Geophysical Research Abstracts
Vol. 18, EGU2016-16605, 2016
EGU General Assembly 2016

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

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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 longterm nucleation phase preceding the Mw8.1 earthquake, characterized by creep acceleration on the subduction interface associated with a progressive frictional weakening.