

# Concepción and Palma Escrita Formations, Western Puerto Rico

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GEOLOGICAL SURVEY BULLETIN 1394-D

*Prepared in cooperation with the  
Commonwealth of Puerto Rico  
Department of Natural Resources*



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By DAVID H. McINTYRE

## CONTRIBUTIONS TO STRATIGRAPHY

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*The Concepción Formation of  
Late Cretaceous age is redefined, and the name  
Palma Escrita Formation is adopted for a  
sequence of early Tertiary age*

**UNITED STATES DEPARTMENT OF THE INTERIOR**

**ROGERS C. B. MORTON, *Secretary***

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## CONTRIBUTIONS TO STRATIGRAPHY

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# CONCEPCION AND PALMA ESCRITA FORMATIONS, WESTERN PUERTO RICO

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By DAVID H. McINTYRE

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### ABSTRACT

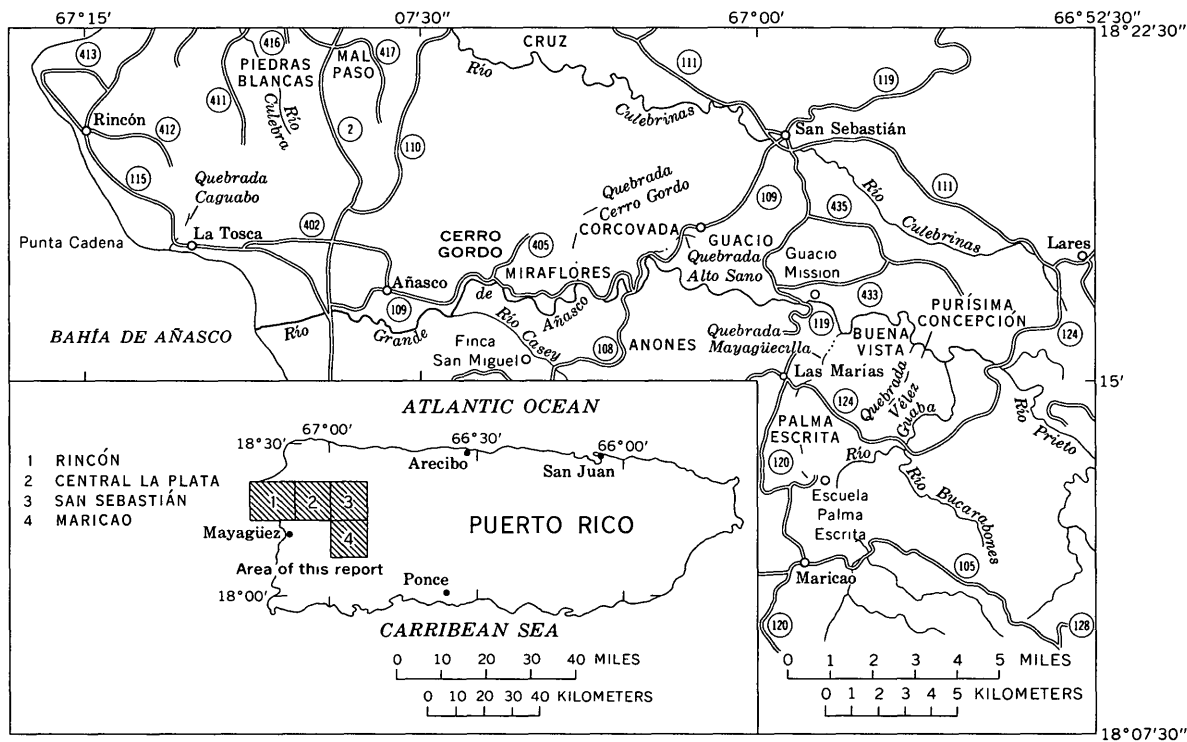
The Concepción Formation is redefined to include only greenish-gray plagioclase and pyroxene porphyry lavas and related volcanoclastic rocks of Late Cretaceous (Campanian-Maestrichtian) age that crop out in the San Sebastián and Maricao quadrangles, western Puerto Rico. Most of the formation has been somewhat altered. Analyses of rare unaltered samples show the rock to be a high-alumina basalt.

The Palma Escrita Formation, of early Tertiary and probable Eocene age, consists chiefly of greenish-gray pumice-rich dacitic to rhyodacitic tuff that crops out in the Central la Plata and Maricao quadrangles. It conformably underlies lavas and volcanoclastic rocks of the Mal Paso Formation (lower middle Eocene). Rocks in the Central la Plata quadrangle formerly included in the Concepción Formation now are considered part of the Palma Escrita Formation.

### INTRODUCTION

The geology of western Puerto Rico is being studied as part of a program of geologic mapping and mineral resource investigation of Puerto Rico conducted by the U.S. Geological Survey in cooperation with the Department of Natural Resources, Commonwealth of Puerto Rico. In past years, during which the results summarized in this report were obtained, the program also was supported by the Puerto Rico Economic Development Administration.

The stratigraphic results of geologic mapping in the San Sebastián, Central la Plata, and Rincón quadrangles, northwestern Puerto Rico (fig. 1), have been reported earlier by McIntyre, Aaron, and Tobisch (1970). (See also Tobisch and Turner, 1971; McIntyre, 1971.) Further fieldwork in western Puerto Rico, prin-



**FIGURE 1.**—Index map of part of western Puerto Rico showing geographic and physiographic features cited in text.

cipally in the Maricao quadrangle (fig. 1), has clarified some of the stratigraphic relations and has indicated the need for some revision of the stratigraphic nomenclature proposed by McIntyre, Aaron, and Tobisch (1970). This revision involves redefinition of the Concepción Formation and proposal of a new formation, the Palma Escrita Formation, to include rocks excluded from the Concepción as redefined.

### CONCEPCION FORMATION OF MCINTYRE, AARON, AND TOBISCH (1970)

McIntyre, Aaron, and Tobisch (1970, p. D10) defined the Concepción Formation as "Near-vent dacitic and rhyodacitic pyroclastic rocks and lavas associated with two separate, but related vent areas in northwestern Puerto Rico \* \* \*." Type localities were defined in Barrio Purísima Concepción in the San Sebastián quadrangle, where the formation consists of an intertonguing sequence of lavas and tuff-breccias that contain plagioclase and clinopyroxene phenocrysts and of thin-bedded tuff that contains crystals of plagioclase, clinopyroxene, and hornblende and fragments of plagioclase porphyry and pumice. All these rocks in the San Sebastián quadrangle are somewhat altered and contain epidote, chlorite, prehnite, or zeolites. This alteration seriously interfered with determination of original chemical composition and the proper classification of these rocks. No fossils or other age data were known for these rocks in the San Sebastián quadrangle.

A sequence of dacitic and rhyodacitic pyroclastic rocks and lavas in the Central la Plata quadrangle (fig. 1) were correlated on the basis of apparent similarity in stratigraphic position with those in Barrio Purísima Concepción in the San Sebastián quadrangle. These rocks, less altered than those in Barrio Purísima Concepción, were used to characterize the chemical composition of the Concepción Formation as defined by McIntyre, Aaron, and Tobisch (1970). An Eocene age for the Concepción was suggested by the stratigraphic relations in the Central la Plata quadrangle.

### NEW DATA AND REVISED NOMENCLATURE

New data discovered during fieldwork in the Maricao quadrangle have demonstrated that the correlation of the rocks in

Barrio Purísima Concepción, San Sebastián quadrangle, with those in the Central la Plata quadrangle is incorrect. The new data are as follows:

1. Chemical analyses of rare samples of unaltered rocks in the area adjacent to Barrio Purísima Concepción, San Sebastián quadrangle, show that the unit present there is a high-alumina basalt, not dacite or rhyodacite.
2. A fossil locality now known to be in the Barrio Purísima Concepción rocks contains Foraminifera of Campanian-Maestrichtian (Late Cretaceous) Age.
3. Rocks identical in composition and stratigraphic position to the dacitic and rhyodacitic rocks of the Central la Plata quadrangle also are present in the Maricao quadrangle. These rocks contain early Tertiary Foraminifera and are not related to rocks of the Barrio Purísima Concepción type that occur in the same area (fig. 2).

In order to resolve the discrepancies now apparent, the following changes in stratigraphic nomenclature are made:

1. The Concepción Formation is redefined to include only those rocks of Late Cretaceous age in Barrio Purísima Concepción in the San Sebastián quadrangle and other directly related rocks in adjacent areas.
2. Rocks of early Tertiary age in the Central la Plata quadrangle, formerly included in the Concepción Formation, are grouped in a new unit, the Palma Escrita Formation. Rocks in the Maricao quadrangle identical in composition and stratigraphic position with those of the Central la Plata quadrangle also are included in the Palma Escrita Formation.

### CONCEPCION FORMATION REDEFINED

The Concepción Formation, as redefined, consists of an interbedded sequence of gray and greenish-gray porphyritic lavas, tuff-breccias, and thin-bedded tuffs that crop out in the San Sebastián and Maricao quadrangles. The type localities (along the Río Añasco near the Route 119 bridge, along the road between Barrios Purísima Concepción and Buena Vista, and in Quebrada Vélez) described in McIntyre, Aaron, and Tobisch (1970, p. D10) are retained.

The lavas and tuff-breccias in the Concepción Formation contain phenocrysts of plagioclase and clinopyroxene and often are amygdaloidal. The thin-bedded tuffs contain abundant crystals



of plagioclase and clinopyroxene or hornblende in addition to porphyritic nonvesicular rock fragments and pumice or scoria. Nearly all these rocks have been somewhat altered, so that chlorite, epidote, prehnite, or zeolites are now present in varying amounts. Many samples also contain pyrite. The alteration tends to obscure the original textures and compositions. Analyses of rare unaltered parts of the formation show that it is a high-alumina basalt.

The contact relations of the Concepción Formation and surrounding units are obscured chiefly by faulting. The Concepción Formation is bordered on the southwest by the Río Blanco Formation (Campanian-Maestrichtian); the contact is a fault (fig. 2). To the northeast, a fault also separates the Concepción from the Palma Escrita and Mal Paso Formations (lower Tertiary). Because of the faulting, there is no physical evidence concerning the stratigraphic position of the Concepción Formation relative to adjacent formations.

Evidence for the age of the Concepción Formation is provided by Foraminifera in a thin limestone lens near the northwest border of the Maricao quadrangle (this area of Concepción not shown in fig. 2). This locality (USGS locality f-35157) earlier was believed to be in the Río Blanco Formation, but mapping in the Maricao quadrangle has shown conclusively that the limestone lens is, instead, in the Concepción. The limestone is interbedded with green thin-bedded tuff and dark-greenish-gray plagioclase porphyry lava of the Concepción. According to K. N. Sachs, Jr., the Foraminifera are indicative of a Campanian-Maestrichtian Age (McIntyre, Aaron, and Tobisch, 1970, p. D9).

## PALMA ESCRITA FORMATION

The name Palma Escrita Formation is herein adopted for a sequence consisting chiefly of pumice-rich dacitic to rhyodacitic volcanoclastic rocks of early Tertiary age that crop out in the Central la Plata and Maricao quadrangles. The type area for the formation is in Barrio Palma Escrita, Municipio de Las Marías, in the Maricao quadrangle (fig. 2). The typical exposures are along the unimproved road along the east flank of the ridge that extends northward from Escuela Palma Escrita (95,000E; 42,060N to 95,840E; 43,020N (Puerto Rico Meter Grid System coordinates)). Reference exposures are those along Route 405, Barrio Cerro Gordo, Municipio de Añasco, in the Central la Plata quadrangle.

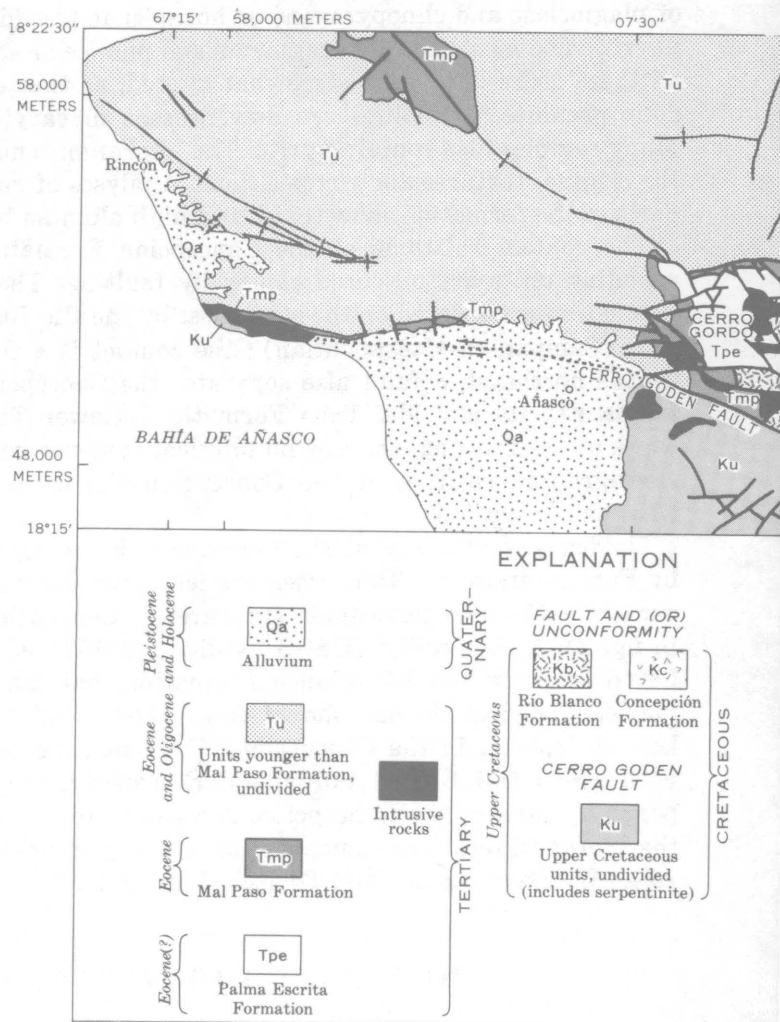
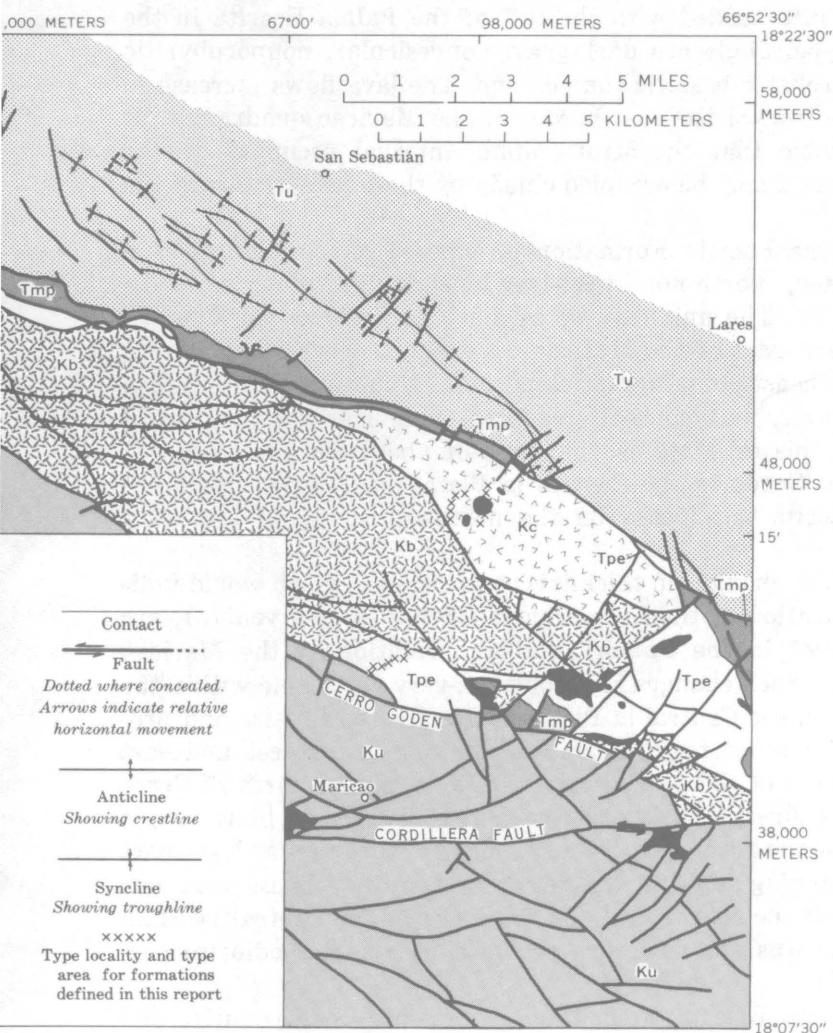


FIGURE 2.—Generalized geologic map of part of western Puerto Rico showing Rincón quadrangle), McIntyre (1971,

Pumice lapilli tuffs and pumice-rich tuffs in the Palma Escrita Formation usually are greenish gray, well indurated, and thick to thin bedded. These rocks consist chiefly of pumice and glass shards altered to chlorite or to intergrowths of quartz and alkali feldspar. Plagioclase is the only phenocryst mineral; other minerals that may be present in very small amounts are hornblende, clinopyroxene, quartz, pyrite, magnetite, and sphene. A few red non-



stratigraphic units cited in text. Generalized from J.M. Aaron (unpub. data, 1973), and Tobisch and Turner (1971).

vesicular lava fragments locally are present, particularly near the contact with the overlying Mal Paso Formation.

The Palma Escrita Formation weathers readily to a reddish-brown, yellowish-brown, and yellow saprolite. The altered pumice fragments, often recognizable in saprolite exposures, appear as lenticular or irregular patches that are either green or red, depending on the degree of weathering.

Locally interbedded with the tuff of the Palma Escrita in the Maricao quadrangle are dark-gray, nonvesicular, nonporphyritic lavas of probable basaltic composition. The lava flows increase in abundance toward the east border of the Maricao quadrangle. It is conceivable that the stratigraphic interval occupied by the Palma Escrita may be occupied chiefly by these lavas (toward the east).

The Palma Escrita Formation is exposed on both noses of a much-faulted, north-northwest-trending doubly plunging anticline (fig. 2). The unit may be as much as 2,200 m thick in the northeastern part of the Maricao quadrangle, where it crops out on the southeast-plunging anticlinal nose. Extensive cover in that area, however, may conceal structural complications that would invalidate this estimate. A thickness of about 800 m is exposed near Cerro Gordo in the Central la Plata quadrangle, where the Palma Escrita is exposed on the northwest-plunging anticlinal nose.

Systematic changes in thickness or grain size, which would indicate the position of the formation relative to source vent(s), are not apparent in the Palma Escrita Formation in the Maricao quadrangle. Such changes are, however, very noticeable within the formation in the Central la Plata quadrangle. Grain size and proportion of pumice to glass shards diminish southwest and east from the area of the granodiorite porphyry pluton north of Cerro Gordo. The direction to the source vent is also shown by the rapid thinning of the formation toward the east; however, at least part of this thinning may be the result of faulting. These relations suggest that the source vent for the rocks in the Central la Plata quadrangle was at a site now occupied by the granodiorite porphyry body.

The Palma Escrita Formation is overlain concordantly, and probably conformably, by basaltic lavas and pyroclastic rocks of the Mal Paso Formation. The contact of the Palma Escrita with

adjacent older formations is, at most places, a fault. About 1 km northwest of Escuela Palma Escrita, the contact with the Río Blanco Formation (Campanian-Maestrichtian) does not appear to be a fault contact (fig. 2). If not a fault plane, the contact must be an unconformity because of the discordance in attitude between the two formations and because of the probable time interval separating them.

The exact age of the Palma Escrita Formation is not known. Planktonic Foraminifera have been found at scattered localities, but preservation has been poor. A sample containing well-preserved foraminifers (location: 96,200E; 41,680N) was sent to E. A. Pessagno, Jr., who stated (written commun., May 13, 1971) that "The planktonic forams in MM-248 appear to be late Paleocene to Eocene in age. There is a possibility of reworking of Upper Cretaceous (middle Cenomanian to lower Turonian)." This approximate age assignment is in accord with the physical stratigraphic relations. The Mal Paso Formation, which conformably overlies the Palma Escrita, is of early middle Eocene age (McIntyre, Aaron, and Tobisch, 1970, p. D12). It is unlikely, therefore, that the underlying relatively thin, rapidly deposited Palma Escrita Formation is older than Eocene.

#### REFERENCES CITED

- McIntyre, D. H. 1971, Geologic map of the Central la Plata quadrangle, Puerto Rico: U.S. Geol. Survey Misc. Geol. Inv. Map I-660.
- 1973, Geology of the Maricao quadrangle, Puerto Rico: U.S. Geol. Survey open-file report, 36 p., map.
- McIntyre, D. H., Aaron, J. M., and Tobisch, O. T., 1970, Cretaceous and lower Tertiary stratigraphy in northwestern Puerto Rico: U.S. Geol. Survey Bull. 1294-D, p. D1-D16.
- Tobisch, O. T., and Turner, M. D., 1971, Geologic map of the San Sebastián quadrangle, Puerto Rico: U.S. Geol. Survey Misc. Geol. Inv. Map I-661.