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-479

STRATIGRAPHY

STRATIFIED ROCKS SOUTH OF THE CERRO MULA FAULT

The relations of the undivided volcanic rocks (Kv) south of the Quebrada Vicente fault to the other formations is unknown, but tentative correlation with rocks to the south suggests that these volcanic rocks are the oldest rocks exposed in the quadrangle.

The Río Orocovis Group (Berryhill, 1965) is of Albian to early Santonian age (R. F. Briggs, written commun., 1965). The group is probably equivalent in age to much of the stratigraphic sequence north of the Cerro Mula fault.

STRATIFIED ROCKS NORTH OF THE CERRO MULA FAULT

The stratigraphy of the volcanic and volcaniclastic rocks has been described by Pease (1968); it corresponds in a general way to the sequence established by Kaye (1959) in the northern part of the quadrangle, but the units mapped are not everywhere the same, and several stratigraphic names have been changed.

The Santa Olaya Lava, Río de la Plata Sandstone, Camarones Sandstone, Tortugas Andesite, Carrazo Breccia, and Guaynabo Formation form a complex stratigraphic pile of volcanic and volcaniclastic rocks centered somewhere east of the quadrangle (Pease, 1968). The base of the sequence is younger than Albian; the top is upper Campanian.

The Santa Olaya Lava is best exposed in the east-central part of the Naranjito quadrangle where it interfingers with the Río de la Plata and Camarones Sandstones to the north and west. In the Aguas Buenas quadrangle the Santa Olaya intertongues northward with the Camarones Sandstone and the Guaynabo Formation, which is composed chiefly of well-stratified reworked volcaniclastic rocks. The Mamey Lava Member of the Camarones and the Martín González Member of the Guaynabo are believed to be time-equivalent. If so, the upper part of the Guaynabo Formation is younger than the Camarones Formation, whereas the lower part of the Guaynabo is correlative with the Camarones. The Tortugas Andesite, a subaerial volcanic unit, is locally intertongued near the top of the Guaynabo Formation. The Carrazo Breccia is a coarse submarine volcanic breccia containing fragments believed to be derived from the Tortugas Andesite and Santa Olaya Lava. It is here interpreted as being interstratified with the Guaynabo Formation, Camarones Sandstone, and Tortugas Andesite on the northeastern flank of the volcanic pile, but structural complications and difficulty in identification of the fragments in the breccia leave this interpretation open to question.

The Monacillo and La Muda Formations rest disconformably and locally unconformably on the older strata. Both are littoral and shallow-water marine deposits that contain lenticular bodies of limestone; the largest is the Trujillo Alto Limestone Member of the Monacillo. Megafossils from limestones in the La Muda indicate a Maestrichtian age; those from the Trujillo Alto have been identified only as Late Cretaceous.

The Guaracanal Andesite of Paleocene and early Eocene(?) age consists of ejecta from vents apparently located 2 km southeast of La Muda. It rests with apparent conformity on the Monacillo Formation, but locally both the Guaracanal and the overlying Río Piedras Siltstone overlap the Monacillo and rest disconformably on the pre-Maestrichtian unconformity. The overlying Río Piedras Siltstone, composed of fine volcanic ash and epiclastic debris, contains Foraminifera near its base that are tentatively identified as late Paleocene (J. Seiskind, written commun., 1959).

HYDROTHERMALLY ALTERED ROCKS AND VEINS

Altered rocks ranging from jasperoid to argillite are associated with major shear zones. The petrography of these rocks has been described by Pease (1960). Alteration is most intense at Cerro Marquesa along an extension of the altered zone that forms a large hogback at Cerro la Peña in the adjacent Naranjito quadrangle (Pease, 1968). A similar but less prominent zone lies along the north side of the Quebrada la Vegua fault. The altered rocks in the southwest corner of the quadrangle lie along an eastward extension of the altered zone that forms the crest of Cerro La Tina in the Comerío quadrangle (Pease and Briggs, 1960). Volcanic rocks and quartz diorite are altered in a mineralized zone on the south side of the La Muda fault; in the southeast corner of the quadrangle the zone contains some coarse pegmatite containing patches of golden-brown mica.

Veins of quartz, calcite, chlorite, and zeolites are widespread. Quartz veins commonly contain sulfides in areas of intrusive rock and along major shear zones. Zeolite veins are most common in the Tortugas Andesite and in strata north of the Tortugo and Carrazo faults.

The quartz vein mapped east-northeast of Aguas Buenas is more than 2 meters thick; it contains pyrite and traces of chalcopyrite. A similar vein has been mapped near Escuela Daniel Díaz in barrio Celada near the east edge of the quadrangle. A vein of brown garnet about 2 meters thick crops out in the southeast corner of the quadrangle west of the Río Grande de Loíza.

ECONOMIC GEOLOGY

METALLIC MINERALS

Most sulfide minerals in the quadrangle are associated with altered quartz diorite. The principal sulfide is pyrite which is sporadically disseminated in both intrusive rock and volcanic country rocks, but chalcopyrite and other copper sulfides occur in major shear zones in quartz diorite and in quartz veins in the country rock. Molybdenite and traces of gold and silver are common associates of the copper sulfides.

Disseminated copper sulfides occur in the porphyritic quartz diorite along the southwest side of the La Muda fault in the east-central part of the quadrangle. Test holes indicate that the deposit is submarginal. Traces of copper sulfide are also found in quartz diorite along the southeast side of the stock near Quebrada Las Curias and in the abandoned quarry near the center of the large stock north of the Altos de San Luis, also in amphibole schist adjacent to a small dike in a roadcut about 1,200 m west-southwest of Bairoa near the south edge of the quadrangle.

NONMETALLIC MATERIALS

Sand and gravel.—Large quantities of sand and gravel are produced from pits in terrace deposits in the flood plain of the Río Grande de Loíza, principally below the dam; smaller pits are scattered throughout the quadrangle. Sand and gravel suitable for aggregate and road construction are available in alluvial deposits along the lower reaches of the Río Guaynabo and Río Piedras.

Crushed stone.—Stone for use as base course, aggregate, and riprap is quarried in many places.

Volcanic rock in the Carrazo Breccia is most commonly quarried; it is massive, well indurated, relatively homogeneous, and has sufficiently uniform strength and toughness for most uses. Lava and breccia in the Río Orocovis Group is also usable, but much of it is partly altered or deeply weathered. Rocks from the quarry in the Tortugas Andesite just north of the intersection of Highway 1 with Highway 181 contain appreciable zeolite and should be used with caution as an aggregate for concrete.

Thin lavas interstratified with bedded rocks in several formations also make suitable crushed rock and may be local sources, but their volume is generally small. They commonly are more easily to drill and blast than the fragmental rocks of the Carrazo Breccia and Río Orocovis Group.

The thin-bedded rocks of the Río Piedras Siltstone and Leprocomio Member of the Guaynabo are being quarried for aggregate but probably are not as satisfactory as the more massive rocks because even slight weathering causes slabs rather than blocks to form on crushing.

Massive limestone from the La Muda Formation and the Trujillo Alto Limestone Member of the Monacillo Formation makes excellent aggregate or base course, but limestone exposures in the La Muda Formation are small, and although the Trujillo Alto Member is conveniently located in the northeast corner of the quadrangle, most exposures are close to the water table.

Lightweight aggregate.—Some of the deeply weathered rocks may be suitable for lightweight aggregate. Good results have been obtained with samples collected from deep saprolite in the north-central part of the quadrangle, from weathered exposures of quartz diorite south of El Laborinto in the headwaters of the Río Cayaguás, and from much of the weathered tuffaceous material of the Carrazo Breccia in the northeastern part of the quadrangle.

Limestone.—Limestone in the San Juan area is readily available and generally more suitable for cement manufacture than the limestone in the Aguas Buenas quadrangle. However, weathered siltstone of the Río Piedras and possibly of the Leprocomio Member of the Guaynabo may be suitable for making Portland cement.

Fill.—Weathered and fresh rock from all formations in the quadrangle have been used for road fill. The most commonly used, and least satisfactory, is weathered Río Piedras Siltstone which tends to break down to plastic clay and to fracture along bedding planes, causing serious instability.

Clays.—The saprolite that blankets much of the north-central part of the quadrangle, particularly in Barrio Cupey, may be a possible source of brick and ceramic clay.

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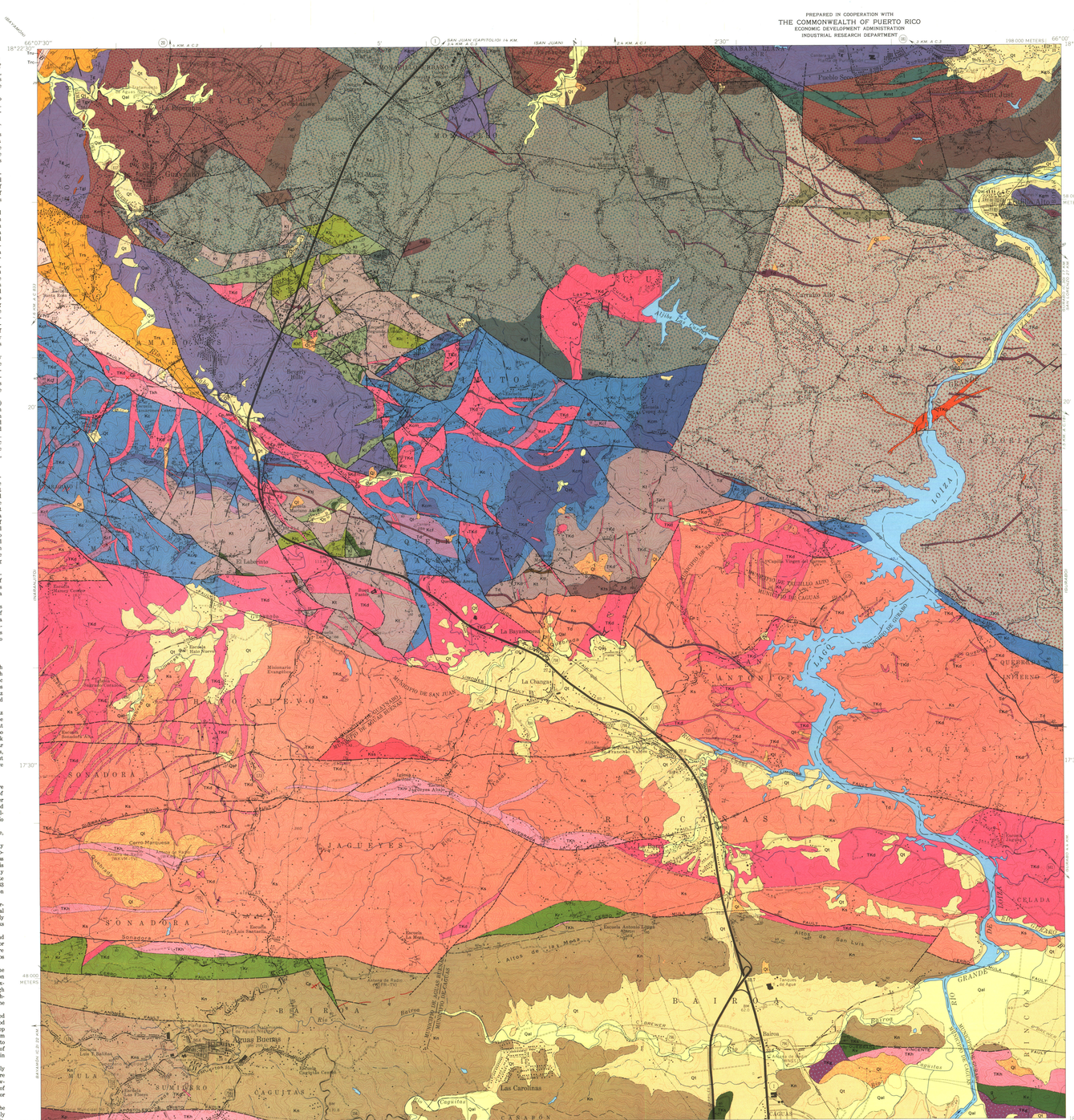
66°07'30"
18°22'30"
5'
2'30"
66°00'
18°15'
17'30"
20'
48 000 METERS
58 000 METERS
198 000 METERS
SAN JUAN (CAPITOLIO) 14 KM.
(SAN JUAN)
CAGUAS (PLAZA) 5.3 KM.
CAGUAS (PLAZA) 1.4 KM.
CAYEY 24 KM.
Base by U.S. Geological Survey, 1957
2000-meter grid based on Puerto Rico coordinate system
Geology by M. H. Pease, Jr., assisted by P. A. Geisbert and A. E. Perry, 1965–64
SCALE 1:20 000
CONTOUR INTERVAL 10 METERS
DASHED LINES REPRESENT 5-METER CONTOURS
DATUM IS MEAN SEA LEVEL
APPROXIMATE MEAN DECLINATION, 1968
Río Piedras Siltstone
Guaracanal Andesite
La Muda Formation
Monacillo Formation
Río de la Plata Sandstone
Santa Olaya Lava
Tortugas Andesite
Carrazo Breccia
Camarones Sandstone
Guaynabo Formation
Los Negros Formation
Perchas Formation
Volcanic rocks, undivided
Diabase
Hornblende porphyry
Quartz diorite
Granodiorite
Hydrothermally altered rocks
Amphibole schist
Alluvial deposits
Landslide deposits
Terrace deposits
Contact
Fault
Anticline
Syncline
Minor anticline, showing plunge
Minor syncline, showing plunge
Horizontal fold axis
Strike and dip of beds
Strike and dip of foliation in igneous rock
Inclined
Vertical
Overturned
Horizontal
Dip uncertain
Vein
Mineral occurrence
Río Grande de Loíza
Río Gurabo
Río Cagüitas
Río Bairoa
Río Turabo
Río Cañovanas
Río Canóvanas
Río Grande
Río Loíza
Lago de Loíza
Lago de Loíza
Lago de