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TOP OF THE FLORIDAN ARTESIAN AQUIFER

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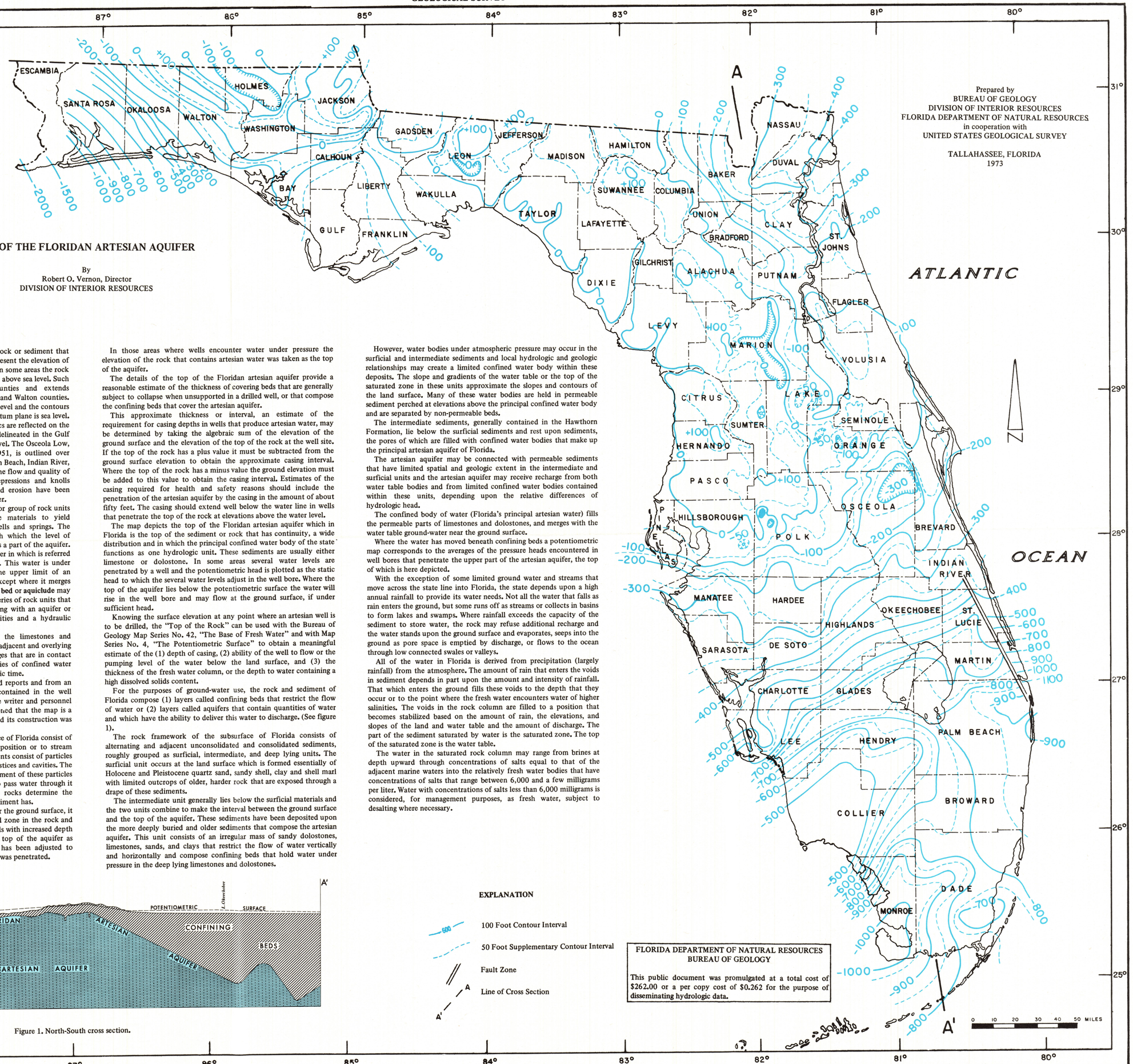

This map depicts the approximate top of the rock or sediment that composes the Floridan aquifer. The contours represent the elevation of the top of this rock in relation to mean sea level. In some areas the rock is exposed at or near the land surface and may lie above sea level. Such an area occurs along the middle Gulf counties and extends northwesterly into Holmes, Jackson, Washington and Walton counties. In other areas of Florida the rock lies below sea level and the contours are shown with a minus prefix. The zero line or datum plane is sea level.

Numerous geologic and structural characteristics are reflected on the map. Among others, the Ocala uplift is clearly delineated in the Gulf Coastal counties where the rock rises above sea level. The Osceola Low, a large fault block described by Vernon in 1951, is outlined over Osceola County, and a coast parallel fault in Palm Beach, Indian River, Martin and St. Lucie counties, partially controls the flow and quality of the artesian water in these counties. Deep depressions and knolls representing karst, early geologic structures and erosion have been recorded in the irregular penetrations of the aquifer.

An **aquifer** is part of a rock unit, a rock unit or group of rock units that contain sufficiently saturated, permeable materials to yield significant sustained quantities of water to wells and springs. The unsaturated part of the permeable unit through which the level of ground water may fluctuate with time, constitutes a part of the aquifer. An **artesian aquifer** is a confined aquifer, the water in which is referred to as the **artesian water or artesian water body**. This water is under pressure greater than atmospheric pressure. The upper limit of an artesian aquifer is the base of a confining bed, except where it merges with water table in recharge areas. The **confining bed** or **aquiclude** may consist of part of a rock unit, a rock unit, or a series of rock units that are stratigraphically adjacent to and/or alternating with an aquifer or aquifers, and which have restrictive permeabilities and a hydraulic conductivity distinctly below that of an aquifer.

The **Floridan artesian aquifer** consists of the limestones and dolostones of Cretaceous to Eocene ages and of adjacent and overlying permeable sediments of Miocene and younger ages that are in contact with the carbonates. The aquifer contains a series of confined water bodies that act as one hydrologic unit over geologic time.

The map represents data taken from published reports and from an intensified study of rock cuttings and cores contained in the well sample library of the Bureau of Geology by the writer and personnel with the Bureau of Geology. The user is cautioned that the map is a gross representation of the top of the aquifer and its construction was made upon widely spaced data points.

The rock materials that compose the subsurface of Florida consist of sediments that are closely related to marine deposition or to stream deposition along the sea's margins. These sediments consist of particles of rock matter that are separated by pores, interstices and cavities. The size, degree, type, shape, connection and arrangement of these particles determine the ability of the rock to hold and to pass water through it or in other terms these characteristics of the rocks determine the amount of **porosity** and **permeability** that the sediment has.

In areas of recharge where the aquifer lies near the ground surface, it is common for wells to penetrate an unsaturated zone in the rock and to encounter decreased static water heads or levels with increased depth of penetration of the rock. In such areas the top of the aquifer as mapped includes the unsaturated zone or it has been adjusted to represent the elevation at which the highest rock was penetrated.

In those areas where wells encounter water under pressure the elevation of the rock that contains artesian water was taken as the top of the aquifer.

The details of the top of the Floridan artesian aquifer provide a reasonable estimate of the thickness of covering beds that are generally subject to collapse when unsupported in a drilled well, or that compose the confining beds that cover the artesian aquifer.

This approximate thickness or interval, an estimate of the requirement for casing depths in wells that produce artesian water, may be determined by taking the algebraic sum of the elevation of the ground surface and the elevation of the top of the rock at the well site. If the top of the rock has a plus value it must be subtracted from the ground surface elevation to obtain the approximate casing interval. Where the top of the rock has a minus value the ground elevation must be added to this value to obtain the casing interval. Estimates of the casing required for health and safety reasons should include the penetration of the artesian aquifer by the casing in the amount of about fifty feet. The casing should extend well below the water line in wells that penetrate the top of the rock at elevations above the water level.

The map depicts the top of the Floridan artesian aquifer which in Florida is the top of the sediment or rock that has continuity, a wide distribution and in which the principal confined water body of the state functions as one hydrologic unit. These sediments are usually either limestone or dolostone. In some areas several water levels are penetrated by a well and the potentiometric head is plotted as the static head to which the several water levels adjust in the well bore. Where the top of the aquifer lies below the potentiometric surface the water will rise in the well bore and may flow at the ground surface, if under sufficient head.

Knowing the surface elevation at any point where an artesian well is to be drilled, the "Top of the Rock" can be used with the Bureau of Geology Map Series No. 42, "The Base of Fresh Water" and with Map Series No. 4, "The Potentiometric Surface" to obtain a meaningful estimate of the (1) depth of casing, (2) ability of the well to flow or the pumping level of the water below the land surface, and (3) the thickness of the fresh water column, or the depth to water containing a high dissolved solids content.

For the purposes of ground-water use, the rock and sediment of Florida compose (1) layers called confining beds that restrict the flow of water or (2) layers called aquifers that contain quantities of water and which have the ability to deliver this water to discharge. (See figure 1).

The rock framework of the subsurface of Florida consists of alternating and adjacent unconsolidated and consolidated sediments, roughly grouped as surficial, intermediate, and deep lying units. The surficial unit occurs at the land surface which is formed essentially of Holocene and Pleistocene quartz sand, sandy shell, clay and shell marl with limited outcrops of older, harder rock that are exposed through a drape of these sediments.

The intermediate unit generally lies below the surficial materials and the two units combine to make the interval between the ground surface and the top of the aquifer. These sediments have been deposited upon the more deeply buried and older sediments that compose the artesian aquifer. This unit consists of an irregular mass of sandy dolostones, limestones, sands, and clays that restrict the flow of water vertically and horizontally and compose confining beds that hold water under pressure in the deep lying limestones and dolostones.

Figure 1. North-South cross section.

However, water bodies under atmospheric pressure may occur in the surficial and intermediate sediments and local hydrologic and geologic relationships may create a limited confined water body within these deposits. The slope and gradients of the water table or the top of the saturated zone in these units approximate the slopes and contours of the land surface. Many of these water bodies are held in permeable sediment perched at elevations above the principal confined water body and are separated by non-permeable beds.

The intermediate sediments, generally contained in the Hawthorn Formation, lie below the surficial sediments and rest upon sediments, the pores of which are filled with confined water bodies that make up the principal artesian aquifer of Florida.

The artesian aquifer may be connected with permeable sediments that have limited spatial and geologic extent in the intermediate and surficial units and the artesian aquifer may receive recharge from both water table bodies and from limited confined water bodies contained within these units, depending upon the relative differences of hydrologic head.

The confined body of water (Florida's principal artesian water) fills the permeable parts of limestones and dolostones, and merges with the water table ground-water near the ground surface.

Where the water has moved beneath confining beds a potentiometric map corresponds to the averages of the pressure heads encountered in well bores that penetrate the upper part of the artesian aquifer, the top of which is here depicted.

With the exception of some limited ground water and streams that move across the state line into Florida, the state depends upon a high annual rainfall to provide its water needs. Not all the water that falls as rain enters the ground, but some runs off as streams or collects in basins to form lakes and swamps. Where rainfall exceeds the capacity of the sediment to store water, the rock may refuse additional recharge and the water stands upon the ground surface and evaporates, seeps into the ground as pore space is emptied by discharge, or flows to the ocean through low connected swales or valleys.

All of the water in Florida is derived from precipitation (largely rainfall) from the atmosphere. The amount of rain that enters the voids in sediment depends in part upon the amount and intensity of rainfall. That which enters the ground fills these voids to the depth that they occur or to the point where the fresh water encounters water of higher salinities. The voids in the rock column are filled to a position that becomes stabilized based on the amount of rain, the elevations, and slopes of the land and water table and the amount of discharge. The part of the sediment saturated by water is the saturated zone. The top of the saturated zone is the water table.

The water in the saturated rock column may range from brines at depth upward through concentrations of salts equal to that of the adjacent marine waters into the relatively fresh water bodies that have concentrations of salts that range between 6,000 and a few milligrams per liter. Water with concentrations of salts less than 6,000 milligrams is considered, for management purposes, as fresh water, subject to desalting where necessary.

EXPLANATION

600 — 100 Foot Contour Interval

50 Foot Supplementary Contour Interval

Fault Zone

A — A' Line of Cross Section

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