Pluvial Lake Carrizo: A much larger Lake in the Carrizo Plain during the Ice-age Maximum ~20,000 Years Ago

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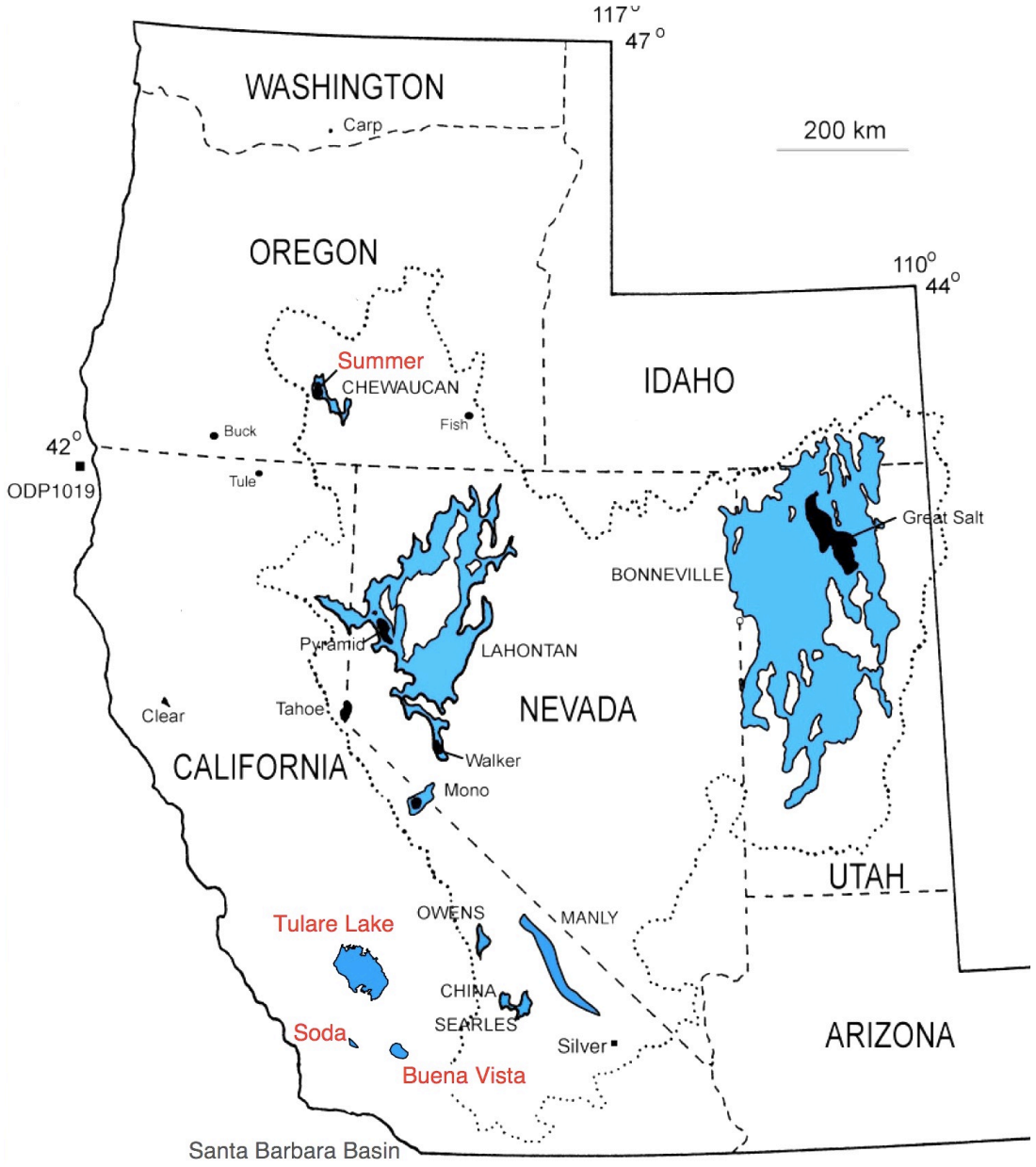
- Manuel Palacios-Fest, Terra Nostra Earth Sciences Research

Pluvial Lakes of the western U.S.
(after Benson, 2004)



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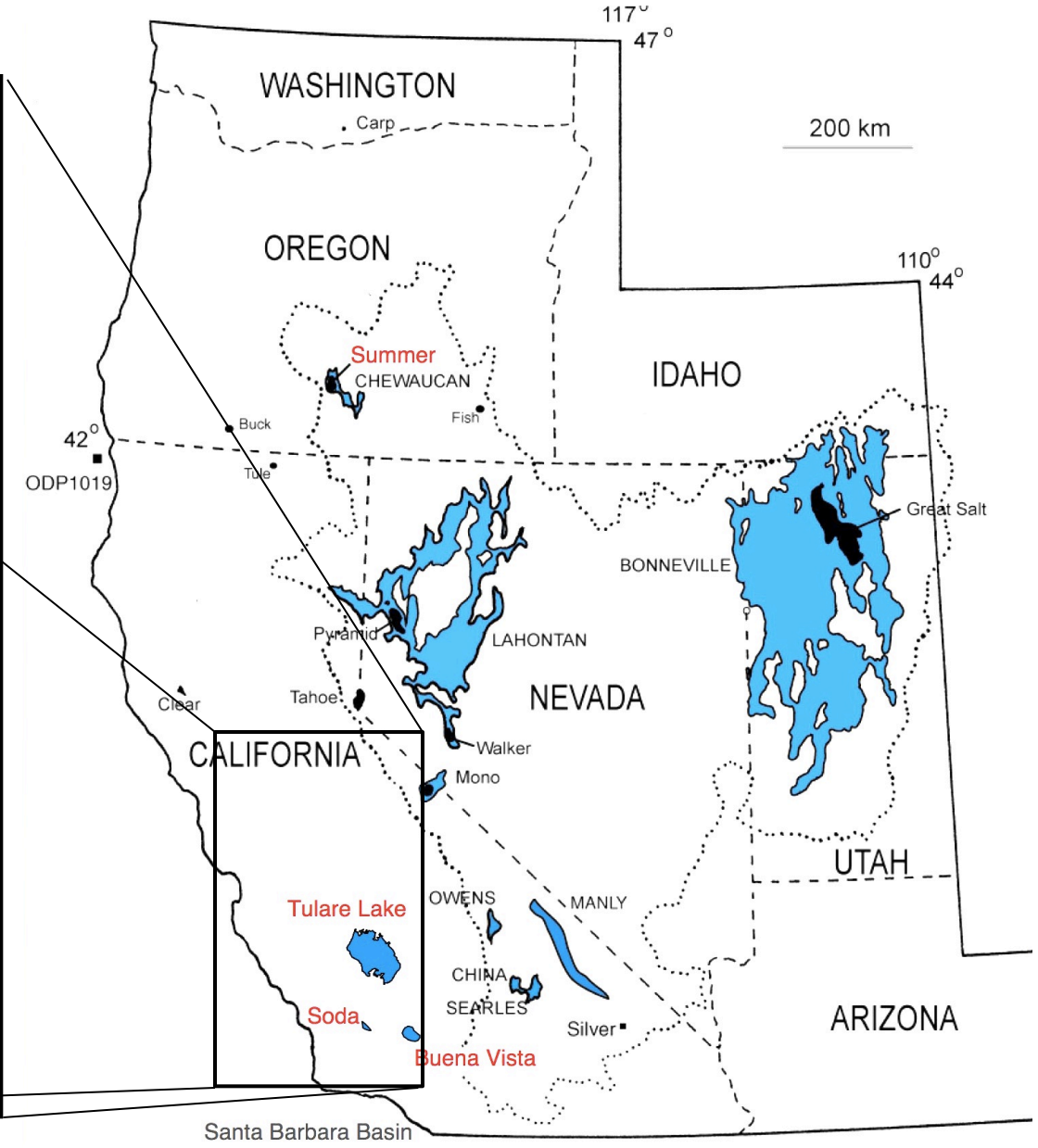
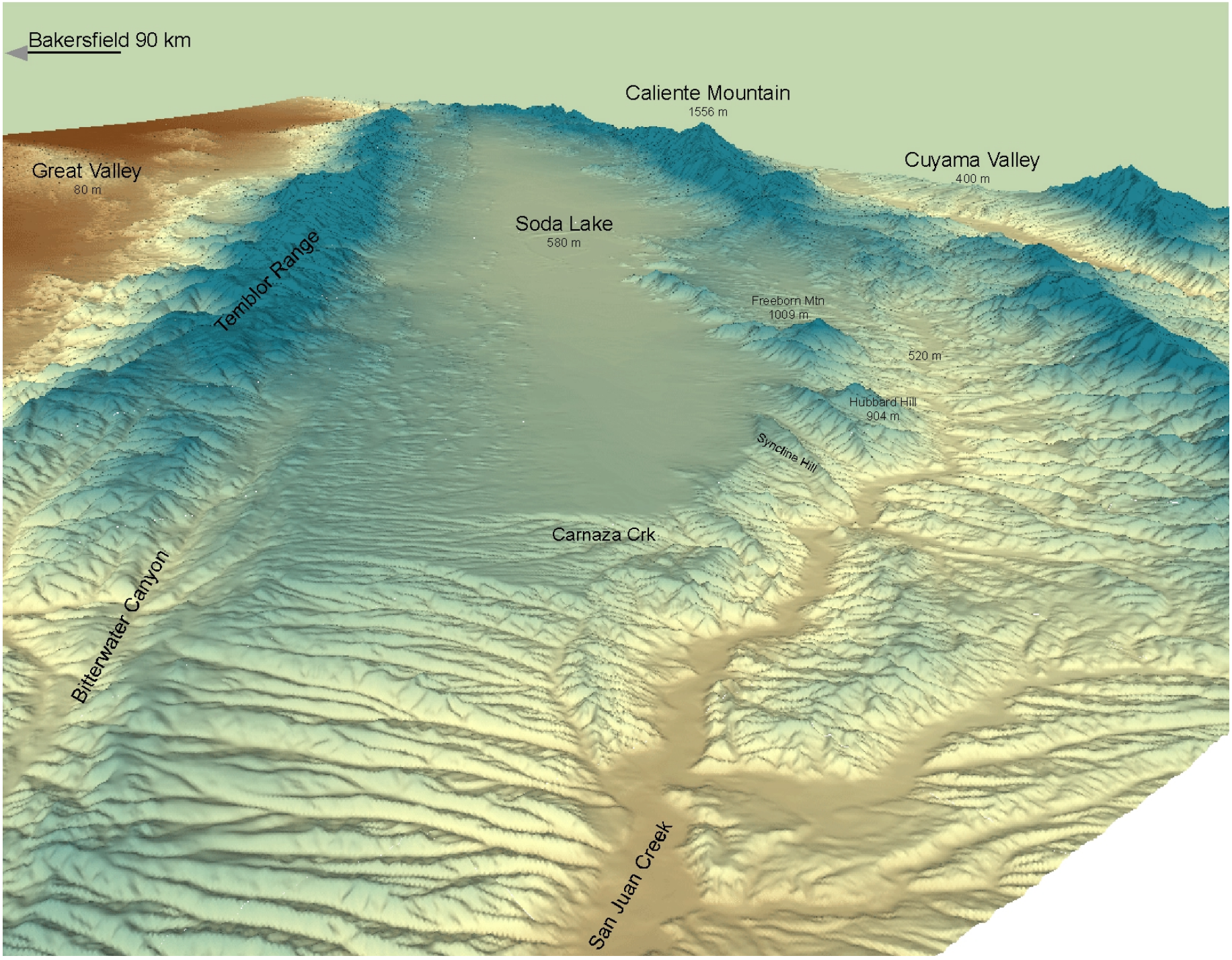
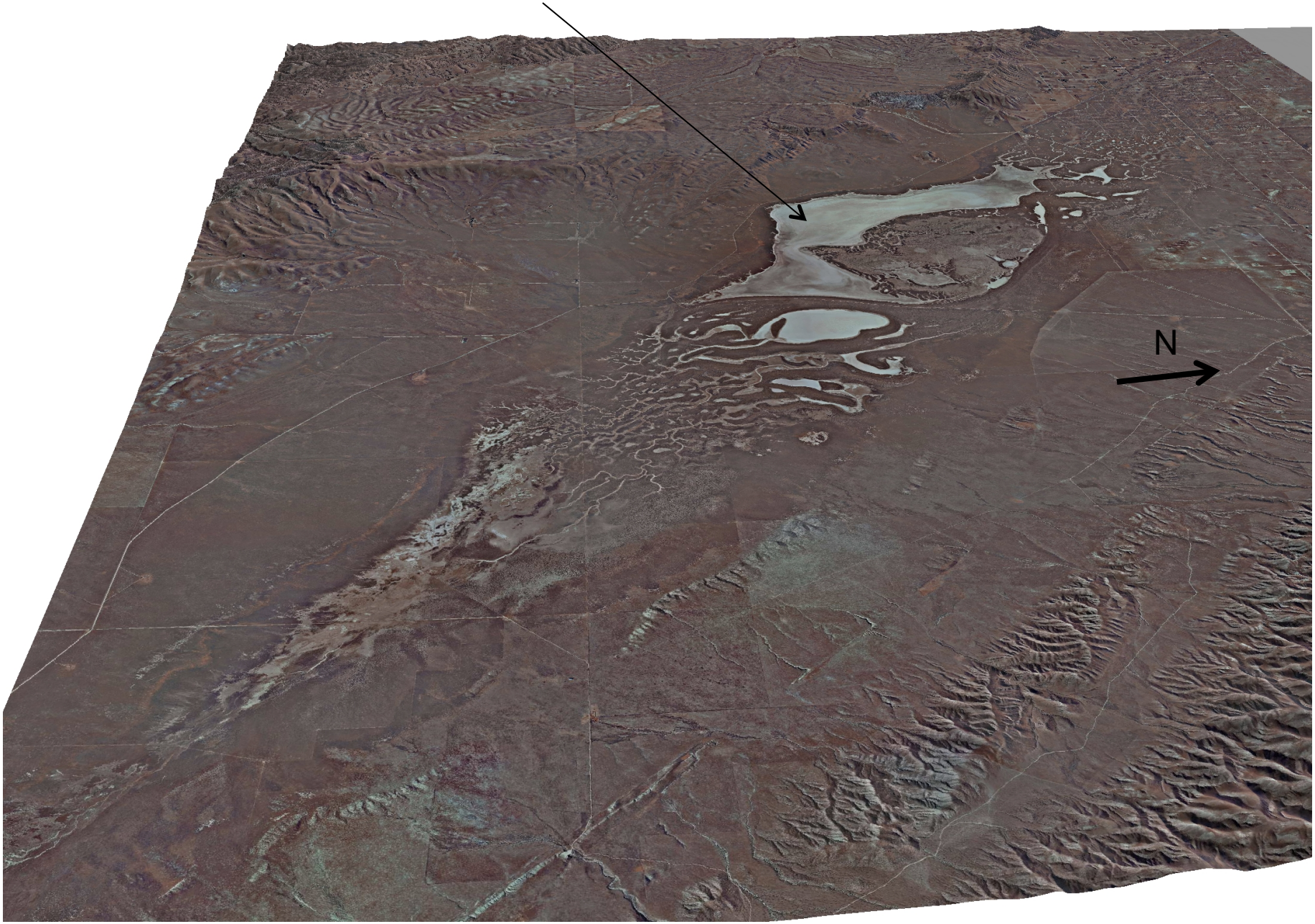
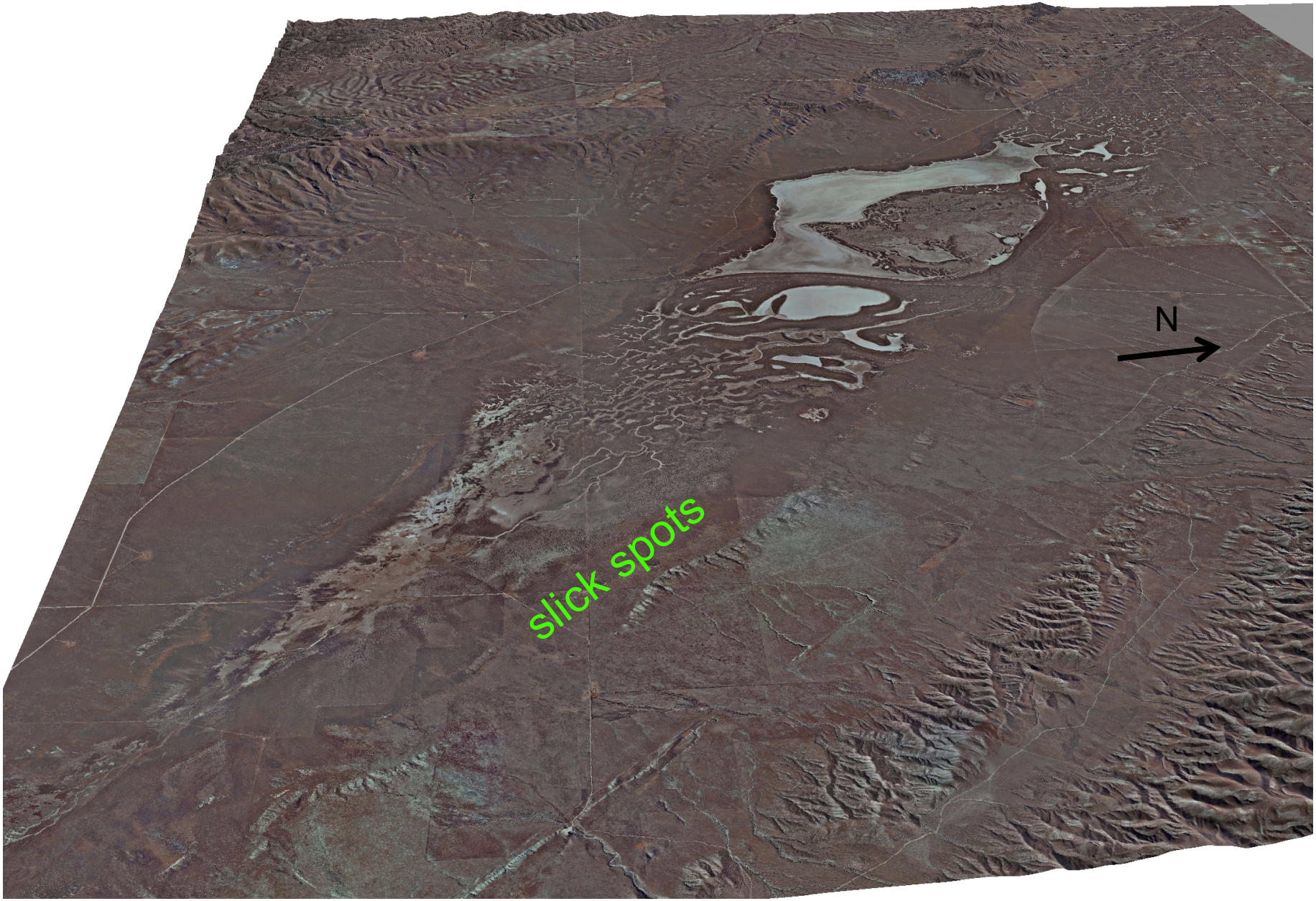



Bakersfield 90 km
Caliente Mountain
1556 m
Great Valley
80 m
Cuyama Valley
400 m
Soda Lake
580 m
Temblor Range
Freeborn Mtn
1009 m
520 m
Hubbard Hill
904 m
Syncline Hill
Carnaza Crk
Bitterwater Canyon
San Juan Creek

Extent of the modern Lake

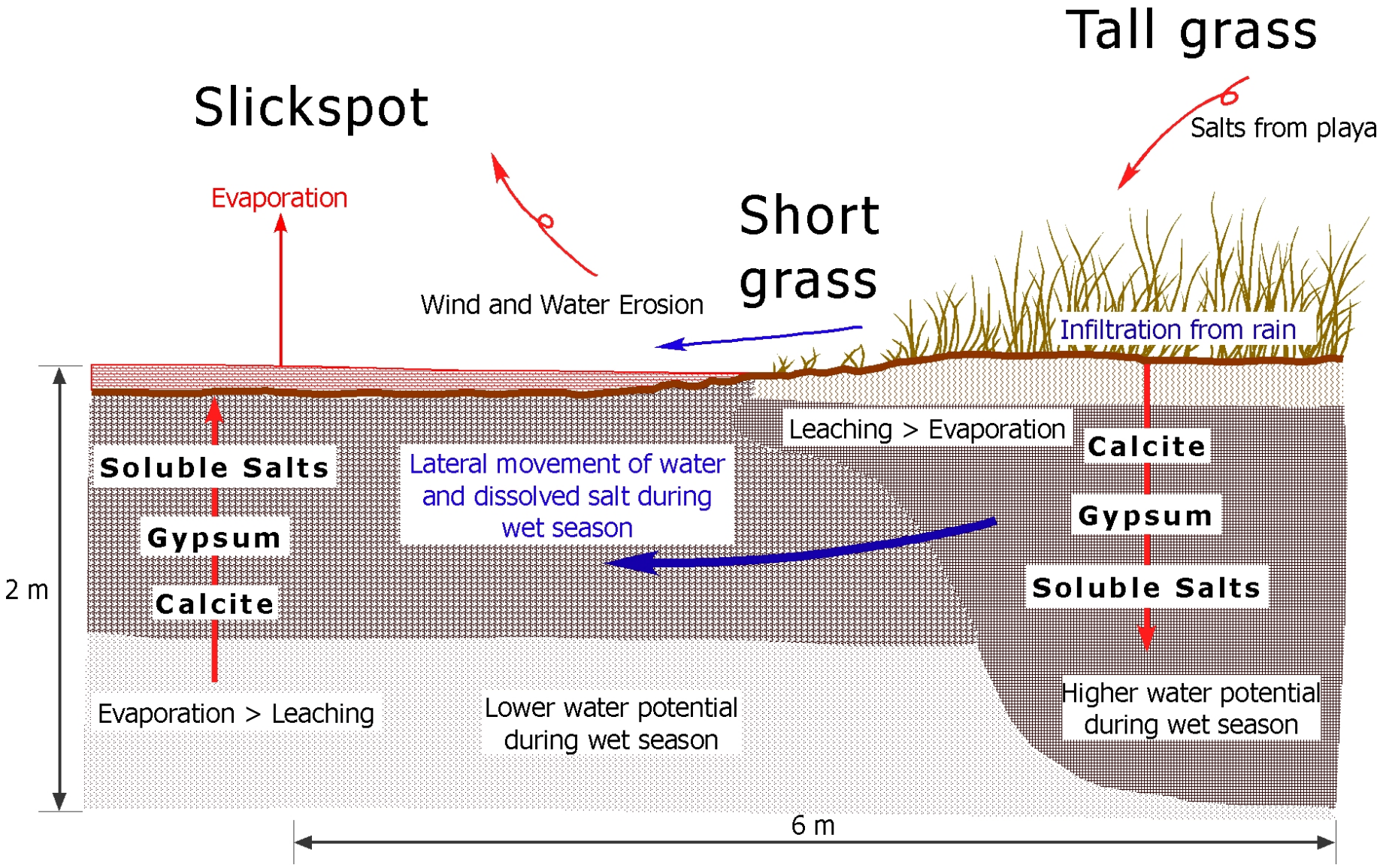


Ancient shoreline defined by "slickspots"



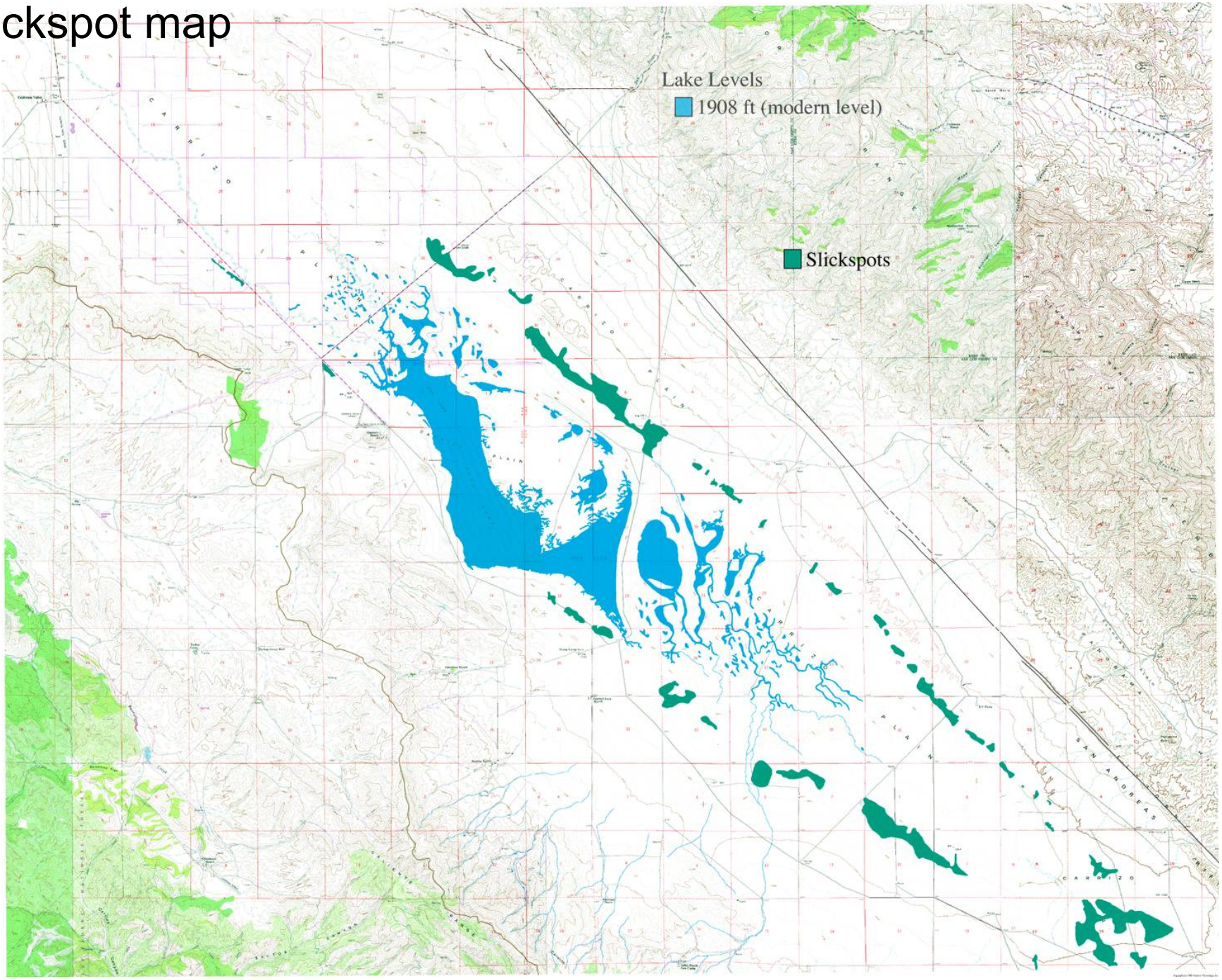

3883-24
slick spots

Surface photo of slickspots

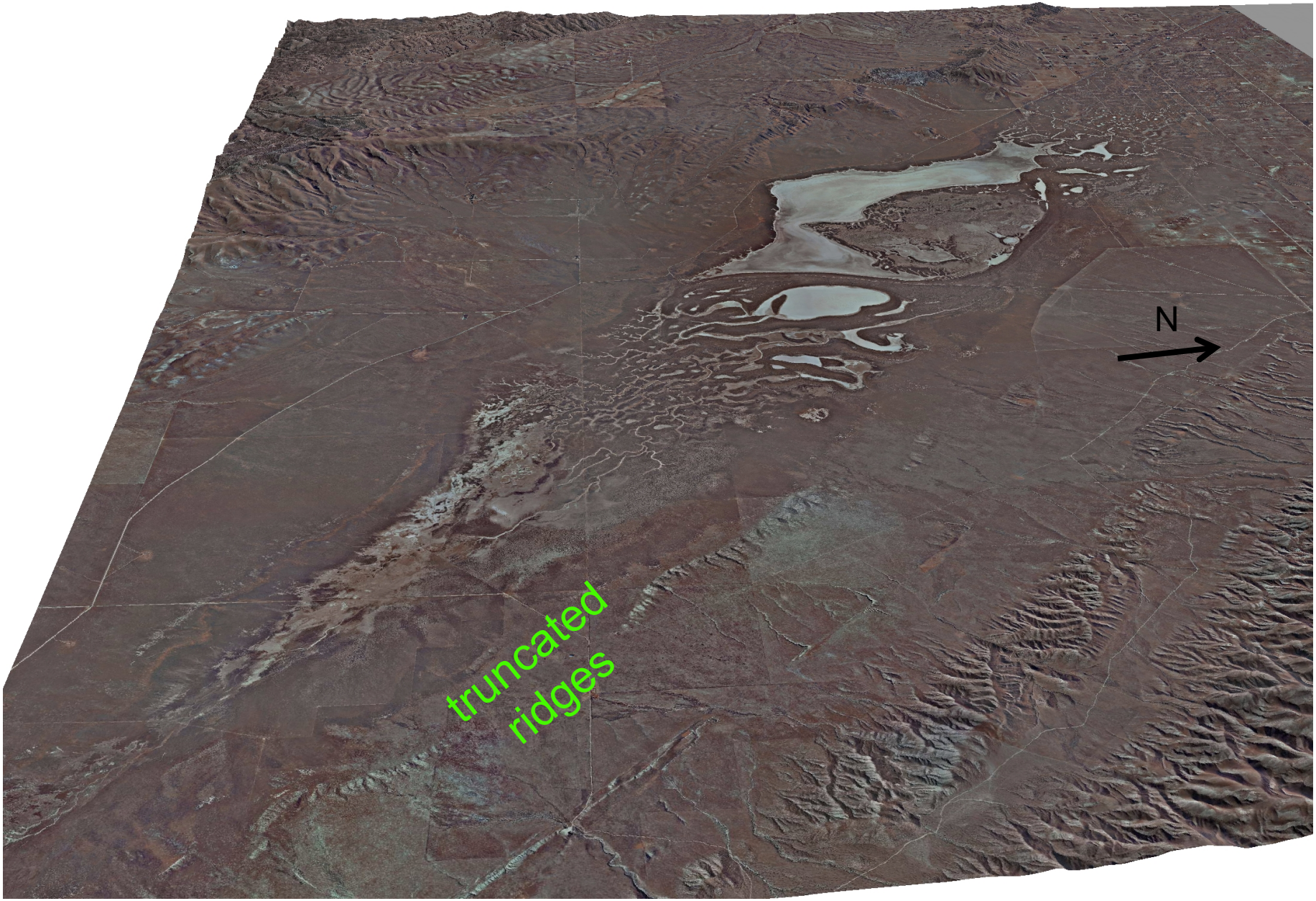


after Reid et al. (1993)

Slickspot map



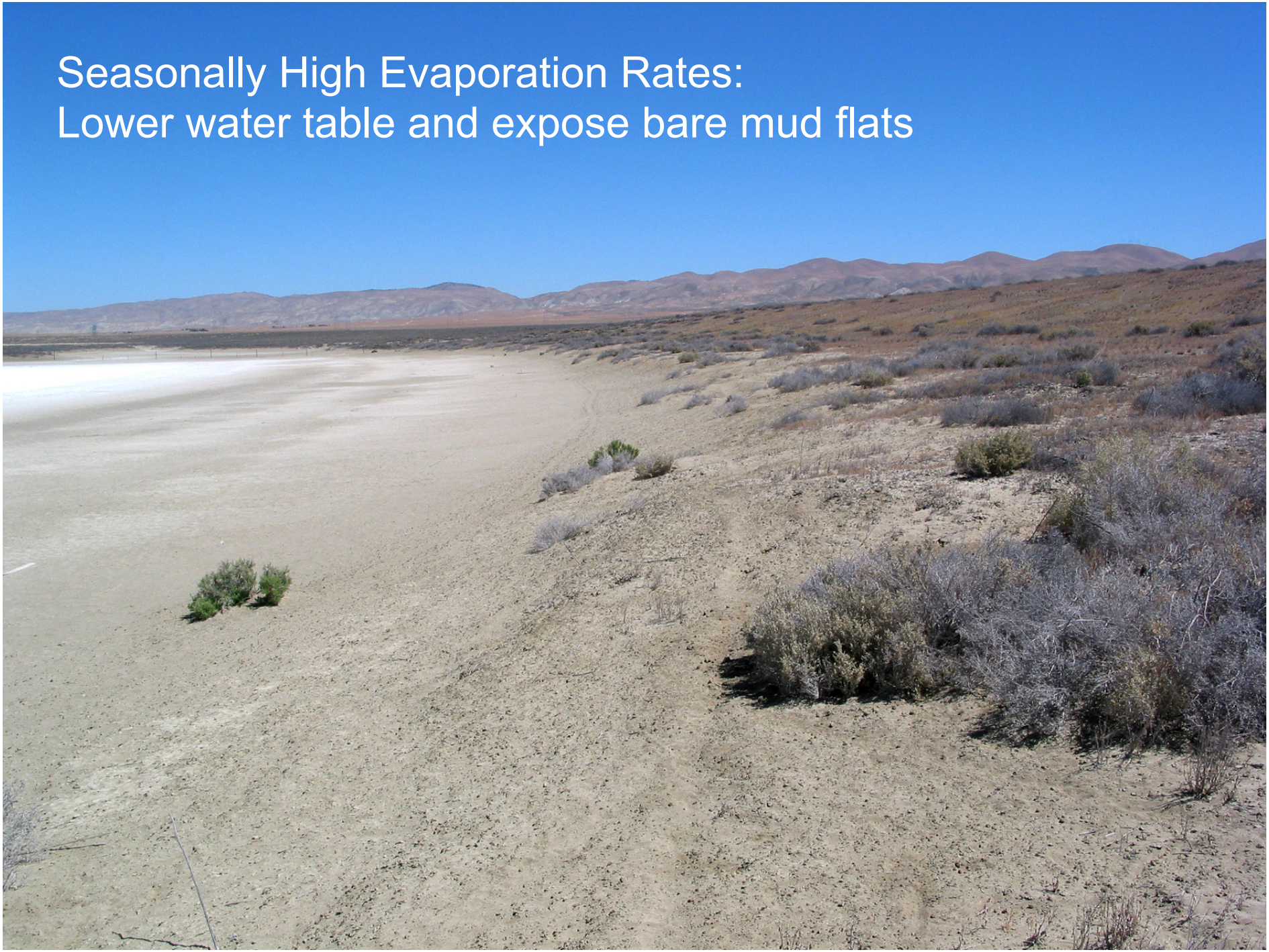
Ancient shoreline defined by "trimmed" anticlinal ridges




3883-24
slick spots
truncated ridges

Recession of ancient shoreline defined by clay dunes

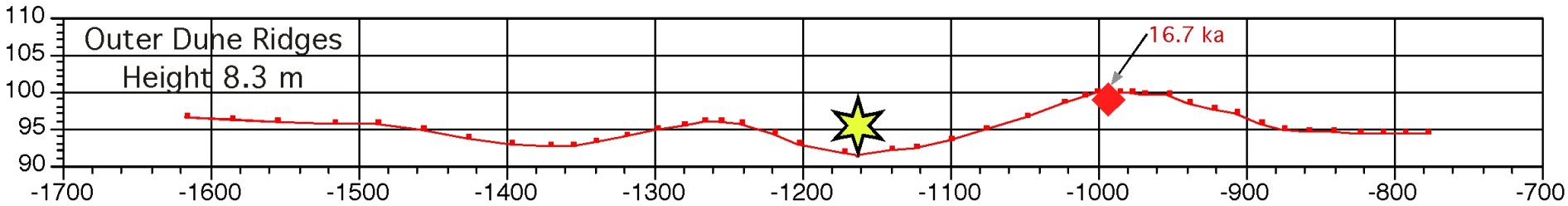
Seasonal Flooding: Supply, concentrate, and distribute salt

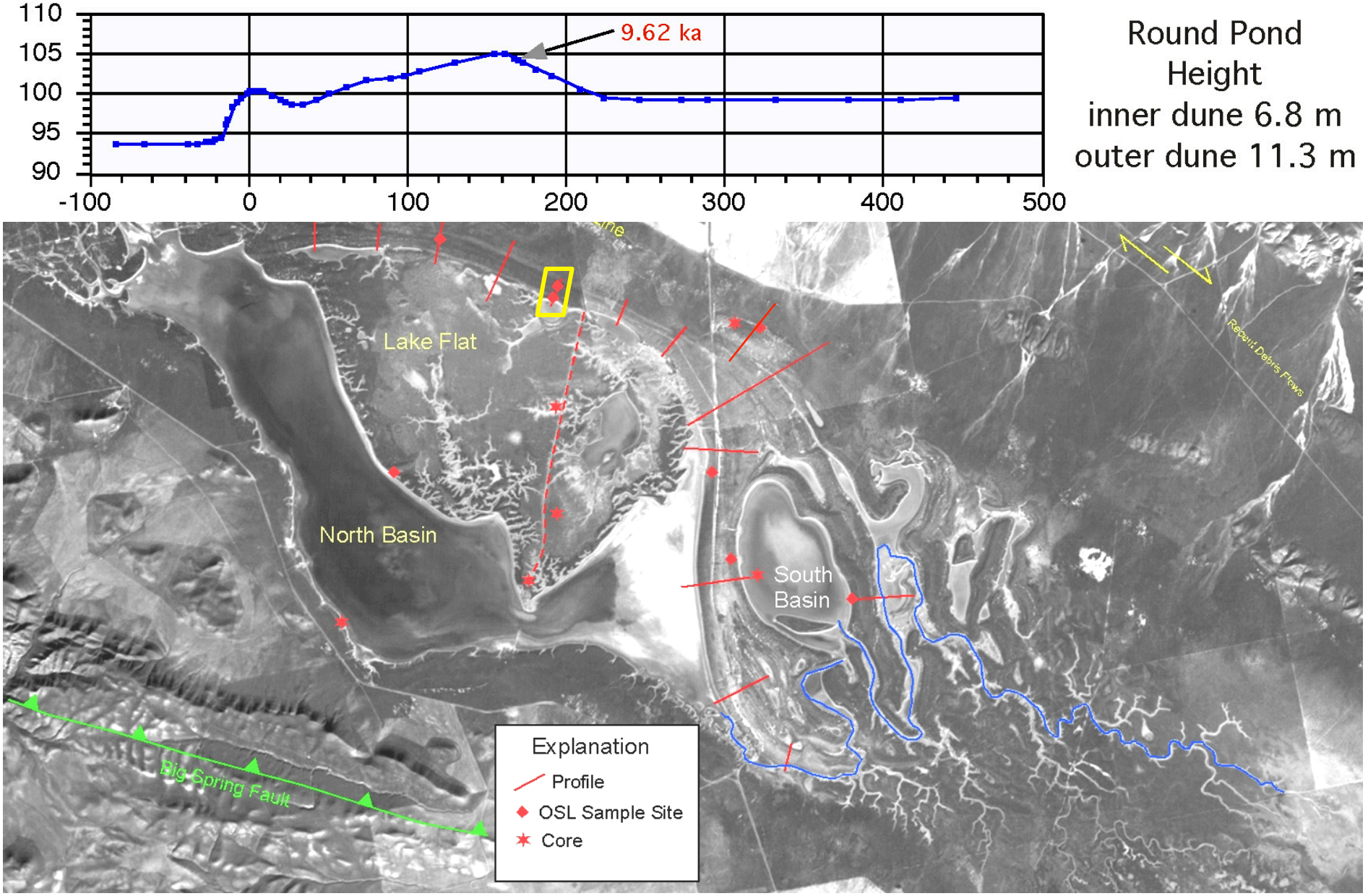

Seasonally High Evaporation Rates:
Lower water table and expose bare mud flats

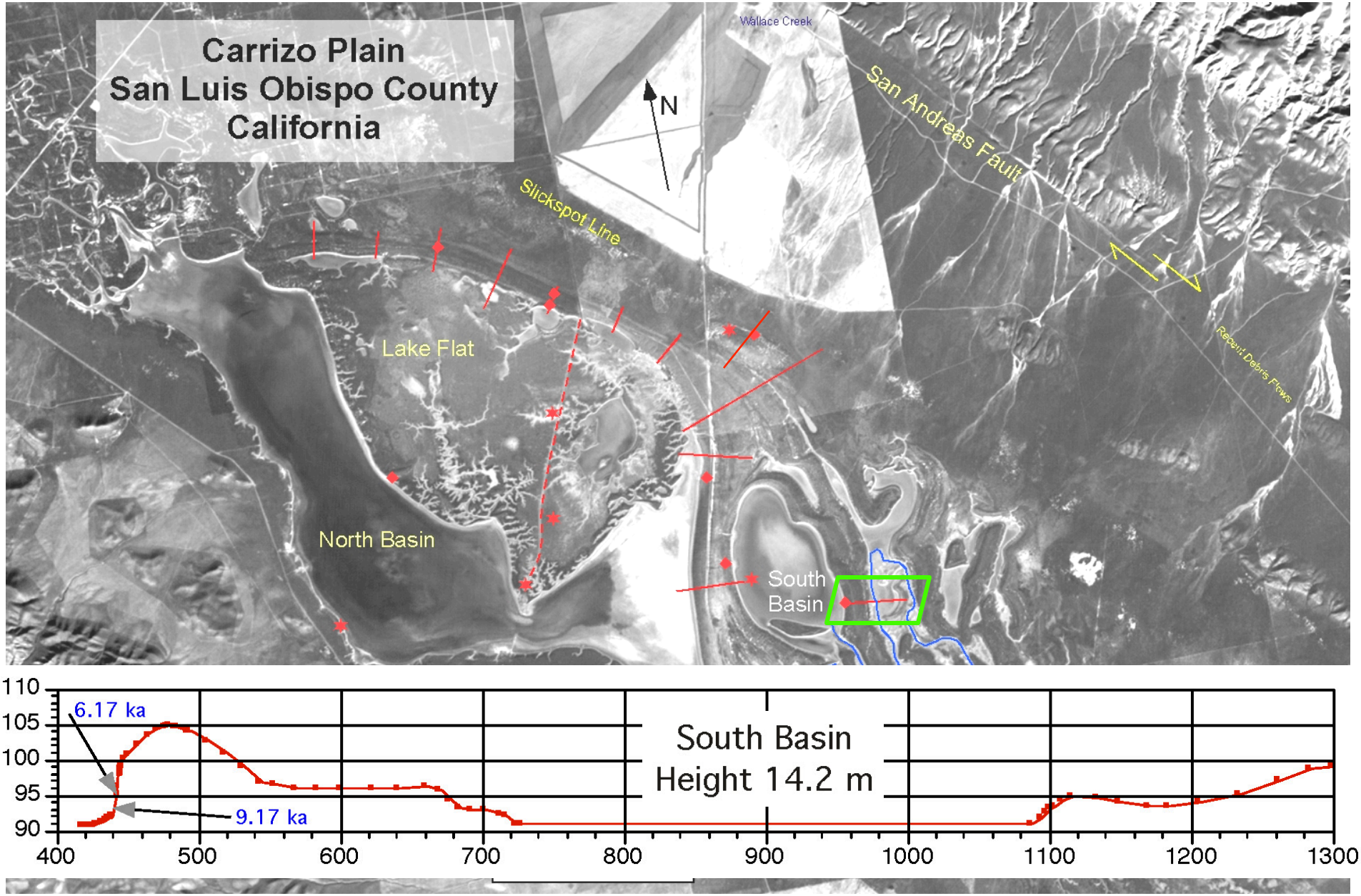

Seasonally High Evaporation Rates:
Dry exposed mud and form clay aggregates

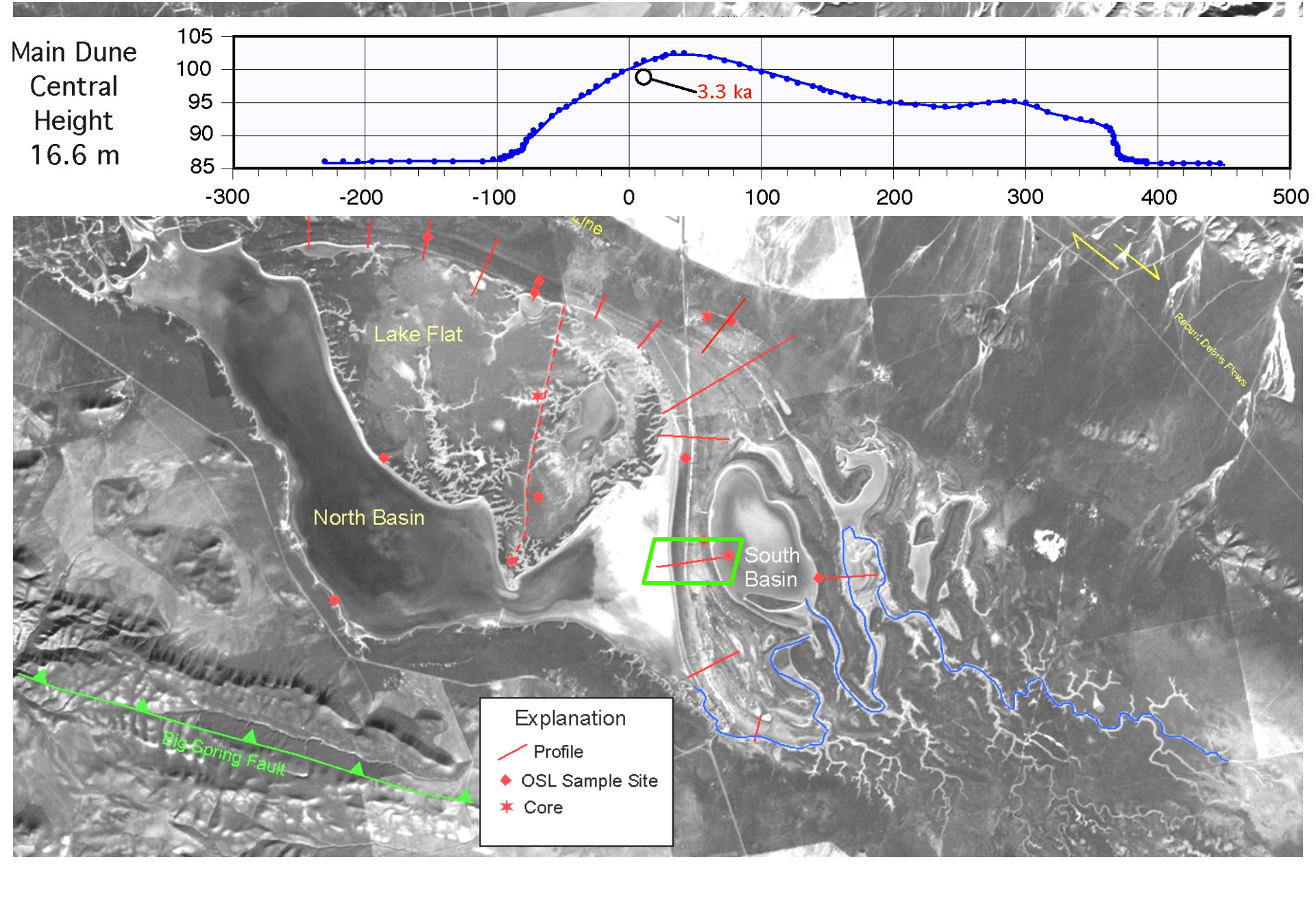

Wind: Strong unidirectional winds during dry season
allow aeolian transport before next wet season

Profile of Outermost Clay Dunes

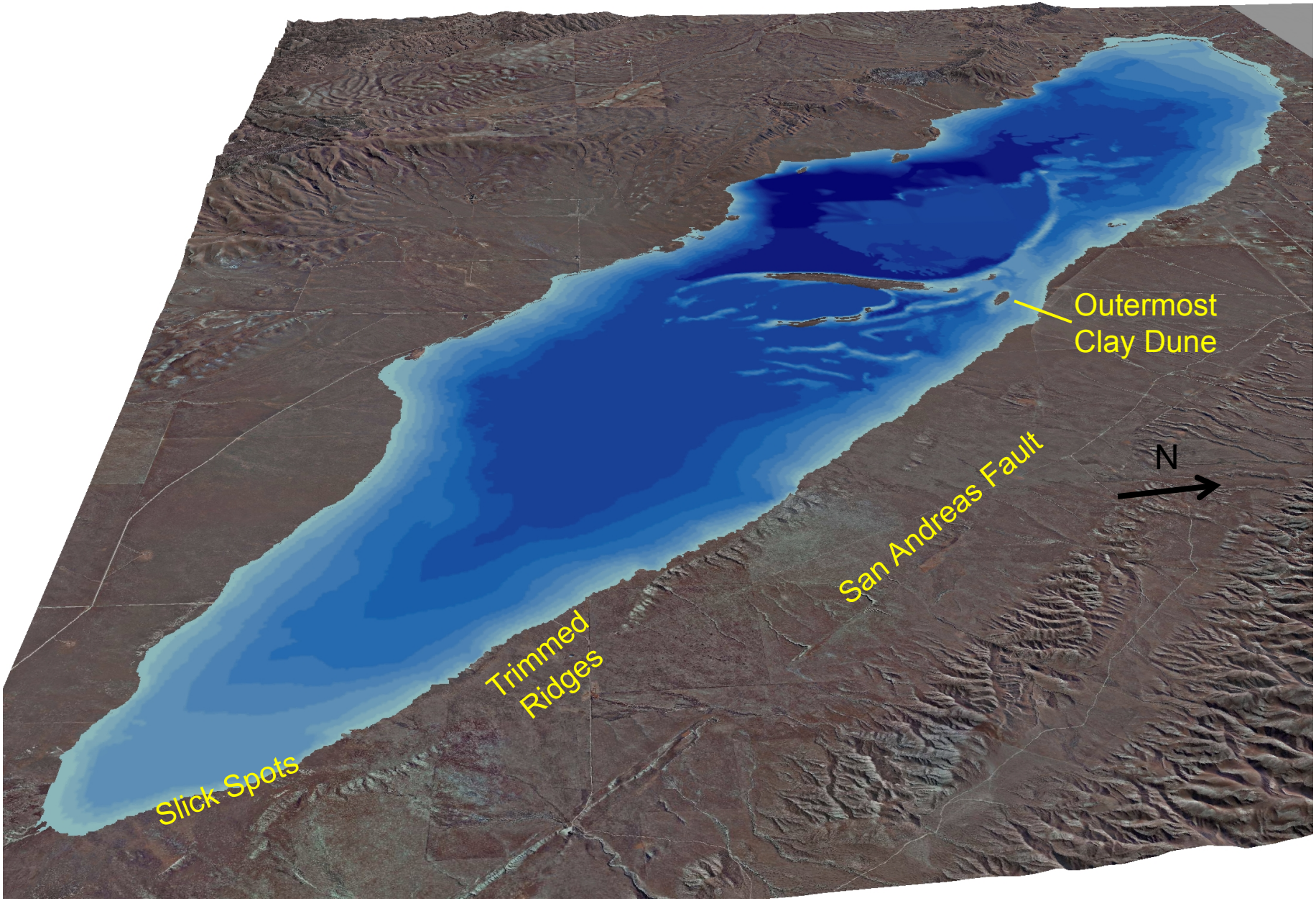



110
105
100
95
90
-100
0
100
200
300
400
500
9.62 ka
Round Pond
Height
inner dune 6.8 m
outer dune 11.3 m
Lake Flat
North Basin
South
Basin
Recent Debris Flows
Big Spring Fault
Explanation
Profile
OSL Sample Site
Core

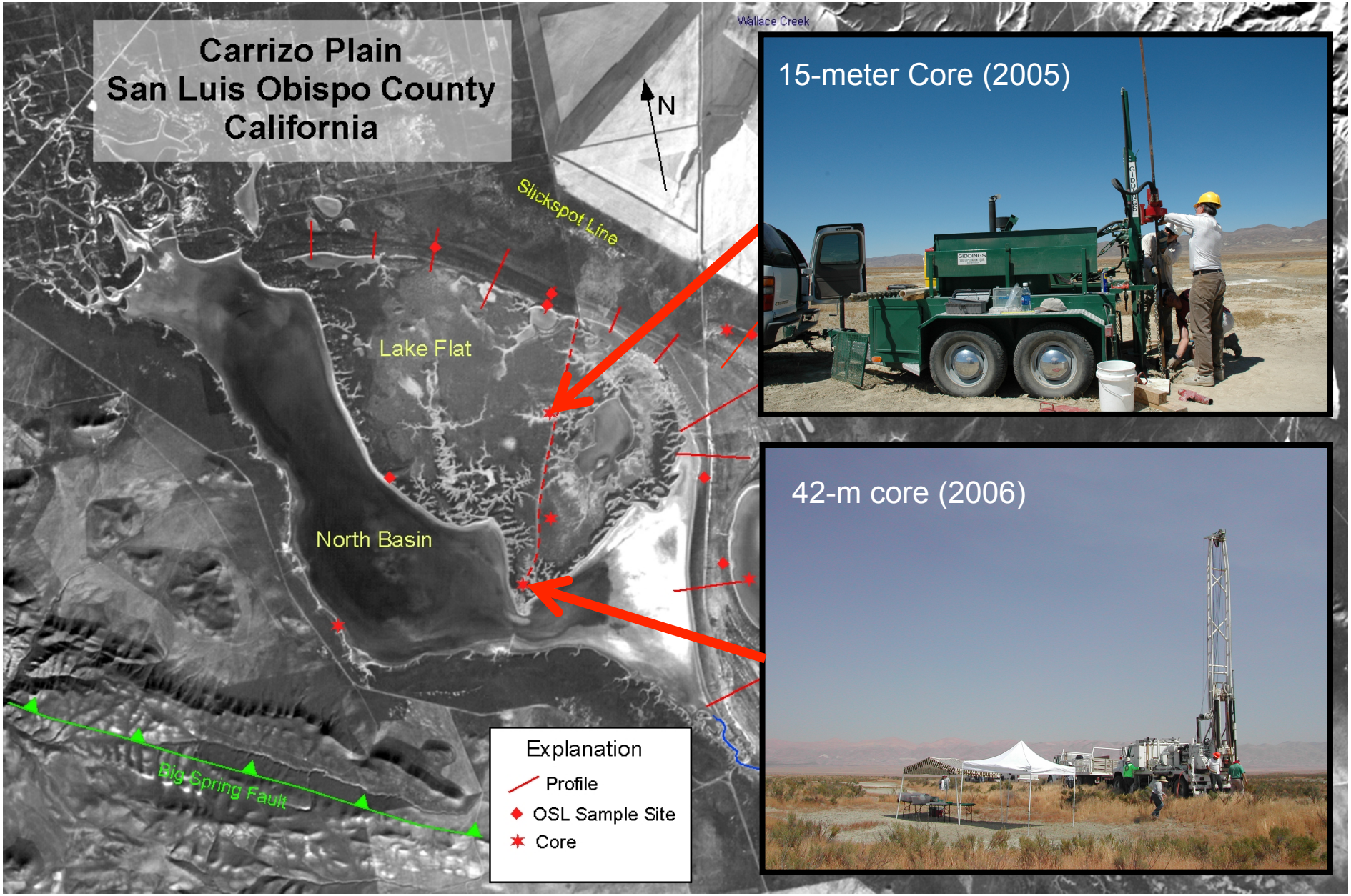

Carrizo Plain
San Luis Obispo County
California
Wallace Creek
N
San Andreas Fault
Slickspot Line
Lake Flat
North Basin
South
Basin
Recent Debris Flows
110
105
100
95
90
6.17 ka
9.17 ka
South Basin
Height 14.2 m
400
500
600
700
800
900
1000
1100
1200
1300


Main Dune
Central
Height
16.6 m
105
100
95
90
85
-300
-200
-100
0
100
200
300
400
500
3.3 ka
Lake Flat
North Basin
South
Basin
Big Spring Fault
Recent Debris Flows
Explanation
Profile
OSL Sample Site
Core

High Stand (~595 m) before 16.7 ka



When exactly *was* the lake at its maximum size?



Lake bottom sediments from core samples

Oxidized Lithology

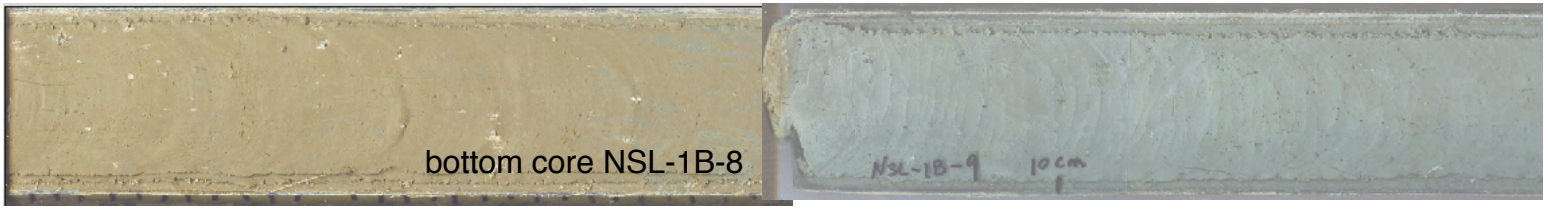
- light olive-brown (5Y 6/4)
- 1-10 mm, euhedral, gypsum xtals common
- microscopic gypsum xtals in clay matrix
- relatively high magnetic susceptibility (κ=20-60 cgs units)
- massive
- pollen preservation very poor throughout core
- 10-20 μm charcoal ubiquitous
- no diatoms

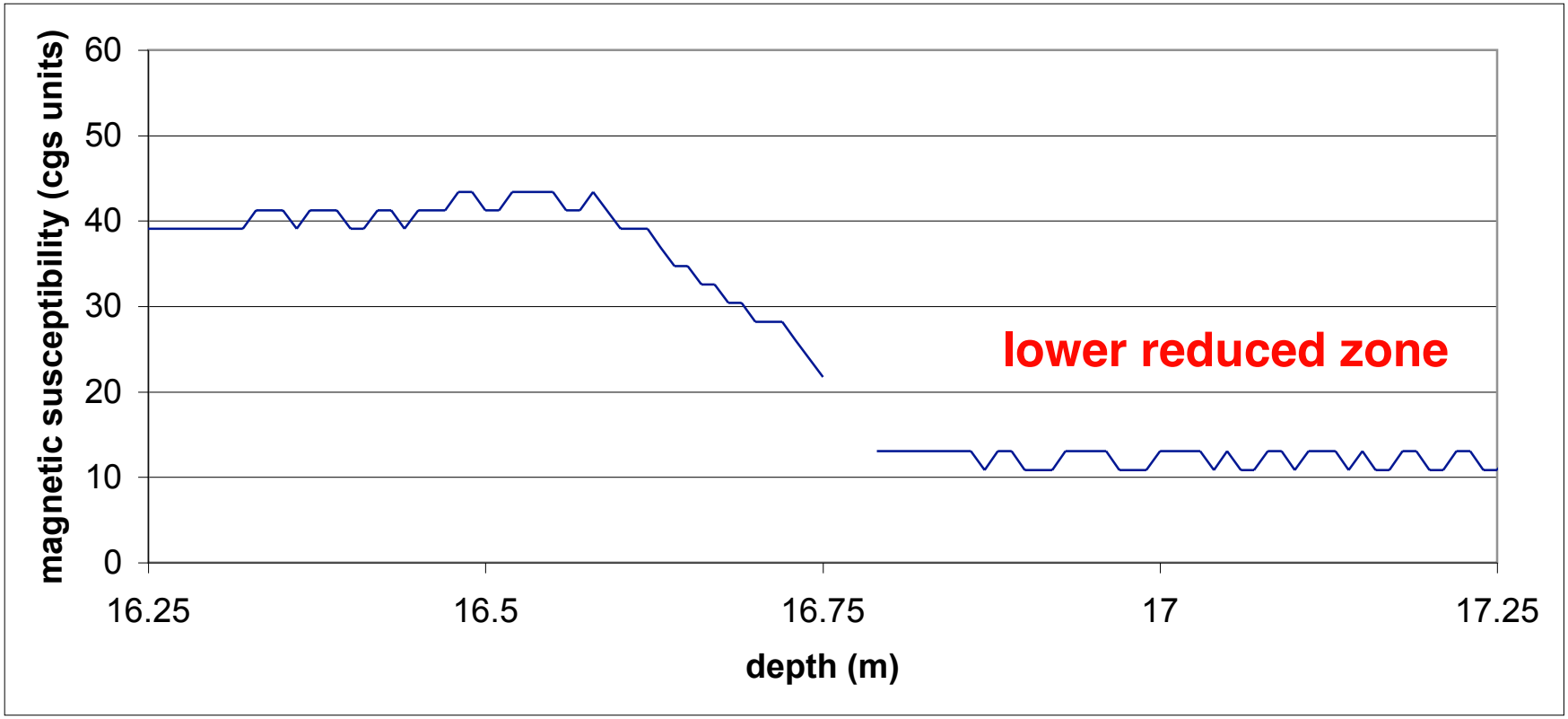
Lake bottom sediments from core samples

Reduced Lithology

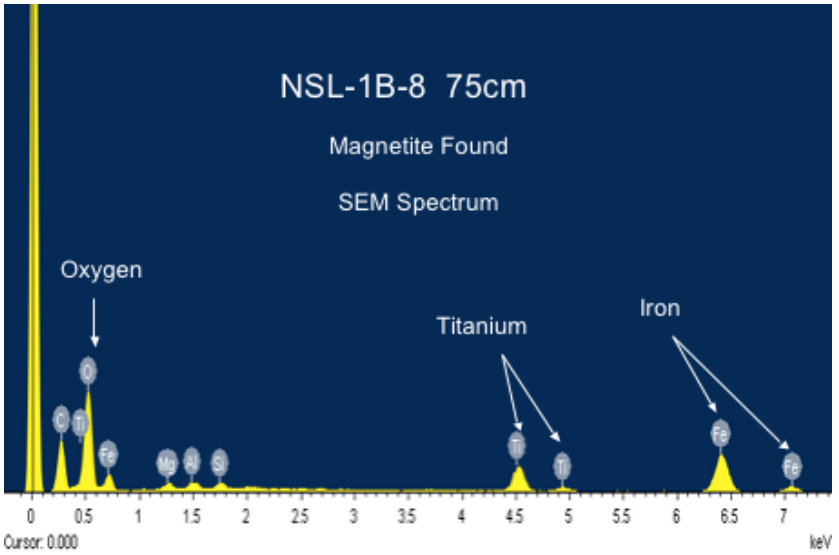
- *dark gray (5Y 4/1); greenish gray (10Y or 10GY 5/1)*
- *1-10 mm, euhedral, gypsum xtals UNcommon; sometimes in discrete layers*
- microscopic gypsum xtals in clay matrix
- *very low magnetic susceptibility (κ<20 cgs units)*
- massive
- pollen preservation very poor throughout core
- 10-20 μm charcoal ubiquitous
- no diatoms

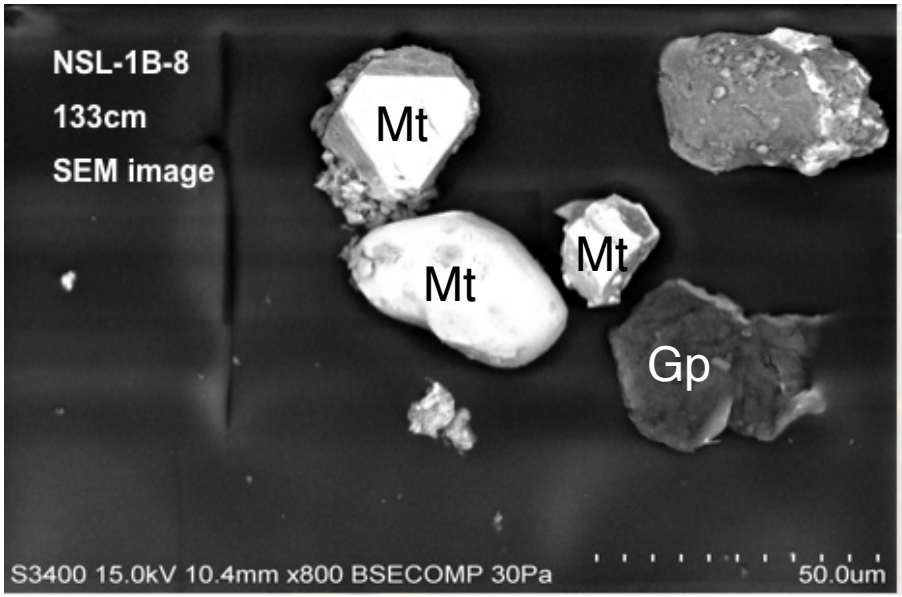
Magnetic susceptibility contrast across boundary between oxidized and reduced sediments

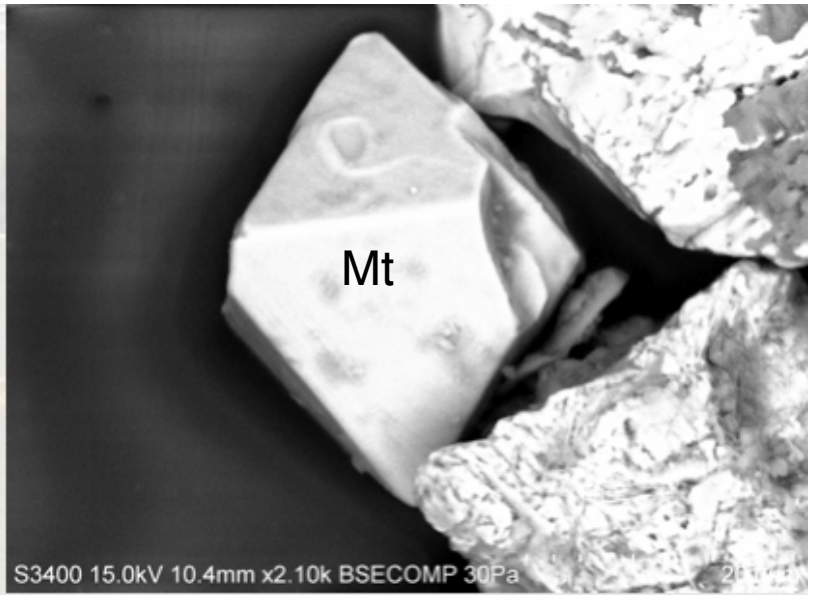




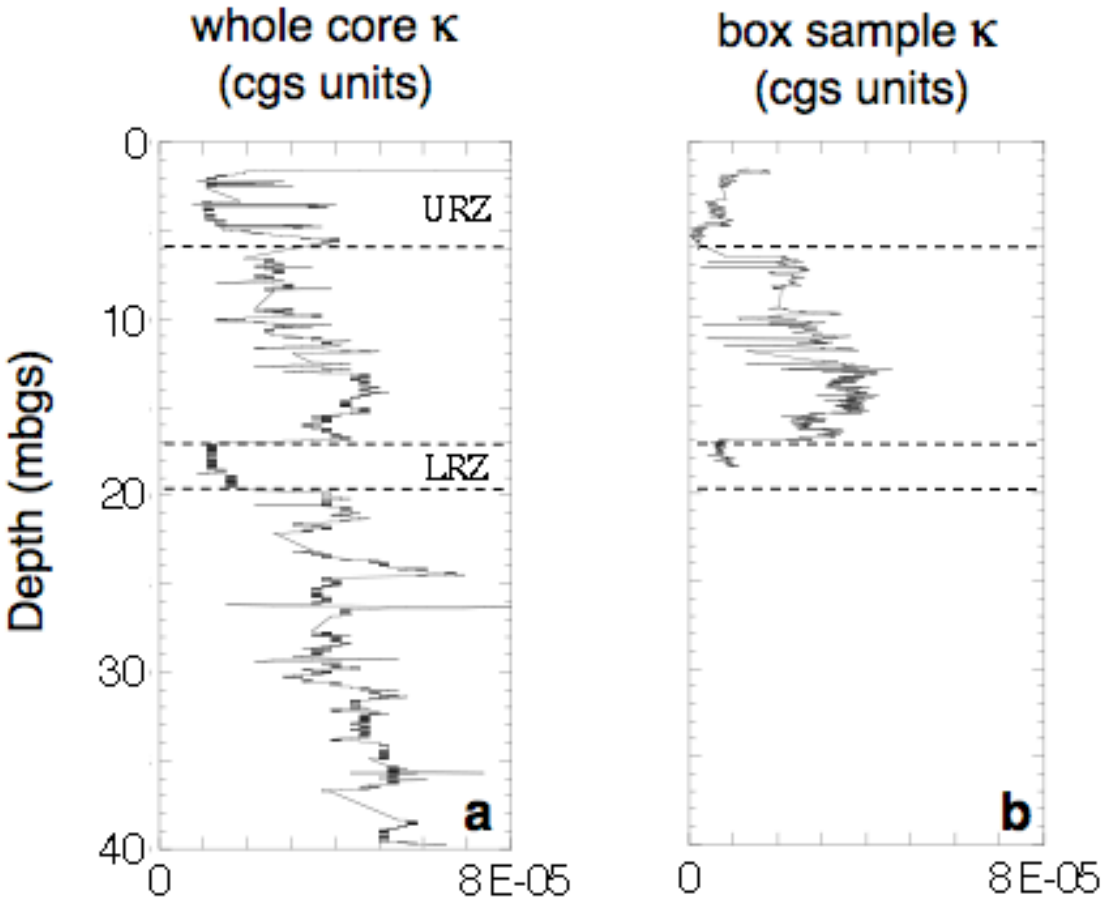
1-50 μm magnetite easily identified in oxidized sediments; none observed in reduced sediments







Magnetic susceptibility logs downcore identify an upper (URZ) and lower (LRZ) reduced zones

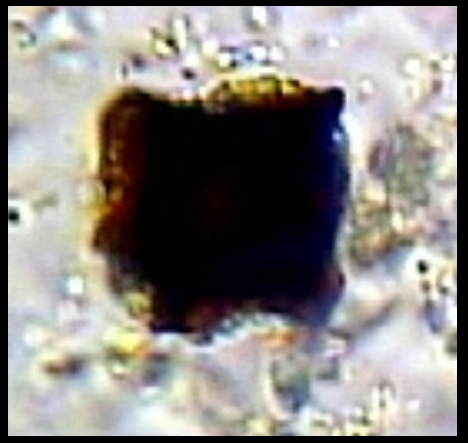


Pollen, etc. found in Upper Reduced Zone

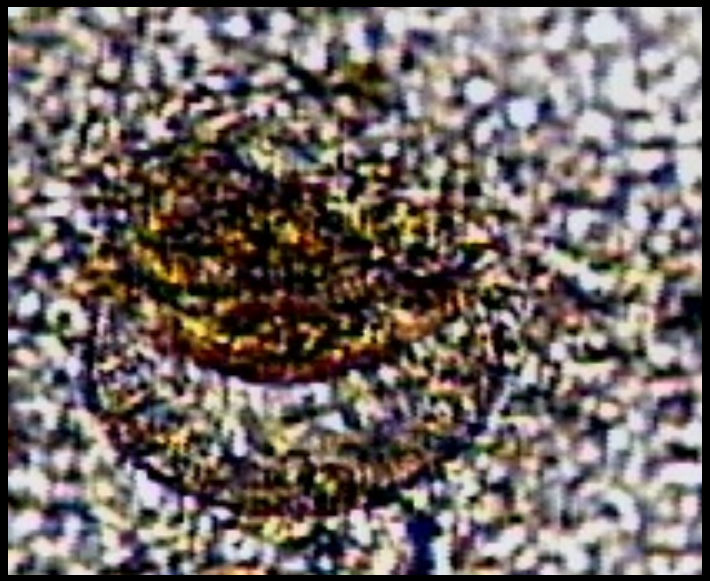
artemisia

juniper

charcoal



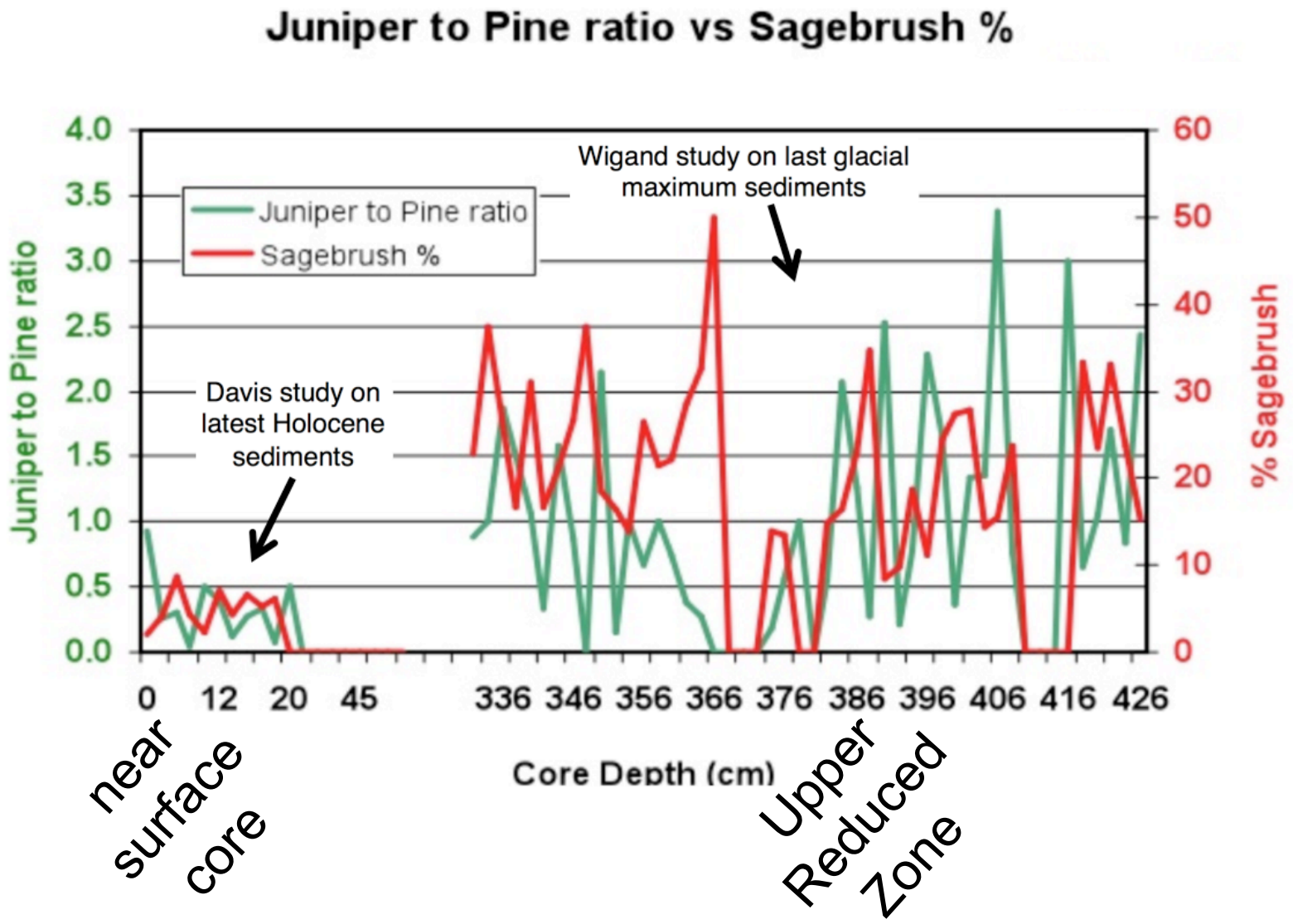
pinus



atriplex

blue-green algae

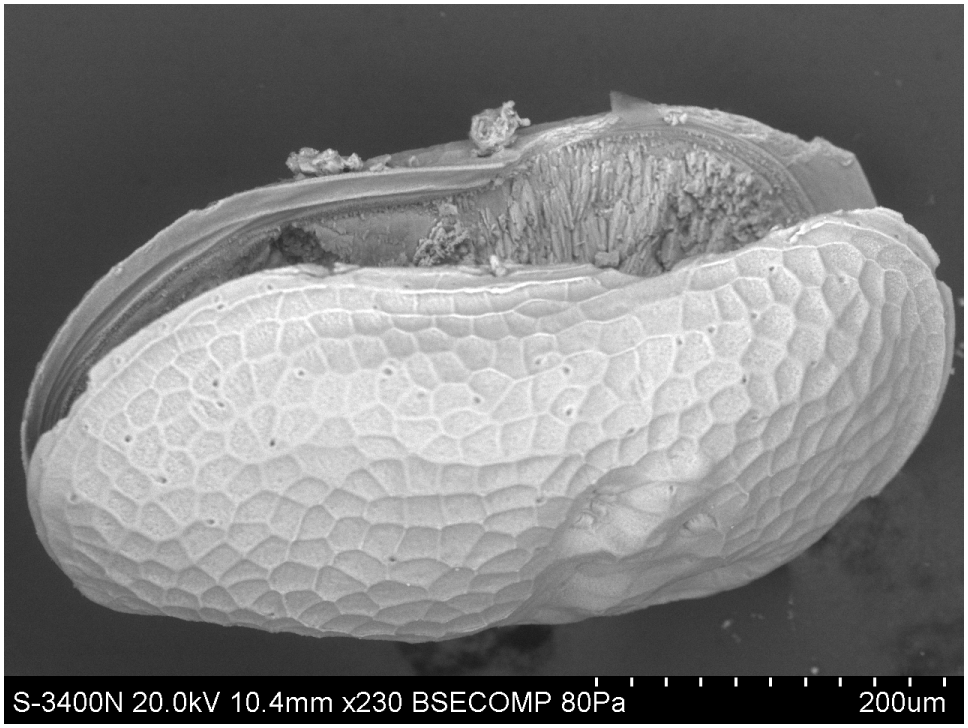
Pollen in Upper Reduced Zone much more mesic than pollen from past few hundreds of years (Davis, 1999)



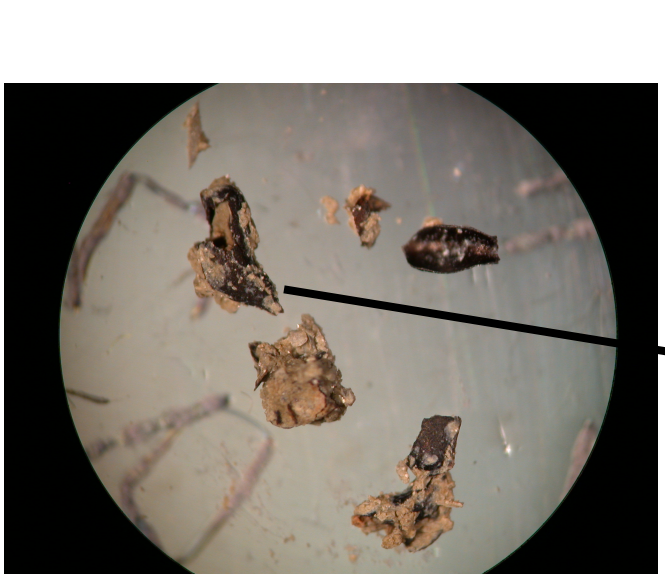
Ostracodes were observed in the upper reduced zone. The taxa present were *Limnocythere staplini, Limnocythere ceriotuberosa, Candona patzcuaro, and Cyprinotus glaucus.* The range of salinities for this assemblage is from 500-5,000 ppm, a range that is considerably lower than the saltwater brine existing today.

Limnocythere ceriotuberosa

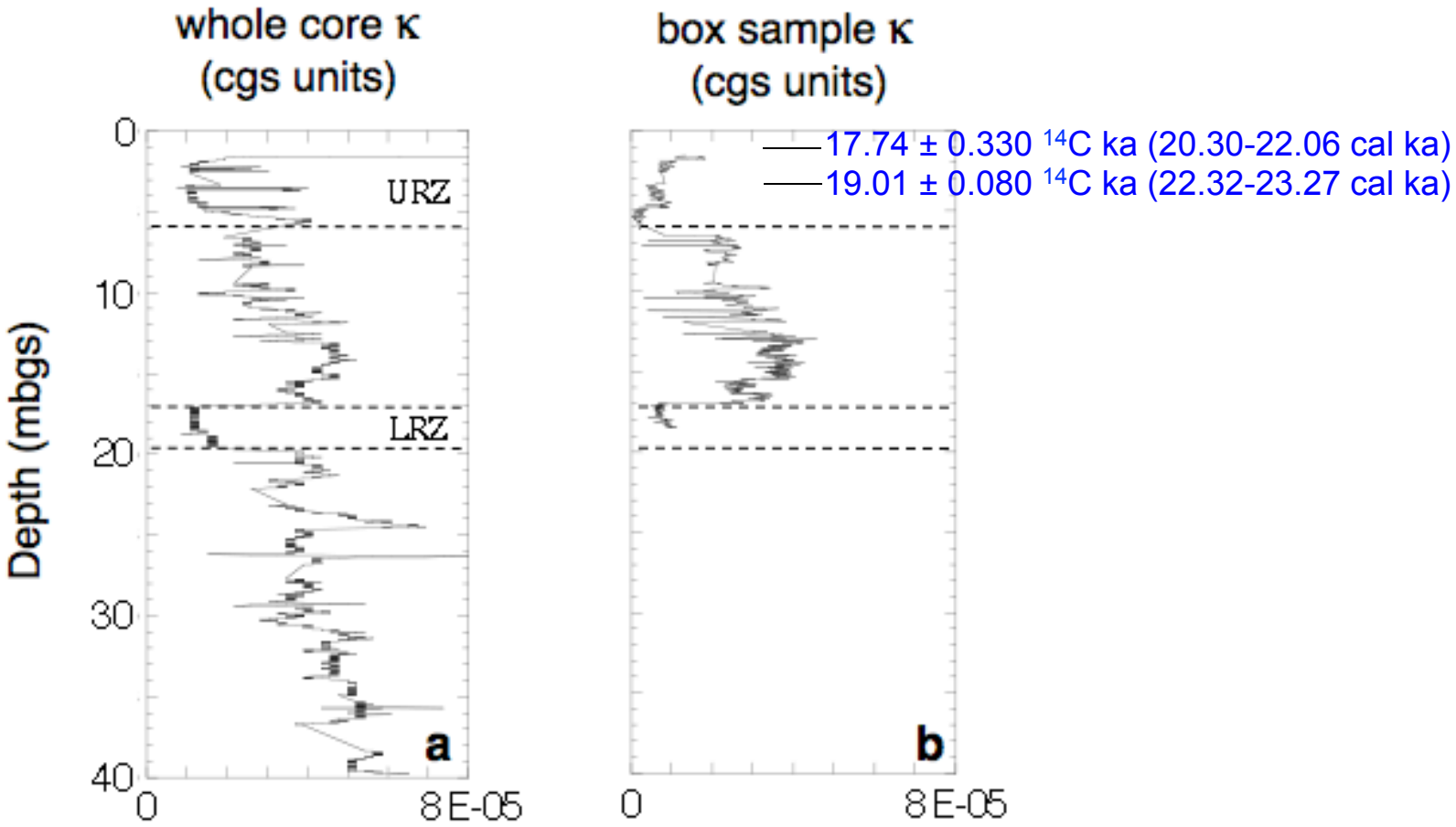
SEM Lab
Geological Sciences
CSU Bakersfield



Seed pods of Scirpus Maritimus(?) (alkali bulrush) found in 1 cm-thick layer within reduced sediments (same horizon as ostracode sample)



^{14}C dates from charcoal and seed pods yield URZ age of ~22 cal ka



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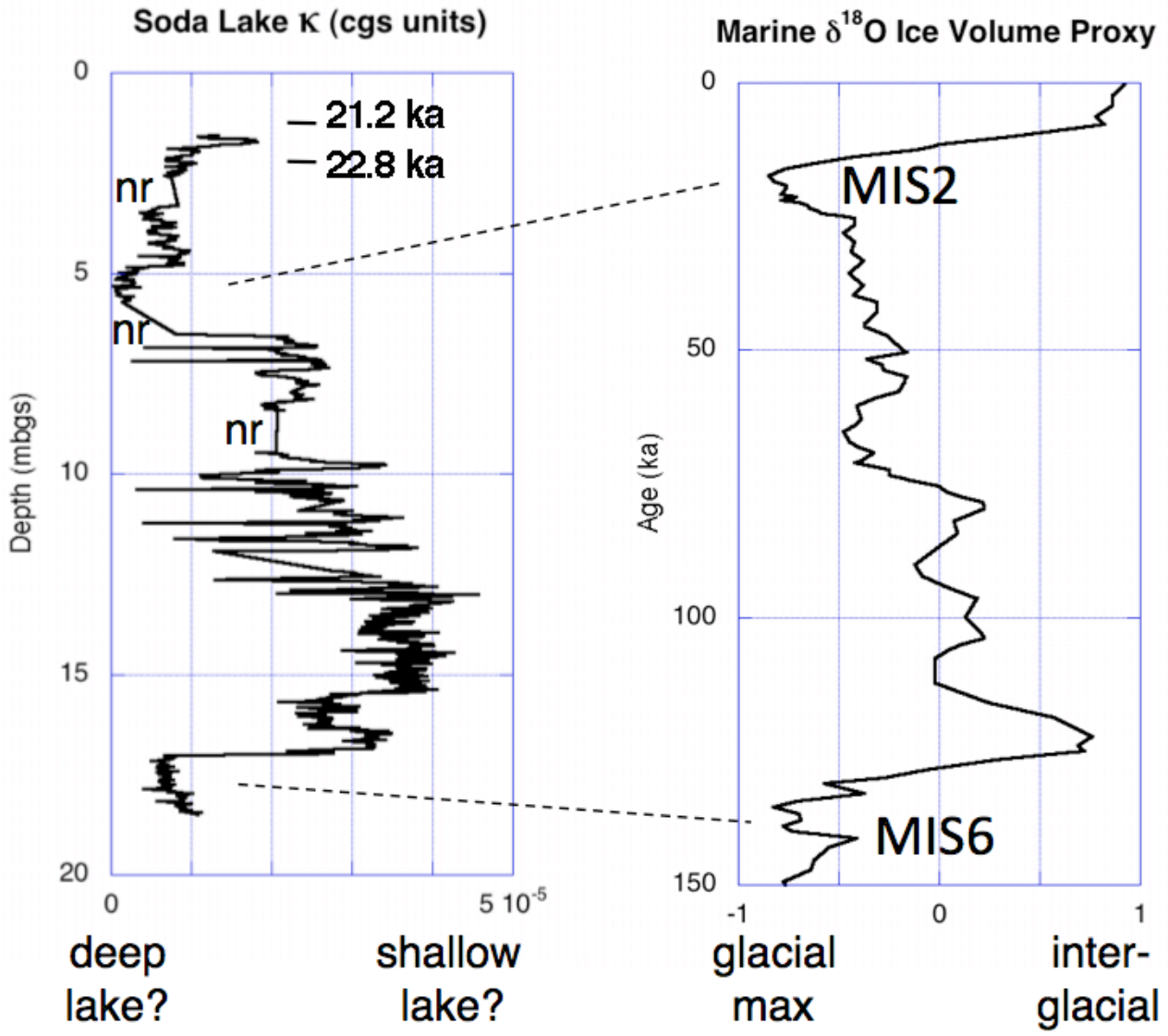
More rain and lower temperatures = deeper lakes.


Soda Lake κ (cgs units)
Marine δ18O Ice Volume Proxy
21.2 ka
22.8 ka
nr
nr
nr
MIS2
MIS6
Depth (mbgs)
Age (ka)
0
5
10
15
20
0
5 10-5
0
50
100
150
-1
0
1
deep lake?
shallow lake?
glacial max
inter-glacial

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