Crustal and Upper Mantle Structure in the Flat Slab Region of Central Chile and Argentina

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The shallow dips of the subducting Nazca plate appear to significantly influence the tectonics of central Chile and Argentina where magmatism and deformation are present nearly 1000 km away from the plate boundary. We calculate receiver functions from data recorded by the recent PASSCAL CHARGE array (Figure 1), which transected the Andes and Sierras Pampeanas in this region, to constrain the crustal structure of this region. Beneath the northern transect of the CHARGE array, where the Nazca slab flattens near 100 km, we find the crust is over 60 km thick beneath the Andes and that it thins to the east (Figure 2). The thick crust, however, extends ~200 km to the east of the high elevations. Estimates of Poisson’s ratio, which can be used to make inferences about crustal composition, measured from receiver functions, vary along ancient terrane boundaries exhibiting higher values to the west. Interestingly, we observe that the amplitude of the phase corresponding to the Moho on receiver functions diminishes to the west, complicating our images of crustal structure. These observations of thickened crust within a region of low elevations, diminished receiver function arrivals, and reports of high shear-wave speeds atop of the mantle wedge overlying the shallowly subducted Nazca slab, suggest to us that a portion of the lower crust beneath the western Sierras Pampeanas has been eclogitized. Receiver function arrivals marking the location of the Nazca slab remain more elusive, suggestive of a small impedance contrast between the slab and overlying mantle.

Figure 1. Locations of CHARGE stations shown as black squares plotted on a map of volcanism in central Chile and Argentina including the Sierra del Morro, Dona Ana, and Maquinas areas as well as other important landmarks such as the Aconcagua region. The track of the Juan Fernandez Ridge is shown as a heavy dashed line and solid lines mark the depth contours of the Nazca slab (Cahill and Isacks, 1992). Thin dashed lines mark the boundaries between the Principal Cordillera, Frontal Cordillera, and Precordillera. Locations of various volcanic fields are shown for reference.

Figure 2. Summary cartoon of results from the northern CHARGE transect presenting major observations. Variations in the Moho signature in the northern transect correlate well with locations of the boundary between the Cuyania and Famatina terranes. A nearby cross-section from a local shear-wave tomographic model (Wagner et al., 2005) is also presented (high (blue) and low (red) speed anomalies range between +4% blue to -4%).