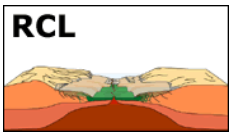
3-D Tomography of the Crust and Upper Mantle Beneath the Gulf Extensional Province and Baja California



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High resolution Rayleigh wave tomography provides a three-dimensional view of shear velocity variations in the crust and upper mantle. We use teleseismic sources propagating across an array of stations to construct maps of velocity variations over a range of periods, with increasing period corresponding to increasing depth of penetration of the seismic surface waves. Rifting of Baja California away from North America began after the cessation of subduction of the Farallon plate about 13 Ma. We find that fragments of the Farallon plate that were never subducted, the Guadelupe and Magdalena microplates, still show up as high velocity anomalies beneath Baja California at depths of 60 to 100 km (panel c in figure). At shallower depths of ~ 30-60 km, where the primary melt production zones are expected for upwelling mantle beneath mid-ocean ridges, we find pronounced low velocity anomalies associated with the major centers of seafloor spreading in the Gulf of California (panels a and b). In the northern Gulf, these anomalies are centered slightly to the west of the plate boundary, suggesting that there may be a dynamic component of upwelling that keeps melt production centered beneath the original location of rifting even as the plate boundary migrates away, or, equivalently, that the upwelling tends to be carried away as the Pacific plate moves northwestward relative to North America.

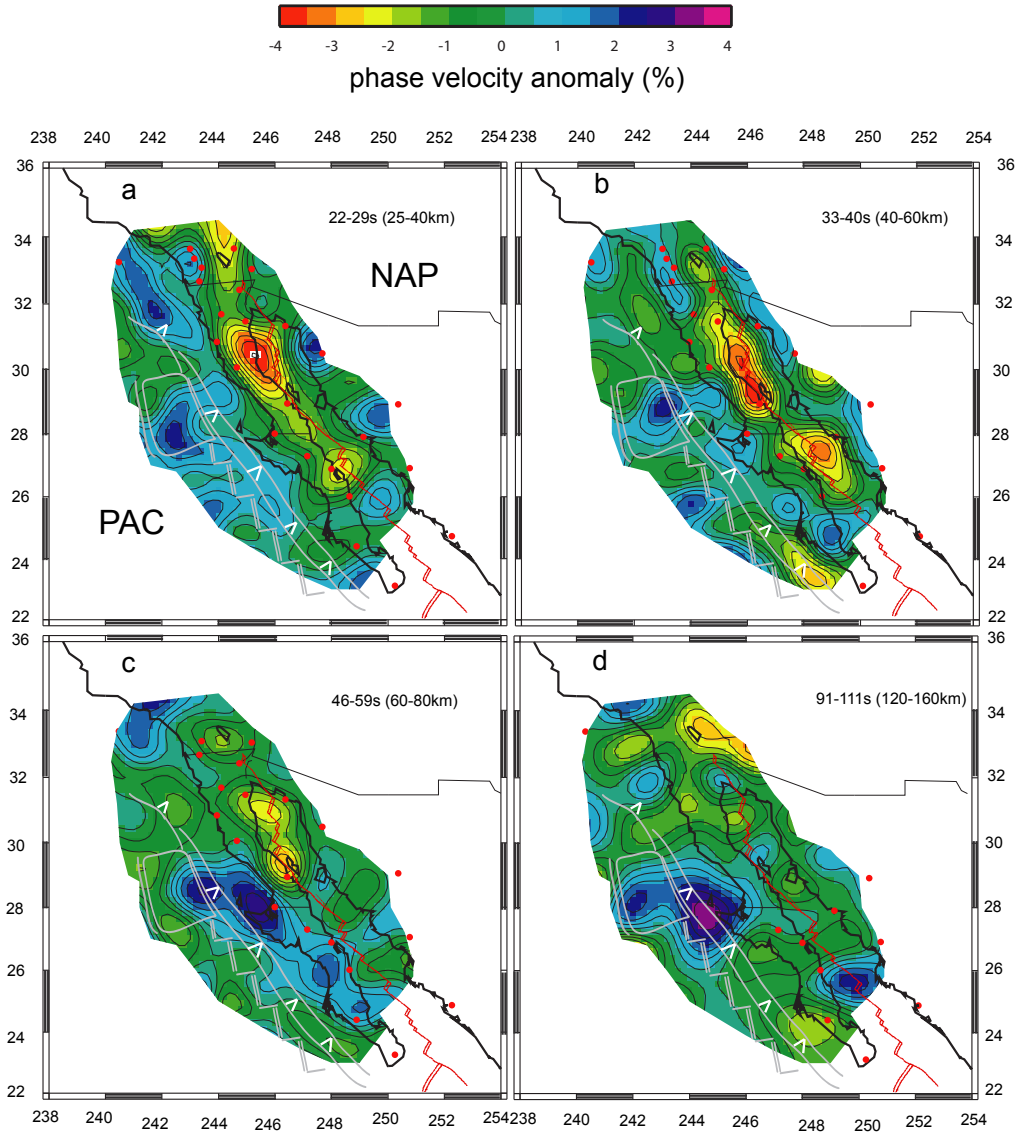

Figure: Phase velocity anomalies of Rayleigh waves in four period ranges in the vicinity of the Gulf of California and Baja California. Each period range is most sensitive to shear velocity in the depth range indicated in the upper right corner of the figures. Location of seismometers indicated by red dots (NARS-Baja, RESBAN and Calnet stations). Current plate boundary in red lines, fossil boundaries in grey.