

*Title: Shear Wave Seismic Interferometry for Lithospheric Imaging*

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Green's function retrieval by seismic interferometry (SI) exists in a variety of forms. A common theme uniting many of the approaches of SI centers on the ability to create new seismic traces by cross correlating a received signal recorded at two separate locations. The sum of this operation for multiple sources results in the creation of a new signal such that one of the recording locations acts as a virtual source to the other. Existing literature supports many examples where SI techniques have proven successful in numerical models and useful for field data scenarios. This presentation focuses on the use of teleseismic earthquake events to create a virtual shear wave source for imaging lithospheric features. Events are selected at long offsets for primarily two reasons: namely, (a) at large offsets the incoming wavefront approximates a plane wave due to spread of the wavefront in relation to the comparatively finite seismic array, and (b) the large distances act as a natural temporal filter to separate the incident P and S arrivals. Furthermore, using shear wave energy as an imaging source benefits from a variety of properties including a lower propagation velocity and the possibility for separate treatment of the shear vertical and shear horizontal fields.

Prior to selecting a field dataset, a series of 1D earth forward modeling experiments with 2D elastic propagation were conducted. Initial modeling results indicate that SP converted energy maps primarily to the vertical component with little presence on the radial component. This suggests that decomposition techniques may be unnecessary as preprocessing for field data, but remains an option should field data dictate its use. Sufficient illumination by unique ray parameter sampling is essential for clearly resolving subsurface features through SI; however, initial decimation studies indicate that while clarity is reduced proportional to reduction of available ray parameters, it is still possible to identify strong reflectors even with relatively poor sampling. A challenge encountered by using earthquake events as an imaging source is the complexity of the source time function (STF). The heterogeneous subsurface near the source locations gives rise to complications of the incident field that need to be mitigated for successful SI application. The frequency and phase spectrum of such events is influenced by the event depth, ghost reflections, near surface complexity, earth's intrinsic attenuation of high frequency content, and travel distance. Numerical experiments indicate that correcting the received signal via whitening, or deconvolution, and bandpass filtering will be required to limit the impact of the STF on data quality.

Finally, a field dataset is selected from southern Mexico with over 100 earthquake events that meet our criteria for magnitude and location. By azimuthally limiting a window around the relatively linear orientation of the seismometer array, earthquakes that vary in offset correspond to sampling of unique ray parameters. In earthquakes with sufficient shear energy, the S, SS, ScS, and SKS phases can be treated as separate events with individual ray parameters. Both of these techniques help to improve the overall illumination of the subsurface with better sampling. By using shear wave SI as a preprocessing technique, we hope to produce an image of the unique subduction setting beneath the seismometer array that offers new interpretable value to the region.