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Advances in Marine Gas Hydrate Exploration and Discovery

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Natural gas hydrates, widely distributed in terrestrial permafrost and continental margins, are recognized as a clean and efficient energy resource, attracting significant global exploration interest. In recent decades, substantial progress has been achieved in hydrate exploration and discovery, driven by advancements in multidisciplinary approaches, including geological, geophysical, and geochemical investigations, as well as numerical simulation techniques. Current research on gas hydrates focuses on several critical aspects: (1) the origin of hydrate gas and its genetic links to deep conventional oil and gas reservoirs; (2) mechanisms controlling hydrate accumulation and reservoir formation; (3) spatial heterogeneity in hydrate deposits and their controlling factors; and (4) innovations in drilling and production testing technologies. This interdisciplinary field integrates knowledge from tectonics, sedimentology, geophysics, geochemistry, petrology, mineralogy, and numerical modeling. Substantial progress in gas hydrate research has been encouraged by scientific and technological breakthroughs, including exploration successes in the South China Sea and other continental margins worldwide, alongside laboratory experiments and simulations. This Reprint aims to advance research on gas hydrate exploration and test mining simulations, emphasizing accumulation mechanisms and assessments of environmental and resource benefits. By addressing these aspects, we seek to provide theoretical insights and methodological frameworks to support the future exploration, drilling, and test production of marine hydrates.

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