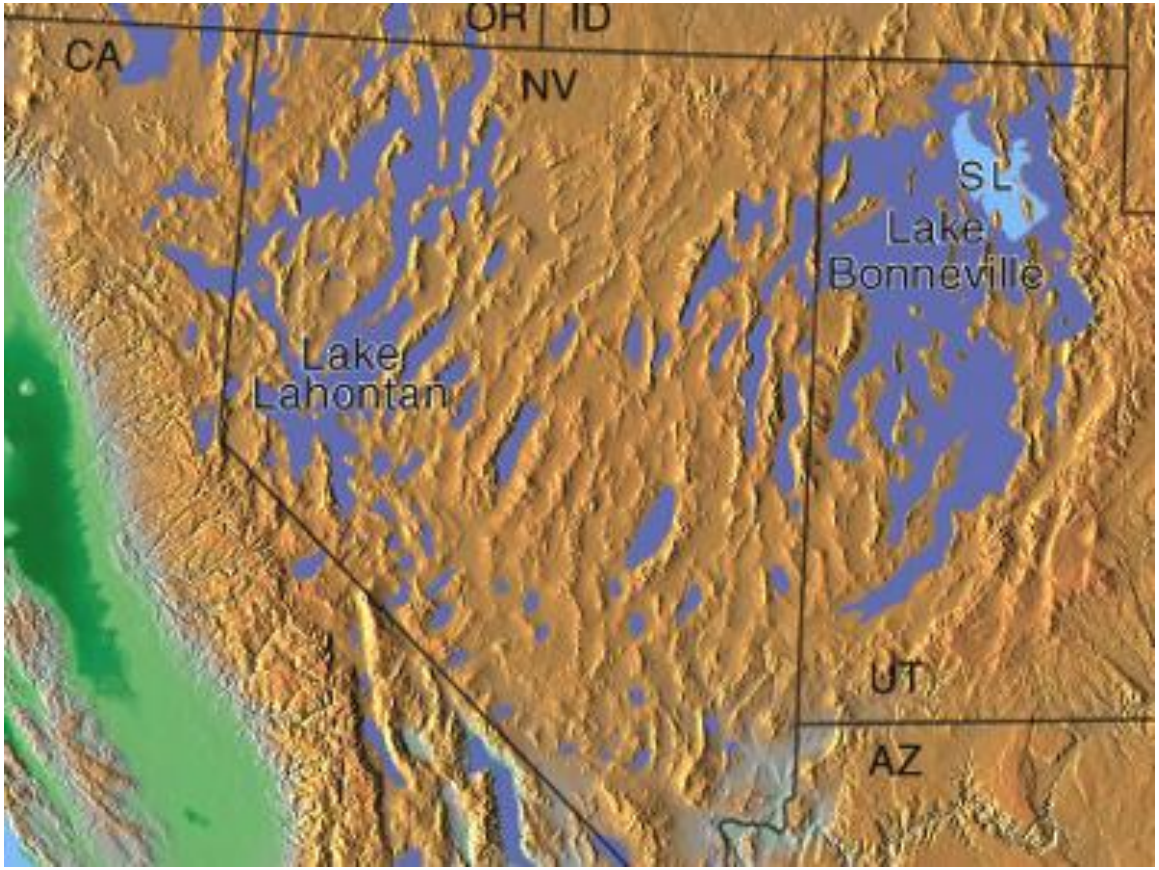
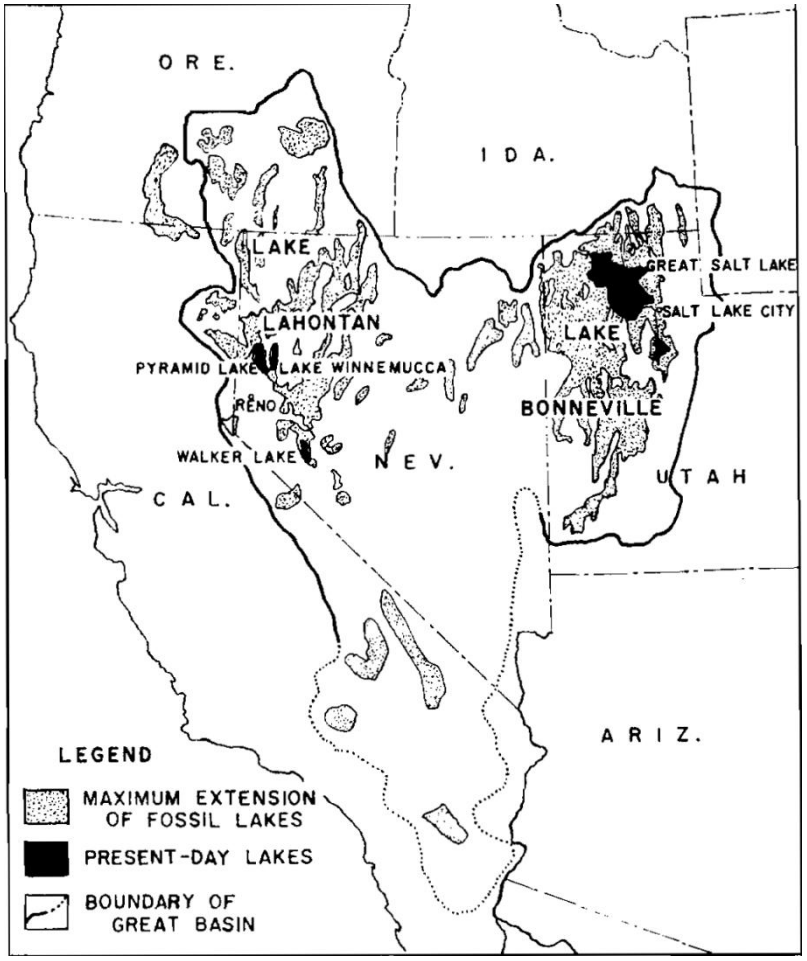
Pluvial Lake Bonneville



Natalie Baker
12/9/09
ESS 433

Lake Bonneville and Lake Lahontan



- High lake levels during glacial period
- Two of largest fossil lakes in the Great Basin

Radiocarbon Chronology of Lake Lahontan and Lake Bonneville- Broecker and Orr

- Date timing of rise and fall of two lakes in Great Basin
- Fresh water carbonate samples- shell, marl, tufas
- C^{14}/C^{12} ratios for a given lake vary based on ratio of water source and exchange rate with atmospheric CO_2
- Changes in types of sediment indicate sequence of high and low lake levels
- Results split into three categories
  - Lake sediments
  - Terrace deposits
  - Wave-cut caves

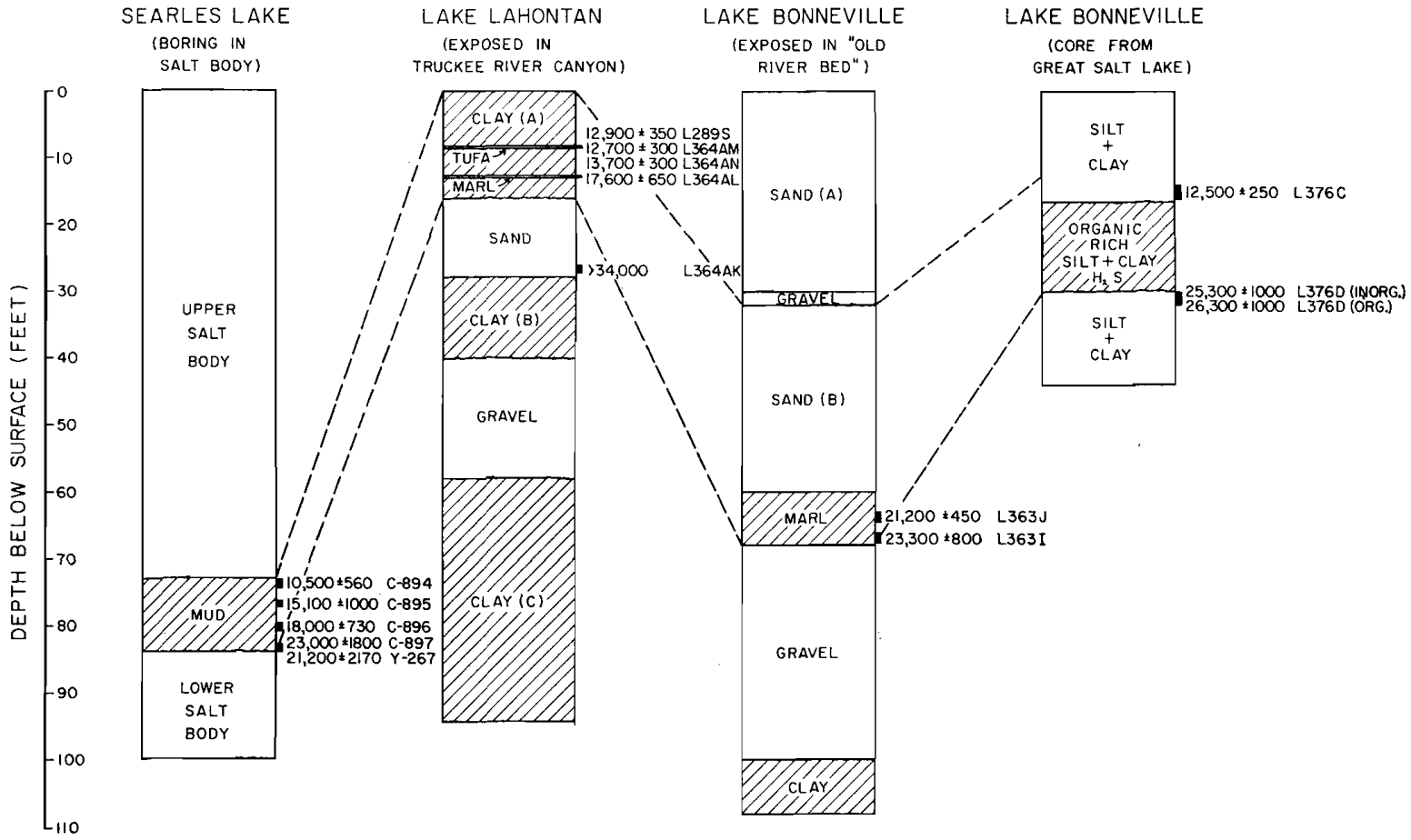
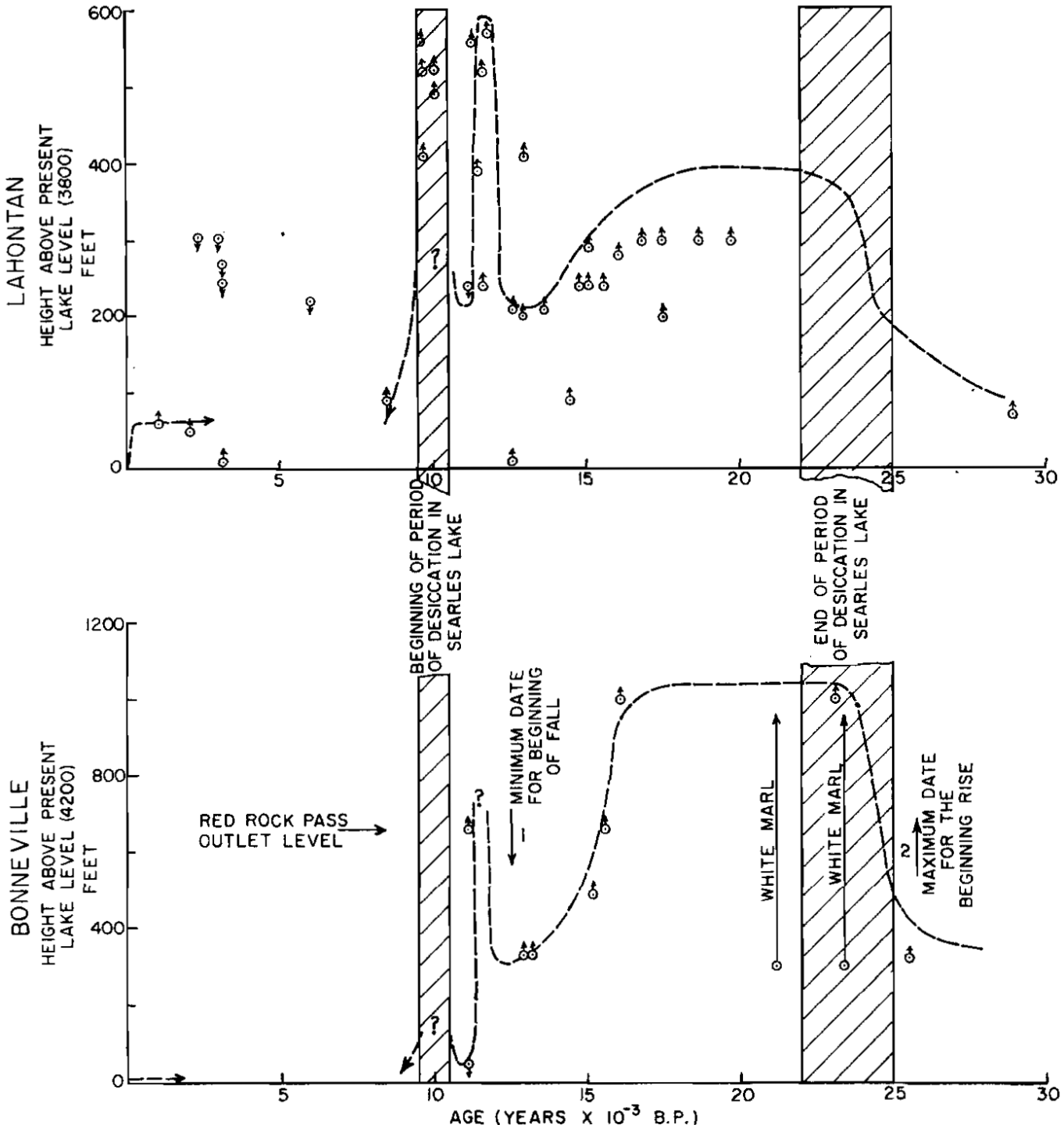


FIGURE 5.—LAKE-SEDIMENT SECTIONS

Correlation lines connect points in the cores corresponding to beginning and end of the last major high-water period for each lake. Age determinations on the Searles Lake core indicated by C were made by the Chicago Laboratory (Libby, 1955); Y indicates determinations made by the Yale Laboratory (Preston *et al.*, 1955).


LAHONTAN
HEIGHT ABOVE PRESENT LAKE LEVEL (3800) FEET
600
400
200
0
5
10
15
20
25
30
BEGINNING OF PERIOD OF DESICCATION IN SEARLES LAKE
END OF PERIOD OF DESICCATION IN SEARLES LAKE
BONNEVILLE
HEIGHT ABOVE PRESENT LAKE LEVEL (4200) FEET
1200
800
400
0
RED ROCK PASS OUTLET LEVEL
MINIMUM DATE FOR BEGINNING OF FALL
WHITE MARL
WHITE MARL
MAXIMUM DATE FOR THE BEGINNING RISE
AGE (YEARS X 10⁻³ B.P.)

Relation of Lake Level to Climate

- Height of lake (with no outlet) dependent on balance of input and output
- Factors affecting input
  - Rate of precipitation
  - Rate of evaporation
  - Net uptake or release of water by glaciers in basin

- Output depends on evaporation rate per unit area of lake surface area and total area of the lake

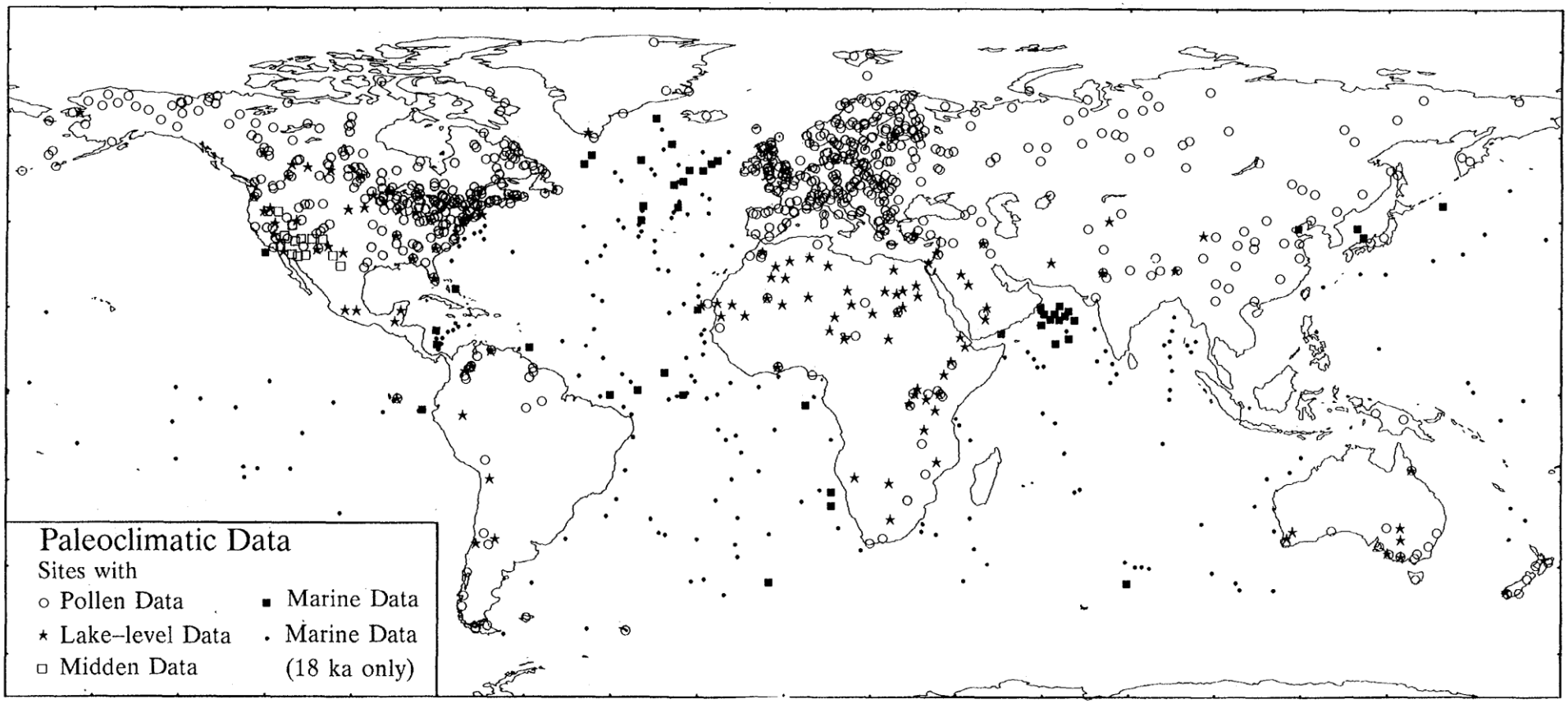
$$A_{lake} = \frac{f_r}{l_e/l_r + f_r - 1} A_{basin}$$

Conclusions

- Not extreme changes in climatic conditions required to produce maximum lake levels
- Increase in rainfall 10-18” plus a decrease in evaporation rate by ~30% and a mean annual temperature decrease of 5°
- Temperature-controlled glacial period greater impact on lake levels than precipitation-controlled glacial period→ glaciers grow from temperature decrease and lakes grow from decreased evaporation over basin

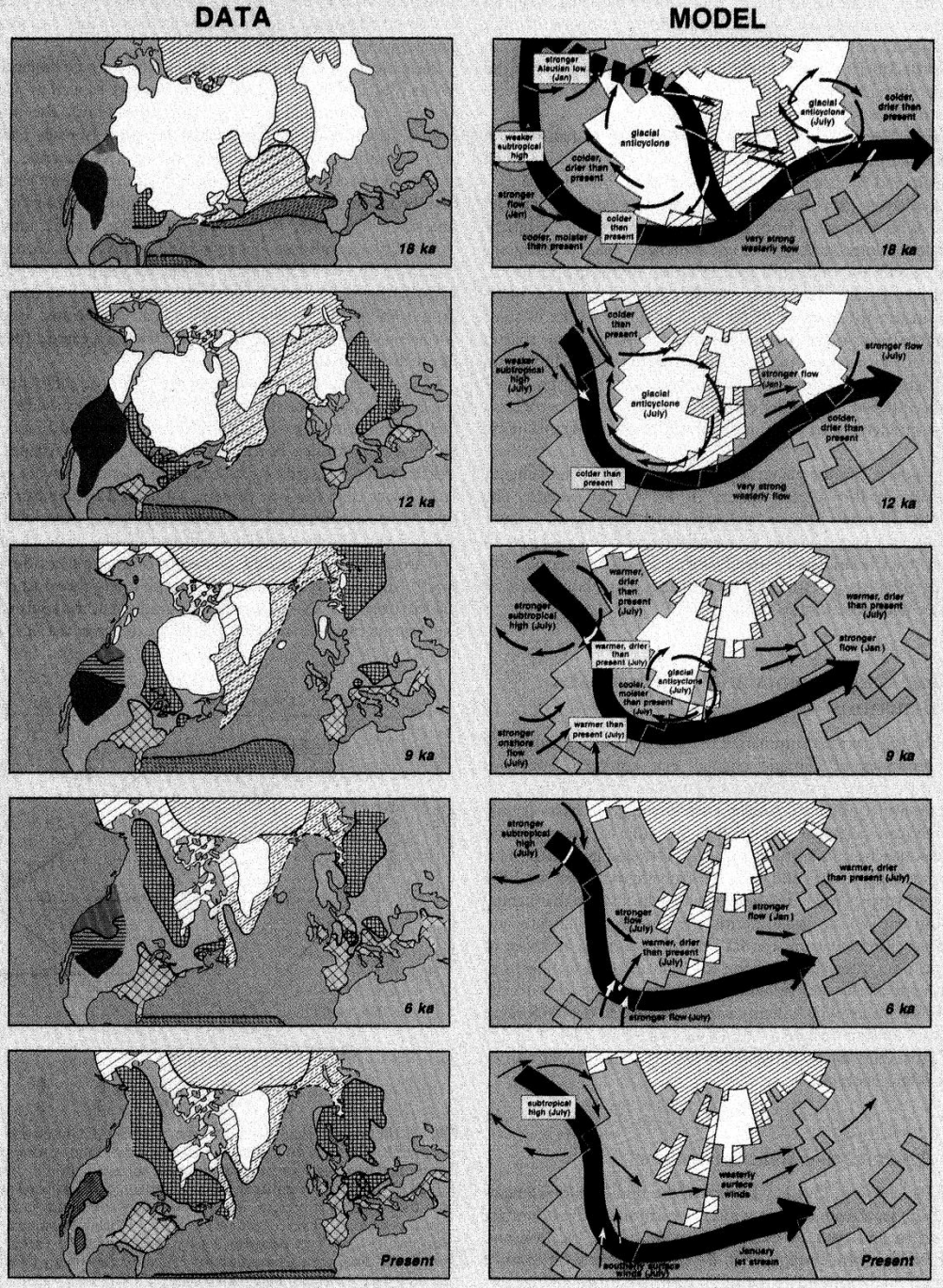
Climatic Changes of the Last 18,000 years: Observations and Model Simulations- COHMAP

- Cooperative Holocene Mapping Project use geologic data to model global and regional climate change
- Goal- improved understanding of the climate system
- 3 types of data to estimate paleoclimate—pollen, lake levels, and marine plankton


Paleoclimatic Data
Sites with
Pollen Data
Lake–level Data
Midden Data
Marine Data
Marine Data
(18 ka only)

Lake Levels

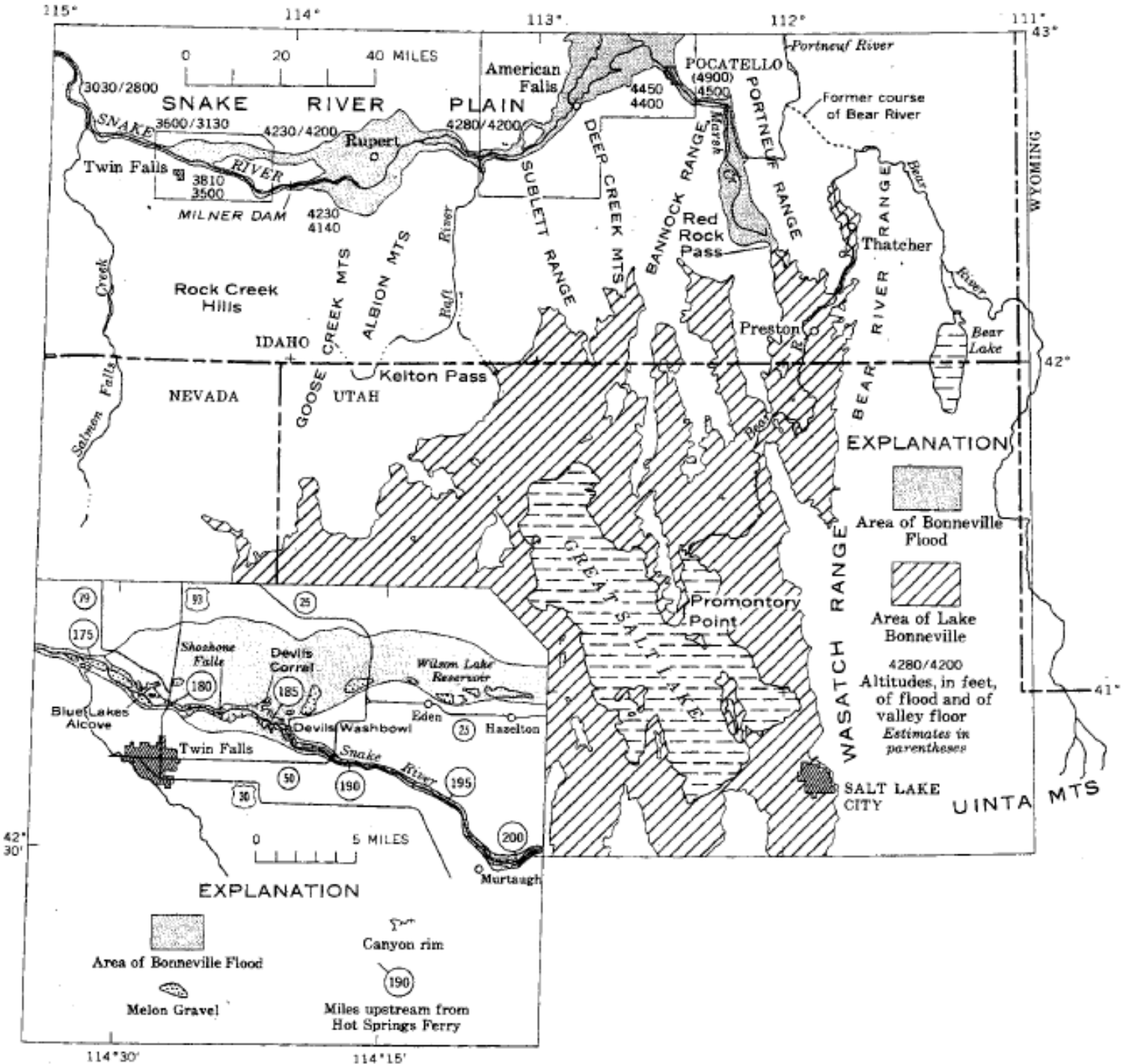
- Lake level data useful in analyzing paleoclimate in arid regions, such as southwest U.S., where pollen records are sparse
- Effective moisture (precipitation – evaporation) directly linked atmospheric circulation in closed-basin lakes
- Growth of Laurentide ice sheet shifted jet stream in North America, resulting in more precipitation in the Great Basin


DATA
MODEL
18 ka
stronger Aleutian low (Jan)
glacial anticyclone
glacial anticyclone (July)
colder, drier than present
weaker subtropical high
colder, drier than present
stronger flow (Jan)
colder than present
cooler, moister than present
very strong westerly flow
18 ka
12 ka
colder than present
weaker subtropical high (July)
glacial anticyclone (July)
stronger flow (Jan)
stronger flow (July)
colder, drier than present
colder than present
very strong westerly flow
12 ka
9 ka
warmer, drier than present (July)
stronger subtropical high (July)
warmer, drier than present (July)
warmer, drier than present (July)
stronger flow (Jan)
glacial anticyclone (July)
cooler, moister than present (Jan)
stronger onshore flow (July)
warmer than present (July)
9 ka
6 ka
stronger subtropical high (July)
warmer, drier than present (July)
stronger flow (July)
stronger flow (Jan)
warmer, drier than present (July)
stronger flow (July)
6 ka
Present
subtropical high (July)
westerly surface winds
January jet stream
Present

Bonneville Flood

- Thought to have occurred ~11,500 years ago at lake level maximum

- Flood spilled over Red Rock Pass, releasing water into Snake River Plain


115°
114°
113°
112°
111°
43°
42°
41°
0 20 40 MILES
SNAKE RIVER PLAIN
American Falls
POCATELLO (4900) 4500
Portneuf River
Former course of Bear River
3030/2800
3600/3130
4230/4200
4280/4200
4450
4400
Rupert
Twin Falls
3810
3500
MILNER DAM
4230
4140
SNAKE RIVER
Rock Creek
Rock Creek Hills
IDAHO
NEVADA
UTAH
Salmon Falls Creek
GOOSE CREEK MTS
ALBION MTS
Raft River
SUBLETT RANGE
DEEP CREEK MTS
BANNOCK RANGE
Marsh Cr.
PORTNEUF RANGE
Red Rock Pass
Kelton Pass
Preston
Thatcher
BEAR RIVER RANGE
Bear River
Bear Lake
WYOMING
GREAT SALT LAKE
Promontory Point
WASATCH RANGE
SALT LAKE CITY
UINTA MTS
EXPLANATION
Area of Bonneville Flood
Area of Lake Bonneville
4280/4200
Altitudes, in feet, of flood and of valley floor
Estimates in parentheses
79
93
25
175
Shoshone Falls
180
Devils Corral
185
Wilson Lake Reservoir
Blue Lakes Alcove
Devils Washbowl
Eden
Hazelton
Twin Falls
Snake River
50
190
195
30
200
Murtaugh
0 5 MILES
42° 30'
114°30'
114°15'
EXPLANATION
Area of Bonneville Flood
Melon Gravel
Canyon rim
190
Miles upstream from Hot Springs Ferry

References

- Broecker, Wallace S., and Phil C. Orr. "RADIOCARBON CHRONOLOGY OF LAKE LAHONTAN AND LAKE BONNEVILLE." *BULLETIN OF THE GEOLOGICAL SOCIETY OF. AMERICA*. 69. (1958): 1009-32. Print.
- COHMAP authors. "Climatic Changes of the Last 18,000 years: Observations and Model Simulations." *Science*. 241.4869 (1988): 1043-52. Print.
- Malde, Harold E. "The Catastrophic Late Pleistocene Bonneville Flood in the Snake River Plain, Idaho." *Geological Professional Paper 596*. Print.