Goldschmidt 2025 Abstract
https://doi.org/10.7185/gold2025.25782

Seismic Anisotropy and Olivine Fabric Transitions in the Yugu Peridotites (Gyeonggi Massif, South Korea)

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Seismic anisotropy in the upper mantle is largely controlled by olivine deformation, which produces distinct lattice preferred orientations (LPOs) in response to shear strain. This study examines the relationship between olivine fabric transitions and seismic anisotropy using the Yugu peridotites in the Gyeonggi Massif, South Korea. The peridotites, primarily composed of spinel harzburgite with minor lherzolite and pyroxenite, provide insights into mantle shear zone processes. Based on microstructural analysis, they are classified into three groups: proto-mylonite (PM), mylonite (M), and ultra-mylonite (UM).

PM samples exhibit strong A-type olivine fabrics, characterized by well-developed LPO and high seismic anisotropy (AVp = 7.9–11.5%, max. AVs = 5.49–8.48%). Mylonitic peridotites transition to D-type fabrics with moderate anisotropy, while UM samples display weakly developed E-type fabrics, resulting in reduced seismic anisotropy (AVp = 4.1–5.9%, max. AVs = 2.91–4.09%). The progressive weakening of seismic anisotropy correlates with increasing shear strain and grain size reduction, indicating that fabric strength plays a dominant role in seismic properties.

The calculated anisotropic layer thickness suggests that seismic anisotropy is notably higher in PM-rich regions than in UM-rich zones, emphasizing the impact of shear localization on mantle deformation. These results enhance the understanding of seismic anisotropy variations in mantle shear zones and provide valuable constraints for interpreting seismic data related to peridotite exhumation and mantle dynamics.