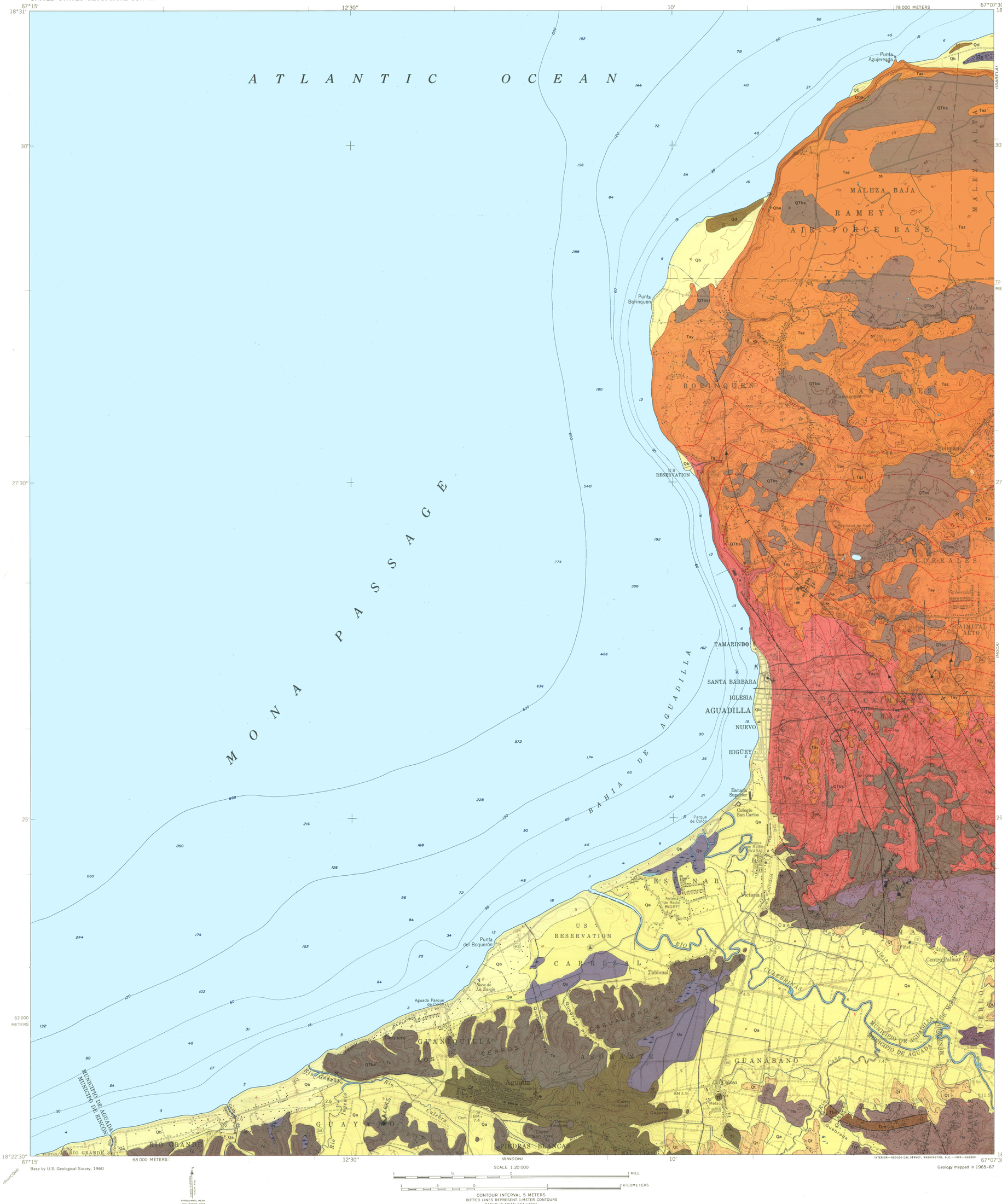
DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

PREPARED IN COOPERATION WITH THE
COMMONWEALTH OF PUERTO RICO
ECONOMIC DEVELOPMENT ADMINISTRATION
INDUSTRIAL RESEARCH DEPARTMENT

MISCELLANEOUS GEOLOGIC INVESTIGATIONS
MAP I-569



EXPLANATION

Qb — Beach deposits
Quartz sand, shell fragments, and scattered grains of other minerals resistant to weathering; cementation to beachrock common; deposits inland from present shoreline covered by a thin blanket of sand blown from present beaches and dunes; gently crossbedded, generally dipping toward sea. 0-5± m thick

Qd — Sand dune deposits
Generally fine sand composed mainly of shell fragments, but locally containing some quartz sand; steeply crossbedded. 0-15 m thick

Qs — Swamp deposits
Sandy organic muck and peat. 0-2± m thick

Qa — Alluvium
Clayey sand and sandy clay, containing scattered pebbles and cobbles of volcanic rocks in some areas; gently crossbedded and laminated. 0-10± m thick

Ql — Landslide deposits
Blocks of limestone and of sandy clay as long as 30 m in a mass of sandy clay. 0-20± m thick

Recent — QUATERNARY

Qt — Terrace deposits
Clayey sand and sandy clay containing scattered pebbles of volcanic rocks and quartz; commonly crossbedded. 0-5± m thick

Pleistocene

Qba — Ancient beach deposits
Crossbedded and cross-laminated sandstone containing fine to very fine grains of quartz and shell fragments, locally pebbly, containing corals and molds of Quaternary mollusks (David Wilson, written commun., 1968). 0-12 m thick

QTbs — Blanket sand deposits
Unstratified mixtures of fine to medium quartz sand and light- to moderate-brown clay; all material mapped in this category has been lowered from less than 5 m to as much as 30 m by solution of underlying limestone (Briggs, 1966). 0-30 ? m thick

UNCONFORMITY

Taz / Tay — Aymamón Limestone
Taz, upper member, very pale orange to bright yellow chalk containing many beds of large Ostrea haitensis Gabb and other fossils; interbedded with hard rugg very pale orange to white limestone, some of which is fossiliferous; in upper part commonly hard, white, very pure, and commonly recrystallized limestone like lower member. Less than 80 m exposed
Tay, lower member, white to very pale orange, locally pale-yellow and grayish-pink very pure fossiliferous limestone, generally indurated into finely crystalline rather dense limestone (Monroe, 1966), locally a recemented solution breccia. Surface has been dissolved into abundant sharp spires a fraction of a meter high. Thin-bedded granular limestone and chalk like underlying Aguada Limestone is exposed on Highway 2 northnortheast of Canteras Aguadilla. Formation rests with sharp contact on underlying Aguada Limestone. 110 m thick

Miocene

Ta — Aguada Limestone
Thick layers of very pale orange to pink hard calcarenite alternating with chalky and rubbly limestone; sparingly fossiliferous; at top 1 to 3 meters consists of orange to pink granular thin-bedded and cross-laminated limestone in which individual beds range in thickness from 1 to 7 cm. 30 m thick

Tc — Cibao Formation
Interbedded calcareous clay, soft earthy chalk, and hard very fine grained calcarenite and soft nongranular limestone, ranging in color from light bluish gray where fresh to pale yellowish orange and moderate orange pink where weathered; commonly fossiliferous, locally containing many oysters; in area near Aguada, base contains 5-10 m of irregularly bedded medium-grained calcarenite locally resting on a few meters of sandy gravel. 200-250 m thick

Oligocene

Ts — San Sebastián Formation
Lenticular beds of olive-brown to dusky-yellow fine to medium sand, sand and gravel, and red and greenish-gray clay. Basal 20 m contains abundant cobbles. 0-150? m thick

UNCONFORMITY

Tt — Tuffaceous sandstone, siltstone, and shale
Fine- to medium-grained thin- to thick-bedded sandstone and siltstone composed of particles of volcanic ash, in part reworked; mostly deeply weathered to clay; highly sheared dark-gray and reddish-gray claystone on Cerro Vadi; these rocks and equivalent rocks farther east are believed to be of Eocene age (D. H. McIntyre, oral commun., 1967). 400-1200 m thick

Ttm — Massive tuff
Massive crystal tuff composed largely of medium grains of white plagioclase in a very fine grained dark-gray groundmass; a few obscure bedding planes noted. About 100 m thick

Tts — Stratified tuffaceous sandstone
Thin- to thick-bedded fine- to medium-grained sandstone and siltstone composed of particles of volcanic ash; locally weathered to thin-bedded to massive pink and yellow clay. About 1200 m thick

Eocene — TERTIARY

Contact
Dashed where approximately located; short dashed where gradational or inferred

Fault
Dashed where approximately located; short dashed where indefinite; dotted where concealed. U, upthrown side; D, downthrown side

Anticline
Showing crestline and direction of plunge. Dashed where approximately located

Approximate syncline
Showing troughline and direction of plunge

30 Inclined · 65 Overturned · + Vertical
Strike and dip of beds

120 Structure contours
Drawn on top of Aguada Limestone. Dashed where approximately located or inferred from overlying structure; short dashed where datum is above ground surface. Contour interval 30 meters

× Control point showing outcrop of key horizon used in locating structure contour lines

Quarry

STRUCTURAL, ENGINEERING, AND ECONOMIC GEOLOGY

Structure.—The volcanic rocks exposed near the southeastern corner of the quadrangle are tightly folded, locally overturned, and cut by several faults. The belt of massive tuff is bounded by faults and appears to have been dropped into a graben, as similar rock higher in the section is exposed south of the quadrangle. West of Highway 2 deep weathering and extensive cultivation have so obscured the bedding at most places that structural data cannot be procured. A notable bed of dark-gray and reddish-gray claystone exposed on Cerro Vadi and on the very small hill 500 m southwest of the sugar refinery at Coloso is highly sheared and the joints are filled with calcite veins; these outcrops may be near a large fault, but no other signs of large-scale faulting were seen. Most of the area of Eocene rocks north and west of Cerro Vadi shows only a thick soil of dark red clay.

The strata of Oligocene and Miocene age on the eastern edge of the quadrangle have a northerly dip of less than 1 degree in the north to about 4 degrees in the southern part of barrio Caimital Bajo. This dip is interrupted by an anticlinal flexure that plunges north-northwest from the northeastern part of barrio Victoria toward Punta Borinquen. West of the axis of the anticline the strike is nearly due north and the dip is as much as 10 degrees to the west. The dip is interrupted by at least 4 small faults along which the strata dipping toward the west have been raised as much as 30 meters. At least one of these faults seems to be responsible for the north-northwesterly trend of the coastline north of Aguadilla. In the latitude of Victoria the strike of the rocks turns westerly and in the area northwest of Aguada the strike is about N. 70 E. and the dip about 5 degrees north.

The Oligocene strata rest with angular unconformity on the underlying volcanic rocks, whose surface has a relief of at least 70 meters near Aguada.

Landslides.—The steep slopes on the escarpment east of Victoria consist of calcareous clay of the Cibao Formation that is overlain at the top of the bluff by the Aguada Limestone. When the clay becomes water soaked it tends to flow and to sluff off downhill. This removes support from beneath the limestone, which then slides down the lubricated slope. Consequently this slope is covered by landslide blocks of all sizes consisting of limestone and calcareous clay (Monroe, 1964).

Limestone.—Very large quantities of limestone are available in the outcrop belts of the Aguada and Aymamón Limestones. The lower part of the Aymamón is very pure calcium carbonate suitable for chemical use. It is generally unconsolidated below the surface, but hardened at the surface into a marble-like rock. The upper member of the Aymamón, however, contains large lenses of slightly limonitic chalk, so that it is not pure enough to be of chemical grade; on the other hand it is a chalky rock that is quarried as fill, as it compresses well.

Sand and gravel.—Very little sand is available in the quadrangle except along the beaches. This sand should not be excavated because of danger of accelerating beach erosion. Some of the beach deposits inland from the shore are of the same quality and can be mined safely. Small quantities of sand and gravel that must be washed before use are available in the San Sebastián Formation and the terrace deposits of Río Culebrinas.

Fill and aggregate.—Small quarries supplying fill have been opened at several places in the outcrop belt of the upper member of the Aymamón Limestone. Large quarries in the lower part of the Aymamón have been opened both north and south of Highway 2, in Canteras Aguadilla and northeast of these quarries. The largest quarries are in the Aguada Limestone east of Highway 2, east of Aguadilla; most of this rock is used as fill, but some is crushed for use as concrete aggregate. There are several large quarries of impure chalk at the side of Highway 115 east of Aguada. At a few places small pits have been opened in weathered volcanic material and in the terrace deposits to supply fill for roads that cross the alluvial plain of Río Culebrinas.

REFERENCES

Briggs, R. P., 1966, The blanket sands of northern Puerto Rico: Caribbean Geol. Conf., 3d, Trans., p. 60–69, Kingston, Jamaica.

Monroe, W. H., 1964, Large retrogressive landslides in northcentral Puerto Rico: U.S. Geol. Survey Prof. Paper 501-B, p. B123–B125.

———, 1966, Formation of tropical karst topography by limestone solution and reprecipitation: Caribbean Jour. Sci., v. 6, p. 1-7 [1967].

Zapp, A. D., Bergquist, H. R., and Thomas, C. R., 1948, Tertiary geology of the coastal plains of Puerto Rico: U.S. Geol. Survey Oil and Gas Inv. Prelim. Map 85.

INDEX TO GEOLOGIC MAPPING IN PUERTO RICO

Base by U.S. Geological Survey, 1960

Geology mapped in 1965–67

SCALE 1:20 000
1 MILE
2 KILOMETERS

CONTOUR INTERVAL 5 METERS
DOTTED LINES REPRESENT 1-METER CONTOURS
DATUM IS MEAN SEA LEVEL
DEPTH CURVES AND SOUNDINGS IN FEET—DATUM IS MEAN LOW WATER
SHORELINE SHOWN REPRESENTS APPROXIMATE LINE OF MEAN HIGH WATER
THE MEAN RANGE OF TIDE IS APPROXIMATELY 0.3 METERS

APPROXIMATE MEAN DECLINATION, 1969

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GEOLOGIC MAP OF THE AGUADILLA QUADRANGLE, PUERTO RICO

By
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1969