## 5. Structure of the "fossil valley" at Nare

The excavation for the construction of the subsurface dam at Nare revealed a whole section of the "fossil valley" and thus made it possible to study its structure in detail. Fossil valleys are frequently found in West Africa, in particular in the Niger River basin where some test drillings have already been conducted. However, this project was probably the first example of direct inspection of the structure of a fossil valley through a full-section excavation.

The information obtained at the subsurface dam site is as follows. A geological cross-section of the fossil valley is shown in Fig. 5.1.

(1) Shape of the "fossil valley"
The revealed fossil valley had a width of about 130 m at its bottom and about 180 m at the top of its side slopes. The bottom of the valley was not flat, but slightly undulating in the shape of "W". Its depth varied from 5.9 m at the shallowest part around the center of the bottom to 8.3 to 8.5 m at the deepest part.

The side slope of right bank was relatively steep with a declination of about 30 degrees, whereas the declination of the side slope of left bank was between 9 and 10 degrees.

This fossil valley was thought to be buried along the present Kolongo River.

(2) Characteristics of the "fossil valley sediment"
The sediment that buried the fossil valley (the fossil valley sediment) was classified roughly into the following layers:

1) Deposit of the present flood plain
This was the surface layer that was probably deposited by the floods of the present river. This layer, which was 0.3 to 0.7 m thick in general, mainly consisted of clay, sand and organic soil. In some places, its lower layer, the “upper stratum of the fossil valley”, was exposed on the ground surface.

2) Upper stratum of the fossil valley
This was clayey or silty sediment extending just under the “deposit of the present flood plain” to 4 to 5.5 m below the ground surface. This stratum contained sandy layers in the form of a 0.5- to 1-m-thick belt or lens. During the construction of the subsurface dam, there was a great quantity of water springing from these sandy layers, which prevented excavation work for a while.

3) Lower stratum of the fossil valley
This stratum, which extended from 4 to 5.5 m below the ground surface down to the bottom of the fossil valley (except some parts), consisted of layers of sand, granules, silt and lignite. The boundaries of these layers were relatively clear. Each layer had an interfinger or massive structure. The sand layers had partial cross-lamination. Most of the granules and the coarse sand seemed to have their origin in the oolitic concretions of the lateritic crust.

There were penetrations in the form of an interfinger of the silty or sandy layers, which were classified as the “upper stratum”, into some parts of this “lower stratum”. The distinction between the “upper stratum” and the “lower stratum” was thus not very strict.

4) Basal stratum of the fossil valley sediment

At some parts between the “lower stratum” and the basement rock, a stratum of hard silt rock interposed. Its clear unconformity with the “lower stratum”, and its advanced compaction and cementation compared with the other fossil valley sediment that had an unconsolidated or semi-consolidated state showed that this stratum of hard silt rock was formed much earlier than the “lower stratum”.

In the lower part of this “basal stratum”, a piece of angular gravel was observed. It is probably a remnant of the fluvial deposits dating back to when the fossil valley was formed by active erosion by the old river.

5) Basement rock

The bottom and the side slopes of the fossil valley consisted of basement rock (old age rock) that had the appearance of contaminated rock composed of granite, diorite, amphibolite and slightly metamorphosed sedimentary rock. The basement rock of the right bank of the valley was covered with a hard, lateritic crust about 3 m thick.

On the basement rock of the bottom of the fossil valley, a fault (argillized zone 0.5 m wide) with a strike slightly oblique to the direction in which the fossil valley extension was observed. On the basement rock around this fault, fractured or heavily argillized zones were also observed.

(3) Difference in hydraulic characteristics among the constituent layers of the fossil valley

The permeability coefficients of the sand layers in the “upper stratum” and in the “lower stratum” of the fossil valley sediment were estimated to be $10^{-2}$ to $10^{-4}$cm/sec. On the other hand, those of the silt, the cemented sand and the lignite layers fell to $10^{-6}$ to $10^{-7}$cm/sec.

The excavation for the construction of the subsurface dam encountered perched water (groundwater that accumulates in the lens shape above the "main" groundwater), from which a great quantity of water sprang. The presence of this perched water can be explained by a significant difference, as described above, in the permeability coefficients among the constituent layers of the fossil valley.

At the part where the boundary between the “upper stratum” (silty layers) and the “lower stratum” (sandy layers) was clear, there was a space 0.5 to 3 cm wide between both strata. On the roof of this space, there was thick "water grime", which indicated that this space had been a groundwater channel for a long period. （See Fig. 5.1）

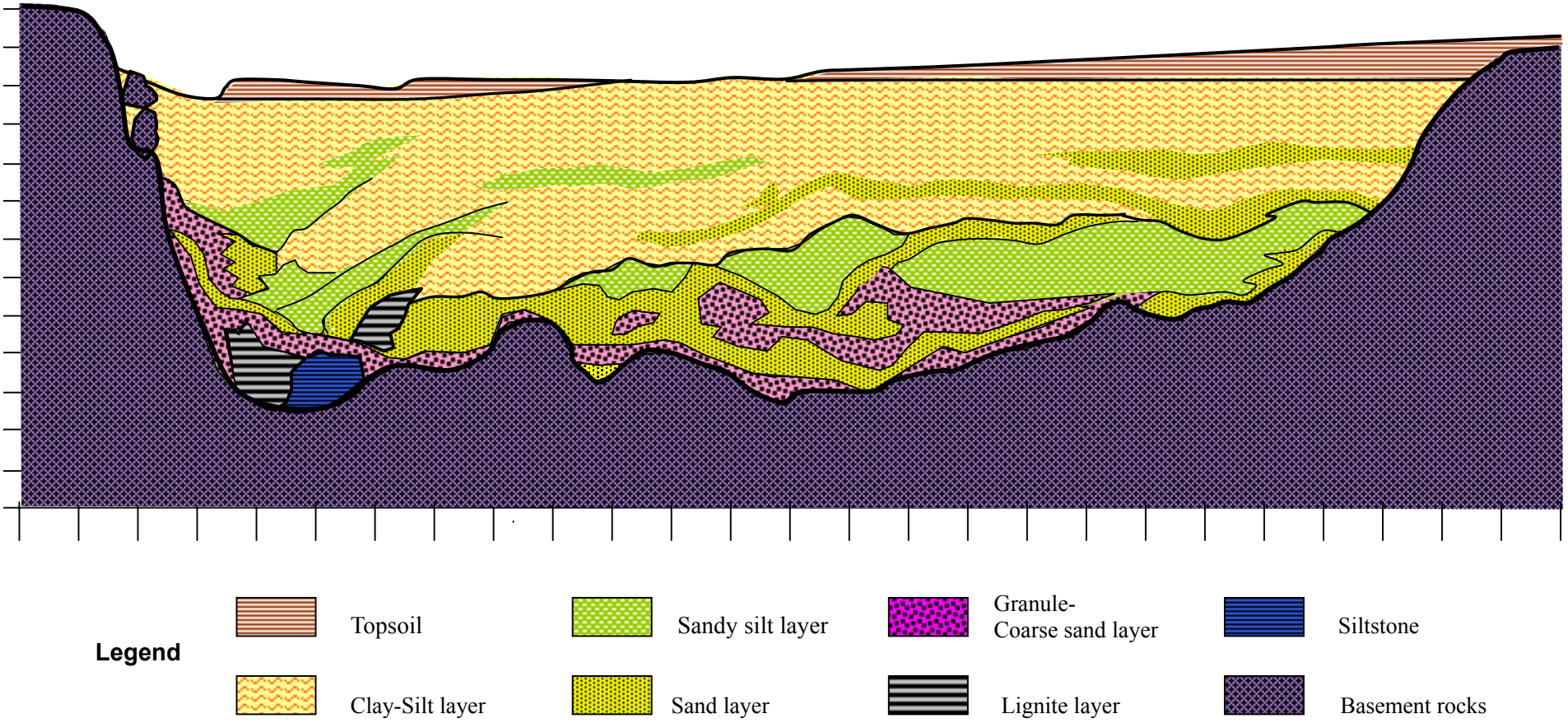


Fig.5.1: Geological cross-section of the "fossil valley" at the subsurface dam site (upstream excavation profile)

Note: The vertical scale of the profile is different from the horizontal scale.