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Studying the Seismogenic Coupling Zone with a Passive Seismic Array: The TIPTEQ experiment in Southern Chile

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Subduction zones, the expression of convergent plate boundaries, generate the world's largest and most destructive earthquakes. The Southern Chilean subduction zone is an ideal natural laboratory to study the processes involved in generating these devastating earthquakes and is one of the main aims of the international and interdisciplinary research initiative TIPTEQ (from The Incoming Plate to megaThrust EarthQuake processes). High resolution images, using different techniques as well as different physical parameters, form the base for identifying the processes involved.

Within the project two dense amphibious passive seismic networks have been installed between Nov. 2004 and Oct. 2005, both covering the entire forearc from the trench to the active volcanic front. The Northern array was located between 37° and 39° South including the epicentre of the 1960 magnitude Mw=9.5 Valdivia, Chile, earthquake. It consisted out of 120 continuously recording, three component stations on land and 10 continuously recording Ocean Bottom Seismometers/Hydrophones (OBS/H) at sea. The Southern array was located between 41.5° and 43.5° South roughly in the middle of the rupture zone of the Valdivia earthquake. It consisted out of 20 continuously recording three component stations on land and 20 continuously recording Ocean Bottom Seismometers/Hydrophones (OBS/H) at sea.

Several hundreds of micro earthquakes could be located using manual picked P- and S-wave arrivals. Joint inversions for earthquake location and one dimensional velocity model were carried out and give a detailed snapshot of the seismicity distribution in both study regions. The subducting Nazca plate can be clearly identified in both regions dipping at a similar angle of about 30° suggesting that the age of the subducting plate does not control the subduction angle. While in the South high seismicity is found in the crust ($<$20km) along the active volcanic arc, we could detect only very few events in the Northern region. However, both regions exhibit a strong seismic clustering along the shoreline (West coast of Chiloe for the Southern region), indicating active deformation of the continental forearc and within the seismogenic coupling zone.

Additionally, combining high resolution hypocenter location, fault plane solutions, seismic tomography, and receiver function images we will tackle the question of the precise location of the down dip end of the seismogenic interface and its relationship to intermediate depth seismicity and the continental crust/mantle discontinuity.