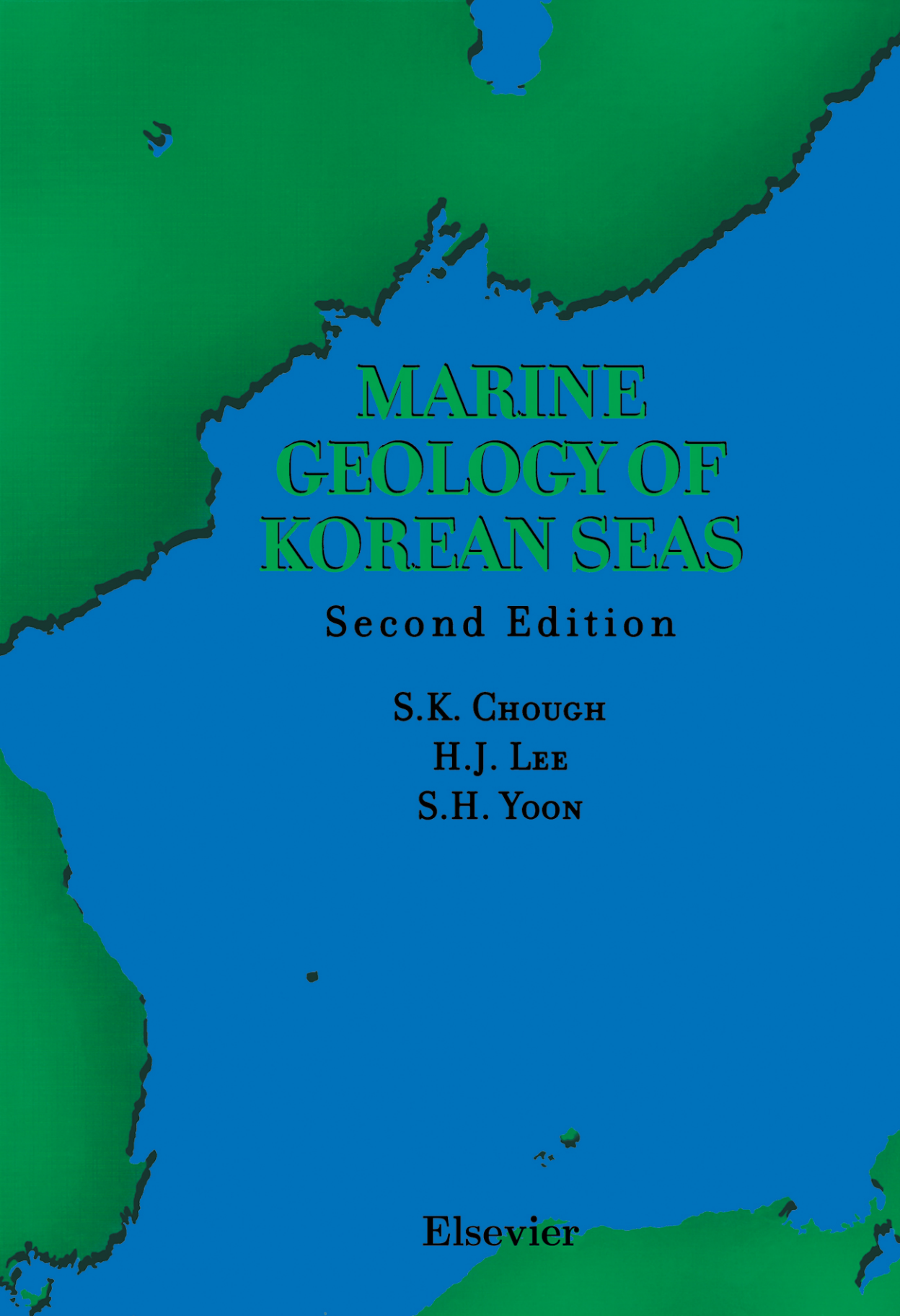

MARINE GEOLOGY OF KOREAN SEAS

Second Edition

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Marine Geology of Korean Seas

2nd Edition

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Preface (2nd Edition)

Marine Geology of Korean Seas was first published in 1983. Since that time tremendous progress has been made in the geological understanding of the Korean Seas with the advances in sophisticated exploration technique and reinforcement of research personnel, specifically in the areas of marine geophysics, sedimentology, geochemistry, and paleoceanography. Over the past two decades, the number of research scientists in marine geology has been doubled (or tripled) in most academic institutions (15 universities), the Korea Ocean Research and Development Institute (KORDI), and the Korea Institute of Geology, Mining and Materials (KIGAM).

In the Yellow Sea, continuous efforts have been made to explore hydrocarbon in the concession blocks. Although regional basin analysis in the eastern part of the Yellow Sea (Concession Blocks I–III) was instigated in 1970 by Gulf Oil Limited, additional data were acquired and reinterpreted in 1987 by Marathon Oil Company in cooperation with the Korea National Oil Corporation (KNOC). Twenty holes have since been drilled throughout the Yellow Sea basins. On the other hand, both shallow subsurface mapping using high-frequency profiling and deep cores (up to 60 m deep) into the Holocene/Pleistocene boundary have been made by the KIGAM to reveal late Quaternary depositional processes and sequence stratigraphy in this unique epicontinental sea. Studies have also been active by the KORDI and the academic institutions for environmental changes in the eastern part of the sea, estuaries, and tidal flats, delving into aspects of sediment transport and deposition, physical oceanography (tides, waves, and coastal currents), geochemistry, and air–sea interactions.

The sea south of the Korean Peninsula, South Sea, is characterized by numerous islands that have been submerged during the last transgression. Shallow subsurface mapping using high-resolution seismic profiling has revealed that the sea is characterized by complex incised valley systems and transgressive deposits during the rise in sea level. This is an area for further detailed studies of high-resolution sequence stratigraphy. A number of offshore exploratory wells have also been drilled, revealing hydrocarbon potential.

In the East Sea (Sea of Japan), studies have focused on the Ulleung Basin and its surrounding margins, using single- and multi-channel seismic profiling, magnetic and gravity data, closely spaced (5.5-km interval) high-frequency profiling (Chirp), and multibeam mapping. More than ten exploratory wells have been drilled in the southern margin of the basin (Block VI) where commercial development of gas is being sought. The

coverage of Chirp and Seabeam profiling by the National Oceanographic Research Institute (NORI) provides an unprecedented data base. Deep piston coring in the basin and analyses of sedimentary facies, microorganisms, and oxygen and carbon isotope data help reveal paleoceanographic and environmental changes in the sea. Aspects of water circulation and the formation of deep water masses in the deep basins have also been described by physical and chemical oceanographers.

The subsurface geology of the Korean Seas is intimately related to that on the adjacent land; especially, the tectonic evolution of the Mesozoic and Cenozoic sedimentary basins is contiguous to that on land. For this reason, an expansion has been made in this edition to relate details of basin evolution on land to those under the sea.

At this stage, it is timely to summarize the hitherto-revealed knowledge on the geology of the Korean Seas for a second time. In this edition, we have incorporated the new results and interpretations that help formulate geological hypotheses and corollary on the evolution of the Korean Seas in relation to the adjacent continents. We have followed the basic framework of the first edition, but amply expanded the volume to include recent developments in every realm of marine geology in the past 16 years. Because of the lack of our knowledge on the northern part of the peninsula (north of 38th parallel; DMZ), this book focuses on the sea floor off the Republic of Korea. Geographic names follow the current-use Romanization proposed by the Government of Korea.

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CHAPTER 1

Introduction

The Korean Seas (Fig. 1.1) are geologically unique. The Yellow Sea (or West Sea) is a shallow (less than about 100 m), postglacially submerged epicontinental sea bounded on the east by a long stretch of ria-type coast. The western part of the East Sea (Sea of Japan) is characterized by a narrow shelf with a straight coastline. The Yellow Sea floor is rather flat and progressively deepens toward the southeast to form the Okinawa Trough in the northern East China Sea. The East Sea deepens abruptly seaward, forming a number of deep basins between ridges and surrounding margins that are related to the opening of a back-arc basin associated with subduction of the Pacific Plate. The South Sea, bounding the southern coast of the Korean Peninsula, is also shallow and flat, similar to the Yellow Sea, but characterized mostly by rocky embayments.

Regional studies on the geological structure of the Yellow Sea were made in a joint survey (Emery et al., 1969; C.S. Kim et al., 1969) supported by the Committee for Co-Ordination of Joint Prospecting for Mineral Resources in Asian Offshore Areas (CCOP) (Fig. 1.2). An airborne magnetic survey was also conducted in the Yellow and South seas and the southern part of the East Sea (Bosum et al., 1971) (Fig. 1.2). Regional basin-scale studies on the concession blocks (Blocks I–V; Fig. 1.3) were made by the Marathon Oil Company (1987) and the Korea National Oil Corporation (KNOC) (PEDCO, 1997) based on gravity, magnetic, seismic, and drilling data. These studies in the Yellow Sea showed the existence of two large-scale Mesozoic–Cenozoic non-marine basins (North and South Yellow Sea basins) bounded by basement highs (massifs) (Fig. 1.3). In the Cretaceous, these basins were contiguous to those on land in a retroarc basinal setting.

Attempts have been made by the Korea Institute of Geology, Mining and Materials (KIGAM) mapping projects since the early seventies to obtain data on the geological structure of the shallow portions of the Yellow Sea (Chough, 1983a). These were followed by deep drilling of Quaternary deposits in the southeastern Yellow Sea revealing depositional history and sequence stratigraphy of the regressive/transgressive systems (KIGAM, 1996; Jin and Chough, 1998). The surface sediment distribution in the entire Yellow Sea has been compiled and interpreted in terms of physical processes (H.J. Lee and Chough, 1989). Recently, closely spaced, high-resolution seismic data have been obtained in the entire Yellow Sea by the National

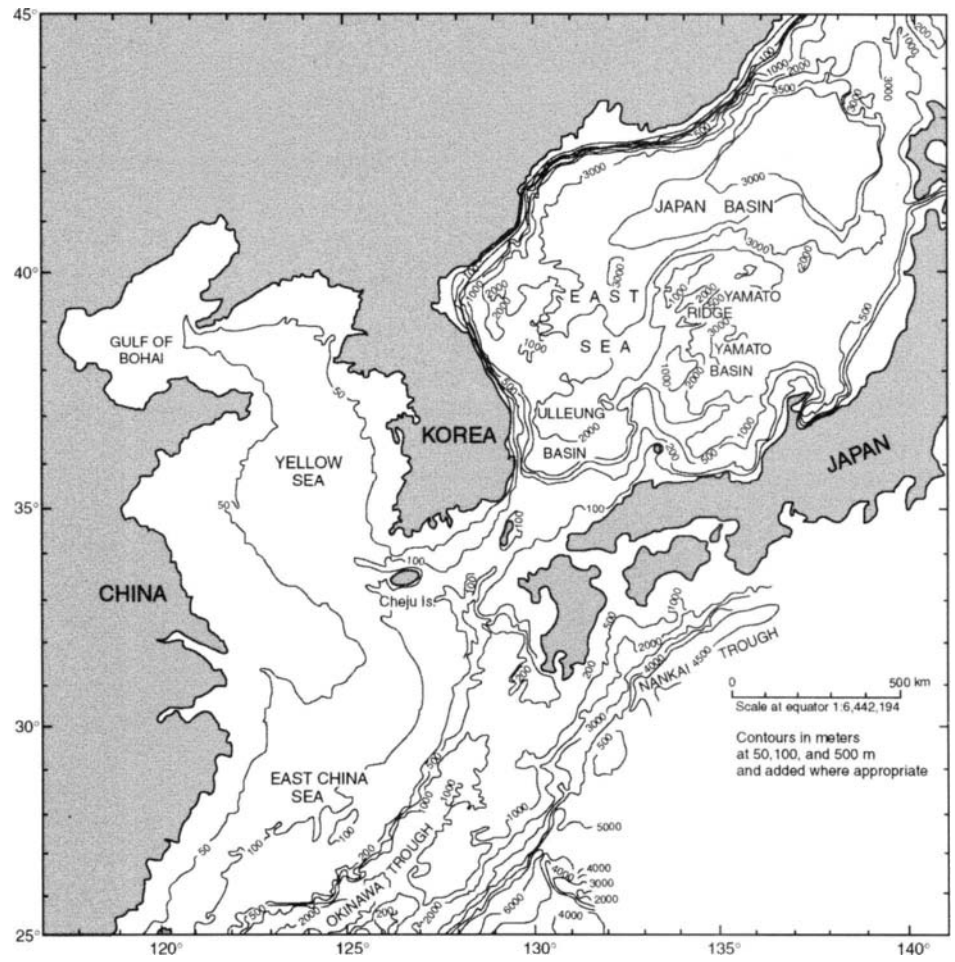

Fig. 1.1. Bathymetry of the Korean Seas: the Yellow Sea, northern part of the East China Sea, and the East Sea (Sea of Japan). Contours in meters. Modified after Mammerickx et al. (1976) by permission of the Geological Society of America, Inc.

Oceanographic Research Institute (NORI) using the Chirp system. In the meantime, drilling activities have also been greatly increased in the South Sea and the northern East China Sea, aiming at the deformed Tertiary strata whose economic hydrocarbon potential was strongly predicted by earlier studies.

On the continental margin of the East Sea, the KIGAM conducted a cooperative seismic survey with the Federal Institute of Geoscience and Mineral Resources of Germany (Schlüter and Chun, 1974) to reveal possible