Unmasking Nebraska’s “Desert in Disguise”

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Sletto, B., 1997, Desert in Disguise: Earth 6(1), 42-49
Sand Hills

Loess Hills

You are here
about 2 miles
dunes in this image are up to 300 feet high
The south-facing slopes are steeper than the north-facing slopes.
Jim Swinehart, *Dune Messiah*

Joe Mason, *Lord of the Loess*
With only radiocarbon dating....

“We were working on mysteries without any clues.”

Bob Seger, *Night Moves*
Wind-blown sand sheet between thick peat layers
enter
Ron Goble, *OSL guru*

**Optically Stimulated Luminescence**
enter
Ron Goble, *OSL guru*

**Optically Stimulated Luminescence**
OSL dates on Sand Hills sand and down-wind silt

from Miao et al., 2007, *Geology*, v. 35, p. 119-122
Dunes on the Great Plains roll along like a tank tread: *Deposition at the front end, erosion at the back end.*
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*For the most part, the dunes in the Sand Hills rest on river-deposited sand and gravel.*
Navajo Sandstone, southern Utah
Back to Nebraska:
What did the Sand Hills look like when the dunes were active?

Crossbedding exposed during construction of Calamus Dam near Burwell. Frozen paleontologist (Bob Hunt) for scale.
Navajo Ss, southern Utah

**Interpretation:** Dune sand was changed to quicksand by earthquake.
But these crossbedded dune sands have never been water-saturated—Need a new hypothesis!
Bison track in vertical cross-section.
Bison tracks in plan view, central Sand Hills
What did the Sand Hills look like when the dunes were active?

Killpecker Dunes, north of Rock Springs, WY.
Jurassic dinosaur tracks in cross-section, southern Utah
How did the rest of the prairie ecosystem fare as dunes became active?
Gopher diggings, Nebraska Sand Hills
modern soil

800-year-old dune sand

buried soil
Gopher burrows at contact between paleosol (gray) and 800-year-old dune sand.
As active dunes spread over the landscape, gopher populations crashed.
Mount Saint Helens, WA,
May 18, 1980

Analogy
Mount Saint Helens, WA, May 18, 1980

Blast deposits and ash are about 1.5 feet deep at this site.

Snowpack

Original soil
Mount Saint Helens, May 18, 1980

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Snowpack

Original soil

To be back-filled
Why burrow in desert sand?

Namib Sand Sea
Dec. 16-17, 1977

Temperature (°C)

Time (h)

from Robinson and Seely, 1980
Large tetrapod burrows from the Middle Triassic of Argentina: a behavioural adaptation to seasonal semi-arid climate?

Lethaia
pages no-no, 22 OCT 2012 DOI: 10.1111/j.1502-3931.2012.00329.x
Back to Utah’s Jurassic rocks (briefly)
Jurassic burrows dug by a badger-sized, dune-dwelling reptile

Figure 4. Navajo tritylodontid (SMU 76527). Head and neck are absent, as are tail and most of distal parts of hind limbs. Seventeen vertebrae are visible between shoulder girdle and right ilium. Note large olecranon (OL) of ulna and lesser trochanter (LT) of femur. Metacarpals and phalanges (PH) are longer than they are wide.
Nebraska is a long way from a source of moisture, but.....

.....circulation around the Bermuda High brings moist air to Nebraska during the growing season.
Nearly all of the precipitation in the Sand Hills comes from Gulf of Mexico; winds from south bring the moisture in May-July.
Grand Island Monthly Wind Roses, 1972-1997 lines point upwind

0.1-5 m/s  5.1-10 m/s  10.1-15 m/s
Linear dunes form in areas with two wind directions that diverge by more than 90°.
The linear dunes in the Sand Hills were shaped by bimodal winds of subequal strength.
If sand were free to migrate today, what would dune orientation be?

**Fryberger Method for Calculating Sand Drift**

\[ Q \propto V^2 \left( V - V_t \right) t \]

- \( Q \) = annual rate of sand drift
- \( t \) = time the wind blows (as percentage)
- \( V \) = wind velocity
- \( V_t \) = threshold velocity for sand movement \( \approx 12 \) knots (measured at 10 m height)

Sand drift roses, modern winds; red lines point upwind
Black lines--calculated orientations of dune crests
Modern

800 years ago

northerly vector

Broken Bow
trend of hypothetical transverse dune

southerly vector

b. northerly vector

340°

17.5°

southwesterly vector 250°

212.5°

trend of longitudinal paleo-dune

800 years ago
**Conclusion:** During major droughts, Spring-Summer winds shifted to southwest, cutting off moisture from Gulf

About 65% of the groundwater in storage in the High Plains Aquifer lies beneath Nebraska. Note that much of Nebraska’s groundwater is under the Sand Hills.

The steady-flowing Loup meets the dry Platte at Columbus.