Late Quaternary Erosion Rates in the San Gorgonio Pass: Insights from Thermoluminescence Thermochronology

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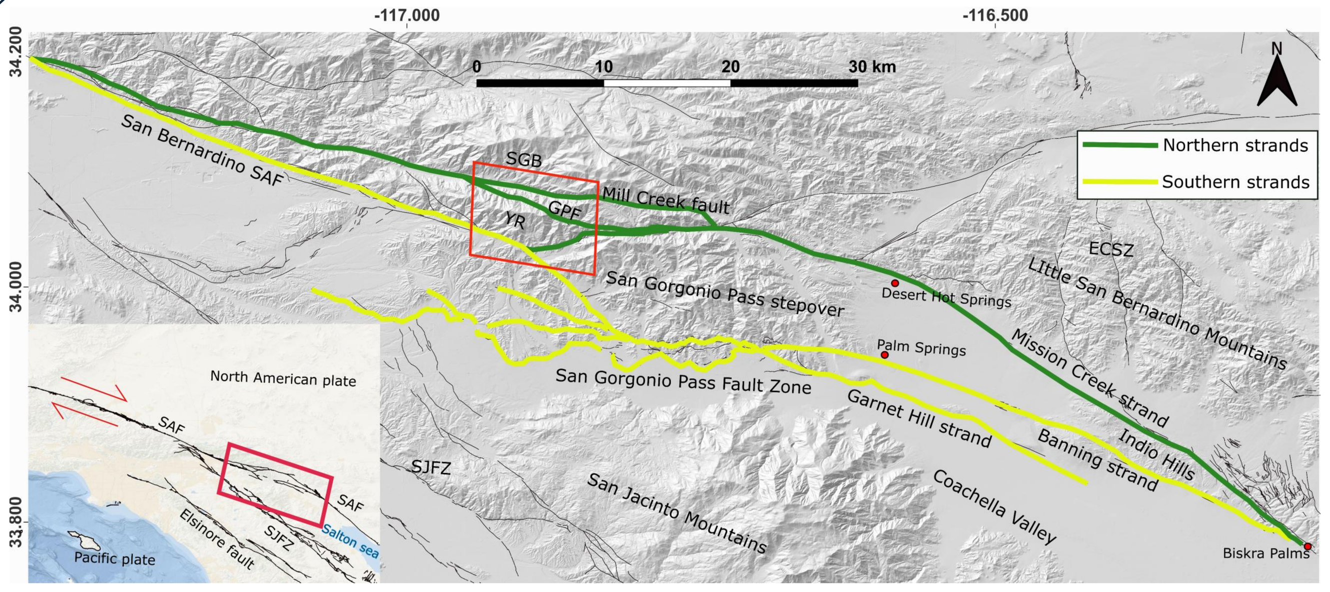
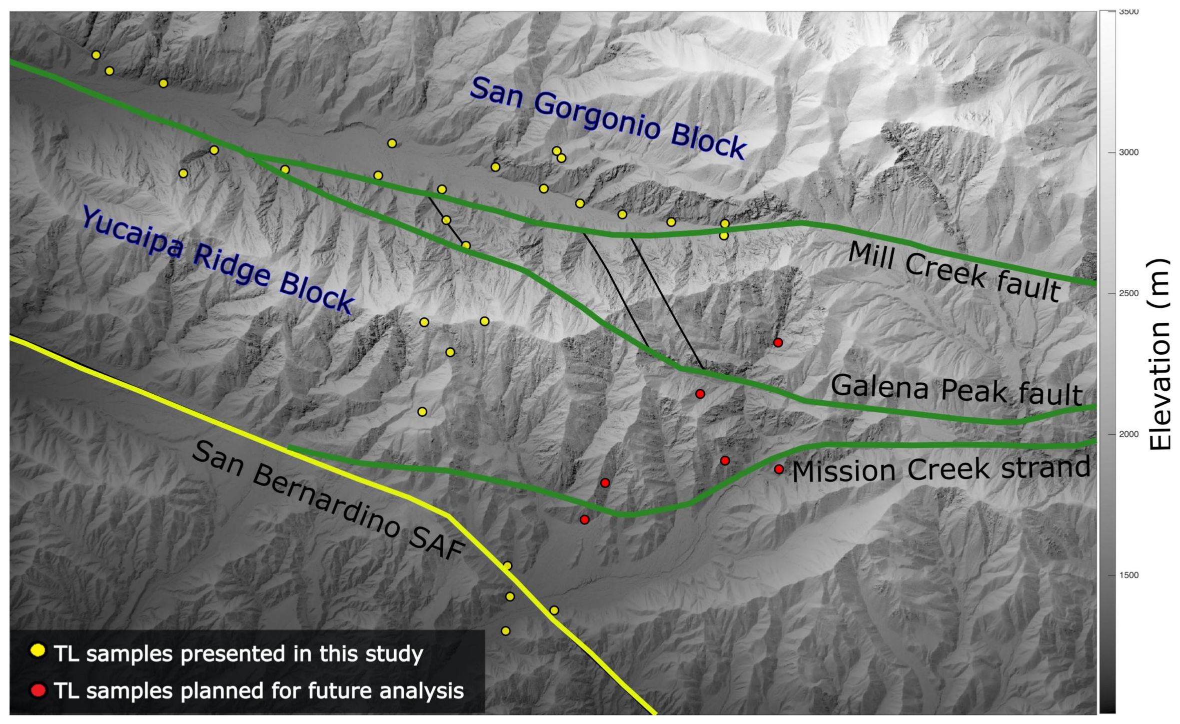
1. INTRODUCTION



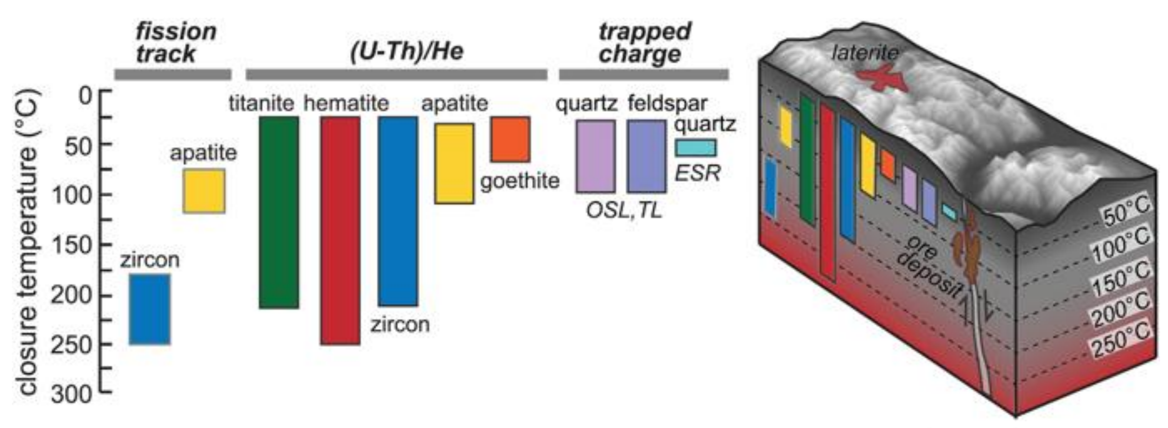
Tectonic setup of southern California depicting the major fault strands that are categorized into northern and southern strands following Beyer et al. (2018). This categorisation shows the two pathways available for navigation of slip through the San Gorgonio Pass. The study area extent is highlighted with a red parallelogram.



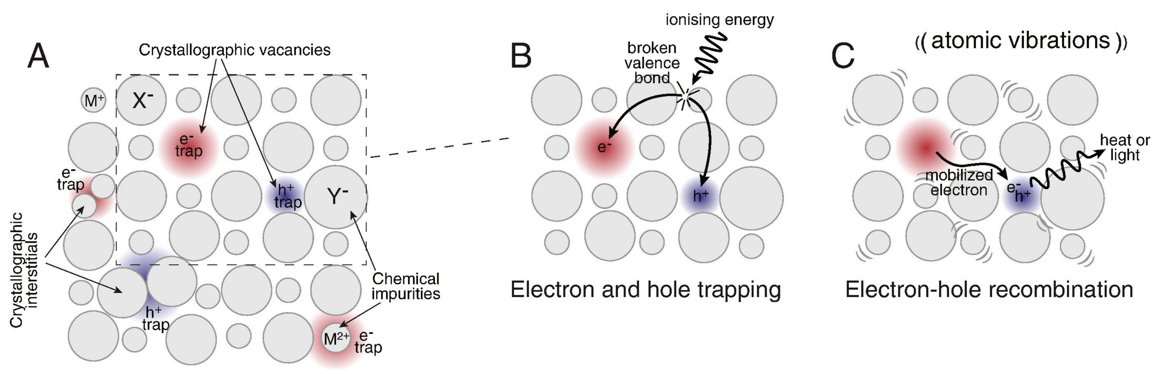
Can the spatial variability in TL erosion rates be exploited to understand slip partitioning between fault strands in the San Gorgonio Pass region?

How do topography and factors like proximity to fault strand and precipitation influence the exhumation rates estimated from TL thermochronology?

2. TL THERMOCHRONOLOGY



(Ault et al., 2019).

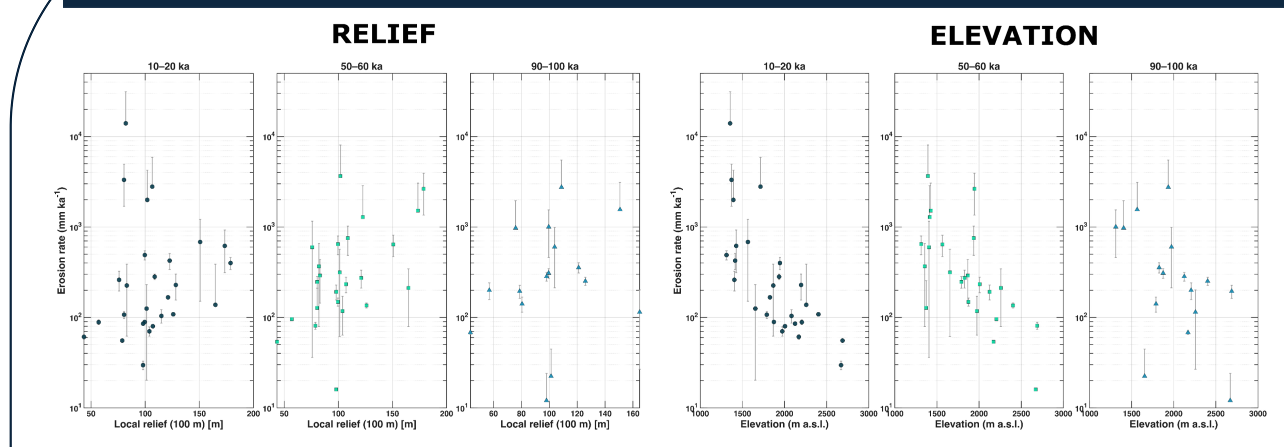


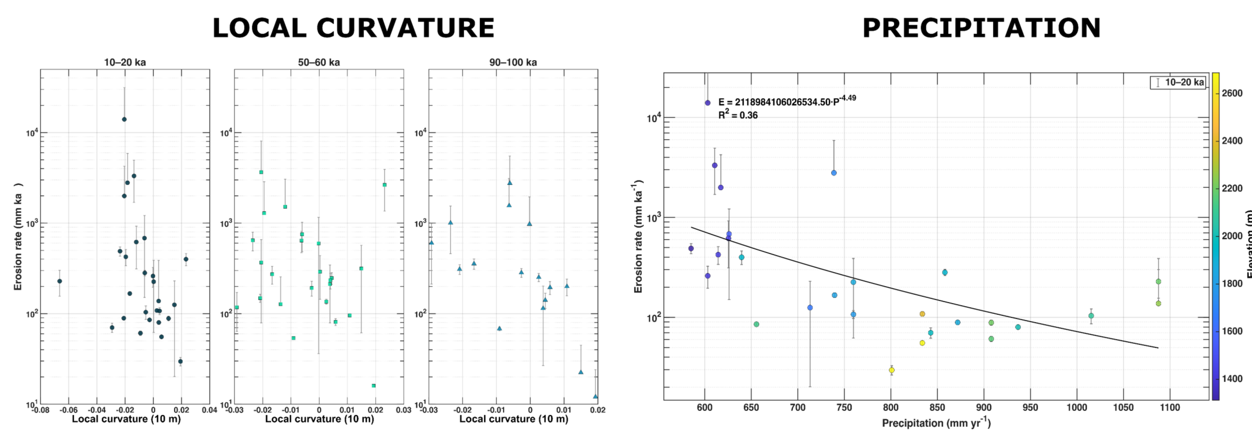
Schematic illustrating the buildup and emptying of electrons in a crystal lattice (King et al., 2016c)

TL thermochronology is an ultra-low temperature thermochronometer

Feldspar and Quartz crystals start building up charge as the bedrock crosses the closure temperature

3. COMPARING TL EROSION RATES WITH TOPOGRAPHIC METRICS

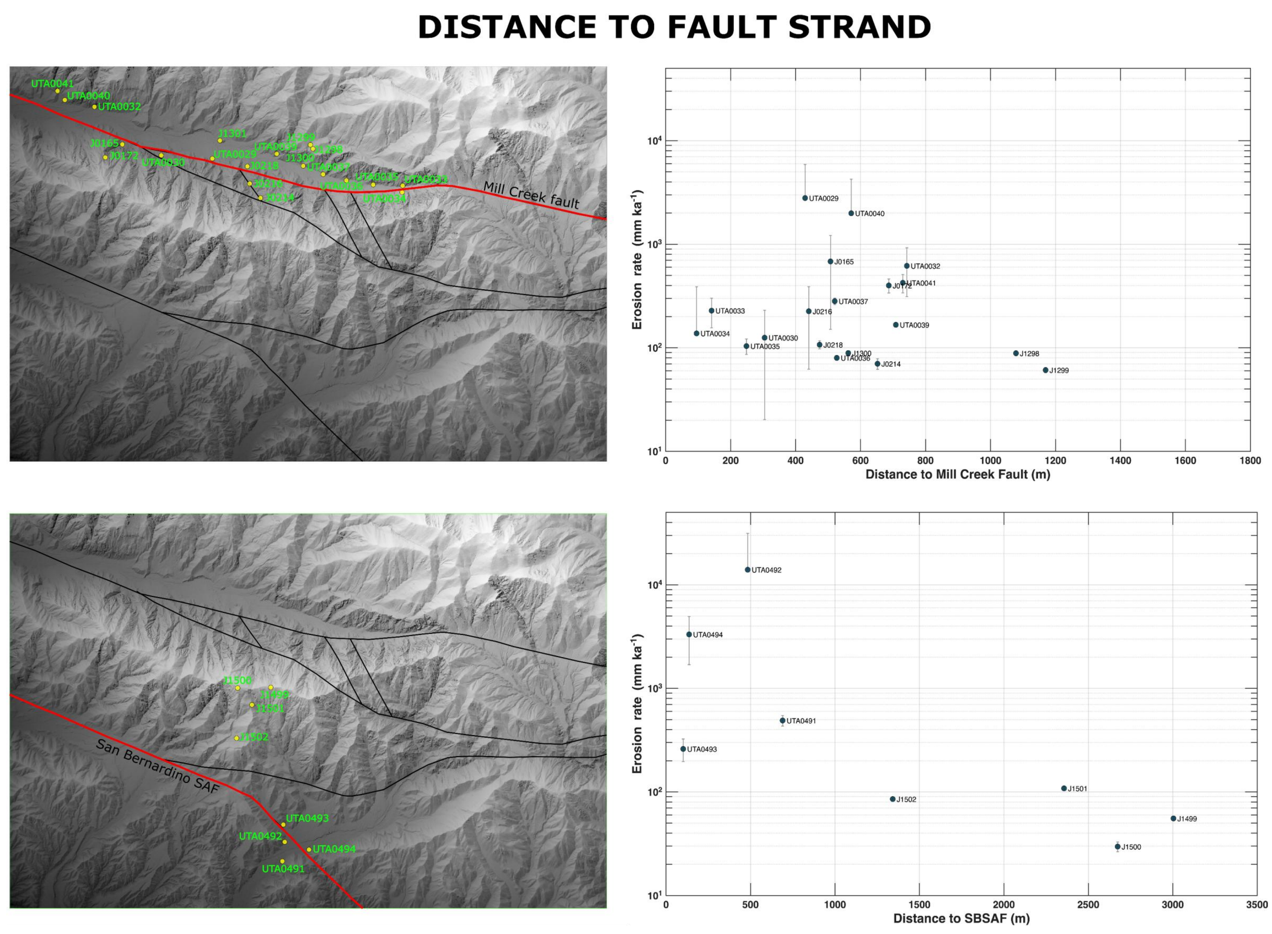




Fastest exhumation occurring in steep, high-relief, and concave areas that sit of the landscape

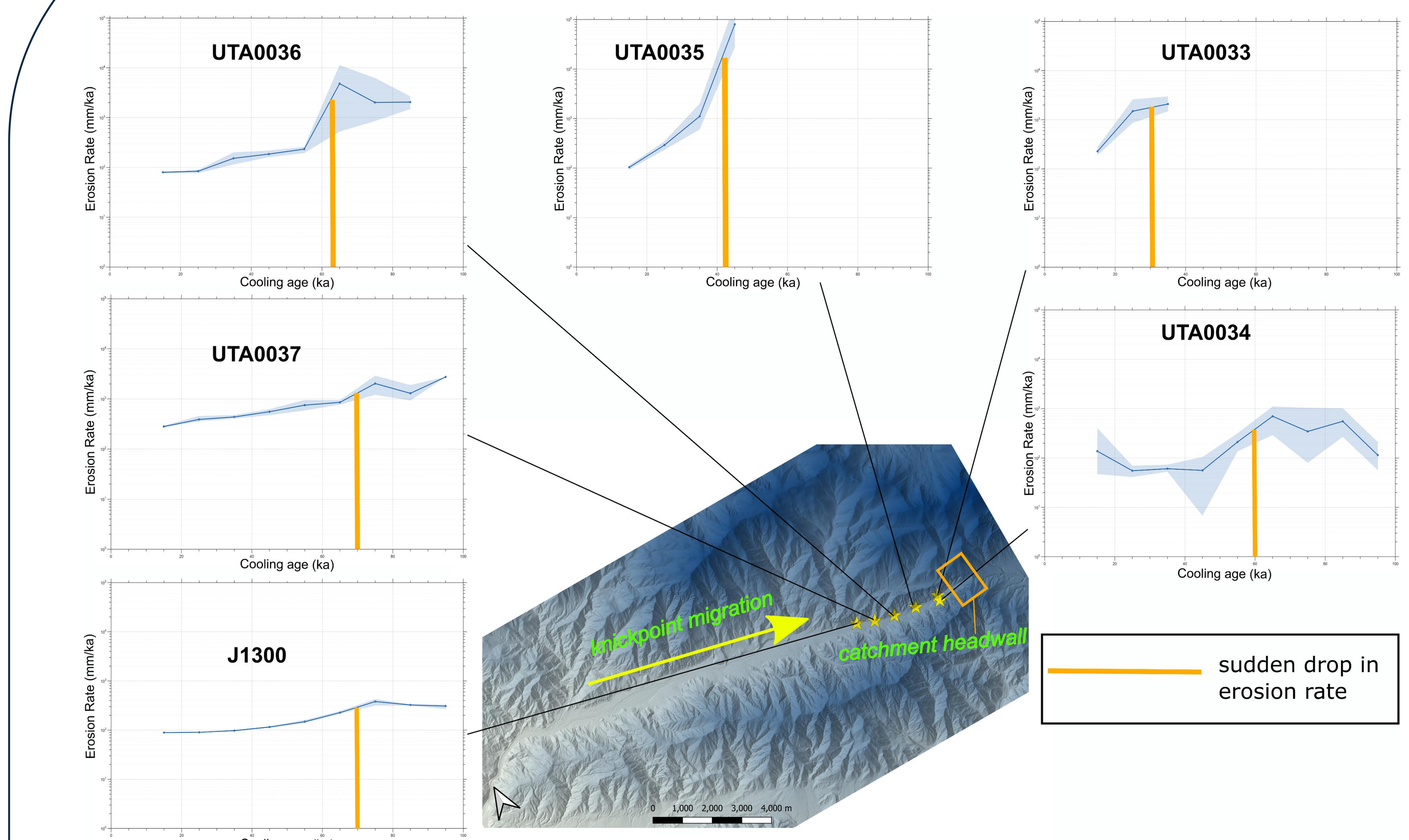
Ridge tops and low relief relict surfaces sitting high in the landscape exhibit low erosion rates

High erosion rates concentrated at low elevation areas that receive least precipitation



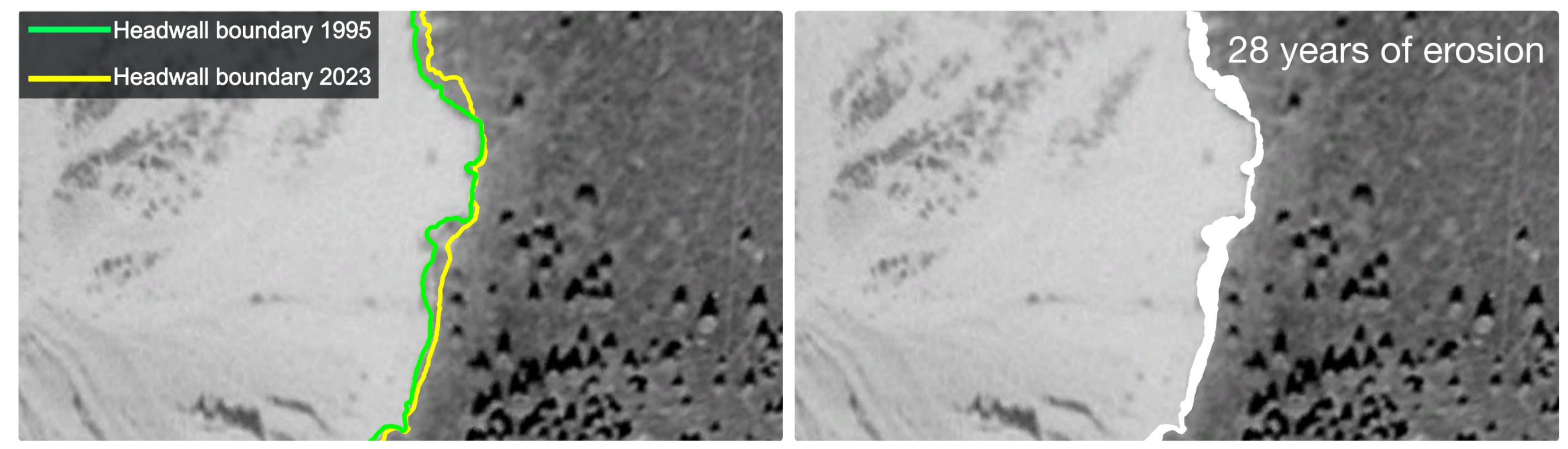
Samples collected close to San Bernardino SAF show high erosion rates.

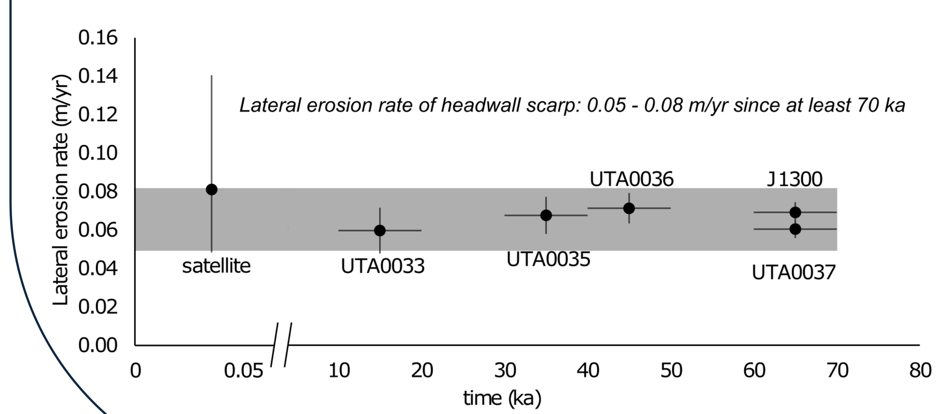
4. BEDROCK COOLING HISTORY CAPTURES KNICKPOINT MIGRATION



Lateral knickpoint migration speed (v) is estimated using the following expression:

$$v(m/yr) = \frac{\text{Distance of sample to catchment headwall } (m)}{\text{Cooling age corresponding to sudden drop in erosion (ka)}}$$

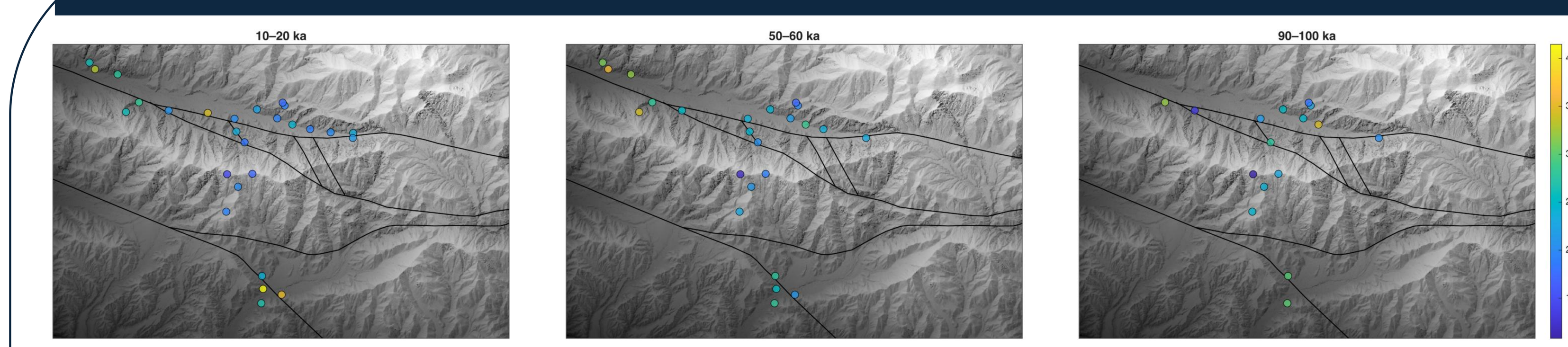


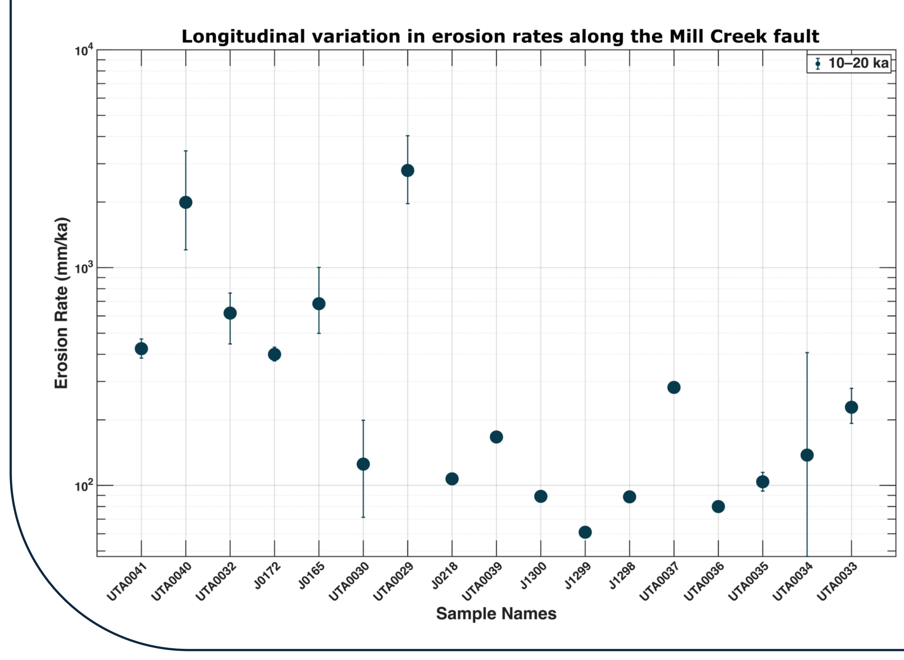


Erosion rates from TL samples and historical satellite imagery agree within 1σ.

Tracking the locus of this knickpoint backwards in time can reveal when and where the base level dropped

5. EROSIONAL DICHOTOMY ON THE MILL CREEK FAULT





Across all time bins, western MCF appears to be eroding faster than eastern MCF.

Strong West-East gradient in erosion rate along the MCF

Erosion rates across SBSAF display a noticeable increase during 10–20 ka integration interval.

6. TAKEAWAYS

Where is the erosion rate fastest: Low elevation high relief areas of the landscape (e.g., valley)

What drives erosion: Tectonic reorganisation, evidenced by erosional contrasts along the MCF and a migrating knickpoint.

How is uplift partitioned? Higher erosion rates concentrated on the San Bernardino SAF and the Mill Creek fault west of the juncture with Galena Peak fault.

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