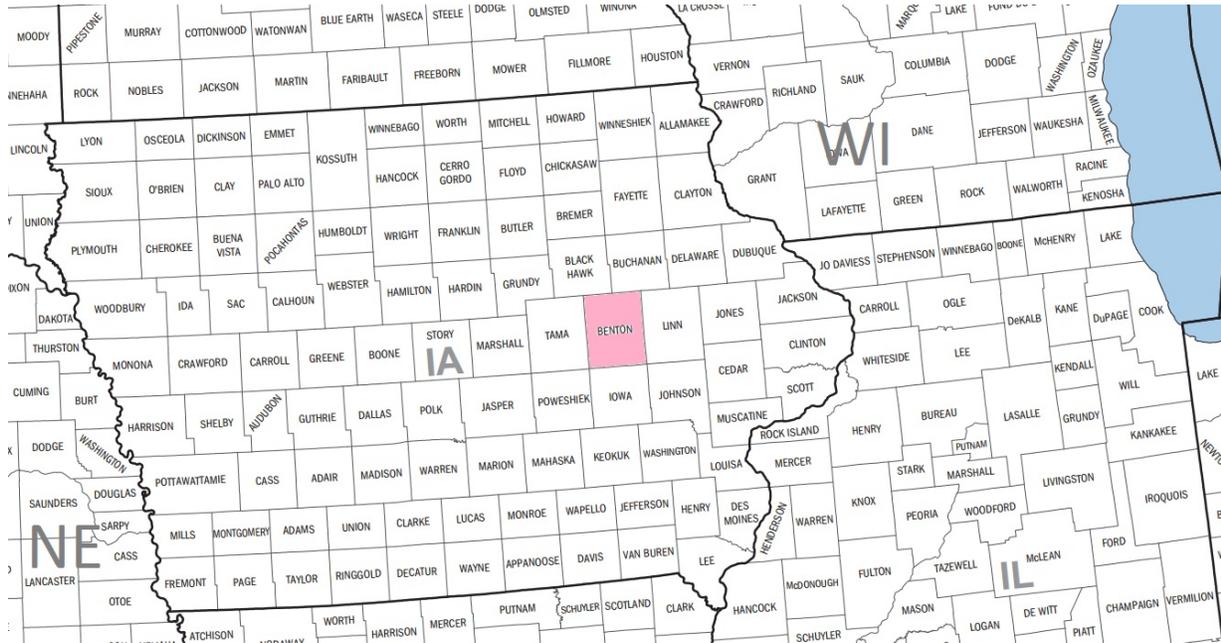


University of Northern Iowa

The Geology of Benton County, Iowa

A paper on the geologic history, bedrock, landforms, natural history, and economic geology of Benton County, Iowa



Jordan Evans

Chad Heinzl

Geology of Iowa

4/27/16

Signature Page

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Abstract

The geology of Iowa may not seem very interesting at first. But it's actually pretty diverse. Iowa is full of marine fossils, good soil, rolling hills, agriculture, and many more compelling topics of discussion that makes our home great. My home of Benton county is one of the largest counties in the state, and is full of geologic and historical information that gives clues to what Iowa looked like in the past. In this report there is data and information about topics such as; geologic history, natural resources, bedrock geology, landforms, geography, history of the county, and how economic geology plays a key role in how the state and the county functions as a whole.

Introduction

A lot of people just go about their day without knowing anything about the world around us. They just walk around in their own little world without a clue on the magnificent things there are on this planet. And people in Iowa are no different. Sure,

we have the farmers who probably know quite a bit about the soil, but that is probably the extent of their knowledge. The people that really know what is going on is the scientists. The best out of those being Chad Heinzl. Iowa is actually extremely diverse in its bedrock and landscapes, all you have to do is get off the interstate. In the following report, I would like to share the discoveries that I found while conducting research on Benton county Iowa to better help the education of students and teachers that are interested in the geology of Iowa. This project is mainly focused to high school to lower level college students that wish to explore the world around them and get some real experience in the geologic field and that are interested in the earth and environmental sciences and especially want to know what Iowa is like geologically. This is going to ROCK.

Benton County

Benton County Iowa is located in Eastern Iowa (shown below). It has mostly Devonian bedrock with a little Pennsylvanian and Silurian. My hometown of Shellsburg, Iowa is part of the Devonian section.

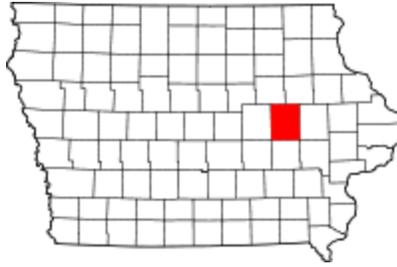


Figure 2. Benton county in respect to the state of Iowa

Benton County was formed on December 21, 1837 from sections of Dubuque County. It was named after Thomas Hart Benton, lawyer, colonel in the War of 1812, and Senator from Missouri for a period of 30 years. The Benton County Courthouse, located in Vinton, was built in 1906. It was listed on the National Register of Historic Places in 1976 as a part of the County Courthouses in Iowa Thematic Resource.

The population 26,076 as of the 2010 census and it contains about 718 square miles, 716 sq. miles or that is land and the other 2 sq. miles is water.

The main river in Benton County is the Cedar river. It's 338 miles long starting in Minnesota and flowing into the Iowa river and then into the Mississippi river. Multiple larger Iowa cities are based around the Cedar river including; Waverly, Cedar Falls, Waterloo, Vinton, and Cedar Rapids.

The main watersheds of Benton County are the Middle Cedar watershed and the Middle Iowa watershed, with the majority of the county dominated by the Middle Cedar.

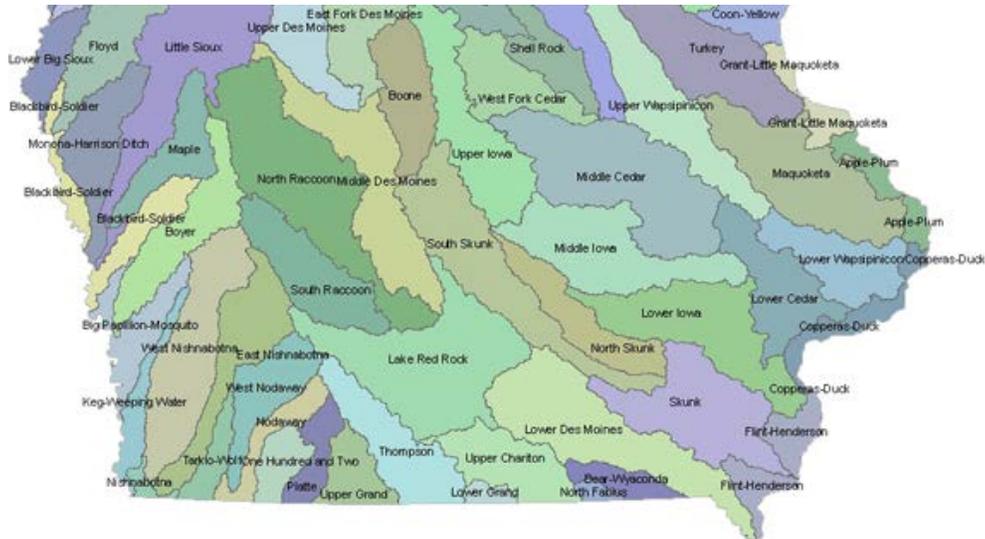


Figure 3:

Main watersheds of Iowa.

Aerial View of Benton County



Figure 4: An aerial view of the three main drainage systems of Benton County; the Wapsipinicon River, the Cedar River, and the Iowa River.

Benton County with Respect to the State of Iowa

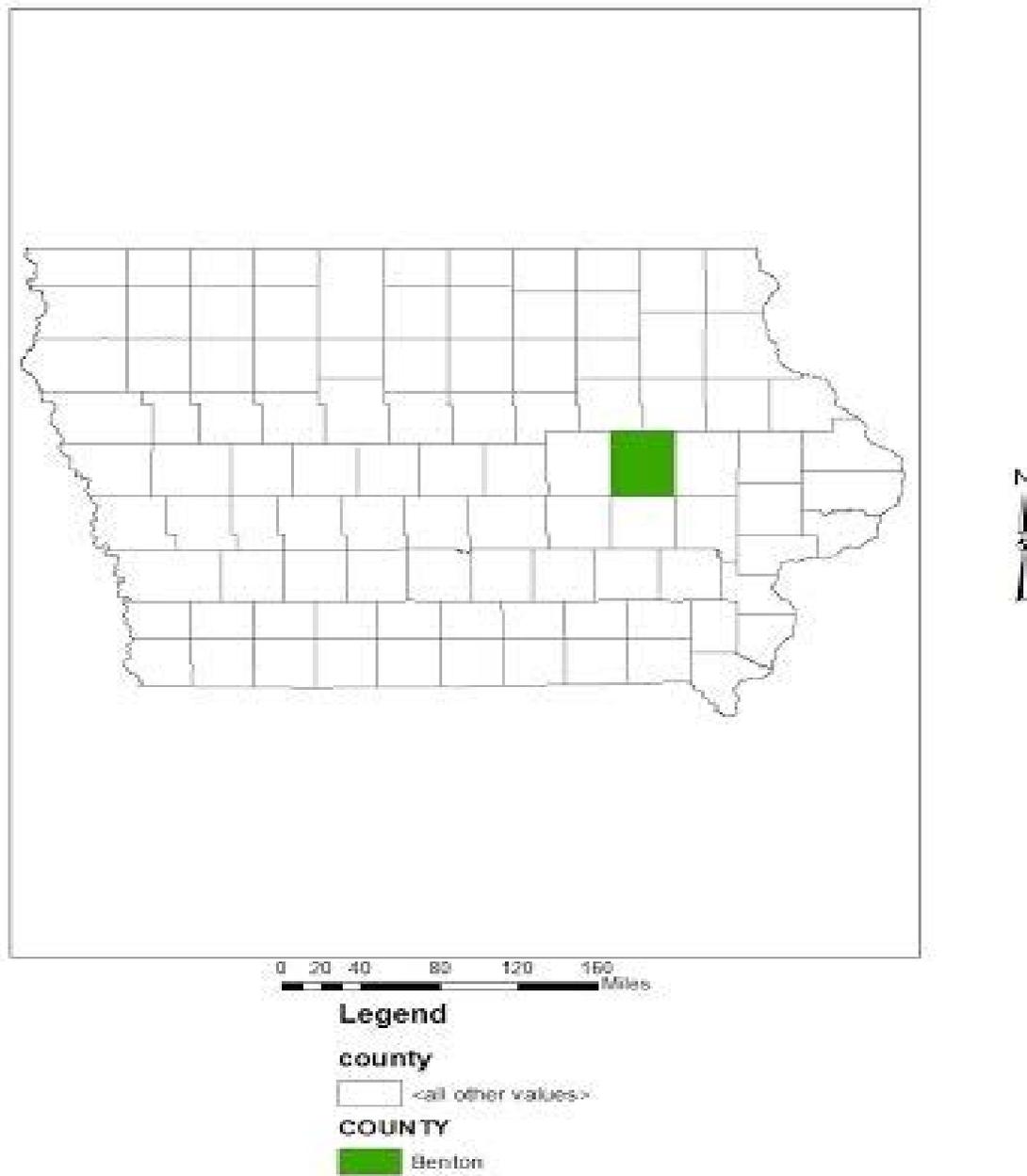


Figure 5: Benton county as respect to Iowa as a whole.

Summary of the Geology of Iowa

Iowa is rich in sedimentary rocks. The primary rock types that make up Iowa are limestone, dolomite/dolostone, and gypsum. Just about anywhere you can go you can find those three. There's a wide range of differing ages amongst Iowa's bedrock.

The very northwest corner of Iowa is a tiny sliver of Precambrian Sioux Quartzite. This is the end of a rock body that reaches up into Minnesota and South Dakota. Its primary uses were in construction and it's now being made into countertops.

In the very northeast corner of the state is some Cambrian age bedrock. Also in the northwest section of Iowa is a larger section of Ordovician bedrock.

The "nose" of Iowa as they call it is made of Silurian bedrock. It is to the far east ranging to the northwest of Iowa.

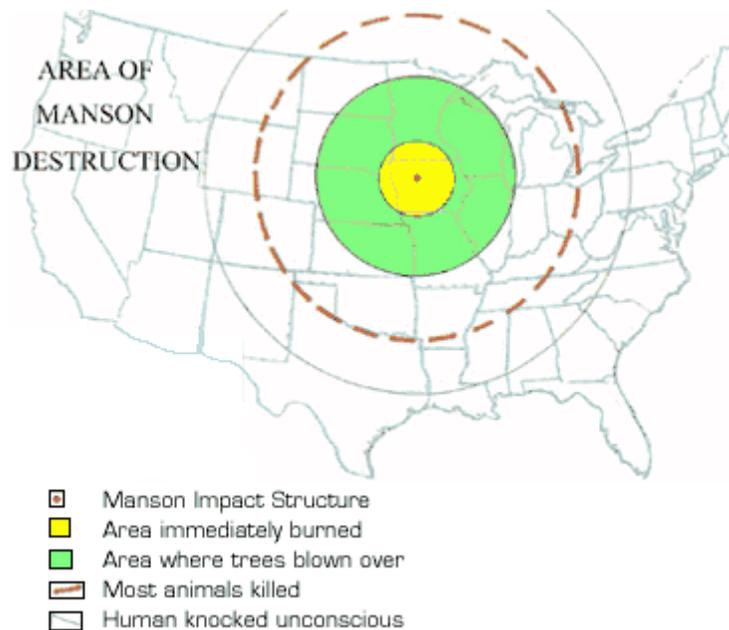
One of the largest sections of bedrock is Iowa's Devonian. It ranges from northcentral Iowa down to southeast Iowa.

The biggest section of bedrock is of Carboniferous age. It's mostly made up of Pennsylvanian with a strip of Mississippian to the east of it. This bedrock makes up over half of the state.

The rest of the bedrock is made up of a tiny section of Jurassic age in central Iowa and Cretaceous that makes up most of the northwest corner of Iowa. The Cretaceous aged bedrock has a "tail" that reaches down the west side of Iowa down to southern Iowa.

All of the different sections of bedrock have a northwest to southeast trend.

Iowa's bedrock contains two known impact structures. The main one being the Manson impact structure in Manson Iowa. The meteorite was said to be about 1.2 miles in diameter and left a crater about 24 miles in diameter. It struck earth during the Cretaceous period 74 Ma. The impact caused the underlying bedrock to be pushed

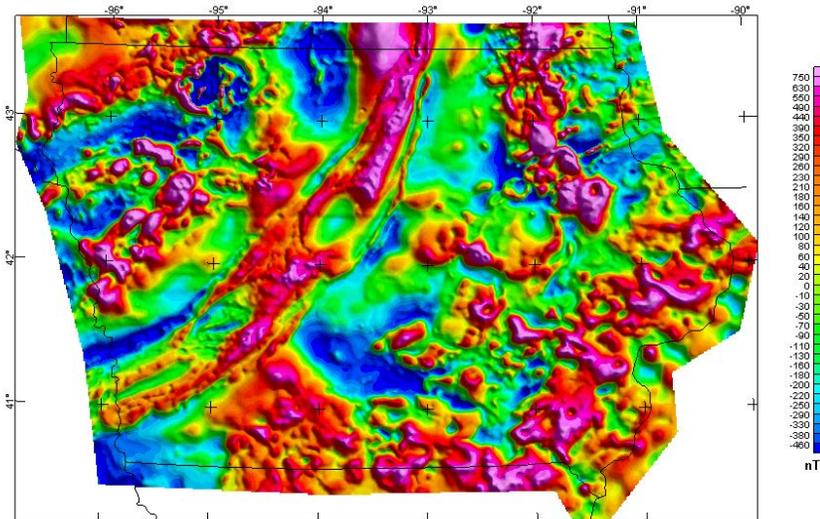


down several hundred feet.

Figure 6: Area of Destruction of the Manson Impact Structure

The other impact structure is located in Decorah. Basically the entire town of Decorah lies on top of this impact crater. This structure was much more recently found. It was made by a meteorite about 200 meters in diameter. It occurred during the Middle Ordovician. The impact pushed down the underlying layers of bedrock several hundred feet, but did not quite reach the mantle.

Deeply buried under Iowa's bedrock lies the mid continent rift system. This is a billions of years old fault scar that extends from Kansas to Lake Superior. It is about 2,000 feet wide. Iowa has practically no seismic activity and is one of the most stable states in the country. The rift was formed when the continent's core, the North American craton, began to split during the Mesoproterozoic era (precambrian), about 1.1 billion years ago. The rift failed, leaving behind thick layers of rock that are exposed in its northern reaches, but buried beneath later sedimentary formations along most of its



western and eastern arms.

Figure 7: A magnetic view of the Mid Continent rift system curving through the center of the state.

The state rock of Iowa is the Geode. Just about every school child knows what a geode is and that if you break it open, sparkly wonder awaits inside. They are

abundantly found in southeast Iowa and range from pink to gray in color. They are extremely common in Geode State Park in Henry county.

There are eight different landforms that make up Iowa's surficial geology. They are the Paleozoic plateau, also known as the Driftless Area, is a region of scenic, high relief landscapes with features such as resistant, bluff-forming bedrock outcrops, deep V-shaped valleys, caves, springs, and sinkholes.

The Des Moines Lobe, often called the Prairie Pothole Region, was glaciated up until 12,000 years ago during the Wisconsin glaciation. The area is marked by rolling terrain and ridges. Historically, this area was spotted with interconnected swamps, but most of which were drained for farmland. The Iowa Great Lakes occur along the western edge of the Des Moines lobe.

The Southern Iowa drift plain, covers most of the southern half of Iowa. This is probably the most familiar landscape to travelers, since most of Interstate 80 in Iowa runs through the southern Iowa drift plain. The classic Iowa landscape, consisting of rolling hills of Wisconsin-age loess on Illinoian till.

The Southern Iowa drift plain is some of the most productive agricultural land in the world.

The Mississippi alluvial plain generally has level areas of stream terraces, paleochannels, backwater sloughs, and oxbow lakes.

The Loess Hills consist of very thick deposits of loess in western Iowa that was deposited during the Wisconsin and Illinoian periods. It is highly eroded leaving stark, beautiful "golden hills".

The lowan surface in northeast Iowa is covered with eroded Illinoian till and moderate loess formation, usually in the form of paha's. It's mostly flat except for steep rolling hills near river valleys and deeper valleys.

The Northwest Iowa plains are rolling hills consisting of eroded soils developed since pre-Wisconsinan glaciation, but with significant amounts of loess.

And finally, the Missouri alluvial plain is the only truly flat region of Iowa, and contains areas of terraces, sloughs, and oxbows. Its valley trench is not as deep as the Mississippi River system, and the Missouri River is held in a much narrower channel.

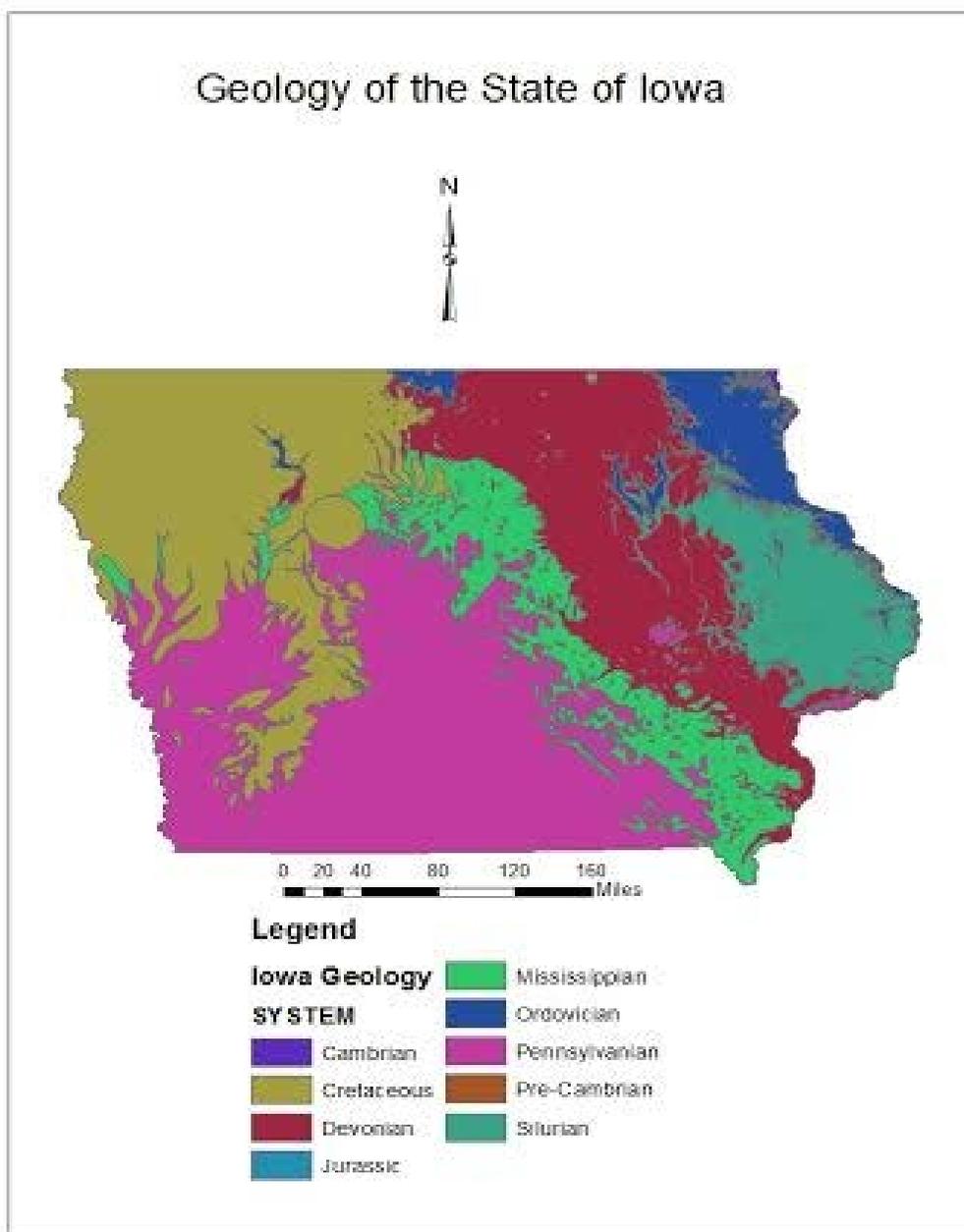


Figure 8: Bedrock of the state of Iowa based on age.

Landforms of the State of Iowa

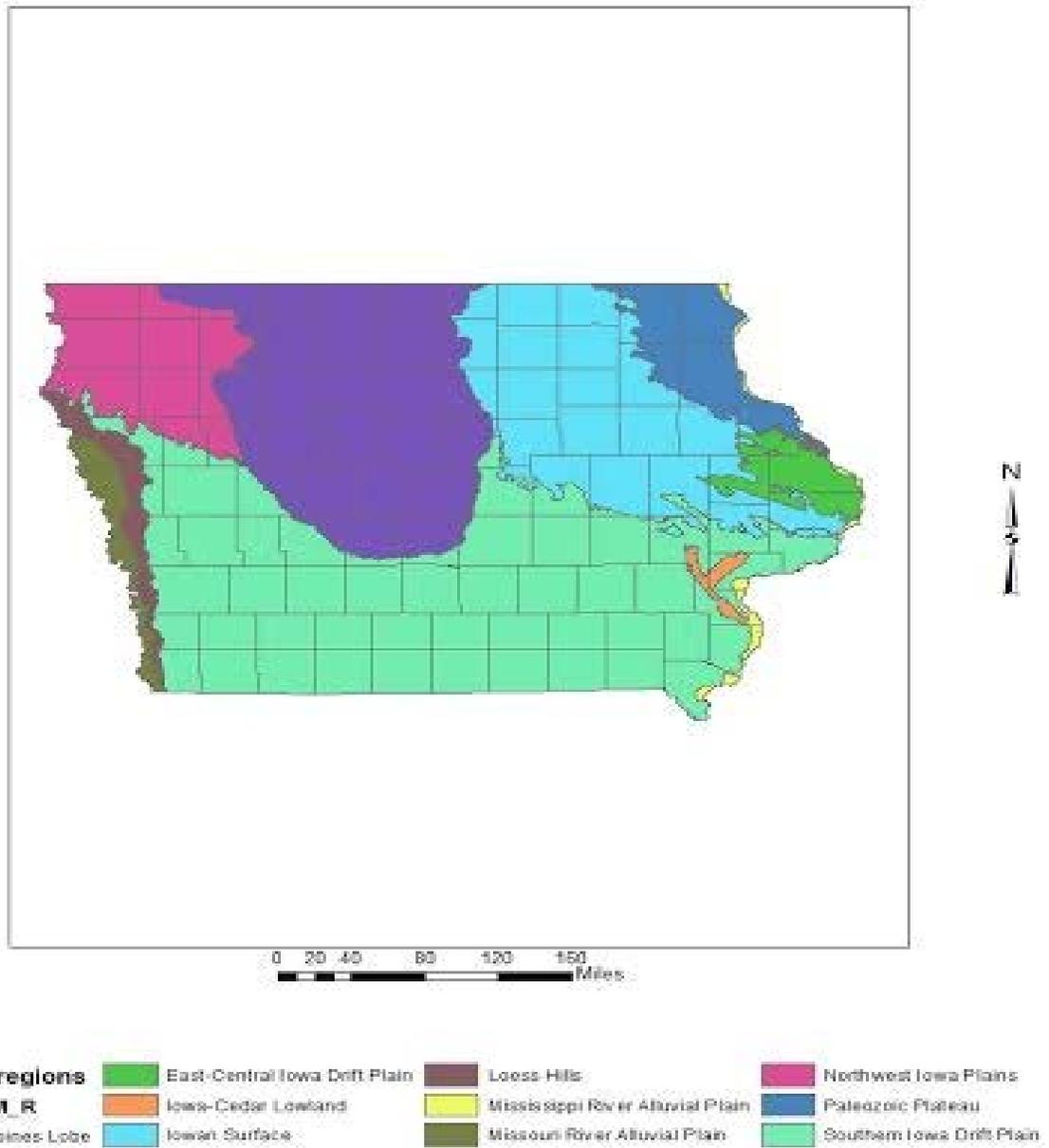
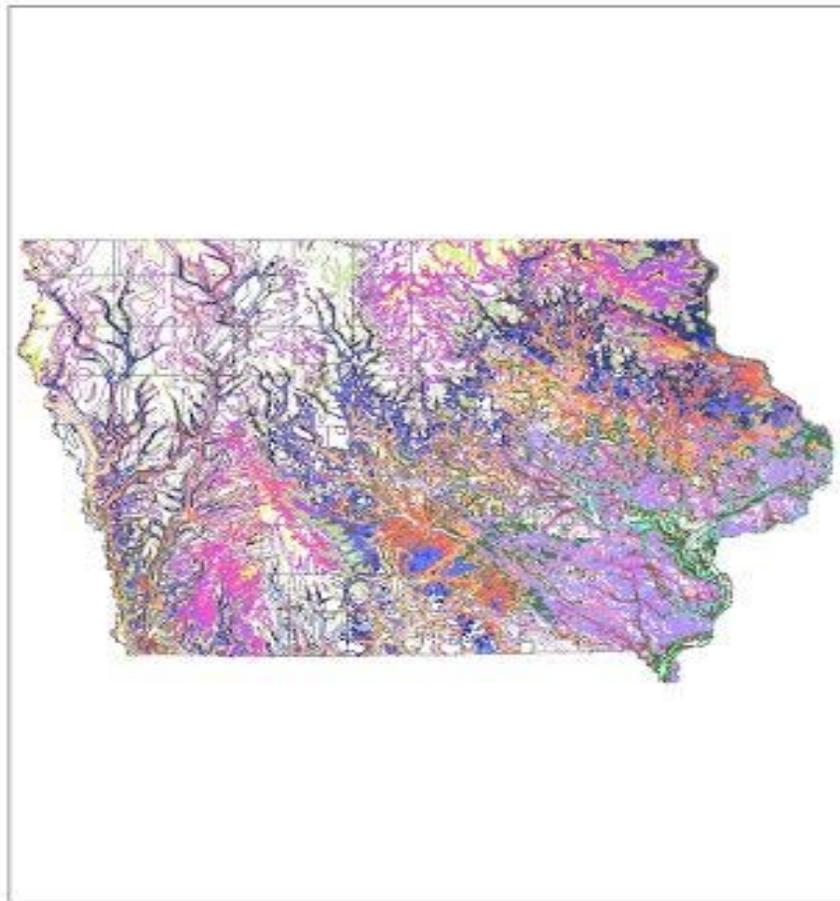


Figure 9: Landforms areas of the state of Iowa.

Bedrock Topography of Iowa



Legend

Bedrock_topography	— 400	— 650	— 900	— 1150
CONTOUR	— 450	— 700	— 950	— 1200
— 250	— 500	— 750	— 1000	— 1250
— 300	— 550	— 800	— 1050	— 1300
— 350	— 600	— 850	— 1100	— 1350

Figure 10: Bedrock topography of the state of Iowa made of contours.

Soil Series of Northwest Iowa

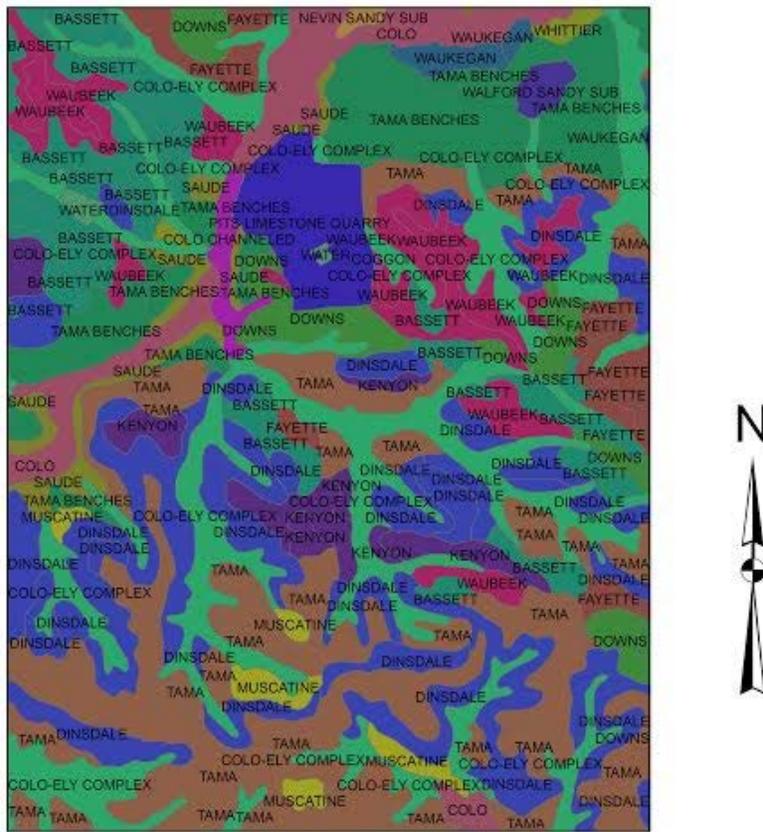


Figure 11: Northwest Iowa soil series parcel.

Soil Series of Northeast corner of Iowa

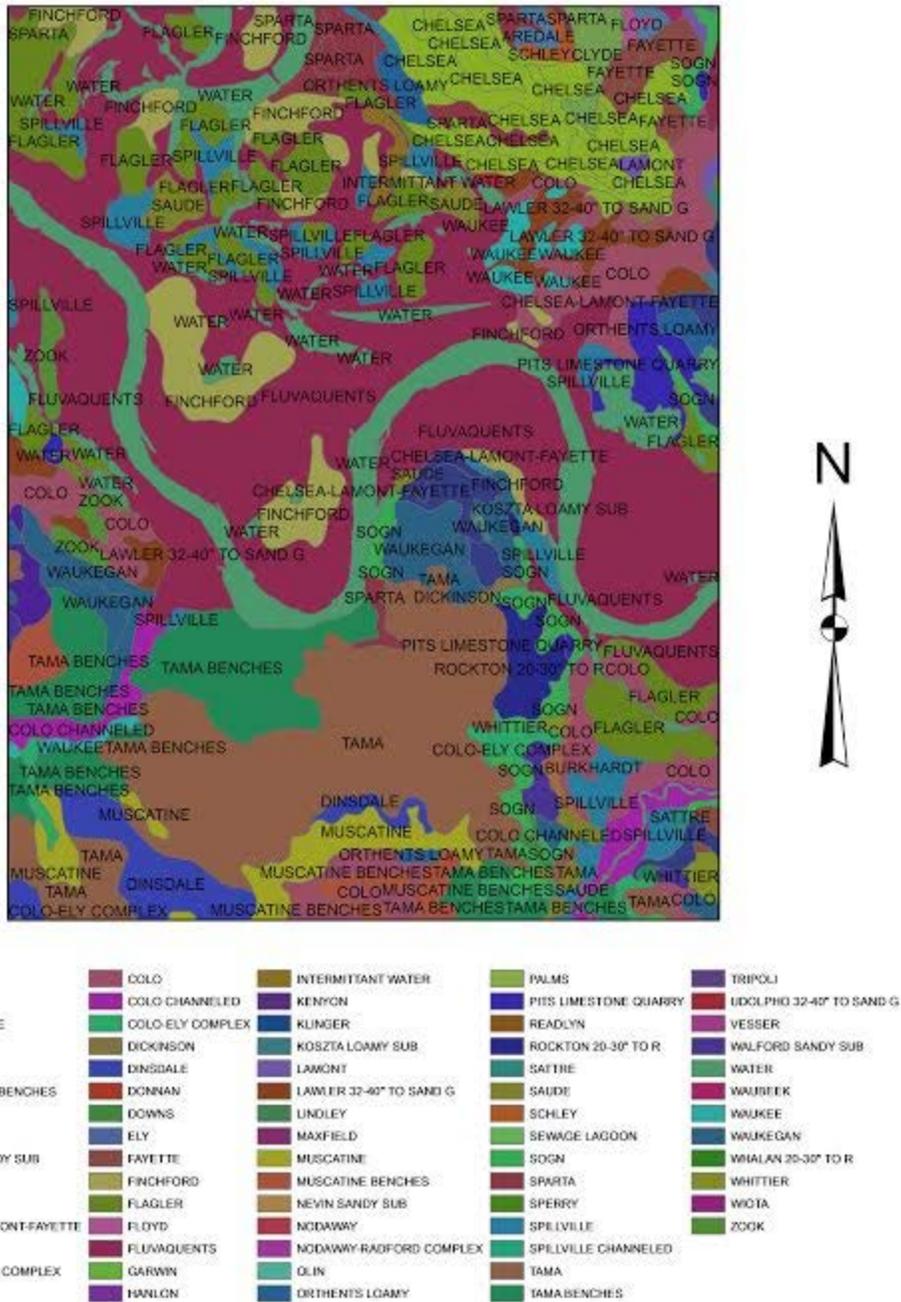
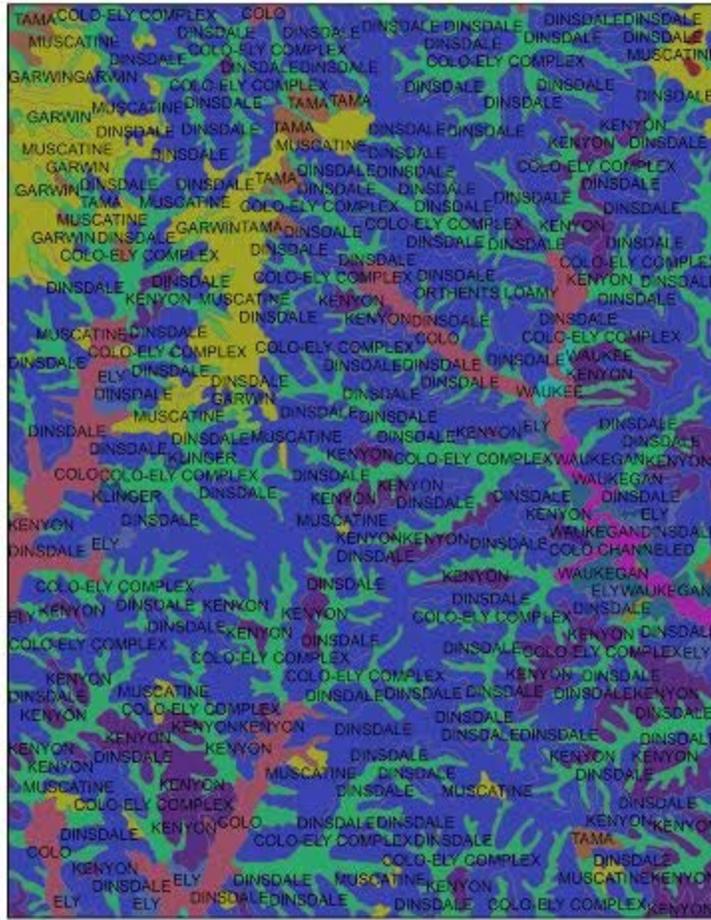


Figure 12: Northeast Iowa soil series parcel.

Soil Series of Southeast Iowa



Legend

ssurgo_soil_06

SOILSERIES

ANIMAL WASTE	COLO	INTERMITTANT WATER	PALMS	TRIPOLI
AREDALE	COLO CHANNELED	KENYON	PITS LIMESTONE QUARRY	UDOLPHO 32-40" TO SAND G
ATTERBERRY	COLO-ELY COMPLEX	KUNGER	READLYN	VESSER
ATTERBERRY BENCHES	DICKINSON	KOSZTA LOAMY SUB	ROCKTON 20-30" TO R	WALFORD SANDY SUB
BACKBONE	DINSDALE	LAMONT	SATTRE	WATER
BASSETT	DONNAN	LAWLER 32-40" TO SAND G	SAUDE	WAUBEEK
BREMER SANDY SUB	DOWNS	LINDLEY	SCHLEY	WAUKEE
BURKHARDT	ELY	MAXFIELD	SEWAGE LAGOON	WAUKEGAN
CHELSEA	FAYETTE	MUSCATINE	SOGN	WHALAN 25-30" TO R
CHELSEA-LAMONT-FAYETTE	FINCHFORD	MUSCATINE BENCHES	SPARTA	WHITTIER
CLYDE	FLAGLER	NEVIN SANDY SUB	SPERRY	WOTA
CLYDE-FLOYD COMPLEX	FLOYD	NODAWAY	SPILLVILLE	ZOOK
COGON	GARWIN	NODAWAY-RADFORD COMPLEX	SPILLVILLE CHANNELED	
	HANLON	OLIN	TAMA	
		ORTHENTS LOAMY	TAMABENCHES	

Figure 13: Southeast Iowa soil series parcel.

Soil Series of Southwest Iowa



Legend

ssurgo_soil_06

SOILSERIES

ANIMAL WASTE	COLO	INTERMITTANT WATER	PALMS	TRIPOLI
AREDALE	COLO CHanneLED	KENYON	PITTS LIMESTONE QUARRY	UDOLPHO 32-40" TO SAND G
ATTERBERRY	COLO-ELY COMPLEX	KLINGER	READLYN	VESSER
ATTERBERRY BENCHES	DICKINSON	KOSZTA LOAMY SUB	ROCKTON 20-30" TO R	WALFORD SANDY SUB
BACKBONE	DINSDALE	LAWONT	SATTRE	WATER
BASSETT	DONNAN	LAWLER 32-40" TO SAND G	SAUDE	WAUBEEK
BREMER SANDY SUB	DOWNS	LINDLEY	SCHLEY	WAUKEE
BURKHARDT	ELY	MAXFIELD	SEWAGE LAGOON	WAUKEGAN
CHELSEA	FAYETTE	MUSCATINE	SOGN	WHALAN 20-30" TO R
CHELSEA-LAMONT-FAYETTE	FINCHFORD	MUSCATINE BENCHES	SPARTA	WHITTIER
CLYDE	FLAGLER	NEVIN SANDY SUB	SPERRY	WIOTA
CLYDE-FLOYD COMPLEX	FLOYD	NODAWAY	SPILLVILLE	ZOOK
COGGOON	FLUVAQUENTS	NODAWAY-RADFORD COMPLEX	SPILLVILLE CHanneLED	
	GARWIN	OLIN	TAMA	
	HANLON	ORTHENTIS LOAMY	TAMA BENCHES	

Figure 14: Southwest Iowa soil series parcel.

Specific Geology of Benton County

Benton county is primarily made up of devonian bedrock with a little of pennsylvanian and silurian.

There is very little Silurian bedrock that reaches into benton county. The limestone formation that is present is the La Porte City formation. The plum river fault zone offsets Silurian bedrock in eastern Iowa. The rest of Iowa's Silurian bedrock is made up of dolomite.

Pennsylvanian bedrock is a little more present than Silurian in Iowa. There's a small area of the Des Moines supergroup in the southern part of the county. It is a member of the Cherokee group. The Cherokee group displays an increase in marine sedimentation. Coal are also present throughout the Cherokee group. Other rocks that make up the Cherokee group are; sandstone, shale, limestone, mudstone, and siltstone.

Benton county is dominated by Devonian bedrock. And in particular, the Cedar Valley group and the Bertram/ Otis and Spillville formations. The Bertram formation is a fossiliferous dolomite. The presence of bird's-eye structures suggests episodes of exposure to the atmosphere. The Otis formation overlies the Bertram formation where it reaches a maximum thickness of 50 feet. The Otis formation consists of limestone and dolomite. The Spillville formation is also a fossiliferous dolomite.

All of these different bedrocks were deposited in a marine environment when Iowa was still covered in a shallow sea. That is easily deduced by looking at the fossils found in them. Almost every organism is marine based. You can find brachiopods,

solitary and colonial corals, trilobites, crinoids, gastropods, bivalves, nautiloids, stromatoporoids, algae, echinoderms. But in the Pennsylvanian bedrock you can find land based life like ferns, cordaitan trees, rushes, and scale trees.

There have been multiple mammoth and mastodon tusks and fossils found in Benton county. My friend even found one in her creek near her home.

A great place to find fossils in Iowa is in the Devonian Fossil Gorge in Coralville, Iowa. The floods in the past have washed away the overlying sediment and revealed multiple fossil beds where you can find a variety of very well preserved marine fossils.

While there isn't probably any dinosaur fossils in Benton county. There is a possibility of finding dinosaur fossils in western Iowa where there is Cretaceous and Jurassic bedrock. However, that bedrock is covered in thick Loess which limits the excavation of any potential fossils.

There are two different landform regions in Benton county. It predominantly Iowan surface, with a little bit of Southern Iowa Drift Plain in the southern part of the county. The main watersheds of Benton County are the Middle Cedar watershed and the Middle Iowa watershed, with the majority of the county dominated by the Middle Cedar. The main river in Benton County is the Cedar river. It's 338 miles long starting in Minnesota and flowing into the Iowa river and then into the Mississippi river. Multiple larger Iowa cities are based around the Cedar river including; Waverly, Cedar Falls, Waterloo, Vinton, and Cedar Rapids.

There have been two major flooding events of the Cedar River. The first was in 1933 and the second and largest was in 2008. In 1993, the river flooded some areas of downtown Cedar Rapids. The river crested at 19.83 feet. This was the worst flood in Iowa's recorded history, before the Cedar River flooded again in 2008. In 2008, flooding of the river caused the evacuation of around 20,000 of Cedar Rapids' residents and flooded over 1,200 blocks of the city. Upriver, the Waterloo/ Cedar Falls metropolitan area was less affected, thanks mainly to the large dikes that protect the downtowns of both cities. To the north, the flooding Cedar River collapsed Charles City's landmark suspension bridge, as well as destroyed many homes and community parks.

Geology of Benton County

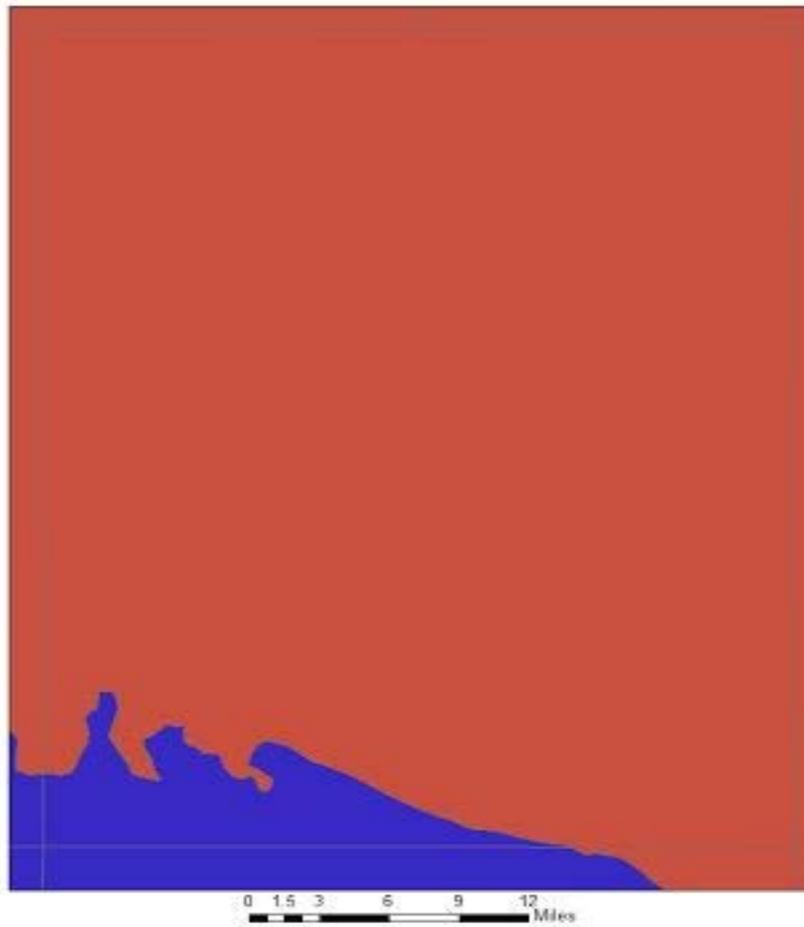


Legend

Iowa Geology	 Cretaceous	 Mississippian	 Pre-Cambrian
SYSTEM	 Devonian	 Ordovician	 Silurian
	 Cambrian	 Jurassic	 Pennsylvanian

Figure 15: Specific geology of Benton county based on age.

Landforms of Benton County



Legend

landform_regions	East-Central Iowa Drift Plain	Loess Hills	Northwest Iowa Plains
LANDFORM_R	Iowa-Cedar Lowland	Mississippi River Alluvial Plain	Paleozoic Plateau
Des Moines Lobe	Iowan Surface	Missouri River Alluvial Plain	Southern Iowa Drift Plain

Figure 16: Landform regions of Benton county

Natural Resources of Benton County

Benton county is full of county parks based along the cedar river. Including Minne Estema, Wildcat Bluff, Benton City, Hoefle Dulin, and many other smaller parks. There you can camp, fish, hunt (on some), play disc golf on the number one course in Iowa (Wildcat Bluff), or just relax on the slow flowing Cedar River (just make sure it's not during flood season).

Iowa's wildlife population includes; deer, pheasants, walleye, turkeys other traditional game or sport fish species, shorebirds, raptors, songbirds, many small mammals and bats, most amphibians, reptiles, many small fish, butterflies, dragonflies and more. Wildlife is hunted for food, sport, and just overall enjoyment by Iowa's

outdoorsmen. There is a possibility for fossil fuels to be found, but no major deposits have been found. A deposit that is big enough would have to be found in order to undergo such a big operation. If you are interested in that field, being able to identify places that could hold these oil reserves can pay out big time, the average salary being around \$160,000 a year. But if you care about the environment, I would recommend trying to work with other natural resources like solar or wind energy.

These resources can be easily sustained as long as we don't over hunt, over fish, and stop damaging our ecosystems at the rate that we are. The world's wildlife should be one of our main priorities now and into the future.

Economic Geology of Benton County

_____ There are multiple different sources in Iowa. The main one being agriculture obviously. Ask anyone in the United States about Iowa and they'll say farming, pigs, and corn more than likely. And as a resident of Benton County, that statement is completely true. But there are also a lot of other interesting things in Iowa that can help you make bank. Like solar power, wind energy, quarries, nuclear plants, logging companies, and fossil fuels.

Specifically in Benton county there is the possibility of major precious metals deposits. In Vinton, the county seat of Benton county, there is a major pluton that is part of the Northeast Iowa Plutonic Complex. There could be potentially millions to billions of dollars worth of precious minerals and metals.

Benton county was known for it's stone production. Specifically, brick and tile production. There were multiple manufacturing plants throughout the county in towns like Shellsburg (my hometown), Norway, Newhall, and Garrison.

There are multiple quarries around Benton county. They specialize mostly in limestone gravel, sand, and other basic aggregate rocks found in our bedrock. Quarries make most of their revenue from removing, selling and shipping rock to a variety of markets that need the material for their projects.

A big part of Iowa's past was in mining for rocks and minerals. There used to be hundreds of different places to mine. Though the number has greatly diminished, it still played a big part in the history of Benton county. On record, there are still 2 mines in Benton county. The Vinton quarry and the Garrison quarry.

Iowa's only nuclear plant sits just outside of Benton county. Duane Arnold Energy Center is located along the Cedar River. It opened in 1974 and it currently generates a net power output of about 615 megawatts by using a single General Electric BWR 4 boiling water reactor inside of a Mark 1 pressure suppression type containment. According to the Nuclear Regulatory Commission, the chance that an earthquake powerful enough to damage the core reactor of the plant was 1 in 31,250.

Just like the rest of Iowa, agriculture plays a huge part in Iowa. It seems like wherever you go, you can see a corn or a soybean field. Iowa has very fertile soil, like most of the midwest. It's always been and always will be a farming state. According to the United States Department of Agriculture, in 2012, Benton county made \$275,384,000 from it's agriculture alone. In 2015, Benton county planted 194,000 acres

of corn and 160,500 acres of soybeans. Iowa is also known for having a lot of livestock. In particular, cows and pigs. Also in 2012 Benton county made \$106,037,000 in Animals and animal products. In 2012, Benton county had a reported 50,000 cattle and calves in its farms.

Agriculture plays a huge part in the yearly income of Benton county. It is the biggest player in our revenue. Over 90% of Benton county is covered by corn and soybean fields. So when people say that all Iowa is corn and soybeans, they're right.

Conclusion

This concludes my report on the geology of Benton county, Iowa. In a state full of agriculture and animals and sometimes questionable people, if you look below the surface, you can find some pretty interesting things.

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