

## Gas hydrates of the marginal seas of the Western Pacific: Bering Sea, Okhotsk Sea, Japan Sea, and South China Sea

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Extensive distribution of marine gas hydrate was suspected from widely distributed BSRs on the continental rise and slope sediments, and occasional recovery of gas hydrate samples by the Deep Sea Drilling Project early 1970s. In 1980-90s, DSDP drilling recovered and identified subsurface gas hydrates in sediments with BSRs in the Blake Ridge, Mid-America trench, Peru margin, Nankai trough and etc. Kvenvolden (1988) estimated the amount of gas hydrate in sediments is 10,000 Gt as carbon. Gas hydrate was really an exciting finding in 20th century not only to the earth science communities but also to human society. Finding of such a huge carbon sink was a challenge to a bio-geochemical model of carbon cycle. Marine gas hydrate also attracted a growing interest as a new energy resource under the current energy crisis. In Japan, METI launched 16 years gas hydrate exploration project in Nankai trough in 2001 after a 5 years successful leading program. A number of countries are also conducting marine gas hydrate project targeting in their deformed accretionary complexes, which have been the focus of R&D projects. However, recently, ROV and submersible dives have revealed characteristic features and seafloor manifestation of methane venting and gas hydrate formation /dissociation events such as microbial colonies and bacterial mats, chemosynthetic communities, carbonate crusts, and even seafloor gas hydrates. These features are often associated with strong BSRs suggesting massive accumulation of subsurface gas hydrate. Marginal seas of the Western Pacific are characterized by such an active methane activity and gas hydrate accumulation. In Japan Sea, we identified a number of strong plumes of thermogenic methane, massive gas hydrate exposed on the seafloor, deep gas chimneys with strong BSRs in Joetsu basin. Methane venting and large plumes, mud volcanoes and deep gas chimneys have also been recognized in the Ullung basin off Korea, and they said that chunks of gas hydrate were recovered by drilling in 2007. South China Sea has been expected to produce gas hydrate deposits due to high accumulation rate of organic rich sediments and high heat flow, and finally they retrieved gas hydrate samples in the northern part of the Sea last year. Northern tip of the South China Sea, S.W of Taiwan, is a part of the accretionary complex, characterized by folded and faulted ridges. Mud volcanoes and mounds, methane plumes, and chemosynthetic communities are common throughout the area. Before the recent findings in these marginal seas, international team of Japan (Kitami Industrial Institute), German, Russia, and Korea revealed active phenomena such as circular structures with gas venting, carbonate concretions, and shallow gas hydrates in the Okhotsk Sea. David Scholle and others (1978) of USGS has early identified a unique seismic feature in Bering Sea and named them as VAMP structure, which is characterized by both a pull-up and pull-down reflectors within a single chimney. They were thought to represent a vertical stack of low velocity and high velocity strata. We can now explain it as gas hydrate deposits underlain by free gas charged sediments. Recently, USGS has re-assessed the resource potential of VAMP, giving a vast amount of methane accumulation. In summary, there identified a characteristic type of gas hydrate deposits in the marginal seas of the Western Pacific. They look different from those developed in passive margins or in accretionary complexes, probably related with characteristic tectonics of marginal seas, high heat flow, high sedimentation/burial rate of organic matter rich sediments. Gas hydrates of the marginal seas of the Western Pacific provide a unique opportunity to assess the resource potential of massive gas hydrate deposits, as well as to study the origin and processes of the formation of gas hydrate and possible impact of methane seeps on global environments.