Dispersal of deep-biosphere communities from submarine mud volcanoes to the overlying hydrosphere

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Submarine mud volcanoes along the plate convergent margins represent "natural pipelines" that vertically transport low density, deformable sediments and gaseous compounds from several kilometers below the seafloor to the overlying hydrosphere. For example, methane is supplied through upward fluid advection via the mud volcanism from the deeper hydrocarbon reservoir and microbial communities near the seafloor consume a large fraction of methane through their aerobic and anaerobic oxidation activities on the seafloor. However, the vertical dispersal of microbial components from the subseafloor habitat to the overlying seawater remains unknown.
Since 2012, using the AUV "Urashima" and ROV "Hyper-Dolphin", we performed an intensive seafloor survey of the submarine mud-volcanic structures off Tanegashima Island, showing well-preserved mud-flow channels suggestive of the recent mud-volcanic activities. During the KH-15-2 cruise in 2015, we obtained sediment core and water samples from the summit of MV#1 and MV#14 using a Navigable Sampling System (NSS). The profiles of methane concentrations in the water column showed a small peak (1-2 nM) at about 40 m and 60 m above the top of MV#1 and MV#14, respectively, indicating the existence of methane plume discharged from the submarine mud volcano. To study taxonomic composition of microbial communities in sediment and water-column habitats, we extracted DNA and then sequenced 16S rRNA genes using a next generation sequencer. The sequence analysis demonstrated that microbial community structures are overall very different above and below the seafloor. However, interestingly, we found some common species, such as "*Atribacteria*"-relatives, which are widely distributed in anaerobic subseafloor sedimentary habitats. Moreover, the distribution patterns of those common species correlate with the peaked methane profiles. Our geochemical and microbiological observations suggest that a small fraction of deep-biosphere microbial communities are geomechanically dispersed with methane from submarine mud volcanoes to the overlying hydrosphere.

Keywords: Mud Volcano, Microbial community structure

