

# Seabed Mapping for the 21st Century – The Marine Environmental Mapping Programme (MAREMAP): Preface

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During the 1970s and 1980s, the British Geological Survey (BGS) carried out systematic surveys of the seabed and sub-seabed around Britain, as part of a Government-funded programme to map the UK Continental Shelf (UKCS). Using an array of sampling, coring and seismic profiling equipment, the programme resulted in a series of geological maps and scientific publications which described the sediments at the seafloor, the sediments deposited during the Quaternary glaciations, and the older sedimentary, igneous and metamorphic rocks. These systematic surveys of the UKCS were followed during the 1990s by BGS and industry co-funded surveys in the deep-water areas to the west of the UK, such as the Rockall Trough and Plateau; although here, the density of sampling, shallow boreholes and seismic surveys was significantly reduced.

In recent years, the focus for offshore surveys has turned to the use of multibeam echo-sounder (MBES) data, supplemented by sampling and seismic profiling where possible. The MBES data provide images of the seafloor that not only allow geologists and other marine scientists to construct new high-resolution interpretations of the seafloor, but also allow the data collected in previous programmes to be re-interpreted, in places where the MBES data have provided greater detail of the seafloor environment. This step-change in resolution was driven by new technology, but also by new competing uses of the marine environment. In the 1970s, the prime purpose of the new surveys was focused on the growing oil and gas industry; but, since then, there have been dramatic increases in offshore industry, including aggregate extraction and the construction of some of the largest offshore wind farms in the world. Environmental issues, associated with coastal erosion, fishing, habitat preservation and the reaction of the seas to climate change, have resulted in EU-led regulations which require much higher resolution data than that provided by the early maps. Westminster and the devolved governments have reacted to these challenges by developing marine spatial planning. However, the real advances have been from the collection and interpretation of new MBES data.

MBES data have been acquired by many different public sector organisations, reflecting the different drivers. The largest programme of data acquisition, the Civil Hydrography Programme, is administered by the Maritime and Coastguard Agency (MCA) on behalf of the United Kingdom Hydrographic Office (UKHO), to gather data to update the nation's nautical charts and publications. However, bathymetric data and derived information such as acoustic reflectance (backscatter) are also useful to geologists, biologists, oceanographers, conservation agencies, fisheries scientists and many other groups with interests in the marine environment, each of whom also acquire MBES data on a more limited scale. Current estimates are that 30–40 % of the UK offshore has been surveyed using

MBES techniques. A modern multibeam sonar can provide up to 25,000 soundings per second – an incredible increase from the old, laborious style of weighted sounds using a lead-line!

Recognising the need to improve co-ordination and sharing of information, a number of initiatives have been established in recent years. To help plan and share opportunities to collect data, the MCA and UKHO organise an annual meeting at which organisations present survey results and their survey plans for the following year. This Civil Hydrography Annual Seminar helps to ensure that marine survey organisations avoid duplication of effort, but also identifies opportunities for collaboration and adding multidisciplinary objectives to survey plans. The data collected are archived and maintained at each of the survey organisations responsible for acquisition; but to improve access to marine data, the Marine Environment Data and Information Network (MEDIN) was established by a consortium of 16 sponsoring organisations. MEDIN is open to both public and private organisations with an interest in marine data and information, and currently has over 30 partners representing the entire marine sector, including government departments (such as the Department for Environment Food and Rural Affairs and the Department of Energy and Climate Change), research institutions and private companies, all of whom add value to marine data.

## The UK Marine Environmental Mapping Programme (MAREMAP)

The result of these initiatives has seen a significant increase in offshore survey efficiency for Government- and publicly-funded organisations. The final step in making best use of the data available to the UK marine community is to produce interpreted outputs. In the marine geosciences, as in other disciplines, the interpretation of MBES data is now carried out by several organisations in the public and university sector. To further co-ordinate these interpretations, two of the NERC's research centres, the BGS and the National Oceanography Centre, plus the NERC partner organisation, the Scottish Association for Marine Science (SAMS), launched the UK Marine Environmental Mapping Programme in 2010. The aim of MAREMAP is to achieve common, national objectives in seafloor and shallow geological mapping, addressing themes such as habitat mapping, Quaternary science, coastal and shelf sediment dynamics and the assessment of human impacts and geohazards in the marine environment.

MAREMAP's primary focus is to integrate common geoscience objectives across NERC organisations; but to be as inclusive as possible, the programme is also open to associate partners with shared interests in marine geoscience. To date,

MAREMAP includes the MCA, the Channel Coastal Observatory, the Centre for Environment Fisheries & Aquaculture Science, Marine Scotland and the universities of Plymouth and Southampton. Working together, and making use of the MBES and other marine information available to them, these organisations are creating a new generation of marine geoscience maps at 1:50,000 scale. The MAREMAP website (<http://www.maremap.ac.uk/index.html>) gives access to these outputs, in addition to the 1:250,000 scale maps created during the original regional mapping programme.

In this volume, we present a collection of studies reflecting the diversity and 'state of the art' in UK seabed mapping. First, Games & Gordon present the results of a study of sensitive commercial multibeam data from the North Sea. This study shows the impact of structures on sediment mobility and also displays repeat survey data indicating the migration of shallow-water bedforms over a short (annual) timescale. Piechaud *et al.* then discuss a modelling study of deep water habitats to the west of Britain; whilst Westhead *et al.* reveal novel applications for presenting seabed and LiDAR terrestrial data to image outcrop structures at sea and onshore. Next, Howe *et al.* present a recent survey of western Scotland and interpret the offshore geological structures, the glacial history and the signature of modern sediment mobility; whilst Vane *et al.* take a novel approach to mapping the contaminant legacy of the River Thames, revealing historical land use and utilising new survey data to show ancestral river transport. Lastly, Bradwell & Stoker utilise new survey data from northern Scotland to present an entirely new reconstruction of the final phase of deglaciation of the British–Irish Ice Sheet. Using a combination of seabed mapping data with cosmogenic nuclide dating methods, these authors overturn current thinking on

the demise of the British–Irish Ice Sheet, by revealing a highly dynamic and responsive ice sheet in this little-studied region of the UKCS.

### Looking ahead

At least half the UKCS is not yet covered by high-resolution MBES and, hence, the UK is lagging behind several countries in the quality of seabed information. This lack of data threatens our environment and limits the development of our natural resources.

The steps taken in recent years to improve the planning of marine surveys, and the archiving, sharing and use of marine information, have changed the way in which public sector organisations collaborate. The MAREMAP programme is a good example of how organisations from different sectors of the marine community can come together to share information and experience to create new geoscience outputs. Delivering high-resolution geological information to Government, industry and the academic sector can help to inform planning decisions which affect our marine environment and to stimulate both the commercial use of the seafloor and the research required, to ensure that our seas achieve good ecological status, as required by both UK and European policy.

We are aware that many site investigation studies, including MBES (also now collected utilising autonomous underwater vehicles), shallow boreholes, seabed samples and shallow seismic surveys, have been commissioned for offshore oil and gas, renewables, cable companies and dredging operations. We are open to integrating these data to improve our knowledge of the shallow submarine geology, and would welcome further contributions from industry to this national mapping programme.