The Driftless Area - A Physiographic Setting

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1. The Driftless Area is a unique geographic region of the upper Midwest.
2. The geologic and geomorphic processes responsible for the creation of the Driftless Area are spatially diverse, but the dissected topographic signature is rooted in long term stream erosion.
3. Post-settlement agricultural practices have altered streamflow processes across the Driftless Area.

Glaciation | Drift | Geology | Topography | Soils | Karst

The region of southwest Wisconsin, northeast Iowa, southeast Minnesota, and northwest Illinois encompasses a topography that is uniquely different from the adjoining landscape. The colloquial term for this region is the Driftless Area. The Driftless Area is identified as a region approximately 24,000 square miles that constitutes a rugged topography with dissected valleys and well-developed stream networks of the Mississippi River that traverse the four-state region.

Early Observations on Drift

Examination of glacial deposits and sediments have found that much of the Driftless Area is not actually driftless and that only southwest Wisconsin and northwest Illinois were ice free during the Pleistocene (1–3). Evidence for glacial deposits have been identified in southeast Minnesota and northeast Iowa (4, 5). These glacial deposits are >500,000 years old (Pre-Illinoian) and found on hilltop ridges. Geomorphologists and geologists generally agree that the signature hill and valley erosional topography of southeast Minnesota and northeast Iowa was not overly manipulated during this glaciation and thus retains a similar topography to southwest Wisconsin and northwest Illinois (3). Research shows that southwest Wisconsin, northwest Illinois, southeast Minnesota, and northeast Iowa were not directly impacted by glacial ice during the last glaciation 10,000-30,000 years ago (late Wisconsin) and allows for the region's signature topography and geologic features (Fig. 1).

Geologists and geomorphologists have debated the origin of the Driftless Area since the early 19th century. In 1823 W.H. Keating's description of the Driftless Area helped defined a region unlike those they traversed from the east. The geologist from Pennsylvania traveled from Chicago to Prairie Du Chien, Wisconsin noting the lack of granitic boulders that were common among glaciated landscapes (6). Field studies by geologists in the mid-19th century presented evidence that the troughs associated with Lake Superior and Lake Michigan basins diverted northern ice to the west and south around the current extent of the Driftless Area (7, 8). Till deposits found within the Iowa and Minnesota sections of the Driftless Area resulted from glaciers flowing east from the northern Great Plains (9).

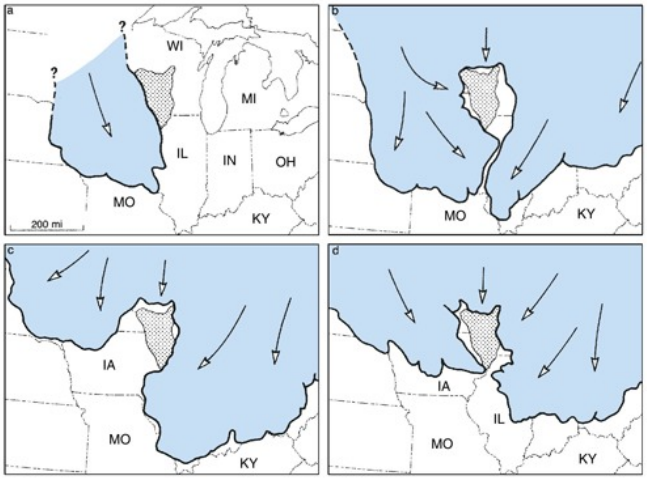

Fig. 1. Maximum extent of (a) early Pre-Illinois glacial episode (1,000.000±years age); Driftless Area shown by stippled pattern; arrow indicates direction of ice movement; (b) late Pre-Illinois glacial episode (600,000±years ago); (c) Illinois Glacial Episode (250,00±years age); (d) late Wisconsin Glacial Episode (22,000 years age). Note: Panel (d) portrays glacier advancement into the Iowan Surface, which is not accurate. Source: Illinois State Geological Survey.

Bedrock Geology

The bedrock geology of the region is primarily sedimentary-age Paleozoic. Between 500 to 250 million years ago a marine environment existed off the continent where eroded particles of sand, silt, and clay were deposited and later lithified into sandstone, shale, limestone, and dolostone. Downcutting of the Mississippi River and associated tributaries during the Pleistocene has helped to expose the Paleozoic rocks (3, 10). Differential weathering and a resultant resisting framework has helped establish the dissected and high relief landscape (∼1,100 ft) of the Driftless Area. The more resistant limestone and dolostone rocks often form cliffs and bluffs, whereas the more erodible shale is indicative of gentle slopes (3, 11). Joints in the bedrock impart pathways for stream courses across the Driftless Area (1).

Statement of Interest

Drift is "a general term for all rock material transported by glaciers and deposited directly from the ice or through the agency of meltwater. It is generally applied to Pleistocene deposits in large regions that no longer contain glaciers." Dictionary of Geologic Terms, 1984

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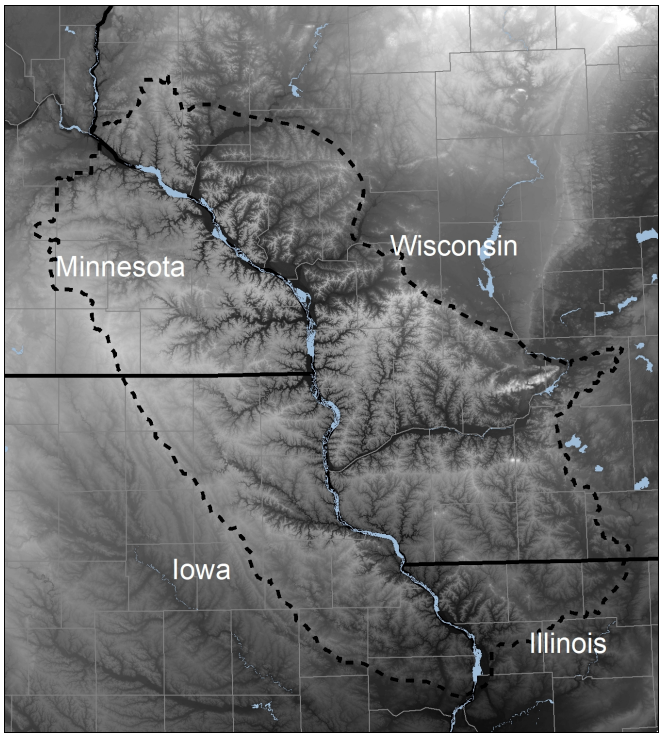

Fig. 2. Topography of the Driftless Area and adjacent regions in southwestern Wisconsin, southeast Minnesota, northeast Iowa, and northwest Illinois. The region is a heavily dissected landscape that is often referred to as coulee or bluff country. The dashed line shows one representation of the Driftless Area boundary.

Topography

The topography of the Driftless Area is strikingly different from its surrounding landscape regions (Figs. 2,3). The high relief, dissected, and eroded landscape is like no other in the upper Midwest. It is a product of little to no glaciation during the late Wisconsin. The geologic origins and geomorphic processes responsible for the creation of the Driftless Area differ are variable across its wide expanse, but the one consistency is long term stream erosion since the area was unglaciated during the last 500,000 years.

Soils

Traversing the landscape are a combination of plateaus, cliffs, bluffs, and hillslopes that help define the physiographic region. Loess derived soils often mantle the Paleozoic rocks. The loess thickness is greatest on low gradient uplands and lower to non-existent on steep slopes. Mass wasting on upland and hillslopes during the late Wisconsin glacial period was responsible for the removal of the loess cap in areas of the Driftless Area (12, 13).

European Settlement

Pre-Settlement Land Cover. In the first geological report to the Governor of Wisconsin, Daniel Edwards described the vegetation as a combination of prairie, savanna, and deciduous forest (14). As European settlement increased in the Driftless Area, much of the broad uplands and flat valley bottoms were cleared for agriculture and forests are now generally confined to side slopes (15). Where upland forest occur they consist of red and white oak *Quercus rubra* and *Q. alba*, sugar maple *Acer saccharum*, cherry *Prunus spp.*, hickory *Carya spp.* and valley lowlands are often comprised of elm *Alnus spp.*, cottonwood and birch *Populus spp.*, ash *Fraxinus spp.*, silver maple, and willow *Salix spp.* (16). The transition, and ultimately transformation of natural vegetation communities to agriculture, caused severe landscape degradation that has negatively impacted the river systems across the Driftless Area (see Vondracek, this volume).

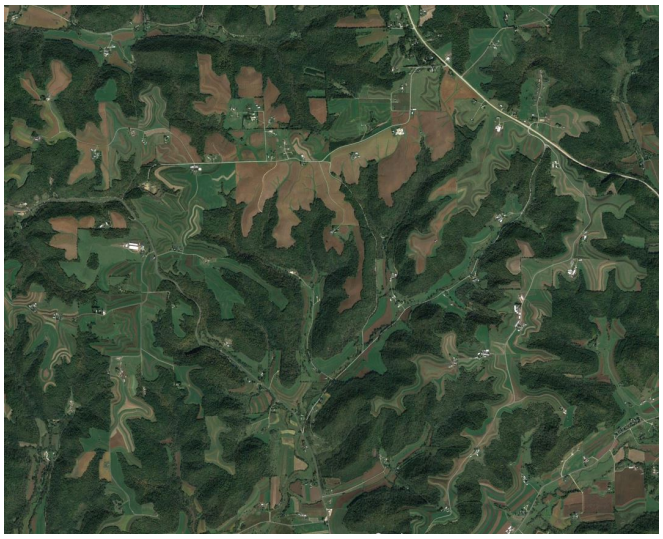

Fig. 3. Aerial imagery of southwestern Wisconsin showing upland farm fields, forested hillslopes, and developed valleys. Source: Google Earth, Inc.

Fig. 4. Driftless Area hillslopes cleared for pasture with rills as evidence of past erosion. Credit: D. Splinter.

Post-Settlement Land Use. Beginning in the early 19th century, European settlement in the Driftless Area promoted landscape disturbance as soon as the trees were removed and the plow broke ground (17). Erosion developed on hillslopes as rain detached the topsoil, which led to the development of rills and gullies (Fig. 4). The eroded soils ended up in small streams and valleys across the Driftless Area (12, 17, 18). Stream aggradation altered the flow hydrology of the fluvial system and resultant channel habitats required for coldwater fish communities, including native Brook Trout *Salvelinus fontinalis* (19). The degradation of the fluvial system in the

Fig. 5. Row crop agriculture on an Driftless Area upland plateau, southwest Wisconsin. Valley initiation and forested hillslopes appearing in the background. Credit: D. Splinter.

Fig. 6. Driftless Area stream flowing through the Bohemian Valley, southwest Wisconsin. Credit: D. Dauwalter.

Driftless Area has been extremely problematic because it harbors thousands of coldwater springs that provide suitable water temperatures to support trout in the upper Midwest (20)(Figs. 5,6).

Karst Features

Within the Driftless Area karst features are common and include caves and sinkholes. The catalyst for karst topography in this region is shallow carbonate bedrock and a minimal amount of sediment covering the limestone and dolostone rock. Karst features are uniformly distributed across the Driftless Area. As acknowledged by Bounk and Bettis (10), karst features "are concentrated where lithologic, hydrologic, and geomorphic conditions have promoted their development and preservation." Karst features and associated topography have promoted the development of springs across the Driftless Area, which provides coldwater streams for trout. These springs often serve as the origin of first-order streams for the resultant dendritic channel pattern that characterizes the region.

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