SF	Convection in the Mantle Wedge Above Subduction Zones	
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Accomplishments:

- Developed a successful cross-disciplinary exchange of knowledge between researchers in numerical geodynamics, experimental rock mechanics and petrology.
- Integrated experimental constraints on mantle rheology (including temperature, pressure, stress, and H_2O content dependence) into 3-D, fluid dynamic, numerical model of subduction.
- Focused model exploration on characteristics of subduction constrained by geophysical *and* petrologic observations (e.g., slab dip, stress-dependence of viscosity, shallow wedge thermal structure).
- Developed numerical method to allow applied velocity surface boundary conditions in numerical models with stress-dependent viscosity.
- Isolated physical and numerical parameters necessary to reproduce observed characteristics of slab geometry (upper mantle dip of 30–60°):
    1. Non-Newtonian mantle viscosity (strain-rate dependent).
    2. High viscosity slab interiors ($\eta_{slab} = 10^6 \times \eta_{ref}$; $\eta_{ref} = 3 \times 10^{19}$ Pa s).
    3. High resolution finite element mesh (less than 1–3 km), capable of resolving 8 orders of magnitude in viscosity within the subduction zone.
    4. Low viscosity shear zone ($\eta_{sz} \leq 10 \times \eta_{ref}$)
    5. Large model domain to isolate slab dynamics from boundary conditions. Model domain needs to include the surface to the core-mantle boundary and span a minimum of 45° in longitude.

Figures and Captions

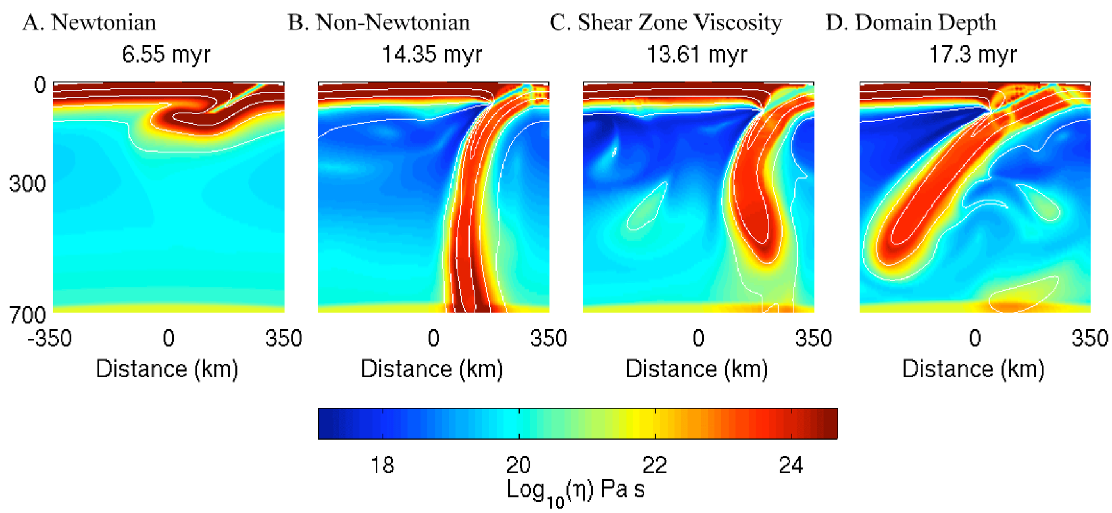

Figure 1: Slab dynamics and rheology. Each panel displays the viscosity (color) and temperature (contours every 300°C) for a time (indicated above) illustrating the evolution of the slab for a given set of model parameters. All models have the same boundary conditions including a fixed horizontal velocity of 5 cm/yr to the right of the shear zone and 0 cm/yr to the left. The domain size is 45° longitude and 1500 km deep for models A-C, and 2890 km for model D. The plate boundary is modeled as a low viscosity shear zone.

A. Newtonian viscosity (temperature and pressure dependent) leads to flat slab subduction and subsequent shortening-accommodated convergence.

B. Non-Newtonian viscosity (same as A, with stress dependent viscosity in the upper mantle) decouples the slab but leads to vertical subduction in shallow model domains.

C. Increasing the shear zone viscosity by a factor of ten inhibits subduction, causing convergence to be partially accommodated by shortening.

D. Full mantle model domain (depth=2890 km) sufficiently decouples the influence of reflecting boundary conditions and a stronger return flow on the right side of the box (due to surface velocity boundary condition) from the slab induced flow to allow the local balance of forces to determine the evolution of the slab. This model reproduces an intermediate value dip angle (45°) in the range of observed slab dip angles.