

## Tracing the history of activities of marine mud volcanoes

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For the last few years, we have attempted to investigate deep structure of the Kumano mud volcanoes applying various sorts of acoustic methods. These approaches made it possible to image varied ancient structure of the mud volcanoes and to interpret the brief history of their past activities. In this study, 3-D seismic data from KT04-12 and KT06-19, 2-D seismic data from METI's fundamental investigation 'Tokaioki-Kumanonada', and AUV Urashima's Subbottom profiler (SBP) data on YK06-08 were mainly used.

In Kumano Knoll No.3 and the twin mud volcanoes, Kumano Knoll No.5 and No.6, several umbrella-shaped structures were found interbedded beneath the present mud volcanoes by the 3-D and 2-D seismic data. These structures are not intrusive clastic bodies but sedimentary because the umbrellas are unconformably overlain by the surrounding trough sediments. Thus, it can be considered that the interbedded umbrella-shaped structures were once erupted clastic sediments but have been buried by the trough sediments. The deepest umbrella below the Kumano Knoll No.3 is observed just on a clear angular unconformity, which is estimated as several hundred thousand years old (corresponding to Ogasa Group) by stratigraphic comparison with the borehole data in METI's wells. And supposedly, there have been four major periods of mud volcanic activity at least since then, being extruded from the one mud diapir. Below the adjoining Kumano Knoll No.5 and No.6, there are umbrella structures of size with which both mud volcanoes are covered. The deepest umbrella below the both mud volcanoes are estimated as older than 1 Ma (corresponding to Kakegawa Group).

For the Kumano Knoll No.8, although seismic survey is not applied yet, it was found by AUV Urashima's SBP survey that the knoll which is only 40 m in height is covered with the trough sediments. The stratigraphy in the shallow sediments around the Kumano Knoll No.8 indicates that the knoll is relatively young mud volcano where there were clastic intrusions, depressions and uplifts for the past several tens of thousands years.