SIGNALS OF FLOOD DRIVEN PROCESSES RECORDED IN CHANNEL-LIKE STRUCTURES NEAR THE GRAND RHONE RIVER MOUTH

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Abstract
The study of sedimentary processes in the Gulf of Lions has been the topic of various works and is dealt today in the frame of several programs, like ORME (Mediterranean Regional Observatory of Environment), PNEC (Coastal Environment National Program) or EUROSTRATAFORM (UE-5th PCRD). However, the fate of river-borne sediments supplied during river floods is still poorly understood. Several major river-flow events occurred on the Rhone River in 1994, 2002, 2003. In the area close to the mouth, channel-like structures were investigated in order to assess their role in the sediment transport during flow events based upon analysis of granulometric parameters as well as ^{210}Pb and ^{137}Cs vertical profiles.
Keywords : Gulf Of Lions, Sediment Transport, Radionuclides.

Desciption of the studied area
With a catchment area of nearly 98800 km2 and a length of 812 km, the Rhone is the most important river of the western Mediterranean basin. Its average liquid flow rate is 1700m^3/s. Nevertheless, it can reach 13000m^3/s during exceptional flood period, for instance in December 2003. The Grand Rhone is thought to transport average annual amounts of 7.4Mt of sediments with high interannual variations [1]. Most of its annual sediment load is discharged during flood events. The area close to the Rhone River mouth is characterized by very high apparent sedimentation rates, i.e. 30-50cm per year, due to aggregation and floculation processes in the mixing zone between fresh and saline waters. Recently, channel-like structures have been reported on seabeam survey in this area. These structures may play a significant role in sediment transports during flood events. In order to better assess this role we analyzed cores from these structures regarding both their granulometry and their content in particle-reactive radionuclides (^{210}Pb, ^{137}Cs). ^{210}Pb is produced naturally while ^{137}Cs is a man-made radionuclide originating in this area from fallout arising from past atmospheric bomb testings and the Chernobyl accident and also from authorized released into the Rhone river by nuclear installations. Indeed, four power plants and the site of Marcoule with a reprocessing plant which is being dismantled since 1997 are installed along the Rhone banks.

Material and methods
Since 2001, IRSN has realised various cruises of sediments sampling in the Gulf of Lions. Among them, the REMORA 3 (November 2002) and BOBORHONE 2 (February 2004) cruises aimed at studying the sediment compartment in the close vicinity of the Rhone River mouth. The last quoted was carried out just after the exceptional flood that occurred in December 2003 with the highest flow rate ever recorded on this river.

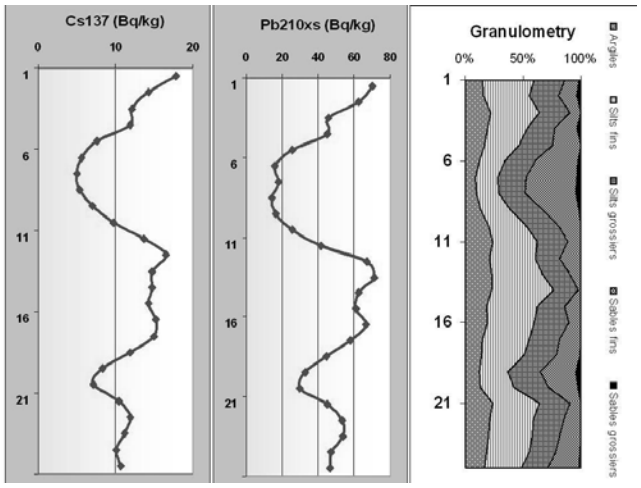

Fig. 1. (a) ^{137}Cs profile, (b) ^{210}Pb in excess profile, (c) granulometric profile sampled in a channel-like structure during REMORA 3

Multicorers were used to sample the channel-like structures at 30m depth. In the laboratory, samples undergo two kinds of analysis: granulometry and gamma spectrometry respectively realized with a laser granulometer Beckmann & Coulter 13320 and performed using Ge-detectors in a very low background installation in Orsay in order to detect ^{210}Pb and ^{137}Cs.

Results and discussion
In both cores (fig1& 2), ^{210}Pb and ^{137}Cs profiles are very similar, indeed the correlation coefficient is high between these two parameters (>0,75). Higher radionuclides contents are concomitant with higher silts contents (<63μm). On the contrary, increase in coarse grain contents (>63μm) appears when ^{137}Cs and ^{210}Pb decrease giving clear signals of flood events.

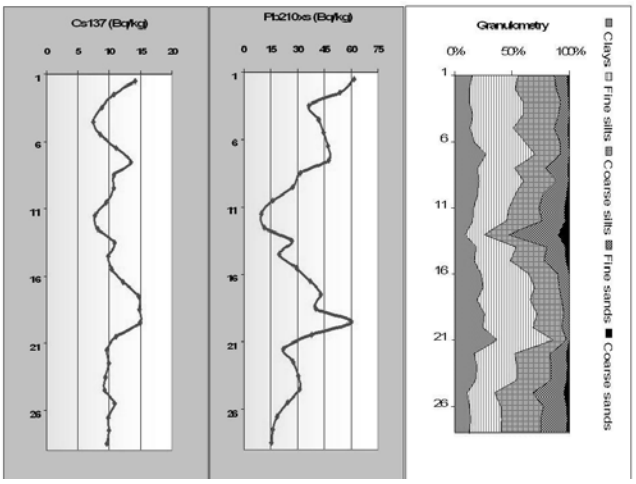

Fig. 2. (d) ^{137}Cs profile, (e) ^{210}Pb in excess profile, (f) granulometric profile sampled in a channel-like structure during BOBORHONE 2

It is obvious that floods led to supply of coarser sediments and in addition it is well known that when particles are delivered in high quantity they do not scavenge dissolved ^{210}Pb as efficiently as sediment supplied with lower concentrations. In the same way, during flow events ^{137}Cs dilution factor is very high leading to low contents when high flow rate occurs (Fig f). However regarding radionuclides released into the Rhone river remobilization of sediments labelled by former releases can also happen, and the relationship with flow rates may not be that simple.
Another interesting feature is the almost constant lag appearing in the peak layers between radionuclides and granulometry. Peak in fine grains content seems to occur prior to the peak in ^{210}Pb and ^{137}Cs. This is certainly to be linked to sediments dynamics. The instrumentation of the Rhone River mouth with ADCP, altimeters and CTD probes will be carried out from October 2006 to March 2007 in order to qualify and quantify precisely the impact of such events on sedimentary records (erosion, sedimentation).

Reference

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