Chapter 8: Soils of the Midwestern US

It's sometimes easy to take the soil beneath our feet for granted. Yet soil has always been with us—it is the foundation of our houses and roads, and from the soil comes our food, fiber, and paper. Soil provides a grassy surface for our parks and fodder for our gardens. Scientists look at soil as a record of the integration of the **climate** and life of an area. The scientist, the engineer, and the gardener may all look at the soil below them in different ways, but perhaps no one has a more integral relationship with soil than a farmer. The economic success of producing crops is intimately tied to the quality of the soil upon which those crops grow, and the most successful farmers are very well versed in the science of their soil.

Known for some of the richest soil in the US, the Midwest is home to some of the most productive agricultural soil in North America. According to the USDA, the US contains only about 5% of the world's population, but it provides more than 25% of the world's food supply. The Midwest is home to the Corn Belt, the largest corn producing area in the US, supporting over a hundred-billion-dollar-a-year industry that helps feed the world but also produces plastics, **biofuel**, livestock feed, and more. How did the soil in this area come to be so fruitful?

What is "Soil"?

Generally, **soil** refers to the top layer of earth—the loose surface of the Earth as distinguished from rock—where vegetation grows. The word is derived (through Old French) from the Latin *solum,* which means "floor" or "ground." It is the most basic resource upon which all terrestrial life depends, and soil is one of the most important resources we have. The Midwest has a wide variety of soils, and each type of soil has a story to tell of its origin.

Soils are composed of a mixture of two key ingredients. The first is plant litter, such as dead grasses, leaves, and fallen debris. Worms, bacteria, and fungi do the job of breaking these down into the nutritious organic matter that helps soil to be so nourishing to future plant growth. The second important component of soil is the sediment derived from the **weathering** of rock that is then transported by **wind**, water, or gravity. Both of these components can influence the texture and consistency of the soil, as well as the **minerals** available for consumption by plants.

All soils may seem alike, but there can be vast differences in soil properties even within small areas. A single acre may have several different soil types, each with its own assets and drawbacks. Some types of soil are clayey or prone to flooding, while others are stable enough to be used as a foundation for buildings. The most identifiable physical properties of soils are texture, structure, and **color**, which provide the basis for distinguishing soil **horizons**. Texture refers to the percentage of **sand**, **silt** and **clay** that makes up the soil. The textures have specific names, as indicated in *Figure 8.1*.

Review

climate • *a description of the average temperature, range of temperature, humidity, precipitation, and other atmospheric/hydrospheric conditions a region experiences over a period of many years (usually more than 30).*

biofuel • *carbon-based fuel produced from renewable sources of biomass like plants and garbage.*

weathering • *the breakdown of rocks by physical or chemical means.*

horizon • *a layer in the soil, usually parallel to the surface, which has physical characteristcs (usually color and texture) that are different from the layers above and below it.*

sand • *rock material in the form of loose, rounded, or angular grains, and formed as a result of the weathering and decomposition of rocks.*

CHAPTER AUTHORS

William F. Kean
Carlyn S. Buckler

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loam • *a soil containing equal amounts of clay, silt, and sand.*

peds • *clumps of soil, identified by their shape, which may take the form of balls, blocks, columns, and plates.*

till • *unconsolidated sediment that is eroded from the bedrock, then carried and eventually deposited by glaciers as they recede.*

loess • *very fine grained, wind-blown sediment, usually rock flour left behind by the grinding action of flowing glaciers.*

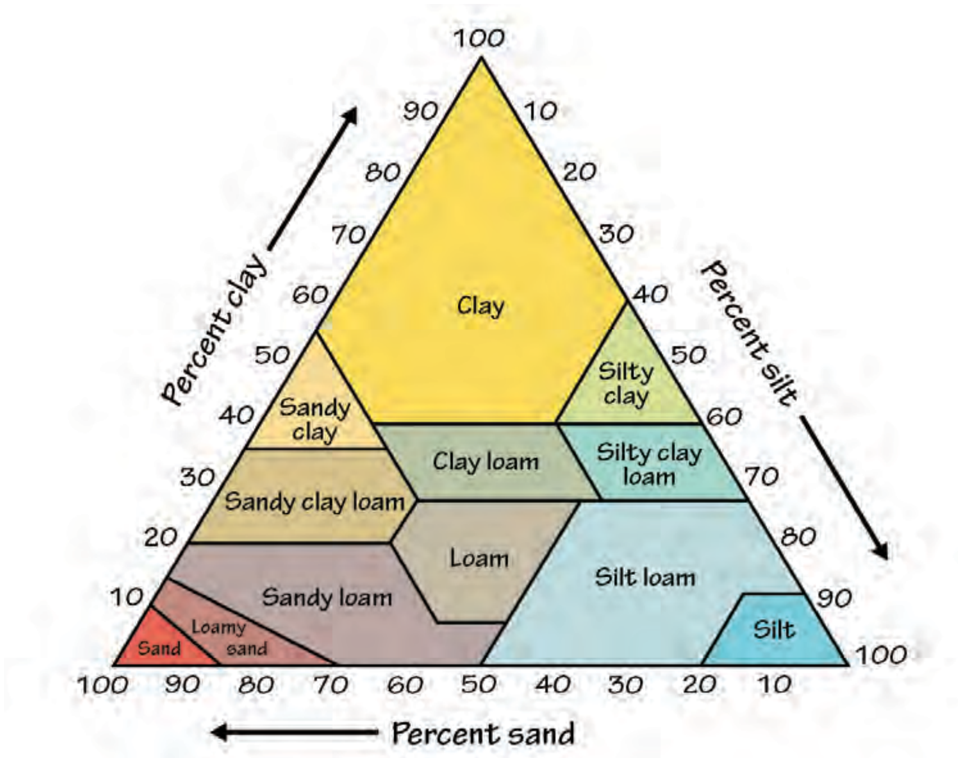

Figure 8.1: Soil texture triangle.

Generally, the best agricultural soils are those with about equal amounts of clay, silt, and sand. A soil of that type would be called a **loam**. Soils that are mostly sand do not hold water very well and dry quickly. Soils with too much clay may never dry out.

Soil structure refers to the way the soil forms clumps. These clumps are known as **peds**. The peds are identified by the shape of the soil clods, which take the form of balls, blocks, columns, and plates. These structures are easiest to see in recently plowed fields, where the soil is often granular and loose or lumpy. Soil color is its most obvious physical property. The color is influenced by mineral content, the amount of organic material, and the amount of water it routinely holds. The colors are identified by a standard soil color chart called the Munsell chart.

Ultimately there are five variables that affect the characteristics of soil worldwide.

1. *Parent material* is the original geologic material from which the soil formed. This can be bedrock, preexisting soils, or other materials such as **till** or **loess**.

2. *Climate* strongly determines the temperature regime, amount of moisture, and type of biota that interact with the parent material. This will affect the extent of chemical and physical weathering on the soil-forming material.

3. *Topography*, or landscape, of the area is related to the relative position of the soil on the landscape; this includes the presence or absence of hills and the slopes between high and low areas. Topography influences natural drainage. Gravity moves water down slopes to depressions or streams and pulls free water downward through the soil. Soils on hills tend to be dry, and soils in depressions and valleys are often wet or saturated.

4. *Biota* or living organisms that live on or in the material affect soil development through their influence on the amount and distribution of organic matter in the soil. For example, plants contribute significantly to the formation of humus, and animals alter a soil's characteristics by leaving behind decayed remains and wastes. Decomposers like bacteria and fungi help to free up the nutrients locked away in these remains and wastes, and these freed nutrients are then recycled and used by new life forms within the same soil. Additionally, animal burrows create spaces in the soil horizons that allow for deeper penetration of air and water, which, in turn, aid plant development. For its part, organic matter impacts the water-holding capacity of the soil, the soil's fertility, and root penetration.

5. *Time* is required for soils to develop while the four elements mentioned above interact. The effects of time can be seen when comparing soils on a glaciated region to either soils formed on recent flood plain deposits or soils in a non-glaciated area at the same latitude.

Soil Orders

Just as rocks are classified into different types based on how they formed (**igneous**, **metamorphic**, or **sedimentary**), their mineral composition, and other characteristics, soils also have their own classification scheme. Soils are divided into 12 dominant orders based on their composition, structures, and types and number of horizons. A typical soil profile is given below (*Figure 8.2*). It shows the transition from the parent material (horizons R and C) to the highly developed or changed horizons (O through B), although not every soil profile will have all the horizons present.

Soils can also be categorized by their location (northern vs. southern soils), the type of vegetation growing on them (forest soils vs. prairie soils), their topographic position (hilltop soils vs. valley soils), or other distinguishing features. The system used to classify soils based on their properties is called **soil taxonomy**. It was developed by the US Department of Agriculture, with the help of soil scientists throughout the country.

In soil taxonomy, all soils are arranged into one of 12 major units, or **soil orders**. These 12 orders are defined by diagnostic horizons, composition, soil structures, and other characteristics. Soil orders depend mainly on climate and the organisms within the soil. These orders are further broken down into 64 suborders based on properties that influence soil development and plant growth, with the most important property being how wet the soil is throughout

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igneous rocks • *rocks derived from the cooling of magma underground or molten lava on the Earth's surface.*

metamorphic rocks • *rocks formed by the recrystallization and realignment of minerals in pre-existing sedimentary, igneous, and metamorphic rocks when exposed to high enough temperature and/or pressure.*

sedimentary rocks • *formed through the accumulation and consolidation of grains of broken rock, crystals, skeletal fragments, and organic matter.*

Soils

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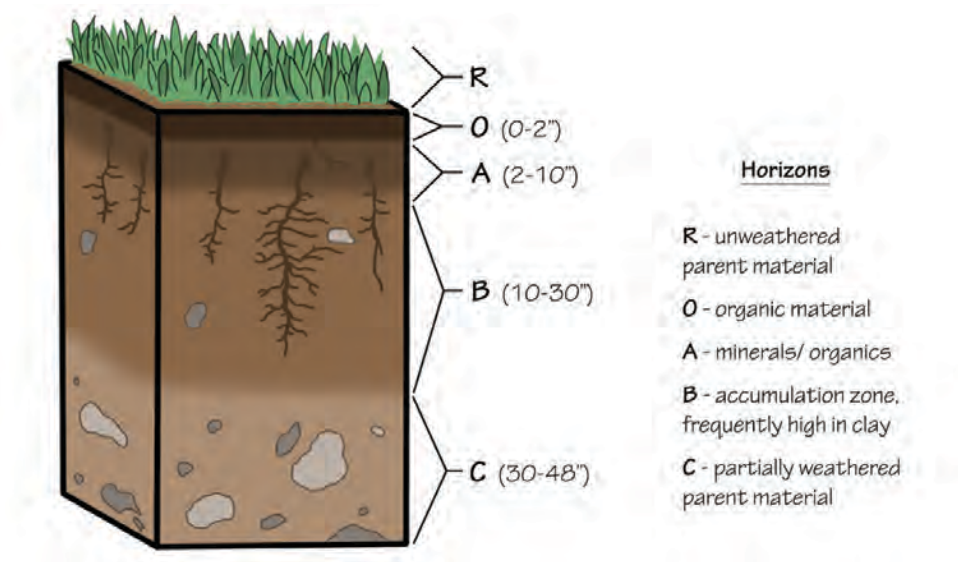

Figure 8.2: Typical soil profile.

the year. The suborders are, in turn, separated into great groups (300+) and subgroups (2400+). Similar soils within a subgroup are grouped into even smaller families (7500+), and the similar soils within families are grouped together into the smallest category of all: a series. There are more than 19,000 soil series described in the United States, with more being defined every year (*Figure 8.3*).

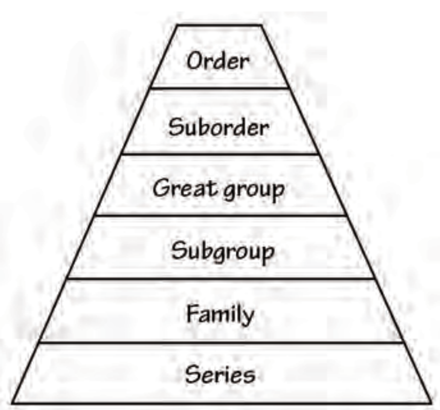

Figure 8.3: Soil taxonomy.

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The 12 soil orders

Name	Description	Controlling factors	Percentage of global ice-free land surface	Percentage of US ice-free land surface
Alfisols	Highly fertile and productive agricultural soils in which clays often accumulate below the surface. Found in humid and subhumid climates.	climate and organisms	~10%	~14%
Andisols	Often formed in volcanic materials, these highly productive soils possess very high water- and nutrient-holding capabilities. Commonly found in cool areas with moderate to high levels of precipitation.	parent material	~1%	~2%
Aridisols	Soils formed in very dry (arid) climates. The lack of moisture restricts weathering and leaching, resulting in both the accumulation of salts and limited subsurface development. Commonly found in deserts.	climate	~12%	~8%

The 12 soil orders (continued)

Entisols	Soils of relatively recent origin with little or no horizon development. Commonly found in areas where erosion or deposition rates outpace rates of soil development, such as floodplains, mountains, and badland areas.	time and topography	~16%	~12%
Gelisols	Weakly weathered soils formed in areas that contain permafrost within the soil profile.	climate	~9%	~9%
Histosols	Organic-rich soils found along lake coastal areas where poor drainage creates conditions of slow decomposition and peat (or muck) accumulates.	topography	~1%	~2%
Inceptisols	Soils that exhibit only moderate weathering and development. Often found on steep (relatively young) topography and overlying erosion-resistant bedrock.	time and climate	~17%	~10%
Mollisols	Agricultural soils made highly productive due to a very fertile, organic-rich surface layer.	climate and organisms	~7%	~22%

The 12 soil orders (continued)

Oxisols	Very old, extremely leached and weathered soils with a subsurface accumulation of iron and aluminum oxides. Commonly found in humid, tropical environments.	climate and time	~8%	~.02%
Spodosols	Acidic soils in which aluminum and iron oxides accumulate below the surface. They typically form under pine vegetation and sandy parent material.	parent material, climate, and organisms	~4%	~4%
Ultisols	Soils with subsurface clay accumulations that possess low native fertility and are often red hued (due to the presence of iron oxides). Found in humid tropical and subtropical climates.	climate, time, and organisms	~8%	~9%
Vertisols	Clayey soils with high shrink/swell capacity. During dry periods, these soils shrink and develop wide cracks; during wet periods, they swell with moisture.	parent material	~2%	~2%

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Great Lakes • *the largest group of freshwater lakes on Earth (by total surface area and volume), located on the US-Canadian border.*

glacier • *a body of dense ice on land that does not melt away annually and has sufficient mass to move under its own weight.*

Wisconsinian glaciation • *the most recent interval of glaciation, which occurred during the Pleistocene, 85,000 to 11,000 years ago.*

Illinoian • *a period of glaciation that occurred during the Pleistocene, 191 to 131 thousand years ago.*

Pre-Illinoian glaciation • *a grouping of the Midwestern glacial periods that occurred before the Wisconsinian and Illinoian glaciations.*

Dominant soils of the Midwestern US

The soil orders found in the Midwest are:

Alfisols (**al**-fuh-sawls): Alfisols are widely distributed throughout the Midwest but are less prominent in the western portion.

Entisols (**en**-ti-sawls): Entisols are most concentrated in the Central Sands of Wisconsin and the Loess Hills of western Iowa. They can also be found sprinkled about parts of Wisconsin, the western half of Michigan's Lower Peninsula, and northern Minnesota.

Histosols (**his**-tuh-sawls): As one would imagine, the Histosols are primarily clustered around the **Great Lakes** and can therefore be found in Michigan's Upper Peninsula, northern Wisconsin, and northern Michigan.

Inceptisols (in-**sep**-tuh-sawls): Inceptisols are not widespread throughout the Midwest, but they are highly concentrated in the northeast corner of Minnesota.

Mollisols (**mol**-uh-sawls): Mollisols dominate the western portion of the Midwest along with large parts of northern and central Illinois.

Spodosols (**spod**-uh-sawl): In the Midwest, Spodosols are exclusively concentrated in northern Wisconsin, Michigan's Upper Peninsula, and the northern portion of Michigan's Lower Peninsula.

National and Midwest Soils

Below are maps showing the locations of the predominant soils in the nation (*Figure 8.4*), and in the Midwest (*Figure 8.5*). The Midwest soil types tend to relate to topography and parent material, with some relation to climate.

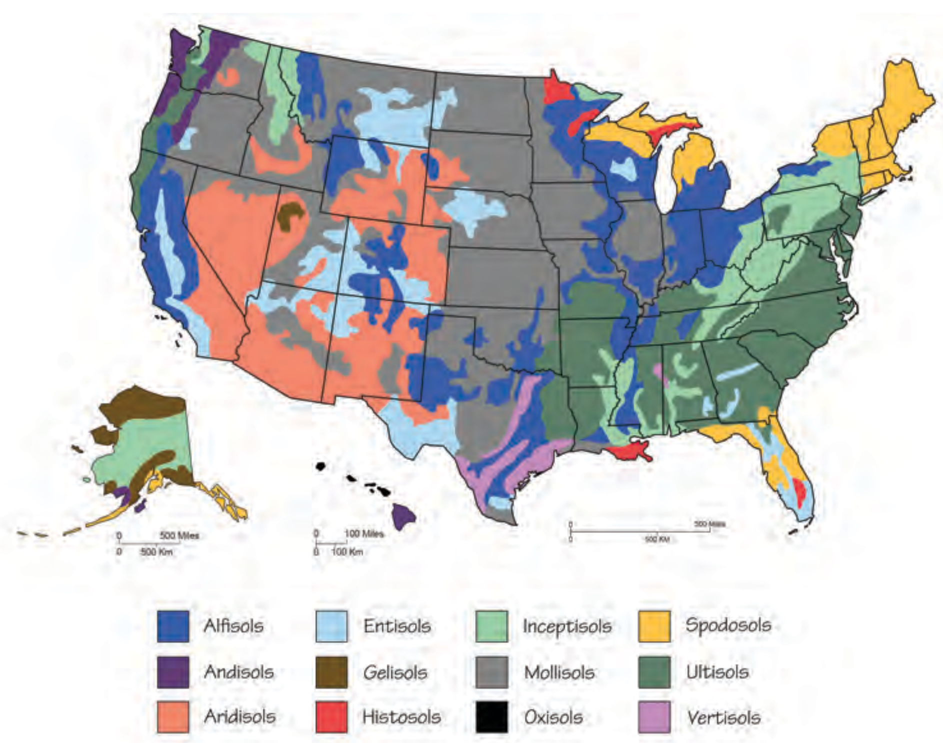

Figure 8.4: Soil map of the US.

Soils 8

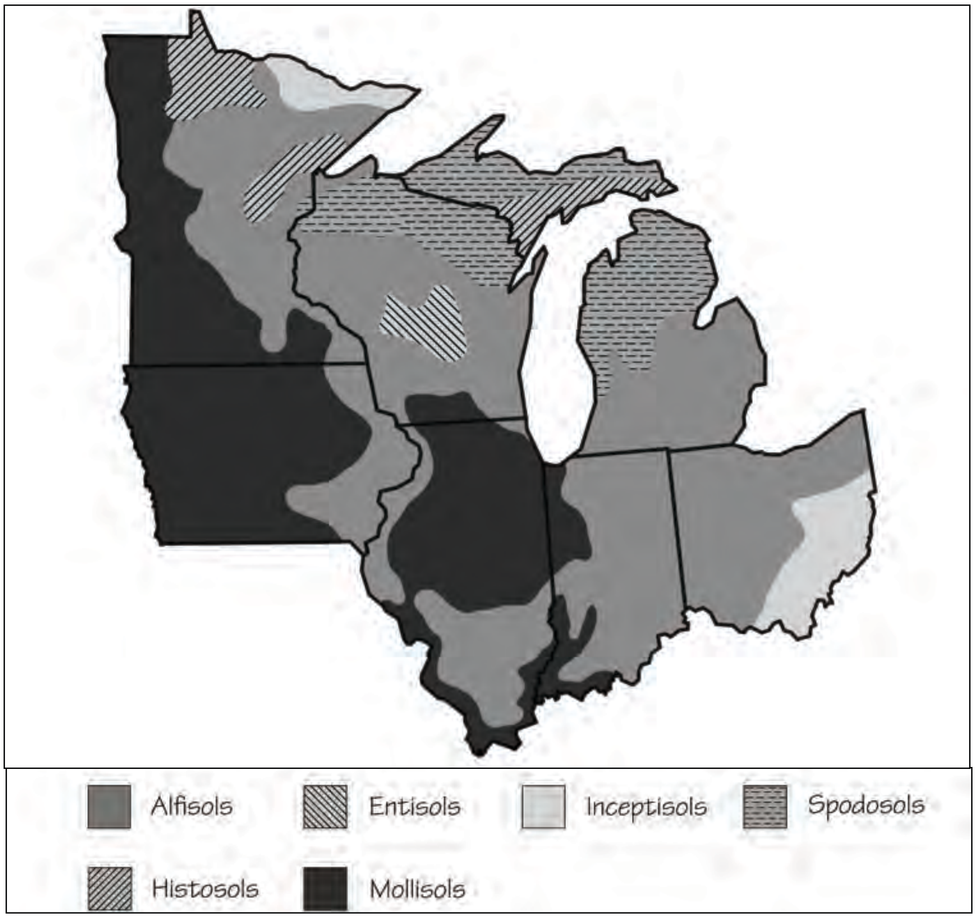

Figure 8.5: Soil map of the Midwest.

Geology of the Midwest: Parent Material

A quick look at the maps below (*Figures 8.6–8.8*) shows that the dominant parent material for Midwest soils is **glacial** deposits from the **Wisconsinan**, **Illinoian** and **Pre-Illinoian** advances. These covered the Midwest from about two million years ago to the final retreat of the Wisconsinan glaciation about 10,000 years ago. The material from the glaciers is primarily **till**, glacial fluvial deposits (as **outwash plains**), and loess deposits.

See Chapter 6: Glaciers for more information about these glaciations.

Till is the unsorted material—from boulders to fine clay silt—deposited by glaciers as they advance and recede. When a glacier retreats, a line of sediment from the flowing river remains behind and can be seen as a ridge of sand and/or gravel, such as that found in **kames** and **eskers**. Beyond the edges of the glacier, as melting of the glaciers continues, sediment-laden waters create large, sandy flats, known as outwash plain**s**. Fluvial (outwash) material is a very common parent material in the Central Lowlands region. Another aspect of glaciation in this region was the accumulation of loess (windblown silt) distributed across the

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till • *unconsolidated sediment that is eroded from the bedrock, then carried and eventually depositied by glaciers as they recede.*

outwash plain • *large sandy flats created by sediment-laden water deposited when a glacier melts.*

kame • *an irregularly shaped mound made up of sediment that accumulated in a depression on a retreating glacier.*

esker • *a sinuous, elongated ridge of sand and gravel.*

landscape that was part of the outwash plains. The Mississippi and Missouri Rivers, as well as other rivers in the area, aided the distribution and deposition of loess to the Midwest, creating the rich agricultural area we have today.

A simplified map of the soils of the Midwest (*Figure 8.4*) shows that, when compared to *Figures 8.7* and *8.8*, the soil types are strongly correlated with the age of the glacial deposits. It is only the southern margins of the Midwest in Illinois, Indiana, and Ohio that escaped the advancing and retreating ice.

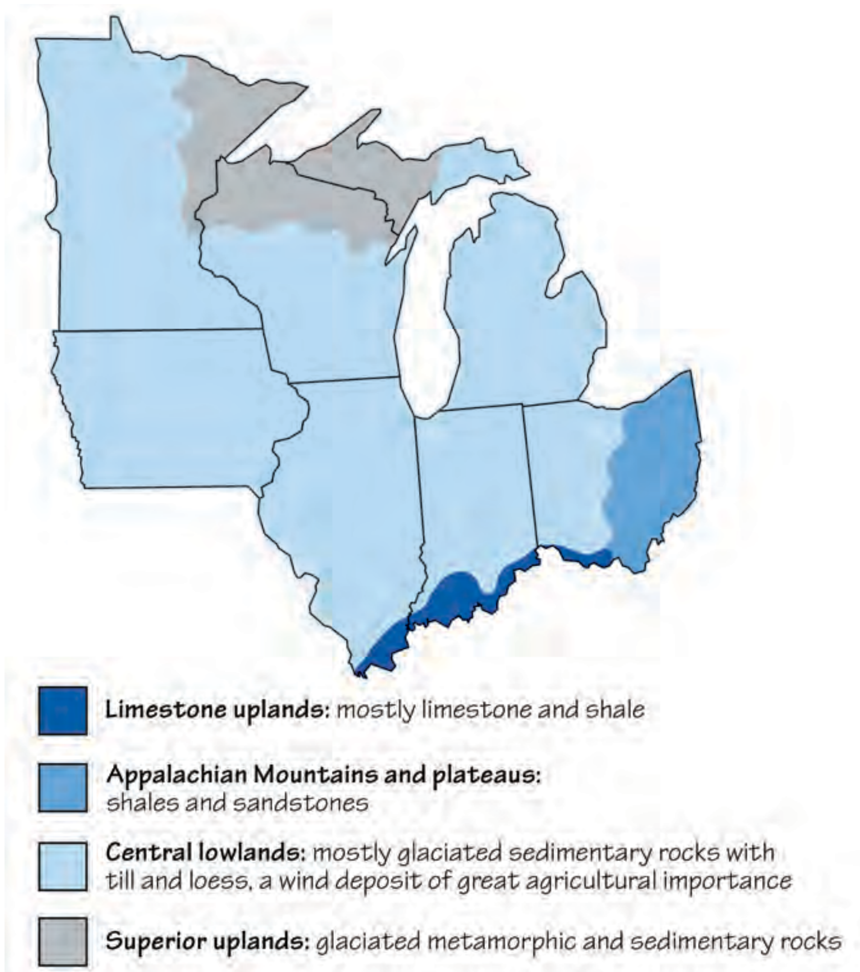

Figure 8.6: Physiographic and regolith map of the Midwest.

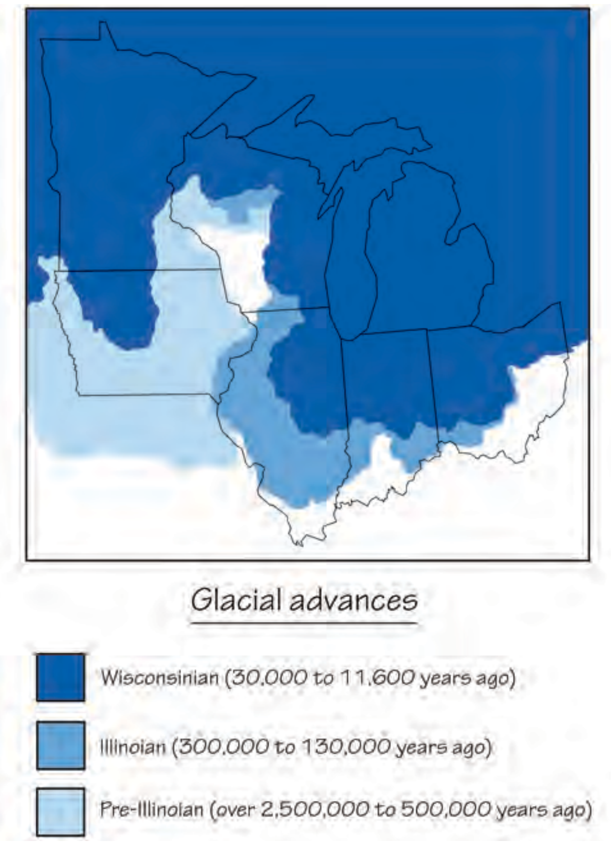

Figure 8.7: Extent of the glacial sheets in the Midwest.

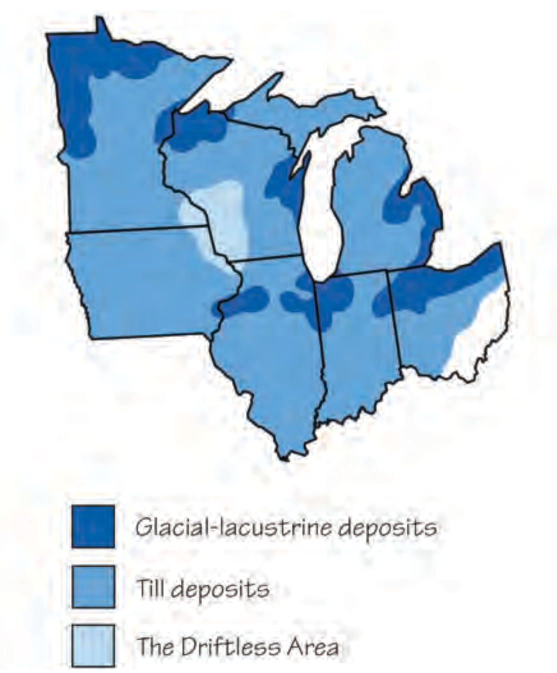

Figure 8.8 Generalized glacial deposits in the Midwest.

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Soils

Region 1

volcanism • *the eruption of molten rock onto the surface of the crust.*

quartz • *the second most abundant mineral in the Earth's continental crust (after feldspar), made up of silicon and oxygen (SiO_2).*

iron • *a metallic chemical element (Fe).*

Laurentide Ice Sheet • *an ice sheet that covered most of Canada during the last major glaciation.*

ice age • *a period of global cooling of the Earth's surface and atmosphere, resulting in the presence or expansion of ice sheets and glaciers.*

Soils of the Superior Upland

Region 1

The Superior Upland region of the Midwest reveals a vibrant record of tropical seas, violent **volcanic** eruptions, and huge glaciers. Sand deposited over 400 million years ago provides some of the purest **quartz** deposits in the US, which are used in the glass and foundry industries today. Ten to twenty thousand years ago this area was covered by glaciers, and the deposits those glaciers brought with them—either directly or indirectly—make up most of the parent material of the soil today. Agriculture is big here, although not as prolific as in Region 2 due to the mountainous topography, near-surface bedrock, and cooler climate. However, the soil here does supports over 1.5 million acres of mixed hardwood and coniferous forests in, among other places, the Chequamegon National Forest (Wisconsin), the Nicolet National Forest (Wisconsin), and the Porcupine Mountains (the Upper Peninsula of Michigan). This region is part of one of the oldest mountain ranges in the world, a range composed of resistant igneous and metamorphic rocks that includes the 3.6-billion-year-old **Morton Gneiss** of Minnesota, some of the oldest exposed rock in the world.

See Chapter 2: Rocks for more about the formation of the Morton Gneiss and other Midwestern rocks.

The climate, the hardwood and conifer forests, and the numerous wetlands provide the conditions for producing the dominant soil of the region, a Spodosol, or more specifically the Spodosol of suborder Orthods (*Figure 8.5*). This soil is typical of cold, wet climates and, frequently, sandy parent material. The spruce and fir forests and the bogs of the north are typical ecosystems for this soil.

Mineral mining is also big in this region. In northeastern Minnesota, the Minnesota Iron Range holds the largest deposit of **iron ore** in the nation, and it is composed of the Mesabi, Cuyuna, Vermilion, and Gunflint mountain ranges. The eastern end of the region is also home to many iron mines near Ishpeming and Negaunee in Michigan. These deposits color the local soils and sand deposits with a noticeable red hue due to the rusting iron.

About 13,000 years ago, the **Laurentide Ice Sheet**, which covered most of Canada at the time, began to melt at its southern border. In its prime, the Laurentide was more than 5 kilometers (3.1 miles) thick at its thickest point on what is now the Hudson Bay. This sheet of ice weighed so much that it depressed the **crust**, allowing for an expansive lake to form as the ice melted. This lake developed in an area that separates the Mississippi watershed from areas that drain northward. Lake Agassiz was born, and it is said to have been the largest lake ever to exist, the volume of which, today, could contain all the water in all the lakes on Earth. As glaciers continued to melt at the end of the last **ice age**, several modern river valleys were carved out by the waters spilling over from Lake Agassiz, including the Minnesota River and the Red River Valley, the latter of which was formed from silt deposited from the lake. Much of the water from Lake Agassiz was drained into what are now the Minnesota and the Mississippi Rivers and also into Lake Superior. These sediments provided the parent material for many of the soils in these northern river valleys and were also the source for some of the loess deposits common to the region.

Loess deposits are found throughout the Midwest, including the Superior Upland region, and although wind brought these materials to the area, water **erosion** is now the primary reason these soils are being washed away. Methods to combat the loss of the soil in this area include the use of "no till" farming and the planting of cover crops, which are crops planted after a main crop is harvested that help to decrease runoff, increase soil quality, and also provide habitat for animals during the winter.

Soils of the Central Lowland

Region 2

The Central Lowland is home to some of the richest agricultural land in the US. Although the soil here has been affected for a considerable amount of time by the climate, life, and **plate tectonics**, most of the topography and soil found here is the result of glacial activity during the **Pleistocene**. Multiple episodes of formation and melting of glaciers over the last 2.5 million years have shifted massive amounts of sediment and rock, carved gorges with their advance, and produced caves, lakes, river beds, and streams with their melt.

During this stretch of time, the glaciers advanced, receded, melted, and reformed repeatedly as the climate cooled during the ice age and then warmed somewhat during interval periods. The farther south one goes in the Midwest, the fewer the advances that were experienced. The glaciers brought with them rocks, sands, silts, and clays as they traversed the Canadian terrain. The more obvious glacier depositional features can be seen north of Illinois and Indiana, such as **drumlins**, kames, eskers, and **moraines** (*Figure 8.9*). The surfaces in the southern parts of the region are covered mostly by outwash and loess deposits that developed near the terminus of the ice sheets. These deposits are made up of predominantly silt and clay-sized material. While the parent material for much of the northern area is ground moraine, the sediment was plastered down by the advancing ice. Normally, the composition of the ground moraine is at least partly determined by the type of bedrock encountered by the advancing ice. Not surprisingly, much of central Wisconsin and Minnesota has sandy ground because the bedrock is **Cambrian sandstone**, whereas eastern Wisconsin has very clay-rich soils because the glaciers advanced over exposures of the Maquoketa Shale, a very soft and clay-rich **shale**. Prominent glacial features in Wisconsin are drumlins, elongated hills that form parallel to the flow of a glacier and are made of compacted glacial sediments, frequently till. They make for dramatic-looking farm fields, such as those seen in *Figure 8.10*.

plate tectonics • *the way by which the plates of the Earth's crust move and interact with one another at their boundaries.*

Pleistocene • *a subset of the Quaternary, lasting from 2.5 million to about 11,700 years ago.*

drumlin • *a teardrop-shaped hill of till that was trapped beneath a glacier and streamlined in the direction of the flow of the ice moving over it.*

moraine • *an accumulation of unconsolidated glacial debris (soil and rock) that can occur in currently glaciated and formerly glaciated regions.*

shale • *a dark, fine-grained, laminated sedimentary rock formed by the compression of successive layers of silt- and clay-rich sediment.*

Region 2

Driftless Area • *a region that did not experience glaciation, located in parts of southwestern Wisconsin, eastern Minnesota, and northeastern Illinois and Iowa.*

Quaternary • *a geologic time period that extends from 2.6 million years ago to the present.*

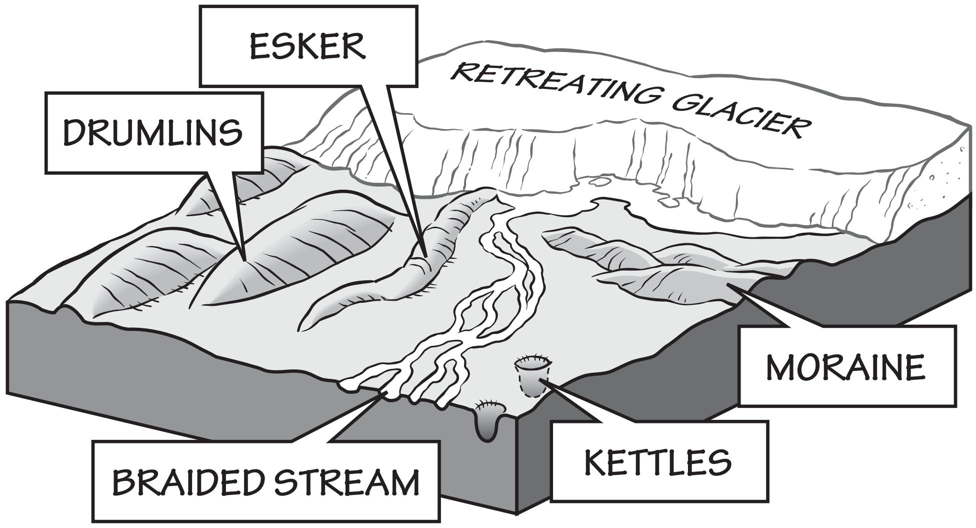

Figure 8.9: Glacial deposits.

Figure 8.10: Drumlins formed by glacial drifts near Cross Plains, Wisconsin.

The **Driftless Area**, found in parts of southwestern Wisconsin, eastern Minnesota, and northeastern Illinois and Iowa, did not experience glaciation. This locale is known as the Driftless Area since it lacks glacial deposits, which are collectively called drift. Glaciers are known to have reached all sides of the Driftless Area at various times throughout the **Quaternary** Ice Age, but are not known to have completely encompassed the area at any time.

See Chapter 6: Glaciers to learn more about the Driftless Area.

This resulted in an island of much older soils in a sea of younger soils. It also is one of the few areas of the Central Lowland with highly dissected river valleys, known locally as the Coulee Country.

Parts of Wisconsin also have remnants of drained glacial lakes. The most prominent example is Glacial Lake Wisconsin that drained rapidly as it broke through a terminal moraine of the Green Bay Lobe near the site of the Wisconsin Dells. The draining water carved the Wisconsin River Valley at the Dells and left behind a glacial lakebed near Tomah, Wisconsin where cranberries are grown today. Other noted glacial lakebeds that contributed to the agriculture of the state are Glacial Lake Oshkosh in the northeast part of the state, and Glacial Lake Yahara in the south central part of the state.

Western and northern Ohio along Lake Erie also have a distinct glacial history because much of the area is composed of glacial lakebed sediments generated when the ice retreated into the Lake Erie Basin, producing a marginal lake known as Glacial Lake Warren. This area is known for its vineyards, orchards, and fields of farm vegetables.

The dominant soil types for the Central Lowlands are Alfisols, of suborders Udalfs, and Aqualfs, with a small section in northwestern Minnesota of Boralfs. The first two are more common in warm humid regions, whereas the last is found in cold regions. They are not as weathered as some soils, so they are still rich in nutrients. The soils to the south of the region are thicker than those to the north.

The second most common soil types are Mollisols, which can be found in the Central Lowlands where loess deposits are dominant and the vegetation was originally grassland. These soils are prominent in western Minnesota, Iowa, and much of Illinois and are of the suborder Udolls.

There are small sections with Entisols (suborder Psamments) in central Wisconsin associated with Glacial Lake Wisconsin. Northern Minnesota has a section of Histosols, and northeast Michigan has a small area of Inceptisols.

Soils of the Inland Basin
Region 3

The Inland Basin is the only area not extensively influenced by the numerous glacial advances. The region is geologically referred to as a basin because of its bedrock type, but geographically it is a plateau formed during mountain building to the east. This plateau (the major portion of which is known as the Allegheny Plateau) occupies most of western Pennsylvania, part of eastern Ohio, more than half of West Virginia, the western tip of Maryland, the upland southern portion of New York, and a marginal portion of southern Indiana and Illinois. The Allegheny Plateau has been greatly eroded by swift rivers and streams that have cut deep valleys, leaving behind steep hills as remnants of the former surface. For the most part, elevations range from about 370 to 760

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bituminous coal • *a relatively soft coal containing a tarlike substance called bitumen, which is usually formed as a result of high pressure on lignite.*

petroleum • *a naturally occurring, flammable liquid found in geologic formations beneath the Earth's surface.*

natural gas • *a hydrocarbon gas mixture composed primarily of methane (CH4), but also small quantites of hydrocarbons such as ethane and propane.*

coal • *a combustible, compact black or dark-brown carbonaceous rock formed by the compaction of layers of partially decomposed vegetation.*

Mississippian • *a subperiod of the Carboniferous, spanning from 359 to 323 million years ago.*

meters (1200 to 2500 feet) above sea level. The valleys and gentler slopes of the Alleghenies are dotted with farms on which grain is grown and dairy and beef cattle are raised. The area is rich in **bituminous coal**, especially in Pennsylvania, West Virginia, and Ohio. There are deposits of **petroleum** and **natural gas**, and lumbering is also an important industry in this area. The plateau is divided into unglaciated and glaciated regions.

Unglaciated Allegheny Plateau

The Unglaciated Allegheny Plateau is located in an arc around southeastern Ohio that extends into western Pennsylvania and West Virginia. This area is a dissected plateau, characterized by sandstone, shale, and **coal** seams that are **Mississippian** through **Permian** in age. A good example of the dissected nature of this area, and a spectacular scenic location, is the Hocking Hills in southeast Ohio. This area is dominated by Inceptisols of suborder Ochrepeds (*Figure 8.5*). These soils have thin, light-colored surface horizons. The bedrock is mostly composed of shales, **limestones**, and sandstones that are **Devonian** through Permian in age but still have only thinly developed soils.

Glaciated Allegheny Plateau

The Glaciated Allegheny Plateau lies within the area covered by the **last glacial maximum**. As a result, this area of the Allegheny Plateau has lower relief and gentler slopes than does the relatively rugged Unglaciated Allegheny Plateau. In general, the glaciated portion lies to the north and west of the unglaciated portion, and it forms an arc from northeastern to southeastern Ohio. This area—only a few hundred square kilometers owing to the blockage that the steep relief of the mountains provides at the edge of the ice sheet—contains only old drift now buried by long periods of soil development. The dominant soil type of this area is an Alfisol of suborder Udalf.

State Soils

Just as many states have official state flowers, birds, and **fossils**, they also have official soils. State soils are most often determined by a vote of soil scientists in the state, and, absent any political wrangling, usually represent the most productive soils and those that most closely resemble everyone's favorite soil: loam. As mentioned earlier, loam soils are almost equal parts sand, silt, and clay.

Illinois

The Illinois state soil is the Drummer soil, an Alfisol. Drummer soils consist of very deep, poorly drained soils that formed in 1 to 1.5 meters (40 to 60 inches) of loess or other silty material in the underlying stratified, loamy, glacial drift. Drummer soils are the most extensive soils in Illinois and cover more than 1.5 million acres.

State Soils

Indiana
The state soil of Indiana is the Miamian series, formed in calcareous, loamy till on the Wisconsin Till Plains. This Alfisol covers 321,722 hectares (794,994 acres) of the state of Indiana and is nationally ranked for agricultural production because of its high productivity.

Iowa
The Tama series is the state soil of Iowa. This Mollisol is considered one of the most productive in the state and is not surprisingly used for agricultural purposes. It makes up about 333,000 hectares (825,000 acres) in east central and eastern Iowa. Tama soils formed in 1.2 meters or more (four feet or more) of silty loess, under tall prairie grasses.

Michigan
The Kalkaska soils are Michigan's state soil series. They are Spodosols that occur in both the Upper and Lower Peninsulas of Michigan. There are over 300,000 hectares (750,000 acres) of these soils throughout the state. Kalkaska soils formed in sandy deposits left behind by the retreating glaciers. These soils primarily support hardwood timber, namely sugar maple and yellow birch.

Minnesota
Lester soils, the state soil series of Minnesota, are found in the south central portion of the state. They are of moderate extent and total over 240,000 hectares (600,000 acres). These Mollisols formed in loamy, calcareous glacial till on ground moraines. The principal crops grown in these soils are corn and soybeans.

Ohio
The Miamian series is the state soil of Ohio. It consists of very deep, well-drained soils that formed in a thin layer of loess and in the underlying loamy till, which is also high in lime. They are the most extensive soils in Ohio and are found on more than 300,000 hectares (750,000 acres) throughout the state. Corn, soybeans, and winter wheat are the primary crops grown in this soil.

Wisconsin
Wisconsin's state soil is the Antigo Silt Loam, named after the city of Antigo, Wisconsin in the northern part of the state. Antigo soils, which are Alfisols, are well drained and formed in loess and loamy sediments over stratified sandy outwash that cover more than 120,000 hectares (300,000 acres).

Permian • *the geologic time period lasting from 299 to 252 million years ago.*

limestone • *a sedimentary rock composed of calcium carbonate ($CaCO_3$).*

Devonian • *a geologic time period spanning from 419 to 359 million years ago.*

last glacial maximum • *the most recent time the ice sheets reached their largest size and extended farthest towards the equator, about 26,000 to 19,000 years ago.*

fossil • *preserved evidence of ancient life.*

Resources

Books

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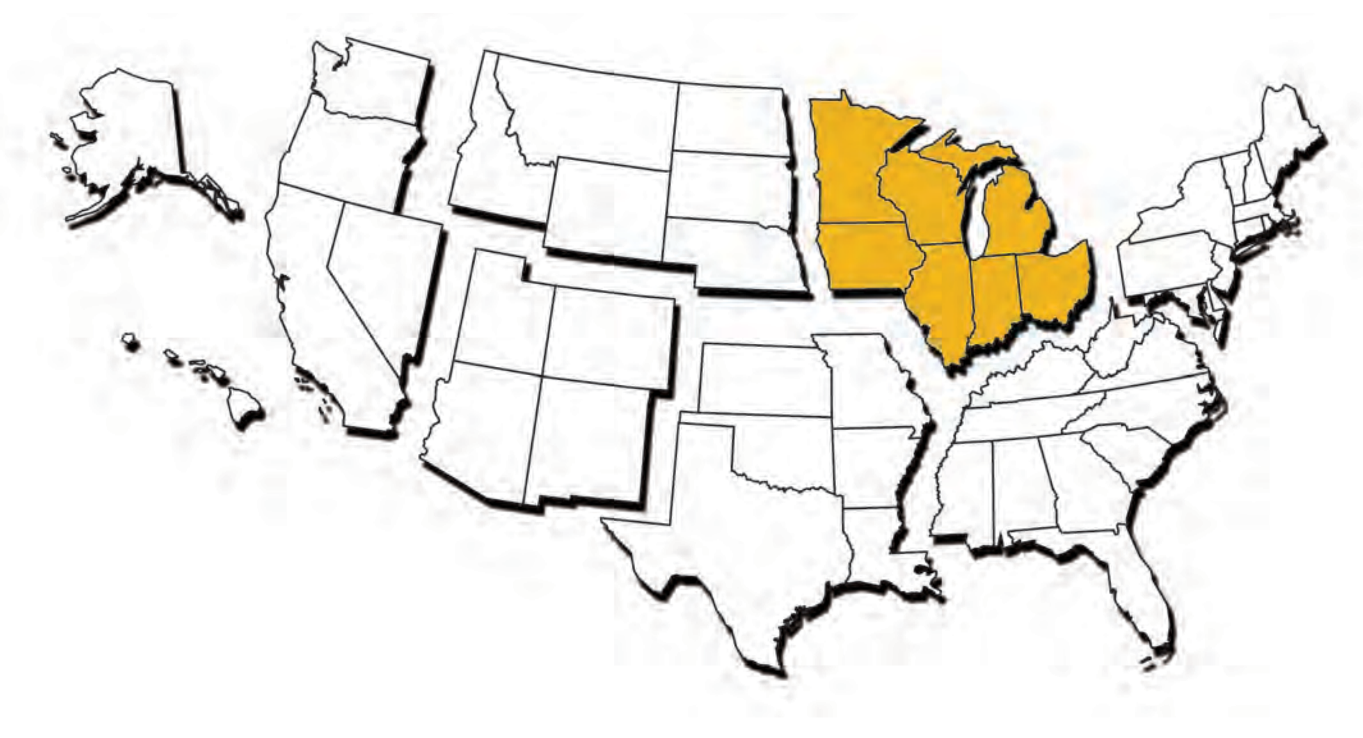
The *Teacher-Friendly* Guide™

to the Earth Science of the Midwestern US



Edited by Mark D. Lucas, Robert M. Ross, & Andrielle N. Swaby

Paleontological Research Institution
2014

ISBN 978-0-87710-507-7
Library of Congress no. 2014953666
PRI Special Publication no. 46

1259 Trumansburg Road
Ithaca, New York 14850 USA
priweb.org

First printing October 2014

This material is based upon work supported by the National Science Foundation under grant DRL-0733303. Any opinions, findings, and conclusions or recommendations are those of the author(s) and do not necessarily reflect the views of the National Science Foundation. The publication also draws from work funded by the Arthur Vining Davis Foundations and The Atlantic Philanthropies.

The interactive online version of this *Teacher-Friendly Guide*™ (including downloadable pdfs) can be found at http://teacherfriendlyguide.org. Web version by Brian Gollands.

The Teacher-Friendly Guide™ series was originally conceived by Robert M. Ross and Warren D. Allmon. Original illustrations in this volume are mostly by Jim Houghton (The Graphic Touch, Ithaca), Wade Greenberg-Brand, and Christi A. Sobel.

Layout and design by Paula M. Mikkelsen, Elizabeth Stricker, Wade Greenberg-Brand, and Katherine Peck.

Cite this book as:
Lucas, M. D., R. M. Ross, & A. N. Swaby (eds.), 2014, *The Teacher-Friendly Guide to the Earth Science of the Midwestern US.* Paleontological Research Institution, Ithaca, New York, 316 pp.

Cite one chapter as (example):
Wall, A. F., and W. D. Allmon, 2014, Fossils of the Midwestern US. Pages 57–83, in: M. D. Lucas, R. M. Ross, & A. N. Swaby (eds.). *The Teacher-Friendly Guide to the Earth Science of the Midwestern US.* Paleontological Research Institution, Ithaca, New York.

On the back cover: Blended geologic and digital elevation map of the Midwest. Each color represents the age of the bedrock at the surface. Adapted from Barton, K.E., Howell, D.G., Vigil, J.F., *The North America Tapestry of Time and Terrain*, US Geological Survey Geologic Investigations Series I-2781, http://pubs.usgs.gov/imap/i2781.