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Mud volcanism and thermal structure in the western Mediterranean Ridge accretionary complex (Eastern Mediterranean)

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Submarine mud volcanoes are discovered in most subduction zones of the world, and those developed on accretionary prisms are considered to document material recycling and fluid migration within the prisms. The Eastern Mediterranean has numerous mud volcanoes, most of which develop on contiguous belt within the Mediterranean Ridge (MedRidge) accretionary complex. However, mud volcano fields in the western MedRidge remain poorly studied, although those in the central and eastern MedRidge have been heavily surveyed during an Ocean Drilling Project or European projects. This study aims at understanding material recycling and fluid migration within the western MedRidge accretionary complex. In order to achieve this objective we delineate possible ascent style of the ejecta forming the Medee-Hakuho Mud volcano (MHMV) in the western MedRidge, by applying the vitrinite reflectance technique to ejecta samples retrieved by ROV NSS (Navigable Sampling System) during KH-06-4 Leg 6 Cruise.

First, we modeled the 2-D thermal structure in the western MedRidge taking into account frictional heating on the plate interface for estimation of the source depth of the ejecta from MHMV. The result suggests an effective coefficient of friction of less than 0.05, and a temperature of about 120+/-15^{o}C along the plate interface at a distance of 180 km from the deformation front, the location of a seaward toe of the Aegean backstop. Second, we evaluated the source depth of the ejecta from MHMV using vitrinite reflectance based on the modeled thermal structure. The result suggests that the ejecta matrix showing vitrinite reflectance (VR) values of about 0.59% was derived at a temperature of around 85^{o}C, corresponding to a depth of approximately 5.5 kmbsf, whereas the clasts (e.g., shales and siltstones) representing VR of ~0.6-1.0% were derived from much deeper depths. Most of the (pre-)Aptian clasts were considered to have been jacked up to the depth of 5.5 kmbsf due to underplating at the toe of a rigid backstop that had developed below MHMV after underthrusting due to plate subduction. At that depth, fluid pressure may have been dramatically increased due to underplating, and consequently fluid-rich sediments accompanying surrounded clasts ascended through an existing backthrust.

Keywords: mud volcano, thermal structure, Mediterranean Ridge, Eastern Mediterranean