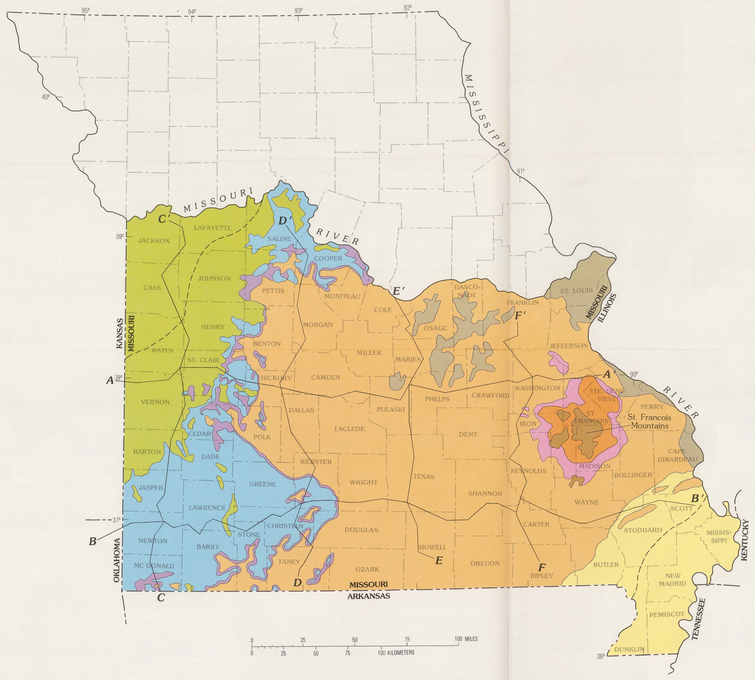

INDEX MAP SHOWING GENERALIZED OUTCROP AREAS OF GEOHYDROLOGIC UNITS AND TRACE OF GEOHYDROLOGIC SECTIONS

EXPLANATION

- POST-PALEOZOIC SEDIMENTS
- WESTERN INTERIOR PLAINS CONFINING SYSTEM
- SPRINGFIELD PLATEAU AQUIFER
- OZARK CONFINING UNIT
- OZARK AQUIFER
- ST. FRANCOIS CONFINING UNIT
- ST. FRANCOIS AQUIFER
- BASEMENT CONFINING UNIT
- UNNAMED, LOCAL GEOHYDROLOGIC UNITS
- APPROXIMATE SUBSURFACE LIMIT OF OZARK PLATEAUS AQUIFER SYSTEM
- A A′ TRACE OF GEOHYDROLOGIC SECTION

DIAGRAM SHOWING WELL-NUMBERING SYSTEM

EXPLANATION

GEO-HYDROLOGIC UNITS		GEOLOGIC FORMATIONS
		QUATERNARY SYSTEM
		Glacial Drift
		Alluvium
POST-PALEOZOIC SEDIMENTS	Qd	
	Qa	
	Qr	CENOZOIC ERATHEM
	Mz	MESOZOIC ERATHEM
	K	CRETACEOUS SYSTEM
WESTERN INTERIOR PLAINS CONFINING SYSTEM	IP	PENNSYLVANIAN SYSTEM
	IPp	Pleasanton Formation
	IPm	Marmaton Group
	IPc	Cherokee Shale
SPRINGFIELD PLATEAU AQUIFER	M	MISSISSIPPIAN SYSTEM
	Msg	Ste. Genevieve Limestone
	Msl	St. Louis Limestone
	Mw	Warsaw Limestone
	Mbk	Keokuk and Burlington Limestones
	Mo	Osagean Series (undifferentiated)
OZARK CONFINING UNIT	Mn	Northview Shale
	Ms	Sedalia Limestone
	Mco	Compton Limestone
	Mc	Chouteau Limestone
	Mk	"Kinderhook shale" of Thompson (1986, p. 23-24)[1]
		MISSISSIPPIAN AND DEVONIAN SYSTEMS
	M-Dc	Chattanooga Shale
	D	DEVONIAN SYSTEM
OZARK AQUIFER		ORDOVICIAN SYSTEM
	Ok	Kimmswick Limestone
	Od	Decorah Formation
	Os	St. Peter Sandstone
	Oe	Everton Formation
	Osm	Smithville Formation
	Op	Powell Dolomite
	Oc	Cotter Dolomite
	Ojc	Jefferson City Dolomite
	Or	Roubidoux Formation
	Og	Gasconade Dolomite
	Ogg	Gunter Sandstone Member
		CAMBRIAN SYSTEM
	Ce	Eminence Dolomite
	Cp	Potosi Dolomite
ST. FRANCOIS CONFINING UNIT	Cdd	Doe Run and Derby Dolomites
	Cd	Davis Formation
ST. FRANCOIS AQUIFER	Cb	Bonneterre Formation
	Cr	Reagan Sandstone[1]
	Cl	Lamotte Sandstone
BASEMENT CONFINING UNIT	pЄ	PRECAMBRIAN

Note: Small Quaternary deposits along rivers and streams are not shown on geologic sections.

[1] Unit follows usage of Missouri Division of Geology and Land Survey

Contact—Dashed where approximately located

Fault—Arrows indicate relative direction of movement

Well or test hole—See well-numbering diagram for description of number

INTRODUCTION

As part of the U.S. Geological Survey's Regional Aquifer-System Analysis Program, geologic formations in southern Missouri (index map) were grouped into eight regional geohydrologic units on the basis of relative rock permeability and well yields (Imes and Emmett, in press). Geohydrologic unit boundaries do not necessarily coincide with geologic unit boundaries or geologic time lines, but are determined by regional hydrologic properties, which may vary from one area to another. The geologic formations were grouped into the geohydrologic units to determine the hydrologic characteristics of regional aquifer systems and associated regional confining units in parts of Arkansas, Kansas, Missouri, and Oklahoma. This report presents a correlation of the regional geohydrologic units to corresponding geologic formations in southern Missouri. Included in the report is a brief geologic history of southern Missouri.

GEOLOGIC HISTORY

The geologic history of southern Missouri includes several periods of inundation by ancient seas, during which substantial quantities of sediment were deposited and lithified, and intervening periods during which the area was uplifted and the lithified sediments were eroded. Crystalline rocks of Precambrian age (geohydrologic sections *A–A′* through *F–F′*) form the basement on which younger sedimentary rocks were deposited during periods of inundation.

Millions of years of Precambrian erosion of the crystalline basement resulted in the development of a rugged topography. This surface was partly inundated by a transgressive Late Cambrian sea, and sediments were deposited and lithified to form the sequence of formations from the Lamotte Sandstone to the Eminence Dolomite. In western Missouri, the Reagan Sandstone[1] was deposited as a near-shore facies of the Lamotte Sandstone (Kurtz and others, 1975; geohydrologic section *B–B′*). From Late Cambrian to Early Ordovician time, sedimentation generally decreased, but renewed submergence in Early Ordovician time initiated the deposition of calcareous sediments that formed the sequence of formations from the Gasconade Dolomite to the Smithville Formation. At the end of this deposition, the area was uplifted, resulting in fracturing and faulting of the rocks and extensive dolomitization as freshwater flushed seawater from the rocks (Back and Hanshaw, 1970). Erosion and dissolution of the uplifted carbonate rocks resulted in a well-developed and widespread karst terrane. A series of major and minor transgressions and regressions of the sea occurred at the end of this major erosional period. Transgressive seas at the beginning of Middle Ordovician time formed deposits that lithified to form the sequence of formations from the St. Peter Sandstone to the Kimmswick Limestone (geohydrologic section *C–C′*).

Silurian and Devonian sediments, mainly deposited as calcareous mud, were probably limited to the flanks of the uplifted area, along the western and eastern borders of southern Missouri (geohydrologic section *C–C′*). Most of the Silurian and Devonian deposits were subsequently eroded. The Chattanooga Shale of Late Devonian and Early Mississippian age is the only remnant of these deposits in southern Missouri. At the end of Silurian and Devonian times, fresh ground water in the uplifted area continued to increase the permeability of the underlying rocks through solutional activity. Since Devonian time, the area has undergone two major cycles of inundation and uplift. The first of these cycles included the deposition of Mississippian sediments, containing clay that lithified to almost impermeable shale and calcareous mud that lithified to limestone. The Mississippian rocks in southern Missouri consists of the sequence of formations from the "Kinderhook shale" of Thompson (1986, p. 23–24)[1] to the Ste. Genevieve Limestone. The second cycle began in early Pennsylvanian time, during which large quantities of clay, sand, and calcareous mud were deposited. These deposits lithified to thick layers of Pennsylvanian shale, sandstone, and limestone. The widespread and deep erosion that occurred after the Pennsylvanian sea receded continues to the present time and has removed most of the Pennsylvanian deposits from southern Missouri. Pennsylvanian rocks are represented by the sequence of formations from the Cherokee Shale to the Pleasanton Formation. During this erosional period, stress released in the Mississippian and Ordovician rocks because of unloading resulted in faults and fractures. Several of the larger faults in southern Missouri are shown on the geologic sections, such as the Eldorado Springs fault (geohydrologic section *C–C′*), which has as much as 270 feet of displacement (McCracken, 1971). Although the the sequence of sedimentary rocks overlying the Precambrian basement complex is about 3,000 feet thick in extreme southeastern Missouri (geohydrologic section *B–B′*), the sequence is not as thick in most of southern Missouri. Extensive post-Pennsylvanian uplift and erosion has exposed Precambrian rocks in the St. Francois Mountains of southern Missouri (index map). The long period of erosion, deep weathering, and continued dissolution of Mississippian, Ordovician, and Cambrian carbonate rocks during post-Pennsylvanian time has produced a sequence of extremely permeable rocks in southern Missouri. An extensive well-developed karst has formed in the upper few hundred feet of the carbonate rocks. Seawater has been flushed from the rocks in all but the extreme southeastern and northwestern parts of southern Missouri, resulting in the large, productive Ozark Plateaus aquifer system.

CORRELATION OF REGIONAL GEOHYDROLOGIC UNITS TO GEOLOGIC FORMATIONS

Geohydrologic units that form the Ozark Plateaus aquifer system are exposed at the land surface in a concentric pattern centered on the St. Francois Mountains with older stratigraphic units exposed closer to the core of the mountains (index map). The three aquifers and two intervening confining units that comprise the aquifer system are, in descending order, the Springfield Plateau aquifer, the Ozark confining unit, the Ozark aquifer, the St. Francois confining unit, and the St. Francois aquifer. The principal geologic formations in each geohydrologic unit are included in the following list; however, some formations of lesser areal extent and hydrologic significance are not included:

1. Springfield Plateau aquifer—St. Louis Limestone, Salem Limestone, Warsaw Limestone, and Keokuk and Burlington Limestones
2. Ozark confining unit—Northview Shale, Sedalia Limestone, Compton Limestone, Chouteau Limestone, "Kinderhook shale" of Thompson (1986, p. 23–24), and Chattanooga Shale
3. Ozark aquifer—Kimmswick Limestone, Decorah Formation, St. Peter Sandstone, Everton Formation, Smithville Formation, Powell Dolomite, Cotter Dolomite, Jefferson City Dolomite, Roubidoux Formation, Gasconade Dolomite, Eminence Dolomite, and Potosi Dolomite
4. St. Francois confining unit—Doe Run and Derby Dolomites and Davis Formation
5. St. Francois aquifer—Bonneterre Formation, Reagan Sandstone, and Lamotte Sandstone.

The Ozark Plateaus aquifer system is confined above by the Western Interior Plains confining system (composed of Pennsylvanian and Upper Mississippian rocks in southern Missouri) and below by the Basement confining unit (composed of Precambrian crystalline rocks). The northern limit of the Ozark Plateaus aquifer system is the Missouri River and the eastern limit approximately coincides with the Mississippi River. The aquifer system extends to the west into Kansas, to the southwest into Oklahoma, and to the south into Arkansas (Imes and Emmett, in press). A detailed correlation of geohydrologic units and geologic formations that comprise the Ozark Plateaus aquifer system and Western Interior Plains confining system with general descriptions of their geohydrologic properties is presented in Imes and Smith (in press). In the northwestern part of southern Missouri, the Western Interior Plains confining unit (index map) is partly underlain by the Western Interior Plains aquifer system. This aquifer system is stratigraphically equivalent to the Ozark Plateaus aquifer system (geohydrologic section *C–C′*). The approximate boundary between the two aquifer systems is shown by the dashed line on the index map. This boundary is defined by the dissolved-solids concentration of the water in the two aquifer systems; the Western Interior Plains aquifer system contains saline water that is moving generally eastward, whereas the Ozark Plateaus aquifer system contains freshwater that is moving generally westward. A detailed discussion of the Western Interior Plains aquifer system is presented in Imes and Smith (in press).

The post-Paleozoic sediments in the southeastern part of southern Missouri also contain aquifers and confining units that are part of much larger regional geohydrologic units in the Mississippi Embayment. These regional geohydrologic units are being studied as part of the U.S. Geological Survey's Gulf Coastal Plain Regional Aquifer-System Analysis.

CONTROL USED TO CONSTRUCT GEOHYDROLOGIC SECTIONS

The geologic sections on these two sheets are based on well or test hole data obtained from the files of the Missouri Division of Geology and Land Survey, Rolla, Missouri. Locations are shown according to the General Land Office coordinate system (well-numbering system diagram). The first three sets of numbers in this system designate township, range, and section. The letters that follow indicate quarter section, quarter-quarter section, and quarter-quarter-quarter section. The quarter sections are represented by letters A, B, C, and D, in counterclockwise order, starting in the northeast quadrant.

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CONVERSION FACTORS

Multiply	By	To Obtain
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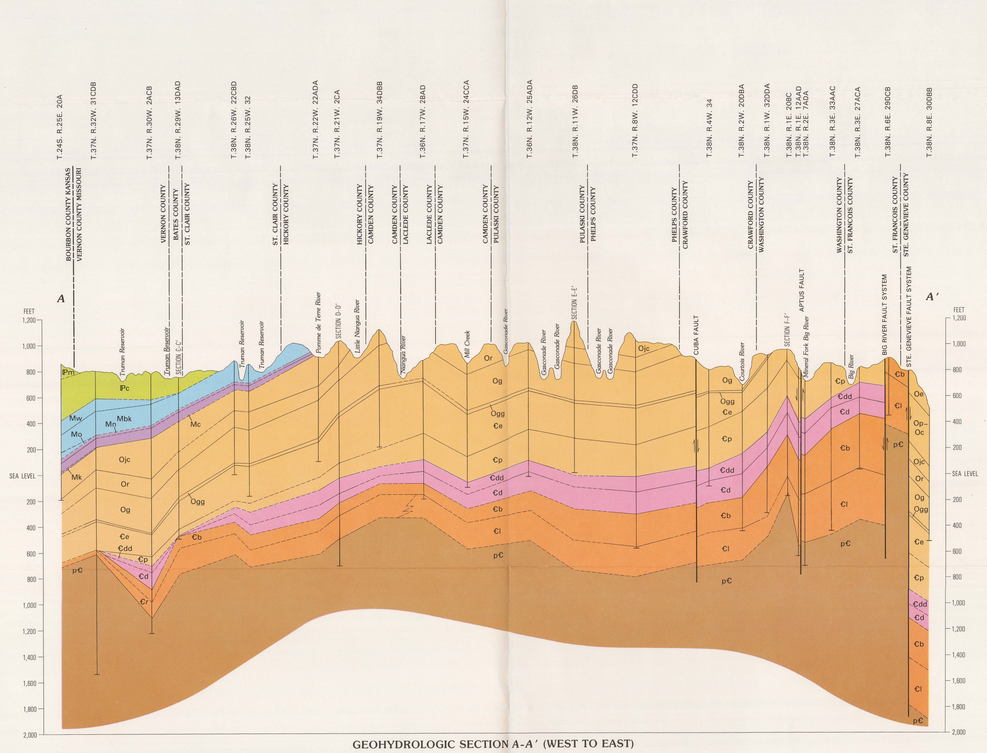
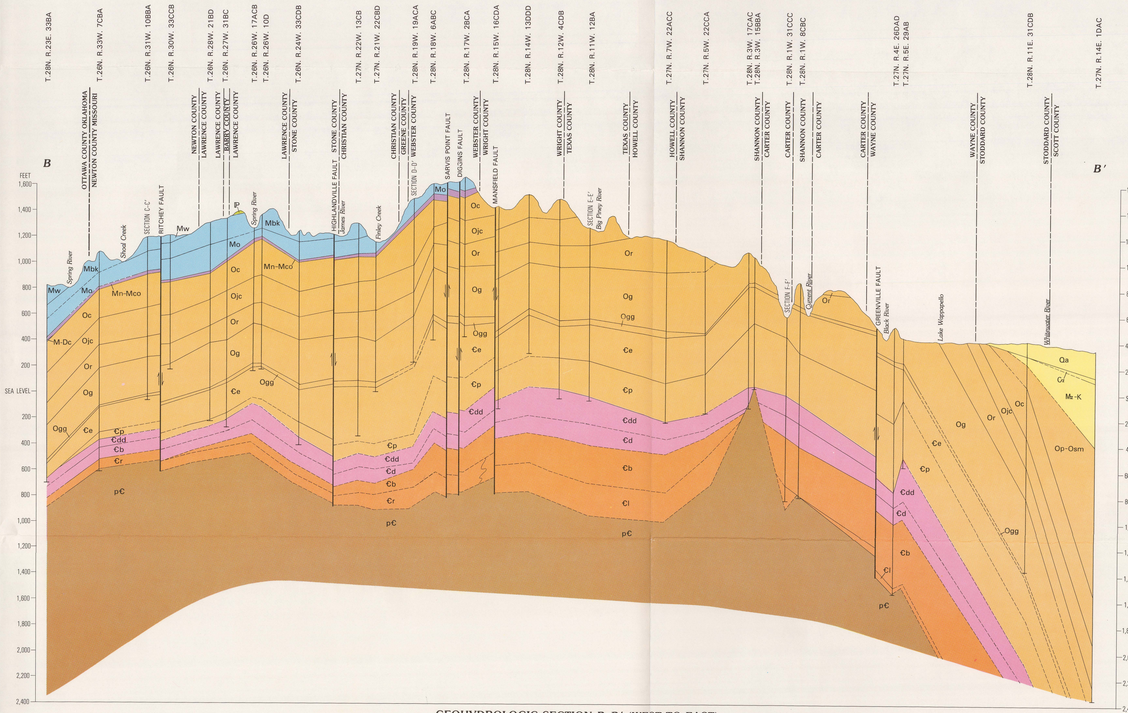
mile	1.609	kilometer



GEOHYDROLOGIC SECTION *A–A′* (WEST TO EAST)



GEOHYDROLOGIC SECTION *B–B′* (WEST TO EAST)

0 10 20 30 40 50 60 70 80 90 100 MILES
0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 KILOMETERS
Vertical scale greatly exaggerated

CORRELATION OF REGIONAL GEOHYDROLOGIC UNITS TO GEOLOGIC FORMATIONS IN SOUTHERN MISSOURI

By
B.J. Smith and J.L. Imes

1991

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