

*”Mareano will provide
essential knowledge for an improved
environmental-based management of
the seas in the future”*

Heidi Sørensen,
Secretary of State, Ministry of Climate and Environment.
Spring 2008.

MAREANO – NEW KNOWLEDGE ON NORWAY'S MARINE AREAS

The MAREANO Programme Group

WHY MAREANO?

Norway has a vast marine territory and harvests great wealth from the sea. The fishing industry has been the heart of the Norwegian economy for centuries, and revenue from the oil and gas industry now contributes immensely. Despite this dependency on the sea, our knowledge of the seabed environment has remained poor. Discoveries over the last decade, such as the presence of numerous large coral reefs on the continental shelf off central Norway, highlight how much remains unknown. The Government has set out to fill the gaps in our knowledge through the seabed mapping programme MAREANO (MARine aREAL database for NORwegian sea areas).

”MAREANO is the result of our inquisitiveness. We want to have more detailed knowledge about an important part of Norwegian areas - simply a part of the Kingdom of Norway that can not be seen with the naked eye”

Helga Pedersen, Minister of Fisheries and Coastal Affairs. Autumn 2006

There are many arguments for this large-scale mapping of the marine environment and marine resources, such as the political demand that the marine environment and resource management must be based upon an ”ecosystem approach”. This is stated in Report No. 12 to the Storting (2001–2002) ”Protecting the Riches of the Seas”, as well as in international conventions signed by Norway. The ecosystem approach has also been incorporated in both the Marine Resources Act (2008) and the Nature Diversity Act (2009). The principle has been followed up in the Management Plans for the Barents Sea and the Sea Areas off the Lofoten Islands, as well as in the Management Plans for the Norwegian Sea and for the North Sea and Skagerrak.

An ecosystem is a community of organisms living in a given area, interacting with each other and with the physical environment. Incomplete or missing knowledge of the physical environment undermines the prospect of an integrated management of resources and the environment. Historically, Norway has made little effort to obtain basic knowledge of our seascape, a knowledge that we take for granted on land: What does it look like? What does the seabed consist of? Where are the coral reefs? What do we know about natural diversity, and about the interaction between seabed geology, seascape, biodiversity and biological resources? Where do the pollutants end up? We had only vague answers to these questions because

Norwegian coastal and sea areas were among the most poorly mapped in Europe.

Sustainable use of coastal and marine resources must be based on knowledge. But this knowledge is difficult to obtain for the various stakeholders within the public administration, aquaculture, fisheries, the oil and energy industry, etc. Without a substantial effort to address this lack of knowledge, future decisions may be based upon deficient foundations – hence the need for a large-scale national initiative to map our sea areas.

MAREANO has been developed through a collaboration between the Institute of Marine Research (IMR), the Geological Survey of Norway (NGU) and the Norwegian Mapping Authority Hydrographic Service (NHS). The agreement to establish a common mapping programme was made in May 1998. The decision was based on the success of the Skagerrak Project, where NGU, NHS, the University of Bergen, IMR and what is now called the Norwegian Environment Agency (then SFT) had collaborated to map the seabed and describe the environment. In January 2000, the first proposal was sent to the Ministry of Industry and Commerce, the Ministry of Fisheries and the Ministry of the Environment with the proposition of a 3-year programme in the Norwegian Sea (figure 1).

Patience is required when proposing large-scale initiatives across ministries and disciplines, and in the autumn of 2004 a last

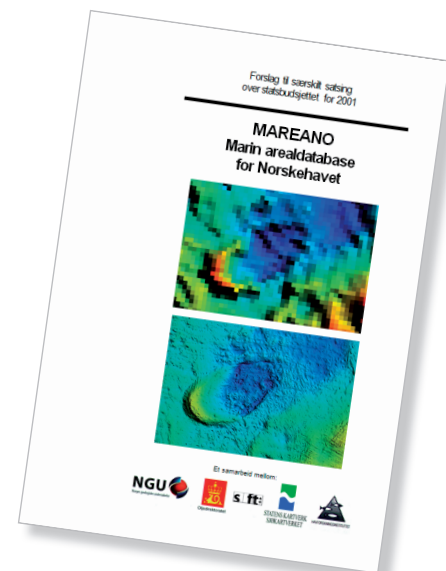


Figure 1. The first proposal for financing of MAREANO was submitted in January 2000.

attempt was made, focusing on the Barents Sea. The development of an ecosystem-based management plan for the Barents Sea had revealed large knowledge gaps that needed to be filled – and MAREANO was the necessary tool. Thus, in June 2005, five million kroner were finally granted for the start-up phase. At last, after a seven-year-long effort, scientists and engineers could finally start the mapping of bathymetry, geology and biology of the seabed in the areas off Lofoten and in the southern Barents Sea.

In the Management Plan for the Barents Sea and the Sea Areas off the Lofoten Islands, the

What is expected of MAREANO?

MAREANO is expected to provide scientific information on what the Norwegian seabed looks like, its geology, chemistry, and the biological communities that inhabit it. This information, including, how the seabed environment is affected by anthropogenic processes, is needed for the sustainable management of Norway's large marine territory.

The mapped areas are divided into various bottom types and biotopes, where some are dominated by particularly vulnerable and prominent species. This is useful for national and international management and various marine industries. Formerly unknown or unnamed biotopes and nature types are also documented. Biodiversity, seabed productivity and new species to science are described and delivered along with terrain and bottom type maps.

The MAREANO programme is a cross-sector initiative including several disciplines, which aims to map and carry out basic studies of the seabed's physical, biological and chemical environment. The results are made available to all interested parties and presented continuously on the MAREANO website: mareano.no.

Main deliverables from MAREANO:

- Information on bottom types, nature types/ biotopes and geological conditions
- Information on the distribution of benthic fauna, animal communities, biodiversity and biological production
- Chemical environmental status in the sediments
- Detailed bathymetric maps
- Database and map service with systematic information on Norwegian sea and coastal areas

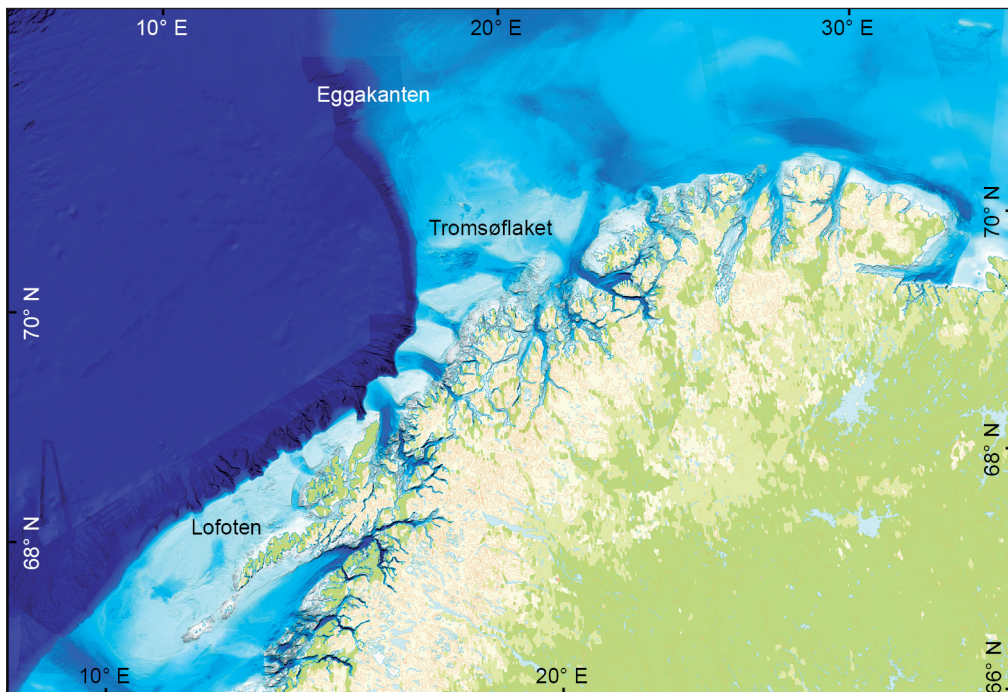


Figure 2. The area from Lofoten to Tromsøflaket and Eggakanten was prioritized in the original MAREANO proposal in January 2000.

which – in addition to the above-mentioned ministries – comprises representatives from the Ministry of Petroleum and Energy, the Ministry of Transport and Communications and the Ministry of Local Government and Modernisation. A Programme Group, responsible for the progress of the project, consists of government representatives with management responsibilities for the sea areas as well as management representatives from the partner agencies. One responsibility assigned to the Programme Group is to suggest which areas to map. The mapping itself is carried out by NHS, NGU and IMR within the Executive Group, which reports to the Programme Group. This system ensures a co-ordinated effort across disciplines and efficient use of expertise, equipment and new technology. Not least of all, the organisation of MAREANO proves how well anchored the programme is within central political and administrative management.

Government expressed the need to strengthen our knowledge through initiatives such as MAREANO (see Basic Facts 1). The areas off Lofoten and Vesterålen (Nordland VII and Troms II) and Eggakanten north from Tromsøflaket were highlighted as prioritised areas for seabed mapping in the MAREANO programme (figure 2). MAREANO contributed considerably with new knowledge in the update of the Management Plan in 2011. During the period from 2006 to 2015, the funding of MAREANO has increased from NOK 23.6 million to over NOK 90 million per year, the focus still being to improve the knowledge base for future updates of our respective Management Plans. Today, Norway has Management Plans for all its sea areas. In the Management Plan for the North Sea and Skagerrak, which came in 2013, it is stated that mapping of the seabed through MAREANO is still important and should be continued.

All the management plans identify particularly valuable and vulnerable areas (figure 3) that are prioritised in the MAREANO mapping.

The MAREANO programme represents a large-scale political effort which, from 2015, is financed by two ministries: the Ministry of Trade, Industry and Fisheries and the Ministry of Climate and Environment. The programme has an Administrative Board,

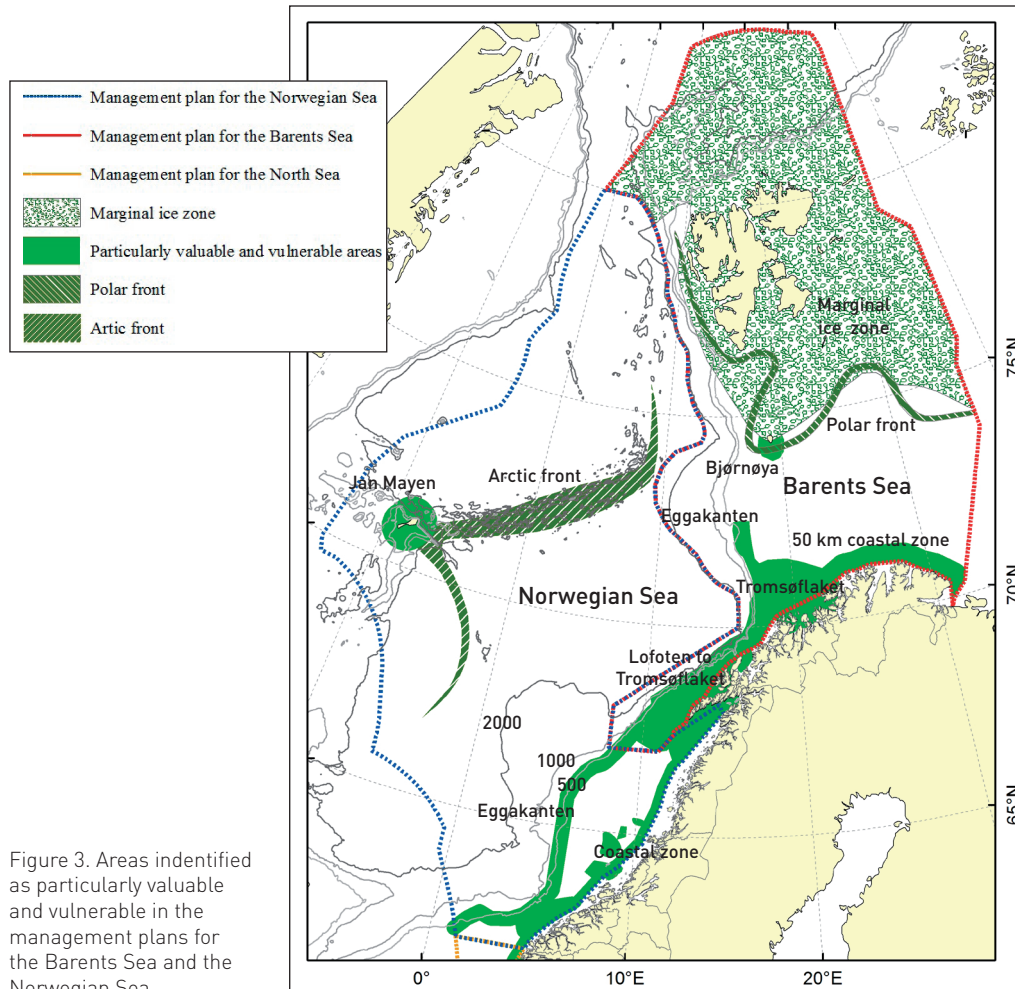


Figure 3. Areas identified as particularly valuable and vulnerable in the management plans for the Barents Sea and the Norwegian Sea.

WHAT DOES MAREANO DELIVER, AND TO WHOM?

In the period from 2005 to 2009, MAREANO mapped depth, seabed geology, natural resources and biodiversity, as well as chemical substances and pollution in the prioritised areas off Lofoten and north to the Eggakant area (figure 4). In the period 2010–2015, similar knowledge was gathered in the Norwegian Sea and the Barents Sea along the Russian border. MAREANO has mapped approximately 177,000 km². The seabed in these areas varies considerably, with large banks and shallow

areas divided by deep troughs and marine valleys (figure 5).

The Norwegian continental shelf is at its narrowest off Vesterålen. It is less than 10 km wide off Andøya, while the North Sea and the Barents Sea mainly consist of shelf areas. Many new discoveries have been made, such as exciting areas of gas seeps, gigantic sand waves and more than 300 coral reefs in Hola off Vesterålen.

More than 2200 marine species/taxa have been recorded, of which 1450 have been identified to species level. Ten-folds of these are new to Norway or have a different distribution than formerly thought, and new unknown species to science have been registered by MAREANO or by scientists outside the programme who have continued to work with the MAREANO

material. It is also worth mentioning the gas seep off Røst, west of Lofoten, where a habitat dominated by beard worms (Pogonophora) – characteristic of hydrothermal vents – was found. An area of soft corals found around Bjørnøyraset has caught international interest. The corals are predominantly a new species in Norwegian waters, the soft coral *Radicipes gracilis*. But large areas remain to be mapped. The Barents Sea and the Norwegian Sea have some of the world's largest fish stocks and largely unknown deep-sea areas.

The use of new technology and modern research vessels have allowed MAREANO to deliver knowledge, not only about the seabed, but also about how organisms relate to their environment both on a small (100 m) and large (1–10 km) scale. On land, most nature

Division of Work and Deliverables in MAREANO

SEABED TOPOGRAPHY

The Norwegian Mapping Authority Hydrographic Service (NHS) delivers detailed bathymetric maps based on measurements with multi-beam echo-sounders.

LANDSCAPE, BOTTOM TYPES, SEDIMENTS, AND GEOMORPHOLOGY

The Geological Survey of Norway delivers maps describing the bottom type, sediments and geomorphology of the seabed based on terrain analyses of multibeam echosounder bathymetry data, and video footage and sediment samples from the seabed.

NATURAL RESOURCES, SPECIES, BIOMASS AND BENTHIC HABITATS

The Institute of Marine Research delivers maps of natural resources: species, biomass and benthic habitats, based on information from video and samples collected by grab, sledge and beam trawl.

NATURE TYPES

The Institute of Marine Research and the Geological Survey of Norway deliver maps of nature types (biotopes) based on models of observed biotope distribution and full-coverage predictions across MAREANO mapping areas. The models are based on multivariate statistical analyses of the relationships between natural resource occurrences (benthic habitats, biodiversity, indicator species) and bottom conditions (fine-scale topography, sediments, depth, water masses).

BASELINE MAPPING OF ENVIRONMENTAL POLLUTANTS

The Geological Survey of Norway and the Institute of Marine Research cooperate on baseline mapping of environmental pollutants in seabed sediments. This includes analyses of organic and inorganic chemicals, among others, PAHs, PCBs, heavy metals, Arsenic and Barium.

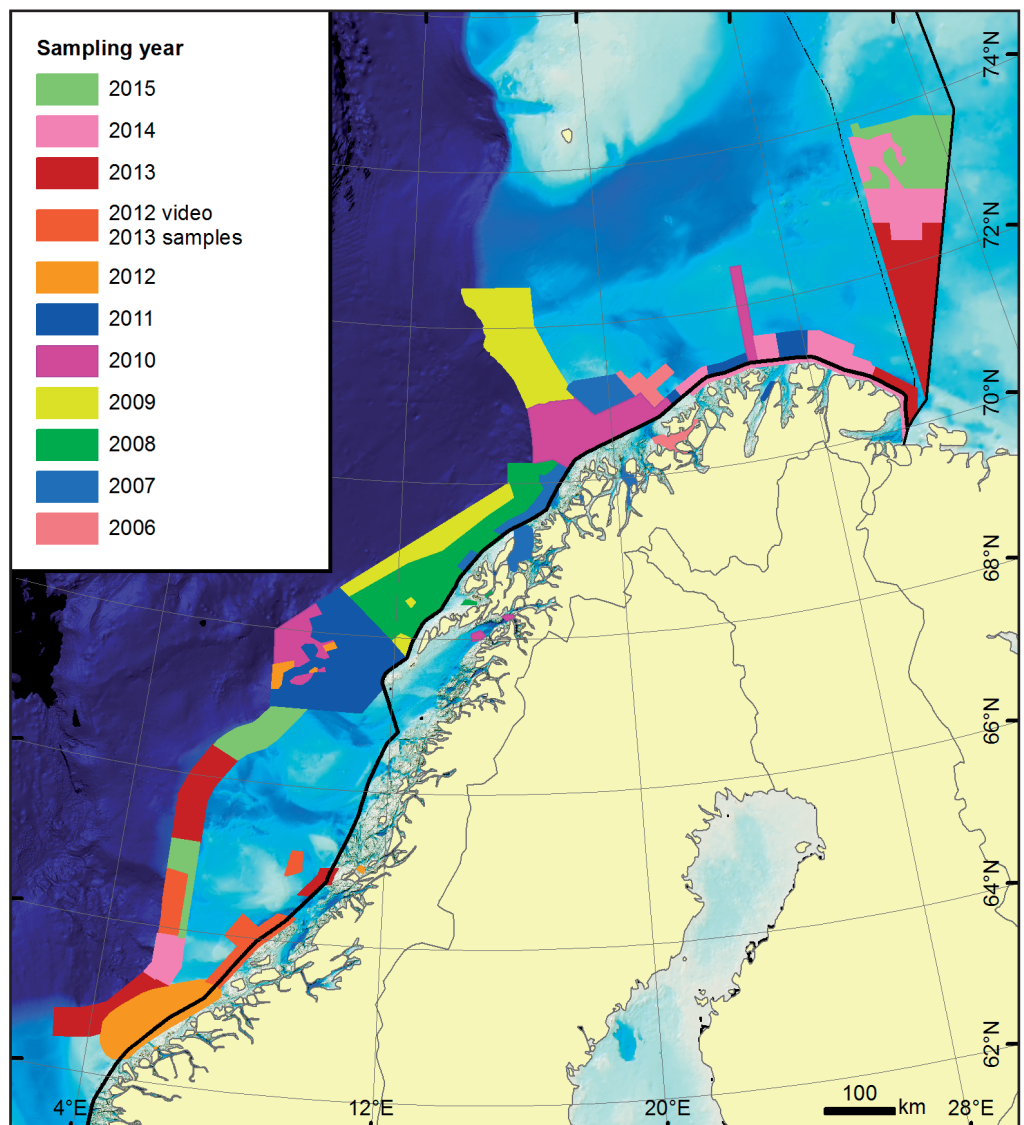


Figure 4. Areas mapped by MAREANO 2006–2015 with regard to geology, biology and seabed chemistry.

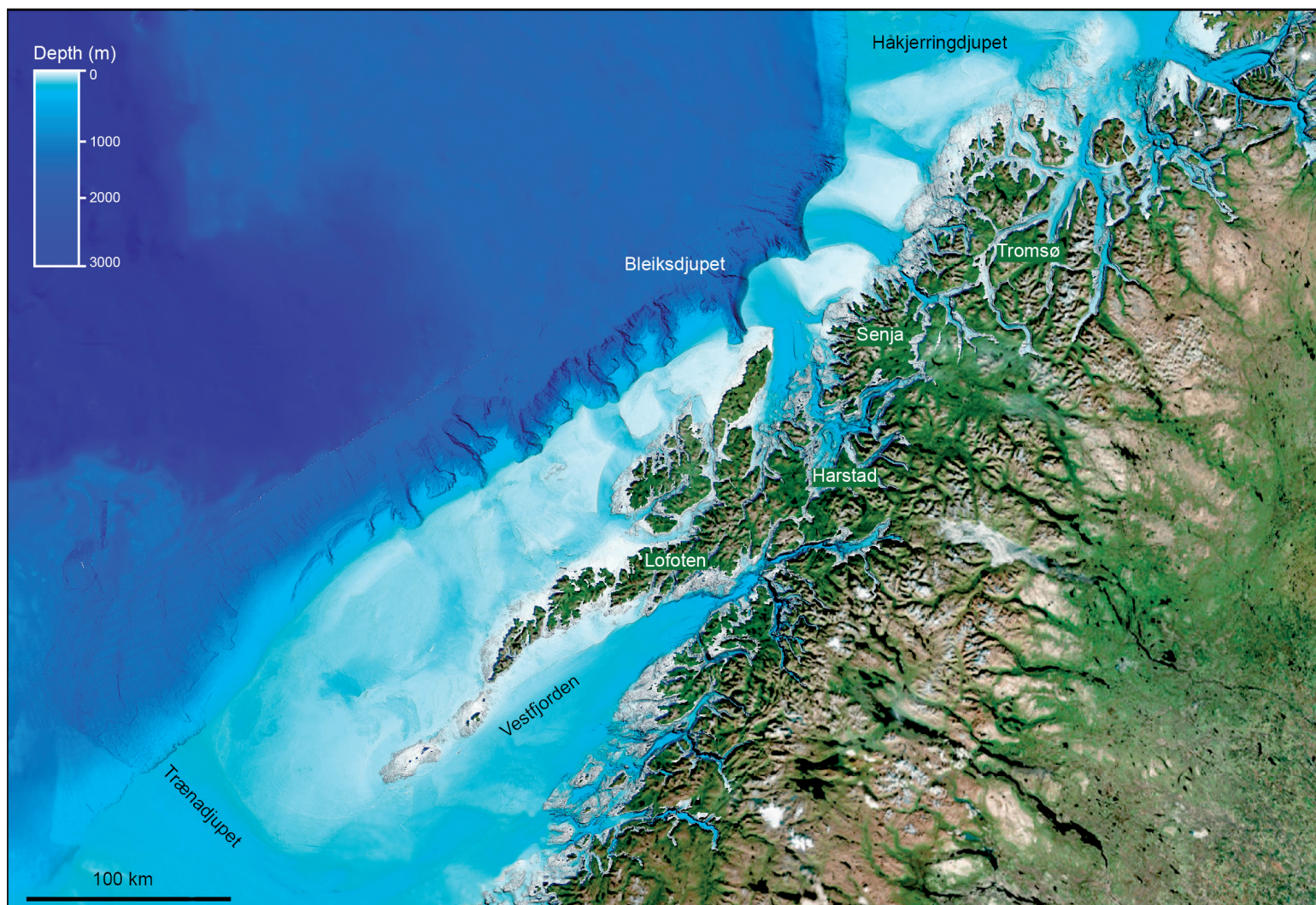


Figure 5. The continental shelf and the continental slope off Lofoten have Norway's most varied topography.

types are named, which is a great help to the management. However, the seabed is so unexplored that there are still nature types that have not been described.

MAREANO systemises and makes basic knowledge about the seabed and the marine environment available in a dedicated database, providing information such as chemical environmental status (and possible pollution) and the location of vulnerable ecosystems and important habitats. The main channel for communicating results is the portal mareano.no.

Chapters 2.1 and 2.2 explain how data are collected during surveys. A presentation of the unique seascapes and fauna in the mapped areas is provided in chapters 3–8. Water masses and bottom currents in selected parts of the mapped areas are described in chapter 9, followed by a description of the status of pollution in seabed sediments and signs of physical effects of fishing in chapter 10. In addition to the targeted mapping carried out by MAREANO, chapter 11 contains a general description of the geology and the

oceanography of the Barents Sea, as well as the main results from annual surveys of marine resources since 2005, carried out by IMR. An important part of the MAREANO programme is to make existing and new knowledge on our sea areas available to managing agencies and the general public. Chapter 12 describes how MAREANO handles this task. Practical use of the new knowledge is outlined in chapter 13, followed by thoughts on future work related to new management tasks in chapter 14. Enjoy!

"All Norwegian sea areas shall be mapped and ensured a comprehensive and environmentally responsible management. The goal is to prevent all activities that may threaten the environment"

Helen Bjørnøy, Minister of the Environment. The time of approval by the Parliament of the Management Plan for the Marine Environment of the Barents Sea and the Sea Areas off Lofoten Islands. Spring 2006.