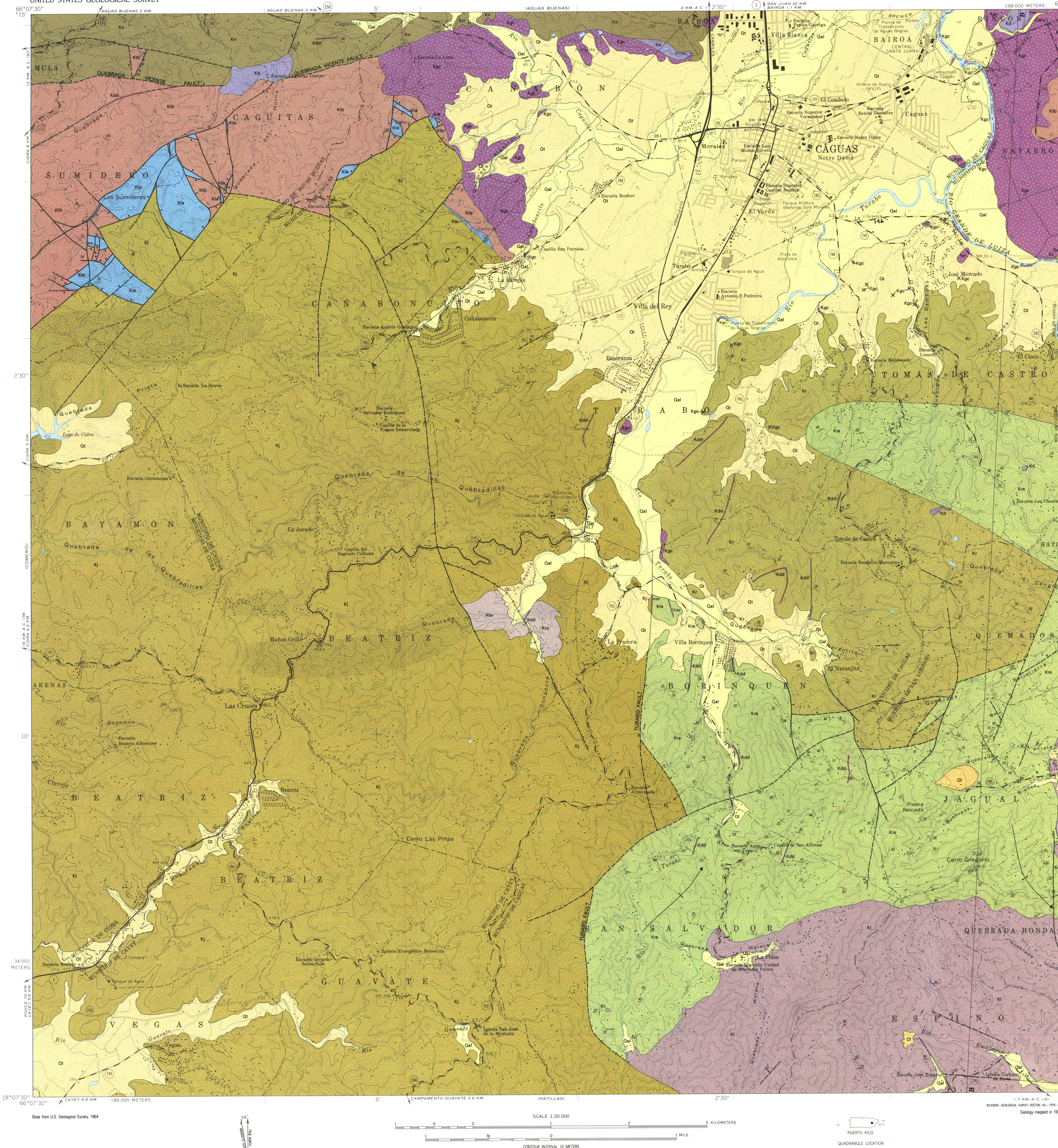
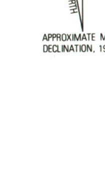
DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

PREPARED IN COOPERATION WITH THE
COMMONWEALTH OF PUERTO RICO
DEPARTMENT OF NATURAL RESOURCES

MISCELLANEOUS INVESTIGATIONS SERIES
MAP I–1152



Base from U.S. Geological Survey, 1964



SCALE 1:20 000

1 .5 0 1 2 3 KILOMETERS

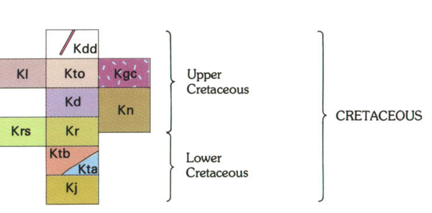
1 ½ 0 1 MILE

CONTOUR INTERVAL 10 METERS
DASHED LINES REPRESENT 5-METER CONTOURS
DOTTED LINES REPRESENT 1-METER CONTOURS
DATUM IS MEAN SEA LEVEL

INTERIOR—GEOLOGICAL SURVEY, RESTON, VA—1979—G78579

Geology mapped in 1975–76

CORRELATION OF MAP UNITS



DESCRIPTION OF MAP UNITS

Qal ALLUVIUM (HOLOCENE AND (OR) PLEISTOCENE)—Unconsolidated clay- to boulder-sized material deposited in major stream channels; also underlies present flood plains, which are relatively broad along the Rio Grande de Loiza and its major tributaries in the Caguas valley. Locally includes remnants of several low terraces. Thickness locally more than 10 m

Qt TERRACE DEPOSITS AND FANGLOMERATE (HOLOCENE AND (OR) PLEISTOCENE)—Unconsolidated to weakly consolidated clay- to boulder-sized material. Predominantly terrace deposits, which underlie greater part of the Caguas valley; near adjacent upland areas, deposits grade into marginal fan, slopewash, and minor landslide deposits. Locally include stream-channel deposits. Thickness locally may be more than 15 m

Ql LANDSLIDE DEPOSITS (HOLOCENE AND (OR) PLEISTOCENE)—Debris avalanche to mudflow type composed of abundant boulders in soil and weathered-rock matrix

Kdd DIORITE PORPHYRY (UPPER CRETACEOUS)—Forms numerous dikes, of which only the largest have been mapped. Dikes have dominant north to northeast trend, cut older plutonic and volcanic rocks, and appear to be most numerous in the east-central part of quadrangle near valley of Rio Turabo. Medium-dark-gray to slightly greenish-gray rock containing abundant medium-grained phenocrysts of hornblende and of zoned and commonly albitized plagioclase. The hornblende is subhedral, partly altered to chlorite and some epidote, calcite, and iron oxide. The plagioclase is subhedral, intermediate in composition, fresh to moderately altered to sericite and clay, and locally rimmed or partly rimmed by granophyric intergrowths of quartz and sodic plagioclase. The unit also commonly contains small grains of magnetite and scarce phenocrysts of quartz and biotite. The quartz is subhedral to anhedral and is locally rounded and embayed by partial resorption. The matrix is a fine- to very fine grained aggregate of plagioclase, subordinate hornblende, chlorite, magnetite, and pyrite, as well as scarce quartz and biotite. The plagioclase and hornblende are strongly altered in some dikes

Kl GRANODIORITE OF SAN LORENZO (UPPER CRETACEOUS)—Medium-dark-gray predominantly medium-grained rock with hypidiomorphic granular texture. Largely unfoliated, but locally has simple planar arrangement of hornblende and biotite crystals. Locally contains small subrounded autoliths(?) that are darker and in part more mafic than the host rock, small subrounded metavolcanic xenoliths, and a few areas of older diorite that are too small or partly assimilated, and thus too poorly defined, to map. Locally contains a few aplite dikes, a few thin quartz and pegmatite seams, and scarce diorite porphyry dikes. These dikes occur most commonly near the contact of the unit with older volcanic rocks. The contact zone is commonly complex, the granodiorite penetrating the country rock in a very intricate manner. The country rock has been metamorphosed to amphibole hornfels and locally to schist; in fact, in the area between this unit and the Caguas pluton to the north, virtually all Robles(?) rocks show some metamorphic effects. Average modal composition of granodiorite is about 55 percent plagioclase, 10 percent potassium feldspar (15 percent of total feldspar), 23.5 percent quartz, 8.5 percent hornblende, 2 percent biotite, 1 percent magnetite, and accessory sphene, apatite, and zircon. Although granodiorite in average composition, the rock ranges locally to tonalite, generally near the contact with older volcanic rocks. Plagioclase is largely andesine, but ranges to calcic oligoclase, is commonly zoned, may be partly sericitized and argillized, and is sparsely altered to epidote, clinozoisite, and calcite. Potassium feldspar is anhedral and characterized in part by sparse to moderately abundant fine microperthitic intergrowths; potassium feldspar includes a little microcline, but mostly appears to be transitional from orthoclase to microcline

Kgc GRANODIORITE OF CAGUAS PLUTON (UPPER CRETACEOUS)—Medium-dark-gray predominantly medium-grained rock with hypidiomorphic granular texture; largely unfoliated. Closely resembles granodiorite of San Lorenzo in appearance and mineralogy. Locally contains subrounded to rounded and ovoid autoliths(?) that are generally finer grained, darker, and in part more mafic than the host rock; these autoliths(?) range from a few centimeters to 1 meter in diameter. Locally, especially near boundary, pluton contains small masses of younger granodiorite porphyry, scarce aplite dikes, and a few diorite porphyry dikes. Contact zone is commonly a complex mixture of granodiorite and country rock, and the granodiorite may be breccialike, containing abundant subrounded inclusions of heterogeneous metavolcanic material. The country rock has been metamorphosed to amphibole hornfels and locally to schist. Average modal composition of rock is about 55 percent plagioclase, 12 percent potassium feldspar (18 percent of total feldspar), 17 percent quartz, 12.5 percent hornblende, 2.5 percent biotite, 1 percent magnetite, and accessory sphene, apatite, and zircon, and very rare clinopyroxene

Kto TONALITE (UPPER CRETACEOUS)—Forms small mass that lies in central part of quadrangle between Caguas pluton on the north and San Lorenzo batholith on the south. Medium-dark-gray, predominantly medium-grained (though locally porphyritic) rock that is similar in appearance to the Caguas pluton and to the major pluton (granodiorite and associated tonalite of San Lorenzo) within the San Lorenzo batholith. Average modal composition is about 57 percent plagioclase, 30 percent quartz, 12 percent mafic material, 1 percent magnetite, and accessory sphene, apatite, and zircon; locally pyritic. Mafic minerals hydrothermally altered in large part, but appear to be hornblende and subordinate biotite

Kd DIORITE (UPPER CRETACEOUS)—Forms two small bodies associated with northern part of Caguas pluton and several additional small bodies in country rock surrounding pluton. Medium- to dark-gray, predominantly medium-grained, heterogeneous rock that is banded locally and may contain hornblendite in pods and dikelike masses. Locally contains small subrounded autoliths(?) that are darker and in part more mafic than the country rock; also locally contains abundant small angular metavolcanic xenoliths. Rock is composed largely of plagioclase (predominantly andesine) and hornblende that occur in subhedral commonly interlocking crystals, a small variable amount of clinopyroxene, minor biotite locally, about 3 percent magnetite, and accessory sphene, apatite, and zircon

Kn LOS NEGROS FORMATION (UPPER CRETACEOUS)—Present along northern edge of quadrangle, north of Quebrada Vicente fault and Caguas pluton. Predominantly medium-dark- to dark-greenish-gray thick-bedded to massive pyroxene-rich basaltic tuff, which is composed of ash- to lapilli-sized crystal and lithic fragments. There are a few thin sequences of laminated to thin-bedded fine- to medium-grained tuff, as well as subordinate medium-dark- to dark-greenish-gray volcanic breccia and aphanitic to fine-grained pyroxene-rich basaltic lava. Rocks generally altered to hornfels near contact with Caguas pluton, but locally schistose. Thickness probably more than 600 meters

Kdr MIXED ROCK (DIORITE AND METASEDIMENTARY ROCKS OF ROBLES FORMATION?) (UPPER AND LOWER CRETACEOUS)—Intimate mixture of diorite with siltstone and sandstone that have been altered to hornfels

Kr ROBLES FORMATION(?) (UPPER AND LOWER CRETACEOUS)—Present in eastern half of quadrangle between Caguas pluton on north and San Lorenzo batholith on south. Predominantly ash- to lapilli-sized tuff (grading locally into breccia) containing subordinate andesitic lava and scarce thin sequences of siltstone and sandstone. Tuff is medium-dark- to dark-greenish-gray, locally laminated to thin-bedded, but largely thick-bedded to massive, crystal- and lithic-rich. Crystal fragments are predominantly plagioclase, but include very subordinate clinopyroxene; minor hornblende and quartz occur locally. Lithic fragments include tuff, lava, and pumice or altered pumice. The very fine grained matrix appears to contain variable amounts of plagioclase fragments, altered glass or pumice, and zeolites with associated secondary minerals; common alteration products include clay, sericite, calcite, chlorite, epidote, clinozoisite, quartz, pyrite, pyrrhotite, and limonite stain. Breccia contains subrounded to subangular blocks ranging from 32 mm to a meter or more in diameter; blocks may be homogeneous (composed of tuff resembling rock matrix) or heterogeneous (including a variety of tuff and lava types). The lava is dark gray to dark greenish gray, yellowish to brownish weathering, and aphanitic to fine grained. It contains sparse to abundant plagioclase phenocrysts and sparse phenocrysts of clinopyroxene and hornblende (in part replacing pyroxene); lava is locally amygdaloidal. The groundmass appears to be composed largely of plagioclase microlites and mafic or altered mafic material, and it contains same secondary minerals as the tuff

Krs Siltstone and sandstone of Robles Formation(?)—Occurs within two stratigraphic units. In lower unit, lying north and west of the San Lorenzo batholith, the siltstone and sandstone predominate, but are interbedded with abundant tuff, minor volcanic breccia, and a few thin lava flows. Upper unit is predominantly tuff, but contains abundant siltstone and sandstone, as well as scarce breccia and lava. Siltstone and sandstone are dark gray to dark greenish gray, but weather yellowish brown, and are fine to very fine grained, equigranular, generally laminated to thinly bedded, and flaggy to blocky splitting. Unit is composed of plagioclase and hornblende and commonly contains dark opaque minerals. These fine-grained rocks commonly exhibit graded bedding. Virtually all of the Robles Formation(?) exhibits metamorphic effects in varying degrees. It may be schistose near its contacts with the San Lorenzo batholith and Caguas pluton (especially the latter), but is generally a hornfels. The sedimentary rocks have been altered to amphibolites. The part of Robles Formation(?) (Kr and Krs) exposed in Caguas quadrangle may have a thickness of about 3,000 meters

Ktb TORRECILLA BRECCIA (LOWER CRETACEOUS)—Predominantly crudely stratified volcanic breccia, which is transitional locally to massive tuff, subordinate andesitic lava flows, and a few layers of siltstone and sandstone. The breccia is medium-dark-greenish-gray rock containing abundant clasts that are chiefly lava, but locally include numerous tuff fragments or minor pumice, in a pyroxene-rich ash- to lapilli-sized matrix. Locally the clasts average less than 15 cm in diameter, but characteristically are coarse to very coarse and consist of lenses, pods, and subangular fragments of lava that may be more than 5 m in longest dimension. The lava is medium dark to dark greenish gray, aphanitic, locally amygdaloidal, and contains sparse to abundant pyroxene phenocrysts and (or) plagioclase phenocrysts that are generally much less common. Lava flows resemble the lava in the breccia; locally the lava appears to be intrusive. Sparse thin sequences of laminated to thin-bedded siltstone and laminated to medium-bedded, medium-grained sandstone and tuff are present. Near Caguas pluton, the Torrecilla rocks are mostly altered to hornfels, but locally, to schist. Thickness may be as much as 1,000 meters

Kta Aguas Buenas Limestone Member—Occurs intermittently at base of Torrecilla Breccia, largely bounded by faults. Aphanitic, medium-gray to medium-dark-bluish-gray limestone where unmetamorphosed, but near Caguas pluton, it is light gray (locally mottled), recrystallized, and fine to medium grained. Locally, the rock is laminated to thickly bedded (commonly crudely bedded), but generally it is massive, cavernous, and characterized by karst topography; it contains sparse fossiliferous layers. Impossible to estimate maximum thickness, because of extensive faulting and lack of bedding in thickest sections

Kj FORMATION J (LOWER CRETACEOUS)—Major unit in western half of quadrangle. South of Quebrada de las Quebradillas, unit is predominantly volcanic breccia interlayered with massive to poorly stratified tuff, a few thin lava flows, and scarce siltstone and sandstone. The tuff is dark gray to dark greenish gray and is composed chiefly of abundant granule-sized andesitic lava fragments, which in places are highly pumiceous, in an aphanitic to fine-grained generally calcareous matrix. The lava fragments contain abundant plagioclase phenocrysts and very subordinate pyroxene, which is altered locally to hornblende and other secondary minerals; plagioclase crystals impart characteristic speckled appearance to the rock. The breccia resembles the tuff except for the size of the sparse to abundant, subangular to subrounded lava blocks, which may range up to a meter or more in diameter, but are mostly much smaller. The section contains a few thin sequences of laminated to medium-bedded siltstone and fine-grained sandstone, also scarce impure limestone in thin lenticular layers. North of Quebrada de las Quebradillas, the tuff and breccia also predominate, but toward the top, the formation contains abundant lava (forming a few dikes as well as flows) some flow breccia, and scattered thin layers of siltstone and sandstone. The andesitic lava is medium to dark gray when fresh, aphanitic to finely grained, and amygdaloidal in places. The lava contains abundant to relatively sparse plagioclase phenocrysts, subordinate pyroxene phenocrysts (which may be rounded as a result of resorption and are altered locally to secondary minerals), and rare quartz phenocrysts. Near top of the formation, most of the lava is silicified and bleached to shades of light to medium gray. The flow breccias are thick massive-looking units rich in plagioclase crystals and contain abundant flow fragments that are generally less than 15 cm in diameter. Very thick, but impossible to estimate thickness, owing to lack of structural data

CONTACT—Contacts of terrace deposits and fanglomerate (Qt) with bedrock are approximately located. Contact between alluvium (Qal) and terrace deposits and fanglomerate (Qt) in northern part of Caguas urban area is queried, because of extensive modification of land surface

INTERMITTENT OUTCROP IN RIVER BED

×Kgc EXPOSURE TOO SMALL TO MAP

FAULT—Showing dip and possible strike-slip movement. Dashed where approximately located; dotted where concealed; queried where existence doubtful. Bar and ball on downthrown side

ANTICLINE—Showing trace of axial plane and plunge of axis; approximately located

SYNCLINE—Showing trace of axial plane and plunge of axis; approximately located

STRIKE AND DIP OF PRIMARY FOLIATION IN PLUTONIC ROCKS—Shown by planar arrangement of mafic minerals and orientation of mafic-rich segregations

80 Inclined

Vertical

55 STRIKE AND DIP OF BEDS IN VOLCANIC ROCKS

AREA OF EXTENSIVE HYDROTHERMAL ALTERATION

PROSPECT

INTRODUCTION

The Caguas quadrangle was mapped during a period of about six months in 1975–76. The southwest quarter of the quadrangle received only reconnaissance study, and there is a lack of structural data in that area. In places the geology fails to match that shown on adjacent published maps. This is due in part to an advance in knowledge of the geologic units involved, and in part, perhaps, to more accurate mapping in the Caguas quadrangle.

VOLCANIC ROCKS

The oldest rocks in the Caguas quadrangle are assigned to formation J, which is widely exposed in the Comerio quadrangle (Pease and Briggs, 1960) to the west, in the Cayey quadrangle (Berryhill and Glover, 1960) to the southwest, and in the Patillas quadrangle (Lynn Glover, written commun., 1967) to the south; in the last two areas it is referred to as formation A. Formation J is also tentatively correlative with the Rio Abajo Formation, named and described by M'Gonigle (1977, 1978) in the Humacao quadrangle, 7½ minutes to the east.

Formation J is the least well known of the units present in the Caguas quadrangle, because of the reconnaissance nature of the mapping in the southwest part of the area, and because it is more extensively altered, more deeply weathered, and less well exposed than the other units. Most of formation J appears to be composed of a thick monotonous section of volcanic breccia and tuff, but the unit also contains a few thin lava flows and rare layers of siltstone and sandstone. The three-fold subdivision shown by Glover (written commun., 1967) in the Patillas quadrangle could not be recognized in the Caguas quadrangle, perhaps owing to the poor quality of the exposures, and it seems doubtful that it could be extended northward into the Caguas quadrangle. However, the thick flows and flow breccias toward the top of the formation could undoubtedly have been mapped if there had been sufficient time, and these would have been very helpful in working out the structure in that area.

Formation J is overlain by the Aguas Buenas Limestone Member at the base of the Torrecilla Breccia, although the two appear to be in fault contact everywhere except at the easternmost exposure of the limestone, to the northwest of La Rampla. The limestone is lenticular and seems to thicken considerably near the west edge of the quadrangle, where relatively large exposures of the limestone are characterized by karst topography. The limestone can be best observed in the large pits northwest of La Rampla and south of Escuela La Lima.

A much faulted, incomplete section of the Torrecilla Breccia is exposed to the north of formation J and is bounded on the north by the Quebrada Vicente fault. This formation was named by Briggs (1969), and it is correlated with formation K in the Comerio quadrangle and formation D in the Cayey quadrangle. It is also correlative with the upper part of the Pitahaya Formation, named and described by M'Gonigle (1977, 1978) in the Humacao quadrangle to the east.

The Perchas Formation, which overlies the Torrecilla Breccia in some areas, has been mapped in the extreme southwest corner of the Aguas Buenas quadrangle (Pease, 1968a) to the north, but it could not be found in the Caguas quadrangle. Likewise, the Perchas Formation is not shown in the Comerio quadrangle to the west, where it may have been included with formation K (Torrecilla Breccia). It does continue, however, as a narrow belt along the southern boundary of the Naranjito quadrangle (Pease, 1968b) to the northwest of the Caguas quadrangle.

A large area in the east-central part of the Caguas quadrangle is underlain by possible Robles Formation (Kr and Krs), which seems to be lacking in fossils. However, on the basis of lithology, the unit is tentatively correlated with the Robles Formation of Early and Late Cretaceous age that is widely exposed in the Comerio quadrangle and adjacent areas to the west. The Robles is partly correlative with the Los Negros Formation, which lies to the north of both the Quebrada Vicente fault and the Caguas pluton and represents a facies that accumulated at a greater distance from the volcanic source or sources. The Robles(?) contains abundant layers of siltstone and sandstone, and these rocks continue into the Juncos quadrangle (Broedel, 1961) to the east, where they were lumped with several other units and mapped by Broedel as "undifferentiated volcanic rocks." Similar rocks (although metamorphosed to hornfels) are present along the northwest boundary of the Yabucoa quadrangle (Rogers and others, 1978) and in the valley of the Rio Maunabo, which is in the southwest quadrant of the Yabucoa quadrangle.

PLUTONIC ROCKS

The granodiorite mapped in the southeast corner of the Caguas quadrangle represents a portion of the San Lorenzo batholith, which underlies an area of about 500 km^2 in southeastern Puerto Rico and has been described in some detail in the Humacao (M'Gonigle, 1978), Punta Guayanés (Rogers, 1977), Yabucoa-Punta Tuna (Rogers and others, 1978), and Juncos (Broedel, 1961) quadrangles. It also extends south into the Patillas quadrangle, for which a preliminary geologic map and brief lithologic descriptions (Lynn Glover, written commun., 1967) are available. Potassium-argon age data suggest that the batholith was emplaced over a period of about 12 m.y. in Late Cretaceous time (Cox and others, 1977; Rogers, 1977), although this probably represents a minimum age span.

The Caguas pluton appears to be a satellite of the San Lorenzo batholith. The granodiorite comprising most of the pluton closely resembles the predominant granodiorite and associated tonalite facies of the San Lorenzo batholith. In fact, the two bodies are probably contemporaneous and connected at a relatively shallow depth. The Caguas pluton has a few small diorite bodies on or near its periphery, as does the San Lorenzo batholith. In addition, the Caguas pluton contains a small amount of light-gray highly felsic porphyry resembling the late-stage differentiates at Punta Guayanes, although the masses are too small to map.

STRUCTURAL GEOLOGY

The mapped area lies within the central tectonic block of Puerto Rico, which is bounded by west-northwest-trending fault zones having large left-lateral displacement and perhaps also considerable vertical displacement (Cox and Briggs, 1973). This block contains two batholiths (with satellitic plutons) of Late Cretaceous age, batholiths that have intruded older Cretaceous volcanic rocks. In addition, the block contains some small stocks and volcanic rocks of Eocene age (not shown on map).

The volcanic rocks in the western half of the Caguas quadrangle may lie near the east end of a broad regional anticline having a trend slightly north of west, which continues westward into the Comerio and Barranquitas quadrangles (Briggs, 1969, fig. 2). The east end of this structure has been greatly modified by faulting and major intrusive masses, however, and is no longer defined. In particular, the anticline has been disrupted by the north-trending Turabo fault, which juxtaposes the Robles Formation(?) and formation J, thus exhibiting large stratigraphic displacement. Remnants of the well-bedded Robles Formation(?) that lie east of the Turabo fault in the Caguas, Juncos, and Yabucoa quadrangles have been domed and dislocated, probably by the intrusion of the San Lorenzo batholith, and do not define an anticline. The apparent chaotic structure in the Robles(?) rocks in the southeast corner of the Caguas quadrangle may also be due in part to prebatholith faulting and to such lesser elements as submarine slumping and sliding in the Robles(?) sediments before they were consolidated, as well as recent creep on steep slopes. To the north of El Naranjito, the rocks of the Robles Formation(?) have a west-northwesterly strike and dip uniformly to the northeast at low to moderate angles. Just to the east of this area, in the Juncos quadrangle, the Robles(?) rocks may be separated from Torrecilla (or Pitahaya) rocks to the north by a westerly trending fault that is roughly parallel to the Rio Grande de Loiza. In the Yabucoa quadrangle the Robles(?) rocks may have been bounded structurally on the south by the postulated northwest-trending fault that is believed to have been present in the vicinity of the Rio Maunabo valley during the early history of the San Lorenzo batholith (Rogers and others, 1978). The Robles(?) rocks are also present along the eastern edge of the Patillas quadrangle and are probably separated from formation J to the west by a southward extension of the Turabo fault from the Caguas quadrangle. The Turabo fault has been cut out in part by the San Lorenzo batholith, and in the northeast corner of the Patillas quadrangle, the fault appears to have been offset several kilometers to the east, possibly by a west-trending fault that predates the batholith.

The Caguas quadrangle contains a number of large to moderately large normal faults older than the plutonic rocks, but only a few younger faults have been recognized. This may be due in part to the scarcity of exposures in the area underlain by the Caguas pluton, as well as to the difficulty of recognizing faults in large homogeneous masses such as the Caguas pluton and San Lorenzo batholith.

The regionally most extensive fault in the Caguas quadrangle may be the east-trending Quebrada Vicente fault, which is present in the northwest corner of the area and juxtaposes the lower part of the Torrecilla Breccia on the south with the Los Negros Formation of the Rio Orocovis Group on the north. This fault continues to the west across the northern part of the Comerio quadrangle, where the Los Negros rocks to the north are wrongly identified as formation K (Torrecilla Breccia), and into the Barranquitas quadrangle, where it terminates against the Rio Arroyata fault. Because there is a belt of Perchas Formation along the southern border of the Naranjito quadrangle, it is apparent that there must be a fault (unmapped) near the northern edge of the Comerio quadrangle separating Los Negros rocks on the south from Torrecilla Breccia and (or) Perchas rocks on the north. For a distance of about 6 km along the northern edge of the Caguas quadrangle, the fault is cut out by the Caguas pluton and may have controlled the northern boundary of that mass. The fault reappears in the southeast corner of the Aguas Buenas quadrangle, where it has been offset northward by a north-northwest-trending left-lateral wrench fault, and it may continue eastward to a point about 1.5 km east of Gurabo in the Gurabo quadrangle (Seiders, 1971), where it terminates against the Cerro Mula fault. The Quebrada Vicente fault proper may actually lie a little farther to the south in the Juncos quadrangle (J. W. M'Gonigle, oral commun., 1976) and juxtapose rocks of the Torrecilla Breccia (or Pitahaya Formation) and Los Negros Formation, as it does to the west. On the other hand, the fault mapped in the Gurabo quadrangle may be the Quebrada Vicente, and the other fault recognized by M'Gonigle may be a similar related east-trending fault.

Many faults in the Caguas quadrangle have been intruded by elongate to dikelike igneous masses too small to map, and these rocks often serve as a clue to the location of faults. These small intrusive bodies range, in chronological order, from diorite to younger granodiorite, aplite, and diorite porphyry. Most of the north- to northeast-trending diorite porphyry dikes that have been mapped probably follow faults or dominant joint sets. The southern part of the Caguas pluton is not as extensive as indicated on the published compilations of Puerto Rican geology (Briggs, 1964; Briggs and Akers, 1965; Cox and Briggs, 1973), nor is it bounded on the south by an east-trending fault. However, a narrow southward extension of the pluton does appear to underlie the Rio Turabo valley near its junction with Quebrada Beatriz, and this projection may have been controlled by the major north-trending Turabo fault, which has dropped the Robles Formation(?) against formation J.

ECONOMIC GEOLOGY

The Caguas quadrangle contains only one known prospect, a zinc prospect located in Quebrada Beatriz and lying a short distance southwest of the geographic center of the map (Cox and Briggs, 1973). It occurs in a belt of argillic alteration that has affected both the volcanic rocks containing the prospect and, to a lesser extent, the adjacent plutonic rock. Mineralization occurs in small veins that may be related to the north-northwest-trending fault that bounds the small tonalite pluton on the west. Although shown as a normal fault, horizontal slickensides indicate that there may also have been some strike-slip movement along this fracture. The altered belt continues to the west for several kilometers beyond the fault, and this may indicate the continuation of the tonalite pluton at depth. The east end of the altered belt, in the area immediately northeast of the tonalite pluton, contains some iron mineralization, which seems to consist largely of banded hematite and limonite deposits.

The large area of hydrothermally altered rocks around Lago de Cidra in the Comerio quadrangle (Pease and Briggs, 1960) extends a short distance east into the Caguas quadrangle. The altered rock consists mainly of quartz and sericite, accompanied locally by pyrite, and may reflect the presence of an underlying plutonic body.

A narrow belt of altered rocks underlies Cerro La Tiza near the northern border of the Comerio quadrangle (Pease and Briggs, 1960; Hildebrand, 1961), and an eastern extension of this zone continues into the southwest corner of the Aguas Buenas quadrangle (Pease, 1968a) and the northwest corner of the Caguas quadrangle in the Los Negros Formation. It was not mapped in the Caguas quadrangle, however, because the alteration is patchy and irregular, and the rocks are predominantly fresh.

Traces of copper mineralization were noted in rocks of the Caguas pluton and San Lorenzo batholith, but such occurrences are rare. The copper minerals include chalcopyrite, malachite, and azurite, which occur disseminated sparsely through the host rock or in veinlets that fill fractures.

There are numerous borrow pits in the quadrangle. Volcanic and plutonic rocks have been recovered from these pits and used for fill, road metal, concrete aggregate, and other construction purposes. In particular, two sizable quarries in the Aguas Buenas Limestone Member of the Torrecillo Breccia are an important local source of crushed stone for aggregate and road building.

Quartz-rich sand derived from the granodiorite of the Caguas pluton has been recovered from many sites on the flood plains of the Rio Grande de Loiza and Rio Turabo, but at the present time this sand is being recovered mainly from the riverbed at the confluence of those streams.

ENGINEERING GEOLOGY

The extensive alluvial deposits within the Caguas quadrangle range from weakly consolidated to unconsolidated. They are easily excavated, but they are characterized in part by poor stability and might form insecure foundations for many structural purposes. The degree of instability depends in part on the clay content, which is high in many alluvial deposits. Most of these deposits underlie lowland areas that are subject to flooding during periods of torrential rainfall, and this should be considered in the selection of construction sites. The broad flood plains of the Rio Grande de Loiza and its larger tributaries are particularly subject to flooding and perhaps should be left largely to agriculture and a few other activities, such as the recovery of sand for concrete aggregate.

In many places the rocks within the quadrangle are characterized by the development of deep soil and saprolite, which may be unstable on steep slopes and may constitute a danger for construction sites.

Most of the fresh and unfractured volcanic and plutonic rocks in the quadrangle should be suitable for ordinary engineering uses. However, rocks from areas of hydrothermal alteration, major fault zones, and extensive fracturing should be avoided.

SELECTED REFERENCES

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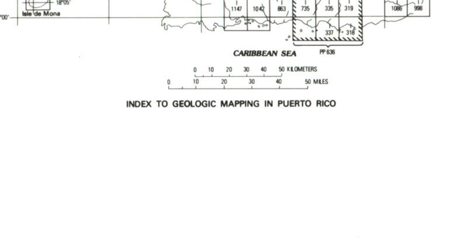

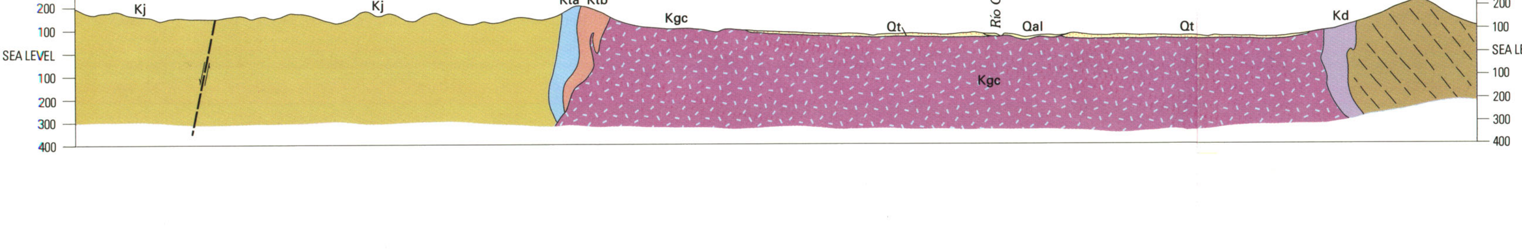

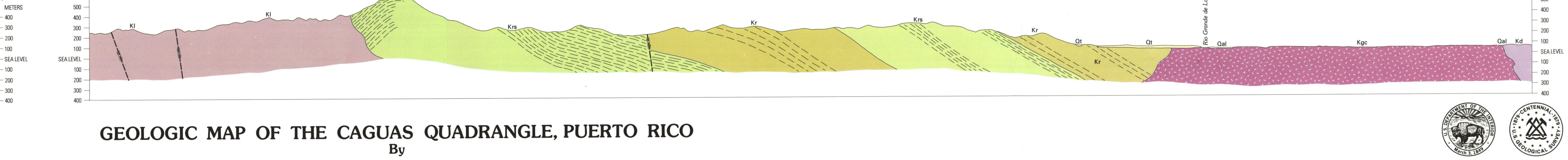

GEOLOGIC MAP OF THE CAGUAS QUADRANGLE, PUERTO RICO

By

Cleaves L. Rogers

1979

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