The southwestern United States is a tectonically active and geologically complex region. This study focuses on two contrasting tectonic domains. The Basin and Range is characterized by extension and broadly distributed internal deformation, and has experienced volcanism throughout the Cenozoic. In contrast, the Colorado Plateau has less recent volcanism and a comparatively rigid and thick lithosphere. It is not well-understood whether these differences are due to thermochemical heterogeneity within the lithosphere, tectonic activity, deeper mantle forcings, or properties of the Lithosphere-Asthenosphere Boundary (LAB). Specifically, partial melt may play a role in defining the LAB in parts of the western US, and it is crucial to constrain the geometry and extent of melt to understand its influence on lithospheric evolution.

Addressing these questions requires a high-resolution model of seismic wavespeed containing quantitative constraints on the depth, Vs contrast, and sharpness at the LAB. We perform Common-Conversion Point (CCP) stacking of Sp receiver functions, which suggests that the LAB is shallower, flatter, and stronger below the Basin and Range than below the Colorado Plateau. Data from the CCP stack–which is sensitive to the locations of shear wavespeed gradients–is combined with Rayleigh wave phase velocities–which are sensitive to bulk wavespeed–in a Bayesian joint inversion. The inversion utilizes a Markov Chain Monte Carlo algorithm to obtain a suite of models that fit our data, from which a preferred model, along with information about the distribution of individual model parameters such as crustal thickness, can be extracted.

We present 1-D profiles of Vs with depth across an area of ~1300 by ~1000 km spanning from Central California to the Great Plains. Lateral variations in these profiles reflect heterogeneity in LAB depth and the Vs contrast from lithosphere to asthenosphere, as well as absolute Vs throughout and below the lithosphere. Comparison with forward-modeling of the effects of thermal and chemical anomalies, as well as partial melt, on Vs will elucidate the mechanisms that control lithospheric properties as well as the evolution of the iconic landscapes of this region.

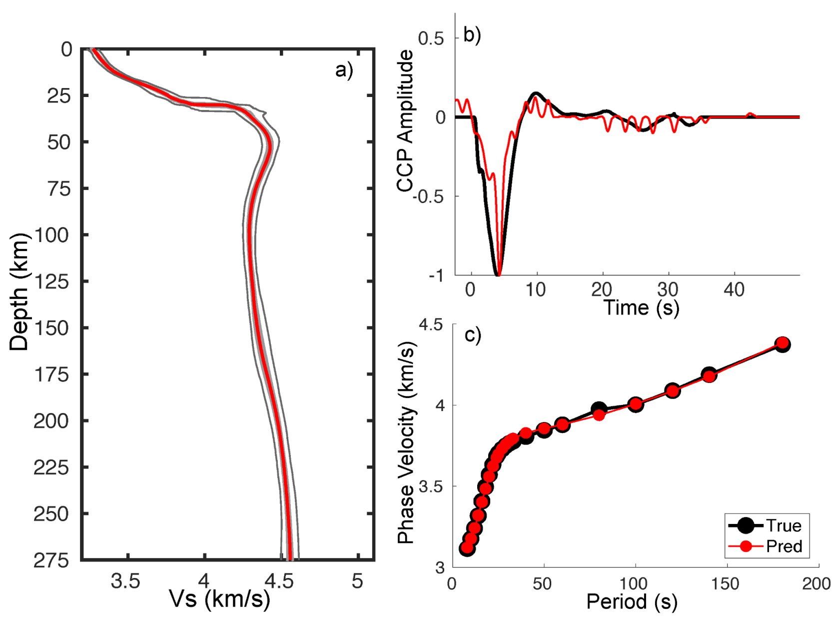

Figure 1: Joint inversion results below seismic station TUC in Arizona. a) Vs profile with depth. b) Predicted (red) and observed (black) CCP stack data. c) Predicted (red) and observed (black) Rayleigh wave phase velocities.