Preface

“Exploration of Gas Hydrates: Geophysical Techniques” adds an important dimension to the story of Natural Gas Hydrates from an energy perspective. Natural Gas Hydrates present an enormous opportunity and also a series of challenges if they are to be exploited on a large scale to bring vast quantities of a relatively clean fuel to market. Among these challenges, characterization and especially quantification of the methane hydrate resource present on our continental margins is of primary concern at this point in time. Geophysics is the best tool we have to meet this challenge.

Seismic reflection methods have been used for several decades as the primary means to detect of gas hydrates in continental margins. However, while the detection of gas hydrates in marine sediments is relatively straightforward from analysis of the anomalous amplitude and phase of reflectors, the accurate determination of gas hydrate quantities in subsurface space is an altogether more difficult task. As a pre-requisite, seismic acquisition parameters must be specified that adequately illuminate and sample the subsurface in a highly repeatable way, and with sufficient spatial resolution and dynamic range for the task. This requires “industry standard” seismic acquisition equipment and protocols rather than the more common standards used for academic research. Even then, quantification of gas hydrate and free gas volumes is only possible by taking a highly systematic approach to seismic data processing and analysis that incorporates forward modeling, inversion and calibration steps. The data analysis must be conducted within the proper geological context, which informs realistic and sufficiently flexible rock physics models of the sediment-fluid-hydrate-gas system.

While seismic methods remain at the cornerstone of geophysical assessment of hydrate resources, the increasing role and value of marine controlled source electromagnetic methods is also well demonstrated. Resistivity responses to hydrate and gas volumes are generally more linear than the seismic responses, and taken together, electromagnetics plus seismics provide an excellent framework for reducing uncertainties in rock property assignments and therefore volumetric calculations of hydrates and gas in place. Downhole logging, direct sampling and
geochemical analysis then provide the final ground-truth needed to validate and calibrate the rock physics models used in the three-dimensional Earth volume.

This book outlines such an approach to quantitative geophysical data analysis, with special reference to India’s National Gas Hydrates research programme. While making excellent use of the experience of this concerted effort in marine geophysical, geological investigations on the continental margins of the Indian Subcontinent, the authors have also drawn upon type examples from many other localities worldwide where hydrates have been studied in detail. This compilation of real data examples, with good quality figures and explanations is an especially valuable resource for scientists interested in natural gas hydrate occurrences and their geophysical expression.

Doctors Thakur and Rajput have put in one place an up-to-date review of geophysical methods applied to methane hydrate resource evaluation, and provided the big picture context to reinforce the relevance of this topic to a wider audience.

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26 August, 2010

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