

OSL CHRONOLOGIES FOR AEOLIAN ACTIVITY IN THE CONTEXT OF LAKE-LEVEL FLUCTUATIONS, DRAINAGE REORGANIZATION AND GLACIAL RETREAT, NORTH-CENTRAL MINNESOTA.

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Introduction: Dunes and stratified eolian sediments are a significant component of the postglacial landscape across the mid-continent. During the 1970s, a benchmark study in north-central Minnesota inferred a period of eolian activity 8,000 — 5,000 years ago (i.e., the Altithermal Hypsithermal periods), based upon radiocarbon dates on charcoal and organic material preserved within paleosols developed in dunes [1]. We revisited a classic locality at Lake Winnibigoshish (N 47°27'; W 94°12'), and sample other dune-forms to hypothesis-test whether eolian landform development occurred during the middle Holocene. Optical luminescence techniques can better resolve Minnesota's eolian chronologies by directly dating the emplacement of bed forms; sediments are typically oxidized and lack preserved organic materials suitable for ¹⁴C dating.

Sampling: After extensive field reconnaissance and GPR (ground-penetrating radar) imaging of subsurface contexts, we described stratigraphic relationships at 8 sites across north-central Minnesota. Using natural exposures and hand-dug pits, we targeted >20 contexts for optical dating. Samples were collected with PVC tubes and lightproof bags.

Methods: Under amber light, samples were wet-sieved and treated with dilute HCl to remove carbonates, and then floated in 2.7 g/cm³ sodium polytungstate to isolate heavy minerals, which were identified by XRD (x-ray diffraction). We used a standard pretreatment to refine the sample: 1) initial etch and removal of feldspars using 10% HF for 1 hour; 2) etch with 48% HF in a mechanical shaker for ~50 minutes; 3) react with 47% HCl to remove fluorides; 4) re-sieving to remove the <75 gm fraction; 5) infrared stimulation test (IRSL) to verify removal of feldspar grains; and 6) possible repeat of refinement steps to assure sample purity.

The primary luminescence techniques employed included a preheat plateau test and single aliquot regenerative-dose measurements (OSL SAR) [2] on prepared quartz of the average grain size represented

in the sediment sampled. Measurements were conducted using a RISO TL/OSL DA-15 reader (470 nm, 2 U-340 filters). The SAR protocol used four regenerative dose points (5, 10, 20, 40 Gy) with an initial preheat (PH₁) of 260°C/10 sec, after which the natural dose (L.) was measured using 90% blue diodes (60 sec) at 125°C. The irradiations were followed by a preheat (PH₂) of 260°C/10 sec, and a small test dose.

Values for dose rate (D_r) were calculated from ICP-MS and AAS measurements of the concentrations of K, U and Th in bulk sample splits treated with an HF-HNO₃ HClO₄ digestion, and dilution [3]. The *in situ* water content was measured after oven-drying the sediment at 100°C.

Conclusion/References: Replicate optical dates suggest there was a period of dune mobilization during the late Pleistocene (13-12 ka), followed by a cessation. Eolian dynamism then peaked after 8 ka, which is a time period characterized by aridity across the mid-continent region [4]. These new dates from Minnesota can be compared with other published records from the Great Lakes region [5].

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[4] Dean, W.E., Ahlbrandt, T.S., Anderson, R.Y., and Bradbury, J.P. (1995) Regional Aridity in North America during the middle Holocene. The Holocene 6:145-155.

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