GEOLOGIC AND HYDROLOGIC DATA COLLECTED AT TEST WELL NC-5, BARCELONETA, PUERTO RICO

By Jesús Rodríguez-Martínez, John L. Hartley, and Arturo Torres-González

---

U.S. GEOLOGICAL SURVEY

Open-File Report 90-390

Prepared in cooperation with the

PUERTO RICO DEPARTMENT OF NATURAL RESOURCES

San Juan, Puerto Rico
1991

U.S. DEPARTMENT OF THE INTERIOR
MANUEL LUJAN, JR., Secretary
U.S. GEOLOGICAL SURVEY
Dallas L. Peck, Director

For additional information write to:

District Chief
U.S. Geological Survey
P.O. Box 364424
San Juan, Puerto Rico 00936-4424

Copies of this report can be purchased from:

U.S. Geological Survey
Books and Open-File Reports
Federal Center
Box 25425, Denver, CO 80225

CONTENTS

ILLUSTRATIONS

TABLES

CONVERSION FACTORS

Multiply	By	To Obtain
	Length	
inch	25.4	millimeter
foot	0.3048	meter
mile	1.609	kilometer
	Area	
square mile	2.590	square kilometer
	Flow	
gallon per minute	0.06308	liter per second

GEOLOGIC AND HYDROLOGIC DATA COLLECTED AT TEST WELL NC-5, BARCELONETA, PUERTO RICO

By Jesús Rodríguez-Martínez[1], John L. Hartley[2], and Arturo Torres-González[1]

ABSTRACT

Test well NC-5 was drilled in the municipality of Barceloneta, as part of a study of the aquifers in the Northern Coastal Province of Puerto Rico. The total depth of the well was 2,564 feet. Hydrologic and geologic data collected during drilling included continuous core, water-quality data, head measurements, geophysical logs, and estimates of well yields from the water-bearing zones. Detailed petrological and microfaunal analyses of the core were made to determine the mineralogical content, ages, and paleoenvironments of deposition.

The core recovered from test well NC-5 indicated that the well penetrated five formations of middle Tertiary age: the Aymamón Limestone, the Los Puertos Limestone, the Cibao Formation (including the Montebello Limestone Member), the Lares Limestone, and the San Sebastián Formation. Five hydrogeologic units were encountered in NC-5: three aquifers and two confining units. The uppermost unit is a water-table aquifer and contains the Aymamón Limestone, Los Puertos Limestone, and the uppermost strata of the Cibao Formation. The entire water-table aquifer contains freshwater. Two confining units and a lower artesian aquifer of local extent, occur in the informally named upper member of the Cibao Formation. The underlying artesian aquifer is composed of the lowermost beds of the upper member of the Cibao Formation, the Montebello Limestone Member of the Cibao Formation, and the Lares Limestone.

INTRODUCTION

The Northern Coastal Province in Puerto Rico is part of a coastward-thickening wedge of platform carbonates and minor clastic rocks of Oligocene to Holocene age. Extensive dissolution of limestone has created excellent examples of humid tropical karst landforms. Flanking the central mountains of Cretaceous and early Tertiary age, this wedge sequence extends from Aguada, in the western part of the island, to Loíza 30 miles east of San Juan, and underlies an area of approximately 700 square miles.

---

[1] U.S. Geological Survey, Water Resources Division, San Juan, Puerto Rico.

[2] Department of Geology, University of New Orleans, New Orleans, Lousiana.

Limited geologic and hydrologic data are available for the subsurface coastal areas of northern Puerto Rico. As part of a cooperative study between the U.S. Geological Survey and the Puerto Rico Department of Natural Resources, fifteen test wells were drilled (fig. 1) to better understand the geologic and hydrologic characteristics of the aquifers and confining units of the Northern Coastal Province (Torres-González and Wolansky, 1984).

Purpose and Scope

This report presents the geologic and hydrologic data collected at test well NC-5, drilled in 1986 in the municipality of Barceloneta, north-central Puerto Rico (figs. 1 and 2). The data include water levels, aquifer thickness, lithology, and water-quality data for the major aquifers identified at this site. These data will aid the correlation of major north coast hydrogeologic and geologic units (fig. 3) and help quantify the direction and rate of ground-water flow in the Northern Coastal Province.

The drilling and coring program was designed to allow the continuous collection of core samples for geologic, hydrogeologic, and paleontologic analysis. Geophysical logs were made to help describe and define major geologic and hydrologic units. Water-level measurements were made and water-quality samples were collected from discrete water-bearing zones.

Location of Study Area

The municipality of Barceloneta is located in the north-central part of Puerto Rico, approximately 35 miles west of San Juan. The well is located about one-quarter of a mile south of Highway 2, along Highway 140 near Cruce Dávila (fig. 2). The land surface altitude at the well site is 312 feet above mean sea level.

DATA-COLLECTION METHODS

Drilling and Well-Construction Methods

Test well NC-5 was drilled to a depth of 2,564 feet below land surface. The well was drilled by a hydraulically driven, reverse air drill that uses air under pressure. The drill stem consisted of 20-foot sections of threaded, seamless, double-walled pipe. As drilling progressed, air was forced under high pressure through the annulus between the two walls of the drill stem, forcing formation water and core samples up the center of the drill stem. Cores and water were ejected from the inner pipe into a large cyclone container that served as a sample collector.

Test well NC-5 was cased with 2.5 inch diameter casing from land surface to a depth of 1,070 feet below land surface. From 1,070 to 2,564 feet, the well is uncased. A construction diagram for test well NC-5 is shown on figure 4.

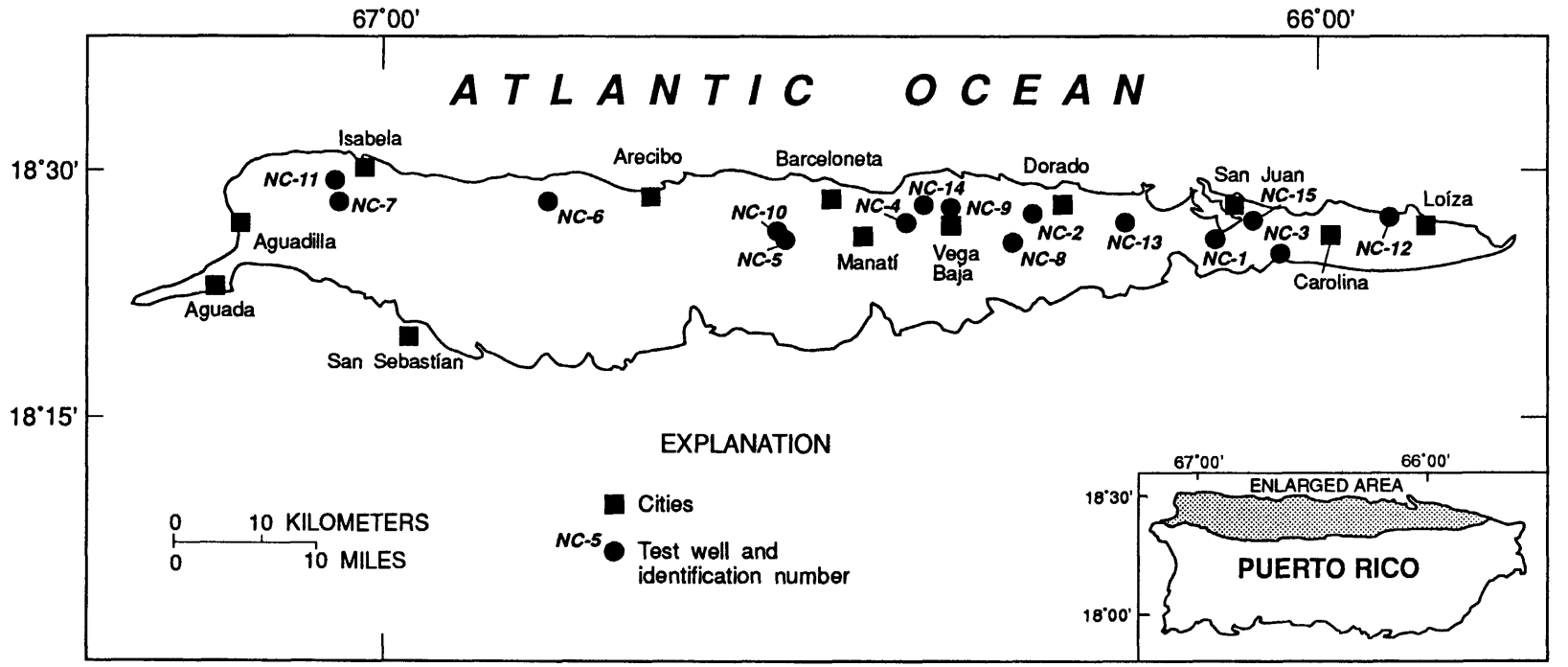

Figure 1.--Areal extent of the Northern Coastal Province of Puerto Rico and the location of cities and test wells.

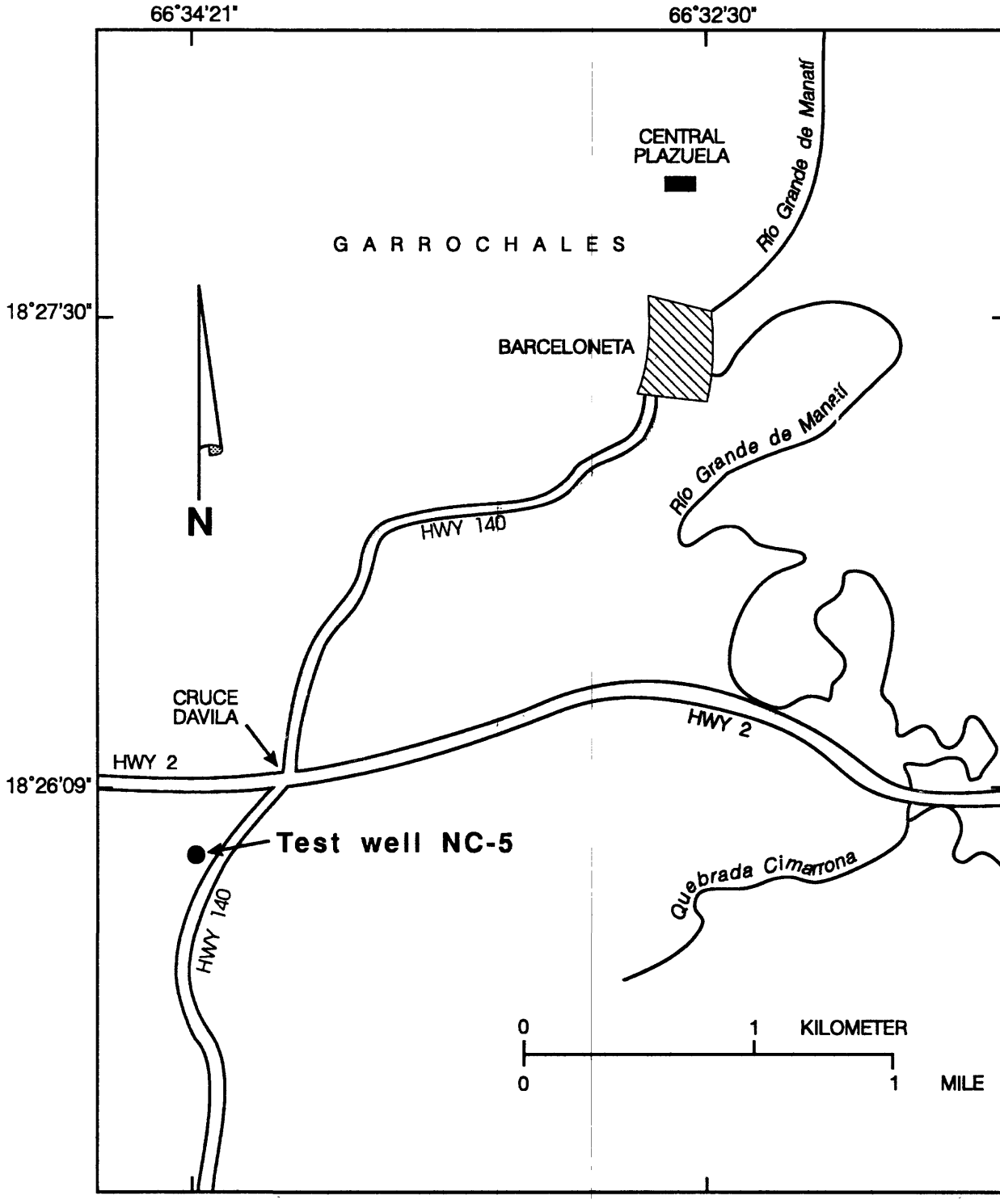

Figure 2.--Location of test well NC-5 in the Barceloneta area, Puerto Rico.

Coring

Test well NC-5 was cored continuously from land surface to the total depth of the well. Core samples were retrieved, measured, described, and placed in wooden boxes for preservation and storage at the University of Puerto Rico at Mayagüez. Each box holds the equivalent of one drill stem length, approximately 20 feet of core. Representative core samples were also collected for storage at the U.S. Geological Survey office in San Juan. Core recovery ranged from poor to excellent. Poor core recovery was common in cavernous zones.

Dolomite Analysis

Selected cores collected between 475 to 2,435 feet below land surface were tested for the presence of dolomite by X-ray diffraction or by staining thin sections with alizarin-S red and potassium ferrocyanide. In the X-ray analysis, the amount of dolomite is determined as a percent of the total carbonate in the powdered sample. In the stained thin-section analysis, the percent dolomite was determined by visually estimating the percent of unstained carbonate grains in the thin-section sample. A visual estimate of percent dolomite in other samples could then be made by comparing the samples with cores that have been more extensively evaluated. Results are given in table 1.

Table 1.--*Estimates of the percent of dolomite in cores of test well NC-5*

Core interval, in feet	Percent dolomite
475 - 480	10 - 50
1080 - 1120	1 - 5
1188 - 1270	5 - 15
1270 - 1276	5 - 30
1580 - 1680	10 - 15
1705 - 1712	5 - 50
1760 - 1790	25 - 75
1920 - 1997	3 - 5
2018 - 2090	1 - 5
2100 - 2120	10
2130 - 2190	7 - 10
2190 - 2220	10
2253 - 2263	10 - 25
2300 - 2304	1 - 5
2390 - 2435	10

Borehole Geophysics

In the borehole of test well NC-5, a suite of geophysical logs was run by lowering the logging tool down the inner drill stem. Only gamma-gamma, natural gamma, and neutron porosity logs could be obtained in this manner. Removal of the drill stem in test well NC-5 resulted in the immediate collapse of the borehole, thus preventing collection of open-hole geophysical log data. The geophysical readings obtained from the inside of the drill stem show minimal attenuation effects.

Hydrologic Measurements

Water-level measurements (table 2) were made at approximately 20-foot depth intervals, using either an electric sensor or a steel tape. Measurements were made on the inside of the drill stem before the next section of drill stem was connected. Time restrictions prohibited a full recovery of water levels. Water-level measurements also were made prior to commencement of drilling activity each day and within selected intervals identified on the basis of a noticeable increase in water ejected from the discharge pipe.

Flow measurements were made at the discharge point of the cyclone collector. Flow measurements were collected as drilling proceeded to provide data on the relative yields. Specific-conductance measurements also were made at the discharge point of the cyclone collector and provided geochemical information on the quality of formation water.

Table 2.--*Selected hydrologic data of test well NC-5*

Depth below land surface, in feet	Water level below land surface, in feet	Specific conductance, in microsiemens per centimeter at 25 degrees Celsius	Well yields, in gallons per minute
336	312	450	150
557	312	500	300
620	312	395	375
640	312	550	400
680	312	420	400
745	312	410	400
776	275	410	300
815	275	410	290
863	10	425	350
955	10	420	300
1155	0	422	300
1290	0	440	450
1314	0	475	450
1493	0	600	500
1534	5	500	375
1576	5	1400	325
1741	2	1750	180
1855	2	1400	180
2055	1	1480	150
2330	1	1480	150

GEOLOGIC AND HYDROLOGIC DATA

The rocks that crop out in the Northern Coastal Province have been mapped as seven formational units by Monroe (1980). Seiglie and Moussa (1984) later modified the geologic framework described by Monroe on the basis of additional paleontologic data collected from corehole, well cuttings, and outcrop samples (fig. 3). They recognized that the lithologic character of the units change as they extend from their outcrop into the subsurface. This report uses the nomenclature presented by Seiglie and Moussa (1984).

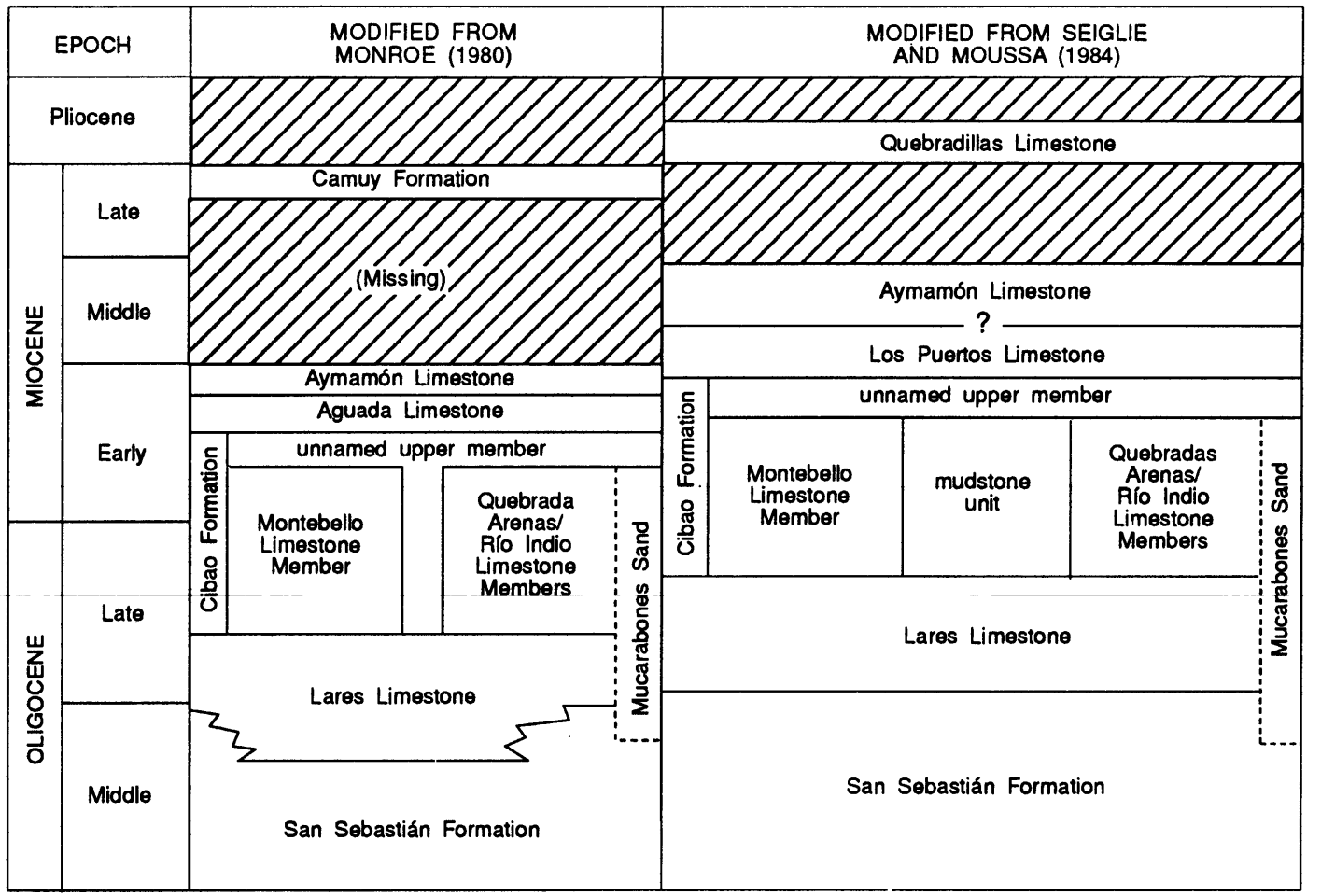

Figure 3.--Stratigraphic nomenclatures of the middle Tertiary basin of the Northern Coastal Province, Puerto Rico.

Description of Geologic Units

Test well NC-5 penetrated the Aymamón Limestone, the Los Puertos Limestone, the Cibao Formation (including the Montebello Limestone Member), the Lares Limestone, and the upper part of the San Sebastián Formation (fig. 4 and table 3).

The Aymamón Limestone of Miocene age (0 to 381 feet) is dominated by vuggy, red-algal, skeletal, wackestone-packstone and packstone, with local beds of coral rubble. The Aymamón Limestone is underlain by 289 feet of the Miocene age Los Puertos Limestone (381 to 670 feet). The upper part of the Los Puertos Limestone consists mostly of miliolid and soritid wackestone, wackestone-packstone, and some grainstone. The lower half of this formation consists of a red-algal packstone unit.

The 1,035-foot thick Cibao Formation (from 670 to 1,705 feet deep), also of Miocene age, underlies the Los Puertos Limestone. The 289-foot thick, informally designated upper member of the Cibao Formation (Monroe, 1980), (from 670 to 959 feet deep), consists in descending order of (a) an upper unit of a miliolid and soritid packstone, and some grainstone; (b) a section of argillaceous intraclast wackestone, claystone marl, gastropod argillaceous wackestone, and miliolid argillaceous wackestone-packstone; (c) a section made up mostly of grainstone, miliolid and soritid wackestone-packstone, packstone and red-algal wackestone-packstone; (d) a section composed mostly of a soritid-oyster-quartzose sandy marl with minor skeletal wackestone; and (e) a lowermost unit dominated by a red-algal Halimeda-bearing packstone with root molds in the top, a minor molluscan-reefal wackestone, and a miliolid red-algal wackestone-packstone. The underlying Montebello Limestone Member (early Miocene age) of the Cibao Formation is 746 feet thick (959 to 1,705 feet) and consists in a downward order of (a) an uppermost section composed of a red-algal packstone, a locally coral-rich packstone-grainstone, and a rhodolitic-molluscan and Halimeda-bearing wackestone-packstone; and (b) a basal unit made up mostly of Heterostegina- and Lepidocyclina-bearing skeletal dolomitic packstone-wackestone, and molluscs, including high-spired gastropods, that are locally abundant.

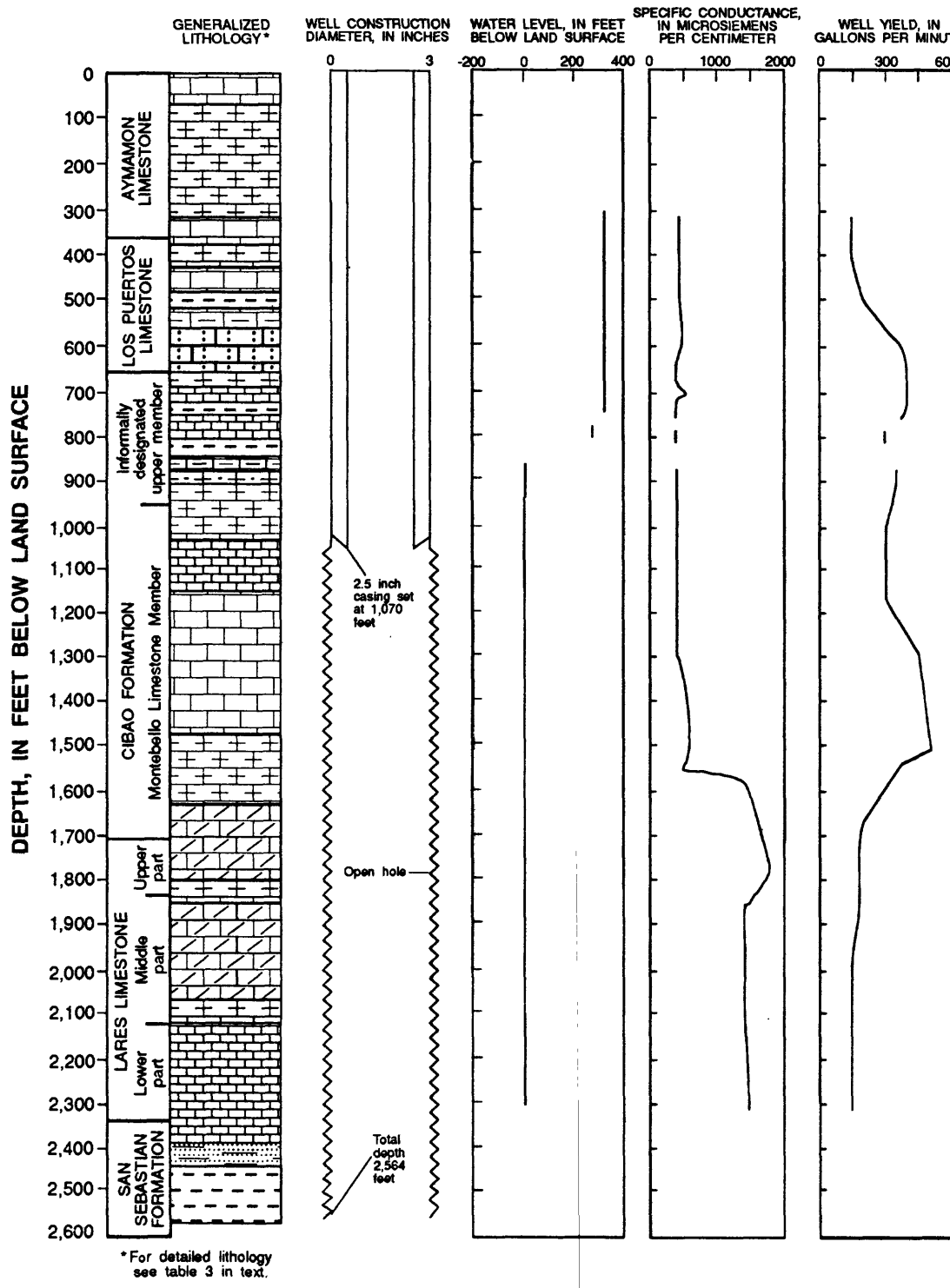

Figure 4.--Lithologic log, well construction diagram, water levels, specific conductance, well yield, and geophysical logs of test well NC-5.

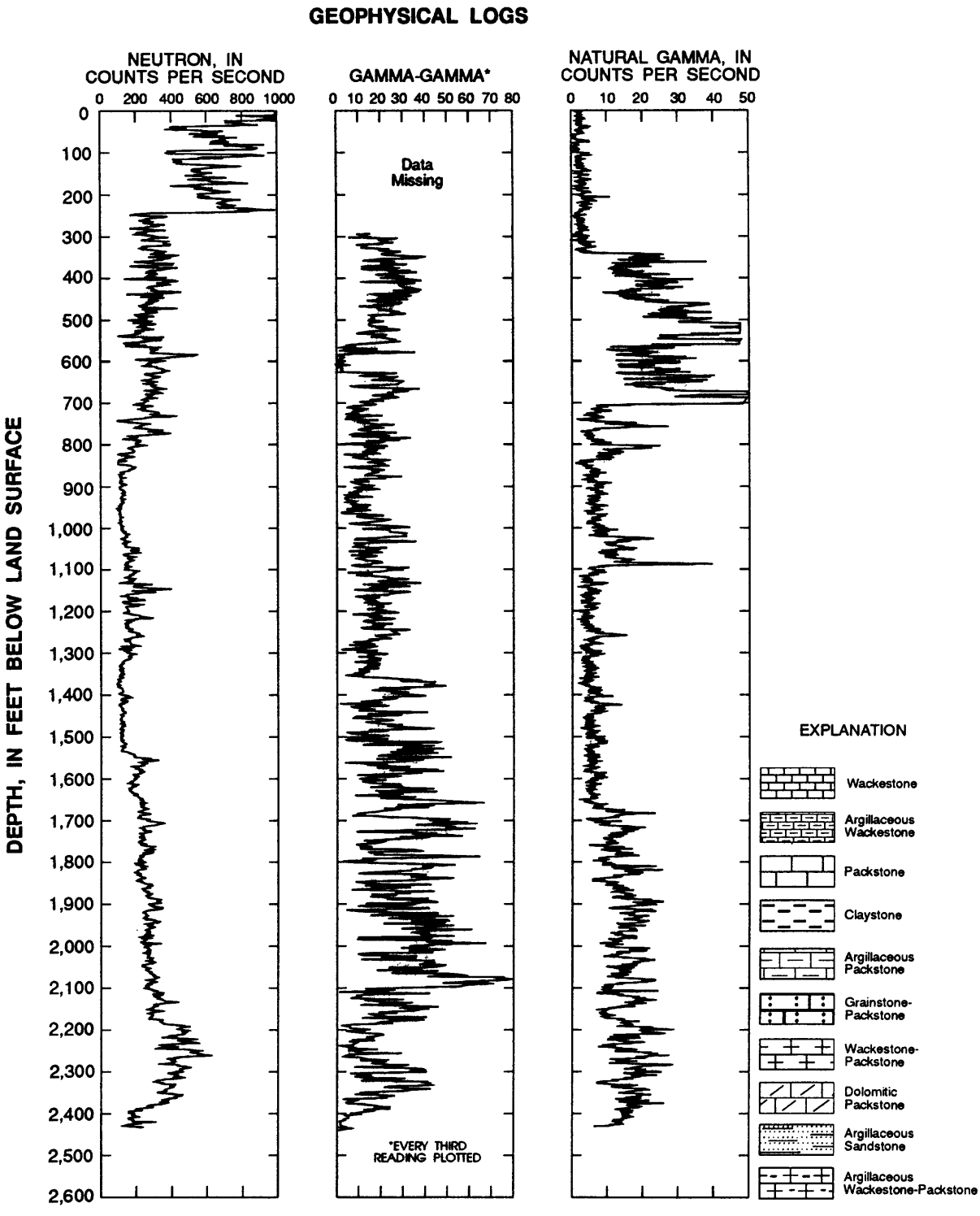

Figure 4.--Lithologic log, well construction diagram, water levels, specific conductance, well yield, and geophysical logs of test well NC-5 (continued).

The 639-foot thick Lares Limestone of Oligocene age (1,705 to 2,344 feet) underlies the Cibao Formation. In test well NC-5, the Lares Limestone is informally divided into upper, middle, and lower parts. The upper part is 137 feet thick, and consists in a downward order of (a) an upper half made up mostly of red-algal dolomitic wackestone-mudstone overlain by red algae and Heterostegina-rich packstone; (b) a lower half composed mostly of a burrow-mottled, slightly dolomitic, and locally rhodolitic wackestone; and (c) a minor intraclastic skeletal wackestone-packstone overlain by light gray to very light gray soritid miliolid wackestone-packstone. The upper part is capped with a soritid-molluscan bearing dolomitic wackestone-mudstone that grades upward into dolowackestone. The middle part of the Lares Limestone is 288 feet thick and is a dominantly red-algal dolomitic wackestone, with Miogypsina, Lepidocyclina, and Heterostegina. Several coral buildups were found scattered throughout this part. The boundary between the lower and middle parts is gradational and is represented by dolomitic wackestone-packstone. The lower part is 214 feet thick and comprises three major lithologies: (a) an argillaceous skeletal red-algal wackestone, occurring at the base of the formation; (b) a skeletal packstone; and (c) a Lepidocyclina wackestone.

The lowermost 220 feet penetrated in test well NC-5 corresponds to the San Sebastián Formation. This formation is of Oligocene age and consists of the following main lithologies in a downward order: (a) a Lepidocyclina- and bryozoan-bearing glauconitic packstone-grainstone; (b) a slightly argillaceous, poorly fossiliferous wackestone, locally glauconitic and stylolitic, with molluscs as the dominant fossils; (c) a fine-grained argillaceous sandstone grading up to argillaceous, slightly dolomitic packstone-wackestone, with glauconite and minor amounts of quartz; (d) a claystone with beds of carbonaceous shale and several minor beds of wackestone; and (e) a reddish-brown and purple-mottled claystone and shale.

Description of Hydrogeologic Units

Test well NC-5 penetrated three water-bearing zones: a water-table and two artesian zones. The uppermost water-bearing unit consists of the Aymamón Limestone, the Los Puertos Limestone, and the uppermost strata of the upper member of the Cibao Formation. This water-bearing unit extends from the water table (312 feet below land

surface) to 745 feet below land surface. This lower depth (745 feet) also represents the top of a confining unit that extends to a depth of 776 feet and consists of calcareous claystone and marl. This confining unit is located within the informally designated upper member of the Cibao Formation. Underlying this confining unit is an artesian water-bearing zone extending to a depth of 815 feet (40 feet thick). This water-bearing unit is also included in the upper member of the Cibao and is underlain by a 48-foot thick confining unit, consisting mostly of argillaceous wackestone, calcareous claystone, and marl with sparse quartz sand. This confining unit extends from 815 to 863 feet and is located in the upper part of the informally named upper member of the Cibao Formation. An underlying artesian aquifer, 1,467 feet thick, extends to a depth of 2,330 feet. This unit is located in the lowermost strata of the upper member of the Cibao Formation, the Montebello Limestone Member of the Cibao Formation, and the Lares Limestone.

Saltwater was not encountered within the water-table or artesian aquifers. However, specific conductance measurements varied from 395 to 550 microsiemens per centimeter in the water-table aquifer and from 410 to 1,750 microsiemens per centimeter in the artesian aquifers (fig. 4, table 2). The water levels remained constant within the water-table aquifer at 312 feet below land surface, but ranged from 275 feet below land surface to land surface in the artesian zones. Estimates of yield ranged from 150 to 400 gallons per minute in the water-table aquifer and 150 to 500 gallons per minute in the artesian aquifers (fig. 4).

SUMMARY

This report presents data collected from test well NC-5, drilled in 1986 in the municipality of Barceloneta, north-central Puerto Rico. Test well NC-5 was drilled to determine the depth, thickness, and hydraulic properties of the water-table and artesian aquifers of this area as part of a study of regionally extensive aquifer systems in the Northern Coastal Province of Puerto Rico. Data collected from this test well include descriptions of the core samples, geophysical logs, water levels, specific conductance of water samples, descriptions of the hydrogeologic units, and dolomite percentage of the core samples.

Test well NC-5 penetrates limestone, lesser amounts of terrigenous sedimentary rock, and traces of dolomite, all of late Oligocene to late Miocene Age. The well penetrated (from top to bottom) the Aymamón Limestone, the Los Puertos Limestone, the Cibao Formation, the Lares Limestone, and was completed in the San Sebastián Formation.

Five hydrogeologic units were encountered in test well NC-5: a water-table aquifer and two artesian aquifers, separated by two intervening confining units. All of the aquifers contained freshwater. The water level remained constant at 312 feet below land surface in the water-table aquifer, but varied from 275 feet below land surface to land surface in the artesian aquifers. During drilling, well yields varied from 150 to 400 gallons per minute in the water-table aquifer, and from 150 to 500 gallons per minute in the artesian aquifers. The specific conductance of water from test well NC-5 ranged from 395 to 550 microsiemens per centimeter in the water-table aquifer and from 410 to 1,750 microsiemens per centimeter in the artesian aquifers.

SELECTED REFERENCES

Briggs, R.P., and Akers, J.P., 1965, Hydrogeologic map of Puerto Rico and adjacent islands: U.S. Geological Survey Hydrologic Investigations Atlas HA-197, 1 pl.

Giusti, E.V., and Bennet, G.D., 1976, Water resources of the north coast limestone area, Puerto Rico: U.S. Geological Survey Water-Resources Investigation Report 42-75, 42 p.

Hartley, J.R., 1989, Subsurface geology of the Tertiary carbonate rocks, northwestern Puerto Rico: New Orleans, Louisiana, University of New Orleans, unpublished Master's thesis, 214 p.

Monroe W.H., 1980, Geology of the middle Tertiary formations of Puerto Rico: U.S. Geological Survey Professional Paper 953, 93 p.

Seiglie, G.A., and Moussa, M.T., 1984, Late Oligocene-Pliocene transgressive-regressive cycles of sedimentation in northwestern Puerto Rico, in Schlee, J.S., ed., Interregional unconformities and hydrocarbon accumulation: American Association of Petroleum Geologists Memoir 36, p. 89-95.

Torres-González, Arturo, and Wolansky, R.M., 1984, Planning report for the comprehensive appraisal of the ground-water resources of the North Coast Limestone area of Puerto Rico: U.S. Geological Survey Open-File Report 84-427, 32 p.

Table 3.--*Lithologic descriptions of core samples from test well NC-5, Barceloneta, Puerto Rico*
(Lithologic descriptions, stratigraphic determinations, and paleontologic identifications by John L. Hartley)

Latitude: 18°25'43"
Longitude: 66°34'15"
Land surface altitude: 312 feet above mean sea level
Total depth: 2,564 feet

Lithologic description	Depth, in feet below land surface
Miocene Series	
Aymamón Limestone	
Packstone, very pale orange to creamy white, densely crystalline; with Amphistegina common to abundant; soritids and other benthic foraminifera; red algae and echinoderms rare; branched coral and molluscs common in upper 50 feet. Porosity: 7-12 percent; moldic, fracture, and vuggy.	0-62
Wackestone-packstone, grayish-orange-pink to moderate pink, burrow-mottled; clay-filled vugs occur in the unit; with abundant miliolids, soritids common; Amphistegina, planktonic foraminifera, molluscs, ostracods and echinoderms rare; high-spired gastropods occur at the top of the unit; coral, including Monastrea and Caulastrea (?), rare to present. Porosity: 7-10 percent; vuggy.	62-85
Wackestone-packstone, pale yellow-orange, chalky; with silt-size skeletal fragments; few soritids and molluscs noted. Porosity: 7-10 percent; interparticle and microscale vuggy with minor moldic.	85-95
Wackestone-mudstone, grayish-pink, crystalline; with thin-shell bivalves; trace amounts of red algae and foraminifera. Porosity: 5-7 percent; vuggy and fracture.	95-110
Packstone, pale to moderate orange-pink, fine- to very coarse-grained; abundant fine-grained skeletal fragments; with Amphistegina, miliolids, and echinoderms; rare thin-shelled molluscs. Porosity: 12-15 percent; moldic developed within small unidentified fragments.	110-150
Wackestone-packstone, very pale orange, mostly very fine-grained with larger clasts in the matrix; soritids, miliolids, and molluscs common; some to common crustose red algae; coral and Halimeda rare. Porosity: 10-12 percent; vuggy and moldic.	150-190
Wackestone-packstone, grayish-orange-pink to very pale orange; same as 214-218.	190-209

Table 3.--*Lithologic descriptions of core samples from test well NC-5, Barceloneta, Puerto Rico*--Continued

Lithologic description	Depth, in feet below land surface
Clay, red-brown.	209-214
Packstone-grainstone, very fine to calcisiltite; very pale orange, dense with articulate red algae, miliolids, soritids, Amphistegina, molluscs, green algae, and echinoderms.	214-218
Packstone-wackestone, grayish-orange-pink, matrix is slightly chalky and pelloidal, fine- to coarse-grained, fair sorting, well-rounded grains; with abundant to common articulate red algae; miliolids common; some soritids, Amphistegina, molluscs, green algae, and echinoderms. Porosity: 3-5 percent; vuggy and fracture.	218-228
Packstone-grainstone, very pale orange to grayish-orange-pink, fine- to coarse-grained; interval made up of alternating zones of limestone and clay-infilled vugs that are each 1 to 2 feet thick; with articulate red algae common to abundant, micritized pelloids of red algae (?) common; some echinoderms; miliolids, soritids, coral, Halimeda and encrusting red algae rare.	228-260
Grainstone, grayish-orange-pink to very pale orange, very fine-grained, fairly well-sorted, well-rounded, faintly cross-laminated, well-cemented; with articulate red algae common to abundant; echinoderms common; some miliolids and soritids; rare quartz. Porosity: a few percent; interparticle.	260-270
Wackestone-packstone, grayish-orange-pink; fine- to very fine-grained skeletal fragments, probably red-algal fragments; with ostracods, soritids, and small gastropods; several thick clay-filled vugs present. Porosity: 10 percent, decreasing upward to a few percent; vuggy.	270-295
Same as 315-335; several large clay-filled vugs (up to 4 feet thick) present.	295-310
Wackestone, grayish-orange, densely crystalline; very large clay-filled vugs present; manganese dioxide stains occur in the rock; limonite-stained calcite cement fills fractures and some vugs; fossils obscured by recrystallization but a few soritids and molluscs are noted. Porosity: 5-7 percent; vuggy; unit may be cavernous.	310-315
Wackestone-packstone, grayish-orange-pink; with abundant pelloids (micritized red algae?); red algae, echinoderms common; some Amphistegina, miliolids, and planktonic foraminifera; molluscs and coral rare. Porosity: 3-5 percent; moldic, interparticle, and minor vuggy.	315-335
Grainstone, similar to 339-341 without large fossils; well-sorted siltclasts.	335-339

Table 3.--*Lithologic descriptions of core samples from test well NC-5, Barceloneta, Puerto Rico*--Continued

Lithologic description	Depth, in feet below land surface
Grainstone, very pale grayish-orange-pink to very pale orange, very fine-grained; with large whole fossils in fine matrix; red algae common to abundant; soritids common; some Halimeda, coral, molluscs, and Amphistegina; echinoderms rare. Porosity: 10-12 percent; moldic and vuggy.	339-341
Wackestone, grayish-orange-pink; with miliolids common; soritids, few molluscs. Porites occurring at the top of the unit. Porosity: a few percent; moldic.	341-345
Wackestone, mottled yellow-gray, crystalline; spar-filled fractures common; burrows; clay-filled vugs occur in the upper part of the unit; most fossils unidentifiable, very fine- to silt-sized fragments; red algae, soritids, and a few miliolids noted.	345-364
Packstone-wackestone, similar to 368-374; some of the vuggy porosity has been reduced by clay-infilling. Porosity: 11 percent; vuggy and moldic.	364-368
Grainstone, grayish-orange-pink to moderate pink, fine- to coarse-grained, poorly sorted, well-cemented; with articulate red algae as the dominant fossil type; molluscs include bivalves and high-spired gastropods; soritids, Amphistegina, and miliolids. Porosity: 7 percent; moldic.	368-374
Wackestone, very pale orange, densely crystalline, poorly fossiliferous; rock is highly fractured and in places resembles a recemented breccia; clay-filled vugs occur in the upper part of the unit; fossils include miliolids, small rotalids, rare soritids; Porites near the base. Porosity: very high, predominantly vuggy. A percent was not determined because of fragmental rock recovery.	374-381
Los Puertos Limestone	
Grainstone, grayish-orange to moderate orange-pink, medium- to coarse-grained, laminated; clasts well-rounded and poorly imbricated; with abundant articulate red algae; rare to some Amphistegina; miliolids, soritids, and encrusting foraminifera; molds of molluscs or Halimeda common; intraclasts and quartz present. Porosity: 15 percent; moldic, vuggy, and interparticle.	381-383
Wackestone, very pale orange, grayish-orange, and brownish-orange, karstified with conchoidal fracture; recrystallization obscures many of the fossils; fossils include miliolids, soritids; rare Amphistegina and Porites; bivalves were noted in the upper one third of the unit. Porosity: at least 10-15 percent; vuggy.	383-418

Table 3.--*Lithologic descriptions of core samples from test well NC-5, Barceloneta, Puerto Rico*--Continued

Lithologic description	Depth, in feet below land surface
Wackestone to wackestone-packstone, very pale orange with patches of darker yellow-brown, dense, pelloidal; poor sorting; matrix, very fine-grained, recrystallized, with very coarse- to gravel-sized clasts; mud and spar filled vugs, vertical fractures and root molds in the upper part of unit; molluscs and red algae common in lower part; many molluscs are large; common in upper part of unit, include high-spired gastropods; Faverina fecal pellets; ostracods, echinoderms; some to rare foraminifera including miliolids, soritids, and encrusting types. Porosity: 5-10 percent, higher where molluscs molds are common; moldic and vuggy.	418-441
Wackestone, brownish-yellow, same as 456-464; red-brown clay occurs in some vugs; other vugs lined with calcite spar. Porosity: 10-15 percent; vuggy.	441-445
Wackestone; same as 456-464.	445-449
Grainstone, very pale orange, fine- to medium-grained; shoaling upward sequence from underlying wackestone; soritids, miliolids, and molluscs common to rare. Porosity: 5-7 percent; moldic.	449-456
Wackestone, very pale orange to orange-pink at top of unit; gastropod molds, geopetal structures common; molluscs include large bivalves and gastropods common to abundant; soritids and finger coral common. Porosity: 5-10 percent; moldic, patchy distribution, some shelter porosity.	456-464
Grainstone, very pale orange; with abundant gastropods and other molluscs; soritids and lesser amounts of miliolids; interbedded with a thin unit of wackestone at 466 to 468 feet. Porosity: 5-10 percent; moldic, with minor vuggy porosity at the top of the unit.	464-473
Grainstone, light to medium gray; quartz-rich; varied open-marine fossil assemblage shows signs of pyritization; only notable fossils are encrusting foraminifera and Halimeda, which occur at the top of the unit. Porosity: 3-5 percent; moldic.	473-475
Dolomudstone-wackestone; thin-shelled molluscs and foraminifera, rare.	475-480
Packstone-grainstone, light to medium gray, coarse-grained, quartz-rich (up to 50 percent); locally, rock could be considered a floatstone due to the large fragments of coral and molluscs. Other fossils same as underlying unit; this unit infill burrowed nondepositional surface below.	480-490

Table 3.--*Lithologic descriptions of core samples from test well NC-5, Barceloneta, Puerto Rico*--Continued

Lithologic description	Depth, in feet below land surface
Packstone, light to medium gray, burrow-mottled, very fine- to fine-grained; fossils include common to abundant articulate red-algal fragments; echinoderms common; some miliolids and small rotalids. Halimeda and dasyclad algae rare; this unit contains at least one nondepositional surface with partially compacted vertical burrows infilled with material from the overlying unit; the surface has vertical fractures that may be the result of partial desiccation.	490-495
Packstone, mottled dark and light gray; lower part of the unit is dense, and contains dark gray intraclasts in a chalky matrix; fossils suggest cross-cutting relationship is diagenetic; upper part of the unit is dense limestone, mottling of unit result of lighter colored material infilling burrows in darker rock; unit is quartz rich in the lower part, less so in the upper part; miliolids and soritids are dominant fossils; small bivalves and gastropods; unit capped by 1 foot of poorly fossiliferous mudstone-wackestone. Porosity: 5-7 percent; interparticle in lower part of the unit; decreasing to 1-2 percent; vuggy at the top of the unit.	495-502
Packstone, light gray, quartz in places; with molluscs; include high- and low-spired gastropods, bivalves and Kuphus; soritids common.	502-508
Claystone, light gray.	508-510
Sandstone muddy to sandy limestone, light to medium gray; a few soritids are present.	510-518
Claystone and marl, light gray; with a few soritids.	518-526
Wackestone, light to medium gray, locally chalky; very small miliolids common; soritids; molluscs include high-spired gastropods, and are most common at the top and bottom of the unit; scattered coral. Porosity: 7-10 percent; moldic with minor vugs.	526-537
Shale and claystone, yellow-brown; with gastropods and soritids.	537-540
Marl, interbedded with packstone, light gray to yellow-gray; packstone similar to underlying units; soritids more abundant in packstone; Halimeda is restricted to packstone unit; miliolids, gastropods, and echinoderms present both in the packstone and marl. Porosity: 3-5 percent; vuggy in places; marl unit contains negligible porosity.	540-568
Grainstone-packstone, similar to 585-600; large rhodolites, high-spired gastropods, and large bivalves in the lower part of unit; upper few feet of the unit have a pinkish tint. Porosity; 3-5 percent; vuggy.	568-585

Table 3.--*Lithologic descriptions of core samples from test well NC-5, Barceloneta, Puerto Rico*--Continued

Lithologic description	Depth, in feet below land surface
Grainstone-packstone; similar to 600-635; mottling result of calichification; central 5 feet of the unit is dense limestone flanked on top and bottom by chalky wackestone; root molds. Porosity: a few percent; interparticle and moldic.	585-600
Similar to 635-664, less chalky in lower half of the unit. Caliche mottling occurs in the upper half of the unit; molluscs and miliolids common at top of unit; encrusting foraminifera. Porosity: 10 percent; vuggy in the upper part of the unit.	600-635
Similar to 664-670; several zones of chalky limestone or indurated limestone fragments within a marly matrix between 639 and 650 feet; rock texture suggests calichification. Porosity: 3-5 percent; interparticle; fracture porosity in indurated rock; interparticle porosity higher in the chalky rock.	635-664
Grainstone-packstone, very pale orange, mottled yellow-brown, fine- to very fine-grained; darker mottling reflects zones of calichification; interval is capped with pale yellow-brown caliche-pisolite grainstone; skeletal clasts are micritized; articulate red algae fragments are dominant fossils; ostracods and miliolids common; rare soritids and molluscs.	664-670
Cibao Formation (informally designated upper member)	
Wackestone, very light greenish-gray, argillaceous, locally very friable; fossils include small miliolids, abundant Porites, and small molluscs.	670-680
Packstone, light gray, medium- to coarse-grained. Fossils include large molluscs; Kuphus; Halimeda; miliolids, soritids common; rare to some ostracods and smaller molluscs. Porosity: a few percent; moldic.	680-688
Wackestone, light to dark gray; core recovery in lower part unit is rubbly; intraclasts from lower part occur within upper part of unit.	688-693
Grainstone, molluscan, yellow-gray. Porosity: 5 percent; moldic.	693-696
Wackestone-packstone, light to medium gray, argillaceous, marly in places; soritids common, some small bivalves and gastropods. Porosity: a few percent.	696-716
Grainstone, creamy white, fine- to coarse-grained; grain size coarsest in the middle of the interval; large mollusc fragments with red-algal fragment matrix; Halimeda and dasyclad algae. Porosity: 10-12 percent; moldic, vuggy, and interparticle.	716-733

Table 3.--*Lithologic descriptions of core samples from test well NC-5, Barceloneta, Puerto Rico*--Continued

Lithologic description	Depth, in feet below land surface
Wackestone-packstone, yellow-gray to very pale orange, slightly argillaceous; fossils included small gastropods and soritids.	733-737
Mudstone, yellow-gray, densely crystalline.	737-741
Claystone, chalky white, calcareous; with a few soritids and miliolids.	741-750
Claystone, yellow-brown to greenish-gray.	750-755
Wackestone, yellow-gray, argillaceous, well-cemented in places; with molluscs, miliolids, and soritids.	755-765
Mudstone and claystone, yellow-gray.	765-770
Wackestone, creamy white, similar to 800-812; few Porites noted; caliche pisolite wackestone at 779 feet.	770-800
Wackestone and marl, light greenish-gray to light yellow-gray, argillaceous; recovery is poor, mostly as powder and rock fragments; miliolids and soritids common; bivalves; red algae rare. Porosity: a few percent; moldic, poor recovery may reflect high secondary porosity.	800-812
Wackestone, creamy white, densely crystalline, resembles recemented breccia; soritids and red algae.	812-820
Wackestone, light gray, argillaceous, friable near the top; intraclasts occur at both the top and bottom of the unit; some soritids and bivalves.	820-840
Claystone, light gray with greenish-gray shale layers; indurated quartz-rich wackestone occurs between 847 and 853 feet; fossils found in wackestone included soritids, ostracods, and thin-shelled bivalves; only soritids found in the claystone.	840-855
Sand, quartz yellow; with volcanic rock fragments, in a carbonate mud matrix.	855-860
Claystone, greenish-gray, mottled yellow-brown, non-fossiliferous.	860-870
Packstone-wackestone, light greenish-gray, very argillaceous, quartzose, interbedded with minor shale; red algae is dominant fossil; miliolids common; soritids, molluscs, and echinoderms; partially calichified.	870-880
Packstone-wackestone, light gray, fragments intermixed with clay and quartz.	880-900

Table 3.--*Lithologic descriptions of core samples from test well NC-5, Barceloneta, Puerto Rico*--Continued

Lithologic description	Depth, in feet below land surface
Shale and mudstone, dark gray.	900-903
Wackestone, light gray, argillaceous and sandy; quartz, volcanic rock fragments; fossils include soritids, miliolids, and gastropods.	903-915
Sand, yellow-brown quartz with volcanic rock fragments, and minor clay.	915-918
Wackestone, very light gray to white, similar to 959-993; quartz sand and Kuphus occur above 930 feet. Gravel- and sand-sized clasts were recovered in the lower part of the unit.	918-937
Sand, quartz, and clay, yellow-brown, interbedded.	937-940
Wackestone-packstone, light gray, pelloidal, similar to 959-993; some ostracods, fecal pellets; and Halimeda rare. Porosity: 5-7 percent; interparticle and moldic.	940-955
Claystone and shale, dark gray.	955-959
Cibao Formation (Montebello Limestone Member)	
Wackestone-packstone and wackestone, argillaceous, (interbedded), dense; with abundant miliolid and soritid foraminifera, abundant small molluscs, and finger coral locally present. Porosity: less than 5 percent; moldic and vuggy.	959-993
Packstone-grainstone, reef rock, light gray; with abundant recrystallized coral; molluscs, miliolids, and soritids.	993-997
Wackestone to wackestone-packstone, light gray; similar to 1030-1045, only crystalline coral floatstone. Porosity: less than 5 percent; moldic and vuggy.	997-1030
Wackestone to wackestone-packstone, light gray, densely crystalline; limonite-stain vugs; fossils include large gastropods, rhodolites; Halimeda, soritids, Miogypsina , and other foraminifera. Porosity: 5-10 percent; vuggy.	1030-1045
Grainstone, yellow-gray; same as 1065-1074; Kuphus is present.	1045-1055
Wackestone, chalky, to calcisiltite, very light yellow-gray; with abundant soritids. Porosity: undetermined; interparticle.	1055-1065

Table 3.--*Lithologic descriptions of core samples from test well NC-5, Barceloneta, Puerto Rico*--Continued

Lithologic description	Depth, in feet below land surface
Grainstone/rudstone, yellow-gray, dense; well-cemented with large spar fractures present; rudstone consists of large branched-coral fragments in a matrix of fine- to coarse-grained grainstone; grainstone, molluscs abundant, red algae common, miliolids, soritids, and Miogypsina; echinoderms rare.	1065-1074
Wackestone-packstone, light gray to yellow-gray, chalky, fine-grained; grades upward to packstone.	1074-1080
Packstone, very pale orange to yellow-gray, grades upward to grainstone at 1105 feet; slightly dolomitic near top of interval; red algae is dominant fossil; locally rhodolitic, open, leafy, concentric crusts around fairly large nuclei; echinoderms, pelloids, Halimeda common to some; and foraminifera include Amphistegina, Miogypsina; miliolids and planktonics rare. Porosity: up to 10 percent; moldic and interparticle, porosity is greatest at the top of the interval. The lower part of interval is dense, with only a few percent, moldic porosity.	1080-1120
Wackestone, very pale orange, dense, pelloidal, and locally burrowed; dominant fossils include red algae, small molluscs; Halimeda common, some echinoderms, Porites, miliolids, and soritids. Porosity: 3 percent; moldic.	1120-1160
Packstone, very pale orange, same as 1316-1360; vugs lined or occluded by calcite spar; some vugs and molds are limonite-stained. Porosity: 5-7 percent; moldic and minor interparticle, cavernous porosity at 1175 to 1180 feet.	1160-1188
Packstone-grainstone, yellow-gray to very pale orange, fine- to medium-grained (with a few zones of coarser material); dolomitic in the lower part of interval; red algae (heavily micritized) dominant fossil; rhodolites present at base of interval; varied foraminiferal assemblage; echinoderms, pelloids, some to common; Porites, molluscs include large gastropods and Kuphus. Porosity: variable, 5-7 percent in the calcitic rock, 25-30 percent in the dolomitic rock.	1188-1270
Wackestone to calcisiltite, very pale orange to yellow-gray, fine-grained; pelloidal, dolomitic (30 percent); centers of dolomite rhombs dissolved; red algae is dominate fossil; some echinoderms, miliolids, and thin-shelled pelecypods. Porosity: 3-5 percent; intercrystalline and micros-size vugs.	1270-1276
Packstone, very pale orange, same as 1316-1360.	1276-1288
Packstone, very pale orange, coarse-grained, well-cemented; red algae abundant; some massive and branched coral, pecten, and other molluscs; boundstone at 1290 feet; aragonitic fossils remain as molds, some filled with dog-tooth calcite spar. Porosity: less than 5 percent; moldic.	1288-1300

Table 3.--*Lithologic descriptions of core samples from test well NC-5, Barceloneta, Puerto Rico*--Continued

Lithologic description	Depth, in feet below land surface
Grainstone, very pale orange, coarse-grained; coral-rich; reef rock in places; the interval capped by coarse-grained coquina of molluscs and coral. Porosity: 7-10 percent; moldic.	1300-1316
Packstone, very pale orange, medium- to fine-grained, well rounded, poorly sorted; dominant fossil is articulate red algae (fragments); some Amphistegina, Miogypsina, rotalids, encrusting foraminifera; and some to common echinoderms; upper part of interval characterized by high-spired gastropods; sporadical occurrence of Porites.	1316-1360
Packstone, very pale orange, similar to 1375-1425; coarse- to very-coarse grained, well-cemented, and well-sorted; crustose red algae more common than underlying interval, approaching boundstone lithology; large molluscs occur at top of interval; scattered coral. Porosity: 7 percent; interparticle.	1360-1375
Packstone, very pale orange, pelloidal, fine- to medium-grained, well-sorted; not well-cemented or has been subjected to dissolution, slightly friable; dominant fossil fragments include articulate red algae; minor molluscs, Heterostegina, Lepidocyclina; pecten and high-spired gastropods at top of interval. Porosity: 7-10 percent; interparticle and moldic.	1375-1425
Boundstone, very pale orange, coralgal; fossils include molluscs and ostracodes. Porosity: 1-2 percent; moldic.	1425-1435
Reef rock, wackestone matrix, coralgal; very pale orange; ostracods, molluscs (including high-spired gastropods); miliolids, encrusting and planktonic foraminifera; and echinoderms. Porosity: 10 percent; moldic and interparticle.	1435-1447
Packstone, very pale orange; similar to 1475-1495; large molluscs near top of interval include pelecypods, gastropods, high-spired gastropods. Porosity: higher in the mollusc-rich zone.	1447-1460
Grainstone, very pale orange, well-indurated; articulate red algae, dominant fossil; foraminifera (miliolids, Miogypsina, Amphistegina, Lepidocyclina, Heterostegina, and planktonics) common; some bryozoans, echinoderms, and molluscs. Porosity: 10 percent; moldic and interparticle; reduced by calcite spar.	1460-1475
Packstone, very pale orange, similar to 1495-1550; but more densely cemented; large pelecypods occur in the upper part of interval; brecciated micritic intraclasts in the lower part of interval; miliolids and soritids rare. Porosity: few percent; moldic.	1475-1495

Table 3.--*Lithologic descriptions of core samples from test well NC-5, Barceloneta, Puerto Rico*--Continued

Lithologic description	Depth, in feet below land surface
Packstone to grainstone, yellow-gray to very pale orange, pelloidal; chalky in places; thick-branched red algae most common fossil in grainstone; only some occur in packstone; branched coral and molluscs scattered throughout the interval; mollusc concentration between 1505 and 1525 feet (include cowries, pecten, and high-spired gastropods); ostracods, Amphistegina rare. Porosity: 7-10 percent; moldic and interparticle.	1495-1550
Coral reef rock, massive; with benthic foraminifera, molluscs, and red algae.	1550-1560
Packstone-wackestone, yellow-gray, similar to 1580-1680, but without Lepidocyclina, dense, with iron oxide stained slickensides; chalky fragmental layers at top and bottom of interval. Porosity: a few percent; moldic and fracture, large amount of porosity may occur in the fragmental layer.	1560-1580
Similar to 1680-1705, except dolomitic (10-15 percent) and with common very large Lepidocyclina; worm tubes and encrusting foraminifera occur in places; molluscs common between 1620 and 1630 feet; brecciated intraclasts packstone at 1633 feet, clast size from 0.12 to 0.20 in. diameter; red algae common above 1640 feet. Porosity: 5-7 percent; interparticle, intercrystalline, intracrystalline (centers dolomite rhombs dissolved) minor moldic.	1580-1680
Packstone-wackestone, yellow-gray; very fine-grained to silt-sized matrix; other clasts are medium- to very coarse-grained; Heterostegina dominant fossil; coral, bryozoans, molluscs, and red algae rare. Porosity: a few percent; fracture and interparticle.	1680-1705
Oligocene Series	
Lares Limestone (upper part)	
Wackestone-mudstone, light olive-gray, dolomitic, grades to dolowackestone at 1710 feet; numerous molds of molluscs, some soritids, Lepidocyclina, and coral molds. Porosity: 10-15 percent; moldic and intercrystalline.	1705-1712
Packstone, yellow-gray, similar to 2263-2283; Lepidocyclina is dominant fossil; Amphistegina floridana (Bermudez) common; some echinoderms, bryozoans; and minor red algae; pecten and oysters occur near the top of the unit.	1712-1740
Packstone, yellow-gray to chalky-white, dense; crustose and rhodolitic red algae dominant fossil type; echinoderms common, pelecypods, Amphistegina and Lepidocyclina rare. Porosity: 5-7 percent; interparticle and intraparticle.	1740-1760

Table 3.--*Lithologic descriptions of core samples from test well NC-5, Barceloneta, Puerto Rico*--Continued

Lithologic description	Depth, in feet below land surface
Wackestone-dolomudstone, yellow-gray, finely crystalline, less dolomitic in upper part; few irregular laminations; delicate articulate red algae most abundant fossil; robust crustose red algae at top of interval; echinoderms, ostracods, miliolids, and planktonic foraminifera rare. Porosity: 2-3 percent; interparticle and intercrystalline.	1760-1790
Wackestone-packstone, light to very light gray, mottled; pelloidal matrix in places; many fossils have micritic rims; foraminifera dominant fossil type (soritids common; some miliolids, Lepidocyclina, Amphistegina), Halimeda rare, ostracods, red algae, echinoderms, bryozoans, and coral.	1790-1803
Wackestone to packstone, yellow-gray, dense; pelloidal matrix, in places recrystallized to microspar; interval burrowed and cut by spar-filled vertical fractures; one or more scour surfaces overlain by medium to coarse packstone-grainstone with intraclasts underlying interval; foraminifera (Miogypsina, Amphistegina, soritids, encrusting types; miliolids, and unidentified genera, rare); ostracods, Halimeda ; red algae; rhodolite, echinoderms, very small gastropods, and pelecypods rare; Faverina fecal pellets. Porosity: 2 percent; moldic.	1803-1810
Wackestone, white, pelloidal, chalky; clasts, very fine- to fine-grained; minor carbonaceous material; Porites, small gastropods and few pelecypods occur as molds; some red algae, ostracods, miliolids, and soritid foraminifera. Lepidocyclina common in small layer.	1810-1832
Lares Limestone (middle part)	
Wackestone-packstone, light olive-gray; clasts, very fine- to very coarse-grained; burrowed mottled with carbonaceous laminations; laminations in lower few feet of interval contain thin coal seams; Lepidocyclina, with fewer miliolid and soritids, red algae, ostracods; scattered molluscs. Porosity: 10-12 percent; moldic and interparticle.	1832-1842
Wackestone, yellow-gray, burrow-mottled; same as 1890-1920; Porites pervasive in interval.	1842-1860
Reef rock; with packstone matrix, light olive-gray, fine-grained, with lenses of grainstone, fine-grained; branched and massive coral, rhodolites, molluscs, ostracods, planktonic foraminifera, minor miliolids, and soritids; calcite spar some infilling pore space. Porosity: 10 percent; moldic, interparticle, and vuggy.	1860-1880

Table 3.--*Lithologic descriptions of core samples from test well NC-5, Barceloneta, Puerto Rico*--Continued

Lithologic description	Depth, in feet below land surface
Wackestone, yellow-gray, dolomitic; same as 1920-1997; but more rhodolitic; cowries, pecten.	1880-1890
Wackestone, yellow-gray, burrow-mottled; with carbonaceous laminations; patchy distribution of rhodolites; some red algae, thin-shelled pelecypods, gastropods, and soritid foraminifera. Porosity: few percent; interparticle.	1890-1920
Wackestone, yellow-gray dolomitic (3 to 5 percent); common to abundant crustose and articulate red-algal fragments; open leafy rhodolites at base of interval; thick branch crustose rhodolites at top of interval; micritized red algae; Lepidocyclina, ostracods, calcipheres; rare Amphistegina and Kuphus.	1920-1997
Packstone to wackestone, yellow-gray, unidentifiable silt-size carbonate particles; medium grained clasts; wispy laminations interrupted by burrowing; articulate and crustose red algae, molluscs, echinoderms, ostracods, and foraminifera (miliolids, encrusting types, Miogypsina, and Amphistegina). Porosity: 7-10 percent; interparticle, moldic, and vuggy.	1997-2013
Reef rock. Porosity undetermined; probably high; moldic porosity due to coral dissolution.	2013-2018
Wackestone, yellow-gray, slightly dolomitic, fine- to coarse-grained clasts; with wispy organic laminations; articulate and branching crustose red algae dominant fossil; Lepidocyclina and Heterostegina rare to some. Porosity: few percent; intercrystalline and intraparticle.	2018-2090
Packstone, yellow-gray, coarse-grained; in places, grades to grainstone and rudstone; foraminifera common (Amphistegina, Lepidocyclina, and Miogypsina, with few Heterostegina, planktonic, and encrusting types), red algae, small platy coral, echinoderms and molluscs (which includes oysters) rare. Porosity: few percent; intercrystalline and intraparticle.	2090-2100
Rudstone, light olive-gray, and dolomitic (10 percent); wispy organic-rich laminations more common towards the top of interval; chalky white calcisiltite at top of interval; dominant fossil is club shaped Porites; ostracods, molluscs, echinoderms, encrusting foraminifera; minor Halimeda, Lepidocyclina, calcipheres, and red algae.	2100-2120
Wackestone, yellow-gray, dolomitic, same as 2190-2220.	2120-2130

Table 3.--*Lithologic descriptions of core samples from test well NC-5, Barceloneta, Puerto Rico*--Continued

Lithologic description	Depth, in feet below land surface
Lares Limestone (lower part)	
Wackestone, light olive-gray, dolomitic (7-10 percent), rhodolitic; rhodolites have open leafy structure around a small nucleus, planar rather than spherical; thin-shelled pelecypods, Miogypsina, miliolids, ostracods, planktonic foraminifera, and minor articulate red algae fragments; massive corals are present at the top of interval. Porosity: 10-12 percent; intercrystalline, intraparticle, microscale vug.	2130-2190
Wackestone, yellowish-gray, dolomitic (10 percent); horsetail stylolites common in lower two-thirds of interval; dominant fossil in lower two-thirds of interval is Lepidocyclina, minor Heterostegina, Amphistegina floridana, and so on. Angulata; Heterostegina, is dominant fossil in upper one-third of unit; increasingly dolomitic in upper part of unit. Porosity: variable and proportional to dolomite content; intercystalline and intraparticle (7-10 percent).	2190-2220
Packstone-wackestone, light gray with slight greenish tint, slightly argillaceous, glauconitic, dense; pelloidal matrix, clasts poorly sorted and range from very fine to coarse; red algae (both articulate and thick-branched crustose varieties, few poorly formed rhodoliths); foraminifera (include miliolids, Miogypsina, Amphistegina, Lepidocyclina, Halimeda), dasyclad algae and worm tubes; few muddy intraclasts.	2220-2253
Wackestone, light yellowish-gray, dolomitic (10 percent); fossils include large Lepidocyclina with few Heterostegina, bryozoans, red algae and molluscs; horsetail stylolites common; dolomite more common along the stylolites. Porosity: 7-10 percent; intercrystalline and intraparticle.	2253-2263
Same as in 2220-2253.	2263-2283
Wackestone, greenish-gray, slightly dolomitic (1-5 percent), very argillaceous; fossils include large Lepidocyclina, echinoderms, and small molluscs (fragments).	2283-2297
Packstone-wackestone, light gray, with slight greenish tint, dense, slightly argillaceous, glauconitic; pelloidal matrix, poorly sorted clasts, very fine to coarse; red algae most common fossil (both articulate, thick-branched crustose, varieties, few poorly formed rhodoliths); echinoderms, oysters, Lepidocyclina, Halimeda rare.	2297-2300
Wackestone, greenish-gray, slightly dolomitic (1-5 percent), very argillaceous; fossils include large Lepidocyclina, echinoderms, and small molluscs.	2300-2304

Table 3.--*Lithologic descriptions of core samples from test well NC-5, Barceloneta, Puerto Rico*--Continued

Lithologic description	Depth, in feet below land surface
Wackestone, light greenish-gray mottled, argillaceous, burrowed; horsetail stylolites common; red algae and Lepidocyclina, most common fossil; molluscs, echinoderms, small coral fragments, Amphistegina rare, and few small bored rhodoliths. Porosity: few percent; interparticle along the stylolites.	2304-2344
San Sebastián Formation	
Packstone-grainstone, light greenish-gray; with lenses of dark greenish-gray, glauconitic, fine- to medium-grained clasts; Lepidocyclina, bryozoans, echinoderms, Heterostegina, Miogypsina (?), molluscs, red algae, coral, and encrusting foraminifera. Porosity: few percent; interparticle, intraparticle, and micro-scale vuggy porosity.	2344-2355
Wackestone, light green to greenish-gray, slightly argillaceous, poorly fossiliferous; interval is glauconitic and stylolitic; bioturbated but some irregular laminations remain; molluscs, Heterostegina, miliolids, and Lepidocyclina at the top of unit.	2355-2358
Same as in 2344-2355.	2358-2363
Same as in 2355-2358.	2363-2390
Sandstone, argillaceous, greenish-gray, fine-grained, grades upward to packstone-wackestone, argillaceous in places; small lenses of siltstone. Glauconite, minor quartz, common throughout interval; dolomitic (up to 10 percent); fossils include molluscs, Heterostegina, calcipheres, ostracods, and planktonic foraminifera; wackestone is most fossiliferous at top of interval.	2390-2435
Claystone, dominantly olive-green; with beds of carbonaceous shale up to 5 feet thick; several beds of wackestone up to 2 feet thick; claystone and shale contain traces of plant material, thin-shelled pelecypods, and scattered high-spired gastropods; wackestone contains similar bryozoans and Lepidocyclina.	2435-2545
Claystone-shale, reddish-brown with purple mottling.	2545-2564