Natural and artificial radionuclides in oceanographical studies: environmental reconstruction and sediment dynamics

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OBJECTIVES: to enable the use of radionuclides (natural and artificial) in the oceanographic process: examples in marine pollution and sediment dynamics

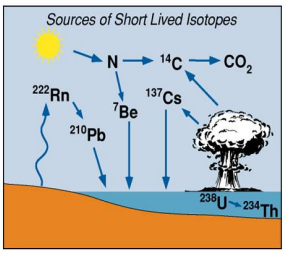
INTRODUCTION

Radionuclides in marine environmental studies

- Sediment accumulation rates
- Transport of elements to oceans
- Gas exchange
- Water mass circulation

Radionuclides origin

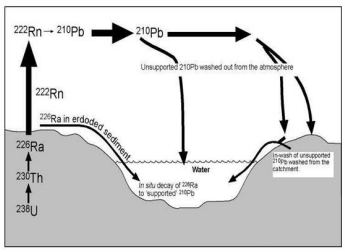
- *Natural radionuclides*
  - *Cosmic-ray*: produced in the upper layers of the troposphere and the stratosphere: ^{7}Be and ^{14}C
  - *Natural decay products*: ^{235}U, ^{238}U and ^{232}Th (decay chain, several radioisotopes)
- *Artificial radionuclides*: produced by nuclear tests and nuclear power plants :
  - Worldwide dispersion by radioactive fallout
  - ^{137}Cs, $^{239+240}Pu$ and others

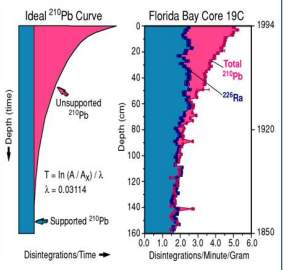


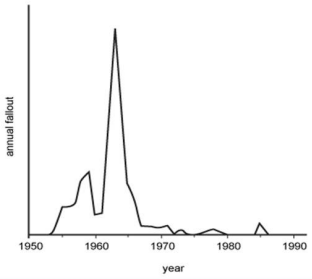
Nuclide	Half-life	Utility	Reference
^{7}Be	53 d	Residence time of particles and particle-sorbed pollutants, particle mixing, and short-term sedimentation rates	Aaboe et al. (1981); Baskaran and Santschi (1993); Baskaran et al. (1997)
^{137}Cs	30 y	Watershed erosion, sedimentation, and mixing	Ritchie et al. (1974); Baskaran and Naidu (1995)
^{210}Pb	22.1 y	Residence times of particles and particle-sorbed pollutants, particle mixing, and sedimentation rates	Rama et al. (1961); Baskaran and Santschi (1993); Baskaran et al. (1997)
^{224}Ra	3.66 d	Biogeochemical processes in salt marsh	Bollinger and Moore (1993)
^{234}Th	24.1 d	Rates of removal of Th and particle-reactive pollutants from solution, short-term particle mixing, and sedimentation rates in estuaries	Aller et al. (1980); McKee et al. (1986)
^{228}Th	1.9 y	Rates of removal of Th and particle-reactive pollutants from solution, short-term sediment accumulation	Kaufman et al. (1981); Minagawa and Tsunogai (1980)
^{238}U	4.5×10^{9} y	Removal of metals from low-salinity estuarine waters	Borole et al. (1982)
$^{239,240}Pu$	2.4×10^{4} y	Sedimentation and mixing	Benninger et al. (1979); Ravichandran et al. (1995a)

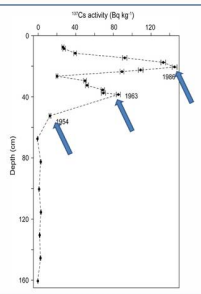
Modified from Baskaran (1999).

^{210}Pb and ^{137}Cs IN THE ENVIRONMENT

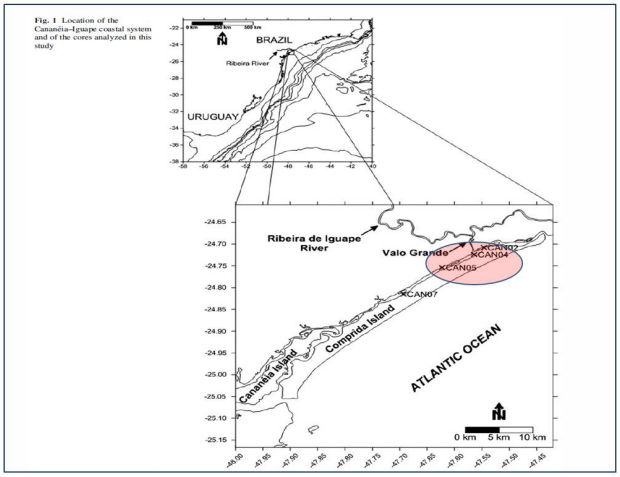


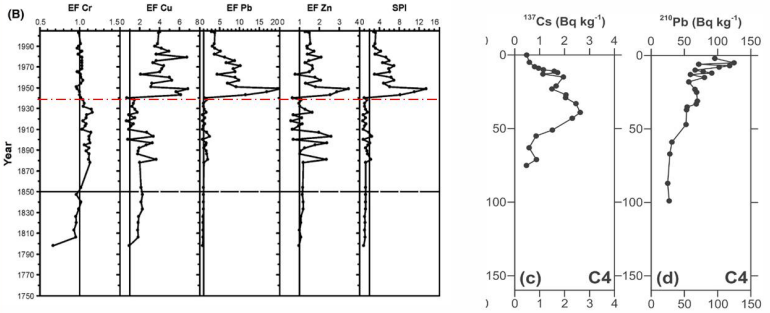


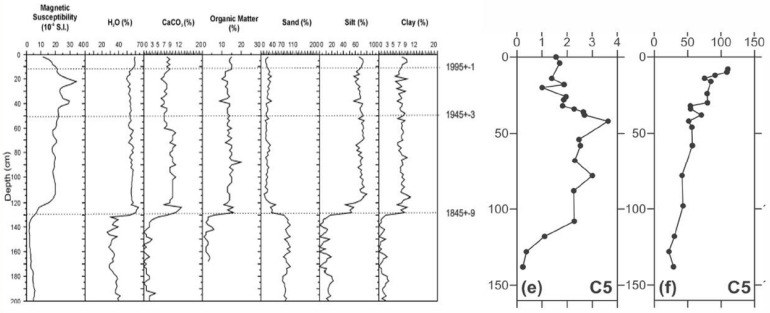




ACTIVITY 1: in this activity we intend to use the dating from ^{210}Pb and ^{137}Cs to understand anthropic activities in an estuarine system

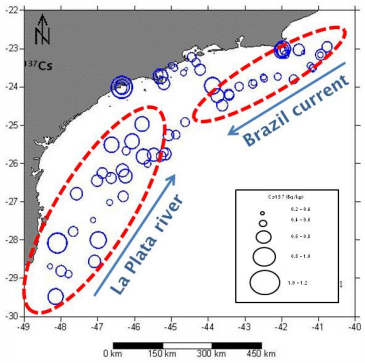


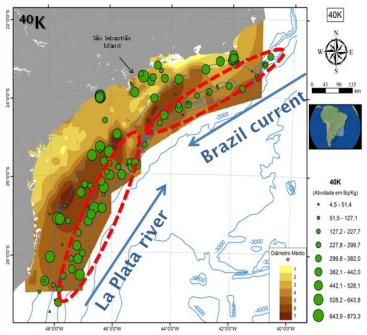




ACTIVITY 2: in this activity we intend to use the levels of ^{137}Cs and ^{40}K to understand sediment dynamics in a Continental Shelf

- Recognize depositional areas
- Current influences
- Grain size





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