Belgian Marine Geosciences in the Grand Challenges

The “Grand Challenges in Ocean and Polar Sciences” initiated by ECOPS are likely to convey to European ocean and polar sciences a new momentum. The 1992 Obernai meeting fostered a series of Euroconferences, which defined objectives in ice coring, arctic science, deepsea research, ocean and coastal forecasting and in biodiversity research (fig. 1). The scale of investment considered in each of these major ventures should be of the order of 50 MECU, over a period of 10 years. The recommendations of the Euroconferences were endorsed by a general assembly in Bremen in October 1994.

The report of the Grand Challenge “The Deepsea as a Changing Environment” confirmed the standing need for the acquisition of large sediment cores, up to 200 m long, for unraveling the high-resolution paleo-environmental record locked in Europe’s continental margins. A need which cannot be met by the current facilities, and which - in spite of former European initiatives (NEREIS) - still remains without response.

As a possible approach, we proposed a flexible and sustainable operational scheme, involving the periodic rental of an industrial drilling vessel for providing European teams with the required data. Simultaneously, such a vessel should offer testing facilities for new technological developments, and a training platform for education at sea. CORSAIRES (CORing Stable And Instable Realms in European Seas), was granted a 500 kECU funding under the MAST3 Concerted Actions scheme, for preparing the European network and programme infrastructure. It endeavours to provide a significant European contribution to Phase 3 of ODP’s Long Range Plan, in which the use of alternate platforms is advocated.

This Concerted Action, coordinated by Ghent University, opens vast perspectives also for other Belgian teams, wishing to join a fastly developing scientific and technological field, with a real potential for a significant economical spin-off.

key-words: Grand Challenges, Marine Geosciences, oceanic drilling, methane hydrates
Grand Challenges in the Belgian Marine Geosciences

The high-resolution sedimentary records needed for the Deepsea Grand Challenge are typically found in sites of high sediment fluxes. High-latitude margins for instance are excellent sites for such records, but their slopes are prone to major instabilities (e.g. Laberg 1994, Vanneste 1995).

It has however recently been recognized that the large slope instabilities, more and more highlighted along the polar North Atlantic margins, are not merely a potential disturbing factor of the sedimentary record, but also might prove a truly active agent in the climatic processes themselves, through a intriguing but probably most influential agent: methane hydrates. Methane hydrates are ice-like mixtures of gas and water in which the gas molecules are trapped within a cage-like framework of water molecules. Such clathrates are stable under pressure and temperature conditions that occur worldwide in offshore sediments of outer continental margins and continental slopes, where there are cold bottom-water temperatures and deep waters, exceeding 500 m.

Samples of gas hydrates have been recovered by drilling from many margins of the world, and geophysical or geochemical evidence for them has been found on many other sites. Extensive oceanic occurrences of gas hydrates are inferred, mainly on the basis of the appearance on marine seismic-reflection profiles of a pronounced, bottom-simulating reflector (BSR), thought to coincide with the base of the gas-hydrate stability field. If current estimates of this methane reservoir are correct, then the amount of methane carbon in gas hydrates is about twice the carbon locked in all known fossil fuel deposits (coal, oil and natural gas) (Kvenvolden, 1993).

Beyond any consideration about the potential of this vast reservoir as energy resource for the 21st century, maybe the most attractive concept evokes the possible role of this frail methane reservoir on climate. Seabed hydrates might yield the hitherto missing link in our understanding of the dynamic interaction between cryosphere, hydrosphere, lithosphere and atmosphere, and in the still poorly understood termination of ice ages.

Indeed, any glacial advance (fig. 2) causes a progressive sea-level drop, which involves a pressure decrease on the seabed, significantly enough for destabilizing hydrates (Paull et al. 1991, Paull et al. 1996). Besides a probable top-down destabilization, the pressure drop will certainly cause the decay of a thin hydrate layer and the injection of gas at the base of these sub-seabed "ice caps". Such gas injections will severely decrease the shear strength at the base of these hydrate layers, triggering large submarine slides on the continental slope. Huge slides, involving the destabilization of volumes exceeding a thousand cubic kilometres, are more and more documented, in particular along high-latitude margins. Their potential for releasing vast amounts of methane - a strong greenhouse gas - into the atmosphere is real. It has been suggested that such releases of oceanic hydrates may have been quantitatively significant to provide a negative feedback mechanism on glacial advances (Paull et al. 1991). But any warming trend should also potentially trigger positive feedback loops, through the warming of the bottom waters. Such positive feedback loops might be triggered any time in the deglaciation phase, maybe even now, and their potential control on short climatic warming events deserves attention.

RCMG ventures to valorize former seabed seismic refraction experiments made on the Antarctic continental shelf - within the framework of the Belgian Research Programme on the Antarctic - for evaluating the processes and the present degree of hydrate destabilization in the seabed, as well as the role of hydrate decay in giant slope failures and catastrophic methane releases in the atmosphere. And one of the objectives of the CORSAIRES programme will be to contribute to a better sampling strategy of these fascinating but elusive natural-gas hydrates along the European margins. A challenge, inviting true multi-disciplinary actions within the Belgian oceanographic community.
References


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