BEDROCK GEOLOGY OF DIXON EAST QUADRANGLE
LEE COUNTY, ILLINOIS

Prairie Research Institute
ILLINOIS STATE GEOLOGICAL SURVEY

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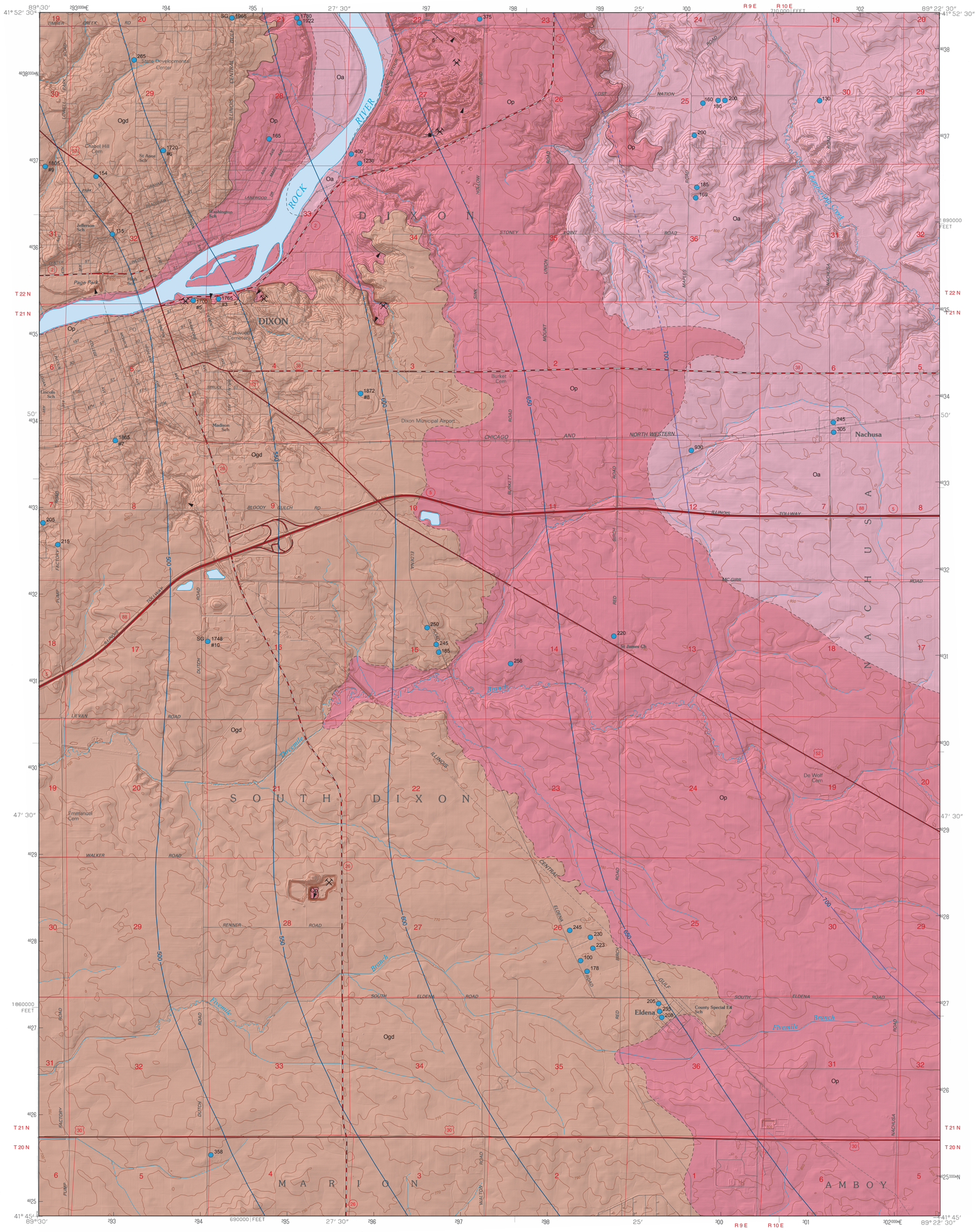
2013

Illinois Geologic Quadrangle Map
IGQ Dixon East-BG



EXPLANATION

- Ordovician
  - Mohawkian
    - Ogd — Galena and Decorah Formations
    - Op — Platteville Formation
    - Oa — Ancell Group

Symbols

- 5 — Strike and dip of bedding; number indicates degree of dip
- Vertical joint
- Active quarry
- Abandoned quarry
- Outcrop of special note; shown where contact, map unit, or fault was well exposed at time of mapping

Drill Holes
From which subsurface data were obtained

- Water well
- SG ○ 125 #3 — Labels indicate samples (s) or geophysical log (g). Numeric labels indicate total depth of boring in feet. Unit label denotes City of Dixon municipal water-well number.

Line Symbols
Dashed where inferred

- Contact
- 500 — Elevation of Glenwood Formation top in feet above sea level

Note: Well and boring records are on file at the ISGS Geological Records Unit and are available online from the ISGS website.

Base map compiled by the Illinois State Geological Survey from digital data (2009 TIGER/Line Shapefiles) provided by the United States Census Bureau. Hillshade and contours derived from 2008 LiDAR provided by the Illinois Department of Transportation and the Illinois Height Modernization Program.

North American Datum of 1983 (NAD 83)
Projection: Transverse Mercator
10,000-foot ticks: Illinois State Plane Coordinate system, west zone (Transverse Mercator)
1,000-meter ticks: Universal Transverse Mercator grid system, zone 16

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SCALE 1:24,000

1 — 1/2 — 0 — 1 MILE
1000 — 0 — 1000 — 2000 — 3000 — 4000 — 5000 — 6000 — 7000 FEET
1 — .5 — 0 — 1 KILOMETER

BASE MAP CONTOUR INTERVAL 10 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929

Geology based on field work by Dennis R. Kolata, 2011–2012.

Digital cartography by Jane E. Johnshoy Domier and Coy E. Potts, Illinois State Geological Survey. Hillshade by Donald E. Luman.

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4		5
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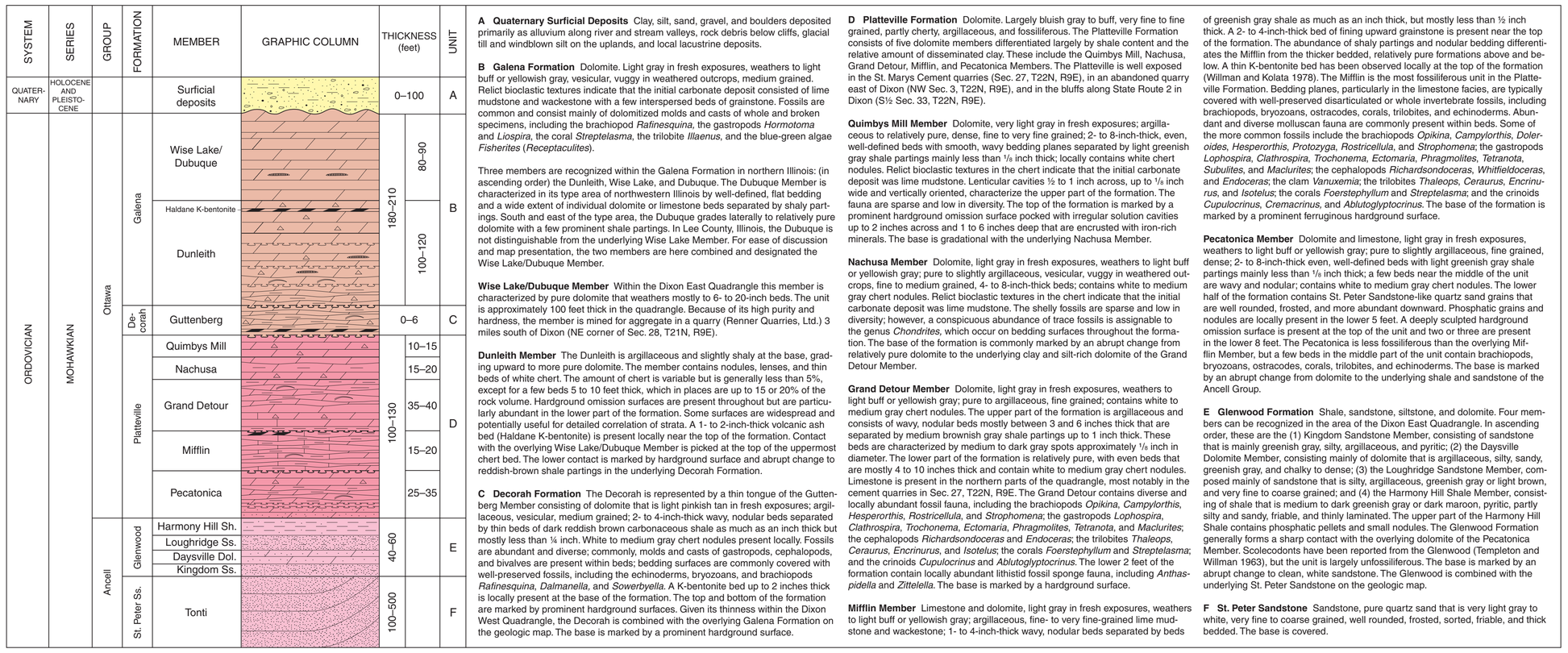
ADJOINING QUADRANGLES
1 Polo
2 Grand Detour
3 Daysville
4 Dixon West
5 Franklin Grove
6 Harmon
7 Walton
8 Amboy

2° TRUE NORTH MAGNETIC NORTH
APPROXIMATE MEAN DECLINATION, 2013

ROAD CLASSIFICATION

- Primary highway, hard surface
- Secondary highway, hard surface
- Light-duty road, hard or improved surface
- Unimproved road
- Interstate Route
- U.S. Route
- State Route



A Quaternary Surficial Deposits Clay, silt, sand, gravel, and boulders deposited primarily as alluvium along river and stream valleys, rock debris below cliffs, glacial till and windblown silt on the uplands, and local lacustrine deposits.

B Galena Formation Dolomite. Light gray in fresh exposures, weathers to light buff or yellowish gray, vesicular, vuggy in weathered outcrops, medium grained. Relict bioclastic textures indicate that the initial carbonate deposit consisted of lime mudstone and wackestone with a few interspersed beds of grainstone. Fossils are common and consist mainly of dolomitized molds and casts of whole and broken specimens, including the brachiopod *Rafinesquina*, the gastropods *Hormotoma* and *Liospira*, the coral *Streptelasma*, the trilobite *Illaenus*, and the blue-green algae *Fisherites* (*Receptaculites*).

Three members are recognized within the Galena Formation in northern Illinois: (in ascending order) the Dunleith, Wise Lake, and Dubuque. The Dubuque Member is characterized in its type area of northwestern Illinois by well-defined, flat bedding and a wide extent of individual dolomite or limestone beds separated by shaly partings. South and east of the type area, the Dubuque grades laterally to relatively pure dolomite with a few prominent shale partings. In Lee County, Illinois, the Dubuque is not distinguishable from the underlying Wise Lake Member. For ease of discussion and map presentation, the two members are here combined and designated the Wise Lake/Dubuque Member.

Wise Lake/Dubuque Member Within the Dixon East Quadrangle this member is characterized by pure dolomite that weathers mostly to 6- to 20-inch beds. The unit is approximately 100 feet thick in the quadrangle. Because of its high purity and hardness, the member is mined for aggregate in a quarry (Renner Quarries, Ltd.) 3 miles south of Dixon (NE corner of Sec. 28, T21N, R9E).

Dunleith Member The Dunleith is argillaceous and slightly shaly at the base, grading upward to more pure dolomite. The member contains nodules, lenses, and thin beds of white chert. The amount of chert is variable but is generally less than 5%, except for a few beds 5 to 10 feet thick, which in places are up to 15 or 20% of the rock volume. Hardground omission surfaces are present throughout but are particularly abundant in the lower part of the formation. Some surfaces are widespread and potentially useful for detailed correlation of strata. A 1- to 2-inch-thick volcanic ash bed (Haldane K-bentonite) is present locally near the top of the formation. Contact with the overlying Wise Lake/Dubuque Member is picked at the top of the uppermost chert bed. The lower contact is marked by hardground surface and abrupt change to reddish-brown shale partings in the underlying Decorah Formation.

C Decorah Formation The Decorah is represented by a thin tongue of the Guttenberg Member consisting of dolomite that is light pinkish tan in fresh exposures; argillaceous, vesicular, medium grained; 2- to 4-inch-thick wavy, nodular beds separated by thin beds of dark reddish brown carbonaceous shale as much as an inch thick but mostly less than ¼ inch. White to medium gray chert nodules present locally. Fossils are abundant and diverse; commonly, molds and casts of gastropods, cephalopods, and bivalves are present within beds; bedding surfaces are commonly covered with well-preserved fossils, including the echinoderms, bryozoans, and brachiopods *Rafinesquina*, *Dalmanella*, and *Sowerbyella*. A K-bentonite bed up to 2 inches thick is locally present at the base of the formation. The top and bottom of the formation are marked by prominent hardground surfaces. Given its thinness within the Dixon West Quadrangle, the Decorah is combined with the overlying Galena Formation on the geologic map. The base is marked by a prominent hardground surface.

D Platteville Formation Dolomite. Largely bluish gray to buff, very fine to fine grained, partly cherty, argillaceous, and fossiliferous. The Platteville Formation consists of five dolomite members differentiated largely by shale content and the relative amount of disseminated clay. These include the Quimbys Mill, Nachusa, Grand Detour, Mifflin, and Pecatonica Members. The Platteville is well exposed in the St. Marys Cement quarries (Sec. 27, T22N, R9E), in an abandoned quarry east of Dixon (NW Sec. 3, T22N, R9E), and in the bluffs along State Route 2 in Dixon (S½ Sec. 33, T22N, R9E).

Quimbys Mill Member Dolomite, very light gray in fresh exposures; argillaceous to relatively pure, dense, fine to very fine grained; 2- to 8-inch-thick, even, well-defined beds with smooth, wavy bedding planes separated by light greenish gray shale partings mainly less than ⅛ inch thick; locally contains white chert nodules. Relict bioclastic textures in the chert indicate that the initial carbonate deposit was lime mudstone. Lenticular cavities ½ to 1 inch across, up to ⅛ inch wide and vertically oriented, characterize the upper part of the formation. The fauna are sparse and low in diversity. The top of the formation is marked by a prominent hardground omission surface pocked with irregular solution cavities up to 2 inches across and 1 to 6 inches deep that are encrusted with iron-rich minerals. The base is gradational with the underlying Nachusa Member.

Nachusa Member Dolomite, light gray in fresh exposures, weathers to light buff or yellowish gray; pure to slightly argillaceous, vesicular, vuggy in weathered outcrops, fine to medium grained, 4- to 8-inch-thick beds; contains white to medium gray chert nodules. Relict bioclastic textures in the chert indicate that the initial carbonate deposit was lime mudstone. The shelly fossils are sparse and low in diversity; however, a conspicuous abundance of trace fossils is assignable to the genus *Chondrites,* which occur on bedding surfaces throughout the formation. The base of the formation is commonly marked by an abrupt change from relatively pure dolomite to the underlying clay and silt-rich dolomite of the Grand Detour Member.

Grand Detour Member Dolomite, light gray in fresh exposures, weathers to light buff or yellowish gray; pure to argillaceous, fine grained; contains white to medium gray chert nodules. The upper part of the formation is argillaceous and consists of wavy, nodular beds mostly between 3 and 6 inches thick that are separated by medium brownish gray shale partings up to 1 inch thick. These beds are characterized by medium to dark gray spots approximately ⅛ inch in diameter. The lower part of the formation is relatively pure, with even beds that are mostly 4 to 10 inches thick and contain white to medium gray chert nodules. Limestone is present in the northern parts of the quadrangle, most notably in the cement quarries in Sec. 27, T22N, R9E. The Grand Detour contains diverse and locally abundant fossil fauna, including the brachiopods *Opikina*, *Campylorthis*, *Hesperorthis*, *Rostricellula*, and *Strophomena*; the gastropods *Lophospira*, *Clathrospira*, *Trochonema*, *Ectomaria*, *Phragmolites*, *Tetranota*, and *Maclurites*; the cephalopods *Richardsondoceras* and *Endoceras*; the trilobites *Thaleops*, *Ceraurus*, *Encrinurus*, and *Isotelus*; the corals *Foerstephyllum* and *Streptelasma*; and the crinoids *Cupulocrinus* and *Ablutoglyptocrinus.* The lower 2 feet of the formation contain locally abundant lithistid fossil sponge fauna, including *Anthaspidella* and *Zittelella.* The base is marked by a hardground surface.

Mifflin Member Limestone and dolomite, light gray in fresh exposures, weathers to light buff or yellowish gray; argillaceous, fine- to very fine-grained lime mudstone and wackestone; 1- to 4-inch-thick wavy, nodular beds separated by beds of greenish gray shale as much as an inch thick, but mostly less than ½ inch thick. A 2- to 4-inch-thick bed of fining upward grainstone is present near the top of the formation. The abundance of shaly partings and nodular bedding differentiates the Mifflin from the thicker bedded, relatively pure formations above and below. A thin K-bentonite bed has been observed locally at the top of the formation (Willman and Kolata 1978). The Mifflin is the most fossiliferous unit in the Platteville Formation. Bedding planes, particularly in the limestone facies, are typically covered with well-preserved disarticulated or whole invertebrate fossils, including brachiopods, bryozoans, ostracodes, corals, trilobites, and echinoderms. Abundant and diverse molluscan fauna are commonly present within beds. Some of the more common fossils include the brachiopods *Opikina*, *Campylorthis*, *Dolerorthis*, *Hesperorthis*, *Protozyga*, *Rostricellula*, and *Strophomena*; the gastropods *Lophospira*, *Clathrospira*, *Trochonema*, *Ectomaria*, *Phragmolites*, *Tetranota*, *Subulites*, and *Maclurites*; the cephalopods *Richardsondoceras*, *Whitfieldoceras*, and *Endoceras*; the clam *Vanuxemia*; the trilobites *Thaleops*, *Ceraurus*, *Encrinurus*, and *Isotelus*; the corals *Foerstephyllum* and *Streptelasma*; and the crinoids *Cupulocrinus*, *Cremacrinus*, and *Ablutoglyptocrinus.* The base of the formation is marked by a prominent ferruginous hardground surface.

Pecatonica Member Dolomite and limestone, light gray in fresh exposures, weathers to light buff or yellowish gray; pure to slightly argillaceous, fine grained, dense; 2- to 8-inch-thick even, well-defined beds with light greenish gray shale partings mainly less than ⅛ inch thick; a few beds near the middle of the unit are wavy and nodular; contains white to medium gray chert nodules. The lower half of the formation contains St. Peter Sandstone-like quartz sand grains that are well rounded, frosted, and more abundant downward. Phosphatic grains and nodules are locally present in the lower 5 feet. A deeply sculpted hardground omission surface is present at the top of the unit and two or three are present in the lower 8 feet. The Pecatonica is less fossiliferous than the overlying Mifflin Member, but a few beds in the middle part of the unit contain brachiopods, bryozoans, ostracodes, corals, trilobites, and echinoderms. The base is marked by an abrupt change from dolomite to the underlying shale and sandstone of the Ancell Group.

E Glenwood Formation Shale, sandstone, siltstone, and dolomite. Four members can be recognized in the area of the Dixon East Quadrangle. In ascending order, these are the (1) Kingdom Sandstone Member, consisting of sandstone that is mainly greenish gray, silty, argillaceous, and pyritic; (2) the Daysville Dolomite Member, consisting mainly of dolomite that is argillaceous, silty, sandy, greenish gray, and chalky to dense; (3) the Loughridge Sandstone Member, composed mainly of sandstone that is silty, argillaceous, greenish gray or light brown, and very fine to coarse grained; and (4) the Harmony Hill Shale Member, consisting of shale that is medium to dark greenish gray or dark maroon, pyritic, partly silty and sandy, friable, and thinly laminated. The upper part of the Harmony Hill Shale contains phosphatic pellets and small nodules. The Glenwood Formation generally forms a sharp contact with the overlying dolomite of the Pecatonica Member. Scolecodonts have been reported from the Glenwood (Templeton and Willman 1963), but the unit is largely unfossiliferous. The base is marked by an abrupt change to clean, white sandstone. The Glenwood is combined with the underlying St. Peter Sandstone on the geologic map.

F St. Peter Sandstone Sandstone, pure quartz sand that is very light gray to white, very fine to coarse grained, well rounded, frosted, sorted, friable, and thick bedded. The base is covered.

Introduction

The Dixon East Quadrangle is situated in the northwestern part of Lee County, Illinois, encompassing most of the city of Dixon, which is the county seat and the largest town in Lee County. The Rock River flows through the northwestern parts of the quadrangle. The upland areas are mostly cultivated for corn and soybeans. Limestone has been mined for cement production and aggregate use in the northwestern parts of the quadrangle. The most significant residential and commercial developments in the county occur in the Dixon East Quadrangle.

The quadrangle lies in the Rock River Hill Country of the Central Lowlands Province. The topography was formed primarily by deposition of glacial sediments (clay, silt, sand, and gravel) in a till plain that was subsequently dissected by erosional processes of the Rock River and its tributaries. Bedrock in the Dixon East Quadrangle is largely concealed beneath the till plain except for local exposures along the river bluffs and tributary ravines in the northern regions of the quadrangle. The glacial deposits range in thickness from 0 to 50 feet but reach thicknesses of 100 feet in buried stream valleys in the southern parts of the quadrangle (Piskin and Bergström, 1975). Bedrock formation contacts are largely inferred because of the widespread surficial cover. Surface elevations range from 820 feet in the upland areas to 650 feet along the banks of the Rock River.

Compilation of this map is based on an examination of bedrock exposures in quarries, road excavations, railroad cuts, and natural exposures along streams and waterways. Subsurface information was obtained from water-well records and drill cuttings filed at the Illinois State Geological Survey (ISGS). Of particular note are two deep wells complete with wireline logs and cuttings: (1) City of Dixon water well No. 10 (IP 121032353400; SW SW NW Sec. 16, T21N, R9E; latitude 41°48′34″N and longitude 89°28′35″W; total depth 1,748 feet) and (2) Dixon State School well No. 3 (IP 121030009200; SW SW SW Sec. 21, T22N, R9E; latitude 41°52′29″N and longitude 89°28′22″W; total depth 1,965 feet). Field notes made by previous geologists and filed in the ISGS Library were another valuable source of information.

The bedrock in Lee County was illustrated very generally on early statewide geologic maps (Worthen 1875, Weller 1906); however, the first concerted investigations of the area were published by Knappen (1926) in his report of the Dixon 15′ Quadrangle, which includes the area covered by the Dixon East 7.5′ Quadrangle. In addition, a map showing the bedrock geology of Lee County, including the Dixon East Quadrangle, was published by McGarry (1999). Stratigraphic and structural investigations in the Dixon area include those by Templeton and Willman (1952, 1963), Kolata and Buschbach (1976), Willman and Kolata (1978), and Kolata et al. (1978).

Stratigraphy

Bedrock consists of Late Ordovician marine sandstone, siltstone, and shale overlain by dolomite and limestone, in turn overlain unconformably by Quaternary glacial drift consisting of clay, silt, sand, and gravel. In the northern third of the quadrangle, bedrock is covered by less than 25 feet of glacial drift, and in many areas along the bluffs of Chamberlain Creek and Rock River, bedrock occurs at the surface. In the southern two-thirds of the quadrangle, the glacial drift reaches thicknesses of approximately 100 feet (Piskin and Bergstrom 1975).

It has been standard practice of the ISGS during the past few decades to follow the Ordovician classification and nomenclature proposed by Templeton and Willman (1963). Their stratigraphy was adopted in large part by that of Willman and Kolata (1978), who made minor revisions to some members and documented the presence of nine widespread K-bentonite beds. These stratigraphic investigations have shown that the Late Ordovician carbonate succession consists of distinctive rock units that can be traced over wide areas of the Midcontinental United States. Correlation of rock units is based largely on (1) the relative amount of disseminated clay, (2) chert content, (3) widely traceable K-bentonite beds, and (4) hardground omission surfaces. These were the primary features used to subdivide the Platteville and Galena carbonate succession into 1 megagroup, 2 groups, 3 subgroups, 10 formations, 32 members, and 9 beds. In the outcrop area of northern Illinois where the type sections for many of the subdivisions occur, the succession ranges from a mere 300 to 350 feet thick. Compared with other Paleozoic rock units, the Illinois Upper Ordovician carbonate succession is one of most highly subdivided units in North America. Many of the formations are too thin to map at the current scale of 1:24,000 and therefore do not meet the "test of mappability" recommended in the North American Stratigraphic Code (2005). Furthermore, the ranks of "megagroup" and "subgroup" are not recognized in the Code (2005). Based on these facts, adjustments in the ranks of the Illinois Upper Ordovician lithostratigraphic units are warranted. The simplest way to bring the Templeton and Willman (1963) and Willman and Kolata (1978) classification schemes up to code and to maintain the usefulness of the numerous recognized units is to reassign the ranks of the lithostratigraphic units. It is here proposed that the revised classification would (1) eliminate the megagroups and subgroups, (2) reassign the Ottawa megagroup to the rank of group, (3) reassign the Platteville, Decorah, and Galena groups to formations, (4) reassign the Pecatonica, Mifflin, Grand Detour, Nachusa, and Quimbys Mill formations to members of the Platteville Formation, (5) reassign the Spechts Ferry, Kings Lake, and Guttenberg formations to members of the Decorah Formation, (6) reassign the Dunleith, Wise Lake, and Dubuque formations to members of the Galena Formation, (7) reassign all 32 corresponding members to beds, and (8) keep the nine named K-bentonite beds (Willman and Kolata, 1978) at bed rank (fig. 1). For the time being, the St. Peter Sandstone and Glenwood remain at formation rank within the Ancell Group. The series and stage names as well as boundaries are also updated in recognition of the recent advancements in Ordovician chronostratigraphy.

Several hardground omission surfaces within the Galena and Platteville Formations are widespread and persistent. They are readily identified in outcrops and drill cores and are useful in correlating this part of the stratigraphic column. These planar surfaces are characterized by irregular solution cavities, mainly less than 2 inches across. They penetrate the bedding planes to depths of 2 to 3 inches, are stained by iron-rich minerals, and are backfilled with sediment from the overlying unit. They are interpreted as being caused by subaqueous chemical erosion of carbonate sediments during highstand sea level (Kolata et al. 1998, 2001). Some of the more significant surfaces include (1) approximately 15 to 20 surfaces in the lower part of the Dunleith Member, (2) the top of the Guttenberg Member, (3) the top of the Quimbys Mill Member, (4) the top of the Mifflin Member, (5) the top of the Pecatonica Member, and 6) two or three surfaces in the lower 10 feet of the Pecatonica Member.

Structural Geology

The Dixon East Quadrangle lies near the northern margin of the Illinois Basin and is situated in a structurally complex area near the termination of the Sandwich Fault Zone, Plum River Fault Zone, and the projected trend of the La Salle Anticlinorium (fig. 2). Lying parallel to and south of the Sandwich Fault Zone in Lee and Ogle Counties is the Ashton Anticline. This broad anticline brings Middle Ordovician and Upper Cambrian rocks to the bedrock surface along the south side of the Sandwich Fault Zone northeast of the Dixon East Quadrangle and is responsible for the pronounced southwestward dip of bedrock within the quadrangle. The regional dip is portrayed on the geologic map by structural contours that show the sea level elevation of the top of the Glenwood Formation.

Small-Scale Domes and Folds

Some of the most extensive bedrock outcrops in the Dixon East Quadrangle are exposed in the open-pit limestone mines north of Dixon, Illinois (Sec. 27, T21N, R9E). The common mining practice here has been to extract the Mifflin Member for cement production, leaving the hardground at the top of the Pecatonica Member exposed in wide areas of the quarry floor. Because the surface is parallel to bedding, widespread, and easily recognized in outcrops, it makes an excellent structural horizon for detailed mapping. One of the most common structures observed in the quarry floor are small domes and folds that are superimposed on the southwestward regional dip. Typically, the domes are round to elliptical, range from 30 to 200 feet in diameter, and are up to 20 feet high. Some of the domes are sites where the Mifflin limestone has undergone significant dissolution, forming clay-filled cavities. The somewhat larger folds consist mainly of northwest-trending monoclines and anticlines, which appear to have as much as 25 feet of relief and are hundreds of feet long (NW NE Sec. 27, T21N, R9E). The uniform stratigraphic thicknesses suggest that the folds were formed during post-Ordovician time and likely are tectonic in origin.

Bedrock fracture patterns indicate dominant northwest and subdominant southwest trends similar to other regions of northern Illinois (McGarry, 2000). Fractures are particularly well exposed in the floor and walls of the cement quarries in Sec. 27, T22N, R9E.

Economic Resources

Limestone

For many years, high-calcium, low-magnesium limestone has been mined for cement production at St. Marys Cement Company in Dixon, Illinois (Sec. 27, T22N, R9E). The Mifflin Member is the primary target, but high-quality limestone locally is present in the lower 10 to 20 feet of the overlying Grand Detour Formation as well. The limestone grades to dolomite south of a line that corresponds approximately with the northern boundary of T21N, R9E.

Dolomite

In northern Illinois, the Platteville and Galena dolomite is widely quarried for use as aggregate, road-surfacing material, agricultural lime, and riprap. The Renner Quarry situated south of town and west of Illinois State Route 26 (center NE Sec. 28, T21N, R9E) was the only active aggregate quarry at the time of mapping.

Sandstone

St. Peter Sandstone occurs at or near the surface in the northern parts of the Dixon East Quadrangle and has potential for exploitation. This sandstone is well known for its use in the manufacture of glass, filter, and molding sand and as an abrasive. It is also used in hydraulic fracturing of oil and gas wells.

Groundwater

Most domestic wells in the Dixon area draw water from the St. Peter Sandstone aquifer or from fractured dolomite in the Galena and Platteville Formations at depths ranging from 150 to 300 feet. The municipal wells produce water from Cambrian aquifers at depths of 1,500 to 2,000 feet.

Acknowledgments

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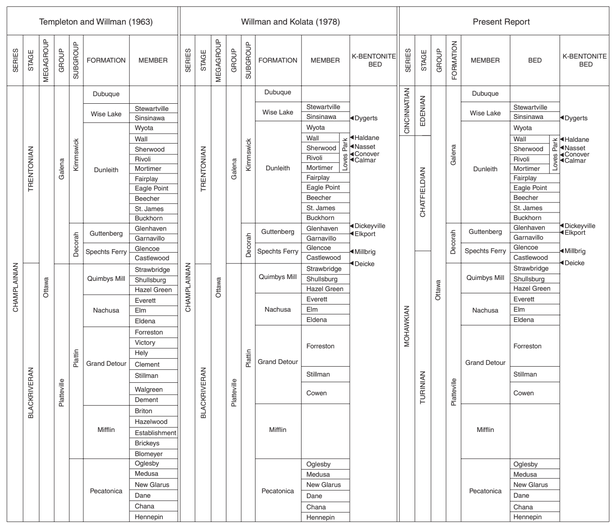

Figure 1 Comparison of the proposed lithostratigraphic classification of the Platteville and Galena carbonate rocks in northern Illinois with those of Templeton and Willman (1963) and Willman and Kolata (1978).

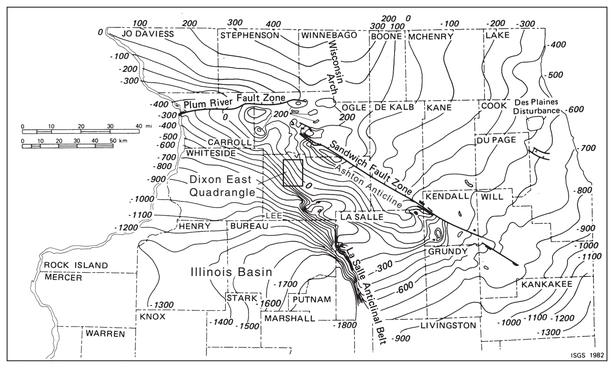

Figure 2 Structural configuration of the Cambrian Franconia Formation in northern Illinois showing the Dixon East Quadrangle relative to major structural features (compiled by Janis D. Treworgy and published in Kolata and Graese, 1983).

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