Late Pleistocene Mono Basin Beach Berms, California: Preliminary OSL Ages

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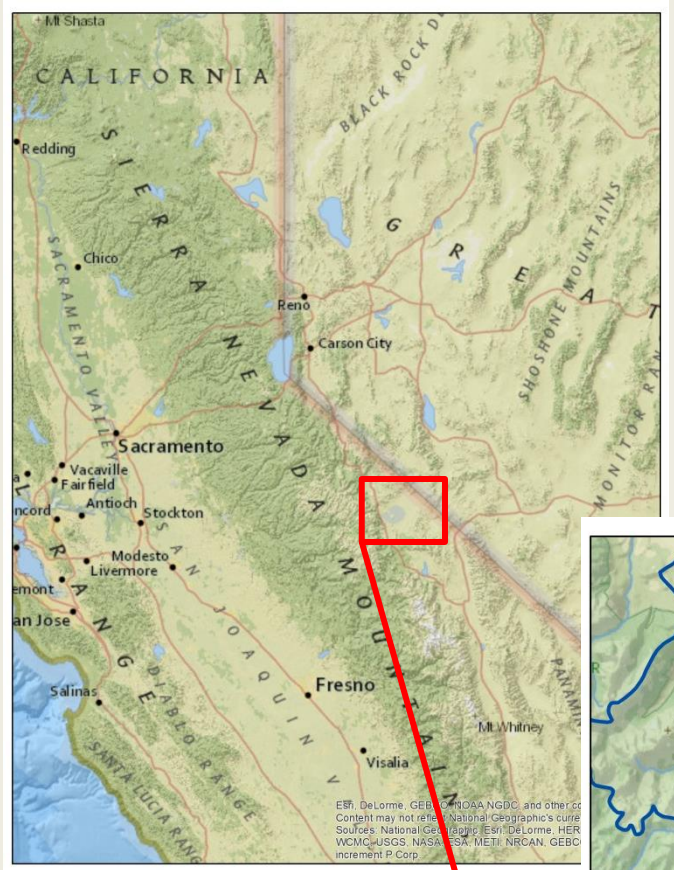
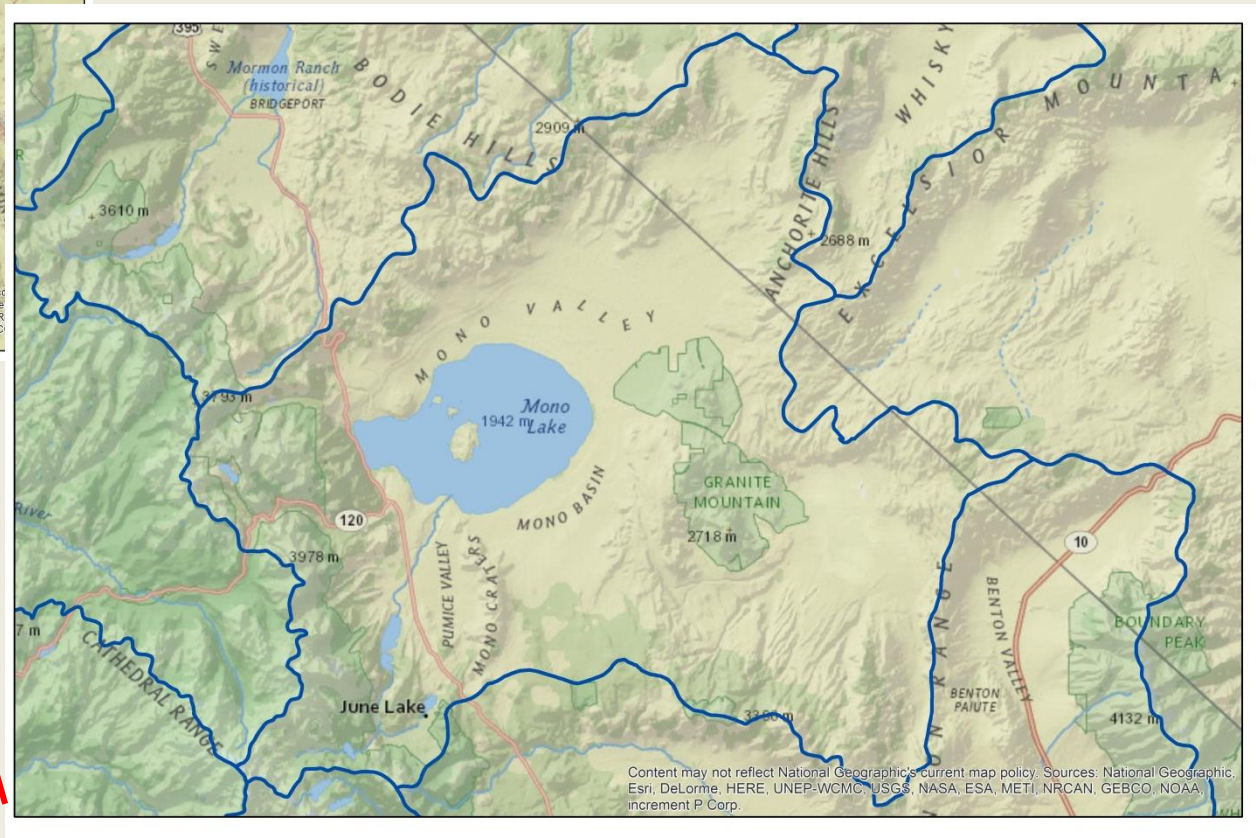
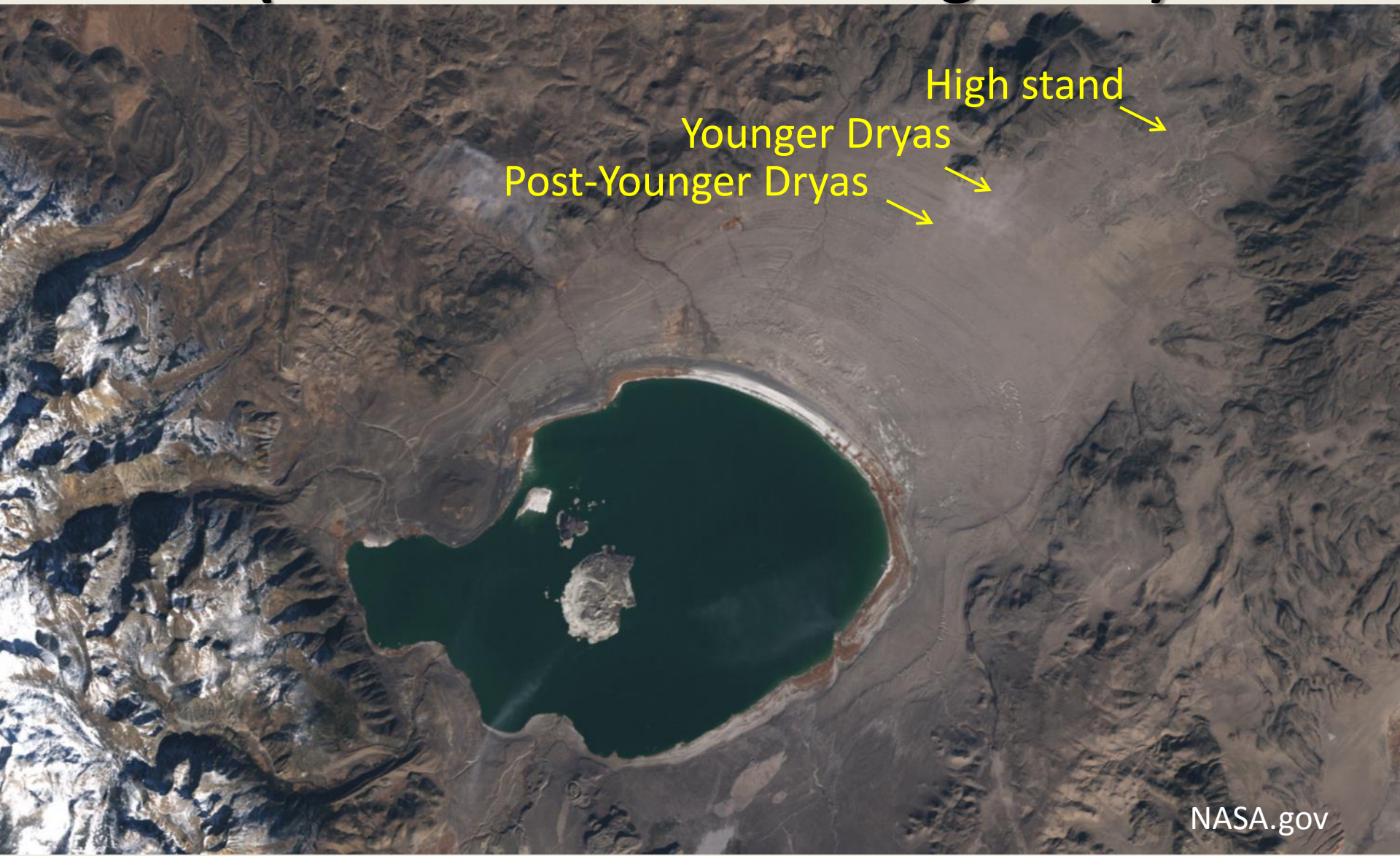


California and western Nevada

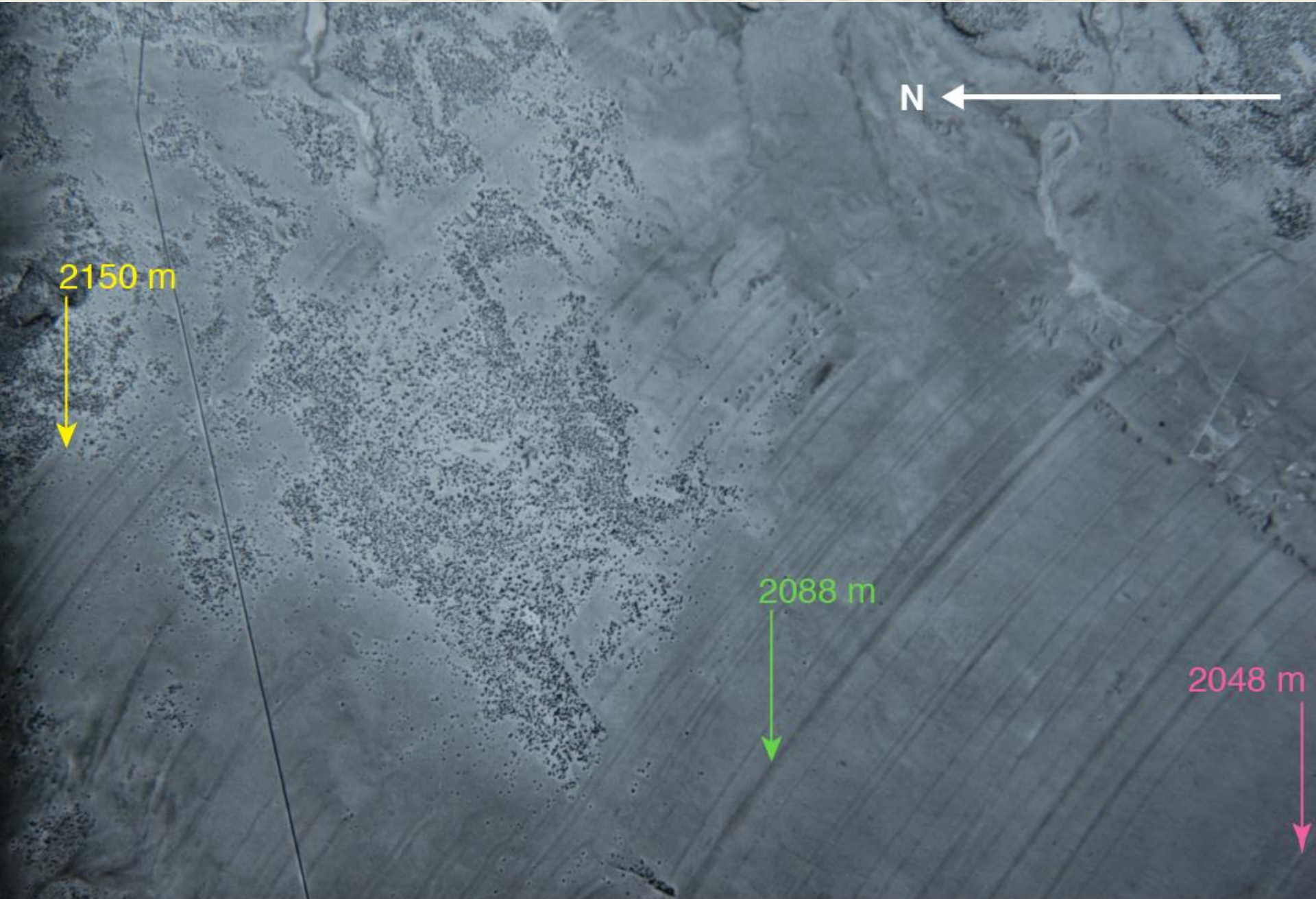
- Mono Basin is currently internally drained
- Glaciated on SW side of basin in late Pleistocene



Mono Lake basin shoreline berms (about 35 berms recognized)

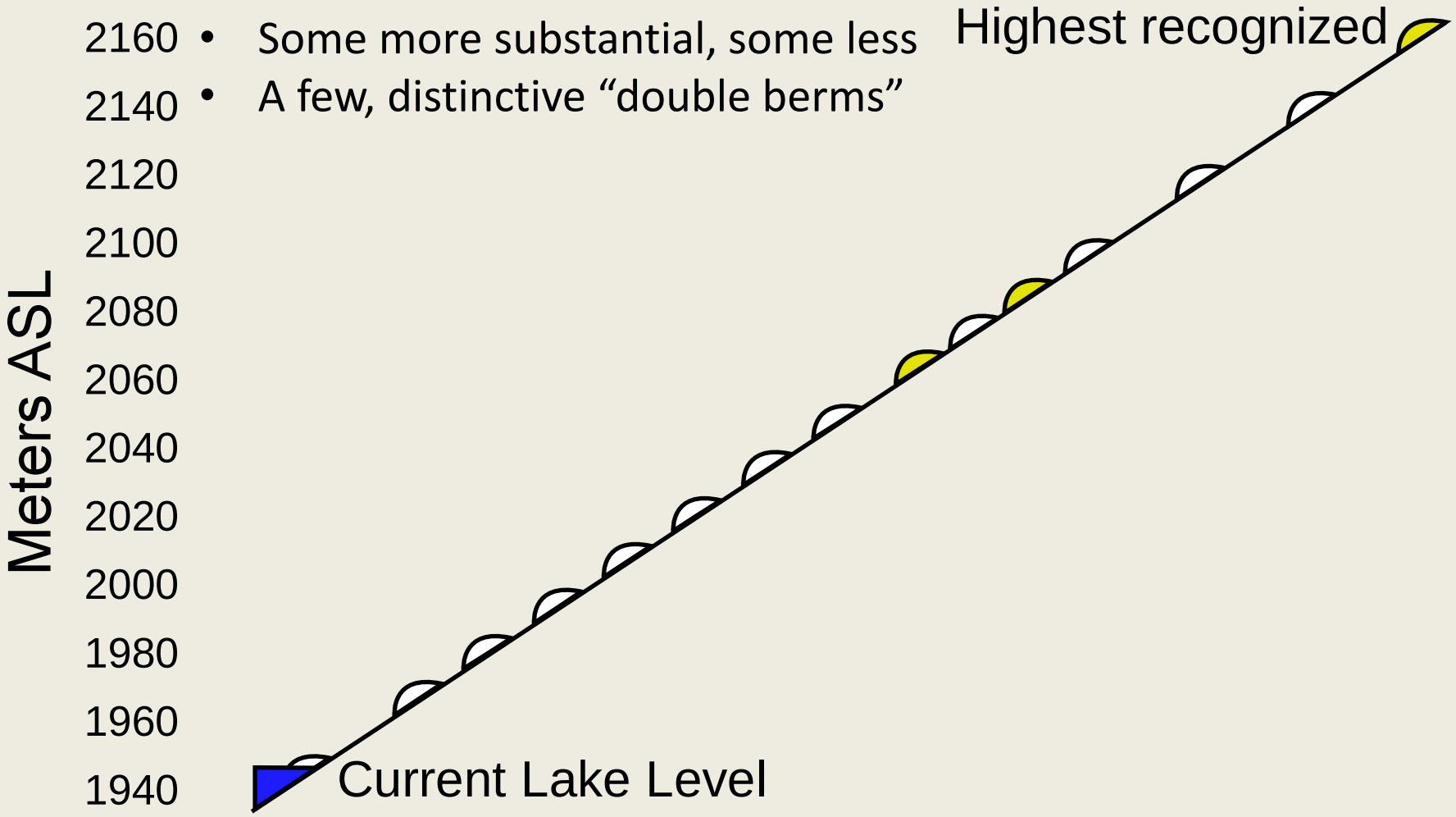


Mono Lake basin shoreline berms

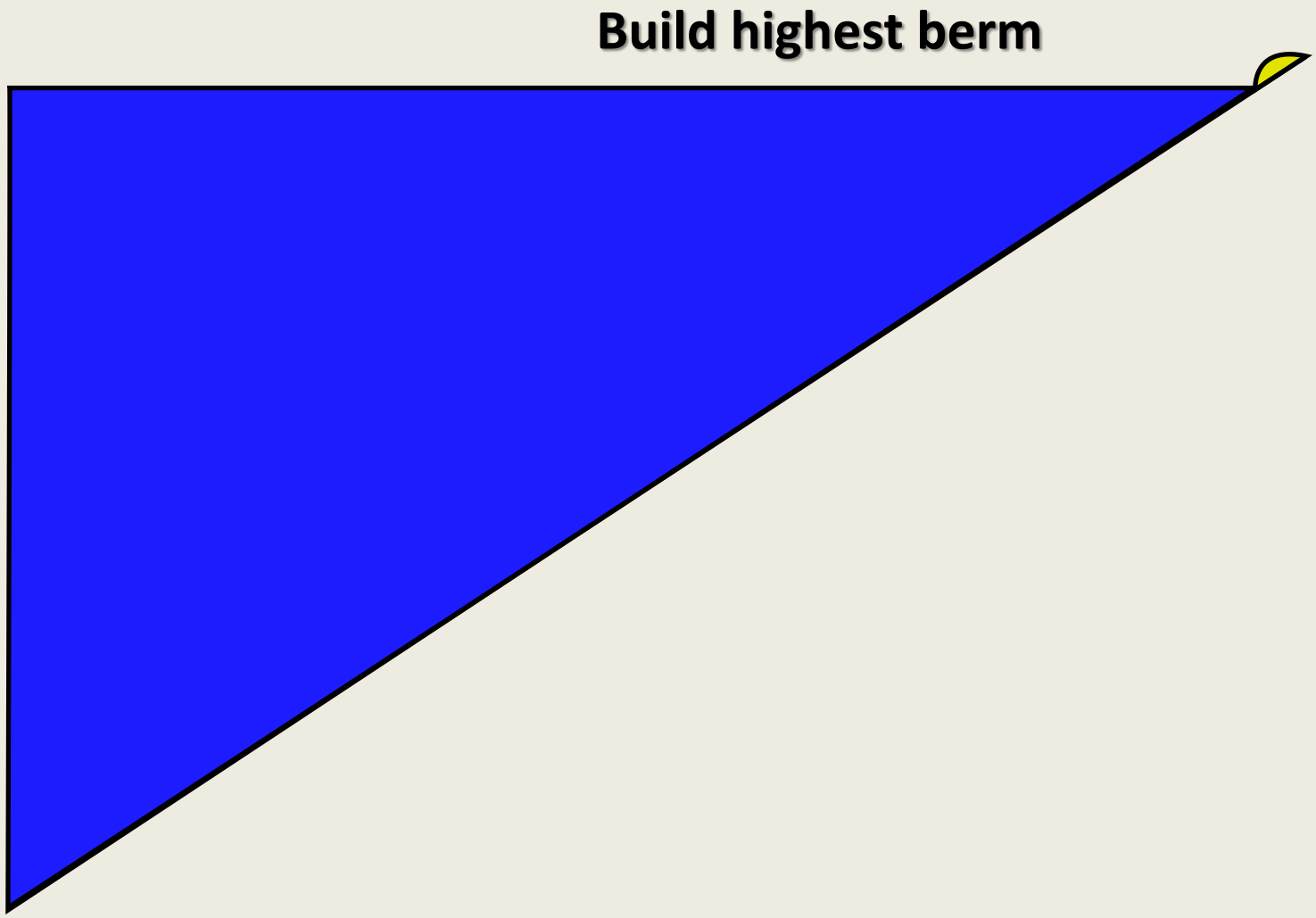


Development of Mono Beach Berms

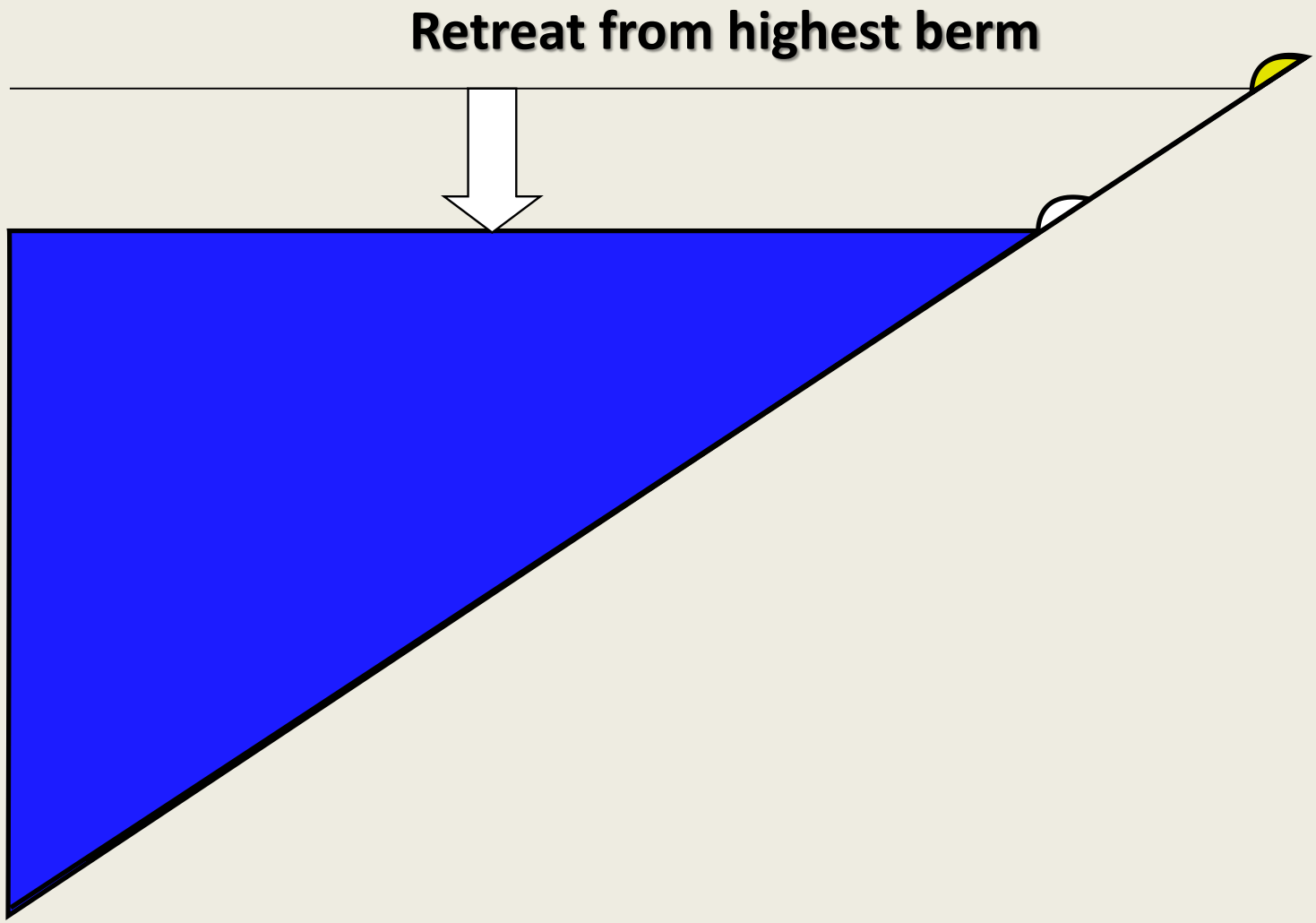
- Suite of ~35 berms at different elevations
- Some more substantial, some less
- A few, distinctive “double berms”



Development of Mono Beach Berms

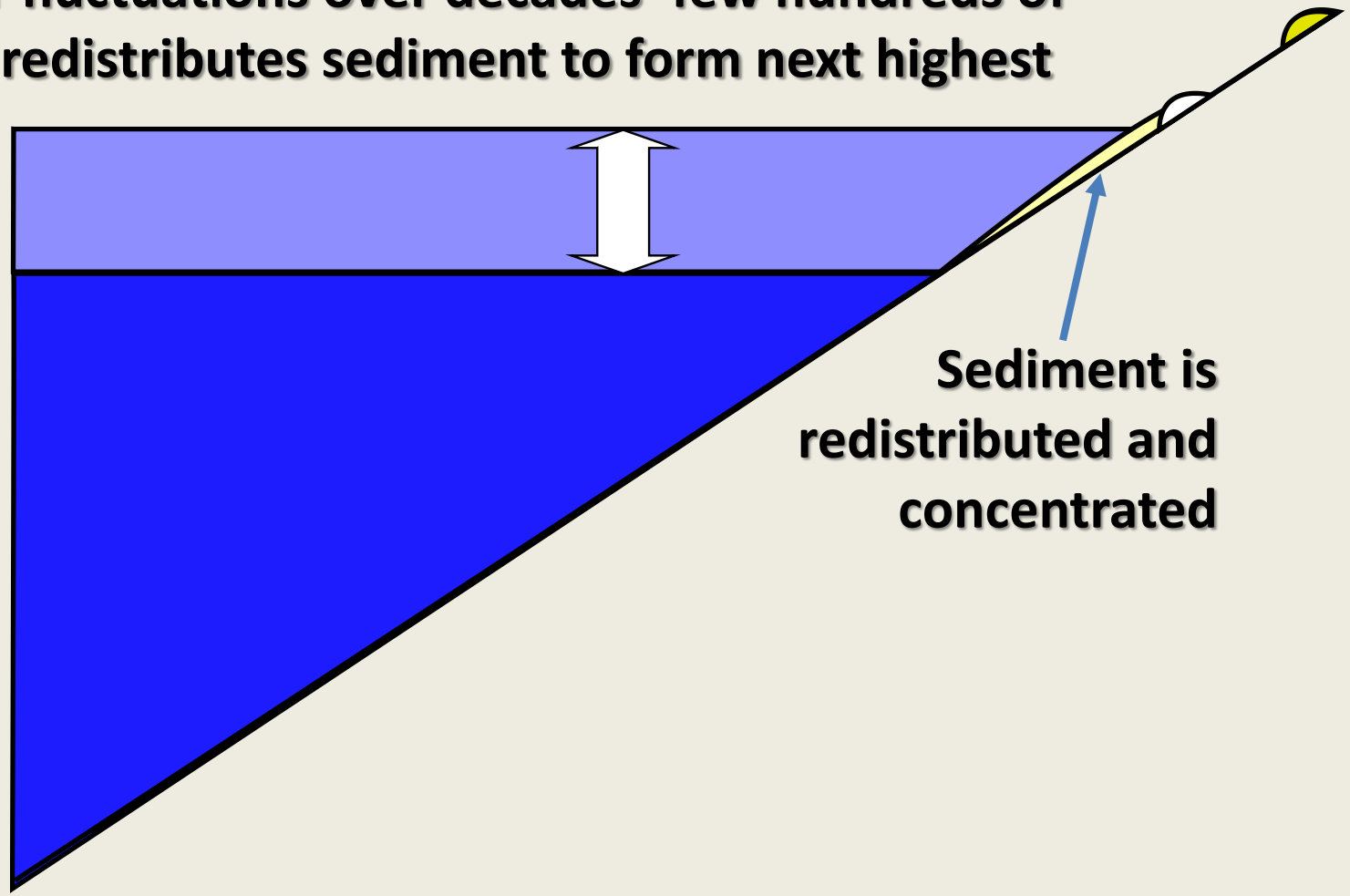


Development of Mono Beach Berms



Development of Mono Beach Berms

Water fluctuations over decades–few hundreds of years redistributes sediment to form next highest berm



Development of Mono Beach Berms

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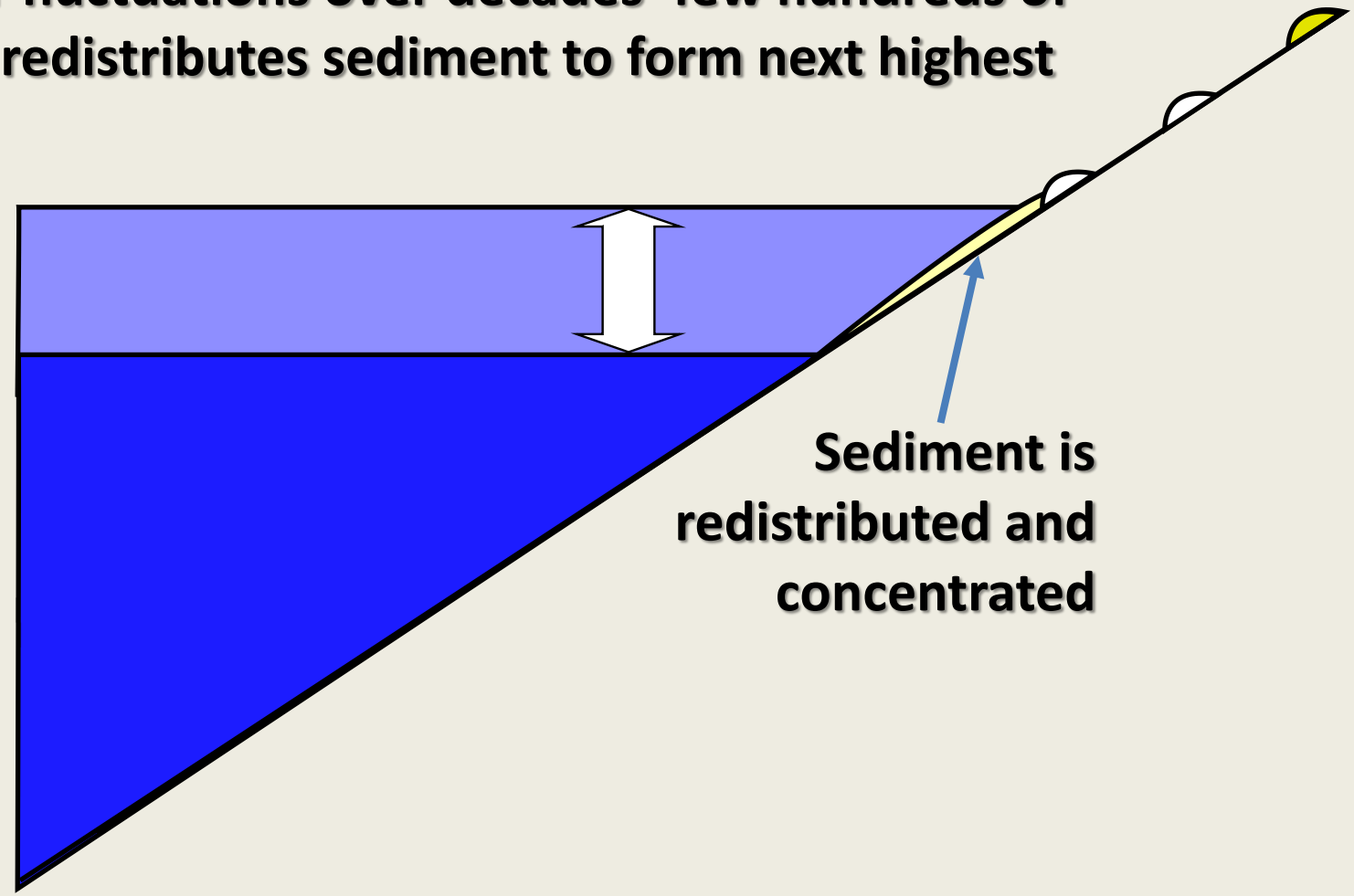
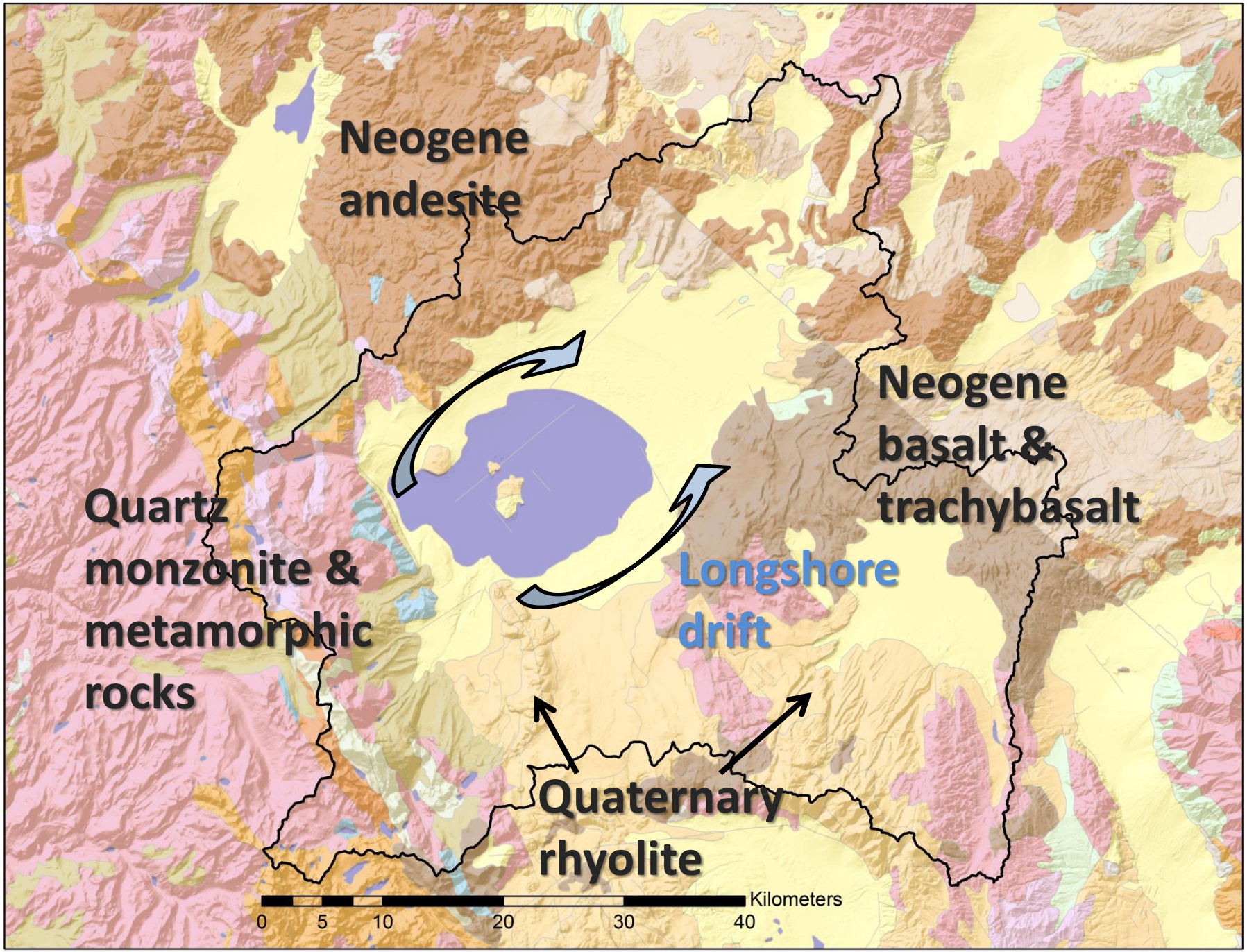
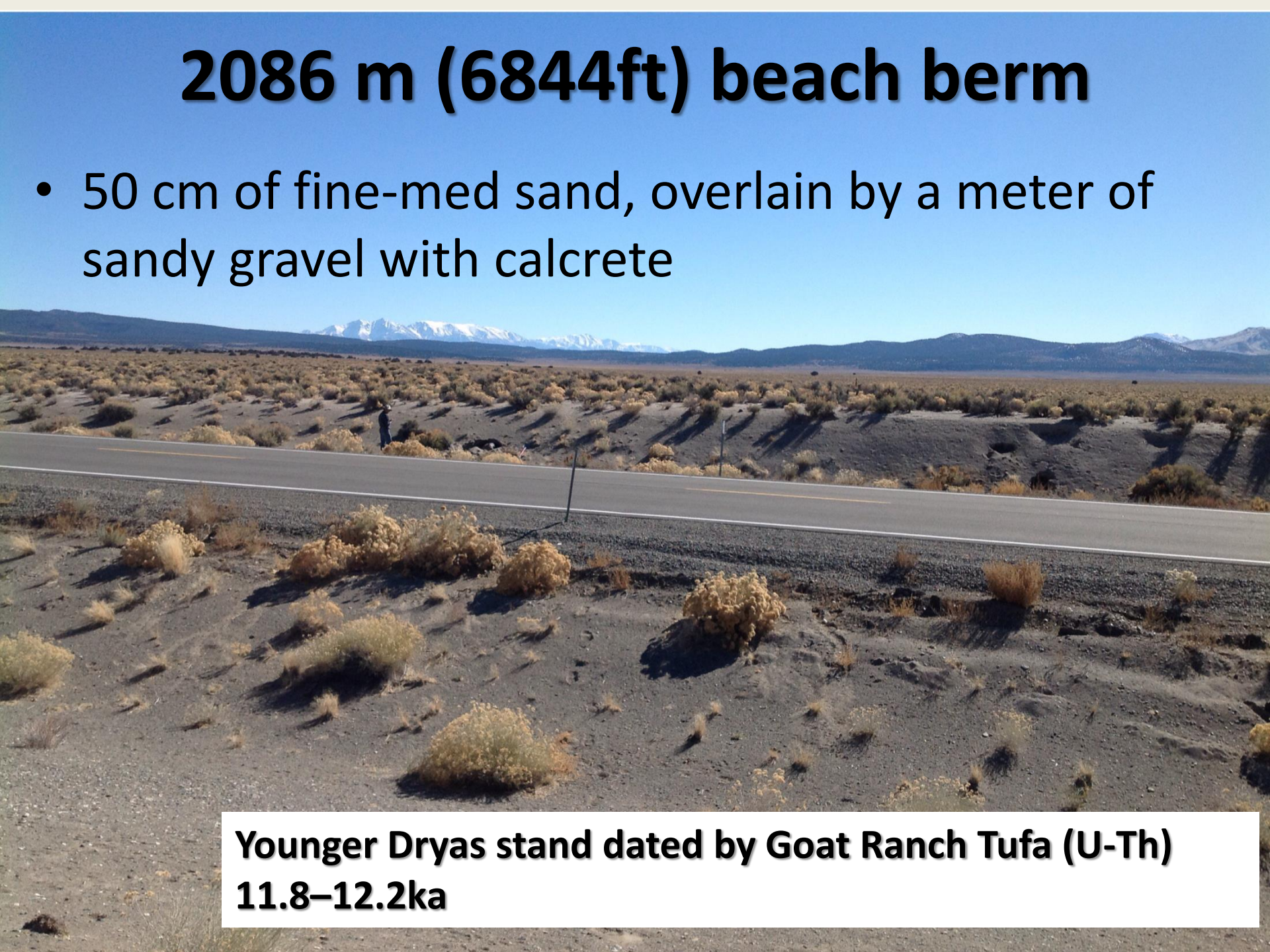



Neogene andesite
Neogene basalt & trachybasalt
Quartz monzonite & metamorphic rocks
Longshore drift
Quaternary rhyolite
Kilometers
0
5
10
20
30
40

2086 m (6844ft) beach berm

- 50 cm of fine-med sand, overlain by a meter of sandy gravel with calcrete



Younger Dryas stand dated by Goat Ranch Tufa (U-Th) 11.8–12.2ka

2066m (6777ft) berm– Two samples

20m lower than Younger Dryas berm – expected age ~11.7-12.1 ka

- Fine-medium grained sand with sandy pebble gravel above and below, overlain by planar parallel pebble gravel with sand
- Upper flow regime foreshore environment

2162m (7092ft) "Ultimate high stand" berm

- Well rounded fine-grained sand; planar laminated, underlain by granule gravel with crude bedding and fine-grained sand
- Upper flow regime backshore environment

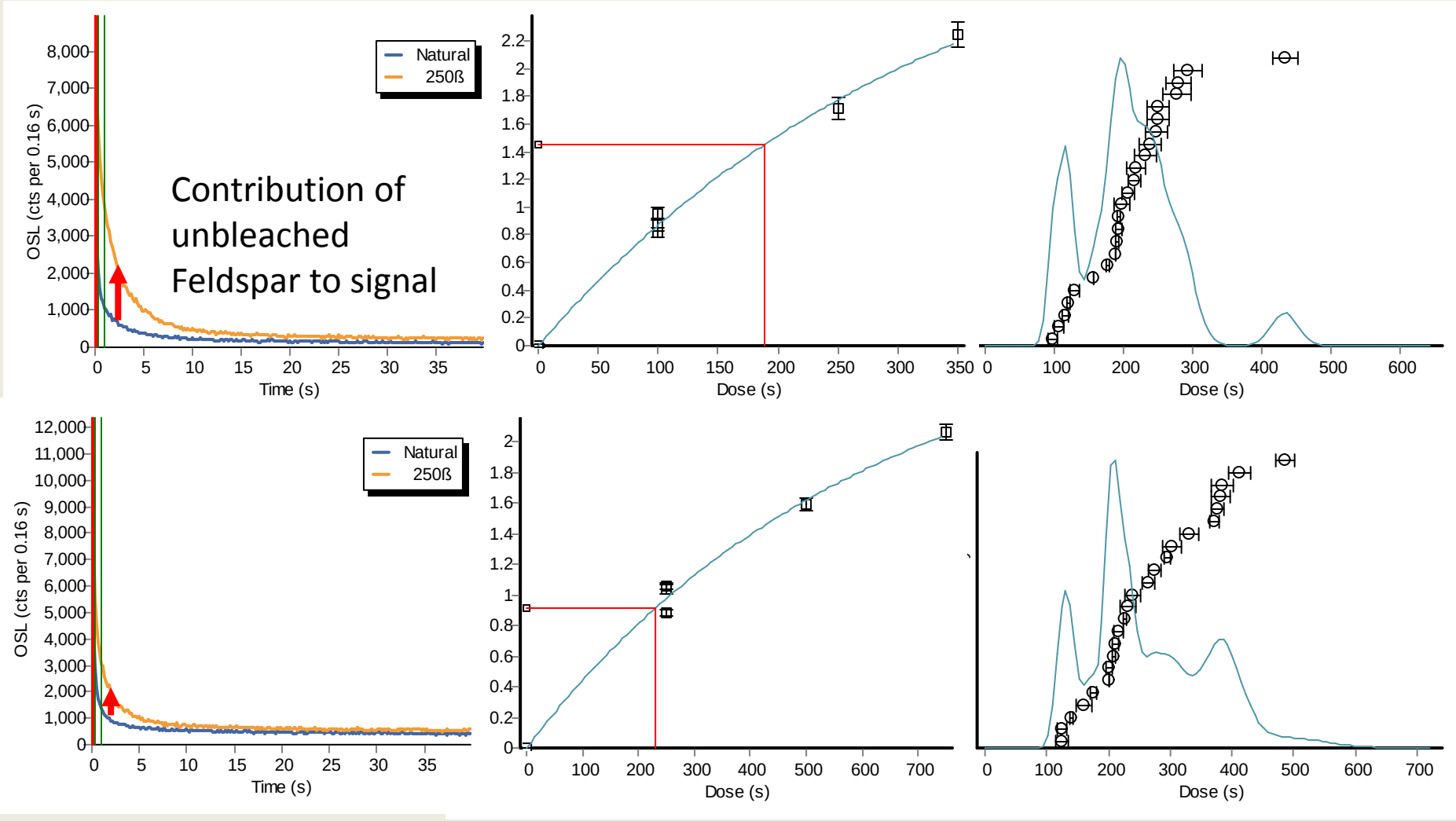
7092.25-ft A berm

Purified Quartz & K-rich feldspar sample preparation

- Wet sieve for 180-250µ fraction
- Acid cleaning with 10% HCL & organic matter removal with H_2O_2
- Heavy liquid separation (2.58 g cm-1)
- Etching of quartz 40% HF & feldspar in 10% HF
- Quartz purity tested using infrared (IR) stimulation

Mono Basin – Younger Dryas beach berm

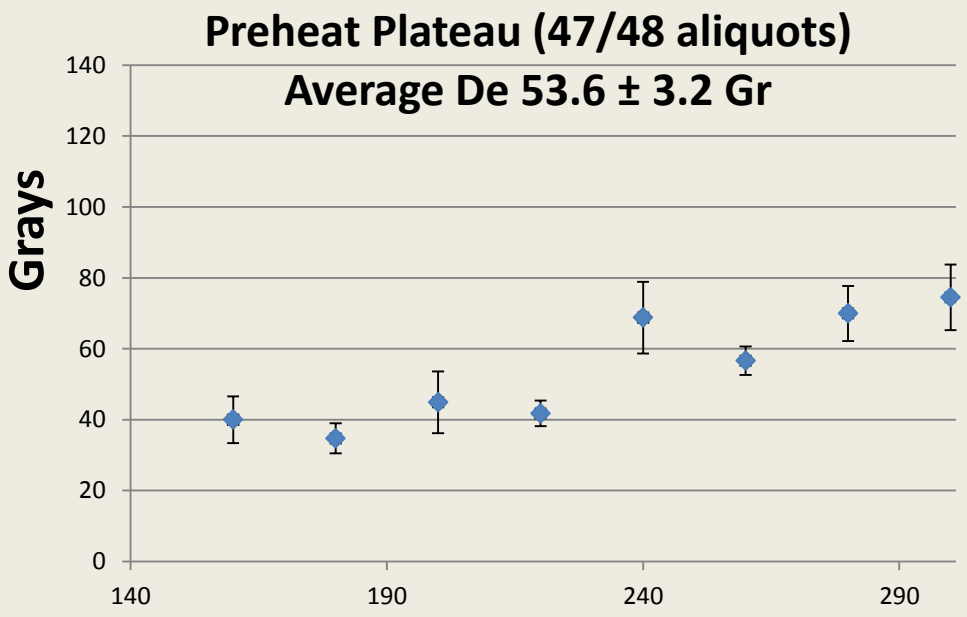
- Two examples of Continuous Wave data
- Feldspar contamination leads to high background



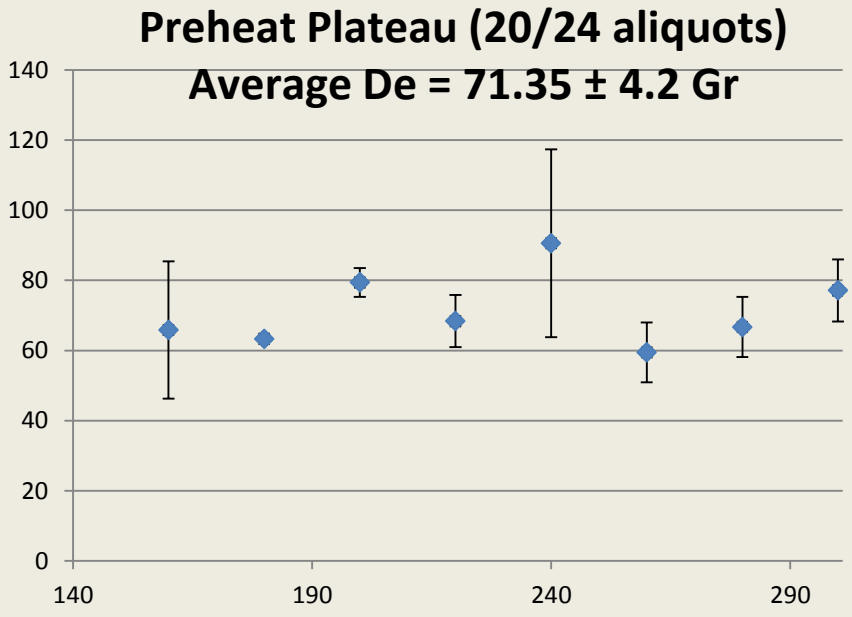
Beach berm correlated to Younger Dryas high stand

- Etched twice, but still noisy data and high background
- Used Pulsed OSL to decrease background levels due to Feldspar

Continuous Wave



Pulsed OSL



- Background subtraction in Continuous Wave data leads to lower estimated doses due to feldspar contamination of quartz signal

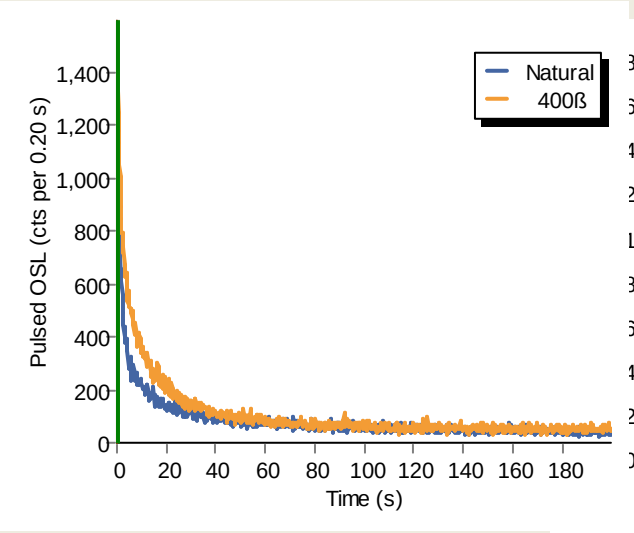
Pulsed OSL measurements

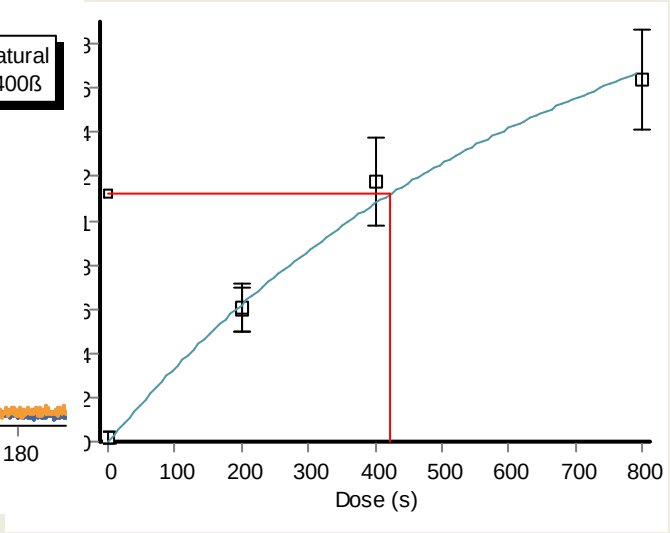
- TL/OSL Risø DA-15 Post-IR (IR 870 ± 40 nm) Pulsed OSL Blue (470 ± 30 nm) stimulation
- Pulse 50µs on – 200µs off
- Detection of quartz signal through UV filters
- Large aliquot (5-8 mm stainless steel cups) appropriate for late Pleistocene samples*

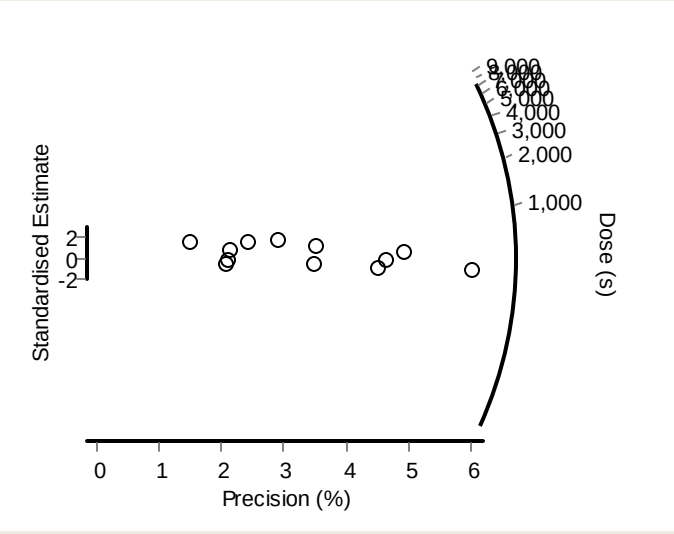
* Murray et al. (2015) *Radiation Measurements* and Thomsen et al. (2016) *Quaternary Geochronology*

Pulsed OSL results for YD berm

- 13/24 cups passed screening
- 60.92 ± 2.93 Gy (dose rate of 4.54±0.3 Gy/ka)
- 13.41 ± 1.13 ka



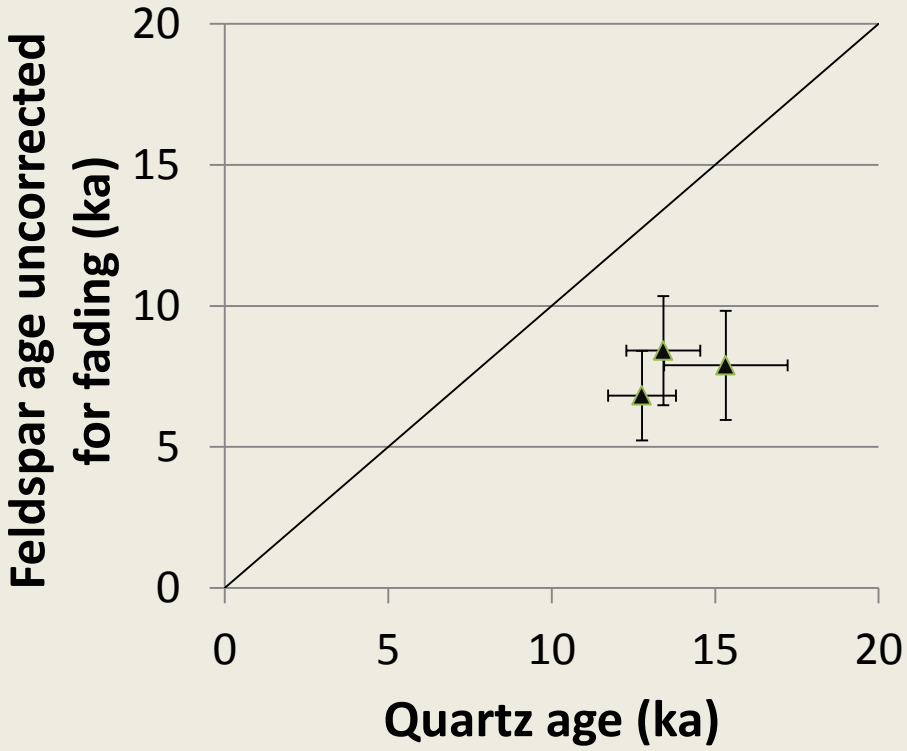




Mono Basin – Quartz vs Feldspar estimated dose

- High Stand berm has high estimated dose (225 Gy) but no Feldspar data

- Quartz bleaches in sunlight much more readily
- Therefore lower uncorrected Feldspar ages show Quartz is likely well bleached (Murray et al., 2012)



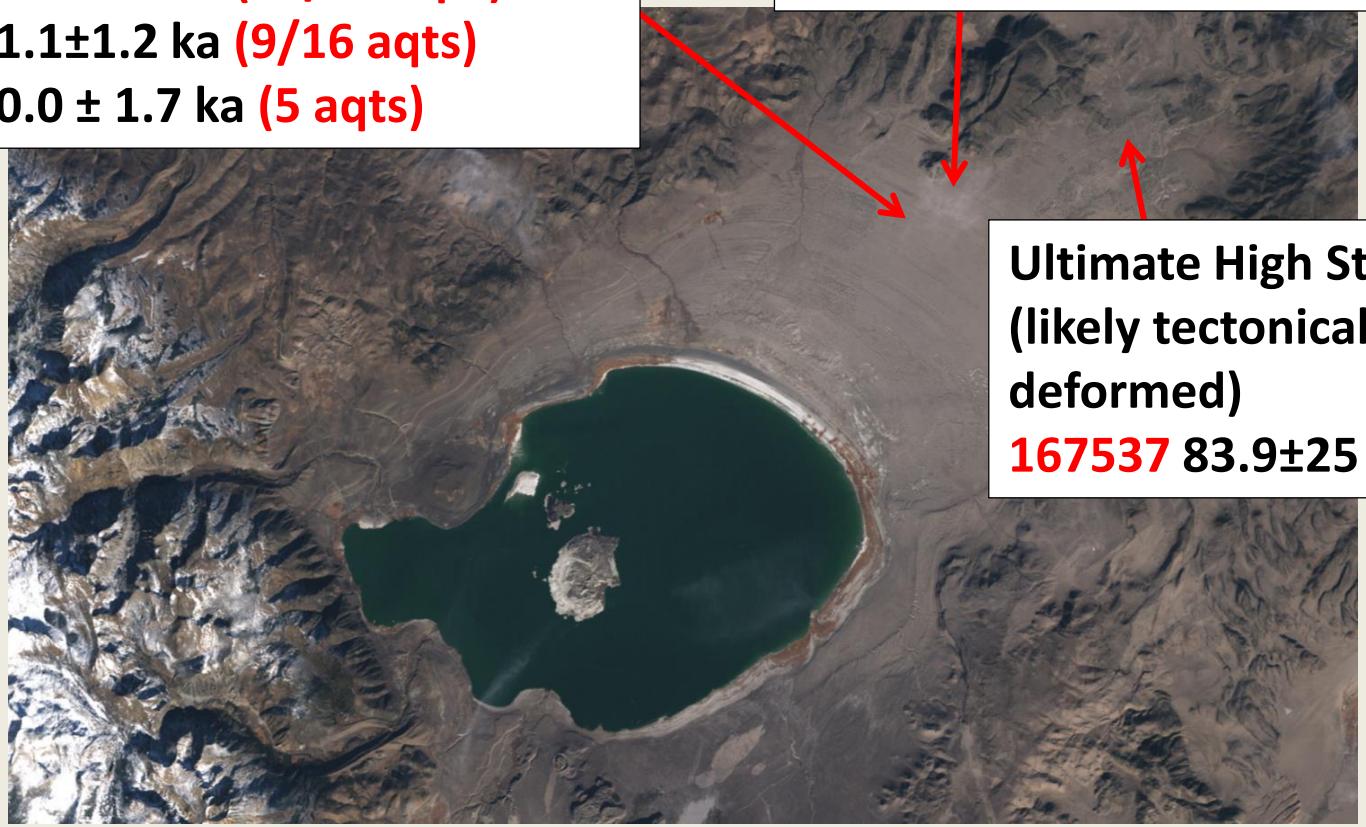
Conclusion:
Beach berms likely well bleached

Pulsed OSL Quartz

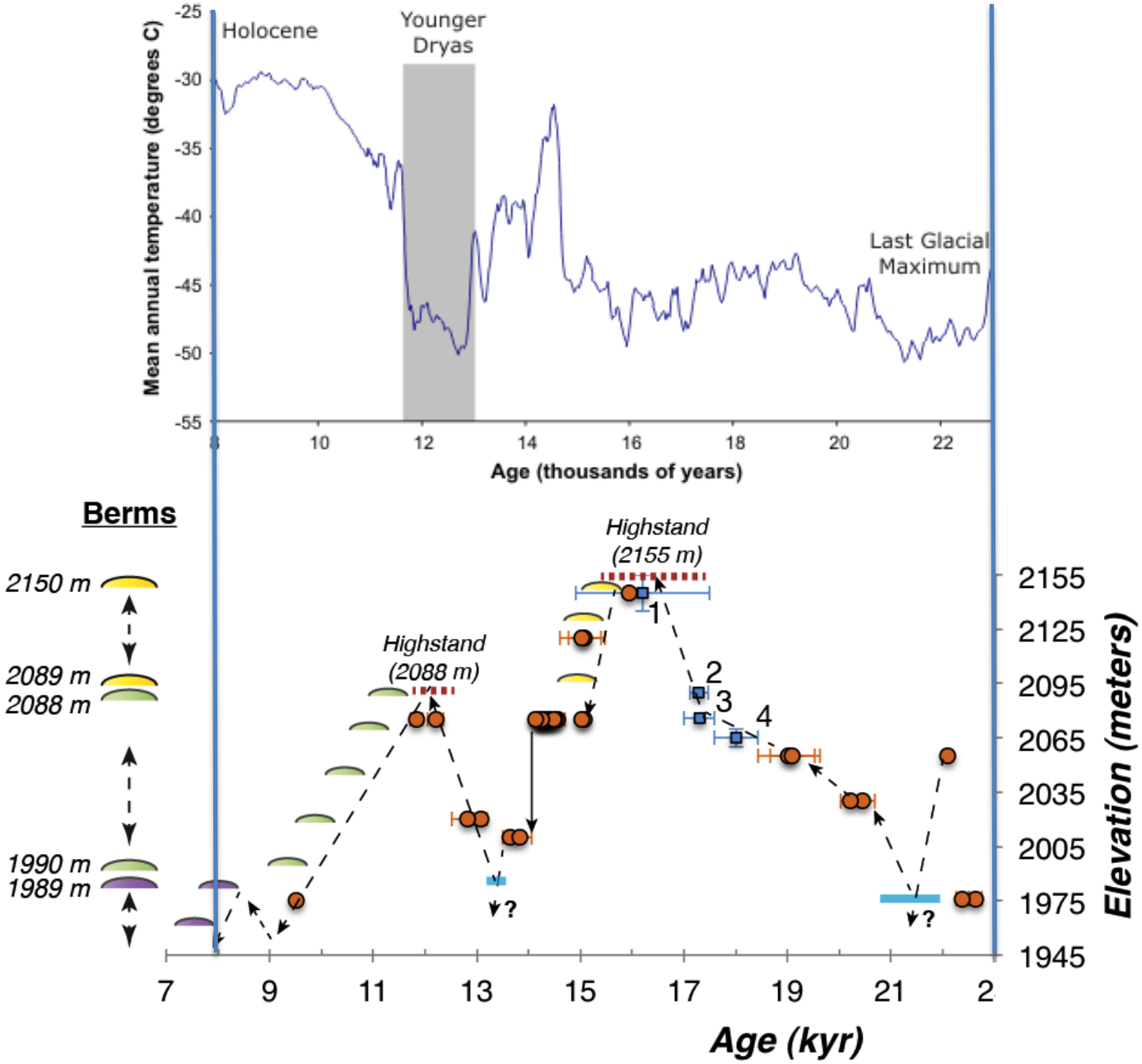
Ages (assuming 4% ± 4% w.c.)

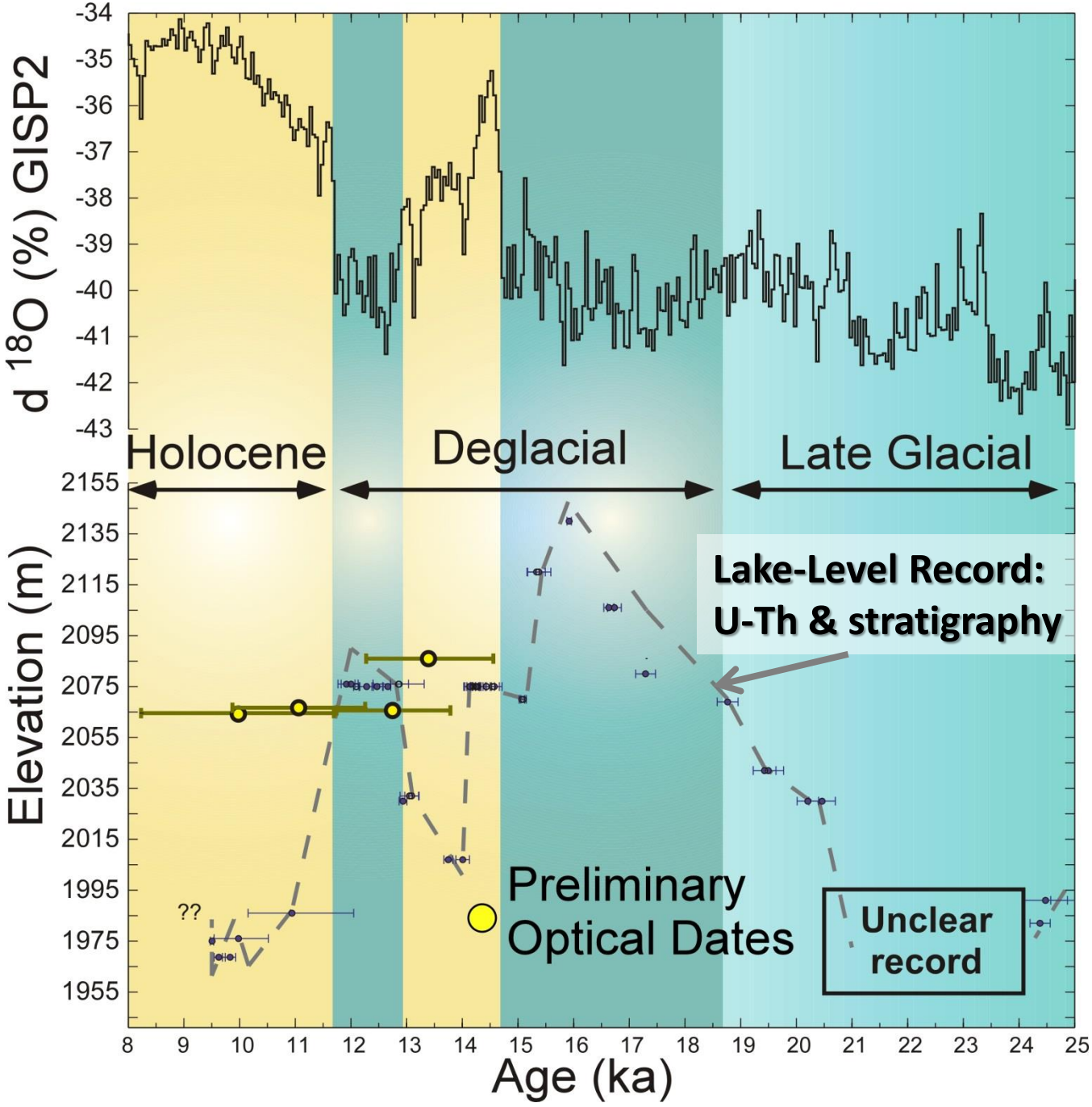
Post-Younger Dryas
167533 12.8±1.0 ka **(14/18 aqts)**
167534 11.1±1.2 ka **(9/16 aqts)**
167535 10.0 ± 1.7 ka **(5 aqts)**

Younger Dryas
167532 13.4±1.1 **(28/33 aqts)**



Ultimate High Stand Berm (likely tectonically deformed)
167537 83.9±25 ka **(6 aqts)**


Holocene
Younger Dryas
Last Glacial Maximum
Mean annual temperature (degrees C)
-25
-30
-35
-40
-45
-50
-55
10
12
14
16
18
20
22
Age (thousands of years)
Berms
2150 m
2089 m
2088 m
1990 m
1989 m
Highstand (2155 m)
Highstand (2088 m)
1
2
3
4
?
?
2155
2125
2095
2065
2035
2005
1975
1945
Elevation (meters)
7
9
11
13
15
17
19
21
2
Age (kyr)


d 18O (%) GISP2
-34
-35
-36
-37
-38
-39
-40
-41
-42
-43
Holocene
Deglacial
Late Glacial
Elevation (m)
2155
2135
2115
2095
2075
2055
2035
2015
1995
1975
1955
Lake-Level Record:
U-Th & stratigraphy
??
Preliminary
Optical Dates
Unclear
record
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
Age (ka)

Conclusions

- First-cycle quartz and feldspar in the Mono Basin are appropriate for optical dating
- Beach berm sediments are well bleached
- Preliminary optical dates in the basin are consistent with U-Th series dates on high density carbonates
- Optical dating of suite of beach berms may clarify late Pleistocene to Holocene climatic transitions in eastern California desert region