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RESISTIVITY INVESTIGATION OF THE COASTAL RIDGE AQUIFER HYDROSTRATIGRAPHY MARTIN COUNTY, FLORIDA

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ABSTRACT

Surface DC resistivity surveys were used to delineate the hydrostratigraphic zones of the Coastal Ridge Aquifer in Martin County, Florida. Data from fifty-two vertical electric sounding (VES) profiles indicate three distinct geoelectric layers within the aquifer. The layers are: 1) a shallow, low resistivity zone, 1 to 3 meters thick and at or near the surface, 2) a shallow, low resistivity zone, 2 to 12 meters thick and below layer one, and 3) a deep, high resistivity-target zone, approximately 20 meters thick and below layer two. The deep, low resistivity layer, which is the lower boundary beds of the aquifer, lies immediately below the target zone.

The siliceous and carbonate clastic sediments of the aquifer are Pliocene and Pleistocene in age. Integration of lithologic and geoelectric data show the deep, high resistivity zone to be composed of 1) a well-cemented, porous calcarenite and 2) coarse shell and sand beds. Of the sediments within the Coastal Ridge Aquifer, these lithologies have the greatest potential for water-well development, but are limited to an area east of Green Ridge. Green Ridge is a linear geomorphic feature approximately 21 km inland from the present coast line. This ridge delimits the western extent of the Coastal Ridge Aquifer.

This application of surface DC resistivity surveys is not limited to the Coastal Ridge Aquifer. Regions that have 1) layered, semi-

horizontal strata, 2) lithologic contrast, and 3) constant water quality of low ionic strength should produce geoelectric results suitable for hydrostratigraphic investigations. This geoelectric survey of the Coastal Ridge Aquifer should prove to be an informative, predictable example for future investigations.

INTRODUCTION

The shallow aquifer of Martin County is a major source of potable water, particularly for the coastal, urban areas (Lichtler, 1960). According to the 1980 Census, the county's population has increased 128% since 1970; 600% along coastal margins. Coastal municipalities have met increased fresh water demands by augmenting pumping rates of nearby well fields. Increased pumpage has induced salt water intrusion in near-coast well fields (Lichtler, 1960; Scott and others, 1977). It is evident that future demands must be supplemented by additional fresh water sources developed further inland, where the threat of salt water intrusion is reduced.

Inland, fresh water sources have been located in neighboring counties. Fischer (1978) describes a shallow, cavernous "high-permeability zone" within eastern Palm Beach County. In addition to this unit, Scott (1977) indicates other, less permeable, units extending downward to the upper confining layers of the Floridan Aquifer. In St. Lucie County, Bearden (1972) describes eastward-thickening sediments with a fresh water potential that can supplement urban and agricultural demands. In all cases, potential aquifers occur in coarse carbonate and siliceous clastics of Pliocene to Pleistocene age. It is therefore reasonable to assume that inland, fresh water zones exist in Martin County and are contained within Pliocene-Pleistocene sediments.

Development of new fresh water sources in Martin County necessitates a preliminary study, delineating the vertical and lateral extent of the Pliocene-Pleistocene sediments. Traditionally, core and borehole analyses are conducted for such a study. However, these sediments were deposited during numerous sea-level changes, resulting in lateral facies shifts. Exploration by conventional methods would produce limited results, while expending large amounts of time and money, due to these lateral changes and the large size of the area of investigation.

An alternative to the traditional survey is the use of surface electrical geophysical techniques. In recent years, geophysical surveys have been applied to the solution of shallow (100 meters in depth) geologic and hydrogeologic problems. These surveys are advantageous in that they are economical, requiring less time and manpower than conventional methods, and provide a justifiable quality of information due to refinements in field and data reduction within recent years. Direct current resistivity surveys are particularly advantageous in that the results are easier to handle quantitively than electromagnetic soundings, the equipment is less cumbersome than seismic equipment, and they have sounding resolution sufficient to resolve the shallow lithostratigraphy of the Pliocene-Pleistocene sediments.

This investigation includes a compilation of electrical soundings with available lithologic and water-quality data. These data are used to delineate the shallow lithostratigraphy of the Pliocene-Pleistocene section in central and eastern Martin County. The ultimate objective is to locate and map zones with good potential as sources of potable ground water.

THEORY

Electrical Properties of Earth Materials

The physical property measured by the direct current method is resistivity. The definition of resistivity is illustrated in Figure 1. It is apparent that resistivity and its inverse, conductivity, are inherent properties of a particular material, and are independent of geometry, as opposed to resistance and conductance (Stewart, 1981). The units of resistivity are ohm-meters in SI units, and conductivity is measured in mhos/meter. The instruments used (Scintrex IPC-7/2.5kW transmitter, RDC-8 receiver unit, and a Soiltest R-50 C.D. Resistivity Meter) measure current (I) in amperes or milliamperes and potential change (ΔV) in volts. Apparent resistivity values are derived from these measurements using a formula whose equation is dependent upon the electrode array configuration. The formulae for the Wenner and Schlumberger arrays are:

$$\rho_a = 2\pi a\ (\Delta V/I) \qquad \text{(Wenner)} \qquad (1)$$

$$\rho_a = \frac{\frac{(\overline{AB})^2}{2} - \frac{(\overline{MN})^2}{2}}{\overline{MN}}\ \frac{\Delta V}{I} \qquad \text{(Schlumberger)} \qquad (2)$$

where:

ρ_a = apparent resistivity,

a = the distance between any two adjacent electrodes,

$\overline{AB}$ = the distance between the current electrodes,

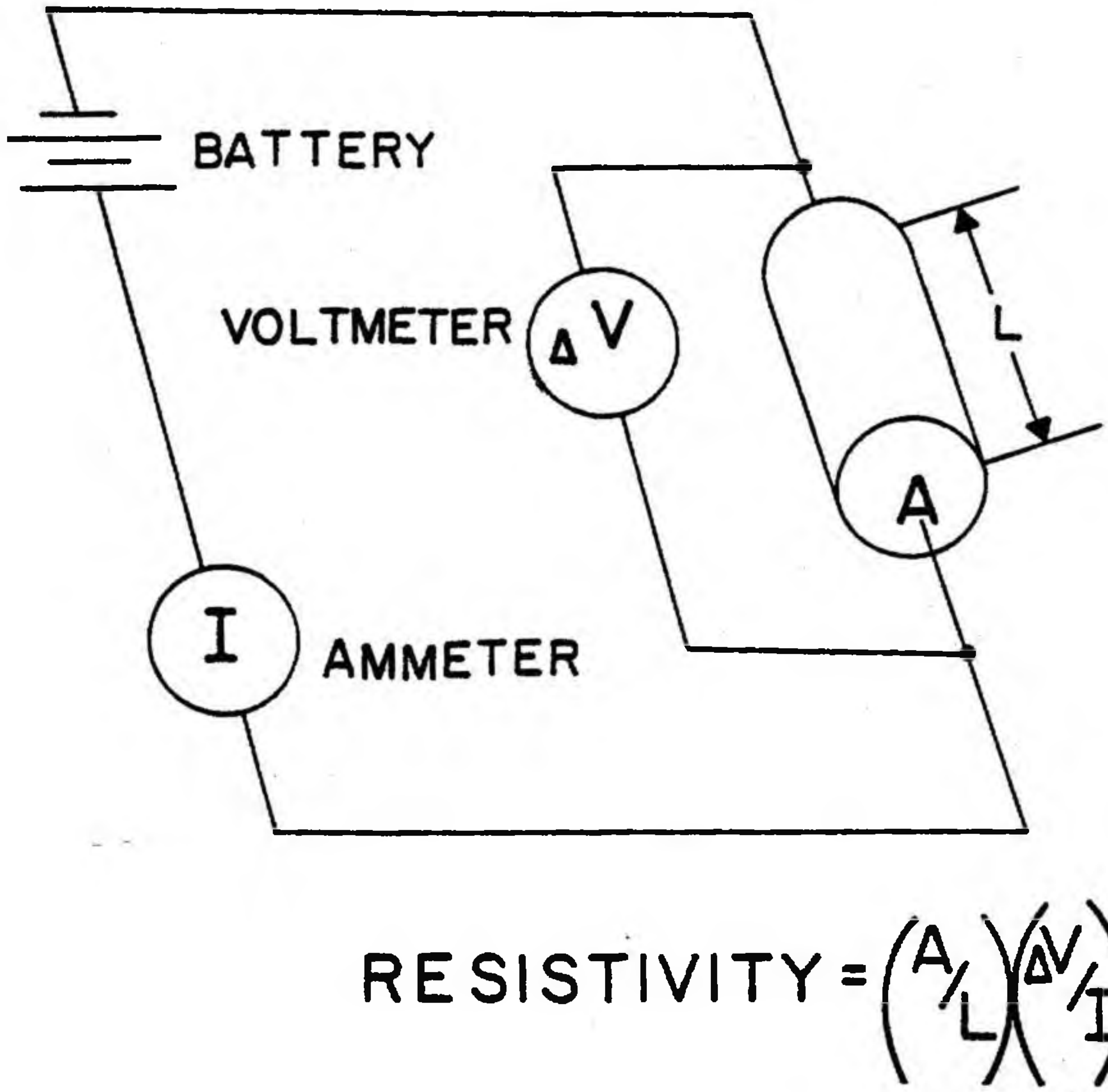

Figure 1. Definition of resistivity.

$\overline{MN}$ = the distance between the potential electrodes,

I = current (amperes), and

ΔV = change in potential (volts), (Zohdy and others, 1974).

The intensity of electrical current which will flow through the ground is dependent upon three properties of earth materials: 1) mineralogy, 2) pore surface and effective porosity, and 3) the amount and conductivity of interstitial fluids (Layton and Stewart, 1982). Common detrital minerals, i.e. - quartz, calcite, and feldspars, exhibit resistivities of 10^3 to 10^9 ohm-meters (Telford and others, 1976). Clays exhibit resistivity values of 1 to 100 ohm-meters (Telford and others, 1976) as they allow current flow across grains in the matrix (Keller and Frischknecht, 1966). Saturated clays will be surrounded by films of partially mobile ions which migrate under a potential gradient. This addition to the normal migration of ions causes a significant reduction in resistivity in clay-rich rocks and sediments (Davis and DeWiest, 1966). Most earth materials, however, behave as electrical resistors or at best as semi-conductors. Bulk resistivities of geologic units are lower than the minerals of which they are composed because most electrical current passes through pore spaces. Thus, resistivity becomes largely a function of effective porosity and chemistry of the saturation fluid (Davis and DeWiest, 1966). Effective porosity is the interconnected pore volume divided by the total volume (Stewart, 1981).

Current flow, thus bulk resistivity, is affected by three porosity related phenomena: 1) surface conditions, 2) pore fluid conduction, and 3) tortuousity. Water, a polar molecule, forms an electrically bonded layer on grain surfaces (Keller and Frischknecht, 1966), particularly in silicate clay minerals. This electrical double layer is more conductive than the mineral. Since current flow is across grain surfaces, it is greatly influenced by pore surface area in two ways: 1) by restricting the total cross-sectional area of pores filled with conducting fluids and 2) by reducing the pore surface area of interstices through which the current will flow in the electrical double layer (Layton and Stewart, 1982).

Pore fluid conduction is simply direct ionic conduction by the pore fluid (Stewart, 1981). Fluids low in ionic strength (i.e., fresh water) will not conduct an electric current as readily as fluids high in ionic strength (i.e., salt water). It is obvious that pore-fluid conductivity influences bulk conductivity or, conversely, bulk resistivity. Figure 2 illustrates the relationship between pore fluid resistivity and bulk resistivity. At low fluid resistivities there is nearly a 1:1 relationship between pore-fluid resistivity and bulk resistivity. As fluid resistivities increase the relationship deviates from the 1:1 ratio and bulk resistivity increases rapidly. From this graph it can be inferred that when pore-fluid resistivities are high, the values of bulk resistivity will be strongly influenced by porosity. When pore fluids have low resistivities, bulk resistivity will be dictated by the pore-fluid resistivity.

Tortuousity is the deviation of average current flow paths from a straight line due to flow around mineral grains (Stewart, 1981). Greater tortuousity results in higher resistivity values. This porosity related phenomena is not as significant as surface conditions or pore fluid conduction.

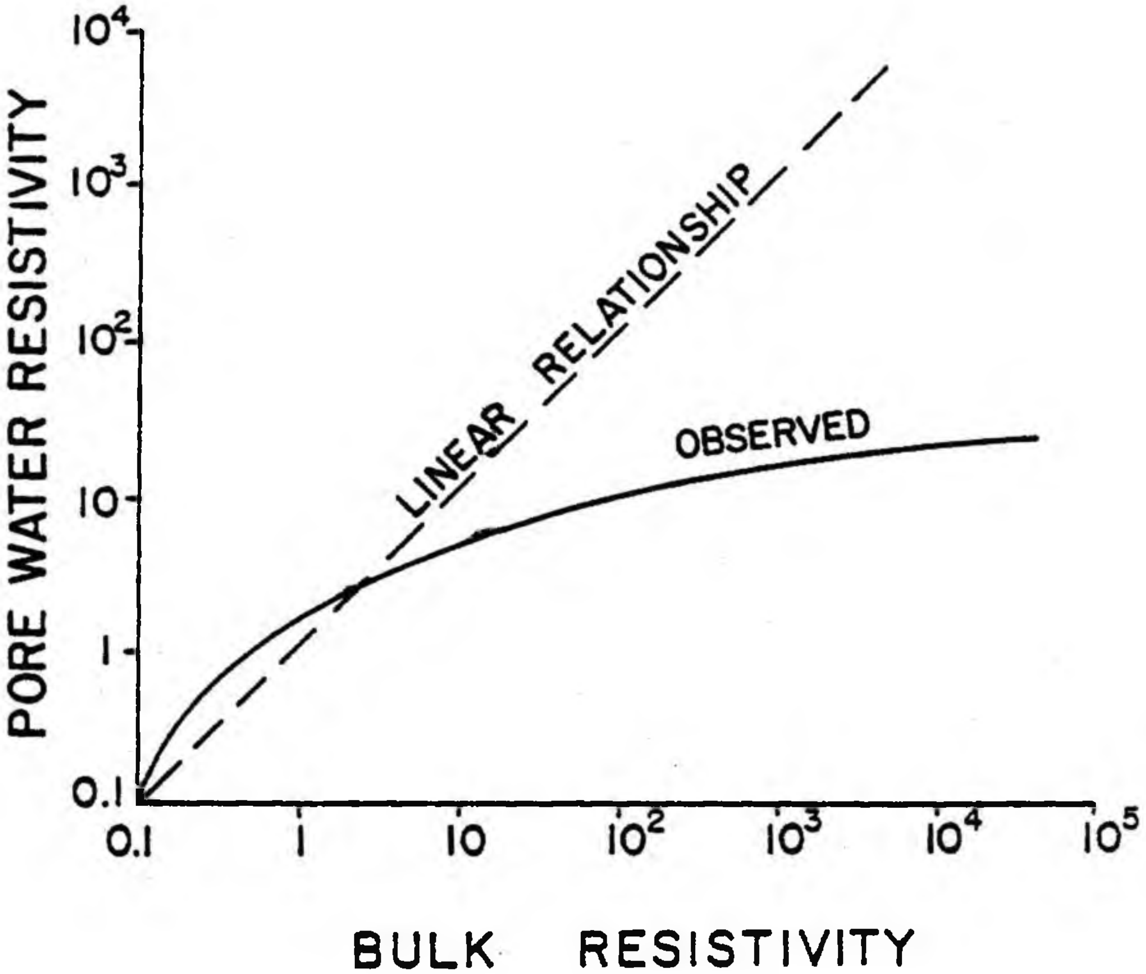

Figure 2. Relationship between pore fluid resistivity and bulk resistivity (in ohm-meters). A near 1:1 relationship between pore water resistivity and bulk resistivity exists at low fluid resistivities up to approximately 5 ohm-meters. Beyond 5 ohm-meters bulk resistivity increases rapidly becoming primarily a function of porosity (modified from Keller and Frischnecht, 1966).

Previous Applications of D.C. Resistivity to Ground Water Surveys

Swartz (1937, 1939) used direct current (DC) resistivity soundings to delineate fresh water bodies in salt water regions in the Hawaiian Islands. Since then DC surveys have been applied to the solution of many geologic and hydrogeologic problems. Investigations delineating fresh water bodies or the limits of salt water intrusion have been conducted by Zohdy and others (1969), Flathe (1970), Lazreg (1972), Zohdy and others (1974), Gorhan (1976), Fretwell and Stewart (1981), Reed and others (1981), Stewart and others (1981), and Layton and Stewart (1982). The location and extend of chemical plumes and contaminated waters, such as landfill leachates, mine drainage, and sewage effluent, have been determined by DC resistivity surveys by Cartwright and McComas (1968), Warner (1969), Hackbarth (1971), Merkel (1973), Fink and Aulenbach (1974), Stollar and Roux (1975), Kelly (1976), Klefstad and others (1976), and U.S. Environmental Protection Agency (1978). DC resistivity methods have also been used to locate specific geologic features, such as buried sand and gravel deposits (Davis and DeWiest, 1966; Zohdy and others, 1974; Heigold and others, 1979), fresh water-bearing sandstones (Fischer, 1978), and reef limestones (Layton and Stewart, 1982).

LOCATION OF STUDY AREA

Martin County, an area of approximately 1450 km^2, lies in the southeastern part of peninsular Florida between Lake Okeechobee on the west and the Atlantic Ocean on the east. It is bounded by St. Lucie and Palm Beach Counties to the north and south, respectively (Figure 3). The area of investigation is located in the east and central portions of the county. This includes all or parts of Townships 38-40 South and Ranges 38-42 East (Figure 4). The investigation was conducted within the St. Lucie Inlet, Gomez, Rood, West Palm 2NE, Palm City, Indiantown SE, Indiantown NW, Indiantown, and Okeechobee 4SE 7½' topographic map quadrangles. Latitudes of the study area boundaries are $26^{\circ}58'14''$ to $27^{\circ}09'32''$ S. Longitudes are $80^{\circ}09'09''$ to $80^{\circ}32'45''$ W.

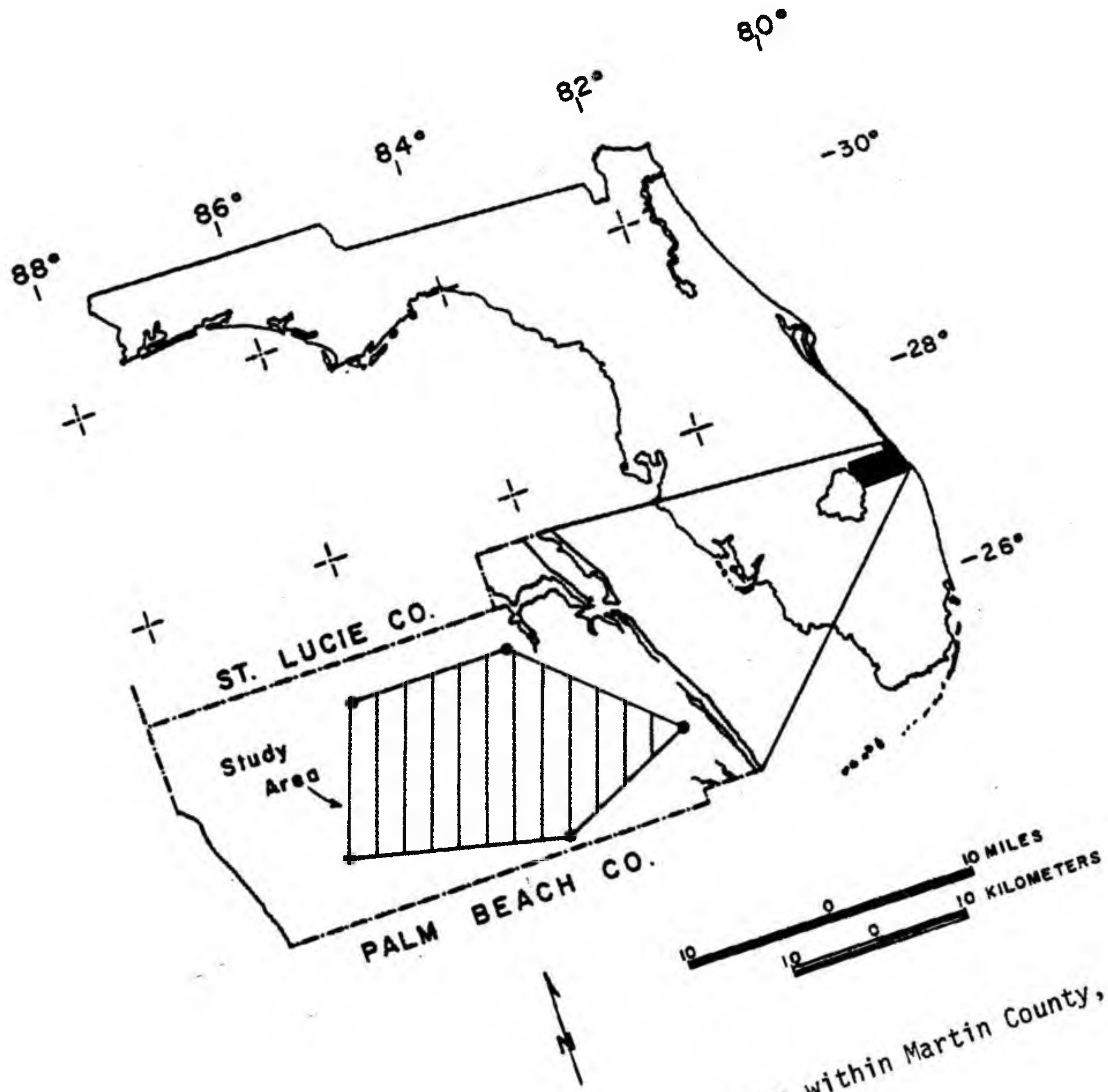

Figure 3. Location of study area within Martin County, Florida.

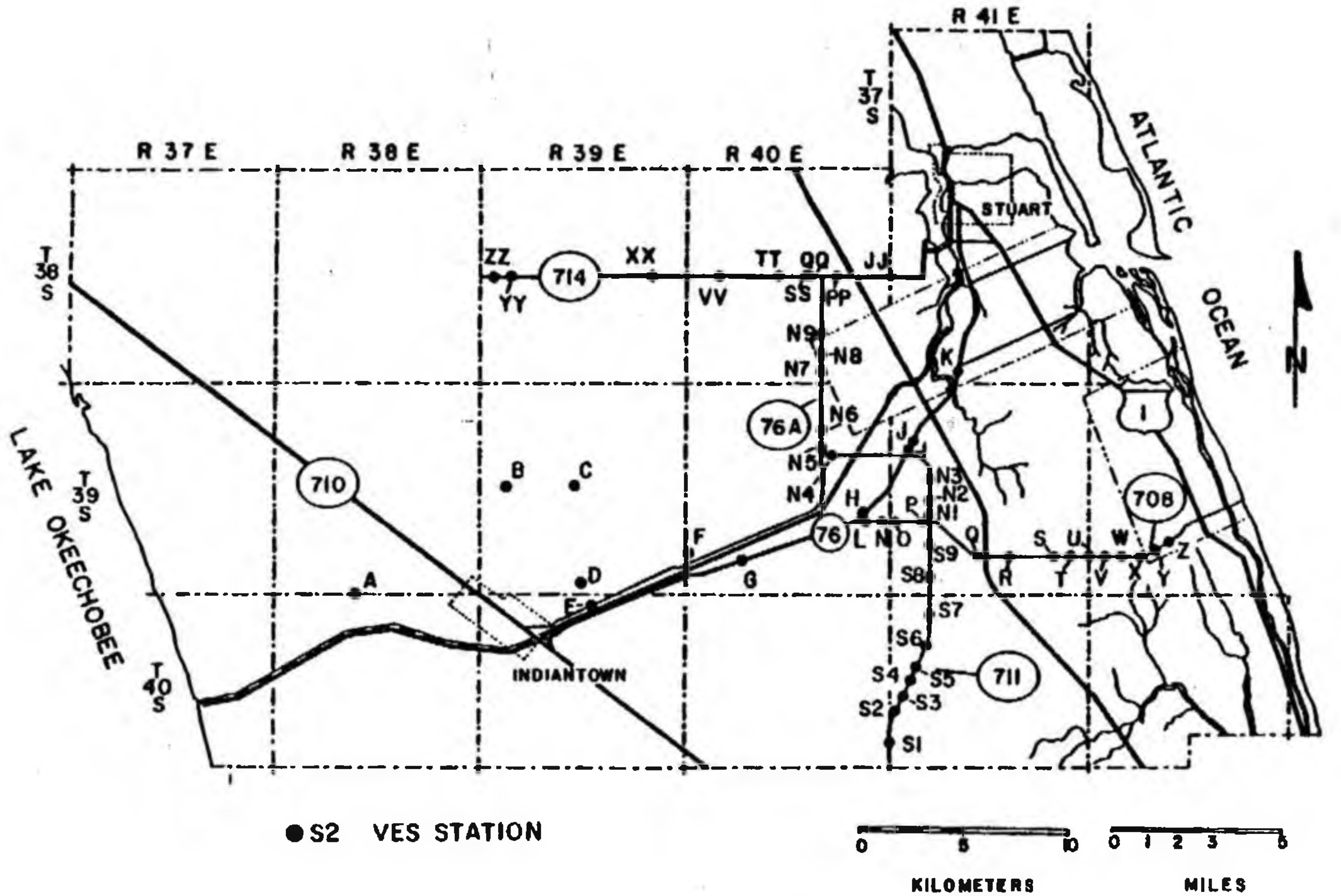

Figure 4. Location and distribution of vertical electric sounding stations within the study area.

DESCRIPTION OF STUDY AREA

Martin County lies within the Atlantic Coastal Province (Meinzer, 1923). The county is further divided into three smaller physiographic regions: 1) Atlantic Coastal Ridge, 2) Eastern Flatlands, and 3) Everglades (Davis, 1943). "East is a region in which a certain similarity of topography or relief prevails or a certain soil type or vegetation cover is common" (Lichtler, 1960, p.6). The area of investigation lies in the Atlantic Coastal Ridge and partly in the Eastern Flatlands (Figure 5).

Except for the sand hills, which reach a maximum elevation of approximately 22 meters near Hobe Sound, relief is low. Regionally, elevation increases from east to west, ranging from mean sea level to approximately 8 meters. A gentle rise in elevation (Green Ridge) in the central portion of the study area attains altitudes of 9 to 11 meters above sea level (Lichtler, 1960). West of Green Ridge the land surface is extremely flat, having a very slight slope to the south. MacNeil (1949) describes a ridge in western Martin County. He interprets this ridge to be an old shoreline of a lagoon extending from Brevard County southward through Indian River and St. Lucie Counties, ending at Indiantown as a sharp cape. MacNeil believes this ridge is the southernmost extent of the Orlando Ridge. White (1970) shows this ridge to be separate from the Orlando Ridge and assigns it to the southern 12 meters crest of the Osceola Plain. He agrees with MacNeil in that the ridge is a long spit/cape or offshore shoal feature.

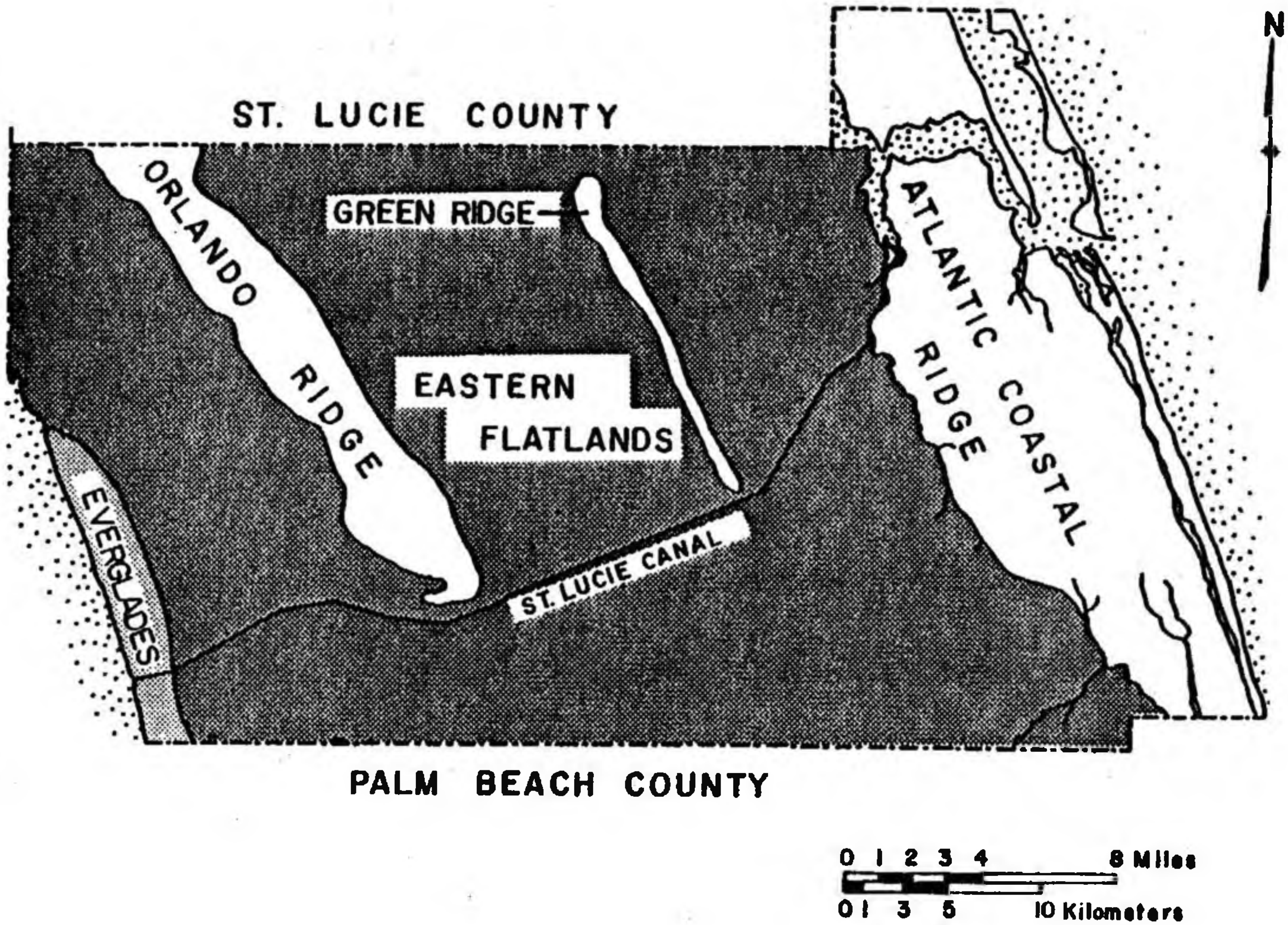

Figure 5. Physiographic subdivisions of Martin County, Florida (modified from Lichtler, 1960).

The St. Lucie River and the Loxahatchee River form the major drainage basins within the study area. The St. Lucie Canal primarily conveys flood waters from Lake Okeechobee to the St. Lucie River. The north and south forks of the St. Lucie River drain much of the east and northeast section. The Loxahatchee River drains the southeastern section (Lichtler, 1960). Both basins are remnants of the Pamlico Intracoastal Waterway (MacNeil, 1949) and form a boundary between the Atlantic Coastal Ridge and the Eastern Flatlands. Much of the area west and south of Green Ridge has poorly defined drainageways and remains marshy most of the year. Standing water and ponding is common throughout the county, especially during the rainy season.

Vegetation over Martin County is varied. The sandhills supports growths of bunch grass, pines, and palmettos. Westward, the flatlands are characterized by cypress, pine, palmetto, and marsh vegetation. Over much of the county this natural vegetation has been replaced by pastureland and citrus groves. Soils in these provinces are sandy and probably of Pamlico terrace origins (MacNeil, 1949; White, 1970). These sandy soils continue westward where they grade into the mucky, organic soils of the Everglades. Here, vegetation is typically sawgrass and stunted cypress.

Climate

Martin County has a subtropical climate due to its flat terrain, low latitude, and proximity to coastal waters. It has an average temperature of approximately 24^{o}C. A controlling factor of the climate is the presence of the nearby Gulf stream. Convective atmospheric systems generate nearly 60% of the annual precipitation (South Florida

Water Management District, 1980) during the rainy season from June through October (Lichtler, 1960). Average rainfall varies from about 1.27m to 1.42 m, with the coastal area receiving up to 2.03 m (South Florida Water Management District, 1980).

GEOLOGY

The igneous and metamorphic rocks forming the basement complex of peninsular Florida are covered in Martin County by approximately 4,000 meters of sedimentary rocks, most of which are of marine origins. In Martin County, dominant lithologies down to approximately 200 meters are sands and sandstones, limestones, silts, and clays. Below that depth dominant rock types are limestones and dolomites (Lichtler, 1960). Only about the top 460 meters of sediments that have been penetrated by water wells will be discussed (Figure 6).

Pre-Miocene Units

The deepest water wells in Martin County penetrate into the Avon Park limestone of Eocene age. These wells reach depths of approximately 460 meters. The total thickness of the Avon Park is not known. The late Eocene Ocala Group (Cooke, 1945) is generally less than 30 meters thick and overlies the Avon Park limestone. Although Puri (1953) subdivided this group, no core samples from Martin County are known to exist and no such distinction can be made. An unconformity marks the boundary between the Ocala Group and the overlying Suwannee Limestone. A thin unnamed calcilutite overlies the Ocala Group. This limestone may be upper Eocene or Oligocene, as its age is undetermined (Mooney, 1980).

The Suwannee was deposited in the Oligocene. After deposition the Suwannee was subjected to marine regression and post-Oligocene erosion (Vernon, 1951). The Suwannee's thickness varies from 6 to 18 meters

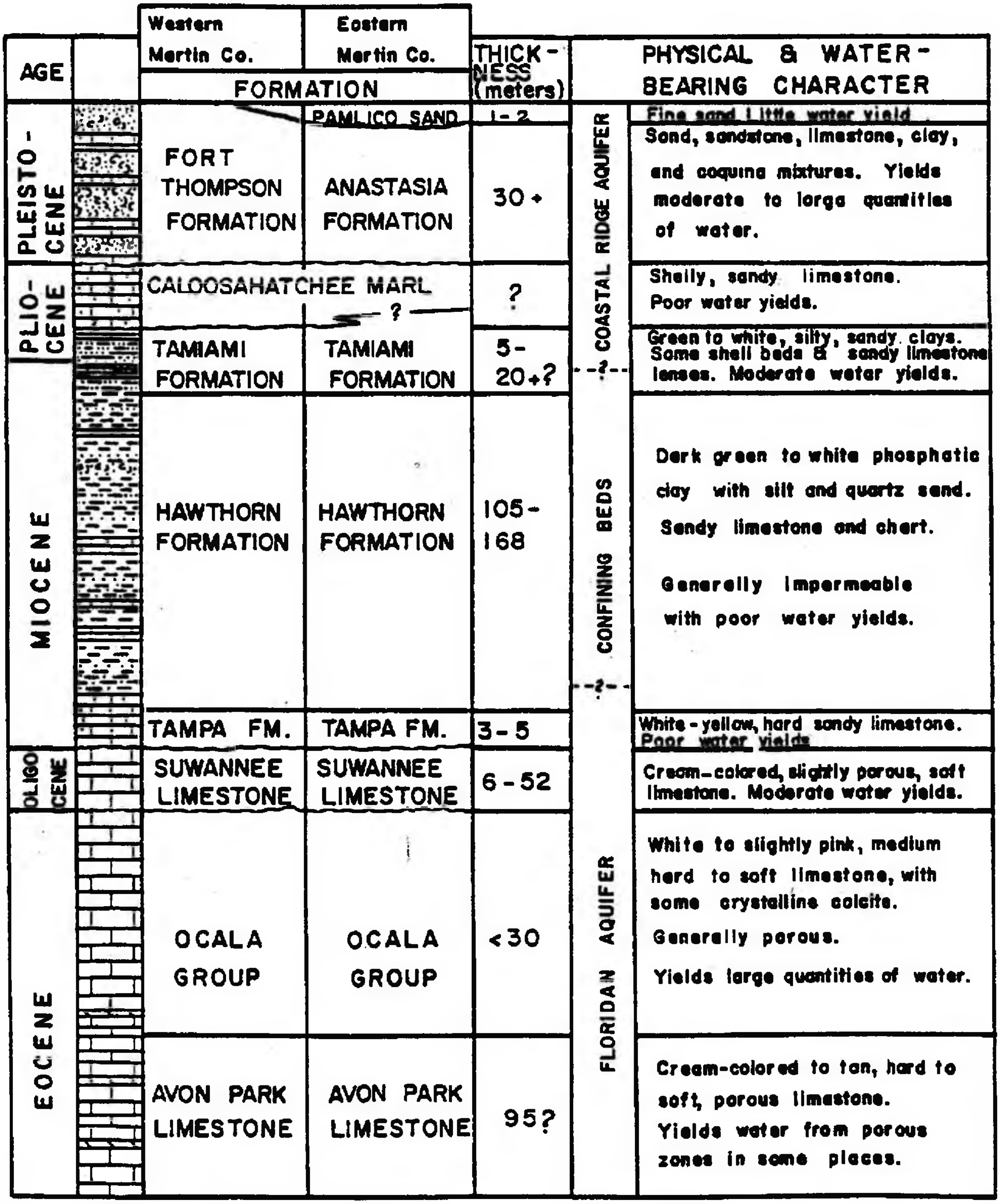

Figure 6. Generalized section of geologic formations in Martin County, Florida.

over much of the county to as much as 52 meters in the eastern portions. Lichtler (1960) attributes this variation in thickness to late-Oligocene or post-Oligocene activity along a fault that is roughly parallel to and approximately 8 kilometers inland from the coast line. The eastern, downthrown side of the fault was protected from erosion, therefore sediment thickness is much greater than on the unprotected, western, upthrown side. The faulting is probably associated with crustal movements that formed the Ocala Uplift (Cooke, 1945; Vernon, 1951; Winston, 1976).

The lithologies of these Pre-Miocene units vary from the recrystallized, porous limestones of the Avon Park to the granular, often chalky, limestones of the Suwannee. These Pre-Miocene limestones are cream to tan to pink, soft to hard, and are generally porous and permeable to slightly permeable. These limestones form the Floridan Aquifer. Additional, detailed information of these Pre-Miocene units in Martin County is given by Lichtler (1960) and Mooney (1979).

Miocene Units

The Miocene series in Martin County consists of the Tampa Formation of early Miocene age and the Hawthorn Formation of early and middle Miocene age. These units lie unconformably on the Suwannee Limestone. Traditionally, the Tamiami Formation has been included in the Miocene; however, based on nanofossil examinations (Akers, 1974) and recent stratigraphic revisions, some of the upper portions of the Tamiami Formation are now classified as Mid-Pliocene.

The Tampa sediments are perplexing stratigraphic units because of the lack of agreement of the lithologic character, geographic distribution, and age as reported in the literature (Scott and MacGill, 1981). At its type locality the Tampa Formation is a white to yellowish, hard, dense, and very sandy limestone. A limestone located approximately 3.2 km south of Stuart, Florida in Martin County has been tentatively correlated with the Tampa. It is similar to the Tampa Formation of the type locality, lies just below the Hawthorn, and is three to five meters thick (Lichtler, 1960).

Like the Tampa sediments, the Hawthorn Formation varies greatly across the state. In Martin County the unit consists of beds of white to dark green, phosphatic, silty to sandy clays. Thin layers and lenses of sandy, phosphatic limestone, chert, sandstone, and shell occur within the Hawthorn. Dolomite cement is common as well (Scott, 1983). The Hawthorn Formation's thickness in Martin County varies from approximately 100 to 168 meters (Lichtler, 1960).

Post-Miocene Units

For nearly 90 years the late Tertiary and Quaternary sediments of southern Florida have presented problems of nomenclature and stratigraphy. Hunter (1978), addressing these problems, proposed several revisions of terminology in an attempt to clarify the controversy surrounding south Florida stratigraphy. The Tamiami Formation, originally assigned to the Pliocene (Mansfield, 1939), was redefined by Parker and others (1955) to include "all the Upper Miocene materials in southern Florida". Parker's Tamiami Formation has a major regional unconformity within it, however, separating the upper and lower units. The upper unit contains Pliocene sediments (Akers, 1974), while the lower unit, based on vertebrates, foraminifera, and molluscs, contains

Miocene sediments. Therefore, Hunter (1978) suggests a division of the formation into upper and lower units based upon the occurrence of two regional unconformities in the Neogene System. While Hunter has traced these unconformities in the Caloosahatchee River area and to the west side of Lake Okeechobee, they can only be inferred in Martin County as the necessary stratigraphic data needed to confirm them do not exist. Hunter assigns a Pliocene age to the Tamiami Formation in the Lake Okeechobee area.

Lichtler (1960) does not distinguish any lithologic break between the Hawthorn and Tamiami Formations. This implies that at least part of the Tamiami Formation is white to green, silty to sandy clays. North of Martin County, in Indian River County, the lower beds of the Tamiami are white to light gray, calcisiltites to calcirudites. Bed deposits vary from original shell material to recrystallized material and coquina. Basal beds grade into green to greenish gray, poorly consolidated, phosphatic calcisiltites to calcarenites. Some moldic porosity may occur locally. Upper beds are white to dark gray, hard, well-cemented calcisiltites to calcirudites. Moldic porosity is common to abundant (Frazee and Johnson, 1983). Similar lithologies have been described in the FPL core No. 1 in western Martin County (Figure 7 and Appendix C). Well cuttings from eastern Martin County contain deposits that may be from the Tamiami Formation, but core samples are needed for better identification. The Tamiami beds can provide quantities of water suitable for supplemental agricultural and domestic use (Parker and Cooke, 1944; Frazee and Johnson, 1983).

Since Matson and Clapp (1909) adopted Caloosahatchee Marl as a formation name, the classification of the Pliocene, shelly, sandy

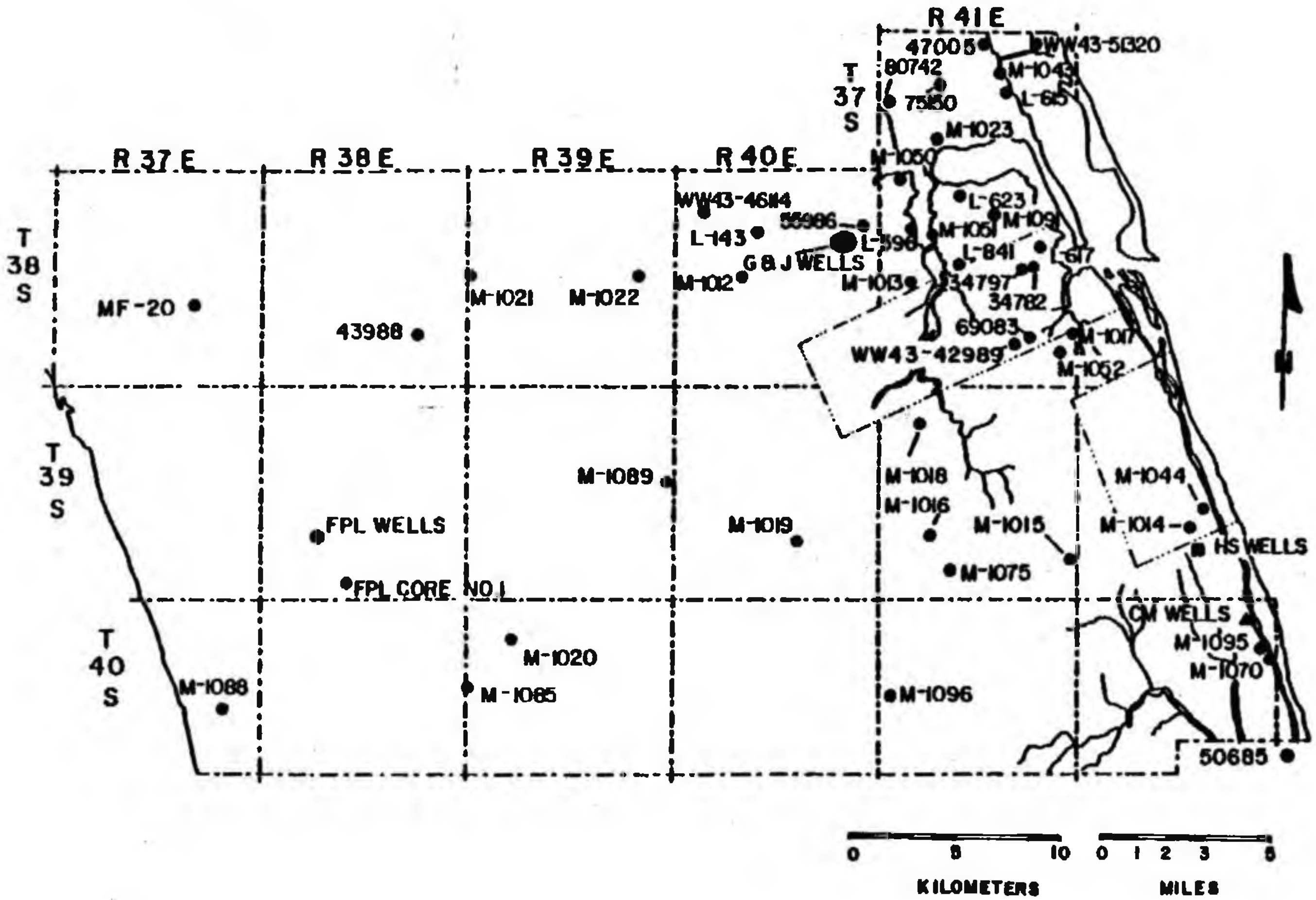

Figure 7. Location and distribution of lithologic data within Martin County, Florida.

limestone unconformably overlying the Tamiami Formation has been a subject of debate and controversy. Parker and Cooke (1944) state that its thickness varies from 9-15 meters in the West Palm Beach area and that it thickens to the south and east, and interfingers with the Tamiami Formation. Lichtler (1960) places the Caloosahatchee Marl over the Tamiami units, based on Cooke's (1945) description of the marl in western Martin County. Hunter (1978) states that the Caloosahatchee is too thin from Lake Okeechobee to southern Palm Beach County to be mappable as a formation and should be considered as the lowest member of the Fort Thompson Formation. These and many other discrepancies are commonplace, with no near-future resolution. Thus, it is sufficient to say that the Caloosahatchee Marl does occur in western Martin County, possibly in eastern Martin County, but it is of unknown thickness and extent.

The Fort Thompson Formation was defined by Sellards (1919) in its type locality as alternating beds of fresh water and brackish water deposits with marine shelly marl of Pleistocene age. Similar deposits occur in Martin County (Lichtler, 1960). The Fort Thompson Formation, unconformably overlies the Caloosahatchee Marl. It may extend as far east at the Atlantic Coastal Ridge where it merges with the Anastasia Formation. Generally, it is a poor aquifer, but may provide water where sand and shell dominate the lithology (Parker and Cooke, 1944).

The Anastasia Formation in Martin County "consists mostly of sand, shell beds, and thin discontinuous layers of sandy limestone or sandstone" (Lichtler, 1960, p. 20). The consolidated coquina phase of the Anastasia Formation crops out at various points along coastal Martin County. It grades from a coarse coquinoid limestone to a microcoquina (Puri and Vernon, 1959). This formation forms the backbone of the Atlantic Coastal Ridge and is wedge-shaped, thinning landward where it merges with the Fort Thompson Formation (Parker and Cooke, 1944). The Anastasia Formation lies unconformably on the Caloosahatchee Marl or older formations. It is overlain unconformably by the Pamlico Sand (Lichtler, 1960).

Serving as a major source of fresh ground water, the Anastasia may be more than 30 meters thick in eastern portions of Martin County. Thin, permeable shell, limestone, and/or sandstone beds, 15 to 38 meters below land surface yield large quantities of potable water (Lichtler, 1960).

The Pamlico Sand extends over most of Martin County, except on the 12 meter crest of the Osceola Plain (White, 1970). This terrace sand is only about one meter thick. It is not a source of appreciable amounts of ground water in Martin County (Lichtler, 1960).

GENERAL HYDROLOGY

An aquifer may be defined "as a saturated permeable geologic unit that can transmit significant quantities of water under ordinary hydraulic gradients" (Freeze and Cherry, 1979, p. 47). Based on this criterion, two aquifers exist in Martin County: the deep, artesian, Floridan Aquifer, and the shallow, nonartesian aquifer. The thick, low permeability deposits of the Hawthorn and lower Tamiami Formations separate the aquifers. The Floridan Aquifer yields large quantities of ground water that is moderately to highly mineralized. Water from the shallow aquifer is generally fresh, except along coastal margins where salt water encroachment is common.

Artesian Aquifer

The Floridan Aquifer underlies all of Florida and parts of southern Georgia. Parker and others (1955, p. 89) define the Floridan to include

> "parts or all of the middle Eocene (Avon Park and Lake City limestones), upper Eocene (Ocala limestone), Oligocene (Suwannee limestone) and Miocene (Tampa limestone, and the permeable parts of the Hawthorn that are in hydrologic contact with the rest of the aquifer)."

The artesian aquifer underlying Martin County is composed of the Avon Park Limestone, the Ocala Limestone, and an unnamed calcilutite of uncertain age (Mooney, 1979). The formations dip to the south or southeast. The top of the aquifer varies from about 198 meters below land surface in the northeastern portions of the county to greater than 330 meters below land surface in the vicinity of Jonathan Dickinson State Park in the southeastern portion of the county. Potentiometric surface elevations generally vary from 12 to 15 meters above mean sea level, but may range from 9 to 16 meters (Lichtler, 1960; Brown and Reece, 1979; South Florida Water Management District, 1980). Water quality is vertically and areally variable. Total dissolved solids are relatively high, rendering the water unsuitable for domestic use (Reece and others, 1980; South Florida Water Management District, 1980). Locally, mineralization may be low enough to allow use for livestock and citrus irrigation. Detailed information regarding the Floridan aquifer and its water quality in southeast Florida can be found in Bearden (1972), Sherwood (1973), Meyer (1974), Brown and Reece (1979), Mooney (1979) and South Florida Water Management District (1980).

Shallow Aquifer

The shallow aquifer is the principal source of fresh ground water in Martin County. The aquifer is usually unconfined, but leaky aquifer conditions exist locally, particularly where discontinuous clay lenses act as semi-confining layers, as in the Indiantown area (South Florida Water Management District, 1980). Aquifer limits extend from the water table to greater than 60 meters below land surface. Strata have been assigned to the Pleistocene (Pamlico Sand, Anastasia and Fort Thompson Formations) and Pliocene (Caloosahatchee Marl and/or the upper units of the Tamiami Formation) Epochs (Parker and Cooke, 1944; Lichtler, 1960). The lithology of the aquifer is predominantly sand with lenses of shell and thin beds of sandy limestone and sandstone. Large capacity wells are developed in limestone, sandstone, and/or shell beds. Highly permeable, cavity-riddled, calcarenites occur within the shallow aquifer in northeastern Palm Beach County (Fischer, 1978). Similar zones probably exist in eastern Martin County. Lithology varies laterally and vertically due to the predominantly shallow marine depositional environment of the sediments.

Shallow aquifer transmissivity values are highest in eastern and southeastern Martin County. This is due to greater aquifer thickness and more permeable sediments. Calculated storage coefficient/specific yield of wells range from 0.002 to 0.16 (South Florida Water Management District, 1980).

Water quality is generally good, with usually less than 1000 ppm total dissolved solids. Table 1 lists the composition of well-water samples typical of the shallow aquifer. Figure 8 shows the location and distribution of the sample sites. When the major anions, Cl^-, HCO_3^-, and SO_4^{-2}, are converted to milliequivalents and plotted as total milliequivalents versus specific conductance, linear regression analysis shows a strong positive correlation coefficient of 0.9999. More importantly, Cl^- alone accounts for 99% of the correlation and variance. Thus conductance and, conversely, resistance, is dependent upon the concentrations of these major anions, particularly chloride. Water samples are typically calcium-magnesium bicarbonate type, but due to encroachment become sodium chloride type in the Stuart and near-coast areas (South Florida Water Management District, 1980). Within the county, water quality may be locally poor. This may be due to commercial irrigation with water from the Floridan Aquifer, contamination with canal water (Bearden, 1972), residual salts from ancient seas

Table 1. Analyses of well-water samples from the shallow aquifer in Martin County, Florida.*

Sample No.	Calcium (Mg/L as Ca)	Magnesium (Mg/L as Mg)	Sodium (Mg/L as Na)	Potassium (Mg/L as K)	Chloride (Mg/L as CL)	Carbon Dioxide (Mg/L as CO_2)	Bicarbonate (Mg/L as HCO_3)	Bicarbonate Alkalinity (Mg/L as $CaCO_3$)	Sulfate Dissolved (Mg/L as SO_4)	Spec. Cond. ~umohs
M-1030	93	2.4	17	0.9	20	5.3	264	217	27	530
M-1031	35	1.4	15	1.4	8.3	3.9	96	79	38	290
M-1041	92	9.2	33	1.4	46	30	380	312	1.6	685
M-1042	92	4.2	8.6	3.7	6.6	46	288	236	11	470
M-1045	60	6.3	45	1.4	82	7.1	352	289	1.4	572
M-1046	82	5.7	130	4.8	220	19	368	302	8.9	680
M-1047	3.7	1.1	2.1	0.5	21	45	28	23	6.0	105
M-1049	110	5.8	29	1.1	36	15	584	479	1.8	680
M-1050	110	8.5	55	2.6	75	16	624	512	3.4	670
M-1051	97	4.4	30	1.6	43	12	308	253	4.8	530
M-1052	130	9.9	55	2.0	91	38	436	341	11	920
M-1053	170	89	810	23	1600	18	360	295	85	---
M-1054	330	730	6200	230	11000	11	268	220	1500	25500
M-1055	82	3.3	54	1.4	29	14	349	286	17	670
M-1058	6.9	1.0	13	0.4	15	64	32	26	3.3	115
M-1071	58	1.5	17	1.2	28	3.6	180	148	11	420
M-1073	78	2.7	17	1.1	24	2.8	280	230	0.3	480
M-1084	160	16	130	4.6	220	---	415	340	130	---
M-1096	110	9.0	46	1.0	90	29	360	295	0.0	800
M-1100	100	7.2	38	2.3	64	6.4	320	262	2.2	675
WW43-51320	88	48	450	24	704	32	181	149	115	---
WW43-42983	77	7.3	15	---	16	32	234	192	10	---
GS-23	128	26	182		238	---	418	---	139	1560
L-01	64	7.4	16		13	---	231	---	17	428
L-09	148	19	6.7		10	---	489	---	39	802
L-13	39	2.1	9.7		16	---	120	---	5.1	233
L-15	124	10	51		79	---	396	---	24	887
L-22	128	30	124		161	---	548	---	34	1380
L-98	102	4.6	35		108	---	224	---	12	701
L-214	---	---	---		92	---	---	---	---	746
L-655	70	0.9	7.8	0.7	16	---	220	---	0.5	386
L-657	86	2.3	9.6	0.4	15	---	272	---	0.0	459
L-936	134	35	459	---	~626	---	492	---	128	2850
L-939	109	3.4	7.4	1.4	16	---	363	---	1.6	588

*Data were collected from the following sources:

Well No.	Source
M-0000	(Miller, 1980)
WW00-00000	(South Florida Water Management, unpublished)
GS-00	(Lichtler, 1960)
L-000	(Lichtler, 1960)

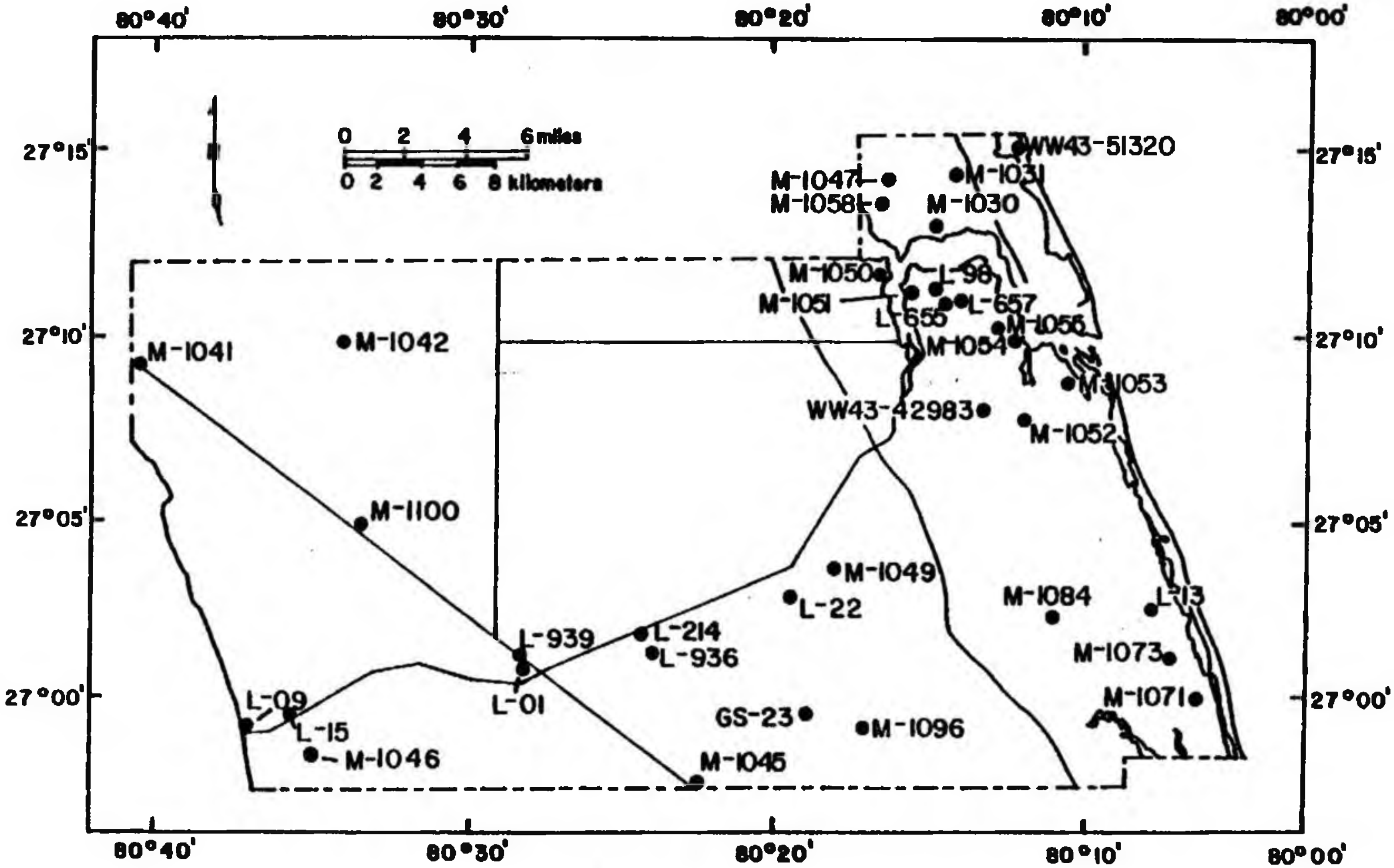

Figure 8. Location and distribution of nonartesian well-water samples within Martin County, Florida.

(Lichtler, 1960), or upward leakance from the Floridan Aquifer (South Florida Water Management District, 1980).

Recharge is primarily from percolation of rainfall in and immediately adjacent to the county. Drainage canals may provide some recharge during the rainy season. Recharge may be poor in areas where clay lenses act as semi-confining layers. Ponding results in these regions, especially during the rainy season.

Ground water is discharged through runoff and flow into streams, springs, lakes, canals, and through pumpage from wells. Many small streams and sloughs discharge directly into Lake Okeechobee or the Atlantic Ocean. Where ponding occurs, evapotranspiration is the major means of water loss.

FIELD AND LABORATORY TECHNIQUES

Two resistivity units were used for data acquisition: a Soiltest Model R-50 Stratameter direct current resistivity unit and a Scintrex IPC-7/2.5kW transmitter, RDC-8 direct current resistivity unit. All field data were collected between March 8 to 11, May 3 to June 16, and on November 10, 1982. A total of 51 survey stations over an approximately 587 km^2 area were established during the field season. The location and distribution of the DC resistivity soundings are shown in Figure 4.

The resistivity data were obtained using both the Wenner and Schlumberger electrode arrays (Zohdy and others, 1974; Telford and others, 1976). A maximum "a" spacing of 160 meters ($\overline{AB}$=480 meters) was used in the Wenner array. The ratio of current electrode spacing to potential electrode spacing from Schlumberger soundings was maintained between 5:1 and 10:1.

All DC resistivity data were reduced using an automatic inversion computer program derived by Zohdy and Bisdorf (1975). Reduced data provide depth, thickness, and bulk resistivity values for layers in the geoelectric section. Values of reduced data from each VES station are listed in Appendix A.

RESULTS

Fifty-two geoelectric profiles were compiled from the reduced data. Each profile was constructed on a Cartesian graph with apparent resistivity, ρ_a, given to the abscissa axis and depth, Z_m, given to the ordinate axis. All of the geoelectric sections exhibit the same general profile. As illustrated in Appendix B, this profile is composed of two principal peaks separated by a trough, representing three major geoelectric layers within the Coastal Ridge Aquifer. The uppermost geoelectric layer correlates with the first peak. This layer has moderate to high resistivity values, is thin (1-3 meters thick), and is at or near the surface. It represents the resistive, medium- to very fine-grained, white to gray, siliceous surficial sands. At some locations this peak reflects, in part, roadfill. These surficial sands grade downward into shelly, medium- to very fine-grained, siliceous sands with variable percentages of silt, clay, and organic matter. These sediments comprise the second geoelectric layer and are reflected in the profile by a trough of moderate to low resistivity. The corresponding geoelectric layer is thin to moderately thick, varying from 2-12 meters in most cases.

The third geoelectric layer (i.e., the target zone) correlates with the second peak of the profile. This peak, lying immediately below the trough, is of major importance as it represents those sediments having the greatest potential for water resource development. This peak varies widely in resistivity and thickness. Generally, its relative resistivity values are moderate to high. Thicknesses range from approximately 6 meters to as much as 54 meters, but are commonly about 20 meters. This geoelectric layer is composed of sediments of variable lithologies. Examination of well cuttings and a core show these lithologies become finer-grained in a landward direction. Well cuttings indicate that in the easternmost portions of the study area the dominant lithology is a well-cemented, shelly calcarenite. Lithologic data and well completion reports (Appendix C) indicate lenses of sand and cavernous zones occur within the calcarenite, which correlates well with Fischer's (1978) high-permeability zone or "Turnpike Aquifer" in Palm Beach County. In the east-central and central portions the dominant lithologies are interbedded sandstones and shell beds. Medium- to fine-grained, gray, siliceous sand is also prevalent. Locally, clay and marl may be present in minor quantities. South of Green Ridge (Figure 5) these finer sediments may be present in larger quantities. In the west-central and western portions (i.e., west of Green Ridge), silt, clay, and marl are present in large percentages, are intermixed with fine, gray to brown, siliceous sand and shell, and may locally be the dominant lithologies.

A fourth geoelectric layer is reflected in the profile by a rapid decrease in resistivity values with increasing depth, beginning just below the second peak. Generally, these values decline to 10 ohm-meters or less. These lower resistivities represent the confining units below the Coastal Ridge Aquifer. The dominant sediments are olive-green to greenish-gray, carbonate and siliceous silts, fine sands, and clays. Shell material, dolomite, and phosphate are present throughout. These sediments may or may not be consolidated. The confining units lie 40 to 50 meters below land surface.

Of the 52 geoelectric profiles, 68.7% fall within a well-defined envelope (Figure 9). Only 13.7% of the profiles are to the left of the envelope, indicating shallow, low resistivity geoelectric layers. These latter profiles were derived from vertical electric sounding (VES) stations either west or south and southeast of Green Ridge. These lower resistivities result from high percentages of fine sediments, poor water quality, or both. More resistive, deeper geoelectric layers fall to the right of the envelope and comprise 17.6% of the data. These profiles represent shell beds and calcarenites located in the easternmost and northernmost portions of the county.

Four geoelectric cross sections were compiled from the 52 profiles. Two cross sections are west-to-east traverses, one is a south-to-north traverse, and the fourth is oriented southwest-to-northeast. All cross sections nearly parallel major roads in the study area. The location and extent of the cross sections are shown in Figure 10. Cross section A-A' extends from 6.4 km west of SR 710 at Indiantown, eastward along highways 76 and 708 to Hobe Sound. Cross section B-B' extends northward along SR 711 and SR 76A, from 2.4 km north of the Martin-Palm Beach county line to SR 714. The third cross section, C-C', extends from the Hale Dairy Road (SR 609)-SR 714 intersection, eastward along SR 714 to the Palm City-Stuart area. The southwest-to-northeast cross section, D-D', extends from 5.6 km west of the SR 76-SR 708 intersection to 0.3 km south of the SR76-Salerno Road intersection. Total length of the cross sectional coverage is approximately 105 km. The geoelectric cross sections are shown in Figures 11, 12, 13, 14 at a vertical

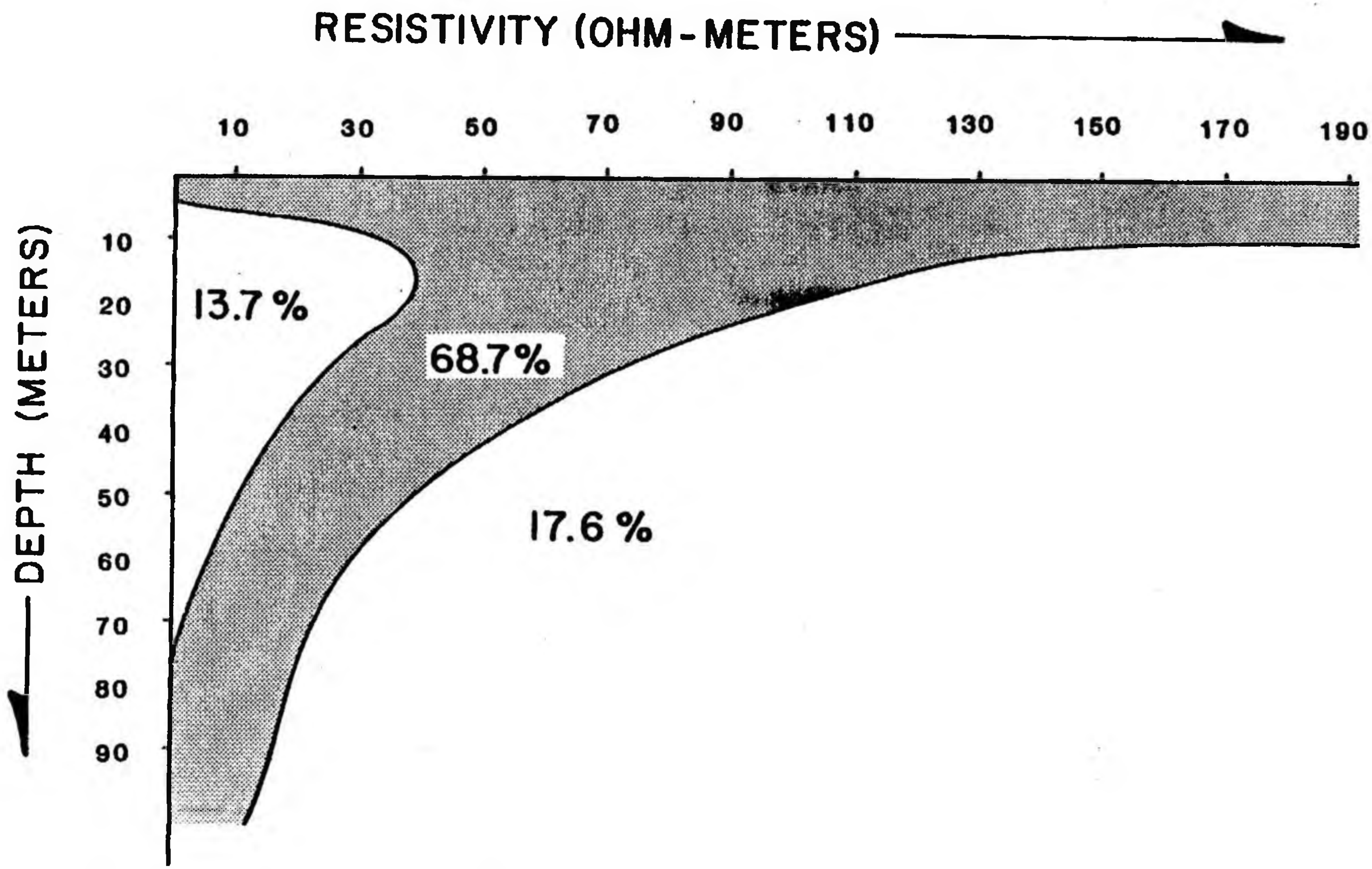

Figure 9. Distribution of resistivity values versus depth for all data.

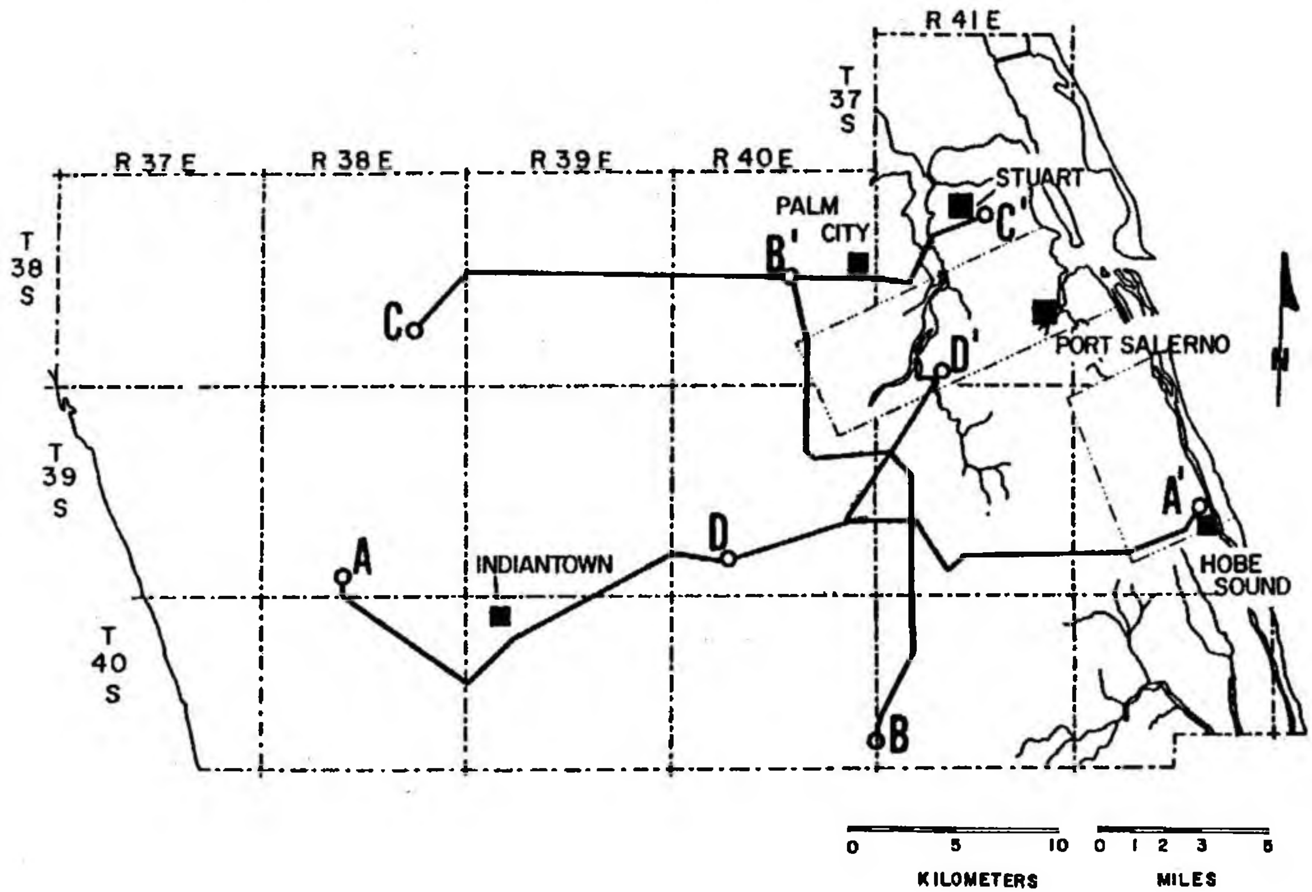

Figure 10. Location and extent of geoelectric cross sections within Martin County, Florida.

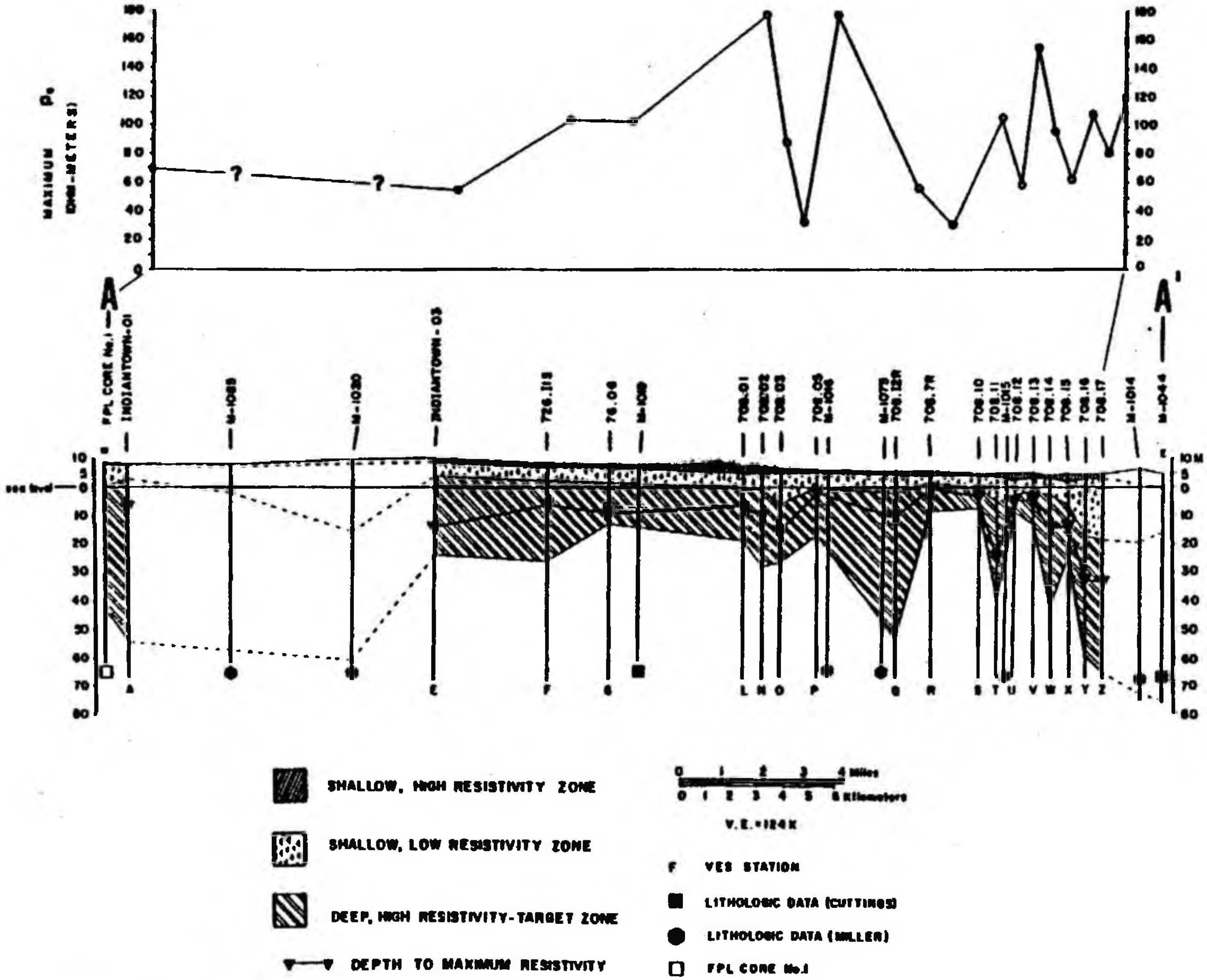

Figure 11. Cross section of geoelectric traverse A-A'.

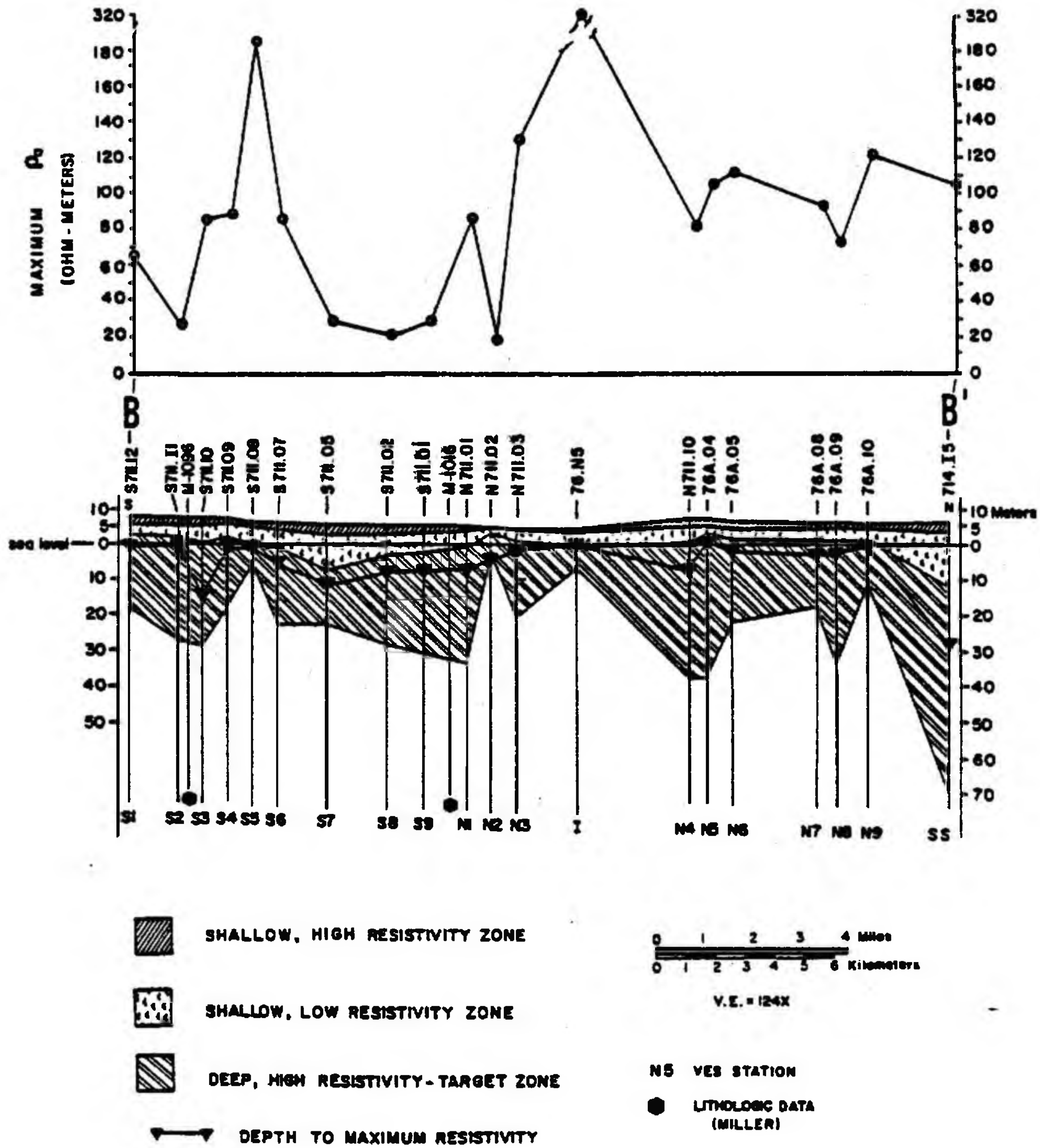

Figure 12. Cross section of geoelectric traverse B-B'.

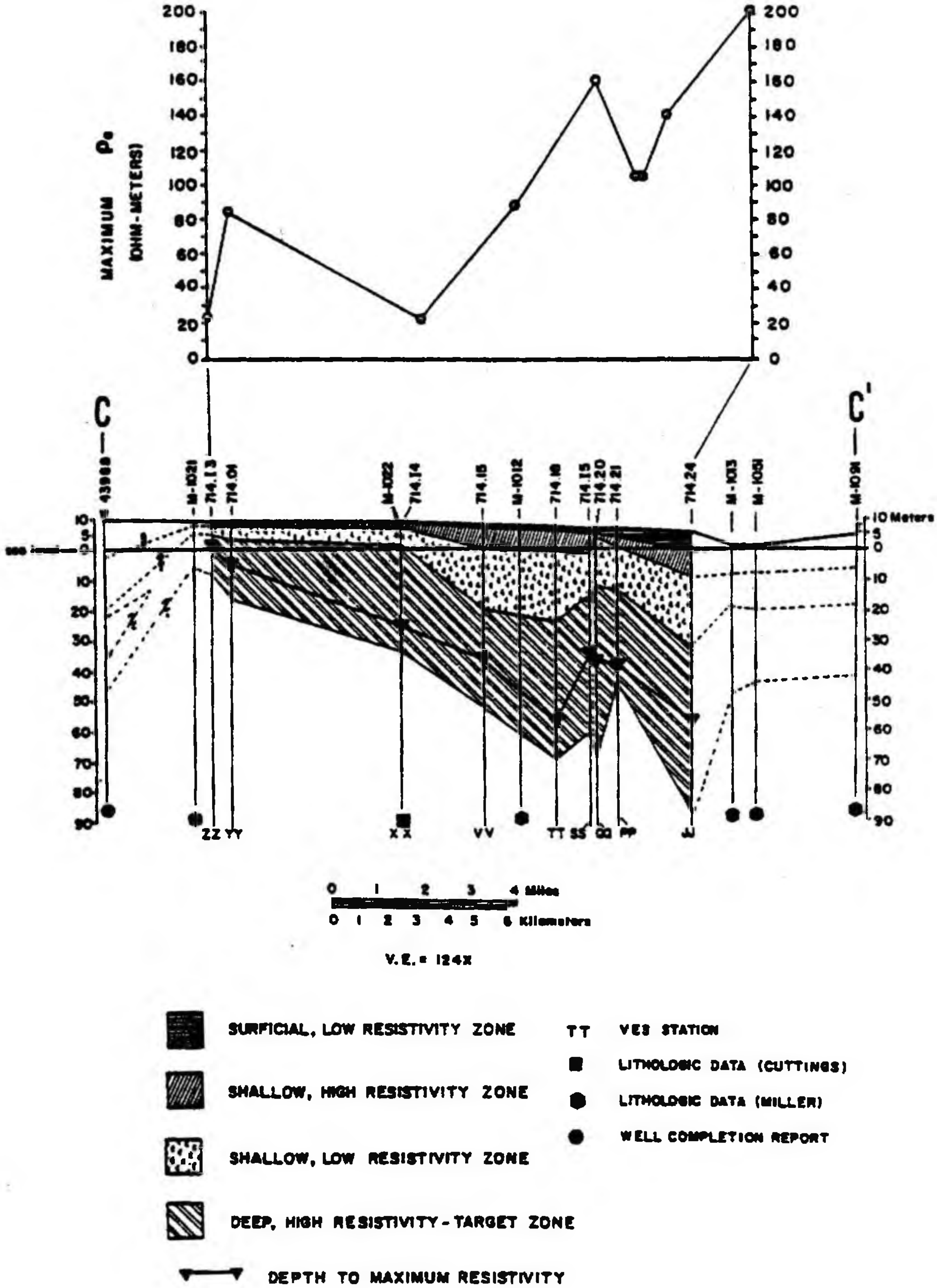

Figure 13. Cross section of geoelectric traverse C-C'.

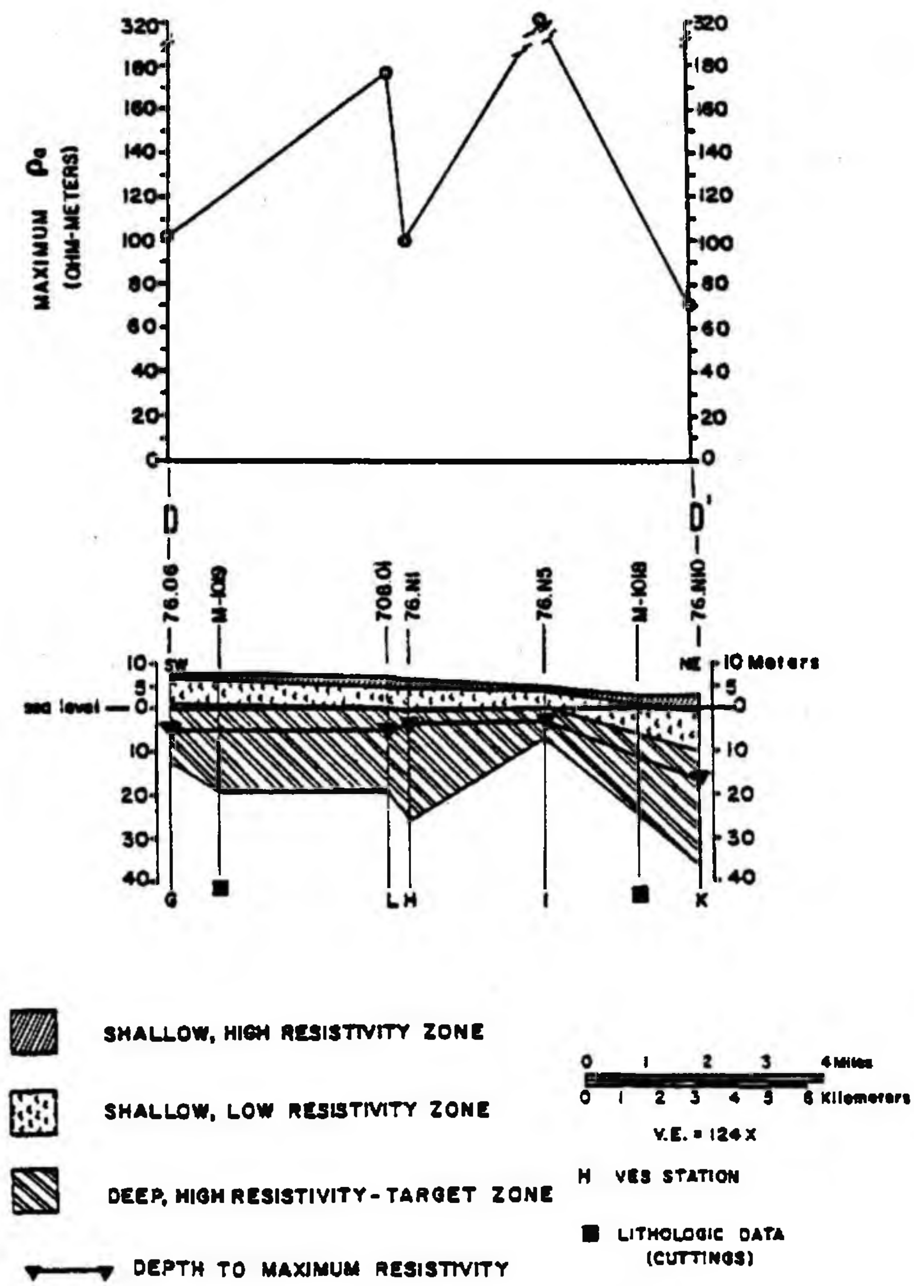

Figure 14. Cross section of geoelectric traverse D-D'.

exaggeration of 124X. Above each cross section is a graph indicating the maximum resistivity value of the target zone at each VES station.

Three distinctive geoelectric layers are illustrated in all four cross sections. A surficial low resistivity layer is also shown in the eastern portions of cross section C-C'. The depth of effective penetration for the electrode spacings used extends well below the depths shown in all cross sections. The bottom of each profile represents the top of the low resistivity confining units below the target zone.

Lithologic data indicate that changes in the lithologic character of the strata are transitional, exhibiting no distinctive boundaries. Also, a geoelectric layer need not correspond to any specific lithology or stratum. Therefore, boundaries between layers were determined strictly by a mechanical procedure referred to here as the midpoint method. The boundary separating the shallow, high resistivity zone from the shallow, low resistivity zone was determined by finding the midpoint between the maximum value of the first peak and the minimum value of the trough. Except for the lower limit of the deep, high resistivity-target zone, all other boundaries were determined similarly. The lower boundary of the target zone was assigned to the depth at which the resistivity decreased to half the maximum value (Appendix D).

The midpoint method works well for the VES profiles. Intuitive correlation may provide more precise boundary locations when nearby lithologic data can be integrated with geophysical data. Consequently, graphically-picked boundaries may shift vertically, based upon correlation with lithologic data. Horizon depths determined graphically are very similar to horizon depths based on available lithologic data. This increases the confidence in graphically-picked horizons where lithologic control is not available.

All four geoelectric cross sections exhibit at least three similar, distinctive features. First, the upper boundary of the low resistivity confining units is variable and undulatory. This uneven nature is reflected in the overlying geoelectric layers, but is less pronounced with each successive overlying unit. High resistivity values in the target zone nearly always occur over points of higher elevation in the confining units. Similarly, lower resistivity values occur over troughs in the underlying units.

Second, a general eastward dip and thickening occurs in the geoelectric layers. Cross section C-C' (Figure 13) shows the greatest amount of easterly dip, with each layer becoming deeper and thicker as the section approaches the St. Lucie River. Cross section D-D' (Figure 14) shows a similar trend, but to a lesser degree and extent. Geoelectric layers dip and thicken eastward from VES 76.N5. Dipping layers occur in the easternmost portions of cross section A-A' (Figure 11). This trend is not as obvious or as great as in the previous two cross sections. Cross section B-B' (Figure 12) does not reflect this trend well as it is a south-to-north traverse, essentially along strike. The geoelectric layers show some dip and thickening in the northernmost portions of the cross section. A review of the cross sections indicates that the greatest dips and thickest units occur in the northeast, near the St. Lucie River. The geoelectric units become thinner and have lower dips in the south eastern section, near Hobe Sound. In the central and western portions of the study area, geoelectric layers are thinner and show only a slight easterly dip. In the Indiantown area the geoelectric layers, especially in the target zone, thicken (Figure 11). This interpretation is based primarily on lithologic data. Additional geophsyical data are needed to substantiate this correlation.

Third, in nearly all of the VES profiles the maximum resistivity in the section occurs at or above the midpoint of the target zone. Like the geoelectric layers, the trend of the depth to maximum resistivity roughly parallels the undulatory nature of the underlying units.

DISCUSSION

Correlation of Resistivity with Geology and Water Quality

As previously described, matrix mineralogy, porosity, and the amount and conductivity of the interstitial fluids determine the amount of resistance an electrical current experiences while flowing through the ground. The dominant lithologies of surficial deposits in Martin County, carbonates (limestones and shell beds), siliceous, terrigenous clastics (sands and sandstones), and marls (carbonate silts) do not readily conduct current electronically. Where appreciable amounts of clay minerals exist in a measured section, as in western Martin County, electrical conduction can occur along clay surfaces, reducing the bulk resistivity. Such a reduction will be reflected in a vertical electric profile. Lithologic data (Appendix C) indicate that over much of the study area, clay minerals are not present in significant quantities in the shallow strata, particularly within the deeper, high resistivity-target zone. Therefore, resistivities of earth materials in central and eastern Martin County may be expressed in terms of their porosities and the quality of interstitial fluids.

Previous resistivity studies have correlated water quality to resistivity response. Worthington (1976), in determining the effectiveness of surficial electrical surveys as applied to arenaceous aquifers, assumes a resistivity response of 29 ohm-meters for water quality of 250 ppm NaCl. Jakob (1980), working in Collier County, Florida, found that the potable water limit of 250 ppm Cl^- corresponds approximately to a resistivity of 30 ohm-meters. A comparison of well-water conductivities, chemical data, and electrical soundings (Stewart and others, 1982) of similar areas in Collier County suggests a resistivity value of 20 ohm-meters for the potable water limit. Vertical sounding and lateral resistivity well-log data from Collier County indicate a wide range of resistivity values for potable water. Therefore, Layton and Stewart (1982, p. 42) suggest the 30 ohm-meter value as a "safe, conservative estimate of the potable water limit in southern Florida".

A comparison of water quality to resistivity values cannot be made in Martin County as proper well-data (lateral resistivity logs) do not exist for strata of the Coastal Ridge Aquifer. As indicated by Table 1, chloride content is generally well below the 250 ppm potable water limit. Additional water sample data from 771 wells in Martin County indicate that chloride content is less than the 250 ppm limit over most of the county (Lichtler, 1960).

In determining hydraulic conductivity and water quality for the shallow aquifer in Palm Beach County, Scott (1977) ranked water into four groups, based on ion concentrations in solution and total dissolved solids. Scott (p. 16) states "that the quality of water contained in the shallow aquifer varies with physiographic regions and depth below land surface". This is due to the character and composition, distribution, and structure of the earth material through which the water moves. Consequently, good quality water occurs within the Atlantic Coastal Ridge and the eastern portions of the Flatlands. Poorer quality water occurs in the western part of Palm Beach County, and is attributed to changes in lithologic character and increases in dissolved solid concentrations due to poor circulation within the strata. By ranking the data from Table 1 into water quality groups (Table 2), trends similar to those in Palm Beach County are shown to occur in Martin County (Figure 15). It should be noted that ranges set for each ion listed in groups A and B are very conservative and well within potable water limits.

Of the 34 samples listed in Table 1, 24 fall within the limits established for group A or group B, indicating good or moderately good quality water. The remaining 10 samples, group C, which have greater than 100 mg/l chloride, occur in regions: 1) subject to salt water encroachment, 2) that are flat lying and have poor water circulation, or 3) have been contaminated in some manner. Those samples from group A occur predominantly within the Atlantic Coastal Ridge province or in the eastern portions of the Flatlands. Those samples from group A that occur in the western part of the county are located within the "Orlando Ridge" (Lichtler, 1960) or where shell beds are the dominant lithology. Samples from group B are distributed county wide and exhibit no certain trend. These samples may indicate locations with moderate to good water circulation and lithologies dominated by shell beds, sands, and/or limestones.

Analyses of the well-water samples (Table 2) indicate low electrolyte concentrations over much of the county. Low electrolyte concentrations do not readily conduct an electric current and the principal conduction is along grain surfaces. If water quality is good, porosity and other lithologic factors dominate the observed bulk resistivity response. Within the areas characterized by water quality groups A and B, variations in resistivity are principally due to lithologic variations. Therefore,

Table 2. Water quality data from well-water samples ranked according to Cl^- and $SO_4^=$ content.

Sample No.	Cl (mg/l)	MG (mg/l)	$SO_4^=$ (mg/l)	Ca^+ (mg/l)	Na^+&K^+ (mg/l)
Group A: Good quality water					
M-1041	46	9.2	1.6	92	34.4
M-1047	21	1.1	6.0	3.7	2.6
M-1049	36	3.4	3.4	110	30.1
M-1051	43	4.4	4.8	97	31.6
M-1058	15	1.0	3.3	6.9	13.4
M-1073	24	2.7	0.3	78	18.1
M-1042	8.6	4.2	11	92	12.3
M-1071	28	1.5	11	58	18.2
WW43-42983	18	7.3	10	77	15
L-01	13	7.4	17	64	16
L-13	16	2.1	5.1	39	9.7
L-655	16	0.9	0.5	70	9.5
L-657	15	2.3	0.0	86	10.2
L-939	16	3.4	1.8	109	8.8
Group B: Moderately good quality water					
M-1030	20	2.4	27	93	17.9
M-1031	8.3	1.4	38	35	16.4
M-1045	82	6.3	1.4	60	46.4
M-1050	75	8.5	3.4	110	52.6
M-1052	91	9.9	11	130	57
M-1055	29	3.3	17	82	56.4
M-1096	90	9.0	0.0	110	47
M-1100	64	7.2	2.2	100	40.3
L-15	79	10	24	124	51
L-09	10	19	39	148	6.7
Group C: Poorer quality water					
M-1046	220	5.7	8.9	82	134.6
M-1053	1600	89	85	170	8330
M-1054	11,000	730	1500	330	6430
WW43-51320	784	48	115	88	474
GS-23	238	26	139	128	182
M-1084	220	16	130	160	134.6
L-22	161	30	34	128	124
L-98	108	4.6	12	102	35
L-936	626	35	128	134	-

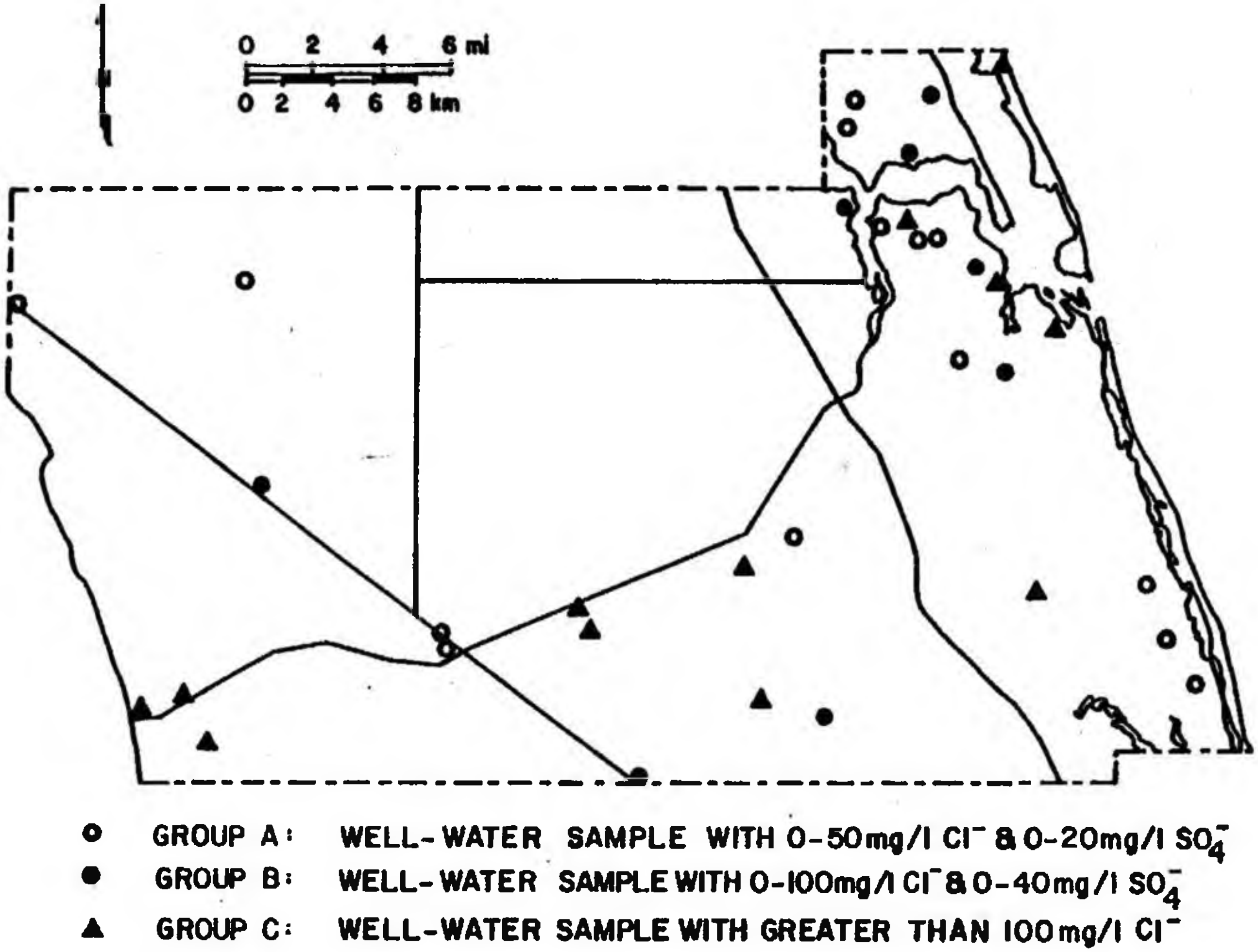

Figure 15. Distribution of water quality groups in Martin County, ranked according to Cl^- and $SO_4^=$ content.

it can be inferred that resistivity response of earth materials in Martin County is primarily a function of porosity.

A comparison between VES Indiantown-01 (Appendix B) and Florida Power and Light Core No. 1 (Appendix C) shows that the second, principal high resistivity geoelectric layer correlates to that part of the core with obvious porosity. The maximum resistivity of 69 ohm-meters at a depth of 14 meters below land surface corresponds to a poorly indurated, shelly sand with moldic porosity. Immediately above and below this sand, 10 to 13 meters and 16 to 20 meters below land surface, are poorly- to well-indurated limestones. These limestones consist of shell hash and quartz sand cemented with sparry calcite. Moldic porosity and pinpoint vugs are common.

Application of the midpoint method to the profile places the upper and lower limits of the target zone at 8 and 60 meters, respectively. Comparison of the VES profile to the core shows the predominant lithology in this zone consists of calcite-cemented, medium- to very fine-grained sands with thin limestones and shell beds throughout. While moldic porosity occurs in the deeper limestones and shell beds, silts and clays fill the voids, probably increasing porosity but reducing permeability. Consequently, the increased porosity of the finer-grained material is reflected in the lower observed bulk resistivities of the geoelectric section.

Geoelectric Cross Sections

While the four geoelectric cross sections exhibit common features, each bears individual characteristics that merit further discussion. In the central portion of cross section A-A' (Figure 11) the geoelectric layers are generally flat-lying with only a moderately undulating surface in the confining beds. Maximum resistivity values within the target zone increase from VES Indiantown-03 to VES 708.01 while depth to maximum resistivity varies only slightly. This indicates a decrease in porosity in an easterly direction. Correlation of VES 76.06 (Appendix B) with lithologic log M-1019 (Appendix C) shows the dominant lithology of the target zone within this area is shell material with coarse sand. Lithologic data from log M-1020, west of the section in question, show significant quantities of clay intermixed with sand and some shell material at similar depths. It is apparent that the reduction in porosity within the target zone is related to the decrease of fine-grained material in an easterly direction.

Between VES 708.01 and VES 708.07R, the confining units exhibit two troughs separated by a small crest. This pattern is reflected in the depth of the target zone, depth to maximum resistivity, and in the maximum resistivities. Resistivity response indicates a lithologic and porosity contrast between the trough margins and the trough centers. The westernmost, shallow trough is characterized in the target zone by relatively high resistivity values at the trough margins, VES stations 708.01 and 708.05. Resistivities are low within the trough, generally decreasing in value with depth. Such a response is indicative of a silt- and clay-rich depression bordered by coarser-grained deposits. Correlation of VES 708.05 to lithologic log M-1016 indicates that the target zone at this locale is predominantly shell and sand with some coarse sandstones and limestones. Lying southeast of Green Ridge, this trough may represent a shallow channel associated with the end of the ridge and that has been filled with fine sediments.

The second, larger depression exhibits lower resistivities within the trough. Sediments in the section are primarily shell material and sand intermixed with clays. However, the maximum resistivity of the target zone corresponds to shells, sandstones, and limestones. Lower resistivities of the target zone may be attributed to poor quality water due to: 1) poor ground water circulation caused by overlying semi- to impermeable clay layers, 2) contamination by fertilizers, nutrients, and water from the Floridan Aquifer, from nearby citrus groves, or 3) a combination of these factors.

The fact that these depressions lie in close proximity to each other and contain significant percentages of clay might suggest karstic development and in-filling. Solution features landward of the present day dunes are common in Martin County, as is illustrated in the Gomez 7½" topographic map. However, the configuration of the target zone and depths to maximum resistivity strongly reflect the topographic nature of the underlying confining beds. Thus these depressions may have been topographic lows during the deposition of the Coastal Ridge Aquifer sediments, trapping finer-grained materials within them while coarser-grained materials formed shoals and shallow ridges.

In the eastern portions of cross section A-A' (Figure 11) the surface of the confining beds is variable and undulatory, but expresses some periodicity. This periodicity is reflected by alternating moderate and high values in the maximum resistivity values of the target zone. The highest values occur over the topographic highs of the confining beds. This implies that the confining beds have influenced the depositional history of the overlying units or compaction has altered the fabric of the target zone overlying these highs. The eastern portion of the cross section lies within the Atlantic Coastal Ridge province. Parker and Cooke (1944) state that this ridge exists, in part, due to an underlying, pre-existing beach ridge system. Such periodicity of resistivity may be expected in a beach ridge system as ridges are more susceptible to sorting, loss of fine-grained material, and possibly earlier cementation than are the sheltered swales. Higher resistivities, then, would be expected to occur at ridges, while lower resistivities would occur in troughs.

Again resistivity values express a general increase (west to east) from VES 708.07R to 708.17. This increase is a function of increased cementation in an easterly direction. Lithologic data (Appendix C) indicate that the dominant lithology of the target zone along coastal Martin County is a well-cemented, shelly calcarenite. However, loosely-cemented shell beds and poorly cemented and/or cavernous sands occur within this calcarenite. These zones may account for the occurrence of moderate resistivities and are often "water-bearing" as indicated by drillers' completion reports (Appendix C).

An interesting feature is that the upper boundary of the target zone from VES 708.12 to VES 708.16 forms a dome-like shape typical of a bioherm or some biological "reef" build-up. Coral materials have been reported in drillers' completion reports from the Stuart area, the Hobe Sound area, and in Tequesta, Florida, which lies immediately south of the Martin County line in northeast Palm Beach County. The locations of reported coral material form a trend parallel to the present day coast line. However, it is not known whether the coral materials are from actual bioherms or are allogenic. Additionally, no lithologic data are known to exist for this portion of cross section A-A'. Therefore, the true nature of this dome-like feature is at best speculative. If a true bioherm does exist at this location, its stratigraphic relationship with the beach ridge system must be defined, or the interpretation of a beach ridge system to explain these periodic geoelectric responses may have to be reevaluated.

VES stations of cross section B-B' (Figure 12) can be divided into two groups. The first group is composed of stations located south and southeast of Green Ridge. VES profiles from these stations exhibit lower resistivities throughout the section. These stations lie within the Eastern Flatlands province where relief and the water table gradient are very low. As indicated by lithologic data (well M-1096, Appendix C), "hardpans" and clay lenses occur in these areas. These clay lenses (which act as semi-permeable or impermeable barriers) cause fresh water to pond at the surface and result in poor ground-water circulation. Hence, residual sea water may still remain in the subsurface, especially at greater depths (Lichtler, 1960).

A high resistivity response occurs at VES S711.08. Moderate resistivity responses occur on either side of this VES station. In this area the target zone thins considerably, reaching a minimum thickness at VES S711.08. The target zone overlies a topographic high of the confining beds. It is possible that these moderate and high resistivity responses reflect sediments of coarser grain size, greater cementation, or both, being influenced by this high during the time of deposition. Data indicate the occurrence of these topographic highs to be local and discontinuous. Therefore, the location and extent of these highs are not readily predictable.

The second group of VES stations in cross section B-B' extends from VES N711.03 to VES 714.I5. These stations have consistently higher resistivity values within the target zone than do the southern stations. Maximum resistivity values generally range from 70 to 130 ohm-meters and are usually located 9 to 10 meters below land surface. Such continuity would indicate rather uniform lithologic character at these depths. No nearby lithologic data are available. Surrounding lithologic data, however, would indicate a rather constant lithology at 9 to 12 meters below surface. Lithologic log M-1018 (Appendix C) 5.0 km east of the cross section, is composed mostly of *Donax*, *Tellina*, and *Chione* fragments intermixed with coarse sand at an interval ranging from 6 to 12 meters below surface. North of the cross section, the M-1012 log and the Gee and Jenson wells indicate large percentages of unconsolidated, coarse- to fine-grained fragments of *Donax*, *Chione*, *Venus*, and *Trachycardium* shells mixed with light gray to brown quartz sands at similar intervals. Equally important is the fact that VES profiles in this area are the same or very nearly similar to the VES 726.I1S and VES 76.06 profiles. Maximum resistivities peaks of these two profiles have been correlated to shells, shell fragments, and sand. Thus, it can be inferred that the maximum resistivities of the northern half of cross section B-B' are a response to a shell and sand lithology.

It is important to note that this geoelectric continuity extends only as far as the southern limit of Green Ridge. Lying between the Atlantic Coastal Ridge province and Green Ridge, the depositional environment of the sediments represented in this portion of cross section B-B' was probably controlled by the same regional topographic and geologic settings that determined the character of the Atlantic Coastal Ridge and possibly Green Ridge. This implies that there is a correlation between present day geomorphological features and the location, extent, and character of the sediments of the Coastal Ridge Aquifer.

Lithologic data suggest an increase in sediment grain size from west to east in the sediments depicted in cross section C-C' (Figure 13). This trend is reflected in the values of maximum resistivity, which increase in an eastward direction. Significant quantities of clay and silt occur throughout most of lithologic section M-1021 (Appendix C). As a result, a nearby geoelectric profile VES 714.I3 (Appendices A and B) shows reduced resistivities.

Lithologic log M-1022 and VES 714.I4 are located on the western side of Green Ridge. The sand and shell lithology contains silt throughout the measured section. Consequently, the geoelectric profile of VES 714.I4 displays very low values.

Lithologic logs east of Green Ridge have little or no silt-sized sediments, especially in the upper portions of the target zone. The low silt content results in a marked increase in resistivity values throughout the measured section. This implies that Green Ridge may delimit a facies change, separating finer-grained sediments in central and western Martin County from the shell beds, calcirudites (coquina), and calcarenites in eastern Martin County. Miller (1980) illustrates a poorly defined carbonate feature beneath Green Ridge that may be genetically related to the deposition of these eastern sediments. Further research is needed to substantiate such a relationship.

Lithologic data indicate that the dominant sediments in the Palm City area are thick shell beds, calcirudites, and calcarenites. Cementation varies from unconsolidated to well-lithified. Lithification tends to be better developed and more extensive with increasing depth. This trend is illustrated in the eastern geoelectric profiles of cross section C-C'. Maximum resistivity values from the target zone in VES profiles 714.15 through 714.24 (Appendices A and B) range from 90 to 200 ohm-meters. The Gee and Jenson wells (Appendix C) indicate the corresponding lithology is a sandy, well-lithified, fossiliferous, limestone. Overlying this limestone are unconsolidated or friable shell beds intermixed with fine sand, and some marl and clay. Resultantly, resistivity values are generally between 30 and 60 ohm-meters.

The eastward dipping trend of the geoelectric layers is greatest in the area represented by the eastern portions of cross section C-C'. Well cuttings show that the well-cemented calcarenite of the target zone is generally deeper in this region than are the corresponding sediments of the central and western portions of the study area. These sediments were deposited during a time in which the forks of the St. Lucie River were embayments, extending farther inland, and subjecting the area to shallow marine influence.

The thickness of the target zone is also greatest in the eastern portions of the area represented by cross section C-C'. Maximum thickness is nearly 60 meters in the measured section of VES 714.24. Lithologic data show the calcarenite grades downward into silty sands and calcilutites with clay.

The lower half of the target zone in the eastern portion of cross section C-C' may contain some fine-grained materials. Thus, the lower half of the target zone in the Palm City area may not always be suitable for water-well development. Such development may be restricted to the upper half of the target zone or to a depth no greater than the depth of maximum resistivity as a precaution to avoid these fine-grained sediments.

Maximum resistivity zones (cross section D-D', Figure 14) occur within the upper half of the target zone, often near the zone's upper limit. These resistivities correspond to shell beds with medium- to fine-grained quartz sands as indicated by lithologic logs M-1018 and M-1019 (Appendix C). Log M-1018 also shows the presence of some silt and clay within the measured section. The presence of these fine sediments is reflected in the values of maximum resistivities, which show a slight regional decline from west to east.

VES profile 76.N5 has an abnormally high resistivity response in the target zone. The thin target zone in this measured section appears to drape over a large, high area of the confining units and dip easterly. Maximum resistivity occurs at or near the upper boundary of the target zone. Such a response is indicative of a thoroughly indurated calcarenite.

Maximum resistivities of the target zone illustrated in the four geoelectric cross sections indicate the presence of 1) a well-cemented calcarenite, or 2) shell beds, or 3) both. These lithologies exhibit high resistivity values as electrical current passes only through pore space, and then only along grain surfaces. The calcarenite lies principally in the eastern portions of the study area. Drillers' completion reports and well cuttings (Appendix C) show that the calcarenite extends northward into St. Lucie County, eastward into the Stuart and Port Salerno areas, where well fields already exist, and southward along the Atlantic Coastal Ridge. Cavernous zones, commonly filled with sand, may occur within this unit. These sediments exhibit water-bearing potential in that they are usually coarse-grained and may be porous, are of suitable thickness for water-well development, and rather continuous in eastern Martin County.

The shell bed lithology often occurs with the calcarenite, but has a greater regional extent than the calcarenite. Gee and Jenson wells (Appendix C) in the Palm City area indicate unconsolidated, coarse-grained, shell units, 10 to 20 meters thick. Consolidated and unconsolidated sediments occur over much of eastern Martin County. Shell beds extend along state road 76 as far west as the location of VES 726.I1S (Site F, Figure 4). Farther west, at the VES 726.I3S location, the geoelectric profile is indicative of a shell bed lithology. Note that this does not necessarily indicate that the shell beds are continuous across the study area. To the contrary, lithologic data indicate rapid lithologic changes over short distances in western and central Martin County. Furthermore, White (1970, p. 110) states that the area between Green Ridge and "Orlando Ridge", known as Allapatah Flats, is probably composed of "a group of progradational beach ridges". Relief is this area is so low that the subparallel pattern of the ridges is outlined only by sloughs and shallow, marshy lakes. If this area is truely a beach-ridge system, then the loss of nearly all topographic expression of the system probably results from the "solution of sands which were dominantly shell" (White, 1970, p. 110).

Collapse of these sands greatly reduces the possibility of continuous shell beds across the central portions of Martin County. Still, where shell beds occur with suitable shell size, bed thickness, and extent, water-well development potential may exist.

Resistivity response west and south of Green Ridge can be variable and may be low throughout the measured section. Sediments may contain significant amounts of silts and clays. The presence of these fine-grained sediments in the third geoelectric layer is of primary importance as it decreases the potential of water-well development within this zone. A division of the geoelectric layer, separating those regions with significant fine-grained fractions from those with little or no fine sediments, can be made. Figure 16 illustrates a boundary, approximately 21 km inland from the present coast line, which denotes the approximate western limit of the eastern calcarenite and shell beds. These strata compose the major portions of the Coastal Ridge Aquifer. Strata with potential for water-well development may exist west of this limit. However, the location and extent of such strata, other than "Orlando Ridge", are not known.

The actual western extent of the Coastal Ridge Aquifer may vary locally from this boundary. Regionally, however, the boundary conforms to similar limits established in adjacent or nearby areas. The best quality water from water-bearing zones of Palm Beach County are found only in eastern portions. A line drawn through the western limit of these zones show that they vary between 19 and 22.5 km in width from the coast. Scott (1977, p. 7) states that these zones are composed of "beds of large shells and low sand content", coquina, calcareous sandstones, and cavernous limestones. These sediments are Pleistocene

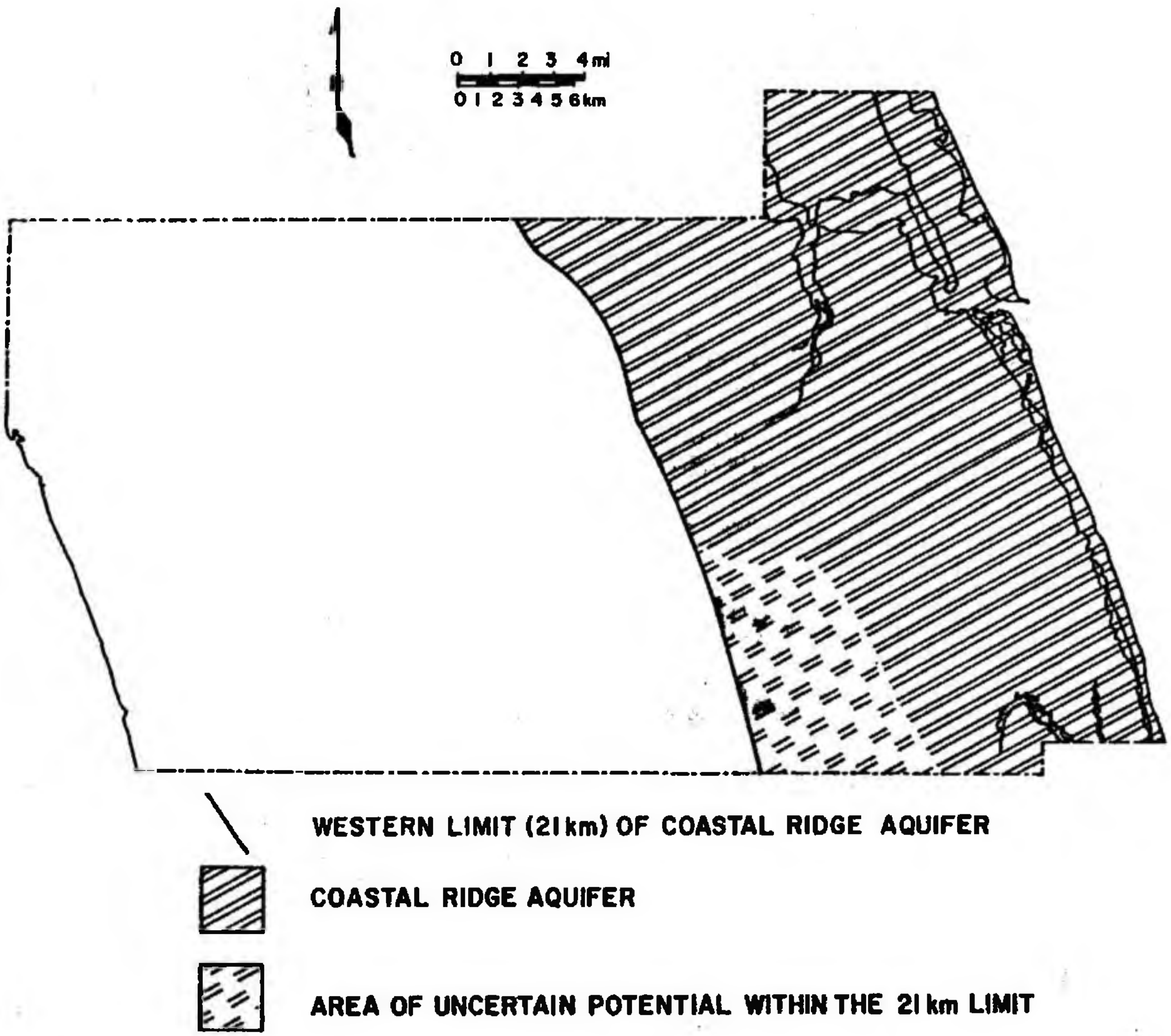

Figure 16. Location and extent of the Coastal Ridge Aquifer in Martin County, Florida.

(Anastasia Formation) and possibly Pliocene (Caloosahatchee Marl and/or Tamiami Formation) in age. Similarly, Frazee and Johnson (1983) show the western limit of the recrystallized limestone of the shallow rock zone in Indian River and Brevard Counties to be generally 21 to 22 km inland. These sediments are predominantly Pliocene (Tamiami Formation) in age overlain by Pleistocene strata (Anastasia Formation). Moreover, this 21 km limit in Martin County coincides approximately with the Anastasia-Caloosahatchee formation boundary established by Vernon and Puri (1964).

SUMMARY AND CONCLUSIONS

Geoelectric profiles reveal the occurrence of three distinct geoelectric layers within the surficial aquifer. High resistivity response, usually exceeding 100 ohm-meters at or near the surface, is due to the presence of medium- to fine-grained siliceous sands. This geoelectric layer is thin, being only a few meters in thickness at most.

Low resistivity response characterizes the second geoelectric layer. Within this zone, sediments are quartz sands intermixed with shell material, silts, and clays. Generally, fine-grained materials are present in significant quantities. Where clays beds or lenses exist, downward flow may be impeded, resulting in the ponding of water at the surface.

Lying immediately beneath the low resistivity layer is the third geoelectric unit, which commonly has a resistivity response greater than 50 ohm-meters. This layer is primarily composed of a well-cemented calcarenite and/or shell beds intermixed with quartz sands. Lithologic data indicate that the calcarenite occurs only in eastern portions of Martin County. Furthermore, the western portion of this zone may contain significant amounts of fine-grained sediments, rendering much of the area unsuitable for high-yield water-well development.

Ground water quality is relatively good and constant over much of the county. Variation in resistivity response can be attributed to changes in lithologic character and effective porosity.

Resistivity response becomes variable and may be low throughout the measured section in areas west and south of Green Ridge. Higher and most consistent resistivity values occur in regions east of Green Ridge. Geoelectric profiles east of Green Ridge reflect those sediments with the greatest potential for water-well development. These sediments are the calcarenite and shell beds of the deep, high resistivity zone.

Integration of these surficial electrical resistivity surveys with lithologic and water-quality data allows for the delineation of those strata with water-bearing potential. A boundary has been identified 21 km inland from the present day coast line. The boundary separates those sediments with good water-producing potential from those with little or no potential. This boundary essentially delimits the western extent of the Coastal Ridge Aquifer.

The Coastal Ridge Aquifer can be developed to supply supplemental quantities of water to the municipalities of coastal Martin County. The aquifer consists of three geoelectric layers of which the deep, high resistivity zone is of primary importance. This zone is dominantly a calcarenite, but may have shell beds and cavernous zones associated with it. The aquifer extends from the surface to the confining layers separating this aquifer from the Floridan Aquifer. The aquifer's thickness varies from as little as 5 meters at its western limit to as great as 60 meters in eastern portions of the county. Generally, the aquifer thickness ranges from 20 to 30 meters. The aquifer seems to have some geological relationship with local geomorphic features, but this relationship has not been adequately defined. Southern and northern limits of the Coastal Ridge Aquifer are not known. Lithologic and water-quality data from nearby regions would suggest that this aquifer extends southward at least into Palm Beach County and northward as far as Brevard County. Sediments of the aquifer are Pleistocene and Pliocene in age.

The fact that similar water quality and lithologic data exist in nearby regions suggests that surface DC resistivity surveys are applicable to these areas. In other words, the application of DC resistivity surveys to delineate the hydrostratigraphy in the shallow, clastic sediments in Martin County is not unique. More importantly, this technique is not unique to the Coastal Ridge Aquifer. To the countrary, DC surveys can be used to delineate hydrostratigraphic zones in regions that meet certain basic requirements. First, lithologic strata should be layered and at least semi-horizontal. Complex stratigraphic and/or structural relationships, as well as steeply dipping strata, tend to render resistivity curves difficult to interpret and often useless. Second, lithologic variation of the strata must be great enough to reflect a resistivity contrast in the data curves. Such variation may be the result of the degree of cementation, porosity development, contrast in grain size, or mineralogy. Any combination of these factors may be sufficient to create enough lithologic variation to cause a resistivity contrast. Third, water quality must be constant and of low ionic strength. Rapid changes in water quality over short distances make hydrostratigraphic correlation difficult or impossible.

To better illustrate some of these requirements a generalized hydrostratigraphic diagram is shown in Figure 17. This diagram depicts a "typical" coastal ridge aquifer and its associated geoelectric layers. With each geoelectric layer a lithologic example is given to illustrate

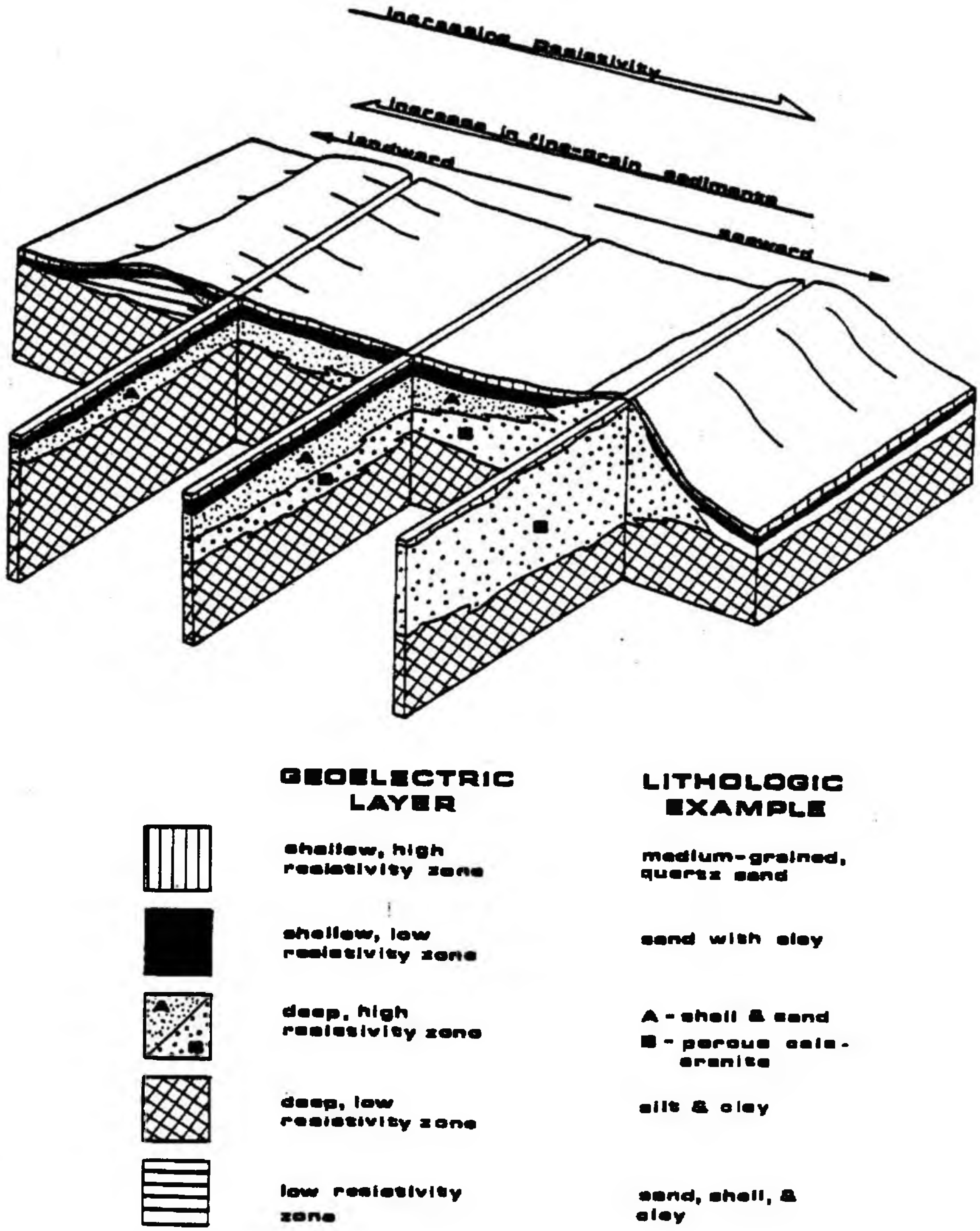

Figure 17. Schematic diagram of geoelectric zones of a layered, near-coast environment.

what type of strata might give such a resistivity response. It is greatly simplified by assuming that the limits of each geoelectric layer correspond to the limits of a particular lithology.

The model shows several important features. First, the deep, low resistivity layer is overlain by roughly parallel, seaward-dipping layers. Each successive, overlying layer extends farther landward. Also, each layer becomes thinner in landward direction. Thus, these layers may represent a transgressive or onlapping sequence. Second, grain size is generally coarser in the area of the coastal ridge (large stippled pattern, Fig. 17) and becomes finer in a landward direction. Consequently, resistivity values are lower in a landward direction. Third, resistivity values increase in a seaward direction. This trend is due to several factors. As mentioned, coarser grain size in a seaward direction is partly responsible. Additionally, lower bulk porosity of unit A (small stippled area, Fig. 17) of the deep, high resistivity layer and lower bulk porosity and a greater degree of cementation in unit B (large stippled area) contribute to the increased resistivity. Due to coarser grain size and secondary porosity and the lack of fine-grained sediments these units are best suited for water-well development from the aquifer. Finally, a shallow, low resistivity layer lies landward of the coastal ridge aquifer. Its lithology is similar to that of unit A, but the presence of clay makes this layer a poor prospect for water-well development.

The surface DC resistivity survey method is applicable to regions that meet these basic requirements. Strata need not belong to a transgressive sequence nor do the sediments have to be clastics. Still, in regions that may contain coastal ridge features this example should be an informative and predictive model.

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Appendix A: Part 1-Field data of fifty-two vertical electric soundings from Martin County, Florida.

VES INDIANTOWN 01 (Site A)

A-Spacing (meters)	Resistivity (Ohm-meters)
1.0	221.715
1.5	164.410
2.0	111.197
3.0	68.874
4.0	82.846
6.0	67.858
8.0	60.695
10.0	61.732
15.0	62.270
20.0	59.276
30.0	54.292
40.0	56.322
60.0	44.711
80.0	41.871
100.0	32.484
120.0	25.108
140.0	21.991
160.0	18.699

VES 726.I3S (Site B)

A-Spacing (meters)	Resistivity (Ohm-meters)
2.03	26.036
2.84	30.563
4.05	37.158
6.08	51.907
6.08	55.152
8.12	59.218
8.12	63.024
12.16	78.776
16.20	81.757
20.26	81.097
20.26	78.595
28.37	77.742
28.37	76.387
40.50	69.011
60.80	49.332
60.80	55.016
81.10	35.493
81.10	38.563
121.60	14.504
162.10	14.523
202.70	4.929
202.70	5.056

VES 726.I4S (Site C)

A-Spacing (meters)	Resistivity (Ohm-meters)
2.03	40.100
2.84	47.247
4.05	49.196
6.08	38.823
6.08	36.194
8.12	35.760
8.12	33.546
12.16	30.344
16.20	31.840
20.26	29.259
20.26	29.393
28.37	27.787
28.37	27.301
40.50	20.950
60.80	11.582
60.80	13.306
81.10	7.259
81.10	7.987
121.60	3.527
162.10	3.555
202.70	3.975
202.70	2.068

VES INDIANTOWN 03 (Site E)

A-Spacing (meters)	Resistivity (Ohm-meters)
1.0	751.101
1.5	495.359
2.0	368.598
3.0	278.038
4.0	157.509
6.0	64.164
8.0	42.615
10.0	34.935
15.0	32.044
20.0	33.552
30.0	32.319
40.0	31.919
60.0	23.185
80.0	15.783
100.0	12.315

VES 726.11S (Site F)

A-Spacing (meters)	Resistivity (Ohm-meters)
2.03	39.243
2.84	39.342
4.05	38.062
6.08	38.113
6.08	45.023
8.12	42.720
8.12	50.374
12.16	55.930
16.20	67.031
20.26	62.546
20.26	59.752
28.37	60.031
28.37	57.152
40.50	53.717
60.80	36.163
60.80	39.021
81.10	20.877
80.10	21.840
121.70	9.071
162.10	4.638
202.70	4.234
202.70	4.376

VES 76.06 (Site G)

A-Spacing (meters)	Resistivity (Ohm-meters)
1.0	151.502
1.5	118.538
2.0	108.068
3.0	71.083
4.0	52.025
6.0	38.227
8.0	37.347
10.0	40.401
15.0	47.784
20.0	48.469
30.0	48.432
40.0	39.458
60.0	37.699

VES 76.N1 (Site H)

A-Spacing (meters)	Resistivity (Ohm-meters)
1.0	105.322
1.5	108.142
2.0	103.343
3.0	81.357
4.0	68.136
6.0	58.547
8.0	58.961
10.0	60.319
15.0	60.790
20.0	62.832
30.0	57.100
40.0	49.511
60.0	30.159
80.0	20.106
100.0	11.750
120.0	8.068
140.0	5.806

VES 76.N5 (Site I)

A-Spacing (meters)	Resistivity (Ohm-meters)
1.0	89.998
1.5	176.719
2.0	163.358
3.0	143.373
4.0	141.599
6.0	140.014
8.0	152.956
10.0	160.661
15.0	163.520
20.0	112.595
30.0	77.640
40.0	60.928
60.0	32.308
80.0	22.167
100.0	22.996
120.0	33.778
140.0	12.579
160.0	29.556

VES 76.N5S (Site J)

A-Spacing (meters)	Resistivity (Ohm-meters)
2.03	212.565
2.84	229.800
4.05	167.778
6.08	157.650
6.08	153.736
8.12	193.699
8.12	187.200
12.16	196.798
16.20	201.093
20.26	134.367
20.26	108.241
28.37	81.957
28.37	86.774
40.50	53.749
60.80	26.811
60.80	23.096
81.10	10.698
81.10	10.982
121.60	5.176
162.10	8.480
202.70	5.168
202.70	3.907

VES 76.N10 (Site K)

A-Spacing (meters)	Resistivity (Ohm-meters)
1.0	159.733
1.5	154.862
2.0	139.432
3.0	140.866
4.0	135.794
6.0	113.091
8.0	92.287
10.0	81.744
15.0	70.309
20.0	62.832
30.0	55.970
40.0	48.255
60.0	30.913
80.0	20.358
100.0	8.482

VES 708.01 (Site L)

A-Spacing (meters)	Resistivity (Ohm-meters)
2.03	124.253
2.84	102.030
4.05	72.609
6.08	67.564
6.08	67.837
8.12	74.500
8.12	70.387
12.16	84.464
16.12	94.453
20.26	93.818
20.26	124.787
28.37	89.762
28.37	93.301
40.50	77.258
60.80	46.329
60.80	46.950
81.10	25.598
81.10	26.832
121.70	8.247
162.10	4.697

VES 708.02 (Site N)

A-Spacing (meters)	Resistivity (Ohm-meters)
2.03	103.41
2.84	67.828
4.05	47.585
6.08	43.970
6.08	43.970
8.12	33.888
8.12	45.678
12.16	52.612
16.20	54.336
20.26	57.722
20.26	55.844
28.37	52.765
28.27	53.545
40.50	46.924
60.80	32.475
60.80	34.264
81.10	17.574

VES 708.03 (Site O)

A-Spacing (meters)	Resistivity (Ohm-meters)
2.03	34.566
2.84	22.064
4.05	16.093
6.08	15.363
6.08	14.772
8.12	15.072
8.12	15.884
12.16	15.610
16.20	17.490
20.26	17.932
20.26	18.492
28.37	17.129
28.37	17.118
40.50	14.996
60.80	9.414
60.80	10.107

VES 708.05 (Site P)

A-Spacing (meters)	Resistivity (Ohm-meters)
1.0	461.380
1.5	407.923
2.0	322.004
3.0	152.270
4.0	77.359
6.0	45.616
8.0	38.855
10.0	42.142
15.0	42.977
20.0	51.773
30.0	49.939
40.0	47.249
60.0	32.798
80.0	23.323
100.0	14.765
120.0	11.234
140.0	9.148
160.0	4.725

VES 708.I2R (Site Q)

A-Spacing (meters)	Resistivity (Ohm-meters)
1.0	47.832
1.5	44.184
2.0	42.021
3.0	39.472
4.0	39.735
6.0	43.090
8.0	38.101
10.0	38.516
15.0	44.014
20.0	45.365
30.0	43.344
40.0	41.218
60.0	37.699
80.0	19.101
100.0	20.609

VES 708.07R (Site R)

A-Spacing (meters)	Resistivity (Ohm-meters)
2.03	16.951
2.84	14.471
4.05	12.799
6.08	13.794
6.08	14.625
8.12	14.789
8.12	15.862
12.16	15.516
16.20	16.252
20.26	14.952
20.26	15.060
28.37	12.181
28.37	12.804
40.50	10.951
60.80	6.734
60.80	6.892
81.10	3.843
81.10	4.260
121.60	1.560
162.10	0.920
202.70	0.727
202.70	0.792

VES 708.10 (Site S)

A-Spacing (meters)	Resistivity (Ohm-meters)
1.0	148.279
1.5	166.087
2.0	154.574
3.0	101.817
4.0	79.144
6.0	59.301
8.0	53.030
10.0	51.082
15.0	49.292
20.0	43.605
30.0	33.172
40.0	26.389
60.0	15.080
80.0	13.069
100.0	8.168
120.0	10.028

VES 708.11 (Site T)

A-Spacing (meters)	Resistivity (Ohm-meters)
1.0	144.119
1.5	111.941
2.0	97.500
3.0	73.421
4.0	51.673
6.0	39.622
8.0	17.040
10.0	39.082
15.0	36.757
20.0	40.212
30.0	43.166
40.0	25.133
60.0	31.290
80.0	22.619
100.0	15.708
120.0	8.972
140.0	7.037
160.0	4.021

VES 708.12 (Site U)

A-Spacing (meters)	Resistivity (Ohm-meters)
1.0	58.413
1.5	57.445
2.0	62.019
3.0	58.718
4.0	84.723
6.0	39.546
8.0	36.492
10.0	37.511
15.0	40.435
20.0	44.359
30.0	43.731
40.0	41.971
60.0	29.028
80.0	21.079
100.0	14.451
120.0	12.064
140.0	7.037
160.0	6.032

VES 708.13 (Site V)

A-Spacing (meters)	Resistivity (Ohm-meters)
1.0	100.013
1.5	106.031
2.0	106.497
3.0	70.461
4.0	54.715
6.0	55.418
8.0	58.207
10.0	62.518
15.0	65.502
20.0	60.319
30.0	51.648
40.0	39.710
60.0	32.798
80.0	30.159
100.0	14.451
120.0	10.556
140.0	6.158
160.0	7.037

VES 708.14 (Site W)

A-Spacing (meters)	Resistivity (Ohm-meters)
1.0	86.140
1.5	67.917
2.0	68.610
3.0	53.609
4.0	48.682
6.0	42.977
8.0	44.786
10.0	44.883
15.0	54.475
20.0	49.135
30.0	55.983
40.0	51.019
60.0	41.846
80.0	32.673
100.0	18.221
120.0	11.310
140.0	13.195
160.0	4.021

VES 708.15 (Site X)

A-Spacing (meters)	Resistivity (Ohm-meters)
1.0	49.366
1.5	55.136
2.0	59.324
3.0	58.718
4.0	56.122
6.0	52.779
8.0	48.606
10.0	48.632
15.0	51.836
20.0	56.549
30.0	53.344
40.0	54.538
60.0	35.814
80.0	28.651
100.0	22.619
120.0	11.310
140.0	13.195
160.0	7.037

VES 708.16 (Site Y)

A-Spacing (meters)	Resistivity (Ohm-meters)
1.0	304.053
1.5	288.235
2.0	295.301
3.0	245.729
4.0	231.676
6.0	177.713
8.0	143.356
10.0	178.380
15.0	88.970
20.0	80.676
30.0	73.325
40.0	65.094
60.0	56.926
80.0	44.736
100.0	33.929
120.0	25.635
140.0	31.667
160.0	14.074

VES 708.17 (Site Z)

A-Spacing (meters)	Resistivity (Ohm-meters)
1.0	250.271
1.5	195.814
2.0	185.889
3.0	298.999
4.0	146.017
6.0	131.947
8.0	116.112
10.0	105.809
15.0	195.188
20.0	83.817
30.0	78.603
40.0	82.435
60.0	73.890
80.0	65.345
100.0	33.301
120.0	69.366
140.0	41.343
160.0	27.143

VES 714.13 (Site ZZ)

A-Spacing (meters)	Resistivity (Ohm-meters)
2.03	32.745
2.84	22.672
4.05	14.750
6.08	12.912
6.08	12.818
8.12	13.563
8.12	13.314
12.16	14.455
16.20	13.248
20.26	12.882
20.26	13.080
28.37	10.814
28.37	11.366
40.50	9.631
60.80	6.775
60.80	6.734
81.10	4.932
81.10	5.236
121.60	3.402
162.10	2.209
202.70	2.324
202.70	1.359

VES 714.01 (Site YY)

A-Spacing (meters)	Resistivity (Ohm-meters)
1.0	144.684
1.5	133.543
2.0	100.352
3.0	60.000
4.0	42.123
6.0	34.457
8.0	24.580
10.0	37.197
15.0	39.867
20.0	48.004
30.0	38.821
40.0	42.977
60.0	26.540
80.0	20.961
100.0	17.467

VES 714.14 (Site XX)

A-Spacing (meters)	Resistivity (Ohm-meters)
2.03	36.440
2.84	31.519
4.05	25.474
6.08	20.936
6.08	21.013
8.12	20.072
8.12	20.020
12.16	19.648
16.20	19.253
20.26	18.788
20.26	18.653
28.37	18.005
28.37	18.148
40.50	16.439
60.80	11.067
60.80	35.050
81.10	42.226
81.10	21.996
121.60	3.352
162.10	2.167
202.70	1.858
284.47	1.401

VES 714.15 (Site VV)

A-Spacing (meters)	Resistivity (Ohm-meters)
1.0	253.042
1.5	277.972
2.0	280.184
3.0	285.841
4.0	280.585
6.0	248.399
8.0	220.362
10.0	202.256
15.0	154.944
20.0	119.381
30.0	90.833
40.0	81.179
60.0	61.827
80.0	53.784
100.0	43.291
120.0	34.080
140.0	24.454
160.0	23.022

VES 714.18 (Site TT)

A-Spacing (meters)	Resistivity (Ohm-meters)
1.0	158.332
1.5	158.858
2.0	163.358
3.0	160.847
4.0	159.846
6.0	142.125
8.0	125.311
10.0	110.773
15.0	89.253
20.0	79.780
30.0	77.641
40.0	74.644
60.0	75.775
80.0	86.457
100.0	67.858
120.0	61.148
140.0	52.339
160.0	39.710

VES 714.I5 (Site SS)

A-Spacing (meters)	Resistivity (Ohm-meters)
2.03	120.645
2.84	133.514
4.05	131.758
6.08	124.833
6.08	127.539
8.12	114.615
8.12	112.694
12.16	94.417
16.20	85.312
20.26	85.868
20.26	88.936
28.37	78.679
28.37	79.513
40.50	76.026
60.80	73.569
60.80	73.768
81.10	60.365
81.10	61.775
121.60	40.100
162.10	28.437
202.70	20.990
202.70	21.602

VES 714.20 (Site QQ)

A-Spacing (meters)	Resistivity (Ohm-meters)
1.0	97.185
1.5	119.669
2.0	105.152
3.0	117.813
4.0	104.830
6.0	75.511
8.0	64.038
10.0	57.554
15.0	55.795
20.0	58.685
30.0	54.450
40.0	53.746
60.0	69.366
80.0	60.919
100.0	49.574
120.0	50.291
140.0	46.269
160.0	26.440

VES 714.21 (Site PP)

A-Spacing (meters)	Resistivity (Ohm-meters)
1.0	108.878
1.5	110.122
2.0	113.094
3.0	114.834
4.0	124.660
6.0	132.700
8.0	132.670
10.0	121.454
15.0	114.606
20.0	100.531
30.0	99.125
40.0	88.216
60.0	78.414
80.0	59.313
100.0	40.841
120.0	39.132
140.0	23.145
160.0	26.138

VES 714.24 (Site JJ)

A-Spacing (meters)	Resistivity (Ohm-meters)
10.0	60.382
15.0	69.084
20.0	76.027
30.0	80.845
40.0	88.216
60.0	99.149
80.0	83.943
100.0	98.018
120.0	78.414
140.0	90.604
160.0	76.303

VES 76A.10S (Site N9)

A-Spacing (meters)	Resistivity (Ohm-meters)
2.03	110.396
2.84	84.337
4.05	68.059
6.08	64.776
6.08	61.632
8.12	71.061
8.12	67.891
12.16	72.804
16.20	69.570
20.26	66.309
20.26	65.266
28.37	60.102
28.37	62.507
40.50	49.957
60.80	33.460
60.80	36.816
81.10	21.777
81.10	24.336
121.60	10.523
162.10	6.145
202.70	5.963
202.70	10.571

VES 76A.09 (Site N8)

A-Spacing (meters)	Resistivity (Ohm-meters)
1.0	150.189
1.5	124.335
2.0	96.746
3.0	68.689
4.0	55.846
6.0	53.193
8.0	54.286
10.0	56.737
15.0	59.376
20.0	61.073
30.0	53.897
40.0	48.003
60.0	43.078
80.0	22.519
100.0	9.236
120.0	7.841

VES 76A.08 (Site N7)

A-Spacing (meters)	Resistivity (Ohm-meters)
2.03	58.898
2.84	54.003
4.05	59.528
6.08	61.773
6.08	64.252
8.12	66.478
8.12	65.520
12.16	76.567
16.20	76.172
20.26	70.443
20.26	69.403
28.37	63.692
28.37	62.047
40.50	47.398
60.80	25.095
60.80	28.887
81.10	13.945
81.10	14.976
121.60	5.119
162.70	2.895
202.70	3.021
202.70	3.539

VES 76A.05 (Site N6)

A-Spacing (meters)	Resistivity (Ohm-meters)
2.03	127.056
2.84	94.218
4.05	71.377
6.08	57.912
6.08	61.012
8.12	61.510
8.12	57.782
12.16	65.694
16.20	63.603
20.26	63.606
20.26	64.806
28.37	63.380
28.37	63.426
40.50	51.189
60.80	34.747
60.80	37.056
81.10	24.069
81.10	21.840
121.60	9.300
162.10	5.383
202.70	5.367
202.70	5.515

VES 76A.04 (Site N5)

A-Spacing (meters)	Resistivity (Ohm-meters)
2.03	70.767
2.84	40.445
4.05	38.106
6.08	54.909
6.08	57.220
8.12	57.690
8.12	60.278
12.16	67.685
16.20	70.078
20.26	77.122
20.26	73.539
28.37	70.717
28.37	68.482
40.50	64.745
60.80	49.118
60.80	52.568
81.10	33.621
81.10	35.567
121.60	14.931
162.70	8.430
202.70	5.724
202.70	6.572

VES N711.10 (Site N4)

A-Spacing (meters)	Resistivity (Ohm-meters)
1.0	97.562
1.5	91.668
2.0	73.850
3.0	57.568
4.0	53.508
6.0	50.931
8.0	45.515
10.0	51.711
15.0	58.905
20.0	61.073
30.0	60.587
40.0	53.784
60.0	41.846
80.0	33.125
100.0	16.650
120.0	5.922
140.0	8.687
160.0	4.132

VES N711.10S (Site N4)

A-Spacing (meters)	Resistivity (Ohm-meters)
2.03	118.025
2.84	86.497
4.05	57.348
6.08	42.686
6.08	51.222
8.12	51.156
8.12	50.294
12.16	56.878
16.20	53.828
20.26	57.404
20.26	56.303
28.37	53.858
28.37	56.992
40.50	52.990
60.80	38.822
60.80	39.435
81.10	22.923
81.10	25.833
121.60	9.954
162.10	5.078
202.70	5.565
202.70	4.826

VES N711.03 (Site N3)

A-Spacing (meters)	Resistivity (Ohm-meters)
1.0	51.615
1.5	58.482
2.0	64.300
3.0	68.784
4.0	74.444
6.0	81.279
8.0	86.154
10.0	94.625
15.0	95.473
20.0	90.227
30.0	82.164
40.0	73.890
60.0	51.271
80.0	31.315
100.0	19.855
120.0	12.591
140.0	11.611
160.00	7.932

VES N711.02 (Site N2)

A-Spacing (meters)	Resistivity (Ohm-meters)
2.03	13.308
2.84	16.937
4.05	20.571
6.08	23.339
6.08	23.871
8.12	23.756
8.12	25.676
12.16	28.172
16.20	23.372
20.26	21.229
20.26	22.344
28.37	19.271
28.37	19.472
40.50	14.909
60.80	10.003
60.80	11.221
81.10	6.288
81.10	6.657
121.60	2.687
162.10	1.393
202.70	1.430
202.70	1.023

VES N711.01 (Site N1)

A-Spacing (meters)	Resistivity (Ohm-meters)
1.0	83.426
1.5	82.572
2.0	72.393
3.0	57.078
4.0	50.995
6.0	50.969
8.0	55.241
10.0	58.434
15.0	63.240
20.0	69.241
30.0	72.742
40.0	62.581
60.0	47.501
80.0	38.076
100.0	20.358
120.0	12.742
140.0	7.539
160.0	5.660

VES S711.01 (Site S9)

A-Spacing (meters)	Resistivity (Ohm-meters)
2.03	17.511
2.84	16.866
4.05	14.042
6.08	13.598
6.08	12.986
8.12	15.022
8.12	13.998
12.16	16.036
16.20	17.026
20.26	17.254
20.26	15.620
28.37	16.559
28.37	21.014
40.50	12.020
60.80	10.264
60.80	9.456
81.10	5.788
81.10	5.516
121.70	2.340
162.10	1.238
202.70	1.212
202.70	1.751

VES S711.02 (Site S8)

A-Spacing (meters)	Resistivity (Ohm-meters)
2.03	21.573
2.84	19.948
4.05	16.671
6.08	13.598
6.08	13.376
8.12	12.576
8.12	9.167
12.16	12.961
16.20	12.970
20.26	13.159
20.26	13.239
28.27	12.704
28.37	12.425
40.50	10.402
60.80	6.603
60.80	6.640
81.10	3.843
81.10	3.994
121.60	1.734
162.10	1.703
202.70	2.181
202.70	1.051

VES S711.05 (Site S7)

A-Spacing (meters)	Resistivity (Ohm-meters)
2.03	17.700
2.84	17.315
4.05	15.370
6.08	13.664
6.08	14.793
8.12	13.741
8.12	14.455
12.16	10.922
16.20	13.930
20.26	14.056
20.26	12.748
28.37	14.276
28.37	13.561
40.50	11.499
60.80	8.172
60.80	8.763
81.10	3.610
81.10	3.960
121.60	1.560
162.10	0.774
202.70	0.485
202.70	0.771

VES S711.07 (Site S6)

A-Spacing (meters)	Resistivity (Ohm-meters)
1.0	139.432
1.5	134.702
2.0	113.798
3.0	74.872
4.0	52.050
6.0	41.846
8.0	41.770
10.0	42.474
15.0	44.485
20.0	54.161
30.0	50.882
40.0	37.950
60.0	28.915
80.0	20.961
100.0	8.985
120.0	8.520

VES S711.08 (Site S5)

A-Spacing (meters)	Resistivity (Ohm-meters)
1.0	82.741
1.5	79.170
2.0	71.086
3.0	57.361
4.0	46.548
6.0	43.015
8.0	46.797
10.0	53.784
15.0	59.753
20.0	64.591
30.0	75.945
40.0	52.276
60.0	37.171
80.0	20.609
100.0	17.467
120.0	10.631
140.0	7.301

VES S711.09 (Site S4)

A-Spacing (meters)	Resistivity (Ohm-meters)
1.0	94.842
1.5	89.283
2.0	78.324
3.0	56.041
4.0	38.730
6.0	45.955
8.0	48.204
10.0	50.768
15.0	55.512
20.0	53.407
30.0	50.693
40.0	34.934
60.0	21.111
80.0	14.376
100.0	8.734
120.0	6.258
140.0	4.926

VES 711.10 (Site S3)

A-Spacing (meters)	Resistivity (Ohm-meters)
1.0	106.038
1.5	110.480
2.0	98.932
3.0	74.344
4.0	52.779
6.0	41.959
8.0	41.067
10.0	43.103
15.0	51.177
20.0	53.156
30.0	56.535
40.0	53.030
60.0	37.171
80.0	20.961
100.0	15.017
120.0	9.425
140.0	6.070
160.0	4.122

VES S711.I1 (Site S2)

A-Spacing (meters)	Resistivity (Ohm-meters)
1.0	97.437
1.5	109.038
2.0	100.880
3.0	79.849
4.0	64.416
6.0	41.884
8.0	33.979
10.0	30.536
15.0	27.520
20.0	22.695
30.0	18.581
40.0	16.064
60.0	9.953
80.0	6.283
100.0	4.461
120.0	3.167
140.0	3.695

VES S711.12 (Site S1)

A-Spacing (meters)	Resistivity (Ohm-meters)
1.0	59.041
1.5	63.647
2.0	49.749
3.0	43.713
4.0	39.584
6.0	40.263
8.0	47.450
10.0	46.244
15.0	45.805
20.0	43.605
30.0	39.198
40.0	34.934
60.0	15.834
80.0	14.175
100.0	7.477
120.0	4.222

Appendix A: Part 2-Reduced field data from an automatic inversion program by Zohdy and Bisdorf (1975).

VES Indiantown-01 (Site A)

A-Spacing (meters)	Observed Response (Ohm-meters)
1.0	222.0
2.0	116.0
3.0	81.0
4.0	69.0
5.0	64.0
6.0	62.0
8.0	61.0
10.0	62.0
15.0	63.0
20.0	63.0
30.0	60.0
40.0	56.0
60.0	48.0
70.0	44.0
80.0	40.0
90.0	36.0
100.0	32.0
120.0	26.0
140.0	22.0
160.0	18.7

Thickness (meters)	Depth (meters)	Resistivity (Ohm-meters)
0.1000	0.1000	299.5659
0.0468	0.1468	299.3386
0.0687	0.2154	302.9939
0.1008	0.3162	309.0525
0.1479	0.4641	309.5227
0.2168	0.6808	282.2690
0.3093	0.9902	204.0774
0.8074	1.7976	79.3379
0.7980	2.5956	48.7707
0.9275	3.5231	55.3153
0.9681	4.4912	59.0249
0.9802	5.4714	59.4975
1.9798	7.4511	60.7579
1.9935	9.4447	64.4078
4.9999	14.4445	69.0001
4.9990	19.4436	67.7732
9.9567	29.4002	60.9044
9.9087	39.3089	54.1819
19.5235	58.8324	44.6037
9.3927	68.2251	34.2698
9.0052	77.2303	27.7137
8.6003	85.8306	22.3377
8.1284	93.9590	17.9272
14.9198	108.8788	13.1309
13.6489	122.5277	9.3259

VES 726.I3S (Site B)

A-Spacing (meters)	Observed Response (Ohm-meters)
2.0	26.0
4.0	37.5
6.0	53.0
8.0	65.0
10.0	74.0
15.0	81.0
20.0	81.0
30.0	75.0
40.0	68.0
50.0	60.0
70.0	46.0
90.0	32.0
100.0	26.0
120.0	16.0
140.0	10.0
160.0	7.5
200.0	5.0

Thickness (meters)	Depth (meters)	Resistivity (Ohm-meters)
0.2000	0.2000	20.5354
0.0936	0.2936	20.5846
0.1373	0.4309	20.3640
0.2015	0.6324	19.7718
0.2956	0.9279	19.0940
0.4342	1.3622	19.8760
0.6239	1.9860	25.5623
1.5240	3.5101	60.6854
1.0331	4.5432	147.4320
1.3349	5.8780	140.6800
1.6142	7.4933	125.6035
4.6630	12.1553	107.3450
4.9752	17.1304	88.1908
9.9434	27.0738	68.4206
9.6923	36.7661	52.8598
9.4054	46.1715	42.1154
17.5590	63.7305	28.5274
14.6720	78.4026	15.1988
6.0275	84.4301	8.9957
9.4041	93.8342	5.1152
6.8398	100.6739	2.5848
5.9891	106.6631	1.6968

VES 726.I4S (Site C)

A-Spacing (meters)	Observed Response (Ohm-meters)
2.0	40.0
4.0	48.0
6.0	38.0
8.0	33.9
10.0	32.0
12.0	31.0
15.0	32.0
20.0	30.0
30.0	26.0
50.0	17.0
70.0	10.0
90.0	6.0
100.0	5.0
150.0	3.5

Thickness (meters)	Depth (meters)	Resistivity (Ohm-meters)
0.2000	0.2000	33.2186
0.0936	0.2936	33.4132
0.1373	0.4309	32.5791
0.2014	0.6323	31.5063
0.2958	0.9281	32.5154
0.4235	1.3516	42.7095
0.5410	1.8926	71.3797
1.9323	3.3249	62.9524
1.8005	5.6255	25.1707
1.7052	7.3306	17.2852
1.9156	9.2462	21.3067
1.9971	11.2433	31.4961
2.7980	14.0414	45.6461
4.6693	18.7106	49.9391
9.9474	28.6580	30.6691
15.1759	43.8339	9.7010
7.7282	51.5622	2.1186
6.3793	57.9415	1.0072
4.9729	62.9144	1.2993

VES INDIANTOWN-03 (Site E)

A-Spacing (meters)	Observed Response (Ohm-meters)
2.0	369.0
3.0	270.0
4.0	161.0
5.0	90.0
6.0	62.0
8.0	43.0
10.0	36.0
15.0	32.0
20.0	33.0
30.0	33.5
40.0	31.0
50.0	28.0
60.0	23.5
80.0	15.8
90.0	13.8
100.0	12.5

Thickness (meters)	Depth (meters)	Resistivity (Ohm-meters)
0.2000	0.2000	554.0457
0.0936	0.2936	550.5615
0.1373	0.4309	553.8179
0.2015	0.6324	565.0381
0.2958	0.9282	574.3467
0.4342	0.3623	545.7036
0.6255	1.9878	412.1711
0.8356	2.8234	193.8232
0.5019	3.3254	56.8464
0.1668	3.4921	9.8768
0.4917	3.9838	16.9156
0.2125	4.1963	2.2662
1.5344	5.7307	17.4480
4.9803	10.7110	45.5531
4.8938	15.6048	53.8387
9.9999	25.6047	45.1841
9.6977	35.3023	31.2478
8.8108	44.1132	19.6849
7.7340	51.8472	12.4662
13.7195	65.5667	7.7202
7.2180	72.7847	6.7050

VES 726.I1S (Site F)

A-Spacing (meters)	Observed Response (Ohm-meters)
2.0	39.0
4.0	39.0
6.0	41.0
8.0	48.0
10.0	52.5
15.0	60.0
20.0	63.0
40.0	60.0
50.0	46.0
60.0	38.0
80.0	28.0
100.0	14.9
120.0	9.3
160.0	5.9
200.0	4.2

Thickness (meters)	Depth (meters)	Resistivity (Ohm-meters)
0.2000	0.2000	39.5767
0.0935	0.2935	39.4804
0.1372	0.4307	39.4171
0.2016	0.6323	39.6175
0.2958	0.9281	40.1392
0.4343	1.3624	39.8746
0.6359	1.9983	36.3190
1.9833	3.9816	30.5653
1.9499	5.9315	45.1976
1.6308	7.5623	79.5159
1.5421	9.1044	101.5311
4.2989	13.4033	100.7900
4.6890	18.0922	95.4773
19.9854	38.0777	65.6270
8.7783	46.8560	32.1359
7.5552	54.4111	19.5558
12.2099	66.6210	10.2510
10.2379	76.8589	5.5692
10.1510	87.0099	4.0634
24.2047	111.2146	3.7286

VES 76.06 (Site G)

A-Spacing (meters)	Observed Response (Ohm-meters)
1.0	151.0
2.0	101.0
3.0	71.0
4.0	52.0
6.0	38.5
7.0	37.0
8.0	36.8
9.0	38.0
10.0	40.0
15.0	47.7
20.0	50.0
30.0	48.0
40.0	43.0
50.0	37.5
60.0	32.5
80.0	24.0
100.0	18.0
120.0	13.0
140.0	9.5
200.0	3.6

Thickness (meters)	Depth (meters)	Resistivity (Ohm-meters)
0.1000	0.1000	184.0648
0.0467	0.1467	183.4938
0.0687	0.2154	184.5310
0.1008	0.3162	185.9438
0.1479	0.4641	185.5083
0.2169	0.6810	173.3428
0.3148	0.9958	142.0542
0.9560	1.9518	96.7906
0.8596	2.8114	52.5075
0.6376	3.4490	21.4470
1.2605	4.7095	13.4318
0.9466	5.6561	24.3784
0.9931	6.6491	40.8100
0.8760	7.5251	63.6608
0.7467	8.2718	89.4072
3.8550	12.1268	101.5735
4.8250	16.9518	73.2298
9.9193	26.8711	47.4924
9.3319	36.2030	31.0552
8.9805	45.1835	23.8607
8.9422	54.1257	20.7056
18.0102	72.1359	18.1612
17.5473	89.6832	14.3082
15.4385	105.1216	9.1139
10.4683	115.5899	4.0011

VES 76.N1 (Site H)

A-Spacing (meters)	Observed Response (Ohm-meters)
1.0	103.0
1.5	108.0
2.0	103.0
3.0	81.0
4.0	68.0
6.0	59.0
8.0	59.0
10.0	60.0
15.0	62.0
20.0	63.0
25.0	60.0
30.0	57.0
40.0	50.0
60.0	32.0
70.0	25.0
80.0	19.5
90.0	15.0
100.0	11.8
120.0	8.0
140.0	5.8

Thickness (meters)	Depth (meters)	Resistivity (Ohm-meters)
0.1000	0.1000	92.1645
0.0468	0.1468	92.6896
0.0687	0.2154	91.3086
0.1008	0.3162	89.1557
0.1479	0.4641	89.7994
0.2159	0.6800	103.4386
0.3011	0.9811	142.4183
0.4748	1.4558	159.2888
0.4968	1.9526	105.6267
0.8479	2.8006	47.0589
0.7358	3.5364	25.9389
1.8962	5.4326	37.6235
1.8799	7.3124	79.3292
1.7947	9.1072	98.4512
4.9031	14.0103	81.8466
4.9999	19.0102	69.0447
4.9915	24.0016	64.6677
4.9634	28.9650	59.1308
9.6747	38.6397	45.7175
15.7747	54.4144	20.0607
4.8867	59.3011	6.9842
3.0303	62.3314	3.0200
1.6818	64.0132	1.2192
1.0185	65.0317	0.5658
3.8654	68.8970	0.8249

VES 76.N5 (Site I)

A-Spacing (meters)	Observed Response (Ohm-meters)
1.5	177.0
2.5	150.0
3.0	144.0
4.0	140.0
6.0	141.0
8.0	152.0
10.0	160.0
13.0	165.0
15.0	159.0
20.0	118.0
23.5	95.0
30.0	80.0
40.0	61.0
50.0	44.0
60.0	33.0
80.0	22.1
100.0	17.0
120.0	14.5
140.0	12.6

Thickness (meters)	Depth (meters)	Resistivity (Ohm-meters)
0.1500	0.1500	204.5078
0.0702	0.2202	203.3610
0.1029	0.3230	203.2762
0.1512	0.4742	205.7021
0.2218	0.6961	210.0218
0.3257	1.0218	204.4462
0.4727	1.4944	162.8625
0.9338	2.4282	102.7019
0.4660	2.8942	87.1424
0.9837	3.8779	102.8857
1.9056	5.7835	183.8289
1.5755	7.3590	320.5049
1.7304	9.0894	312.3403
2.9751	12.0645	219.8739
1.9513	14.0159	144.7439
4.3084	18.3242	82.7755
2.5302	20.8544	47.6201
4.3656	25.2199	33.1484
7.4738	32.6937	29.6402
8.6641	41.3578	32.2124
9.0306	50.3884	31.3717
16.5515	66.9399	21.0534
12.0927	79.0326	9.2087
10.3664	89.3990	5.5609

VES 76.N5S (Site J)

A-Spacing (meters)	Observed Response (Ohm-meters)
2.0	212.5
3.0	220.0
4.0	170.0
5.0	157.0
7.0	170.0
10.0	195.0
15.0	185.0
20.0	147.0
30.0	80.0
40.0	46.0
60.0	26.0
80.0	11.0
100.0	7.0
150.0	4.5
200.0	4.0

Thickness (meters)	Depth (meters)	Resistivity (Ohm-meters)
0.2000	0.2000	221.2561
0.0936	0.2936	218.4572
0.1373	0.4309	218.9497
0.2015	0.6324	224.9539
0.2952	0.9276	240.7671
0.4328	1.3604	251.1355
0.6304	1.9908	186.4158
0.8819	2.8727	98.0679
0.9072	3.7799	85.1608
0.9997	4.7797	134.8236
1.6598	6.4395	286.7549
2.5651	9.0046	327.2283
4.9231	13.9277	152.1971
4.0327	17.9603	67.6318
7.3084	25.2688	39.2079
8.2269	33.4957	35.5626
17.0712	50.5669	29.1459
11.7470	62.3138	10.5011
8.9428	71.2566	3.3051
22.8050	94.0616	1.5179

VES 76.N10 (Site K)

A-Spacing (meters)	Observed Response (Ohm-meters)
1.0	158.0
2.0	151.0
3.0	145.0
4.0	134.0
6.0	113.0
8.0	92.0
10.0	82.0
15.0	69.0
20.0	64.0
30.0	56.0
40.0	47.0
60.0	31.0
70.0	25.0
80.0	20.0
90.0	15.0
100.0	8.5

Thickness (meters)	Depth (meters)	Resistivity (Ohm-meters)
0.1000	0.1000	159.6667
0.0468	0.1468	159.7138
0.0687	0.2154	159.7787
0.1008	0.3162	159.7936
0.1479	0.4641	159.4157
0.2171	0.6812	158.7895
0.3187	0.9999	157.5429
1.0000	1.9999	156.9653
0.9993	2.9992	150.3080
0.9903	3.9895	126.3379
1.8877	5.8772	85.9592
1.7520	7.6292	56.3602
1.7601	9.3893	47.7775
4.7964	14.1857	54.4445
4.9982	19.1839	70.7329
9.9855	29.1694	67.4831
9.6009	38.7702	46.4818
16.3431	55.1133	22.9713
5.7668	60.8801	9.6085
3.5436	64.4237	4.0439
0.6942	65.1179	0.5329

VES 708.01 (Site L)

A-Spacing (meters)	Observed Response (Ohm-meters)
2.00	124.00
2.84	102.00
4.05	72.60
6.10	67.60
8.10	74.50
12.20	84.50
16.20	94.50
20.30	93.80
28.40	89.70
40.50	77.30
60.80	46.90
81.10	26.80
121.60	8.25
162.10	4.70

Thickness (meters)	Depth (meters)	Resistivity (Ohm-meters)
0.2000	0.2000	149.2325
0.0936	0.2936	148.3018
0.1373	0.4309	149.2740
0.2015	0.6324	152.7563
0.2957	0.9281	156.2553
0.4342	1.3624	150.3840
0.6279	1.9902	115.7802
0.7431	2.7334	64.4658
0.9244	3.6577	34.6136
1.9165	5.5742	42.9422
1.8544	7.4286	98.4180
3.1147	10.5434	175.5860
3.5713	14.1147	158.5638
4.0053	18.1200	132.0273
8.0893	26.2093	101.7737
11.4181	37.6294	63.0215
14.3635	51.9910	23.5149
5.6549	57.6459	4.1065
17.9699	75.6158	2.3920

VES 708.02 (Site N)

A-Spacing (meters)	Observed Response (Ohm-meters)
2.00	103.4
2.84	67.8
4.05	47.6
6.10	43.9
8.10	33.9
12.20	52.6
16.20	54.3
20.30	57.7
28.40	52.7
40.50	46.9
60.80	32.5
81.10	17.5

Thickness (meters)	Depth (meters)	Resistivity (Ohm-meters)
0.2000	0.2000	135.4045
0.0936	0.2936	135.6832
0.1373	0.4309	137.9023
0.2015	0.6324	141.1194
0.2958	0.9282	140.7883
0.4329	1.3610	124.7059
0.6071	1.9682	82.7697
0.6779	2.6460	41.1669
0.8302	3.4762	21.0984
1.7257	5.2019	21.6149
1.9967	7.1986	37.0765
3.7502	10.9489	65.8395
3.4589	14.4077	86.6738
3.7481	18.1558	86.0174
7.9380	26.0938	74.1307
12.0037	38.0975	51.5002
16.8153	54.9128	22.0880

VES 708.03 (Site O)

A-Spacing (meters)	Observed Response (Ohm-meters)
2.0	34.6
2.8	21.0
4.1	16.1
6.1	15.0
8.1	15.2
12.2	16.0
16.3	17.4
20.3	17.5
28.5	17.1
40.6	14.9
50.8	12.5
61.0	9.8

Thickness (meters)	Depth (meters)	Resistivity (Ohm-meters)
0.2000	0.2000	72.1270
0.0936	0.2936	73.2137
0.1373	0.4308	74.9561
0.2015	0.6324	75.0559
0.2947	0.9270	65.5168
0.4062	1.3333	40.0617
0.4634	1.7966	16.3551
0.5179	2.3145	8.8899
1.1662	3.4807	12.2644
1.9801	5.4608	16.0479
1.9559	7.4167	13.6186
4.0840	11.5008	15.2457
3.9061	15.4068	23.6661
3.5768	18.9836	30.7189
7.8700	6.8536	27.9406
11.7145	38.5681	14.8451
6.9715	45.5396	5.2903

VES 708.05 (Site P)

A-Spacing (meters)	Observed Response (Ohm-meters)
1.0	460.0
2.0	315.0
3.0	155.0
4.0	77.0
6.0	45.0
8.0	39.0
10.0	39.0
15.0	45.0
20.0	51.0
25.0	53.0
30.0	53.0
40.0	47.0
50.0	40.0
60.0	33.0
70.0	26.0
80.0	21.0
100.0	14.5
120.0	11.0
140.0	9.0
160.0	4.7

Thickness (meters)	Depth (meters)	Resistivity (Ohm-meters)
0.1000	0.1000	520.5808
0.0468	0.1468	522.1345
0.0687	0.2154	517.9697
0.1008	0.3162	513.0291
0.1479	0.4641	517.6155
0.2169	0.6810	548.7114
0.3159	0.9970	618.9553
0.9715	1.9685	359.5303
0.3359	2.3044	35.5488
0.3332	2.6375	11.6434
0.7894	3.4270	5.5089
1.9975	5.4245	30.3178
0.7731	6.1976	176.1531
3.7879	9.9855	98.5836
4.6128	14.5984	81.1947
4.9190	19.5173	69.6873
4.9791	24.4964	53.0807
9.2133	33.7097	31.7235
7.4387	41.1484	15.9179
6.2451	47.3935	9.3976
6.1722	53.5657	7.4058
6.9730	60.5387	7.5295
16.9577	77.4964	9.3484
18.8372	96.3336	11.1767
17.2725	113.6061	7.7689

VES 708.I2R (Site Q)

A-Spacing (meters)	Observed Response (Ohm-meters)
1.0	48.0
2.0	41.0
3.0	40.0
7.0	39.0
9.0	38.2
11.0	40.0
15.0	43.0
20.0	44.0
30.0	43.0
40.0	39.8
50.0	36.0
60.0	33.9
70.0	30.0
80.0	28.0
90.0	23.0
100.0	20.0
120.0	14.0

Thickness (meters)	Depth (meters)	Resistivity (Ohm-meters)
0.1000	0.1000	55.8455
0.0468	0.1468	55.9480
0.0687	0.2154	56.3496
0.1008	0.3162	56.6165
0.1479	0.4641	55.5002
0.2165	0.6806	50.4388
0.3150	0.9956	42.6698
0.9900	1.9856	38.7494
0.9964	2.9820	39.2119
3.9827	6.9647	35.2435
1.9831	8.9478	44.1120
1.9393	10.8871	51.7857
3.8773	14.7644	55.3139
4.9633	19.7277	51.3024
9.9946	29.7223	44.2056
9.9632	39.6855	40.8305
9.9231	49.6087	37.9963
9.8002	59.4088	32.4115
9.3826	68.7915	24.9831
8.6247	77.4162	17.7752
7.4350	84.8512	11.6440
5.8604	90.7115	6.9118

VES 708.07R (Site R)

A-Spacing (meters)	Observed Response (Ohm-meters)
2.0	16.5
2.8	14.0
4.1	12.9
5.1	13.0
6.1	13.7
8.1	15.5
12.2	16.1
16.3	15.5
20.3	14.8
28.5	12.8
40.6	10.0
50.8	8.0
61.0	6.5
81.3	4.2
121.9	1.6

Thickness (meters)	Depth (meters)	Resistivity (Ohm-meters)
0.2000	0.2000	24.2156
0.0935	0.2935	24.1447
0.1373	0.4308	24.6671
0.2015	0.6323	25.3076
0.2955	0.9277	24.5230
0.4280	1.3557	18.9002
0.5610	1.9167	10.1870
0.6411	2.5578	6.1793
1.2713	3.8291	9.2177
0.8863	4.7154	19.9924
0.7484	5.4638	30.0450
1.6671	7.1309	28.9841
4.0541	11.1850	20.1293
4.0528	15.2377	14.2154
3.8561	19.0939	11.4229
7.7649	26.8587	9.4197
11.4835	38.3422	8.1676
9.6428	47.9850	7.1085
9.2426	57.2276	5.5144
14.3844	71.6120	2.5998

VES 708.10 (Site S)

A-Spacing (meters)	Observed Response (Ohm-meters)
1.0	148.0
1.5	163.0
2.0	152.0
3.0	102.0
5.0	67.0
7.0	57.0
9.0	52.5
10.0	52.0
13.0	50.0
15.0	48.0
20.0	44.0
30.0	34.0
40.0	26.4
60.0	16.5
80.0	11.2
90.0	9.5
100.0	8.2

Thickness (meters)	Depth (meters)	Resistivity (Ohm-meters)
0.1000	0.1000	118.4260
0.0468	0.1468	119.8059
0.0687	0.2154	117.0884
0.1007	0.3161	112.5115
0.1479	0.4641	113.8499
0.2127	0.6768	147.7561
0.2694	0.9462	253.7193
0.4340	1.3802	295.7383
0.4996	1.8798	178.2966
0.8028	2.6826	64.1639
0.9771	3.6596	16.0072
1.8466	5.5062	32.1257
1.8018	7.3081	83.2621
0.8345	8.1426	105.4356
2.8848	11.0273	80.3745
1.9864	13.0137	54.6304
4.6993	17.7130	36.6246
8.6919	26.4049	23.1420
8.6604	35.0653	17.9084
17.2221	52.2874	13.5943
15.2763	67.5637	7.8697
6.3608	73.9244	4.6348

VES 708.11 (Site T)

A-Spacing (meters)	Observed Response (Ohm-meters)
1.0	145.0
2.0	101.0
3.0	72.0
4.0	52.0
6.0	40.0
9.0	36.1
10.0	36.0
15.0	37.0
20.0	39.9
30.0	42.2
40.0	40.0
50.0	36.0
60.0	31.0
80.0	21.0
90.0	17.5
100.0	15.0
120.0	10.5
140.0	7.0
160.0	4.0

Thickness (meters)	Depth (meters)	Resistivity (Ohm-meters)
0.1000	0.1000	169.5038
0.0467	0.1467	168.8527
0.0687	0.2154	169.5062
0.1008	0.3162	171.0100
0.1479	0.4641	172.5458
0.2171	0.6812	168.8372
0.3174	0.9986	150.5737
0.9581	1.9566	95.9082
0.8305	2.7871	46.9169
0.7536	3.5407	28.2498
1.6007	5.1414	22.7142
2.8527	7.9941	27.7189
0.9958	8.9899	34.6172
4.9537	13.9436	45.0045
4.7676	18.7111	57.5495
9.7518	28.4629	57.7950
9.9825	38.4454	44.6148
9.5823	48.0277	31.0840
8.7899	56.8176	20.9409
14.2878	71.1053	10.8302
5.1249	76.2303	5.1207
3.6644	79.8947	2.7723
2.5706	82.4652	0.6380
8.3881	90.8533	1.2064

VES 708.12 (Site U)

A-Spacing (meters)	Observed Response (Ohm-meters)
1.0	58.0
2.0	62.0
3.0	59.0
4.0	47.0
5.0	34.0
6.0	29.5
8.0	28.0
10.0	29.0
15.0	38.0
20.0	45.0
30.0	46.0
40.0	41.0
50.0	35.0
60.0	29.5
70.0	25.0
90.0	17.5
100.0	14.3
110.0	11.0
130.0	8.0
140.0	7.4
160.0	6.1

Thickness (meters)	Depth (meters)	Resistivity (Ohm-meters)
0.1000	0.1000	52.9278
0.0468	0.1468	53.3055
0.0687	0.2154	52.8187
0.1008	0.3162	51.5827
0.1479	0.4641	51.0436
0.2166	0.6807	56.5854
0.3063	0.9871	75.2109
0.9450	1.9320	95.5898
0.9678	2.8998	60.1958
0.7192	3.6190	18.8686
0.5412	4.1602	8.7896
0.6084	4.7686	7.8711
1.8459	6.6136	14.7466
1.7084	8.3220	43.4807
0.7984	9.1204	400.4382
3.6613	12.7817	98.2481
9.8620	22.6437	57.5034
9.6645	32.3082	34.1259
8.6417	40.9499	20.6386
7.4170	48.3669	12.5376
6.2808	54.6477	7.8062
10.1271	64.7748	4.2477
4.6044	69.3791	2.8584
4.7479	74.1270	2.5341
11.0544	85.1814	2.5635
6.7949	91.9763	2.9761

VES 708.13 (Site V)

A-Spacing (meters)	Observed Response (Ohm-meters)
1.0	100.0
2.0	105.0
3.0	70.0
4.0	55.5
5.0	52.2
7.0	55.0
9.0	60.0
10.0	62.0
15.0	65.0
20.0	61.0
30.0	50.5
40.0	39.0
50.0	35.0
60.0	33.0
70.0	30.0
80.0	26.8
90.0	21.5
100.0	14.1
110.0	11.0
120.0	9.0
130.0	8.0
140.0	7.0
150.0	6.5

Thickness (meters)	Depth (meters)	Resistivity (Ohm-meters)
0.1000	0.1000	99.9784
0.0468	0.1468	100.2941
0.0687	0.2154	100.1397
0.1008	0.3162	99.3877
0.1479	0.4642	98.8452
0.2171	0.6813	100.6244
0.3179	0.9992	108.6848
0.9996	1.9988	98.4155
0.8839	2.8827	45.5895
0.8060	3.6888	28.2652
0.9197	4.6084	32.5774
1.9929	6.6013	57.5323
1.7835	8.3848	92.7014
0.9107	9.2955	95.2551
4.9505	14.2460	74.5409
4.9099	19.1558	50.1152
9.2832	28.4391	33.4990
9.0400	37.4791	25.4482
9.1719	46.6510	22.8789
9.1716	55.8226	20.5604
8.9800	64.8025	17.3367
8.4904	73.2930	13.5496
7.8009	81.0938	10.1233
7.0236	88.1174	7.4266
6.3424	94.4598	5.5661
5.8743	100.3341	4.3874
5.6642	105.9983	3.6995
5.7754	111.7737	3.4113

VES 708.14 (Site W)

A-Spacing (meters)	Observed Response (Ohm-meters)
1.0	87.0
2.0	67.0
3.0	53.0
5.0	45.0
7.0	44.0
9.0	45.5
10.0	46.0
15.0	52.0
20.0	54.0
30.0	54.1
40.0	51.0
50.0	47.5
60.0	43.0
70.0	38.0
80.0	33.0
90.0	36.5
100.0	18.0
110.0	13.7
120.0	10.1
130.0	8.0
140.0	6.5
150.0	5.4
160.0	4.6

Thickness (meters)	Depth (meters)	Resistivity (Ohm-meters)
0.1000	0.1000	86.8346
0.0468	0.1468	86.6376
0.0687	0.2154	87.0016
0.1008	0.3162	87.9159
0.1479	0.4641	88.9763
0.2171	0.6812	87.9022
0.3179	0.9991	79.8263
0.9687	1.9678	54.0306
0.9220	2.8899	35.5695
1.9211	4.8110	33.8209
1.9987	6.8097	42.4861
1.9790	8.7887	51.7811
0.9779	9.7666	56.9346
4.8686	14.6351	61.7756
4.9258	19.5610	62.3842
9.9975	29.5584	55.1757
9.8928	39.4512	43.6074
9.5352	48.9864	32.9829
8.9620	57.9483	23.9823
8.1291	66.0774	16.6839
7.0793	73.1514	11.0933
5.8390	78.9903	6.9963
4.4628	83.4531	4.0920
2.9858	86.4389	2.1008
1.3685	87.8074	0.7410
5.0703	92.8777	2.1209
4.4065	97.2841	1.4296
3.7588	101.0429	0.9499

VES 708.15 (Site X)

A-Spacing (meters)	Observed Response (Ohm-meters)
1.0	49.0
2.0	58.3
3.0	59.0
4.0	57.5
5.0	55.0
6.0	52.0
8.0	49.5
10.0	49.0
12.0	50.0
15.0	52.0
20.0	57.0
25.0	58.0
30.0	57.0
40.0	51.5
50.0	44.0
60.0	35.0
70.0	28.0
80.0	24.5
100.0	19.1
120.0	14.9
140.0	11.0
150.0	8.5

Thickness (meters)	Depth (meters)	Resistivity (Ohm-meters)
0.1000	0.1000	44.8447
0.0468	0.1468	45.0095
0.0687	0.2154	45.1445
0.1007	0.3161	44.7836
0.1479	0.4640	43.8232
0.2171	0.6811	43.7465
0.3162	0.9973	51.6324
0.9316	1.9289	79.0914
0.9926	2.9215	69.7729
0.9829	3.9044	48.0036
0.9446	4.8491	36.3366
0.9340	5.7830	31.7026
1.9320	7.7151	32.9901
1.9996	9.7147	43.9235
1.8963	11.6110	62.9677
2.5380	14.1489	89.8911
4.1510	18.3000	107.2883
4.7080	23.0080	91.0222
4.9987	28.0067	68.0995
9.4849	37.4917	41.3027
8.0006	45.4923	22.0840
6.9571	52.4494	13.8553
6.8512	59.3005	11.0938
7.4265	66.7270	10.8595
17.0663	83.7933	12.3553
18.3162	102.1095	13.1384
15.9125	118.0220	8.1670

VES 708.16 (Site Y)

A-Spacing (meters)	Observed Response (Ohm-meters)
1.0	310.0
2.0	287.0
3.0	251.0
4.0	220.0
6.0	170.0
8.0	140.0
10.0	118.0
15.0	89.0
20.0	79.0
30.0	71.0
40.0	67.0
50.0	62.0
60.0	56.0
80.0	44.0
100.0	34.0
120.0	26.0
140.0	19.0
160.0	13.8

Thickness (meters)	Depth (meters)	Resistivity (Ohm-meters)
0.1000	0.1000	317.0178
0.0468	0.1468	317.2637
0.0687	0.2154	317.1558
0.1007	0.3162	316.5125
0.1478	0.4640	316.2424
0.2171	0.6811	317.8320
0.3187	0.9998	321.7988
0.9993	1.9992	301.1497
0.9810	2.9801	227.8925
0.9468	3.9269	171.1691
1.8380	5.7649	127.8906
1.7953	7.5602	97.4316
1.7596	9.3198	77.9884
4.3810	13.7008	61.5763
4.6793	18.3801	60.9256
9.9208	28.3009	74.7297
9.9896	38.2905	80.4196
9.9112	48.2017	69.3262
9.6278	57.8294	54.8958
17.8215	75.6509	36.7029
14.9487	90.5996	20.2393
11.4320	102.0316	10.2905
7.5122	109.5438	4.5432

VES 708.17 (Site Z)

A-Spacing (meters)	Observed Response (Ohm-meters)
1.0	228.0
2.0	185.0
3.0	168.0
4.0	151.0
5.0	140.0
6.0	130.0
8.0	115.0
10.0	103.0
15.0	88.0
20.0	81.0
25.0	79.0
32.0	80.0
40.0	81.0
50.0	80.0
60.0	77.0
70.0	73.0
90.0	62.0
100.0	56.0
110.0	48.3
120.0	41.0
130.0	34.0
140.0	24.0

Thickness (meters)	Depth (meters)	Resistivity (Ohm-meters)
0.1000	0.1000	257.6411
0.0468	0.1468	258.1982
0.0687	0.2154	259.9119
0.1008	0.3162	261.4077
0.1479	0.4642	258.2043
0.2168	0.6809	240.3933
0.3158	0.9967	204.6687
0.9812	1.9779	166.0285
0.9910	2.9690	159.7268
0.9900	3.9590	148.7900
0.9795	4.9384	129.9833
0.9627	5.9011	111.2904
1.8727	7.7738	88.9935
1.8123	9.5861	69.6891
4.5387	14.1248	57.6595
4.8540	18.9789	63.5136
4.9884	23.9673	82.1794
6.8442	30.8115	105.2597
7.6993	38.5108	118.9226
9.8382	48.3490	113.3883
9.9990	58.3480	94.8019
9.8188	68.1668	73.8295
17.9556	86.1224	46.6316
7.4742	93.5966	27.1404
6.1879	99.7845	17.6041
4.6972	104.4816	10.4566
3.0310	107.5126	5.2737

VES 714.I3 (Site ZZ)

A-Spacing (meters)	Observed Response (Ohm-meters)
2.0	33.00
2.8	22.50
4.1	15.00
6.1	13.00
8.1	13.50
12.2	13.90
16.3	13.60
20.3	12.90
28.5	11.50
40.6	9.30
61.0	6.80
81.3	5.20
121.9	3.40
162.6	2.15
203.2	1.30

Thickness (meters)	Depth (meters)	Resistivity (Ohm-meters)
0.2000	0.2000	60.1928
0.0936	0.2936	59.7101
0.1373	0.4309	60.8433
0.2015	0.6323	62.7192
0.2958	0.9282	61.8864
0.4271	1.3553	46.2137
0.5166	1.8719	20.0209
0.3920	2.2639	5.7897
0.7773	3.0412	4.5805
1.9988	5.0400	13.6092
1.8528	6.8658	23.0457
4.0679	10.9337	18.3916
4.0767	15.0104	14.1717
3.9112	18.9216	11.7859
7.7296	26.6513	8.8471
10.7150	37.3662	5.9538
18.7688	56.1350	5.2713
19.9585	76.0936	6.1262
37.9195	114.0131	4.1726
15.7774	129.7905	0.6659

VES 714.01 (Site YY)

A-Spacing (meters)	Observed Response (Ohm-meters)
1.0	145.0
2.0	100.0
3.0	60.0
4.0	43.0
6.0	35.0
7.0	34.0
8.0	34.0
10.0	35.0
15.0	42.0
20.0	48.0
25.0	49.0
40.0	38.0
50.0	32.0
60.0	26.5
70.0	23.0
90.0	18.9
100.0	17.5

Thickness (meters)	Depth (meters)	Resistivity (Ohm-meters)
0.1000	0.1000	171.2144
0.0468	0.1468	170.4076
0.0687	0.2154	170.1337
0.1008	0.3162	171.0846
0.1479	0.4641	174.0718
0.2171	0.6812	175.2971
0.3185	0.9998	165.3489
0.9527	1.9525	96.6124
0.6657	2.6182	29.2956
0.5189	3.1371	12.8620
1.5568	4.6939	16.3045
0.9917	5.6856	29.5046
0.9781	6.6637	42.1890
1.7624	8.4261	61.1767
4.0908	12.5169	84.2668
4.6318	17.1487	76.6081
4.9876	22.1363	58.6642
14.0868	36.2231	30.8421
7.6579	43.8809	14.9643
7.0212	50.9021	10.3190
7.2377	58.1397	9.0068
16.8869	75.0267	10.1748

VES 714.I4 (Site XX)

A-Spacing (meters)	Observed Response (Ohm-meters)
2.0	37.00
2.8	33.00
4.1	25.50
6.1	20.80
8.1	20.00
12.2	19.10
16.3	19.00
20.3	18.50
28.5	18.00
40.6	16.30
61.0	11.00
81.3	7.20
121.9	3.30
163.6	2.17
203.2	1.85

Thickness (meters)	Depth (meters)	Resistivity (Ohm-meters)
0.2000	0.2000	43.1517
0.0936	0.2936	42.9478
0.1373	0.4309	43.0667
0.2016	0.6324	43.7025
0.2958	0.9282	44.4718
0.4343	1.3625	43.6591
0.6342	1.9967	37.3312
0.7615	2.7582	25.8208
1.1389	3.8970	16.0459
1.8166	5.7136	13.7821
1.9792	7.6928	17.5732
4.0975	11.7903	21.5099
4.0980	15.8883	21.6765
3.9988	19.8871	21.6927
8.1981	28.0852	21.7519
11.9985	40.0837	17.5222
17.3362	57.4198	8.0921
9.9973	67.4171	2.2355
7.4246	74.8417	0.3559
22.4792	97.3209	0.7190

VES 714.18 (Site TT)

A-Spacing (meters)	Observed Response (Ohm-meters)
1.0	158.0
2.0	160.0
3.0	162.0
4.0	159.0
6.0	140.0
7.0	131.0
9.0	128.0
10.0	110.0
15.0	89.0
20.0	80.0
30.0	75.0
40.0	75.0
60.0	79.0
70.0	80.5
80.0	80.5
100.0	74.0
120.0	63.0
140.0	51.0
160.0	40.0

Thickness (meters)	Depth (meters)	Resistivity (Ohm-meters)
0.1000	0.1000	156.8146
0.0468	0.1468	157.1314
0.0687	0.2154	157.4284
0.1008	0.3162	157.0789
0.1479	0.4642	155.2054
0.2171	0.6812	151.4927
0.3186	0.9998	149.2466
0.9981	1.9979	167.0934
0.9971	2.9950	175.5855
0.9993	3.9943	157.4497
1.9896	5.9839	138.9013
0.9873	6.9712	123.8559
1.9433	8.9145	105.6194
0.9448	9.8593	87.6094
4.4496	14.3089	61.0471
4.3255	18.6344	44.8119
9.7901	28.4245	59.0443
9.2879	37.7124	114.0033
17.1848	54.8972	160.1855
9.7089	64.6061	130.1436
9.9974	74.6036	101.0788
18.9685	93.6721	64.9823
15.3075	108.8795	32.6090
9.7331	118.6126	13.0933

VES 714.15 (Site VV)

A-Spacing (meters)	Observed Response (Ohm-meters)
1.0	252.0
2.0	281.0
3.0	290.0
4.0	285.0
6.0	261.0
7.0	250.0
9.0	220.0
10.0	205.0
15.0	152.0
20.0	118.0
30.0	91.0
40.0	79.0
60.0	65.0
80.0	54.0
90.0	48.0
100.0	44.0
120.0	34.0
140.0	24.5
160.0	23.0

Thickness (meters)	Depth (meters)	Resistivity (Ohm-meters)
0.1000	0.1000	225.0731
0.0468	0.1468	225.1023
0.0687	0.2154	223.6505
0.1008	0.3162	221.6756
0.1479	0.4642	223.7455
0.2167	0.6809	240.6951
0.3145	0.9954	279.0378
0.9754	1.9708	334.0156
0.9937	2.9645	326.9031
1.0000	3.9645	298.1396
1.9909	5.9555	256.6968
0.9794	6.9349	213.8634
1.9029	8.8378	172.1282
0.9144	9.7522	138.0547
4.2810	14.0332	94.7279
4.1310	18.1642	66.5680
9.1600	27.3242	68.2704
9.9209	37.2450	87.4064
19.9080	57.1531	86.3557
18.2181	75.3712	49.9316
7.5684	82.9396	28.2383
6.4552	89.3948	18.9372
10.3332	99.7281	11.1369
9.9880	109.7161	8.2375

VES 714.I5 (Site SS)

A-Spacing (meters)	Observed Response (Ohm-meters)
2.0	120.0
3.0	135.0
4.0	133.0
6.0	125.0
7.0	118.0
9.0	108.0
10.0	103.0
15.0	88.0
20.0	83.0
30.0	79.0
40.0	76.0
60.0	73.0
80.0	61.0
100.0	60.0
120.0	41.0
150.0	32.0
200.0	23.0

Thickness (meters)	Depth (meters)	Resistivity (Ohm-meters)
0.2000	0.2000	93.5957
0.0936	0.2936	92.0135
0.1373	0.4308	90.4491
0.2016	0.6324	91.0920
0.2951	0.9275	100.1298
0.4205	1.3480	128.5317
0.5858	1.9338	171.4297
0.9492	2.8831	179.9338
0.9969	3.8800	150.7029
1.9744	5.8543	109.4662
0.9529	6.8072	84.1424
1.8657	8.6729	70.5777
0.9280	9.6009	63.4201
4.7548	14.3556	61.2224
4.9567	19.3123	69.9210
9.9463	29.2586	91.7974
9.8269	39.0855	104.6717
19.9560	59.0415	81.4126
18.4257	77.4672	47.0936
15.8763	93.3435	27.1416
13.9602	107.3037	17.3788
19.9243	127.2280	12.5624

VES 714.20 (Site QQ)

A-Spacing (meters)	Observed Response (Ohm-meters)
1.0	97.0
2.0	122.0
3.0	119.0
4.0	105.0
6.0	76.0
8.0	64.0
9.0	60.0
10.0	58.0
15.0	53.0
20.0	52.5
30.0	56.0
40.0	63.0
50.0	65.0
60.0	66.0
70.0	65.0
80.0	60.0
100.0	56.0
120.0	47.0
140.0	39.5
160.0	33.0

Thickness (meters)	Depth (meters)	Resistivity (Ohm-meters)
0.1000	0.1000	79.5017
0.0468	0.1468	78.6298
0.0686	0.2154	76.9344
0.1007	0.3162	75.6935
0.1479	0.4641	79.3015
0.2134	0.6775	97.9902
0.2884	0.9658	144.7034
0.9038	1.8696	186.4087
0.9988	2.8684	125.2642
0.9315	3.7999	74.4390
1.6416	5.4416	41.3250
1.6337	7.0753	30.5140
0.8785	7.9537	31.0243
0.9218	8.8755	33.2366
4.9377	13.8132	42.2352
4.9355	18.7487	59.9059
9.1983	27.9470	86.0834
8.9945	36.9414	104.4603
9.5100	46.4514	98.9801
9.9267	56.3781	84.8448
9.9693	66.3474	69.2182
9.7528	76.1002	55.2036
18.1702	94.2704	38.1184
15.4427	109.7131	22.2911
12.2611	121.9742	12.4515

VES 714.21 (Site PP)

A-Spacing (meters)	Observed Response (Ohm-meters)
1.0	109.0
2.0	110.0
3.0	115.0
4.0	122.0
6.0	138.0
8.0	136.0
10.0	128.0
15.0	112.0
20.0	101.0
30.0	95.0
40.0	91.0
50.0	85.0
60.0	78.0
70.0	69.0
90.0	52.0
110.0	40.0
130.0	30.0
150.0	24.0

Thickness (meters)	Depth (meters)	Resistivity (Ohm-meters)
0.1000	0.1000	117.9992
0.0468	0.1468	117.7416
0.0687	0.2154	118.4409
0.1008	0.3162	119.7650
0.1479	0.4641	119.7501
0.2170	0.6811	113.0533
0.3167	0.9978	98.1728
0.9912	1.9890	86.8899
0.9573	2.9463	140.4963
0.8301	3.7763	225.0497
1.8600	5.6363	206.3596
1.9895	7.6258	131.8082
1.8762	9.5020	87.1711
4.4802	13.9822	62.0105
4.8553	18.8375	70.5053
9.7656	28.6030	119.9916
9.5633	38.1664	141.8083
9.9813	48.1477	101.2989
9.3394	57.4871	64.0534
8.1774	65.6644	39.9641
12.7164	78.3808	20.1641
9.6459	88.0267	9.8836
9.7672	97.7939	7.5657

VES 714.24 (Site JJ)

A-Spacing (meters)	Observed Response (Ohm-meters)
10.0	60.0
15.0	70.0
20.0	76.0
25.0	78.0
30.0	80.0
40.0	89.0
50.0	95.0
60.0	99.0
70.0	102.0
80.0	102.5
90.0	102.0
100.0	101.0
110.0	99.0
120.0	95.0
130.0	91.0
140.0	86.0
150.0	83.0
160.0	76.0

Thickness (meters)	Depth (meters)	Resistivity (Ohm-meters)
1.0000	1.0000	44.9447
0.4678	1.4678	44.7153
0.6865	2.1543	43.6622
1.0076	3.1618	43.1390
1.4773	4.6391	46.9374
2.0835	6.7226	63.7109
2.8037	9.5263	92.9245
4.6992	14.2255	92.7740
4.9801	19.2056	76.7129
4.9964	24.2020	74.0588
4.9482	29.1502	83.8776
9.2913	38.4415	114.7313
8.1577	46.5992	169.3890
7.9013	54.5004	201.4009
8.5109	63.0114	194.4830
9.3079	72.3193	169.7879
9.8623	82.1816	141.4303
9.9852	92.1668	113.5040
9.7463	101.9131	88.6063
9.1862	111.0993	67.2031
8.3299	119.4292	49.1999
7.3045	126.7337	34.8818
5.9666	132.7002	23.0278

VES 76A.10 (Site N9)

A-Spacing (meters)	Observed Response (Ohm-meters)
2.0	113.0
3.0	80.0
4.0	68.0
6.0	64.0
8.0	70.0
10.0	74.0
15.0	73.0
20.0	68.0
30.0	59.0
40.0	50.0
60.0	35.0
80.0	24.0
100.0	16.0
120.0	11.0
150.0	7.1
200.0	5.9

Thickness (meters)	Depth (meters)	Resistivity (Ohm-meters)
0.1800	0.1800	170.0957
0.0842	0.2642	168.0353
0.1236	0.3878	171.3010
0.1813	0.5690	178.6608
0.2659	0.8350	183.7491
0.3898	1.2248	159.8389
0.5335	1.7583	93.9184
0.6473	2.4056	37.6215
0.6763	3.0819	28.4107
1.7920	4.8739	58.8756
1.5628	6.4366	119.1788
1.6473	8.0840	118.8228
4.4953	12.5792	85.5512
4.4154	16.9946	61.8143
8.7456	25.7401	52.6149
8.8104	34.5505	49.6039
17.1217	51.6722	37.6676
13.7326	65.4048	17.0725
6.9724	72.3772	4.5250
9.1179	81.4951	3.2184
12.8296	94.3248	1.7958

VES 76A.09 (Site N8)

A-Spacing (meters)	Observed Response (Ohm-meters)
1.0	150.0
2.0	97.0
4.0	59.0
5.0	53.0
6.0	53.0
8.0	55.0
10.0	58.0
15.0	61.0
20.0	60.0
30.0	55.5
40.0	49.5
50.0	44.0
70.0	30.5
80.0	25.0
90.0	18.0
100.0	11.5
120.0	7.8

Thickness (meters)	Depth (meters)	Resistivity (Ohm-meters)
1.1000	0.1000	185.4692
0.0467	0.1467	184.8750
0.0687	0.2154	186.2272
0.1008	0.3162	189.1707
0.1479	0.4641	191.7084
0.2171	0.6812	184.5141
0.3163	0.9974	154.2718
0.8998	1.8972	75.9313
1.5891	3.4864	32.8205
0.9748	4.4612	43.9273
1.0000	5.4612	56.9363
1.9727	7.4339	68.7557
1.9665	9.4003	73.1301
4.9752	14.3755	70.0553
4.9996	19.3751	63.5341
9.9503	29.3254	54.9773
9.7724	39.0978	44.4342
9.3587	48.4565	33.3945
16.1617	64.6181	18.3367
5.8342	70.4523	8.2913
3.8429	74.2952	3.9122
1.4377	75.7329	1.0409

VES 76A.08 (Site N7)

A-Spacing (meters)	Observed Response (Ohm-meters)
2.0	59.0
3.0	57.0
5.0	59.0
7.0	65.0
10.0	74.0
15.0	76.0
20.0	72.0
30.0	59.5
40.0	48.0
60.0	38.0
80.0	15.0
100.0	8.0
120.0	4.6
150.0	3.1
200.0	2.9

Thickness (meters)	Depth (meters)	Resistivity (Ohm-meters)
0.2000	0.2000	58.9929
0.0935	0.2935	58.9117
0.1373	0.4309	59.0150
0.2016	0.6324	59.2337
0.2959	0.9283	59.3579
0.4343	1.3625	58.7240
0.6371	1.9997	56.6873
0.9993	2.9990	55.4364
1.9936	4.9926	63.5207
1.9323	6.9249	81.5155
2.8728	9.7976	92.7092
4.9639	14.7615	83.7156
4.9635	19.7251	63.4330
9.4575	29.1826	42.6922
8.8461	38.0287	28.6615
16.0339	54.0625	17.1122
12.3151	66.3776	7.4665
6.2319	72.6095	2.0694
9.9834	82.5929	1.8413
13.4149	96.0079	0.9496

VES 76A.05 (Site N6)

A-Spacing (meters)	Observed Response (Ohm-meters)
2.0	128.0
3.0	87.0
4.0	73.0
6.0	61.0
8.0	60.0
10.0	71.0
15.0	64.5
20.0	65.5
30.0	62.0
40.0	53.0
60.0	37.0
80.0	28.0
100.0	15.0
120.0	9.5
150.0	6.0
200.0	5.3

Thickness (meters)	Depth (meters)	Resistivity (Ohm-meters)
0.2000	0.2000	175.9088
0.0936	0.2936	174.6126
0.3171	0.4307	174.6369
0.2016	0.6323	177.2325
0.2957	0.9280	183.4288
0.4342	1.3621	173.5641
0.6080	1.9701	109.8585
0.7541	2.7242	44.9679
0.6967	3.4208	27.0802
1.9006	5.3215	43.2753
1.8691	7.1905	92.2875
1.8013	8.9918	111.8624
4.9597	13.9515	85.9159
4.9702	18.9218	65.8622
9.8983	28.8200	59.3745
9.7746	38.5946	50.2280
18.6037	57.1983	34.7022
16.8181	74.0164	21.1678
13.9764	87.9928	11.5914
9.6865	97.6792	5.1361
7.4298	105.1090	1.5789

VES 76A.04 (Site N5)

A-Spacing (meters)	Observed Response (Ohm-meters)
2.0	71.0
3.0	40.0
4.0	41.0
6.0	53.0
8.0	61.0
10.0	65.0
15.0	70.0
20.0	72.0
30.0	70.0
40.0	65.0
60.0	52.0
80.0	38.0
100.0	26.0
120.0	15.5
150.0	9.5
200.0	6.0

Thickness (meters)	Depth (meters)	Resistivity (Ohm-meters)
0.2000	0.2000	149.7298
0.0936	0.2936	150.6960
0.1373	0.4308	155.0175
0.2014	0.6323	158.0977
0.2952	0.9275	140.4302
0.4032	1.3306	81.5313
0.4034	1.7340	25.9776
0.5519	2.2859	12.3958
0.9791	3.2649	31.1004
1.5296	4.7946	96.7436
1.6464	6.4410	105.2628
1.8950	8.3360	86.2630
4.9519	13.2879	75.9542
4.9821	18.2700	74.7393
9.9491	28.2191	78.6057
9.9996	38.2187	73.1262
19.0160	57.2346	44.1649
13.7156	70.9503	16.0679
6.6546	77.6048	4.1512
1.6559	79.2607	0.6072
2.7636	82.0243	0.4316

VES N711.10 (Site N4)

A-Spacing (meters)	Observed Response (Ohm-meters)
1.0	97.5
2.0	74.0
4.0	52.0
6.0	48.0
8.0	48.0
9.0	50.0
10.0	51.7
15.0	58.0
20.0	61.0
30.0	60.0
40.0	56.0
50.0	49.0
60.0	43.0
70.0	36.0
80.0	30.0
90.0	25.0
100.0	20.5
120.0	13.0
140.0	6.0

Thickness (meters)	Depth (meters)	Resistivity (Ohm-meters)
0.1000	0.1000	96.2913
0.0467	0.1467	95.7792
0.0686	0.2153	95.7540
0.1008	0.3161	96.6070
0.1479	0.4640	98.6958
0.2170	0.6810	101.6465
0.3187	0.9996	100.3488
0.9874	1.9870	74.2519
1.7761	3.7631	35.1134
1.9298	5.6929	35.6071
1.9670	7.6599	57.8126
0.9323	8.6922	73.6264
0.9206	9.5129	79.3968
4.7150	14.2278	81.6859
4.9077	19.1355	76.7950
9.9837	29.1192	69.6284
9.9462	39.0654	58.2537
9.6661	48.7315	44.3150
8.9864	57.7178	30.7899
7.8530	65.5709	19.7056
6.3132	71.8841	11.5012
4.4258	76.3099	5.8265
2.2364	78.5463	2.1192
8.9006	87.4469	2.5165

VES N711.10S (Site N4)

A-Spacing (meters)	Observed Response (Ohm-meters)
2.0	119.0
3.0	83.0
4.0	59.0
6.0	51.0
7.0	50.5
9.0	51.0
15.0	56.0
20.0	58.0
25.0	58.5
30.0	58.0
40.0	53.0
60.0	39.0
80.0	25.5
100.0	16.0
120.0	10.3
150.0	6.0
200.0	4.8

Thickness (meters)	Depth (meters)	Resistivity (Ohm-meters)
0.2000	0.2000	185.4665
0.0936	0.2936	183.6452
0.1373	0.4309	184.9036
0.2015	0.6324	189.0233
0.2957	0.9281	193.3239
0.4321	1.3602	164.8946
0.5712	1.9315	86.4610
0.6484	2.6798	30.9702
0.7388	3.3187	26.1124
1.9711	5.2897	48.3090
0.9978	6.2875	61.8716
1.9991	8.2866	56.0757
5.9986	14.2853	55.9992
4.8045	19.0898	79.0817
4.6327	23.7224	95.8979
4.7847	28.5071	93.1245
9.9957	38.5027	68.2762
16.1307	54.6334	24.5714
2.8963	57.5317	1.6370
5.0618	62.5935	1.1040
1.0848	63.6782	0.1019
5.8620	69.5402	0.1964

VES N711.03 (Site N3)

A-Spacing (meters)	Observed Response (Ohm-meters)
1.0	50.0
2.0	65.0
3.0	69.0
4.0	74.0
6.0	84.0
8.0	90.0
10.0	93.0
20.0	95.0
30.0	82.0
40.0	71.0
50.0	60.0
60.0	50.0
70.0	37.8
90.0	28.0
110.0	21.0
130.0	15.0
150.0	10.0
160.0	7.9

Thickness (meters)	Depth (meters)	Resistivity (Ohm-meters)
0.1000	0.1000	44.1335
0.0468	0.1468	44.3904
0.0687	0.2154	44.3908
0.1008	0.3162	43.8205
0.1479	0.4641	42.8650
0.2171	0.6813	43.8023
0.3139	0.9951	54.0574
0.9174	1.9126	83.9849
0.9739	2.8865	82.0638
0.9884	3.8749	81.0409
1.9277	5.8026	98.9866
1.8613	7.6639	122.8671
1.8850	9.5489	129.4746
9.9695	19.5184	105.8091
9.7225	29.2409	69.0883
9.2041	38.4450	47.8739
8.7479	47.1929	35.3395
8.4717	55.6646	28.0841
8.3723	64.0369	23.8664
16.7031	80.7400	20.0646
16.5195	97.2595	16.2249
15.1945	112.4540	11.5522
11.2266	123.6806	5.8755

VES N711.02 (Site N2)

A-Spacing (meters)	Observed Response (Ohm-meters)
2.0	13.20
2.8	16.90
4.1	20.10
6.1	23.50
8.1	25.80
12.2	27.00
16.3	25.00
20.3	23.00
28.5	19.50
40.6	15.20
61.0	11.00
81.3	6.40
121.9	2.25
162.6	1.38
203.2	1.03

Thickness (meters)	Depth (meters)	Resistivity (Ohm-meters)
0.2000	0.2000	8.9049
0.0936	0.2936	9.0212
0.1373	0.4309	8.8681
0.2015	0.6323	8.5265
0.2958	0.9282	8.6604
0.4229	1.3511	11.5719
0.5192	1.8703	20.9404
0.5346	2.4049	35.7143
0.9076	3.3124	43.8316
1.6491	4.9615	43.3953
1.8901	6.8516	37.3325
4.0985	10.9502	26.7984
3.9354	14.8856	17.9830
3.7422	18.6277	14.5951
7.9270	26.5547	14.8880
12.0634	38.6181	17.7303
19.2913	57.9094	11.2041
10.0824	67.9917	2.4438
14.4643	82.4560	0.5053
15.2926	97.7486	0.2158

VES N711.01 (Site N1)

A-Spacing (meters)	Observed Response (Ohm-meters)
1.0	83.0
2.0	72.0
3.0	57.0
4.0	51.0
5.0	49.0
6.0	50.0
7.0	53.0
8.0	55.0
9.0	57.0
10.0	59.0
15.0	65.0
20.0	70.0
30.0	71.0
40.0	63.0
50.0	53.0
60.0	47.5
70.0	43.0
80.0	38.0
90.0	26.5
100.0	19.8
110.0	14.5
120.0	11.5
130.0	9.5
140.0	8.0
150.0	7.8
160.0	6.0

Thickness (meters)	Depth (meters)	Resistivity (Ohm-meters)
0.1000	0.1000	82.8932
0.0468	0.1468	82.7180
0.0687	0.2154	82.9253
0.1008	0.3162	83.5392
0.1479	0.4641	84.5209
0.2171	0.6812	84.5164
0.3185	0.9998	80.0761
0.9849	1.9846	60.2561
0.9454	2.9300	41.3433
0.9572	3.8873	37.8129
0.9906	4.8779	42.8702
0.9994	5.8773	52.0014
0.9821	6.8594	61.9572
0.9597	7.8191	70.6621
0.9450	8.7641	77.2311
0.9394	9.7035	81.5983
4.7605	14.4640	85.3364
4.9139	19.3779	81.6348
9.9990	29.3769	68.1208
9.7581	39.1350	49.7728
9.2196	48.3545	35.3238
8.4832	56.8377	24.6536
7.6177	64.4554	16.9398
6.6545	71.1099	11.4046
5.6278	76.7377	7.4886

VES N711.01 (Site N1)
(continued)

Thickness (meters)	Depth (meters)	Resistivity (Ohm-meters)
4.5473	81.2850	4.7269
3.4326	84.7176	2.8044
2.2862	87.0038	1.4757
1.0590	88.0629	0.5426
5.1017	93.1646	2.0818
4.5805	97.7451	1.4925

VES S711.01 (Site S9)

A-Spacing (meters)	Observed Response (Ohm-meters)
2.0	17.50
2.8	16.90
4.1	14.00
6.1	13.60
8.1	13.90
12.2	15.50
16.3	16.90
20.3	17.30
28.5	16.20
40.6	13.20
61.0	9.20
81.3	5.70
121.9	2.30
162.6	1.25

Thickness (meters)	Depth (meters)	Resistivity (Ohm-meters)
0.0936	0.2936	17.8831
0.1373	0.4309	17.8231
0.2016	0.6324	18.0621
0.2957	0.9281	18.7879
0.4328	1.3609	20.1325
0.6370	1.9979	19.6485
0.7883	2.7862	14.7155
1.2052	3.9915	9.6043
1.9169	5.9084	9.1771
1.9710	7.8794	15.0763
3.4298	11.3091	27.2181
3.6386	14.9477	28.7877
3.9282	18.8759	23.0223
8.1468	27.0227	16.3119
11.2918	38.3145	10.3759
16.7676	55.0820	5.6604
13.2701	68.3521	2.6254
17.0942	85.4463	0.8352

VES S711.02 (Site S8)

A-Spacing (meters)	Observed Response (Ohm-meters)
2.0	21.60
2.8	19.90
4.1	16.60
6.1	13.50
8.1	12.80
12.2	12.60
16.3	13.00
20.3	13.10
28.5	12.50
40.6	10.30
61.0	6.60
81.3	3.80
121.9	1.70
162.6	1.22
203.2	1.05

Thickness (meters)	Depth (meters)	Resistivity (Ohm-meters)
0.2000	0.2000	23.4363
0.0934	0.2934	23.3209
0.1373	0.4308	23.2713
0.2016	0.6323	23.3687
0.2958	0.9282	23.8217
0.4341	1.3622	24.3280
0.6374	1.9996	23.4888
0.7901	2.7897	18.6388
1.1863	3.9760	11.2812
1.7251	5.7011	7.4563
1.9395	7.6406	9.1436
4.0011	11.6417	15.7318
3.8102	15.4519	20.4780
3.8765	19.3284	19.3337
8.1916	27.5200	15.3632
11.4418	38.9618	9.1922
14.1057	53.0675	3.2518
6.5892	59.6567	0.7094
10.6076	70.2643	0.2821
32.4225	102.6868	0.8084

VES S711.05 (Site S7)

A-Spacing (meters)	Observed Response (Ohm-meters)
2.0	17.7
2.8	17.6
4.1	15.5
6.1	13.8
8.1	13.5
12.2	13.1
16.3	13.4
20.3	14.0
28.5	13.8
40.6	12.0
61.0	8.0
81.3	4.0
121.9	1.6
162.6	1.0
203.2	1.0

Thickness (meters)	Depth (meters)	Resistivity (Ohm-meters)
0.2000	0.2000	15.3508
0.0936	0.2936	15.2440
0.1373	0.4309	15.0426
0.2016	0.6324	15.0748
0.2949	0.9273	16.7292
0.4212	1.3486	21.1241
0.6239	1.9725	22.1103
0.7984	2.7708	17.1359
1.2675	4.0383	12.8414
1.9135	5.9518	10.2117
1.9222	7.8740	9.1589
4.0965	11.9705	11.7907
3.7048	15.6753	20.6685
3.2956	18.9709	28.1306
7.6644	26.6353	24.2976
11.7830	38.4183	12.4662
11.5071	49.9253	2.7232
8.4763	58.4016	0.6902
25.4281	83.8297	0.2479
22.8215	106.6512	0.1284

VES S711.07 (Site S6)

A-Spacing (meters)	Observed Response (Ohm-meters)
1.0	139.00
2.0	114.0
4.0	51.0
6.0	42.0
7.0	41.8
9.0	42.0
10.0	43.0
15.0	49.0
20.0	54.0
30.0	51.0
40.0	38.0
60.0	28.9
80.0	21.0
90.0	17.0

Thickness (meters)	Depth (meters)	Resistivity (Ohm-meters)
0.1000	0.1000	150.1252
0.0468	0.1468	149.9708
0.0687	0.2154	149.2615
0.1008	0.3162	148.4310
0.1479	0.4641	149.6005
0.2170	0.6812	154.5998
0.3182	0.9994	162.0919
0.9947	1.9940	128.0556
1.3944	3.3885	29.2798
1.5032	4.8917	19.1106
0.9891	5.8808	34.8074
1.9263	7.8071	56.5955
0.8850	8.6921	75.2945
4.4419	13.1340	84.7875
4.7898	17.9238	78.8617
9.9829	27.9067	56.4257
9.3229	37.2296	33.9372
16.5796	53.8092	19.2910
14.9518	68.7609	11.4581
6.4512	75.2121	7.1528

VES S711.08 (Site S5)

A-Spacing (meters)	Observed Response (Ohm-meters)
1.0	83.0
2.0	71.0
4.0	47.0
5.0	43.5
6.0	43.0
8.0	46.0
13.0	60.0
20.0	70.0
25.0	74.0
30.0	73.0
40.0	52.0
50.0	44.0
60.0	38.0
80.0	25.5
110.0	14.0
130.0	8.0

Thickness (meters)	Depth (meters)	Resistivity (Ohm-meters)
0.1000	0.1000	91.7255
0.0467	0.1467	91.3939
0.0687	0.2154	90.8561
0.1008	0.3162	90.5293
0.1479	0.4641	92.0273
0.2169	0.6810	96.8437
0.3176	0.9986	103.1136
0.9871	1.9856	71.8308
1.4867	3.4724	20.0693
0.9110	4.3834	21.7559
0.9983	5.3817	38.0493
1.5311	6.9128	85.5239
2.7207	9.6335	184.4950
6.2051	15.8385	120.4799
4.9960	20.8345	83.5123
4.9055	25.7400	61.2894
9.1117	34.8517	40.2636
8.1405	42.9922	25.3302
7.5037	50.4959	17.7842
13.8850	64.3809	11.8737
6.5342	70.9150	8.5037
11.7327	82.6478	5.8301

VES S711.09 (Site S4)

A-Spacing (meters)	Observed Response (Ohm-meters)
1.0	95.0
2.0	78.0
3.0	56.0
5.0	46.0
7.0	47.0
10.0	51.8
15.0	56.0
20.0	56.0
30.0	51.0
40.0	35.0
50.0	29.5
60.0	21.0
80.0	14.5
100.0	8.7
120.0	6.3
140.0	4.9

Thickness (meters)	Depth (meters)	Resistivity (Ohm-meters)
0.1000	0.1000	105.2839
0.0468	0.1468	105.1786
0.0687	0.2154	104.7413
0.1008	0.3162	104.4778
0.1479	0.4641	105.7462
0.2171	0.6812	108.5037
0.3186	0.9998	109.7893
0.9777	1.9775	73.1437
0.7832	2.7607	28.7343
1.7710	4.5318	26.3197
1.9382	6.4699	57.4084
2.6039	9.0738	88.0639
4.7324	13.8062	83.2231
4.9851	18.7913	69.0727
9.7918	28.5831	46.8671
8.8192	37.4023	27.2431
7.9584	45.3607	17.5996
7.5698	52.9305	13.1189
15.1005	68.0309	10.2464
15.8511	83.8821	8.7805
16.1754	100.0575	7.6067

VES S711.10 (Site S3)

A-Spacing (meters)	Observed Response (Ohm-meters)
1.0	106.0
1.5	110.0
2.0	99.0
3.0	74.0
4.0	53.0
6.0	42.0
7.0	41.0
9.0	42.0
15.0	49.0
25.0	55.9
30.0	56.0
40.0	53.0
50.0	46.0
60.0	37.0
80.0	21.0
100.0	15.0
120.0	9.5
140.0	6.0
160.0	4.0

Thickness (meters)	Depth (meters)	Resistivity (Ohm-meters)
0.1000	0.1000	103.5679
0.0468	0.1468	102.8813
0.0687	0.2154	101.3808
0.1008	0.3162	100.7567
0.1479	0.4641	105.0362
0.2150	0.6791	121.9136
0.3080	0.9872	149.1803
0.4956	1.4828	141.1103
0.4875	1.9703	90.8111
0.7953	2.7655	39.2804
0.6071	3.3727	16.9605
1.5819	4.9546	18.2189
0.9928	5.9474	32.4849
1.8943	7.8417	53.4490
5.0963	12.9380	83.4451
9.3398	22.2778	84.2156
4.9776	27.2554	69.6781
9.8778	37.1333	50.6893
9.0643	46.1976	31.6226
7.8564	54.0540	19.3069
11.8296	65.8835	8.9596
6.9328	72.8163	2.9891
2.6756	75.4919	0.6956
9.8046	85.2966	1.6072

VES 711.I1 (Site S2)

A-Spacing (meters)	Observed Response (Ohm-meters)
1.0	97.0
1.5	109.0
3.0	80.0
6.0	42.0
8.0	34.0
10.0	30.0
15.0	25.1
20.0	23.0
30.0	19.5
40.0	16.0
60.0	9.9
80.0	6.1
100.0	4.5
140.0	3.7

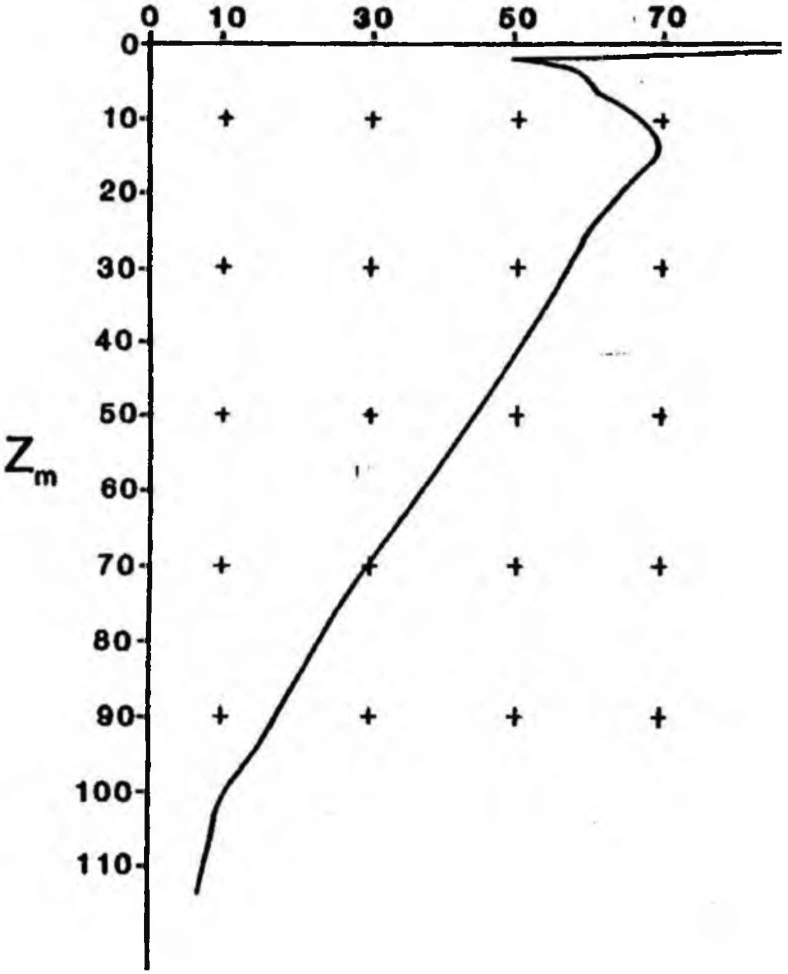
Thickness (meters)	Depth (meters)	Resistivity (Ohm-meters)
0.1000	0.1000	74.8808
0.0468	0.1468	73.7493
0.0686	0.2154	71.7271
0.1008	0.3162	71.2697
0.1475	0.4637	79.5349
0.2057	0.6694	111.6637
0.2723	0.9417	168.2326
0.4642	1.4059	166.3046
1.4337	2.8397	69.6273
2.2807	5.1204	23.2614
1.8536	6.9740	25.5303
1.9259	8.8998	26.5297
4.8329	13.7328	24.0806
4.9332	18.6659	24.6821
9.9134	28.5793	24.0274
9.1889	37.7682	14.8717
12.1883	49.9565	4.5895
6.2358	56.1924	1.1290
10.3692	66.5616	1.4022

VES S711.12 (Site S1)

A-Spacing (meters)	Observed Response (Ohm-meters)
1.0	59.0
2.0	54.0
3.0	44.0
5.0	40.0
7.0	43.0
9.0	45.8
12.0	46.1
20.0	43.9
30.0	39.0
40.0	35.0
50.0	27.0
60.0	18.1
80.0	12.3
100.0	7.4
120.0	4.2

Thickness (meters)	Depth (meters)	Resistivity (Ohm-meters)
0.1000	0.1000	62.1236
0.0467	0.1467	61.8882
0.0687	0.2154	61.7725
0.1007	0.3161	61.8419
0.1479	0.4640	62.8630
0.2170	0.6811	64.6584
0.3185	0.9996	65.5105
0.9907	1.9903	49.7710
0.9173	2.9075	29.0658
1.9564	4.8639	31.6059
1.9190	6.7829	54.5002
1.8732	8.6561	64.4010
2.9505	11.6066	57.4817
7.9812	19.5878	44.5172
9.8838	29.4716	37.1257
9.6591	39.1306	29.4821
9.0831	48.2137	20.7853
8.0662	56.2799	13.3829
11.5522	67.8321	5.6880
2.2648	70.0970	0.5411

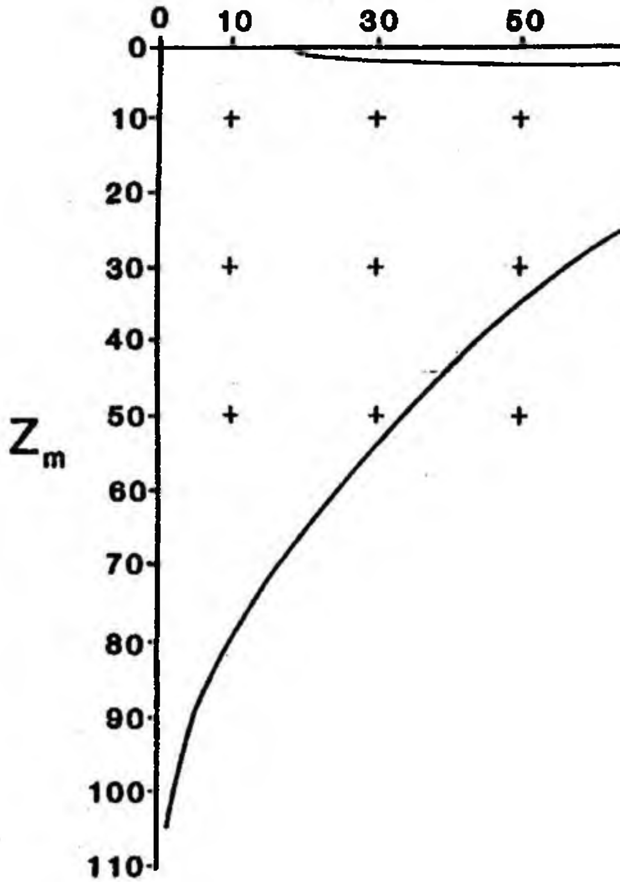
Appendix B: Fifty-two vertical electric sounding curves plotted as resistivity (ohm-meters) versus depth (meters).

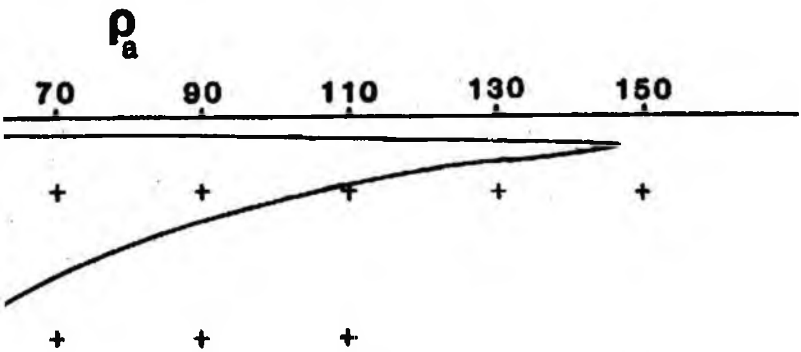


0
10
30
50
70
0
10
20
30
40
50
60
70
80
90
100
110
Zm

ves: Indiantown 01

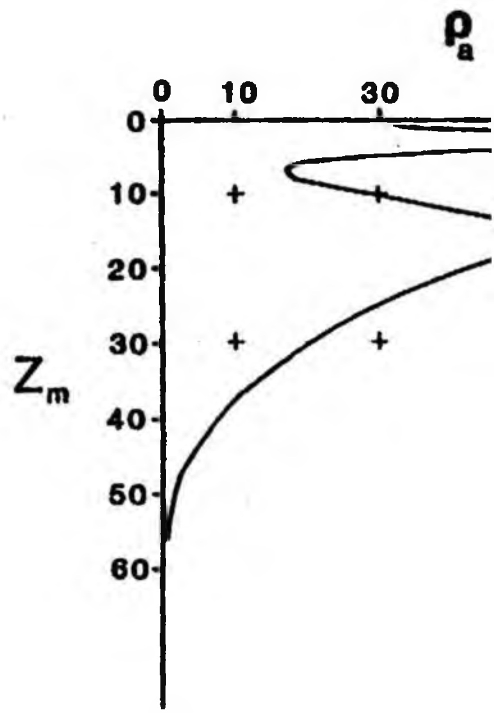
SITE A

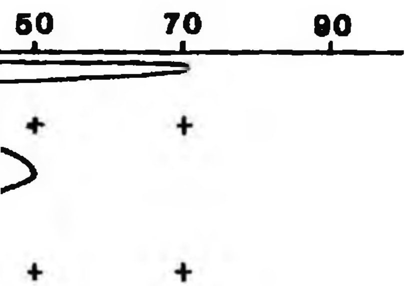

0
10
30
50
0
10
20
30
40
50
60
70
80
90
100
110
Z_m



ves: 726.13S

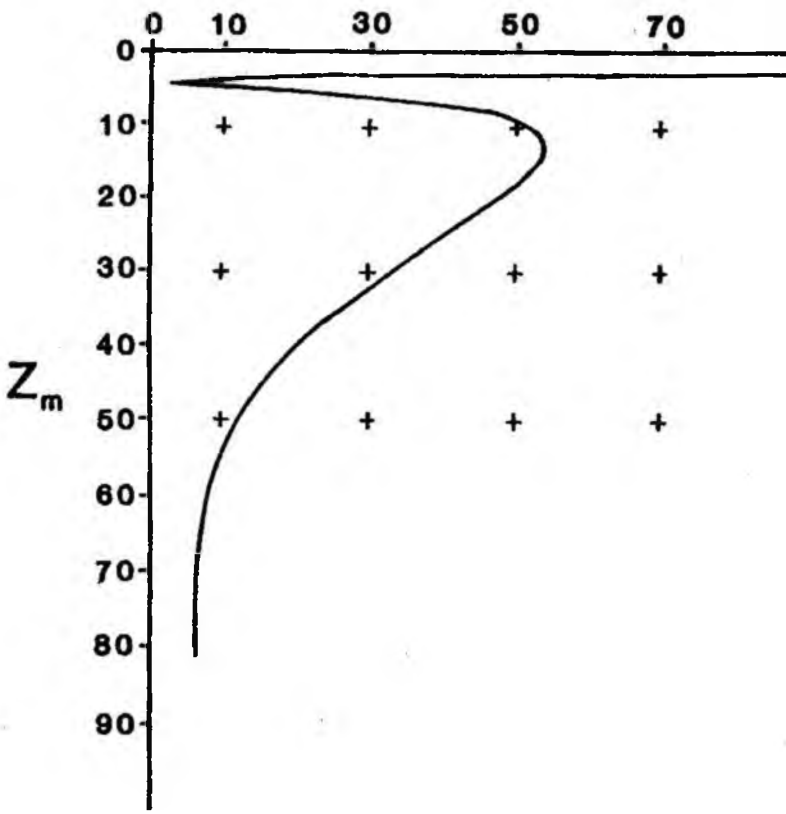
SITE B


ρa
0
10
30
0
10
20
30
40
50
60
Zm

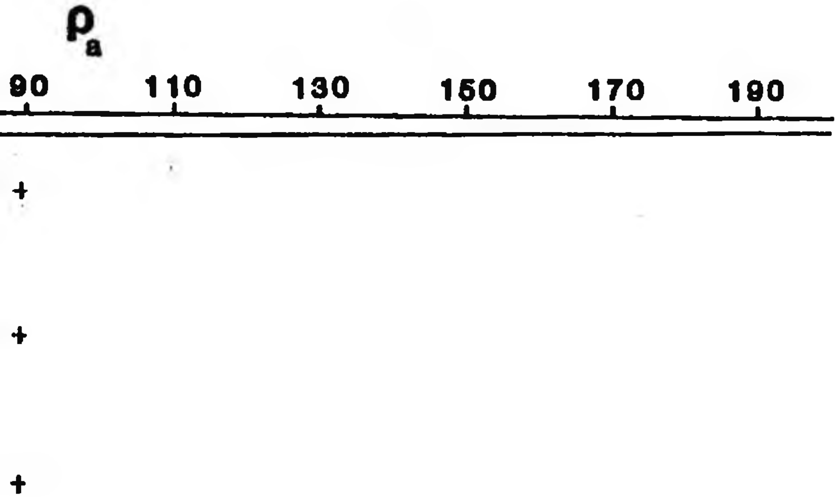


ves: 726.I4S

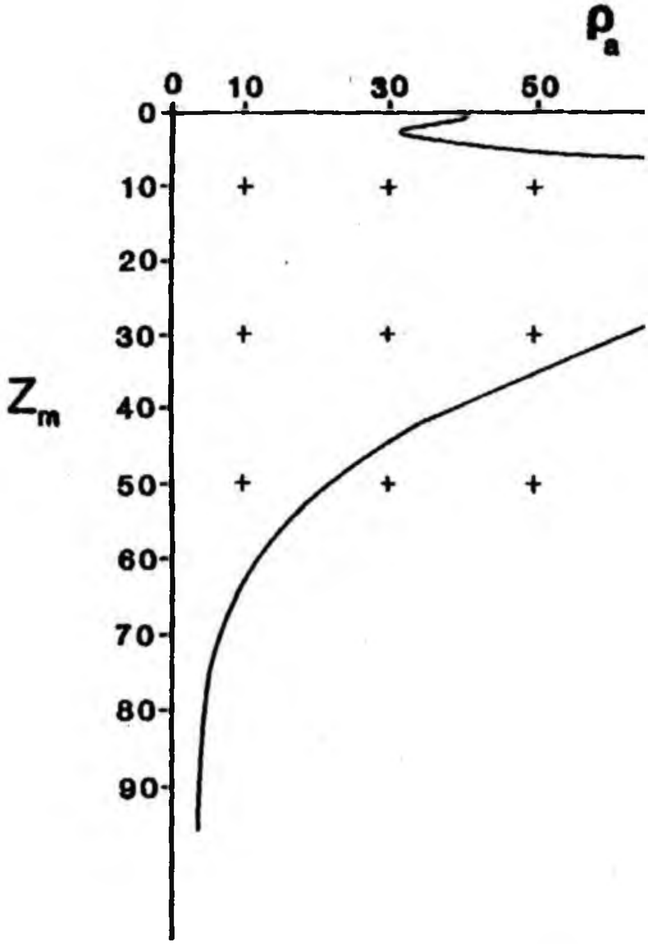
SITE C



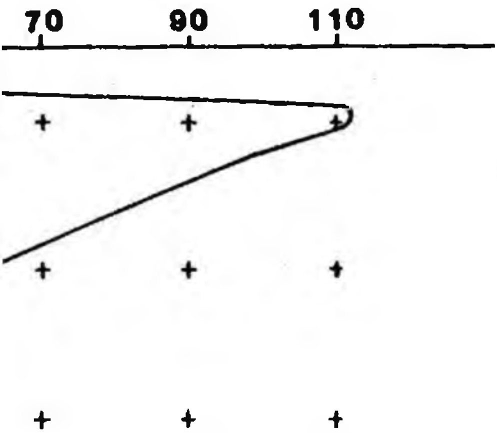
0
10
30
50
70
0
10
20
30
40
50
60
70
80
90
Z_m



ves: Indiantown 03
SITE E

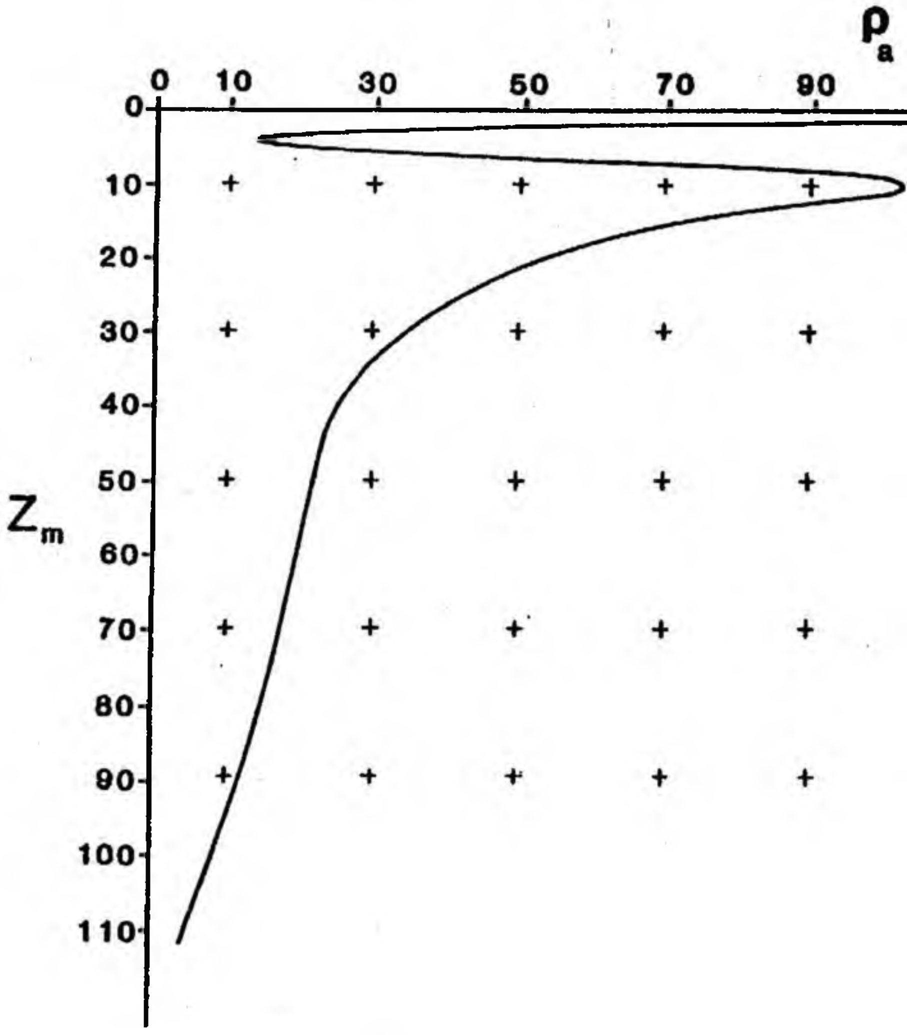


ρa
0
10
30
50
Zm
0
10
20
30
40
50
60
70
80
90



ves: 726.I1S

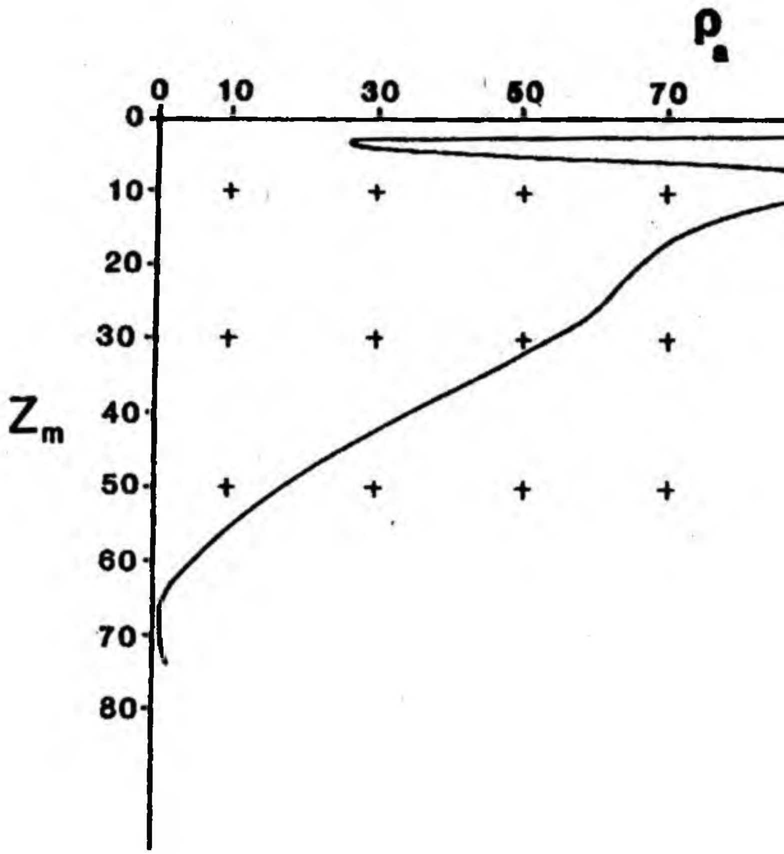
SITE F

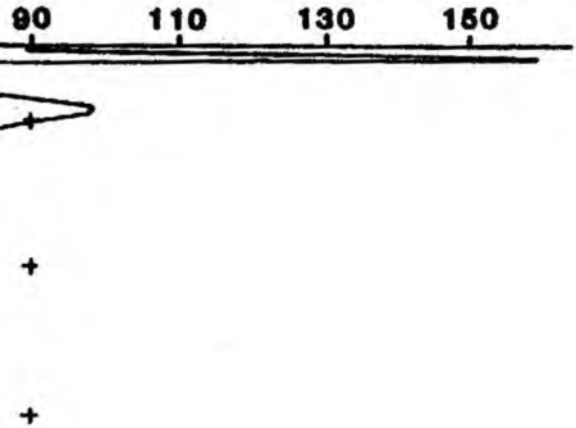


ρ_a
0
10
30
50
70
90
0
10
20
30
40
50
60
70
80
90
100
110
Z_m

ves: 76.06

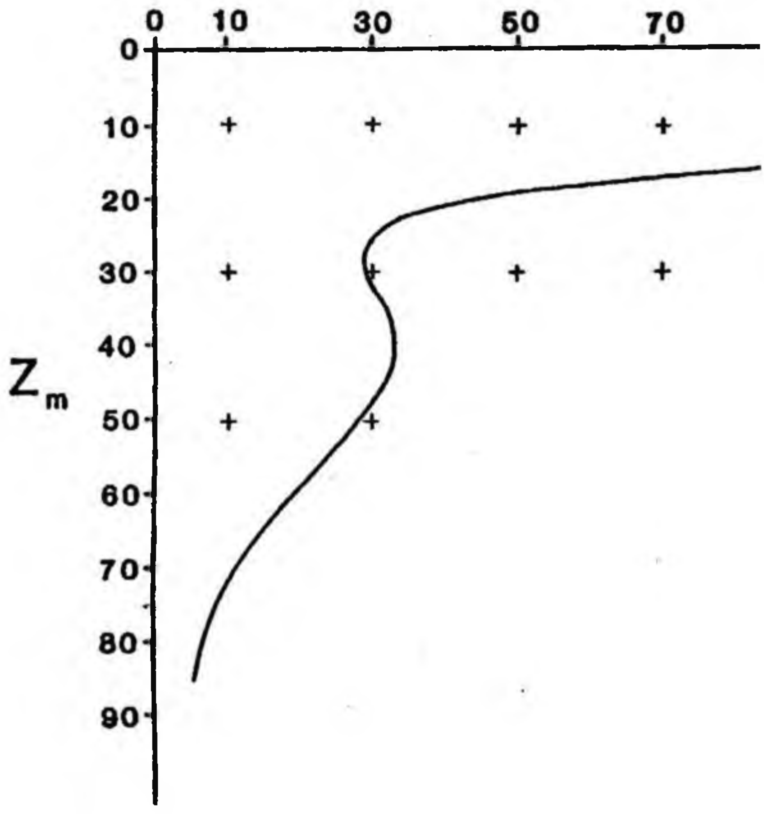
SITE G

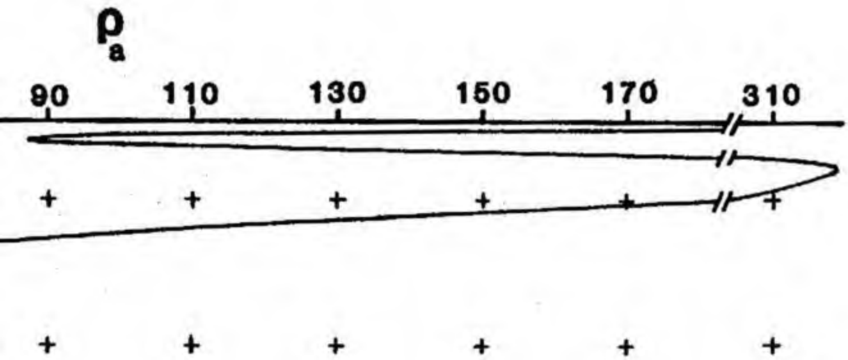

ρa
0
10
30
50
70
0
10
20
30
40
50
60
70
80
Zm



ves: 76.N1

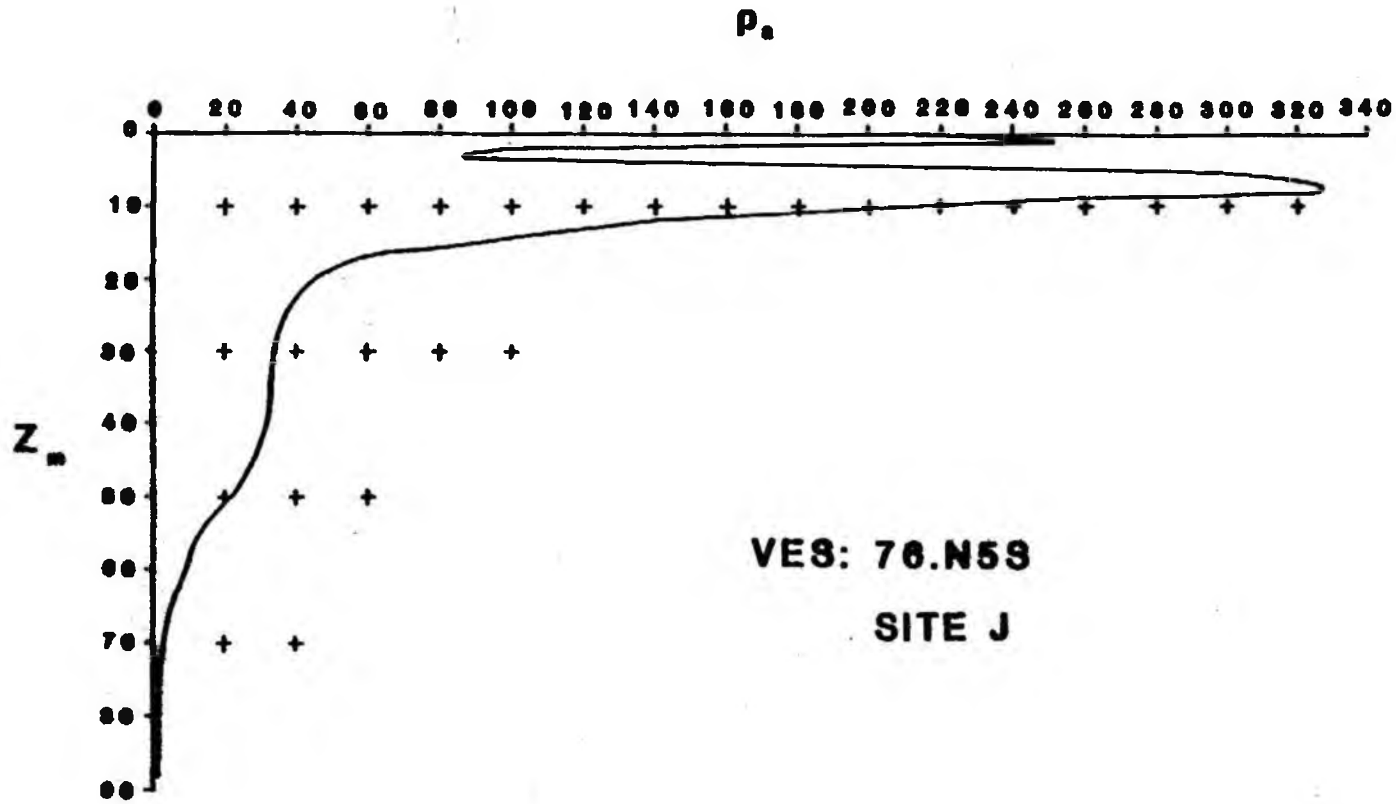
SITE H

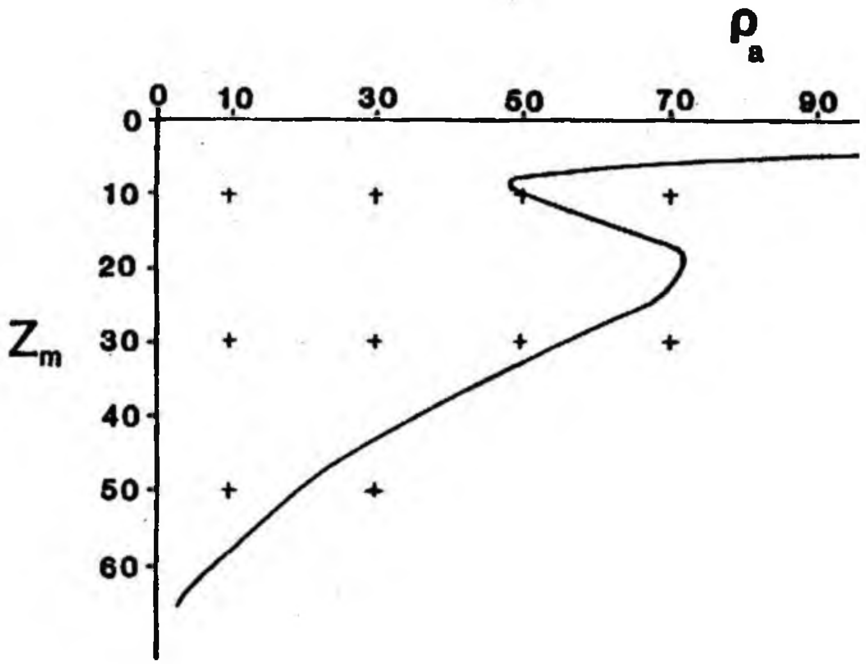

0
10
30
50
70
0
10
20
30
40
50
60
70
80
90
Z m



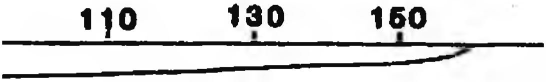
ves: 76.N5

SITE I


ρ_a
Z_m
VES: 76.N5S
SITE J

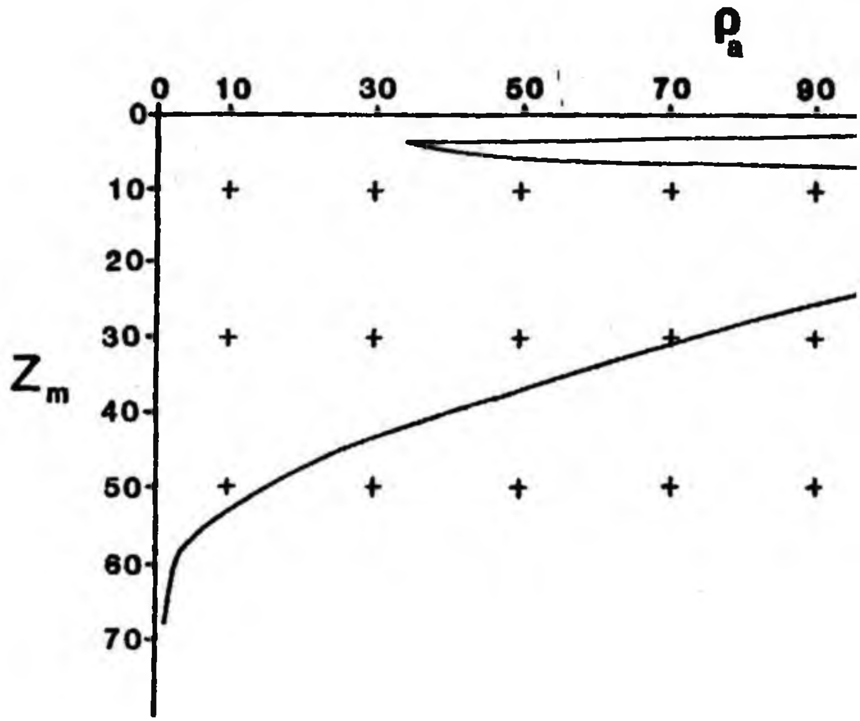


ρa
0
10
30
50
70
90
0
10
20
30
40
50
60
Zm

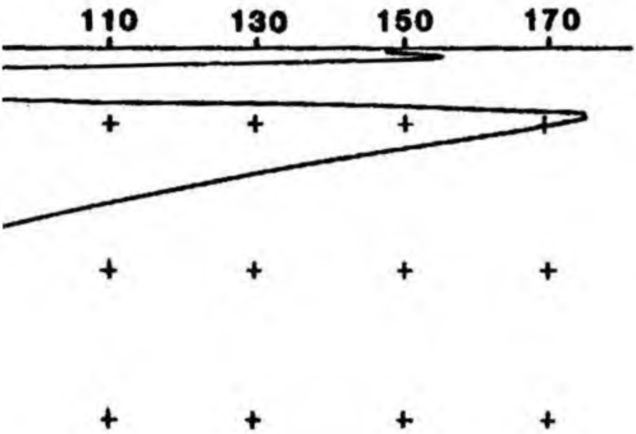


ves: 76.N10

SITE K



ρa
0 10 30 50 70 90
0 10 20 30 40 50 60 70
Zm



ves: 708.01

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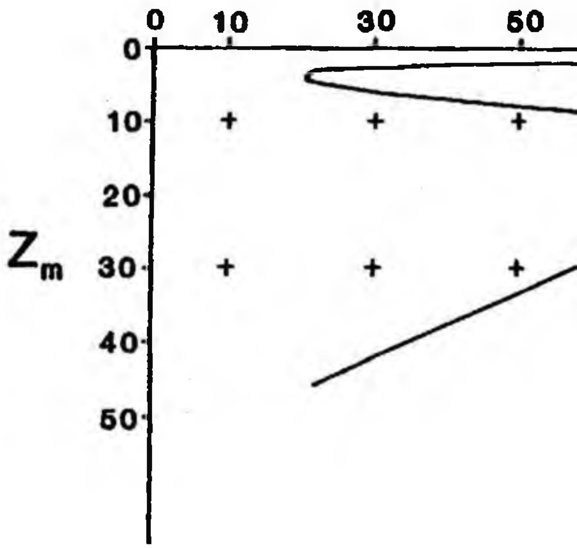

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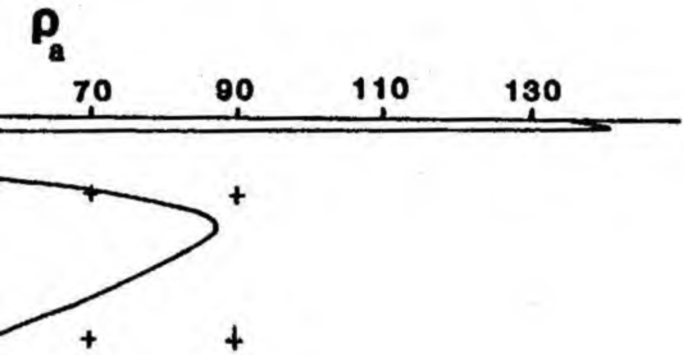

ves: 708.02

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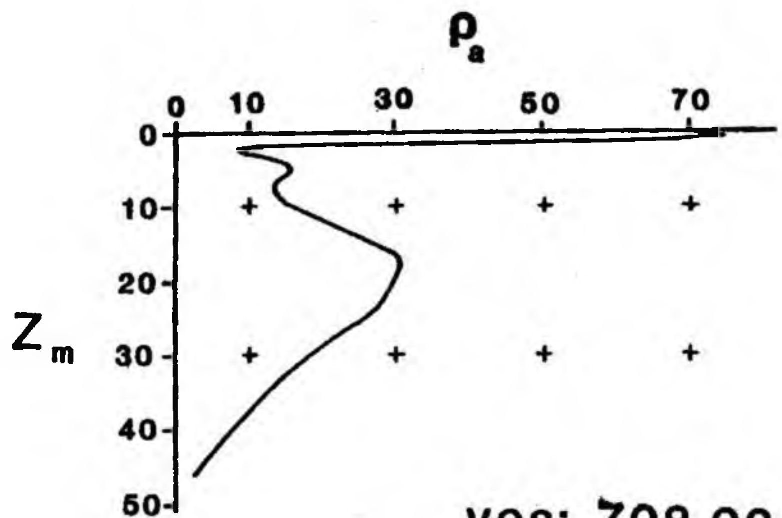

ves: 708.03
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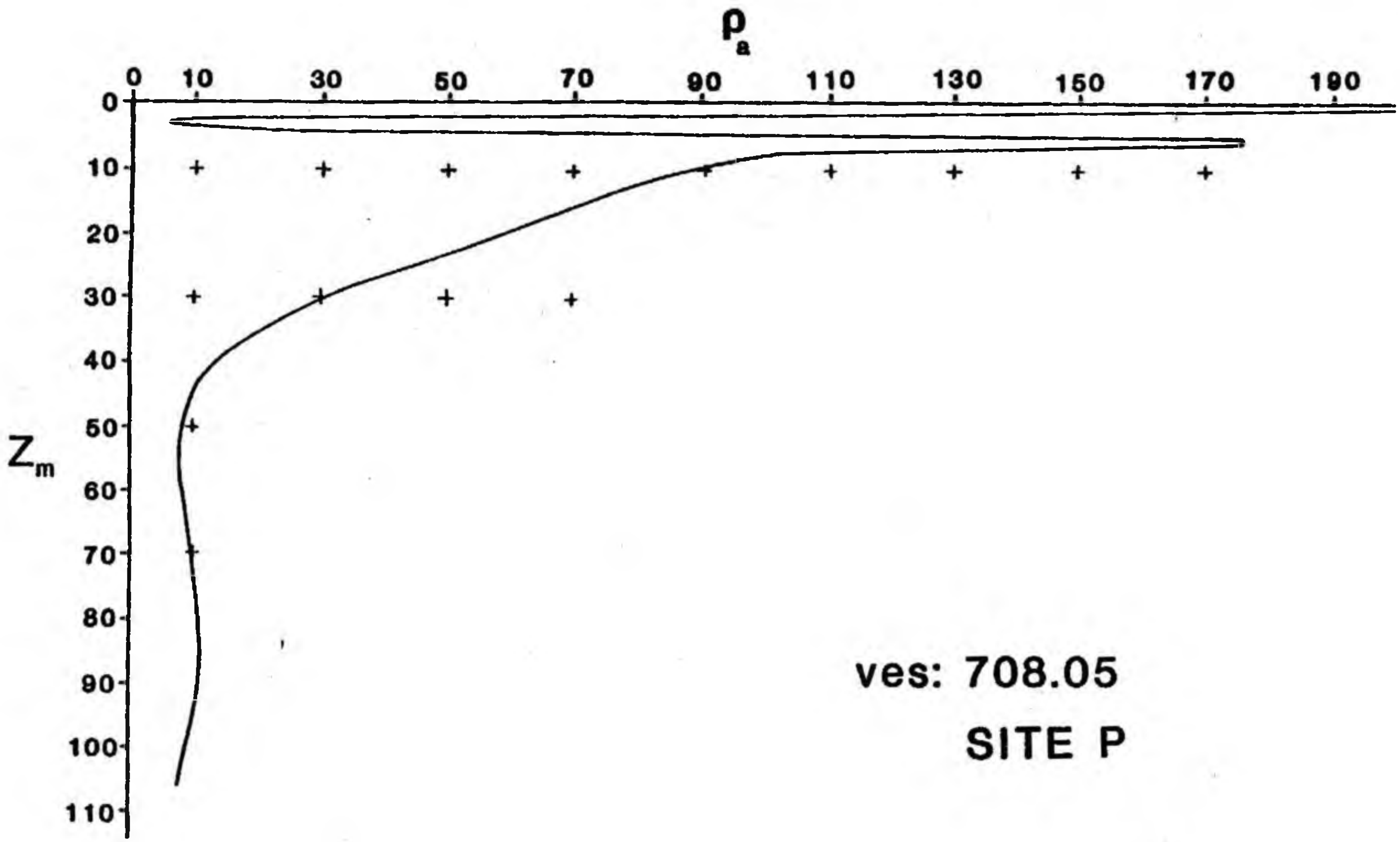
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Zm
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ves: 708.05
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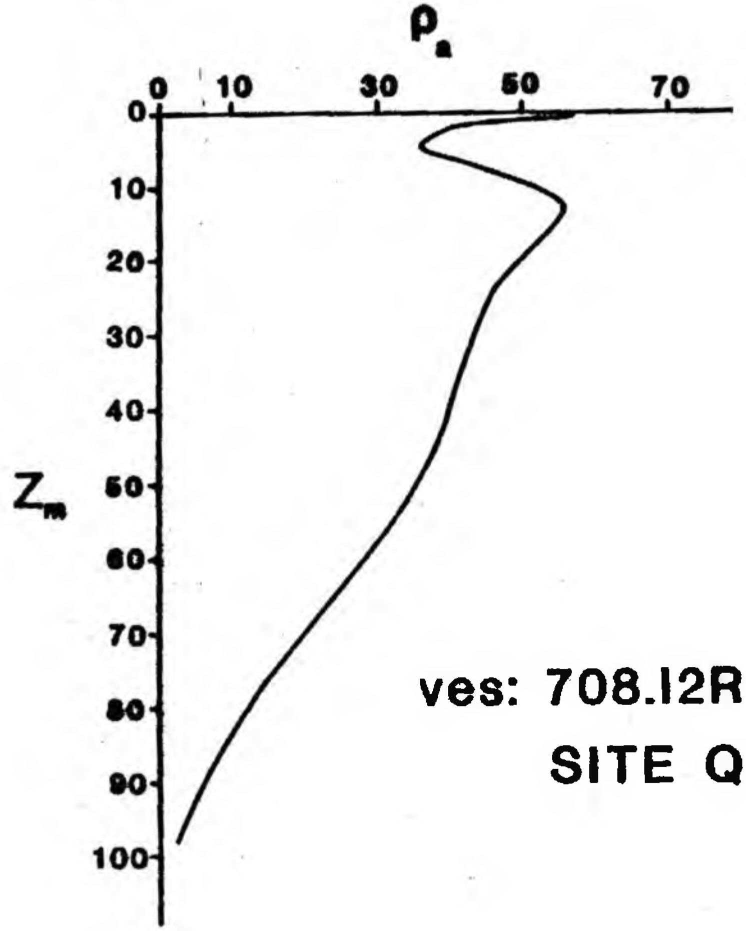
ρa
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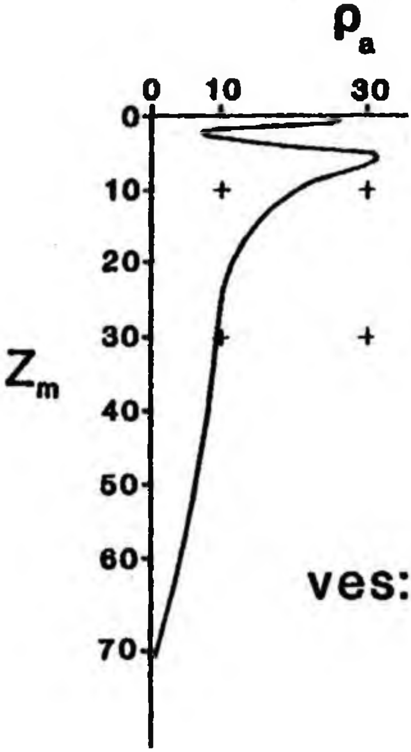

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Z_m
ves:

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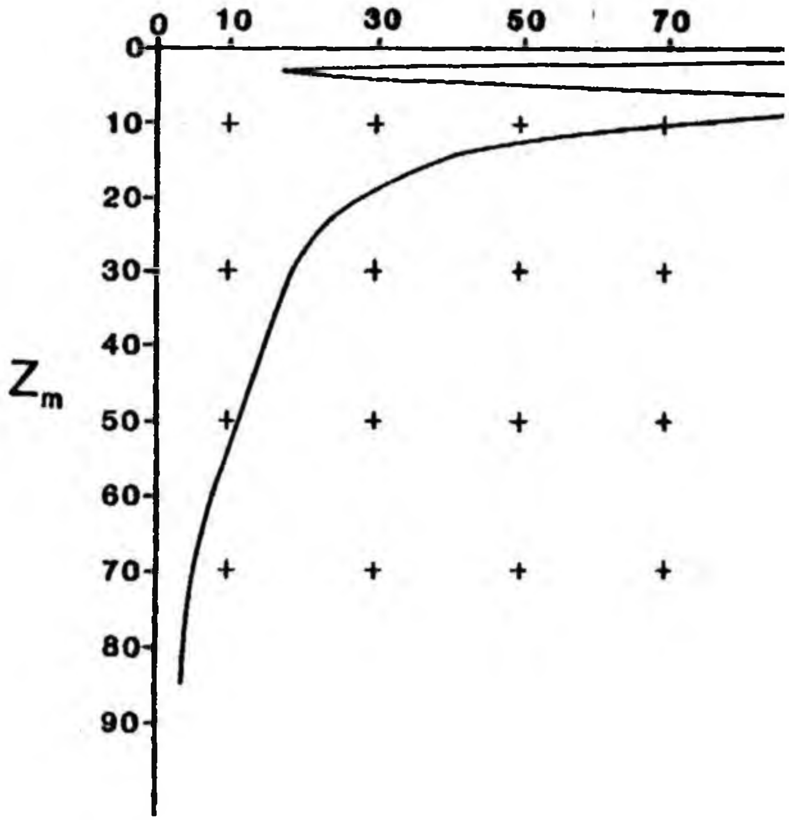
708.07R

SITE R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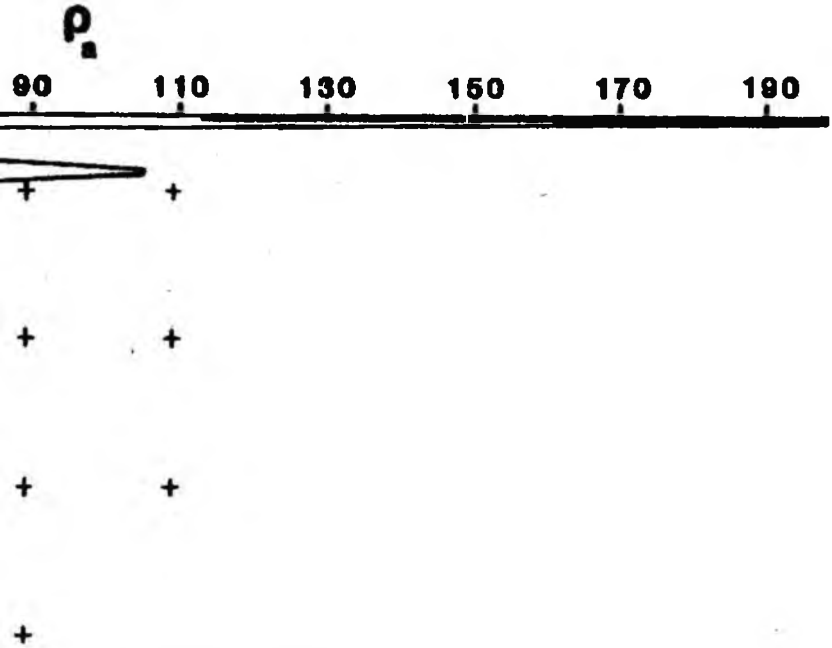

ves: 708.10

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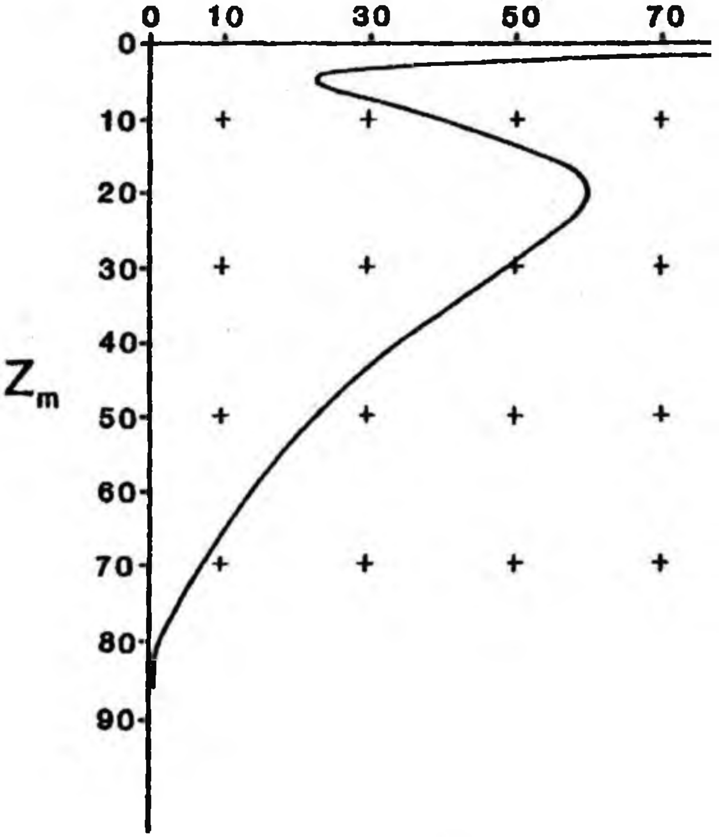

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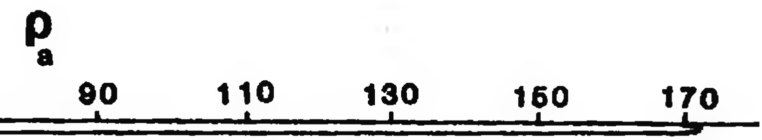

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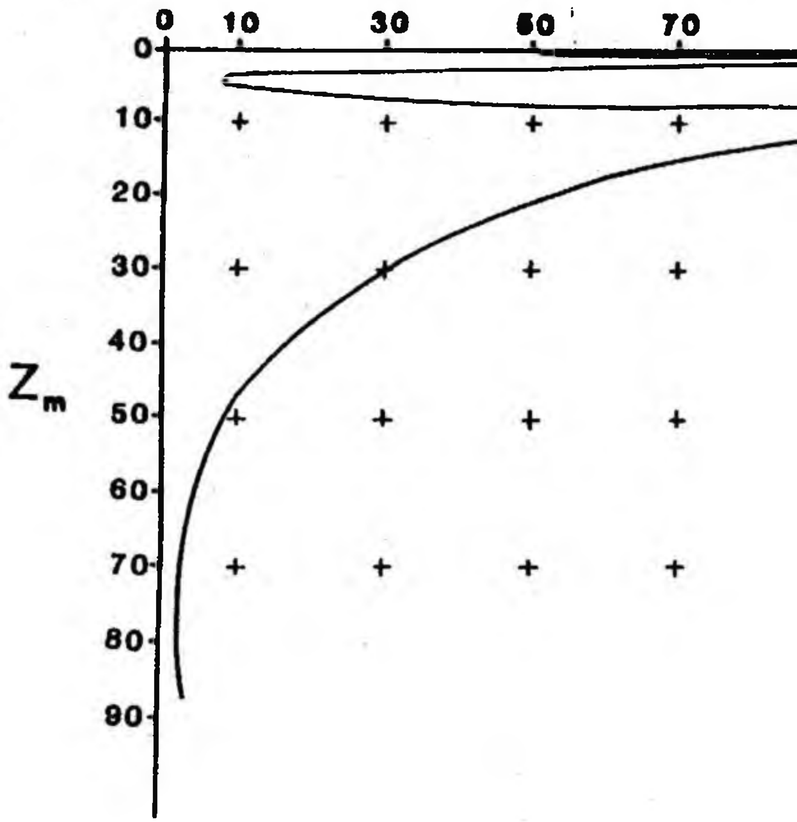

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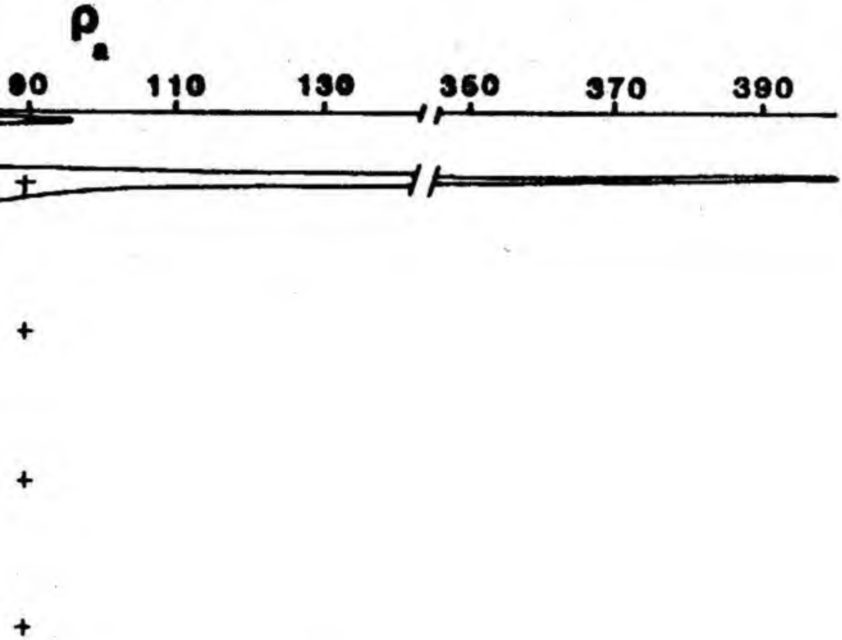

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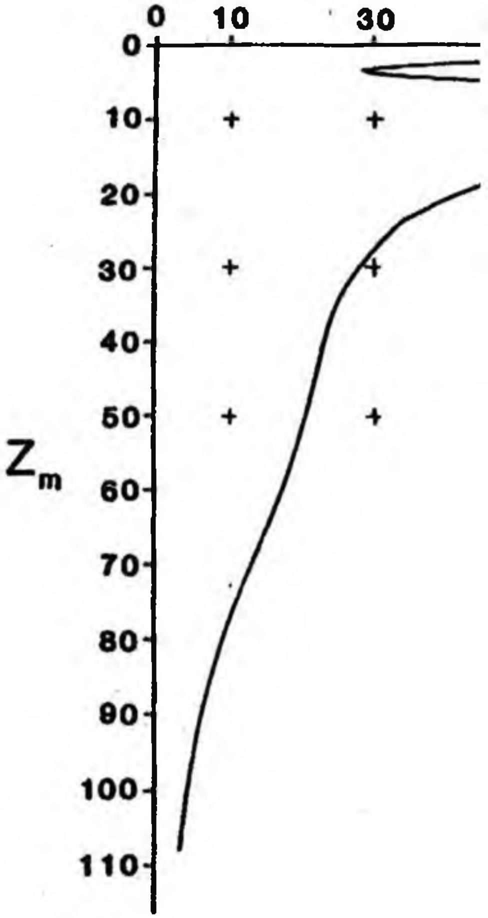
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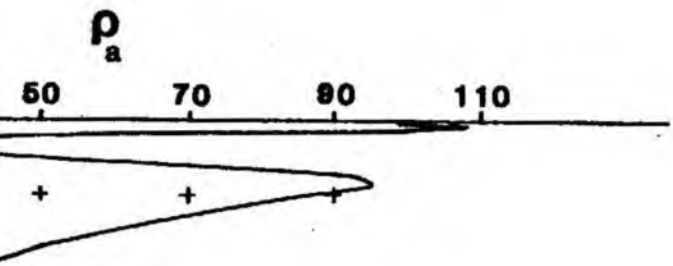

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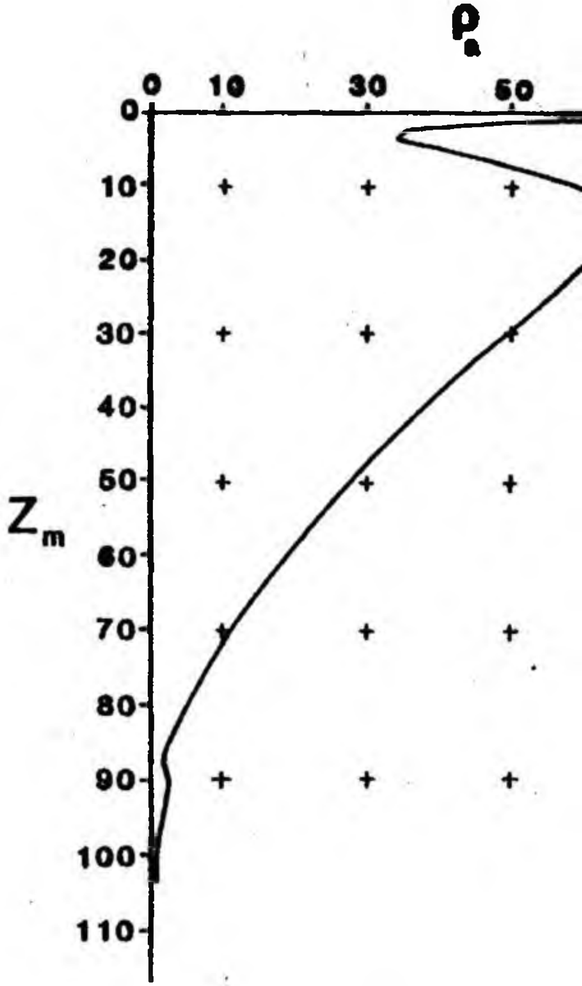

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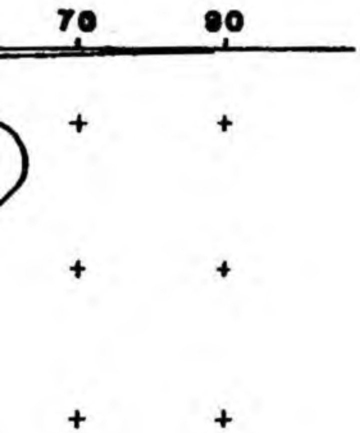

Ves: 708.14

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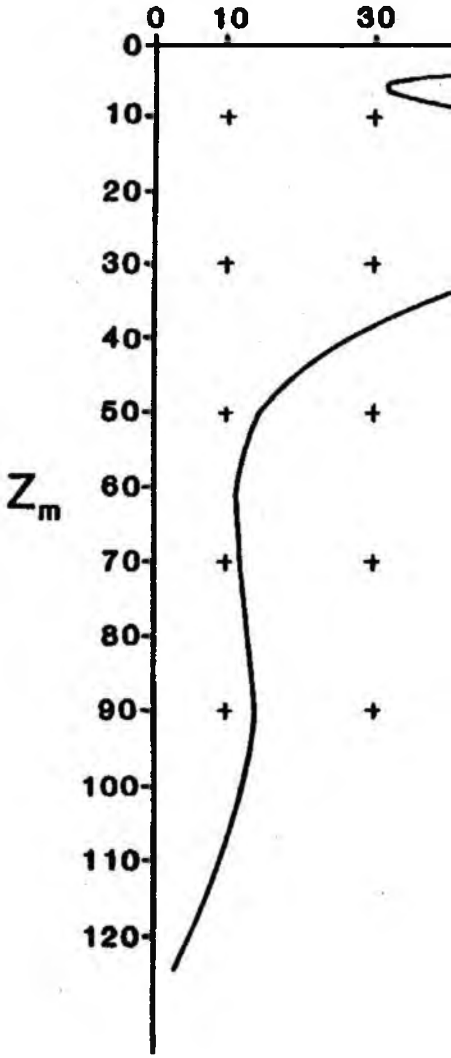

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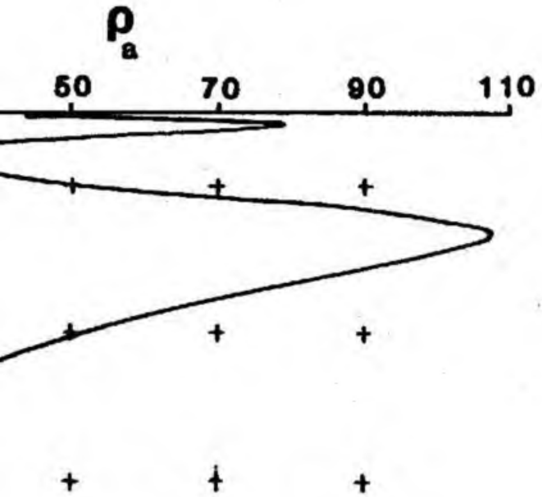

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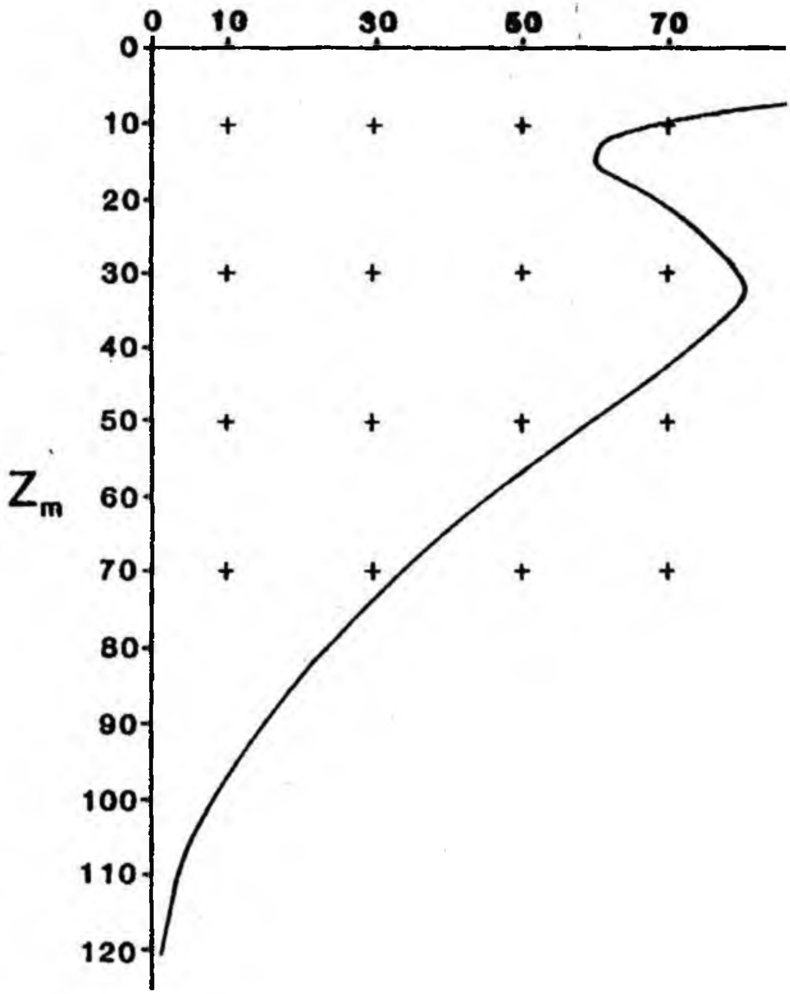

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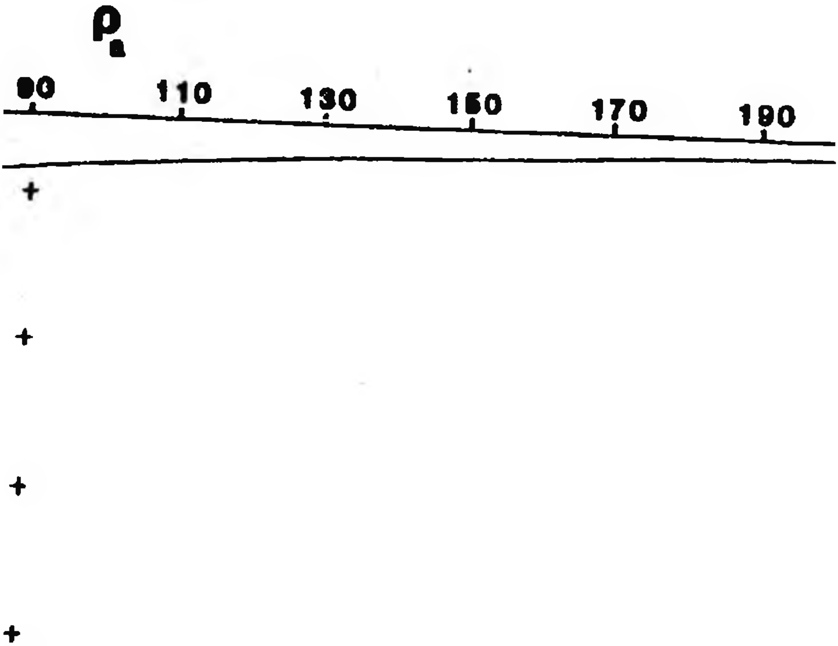

Ves: 708.16

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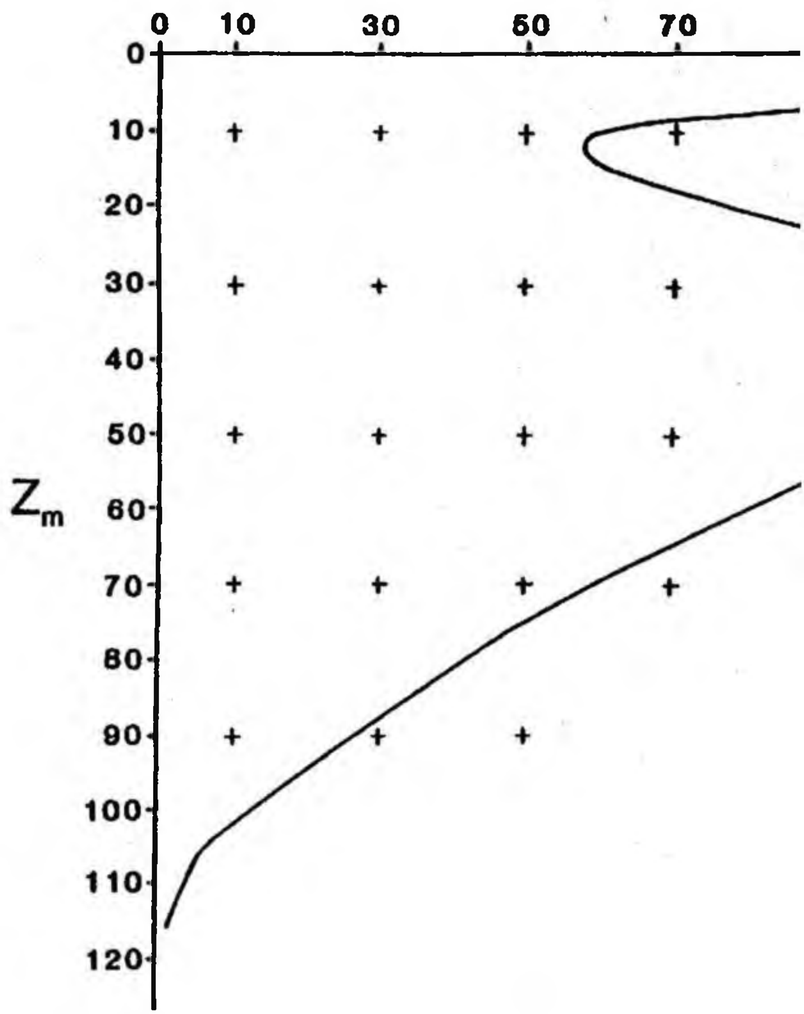

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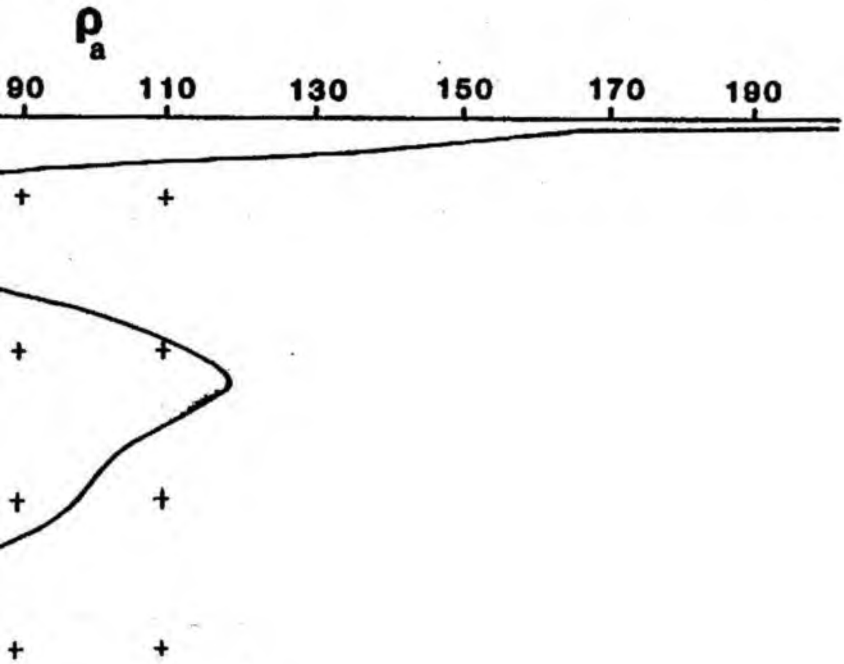

ves: 708.17

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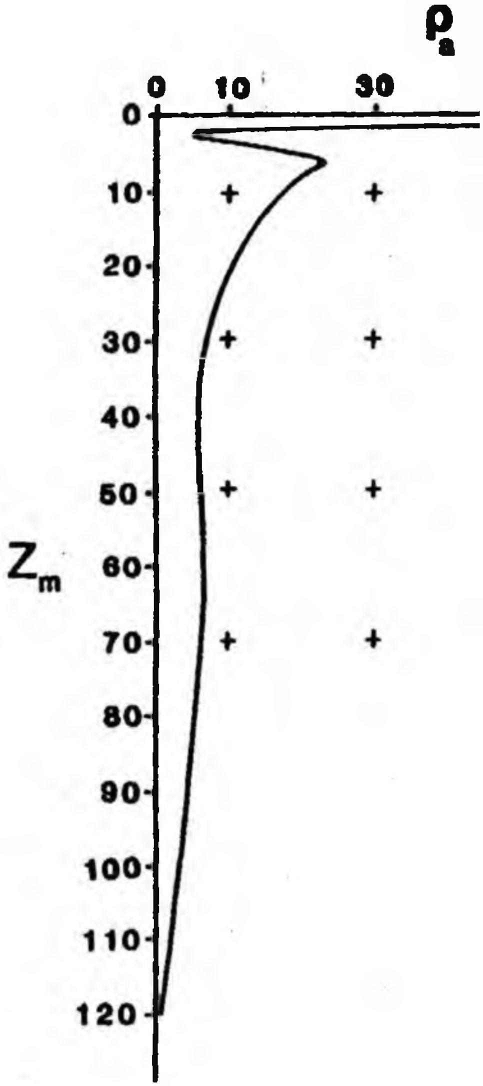

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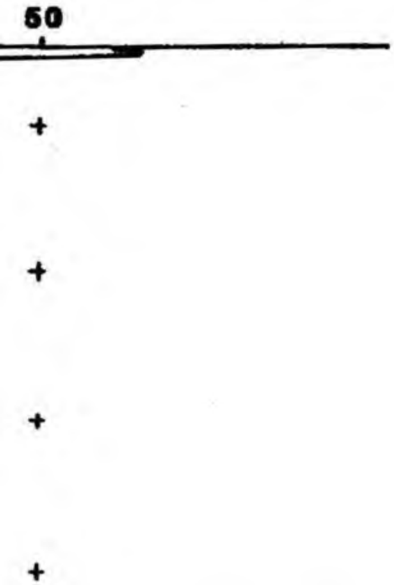

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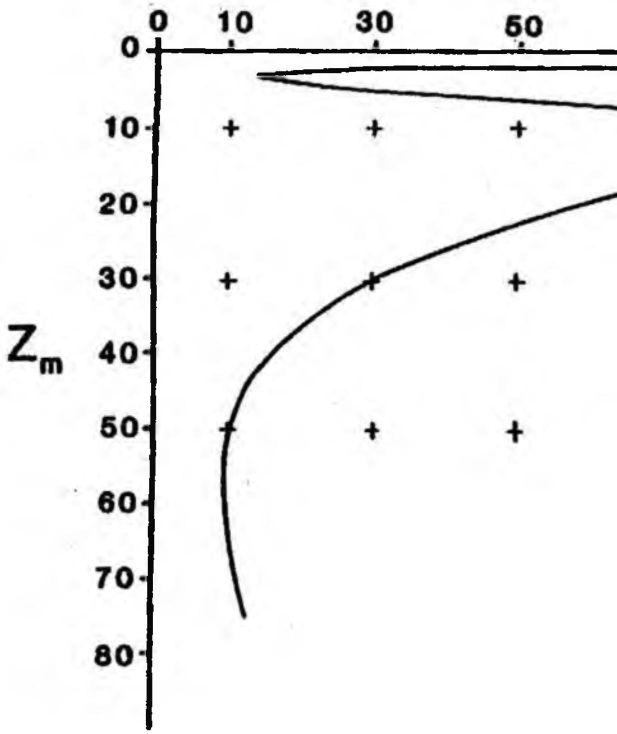

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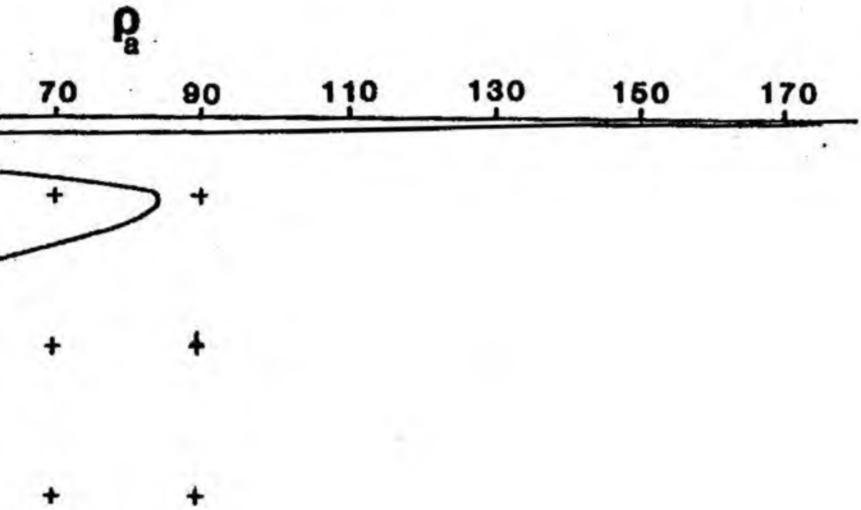

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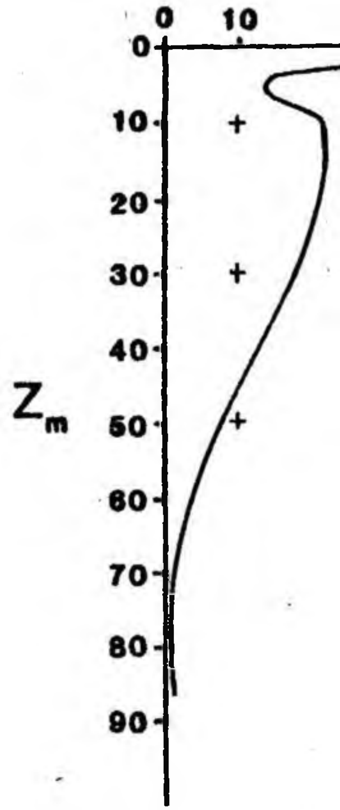

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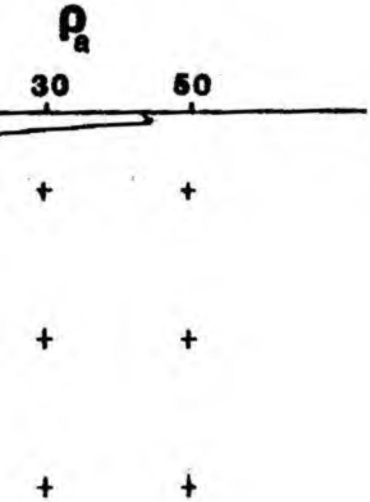

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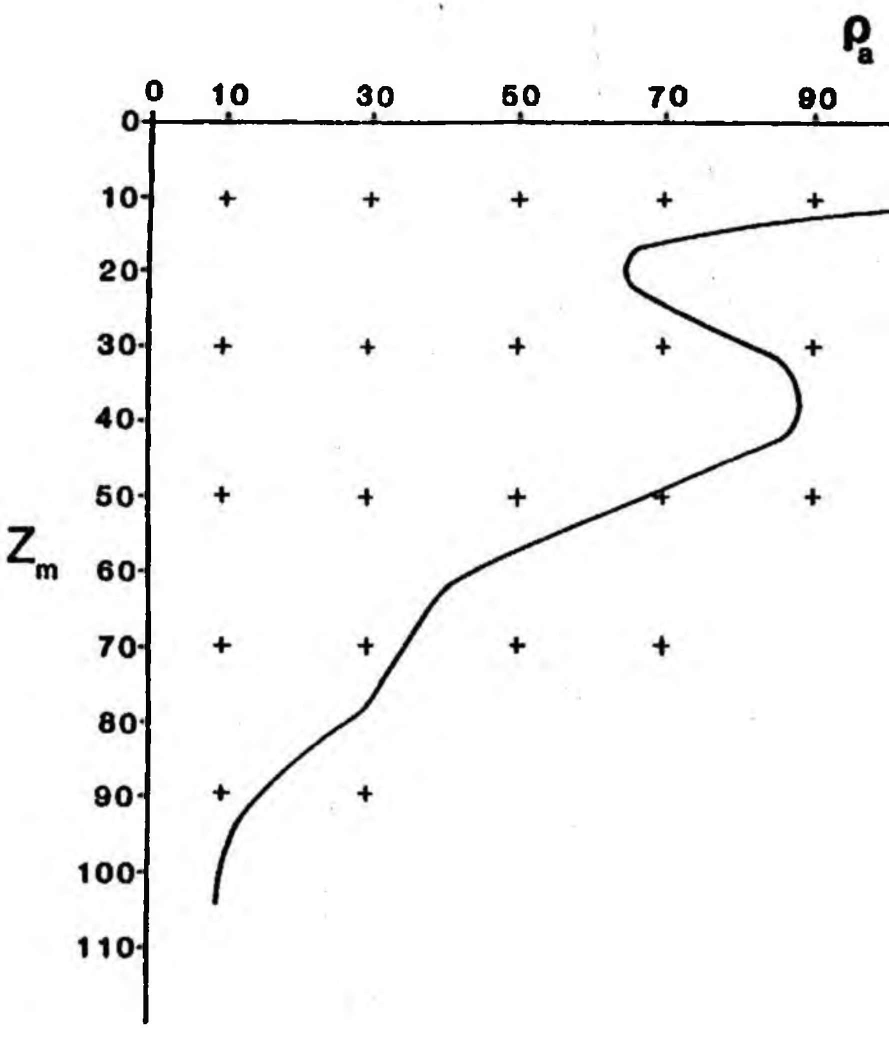

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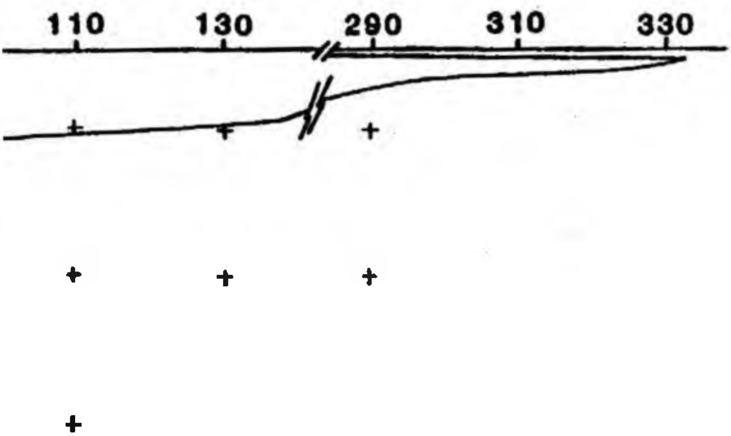

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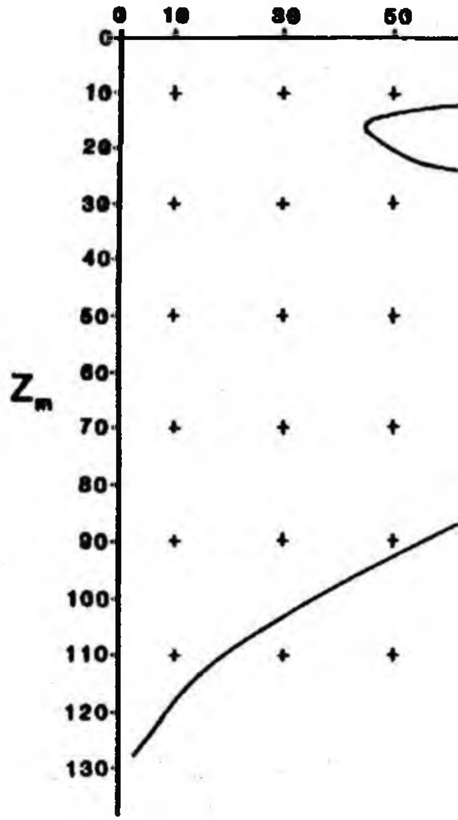

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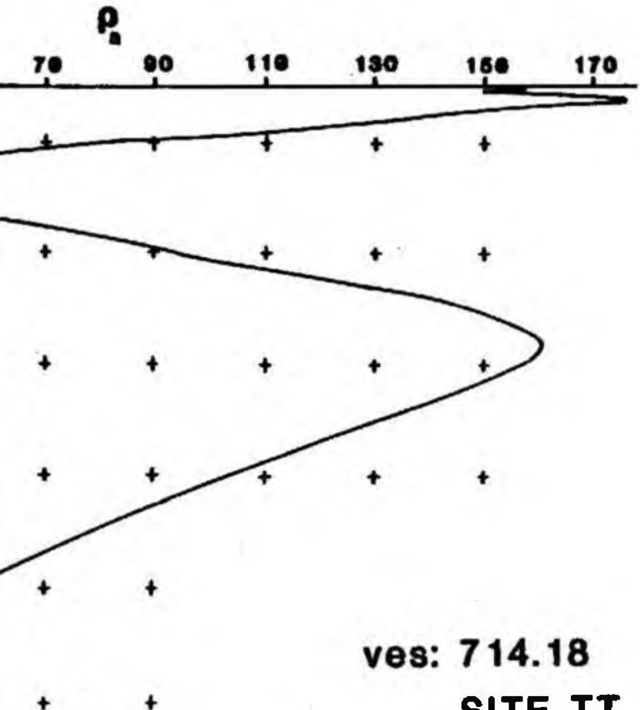

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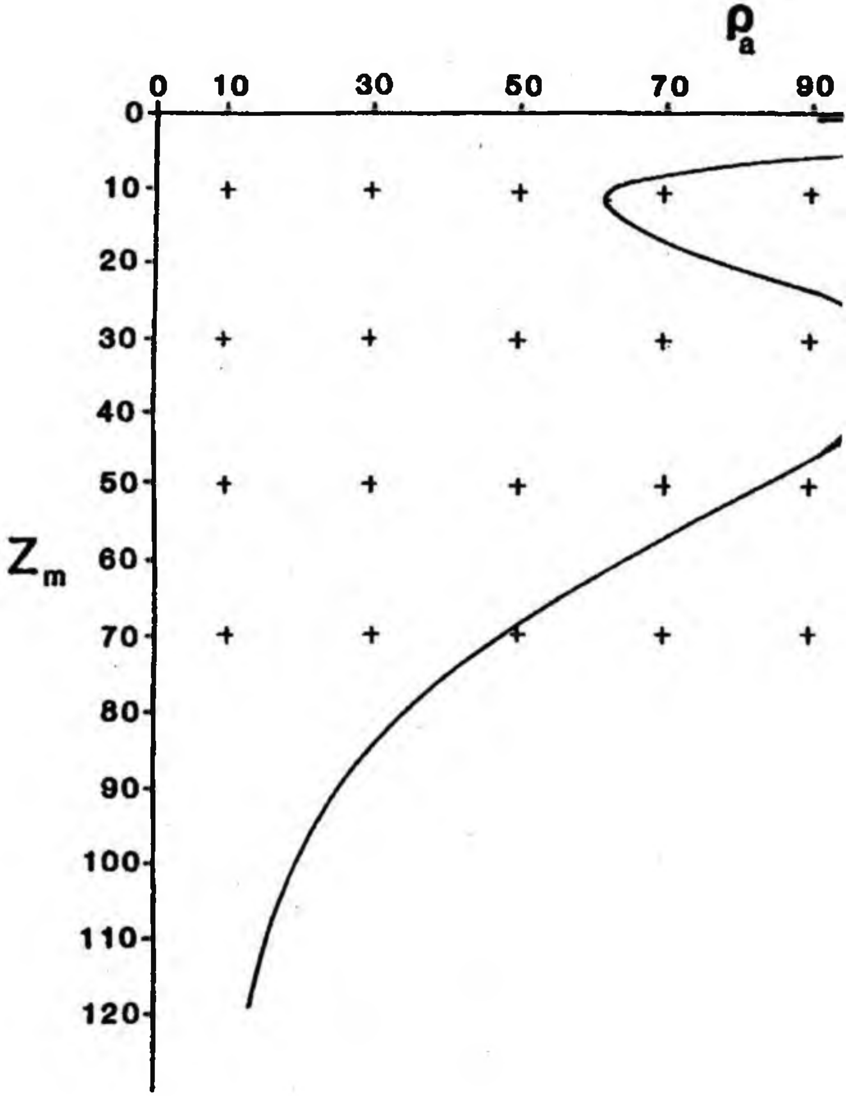

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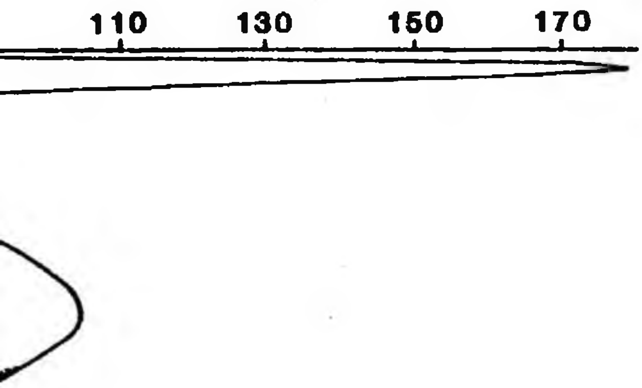

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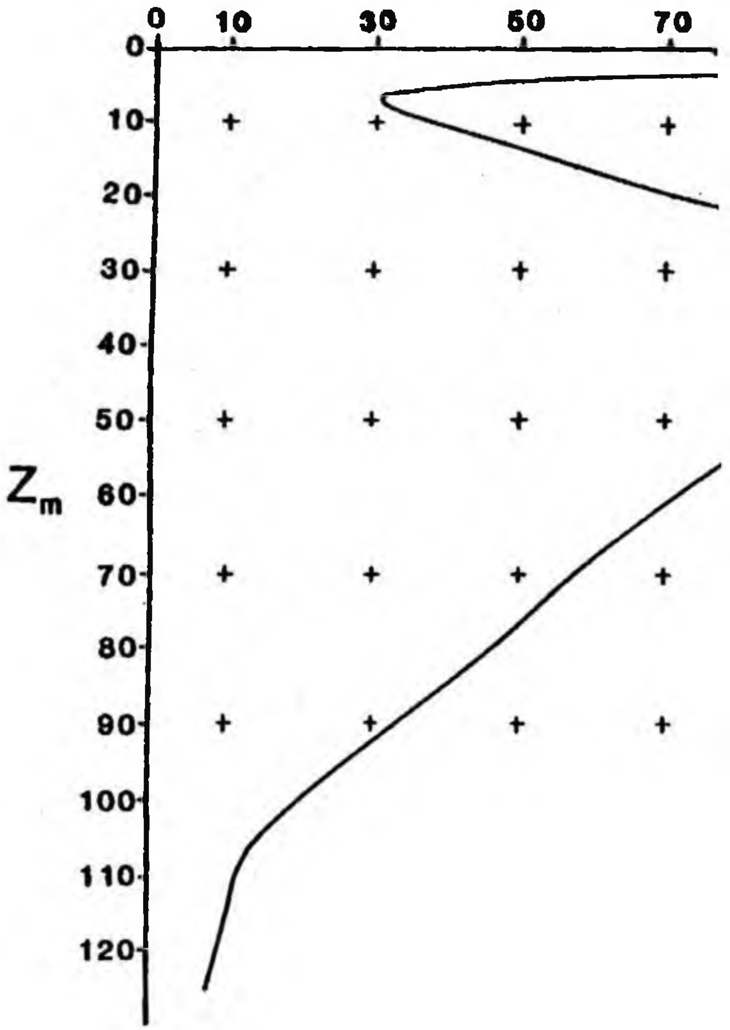

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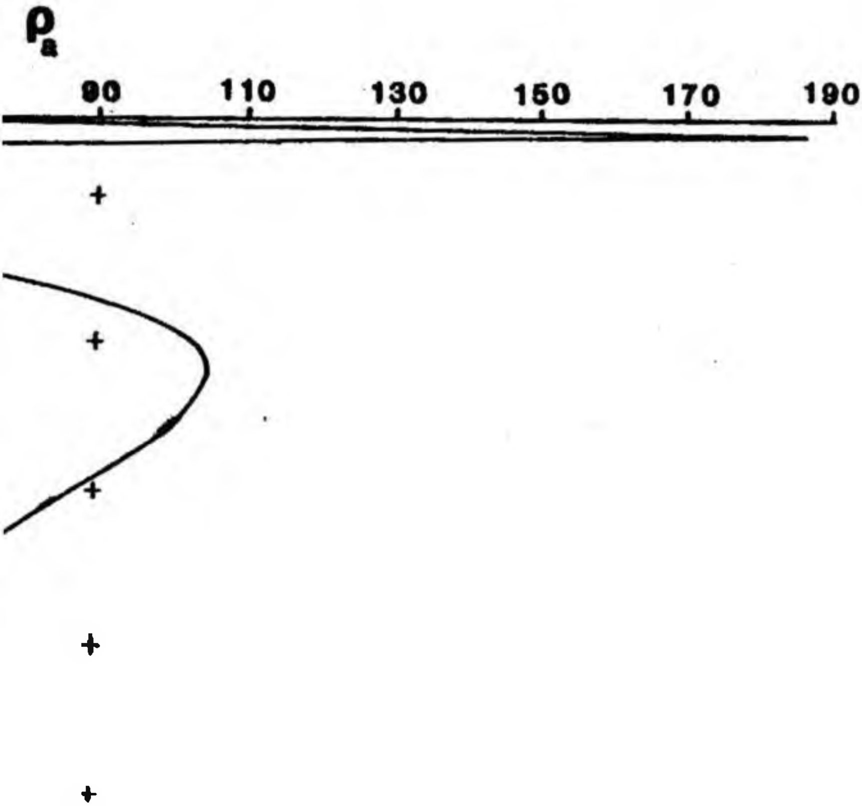

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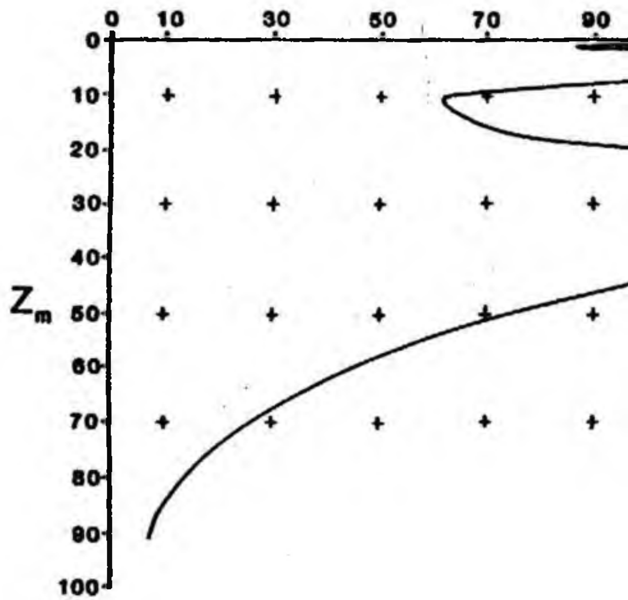

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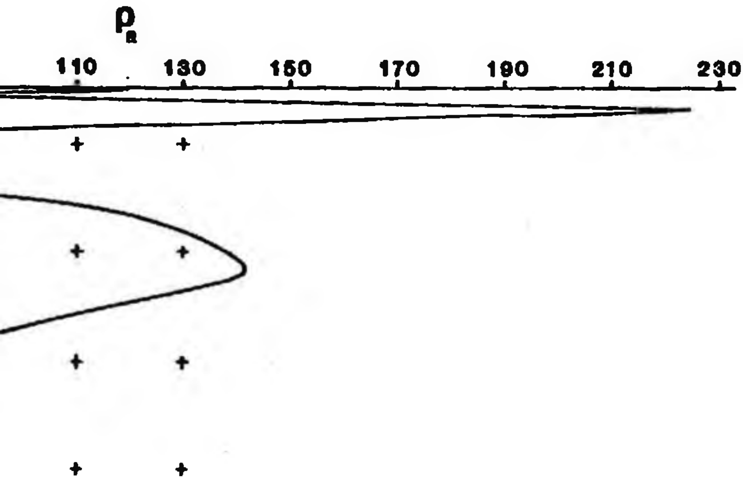

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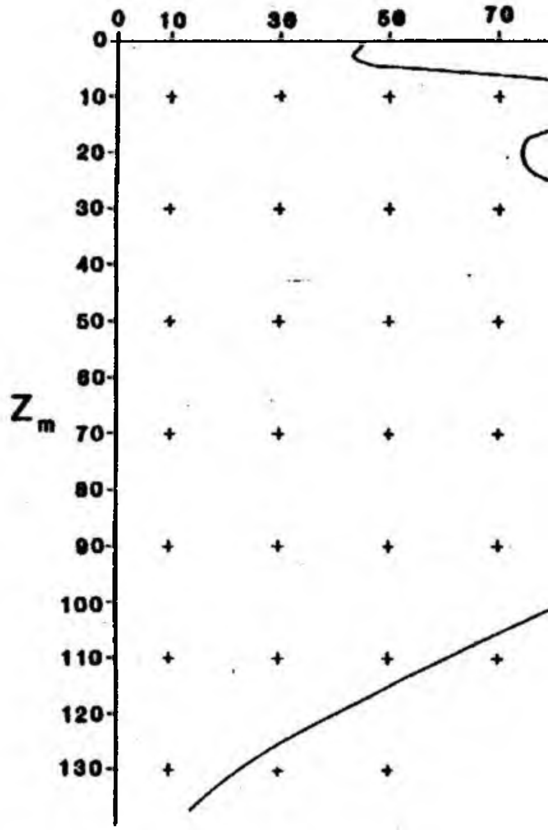
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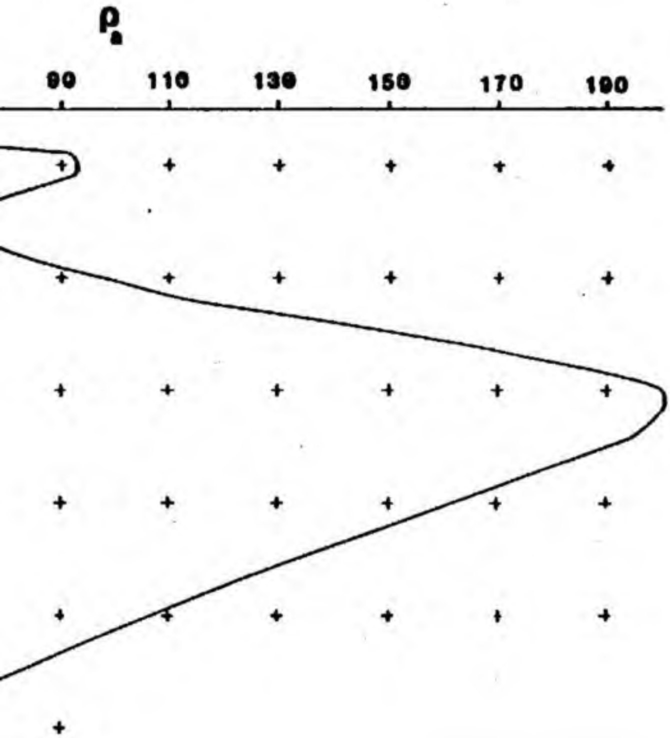

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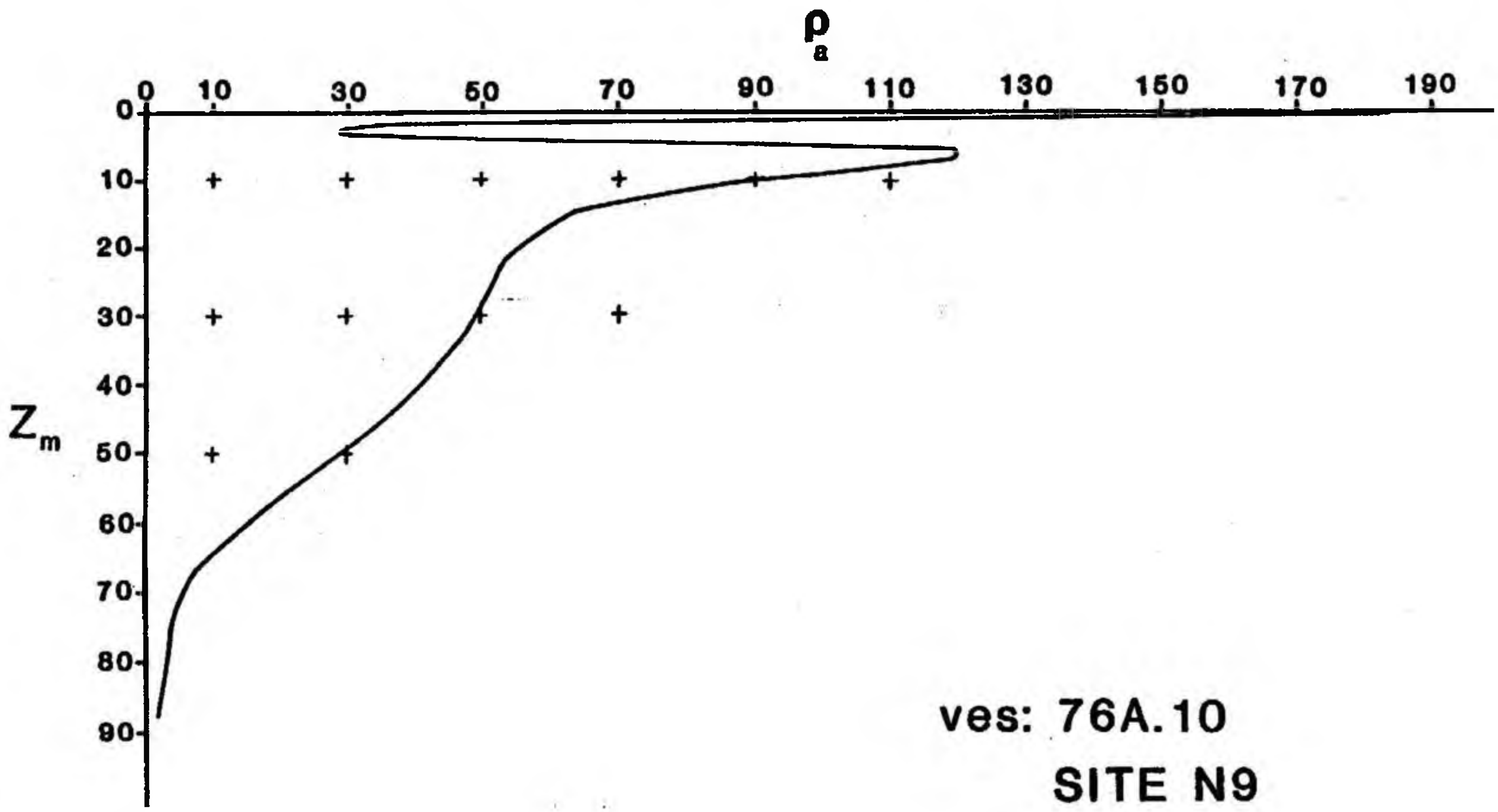
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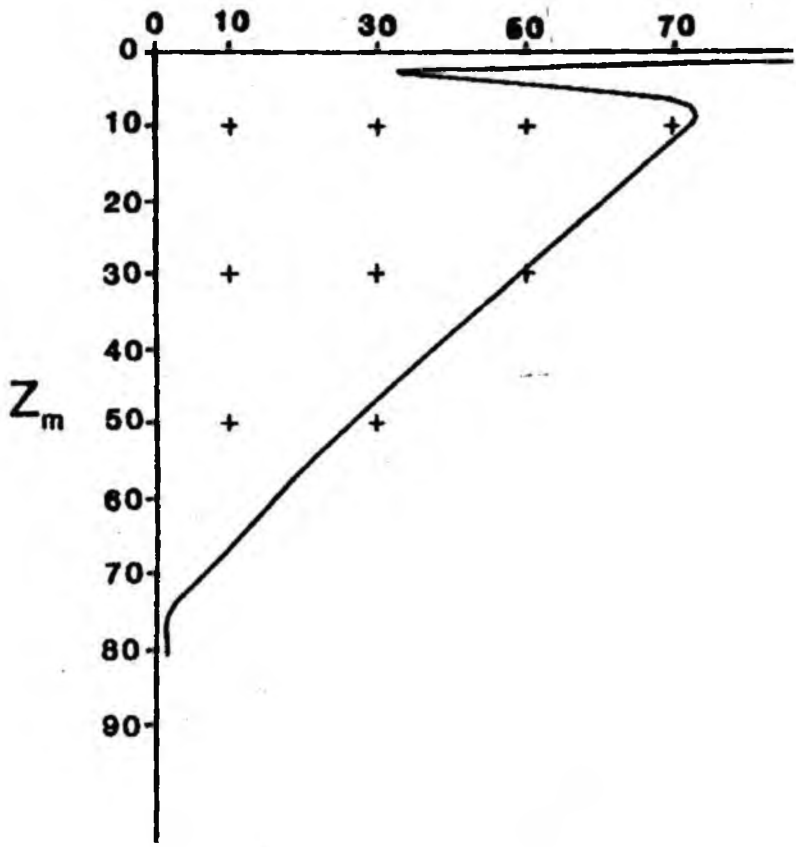
ves: 76A.10
SITE N9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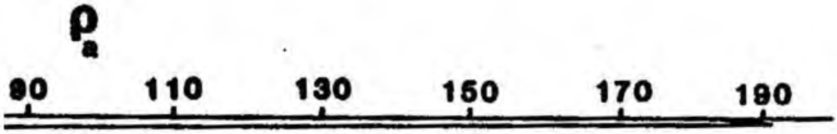

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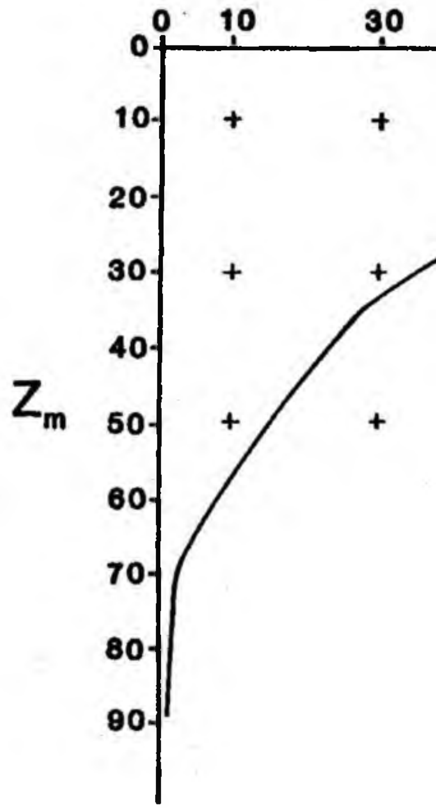

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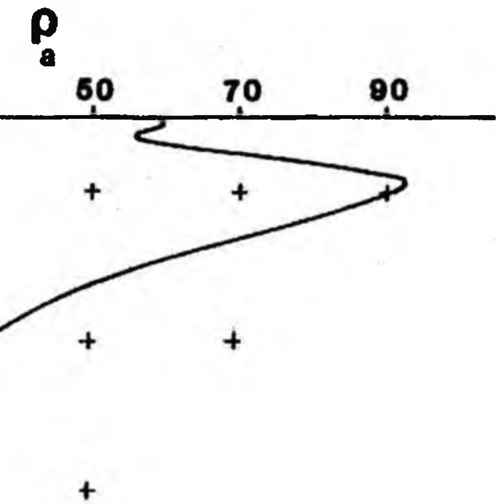

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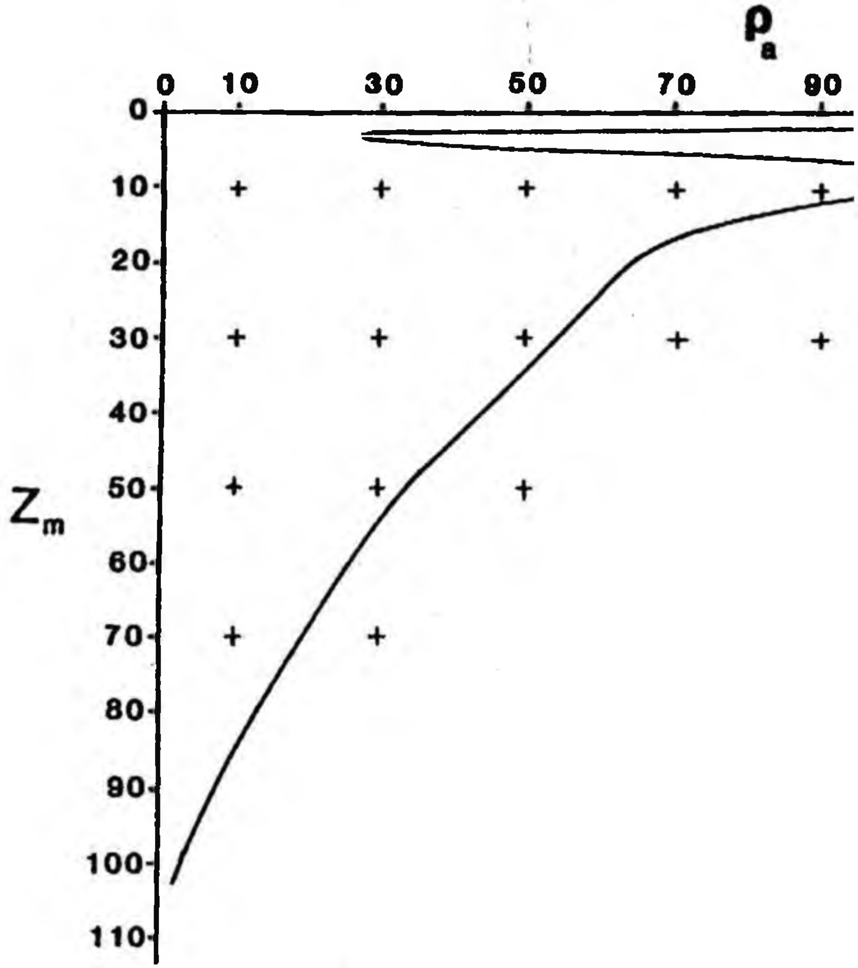

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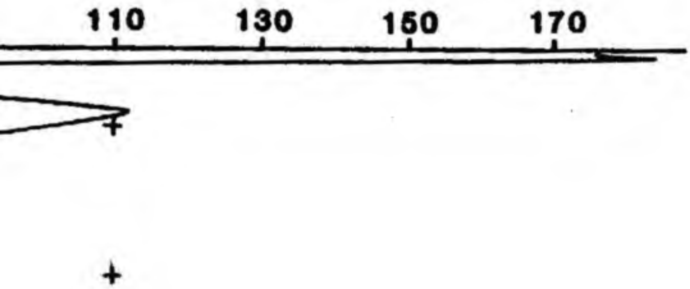

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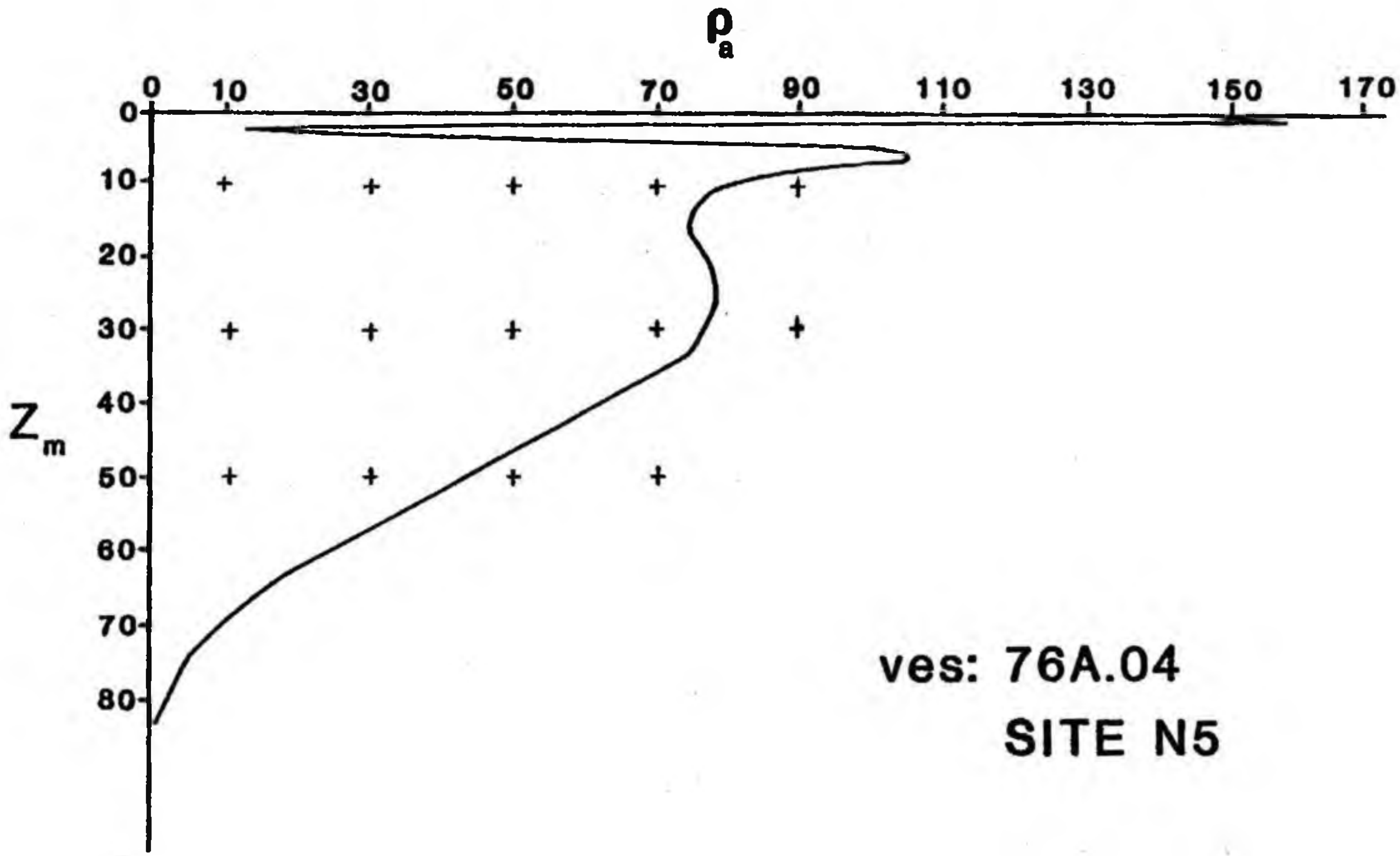

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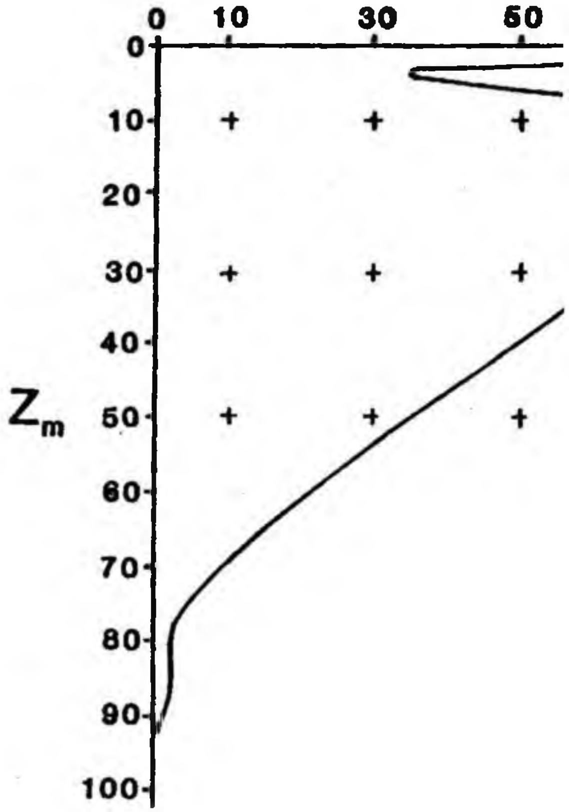
Zm
ves: 76A.04
SITE N5



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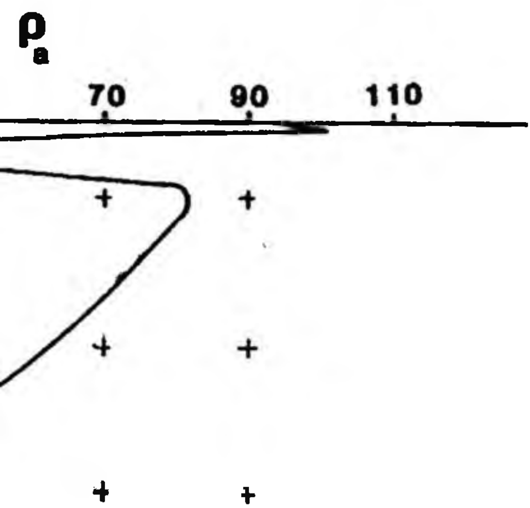
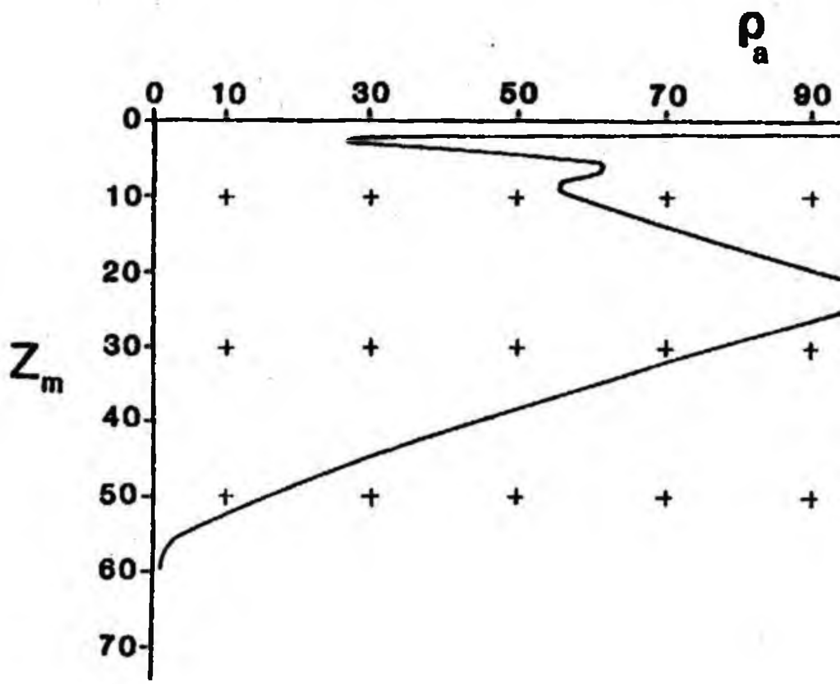


ves: N711.10

SITE N4



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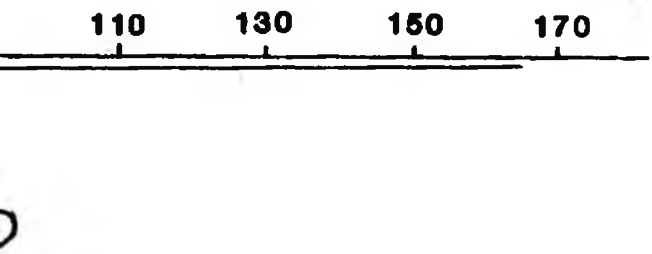
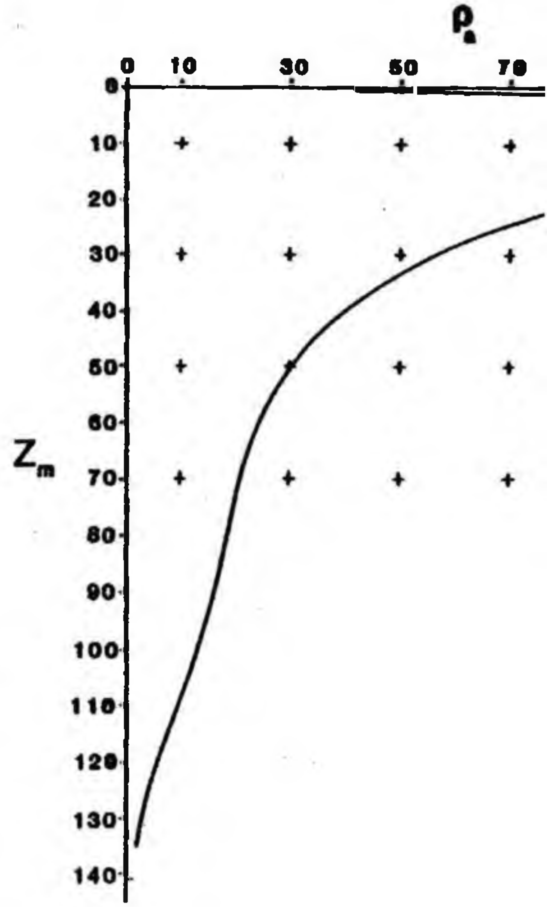


ves: N711.10S

SITE N4



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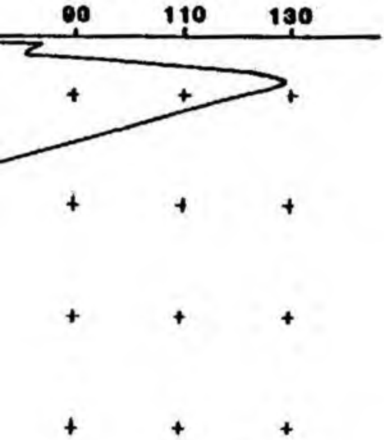

ves: N711.03

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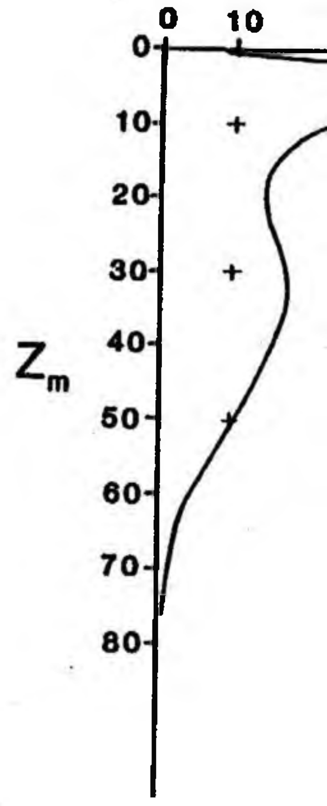

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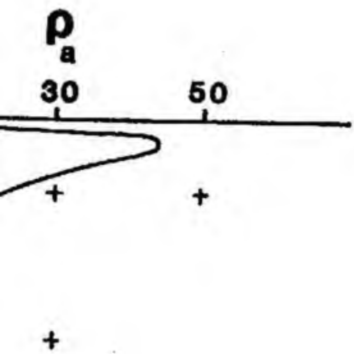

ves: N711.02

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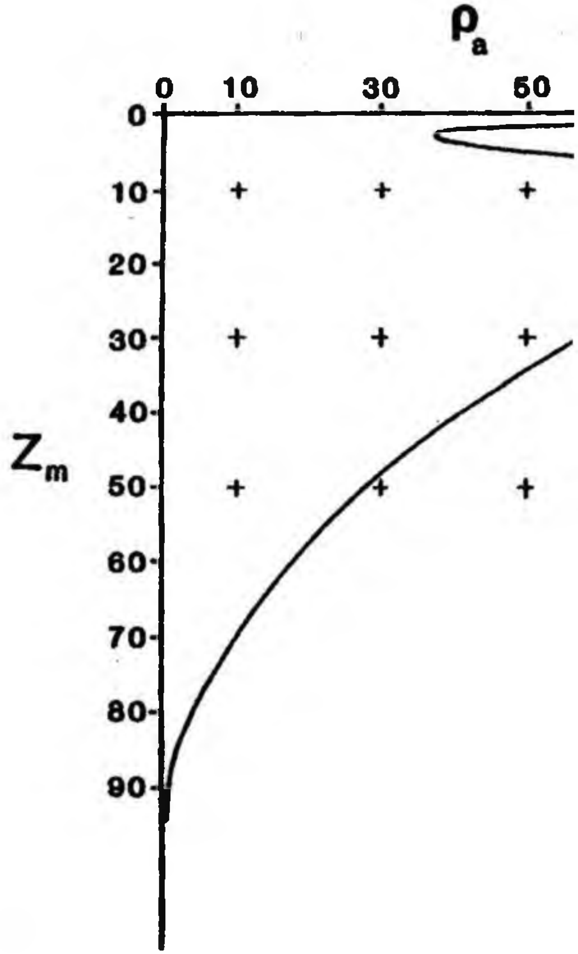

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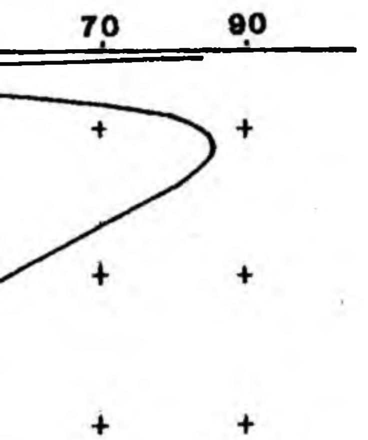

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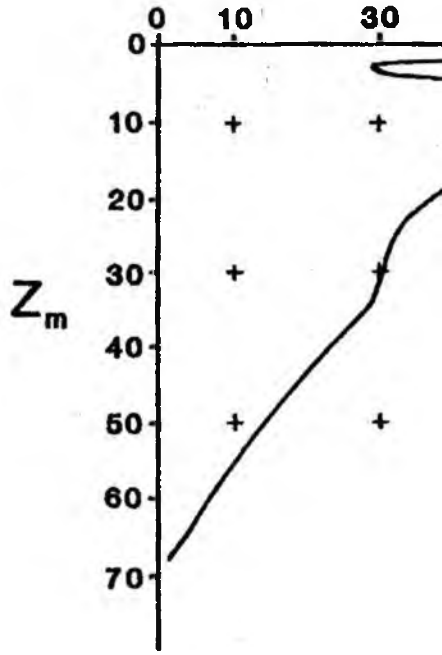

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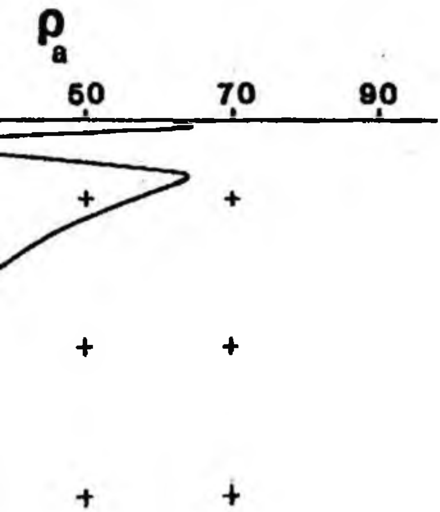

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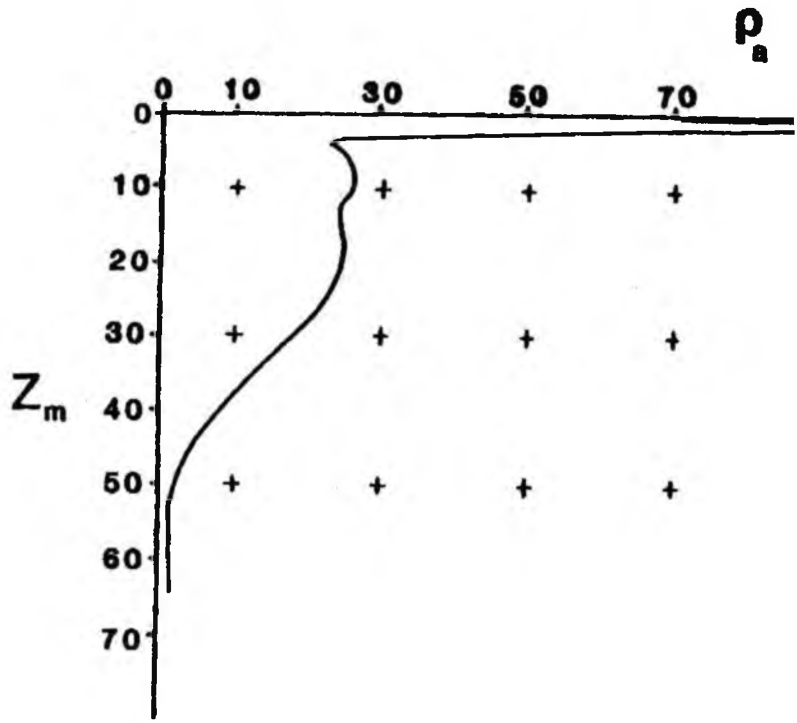

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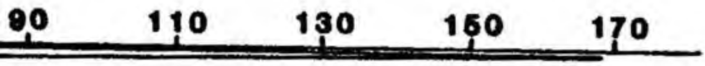

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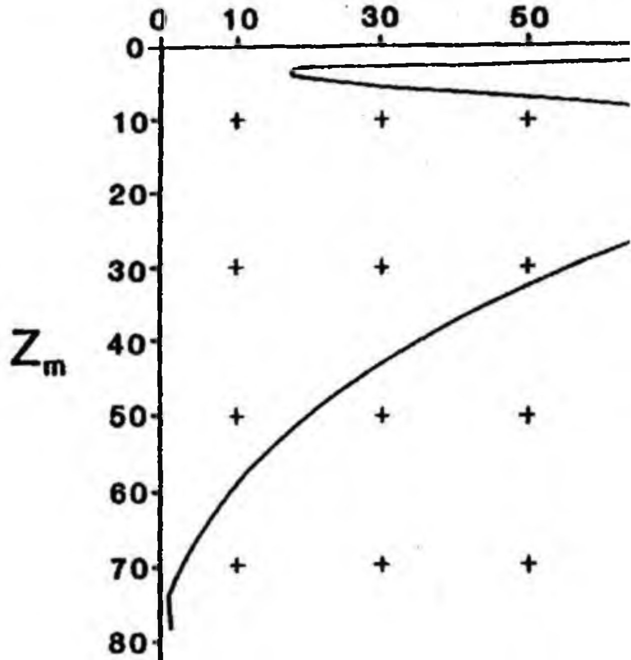
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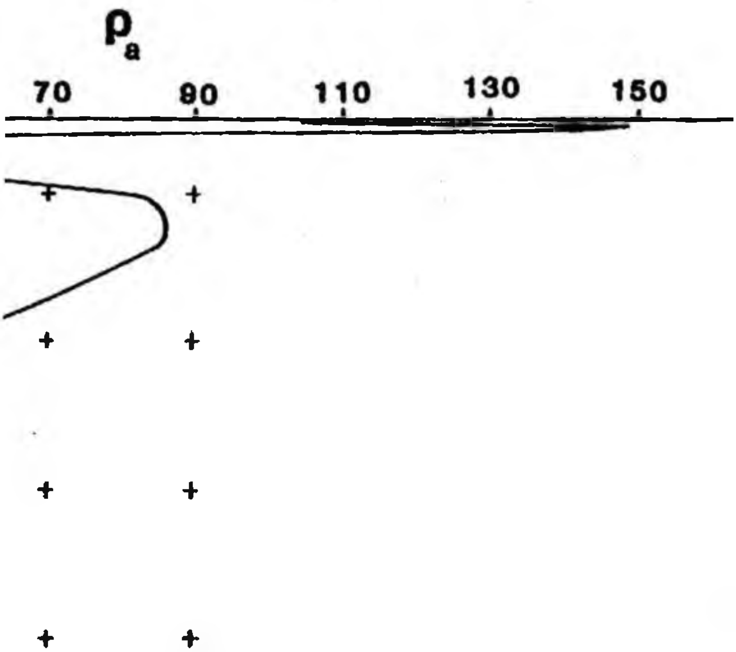

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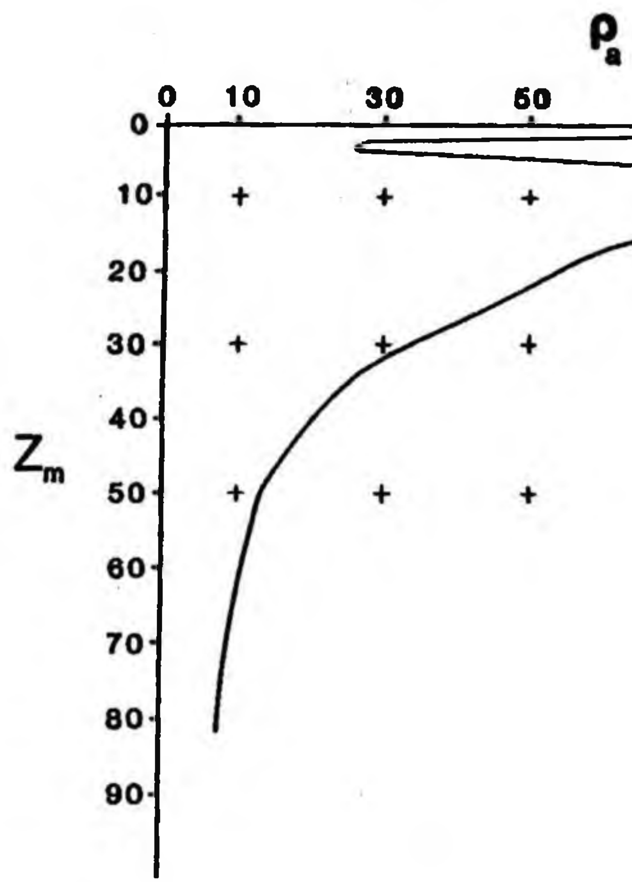

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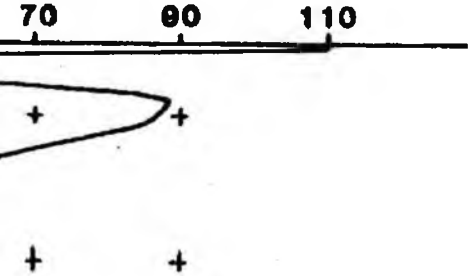

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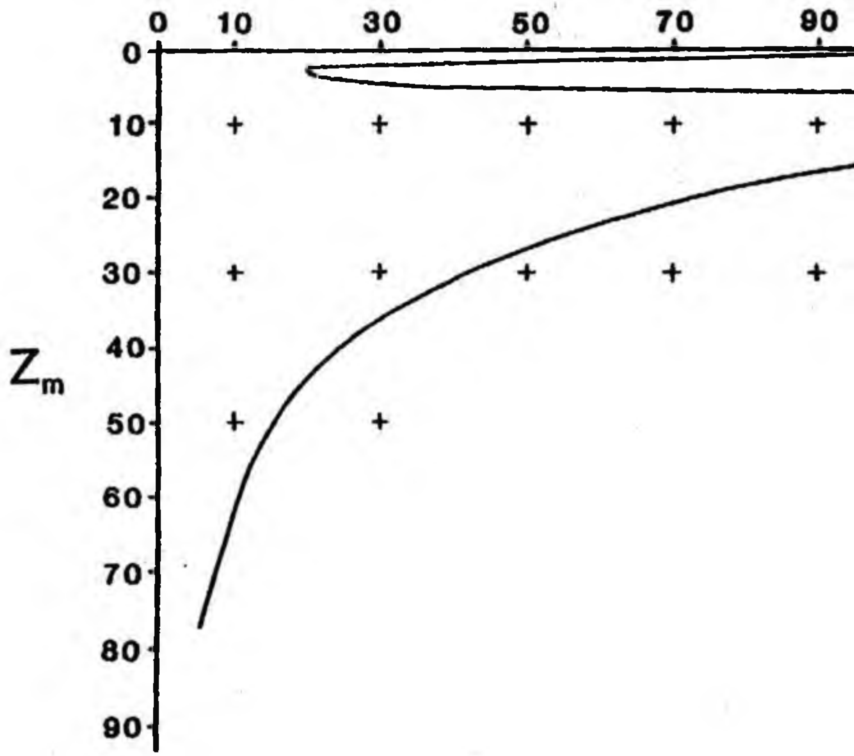

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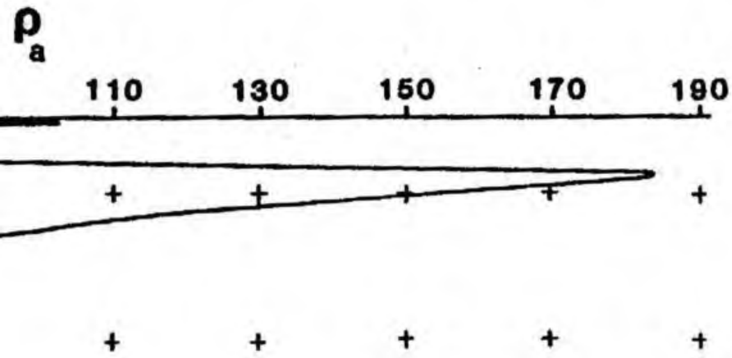

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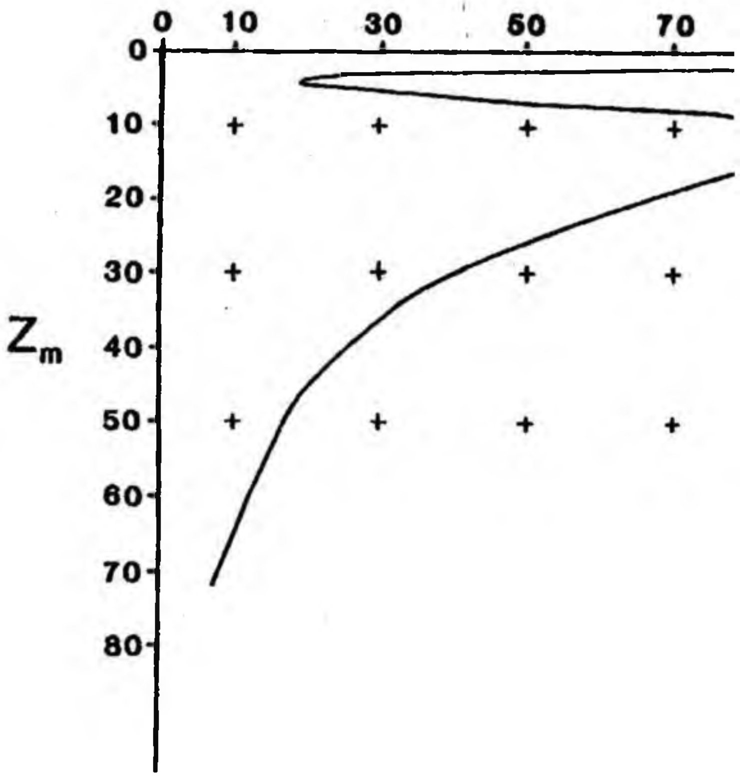

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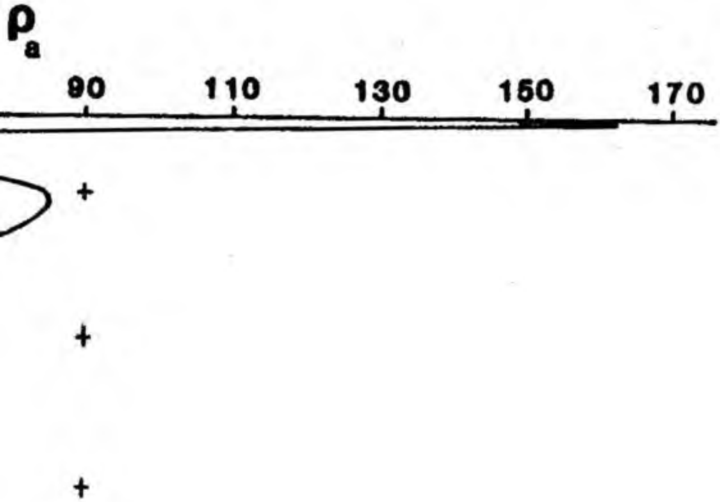

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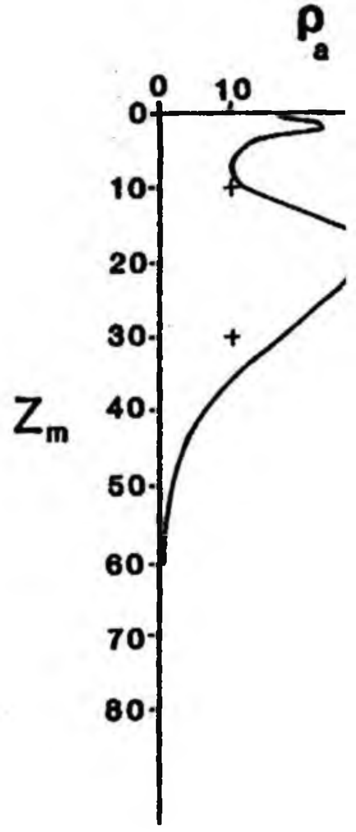

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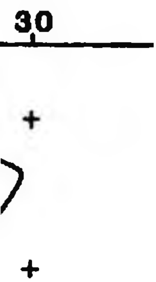

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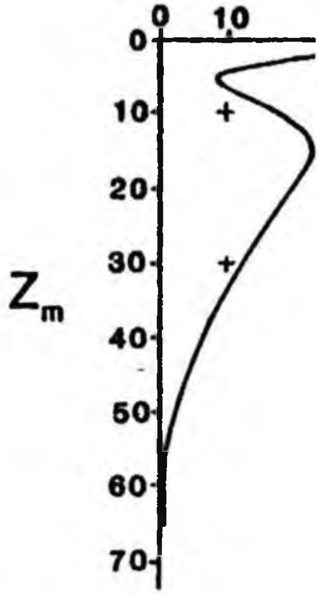
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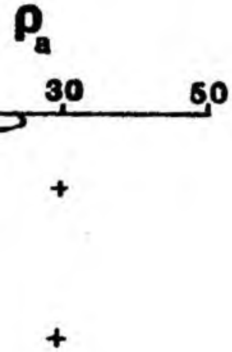

ves: S711.02
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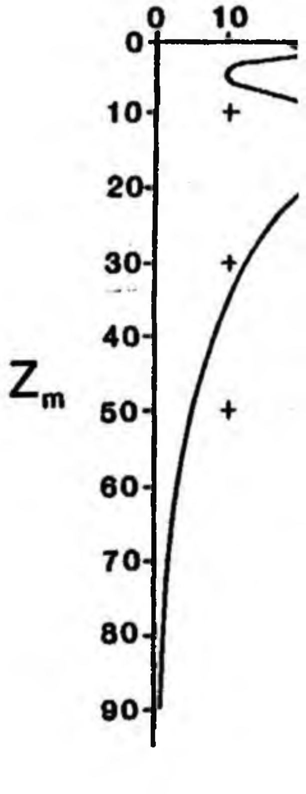

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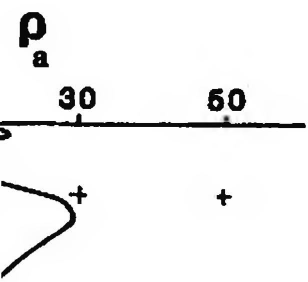


ves: S711.01

SITE S9

Appendix C: Lithologic data from some water wells in Martin County, Florida. Wells with M-0000 numbers are from Miller (1980). Wells with WW00-00000 and MF-00 numbers are from South Florida Water Management District (unpublished). Wells with GS-00 or L-000 numbers are from Lichtler (1960). Wells with G&J letters are from Gee and Jenson (unpublished).

Lithologic Log of Well FPL - Core No. 1

Depth Below Land Surface		Geologic Description
Ft.	M.	
0-7	0-2.1	Sand, fine- to medium-grained, gray, plant material
7-10	2.1-3.0	Poorly sorted quartz sand, coarse to fine, gray to brown, clay and organic material
10-14.5	3.0-4.4	Sand, brown to gray-brown, very fine- to fine-grained, clay and organic material
14.5-15.5	4.4-4.7	No sample
15.5-32.0	4.7-9.8	Sand, light orange to yellowish-brown, very fine- to medium-grained, occasional clay stringer and organics, some pin point vugs at base of interval
32-40	9.8-12.2	Limestone, light brown to medium gray, moldic porosity, shell (Chione), sparry calcite cement, high recrystallization
40-42	12.2-12.8	Limestone, grayish brown, moldic porosity and pin point vugs, 35% quartz sand, sparry calcite cement
42-52	12.8-15.8	Sand, light gray, fine-to medium-grained, poorly indurated, some fossil molds, some clay and silt
52-58	15.8-17.7	Shell bed, olive gray, some porosity, silt and gray, poorly indurated
58-60	17.7-18.3	Sand, light gray, very fine- to medium-grained, mollusk fragments, clay and silt
60-66	18.3-20.1	Shell bed, light gray, poorly indurated, fine-grained quartz sand. Shell content increases near bottom of interval, shell very broken
66-73	20.1-22.3	No sample

Lithologic Log of Well FPL - Core No. 1 continued

Depth Below Land Surface Ft.	M.	Geologic Description
73-79	22.3-24.1	Sand, light gray, fine- to medium-grained, unconsolidated, slightly phophatic, fossil fragments and mollusk shells
79-83	24.1-25.3	No sample
83-120	25.3-36.6	Shell bed (shell hash), light olive gray, unconsolidated, slightly phosphatic, 30% quartz sand, fossil fragments, mollusks, clay increases with depth
120-123	36.6-37.5	No samples
123-132	37.5-40.2	Clay, light olive, poorly indurated, some shell and shell fragments, calcareous sand, lenses of limestone, soft
132-134	40.2-40.8	White to yellowish gray marl, some large fragments, poorly indurated, quartz sand, clay, coarse-grained
134-135	40.8-41.1	Shell bed, light olive gray, poorly indurated, quartz sand, clay
135-139	41.1-42.4	Limestone and marl, yellowish gray, poorly indurated, sparry calcite cement, 20% quartz sand, mollusk fragments. Some thin limestone lenses may be well indurated
139-162	42.4-49.4	Limestone and marl, yellowish gray, some moldic porosity, pin point vugs, moderate induration, sparry calcite cement, clay, quartz sand, shell fragments. Degree of induration highly variable over short distances
162-167	49.4-50.9	No sample
167+	50.9+	Sand, silt, and clay, olive-green to olive-gray, scattered shell, some dolomite and phosphate

Lithologic Log of Well M-1012

Depth Below Land Surface Ft.	M.	Geologic Description
0-5	0-1.5	Sand, white-gray
10	3.0	Sand, coarse-grained, white
20	6.1	As above and 10% gray clay
30	9.1	Sand, gray-white and 20% hard shell
50	15.2	Shell, fine and 30% brown-gray sand
80	24.4	Shell, 20% sandstone and some gray sand
90	27.4	As above and 40% sandstone
100	30.5	Shell, fine sandstone and gray sand
110	33.5	Sand, gray, 40% shell, and 10% gray-white clay
140	42.7	Sand, fine, gray and fine shell
180	54.9	Clay, sandy, light-green
240	72.2	Sand, clayey, light-green

Lithologic Log of Well M-1013

Depth Below Land Surface		Geologic Description
Ft.	M.	
0-5	0-1.5	Sand, gray, fine-to-medium grained
10	3.0	Sand, gray-white
20	6.1	Sand, coarse-grained, gray
30	9.1	Sand, gray-brown, and some fine shell
40	12.2	Shell and some sandstone and gray sand
60	18.3	Shell, sandstone and gray-white sand
70	21.3	Sandstone, 20% shell, and some coarse gray sand
100	30.5	Shell, sandstone, limestone, and 20% gray sand
120	36.6	Shell, fine-grained sandstone and 30% coarse gray sand
130	39.6	Shell and gray sand
140	42.7	Shell, fine and fine-grained, brown-gray sand
160	48.8	Sand, gray-green, and some shell
170	51.8	Clay, sandy, green and some sand
200	61.0	Clay, green

Lithologic Log of Well M-1014

Depth Below Land Surface Ft.	M.	Geologic Description
0-5	0-1.5	Sand, fine-grained, white
10	3.0	Sand, fine-medium grained, white-gray sand
20	6.1	Sand, yellow-tan
30	9.1	Sand, light tan
40	12.2	Sandstone, cemented, beige and some shell
50	15.2	Sandstone, cemented, beige
60	18.3	Sandstone, smaller
70	21.3	Limestone, soft, dark gray
80	24.4	Sand, tan and shell
90	27.4	Sandstone, fine-coarse, white and 20% shell
100	30.5	As above but darker
110	33.5	Shell and 20% sand
120	36.6	Shell, 30% limestone, and some sand
160	48.8	Shell, sand, sandstone and limestone
170	51.8	Shell, hard, marl, 40% sand, gray
180	54.9	Sandstone, 40% gray clay
190	57.9	Sand, gray and 30% gray shell
200	61.0	Shell, some sandstone and gray clay
220	67.1	Shell, sand, fine, and gray clay
230	70.1	Sand, gray, some shell and gray clay
230-240	70.1-72.2	Clay, sandy, gray
270	82.3	Sand, coarse, gray and gray clay
340	103.7	Sand, clayey, light green

Lithologic Log of Well M-1015

Depth Below Land Surface Ft.	M.	Geologic Description
0-5	0-1.5	Sand, fine-medium grained, gray
10	3.0	Sand, gray, shell, and some marl
20	6.1	Sand, gray, shell, and some sandstone
30	9.1	Sandstone, hard, gray-white
40	12.2	Shell and some gray sandstone
60	18.3	Limestone, dark gray, sandstone, and some shell
70	21.3	Limestone, dark gray, sandstone, and sand
80	24.4	As above with shell
90	27.4	Shell, fine-to medium-grained
100	30.5	Shell, sand, limestone and sandstone
110	33.5	Limestone, coarse and white-gray sand
120	36.6	Sand, white-gray and limestone
130	39.6	Limestone, coarse, and white-gray sand
140	42.7	As above with more sand
150	45.7	Sand, gray, and some sandstone
160	48.8	Sandstone and 20% shell
170	51.8	Sand, gray, shell, and some light-gray clay
190	57.9	Clay, sandy, gray
210	63.5	Clay, gray-green

Lithologic Log of Well M-1016

Depth Below Land Surface Ft.	M.	Geologic Description
0-5	0-1.5	Sand, fine- to medium-grained, gray
10	3.0	Marl, dark brown and sand
20	6.1	Sand, dark brown
30	9.1	Shell, 50% fine, and brown sand
40	12.2	Shell 80%, and brown sand
50	15.2	Mostly shell and some white sand
70	21.3	Sandstone, hard, gray and some shell
90	27.4	Limestone, coarse, gray and sandstone
110	33.5	Limestone, gray, sandstone, and 40% gray clay
120	36.6	Limestone, gray-white, sandstone and some sand
130	39.6	As above with some light green clay
140	42.7	Sand, light green, and some clay
150	45.7	As above with sandstone
180	54.9	Clay, green and little sand

Lithologic Log of Well M-1017

Depth Below Land Surface Ft.	M.	Geologic Description
0-5	0-1.5	Sand, fine-medium, gray
10	3.0	Marl, dark drown and gray, and some sand
20	6.1	Sand, coarse, gray, and some sandstone
30	9.1	Sand, dark brown-black
50	15.2	Shell 70%, and medium-grained sand, gray
60	18.3	As above with smaller shell
70	21.3	Shell 50%, and medium-grained sand, gray
90	27.4	Sand, gray, shell and some limestone
100	30.5	Limestone, hard, gray-white, compressed shell and 20% gray-brown sand
110	33.5	Limestone, sandstone and 30% medium-fine grained brown sand
120	36.6	Limestone, gray, and 20% brown sand
130	39.6	Shell, small, sandstone, and 30% brown sand
150	45.7	As above with some limestone
160	48.8	As above with 50% brown sand
170	51.8	Limestone, sandstone, 40% fine-grained brown sand, 10% gray-green clay
180	54.9	Sandstone and some light green clay
190	57.9	Sandstone, some light green clay and some shell
220	67.1	Clay, dark green

Lithologic Log of Well M-1018

Depth Below Land Surface Ft.	M.	Geologic Description
0-5	0-1.5	Very fine-grained, quartz, sand, white to gray, plant and root material
5-20	1.5-6.1	Very fine-grained sand, brown, high amounts of clay, plant materials
20-30	6.1-9.1	Shell fragments, 60-70%, fine-grained, quartz sand, some clay
30-50	9.1-15.2	Shell and shell fragments (Donax, Tellina, and Chione), fine-grained sand, quartz and carbonate silt, some clay
50-70	15.2-21.3	Coarse shell fragments with some fine-grained sand, increase in silt and clay near bottom of interval
70-80	21.3-24.4	Marl and shell fragments, 10-15% fine-grained sand, high % of fine-grained material
80-90	24.4-27.4	Quartz and carbonate silt with medium-grained shell fragments
90-100	27.4-30.5	Marl and coarse shell fragments, quartz and carbonate silt
100-130	30.5-39.6	Shell fragments, some large, with silt and clay (marl)
130-150	39.6-45.7	Shell and shell fragments, medium-grained carbonate sand, fine-grained quartz sand, clay, increase in fines near bottom of interval
150-170	45.7-51.8	Shell fragments and silt and clay
170-200	51.8-61.0	Olive green to gray silt and clay with shell fragments

Lithologic Log of Well M-1019

Depth Below Land Surface		Geologic Description
Ft.	M.	
0-5	0-1.5	White-tan quartz sand
5-10	1.5-3.0	White-orange fine sand, white clay
10-20	3.0-6.1	Sand, brown-white, small shells (Donax, Tellina, and Chione)
20-60	6.1-18.3	Shell, large-small with coarse-fine sand
60-90	18.3-27.4	Large-small shell, sandstone, 20-30% gray sand, some silt
90-110	27.4-33.5	Fine sand, sandstone, shell, 10% silt and clay
110-120	33.5-36.6	Coarse sand and shell, some silt
120-130	36.6-39.6	Fine sand and silt, 50% shell, coarse to small
130-150	39.6-45.7	Marl and fine sand with shell, white-gray
150-180	45.7-54.9	Very fine sand and gray-green to dark green silt and clay with shell

Lithologic Log of Well M-1020

Depth Below Land Surface Ft.	M.	Geologic Description
0-5	0-1.5	Sand, gray-brown
10	3.0	Sand, fine-medium, brown, and dark brown marl
20	6.1	Sand, rust brown, and 20% dark brown clay
30	9.1	Sand, dark brown, and 20% dark brown clay
40	12.2	Clay, dark brown, and 50% fine, light brown sand
50±	15.2±	Sand, light brown, and 10% dark brown clay
60	18.3	Sand, light brown, and 50% light brown clay
70	21.3	Shell, fine, brown clay, and 30% light brown sand
80	24.4	Sand, light brown, shell, 20% gray clay
120	36.8	Shell and 30% fine-grained, brown sand
130	39.6	Sand, gray, shell and 10% white clay
140	42.7	Shell, and 20% brown sand
150	45.7	Shell, and 30% brown sand
170	51.8	Sand, gray and light green clay
200	61.0	Clay, dark green

Lithologic Log of Well M-1021

Depth Below Land Surface		Geologic Description
Ft.	M.	
0-5	0-1.5	Sand, fine- to medium-grained, gray, 1 to 2 feet, gray-green clay
10	3.0	Shell, small, fine-grained, brown and 10% gray-green clay
20	6.1	Coquina, and small shell
30	9.1	Sand, 40% fine-grained, gray, smooth and sandstone and shell
40	12.2	Sand, 50% fine-grained, gray-white, very smooth, sandstone and shell
50	15.2	Clay, 90% gray, 10% shell
60	18.3	Clay, 5% gray, 50% shell
70	21.3	Sand, 60% clayey, gray, and shell
80	24.4	Sand, 30% clayey, gray, and shell
100	30.0	Sand, 30% clayey, gray, and shell
110	33.5	Sand, fine, shell and 30% clayey sand
120	36.8	As above and some sandstone
130	39.6	Sand, 40% clayey, gray, and small shell
140	42.7	Sand, 30% fine, gray, 20% clay and gray-green small shell
150	45.7	Sand, gray, shell, and 20% green clay
180	54.9	Clay, dark green and 5% shell

Lithologic Log of Well M-1022

Depth Below Land Surface Ft.	M.	Geologic Description
0-5	0-1.5	Fine-grained, gray quartz sand, plant matter
5-10	1.5-3.0	Sand, 80% fine-grained, 20% brown clay
10-20	3.0-6.1	Clay, 60%, dark brown, medium- to fine-grained brown sand
20-30	6.1-9.1	Fine-grained sand with small shell and shell fragments (Chione), some clay
30-50	9.1-15.2	Sand, coarse- to fine-grained with small shell and shell hash, silt and clay
50-70	15.2-21.3	Fine, quartz sand with shell and clay
70-90	21.3-27.4	Fine-grained sand with gray-green silt and clay. Some shell and shell hash
90-100	27.4-30.5	Silt and clay, gray to greenish-gray, limestone bits, (Chione)
100-110	30.5-33.5	Shell with fine quartz and silt and clay
110-140	33.5-42.7	Fine quartz sand and silt, gray to olive gray, small shell and some carbonate silt
140-170	42.7-51.8	Silt, gray-green, fine quartz sand, some shell, increase in carbonate silt and clay
170-200	51.8-61.0	Dark olive green silt and clay with fine, quartz sand and shell

Lithologic Log of Well M-1023

Depth Below Land Surface Ft.	M.	Geologic Description
0-5	0-1.5	Sand, fine- to medium-grained, white-gray
10	3.0	Sand, medium- to coarse-grained, dark brown
20	6.1	Sand, light tan
30	9.1	Sand, dark tan
40	12.2	Sand, fine-grained, gray-brown
50	15.2	Limestone, gray
60	18.3	As above, finer
70	21.3	As above and 10% coarse, gray sand
80	24.4	Sand, 40% brown-gray, and shells
90	27.4	Sand, 40% clayey, brown-gray and shells
100	30.5	Sand, 30% clayey, brown-gray and shell
110	33.5	Sand, 40% gray-brown, some shell, gray limestone and sandstone
120	36.8	Sand, 30% gray-brown, shell, limestone and sandstone
140	42.7	Sand, 40% gray-brown, shell, limestone and sandstone
160	48.8	Sand, 60% gray-brown, shell, limestone and sandstone
180	54.9	Sand, 50%, gray-brown, and shell
220	67.1	Clay, 90% dark green and fine-grained sand

Lithologic Log of Well M-1043

Depth Below Land Surface Ft.	M.	Geologic Description
0-8	0-2.4	Sand, fine-grained, white
12	3.7	Sand, fine- to coarse-grained
52	15.8	Sand, fine- to coarse-grained, tan-yellow
61	18.6	Sand, shell, and clay
66	20.1	Sandstone, fine-grained, tan
68	20.7	Sand, fine-grained, white-tan
76	23.2	Sandstone or limestone and shells
85	25.9	Limestone and shells, dark gray
100	30.5	Rock, large, dark gray limerock and large shell fragments
110	33.5	Limerock, calcite cement, gray, shell fragments and hard dark gray rock
120	36.6	Limestone, fine-grained, cemented together, and shell fragments
138	42.1	Limestone, fine-grained, gray and shell fragments
170	51.8	Limestone, fine-grained, gray and shell fragments
210	64.0	Limestone, fine-grained, gray
220	67.1	Clay, sandy, green and shell fragments

Lithologic Log of Well M-1044

Depth Below Land Surface Ft.	M.	Geologic Description
0-4	0-1.2	Sand, fine- to medium-grained, white
25	7.6	Sand, fine- to medium-grained, yellow-tan
30	13.6	Sand, very coarse-grained, tan, some calcite cement
50	15.2	Sandstone, medium- to very coarse-grained, tan, calcite cement
60	18.3	Sandstone with calcite cement, medium- to very coarse-grained, tan
65	19.8	Sandstone with calcite cement, fine- to medium-grained, tanish orange
84	25.6	Sandstone with calcite cement, medium- to coarse-grained, orange-tan
95	29.0	Sand, fine-grained, gray and shell
100	30.5	Shells and fine-grained sand, tan-dark gray, with calcite cement
110	33.5	Shell fragments, coquina, and rock bits, dark gray
117	35.7	Rock, coarse to large, dark gray and shell fragments
120	36.8	Rock, coarse to large, dark gray and shell fragments
125	38.1	Rock, very coarse to large, dark gray, shell fragments, and light tan sandstone
130	39.6	Sandstone with calcite cement, fine-grained, tan rock and shell
140	42.7	Sandstone with calcite cement, fine-grained, dark gray, rock bits and shell

Lithologic Log of Well M-1044 continued.

Depth Below Land Surface Ft.	M.	Geologic Description
150	45.7	Limestone and tan to grayish-tan sandstone
160	48.8	Limestone, tan to dark green and shell
170	51.8	Limestone, gray and shell
185	56.4	Clay, light gray, shell and sandstone
200	61.0	Clay, dark green, sandstone and shell

Lithologic Log of Well M-1050

Depth Below Land Surface Ft.	M.	Geologic Description
0-10	0-3.0	Fine-grained sand, white to tan, silt, gray and plant matter
10-20	3.0-6.1	Fine-grained sand, tan, with silt. Few shells and some plant matter
20-30	6.1-9.1	Silt and fine-grained sand with marl, some coarse-grained sand and some shell
30-50	9.1-15.2	Silt and fine-grained sand, tan to dark gray, coarse shell fragments, clay and marl throughout the interval
50-80	15.2-24.4	Shell and sand, calcite cement, some sandstone stringers, generally low % of silt, some shells are whole and loose (Donax, Tellina, and Chione)
80-90	24.4-27.4	Shell hash with silt, some carbonate silt
90-130	27.4-39.6	Shell and sand with calcite cement, pelecypods, gastropods, echinoid spines, and foraminifers. Cementation varies from well-cemented to loosely cemented
130-150	39.6-45.7	Shell and sand, calcite cement, sandstone and limestone. Shell generally small
150-180	45.7-54.9	Shell, some carbonate cement, quartz and carbonate silt and marl

Lithologic Log of Well M-1051

Depth Below Land Surface Ft.	M.	Geologic Description
0-5	0-1.5	Fine-grained, white sand, some brown clay and shells
5-20	1.5-6.1	Fine-grained, tan sand, some clay and shell
20-40	6.1-12.2	Poorly sorted sand with clay, chalky shell, tan to white
40-50	12.2-15.2	Fine- to very-fine grained sand with brown clay, increase in shell content
50-70	15.2-21.3	Shell and sand, calcite cement, carbonate and quartz silt, some clay. Silt and clay increase near bottom of interval
70-80	21.3-24.4	Shell hash and poorly sorted sand, 30% silt and clay
80-100	24.4-30.5	Shell and sand, calcite cement, (*Donax*, *Tellina*, ostracodes)
100-120	30.5-36.8	Very fine-grained sand and shell, some marl
120-140	36.8-42.7	Shell and sand, calcite cement, sandstone
140-160	42.7-48.8	Shell and sand, calcite cement, foraminifera, gray to olive green silt present near bottom of interval
160+		Sand and silt, clayey, olive-green

Lithologic Log of Well M-1052

Depth Below Land Surface Ft.	M.	Geologic Description
0-10	0-3.0	Sand, tan to yellow
12	3.7	Hardpan, black
16	4.9	Sand, fine- to medium-grained, tan
17	5.2	Clay, sandy, gray
24	7.3	Shells, loose and fine white sand
68	20.7	Shells, sand, fine-grained
70	21.3	Clay, dark gray
85	25.9	Shells, broken and whole, and fine-grained sand
105	32.0	Shells, broken and whole, gray and tan, dark gray clay and siltstone
117	35.7	Sandstone and shells
137	41.8	Clay, green, and shells grading into sandstone and limestone
160	48.8	Clay, sandy, soft, green

Lithologic Log of Well M-1070

Depth Below Land Surface Ft.	M.	Geologic Description
0-1	0-0.3	Sand, fine-grained, dark brown
3	0.9	Sand, white
6	1.8	Sand, fine-grained, brown to reddish brown
13	4.0	Sand, fine-grained, tan
19	5.8	Sand, fine-grained, reddish brown
27	8.2	Clay, sandy, tan
40	12.2	Sand, coarse-grained, tan
60	18.3	Sand, coarse-grained, tan and bits of sandstone
80	24.4	Sandstone, coarse-grained, tan hard
102	31.1	Sandstone, fine-grained, tan, very hard
110	33.5	Shell fragments, crushed, cream to reddish brown and sandstone
120	36.8	Sandstone, shell fragments and some dark gray phosphorite
140	42.7	Shell fragments, tan to dark gray
150	45.7	Limestone, sandy, cream
176	53.6	Limestone, sandy, cream tan, and shell
180	54.9	Limestone fragments, shell fragments and marl
200	61.0	Shell fragments and some limestone fragments
235	71.6	Shell fragments and sandstone fragments
310	94.5	Sandstone, gray, some shell fragments, some light green clay

Lithologic Log of Well M-1075

Depth Below Land Surface Ft.	M.	Geologic Description
0-5	0-1.5	Sand, clayey, yellow-brown
10	3.0	Sand, clayey, gray and shell
35	10.7	Shells and some clay
54	16.5	Shells, sandstone, and dark limestone
96	26.2	Sandstone and shells, hard
100	30.5	Shells, fine-grained sand and clay

Lithologic Log of Well M-1085

Depth Below Land Surface Ft.	M.	Geologic Description
0-5	0-1.5	Sand, tan to brown and some shell
9	2.7	Sand, clayey, black, organic
16	4.9	Sand, fine- to medium-grained and large amount of shell
18	5.5	Sand, clayey, fine-grained, blue green
24	7.3	Limestone, sandy, tan-gray, hard
29	8.8	Limestone, sandy, tan to buff
35	10.7	Shells, loose, tan to dark brown
38	11.6	Sand, clayey, fine- to coarse-grained, dark brown to black, organic
55	16.8	Shells, broken brown to gray
78	23.8	Shells, and fine-grained gray to tan sand
79	24.1	Hard sandstone streak
90	27.4	Shells, tan to gray, some sand and hard limestone

Lithologic Log of Well M-1088

Depth Below Land Surface Ft.	M.	Geologic Description
0-7	0-2.1	Sand, fine-grained, white
11	3.4	Shell and sand, brown, soft
15	4.6	Clay, sandy, gray
22	6.7	Shell, broken and sand
25.5	7.8	Shell, cemented and sand
45.5	13.9	Shell, broken, tan to brown and some clay and sand
70	21.3	Shells, large broken pieces and some whole, brown to black
87	26.5	Shells and limestone, gray to black
88	26.8	Clay, sandy, gray-green, and broken dark shells
96	29.3	Shells, broken, black and fine-grained sand
106	32.3	Shells, broken and fine-grained sand, tan to white
118	36.0	Clay, sandy, light green and some broken shell
122	37.2	Clay, sandy green
135	41.1	Marl, gray-green and broken shells
145	44.2	Limestone, sandy, gray green, friable
155	47.2	Clay, sandy, dark green, fairly soft
180	54.9	Clay, sandy

Lithologic Log of Well M-1089

Depth Below Land Surface Ft.	M.	Geologic Description
0-4	0-1.2	White, fine-grained sand
5	1.5	Hardpan, black to dark brown
7	2.1	Limestone, broken, and sand
12	3.7	Sand, clayey, fine, white
18	5.5	Sand, fine- to coarse-grained, clear
28	8.5	Shells, broken, tan
30	9.1	Shells, and sandy clay
46	14.0	Sand, silty, fine-grained and light gray
48	14.6	Sand and shell, tan to buff
69	21.0	Sand, silty, fine-grained and light gray
76	23.2	Shells, and fine-grained, white to light gray
94	28.7	Clay, sandy, gray and shells
98	29.9	Limestone, sandy, friable, and shells
126	38.4	Sandstone, soft, light gray to light green and some shells
143	43.6	Limestone, sandy, soft, and a few shells
149	45.4	Shell, cemented, with cavernous zones

Lithologic Log of Well M-1091

Depth Below Land Surface Ft.	M.	Geologic Description
0-5	0-1.5	Sand, fine-grained, white
7	2.1	Hardpan
33	10.1	Sand, fine- to medium-grained, tan to very dark
37	11.3	Clay, light brown
39	11.9	Sand, black clay
41	12.5	Sand, brown, fine- to medium-grained
43	13.1	Clay, sandy, very soft, black
65	19.8	Shells, brown to dark gray, and some sand
85	25.9	Limestone, sandy, dark gray, and shells
105	32.0	Limestone and shell, sandy, light gray to tan
155	47.2	Shell, broken, cemented, tan to light gray
182	55.5	Shell, broken, and green clay streaks
200	61.0	Clay, sandy, dark green and shell

Lithologic Log of Well M-1095

Depth Below Land Surface Ft.	M.	Geologic Description
0-11	0-3.4	Road fill
20	6.1	Sand, fine-grained, brown
45	13.7	Sand, fine- to coarse-grained, yellow-brown
52	15.8	Sandstone, shelly, cemented, tan to light brown, hard
60	18.3	Shells, broken, tan and bits of light brown sandstone
107	32.6	Sandstone, calcite cement, tan to grayish tan, and shell fragments
120	36.8	Sandstone, calcite cement, gray, shell fragments, some brown organic materials
130	39.6	Shell fragments, tan to gray, and some sandstone
160	48.8	Shell fragments, dark gray, some sandstone and bits of phosphatic material
180	54.9	Limestone, sandy, creamy tan and gray shell
200	61.0	Limestone, sandy, creamy tan, hard, large amount of gray shell fragments
240	73.2	Limestone, sandy, gray, shell fragments

Lithologic Log of Well M-1096

Depth Below Land Surface		Geologic Description
Ft.	M.	
0-7	0-2.1	Sand, fine- to medium-grained, white
24	7.3	Clay, brown (organic hardpan) to blue, shell and shell
28	8.5	Shells, broken, and gray limestone
64	19.5	Limestone, dark gray, soft
106	32.3	Shell, and gray-tan sand
146	44.5	Shell, white to tan, and slightly cemented sand
172	52.4	Clay, sandy, green
224	68.3	Clay, silty, dark green
240	73.2	Clay, dark green, tough

Lithologic Log of Well MF-20

Depth Below Land Surface Ft.	M.	Geologic Description
0-25	0-7.6	No lithologic data
25-45	7.6-13.7	Limestone, gray, shell, well-cemented, hard
45-60	13.7-18.3	Limestone, light gray, shelly, poorly cemented to well cemented, quartz sand
60-65	18.3-22.9	Limestone, white to tan, quartz sand, white
75-80	22.9-24.4	Limestone, white to tan, quartz sand, trace of clay
80-95	24.4-29.0	Limestone, shell, increase in sand content at bottom of interval
95-115	29.0-35.0	Limestone and shell with light green to gray plastic clay, quartz sand
115-125	35.0-38.3	Sample missing
125-135	38.3-41.1	Limestone, light green to gray, hard, sand with a trace of clay
135-160	41.1-48.8	Clay, light gray to olive green, calcareous, sand and shell
160-180	48.8-54.9	Clay, olive-green, sandy, quartz and carbonate silt, phosphatic, shell
180-190	54.9-57.9	Clay, olive-green, plastic, sand and shell, phosphatic

Lithologic Log of Well G&J 1-D

Depth Below Land Surface Ft.	M.	Geologic Description
0-5	0-1.5	Sand: silica, light graying brown, very fine to medium-grained, minor medium brown clay and organic matter (roots, bark), unconsolicated
5-20	1.5-6.1	Clayey sand: silica, light to medium brown, very fine to medium grained, hardpan (cemented sand), increasing clay content with depth, consolidated to poorly lithified
20-40	6.1-12.2	Marl: medium grayish brown, carbonate, silty clay, very fine to medium-grained, silica sand, consolidated Limestone: biomicrite, gray, fossiliferous
40-50	12.2-15.2	Sand: silica, light brownish gray, very fine to fine-grained, some light gray clay, consolidated with minor lithification, minor shell fragments, very fine to fine-grained
50-60	15.2-18.3	Shell: light brown, medium to very coarse-grained, juvenile and adult pelecypods (*Chione sp.*, *Tellina sp.*) Sand: silica, light to medium gray, very fine to medium-grained, some calcareous cement, light brown clay, unconsolidated, minor phosphatic sand
60-115	18.3-35.1	Shell: light brown to gray, fine- to very coarse-grained, mostly pelecypods (*Chione sp.*, *Tellina sp.*, *Venus sp.*), some gastropods (*Olivilla sp.*), worm tubes, unconsolidated Limestone: light to medium gray, well lithified to friable, calcarenite to biomicrite Sand: light to medium gray, very fine- to medium-grained, some clay, phosphatic sand

Lithologic Log of Well G&J 1-D continued

Depth Below Land Surface Ft.	M.	Geologic Description
115-135	35.1-41.1	Limestone: gray, well-lithified, fossiliferous, calcarenite
		Sand: carbonate, light gray, very fine to fine-grained, abundant silty clay, with consolidated shell fragments, medium to very coarse-grained, mostly pelecypods, minor phosphatic sand
135-140	41.1-42.7	Silty sand: silica sand, carbonate silt, medium grayish green, very fine to fine-grained, consolidated

Lithologic Log of Well G&J 2-D

Depth Below Land Surface Ft.	M.	Geologic Description
0-5	0-1.5	Sand: silica, light grayish brown, fine to coarse-grained, abundant silt, unconsolidated
5-25	1.5-7.6	Sand: silica, light brown, very fine to coarse-grained, friable, abundant silt and clay, minor phosphate, light to medium grayish brown hardpan (cemented sand) at 20-25 feet, fine to coarse-grained, friable, abundant clay, some phosphate
25-30	7.6-15.2	Marl: light brownish gray, some silica sand, fine to coarse-grained, abundant carbonate silt and clay, unconsolidated, phosphate sand, minor shell fragments at 45 feet.
50-75	15.2-22.9	Shell: light brownish gray, unconsolidated, very fine to medium-grained, abundant pelecypods (*Tellina sp.*), some gastropods (*Olivella sp.*) Sand: silica, very fine to medium-grained, some light brown clay, some phosphatic sand
75-90	22.9-27.4	Sand: carbonate with minor silica, light grayish brown, very fine to medium-grained, abundant silt, unconsolidated, shell fragments, fine-grained, phosphate sand
90-120	27.4-36.6	Limestone: light brown, very fine to medium-grained, well lithified, fossiliferous with abundant pelecypods Sand: light gray, very fine to fine-grained, with some silty clay and phosphatic sand

Lithologic Log of Well G&J 2-D continued

Depth Below Land Surface		Geologic Description
Ft.	M.	
120-135	36.6-41.1	Limestone: light to medium gray, calcarenite, poorly-cemented, friable, abundant shell fragments, pelecypods (Chione sp.), gastropods (Turitella sp.), minor clay and sand
135-140	41.2-42.7	Silty sand: carbonate, greenish gray, consolidated, minor limestone, as in 120-135 feet, minor shell fragments

Lithologic Log of Well G&J 3-D

Depth Below Land Surface Ft.	M.	Geologic Description
0-20	0-6.1	Sand: silica, light yellowish to brownish gray, very fine to fine-grained, unconsolidated
20-45	6.1-13.7	Sandy shell: fine to very coarse-grained, abundant pelecypods (*Chione sp.*, *Donax sp.*), gastropods (*Olivella sp.*), unconsolidated
		Limestone: medium to dark gray, calcarenite, 30-40 percent, well-cemented, fossiliferous, some fine-grained silica and phosphatic sand
45-65	13.7-19.8	Shell: as in 20-45 feet; limestone decreasing to less than 10 percent
65-95	19.8-29.0	Shell: as in 20-45 feet
		Limestone: light grayish green to medium brown, calcarenite, 30-40 percent of sample
95-145	29.0-44.2	Limestone: greenish gray, calcarenite, 60 percent, well cemented, silica sand, phosphate, shell fragments
145-150	44.2-45.7	Silty sand: olive green, carbonaceous, abundant fine-grained silica sand with phosphate

Lithologic Log of Well G&J 4-D

Depth Below Land Surface Ft.	M.	Geologic Description
0-5	0-1.5	Sand: silica, medium brown, very fine to fine-grained, minor organic debris
5-15	1.5-4.6	Sand: silica, light brownish gray, abundant silt, very fine to fine-grained
15-30	4.6-9.1	Shell: shell fragments, fine to coarse-grained, abundant pelecypods (Donax sp., Trachycardium sp.), juvenile to adult, gastropods, unconsolidated
30-95	9.1-29.0	Shell: shell fragments, fine to coarse-grained, abundant pelecypods (Donax sp., Venus sp.) Limestone: light greenish to dark gray, calcarenite, well-cemented, some silica and phosphate sand
95-135	29.0-41.1	Limestone: light greenish gray, calcarenite, well-cemented, silica and phosphatic sand, shell fragments
135-140	41.1-42.7	Limestone: as in 95-135 feet Clay: greenish gray, abundant

Lithologic Log of Well G&J 5-D

Depth Below Land Surface Ft.	M.	Geologic Description
0-5	0-1.5	Sand: silica, dark brown, very fine to fine-grained, consolidated, some clay, some organic debris
5-30	1.5-9.1	Silty clay: light brownish gray, abundant clay, consolidated
30-40	9.1-12.2	Shell: light brown to gray, unconsolidated, fine to coarse-grained, abundant pelecypods (*Tellina* sp., *Chione* sp., *Trachycardium* sp.)
		Sand: silica, light brownish gray, very dine to fine-grained, minor clay
40-90	12.2-27.4	Shell: unconsolidated mollusc fragments as in 30-40 feet
		Limestone: light to dark gray calcarenite, lithified, some sand and shell fragments
90-120	27.4-36.6	Limestone: light to medium greenish gray, calcarenite, well-cemented, silica and phosphate sand, shell fragments, fine-grained, some shell fragments
120-145	36.6-44.2	Silty sand: light greenish gray, plastic consolidated, silica and phosphate sand, very fine to fine-grained

Lithologic Log of Well G&J OW-2D

Depth Below Land Surface Ft.	M.	Geologic Description
0-5	0-1.5	Sand: silica, dark brown, very fine to fine-grained, abundant organic debris, unconsolidated
5-20	1.5-6.1	Clayey sand: silica, light to medium grayish brown, abundant clay, very fine to fine-grained, unconsolidated
29-60	6.1-18.3	Shell: light brown to gray, fine to coarse-grained, abundant pelecypods (Venus sp., Chione sp.), juvenile to adult, few gastropods Sand: silica, light grayish brown, fine to medium-grained, some calcareous cement, minor phosphate gravel
60-95	18.3-29.0	Shell: light brown to gray, fine to coarse-grained, abundant pelecypods Limestone: medium gray, calcarenite, coquina (cemented shell), well-lithified Sand: silica, light grayish brown, phosphatic, very fine to fine-grained, some clay
95-135	29.0-41.1	Limestone: light to medium gray, calcarenite, well lithified, some partially cemented shell fragments, medium to coarse-grained Sandy clay: silica, yellowish gray, very fine to fine-grained, with minor phosphatic sand
135-145	41.1-44.2	Silty sand: olive green, silica sand, carbonate silt, stiff, phosphatic, consolidated

Lithologic Log of Well G&J OW-3D

Depth Below Land Surface Ft.	M.	Geologic Description
0-5	0-1.5	Sand: silica, dark brown, very fine to fine-grained, abundant organic debris, unconsolidated
5-15	1.5-4.6	Clayey sand: silica, yellowish gray, abundant clay, very fine to fine-grained, consolidated
15-30	4.6-9.1	Shell: light brown to gray, fine to very coarse-grained, unconsolidated, abundant pelecypods (*Venus sp.*), juvenile to adult Sandy clay: light grayish brown silica, fine-grained, phosphatic sand, unconsolidated
30-85	9.1-25.1	Shell: as in 15-30 feet Limestone: light grayish brown, calcarenite, well-lithified, with silica and phosphatic fine-grained sand
85-135	25.9-41.1	Limestone: light olive gray, calcarenite, well-lithified, minor silica and phosphatic sand and shell fragments
135-150	41.1-45.7	Silty sand: olive green, silica sand, carbonate silt, phosphatic, consolidated

Lithologic Log of Well WW43-29349

Depth Below Land Surface Ft.	M.	Geologic Description
0-10	0-3.0	Sand, quartz, medium- to fine-grained, tan
10-20	3.0-6.1	As above with shell fragments
20-30	6.1-9.1	As above
30-40	9.1-12.2	No data
40-50	12.2-15.2	Sand, quartz, medium- to fine-grained, some broken shell, some clay, formation soupy, light gray
50-65	15.2-19.8	Small, broken shell with sand
65-72	19.8-21.8	Broken shell, a few limestone chips, quartz sand, fine-grained, water-bearing
72-103	21.8-31.8	Very fine-grained sand with considerable clay, formation soupy
103-118	31.8-37.9	Sand, shell, and clay
118-125	37.9-38.1	No data
125-130	38.1-39.6	Limestone ledge at 118, limestone chips and broken shell, water-bearing

Lithologic Log of Well WW43-42939

Depth Below Land Surface Ft.	M.	Geologic Description
0-9	0-2.7	Sand, quartz, medium- to fine-grained, clear to frosted, white, well-sorted. Trace of organic material
9-14	2.7-4.3	Hardpan, tan to dark brown, quartz sand, medium- to fine-grained, clay
14-30	4.3-9.1	Sand, quartz, medium- to fine-grained, tan , trace of organics and clay
30-43	9.1-13.1	As above
43-56	13.1-17.1	Thin sandstone ledge at 46 ft. (14 m), sand, quartz, underlying, medium- to coarse-grained, tan, water-bearing
56-64	17.1-19.5	Same as above
64-74	19.5-22.6	Sandstone ledge at 64 ft. (19.5 m), sand, shell, with very coarse sand and limestone chips underlying, cream to tan, water-bearing

Lithologic Log of Well WW43-46114

Depth Below Land Surface		Geologic Description
Ft.	M.	
0-20	0-6.1	Sand, hardpan
20-40	6.1-12.2	Sand and shell
40-60	12.2-18.3	Coarse sand and shell
60-80	18.3-24.4	Coquina rock, sand and shell
80-100	24.4-30.5	Rock, sand, shell
100-105	30.5-32.0	Rock and large shell
105-109	32.0-32.2	Shell and limestone

Lithologic Log of Well WW43-51320

Depth Below Land Surface		Geologic Description
Ft.	M.	
0-10	0-3.0	Sand, quartz, medium- to fine-grained, small broken shell, tan
10-20	3.0-6.1	Same as above
20-30	6.1-9.1	Same as above
30-40	9.1-12.2	Top of ledge at 40 ft. (12.2m), cemented sandstone, color tan
40-45	12-2-13.7	No sample
45-50	13.7-15.2	Broken shell, coarse sand, tan
50-60	15.2-18.3	As above, light tan to gray
60-90	18.3-27.4	As above
90-100	27.4-30.5	Large broken shell, gray
100-130	30.5-39.6	As above
130-140	39.6-42.7	Large shell, broken, with limestone, white to gray
140-150	42.7-45.7	Small broken shell, fine-grained sand
150-160	45.7-48.8	Medium-sized, broken shell, fine-grained sand
160-180	48.8-54.9	Large, broken shell, fine-grained sand
180-190	54.9-57.9	Top of Hawthorn, clay, fine-grained sand, green

Lithologic Log of Well Hobe Sound-01

Depth Below Land Surface		Geologic Description
Ft.	M.	
0-18	0.5.5	White sand
18-35	5.5-10.7	Yellow sand
35-40	10.7-12.2	Light brown sand
40-57	12.2-17.4	White sand
57-59	17.4-20.0	Yellow sand
59-82	20.0-25.0	Gray sandstone
82-105	25.0-32.0	Sandstone
105-110	32.0-33.5	Sand with a little clay
110-116	33.5-35.4	Sand and shell
116-126	35.4-38.4	Sand and shell
126-144	38.4-43.9	Sand and shell

Lithologic Log of Well Hobe Sound-05

Depth Below Land Surface		Geologic Description
Ft.	M.	
0-5	0.-1.5	Top soil
5-20	1.5-6.1	White sand
20-25	6.1-7.6	Water-bearing sand
25-55	7.6-16.8	White sand
55-60	16.8-18.3	Gravel
60-65	18.3-19.8	Heavy gravel, water-bearing
65-96	19.8-29.3	Water-bearing gravel and sand

Lithologic Log of Well Hobe Sound-10

Depth Below Land Surface Ft.	M.	Geologic Description
0-24	0-7.3	Brown and white sand
24-58	7.3-17.7	Brown sand with clay streaks
58-62	17.7-18.9	Brown and white rock
62-70	18.9-21.3	Medium brown rock
70-86	21.3-26.2	Medium hard rock
86-98	26.2-29.9	Rock and shell
98-105	29.9-32.0	Medium brown, hard rock

Lithologic Log of Well Hobe Sound-11

Depth Below Land Surface Ft.	M.	Geologic Description
0-45	0-13.7	Sand, light brown
45-63	13.7-19.2	Sand
63-70	19.2-21.3	Sand and shell
70-75	21.3-22.9	Sandstone firm
75-84	22.9-25.6	Sandstone soft
84-85	25.6-25.9	Sandstone hard
85-93	25.9-28.3	Sandstone firm
93-100	28.3-30.5	Sand and shell

Lithologic Log of Well Camp Murphy-01

Depth Below Land Surface		Geologic Description
Ft.	M.	
0-5	0-1.5	White sand
5-30	1.5-9.1	Yellow sand
30-35	9.1-10.7	Yellow sand and sandstone
35-55	10.7-16.8	White sandstone and shell rock
55-90	16.8-27.4	White sandstone and shell rock

Lithologic Log of Well Camp Murphy-03

Depth Below Land Surface		Geologic Description
Ft.	M.	
0-3	0-0.9	White sand
3-15	0.9-4.6	Yellow sand
15-20	4.6-6.1	Yellow sand
20-25	6.1-7.6	Fine-grained sand
25-35	7.6-10.7	White sand, coarse
35-40	10.7-12.2	White sand and shell, porous
40-55	12.2-16.8	White sand and shell
55-90	16.8-27.4	White sand and shell, gray to white

Lithologic Log of Well Camp Murphy-06

Depth Below Land Surface		Geologic Description
Ft.	M.	
0-5	0-1.5	White sand
5-40	1.5-12.2	Yellow sand
40-70	12.2-21.3	White sand, fine- to medium-grained, "quicksand" and some stone
70-105	21.3-32.0	Light, fine sand with shell and rock

Lithologic Log of Well FPL-9265

Depth Below Land Surface		Geologic Description
Ft.	M.	
0-8	0-2.4	Brown clay-type sand
8-19	2.4-5.8	Gray, fine-grained sand
19-23	5.8-7.0	Firm shelves of lime rock, sand and shell
23-40	7.0-12.2	Soft sand and some lime rock
40-58	12.2-17.7	Gray, fine-grained sand
58-70	17.7-21.3	Shell, gray sand

Lithologic Log of Well FPL-10243-02

Depth Below Land Surface Ft.	M.	Geologic Description
0-10	0-3.0	Brown clay
10-25	3.0-7.6	Fine shell
25-30	7.6-9.1	Rock, sand, and fine shell
30-45	9.1-13.7	Large shell
45-55	13.7-16.8	Shell and coarse sand
55-60	16.8-18.3	Large shell
60-75	18.3-22.9	Green marl
75-80	22.9-24.4	Marl and fine-grained sand

Lithologic Log of Well FPL-10243-03

Depth Below Land Surface Ft.	M.	Geologic Description
0-10	0-3.0	Coral sand
10-20	3.0-6.1	Brown clay and shell fragments
20-35	6.1-10.7	Brown clay and shell fragments
35-40	10.7-12.2	Gray sand and shell fragments
40-47	12.2-14.3	Marl, rock and shell
47-50	14.3-15.2	Marl, rock and shell
50-68	15.2-20.7	Marl and fragments of shell
68-75	20.7-22.9	Marl
75-83	22.0-25.3	Marl

Lithologic Log of Well FPL-10243-04

Depth Below Land Surface Ft.	M.	Geologic Description
0-20	0.6.1	Red clay
20-30	6.1-9.1	Fine-grained, gray sand and shell
30-40	9.1-12.2	Fine-grained, gray sand and shell
40-50	12.2-15.2	Gray marl
50-60	15.2-18.3	Gray marl and shell fragments
60-70	18.3-21.3	Gray sand and shell
70-80	21.3-24.4	Gray sand and shell
80-83	24.4-25.3	Gray sand and shell

Lithologic Log of Well FPL-10243-05

Depth Below Land Surface Ft.	M.	Geologic Description
0-10	0-3.0	Gray sand
10-20	3.0-6.1	Gray sand
20-30	6.1-9.1	Gray sand and shell fragments
30-40	9.1-12.2	Gray sand and shell fragments
40-50	12.2-15.2	Gray sand and shell fragments and rock and shell
50-60	15.2-18.3	Light gray sand, rock, and shell
60-70	18.3-21.3	Light gray sand, rock, and shell
70-81	21.3-24.7	Gray sand and shell

Lithologic Log of Well FPL-10243-06

Depth Below Land Surface Ft.	M.	Geologic Description
0-10	0-3.0	Brown clay
10-20	3.0-4.6	Brown clay
20-30	4.6-9.1	Gray sand and shell fragments
30-40	9.1-12.2	Gray sand and shell fragments
40-50	12.2-15.2	Gray sand and shell
50-60	15.2-18.3	Gray sand and shell
60-70	18.3-21.3	Gray sand and fine shell
70-80	21.3-24.4	Gray sand and fine shell

Lithologic Log of Well FPL-74096-01

Depth Below Land Surface Ft.	M.	Geologic Description
0-10	0-3.0	Black mud
10-20	3.0-6.1	Gray marl and shell
20-25	6.1-7.6	Gray marl and shell
25-30	7.6-9.1	Gray marl and shell
30-35	9.1-10.7	Gray marl and shell and traces of rock
35-40	10.7-12.2	Gray marl and shell and traces of rock
40-50	12.2-15.2	Gray marl and shell and traces of rock
50-70	15.2-21.3	Gray marl and shell
70-75	21.3-22.9	Gray marl and traces of shell
75-80	22.9-24.4	Green marl

Lithologic Log of Well FPL 74097-02

Depth Below Land Surface		Geologic Description
Ft.	M.	
0-5	0-1.5	Top soil
5-10	1.5-3.0	Mixed sand and top soil
10-15	3.0-4.6	Sand and shell
15-20	4.6-6.1	Sand and shell
20-25	6.1-7.6	Coarse sand
25-30	7.6-9.1	Sand, shell, and marl
30-35	9.1-10.7	Coarse sand and shell
35-40	10.7-12.2	Marl, sand, and shell
40-45	12.2-13.7	Marl, sand, and shell
45-50	13.7-15.2	Marl, coarse sand, and large shell
50-55	15.2-16.8	Marl and fine sand
55-60	16.8-18.3	Marl, coarse sand and shell
60-65	18.3-19.8	Green marl
65-70	19.8-21.3	Green marl and sand and shell
70-75	21.3-22.9	Marl, sand, and shell
75-80	22.9-24.4	Green marl
80-140	24.4-42.7	Fine-grained, gray sand and marl
140-150	42.7-45.7	Green marl
150-170	45.7-51.8	Green marl and shell fragments, traces of rock
170-190	51.8-57.9	Green marl

Lithologic Log of Well 34782

Depth Below Land Surface Ft.	M.	Geologic Description
0-10	0-3.0	White sugar sand
10-30	3.0-9.1	Gray sand
30-50	9.1-15.2	Coarse sand and fine shell
50-63	15.2-19.2	Coarse sand and shell

Lithologic Log of Well 34797

Depth Below Land Surface Ft.	M.	Geologic Description
0-10	0-1.5	White sugar sand
10-30	1.5-9.1	Gray sand
30-50	9.1-15.2	Coarse sand and fine shell
50-75	15.2-22.9	Gray sand
75-85	22.9-25.9	Coarse sand and shell

Lithologic Log of Well 43988

Depth Below Land Surface		Geologic Description
Ft.	M.	
0-42	0-12.8	Sand and shell
42-65	12.8-19.8	Sand, shell, and marl
65-76	19.8-23.2	Shell and marl
76-96	23.2-29.3	Green marl
96-98	29.3-29.9	Marl and water sand
98-118	29.9-36.0	Green marl
118-138	36.0-42.1	Green marl
138-144	42.1-43.9	Green marl
144-147	43.9-44.8	Marl and water sand
147-167	44.8-50.9	Marl and water sand
167-187	50.9-57.0	Green marl
187-207	57.0-63.1	Marl and silty marl
207-227	63.1-69.2	Marl and silty marl
227-238	69.2-72.5	Marl and silty marl
238-246	72.5-75.0	Marl and water sand
246-260	72.5-79.2	Green marl

Lithologic Log of Well 47005

Depth Below Land Surface Ft.	M.	Geologic Description
0-16	0-4.9	White sand
16-25	4.9-7.6	Tan white
25-35	7.6-10.7	Light brown sand
35-49	10.7-14.9	Brown sand
49-58	14.9-17.7	Gray and brown sand
58-64	17.7-19.5	Gray sand
64-79	19.5-24.1	Gray sand with light shell
79-90	24.1-27.4	Clay, sand, shell and rock
90-110	27.4-33.5	Rock, sand, and shell

Lithologic Log of Well Hobe Sound-50681

Depth Below Land Surface		Geologic Description
Ft.	M.	
0-15	0-4.6	White sand
15-25	4.6-7.6	Brown sand
25-40	7.6-12.2	Fine-grained, gray sand
40-73	12.2-22.3	Coral and shell

Lithologic Log of Well 50685 at Tequesta, Florida

Depth Below Land Surface		Geologic Description
Ft.	M.	
0-15	0-6.1	White sugar sand
20-30	6.1-9.1	Coarse brown sand
30-55	9.1-16.8	Fine-grained sand
55-64	16.8-19.5	Shell and coral

Lithologic Log of Well 55986

Depth Below Land Surface		Geologic Description
Ft.	M.	
0-21	0-6.4	Gray sand to white sand to tan hardpan and black muck
21-42	6.4-12.8	Tan hardpan and dark gray sand and shell
42-63	12.8-19.2	Dark gray sand, shell and rock to medium gray sand, fine-grained, and wet sandstone
63-94	19.2-28.7	As above, but gravel is dry
94-105	28.7-32.0	Medium gray sand and rock going to light gray, broken shell & sandstone

Lithologic Log of Well 69083

Depth Below Land Surface		Geologic Description
Ft.	M.	
0-4	0-1.2	Brown, fine-grained sand
4-18	1.2-5.5	Brown, slightly silty, fine-grained sand
18-35	5.5-10.7	Brown to tan, fine-grained sand with a seam of silty fine-grained, brown sand
35-50	10.7-15.2	Gray, fine-grained sand
50-61	15.2-18.6	Gray, fine-grained sand with traces of shell fragments
61-63	18.6-19.2	Weathered shell and limestone fragments, lightly cemented
63-69	19.2-21.0	Loose shells and limestone fragments with traces of fine-grained sand

Lithologic Log of Well 75150

Depth Below Land Surface Ft.	M.	Geologic Description
0-10	0-3.0	Sand, quartz, fine- to medium-grained, gray to brown
10	3.0	Hardpan, sand, and clay
20	6.1	Sand, quartz, fine-grained, clay, broken shell, gray
30	9.1	Sand, fine- to medium-grained, clay, organic, brown
40	12.2	Sand, fine-grained, small, broken shell, gray
50	15.2	Sand, fine-grained, clay and silt
60	18.3	Sand, quartz, fine-grained, clay, broken shell, gray
70	21.3	As above
80-110	24.4-33.5	As above
120	36.8	Sand, quartz, medium-grained, clay, shell, formation soupy
126	38.4	Large shell, broken limestone, conglomerate, water-bearing
147	44.8	Sandstone

Lithologic Log of Well 80742

Depth Below Land Surface Ft.	M.	Geologic Description
0-9	0-2.7	Light sand
9-13	2.7-4.0	Tan sand
13-20	4.0-6.1	Light gray sand
20-23	6.1-7.0	Gray sand
23-29	7.0-8.8	Brown sand
29-32	8.8-9.8	Yellow sand
32-38	9.8-11.6	Clay and brown sand
38-41	11.6-12.5	Light brown sand
41-49	12.5-14.9	Tan sand
49-52	14.9-15.8	Clear sand
52-60	15.8-18.3	Gray sand
60-78	18.3-23.8	Brown silt and sand, shell fragments, rock and shell

Lithologic Log of Well L-143

Depth Below Land Surface Ft.	M.	Geologic Description
0-30	0-9.1	No sample
30-42	9.1-12.8	Sand, brown, coarse-grained, few shells
42-63	12.8-19.2	Shell fragments and sand with calcite cement (*Donax*)
63-105	19.2-32.0	As above with some gray-brown micaceous, sandy clay. *Elphidium* and *Nonion* forams
105-147	32.0-44.8	As above, plus some white to gray-brown very sandy, hard limestone
147-186	44.8-56.7	No sample
186-188	56.7-57.3	Sand, light green, medium- to very coarse-grained, rounded, clear to frosted; mollusk fragments, coral, and echinoid spines
188-209	57.3-63.7	Limestone, gray-brown, hard to soft, clayey and very sandy, calcite cement, some shells
209-230	63.7-70.1	As above plus *Amphisteqina lessonii* forams
230-252	70.1-76.8	Sand, quartz, gray, some clay and many shell fragments and coral
252-273	76.8-83.2	Shell fragments with sand and olive-drab clay
273-294	83.2-89.6	No sample
294+	89.6+	Pre-Pliocene sediments

Lithologic Log of Well L-596

Depth Below Land Surface Ft.	M.	Geologic Description
0-5	0-1.5	Sand, gray, quartz, fine- to medium-grained, average fine-grained, subrounded to angular, clear to frosted
5-10	1.5-3.0	Sand, tan-gray, fine- to medium-grained, clear to frosted; noncalcareous
10-21	3.0-6.4	As above, but light tan-gray
21-26	6.4-7.9	Sand, light to dark tan-gray, fine- to coarse-grained, clayey, slightly calcareous
26-31	7.9-9.4	Sand, dark olive-drab, very micaceous, clayey, slightly calcareous
31-36	9.4-11.0	Sand, dark gray to yellow-green, slightly clayey, slightly calcareous
36-42	11.0-12.8	Sand, gray, slightly calcareous, very fine- to medium-grained, frosted to clear
42-47	12.8-14.6	As above to 44 feet (13.4m); from 44 to 47 feet - sand, gray, slightly micaceous, very fine- to coarse-grained; contains some soft, gray, sandy limestone, phosphorite, and poorly preserved fossils
47-52	14.6-15.8	Limestone, tan to dark gray, hard to soft, sandy with calcite, small shell fragments
52-57	15.8-17.4	As above and numerous shell and shell fragments
57-59	17.4-18.0	Shell marl, gray to tan
59-60	18.0-18.3	Limestone, tan to dark gray, hard, dense to porous, sandy, calcite cement, small shell fragments, phosphatic; fine- to very coarse-grained quartz sand
60-61	18.3-18.6	As above, but more porous

Lithologic Log of Well L-615

Depth Below Land Surface		Geologic Description
Ft.	M.	
0-10	0-3.0	Sand, cream, quartz, medium- to coarse-grained, some orange-red clay, noncalcareous
10-15	3.0-4.6	Sand, dark red-brown, quartz, medium- to coarse-grained, carbonaceous, noncalcareous, some clay
15-20	4.6-6.1	Sand, dark orange-red, medium- to very coarse-grained, a few small shell fragments, clusters of calcite, some clay
20-25	6.1-7.6	Sand, red-orange, quartz, medium- to coarse-grained, noncalcareous
25-30	7.6-9.1	Sand, red-orange to cream, quartz, medium- to coarse-grained, frosted to clear, a few small red shell fragments
30-35	9.1-10.7	Sand, cream, quartz, slightly micaceous, fine- to very coarse-grained, large grains frosted, few mollusk fragments, well preserved foraminifers with orange-red clay
35-40	10.7-12.2	Sand, light tan-gray, a few scattered mollusk fragments, foraminifers, clear calcite particles and mica flakes
40-45	12.2-13.7	Sand, tan-gray, medium- to coarse-grained, few mica flakes, slightly calcareous
45-60	13.7-18.3	As above, noncalcareous
60-65	18.3-19.8	Sand, dark orange-red, quartz, some clay and mica flakes, noncalcareous

Lithologic Log of Well L-617

Depth Below Land Surface Ft.	M.	Geologic Description
0-5	0-1.5	Sand, cream, quartz, fine- to medium-grained, noncalcareous
5-10	1.5-3.0	Sand, red-brown, quartz, medium- to coarse-grained, noncalcareous, carbonaceous
10-25	3.0-7.6	Sand, tan-gray, quartz, slightly clayey, slightly micaceous, non-calcareous
25-30	7.6-9.1	Sand, dark gray, quartz, micaceous, clayey phosphatic, small shell fragments, calcareous
30-50	9.1-15.2	Sand, dark gray, quartz, micaceous, very phosphatic, some clear calcite, shell fragments, foraminifers
50-63	15.2-19.2	Sand, dark gray, quartz, very fine- to fine-grained, micaceous, calcareous, very phosphatic, clayey, mollusks fragments, coral, some fresh water gastropods at 63 feet (19.2m)
63-73	19.2-22.3	Sand, dark gray, quartz, fine- to medium-grained, micaceous, calcareous, very phosphatic, clayey, small clusters of calcite, mollusk shells, abundant microfossils
73-75	22.3-22.9	As above, medium- to coarse-grained
75-80	22.9-24.4	Sand, tan-gray, fine- to medium-grained, micaceous, phosphatic, shell fragments, calcite, fossiliferous, limestone, some white clay
80-87	24.4-26.5	Sand, tan, quartz, fine- to medium-grained, clayey, shell fragments

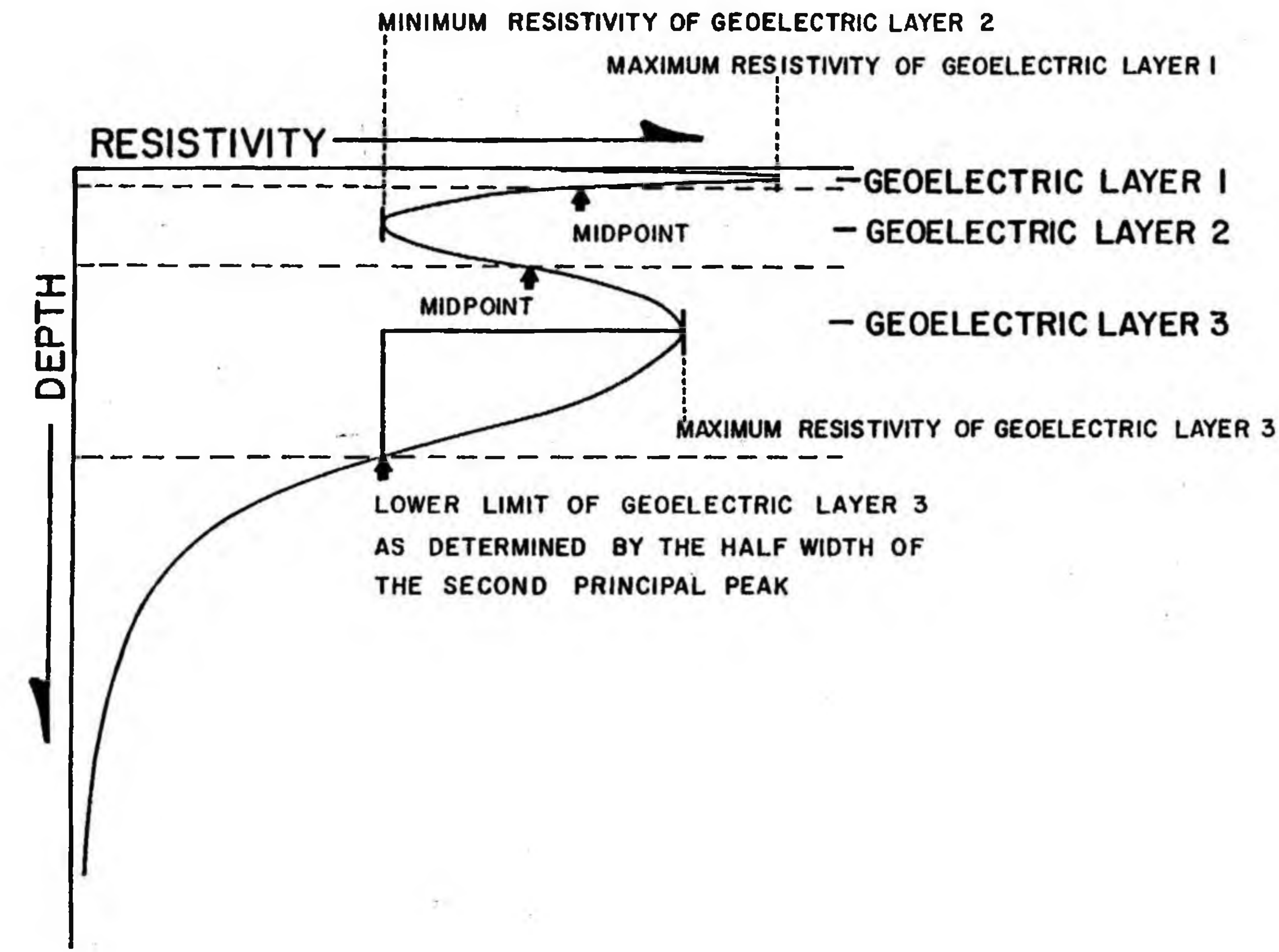
Lithologic Log of Well L-623

Depth Below Land Surface Ft.	M.	Geologic Description
0-5	0-1.5	Sand, light gray, quartz, medium- to coarse-grained, clear to frosted
5-10	1.5-3.0	Sand, cream, quartz, medium- to coarse-grained, slightly carbonaceous
10-20	3.0-6.1	Sand, cream, quartz, medium- to coarse-grained, some red-brown clay, slightly carbonaceous
20-25	6.1-7.6	Sand, cream, quartz, medium- to-coarse-grained, red-brown clay
25-35	7.6-10.7	As above, but coarse-grained
35-40	10.7-12.2	Sand, tan, quartz, very fine- to fine-grained, a few particles of dark gray sandy clay and mica
40-45	12.2-13.7	Sand, white, quartz, fine- to medium-grained, a few particles of clay and mica
45-50	13.7-15.2	Sand, white, quartz, very fine-grained, micaceous, iron oxide and calcite cement
50-52	15.2-15.8	Sand, white, quartz, fine- to coarse-grained, some brown sandy clay, crystalline calcite, shell fragments, micaceous
52-55	15.8-16.8	Limestone, tan-gray, hard, porous, vuggy, fossiliferous, some phosphorite
55-100	16.8-30.5	Sand, fine- to medium-grained, layers of soft, cream limestone, and hard, gray, nodular sandstone, shell fragments with calcite cement
100-110	30.5-33.5	Sand, tan, quartz, shell fragments and forams

Lithologic Log of Well L-841

Depth Below Land Surface Ft.	M.	Geologic Description
0-21	0-6.4	Sand, quartz, medium-grained, brown
21-42	6.4-12.8	Sand, quartz, medium-grained, brown
42-55	12.8-16.8	Sand, quartz, fine- to medium-grained, brown
55-63	16.8-19.2	Sand, light tan, quartz, medium-grained, a few shell fragments
63-84	19.2-25.6	Sand, tan, quartz, fine- to medium-grained, some shell material, a few forams, thin limestone and sandstone layers
84-105	25.6-32.0	Sand, tan, quartz, very fine- to medium-grained, shell material, "quicksand" at 88 feet (26.8m)
105-116	32.0-35.4	Sand, tan, quartz, very fine-grained, shells
116-126	35.4-38.4	Sand, tan-gray, quartz, very fine- to fine-grained, shell and phosphate nodules
126-147	38.4-44.8	Sand, light gray, quartz, fine- to medium-grained, shell fragments, thin layers and lenses of limestone and sandstone, sand coarser near bottom of interval
147-168	44.8-51.2	Sand, light tan-gray, quartz, fine-grained, shell fragments, some phosphorite, limestone layer at 150-152 feet (45.7-46.3m)
168-189	51.2-57.6	Sand, light gray, quartz, fine-grained, slightly shelly, some phosphorite and shell
189-210	57.6-64.0	Sand, quartz, fine-grained, gray-green clay, shell and limestone lenses, micaceous
210-231	64.0-70.4	Sand, gray-green, fine-grained, green clay, silt, phosphorite

Appendix D: A generalized vertical electric sounding curve illustrating the mechanical methods used to determine the limits of each geoelectric layer.


MINIMUM RESISTIVITY OF GEOELECTRIC LAYER 2
MAXIMUM RESISTIVITY OF GEOELECTRIC LAYER I
RESISTIVITY
GEOELECTRIC LAYER I
MIDPOINT
GEOELECTRIC LAYER 2
MIDPOINT
GEOELECTRIC LAYER 3
DEPTH
MAXIMUM RESISTIVITY OF GEOELECTRIC LAYER 3
LOWER LIMIT OF GEOELECTRIC LAYER 3
AS DETERMINED BY THE HALF WIDTH OF
THE SECOND PRINCIPAL PEAK