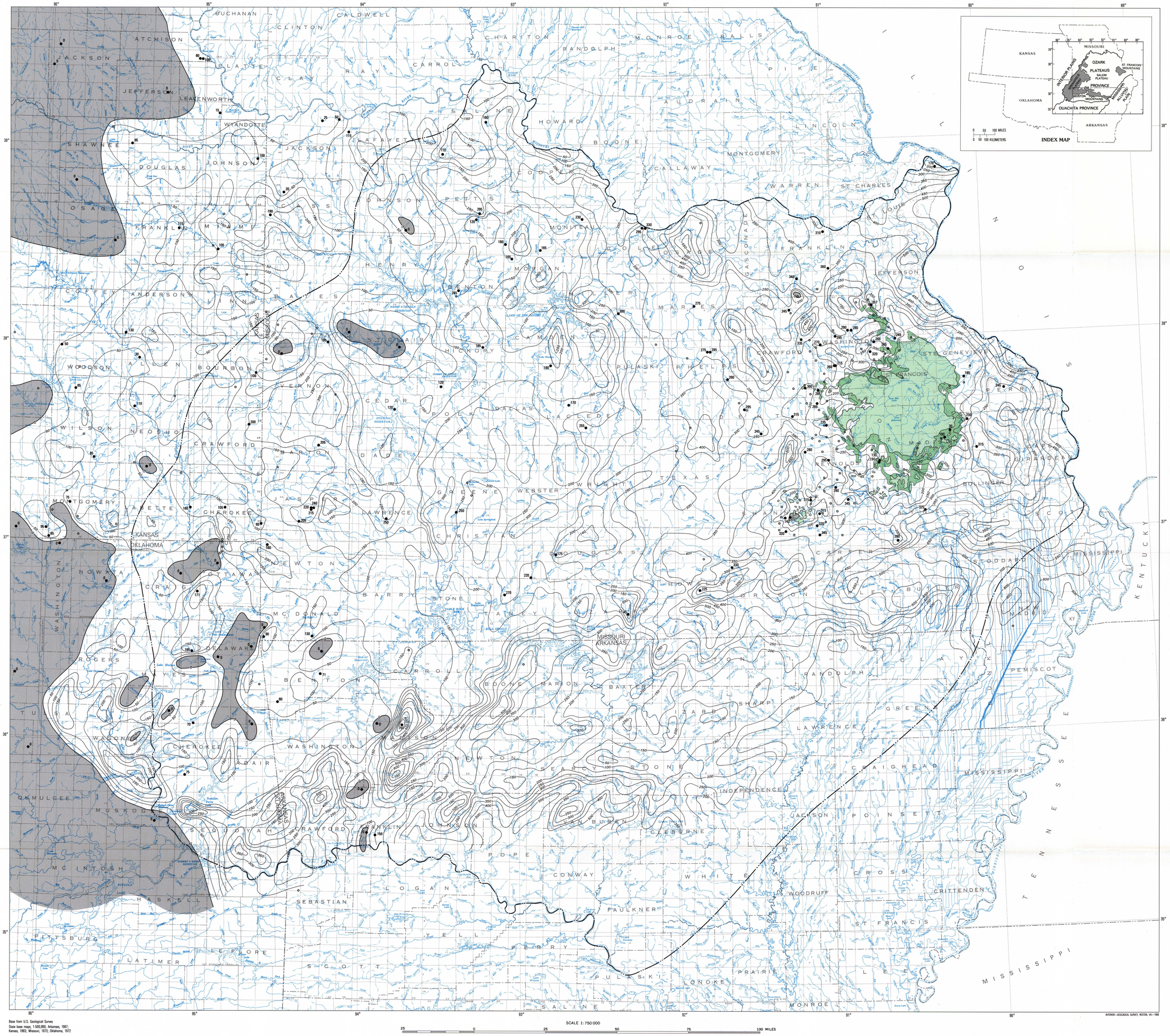
DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

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



Base from U.S. Geological Survey
State base maps, 1:500,000: Arkansas, 1967; Kansas, 1983; Missouri, 1973; Oklahoma, 1972

SCALE 1:750 000

25 0 25 50 75 100 MILES
25 0 25 50 75 100 KILOMETERS

INTERIOR—GEOLOGICAL SURVEY, RESTON, VA—1990

EXPLANATION

- Outcrop area of St. Francois confining unit
- Outcrop area of rocks comprising geohydrologic units older than St. Francois confining unit
- Area where St. Francois confining unit and stratigraphically equivalent units are missing in the subsurface
- Contact
- Approximate boundary of Ozark Plateaus aquifer system
- 50 — Line of equal thickness of St. Francois confining unit[1]—Lines in areas of few control points are consistent with thickness data calculated from digital representations of altitude of top of St. Francois confining unit and altitude of top of underlying St. Francois aquifer. Interval, in feet, is variable.
- 345 Control data point[1]—Part of Central Midwest Regional Aquifer-System Analysis data base. Number is thickness, in feet, of St. Francois confining unit.
- Auxiliary control data point[1]

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

THICKNESS

The thickness of the St. Francois confining unit, as determined from well-log data, ranges from 0 to 730 feet in the Ozark Plateaus province (index map). The maximum thickness occurs in Madison County, Arkansas, and is coincident with a deep depression in the Precambrian surface. The confining unit generally is thicker to the northeast and to the southeast near the Mississippi Alluvial Plain (index map). The confining unit becomes thinner in western Missouri (ranging from about 100 to 300 feet) and stratigraphically equivalent units pinch out a few miles west of the Ozark Plateaus aquifer system in eastern Kansas and northeastern Oklahoma, near the terminus of Late Cambrian seas (Kurtz and others, 1975) and adjacent to Precambrian topographic highs. The semipermeable rock unit thins abruptly at the fringes of the St. Francois Mountains where older rocks have been lifted and truncated by erosion.

The Davis Formation is absent from the St. Francois confining unit at isolated locations in Cass, Saline, and Douglas Counties, Missouri, but is present in the remainder of the province, except where the entire confining unit is missing. The Davis thins to the southwest because lower sediments of the Davis become more clastic and change facies to Reagan Sandstone (Thacker, 1974). The Derby and Doe Run Dolomites are more uniform in thickness and are present throughout the Ozark Plateaus province, except where the units truncate against Precambrian peaks.

GEOHYDROLOGIC PROPERTIES

The St. Francois confining unit retards the flow of ground water between the more permeable Ozark and St. Francois aquifers. Geologic formations that are considered confining units on a regional scale may have more aquifer-like properties locally where lithologic or structural features increase the formations' hydraulic conductivity. Thus the terms aquifer and confining unit, as defined regionally, may not adequately describe the hydraulic properties of a rock group locally. A regional confining unit may locally transmit water laterally at a rate comparable to the overlying and underlying aquifers.

Where the hydraulic conductivity of a confining unit is considerably less than that of the adjacent aquifers, the direction of water movement through the confining unit is nearly vertical (Neuman and Witherspoon, 1969, p. 127) and the rate of flow is proportional to the hydraulic gradient across the unit. The rate of vertical movement of water through a confining unit is determined by its leakage coefficient (L), the ratio of the confining unit's vertical hydraulic conductivity (K') to its thickness (b), or ($L=K'/b$). The vertical hydraulic conductivity is a function of several physical properties of the geologic formations comprising the confining unit. Significant factors that affect the tendency of sedimentary rocks to impede the movement of water include the presence of shale (usually a mostly impermeable material), the rocks' primary permeability, post-depositional development of solution channels, and the presence of fractures and faults. The leakage coefficient is inversely proportional to the thickness of the confining unit; that is, a thicker confining unit is a more effective barrier to ground-water flow.

LITHOLOGY

Of the two mainly carbonate formations, which together form the St. Francois confining unit, the lower part of the Davis Formation generally has a larger shale content. In the Davis Formation, shale usually is more prevalent near the base and carbonate rocks more predominant near the top. Locally, the Davis may contain large quantities of sand and silt. Conglomerates are a common characteristic. The net shale thickness in the Davis is greatest in the northeast part of the Ozark Plateaus province around the St. Francois Mountains. To the southwest, the lower part of the Davis undergoes a facies change to Reagan Sandstone.

The Derby and Doe Run Dolomites generally have a lesser shale content than the Davis Formation; however, in some areas they may contain as much shale and silt as the Davis Formation. The contact between the two conformable units is sometimes obscure and the Derby and Doe Run Dolomites can have similar lithology to the Davis Formation. The Derby and Doe Run Dolomites are regarded as a transition unit, dividing Cambrian sedimentary rocks that contain a large clastic content below from those sedimentary rocks that contain only small quantities of clastic material above.

CONVERSION FACTORS

Multiply inch-pound unit	By	To obtain SI unit
foot	0.3048	meter
mile	1.609	kilometer
square mile	2.590	square kilometer
foot per mile	0.1894	meter per kilometer

Thickness of St. Francois confining unit

MAJOR GEOHYDROLOGIC UNITS IN AND ADJACENT TO THE OZARK PLATEAUS PROVINCE, MISSOURI, ARKANSAS, KANSAS, AND OKLAHOMA—ST. FRANCOIS CONFINING UNIT

By
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1990