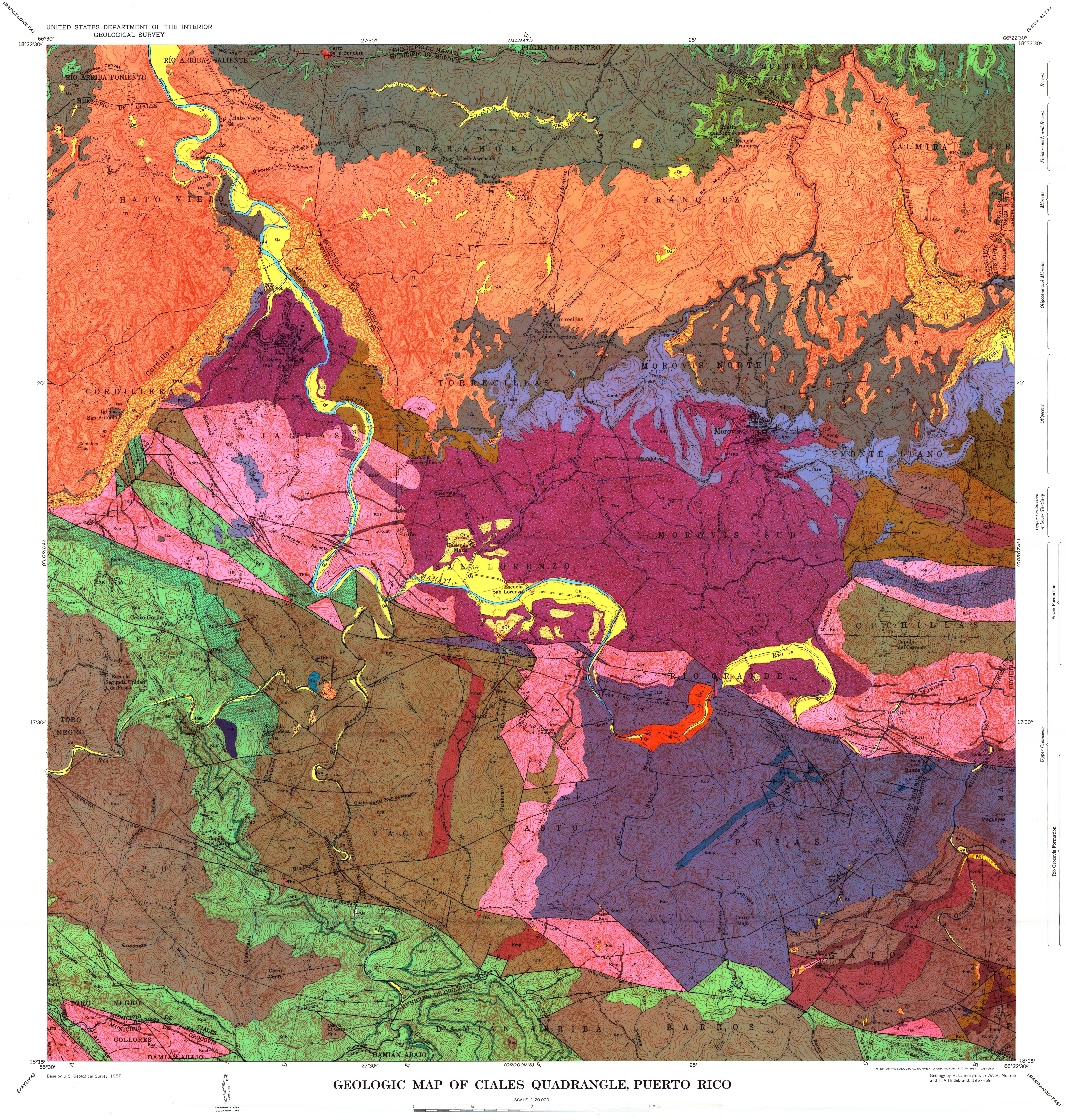
UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY



Base by U.S. Geological Survey, 1957

GEOLOGIC MAP OF CIALES QUADRANGLE, PUERTO RICO

SCALE 1:20 000

1 ½ 0 1 MILE

1 .5 0 1 KILOMETER

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

INTERIOR—GEOLOGICAL SURVEY, WASHINGTON, D.C.—1964—G64069

Geology by H. L. Berryhill, Jr., W. H. Monroe and F. A Hildebrand, 1957–59

EXPLANATION

SEDIMENTARY AND VOLCANIC ROCKS

QUATERNARY

Recent

Qa

Alluvium

Unconsolidated silt, sand, gravel, cobbles, and boulders in and adjacent to streams; includes isolated deposits in limestone sinks

Pleistocene(?) and Recent

Qt

Stream-terrace deposits

Unconsolidated silt, sand, gravel, cobbles, and boulders 15–50 m above stream level

Qc

Colluvium

Talus fans and landslides; most prevalent along cuesta inface of Lares Limestone

UNCONFORMITY

TERTIARY

Miocene

Ta

Aguada Limestone

Interbedded hard and marly limestone; on tops of two small hills at north edge of quadrangle

Oligocene and Miocene

Tc, Tcq, Tcr, Tca, Tcr

Cibao Formation

Tc, *Cibao Formation undifferentiated, chalk and marl, lenticular beds of impure limestone and sandy marl.*

Tcq, *Quebrada Arenas Limestone Member, alternate beds of hard finely crystalline limestone and chalky limestone.*

Tcr, *Río Indio Limestone Member, forms two parts, one above and one below Almirante Sur Sand Member; upper part is nearly white porous limestone composed of tightly cemented shell and limestone fragments; lower part is yellow fragmental limestone that locally is slightly crossbedded.*

Tca, *Almirante Sur Sand Member, crossbedded subrounded to subangular coarse-grained sand*

Oligocene

Tl

Lares Limestone

Massive hard crystalline pale-orange to nearly white locally coralline limestone

Tss, Tssg

San Sebastián Formation

Tss, *sandy limestone member, thickness variable; transitional between lower part of San Sebastián Formation and Lares Limestone.*

Tssg, *sand and gravel member; stratified, locally crossbedded, poorly indurated sandstone, silt, and clay of variable thickness containing much gravel; sandstone and gravel typically predominate in lower part which contains lenses of cobble conglomerate locally at base; characteristically greenish gray but include some grayish-red and yellowish-gray layers*

UNCONFORMITY

CRETACEOUS OR TERTIARY

Upper Cretaceous or lower Tertiary

TKc

Carreras Siltstone

Calcareous, laminated, dark-gray to olive-black; in beds generally 5–20 cm thick; after leaching of calcium carbonate, very light brown with grayish-red streaks; upper third only crops out at east-central edge of quadrangle

CRETACEOUS

Upper Cretaceous

Pozas Formation

Kpu

Upper breccia member

Massive gray volcanic breccia consisting generally of andesitic, feldspathic lava fragments in a feldspathic tuff matrix

Kpbf, Kpb

Blacho Tuff Member

Red-hued sequence of lapilli tuff (in part mudflow deposits), tuff, and lenses of fluvial gravel.

Kpbf, *ledge-forming dacite-ash-flow deposits generally 10–40 m thick*

Kpm

Minguillo Lava Member

Andesitic lava

Km, Kmg, Km

Manicaboa Formation

Cyclic interbedded sequence of massive grayish volcanic breccia and breccia-conglomerate in layers generally 1–30 m thick alternating with laminated gray reworked fine and coarse tuff in layers generally 1–25 m thick. Basal part seems to intertongue with upper part of Avispa Lava Member in central part of quadrangle.

Kmg, *unit having a concentration of small volcanic bombs(?) altered to green nontronite(?)*

Río Orocovis Formation

Kob

Basalt tuff member

Basalt tuff, distinctive greenish-gray; contains a profusion of large pyroxene phenocrysts

Koac, Koat, Koa, Koab, Koat, Koal

Avispa Lava Member

Andesitic pillow lavas characterized by abundance of plagioclase phenocrysts.

Koac, *intraformational conglomerate.*

Koat, *lenticular layers of laminated reworked tuff generally less than 10 m thick.*

Koab, *volcanic breccia*

Koal, *reef limestone*

Kop, Kopp

Perchas Lava Member

Amygdaloidal-basaltic pillow lavas containing a few thin lenses of reworked tuff.

Kopp, *feldspathic lava flow having high potash content*

Komt, Kom, Komb

Magüeyes Member

Kom, *amygdaloidal-basaltic pillow lavas.*

Komt, *persistent layers of reworked fine and coarse tuff.*

Komb, *volcanic breccia*

INTRUSIVE ROCKS

CRETACEOUS OR TERTIARY

Upper Cretaceous or lower Tertiary

Age relations uncertain

TKg

Granodiorite

Plutonic igneous rock making up the Ciales and Morovis stocks

TKd

Diorite

Small plutonic bodies and dikes principally associated with faults; includes a large dike cutting Morovis stock

TKs

Augite syenite

Plutonic body associated with Morovis stock

TKas

Alkali syenite

Small plutonic body near southeast corner of quadrangle

TKha

Hornblende andesite

Dikes commonly associated with faults; forms larger body of intermixed andesite and diorite associated with Minguillo Lava Member

CRETACEOUS

Upper Cretaceous

Kb

Basalt and andesitic basalt

Dikes, a sill, and larger masses of intrusive lava, probably flow feeders; principally in southeastern part of quadrangle

Kg

Altered gabbro(?)

Plutonic igneous body near southeast corner of quadrangle; feldspars characteristically altered to sericite and muscovite

Ka

Altered andesite(?)

Porphyritic intrusive about 5.5 km south of Ciales; plagioclase and pyroxene phenocrysts extensively altered

METAMORPHIC ROCKS

CRETACEOUS OR TERTIARY

Upper Cretaceous or lower Tertiary

TKr

Hydrothermally altered volcanic rocks

Mottled red and light brown, siliceous; in one area in southeastern part of quadrangle

Contact

Dashed where approximately located; short dashed where indefinite; queried where probable

U D ?

High-angle fault

Dashed where approximately located; queried where probable. U, *upthrown side;* D, *downthrown side*

Fault

Showing relative horizontal movement. Dashed where approximately located

T A

Horizontal movement on fault

T, *towards observer;* A, *away from observer. Shown on sections only*

Shear zone

Anticlinal axis

Showing trace of axial plane. Approximately located; queried where probable

Synclinal axis

Showing trace of axial plane. Approximately located; queried where probable

FA

Plunge of fold axes

Beds too tightly folded to show individual folds

80

Strike and dip of beds

90

Strike and dip of vertical beds

Horizontal beds

50

Generalized strike and dip of crumpled beds

Approximate strike and dip of beds

Probable attitude of bedding

Queried where doubtful. Shown in sections only

Vertical lineation

Shown only in augite syenite (TKs)

C 10

Copper mineralization

Number refers to locality described in text

GB 36

Galena and barite prospect

2

Outcrop locality described in text