

DEEP-SEA AND SUB-SEAFLOOR RESEARCH – UNDERSTANDING THE PAST AS A KEY FOR A SUSTAINABLE FUTURE

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Although it covers vast expanses of the Earth, the floor of the deep-sea has been studied less than the surface of Mars. Only in recent decades have we begun to really explore it, and to acknowledge the need to comprehensively coordinate research efforts on an international level. What is required now (i.e. within the next decade, or framework programme for that matter) is the establishment of a long-term research approach that considers (i) the sustainable management of the ocean, and particularly the deep-sea in view of increasing human activities (fishery, hydrocarbon exploration); (ii) the necessity to unravel deep-seated geological, biological and chemical processes that drive seafloor ecosystems; and (iii) the value of seabed archives for the reconstruction of paleo-environmental conditions and the improved prediction of future climate change. Such a research approach must fully comply with the needs of society, policymakers and industry and should lead to a sustainable use of the oceans.

Such an approach will offer several important benefits for industry and society, including the transfer of know-how from academic research to industry. This could facilitate, for example, the development of joint ventures dealing with state-of-the-art seagoing technology, or the provision of research results from fields which are of direct commercial interest (e.g. microbiology, hydrothermal ore deposition) or which can identify processes which might have considerable impacts over time (e.g. climate change, submarine landslides, tsunamis).

In any case, both deep-sea exploration and sub-seafloor drilling/sampling by academia can provide two key components in understanding how deep-sea ecosystems currently function, and how they will respond to global change and affect mankind in the future:

- a. an inventory of present deep-sea and subsurface processes and biospheres, and their links to surface ecosystems, including seafloor observation and baseline studies, and
- b. a high resolution archive of past variations in environmental conditions and biodiversity.

For both components, an international effort is needed to share knowledge, methods and technologies, including mission-specific operations to increase the efficiency, coverage and accuracy of sub-seafloor sampling and exploration (e.g. by tying efforts by the EC and IODP/ECORD).

The deep biosphere has been discovered only within the past two decades and comprises the last major frontier for biological exploration. We lack fundamental knowledge of the composition, diversity, distribution and physiology of sub-seafloor biological communities at Earth's extremes, and their interaction with seafloor ecosystems and life in the deep-sea in general. Equally, there is an emerging need to shed light on geodynamic processes which strongly influence biological activity, and how such processes tie into the emission of geofuels and the formation of hydrocarbons, minerals and other resources. In addition, geodynamic processes may cause natural hazards such as earthquake slip, submarine landslides, or tsunamis with a profound impact on humans and ecosystems. The governing principles and potential triggers for these events are poorly understood, yet they pose a major threat to both deep-sea ecosystems and humans who rely on goods and services from the deep-sea (e.g. seafood, bioactive molecules, oil, gas and minerals) or who live in close proximity to the sea (i.e. >60% of the global population live within the marginal 50km of the continents).

Cross-disciplinary research must underpin Europe's emerging Marine Strategy and Maritime Policy by addressing aspects such as (i) the legal framework related to marine resources (e.g. relatively straightforward for hydrocarbons or minerals, but incredibly complex for microbial medical products); (ii) the socio-economic consequences of their exploitation; and (iii) territorial aspects in the deep-sea, to name just a few. Given the overall cost of seagoing operations and societal demand to exploit the ocean (fishery, minerals, transport, etc.), a synergetic approach across disciplines and borders – potentially tied to larger integrated projects – must follow.