L1-2 Pre-seismic Precursory Signal Identification of Subduction Earthquake from Geodesy and Seismic Network

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We look for a highly research-oriented Ph.D. candidate to join in our FONDAP Research Center CIGIDEN program dedicated for natural hazards from subduction earthquake. The great earthquakes mostly occur along the plate-bounding between subducting and overriding plates along convergent margins. Therefore, understanding the physical processes related to great subduction zone earthquakes has long been one of the main contests of geosciences. Over the past decade there has been a tremendous increase in the number and density of geodetic Global Positioning System (GPS) and seismic networks deployed to study of earthquakes. These deployments, together with the greatly improved precision and temporal resolution of GPS estimates of site positions capture intriguing deformation transients at active subduction margins (e.g., McCaffrey et al., 2008; Rogers & Dragers, 2003). In the interseismic period, the steady downward pull of the oceanic plate produces a strain accumulation along the seismogenic part of the plate interface in response to its unstable, stick-slip like frictional behavior (e.g., Marone, 1998). The rate of the plate convergence accumulated as slip deficit is kinematically defined as the degree of locking. Geodetic observations of recent large subduction earthquakes have revealed a spatial correlation between the extent and magnitude of coseismic ruptures and the degree of locking along the plate interface (Chlieh et al., 2008, Moreno et al., 2010, Loveless and Meade, 2010), Hence, mapping the state of locking degree at the plate boundary and understand slow slip events, which promote the great subduction earthquake, can provide immense help for understanding the physical control of strain accumulation and release of great earthquakes, which is a relevant tool for assessing the seismic hazards.

The 2014 Pisagua earthquake have been preceded by a slow slip event that could be observed in the GPS coastal stations at least 8 months before the main event (Ruiz, S. et al., 2014; Kato et al., 2016; Socquet et al., 2017). The slow slip event stressed an inactive reverse crustal fault located in the upper plate triggering a foreshock of magnitude Mw 6.7 on 16 March 2014 and also triggered the main Mw 8.2 earthquake. Some authors proposed alternative interpretations such as: the shallow event triggered the Mw 8.2 earthquake (González et al., 2015), or that precursory slip was only due to cumulative co-seismic moment released by plate interface foreshocks (Schurr et al., 2014; Bedford et al., 2015). Additionally, in case of March 11, 2011 Tohoku-Oki earthquake, slow slip locally preceded the March 9, 2011 foreshock with a 1-month duration from February 2011 to the Mw 7.3 foreshock. While postseismic deformation for the Mw 7.3 foreshock was apparent, no preslip with moment greater than Mw 6.2 in the vicinity of the foreshock hypocenter or > 6 along the interface near the trench occurred. Hi-net tilt records were examined by Hirose (2011) for precursory tilt change in the short term (days) to medium term (month) to look for preslip to the 2011 event. This information suggests either small-scale heterogeneity or temporal variation in frictional behavior provided slow slip events from the high rate GPS and seismic network can be used to analysis to understand the acceleration of earthquakes in Chilean subduction region in the high locked region in the subduction earthquake.

Our research group has very good national/international collaborations with integration of geologist, geophysicist, seismologist, geodesist including experts in computer skills.