Prepared in cooperation with the U.S. Geological Survey, Charles G. Groat, Director,
under the National Geologic Mapping Program supported by the
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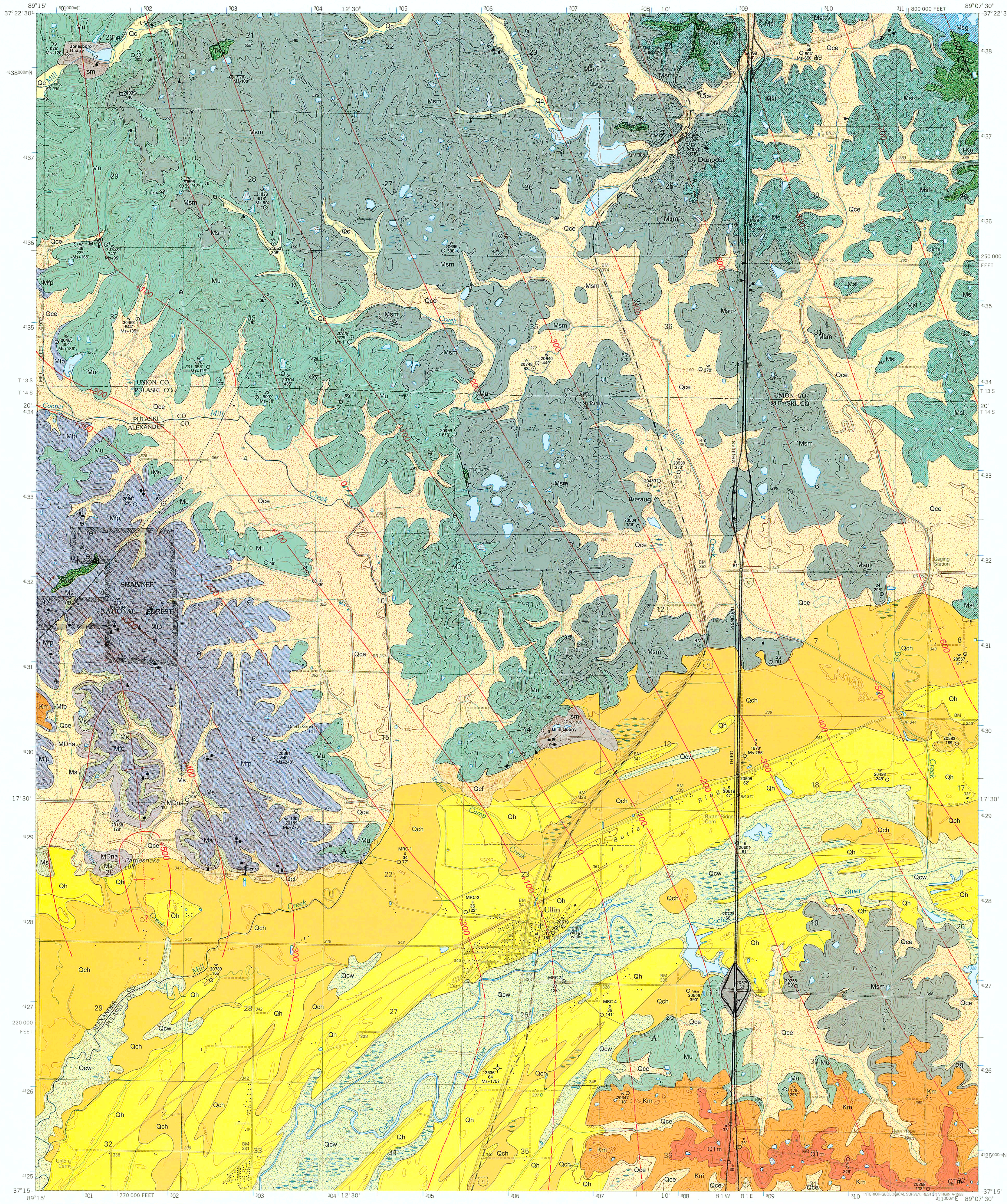
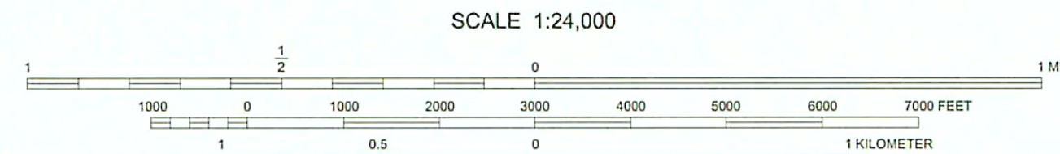


Base from U.S. Geological Survey, 1966; photorevised 1990
10,000-foot grid based on Illinois coordinate system

Cartography by Williams & Heintz Map Corp.

SCALE 1:24,000



CONTOUR INTERVAL 10 FEET
DOTTED LINES REPRESENT 5-FOOT CONTOURS
NATIONAL GEODETIC VERTICAL DATUM OF 1929

# GEOLOGIC MAP OF THE DONGOLA QUADRANGLE ALEXANDER, PULASKI, AND UNION COUNTIES, ILLINOIS

W. John Nelson, Leon R. Follmer, and John M. Masters

1999

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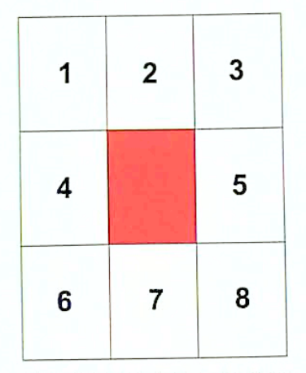
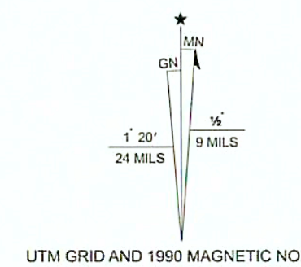


1 Jonesboro
2 Anna
3 Mt. Pleasant
4 Mill Creek
5 Cypress
6 Tamms
7 Pulaski
8 Olmsted

ADJOINING 7.5-MINUTE QUADRANGLES



UTM GRID AND 1990 MAGNETIC NORTH
DECLINATION AT CENTER OF SHEET

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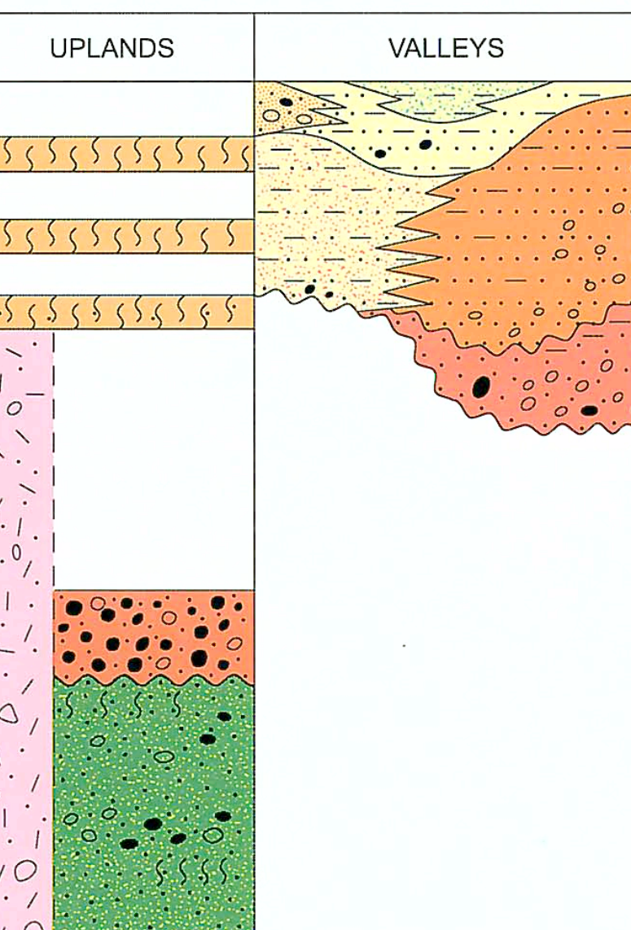
Department of Natural Resources
**ILLINOIS STATE GEOLOGICAL SURVEY**
William W. Shilts, Chief
Champaign, Illinois

Geologic Map of the
**DONGOLA QUADRANGLE, ILLINOIS**
Illinois Geologic Quadrangle 19



| SYSTEM | SERIES AND STAGE | | FORMATION | | THICKNESS ft (m) | | UNITS | |
|---|---|---|---|---|---|---|---|---|
| | | | UPLANDS | VALLEYS | UPLANDS | VALLEYS | UP. | VAL. |
| Quaternary | Holocene | | | Cahokia | | 0–38 (0–12) | | H |
| | Pleistocene | Wisconsinan | Peoria Silt | Equality<br>Henry | | 0–80 (0–24)<br>0–120 (0–37) | A | I<br>J |
| | | | Roxana Silt | | 2–10 (0.6–3) | | B | |
| | | Illinoian | Loveland Silt | Pearl | 0–4 (0–1) | 0–50 (0–15) | C | K |
| | | | Residuum, colluvium, and karst fill | | 0–60 (0–18)<br>0–4 (0–1) | | D | |
| | | Pre-Illinoian | | | | | | |
| Tertiary | Pliocene | | Mounds Gravel | | 0–50 (0–15) | | E | |
| | Miocene to Paleocene | | unnamed deposits | | 0–50? (0–15) | | F | |
| Cretaceous | Upper | Maas-trichtian | McNairy | | 0–100 (0–30) | | G | |

Thickness is not to scale

DESCRIPTION

UPLANDS

**A Peoria Silt** *Silt* is mottled in light to medium gray, yellowish gray, and yellowish brown and has an angular blocky structure. It has a slight clay content and is generally well drained, relatively dry, and crumbly in well samples. Root traces, organic matter, and pellets and stains of iron and manganese oxides are features of the modern soil developed in this unit. The Peoria is at the surface in nearly all upland areas and ranges from 3 to 20 feet thick, increasing toward the Cache Valley. The Peoria is interpreted as loess, or wind-blown silt deposited during late Wisconsinan glaciation. ***Not mapped.***

**B Roxana Silt** *Silt* is generally medium brown to medium reddish brown, exhibits little or no mottling, and has a massive structure. Clay content is greater than that of the Peoria, so the Roxana holds water and is commonly soft and plastic in fresh well samples. Black oxides of manganese and iron occur as tiny pellets and fracture-fillings. The Farmdale Geosol is developed in the Roxana. Thickness ranges from 2 to 10 feet, increasing toward the Cache Valley. The Roxana is considered to be loess of middle Wisconsinan age. ***Not mapped.***

**C Loveland Silt** *Sandy silt.* The Loveland is typically mottled in grayish to yellowish brown and reddish to orange-brown. It is clay-rich and contains scattered small pebbles near the base. Angular blocky structure and well-developed peds and clay skins were formed during development of the Sangamon Geosol, a buried soil. The Loveland is discontinuous and generally less than 4 feet thick; it is interpreted as loess of Illinoian age. A possible pre-Loveland loess was observed in samples from an ISGS stratigraphic test hole in the SW¼ of Sec. 33, T13S, R1W. This older silt is about 5 feet thick and yellowish brown, massive, and clay-rich. ***Not mapped.***

**D Residuum, colluvium, and karst fill** *Clay with sand, gravel, and chert fragments.* The clay is deep reddish orange to reddish brown, waxy, stiff, and heavily slickensided. It contains scattered sand grains and small, well-rounded quartz and chert pebbles derived from Tertiary-Cretaceous deposits. Also abundant are angular fragments of bleached chert derived from Mississippian limestone. This material mantles bedrock in the northeast part of the quadrangle and is highly variable in thickness, commonly filling sinkholes. This unit is known only from well records and manmade excavations. An excavation for a highway interchange north of Dongola revealed pinnacles of limestone, at least 10 feet high, surrounded by this material. A bridge boring along I-57 about ½ mile southeast of Dongola penetrated 57 feet of red clay. Most of this unnamed unit probably is of late Tertiary to early Pleistocene (pre-Loveland) age, but some of it may be much older. ***Not mapped.***

**E Mounds Gravel** *Gravel, conglomerate, sand, and sandstone.* The Mounds is composed largely of subangular to well-rounded chert pebbles, mostly less than 1 inch across but some as large as 3 inches. Sandstone fragments and small quartz pebbles also are present. Bronze patina on pebbles is characteristic of the Mounds. The matrix is sand and clay; the cement is limonite and goethite. Sand and sandstone are light gray to dark brown and composed mostly of quartz, with scattered chert grains. Sand and gravel commonly are cemented by limonite. This unit is thickly mantled by loess on hilltops south of the Cache Valley. The lower contact is unconformable.

**F Unnamed deposits** *Sand and gravel.* Most of the sand is red, orange, and brown, fine- to coarse-grained, and contains small rounded quartz and chert pebbles along with rip-up clasts of light gray, silty clay. Also found are large float blocks of white to light gray, well-lithified sandstone that is composed of nearly 100% pure, fine quartz grains. The white sandstone may be laminated to massive, and in places contain fossil root casts. Gravel is composed of small, well-rounded pebbles of gray to black, vitreous chert, along with a smaller proportion of quartz pebbles. Gravel may be either uncemented or cemented by iron oxide. The unit is poorly exposed, and observed mainly as float in the northeast part of the quadrangle. Some of it may fill sinkholes. Some of the sand, especially the white quartz sandstone, may belong to the McNairy Formation. The gravel is similar to deposits of Eocene age in nearby quadrangles (Nelson et al., 1995). Included in TKu where mapped.

**G McNairy Formation** *Sand, silt, and clay.* Sand is white to gray and red, very fine- to medium-grained, micaceous, and clayey. Interbeds of white to gray clay and silt are common. The McNairy is mapped in low, rolling hills in the southern part of the quadrangle, but it is thickly mantled by loess and no outcrops were found. Mapping and description of this unit are based on well records and outcrops in adjacent areas. The lower contact is unconformable.

VALLEYS

**H Cahokia Fm.** *Silt, sand, clay, gravel, and rock debris.* Silt and silty clay are yellowish to brownish gray, commonly mottled, laterally variable, and contain much organic material and evidence of rooting. Clays are chiefly composed of smectite and mixed-layer clay minerals. Sand is very fine to very coarse, chiefly quartz with 5 to 20% chert and lithic fragments. Sand grains are subangular to well rounded; rounding improves in the coarser fraction. Gravel is chiefly well-rounded chert pebbles up to about ½ inch in diameter, combined with roughly 10% quartz pebbles and less than 10% igneous and metamorphic rocks reworked from older gravels. Along the broad valleys of the upper Cache River, Little Creek, and Big Creek, the Cahokia is dominantly silt derived from upland loess. Surface soils are weakly developed; buried soils are common. Along small upland valleys, the Cahokia is a mixture of silt and angular chert fragments derived from weathered bedrock. ***Alluvial fan facies (Qcf)*** consists of silt intermixed with angular rock fragments, found at the foot of steep slopes on the north side of the Cache Valley northwest of Ullin. ***Wetland facies (Qcw)*** is soft, gray clay and silt rich in organic matter, found in abandoned channels and swales within the Cache Valley. The remainder of the Cahokia represents Holocene alluvium and minor amounts of colluvium. Its lower contact is erosional in some places, but in most areas the contact is gradational and the Cahokia is not differentiated from underlying ***Equality (Qce)*** and ***Henry (Qch) Formations***.

**I Equality Fm.** *Silt and clay, minor sand and gravel.* Silt and clay are medium to dark brownish, olive, greenish, and bluish gray, stiff, and massive to finely laminated. Logs and other plant matter are common, as are limonite concretions. Lenses and laminae of fine sand are present. Gravel lenses occur locally near the base. Clays are dominantly illite and commonly are calcareous. The contact to the Cahokia Formation is gradational, and difficult to identify even in cores. The Equality underlies all large tributaries to the Cache Valley, where it is overlain by the Cahokia Formation. A boring near the mouth of Little Creek penetrated 81 feet of Equality without reaching the base. Near the margins of the Cache Valley, the Equality intergrades laterally with the Henry Formation. The Equality is interpreted as fluvial overbank and lacustrine sediments deposited in slack-water lakes that formed during Wisconsinan interglacial episodes (Esling et al., 1989). The lower contact is erosional and rests on Paleozoic bedrock in most places.

**J Henry Fm.** *Sand, gravel, and minor silt and clay.* Sand dominates; it ranges from very fine- to coarse-grained and is composed of 80 to 95% quartz along with 5 to 15% chert, lithic grains, mica, and coal fragments. Fine sand is mostly subangular to subrounded, whereas coarse sand is rounded to well rounded. Gravel is composed of subrounded to well-rounded pebbles, most of which are smaller than ½ inch but range up to 1¼ inch in diameter. Chert pebbles are most common, followed by quartz and a wide variety of igneous and metamorphic rocks. The Henry Formation makes up the bulk of the fill in the Cache Valley, where it ranges up to at least 120 feet thick and comprises one or more fining-upward sequences (*see cross section*). Gray to brown, massive to laminated silt and clay interbed with sand in the upper part of the Henry. Weakly developed paleosols occur in the upper part of the unit. Map unit ***Qh*** is shown on sandy ridges in the Cache Valley, where the Cahokia Formation is thinner than 10 feet. These ridges represent longitudinal bars and point bars that stand high because of original topography and differential compaction. Map unit ***Qch*** is used in broad, level areas of the valley, where the Henry is overlain by 10 feet or more of the silty Cahokia Formation. The Henry represents fluvial channel, point-bar, longitudinal-bar, and natural levee deposits, and probably some aeolian sands on the tops of ridges such as Butter Ridge. A large portion of the sediment was derived from Wisconsinan glacial outwash (Esling et al., 1989). The lower contact is erosional.

**K Pearl Fm.** *Sand, gravel, and sandy clay.* Sand and gravel of the Pearl form the lower part of the valley-fill sequence in the Cache Valley (*see cross section*). These sediments are similar to sand and gravel of the Henry Formation, but overall are coarser and comprise a single upward-fining sequence. Gravel clasts are subrounded to well rounded and range up to 3 inches in diameter near the base of the unit. Chert pebbles predominate; quartz and igneous and metamorphic rocks make up 10 to 20% of the gravel fraction. The Pearl is interpreted as fluvial-channel deposits of Illinoian age and is largely derived from glacial outwash.

## EXPLANATION

| | Map unit | | |
|---|---|---|---|
| Holocene | Qc, Qcf, Qcw | Cahokia Formation<br>Qcf, alluvial fan facies<br>Qcw, wetland facies | QUATERNARY |
| Pleistocene | Qce | Cahokia and Equality Formations, undifferentiated | |
| | Qch | Cahokia and Henry Formations, undifferentiated<br>*Mapped in low, level areas of Cache Valley where Cahokia is 10 feet or thicker* | |
| | Qh | Henry Formation<br>*Mapped on ridges in Cache Valley where Cahokia is less than 10 feet thick* | |
| | | unconformity | |
| Pliocene and older | QTm | Mounds Gravel | TERTIARY |
| | | unconformity | |
| ? | TKu | Tertiary and Cretaceous strata, undifferentiated | |
| Maas-strichtian | Km | McNairy Formation | CRETA-CEOUS |
| | | unconformity | |
| Valmeyeran | Msg | Ste. Genevieve Limestone | MISSISSIPPIAN |
| | Msl | St. Louis Limestone | |
| | Msm | Salem Limestone | |
| | Mu | Ullin Limestone | |
| | Mfp | Fort Payne Formation | |
| | | unconformity | |
| Kinder-hookian | Ms | Springville Shale and Chouteau Limestone | |
| | | unconformity | |
| Upper Devonian | MDna | New Albany Shale | DEVONIAN |

SYMBOLS

5 Strike and dip of bedding; dip in degrees

Apparent or approximate strike and dip of bedding

Horizontal bedding

Vertical joints or fractures

Chert breccia

Outcrop of special note; shown where unit or contact was well exposed during mapping

Abandoned quarry: L = limestone, S = silica

Caved adit or drift mine for silica

DRILL HOLES FROM WHICH SUBSURFACE DATA WERE OBTAINED

2 1670' Dry oil-test hole, with ISGS county number and depth in feet

21053 670 Other borings, with ISGS county number and depth in feet. e = engineering, i = industrial minerals, s = stratigraphic test, w = water well

Ms-110' (As notation on a well) Elevation of top of Springville Shale in feet

LINE SYMBOLS: Dashed where inferred; dotted where concealed

Contact

Fault; ball and bar on downthrown side

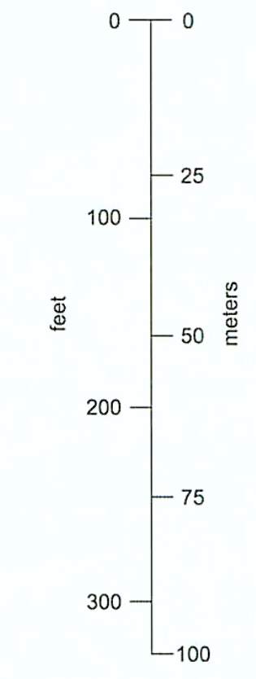
Axial trace of anticline

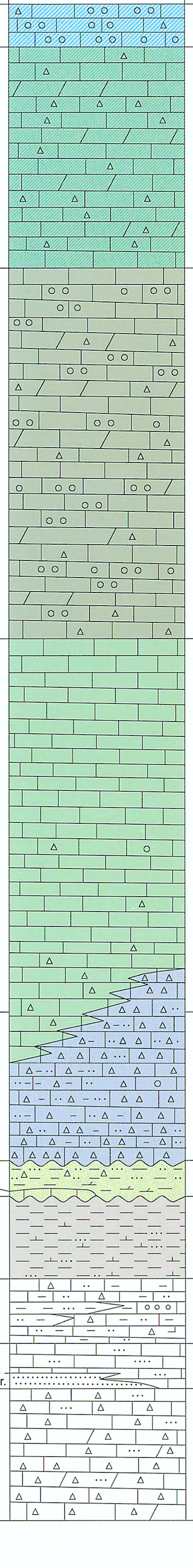
A A' Line of cross section

300 Structure contour (drawn on top of Springville Shale; elevation in feet)

sm Active surface mine or quarry

af Artifical fill





| SYSTEM | SERIES | FORMATION | THICKNESS ft (m) | DESCRIPTION UNIT |
|---|---|---|---|---|
| MISSISSIPPIAN | Valmeyeran | Ste. Genevieve Limestone | <50 (<15) | L |
| | | St. Louis Limestone | 270–330 (82–101) | M |
| | | Salem Limestone | 400–450 (122–137) | N |
| | | Ullin Limestone | 400–450 (122–137) | O |
| | | Fort Payne Formation | 100–240 (30–73) | P |
| | | Springville Shale | 23–57 (7–17) | Q |
| | Kinder-hookian | Chouteau Ls. | | |
| DEVONIAN | Upper | New Albany Shale | 65–127 (20–39) | R |
| | Middle | St. Laurent Formation | 44–95 (13–29) | S |
| | | Grand Tower Limestone | 30–58 (9–18) | T |
| | | Dutch Creek Ss. Mbr. | | |
| | Lower | Clear Creek Formation | 380+ (116+) | U |

DESCRIPTION

**L Ste. Genevieve Limestone** This unit does not crop out in the Dongola Quadrangle, but is projected into the northeast corner on the basis of mapping in adjacent quadrangles, where the Ste. Genevieve consists of light gray, oolitic and skeletal grainstone interbedded with light to medium gray skeletal packstone, wackestone, and lime mudstone.

**M St. Louis Limestone** *Limestone* is largely medium to dark gray and brownish gray lime mudstone and fine-grained skeletal wackestone and packstone, with numerous chert nodules. The most distinctive lithology is lithographic to microgranular, dolomitic lime mudstone that contains dark gray to black, vitreous chert nodules. Some of this rock has faint, planar laminations. Wackestones and packstones of the St. Louis are siliceous and contain much chert and drusy quartz. These rocks also contain numerous brachiopods, bryozoans, echinoderms, and rugose corals. The upper part of the St. Louis contains beds of light gray skeletal wackestone and packstone without oolites. Near the base of the St. Louis, the colonial coral *Acrocyathus floriformis* is common and locally accompanied by *Syringopora* and *Chaetetes*. The lower contact is gradational and probably intertongues with the Salem.

**N Salem Limestone** *Limestone.* The upper half of the unit is mostly medium to dark gray and brownish gray, fine- to coarse-grained skeletal wackestone, packstone, and grainstone in beds 2 to 3 feet thick. Fossil grains are typically broken, abraded, and lighter in color than the matrix. Oolites are common; some intervals are crossbedded. A few interbeds of dark gray, dolomitic, cherty lime mudstone are present. The lower half of the unit contains limestone of varied lithology, ranging from dark gray, argillaceous, cherty lime mudstone and skeletal wackestone to light gray, fine- to coarse-grained, skeletal and oolitic packstone and grainstone. These lithologies seem to recur in cyclic fashion, cycles being 10 to 20 feet or thicker. Salem fossils include brachiopods, gastropods, crinoids, blastoids, bryozoans, endothyrid Foraminifera, and corals. The rugose coral *Acrocyathus proliferus* is abundant near the top of the Salem, where it is a useful horizon marker. The coral occurs in rocks ranging from lime mudstone to oolitic grainstone, so it does not appear to be dependent on facies. The lower contact is gradational and intertonguing; Salem and Ullin lithologies alternate through an interval as thick as 80 feet.

**O Ullin Limestone** *Limestone.* The Ullin contains two types of limestone that intergrade vertically and laterally. One type consists of speckled light gray to yellowish gray, medium- to very coarse-grained packstone and grainstone. The speckled appearance is produced by dark echinoderm fragments in a dull white matrix of fenestrate bryozoan fragments. Tabular-planar and wedge-planar crossbedding is conspicuous and occurs in sets as thick as 5 feet. Also present are beds of light to medium gray, well-sorted, coarse crinoidal grainstone. The speckled limestone is most common in the upper part of the Ullin, where the grain size and average bedding thickness increase upward. The other type of limestone is unspeckled medium-light to medium-dark gray, very fine- to coarse-grained skeletal packstone and grainstone. This rock is slightly siliceous and contains dark gray argillaceous partings and up to 10% chert nodules and bands. The white to dark bluish gray chert has dull to vitreous luster and contains well-preserved bioclastic texture. The speckled and unspeckled limestones represent, respectively, the Harrodsburg and Ramp Creek Members of the Ullin Limestone described by Lineback (1966); however, the Harrodsburg and Ramp Creek are more accurately called lithofacies than members (Lasemi et al., 1994). The contact with the Fort Payne is gradational and intertonguing.

**P Fort Payne Formation** *Limestone, bedded chert, and ganister.* Limestone is dark gray or dark olive gray to nearly black, dolomitic lime mudstone to very fine-grained skeletal wackestone and packstone. It is very siliceous and contains 10 to 30% dark-colored, dull to slightly vitreous chert nodules. These commonly occur as small, vesicular, highly angular blebs complexly intergrown with carbonate rock. Wavy partings and laminae of dark gray to black silty shale and siltstone are common, especially near the base of the Fort Payne. Beds are tabular to slightly uneven and 2 to 12 inches thick. The only fossils are rare echinoderm fragments. *Bedded chert* of the Fort Payne is bluish gray to dull yellow and orange-brown and porous and vuggy. It has a scraggly, worm-eaten or wood-grained texture and lacks fossils. Beds are wavy to crenulated and typically 4 to 24 inches thick. *Ganister* of the Fort Payne is orange-brown to reddish orange, coarsely granular, porous silica that is crudely stratified. Bedded chert and ganister commonly occur together and may be intricately intergrown. The contact with the Springville Shale is sharp and probably disconformable.

**Q Springville Shale** *Shale, siltstone, and "calico rock."* Shale and siltstone are greenish gray to bluish gray, siliceous, unevenly laminated, and mostly noncalcareous. Horizontal burrows and trails are present. The Springville coarsens upward from clay-shale at the base to siltstone at the top. Calico rock is a bedded siliceous rock that locally occurs in the upper Springville. It is light gray, mottled, and variegated in pink, purple, orange, gray, and brown. Calico rock is dense, hard, and closely jointed; and it occurs in blocky beds as thick as 18 inches separated by thinner layers of laminated siltstone and silty shale. The ***Chouteau Limestone*** underlies the Springville in the Rigney # 1 Hileman well in Sec. 21, T13S, R1W. The limestone is about 1 foot thick, light olive gray and "sublithographic" (E. Atherton sample log, ISGS, open files). The contact with the New Albany is sharp and probably disconformable.

**R New Albany Shale** *Shale.* The upper part is dark brownish gray to black (weathering silvery gray) and hard, brittle, highly fissile, and pyritic. The lower part is mottled olive to brownish gray, less fissile, slightly calcareous, and contains siltstone laminae. Exposures are few; this description is based largely on well samples. The lower contact is sharp.

**S St. Laurent Formation** *Limestone, shale, and siltstone.* Limestone is mostly medium to dark gray and brownish gray, argillaceous and silty, lime mudstone to fine-grained skeletal wackestone and packstone. These rocks contain nodules of bluish gray, semi-vitreous chert, dark gray wavy shale partings, horizontal burrows and trails, black-coated stylolites, and glauconite grains. Oolites (Rendleman Oolite Bed?) were noted 20 to 30 feet from the top of the unit in one well. Shale and siltstone occur in the middle part of the formation, and are medium to dark olive gray, calcareous, and glauconitic. The lower contact appears to be sharp. ***Subsurface only.***

**T Grand Tower Limestone** *Limestone and sandstone.* Limestone includes light gray, coarse-grained crinoidal grainstone and medium olive gray to brownish gray lime mudstone, wackestone, and packstone. Well-rounded quartz grains are abundant in the lower part of the unit. The ***Dutch Creek Sandstone Member*** at the base is composed of white to light gray quartz arenite that is fine- to medium-grained, with scattered coarse grains in the lower part. The sand grains are well rounded and commonly have quartz overgrowths. The cement is calcite; calcareous sandstone intergrades with sandy limestone. The lower contact is gradational. ***Subsurface only.***

**U Clear Creek Formation** *Limestone and chert.* Limestone is light gray to brownish gray, dolomitic lime mudstone. It is generally silty, and the upper part is sandy. The chert is dull white to light bluish gray, soft and porous, and slightly calcareous. Although not the oldest unit reached by drilling in the Dongola Quadrangle, the Clear Creek is the oldest for which reliable logs are available. ***Subsurface only.***

## MAPPING PROCEDURE

Bedrock geology of the Dongola Quadrangle was mapped by W. John Nelson from November 1992 to March 1993. In addition to outcrop study, Nelson examined all available well records for the area and logged all available sets of well samples. A first draft of the bedrock geologic map was completed in June 1993.

Nearly all upland areas of the Dongola Quadrangle are mantled by thick surficial deposits, consisting of loess or wind-blown silt that varies from 5 to 25 feet thick, and residual and colluvial materials that locally exceed 50 feet thick. These deposits are not mapped, but are depicted and described on the stratigraphic column. Their presence renders the mapping of bedrock contacts a matter of inference in most areas, particularly southeast of the Cache Valley. The nature, extent, and distribution of undifferentiated Tertiary and Cretaceous sediments (map unit ***TKu***) also is poorly known.

Surficial geology of lowland areas was mapped in 1995 by Leon Follmer and John Masters. In this mapping, the authors relied heavily on USDA soil surveys (Parks and Fehrenbacher, 1968; Miles, 1979), supported by inferences gleaned from the topography. Soil survey maps are based on 16 to more than 100 hand-auger borings per square mile, to depths of about 5 feet. Hand augering was supplemented by deeper borings made with a Giddings power probe and by test pits and trenches. Thus these surveys are based on very thorough sampling of the surficial materials. We supplemented these data with sample logs from deeper test holes, principally the 6 holes used to construct the Cache Valley cross section, engineering logs of bridge borings made by the Illinois Department of Transportation along Interstate Highway 57, and continuous cores from 6 stratigraphic tests drilled by the ISGS in 1998. Following this final round of drilling, the geologic map was revised and prepared for publication.

## STRUCTURAL GEOLOGY

The Dongola Quadrangle is located near the southwestern margin of the Illinois Basin. Bedding regionally strikes NNW and dips NE at 1½° to 2°. At most outcrops, the dip of bedding is too gentle to measure. Because outcrops are scarce and few marker beds are present, small structures may have been overlooked. The elevation of the top of the Springville Shale is indicated by red contour lines on the geologic map. No structure contours were drawn in the southwestern part of the quadrangle because no data are available there.

A previously unmapped anticline is present in the west-central part of the quadrangle. Its axis curves from southeast to south, and bedding on both flanks dips 2° to 4°. At the edge of the Cache Valley near Rattlesnake Hill, the New Albany Shale is exposed at the crest of the anticline, and younger units on its flanks. The anticline continues beneath the Cache Valley, where there are no data to map it.

A northeast-striking fault was mapped in the northern part of T14S, R1W. Although the fault surface is not exposed, its presence is indicated by strikingly linear valleys and ridges, strongly developed joints, and outcrops of chert breccia. Well data indicate bedrock units are displaced 50 to 100 feet down to the southeast across this fault. The Fort Payne Formation is highly leached and silicified near the fault, suggesting hydrothermal activity in the fractured rock (Berg and Masters, 1994).

The northeast-striking fault is one of a series of small faults in southern Illinois that lie along the Commerce geophysical lineament (Langenheim and Hildenbrand, 1997). The Commerce lineament is a northeast-trending gravity and magnetic feature that extends from northeast Arkansas to near Vincennes, Indiana. Faults along the Commerce lineament in Missouri, only 20 miles southwest of Dongola, displace sediments as young as Holocene (Harrison et al., 1999). Moreover, 12 earthquakes having magnitudes of 3.1 to 4.7 have been recorded along or close to the Commerce lineament (Harrison and Schultz, 1994). Among these are the magnitude 4.2 event of February 5, 1994, the epicenter of which was approximately 1 mile west of Dongola. These observations raise the possibility that segments of the Commerce lineament are active faults.

A small fault striking N10–15°W was observed in the NW¼ SW¼ of Sec. 2, T14S, R1W. The fault is indicated by linear outcrops of chert breccia, heavily impregnated by iron oxide. Brightly colored Tertiary or Cretaceous sand along this fault may be downdropped into a graben or half-graben.

Jointing is well developed in the western part of the quadrangle and weakly developed in the eastern part. The primary trends are N–S to N10°W and E–W to N60°E.

## THE CACHE VALLEY

The most prominent feature of the Dongola Quadrangle is the Cache Valley, the 2- to 3-mile-wide lowland that crosses the southern part of the map area. The Cache Valley extends from the Ohio River in Pope County to the Mississippi River in Alexander County, a distance of about 50 miles. The Cache River and other small streams that currently occupy this great valley clearly did not cut it. The Cache Valley actually is wider and more deeply cut into bedrock than the modern Ohio River Valley between Paducah and Cairo (Masters and Reinertsen, 1987).

The Cache Valley is the ancestral course of the Ohio River. The valley may have begun to develop during the Tertiary Period (more than 2 million years ago) at the boundary between the bedrock-cored Shawnee Hills to the north and the more readily eroded sediments of the Mississippi Embayment to the south. By early Pleistocene time, the Cache Valley may have carried a river of modest size. A crucial event in its history, however, took place between 175,000 and 130,000 years ago when one of the Illinoian ice sheets covered nearly all of Illinois except the southern tip, reaching within 15 miles north of Dongola. The Illinoian glaciers and their till and outwash deposits disrupted older drainage systems from West Virginia to Illinois, forcing most streams to flow south and west toward a new master stream close to the present course of the Ohio River. When the Illinoian glaciers melted, torrents of sediment-laden meltwater poured into the ancestral Ohio River, scouring the Cache Valley deeply into bedrock and leaving deposits of coarse sand and gravel now called the Pearl Formation.

Following the warm, interglacial Sangamonian Age (125,000 to 75,000 years ago) occurred the final series of glaciations during the Wisconsinan Age (75,000 to 10,000 years ago). Wisconsinan ice sheets reached their southern limit near Mattoon and Paris in east-central Illinois. The Cache Valley again received floods of glacial meltwater, which deposited sand and gravel in channels, bars, and natural levees. These deposits comprise the Henry Formation. Gravel in the Henry is generally finer than that in the Pearl because the Wisconsinan glacial border lay farther from the Cache Valley. During high river stages, all the tributaries of the Cache Valley became slack-water lakes, in which silt and clay of the Equality Formation were deposited (Esling et al., 1989). During low river stages, the wind periodically carried silt from the exposed flats of the Cache and other great rivers, and deposited it upon the nearby hills as loess.

Near the end of the Wisconsinan Age, between 25,000 and 8,000 years ago, the Ohio River shifted from the Cache Valley to its present course (Masters and Reinertsen, 1987; Esling et al., 1989). Only small streams now entered the valley, although at times of flood (before construction of artificial levees), the Ohio temporarily reoccupied its former course. Sediments left behind by these events, consisting mainly of silt (eroded from the loess hills) intermixed with rock debris and sand reworked from the Henry, comprise the Cahokia Formation.

## ECONOMIC GEOLOGY

Limestone is the principal economic resource of the Dongola Quadrangle. The Columbia Quarry Co. operates two quarries in the Ullin Limestone: the Jonesboro Quarry at the northwest corner of the quadrangle, and the Ullin Quarry on the bluff north of Ullin. The stone from both quarries is used for bituminous and concrete aggregate, road surfacing, riprap, and agricultural lime. In addition, limestone from the Jonesboro Quarry is used for desulfurization (Samson and Masters, 1992). The Ullin formerly was quarried for building stone in the northwest part of the quadrangle.

Lamar (1959) discussed limestone resources of the Ullin in southern Illinois under the heading "Warsaw-Salem Limestone." The Ullin undoubtedly is the formation best suited for limestone quarrying in the quadrangle. The relatively chert-free upper part of the Salem also has potential for a variety of uses. Limestones of the lower Salem, St. Louis, and Fort Payne contain greater proportions of chert and so are less attractive for quarrying.

A small, abandoned open pit and a collapsed drift mine or prospect pit for silica were observed along a ravine in the NE¼ SW¼, Sec. 8, T14S, R1W. The exposed material is ganister derived from leached, silicified Fort Payne. No information is available on the operators or dates of operation of these mines. Ganister from the Fort Payne formerly was mined for use in making fire brick (Lamar, 1953).

According to ISGS records, 11 test holes for oil and gas have been drilled in the Dongola Quadrangle. None of these wells achieved commercial production. The deepest test was the Ullin Oil and Gas Co. # 1 Anderson (county no. 64), about 1 mile south of Ullin. This hole was drilled in 1916 to a total depth of 2,636 feet in the Plattin Limestone (Middle Ordovician). A show of oil was reported in the Kimmswick (Trenton) Limestone, which overlies the Plattin. Oil was briefly recovered from the Rigney # 1 Hileman test (county no. 1) in Sec. 21, T13S, R1W, which was drilled in 1955. After a show of oil was encountered about 60 feet above the base of the Fort Payne Formation, the well was shot and sand-fractured. Oil reportedly flowed to the surface for three days; but the output rapidly dwindled, and the well was capped.

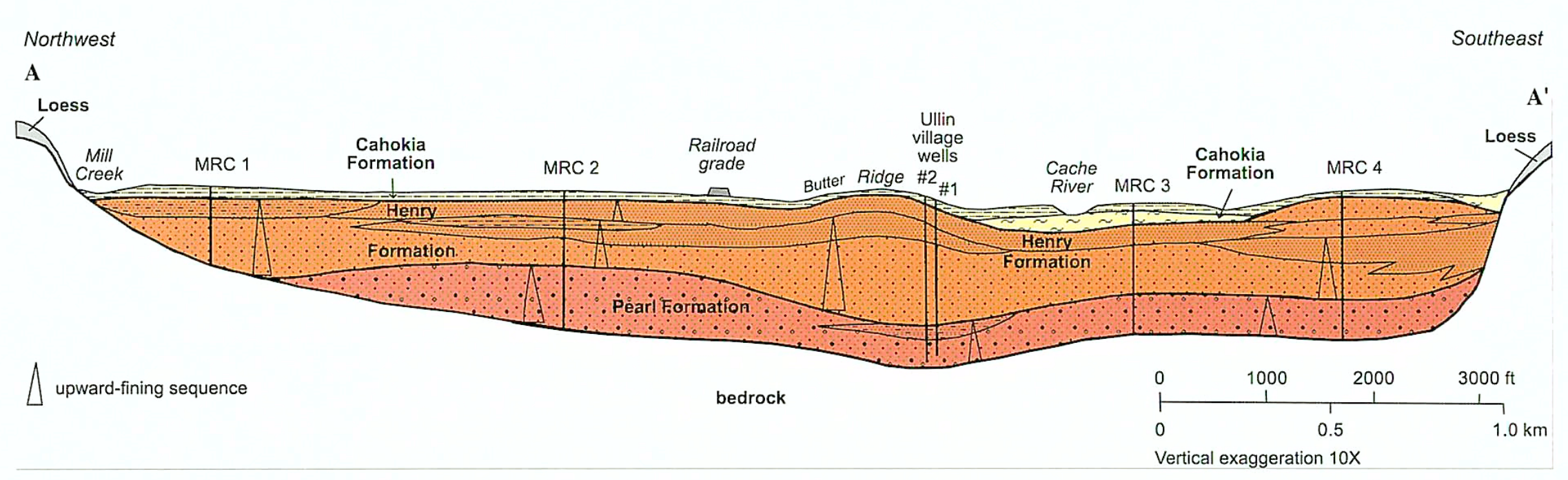
Future petroleum prospects of the Dongola Quadrangle are speculative. No test holes have been drilled on the anticline in Secs. 17 and 20, T14S, R1W. The southern extent of the anticline is unknown. Potential reservoir rocks include the Dutch Creek Sandstone (Middle Devonian), the Clear Creek Formation (Lower Devonian), and the Kimmswick Limestone (Middle Ordovician).

## GROUNDWATER

Groundwater within the Cache Valley is obtained chiefly from sand and gravel aquifers in the Henry and Pearl Formations. In some areas of the valley, domestic wells may be completed at depths as shallow as 30 feet in the upper part of the Henry. Where larger quantities of water are required, wells are generally drilled into coarse sand and gravel in the lower part of the Henry or the underlying Pearl Formation, at depths of 100 to 175 feet. One of the Ullin municipal wells flowed 300 gallons per minute through 8-inch casing set near the base of the Pearl Formation.

Outside of the Cache Valley, water wells generally must tap bedrock aquifers. Many wells in the eastern part of the quadrangle are completed in the Salem and Ullin Limestones at depths ranging from about 150 to 400 feet. For example, one of the Dongola municipal wells was completed in "creviced limestone" of the Salem at a depth of 178 feet, and yielded 200 gallons of water per minute through 10-inch casing. Because most water wells lack detailed logs or production data, little is known about Salem and Ullin aquifers. Some coarse grainstones of the Salem and Ullin may be permeable, but in most cases fracture porosity probably is the key to water production.

The Ullin and Salem Limestones are absent or at the surface in the west-central part of the quadrangle, so deeper aquifers must be sought here. Most wells in this area are completed in the Dutch Creek Sandstone Member of the Grand Tower Limestone (Middle Devonian). The Dutch Creek commonly is weakly cemented and permeable to groundwater. At least one water well produces from the Clear Creek Formation, below the Dutch Creek. The Clear Creek typically is a non-porous, very fine-grained rock, which probably will yield water only where it is fractured.



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