Effect of mass wasting on the topographic evolution of a mid-ocean ridge detachment fault footwall

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We present the preliminary results of the first author's Ph.D. project, entitled "Fluid-rock interactions in the context of mantle exhumation at slow-spreading ridges". At slow-spreading ridges, the new seafloor is commonly made of tectonically exhumed mantle, where hydrothermal reactions lead to the serpentinization of peridotites, the release of hydrogen and methane, formation of high pH fluids and carbonate-crystallization in the serpentinized basement. The objectives of the Ph.D. are to acquire new constraints on the hydrothermal fluid pathways, and on the fluid-rock reaction and exchanges in this tectonically-dominated MOR context, primarily based on data and samples collected in 2017 during ROVsmooth cruise to the SWIR near 64°E. The first few months of work have been focused on the study of High-Resolution bathymetry and ROV videos to constrain geological and tectonic setting of hydrothermal venting and carbonation in the footwall of an active axial detachment. This detachment exhumes serpentinized peridotites in its footwall and hosts the Old City hydrothermal field and carbonate deposits (Cannat et al., Goldschmidt Conference 2019).

This work reveals the complex mass wasting structures and its role in channeling hydrothermal fluids to the seafloor. The top portion of the footwall includes 1-3 distinct breaks in slope, corresponding to coherent mass-wasted blocks 200-1300 m wide and 2880-3500 m long in along-slope direction. Steeper slopes between these blocks bear decametre scale erosional features which are lined by conical debris deposits. Both these eroded scarps, and intervening mass-wasted blocks are cut by smaller scarps, up to 120 m in downslope-offset and 600 m in along-slope direction, which are interpreted as most recent mass-wasting structures. Some of the scar surfaces do develop erosional and depositional features and others lack them suggesting that they are relatively younger. The Old City hydrothermal field is hosted in one of this relatively recent scarp, that cuts into a relatively high slope region (29°-33°), which may correspond to the eroded scarp of a large (several kilometers) landslide, or an eroded portion of the detachment fault surface. HR bathymetry is lacking to discriminate between the two interpretations. Overall, our observations indicate that the top of this detachment fault footwall is heavily modified by landslides and mass wasting structures play a role in channeling hydrothermal circulations associated with carbonation of the exhumed ultramafic rocks.