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# Upper crustal fault reactivation and the potential of triggered earthquakes on the Atacama Fault System, N-Chile

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The Atacama Fault System (AFS) is an active trench-parallel fault system, located in the forearc of N-Chile directly above the subduction zone interface. Due to its well-exposed position in the hyper arid forearc of N-Chile it is the perfect target to investigate the interaction between the deformation cycle in the overriding forearc and the subduction zone seismic cycle of the underlying megathrust. Although the AFS and large parts of the upper crust are devoid of any noteworthy seismicity, at least three M=7 earthquakes in the past 10 ky have been documented in the paleoseismological record, demonstrating the potential of large events in the future.
We apply a two-fold approach to explore fault activation and reactivation patterns through time and to investigate the triggering potential of upper crustal faults. 1) A new methodology using high-resolution topographic data allows us to investigate the number of past earthquakes for any given segment of the fault system as well as the amount of vertical displacement of the last increment. This provides us with a detailed dataset of past earthquake rupture of upper plate faults which is potentially linked to large subduction zone earthquakes. 2) The IPOC Creepmeter array (http://www.ipoc-network.org/index.php/observatory/creepmeter.html) provides us with high-resolution time series of fault displacement accumulation for 11 stations along the 4 most active branches of the AFS. This array monitors the displacement across the fault with 2 samples/min with a resolution of 1$\mu$m. Co-located seismometers record the seismicity at two of the creepmeters, whereas the regional seismicity is provided by the IPOC Seismological Networks. Continuous time series of the creepmeter stations since 2009 show that the shallow segments of the fault do not creep permanently. Instead the accumulation of permanent deformation occurs by triggered slip caused by local or remote earthquakes. The 2014 Mw=8.2 Pisagua Earthquake, located close to the creepmeter array, triggered large displacement events on all stations. Another event recorded on all stations was the 2010 Mw=8.8 Maule earthquake located 1500km south of the array.
Exploring observations from both datasets, we can clearly state that triggering of upper crustal faults is observed for small-scale displacements. These findings allow us to speculate that the observed larger events in the past are likely being triggered events that require a critically prestressed condition of the target fault that is unclamped by stress changes triggered by large or potentially even small subduction zone earthquakes.