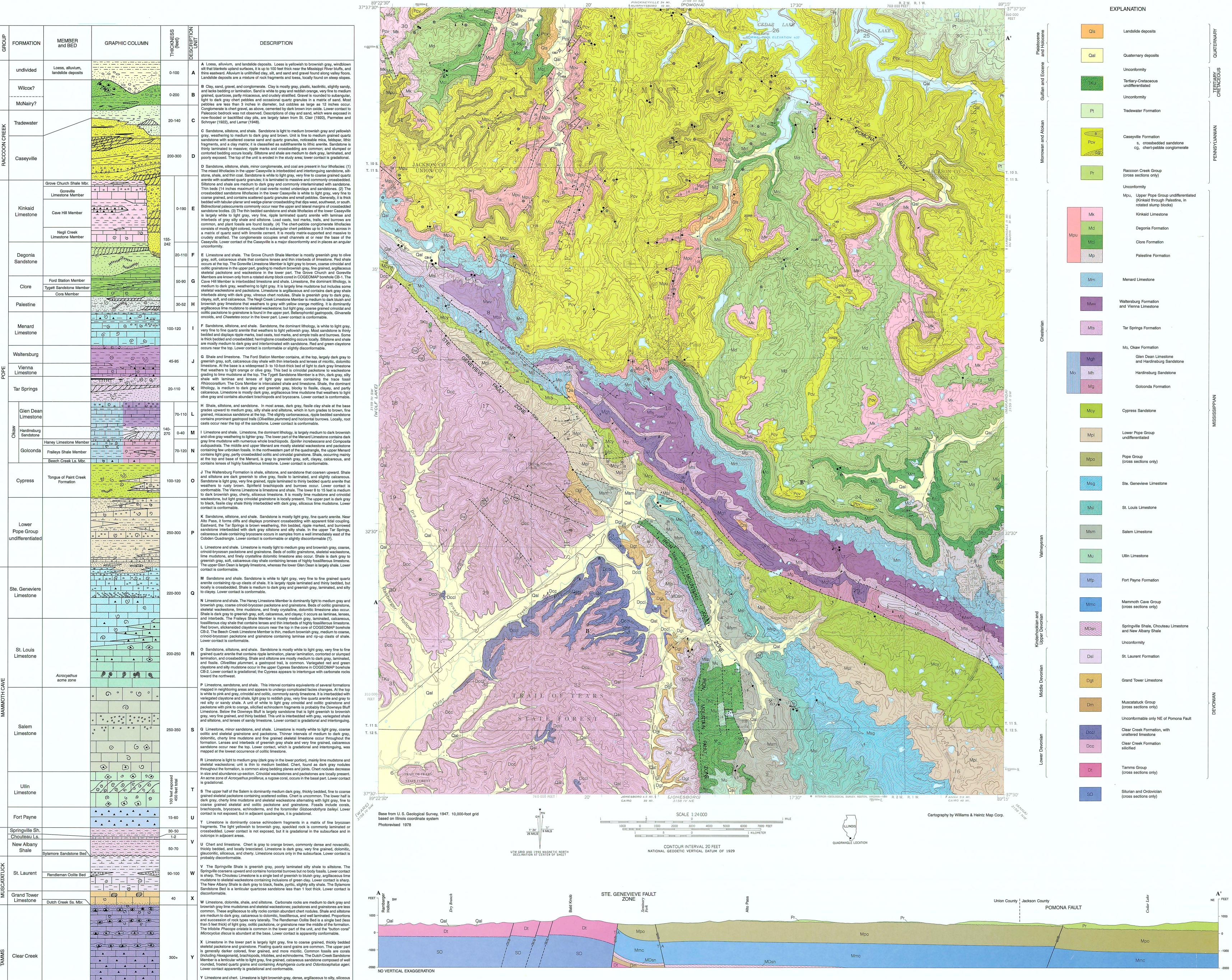
Prepared in cooperation with the U.S. Geological Survey Illinois Department of Energy and Natural Resources Dallas L. Peck, Director, under the cooperative ILLINOIS STATE GEOLOGICAL SURVEY COBDEN QUADRANGLE, ILLINOIS Geologic Mapping Program (COGEOMAP) Morris W. Leighton, Chief cades, are all collapsed or flooded. Information on the **EXPLANATION** The Cobden Quadrangle lies along the border between mines and the clay is taken from St. Clair (1920), the northeast flank of the Ozark Dome and the south-Parmelee and Schroyer (1922), and Lamar (1948). west margin of the Illinois Basin. The Ste. Genevieve Clay mining near Mountain Glen peaked during LINE SYMBOLS: Dashed where inferred; Fault Zone separates Devonian and older rocks on the World War I, when German imports were cut off. The dotted where concealed dome from Mississippian and Pennsylvanian rocks in clay, used chiefly for making glass pots and crucibles, the basin. The north edge of the Mississippi Embayment occurred as sedimentary deposits interlayered with sand, GRAPHIC COLUMN DESCRIPTION (a northward projection of the Gulf Coastal Plain Provsilt, chert gravel, and lignite. The thickest clay deposit ince) is about 15 miles south of the quadrangle. Cretareported was 87 feet. Most clay deposits apparently ceous and Tertiary sediments of the embayment origioccupied steep or vertical-walled depressions in Paleonally extended farther north and are preserved in small, zoic bedrock. The authors cited above suggested that the Fault: bar and ball on downthrown side downfaulted, erosional outliers in the southern part of A Loess, alluvium, and landslide deposits. Loess is yellowish to brownish gray, windblown deposits lay in sinkholes or erosional depressions in the silt that blankets upland surfaces, it is up to 100 feet thick near the Missisippi River bluffs, and the Cobden Quadrangle. old land surface. Mapping for this study indicates, howlandslide deposits thins eastward. Alluvium is unlithified clay, silt, and sand and gravel found along valley floors. The Ste. Genevieve Fault Zone, a major tectonic ever, that at least some of the clay occurs in grabens



lime mudstone. Brachiopods and the trilobites Amphigenia curta, Eodevonaria melonicus, and

Odontocephalus ageri are moderately common. The slightly irregular beds are several inches thick. Light colored, tripolitic chert nodules and discontinuous layers represent one-quarter to

one-third of the volume of the rock. In large areas (particularly north of Clear Creek), the formation appears to be entirely silicified to light colored, thinly bedded, highly fractured chert.

Base is not exposed in study area.

A A A A

**A A A** 

Reverse fault: triangle on upthrown side A——A' Line of cross section Strike-slip movement Strike and dip of bedding; number indicates degree of dip Horizontal bedding Joints: centered block on symbol indicates vertical; block on side indicates non-vertical joint and dip direction Outcrop of special note, shown where contact, map unit, or fault was well exposed at time Arrows indicate paleocurrent direction pointer indicates bidirectional flow Clay pit or mine pointer indicates direction of origin Acrocyathus proliferus Acme Zone slickenslide striations DRILL HOLES FROM WHICH SUBSURFACE DATA WERE OBTAINED ISGS cored test hole Oil test hole, with ISGS county number ⊙<sup>244</sup> Water well, with ISGS county number NELSON Index map showing areas geologically surveyed by

feature of the Midcontinent, extends more than 120 miles through southeastern Missouri and southernmost Illinois. The master fault, sometimes called the Rattlesnake Ferry Fault, strikes northwest and juxtaposes the Clear Creek Formation (Lower Devonian) on the southwest, upthrown block against strata of the Pope Group (Chesterian, Upper Mississippian) on the northeast, downthrown block (cross section A-A'). The net throw is at least 2,000 feet. Strata along the fault dip as steeply as 50° northeast, forming a large monocline. In the adjacent Wolf Lake Quadrangle, bedding is locally overturned along the master fault (Devera 1994). The fault itself is marked by a zone of sheared and brecciated rock several hundred feet wide. The presence

of the monocline and overturned bedding along the

trends southeast, passing just south of Cobden. The

monocline along the Ste. Genevieve Fault Zone abruptly

proprietary seismic reflection profile across the mono-

cline a short distance south of the Cobden Quadrangle

indicates that the fold is underlain by two or more

southwest-dipping, high-angle reverse faults that die out

and syntectonic conglomerates in the Caseyville Forma-

tion (Desborough 1961a,b, Nelson and Lumm 1985)

indicate that the Ste. Genevieve Fault Zone was active

Concurrent with the Ouachita orogeny, this episode

involved compressional uplift of a basement block and

attendant drape-folding of sedimentary cover (Nelson

The Iron Mountain Fault Zone displaces both Paleo-

zoic bedrock and weakly lithified Tertiary-Cretaceous

sediments (cross section B-B'). Downfaulted strata

include lignite that contains Eocene pollen (D.J.

Nichols, USGS, personal communication 1993). The

faults outline grabens and dip nearly vertically. Calcite-

filled vertical joints subparallel to the Iron Mountain

Fault Zone are abundant in nearby limestone outcrops.

These features indicate that the post-Eocene tectonic

episode was extensional. The grabens along the Iron

Mountain Fault Zone may be pull-apart structures pro-

Clendenin et al. (1989) and Schultz et al. (1992). Con-

rary evidence in the form of small north-trending er

echelon anticlines (not shown on the map) along Semi-

Ferry Fault, implies right-lateral wrench faulting.

nary Fork, immediately northeast of the Rattlesnake

The Pomona Fault, which passes through the north-

duced by left-lateral wrench faulting, as suggested by

and Lumm 1985, Clendenin et al. 1989).

during Morrowan (Early Pennsylvanian) sedimentation.

Angular unconformities, deflected paleodrainage,

upward through the Paleozoic sedimentary column.

widens southward, and dips of bedding decrease. A

master fault imply that it is a reverse fault that dips

steeply (60-80°) southwest (Nelson and Lumm 1985, Devera 1993). A zone of smaller faults trends parallel to strike of bedding about 2,000 feet northeast of the master fault. These faults are indicated by elimination of formations from the outcrop belt. The fault surfaces are not exposed; we interpret them to be high-angle normal faults that intersect the Rattlesnake Ferry Fault at depth (cross section A-A'). South of Clear Creek, the Ste. Genevieve Fault Zone abruptly widens and splits. One branch, the Iron Mountain Fault Zone, curves southward and the other branch

taken from crossbedding at sandstones; single pointer indicates one direction of flow; opposing

Large float blocks of Dutch Creek Sandstone: Vertical fracture with horizontal (strike-slip)

east quarter of the Cobden Quadrangle, is parallel with the master fault. Fracture patterns along the Pomona Fault are consistent with high-angle reverse faulting along a southwest-dipping fault surface (Johnson 1970). As observed by Nelson and Lumm (1985) and contrary to Desborough (1961a), Mississippian rocks along the Pomona Fault are offset, but Pennsylvanian rocks are merely fractured and folded into a monocline. Also, units underlying the Caseyville Formation are older southwest of the fault than they are northeast of the fault (cross section A-A'). This evidence indicates that the southwest side of the Pomona Fault was uplifted in post-Kinkaid, pre-Caseyville time; additional post-Caseyville

> uplift folded but did not shear the Caseyville. Hence, the timing and sense of displacement (reverse, southwest side upthrown) on the Pomona and master faults are A pre-Ouachita episode of displacement along the Pomona Fault is indicated by borehole data. Deep wells northeast of the fault (outside of the Cobden Quadrangle) encountered the New Albany Shale unconformably overlying Lower Devonian or older strata, whereas a complete Middle Devonian succession occurs southwest of the fault. This evidence implies that the northeast side of the fault was uplifted in late Middle Devonian time. Thus, Devonian displacement was normal and opposite to the later (Ouachita) displacement. The same tectonic history (Devonian normal faulting followed by post-Mississippian reverse faulting) was first recognized along the Ste. Genevieve Fault Zone in Ste. Genevieve County, Missouri, by Weller and St. Clair (1928). A concealed fault or fracture zone may underlie Quaternary alluvium along Clear Creek. No displace-

ment is evident along this inferred structure, but the valley is remarkably linear and trends perpendicular to the master fault. Also, the Clear Creek Formation is only partly silicified southeast of Clear Creek but totally silicified northwest of Clear Creek. The W. McK. [sic] Smith No. 1 Hines well in the valley of Clear Creek (well 14, SW SE, Sec. 21, T11S, R2W) drilled through more than 110 feet of crystalline quartz at the expected position of the Kimmswick Limestone (Middle Ordovician). These findings suggest that faults beneath the valley compartmentalized the movement of mineralizing

Many small faults were mapped in the area between the Pomona Fault and the master fault. Previous geologists, including St. Clair (1920), Ekblaw (1925), and Desborough (1961a,b), observed that the small faults mainly displace the Pope Group (Mississippian) but do not affect the Caseyville Formation (Pennsylvanian). We confirmed their observations; tilted and faulted Pope Group rocks are truncated with angular unconformity by nearly horizontal Caseyville strata. In some cases, minor additional movement took place after deposition of the Caseyville. Our mapping revealed for the first time that these faults do not displace units below the Palestine Formation. The faults are listric and merge with bedding in shale at the top of the Menard Limestone (cross section C-C'). Downdropped strata rotated backward so that they dip toward the fault surfaces. In several instances, thrusting took place where faults curve upward in sledrunner fashion. We interpret this deformation as rotational slumping or landsliding that took place in response to tectonic and seismic activity along the Ste. Genevieve Fault Zone. In summary, we believe that three major tectonic episodes took place in the Ste. Genevieve Fault Zone in

the Cobden Quadrangle: (1) Middle Devonian normal faulting along the Pomona Fault, (2) Early Pennsylvanian compressive-block faulting and folding of sedimentary cover, occurring throughout the fault zone and inducing widespread rotational slumping of Mississippian strata, (3) post-Eocene, left-lateral wrench faulting along the Iron Mountain Fault Zone and probably other

Kaolinitic clay was formerly mined from open-pit and underground workings in the south-central part of the Cobden Quadrangle. The mines, inactive for many de-

bounded by tectonic faults. Additional clay undoubtedly remains in the Mountain Glen area. Evaluation of reserves will require a thorough core-drill program based on the awareness that clay occurs in narrow fault-bounded depressions.

No coal is known to have been mined in the Cobden Quadrangle. Coal seams up to about 14 inches thick were observed in the upper part of the Caseyville Formation in Sections 30 and 31, T10S, R1W. An upper Caseyville coal bed was formerly mined on a small scale in the adjacent Makanda Quadrangle (Jacobson and

Four oil and gas test holes are on record for the Cobden Duadrangle. All were dry and abandoned, but shows of oil and/or gas were reported for three of the four. The Sturdevant No. 1 Rendleman borehole (well 15) in Section 23, T11S, R2W, was drilled in 1930 to a depth of 515 feet in the Ste. Genevieve Limestone. The Frank Bridge No. 1 Godwin borehole (well 1464) in Section 28, T10S, R2W, was drilled in 1960 to a depth of 925 feet in the Ste. Genevieve Limestone. A show of oil was reported at a depth of 732 to 738 feet in sandstone of the lower Pope Group. Also in Section 28, the Burr Lambert No. 1 Hagler borehole (well 1367), drilled in 1948 reached a total depth of 2,565 feet in the Clear Creek Formation. Oil and gas were observed along fractures in a core taken from the Grand Tower Limestone in this well. Finally, the W. McK. [sic] Smith No. 1 Hines test hole (well 14), drilled along Clear Creek in Section 21 T11S, R2W, in 1920, was abandoned at a depth of 1,425 feet in "Trenton rock" (Kimmswick Limestone, Ordovician). Shows of oil were reported in Lower Devonian limestone and chert at depths of 202, 465 to 608, and 822 feet. Samples from the last 110 feet of the Hines well consist of crystalline quartz, which suggests that the

borehole intersected a fault zone.

Silica derived from the Clear Creek Formation was mined in an open pit north of the summit of Bald Knob in the southeast quarter of Section 17, T11S, R2W. The Clear Creek Formation appears to be entirely silicified northwest of Clear Creek and partially silicified southeast of Clear Creek. Microcrystalline silica (tripoli) has been mined extensively south of the Cobden Quadrangle and, to a lesser degree, west of the quadrangle. Most outcrops of silicified Clear Creek Formation in the Cobden Quadrangle consist of hard, bedded chert rather than tripoli. A thick cover of residual chert and colluvium hinders assessment of silica resources from the outcrop. Drilling would be necessary to determine the extent and quality of tripoli deposits in this area. An ample supply of chert gravel, usable for surfacng gravel roads, is available along all creeks in the southwestern part of the quadrangle.

Several Mississippian formations in the Cobden Quad-

angle contain limestone suitable for commercial quarry-

ing. The Ste. Genevieve Limestone is quarried near Anna, about 2 miles southeast of the Cobden Quadrangle, and used for agricultural lime, crushed stone, and concrete aggregate. The best area for quarrying the Ste. Genevieve in this quadrangle is south of Mountain Glen, where it has a wide outcrop belt and dips gently. Farther north, the outcrop belt is narrower, beds are strongly ilted, and many large sinkholes occur. South of the study area, the Ullin Limestone is quarried for agricultural lime and other uses. The Ullin in the Cobden Quadrangle appears similar in quality, but its outcrop area is small. The overlying Salem Limestone has a larger outcrop area near the center of the southern edge of the quadrangle. This unit contains rock that may be suitable for aggregate and road gravel. Several formations in the Pope Group contain limestone units thick enough to quarry. A small quarry formerly operated in the Kinkaid Limestone just east of the abandoned railroad in the NE SW, Section 28, T10S, R2W. In addition to the Kinkaid, the Menard Limestone, Glen Dean Limestone, Golconda Formation, and possibly Paint Creek Formation may be suitable to quarry. Compared with the extensive nearby deposits of Ste.

Pope Group a less attractive source of commercial lime-Richard W. Harrison and C. William Clendenin reviewed the map and offered many valuable suggestions on structure and tectonic history. Heinz H. Damberger, Dennis R. Kolata, and E. Donald McKay also provided

enevieve and Ullin Limestones, however, the limited

thickness and outcrop area of these units renders the

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Rendleman well NO VERTICAL EXAGGERATION Note: The amount of downward displacement in the graben along the Iron Mountain Fault Zone, and the thickness of Tertiary and Cretaceous strata in that graben, are unknown. This fault zone is believed to have a left-lateral strike-slip component.

Schematic cross section showing pre-Caseyville rotational slumping of Chesterian strata in Sections 32 and 33, T10S, R2W, Jackson County. Section is 8X map scale; there is no vertical exaggeration. Some faults shown in the section were omitted from the map to avoid crowding.

## GEOLOGIC MAP OF THE COBDEN QUADRANGLE, JACKSON AND UNION COUNTIES, **ILLINOIS**

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