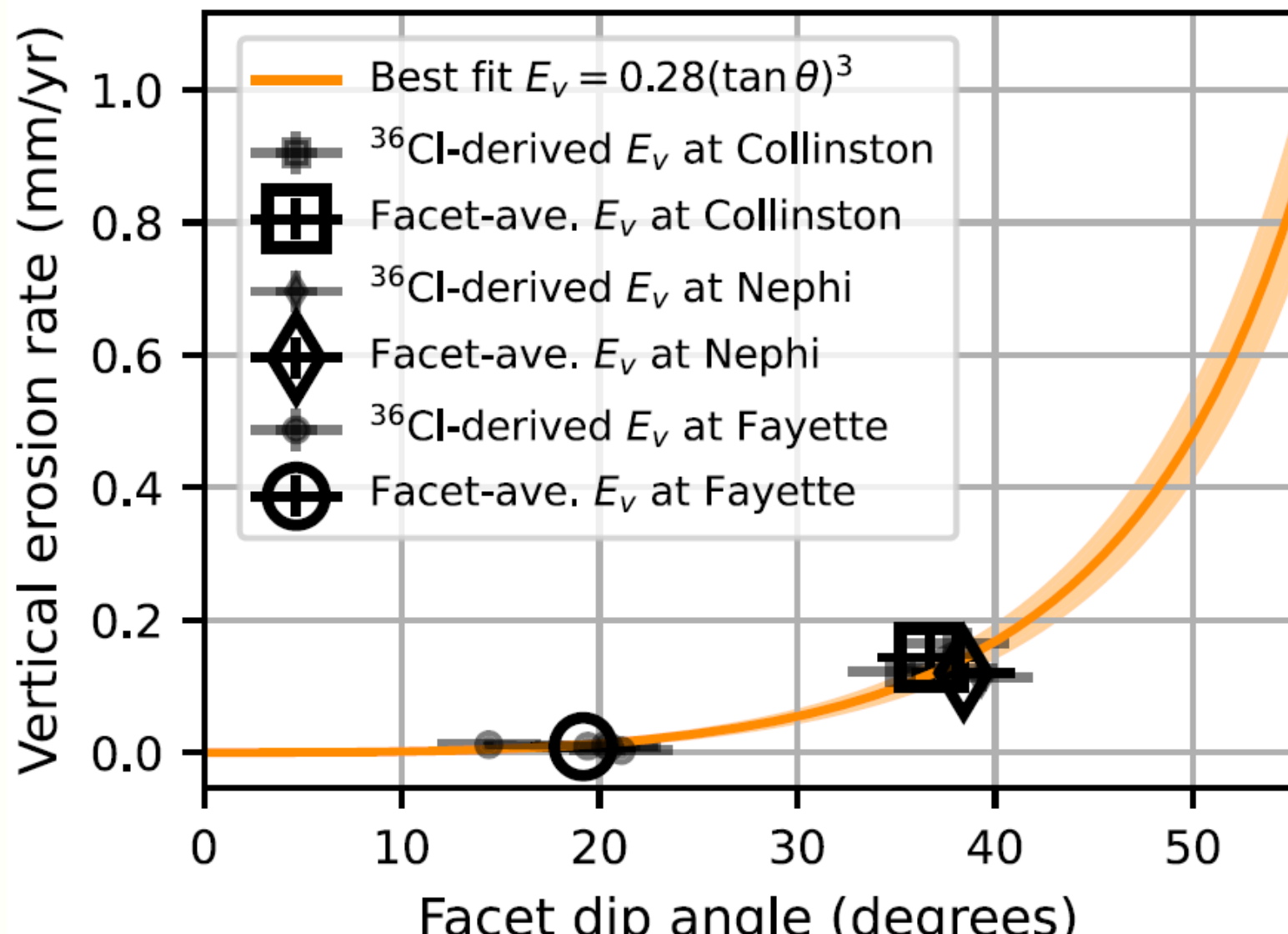


Test model predictions: Measure facet angle along the Wasatch Fault where slip rate, erosion rate, and fault dip have been constrained



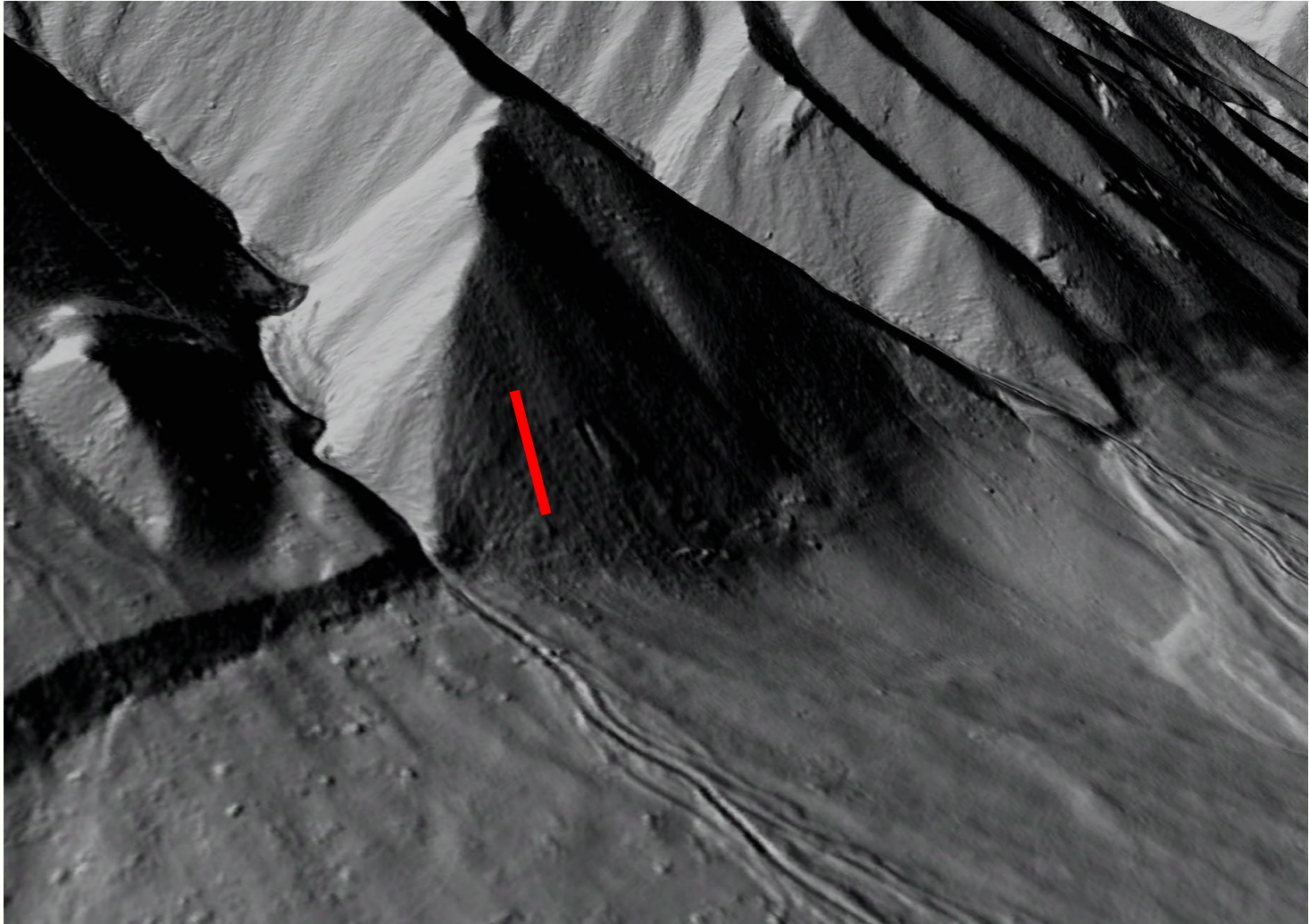






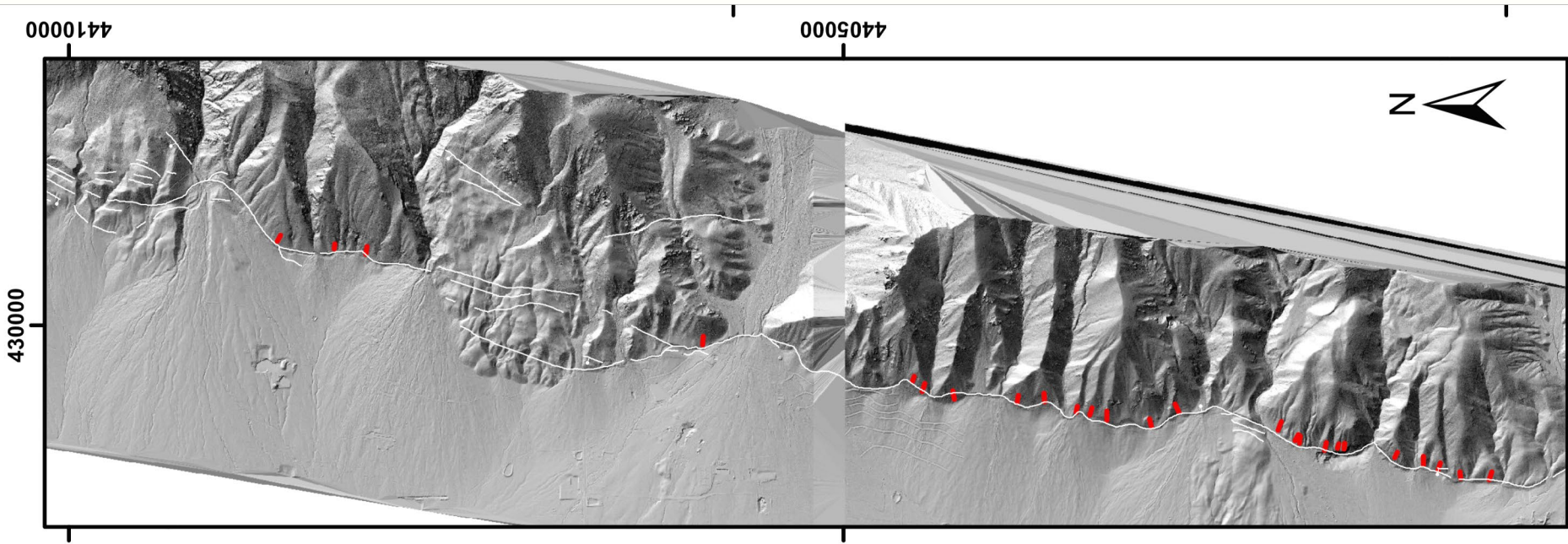
Methods:

- Use 1 m resolution digital elevation models (DEMs)
- Measure average facet angle over ~ 100 m horizontal distance starting at the fault or above the highest shoreline

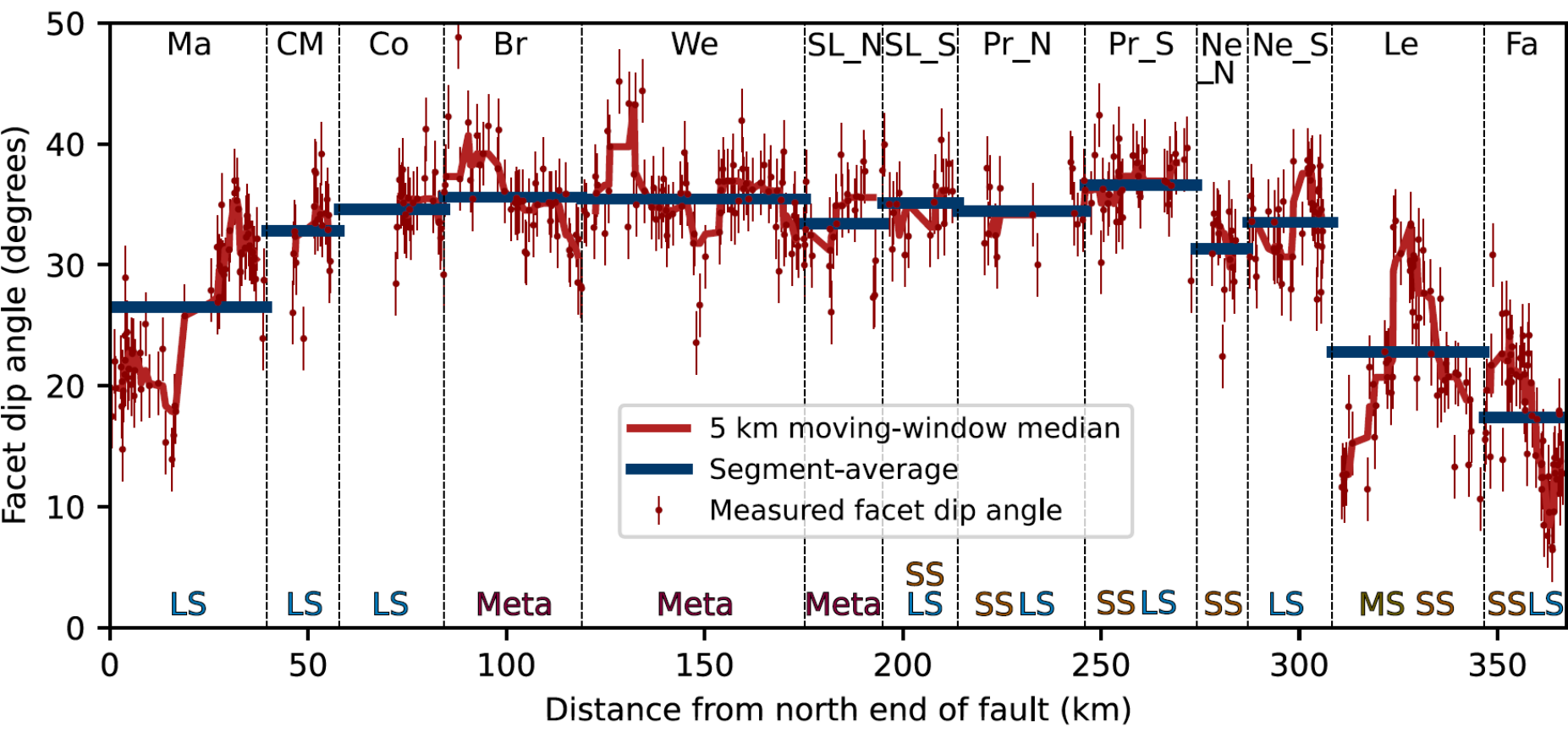


Criteria to select a viable facet:

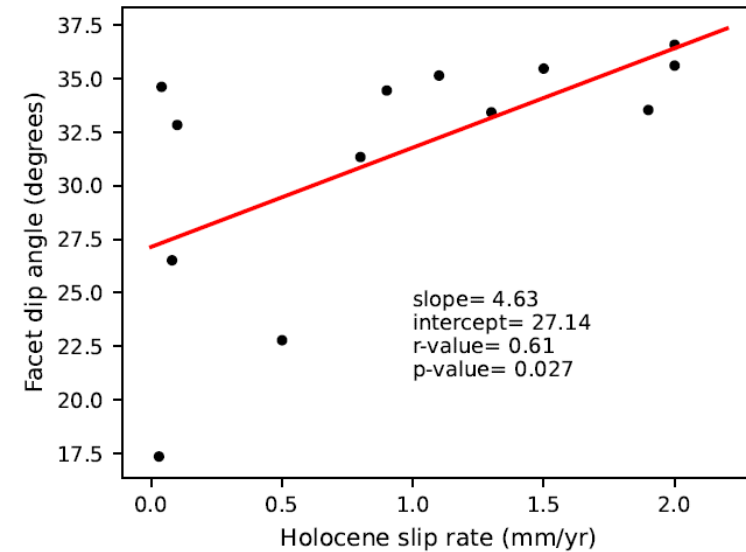
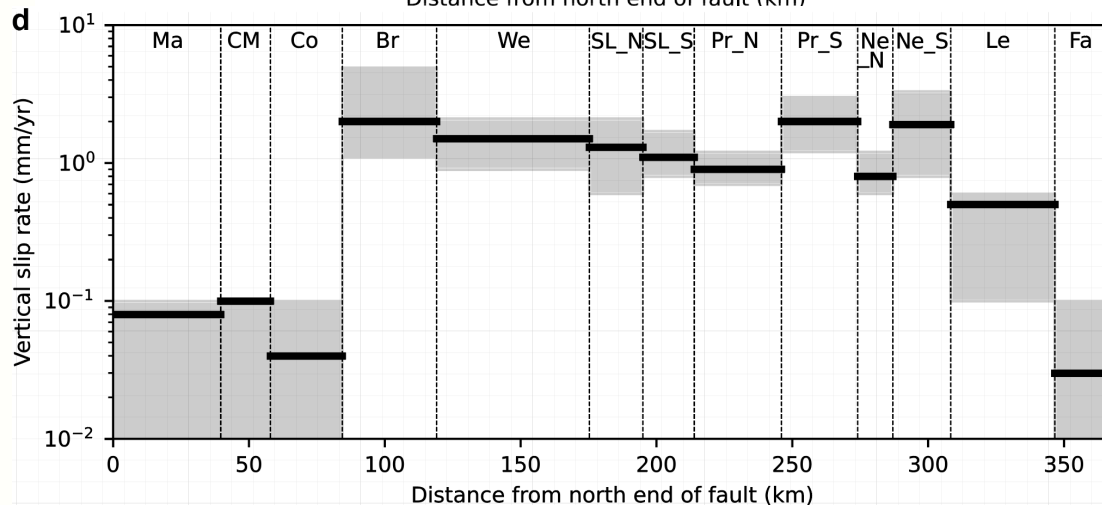
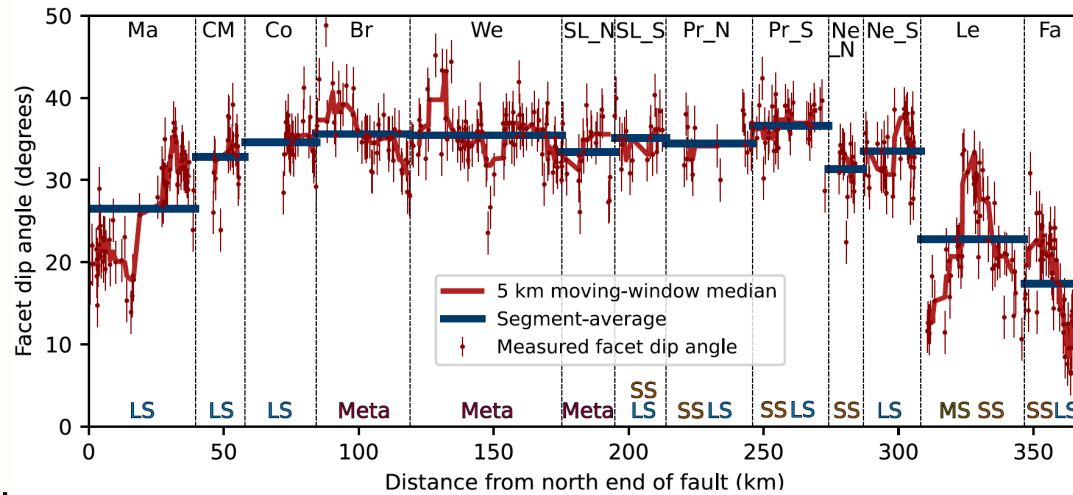
- Bedrock or bedrock thinly mantled by regolith.
- Semi-plainer.
- Not heavily dissected by other processes such as debris flows.
- Absence of deep-seated landslides.
- Baselevel controlled predominantly by the range bounding fault.
- A narrow active fault zone composed of a single active range-bounding fault.



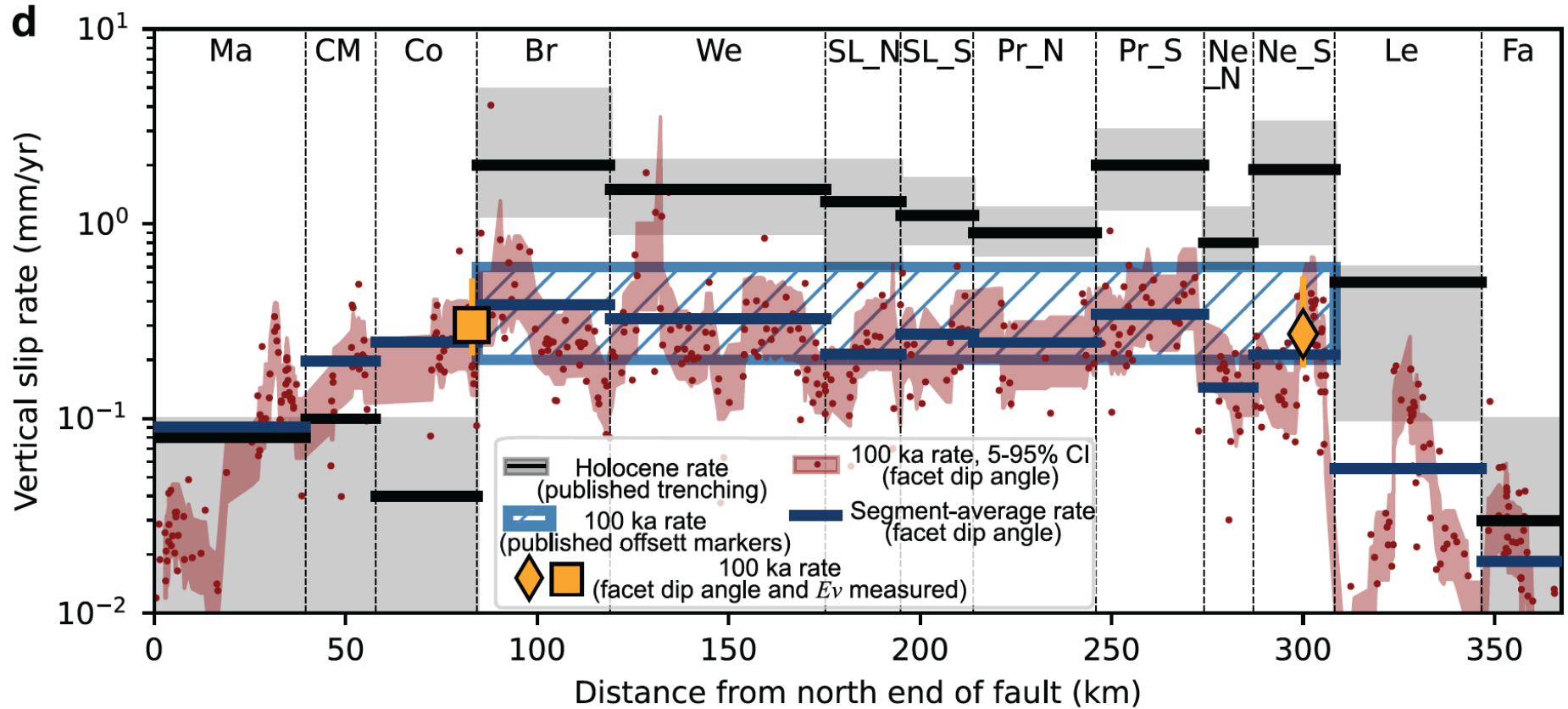
Mean facet steepness of each fault segment varies systematically from > 35 degrees in the center of the fault array to < 20 degrees at the southern end



Result: Strong correlation between along-strike measurements of facet angle and Holocene slip rate

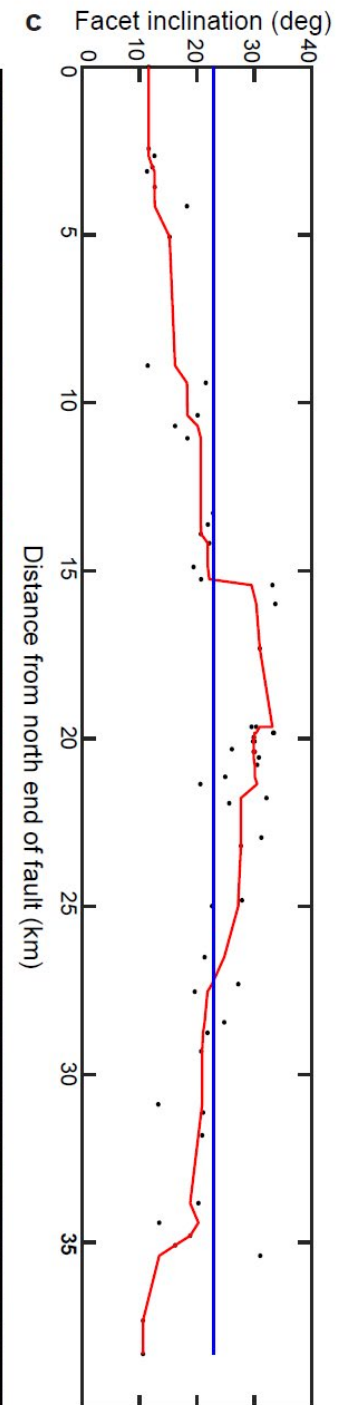
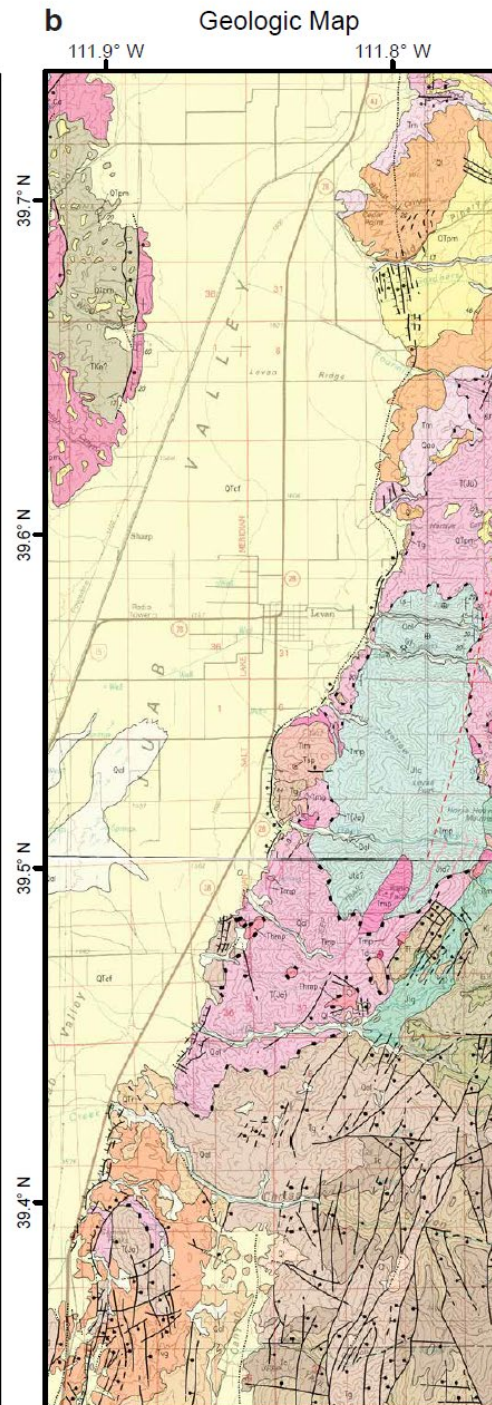
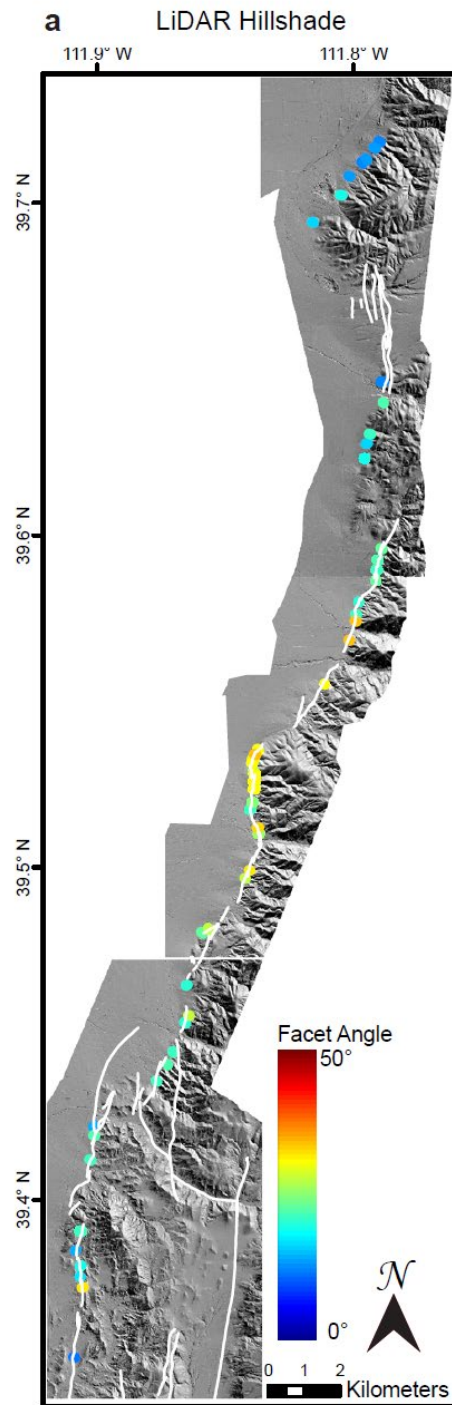


Modeled absolute 100 ka average slip rates are consistent with estimates previously made from offset geomorphic features

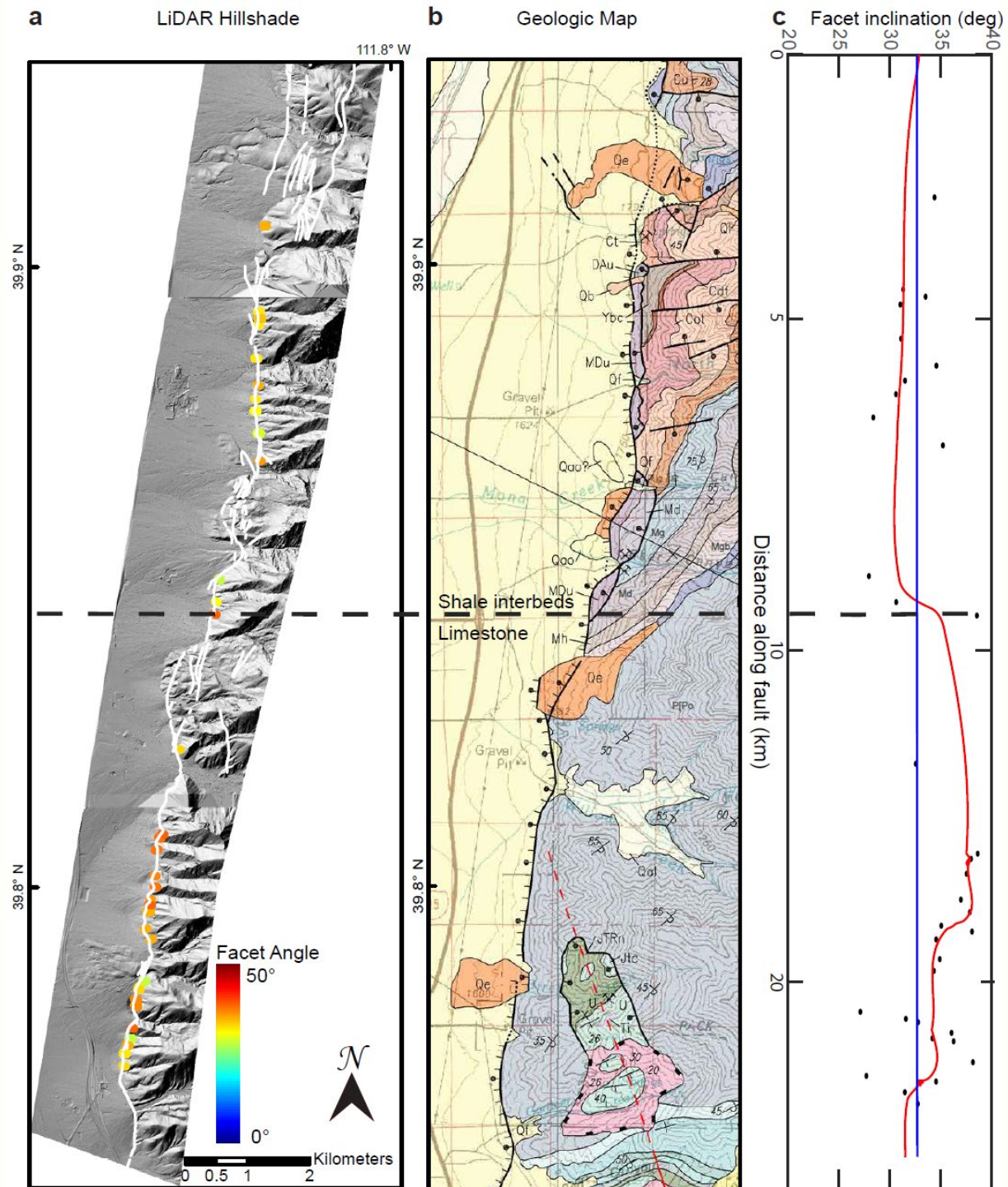


Does facet
angle depend
on lithology?

No

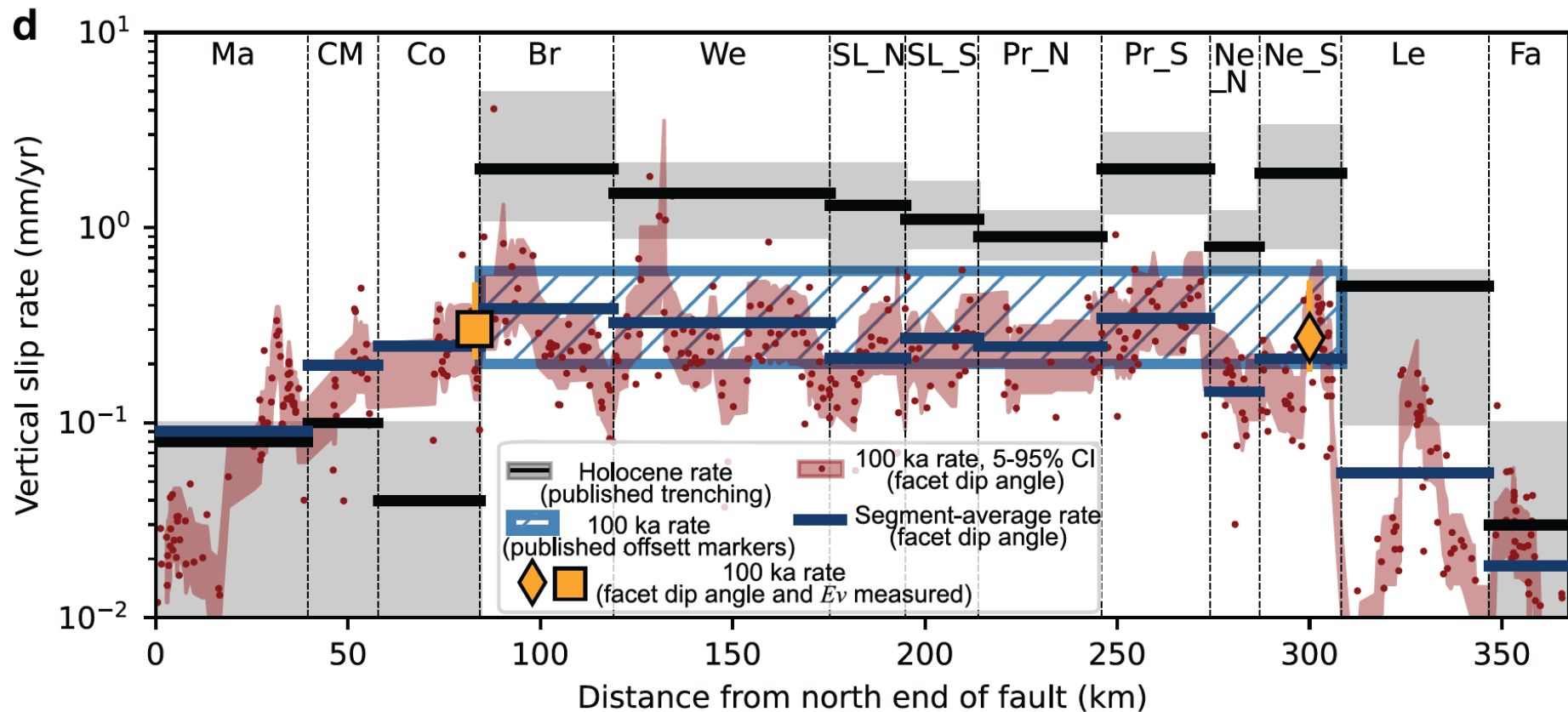


YES



Conclusion:

- Facet-slope analysis could be a useful low-cost paleoseismology tool to estimate both relative and absolute long-term slip rates on range-bounding normal faults directly from topography



**Bedrock Offset Across the Wasatch Fault
in Salt Lake City, Utah,
from Teleseismic Converted Phases
and Its Geologic Implications**

by

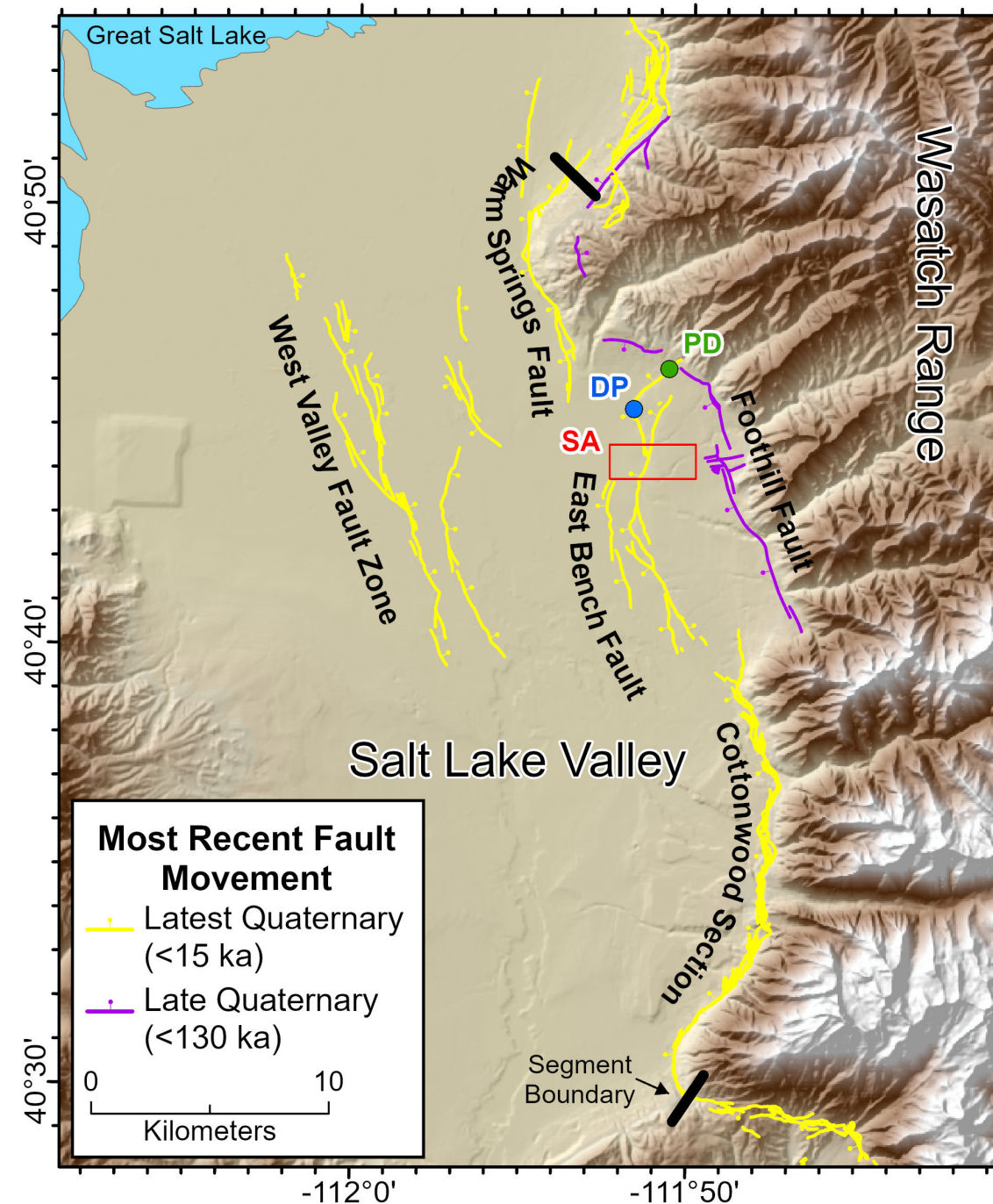
HyeJeong Kim*, James C. Pechmann, Fan-Chi Lin
University of Utah, Salt Lake City, Utah

Adam P. McKean, Christian L. Hardwick
Utah Geological Survey, Salt Lake City, Utah

***Now at UMR Géoazur, Université Côte d'Azur, France**

Work recently published in Seismological Research Letters

**Utah Quaternary Fault Parameters Working Group
February 9, 2026**



Foothill fault:

No Holocene movement
(NSHM 2023 vert slip rate of 0.41 mm/yr → 4.8 m H slip!)

East Bench fault:

PD: Penrose Drive Trench Site
(DuRoss et al., 2014)

5 Holocene surface faulting eqs
Vert slip rate = 0.7 ± 0.2 mm/yr
since 12.1 ka

DP: Dresden Place Trench Site
(Garr, 1986; Machette et al., 1992)

Vert slip rate $> 0.32 +0.06/-0.04$ mm/yr since 13.75 ± 2.0 ka

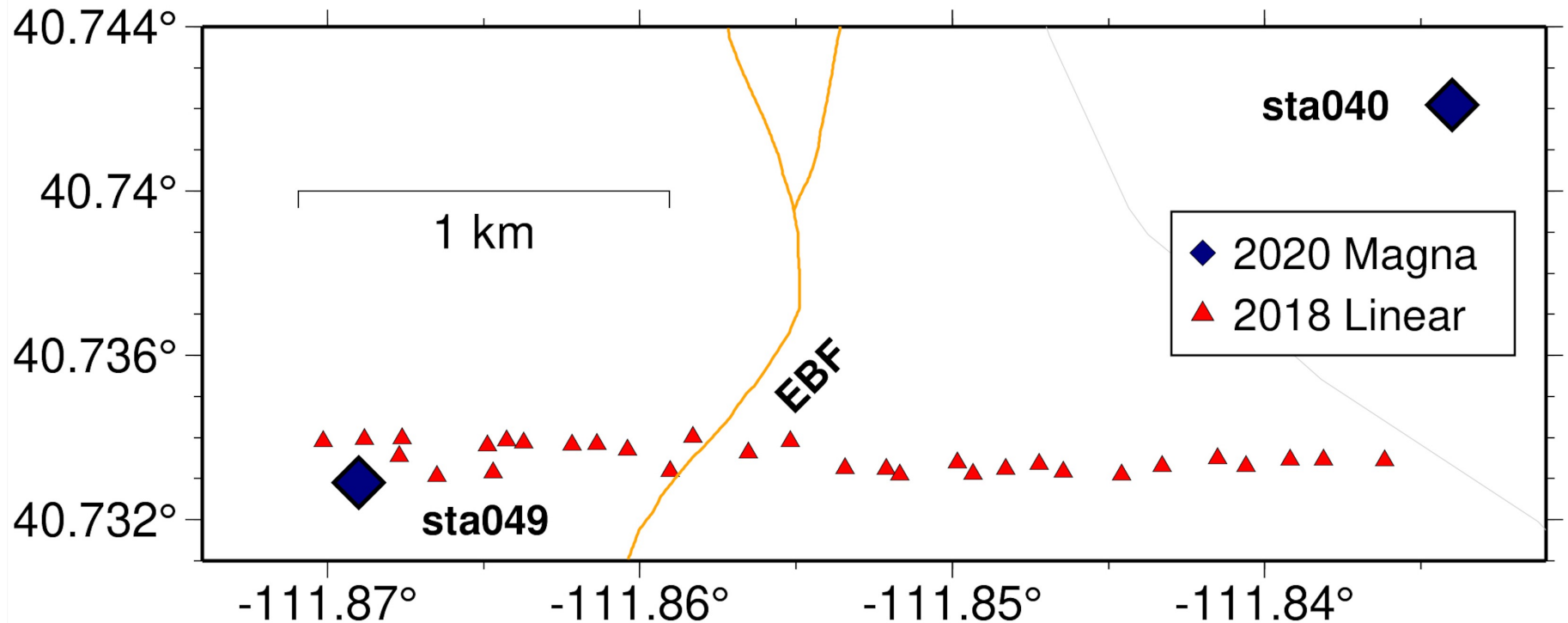
Whole SLC segment:

Vert slip rate = 1.2 ± 0.2 mm/yr
(1 σ) since 7.7 ± 0.4 ka
(DuRoss and Hylland, 2015)

Outline

- (1) Slip transfer from Foothill to East Bench fault**
- (2) 1700 S seismic array across East Bench fault**
- (3) Receiver function method**
- (4) Seismic velocity structure of study area**
- (5) Bedrock offset across the fault**
- (6) Minimum near-surface fault dip**
- (7) Estimated age of East Bench fault**

Study Area



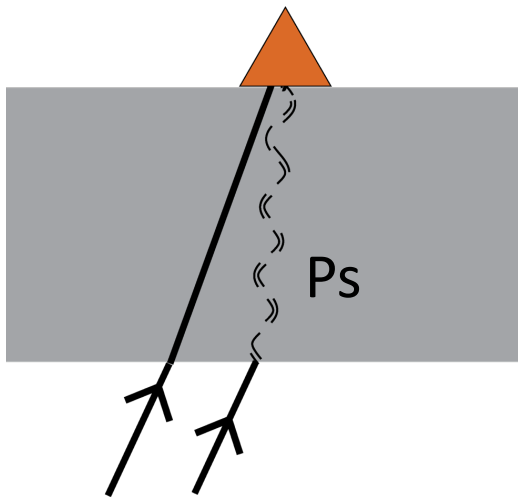
EBF = East Bench fault

Red triangles: 1700 South nodal array (Feb 2018)

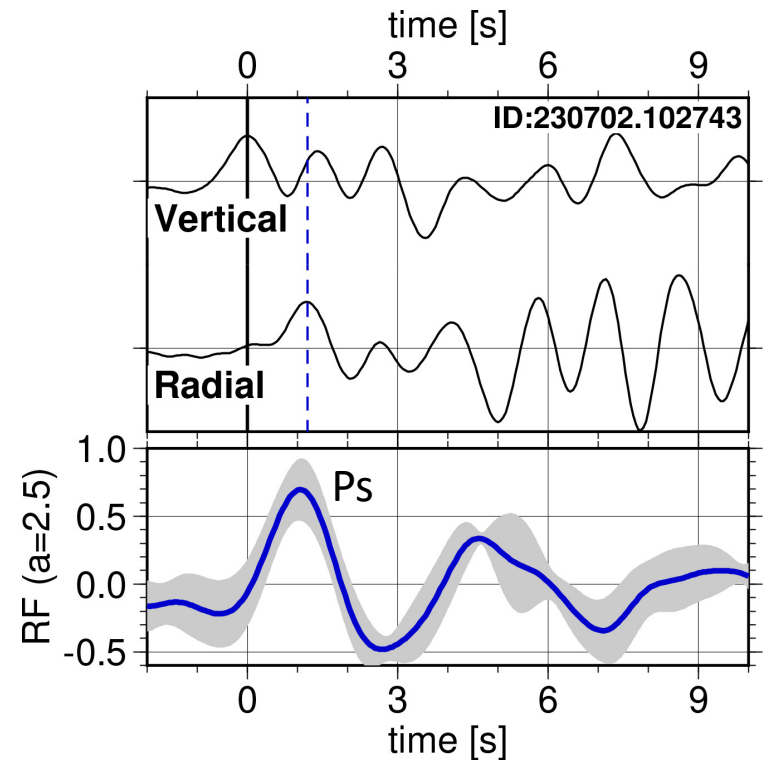
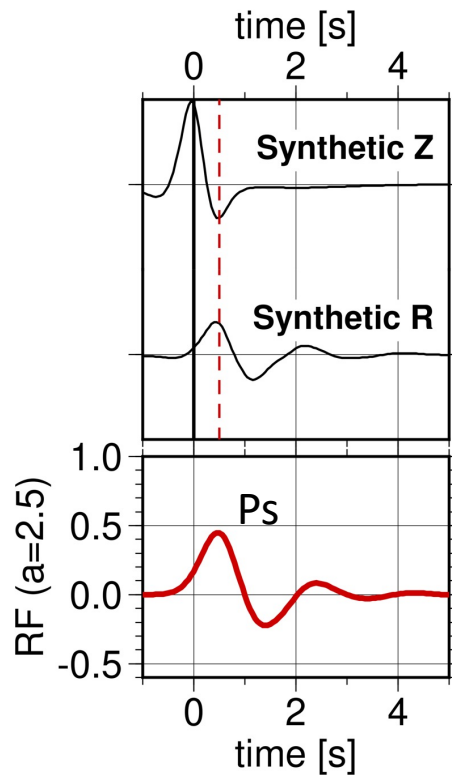
Blue diamonds: Velocity models from Kim et al. (2025)

Receiver Function Method

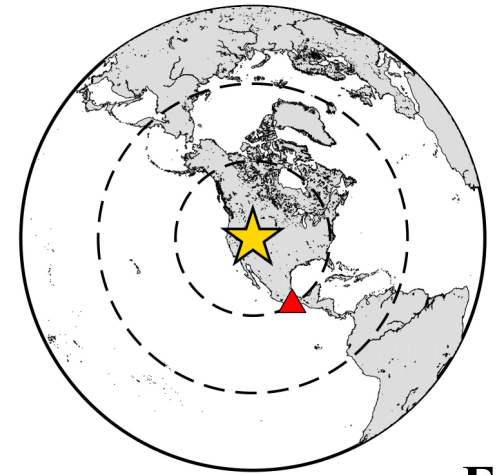
- **Receiver functions** highlight any Ps phase produced at a strong impedance contrast, e.g., the Moho or a boundary between bedrock and overlying sediments
- Thicker or slower layer above boundary $\rightarrow$ larger receiver function peak delays



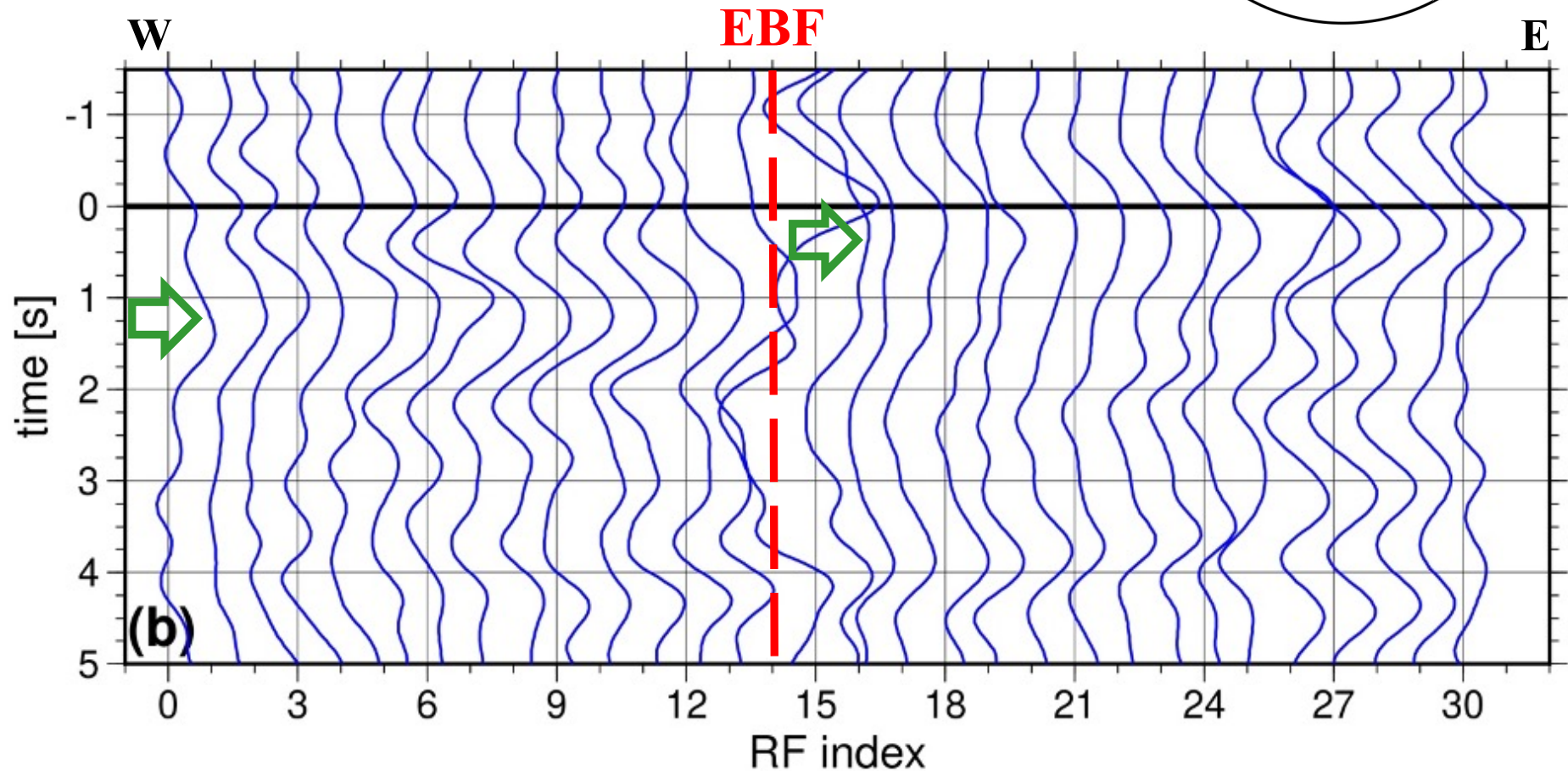
Ps: Incoming teleseismic P-wave converts to S-wave at boundary



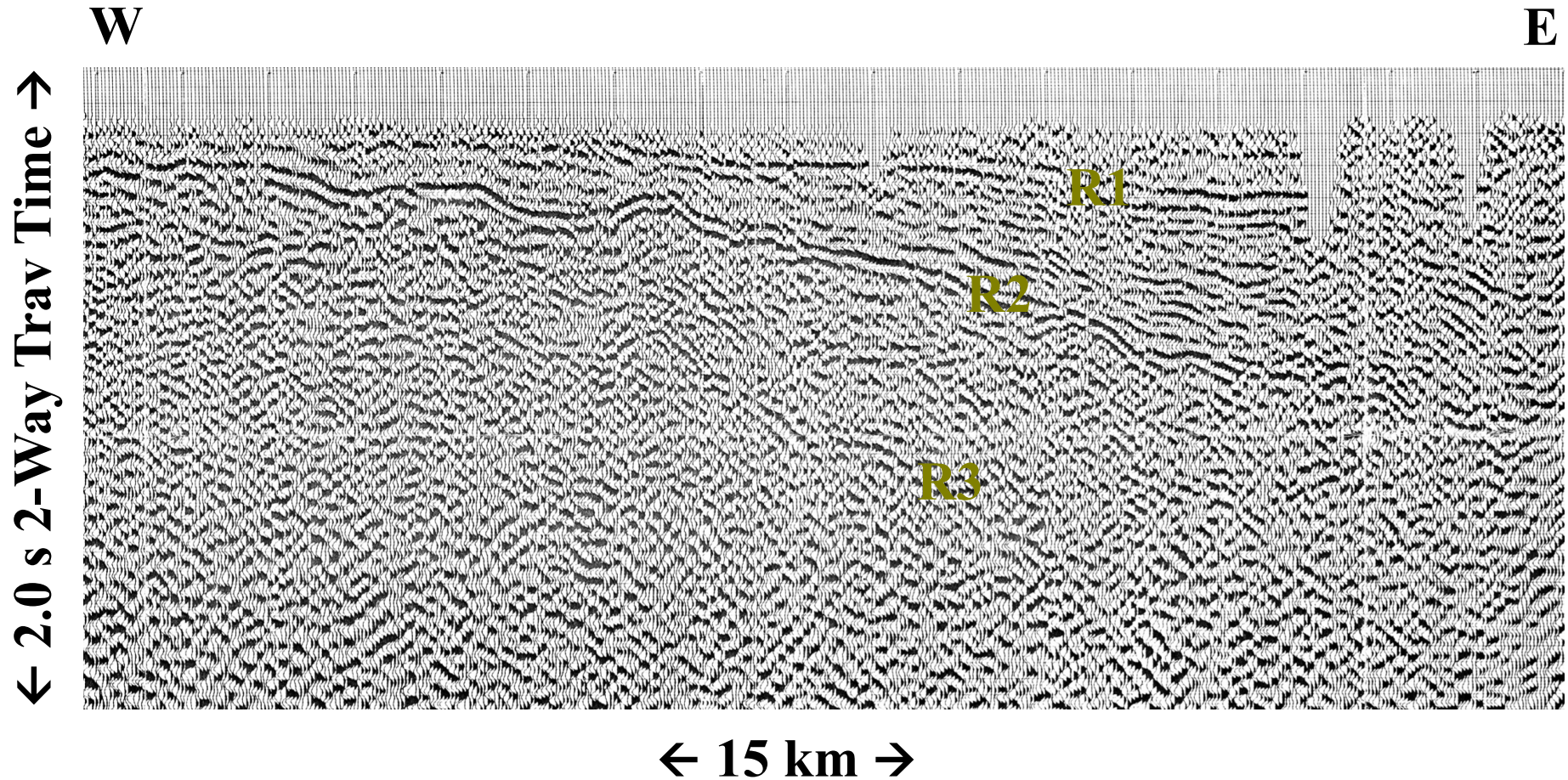
Receiver Functions from M 7.2 S Mexico Teleseism



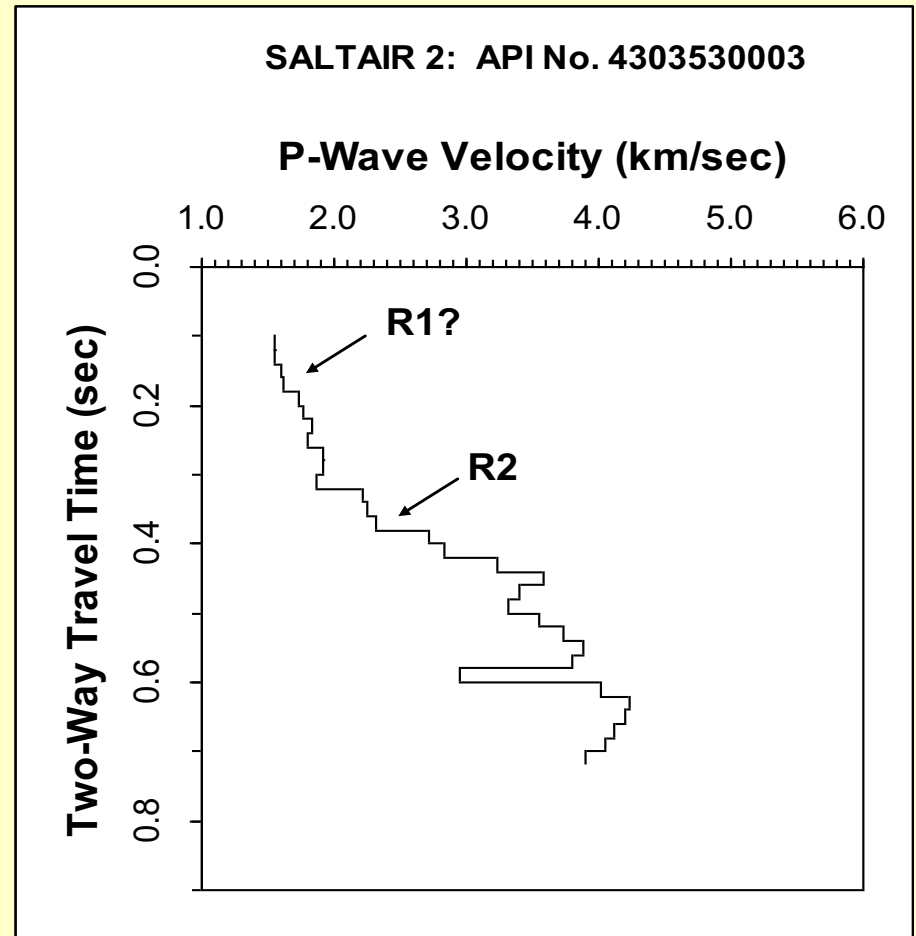
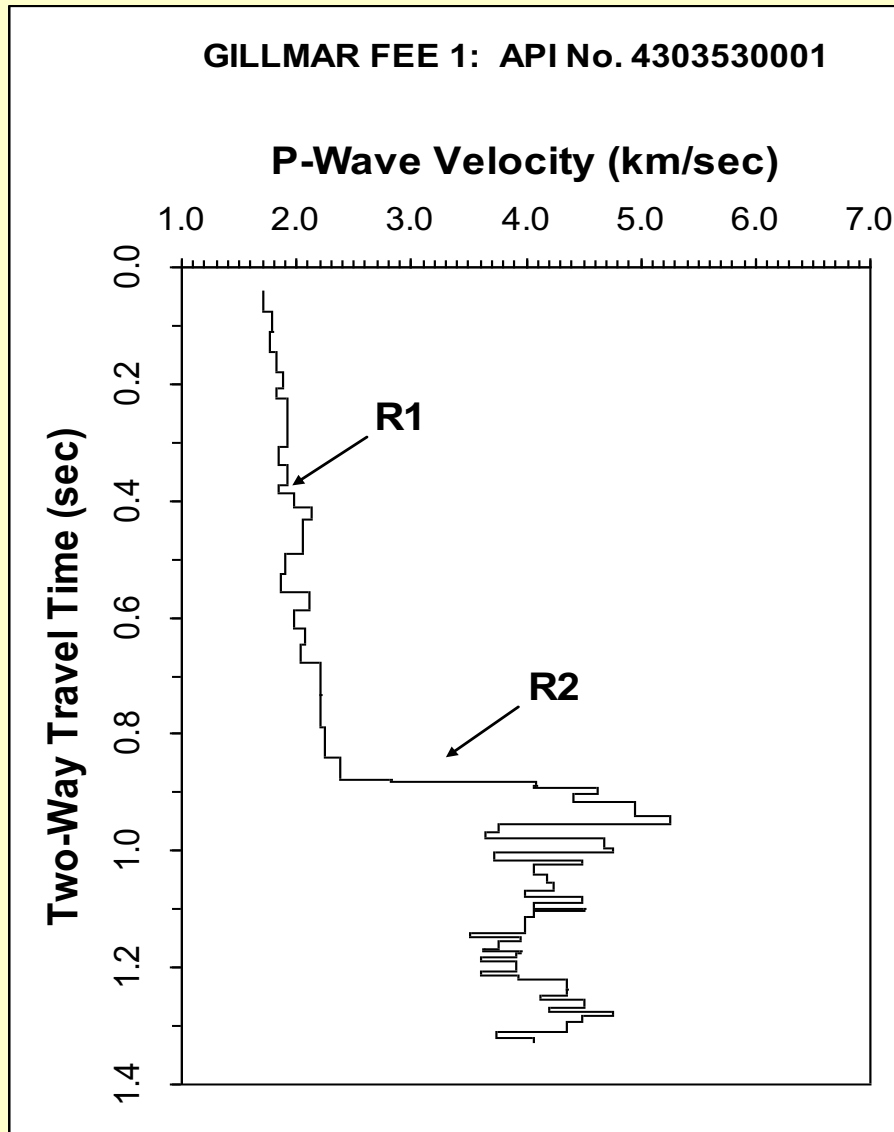
⇒ 1st peak: Ps phase



Seismic Reflection Line R11 Across N Salt Lake Valley (Radkins et al., 1989; Hill et al., 1990)



Sonic Log Profiles Near Line R11, N Salt Lake Valley



- Largest V_p discontinuity is R2
- R2 V_p increase spans 20–100 m

Pechmann et al. (2010)

SALT LAKE BASIN MODEL (Hill et al., 1990)

Ground Surface

Unconsolidated Quaternary Sediments

R1

Semiconsolidated Tertiary Sediments

R2

Top of Bedrock

Tertiary Sedimentary Rocks

Bottom of Basin Fill

R3

12 ± 2 to 18 Ma

Basement

- R2 is a lithification horizon; not precisely dated anywhere
- Degree of lithification depends on both age & depth of burial
- Rate of subsidence varies across the Salt Lake basin
- → R2 is not necessarily the same age everywhere

3-step Joint Inversion of Rayleigh Wave Ellipticity & Receiver Functions

Kim et al., 2025

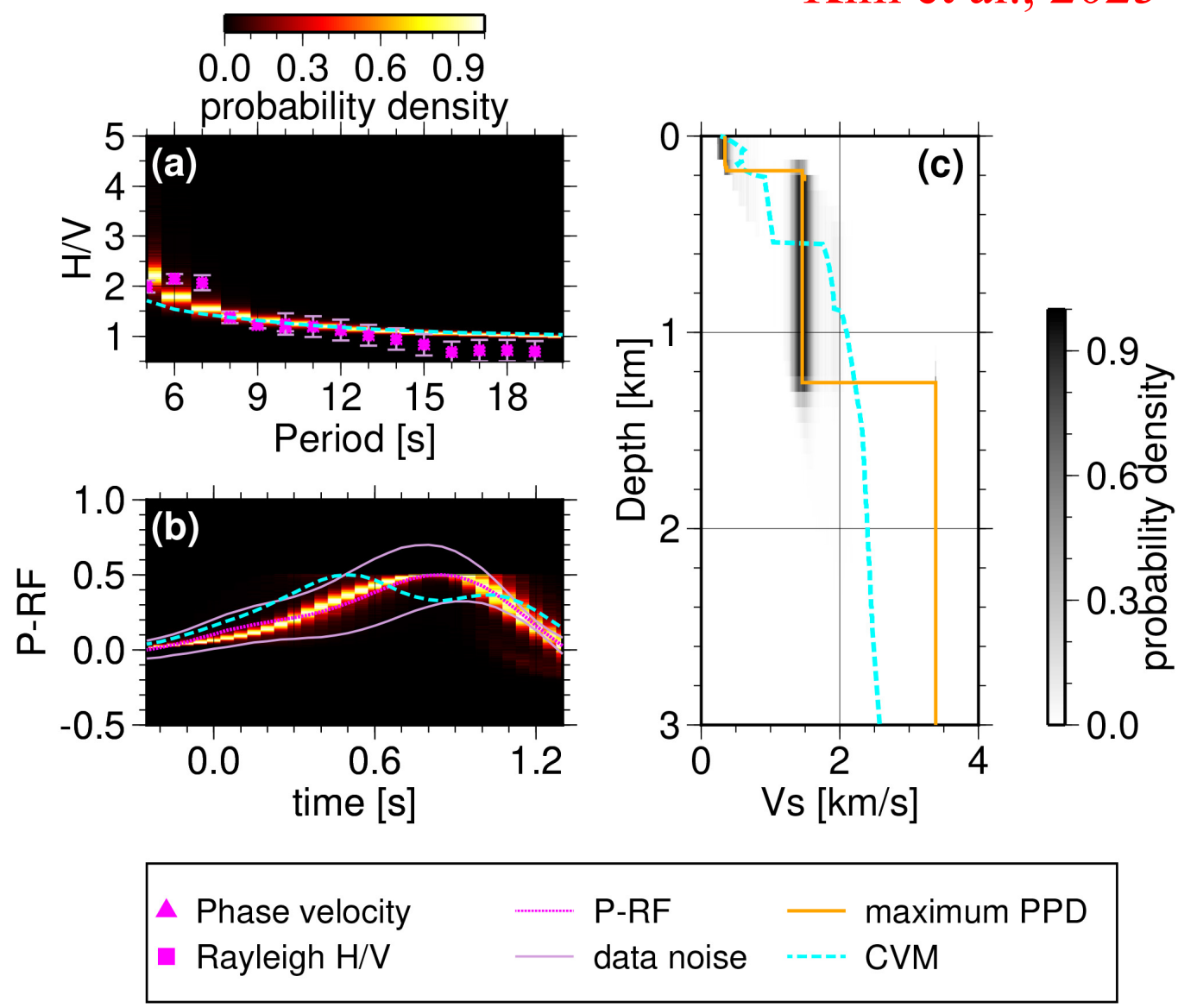
Iterative Bayesian Inversion for 1D 4-Layer Model

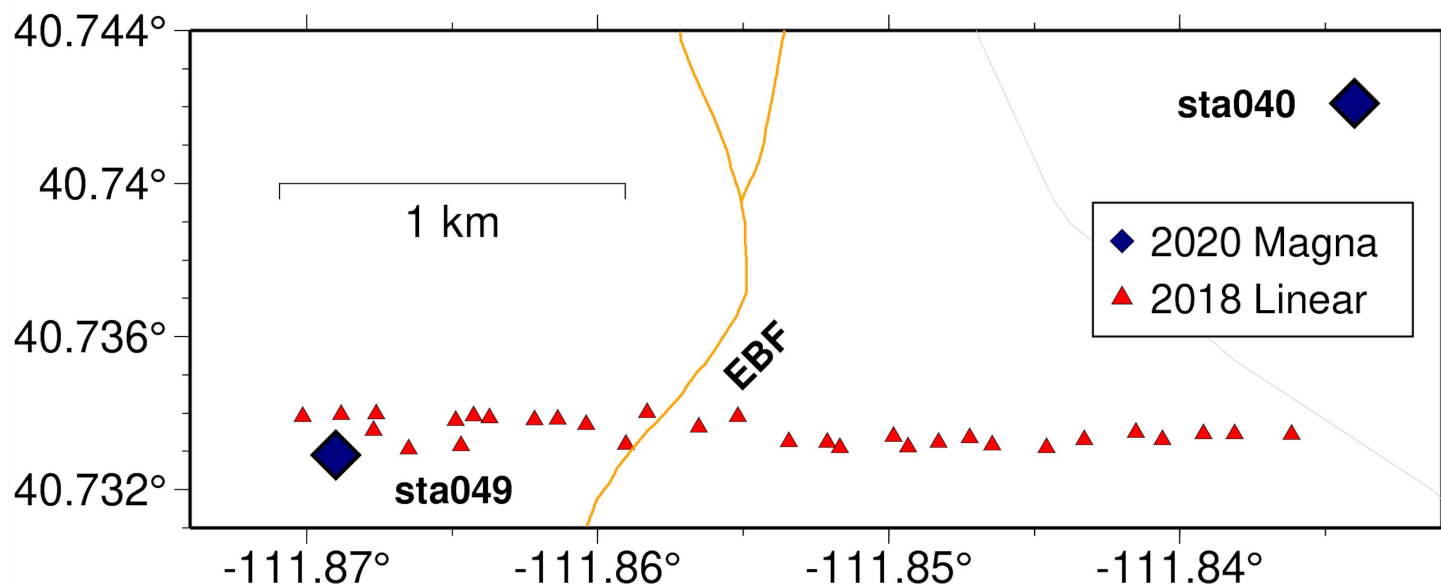
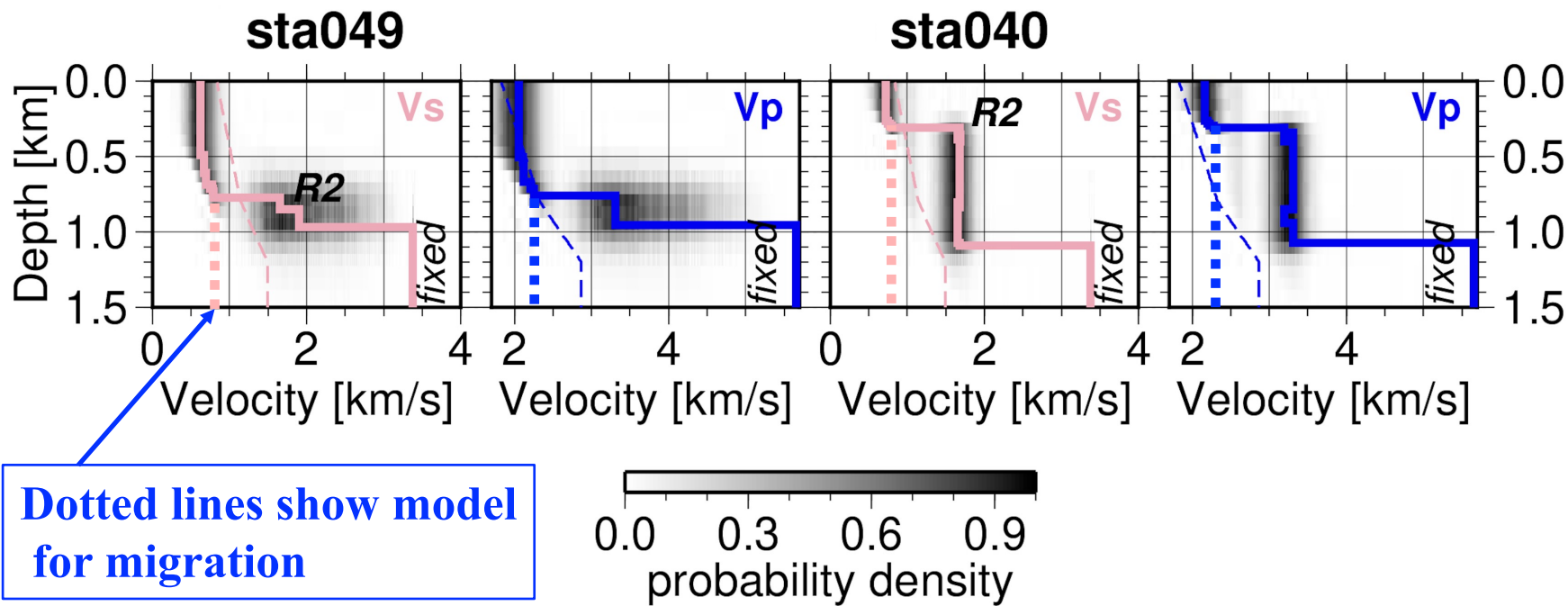
1st Iteration:
Basin-wide 1D Rayleigh wave phase velocity inversion →

Fix:
 V_p and V_s for bottom 2 layers, depth to 4th layer

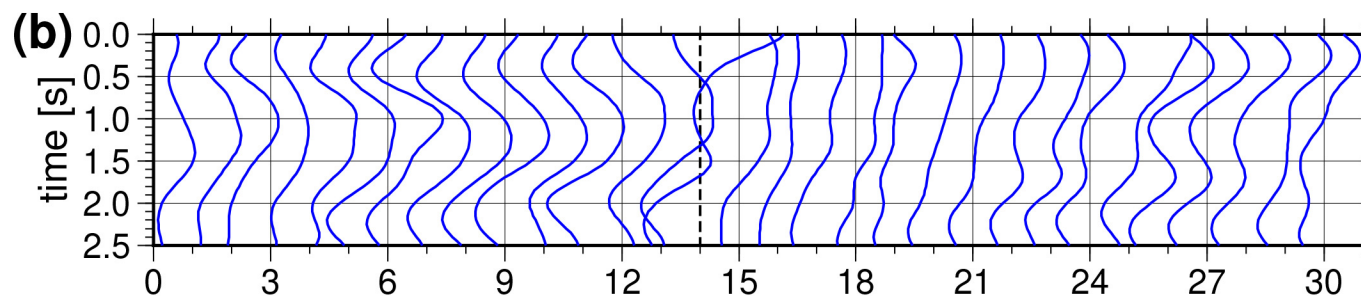
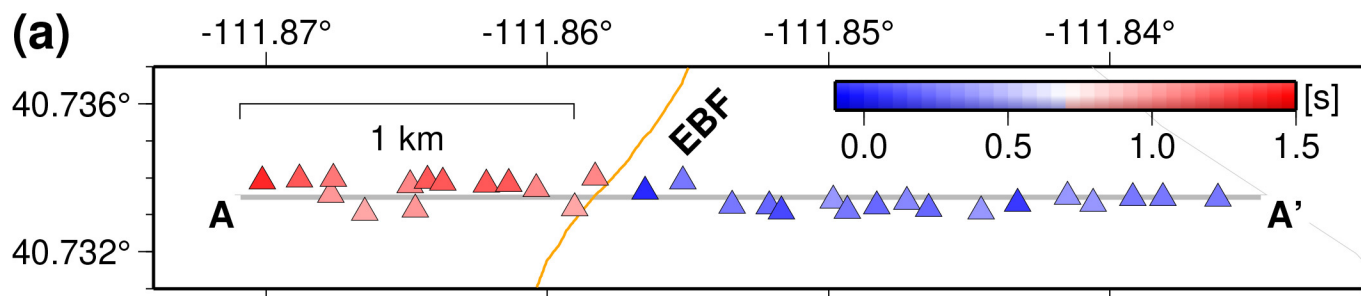
2nd Step:
Rayleigh wave H/V

3rd Step:
Rayleigh wave H/V + RF

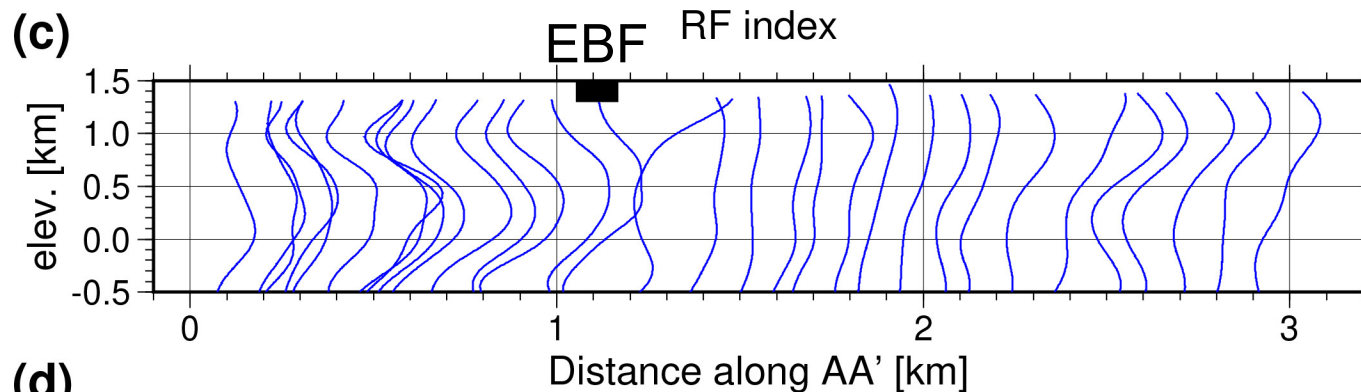




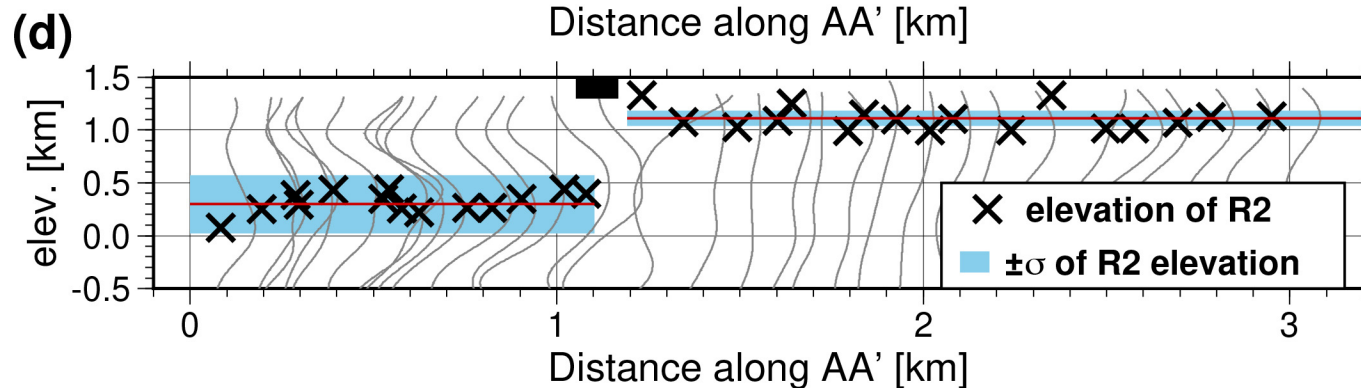
Unmigrated



Migrated

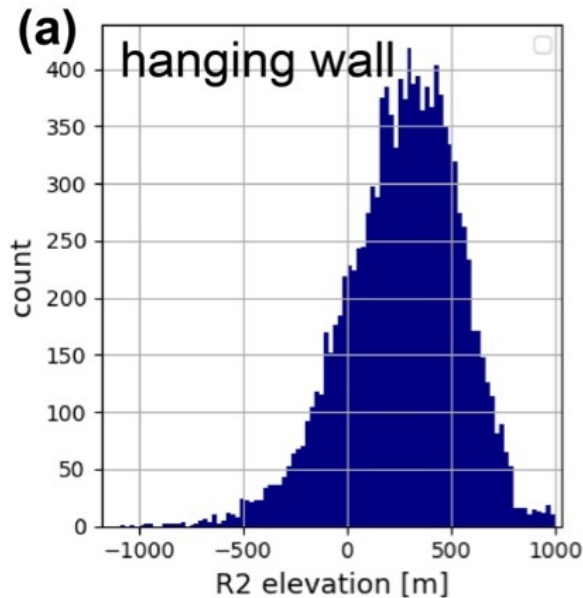


Migrated

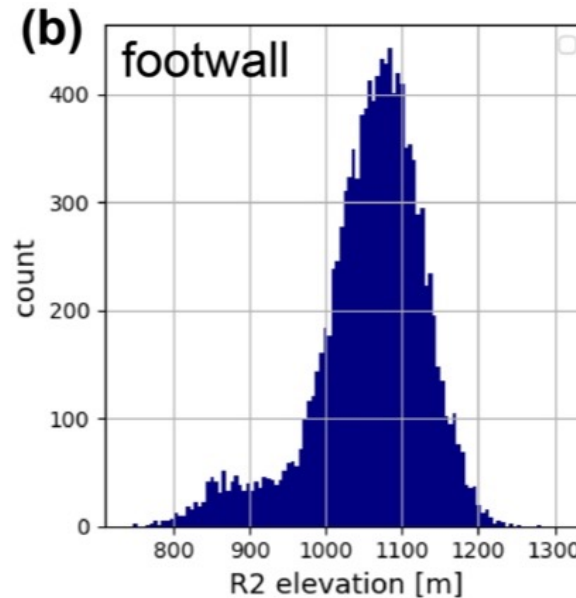


R2 offset
 = 860 m
 (revised
 up 6%)

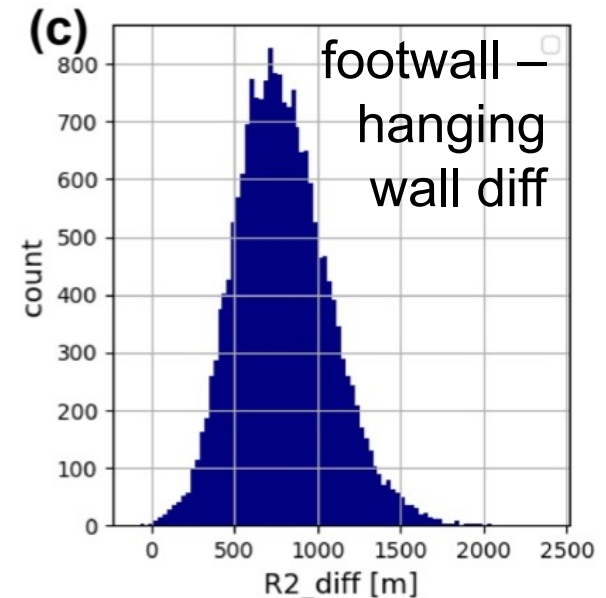
Mean R2 Elevation Histograms from Migrations with Ensembles of 1D Models from Bayesian Inversions (Top Layers)



$$\sigma = 275 \text{ m}$$



$$\sigma = 73 \text{ m}$$



$$\sigma = 288 \text{ m}$$

Elevation difference histogram from 20,000 differences between random samples of hanging wall and footwall elevations

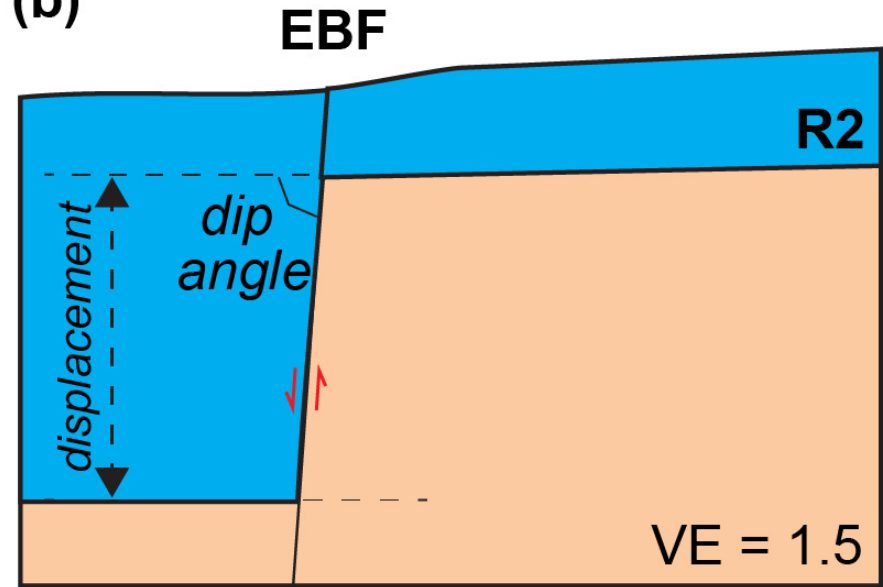
→ **Bedrock (R2) offset across EBF = $860 \pm 290 \text{ m}$**

(a)



**Before slip began on
East Bench fault**

(b)

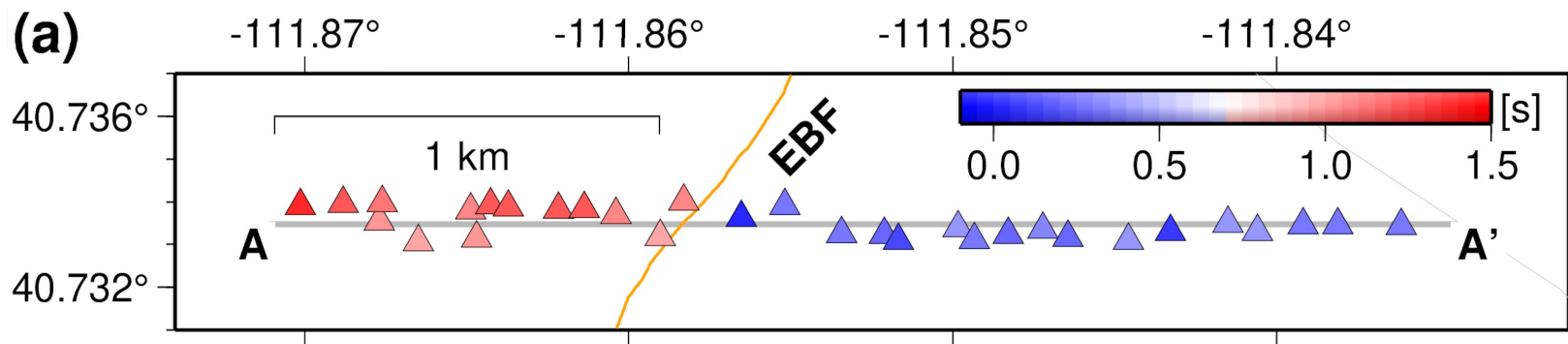
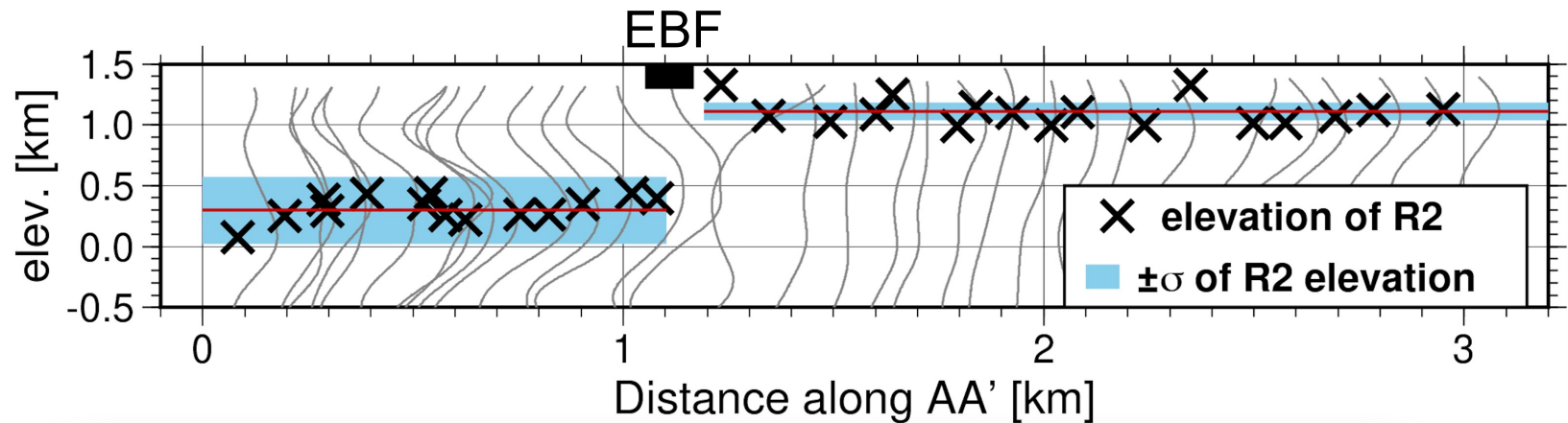


Today

We use our measured R2 displacement across the EBF to:

- 1) Calculate a minimum near-surface dip angle
- 2) Estimate the length of time this fault has been active

Minimum Near-Surface Fault Dip



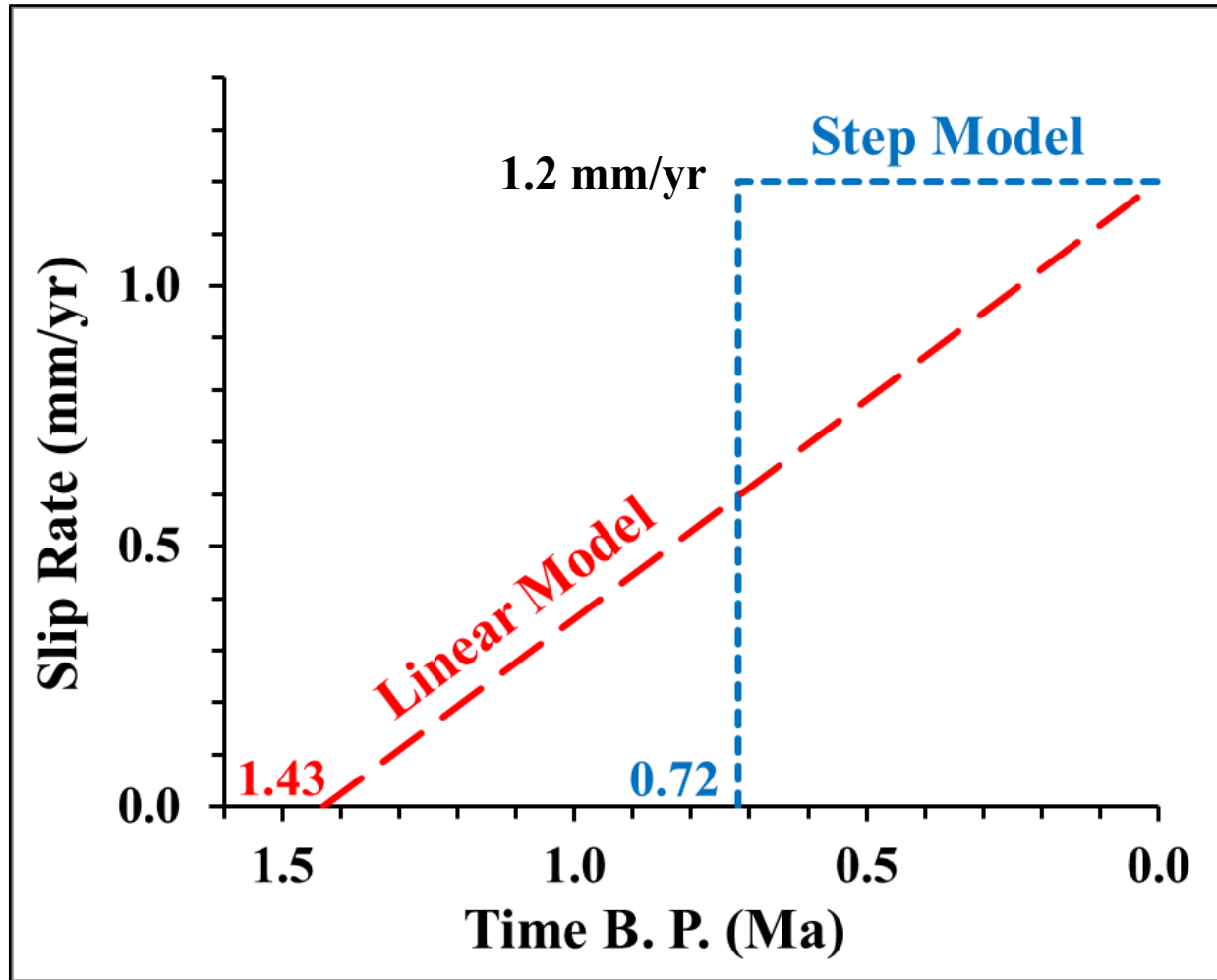
E-W distance between 2 closest stations on opposite sides of the EBF = 151 m.
 $\therefore$ Min apparent dip on cross section = $\tan^{-1}(860 \pm 290 \text{ m} / 151 \text{ m}) = 80^\circ (75^\circ - 83^\circ)$

$\rightarrow$ Minimum true dip ($\perp$ to 40° strike) = $82^\circ \pm 3^\circ (< 1100 \text{ m})$

Consistent with

- (1) Fault dip in Penrose Drive trenches = $85^\circ \pm 5^\circ (< 5 \text{ m}; \text{Duross et al., 2014})$
- (2) EBF dips from reflection profiles = $\sim 86^\circ$ and $74^\circ (< 300 \text{ m}; \text{Liberty et al., 2021})$

Estimated Age of East Bench Fault



**Age of onset of slip on East Bench fault
= 0.7 ± 0.3 Ma to 1.4 ± 0.5 Ma**

Conclusions

- **Ps converted phases in teleseismic receiver functions, combined with local velocity models, image an 860 ± 290 m vertical bedrock offset caused by movement on the East Bench fault.**
- **From this observation, and the distance between the 2 closest stations on opposite sides of the fault, we calculate a dip of $\geq 82^\circ \pm 3^\circ$ in the top 1100 m.**
- **From the bedrock offset, assuming a current slip rate of 1.2 ± 0.2 mm/yr and a range of scenarios for the slip rate transfer from the Foothill to the East Bench fault, our best estimate for when the transfer began is 0.7–1.4 Ma.**

Possible Future Applications of Receiver Functions from Temporary Geophone Deployments

- **Observations of variations in R2 offsets along the EBF to provide clues as to how the slip transfer from the FF to the EBF developed over time.**
- **Detailed maps of R2 depth in Wasatch Front sedimentary basins to improve analyses of ground shaking hazards.**
- **Receiver function profiles across faults to potentially yield information on fault dips, displacements, slip rates and/or duration of faulting—if impedance contrasts can be correlated across the fault and other necessary information is available, such as dates or slip rates.**

Virginia Street Fault

Adam McKean and Zach Anderson



UTAH GEOLOGICAL SURVEY

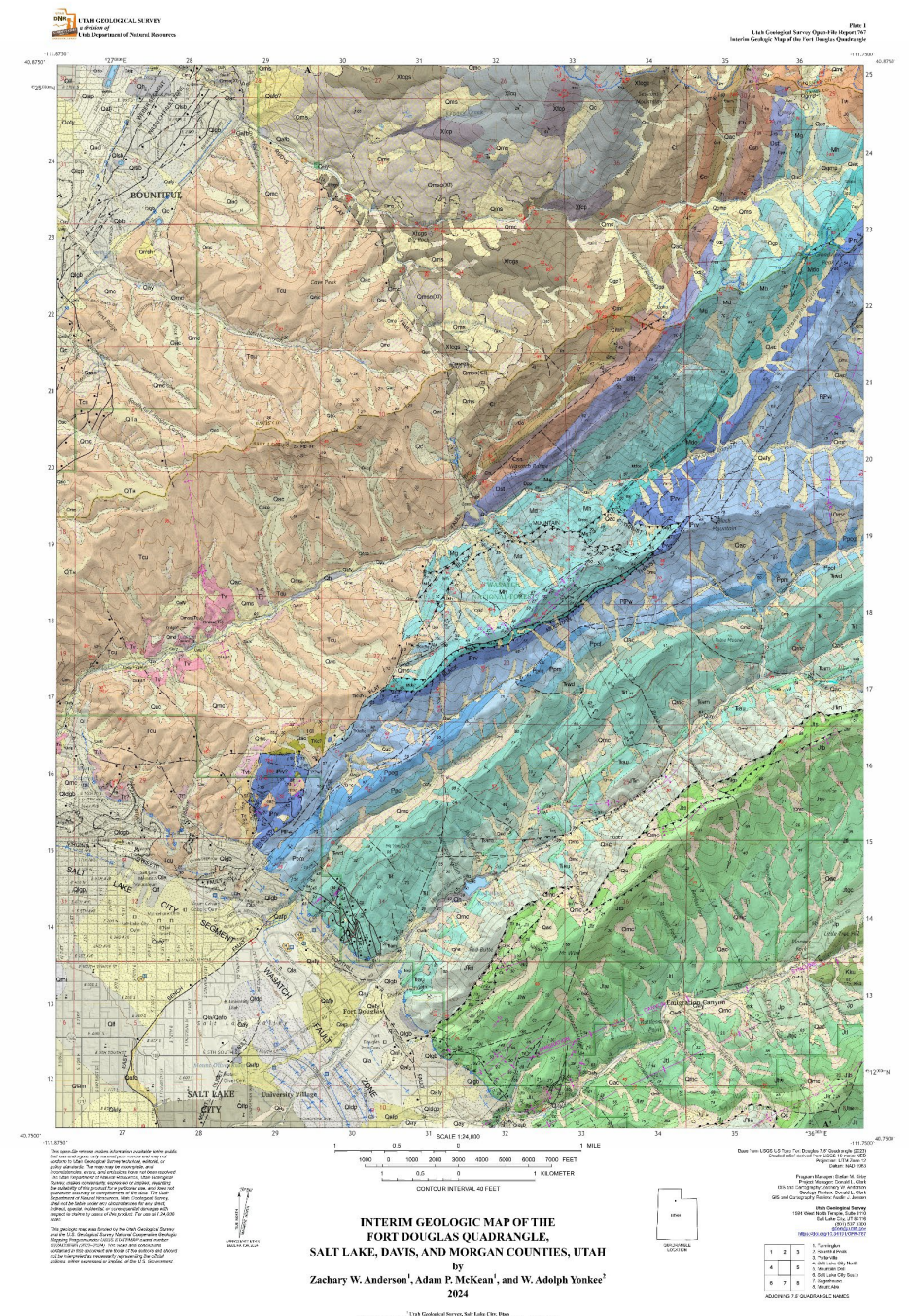
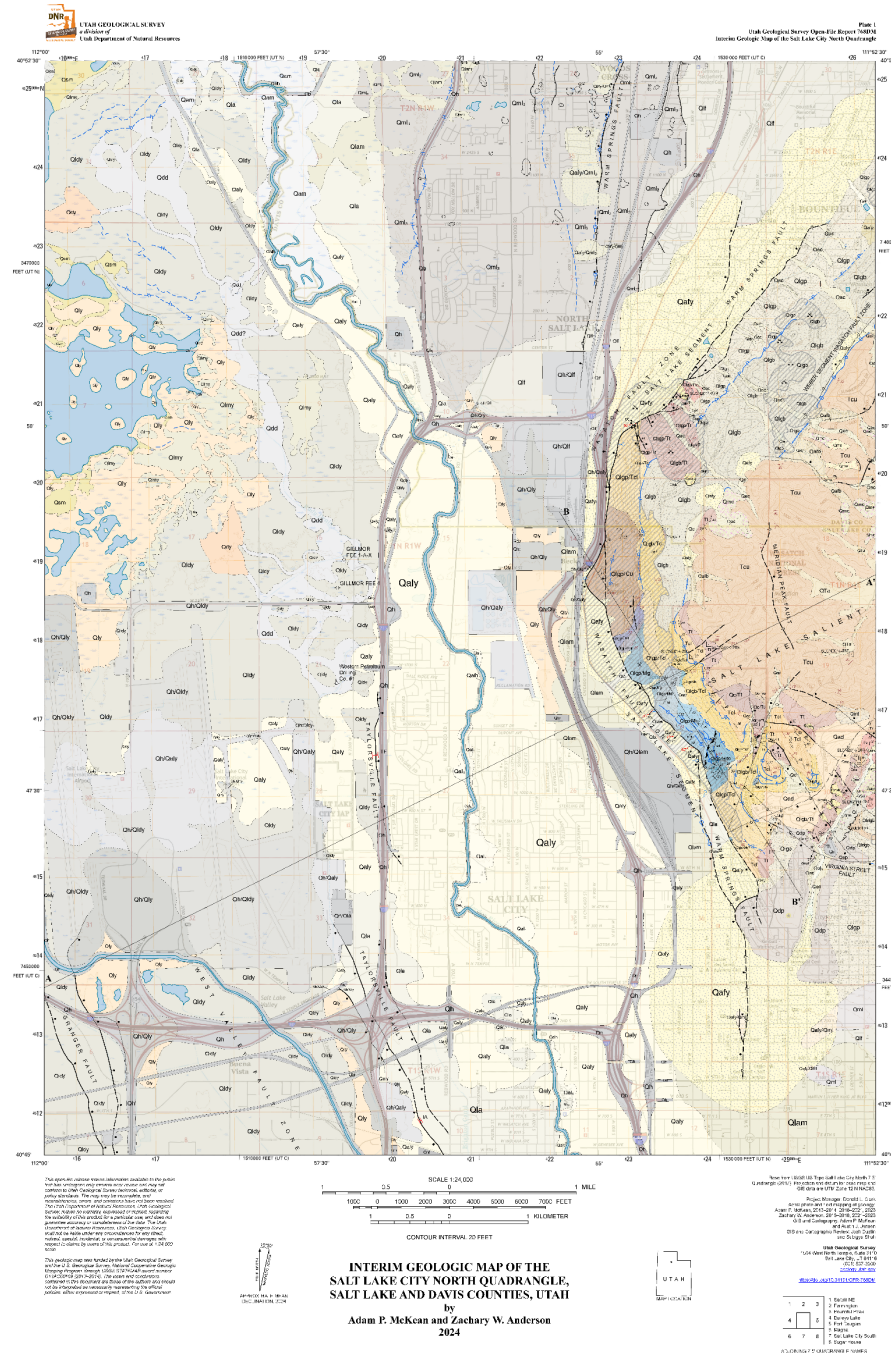
Photograph by Adam Hiscock, UGS

geology.utah.gov

New Geologic Mapping

Salt Lake City
North
(McKean and
Anderson, 2024)

Fort Douglas
(Anderson et al.,
2024)



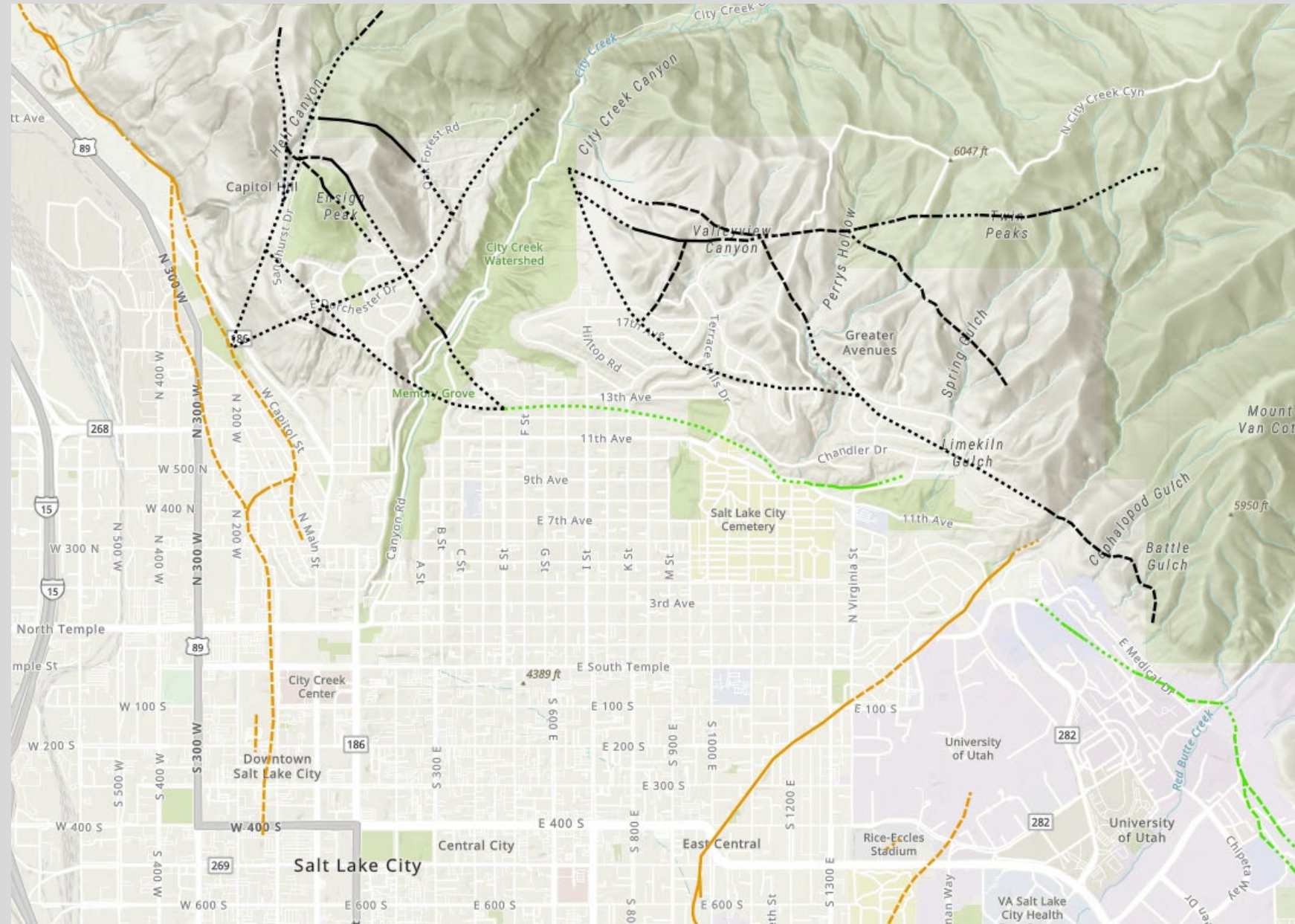
Virginia Street Fault

Current Utah Quaternary
Fault Database

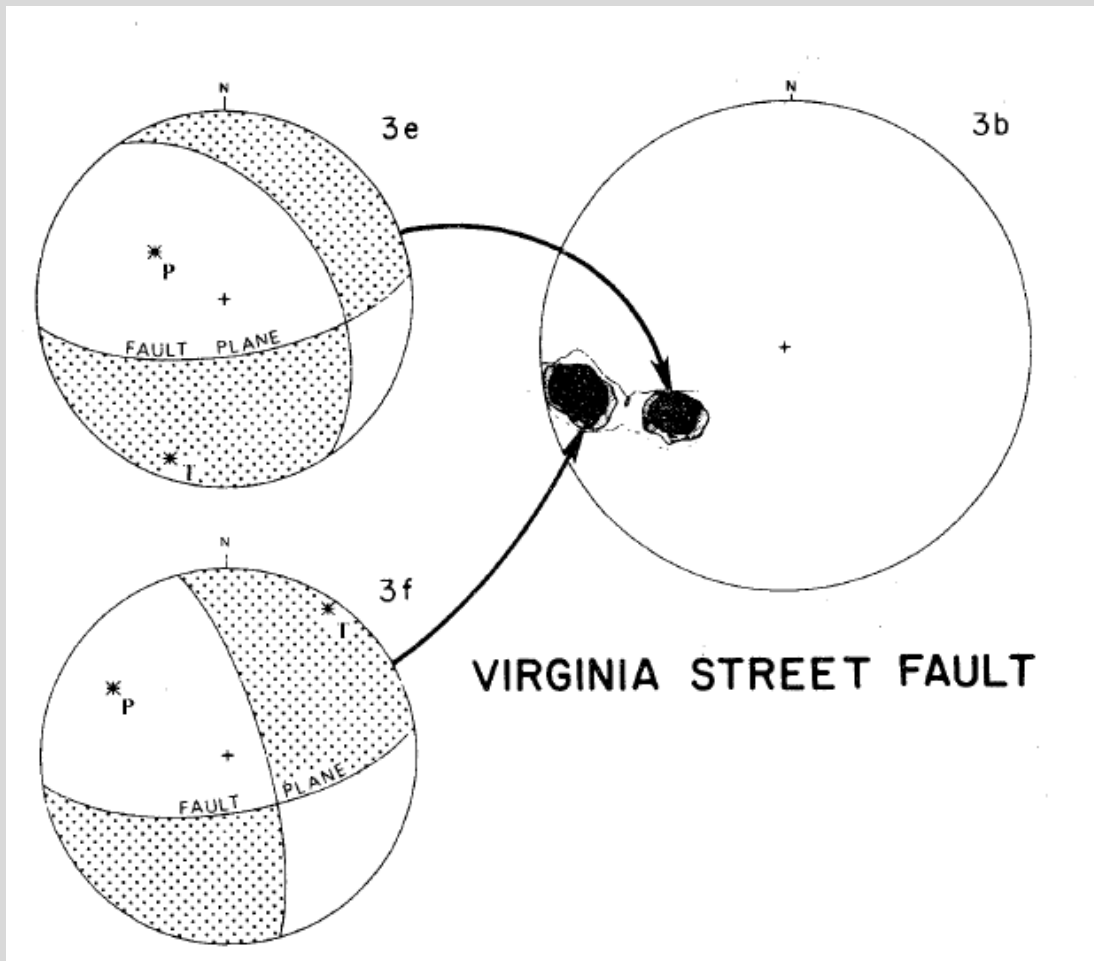
Structure age

Eastern Part <130,000

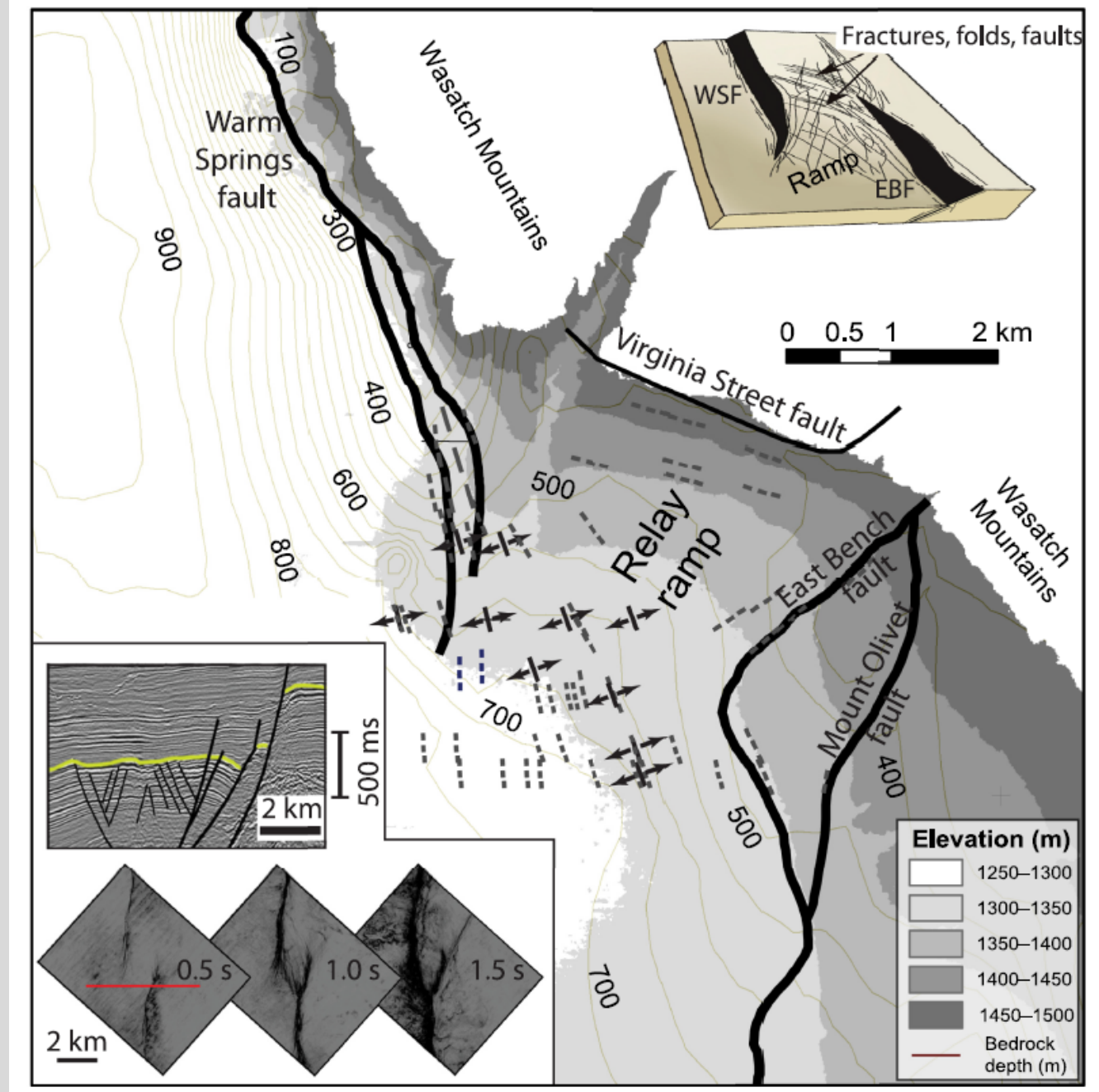
Western part <2,600,000



Structural Setting



Pavlis and Smith, 1979, $n=18$, small exposure of east-west fault plane with a strike of 80° with dips steeply to the south 68°



Virginia Street fault evidence

Scott and Shroba 1985

- Striated fault plane in quarry, 100 m long exposure
- Lake Bonneville gravels removed by quarrying
- 1966 Van Horn observed probable faulting in Lake Bonneville deposits
- Disrupted zones of pebbly silt as wide as 15 cm adjacent to fault plane
- No estimated total offset of Lake Bonneville deposits. One marl offset a few cm.
- Older lake cycle deposits just below scarp in gravel pit. Not buried deeply.
- Interpreted to have limited offset in Pleistocene and since 150 ka.



1937 Aerial Imagery

Virginia Street Fault History

Van Horn, 1981

Van Horn, 1982

Scott and Shroba, 1985

Van Horn and Crittenden, 1987

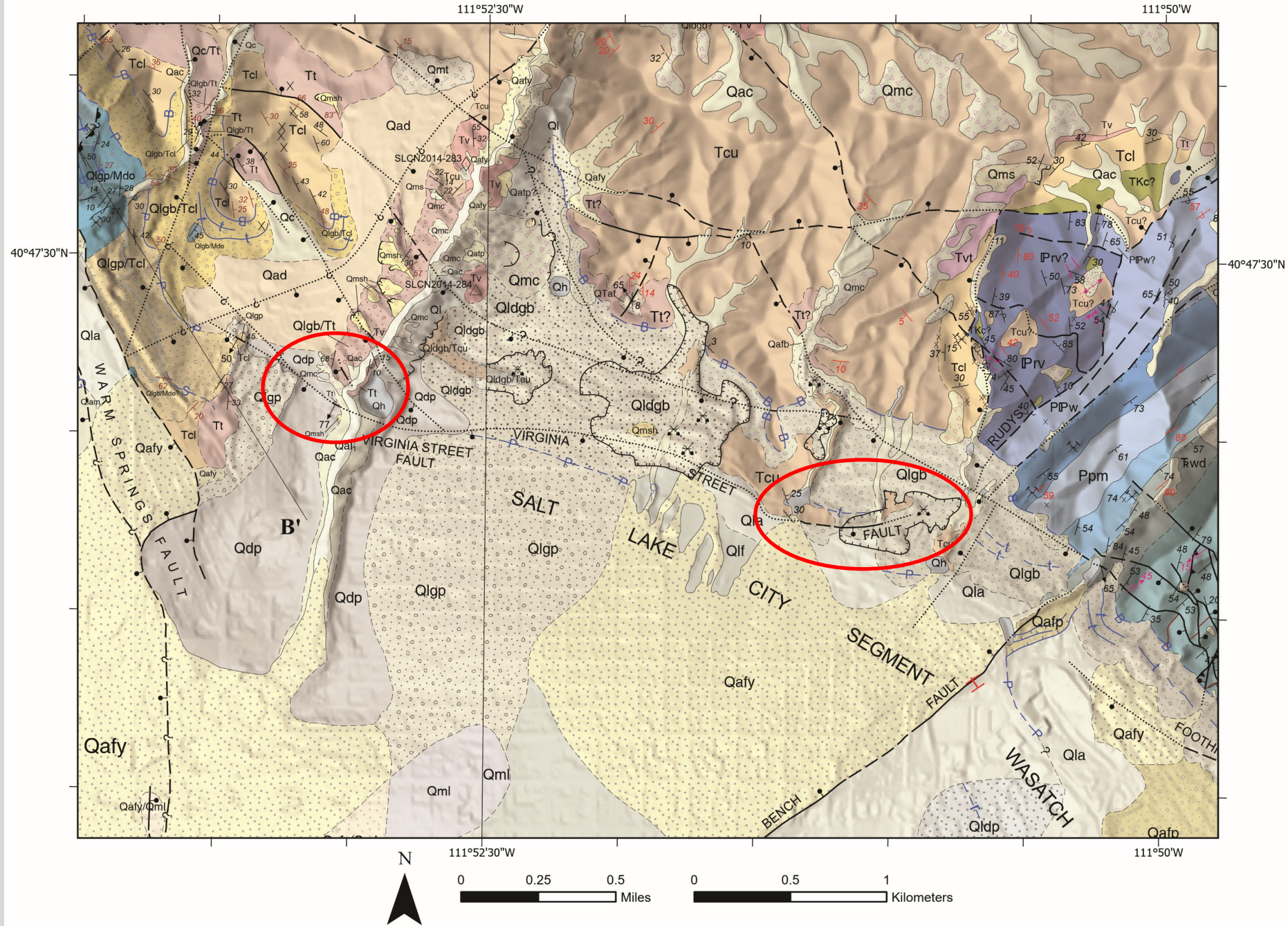
Bryant, 1990

Personius and Scott, 1992

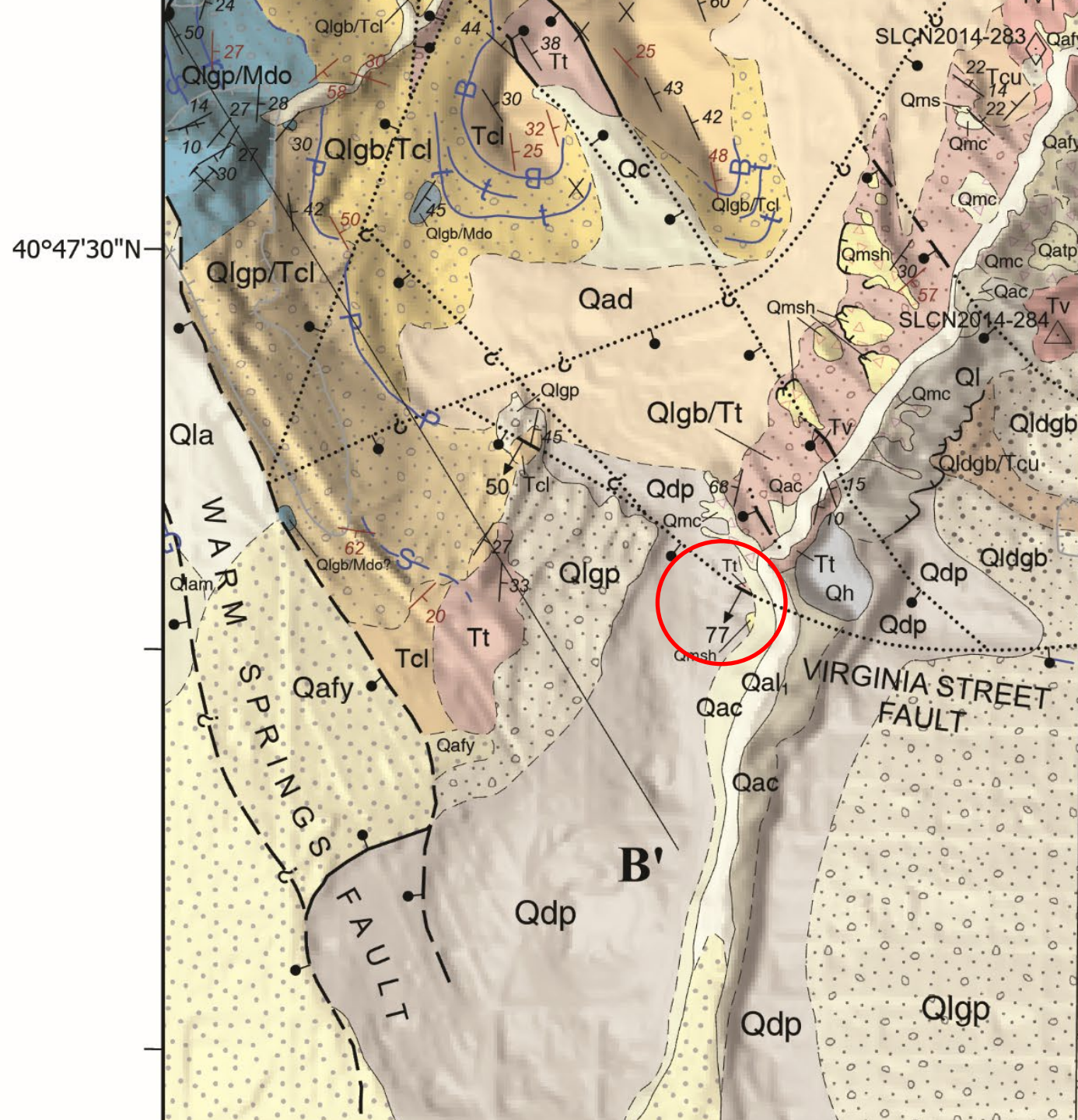
McDonald et al., 2020

Anderson et al., 2024

McKean and Anderson, 2024

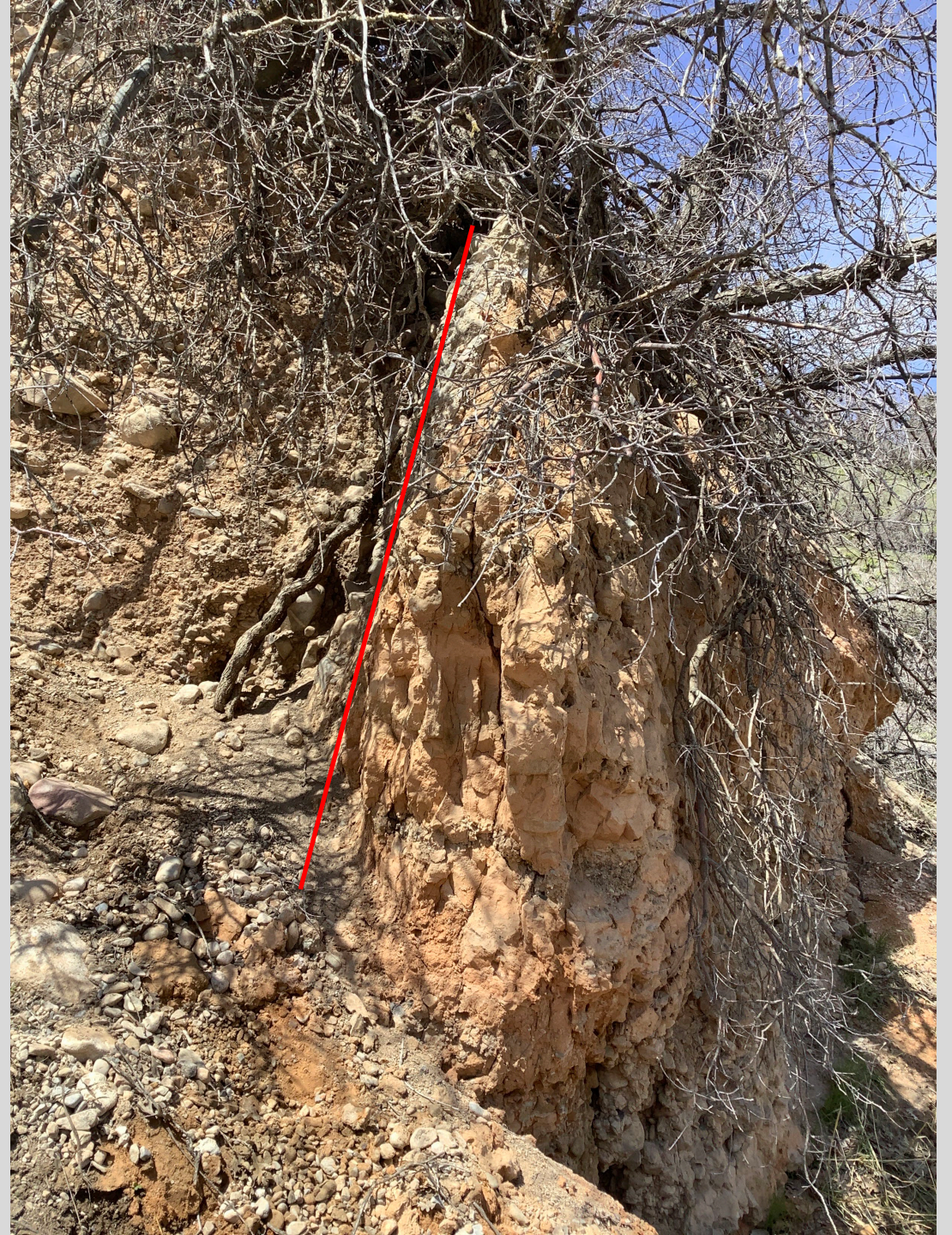


Rediscovered Fault Exposure

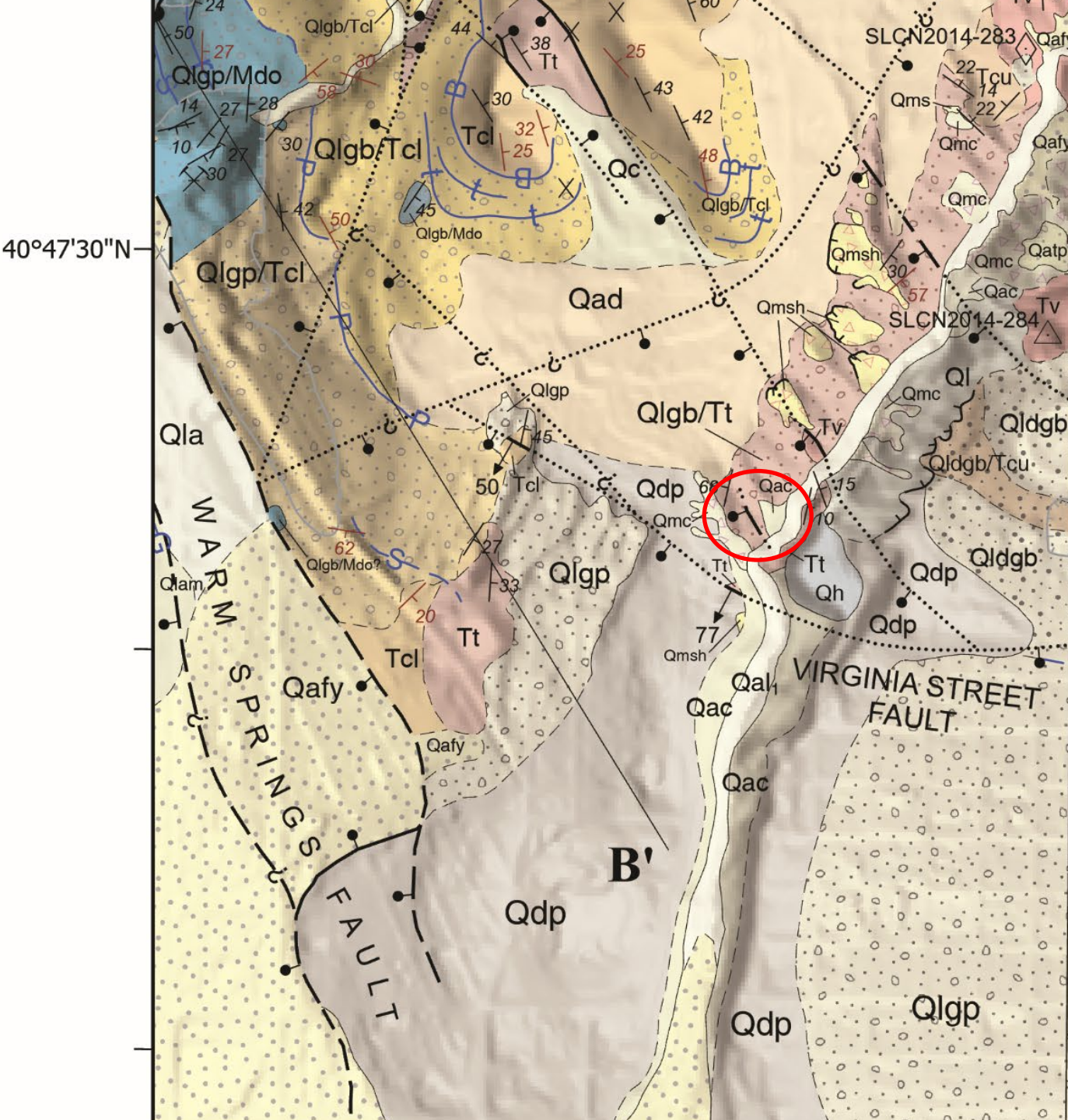


Rediscovered Fault Exposure

- Right (north):
 - Tuffaceous sandstone and conglomerate
 - Middle to Early Eocene age
 - dipping to East 17°
- Left (south):
 - Lake Bonneville gravels and sand
 - Late Pleistocene age
 - Sub horizontal dip
- Fault plane has a dip of 77° to the south
- Fault age is $<15,000$

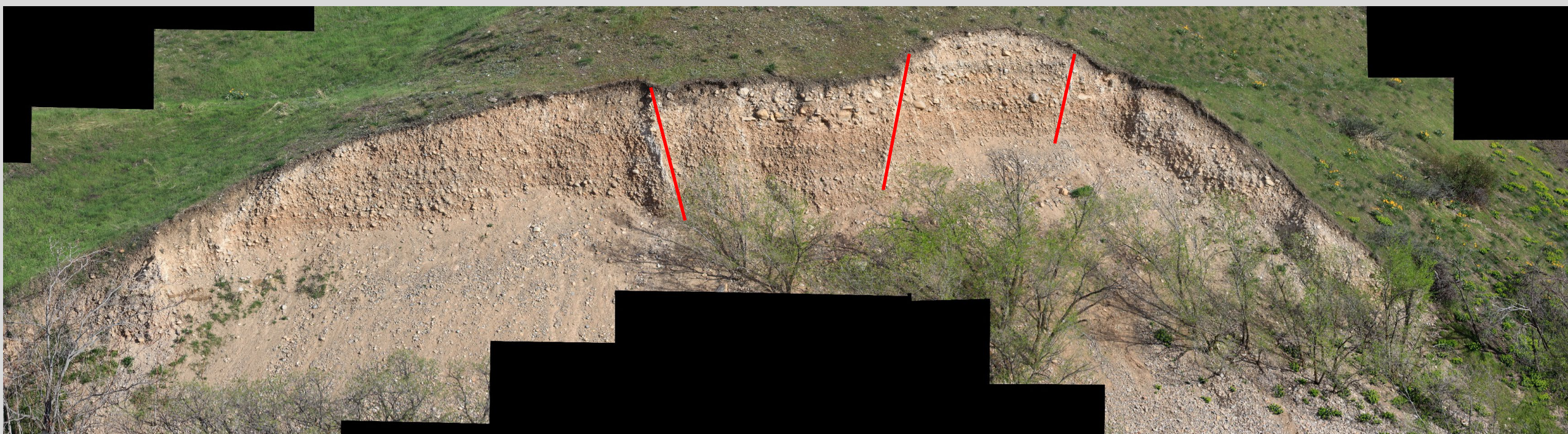


New Fault Exposure



Photograph by Adam Hiscock, UGS

New Fault Exposure



New Fault Exposure

- Small offset on each fault
- Carbonate cement along fault
- Offsetting unconsolidated Late Pleistocene Lake Bonneville sand and gravel



New Fault Exposure

- Small offset on each fault
- Carbonate cement along fault
- Offsetting unconsolidated Late Pleistocene Lake Bonneville sand and gravel
- Rotated pebbles in fault zone
- Fault age is <15,000



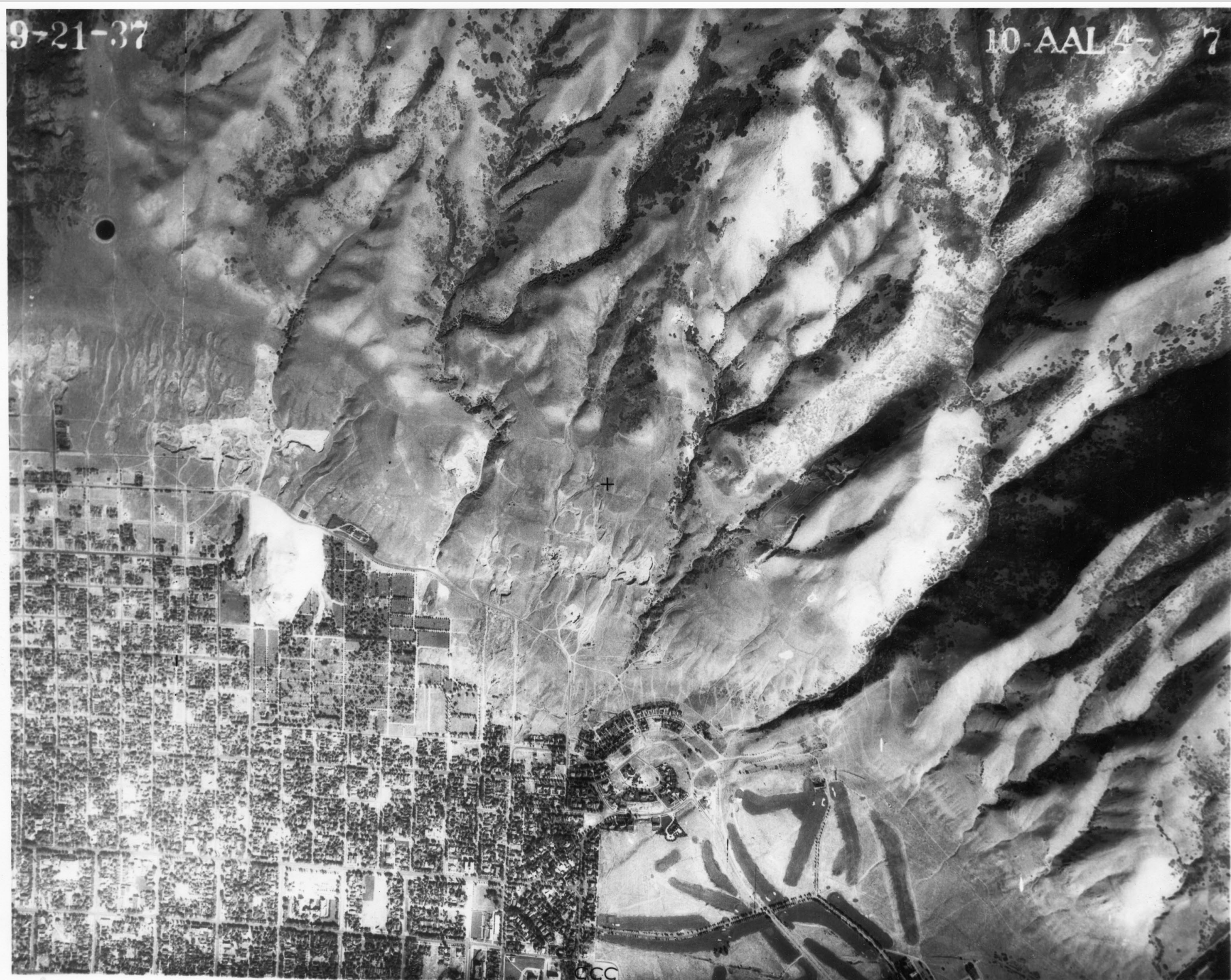
Mystery Fault Photograph

- **Title:** Section of a fault in valley deposits, northeastern suburb of Salt Lake City. Salt Lake County, Utah. 1901.
- **Photographer:** Grove Karl Gilbert (date 1901)
- **Summary from USGS:** Section of a fault in valley deposits, northeastern suburb of Salt Lake City, Utah. At left coarse alluvium of the foot slope of the Wasatch Range; at right sandy silt deposited by Pleistocene lake; between the two a belt of disturbed material the shear zone of the fault. Salt Lake County. 1901. (Similar to photo no. 1793a).



Mystery Fault Photograph

- Could Gilbert's fault photograph be the eastern Virginia Street fault?
- Earliest Aerial Image from 1937
- Fault age <15,000?

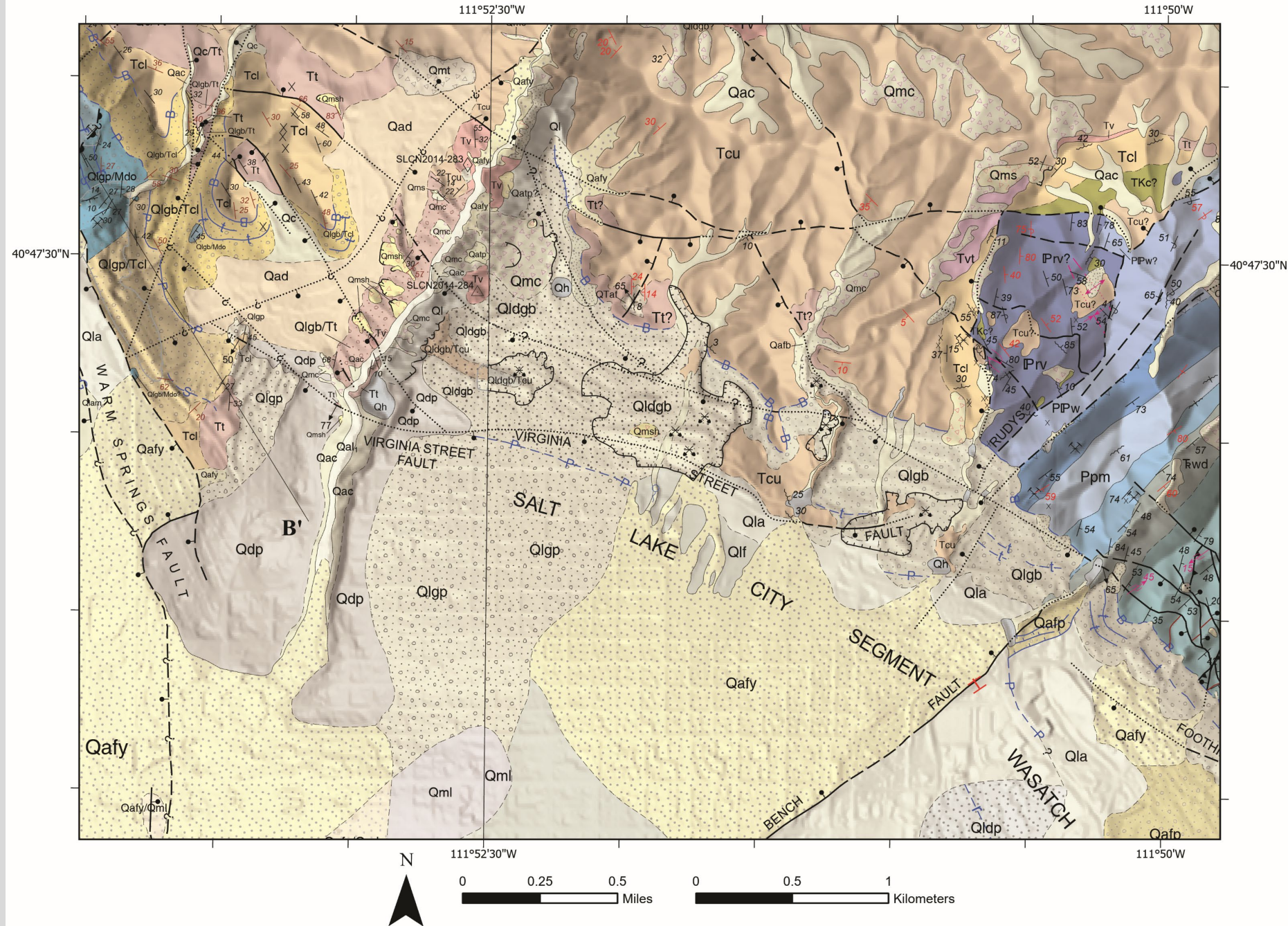


Mystery Fault Photograph

- Could Gilbert's fault photograph be the eastern Virginia Street fault?
- Earliest Aerial Image from 1937
- Fault age <15,000?



- Rediscovered fault exposure
 - Lake Bonneville gravels on older Tuffaceous strata
- Newly discovered fault exposure
 - Offsetting Lake Bonneville gravels
- Could G.K. Gilbert Photograph be eastern Virginia Street fault?
- Suggest Virginia Street fault be considered <15,000





Thank you



UTAH GEOLOGICAL SURVEY

geology.utah.gov

Utah Quaternary Fault Database Updates

Adam I. Hiscock, Utah Geological Survey, Geologic Hazards Program

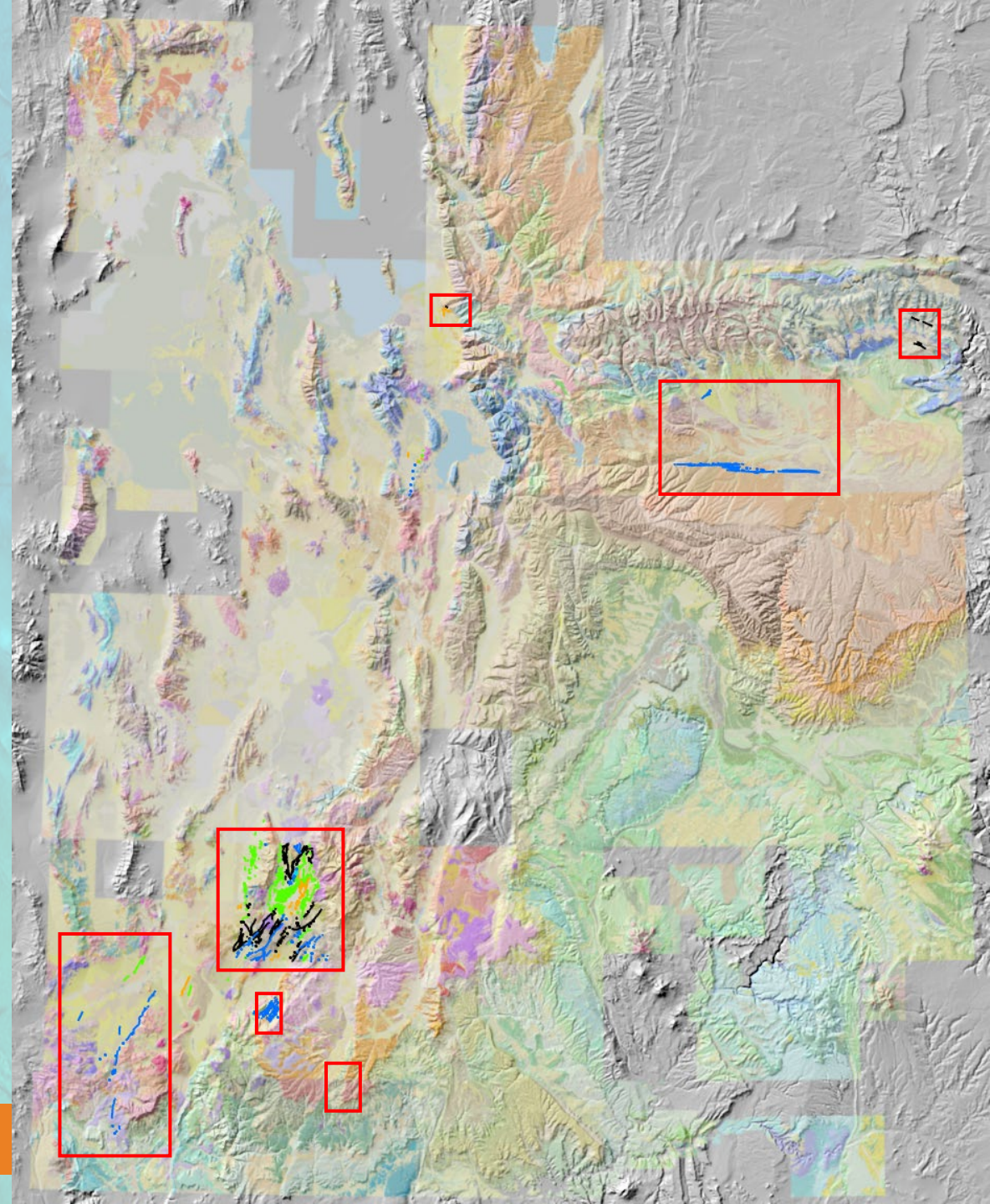


Utah Quaternary Fault Database

- Previously the Utah Quaternary Fault and Fold Database – changed/simplified name to Utah Quaternary Fault Database in 2010's when it went “online”
- UQFD lives on the Utah Geologic Hazards Portal; also available through the Utah Geographic Reference Center (UGRC) State Geographic Information Database (SGID)
- Historically, most fault mapping data from Geologic Maps; all mapping must be peer-reviewed to be included
- Newer UGS lidar-based fault mapping is more widely available for large parts of Utah
- Previously, updates were just pushed to the online database with no citable DOI/associated publication
- Periodic updates to the U.S. Geological Survey's Quaternary Fault and Fold Database of the United States

2025 UQFD Update

- Publishing as a UGS Data Series pub – so that all our updates have a citable DOI and a GIS database containing the fault mapping updates
- Included updated fault mapping from numerous new 24k and 30x60 scale peer-reviewed, published, geologic maps
- Currently in review – expect to be out shortly



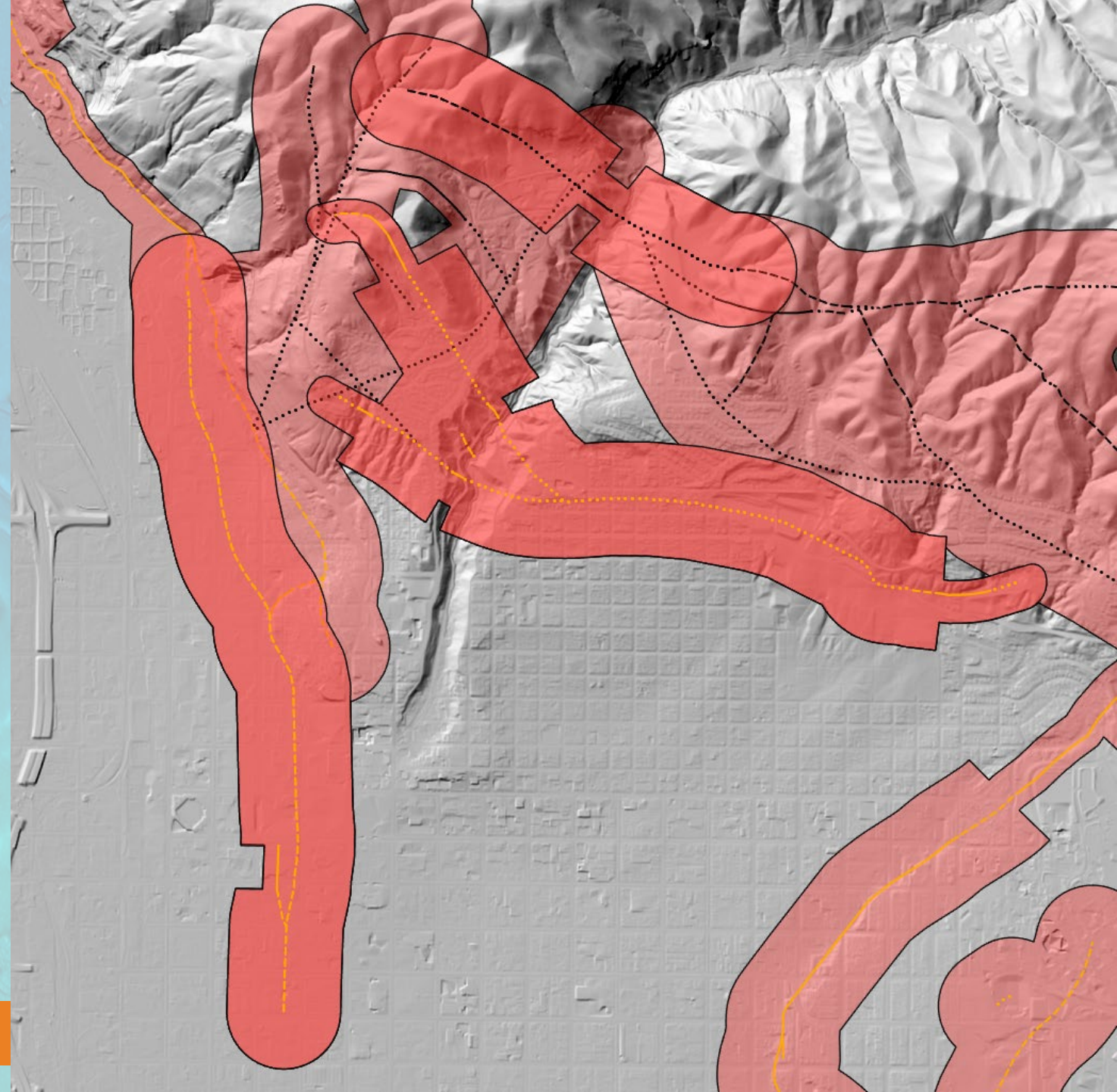
2025 UQFD Update Process

- Comb through newly-published 24k and 30x60 geologic maps and pull-out suspected Quaternary-active faults
- Involves discussions with authors (geologic mappers) and geomorphic review of faults in lidar data
- Faults are assigned full attributes in accordance with the UQFD
- Fault age/activity category assigned based on offset geologic units and geomorphic relationships
- GIS data internally peer-reviewed, in addition to full UGS review

	<150 Years, Well Constrained
	<15,000 Years, Well Constrained
	<15,000 Years, Moderately Constrained
	<15,000 Years, Inferred
	<130,000 Years, Well Constrained
	<130,000 Years, Moderately Constrained
	<130,000 Years, Inferred
	<750,000 Years, Well Constrained
	<750,000 Years, Moderately Constrained
	<750,000 Years, Inferred
	<2.6 Million Years, Well Constrained
	<2.6 Million Years, Moderately Constrained
	<2.6 Million Years, Inferred
	Undetermined, Well Constrained
	Undetermined, Moderately Constrained
	Undetermined, Inferred

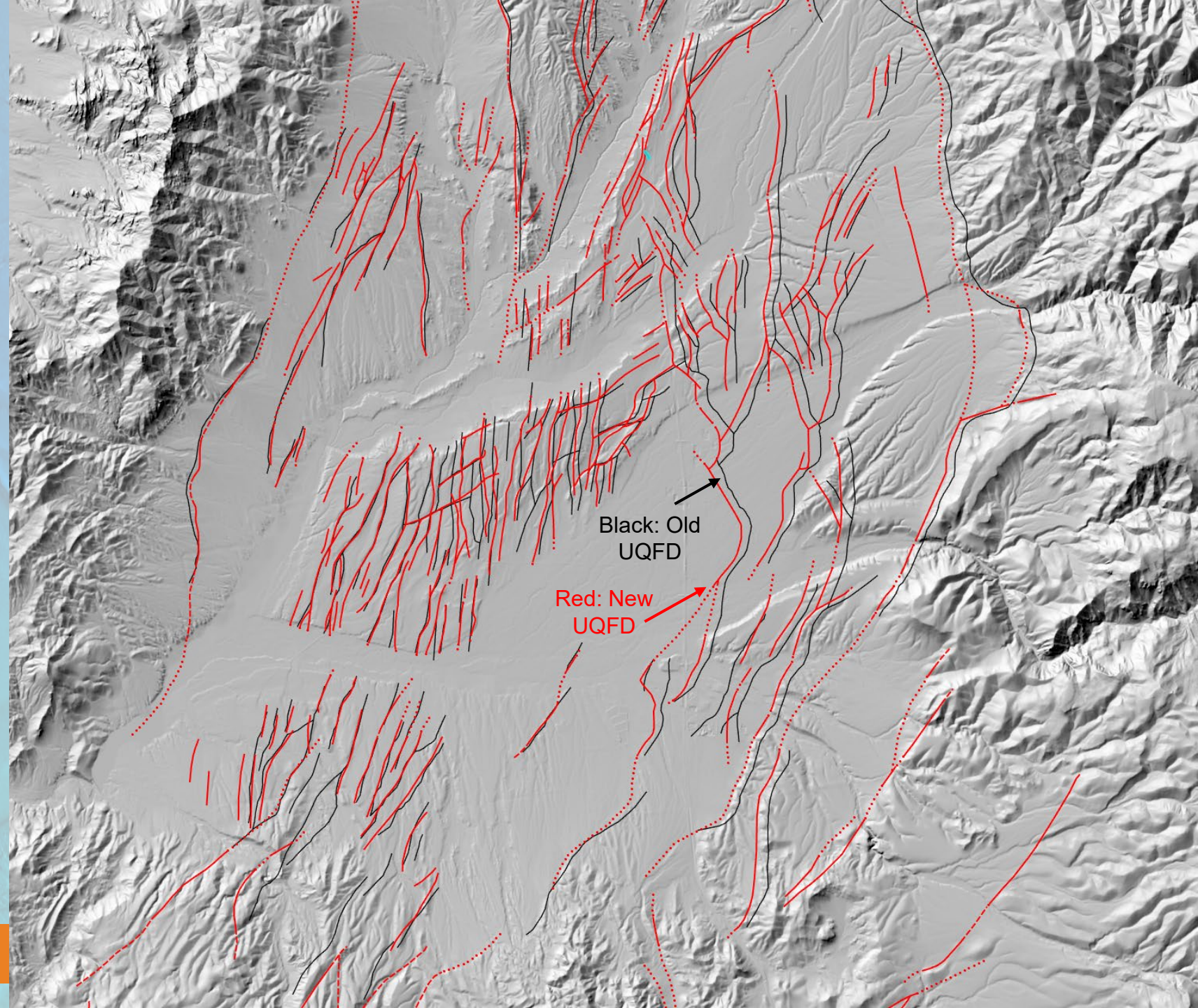
2025 UQFD Update Process

- Only faults with previously published surface-fault-rupture special-study-zones (SSZ's) get updates to SSZ's.
 - Wasatch fault zone – places where mapping has changed since RI-280 (McDonald et al., 2020), we've also updated the associated SSZ's
 - Example – Virginia Street fault, mapped by Adam McKean and Zach Anderson (previous talk)



Example

- Beaver Basin area (Beaver, UT)
- Many faults mapped previously (light blue lines), but before lidar
- Beaver SW & NW 30x60 Geologic Quads (Rowley et al., 2019 & 2020)
- Future, even newer mapping (Biek et al., 2027?) will refine this complex zone of faulting even further



**Wasatch Fault Zone
Salt Lake City/Weber
segments
(includes updated SSZs)**

**Duchesne-Pleasant
Valley fault system**

**Beaver Basin faults
Mineral Mountains faults
Black Mountains faults**

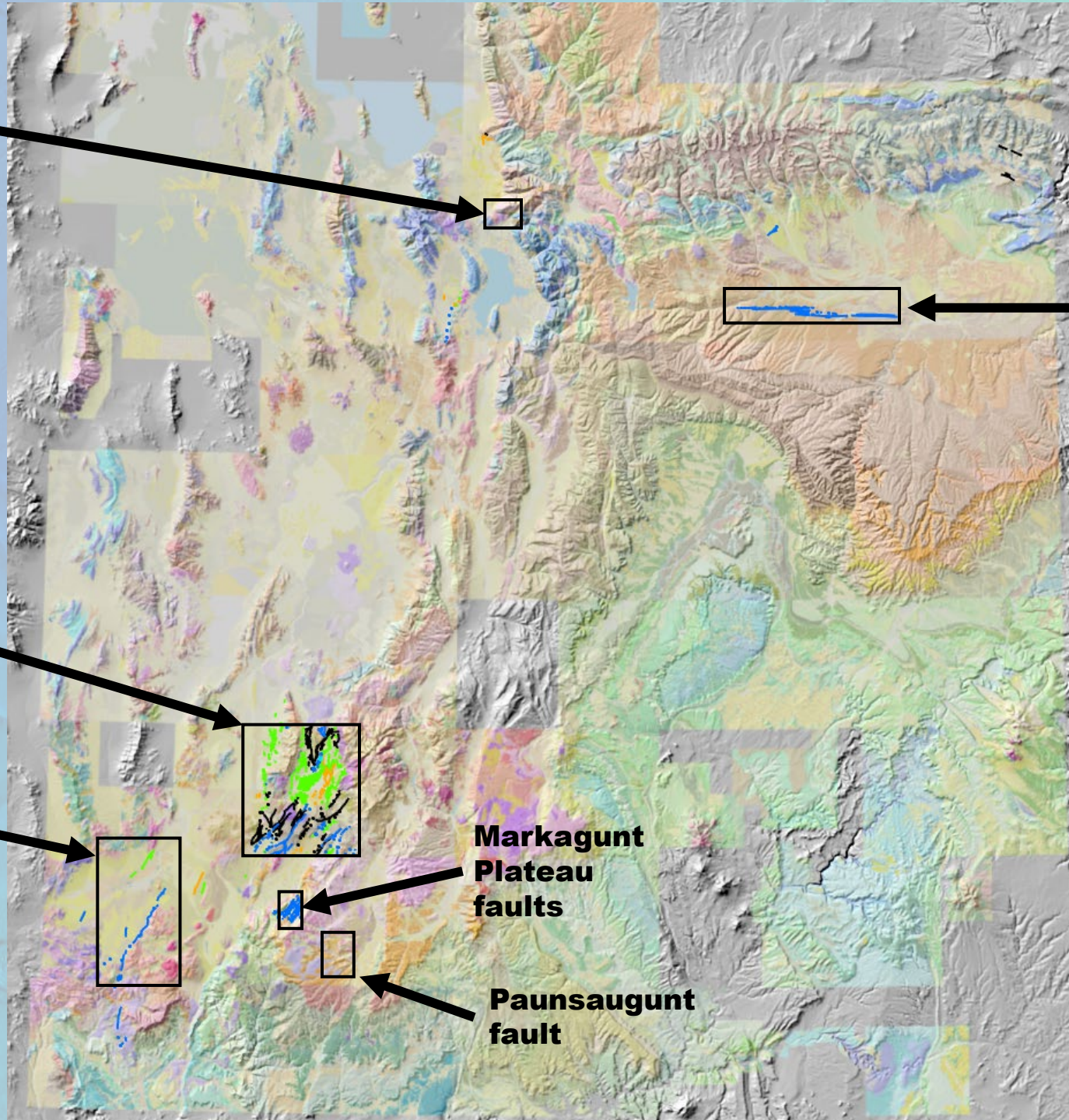
**Wah Wah Mountains fault
Antelope Range fault**

**Markagunt
Plateau
faults**

**Paunsaugunt
fault**

**2025 UQFD
Update**

**Notable Faults
Included**



Future/Yearly UQFD Updates

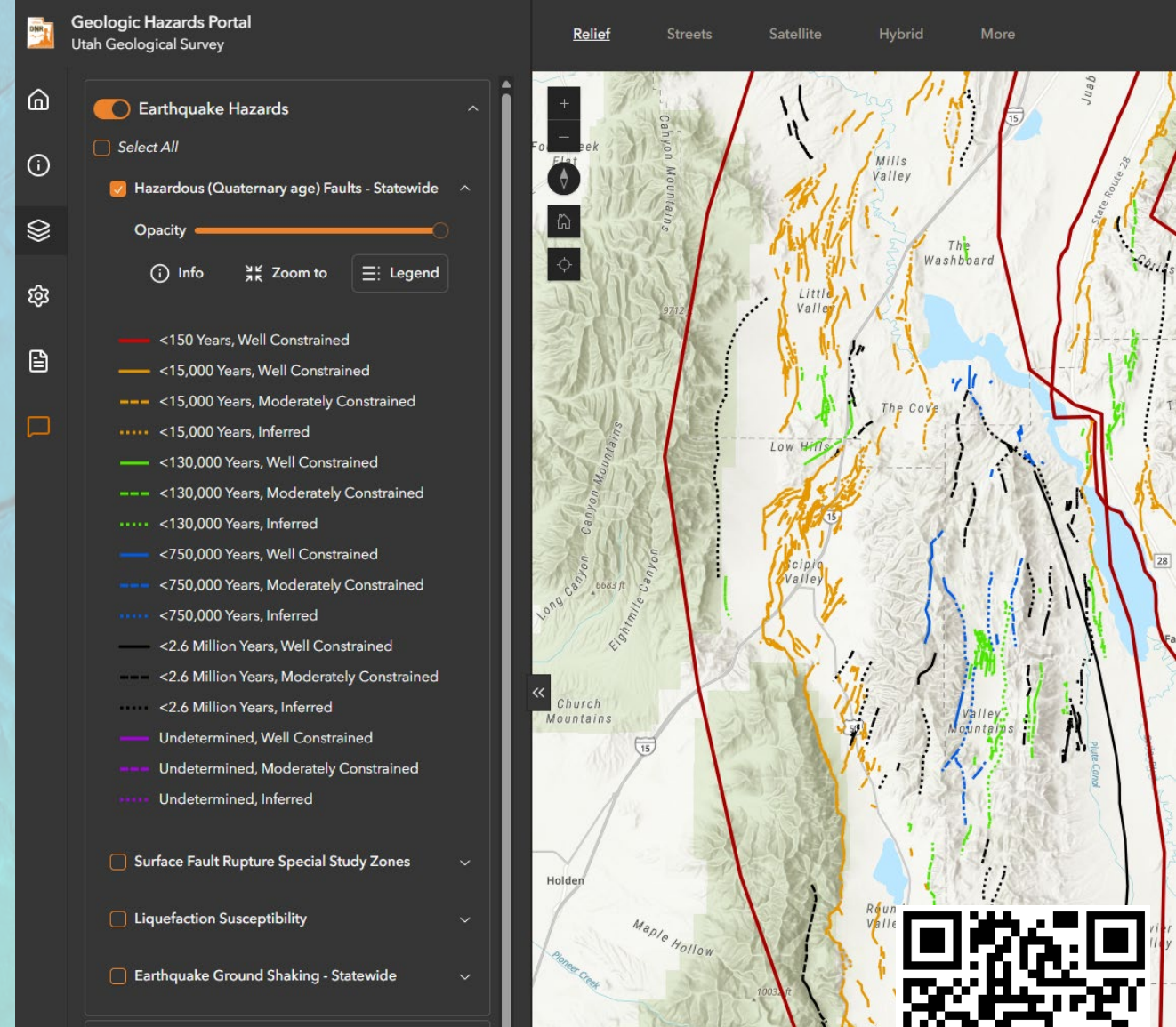
- Plan to release a yearly UGS Data Series UQFD update
- Collaborative effort between the UGS's Geologic Hazards Program and Geologic Mapping Program
- To include new geologic mapping primarily
 - 2027: Beaver 30x60 and Panguitch 30x60 (Biek), Ogden Valley 24k quads
- All future publications will include a DOI and a fully-attributed GIS database containing the new mapping and full UQFD
- All new mapping will be added to the UQFD on the Utah Geologic Hazards Portal and the UGRC's SGID.

Updates to the USGS

- Periodic updates to the U.S. Geological Survey's Quaternary Fault and Fold Database of the United States
- However, the USGS does not update their database very frequently.
- Currently showing last update in September 2020.
- UGS will be submitting a comprehensive update of the Utah Quaternary Fault Database to the USGS shortly
- **Important – Always use the UGS's Utah Quaternary Fault Database for the most up-to-date fault mapping**

Utah Geologic Hazards Portal

- One-stop-shop for all UGS Geologic Hazards Mapping products (fault mapping, special-study-zones, landslide susceptibility, flooding, problem soils, etc.)
- Replaced the Utah Quaternary Fault Database (UQFD) web map – UQFD now lives on the Hazards Portal.



<https://hazards.geology.utah.gov>



**Click on
INFO here**

- Full GIS Database containing ALL data in the portal is available for download

**Full GIS
database
download
link here**

<https://hazards.geology.utah.gov>



UTAH GEOLOGICAL SURVEY

A screenshot of the Utah Geologic Hazards Portal website. The page has a dark sidebar on the left with icons for home, info, layers, settings, documents, and a report generator. The main content area is titled "Geologic Hazards Portal" and "Utah Geological Survey". It includes a "Map Details" section with a disclaimer, a description of the data, and instructions on how to use the map. Below this is a "Data Sources" section. At the bottom of the sidebar, there are links for "References", "Acknowledgments", and "Contact Webmaster". The right side of the page shows a map of a region in Utah with various geologic hazards highlighted in orange, green, and blue. A QR code is located in the bottom right corner of the page.

Geologic Hazards Portal
Utah Geological Survey

Map Details

Disclaimer: Please note that most hazards have been mapped within specific study areas and not comprehensively statewide. Therefore, the absence of data in a particular location does not indicate the absence of geologic hazards.

The Utah Geologic Hazards Portal is a compilation of data from the Utah Geologic Hazards Database and contains post-2008 UGS geologic hazard map data and data from other sources. This mapping is intended to provide planners, local government officials, property owners, developers, engineers, geologists, design professionals, and the public with information on the type, location, and relative susceptibility of geologic hazards that may impact existing and future infrastructure and development. The data also supports emergency response and recovery planning, as well as community risk assessment for existing development and infrastructure.

Hazard map layers can be enabled using the group toggle buttons and layer checkboxes. Select features on the map to view detailed information about hazard susceptibilities. Create summary reports for individual areas by using the Report Generator tool.

For more information about geologic hazards in Utah, see <https://geology.utah.gov/hazards/> or contact the UGS.

Data Sources

The database for the Utah Geologic Hazards Portal contains geologic hazard information and data from UGS studies and other sources. Detailed geologic hazard mapping is available for limited areas and additional mapping is ongoing. The database is periodically updated to incorporate the results of new mapping.

The data exists as an attributed GIS feature class available for download: [GIS Data](#)

Database Updated February 2025

Projection: WGS84

UGS geologic hazard study reports and other downloads are available here: <https://geology.utah.gov/hazards/info/publications/>

[References](#) [Acknowledgments](#)

[Contact Webmaster](#)

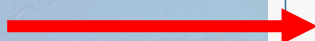
[Start Exploring](#) [Open Data Disclaimer](#)

Esri, NASA, NGA, USGS | Utah Geospatial Resource Center, Esri, TomTom, Garmin

Utah Geological Survey

UGRC SGID Download/Web Map

**UQFD
Download
Here**



Utah SGID

Utah Quaternary Faults

✓ Authoritative

Private Member ⓘ
Utah DNR Online Maps

Summary

Utah Quaternary Faults

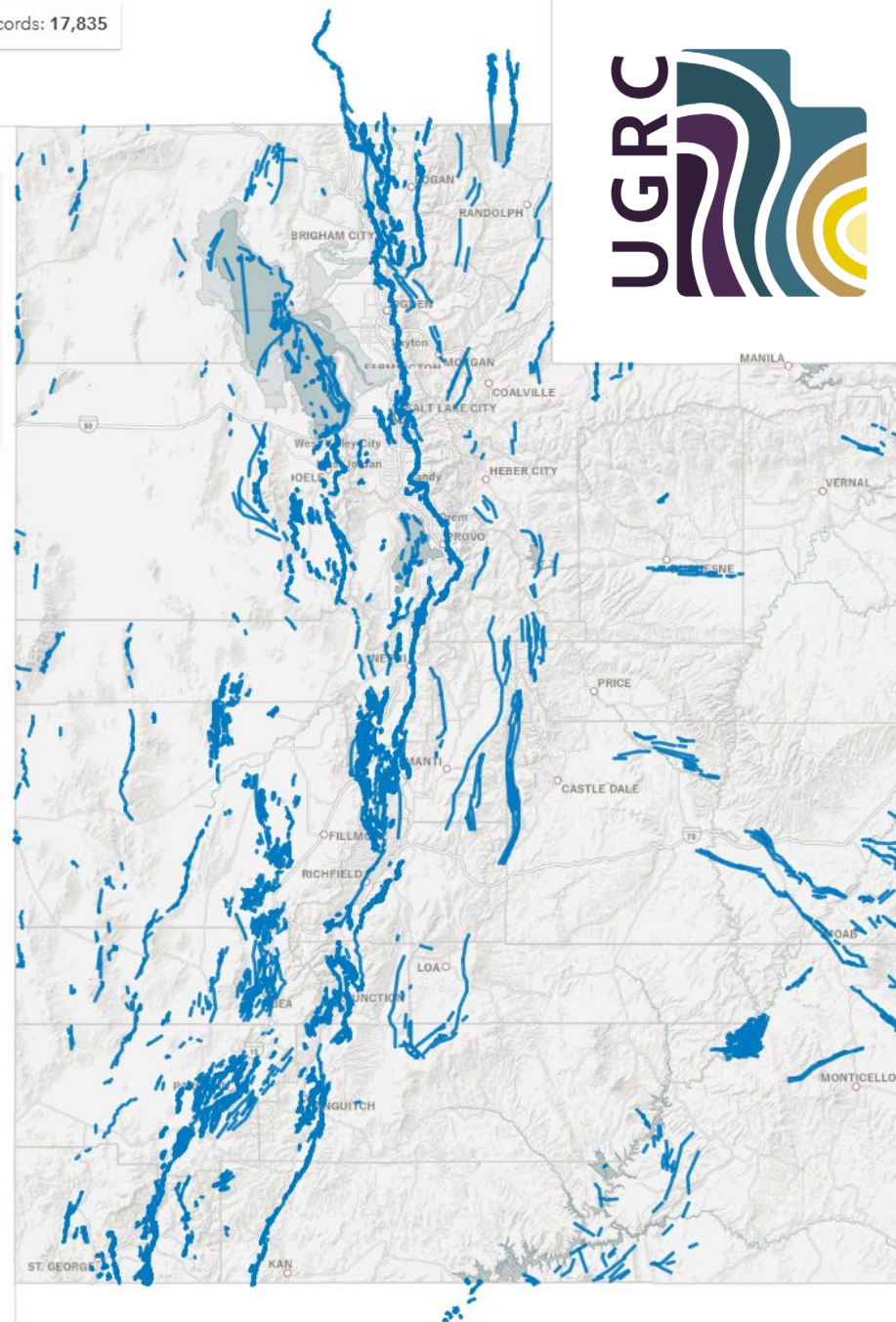
View Full Details

Download

Details

-  **Dataset**
Feature Layer
-  **October 10, 2025 at 4:45:48 PM MDT**
Info Updated
-  **October 10, 2025 at 4:44:15 PM MDT**
Data Updated
-  **December 7, 2020 at 3:31:51 PM MST**
Published Date
-  **Records: 17,835**
[View data table](#)
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<https://tinyurl.com/utqfaults>



UTAH GEOLOGICAL SURVEY



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Thank You!



UTAH EARTHQUAKE ACTION ALLIANCE



Citizen-Led Earthquake Preparedness for Utah

February 2026 | Trae Bowman GIT, Grant Willis (UGS Emeritus), & Matthew Morriss, Ph.D. P.G.

Interested? Email: ueaa.board@gmail.com



Utah's Seismic Reality

The Wasatch Fault runs through the heart of Utah's most populated corridor



>40%

Probability of M7.0+
earthquake within 50 years
along the Wasatch Front



140,000+

Unreinforced masonry
buildings at risk of
collapse across Utah



2.5M

Utahns living in
high seismic hazard
zones statewide

Post-Earthquake Hazards

Infrastructure failure cascades into environmental and public health crises



Structural Collapse

Unreinforced masonry (URM) buildings are the #1 threat in a major quake. Utah has 140,000+ URM buildings with no state program for retrofitting or replacement.

Industrial smokestacks and chimneys are particularly vulnerable — collapse sends heavy debris into streets and adjacent structures.

No state funding mechanism currently exists for URM mitigation.



New Priority: Environmental & Health Risks

Collapsing industrial structures release toxic dust — silica, asbestos, heavy metals — creating acute respiratory hazards across affected areas.

Ruptured gas lines and chemical storage facilities compound contamination risk, especially along the Wasatch Front industrial corridor.

Liquefaction near Great Salt Lake threatens infrastructure and could mobilize contaminated sediments.

Utah's industrial corridor overlaps almost entirely with its highest seismic hazard zones.

The Gap We're Filling

BEFORE: December 2024

The Utah Seismic Safety Commission (USSC) served as the state's primary advisory body on earthquake preparedness, coordinating research, policy recommendations, and public awareness for decades.



AFTER: Legislature Dissolved USSC

No dedicated state body for seismic safety coordination. No advocacy. No centralized public education. No voice pushing for URM retrofitting or preparedness funding.



UEAA: A Citizen-Led Response

Community outreach over legislative advocacy. Real people driving preparedness from the ground up — not waiting for government to act.

Model we're following



Seattle's ASAP! (Alliance for Safety, Affordability, and Preservation)



The Seattle Times

Local Politics

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Will Seattle at last take action on buildings that can kill when earthquakes hit? A new push is afoot

March 9, 2020 at 6:00 am | Updated March 9, 2020 at 6:46 am



ASAP! Timeline

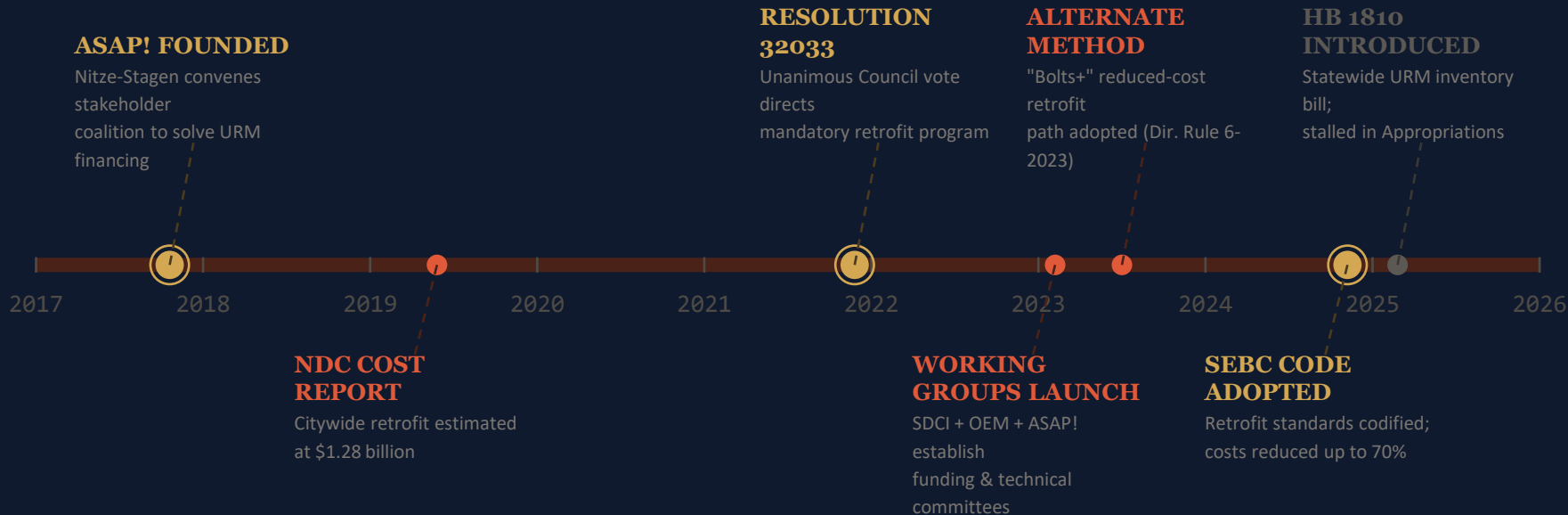
Alliance for Safety, Affordability & Preservation · Seattle, WA · 2017–2026

1,100+ URM BUILDINGS

86% QUAKE PROB / 50 YR

MANDATORY ORDINANCE: STILL PENDING

- Major milestone
- Progress step
- Stalled



76

buildings recognized as retrofitted

9

voluntary owner applications (2024–25)

0

mandatory ordinances enacted

Six years of infrastructure building — but voluntary uptake remains minimal and mandatory retrofit is still pending.

Building a Cross-Sector Coalition

We're recruiting founding board members from disciplines that must work together

Geosciences

Geologists, seismologists, and earthquake engineers who understand the hazard

Real Estate/Historic Preservation groups

Agents, appraisers, and developers who shape how risk is communicated to buyers

Insurance

Underwriters and adjusters who quantify earthquake risk and recovery costs

Design & Engineering

Structural engineers and architects who design resilient buildings

Emergency Management

Local and regional EM officials who coordinate disaster response

Community Leaders

Elected officials, business owners, and advocates with statewide reach

Statewide representation: Wasatch Front, Logan, St. George, and rural Utah

Year One: Foundation Building

Spend our first year developing organizational identity and strategic direction



Q1 2026

Inaugural Board Meeting

Convene founding members. Begin mission statement and organizational identity workshops.

Q2 2026

Strategic Framework

Define one & five-year goals, delegated roles (web, finance, outreach), and partnership strategy.

Q3 2026

Community Outreach

Launch public awareness efforts. Engage partner organizations. Build statewide volunteer network.

Q4 2026

Strategic Plan Delivery

Publish multi-year strategic plan. Establish ongoing operations and sustainable funding model.

2034 Olympics in Salt Lake City — a forcing function for preparedness improvements



Join Us as a Founding Board Member

We're looking for about a dozen dedicated people to shape UEAA's mission, strategy, and impact over the next year and beyond.

What we're asking:

- 1) Monthly meetings.
- 2) Help develop our mission statement, five-year goals, and strategic plan.
- 3) Bring your professional expertise and community connections to a grassroots effort that will make Utah safer.

Email: ueaa.board@gmail.com