Story County Geology: the Story in the Rocks

Janet Dixon
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Janet Dixon

Dr. Chad Heinzel

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Introduction

The generation that we are now educating will be called upon to solve significant global problems as both earth and human systems change rapidly. A sound scientific education that focuses on understanding how scientific models and theories are built from well-reasoned interpretations of scientific observations will be crucial in providing future citizens with the skills to address these problems. The Next Generation Science Standards emphasize not only learning a collection of facts about science, but fully understanding the nature of the scientific process of reasoning. For example, middle school students in Iowa are expected to be able to explain how the evidence from rock layers is used to construct the 4.6 billion year history of the earth.

Overview of Iowa Geology

The landscape of Iowa is heavily influenced by the three major periods of glaciation during the Holocene. The Pre-Illinoian glaciation dating back about 2.5 Ma scoured the entire state. The Illinoian and Wisconsonian glaciers created the rich, flat Des Moines Lobe of north central Iowa, burying it under about 100 feet of glacial drift. The three advances of the Wisconsonian period, the Bemis advance, the Altamont advance, and the Algona advance, flattened most of the Des Moines Lobe and left terminal moraines and kettles (shown in Figure 1) in belts across the region.

Figure 1. Kettle in McFarland Park near the site of the Bauge Cabin.
Photo taken May 2, 2016 by Janet Dixon

To the south of the Des Moines Lobe is a region of relatively flat glacial drift dissected by deeply cut stream beds, the Southern Iowa Drift Plain. To the east of the Des Moines Lobe is the Iowan Surface, a gently rolling landscape of glacial drift with wind-generated paha built from blowing sand. The area

was not glaciated during the most recent glaciated during most of the Wisconsonian advance, and has wide river valleys produced by glacial outwash running from north central to southeast produced by glacial outwash. In the northeast corner of Iowa is the Paleozoic Plateau. The bedrock in this region, in contrast to the other regions in the state, is not topped by a thick layer of glacial drift, but by a thin layer of loess. Erosion has carved deep river valleys and the rock strata from the Cambrian era are visible along the bluffs of the Mississippi. A narrow band of steep, highly eroded terrain formed by windblown fine silt piling up against the ice sheet, the Loess Hills, lies to the west of the Southern Drift Plain, and the southern half of the state is framed on the boundaries by the Missouri and Mississippi Alluvial Plains. (Prior, J.C., 1991)

Iowa spent much of its geological history underwater. The Mississippi arch and the Transcontinental Arch bounded an inland sea for much of the Iowa's Paleozoic history. Many of the rock layers contain evidence of marine deposition in shallow seas, including marine fossils, limestone, dolomite, and evaporites. Periodically during Iowa's history the seas retreated: many of the rock layers contain evidence of transgression-regression cycles and unconformities in the rock record that indicate surface erosion in the absence of the sea.

The oldest exposed bedrock in the state, the Sioux quartzite, can be found at the northwestern corner. This seems counterintuitive since the general trend is older exposures to the northeast and older exposures to the southwest. The northwest corner of Iowa near the highest point of the Transcontinental Arch, a supplier rather than an accumulator of sediments. The Southeastern Nebraska Arch has risen and subsided periodically since the Precambrian. (Bunker, 1981). The Nemaha uplift of the Pennsylvanian Period raised this corner of the state and erosion exposed the Precambrian rock.

Otherwise the surface bedrock generally goes from oldest at the northeast corner of the state, with exposures from the Ordovician period along the Mississippi River, to youngest at the southwest corner of the state, where the surface bedrock is of the Kentuckian period. Why do the layers of bedrock generally slant from northeast to the southwest, in spite of the fact that the elevation of the

land climbs gently from east to west? The rise of the Mississippi River Arch and the subsidence of the Forest City Basin created dry land in the northeast half of the state, and deposition occurred in the southwest half of the state. (Anderson, 1998, p. 229) The continent began tilting from west to east only about 40 to 70 million years ago with the subduction of the Pacific Plate and the rise of the Rocky Mountains. (USGS Geology in the Parks, 2014) Significant erosion has occurred with each glacial period, flattening the landscape and removing the top layers of rock.

A Brief Social History of Story County

In the eighteenth century, prior to the expansion of the United States west of the Mississippi, there was little human presence in what is now Story County. The area was not prime game land, and particularly where Squaw Creek flows into the Skunk River was marshy and difficult to traverse. It was part of a twenty mile buffer zone between the Dakota Sioux to the northwest and the Sac and Foxes to the southeast. Prior clashes between the two Native American groups had led to a truce mediated by Europeans in the area, presumably French fur traders, and the area was unoccupied with only one recorded incident that happened in the year 1850. The Native Americans preferred the wider Boone and Des Moines river valleys to the west and the Cedar and Iowa Rivers to the east as yielding better agriculture and more bountiful game.

In 1803 the area that is now Iowa officially became part of the United States of America following the Louisiana Purchase. The Blackhawk War of 1832 opened up the land west of the Mississippi River to settlement by Easterners of European descent. It took until the middle of the century for the newcomers to start settling central Iowa. Iowa became a separate territory in 1838 and on December 8, 1846 the 29th state.

The early settlement in the area was migration from New York, Pennsylvania, and Indiana. More recent settlers came directly from Norway: Story City celebrates Scandinavian Days for a week each summer. The better drained land, more suited to agriculture, tended to fill up first and the swampier land later. Geography was a serious barrier to both movement and settlement: the Skunk

River could be forded only in two places in the area, at Hannum's Mill in Bloomington and at Cambridge. The river was known to travelers as "The Slough of Despond". (Mead, 1955) By 1852, shortly before the formation of Story County, the population of the area was 214.

Story County was organized in 1853 with the county seat located somewhat centrally in Nevada. The county is named for Justice Joseph Story, a contemporary of Justice John Marshall. At this time the area had several grist mills. Transportation was provided by a stagecoach service that could take a week to cover the distance from Nevada to Iowa City. The stagecoach ran along the modern County E29, now known as Stagecoach Road.

The Iowa General Assembly appropriated $10,000 in funding in 1858 for a state agricultural college, offering the funds to the county that could provide the greatest amount in matching funds. Boone and Story County citizens cooperated in raising the funds to establish a college within Story County, and the location chosen was to the west of the village at the confluence of the Skunk River and Squaw Creek, and one and a half miles to the east of New Philadelphia. The Civil War intervened and drew resources away from the initiative, but with the passage of the Morrill Act in 1862 it was possible to begin a land grant agricultural college in Ames: Iowa State College, which later became Iowa State University. Iowa State College opened for its first regular term in 1869. President Welch was remarkably modern in his thinking: women were offered the same educational opportunities as men. He justified his position in his inaugural address as follows:

> "We offer, then, to the young women who , from time to time, shall resort to this college, a scope for scientific progress and research as unlimited and free as that which we offer to the other sex:
>
> 1st--Because all the faculties of the human mind have, without respect to gender, a natural, unquestionable right to discipline and development.
> 2nd--Because the duties of motherhood to which God has appointed her, require, for their complete performance, a wide and cultivated intelligence.
> 3rd--Because general intellectual and moral culture will sanctify, elevate and purify the influences of the home, and render it a genuine school for the training of the future citizen.
> 4th--Because we would enable her to make provision for her own self-support, by a special preparation to engage in many suitable employments on a footing equal with man, both as to the skill and the remuneration of the worker.

5th-Because we would supply as far as possible one great necessity to woman, namely, a means for the culture and a field for the action of peculiar talent, thus giving relief to the aimlessness of many lives, and adding many nobel workers to the world.
6th--Because we would call all learning and culture to the aid of woman in accomplishing her natural mission, the advancement of general morality and virtue." (Payne, 1911)

Contrary to what one might expect the town of Ames did not grow up around Iowa State College. Instead, its fortune was driven by transportation improvements. The town was named for Oakes Ames, a Massachussetts Congressman known for some dubious transactions with the Union Pacific Railroad. A deal cut over a purchase of land resulted in a depot being established near the current location of downtown Ames. (Meads, 1955) The result was that Ames was at the crossroads of a couple of rail lines: the Chicago & Northwestern Line provided daily east-west passenger and freight service and other railroads provided similarly efficient north-south service. In addition the Lincoln Highway was routed through Ames. The road was graveled in 1915 using gravel from four pits between Ames and Nevada, paved as far as Squaw Creek in 1916, and paved through to the Campustown area by 1921. Travelers on the Lincoln Highway brought tourist dollars into the city.

Iowa State College became Iowa State University, and its enrollment is now 36,001 students. It is the main driver of the economy in Ames. The Ames population reached over 50,000 in the 2010 census, giving it the status of a city. There are numerous industries, including several quarries, based in Ames. The City of Ames is nearly ten times larger than the second largest community (Nevada), and nearly twenty times larger than Story City or Huxley. It continues to expand and add a variety of industries, from small technological businesses to large industrial operations such as the Barilla pasta plant.

A History of Geological Resources in Story County

By far the most important geological resource of Story County is the water supply. Both Ames and Nevada rely on the alluvial aquifer of the South Skunk River, which runs in an old river channel that predates the glacial periods. The old Hallett's Quarry, which became the Ada Hayden Heritage

Park in 2001, acts as a reservoir to recharge the aquifer in times of drought. The ethanol industries and the Barilla pasta plant are among the industries that rely heavily on this resource. Historically a few wells tapped the bedrock aquifers, such as the City of Nevada which tapped the Jordan Sandstone and the Iowa State University Farm which drilled into the Devonian, but it seems that currently most water withdrawals are from alluvial aquifers. (Thompson, 1982)

The abundant rich soil on the Des Moines Lobe, created by the deposition of glacial till followed by years of organic buildup under the tallgrass prairie, is nearly as important as the water supply as an essential geological resource. Virtually all of Story County except the river beds, towns, and a few parks are planted in corn and soybeans. Farming has historically been the chief industry of this area.

Rock resources are provided by the The Martin-Marrietta Mine on West River Drive on the north side of Ames, and the Hallet Materials quarry on South Dayton Ave on the South side of Ames. Martin-Marietta mines limestone aggregate of varying sizes from the Gilmore City Formation and the Eagle City and Maynes Creek members of the Hampton Formation, all of the Mississippian System.

Even though Story County is well within the coal belt in Iowa and the coal is of high quality, the coal mining industry never really took off. The first mine in the county was opened in 1885 near Collins and worked for just over ten years. From 1892 until 1898 Story County's most productive mine was operated by the Northstar Oil and Coal Company at a location halfway between Gilbert and Story City. Enough coal was produced here to warrant extending the Chicago & Northwestern Rail Line to the mine in order to ship coal out of state. Two more coal mines near Gilbert were operated for a few years during the middle of the 1890's. (Lees, 1909, p. 575) On the positive side, It is comforting to know that homes in Story County, unlike those in parts of Des Moines, are unlikely to disappear into sinkholes because the underlying rock is riddled with coal mines.

The Bedrock of Story County

The surface bedrock in Story County is mainly Pennsylvanian with fingers of Mississippian

coming in roughly along the Skunk and Squaw Rivers and Onion and Indian Creeks, and on the eastern side of the county unconnected with a river valley. The Mississippian formations are mainly of the Augusta Group and St. Louis and Pella Formations, but small areas of the Gilmore City and Kinderhookian Formations are present in the Squaw Creek valley. The Pennsylvanian surface bedrock comprises the Upper Cherokee Formation and the Marmaton Group. Figure 2 shows the topography of the bedrock surface in Story County.

Figure 2. The surface topography of the bedrock underneath the glacial drift in Story County. The contour lines are in 50 foot intervals. (Kent & Sendlein, 1972; Witzke, et. al. 2014).

Although most of Story County is under 80 to 100 feet of glacial drift, it is possible to find a number of bedrock exposures along the creek beds. Many are in publicly accessible places, including Reactor Woods on Onion Creek, the Skunk River Greenbelt near Soper's Mill, and in some of the creeks at McFarland Park. The McFarland Park dolomite exposures are in two creek beds that join and flow into the Skunk River, one originating near the site of the old Bauge cabin and the other draining