800 Structure contour, feet

Fort Payne Formation

This version of the geology of the Hopkinsville 30 x High-calcium limestone consists of 95 percent or more 60 minute quadrangle was digitally compiled mostly from calcium carbonate (CaCO₃); it is dense, homogeneous, J.S. Geological Survey 7.5-minute geologic quadrangle chert-free, and commonly oolitic. This type of limestone maps (GQ's), as cited in the references. The GQ's are is useful in many industrial applications, such as sulfur products of a cooperative mapping project between the sorbents for acid mine drainage, scrubber material for S. Geological Survey and the Kentucky Geological coal-fired power plants, and chemical lime. Three active Survey from 1960 to 1978. The 7.5-minute quadrangles limestone quarries are located in the Hopkinsville 30 x Gravel has been mined mainly from pits in the Tusca-

that make up the Hopkinsville 30 x 60 minute quadrangle 60 minute quadrangle. site as an Internet map service (Anderson and others, the quadrangle.

(GIS) for analysis or manipulation of data. Regional studies on the geology and stratigraphy of Mississippian rocks have resulted in changes in the stratigraphic nomenclature and correlation of rock units

Oil and gas wells in the Hopkinsville quadrangle are since the original GQ's were published (Sable and Dever, mainly test wells; few produce in economic quantities. 1990). These changes are shown on this map, and were Approximately 800 wells have been drilled, ranging on necessary for compilation of regional maps and for average from 900 to 2,800 ft deep. The deepest wells stratigraphic continuity between 7.5-minute quadrangles. penetrate the Knox Formation of Ordovician and Cam-The data presented here stop at the state line, and data brian age, and the deepest pay formations are the New from Tennessee are not included. The Kentucky Geological Survey's new 30 x 60 minute, 1:100,000-scale geologic map series has potential for

new analysis of structural and other geologic features. The Hopkinsville 30 x 60 minute quadrangle map provides a regional perspective regarding erosional and depositional features, faulting, and geologic framework that may lead to new discoveries concerning mineral and

energy resources. PROCEDURE

The 7.5-minute geologic quadrangle maps were digitally compiled using a semi-automated data capture technique to convert hard-copy geologic maps into digital format. Compiling 7.5-minute maps into a 30 x 60 minute map required the resolution of significant problems, such as correlating geologic formations and contacts across quadrangle boundaries, and resolving nonuniform structure-contour datums or intervals (Fig. 2). The metadata portion of the digital file provides detailed information about the conversion process. Formation codes were assigned to point, line, and polygon features using the American Association of Petroleum Geologists' standard stratigraphic code (Cohee, 1967), which was modified by the Kentucky Geological Survey for state-specific water for domestic supply; wells produce approximately use. Since various authors compiled the 7.5-minute 500 gal/day. Alluvium in other parts of the Hopkinsville GQ's between 1960 and 1978, geologic formations and quadrangle is generally inadequate for domestic water formation contacts were not mapped the same way on supply. Terrace deposits supply water in small quantities; each map. Resolution of the differences between quad- wells yield less than 10 gal/min (Carey and Stickney, rangles was necessary for efficient topological analysis 2005). One spring was reported as yielding 47 gal/min in a GIS environment. In addition, numerous thin, less extensive formations, and associated members, mapped on individual 7.5-minute quadrangle maps are too small a bailer at approximately 100 gal/day. to be mapped on a 30 x 60 minute quadrangle map. These problems were resolved by adhering to geologic, in fault zones (mainly hanging walls and gouge zones) cartographic, and GIS standards appropriate for the and as much as 20 gal/min in fractures. Most flowing scale of the map. This map is a compilation of existing wells in Chesterian rocks come from sandstones, yielding maps, and no additional geologic field work took place. approximately 100 gal/day. Few springs are adequate When there were problems in stratigraphic correlation for domestic water supply. Limestone formations with between quadrangles, the best current data available solution openings and springs at the base of the formation

were used to resolve these differences. GEOLOGIC SETTING AND STRUCTURAL GEOLOGY mostly of gently dipping sedimentary rocks of Mississip- in solution openings. Springs produce 10 to 1,500 gal/min deposits. The quadrangle lies almost entirely within the early fall (Carey and Stickney, 2004a, b, 2005). Mississippian Plateau, where thick limestones of Mississippian age (Meramecian) form a broad karst terrain. Chesterian limestones and sandstones form a small HAZARDS arcuate belt in the northeastern part of the quadrangle,
The majority of the engineering and geologic hazard The Meramecian limestones were shallow marine de- to building foundations, roads, farm ponds, and farm posits, whereas the Chesterian rocks record a continental equipment. The collapse or slow depression of soil shelf environment periodically interrupted by deposition overlying bedrock is caused by weathering and erosion of deltaic and near-shore sandstones and shales of the soil, which is then carried away by the cave conduit (Grabowski, 1986). Cretaceous sand, gravel, and chert that drains the sinkhole (Currens, 2002). Sinkhole flooding are the principal constituents of the Tuscaloosa Forma- occurs when cave passages and associated sinkholes tion, and represent nonmarine deposits derived from become choked with more rainfall than they can drain. Mississippian and Devonian rocks. Limestones are Meramecian rocks that form a broad eroded soil, trash, or natural rockfall. A second cause karst terrain containing numerous sinkholes, disappearing of sinkhole flooding is discharge capacity being limited streams, springs, and caves. The Ste. Genevieve and farther downstream, perhaps by backflooding from other Chesterian rocks are about 600 ft thick, and, in ascending terrain in the Hopkinsville quadrangle means the area

The southwestern part of the Hopkinsville quadrangle borders the Jackson Purchase Region of Kentucky, which is the northeastern part of the Mississippi Embayment. The extent of the Mississippi Embayment is delineated by Cretaceous and Tertiary sediments, some of which extend as outliers into the Hopkinsville quadrangle. Numerous mostly northeast-trending, high-angle nificantly affect the Hopkinsville area. Earthquake prenormal faults displace Paleozoic rocks along the eastern diction is not a dependable part of seismology, but and northeastern borders of the Mississippi Embayment geologists do know that earthquakes will cause damage (McDowell, 1986).

ECONOMIC GEOLOGY Limestone, gravel, sandstone, oil, and vein minerals damage because of ground-motion amplification and are the principal mineral resources in the Hopkinsville liquefaction. Liquefaction is a process in which rock quadrangle. Limestone suitable for building stone, becomes saturated or loses shear strength, then is crushed stone, road metal, and agricultural lime has temporarily transformed into a fluid mass, resulting in been quarried from the Paint Creek Limestone, Renault structural damage. No major earthquakes have been Limestone, St. Louis Limestone, Ste. Genevieve Limerecorded in the quadrangle in recent years, but they stone, and Warsaw Formation of Mississippian age. have occurred in the geologic past, and are likely to Typically, the Ste. Genevieve Limestone is of high occur again. chemical quality, composed of high-calcium limestone.

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The data files resulting from digitizing the GQ's are loosa Formation where deposits are up to 40 ft thick. part of a comprehensive relational and spatial data set The gravel, with associated sand and silt, is used for being developed by the Kentucky Geological Survey. road metal, road bases, and other construction purposes.

The digital geology will be available on the KGS Web Currently, no sand and gravel operations are active in 1999). Users will have at their disposal spatial data sets Quartz sandstone is mined from selected layers of the from which to select map themes to create custom maps Caseyville Formation of Pennsylvanian age, and from and add supplemental oil, mineral, coal, or water infor- the Big Clifty Sandstone of Mississippian age. Generally, mation. This powerful database of geologic information the sandstones are clean, very fine-grained, evencan also be used in a geographic information system bedded, partly friable, and contain some clay and mica. Sandstone uses include glass manufacturing, molding sand, and building stone. One active sandstone quarry is present in the Hopkinsville quadrangle.

Albany Shale (Devonian) and the Clear Creek Formation, Devonian limestone below the New Albany Shale None of these formations are exposed at the surface in the quadrangle. Approximately 100,000 barrels of oil were produced from wells in the Guthrie 7.5-minute uadrangle between 1947 and 1963. From 1919 to 1999, about 14 million barrels of oil were produced in the Hopkinsville quadrangle; in 2000, about 29,000 barrels were produced. These wells and small oil pools are structural highs that trap oil and gas.

The Hopkinsville 30 x 60 minute quadrangle lies within parts of the Cumberland River and Green River surface drainage basins. The Cumberland River, located in the southwestern part of the quadrangle, flows northwest. Over 80 percent of the population in the quadrangle is served by domestic water wells or springs. In Christian County alone, about 9,200 people rely on private domestic water supply (Carey and Stickney, 2005). In rural areas, nonpoint-source pollution such as pesticides fertilizers, and manure have an impact on the quality of domestic water supply. Alluvium along the Cumberland River yields enough

Inconsolidated deposits of the Tuscaloosa Formation typically are not significant aquifers, only adequate for Chesterian formations yield as much as 100 gal/min

where they crop out in areas of steep topography yield as much as 100 gal/min. Meramecian Ste. Genevieve and St. Louis Limestones typically occupy lowland karst The geology of the Hopkinsville quadrangle consists valleys and can yield more than 50 gal/min from wells pian and Pennsylvanian age, semiconsolidated sand at or near stream level. The groundwater production and gravel of Cretaceous age, and Quaternary alluvial numbers may vary in dry seasons such as summer and

nation occupy small areas and grabens to the northeast. Sinkhole collapse and sinkhole flooding cause damage This may happen because the throat of the sinkhole has The Ste. Genevieve, St. Louis, Salem, and Warsaw become clogged with debris, which may consist of St. Louis Limestones are each up to 500 ft thick. Overlying sinkholes (Currens, 2002). The dominance of karst order, are Renault Limestone, Bethel Sandstone, Paint has a moderate to high sensitivity to pollution. Contam-Creek Limestone, Cypress Sandstone, Golconda For- inants may easily enter the sinkholes, cave passages mation, Hardinsburg Sandstone, and Glen Dean Lime- and solution openings of karst, and flow rates are high. Correction and prevention of engineering problems, karst subsidence, and contamination is possible by analysis of topography, consulting geologic maps, looking for signs of previous damage, and consulting professional engineers and geologists. The Hopkinsville quadrangle is close to the New Madrid eismic Zone, where a major seismic event could sig-

based on earthquake magnitude, distance from the

epicenter, and local geology. Areas of thick alluvium and

other unconsolidated sediments are prone to the most

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