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Melt Band Formation in a Mid-Ocean Ridge Corner Flow

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It has been well established through a variety of experimental and numerical studies that imposing an external shear on a system of partial melt will result in the compaction of the solid matrix and expulsion of the interstitial liquid melt; this leads to the formation of regions of contrasting high and low porosity that are commonly referred to as melt bands. These shear induced melt bands have been proposed to channel melt beneath a mid-ocean ridge (MOR). In this contribution, we evaluate the suitability of melt band formation as a mechanism for melt channeling beneath a MOR using a linear instability analysis with three different matrix viscosity conditions: isotropic strain-rate independent, isotropic strain-rate dependent, and anisotropic strain-rate independent. Our analysis shows that the largest amplitude bands channel melt away from the ridge axis toward the base of the plate at the lithosphere-asthenosphere boundary. We also show that effectiveness of channeling through the bands is highly dependent on the mantle bulk viscosity and the initial porosity perturbation amplitude, both of which are poorly defined.