

FROZEN HEAT

A GLOBAL OUTLOOK ON METHANE GAS HYDRATES

VOLUME TWO

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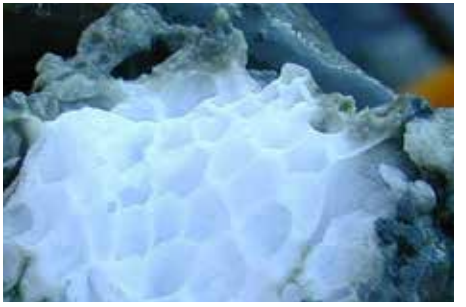

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Scott Dallimore and **Ray Boswell**

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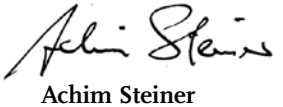
FOREWORD

Growing energy demands, uncertainty about supplies, and the urgent need to reduce emissions of greenhouse gases mean that the world faces an uncertain energy future. Many countries have begun to explore alternative energy sources, including so-called unconventional fossil fuels such as natural gas hydrates.

Gas hydrates generally occur in relatively inaccessible polar and marine environments, which is why they have not been extensively studied until recently. Research about naturally occurring gas hydrates has increased markedly over the past two decades, however, and understanding about where hydrates occur and how they might be exploited is growing rapidly. Japan has recently tested offshore production of natural gas from a hydrate reservoir located more than 1,300 metres below the sea's surface and other countries are also actively exploring production potentials.

Continuing a tradition of identifying emerging issues, the Global Outlook on Methane Gas Hydrates is the result of a rigorous assessment process designed to ensure the availability of scientifically credible and policy-relevant information. This assessment format brings together diverse strands of knowledge and is a key mechanism through which science informs decision-making.

This report provides a basis for understanding how gas hydrates occur and the emerging science and knowledge as to their potential environmental, economic, and social consequences of their use. The intention of this publication is to enable sound policy discourse and choices that take into account a number of important perspectives.



Achim Steiner
UN Under-Secretary General
and Executive Director of UNEP

PREFACE

This is the second volume of Frozen Heat: A global outlook on methane gas hydrates, a two-volume examination of the nature and energy potential of gas hydrates. UNEP's purpose in preparing this report is to inform the global discussion about this potential resource by compiling a comprehensive summary of current issues in global gas hydrate research and development. The first volume of Frozen Heat covered the science of gas hydrates and their role in natural systems. This volume examines the potential impact of gas hydrates as a possible new and global energy resource.

Figure 1.1: Natural gas infrastructure in northern Russia. (Courtesy of Lawrence Hislop, GRID-Arendal)

Figure 1.2: Japan, Canada, China, S. Korea, India, the U.S., Germany, Norway and other nations have made significant scientific and technical advances with respect to gas hydrates. (Photo left courtesy of JOGMEC: Photo of operations of the Drill Ship Chikyu in the Nankai Trough, 2013; Photo right courtesy of KIGAM: Scientific party with hydrate recovered from UBGH01 (Ulleng Basin Gas Hydrate 01) Expedition in Ulleung Basin, East sea, Korea, 2007).

Methane gas hydrates – the most common kind of gas hydrate – are solid, ice-like combinations of methane and water that are stable under conditions of relatively high pressure and low temperature. Found mainly in relatively harsh and remote polar and marine environments, gas hydrates occur most commonly beneath terrestrial permafrost and in marine sediments along or near continental margins. Naturally occurring gas hydrates contain most of the world's methane and account for roughly a third of the world's mobile organic carbon.

Gas hydrates were not studied extensively until fairly recently. In the 1930s, they were recognized as an industrial hazard that can form blockages in oil and gas pipelines. In the late 1970s and early 1980s, a series of deep-ocean scientific drilling expeditions confirmed their existence in nature and revealed their abundance. Growing energy demands and climate concerns have focused the attention of both industry and national governments on the potentially immense quantity of methane – a relatively clean-burning fuel – locked in natural gas hydrates.

The result has been significantly increased research into gas hydrates over the past two decades. Several countries have developed national gas hydrate research programs, and the pace of scientific discovery about the nature and extent of gas hydrate deposits is accelerating. Industry is beginning to invest in understanding the hazards that naturally occurring gas hydrates pose to deep-water and Arctic energy development. Academia is making significant progress in understanding the basic physics and chemistry of gas hydrates, their impact on the physical properties of sediments, and the role of gas hydrates in global environmental processes. However, the primary driver for much of the current interest is the potential contribution to energy security that gas hydrates offer to a world with steadily increasing energy demands and uncertain future energy supplies.

This volume of Frozen Heat examines the current state of knowledge about the distribution and availability of gas hydrates, the status of recovery technology, the potential environmental impacts of gas hydrate development, and the potential role of methane from gas hydrates in a future energy system, particularly as part of the necessary transition to low-carbon and, ultimately, no-carbon energy sources. It also looks at the role gas hydrates might play in future economic development worldwide – especially in the development of greener, more sustainable and environmentally friendly economies.

The central message in Volume 2 is that gas hydrates could potentially represent a large global energy resource. Even if no more than a small subset of the global resource is accessible through existing technologies, that portion still represents a very large quantity of natural gas. Moreover, the accessible subset could occur in places where conventional hydrocarbon production is already planned and/or underway and in areas with strong societal motivations for developing domestic energy resources. However, the commercial viability and environmental impacts of gas hydrate development are still very poorly known. Substantial additional basic science, engineering, and technology development will be needed to enable well-informed decisions.

Although commercial production of methane from gas hydrates is still in the future, that future is moving closer. Ultimately, a combination of technological advances and favourable global/regional market conditions will likely make gas hydrate production economically viable, at least in some regions or for some deposits. This volume attempts to pull together the information people will need to evaluate future energy resource options and the role gas hydrates might play in those options.