Precambrian time (all of geologic time before the Cambrian Per-

iod) began when the Earth became a solid entity about 4.5 billion

years ago and ended when the Cambrian Period began, about 570

million years ago. “Precambrian” is actually an informal term used

by geologists. This long period of time is divided formally into two
eons—the Archeozoic (greater than 2.5 billion years ago) and the

Proterozoic (2.5 billion to 570 million years ago). Despite the immense

span of time it represents, the Precambrian is the most poorly known

of the geologic subdivisions in Ohio, in part because Precambrian
rocks are nowhere exposed in the state. These primarily crystalline
igneous and metamorphic rocks are deeply buried beneath younger
Paleozoic sedimentary rocks at depths ranging from about 2,500 feet
in western Ohio to more than 13,000 feet in southeastern Ohio. These
rocks are collectively referred to by geologists as the “basement”

because they form the foundation for the overlying Paleozoic rocks.

Drillers commonly refer to the Precambrian rocks as the “granite,”
in reference to a common rock type found below the Paleozoic
rocks. Ohio’s Precambrian rocks appear to have formed in the late
Precambrian, between about 1.5 billion and 800 million

years ago. Older Precambrian rocks have not as yet been found in the

state.

Our knowledge of Precambrian rocks is derived from direct
sampling of them through deep oil and gas well or other bore-
holes or indirect geophysical means such as aeromagnetic and
gravity maps, reflection seismic lines, or study of earthquake waves.

Geophysical techniques are comparatively new, and it has only been
since the early 1980’s that geophysical data have become widely
available.

PRECAMBRIAN GEOLOGY OF OHIO

Known Precambrian history of Ohio began with the emplacement
of a vast, horizontal, 7-mile-thick layered sheet of granite (coarse-

grained igneous rock formed at depth) and rhyolite (fine-grained
volcanic equivalent of granite formed near the surface) beneath
western Ohio and neighboring states to the west. This emplacement
has been attributed to an uprising in the Earth’s mantle, known as
a superswell. Radioisotopic dating suggests that this event took
place between about 1.4 and 1.5 billion years ago, forming what
geologists call the Granite-Rhyolite Province.

Continued continental doming of the superswell caused the crust
beneath western Ohio, Indiana, and Kentucky to extend and split
(rifting), resulting in major faulting and consequent downdropping
to form a complex rift basin, now known as the East Continent Rift
Basin. Molten basalt flowed upward as erosion began to fill the
basin with clastic sediment, perhaps as much as 20,000 feet thick
in some places. This extensive deposit is known as the Middle Run
Formation. About 1 billion years ago, doming ceased and the rift
became a failed or aborted rift. Rifting, volcanic activity, and basin
filling also ceased.

At the time of rifting, it appears that eastern Ohio marked the edge
of the North American protocontinent. Between about 990 and 880

million years ago a continent to the east collided with North America,
resulting in extensive crustal compression and development of a
mountain range that geologists call the Grenville Mountains. What
is thought to be the zone of continental collision, known as a suture
zone, is located in eastern Ohio and is called the Coshocton Zone.

As these continents collided along a 3,000-mile-long line, stretch-
ing perhaps from Sweden to Mexico, rocks were folded, twisted,
temmetamorphosed, and thrust westward across part of the rift zone
in western Ohio. This north-south-oriented, 30-mile-wide zone of
east-dipping, imbricated thrust slices is called the Grenville Front
Tectonic Zone and marks the westward limit of the Grenville Moun-
tains. The Grenville Front in western Ohio is a sharp demarcation
between relatively undisturbed 1.5 billion-year-old granitic rocks
to the west and 800- to 900-million-year-old, greatly disturbed
metamorphic rocks to the east.

After the Grenville Mountains were formed, a 300-million-
year-long period of deep erosion occurred during the Late Precambrian.

During this time the landscape was reduced to a gently rolling surface and the Grenville
Mountains were carved away, exposing their roots of high-grade metamor-
phic rocks. It is probable that even the upper part of the rift-basin sedimentary
rocks were removed at this time. At some time during this interval, ex-
tensive strike-slip faulting occurred.

The close of the Precambrian was marked by the advance of Cam-
brian seas across this geologically complex but topographically simple surface, formed by multiple
events during more than a billion years of time. This topographic
surface and its structural configuration would subtly influence the
subsequent geologic history of Ohio forevermore.

ECONOMIC AND ENVIRONMENTAL INFLUENCE

OF PRECAMBRIAN ROCKS

At the present time, no minerals are produced directly from
Precambrian rocks in Ohio. There is a potential for petroleum and
natural gas to be present in economic quantities in Precambrian
sedimentary rocks.

The economic potential for metallic ores, particularly sulfides

of lead and zinc, also remains unevaluated. Small amounts of sulfide
mineralization occur in carbonate rocks of northwestern Ohio and
other areas of the state. It is probable that these occurrences represent
deposition by fluids derived from Precambrian rocks.

The small to moderate-sized earthquakes that periodically strike
Ohio originate in Precambrian rocks along ancient faults and other
zones of weakness that are reactivated by modern crustal stresses.
The most seismically active area of the state, in Shelby and Auglaize
Counties in western Ohio, is now known to be associated with a
segment of the East Continent Rift Basin that has been termed the
Fort Wayne or Anna-Champaign rift. Increased knowledge of the
Precambrian basement rocks may one day enable us to estimate the
location, frequency, and maximum size of earthquakes in certain
areas of the state.

continued ➔
East-west cross section of Ohio showing relationships of Precambrian rocks and the East Continent Rift Basin to overlying Paleozoic sedimentary rocks.


FURTHER READING


