

REGIONAL ADVANCED SCHOOL ON PHYSICAL, ANALYTICAL AND MATHEMATICAL TOOLS FOR THE STUDY OF MARINE PROCESSES OF COASTAL AREAS

Lecture 12

Radionuclides as tracers for particle dynamics

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Natural and anthropogenic radionuclides are a powerful tool for tracing particle dynamics in the ocean. They have been widely used for studying particle export fluxes from surface water and to estimate sediment accumulation and mixing rates. This information is essential for many purposes: from carbon cycle studies related to climate change, to problems concerning coastal management, like identification of areas of maximum pollutant accumulation or re-construction of the pollution history of coastal areas and identification of processes with negative impact on marine resources, to model validation.

An overview is given on the basic principles for the use of the radionuclides of the natural decay series as tracers for different processes at different time scales in the marine environment.

The first part of the lecture deals with the $^{238}\text{U}/^{234}\text{Th}$ disequilibrium as tracer for particulate organic carbon flux from the euphotic zone: where and how the method can be used, what are the advantages and disadvantages, the procedures, calculations, assumptions and models. Some examples are given, highlighting the critical points and illustrating the sensitivity of the method.

The second part of the lecture shows the information that can be derived from the combined use of natural and anthropogenic radionuclides profiles in sediment. Examples are shown of the application of the method to a coastal area, where information is derived on the stability of sedimentary deposits, on sediment accumulation rates and on bioturbation rates. Also in this case the method, critical points and models are illustrated and discussed.

LAYOUT OF LECTURE 12

1. Particle sources and cycle in the marine environment
2. Natural radionuclides decay series

- Biogeochemical behavior of natural radionuclides
- Equilibrium/disequilibrium
- Processes that can be traced
- Time scales
- Selection of the tracer

3. Particle dynamics in the upper ocean:

- Biological pump and its variability
- Methods for estimating POC flux
- The $^{238}\text{U}/^{234}\text{Th}$ disequilibrium method
- Assumptions and model
- Data and examples

4. Sedimentation processes

- Why are we interested in sediments
- Sediment structure and radionuclide concentration
- Anthropogenic radionuclides and ^{210}Pb as tracers of sedimentation processes in coastal areas.
- Natural radionuclides as tracers of bioturbation processes.
- Assumptions and models
- Data and examples.