Sedimentological and mineralogical characteristics of muds from two intertidal zones, French Guiana.

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This study is the first step of a project on the fieldwork of French Guiana, which aims to characterize physical properties of muds from the Amazonian coastline. The main purpose is to improve the knowledge of deposition / erosion and the consolidation processes using the study of sedimentological and mineralogical properties of fine sediments.

Two studied cross-shore lines (Fig. 1) were chosen in relation to their distinct morphology, energy and plant cover.

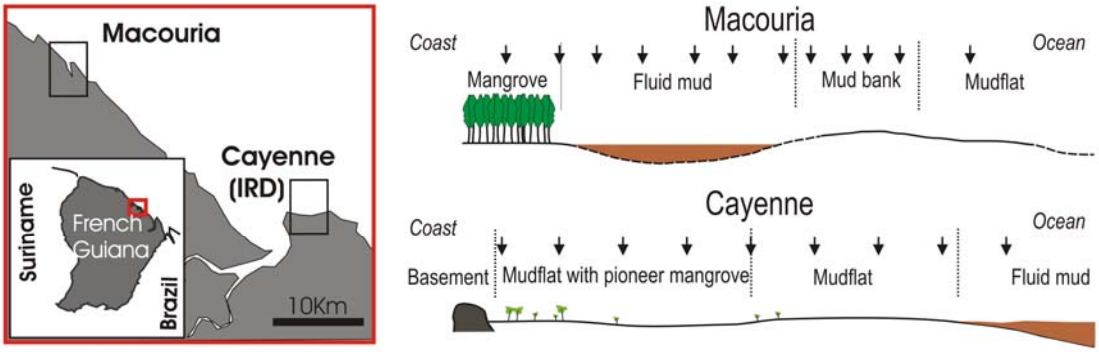


Figure 1: location and sketch of the two studied cross-shore lines: Macouria and Cayenne. The arrows indicate the sampling location.

The first one is located near the mouth of the river Macouria between a coastline in erosion with a well developed mangrove and a mud bank. The second one is located at Cayenne in front of the IRD (Institut de Recherche et de Développement) and it extends from the coastal Precambrian basement to the fluid mud along a mudflat with pioneer mangrove.

Surface sediments and short cores were sampled in order to determine physical properties *i.e.* concentration, shear strength, grain size distribution and mineralogy.

Concentration and shear strength measures on surface samples evolve according the topography. Indeed, the concentration of the "Macouria" sediments is about 700g.l^{-1} on stiff muds in mangrove (Fig 2) and the shear strength is about 80kN.m^{-2}. Inversely, the values of the fluid mud decrease strongly to reach 326g.l^{-1} and 43N.m^{-2} for the concentration and the shear strength, respectively. The mud bank presents logically increasing values (concentration: 450g.l^{-1} and shear strength: 55kN.m^{-2}). The same conclusion is given for the IRD cross-shore line.

On the two areas, grain size distribution and mineralogy appear to be homogeneous (Fig 2). Some slight variations are observed according the shear strength data. In fact, soft muds are mainly composed of fine silts and illites, stiff muds of coarse silts and quartz. The comparison between the two studied cross-shore lines shows broadly a coarser grain size and stronger shear strength for the Macouria area.

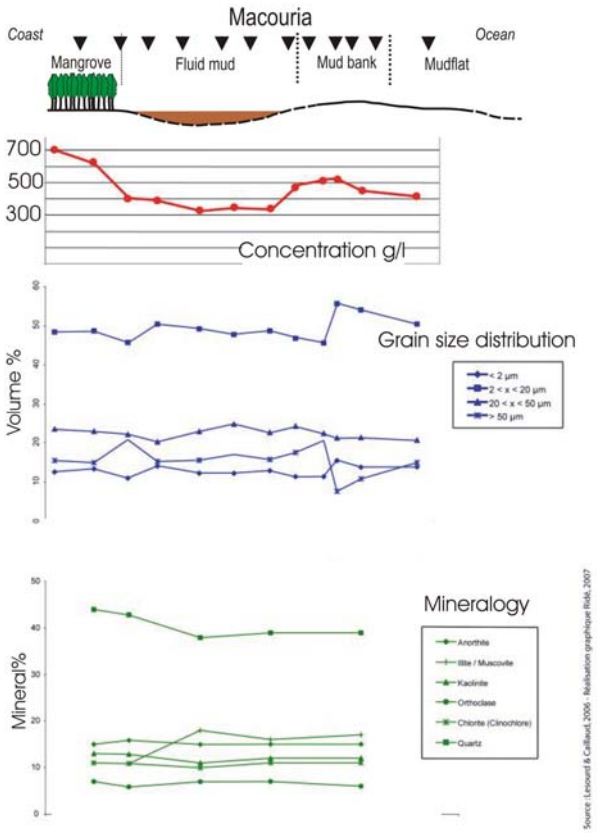


Figure 2: Examples of data (concentration, grain size and mineralogy) for Macouria area.

The observation of whole cores evidenced thin tidal layers, especially for the "Cayenne" area at the vicinity of the basement. They were sometimes difficult to distinguish (area next to fluid mud lake), where mud appears to be macroscopically homogeneous.

Specific X–ray technique applied on whole cores allows well discriminating the thin tidal layers (Fig. 3). Dark layer corresponds to a dense material and indicates a coarser grain size. It is associated to a flood deposit. At the opposite, the light layer affiliates to a finest material deposited during slack period.

Planar bedding and wavy bedding structures are evidenced in Cayenne and Macouria areas, respectively, and depend of the hydrodynamic factor. In Cayenne area, hydrodynamic is mainly influenced by tides, swell being amortized during its propagation on fluid mud lake. Sedimentary structures are typically planar bedding layers. In Macouria area where swell influence is more significant, sedimentary structures are typically wavy bedding layers interpreted as planar bedding layers disturbed by swell propagation.

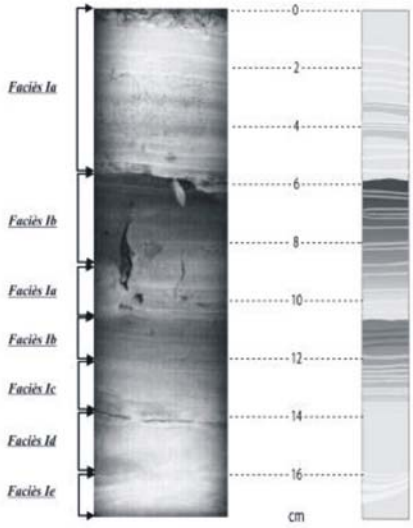
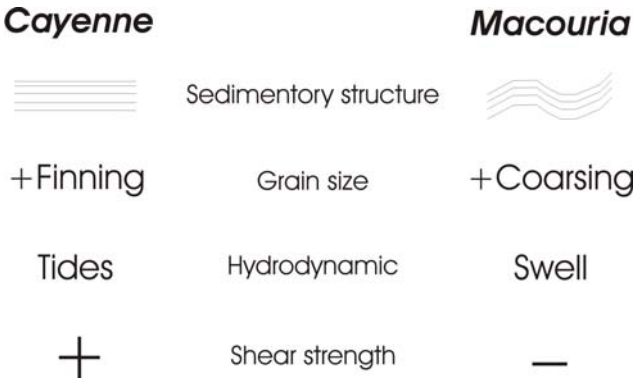


Figure 3: X-ray radiography of a short core – Cayenne (IRD4)



In conclusion, physical properties generally evidenced a homogeneous deposit on the two intertidal zones. Grain size distribution is mainly represented by fine silt whereas the mineralogy is dominated by quartz and clay minerals (illite). Whether mud appears to be macroscopically homogeneous, X-ray technique allows discriminate thin tidal layers (Fig. 4).

Figure 4: Interpretation of data: comparison of Macouria and Cayenne areas

Interpretations of the obtained data are proposed in the hydrodynamic cycle framework of fine sediments from the Amazonian coastline.