Seismic anisotropy in the upper mantle is believed to result from olivine crystals that are realigned during deformation (Savage, 1999). Under finite strain the fast axes of olivine tends to align with the longest axes of strain ellipse (Ribe, 1992) leading to a lattice preferred orientation (LPO) causing both P and S wave ‘differences’. With P waves, this is evidenced by different speeds with different propagation directions, with the fastest quasi-P wave propagating along the axis of maximum extension, which for the case of large finite strains in a simple shear regime, is in the direction of shear (Savage, 1999). Where high strains are operating, dynamic recrystallization, where minerals recrystallize in the direction of least stress may contribute to anisotropy ((Zhang and Karato, 1995). Dynamic recrystallization can result in a reduction of grain size and hence weakening by grain-size-sensitive flow, thus collapsing deformation onto narrower planes (Rutter and Brodie, 1992).

References


Data Repository Figure: . Plot of ø (angle of maximum elongation relative to plane of shear) vs. displacement length for a zone undergoing simple shear. We set the width (W) to be same as that observed in southern South Island (335 km) and let ø be 20º as suggested by observations south of T1 (Figure 1).
\[
\tan(2\phi) = \frac{2W}{d}
\]

\(W = \text{width} = 335 \text{ km}\)

\(d = \text{displacement}\)

Baldock & Stern (online Data repository figure)