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Extreme ecosystem studies in the deep ocean: technological developments EXOCET/D

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EXOCET/D (http://w3.ifremer.fr/exocetd) is a three-year project starting in 2004 and funded by the European Commission (STREP, FP6-GOCE-CT-2003-505342).

The aim of EXOCET/D is the technological development of a specific instrumentation allowing the study of natural or accidentally perturbed ecosystems found in the deep ocean. These ecosystems are related to the emission of reduced fluids (cold seeps, hydrothermal vents), peculiar topographic structures (seamounts, deep corals), massive organic inputs (sunken woods) or to unpredictable events (pollution, earthquakes). Beside their insularity in the abyssal plain, the targeted ecosystems are characterized by patchy faunal distributions, unusual biological productivity, steep chemical and/or physical gradients, high perturbation levels and strong organism/habitat interactions at infra-metric scales. Their reduced size and unique biological composition and functioning make them difficult to study with conventional instrumentation and require the use of submersibles able to work at reduced scales on the seafloor as well as the development of autonomous instruments for long-term monitoring (seafloor observatories e.g. EU projects ASSEM and ESONET). In addition, the increasing anthropic pressure on these poorly known deep-sea ecosystems emphasises the need for a rapid development of technologies dedicated to their investigation. Several European countries are now purchasing or developing deep-sea underwater vehicles but their acquisition alone is not sufficient to realise effective integrated deep-sea studies. There is an urgent need for fast but long term stable multi-sensor instrumentation that can be either connected

to autonomous seafloor observatories or deployed on underwater vehicles.

The general objective of this project is to develop, implement and test specific technologies aimed at exploring, describing and quantifying biodiversity in deep-sea fragmented habitats as well as at identifying links between community structure and environmental dynamics. Onboard experimental devices will complement the approach, enabling experiments on species physiology.

The achievement of the objectives will be attained by a constant collaboration between the technological teams in charge of the development, and the scientists in charge of instrument specifications and final validation. Collection of high resolution data is a crucial step forward to the understanding of factors influencing marine community structure and functioning at small spatial scales. Time- series studies are also essential to understand natural ecosystem dynamics. Cost efficient and reliable solutions will be found to make these instruments suitable for long term deployments on stationary deep-sea observatories or used as payload systems on underwater vehicles. The themes that will be addressed in EXOCET/D include :

- 3D video imagery and small scale reconstruction, long term video module, potential of acoustic imagery vs video imagery for ecosystem mapping
- *in situ* analysis of habitat chemical and physical components using in situ analyser and sensors (methane, flow) associated with water sampling,
- quantitative sampling of macro- and microorganisms, *in vivo* experiments in simulated in situ conditions;
- integration of multidisciplinary and multi scale data on a SIG software,
- instrument implementation on deep-submersibles
- sub-systems and scientific validation during demonstration actions, and final submersible cruise in 2006 (MoMARETO, hydrothermal vents, Mid Atlantic Ridge).