Direct evidence of hydration into mantle during shearing below a transform fault: Prince Edward transform fault, Southwest Indian Ridge

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Southwest Indian Ridge (SWIR) is located to the southwest of Rodriguez Triple Junction, where three Indian ocean ridges meet (Zhou & Dick, 2013, Nature). SWIR is one of the slowest spreading ocean ridges in the world. In this study, we studied microstructural development of 21 peridotite samples obtained from Prince Edward transform fault of SWIR by PROTEA5 cruise in 1983. The peridotites consist dominantly of olivine, orthopyroxene and clinopyroxene with minor amounts of amphibole and plagioclase as well as secondary minerals such as serpentine and magnetite. The peridotites were classified into four groups based on their microstructures: 3 ultramylonites mostly consisting of extremely fine crystals (3-5μm), 13 heterogeneous tectonites consisting of coarse-grained crystals and fine-grained matrix, 1 cataclasite and 4 intensely serpentinized peridotites. Olivine Mg# is 0.90-0.91 and spinel Cr# is 0.1-0.35. Amphibole crystals have chemical compositions of tremolite and magnesio-hornblende and they were intensely deformed within the ultramylonites and the heterogeneous tectonites, indicating that they have occurred before or during intense shearing in mantle. Moreover, extremely fine grain sizes of olivine and microboudin textures in both pyroxene and spinel crystals suggest that these peridotites have been sheared under high stress conditions. Furthermore, olivine crystal-fabrics within the amphibole bearing peridotites have B and E types that could be developed under hydrous conditions, whereas olivine fabrics within the other peridotites have A and D types that could be developed under anhydrous conditions (Karato et al., 2008, Annu. Rev. Earth Planet. Sci.). Consequently, the petrophysical characteristics of peridotites in this study indicate that the uppermost mantle below the Prince Edward transform fault has been locally but intensely hydrated during shearing due to transform movement.

Keywords: Transform fault, mantle, olivine fabrics