Quantifying CRYSTALLOGRAPHICAL ORIENTATATIONS OF PLANAR DEFORMATION FEATURES IN OLIVINE USING COMBINED OPTICAL AND EBSD DATA

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Planar deformation features are a common feature in shock-deformed olivine, both experimentally in conditions corresponding to crustal shear zones (Druivenak et al., 2011) and impact structures e.g., (Stöffler et al., 1991) and in deep crustal shear zones (Ryan et al, 2022). Hence, the identification of different planes associated with the shock deformation is essential to access the stress levels during deformation, important feature during studies of earthquake deformation. This study utilises a combination of optical and EBSD data combined to infer which of the possible crystallographic planes that are represented by the planar deformation features in olivine, observed in samples from the Reinfjord ultramafic complex, associated with lower crustal earthquakes (Sørensen et al., 2019, Ryan et al, 2022). First, calculated plane traces are compared with the observed plane traces in the free open source Matlab ® toolbox MTEX for analyzing and modelling crystallographic textures by means of EBSD or pole figure data (Bachmann et al., 2010), then the dip and dip direction of the observations of planes in the optical microscope. Our results demonstrate: 1) That several planes are active during high stress deformation of lower crustal olivine rich rocks; 2) Some planes develop recrystallization features, whereas others , whereas others develop later and do not develop recrystallization features.

By looking at several grains, we found that the developed fractures highly depend on the orientation of the host grain with respect to the external stress field. Using the demonstrated methodology, it should be possible to map out the relative abundance of planar deformation features along different crystallographic planes in high stress deformed olivine and other transparent silicates. The method can be refined by calculation of the exact thickness of the sample using interference colors calculated using the code published by Sørensen (2013) now available in MTEX. This will enable the calculation of exact plane inclinations extracted from multifocal optical images that can be compared with crystallographic planes calculated in MTEX from the EBSD data.

References

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