Receiver Function Imaging of Seismic Structure beneath Southern Mexico Using VEOX Data

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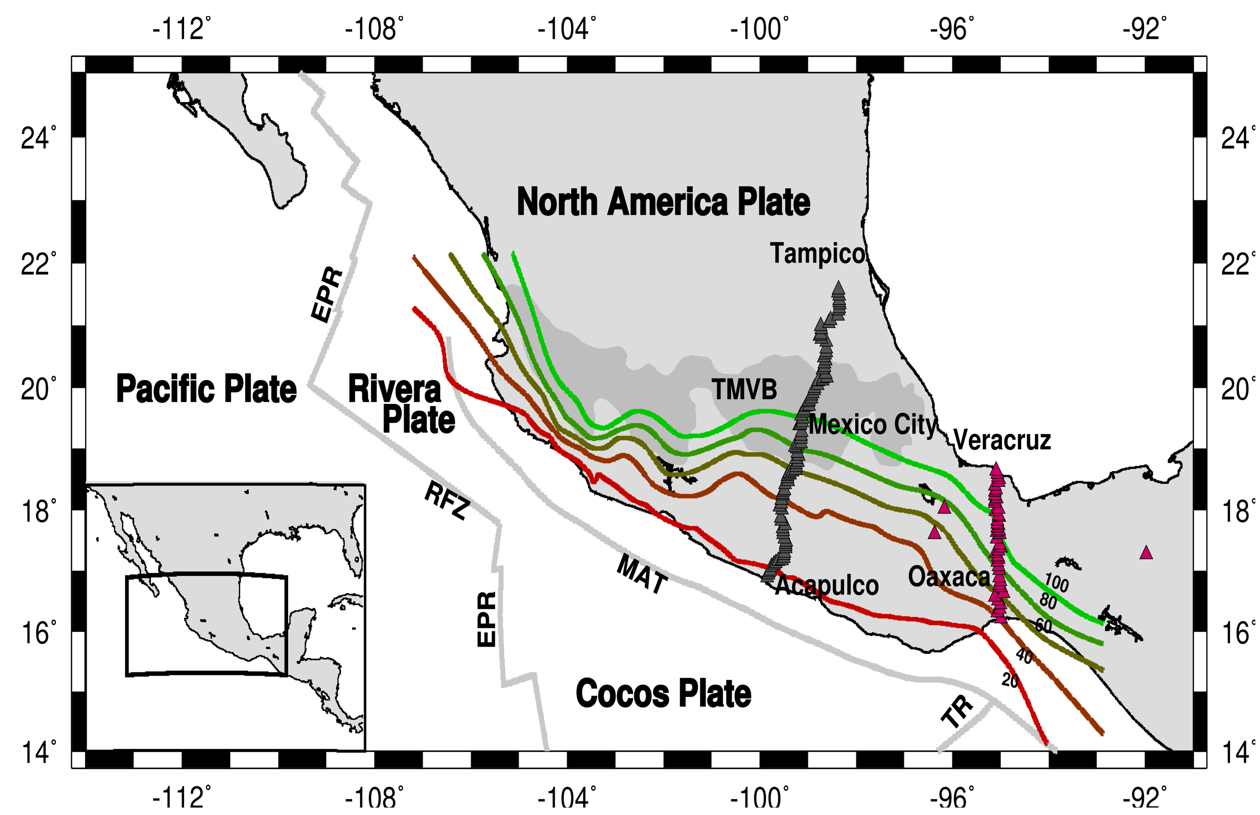
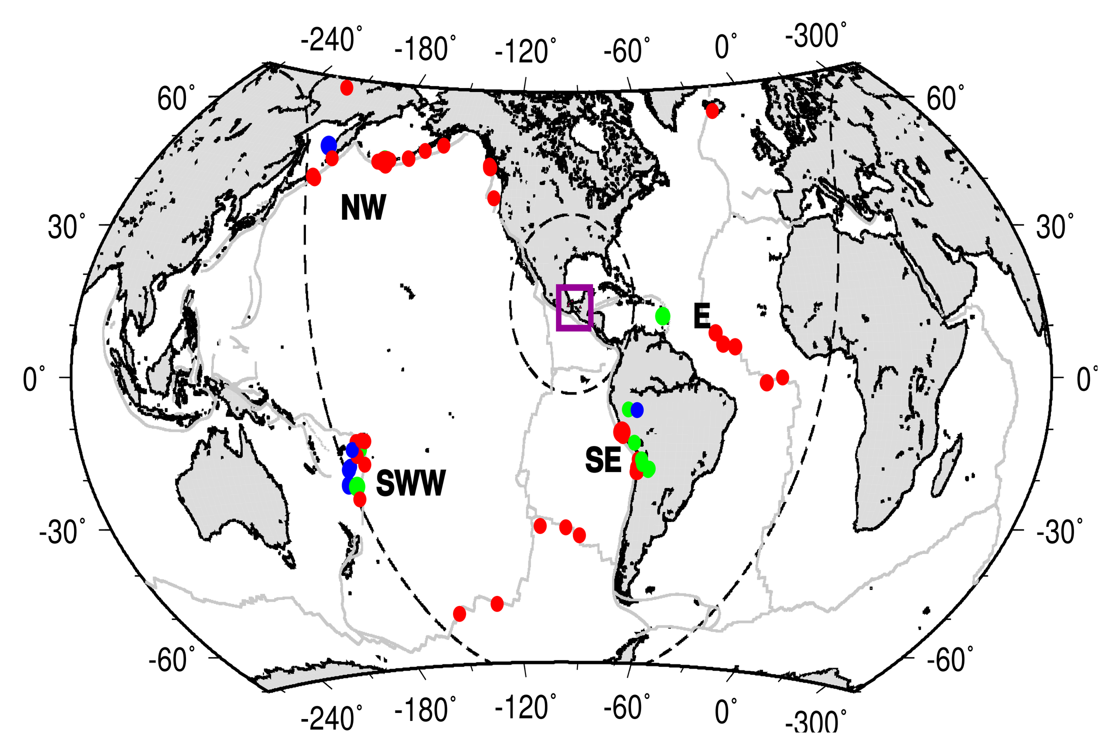
1 Abstract

We use receiver functions (RFs) using teleseismic evensts recorded by the VEOX line (Veracruz-Oaxaca Seismic Line) to investigate the seismic structure along the Isthmus of Tehuantepec, from Montepio, Veracruz, at the Gulf of Mexico, to San Mateo del Mar, Oaxaca, at the Pacific coast. We observe strong azimuthal variations in RFs, indicating large lateral variations in crustal structure beneath the receiver. Our preliminary migrated image from RFs shows that the Cocos plate is subducting in a constant dip of about 20°.

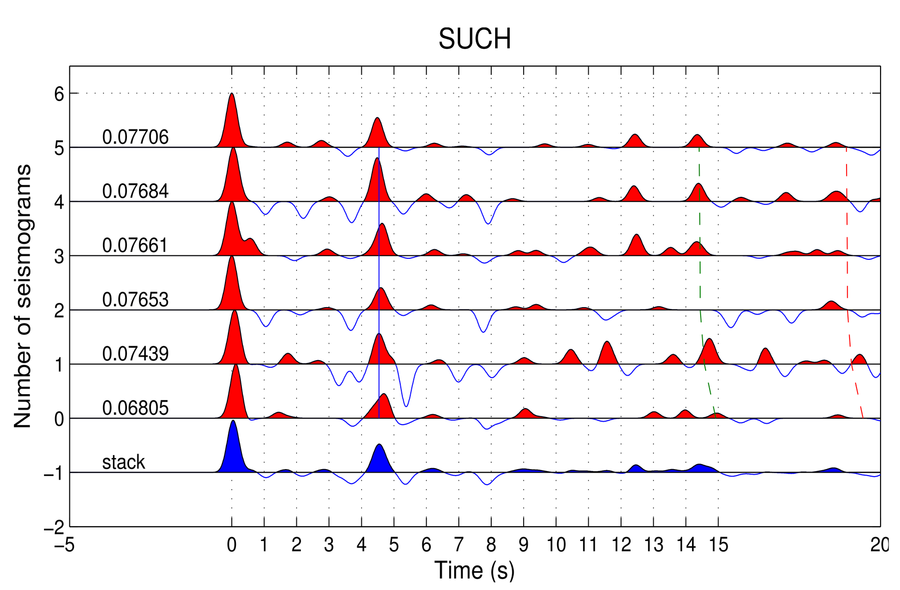
2 Data

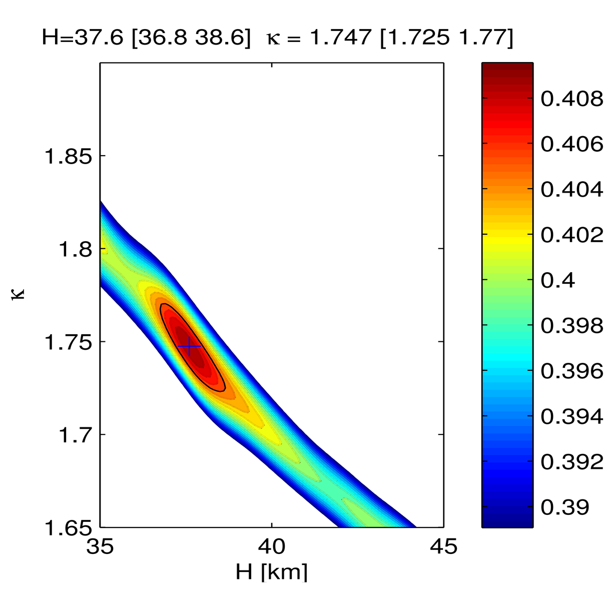




Map on the left shows the region of our study and two seismic arrays (MASE operated from 01/2005 to 02/2007 and VEOX from 07/2007 to now). Isodepth contours of the subducted Cocos plate beneath the North American plate (Pardo and Suarez, 1995) are shown in the map. Map on the right shows the distribution of teleseismic events used in the study, which mostly includes events in the east, south-east, south-south-west, and north-west direction from the station array enclosed in the box. Dotted lines are distance of 30° and 90° away from the center of the study area. The events are colored in different colors according to depths.

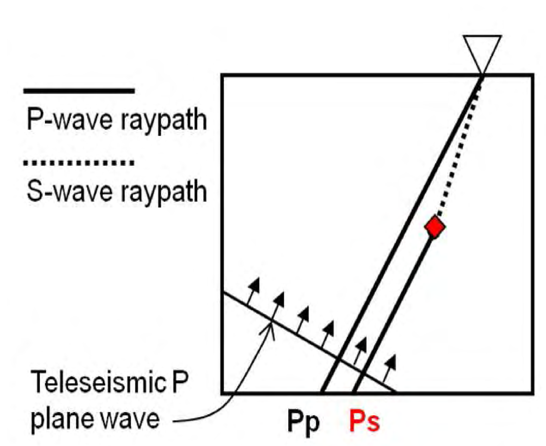
3 Method: RF Stacking Algorithm and RF Migration

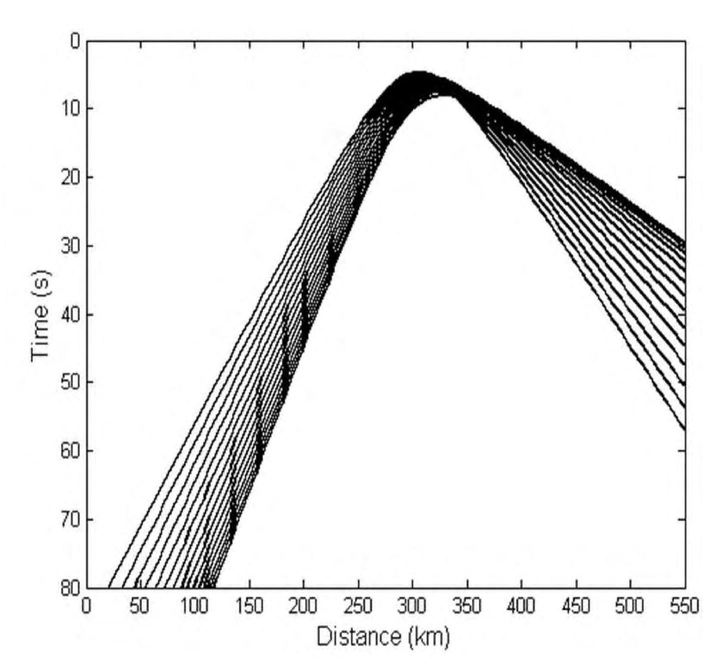




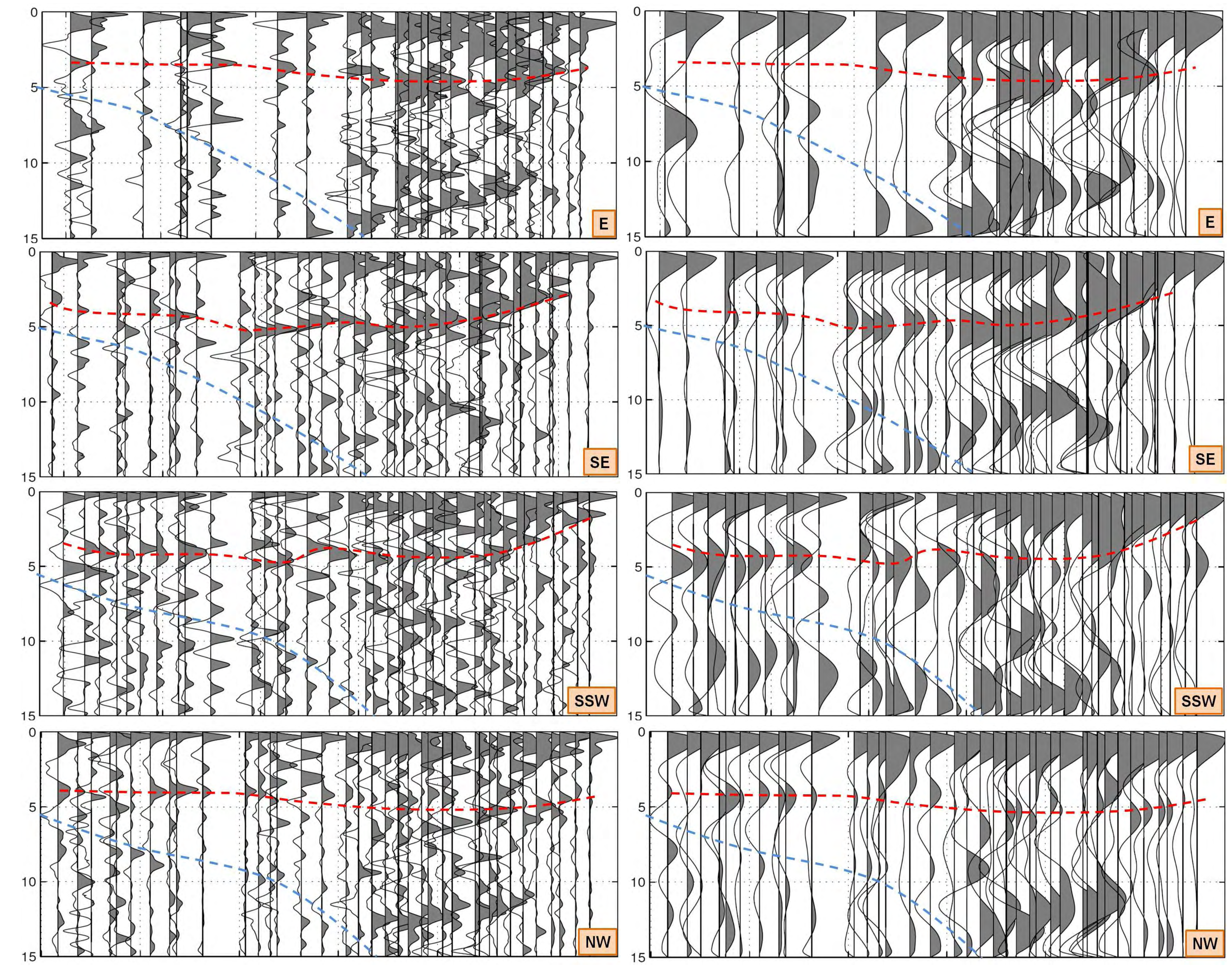
Crustal thickness (Moho, H) and Vp/Vs ratio (κ) for station SUCH. On the left are the individual RF traces sorted according to the ray parameter. The predicted arrival times of the primary phase (Pms) and two multiples (PpPms and PsPms) are marked by the solid and dashed lines. On the right is the contour map of the weighted summation function (Zhu and Kanamori, 2000) for the crustal thickness (Moho, H) and Vp/Vs ratio (κ).

Schematic view of showing plane wave that travels from below and converts into Ps phase at the scattering point (right) and the travel time curve for Ps wave by varying the incident angle of the plane wave and fixing the scattering point (left). Incident plane wave is assumed to be P wave coming from a distant source; as hitting the scatterer, it converts to S wave to become Ps. Ps wave is migrated using a Kirchhoff-style migration, which characterizes the ouput model as a grid of point scatters. For the travel time plot, the incident angle of the plane wave from 10° to 80° is varied in every 5°.

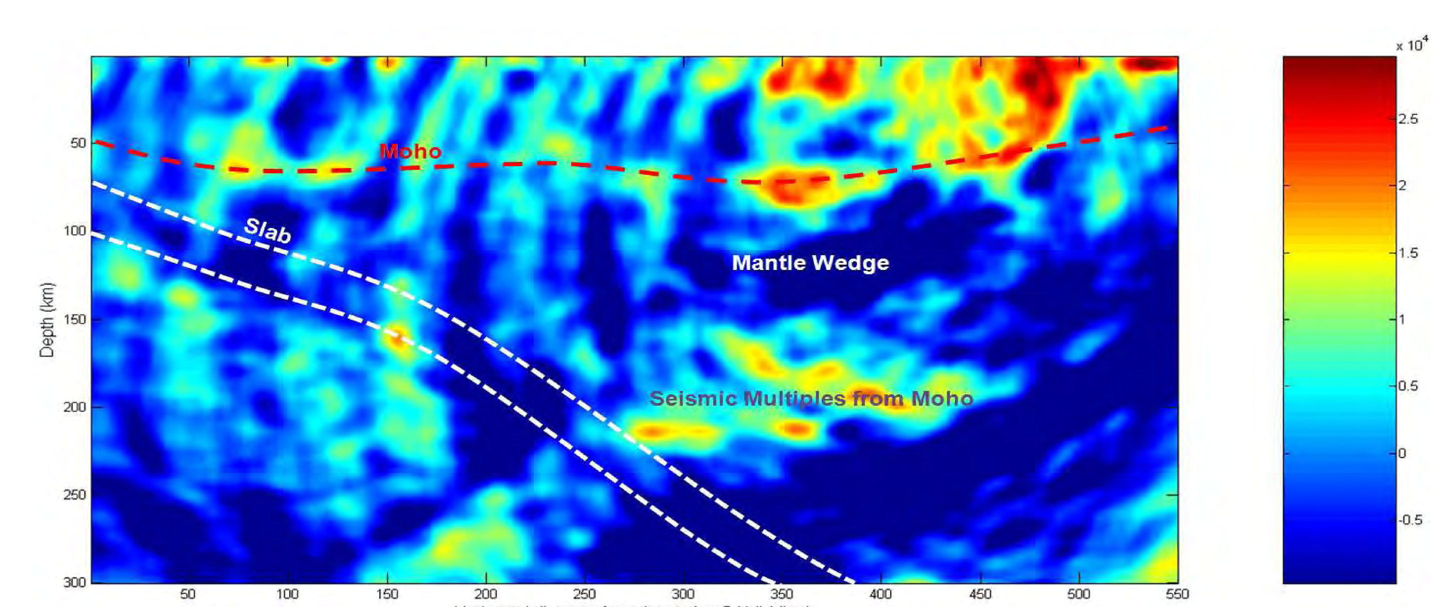




4 RF Results



Stacked RFs for four different backazimuths (E, SE, SSW, and NW). Figures on left are the stacked RFs filtered in 1 sec, and the figures on right are filtered in 4 sec. For all the figures, the dotted red lines indicate the Moho along the VEOX array, and the dotted blue lines indicate the subducting slab at about 20°. Note that the station quality is poor near the Pacific coast because of frequent flood events. Strong azimuthal variations of Moho are observed in the mid-section of the figures. The Moho depths are picked deeper for the RFs in the south-east direction. This is due to the fact that the trench-normal plane of the overlying plate is tilting to the south-east.



Migrated image using Pms and Pds phase. A shallowly subducting slab at about 20° is shown in dotted white lines, and the Moho in a dotted red line. The dipping oceanic crust is shown clearly although the Moho is not because of the lack of data near the Pacific coast and the strong azimuthal variations of Moho in the mid-section of the image. Seismic multiples from the Moho are appeared to be strong and complicated in the mid-section.

5 References

- Pardo, M., and Suarez G., 1995. Shape of the subducted Rivera and Cocos plates in southern Mexico: Seismic and tectonic implications, J. Geophys. Res., 100, 12,357-12,373.
- Zhu, L. and Kanamori, H., 2000. Moho Depth Variation in Southern California from Teleseismic Receiver Functions, J. Geophys. Res., 105, 2, 969-2,980.