Near seafloor dynamics of mid-ocean ridge hydrothermal flows and formation of diffuse vents at the Lucky Strike hydrothermal field, mid-Atlantic ridge

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Hydrothermal fluids deriving from km-scale convection cells at mid-ocean ridges enable most magmatic heat and chemical element transfers from the oceanic crust to the ocean. These hot hydrothermal fluids are modified in the highly permeable domain that lies within a few hundred meters of the seafloor. Mixing with secondary seawater circulations, near seafloor chemical reactions and conductive heating/cooling allow for the formation of diffuse effluents that vent mid to low temperature fluids. These diffuse vents release larger heat and chemical fluxes than the high temperature black smokers, and host most of the chemiosynthetic biological activity at mid-ocean ridges vents.

The Lucky Strike basalt-hosted hydrothermal field comprises at least 15 well studied vent sites, most displaying a semi-elliptical domain of diffuse venting, 20 to 50m in diameter, surrounding a central sulfide mound. The estimated heat flux at each site is at least 10-20 MW (Barreyre et al., 2012). We present preliminary vent site-scale numerical models of the formation and circulation of diffuse fluids constrained by geological observations, seafloor mapping, fluid chemistry and long time series of fluid temperature acquired at Lucky Strike as part of the EMSO-Azores long term monitoring initiative. Our models simulate the injection and dynamical fate of a hot (350-400°C) hydrothermal "jet" at the base of a 2D, initially cold, permeable domain. We test the effects of dynamical parameters such as permeability, and injection T°, size and rate on venting T°. The models also include anhydrite precipitation leading to the formation of complex, impermeable barriers which are key for diffuse flow formation.