DEPARTMENT OF MARINE CHEMISTRY AND GEOLOGY (MCG)

Scientists of MCG aim to identify and quantify biogeochemical processes involved in ocean-climate interaction and to develop a mechanistic understanding of their temporal variability. The ensueing insight in the modern ocean is also crucial to understand, reconstruct and predict past and future impacts and feedbacks of ocean induced climate change.

The research in MCG is divided into three distinct themes:
1. Biogeochemical processes in ocean waters and air-sea exchange.
2. Export and settling from the upper ocean and early diagenesis.
3. Sedimentation and palaeoceanography.

Moreover MCG is responsible for the national facilities for nutrient analyses and XRF core scanning, and it supports the Scanfish undulating instrument. Several projects cross- link with the other NIOZ departments FYS, BIO, and MBT. Scientists of MCG play leading roles in European, international, and national projects. Some 40 people work in the department, including 7 tenured scientists, 9 postdoctoral investigators, 4 PhD students, 10 techicians and about 10 undergraduate students and trainees.

Theme 1. Biogeochemical processes in ocean waters and air-sea exchange.
The efficiency of the biological pump, that is the uptake of CO_2 from the atmosphere and subsequent export of biogenic particles into the deep oceans, is determined by the food-web in the upper ocean. This food-web is in part structured by the species composition, size distribution, and activity of the phytoplankton community. Iron, an essential trace element for CO_2 fixation and phytoplankton growth, has been identified as a limiting resource in High Nutrient Low Chlorophyll areas in the world ocean. The bio-availability of and competition for Fe is considered crucial in driving the biological pump and biogeochemical cycles in the upper as well as in the deep ocean.

Theme 2. Export and settling from the upper ocean and early diagenesis.
This research theme aims to quantify the biogeochemical cycling of major elements in the bottom boundary layer and surficial sediments by combining direct measurements of deposition- and rebound fluxes of particulate matter with model estimates of deposition-, recycling-, and burial fluxes. The transfer of organic particles from an advection dominated water column to a diffusion controlled porous sedimentary matrix invokes a succession of microbially mediated primary redox-reactions, resulting in the oxidation of organic matter and the reduction of oxidants. This change in biogeochemical conditions drives secondary reactions, being the re-oxidation of reduced oxidants, the dissolution of inorganic fractions (biogenic silicate, carbonates), and the precipitation of newly formed minerals (authigenesis).

Theme 3. Sedimentation and paleoceanography.
Sediment deposits on the continental margins represent a repository for particulate matter originating from different sources, primarily including terrigenous sediments resulting from continental erosion, and organic matter and siliceous and carbonate skeletal material produced by a variety of pelagic and benthic organisms. The biogeochemical and physical processes involved in the production of these materials and the physical processes and pathways involved in the transport of these materials to the site of ultimate deposition are controlled by the interaction of local and regional geology and geomorphology of the continental margin with oceanographic and climatological forcing conditions operating on both regional and global scales. Research theme 3 aims to study both currently active processes of sedimentation on the continental margin, and at the same time use the sedimentary archive of continental margin deposits to reconstruct variation in climatological and oceanographic forcing conditions in the past, as a reference to expected future change.