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Melting-induced fluctuations on the shallow thermal regime at the Vema transform, Mid Atlantic Ridge

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The thermal evolution of a transform fault depends on the mechanics of the system, such as friction and mineralogical profile, the effects of hydrothermal cooling and the fluctuations of the base temperature. We examined the case of the Vema transform at 11°N along the Mid Atlantic Ridge and estimated the temperature fluctuations at 3-4 kbar, i.e. in the region unaffected by hydrothermal or mechanical contributions at the base of the lithosphere. We found that variations in the mantle source composition at depth (>3Gpa), in particular the ratio between low- and high-solidus lithologies (pyroxenites vs. peridotites) may induce variations of up to 40 °C in the shallow regime (Brunelli et al., 2018). These variations results in 1-5 My long cycles that overprint the effects of spreading rate variability. In a slow-spreading setting this effect can amplify or smooth the variation induced by the spreading rate evolution through time. Varying the source lithological composition also results in delivering a different lithological association and crustal structure to the shallow system: a high pyroxenitic content in the source results in strong heat consumption at depth, depression of the shallow T regime, thin basaltic crust and deliver of a lherzolite dominated assemblage to the deep crust. On the other hand low or negligible pyroxenitic content results in higher T at the base of the lithosphere, thick basaltic layer and harzburgitic dominated deep crust. The lithological variability of the lithospheric mantle increases with the increase of pyroxenitic content in the crust.

Brunelli, D., et al., 2018. Thermal effects of pyroxenites on mantle melting below mid-ocean ridges Nature Geoscience: 1.