

Preliminary Results of the RV SONNE cruise SO251b in the Kumano Basin (Nankai Trough subduction zone, Japan)

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Mud volcanoes are topographic highs on the ocean seafloor related to expulsion of sediments and fluids from depth. The characterization of the ejecta is helping to constrain the source origin of mud volcanoes and, at the same time, provides important mineralogical, geochemical and rheological information at depths not reachable through scientific drilling. Off the Kii-peninsula, on the Kumano Basin seafloor, 13 mud volcanoes have been identified from previous scientific investigations in the area (Kuramoto et al., 2001; Morita et al., 2004; Pape et al., 2014). The mud volcanoes' ejecta have been suggested to originate both in the inner accretionary prism and below it, on the plate interface between the Philippine and Eurasian plates (Pape et al., 2014; Toki et al., 2014; Nishio et al., 2015). The Kumano region is known to be subject to large earthquakes, with last occurrences in 1944 (Tonankai, $M_w=8.2$) and 1946 (Nankai, $M_w=8.3$) (Ando et al., 1975; Cummins et al., 2002; Linde and Sacks, 2002; Kodaira et al., 2004). Multiple evidences from other regions affected by mud volcanism suggest that mud volcanoes activity is linked with earthquake (Mellors et al., 2007; Kopf et al., 2010; Rudolph and Manga., 2012). Tsunogai et al. (2012) hypothesized such link could also exist for the Kumano Basin mud volcanoes. However, full understanding of this relationship needs to be supported by detailed studies on mud volcanoes to understand their evolution both in time and space, as well as to link them with the seismogenic zone at depth.

Two scientific cruises with the RV SONNE were held on the Kumano Basin in 2012 (SO222) and 2016 (SO251b). The main purposes of the SO251b cruise were (1) to recover the long-term monitoring devices installed in 2012 on 3 mud volcanoes (MV#2, MV#3, MV#4) and (2) to monitor heat flow, pore water geochemistry, bathymetric and subbottom variations on the Kumano Basin seafloor in order to compare the newly acquired data to the SO222 ones.

Four long-term observatories, measuring pressure and temperature in MeBo boreholes, were recovered during multiple dives with the ROV PHOCA from Geomar and are currently under analysis. The long-term data series, together with records from the DONET network, will allow to define the link between mud volcanoes and earthquakes. At the same time, the multibeam echosounder survey (Kongsberg EM122, 12 kHz) was expanded from 2012 to cover most of the Kumano Basin, from 136°10' to 137°30' East. The recently acquired data unraveled a new mud volcano (MV#14, which was also groundtruthed with the recovery of mud breccia) and interesting bathymetric changes in correspondence of some of the most active mud volcanoes (MV#2, MV#13). The differential bathymetry provides constraints on mud flows occurrence between 2012 and 2016. Several loci of possible gas emission (>40) were discovered on the basin seafloor, often situated on top of mud volcanoes or near suspected ones, characterized by strong acoustic signals within the water column. Geochemistry results from sediment cores scattered through the research area showed, according to preliminary analyses conducted onboard, slight freshening with increasing depth, pointing towards a possible deep-seated fluid source. Heat flow measurements with a violin-bow probe through the basin and the active mud volcanoes (identified in 2012) revealed marked differences from the SO222 measurements, supporting ongoing fluid/mud emissions especially on MV#2 and MV#13.

Keywords: Mud Volcano, Kumano Basin, Long-term observation