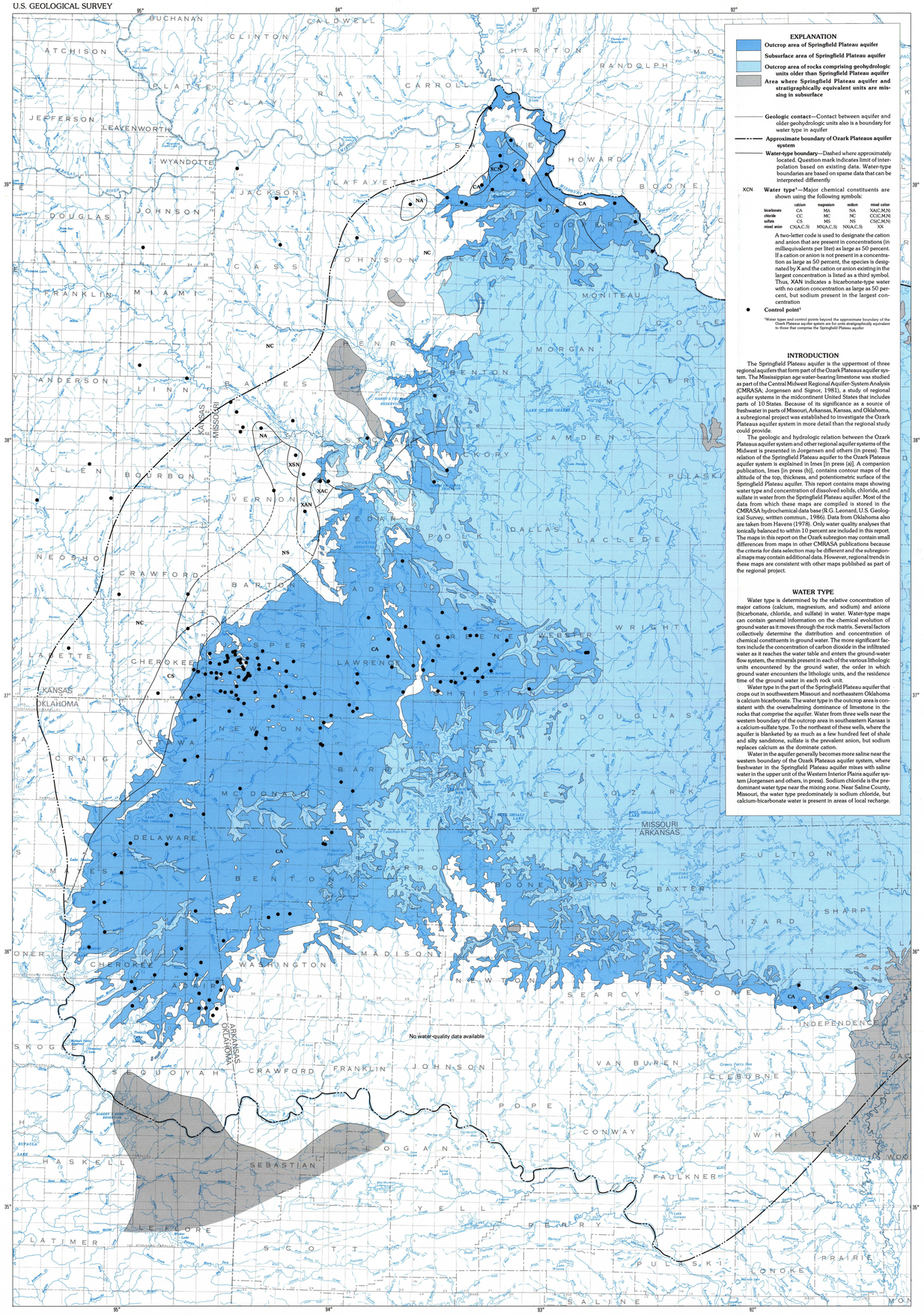
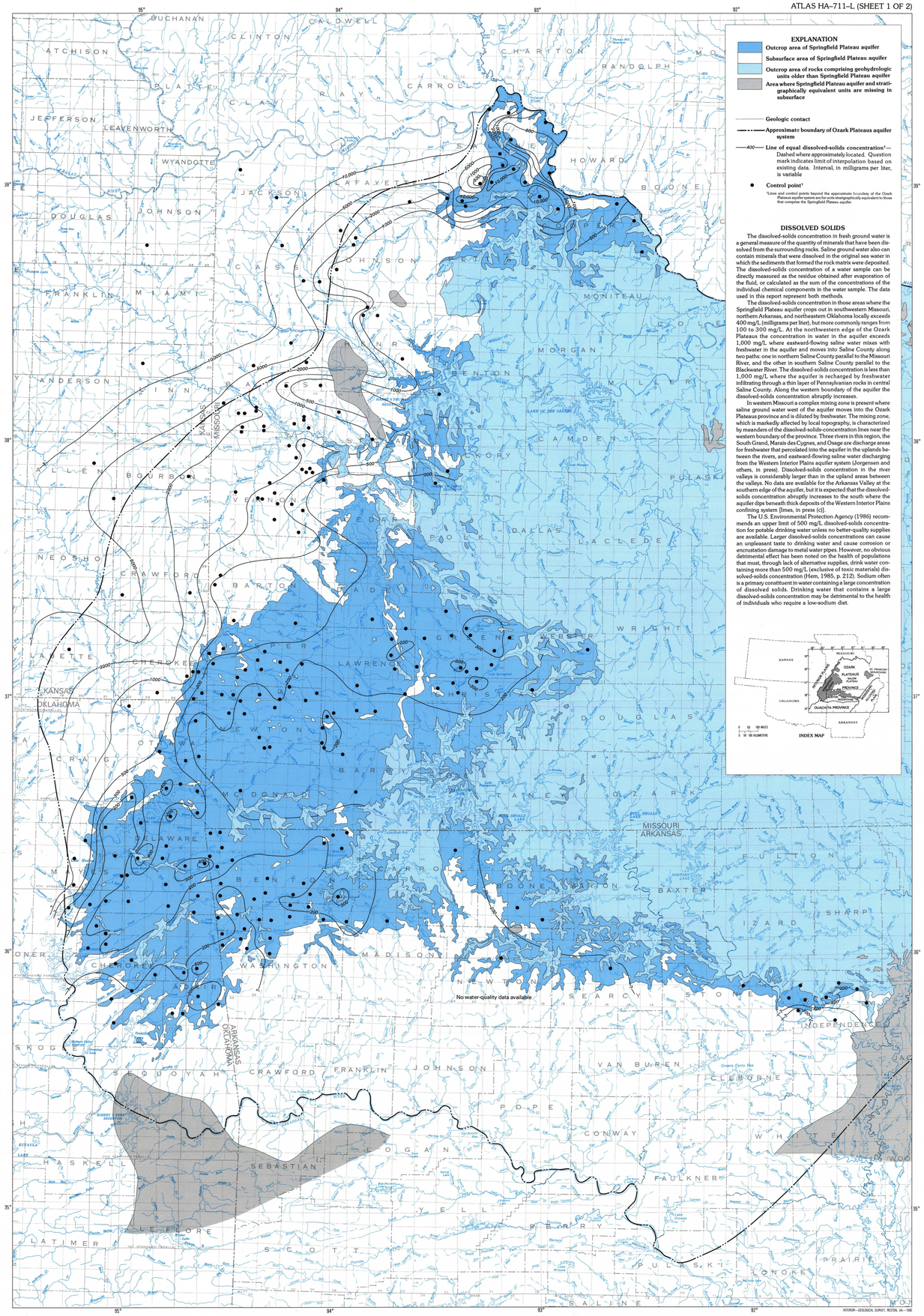


Water type



Dissolved-solids concentration

EXPLANATION

- Outcrop area of Springfield Plateau aquifer
- Subsurface area of Springfield Plateau aquifer
- Outcrop area of rocks comprising geohydrologic units older than Springfield Plateau aquifer
- Area where Springfield Plateau aquifer and stratigraphically equivalent units are missing in subsurface

Geologic contact—Contact between aquifer and older geohydrologic units also is a boundary for water type in aquifer

Approximate boundary of Ozark Plateaus aquifer system

Water-type boundary—Dashed where approximately located. Question mark indicates limit of interpolation based on existing data. Water-type boundaries are based on sparse data that can be interpreted differently

XCN **Water type**[1]—Major chemical constituents are shown using the following symbols:

	calcium	magnesium	sodium	mixed cation
bicarbonate	CA	MA	NA	XA(C,M,N)
chloride	CC	MC	NC	CC(C,M,N)
sulfate	CS	MS	NS	CS(C,M,N)
mixed anion	CX(A,C,S)	MX(A,C,S)	NX(A,C,S)	XX

A two-letter code is used to designate the cation and anion that are present in concentrations (in milliequivalents per liter) as large as 50 percent. If a cation or anion is not present in a concentration as large as 50 percent, the species is designated by X and the cation or anion existing in the largest concentration is listed as a third symbol. Thus, XAN indicates a bicarbonate-type water with no cation concentration as large as 50 percent, but sodium present in the largest concentration

Control point[1]

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

INTRODUCTION

The Springfield Plateau aquifer is the uppermost of three regional aquifers that form part of the Ozark Plateaus aquifer system. The Mississippian age water-bearing limestone was studied as part of the Central Midwest Regional Aquifer-System Analysis (CMRASA; Jorgensen and Signor, 1981), a study of regional aquifer systems in the midcontinent United States that includes parts of 10 States. Because of its significance as a source of freshwater in parts of Missouri, Arkansas, Kansas, and Oklahoma, a subregional project was established to investigate the Ozark Plateaus aquifer system in more detail than the regional study could provide.

The geologic and hydrologic relation between the Ozark Plateaus aquifer system and other regional aquifer systems of the Midwest is presented in Jorgensen and others (in press). The relation of the Springfield Plateau aquifer to the Ozark Plateaus aquifer system is explained in Imes [in press (a)]. A companion publication, Imes [in press (b)], contains contour maps of the altitude of the top, thickness, and potentiometric surface of the Springfield Plateau aquifer. This report contains maps showing water type and concentration of dissolved solids, chloride, and sulfate in water from the Springfield Plateau aquifer. Most of the data from which these maps are compiled is stored in the CMRASA hydrochemical data base (R.G. Leonard, U.S. Geological Survey, written commun., 1986). Data from Oklahoma also are taken from Havens (1978). Only water quality analyses that ionically balanced to within 10 percent are included in this report. The maps in this report on the Ozark subregion may contain small differences from maps in other CMRASA publications because the criteria for data selection may be different and the subregional maps may contain additional data. However, regional trends in these maps are consistent with other maps published as part of the regional project.

WATER TYPE

Water type is determined by the relative concentration of major cations (calcium, magnesium, and sodium) and anions (bicarbonate, chloride, and sulfate) in water. Water-type maps can contain general information on the chemical evolution of ground water as it moves through the rock matrix. Several factors collectively determine the distribution and concentration of chemical constituents in ground water. The more significant factors include the concentration of carbon dioxide in the infiltrated water as it reaches the water table and enters the ground-water flow system, the minerals present in each of the various lithologic units encountered by the ground water, the order in which ground water encounters the lithologic units, and the residence time of the ground water in each rock unit.

Water type in the part of the Springfield Plateau aquifer that crops out in southwestern Missouri and northeastern Oklahoma is calcium bicarbonate. The water type in the outcrop area is consistent with the overwhelming dominance of limestone in the rocks that comprise the aquifer. Water from three wells near the western boundary of the outcrop area in southeastern Kansas is a calcium-sulfate type. To the northeast of these wells, where the aquifer is blanketed by as much as a few hundred feet of shale and silty sandstone, sulfate is the prevalent anion, but sodium replaces calcium as the dominate cation.

Water in the aquifer generally becomes more saline near the western boundary of the Ozark Plateaus aquifer system, where freshwater in the Springfield Plateau aquifer mixes with saline water in the upper unit of the Western Interior Plains aquifer system (Jorgensen and others, in press). Sodium chloride is the predominant water type near the mixing zone. Near Saline County, Missouri, the water type predominately is sodium chloride, but calcium-bicarbonate water is present in areas of local recharge.

EXPLANATION

- Outcrop area of Springfield Plateau aquifer
- Subsurface area of Springfield Plateau aquifer
- Outcrop area of rocks comprising geohydrologic units older than Springfield Plateau aquifer
- Area where Springfield Plateau aquifer and stratigraphically equivalent units are missing in subsurface

Geologic contact

Approximate boundary of Ozark Plateaus aquifer system

400 **Line of equal dissolved-solids concentration**[1]—Dashed where approximately located. Question mark indicates limit of interpolation based on existing data. Interval, in milligrams per liter, is variable

Control 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 Springfield Plateau aquifer

DISSOLVED SOLIDS

The dissolved-solids concentration in fresh ground water is a general measure of the quantity of minerals that have been dissolved from the surrounding rocks. Saline ground water also can contain minerals that were dissolved in the original sea water in which the sediments that formed the rock matrix were deposited. The dissolved-solids concentration of a water sample can be directly measured as the residue obtained after evaporation of the fluid, or calculated as the sum of the concentrations of the individual chemical components in the water sample. The data used in this report represent both methods.

The dissolved-solids concentration in those areas where the Springfield Plateau aquifer crops out in southwestern Missouri, northern Arkansas, and northeastern Oklahoma locally exceeds 400 mg/L (milligrams per liter), but more commonly ranges from 100 to 300 mg/L. At the northwestern edge of the Ozark Plateaus the concentration in water in the aquifer exceeds 1,000 mg/L where eastward-flowing saline water mixes with freshwater in the aquifer and moves into Saline County along two paths: one in northern Saline County parallel to the Missouri River, and the other in southern Saline County parallel to the Blackwater River. The dissolved-solids concentration is less than 1,000 mg/L where the aquifer is recharged by freshwater infiltrating through a thin layer of Pennsylvanian rocks in central Saline County. Along the western boundary of the aquifer the dissolved-solids concentration abruptly increases.

In western Missouri a complex mixing zone is present where saline ground water west of the aquifer moves into the Ozark Plateaus province and is diluted by freshwater. The mixing zone, which is markedly affected by local topography, is characterized by meanders of the dissolved-solids-concentration lines near the western boundary of the province. Three rivers in this region, the South Grand, Marais des Cygnes, and Osage are discharge areas for freshwater that percolated into the aquifer in the uplands between the rivers, and eastward-flowing saline water discharging from the Western Interior Plains aquifer system (Jorgensen and others, in press). Dissolved-solids concentration in the river valleys is considerably larger than in the upland areas between the valleys. No data are available for the Arkansas Valley at the southern edge of the aquifer, but it is expected that the dissolved-solids concentration abruptly increases to the south where the aquifer dips beneath thick deposits of the Western Interior Plains confining system [Imes, in press (c)].

The U.S. Environmental Protection Agency (1986) recommends an upper limit of 500 mg/L dissolved-solids concentration for potable drinking water unless no better-quality supplies are available. Larger dissolved-solids concentrations can cause an unpleasant taste to drinking water and cause corrosion or encrustation damage to metal water pipes. However, no obvious detrimental effect has been noted on the health of populations that must, through lack of alternative supplies, drink water containing more than 500 mg/L (exclusive of toxic materials) dissolved-solids concentration (Hem, 1985, p. 212). Sodium often is a primary constituent in water containing a large concentration of dissolved solids. Drinking water that contains a large dissolved-solids concentration may be detrimental to the health of individuals who require a low-sodium diet.

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

WATER TYPE AND CONCENTRATION OF DISSOLVED SOLIDS, CHLORIDE, AND SULFATE IN WATER FROM THE SPRINGFIELD PLATEAU AQUIFER IN MISSOURI, ARKANSAS, KANSAS, AND OKLAHOMA

By
J.L. Imes and J.V. Davis
1990

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