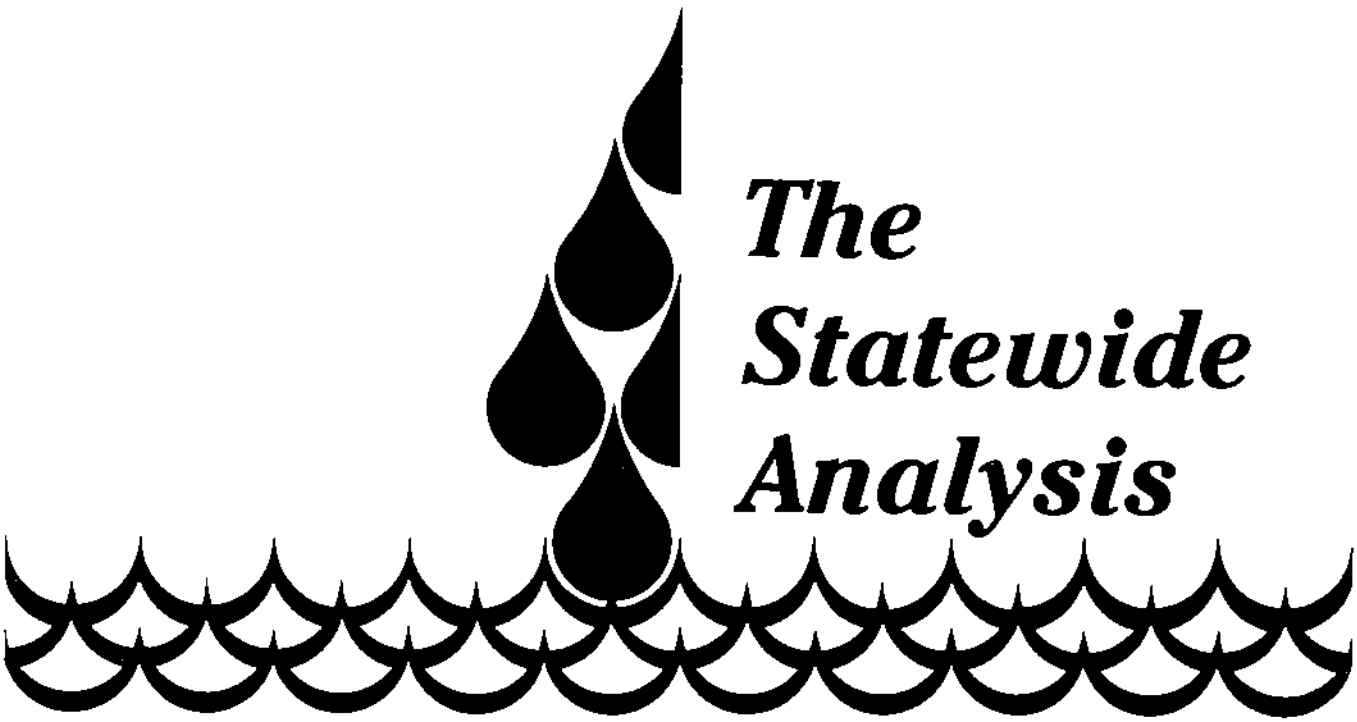
The
Statewide
Analysis

Environmental Conditions

HYDROLOGIC SETTING

The geographic location of the state is important because it determines the climatic and geologic conditions to which it is subject. These, in turn, define the nature, amount, and distribution of precipitation and the consequent water resource, including its relative occurrence as ground or surface water.

The State of Indiana lies within the limits of latitude 37° 46′ 18″ and 41° 45′ 33″ north, for an extreme length of 275.5 miles in a north-south direction; and between longitude 84° 47′ 05″ and 88° 05′ 50″ west with an extreme width in an east-west direction of 142.1 miles.

The state has a maximum topographic relief of about 900 feet, with elevations ranging from about 300 feet above mean sea level at the mouth of the Wabash River to slightly more than 1,200 feet in Randolph County in east-central Indiana.

The gross area of the state is approximately 36,532 square miles (23,380,000 acres), of which approximately 241 square miles (154,240 acres) lie within Lake Michigan.

Climate As a result of its geographic setting, the climate of Indiana is classified as continental. It is influenced primarily by eastward moving masses of cold polar air from the north and warm gulf air from the south. These two forces form low pressure centers which generally move easterly over the state. Other characteristics include high humidity and frequent variations in temperature combined with considerable local precipitation.

The temperature regime in Indiana is important because it (1) defines the growing and dormant seasons, (2) is the major driving force in the process of evapotranspiration, which consumes about two-thirds of average annual precipitation, and (3) heavily influences the rainfall-runoff relationship, in that it serves in substantial measure to determine both the mode in which precipitation occurs and the ability of the soil to absorb precipitation.

Average annual temperatures range from 49°F. along the Michigan state line to more than 56°F. along the Ohio River. The average annual temperature in Indiana is approximately 53°F. Figure 2 illustrates the statewide distribution of average annual temperatures. The average monthly temperatures are subject to wide variations. January, the coldest month, has average annual temperatures ranging from 24°F. to 34°F. from north to south. July, the warmest month, has a temperature range of from 72°F. to more than 78°F. from the Michigan border to the Ohio River.

The average annual statewide precipitation in Indiana is 38 inches, ranging from 36 inches to 44 inches from north to south as shown on Figure 3. Of this amount, average annual snowfall ranges from 70 inches to 16 inches from north to south. Snowfall accounts for approximately two to seven inches of average annual precipitation.

Precipitation is normally well distributed with respect to the growing season (April through October), with about fifty-nine percent of the average annual total occurring within that period. April, May, June, and July each have a state annual average precipitation of about four inches, while October and December, the lowest months, each have about 2.5 inches.

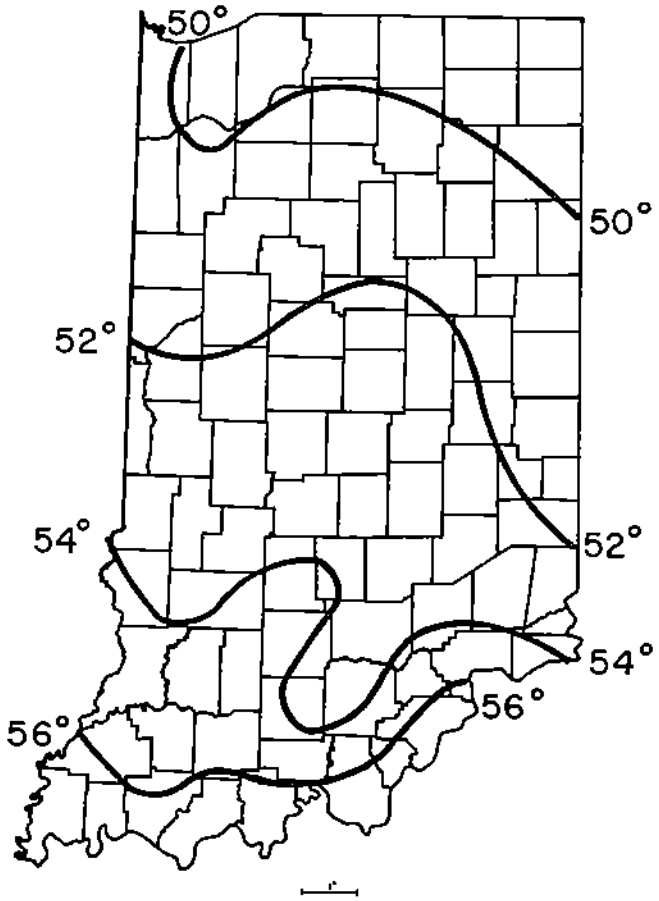

Figure 2
Map of Indiana showing annual temperature in degrees Fahrenheit.

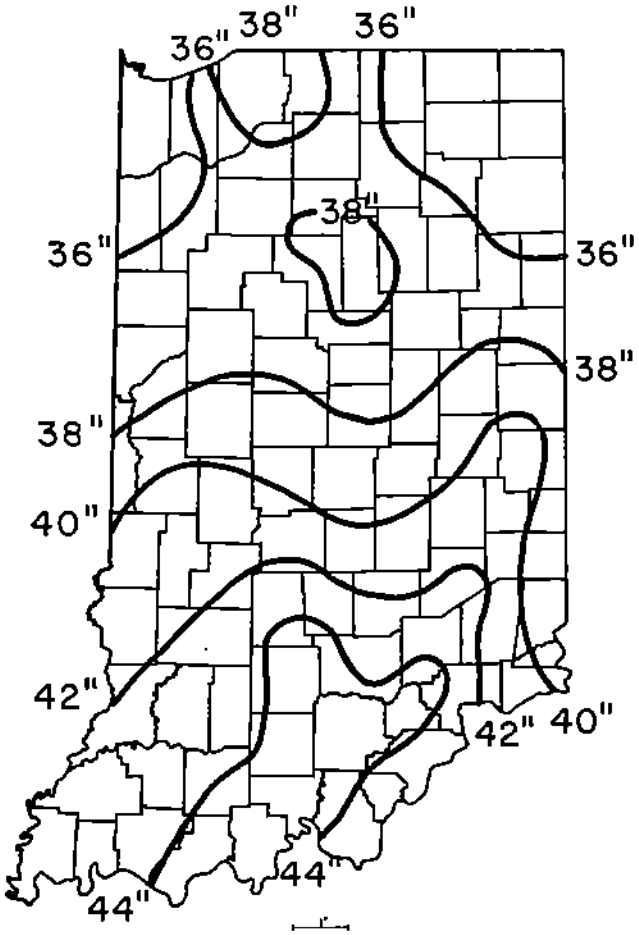

Figure 3
Map of Indiana indicating the distribution of annual average precipitation.

The average annual precipitation data does not provide information on the extremes, either of excess or deficiency, which characterize the state. For example, in the early 1930s and 1940s, Indiana experienced major droughts. Precipitation was sixty-five percent below normal in 1930 and sixty-eight percent below normal in 1941. On the other hand, 1957 was a particularly wet year, with precipitation being one hundred and thirty-five percent above the annual average value.

Extreme amounts of precipitation may occur during storm periods. In March 1913, the southern portion of the state received twenty-one percent (9 inches) of the annual average precipitation in five days, while in 1957 the west-central portion received twenty percent (8 inches) of the average annual precipitation in just one storm event.

In perspective, the climatic setting is such that Indiana on a long-term basis, has a relatively abundant supply of precipitation. Therefore Indiana does not have to contend with the many problems and consequences that would result from an arid or semi-arid climate.

The Geology

Of equal importance to the climatic setting, which controls the amount of precipitation, are the geology and topography of Indiana which influence the disposition of the precipitation and its availability as a water resource.

The location and availability of the Indiana water resource are intimately related to its geology and soils. The proportion of precipitation that runs off the land as surface water rather than infiltrating the soil is dependent in part upon the topography, the geologic conditions, and the soils. In addition, these same factors have substantial influence upon the amount and occurrence of ground water.

Glacial History Perhaps the largest single influence upon the topography of Indiana has been that of glaciation. Glacial lobes, the large, rounded projections from the main body of a glacier, repeatedly entered Indiana during the Ice Age. Figure 4 indicates the general extent of glaciation in Indiana and surrounding states. The glacial lobes entered the state from at least two directions, from the northeast out of the Lake Erie and Saginaw Bay basins and from the north out of the Lake Michigan basin.

As glaciers advance and retreat under the influence of climatic conditions, the topography is transformed. An advancing glacier scours the land surface while a retreating glacier leaves behind large deposits of materials previously scoured from the earth's surface. Glacial drift, the rock material transported by glaciers, covers the northern two-thirds of the state as a legacy of the most recent period of glaciation. Another one-quarter of the state is covered in part by drift of older glacial episodes.

Figure 5 illustrates the location of glacial drift and other unconsolidated deposits in Indiana. Deposits of the last major glaciation, the Wisconsinan (14,000–22,000 years ago), are well represented, but deposits of the Illinoian and older glaciations are much more discontinuous. Their positions and sequences are mostly pieced together from very fragmentary evidence. Eight or nine distinct till sheets (layers of unsorted debris representing mostly the melting out of the basal ice load) overlap one another in western Indiana. These deposits of both northern and eastern lobe origin represent at least six or seven principal glacial advances. Each till sheet is separated from the next overlying or underlying sheet by evidence of weathering or of pond sedimentation during interglacial periods similar to the present interglacial period. At least six or seven distinct till sheets, all of northeastern

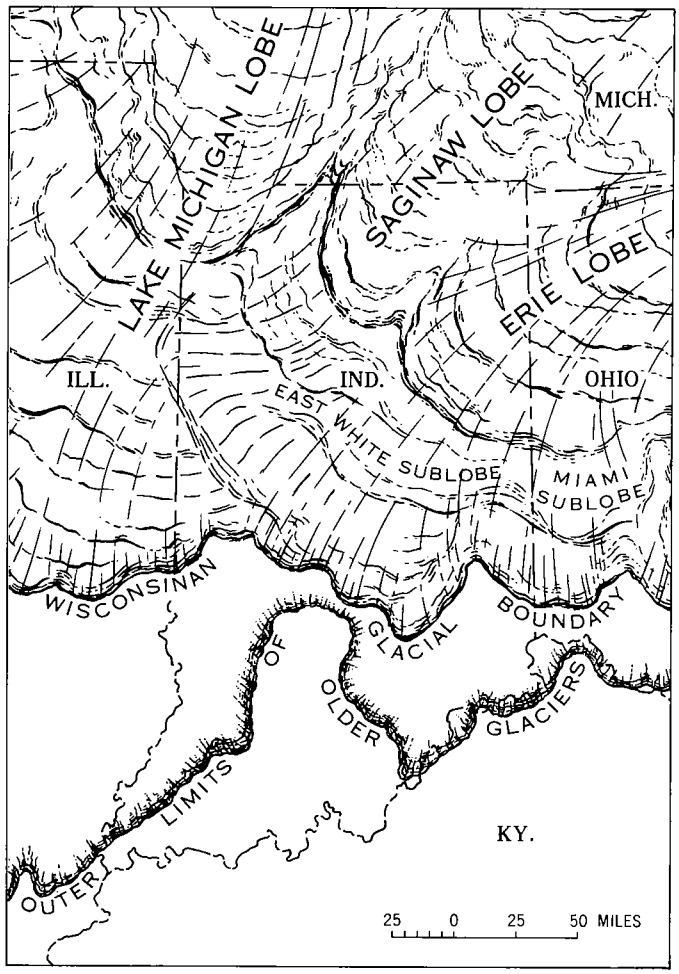

Figure 4
Map of Indiana and parts of adjoining states showing major ice lobes and sublobes during the Wisconsinan age.

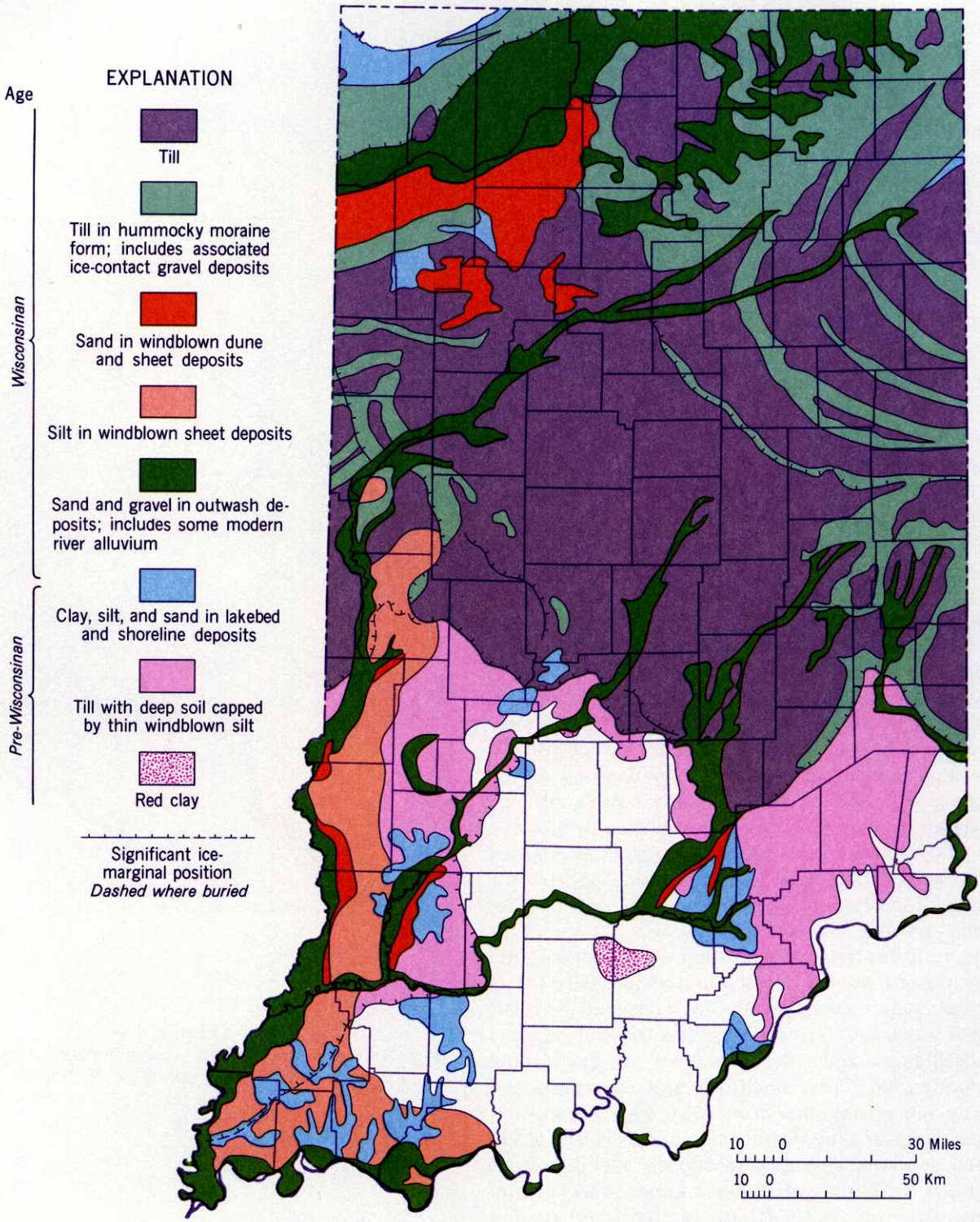

Figure 5
Map of Indiana showing general distribution of unconsolidated deposits. The uncolored areas in southern Indiana represent areas with little or no unconsolidated deposits.

origin and of at least three major glacial episodes, overlap one another in eastern Indiana.

Fewer drift sheets are present in central Indiana and in parts of northern Indiana because of glacial erosion of the earlier formed sheets, but these correspond in sequence and in time of deposition to some drifts in the marginal zones. These till sheets rest sharply one on the other in some places, but commonly they are separated by sands and gravels that were deposited by glacial meltwaters beneath or in front of the several ice sheets.

The remaining nonglaciated area of south-central Indiana shows evidence of drainage changes related to glacial activity. Examples of these changes include those that occurred during the creation of the Ohio River and its tributaries and the creation and eventual drainage of numerous ice-dammed lakes.

Bedrock Geology Indiana's bedrock formations have been assigned ages that place them in the Paleozoic Era of time. They are, therefore, more than two hundred million years old. Figure 6 illustrates the geologic timescale and the Indiana rock types associated with each geologic period. The principal bedrock formations in Indiana are associated with the Pennsylvanian, Mississippian, Devonian, and Silurian periods. These sedimentary rock formations consist mainly of sandstone, siltstone, shale, limestone, and dolomite. These are for the most part the deposits from a series of inland seas that occupied what is now Indiana and surrounding states through most of Paleozoic time. In addition, terrestrial sedimentary deposits are located in parts of Indiana and include large deposits of coal, the remnants of great swamp forests.

The typical sequence of rock types composing the various bedrock formations found in Indiana is shown in Figure 7. The Precambrian, Cambrian, and portions of the Ordovician bedrock are located only at the subsurface. On the other hand, the Pennsylvanian, Mississippian, Devonian, Silurian, and portions of the Ordovician formations are located near the surface or as outcroppings.

The various ages of bedrock which occur below the surface or as outcroppings in Indiana are shown in Figure 8. The bedrock in northeastern Indiana dips northward into a structural depression called the Michigan Basin. Bedrock in northwestern and central Indiana is draped like a stack of blankets over an archlike structure whose axis lies across the state approximately from Liberty in southeastern Indiana to Hammond in the northwestern corner of the state. The bedrock in southern Indiana dips southeastward into a structural depression known as the Illinois Basin.

The sequence of sedimentary rock is about 3,000

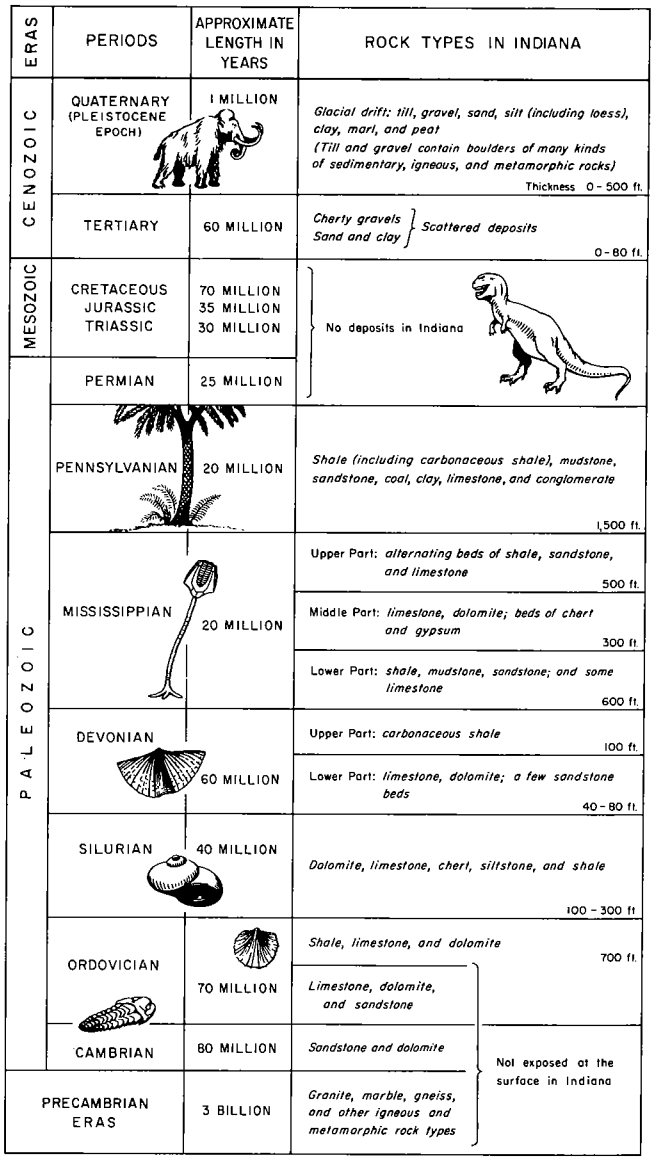

Figure 6
The geologic timescale and the Indiana rock types associated with each geologic period.

feet thick near Muncie but is 5,000 feet thick at the Michigan border and more than 12,000 feet thick at the southwest corner of the state. Erosion has removed great thicknesses of the sedimentary rocks and also has beveled them, so that the oldest (Ordovician) rocks lie at the bedrock surface near Richmond and

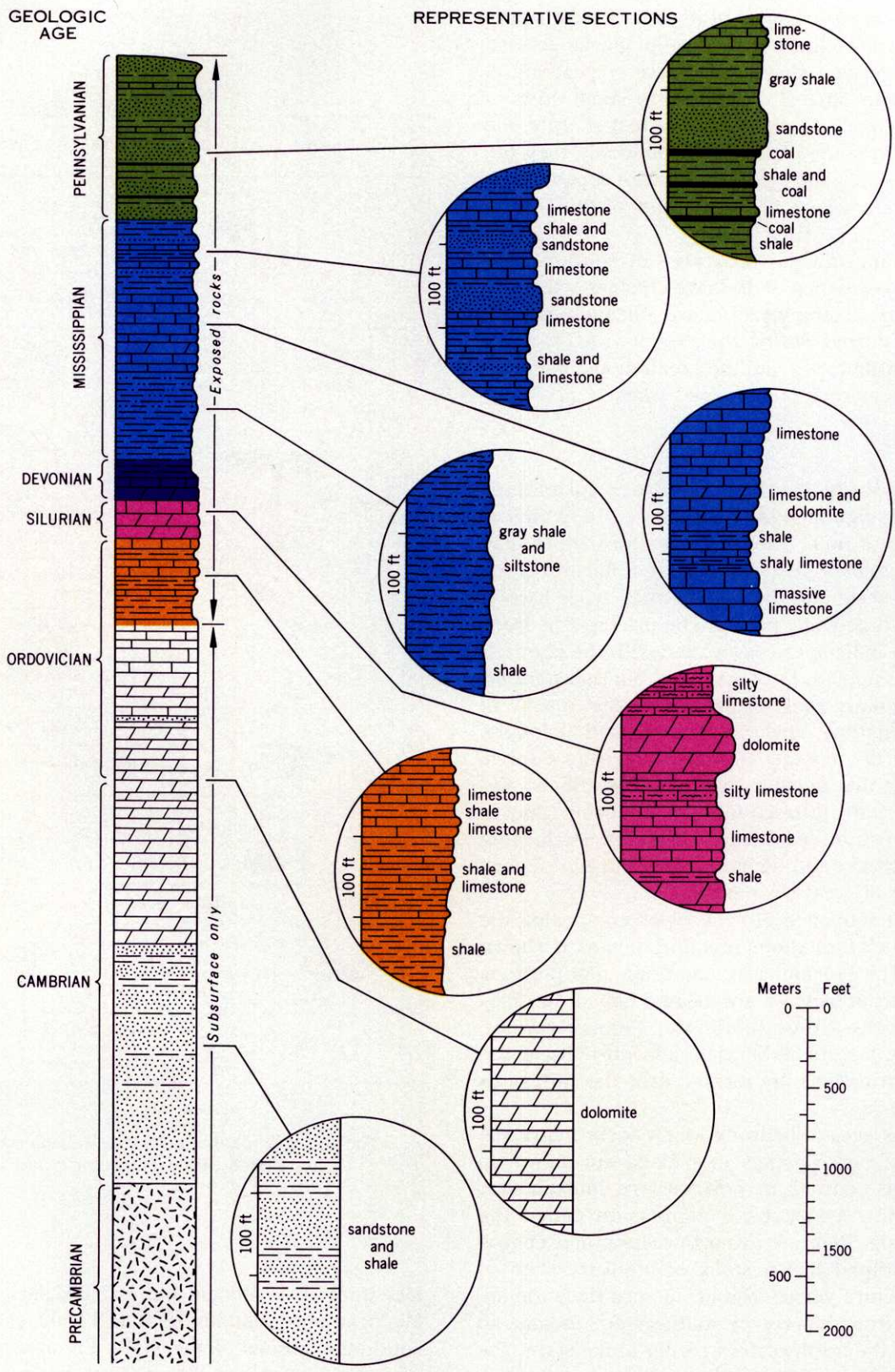

Figure 7
Schematic representation showing the sequence of rocks composing Indiana bedrock deposits during the Paleozoic Era.