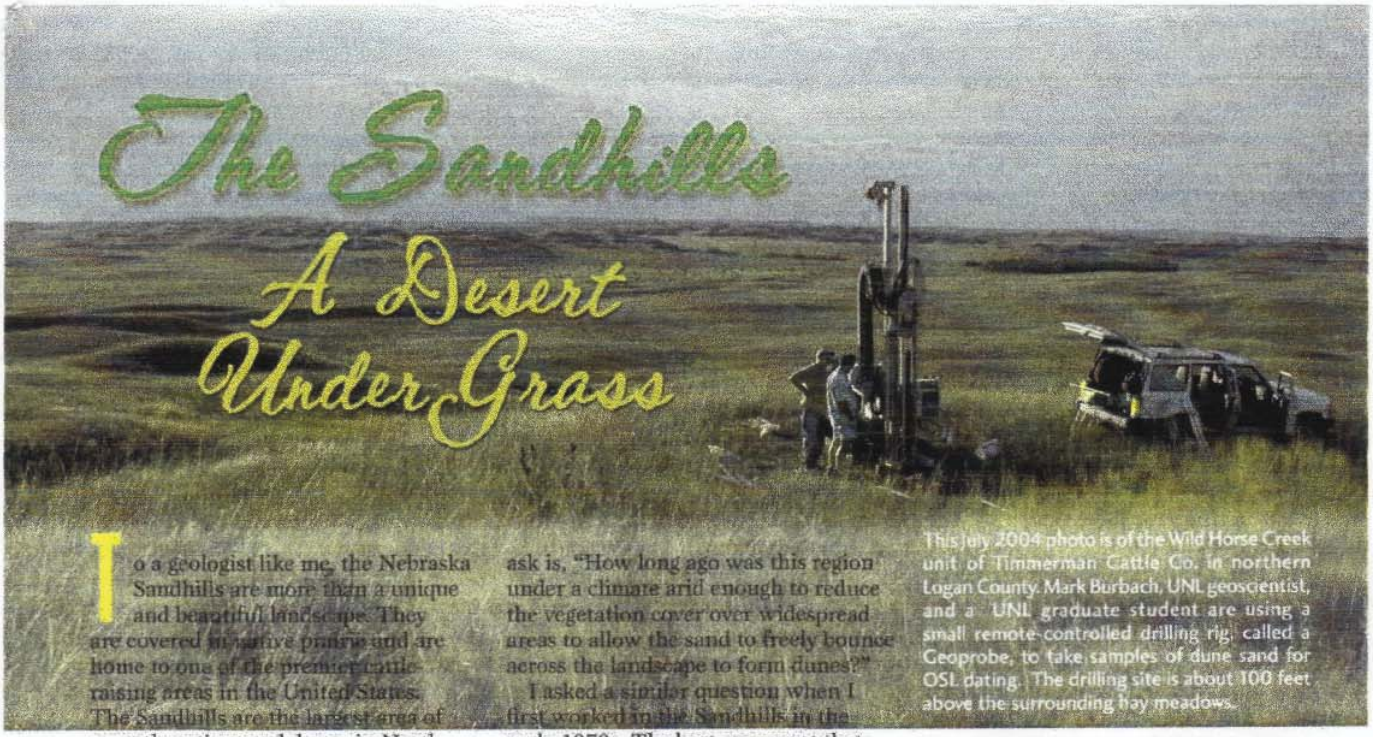
The Sandhills
A Desert Under Grass



This July 2004 photo is of the Wild Horse Creek unit of Timmerman Cattle Co. in northern Logan County. Mark Burbach, UNL geoscientist, and a UNL graduate student are using a small remote-controlled drilling rig, called a Geoprobe, to take samples of dune sand for OSL dating. The drilling site is about 100 feet above the surrounding hay meadows.

To a geologist like me, the Nebraska Sandhills are more than a unique and beautiful landscape. They are covered in native prairie and are home to one of the premier cattle raising areas in the United States. The Sandhills are the largest area of recently active sand dunes in North America. They contain a valuable record of past climate fluctuations, a story of times like today when enough rain falls to maintain a stabilizing cover of vegetation, and times of aridity when the protective grasses were reduced enough to allow the ever-present winds to blow sand across the land and reshape the dunes.

Earth scientists have long known that, given a sufficient sand supply, an arid (desert) climate is required to create large areas of blowing sand. This is because of the relationship between how sand is transported over the ground and the how the vegetation grows on that ground. Sand grains are moved by winds blowing faster than 8 miles per hour and are bounced along the ground in arcs fewer than 3 feet high. Because sand grains travel in short hops, they can be stopped from bouncing further when the plant cover is sufficiently dense, usually when more than 30 to 40 percent of the ground is covered by plants.

So when a geologist finds a deposit of wind-blown sand covering hundreds to thousands of square miles, it's a pretty sure bet that it was formed under an arid climate, with only a sparse cover of vegetation. In the case of the Sandhills, the deposit of sand rests just inches beneath the prairie vegetation and can be several hundred feet thick beneath the largest dunes. The first question a geologist might ask is, "How long ago was this region under a climate arid enough to reduce the vegetation cover over widespread areas to allow the sand to freely bounce across the landscape to form dunes?"

I asked a similar question when I first worked in the Sandhills in the early 1970s. The best answer at that time was that this region was last dry enough for sand to be blown into dunes during the last ice age, between 12,000 and 24,000 years ago. Geologists postulated that since the end of the ice age, blowing sand was primarily confined to blowouts (small wounds cut into the landscape) and that both the large and small dunes were kept from moving by a cover of prairie vegetation. In other words, the Sandhills landscape had not changed much in more than 400 human generations. Cattle have replaced buffalo, and ranching has replaced nomadic native hunters; but aside from a somewhat sparser grass cover prior to modern range management and a few more blowouts and spotty vegetation during droughts like the those of the 1930s, your dune buggy would have stayed in the garage for the past 12,000 years.

By 1983 we had gathered enough evidence to publish a report that proposed several episodes of sand dune activity during the last 12,000 years in the Sandhills and the smaller dune fields of the Rocky Mountains. We had only scratched the surface of this story and there were still many skeptics. It would take a scientific breakthrough before we would really begin to flesh out the story.

The breakthrough was primarily the work of archeologists, geologists and physicists at Britain's Oxford University in the late 1980s and early 1990s. It is a technique called "optically stimulated luminescence" dating, and it has given us the means to accurately determine (within an error of 5 to 10 percent) when a grain of sand last saw sunlight. In other words, we can answer the question; "How long ago was that sand grain buried?" All we need is sand made of quartz, which makes up about 75 percent of all sand grains in the Sandhills.

OSL dating exploits the ability of abundant, naturally occurring minerals, such as quartz, to record their exposure to natural radiation, primarily from the radioactive decay of potassium, uranium, and thorium contained within minerals in the adjoining sediment. The electrons given off by the radiation are trapped on defects within the quartz crystal. When the grains are exposed on the surface, the energy from sunlight evicts electrons from these traps And under blue light in the lab, the grains give off light, which OSL can measure to determine how long the grain was buried.

My colleagues and I at the University of Nebraska-Lincoln began working with the Oxford scientists, and by 2000 we had established our own OSL laboratory in the UNL Geosciences Department. Since then we have sampled dunes throughout the Sandhills, both in natural exposures and in holes drilled through the

dunes. The samples we obtain by drilling are especially important because we take as many as 10 samples per 100 feet of depth. The results so far indicate that the last major period of aridity and sand dune movement occurred between 700 and 1,000 years ago There have been several other periods when the Sand Hills were active and best described as a dune desert: 2,300-2,700 years ago, 3,000 to 4,000 years ago and 7,000 to 9,200 years ago.

We are currently working on two separate projects funded by the National Science Foundation. The Sand Hills Biocomplexity project involves sand, grass, and water, their interactions, and the stability of the Nebraska Sand Hills over the last few thousand years. The second project, called "Dune-Dust," seeks to understand the relationship between the timing of sand dune formation and thick dust (loess) deposits over the last 20,000 years that occur downwind from the Sand Hills. We can work on both projects at the same time, taking samples from the upper 30 feet of a sand dune for the biocomplexity project and deeper samples for the Dune-Dust project.

Last summer, we collected drill samples from dunes on Tom Hansen's 77 Ranch (Lincoln County), the Diamond Bar Ranch (Logan County), the Wild Horse Creek unit of the Timmerman Cattle Co. (Logan County), the Eldred Ranch (Garden County) and the Johnson Ranch (Brown County).

We scientists would like to express our gratitude for the cooperation we have gotten from the Sand Hill ranching community in furthering this research. We hope our work on past climates and periods of active dune sand formation in the Sand Hills will bring a new perspective on the dynamic nature of this landscape to those who live and work in this unique region, as well as those who admire it from outside. As for now, it is a fortunate circumstance that we are living in a time when the Sand Hills climate is in a "wet" and vegetated phase. ■ *By James Swinehart, professor and research geologist with the School of Natural Resources in the Institute of Agricultural and Natural Resources, University of Nebraska-Lincoln. Photos courtesy of James Swinehart.*

This blowout on the Terry and Denise Vinton Ranch about 7 miles south of Mullen alongside Hwy. 97 should not be a source of embarrassment, but rather looked to as a great geological site. The UNL geology students in the photo helped James Swinehart take OSL samples and the ages determined for the different layers of dune sand have been placed on the image.

Tom Hansen meets on his North Platte ranch with James Swinehart, a UNL geologist (center), and Joe Mason, a University of Wisconsin geologist, to discuss their research on the migration of sand dunes.