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Crustal structure from teleseismic P-wave receiver function analysis in the Maule Region, Central Chile

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A temporary passive seismic network of 31 broad-band stations was deployed in the region around Talca and Constitución between 35°S to 36°S latitude and 71°W to 72.5°W longitude. The network was operated between March and October 2008. Thus, we recorded data prior the magnitude Mw=8.8 earthquake of 27 February 2010 at a latitude of the major slip and surface uplift. The experiment was conducted to address fundamental questions on deformation processes, crustal and mantle structures, and fluid flow. We present results of a teleseismic P receiver function study that covers the coastal region and reaches to the Andes. The aim is to determine the structure and thickness of the continental crust and constrain the state of hydration of the mantle wedge.

The P-wave receiver function technique requires large teleseismic earthquakes from different distances and backazimuths. A few percent of the incident P-wave energy from a teleseismic event will be converted into S-wave (Ps) at significant and relatively sharp discontinuities beneath the station. A small converted S phase is produced that arrives at the station within the P wave coda directly after the direct P-wave. The converted Ps phase and their crustal multiples contain information about crustal properties, such as Moho depth and the crustal vp/vs ratio.

We use teleseismic events with magnitudes mb > 5.5 at epicentral distances between 30° and 95° to examine P-to-S converted seismic phases. Our preliminary results provide new information about the thickness of the continental crust beneath the coastal region in Central Chile. At most of the stations we observed significant energy from P to S converted waves between 4 and 5 s after the direct P-wave within a positive phase interpreted as the Moho, occurring at 35 to 40 km. The great Maule earthquake of 27 February 2010 nucleated up-dip of the continental Moho. The rupture of this earthquake seems to have propagated down-dip of the Moho. The Moho reflection show a positive polarity, indicating that the mantle is either dry or only moderately hydrated. We observed converted energy from an intracrustal boundary at around 2 s that disappears near the coast. Further, positive polarity peaks occur that are possibly caused by the down going plate.