Strength of the Subducted Slab: Implications for Deep Focus Earthquakes *	X17B1

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The strength of the material of the transition zone at the pressures and temperatures appropriate to subduction have been determined in the laboratory using both the DIA and T-cup multi-anvil pressurizing systems and synchrotron radiation at the X17B1 wiggler port at the NSLS.

The measurement technique consists of several steps: 1. A loose powder sample is used in the study. The deviatoric stress is generated by the stress concentrations between grains. Typically, in the elastic region, (σ_1 - σ_3) = 1.5 times the pressure on loading. As the yield point is obtained, the differential stress falls below this value. 2. The differential stress is monitored as a function of time by recording diffraction spectra every 30 seconds after heating to the desired temperature. This time dependence reflects the effective power law for the stress release process. The time interval varies from an hour to a few days. 3. Several recovered samples are examined with TEM to define the flow mechanism. This methodology is limited to relatively small plastic strains (a few percent) and the threshold deviatoric stress that can be observed is of the order of 0.1 GPa. These data have been obtained for the major phases of the mantle including olivine, wadsleyite, ringwoodite, majorite rich garnet, and perovskite. Both 'wet' and dry samples of the olivine series have been studied.

Requiring a storage capacity of 0.1 GPa for 100 years as a criterion for a seismogenic region, we conclude that olivine cannot sustain earthquakes deeper than 300 km in all but the coldest subducting slabs owing to the temperature induced weakening. Transition zone minerals, on the other hand, being much stronger, can store the necessary strain energies at temperature expected between 400 and 700 km for even relatively hot slabs. These results suggest that the bimodal distribution of earthquake activity with depth is simply a reflection of the strength dependence of the stable phases and thus does not require different triggering mechanism for earthquakes above and below 400 km.

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