

25. A R U B A

BY

J. H. WESTERMANN.

With geological map.

In the beginning of the year 1885 Aruba was surveyed as to its geology by K. MARTIN. Although this surveyer stayed only a few days on the island he succeeded in obtaining a clear view of the general geological features¹⁾. It is, however, very well understandable that during our stay²⁾ some corrections could be introduced in the geological map of Aruba and in the older ideas concerning the genesis of some rocks.

Beside the above quoted publication by MARTIN some other geological literature about the island exists; the latter is not worth mentioning here being of no great importance.

On the island of Aruba occur three formations, all being quite different in age and in nature of rocks:

1. the diabase-schist-system,
2. the quartzdiorite-batholith and its differentiates,
3. the limestone- and detritus-formation.

Except for the youngest one the ages of the formations could not be determined. In correlation, however, with other islands of the Antilles-group acceptance of a certain age for the first two formations seems possible.

The oldest system, the diabase-schist-complex, is supposed to be of Cretaceous age, in relation with the acceptance of the Cretaceous age of the diabase on Curaçao and of other resembling rocks in several other Antilles-islands.

Consequently, the intrusion of the quartzdiorite-magma into the diabase-schist-complex must have taken place in youngest Mesozoic or older Tertiary

¹⁾ „Bericht über eine Reise nach Niederländisch West-Indien, und darauf gegründete Studien“. Leiden, E. J. Brill, 1888.

²⁾ In connection with the geological excursion to the Dutch Leeward Islands of the Lesser Antilles in the summer of 1930 under the leadership of Prof. Dr. L. RUTTEN. University of Utrecht, Holland.

time. This agrees with the age of similar intrusions in other West-Indian islands.

The youngest formation is a Quaternary one, as far as is known.

1. The diabase-schist-system (occurrence: the middle part of the island; some smaller regions in the N. W. corner and near the East-coast).

It is a striking fact, that, in consequence of the selective erosion, this formation outcrops as a "mountainous" landscape, in which are found as the highest points of the island the Jamanota (188 m), the Arikok (185 m), the Seroe Kabaai (170 m) and the Gran Tonel (155 m). Most of the hills in the diorite-landscape are lower than these hills composed of the oldest rocks of Aruba.

The rocks of this system are strongly folded, in such a way that individual folds cannot be recognized. The strikes of the strata, although varying, are on an average about N 90 E; the dips are almost all very steep to the South or to the North; some strata show a vertical position. The diabases occur in the system as concordant masses in- or extruded before or during the folding-processes, and, besides, as discordant masses that probably in- or extruded after the folding.

The diabases constitute a great part of this system; many of them are composed chiefly of plagioclase and hornblende, and do not contain augite anymore, this mineral having been changed into uralite (in connection with the strong folding and locally with the intrusion of the younger dioritic magma): uralite-diabase.

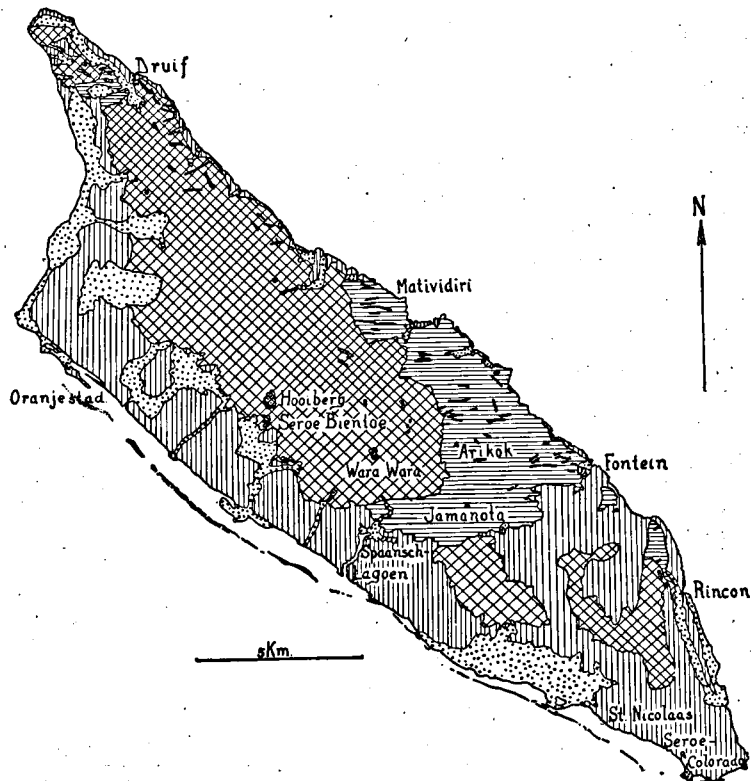
Of the schistose rocks must be mentioned gray- and grayish-green-coloured rocks, that can be called hornblende-schists. May be, most of these originated from tuffaceous sediments. Besides, hardly altered tuffs occur, probably with *Radiolaria*. Rocks, transitional between these tuffs and the above mentioned hornblende-schists were not found.

Other schistose rocks are the amphibolites, that are found especially in the N. W. corner of the island.

As mentioned above, this formation can be possibly compared with the diabase- and Knip-formation on Curaçao, and with the Washikemba-formation on Bonaire.

The amphibolites are also found as small exogenous inclusions in the diorite, taken up by the dioritic magma. Due to the same magma the marginal older rocks (diabases, hornblende-schists and amphibolites) show a certain contactmetamorphism: the amphibolites have been enriched by the magma with plagioclase- and quartz-material, whereas nearer the diorite these rocks show a network of small, injected quartz-plagioclase-veins ("hybrid rocks").

Both these exogenous inclusions in the diorite and the contactmetamorphism of the diabases and schists make it obvious that the diorite-batholith must have been intrusive into — and thus must be younger than — the diabase-schist-system. It is impossible to say whether a partial roof-foundation took place during the batholithic intrusion, or not. In any case a great part of the roof (the older rocks) must have been eroded



Geological Sketch-Map of Aruba.

-  Diabases and Schists.
-  Quartz-diorite.
-  „Hooiberg”-rock (in quartz-diorite).
-  Porphyrite-dikes (in quartz-diorite and diabases, schists).
-  Quaternary limestone.
-  Diorite-detritus and Coastdunes.

after the diorite-intrusion, so that today the greater part of the surface of the island is occupied not by the older rocks but by the diorites.

2. The diorite-batholith and its differentiates.

The intrusion of the dioritic magma into the diabase-schist-system must have taken place after or during the folding of these older rocks; the fact that the general strike of the porphyrite-dikes (that also belong to the batholith) in the older rocks is about the same as that of the older rocks themselves, seems to point to an intrusion during the folding.

The diorite has been denuded to a rather low level with an average altitude of about 40 m; and in distinction from the landscape of the older rocks the diorite-landscape generally is a flat one, in which are found numerous "Felsenmeere" of big rounded off and exfoliated diorite-monoliths ("Wollsackbildung", pillowstructure).

Very curious in the flat diorite-landscape are several steep hills (f. i. the high cony Hooiberg — 164 m —, east from Oranjestad; the Seroe Bientoe — 85 m — and the Wara Wara — 98 m —), that obviously are more or less preserved by selective erosion. These hills are composed of a beautiful, darkecoloured, igneous rock, in which many big hornblende-crystals are particularly striking. Furthermore, its main constituent minerals are monoclinic pyroxene, plagioclase and quartz; the two latter minerals must have crystallized after the ferromagnesian minerals. Through this "Hooiberg" rock run many dikes of aplites and diorites, that enclose fragments of the "Hooiberg" rock. Therefore, this "Hooiberg" rock must be older than the diorite. After the consolidation of the former, dioritic magma intruded. It may be assumed, that the "Hooiberg" rock constitutes a first-solidification-differentiation in the dioritic batholith.

The most common rock of the batholith is quartzdiorite. Two kinds of quartzdiorite have been found, that is to say, in the first place quartz-hornblende-biotite-diorite, in the second place quartz-hornblende-diorite. Beside the quartzdiorites, biotitegranites and quartz-hornblende-augite-(-hypersthene)-(biotite)-gabbro's here and there occur. Granodiorites, so wellknown in other parts of America, are not wanting on Aruba either.

The younger representatives of the magmatic sequence are found as dikes in the diorite, and also in the older rocksystem. In the latter rocks even diorite-dikes occur, proving that not far down the top of the batholith is present. Especially in the northern- and north-eastern-part of the island numerous wide and long dikes can be recognized running through the rocks over several hundred meters. These dike-rocks are dike-diorites, dike-granites, dike-granodiorites, (quartz-)diorite-porphyrates and vintliths; the latter being transitional between porphyritic and lamprophyric rocks. It is worth mentioning that on Curaçao about the same dike-rocks and even dioritic rocks are met with. Hence, a similar batholithic intrusive rock as on Aruba must exist in the underground of that island. Possibly this is also true for Bonaire, but there the batholith must lie still deeper, because only one outcrop of a quartz-hornblende-diorite-dike has been found (near Seroe Grita Kabai) and no others of the nature of the Aruba-batholithrocks occur, as far as is known.

Still younger dike rocks are melanocratic ones, usually malchites, and leucocratic rocks. The latter show a great variety, and constitute dioritic aplites, granitic aplites, granodioritic aplites, quartz-albitites, gabbro-aplites and pegmatites.

The very youngest magmatic and postmagmatic rocks, occurring as dikes and veins in the above-mentioned eruptive rocks, are quartz-rocks, quartz-epidote-rocks, epidote-quartz-rocks and epidote-rocks.

3. The limestone- and detritus-formation.

The limestone (partly coral limestone) lies unconformably on the two older rock formations. Before the deposition of the limestone both these older rock formations must have been partly denuded. Whether the whole island or only a part of it was under sealevel during the deposition, and whether the limestone formerly covered the whole island or only a part of it, remains questionable for the present. The limestone-covering has been partly denuded and today it is found especially in the Southeastern part, further as a zone, about 2 km wide, along the South- and Westcoast, and as a narrow, frequently interrupted border along the North(East)coast.

Probably two periods of limestone-deposition can be distinguished, separated by a time in which changes of levels took place. The older limestone has the highest situation; at many places its layers dip to the surrounding sea, indicating that this limestone must have belonged to a slightly arched limestone-cap over the whole island or over a part of it. The younger limestone is present as a horizontal or nearly horizontal lower terrace bordering the island.

In several places many fossils have been found, *Corals*, *Lamelli-branchiates* and *Gastropodes*. At the S. E. point of Aruba, Seroe Colorado, the limestone became changed into phosphorite.

Large deposits of diorite-detritus occur especially along the South- and Westcoast, brought there by the "rooien" (small rivers that contain water only in the rainy season) from the low diorite-hills. This detritus lies partly on the limestone and must accordingly be very young; it is also possible that it lies partly under the younger limestone; of course it is difficult to determine whether in certain places the limestone-covering has disappeared, or whether it has never been there.

The younger geological history of Aruba was characterized by several slow changes of level, both in a positive and in a negative way (compare with Curaçao). These young movements can be distinguished by considering the way in which the limestone and the diorite-detritus occur on the island; also by considering the presence of coves in the diorite-monoliths, and the occurrence of a long, frequently interrupted shore-coralreef, rising for the greater part above sealevel (uplifted?), and lying before and parallel to the Southcoast.

In consequence of the N. E. and E. tradewinds a coralreef could not develop along the N., N. E. and E. coasts; but there many undercuts, wavecut chasms and coves occur in the rocks, the so-called "boca's". In front of the Westcoast only separate coralstocks are met with; possibly a reef could not grow here because of the sandy seabottom.

The very youngest geological features are the coastdunes, composed of limestone-sand, quartz-sand or of both, depending on the place of occurrence. They are found especially on the N.E., E. and W. coasts (N.E. and E. tradewinds). As in Curaçao (Schottegat) some handshaped inland-bay's with a junctioncanal to the sea can be found in Aruba; in distinction from the Schottegat these are either entirely or almost dry.

In the nineteenth and in the beginning of the twentieth century Aruba exported some gold; the gold was won partly from the many goldbearing quartzdikes in the diorite-batholith; since about 1914 the exploitation has been stopped. Also the phosphateworking in Seroe Colorado came to an end. Instead of these workings other soil-exploitations have been started; that is to say the mining of quartz for highway-construction (the quartz is used in the foundation of the new road between Oranjestad and Sint Nicolaas), and the digging away of socalled "fresh sand" (diorite-sand) for the fabrication of concrete and cement.