

Preface

Marine environments are increasingly important to human activities, with increasing exploration of our “Blue Planet” and with the development of resource extraction and offshore construction in often challenging environments. For these activities, we need an accurate knowledge of the seabed and what lies immediately beneath it. Are there methane reservoirs frozen below a particular Arctic seabed? What is the “plumbing system” below a field of hydrothermal vents? Can resources be safely extracted from a particular area, or is the seabed unstable? Will the installation of gravity bases for a large offshore wind farm be possible, or will the location of the different turbines be constrained by the local geology? Will drilling work in this site, or are there hidden obstacles that are going to block it? Or is there a risk of punch through, affecting economic viability as well as risks to humans, assets and the environment? Human activities also affect the marine environments, and knowing how they do so is now essential. How does resource extraction affect the subsurface geology? How do marine habitats fare with particular activities (e.g. trawl fishing) or how well do they recover after these activities cease (e.g. Grand Banks fishing moratorium)? How successful is a particular carbon capture and storage facility in keeping CO₂ safely in the ground? If siting an offshore structure at one place, will it be safer or riskier than siting it 15 m away? All these questions, and many more, are routinely faced by marine scientists and geotechnical engineers.

This book is for them and for anyone interested in the discovery of what lies below the seabed. Through fact-packed chapters, we aim to illustrate the evolution of the *Acoustic Interrogation of Complex Seabeds* (the title of this book) from its initial concepts to the answer products now available on the market. First author Jacques Yves Guigné did his Ph.D. at the University of Bath and graduated in 1986, with some key ideas about how to improve existing geoacoustic tools. He then founded Guigné International Ltd. to pursue further the prototyping and experimentation of these thoughts in collaboration with his academic role at C-CORE (Memorial University of Newfoundland). He later cofounded PanGeo Subsea Inc., to develop the prototypes into commercial sub-seabed exploration tools. He also founded Acoustic Zoom Inc., to expand on the physics behind the sonar-based

sciences to new applications for unprecedented earth imaging. Jacques' work earned him the Rayleigh Medal, the premier award from the Institute of Acoustics (in 2013), and a D.Sc. from the University of Bath (in 2014). This book is focused on Jacques' work and his achievements and in particular the development and use in the field of the *Acoustic Corer* now marketed by PanGeo Subsea Inc. (Canada). Second author Philippe Blondel joined the University of Bath in 1999, where he has specialised in sonar mapping, developing multistatic sonars and writing textbooks such as the *Handbook of Sidescan Sonar* (Springer, 2009) and *Bathymetry and its Applications* (InTech, 2011). He is teaching physics to undergraduate and post-graduate students and he is also deputy director of the Centre for Space, Atmospheric and Oceanic Science (CSAOS). Both authors started collaborating and exchanging ideas after their first meeting in 2007, and Jacques Yves Guigné is now a visiting professor at the University of Bath.

This double authorship offers a double perspective to this book. The insights of the inventor of many devices for acoustic seabed interrogation (ASI) result from several decades of hard work, in the laboratory and in the field. This book aims to explain the thought processes but also the everyday use at sea and how it compares with other technical approaches. Springer Briefs are meant for "experienced readers", and in this spirit, we assume known the basics of underwater acoustics, marine geophysics and seismic prospection. The reader desirous to know more (or refresh some concepts) will be invited where necessary to look at specific references known in the field, such as *Applied Geophysics* (Cambridge University Press, 1990), written by W.M. Telford, L.P. Geldart and R.E. Sheriff, and *An Introduction to Underwater Acoustics* (Springer, 2009), written by X. Lurton. Both books have seen several editions, a strong measure of their success. Other references will be presented wherever felt necessary.

We hope that this short book will help appreciate the challenges of acoustic seabed interrogation and how this can be successfully addressed in even the most complex environments with a new instrument (the *Acoustic Corer*) presented in a variety of situations.

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