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Determining the Age of a Stabilized Dune Field

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Objectives

The aim of this project was to assess the development and age of the Kearney Dunefield in central Nebraska through the collection and analysis of sand samples from the inactive dunes. These dunes are not part of the well-known Nebraska Sandhills, and so far have not been thoroughly studied. Similar assessments have been conducted on dune fields throughout the Great Plains, and this study seeks to place the Kearney Dunes into a regional context.

Methods

- Three cores were collected by vibracoring.
- 5 sediment samples were taken from the cores in a darkroom.
- The samples were treated to separate the quartz grains in the sand
- Optically Stimulated Luminescence dating (OSL) was used to determine when the grains were last exposed to sunlight.
- The grains received incremental doses of radiation to determine luminescence.
- The ages of burial were calculated using the Central Age Model.

Core Descriptions

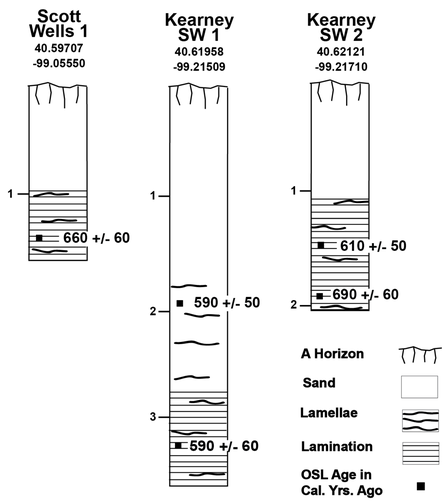


Figure 1. Sediment from three cores collected from the Kearney Dunefield. OSL ages are given with their uncertainty in calendar years ago.

Core Locations

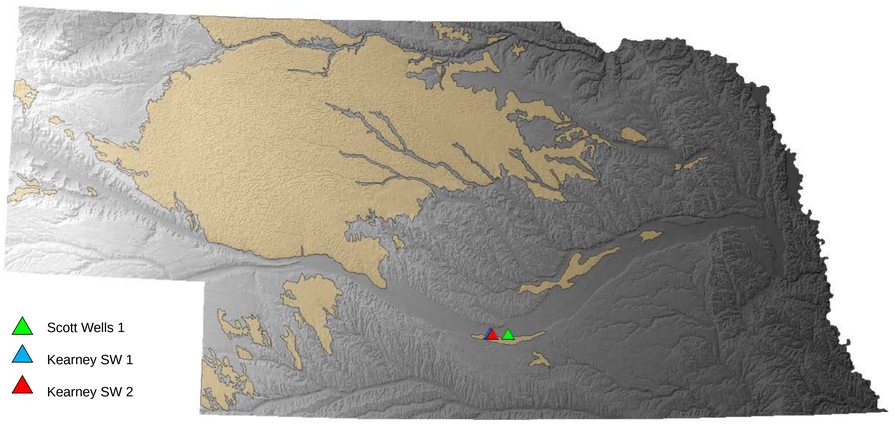


Figure 2. Extent of sand dunes in Nebraska.

Optically Stimulated Luminescence Ages

Table 1. Equivalent dose, dose rate data, and OSL age estimates

Field #	UNL Lab #	Depth (m)	U (ppm)	Th (ppm)	K_2O (wt %)	Moisture H_2O (%)[a]	Dose Rate (Gy/ka)	CAM[b] D_e (Gy) ± 1 Std. Err.	Aliquots (n)[c]	OSL Age ± 1 σ (yrs ago)	O.D.[d] %
Scott Wells 1-2	UNL-4125	1.3	1.2	5.7	2.3	5.0	2.56 ± 0.15	1.7 ± 0.1	24/31	660 ± 60	17.3 ± 3.6
Kearney SW 1-2	UNL-4127	1.9	1.1	5.3	2.3	5.0	2.52 ± 0.15	1.5 ± 0.1	23/25	590 ± 50	12.4 ± 5.9
Kearney SW 1-3	UNL-4128	3.2	1.2	5.9	2.4	5.0	2.63 ± 0.16	1.5 ± 0.1	24/25	590 ± 60	26.7 ± 6.3
Kearney SW 2-2	UNL-4130	1.5	1.1	5.9	2.4	5.0	2.59 ± 0.15	1.6 ± 0.0	21/24	610 ± 50	4.8 ± 2.9
Kearney SW 2-4	UNL-4132	1.9	1.0	4.2	2.2	5.0	2.35 ± 0.14	1.6 ± 0.1	21/25	690 ± 60	10.3 ± 3.8

[a] Assumes 50% error in long term estimated moisture content
[b] Central Age Model (Galbraith et al., 1999)
[c] Accepted disks/all disks
[d] Overdispersion

Dunefield Age Comparison

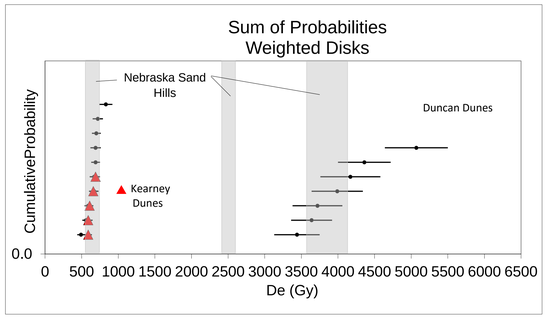


Figure 3. Activation ages of Nebraska dunefields

Figure 3 shows the ages (in thousands of years before present) of the activity of three separate dune fields in Nebraska. The Nebraska Sand Hills show three distinct periods of activity, over the last 6000 years, the Duncan Dunes show two, and the Kearney Dunefield indicates one recent period of activity.

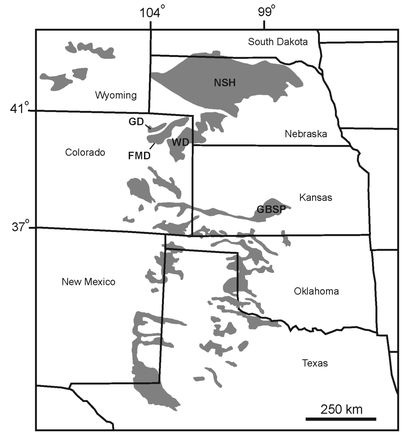
Discussion

The OSL ages for the Kearney cores fall between approximately 590 and 690 years ago. These dates overlap with a period of activation for the Nebraska Sandhills, as well as for the Duncan Dunes near Columbus, Nebraska. These events are associated with large-scale drought episodes in the Great Plains (Miao et al., 2007). Evidence for these megadroughts has also been found in Colorado and Kansas, supporting the interpretation that these are large regional events (Hanson et al., 2009).

The analysis of the Kearney Dunes shows that these megadroughts also significantly affected dunefields in the Eastern Great Plains.

The Kearney cores only reach 3.5 meters in depth, and thus do not show older periods of activation. Further study is required to determine if the Dunefield was activated during other times in the past, such as those recognized in the Sandhills.

Figure 4. Distribution of sand dunes in the lower Great Plains



From Hanson et al., 2009.

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