Active Tectonics in a Quaternary Landscape

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Research Geologist (AZGS)
Funded by STATEMAP Program

Photo by volunteer Jennifer Polakis

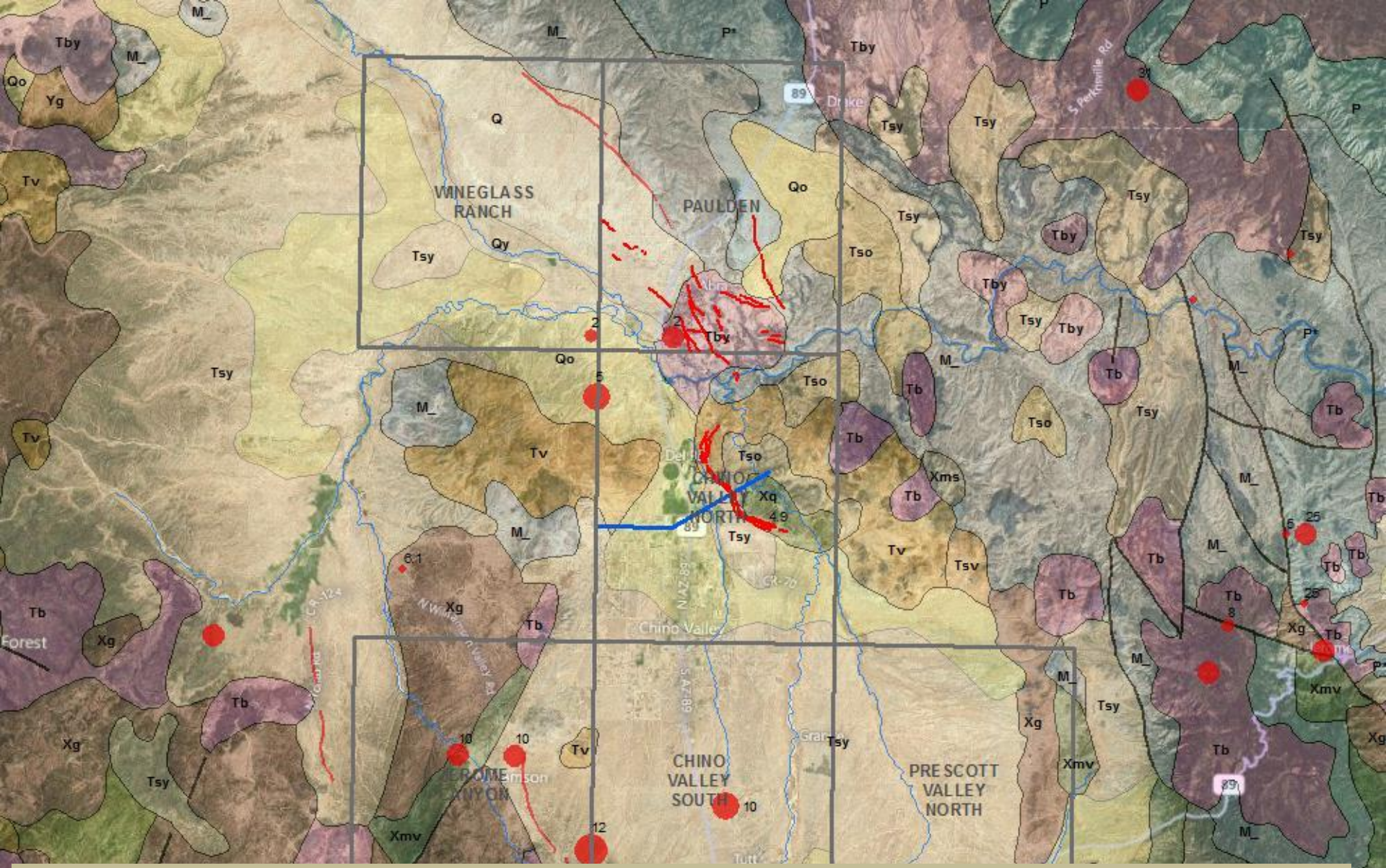
Home on the range
(AZGS field camp, Granite Creek, Chino Valley, November 2008)

Acknowledgements

- Co-authors Phil Pearthree, Jeri Young and John Douglass
- AZGS Team: Phil Pearthree, Ann Youberg, Joe Cook, Jon Spencer, Charles Ferguson, Michael Conway, and Jeri Young
- AZGS volunteers Jennifer Polakis and Frank Romaglia
- David Haddad and Ramon Arrowsmith (ASU)
- Chino Valley land owners, especially Well's ranch

What is it about the Chino Valley area?

- Headwaters and groundwaters of the Verde River
- Diverse geology
- Active faults and seismicity
- Ancestral rivers and streams
- Unique drainage capturing events
- Always more geology to be discovered



- M5 earthquake near Williamson area occurred Feb. 4, 1976.
- Big Chino Fault has the potential to produce an M7 event. Last rupture was during the early Holocene/Late Pleistocene with up to 6 to 10 feet of offset.

Example of recent fault scarps

Borrego fault scarp, April 2010, M7.2

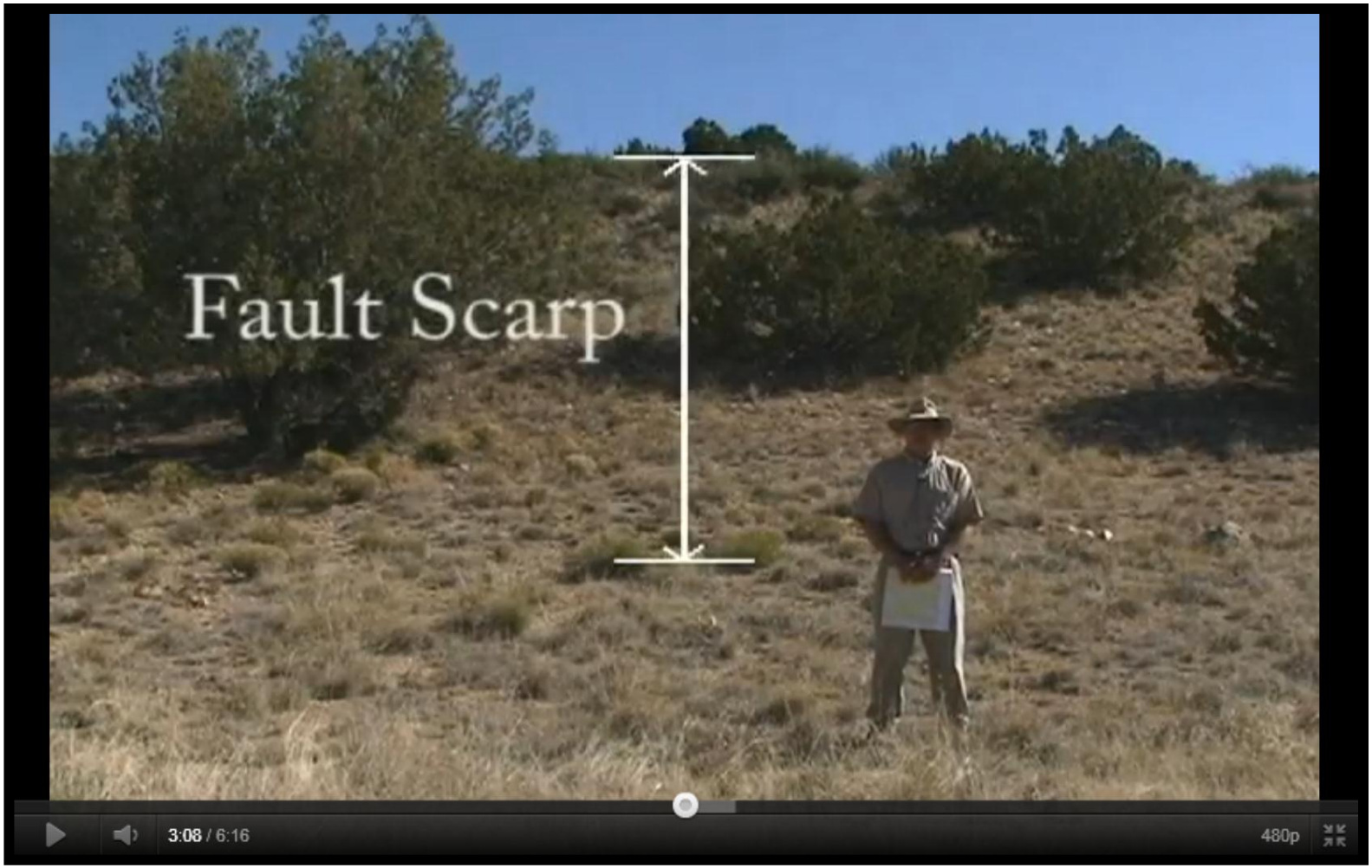
Photo from UGS

Dixie Fault, NV, 1954, M6.8

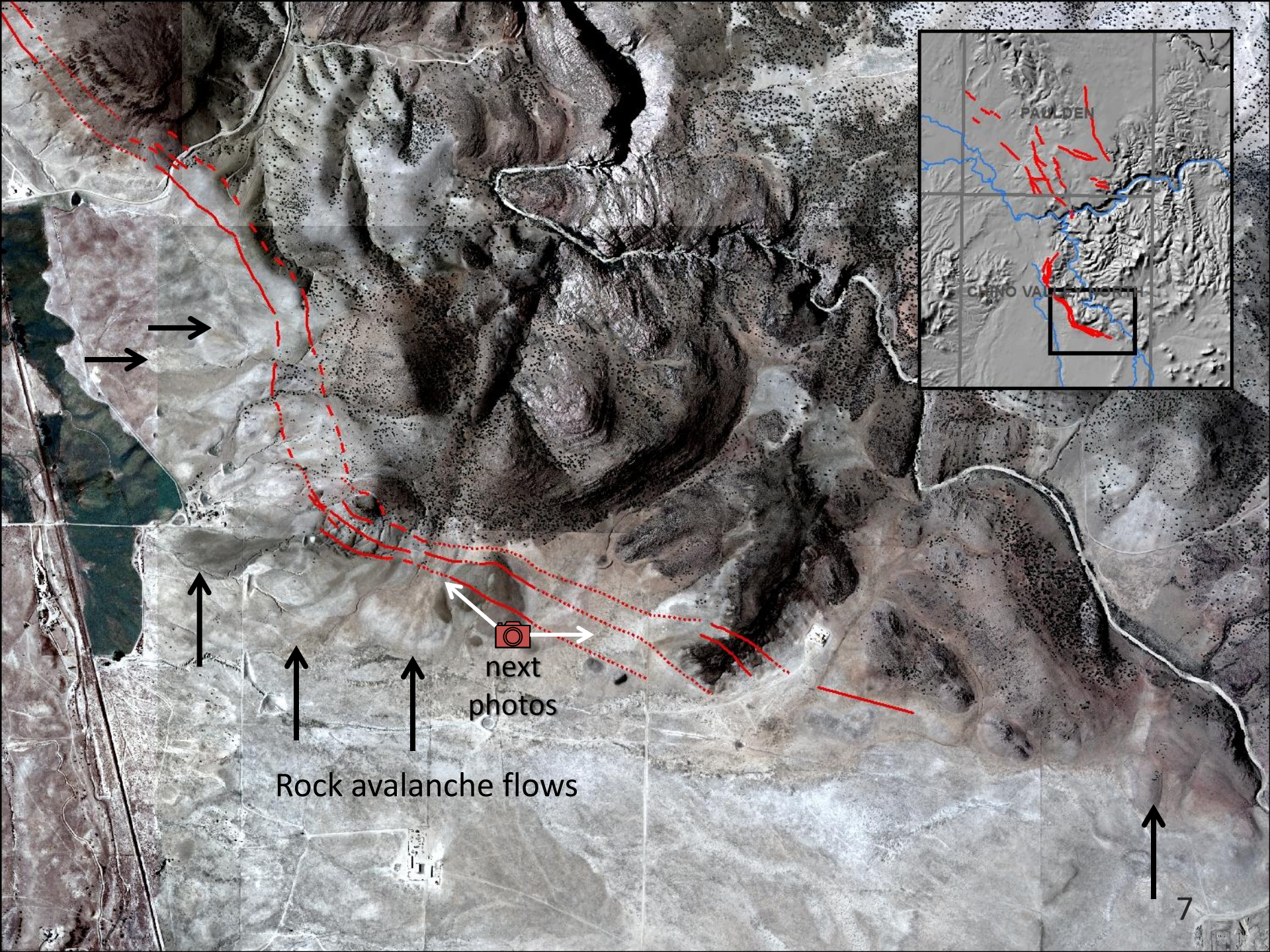
Photo from abf.org

Photo from Austin Elliot

Phil Pearthree at the base of the Big Chino fault scarp



http://www.youtube.com/watch?v=KkpC1ces0Q4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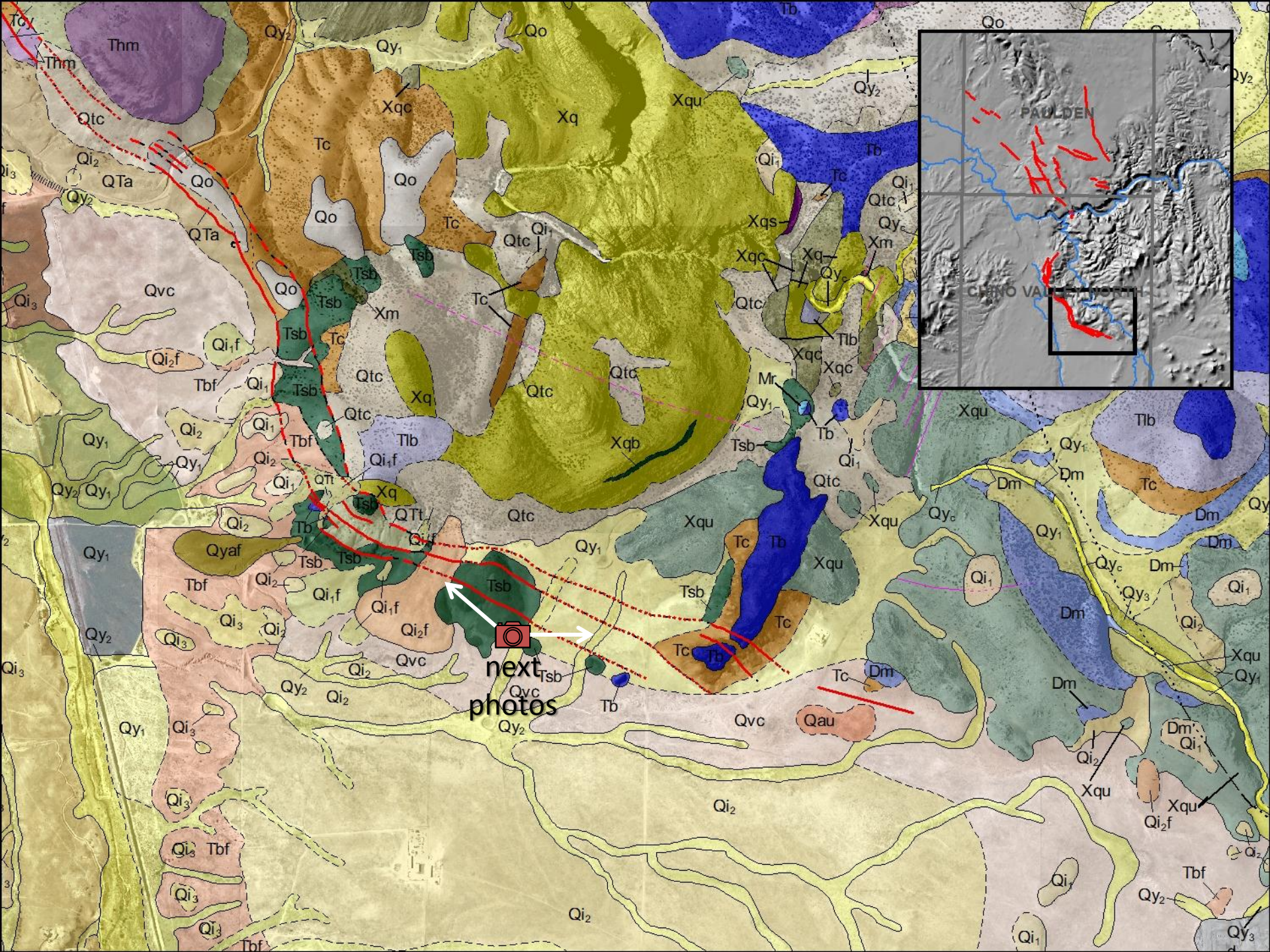
next
photos
Rock avalanche flows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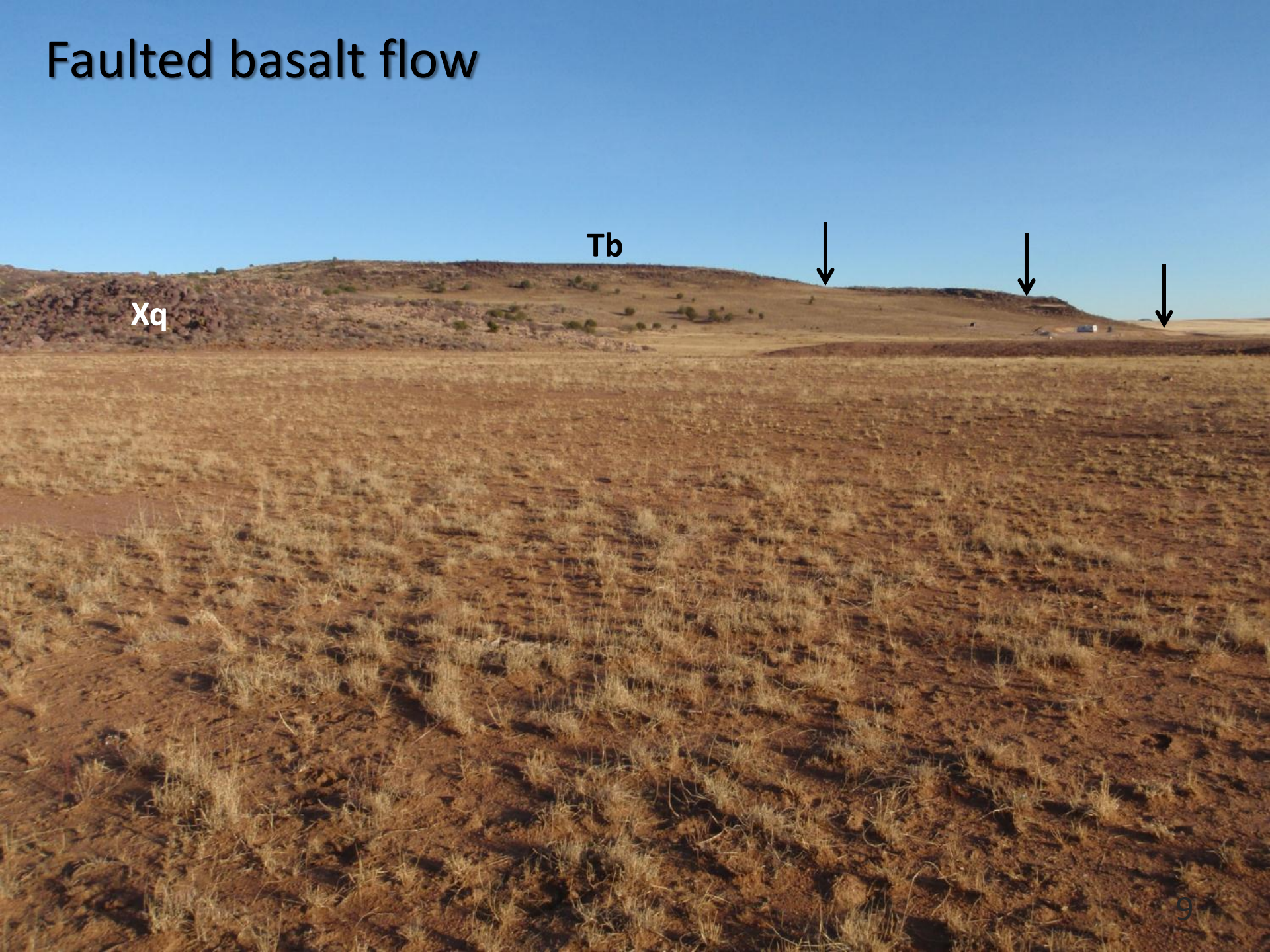
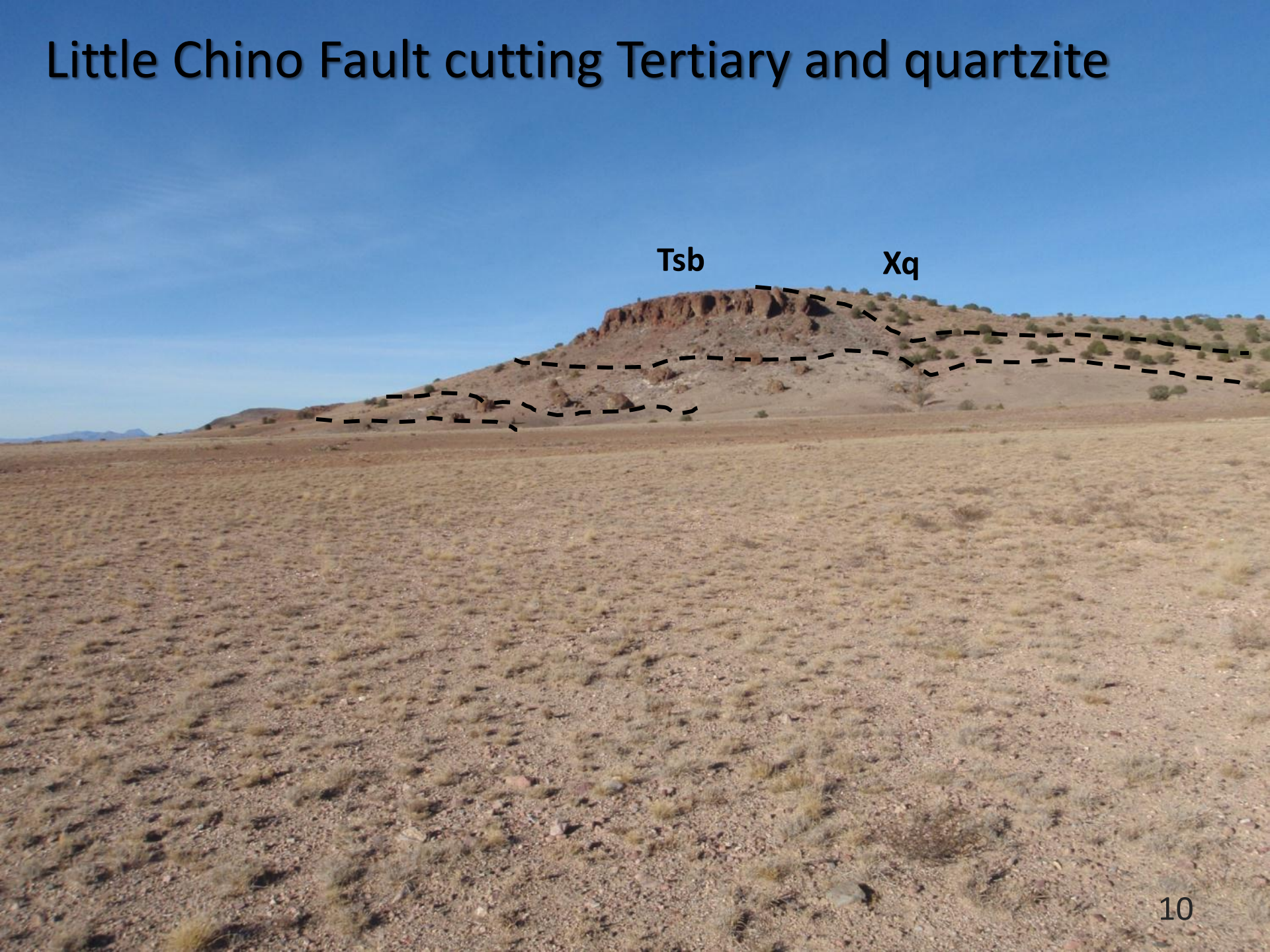
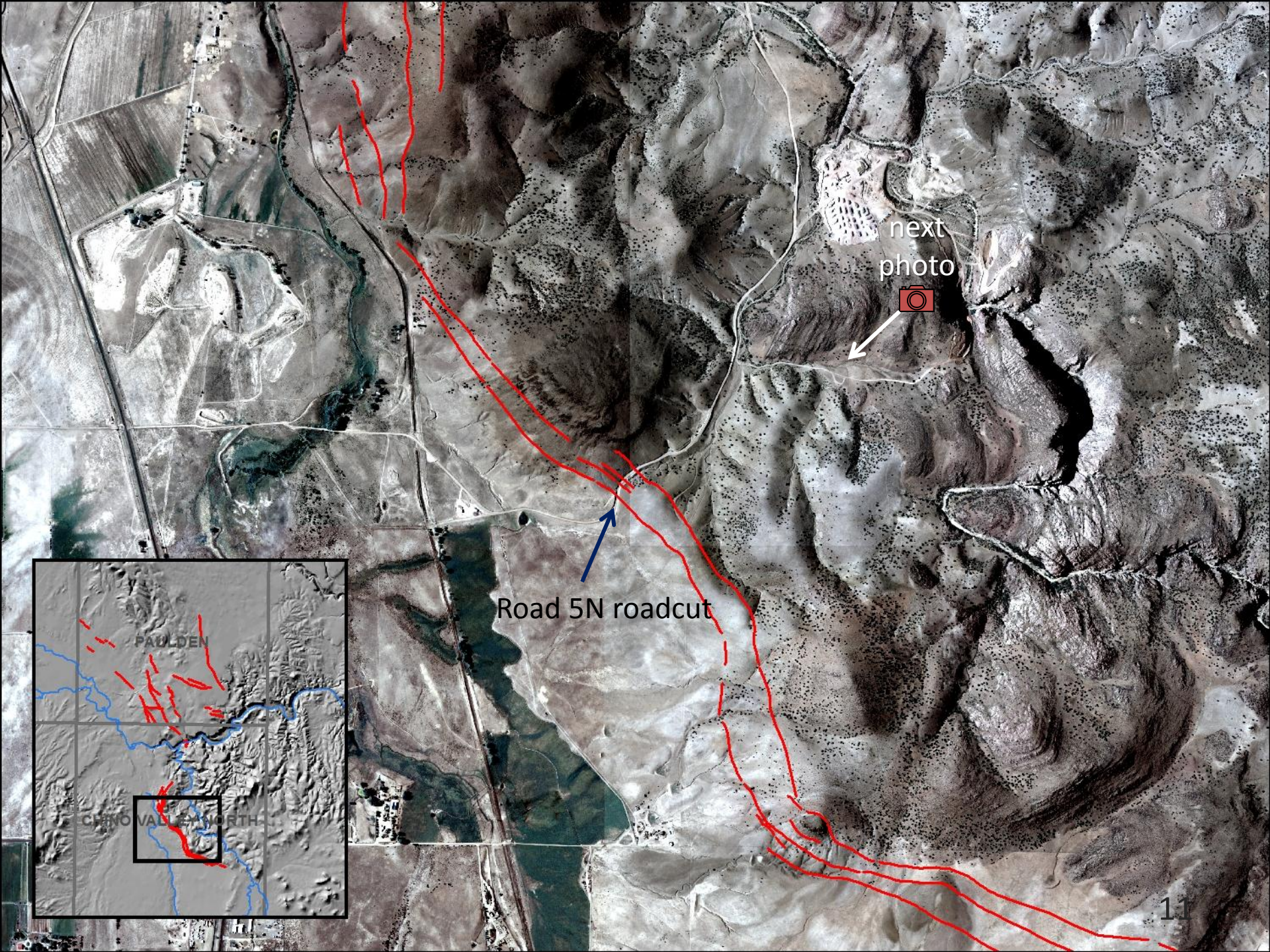
Faulted basalt flow



Little Chino Fault cutting Tertiary and quartzite




next
photo
Road 5N roadcut
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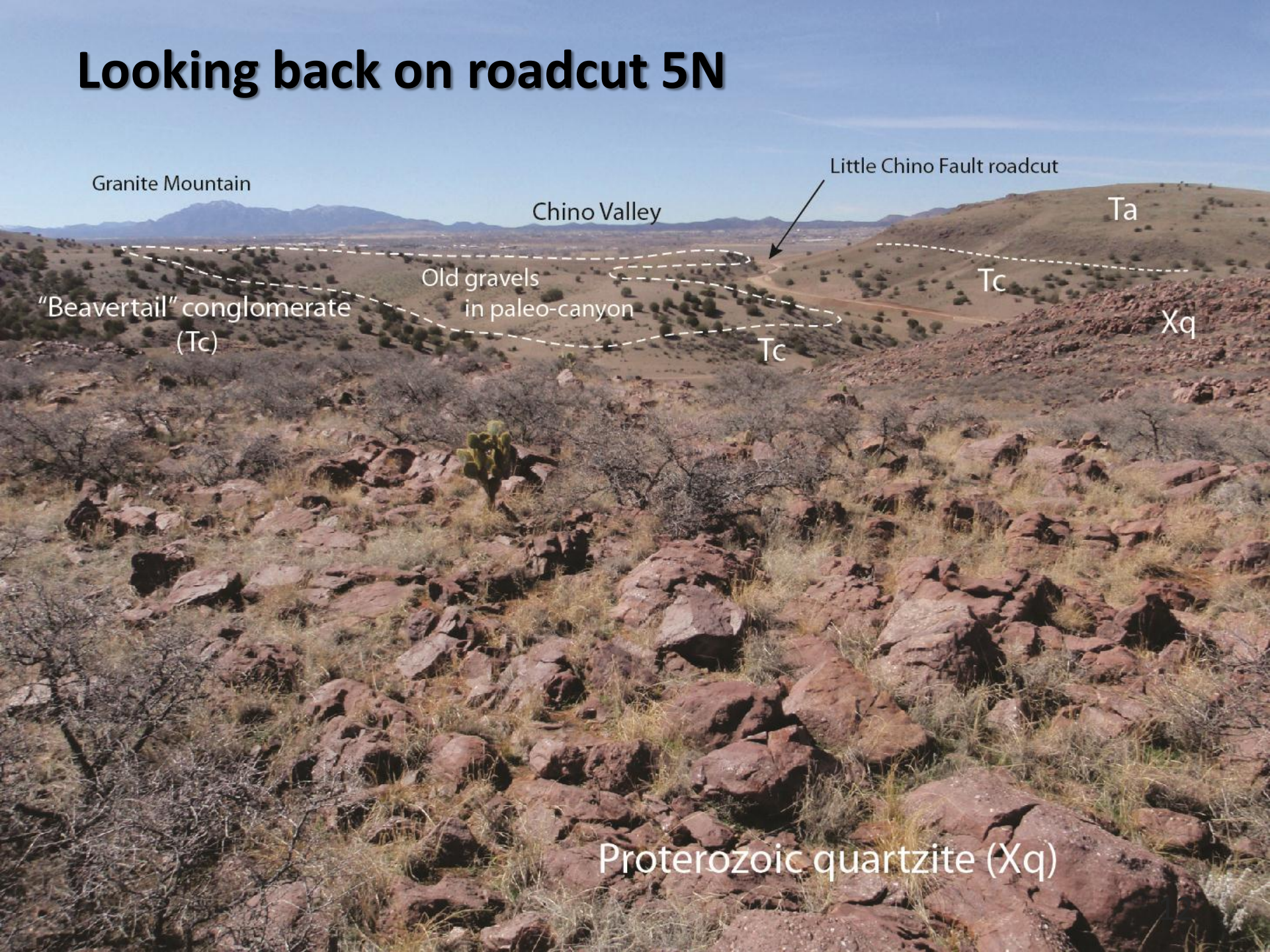
CHINO VALLEY NORTH

Looking back on roadcut 5N

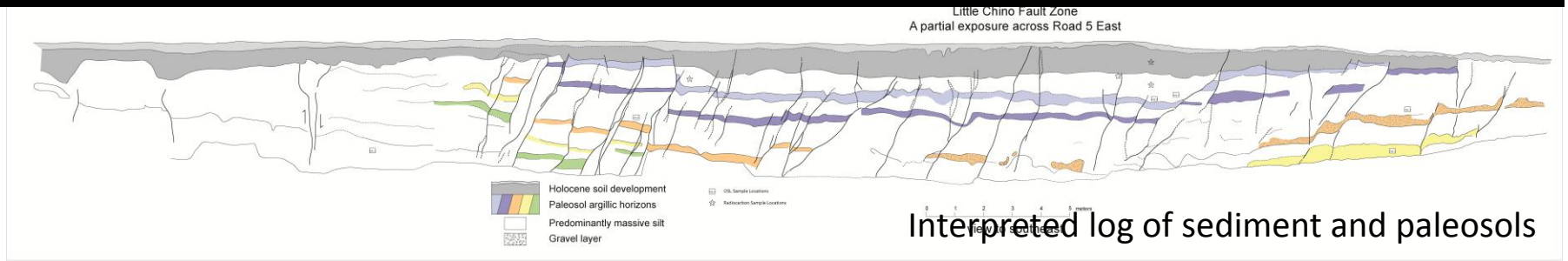


Road 5N roadcut through Quaternary deposits


Fault scarp
UP
DOWN
tilted gravel beds

Paleoseismic research on Little Chino Fault

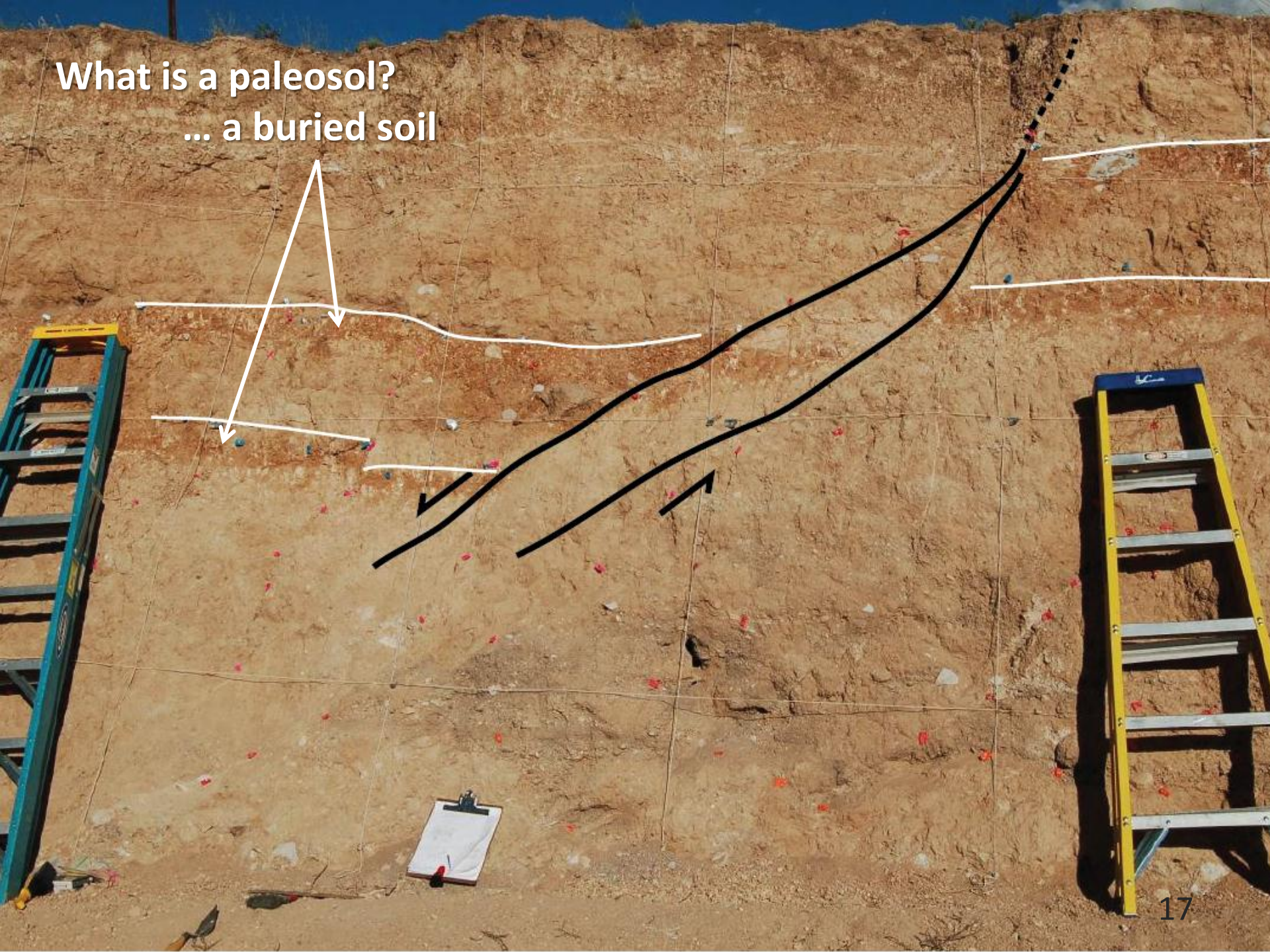
Stitched panorama of east wall (by David Haddad, ASU)

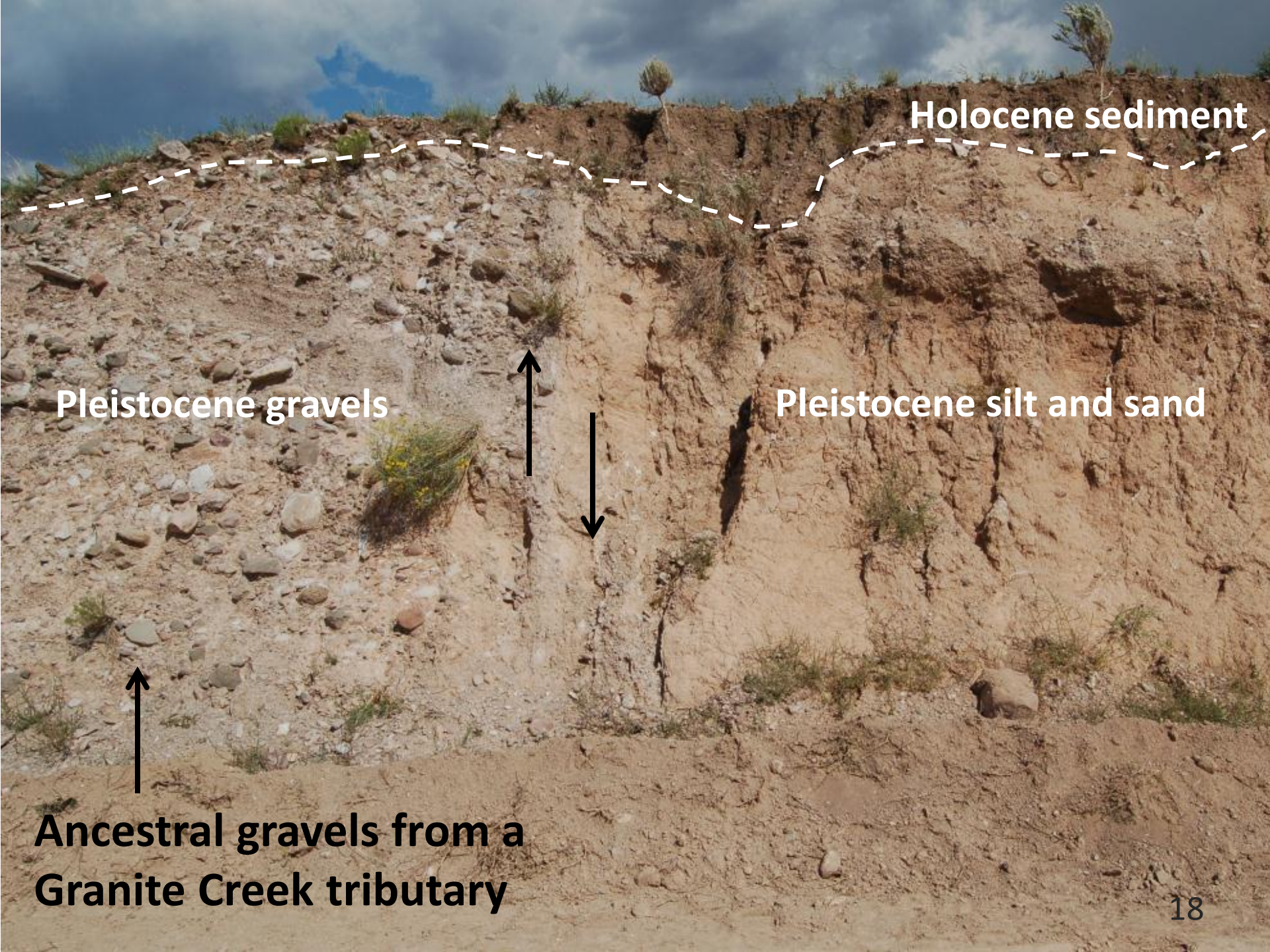


Interpreted log of sediment and paleosols

YouTube: http://www.youtube.com/watch?v=bK-eKFqaR1U&feature=related

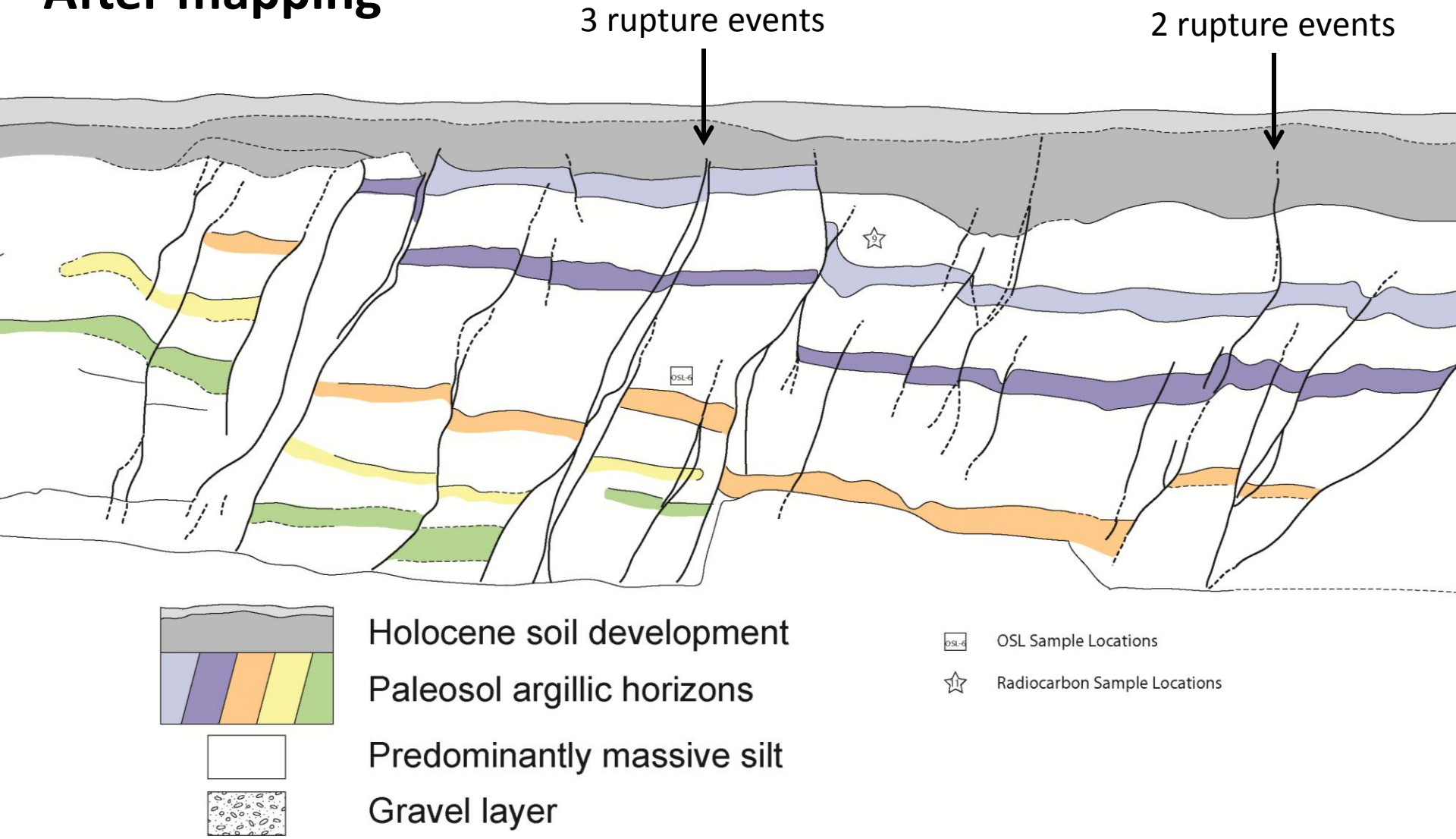
Mapping the east wall along Road 5N


What is a paleosol?
… a buried soil

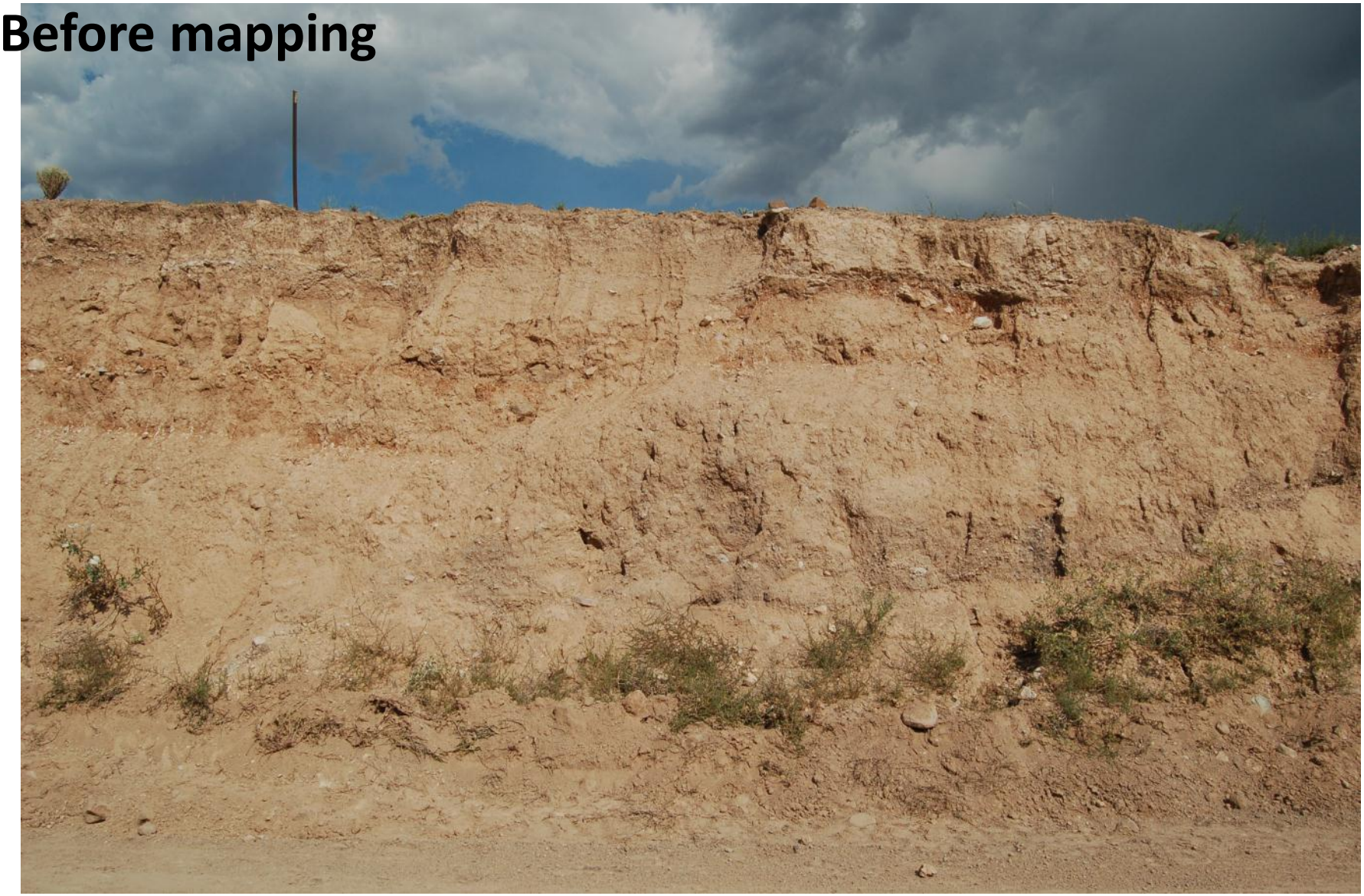

Holocene sediment
Pleistocene gravels
Pleistocene silt and sand
Ancestral gravels from a Granite Creek tributary

Before mapping

After mapping

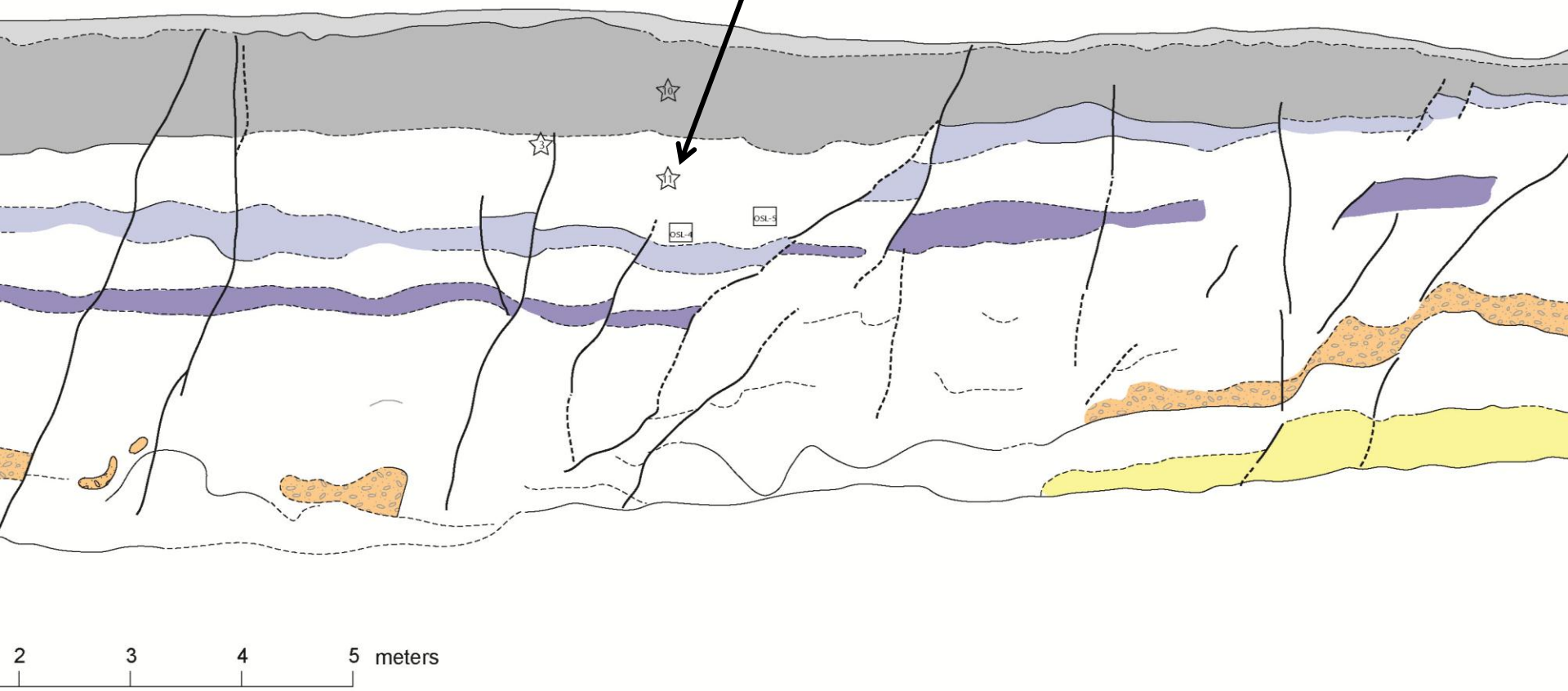


Before mapping



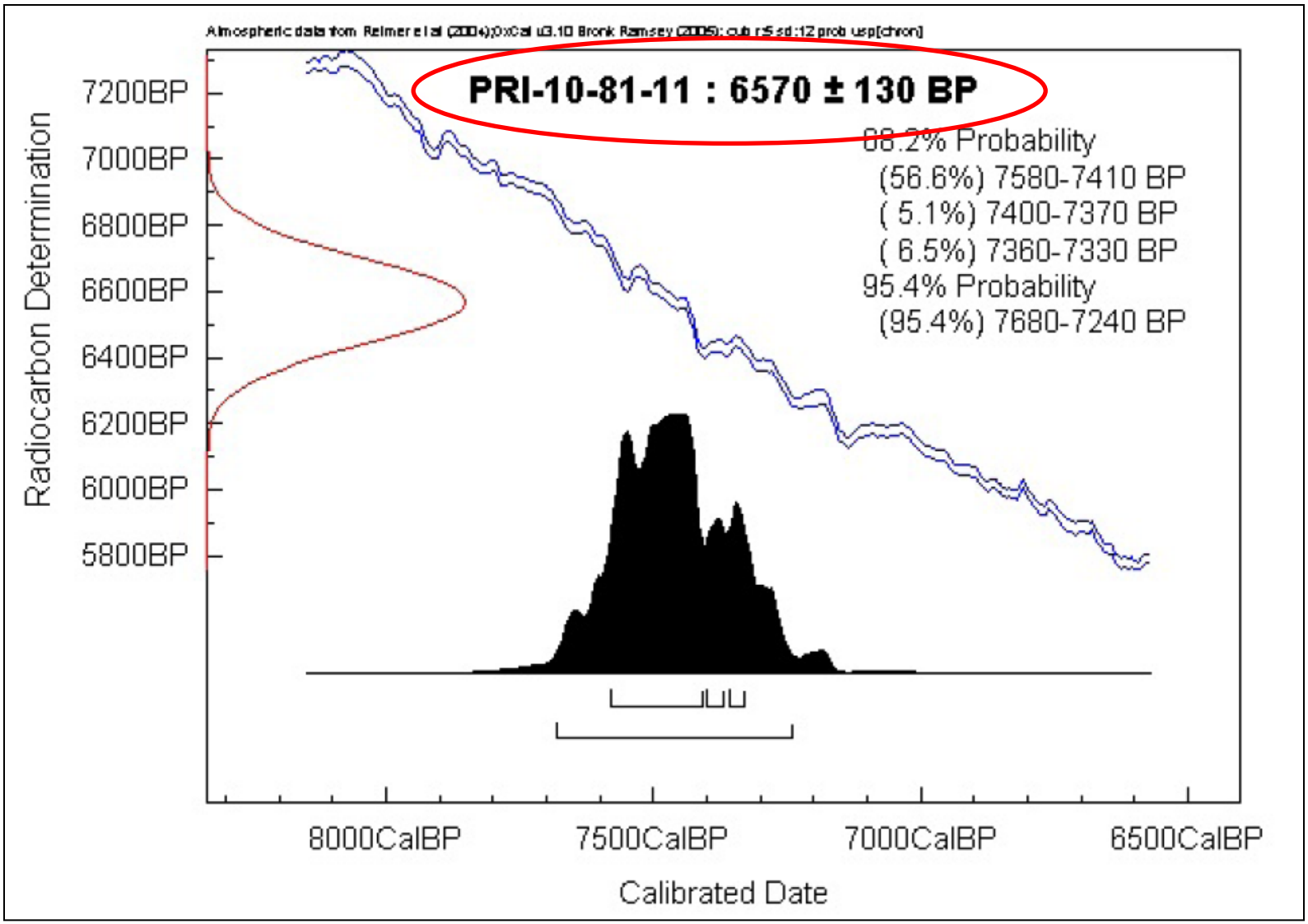
Chino Fault Zone
osure across Road 5 East

After mapping



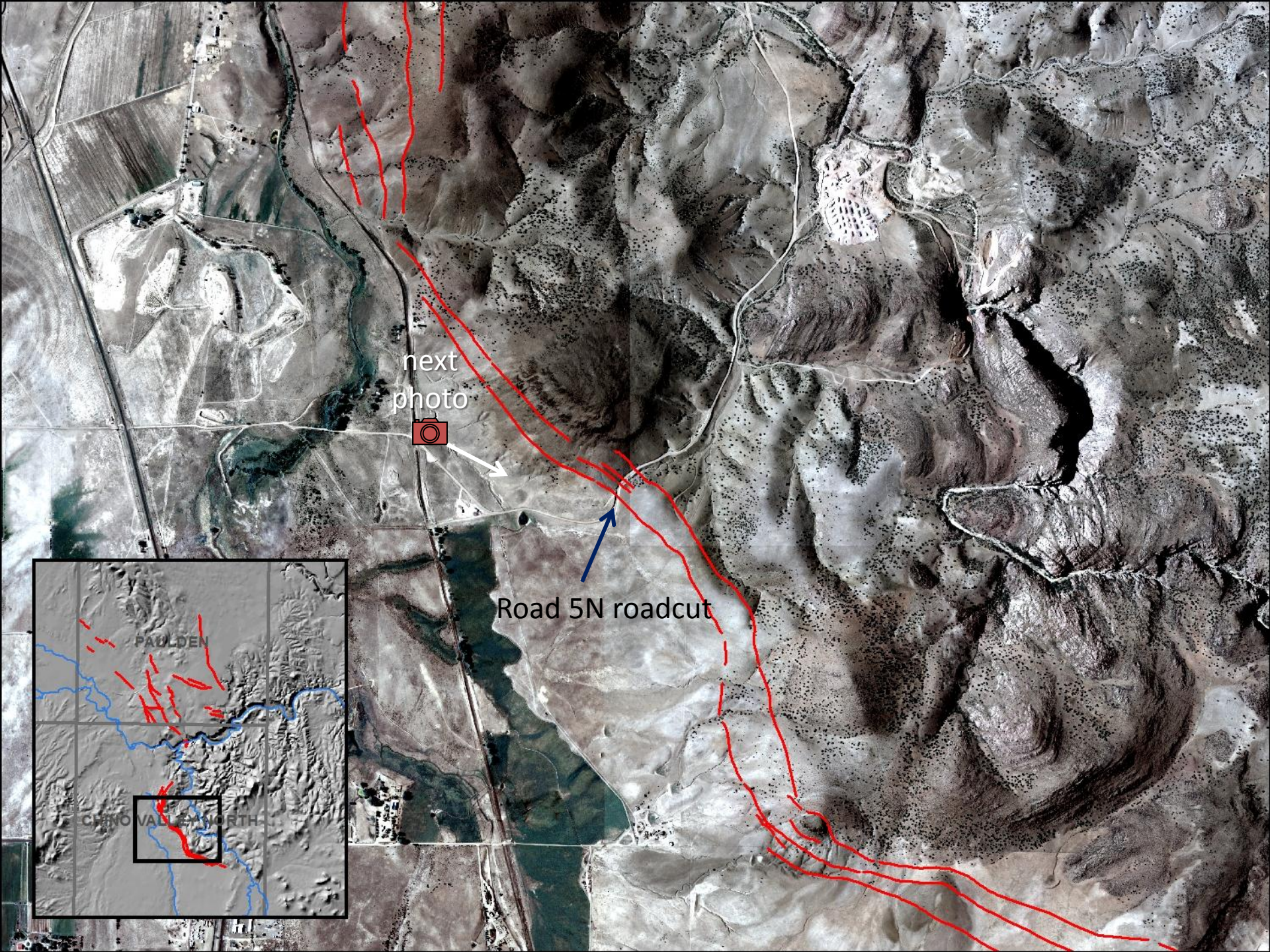
ew to southeast

Preliminary radiocarbon



Preliminary results of LCF at Road 5N

- 3 seismic events exposed in road cut
- Rupture along strands up to 1.5 meters
- Age of youngest soil is Holocene
- Next oldest soil at least 6,500 years old
- Awaiting additional ages of sand and fine gravel (from OSL)
- Awaiting use of ground-based LIDAR
- Age of most recent event unresolved
- Geomorphology of LCF complex and unresolved


next
photo
Road 5N roadcut
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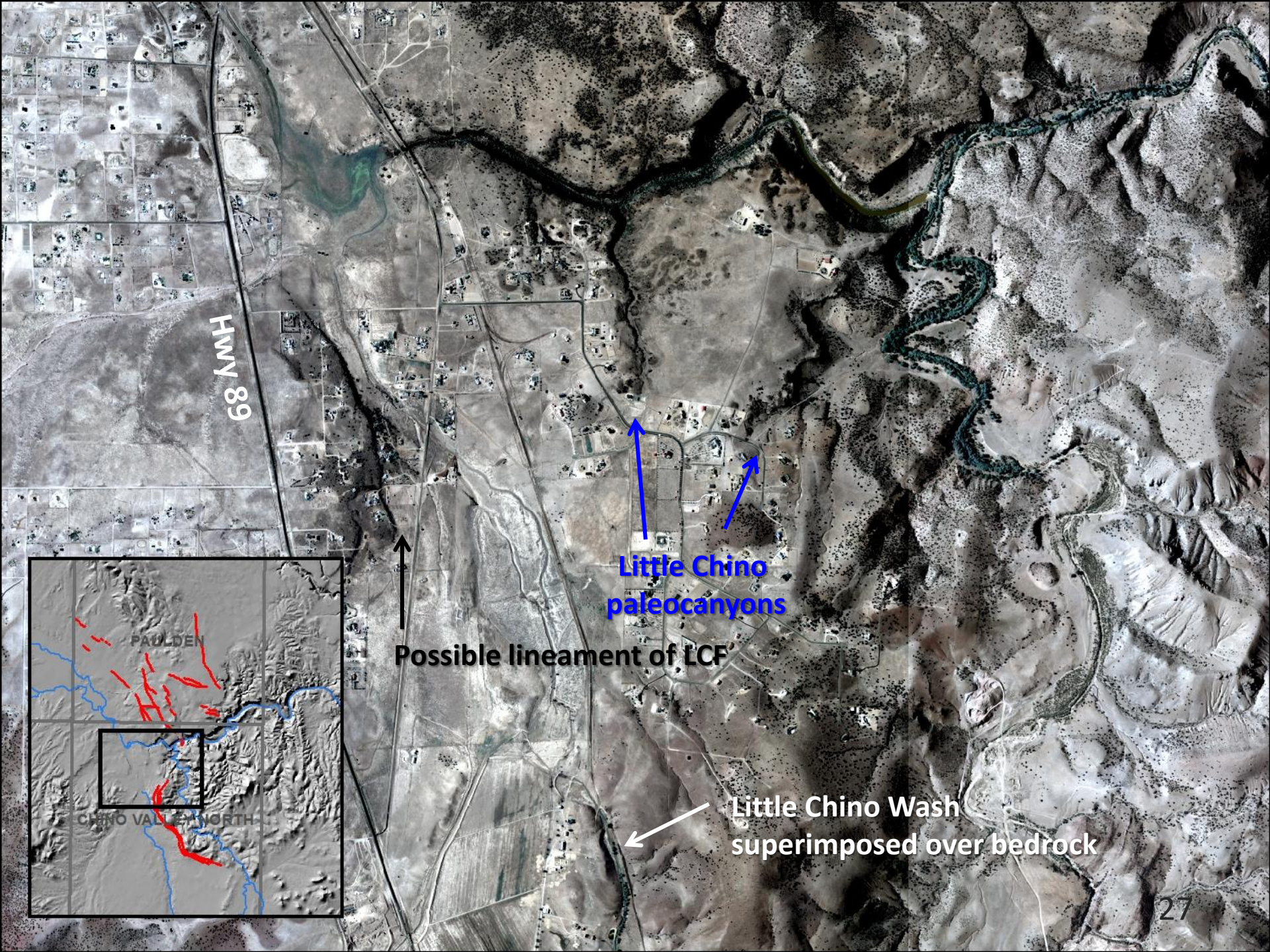
CHINO VALLEY NORTH


Fault scarp
UP
DOWN
tilted gravel beds


Hwy 89
Little Chino paleocanyons
Possible lineament of LCF
Little Chino Wash superimposed over bedrock
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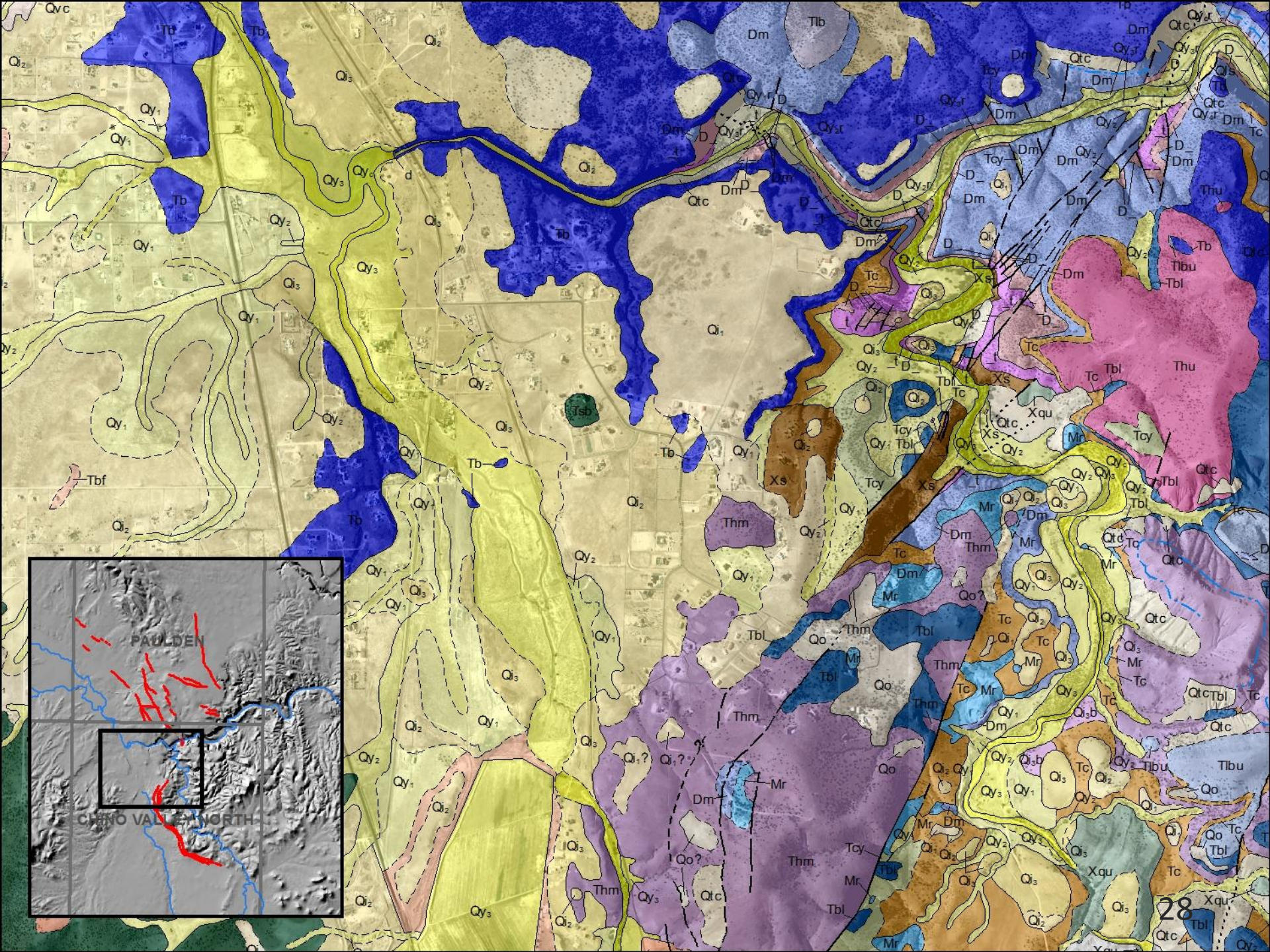
CHINO VALLEY NORTH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CHINO VALLEY NORTH
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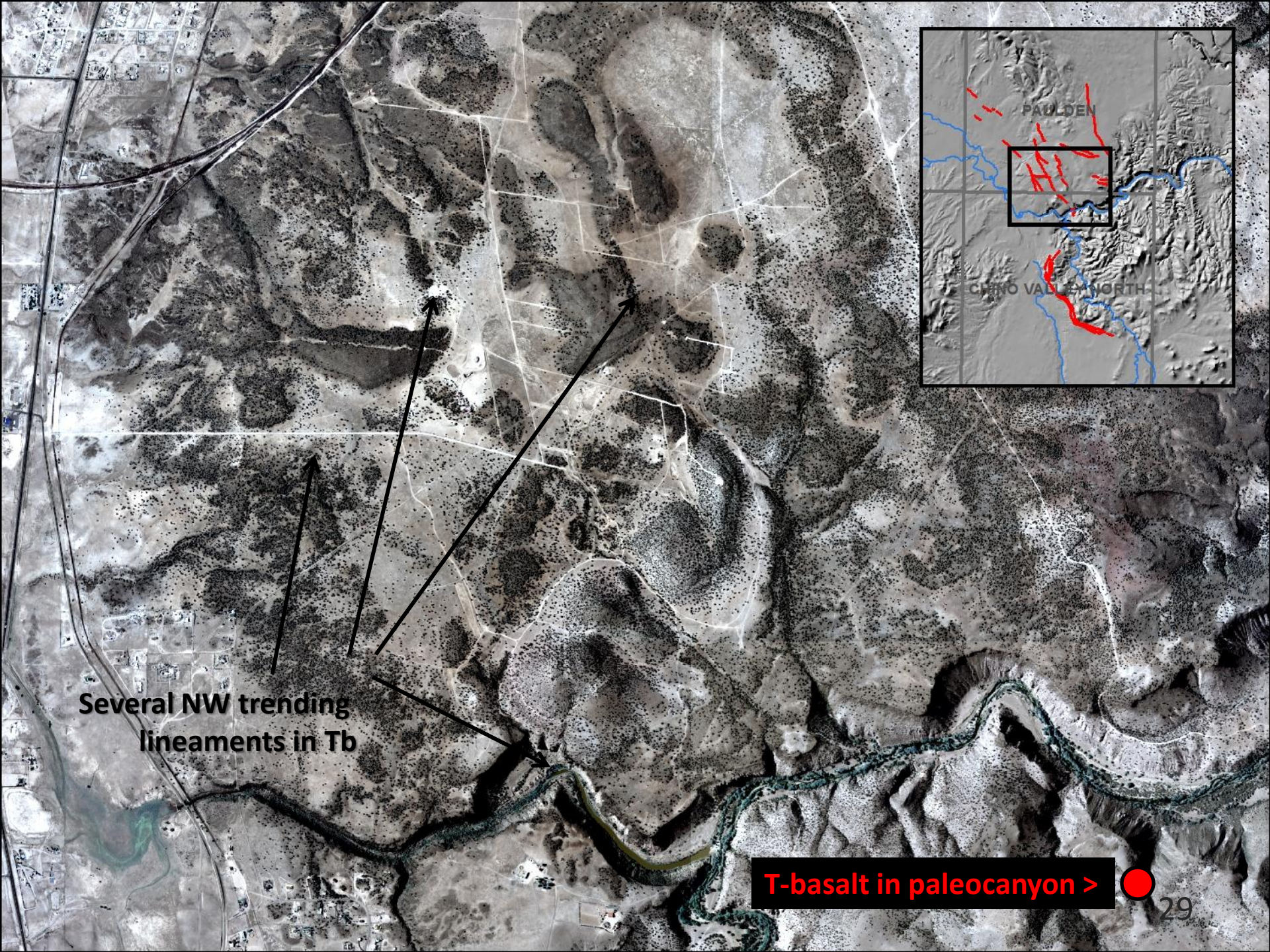
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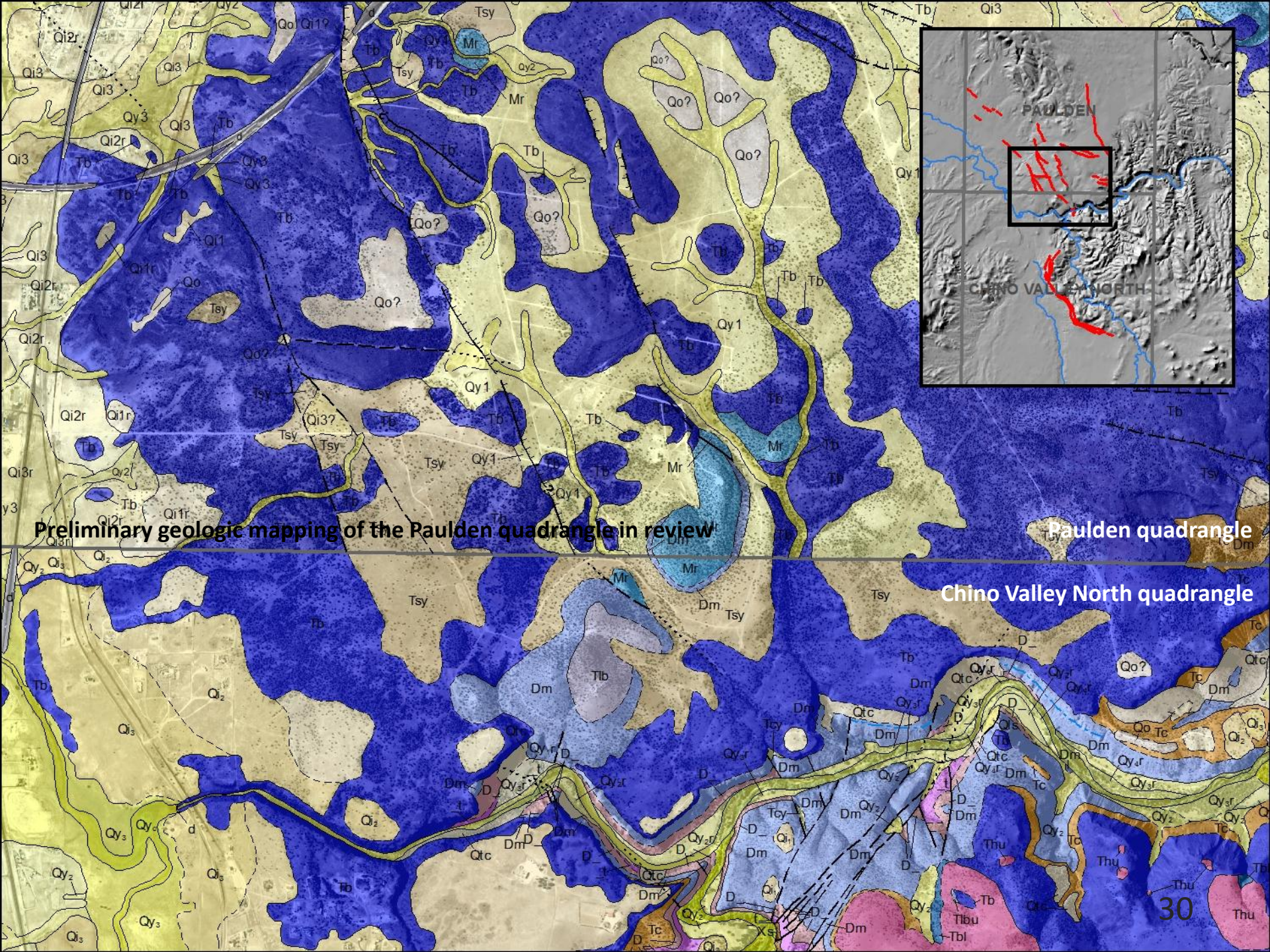
CHINO VALLEY NORTH
Several NW trending lineaments in Tb
T-basalt in paleocanyon >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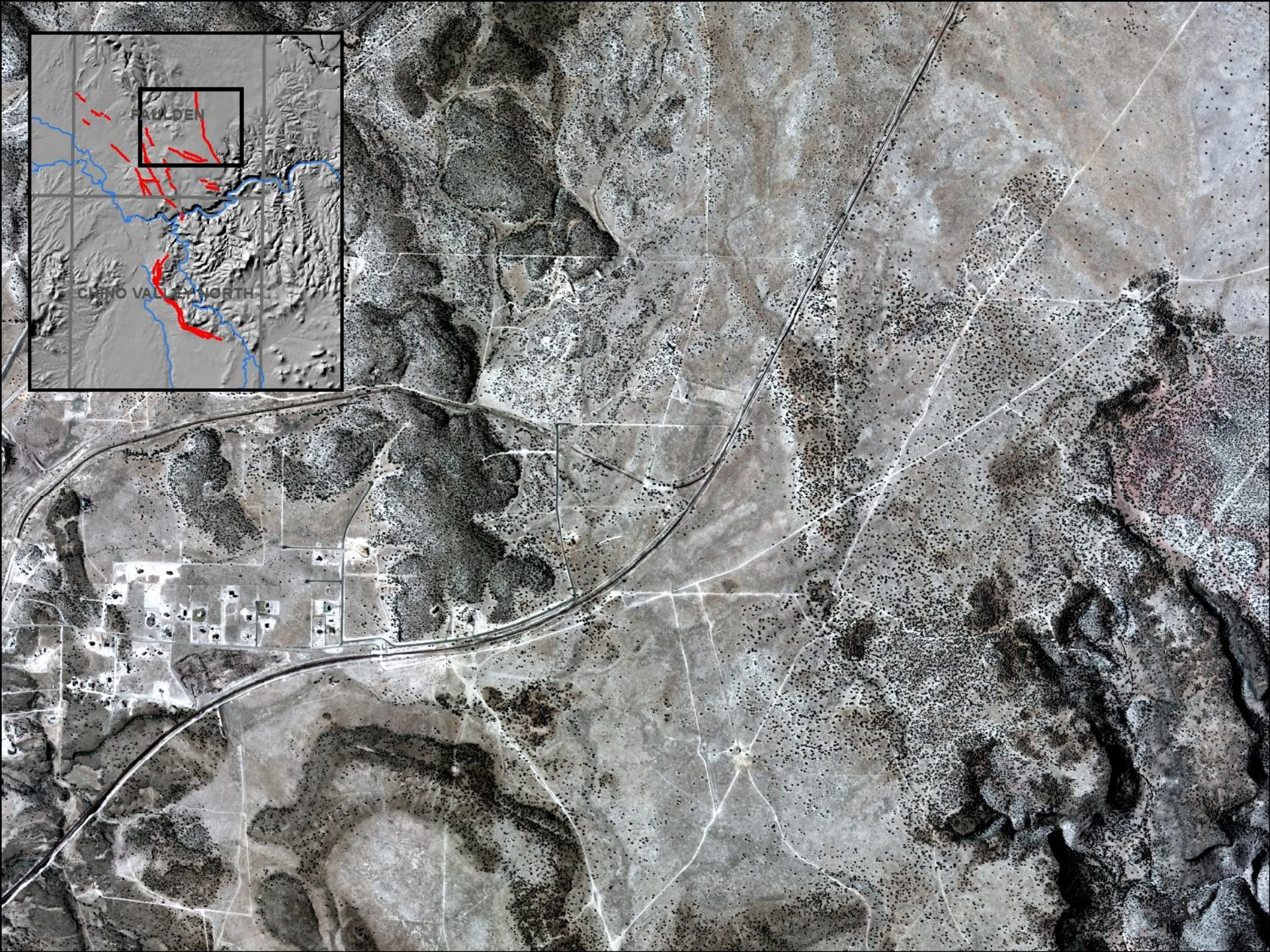
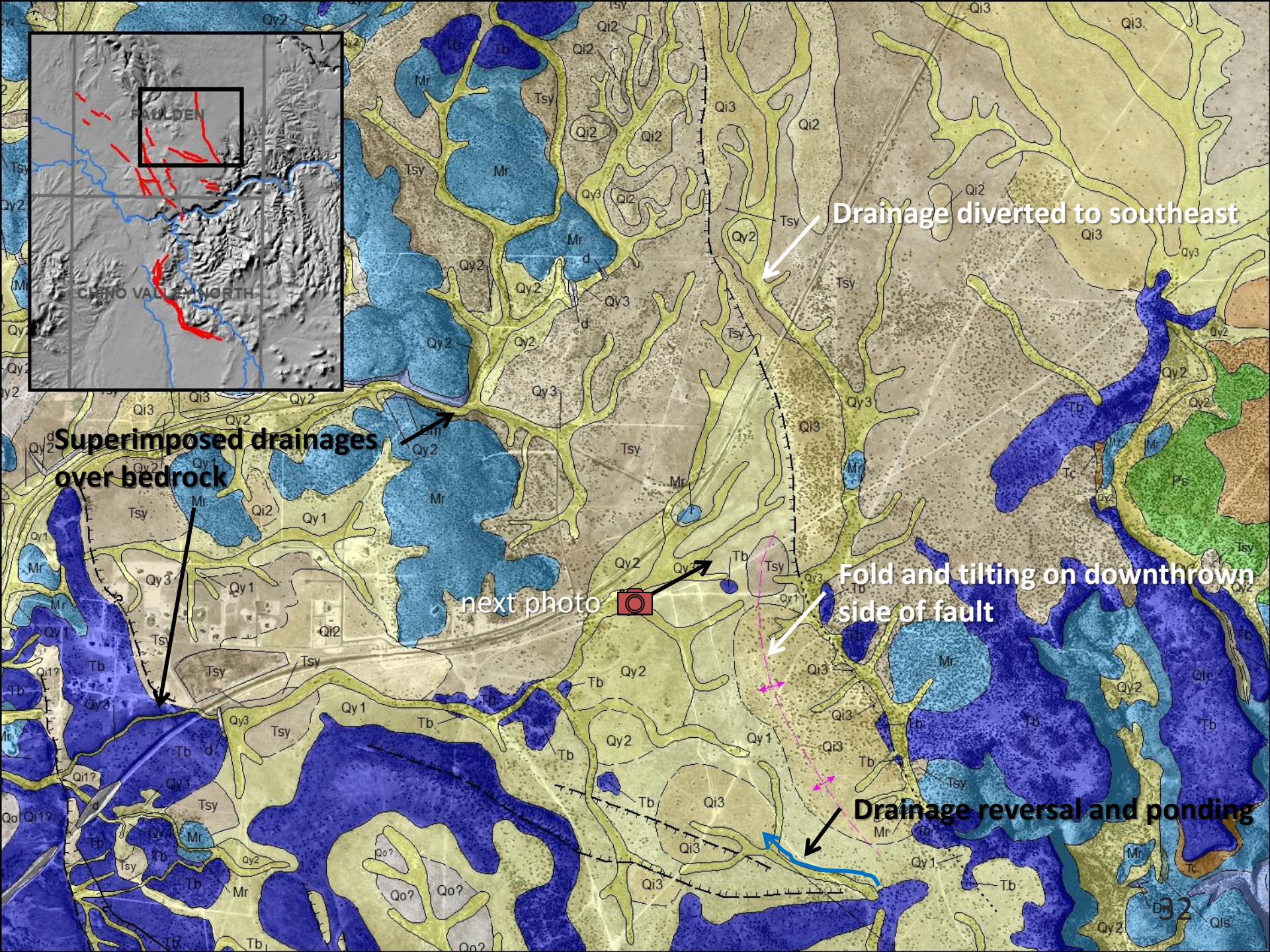
CHINO VALLEY NORTH
Preliminary geologic mapping of the Paulden quadrangle in review
Paulden quadrangle
Chino Valley North quadrangle

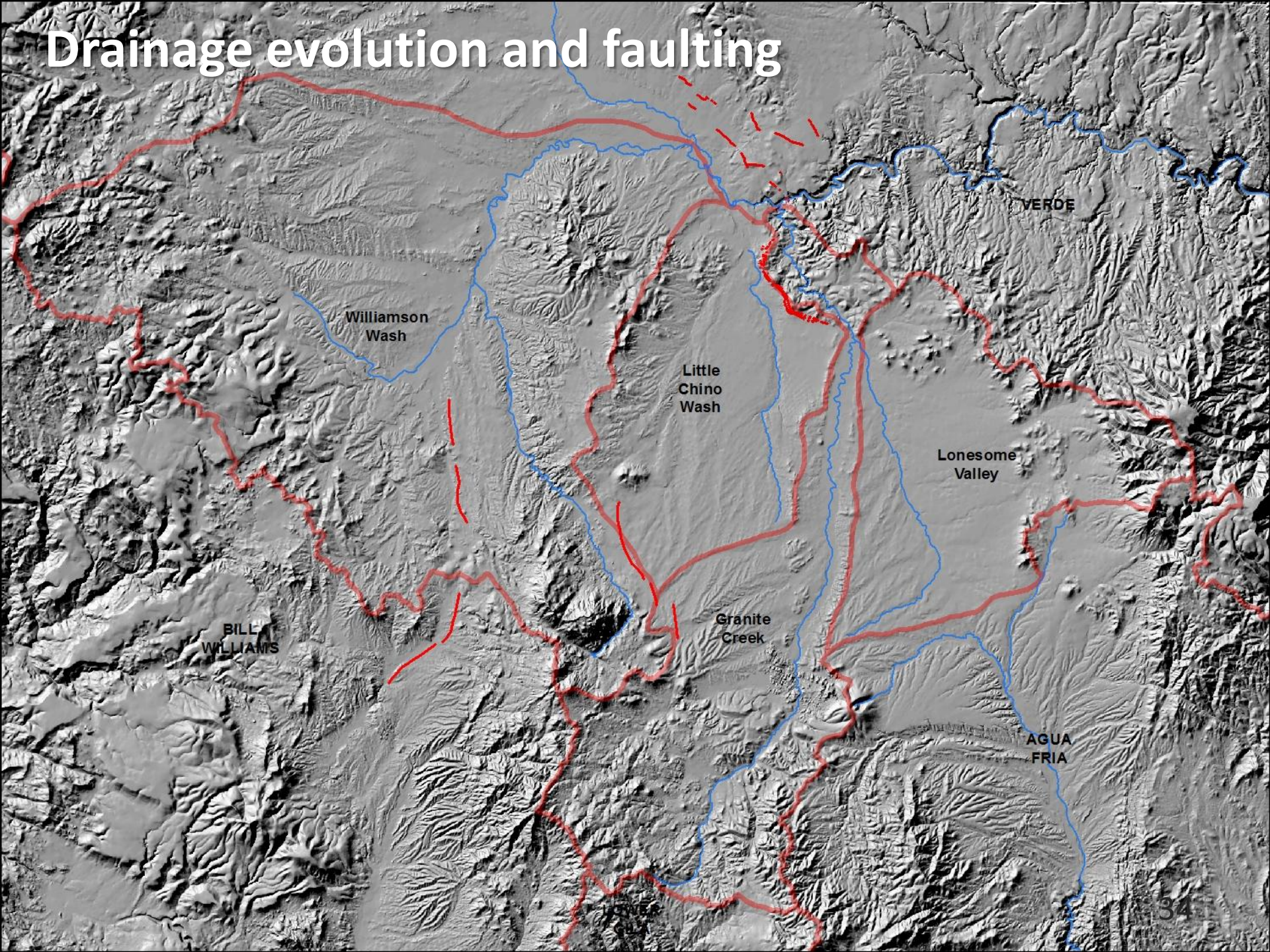

FAULDEN
CHINO VALLEY NORTH


FAULDEN
CHINO VALLEY NORTH
Drainage diverted to southeast
Superimposed drainages over bedrock
next photo
Fold and tilting on downthrown side of fault
Drainage reversal and ponding

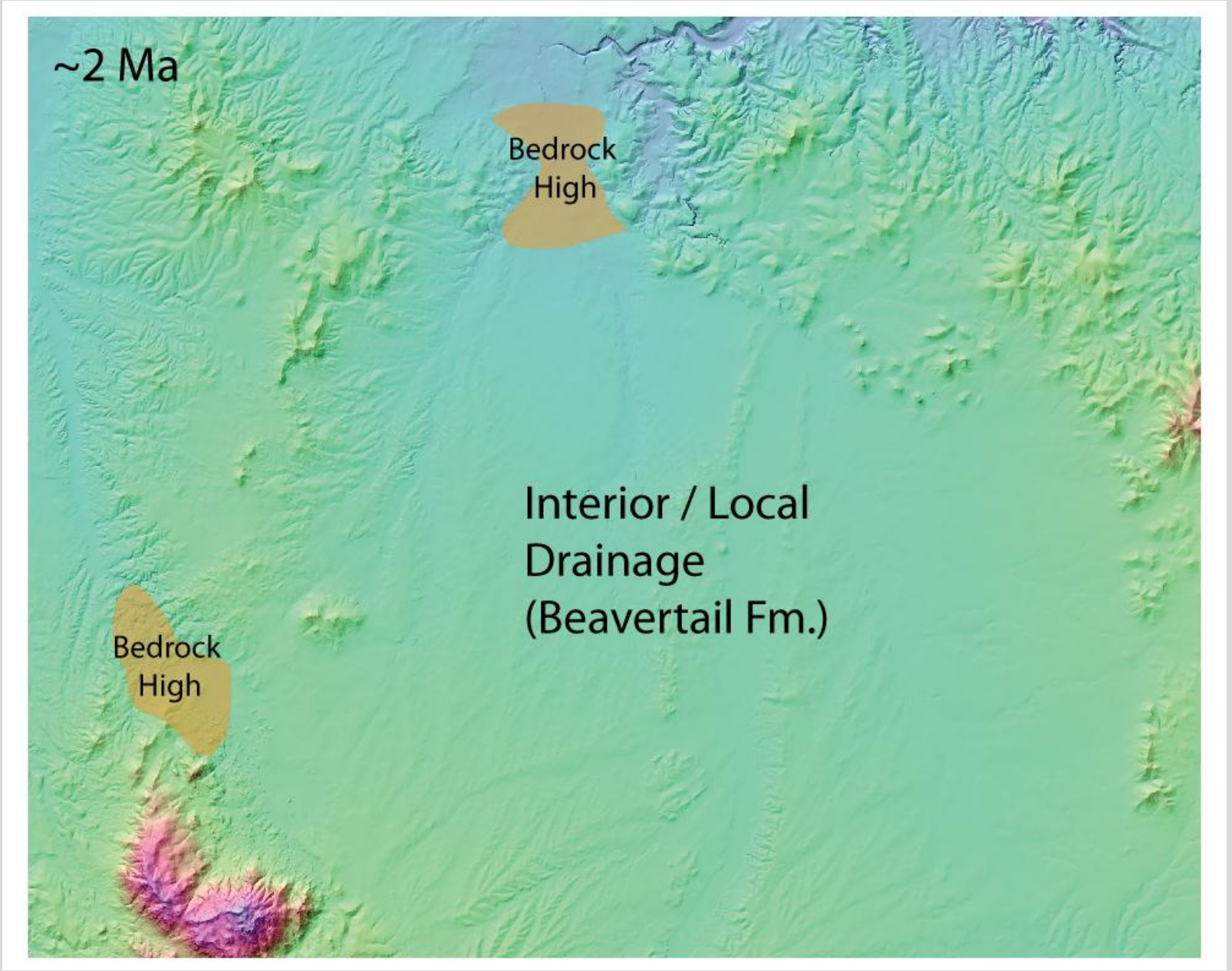
Fault scarp NE of Paulden, offsetting Late Quaternary soil development

View northeast

Drainage evolution and faulting



Time series by John Douglass, 2011



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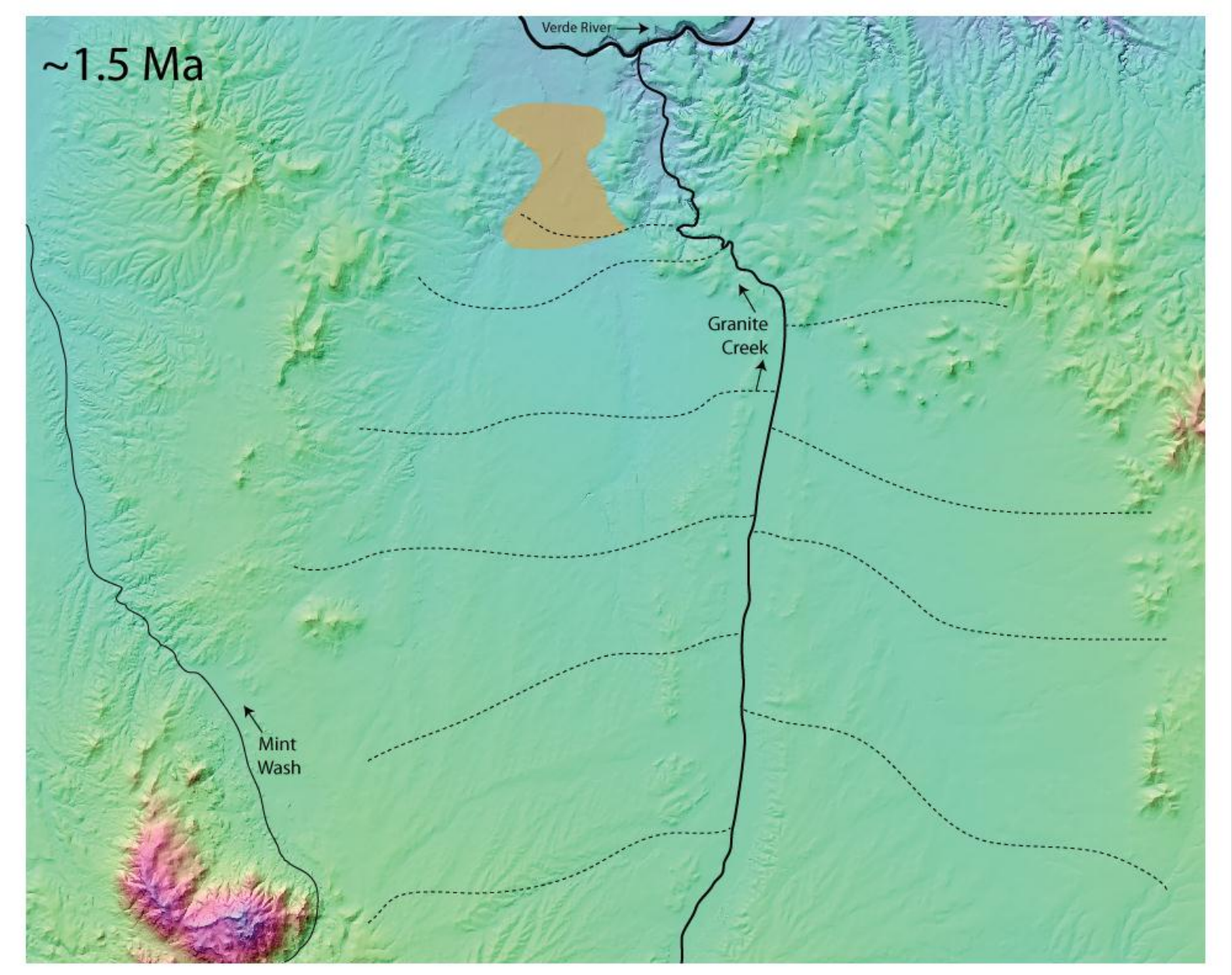

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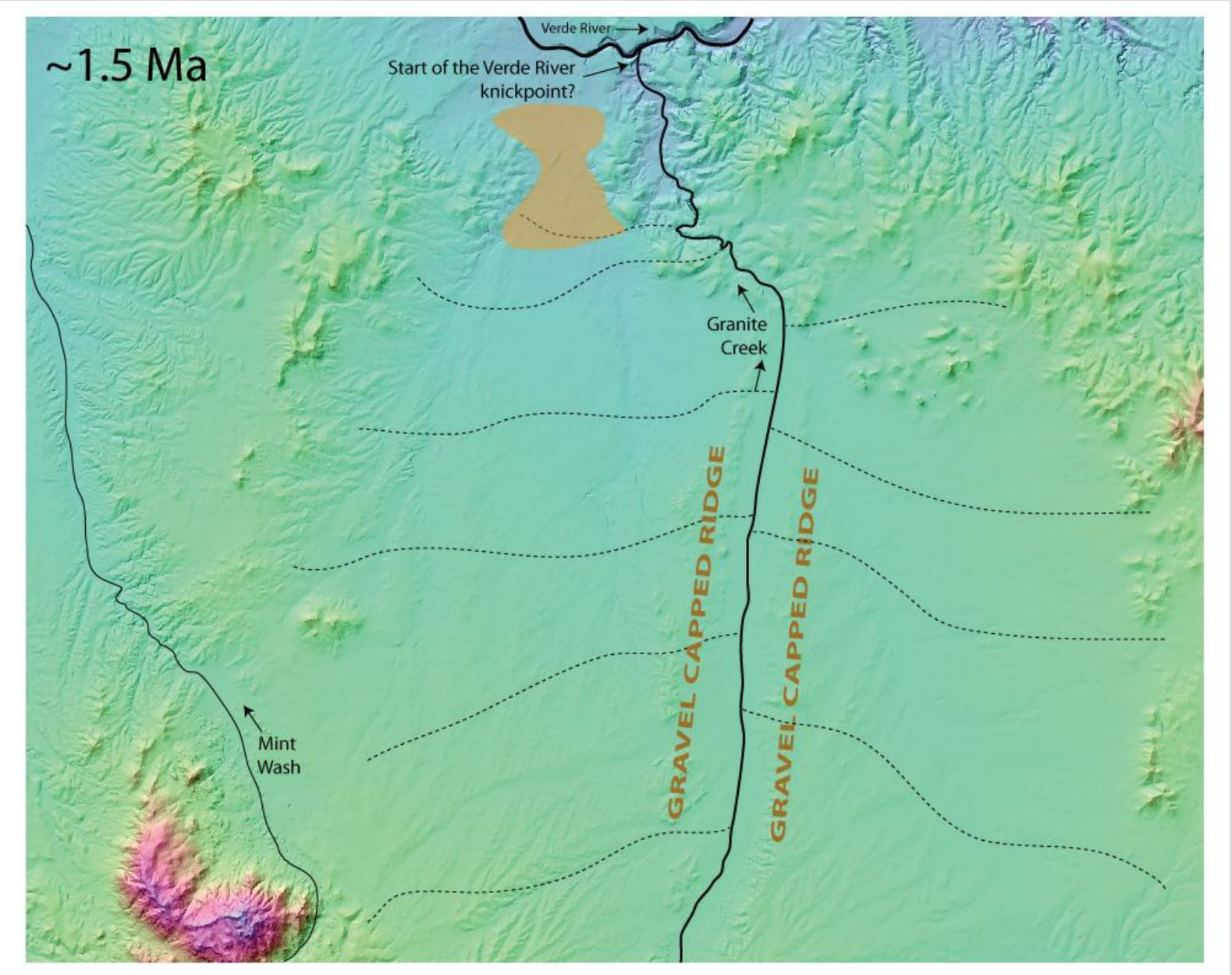

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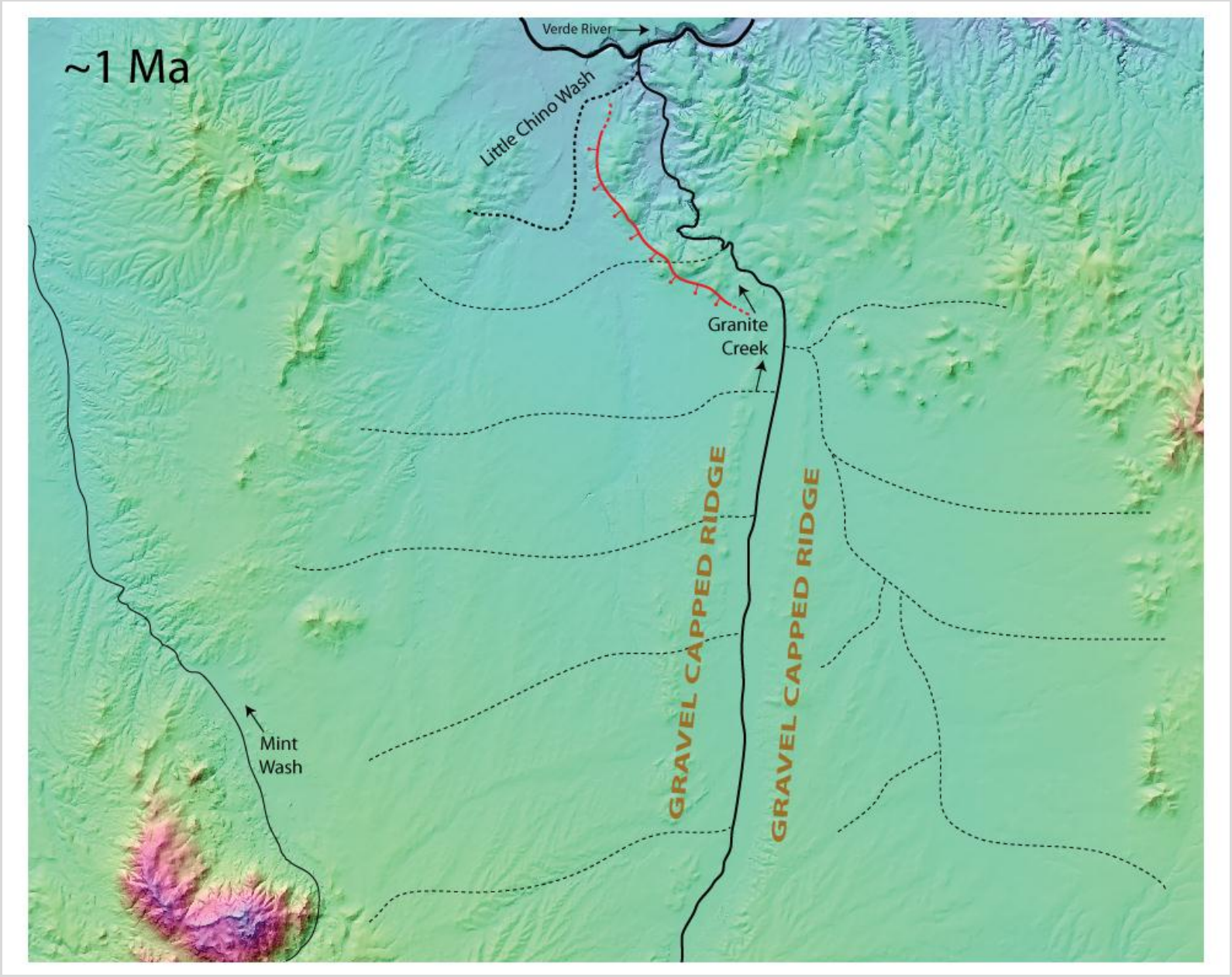

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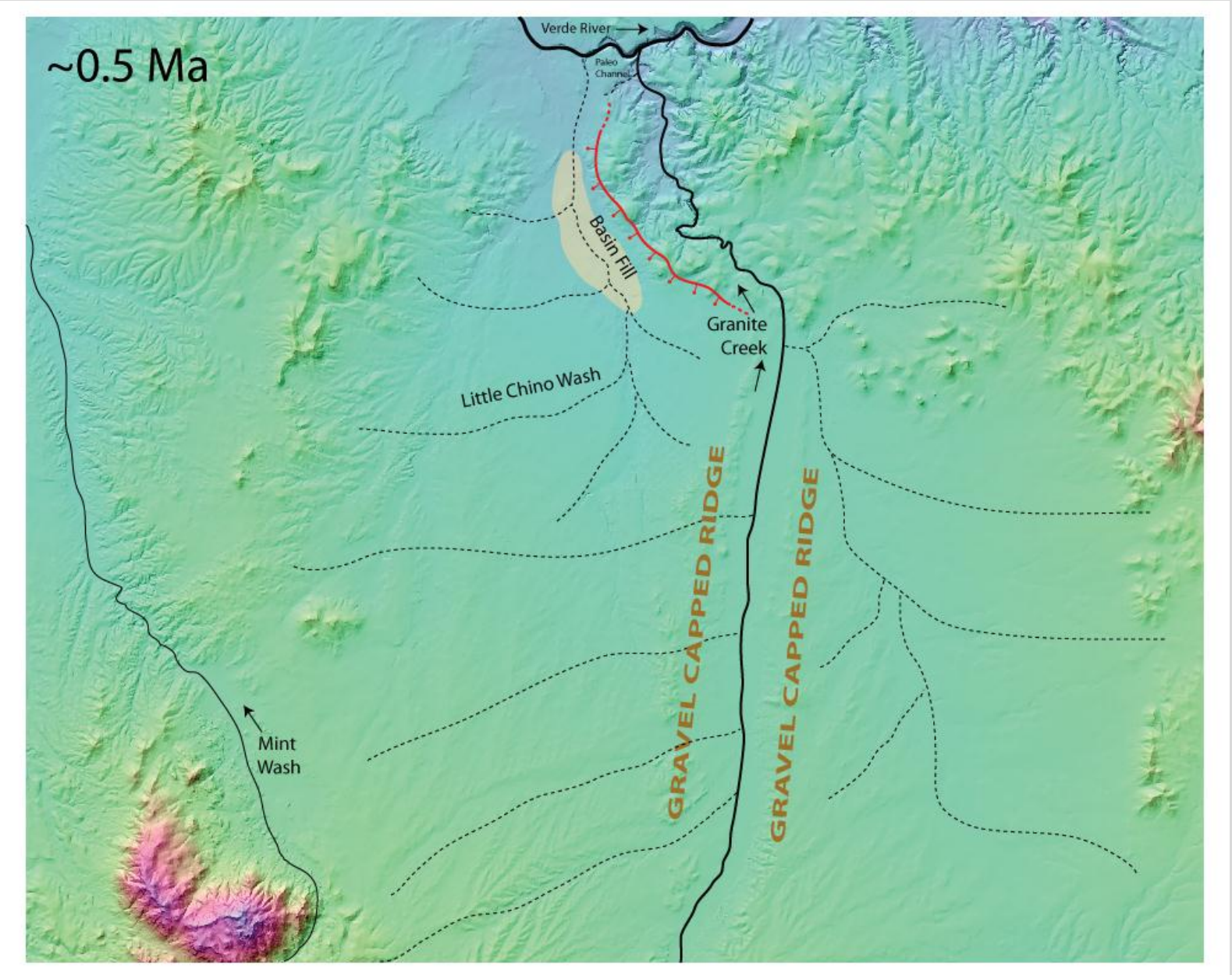

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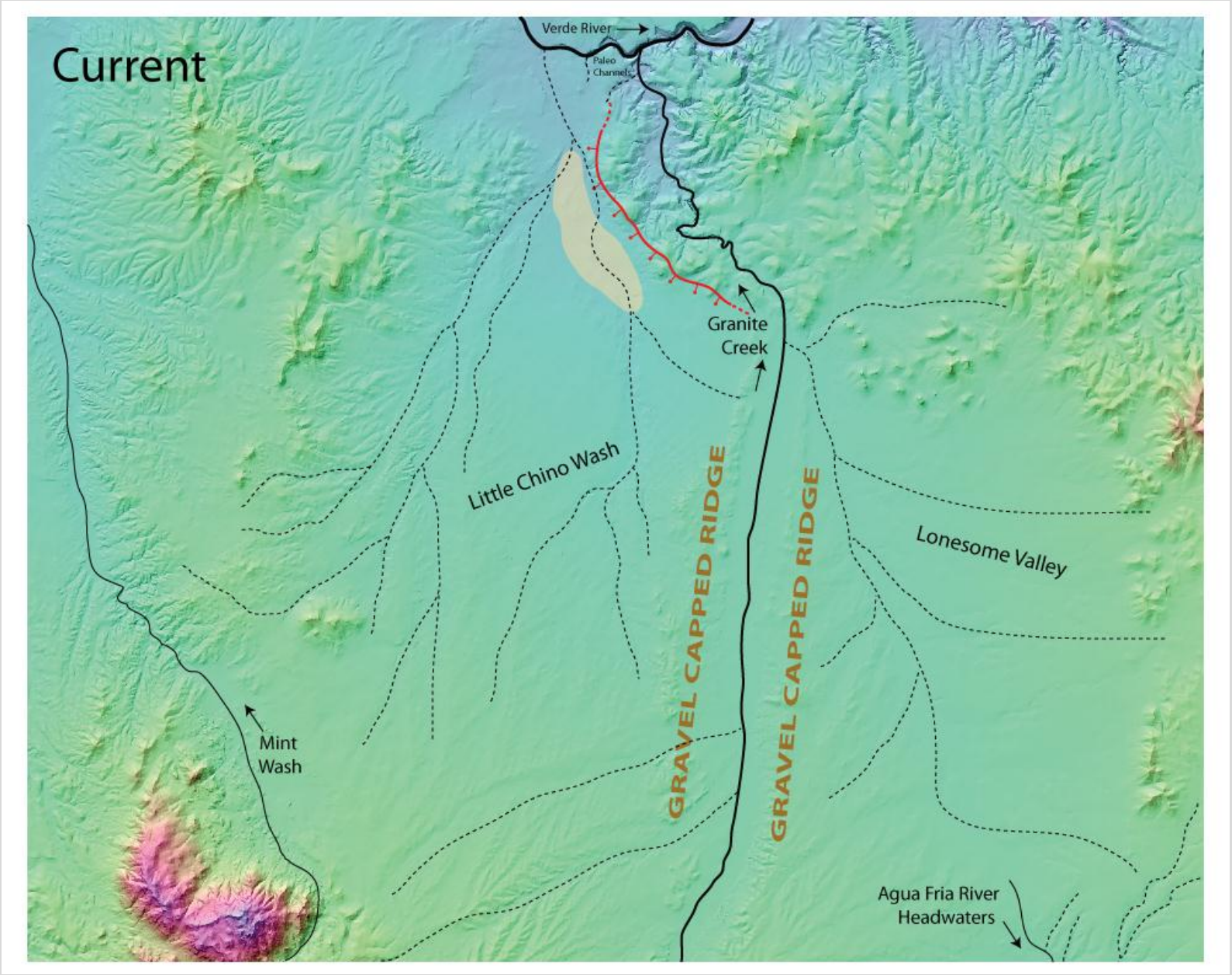


Future Research?

- Why are apparently young fault scarps poorly expressed in the landscape?
- How many other Quaternary fault strands exist?
- Can these fault be accurately mapped as it relates to basin formation and subsurface basin models for understanding groundwater characterization?
- What are the seismic hazards in the region?
- What is the timing associated with the various drainage changes?
- How old is Granite Creek and Big Chino valley?
- How old is the Verde River in this area?

Thank You!

ADDITIONAL SLIDES

Previous Work

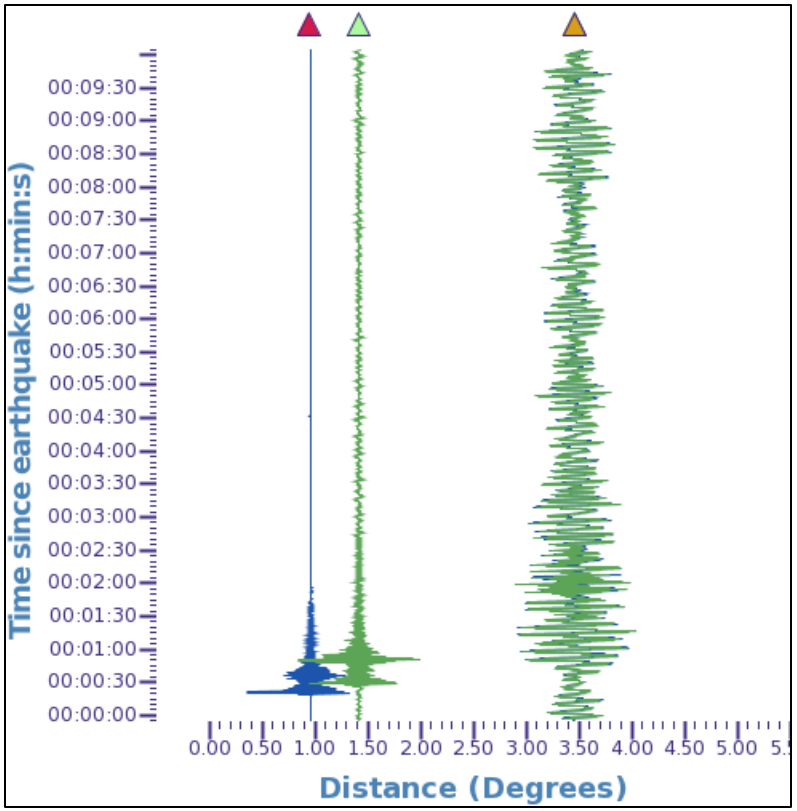
- The Big Chino Fault *(Krieger, 1965 and 1967; Hamblin et al. 1970; Soule, 1978; Pearthree and others, 1983; Euge and others, 1992; Pearthree and Bausch, 1999; Menges and Pearthree, 1983; Van Horn, 1976)*
- Little Chino Fault *(Blasch et al., 2005; DeWitt et al., 2008 and Gootee et al., 2010)*

Ongoing Work

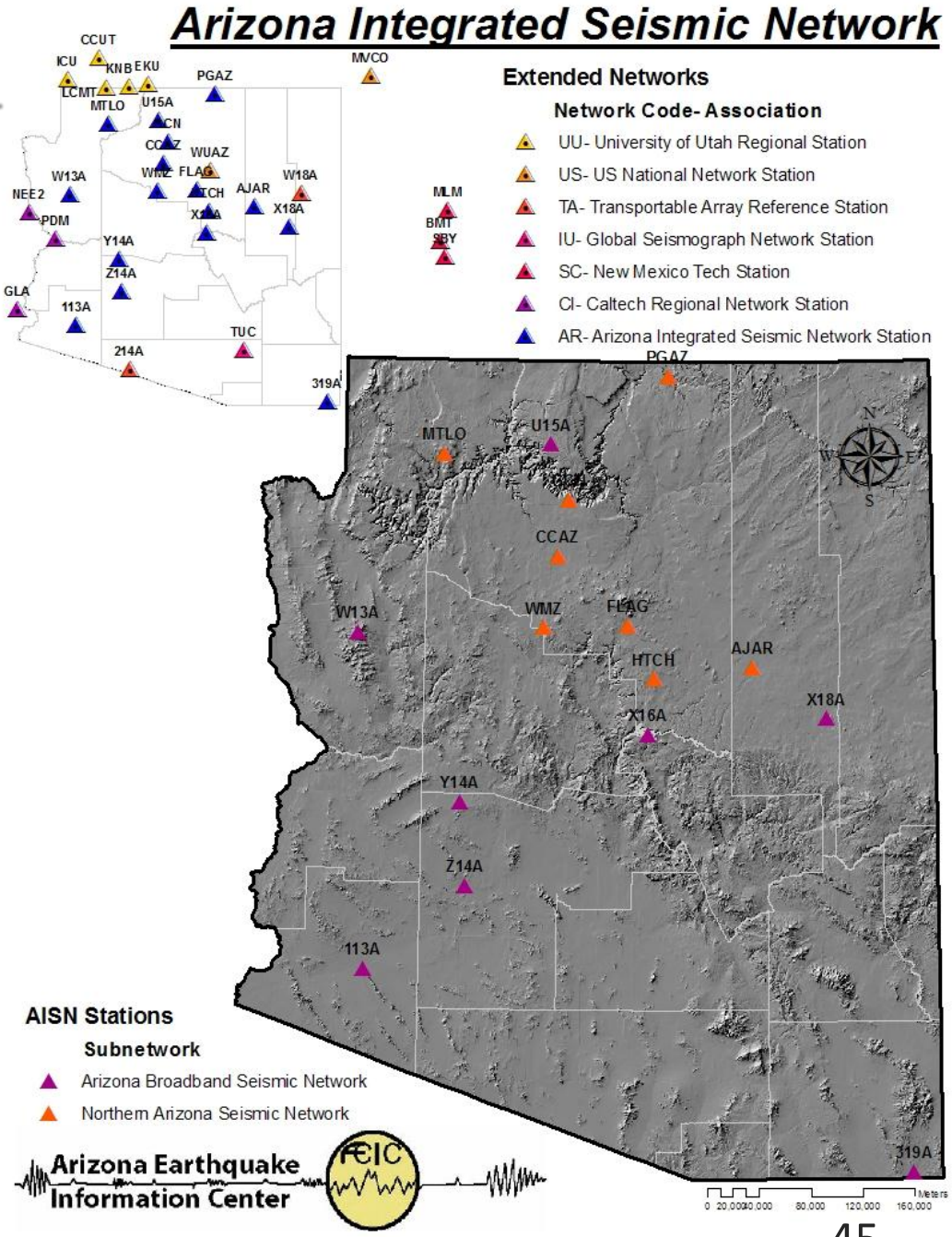
- Ongoing work on Quaternary faults and history and formation of the Verde River and its tributaries *(Gootee, B., Pearthree P., Douglass, J., and Young, J.)*

M3.5 event, Oct. 25, 2011

Seismographs used to plot the event



- ABSN Network -Pink/Red Triangle – W13A – Hualapai Mtn Park, Kingman AZ - 1.1 deg/127 km to EQ
- ABSN Network - Green Triangle – U15A – North Rim, AZ, - 1.6 deg/181 km to EQ
- Gold Triangle – Pinyon Flats Observatory, CA – 3.5 deg/385 km to EQ



Source: AZGS - AISN