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# On spreading modes and magma supply at slow and ultraslow mid-ocean ridges

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The availability of magma is a key to understand mid-ocean ridge tectonics, and specifically the distribution of the two contrasted spreading modes displayed at slow and ultraslow ridges (volcanically-dominated, and detachment fault-dominated). The part of the plate divergence that is not accommodated by magma emplaced as gabbros or basaltic dikes is taken up by normal faults that exhume upper mantle rocks, in many instances all the way to the seafloor.

Magma is, however, more than just a material that is, or is not, available to fill the gap between two diverging plates. It is the principal carrier of heat into the axial region and as such it may contribute to thin the axial lithosphere, hence diminishing the volume of new plate material formed at each increment of plate separation. Magma as a heat carrier may also, however, if emplaced in the more permeable upper lithosphere, attract and fuel vigorous hydrothermal circulation and contribute instead to overcooling the newly formed upper plate (Cochran and Buck, JGR 2001).

Magma is also a powerful agent for strain localization in the axial region: magma and melt-crystal mushes are weak; gabbros that crystallize from these melts are weaker than peridotites because they contain abundant plagioclase; and hydrothermally-altered gabbros, and gabbro-peridotite mixtures, are weaker than serpentinites because of minerals such as chlorite and talc. As a result, detachment-dominated ridge regions that receive very little magma probably have a stronger axial lithosphere than detachment-dominated ridge regions that receive a little more magma.

Because magma has this triple role (building material, heat carrier, and strain localization agent), and because it is highly mobile (through porosity, along permeability barriers, in fractures and dikes), it is likely that variations in magma supply to the ridge, in time and space, and variations in where this magma gets emplaced in the axial plate, cause a greater diversity of spreading modes, and of the resulting slow and ultraslow lithosphere composition and structure, than suggested by the first order dichotomy between volcanically-dominated and detachment-dominated spreading.

In this talk I illustrate these points using results of recent studies at the Mid-Atlantic and Southwest Indian ridges.