CHEMICAL AND PHYSICAL PROPERTIES

The areal distribution of dissolved-solids concentration, temperature, primary water type, and pH are shown on maps and discussed in the following sections. The dissolved-solids concentration and temperature are shown to the downdip limit of the aquifer. The abundance of geophysical well logs (Grubb, 1986; Wilson and Hosman, 1988), both onshore and offshore, make it possible to estimate both dissolved-solids concentration and temperature throughout a large area where data from water samples are not available. Primary water type and pH generally are not shown in the deeper part of the Mississippi embayment because of the absence of chemical data.

Dissolved-Solids Concentrations

The concentration of dissolved solids in water from the middle Wilcox aquifer, based on median values of all samples in each 100-square-mile area, ranges from 26 mg/L in the northern part of the Mississippi embayment aquifer system area to 125,500 mg/L in a downdip area in southeastern Texas (table 1). Concentrations larger than 10,000 mg/L are depth-averaged values as described by Pettijohn and others (1988). The trend noted above indicates that the concentration of dissolved solids increases in a downdip direction. The largest increase downdip over the shortest distance occurs near middip for most of the aquifer. About one-third of the aquifer area has concentrations of dissolved solids that are less than 500 mg/L (fig. 5).

The concentration of dissolved solids in ground water from the outcrop and subcrop areas generally ranges from 26 to 500 mg/L. Exceptions are areas in southeastern Arkansas, southwestern Alabama, parts of southern Texas, and the large outcrop area overlying the Sabine uplift where the concentration ranges from 500 to 3,000 mg/L.

From the Sabine uplift eastward to southwestern Alabama and from the outcrop to middip, the concentration of dissolved solids generally ranges from slightly less than 500 to 10,000 mg/L except in southeastern Arkansas where the concentration ranges from 3,000 to 10,000 mg/L. From the Sabine arch eastward to southwestern Alabama and from about middip to the downdip limit of the aquifer, the concentration ranges from 10,000 to about 150,000 mg/L.

From the Sabine uplift westward to the Trinity River and in the area from the outcrop along the updip limit to middip, the concentration of dissolved solids generally ranges from less than 500 to 3,000 mg/L. The smaller concentrations at middip are attributed to the shallow depth of the aquifer in the area adjacent to the Sabine uplift. From the Saline uplift to the Trinity River and from middip to the downdip limit of the aquifer, the concentration increases from 3,000 to about 70,000 mg/L.

From the Trinity River southwestward to the San Marcos arch the concentration of dissolved solids ranges from less than 500 mg/L near the outcrop to about 10,000 mg/L at middip. From middip to the downdip limit of the aquifer the concentration ranges from 10,000 to more than 70,000 mg/L.

From the San Marcos arch southwestward to the Rio Grande the concentration ranges from less than 500 mg/L in updip areas to about 3,000 at middip. It increases to about 70,000 mg/L in downdip areas. Concentrations of dissolved solids that exceed 70,000 mg/L occur in downdip areas in southeastern Texas and southern Louisiana. The increase in concentration of dissolved solids from the updip limit to the downdip limit is attributed to mineral-water interaction such as dissolution of silicates in outcrop areas and to the dissolution of evaporites composing salt domes in the deeper downdip parts of the aquifer (fig. 4).

Temperature

The temperature of water from the middle Wilcox aquifer, based on combined depth-averaged values and the median values of all samples in each 100-square-mile area, ranges from 15 degrees Celsius in the outcrop of the northern part of the Mississippi embayment aquifer system area to 117 degrees Celsius in a downdip area in southeastern Texas (table 1). Temperature in the outcrop along the updip limit of the aquifer is generally less than 20 degrees Celsius in the area extending from the Texas-Arkansas border eastward to southwestern Alabama and ranges from 20 to 30 degrees Celsius in the area extending from the Texas-Arkansas border southwestward to the Rio Grande (fig. 5). Generally the temperature ranges from 15 to 30 degrees Celsius where the concentration of dissolved solids is less than 3,000 mg/L. East of the Sabine arch where the concentration increases to 35,000 mg/L the temperature is about 50 degrees Celsius. In areas where the concentration of dissolved solids increases from 35,000 mg/L to more than 70,000 mg/L, the temperature of the ground water generally ranges from 50 degrees to more than 100 degrees Celsius.

Primary Water Type

The primary water types in the middle Wilcox aquifer, which are based on the most frequently observed type (mode) in each 100-square-mile area, are calcium bicarbonate, sodium bicarbonate, and sodium chloride (fig. 6). Calcium bicarbonate is the primary water type in the outcrop in Missouri, Kentucky, Mississippi, and the southern Texas area southwest of the San Marcos arch. Sodium bicarbonate is the primary water type in the remaining outcrop areas and all areas from outcrop to middip. Sodium chloride is the primary water type in all downdip areas.

pH

The pH of water from the middle Wilcox aquifer, based on median values of all samples in each 100-square-mile area, ranges from 4.8 in the outcrop area of south-central Arkansas to 9.0 in eastern Texas (table 1). The pH generally increases from the outcrop along the updip limit to middip and decreases from middip to the downdip limit of the aquifer (fig. 7).

The pH generally ranges between 6 and 9 in the outcrop area overlying the Sabine uplift and between 5 and 8 in the outcrop area extending from the Mississippi River eastward to southwestern Alabama. The pH generally ranges between 5 and 8 in the outcrop area extending from the Mississippi River westward to the Texas-Arkansas border and between 6 and 8 in the outcrop area extending from the Texas-Arkansas border southwestward to the Rio Grande.

From outcrop to middip the pH ranges from about 6 to 8 in the area extending from the Mississippi River eastward to southwestern Alabama and from about 6 to 7 in the northern part of the Mississippi embayment aquifer system area. From outcrop to middip the pH generally ranges between 7 and 9 in the area extending from the Mississippi River southwestward to the Rio Grande.

From middip to the downdip limit of the data, the pH generally ranges between 7 and 9 in the area extending from the Mississippi River eastward to southwestern Alabama and is about 8 in the area extending from the Mississippi River westward to the Sabine arch. From middip to the downdip limit of the data, the pH generally ranges between 5 and 7 in the area extending from the Sabine arch southwestward to the San Marcos arch and about 6 to 8 between the San Marcos arch and the Rio Grande.

CHEMICAL CONSTITUENTS

The areal distributions of eight constituents in ground water are shown on maps and discussed below. The constituents mapped are the major chemical components in ground water from the Gulf Coastal Plain. Lines of equal concentration of constituents generally are absent in downdip areas of the aquifer in central Louisiana and southern Mississippi due to the absence of data.

Calcium

The concentration of dissolved calcium in water from the middle Wilcox aquifer, based on median values of all samples in each 100-square-mile area, ranges from 0.4 mg/L in central Mississippi to 12,000 mg/L in south-central Arkansas (table 1). The concentration generally decreases from the outcrop to middip and then increases from middip to the downdip limit of the aquifer except in southern Arkansas where the concentration increases from outcrop to middip (fig. 8).

The concentration of dissolved calcium generally ranges from 5 to 10 mg/L in the outcrop area, extending from the Texas-Arkansas border eastward to southwestern Alabama except in northeastern Arkansas and eastern Mississippi where it is about 50 mg/L. The concentration ranges from about 5 to 100 mg/L in the outcrop area that extends from the Texas-Arkansas border southwestward to the Rio Grande and in the outcrop area that overlies the Sabine uplift.

From outcrop to middip the concentration of dissolved calcium ranges from 5 to about 100 mg/L in all of the aquifer area except in southern Arkansas and northern Louisiana where it exceeds 10,000 mg/L. Except for this area in southern Arkansas and northern Louisiana, the concentration of dissolved calcium in the aquifer is generally the smallest near middip.

From middip to the downdip limit of the data the concentration of dissolved calcium ranges from 100 to more than 1,000 mg/L in the area extending from the Sabine arch eastward to southwestern Alabama and from 100 to about 10,000 mg/L in the area extending from the Sabine arch southwestward to the San Marcos arch. From middip to the downdip limit of the data the concentration ranges from 5 to 1,000 mg/L between the San Marcos arch and the Rio Grande.

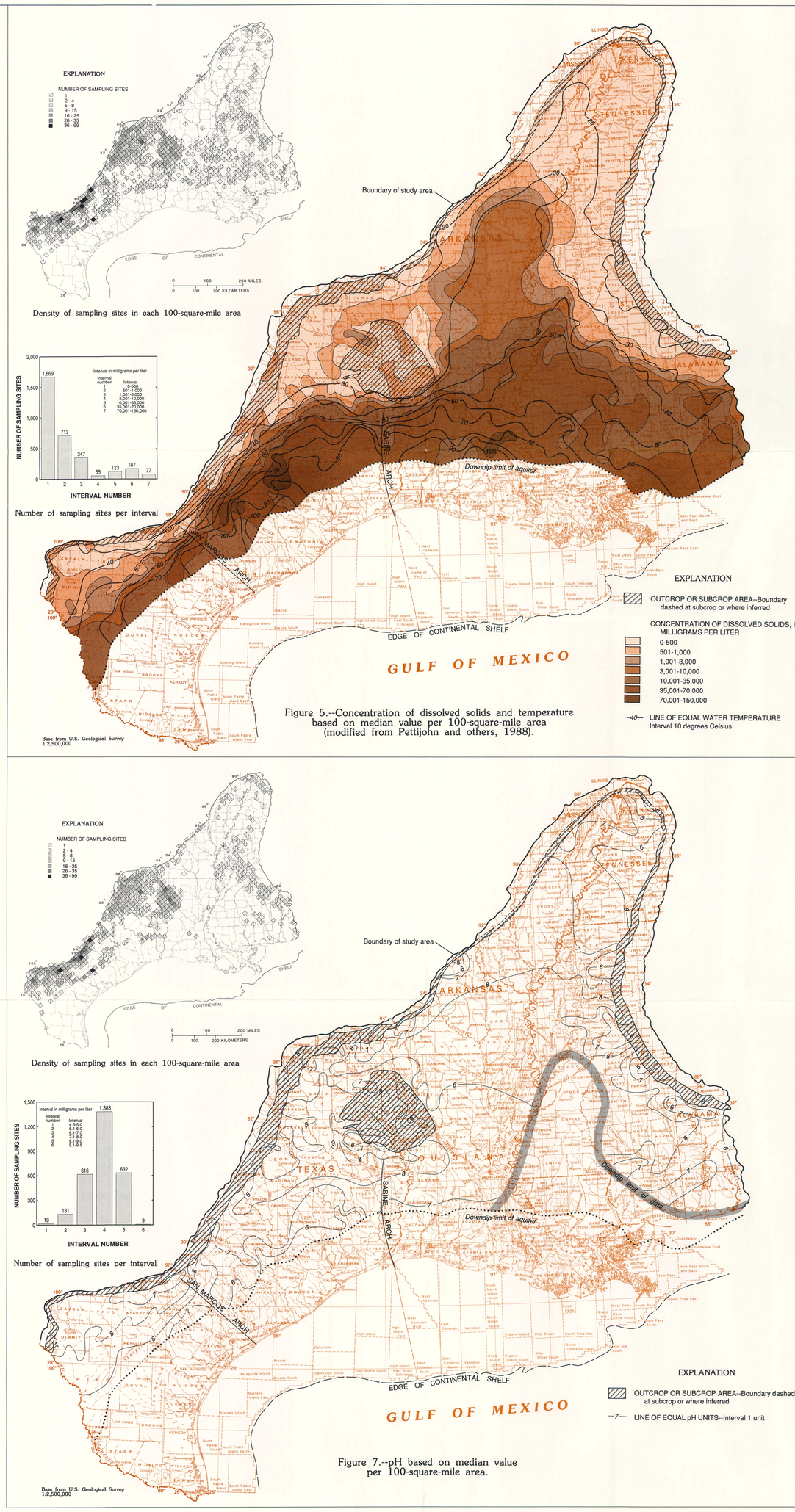

Figure 5.--Concentration of dissolved solids and temperature based on median value per 100-square-mile area (modified from Pettijohn and others, 1988).

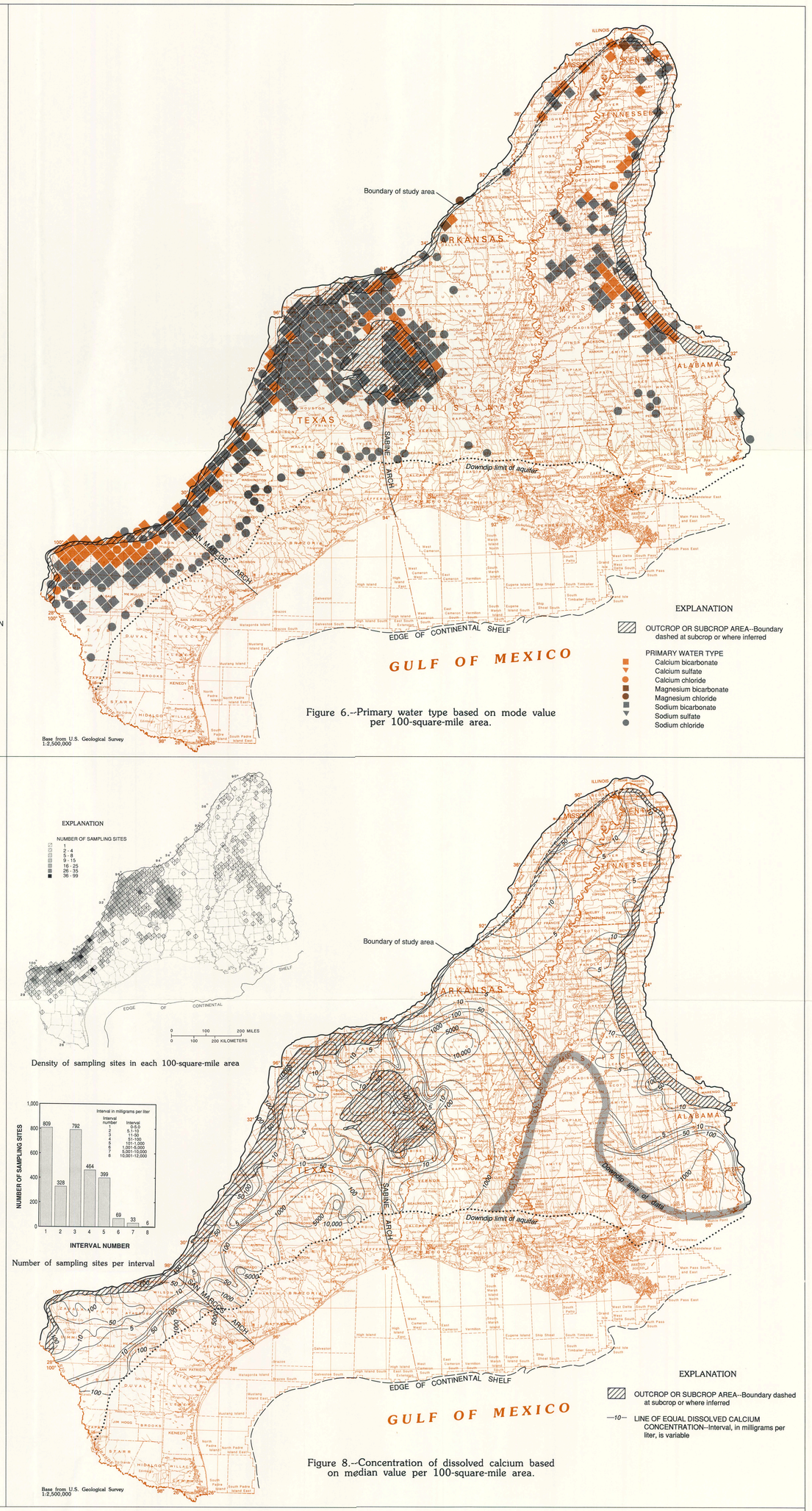

Figure 6.--Primary water type based on mode value per 100-square-mile area.

Figure 7.--pH based on median value per 100-square-mile area.

Figure 8.--Concentration of dissolved calcium based on median value per 100-square-mile area.

SCALE 1:3 500 000
50 0 50 100 150 200 250 MILES
50 0 50 100 150 200 250 KILOMETERS

PROPERTIES AND CHEMICAL CONSTITUENTS IN GROUND WATER FROM THE MIDDLE WILCOX AQUIFER, GULF COAST REGIONAL AQUIFER SYSTEMS, SOUTH-CENTRAL UNITED STATES

by

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