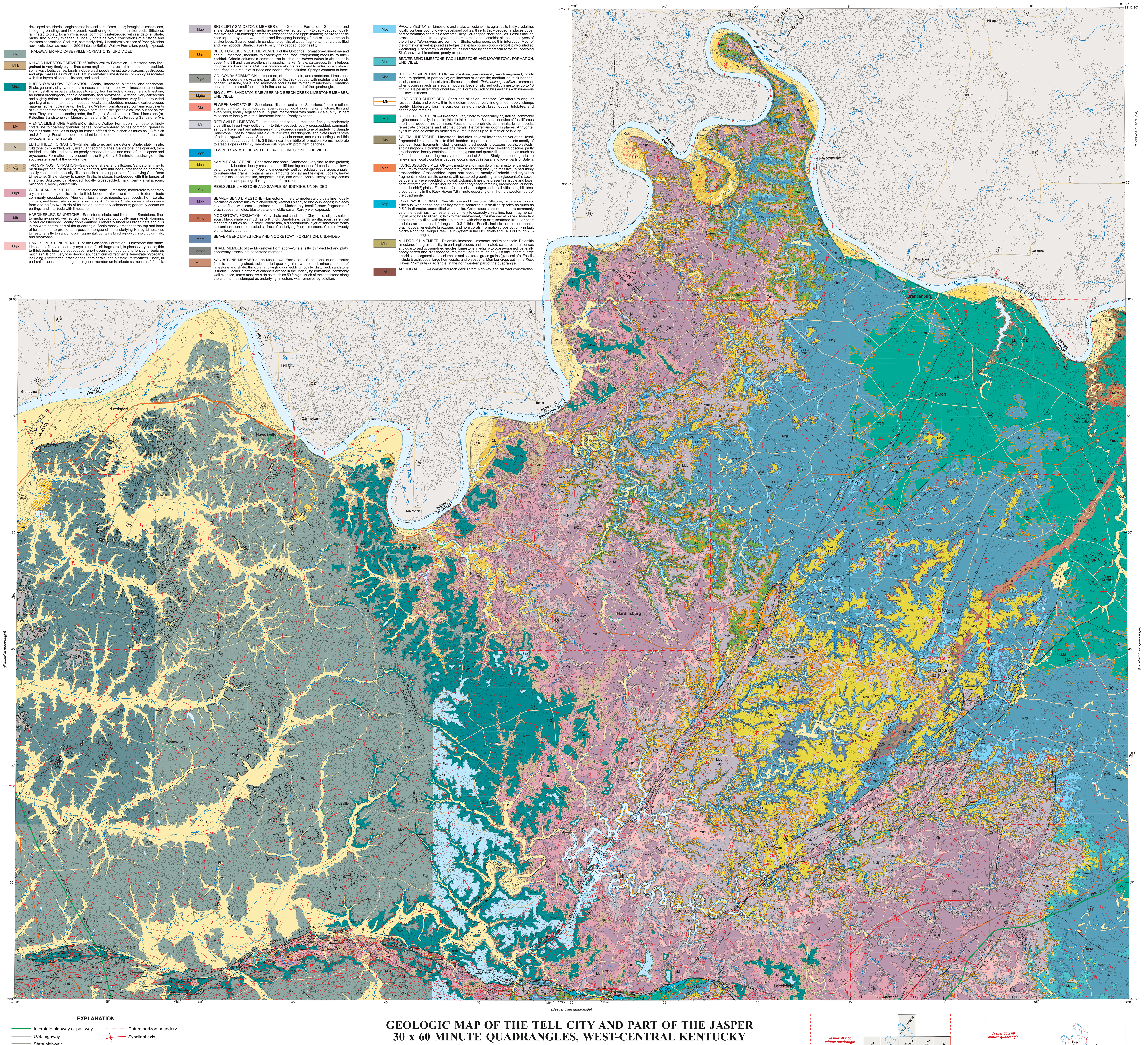
KGS KENTUCKY GEOLOGICAL SURVEY
James C. Cobb, State Geologist and Director
UNIVERSITY OF KENTUCKY, LEXINGTON

GEOLOGIC MAP OF THE TELL CITY AND PART OF THE JASPER 30 x 60 MINUTE QUADRANGLES, WEST-CENTRAL KENTUCKY

Matthew M. Crawford

Cartography by Terry D. Hounshell



Qal ALLUVIUM—Silt, sand, clay, and gravel; partly intermixed. Silt, clayey. Sand, fine- to medium-grained, subrounded to subangular quartz. Clay, commonly silty. Gravel, sandstone, limestone, chert, and silicified limestone of local derivation along smaller streams; includes reworked river-terrace deposits along the Ohio River.

Ql LANDSLIDE DEPOSITS—Sand, gravel, and rubble. Consists of masses of sandstone and shale from Buffalo Wallow Formation, sandstone from Tar Springs Formation, and limestone and shale from Glen Dean Limestone. Mapped in the Mattingly 7.5-minute quadrangle.

Qao OLDER ALLUVIUM—Clay, silt, sand, and gravel. Clay and silt, laminated; grades laterally to silty sand near Ohio River, forms conspicuous terraces now being dissected by erosion. Sand and gravel, medium- to coarse-grained; crudely bedded. Gravel consists of glacially derived crystalline plutonic rocks, igneous rocks, limestone, quartz, and chert. Formation is mapped locally on the Rock Haven, Rome, and Mattingly 7.5-minute quadrangle maps. This formation has also been interpreted as the equivalent of the fluvial deposits that were mapped on the Falls of Rough 7.5-minute quadrangle.

Qe WINDBLOWN SAND—Sand, very fine to fine, composed of angular quartz grains, well-sorted, crossbedded; hummocky ridges on higher terrace levels.

Qlt LACUSTRINE AND TERRACE DEPOSITS—Gravel, silt, and sand. Sand is fine- to coarse-grained, mainly angular quartz. Gravel contains rounded pebbles and cobbles of chert, quartz, limestone, and glacially derived crystalline rocks of igneous and metamorphic origin. Generally silty in upper 25 to 30 ft, coarser near the base. Formation is present in Ohio River Valley below younger alluvium in most places. May include younger alluvial deposits.

Qel LOESS—Silt, in part calcareous; commonly covers hilltops and gentle upland slopes; about 40 ft thick along some bluffs of the Ohio River. Accumulated largely during the Wisconsinan glaciation. Formation is mapped locally on the Maceo 7.5-minute quadrangle map.

Qt TERRACE DEPOSITS—Gravel, sand, and silt. Unconsolidated to partly indurated stream terrace deposits. Gravel is mainly subrounded to rounded pebbles of chert, limestone, quartz geodes, and crystalline rocks; occurs in lenses; cemented by iron oxide. Sand, silt, and clay occur as a highly weathered, weakly cemented matrix.

Qtc CONTINENTAL DEPOSITS—Gravel, subangular to subrounded chert pebbles, subrounded to rounded white quartz pebbles, some pebbles with polished surfaces; stratification indistinct; locally cemented with iron oxides and hydroxides. Unit mapped on the Jasper 30 x 60 minute quadrangle map.

Pc CARBONDALE FORMATION—Sandstone, siltstone, shale, coal, and underclay. Sandstone, fine- to medium-grained, medium- to thick-bedded, massive in some parts; sparsely micaceous and possibly glauconitic, locally cemented by calcium carbonate. Siltstone and shale contains scattered carbonaceous material; clay shale in lower part of unit contains ellipsoidal concretions of siderite. Coal, thin, banded, sulfurous, moderately pyritic. Underclay, silty, thin-bedded. Coal bed at base of formation is correlative with the Davis coal bed. All units are poorly exposed; lithologic descriptions come from core of diamond drillholes.

Pt TRADEWATER FORMATION—Sandstone, shale, siltstone, limestone, and coal. Sandstone, fine- to medium-grained, coarse-grained in crossbeds; large crossbeds; in places calcareous and very resistant. Lower part of sandstone, fine- to medium-grained, thin-bedded, interbedded with shale. Grades vertically and horizontally into overlying sandy shale and underlying clayey shale. Locally fills channels in underlying unit. Shale, silty, contains scattered carbonaceous material and few limonite nodules. Siltstone, micaceous, commonly in an interlensing siltstone, shale, clay shale, and sandstone sequence. Limestone, fine-grained, contains numerous brachiopods and crinoid fragments. Coal, not persistent, highly lenticular; dull, locally dirty and sulfurous, with small amounts of pyrite; hard siliceous partings where thickest.

Pca CASEYVILLE FORMATION—Sandstone, siltstone, shale, and coal. Sandstone, commonly stained by limonite; fine- to medium-grained, subangular to subrounded quartz grains; generally thin- to medium-bedded, some thick-bedded, locally well-developed crossbeds; conglomeratic in basal part of crossbeds; ferruginous concretions, liesegang banding, and honeycomb weathering common in thicker beds. Siltstone, laminated to platy, locally micaceous, commonly interbedded with sandstone. Shale, partly silty, slightly micaceous; locally contains ovoid concretions of siltstone and ironstone concretions. Coal, thin, commonly shaly. Unconformity at base of Pennsylvanian rocks cuts down as much as 250 ft into the Buffalo Wallow Formation, poorly exposed.

Ptc TRADEWATER AND CASEYVILLE FORMATIONS, UNDIVIDED

Mbk KINKAID LIMESTONE MEMBER of Buffalo Wallow Formation—Limestone, very fine-grained to very finely crystalline; some argillaceous layers; thin- to medium-bedded, some wavy beds; dense; fossils include brachiopods, fenestrate bryozoans, gastropods, and algal masses as much as 0.1 ft in diameter. Limestone is commonly associated with thin layers of shale, siltstone, and sandstone.

Mbw BUFFALO WALLOW FORMATION—Shale, limestone, siltstone, and sandstone. Shale, generally clayey, in part calcareous and interbedded with limestone. Limestone, finely crystalline, in part argillaceous to sandy, few thin beds of conglomeratic limestone; abundant brachiopods, crinoid columnals, and bryozoans. Siltstone, very calcareous and slightly dolomitic; partly thin resistant bedding. Sandstone, very fine subrounded quartz grains; thin- to medium-bedded, locally crossbedded; moderate carbonaceous material; some ripple marks. The Buffalo Wallow Formation also contains equivalents of five other stratigraphic units, shown here in the stratigraphic column but not on the map. They are, in descending order, the Degonia Sandstone (d), Clore Limestone (c), Palestine Sandstone (p), Menard Limestone (m), and Waltersburg Sandstone (w).

Mv VIENNA LIMESTONE MEMBER of Buffalo Wallow Formation—Limestone, finely crystalline to coarsely granular, dense; brown-centered oolites common; generally contains small nodules of irregular lenses of fossiliferous chert as much as 0.3 ft thick and 8 ft long. Fossils include abundant brachiopods, crinoid columnals, fenestrate bryozoans, and horn corals.

Ml LEITCHFIELD FORMATION—Shale, siltstone, and sandstone. Shale, platy, fissile. Siltstone, thin-bedded, wavy irregular bedding planes. Sandstone, fine-grained, thin-bedded, limonitic, and contains poorly preserved molds and casts of brachiopods and bryozoans. Formation only present in the Big Clifty 7.5-minute quadrangle in the southeastern part of the quadrangle.

Mts TAR SPRINGS FORMATION—Sandstone, shale, and siltstone. Sandstone, fine- to medium-grained; medium- to thick-bedded, few thin beds; crossbedding common, locally ripple-marked; locally fills channels cut into upper part of underlying Glen Dean Limestone. Shale, clayey to sandy, fissile; in places interbedded with thin lenses of siltstone. Siltstone, thin-bedded, locally crossbedded; hard; partly argillaceous, micaceous, locally calcareous.

Mgd GLEN DEAN LIMESTONE—Limestone and shale. Limestone, moderately to coarsely crystalline, locally oolitic, thin- to thick-bedded, thicker and coarser-textured beds commonly crossbedded. Abundant fossils: brachiopods, gastropods, horn corals, crinoids, and fenestrate bryozoans, including *Archimedes*. Shale, varies in abundance from one-half to two-thirds of formation; commonly calcareous; generally occurs as partings and interbeds with limestone.

Mh HARDINSBURG SANDSTONE—Sandstone, shale, and limestone. Sandstone, fine- to medium-grained, well sorted; mostly thin-bedded but locally massive cliff-forming; in part crossbedded, locally ripple-marked. Generally underlies broad flats and hills in the west-central part of the quadrangle. Shale mostly present at the top and base of formation; interpreted as a possible tongue of the underlying Haney Limestone. Limestone, silty to sandy, fossil fragmental; contains brachiopods, crinoid columnals, and bryozoans.

Mgh HANEY LIMESTONE MEMBER of the Golconda Formation—Limestone and shale. Limestone, finely to coarsely crystalline, fossil-fragmental, in places very oolitic; thin to thick beds, locally crossbedded; chert occurs as nodules and lenticular beds as much as 1 ft long. Very fossiliferous: abundant crinoid fragments, fenestrate bryozoans, including *Archimedes*, brachiopods, horn corals, and blastoid *Pentremites*. Shale, in part calcareous; thin partings throughout member as interbeds as much as 2 ft thick.

Mgb BIG CLIFTY SANDSTONE MEMBER of the Golconda Formation—Sandstone and shale. Sandstone, fine- to medium-grained, well sorted; thin- to thick-bedded, locally massive and cliff-forming; commonly crossbedded and ripple-marked; locally asphaltic near top; honeycomb weathering and liesegang banding of iron oxides common in thicker beds. Sparse fossils in sandstone consist of wood fragments that are coalified and brachiopods. Shale, clayey to silty; thin-bedded, poor fissility.

Mgc BEECH CREEK LIMESTONE MEMBER of the Golconda Formation—Limestone and shale. Limestone, medium- to coarse-grained; fossil fragmental; medium- to thick-bedded. Crinoid columnals common; the brachiopod *Inflatia inflata* is abundant in upper 1 to 3 ft and is an excellent stratigraphic marker. Shale, calcareous; thin interbeds in upper and lower parts. Outcrops common along streams and hillsides, locally absent at surface as a result of surface and near-surface solution. Springs common at base.

Mgo GOLCONDA FORMATION—Limestone, siltstone, shale, and sandstone. Limestone, finely to moderately crystalline, partially oolitic; thick-bedded with nodules and bands of chert. Siltstone, shale, and sandstone occur as thin to medium interbeds. Formation only present in small fault block in the southwestern part of the quadrangle.

Mgbc BIG CLIFTY SANDSTONE MEMBER AND BEECH CREEK LIMESTONE MEMBER, UNDIVIDED

Me ELWREN SANDSTONE—Sandstone, siltstone, and shale. Sandstone, fine- to medium-grained; thin- to medium-bedded, even-bedded; local ripple marks. Siltstone, thin and even beds, locally argillaceous; in part interbedded with shale. Shale, silty, in part micaceous; locally with thin limestone lenses. Poorly exposed.

Mr REELSVILLE LIMESTONE—Limestone and shale. Limestone, finely to moderately crystalline; in part very oolitic; thin- to thick-bedded, locally crossbedded; commonly sandy in upper part and interfingers with calcareous sandstone of underlying Sample Sandstone. Fossils include blastoid *Pentremites*, brachiopods, and plates and calyxes of crinoid *Agassizocrinus*. Shale, commonly calcareous, occurs as partings and thin interbeds throughout unit, 1 to 3 ft thick near the middle of formation. Forms moderate to steep slopes of blocky limestone outcrops with prominent benches.

Mgr ELWREN SANDSTONE AND REELSVILLE LIMESTONE, UNDIVIDED

Msa SAMPLE SANDSTONE—Sandstone and shale. Sandstone, very fine- to fine-grained; thin- to thick-bedded, locally crossbedded; cliff-forming channel-fill sandstone in lower part; ripple marks common. Poorly to moderately well consolidated; quartzose, angular to subangular grains, contains minor amounts of clay and feldspar. Locally, heavy minerals include tourmaline, magnetite, rutile, and zircon. Shale, clayey to silty, occurs as thin beds and partings throughout the formation.

Mrs REELSVILLE LIMESTONE AND SAMPLE SANDSTONE, UNDIVIDED

Mbb BEAVER BEND LIMESTONE—Limestone, finely to moderately crystalline, locally bioclastic or oolitic; thin- to thick-bedded; weathers slabby to blocky in ledges; in places cavities filled with coarse-grained calcite. Moderately fossiliferous: fragments of brachiopods, crinoids, blastoids, and trilobite casts. Rarely well exposed.

Mmo MOORETOWN FORMATION—Clay shale and sandstone. Clay shale, slightly calcareous, black shale as much as 5 ft thick. Sandstone, partly argillaceous; rare coal stringers as much as 6 in. thick. Where thin, a discontinuous layer of sandstone forms a prominent bench on eroded surface of underlying Paoli Limestone. Casts of woody plants locally abundant.

Mbm BEAVER BEND LIMESTONE AND MOORETOWN FORMATION, UNDIVIDED

Mmoh SHALE MEMBER of the Mooretown Formation—Shale, silty, thin-bedded and platy, apparently grades into sandstone member.

Mmos SANDSTONE MEMBER of the Mooretown Formation—Sandstone, quartzarenite; fine- to medium-grained, subrounded quartz grains, well-sorted; minor amounts of limestone and shale; thick planar trough crossbedding, locally disturbed; sandstone is friable. Occurs in bottom of channels eroded in the underlying formations, commonly well exposed, forms massive cliffs as much as 50 ft high. Much of the sandstone along the channel has slumped as underlying limestone was removed by solution.

Mpa PAOLI LIMESTONE—Limestone and shale. Limestone, micrograined to finely crystalline, locally contains poorly to well-developed oolites; thin- to thick-bedded; at places upper part of formation contains a few small irregular-shaped chert nodules. Fossils include brachiopods, fenestrate bryozoans, horn corals, and blastoids; plates and calyxes of the crinoid *Talarocrinus* are common. Shale, calcareous, as thin interbeds. Most of the formation is well exposed as ledges that exhibit conspicuous vertical joint-controlled weathering. Disconformity at base of unit indicated by chert breccia at top of underlying St. Genevieve Limestone, poorly exposed.

Mbp BEAVER BEND LIMESTONE, PAOLI LIMESTONE, AND MOORETOWN FORMATION, UNDIVIDED

Msg STE. GENEVIEVE LIMESTONE—Limestone, predominantly very fine-grained, locally medium-grained, in part oolitic; argillaceous or dolomitic; medium- to thick-bedded, locally crossbedded. Locally fossiliferous: the crinoid *Platycrinites penicillus* is common. Chert occurs in beds as irregular nodules. Beds of silicified oolitic limestone, up to 10 ft thick, are persistent throughout the unit. Forms low rolling hills and flats with numerous shallow sinkholes.

Mlr LOST RIVER CHERT BED—Chert and silicified limestone. Weathers to angular residual slabs and blocks; thin- to medium-bedded, very fine-grained, rubbly; slumps readily. Moderately fossiliferous, containing crinoids, brachiopods, trilobites, and cephalopod remains.

Msl ST. LOUIS LIMESTONE—Limestone, very finely to moderately crystalline; commonly argillaceous, locally dolomitic; thin- to thick-bedded. Spherical nodules of fossiliferous chert and geodes are common. Fossils include crinoid columnals, brachiopods, fenestrate bryozoans and silicified corals. Petroliferous odor in places. Anhydrite, gypsum, and dolomite as mottled mixtures in beds up to 10 ft thick or in vugs.

Ms SALEM LIMESTONE—Limestone, includes several interlensing varieties; fossil fragmental limestone; thin- to thick-bedded, in part crossbedded; consists mostly of abundant fossil fragments including crinoids, brachiopods, bryozoans, corals, blastoids, and gastropods. Dolomitic limestone, fine- to very fine-grained; bedding obscure, partly crossbedded; locally contains abundant gypsum and quartz-filled geodes as much as 2 ft in diameter, occurring mostly in upper part of Salem. Shaly limestone, grades to limey shale; locally contains geodes; occurs mostly in basal and lower parts of Salem.

Mhb HARRODSBURG LIMESTONE—Limestone and minor dolomitic limestone. Limestone, medium- to coarse-grained, moderately well-sorted; blocky to massive, in part thinly crossbedded. Crossbedded upper part consists mostly of crinoid and bryozoan fragments in clear calcite cement, with scattered greenish grains (glauconite?). Lower part generally even-bedded, crinoidal. Dolomitic limestone present in middle and lower parts of formation. Fossils include abundant bryozoan remains, brachiopods, crinoids, and echnoid(?) plates. Formation forms resistant ledges and small cliffs along hillsides, crops out only in the Rock Haven 7.5-minute quadrangle, in the northwestern part of the quadrangle.

Mfp FORT PAYNE FORMATION—Siltstone and limestone. Siltstone, calcareous to very siliceous, with dense angular fragments; scattered quartz-filled geodes as much as 0.5 ft in diameter, some filled with calcite. Calcareous siltstone beds are commonly very fine fossil hash. Limestone, very finely to coarsely crystalline; fossil fragmental, in part silty; locally siliceous; thin- to medium-bedded, crossbedded at places. Abundant geodes mainly filled with calcite but some with clear quartz; scattered irregular chert nodules as much as 1 ft long and 0.3 ft thick. Fossils include crinoid columnals, brachiopods, fenestrate bryozoans, and horn corals. Formation crops out only in fault blocks along the Rough Creek Fault System in the McDaniels and Falls of Rough 7.5-minute quadrangles.

Mbm MULDRAUGH MEMBER—Dolomitic limestone, limestone, and minor shale. Dolomitic limestone, fine-grained, silty, in part argillaceous and laminated; scattered chert lenses and quartz- and gypsum-filled geodes. Limestone, medium- to coarse-grained; generally poorly sorted and crossbedded; resistant units as much as 20 ft thick contain large crinoid stem segments and columnals and scattered green grains (glauconite?). Fossils include brachiopods, large horn corals, and bryozoans. Member crops out in the Rock Haven 7.5-minute quadrangle, in the northwestern part of the quadrangle.

af ARTIFICIAL FILL—Compacted rock debris from highway and railroad construction.

SYSTEM	SERIES	GROUP	FORMATION, MEMBER, AND BED	LITHOLOGY	THICKNESS IN METERS (FEET)
QUATERNARY	Holocene		Alluvium	Qal	0–9 (0–30)
			Landslide deposits	Ql	0–46 (0–140)
			Older alluvium	Qao	0–36+ (0–110+)
	Pleistocene		Eolian sand, dune sand	Qe	0–36+ (0–110+)
			Lacustrine and terrace deposits	Qlt	0–9 (0–30)
			Loess	Qel	0–50 (0–150)
TERTIARY(?)	Pliocene(?)		Terrace deposits	Qt	0–13 (0–40)
			Continental deposits	Qtc	0–9 (0–30)
PENNSYLVANIAN	Middle Pennsylvanian		Carbondale Formation (Dekoven (No. 7) coal; Davis (No. 6) coal)	Pc	30+ (90+)
	Lower and Middle Pennsylvanian	Tradewater and Caseyville Formations, undivided	Tradewater Formation (Western Ky. (No. 5) coal; Lewisport/Mannington coals; Lead Creel coal; Truman Hill coal; Deanfield coal; Hawesville coal)	Ptc, Pt	56–164+ (170–500+)
			Caseyville Formation	Ptc, Pca	128+ (390+)
MISSISSIPPIAN	Chesterian	Buffalo Wallow Formation	Kinkaid Limestone Member	Mbk	0–9 (0–30)
			Degonia Sandstone		36–85 (110–260)
			Clore Limestone		
			Palestine Sandstone		
			Menard Limestone		
			Waltersburg Sandstone		
			Vienna Limestone	Mv	0–2 (0–6)
			Tar Springs Sandstone	Mts	8–26 (24–79)
			Leitchfield Formation	Ml	13+ (40+)
			Glen Dean Limestone	Mgd	7–26 (20–79)
			Hardinsburg Sandstone	Mh	7–25 (20–75)
		Golconda Formation	Haney Limestone Member	Mgh	7–16 (20–50)
			Big Clifty Sandstone Member	Mgbc, Mgb	9–36 (30–110)
			Beech Creek Limestone Member	Mgc	2–7 (5–20)
			Elwren Sandstone	Mgr, Me	1–5 (3–20)
			Reelsville Limestone	Mr	2–13 (7–40)
			Reelsville Limestone and Sample Sandstone / Sample Sandstone	Mrs, Msa	3–30 (19–90)
			Beaver Bend Limestone and Mooretown Formation / Beaver Bend Limestone	Mbm, Mbb	2–8 (7–25)
			shale member of Mooretown Fm.	Mmoh	2–16 (5–50)
			sandstone member of Mooretown Fm.	Mmos	0–36 (0–110)
			Mooretown Formation	Mmo	1–39 (3–130)
			Paoli Limestone	Mpa	3–16 (10–50)
	Meramecian		Ste. Genevieve Limestone	Msg	20–70+ (60–215+)
			Lost River Chert	Mlr	0–4 (0–12)
			St. Louis Limestone	Msl	20–70+ (60–215+)
			Salem Limestone	Ms	30–46 (90–140)
			Harrodsburg Limestone	Mhb	8–15 (25–45)
			Fort Payne Formation	Mfp	66+ (200+)
	Osagean	Borden Formation	Muldraugh Member	Mbm	33+ (100+)

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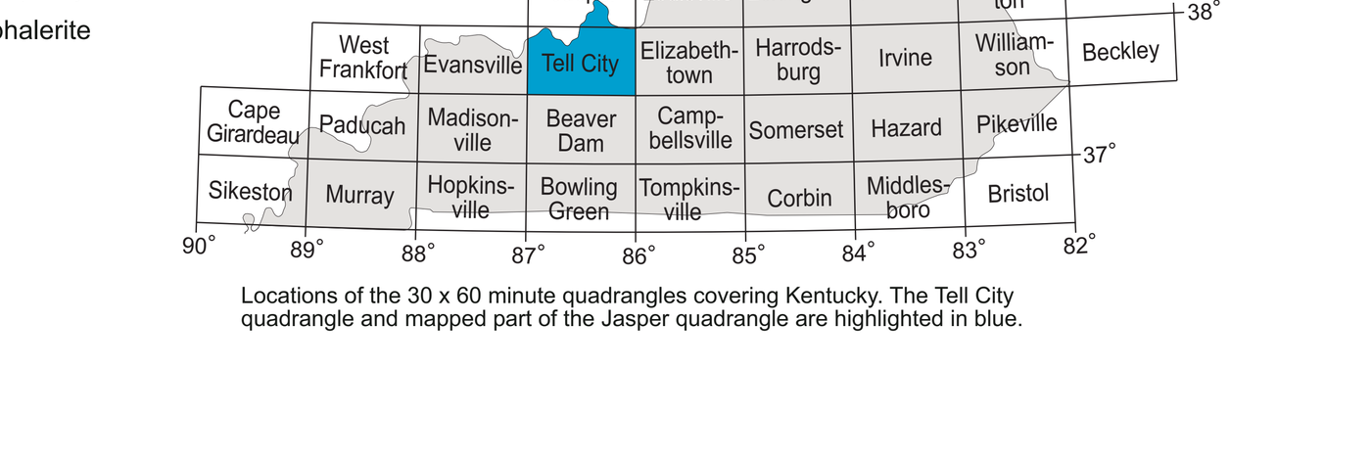
EXPLANATION

- Interstate highway or parkway
- U.S. highway
- State highway
- State boundary
- County boundary
- City boundary
- Railroad
- Normal fault (U, upthrown side; D, downthrown side)
- Concealed fault
- Contact
- Concealed contact
- Secondary contact
- Erosional contact
- Structure contour, feet
- Datum horizon boundary
- Synclinal axis
- Coal bed
- Secondary coal bed
- Concealed coal bed
- Active stone quarry or mine
- Abandoned stone quarry or mine
- Active pit; clay
- Abandoned pit; gravel, sand, or clay
- Abandoned asphaltic sandstone quarry
- Mineral prospect, fluorite and sphalerite
- Diamond drillhole
- Abandoned mine shaft; coal



Locations of the 30 x 60 minute quadrangles covering Kentucky. The Tell City quadrangle and mapped part of the Jasper quadrangle are highlighted in blue.

SCALE 1:100 000

universal transverse Mercator projection, zone 16: 1927 North American datum

TOPOGRAPHIC CONTOUR INTERVAL 20 METERS

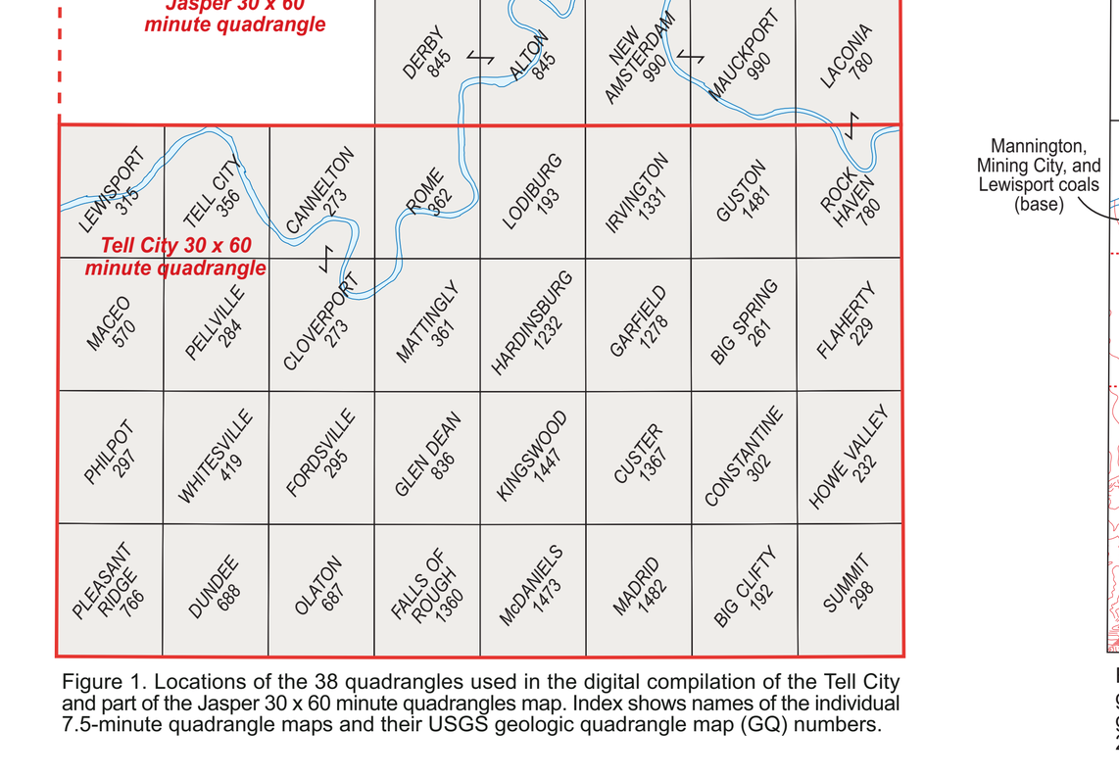


Figure 1. Locations of the 38 quadrangles used in the digital compilation of the Tell City and part of the Jasper 30 x 60 minute quadrangles map. Index shows names of the individual 7.5-minute quadrangle maps and their USGS geologic quadrangle map (GQ) numbers.

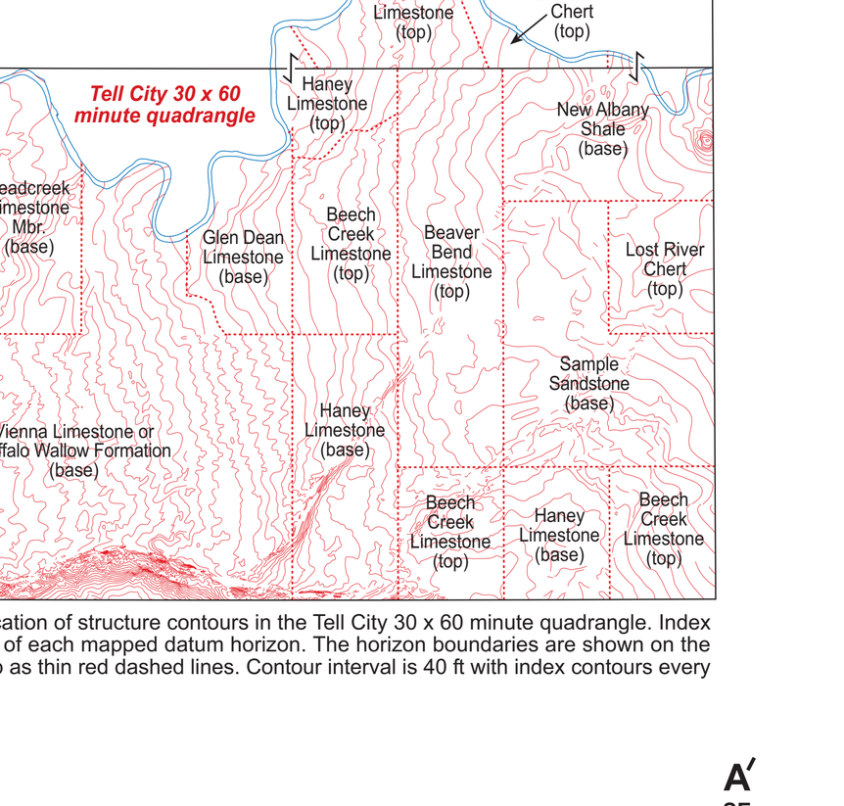
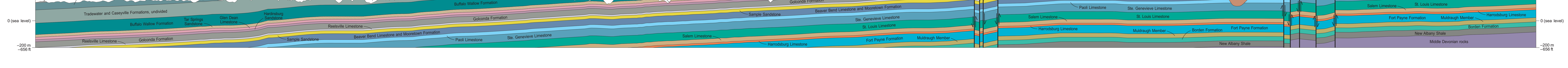


Figure 2. Location of structure contours in the Tell City 30 x 60 minute quadrangle. Index gives names of each mapped datum horizon. The horizon boundaries are shown on the geologic map as thin red dashed lines. Contour interval is 40 ft with index contours every 200 ft.

NOTE: cross section is diagrammatic
vertical exaggeration 8x



INTRODUCTION

This version of the geology of the Tell City and part of the Jasper 30 x 60 minute quadrangles was digitally compiled mostly from U.S. Geological Survey 7.5-minute geologic quadrangle maps (GQ's), as cited in the references. The GQ's are products of a cooperative mapping project between the U.S. Geological Survey and the Kentucky Geological Survey from 1960 to 1978. Several regional studies on the geology and stratigraphy of western Kentucky (summarized in Greb and others, 1992) have resulted in changes in the stratigraphic nomenclature and correlation of coal-bearing formations in the Western Kentucky Coal Field since the original GQ's were mapped. These changes are shown on this map, and were necessary for compilation of regional maps and for stratigraphic continuity between 7.5-minute quadrangles. The 7.5-minute quadrangles that make up the Tell City and part of the Jasper 30 x 60 minute quadrangles are shown in the index map. The data files resulting from the digitization of the GQ's are part of a comprehensive relational and spatial data set developed by the Kentucky Geological Survey. The data are available on the KGS Web site (Anderson and others, 1999). Users have at their disposal a spatial database from which to select any map or particular map themes to create custom maps and add supplemental oil, mineral, coal, or water information. This powerful database of information can be used in a geologic information system (GIS) for analysis or manipulation of the data.

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 (1) correlating geologic formations across quadrangle boundaries, (2) resolving nonuniform structure-contour datums and inferred contacts or intervals, and (3) resolving discrepancies in Quaternary alluvium boundaries and nomenclature. The metadata portion of the digital file provides detailed information about the conversion process. Formations codes were assigned using the American Association of Petroleum Geologists' standard stratigraphic code (Cohee, 1967), which was modified by the Kentucky Geological Survey for state-specific use. Formations and formation boundaries were not mapped the same way on each of the 7.5-minute quadrangle maps, since they were compiled by various authors between 1960 and 1978. Resolution of the differences between quadrangles was necessary for efficient topological analysis 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 to be mapped on a 30 x 60 minute quadrangle map. These problems were resolved by adhering to geologic, cartographic, and GIS standards appropriate for the scale of the map.

This map is a compilation of existing maps, and no additional geologic field work took place. When there were problems in stratigraphic correlation between quadrangles, the best current data available were use to resolve these differences.

GEOLOGIC SETTING AND STRUCTURAL GEOLOGY

The geology of the Tell City 30 x 60 minute quadrangle and the Kentucky portion of the Jasper 30 x 60 minute quadrangle consists of flat-lying sedimentary rocks of Mississippian, Pennsylvanian, and Quaternary age. The Mississippian Plateau dominates most of the map, whereas the Pennsylvanian strata occupy part of the Western Kentucky Coal Field of the Illinois Basin. The Mississippian System in this part of Kentucky is represented by marine sedimentary rocks, which originally extended across much of the south-central and southwestern parts of the state (Grabowski, 1986). The Pennsylvanian geology consists of sandstones, conglomerates, siltstones, shales, and coal of alluvial or deltaic origin. Sandstones and siltstones make up between 50 and 80 percent of the coal-bearing rocks in the coal field. The physiographic boundary between the Mississippian Plateau and the Western Kentucky Coal Field is commonly termed the "Dripping Springs Escarpment" (Newell, 1986). Quaternary deposits consisting of alluvium, terrace deposits, loess, and lacustrine deposits make up a significant amount of the geology near the Ohio River and its tributaries. All of these sediments consist of unconsolidated gravel, sand, silt, and clay, and locally contain sparse to abundant organic matter.

The Rough Creek Fault System is an east–west-trending fault system located along the northern margin of the Reelfoot Rift, which bounds the Rough Creek Graben (Greb and others, 1992). Tectonic activity during several geologic periods resulted in a complex fault zone with high-angle normal faults and less common thrust, reverse, and strike-slip faults. Two fault splays (the westernmost named the Locust Hill Fault) intersect the Rough Creek Fault System in a northeast direction, creating a series of horsts and grabens extending into Illinois. These complex fault systems have had some control on deposition of sediments, drainage-system patterns, dip of beds, structural traps, and accumulation of oil and natural gas. Most of the folding and faulting affecting the Pennsylvanian rocks was post-Pennsylvanian and probably post-Paleozoic (Greb and others, 1992). Syndepositional movement along structures during Pennsylvanian peat deposition could have caused splitting, thickening, and thinning of coal seams (Greb and others, 1992).

During the Mississippian, a variety of detrital and chemical sedimentary rocks were deposited. Terrigenously derived clastics were mostly deposited in deltas from the northeast, whereas carbonate deposits accumulated as shallow marine shelves that adjoined the deltaic environment, at a time when little detritus was being transported (Sable and Dever, 1990). A striking deviation from these deposits in the Tell City area is the sandstone member of the Mooretown Formation, a fluvial, submarine paleochannel that extends northeast-southwest across parts of west-central Kentucky. Emerging from the subsurface near the Breckinridge-Hardin County line, this channel extends approximately 30 mi to Fort Knox. In outcrop, the sandstone body creates and fills a steep-walled, narrow (0.5 to 0.8 mi wide), irregularly sinuous channel cut into the Paoli, Ste. Genevieve, and St. Louis Limestones (Sedimentation Seminar, 1969). Toward the southwest the sandstone channel becomes broken-up, friable, and slumped because of dissolution of underlying carbonates and faulting. Toward the northeast the channel forms a prominent straight ridge that rises above the surrounding rocks. Thickness varies from 50 to 100 ft, and the ridge is composed of fine- to medium-grained sandstone.

ECONOMIC GEOLOGY

Limestone, oil, gas, coal, clay, sand and gravel, asphaltic sandstone, and gypsum are the principal economic and mineral resources in the Tell City quadrangle. Limestone has been quarried from formations ranging in age from Early to Late Mississippian. Most of the limestone is quarried for uses such as road metal, asphalt and concrete aggregate, railroad ballast, riprap, cement production, dimension stone, chemical limestone, and agricultural lime. Characteristics such as chert content, abundance of argillaceous impurities, and percentage of high-purity calcium carbonate contribute to the quality, or lack thereof, of limestone. The Paoli Limestone, Ste. Genevieve Limestone, and St. Louis Limestone are the principal units that have been quarried in the eastern part of the Tell City quadrangle. No quarries are presently producing from the St. Louis Limestone. In the central part of the quadrangle, near and around the Dripping Springs Escarpment, limestone is quarried from the Haney Limestone of the Golconda Formation and the Glen Dean Limestone. The limestone produced in Mississippian rocks, toward the Western Kentucky Coal Field, has been mainly quarried from the Kinkaid Limestone Member of the Buffalo Wallow Formation.

Oil and gas have been produced from rock of Cambrian through Pennsylvanian age. Most of the several million barrels of oil produced in west-central Kentucky has come from sandstones and limestones of Late Mississippian age. The presence of oil or gas is mainly controlled by the complex intertonguing of units: facies changes from sandstone to shale, and permeability variations within sandstone. Silurian and Devonian rocks commonly referred to as the "Corniferous" have produced a significant amount of western Kentucky's oil and gas. Production in the Tell City quadrangle primarily comes from the black shales and limestone of Late Devonian age. A few test holes have been drilled into Cambrian (Knox Dolomite) and Ordovician rock, but only slight shows of oil and gas have been reported.

Small oil and gas fields are scattered throughout the Tell City quadrangle; most wells in the quadrangle range form 400 to 900 ft deep. The Muldraugh and Doe Run Gas Fields in Meade County, in the northeastern part of the quadrangle, were among the earliest and most abundant gas-producing fields in the state. The total gas production for Meade County in 2000 was 333,803,000 million cubic feet (Kentucky Geological Survey, 2001a). Now that only a few scattered gas wells are used for local heating, the fields have been converted into storage reservoirs for gas produced elsewhere. Meade County today accounts for less than 10 billion cubic feet of natural gas production per year.

Western Kentucky has produced 51 percent of Kentucky's oil. Devonian limestone in the Concord Church Field, part of which is in the Dundee 7.5-minute quadrangle of the Tell City 30 x 60 minute quadrangle, was the first significant oil discovery in the Western Kentucky Coal Field. Oil was found in the Concord Church Field in porous limestones ranging from 125 to 225 ft below the base of the New Albany Shale. Total production was estimated by Thomas M. Galey in 1952 (cited in Gourdarzi and Smith, 1968) to be about 250,000 barrels of oil. Currently, the top producing counties in the Tell City quadrangle are Breckinridge and Hancock, each producing approximately 10,000 barrels per year. The deepest oil wells, penetrating Cambrian and Ordovician rocks, range from 6,040 ft at the edge of the coal field in the northwestern part of the quadrangle to 5,350 ft in the extreme northeastern part of the quadrangle.

Oil and gas are also produced from stratigraphic traps in sandstones and limestones of Mississippian and Pennsylvanian age. Significant production has come from the Tar Springs Sandstone, Big Clifty Sandstone, Sample Sandstone, and Salem Limestone of Mississippian age and from the Caseyville Formation of Pennsylvanian age. The Tar Springs Sandstone is the principal oil-producing formation of Mississippian age. Some fields, with well depths ranging from 200 to 1,200 ft, have yielded as much as 12 million barrels of oil since their discovery.

Approximately 2.4 billion short tons of bituminous coal has been mined in the Western Kentucky Coal Field since mining began in the state. More than 35 coal beds have been named in western Kentucky, and several have been mined in the Tell City quadrangle (Greb and others, 1992). Hancock County produced 62,506 short tons of coal in 1991. Ohio County, in the southwestern part of the quadrangle, produced 3,213,888 short tons of coal in 1995 and 141,799 tons in 1999 (Overfield and others, 2003). Seventy-five percent of the mines are surface operations (Greb and others, 1992). The Tradewater Formation may contain more than 20 mined coal beds; most are patchy and discontinuous, accounting for less than 10 percent of the total annual production (Greb and others, 1992). The Carbondale Formation, which is exposed in the extreme western part of the quadrangle, accounts for more than 80 percent of the coal field's annual production (Greb and others, 1992). In descending stratigraphic order, the coal beds in the Carbondale are the Lewisport (W. Ky. No. 4), Lead Creek, Deanfield, and Hawesville. Many other thin, lenticular, discontinuous coal beds have been mined locally for domestic use. The Lewisport coal ranges in thickness from 0 to 5 ft and may be split by up to 5 ft of shale (Greb and others, 1992). The Lewisport coal commonly contains pyritic or siliceous partings, and its sulfur content is 3.5 to 4 percent. The Lead Creek coal covers up to 10 mi² in some areas, and ranges in thickness from 1 to 4 ft. It commonly has sulfur values from 5 to 8 percent and ash values from 11 to 18 percent (Greb and others, 1992). Nearly 45,000 short tons of the Deanfield coal was produced between 1980 and 1990. Stratigraphically, it occurs 50 ft above the Hawesville coal, and ranges in thickness from 3.5 to 4 ft; it is at approximately the same stratigraphic level as the W. Ky. No. 2 coal. The Hawesville coal is 80 ft above the top of the Caseyville Formation, and occurs in lenticular patches; the common thickness is 3 ft or less. It often contains a 6-in.-thick pyritic parting, and may be replaced by sandstone (Greb and others, 1992). The Hawesville coal was one of the most heavily mined deposits in western Kentucky before the Civil War, but in recent years an average of only 20,000 short tons a year has been produced.

Clay, commonly called underclay, is mined from above and below several coal beds in the western part of the quadrangle. These underclays range from 3 to 30 ft thick. Clay shale is a possible resource for lightweight aggregate, brick, sewer pipe, and tile. Shale from the Hardinsburg Sandstone and Sample Sandstone (Mississippian) has also been used for the manufacture of brick and roofing tile. Brick made locally from red clay soil formed on the weathered surface of the St. Genevieve Limestone has been used for houses. It has proved to be structurally sound and resistant to weathering.

Sand and gravel is mined in pits in terrace deposits along the Ohio River throughout the region. Sand and gravel for road metal is quarried in pits up to 70 ft deep. Considerable iron-oxide staining prevents these deposits from being suitable for use as concrete. The Sample Sandstone was once used as dimension stone for foundations and fireplaces, but no deposits appear large enough for commercial use. In the Flaherty 7.5-minute quadrangle, the sandstone along the northern half of Sand Ridge has been used for building aggregate. It is clean, well-sorted, quartzose sandstone that is easily excavated and disaggregated.

Asphaltic sandstone, also called tar sand, has been mined from the Big Clifty Sandstone for use as rock asphalt, molding sand, and glass. Ten to 25 ft of barren sandstone, siltstone, and loess overlie about 15 feet of fine-grained sandstone mixed with bituminous material. The bitumen content of the lower half of the asphaltic zone varies between 6 and 10 percent. Asphaltic sandstone was mined at the Gar Rock mine complex in the Custer and Garfield 7.5-minute quadrangles up until the 1930's. During the 1980's, periodic attempts have been made to reclaim the petroleum in the rock by heat treatment or distillation (Anderson, 1994).

Gypsum and associated anhydrite have been found in the eastern part of the Tell City quadrangle. Gypsum and anhydrite are often present in the St. Louis Limestone at a depth of 350 to 500 ft. Thin beds, vein deposits, or nodules of gypsum can be more than 2 ft thick and can total up to 30 ft in one area. Uses include plaster, wallboard, pottery molds, cement, and soil conditioner (Anderson, 1994). Other minerals in the area that have been prospected include fluorite, sphalerite, and barite. No gypsum has been produced in this area recently.

ENGINEERING GEOLOGY

Engineering problems tend to occur in clay shale associated with coals and in outwash and lacustrine deposits with high clay content. Small landslides and slumps occur locally on steep slopes in the Pellville 7.5-minute quadrangle, in the Western Kentucky Coal Field. Clay-shale deposits are generally overlain by massive sandstone, and slumping is most common where joints in the sandstone parallel the slope. Excavations in the shale, for roads or building foundations, may oversteepen the slope and undercut the sandstone, causing slides to occur, especially when the material is saturated with water. Outwash and lacustrine deposits with high clay content present engineering problems, because roads built on them tend to yield and push out under heavy traffic. Lacustrine deposits have good to poor compaction and moderate to high susceptibility to frost action. When the water table reaches the surface, the shrink-swell potential is high.

Although most of the coal mines in the Tell City quadrangle are surface mines, underground coal mining and surface subsidence are also potential hazards. When strata above mined-out coal beds collapse, resulting property loss can be substantial. If the overlying strata are not of sufficient thickness and strength, or the underclay is too soft, the result will be surface movement, causing structural damage (Sergeant and others, 1988). Structural damage and property damage can include cracks in foundations, curvature of walls, collapse of buildings, and damage to utility lines.

The location of the Tell City quadrangle presents potential for seismic hazards as well. The western part of the quadrangle is approximately 100 mi from the Jackson Purchase Region, which, in the past, has produced significant strong seismic activity from the New Madrid Fault Zone. Many areas near the Ohio River are situated on unconsolidated river deposits and thick soils, which have potential for producing significant seismic hazards. Shear waves from earthquakes in the New Madrid Seismic Zone are expected to be strongly affected by the sharp bedrock/soil interface in the quadrangle. Thick deposits of soft sediment and soil have a consequential influence on the characteristics of ground shaking during an earthquake (Street and others, 2001): these thick, loosely packed sediments and soils overlying hard bedrock tend to amplify any ground motions (Kentucky Geological Survey, 2001b). Ground-motion amplification can lead to liquefaction, a temporary transformation of material into a fluid mass, which can result in foundation failure and other property damage.

Many areas along the Ohio River in the Tell City quadrangle are susceptible to flooding. High water flow over time or intense rains producing flash floods can cause significant damage to crops, buildings, and homes on or near floodplains. Proper flood data should be gathered to find out more about risk and construction activities.

HYDROGEOLOGY

The Tell City quadrangle is part of the Ohio River Basin and a small part of the Green River Basin. Meade, Breckinridge, and Hancock Counties in the Tell City quadrangle border the Ohio River, from which water for domestic and agricultural use occurs in alluvium, outwash, terrace, and floodplain deposits. Wells drilled into these areas can produce up to 5,000 gal/min, and nearly all wells furnish more than 500 gal/day (Carey and Stickney, 2005). Nonpoint-source pollution, resulting from coal mining and agriculture, for example, is a potential hazard for the sand and gravel aquifers along the Ohio River.

In the gently rolling uplands and karst regions of the Tell City quadrangle, water is obtained from fractures, caverns, and other solution openings in Mississippian limestone. The limestones in this area can produce water ranging from 50 to 500 gal/day. Perennial springs in limestones also yield enough water for domestic use. Major springs can produce flows of several hundred to several thousand gallons a minute. Joints and faults in the earth's crust may extend for tens of feet up to several miles in length, and often hold significant amounts of groundwater. Exploiting these geologic features is a common technique used in the exploration for groundwater (Carey and Stickney, 2005).

Geologic hazards are also a concern in the karst areas of the Tell City quadrangle. The older Mississippian rocks in the northeastern and eastern parts of the quadrangle contain numerous sinkholes, disappearing streams, and springs, all of which characterize a karst terrane. Building foundations may be adversely affected by jointing in the limestone or development of sinkholes. Also, water that accumulates quickly and travels fast, as occurs in a karst aquifer, presents the potential for sinkhole flooding and vulnerability to pollution.

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