Tectonic controls on melting and oceanic crust composition at mid-ocean ridges.

L. Mezri[1], J. Garcià-Pintado[1] and M. Pérez-Gussinyé[1]

[1]MARUM - Center for Marine Environmental Sciences, University of Bremen, Bremen, Germany

Superfast and ultraslow ridges are end-members of the Earth's ridge system, where oceanic crust forms, and displays a great diversity in composition, hydrothermal systems and biological communities. At both ridge types, the thickness of the seismic crust varies across the axis, with the wavelength of oscillations being longer at slower ridges. The emerging consensus proposes this to reflect the alternation between magmatism and tectonics, which is controlled by an oscillating magma supply. While the role of magmatism on tectonics has been extensively studied, the role of tectonics on magmatism is not yet understood; the two are even thought to be dissociated. We address this by modeling ridge systems starting from continental extension. Our dynamic models simulate melting, serpentinization, hydrothermal cooling, and ocean loading. For ultraslow systems, we find that the importance of tectonics is controlled by ocean loading promoting long offset faults, and the balance between hydrothermal cooling and heat release processes, driven by serpentinization and magma emplacement in the crust. In our model, faulting mode influences crustal composition, mantle flow beneath the ridge and melt productivity, which can have a major impact on hydro- and eco-systems. At superfast ridges, we find that the lower crust is a dynamic environment in which molten lower crustal and mantle rocks mix, at the location where magma chambers are seismically imaged. We hypothesize that this influences the chemical composition of MORB.