CHEMICAL AND PHYSICAL PROPERTIES

The areal distributions of dissolved-solids concentrations, temperature, primary water type, and pH are shown on maps and discussed in the following sections. The dissolved-solids concentrations and temperature are shown to the downdip limit of permeable zone D. The abundance of geophysical well logs (Grubb, 1986, and Wilson and Hosman, 1988), both onshore and offshore, make it possible to estimate both dissolved-solids concentrations and temperature throughout a large area where data from water samples are not available. Primary water type and pH generally are not shown offshore because of a lack of data.

Dissolved-Solids Concentrations

The concentration of dissolved solids in water from permeable zone D, based on median values of all samples in each 100-square-mile area, ranges from 15 mg/L in the outcrop area to 232,000 mg/L in south-central Louisiana near the coastline (table 1). Concentrations larger than 10,000 mg/L are depth-averaged values as described by Pettijohn and others (1988). The concentration of dissolved solids increases in a downdip direction in all areas of the permeable zone except for a small area along the outcrop in southern Texas (fig. 5). The largest increase, from 500 to 35,000 mg/L, in about 10 mi, occurs in southeastern Louisiana.

Except for a small area west of Mississippi River, the concentration of dissolved solids ranges from 15 to 500 mg/L in the outcrop area extending from midway between the Sabine arch and the San Marcos arch eastward to the western tip of Florida. From midway between the Sabine arch and the San Marcos arch southwestward to the Rio Grande the concentration in the outcrop area ranges from less than 500 mg/L to more than 3,000 mg/L.

From the Mississippi River eastward to the western tip of Florida the concentration of dissolved solids is less than 500 mg/L from outcrop to about middip. At about middip the concentration increases from 500 to 35,000 mg/L in 10 to 65 mi in the downdip direction and continues to increase to more than 70,000 mg/L in southeastern Louisiana. From the Mississippi River westward to midway between the Sabine arch and the San Marcos arch the concentration of dissolved solids generally ranges from less than 500 mg/L at the outcrop to about 35,000 mg/L at middip. An exception is the area west of the Mississippi River where the concentration is 3,000 mg/L at the outcrop. From about middip southward to the coastline the concentration ranges from 35,000 to more than 70,000 mg/L. In one area in southern Louisiana the concentration exceeds 150,000 mg/L.

From midway between the Sabine arch and the San Marcos arch southwestward to the Rio Grande, the concentration generally ranges from 3,000 mg/L near the outcrop to 35,000 mg/L near middip. From near middip to the coastline the concentration ranges from 35,000 to 150,000 mg/L. The concentration in the Continental Shelf area south of the coastline generally ranges from 35,000 to 150,000 mg/L. The increase in concentration of dissolved solids in a downdip direction is attributed to mineral-water interaction and specifically to the dissolution of evaporites comprising salt domes in the deeper parts of permeable zone D (fig. 4).

Temperature

The temperature of water from permeable zone D, based on combined depth-averaged values and the median values of all samples in each 100-square-mile area, ranges from 12 degrees Celsius in the outcrop area to 110 degrees Celsius along the coastline of southeastern Louisiana (table 1). The temperature in the outcrop area is less than 30 degrees Celsius (fig. 5). At middip the temperature ranges from 40 to 50 degrees Celsius. From middip to the downdip limit of permeable zone D the temperature ranges from 70 degrees Celsius in southern Texas and 80 degrees Celsius in southeastern Texas to 110 degrees Celsius in southeastern Louisiana. Generally where the concentration of dissolved solids is less than 3,000 mg/L the temperature is less than 50 degrees Celsius.

Primary Water Type

The primary water types in permeable zone D, which are based on the most frequently observed type (mode) per 100-square-mile area, are calcium bicarbonate, sodium bicarbonate, and sodium chloride (fig. 6). Calcium bicarbonate is the primary water type in the outcrop to middip area between the Sabine and San Marcos arches and sodium bicarbonate is the primary water type in the outcrop to middip area between the Sabine arch and the western tip of Florida. Sodium chloride is the primary water type in the area between the San Marcos arch and the Rio Grande and in all of the area from middip to the downdip limit of the data.

pH

The pH of water from permeable zone D, based on the median values of all samples in each 100-square-mile area, ranges from 4.7 in a downdip area in southern Louisiana to 9.1 in a middip area in southeastern Louisiana (table 1). The pH generally increases from outcrop to middip and then decreases from middip to the downdip limit of the data (fig. 7).

From the Sabine arch eastward to southwestern Alabama the pH generally increases from 5.0 to 7.0 in the outcrop area, from 7.0 to 9.0 in middip areas, and 5.0 to 7.0 in downdip areas. From the Sabine arch southwestward to the San Marcos arch the pH generally ranges from 7.0 at the outcrop to 8.0 at middip and then decreases to 6.0 downdip near the shoreline in southeastern Texas. From the San Marcos arch southwestward to the Rio Grande, the pH generally increases from 7.0 at the outcrop to 8.0 at middip and then decreases to 5.0 downdip near the coastline of southern Texas.

CHEMICAL CONSTITUENTS

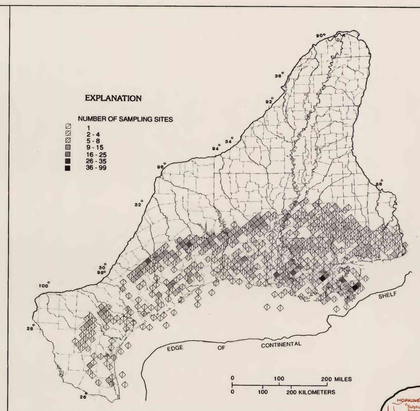
The areal distributions of eight constituents in ground water are shown on maps and discussed below. The constituents mapped are the major chemical components in ground water of the Gulf Coastal Plain. The extent of the areal distribution generally is limited to the onshore areas of permeable zone D because chemical data are not available in the Continental Shelf area except south of the coastline of Louisiana.

Calcium

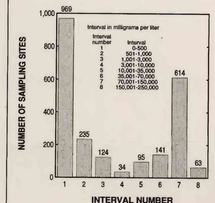
The concentration of dissolved calcium in water from permeable zone D, based on the median values of all samples in each 100-square-mile area, ranges from 0.1 mg/L in the outcrop of southwestern Alabama to 21,600 mg/L near the coastline of southern Texas (table 1). The concentration generally increases from outcrop to middip and then decreases slightly near the downdip limit of data except in the area from about 80 mi east of the San Marcos arch southwestward to the Rio Grande where it increases from outcrop to the downdip limit of data (fig. 8).

The concentration of dissolved calcium in the outcrop area extending from the Sabine arch to the western tip of Florida is generally less than 10 mg/L. From the Sabine arch southwestward to the Rio Grande the concentration in the outcrop area generally ranges from 10 to 100 mg/L.

From about midway between the Sabine arch and the San Marcos arch eastward to southwestern Alabama the concentration of dissolved calcium generally ranges from 10 to 100 mg/L from the outcrop to near middip. In the middip area the concentration increases to 2,000 mg/L. From middip to the downdip limit of data the concentration gradually decreases from 2,000 to 1,000 mg/L in several places. From about midway between the Sabine arch and the San Marcos arch and extending southwestward to the Rio Grande the concentration generally ranges from 100 to 1,000 mg/L from the outcrop to near middip. From middip to the downdip limit of the data the concentration reaches a maximum of about 10,000 mg/L near the coastline of southern Texas. The area east of the Sabine arch with the greatest concentration of dissolved calcium is coincident with the deeper part of the permeable zone.



Density of sampling sites in each 100-square-mile area



Number of sampling sites per interval

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

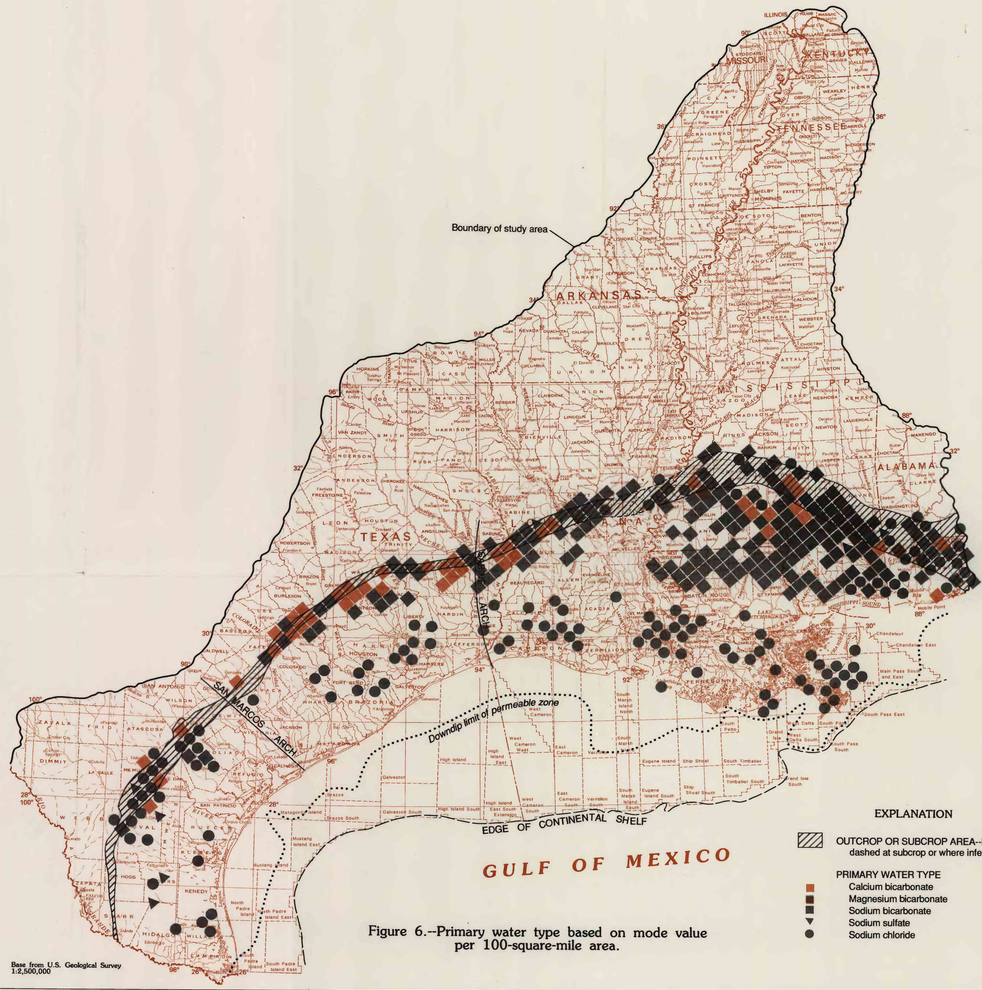
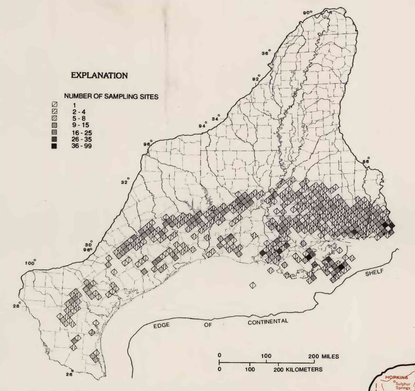
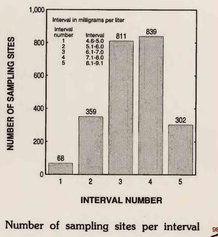


Figure 6.--Primary water type based on mode value per 100-square-mile area.

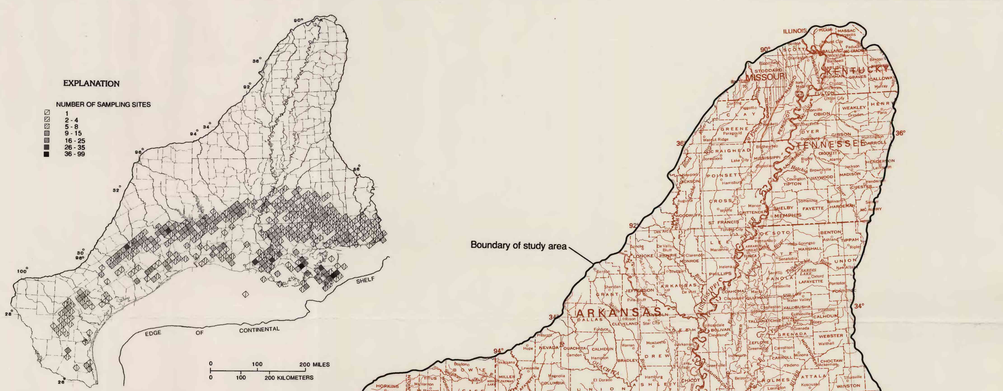


Density of sampling sites in each 100-square-mile area

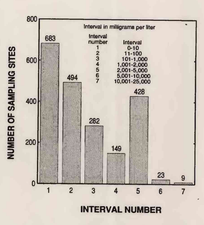


Number of sampling sites per interval

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



Density of sampling sites in each 100-square-mile area



Number of sampling sites per interval

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 PERMEABLE ZONE D (MIDDLE MIOCENE DEPOSITS), COASTAL LOWLANDS AQUIFER SYSTEM, SOUTH-CENTRAL UNITED STATES

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