Late Quaternary Climate Changes on the Central High Plains Recorded in Playa-Lunette Systems

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Playa-Lunette Systems on the Central High Plains of Kansas

- Playa-lunette systems (PLS) are common features of semi-arid and arid regions around the world.
- Playas are relatively small, ephemeral, depressional wetlands.
- Lunettes are isolated dunes that form along the margins of some larger playas.
- PLS are influenced by fluvial, lacustrine, and eolian processes, with the dominant process at a given time dependent on prevailing environmental conditions.
- Due to the small size and ephemeral nature, playas are sensitive to climate fluctuations.
- As a result, PLS provide a record of local-to-mesoscale climate change.

Lane County Site 1
Lane County Site 2
Lane County Site 3
Clark County Site 1
Clark County Site 2
Clark County Site 3

Field Methods

- Cores were collected from six sites in four counties: Lane (2), Clark (1), Thomas (1), and Finney (1) using a Giddings hydraulic coring machine.
- All sites in Lane and Clark counties consisted of a playa and lunette; sites in Thomas and Finney counties consisted of an isolated playa without an associated lunette.

Playa-Lunette Systems Research Sites

- Cores were split using a hand saw and core faces were cleaned.
- Split-core analyses at 0.5 cm intervals included Geotek-mounted:
  - Magnetic susceptibility using a Bartington M3S2 point sensor
  - Spectral color using a Konica-Minolta spectrophotometer

Laboratory Methods

National Lacustrine Core Facility (LacCore)

- Bulk density was measured on whole cores using the Gammay Ray Attenuation and Porosity Evaluation (GRAPE) method.
- Cores were split using a band saw and core faces were cleaned.
- Split-core analyses at 0.5 cm intervals included Geotek-mounted:
  - Magnetic susceptibility using a Bartington M3S2 point sensor
  - Spectral color using a Konica-Minolta spectrophotometer

Cores were analyzed at and assistance was provided by LacCore (National Lacustrine Core Facility), Department of Earth Sciences, University of Minnesota-Twin Cities.

Late Quaternary Climate Change Recorded in Playa-Lunette Systems

- Stable Carbon Isotopes (δ13C) - Playas
- Stable Carbon Isotopes (δ13C) - Lunettes
- Magnetic Susceptibility (μ) - Playas
- Magnetic Susceptibility (μ) - Lunettes
- Spectral Color (L*) - Playas
- Spectral Color (L*) - Lunettes

- C* values within playas indicate length of inundation; more negative values indicate prolonged periods of standing water.
- C* values within lunettes are highly oscillatory, indicating periods of prolonged drought followed by periods with sufficient moisture to support dense vegetation and promote pedogenesis.
- Stable carbon isotope data indicate that throughout the Late Quaternary playas were primarily seasonally exposed and dominated by non-flooded vegetation; 0°C within lunettes indicate that warmer/drier conditions prevailed throughout the Late Quaternary.
- However, magnetic susceptibility data indicate that playas experienced periods of prolonged inundation by water as evidenced by much lower values within playas compared to lunettes. Prolonged droughts were also likely common between wet intervals.
- Spectral color, with higher L* values within playas, also indicates that playas experienced periods of inundation long enough for playa soils to become gleyed. L* values within lunettes are highly oscillatory, suggesting periods of prolonged drought followed by periods with sufficient moisture to support dense vegetation and promote pedogenesis.

Interpretation

- Playas are dominated by several-meter-thick deposits of gleyed clay.
- Lunettes are dominated by a thin, meter-thick accumulation of weakly developed soils with A-C profiles.

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