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Some similar seismic characteristics of the 2014 Iquique and 2015 Illapel earthquakes in Chile

Sergio Ruiz (1), Emilie Klein (2), Francisco del Campo (3), Efrain Rivera (1), Marianne Metois (4), Sergio León (1), Amaya Fuenzalida (5), Piero Poli (6), Christophe Vigny (2), Juan Carlos Baez (3), Andrei Maksymowicz (1), Javier Ruiz (1), Raphael Grandin (7), Gabriel Vargas (8), Felipe Leyton (3), Raúl Madariaga (2), and Luce Fleitout (2)

(1) Universidad de Chile, Geophysics, Chile (sruiz@dgf.uchile.cl), (2) Laboratoire de Géologie. École Normale Supérieure, Paris, France., (3) Centro Sismológico Nacional, FCFM, Universidad de Chile, Chile., (4) Laboratoire de Geologie de Lyon, Terre, Planetes, Environnement, Universite de Lyon, CNRS UMR5276, Universite Lyon 1 - ENS Lyon, Villeurbanne, France, (5) School of Environmental Sciences, University of Liverpool, U.K., (6) Massachusetts Institute of Technology, USA., (7) Institut de Physique du Globe de Paris, Paris, France., (8) Departamento de Geología, FCFM, Universidad de Chile, Chile.

The 2014 Iquique Mw 8.2, and 2015 Illapel Mw 8.3 earthquakes occurred inside of the mega-rupture zones of 1877 in Northern Chile and 1730 in Central Chile, respectively. 1877 and 1730 are the two largest megathrust events that probably controls the seismic cycle of these two zones, recent paleo-seismological studies propose recurrence intervals between $\sim$200 and $\sim$650 years for these giant earthquakes. The two 2014 and 2015 events were very well recorded by large permanent broadband and strong motion networks, temporary broadband digital stations, high rate GPS instruments and InSAR images. With this large dataset we attempt to understand the processes of interaction between slow and fast deformation in these zones, which produced these events of magnitude Mw$\sim$8.0. We study the upper plate deformation before both events using the continuous time displacement of GPS antennas. Both earthquakes show precursory phases: Iquique was preceded by a slow slip event and Illapel was preceded by a deep transient slow slip produced by postseismic deformation due to the Mw 8.8 2010 Maule mega-earthquake. On the other hand, a remarkable feature of the Iquique and Illapel coseismic ruptures was their nucleation processes. Both were preceded in their first 20 seconds by small events that released a tiny fraction of the total seismic energy. The largest release of seismic energy was generated at the end of these precursory ruptures. We can interpret this process in terms of a simple asperity model, where the boundaries of the rupture are controlled by the plate interface. The areas surrounding both rupture zones were weakly coupled and a presented concentration of swarms and repeating events. Finally, we relocated and computed moment tensors of the events of magnitude Mw $\geq$ 4.5. Most of the fore– and after –shocks of both earthquakes are interplate events surrounding the rupture zones of the main events. However, in the Iquique earthquake these events are located in a band of about 50 km from the trench, an area which is usually aseismic elsewhere in Chile. Another important group of fore and after - shocks are located above the plate interface. In the Illapel sequence, most aftershocks are located in the deeper zone of the rupture, some of them are intraplate intermediate depth events with similar characteristics to a previous sequence before the 15 October 1997 Punitaqui slab push event. We suggest that the spatial distribution of foreshocks and aftershocks were strongly controlled by the seismic rupture process and the rheological and tectonic conditions of the erosive margin of Northern and Central Chile.