

# U-series and $^{10}\text{Be}$ dating techniques on offset alluvial deposits: a case study from the San Andreas fault system, California



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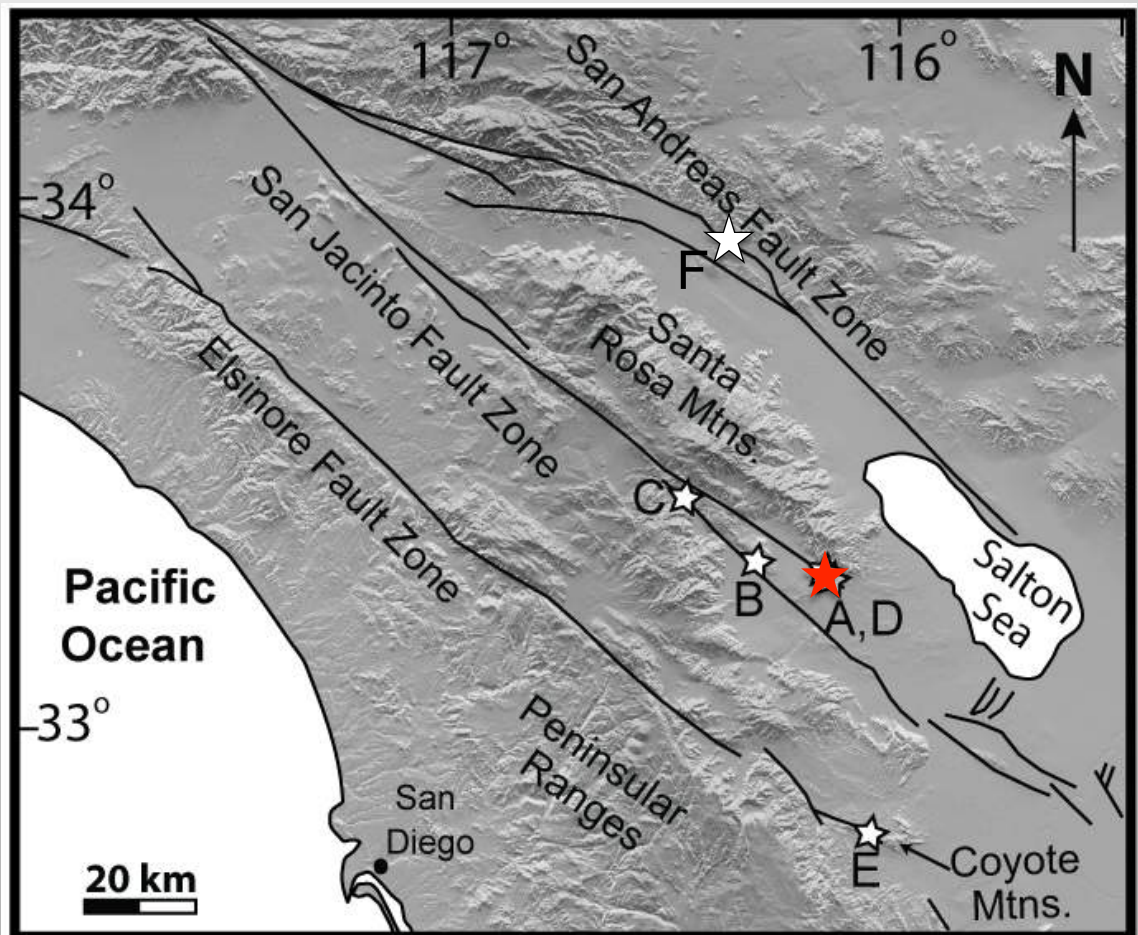
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In collaboration with Warren Sharp  
Kate Fletcher, Mike Oskin, Tom Rockwell, Kate Scharer,

# Alluvial deposits offset along the San Andreas fault system

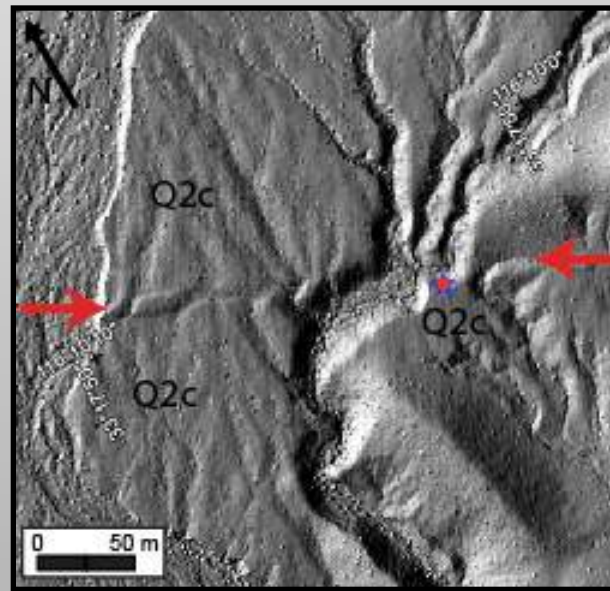
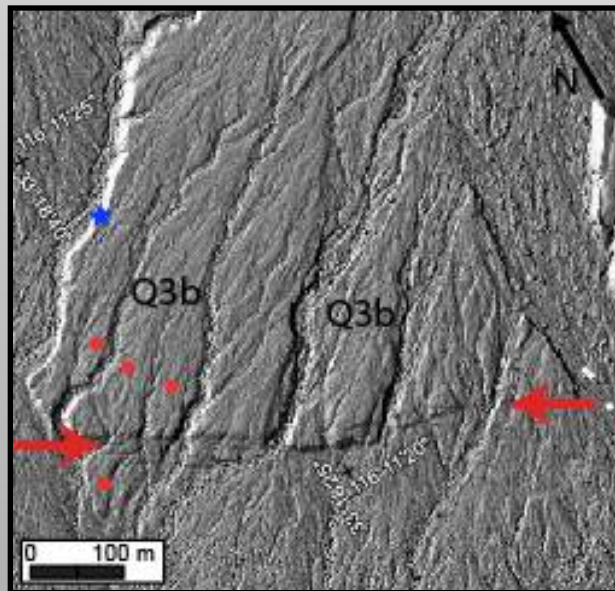
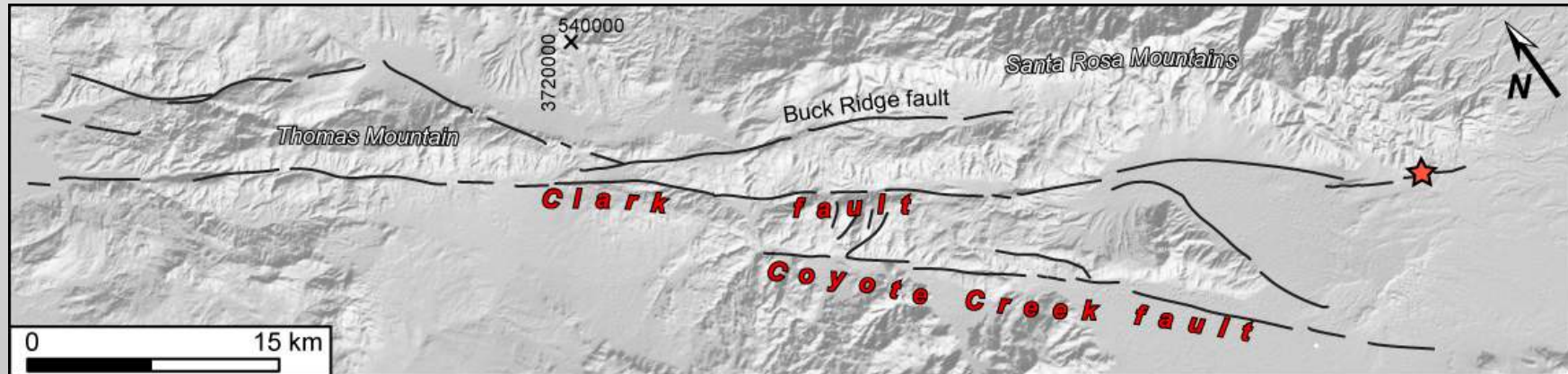
Location: Southwest U.S.

- Anza Borrego & Coachella Valley
- Active tectonics
- Preserved fans



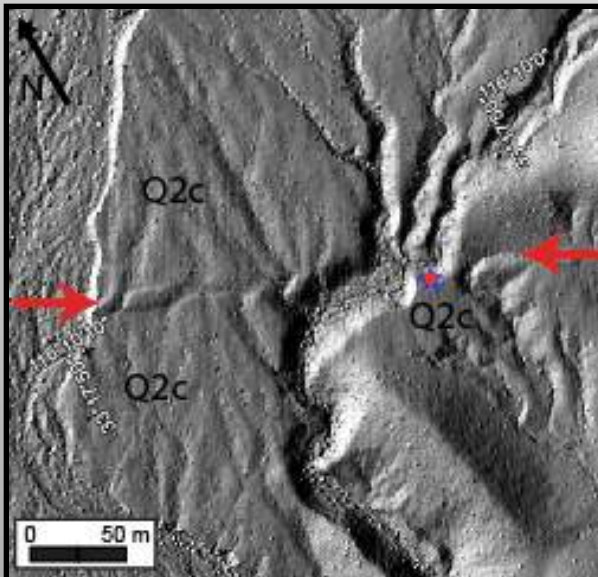
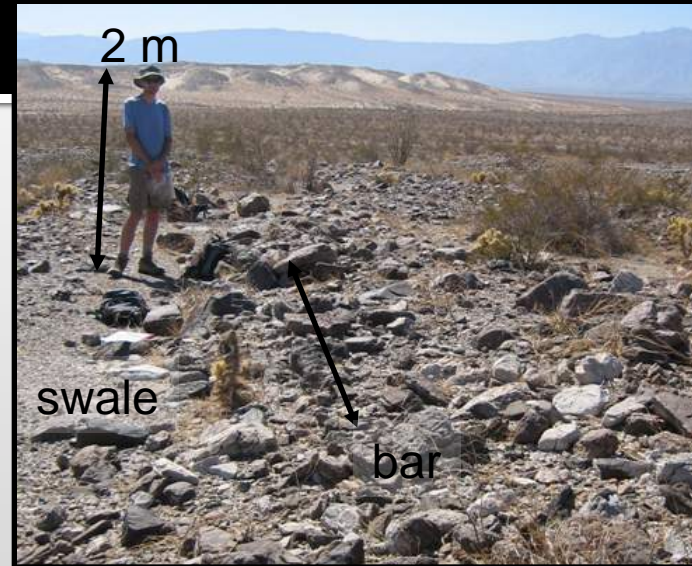
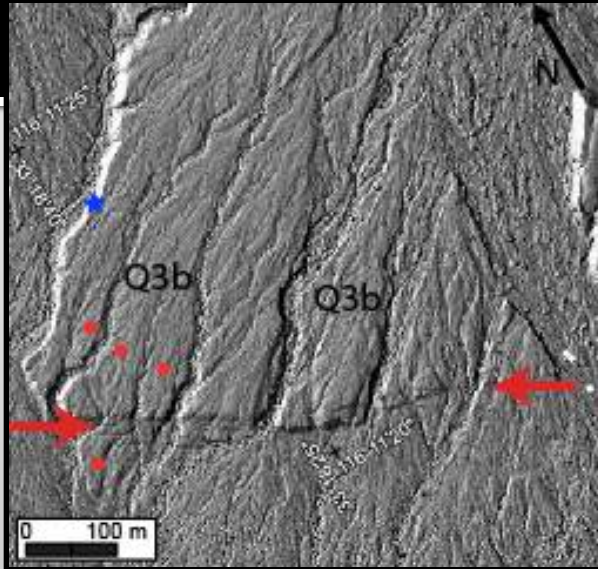


# Alluvial fans offset along the San Jacinto fault zone

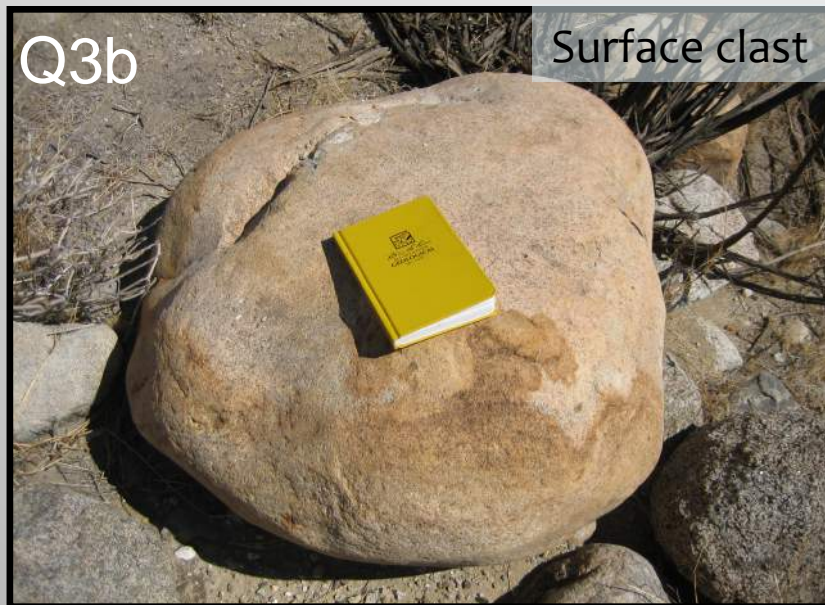




# Alluvial fans offset along the San Jacinto fault zone



# $^{10}\text{Be}$ cosmogenic exposure dating of alluvial surfaces



## Sample collection methods

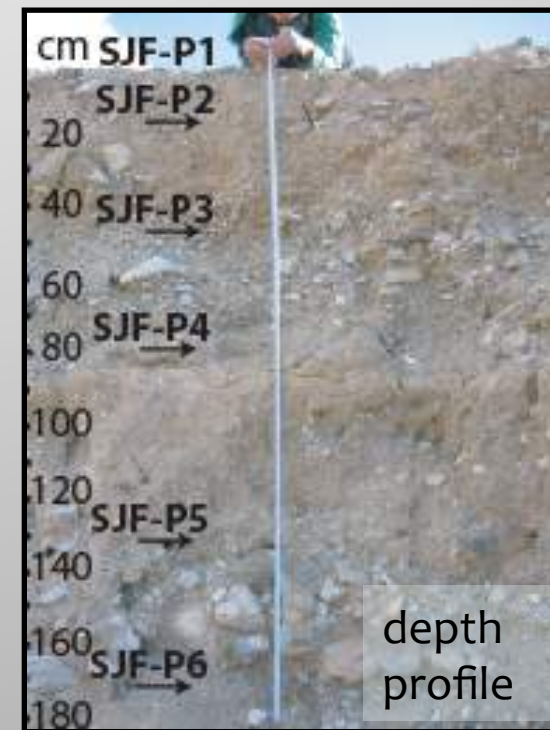
- Amalgamated chips from the top 2-3 cm of surface clasts within debris flow bars or amalgamated pebbles (young surfaces)
- Top 2-3 cm of individual boulders (older surfaces)
- Depth profiles (oldest surfaces)



# $^{10}\text{Be}$ cosmogenic exposure dating of alluvial surfaces

## Inheritance correction

- Active wash samples/debris flows (young and older surfaces)
- Depth profiles (oldest surfaces)

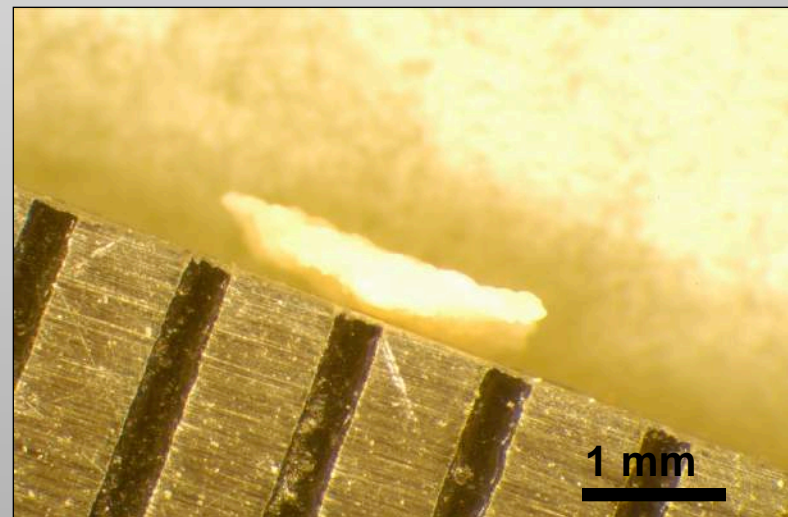


# U-series dating of pedogenic carbonate clast rinds



## Sample collection:

- Collected from or beneath the *zone of maximum* carbonate accumulation
- clast with carbonate on the *undersides* were collected





# Quantifying of Quaternary landforms

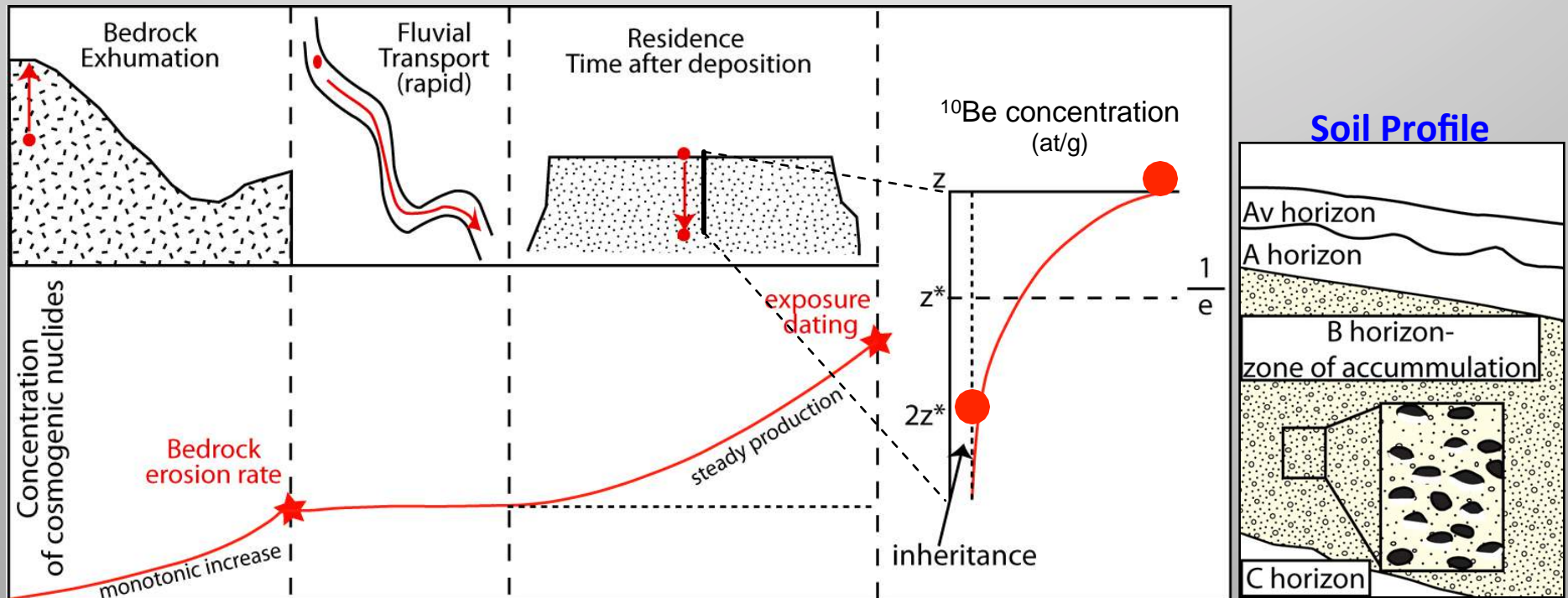
## $^{10}\text{Be}$ ages: maximum ages

- (1) Dates total exposure to cosmic rays
- (2) Age is affected by:
  - a. Inheritance of  $^{10}\text{Be}$  from hillslope residence and fluvial transport
  - b. Erosion of the surface

## U-series ages: minimum ages

- (1) Dates pedogenesis (soil formation)
- (2) Age is affected by
  - a. Carbonate time lag
  - b. Carbonate rind averaging affects
  - c. Detritus correction ( $^{230}\text{Th}$ )

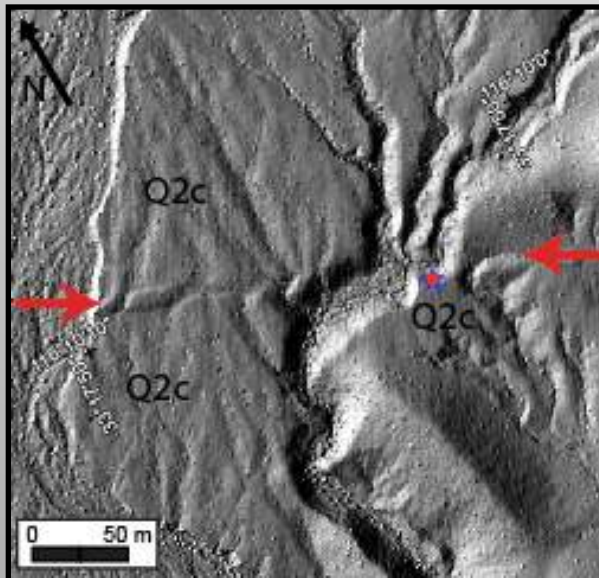
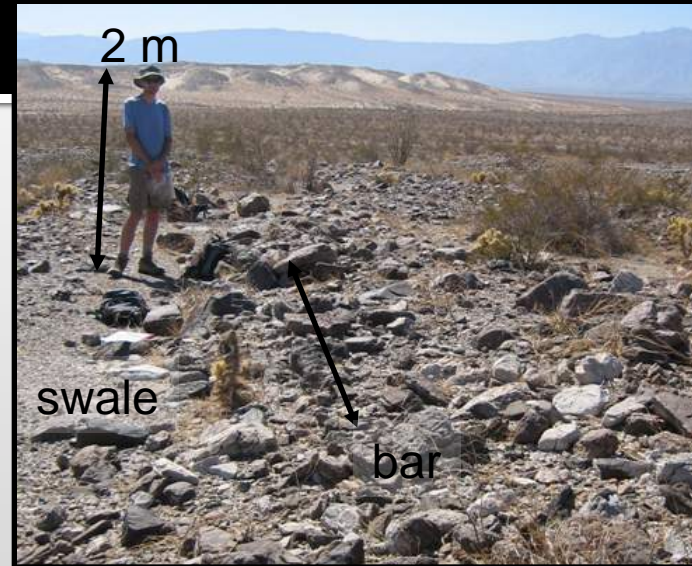
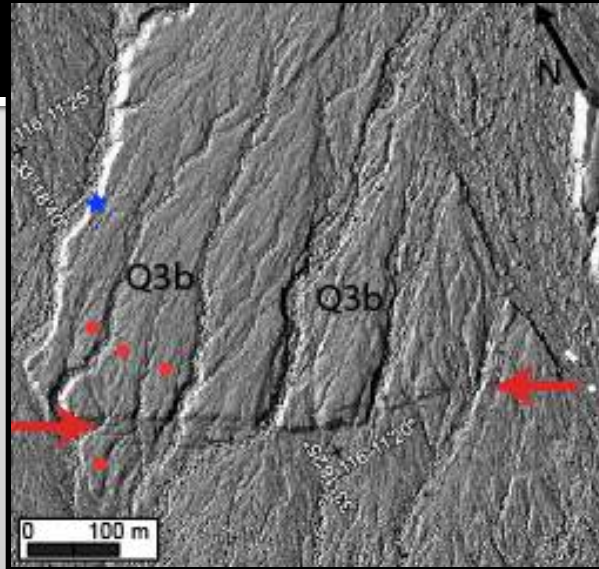
**\*Agreement between the ages (or lack of) allows for an assessment of their reliability**



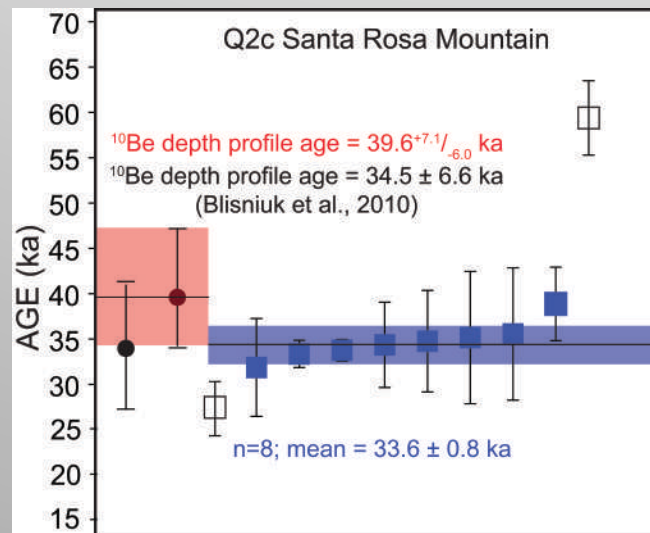
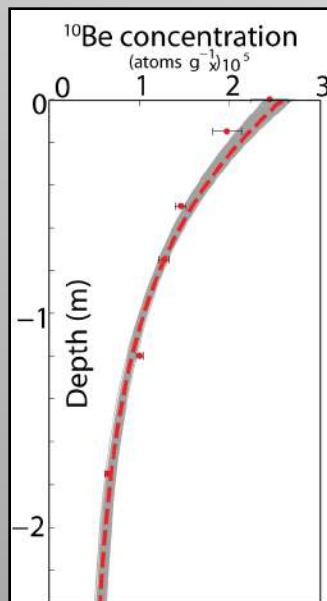
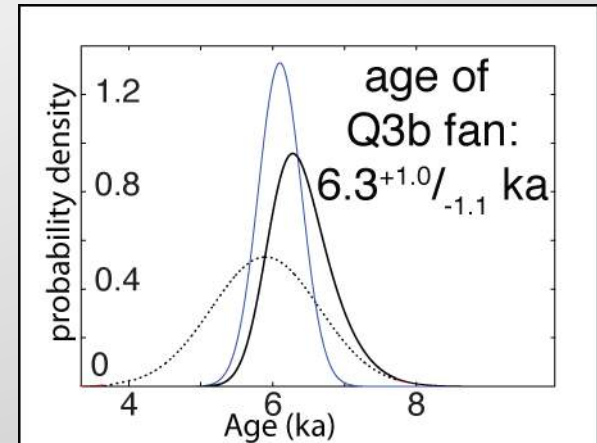
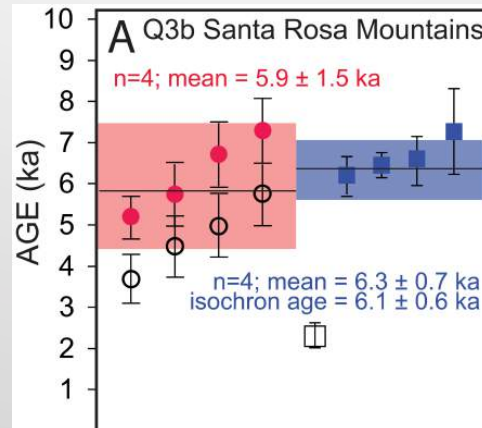
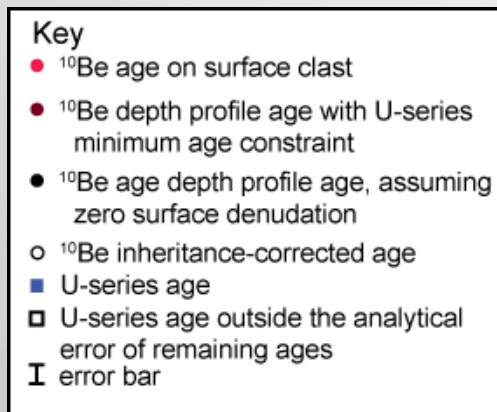
Modified after Anderson et al., 1996



# Alluvial fans offset along the San Jacinto fault zone



# Alluvial fans ages



## Observation:

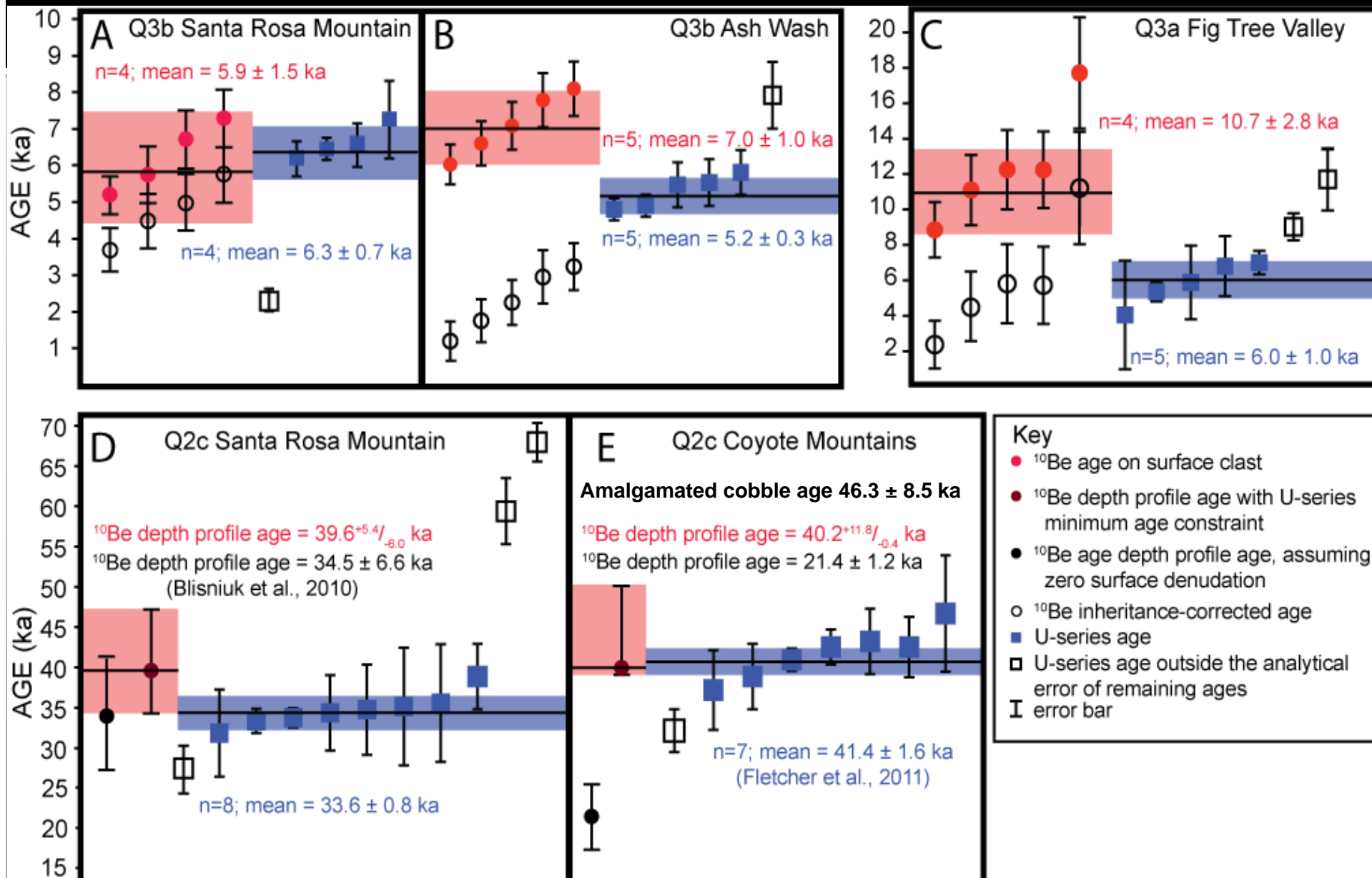
(1) Minimum U-series ages approach  $^{10}\text{Be}$  ages

(2) modern wash samples for Holocene deposits does not correct for inheritance of  $^{10}\text{Be}$  ages

(3) Ages are reliable



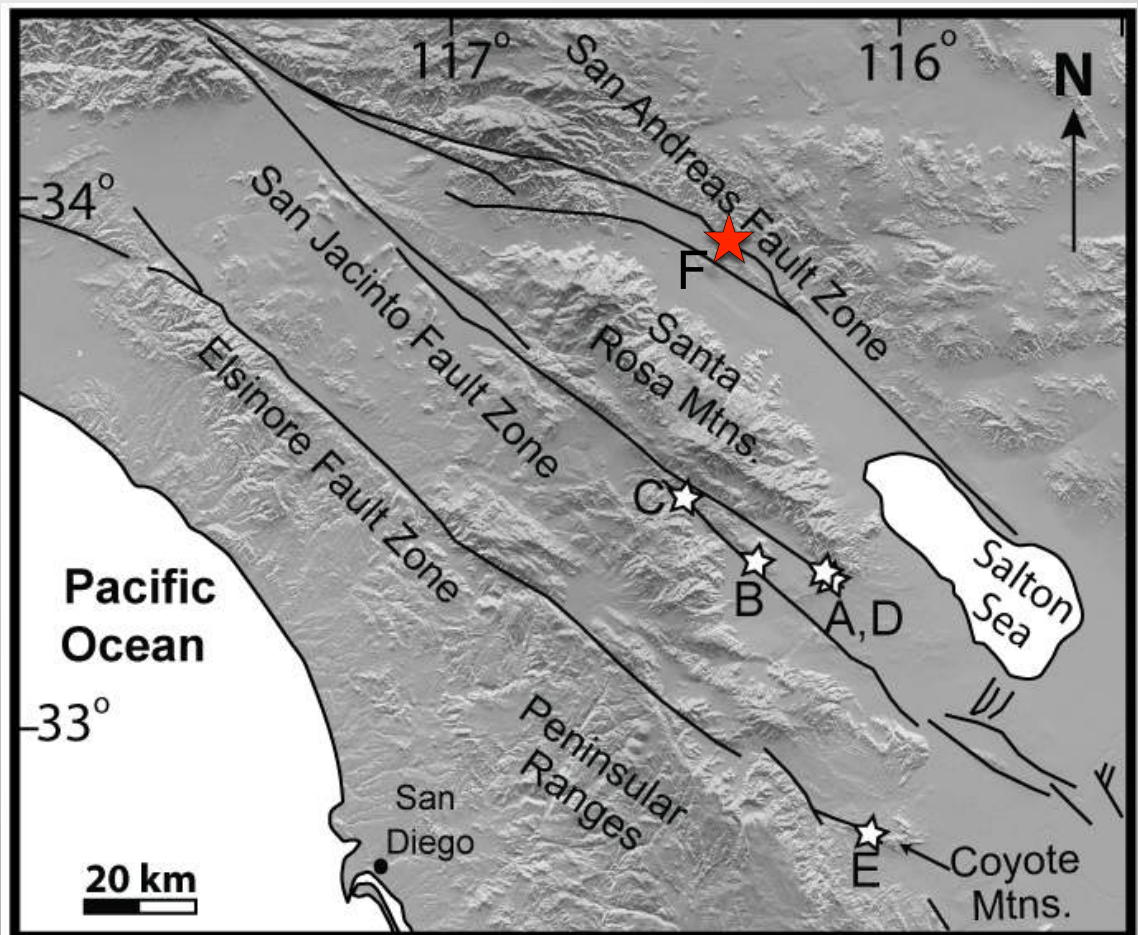
# Summary of fan ages in Anza Borrego:



# Alluvial deposits offset along the San Andreas fault system

Location: Southwest U.S.

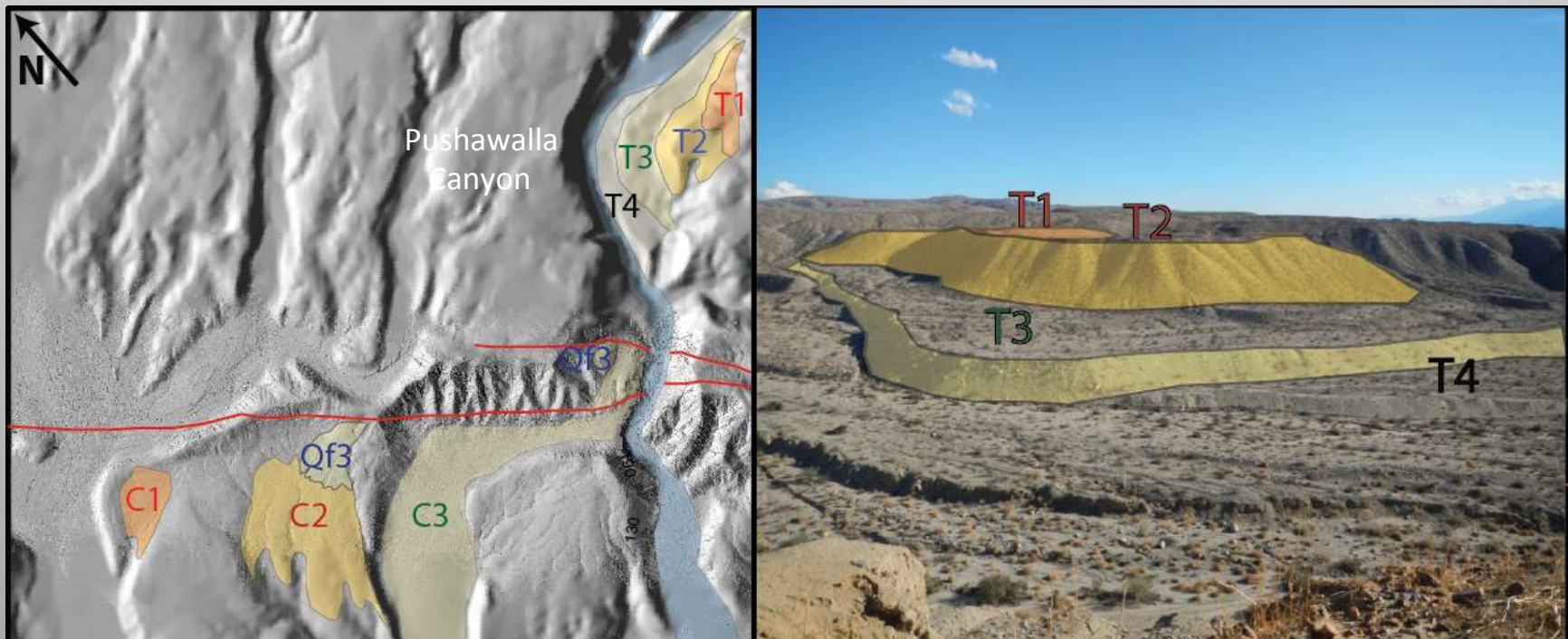
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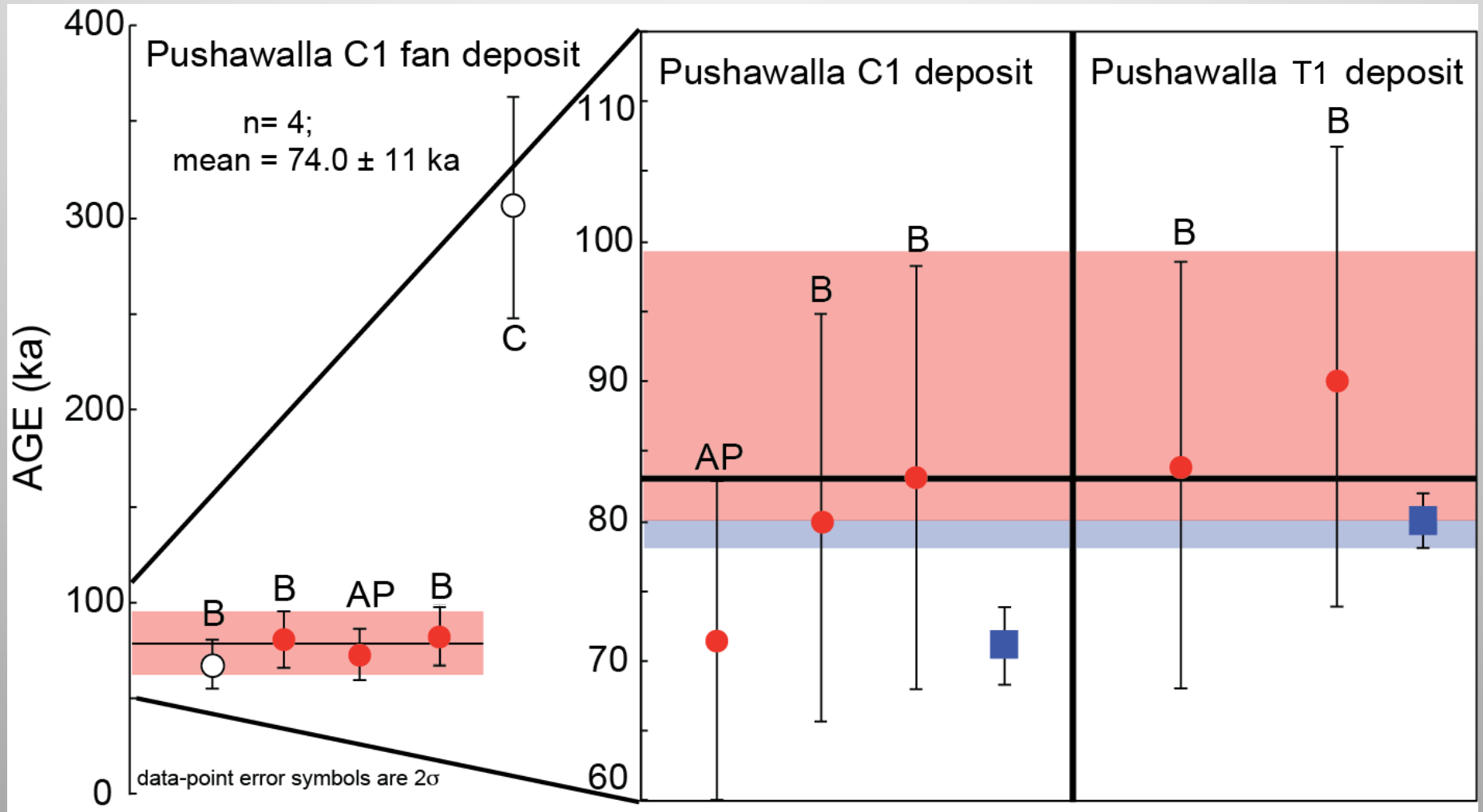


# Ages of fluvial deposits in Coachella Valley

- a) 3 channels completely beheaded
- b) 3 old surfaces that grade into Pushawalla Canyon, the only plausible source.
- c) Terrace deposits across the fault correlate to deposits in the 3 channels.

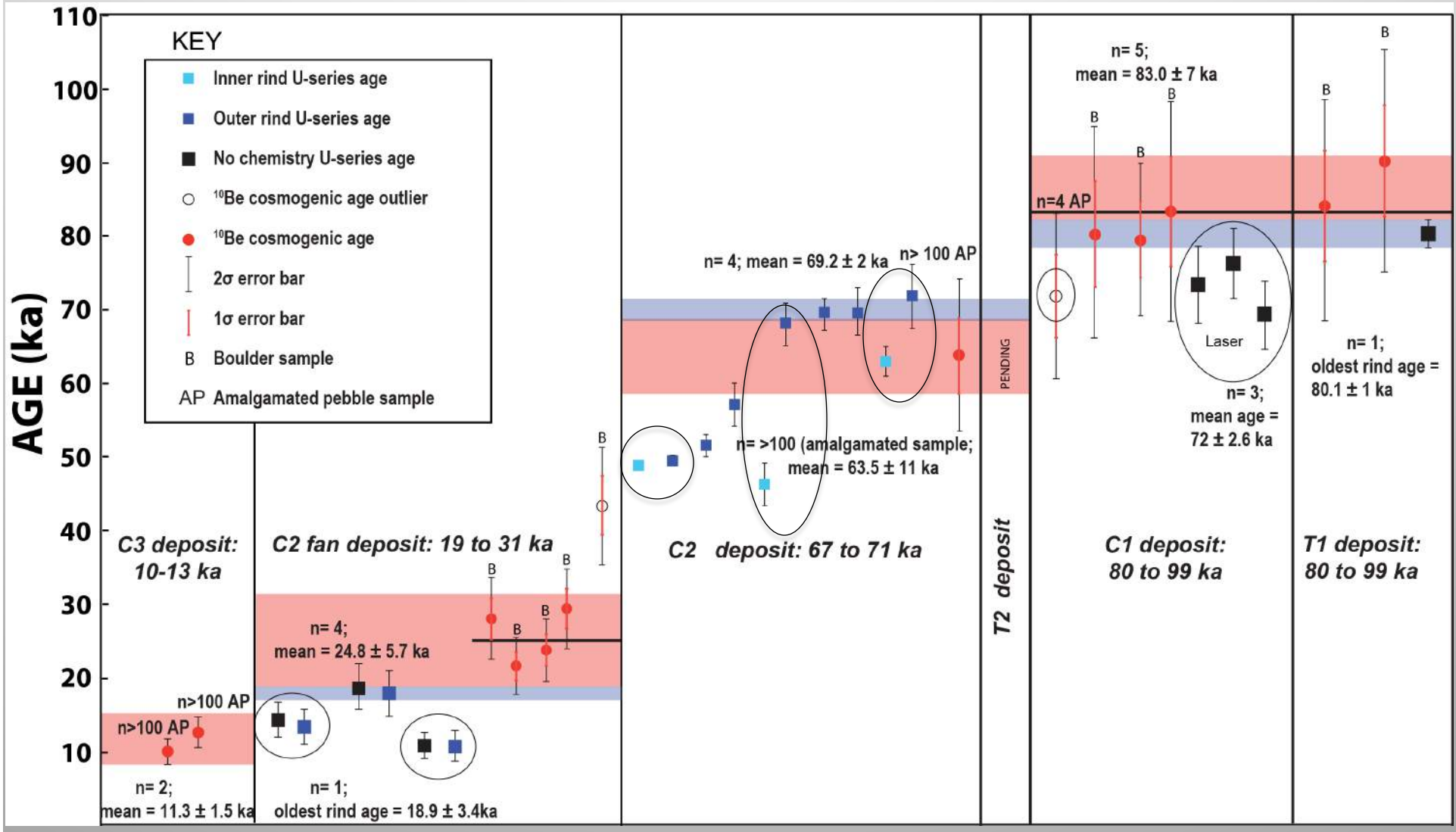


# Summary of ages for deposit in C1

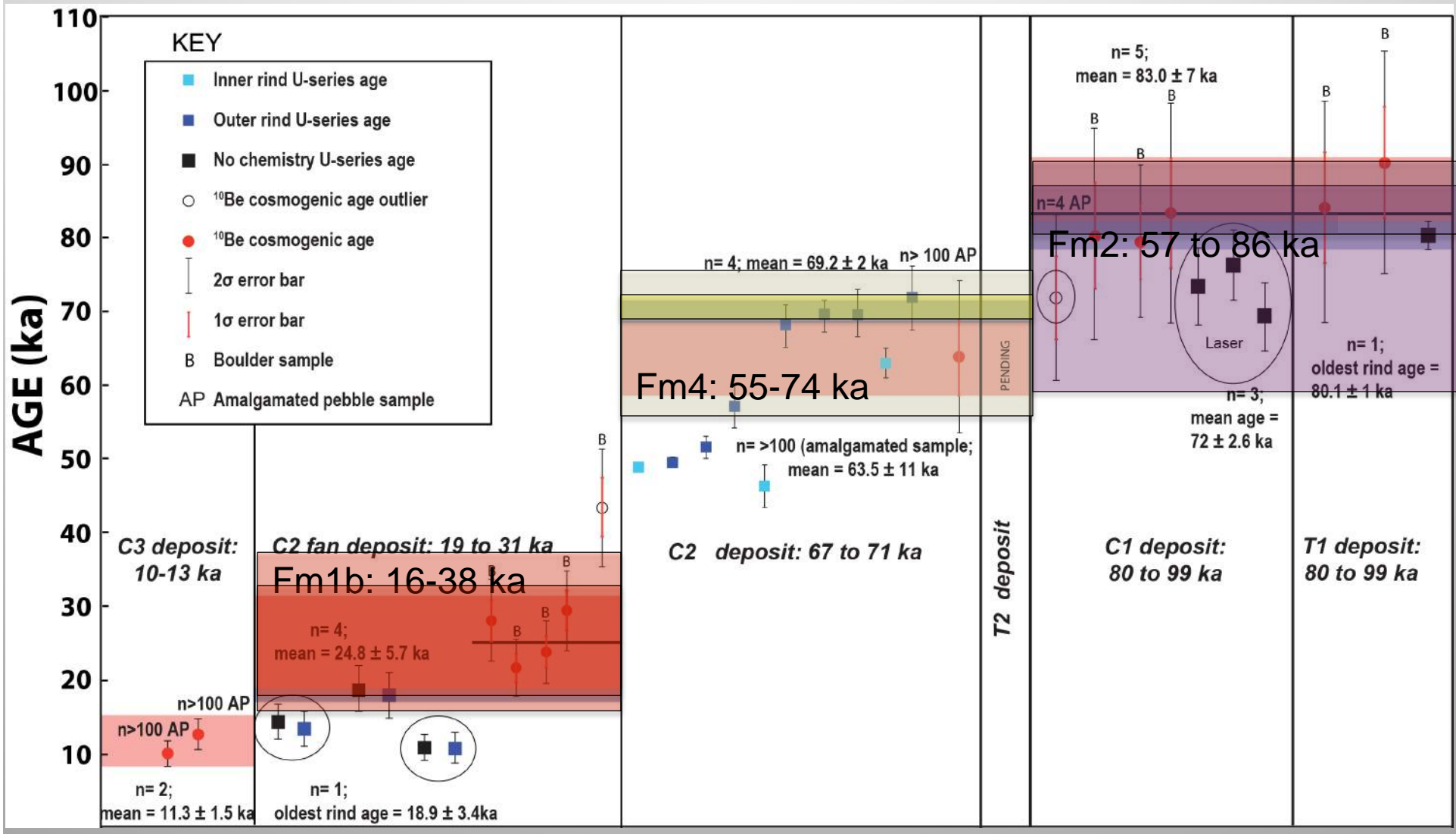




# Summary of ages at Pushawalla Canyon in Coachella Valley



# Summary of ages at Pushawalla Canyon in Coachella Valley





# Quaternary Geochronology

## ***Conclusion:***

- (1) Combining  $^{10}\text{Be}$  and U-series dating yields reliable age estimates
- (2) U-series of pedogenic carbonate can be successfully applied to alluvium as young as mid-Holocene
- (3)  $^{10}\text{Be}$  inheritance of Holocene alluvial deposits appears to be significantly lower than implied from concentrations in active wash deposits
  - suggest reworking of older alluvial fans or
  - sediment production rates may have been higher during fan deposition- not in steady state landscape

# Questions?