AWSFL008-DS3

# NSF Award Abstract - #0125919

## Convection of the Mantle Wedge Above Subduction Zones

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| **NSF Org** | EAR |
| **Latest Amendment Date** | May 24, 2002 |
| **Award Number** | 0125919 |
| **Award Instrument** | Standard Grant |
| **Program Manager** | Kaye Shedlock<br>EAR DIVISION OF EARTH SCIENCES<br>GEO DIRECTORATE FOR GEOSCIENCES |
| **Start Date** | May 15, 2002 |
| **Expires** | April 30, 2004 (Estimated) |
| **Expected Total Amount** | $99971 (Estimated) |
| **Investigator** | J. Gregory Hirth ghirth@whoi.edu (Principal Investigator current)<br>Peter B. Kelemen (Co-Principal Investigator current) |
| **Sponsor** | Woods Hole Ocean Inst<br>Woods Hole, MA 02543<br>508/548-1400 |
| **NSF Program** | 1574 GEOPHYSICS |
| **Field Application** | 0000099 Other Applications NEC |
| **Program Reference Code** | 0000,OTHR, |

# Abstract

This project will provide new constraints on the temperature and viscosity structure of the wedge in subduction zones by combining petrologic and geophysical constraints on the thermal structure of the wedge with experimental and observational constraints on wedge viscosity structure in numerical models of convection. Petrologic and geophysical constraints indicate that current thermal models of subduction zones significantly underestimate the temperature in parts of the mantle wedge.

Observations of low seismic velocity and high attenuation in localized regions of the wedge indicate the presence of high temperatures, aqueous fluids, or melt. Deformation experiments on olivine aggregates indicate that a high water content or high melt fraction can significantly reduce viscosity. Instantaneous dynamic models of subduction provide indirect evidence for low viscosity in the wedge. Agreement between model results and observations of topography and geoid improve significantly for subduction zone models including an isolated low viscosity region in the wedge.

Including a localized region of low viscosity in time-dependent models of convection will: (1) lead to a higher mean wedge temperature, a hotter wedge-crust boundary and a hotter slab-wedge interface, and (2) modify the dynamic coupling between the wedge and the slab. Hybrid (mixed kinematic-dynamic) and dynamic, time-dependent numerical models of convection are being used to characterize the dependence of the wedge temperature and flow distribution on the magnitude and location of localized low viscosity regions. Combining both numerical methods allows isolation of the behavior of the wedge viscosity itself on the flow from the modification of the flow due to changing the viscous coupling of the wedge to the slab. Specifically, the project is investigating the model dependence on: asthenosphere viscosity, localized regions of low viscosity, age of the overriding plate, slab dip, slab velocity, slab age, slab viscosity, fault dip and depth, and nonlinear rheology. The goal is to find models of convection in the wedge that are consistent with both petrologic and geophysical data and include a viscosity structure that more fully reflects the complex rheologic behavior in this environment.

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