SURFICIAL GEOLOGY OF THE HUDSON QUADRANGLE BLACK HAWK COUNTY, IOWA

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Black Hawk Creek near Hudson, IA

Abstract

Our goal for developing the surficial geologic map of the Hudson Quadrangle is to obtain geologic data, which may be used for land use planning tools for Black Hawk County, the city of Hudson, IA, the Natural Resources Conservation Service (NRCS), and local landowners. The city of Hudson and the surrounding Cedar Falls/Waterloo metro area will have access to this data to improve their water resources management plans, wetland protection programs, aggregate resource management programs, and the pollution potential from Iowa's growing confined animal farming operations (CAFOs). These geologic data will further our current understanding and interpretations of the Iowa Erosion Surface. They will also provide baseline information needed by engineers (city and county) within the Hudson Quad. to enhance flood preparedness, mitigation efforts, and their efforts toward sustainable development. UNI's EDMAP program will contribute to the on-going mapping programs of the Iowa Geological and Water Survey (IGWS), the NRCS, and the Black Hawk County Engineers Office. Because the surficial geologic map of Hudson Quadrangle is an ongoing project at this time, the completed Waterloo South Quadrangle surficial geologic map was compared to current data and six geologic formations were identified within the Hudson Quadrangle (Qal, Qallt, Qnw2, and Qwa2).

Introduction

The purpose for developing the surficial geologic map of the Hudson Quadrangle is to obtain geologic data that can be used for county-specific land use planning tools for the city of Hudson, IA, the NRCS, and local farmers. The study area was located in northeastern Iowa, in Black Hawk County (Fig. 1). The Hudson Quadrangle covered an area from 42° 30’ to 42°22’30” N latitude and 92°30’3” to 92°22’29” W longitude. The Hudson Quadrangle lies in a terrain of dissected Pre-Illinoisan glacial deposits that blanket a bedrock surface with significant relief. The study area also represents a portion of the Iowan Erosion Surface and exhibits Wisconsin and Holocene alluvial surfaces, eolian landforms, and discontinuous outcrops of Paleozoic bedrock. Geologic units within the project area include Devonian carbonate bedrock, Pre-Illinoisan glacial sediment and alluvium, Wisconsin outwash, loess, Holocene alluvium and eolian sand.

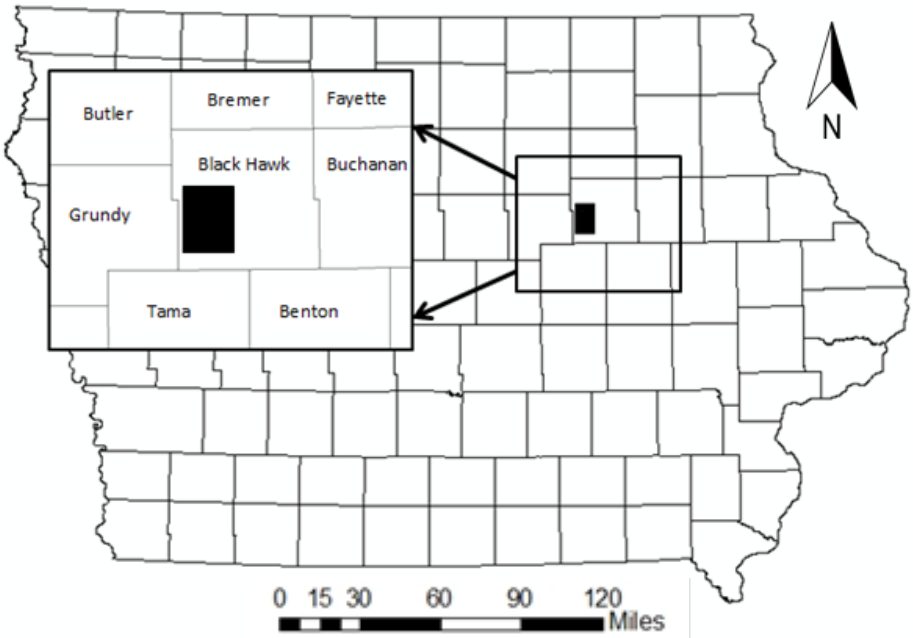

Figure 1. Locality Map of Hudson Quadrangle

Regional Setting

During the Pleistocene, continental glaciers advanced over Iowa, depositing sediments during and after ice contact. The main glacial stages from oldest to youngest were the Pre-Illinoian, Illinoian, and Wisconsinan (Fig. 2). The Hudson Quadrangle lies on the Iowan Surface (Fig. 3). The Iowan Surface displays sweeping, relaxed, open topography. The surface usually appears slightly inclined to gently rolling with long slopes, low relief, and open views to the horizon (Prior, 1991). This region of Iowa has no constructional features associated with glaciations. There are no moraines, eskers, kames, or outwash plains. The Iowan Erosion Surface was previously known as the Iowan Drift Region. A considerable amount of this region is covered by loess, but the major part of the region is covered by thin loam sediment that overlies a stone line on the till (Ruhe, 1969). The Iowan Drift does not exist in northeastern Iowa. The Iowan Drift Region is actually an erosion surface (Ruhe, 1969).

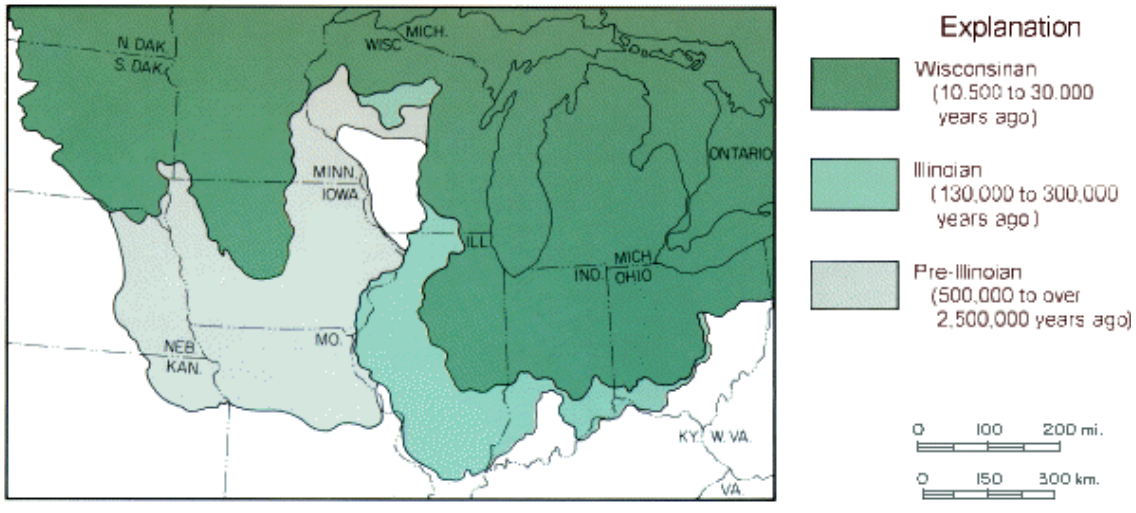

Figure 2. Limits of major Pleistocene glacial advances into the Midwest (Prior, 1991)

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The edge of the erosion surface extends under the thick loess, so the erosion surface itself cannot be the primary source for the loess (Hallberg, 1979). It is assumed that much of the Iowan Erosion Surface must have been created before the loess began to be deposited. Radiocarbon ages indicated that loess deposition began on the erosion surface approximately 18,000-23,000 radiocarbon years ago and between 21,000-29,000 radiocarbon years ago on the areas with paleosols. This aging indicates that erosion and loess deposition were occurring simultaneously (Zanner, 1999). The Iowan Surface was last inhabited by glaciers in Pre-Illinoian time and since then has lain exposed to various episodes of weathering and soil development, erosion, and loess deposition (Prior, 1991).

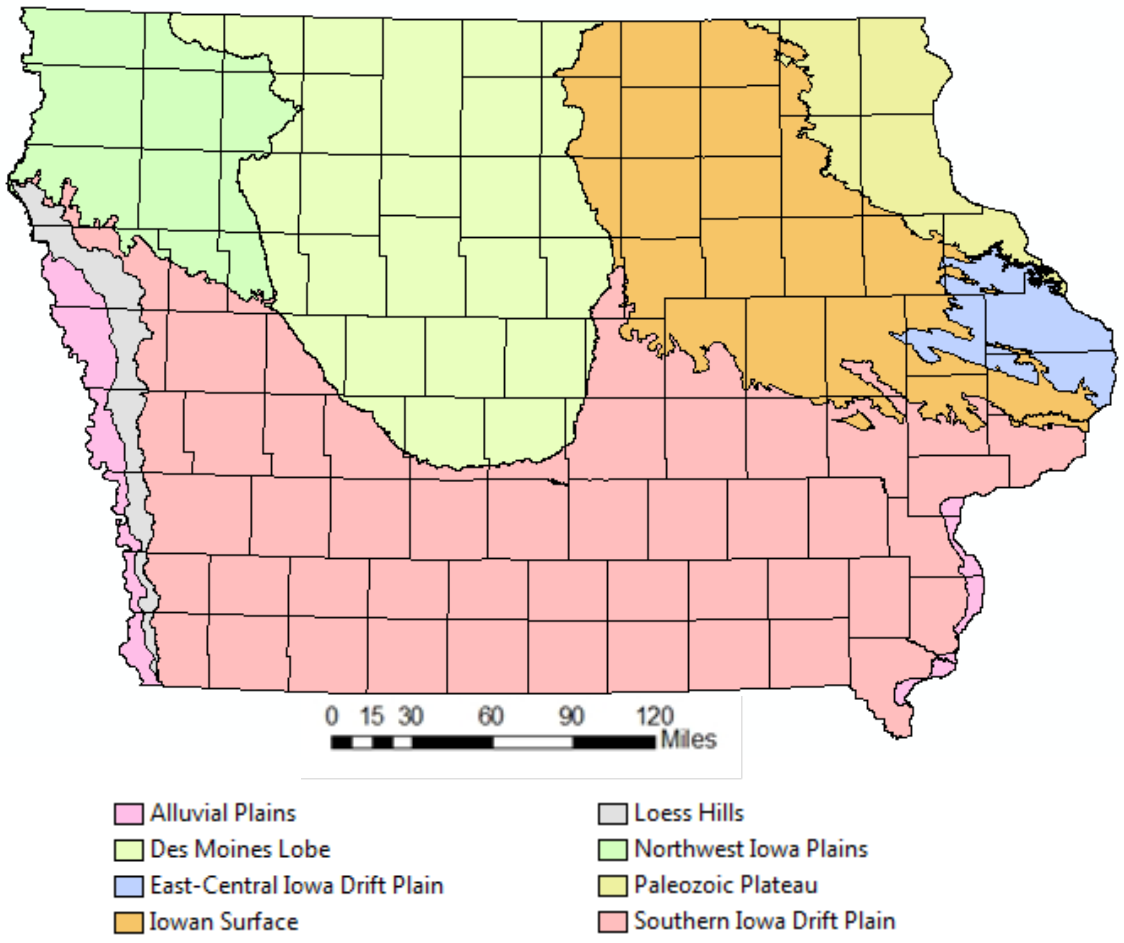


Figure 3. Landform Regions of Iowa

Spatial Data Collection

Geographically referenced data were necessary for this mapping project. This project required obtaining geospatial data (topography, aerial photography, depth to bedrock, and other shapefiles) from the Iowa Natural Resources Geographic Information Systems Library (http://www.igsb.uiowa.edu/nrgislibx/gishome.htm). Spatial data were also collected in the field using Trimble Juno SB units. This mobile mapping enables the collection of field data to lessen the possibility of error in identifying geologic sampling points and mapping units.

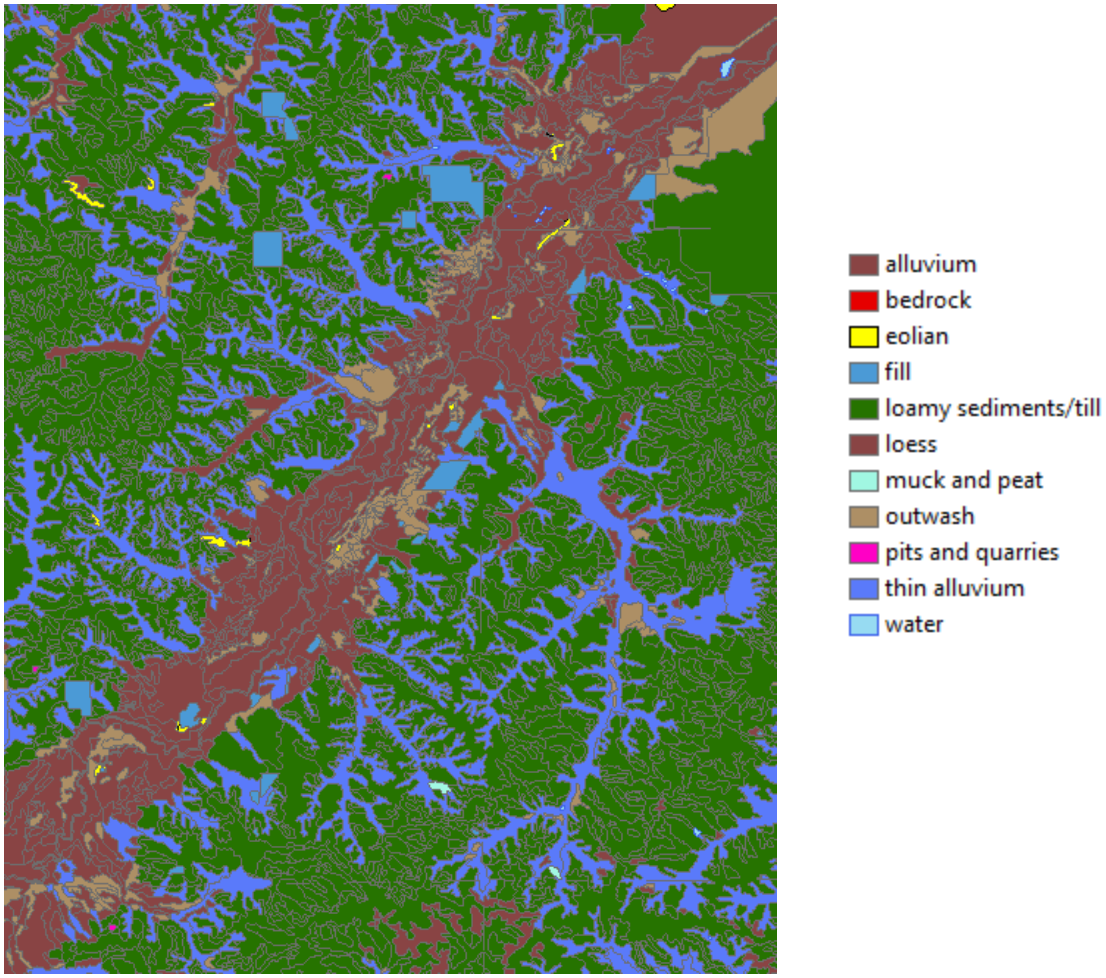


Figure 4. Mapping exhibiting the Hudson Quadrangle's primary soil to Parent Materials relationships

Field Work

Soil samples were taken from the field using a bucket-auger and shovel excavations of surficial outcrops. Soil samples were described in the field notebook on the basis of sediment identification methods. In most cases, the maximum range reached for mapable surface geologic units (soil parent material) was 3 to 12 feet. The hand auger was capable of reaching depths of 20 feet, but the UNI EDMAP team often encountered gravel to cobble sized glacial sediment. This naturally occurring condition made drilling by hand at depths greater than 6 feet difficult. The UNI EDMAP team hand drilled 37 cores and had access to well descriptions from Iowa Geosam database http://www.igsb.uiowa.edu/webapps/geosam/default.asp?state=1). We extensively used soil, vegetation features, and landscape positions to assist our mapping efforts.

GIS Data Processing

Geospatial data were obtained for Black Hawk County and the Hudson Quadrangle from the Iowa Natural Resources Geographic Information Systems Library. While drawing the map features (shape files), a combination of field, supporting geospatial data (aerial photos, topography, LIDAR, etc.), and ArcGIS 10.0 editing tools were used.

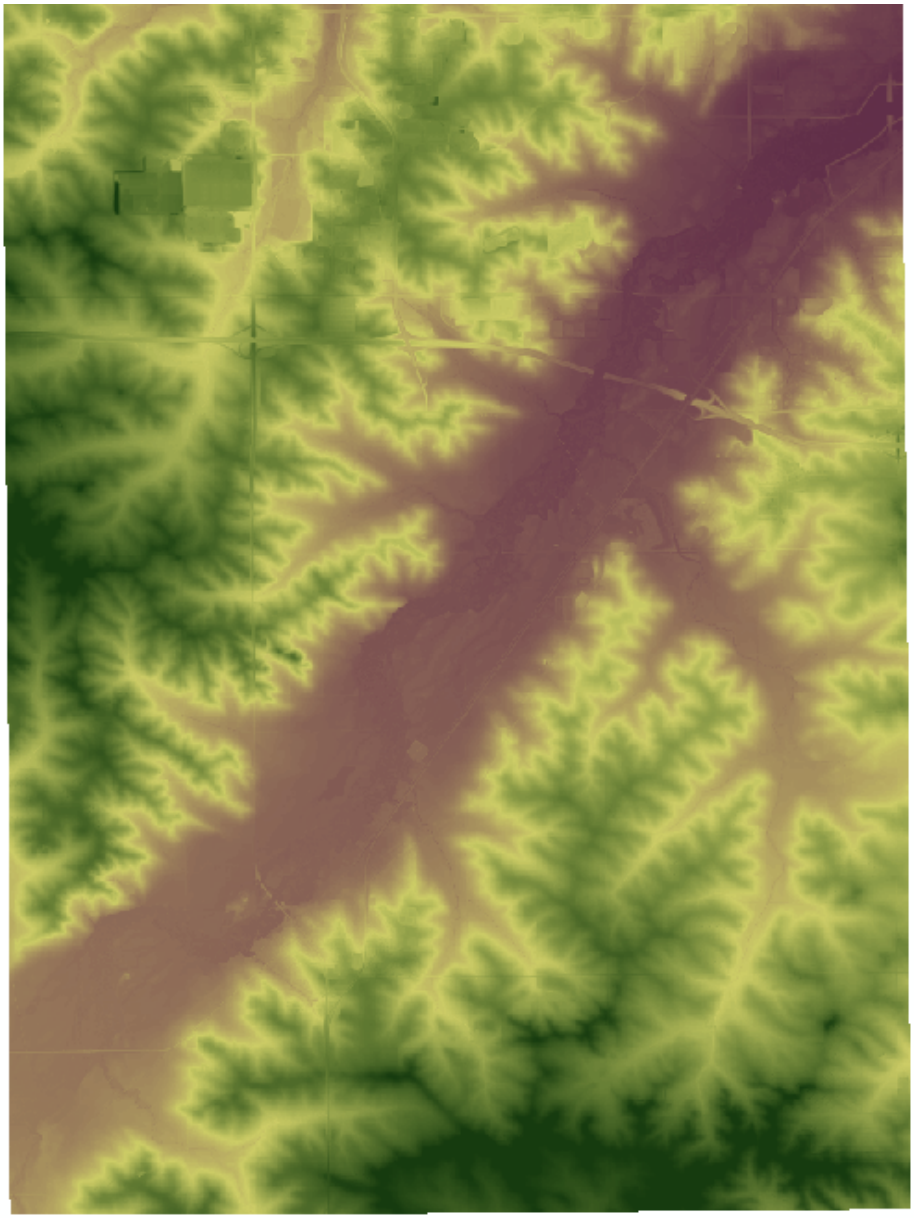


Figure 5. General LIDAR coverage exhibiting glacial uplands (green) and alluvial lowlands (purple) through topographic profiling

Results

From our field work we interpreted six mappable units. The six units include Qal, Qallt, Qwa2, Qnw, Qnw2, and Qe.

CENOZOIC

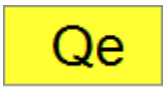
QUATERNARY SYSTEM

HUDSON EPISODE

 - Alluvium (DeForest Formation-Undifferentiated) Variable thickness of less than 1 to 5 m (3-16 ft) of very dark gray to brown, noncalcareous to calcareous, massive to stratified silty clay loam, clay loam, loam to sandy loam alluvium and colluvium in stream valleys, on hill slopes and in closed depressions. May overlie Noah Creek Formation, Wolf Creek or Alburnett formations or fractured Devonian carbonate bedrock. Associated with low-relief modern floodplain, closed depressions, modern drainageways or toeslope positions on the landscape. Seasonal high water table and potential for frequent flooding.

 - Low Terrace (DeForest Formation-Camp Creek Mbr. and Roberts Creek Mbr.). Variable thickness of less than 1 to 5 m (3-16 ft) of very dark gray to brown, noncalcareous, stratified silty clay loam, loam, or clay loam, associated with the modern channel belt of the Shell Rock and West Fork Cedar river valleys. Overlies the Noah Creek Formation. Occupies lowest position on the floodplain, ie. modern channel belts. Seasonal high water table and frequent flooding potential.

HUDSON and WISCONSIN EPISODE



- Sand dunes and Sand Sheets (Peoria Formation-sand facies) Generally less than 3 m (10ft) of yellowish brown, massive, calcareous loamy sand to fine sand. It may over lie yellowish-brown sand and gravel (Noah Creek formation) or reworked unnamed loamy sediments associated with the Iowa erosion Surface and/or it may overlie yellowish to grayish brown, often calcareous sand fractured clay loam to loam diamicton of the Wolf Creek and Alburnett formations

 - Sand and Gravel (Noah Creek Formation) Generally 2 to 8 m (6-26 ft) of yellowish-brown to gray, poorly to well sorted, massive to well stratified, coarse to fine feldspathic quartz sand, pebbly sand and gravel with few intervening layers of silty clay. A thin mantle of loess, reworked loess or fine-grained alluvium (Qal) may be present. This unit includes silty colluvial deposits derived from the adjacent map units. In places this unit is mantled with 1 to 3 m (3-10 ft) of fine to medium, well sorted medium to fine sand derived from wind reworking of the alluvium. This unit encompasses deposits that accumulated in low-relief stream valleys during the Wisconsin Episode and Hudson Episode. Seasonal high water table and some potential for flooding.

WISCONSIN EPISODE

 - Loamy and Sandy Sediment Shallow to Glacial Till (Unnamed erosion surface sediment) Generally 1 to 7 m (3-23 ft) of yellowish-brown to gray, massive to weakly stratified, well to poorly sorted loamy, sandy and silty erosion surface sediment. Map unit includes some areas mantled with less than 2 m (7 ft) of Peoria Formation materials (loess and eolian sand). Overlies massive, fractured, firm glacial till of the Wolf Creek and Alburnett formations. Seasonally high water table may occur in this map unit.

General Map Discussion

The majority of the Hudson Quadrangle may be characterized as an eroded glacial plain. Qwa2, or a loamy to sandy till sequence, makes up approximately 80% of the quadrangle. It was difficult to map in the urban regions of Waterloo as the construction of levees and other structures has greatly altered the surficial geology. The interpretation of the colluvial (Qnw2) was difficult to determine, but we believe that our interpretations are accurate based on our field work and available data.

Sources

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