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BORON CONTENT OF CORE SAMPLES FROM ALLIANCE-28, SURINAM, AS AN INDICATOR OF PALAEOSALINITY

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ABSTRACT

The boron content of the clay fraction of 66 samples from the 338-m deep core hole Alliance-28 in Northern Surinam, indicates a marine palaeosalinity in the Paleocene-Eocene interval at about 295, 240 and 223 m depth, in the Pleistocene interval at about 80 m depth and also in the larger part of the Holocene interval. It furthermore suggests deposition in (almost) fresh water in the upper and lower part of the Paleocene-Eocene interval and in the Pliocene interval. Brackish water is indicated for some parts of the Paleocene-Eocene and the larger part of the Pleistocene intervals.

The boron content is relatively high (60-140) ppm) in the clay fraction of calcareous and/or glauconitic sediments, markedly less (30-60 ppm) in sediments intercalated with brown coal and generally lowest (10-40 ppm) in white kaolin layers.

INTRODUCTION

The boron content in brackish, marine and, to a certain extent, also in hypersaline waters runs parallel to the salinity. After it was discovered that clay may fix the boron, a systematic relationship between environmental salinity and boron content of a sediment, or of its clay fraction, was established (H a r d e r, 1963).

Detailed investigations have shown that a sediment's boron content depends mainly on the boron concentration in the depositional environment (about 4.5 ppm B in sea water), the temperature, the time of contact and the rate of deposition, the origin of the sediment ("inherited" boron), the mineralogical composition, the particle-size distribution and the presence of amorphous materials (P o r r e n g a, 1967 a).

Regionally however, in a related group of sedimentary rocks, a salinity change may simply be inferred from a change in the boron contents, relatively low contents indicating deposition in fresh water and higher contents indicating deposition in more saline waters.

The relationship boron content-palaeosalinity is disturbed if post-depositional processes, such as diagenesis or contamination by boron-containing formation water, cause alterations in the clay composition. Also, the sedimentary clay may alter during tropical weathering and laterite or kaolin formation, with the result that any connection with the original salinity may disappear.

At the request of the Geological Survey, The Netherlands, 66 samples, covering about 335 m of Quaternary and Tertiary sediments, were analysed for their boron content. Based on these boron data a tentative interpretation of the gross-palaeosalinity of the depositional environment is given.

METHOD

Since the finest material of a sediment is mainly responsible for boron fixation, the clay fraction (< 2 microns) was separated from each sample and used for the determination of the boron content. The complicating influence on the boron content of varying proportions of quartz and other minerals that do not fix boron, is thus largely eliminated. This results in more reliable comparisons between the boron data found. If the amount of clay fraction < 2 microns was not sufficient for analysis, the limit was extended to 4 or 8 microns.

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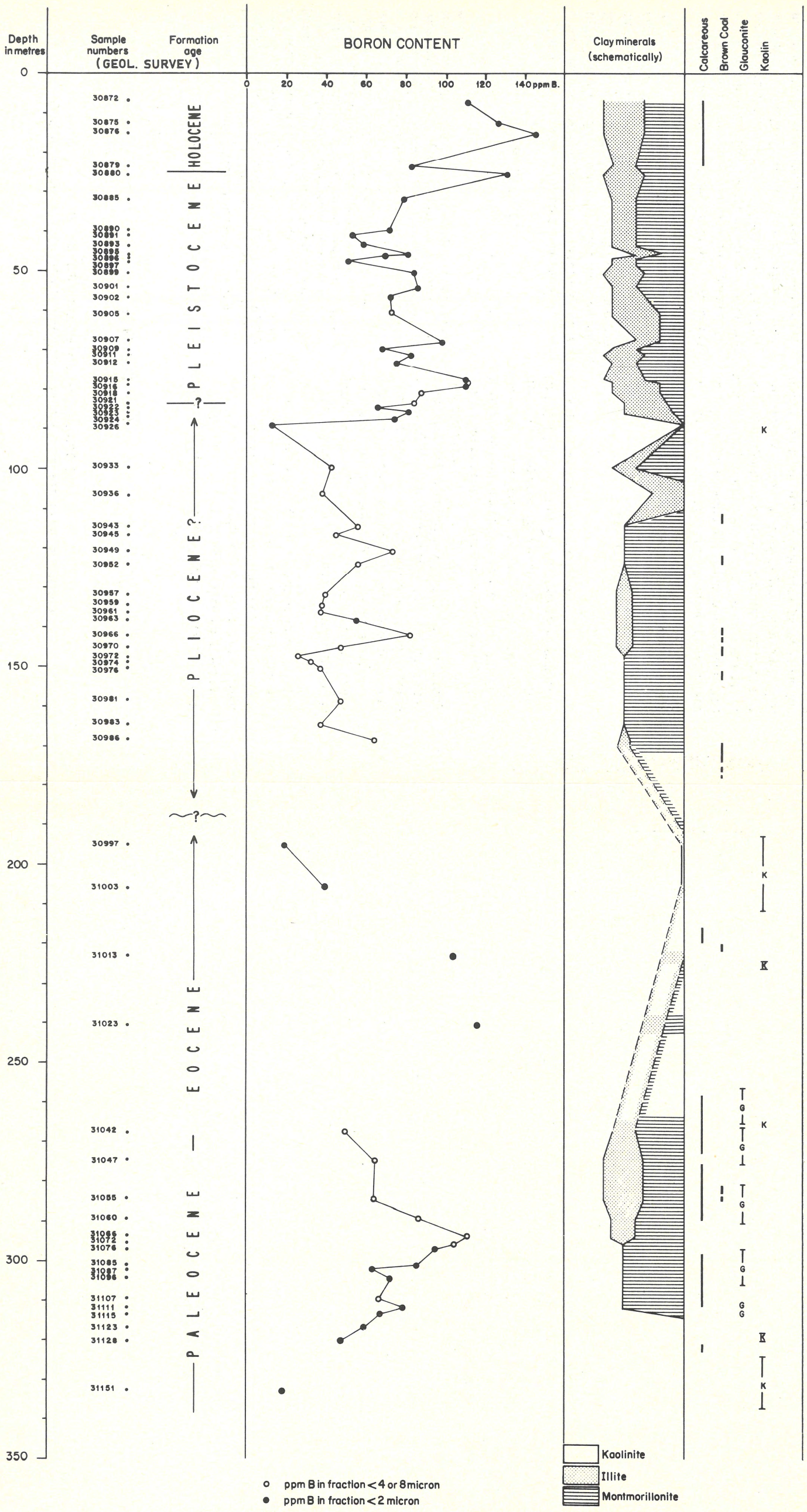


Fig. 1
Boron content in samples from Alliance-28, Surinam.

The boron content was determined by an emission-spectrographic method (P o r r e n g a, 1967b); the error involved in the determination is about 10 per cent of the reported value. Figure 1 shows a plot of the boron content together with some lithological data and the age interpretation as given by the Geological Survey. Figure 1 also shows a plot of the clay minerals in the fraction $< 2\ \mu$ as found by means of X-ray diffraction analysis. In view of the palaeosalinity interpretation it was considered necessary to find out which samples were composed of kaolinite only. These were omitted from the interpretation.

RESULTS AND TENTATIVE INTERPRETATION (see fig. 1)

The sequence was divided into 5 intervals, which are discussed separately below.

a. *265 to 338 m (Paleocene-Eocene)*

The boron content gradually increases from about 20 ppm in the lower part of this interval to a maximum of about 110 ppm at 295 m depth, followed by a gradual decrease to about 50 ppm at a depth of 270 m. Boron contents of 100 to 140 ppm in clays composed of about equal amounts of kaolinite, montmorillonite and illite are normal for sediments deposited in sea water.

The conclusion is that at about 295 m depth the palaeosalinity was similar to the salinity of sea water. Below and above this depth the palaeosalinity was probably somewhat lower and at about 330 m depth the environment was probably a freshwater one.

The sediments generally are calcareous and contain glauconite, at least those containing more than 50 ppm B.

b. *170 to 265 m (Paleocene-Eocene)*

Only four samples from this interval were analysed. Two of them have a high boron content indicating deposition in water with a marine salinity. The two other samples have a low boron content, but any conclusion about deposition in fresh water may not be justified as both samples are kaolins.

c. *90 to 170 m (Pliocene ?)*

The mean boron content is about 50 ppm. It is likely, therefore, that the sediments were laid down in fresh or almost fresh water, well inside the shore line. Variations in the boron content probably reflect changes in the (low) salinity.

There are many brown coal intercalations in this interval.

d. *30 to 90 m (Pleistocene)*

The mean boron content of about 80 ppm indicates that the sediments have been in contact with salt water, with a salinity ranging from brackish to marine. Notably at about 80 m depth, a marine palaeosalinity is likely.

To what extent some post-depositional salt water penetration from the overlying Holocene strata has occurred is not known.

e. *0 to 30 m (Holocene)*

The mean boron content of about 120 ppm is in agreement with the marine environment of deposition as deduced from the presence of faunal remains.

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