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Aftershock seismicity and Tectonic Setting of the 16 September 2015 Mw 8.3 Illapel earthquake

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Powerful subduction zone earthquakes rupture thousands of square kilometers along continental margins but at certain locations earthquake rupture terminates. On 16 September 2015 the Mw. 8.3 Illapel earthquake ruptured a 200 km long stretch of the Central Chilean subduction zone, triggering a tsunami and causing significant damage. Here we analyze the spatial pattern of coseismic rupture and the temporal and spatial pattern of local seismicity for aftershocks and foreshocks in relation to the tectonic setting in the earthquake area. Aftershock seismicity surrounds the rupture area in lateral and downdip direction. For the first 24 hours following the mainshock we observe aftershock migration to both lateral directions with velocities of approximately 2.5 and 5 km/h. At the southern earthquake boundary aftershocks cluster around individual subducted seamounts located on the prolongation of the downthrusting Juan Fernández Ridge indicating stress transfer from the main rupture area. In the northern part of the rupture area a deeper band of local seismicity is observed indicating an alternation of seismic to aseismic behavior of the plate interface in downdip direction. This aseismic region at ∼30 km depth that is also observed before the Illapel 2015 earthquake is likely controlled by the intersection of the continental Moho with the subducting slab.