1. Abstract

- Trench parallel anisotropy from shear-wave splitting is observed in many volcanic arcs, even those where the convergence direction is normal to the trench and the rate of slab roll-back is small.
- Petrologic constraints indicate that the lower crust of arcs will be gravitationally unstable relative to the underlying mantle wedge. Furthermore, crustal velocity structure indicates that large amounts of unstable mafic material is not present at modern arcs.
- Residual peridotites from the fossil Talkeetna Arc section display evidence for high temperature, along-arc mantle flow with an ‘E-Type’ olivine fabric.
- Using instantaneous flow models, we show that 3-D mantle flow velocity gradients associated with small-scale downwellings can promote a localized region of arc parallel directions of maximum shear.
- The maximum shear gradients occur in regions of upwelling return flow, where temperatures are likely higher than that required for the promotion of “B-Type” olivine fabric.

2. Seismic Structure at Volcanic Arcs

2.1 Arc Crustal Structure

- Schellart et al. (2006)

2.2 Mantle Wedge Structure

- Kelemen et al. (2000)

3. Models for Arc Parallel Seismic Anisotropy

3.1 Model 1: Slab Rollback (Kiuso & Silver, 1994; Peyton et al., GRL, 2001)

3.2 Model 2: Wedge Corner Flow with “B-Type” Olivine Fabric (Kowiter et al., EPL, 2005)

3.3 Model 3: Arc-Parallel Flow with “E-Type” Olivine Fabric (Malth et al., JGR, 2003)

4. Evidence for Foundering of Arc Lower Crust

4.1 Cross-section of the Talkeetna Arc, South-central Alaska

4.2 Calculation of Phase Equilibria for Lower Crustal Rocks

5. Numerical Simulations of 3-D Mantle Flow

5.1 Example of Results for Foundering of the Lower Crust

5.2 Example of Results for “Upwelling from the Slab”