Geology. — *Geology of the surroundings of "St. Martha" and "St. Kruis". (Curaçao).* By L. W. J. VERMUNT and M. G. RUTTEN.

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In the surroundings of "St. Martha" and "St. Kruis", which area joins the already described surroundings of "Porto Marie" [1]) to the North, the geological boundaries have been partly sketched in roughly on the geological map of Curaçao by G. J. H. MOLENGRAAFF ("Geologie en Geohydrologie van het eiland Curaçao" 1929). This fact, and the scarcity of tectonical indications on MOLENGRAAFF's map induced us, when visiting Curaçao with some colleagues under the guidance of Prof. L. RUTTEN to survey this region more closely. The geology of this part of Curaçao can be characterized in a few words. A possibly cretaceous core of diabase is covered by the cretaceous "Knip" formation consisting of tuffs and cherts. It is strongly folded and covered unconformably by quarternary limestone. As the "Knip" beds have a large extension in the surroundings of "St. Martha" and "St. Kruis" it has been tried moreover to get better acquainted with the stratigraphy of the "Knip" formation by the drawing of some detailed sections.

Stratigraphy of the "Knip" and the occurrence of diabase in the "Knip".

One of the finest sections was found on the Seroe Wara-Wara, which is situated about 1 km. West of "landhuis St. Kruis". In this section we find from East to West lying upon the diabase (observation W. 181 on the detailed map fig. 1) the "Knip" developed as thin shale layers alternating with limestones, siliciferous-limestones and chert (W. 182—183), the dip being mainly very steep to vertical. Farther to the West we meet with a fairly broad zone of clastic diabase breccia which under the microscope proves to contain strongly altered diabase fragments which are for the greater part chloritized and impregnated with secondary quartz. The cement is calcareous. In places the rock changes into a limestone with many diabase fragments. Then we come again into limestones and siliciferous limestones till observation W. 184 where a rather broad area of diabase begins. The rock is strongly weathered and calcite-bearing. The slides of this diabase (D 12005, 12006) [2]) show in some places an

[1]) Geology of Central-Curaçao. These Proceedings, XXXIV. 1931. p. 271—276.

[2]) The D. numbers refer to the collection of microscopical slides in the Geological Institute of the Utrecht University.

ophitic structure; the feldspars are chloritized and filled up with secondary quartz. The big and small augites are crumbled. On the diabase lie again

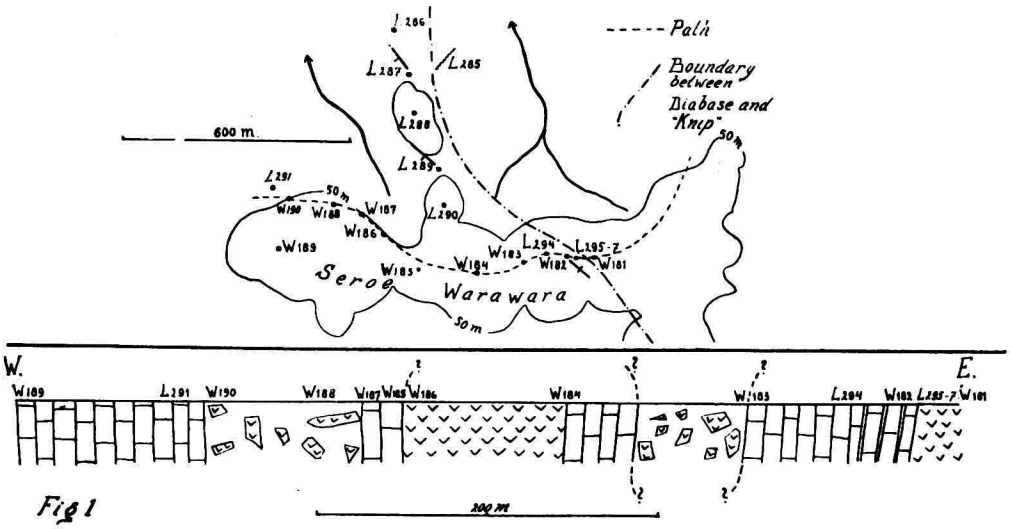

Fig. 1.

limestones and siliciferous-limestones and a calcareous diabase-breccia, the former developed only as a thin layer. The diabase-breccia here not only contains diabase fragments but also chert grains. To the West we find thick beds of cherts and siliciferous-limestones. Possibly we might assume the "Knip" beds East of the diabase area (W. 184—185) as being an infolded syncline in the diabase, whereas it is also possible that the diabase (W. 184—185) is intrusive or intercalated in the "Knip" beds. In this case part of the Curaçao diabase would be younger than the oldest part of the "Knip".

A similar outcrop of diabase and equally difficult to account for, was found South-West of the Seroe Pilaar. Here too we may interpret the outcrop as an eroded centre of an anticline or as a younger intrusion or intercalation of diabase in the "Knip". As we never found any veins of diabase in the "Knip" beds we consider the former opinion the more likely.

Two sections, quite near to each other, were surveyed South-East of "landhuis Groot St. Martha" (fig. 2). The eastern section L. 245 consists of a thick complex of chert and siliciferous limestones in which we find thin layers of tuffaceous material e.g. plagioclase-tuff, and a thin layer of a sandy mica-shale. The thickness of the whole section amounts to about 200 metres. We consider the western-section (L. 241.) as the southern continuation of L. 245. The complex of L. 245 should have be found north of L. 241 and though outcrops are scarce in this region this supposition is supported by observation W. 106 where we found chert. Section L. 241

begins from the north to the South with chert (obs. W. 106 and L. 241a) followed by a diabase region from 241a to W. 102 and possibly farther to the South as far as W. 101, where we found again chert. As there

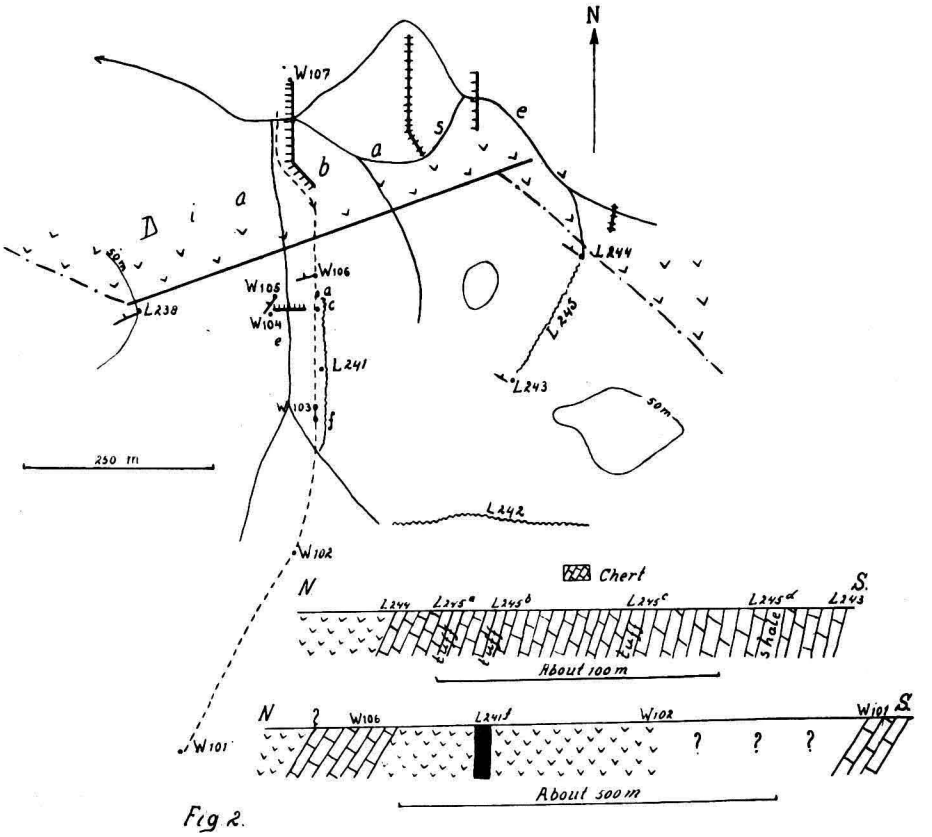

Fig. 2.

are no outcrops from W. 102 to W. 101 nothing positive can be said, however. This diabase region was not found South of L. 245; there are no outcrops. The diabase is very weathered; various slides (D 12038, 12003) show an ophitic structire, the feldspars are strongly polluted and partly sericitized. In the diabase area, at 241*f* we found a strongly weathered veinrock, probably a malchite, as the slide contained oblong phenocrysts of hornblende and smaller plagioclase phenocrists; the matrix consisting of hornblende and plagioclase crystals. The thickness of the vein must be more than 5 metres. Here also we are inclined to regard the diabase zone L. 241c—W. 102 as the core of an anticline. About 400 m. North-West of L. 241 we find a porphyrite-tuff, which is probably a downfold in the diabase region.

Section Seroe Commandant; foreign material in the "Knip".

The section at the Seroe Commandant North-West of "landhuis St.

Kruis", begins with chert, silicificated shale, siliciferous limestones followed by hitherto unknown sub-conglomeratic-beds, which have no resemblance with the conglomerates of the "Midden Curaçao" strata,

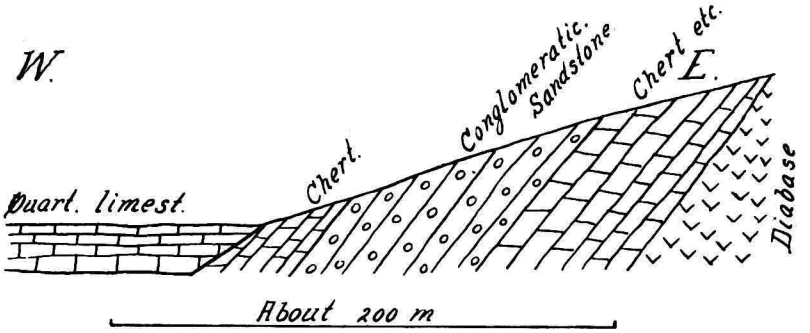

Fig. 3.

though they have common constituants. As the covering layers consist of chert they belong undoubtedly to the "Knip" strata.

The constituants of the conglomerate are: (D 12032, 12031.)

1. Big rounded and angular quartz often cataclastic or quartzitic.
2. Rounded and angular plagioclase fragments; the plagioclase is mainly polluted and shows fine twin-lamellation.
3. Numerous rounded grains of a mica-schist consisting of a fine quartz-aggregate and well trended mica scales.
4. Strongly weathered effusive rock, possibly a porphyrite.
5. A piece of rounded quartz-sandstone and a quartz-plagioclase sandstone.
6. Numerous grains of albite-aplite showing a granophyric intergrowth of quartz and albite.
7. Large idiomorphic hornblende crystals.
8. Possibly a large idiomorphic polluted orthoclase intergrown with quartz.

Part of this constituants were also found near Lagoen (D 12018, 11999) and 800 metres North (D 12035) and 600 metres South-East of landhuis "Knip" (D 12014) in coarse sandstones, intercalated in shales and chert layers [1]). Moreover we found in these slides grains of chlorite-micaschist and amphibolite. The foreign constituants which are the same as mentioned in the "Midden Curaçao" strata must originate from outside Curaçao, as already explained in the discussion of the "Midden Curaçao" strata [2]).

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[1]) This findspot is situated slightly to the North of the Northern boundary of our map.

[2]) Geology of Central-Curaçao, l.c.

Variability of the basal-beds of the "Knip"-strata.

Comparing the described sections (Fig. 1, 2, 3) we state the remarkable fact that the basal-beds of the "Knip"-strata vary strongly in composition in different parts.

Dykes in diabase and "Knip".

We mentioned and described a vein-rock in section L. 241 as possibly a malchite. Rocks of the same constitution, always strongly weathered

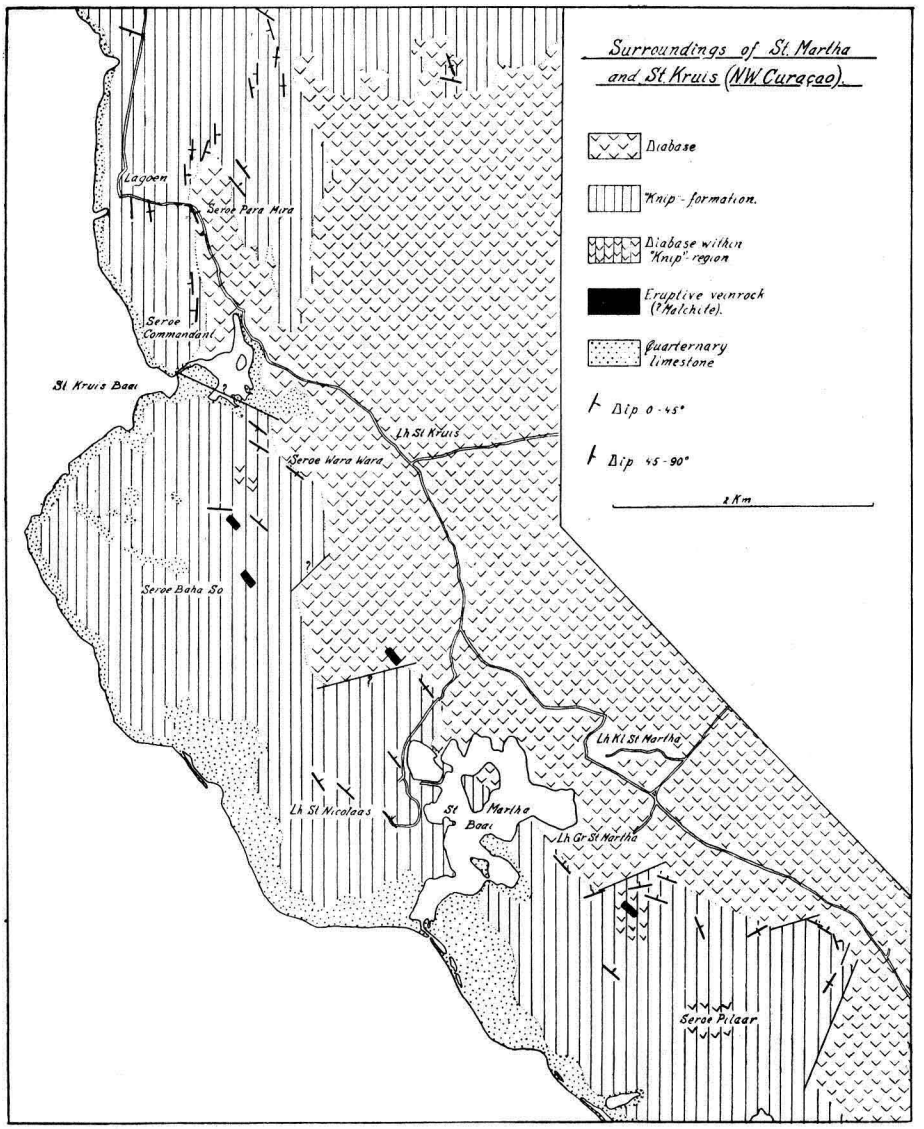

Fig. 4.

were found on several other places i.e. in the diabase North of "St. Nikolaas", in the "Knip" East and North-East of the Seroe Baha-So and 1800 m. West-North-West of landhuis "St. Kruis". The zone of veins runs more or less N. 135 E, which agrees with the general strike of the strata in this part of the island.

We have called all these rocks "Malchites"; it is, however, possible that they are closely connected with the "Vintlites" described by MOLENGRAAFF (l.c.) from the East of the island. Their state of preservation is not sufficient to decide their exact pretographic position. They are genetically connected with the described albitite from "Midden Curaçao" and with the quartz-diorite in North-West Curaçao described by MOLENGRAAFF.

Quarternary limestone on the "Seroe Baha-So."

South-West of "landhuis St. Kruis" we find on the "Seroe Baha-So" and a little to the North hitherto unknown quarternary limestone. The boundaries of the quarternary limestone have been in other regions partly sketched in following the topography.

Occurrence of diabase-breccia.

Still should be mentioned the occurrence of an eruptive diabasa-breccia East of the "Seroe Para-Mira" and the "Seroe Francisco Jobo" in the great diabase-core.

Tectonics.

The "Knip" is on the whole strongly folded and overturned, the inclination being mainly to the East, thus dipping under the diabase. In the southern part of the map we find a number of transverse-flexures some of which attain the size of one km. The transverse-flexures we find South of "landhuis Groot St. Martha" are not only indicated by the boundary Diabase-"Knip", but also by the change of direction of the strike as is clearly visible on the map. In some cases e.g. with the flexure 1 km. South of "Groot St. Martha", we could easily follow the turning of the strike of one chert layer, being first N 135 E and changing to N. 75 E, then continuing in the old direction. The Northern transverse-flexures are sketched in with a question-mark as no strike-observations were made. Their position is not quite sure.