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Identification of a major segment boundary between two megathrust subduction zone earthquakes from aftershock seismicity

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Aftershock seismicity is commonly used to characterize the extent of rupture planes of megathrust earthquakes. From unique datasets, covering the two adjacent fault planes of the Mw 8.0, 1995, Antofagasta and the Mw 7.7, 2007, Tocopilla earthquakes, we were able to identify a segment boundary (SB), located beneath Mejillones Peninsula. This segment boundary hosted the onset of the Antofagasta rupture and constituted the end of the Tocopilla rupture plane. The data recorded during the mission of the German Task Force for Earthquakes after the 2007 Tocopilla earthquake is supporting our observations regarding the northern part of the SB. 34 seismological stations registered the aftershocks from November 2007 until May 2008. First hypocenter determinations show that the aftershock sequences of both events meet along this E-W oriented segment boundary. The segment boundary is furthermore conformed by the historic record of megathrust events. Evidence for long term persistency of this SB comes from geological observations as differential uplift rates across the boundary and different fault patterns. Geomorpholocical analysis defines a topographic anomaly $\sim$ 20 km wide and oriented along strike the SB..The main shock hypocenter determinations (NEIC, local network, ISC) which are related to the start of the rupture are all located in this zone. The SB is further characterized by intermediate b-values derived from a spatial b-value study of the Antofagasta fault plane and hosts several elongated clusters of aftershock seismicity. A detailed study of the focal mechanism solutions in one of these clusters showed a number of aligned strike slip events with one E-W striking nodal plane having a strike angle which is similar to the angle of subduction obliquity of the oceanic Nazca plate in this area.
In further investigations we will search for detailed information on the nature and dynamics of processes along such a segment boundary, their meaning for the initiation of large earthquakes and their persistency throughout multiple seismic cycles.