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Title: Rupture Geometry and Slip Associated With the 2007 November 14 Mw = 7.7 Tocopilla (Chile) Earthquake, as Preliminary Determined by InSAR and GPS Observations

Abstract

A Mw 7.7 subduction earthquake occurred on November 14, 2007 in Tocopilla (northern Chile). This region (between 16.5°S and 23.5°S) had been identified as major seismic gap (~1000 km length) that had not ruptured since the occurrence of the South Peru (Mw = 9.1, 16 August 1868) and the Iquique (Mw = 9.0, 10 May 1877) megathrust earthquakes. This gap was reduced to a length of ~500 km after the occurrence of the Arequipa (Mw = 8.3, 23 June 2001) and the Antofagasta (Mw = 8.1, 30 July 1995) earthquakes. The Tocopilla earthquake occurred within a network of continuous GPS stations operated by IGP, Caltech, DGF and IRD. An array of 21 benchmarks, installed and previously measured periodically by IGP/DGF, was resurveyed after the earthquake, increasing the spatial density of static observations of the surface displacement. We combine space geodesy (InSAR and GPS) data of surface displacement to determine the geometry and kinematics of the rupture on the subduction interface. The deformation pattern in the interferogram constrains the E-W extension of the fault plane. Comparison of the InSAR data of the 2007 Tocopilla and 1995 Antofagasta earthquakes documents clearly the shift in rupture depth between the two events. The Tocopilla rupture apparently extended between 50- 55 and 30-35 km depth and did not propagate up to the surface. Interestingly, the earthquake definitely ruptured the deeper part of the seismogenic interface, well into the transition zone that was identified earlier (Chlieh *et al.*, 2004). Most of the aftershocks following the 2007 event were concentrated near the southern end of the rupture that is clearly defined by the GPS and InSAR data to the north of the Mejillones Peninsula. The region of the subduction zone under the Mejillones Peninsula appears to act as a barrier arresting rupture of large earthquakes (1877, 1995 and 2007 earthquakes). When exploring the details of the rupture on the subduction interface, geodetic data require two distinct patches of slip, consistent with the first results from seismology (Campos *et al.*, Peyrat *et al.*, this session). According to the mean displacement inferred by our models (~1-2 m) the Tocopilla earthquake released a very small portion of the slip deficit accumulated in the seismic gap during the past 130 years (~ 10m) and may be regarded as a possible precursor of a much larger subduction earthquake rupturing the 500 km long gap.