Non-Marine Geological Evidence
Lake Level Studies

• Closed Lake Systems
  – No outlet

• Volumetric changes function of
  – Precipitation-Evaporation
  – arid to semi-arid situations
Regional Patterns of Lake Levels

18k yr BP

FIGURE 7.22  Lake-level status at ~18,000 yr B.P. Lakes were low over most of Africa, but high in the western United States. See text for definition of high, intermediate, and low lake status (Street-Perrott and Harrison, 1985a).

Bradley, 1999
6k yr BP

**FIGURE 7.23** Lake-level status at ~6000 yr B.P. Lakes were high over much of Africa, as they had been for most of the preceding ~3000 yr. See text for definition of high, intermediate, and low lake status (Street-Perrott and Harrison, 1985a).

Bradley, 1999
Conceptual Model of Atmospheric Circulation

18k BP

More humid than today

10-8k BP

Drier than today

Bradley, 1999
Figure 1. (A) Location of study area in western United States (base from Thelin and Pike, 1991). (B) Map of Lake Lahontan subbasins. Maximum extent of Lake Lahontan in dark grey (modified from Rehbein, 1999). Subbasins shown are PL—Pyramid Lake, W—Winnemucca, HL—Honey Lake, SC—Smoke Creek, BR—Black Rock, C—Carson, WR—Walker, Lake Tahoe (LT) and the Truckee River (TR) store and deliver Sierran runoff into the Pyramid subbasin.
Glacial Lake Lahontan

Wave cut notch

Notch carbonate Deposits
Playa Lakes

Enzel et al., 1989
Lake Sediment Records

• Provide Continuous Record
  – Environmental history of lake and environments
  – Inferred climate change
Piston Coring
Inorganic components

• Magnetic susceptibility
• Chemical composition
• Grain size changes
• Isotope records
  – Precipitates
  – biogenic
FIG. 2. Map of the Mono and Owens lake basins, showing approximate location of cores OL84, OL90-1/2, and OL92. Cores OL90-1 and -2 were taken within 200 m of each other.
Fig. 3. Magnetic susceptibility ($\chi$), TOC (Benson et al., 1998b), and rock flour (Bischoff & Cummins, 2001) glacial-proxy records for Owens Lake cores OL90–1/2 and OL92. “S” indicates the presence of an alpine stade.
Pyramid Lake

Figure 1. (A) Location of study area in western United States (base from Thelin and Pike, 1991). (B) Map of Lake Lahontan subbasins. Maximum extent of Lake Lahontan in dark grey (modified from Rebesco, 1999). Subbasins shown are PL—Pyramid Lake, W—Winnemucca, HL—Honey Lake, SC—Smoke Creek, BR—Black Rock, C—Carson, WR—Walker, Lake Tahoe (LT) and the Truckee River (TR) store and deliver Sierran runoff into the Pyramid subbasin.
Northeastern Storminess

- Sites Selected
  - Steep surrounding hillslopes
  - Deep water
  - Steep perimeter bathymetry
  - Inflowing streams
    - Sandy deltas

- Data
  - Visual strat
  - Magnetic susceptibility
  - High resolution x-rays
  - LOI

Noren, et al., 2002
Figure 2 Results of high-resolution, whole-core grain size (GS) analysis and composite sediment record (COMP) for two Lake Morey cores. MO-1 is the distal core and MO-2 is the proximal core. Peaks in GS reflect high-energy fluvial transport events and thus the location of terrigenous layers (indicated in composite sediment record with white bands). Calibrated $^{14}$C dates (with $1\sigma$ uncertainties) shown for each core.
Record of Storminess

Noren, et al., 2002
Figure 1 Inferred storminess in the northeastern United States and relevant climate records. 

- **a.** Individual terrigenous sedimentation event chronologies from study lakes. Letters correspond to lakes in Supplementary Information map and table. Replicate cores recovered in each of four basins contained similar stratigraphies. Two cores were recovered from each lake, each in a distinct depocentre. These depocentres record terrigenous sediment delivery from different stream basins.

- **b.** Histogram of terrigenous sedimentation events (100-yr bins). Values above the superimposed linear-regression are shaded. Histogram values are weighted by the inverse of the number of chronologies that cover each time interval. The trend in the data may reflect the slow propagation (growth) of the stream deltas into the lakes, toward the coring locations. As these deltas approach, smaller pulses of sediment are more readily transported to the coring locations.


- **d.** GISP2 sea-salt (s.s.) Na and e. GISP2 non-sea-salt (n.s.s.) K concentrations, with values above the superimposed linear regressions shaded[^13]. Other GISP2 aerosol deposition time series[^14] exhibit variability similar to s.s. Na and n.s.s. K.