

U.S. Department of the Interior  
National Park Service  
Natural Resource Stewardship and Science Directorate  
Geologic Resources Division



# Effigy Mounds National Monument

## *GRI Ancillary Map Information Document*

Produced to accompany the Geologic Resources Inventory (GRI) Digital Geologic Data for Effigy Mounds National Monument

efmo\_geology.pdf

Version: 9/7/2011

# Geologic Resources Inventory Map Document for Effigy Mounds National Monument

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## Geologic Resources Inventory Map Document



# Effigy Mounds National Monument, Iowa

## Document to Accompany Digital Geologic-GIS Data

[efmo\\_geology.pdf](#)

Version: 9/7/2011

This document has been developed to accompany the digital geologic-GIS data developed by the Geologic Resources Inventory (GRI) program for Effigy Mounds National Monument, Iowa (efmo).

Attempts have been made to reproduce all aspects of the original source products, including the geologic units and their descriptions, geologic cross sections, the geologic report, references and all other pertinent images and information contained in the original publication.

National Park Service (NPS) Geologic Resources Inventory (GRI) Program staff have assembled the digital geologic-GIS data that accompanies this document.

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## About the NPS Geologic Resources Inventory Program

### Background

Recognizing the interrelationships between the physical (geology, air, and water) and biological (plants and animals) components of the Earth is vital to understanding, managing, and protecting natural resources. The Geologic Resources Inventory (GRI) helps make this connection by providing information on the role of geology and geologic resource management in parks.

Geologic resources for management consideration include both the processes that act upon the Earth and the features formed as a result of these processes. Geologic processes include: erosion and sedimentation; seismic, volcanic, and geothermal activity; glaciation, rockfalls, landslides, and shoreline change. Geologic features include mountains, canyons, natural arches and bridges, minerals, rocks, fossils, cave and karst systems, beaches, dunes, glaciers, volcanoes, and faults.

The Geologic Resources Inventory aims to raise awareness of geology and the role it plays in the environment, and to provide natural resource managers and staff, park planners, interpreters, researchers, and other NPS personnel with information that can help them make informed management decisions.

The GRI team, working closely with the Colorado State University (CSU) Department of Geosciences and a variety of other partners, provides more than 270 parks with a geologic scoping meeting, digital geologic-GIS map data, and a park-specific geologic report.

### Products

**Scoping Meetings:** These park-specific meetings bring together local geologic experts and park staff to inventory and review available geologic data and discuss geologic resource management issues. A summary document is prepared for each meeting that identifies a plan to provide digital map data for the park.

**Digital Geologic Maps:** Digital geologic maps reproduce all aspects of traditional paper maps, including notes, legend, and cross sections. Bedrock, surficial, and special purpose maps such as coastal or geologic hazard maps may be used by the GRI to create digital Geographic Information Systems (GIS) data and meet park needs. These digital GIS data allow geologic information to be easily viewed and analyzed in conjunction with a wide range of other resource management information data.

For detailed information regarding GIS parameters such as data attribute field definitions, attribute field codes, value definitions, and rules that govern relationships found in the data, refer to the NPS Geology-GIS Data Model document available at: <http://science.nature.nps.gov/im/inventory/geology/GeologyGISDataModel.cfm>

**Geologic Reports:** Park-specific geologic reports identify geologic resource management issues as well as features and processes that are important to park ecosystems. In addition, these reports present a brief geologic history of the park and address specific properties of geologic units present in the park.

For a complete listing of Geologic Resource Inventory products and direct links to the download site visit the GRI publications webpage [http://www.nature.nps.gov/geology/inventory/gre\\_publications.cfm](http://www.nature.nps.gov/geology/inventory/gre_publications.cfm)

GRI geologic-GIS data is also available online at the NPS Data Store Search Application: <http://nrinfo.nps.gov/Reference.mvc/Search>. To find GRI data for a specific park or parks select the appropriate park

(s), enter "GRI" as a Search Text term, and then select the Search Button.

For more information about the Geologic Resources Inventory Program visit the GRI webpage: <http://www.nature.nps.gov/geology/inventory>, or contact:

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The Geologic Resources Inventory (GRI) program is funded by the National Park Service (NPS) Inventory and Monitoring (I&M) Division.

## Map Unit List

The geologic units present in the digital geologic-GIS datasets produced for Effigy Mounds National Monument, Iowa (efmo) are listed below. Units are listed with their assigned unit symbol and unit name (e.g., Kw - Windrow Formation). Units are listed from youngest to oldest. No description for water is provided. Information about each geologic unit is also presented in the Geologic Unit Information (UNIT) tables (efmounit and clyunit) included with the GRI geology-GIS data (see the GRI Effigy Mounds National Monument and Vicinity, and Clayton Quadrangle digital geologic-GIS datasets, respectively).

### Geologic Map Units

#### Mesozoic Era

##### Cretaceous Period

Kw - [Windrow Formation](#)

#### Paleozoic Era

##### Devonian Period

Dw - [Wapsipinicon Group](#)

##### Silurian Period

Sl - [Lower Silurian, undifferentiated strata](#)

##### Ordovician Period

Om - [Maquoketa Formation](#)

Ob - [Maquoketa Formation, Brainard Member](#)

Of - [Maquoketa Formation, Fort Atkinson Member](#)

Oec - [Maquoketa Formation, Elgin and Clermont Members](#)

Owd - [Wise Lake and Dubuque Formations](#)

Od - [Dunleith Formation](#)

Og - [Galena Group and Platteville Formation, undivided](#)

Odp - [Decorah, Platteville and Glenwood Formations](#)

Osp - [St. Peter Sandstone](#)

Op - [St. Peter Sandstone and Prairie du Chien Group, undivided](#)

Opc - [Oneota and Shakopee Formations](#)

##### Cambrian Period

Cjs - [Jordan Sandstone, St. Lawrence and Lone Rock Formations](#)

Cwe - [Wonevoc and Eau Claire Formations](#)

## Map Unit Descriptions

Descriptions of all geologic map units, listed from youngest to oldest, are presented below.

### **Kw - Windrow Formation (mid Cretaceous)**

mid Cretaceous (upper Albion and/or lower Cenomanian). Lithologies dominated by limonitic iron ore, nodular to massive, part sandy; secondary lithologies include hematite, quartz sand and pebbles, sandstone, reworked chert cluster, clay class and fills. Mapped only in Waukon Quad. Maximum thicknesses to 135 ft [41 m] at Iron Hill, the high. elevation in the map area. Low karst susceptibility, but overlies paleokarstic surface on Galena Group limestone strata in map area. *GRI Source Map ID 75462* ([Open File Map 06-1](#)).

### **Dw - Wapsipinicon Group (Middle Devonian)**

Middle Devonian (upper Eifelian-lower Givetian). Primarily Spillville Formation, local erosional remnants of overlying Pinicon Ridge Formation. Spillville lithologies dominated by medium to thick bedded dolomite, fossil-moldic to vuggy, common calcite void fills; minor dolomitic limestone; basal strata (Lake Meyer Member, 4-7 ft [1.2-2.1 m]) includes sandy dolomite, sandstone, argillaceous siltstone, silty dolomitic shale. Pinicon Ridge lithologies include argillaceous dolomite and shaley dolomite, part sandy (Kenwood Member) and limestone and dolomitic limestone, part brecciated (Spring Grove-Davenport Members). Mapped only in western Calmar Quadrangle. Spillville Formation to 90 ft [27 m] thick; Pinicon Ridge Formation locally to 30 ft [9 m] in map area. Spillville is a ledge-forming interval. Pinicon Ridge is a covered slope former. Moderate karst susceptibility. *GRI Source Map ID 75462* ([Open File Map 06-1](#)).

### **SI - Lower Silurian, undifferentiated strata (Silurian)**

Lower Silurian, undifferentiated strata (mid Llandovery); includes Waucoma Formation in southwestern Castalia Quadrangle combined Tete des Morts-Blanding Formations in southwestern Postville Quadrangle. Waucoma Formation dominated by fossiliferous dense limestone; minor dolomitic limestone and dolomite (lower part); locally cherty in upper part. Tete des Morts-Blanding Formations dominated by fossiliferous dolomite, medium to thick bedded in lower part, thin to medium bedded upper part; fossil moldic, scattered silicified fossils; cherty to very cherty (especially in upper part). Maximum thicknesses in map area: Waucoma Formation to 40 ft [12 m]; Tete des Morts-Blanding Formations to 60 ft [18 m]. Silurian strata are ridge to ledge forming. Moderate karst susceptibility. *GRI Source Map ID 75462* ([Open File Map 06-1](#)).

### **Om - Maquoketa Formation (Ordovician)**

Shale, dolomite. *GRI Source Map ID 75555* ([Open-File Map 2010-01](#)).

### **Ob - Maquoketa Formation, Brainard Member (Upper Ordovician)**

Upper Ordovician (upper Richmondian). Lithologies dominated by green-gray to blue-gray dolomitic shale, part silty; minor thin dolomite and argillaceous dolomite interbeds and nodules. Mapped only in

southern Castalia and Postville Quadrangles. Thicknesses approximate 70-110 ft [21-33 m] where capped by Silurian strata. Brainard is a covered slope-forming interval. Low karst susceptibility. *GRI Source Map ID 75462* ([Open File Map 06-1](#)).

### **Of - Maquoketa Formation, Fort Atkinson Member (Upper Ordovician)**

Upper Ordovician (middle Richmondian). Lithologies dominated by fossiliferous limestone, dolomitic limestone, dolomite; part very crinoidal; part cherty to very cherty (especially in lower half); lower limestone strata are variably argillaceous, minor thin shale partings. Thickness varies in map area between 25 and 65 ft [7.5-20 m] (thickest to west); commonly 35-45 ft [11-14 m] thick. Ledge-forming interval. Moderate to high karst susceptibility, sinkholes common in some areas. *GRI Source Map ID 75462* ([Open File Map 06-1](#)).

### **Oec - Maquoketa Formation, Elgin and Clermont Members (Upper Ordovician)**

Upper Ordovician (lower Richmondian). Elgin Member dominated by dolomite, argillaceous dolomite, and dolomitic limestone, part cherty to very cherty, thin shale interbeds, variably fossiliferous (becomes more skeletal in upper part), much of unit is sparsely fossiliferous to unfossiliferous, burrow fabrics common; lower part dominated by limestone and dolomitic limestone with shaley interbeds, trilobites common in some beds (succession of "Isotelus" and "Anataphrus beds"); basal strata include a pyritic phosphorite (on Dubuque Formation sculpted surface) and dark brown organic shale (part graptolitic). Clermont Member dominated by gray to green-gray shale, calcareous to dolomitic; limestone, dolomitic limestone, or dolomite interbeds. Total Elgin-Clermont thickness in map area varies between 100 and 155 ft [30-47 m]; commonly 110-135 ft thick [34-41 m] (thickest to northwest). Clermont Shale at top of interval varies 10 to 30 ft [3-9 m] thick. Slope- to ledge-forming interval. Clermont Shale with low karst susceptibility. Elgin Member variably shows low to moderate karst susceptibility; karst collapse in underlying Galena Group strata may slope through lower Elgin strata and develop sinkholes in portions of the map area. *GRI Source Map ID 75462* ([Open File Map 06-1](#)).

### **Owd - Wise Lake and Dubuque Formations (Upper Ordovician)**

Upper Ordovician (Edenian, Maysvillian, basal Richmondian). Wise Lake Formation lithologies dominated by dense limestone, medium to thick bedded, fossiliferous, chert free except in basal beds; common dolomitic thalassinoid burrow mottles and networks in many beds; limestone-dominated facies across northern and western map area, replaced southeastward by dolomitic limestone and dolomite. Dubuque Formation characterized by limestone, thin to medium bedded, fossiliferous, part coarsely crinoidal, common thin shale interbeds; chert free; dolomitic to southeast. Total Wise Lake-Dubuque thickness in map area varies 90-110 ft [27-34 m]; Wise Lake Formation 60-73 ft [18-22 m] (thickest to north); Dubuque Formation 30-37 ft [9-11 m]. Ledge- and cliff-forming interval. High karst susceptibility; sinkholes common to abundant. *GRI Source Map ID 75462* ([Open File Map 06-1](#)).

### **Od - Dunleith Formation (Upper Ordovician)**

Upper Ordovician (middle-upper Chatfieldian). Lithologies dominated by dense limestone, thin to medium bedded, fossiliferous, part argillaceous, scattered thin shale and shaley interbeds in lower half, scattered to common chert nodules in some wits; minor dolomitic thalassinoid burrow mottles in some beds. Limestone dominated across most of map area, but Dunleith becomes dominated by dolomitic

limestone and dolomite facies in southeastern map area. Thickness varies 110-145 ft [34-44 m] (thickest to north). Ledge- and cliff- to ridge-forming interval. High karst susceptibility; sinkholes common to abundant. *GRI Source Map ID 75462* ([Open File Map 06-1](#)).

### **Og - Galena Group and Platteville Formation, undivided (Ordovician)**

Dolomite, shale, chert. *GRI Source Map ID 75555* ([Open-File Map 2010-01](#)).

### **Odp - Decorah, Platteville and Glenwood Formations (Upper Ordovician)**

Upper Ordovician (Turinian-lower Chatfieldian). Decorah lithologies dominated by shale in northwestern map area; dominated by limestone with interbedded shale to southeast (includes Carimona, Spechts Ferry, Guttenberg, Ion Members); shale, green-gray, calcareous, scattered brachiopod shell coquinas; limestone, part nodular to wavy-bedded, fossiliferous; lower Decorah strata (Spechts Ferry) dominated by shale throughout map area. Platteville lithologies dominated by dolomite in basal interval, part sandy (Pecatonica Member); upper strata dominated by dense limestone, fossiliferous, part wavy-bedded with shaley interbeds (McGregor Member). Glenwood Shale dominated by shale, green-gray, noncalcareous, part sandy to silty, part phosphatic; minor siltstone, sandstone. Total interval ranges 75-95 ft [23-29 m] thick, commonly 85 ft [26m]; Decorah ranges 40-47 ft [12-14 m] thick (thickest to north); Platteville ranges 28-43 ft [8.5-13 m] (thickest to south); Glenwood ranges 3-10 ft [0.9-3 m] thick. Interval forms an interbedded succession of shale and limestone, generally poorly exposed slope-former, commonly slumped. Carbonate beds are local ledge formers. Low to moderate karst susceptibility; generally an aquitard interval above Cambro-Ordovician aquifer (Jordan-Prairie du Chien aquifer); spring seeps common above shale units; Decorah-Platteville limestone strata locally with solutional and mechanical karst. *GRI Source Map ID 75462* ([Open File Map 06-1](#)).

### **Osp - St. Peter Sandstone (Middle Ordovician)**

Middle Ordovician (Chazyan). Dominated by sandstone, quartzose, fine to medium grained, rare coarse grains, slightly argillaceous in upper part; sandstones poorly consolidated and friable, but top bed commonly hard cemented; basal beds locally with mixed shale, sandstone, and conglomerate (chert, dolomite clasts). Thickness varies 30-225 ft [9-69 m], regionally overlies deeply eroded surface on Prairie du Chien Group; thickest St. Peter noted locally in southeastern map area (Pikes Peak State Park to 225 ft [69 m]); averages 35-60 ft [11-18 m] thick across most of map area (locally 70-130 ft [21-40 m]), averages 50-80 ft [15-24 m] in Hanover and Waukon Quads (locally 90-145 ft [27-44 m]). Lower St. Peter generally a slope-former; upper St. Peter commonly a ridge-former. Low karst susceptibility; very permeable. *GRI Source Map ID 75462* ([Open File Map 06-1](#)).

### **Op - St. Peter Sandstone and Prairie du Chien Group, undivided (Ordovician)**

Dolomite, sandstone. *GRI Source Map ID 75555* ([Open-File Map 2010-01](#)).

### **Opc - Oneota and Shakopee Formations (Lower Ordovician)**

Lower Ordovician (Tremadocian-Arenigian). Dominated by dolomite, part cherty; secondary quartzose sandstone and sandy dolomite. Dolomite beds mostly unfossiliferous, scattered to common voids and

rugs, part laminated to stromatolitic, part intraclastic, locally brecciated units; sandstone units mostly very fine to medium grained, some coarse grains; oolitic chert nodules in some units; scattered chalcedony/quartz nodules and masses. Oneota Formation subdivided into lower Coon Valley Member (includes sandy dolomite, thin sandstone, minor chert) and upper Hager City Member (non-sandy dolomite and cherty dolomite); Shakopee Formation subdivided into lower New Richmond Member (sandstone, sandy dolomite, minor chert) and upper Willow River Member (dolomite, part sandy to cherty, minor green shale). Total Prairie du Chien Group thickness in map area generally varies 240-335 ft [73-102 m] (thickest to south); locally thinner (50-200 ft [15-61 m] thick) where capped by thick St. Peter sections. Shakopee Formation generally 60-100 ft [18-30 m] thick (locally absent where St. Peter is thick); Oneota Formation generally 130-225 ft [40-69 m] thick (locally less where sub-St. Peter). Generally a ledge- to cliff/bluff-forming interval; upper Shakopee commonly a slope-former. Moderate to high karst susceptibility, but sinkholes only locally common. *GRI Source Map ID 75462* ([Open File Map 06-1](#)).

### **Cjs - Jordan Sandstone, St. Lawrence and Lone Rock Formations (Upper Cambrian)**

Upper Cambrian (upper Steptoean-Sunwaptan, upper Franconian-Trempealeuan). Jordan Sandstone is the only exposed Cambrian rock unit in the map area; St. Lawrence and Lone Rock are subcrop units only, beneath alluvium of the Mississippi Valley and its tributaries. Jordan Sandstone dominated by sandstone, part cross-bedded, very fine to medium grained, upper strata part medium to very coarse grained; minor sandy dolomite and dolomite cements, minor intrados. St. Lawrence Formation dominated by dolomite, part silty, and dolomitic siltstone, part argillaceous, part fossiliferous; minor very fine sandstone, silty shale, &aconite, intraclastic units. Lone Rock Formation dominated by sandstone, very fine to fine grained, glauconitic to very glauconitic, common greensands, slightly micaceous, scattered fossil molds; secondary siltstone and shale, scattered intraclastic units; basal beds dolomitic, minor dolomite. Total thickness 260-310 ft [79-95 m]; Jordan Sandstone 80-110 ft [24-34 m]; St. Lawrence Formation 60-80 ft [18-24 m], Lone Rock Formation 110-140 ft [34-43 m]. Low karst susceptibility, Jordan very permeable. St. Lawrence-Lone Rock forms confining interval above Wonewoc aquifer. *GRI Source Map ID 75462* ([Open File Map 06-1](#)).

Sandstone, dolomite. *GRI Source Map ID 75555* ([Open-File Map 2010-01](#)).

### **Cwe - Wonewoc and Eau Claire Formations (Upper Cambrian)**

Upper Cambrian (upper Marjuman-Steptoean; Dresbachian-lower Franconian). Interval represented only by subcrop beneath Mississippi River alluvium. Wonewoc Formation dominated by sandstone, fine to coarse grained, upper part fossiliferous (Ironton Member). Eau Claire Formation dominated by sandstone, very fine to fine grained, part argillaceous, and shale, silty, gray to green-gray, part glauconitic; secondary siltstone, part argillaceous; some units are dolomitic, minor dolomite; part fossiliferous; forms confining interval above Mt. Simon aquifer. Total thickness 245-300 ft [75-90 m]; Wonewoc Formation 125-155 ft [38-47 m]; Eau Claire Formation 120-145 ft [37-44 m]. *GRI Source Map ID 75462* ([Open File Map 06-1](#)).

## GRI Source Map Citations

The GRI digital geologic-GIS maps for Effigy Mounds National Monument, Iowa (efmo) were compiled from the following sources:

Witzke, B.J. and Anderson, R.R., 2006, Bedrock Geology of the Quadrangles containing the Yellow River Basin, Allamakee, Clayton, Fayette, and Winneshiek Counties, Iowa, Iowa Geological Survey, Open-File Map OFM-06-1, 1:50,000 scale. ([Open-File Map 06-1](#)). (*GRI Source Map 75462*)

\*\*\* Well data locations and rock exposure locations weren't captured as a part of the GRI product derived from this source map.

Witzke, B.J., Anderson, R.R., and Pope, J.P., 2010. Bedrock Geologic Map of Iowa, Iowa Geological and Water Survey, Open File Map OFM-2010-01, 1:500,000 scale ([Open-File Map 2010-01](#)). (*GRI Source Map 75555*)

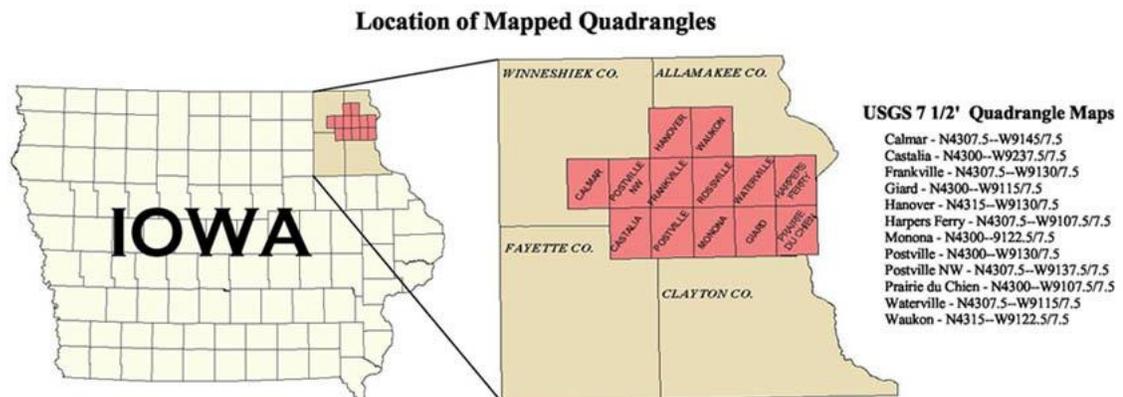
Additional information pertaining to each source map is also presented in the Source Map Information (MAP) table included with the GRI geology-GIS data.

### Open-File Map 06-1

Witzke, B.J. and Anderson, R.R., 2006, Bedrock Geology of the Quadrangles containing the Yellow River Basin, Allamakee, Clayton, Fayette, and Winneshiek Counties, Iowa, Iowa Geological Survey, Open-File Map OFM-06-1, 1:50,000 scale. (*GRI Source Map 75462*)

\*\*\* Digital data provided by the Iowa Geological and Water Survey.

### Open-File Map 06-1 Quadrangle Location



Extracted from: ([Open File Map 06-1](#)).

## Open-File Map 06-1 Legend

# LEGEND

### Well Data Locations

- GEOSAM Well Data
- DOT Bridge Boring Logs

### Rock Exposure Data Locations

- Exposures from Literature

### Landscape Features

-  Rivers and Streams
-  Yellow River Basin

### Roads and Highways

-  U.S. Highways
-  Iowa Highways

### Political Boundaries

-  County Boundaries
-  Incorporated Towns
-  Township Boundaries
-  Section Boundaries
-  7.5' Quadrangle Boundaries

Extracted from: ([Open File Map 06-1](#)).

## Open-File Map 2010-01

Witzke, B.J., Anderson, R.R., and Pope, J.P., 2010. Bedrock Geologic Map of Iowa, Iowa Geological and Water Survey, Open File Map OFM-2010-01, 1:500,000 scale (*GRI Source Map 75555*)

\*\*\* Digital data provided by the Iowa Geological and Water Survey. No additional information other than unit descriptions (see [Map Unit List](#) and [Map Unit Descriptions](#)) were included in this document from this source.

## **GRI Digital Data Credits**

This document was developed and completed by Georgia Hybels (National Park Service) for the NPS Geologic Resources Division (GRD) Geologic Resources Inventory (GRI) Program. Quality Control by Stephanie O'Meara (Colorado State University)

The information contained here was compiled to accompany the digital geologic-GIS map(s) and other digital data for Effigy Mounds National Monument, Iowa (efmo) developed by Georgia Hybels (National Park Service) and Stephanie O'Meara.

GRI finalization by Stephanie O'Meara.

GRI program coordination and scoping provided by Bruce Heise and Tim Connors (NPS GRD, Lakewood, Colorado).