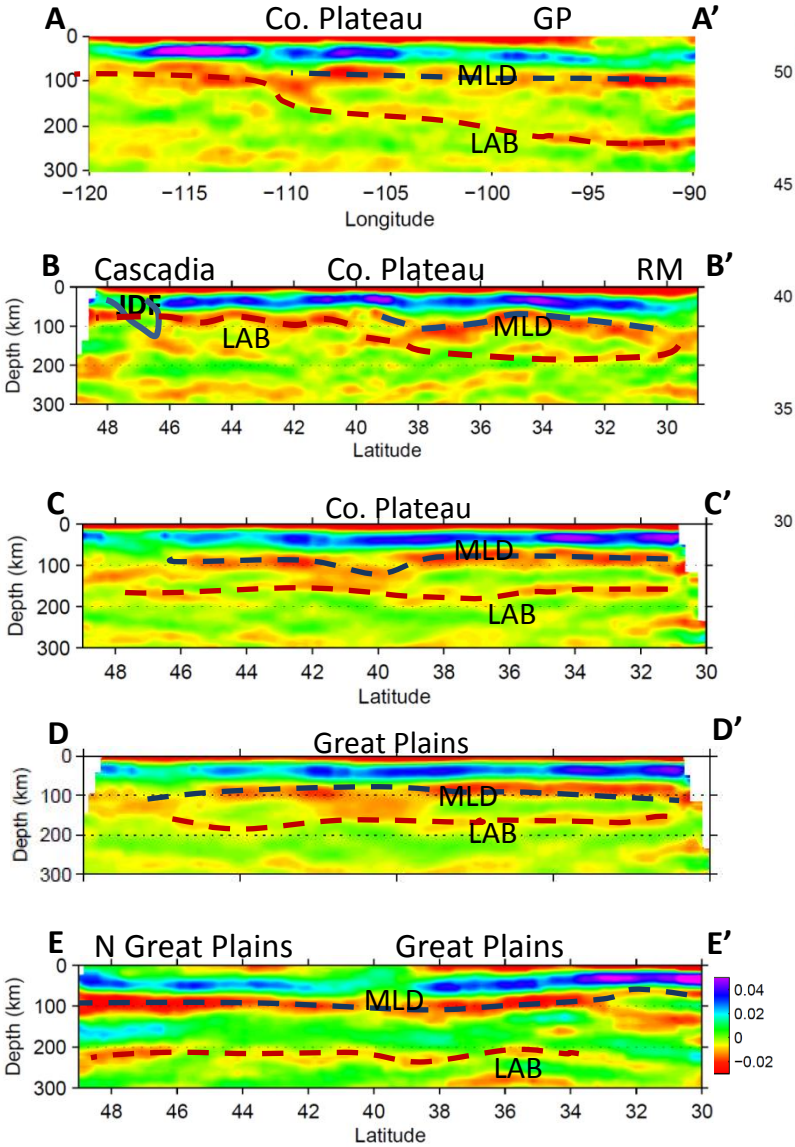
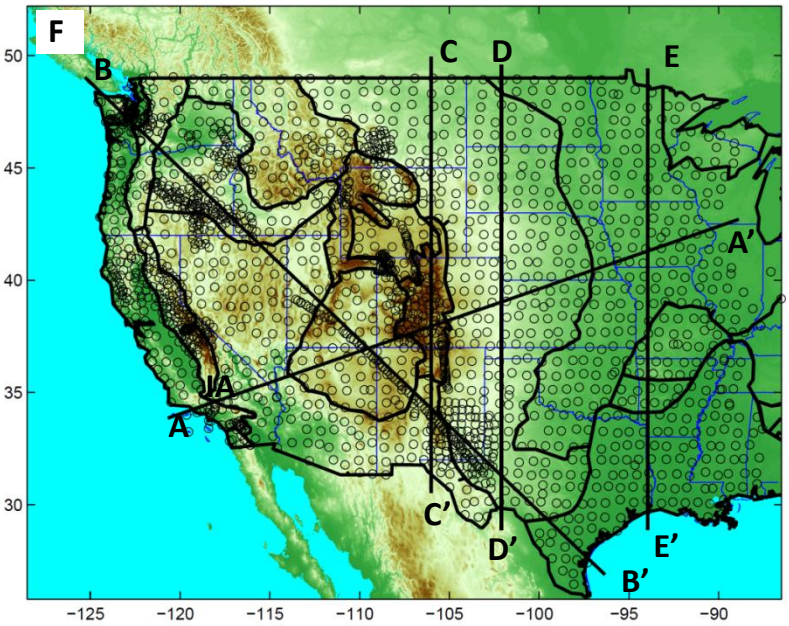
Lithosphere-Asthenosphere Boundary and Mid-Lithospheric Discontinuity mapped by Sp Receiver Functions from the Transportable Array

41,000 Sp receiver functions calculated from teleseismic events in 30-120 delta range recorded at 2,145 Transportable Array and PASSCAL stations are migrated into a common-conversion-point 3D image volume spanning from the west coast of the United States to the Mid-West. This volume covers three separate tectonic regions- the cretaceous and actively deforming western US, the Colorado Plateau, and the cratonic Great Plains. The boundaries of these regions correlate with variations in velocity gradient structure as imaged by this volume of receiver functions. Moreover, each region has distinct characteristics that bear a unique interpretation. The primary findings are: In the western cretaceous, there is a pervasive negative velocity gradient (NVG) of ~8% A(Sp/Sv) ranging from 70-90 km depth which is interpreted as the Lithosphere-Asthenosphere Boundary (LAB). This NVG signal is interrupted at the Juan de Fuca subduction zone and Isabella anomaly, the first due to the presence of the cold subducting slab, and the second a fossil micro-plate plate. The Colorado Plateau has a NVG signal that distinctly steps down from the western one, and is found at 80-120 km depth. This region also contains a second, deeper NVG signal in some areas, which sheds new light on the ongoing debate over the thickness of the lithosphere here. Beneath the cratonic region of the Great Plains is a NVG signal which is lower in amplitude than the west, with ~3% conversion at 80-120 km depth. Contrary to the NVG in the west which denotes the base of the lithosphere, this layer is internal to the lithosphere and dubbed the Mid-Lithospheric Discontinuity (MLD). In addition, there is also a second, deeper NVG at 180-220 km depth that is interpreted here as the cratonic Lithosphere-Asthenosphere Boundary, which has not been previously detected with receiver functions and is a significant finding for understanding the formation and evolution of continents.





Above: Topographic map with cross-section locations- circles demark station locations, black lines are geologic province boundaries as found by Whitmeyer and Karlstrom (2007)
Left: CCP slices with corresponding locations mapped in (F). All slices share the same color pallet.
LAB: Lithosphere- Asthenosphere Boundary
MLD: Mid- Lithospheric Discontinuity
IA: Isabella Anomaly
JDF: Juan de Fuca plate
RM : Rift Margin