

## **Habitats on Antarctic shelves and margins = interaction of cryosphere, geosphere, hydrosphere and biosphere**

### **Goal**

To obtain a better understanding of the interaction between geological, glaciological and physical-oceanographical processes and their capacity to create unique environments and typical Antarctic habitats, understanding of the functioning and health of these habitats, and on the boundary conditions to be respected for the preservation of these habitats.

### *Rationale*

Through an impressive cooperative venture, Europe has taken a leading position in ocean margin research, in particular in those areas involving coupling processes between the Geosphere and the Biosphere: within the EU FP5 Deep Ocean Margin cluster (OMARC), about 19 projects have addressed processes controlling habitat development and destruction in canyon systems, areas of slope instabilities, mud volcanoes, cold seeps related to gas hydrates, carbonate mounds and cold water coral ecosystems, not the least in areas under long term anthropogenic stress (e.g. deep sea trawling). Innovating and advanced technologies have been developed, and a general public awareness of the importance of preserving such unique habitats under e.g. the terms of the UN High Seas Marine Protected Areas has been fostered. Under Belgian impulse, the IOC has started a new programme on Geosphere-Biosphere Coupling Processes, and a Flanders Government pioneer GBCP project is in the phase of signature. Also in the FWO-Flanders and the ESF realms, a major thrust is developing: the FWO project Genesis and the ESF EUROMARGINS projects MoundForce and MVSEIS are supporting substantial margin-related research efforts in Flanders (UGent, KULeuven). Through the Belgian Antarctic Research Programme, an innovating technology for deepsea research has been initiated too: what started as a high-resolution deep-towed geophysical system for Antarctic margin studies is now progressively developing into a multifunctional deep-water observation and measurement concept (the 'deep reef surveyor concept') with different objectives: surveying capacities (high-resolution seismic profiling, acoustic imaging, microbathymetry), observation tool (digital video) with cyberlink transmission to classrooms (education and public outreach), deep-sea experimentation (robotic manipulator), etc. The 'niche' for such tool is the outer shelf and upper slope, down to some 900-1000m. This zone has proved to be a most dynamic and critical zone: it involves the area of incipient slides, the upper boundary of the hydrate stability zone and the usual depth range of cold water coral habitats. The rugged, double-armoured umbilical of the Deep Reef Surveyor has been specially designed for safe operation in Antarctic waters of such depth range.

### *Research topics and areas*

The Antarctic Peninsula offers a wide spectrum of niches to investigate Geosphere-Biosphere Coupling Processes, within a realm where the Cryosphere and the Hydrosphere join as key actors. It is moreover an area of

relatively easy access for shared-cost operations, thanks to the regular traffic of research vessels and the available infrastructure of research bases. A Belgian component for an Antarctic GBCP research within IPY may focus on a few niches in particular:

**1. Fjord systems:** very-high resolution study of the (thin) sedimentary record of inner fjords, already successfully experimented in Greenland fjords (RCMG's transportable survey RIB 'OPUS 3D' is a unique tool for such work), and of the recovery of Life after the latest glacial retreat. Potential for Antarctic versus Arctic comparative study (Svalbard, subarctic Norway). Norwegian fjords host the shallowmost cold-water corals: discoveries ahead in Antarctic fjords ? Target area: Gerlache Strait. A historic territory for a comeback of Belgian research.

**2. Canyon systems:** the cycle of destruction and recovery of Life in canyon systems is one of the hot topics in continental margin research. Canyons developed through major slope failures offer most attractive research objectives. Target area: Gebra valley, or other canyon systems on the Antarctic Peninsula margin.

**3. Hydrothermal systems:** the volcanic domain of Bransfield basin offers a range of opportunities, also for those biological partner teams focusing on bacterial mats. Target area: the Deception Island crater and offshore flanks. An area with a high potential for educational and public outreach actions.

**4. Gas hydrate systems:** gas hydrates have been elicited on the outer margin of the South Shetland Islands (bottom simulating reflectors). Such areas are privileged sites for seep-associated ecosystems, mud volcanism, etc. Target area: the upper South Shetland slope.

**5. Drift deposit systems:** drift deposits controlled by contour currents prove to hold a very-high resolution environmental record. High-resolution seismic studies may elicit drift systems, as targets for coring (link to ACE programme). Target: the inner and outer slopes of the Antarctic Peninsula/Bransfield basin area.

#### *Conservation issues*

The research carried out so far on European and African margins has revealed true devastating impacts of deep-sea trawling on deep-water coral ecosystems. Sightings of deep-water corals have been reported on Antarctic margins (Polarstern), but no targeted research, fully supported by the newly developed European strategy for carbonate mound and deep-water coral reef surveying (GEOMOUND-ECOMOUND strategy), has been conducted so far on Antarctic margins. In view of the increased pressure of deep-water fishery and deepsea trawling on Antarctic margins, a survey and inventory of sites eligible for protection under the terms of the UN High Seas Marine Protected Areas in Antarctic waters is timely and an environmental priority. Belgium, who has conceived the IOC-UNESCO GBCP programme, may play a pioneering role in this matter within IPY.

*Integration of expertise and convergence of disciplines*

(1) marine biologists = investigation of the ecosystems on the Antarctic shelves and margins

(2) marine geologists = investigation of the morphology and nature of the sea-floor, of the principle sedimentary environments, of the geological processes shaping the Antarctic shelves and margins (tectonics, isostasy, volcanism, fluid flow, glacial and glacio-marine sedimentation) and of the geological processes relevant for creating typical Antarctic habitats

(3) glaciologists = investigation of processes associated with ice-sheet grounding zones, floating ice shelves and formation of sea ice and of the glaciological processes relevant for creating typical Antarctic habitats

(4) physical oceanographers = investigation of processes associated with ice-sheet grounding zones, floating ice shelves and formation of sea ice and of the glaciological processes relevant for creating typical Antarctic habitats

**Team outline**

Pilot team: Renard Centre of Marine Geology (RCMG), Profs Dr. J.P. Henriot and M. De Batist. Associated teams in Belgium: marine biology, microbiology, glaciology, paleoclimatology. International associates: the University of Barcelona, Bremen University, Max Planck Institut für Microbiologie Bremen, AWI Bremerhaven, GEOMAR Kiel, Royal NIOZ, Institut Paul-Emile Victor, IFREMER, Osservatorio Geofisico Sperimentale Trieste.