Topographic expression of active faulting on the Great Valley thrust system near Winters, northern California

Charles C. Trexler[1], Alexander Morelan[2], Stephen DeLong[1], Alexandra Pickering[1], Jack Willard[1], Rufus Catchings[1], Robert Sickler[1], Joanne Chan[1], Mark Goldman[1], & Coyn Criley[1]

[1] U.S. Geological Survey Earthquake Science Center [2] California Geological Survey

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Note from the presenting author:
While I am unable to attend the meeting in person, I'd love to talk to you about this work!

Scan the QR code at left to join me on Microsoft Teams from 12 -1 pm on Monday, October 11th, 2021

or you can contact my by email any time at ctrexler@usgs.gov

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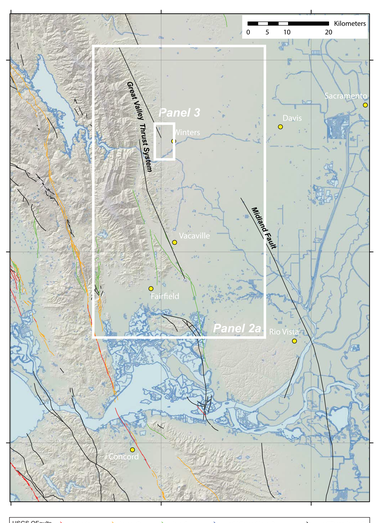
1 Introduction

Seismic sources and hazard within the Sacramento - San Joaquin Delta are relatively poorly constrained:

- Fault slip rates are relatively low
- Reported structures have an array of kinematics, from dextral to reverse and oblique transpression
- Many faults within the Delta are blind, or have ambiguous surface traces

Subsurface structural geometries, kinematics, and slip rates on structures are critical for informing seismic source models and hazard assessments



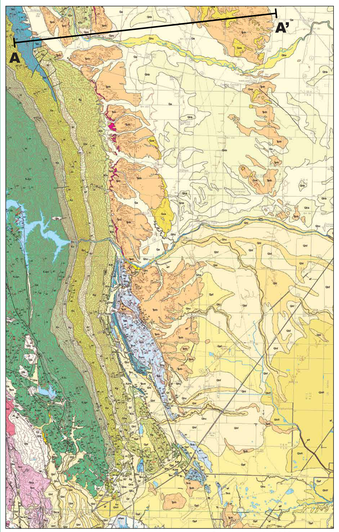
- GPS data suggest as much as
  5 mm/yr of right lateral (plate boundary parallel) deformation
  (D'Alessio et al., 2005; Evans et al., 2012)

  and up to
  2 mm/yr of compressional (plate boundary normal) deformation
  (Graymer & Langenheim, 2021; Graymer & Simpson, 2012)

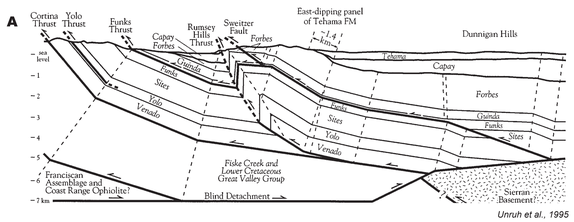
  may be accommodated within the Delta region

- Geomorphology and bedrock geology along strike may provide insight into longer-timescale (several-Ma) kinematics on structures that extend into the Delta region

2a Location and Geometry of the Great Valley thrust system



Graymer et al., 2002



Unruh et al., 1995

- At the latitude of Capay Valley, the eastern margin of the Coast Ranges is defined the Great Valley thrust system, which daylights as a set of west-vergent thrust faults and folds in Tertiary-age units
  - constrained by structural observations and seismic reflection data *(Unruh et al., 1995)*
- Bedrock map patterns suggest this structural system may continue southward along the rangefront

Does the Great Valley thrust system extend into the northern Delta?

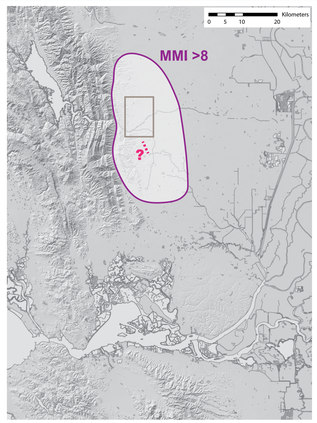
2b The 1892 Vacaville-Winters Earthquake sequence

April 19 1892 M ~6.5

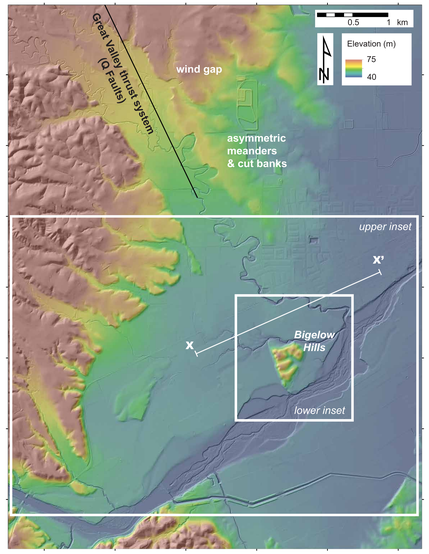
April 21 1892 M ~6.2

- MMI of 8+ in Winters and Vacaville *(O'Connell, 2001)*
- inconsistently located observations of surface deformation
- possible surface rupture near Allendale, south of Winters and east of rangefront? *(Bennett, 1987)*

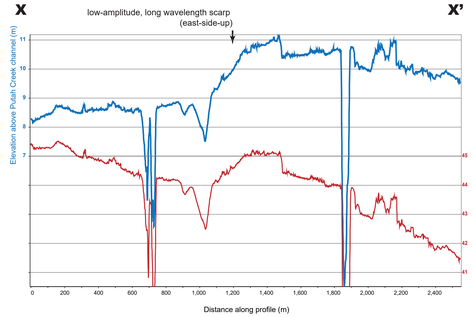
On which structure(s) did the 1892 earthquake sequence occur?



3 Geomorphic evidence of Quaternary activity: the Bigelow fault

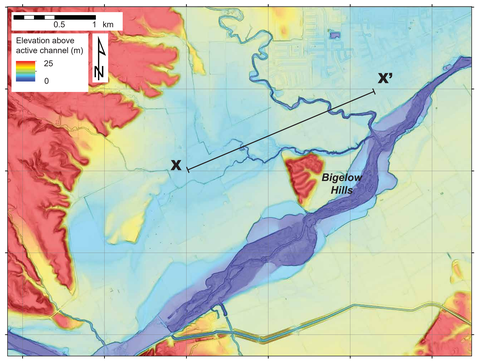


- Linear scarp with wind gaps and constricted channels suggest an active fault
  -- apparent east-side-up displacement, consistent with *Unruh et al. 1995* model (from north along strike)
  -- no apparent lateral displacement
- Bigelow Hills are a prominent feature on the east side of the fault, with a linear western edge



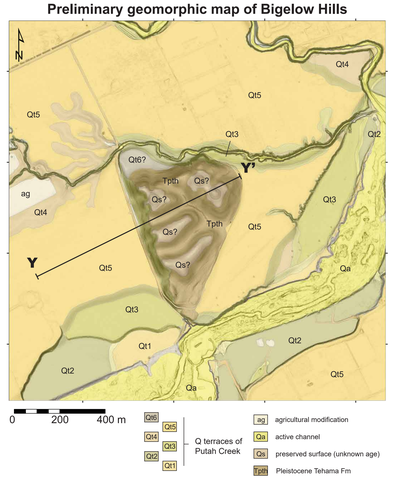
- Low-amplitude scarp visible in terraces near confluence of Dry Creek & Putah Creek
- Putah Creek channel width narrows dramatically at along-strike projection of proposed fault

Elevation above Putah Creek active channel



The Bigelow Hills record activity on a fault in the Great Valley system, and a potential source of the 1892 earthquake sequence

Preliminary geomorphic map of Bigelow Hills



- isolated Bigelow Hills appear truncated along western edge, directly along strike of proposed fault
- Bigelow Hills appear to protect and preserve older, deformed surfaces, and may be useful in constraining rate of displacement across the fault

Ongoing and Future Work

- shallow geophysics survey across Bigelow Hills conducted July 2021 (line Y-Y') to constrain fault location and subsurface orientation
  - additional surveys along strike to north and south?
- age control of deformed Qt5 & Qt6 surfaces to constrain deformation rate
- further geomorphologic work in wind gaps north along fault
- what happens along strike to the south?

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