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Mechanisms and conditions of deformation along an oceanic detachment (Mid-Atlantic Ridge, Fifteen-Twenty Fracture Zone)

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We constrain the mechanisms and conditions of deformation along an oceanic detachment, and its maximum depth of active deformation. The detachment accommodates >20 km of extension and is located off the Mid-Atlantic Ridge at ~15.75°N, where magma supply to the axis is low, and peridotites outcrop within the rift valley. Petrological and textural observations are performed on samples from the fault surface, which shows striations in bathymetry, deep-tow sonar data, and on-bottom images (see MacLeod et al., this meeting). The main lithologies drilled and dredged on the striated surface are highly deformed serpentinite and talc, intact or slightly deformed diabase, peridotite, and scarce gabbro. The striated surface is a thin (<25 cm) serpentinite and talc shear zone, locally missing or not recovered during drilling. Synkinematic growth and solid rotation of minerals produces a strong shear foliation that is sub-horizontal (i.e., subparallel to the detachment), which developed at low temperatures (250-450°C). Talc may form syntectonically after serpentinite in the presence of Si-rich fluids circulating along the fault. Diabase and gabbros show no or little brittle deformation. Deformed rocks accomodate small amounts of strain, and indicate T<600°C. This deformation may be associated to that of the fault. Late-stage clorite alteration affects all lithologies. No evidence of high-T (>600°C), plastic deformation is observed, even in samples dredged below the detachment, along a fault scarp that disects it exposing underlying footwall rocks. Deformation is therefore highly localized along the serpentine/talc shear zone, with little or no strain accommodated by the host rock in the immediate vicinity of the fault. In a lithosphere composed of serpentinized peridotite and gabbro/diabase, strain will be partitioned preferentially into weaker serpentinites, forming weak and long-lived shear zones. Fluids may further enhance strain localization. The low-T deformation (< 450°C) and the presence of diabase disected by the shear zone suggest that the detachment was active in shallow and cold lithosphere. The transition from a strong, unserpentinized lithosphere, to a weak, serpentinized lithosphere, wich occurs at a low degree of serpentinization (<15\%), may act as a mecanical boundary where the detachment may sole out.