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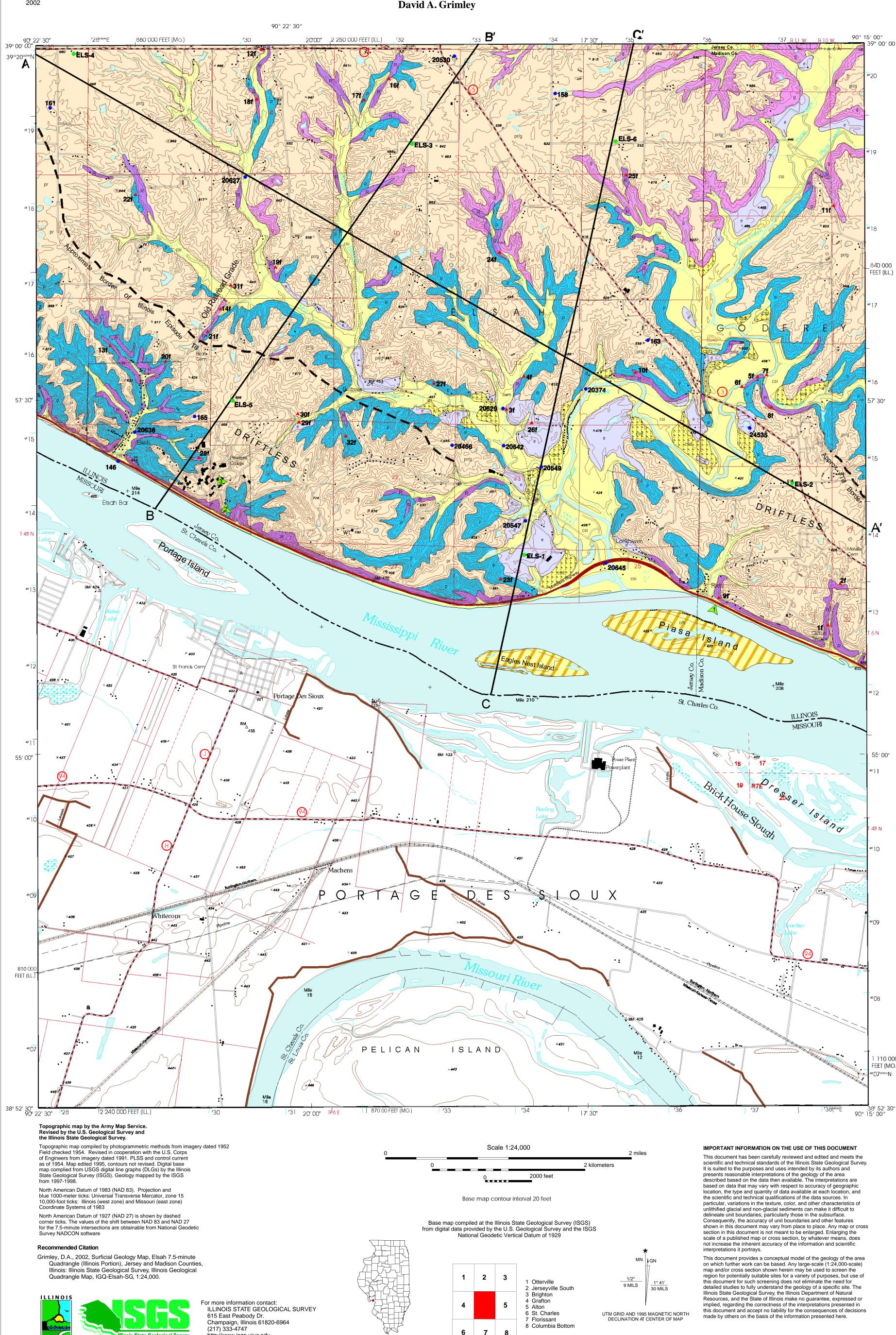
Department of Natural Resources

ILLINOIS STATE GEOLOGICAL SURVEY

Illinois Geological Quadrangle Map: IGQ-Elsah-SG

SURFICIAL GEOLOGY MAP

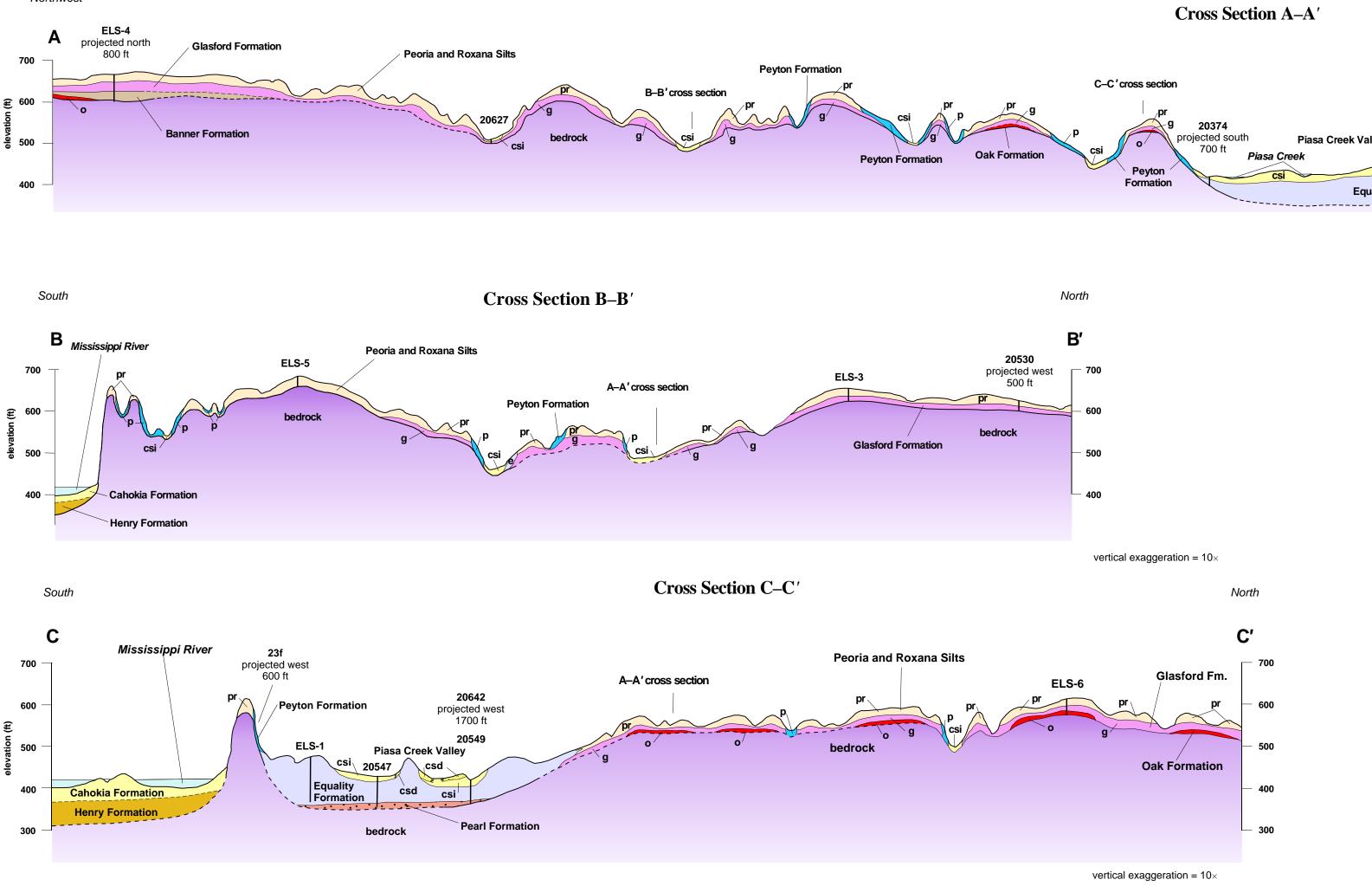
Elsah 7.5-minute Quadrangle (Illinois Portion), Jersey and Madison Counties, Illinois



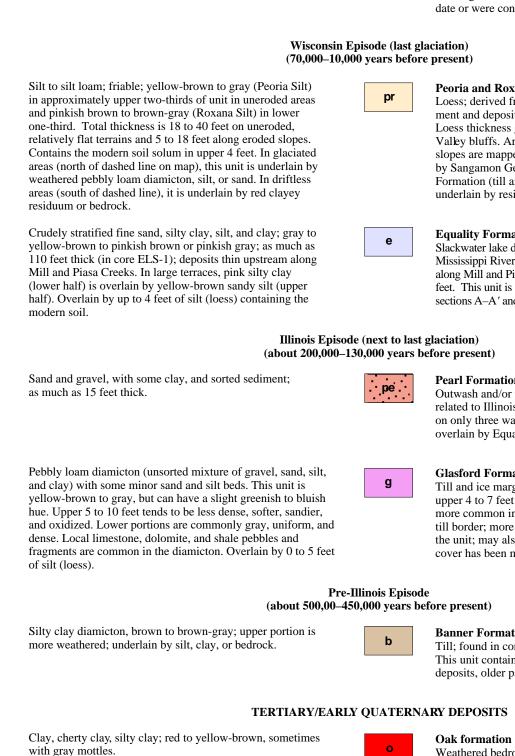
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ADJOINING 7.5-MINUTE QUADRANGLES



Material Description QUATERNARY DEPOSITS Hudson Episode (postglacial) (10,000–0 years before present) Stratified silt, sand, and gravel, with silt at the 5 foot depth; total thickness of up to 30 feet in Piasa and Mill Creek valleys and tributaries; some areas underneath Illinois Route 100 (Great River Road) along the bluffs contain up to 20 feet of sand and gravel fill. The modern soil is very weakly developed, lacking a notable subsoil (no B horizon). Stratified silt, sand, and gravel, with sand or silt at the 5-foot depth: total thickness of up to 30 feet in Piasa and Mill Creek valleys and tributaries. The modern soil contains a B horizon at about the 1.5- to 3.5-foot depth. Stratified clay, silt, and medium sand, up to about 30 feet thick; overlying as much as 80 feet of sand and gravel. Sand and gravel thins toward the bluff line. The modern soil at the surface is generally weakly developed. Silt, pebbly silt, and/or pebbly clay; yellow-brown to reddish; 0 to 20 feet thick; underlain by silt, diamicton (unsorted mixture of gravel, sand, silt, and clay) or bedrock; contains a weakly developed modern soil in the upper 0 to 3 feet.



MISSISSIPPIAN BEDROCK Bedrock exposures or bedrock within about 5 feet of land surface. Includes some talus-covered bedrock slopes at the bluffs of the Mississippi River valley. Faulted and tilted to flat-lying sedimentary rocks. Limestone, dolomite, shale, chert, and siltstone occur, with limestone and shale being the most common.

Lithostratigraphy and Interpretation

Cahokia Formation (silty at 5 feet) River sediment (alluvium); primarily silt; contains finer deposits in the lower portions of Mill and Piasa Creek valleys and contains some sand and gravel at depth, particularly in areas where bedrock is exposed.

Cahokia Formation (sandy silt at 5 feet) Alluvium is found mainly in low terraces and fans in Piasa and Mill Creek valleys. Based on the presence of a soil B horizon, terraces may be early or middle Hudson Episode in age.

Cahokia Formation overlying Henry Formation Postglacial alluvium in the Mississippi River valley; backswamp, fan, and channel deposits (Cahokia Formation) over outwash (Henry Formation).

Peyton Formation Slope sediment (colluvium) and eroded or redeposited loess; a mixture of relatively unsorted loess, till, residuum, and bedrock deposited on side slopes and foot slopes by mass wasting processes. Many steep slopes have eroded loess deposits. Although most deposits are probably Hudson Episode, some predate or were concurrent with loess deposition.

Peoria and Roxana Silts Loess; derived from Mississippi and Missouri River valley sediment and deposited during dust storms of the last glaciation. Loess thickness generally decreases away from the Mississippi Valley bluffs. Areas of severely eroded and redeposited loess on steep slopes are mapped as Pevton Formation. In glaciated areas, underlain by Sangamon Geosol (last interglacial soil) developed in Glasford Formation (till and ice marginal sediment). In driftless areas, underlain by residuum and/or bedrock.

Equality Formation Slackwater lake deposits (formed by sediment damming by the Mississippi River) occur in terraces at 460 to 480 feet elevation along Mill and Piasa Creeks and in their tributaries up to about 490 feet. This unit is also found below the Cahokia Formation (crosssections A–A' and C–C').

Pearl Formation (in cross section C–C' only) Outwash and/or preglacial sediments. This unit is probably related to Illinois Episode ice advance, but its presence is based on only three water-well records; underlain by bedrock and overlain by Equality Formation.

Glasford Formation (< 5 feet of loess cover) Till and ice marginal sediment: contains Sangamon Geosol in upper 4 to 7 feet where not eroded; sandy sorted deposits are more common in upper portions of the unit and near the mapped till border; more dense subglacial till occurs in lower portions of the unit; may also contain some Illinois Episode colluvium. Loess cover has been mostly eroded postglacially.

Banner Formation (in cross section A–A' only) Till; found in core ELS-4, where preserved in a bedrock lowland. This unit contains the Yarmouth Geosol and is underlain by lake deposits, older paleosols (Oak formation), and/or bedrock.

Oak formation (in cross sections only) Weathered bedrock (residuum), weathered loess, and possibly veathered old till deposits that occurred on relatively stable upland areas. Formed by chemical dissolution of carbonate

bedrock, with some admixed Quaternary deposits (Nelson et al. 1991). Chemical weathering of bedrock to residuum is thought to have occurred primarily during the Tertiary (Willman et al. 1989).

Near-surface bedrock

Water bodies

St. Louis Limestone, Salem Limestone, Warsaw Shale, and Burlington Limestone are the most common units (F.B. Denny 2000, personal communication). The St. Louis and Salem Limestones, being very pure carbonate rock and without chert beds, are commonly associated with karst topography.

Quaternary Geology

This Illinois quadrangle, located about 20 miles north of St. Louis, contains the edge of the glacial till border in southwestern Illinois. Till (an unsorted mixture of clay, silt, sand, and gravel deposited directly by glaciers) occurs in the northeastern two-thirds of the Illinois portion of the quadrangle, but is not found on highlands adjacent to the Mississippi River or in the Grafton 7.5-minute Quadrangle to the west (Grimley 1999a). Pre-Illinois and Illinois Episode ice advances from the east and northeast (Willman and Frye 1970, McKay 1979, Grimley 1999b, Grimley et al. 2001) deposited the till, which was later eroded from some along tributary valleys, such as Piasa and Mill Creeks. of the steeper side slopes. Glaciers probably did not overtop bedrock highs within 1.5 miles of the Mississippi River bluffs, such as near Elsah, In the lower Piasa and Mill Creek valleys, lake sediment was deposited Principia College, Lockhaven, and Clifton Terrace; however, earlier deposits could have since been eroded.

Bedrock and Residuum Outcrops of Mississippian limestone, dolomite, and shale are common in the Elsah Quadrangle (F.B. Denny, personal communication 1999). Bedrock crops out along many creeks, several road cuts, and the bluffs of the Mississippi River, where rock is commonly exposed to heights of 75 to 100 feet (fig.1). Bedrock residuum, mapped in cross sections as the informally defined Oak formation (Nelson et al. 1991), was formed mainly by in situ weathering of carbonate bedrock. The Oak formation also includes some strongly weathered loess (windblown silt) mixed with the residuum (Willman et al. 1989, Nelson et al. 1991). The Oak formation is up to 7 feet thick (core ELS-2) and is common in the subsurface beneath gently rolling upland areas. In many areas, the Oak formation has been stripped by slope erosion and/or glacial erosion during pre-Illinois and Illinois Episode ice advances.

Pre-Illinois Episode Deposits Ice advance during the pre-Illinois episode was likely from the east or northeast. The distribution of pre-Illinois episode drift (Banner Formation) is extremely patchy, having been found preserved only in one boring (ELS-4) in a bedrock low in the northwestern corner of the quadrangle (cross section A-A'). In this area of relatively flat topography, Illinois Episode glaciers did not completely erode this older till. In most of this quadrangle, pre-Illinois drift likely was weathered and eroded from hillsides during the long Yarmouth Episode, when a strong soil was developed into the till, as found in the ELS-4 core. Pre-Illinois episode till was slightly thicker than the Illinois Episode till in this one core.

Illinois Episode Deposits Based on occurrences of striations immediately to the east in the Alton Quadrangle (Grimley 1999b), Illinois Episode ice is known to have advanced from the northeast. Illinois Episode diamicton (Glasford Formation) in this quadrangle, mainly interpreted to be till, ranges from 0 to 20 feet in thickness and is present on uplands and valley slopes, mostly north of Mill Creek and Rocky Fork Branch. Till deposits are typically less than 15 feet thick, are interbedded with silt and sand in some areas, and are weathered in upper that is as dry or drier than the current climate (Curry 1999) and is similar and, thus, have a low shear resistance. These loessal deposits are easily portions by the Sangamon Geosol (last interglacial soil).

Glasford Formation till in this area is highly variable in composition and texture. likely because of erosion and incorporation of pre-existing loess, till, clayey residuum (weathered bedrock), and local bedrock into the basal debris load of a relatively thin advancing glacier. Inclusion of silt and other local sediments and rocks was observed in basal portions of the a slightly cooler and drier climate than present at about 45,000 and till. Zones of uniform, dense till, primarily in lower portions of Glasford 40,000 radiocarbon years ago. More details and implications of this core was at least 22 feet above the normal river level. As a result, according to Formation, were deposited subglacially. The proportion of illite in the <2- m clay mineral fraction of the Glasford Formation ranges from 20 to 45%. Clay-size particles (<4 m) in the Glasford Formation range from Wisconsin Episode Deposits (Windblown) Loess (Peoria and Roxana clay on the flood plains. A sign marking the flood height can be found on 18 to 40% (ELS-3, ELS-6, 14f, 21f). Outwash sand and gravel Silts), a windblown silt deposited incrementally during dust storms, was the west side of Clifton Terrace Road near the intersection with Illinois (Pearl Formation) occurs in the lower reaches of Piasa and Mill Creek derived primarily from glaciofluvial deposits of the Mississippi River Route 100. valleys, based on three water-well descriptions (20547, 20629, and 20642). This outwash occurs above bedrock and below Wisconsin Episode lake deposits and is probably related to the advance of glacial ice during the Illinois Episode.

Data Type

ELS-1 • stratigraphic test holes 32f 🔺 outcrops examined 20466 • water wells and engineering borings (county numbers indicated) Location of figure Approximate border of Illinois Episode till

(till is not presently found south and west of this line)

Wisconsin Episode Deposits (Waterlaid) Outwash sand and gravel (Henry Formation) in the Mississippi River valley is attributed to Wisconsin Episode glaciation, which occurred well to the north in northeastern Illinois and the Upper Mississippi River drainage basin. As much as 50 feet of Henry Formation sand and gravel (overlain by as much as 50 feet of postglacial sand, silt, and clay) was deposited in the Illinois portion of the Mississippi River valley during the Wisconsin Episode as a result of sedimentation in the main valley during the last glaciation. This coarse-grained sediment (Henry Formation) grades into fine sand to silty clay lake sediment (Equality Formation) in terraces

by backwaters of the Mississippi River, forming what are known as slackwater lake sediments. Postglacial downcutting into these lake sediments has created slackwater terraces. These terraces, capped by a silty clay) as thick as 110 feet (core ELS-1) near the mouth of the Mississippi River (cross section CBC'). The elevation of the slackwater terraces apparently decreases to 460 feet a few miles upstream along Piasa Creek. These terraces probably correlate with the Cuivre Level of the St. Charles Terrace Group, noted in the St. Louis area (Hajic et al. 1991). Mississippi River downcutting, which formed this terrace level, may have occurred between about 17,000 and 15,500 radiocarbon years ago, although sediments in the terraces are older (Hajic et al. 1991). The Equality Formation occurs below the Cahokia Formation in many areas between 485 and 505 feet and have been radiocarbon dated as being between 20,000 and 16,000 years before present (Hajic et al. 1991,

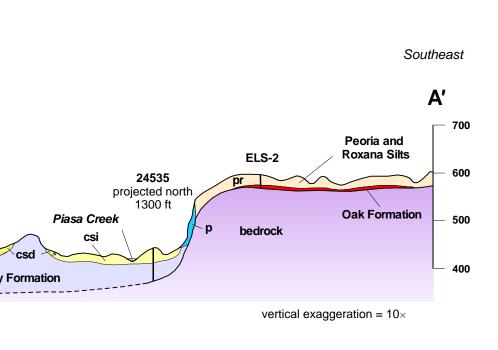
Grimley et al. 1998).

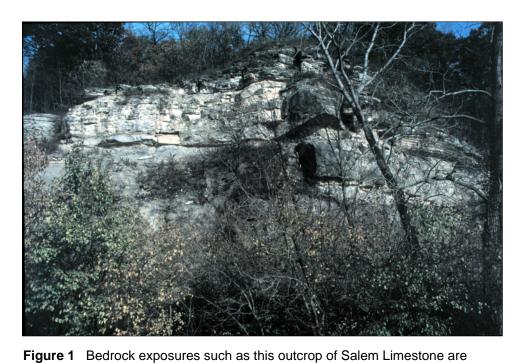
In core ELS-1, on the Piasa Creek Terrace, zones of sediment containing gastropods (snails) and ostracodes (aquatic microfossils) have revealed significant findings about the climatic and environmental conditions of yellow-brown to gray silt, clay, and fine sand (Equality Formation). From 65 to 109 feet, the sediment changes to a reddish brown and pinkish gray silty clay. Radiocarbon ages of $29,600 \pm 700$ [A-0011; present [A-0022; seeds] were determined at depths of 66, 105, and 107 Formation were similar to those of Roxana Silt, which suggests a depth of 105 to 108 feet in the core, several species of gastropods, bivalves, and ostracodes indicate an environment of slow-moving or standing water. The ostracode assemblage is also indicative of a climate Curry, personal communication). Plant macrofossils from this zone, examined by R.G. Baker (University of Iowa), included herbs that grow on floodplains, some prairie taxa, and some taxa from the northern Great Plains today (R.G. Baker, personal communication). Thus, the overall environmental interpretation for the basal zone of Equality Formation is study have been outlined by Grimley et al. (2001).

valley (fig. 2). Loess is up to 40 feet thick in uneroded near-bluff areas but thins to about 18 feet on flat uplands in the northeastern portions of the quadrangle. Most loess overlies Glasford Formation sediments, but some overlies residuum or bedrock in driftless areas.

In June 1999, an excavation for a manhole on the grounds of Principia 25,000 and 12,000 years ago (McKay 1979, Hansel and Johnson 1996). Other large mammalian fossil remains have been found in the area. In 1960, a mammoth tusk (now in the Principia College collections) was found in Equality Formation silt and clay deposits near site 31f (Section 9, T6N, R11W). In the late nineteenth century, varieties of mammalian fossil remains were found in loess deposits near the Alton bluffs (Leighton 1921), several miles to the east of Principia College. These fossils, some species of which are now extinct, included remains of deer, ground sloth, horse, moose, peccary, beaver, mastodon, gopher, brown bear, reindeer, eland, and musk ox (Leighton 1921). A detailed investigation of the site is planned in the future.

Postglacial Deposits Slope (colluvial) deposits (Peyton Formation) occur along many steep side slopes and ravines where the force of gravity has moved and mixed loess with local bedrock fragments and clasts from eroded till. In valleys, river sand and silt (Cahokia Formation) typically overlie slackwater deposits (Equality Formation) at elevations below 490 feet and overlie till (Glasford Formation) or bedrock at higher elevations. In some ravines near the bluffs, the Cahokia or ISGS Library. Formation is gravelly because of its derivation from local bedrock.





common in the Elsah Quadrangle along many ravines and particularly along the bluffs of the Mississippi River. The location of this photo (outcrop 9f), is Section 31. T6N R11W.



Figure 2 View to the west of the Mississippi Valley from the bluffs of Principia College (Sec. 21, T6N, R11W). The broad valley to the west and south was the source of sediment for loess deflation during the Wisconsin Episode when sediment-rich braided streams occupied this valley. In the distance are bedrock bluffs of the Grafton 7.5-minute Quadrangle.



Figure 3 This mammoth tooth, a few inches in length, was found several feet below the surface in loess exposed by sewer excavation on the grounds of Principia College (Sec. 21, T6N, R11W). Wear on this tooth indicates a mature age for this mammoth, which can have a life span of up to 70 years. A smooth polished chewing surface reflects a prairie grass diet, typical for mammoths

Environmental Hazards

Karst (Sinkhole and Cavern Development) Karst topography occurs in many areas of the quadrangle where the limestone bedrock is within about 25 feet of land surface. Sinkholes and underground cavern development are especially common in the central and eastern areas of the quadrangle where thin loess, thin till, and/or residuum overlie pure limestone such as the Salem or St. Louis Formations (Panno et al. 1997). Underground streams in karst areas near the Alton area (several miles to the east of Elsah) were calculated to flow at velocities greater than 0.5 mile per day and commonly followed joint sets in the N60 E and N45 W directions toward the Mississippi River valley (Lamar 1928). Many of the streams in this quadrangle also follow joint sets with these orientations. As a result, bedrock aquifers underlying karst regions are highly susceptible to contamination because surface water sinks quickly into cavernous bedrock and is not filtered through soil, clay, or slowly few feet of loess, occur along these creeks at an elevation of about 460 to permeable bedrock (Panno et al. 1997, Panno and Weibel 1998). Karst 480 feet (fig. 2). The terraces contain fine-grained sediment (fine sand to regions also pose a hazard to buildings because of the danger of sinkhole collapse and widening.

Groundwater Contamination Groundwater supply on the uplands is primarily from fractured carbonate bedrock, mostly limestone. Shallow bedrock aquifers, at less than 50 feet depth, are highly susceptible to contamination through conduit flow if the aquifers are located in karst areas (as just discussed) and are not overlain by a significant cover of shale or clayey till. Henry Formation sand and gravel and Cahokia Formation sand in the Mississippi River floodplain constitute the most of Piasa Creek and Mill Creek valleys (sites 29f, 31f) at elevations below significant Quaternary aquifers in the quadrangle. However, north of the 490 feet and also occurs as clay beds that interfinger with loess deposits Illinois border these areas are limited in extent. Their potential for at elevations below 500 feet (sites 27f, 31f). These clay beds are known contamination is also high because of the relatively thin covering of silt to occur at many sites in the Peoria Silt of the St. Louis area at elevations and clay (approximately 15 to 30 feet). A summary of the factors affecting the potential for contamination in shallow aquifers in Illinois is provided by Berg et al. (1984).

Mass Wasting Erosion, undercutting, and slumping of thick loess deposits and Warsaw shale bedrock (Mississippian) at bluff edges are potential hazards (Killey et al. 1985). Slumps in unconsolidated deposits in this area commonly occur when water collects on top of the clayey this area during the last glaciation. The upper 65 feet of the core contains Sangamon Geosol or Glasford Formation where they underlie the relatively permeable loess. Higher pore water pressures in these perched water tables increase the likelihood of slumping or failure along steep slopes. Slumping and other types of mass wasting of bedrock occur shells], $42,000 \pm 3,100$ [A-0010; shells], and $43,772 \pm 1,590$ years before mostly where jointed carbonate rock overlies impermeable shale. One such slump occurred in Graham Hollow in the Grafton Quadrangle, feet, respectively. Color, clay mineralogy, and age of the lower Equality several miles to the west of Elsah (Collinson et al. 1954).

synchronous deposition of these units. From a rich fossil-bearing zone at **Soil Erosion** Because of the nature of loessal soils, steep slopes along ravines and bluffs are subject to severe soil erosion. Areas where the Peoria and Roxana Silts and Peyton Formation are present have loose, windblown, near-surface silt deposits that are soft and weakly cohesive to that in northwestern Iowa, the Dakotas, or the Canadian prairies (B.B. eroded by running water during heavy rainfalls. Runoff during storms can quickly enlarge rills and gullies, thereby accelerating the process of erosion, as water is channeled into the growing drainage system.

> **Flooding** Severe flooding occurs periodically in the Elsah and Lockhaven areas. During the flood of 1993 (Chrzastowski et al. 1994), the Mississippi River rose almost to the an elevation of 440 feet, which discussions with local land owners, backwaters inundated a large part of the Piasa Creek floodplain, leaving behind a thin layer of sand, silt, and

Material Resources (Unconsolidated)

Sand and Gravel Sand and gravel deposits in this quadrangle, which lie predominantly below the water table, are a potential source for construction materials. Sand in the Mississippi River channel is currently College (near Rackham Court dormitory; Sec. 23, T6N, R11W) revealed being dredged in the Alton area (Bluff City Minerals), several miles fossil teeth and bony parts from an Alce Age@ mammoth (fig. 3). This find downstream from Elsah. The sands near Alton are primarily siphoned was at a depth of several feet in the Peoria Silt, deposited between about from the upper 15 feet of channel sediment and are used for asphalt and mortar. Gravel is not abundant, which somewhat limits the use of these sediments by the construction industry (Goldman 1994). Economically usable river sands probably exist in the Mississippi River channel or in the subsurface on Piasa or Eagles Nest Island, where the cover of clay, silt, and finer sands could be 5 to 40 feet thick.

Mapping Techniques

This surficial geologic map is based in part upon soil series of parent materials compiled from the Jersey County soil survey (Fehrenbacher and Downey 1966) and the Madison County soil survey (Goddard and Sabata 1986). Those data were considerably modified based upon field observations and drilling operations performed as part of this STATEMAP project. Well log data, Illinois Department of Transportation records, and other engineering boring data on file at the Illinois State Geological Survey were used to further aid in mapping and, especially, in constructing the three cross sections. Field outcrop and stratigraphic test hole descriptions are available from the ISGS Geological Records Unit

Map boundaries that are indicated by dashed lines are less reliable subsurface contacts, such as the till boundary. Cross section unit boundaries are dashed where the data are limited or less reliable.

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