STATEMAP
Rochelle-BG

Bedrock Geology of Rochelle Quadrangle

Lee and Ogle Counties, Illinois

Franck Delpomdor

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ILLINOIS
Illinois State Geological Survey
PRAIRIE RESEARCH INSTITUTE

615 East Peabody Drive
Champaign, Illinois 61820-6918
(217) 244-2414
http://www.isgs.illinois.edu

Introduction

The Rochelle 7.5-minute quadrangle is located in north-central Illinois in the south-southeast part of Ogle County and north-north-east part of Lee County, Illinois, about 25 miles southwest of Rockford, 75 miles west of Chicago, and 135 miles east of Cedar Rapids (Iowa). The map covers approximately a 55 square mile area that is bounded by 41° 52' 30" and 42° 00' 00" N latitude and 89° 07' 30" and 89° 00' 00" W longitude. It is bordered by eight 7.5-minute quadrangles, clockwise from top-left: Stillman Valley, Kings, Fairdale, Chana, Creston, Ashton, Steward, and Lee. Most of the land is covered by Quaternary surficial sediments, which are used for agriculture. The residential and commercial developments are centered on Rochelle, Hillcrest and Flagg Center areas.

The topography is marked by a flat plateau up to 800 feet in elevation in the northeast and west of the quadrangle. The average of elevation ranges around 790-830 feet. The topography is marked by a dense hydrographic network composed by the Kyte River and its tributaries, which cover the entire surface of the quadrangle. Bedrock is largely concealed beneath till plains, which are composed of glacial deposits ranging in thickness from 15 to 240 feet. Bedrock exposures are rare, but two quarries, located east and north of the city of Rochelle, expose up to 80 feet of rock.

The geologic map includes the northern margin of the Sandwich Fault Zone (SFZ), which is a fault zone 1/2 to 2 miles wide composed of high angle faults that commonly trend northwestward about 85 miles from near Manhattan, Will County, to near Oregon, Ogle County (Kolata et al., 1978). Bedrock is affected by the SFZ to south, and the Wisconsin Arch to north. The Wisconsin Arch extends into northern Illinois with the Kankakee Arch. The oldest rocks in the quadrangle are formed by the Upper Cambrian Potosi Dolomite and Franconia Formation, which occurs south of the SFZ. North of the faulted zone, the Ordovician rocks rest either conformable on the Upper Cambrian succession or are truncated into the Upper Cambrian rocks (Sauk unconformity). Platteville and Galena strata occur at the bedrock surface in a broad area located respectively south central and north to east of the quadrangle.

Bedrock within the Rochelle Quadrangle was investigated by Leighton (1922), Templeton and Saxby (1947), Odom et al. (1964), Kolata and Willman (1975). Structural geology south of the Rochelle Quadrangle was published by Kolata et al. (1978).

The geologic map is based on the compilation of data from bedrock exposures in quarries and the examination of three hundred and seven water well and structure test records and sixty-three drill cuttings or sample sets stored at the Illinois State Geological Survey (ISGS). The fieldwork was completed in 2019 by the author. All data are available at the Illinois State Geological Survey (ISGS).

Stratigraphy

Bedrock that occurs at or near the surface within the Rochelle Quadrangle is essentially dated as Upper Cambrian to the south, and Middle Ordovician to the north. Their strata are assigned to the St. Croixan, Ibexian and Mohawkian series, and they are divided into Cambrian including Potosi Dolomite and Franconia Formation, Prairie du Chien Group which is only observed in water wells, Ancell Group, Platteville and Galena Formations respectively. The surficial deposits are tabular and deposited during the Quaternary glaciation in North America. The contact with the underlying bedrock is unconformable.

The Upper Cambrian Franconia Formation and Potosi Dolomite are mapped together due the lack of surface exposure and well data in the south-west corner of the quadrangle. The Franconia and Potosi succession are located along the south side of the SFZ. The thickness varies between one hundred twenty feet (API no.121410104300, SW SE SW Sec. 24, T40N, R1E, N41.9206, W89.0697; total depth 1,484 feet) and two hundred fifty feet (API no.121410013300, NW SW SE Sec. 30, T40N, R2E, N41.9086, W89.0455; total depth 935 feet). The Franconia Formation and Potosi Dolomite regionally reach maximum thicknesses of 135 and 150 feet respectively (Buschbach, 1975; Kolata, 2015; Delpomdor and Wirth, 2018). The contact between the Franconia Formation and Potosi Dolomite is uncertain, but a conformable contact was reported by Buschbach (1975). In the south-west corner and central west edge of the quadrangle, the Franconia Dolomite (one hundred forty feet thick, API no.121410024300, SE NW SE Sec. 17, T40N, R2E, N41.9418, W89.0247; total depth 1,001 feet) is directly overlain by the St. Peter Sandstone, from which it is separated by an angular unconformity due to the SFZ (Kolata et al., 1978; Kolata, 2015; Delpomdor and Wirth, 2018). North of the SFZ, the Franconia Formation is conformably overlain by the Potosi Dolomite, which is overlaid with a conformable contact with the Oneota Dolomite or with an unconformable contact with the St. Peter Sandstone, as observed in water well API numbers 121032417000 and 121410104400 sample sets (NE NW SE Sec. 5, T39N, R2E, N41.8847, W89.0215; total depth 970 feet; SW SW SE Sec. 24, T40N, R1E, N41.9206, W89.06910; total depth 1,450 feet). The Eminence Formation, overlying the Potosi Dolomite, is missing due to the truncation by the sub-Tippecanoe unconformity over the Kankakee Arch.

The Prairie du Chien Group is not exposed in outcrops, but water and structure test wells cross this succession. The three formations within the Prairie du Chien Group are mapped together because their identification remains uncertain due to the paucity of definitive subsurface information. The Gunter Sandstone is missing in Lee and Ogle Counties (Willman and Buschbach, 1975). The Oneota Dolomite is conformably overlaid by ten to fifteen feet thick New Richmond Sandstone, which is well identified

in water well API no.121410004700 (NW NE NE Sec. 24, T40N, R1E, N41.9331, W89.0659; total depth 925 feet), API no.121410013300 (NW SW SE Sec. 30, T40N, R2E, N41.9086, W89.0455; total depth 935 feet) and API no.121032417000 (NE NW SE Sec. 5, T39N, R2E, N41.8847, W89.0215; total depth 970 feet) sample sets. This formation is conformably overlaid by the Shakopee Dolomite. The Prairie du Chien Group is unconformably bounded by the underlying Cambrian rocks and overlying St. Peter Sandstone as shown by the variations of thickness ranging between ninety and two hundred sixty feet (API no.121410104300, SW SE SW Sec. 24, T40N, R1E, N41.9206, W89.0697; total depth 1,484 feet; API no.121410029000, NW NW NE Sec. 36, T40N, R1E, N41.9049, W89.0572; total depth 920 feet). The Prairie du Chien is missing in the central west wedge of the quadrangle (API no.121410024300, SE NW SE Sec. 17, T40N, R2E, N41.9418, W89.0247; total depth 1,001 feet). The contact with the St. Peter Sandstone is related with the Sauk unconformity that separates the Sauk Sequence (below) from the Tippecanoe Sequence (above) (Willman et al., 1975).

The Ancell Group comprises the St. Peter Sandstone and Glenwood Formation that are mapped together due to minimal thickness of the Glenwood Formation. The thickness of the Glenwood Formation southward deepens from forty feet to the north (API no.121410019400, SE SW SW Sec. 35, T41N, R1E, N41.9841, W89.0799; total depth 240 feet; API no.121410109100, SE NW NW Sec. 33, T41N, R1E, N41.9838, W89.1146; total depth 235 feet) to eighty feet to the south (API no.121410105800, SE SE SE Sec. 36, T40N, R1E, N41.8914, W89.0547; total depth 250 feet). The St. Peter Sandstone largely covers the lower and medium part of the quadrangle. It thickens with a maximum thickness of four hundred forty-five feet on the central west part of the quadrangle (API no.121410104600, NE SW NW Sec. 25, T40N, R1E, N41.9151, W89.0596; total depth 867 feet; API no.121410024300, SE NW SE Sec. 17, T40N, R2E, N41.9418, W89.0247; total depth 1,001 feet). The St. Peter Sandstone is conformable with the Glenwood Formation. This formation is locally eroded or unconformable with the overlying Pecatonica Formation.

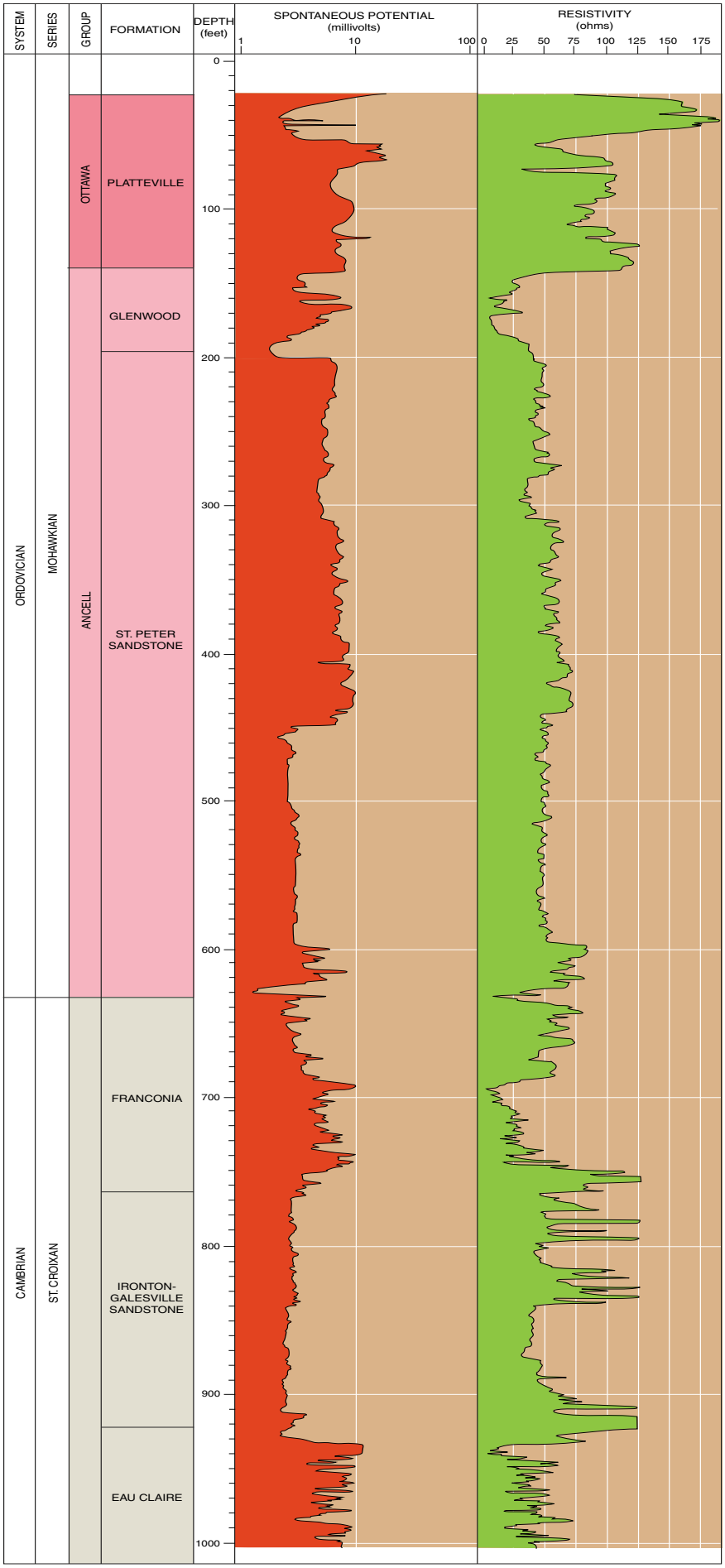
The Platteville Formation is divided into five distinct units (i.e., from base to the top: the Pecatonica, Mifflin, Grand Detour, Nachusa, and Quimbys Mill). In the Rochelle Quadrangle, the units are mapped together because their cumulative thickness of one hundred twenty feet (API no.121410024300, SE NW SE Sec. 17, T40N, R2E, N41.9418, W89.0247; total depth 1,001 feet) constitute a mappable stratigraphy unit at the 1:24,000 scale. The Platteville Formation is exposed in the lower and middle part of Macklin Inc. quarries located northeast and southeast of the city of Rochelle (SE NE NW Sec. 20, T40N, R2E; NW NW SE Sec. 13, T40N, R1E). The Platteville Formation is conformable with the Galena Formation. The formation covers most part of the quadrangle.

The Galena Dolomite comprises the Dunleigh Member and younger units that are eroded at the surface. The Guttenberg Member, that is the lowest unit of the Galena Dolomite, is absent or extremely thin in the quadrangle. The thickness of the Dunleigh Member is up to fifteen feet. A K-bentonite bed, that is one-inch-thick or less, is identified at the base of the Dunleith Member. Chert in nodules and K-bentonite beds have been identified at the basal contact (Willman and Kolata, 1978). The crystalline texture is characteristic of the Dunleigh Member and is the key to telling it apart from the Platteville Formation. The Galena Dolomite is present on the north and north-west of the map area, as indicated by well data. Twelve feet of the Dunleith Member is exposed in the top of the inactive Macklin Inc. quarry located south of East Flagg Rd. one mile north-northeast of the city of Rochelle (NW NW SE Sec. 13, T40N, R1E).

Electric profile

The Spontaneous Potential (SP) and Resistivity (R) logs are passive measurements taken by oil industry and water well loggers that characterize rock formation properties such as the permeability, the porosity, the formation-water resistivity, and the amount of clay fraction. These tools are commonly used for the correlation of formations when compared with data from other analogous wells. The API no.121410024300 structure test well (SE NW SE Sec. 17, T40N, R2E, N41.9418, W89.0247; total depth 1,001 feet) is proposed as representative of the stratigraphy within the Rochelle Quadrangle (Fig. 1).

The Eau Claire Formation is characterized by multiple variations of low and moderate SP baselines that are inversed in the R log. These variations are interpreted as an alternation of non-porous and impermeable dolomitic shale and dolomite. The Ironton-Galesville succession shows a low and flat SP baseline typical of sandy rocks. The R log is principally flat. However, high baselines, respectively at the top and the base, indicate a change of lithology as observed by the sandy dolomite. The Franconia Formation shows a decrease-upward sequence in SP baseline and a change in R baseline to the top, which is interpreted as a change of lithology between non-porous and impermeable dolomite at the base and more porous and permeable dolomitic sandstone at the top. The base of the overlying St Peter Sandstone is marked by 40 feet thick of higher SP and R baselines. They are interpreted as a change of lithology and grain size, as observed by the weathered red porous sandstone, that increase the porosity and permeability. The St. Peter Sandstone shows an increase-upward sequence in SP baseline that slightly decreases at the top. The R log highlights a flat R baseline, but the higher SP and R baselines are measured in the medium to upper part of the unit. The higher baselines are here interpreted as porous and permeable sandstone flooded by freshwater. The Glenwood Formation is characterized by an increase-to-decrease-upward sequence in SP baseline that is inversed in the R log. These baselines are interpreted as a



non-porous and impermeable alternation of shale and sandstone, slightly dolomitic. The Platteville Formation is marked by high SP and R baselines, which are interpreted as tight dolomite. At the base of the Platteville Formation, a baseline drift is observed and is related to lithological variations or a change in the properties of the clays or commonly caused by the relative oxidation of the rocks that are close to the surface.

Structural Geology

In the northeastern Illinois, the structural geology has been investigated using aeromagnetic and reflection seismic surveys by the U.S. Geological Survey and Northeastern Illinois Metropolitan Area Planning Commission during the 1960s. The Rochelle Quadrangle is located along the southern part of the Wisconsin Arch, which is defined as the structurally high portion of the area situated north of the SFZ and separating the Illinois Basin to the south from the Michigan Basin to the northeast and connecting the Wisconsin and Cincinnati Arches (McGinnis and Heigold, 1961; Beck, 1965; McGinnis, 1966) (Fig. 2). The Dunleigh Member and the Platteville Formation occur at the bedrock surface on the southern flank of the Kankakee Arch. Smaller structural features related to the Oregon Anticline and the Ashton Arch are present respectively north and south of the SFZ. The secondary structures linked to the Oregon Anticline are broad and low flexure domes that extend along the downthrown side of the SFZ from Oregon to Rochelle (Bewan, 1939; Kolata et al., 1978). Along these anticlines, the St. Peter Sandstone occurs at the surface. The Ashton Arch is a broad domal uplift, elongated roughly N. 50° W, that is truncated northeastern throughout its length by the SFZ (Willman and Templeton, 1951) (Fig. 2). The Potosi-Franconia rocks are the surface on the northern flank of the arch. South of the SFZ, slightly folded Upper Cambrian to Prairie du Chien Groups are separated to the north slightly west-southwest dipping Upper Cambrian to Galena Dolomite. The SFZ is a south-east oriented 2 mile wide zone, of high-angle faults with a cumulative displacement of 200 to 300 feet down to the north (Kolata et al., 1978). Due to the lack of data, the Sandwich Fault Zone was mapped from data in adjacent areas.

Figure 1 Spontaneous Potential and Resistivity logs of the Ordovician Galena Dolomite and Ancell Group and the Cambrian Potosi Dolomite and Franconia Formation (API no.121410024300, SE NW SE Sec. 17, T40N, R2E, N41.9418, W89.0247; total depth 1,001 feet).

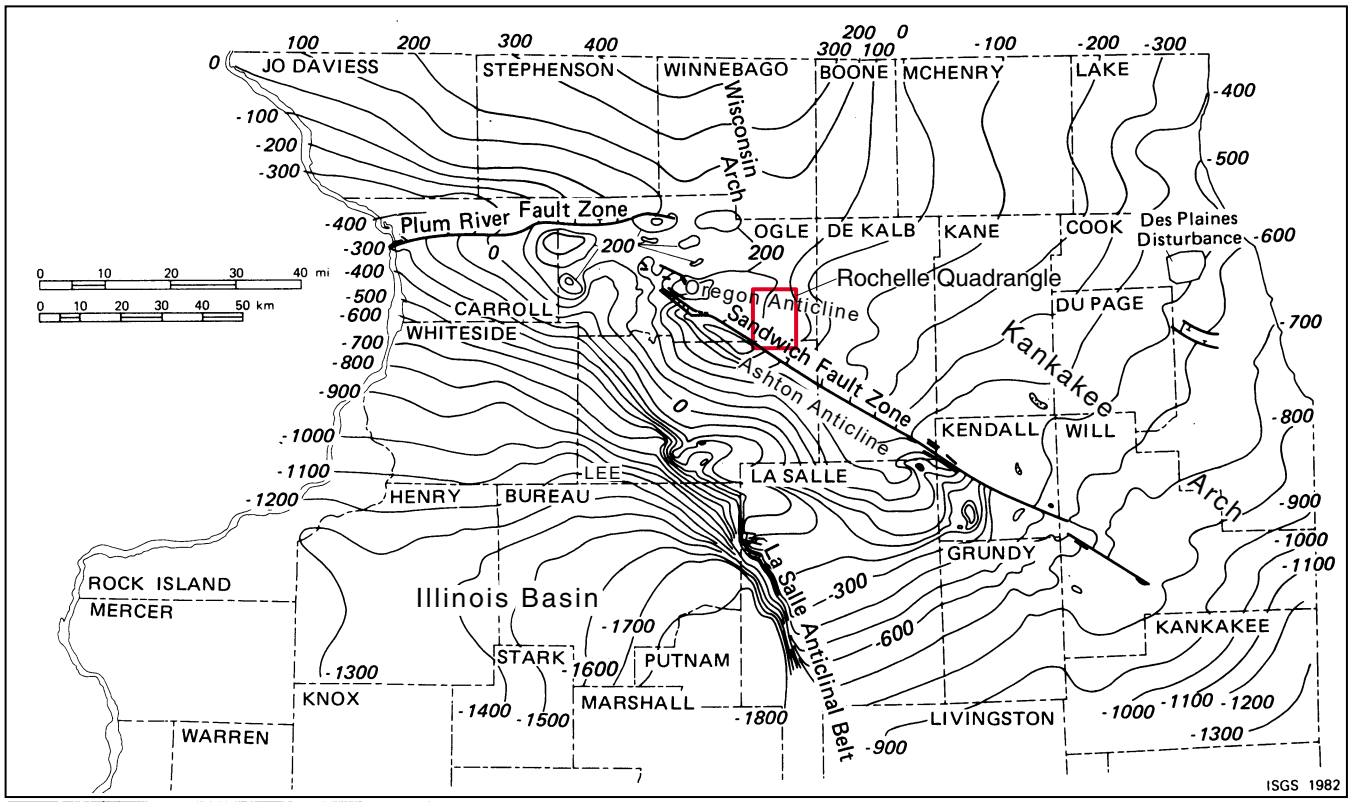


Figure 2 Structural map of the Cambrian Franconia Formation (feet above sea level) in northern Illinois showing the major structural features (modified after Kolata and Graese, 1983 and Kolata, 2015). The Rochelle Quadrangle is located by a red rectangle.

A major unconformity (i.e., sub-Tippecanoe unconformity) occurs at the top of the Cambrian rocks, where the Eminence Formation is missing. This absence suggests a regional erosion caused by tilting of the rocks towards the south and uplifting of the Wisconsin and Kankakee Arches (Kolata et al., 1978). A second major unconformity (i.e., Sauk unconformity) is marked by the deposition of the St. Peter Sandstone that overlaps the Prairie du Chien Group or directly the Cambrian rocks. Such pinch out of the Prairie du Chien Group with the St Peter Sandstone is observed in the API no.121410024300 structure test well (SE NW SE Sec. 17, T40N, R2E, N41.9418, W89.0247; total depth 1,001 feet). The absence of the Guttenberg Member is probably the result of regional vertical movements along the Wisconsin and Kankakee Arches early in Galena time (Kolata et al., 1978).

Economic Resources

Sand and gravel

Unconsolidated sands and gravels from the Quaternary surficial sediments are quarried in an active pit located at the intersection between Linda Ave. and Wayne Rd. at Hillcrest (SW NW NW Sec. 12, T40N, R1E). Pure quartz sand from the St. Peter Sandstone, exploited as a source of sand for making glass products and enhancing recovery from hydrocarbon reservoirs, is a potential economic resource within the quadrangle. Such resource is mined about seventeen miles southwest of the city of Oregon (Sec. 7-8 and 17-18, T23N, R10E) and forty miles west of the city of Ottawa (Sec. 9-10, T33N, R3E).

Stone

Most of the dolomite from the Platteville Formation quarried in the area is used as road gravel, fill and aggregate for construction purposes. Dolomite is exploited in two Macklin Inc. quarries located respectively south of East Flagg Rd. one mile north-northeast of the city of Rochelle (NW NW SE Sec. 13, T40N, R1E) and southeast of South Dement Rd. and East Illinois Route 38 two miles northeast of the Rochelle City Clerk building at Rochelle (SE NE NW Sec. 20, T40N, R2E). Only the stone quarry located southeast of South Dement Rd. and East Illinois Route 38 was active during the time of mapping.

Groundwater

Residential wells in the Rochelle quadrangle recover groundwater largely from dolomite aquifers within the Platteville Formation and the underlying sandstone of the St. Peter Sandstone. Most water wells are drilled between 150 to 250 feet.

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