



Late Holocene Rupture History of the Ash Hill Fault, ECSZ: Coordinated rupture histories with adjacent fault systems?

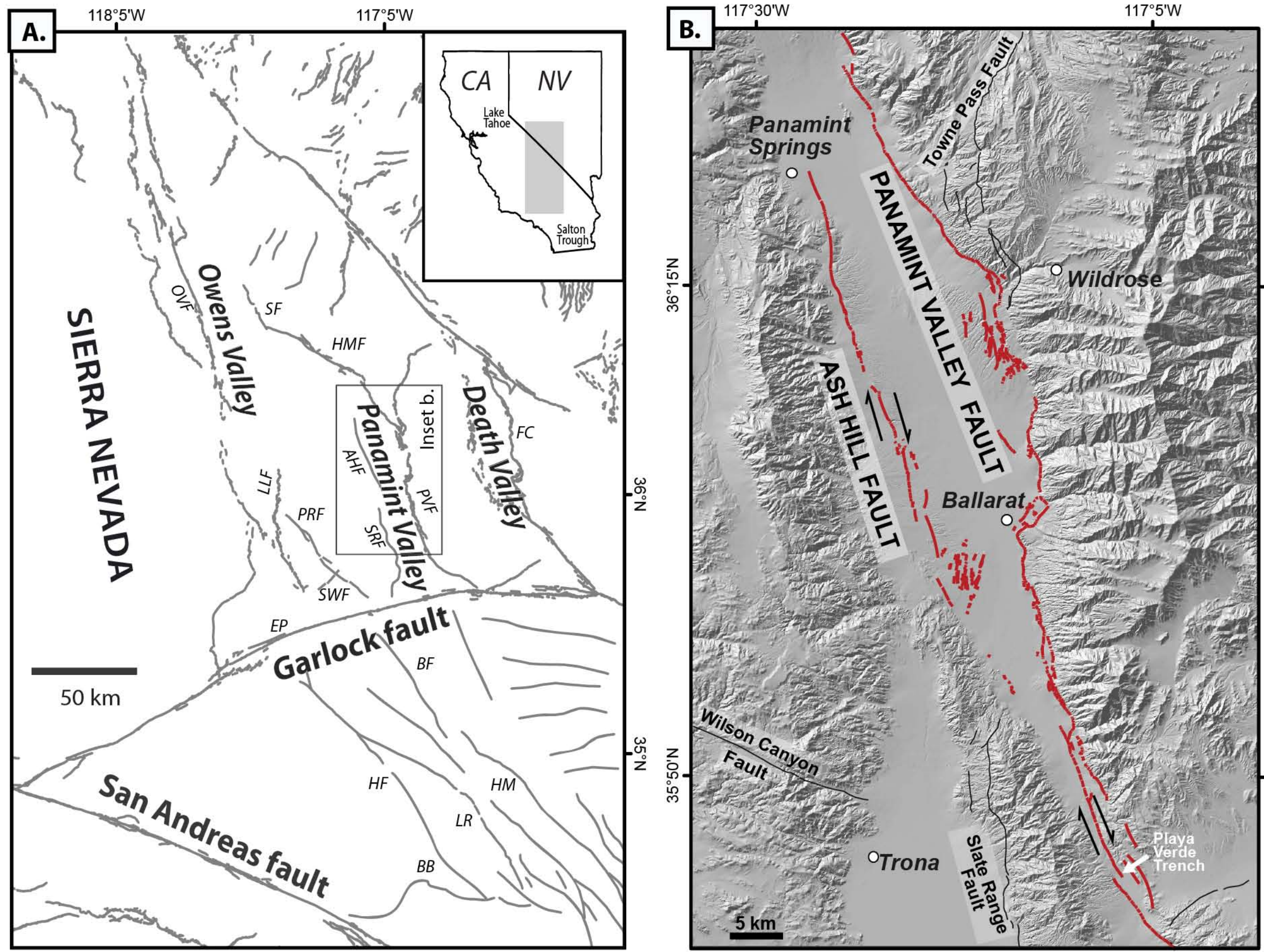
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Summary & Key Findings

- Understanding how intraplate fault systems interact and transfer strain over seismogenic timescales (seconds to ka) requires temporal records of past ruptures along adjacent and intersecting fault networks.
- Here we document the paleoseismic record of late Holocene ruptures along the Ash Hill fault, in the Eastern California Shear Zone (ECSZ), and identify potentially clustered or multi-fault ruptures.
- We develop a new, very-high-resolution, locally calibrated alluvial fan stratigraphy, and combine 1:4k mapping with feldspar luminescence dating (IRSL) and fault offset analysis from field, lidar, and drone based offset data.
- We find evidence for three surface rupturing earthquakes that have occurred since ~4 ka, each with ~1.0 +/- 0.2 m of oblique slip per event.

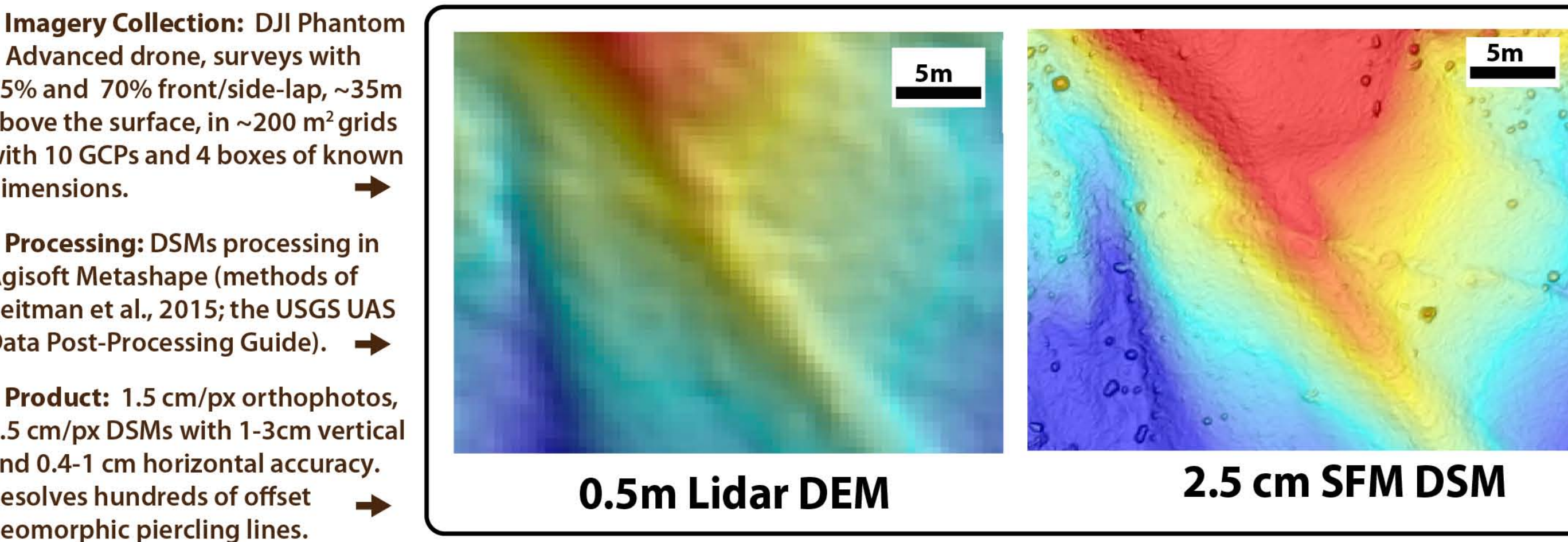
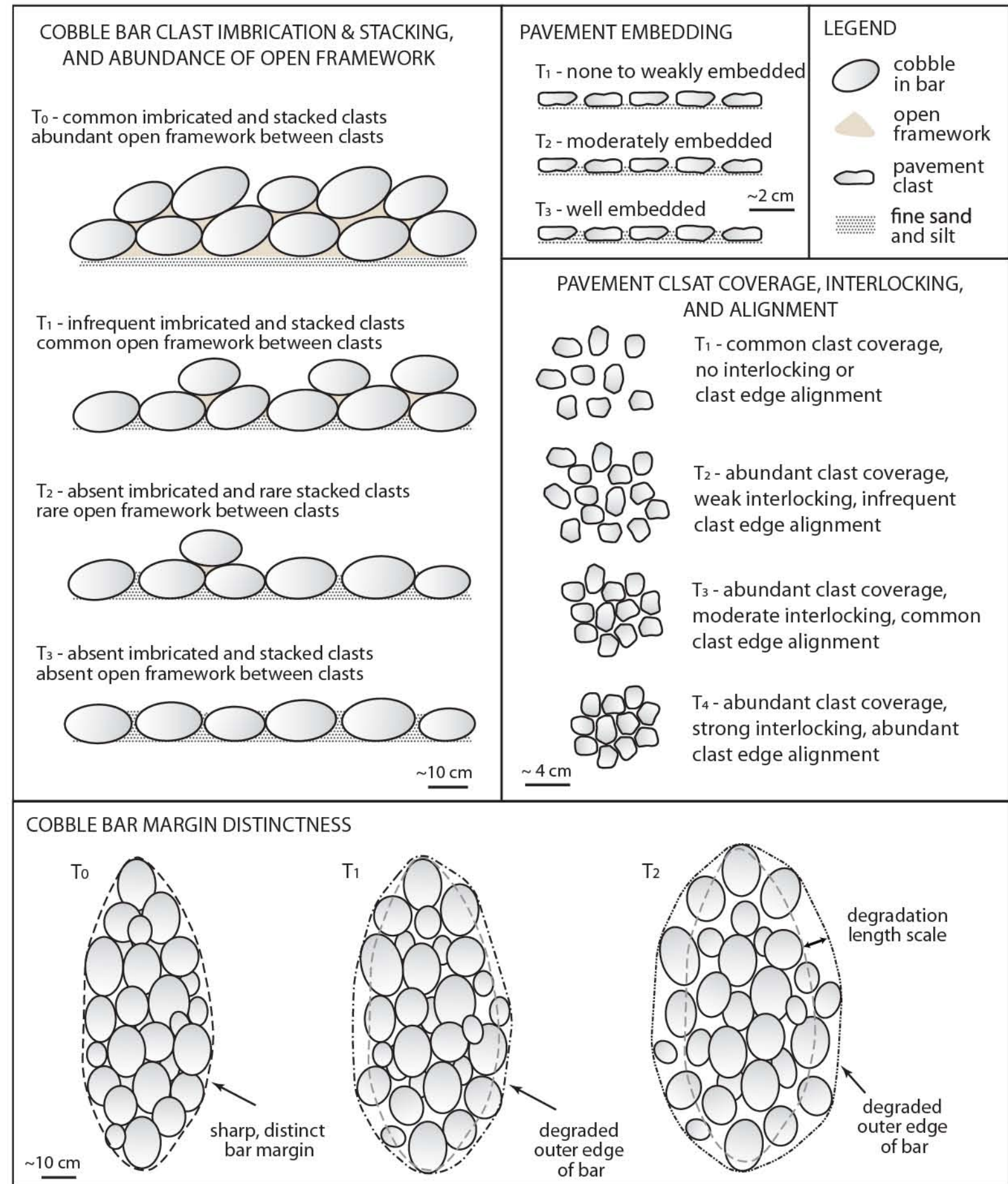


- The timing of each Ash Hill fault rupture overlaps with a paleoseismically dated earthquake on the adjacent, range-bounding, Panamint Valley fault. The two faults additionally have similar recurrence intervals and are bound by morphologically correlative units.
- These data suggest that ruptures on the Ash Hill and Panamint Valley faults occurred in the same or closely temporally related events multiple times throughout the late Holocene.

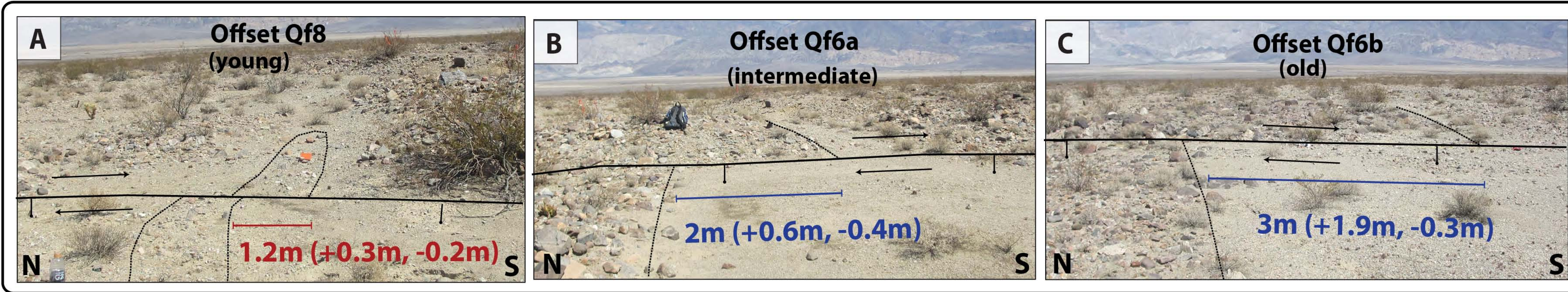
(Regalla et al., 2022, ESPL)

Methods

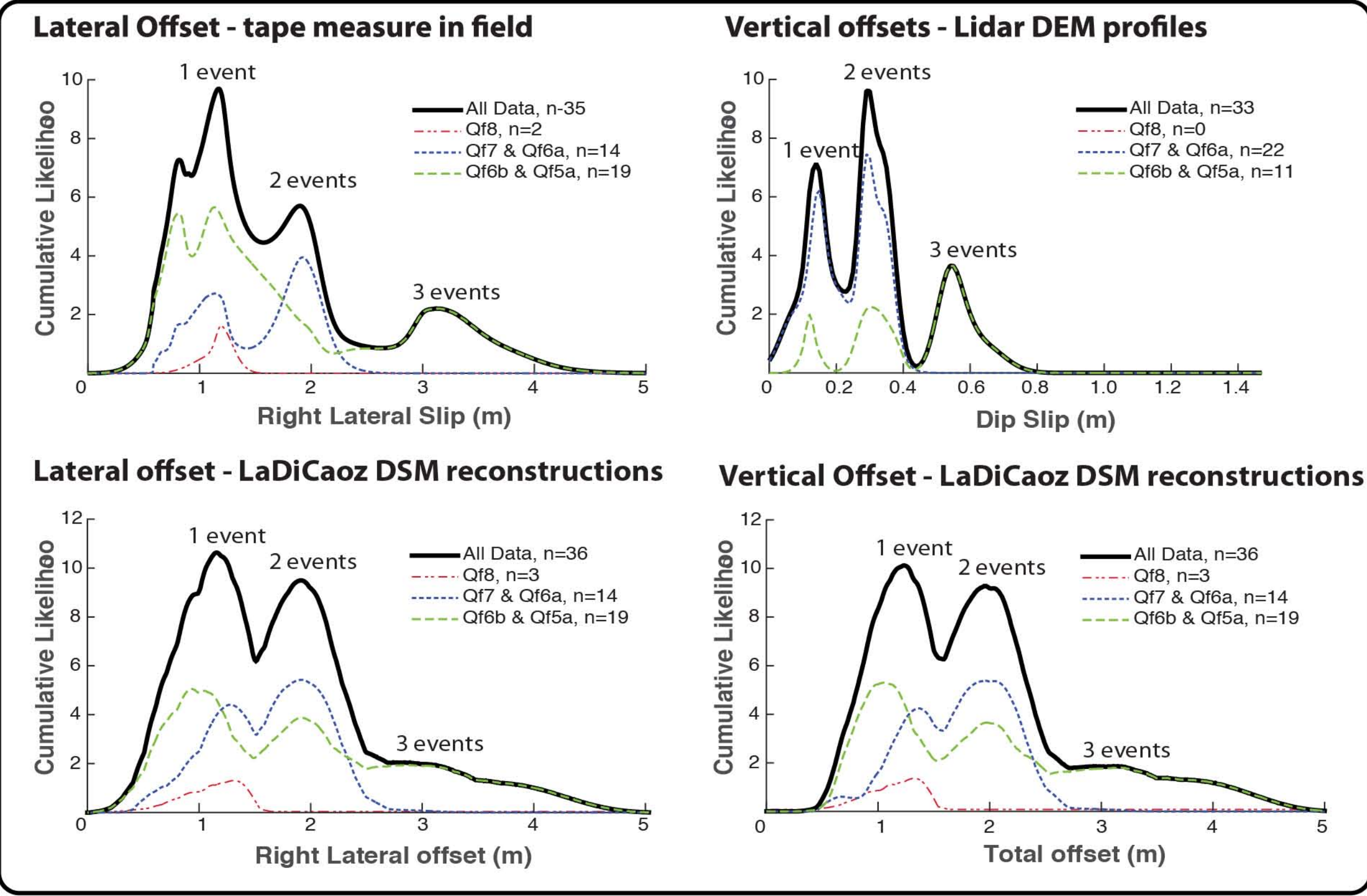
We leverage a multifaceted approach to evaluate the timing of Ash Hill fault ruptures that overcome several challenges common in the ECSZ, including distributed ruptures, small cumulative offsets, and challenges using C14 and quartz luminescence.



Evidence for Three Late Holocene Offsets



Three events recorded along fault strike: Cumulative Offset Probability Distribution (COPD) plots



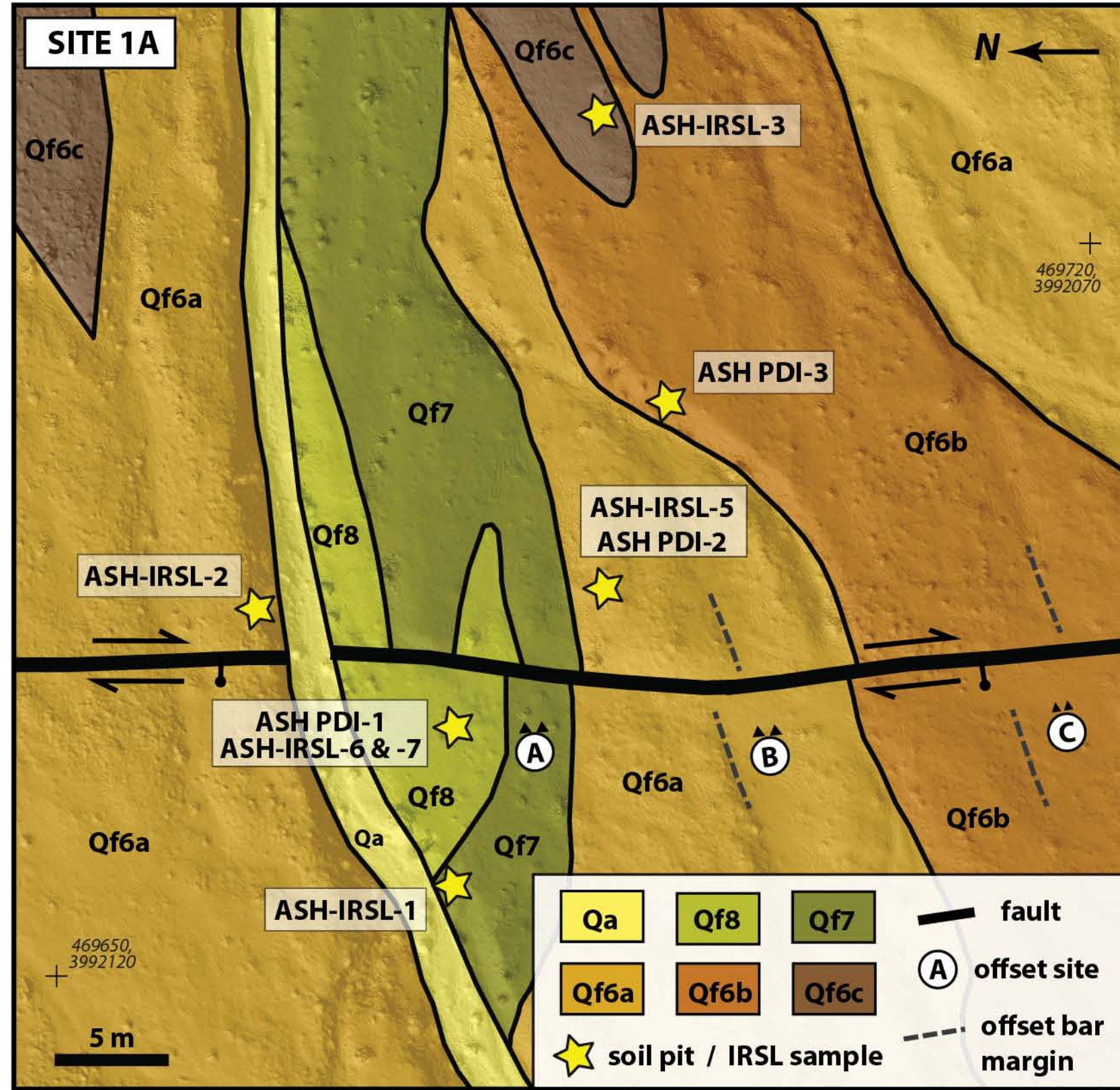
Surficial geologic map of alluvial units at Site 1, where a single fault strand offsets Qf8 through Qf6b units.

Labeled sites A-C indicate locations where laterally offset channel bars were measured in the field (triangles indicate look direction of photos above).

COPD plots for offset geomorphic markers along the southern Ash Hill fault, showing evidence for three events, each bound by mappable alluvial units.

Plots generated by summing the PDFs of slip likelihood for all measurement sites.

Peaks in COPD plots represent clusters of offset magnitudes and are interpreted to reflect displacement during individual earthquakes.

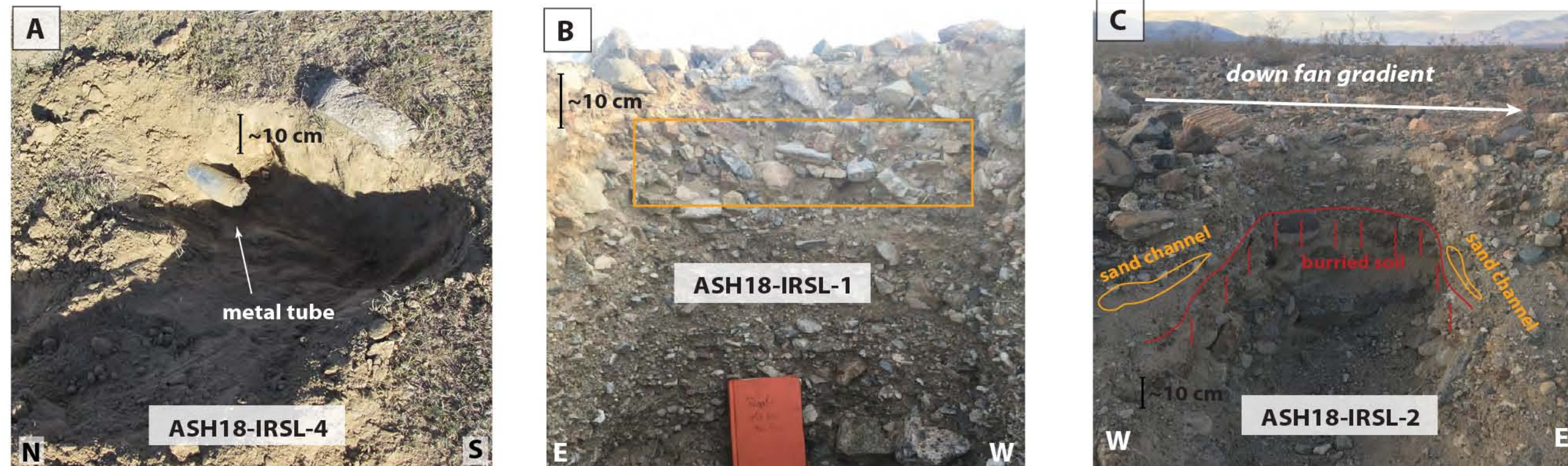


SITE 1

- A single continuous surface rupture offsets three generations of alluvium: Qf8, Qf6a, and Qf6b. Older units record progressively larger offsets.
- Offsets at this site require three events that occurred 1) after the deposition of Qf8, 2) between the deposition of Qf7o and Qf8, 3) and between the deposition of Qf6b and Qf6a.

Rupture Timing

Feldspar IRSL dating of alluvium



We collected bulk matrix from sandy horizons within alluvial units Qf8, Qf6a and Qf6c at Site 1a and one sample from aeolian loess ponded against a single event scarp in Qf7o, for feldspar IRSL dating.

Correlation of Rupture Timing

ASH HILL FAULT	PANAMINT FAULT
Ponded Sediment ★ ASH18-IRSL-4 — IRSL age: 0.16 - 0.44 ka ^b	Qf5 ^a (320-490 cal. ka ^a)
Earthquake 1 (~0.25-0.65 ka)	Earthquake (~0.3-0.5 ka^d)
Qf8 ★ ASH-PDI-1 — surface & soil correlated to unit with ¹⁴ C age of 0.53 - 0.80 cal. ka ^a ★ ASH18-IRSL6&7 — IRSL age: 1.75 - 3.19 ka ^b	Qf4a ^a (530-820 cal. ka ^a)
Earthquake 2 (~0.6-2.5 ka)	Earthquake (~0.9-3.0 ka^d)
Qf7 & Qf7b ★ ASH18-IRSL-1 — IRSL age: 1.50 - 2.90 ka ^b Qf6a ★ ASH-PDI-2 — no other dated units available for surface or soil correlation ★ ASH18-IRSL-2 — IRSL age: 2.20 - 3.10 ka ^b	Qf4b ^a (~1.3-2.3 ka ^a)
Earthquake 3 (2.5-4.3 ka)	Earthquake (3.3-3.6 ka^d)
Qf6b ★ ASH-PDI-3 — soil correlated to units with IRSL & OSL ages of >2.2-3.1 ka ^b & <3.5-4.2 ka ^c Qf6c ★ ASH18-IRSL-3 — IRSL Age: 6.3 - 8.60 ka ^b	Qf3b ^a (~2.1-3.6 ka ^a)
	Earthquake (>4.1 ka^d)

a = Sethanant 2019 and Hoffman 2009
b = McGill et al, 2009
c = and Mahan et al 2007
d = McAuliffe et al., 2013
* = 14C in wood
** = Soil development age

- Feldspar IRSL geochronology and correlation to equivalent dated surfaces in the region bracket rupture timing to ~0.25-0.65 ka, ~0.6-2.5 ka, and ~2.5-4.3 ka.
- Dating and correlation of units yield age intervals for the Ash Hill ruptures that overlap with paleoseismically dated events on the Panamint Valley fault.
- These correlations suggest that Ash Hill and Panamint Valley faults ruptures in the same or closely temporally related events, such as can occur during multi-fault or triggered events. This appears to have occurred repeatedly during the Holocene.
- Such seismic clustering and interfault strain transfer may be common in locations in the ECSZ like Panamint Valley where complexly interlinked networks of inherited faults facilitate rupture "jumps" to adjacent faults*.

*See Poster 108!

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