Sedimentary processes in the Cap-Ferret canyon (Bay of Biscay, NE Atlantic): from seasonal to century time scales

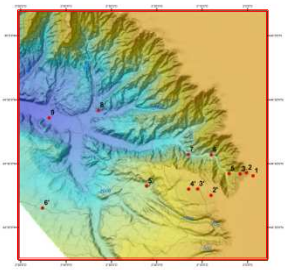
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The Cap-Ferret Canyon (CFC), a major morphologic feature of the Eastern margin of the Bay of Biscay, occupies a deep structural depression that opens about 60 km southwest of the Gironde estuary.

Canyons are often presented as natural conduits for the transfer of particulate matter from the shelf to the deep ocean. Particles are probably not produced locally within the canyon but transported from shallow coastal areas. The age and the frequency of sedimentary processes transporting sediments through canyons are usually unknown.

Such a knowledge is important to understand the reason for canyons being "hot spots" for biological activity, and how changes in particle supply (quality, intensity) could affect a canyon and its associated productivity and biodiversity.

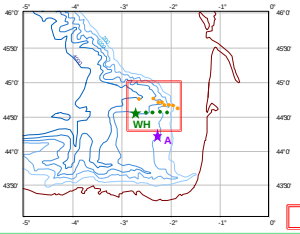


- Located in the inner part of the Bay of Biscay, the Cap-Ferret Canyon is a large structural depression located between the North Armorican passive margin and the Landes stable marginal plateau.
- At present inactive in terms of turbulent gravity flows (Cremer et al, 1999).
- But composition and densities of foraminiferal fauna in the lower reaches are an indication of high organic matter input (Fontanier et al, 2005).

The objective of this work was to estimate to which extent sediment fluxes and deposition within the Cap-Ferret Canyon are different from those observed on the adjacent flanks and open slopes.

Sampling and methods

The present sedimentation framework (fluxes, bioturbation, sediment accumulation) was assessed using sediment trap and interface sediment samples on which particles-reactive radionuclides were measured.



Area corresponding to the detailed view of the introduction

★ long-term moorings with sediment traps (PPS5, surface area 1 m²) deployed on the open slope (sites WH and A):
from August, 28, 2010 to July, 22, 2011

interface cores taken along two depth transect:
- within the Cap-Ferret canyon
- along the southern adjacent flank

from 151 to 32168 m depth.
during the LEVIATHAN cruise (June, 21 to July, 2, 2009).
Sites of moorings were also cored.



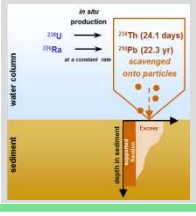
particulate fluxes
^{210}Pb activities
^{210}Pb flux to production ratio



porosity
grain size
excess ^{210}Pb and ^{234}Th activities
bioturbation and sedimentation rates
^{210}Pb flux to production ratio (focusing)

Radionuclides: tracers of sedimentation

From measurements of the two naturally-occurring radionuclides in the water column and in sediments, ^{234}Th and ^{210}Pb, it is possible to estimate (Schmidt et al, 2009):



- focusing ratio (F/P)
- mixed layer depth
- bioturbation rate (D_b)
- sedimentation rate (S)
- mass accumulation rate (MAR)

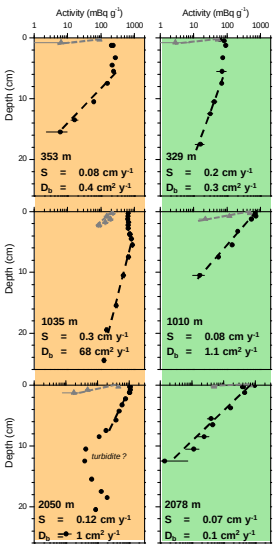
from seasonal to secular time scales.

^{234}Th, ^{210}Pb and ^{226}Ra: measured using a low background high efficiency well type γ-detector

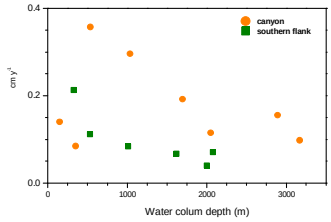


Sediment dynamic at the water-sediment interface

Comparison of sedimentary profiles of:
$^{234}Th_{xs}$
$^{210}Pb_{xs}$ at equivalent depths



Synthesis of ^{210}Pb-based sedimentation rates (cm y^{-1}) versus water column depth within the canyon and on the adjacent slope:



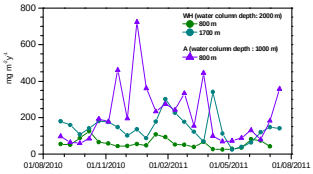
On the southern slope, sedimentation rates present the trend usually observed on margin, with values decreasing from the shelf to the open ocean.

Within the canyon, sedimentation rates exhibit a more complex pattern:
- low values in the head of the canyon, associated with coarse sediments;
- higher levels, compared to the adjacent slope, at depths > 400 m.

The increase of sedimentation rates with depth within the canyon is associated with a change of sediments, that become finer and more detrital (increasing Th content).

^{234}Th-derived bioturbation rates point out the same difference between the two depth transects:
- gradual decrease of D_b with depth on the slope, likely in relation with decreasing organic carbon fluxes with distance from the shelf break,
- very variable D_b and mixed layer thickness within the canyon, revealing larges changes in particle input (quantity, quality).

Particulate fluxes on the southern flank



Total mass flux (mg m^{-2} d^{-1}) from August 2010 to July 2011

	mean	min	max
Site A: 800 m	216	60	724
Site WH: 800 m	59	25	126
1700 m	145	60	724

Large differences in settling fluxes :

➢ between the two sites:

the shallowest site A (1000m) records most of the time the highest fluxes ,

➢ with depth at site WH:

There were two sediment traps on WH mooring (800 and 1700 m in a water colum of 200M): fluxes were always higher in the deep trap.

During the high flux events recorded in the traps, ^{210}Pb fluxes far exceed total supply (F/P > 1).

These temporary high values show a strong ^{210}Pb excess which implies lateral inputs of particles originating from the shelf and upper slope, as observed in the Cap-Ferret Canyon early 90's (Radakovitch and Heussner, 1999).

In conclusion,

based on the comparison of two depth transects along the CFC axis and the southern adjacent flank, we confirm the Cap-Ferret Canyon acts as an efficient trap for laterally-advected sediment from the upper continental slope.

However, even if particulate transfer is efficient in the Cap-Ferret canyon by comparison to the adjacent slope or to the Iberian margin by example, it must be pointed out sedimentation rates recorded in the Cap-Breton canyon, the most important feature in the south of the Bay of Biscay, are far higher (up to few cm per year).

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