EARTHSCOPE SEMINAR
DISCUSSION SUMMARY
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Paper title: Low-velocity zone atop the 410-km seismic discontinuity in the northwestern United States
Authors: Song, Helmberger, and Grand

This paper provides evidence for a low velocity zone (LVZ) on top of the 410 km seismic discontinuity. The authors compute full-waveform synthetics from a variety of proposed velocity models in an effort to model both the timing and amplitude of multiple arrivals resulting from possible structures near the 410. They conclude that their best-fit velocity model is one in which a thin (20km) LVZ with a 5% reduction in velocity exists atop the 410. The authors argue that this conclusion is supported by receiver functions which show a small negative pulse at the 410.

Patty posed the following questions to seed the discussion: Which of the models presented by Song et al. is the best-fit velocity model? Might an LVZ exist atop the 410 in some regions but be too thin to be detected? Is it possible to detect the LVZ with short-period data?

It was pointed out that none of the velocity models presented by the authors are consistent with a hydrated transition zone; in all of the models evaluated in the paper in which an LVZ was imposed, the velocities below the LVZ returned to "normal transition zone velocities". It was noted that, if the transition zone were hydrated as the authors suggest, the velocities below the LVZ should remain low throughout the transition zone. In effect, any partial melt layer would be masked by the lower velocities present in the transition zone. Also, the large positive velocity contrasts used in their models at the base of the LVZ should be visible in other phases.

There was some confusion regarding what constituted a "good fitting model". Ultimately, it was agreed that this is a somewhat subjective and qualitative determination, and that a more quantitative comparison between the models and data would benefit the study.

The question was posed: how does the transition zone become hydrated? The answer to this question appears to be through slab subduction; however this is dependent on several factors. The efficiency with which water goes into Wadsleyite is dependent on the diffusion rate of water, which has not yet been determined experimentally. If the diffusion rates are low enough, the slab will take its water into the lower mantle. If the transition zone is sufficiently hot, the diffusion rate will increase, but the water affinity of Wadsleyite will decrease, potentially offsetting this effect.

Finally, the group considered where we might be able to go to test these ideas. Some suggested regions which are similar to the one studied in this paper; for instance Japan or S. America due to their proximity to subduction (a source of water to hydrate the transition zone), and earthquakes, and are both regions which are reasonable well instrumented. It was also suggested that we should investigate areas which are very different from the northwestern U.S.; for example eastern U.S., near a mid-ocean ridge, or Hawaii, which has lots of sources and receivers, and is a region of mantle upwelling.