

Hydrofrac sand in Wisconsin

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Wisconsin has abundant resources of sand that range in age from young glacial deposits that are less than 30,000 years old to ancient marine sandstones that are 500 million years old (Cambrian age).

Sand has been mined in Wisconsin for a variety of uses since the arrival of the first permanent settlers. The oldest continuing use has been as fine aggregate for mortar and concrete. Molding sand, the sand used to make mold casts for the foundry industry, has been mined since the 1800s. Sand has also been mined for use in filter beds for drinking water and wastewater treatment, for well screen packing, glass manufacture, and bedding for dairy operations. Hydrofrac (or frac) sand for the petroleum industry has been mined in Wisconsin for over 40 years.

Recently, the development of new horizontal drilling technology using frac sand has made possible production of previously unrecoverable natural gas resources. In response, the demand for sand has increased exponentially.

Wisconsin has some of the best resources for frac sand in the country, and our sand, also known as “Northern White,” has a high reputation in the energy industry. However, Wisconsin is not the sole source for frac sand; it is also being mined from Illinois to Oklahoma and as far west as Arizona.

What is frac sand?

Frac sand is quartz sand of a specific grain size that is suspended in fluid and injected into oil and gas wells under very high pressure. The fluid pressure fractures the rock and opens natural fractures and pores that would normally be closed due to the weight of the overlying rock. The sand grains are carried into these fractures and prop them open after the fluid pressure is released. Hence the name “proppant,” a term commonly applied to frac sand.

Not all sands found in Wisconsin have the properties needed to make frac sand. To meet the industry

specifications frac sand needs to be nearly pure quartz, very well rounded, and it must meet tight size gradation standards. Because the sand grains are required to hold open pores produced in the hydrofrac process, they must also have a high compressive strength, generally between 6,000 psi and 14,000 psi. Sands that meet these specifications are mined from Cambrian and Ordovician sandstones (more specifically, from the Jordan, Wonewoc, Mt. Simon, and St. Peter Formations). Sands derived from younger glacial deposits as well as most beach and riverbank sands are too impure and too angular to make frac sand.

Where is frac sand found?

In Wisconsin, principal areas of interest for sand mining have been in the western part of the state, from Burnett County in the north to Trempealeau, Jackson, and Monroe Counties in the south (fig. 1).

Activity in the north, primarily in Barron and Chippewa Counties, has concentrated on mining Jordan sandstone from exposures on hilltops, and on mining Wonewoc sandstone on lower hillsides. The lower part of the Jordan Formation, the Norwalk Member, and the underlying St. Lawrence dolomite and Tunnel City sandstones are too fine grained and contain impurities such as feldspar which make them unsuitable for use as frac sand.

In Pierce County, Jordan sandstone (the upper, coarser-grained Van Oser member) has been mined underground for many years from tunnels driven into the bluffs beneath the Prairie du Chien dolomite. The fact that the Van Oser Member is near the top of the Jordan has created interest in mining it from the floor of depleted Prairie du Chien dolomite quarries on ridgetops in Dunn, St. Croix, and Buffalo Counties.

The bedrock geology map of west-central Wisconsin (fig. 2) gives a more-detailed picture of the distribution of formations that are targets for frac sand development. The pattern on the map is due to erosion that has cut down through the layers, exposing the older

rocks in the valleys. This is the coulee topography that is typical of the unglaciated part of the state.

The Jordan Formation forms a narrow outcrop band on the upper slopes of the ridges, and is exposed in the valleys of southern Pierce County and along the western side of the Chippewa Valley. The Wonewoc forms a wider outcrop area on the lower slopes.

Most new mines under development or proposed in Trempealeau, Dunn, Buffalo, Jackson, and Monroe Counties are in the Wonewoc. The Wonewoc is finer in average grain size than the Van Oser Member of the Jordan, but high purity makes some of the material that is too fine for frac sand suitable for the glass industry. Although the Wonewoc has more material not suited for frac sand, it is easier to mine in the southern region because of the much greater surface exposure, which eliminates the need to mine underground.

Mt. Simon sandstone is found to the northeast in Clark, Wood and northern Jackson and Monroe Counties. There is increasing interest in the Mt. Simon sandstone and the alluvial sand that is locally derived from Mt. Simon sandstone, a large portion of which is mined as a byproduct of cranberry bog construction.

Permits and regulations

Many concerns have been raised regarding environmental and nuisance problems as sand mines proliferate. We have a strong reclamation regulation in N.R. 135, and air and water regulations that have proven adequate for our largest nonmetallic mines, including some sand mines that have operated for many years. Regulators are having to adjust to permitting larger-scale mining operations than they may be accustomed to, but the regulations are the same.

For a summary of regulations that apply to nonmetallic mining in Wisconsin, visit the Department of Natural Resources website at <http://dnr.wi.gov/org/aw/wm/mining/metallic/index.htm>.

Where are we headed?

The sand boom of 2011 in western Wisconsin took many by surprise, especially the regulators who have to deal with permits at the state and local level. Will it last? It is hard to predict exactly how long the rush will last, but it is certain that the pace of new mine development will slow down significantly as mines currently under construction come on line and supply begins to catch up with demand. The good news for county and local officials is that the volume of permit applications is likely to slow in the near future due to market pressures.

Wisconsin sand producers will see increased competition and falling prices as supplies increase. Those that survive will certainly be those with both an adequate reserve of quality sand and direct access to rail or barge transport to keep shipping costs at a minimum.

For more information

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Figure 1. Locations of recent frac sand mines and processing facilities

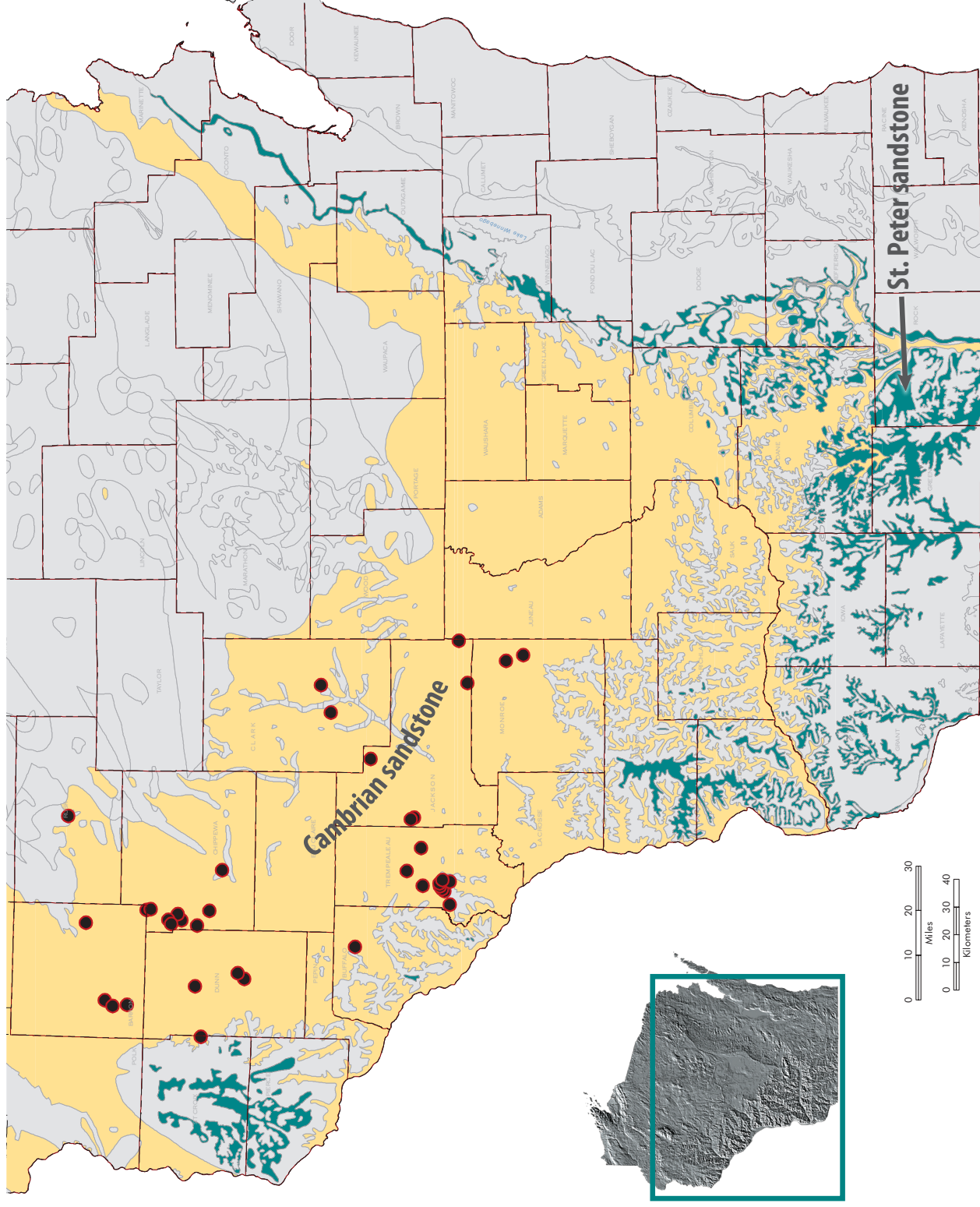


Figure 2. Bedrock geology of west-central Wisconsin

