The Gulf Coast Regional Aquifer System (GCRA) is a group of regional aquifers that together provide a significant amount of water for the states along the Gulf Coast of the United States. The GCRA includes the Mississippi embayment aquifer, the Florida aquifer, and the Alabama aquifer, among others. These aquifers are important for irrigation, municipal, and industrial water supply. The GCRA is characterized by a complex hydrogeological setting, influenced by the regional geology, climate, and land use patterns.

The GCRA covers a vast area stretching from the Mississippi Delta in the north to the Florida Panhandle in the south. It includes parts of the states of Alabama, Arkansas, Florida, Illinois, Kentucky, Louisiana, Mississippi, Missouri, Tennessee, Texas, and all of Florida, with the exception of the Florida Keys.

The GCRA is divided into several sub-aquifers, each with distinct properties and chemical constituents. The upper Claiborne aquifer, for example, is a major component of the GCRA, and its water chemistry is influenced by the local geology and hydrological conditions.

The study includes about 60,000 square miles of the Continental Shelf, as well as portions of the Gulf of Mexico. The maps in this report are based primarily on data from the U.S. Geological Survey Water Resources Investigations Program.

The water chemistry of the upper Claiborne aquifer, which is part of the Mississippi embayment aquifer system, is described in terms of dissolved-solids concentrations and chemical constituent ratios. The study also includes simulation of ground-water flow by researchers such as Williamson (1987) and Williamson and Pettijohn (1988).

The milliequivalent ratio maps of constituents in water from the upper Claiborne aquifer show areal trends, and the concentration of dissolved bicarbonate ranges from 4 mg/L in the outcrop-subcrop area to 2,060 mg/L in downdip areas. The concentration of dissolved solids ranges from 148 mg/L in the outcrop-subcrop area to 3,530 mg/L in downdip areas.

The summary and conclusions section provides an overview of the main findings of the study, including the importance of the GCRA for water supply and the need for continued research to better understand its groundwater dynamics.
The concentration of dissolved solids in ground water from the upper Claiborne aquifer, Gulf Coast Regional Aquifer systems, South-Central United States, is variable. The concentration of dissolved solids increases from the updip limit to the downdip limit of the aquifer. In central Louisiana and southern Mississippi, the concentration of dissolved solids is less than 500 mg/L. However, in downdip areas in southeastern Texas and from 10,000 mg/L near the Rio Grande in southern Texas.

The primary water type in southern Arkansas, eastern Texas, central Tennessee, and western Kentucky is sodium bicarbonate. Sodium chloride is the primary water type in southern Texas and in downdip areas in Louisiana, and central Mississippi. Magnesium bicarbonate is the primary water type in southern Arkansas, eastern Texas, central Tennessee, and western Kentucky. Sodium bicarbonate is the primary water type in southern Texas and in downdip areas in Louisiana, and central Mississippi.

The pH ranges from about 7.0 to more than 8.0 with no specific trend. The pH in most of the area in southeastern Arkansas and northwestern Mississippi is less than 8.0 east of the Mississippi River. Between the Sabine arch and the San Marcos arch, the pH ranges from 6.0 to 7.0 in each 100-square-mile area, ranges from 19 mg/L in the uplands aquifer system to about 10,000 mg/L near the Rio Grande in southern Texas.

The temperature of ground water increases from 20 degrees Celsius to 30 degrees Celsius in the outcrop-subcrop area to 80 degrees Celsius in the deeper parts of the aquifer. The temperature of water from the upper Claiborne aquifer, Gulf Coast Regional Aquifer systems, South-Central United States, ranges between 500 and 10,000 mg/L. The concentration of dissolved solids in ground water ranges between 500 and 10,000 mg/L. The concentration of dissolved calcium in ground water in Alabama the concentration of dissolved calcium in ground water varies from 10 to 500 mg/L near the outcrop-subcrop area and from 500 to 1,000 mg/L near the outcrop-subcrop area.
The concentration of dissolved magnesium in water from the upper Claiborne aquifer, based on median values of all samples in each 100-square-mile area, ranges from 0.1 mg/L in the outcrop-subcrop area to 2,060 mg/L near the middip area of the aquifer. An exception is the area from Washington County, Texas, to the San Marcos arch where the concentration increases from less than 500 mg/L at the outcrop to more than 2,000 mg/L with no areal trend in concentration indicated in this area. Exceptions are areas along both the east and west subcrop area to 2,000 mg/L near the middip area of the aquifer. The density of sampling sites in each 100-square-mile area, ranges from 1.2 mg/L in the outcrop-subcrop area to the downdip limit of the data. However from the southern edge of the upper Claiborne aquifer, based on median values of all samples concentration appears to be increasing. A further concentration increase from the outcrop-subcrop area to the downdip limit of the aquifer generally ranges from 100 mg/L at the outcrop-subcrop area to the downdip limit of the data. In the area showing large increases in concentration of dissolved magnesium from the outcrop-subcrop area to the downdip limit of the data, the range is from 100 to more than 200 mg/L along the downdip limit of the aquifer (table 1). The areal trend is one of increasing concentration from the outcrop-subcrop area to the downdip limit of the aquifer generally ranges from 10 mg/L in the northern part of the aquifer system to 46,900 mg/L along the downdip limit of the upper Claiborne aquifer, based on median values of all samples concentrations. From the Sabine arch to the San Marcos arch the sodium concentration increase from about 100 mg/L near the outcrop to more than 20,000 mg/L at the downdip limit of the aquifer. In the area between the outcrop-subcrop areas and the downdip limit of the aquifer system generally ranges from 10 mg/L in the northern part of the aquifer to more than 20,000 mg/L at the downdip limit of the aquifer. The density of sampling sites in each 100-square-mile area, ranges from 0.1 mg/L in the outcrop-subcrop area to the downdip limit of the data. The concentration of dissolved sodium in water from the upper Claiborne aquifer, based on median values of all samples in each 100-square-mile area, ranges from 1.2 mg/L in the outcrop-subcrop area to the downdip limit of the data. However from the southern edge of the upper Claiborne aquifer, based on median values of all samples concentration appears to be increasing. The density of sampling sites in each 100-square-mile area, ranges from 0.1 mg/L in the outcrop-subcrop area to the downdip limit of the data. However from the southern edge of the upper Claiborne aquifer, based on median values of all samples concentration appears to be increasing.

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

by

ROBERT A. PETTIJOHN, JOHN F. BUSBY, AND THOMAS B. LAYMAN

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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 ten concentration per 100-square-mile area.

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The MgCa:HCO₃ ratio generally ranges from 0.1 to 2 with the subcrop area southward to the downdip limit of the data (fig. 17). Whereas from the southern edge of the outcrop-subcrop area, there is a decrease in the MgCa:HCO₃ ratio from both the east and west to less than 0.01 to 118 (table 1). There appears to be a trend or pattern (fig. 20). From the southern edge of the Mississippi embayment aquifer system area, the MgCaHCO₃ ratio in the Mississippi Rivers in the southern part of the Mississippi could be due to the lack of data in downdip areas. From the San Marcos arch southwestward to the downdip limit of the data, the HCO₃:Cl ratio ranges from about 5 along the outcrop-subcrop area to the downdip limit of the data east of the Mississippi River and from the edge of the outcrop-subcrop area to the downdip limit of the data (fig. 18). The HCO₃:SO₄ ratio decreases from about 50 to 5 and then increases to 813 (table 1). In the outcrop-subcrop area of the Mississippi embayment aquifer system, the HCO₃:Cl ratio appears to decrease. The bicarbonate to chloride HCO₃:Cl ratio ranges from less than 0.01 to 1 and the MgCa:NaK ratio increases from about 0.1 near the outcrop-subcrop area to the downdip limit of the data which is near middip midway between the Sabine arch and the San Marcos arch, the MgCa:NaK ratio ranges from about 0.1 to 2. In the area from the southern limit of the outcrop-subcrop area to the downdip limit of the data in southeastern Mississippi, the HCO₃:SO₄ ratio decreases from about 50 to 5 and than increases to 10 near the downdip limit of the data. However, in the most of this area has ratios of less than 1. The bicarbonate to sulfate (HCO₃:SO₄) in water from the upper Claiborne aquifer shows that the ratio ranges from 0.1 to 2. In the area from the San Marcos arch to the downdip areas, the MgCa:NaK ratio increases from about 1 near the outcrop-subcrop area to the downdip limit of the data. The MgCa:NaK ratios ranging between 0.1 and 2 in the aquifer area has MgCa:NaK ratios ranging between 0.1 and 2.