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日本海東縁、上越海盆の表層ガスハイドレート分布域で掘削した MD179 コアでの海底地すべりの研究
Submarine landslide identified in MD179 cores from shallow gas hydrate area of Joetsu basin, eastern margin of Japan Sea

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Gas hydrate is exposed on a sea floor and is hosted in a shallow depth of sediments in the Joetsu Basin, the eastern margin of the Japan Sea. Linear arrangement of pockmarks and mounds, 50 to 500 m in diameter and 10 to 50 m high and deep, respectively, are identified on both Joetsu knoll and Umitaka spur in the Joetsu Basin. Seismic profiles of these topographic highs reveal gas chimney structure, an effective conduit for the migration of deep-seated gases, develops below the pockmarks and mounds, and the depth of bottom simulating reflectance is estimated to be situated around 100-150m on the spur and knoll. Pockmarks and mounds should have been related to formation and dissociation of gas hydrate. Whereas Un-named ridge situated northeast of the Umitaka spur shows no such characteristic landforms (Matsumoto, 2009; Matsumoto et al., 2009).

Sediment cores are recovered from the Joetsu knoll, Umitaka spur and Un-named ridge during the cruise of R/V Marion Dufresne in 2010 to examine the occurrence and nature of gas hydrate and its surrounding sediments. Bioturbated layers interbedded with thinly laminated (TL) layers, both of which consists of silty clay, are the main constituents of the sediment cores. Blocks or fragments of gas hydrate, carbonate nodules and thin laminations of sand occur in some cores. The repeated bioturbated and TL layers are a diagnostic feature of the Quaternary sediments of the Japan Sea, and the TL layers substitute for marker beds with a help of tephras. Detailed observation of the TL layers makes it easy to recognize landslide horizons in the Japan Sea, in addition.

The recovered sediment is, although, mostly disturbed by tilted horizons, faults, slump folds and breccia except that from the Un-named ridge. The tilted horizons are the most common disturbance of sediments and faults follow them. Slump folds are almost limited to the MD179-3296 that is cored at a pockmark on the Umitaka spur. Detailed examination of TL layers clarified that the TL layers occur in order and a disturbance of sediment is limited in many cores. MD17-3317, which is targeted at a pockmark on the Joetsu knoll, is the most severely disturbed core and consists of breccia originated from repeated debris flow.

Timing and trigger of the submarine landslides are hardly clarified in most cases. Among them, breccia of MD179-3299 that occurs in the upper portion of TL2, the characteristic sediment of the last glacial maximum (LGM) in the Japan Sea, is interpreted as follows. Carbon isotopic analyses and an occurrence of a specific foraminifer strongly suggest a release of methane had occurred around that horizon. And this release of gas caused by the lowered sea level as much as 120 m during the LGM probably led the debris flow on the Umitaka spur.

The thick breccia of MD179-3317 and tilted horizon of MD179-3301 had been formed after the LGM when the global warming had rapidly progressed and sea level had been rising. The Clathrate Gun Hypothesis (Kennett et al., 2002) may be applied to this event. This hypothesis predicts that gas hydrate is unstable at the very time when the interstadial interval had started, and the dissociation of gas hydrate by the warming resulted slope failure such as slump, debris flow and turbidity current.

Seismic activity is another factor that should be considered, because the Joetsu basin is situated in the midst of tectonically active area of the eastern margin of Japan Sea. The Un-named ridge has no physiological sign of release of gas hydrate, and therefore the fault of MD179-3312 will be the case.

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References

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