Sulfate

The concentration of dissolved sulfate in water from the lower Claiborne-upper Wilcox aquifer, based on the median values of all samples in each 100-square-mile area, ranges from 0.2 mg/L in areas of western Kentucky and Tennessee and northwestern Mississippi to 590 mg/L near the downdip limit of the data in southern Texas (table 1). Concentrations generally are larger west of the Sabine uplift than east of the Sabine uplift (fig. 13).

From the Sabine uplift eastward to southwestern Alabama the concentration of dissolved sulfate in both the outcrop area and the area between the outcrop and the downdip limit of the data ranges from about 1 to less than 50 mg/L except in an area adjoining the eastern side of the Sabine uplift where the concentration exceeds 50 mg/L. From the Sabine uplift southwestward to the San Marcos arch the concentration ranges from about 10 to more than 100 mg/L in both the outcrop area and the area from the outcrop to the downdip limit of the data. From the San Marcos arch southwestward to the Rio Grande the concentration generally ranges from 50 to 100 mg/L in the outcrop area and from about 10 to 100 mg/L in the area from the outcrop to the downdip limit of the data except in southern Texas where it exceeds 500 mg/L.

Chloride

The concentration of dissolved chloride in water from the lower Claiborne-upper Wilcox aquifer, based on the median values of all samples in each 100-square-mile area, ranges from 0.8 mg/L in western Tennessee and northwestern Mississippi to 52,540 mg/L in east-central Louisiana near the downdip limit of the aquifer (table 1). However, lines of equal concentration were not extended into the area of the upper range of the concentration because it was the only data point in a very large area of the aquifer. The concentration is variable in the outcrop and middip areas but generally increases in a downdip direction near the downdip limit of the data (fig. 14).

From the Sabine uplift eastward to southwestern Alabama the concentration of dissolved chloride ranges from about 5 to less than 50 mg/L in the outcrop and middip areas except in southwestern Arkansas and northwestern Louisiana where the concentration increases to more than 100 mg/L. The concentration along the downdip limit of the data ranges from about 5 mg/L in south-central Mississippi to more than 1,000 mg/L in southwestern Arkansas and northwestern Louisiana. From the Sabine uplift southwestward to the San Marcos arch the concentration ranges from about 10 to 100 mg/L in both the outcrop area and the area from the outcrop to the downdip limit of the data. From the San Marcos arch southwestward to the Rio Grande the concentration ranges from about 50 to more than 100 mg/L in the outcrop area, from less than 50 to about 100 mg/L in most middip areas, and from about 100 to more than 1,000 mg/L near the downdip limit of the data. Part of the area having a large concentration of chloride is generally coincident with the deeper part of the aquifer and with the location of salt domes (fig. 4).

Silica

The concentration of dissolved silica in water from the lower Claiborne-upper Wilcox aquifer, based on the median values of all samples in each 100-square-mile area, ranges from 1.6 mg/L in southeastern Mississippi to 66 mg/L in an outcrop area in southwestern Arkansas (table 1). However the concentration generally ranges from 10 to 20 mg/L in most of the mapped aquifer area (fig. 15). There appears to be no areal trend in silica concentration in the lower Claiborne-upper Wilcox aquifer.

From the Sabine uplift eastward to southwestern Alabama the concentration of dissolved silica ranges from about 10 to 50 mg/L in the outcrop area and generally from 10 to 20 mg/L in middip areas and areas near the downdip limit of the aquifer. From the Sabine uplift southwestward to the San Marcos arch the concentration generally ranges from 10 to 20 mg/L in both the outcrop area and the area from the outcrop to the downmdip limit of the data. From the San Marcos arch southwestward to the Rio Grande the concentration ranges from more than 10 to less than 50 mg/L but averages about 20 mg/L in both the outcrop area and the area between the outcrop and the downdip limit of the data.

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 fresh-water 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 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 the same ionic ratio greater than 1 indicates an additional source of calcium or magnesium ions such as would result from the dissolution of gypsum. 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 lower Claiborne-upper Wilcox aquifer shows that the ratio ranges from 0.04 in southwestern Arkansas to 7.7 in central Mississippi (table 1). The mapped data show no apparent areal trend but rather random variations in the Mg:Ca ratio across the aquifer area (fig. 16). Most of the mapped data show that the ratio is between 0.50 and 1.

From the Sabine uplift eastward to southwestern Alabama the Mg:Ca ratio generally ranges from 0.50 to 1 in both the outcrop area and the area from the outcrop to the downdip limit of the data except in northwestern and central Mississippi where it exceeds 2. From the Sabine uplift southwestward to the Rio Grande the Mg:Ca ratio generally ranges from 0.50 to 1. Areas with ratios less than 0.50 are more prominent in updip areas and areas with ratios greater than 1 are more prominent along the downdip limit of the data.

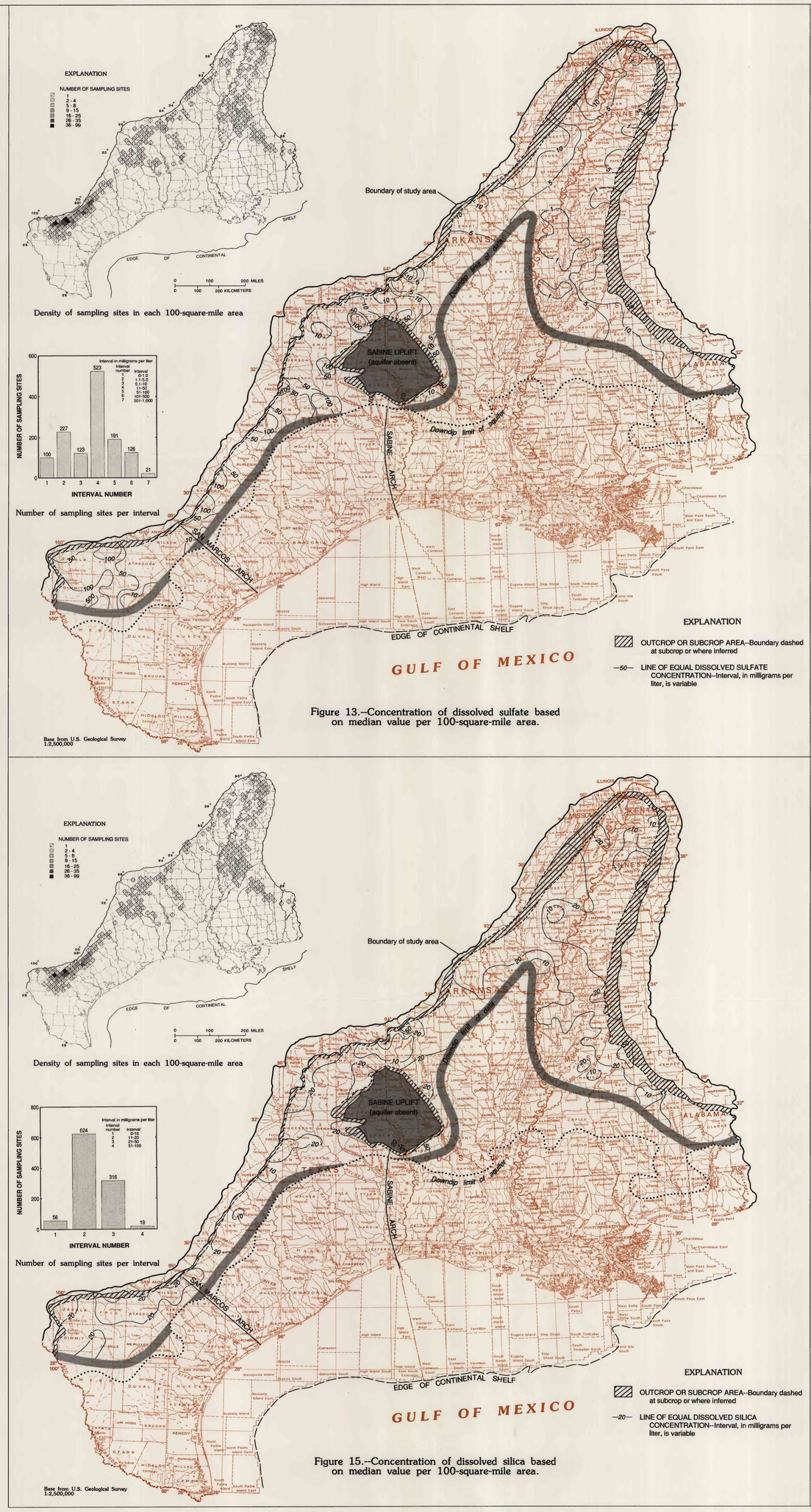

Figure 13.--Concentration of dissolved sulfate based on median value per 100-square-mile area.

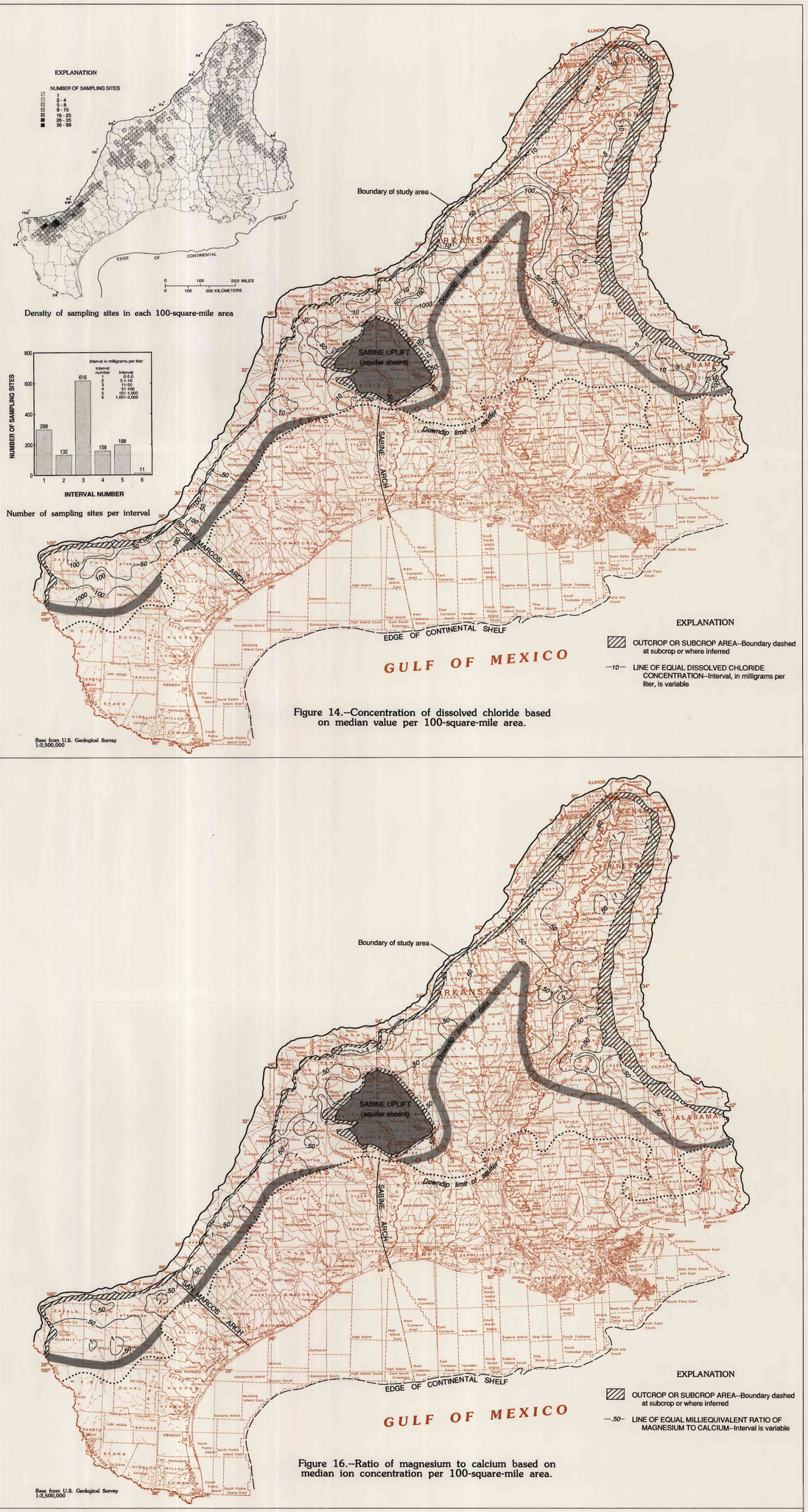

Figure 14.--Concentration of dissolved chloride based on median value per 100-square-mile area.

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.

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

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