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THICKNESS OF THE TERTIARY LIMESTONE AQUIFER SYSTEM, SOUTHEASTERN UNITED STATES

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The Tertiary limestone aquifer system of the southeastern United States is a sequence of carbonate rocks generally referred to as the Floridan aquifer in Florida and the principal artesian aquifer in Georgia, Alabama, and South Carolina. More than 3 billion gallons of water are pumped from the limestone daily making the aquifer system the principal source of municipal, industrial, and agricultural water supply in south Georgia and most of Florida.

The aquifer system includes units of Paleocene to early Miocene age that combine to form a continuous carbonate sequence that is hydraulically connected in varying degrees. Very locally, in the Brunswick, Ga., area, a thin sequence of rocks of Late Cretaceous age is part of the system. In and directly downdip from much of the outcrop area, the system consists of one vertically continuous permeable unit. Farther downdip the aquifer system generally consists of two major permeable zones separated by a less-permeable unit of highly variable hydraulic properties (very leaky to virtually nonleaky). Hydraulic conditions for the system vary from unconfined to confined depending upon whether the argillaceous Miocene and younger rocks that form the upper confining unit have been removed by erosion.

This map shows the thickness of the system, including its upper and lower major permeable zones and, where present, the less-permeable material that separates them. The thickness mapped represents all strata that lie between the top of the highest vertically continuous permeable limestone sequence (top of the aquifer system) and the top of either highly clastic or evaporitic low-permeability rocks that mark the base of the system. The contouring is based primarily on well-point data. The rock and hydrologic units whose collective thickness is mapped here have been delineated on the basis of lithologic and paleontologic data, examined from approximately 40 percent of the control points. The units so established were then extended by means of geophysical logs, available for practically every control point used. In areas of sparse control, the thickness is estimated as the difference between contoured elevations of the top and base of the aquifer system (Miller, 1981a, 1981b). Thicknesses may vary locally from those shown, especially where karst topography has produced considerable relief on the top of the aquifer system. Locally, in South Carolina, only the lower major permeable zone is present. The aquifer system here is less than 100 feet thick.

Different geologic and time-stratigraphic units, in different combinations, make up the aquifer system in different places. Accordingly, this map represents the composite thickness of several such units, the number and ages of which vary from place to place. Because this isopach is essentially a map of rocks of similar permeability characteristics, its interpretation is not exactly the same as the usual isopachous map. Some of the major geologic structures in the mapped area are long-lived; that is, their relative positive or negative expression has remained the same over long periods of geologic time. For this reason, and because movement of these features kept pace with depositional rates, basinal conditions were constant and thick sequences of similar rock types (limestones) were deposited. The major structural features are accordingly expressed on the isopach map as areas of major thickening or thinning of the aquifer system.

The thick sequence of platform carbonates that typify the aquifer system is found generally to the south and east of the 1,000-foot thickness contour. To the north and west of this contour, the thinner sequences of carbonates represent spillover into a foreland basinal area that was also receiving clastics from the north and west. In upbasin areas, complex interbedding and interfingering of clastic and carbonate beds result from this dual source of sediment supply: carbonates from the south and east, and clastics from the north and west.

The areas in southeast Georgia and in the eastern panhandle of Florida where the aquifer system is thick represent the Southeast and Southwest Georgia embayments, respectively. The thin area in north-central peninsular Florida is the result of the aquifer system thinning over the crest and flanks of the positive feature called the Peninsular arch. The thick area in Manatee and Sarasota Counties, Fla., probably represents a part of the South Florida basin. There is no great Gulfward thickening of the aquifer system in south Alabama and western panhandle Florida. In this area, the supply of clastic material was great enough to preclude limestone deposition throughout most of the time the aquifer system was being formed.

In south-central Georgia, a small graben system was active during much of the time of deposition of the aquifer system. Within these grabens, there are more low-permeability carbonate rocks and clastic sediments than in the areas to the northwest and southeast of the fault systems that bound the grabens. The aquifer system is accordingly much thinner within the grabens, as, for example, the area near Moultrie in Colquitt County, Ga., where the system is less than 200 feet thick. Directly to the southeast of this graben system, in the shaded area on the map extending from Grady County northeast to Berrien County, Ga., the aquifer system is very thin, consisting of only a few hundred feet of permeable limestone underlain by low-permeability gypsiferous limestone. Movement along the faults that bound the grabens has juxtaposed the low-permeability material within them opposite permeable rock to either side, thereby restricting the ground-water flow system in the graben area and down the hydraulic gradient from it. Possibly, this restricted flow has not been sufficient to completely remove, by dissolution, the gypsum that fills much of the pore space in the limestones to the southeast (downgradient) of the graben system.

In southwestern Alabama, the north-trending fault that marks the western limit of the aquifer system is the eastern boundary fault of the Mobile graben. The small graben system to the north of it (part of the Gilbertown-Pickens-Pollard fault zone) has created locales favorable for deposition of thick clastic sequences, and has in effect greatly thinned the permeable limestone in this area.

In Echols and Clinch Counties in southeast Georgia, an oval-shaped, northeast-trending, thick pod of limestone may represent the Suwannee Strait, a poorly-understood channel-like feature supposed to separate predominately clastic rocks to the northwest from a predominately carbonate sequence to the southeast. Because the feature mapped here is closed to the northeast and southwest, it is obviously not a channel, but its exact origin is not known.

In south peninsular Florida, local, flat, shelf-like features in Lee County and in northern St. Lucie and southern Indian River Counties, as well as the thin area centering just south of Miami on Florida's east coast are related to features developed on the base of the aquifer system. The shelf-like areas are located where extensive evaporite deposits mark the base of the aquifer. These low-permeability evaporites occur at different altitudes in different wells because they lens and interfinger with carbonate rocks. Regionally, however, they are mapped as if they were one horizon; and their interfingering nature creates the illusion of irregular topography. The thin area near Miami probably represents anhydrite deposition over reef deposits of Late Cretaceous to Paleocene age that were positive areas on the sea floor.

REFERENCES CITED

Miller, J.A., 1981a, Geology and configuration of the top of the Tertiary Limestone Aquifer System, Southeastern United States; U.S. Geological Survey Water-Resources Investigations, Open-File Report 81-1178, 1 sheet.

———1981b, Geology and configuration of the base of the Tertiary Limestone Aquifer System, Southeastern United States; U.S. Geological Survey Water-Resources Investigations, Open-File Report 81-1176, 1 sheet.

EXPLANATION

- Well control point.
- U D — Fault—Vertical or nearly so. U-upthrown side. D-downthrown side.
- 3500 — Line of equal thickness of the limestone aquifer system—Contour interval 100 feet.
- Line showing approximate updip limit of the limestone aquifer system.
- Area where aquifer system is thin due to undissolved intergranular gypsum.

0 10 20 30 40 50 MILES
0 10 20 30 40 50 KILOMETERS