Foundering Lithosphere Imaged Beneath the Southern Sierra Nevada, California, USA

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We produced seismic velocity and attenuation tomographic models using IRIS supported seismic equipment and infrastructure to reveal garnet-rich crust and mantle lithosphere descending into the upper mantle beneath the southeastern Sierra Nevada. The descending lithosphere consists of two layers: an iron-rich eclogite above a magnesium-rich garnet peridotite. These results place descending eclogite above and east of high P wavespeed material previously imaged beneath the southern Great Valley, suggesting a coherence in the lithospheric removal process previously unsuspected. Utilizing perpendicular orientations of shear waves, we produced a depth-dependent model of seismic anisotropy. This model is consistent with estimates of anisotropy from SKS splitting and allows us to further study the processes producing seismic anisotropy.

Figure 1. Topographic map of the southern Sierra Nevada overlain with tomographically determined shear wave splitting and independently determined SKS splitting measurements (circles). Open boxes are depleted garnet peridotite xenoliths localities; solid boxes are spinel peridotite xenolith localities.

Figure 2. Tomographic slices along the purple line in Figure 1. Panel A) is the percent change in P-wave slowness; Panel B) change in shear wave attenuation; Panel C) percent change in the ratio of P-wave to S-wave velocity; Panel D) percent change in shear wave anisotropy. Outlines are interpreted positions of bodies of varying composition, solid - depleted garnet peridotite, dashed - eclogite, dashed-dot - fertile spinel peridotite.