



Changes in interface coupling trigger progressive nucleation of the 2014 Chile megathrust earthquake

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The mechanisms leading to large earthquakes are poorly understood and documented. Interplate earthquakes, such as the April 1st 2014 Mw8.1 North Chile megathrust, can be preceded by a long-term precursory phase, however the link between foreshock activity and associated deformation transients has never been directly established for periods exceeding a few weeks.

Here we show that the velocity of the coastal GPS station of UAPE decreases by 4 mm/yr after the 2005 intraslab earthquake of Tarapaca, suggesting that the subduction interface started to decouple after this slab pull event. Then, 8 months before the megathrust, a group of coastal GPS stations accelerated westward, corresponding to a Mw6.5 slow slip event on the subduction interface, 80% aseismic in nature. Concurrent interface foreshocks underwent a diminution of their radiation at high frequency, suggesting that ruptures were progressively enlarging, with a reducing velocity. This suggests that, in response to the slow sliding of the subduction interface, the widening of foreshock ruptures gradually propagating beyond seismic asperities into surrounding metastable areas is the nucleation mechanism eventually leading to the mainshock.