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Title: Accommodation of convergence in North Chile seismic gap: questions raised by 2007 Mw7.7 Tocopilla earthquake

Abstract

Nazca plate subducts under the South American continent at a rate of ~7 cm/yr oriented ~ 80° at the latitude of North Chile (17°S to 23°S). This area was recognized as a major seismic gap of about 1000 km length since no earthquake occurred during the 120 years following the South Peru (Mw= 9.1, 16 August 1868) and the Iquique (Mw=9.0, 10 May 1877) megathrust events. This gap was reduced to 500 km length after the Arequipa (Mw = 8.3, 23 June 2001) and the Antofagasta (Mw = 8.1, 30 July 1995) earthquakes, and might have accumulated up to 9 m of slip deficit by interseismic loading on the subduction interface. According to usual scaling laws for subduction earthquakes this corresponds to an earthquake of magnitude up to 8.5. On November 14, 2007, a Mw 7.7 subduction earthquake occurred in the southern part of this seismic gap. It was recorded by a network of ~20 cGPS instruments, and ASAR co-seismic interferograms were calculated. Analysis of geodetic data show that the earthquake initiated in the vicinity of Tocopilla city and was arrested ~150km south below Mejillones peninsula, area already identified as a potential seismic barrier. The earthquake activated the deep part of the seismogenic zone down to the transition zone (35-50 km depth) and did not reach the surface. It slipped parallel to the convergence direction requiring no slip partitioning and released a very small portion (<2m) of the slip deficit accumulated in the seismic gap. These specificities raise a series of questions relative to the way convergence is accommodated in North Chile seismic gap. Is Tocopilla earthquake a precursor to a future megathrust event that would release the whole elastic strain accumulated since 130 years? Shall it be regarded as part of a series of Mw 7.5-8 earthquakes occurring every 5 years that break progressively the gap? What part of the convergence is accommodated by aseismic slip events? How is it related to earthquakes? We address these questions by analyzing GPS and InSAR data acquired before and after 2007 Tocopilla earthquake.