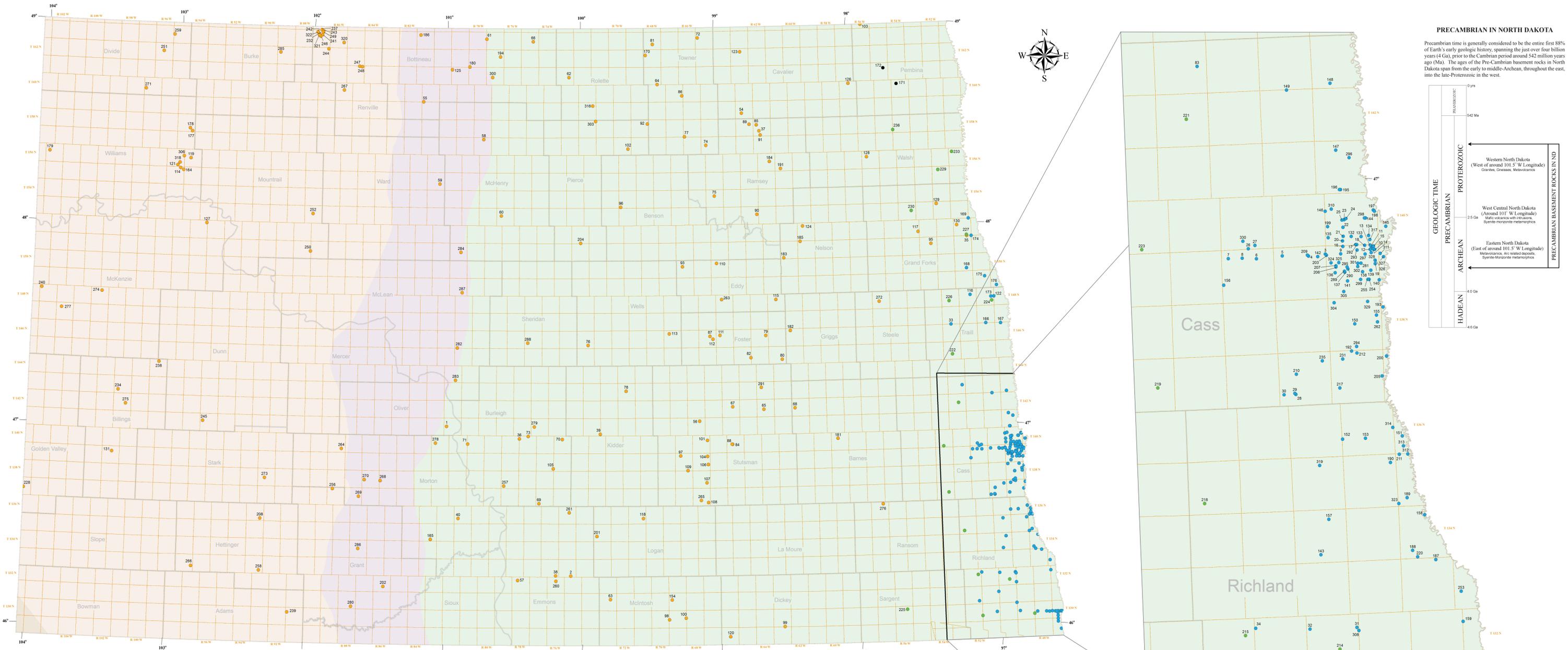




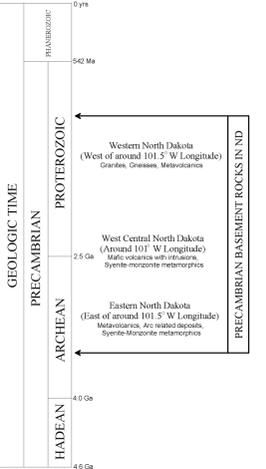
PRECAMBRIAN BASEMENT DRILLHOLE MAP OF NORTH DAKOTA

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2007



PRECAMBRIAN IN NORTH DAKOTA

Precambrian time is generally considered to be the entire first 88% of Earth's early geologic history, spanning the just over four billion years (4 Ga), prior to the Cambrian period around 542 million years ago (Ma). The ages of the Pre-Cambrian basement rocks in North Dakota span from the early to middle-Archean, throughout the east, into the late-Proterozoic in the west.

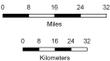


EXPLANATION

- Oil & Gas Drilling Well Location  
Wells drilled to basement for the exploration, development, and production of oil and gas resources in the state. Well information maintained by the North Dakota Oil and Gas Division.
- Water Well Drilling Location  
Wells drilled to basement for the exploration, and development of ground-water resources in the state. Well information maintained by the North Dakota State Water Commission.
- Red River Valley Drilling Project Well  
Wells drilled to basement in support of a framework and geology study on the subsurface of the Red River Valley by Moore (1977). Well information maintained by the North Dakota Geological Survey.
- Subsurface Mineral Exploration Test  
Wells drilled to basement for the purpose of subsurface mineral exploration. Well information maintained by the North Dakota Geological Survey.

- Well ID  
The well identification numbers shown on this map have been assigned in ascending chronological order based on available well drilling information. Where several wells were reported to have been drilled on the same day, the wells were numbered from shallowest Precambrian basement footage penetrated to the deepest.
- Township Boundaries
- County Boundaries

Scale 1:750,000



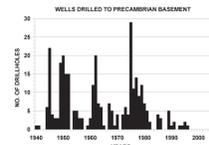
North American Datum 1983 Lambert Conformal Conic

DESCRIPTION OF GENERALIZED GEOTECTONIC BASEMENT TERRANES IN NORTH DAKOTA  
(as modified from Sims et al., 1991)

- Arc-related and scattered Archean rocks - Trans-Hudson Orogeny (1.91 - 1.8 Ga)  
Granitoid and gneissic rocks, metamorphosed mafic-intermediate volcanics, banded iron-formation and interbedded metavolcanics, metamorphosed sedimentary and volcanoclastic rocks, gabbro and related mafic rocks, and locally present diorites.
- Superior-Churchill Boundary Zone - Trans Hudson Orogeny (1.91 - 1.8 Ga)  
Dense arc-derived rocks with scattered Archean crust, possibly intermediate-mafic volcanics with mafic and ultramafic intrusions and Syenite-monzonitic rocks at granulite metamorphic facies.
- Archean Greenstone-Granite-Gneiss Terrane - Superior Craton (2.75 - 2.6 Ga)  
Dense, possibly intermediate-mafic volcanics, arc-derived and back-arc basin deposits along with syenite-monzonitic rocks at granulite metamorphic facies.
- Archean Gneiss Terrane - Wyoming Craton (3.4 - 2.5 Ga)  
Migmatitic and granitoid gneisses and rocks of the Black Hills domain of the Trans-Hudson Orogen.

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Graph showing the number of wells drilled to Precambrian basement in North Dakota since the early 1940s. There have been four periods where the rate of well drilling penetrations into the basement has exceeded 20 penetrations per year: 1) the mid 1940s, 2) around 1950, 3) the early 1960s, and finally 4) the mid to late 1970s. The relatively recent decline in the amount of wells drilled to basement annually can be attributed to the advent of horizontal well drilling in the oil and gas producing areas of the Williston basin along with significant increased production from Paleozoic stratigraphic units.

This map is a compilation of currently available drillhole information for wells that have penetrated the Precambrian basement of North Dakota. The majority of the drillhole information compiled on this map is from the files and databases of the Oil and Gas, and Geological Survey divisions of the North Dakota Department of Mineral Resources. Drillhole information from water well drilling, primarily in eastern North Dakota, is also included here as extracted from water-well information databases of the North Dakota State Water Commission.

The Precambrian basement is defined here as the lowermost and subsequently oldest competent bedrock, of igneous or metamorphic origin present beneath the overlying Phanerozoic sedimentary cover. Four major generalized basement geotectonic terranes exist in North Dakota and are depicted on this map as

and North Dakota Geological Survey, as well as many private drilling companies, have added over 150 drillholes with a basement penetration to the database. Several subsurface mineral resource exploration programs, with drilling focused in the Red River Valley and northeastern North Dakota in Pembina County, have also added to the database.

The most recent basement penetration was in the late summer of 1998 with the drilling of a water-well in northeastern Richland County. The average rate of basement penetrations in North Dakota per year, based on the well information contained here, is around five. The year that saw the most wells drilled to basement was 1977 in which a total of 29 wells were advanced into the basement granites and gneisses underlying easternmost North Dakota (Figure 1).

A large portion of these wells were drilled as a part of the Red River Valley Drilling Project initiated by Moore (1977) whose purpose was to delineate the regional stratigraphic framework in the Red River Valley in North Dakota and Minnesota in support of subsurface mineral exploration.

Drillhole location information used to plot drillhole locations is genetic to the databases used in this compilation. Other drillhole location data was derived from coordinate transformation software utilities available in the public domain. The user is cautioned that the location and positional information used here is approximate and appropriate for use only at the scale presented. Larger scale investigations should refer to the original well files, databases, or drilling records on file for best available drillhole location information.