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THE CLAY MINERALS FROM THE BORING ALLIANCE-28, SURINAM

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ABSTRACT

The clay mineralogical composition of about 75 samples is reported. Kaolinite and anatase are always present, and in some layers these are the only minerals in the clay fraction. In other layers kaolinite is associated with montmorillonite and/or disordered illite-montmorillonite mixed-layer minerals. In two layers illite is found, but always associated with the other clay minerals. In some samples traces of vermiculite and pyrite occur.

METHODS

The clay fraction ($< 2\,\mu$) was obtained in the usual way by sedimentation and decantation. The material was then treated with H_2O_2 to remove the organic matter, with Na-dithionite to remove ferric oxides and hydroxides and with Ca-acetate to replace all exchangeable cations for Ca^{++}.

Of this material X-ray photographs were taken in a Nonius quadruple Guinier-de Wolff camera, using CuKα radiation. Of most of the samples diffractograms were recorded by means of a Hilger-Watts diffractometer.

The identification of the clay minerals was based upon the following observations.

Kaolinite was identified from the 7.15 and 3.57 Å basal reflections and from the characteristic 2.34 and 1.486 Å non-basal reflections.

Montmorillonite was identified from the basal reflection at about 15.4 Å which shifted to 17 Å upon glycolation and to about 10 Å after heating to 270°C or 550°C, and further from non-basal reflections at 2.58 and 1.49 Å.

Illite was identified from the 10 and 5.0 Å basal reflections and from the non-basal reflections at 2.59 and 1.50 Å. The polytype could not be determined, owing to the poor cristallinity.

Mixed-layers were found to be present. The diffractograms often showed a continuous transition from 10 Å onwards to higher interplanar spacings. On heating only the 10 Å line remained, so the mixed-layers are of the disordered montmorillonite-illite type.

Vermiculite was identified from small peaks in the diffractograms at 14.4, 13.8 and 11.8 Å, representing various dehydration phases. The 1.53 Å reflection could not always be observed in the photographs.

Quartz was identified from sharp reflections at 4.25, 3.34, 1.817 and 1.541 Å on the photographs.

Pyrite was identified from sharp reflections at 3.13, 2.71, 2.42, 2.21, 1.915 and 1.63 Å.

Anatase was identified from one reflection at 3.51 Å, visible on the photographs only. The reflection was not due to chlorite because (1) the 14 Å reflection was not present and (2) it remained with the same intensity after heating to 550°C.

RESULTS

The results have been compiled in fig. 1. No attempt was made to give a quantative or even semiquantitative phase analysis, since the methods, known at the time the diffractograms were made, proved to be too unreliable. The crosses in the figure give a qualitative estimation in this sense that it is tried to show the differences when going from one sample to another. Therefore the total number of crosses for one sample is not constant.

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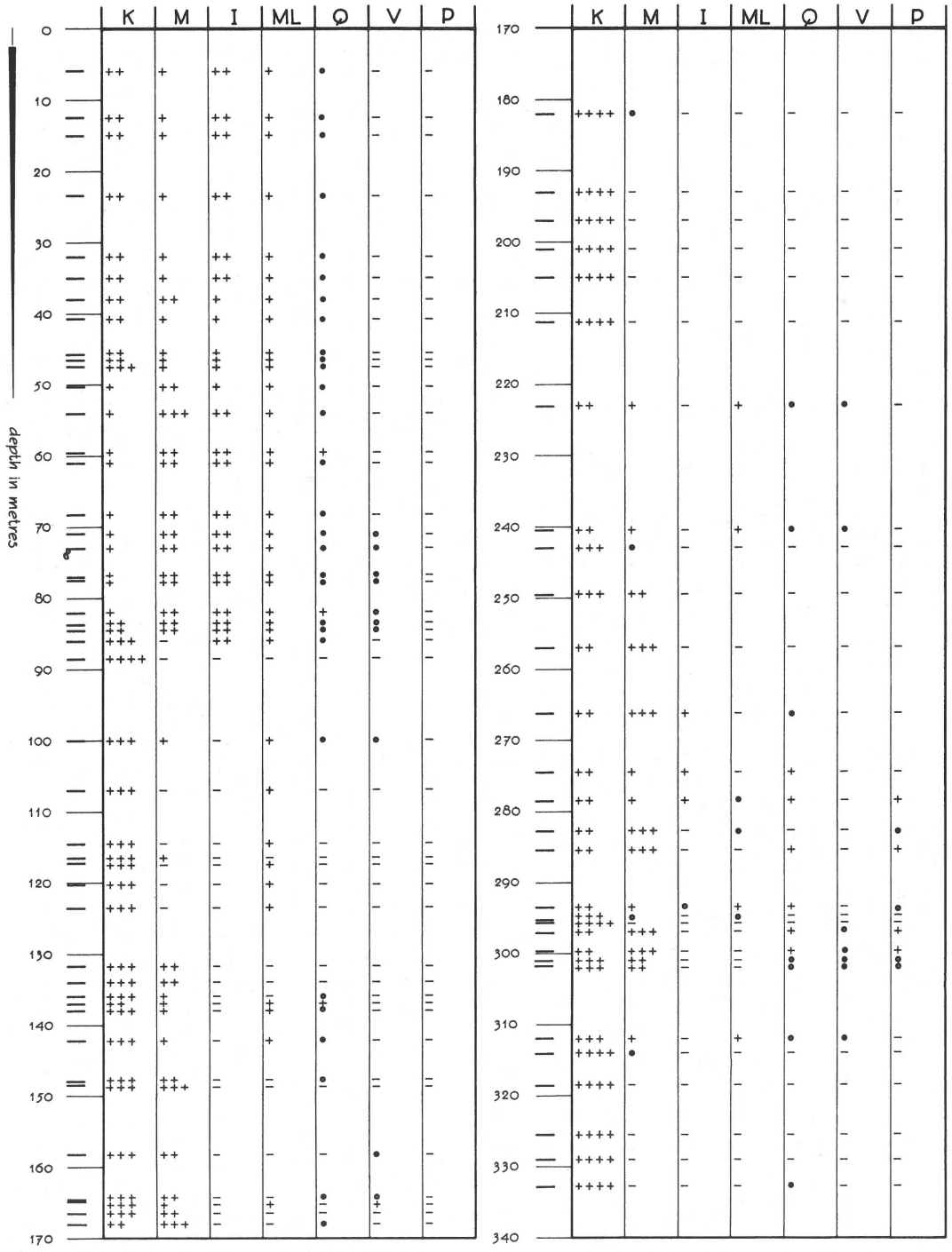


Fig. 1

Qualitative mineralogical analysis of the clay fraction $< 2\mu$. K = kaolinite, M = montmorillonite, I = illite, ML = mixed-layers, Q = quartz, V = vermiculite and P = pyrite. The relative amount of each mineral is indicated by crosses: ++++ = one component only, containing at most traces of other minerals; +++ = abundant; ++ = present in moderate amounts; + = present in small amounts; traces are indicated by a dot.

Two minerals were found to be present in all samples: kaolinite and anatase. Perhaps in some cases the kaolinite may contain some metahalloysite as well. The intensity of the anatase line is fairly constant and seems to be quite independent of the amount of kaolinite present.

Illite is always present and mostly in important quantities in the first 87 metres. Here a very clear boundary occurs. No illite is observed at greater depths, except between 260 and 294 m, and then only sparsely. After the boundary a relatively thin layer (a few metres) occurs, in which kaolinite is the sole clay mineral. This is followed by a layer of about 80 metres thickness in which kaolinite is the dominant clay mineral. It is accompanied by various amounts of montmorillonite mostly in the lower parts of this layer. Going still deeper a layer of about 30 metres thickness follows in which again kaolinite is the sole clay mineral and in which it is well crystallized. At the end of it, at a depth of about 212 m, the kaolinite is associated again with montmorillonite in a 100 m thick layer. In the middle of this layer illite is again found to be present. The next layer, from about 313 m onwards, contains again kaolinite only, which is often well crystallized.

Vermiculite, if present, seems to be associated with the occurrence of montmorillonite. It is curious that vermiculite occurs just outside the layers that contain kaolinite only as clay mineral, and mostly above these layers.

From a macroscopic lithological point of view at various places glauconite-containing clay or sand occurs. It now appears that the clay fraction does not contain the mineral glauconite. What is macroscopically described as glauconite may either have dimensions larger than $2\,\mu$, or consists of other clay minerals with a greenish colour as illite or montmorillonite or even vermiculite.

Two minerals of common occurrence, namely chlorite and gibbsite are entirely absent.

Contamination of the samples with the drilling mud that contained bentonite is believed to have occurred on a very small scale, since there is no correlation between the occurrence of montmorillonite and the plasticity of the rock (unconsolidated or hard).

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