SHORT PERIOD VARIABILITY OF THE CLAY MINERAL SUSPENDED SUPPLY OF A MICROTIDAL ALGERIAN ESTUARY.

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Abstract

The variability of the clay mineral supply at the mouth of a small microtidal Algerian estuary is studied from time series of repeated annual cycles. The annual cycle of the Mazafran river was divided into six dynamic stages which govern the variability of the mineral content of the suspended material. The coarse minerals such as illite or quartz and/or dense as calcite are more present during the strongest dynamic phases (floods). The small minerals as smectite overfloat in the suspension during low dynamic phases, whereas the large ones settle rapidly. Kaolinite follows the decreasing hydrodynamics. This pattern could be applied to other small Mediterranean rivers.

Key-words : Algerian basin, estuaries, river input, mineralogy

Introduction

The Mazafran river estuary lies thirty kilometers west of Algiers (Algeria). It flows on the North-Algerian margin into the western Mediterranean Sea. During an annual hydrological cycle, the clay mineral content varies largely in the estuary of the Mazafran river although its drainage basin is of a small size (about 1850 km^2). The riverine dynamics of the Mazafran river is highly influenced by the semi-arid characteristic of the Mediterranean climate of its drainage basin. Due to its microtidal environment a salt wedge appears at the beginning of the low waters and disappears with the first flood (1).

The strategy of the present work is a weekly sampling of the suspended material carried out during several years at the river mouth. River dynamics was studied and the nature and quantity of its suspended supply were examined to understand the variability of the clay mineral composition in a microtidal Mediterranean estuary.

The phases of the annual cycle of the Mazafran river

The annual cycle has two seasons : the flood season, typically from November-December to March-April, and the low water season from spring to autumn. Their respective duration is highly variable from one year to the other (2).

The dynamic phases of the annual cycle of the Mazafran river were defined by the suspended matter characteristics (concentration, particulate organic carbon percent -POC%-, microflora) and related to the mean daily freshwater discharge. The flow phases have been divided into five stages numbered from I to V (fig. 1). During the rising flood (stage I), suspended matter concentration increases drastically from $mg.l^{-1}$ to several $g.l^{-1}$. Its organic content (POC%) lowers strongly from low waters values (>10%) to a few percent. The flood peak (stage II) is the most dynamic period : suspended matter concentration is the highest (to 25 $g.l^{-1}$ in the Mazafran river waters), and the POC% is the lowest (0.4%). When flood lowers (stage III), the discharge and the suspended load decrease respectively to <10 $m^3.s^{-1}$ and about 500 $mg.l^{-1}$. At the same time POC% increases quickly to 10%. An interflood stage (stage IV) occurs sometimes between the peaks of repeating floods. The interflood dynamics is rather high in spite of the low discharge and low suspended load (10 $mg.l^{-1}$). The organic content is relatively high (POC%>10%). Small floods (stage V) take place either during spring (May to June) or during autumn (October to December). Though discharge increases weakly (1 or 2 to 10 $m^3.s^{-1}$), its environmental impact is important, especially in autumn, because nutrients are supplied. The suspended load increases weakly (to 100 $mg.l^{-1}$) and POC% varies largely. It decreases from more than 30% to a few % at the peak of the flood and comes back to 20% a few days later.

During low waters, five others stages were defined (fig. 2) : the beginning of low waters (stage VI), summer low waters (June and July, stage VII), the long low waters stage in autumn (stage VIII), the optional very long low waters stage which can last to winter (IX), and at least the end of low waters (X). The transitory phase of low waters building (state XI) is always well marked. During these periods, the freshwater discharge is about zero, the particulate load is very low and its content is mainly biogenic and organic.

During the low water phases, the suspended matter has a low content in minerals because the particulate transport is not competent enough. Hence, clay mineral analysis is possible only during the rising (I), peak (II) and lowering (III) of flood, interflood (IV), small floods (V) and a set of indiscriminate low waters stages (VI).

Clay mineral content and its variability

During the annual cycle, the mineral content vary widely over short periods of time. Each dynamic phase is characterized by the mean values of mineral fractions.

Figure 3 shows the variations of the global mineral composition, expressed by the relative percent of total clay, calcite, quartz and other minerals characterized by diffractometry. The highest percentage of clays is observed during the stages of small floods (74%) and during the peaks of floods (69%). The lowest one is found during low waters (49%) which has to be explained. The amount of detritic minerals (sum of quartz and feldspars versus clay materials and calcite) follows an opposite variation with a minimum during floods (20%) and small floods (21%) and a maximum during low waters (41%). The quartz percentage of the detritic minerals is always high. It has two maxima during high (98%) and small floods (94%) and a low minimum during low waters (75%). Calcite presents two maxima, the first one at flood peak (9%) and the second other during low waters (9%) and it is minimum during small floods (3.5%).

Figure 4 shows the nature and the variability of the clay mineral content. Illite is often dominant and always high (about 34%). It is maximum during small floods (58%) and minimum during the rising flood stage (27%). Kaolinite is well represented during rising and flood peak (31%) and then decreases regularly during the others less dynamic stages to 14% only during low waters. Chlorite is more concentrated by low waters (22%) and also during flood rising (19%) but less during peak and small floods (12%). Smectite is well repre-

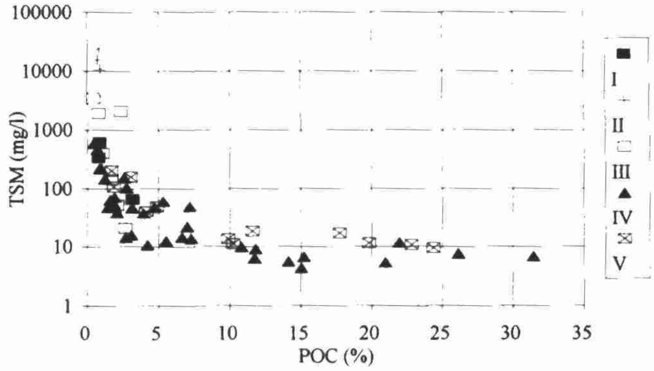

Figure 1 : suspended material characteristics during the various stages of the annual cycle in the Mazafran river estuary : flowing stages. (stages I to V, see text).

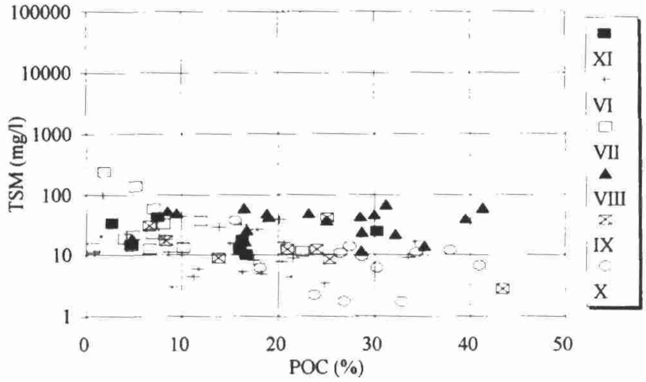

Figure 2 : suspended material characteristics during the various stages of the annual cycle in the Mazafran river estuary : low waters stages. (stages VI to XI, see text).