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Geological study of deep underground material from mud volcanoes in the Kumano Trough off Kii Peninsula

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Submarine mud volcanoes are formed as conical mounds composed of erupted unconsolidated or partially consolidated sediments from mud diapirs which are induced by high pore-fluid pressure developed in the deep underground. Most of them were discovered around subduction zones. Mud diapir that brings deep underground materials to seafloor has an important role for material circulations in subduction zones. Moreover, methane seepages at mound summits are suggested by existences of chemosynthetic biological communities, and accumulation of methane hydrate is expected from core samples and seismic reflection studies. Therefore, mud volcano is also significant in terms of global warming and energy resource.
In order to understand material circulations by mud volcanoes, information about formation mechanism, source layer and its depth is important. In addition, despite mud diapir is generally regarded as rising phenomenon by buoyancy and abnormal high pore pressure, those physical properties are not well investigated. In this study, we discuss the formation mechanism and source depth of mud diapir by using of samples derived form mud volcanoes.
We obtained drilling samples from two sites (C9004, C9005) at the summit of the mud volcano in the Kumano Trough off Kii Peninsula, during CK09-01 using Deep-Sea Drilling Vessel CHIKYU, in March, 2009. Results from Site C9004 are mainly presented because the recovery at Site C9005 is no good.
To understand formation process of mud volcano, anisotropy of magnetic susceptibility, paleomagnetic direction, vitrinite reflectance, density, geological description of breccia, clay mineral composition and microfossil age determination are conducted. Anisotropy of magnetic susceptibility shows particle arrangement within samples to understand sedimentation and deformation fabrics. We measured anisotropy of magnetic susceptibility of matrix parts. The particle arrangement is expressed by three principal axes of magnetic susceptibility ellipsoid: maximum magnetic susceptibility (Kmax), minimum magnetic susceptibility (Kmin), and intermediate magnetic susceptibility (Kint) directions. Muddy sediments usually exhibit the ellipsoidal body characterized by oblate shape. In contrast, the samples from the mud volcano show prolate shape rather than oblate shape. Moreover, Kmax direction is mostly vertical. Therefore, we expected that this mud volcano is influenced by vertical material flow or horizontal shortening. In the depth direction, there is no variation of magnetic susceptibility ellipsoid.
Porosity of the matrix from the mud volcano is almost constant around 50%. In contrast, porosity from basin sediments shows more than 80% at seafloor and decreases with depth due to overburden. Constant values in porosity from the mud volcanoes suggest recent eruption without suffering from gravitational compaction. We will also present estimation of source depth of mud diapir based on vitrinite reflectance.

Keywords: subdution zone, mud volcano, mud diapir, anisotropy of magnetic susceptibility, vitrinite reflectance, porosity