INTRODUCTION

The purpose of this Hydrologic Investigations Atlas is to provide a description of the principal 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 assessing, developing, and managing 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 C presents the physical framework of the Western Interior Plains confining system. The framework is illustrated by maps that show the areal extent, altitude, and thickness of the Upper Mississippian through Jurassic rocks that comprise the confining system. Maps in this chapter are based on data from selected geophysical and lithologic logs and from published maps of stratigraphically equivalent units. Maps that indicate the altitude and configuration of the top and the thickness of the upper and lower units of the confining system have been prepared as part of a series of interrelated maps that describe 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 geohydrologic systems in Kansas and presents a detailed discussion of the methods and data used to prepare and ensure consistency among the sets of maps.

DEFINITION AND AREAL EXTENT OF WESTERN INTERIOR PLAINS CONFINING SYSTEM

The Western Interior Plains confining system consists of a thick sequence of shale, evaporite deposits, sandstone, and limestone that ranges in age from Late Mississippian through Jurassic (table 1). Most of the rocks in the system are composed of fine-grained sedimentary rocks that restrict flow between the Great Plains and the Western Interior Plains aquifer systems. In Kansas, the Western Interior Plains confining system has been divided into two units (fig. 1), a slightly permeable upper unit and a more restrictive lower unit. The stratigraphic relation of the confining system to other geohydrologic systems in Kansas is shown in figure 2. The names of major pre-Desmoinesian, post Mississippian structural features and provinces in the subsurface are those used by the Kansas Geological Survey (Merriam, 1963), as shown in figure 3.

The upper unit of the Western Interior Plains confining system consists of sandy shale and silty sandstone in the Morrison Formation of Jurassic age and undifferentiated Jurassic rocks that may be equivalent to the Entrada Sandstone of Colorado (Zeller, 1968). In Kansas, the upper unit underlies about 19,100 square miles (fig. 1) and crops out only in small areas within Morton County. The unit occurs in an area west of a line trending from Smith County in the northeast to Morton County in the southwest, except where it is absent in Gove County. The upper unit is underlain by the lower unit of the Western Interior Plains confining system. The upper unit is overlain by the Great Plains aquifer system in most of the area and by the High Plains aquifer in the southwestern part.

The lower unit of the confining system consists of shale, salt, anhydrite, limlestone, and sandstone of Permian, Pennsylvanian, and Late Mississippian (Chesterian) ages (table 1). The lower unit underlies about 81,900 square miles and occurs throughout the State except in the extreme southeast corner (fig. 1); the unit crops out in eastern and south-central Kansas. The lower unit directly underlies or is in contact with the upper unit of the Western Interior Plains confining system in far western Kansas, the Great Plains aquifer system in part of western and most of central Kansas, glacial deposits in parts of central and eastern Kansas, and alluvial deposits in the major river valleys in eastern Kansas, (fig. 2). The confining system overlies the Western Interior Plains aquifer system in most of the State. In the few isolated areas where the Western Interior Plains aquifer system is absent, the lower unit of the confining system directly overlies the Precambrian basement confining system.

ALTITUDE AND CONFIGURATION OF TOP OF UNITS

Upper Unit

The altitude[1] on the top of the upper unit (Jurassic rocks) of the Western Interior Plains confining system ranges from about 400 feet in northwest Kansas to greater than 3,400 feet above sea level in the southwest corner (fig. 4). From the lowest area in the northwestern part of the State, the altitude on the top of this upper unit increases toward the east and toward the Bear Creek fault to the south. An abrupt change in the surface south of the fault probably results from subsidence or collapse of rocks after dissolution of some of the salt in the underlying Permian rocks (Gutentag and others, 1981). South of the Bear Creek fault, the slope generally is upward to the southwest.

Lower Unit

A comparison of altitudes on the top of the lower unit (Upper Mississippian, Pennsylvaninan, and Permian rocks) indicates two different types of topographic surfaces (fig. 5). Where the unit crops out in eastern Kansas (fig. 1), contours representing the surface are closely spaced and reflect the dendritic pattern of existing drainage. The slope of the eroded surface in the areas is downward to the east and south. Where the lower unit is buried beneath younger rocks in western Kansas, contours are smooth and widely spaced. In this area, altitudes on the top of the lower unit range from about 200 feet in the northwest corner to about 3,400 feet in the southwest corner. From the lowest area, the surface slopes upward to the south and east. The maximum altitude on top of the lower unit where it crops out ranges from 1,500 feet in Harvey, Marion, and McPherson Counties to about 2,000 feet in Clark and Comanche Counties. The comparatively low area between the Bear Creek and Crooked Creek-Fowler faults in southwestern Kansas is the result of dissolution of salt within the Permian rocks and subsequent collapse of the overlying rocks (Gutentag and others, 1981).

[1]Altitude, as used in this report, refers to the distance above sea level.

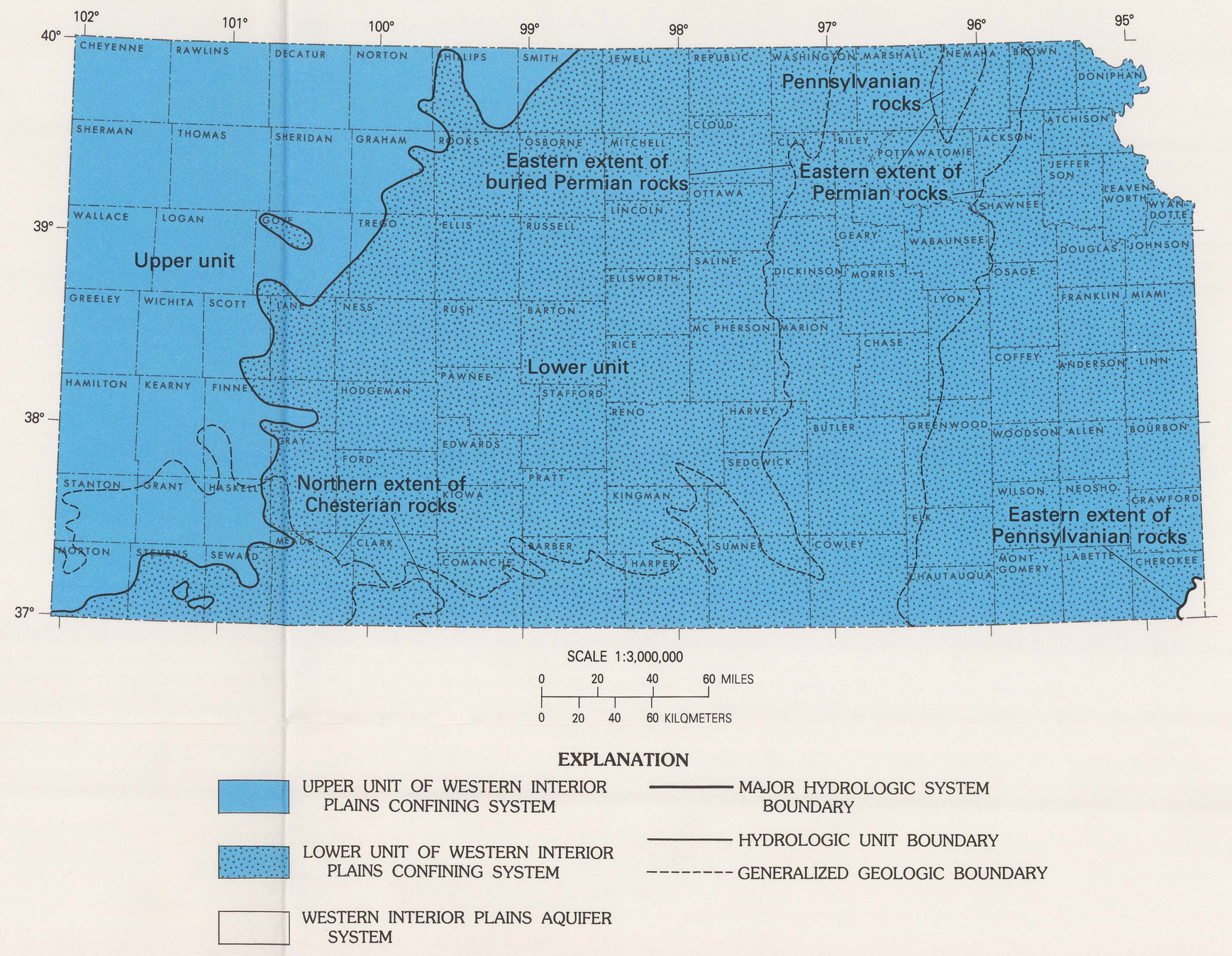

FIGURE 1.—Geohydrologic map showing generalized areal extent of Upper Jurassic rocks in upper unit and Permian, Pennsylvanian, and Upper Mississippian rocks in lower unit of Western Interior Plains confining system.

TABLE 1. Generalized stratigraphic units and related geohydrologic systems.

SYSTEM	Series	Provincial series	Geologic unit	Geohydrologic systems: Subdivisions	Geohydrologic systems: Major systems
QUATERNARY	Holocene		Undifferentiated Quaternary deposits		Alluvial and glacial-drift aquifer system
	Pleistocene				
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	Upper unit	Western Interior Plains confining system
			Undifferentiated Upper Jurassic rocks		
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

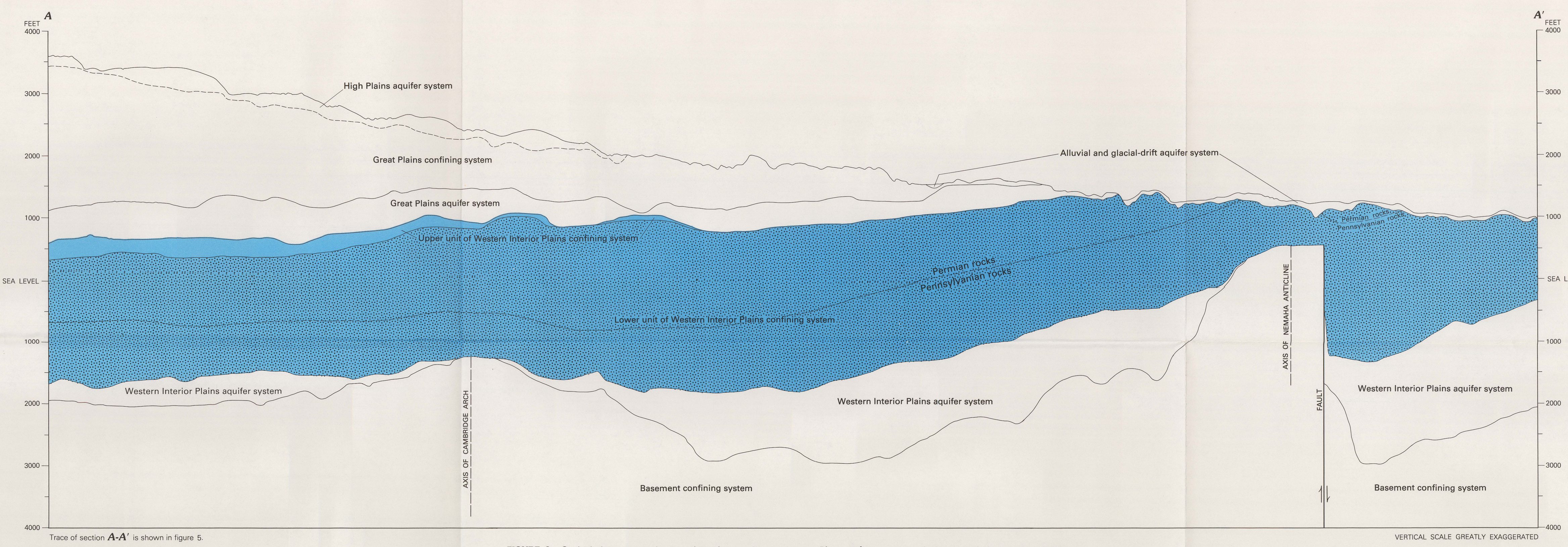

FIGURE 2.—Geohydrologic section showing relation between Western Interior Plains confining system and other geohydrologic systems in Kansas.

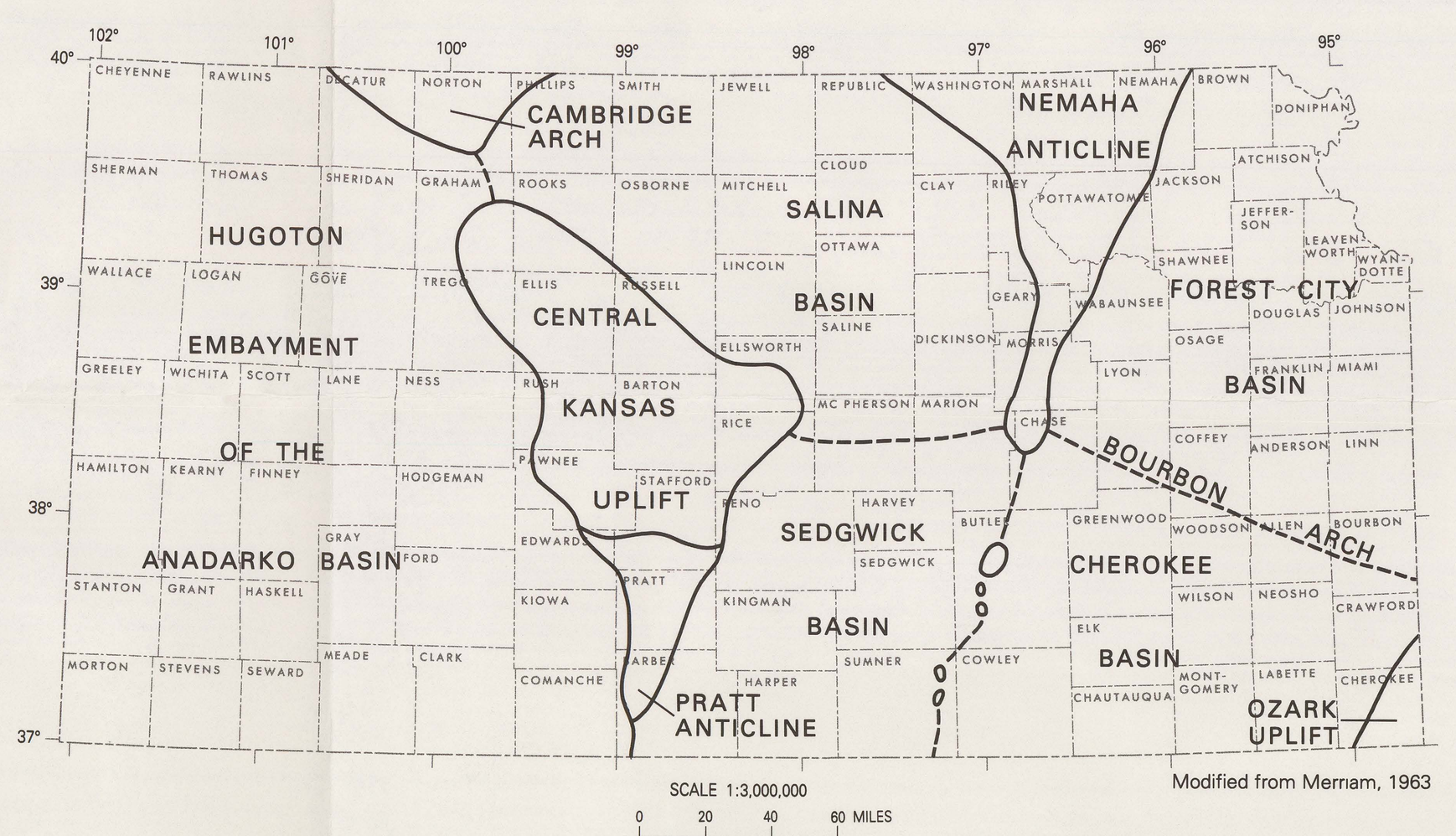

FIGURE 3.—Geohydrologic map showing major pre-Desmoinesian, post-Mississippian structural features and provinces in subsurface.

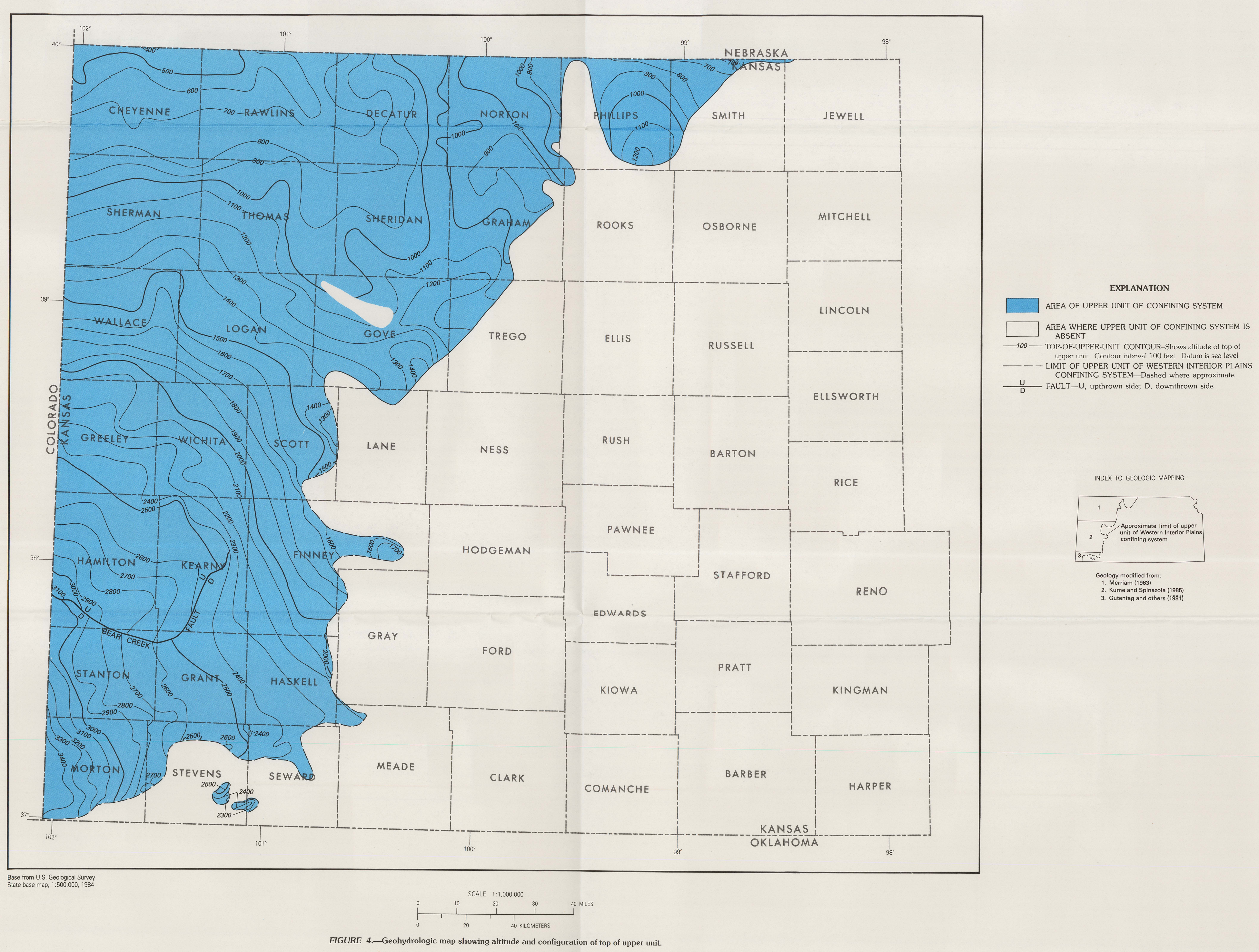

FIGURE 4.—Geohydrologic map showing altitude and configuration of top of upper unit.

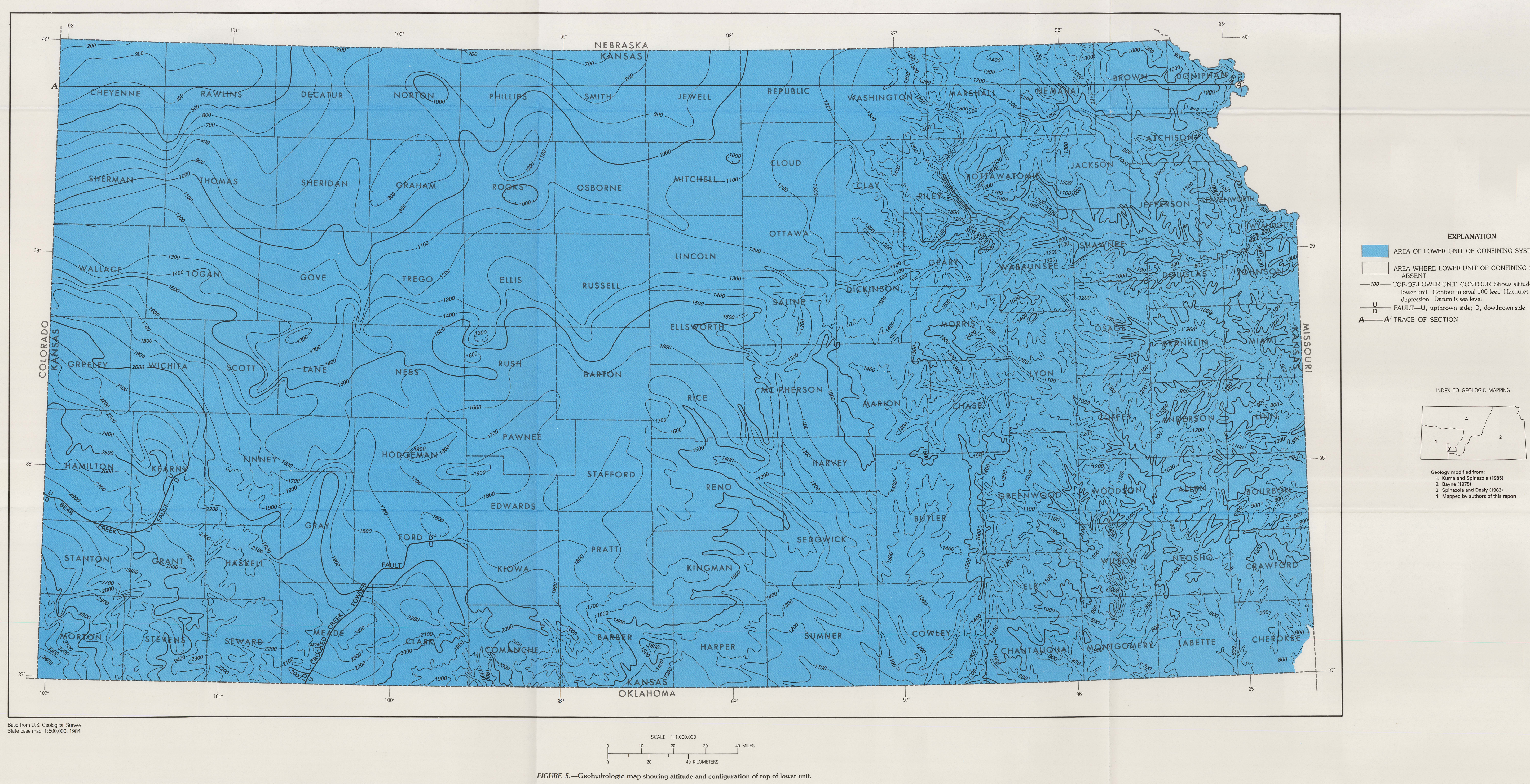

FIGURE 5.—Geohydrologic map showing altitude and configuration of top of lower unit.

INTERIOR—GEOLOGICAL SURVEY, RESTON, VA.—1992

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

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

1992

For sale by U.S. Geological Survey, Map Distribution, Box 25286, Federal Center, Denver, CO 80225