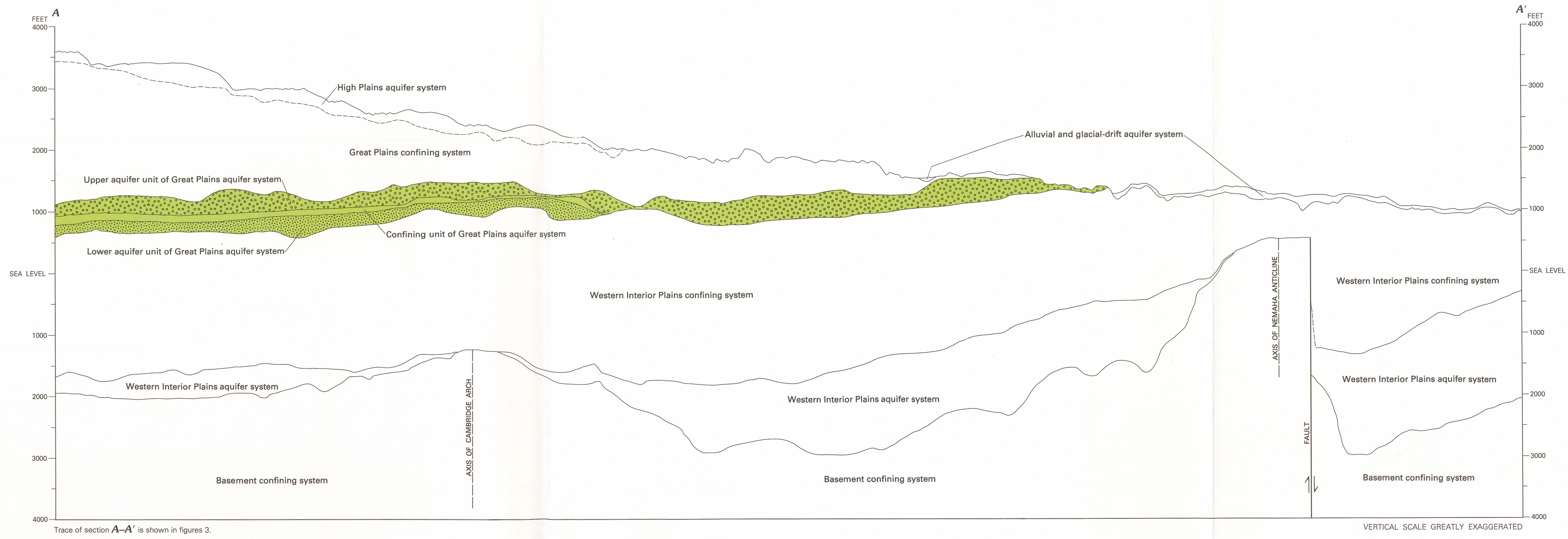


FIGURE 1.—Geohydrologic section showing relation of Great Plains aquifer system to other geohydrologic systems.

INTRODUCTION

The purpose of this map report is to provide a description of one of the principal geohydrologic systems in Upper Cambrian through Lower Cretaceous rocks in Kansas. The report is the result of an investigation 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 B describes the physical framework of the Great Plains aquifer system and presents maps and a geohydrologic cross section that show the thickness, the areal extent, and the altitude and configuration of the top of the Lower Cretaceous rocks that compose the Great Plains aquifer system. The maps are based on data from selected geophysical and lithologic logs and from published maps of stratigraphically equivalent units. Maps that show the thickness and the altitude and configuration of the top of the Great Plains aquifer system have been prepared as part of a series of interrelated maps that describe the stratigraphic interval from the Precambrian surface through Lower Cretaceous rocks. A concerted effort was made to ensure that maps of each geohydrologic system are consistent with maps of underlying and overlying systems; modifications were made where necessary.

Chapter A of this atlas series (Wolf and others, 1990) describes the relation of 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 in the series.

DEFINITION AND AREAL EXTENT

The Great Plains aquifer system, which is generally known as the "Dakota aquifer" in hydrogeologic literature, is one of the most extensive aquifer systems in North America and extends from northern Canada to New Mexico in the United States. The aquifer system in Kansas consists of mostly Lower Cretaceous rocks (table 1). These rocks generally compose a sequence of permeable sandstone, less permeable siltstone, and shale of very slight permeability. As shown in figure 1, the Great Plains aquifer system is overlain by the Great Plains confining system (Upper Cretaceous rocks, predominately shale) or, places, by the High Plains aquifer system and the alluvial and glacial-drift aquifer system (Miocene, Pleistocene, and Holocene sediments). The Great Plains aquifer system is underlain by the Western Interior Plains confining system (rocks of Jurassic, Permian, Pennsylvanian, and Upper Mississippian age).

The Great Plains aquifer system has been divided by the CMRASA (D.G. Jorgensen, U.S. Geological Survey, written commun., 1985) into the following three regional geohydrologic subdivisions: (1) an upper aquifer unit named the "Maha aquifer" (Dakota Formation), (2) a middle, predominantly shale confining unit named the "Apishapa confining unit" (Kiowa Shale), and (3) a lower aquifer unit named the "Apishapa aquifer" (Cheyenne Sandstone). The names "upper aquifer unit" (Dakota Sandstone), "confining unit" (Kiowa Shale), and "lower aquifer unit" (Cheyenne Sandstone) are used in this report instead of the three CMRASA regional geohydrologic subdivisions.

In Kansas, the Great Plains aquifer system crops out mainly in a broad band in the north-central part of the State and subcrops beneath Cenozoic deposits in the south-central and southwestern parts of the State. North and west of the outcrop and subcrop area, the Great Plains aquifer system is present in the subsurface beneath Upper Cretaceous rocks. The area of the aquifer system, which encompasses approximately 41,500 square miles of the western one-half of the State, lies northwest of an irregular line that trends nearly southwest from Washington County to Comanche County and then west through Morton County (fig. 2).

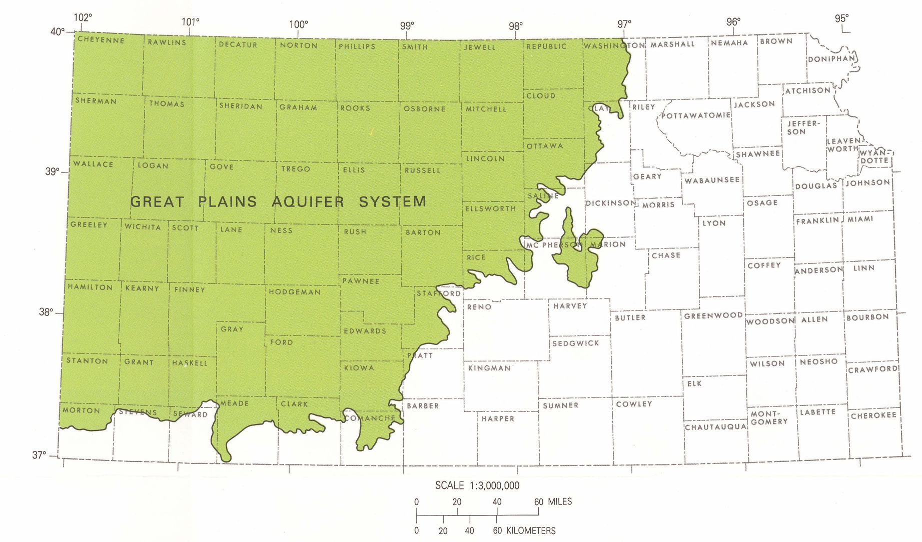
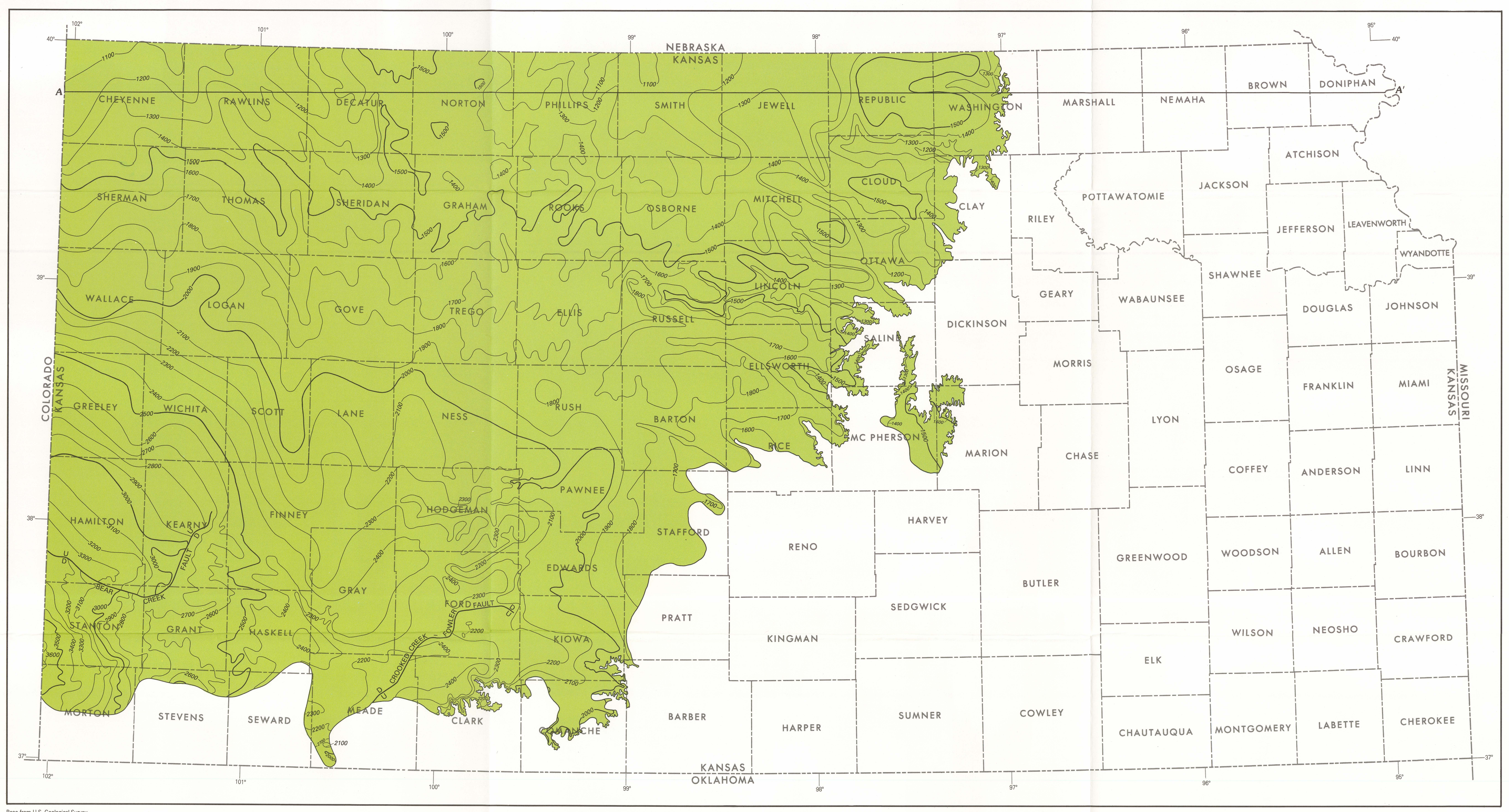


FIGURE 2.—Geohydrologic map showing areal extent of Great Plains aquifer system.

TABLE 1. **Generalized stratigraphic units and related geohydrologic systems**

SYSTEM	Series	Provincial series	Geologic unit	Geohydrologic systems: Subdivisions	Geohydrologic systems: Major systems
QUATERNARY	Holocene Pleistocene		Undifferentiated Quaternary deposits		Alluvial and glacial-drift aquifer system
TERTIARY	Miocene		Ogallala Formation		High Plains aquifer system
CRETACEOUS	Upper		Undifferentiated Upper Cretaceous rocks		Great Plains confining system
	Lower		Dakota Formation	Upper aquifer unit	Great Plains aquifer system
			Kiowa Shale	Confining unit	
			Cheyenne Sandstone	Lower aquifer unit	
JURASSIC	Upper		Morrison Formation Undifferentiated Upper Jurassic rocks	Upper unit	Western Interior Plains confining system
PERMIAN	Upper		Big Basin Formation	Lower unit	
	Lower		Day Creek Dolomite Whitehorse Formation Nippewalla Group Dog Creek Formation Blaine Formation Flowerpot Shale Cedar Hills Sandstone Salt Plains Formation Harper Sandstone Sumner Group Stone Corral Formation Ninnescah Shale Wellington Formation Chase Group Council Grove Group Admire Group		
PENNSYLVANIAN	Upper	Virgilian	Wabaunsee Group Shawnee Group Douglas Group		
		Missourian	Undifferentiated Missourian rocks		
	Middle	Desmoinesian	Undifferentiated Desmoinesian rocks		
		Atokan	Undifferentiated Atokan rocks		
	Lower	Morrowan	Undifferentiated Morrowan rocks		
MISSISSIPPIAN	Upper	Chesterian	Undifferentiated Chesterian rocks		
		Meramecian	Undifferentiated Upper and Lower Mississippian rocks	Upper aquifer unit	Western Interior Plains aquifer system
	Lower	Osagean			
		Kinderhookian	Undifferentiated Lower Mississippian and Upper Devonian rocks	Confining unit	
DEVONIAN					
			Hunton Formation	Upper part of lower aquifer unit	
SILURIAN					
ORDOVICIAN	Upper		Maquoketa Shale		
	Middle		Viola Limestone Simpson Group		
	Lower		Arbuckle Group	Lower part of lower aquifer unit	
CAMBRIAN	Upper				
PRECAMBRIAN			Igneous, metamorphic, and metasedimentary rocks		Basement confining system



Base from U.S. Geological Survey
State base map, 1:500,000, 1964

SCALE 1:1,000,000

FIGURE 3.—Geohydrologic map showing altitude and configuration of top of Great Plains aquifer system.

EXPLANATION

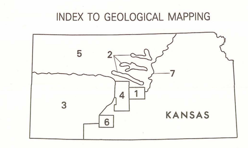
AREA OF GREAT PLAINS AQUIFER SYSTEM

—1100— TOP-OF-AQUIFER CONTOUR—Shows altitude of top of Great Plains aquifer system. Interval 100 feet. Datum is sea level

U/D FAULT—U, upthrown side; D, downthrown side

A——A' TRACE OF SECTION—Shown in figure 1

INDEX TO GEOLOGICAL MAPPING

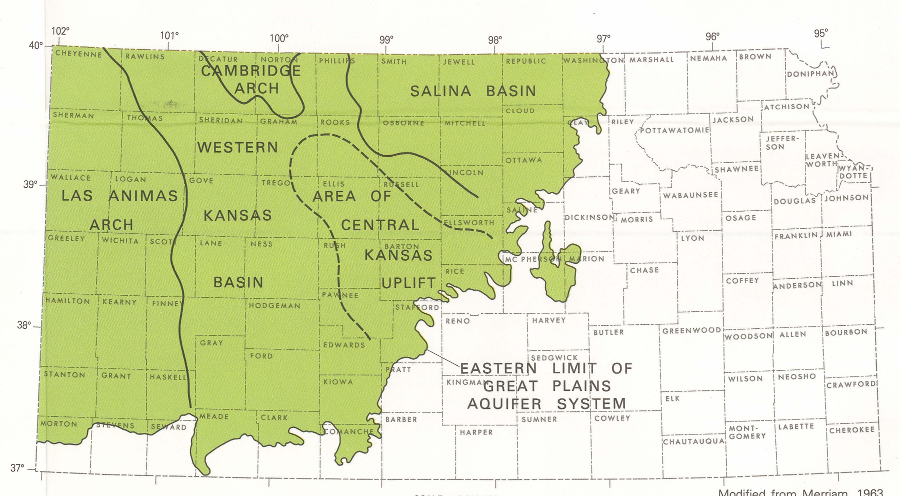


Geology modified from:
1. Bayne and Ward (1974)
2. Bayne (1975)
3. Kume and Spinazola (1985)
4. Latta (1950)
5. Merriam (1957)
6. Lata (1948)
7. Extent of unit modified from Kansas Geological Survey (1964), Merriam (1963), and numerous other published reports

ALTITUDE AND CONFIGURATION OF TOP

The altitude of the top of the Great Plains aquifer system ranges from about 3,600 feet in Stanton and Morton Counties near the southwest corner of the State to about 1,100 feet in Cheyenne, Phillips, and Smith Counties along the Kansas-Nebraska border (fig. 3). From areas of low altitude in the northern part of the State, the top of the aquifer system generally slopes upwards toward its eastern and southern limits in Kansas and toward the Bear Creek Fault to the southwest. Where the Dakota Formation crops out in the north-central part of the State, the top of the aquifer system is dissected by streams that disrupt this general slope to form distinctive dendritic patterns.

A somewhat narrow troughlike feature in the western part of the State is shown by the contours that represent the top of the Great Plains aquifer system. The trough runs from Gray County in the south, through Finney, Scott, Gove, Thomas, and Rawlins Counties, to Cheyenne County in the north. This narrow trough occurs within the area of and probably is related to the nearly linear, north-south structural feature of Mesozoic age known as the Western Kansas Basin (fig. 4). To the east of the basin along the Kansas-Nebraska border, the top of the aquifer system is equivalent to the Cambridge Arch because of locally higher altitudes. From these higher altitudes, the top slopes downward to the west into the Western Kansas Basin and downward to the east into the Salina Basin. In the southwestern part of the State, the top of the aquifer system is notably lower in the area between the Bear Creek and the Crooked Creek-Fowler Faults than in the surrounding areas. This is due to subsidence or collapse of the rocks of the Great Plains aquifer system in the area between the two faults after dissolution of some of the salt in the underlying Permian rocks. South of the Bear Creek Fault, the top of the aquifer system generally slopes upward to the west, instead of generally sloping to the south and southwest, as the top does north of the fault.



Modified from Merriam, 1963

FIGURE 4.—Map showing major Mesozoic structural features in subsurface.

CONVERSION FACTORS AND VERTICAL DATUM

Multiply	By	To obtain
foot	0.3048	meter
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.

GEOHYDROLOGIC SYSTEMS IN KANSAS—PHYSICAL FRAMEWORK OF THE GREAT PLAINS AQUIFER SYSTEM

By
J.M. Spinazola, R.J. Wolf, and H.E. McGovern

1992