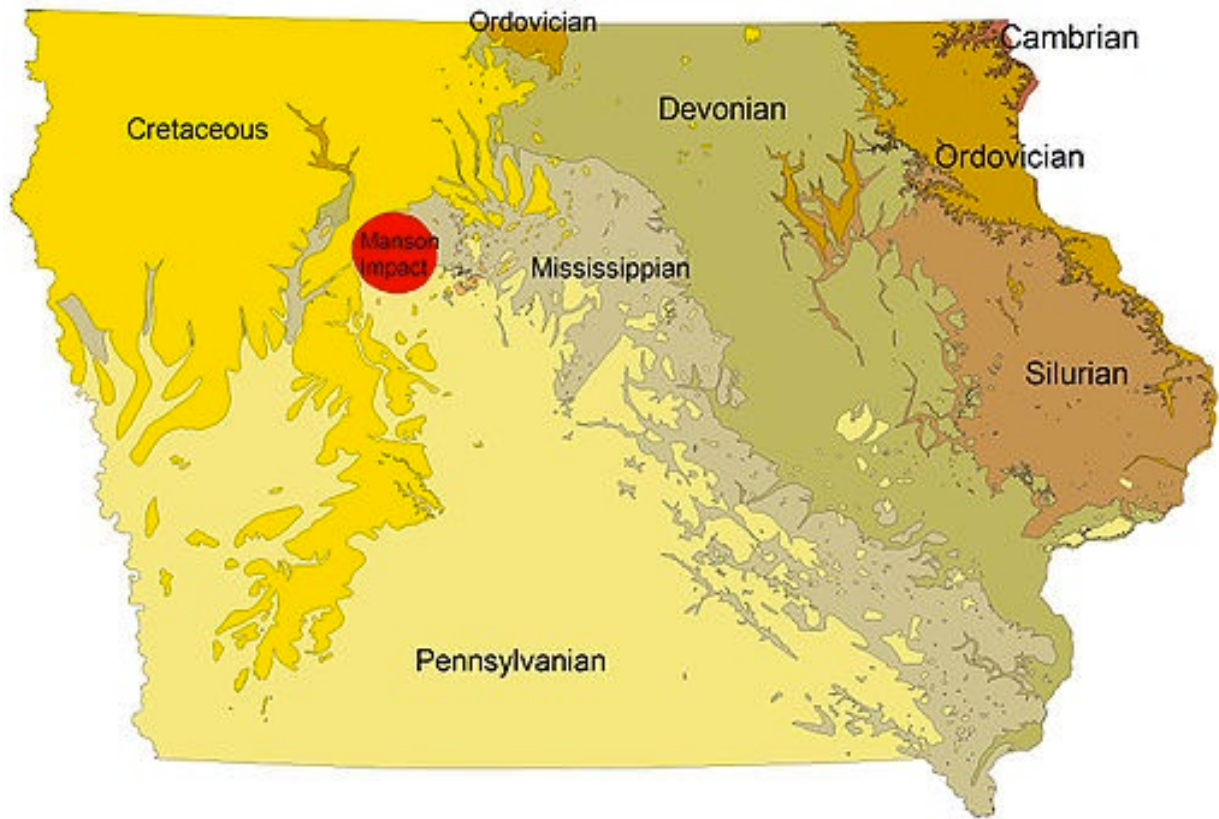


Audrey Nannenga



Exploring Iowa Geology: Geologic Resources of Iowa

Geology of the Manson Impact Structure

Signatures

Audrey Nannenga

Audrey Nannenga

Chad Heinzl

TABLE OF CONTENTS

ABSTRACT..... 4

INTRODUCTION..... 4

SUMMARY OF IOWA’S GEOLOGY..... 8

GEOLOGY OF CALHOUN COUNTY..... 9

NATURAL RESOURCES OF CALHOUN COUNTY..... 11

GEOLOGY APPLICATION TO THE MANSON IMPACT STRUCTURE..... 13

REFERENCES..... 14

Abstract

Calhoun County, located in Northwestern/North Central, is known for its soil, which has resulted in great agricultural success. Natural resources and landscapes are a result of geological processes that occurred over millions of years. The past of Calhoun County displays some of the county's history in more recent years as humans have settled in the area. Calhoun County bedrock is similar to other state patterns, but also has a unique area from the Manson Impact Structure. The geology of the state has changed throughout the years and continues to change as a result of human interactions. Some of these interactions have affected the natural resources found within the county. Through the application of the project, students will learn about a unique geological feature and how it has and continues to affect their community.

Introduction

The Manson Impact Structure is a unique geological formation found in Iowa within Calhoun, Humboldt, and Pocahontas counties. The school district in which I teach and the homes of many of my students lie directly above the impact structure. Although some students are aware of the geological history of the Manson area this activity would provide the opportunity for students to gain a deeper understanding of the previous geologic activity of the area. Students will initially learn about the location of the crater, impact of the meteorite impact on the area and surrounding areas, glacier history, and the craters role in water quality and issues in the Manson area. Students will use GPS units to record the location of important geological features of the Manson Impact Structure. These coordinates will be input a GIS program to connect information on the location. Students

will be able to create maps that connect concepts regarding the crater with specific locations.

Geography

Calhoun County is located in Northeastern/North Central Iowa, shown below (Figure 1). The largest town in the county, Rockwell City, has approximately a population of 2,300. Rockwell City is also the county seat. Manson, the city in which I live, has a population of around 1,900. The third largest city, Lake City, has an approximate population of around 1,900. Other cities in Calhoun County have populations below 1,000 people (2006, Iowa Genealogical Society (IGS)).

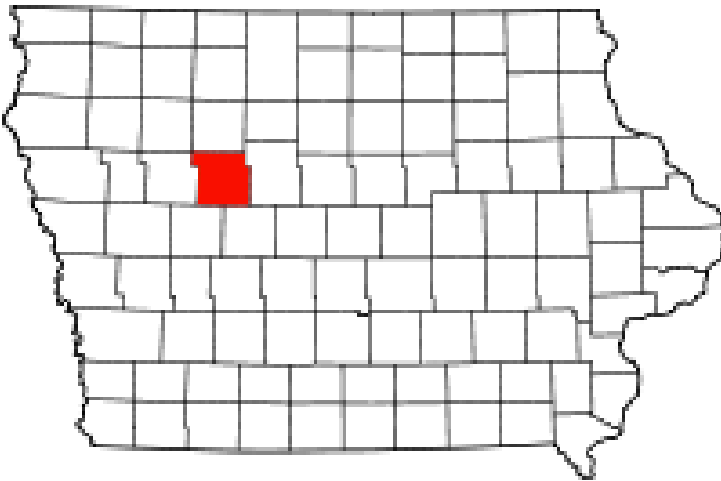


Figure 1. Displays where Calhoun County is located within the state of Iowa. (2016, Calhoun County, Iowa)

Calhoun County is a part of two watersheds: Des Moines River and Raccoon River Watersheds (LaFond, K., 2015). These two watersheds can be viewed in Figure 2 below. A northeastern section of Calhoun County is a part of the Des Moines River Watershed, in which water drains into the Des Moines River. The majority of Calhoun County is a part of

the Raccoon River Watershed. The water in this section of the county drains into the North Raccoon River, which eventually joins the Des Moines River near Des Moines, Iowa.

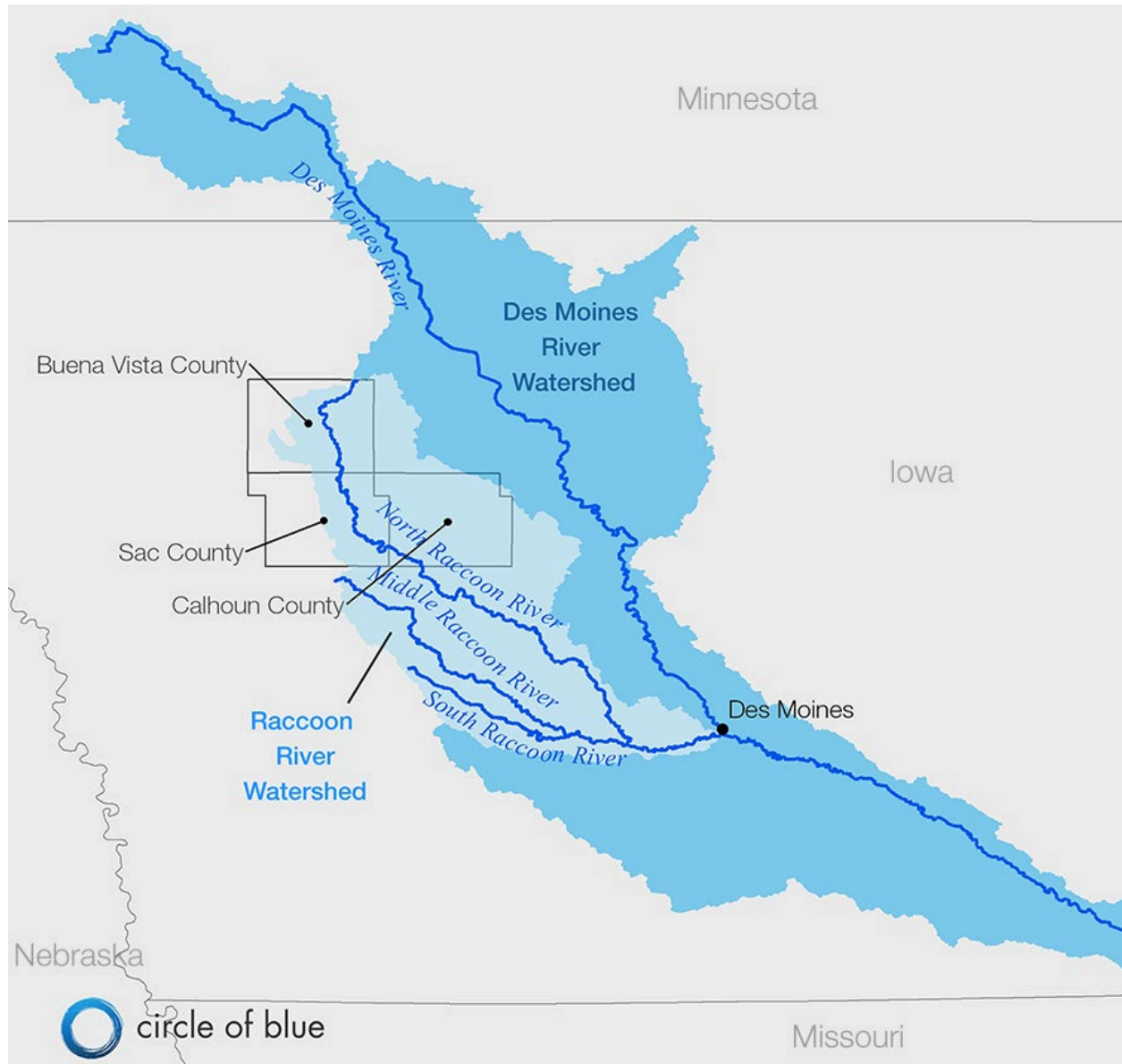


Figure 2. This diagram displays the two main watersheds found within Calhoun County, Iowa. (LaFond, K., 2015)

The soil within Calhoun County is largely used for agriculture. According to the IGS, “at the turn of the 20th century, the digging of ditches and laying of farm drainage tile eliminated wet land unsuitable for growing crops” (2006, Iowa Genealogical Society (IGS)).

This has result in some of the best agricultural land within Iowa. Maintaining the quality of soil is important, as it can also impact the quality of water found in the watershed. Currently Calhoun County is experiencing controversy based on the nitrates from farmland that has entered the watershed and led downstream, impacting the Des Moines Waterworks.

History

Calhoun County, first named Fox County, was mapped in 1851. During the time when the county was formed, Sac and Fox Indians lived in the area. This also explains how the county to the west of Calhoun County got its name. In 1853 the county name was officially changed by legislature to honor John C. Calhoun (United States Vice President). As previously mentioned, Rockwell City is Calhoun County's county seat. The town officially was voted the county seat in 1876. Previously, Lake City was the county seat in 1855 when Calhoun County was officially organized, with a population of less than 100 (2010, Calhoun County Courthouse).

The county's agricultural land was a large draw and significant reason why it was initially settled. According to the IGS, "the first settlers were from states to the east as far as New England... [and] foreign-born groups included Germans, Swedes, Norwegians, Danes, Irish, Hollanders, English, and Czechs" (2006, Iowa Genealogical Society (IGS)). Once the railroad extended from Jefferson to Rockwell City in 1882, there was also a significant amount of settling that took place (2006, Iowa Genealogical Society (IGS)).

Natural resources found in Calhoun County also made it a beneficial place to settle. The watersheds and their quality is an important natural resource (2016, Calhoun County EQIP). One part of the county has a unique form of this resource. There are also two glacial lakes within the county: North and South Twin Lakes. Manson, which lies on top of an

impact structure, has naturally occurring soft water. Calhoun County additionally has great soil, which has led to its agricultural success. The natural plants and vegetation within the county are also natural resources, which also impact wildlife that can be found. The air quality and wind within the county are also of high worth.

Summary of Iowa's Geology

Calhoun County's surficial bedrock, as is of most of Iowa, consists of mostly quaternary period sediments that bury the underlying bedrock. According to Anderson (1999), "throughout most of the state the bedrock is covered by unconsolidated deposits, such as glacial till, sand gravel, and loess" (Anderson, 1999, pg. 2). A significant amount of glacial till continues to cover the Calhoun County area. Specifically above the Manson Impact Structure there is approximately 100 feet of glacial deposits that cover the crater itself (Anderson, 1999, pg. 43). Below the surficial bedrock, the varying patterns of bedrock from many time periods can be observed. Sometimes in areas where the surficial bedrock has been removed, for example streams and quarries, the bedrock can be observed easily.

Iowa as a whole consists of several variations of bedrock. Calhoun County as well consists of several different types of bedrock, as shown in Figure 3. In the northeast corner of the county, the Manson Impact Structure can be found. This has created unique variations of cretaceous bedrock. The mega block zone, crater moat area, and central peak of the crater have different variations of cretaceous bedrock. In central and southern Calhoun County different types of cretaceous bedrock can also be found. A majority of Calhoun County consists of Pennsylvanian bedrock, which covers most of central and southern Iowa (Anderson, 1999, pg. 2-3).

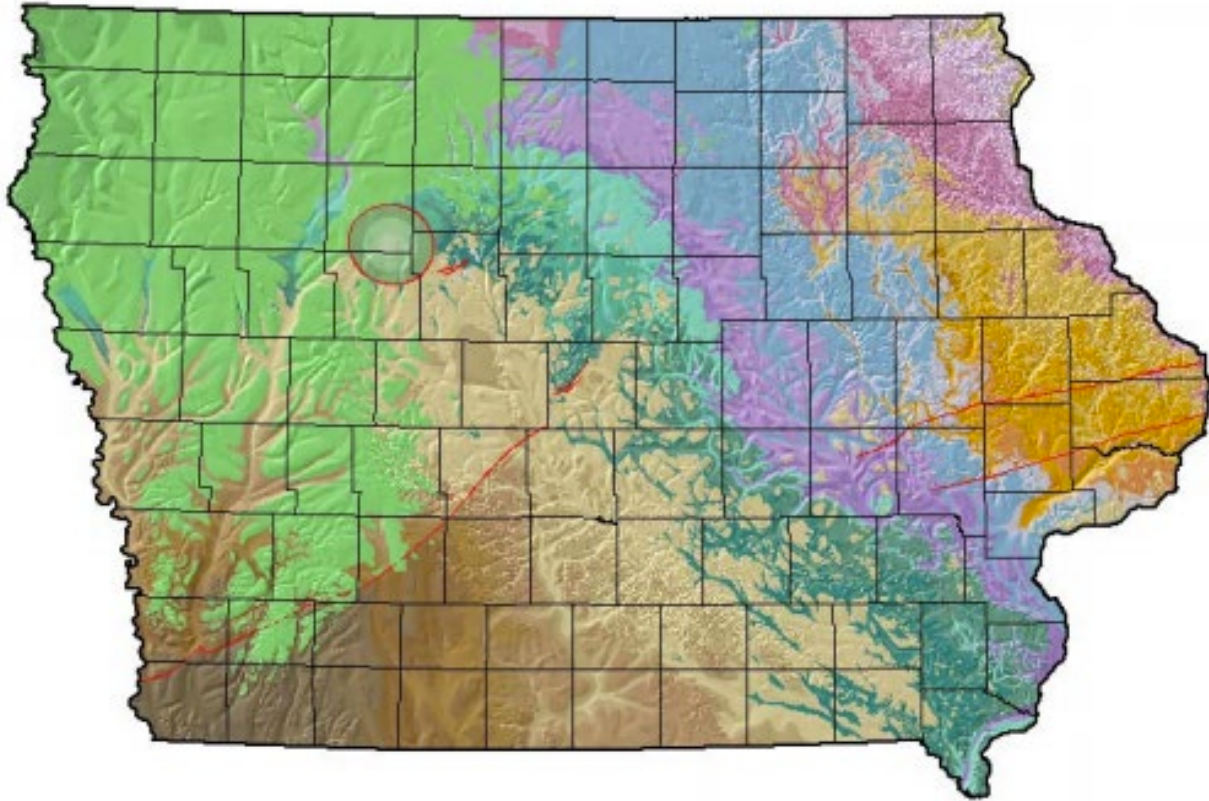


Figure 3. Iowa's bedrock pattern is displayed in this figure. (2004, Iowa Geological Survey, *Bedrock geological map of Iowa*)

Geology of Calhoun County

Bedrock Geology

One of the most well known formations that affected bedrock of the county is the Manson Impact Structure. The structure was formed nearly 74 million years ago. For example, in this area “the Precambrian basement is elevated and occurs directly beneath glacial deposits” (Anderson, 1999, pg. 43). Evidence of this bedrock was observed when wells were dug in the area. Additionally, deformations of the Paleozoic and Mesozoic rocks were observed within the Manson Impact Structure. The shock-formed features found in the Manson area are only identified with meteorite impacts or extraterrestrial bodies. More investigation found shocked quartz grains, which support this unique formation (Anderson,

1999, pg. 43-45). Because of the impact structure, the deposition of various rocks and sediments was disturbed. Implications of the deposition are discussed in the sustainability of resources section.

Fossils

Across the state of Iowa, the most fossils found date back to the Devonian time period, when a shallow sea once covered Iowa. In Pocahontas County, which is north of Calhoun County, corals and crinoid fossils have been found in quarries northwest of Gilmore City (Iowa Geological Survey, 2004). The sea-dwelling organisms that can now be found as fossils can “provide a link between geology and biology that is valuable to the study of global changes and how life adapts” (Prior, 2014). Fossils in general can also be used to help identify an age of the rock layers that they are found within. One of the places most likely to contain Jurassic Period fossils is located to the east of Calhoun County. Fort Dodge, Iowa, within Webster County, contains gypsum formations. According the Iowa Association of Naturalists, “the only fossils within the gypsum formation are conifer pollen and fern spores” (Iowa Association of Naturalists, 1999, pg. 14-15).

Unfortunately, Calhoun County is not well known for fossils. The amount of fossils in the county may be affected by the Manson Impact structure, which occurred after the Devonian period. Additionally, following the impact, the time period to follow resulted in limited fossil formation. Within some rock formations in Calhoun County, limited fossils may be found.

Landform regions and surficial processes

As previously discussed, the meteorite impact formed a significant portion of the landscape of the northeast part of Calhoun County. One of the most misleading parts of the

structure is that it is no longer visible. Glacier advances across Iowa affected our ability to currently view the crater from the surface. The glacial till and sediments, specifically quaternary period sediments, were deposited across the county providing the landscape and soil types we see today (Anderson, 1999, pg. 305).

Natural Resources in Calhoun County

Use of Natural Resources

As previously discussed, Calhoun County has quality natural resources such as water, soil, plants, air and wind. These resources have been used in many ways to help sustain life in the area, as well across the world. The water and soil have been used to support agricultural processes. Quality water is also used for city populations, water sports, and fishing. Natural plants and vegetation are often used as areas for hunting. Although wind may not seem to be a valuable natural resource, in the northern Calhoun County a wind farm or windmills are located.

Natural resources found in Calhoun County also made it a beneficial place to settle. The watersheds and their quality is an important natural resource (2016, Calhoun County EQIP). One part of the county has a unique form of this resource. There are also two glacial lakes within the county: North and South Twin Lakes. Manson, which lies on top of an impact structure, has naturally occurring soft water. Calhoun County additionally has great soil, which has led to its agricultural success. The natural plants and vegetation within the county are also natural resources, which also impact wildlife that can be found. The air quality and wind within the county are also of high worth.

Sustainability of resources

One of the first natural resources of Calhoun County discussed was water. As previously explained, Manson, Iowa has naturally occurring soft water because of the impact structure. Unfortunately the city of Manson is struggling to sustain its unique water. According to Love (2014), “the city’s 1905 well and a nearby 1928 well, both more than 1,200 deep, intersect a series of chaotic rock formations that until the past decade produced ample quantities of soft water” (Love, 2014). The Iowa Department of Natural Resources has alerted city officials of the decreasing supplies provided by the current wells. Concern continues to grow as the water levels decrease, while demand for water and population of Manson increases. Although geologists have stated there is adequate water in the crater, attempts to dig a new well have continued to fail. These attempts cost \$250,000, which in total has cost the city over \$1 million dollars. It will be important for the city of Manson to find a reliable water source in the next 10 years before the current wells run dry.

The quality of water in Calhoun County has also been quite controversial. The two glacial lakes, North and South Twin Lakes, often are not acceptable to swim or fish in. According to CBC online (2016), “the two Calhoun County bodies of water are currently listed on the state’s List of Impaired Waters and the overall goal is to remove them from that list and also improve the recreational opportunities at both lakes” (CBC online, 2016). Previous investigations by the DNR suggested that run off might have affected the water quality and bacterial levels. Runoff has also been to blame for the current controversy of nitrate levels found downstream. Eller (2016) explains how Calhoun County is a part of the “Des Moines Water Works' water-quality lawsuit, arguing in part that the drainage districts being sued contribute little of the high nitrate levels the utility has been forced to remove”

(Eller, 2016). These water quality issues may jeopardize the sustainability and quality of the water in Calhoun County.

Perhaps one of the most sustainable natural resources in Calhoun County is the wind. Current wind turbines in northern Calhoun County have provided energy for surrounding counties. The 13 wind turbines were built in 2011 and went online in 2012, according to Burns (2010). The wind farm will continue to provide sustainable energy for the area for many years to come.

Geology Application to the Manson Impact Structure

One of the most unique geology formations within Calhoun County and Iowa is the Manson Impact Structure. Previous to the implementation of my project I plan on going more in depth with students about the structure and its impression on our community. First, students need to understand its influence on the bedrock and geology in the area. Students must be able to explain how this is different than other parts of the county and state. Students will apply their understanding of geological processes that change the surface of the Earth to explain processes that have shaped the Manson Impact Structure. Many students have a misconception that the crater remains visible from the surface. Applying these processes may help students form conclusions as to why it is no longer visible. Students will also gain a deeper understanding of the natural resources and issues that have arose because of the crater. These previous topics are discussed at limited amounts currently, but will help students gain a deeper understanding of the importance of our project.

I will have students gather information regarding the location of the Manson Impact Structure. Students will first record some of the locations around Manson and the county

that were discussed. Some of these locations may include the Water Treatment Plant, locations of the two working wells, locations of the failed well sites, city hall, the water tower, and distance from the crater that would have been affected by the impact. With collaboration of a district Math teacher, students will calculate the center of the crater. Students will then locate major roadways that intersect the outer boundary of the crater and are nearest to the calculated center of the crater. These areas and the other locations students designated will be entered with information into GIS mapping tools. The locations marked on roadways will hopefully be used as possible areas to create signs that designate that people are entering the Manson Impact Structure and that they are at the center of the crater. Although the crater is not fully visible, it can help the community and visitors understand where the crater is underneath them.

References

- (1999). Iowa geology and fossils. *Iowa Association of Naturalists*. Retrieved from <https://store.extension.iastate.edu/Product/ian702-pdf>
- (2004). Bedrock geological map of Iowa. *Iowa Geological Society*. Retrieved from https://s-iihr34.iihr.uiowa.edu/publications/uploads/ofm-2010-01_txt.pdf
- (2004). Fossil collecting areas of Iowa. *Iowa Geological Society*. Retrieved from <https://s-iihr34.iihr.uiowa.edu/publications/uploads/Em-04.pdf>
- (2006). Calhoun county, Iowa. *Iowa Genealogical Society (IGS)*. Retrieved from <http://www.iowapioneers.com/County%20Guides/CalhounCoGuide.htm>
- (2010). History. *Calhoun County Courthouse*. Retrieved from <http://www.calhouncountyiowa.com/history.htm>

- (2016). Calhoun county EQIP. *United States Department of Agriculture: Natural Resources Conservation Service*. Retrieved from http://www.nrcs.usda.gov/wps/portal/nrcs/detail/ia/programs/financial/eqip/?cid=nrcs142p2_007989
- (2016). Calhoun county, Iowa. *Wikipedia*. Retrieved from https://en.wikipedia.org/wiki/Calhoun_County,_Iowa
- Anderson, W.I. (1998). Iowa's geological past: Three billion years or change. University of Iowa Press: Iowa City, IA.
- Burns, D. Wind project brings 13 turbines to Calhoun County. *Daily Times Herald*. Retrieved from <http://carrollspaper.com/Content/Local-News-Archive/Business/Article/Wind-project-brings-13-turbines-to-Calhoun-County/1/20/11454>
- Eller, D. (2016). Counties argue water quality not their fault seek dismissal. *The Des Moines Register*. Retrieved from <http://www.desmoinesregister.com/story/money/agriculture/2016/04/22/counties-argue-water-quality-not-their-fault-seek-dismissal/83307838/>
- LaFond, K. (2015). Des Moines water utility to file nitrate pollution lawsuit. *Circle of Blue*. Retrieved from <http://www.circleofblue.org/2015/world/des-moines-water-utility-file-nitrate-pollution-lawsuit/>
- Love, O. (2014). Town of Manson tries to save soft water. *The Gazette*. Retrieved from <http://www.thegazette.com/subject/news/town-of-manson-tries-to-save-soft-water-20140525>
- Prior, J.C. (2014). Fossils in Iowa. *Iowa Geological Survey*. Retrieved from <http://www.iihr.uiowa.edu/igs/fossils-in-iowa/>