Angie Alzheimer

Geologic Resources of Iowa for Teachers

Polk County Geology and Exploring the Geology of the Saylorville Gorge

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Introduction

"Iowa," is a Native American word that means "the beautiful land."(Anderson 1998). Iowa's green and lush land not only became famous for its fertile soil and agricultural wealth, but also has many other important natural resources. Surface and underground water are important resources of Iowa, increasing the welfare of people living in Iowa. Iowa also has a variety of useful minerals and rocks that people have used for both industrial and recreational purposes. The major minerals and rocks found in Iowa are limestone and dolomite, gypsum, clay and clay shale and sand and gravel. (Anderson, 1998)

"These natural resources are directly linked to Iowa's geologic history" (Anderson, 1998).

They say the only guarantee we have in life, is change. This is true when we study the life of our planet as well. The major difference is the time at which changes happen to our planet are much longer in the eyes of a human. Change to Planet Earth, more specifically, landscapes of what is Iowa, usually cannot be seen over one person's lifetime. We have many other tools in the science of geology to be able to see the history of Iowa's changing landforms and landscapes.

The Geology of Polk County, Iowa

Iowa's exposed rock record is made up of almost entirely sedimentary rocks. These rock layers have given geologists the ability to tell the story of Iowa's geologic history. There are time frames absent known as unconformities, which make the puzzle more complicated to piece together. (Anderson,1998).

Our planet is around 4.5 billion years old. Iowa's geologic history began about 3 billion years ago, with igneous and metamorphic rock, the oldest exposed rock can be found at the Sioux Quartzite at approximately 1.6 billion years old (Heinzel,2016). See Figure 1. This is the Precambrian Era, which is the majority of Earth's history. The exposed rock found in the later part of the Precambrian gives evidence that Iowa was located along a major Midcontinent Rift System (MRS), 1,450 km long, where lava flowed and shallow intrusive igneous rocks formed (Polk County Comprehensive Plan, 2005). There are several large faults associated with the MRS, one of these faults, the Thurman Redfield Fault Zone, cuts through the northwest corner of Polk County (Polk County Comprehensive Plan, 2005)

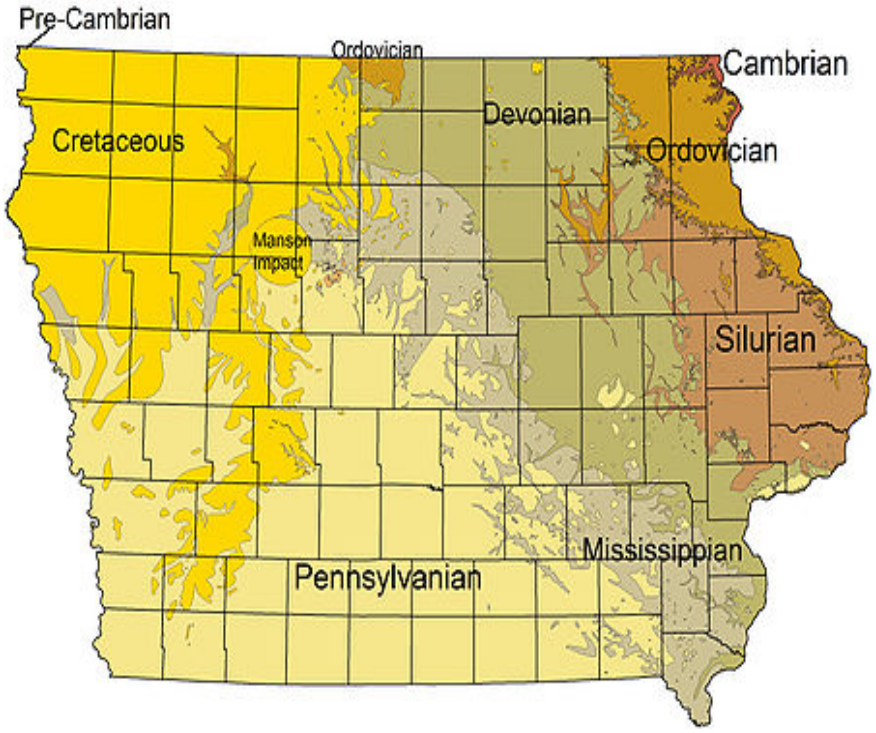

Figure 1. Bedrock Formations in Iowa (Wikipedia, Geology of Iowa)

Most of the rock seen in Polk County comes from the Pennsylvanian Period of the Cherokee and Marmaton groups. See Figure 1. There are areas where this rock has eroded, leaving exposed bedrock from the Mississippian Period. During the Mississippian, shallow seas covered much of the area as the bedrock consists primarily of the marine sedimentary rocks limestone, dolomites, shale, mudstones and sandstones. The seas receded, exposed rock eroded by wind and water, erasing much of the geologic record. When the seas returned in the Pennsylvanian period, deposition occurred again. The repetition of the advanced and receded seas and eroded exposed rock has caused many unconformities in the bedrock below Polk County (Polk County Comprehensive Plan, 2005).

The more recent time period of the Quaternary is seen in the surficial deposits of Polk County. Much of these are influenced by the last glacial stage of the Wisconsian, approximately 60,000 to 10,000 years ago (Polk County Comprehensive Plan, 2005). This massive frozen river pushed soil and rock south, and deposits of clay, unconsolidated sand and cobbles were placed over the exposed rock as the glacier advanced or retreated. These deposits are known as glacial drifts and seen throughout Polk County.

The most recent time is called the Halocene Epoch, from 10,000 years ago to present. This is called the interglacial stage, which is the continued receding of the Wisconsian glacial stage (Polk County Comprehensive Plan, 2005). Drainage patterns in Polk County were reshaped by this most recent glacial stage. The Des Moines Lobe of the glacier, filled in the Moingoina River, which once drained much of Iowa. As the glacier melted, it formed a new drainage pattern,

now known as the Raccoon River, but the East side of the city still has difficulty with draining at times due to this change (Polk County Comprehensive Plan, 2005).

Geography of Polk County

Polk County is located in central Iowa. It is in the fourth tier of Iowa counties north of the Missouri River and is the seventh county west of the Mississippi River (Polk County Comprehensive Plan). It has four watersheds and two prominent rivers: the Des Moines River and the Raccoon River (US Environmental Agency).

There are 763 people per square mile in Polk County, it is the county where the Des Moines Metropolitan area is located, making it the highest populated area in Iowa. The city of Des Moines is at an elevation of 838 feet above sea level. Polk County consists of 594 square miles, the metro area of Des Moines, about 76 square miles of the county has been a significant source of land use change in Polk County (polkcounty.gov)

The Wisconsonsian glaciation has influenced much of the Polk County topography with its superficial deposits, many marshes and ponds located between ridges and moraines produced from the Des Moines lobe. There is a part of Polk County that did not experience the last glaciation of the Des Moines lobe, Southern Iowa Drift Plain, which has topography of steep rolling hills.

The Bemis Advance resulted in a moraine produced by the Des Moines Lobe which is now where the Capital Building is located. See Figure 2.

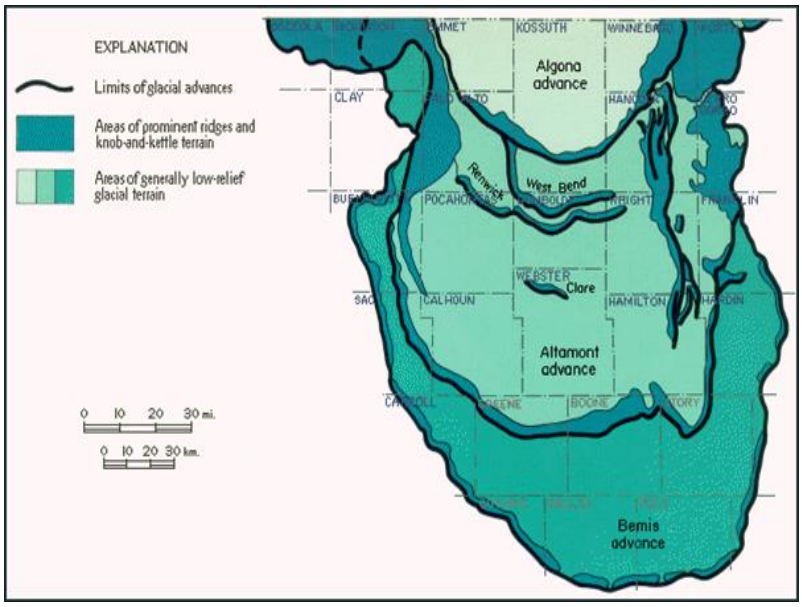

Figure 2. Advances of the Des Moines Lobe (Iowa DNR)

The History of Polk County

Humans have inhabited central Iowa as far back as the last glacial period, about 14,000 years ago. A variety of indigenous people lived in what is now known as polk county for thousands of years.

The first white man to explore the area was in 1673, Joilet and Marquette came down the Des Moines River. They named and marked a village, “la riviere des Moingona, on their map. There was a tribe Moingona, who inhabited the riverbank. The name “de moyen” is said to mean “middle”, and was used to refer to as the middle between the Mississippi and the Missouri rivers.

In 1824, Fort Des Moines was built at the confluence of the Des Moines and Raccoon rivers to help protect the rights of the Sak and Fox Cession of 1842. Then in 1845, the Iowa River Valley was opened to new settlers, a year later, Iowa became a state in the Union.

In the 1840’s, small quantities of coal were first mined at Fort Des Moines and along the lower Des Moines River. Near the end of the 1800’s Iowa was one of the leading states in coal mining thanks to the developed railroad system. It started to decline in the early 1900’s when they switched to mining surface coal instead of underground coal. Then in 1920, all coal mines shut down to switch to cleaner coal in Illinois. The mining in Iowa shifted from coal to gypsum and limestone (Coal, 2002).

The History of Saylorville Lake and Spillway

Figure 3. Saylorville Spillway (Wikipedia, Saylorville)

Location Site: 41°43’37”N 93°41’59”W

This is a reservoir on the Des Moines River, located 11 miles upstream from the city of Des Moines.

There is a long history of the Des Moines river flooding the city, so in 1958, Congress approved the construction of Saylorville Lake by the Army Corps of Engineers, to help provide flood protection for the city of Des Moines (Geological Society of Iowa, 2009). It became fully functioning by 1977. The main function of Saylorville Lake Emergency Spillway was for flood protection. It’s a passive system, which is utilized only when the lake levels exceed 884 feet. If the lake levels reach the maximum of 890 feet, an estimated 21,000 cfs of water flows over the emergency spillway (Geological Society of Iowa, 2009). The spillway does much more than provide protection against flooding; it has a lot wildlife inhabiting the area, provides a steady supply of water to the city of Des Moines, even in times of drought and is used for many recreational purposes such as boating, camping, fishing and hiking (Geological Society of Iowa).

The first flood, after the construction of the emergency spillway, was in 1984. It functioned properly to protect the city, withstanding the flooding waters, but erosion occurred from the water below the spillway’s concrete curtain which cut deeply into the Pennsylvanian bedrock, producing a canyon called the Saylorville Gorge (Geological Society of Iowa, 2009).

The Geology of the Saylorville Gorge

This gorge contains a record of Iowa's landscape during the Pennsylvanian period (310 million years ago). This horizontal strata has alternating layers of the sedimentary rocks limestone, shale (or mudstone), sandstone and coal (Explore Iowa Geology). The various rock types and fossils found in this gorge indicate the environment was one with fluctuating sea levels and low coastal plains that had freshwater channels nearby with vegetation and rolling sand dunes. The shale, sandstone and coal indicate lush freshwater channels with deltas and backwater swamps (Iowa Department of Natural Resources).

Alternating shales and limestones are evidence of the fluctuating sea levels deepening. The rippling sandstone is evidence of the sea levels fluctuating back to more shallow waters. At this time, 350 million years ago, the North American plate was right next to the Equator. This resulted in a warm, tropical environment, one that I would love to live in now! (Iowa Department of Natural Resources)

The fossils found in this area help to determine marine deposits from freshwater deposits. There are several brachiopods, crinoid stems and traces of animal burrowings just below the sea bed in the limestone. Plant and "scale tree" fossils (*Lepidodendron* and *Sigillaria*) found in the sandstone bedrock indicate an ancient river bottom. These vegetation fossils are said to be major contributors to the formation of coal (Iowa Department of Natural Resources). The most recent layers found on the top of the strata are softer deposits from 10,000-30,000 years ago formed during the Glacial Age (Iowa Department of Natural Resources).

Earth Science Unit Plan:

1. **RIDE the ROCK CYCLE**- Students will be a specific rock in the rock cycle and explore the different processes a rock goes through; and document their journey.
    a. http://sciencespot.net/Pages/classearth.html#Anchor6

2. I will show a brief video, explaining the rock cycle and then go into a little bit more detail, asking students questions about their personal experiences in the rock cycle game.

3. **ROCK IDENTIFICATION**- Using rock boxes; Students will identify and categorize 9 rocks into the three classes of rocks.
    Igneous Sedimentary Metamorphic

4. Students will go to https://www.learner.org/interactives/rockcycle/about.html and go through the rock cycle, (I will make a worksheet to help walk them through this interactive website) specifically studying sedimentary rocks and answer the following questions:
    a. How do sedimentary rocks form?
    b. What type of environments do the following types of rocks form:
        1. Limestone
        2. Sandstone
        3. Shale

5. **Fossils**- https://www.youtube.com/watch?v=vqhAPEPByus

6. **Fossils found in the Pennslyvanian –**
    http://dcnr.state.pa.us/topogeo/collecting/fossilsintro/fossils/index.htm

7. **Geologic Time**- Students will have had some practice working with the concept of geologic time. They will interview an older person and make a geologic timescale of that person's life. After they have a clear understanding of the geologic time through this activity, I will let them know the time period is of the Paleozoic Era in the Pennsylvanian Period at the Saylorville Gorge.

8. **Relative Dating-** http://www.ucmp.berkeley.edu/fosrec/BarBar.html

WHO'S ON FIRST? RELATIVE DATING ACTIVITY **NAME**_____

SET A- Interpretation Questions:

1) After you have arranged the cards in order, write your sequence of letters (using each letter only once) on a separate piece of paper. Starting with the top card, the letters should be in order from youngest to oldest.

2) How do you know that "X" is older than "M"? _____

_____

3) Explain why "D" in the rock layer represented by DM is the same age as "M."

_____

_____

4) Explain why "D" in the rock layer represented by OXD is older than "D" in the rock layer represented by DM.

_____

_____

SET B- Interpretation Questions:

1)Using the letters printed in the lower left-hand corner of each card, write the sequence of letters from the youngest layer to the oldest layer (i.e., from the top of the vertical stack to the bottom). This will enable your teacher to quickly check whether you have the correct sequence.

2) Which fossil organisms could possibly be used as index fossils?

_____

3) Name three organisms represented that probably could not be used as index fossils and explain why.

_____

_____

4) In what kinds of rocks might you find the fossils from this activity?

_____

_____

9. **Field Project to Spillway Gorge**

The expectation is that he/she will gather information from this site visit through a scavenger hunt, taking pictures of things they are being asked to identify. Students will take the information that they have been asked to identify and create an end product when they return to the classroom to show evidence of his/her learning. The goal is to allow students to apply the learning they have been doing, therefore, deepening their understanding of the standards.

They will sketch fossils they see in the field. They will also be asked to identify the types of rocks they see. They will use the evidence they gathered at this site location to create a storyline of what happened during the Pennsylvanian. They will compare the sketches or photos they took of the fossils they found at the Gorge to the Pennsylvanian fossil worksheet given to them earlier in the unit.

They will create a comic strip to show his/her understanding of what the environment looked like and the changes that occurred over this time period.

Earth Science S1 Lesson Plan Standards

Level 3 Standard: Students demonstrate they have developed an understanding of:

- how to use the methods of dating and associated evidence to construct an account of Earth's formation and early history
- how the fossil record is used to determine geologic time intervals

Level 2 Standard: Students will recognize or recall:

Specific vocabulary such as:
Index fossil, era, period, epoch, uniformitarianism, laws of superposition
Basic knowledge such as:

- the difference between relative and absolute dating
- the fundamental structure of the geologic time scale

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