Sulfate

The concentration of dissolved sulfate in water from the middle Claiborne aquifer, based on the median values of all samples in each 100-square-mile area, ranges from 0.10 mg/L in the outcrop in northern Mississippi to 3,780 mg/L in an area near the downdip limit of the aquifer in southern Texas (table 1). The concentration of dissolved sulfate is generally larger in the area west of the Sabine uplift then it is in the area east of the Sabine uplift (fig. 13).

From the Sabine uplift eastward to the southwestern corner of Alabama the concentration of dissolved sulfate in the middle Claiborne aquifer generally ranges from 1 to 50 mg/L in the outcrop area. It ranges from about 1 to 10 mg/L in the area between the outcrop and the downdip limit of the data except for two small areas, one in southeastern Mississippi where it exceeds 50 mg/L and one adjoining the Sabine uplift in western Louisiana where it exceeds 100 mg/L. From the Sabine uplift southwestward to the San Marcos arch the concentration generally ranges from 10 to more than 100 mg/L in both the outcrop and the area between the outcrop and the downdip limit of the data. From the San Marcos arch southwestward to the Rio Grande the concentration ranges from less than 100 to more than 1,000 mg/L and shows no specific areal trend or pattern.

Chloride

The concentration of dissolved chloride in water from the middle Claiborne aquifer, based on the median values of all samples in each 100-square-mile area, ranges from 1.3 mg/L in western Tennessee to 73,000 mg/L in southeastern Mississippi (table 1). East of the Sabine uplift near the downdip limit of the data the concentration increases very rapidly over short distances in the downdip direction (fig. 14). West of the Sabine uplift the concentration begins to increase near middip and continues to increase to the downdip limit of the data.

From the Sabine uplift eastward to the southwestern corner of Alabama the concentration of dissolved chloride in the middle Claiborne aquifer is near 10 mg/L in the outcrop area and in the northern part of the Mississippi embayment aquifer system area. It increases to 100 mg/L in parts of the middip area and to more than 50,000 mg/L near the downdip limit of the data. From the Sabine uplift southwestward to the San Marcos arch the concentration generally ranges from 10 to 100 mg/L in the outcrop, increases to 500 mg/L near middip and continues to increase to more than 50,000 mg/L at the downdip limit of the data. From the San Marcos arch southwestward to the Rio Grande the concentration ranges from about 100 to more than 1,000 mg/L in the outcrop and middip areas and increases to more than 50,000 mg/L near the downdip limit of the aquifer in southern Texas. Some parts of the area having a large concentration of chloride are generally coincident with the deeper parts of the aquifer or with the location of salt domes (fig. 4).

Silica

The concentration of dissolved silica in water from the middle Claiborne aquifer, based on the median values of all samples in each 100-square-mile area, ranges from 0.2 to 79 mg/L (table 1). There appears be no areal trend in silica concentration east of the Sabine uplift whereas west of the Sabine uplift the concentration generally decreases from the outcrop to the downdip limit of the data (fig. 15).

From the Sabine uplift eastward to the southwestern corner of Alabama the concentration of dissolved silica in the middle Claiborne aquifer generally ranges from 5 to 50 mg/L. However in most of the area the concentration ranges from 10 to 20 mg/L. From the Sabine uplift southwestward to the San Marcos arch the concentration generally ranges from 20 to 50 mg/L in the outcrop area and decreases to less than 20 mg/L in the area from the outcrop to the downdip limit of the data. From the San Marcos arch southwestward to the Rio Grande the concentration is greater than 20 mg/L in much of the outcrop area and in a small area along the downdip limit of the data and less than 20 mg/L through most of the middip area.

IONIC RATIOS

Selected ionic ratios were mapped to show any trends from outcrop to the downdip limit of the data. A characteristic of ionic ratios is that they are not affected by dilution, assuming that all constituents are diluted to the same degree. Consequently, upward leakage of brine into a freshwater aquifer would not mask the signature of the brine. For example, if the brine were sea water trapped in deep sediments, the ionic ratio would remain that of sea water. Whereas if the ionic ratio is different from sea water and the concentrations of sodium and chloride are larger than for sea water, the brine could be the product of dissolution of evaporites composing salt domes.

Mapped ionic ratios can be used to show trends that may indicate processes or mechanisms that have major control on the water chemistry from outcrop to the downdip limit of the data. For example an ionic ratio of magnesium plus calcium to bicarbonate that is equal to 1 in outcrop areas indicates the dissolution of dolomite or calcite. Whereas downdip of the outcrop this same ionic ratio greater than 1 indicates an additional source of calcium or magnesium ions such as would result from the dissolution of gypsum or if the downdip area is in a salt dome basin it could be dissolution of evaporites. However if this same ratio was less than 1 it would indicate an increase in bicarbonate ions due to a process such as the alteration of silicates. The median ion concentration for each 100-square-mile area, expressed as milliequivalents per liter, was used to calculate an ionic ratio.

Magnesium to Calcium

The areal distribution of the milliequivalent ratio of magnesium to calcium (Mg:Ca) in water from the middle Claiborne aquifer shows that the ratio ranges from 0.01 to 4 (table 1). The mapped data shows no apparent areal trend in the Mg:Ca ratio east of the Sabine uplift (fig. 16). Whereas from the Sabine uplift southwestward to the San Marcos arch the Mg:Ca ratio generally increases from the outcrop to the downdip limit of the aquifer. From the San Marcos arch southwestward to the Rio Grande the Mg:Ca ratio increases from outcrop to middip and decreases from middip to the downdip limit of the aquifer.

From the Sabine uplift to the southwestern corner of Alabama the Mg:Ca ratio in water from the middle Claiborne aquifer generally ranges from 0.30 to 2. The areal extent of the ratios ranging from 1 to greater than 2 and the ratios of less than 0.30 is much smaller than the areal extent of the ratios ranging from 0.30 to 1. The areas having Mg:Ca ratios greater than 2 appear to be localized. From the Sabine uplift southwestward to the San Marcos arch the Mg:Ca ratio in the outcrop generally ranges from 0.30 to 0.50 except for the area adjacent to the north side of the Sabine arch where the ratios are greater than 2. From the outcrop to the downdip limit the ratio increases from 0.50 to more than 1. From the San Marcos arch southwestward to the Rio Grande the Mg:Ca ratio ranges from 0.30 to 0.50 in the outcrop area, increases to greater than 2 near middip, and decreases to about 0.30 near the downdip limit of the aquifer except in the area near the San Marco arch.

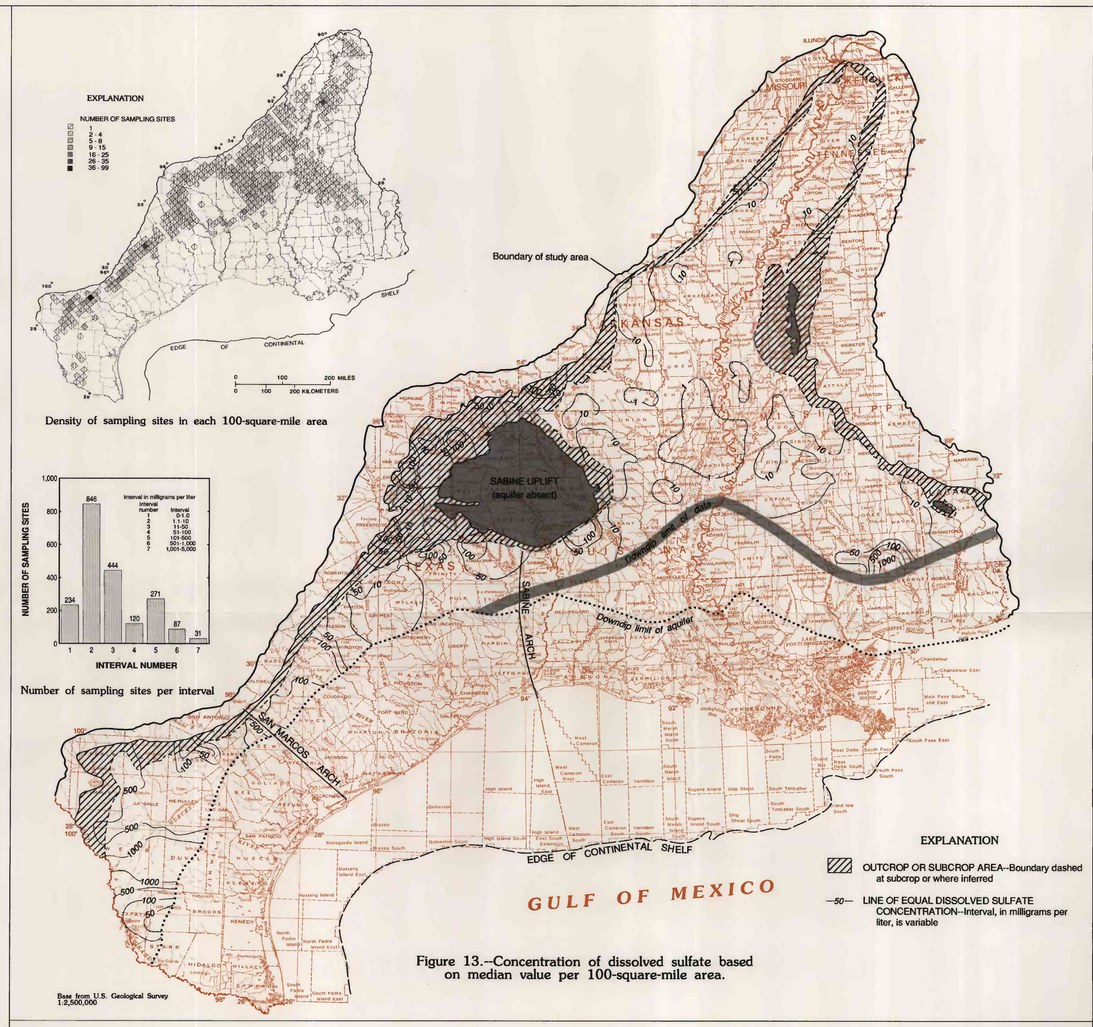

Figure 13.--Concentration of dissolved sulfate based on median value per 100-square-mile area.

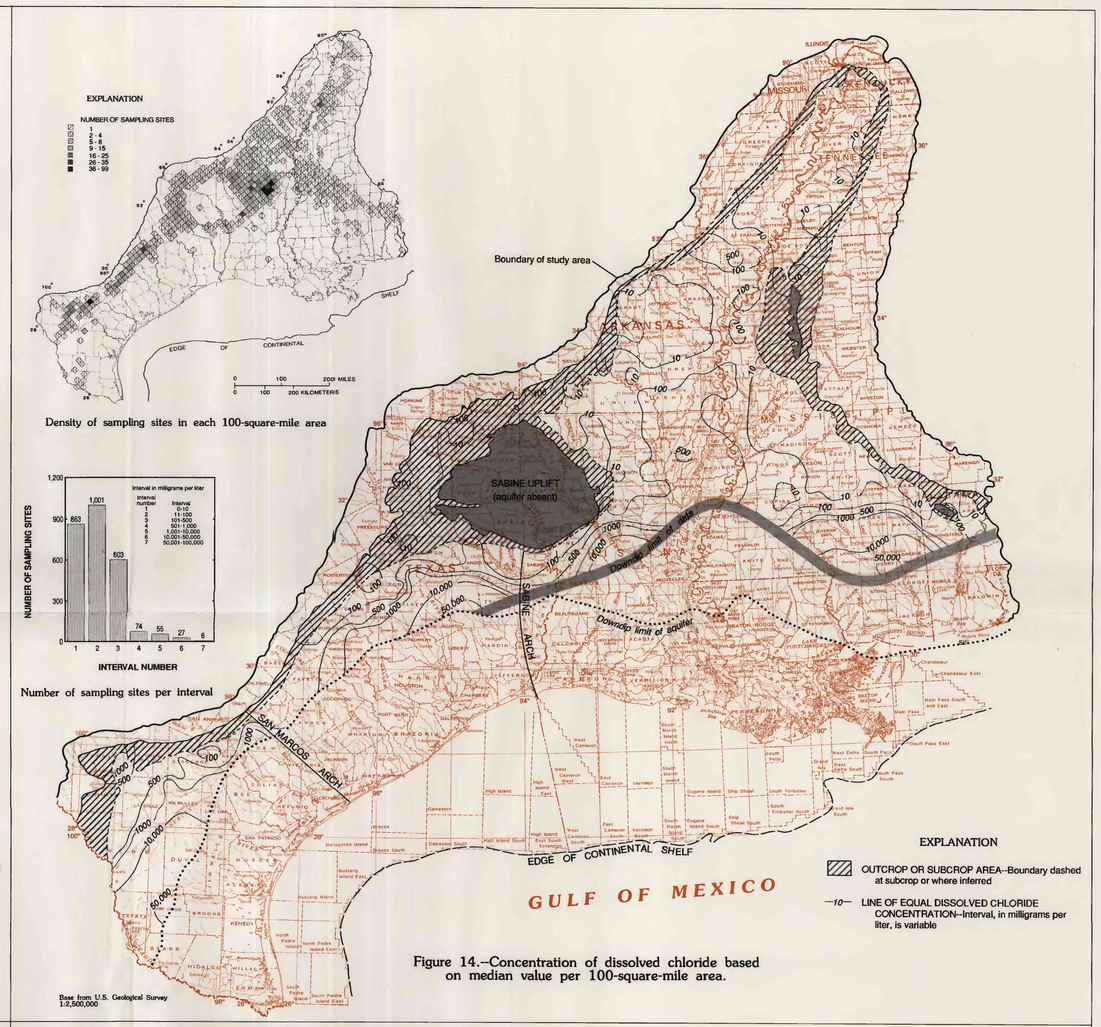

Figure 14.--Concentration of dissolved chloride based on median value per 100-square-mile area.

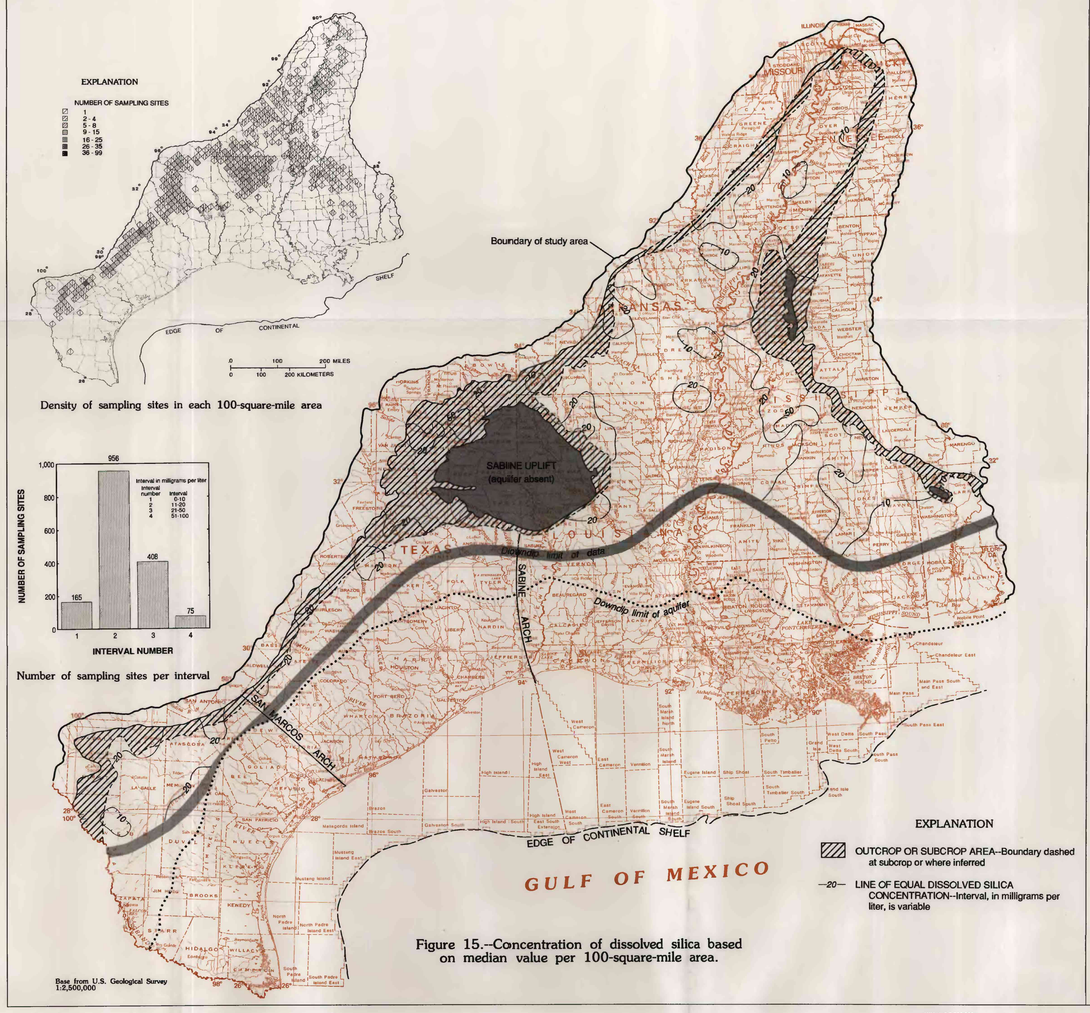

Figure 15.--Concentration of dissolved silica based on median value per 100-square-mile area.

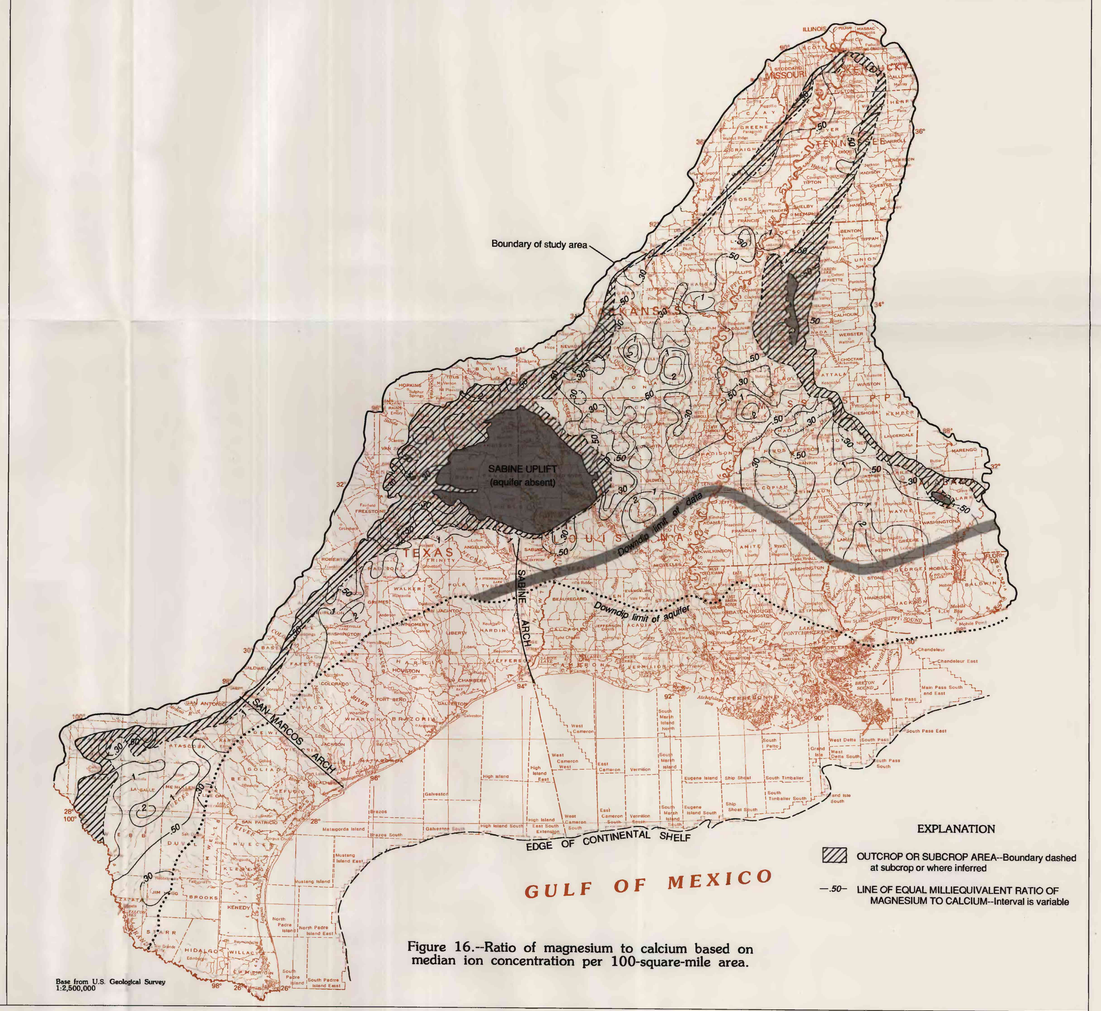

Figure 16.--Ratio of magnesium to calcium based on median ion concentration per 100-square-mile area.

SCALE 1:3 500 000

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

by

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1993