The 8-month precursory phase of the 2014 Mw8.1 North Chile Earthquake, observed by GPS and foreshocks frequency content

Anne Socquet (1), Jorge Jara (1), Jesus Piña Valdes (1), Fabrice Cotton (2), and Nathalie Cotte (1)
(1) ISTerre, Université Grenoble Alpes, CNRS, France (anne.socquet@ujf-grenoble.fr), (2) GFZ, Potsdam, Germany (fabrice.cotton@gfz-potsdam.de)

The mechanisms leading to megathrust subduction earthquakes are poorly known. It has been proposed that the long-term precursory phase of interplate earthquakes is triggered by a slow slip on the fault interface (Bouchon et al., 2013). However, the link between the long-term foreshock activity and associated pre-seismic deformation transients has not been directly established.

The Mw8.1 2014 North Chile earthquake was preceded by a series of earthquakes swarms starting in July 2013, eventually leading to the megathrust nucleation 8 months later. It is therefore an excellent case to study the precursory deformation and seismic activity. So far most studies focused on the 20 days preceding immediately the earthquake when a strong signal occurs (Ruiz et al., 2014; Schurr et al. 2014, Kato et al. 2014, Lay et al. 2014, Yagi et al. 2014), but very little is known about a potential long-term precursor.

Here we show that GPS velocities decrease 8 months before the mainshock, within a radius of 100km of the Mw8.1 earthquake source. This long-term transient signal in GPS time-series occurs simultaneously with an increase of the background seismicity and a decrease in the b-value that were already identified (Schurr et al., 2014). We additionally show that this 8-month precursor is associated with a change in the frequency content of interface earthquakes that impoverish in high frequencies. We interpret these observations as a long-term nucleation phase preceding the Mw8.1 earthquake, characterized by creep acceleration on the subduction interface associated with a progressive frictional weakening.