Deltas and Dunes: The Sand and Gravel Legacy of Glacial Lake Souris in North-Central North Dakota

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Glacial Lake Souris was a proglacial (in-front of the ice) lake that was present in north-central North Dakota during late Wisconsinan time and likely covered an area of 2,251 square miles at its maximum extent. The lake extended from southern Manitoba near the Turtle Mountains in the north to Verendrye in the south (fig. 1). It is thought that this proglacial lake was up to 80 feet deep in its deepest parts, but more commonly was around 30 to 50 feet deep across most of its area. The lake is thought to have existed for only a few hundred years and had drained away by 12,000 years BP (Lord, 1988).

Glacial meltwaters flowing into the lake would transport and rework substantial amounts of sand and gravel from the surrounding glacial sediments, which would eventually be deposited in pseudo-deltaic sand and gravel deposits along the margins of the lake, referred to as turbidity or density current deposits (fig. 2; Bluemle, 1982).

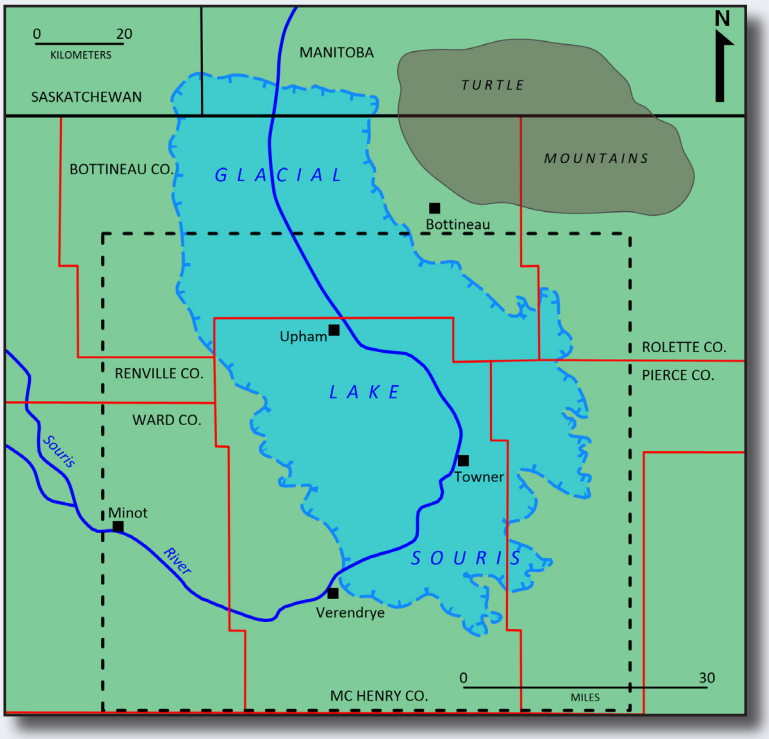

Figure 1. The area covered by Glacial Lake Souris in north-central North Dakota. The dashed line outlines the extent of the map in Figure 2.

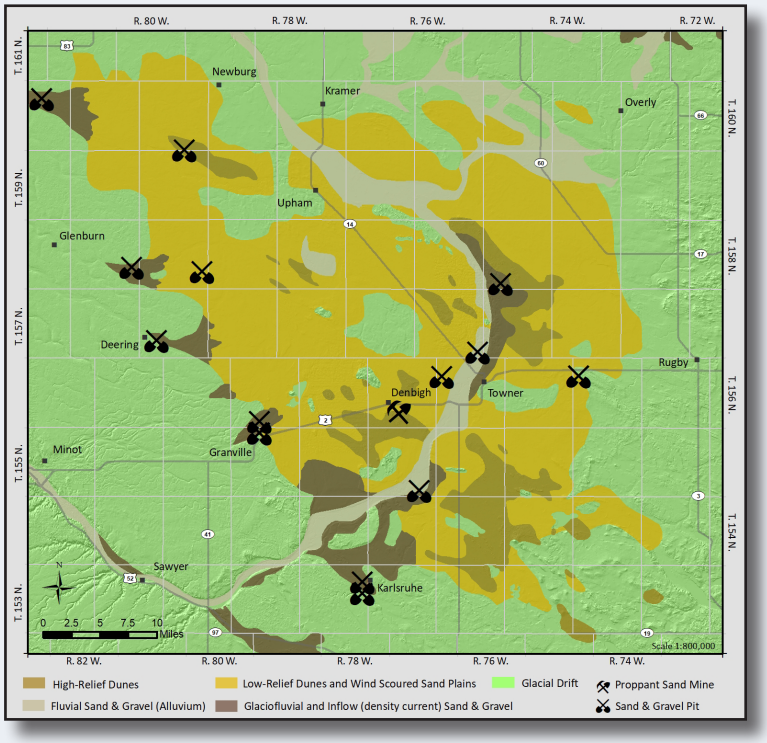

Figure 2. Simplified geologic map of sand and gravel deposits in the area of the Glacial Lake Souris (modified from Clayton and others, 1980).

For several years, these deposits have been home to operating sand and gravel pits (Anderson, 2010) that serve the needs of the construction and transportation industries in the region (fig. 3).

Figure 3. Sand and gravel pits like this one in McHenry County have been developed in Quaternary age glaciofluvial-deltaic sediment associated with the flow of glacial meltwater down the Souris River Valley. These pits produce a variety of materials from fine-grained sand to coarse gravel and large glacio fluvial meltwater boulders transported by glacial meltwater outbursts.

After the disappearance of glacial meltwaters, their sediments (deltaic and offshore sands) were reworked by the wind with much of the finer sand fractions coalescing into numerous dune fields across the lake basin, such as those found across much of northeastern McHenry County (fig. 4). The NDGS recently completed mineralogical studies evaluating the potential of these sand dune deposits for use as proppant (Anderson, 2020 a & b). In-basin proppant sand is currently being produced from dune deposits just southeast of Denbigh, a first for North Dakota, supporting the hydraulic fracturing process for oil wells in the Williston Basin.

Thanks to North Dakota's glacial past, abundant sand and gravel deposits can be found across the entire state. In order to meet the needs of current and future industries in North Dakota, responsible stewardship of these resources will be required, as these resources continue to be explored and developed.

References

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Figure 4. Sand dunes like this one located 13 miles southeast of Towner in McHenry County, at the southeastern edge of the Denbigh Dune Field, have undergone much research the past few years as potential proppant sand sources.