axis 4

"Sediment transfer: source to sink & mud to the mantle"

SCIENTIFIC CONTEXT

Mountains building and their erosion, sediment transfers through rivers into continental plate-forms and deep oceans, are deeply connected with the growth cycle of the earth. Sedimentary processes occurring along continental margins are complex and only partially known, they result from the interaction between deep processes (tectonics with subsidence/uplift) and surficial processes (climate and sea level changes, hydrodynamics). Probing the strong correlation between deep and surface processes in order to understand the Earth growing and to model forecasts needs multidisciplinary approach. Axis 4 aims at reconstructing 4D sedimentary fluxes from source to sink zones and their consequences on long term margin architecture building.

Keywords

- Sediment
- Source to sink
- Mud to mantle
- Record
- Vertical movement
- Deep structure

Coordinators

- Daniel Aslanian (GM)
- Pascal Le Roy (LGO)
- Marina Rabineau (LGO)
- Samuel Toucanne (GM)

Participating laboratories

- **LGO**
  Laboratoire de Géosciences Ocean
  UMR 6538, CNRS, UBO, UBS
- **GM**
  Unité Géosciences Marines
  Ifremer
- **LM2E**
  Laboratoire de Microbiologie des Environnements Extrêmes
  - UMR 6197, CNRS, UBO, Ifremer
- **DYNECO**
  Département dynamique de l'environnement côtier
  Ifremer
- **LEMAR**
  Laboratoire des sciences de l'Environnement Marin
  UMR 6539, CNRS, UBO, IRD, Ifremer

Left: Alluvial Cone in the Var Drainage Basin (Alpes Maritimes)
Right: Bringing the Calyso corer back onboard the N/O Pourquoi Pas ? (Ifremer/GENAVIR)

ROADMAP

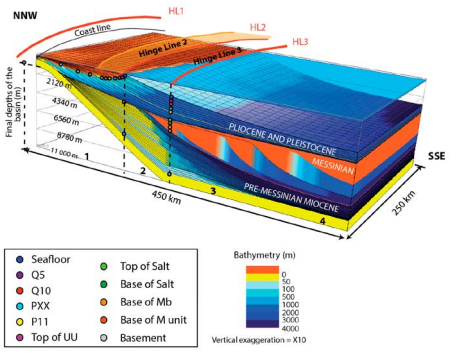
The main objective of axis 4 is to understand and quantify, using marine sediment archives, all changes related to natural parameters (climate, sea level, hydrodynamic and paleoceanography, tectonics) and decipher their relative impact and timing on sedimentary fluxes along continental margins. Based on findings and challenges that have been overcome during the first phase of the LabexMER questions of the phase 2 will be more focused on isotope geochemistry (including the transfer of dissolved material), modelling of sediment transfer (how to connect models from river plains to the deep sea?), and the connections between deep and surface processes (focusing mainly on working areas funded during the first phase of the LabexMER). Among essential questions:

- Can we quantify the Source of sediment produced through time? Fluxes at the terrestrial-coastal interface are still, in fact, very poorly known. The relative role of extreme events (storms, floods, cyclones for example) compared to more continuous record (annual, pluriannual or millennial) is still undetermined.
- What are the relative importance, through time, of tectonic, dynamic topography and palaeoclimate on the erosion processes? Can we decipher their relative role?
- Another important question concerns transfer of sediment towards the deep domain during phases of erosion/transport/deposition on the shelf, by gravity processes via submarine canyons but also more generally through open slope. Scientific questions in this topic concern at the same time the characterization of the processes at the origin of and their role in the formation and evolution of canyons through time (what are the volumes involved, the timing, and the impacts on ecosystems?).
- Can we quantify the amount of sediment arriving in the Sink through time?
- Can we estimate the vertical movements on the margins through time using sedimentary records? What information about the deep behaviour can the sedimentary record give, especially during catastrophic events (huge mass transfer)?
- Can we establish real Source to Sink budgets and model the role of the different parameters?
- What is the role of tectonic heritage versus the location of sedimentary depocentres on the subsidence? What are the impacts of deep structures, their nature, temperature and geometry on the sedimentary record (for instance, salt geometry versus crust nature and thermicity)?

These questions are related to different time scales: from an event-scale (hours, days to weeks with possible direct measurements and instrumentation) to years, thousands years and million years for which internal earth processes (e.g. thinning of the crust) that govern subsidence plays a fundamental role in preservation of sediments and ought to be further understood. Interdisciplinarity and synergies between researchers from both IUEM and Ifremer laboratories on integrated project are strongly encouraged. Axis 4 will support and encourage the emergence of a common research group and initiative of collaboration with axis 3 and 5. As a partner of Ocean Frontier Institute (OFI), together with Dalhousie University (CANADA), GEOMAR (Germany), Woods Hole Oceanographic Institution (WHOI) (Massachusetts, USA) and Lamont-Doherty Earth Observatory (LDEO, Columbia University, New York, USA), Axis 4 will participate at some actions developed in these world-class programs.

EXPECTED RESULTS

Scientific objectives will contribute to a better knowledge of the dynamics of sedimentary transfers between the coast to the abyss domains, integrated over the entire sedimentary continuum, and their consequences at geological timescale. This understanding needs a 4D characterization of sedimentary architecture and paleoenvironments from drainage basins and continental shelves towards the foot of the slopes with a land to sea approach using multiples proxies, but also through a modelling approach dealing with the complete system, which has not yet been achieved within the scientific community. Answering these questions will enable to better understand and better anticipate evolutions that have important consequences such as natural hazards (e.g. tsunamis, storms), coastal areas sensibilities (sea-level rise), climate change but also natural resources (gravels, hydrocarbons, economic zones) in many regions of the world.



DIONISOS stratigraphic model (Leroux *et al*, 2015).