Explore Minnesota: DIAMONDS

Minnesota has:

- An Archean-aged Superior Craton root (Fig. 1) that underlies two thirds of Minnesota; diamondiferous kimberlites have been found elsewhere within the Superior Craton in Ontario and Michigan (Fig. 2).
- Major crustal structures that cross-cut Minnesota's cratonic root, e.g., Vermilion Fault Zone, Great Lakes Tectonic Zone, Quetico Fault, etc., which are excellent kimberlite exploration areas (Fig. 3).
- Kenora-Kabetogama and Keweenawan dike swarms that intersect these and other structures and could have provided pathways for kimberlite emplacement, e.g., similar to the kimberlites found in the Kyle Lake and Attawapiskat kimberlite clusters in northern Ontario. (Fig. 2)
- An Archean terrane with calc-alkaline lamprophyres that is time-equivalent with the Michipicoten greenstone belt in Ontario that has diamondiferous calc-alkaline lamprophyres associated with diamondiferous heterolithic breccias.

Minnesota also has:

- Been a mining state for more than 120 years.
- Reasonable mining taxation and economic incentives, as well as an established permitting process.
- Excellent regional and local bedrock and glacial mapping.
- An excellent aeromagnetic and gravity database covering the entire state.
- Drill core and associated records for more than 7,000 drill holes.
- An online database of mineral exploration records.
- Regional and statewide glacial and glaciofluvial soil and stream sediment surveys.

Minnesota is *underexplored* for diamonds. There has been limited exploration for diamonds by Exmin, a subsidiary of Sibeka (Belgium), that identified garnets, ilmenite, chrome spinel, and chrome diopside. Yet, Minnesota is underlain by the Archean-aged Superior Craton (Fig. 1; after Kirkley et al., 1991, *Gems and Gemology,* with permission) that elsewhere contains diamondiferous kimberlites, diamondiferous lamprophyres, and related heterolithic breccias/volcaniclastic sediments (Fig. 2). While Minnesota has variable thicknesses of glacial overburden, it has an excellent aeromagnetic (Fig. 3) and gravity (Fig. 4) survey of the entire state. The aeromagnetic survey also defines several continental-scale faults, e.g., Vermilion Fault System, Quetico Fault, Great Lakes Tectonic Zone, Rainy Lake-Seine River Fault (Fig. 3). The Paleoproterozoic Kenora- Kabetogama (2.1 Ga) and Mesoproterozoic Keweenawan dike swarms and their intersections with the continental scale fault/ shear zones offer possible structural sites for emplacement of kimberlites.

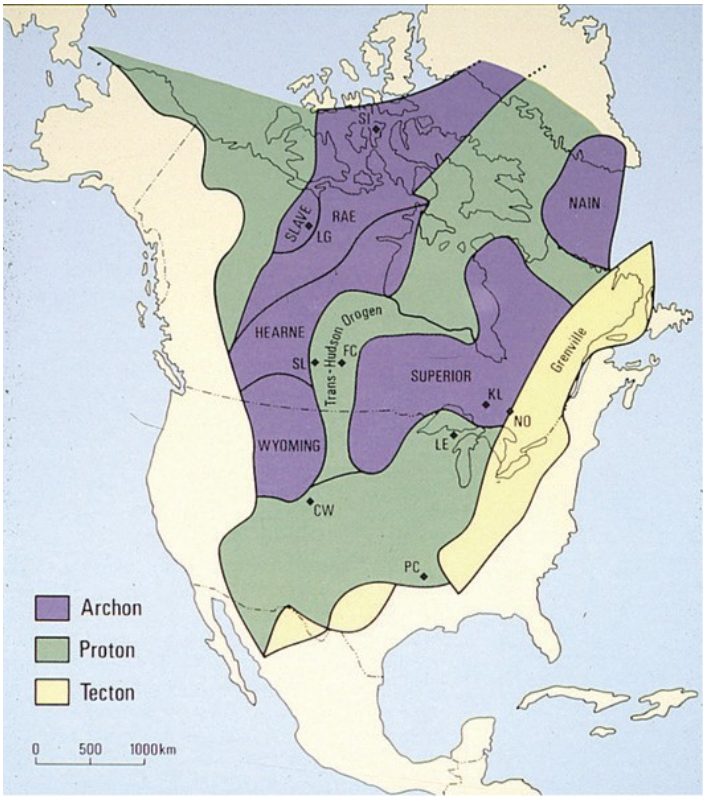

Figure 1. Archean cratons in North America.

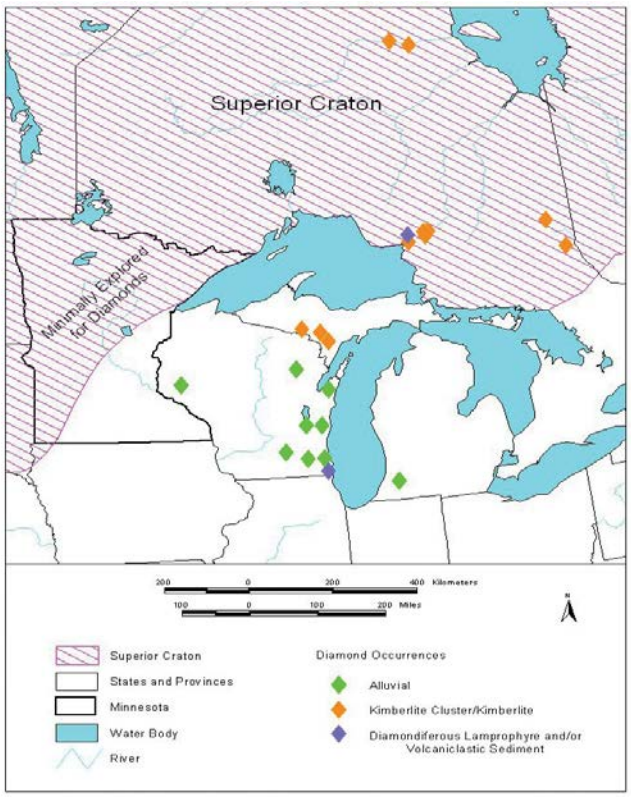

Figure 2. Map of diamond occurrences in relation to the Superior Craton.

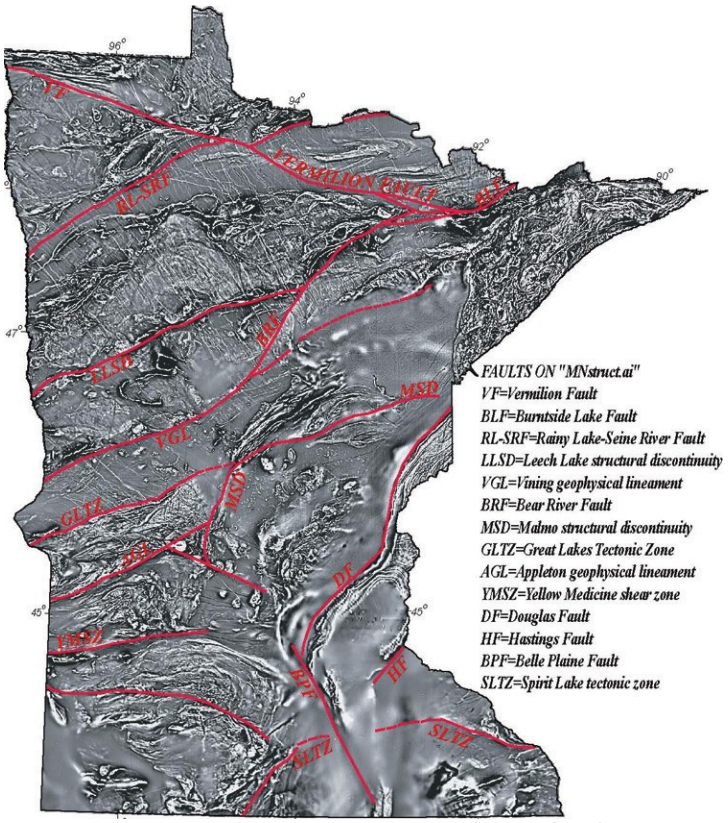

Figure 3. Major structural zones in Minnesota superimposed on the aeromagnetic map of Minnesota.

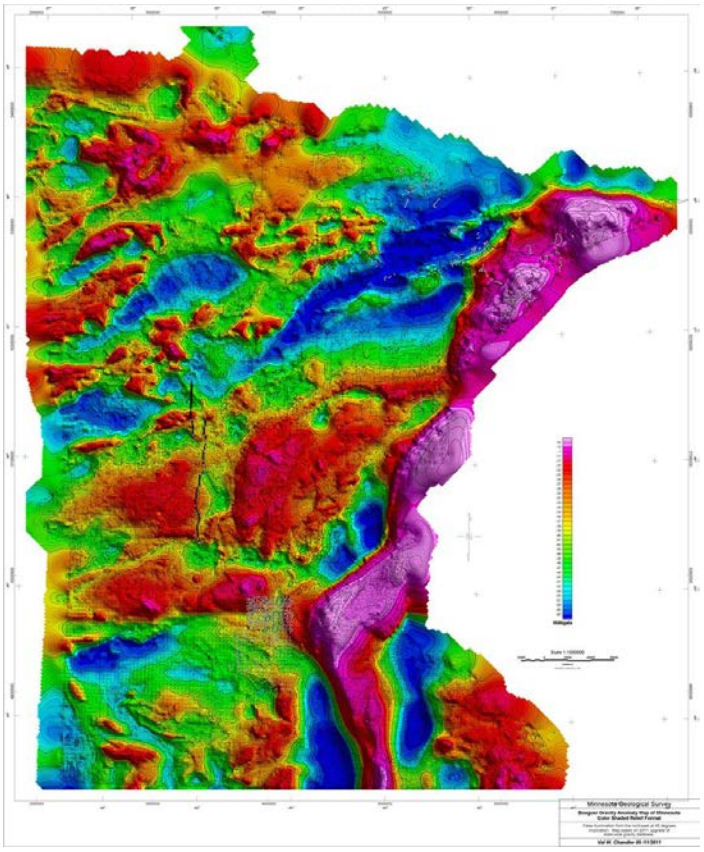

Figure 4. Color shaded relief gravity map showing the Mid-Continent Rift System gravity high in Minnesota.

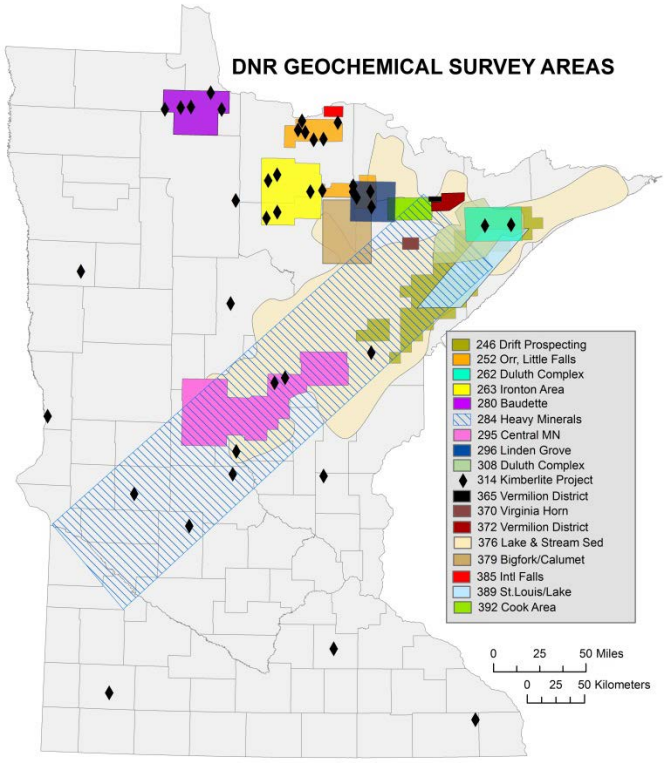

Figure 5. Location of various DNR geochemical soil/till sampling campaigns in Minnesota.

In association with the formation of the Mesoproterozoic (1.1Ga) Mid-Continent Rift System, several 1.1 Ga kimberlites have been identified in the Kyle Lake and Wawa areas in Ontario on the flanks of the rift.

Minnesota has a drill core depository of more than 7,000 drill holes from across the state along with related drill hole and other data. Most of the drilling records and related data can be found online (see next page for contact information). Along with other historical data, hardcopies of maps/reports are also available.

Excellent statewide and regional geophysical data exists for gravity (>57,000 stations) and aeromagnetics. Aeromagnetic data were collected at 300 ft. (~100m) and flown at quarter-mile spacings (~400m), and they were recently reinterpreted using state-of-the-art software. All data are digital. Both the gravity and aeromagnetic data illustrate the Mesoproterozoic Mid-Continent Rift System (red N-S linear feature on Fig. 4). The aeromagnetic data clearly illustrate the regional structures and the Kenora-Kabetogama dike swarm, which intersect or are cut by the major structural zones, setting up possible structural sites for kimberlite emplacement similar to kimberlites emplaced in the Attawapiskat region of Ontario.

Statewide and regional geochemical surveys (Fig. 5) have been conducted for a variety of purposes, and most of these surveys were analyzed for a host of different elements. In some cases, samples still exist for reprocessing.

Three indicator mineral surveys with soil geochemistry were collected in 2004 (MGS-WMC), and 2006-2007 (MGS-NRRI) from tills from several glacial events (Fig. 6). These surveys produced chrome diopsides, a few Cr-pyropes, and Mg-ilmenites. In addition, VMS indicator minerals Mn-epidote and tourmaline suggest a MN or WI volcanogenic source. One of the most striking indicators are gold grains (Figs. 7a and 7b). The pristine gold grains in Figure 7b are unlikely to have travelled more than about one kilometer from their source area. The cluster of high gold grain counts in the northeast (Fig. 7b) occur within 1-2 kilometers south of the Vermilion Fault Zone (Fig. 3).

Minnesota is *underexplored* for kimberlites. Minnesota offers a wide variety of exploration targets in an area underlain by an Archean-aged, deep continental root that is cross-cut by crustal- scale structural zones that make excellent sites for kimberlite emplacement.

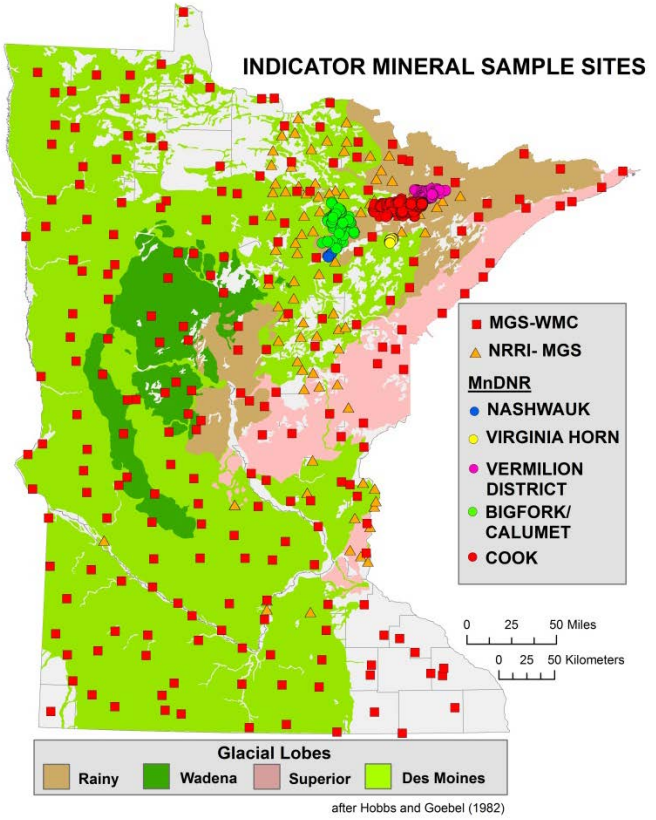

Figure 6. Distribution of various indicator mineral surveys in Minnesota relative to Wisconsin-Era glacial advances

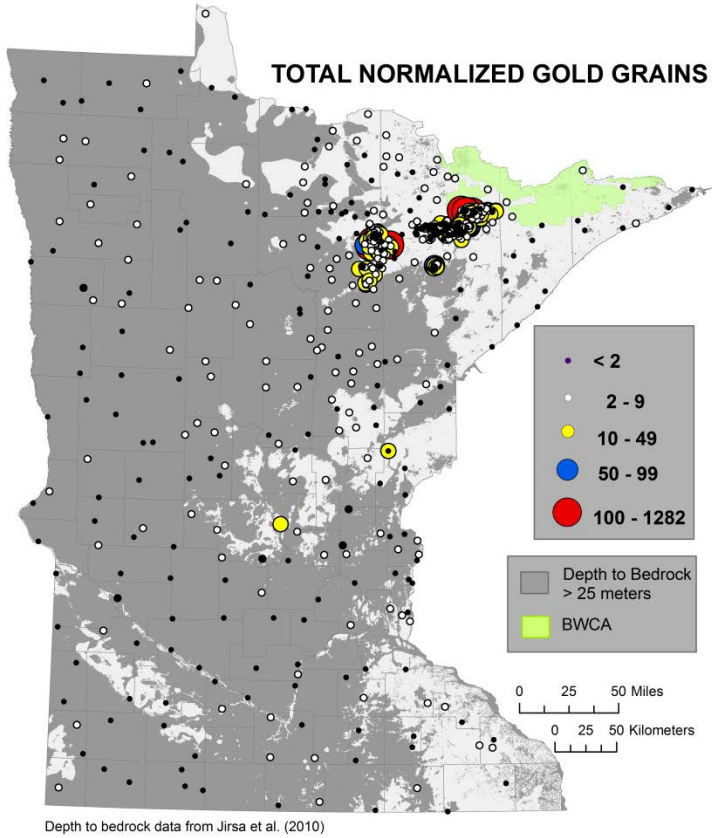

Figure 7a. Total gold grain counts from glacial sediment samples, relative to portions of the state where glacial sediment thickness exceeds 25m .

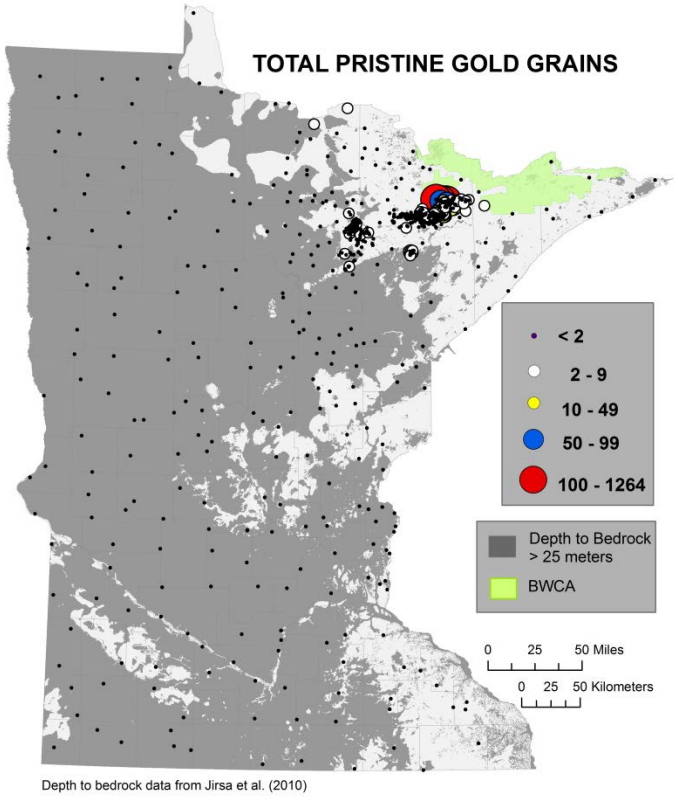

Figure 7b. Distribution of pristine gold grains identified during various glacial indicator mineral surveys.

For more information, contact:

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See also: http://mcc.mn.gov/

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