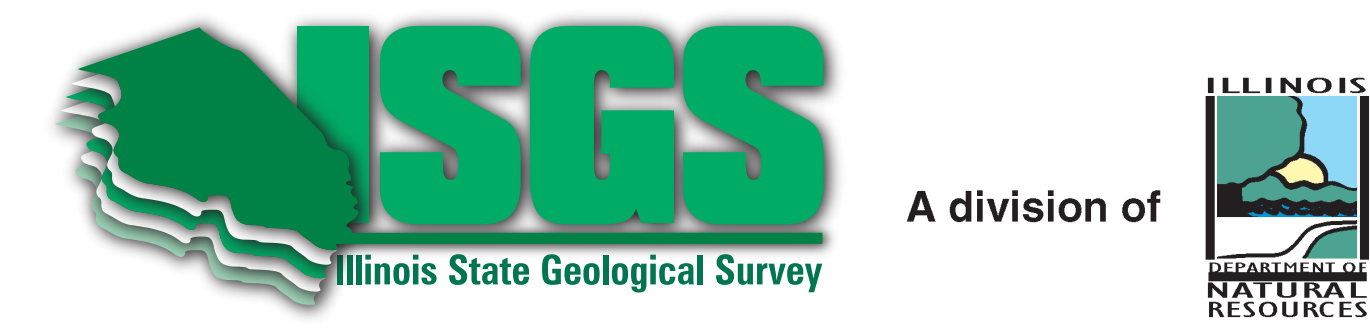


3-D Visualization of Bedrock Resources in Lake County, Illinois

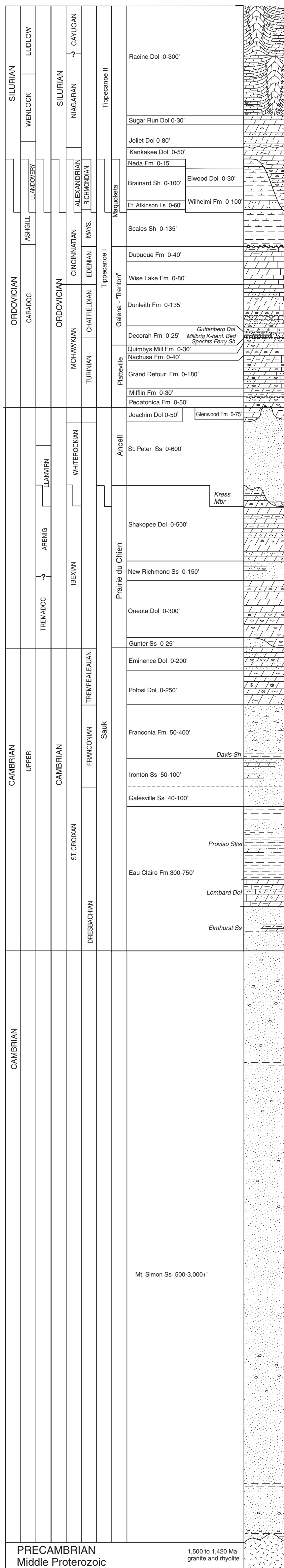
(Sheet 1 of 2) Open File Series 2003-12

Rod R. Blagojevich, Governor

Department of Natural Resources
Joel Brunsvold, Director
ILLINOIS STATE GEOLOGICAL SURVEY
William W. Shilts, Chief



Stratigraphic Column

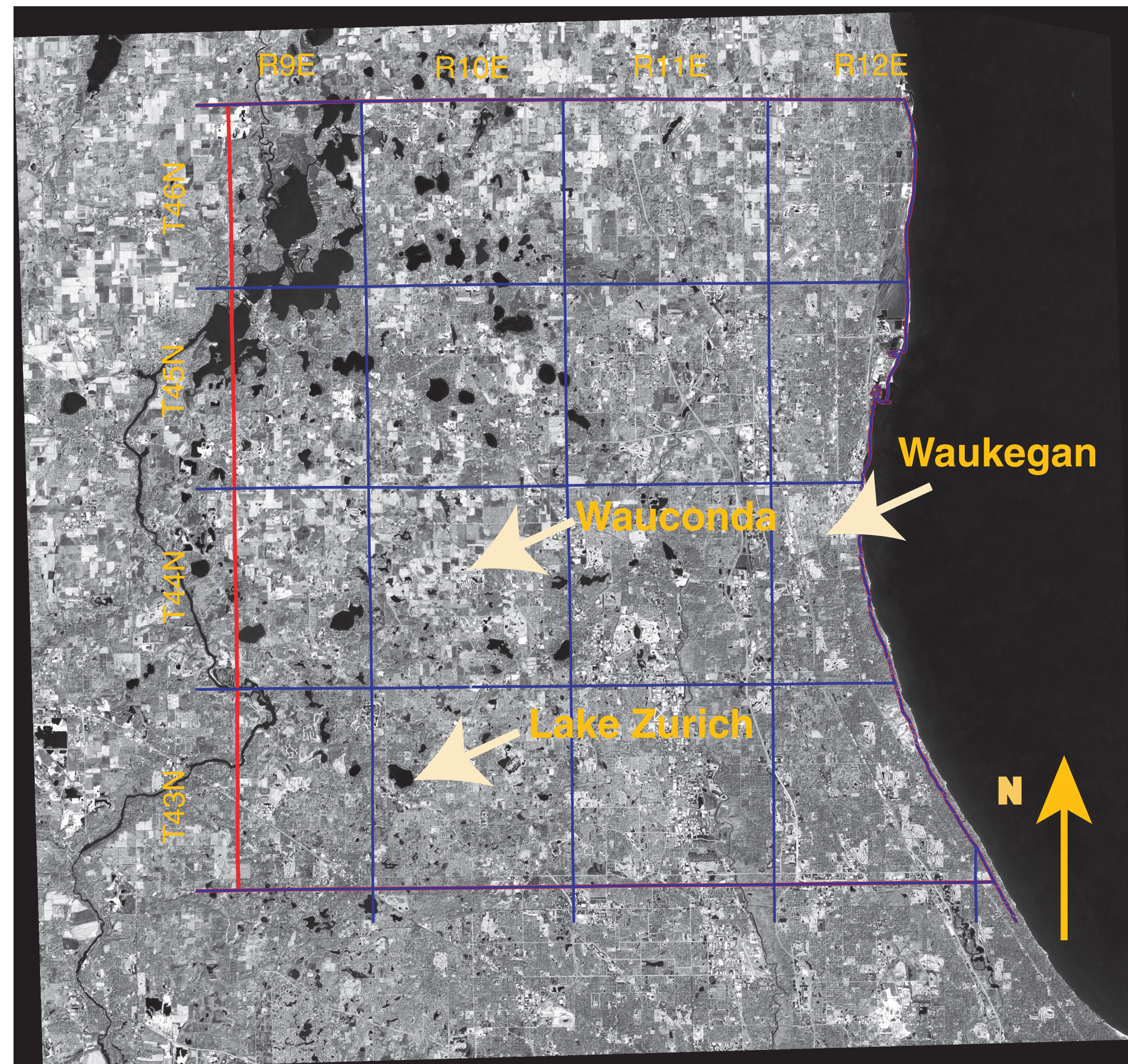


Map Compilation and Interpretation by:

Hannes E. Leetaru
Michael L. Sargent
Matthew H. Riggs
Dennis R. Kolata



Index Map



This image of Lake County, Illinois, was acquired by the Landsat 7 satellite on September 6, 1999, and is derived from the panchromatic channel of the L7 Thematic Mapper sensor. The ground spatial resolution is 15 m x 15 m (50 ft x 50 ft). The image has been ortho-corrected.

Introduction

According to the 2000 United States Census, Lake County is one of the fastest-growing counties in Illinois. Rapid urban expansion and its impact on the environment and mineral resources requires increasingly more detailed information about the bedrock geology in order to make informed planning decisions. In particular, the bedrock is a major source of water for residential, municipal, and industrial use. Consequently, key issues facing Lake County include the quality, quantity, distribution, and accessibility of bedrock groundwater resources. Other potential bedrock issues include underground construction as well as mineral resource assessment and management.

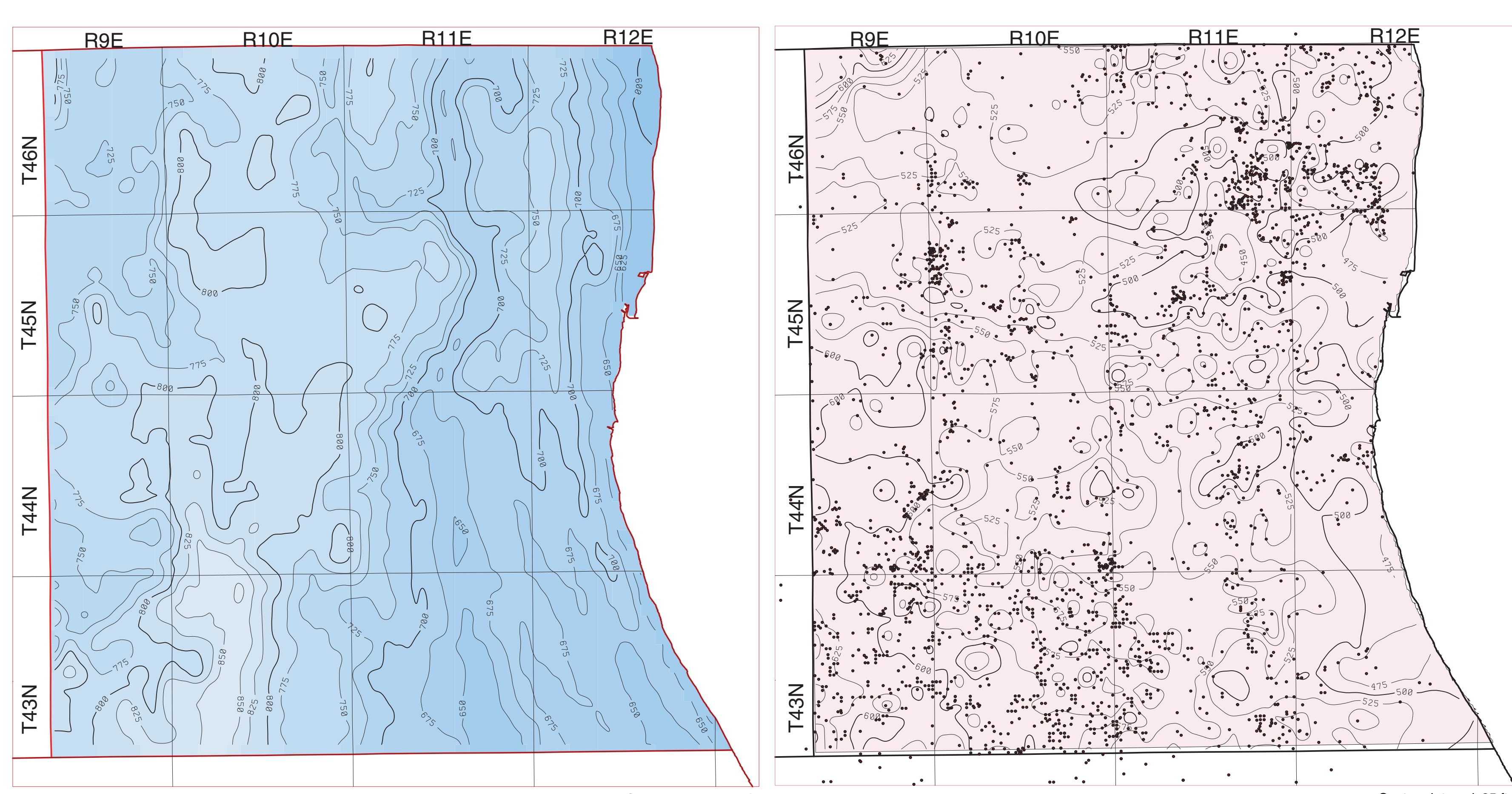
Lake County is situated on the eastern flank of the southward-plunging Wisconsin Arch and in the far western part of the Michigan Basin. All Paleozoic formations dip eastward away from the arch. Silurian rocks thicken eastward into the Michigan Basin and the underlying Cambrian and Ordovician strata thicken southward into the Illinois Basin. An exploratory hole drilled in the northeastern part of the county (U.S. Geological Survey No. 1 Illinois Beach State Park) penetrated approximately 3,400 feet of Silurian, Ordovician, and Cambrian sedimentary rocks (primarily of dolomite, sandstone, and shale) before encountering Precambrian granite. The bedrock is covered throughout the county by 75 to 300 feet of unconsolidated surficial deposits consisting of clay, silt, sand and gravel formed primarily by glacial processes. Silurian dolomite is present at the bedrock surface over the entire county, ranging in thickness from less than 20 feet in the southwestern part to more than 300 feet on the far eastern side. Silurian dolomite forms the uppermost bedrock aquifer in Lake County. The upper part of the dolomite has a large number of fractures, crevices, and solution cavities which tend to yield moderate amounts of water. Higher yields are obtained from the more deeply buried St. Peter Sandstone, Ironton-Galesville Sandstone, and the upper part of the Mt. Simon Sandstone (Larsen, 1973).

Purpose

The principal objective of this mapping effort is to compile a subsurface database that can be used to depict in three dimensions the thickness, distribution, and structure of the major bedrock units in Lake County. Such a database can be used to produce 3-D maps and cross sections down to the top of the Precambrian crystalline rocks. It is anticipated that the database and the maps and models produced from the database will provide important insight to subsurface conditions in Lake County.

Methods

Formation tops were determined for approximately 1,600 drill hole records on file at the Illinois State Geological Survey. The information was entered into a digital database and used to compile county-wide structure and thickness maps, cross sections, 3-D block diagrams, and a stratigraphic column. The data are displayed in Lambert Conformable projection.

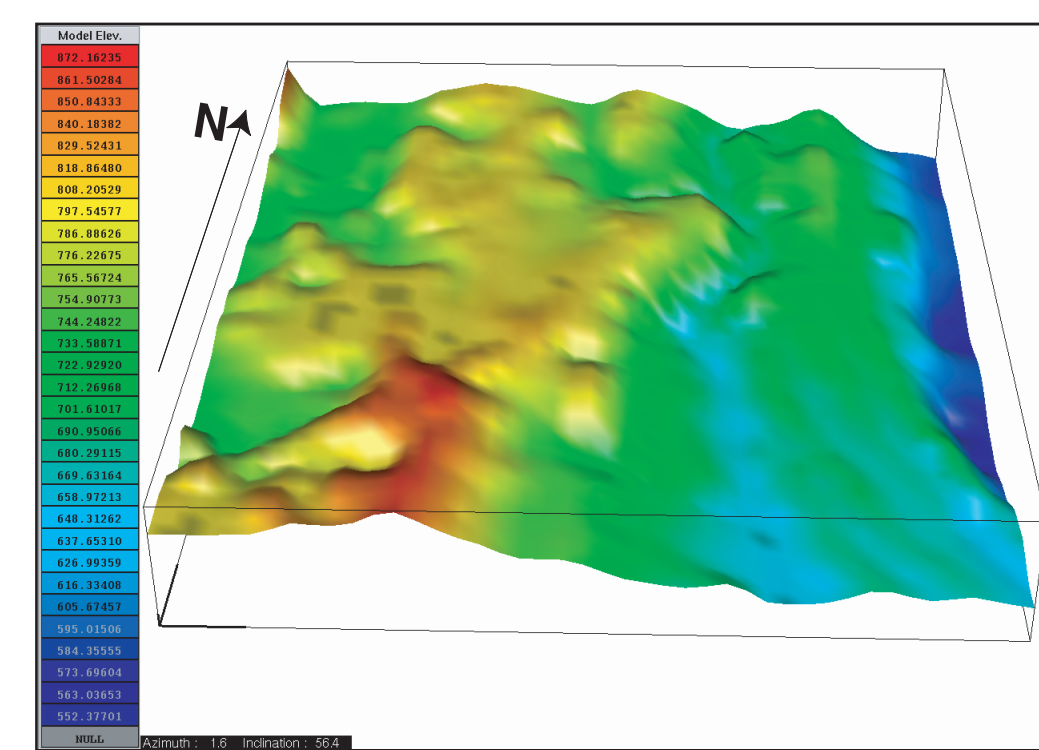


Surface Elevation

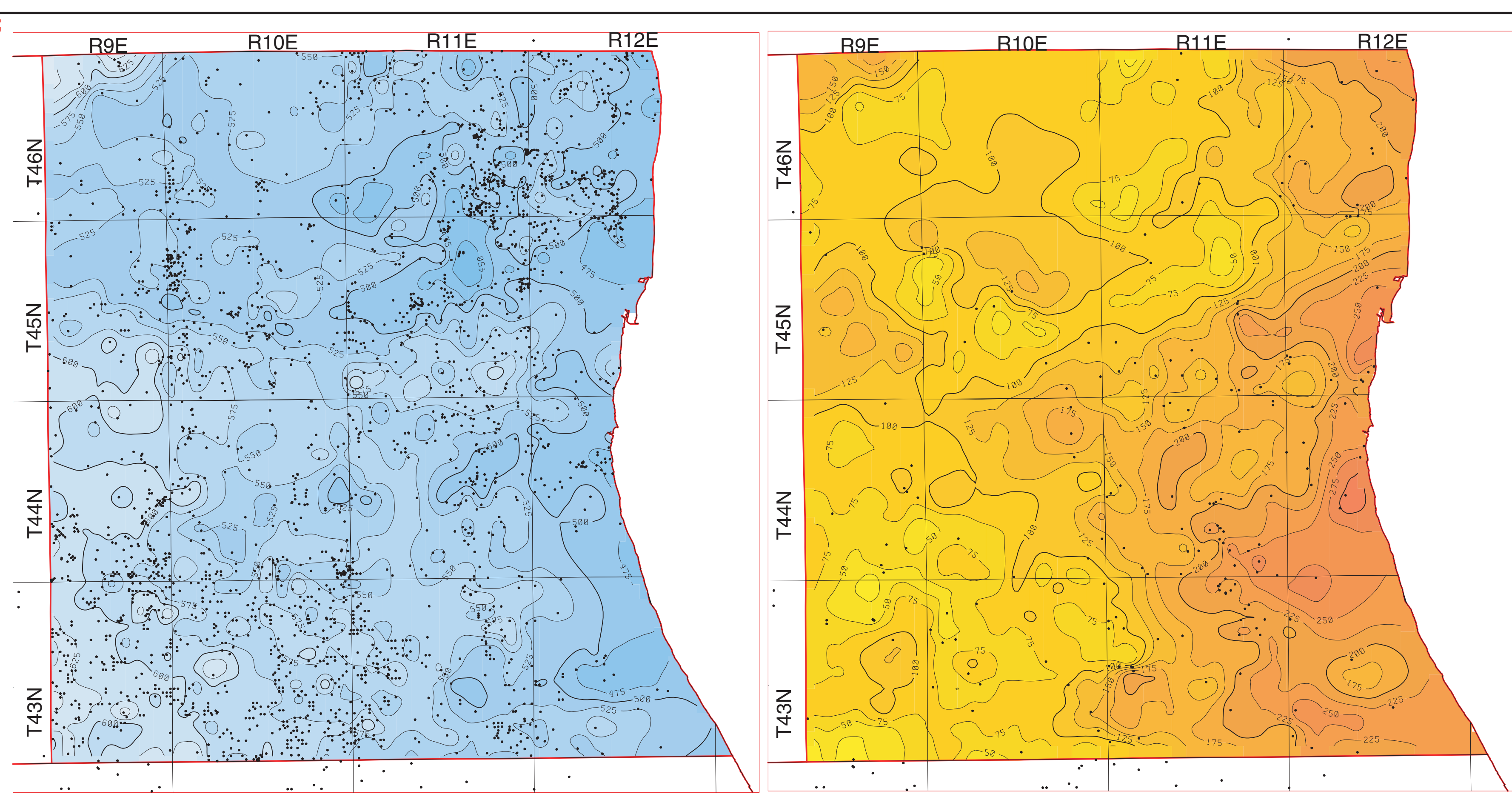
Bedrock Topography and Bedrock Geology

Quaternary

Pleistocene glacial processes significantly modified the topography of Lake County. The sand and gravel beds within these glacial deposits are important aquifers for residential development within Lake County. These aquifers are commonly discontinuous and are interbedded with lake and till sediment that form aquitards.



3-D Representation of the Surface Topography

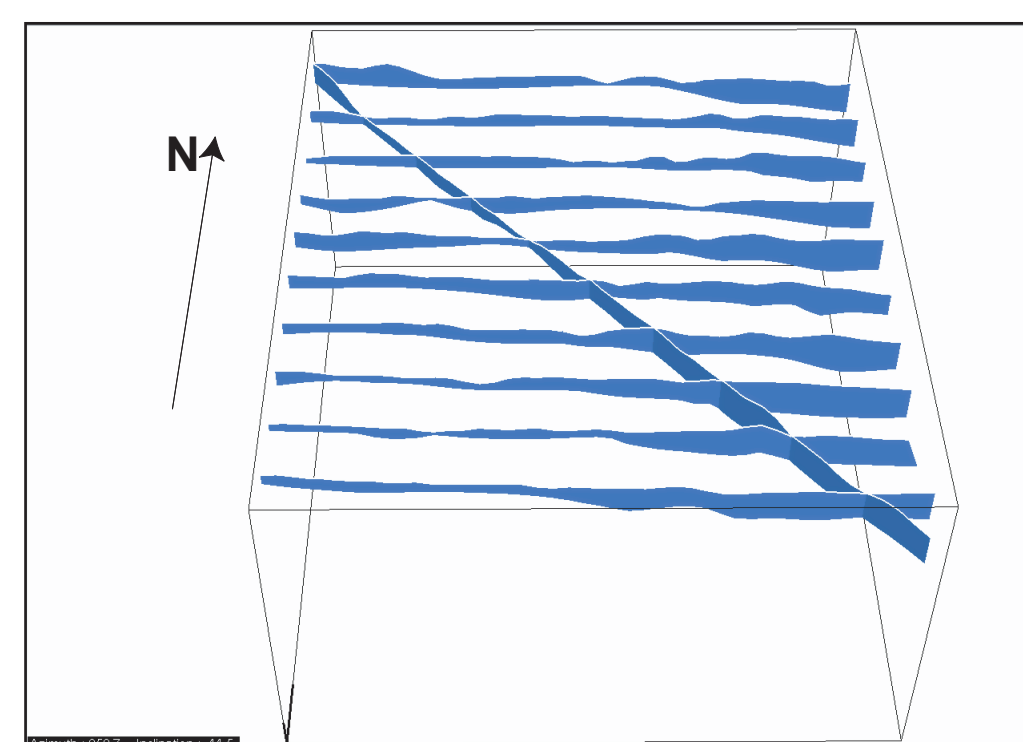


Bedrock Topography

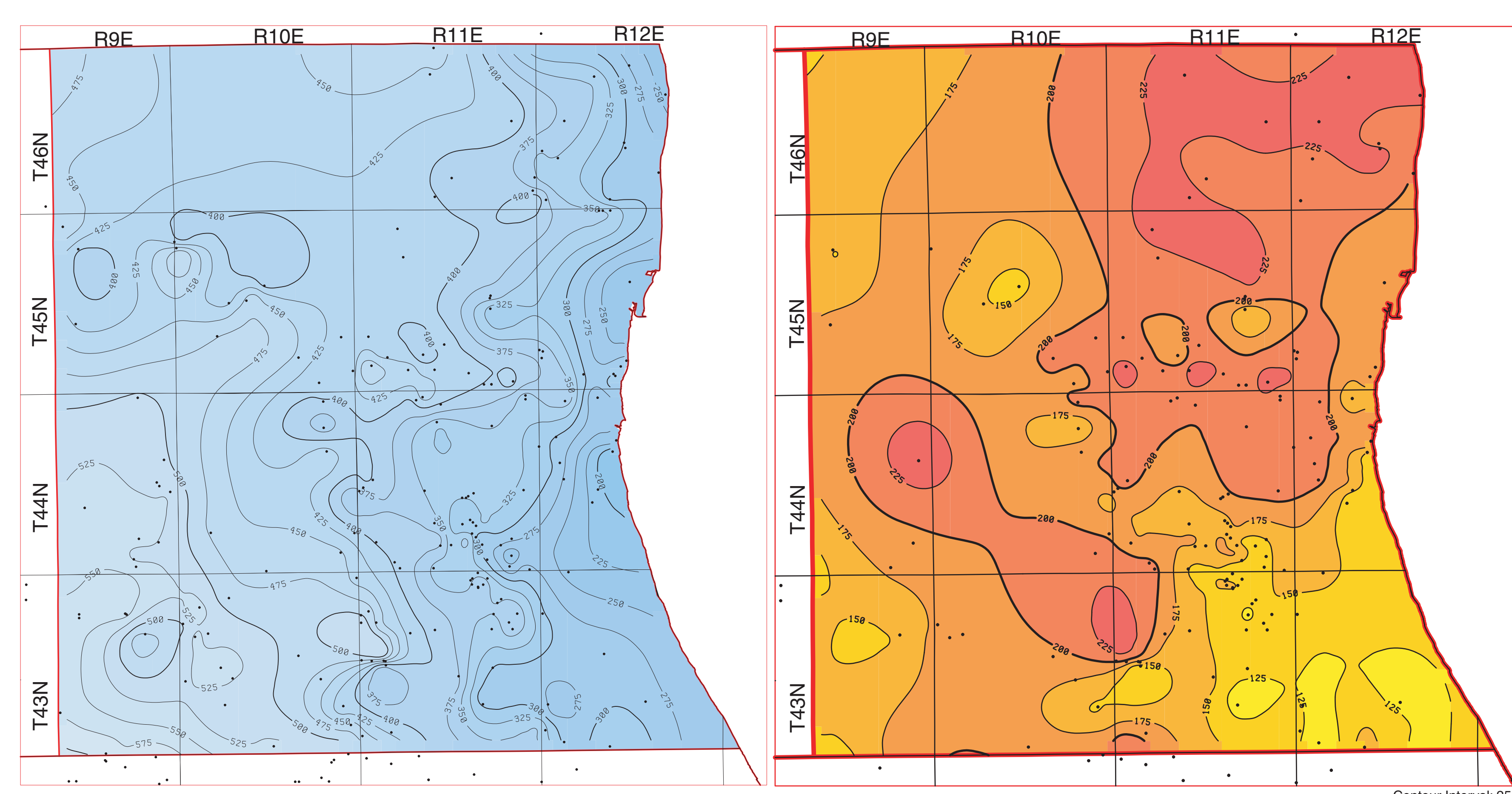
Thickness of Silurian

Silurian

Silurian rocks, consisting mainly of pure to silty dolomite, form the most important bedrock aquifer supplying residences in Lake County. Local porosity and permeability is mainly the result of fractures and dissolution cavities in the dolomite. There is little to no matrix porosity; therefore the dolomite does not have adequate capacity for municipal water wells. The water is recharged locally from precipitation and is susceptible to groundwater contamination.



3-D Representation of the Thickness of the Silurian Age Strata

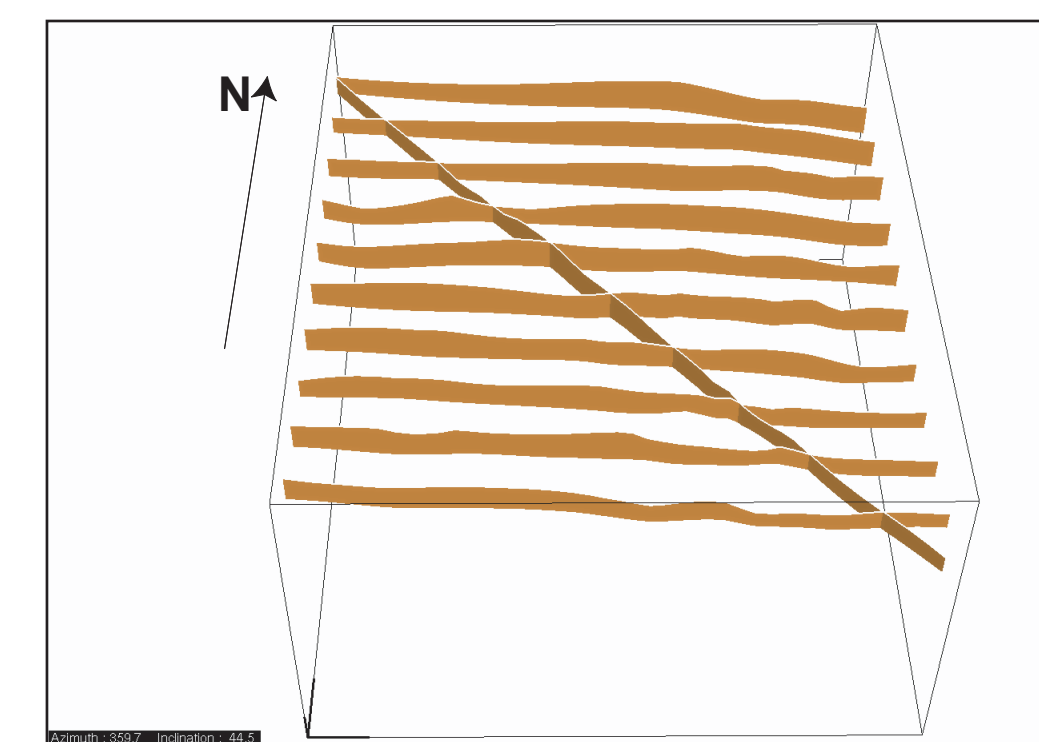


Top of the Maquoketa Formation

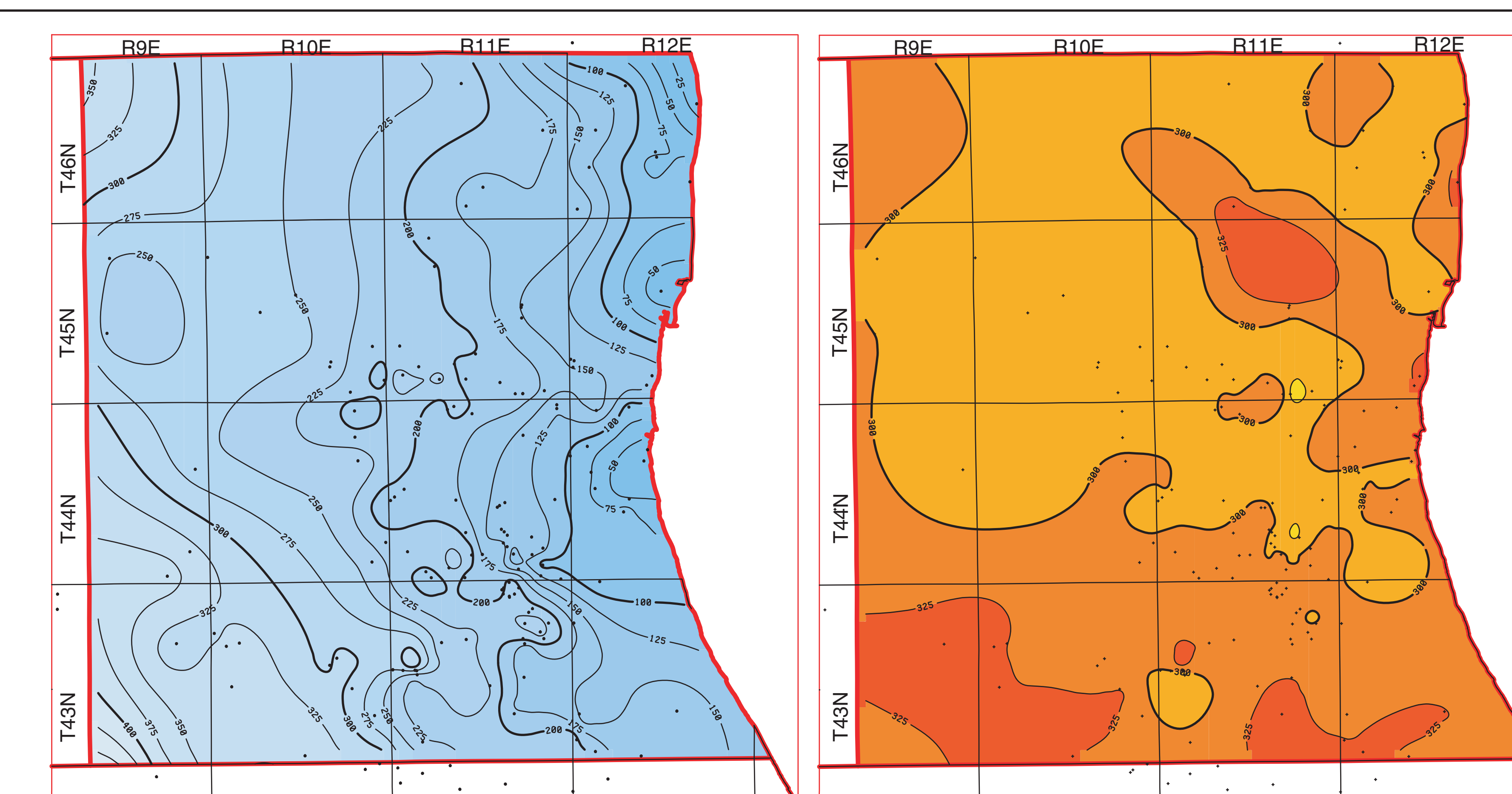
Thickness of the Maquoketa Formation

Maquoketa Formation

The Maquoketa is composed of impermeable to low permeability shales and dolomites that form an important aquitard between the locally recharged Silurian aquifer and the deeper bedrock aquifers.



3-D Representation of the Thickness of the Maquoketa Formation

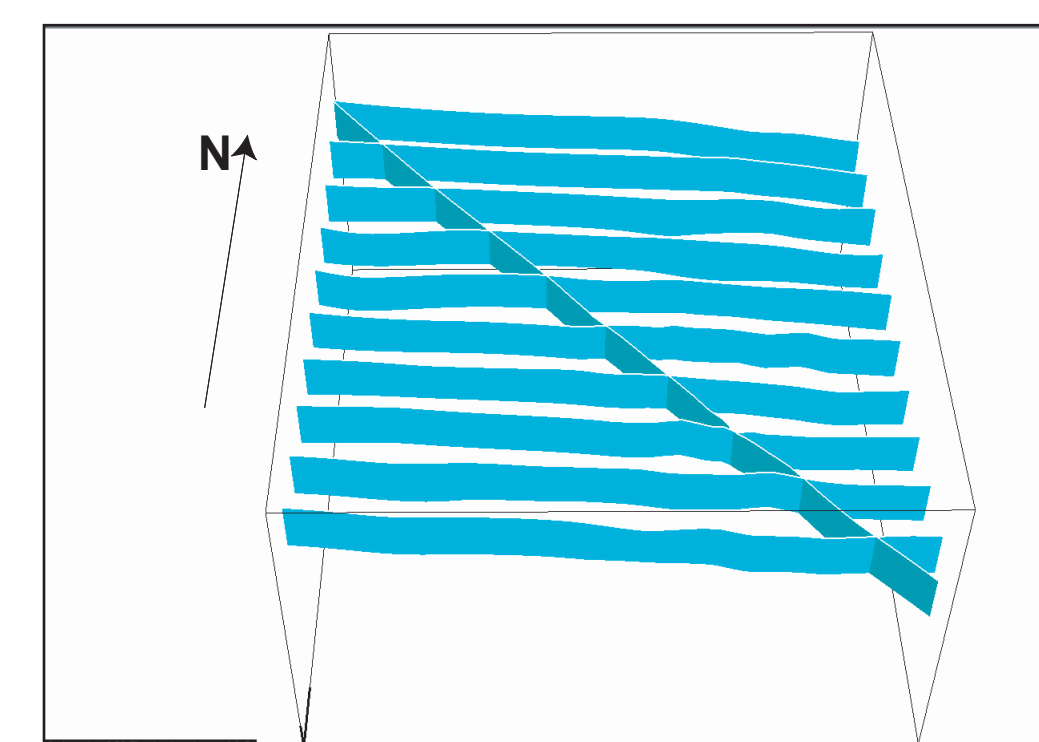


Top of the Galena Limestone

Thickness of the Galena-Platteville Interval

Galena-Platteville Interval

In this study, the Galena and Platteville are combined into a single map unit because they have similar physical characteristics. In Lake County, these rocks consist of relatively pure fine- to medium-grained dolomite with low permeability and porosity.



3-D Representation of the Thickness of the Galena-Platteville Interval

3-D Visualization of Bedrock Resources in Lake County, Illinois

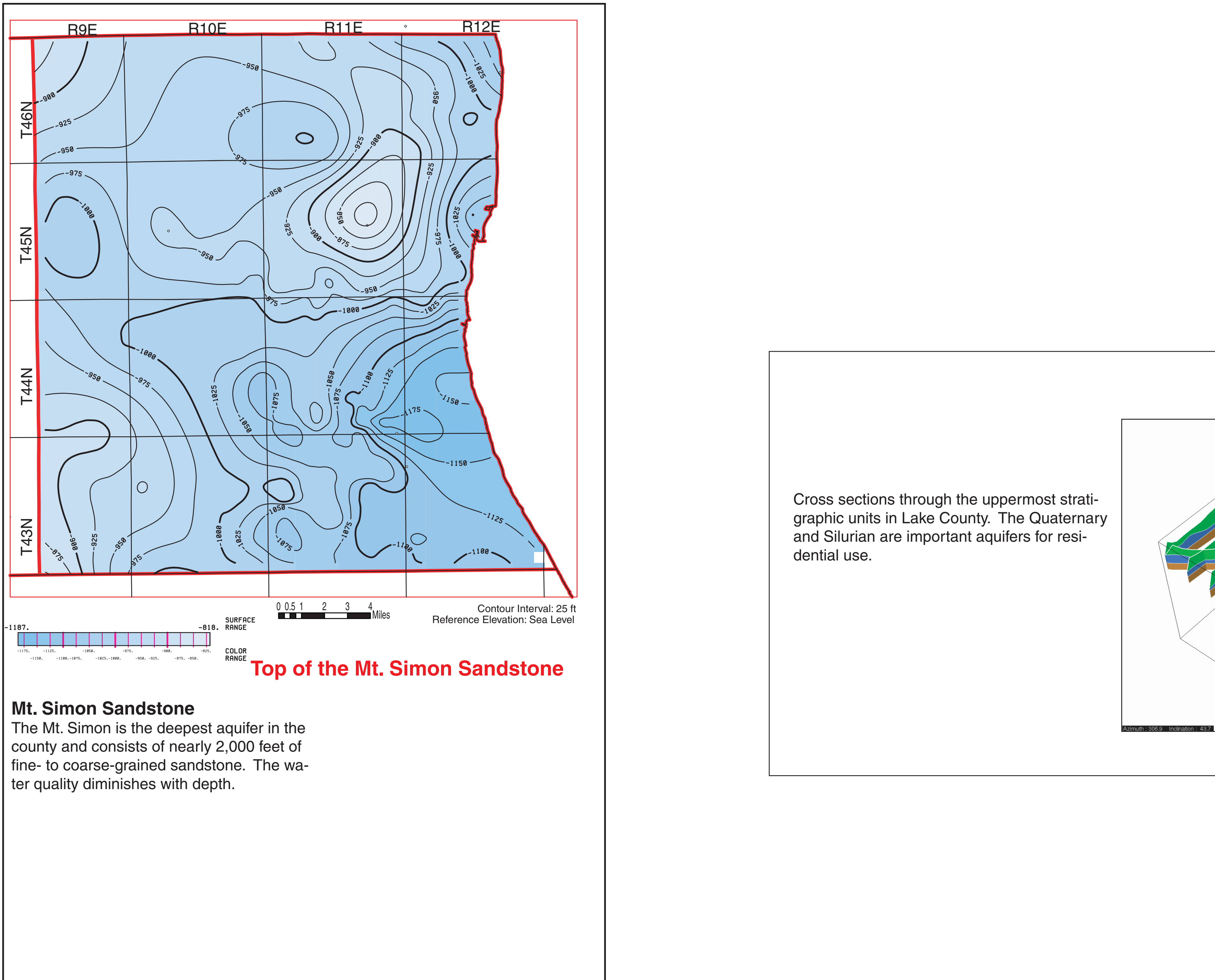
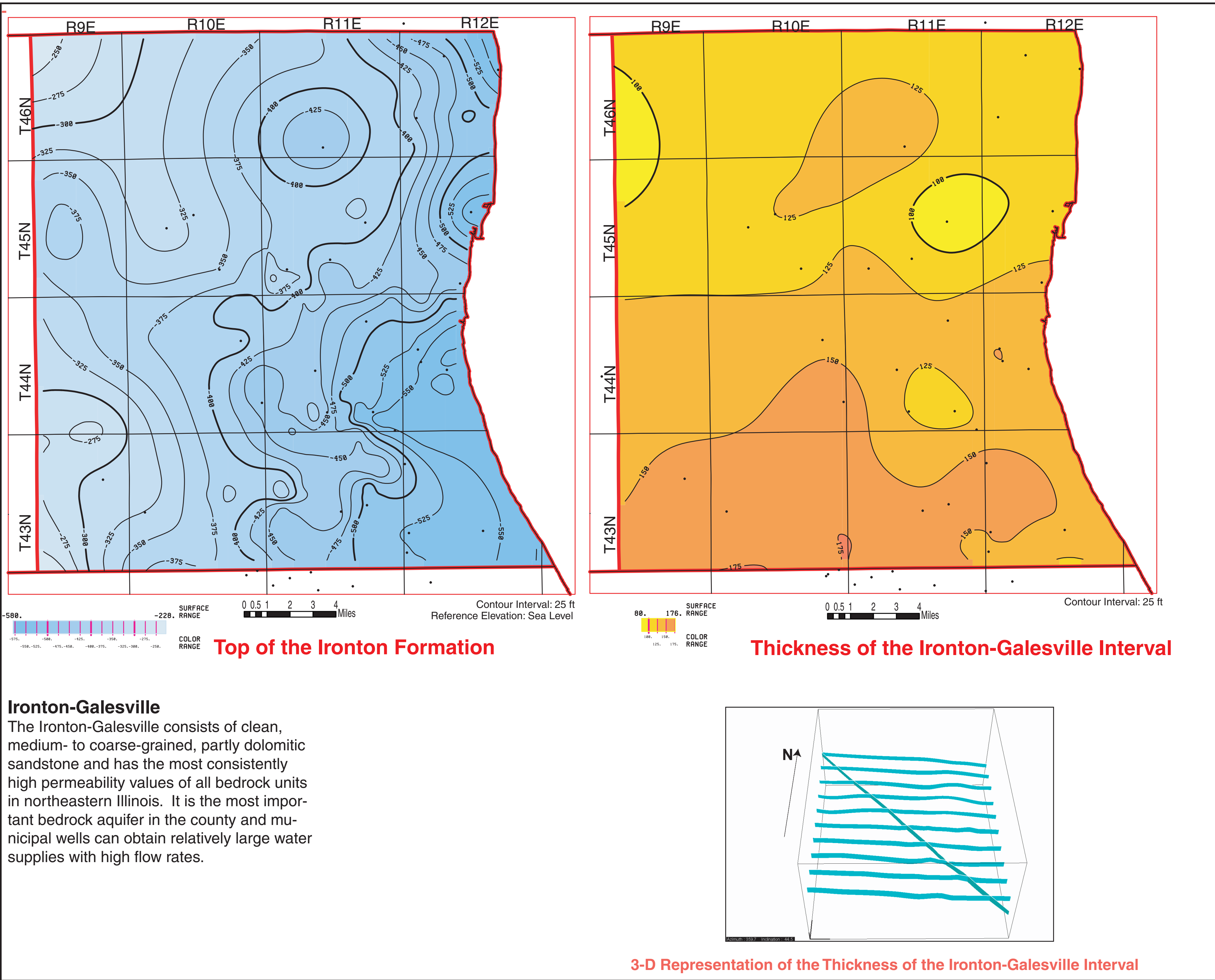
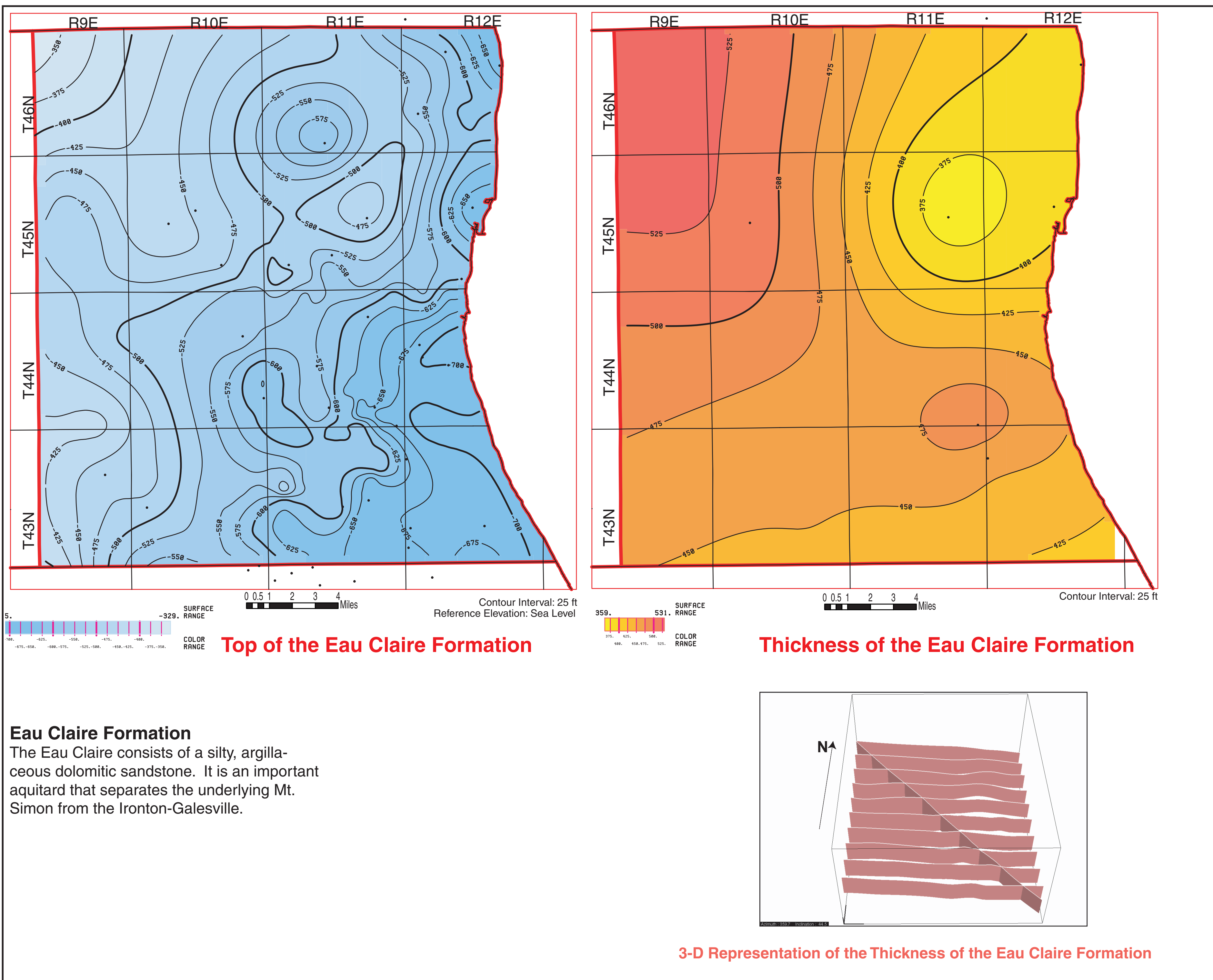
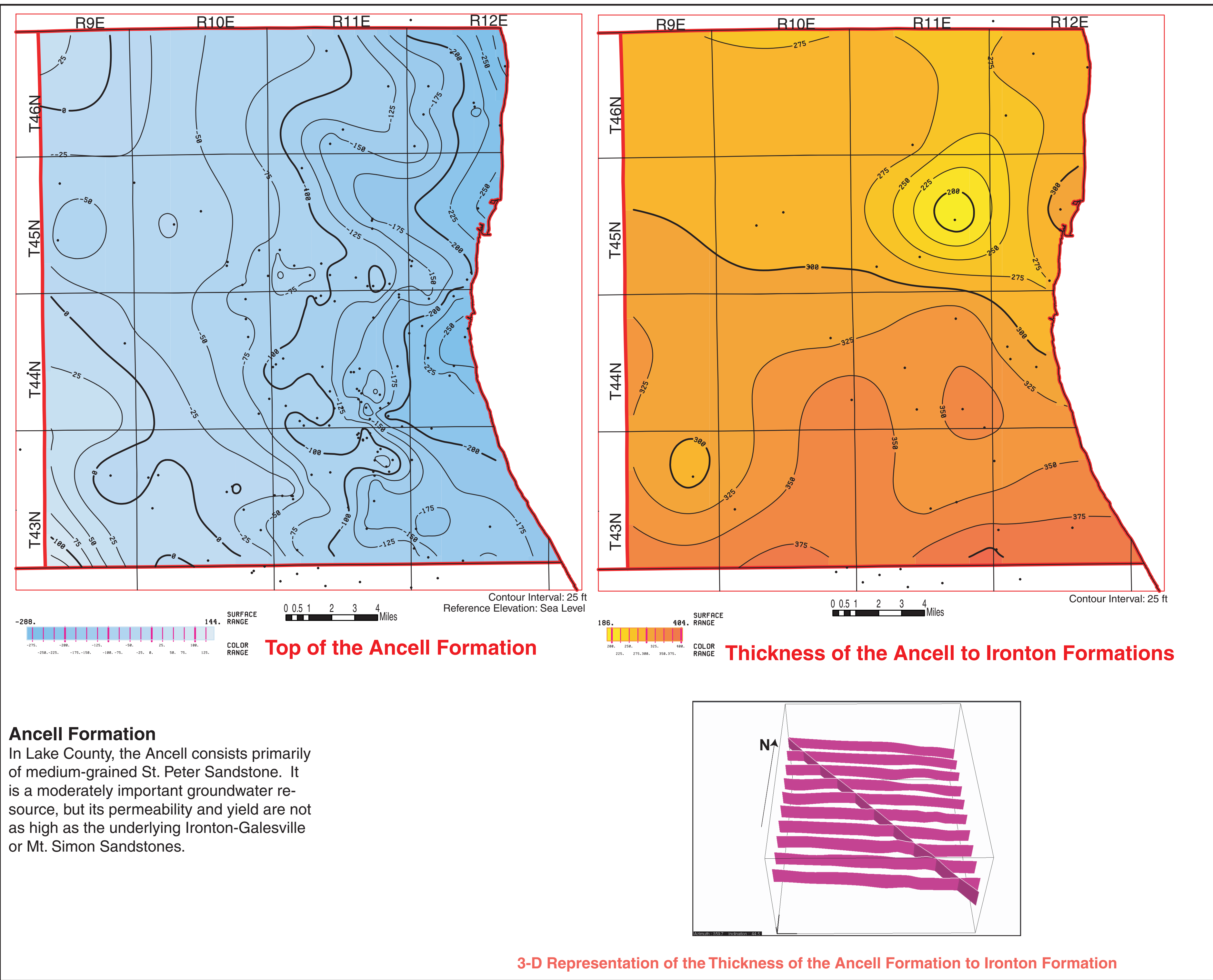
(Sheet 2 of 2) Open File Series 2003-12

This presentation includes the following:

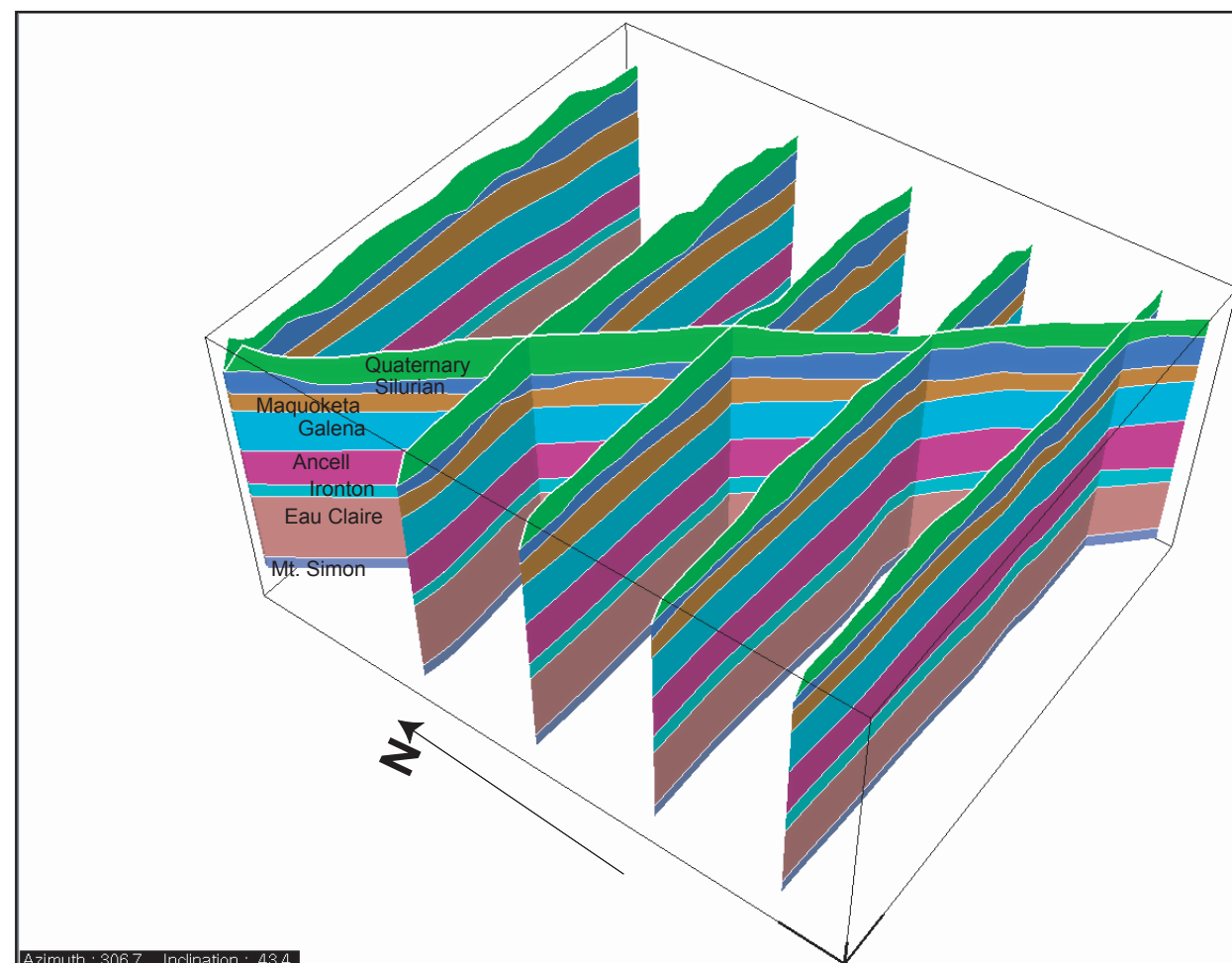
1. Landsat 7 Satellite Image - Obtained on September 6, 1999, from Panchromatic channel of the L7 Thematic Mapper sensor.
2. Land Surface Topography - The land surface throughout Lake County and surrounding areas of northeastern Illinois was shaped by advancing and retreating glaciers mainly during the past 20,000 years. Glacial deposits of clay, silt, sand, and gravel cover the Silurian bedrock. The sand and gravel locally forms productive aquifers whereas the clay and silt tends to impede the movement of water.
3. Bedrock Topography and Geology - The sea level elevation of the top of bedrock is derived from drill-hole records. The bedrock surface in Lake County lies on top of Silurian dolomite formations and below unconsolidated glacial deposits.
4. Structure Contours - This series of maps shows lines of equal sea-level elevations for selected bedrock units including the (1) Maquoketa, (2) Galena (Trenton), (3) Ancell, (4) Ironton-Galesville, (5) Eau Claire, and (6) Mt. Simon.
5. Thickness (isopach) Contours - These maps show lines of equal thickness for the (1) Silurian dolomite formations, (2) Maquoketa, (3) Galena and Platteville, (4) base of the Ancell to the top of the Ironton-Galesville, (5) Ironton-Galesville, and (6) Eau Claire.
6. Cross Sections - Landmark's Zmap+ and Stratamodel software were used to construct the fence diagrams of selected bedrock units.
7. 3-D Block Diagrams - This series of diagrams was also prepared with Landmark Zmap+ and Stratamodel software and shows individual block models of the (1) Silurian dolomite formations undifferentiated, (2) Maquoketa, (3) Galena-Platteville, (4) Ancell, (5) Ironton-Galesville, and (6) Eau Claire.
8. Stratigraphic column shows lithologic symbols, thicknesses, and lithostratigraphic and chronostratigraphic nomenclature.

References

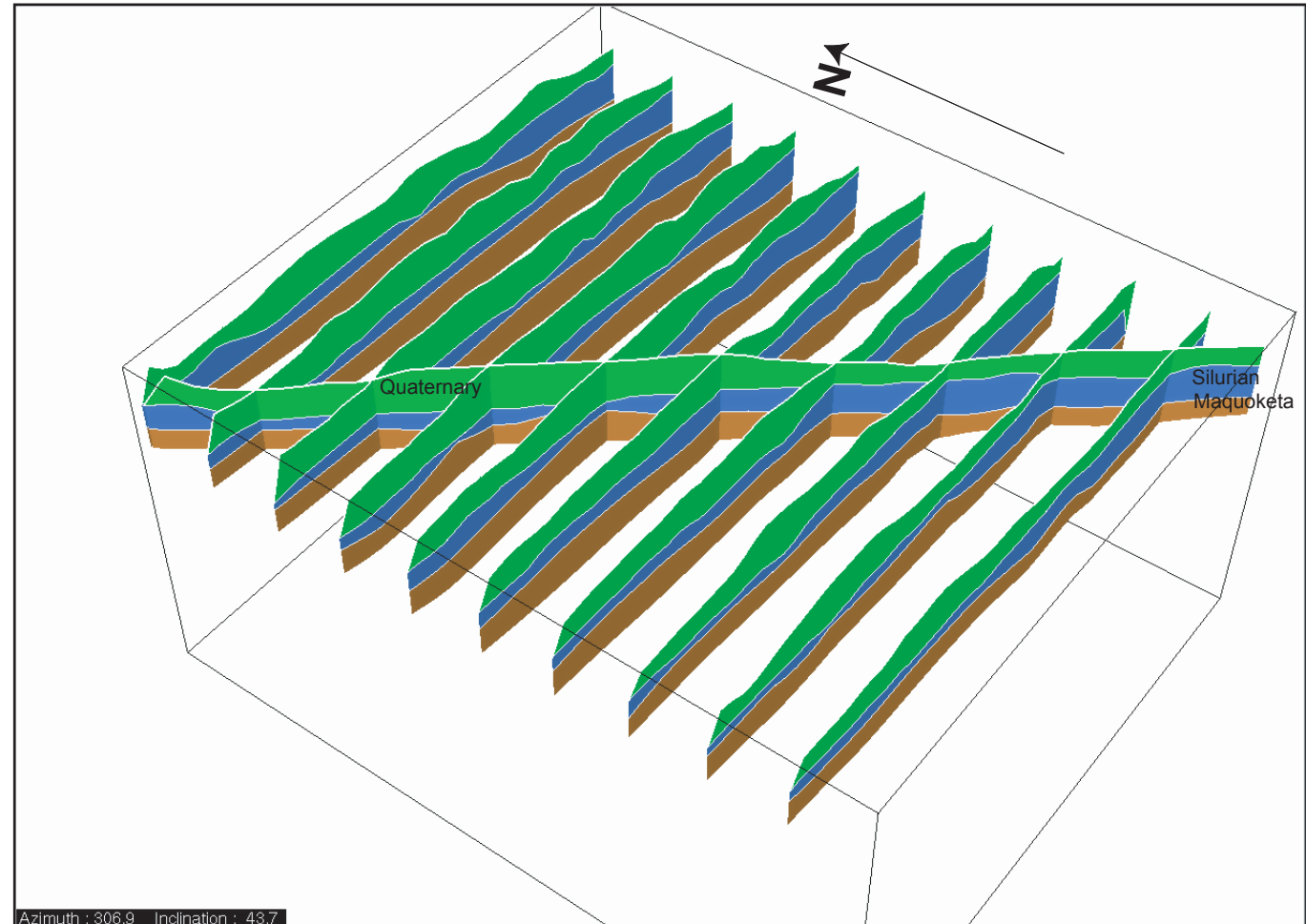
- Bushbach, T.C., 1964, Cambrian and Ordovician strata of northeastern Illinois: Illinois State Geological Survey, Report of Investigations 218, 90 p.
- Hughes, G.M, P. Kraatz, and R.A. Landon, 1966, Bedrock aquifers of northeastern Illinois: Illinois State Geological Survey, Circular 406, 15 p.
- Larsen, J.I., 1973, Geology for planning in Lake County, Illinois: Illinois State Geological Survey, Circular 481, 43 p.



Cross sections through stratigraphic units in Lake County illustrating the morphology of important aquifers and aquitards.



Cross sections through the uppermost stratigraphic units in Lake County. The Quaternary and Silurian are important aquifers for residential use.



Acknowledgments

Curtis Abert, Donald Luman, and Christopher McGarry helped to develop this series of maps. Part of the mapping was done using Landmark Graphics software as part of the Landmark University Grant program to the University of Illinois at Champaign-Urbana.

Disclaimer

This series of maps was prepared for the purposes of geological mapping, resource evaluation, and regional planning. It is based on interpretation of available data obtained from a variety of sources. Locations have not been field verified nor have the data been rigorously reviewed. The Illinois State Geological Survey does not guarantee the accuracy of the unverified data and the interpretations based upon them.