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# How do detachment faults root into the deep lithosphere of slow spreading mid-ocean ridges ?

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Large offset normal faults (also called detachment faults) that exhume mantle-derived peridotites play a significant role in plate divergence at slow-spreading ridges. They are also key for structures accommodating extension at distal continental margins. Metamorphic reactions involving hydrated minerals have been shown to control strain localization in the upper, hydrothermally altered part of the slow-spread axial lithosphere. Very little is known by contrast of the deformation mechanisms that operate in the lower levels of the lithosphere, in non-hydrothermally altered peridotites.

The Southwest Indian Ridge (SWIR) to the east of the Melville Fracture Zone has a particularly low magmatic supply, and magma there is focused along-axis at discrete volcanic centers, leaving corridors in which nearly all the divergence of the plates is accommodated by detachment faults. This end-member setting is a natural laboratory to study melt-starved plate divergence mechanisms, at mid-ocean ridges but also at the continent-ocean transition of divergent margins.

For the study reported here, we have selected 50 samples of moderately serpentinized peridotites from a set of 270 samples dredged in the eastern SWIR nearly amagmatic corridors (Sauter et al., 2013). Olivines and pyroxenes in these samples have porphyroclastic to mylonitic textures. Optical and electronic microscopy and the study of mineral preferred orientations by EBSD reveal complex relations between ductile and brittle deformation mechanisms. Microfracturation and kinks are locally accompanied by partial recrystallization of the primary minerals.
Microprobe data provide constraints on the temperatures prevailing during deformation. We interpret these textures as due to deformation of the mantle at increasing deviatoric stress at and just below the rooting zone of axial detachments. The intensity of this high stress brittle-ductile deformation varies between samples, but it can be detected in all of our SWIR samples, suggesting that, in its initial stage, this deformation episode is pervasively distributed in the nearly amagmatic corridors. It is noteworthy that primary minerals in abyssal peridotites collected in more magmatic slow-spreading ridge settings do not show this pervasive brittle-ductile imprint: probably because melts there help localize deformation in the deep lithosphere.