EarthScope Seminar
Discussion Summary
February 26, 2007
Note-Taker: Kevin C. Eagar

Title: How Laramide-Age Hydration of North American Lithospere by the Farallon Slab Controlled Subsequent Activity in the Western United States
Authors: E. Humphreys, E. Hessler, K. Dueker, G. L. Farmer, E. Erslev, and T. Atwater

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This paper suggests an explanation for the tectonic and magmatic activity in the Western US, including uplift of the Great Plains, by a process of hydrating the listhosphere above the shallowly dipping Farallon slab. They suggest that foundering of the slab exposed this hydrated lithosphere to hot asthenosphere that flowed in behind, causing melting at the base of the lithosphere and uplift of the region. As part of the basis for their argument, they obtained models of P velocity structure beneath the Western US using seismic travel time tomography. They also introduced a new technique of assessing there models using what they refer to as a "squeeze test."

After Jeff's presentation, he posed three questions to seed discussion. 1) Why did the authors not perform additional squeeze tests while using depths greater than 200 km? 2) What is the possible mechanism for the flattening of a slab, and subsequent detachment? 3) What does this imply about the impingement of the Yellowstone plume around 80 Ma?

We discussed some aspects of the squeeze test. The advantage is that it acknowledges vertical smearing while assuming lateral velocity constraints are good, and constrains the minimum velocity perturbation structure required to resolve the data. An issue that Patty brought up was the fact that the authors assume that all the structure stops at the same depth everywhere, and suggested that raypath density could help the authors choose a squeezing depth less arbitrarily. Caroline also suggested that the authors show how this method improves the fit of the tomography data. In the end, there was no consensus among the group about the usefulness of this method.

Nick posed the question: why would we expect the dehydrated slab to sink? The authors suggested that the slab detached and began sinking about 35-60 Ma. A problem encountered with this is exactly how the slab sinks. Does it follow the typical angled path down into the mantle, or does it fall straight down? Did the authors take into account downward flow and suction forces on the lithosphere as the slab sinks? And is the unloading of mass from the descending slab and the addition of partial melt to the base of the lithosphere enough to account for lithospheric uplift even in the presence of downward flow and suction?

We then discussed Jeff's third discussion question: what does this imply about the Yellowstone plume impact? The theory suggests that the plume pushed from the bottom of the slab and eventually broke through, creating the detachment that the authors talk

about. And this detachment helps to explain the increased volcanism observed in the Miocene.