

**SUBMERGED LANDSCAPES
OF THE EUROPEAN
CONTINENTAL SHELF**

Quaternary Paleoenvironments

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Quaternary Paleoenvironments

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Foreword

As little as ten years ago, the idea of producing a systematic and comprehensive examination of the glacial-maximum geomorphology and terrestrial environment of Europe's continental shelf at a pan-continental scale would have seemed either hopelessly fanciful or impossibly ambitious.

For archaeologists, the existence of a vast and now submerged prehistoric territory exposed at lowered sea level had barely entered the professional and academic consciousness. Traditionally, this underwater realm has been regarded as too inaccessible and difficult to deal with, and too ravaged by destructive processes to preserve more than a vestigial record of archaeological sites or landscape features, a record, moreover, considered unlikely to make any difference to the understanding of world prehistory. Such pioneering studies as exist have been focused mainly at local or national level, and sometimes at a regional level, for example in relation to particular sea basins such as the North Sea or the Baltic.

For Earth scientists, more familiar with large-scale collaboration at a continental or global scale, the continental shelf has been extensively studied in the context of plate tectonics, the extension of continental geology under the sea, national resources, coastal zone management, the exploitation of minerals and hydrocarbons, cable and pipeline route surveys and, to a certain extent, Pleistocene sea-level change. It has also been surveyed and mapped topographically at a resolution sufficient for safe navigation. However, analysis and interpretation of seabed data as evidence of a former terrestrial landscape that has been repeatedly exposed and then submerged by sea-level change has remained somewhat peripheral to their concerns.

The idea that the techniques already developed and the large quantities of data obtained piecemeal for many different applications could be synthesized and interpreted to reconstruct and understand the prehistoric occupation of the continental shelf during the various

phases of low sea level was not on anybody's agenda until very recently.

Such is the fate of research questions that fall outside the scope of pre-existing research agendas. Despite boldly expressed aspirations and much protestation of good faith about the virtue of 'interdisciplinarity', successful integration of ideas and methods drawn from many different disciplines remains a formidable challenge; by definition such endeavors lie at the boundaries between more established disciplines and are discounted in consequence, typically falling into the gaps between different conceptual structures, administrative organizations and funding bodies. In turn, the new ideas and agendas required to give momentum to the study of unfamiliar research questions are liable to slow and fitful development. The continental shelf, viewed as a submerged landscape and a former terrestrial environment, is no exception, and has long remained a marginal zone in both a literal and a conceptual sense.

An important recent spur to changing research agendas is the growing importance of understanding sea-level change in a world of climate warming and impending sea-level rise, and the threat this poses to human life and livelihoods on a global scale. The study of Quaternary ice caps, the crustal impact of redistributed masses of ice and water, and the changes of sea level on the continental shelf have been studied in several large global collaborations. But even here, difficulties in the efficient application of standard marine geophysical techniques, compounded by stratigraphic discontinuities and disturbances of seabed sediments, have hampered the study of submerged shoreline features, and more accessible proxy data has often been preferred such as deep-sea sediment cores, shoreline features above modern sea level, or the outputs of Earth-geophysical and climatic modeling. Yet, interpretations based on proxy data and theoretical modeling are only as good as the assumptions that underpin them, and in need of continuous testing and refinement against field data. Since sea level has

been lower than present for most of human history on this Earth and in most regions, it follows that most of the relevant data of past shorelines is now likely to be submerged on the seabed. Moreover, sea-level change is only one part of the history of the continental shelf, being inextricably bound up with the geological history of the Earth's crust and the geomorphological transformations at its surface, as the chapters in this volume make clear.

It was precisely this challenge – the need to bring together a multi-national group of individuals with very different scientific and archaeological skills and interests, but a shared interest in the terrestrial environment of the continental shelf and its potential for the preservation of archaeological data relating to human settlements – that brought into being the idea of “Project Deukalion”, conceived in 2008 by Nicholas C. Flemming and Dimitris Sakellariou. This rapidly led to the formation of the Deukalion planning group with 16 experts from 8 European countries and the goal of drafting the outlines of a multidisciplinary project.

The Deukalion initiative was subsequently expanded and incorporated into the SPLASHCOS network in 2009. SPLASHCOS (Submerged Prehistoric Archaeology and Landscapes of the Continental Shelf) is the outcome of a proposal to the EU COST (Cooperation in Science and Technology) program, designed to stimulate international and interdisciplinary collaboration. As COST Trans-Domain Action TD0902, SPLASHCOS provided sustained support and funding over a four-year period to bring together in regular meetings archaeologists, geoscientists, geophysicists, paleoclimatologists, oceanographers, sea-level experts and representatives of government organizations and offshore industries from 25 European states and over 100 research institutions and agencies in a concerted effort to develop a new research agenda. Funds also included encouragement and training of early-career researchers, and other dissemination activities (see www.splashcos.org for further details). The momentum created by that initiative continues.

This volume is the first major collaborative publication to result directly from the sustained activities of the SPLASHCOS initiative, and is the product of Working Group 2, Environmental Data and Reconstructions, led by Jan Harff. A second volume based on work

initiated by Working Group 1, led by Anders Fischer, on Archaeological Data and Interpretations is in preparation and is intended to examine in detail the evidence of prehistoric archaeology.

In keeping with the nature and aspirations of the SPLASHCOS Action, the authorship of this volume is collaborative, multi-national and multi-disciplinary, and the geographical scope pan-European, dealing with all the major European sea basins, ranging from the Atlantic Ocean and North Sea in the north-west, through the Baltic and the Mediterranean, to the Black Sea in the south-east.

The primary focus is the nature of the continental shelf as it would have existed during periods of lowered sea level as a terrestrial landscape – its variable geographical configuration, topography, sedimentary depositional processes, stratigraphy, climate, ice limits, river drainage, flora and fauna, and its potential and history as a zone of human habitation and a repository of archaeological data. Reconstructing these features is no simple matter, the biggest problem being the multiple ways in which successive cycles of sea-level rise and fall have variously buried, obscured, exposed, eroded or destroyed the material traces of past human activities and their original landscape setting. Hence, a major theme of research and interpretation must be the ways in which sub-sea processes, including commercial activities, have affected the preservation and visibility of formerly terrestrial deposits and their associated archaeological remains.

The problems posed by differential preservation and visibility are not insuperable, nor are they problems unique to the study of submerged land surfaces. Terrestrial archaeologists, too, have increasingly come to realize that the distribution of archaeological sites on land does not reflect in any simple way the distribution of past human activities or past human populations. Rather, such distributions represent a complex interaction between the locations where past peoples left the material traces of their existence, the nature of the activities carried out in these different locations, the manner in which material was discarded, and the various natural and human processes that acted subsequently to transform the land surface.

The term ‘landscape taphonomy’ is sometimes used to describe this field of research, referring to the variable

ways in which the physical features of a past land surface, including land forms, soils and sediments, and the archaeological materials deposited on or in them by successive human generations, have been variously buried, exposed, preserved, mixed, scattered, destroyed or otherwise transformed, whether by processes that are natural in origin or anthropogenic. The problem is especially acute underwater, but no less present on dry land. In both cases, the nature of these transformations remains poorly understood, under-researched, and in need of much greater attention.

The opening four chapters of this volume provide comprehensive overviews at a continental scale of key themes such as geological structure, large-scale tectonic evolution, sea-level change, glacial history, climate, environment and mapping, including the vexed issue of bathymetric maps and databases; these are often assumed to exist already in adequately published or digital form but in reality they are mostly produced for quite different purposes and are too inaccurate or of too coarse a resolution to be of more than limited usefulness for archaeological and paleoenvironmental purposes. The existing accessible and published data provide a broad framework in many regions, but as with so many other examples in the history of science, new research questions will demand the collection of new and more detailed data with methods best adapted to yield the necessary information.

These opening chapters are not confined narrowly to the continental shelf but encompass the continental landmass more widely, and make for illuminating reading, relevant to everyone interested in the natural and human history of the European continent over the past one million years and more.

These themes are followed through in more detail in the subsequent sea-basin chapters, which also include reference to key underwater archaeological finds as examples of preservation mechanisms and the potential for future discoveries. A notable feature is the comprehensive listing of online sources of information. In a digital world, information is increasingly being made available on the internet, either as searchable, accessible and properly maintained databases, or in more ephemeral or inaccessible form, and this is likely to be a growing trend for the future.

Another notable outcome of these chapters is to highlight is the variable nature and extent of the shelf environment in different regions, the variability in geology, oceanographic conditions, geomorphological processes and preservation potential, and the differences of approach best suited to these different conditions. Already the outlines of a more detailed pattern of variability are beginning to emerge more clearly and this will surely provide an important step towards more sharply defined research questions, new field investigations, and improved standards for wide-ranging comparative analysis.

The topics covered in this volume are not only of scientific and intellectual interest, but central to some of the most pressing and practical concerns affecting our collective livelihood, prosperity and sense of common identity in the coming century – understanding of sea-level change and its likely trajectory and human impact, management of a massively increasing volume of digital records, and improved knowledge of how the now-submerged territories of the continental shelf have contributed to the early growth of our civilization.

Much remains to be done, and some of the geophysical knowledge that forms the necessary foundation for new investigation is highly technical. Nevertheless, the interested reader will find this volume an essential starting point for entry into a vast new intellectual, scientific and multidisciplinary territory. It is our hope and expectation that this will create the basis for an expanding field of future research in the coming decades, with improved integration of its multiple sources of information and expertise, an increasing number of participants, a growing investment of resources and funding, a new generation of marine scientists and archaeologists with the proper training to move across the borders of the traditional disciplines, and significant progress in advancing the new discipline of Continental Shelf Prehistoric Research.

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Preface

This book considers the complex question of how, why, and where prehistoric occupation sites and artifacts on the European continental shelf have survived inundation by the postglacial rise of sea level, and how, why and where in other cases they have been destroyed. It forms an essential prelude to the interpretation of known submerged prehistoric archaeological sites and artifacts on the European continental shelf, which are now known to number in excess of 2600 find spots (see splashcos-viewer.eu).

The seed of the idea for this volume was sown in January 2008, when Dimitris Sakellariou invited Nicholas C. Flemming to present a report on continental shelf prehistoric research to the Hellenic Centre for Marine Research in Athens. In the discussions afterwards the idea emerged of a European-scale project which would be submitted to the European Community Framework-7 grant-awarding system in Brussels, and we hoped to obtain several millions of euros for this work. The sixth World Archaeology Conference (WAC6) was held in Dublin in June 2008, and Dimitris attended that meeting. There was a session on seabed prehistoric research organized by Amanda Evans and Joe Flatman. Less than a month later, in July 2008, the third International Conference on Underwater Archaeology (IKUWA3) was held in London, and Dimitris and Nicholas C. Flemming planned a day's session that started with papers on research already conducted on seabed prehistoric sites, and then devoted half a day to planning an application for research funds to the European Commission. The session was attended by about 80 people, and we created an address contact list, and a core planning group of ten people called the "Deukalion Group", after the hero of the Greek flood myth. At the same conference, Joe Flatman and Amanda Evans started to edit a book illustrating examples of seabed prehistoric sites from all over the world (Evans *et al.* 2014), drawn from the papers presented at WAC6 and IKUWA3.

The Deukalion Group was chaired jointly by Nicholas C. Flemming and Dimitris Sakellariou and successive meetings were held at different European academic research venues during 2008 and 2009. In the event, it proved impractical to plan and manage an integrated research project which could qualify for research funding on the scale that we had originally intended, not least because of a changing emphasis in EU funding towards smaller-scale research projects with a strong policy-relevant theme. Accordingly, Geoffrey N. Bailey proposed that in order to perpetuate and expand the group and provide funds for continued planning meetings and exchange of ideas, an application should be submitted to the COST (Cooperation in Science and Technology) Office in Brussels to fund a four-year Action or research network. Geoffrey N. Bailey chaired special meetings of the Deukalion Group to prepare and submit a proposal, which was approved for funding in 2009, leading to the project known as SPLASHCOS, "Submerged Prehistoric Archaeology and Landscapes of the Continental Shelf", (TD0902), which ran from 2009–2013, with a final conference in Szczecin, Poland in September 2013. The COST funding provided support for meetings, working groups dedicated to advancing thinking on particular themes, websites, publications, communications, data archives, training workshops, and field training schools, but not for the costs of new research projects. In the event, individual research groups working within SPLASHCOS were highly successful in raising financial support for fieldwork during the four years of the project.

Many individual reports and publications have been produced during the SPLASHCOS project. Agencies and research groups from 25 European countries participated, with over 100 individual researchers involved. There were 23 projects funded from various sources, both national and international, amounting to over €20 million in total. Numerous academic articles and reports were published in the refereed literature. The present volume

is a concluding publication within the SPLASHCOS schedule.

The editors thank all the authors for their hard work. This book is not a collection of papers where the authors had free rein. They were required to write chapters which addressed a novel range of problems. The energy, commitment, and spirit shown by the authors, and their willingness to respond to the demands of editorial review, has been very encouraging and rewarding, and many of the ideas in this book are the result of the interactions between experts of many disciplines, nationalities and backgrounds at SPLASHCOS meetings. Special thanks are due to Kieran Westley, who acted as coordinator and sub-editor for the group of chapters on the European Northwest Shelf.

In the editing process, Nicholas C. Flemming has led the primary task of reviewing and editing the contributions, with substantial input of intellectual and scientific expertise and revision from Delminda Moura and Jan Harff. Tony Burgess played a critical role in coordinating and formatting the content of the chapters in all stages of preparing the manuscript and Geoffrey N. Bailey critically reviewed the final text to ensure internal consistency, explanation of technical terms and coordination with the archaeological work of the SPLASHCOS project.

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