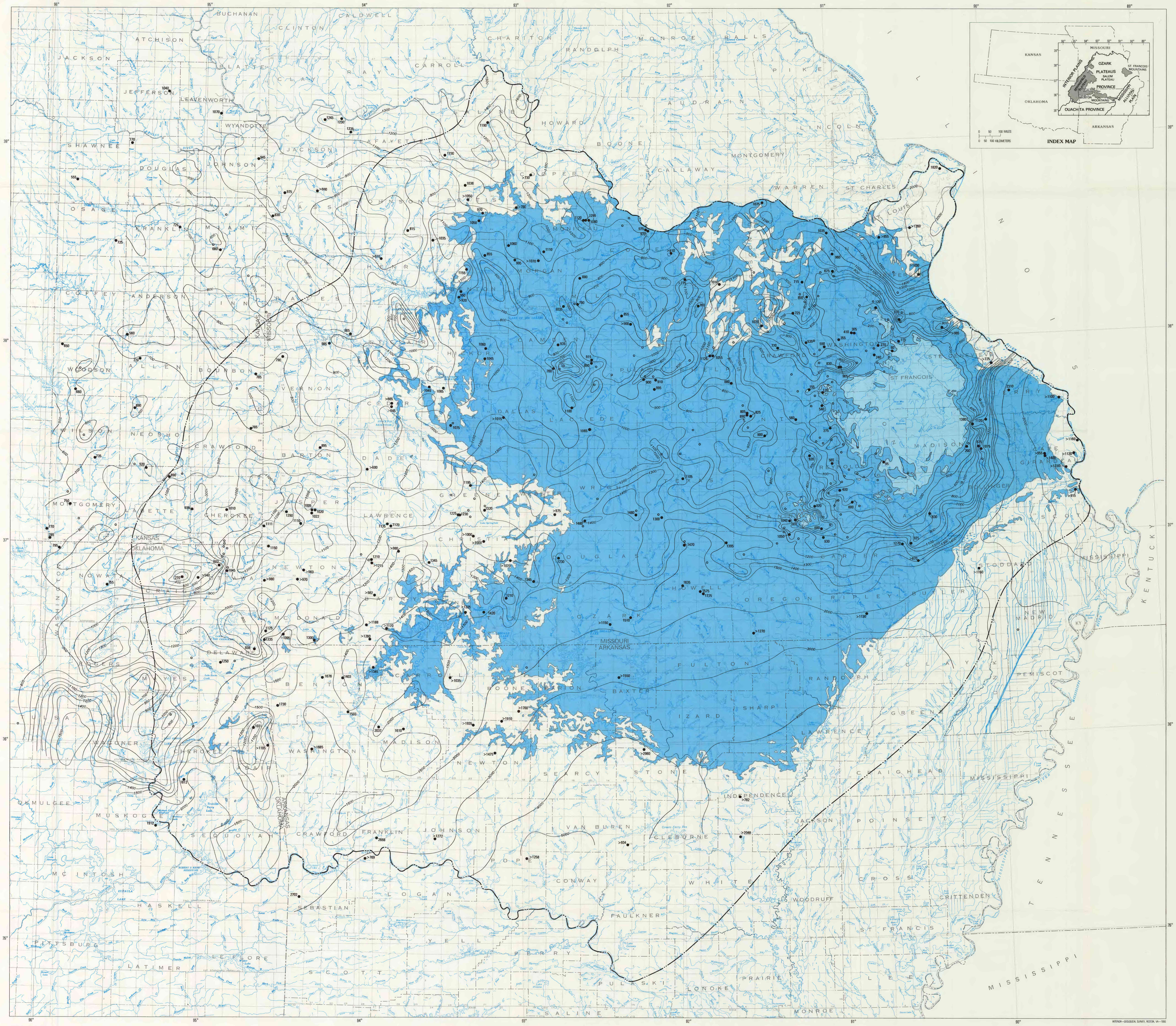
DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

HYDROLOGIC INVESTIGATIONS
ATLAS HA–711–E (SHEET 2 OF 3)




## EXPLANATION

Outcrop area of the Ozark aquifer

Outcrop area of rocks comprising geohydrologic units older than the Ozark aquifer

Contact

Approximate boundary of Ozark Plateaus aquifer system

1200 **Line of equal thickness of Ozark aquifer**[1]—Lines in areas of few control points are consistent with thickness data calculated from digital representations of altitude of top of Ozark aquifer and altitude of top of underlying Lower Ozark confining layer. Interval, in feet, is variable

>1185 **Control data point**[1]—Part of Central Midwest Regional Aquifer-System Analysis data base. Number is thickness, in feet, of Ozark aquifer (>, greater than)

**Auxiliary control data point**[1]

[1]Lines and control points beyond the approximate boundary of the Ozark Plateaus aquifer system are for units stratigraphically equivalent to those that comprise the Ozark Plateaus aquifer system.

## THICKNESS

The Ozark aquifer is the thickest geohydrologic unit in the Ozark Plateaus province. Prior to the uplift of the Ozark dome, the thickness of sediments in the Ozark aquifer apparently increased from less than 1,000 feet in the northwest to more than 3,000 feet in the extreme east and more than 4,000 feet in the extreme south of the Ozark Plateaus province. During the later stages of deposition, the Ozark dome began to rise in southeastern Missouri. Subsequent erosion completely removed the sediments from the immediate vicinity of the St. Francois Mountains, and partially removed the sediments in the eastern part of the province. The Ozark aquifer abruptly thickens to the northeast, east, and south of the St. Francois mountains. The rate of thickening radially from the mountains is much less to the northwest where sediments in the Ozark aquifer were lifted and eroded along an extension of the dome. The aquifer is, on the average, somewhat thinner northwest of the mountains than it is elsewhere, except adjacent to the St. Francois Mountains.

In southeastern Kansas, the aquifer thickness ranges from about 700 to 1,200 feet. The aquifer's thickness changes more abruptly within shorter distances in Oklahoma where Precambrian topographic relief affected the deposition of the oldest rocks comprising the aquifer. Where the aquifer is buried beneath younger rocks, it is apparently thinnest (as indicated by well-log evidence) in Craig County, Oklahoma. The aquifer is only 270 feet thick in eastern Craig County where a prominent Precambrian peak rises above the underlying geohydrologic units and the lowermost geologic units of the Ozark aquifer. The aquifer is missing in Mayes County, Oklahoma, where Precambrian rocks crop out in five small hills.

## HYDRAULIC CHARACTERISTICS AND LITHOLOGY

The characteristic that identifies a geohydrologic unit as an aquifer is its ability to yield usable quantities of water to wells relative to that which is available from surrounding rocks. The properties of the rock that indicate its ability to yield water are its storage coefficient and transmissivity. The storage coefficient of an aquifer is a measure of its water-storage capacity and is directly proportional to the porosity of the rocks comprising the aquifer. The transmissivity ($T = Kb$) of the aquifer, defined as the product of the hydraulic conductivity ($K$) and thickness ($b$) of the aquifer, determines the rate at which water can move through the aquifer. The hydraulic conductivity is a function of several physical properties of the geologic units comprising the aquifer, including lithology (for example, shale is a relatively impermeable material and its presence may decrease the transmissive properties of the aquifer), primary porosity of the rocks, the development of post-depositional solution channels and karst, the presence of fracture and fault systems, and physical properties of the water in the aquifer.

The hydraulic conductivity of the Ozark aquifer has been estimated from specific-capacity data. The areas of greatest hydraulic conductivity are concentrated along an east-trending line passing through the St. Francois Mountains and parallel to the Missouri River, where the hydraulic conductivity may be as great as $10^{-3}$ and $10^{-4}$ foot per second, respectively. The hydraulic conductivity decreases to the south to as small as $10^{-8}$ foot per second near the south boundary of the Ozark Plateaus aquifer system.

The Ozark aquifer consists of a complex sequence of geologic formations range of differing lithologies and varying permeability and porosity. The formations include dolostone, limestone, sandstone, chert, and shale with dolostone as the predominant rock type in most of the Ozark Plateaus province. Dissolution of the carbonate rock along fractures and bedding planes and karst development are the primary cause of permeability in the carbonate rocks. Sandstone, where it exists as massive, well-developed bodies, usually is clean and well sorted and, therefore, tends to be relatively permeable.

The Cambrian rocks represented in the Ozark aquifer are the Potosi and Eminence Dolomites. The Potosi Dolomite probably is, on a regional basis, the most permeable geologic unit within the Ozark aquifer. The massive dolostone contains large quantities of druse (cavities encrusted with finely crystalline quartz). It has a relatively uniform thickness (about 100 to 300 feet) throughout much of the Ozark Plateaus province and an extensive network of karstic solution channels. The overlying Eminence Dolomite is quite similar lithologically, but has a somewhat less well-developed secondary porosity.

Of the Ordovician formations, the lowermost Gasconade Dolomite and overlying Roubidoux Formation are two of the more important water-yielding zones of the Ozark aquifer, especially in the southern and southwestern parts of the Ozark Plateaus province (Melton, 1976, and Lamonds, 1972). The Gasconade primarily is dolostone but contains a major sandstone member that extends from Cooper County, Missouri, south into Boone County, Arkansas. Sandstone is less prevalent in the Gasconade east and west of this approximately linear trend. The Roubidoux Formation is a sandy, cherty dolostone with several distinct sandstone units.

The stratigraphic sequence from the Jefferson City Dolomite to the Smithville Formation consists predominantly of dolostone with minor quantities of shale, chert and sandstone. These formations generally are not as permeable as the older sediments of the Ozark aquifer. Of the Ordovician rocks younger than the Smithville Formation, the St. Peter Sandstone probably is the most permeable and most important water-yielding unit. It is a clean, round-grained, quartzose sandstone with little indication of bedding in the eastern part of the Ozark Plateaus province, but it becomes shaly in the extreme western part of the province and in eastern Kansas. The remainder of the Ordovician formations are dolostone and limestone rocks with minor quantities of shale and sandstone, with the exception of the Sylvan Shale in Oklahoma and the Cason Shale in Arkansas. The latter formations are distinct shale units containing minor quantities of dolomitic sandstone. None of these younger Ordovician rocks are sources of municipal water supplies, but several (Kimmswick Limestone and underlying, Plattin Limestone, and Joachim Dolomite) are penetrated by domestic wells in St. Louis and Jefferson Counties, Missouri, and northern Arkansas.

The limestone and chert formations of Silurian and Devonian age that form the uppermost units of the Ozark aquifer in the north-central and southern part of the Ozark Plateaus province are relatively impermeable in comparison with older formations in the aquifer. The lesser hydraulic conductivity of the upper units reflects a lack of secondary permeability, such as solution-channel development. They generally are not used as sources of water, except locally.

Base from U.S. Geological Survey State base maps, 1:500,000; Arkansas, 1967, Kansas, 1963; Missouri, 1972; Oklahoma, 1972

SCALE 1:750 000

25 0 25 50 75 100 MILES

25 0 25 50 75 100 KILOMETERS

Thickness of Ozark aquifer

# MAJOR GEOHYDROLOGIC UNITS IN AND ADJACENT TO THE OZARK PLATEAUS PROVINCE, MISSOURI, ARKANSAS, KANSAS, AND OKLAHOMA—OZARK AQUIFER

By
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1990