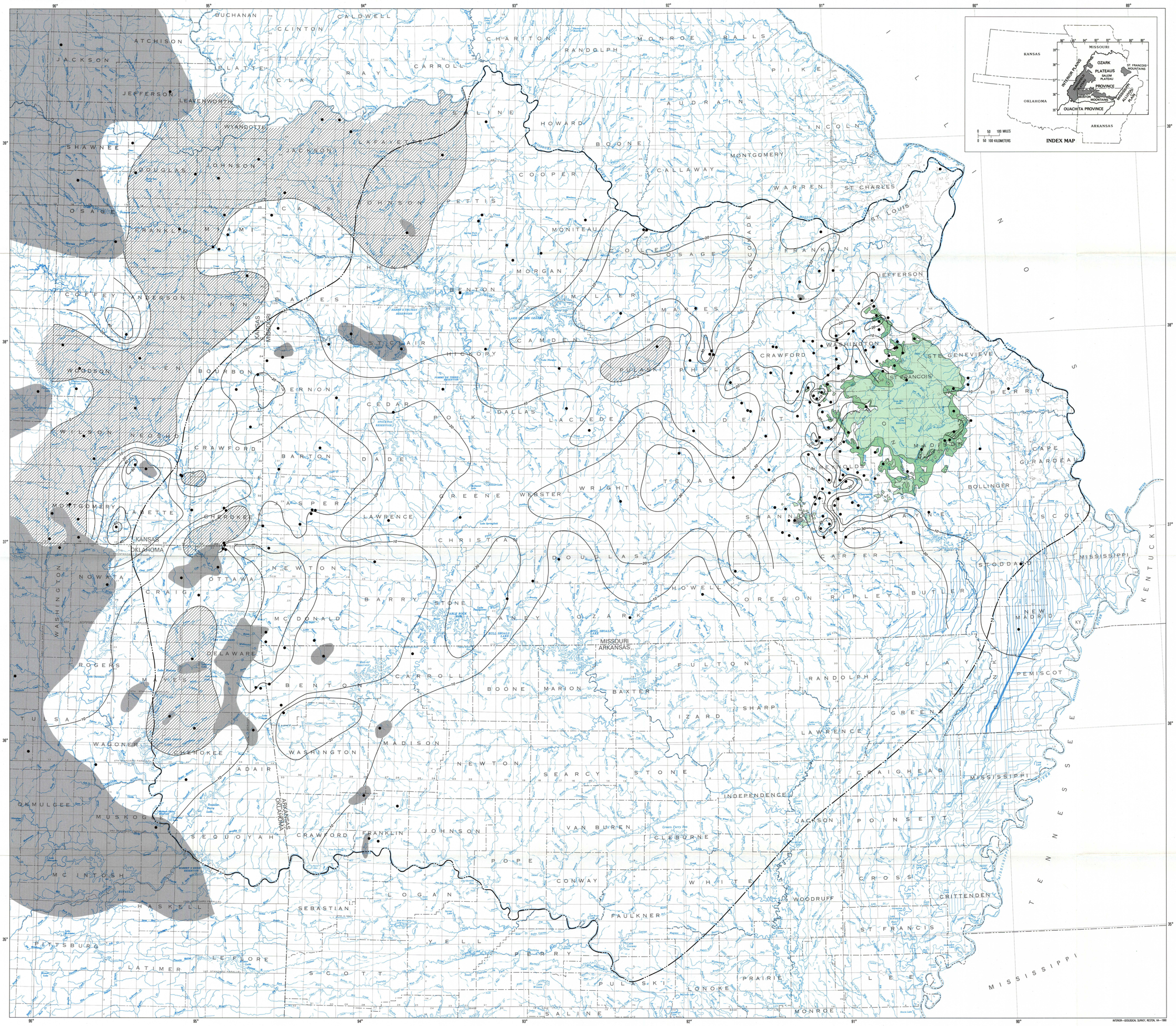

Base from U.S. Geological Survey
State base maps, 1:500,000; Arkansas, 1967; Kansas, 1963; Missouri, 1973; Oklahoma, 1972

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
- 10 — Line of equal percentage shale in St. Francois confining unit[1] — Area of zero percentage shale is hachured. Interval, in percent, is variable
- 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.

SHALE DISTRIBUTION

The shale content of a geohydrologic unit commonly is used as an indicator of its effectiveness as a confining unit. Although this normally is a good measure of confining ability due to the relatively impermeable nature of shale, other factors, such as the presence of fracture zones, may be equally important and counteract the water-impeding ability of the shale. Shale in the St. Francois confining unit may exist as distinct beds, but usually is distributed throughout the limestone and dolostone matrix. Thus the confining ability of this unit is not only a function of its shale content, but also is dependent on the degree of cementation of the carbonate rock and the abundance or lack of post-depositional solution cavities.

The percentage-of-shale content of the St. Francois confining unit ranges from 0 to about 40 percent within the boundary of the Ozark Plateaus aquifer system. The shale content generally is less than 30 percent. Only lithologic logs from five wells show a shale content greater than 40 percent; two are located in Carter County, Missouri, and three are in stratigraphically equivalent units west of the Ozarks in Kansas.

Percentage-of-shale data primarily was derived from results of insoluble-residue analyses on file at the Missouri Division of Geology and Land Survey. In this technique, well-cutting samples in each 5-foot interval of drillhole are placed in hydrochloric acid. The acid dissolves the carbonate matrix and leaves a residue of insoluble clastics and fossil remains. The composition of the residues are characteristic of a particular geologic formation.

Some data for Kansas were obtained from geophysical well-log analyses. The value of the percentage-shale data for estimating the unit's confining ability can be provided by examining the percentage-shale data in conjunction with the thickness of the confining unit. For example, a 20-percent shale content near the St. Francois Mountains, where the confining unit thickness is about 250 feet indicates about 50 feet of net shale thickness; whereas, a 20-percent shale content in Kansas, where the total thickness is about 100 feet, indicates a net thickness of about 20 feet of shale. Generally, the net shale thickness is greater in the east where the confining unit is thicker. No shale is present throughout a large area that parallels the western limit of the St. Francois confining unit adjacent to the west edge of the Ozark Plateaus province.

Generally, significant secondary porosity and permeability have not developed in the limestone and dolostone of the Davis Formation nor in the Derby and Doe Run Dolomites. The relatively fine-grained nature of the dolostones probably ensures that the confining unit is semipermeable, even in regions devoid of shale, although perhaps not as effective a barrier to ground-water flow in these regions as it is in regions with a large net shale content. There is evidence from well cores that the upper part of the Derby and Doe Run Dolomites is quite permeable along a northwest-trending reef zone passing through Wright and Douglas Counties, Missouri. Because the Davis Formation is absent in some of this area, it is possible that the St. Francois and Ozark aquifer are more closely hydrologically linked along the reef zone. Fracture zones are evident in Derby and Doe Run strata and may increase the formation's permeability in localized areas, especially in the vicinity of major faults.

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Percentage of shale in 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