Geologic Atlas of Cook County for Planning Purposes

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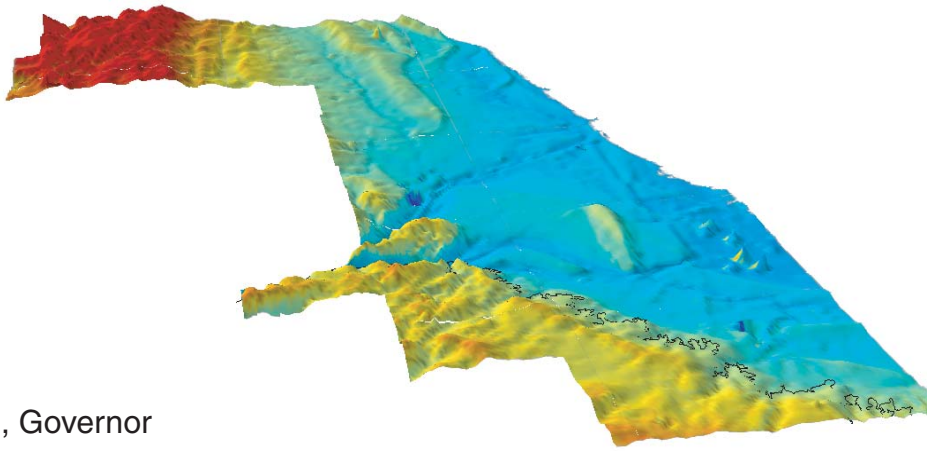
July 27, 2004



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A division of ILLINOIS DEPARTMENT OF NATURAL RESOURCES

CENTRAL GREAT LAKES GEOLOGIC MAPPING COALITION

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Introduction

The impacts of rapid urban expansion on the environment and on our ability to extract essential mineral resources require increasingly more detailed information about the bedrock geology in order to make informed planning decisions. In Cook county, the bedrock is a major source of water for residential, municipal, and industrial use. Consequently, key issues facing Cook County include the quality, quantity, distribution, and accessibility of bedrock groundwater resources. Other important bedrock issues include underground construction as well as mineral resource assessment and management.

Cook County is situated on the eastern flank of the southward-plunging Wisconsin Arch. Silurian rocks thicken eastward into the Michigan Basin and the underlying Cambrian and Ordovician strata thicken southward into the Illinois Basin. The bedrock in Cook County is covered by up to 300 feet of unlithified surficial materials consisting of clay, silt, sand and gravel deposited primarily by glacial processes. Silurian dolomite is present at the bedrock surface over nearly the entire county. These rocks range in thickness from zero in small areas in the northwestern part of the county to more than 300 feet on the far eastern side along the lake shore. Silurian dolomite forms the uppermost bedrock aquifer in Cook County. The upper part of the dolomite has numerous fractures, crevices, and solution cavities which can to yield moderate amounts of water to a well. Higher yields are obtained from the more deeply buried Ordovician St. Peter Sandstone, the Cambrian Ironton-Galesville Sandstone, and the upper part of the Mt. Simon Sandstone, which is also Cambrian.

Purpose

The principal objective of this mapping effort was to compile a database that can be used to depict, in three dimensions, the thickness, distribution, lithologic character and structure of the major bedrock units in Cook County. The a database can be used to produce 3-D maps and cross sections of the complete

succession of Paleozoic rocks down to the top of the underlying 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 Cook County.

Methods

Formation tops were determined for approximately 5,900 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 the Lambert Conformable Projection.

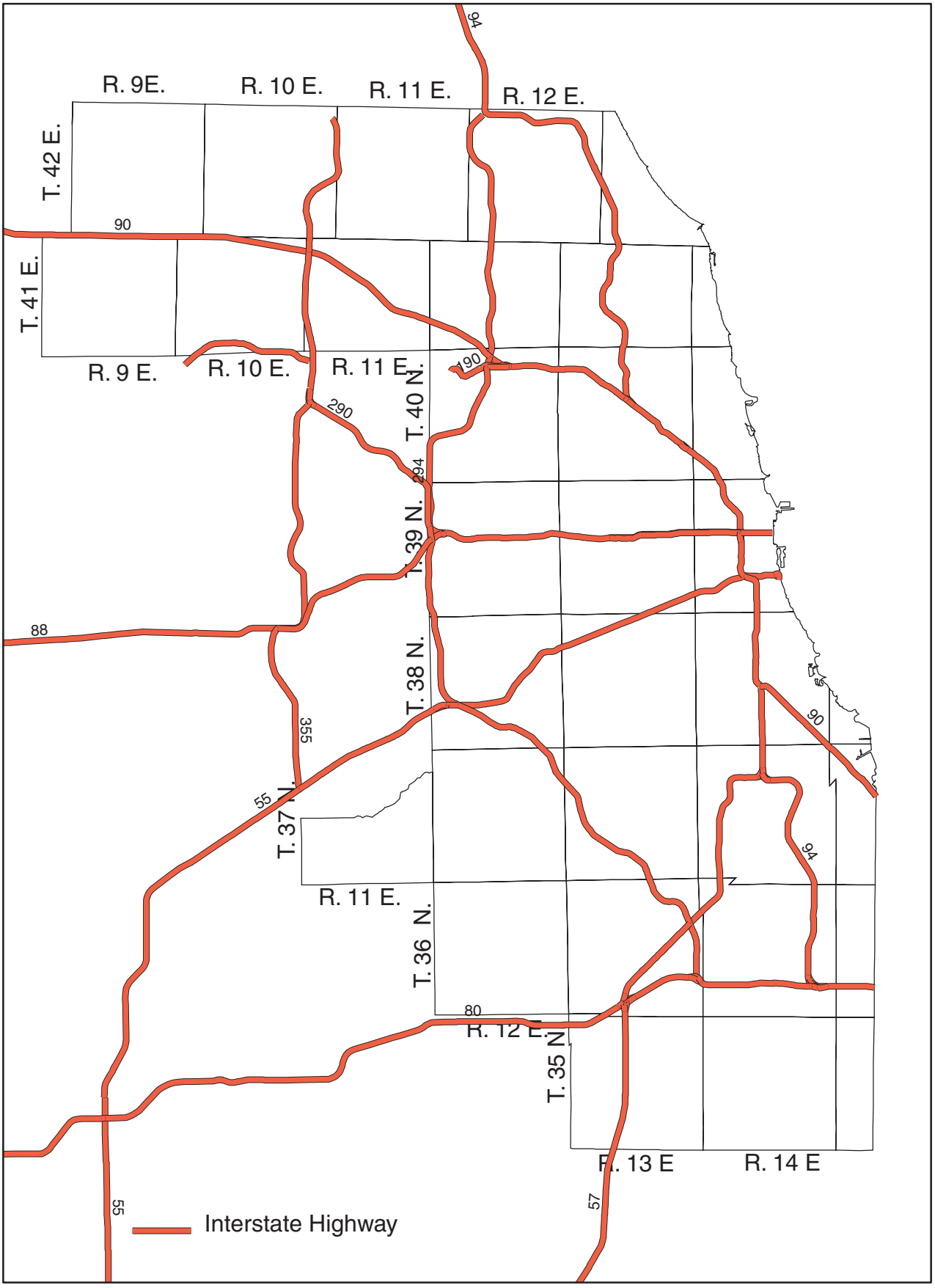
Acknowledgments

Curtis Abert, Ardith Hansel, and Barbara Stiff helped to develop this series of maps. Part of the mapping was done using Landmark Graphics software donated to the University of Illinois at Urbana-Champaign, as part of the Landmark Graphics university grant program. The manuscript benefited from comprehensive review by Robert Finley and Jonathan Goodwin.

Disclaimer

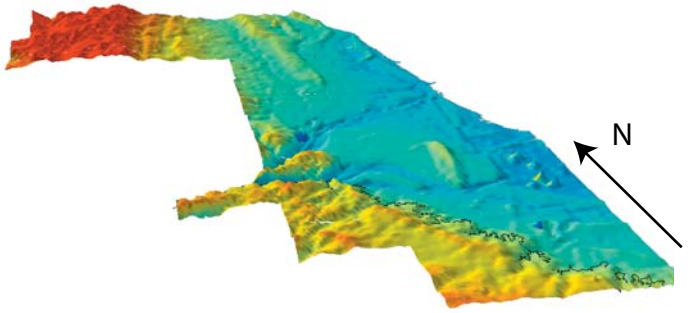
This series of geologic maps was prepared for the purposes of resource evaluation and regional planning. The maps are based on interpretations of available data that were obtained from a variety of sources. Locations of data points have not been field-verified, nor have the data been rigorously reviewed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

Regional geology of Illinois and significant surrounding structrual features. Cook County is colored in red.



Location of interstate highways in Cook County, Illinois.

Topography

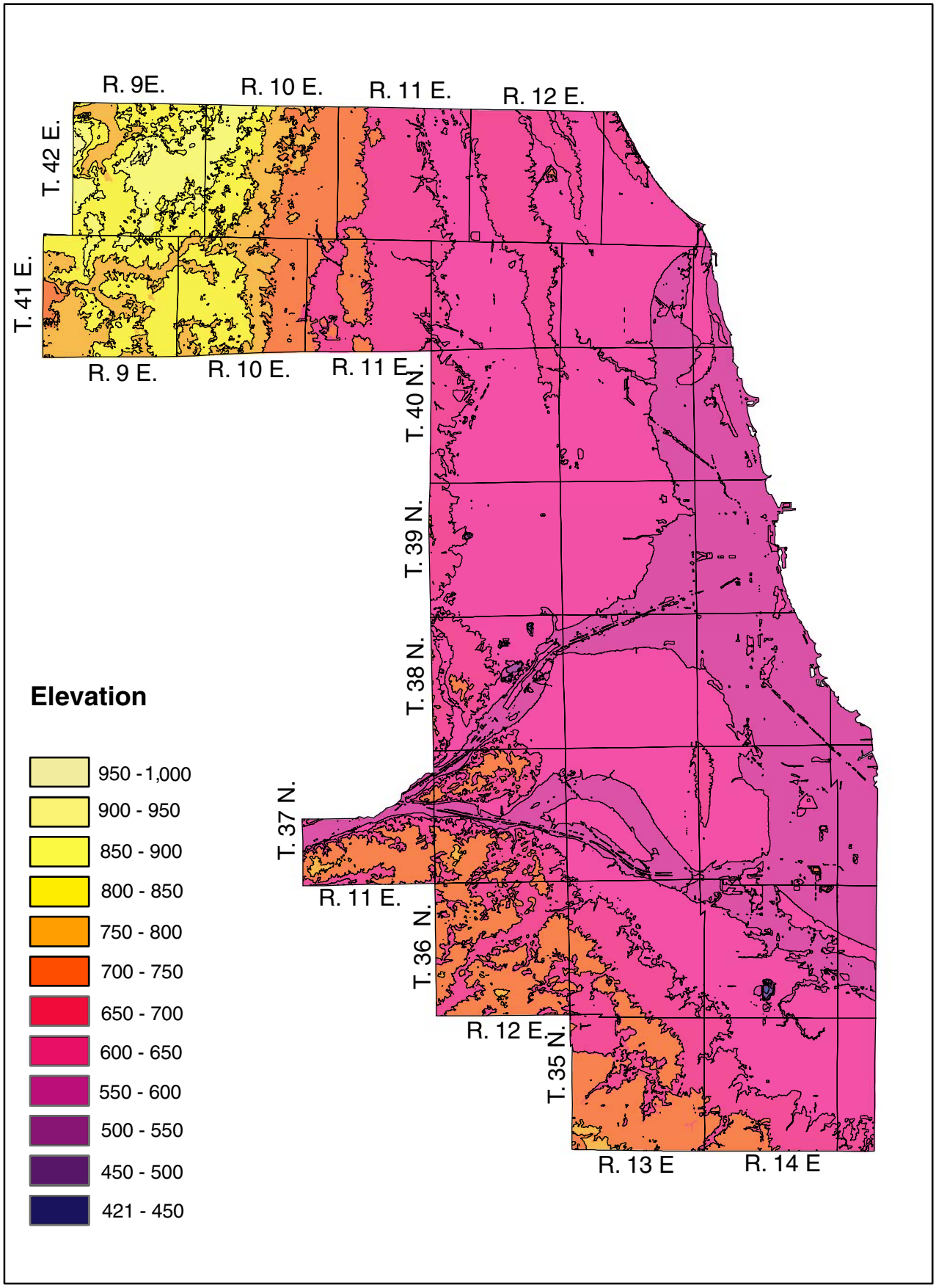


3-D representation of surficial topography in Cook County. Red colored areas are high and blue are low.

Discussion

The landforms of Cook County are mostly the result of depositional glacial processes. The significant topographic features includebroad almost level plains that were once lake beds; concentric, subparallel ridges formed as moraines marking the outer margins of continental glaciers, and gentle, elongate sandyspits, bars and beach ridges formed along the shore of glacial Lake Chicago and other ancestors of present day Lake Michigan.

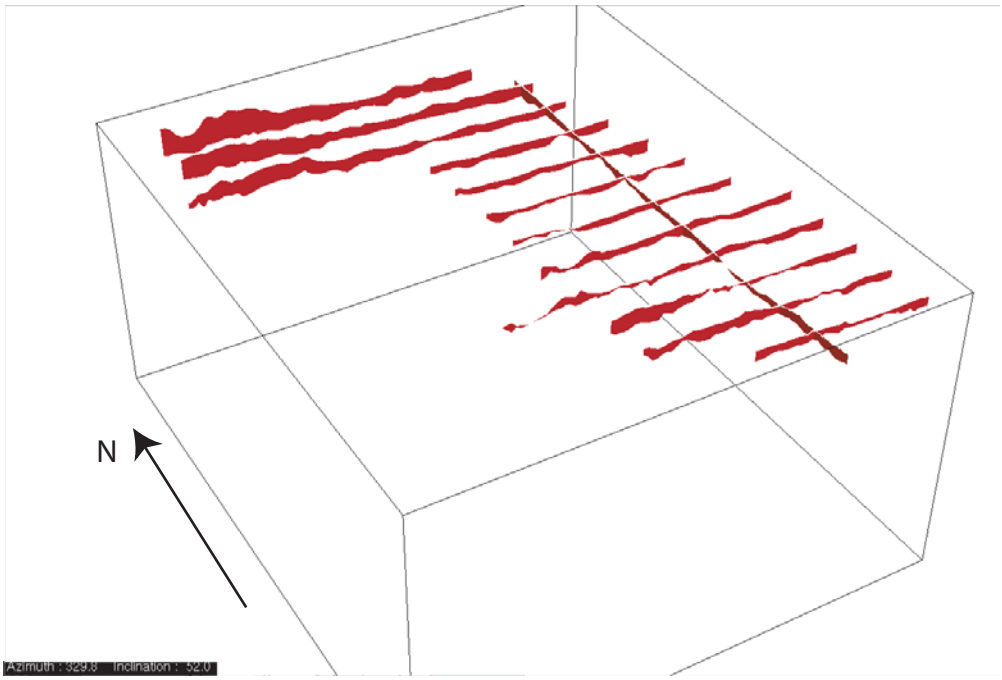
The highest point in Cook County is at the northwest corner and is almost 1000 feet above sea level. For most of the county the topography slopes gradually toward Lake Michigan to the east and is dissected by north-south trending stream-cut valleys. Most of the central and southeastern portion of Cook County is composed of a low flat plain.



Contour Interval: 50 ft

0 2 4 8 12 16 20 24 Miles

Quaternary Deposits



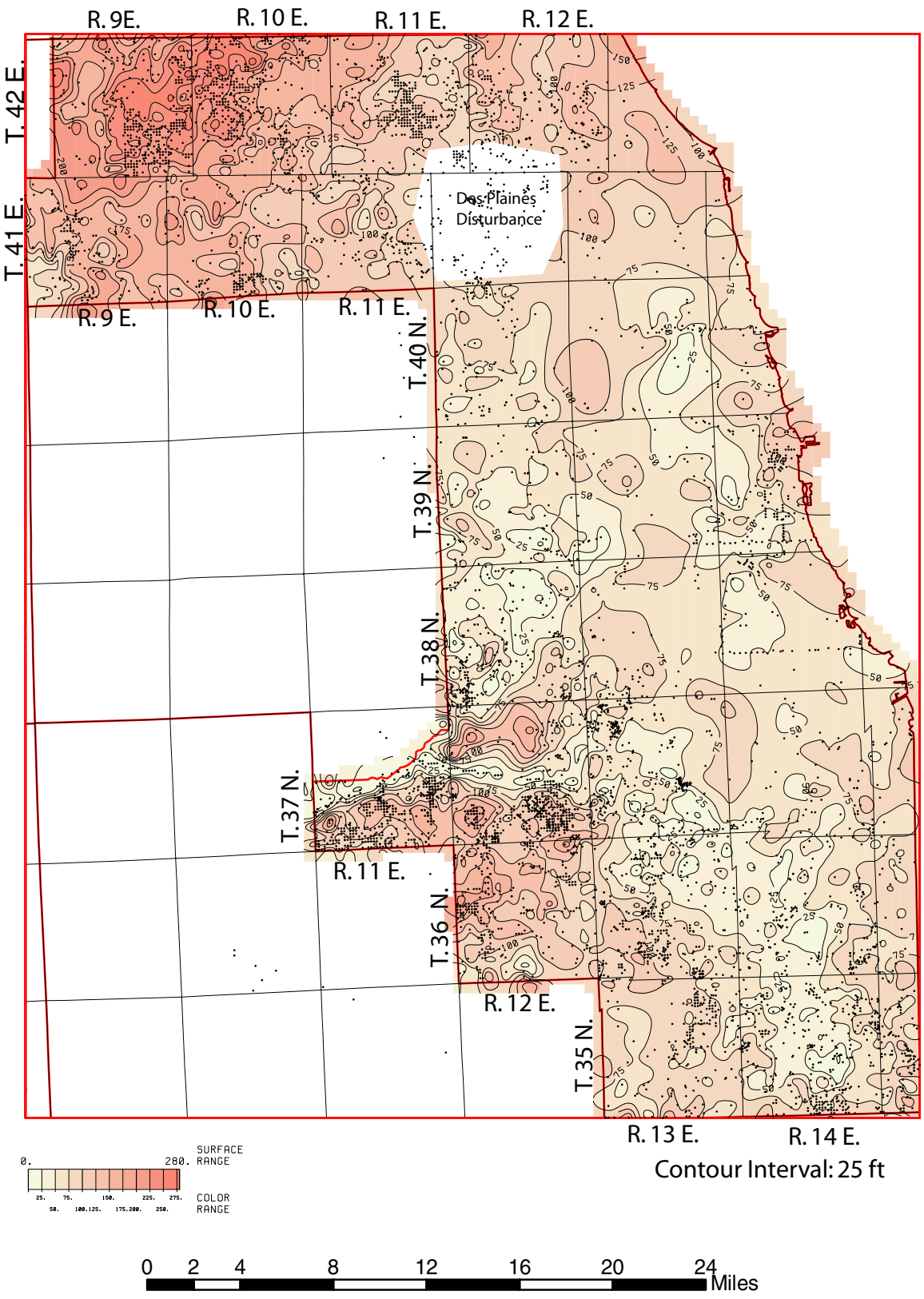
3-D representation of the thickness of the Quaternary deposits

Discussion

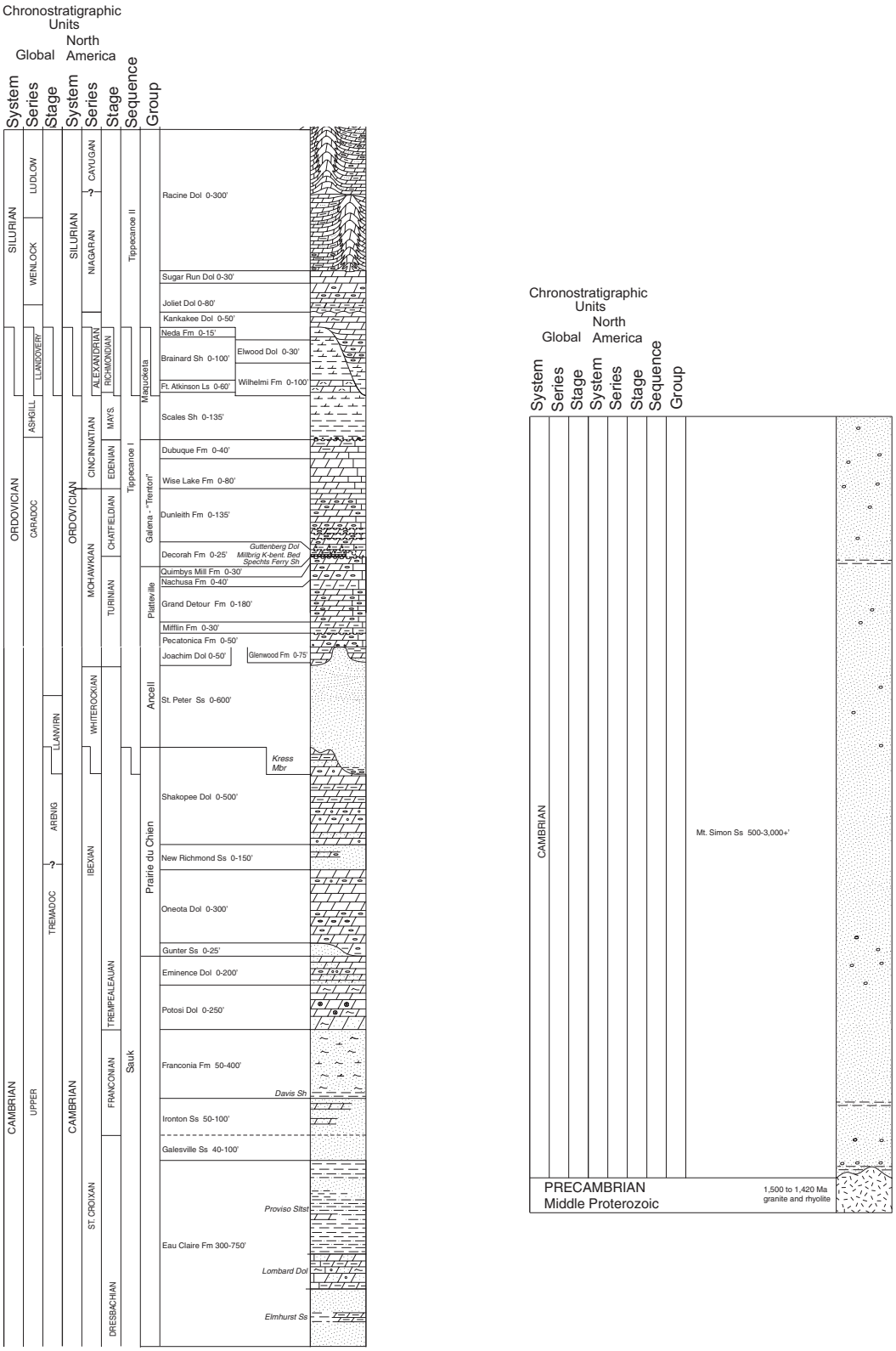
The Quaternary age deposits are mostly the result of glacial processes but they also include post-glacial sediments. Sand and gravel used for road and building construction are recovered from some of these deposits.

Locally, layers of sand and gravel in the Quaternary deposits supply residential users with good quality groundwater. The greatest risk for the groundwater resources in these areas is from surface contamination of relatively shallow aquifers.

More than half of Cook County is underlain by glacial till called the Wadsworth Formation, a clay rich diamictite. The low flat plain in the east-central part of the county is mostly silt and clay of the Equality Formation. These sediments were deposited in the former glacial lake, are composed of silt and clay and, are not considered aquifers.



Thickness of the Quaternary deposits in Cook County, Illinois

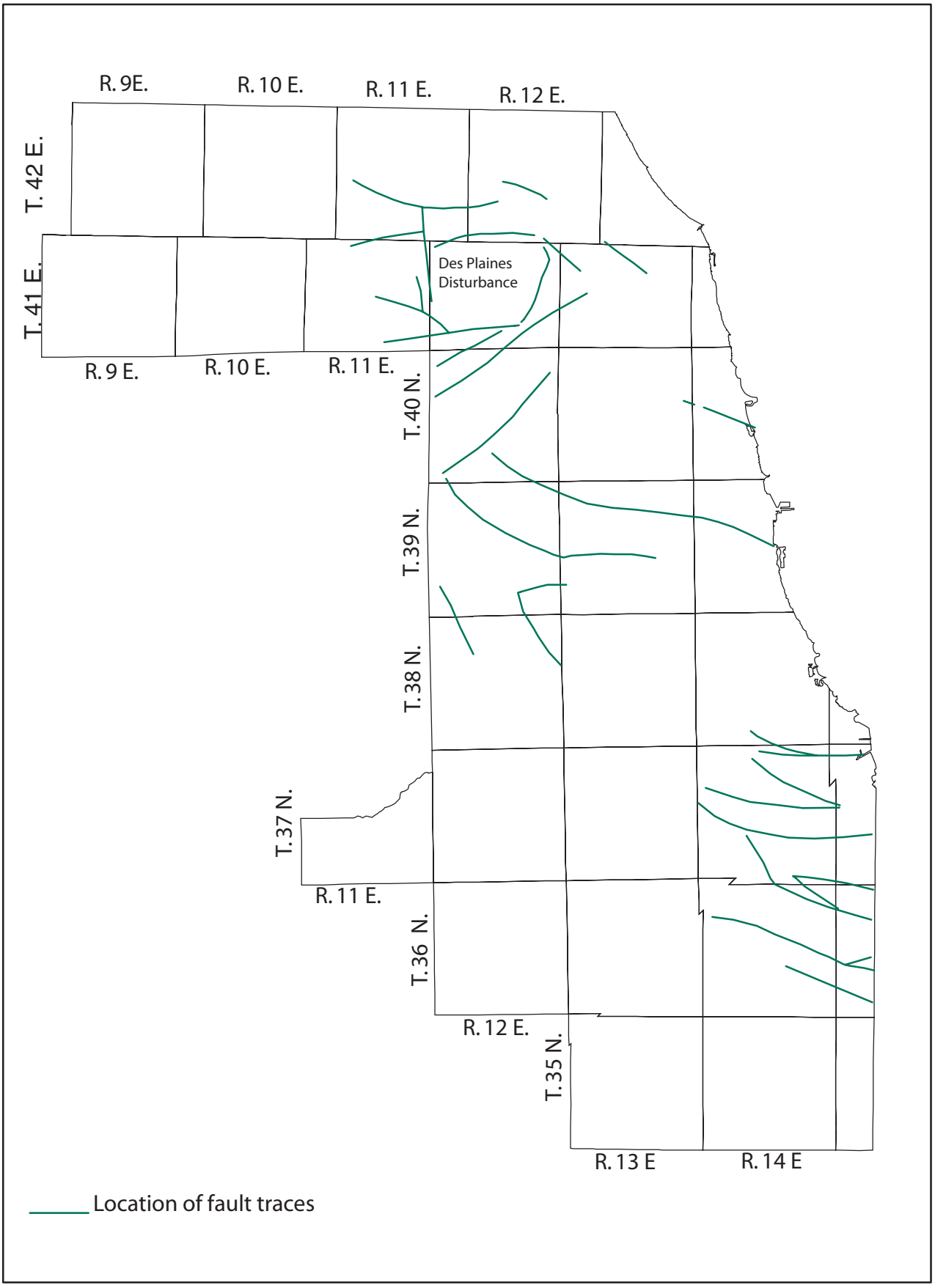


Stratigraphic column showing the succession of bedrock units in northern Illinois.

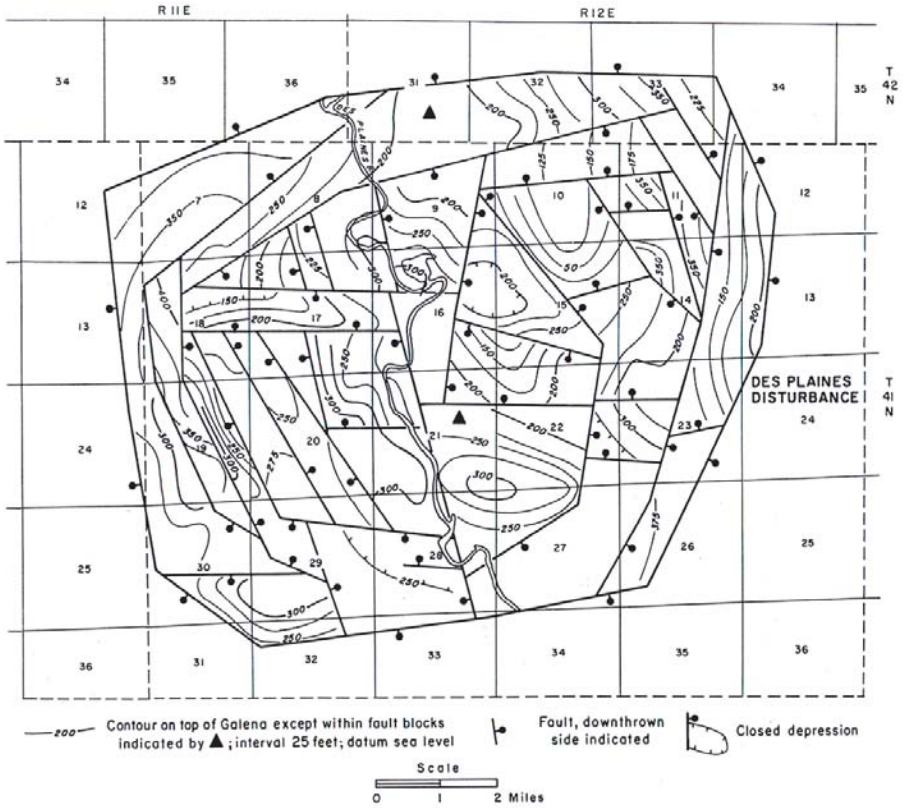
Faulting and the Des Plaines Disturbance

The Des Plaines Disturbance is located mostly in T. 41 N., R. 12 E., Cook County Illinois. It is a roughly circular area of approximately 25 square miles that is intensely faulted. Some of these faults may have as much as 600 feet of vertical movement (Emrich and Bergstrom 1962). The faulted bedrock is buried beneath 75 to 200 feet of glacial drift and the anomaly can only be studied using well control and seismic reflection data. The Des Plaines structure has been interpreted as a probable meteorite-impact structure (Willman 1971).

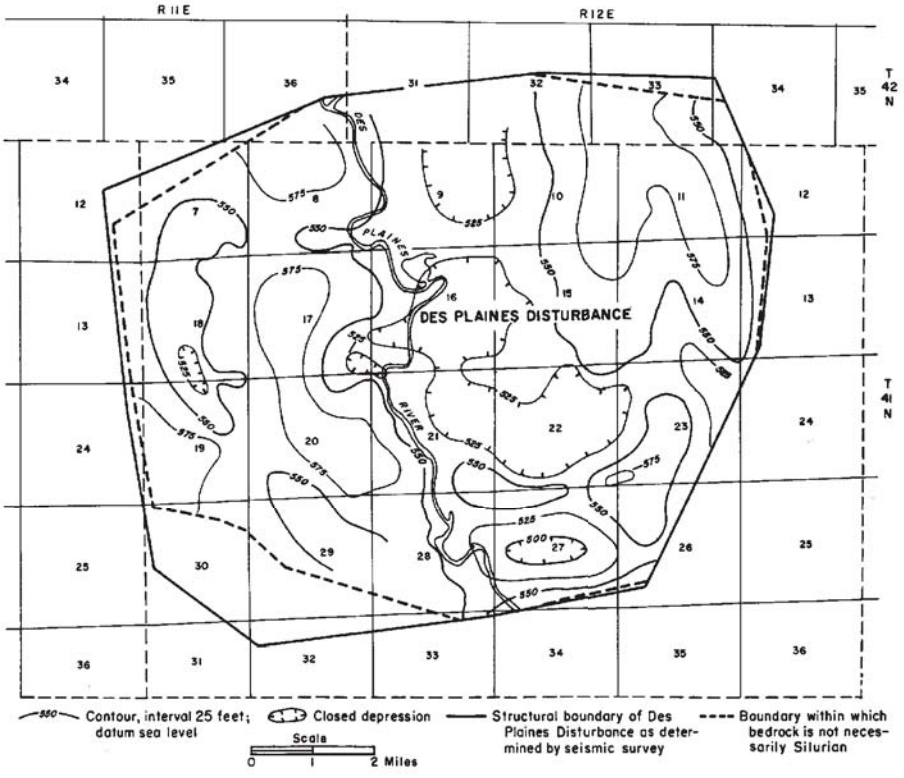
Seismic reflection data suggest that there are numerous other faults within the bedrock of Cook County. None of these faults are currently active and the seismic risk to the Chicago area from them is minimal.



Locations of fault traces in the Galena Group in Cook County, Illinois. Fault locations were interpreted from seismic data collected for Metropolitan Sanitary District District of Greater Chicago (Buschbach and Heim 1972).

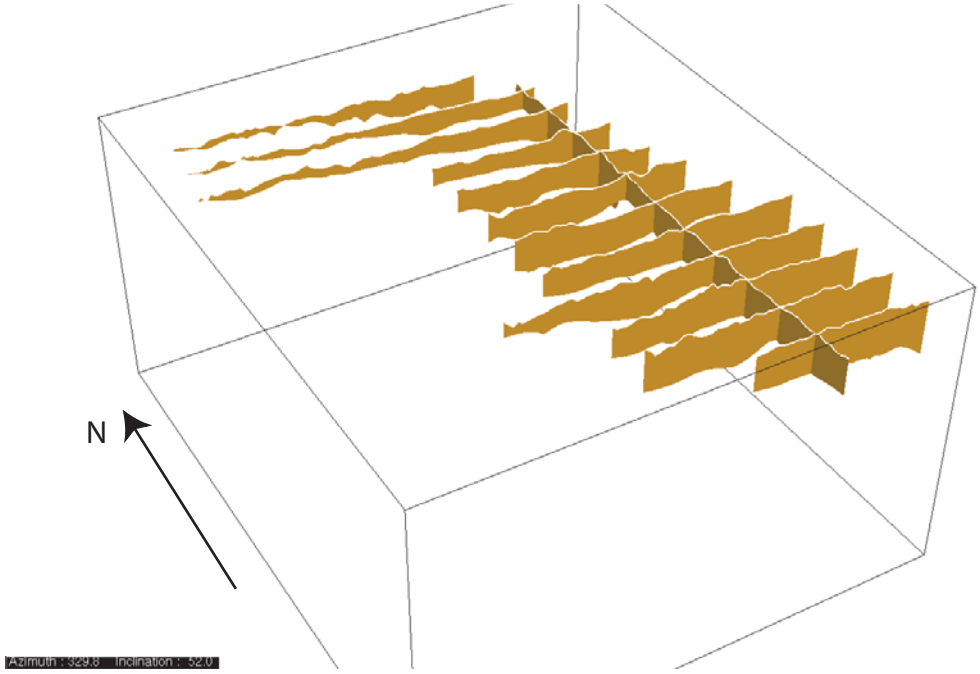


Structure in the Des Plaines Disturbance based on well control and seismic reflection data. (From Buschbach and Heim 1972)



Elevation of the bedrock surface in the Des Plaines Disturbance based on well control and seismic reflection data (From Buschbach and Heim 1972)

Silurian Strata



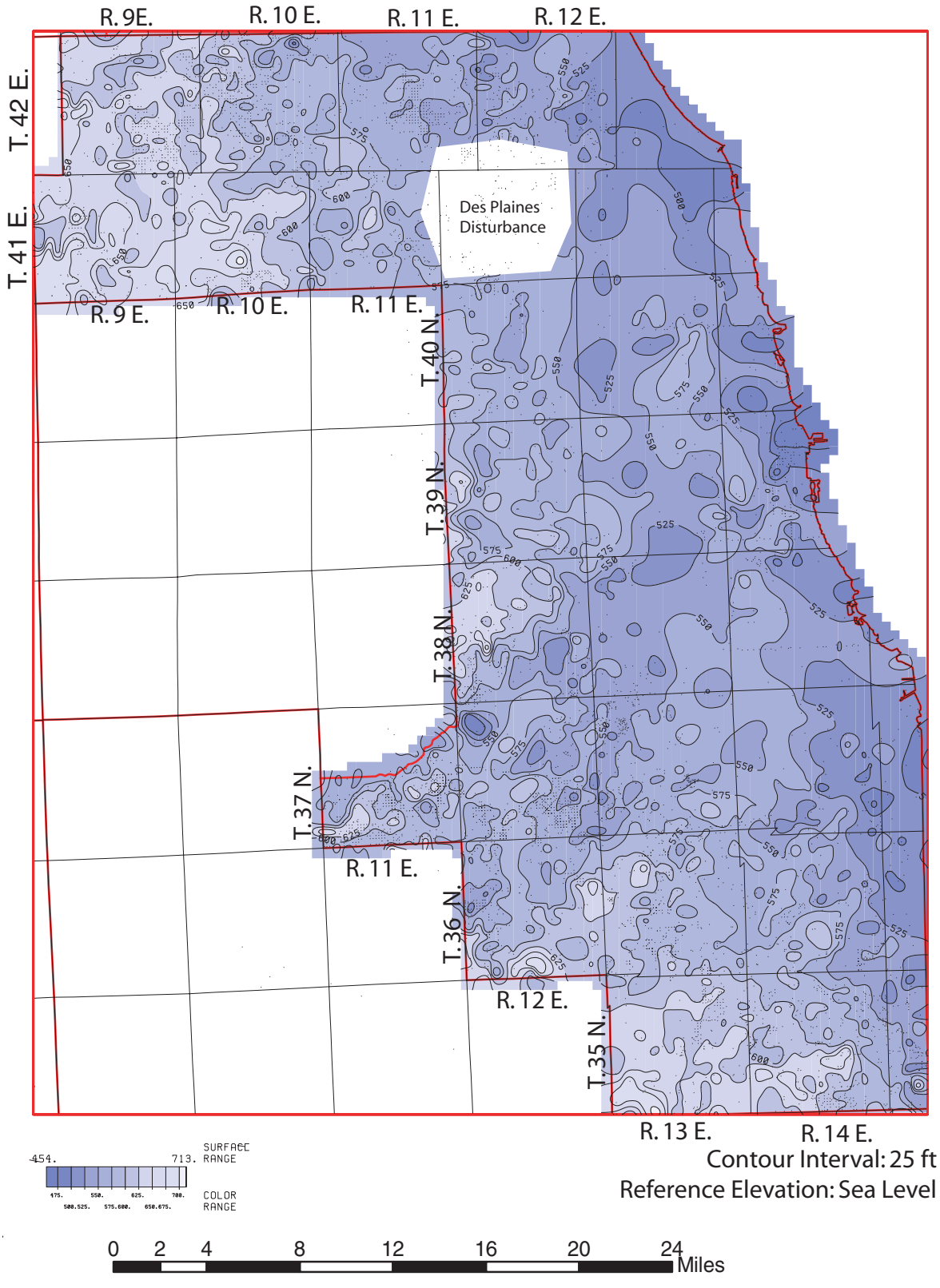
3-D representation of the thickness of the Silurian strata in Cook County.

Discussion

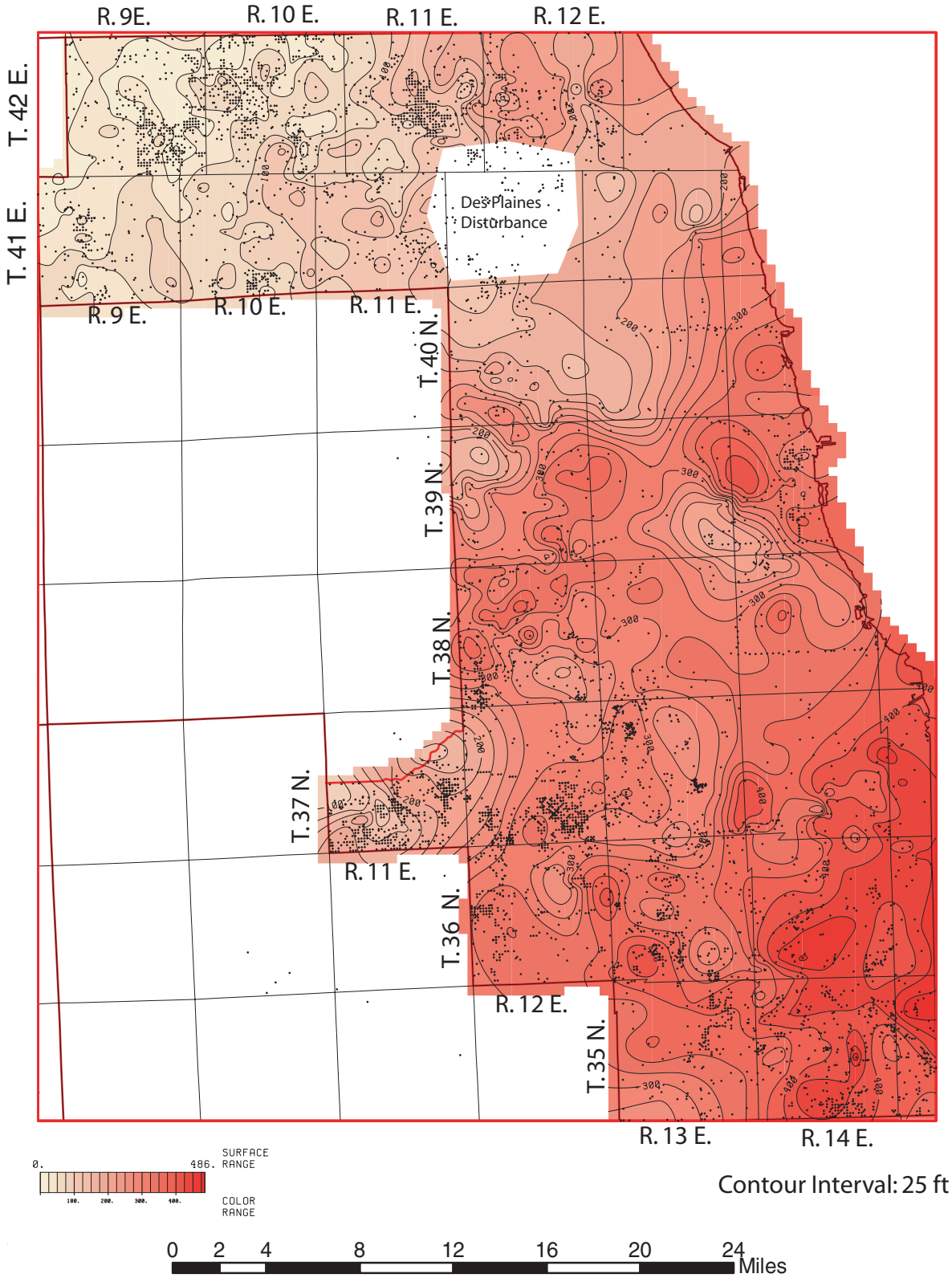
The top of the bedrock in Cook County consists almost entirely of Silurian dolomite. These rocks, Which consist mainly of pure to silty dolomite, form an important bedrock aquifer supplying residences in Cook County. The porosity and permeability of the rocks is mainly the result of fractures and dissolution cavities in the dolomite. The rock itself has no matrix porosity; therefore, the aquifer does not have adequate capacity for most municipal water wells. The water is recharged locally from precipitation and, where the overlying glacial materials are thin, the upper bedrock aquifer is susceptible to groundwater contamination.

The Siluran rocks are a major source of aggregate material and there are both active and closed quarries in Cook County. The Thorton quary in southeast Cook County is among the largest in the United States in terms of annual production of aggregate material.

Our map of the topography of the bedrock surface (interpreted from over 5,900 wells) differs from the Horberg (1950) and Herzog (1994) bedrock maps. Perhaps because we had data from many more more wells, we were unable to verify the east-west trending channel systems shown on the two earlier maps.

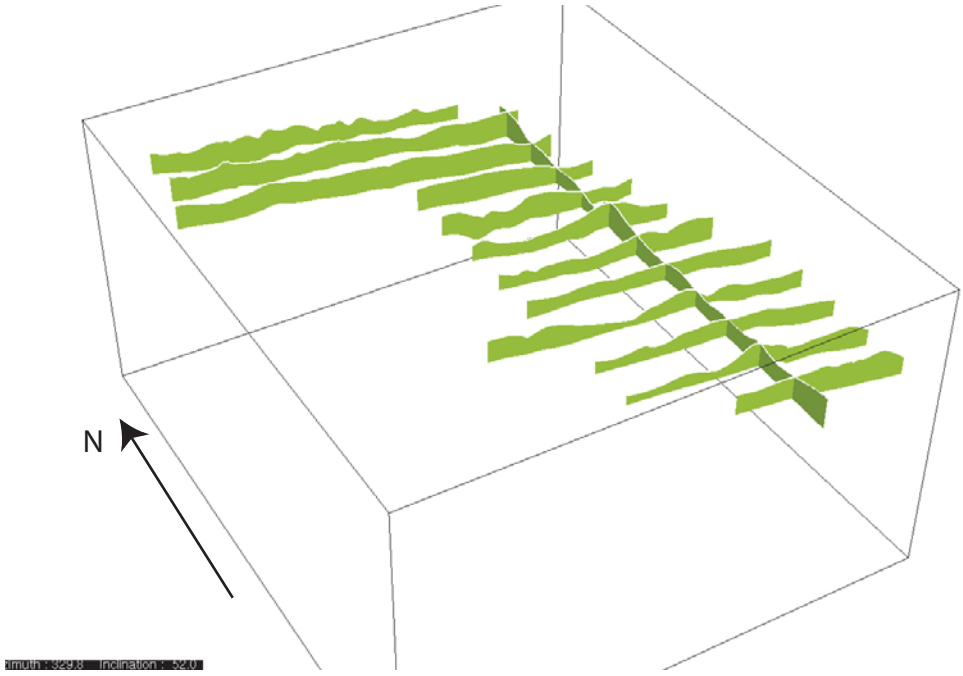


Topography on top of the Silurian formations (bedrock topography) in Cook County, Illinois.



Thickness of the Silurian strata in Cook County, Illinois.

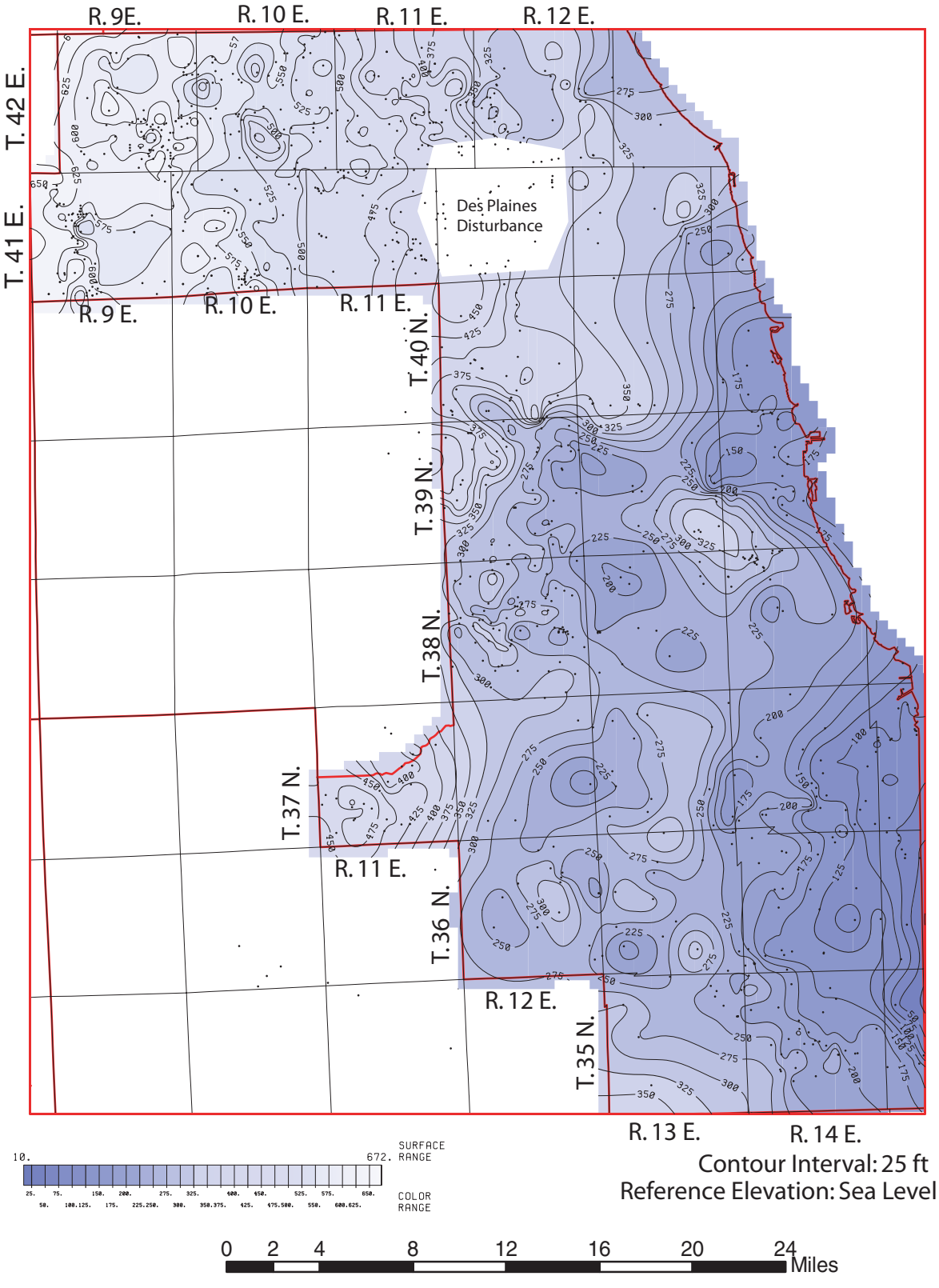
Maquoketa Group



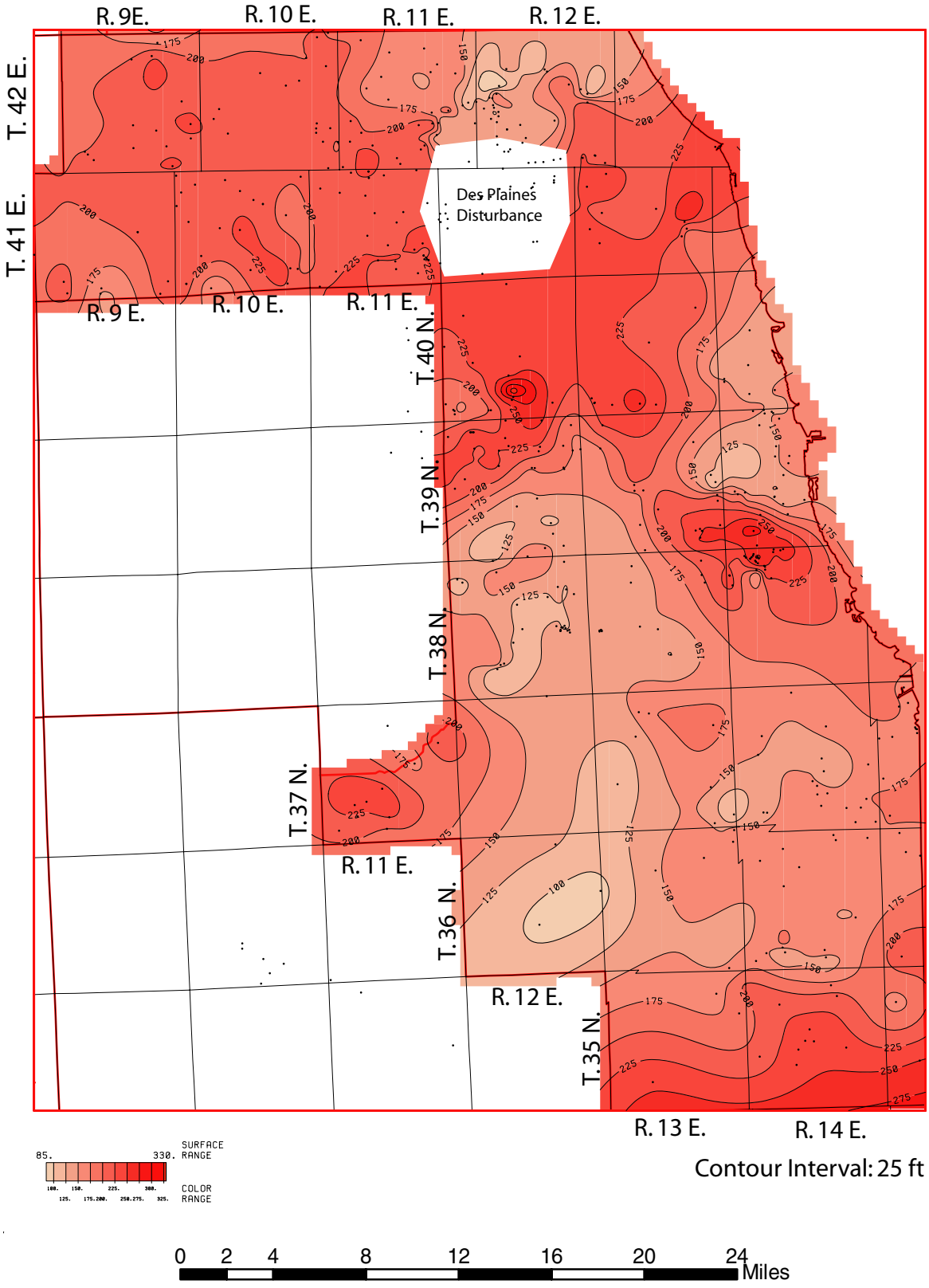
3-D representation of the thickness of the Maquoketa Group in Cook County.

Discussion

The Maquoketa Group (Ordovician) is composed of impermeable to low permeability shales and dolomites that form an important aquitard between the locally recharged Silurian aquifer at the top of the bedrock succession and the deeper bedrock aquifers. There is a significant unconformity on top of the Maquoketa which has caused wide variations in the thickness of the top unit to vary across the county (Kolata and Graese 1983). The Maquoketa Group is up to 260 feet thick in southeastern and central Cook County. In southwestern Cook County there was significant erosion before the overlying Silurian rocks were deposited and, because of this erosion, the unit thins to about 100 feet.

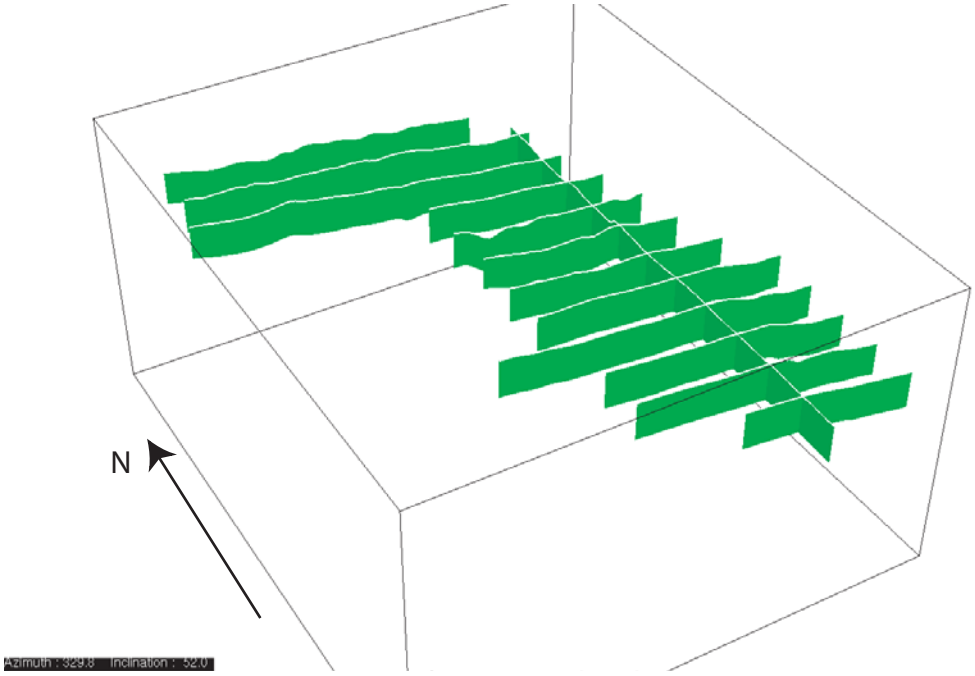


Structure on top of the Maquoketa Group in Cook County, Illinois



Thickness of Maquoketa Group in Cook County, Illinois

Galena and Platteville Groups

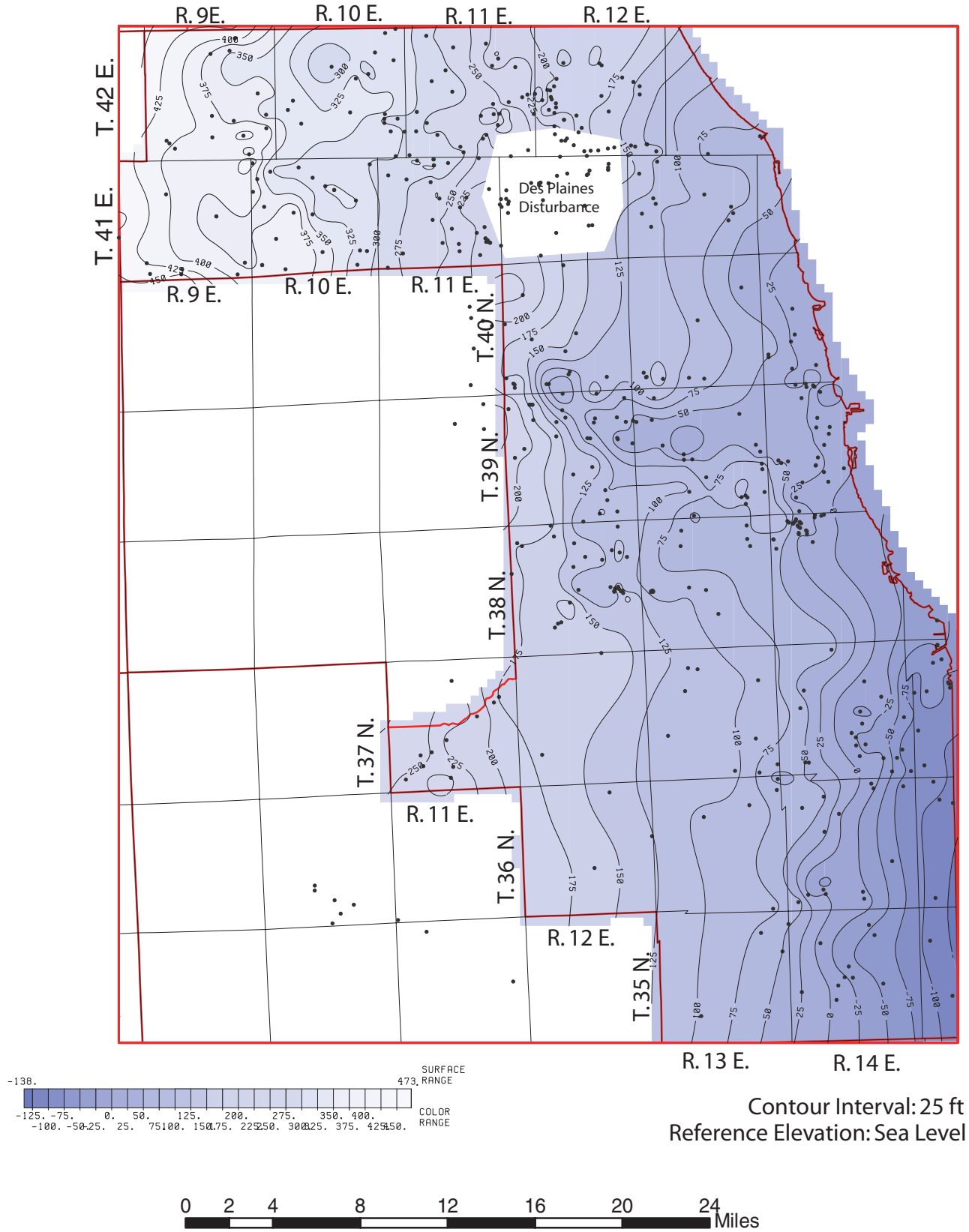


3-D representation of the thickness of the Galena-Platteville interval in Cook County.

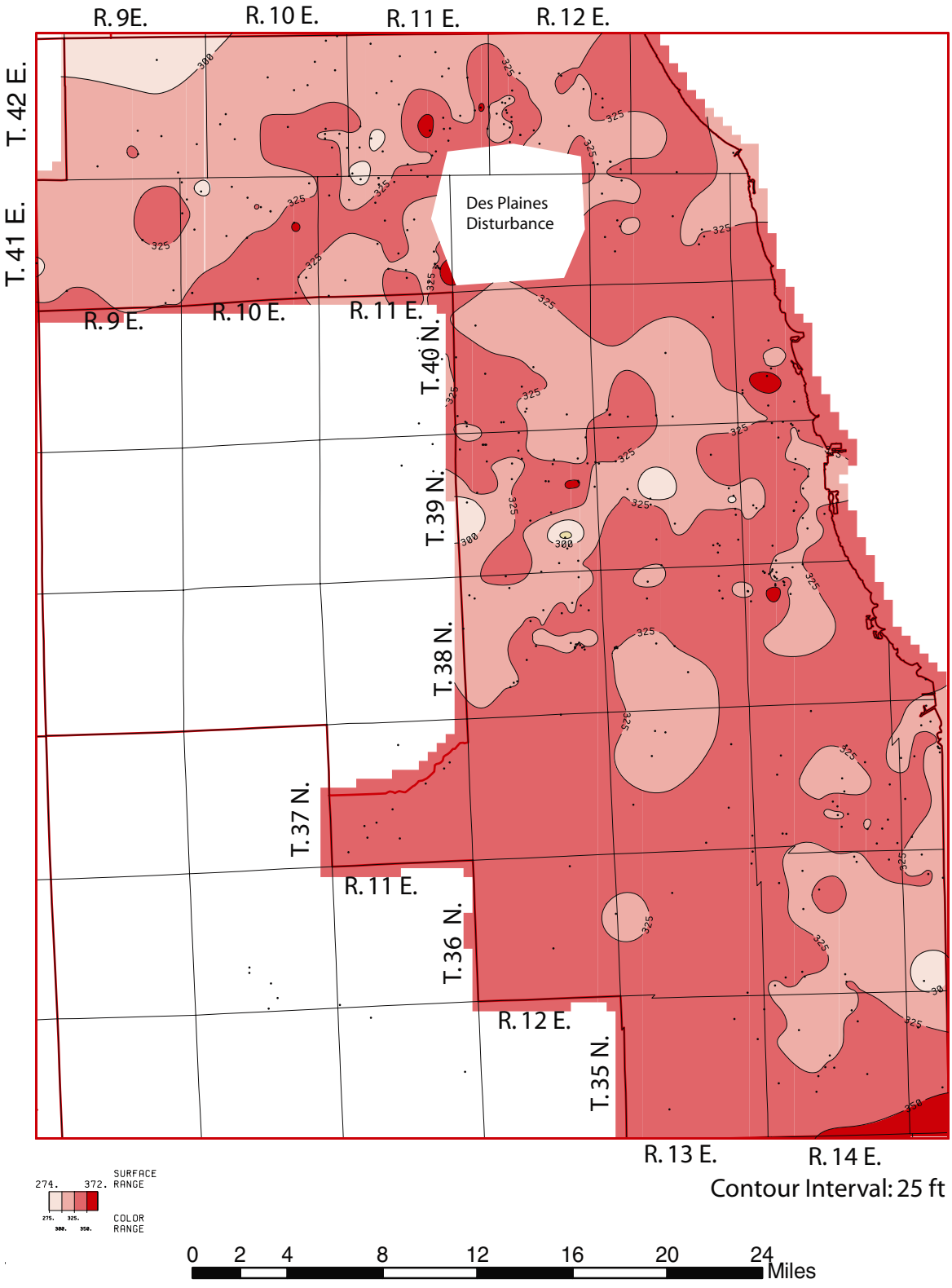
Discussion

In the study area the Galena and PlattevilleGroups are combined into a single map unit because the rocks have similar physical characteristics. The combined thickness ranges from 274 to 372 feet in a somewhat random pattern, however, there is a slight thickening trend from NW to SE across the county. In Cook County, these rocks consist of relatively pure fine- to medium-grained dolomite with low permeability and porosity.

As reserves of aggregate resources in the near-surface Silurian rocks are being depleted, several quarries in the Chicago area have, or are planning to mine the Galena and Platteveille rocks beneath the floor of their existing quarry, accessing these deeper resources via inclines throught he intervening Maquoketa Group. Many quarries in the Cook County areas cannot add to their resources by expanding laterally because of urban development on surrounding land.

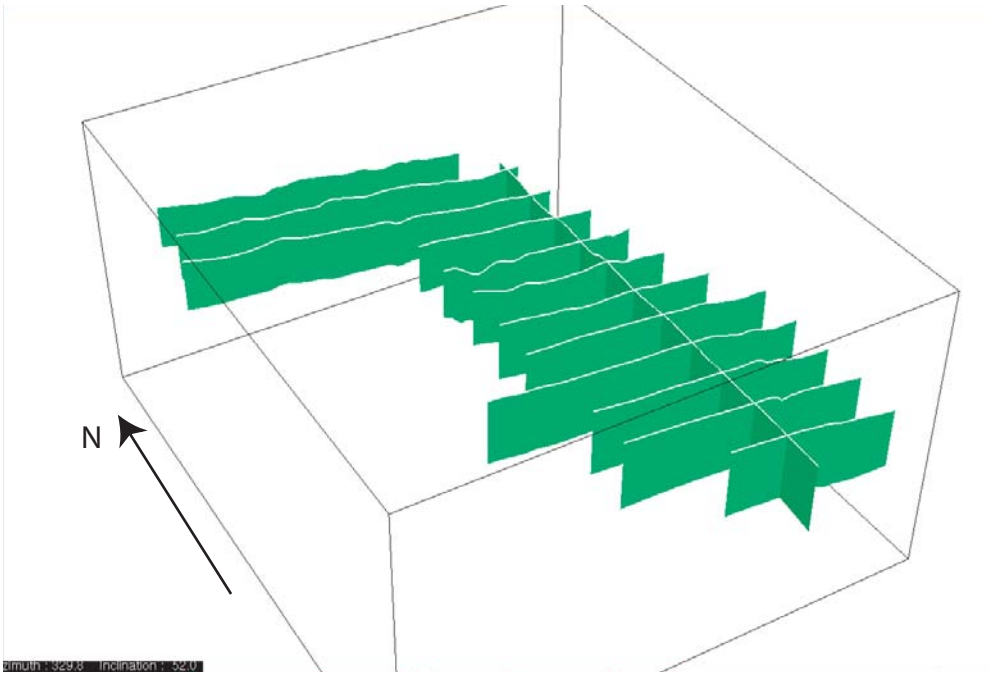


Structure on top of Galena Group in Cook County, Illinois



Thickness of the Galena-Platteville interval in Cook County, Illinois.

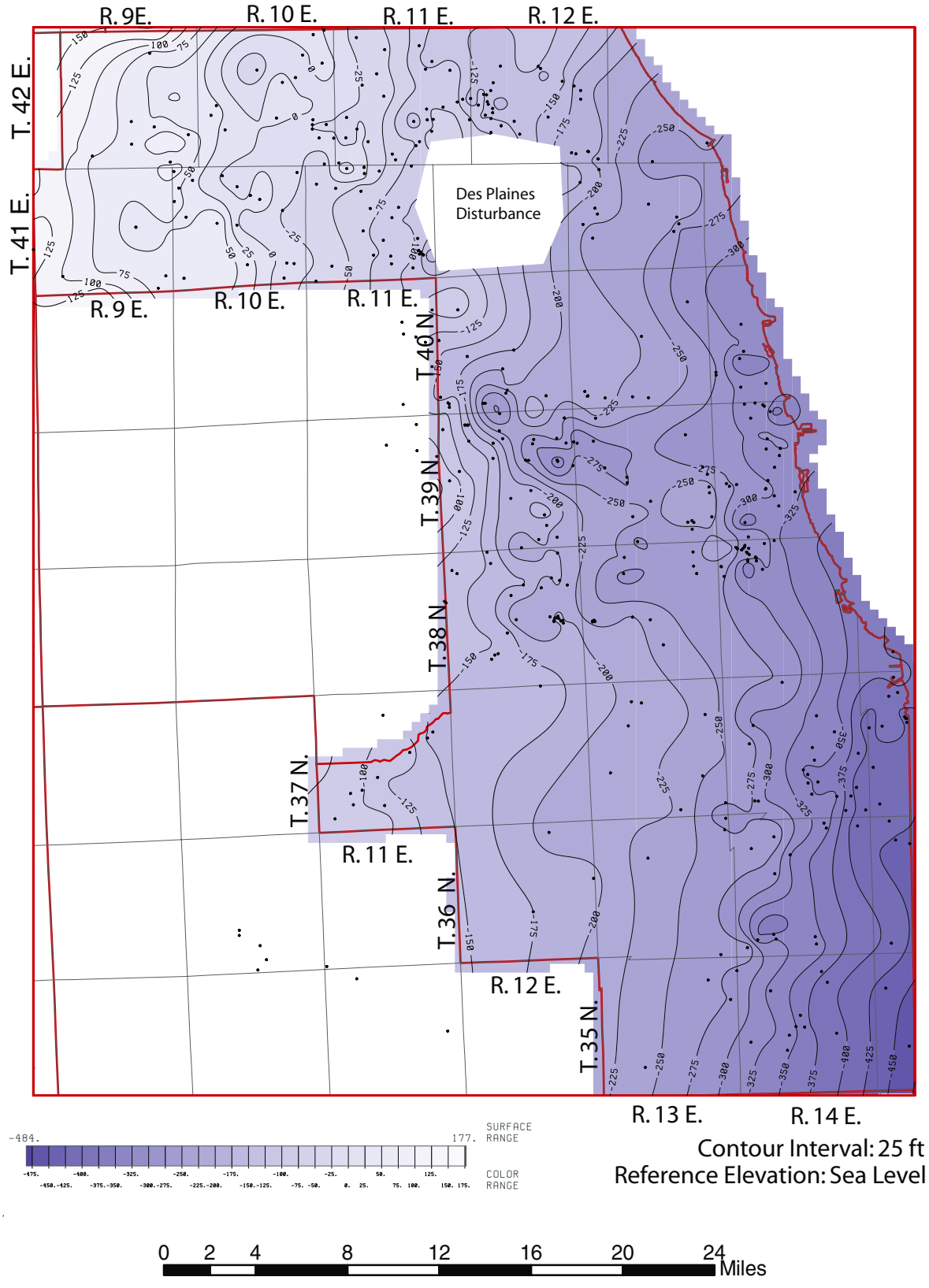
Ancell Group



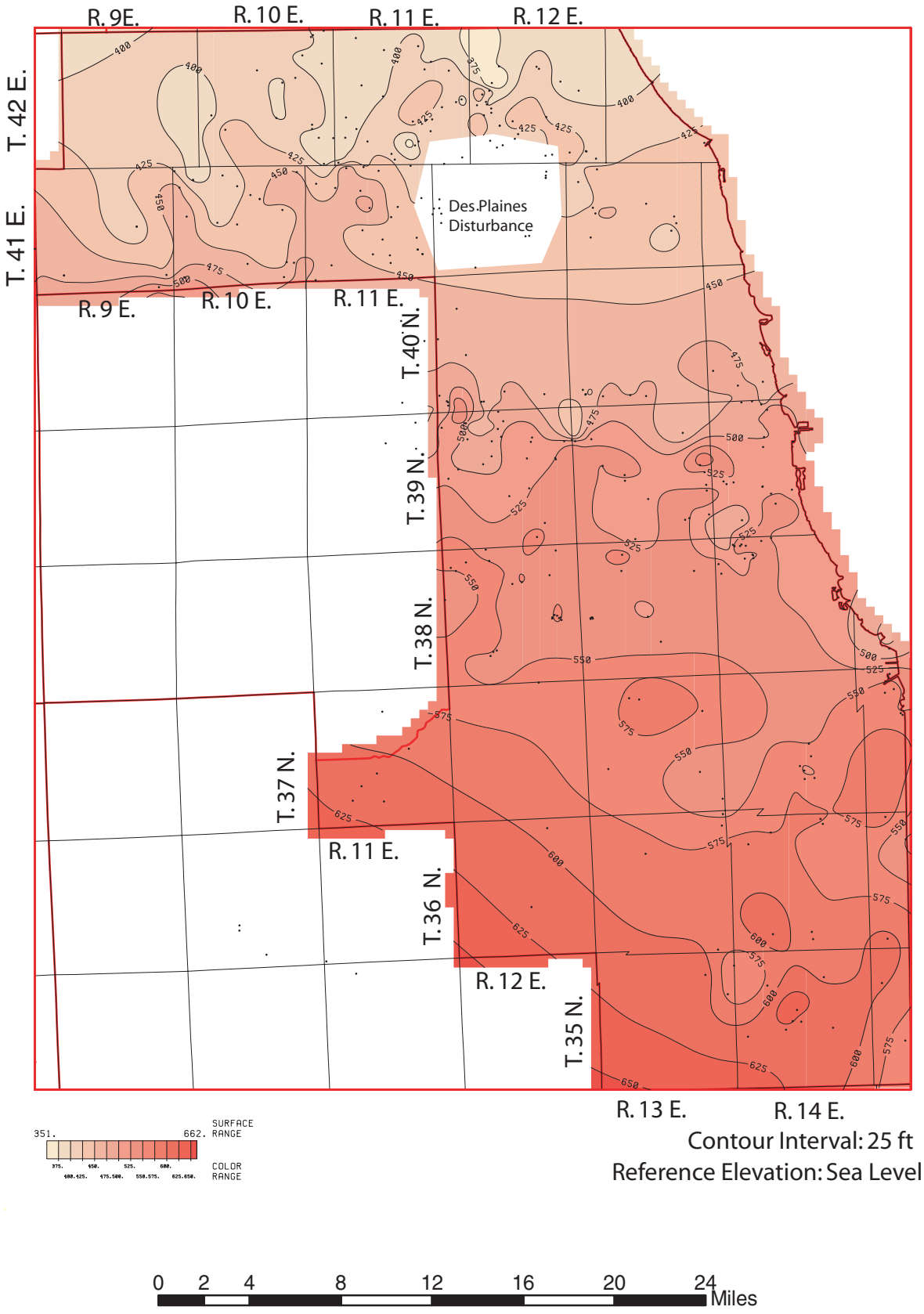
3-D representation of the thickness of the interval from the top of the Ancell Group to the top of Ironton Formation in Cook County.

Discussion

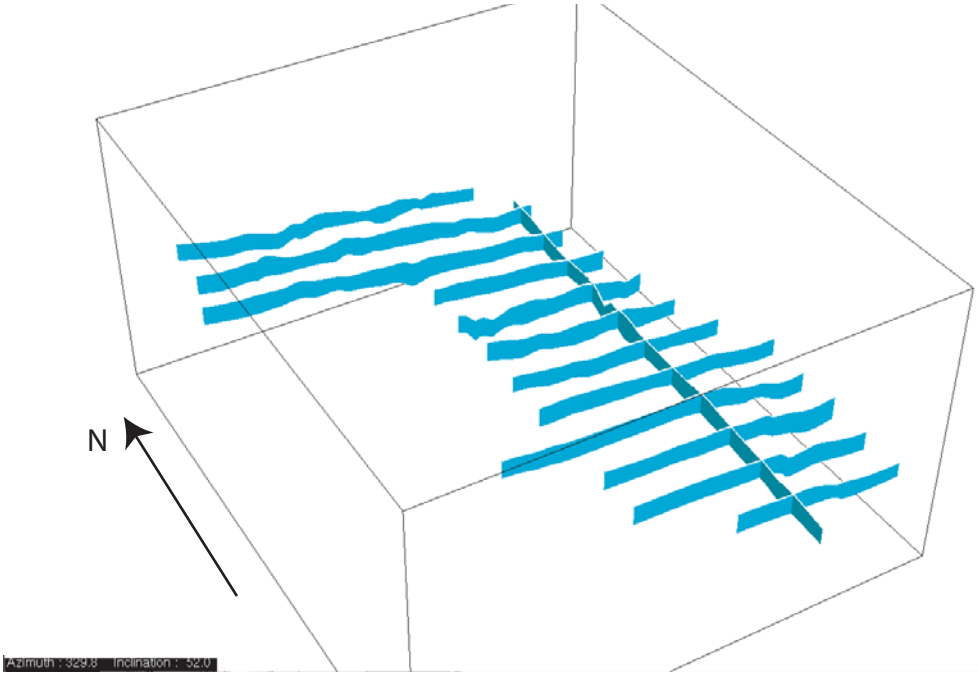
In Cook County, the Ancell Group consists primarily of the medium-grained St. Peter Sandstone. It is a moderately important groundwater resource, but its permeability and water yield are not as great as the underlying Ironton-Galesville or Mt. Simon Sandstones (Suter et al. 1959). The base of the St. Peter Sandstone is a major unconformity. Pre St- Peter erosion removed 100's of feet of underlying formations in Cook County. The penetrated thickness of the interval from thetop of Ancell to the top of Ironton Formation ranges from 351 to 662 feet. The interval's thickness nearly doubles from north to south in Cook County.



Structure on top of the Ancell Group in Cook County, Illinois



Thickness of the top of Ancell to the top of the Ironton Formation interval in Cook County, Illinois

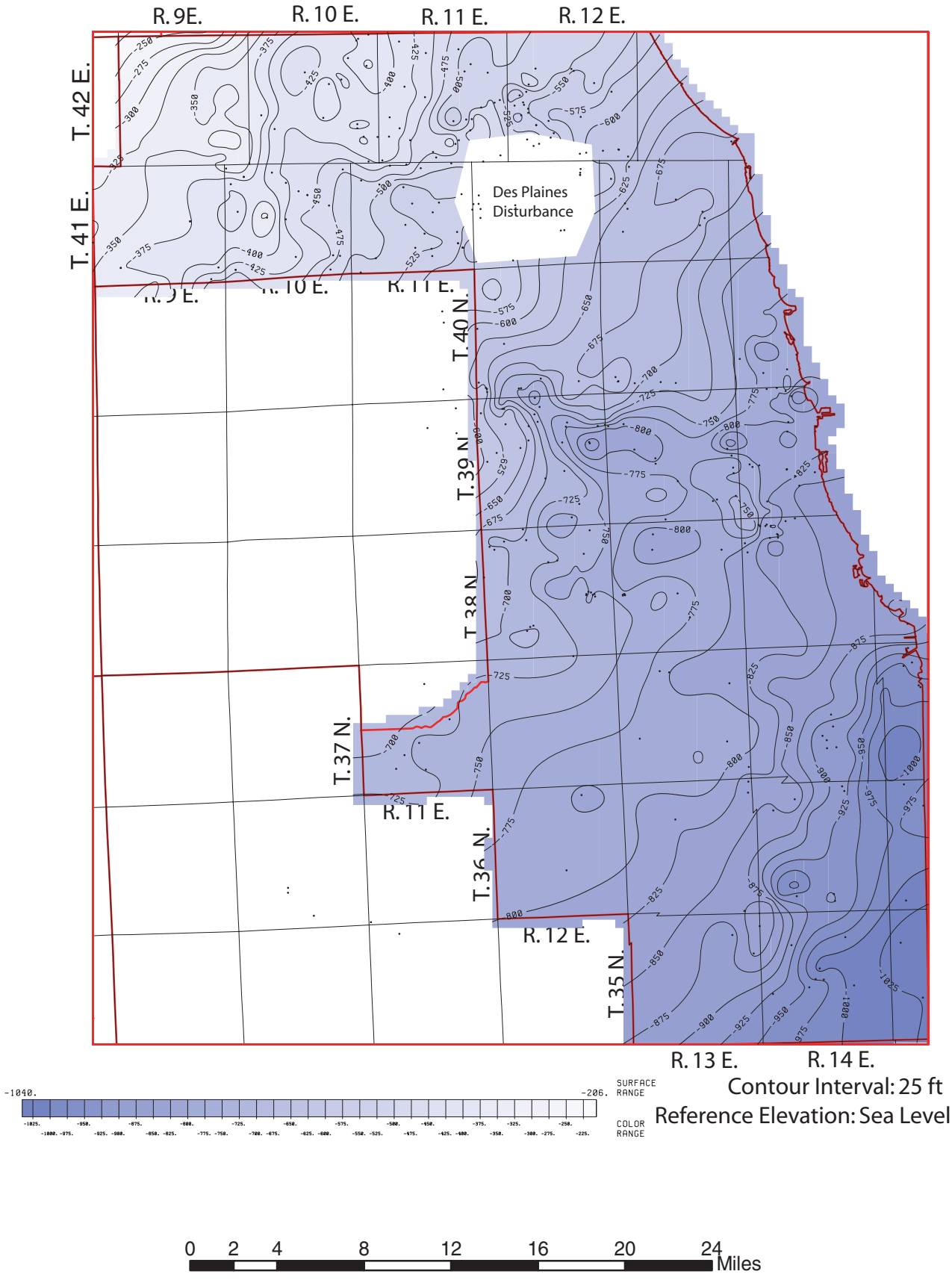


3-D representation of the thickness of the Ironton-Galesville Formation in Cook County.

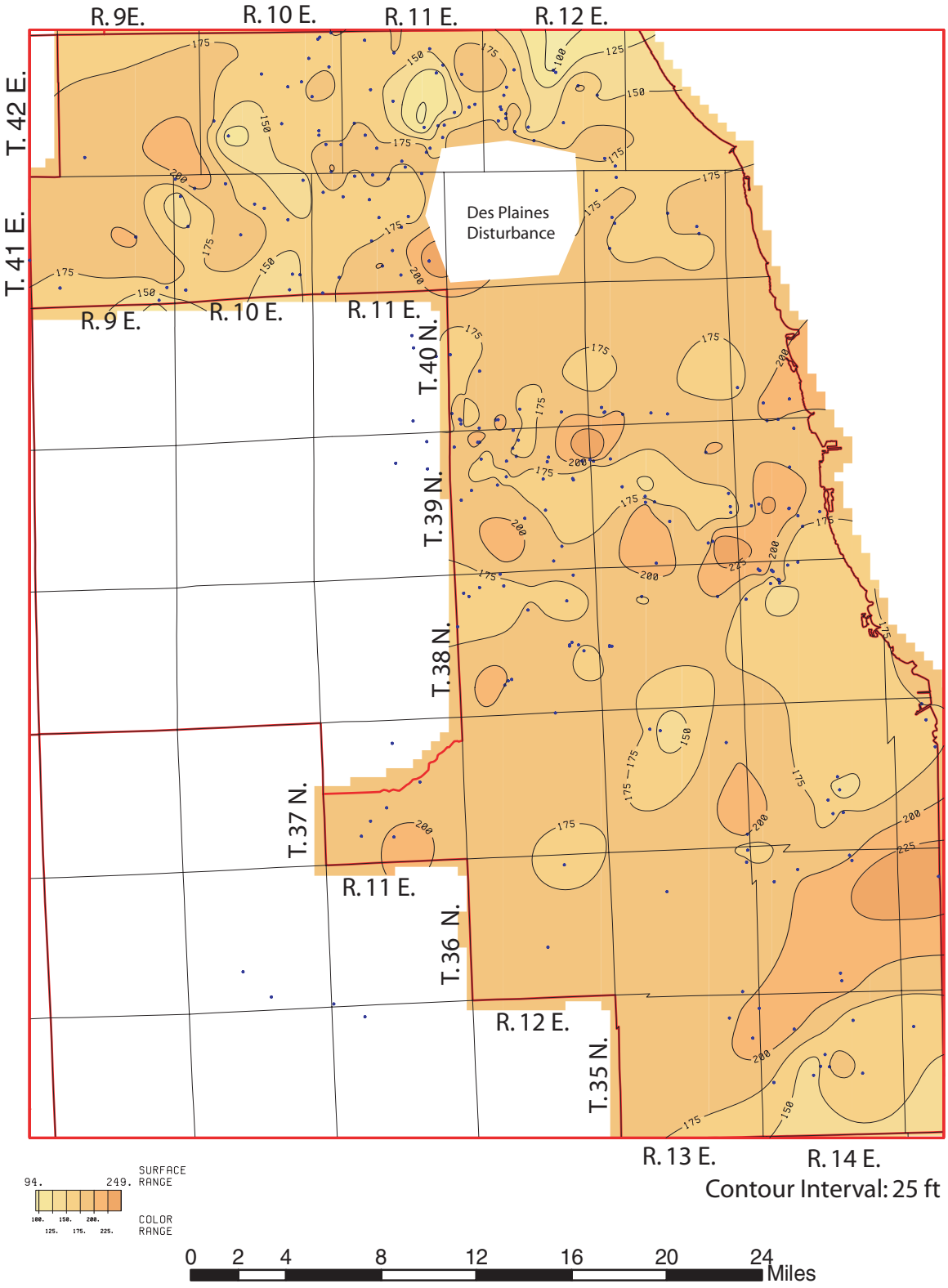
Discussion

The Ironton-Galesville consists of clean, medium- to coarse-grained, partly dolomitic sandstone and consistently has the largest permeability values of all the bedrock units in northeastern Illinois. It is the most important bedrock aquifer in the county and municipal wells can obtain relatively large water supplies with high flow rates.

The penetrated thickness of the Ironton-Galesville ranges from 94 to 249 feet. Although the thickness pattern is mostly random across Cook County, there is a definite thinning of the unit in the northeastern corner of the county and adjacent Lake County. The most permeable part of this sandstone occurs in the lower 20 to 85 feet of the unit, however, the entire thickness of the Ironton-Galesville is a good aquifer.

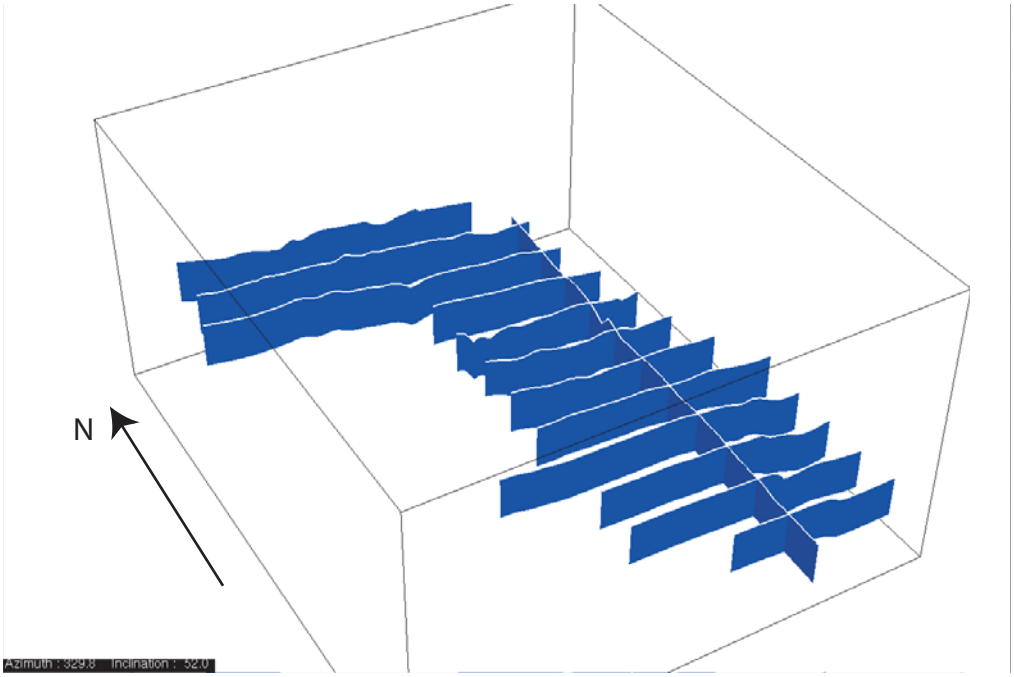


Structure on top of the Ironton Formation in Cook County, Illinois



Thickness of the Ironton-Galesville interval in Cook County, Illinois.

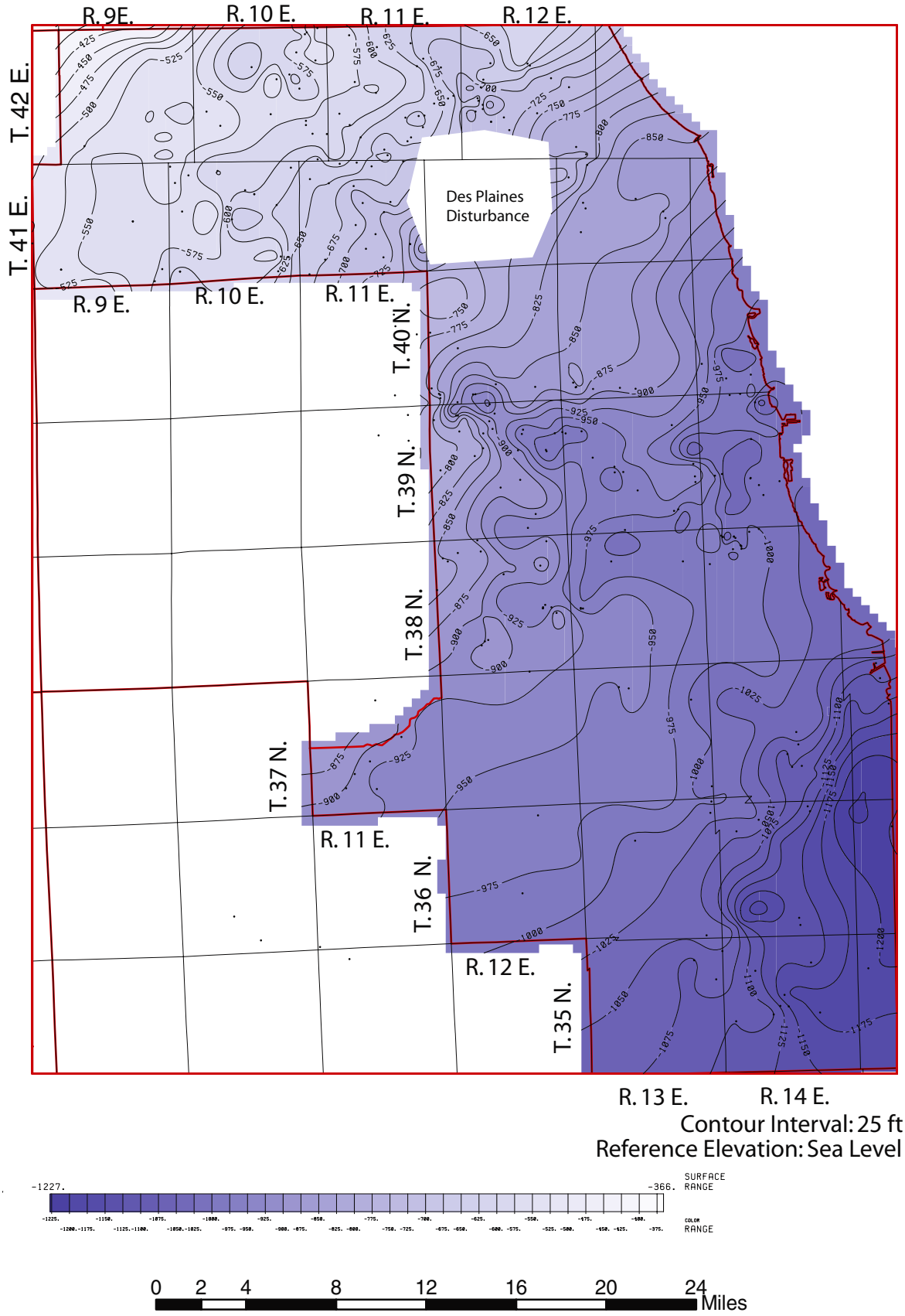
Eau Claire Formation



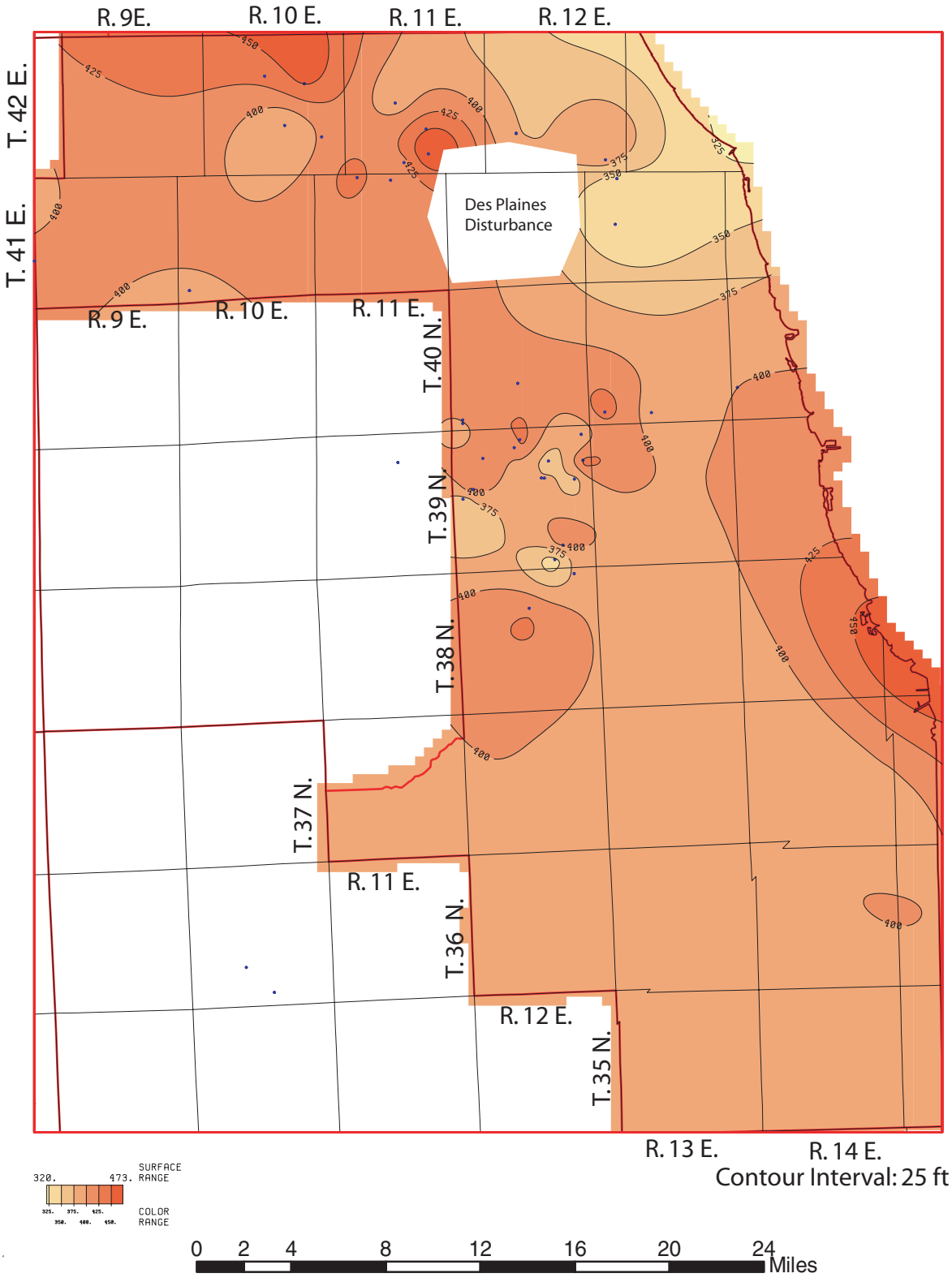
3-D representation of the thickness of the Eau Claire Formation in Cook County.

Discussion

The Eau Claire Formation consists mostly of a silty, argillaceous dolomitic sandstone that ranges in thickness from 320 to 473 feet. Compared to shallower units, few wells penetrated the entire Eau Claire. Those that do are concentrated in specific areas and fail to give good indication of the county-wide thickness trends. The Eau Claire is an important aquitard that separates the underlying Mt. Simon from the Ironton-Galesville. The shales of the Eau Claire Formation protect the groundwater in the Ironton-Galesville from intrusion from the more mineralized water of the underlying Mt. Simon Aquifer.



Structure on top of the Eau Claire Formation in Cook County, Illinois

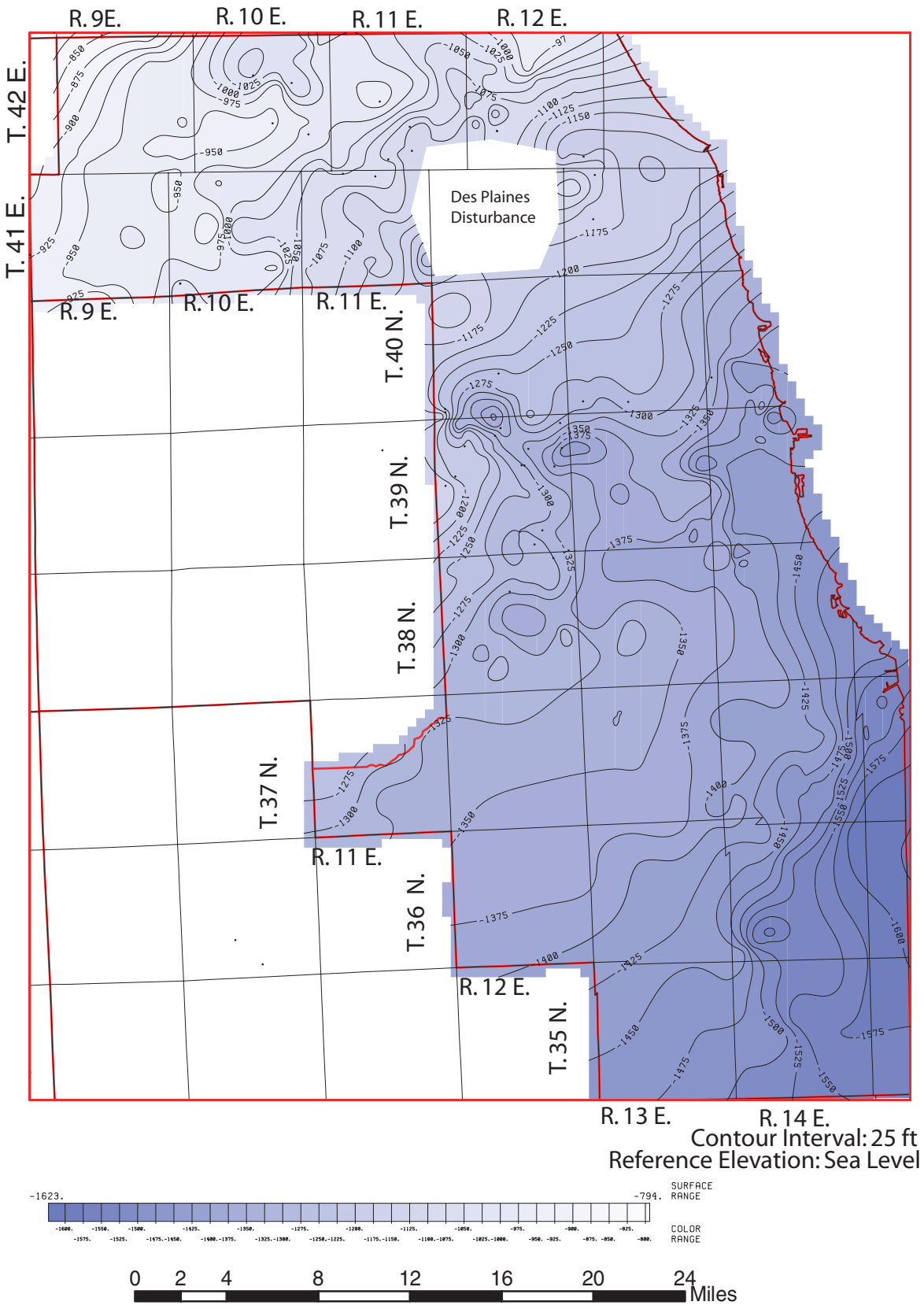


Thickness of the Eau Claire Formation in Cook County, Illinois.

Mt. Simon Formation

Discussion

The Mt. Simon is the deepest aquifer in the county and consists of more than 2,000 feet of fine- to coarse-grained sandstone. The water quality diminishes with depth and is commonly saline below a depth of 1300 feet. The ground water is warmer and more mineralized than the water in the overlying Ironton-Galesville water (Suter et al. 1959).



Structure on top of the Mt. Simon Formation in Cook County, Illinois

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