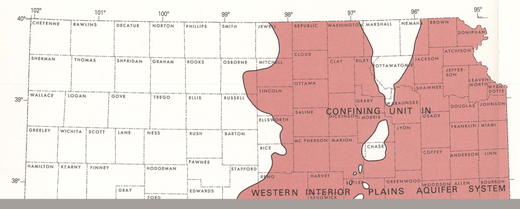
INTRODUCTION

The purpose of this Hydrologic Investigations Atlas is to provide a description of the geohydrologic systems in Upper Cambrian through Lower Cretaceous rocks in Kansas. This investigation was made as part of the Central Midwest Regional Aquifer-System Analysis (CMRASA). The CMRASA is one of several major investigations by the U.S. Geological Survey of regional aquifer systems in the United States. These regional investigations are designed to increase knowledge of the flow regime and hydrologic properties of major aquifer systems and to provide quantitative information for the assessment, development, and management of water supplies. The CMRASA study area includes all or parts of 10 Central Midwestern States (Jorgensen and Signor, 1981), as shown on the envelope cover.

This Hydrologic Investigations Atlas, which consists of a series of nine chapters, presents a description of the physical framework and the geohydrology of principal aquifer and confining systems in Kansas. Chapter E presents maps that show the areal extent, altitude and configuration of the top, and thickness of the Upper Devonian and Lower Mississippian rocks that compose the confining unit in the Western Interior Plains aquifer system in the eastern one-half



DEFINITION AND AREAL EXTENT

In Kansas, a confining unit of almost impermeable shale and shaly limestone restricts flow between the upper and lower aquifers in the stratigraphically equivalent and laterally adjacent Western Interior Plains and Ozark Plateaus aquifer systems. These Upper Devonian and Lower Mississippian rocks (table 1) are included in the rock sequence that has been divided by the CMRASA study (D. G. Jorgensen, U.S. Geological Survey, written commun., 1985) into two separate, laterally adjacent flow systems on the basis of opposing directions of ground-water flow and distinctly different water quality. These two flow systems are:

1. The Western Interior Plains aquifer system—A somewhat ill-defined, saltwater system in which flow generally is slowly eastward. This system extends from the base of the Rocky Mountains in Colorado to the Ozark Plateaus of Missouri and occurs throughout Kansas with the exception of the southeast corner of the State.

The confining unit in the Western Interior Plains aquifer system underlies about 43,000 square miles in Kansas (fig. 1). The confining unit extends westward from the Kansas-Missouri State line across about one-half of the State, except where it is missing over the Nemaha Anticline, in part of the Cherokee Basin, and in a small area on the western flank of the Ozark Uplift (compare figs. 1 and 2). The confining unit subcrops along a southwest-bending line that extends from Jewell County in the north to Clark County in the south. Where the upper aquifer unit is missing, the confining unit lies directly below the thick shale sequence in the Western Interior Plains confining system. The confining unit is not used as a source of water in Kansas because it has minimal permeability and contains saline water. The relation of the confining unit in the Western Interior Plains aquifer system to other geohydrologic systems in Kansas is shown in figure 3.

Altitude and Configuration of Top

The altitude of the top of the confining unit in the Western Interior Plains aquifer system ranges from a high of about 600 feet above sea level in the southeast corner of Kansas to a low of about 5,000 feet below sea level along the Kansas-Oklahoma State line in Clark County (fig. 4). From the zone of

Modified from Merriam, 1963

E 2.—Geohydrologic map showing major pre-Desmoinesian, post-Mississippian structural features and provinces in subsurface.

of Kansas. The chapter is limited to the presentation of the physical framework of the confining unit. The interpretation of the physical framework of the confining unit is based on selected existing geophysical and lithologic logs and published maps of stratigraphically equivalent units. Maps indicating the thickness and the altitude and configuration of the top of the confining unit in the Western Interior Plains aquifer system have been prepared as part of a series of interrelated maps describing the stratigraphic interval from the Precambrian basement through Lower Cretaceous rocks. A concerted effort was made to ensure that maps of each geohydrologic unit are consistent with maps of underlying and overlying units. Chapter A of this atlas series (Wolf and others, 1990) describes the relation of principal geohydrologic systems in Kansas and presents a more detailed discussion of the methods and data used to prepare and ensure consistency among the sets of maps.

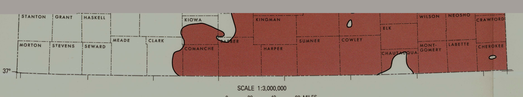
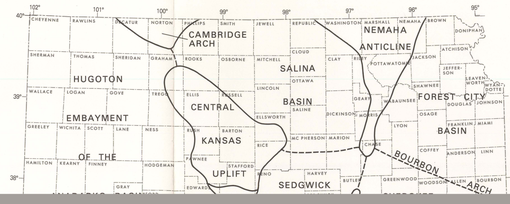


FIGURE 1.—Geohydrologic map showing areal extent of confining unit in Western Interior Plains aquifer system.

which glow generally is rapidly westward. This system originates in the Ozark Plateaus of southern Missouri and extends westward into southeastern Kansas.

The almost impermeable shale and shaly limestone that form a confining layer in the two flow systems is continuous across the western boundary of the Ozark Plateaus aquifer system into the laterally adjacent Western Interior Plains aquifer system, where it is referred to as the "confining unit." The boundary between the two flow systems is not well defined because of a lack of data in the transition zone. The geohydrologic units of the Ozark Plateaus aquifer system designated by Imes (1990) apply only to parts of a few counties in the southeast corner of Kansas. Therefore, in this report, for ease of mapping and convenience of discussion, the Upper Devonian and Lower Mississippian rocks that are included in the laterally adjacent aquifer systems are collectively referred to as the "confining unit in the Western Interior Plains aquifer system," even though the maps also include a small area of a confining unit in the Ozark Plateaus aquifer system in southeast Kansas.



highest altitude on the western flank of the Ozark Uplift in southeast Kansas, the surface dips gently to the northwest toward the Forest City Basin and to the west toward the Cherokee Basin (compare figs. 2 and 4). Along the east edge of the Nemaha Anticline, the westward dip is interrupted, and the top of the confining unit rises steeply and irregularly. The lowest altitudes of the surface in this area are adjacent to the east flank of the Nemaha Anticline. An area of abruptly changing altitude is indicated along the east edge of the Nemaha Anticline, where it was not possible to maintain a 100-foot contour interval at the scale of the map. The confining unit in the Western Interior Plains aquifer system is eroded over the Nemaha Anticline and from a small area on the west flank of the Ozark Uplift.

From the Nemaha Anticline, the top of the confining unit dips to the west into the Salina Basin and to the southwest into the Sedgwick Basin. In the Salina Basin, the unit is buried most deeply (more than 2,100 feet below sea level) near the Central Kansas Uplift, which bounds the basin on the west. In the Sedgwick Basin, the top of the confining unit rises towards the Central Kansas Uplift to the northwest but slopes downward towards the Hugoton Embayment of the Anadarko Basin to the southwest and the Anadarko Basin to the south.

ABLE 1. Generalized stratigraphic units and related geohydrologic systems

Provincial series	Geologic unit	Geohydrologic systems: Subdivisions	Geohydrologic systems: Major systems
	Undifferentiated Quaternary deposits		Alluvial and glacial-drift aquifer system
	Ogallala Formation		High Plains aquifer system
	Undifferentiated Upper Cretaceous rocks		Great Plains confining system
	Dakota Formation	Upper aquifer unit	Great Plains aquifer system
	Kiowa Shale	Confining unit	
	Cheyenne Sandstone	Lower aquifer unit	
	Morrison Formation	Upper unit	
	Undifferentiated Upper Jurassic rocks		
	Big Basin Formation		
	Dog Creek Formation Blaine Formation		
	Cedar Hills Sandstone Salt Plains Formation Harper Sandstone		
	Stone Corral Formation Nirnescah Shale Wellington Formation		
	Chase Group Council Grove Group Admire Group	Lower unit	Western Interior Plains confining system
Virgilian	Wabaunsee Group Shawnee Group Douglas Group		
Missourian	Undifferentiated Missourian rocks		
Desmoinesian	Undifferentiated Desmoinesian rocks		
Atokan	Undifferentiated Atokan rocks		
Morrowan	Undifferentiated Morrowan rocks		
Chesterian	Undifferentiated Chesterian rocks		
Meramecian	Undifferentiated Upper and Lower Mississippian rocks	Upper aquifer unit	Western Interior Plains aquifer system
Osagean			
Kinderhookian			
	Undifferentiated Lower Mississippian and Upper Devonian rocks	Confining unit	
	Hunton Formation	Upper part of lower aquifer unit	
	Maquoketa Shale		
	Viola Limestone Simpson Group		
	Arbuckle Group	Lower part of lower aquifer unit	
	Igneous, metamorphic, and metasedimentary rocks		Basement confining system

FIGURE 3.—Geohydrologic section showing relation of lower aquifer unit in Western Interior Plains aquifer system to other geohydrologic systems.

SYSTEM	Series
QUATERNARY	Holocene
	Pleistocene
TERTIARY	Miocene
CRETACEOUS	Upper
	Lower
JURASSIC	Upper
	Upper
PERMIAN	Lower
PENNSYLVANIAN	Upper
	Middle
	Lower
MISSISSIPPIAN	Upper
	Lower
DEVONIAN	
SILURIAN	
ORDOVICIAN	Upper
	Middle
	Lower
CAMBRIAN	Upper
PRECAMBRIAN	

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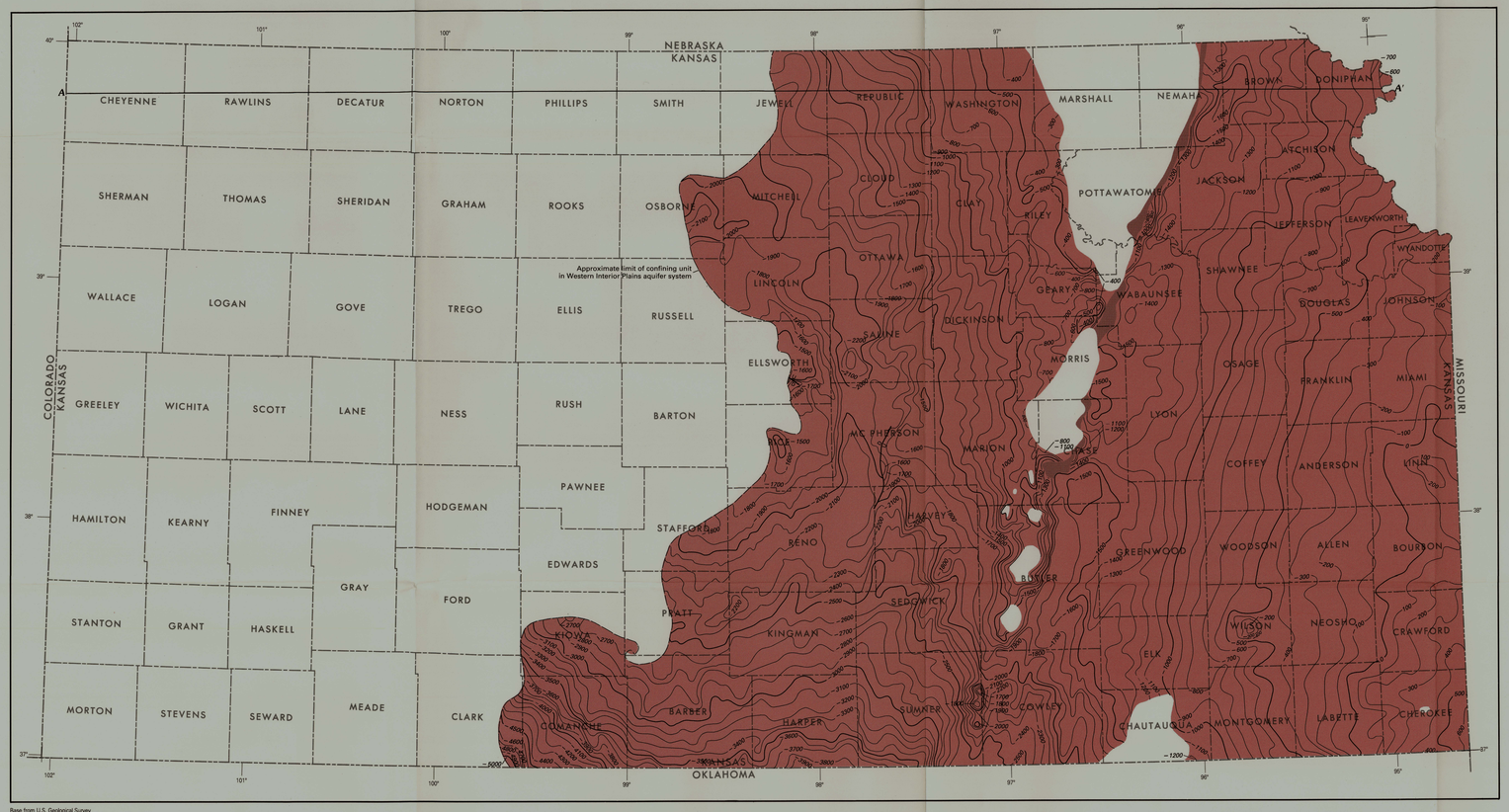

Base from U.S. Geological Survey
State base map, 1:500,000, 1984

SCALE 1:1,000,000
0 10 20 30 40 MILES
0 20 40 KILOMETERS

FIGURE 4.—Geohydrologic map showing altitude and configuration of top of confining unit.

EXPLANATION

- AREA OF CONFINING UNIT
- AREA WHERE CONFINING UNIT IS ABSENT
- AREA OF ABRUPTLY CHANGING ALTITUDE
- *100* — TOP-OF-CONFINING UNIT CONTOUR—Shows altitude of top of confining unit. Contour interval 100 feet. Datum is sea level
- U/D — FAULT—U, upthrown side; D, downthrown side
- *A*—*A'* TRACE OF SECTION

CONVERSION FACTORS AND VERTICAL DATUM

Multiply	By	To obtain
foot	0.3048	meter per day
mile	1.609	kilometer
square mile	2.590	square kilometer
gallon per minute	0.06309	liter per second

Sea level: In this report, "sea level" refers to the National Geodetic Vertical Datum of 1929—a geodetic datum derived from a general adjustment of the first-order level nets of both the United States and Canada, formerly called Sea Level Datum of 1929.

INTERIOR—GEOLOGICAL SURVEY, RESTON, VIRGINIA—1992

SYSTEM

GEOHYDROLOGIC SYSTEMS IN KANSAS—PHYSICAL FRAMEWORK OF THE CONFINING UNIT IN THE WESTERN INTERIOR PLAINS AQUIFER

By