OHIO GEOLOGY

GEOFACTS No. 33

OHIO DEPARTMENT OF NATURAL RESOURCES • DIVISION OF GEOLOGICAL SURVEY

ICE AGE IN OHIO: EVIDENCE BELOW OUR FEET

Imagining ice thousands of feet thick trudging over much of Ohio's landscape during the most recent ice age is overwhelming, especially because these ice sheets are completely absent from Ohio today. However, the debris left behind by glaciers informs us of not only the former presence of ice, but how the mass moved across the land. A simple way to visualize when and where ice advanced, retreated, or stagnated across the state is to study the distribution of glacial landforms in Ohio. Glaciers are not strictly composed of ice; rather, they contain significant amounts of rocks, wood, and other debris from the surrounding landscape. This mass of material is transported and eventually deposited directly by the ice (known as *till*) or can possibly be carried far away by discharging meltwater as outwash. Moraines are the most notable glacial feature created directly by ice movement and are composed of a mixture of till and debris. From flat till plains to morainal hills, much of the material we see on Ohio's surface today is a result of processes that occurred during several events in the Pleistocene, an epoch lasting from about 2.6 million until 11,700 years ago. Only materials deposited during the most recent Wisconsinan Glaciation (24,000–13,000 years ago) remain relatively well preserved compared to earlier events, such as the Illinoian Glaciation that began about 300,000 years ago.

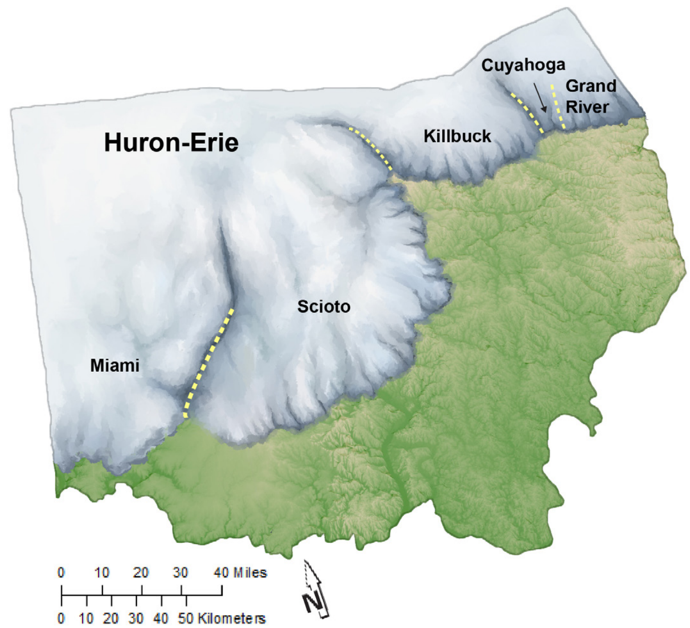

Figure 1. A generalized depiction of the Laurentide Ice Sheet over Ohio during the Late Wisconsinan (last glacial maximum position, approximately 21,000–18,000 years ago) with the associated sublobes of the Huron-Erie Lobe (yellow dashed lines) labelled. The Appalachian Plateau covers most of the unglaciated region in eastern Ohio. Illustration by Madison Perry.

ICE LOBES OF OHIO

Southward glacial expansion from northern Canada began more than two million years ago (mya), during the early Pleistocene, and resulted in the formation of a continental ice mass known as the Laurentide Ice Sheet, which extended into the northern United States and eventually covered approximately two-thirds of Ohio. The ice sheet grew and advanced as the accumulation rates of ice mass exceeded ablation (ice removal or melting) rates. Physical ice movement was attributed to three factors: solid ice flowing internally because of the gravitational pull of glacial material downslope; ice sliding at its base caused by lubricating meltwater beneath the glacier; and underlying soils being deformed as ice progressed across the landscape. Climatic changes caused the ice sheet to advance southward and retreat northward in cycles. During ice advance and retreat, pronounced zones within the ice would move more rapidly than others. Thus, the Laurentide Ice Sheet did not move as a massive, singular block, but rather as separate ice lobes. The last ice lobe to move through Ohio was the Huron-Erie Lobe (or Erie Lobe). The ice was about one mile thick towards present day Lake Erie and thinned to about 1,000 feet towards its southern margin. The speed at which lobes traversed the landscape varied significantly throughout the Pleistocene because of climatic factors. Advance rates of tens to hundreds of feet per year during the Late Wisconsinan are estimated from age dating organic material found in glacial sediment.

The Huron-Erie Lobe was further separated into the Miami, Scioto, Killbuck, Cuyahoga, and Grand River sublobes (fig. 1) as a response to varying conditions beneath the ice, such as bedrock geology and surface topography. These sublobes are named after modern water bodies located within the path of each ice sublobe. Each sublobe had unique thickness, flow direction, and movement. In eastern Ohio, sublobe positions were predominantly controlled by the resilient Pennsylvanian-aged (323–299 million years ago) sandstones and shales of the Appalachian Plateau. To the north of this barrier, ice near present day Lake Erie flowed south and split into the Killbuck, Cuyahoga, and Grand River sublobes. These three northeastern sublobes are less defined because of a lack of clear moraine boundaries, but their paths are often identified by examining differences in soils and subsurface materials. To the west of the Appalachian Plateau, the Late Wisconsinan ice encountered less resistance from the carbonate rocks of lower elevations resulting from earlier glaciations that had travelled through these areas.

The most notable obstacle affecting ice lobe movement west of the Appalachian Plateau was the Bellefontaine outlier, located mostly in Logan and Champaign Counties. The Bellefontaine Outlier, the highest elevation in Ohio, is a glacial-sediment-covered series of uplands composed of Devonian-aged (419–359 mya) shales and limestones surrounded by older Silurian-aged (444–419 mya) carbonate rocks. The Bellefontaine outlier may be an erosional remnant, or it may have formed as a result of deep, structural faulting. As seen by the mapping of moraine distributions, the Bellefontaine outlier effectively separated the Miami Sublobe to the west from Scioto Sublobe to the east (fig. 2). During retreat, the ice became deeply lobed around this

continued

obstacle and created a complex terrain of deposits down ice of the Bellefontaine outlier between the Miami and Scioto sublobes. This complex deposit of till and other glacial material creates an area known as the *interlobate region* or *zone*. These sublobes moved almost independently of one another, which is evidenced by the intermingling of moraines and the results of radiocarbon age-dating methods.

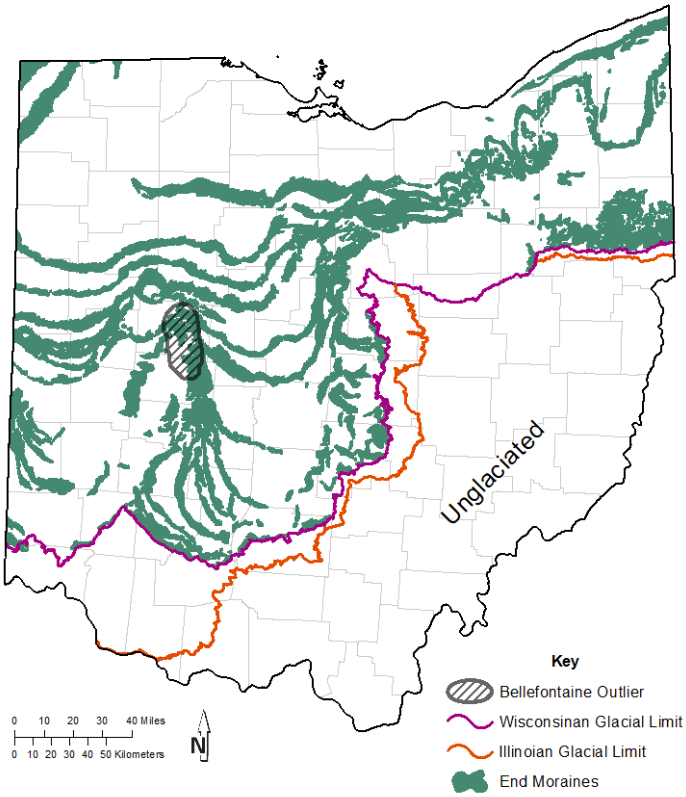

Figure 2. End moraines of Ohio with the last glacial limit (Wisconsinan) and an older glacial limit (Illinoian) denoted. Also marked is the location of the Bellefontaine outlier uplands.

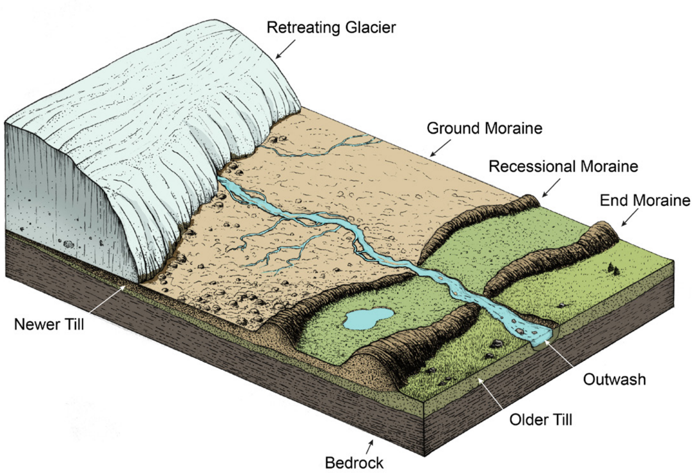

Figure 3. Conceptualized diagram of an ice sheet retreating across a land surface. Illustration by Madison Perry.

MORAINES OF OHIO

Several types of moraines cover over half of the surface of Ohio and are composed of varying amounts of boulders, gravels, sand, silt, and clay (fig. 3). End (or terminal) moraines are ridges of mostly till that form at the edge of the ice's maximum advance. Recessional moraines are similar to end moraines but were formed later, behind the end moraine as the ice lobe retreated and stagnated. In contrast, many flatter areas of till between end or recessional moraines are often ground moraines, which were deposited directly by ice sheet as a widespread blanket of mixed material. Ground moraines are generally formed when the ice was rapidly retreating; till would otherwise be deposited as an end or recessional moraine if the ice was stagnating or was slowly retreating. Moraines may take decades to form depending upon ice activity and debris supply. The assemblage of these moraines serve as geologic snapshots, indicating lobe positions at a specific point in time.

The presence of these moraine features is important when determining glacial chronology, soil characteristics, engineering properties, and aquifer potential. Moraines are often productive agricultural lands when they weather into mixed textured soils. However, compacted clay-rich tills also can have a detrimental effect on plant growth as they can act as an impermeable layer and restrict water flow. These impermeable clay layers also protect deeper water sources from pollution. Abundant clay material from till is sometimes utilized as a resource and is used in pottery, bricks, and construction purposes. Till is usually dense below the surface and is suitable for foundations or building material. Moraines may also contain lenses of stratified sand and gravel, which are typically not mineable sources for aggregates but constitute notable local groundwater aquifers.

The deposits left behind by ice ages leave a lasting impression on Ohio's scenic landscape and influence the lives of many people. Understanding glacial deposits allows us to properly utilize and protect our natural resources. Anyone can appreciate the geologic power of Ohio's ancient ice by studying detailed maps or by simply, and inquisitively, looking beneath our feet.

FURTHER READING

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• This GeoFacts compiled by Tyler A. Norris • October 2019 •
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