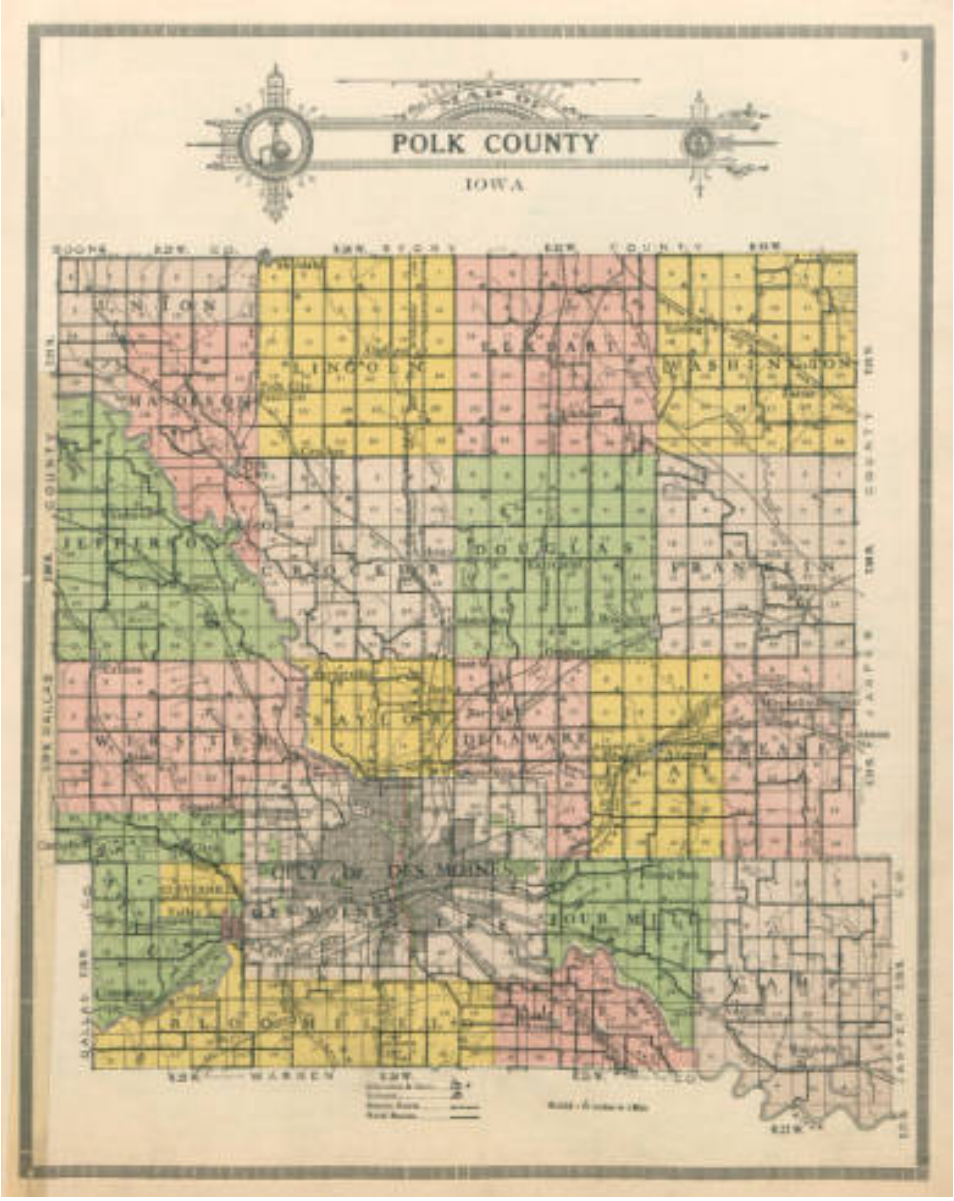
Polk County and Its Geology



Map of Polk County

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Geologic Resources of Iowa for Teachers

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IV. Abstract

Iowa has an interesting bit of geology that spans time from the Pre-Cambrian to the Quaternary. Polk County's bedrock holds a different past than most Iowa's can conceive: Iowa was a shallow ocean area with marine life. The county contains some of the rich Iowan soil that was created via the prairie life that lived millions of years ago. The theme of my student lesson involves understanding how sinkholes form. Using the geologic history of Iowa, I will help students investigate the process of coal forming, locations and how it happened here in Des Moines.

The population of Iowa is most centrally located in the Metro area of Des Moines. There are a few other larger cities but the majority of the population lies in Des Moines Metro. This is important to understand because the large amount of people increases the chance that someone might be affected by a sinkhole.

V. Introduction

a. Thesis

Polk County is located at the tip of the Wisconsin glacier that slide south about 25,000 years ago. This glacier has led to various river formations in Polk County. These rivers cause our county to be prone to flooding. The majority of our bedrock is from the Pennsylvanian Era, as displayed in Figure 1. During this time, Iowa was a shallow sea that housed small marine animals. This is the major source of fossils that are found in Polk County, and most of Iowa for that matter. There were various areas that were swampy lands as the waters receded. This led to lush plant life that further turned into formations of coal under the surface. Coal mining was a large operation in the late 1800's and early 1900's in Polk County, specifically the Des Moines area.

The unit that I have created helps students to answer the question that I was asked many times last year, "Why do we have sinkholes in Polk County?" I felt that using this over-arching question will allow the students to be led

through an investigative process that helps them learn about earth's convection process, the rock cycle, how to read maps, about different types of rocks, understanding the age of earth and how the history of the earth (and region) can lead to catastrophic events that we get to witness now.

b. Geography

Polk County is located in the south central region of the state. The county seat is located in Des Moines, which is about 70 miles north of the Iowa/Missouri border. According to the United States Census Bureau, as of July 2015, the population in Polk County is 467,711. It is the most populated county in the state. The 2nd most populated county has about ½ of the population that Polk County does.

The Des Moines and Raccoon Rivers are the major rivers that run through Polk County. There are at least 7 smaller rivers that also compose the county's waterways. Many of the tributaries run into these same rivers, but also as far as the Mississippi River. There are 4 watersheds that Polk County crosses, as well. They include South Skunk, Middle Des Moines, North Raccoon and Lake Red Rock.

c. History

The land that was to be known as Iowa was purchased by the United States Government from the French during the Louisiana Purchase in 1803. In 1846, the territory of Iowa was created and Polk County was organized at this time. It was named after James Polk, the president during this time (Dixon 1876).

Polk County became a busy region because of the Des Moines River running through it. This was a great means of transportation and people wanted to live nearby.

The largest natural resource that Iowa is known for is its soil. Polk County has plenty to offer in terms of good soil known for producing stellar crops. There are many rivers that are a resource for humans, animals and plants in the county. Coal was a major natural resource in Polk County. Between the years of 1840-1947, coal was mined out. There are many abandoned mines in the county region, which have led to some problems for area residents.

As a resident of Polk County, I feel that the roads are well kept and ditch ways are clean. At the time of this writing, there were a handful of roads that were in construction (due to summer weather) because of needing repaving or bridge work. Polk County has a website in which one can access road conditions. At this website, one can also report county road problems to the County Engineer.

The majority of the population of Polk County lives in the Des Moines metropolitan area. "Between 1990 and 2010, Des Moines' population grew 5 percent, while the population in the rest of Polk County grew 65 percent." (Child and Family Report) The metro area is becoming very crowded and individuals are choosing to move farther away. According to the Child and Family Report, the metro area is growing in Hispanic and African American population and the outlying Polk County is growing in white, non-Hispanic citizens.

In regards to education, there is a large discrepancy between the Des Moines metro area and the rest of Polk County. The Metro area falls much below the rest of the county in 4th grade reading ability and in high school graduation rates. Schools are ranked well when they are either a suburban Metro school or more widespread in the county. (Child and Family Report)

VI. Summary of the Geology of Iowa

Iowa has land nearly as old as the planet found in its bedrock (Figure 1). The oldest bedrock, Precambrian (about 3.5 billion years old), amounts to a small portion in the northwestern corner of the state. Cambrian era bedrock, a tad younger at about 542 million years old, is located in the Northeastern corner. From there the bedrock seems to get younger as one heads southward. The state's southern border has Carboniferous era bedrock, Pennsylvanian and Mississippian, at about 359 million years old. With regards to the surficial content of the state, Anderson (1998) explains, "throughout most of the state the bedrock is covered by unconsolidated deposits such as glacial till, sand gravel and loess." Sometimes the actual bedrock demonstrated in Figure 1 is the material that is on the surface, called outcropping, due to the other deposition materials being moved away.

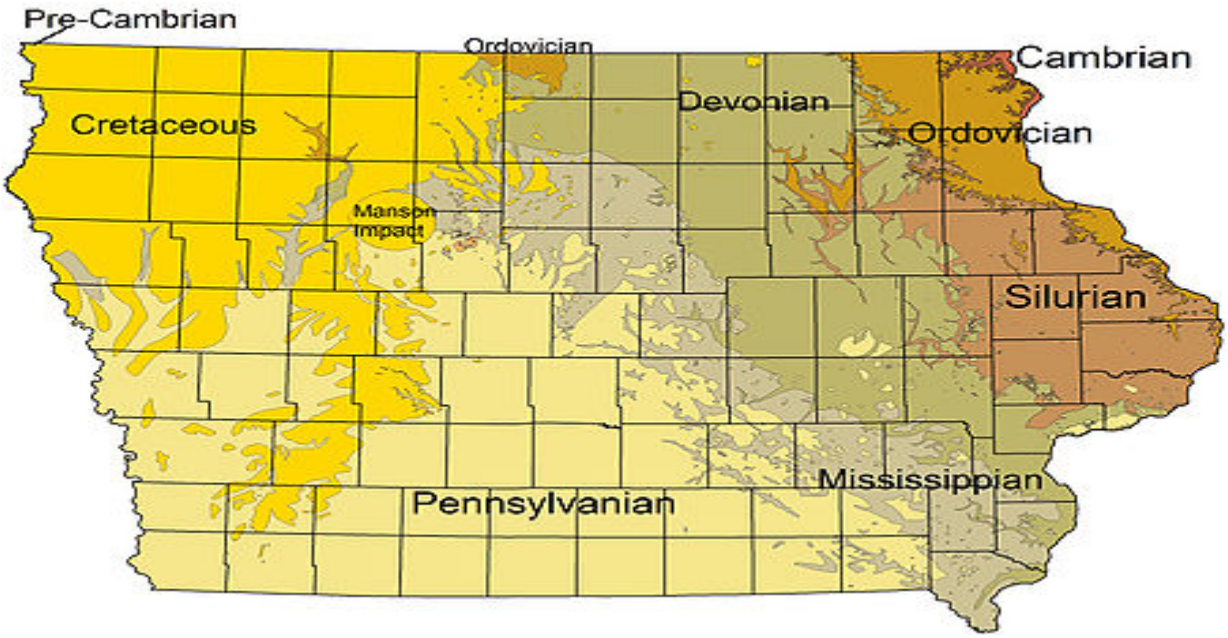

Figure 1. This Iowan map shows the distribution of bedrock by geological eras. (Source: Wikipedia)

VII. Polk County Geology

I live in Polk County. The bedrock found in Polk County is that of the Pennsylvanian era, which lends to the Marmaton and Cherokee groups. In the northeastern region of the county, there is some Mississippian bedrock that is present which created the Augusta group and St. Louis and Pella formations (Polk County, 2005).

The bedrock from these two eras is mainly composed of marine sedimentary rocks from the shallow sea that covered Iowa during this time period. Rocks from this region could include shale, mudstone, limestone, dolomites and sandstone.

Figure 2 shows how the northern 4/5 of the county is covered in land that was pushed southward from a glacier during the Wisconsin glacial stage. The tip of the glacier ended up in the southern aspect of Polk County. This glacier brought with it pieces of the land that it flowed over and deposited clays and sands in different forms, which is the surficial landscape of the green areas of Polk County. It has gently rolling land with end moraines and shallow wetland basins because of the poor drainage. The southern 1/5 of the county consists of the Southern Iowa Drift Plain. The glaciers that created this region were much older than the Wisconsin glacier, which has given wind and water time to do a hefty job of creating a region

where the landscaping of surficial rocks and waterways is abundant. This region has well defined drainage which allows for better wooded areas than the north.

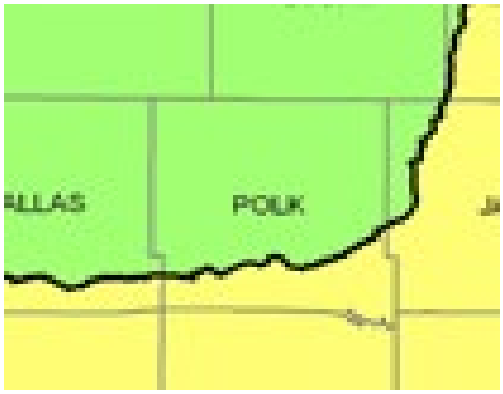

Figure 2: Polk County, Iowa. Shows the surficial difference between southern tip of the Des Moines Lobe (green) and Southern Iowa Drift Plain (Yellow). (Source: Iowa Department of Natural Resources)

Polk County, especially around the Des Moines metro where I am located, is land that floods easily. The four rivers that lie in this county are a significant aspect in this problem. The flood of 1993 was the worst flooding experience of Polk County. It was actually termed the "costliest, most devastating flood in U.S. history" (Iowa Geological Survey).

VII. Natural Resources in Polk County

There aren't as many underground natural resources in Polk County as there are surficial ones. Water and air are the primary ones that Polk County can make claim to. Wetlands, forests, timber and soil are more natural resources that are located in Polk County. There are numerous amounts of wildlife that are indigenous to the Polk County land, as well.

There are two major rivers in Polk County from which water can be reclaimed. The Des Moines and Raccoon rivers and all of their tributaries help keep Polk County well hydrated. The Des Moines Water Works facility cleans these waters to send to homes so they can have safe and healthy water. The rivers also lend to all of the wetlands in the county. The wetlands offer refuge to many plants and animals that are happy to have homes there. There was a time in Iowa's history where the waterways were more plentiful and abundant. The original land

consisted of plentiful wetlands and woodlands. As humans changed the landscaping to meet their own needs, these natural resources have been limited. There have been laws created, such as the Clean Water Act, that require humans to help keep waterways clean. If actions aren't taken to preserve what Polk County has, then urban growth will completely destroy these natural resources.

There are multiple wooded areas that help clean the air but which are dwindling in numbers due to urban growth.

The soil in Iowa is some of the most fertile soil found in the world. Its contents are due to the processes that the earth has deposited in it and the prairie plants that held the soils down.

Coal was a major resource in Polk County that was excavated in the late 19th century. The coal mines have since been closed up because of the resource being mined and depleted in this location. A remaining coal shaft has caused damage to a Des Moines household when a sinkhole was created and a tree fell in a man's front yard. This is the hook that I will be using to entice students to be interested in the geology unit, as it happened just miles away from where my students go to school.

IX. Geology and Rock Cycle Theme "Why do we have sinkholes in Polk County?"

I teach 7th grade Science, where geology is a unit. This lesson plan could easily be used for middle schoolers.

Student Lesson Plan

To begin the Geology unit, students will start by learning the layers of the earth and about convection. Starting with this specific lesson, we will concentrate on the rock cycle and types of rocks. We would be doing rock labs and identification at this time. Students will become privy to rock identification methods. This will include introduction to Big Idea "The Earth's interior is in constant motion through the processes of convection, with important consequences of the surface." Next, I will give students the map of bedrock in Iowa and chart or Eras and have them compare and contrast the documents. This will first be a table discussion, then a whole class discussion to help guide students toward understanding that there are different layers of bedrock in Iowa and some of the history. They will be reading a short informational piece on how fossil fuels form, so that they can understand the connection between all of these maps, rocks and land that we currently live on. I will be revisiting the question, "Why do we have sinkholes in Polk County?" to get

students trying to make these connections. Next I will introduce the map of coal mines in Iowa and have students compare these with the maps of sinkholes, leading into a discussion of the two types of sinkholes created: coal mines and bicarbonate processes.

**It would be fun to get a guest speaker in class that could expand on one of these minor concepts.

Plan Steps

1. Video on Types of Rocks and Rock Cycle via BrainPop
2. Have students list types of rock, then draw rock cycle in groups on dry erase board
3. Introduce Big Idea
4. Map of bedrock in Iowa and chart of eras
    a. Ask students to compare and contrast the 2 documents (Appendix A and B)
    b. Class discussion about comparison

5. Short reading about how fossil fuels were formed (Appendix C)

6. Ask class "Why do we have sinkholes in Polk County?"
    a. See if students come up with the idea

7. Show map of locations of coal mines in Iowa (Appendix D)
    a. Discuss how they mine: especially shafts

8. Show map of sinkholes in Iowa (Appendix E)
    a. Introduction of sink holes
        i. http://whotv.com/2016/04/13/ground-swallows-up-womans-fence-post-how-to-tell-if-abandoned-mine-under-your-home-like-it-is/
    b. Reclamation
        i. Video
    c. Bicarbonate processes via water
        i. News from sinkholes in Florida

We will be wrapping up the lesson by a discussion of the Big Idea again. I will have students list a few ways that "The Earth's interior is in constant motion

through the processes of convection, with important consequences of the surface" within their group, then share as a class.

My hopes for this unit is that students will get an understanding of how the earth is put together, the recycled processes and how it presents to us on the surface. During the unit, I will be trying to engage the students through various hands on activities and labs.

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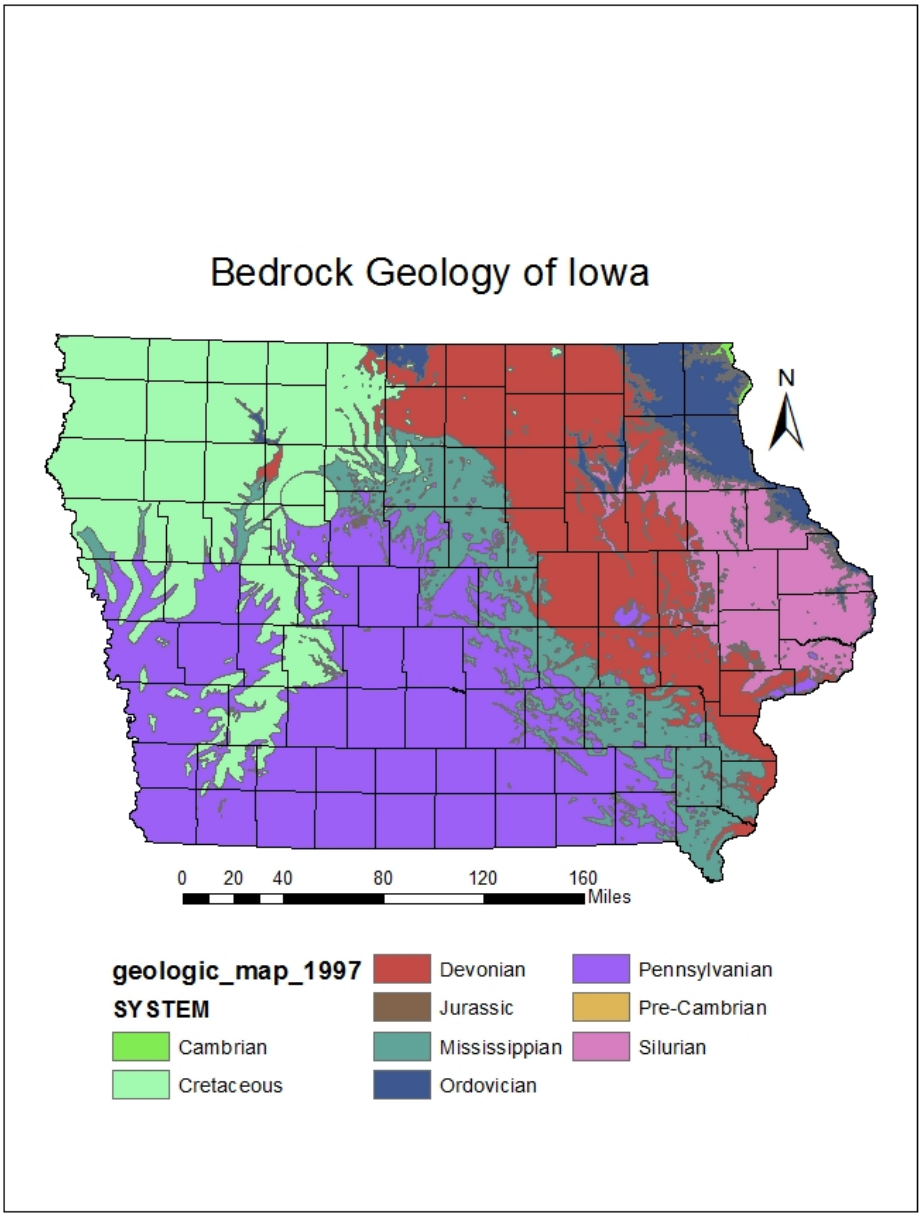
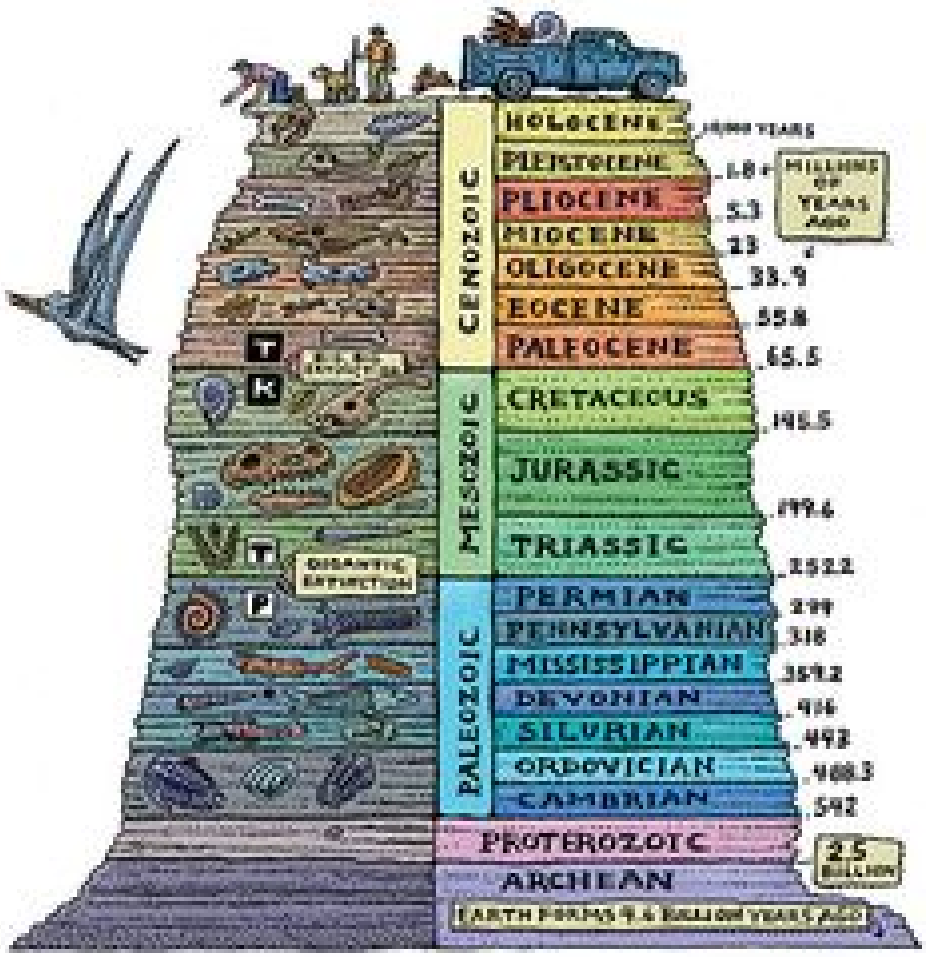
Appendix

A. Map of Bedrock in Iowa



B. Chart of Eras



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C. *How Fossil Fuels were Formed* reading

How Fossil Fuels were Formed

Contrary to what many people believe, fossil fuels are not the remains of dead dinosaurs. In fact, most of the fossil fuels we find today were formed millions of years before the first dinosaurs.

Formation of Coal

Fossil fuels were formed from plants and animals that lived 300 million years ago in primordial swamps and oceans (left). Over time the plants and animals died and decomposed under tons of rock and ancient seas (middle).
Eventually, many of the seas receded and left dry land with fossil fuels like coal buried underneath it (right).
Ten feet of prehistoric plant debris was needed to make one foot of coal.

Fossils Alive
Fossil fuels, however, were once alive!
They were formed from prehistoric plants and animals that lived hundreds of millions of years ago.

Think about what the Earth must have looked like 300 million years or so ago. The land masses we live on today were just forming. There were swamps and bogs everywhere. The climate was warmer. Ancient trees and plants grew everywhere. Strange looking animals walked on the land, and just as weird looking fish swam in the rivers and seas. Tiny one-celled organisms called protoplankton floated in the ocean. When these ancient living things died, they decomposed and became buried under layers and layers of mud, rock, and sand. Eventually, hundreds and sometimes thousands of feet of earth covered them. In some areas, the decomposing materials were covered by ancient seas, then the seas dried up and receded.

During the millions of years that passed, the dead plants and animals slowly decomposed into organic materials and formed fossil fuels. Different types

of fossil fuels were formed depending on what combination of animal and plant debris was present, how long the material was buried, and what conditions of temperature and pressure existed when they were decomposing.

For example, oil and natural gas were created from organisms that lived in the water and were buried under ocean or river sediments. Long after the great prehistoric seas and rivers vanished, heat, pressure and bacteria combined to compress and "cook" the organic material under layers of silt. In most areas, a thick liquid called oil formed first, but in deeper, hot regions underground, the cooking process continued until natural gas was formed. Over time, some of this oil and natural gas began working its way upward through the earth's crust until they ran into rock formations called "caprocks" that are dense enough to prevent them from seeping to the surface. It is from under these caprocks that most oil and natural gas is produced today.

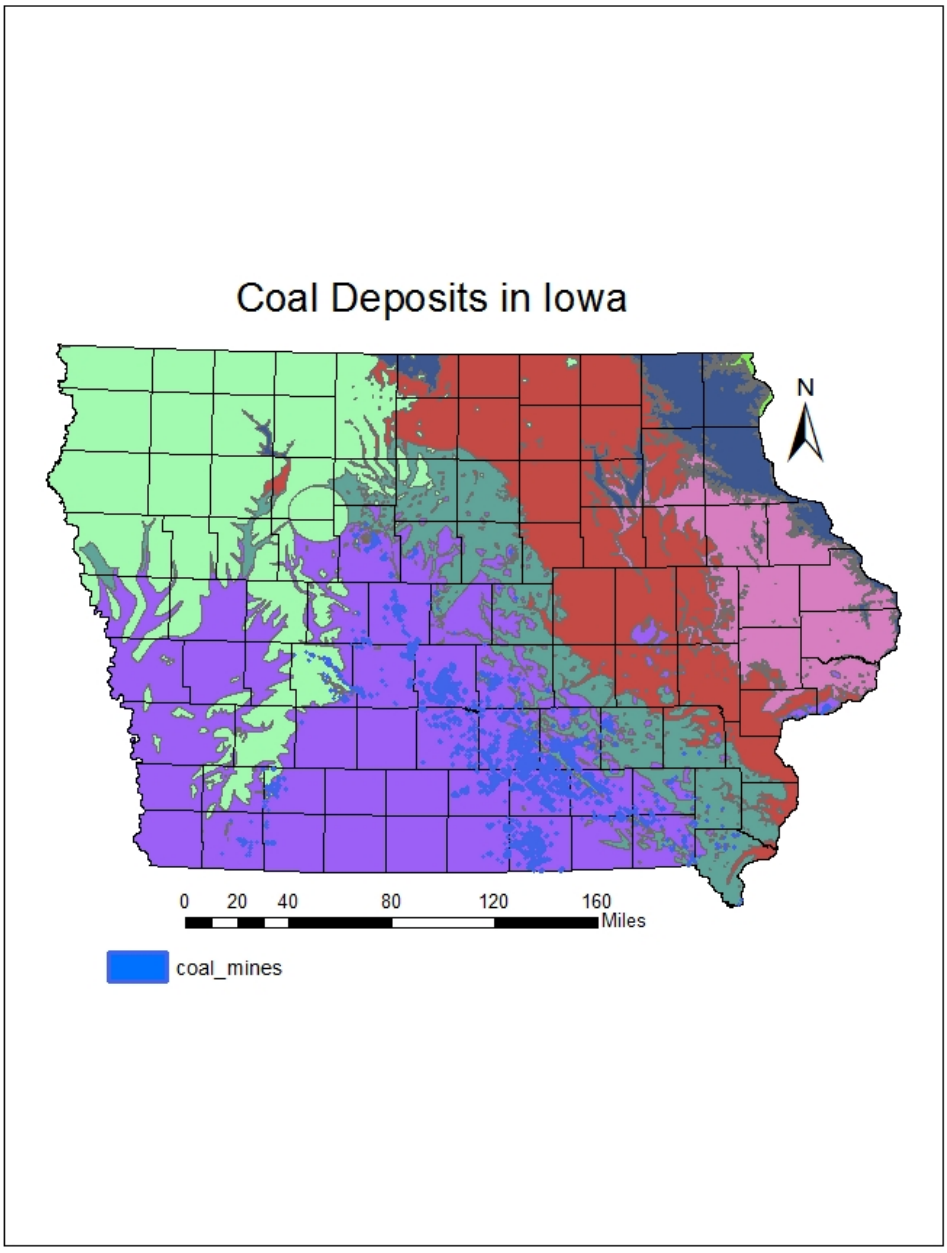
The same types of forces also created coal, but there are a few differences. Coal formed from the dead remains of trees, ferns and other plants that lived 300 to 400 million years ago. In some areas, such as portions of what-is-now the eastern United States, coal was formed from swamps covered by sea water. The sea water contained a large amount of sulfur, and as the seas dried up, the sulfur was left behind in the coal. Today, scientists are working on ways to take the sulfur out of coal because when coal burns, the sulfur can become an air pollutant.

Some coal deposits, however, were formed from freshwater swamps which had very little sulfur in them. These coal deposits, located largely in the western part of the United States, have much less sulfur in them.

All of these fossil fuels have played important roles in providing the energy that every man, woman, and child in the United States uses. With better technology for finding and using fossil fuels, each can play an equally important role in the future.

Accessed online:
http://www.fe.doe.gov/education/energylessons/coal/gen_howformed.html

D. Map of Locations of coal mines in Iowa



E. Map of Sinkhole locations in Iowa