

The Ocean and the European Marine Research Area: Opportunities and Challenges for the 7th Framework Programme by

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Dr. Peter M. Herzig obtained a M.Sc. Geological Sciences in 1983 and a Ph.D. Geological Sciences in 1986 at the Aachen University of Technology.

His specialisation is in marine geology and mineral resources, ore deposits geology and geochemistry. Since 1983, he has participated in 20 research cruises (including deep diving, ROV and drilling cruises) as Chief Scientist, Co-Chief Scientist, ODP Co-Chief Scientist and Shipboard Scientist in the Pacific, Atlantic, Indian, and Antarctic Oceans. He has joined numerous economic geology-related field programmes and consulting projects worldwide.

Mr. Herzig worked at the Aachen University of Technology from 1978 -1987 as a Teaching Assistant, Research Assistant and Research Associate and from 1989-1993 as a Assistant Professor and Associate Professor. In 1987 he spent a year as Post-Doctoral Fellow at the University of Toronto, Canada. He was during 1992 a Visiting Professor at the Geological Survey of Canada. The Freiberg University of Mining and Technology employed him from 1993-2003 as a Full Professor and from 1997-1999 as a Dean. During 2002-2003 he was a Visiting Professor at the Southampton Oceanography Centre, UK.

Presently, Peter M. Herzig is a Adjunct Professor at Université Laval, Quebec City, Canada and a Full Professor at the University of Kiel. He is also Director of the Leibniz Institute of Marine Sciences, IFM-GEOMAR, in Kiel.

He has been and is still active in numerous Committees and Boards, among them he is Chair of the German Marine Research Consortium.

The Galway Declaration of the European Ocean Conference 2004 held in Galway, Ireland, states that 1) the oceans play a crucial role for life on Earth including issues of climate, ecosystems, and resources; 2) marine research is research devoted to the future of coming generations; and 3) sustainable development of marine areas is a key issue of further development of the oceans. Consequently, the major objectives of marine research for the 21st Century include 1) ocean circulation and global climate change; 2) biological, energy and mineral resources; 3) natural disasters including earthquakes, volcanic eruptions and tsunamis, and 4) marine life and ecosystems.

The European oceans have a coast length of 34,000 km and cover about 3 million square kilometres, an area that is equal to the total landmass of Europe. In other terms this means that 50 % of the territory under jurisdiction of European Union member states is under water. These figures indicate the importance of the European ocean with respect to areal coverage. It is, however, even more important to realise that the European ocean and the related marine processes are also of major relevance to the society and the economy of the European countries.

The role of the European ocean in global climate change is based on the fact that ocean circulation is a first-order control on climate variability. The Gulf Stream, for example, is the heat engine that is responsible for the relatively pleasant climate of Europe. Any

changes in the circulation pattern of the Gulf Stream will have a direct impact on European climate. Furthermore, the oceans take up major amounts of atmospheric CO₂, a well-known greenhouse gas that contributes significantly to global warming and melting of polar ice. In this regard, the North Atlantic and the Arctic Ocean are key areas for the climate development in Europe and it is evident that factors such as warming, ice melting, changes in the circulation pattern and intensity need to be closely monitored to detect any changes as early as possible.

Present concentrations of CO₂ in the atmosphere have reached a level that has never occurred before going back in time as far as 450,000 years. In fact, the present level of CO₂ has developed from constantly low concentrations in the Earth's history by a factor of 2 only over the past 120 years. This change to the Earth's atmosphere has resulted in a global average temperature increase of 0.7°C over the same period of time. This level of warming on the other hand is responsible for a sea level rise of about 2.5 mm per year since the 1990s. If we extrapolate this figure to the year 2100, then we have to expect a sea level rise of about 25 cm in 96 years from now which is only about one generation. However, this scenario is even more critical when considering the CO₂ concentration that is expected if present-day CO₂ emissions prevail for the next few decades. In this case, the figure of 2.5 mm sea level rise per year may have to be multiplied by a factor of 4 to 6, that would result in a total estimated increase of about 1.5 m, a figure that could be reached in the year 2100.

A risk analysis for the European ocean has to consider factors such as submarine slides and related tsunamis for areas with gas hydrate occurrences such as the continental slope of Norway, earthquakes and related tsunamis in areas such as the Lisbon region of Portugal, the Gulf of Cadiz, East Sicily, the Hellenic region and the Black Sea, and volcanic eruptions of a nature not seen before at Mount Etna, Sicily. Whereas seismic and volcanic events of the type mentioned are largely triggered by plate tectonic movements in the adjacent oceans, toxic plankton blooms are related to major anthropogenic inputs of nutrients into the ocean. There is no doubt that all those processes and their consequences may present a major threat to the European oceans and need to be monitored similar to the climate-related factors mentioned above. In terms of time scales it has to be noted that the last major catastrophic landslide at the continental margin of Norway occurred about 8,000 years ago (Storegga slide). Traces of the associated tsunami can be found in the geological record of adjacent areas and indicate a strength that, at present day standards, would have caused severe damage to large areas. The last devastating earthquake in Lisbon occurred only 250 years ago with a magnitude between 7.5 and 8 on the Richter scale. However, the frequency of major seismic events in the area is unknown and cannot be predicted with a sufficient level of accuracy. Consequently, monitoring of oceanic processes that may lead to seismic and/or volcanic extremes is essential and needs to be linked directly to land-based observation systems.

European marine research over the past decades has resulted in the discovery of a number of extreme environments and habitats that require protection. These special environments and habitats include 1) mud mounds in the Mediterranean and close to the Iberian Peninsula; 2) deep and cold water coral reefs off shore Norway and the Porcupine area, Ireland; 3) carbonate mounds off shore Ireland; and 4) hydrothermal

vent fauna close to the Azores. In particular the deep and cold water coral communities represent one of the largest ecosystems of this kind in the world and need specific protection.

Marine resources in the European oceans are clearly dominated by biochemical and genetic substances including novel microbiological communities. Bio-prospecting and bio-screening will become increasingly important in order to identify commercial opportunities for the pharmaceutical industry. Unconventional ecosystems with bioactive compounds will also be a subject of significant interest. Finally, gas hydrates off shore Norway and metallic sulphide deposits associated with active hydrothermal systems close to the Azores may become interesting targets for industry, although the time scale for marine mining is uncertain. Because of the high methane concentration in gas hydrates, and the fact that methane is a strong greenhouse gas, the potential use of gas hydrates as an energy source is debated critically.

As a consequence of a number of factors mentioned above, marine research in the European oceans is of extreme importance in order to better understand, evaluate, protect and use the marine environment. In particular, seafloor observatories for long-term monitoring and risk assessment are a strong need to increase the safety of European margins. Furthermore, the European marine infrastructure including research vessels, research planes, drilling systems and remotely operated vehicles needs to be state-of-the-art to meet the demands and expectations of the European society and economy with respect to the sea. Due to the fact that a large number of Europeans live at or close to the sea, coastal zone management has to be improved in a number of ways. The preservation of important marine habitats and biodiversity is of high priority and Marine Protected Areas have to be identified and controlled. Finally, a European Margin Disaster Task Force ("EuMarForce") should be established to facilitate emergency response in case of natural or anthropogenic disasters in the European oceans. In summary, there is no doubt that the European oceans are an integral part of Europe and that over the next few decades, the marine areas will become increasingly important for every one of us living in the European Union.