DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

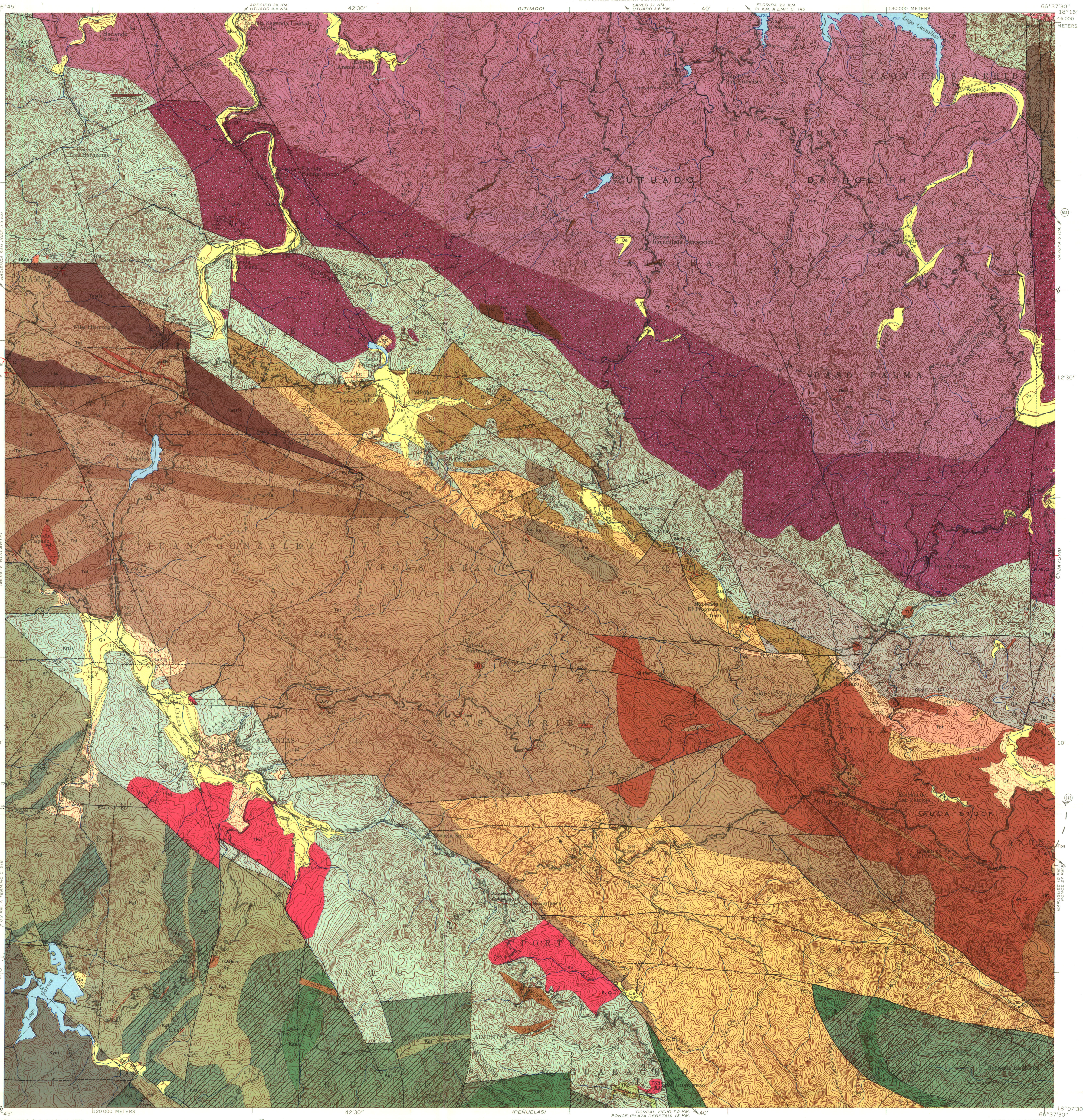
PREPARED IN COOPERATION WITH
THE COMMONWEALTH OF PUERTO RICO
ECONOMIC DEVELOPMENT ADMINISTRATION
INDUSTRIAL RESEARCH DEPARTMENT

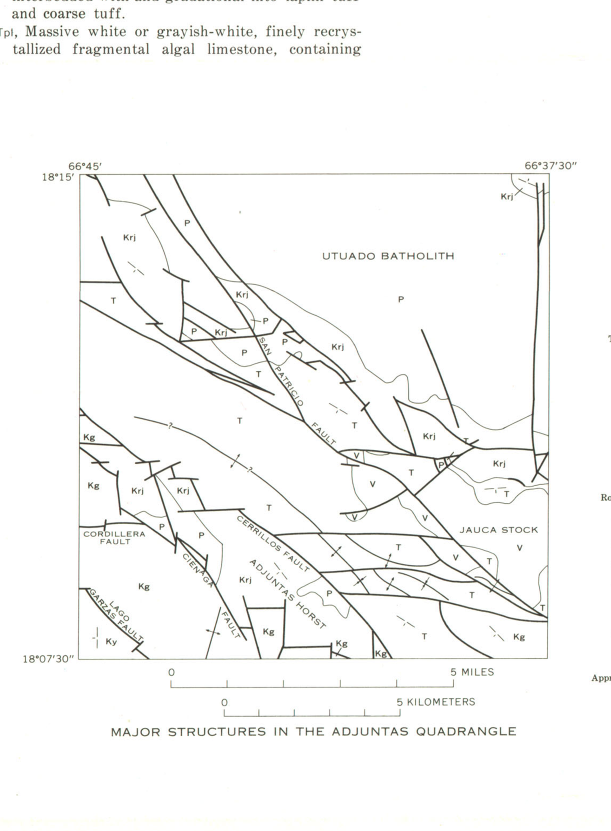
MISCELLANEOUS GEOLOGIC INVESTIGATIONS
MAP I-519

DESCRIPTION OF MAP UNITS

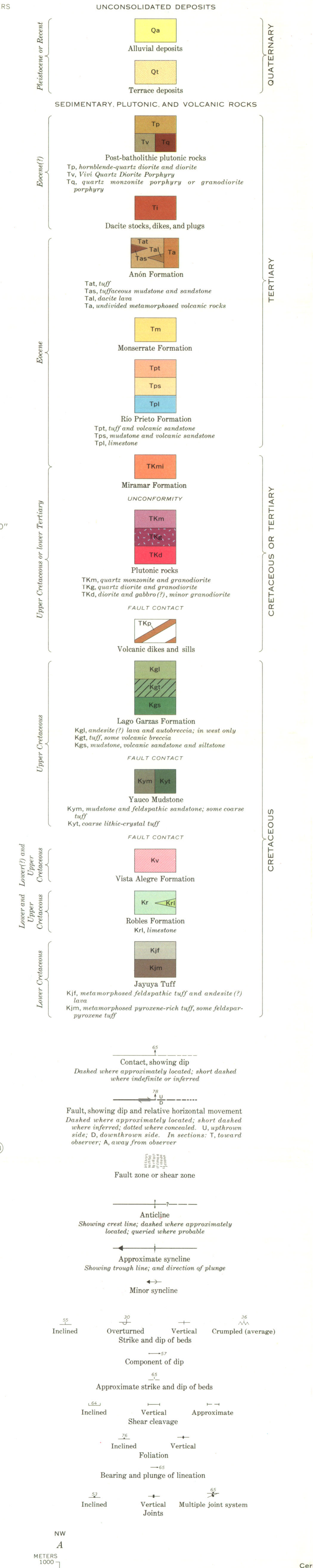
UNCONSOLIDATED DEPOSITS

SEDIMENTARY, PLUTONIC, AND VOLCANIC ROCKS




MAJOR STRUCTURES IN THE ADJUNTAS QUADRANGLE

EXPLANATION



NOTE ON THE STRATIGRAPHY

The Robles Formation first was described by Pease and Briggs (1960), and the Yauco Mudstone was defined by Mattson (1960). More recently, definitive descriptions of the Jayuya Tuff and the Lago Garzas, Río Prieto, Monserrate, and Anón Formations also were given in a report by Mattson (1967); fossil assemblages collected from the sites shown on the geologic map are discussed in this report.

CONTACT-METAMORPHISM

Contact metamorphism during the emplacement of the Utuado batholith has changed parts of the host rocks to hornfels, schist, gneiss, and silicified rock, and epidotized and pyritized rocks are common. Metamorphic effects are visible for as much as a kilometer away from the edge of the batholith and for as much as 0.5 km from the edges of the plutons near Adjuntas.

Metamorphism by the lower Tertiary intrusive dacite has also affected the surrounding rocks, but to a lesser degree. Bedded volcanic rocks are more shattered, veined, and tightly contorted near the dacite stock in the Río Jauca valley than elsewhere, and the limestone of the Río Prieto Formation is finely recrystallized in that area.

Intrusion by post-batholithic plutonic rocks has also metamorphosed host rocks, but in the Cretaceous rocks the later metamorphic effects could not be distinguished from those caused by the Utuado batholith. In areas of pervasive hydrothermal alteration, contact-metamorphic effects of the younger intrusives generally are obscured, but outside these areas rocks of the Monserrate and Anón Formations were altered and locally deformed, presumably by intrusion of the Eocene hornblende-quartz diorite.

HYDROTHERMAL ALTERATION

Effects of hydrothermal silicification, sericitization, pyritization, and addition of potassic minerals are common in the Adjuntas quadrangle. The most common alteration results are hard white granular rocks or softer more micaceous rocks, but copper sulfide mineralization occurs in many areas.

The hydrothermal alteration is distributed in linear zones trending northwestward parallel to the major structural features of the central Adjuntas quadrangle. Faults and fractures provided access for the hydrothermal solutions; the more highly fractured rocks are generally more altered. In general, alteration and the most extensive copper mineralization are confined to rocks near the southwestern edge of the pre-Eocene Utuado batholith, but unfortunately, in the areas of most intense alteration between the Río Pellejas and the Río Viví, the original rocks cannot be identified with certainty. However, hydrothermally altered rocks of well-established middle or late Eocene age are found on the east slope of Monte Hormiga (120,770 m E.; 42,030 m N.) and near La Pica. Thus, the age of at least one episode of alteration and mineralization is probably middle or late Eocene, for lower Oligocene and younger rocks are not strongly deformed, mineralized, altered, or intruded anywhere in Puerto Rico.

Pease (1960) and Hildebrand (1961) have made detailed studies of similar hydrothermally altered rocks in eastern Puerto Rico.

STRUCTURE

The structure of Adjuntas quadrangle is dominated by the northwest-trending Garzas, Ciénaga, Cerrillos, and San Patricio faults, parts of a fault system that extends from Central Aguirre, about 50 km southeast of the Adjuntas quadrangle, 115 km to the west coast of Puerto Rico. For simplicity, this system is referred to herein as the Ponce fault zone for exposures and excellent topographic expression in the Ponce area, just southeast of the Adjuntas quadrangle. In the Adjuntas quadrangle displacements along the fault system are largely vertical, resulting in a series of grabens and horsts, although displacement may be left-lateral on the San Patricio fault. Elsewhere, however, the system shows dominant left-lateral movement (Glover and Mattson, 1960).

No structures or formations can be traced across the entire Ponce fault zone in the Adjuntas quadrangle. Southwest of the Garzas fault, beds of Yauco Mudstone in the Garzas tunnel generally strike north within the quadrangle, with at least four changes in direction of dip across many faults or small folds (B. C. Moneymaker, written commun., 1963). In the complex graben between the Garzas and Ciénaga faults, the Lago Garzas Formation forms a faulted north-trending anticline (section A-A′). The horst between the Ciénaga and Cerrillos faults contains the Robles Formation dipping generally westward to southwestward (section C-C′). The graben between the Cerrillos and San Patricio faults is also complex (section C-C′), containing a small horst of the Lago Garzas Formation. The graben seems to be largely anticlinal in the northwest, but the axis is lost south of a west-trending fault about 1 km south of route 143.

Lower Tertiary rocks north of the San Patricio fault rest unconformably upon or are faulted against Cretaceous rocks, and dip southward toward a synclinal axis in Ponce quadrangle (section C-C′). The structure of the Cretaceous rocks north of the San Patricio fault is obscure; apparently the Utuado batholith occupies the core of an anticline in these strata. Faulting in the east-central part of the quadrangle has uplifted and exposed highly altered rocks, probably Jayuya Tuff, within a Robles terrain.

The time of beginning of movement along the Ponce fault zone is not yet known, but it probably was in the Late Cretaceous or perhaps earlier. The zone was very active in Eocene time or later, as middle or upper Eocene rocks suffered large displacements. Horizontal lineations showing left-lateral movement were preserved on a fault surface in very soft Oligocene and Miocene Ponce Limestone near Ponce (130,530 m E.; 21,200 m N.), close to or within the zone, and a thermal spring has been reported near the zone in the Ponce quadrangle (Mitchell, 1954); thus the fault zone may still be active.

ECONOMIC GEOLOGY

Copper

Within the Adjuntas quadrangle are two economically promising "porphyry copper" deposits (Carlos Vincenty, oral commun., 1965) and numerous other less important copper occurrences. The two large bodies were discovered by geologists of the Ponce Mining Co. (chiefly owned by the American Metals-Climax Co.) and a predecessor firm, detailed exploratory work has been carried out, and at this writing (1966) it appears that mining may begin soon.

The ore bodies are located in an area now commonly referred to as the Viví area, that is located just south and west of Hacienda La Esperanza on the Río Viví. They are part of a broad copper-bearing hydrothermally altered zone that trends northwest from La Pica and Hacienda El Banco on the southeast through the Viví area at least as far as Pellejas.

Other copper-bearing hydrothermally altered rocks are in a zone parallel to and 2 or 3 km north of the chief zone and in a small area in the northwestern corner of the quadrangle which also contains some gold. This latter area may be an extension of the chief zone.

Chalcopyrite is the chief primary copper mineral; it is found in fractures and small veins in hydrothermally altered rocks, in small veins in essentially unaltered rocks, and as disseminated grains in the quartz diorite and grayish-white granodiorite. Secondary copper minerals are covellite, chalcocite, malachite, and cuprite. Distinct copper mineral localities are shown on the geologic map. Molybdenite occurs in small veins at one locality in the Río Viví.

The Viví area contains a closely faulted mosaic of hornblende-quartz-diorite or diorite, Viví Quartz Diorite Porphyry, and altered rocks of the Robles Formation and probably of the Monserrate and Anón Formations. Most rocks in the vicinity are altered to a granular aggregate of quartz, sericite, and pyrite, but the chief host for ore is the hydrothermally altered Viví Quartz Diorite Porphyry. Fractures are more common in the Viví area than elsewhere. Dikes and small intrusions of quartz monzonite porphyry or granodiorite porphyry also are common.

Gold and zinc

A few grains of native gold were seen in a quartz-chalcopyrite-cuprite-malachite vein cutting a highly silicified zone at least a meter wide in hydrothermally altered rock at 119,250 m E.; 45,700 m N. in the northwest corner of the quadrangle. Several other quartz-pyrite and quartz-hematite veins are nearby. According to the Puerto Rico Bureau of Mines (1941, p. 13), samples from pyrite-quartz veins at kilometer post 45 on route 10 (121,860 m E.; 44,860 m N.) assayed up to 0.5 oz. of gold per ton. About a kilometer to the north, at 120,330 m E.; 46,430 m N. and 120,415 m E.; 46,360 m N. in the Utuado quadrangle sphalerite, chalcopyrite(?), pyrite, quartz, and talc(?) occur in small veins also cutting hydrothermally altered rock.

Iron

There are three areas containing small and probably uneconomic iron deposits in the Adjuntas quadrangle:

(1) The Viví area contains magnetite-hematite and magnetite-epidote-garnet veins and replacement bodies in silicified hydrothermally altered rocks at three localities. An aeromagnetic anomaly near here might be in part due to these or other iron-bearing bodies (W. R. Bergey, oral commun., 1961).

(2) In the Río Jauca, near the eastern border at 18°10′ North latitude, magnetite-chalcopyrite-pyrite-quartz boulders on a small spur probably represent replacement of basal Tertiary limestone (Tpl), and cobbles and boulders of magnetite are common both here and upstream. Some manganese minerals are also present.

(3) In the Río Portugués-Alto de la Bandera area magnetite-pyrite-epidote-quartz bodies as much as 2 meters in size replace and vein metamorphosed rocks within a small diorite pluton. Part of the magnetite appears pseudomorphic after hornblende. Hematite and hematite-quartz veins in this area are subparallel to the Cerrillos fault; careful prospecting along this trend might locate other magnetite bodies.

Manganese

One manganese prospect was seen, that of Aurelio Gatti southeast of Lago Garzas. The prospect is described as follows by the Puerto Rico Bureau of Mines (1941): "In 1932 a shaft was sunk 35 feet along the contact of manganese rock, mostly psilomelane, with limestone, a drift of 109 feet extended from the bottom of the shaft, following a 2 to 6-foot vein and a winze 20 feet deep from the end of the drift, all in the vein. Work ceased because of water problems in the shaft and transportation problems. The ore reportedly contained 52 percent Mn."

In 1963 the shaft head was below water level of a small stream draining immediately into an alluvial valley, but psilomelane, with some quartz, epidote, and calcite, was visible in dumps on the valley floor. The prospect is located about at the contact of a volcanic tuff with an underlying lava, both deeply weathered and both in the Lago Garzas Formation, but no limestone was seen and no limestone has been mapped in the Lago Garzas in this quadrangle. Perhaps the reported limestone was a calcite vein.

Stone and gravel

Small intermittently operated stone quarries produce road metal, concrete aggregate, and fill for local needs. The only quarry with a permanent crushing plant is in veined dioritic rock on the south bank of the Río Jauca west of route 140. Gravel banks in the Río Grande de Jayuya and the Río Cidra near Adjuntas are also used as a source for aggregate.

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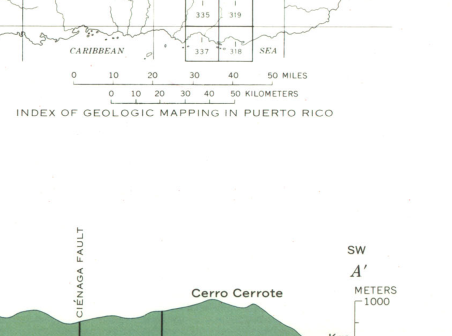
INDEX OF GEOLOGIC MAPPING IN PUERTO RICO

GEOLOGIC MAP OF THE ADJUNTAS QUADRANGLE, PUERTO RICO

By
Peter H. Mattson
1968