Bedrock Geologic Map of the Keokuk 7.5' Quadrangle, Lee County, Iowa, Hancock County, Illinois, and Clark County, Missouri

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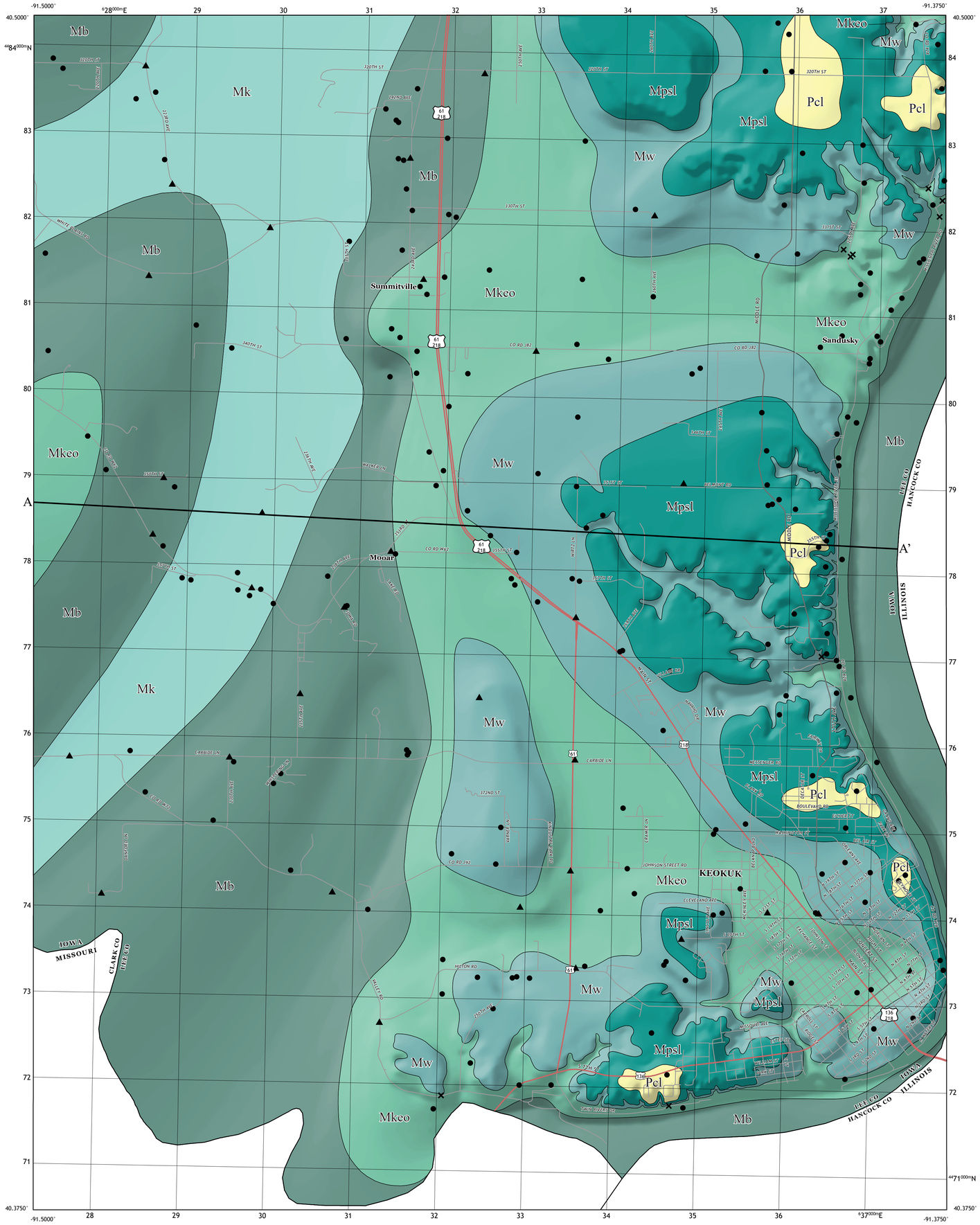
Open File Map: **OFM-21-6**



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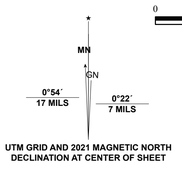
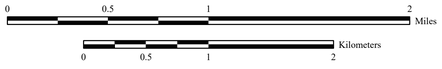
Base map from U.S. Geological Survey (USGS) Keokuk 7.5' Quadrangle map, published by the USGS in 2018. Bedrock topography raster created internally for this map project Keokuk_BR_3m.mxd, version 10/31/21 (ArcGIS Pro 2.8). Map projection and coordinate system based on Universal Transverse Mercator (UTM) Zone 15N, datum NAD83.

The map and cross-section are based on interpretations of the best available information at the time of mapping. Map interpretations are not a substitute for detailed site-specific studies. The views and conclusions contained in this document are those of the authors and should not be interpreted as necessarily representing the official policies, either expressed or implied, of the U.S. Government.

Supported in part by the USGS Cooperative Agreement Number G20AC00243 National Cooperative Geologic Mapping Program (STATEMAP). This work was partially supported by a National Science Foundation Award: Improving Undergraduate STEM Education Grant GP-IMPACT-1600429.

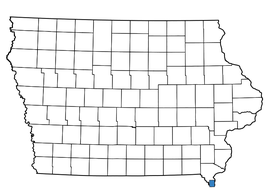


UTM GRID AND 2021 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET



1	2	3
4		5
6	7	8

ADJOINING QUADRANGLES
1 Argyle, IA-MO
2 Nauvoo, IA-IL
3 Niota, IL-IA
4 Wayland, MO-IA
5 Hamilton, IL-IA
6 Kahoka SE, MO
7 Warsaw, IL-MO
8 Sutter, IL



Iowa Geological Survey
Keith Schilling, State Geologist
Published October, 2021

Introduction

The Keokuk Quadrangle lies within the Southern Iowa Drift Plain landform region, which is dominated by loess-mantled till plains in the uplands and fine- to coarse-grained alluvial deposits in stream valleys. The thickness of Quaternary materials overlying the bedrock surface varies widely across the quadrangle ranging from 0 to 18 m (0 – 60 ft), reaching a maximum thickness of 92 m (300 ft) in the western part of the mapping area. An accompanying map of the surficial geology of the Keokuk Quadrangle has been published concurrently with this map (Open File Map OFM-21-7; Tassier-Surine et al., 2021).

The bedrock surface of the Keokuk Quadrangle is dominated by Mississippian strata overlain by Pennsylvanian strata that occur as minor erosional outliers. The majority of the bedrock exposures were found along the bluffs of the Mississippi River along the eastern and southern edges of the mapping area. Geologic reconnaissance of seven exposures and one abandoned quarry within the mapping area were conducted during field activities, although many more may be found along the bluffs of the Mississippi River. There are three abandoned quarries and no active quarries within the mapping area. Additional subsurface information was derived from the analysis of more than 240 water well records, 17 of which have cutting samples that were described as part of this mapping project, and 19 passive seismic data points. For a more detailed account of data resources, mapping methods, and stratigraphy of the Keokuk Quadrangle, please refer to the Summary Map Report.

Stratigraphic Column and Legend

System[1]	Subsystem[1]	Series[1]	Stage[2]	Lithostratigraphic Unit	Map Symbol	Lithology	Thickness (in feet)	Lithostratigraphic Unit Description
Quaternary				Quaternary undifferentiated	Qu		0-60	**Qu - Undifferentiated Unconsolidated Sediments** - Consists of loamy soils developed in loess, glacial till, and colluvium of variable thickness, and alluvial clay, silt, sand, and gravel. The total thickness of the Quaternary deposits typically varies between 0 and 18 m (0 – 60 ft), but can be as much as 92 m (300 ft) thick in the western part of the mapping area. This unit is shown only on the cross-section, not on the map.
Carboniferous	Pennsylvanian	Middle	Desmoinesian-Atokan	lower Cherokee Group	Pcl		<20	**Pcl - Shale and Sandstone** - Pennsylvanian units occur as erosional outliers reaching a thickness of up to 6 m (20 ft) within the mapping area. This unit consists of light to medium gray shale/mudstone that is part silty to sandy, fine to medium quartz sandstone that is rarely conglomeratic, and coal. Some shales are carbonaceous to phosphatic. No outcrops of this unit were identified in the mapping area.
Carboniferous	Mississippian	Upper	Chesterian	Pella or "St. Louis" formations	Mpsl		<40	**Mpsl – Limestone, Sandstone, and Dolostone** - This map unit reaches a maximum thickness of 12 m (40 ft) in the mapping area. It is characterized by limestone, sandstone, dolomitic limestone, and dolostone with minor shale and chert. The Pella Formation can have minor calcareous to dolomitic shale but is dominated by limestone, typically sub-lithographic, with scattered to abundant fossils, primarily brachiopods, echinoderms, and ostracods. The "St. Louis" Formation is dominated by limestone, sandy limestone, sandstone, and dolostone with variable chert. The limestone facies of this unit can be fossiliferous with brachiopods, echinoderms, and several varieties of corals while the dolomitic facies typically exhibit fossil molds. Some fossils are silicified. Sandstones of the "St. Louis" Formation are typically very fine to medium quartz sandstones that are poorly to moderately cemented with calcite or quartz. The lower portion of the "St. Louis" Formation is commonly gray to dark brown dolostone that is locally brecciated and sandy, with minor shale seams, and rare fossils. This mapping unit dominates the bedrock surface in the mapping area and is overlain by Quaternary sediments or Pennsylvanian outliers. Two outcrops of this mapping unit were identified in the mapping area.
Carboniferous	Mississippian	Middle	Meramecian	Warsaw Formation	Mws		<65	**Mws – Shale, Dolostone, and Limestone** - The Warsaw Formation varies in thickness due to erosional disconformities at both the upper and lower contacts, reaching a maximum thickness of approximately 20 m (65 ft) within the mapping area. This unit can generally be divided into two major lithologic groupings, a lower argillaceous dolostone sequence and an upper shale dominated sequence, however preservation is variable as either or both facies may exist in places. The upper shale is typically light to medium gray, silty, and variably dolomitic with minor chert, sand, and sparse quartz geodes. The lower dolostone, sometimes referred to as the "geode beds", is argillaceous to shaly, with scattered to abundant quartz geodes. Minor limestone units occur locally as thin, lenticular beds with crinoidal packstone/grainstone fabrics. Brachiopods, echinoderm debris, and bryozoans are found throughout this mapping unit, although they are more common in the carbonate lithologies. Three outcrops of this unit were observed in the mapping area.
Carboniferous	Mississippian	Lower	Osagean	Keokuk Formation	Mkeo		<90	**Mkeo – Limestone, Dolostone, Chert, and Shale** - The Keokuk Formation can be up to 27 m (90 ft) thick in the mapping area. This unit is dominated by tan to gray interbedded skeletal limestones displaying packstone/grainstone fabrics. Nodular to bedded chert, in part fossiliferous, is common in the lower half of the sequence. Variably argillaceous dolostone and thin shales also occur throughout the unit. The unit displays multiple hardground surfaces and bone beds with scattered to abundant fish debris, the most prominent of these serves as a marker bed at the base of the formation (sometimes referred to as the Burlington-Keokuk or B-K bone bed). Brachiopods, crinoids, bryozoans, solitary corals, and fish bones and teeth occur throughout this unit as both abraded debris and partially articulated specimens. Molds of sponge spicules can occur in the dolostone facies. Minor glauconite and locally abundant geodes are also associated with this unit. Calcite vug fills and rare sphalerite are noteworthy. Five outcrops and one of three abandoned quarries exposing this unit were observed in the mapping area.
Carboniferous	Mississippian	Lower	Osagean	Burlington Formation	Mb		<85	**Mb – Limestone, Dolostone, and Chert** - The Burlington Formation can be up to 26 m (85 ft) thick in the mapping area. This unit is subdivided into three members (in ascending order: the Dolbee Creek, Haight Creek, and Cedar Fork), characterized by distinct lithologic groupings. The Dolbee Creek Member is a pure white crinoidal packstone limestone with minor chert. The Haight Creek Member is characterized by dolostone with an intermittent unit of skeletal limestone (sometimes referred to as the "middle grainstone") and thick beds of chert. A glauconite-rich zone marks the contact between the Haight Creek and Dolbee Creek and can be used as a regional marker bed. Fossil molds are also present in the dolostone facies. The Cedar Fork Member is dominated by white to tan skeletal limestone displaying packstone/grainstone fabrics, nodular to bedded chert, occasional fish debris, and traces of glauconite. Its light color helps differentiate this unit from the dominantly gray packstones of the overlying Keokuk Formation. Outcrops of the Burlington Formation were not observed in the mapping area.
Carboniferous	Mississippian	Lower	Osagean	Kinderhookian formations	Mk		90-130	**Mk – Dolostone, Limestone, and Siltstone** - The Kinderhookian sequence ranges in thickness from 27 to 40 m (90 – 130 ft) in the mapping area. This unit comprises three formations (in ascending order: the McCraney, Prospect Hill, and Wassonville), characterized by distinct lithologic groupings. The McCraney Formation is composed of alternating beds of sparsely fossiliferous, sub-lithographic limestone and dark brown, unfossiliferous dolostone, generating a unique "zebra striped" appearance in outcrop. Calcite vug fills are common and a basal oolite is locally present. The Prospect Hill Formation is a light to medium gray, dolomitic siltstone that grades to shale in some locations. This unit is often laminated with vertical and horizontal burrow fabrics and faint cross-stratified bedforms. Fossils are rare to absent although fossil molds are locally abundant. The Wassonville Formation, which now includes the former Starr's Cave Formation as the basal member, consists of massive dolostone with variable chert that grades into dolomitic limestone lower in the section. The basal Starr's Cave Member is a fossiliferous limestone with packstone/grainstone fabrics and is commonly oolitic. Crinoids (partially articulated) are the dominant fossil type of the Starr's Cave Member. A diverse assemblage of brachiopods are also present with lesser amounts of blastoids, starfish, corals, bryozoans, and trilobites reported. Outcrops of this map unit were not observed as it only occurs at the bedrock surface in a deep bedrock channel in the western part of the mapping area.
Devonian	Upper	Famennian		English River Formation	Der		<20	**Der – Siltstone and Shale** - The English River Formation ranges in thickness from 3 to 6 m (10 – 20 ft) within the mapping area. This unit is dominated by gray to olive green siltstone, locally shaly, with distinct bioturbated fabrics. Bivalves and brachiopods are common, especially in the upper beds, with scattered to abundant fossil molds as well. This unit only appears in the cross-section, not on the map.
Devonian	Upper	Famennian		Saverton Shale Formation	Dss		<80	**Dss – Shale** - The Saverton Shale Formation can be up to 24 m (80 ft) thick within the mapping area. This unit is dominated by green-gray shale, commonly burrowed with sparse to absent macrofossils. This unit only appears in the cross-section, not on the map.
Devonian	Upper	Famennian		Grassy Creek Formation	Dgc		<175	**Dgc – Shale** - The Grassy Creek Formation can be up to 53 m (175 ft) thick within the mapping area. This unit is dominated by organic-rich brown shale with minor green-gray shale in the upper part of the unit. Differentiation between the Grassy Creek and overlying Saverton Shale was primarily based on color and relative abundance of spore carps identified in well cuttings. This unit only appears in the cross-section, not on the map.

[1]Global chronostratigraphic units
[2]Regional chronostratigraphic units

Map Symbols

- bedrock outcrop
- GeoSam point
- geophysics collection point
- unit contact
- cross-section
- hillshade

Road Classification
- U.S. Route
- State Route
- Local Road

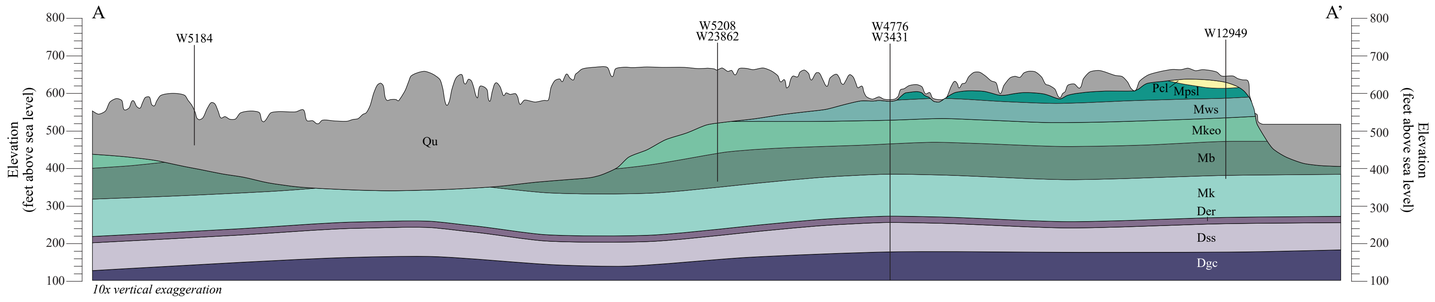
Lithologies
- coal
- dolostone
- dolomitic shale
- fossiliferous limestone
- limestone
- lithographic limestone
- sandstone
- sandy limestone
- shale
- siltstone
- unlithified sediments

Lithology Symbols
- geodes
- chert
- oolitic
- argillaceous zone
- breccia
- unconformity

Acknowledgements

Special thanks to the landowners who allowed access to their properties: Jerry and Joan Boecker as well as Danny and Anna Hodges. Thanks also to Don Smith of Cessford Construction, Co. (Oldcastle Materials) for allowing us to access quarries in and around the mapping area. University of Iowa (UI) Department of Earth and Environmental Sciences (EES) students Dan Bloch, Alethea Kapolis, Allison Kusick, and Brennan Hill helped with various aspects of data collection and management including producing descriptive logs of water well cutting samples, updating well locations, and geophysical data acquisition. Thanks to Rick Langel of the Iowa Geological Survey (IGS) for managing the Iowa geologic sampling database (GeoSam). Brian Witzke (IGS - retired), Associate Professor Brad Cramer (UI-EES), and Illinois State University Professor James "Jed" Day are thanked for their help with the stratigraphic research components stemming from this mapping project as well as many fruitful discussions about the geologic complexities of the tristate region. Casey Kohrt and Chris Kahle of the Iowa Department of Natural Resources provided GIS technical help. Administrative support was provided by Suzanne Doershuk, Melissa Eckrich, Teresa Gaffey, Carmen Langel, and Rosemary Tiwari.

Geologic Cross-Section A-A'



10x vertical exaggeration