Study of Seismic Source Processes of the a Large Subduction Zone Earthquake using Near Field Accerograms : the Mw 7.8 Earthquake in Tocopilla, Northern Chile, November 14, 2007

Raul MADARIAGA\textsuperscript{1}, Sophie PEYRAT\textsuperscript{2}, Jaime CAMPOS\textsuperscript{3} and the Montessus de Ballore team

A large $M_w=7.8$ earthquake occurred on 14 November 2007 in the Northern Chile gap, just north of the site of the large $M_w=8$ Antofagasta earthquake of July 1995. This earthquake ruptured the interplate seismic zone over a length of more than 150 km and generated a series of plate interface aftershocks. Then, on 16 December 2007, a large $M=6.8$ aftershock occurred near the southern bottom of the fault plane of the main event. This event is of the « slab push » type, i.e. an event that occurred inside the subducted Nazca plate due to along slab compression; aftershocks of this event demonstrate that it occurred on an almost vertical fault.

The 2007 event took place just after the installation of new accelerometric networks by Chilean, German and French researchers and short period instruments by our Chilean colleagues. The short period data for this event was used to locate the rupture zone of the main event and its largest aftershock that occurred on very different faults. Interferometric data were used to better define the rupture zone of the main event. The accelerometric data combined with far-field seismic data and SAR images provide a quite complete image of the rupture process. The earthquake broke a long (150 km) and narrow (about 30 km) zone of the plate interface just above the transition zone from continuous to stick slip.

Using a new non-linear inversion method we determined that rupture occurred on two well mapped patches of roughly elliptical shape. Analysis of the accelerograms at different frequency ranges clearly shows the waves propagating in the near field from different asperities. We will discuss the stress transfer during this event and the rupture mechanics at the transition zone. Soon after the main event a surge in seismicity was observed on the Benioff zone at 100 km depth that is mainly of tensional (slab-pull) nature. We will discuss the use of accelerograms to image the rupture process in the 1 s—10 s period band, in which the source process can be described in deterministic terms. For these large subduction zone earthquakes, acceleration and ground velocity in the 1 s—10s band are very stable and constant (0.1 g—0.2 g and 1 m/s—2 m/s) on top of the rupture zone, an interesting result for estimating low frequency strong motion in the deterministic range.

\textsuperscript{1} Laboratoire de Geologie, Ecole Normale Superieure
\textsuperscript{2} Institut de Physique du Globe de Paris
\textsuperscript{3} Departamento de Geofisica, Universidad de Chile