MATERIAL TRANSFER AT THE CONTINENT-OCEAN INTERFACE UNDER THE SCENARIO OF THE ANTHROPOCENE

Lecture 7.1: Prof. Luiz Drude de Lacerda - Materials transfers at the Continent-Ocean Interface under the Scenario of the Anthropocene

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1. Continent-ocean transfer processes

The conception of what happens in continent-ocean transfer processes was developed 20 years ago, but with flexible measurements and poor knowledge about its variability. It involved Basin Properties that gives structure for the major environments (soil, river, estuary, littoral). Besides that, the global climate changes influence the ocean's drivers of pressure and we also have the human dimension with the anthropogenic drivers. From this we can see that we have more than only one source of pressure for the flows between continent and ocean processes. Thus, the change in the behaviour of some processes as a consequence of global climate change affects the responses of coastal zones.

2. Major characteristics of the Continent-Ocean Interface (COI)

The major characteristics of the COI are: Transfer of water, mass and energy at large spatial scale in terrestrial and marine adjacent areas; the transfer occurs from both directions (continent → ocean and ocean → continent) at different temporal and spatial scales; and transfers are affected by natural and anthropogenic vectors.

3. Vectors affecting the continent-ocean transport

The major anthropogenic drivers we recognize are pollution and urbanization, but there also others like wastewaters and agriculture runoff.

According to Meybeck and Vörösmarty (2005), we can list some of the main anthropogenic vectors that affect these environments, like human activities that largely accelerate biogeochemical cycles and the transfer of materials at the planetary scale, which causes cascade effects in food webs; the frequent changes caused in natural fluvial filters functions, particularly because of dams constructions and deforestation of gallery forests, that changes the quality of material available in the environment; and controlled and reduced fluvial discharges due to engineering interventions and effects of global climate change, especially in lower latitudes.

4. Classes of interface systems in Brazil

a. Spatial scale (Exporters/Accumulators, geomorphology)

The interface systems in Brazil can be categorized according to different scales (Knoppers *et al.*, 2009). From the spatial scale perspective, there are exporters and accumulator's systems. There are different formations that causes distinct geomorphology conditions. In some cases, it'll accumulate sediments and cause deposition and in other cases the exportation that have effects like erosion and transport of sediments. From the other side, the accumulator's system typically retains sediments and forms sedimentary environments in the estuarine zone (restinga, bays, sand barriers, island barriers, delta, etc.).

b. Spatial-temporal scale (the specific site has different characteristics along the time/seasonality)

Continental shelf have processes happening that are similar with the terrestrial environment. In deep ocean there is erosion of the continental shelf and sediment transport, specially where the slope changes rapidly, forming rivers that make this transport in deep ocean basin.

In semi-arid locations, with less rainfall, the interface between estuarine and marine waters is closer of the continent. The salt water enters the river channel (intrusion of saltwater) in this season. During rain season the high salinity goes offshore, since the amount of rainfall increases and make the water flow of rivers increase too, expelling the salt water.

5. Shelf sediments

The typical granulometry of shelf sediments are sands (mineral surface <15 $m^2.g^{-1}$) in the areas nearest to the coast. In the direction of the external shelf there is silt (mineral surface 15-40 $m^2.g^{-1}$) and in the final part of the shelf the major sediment is clay (mineral surface >40 $m^2.g^{-1}$).

6. Anthropogenic effects on sediment transport processes

Urbanization, industrialization and agriculture/husbandry resulted in increasing discharges of natural and anthropogenic substances, changes of soil use, in a legacy of irresponsible technologies that faces lack of governance. Some metals has it major sources from natural processes (Pb, Cd) while others have to do with human activities effects (N, P, Cu, Hg, Zn). The increase on nutrient concentration can lead to eutrophication of the environments.

7. Effects of global climate change

With the global climate change and its effects like sea level rise, the impacts look less obvious, but they happen in the same way. In areas of small supply of sediments (e.g. semiarid littorals, seafront mangroves, etc.) the coastal deposits are increasing in the remobilization of pollutants. On the other hand, in tropical and subtropical coastal plain areas dominated by mangroves the sea level rise will induce mangrove migration inland, creating typical areas dominated by the mangrove metabolism (e.g. anaerobic conditions through sulphate reduction). Trace metal biogeochemistry and bioavailability will be highly affected by the sulphate reduction metabolism and part of the metal load will accumulate as metallic sulphides in sediments, part with the abundant dissolved organic carbon compounds (result from incomplete oxidation of organic matter). It will be more available with the erosion of these environments, increasing bioaccumulation and enhancing biota and human exposure through food chains.

Therefore, how global climate change is already affecting the functioning of the semi-arid ecosystems and what can we expect in the future? Apart from the effects of global and regional changes at the semi arid region itself, tele-connections and large scale transfer in the South Atlantic Ocean may also affect the residence time in estuaries and eventually the export and mobility of substances to marine food chains.

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