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Spatial and temporal analysis of the Mw 7.7, 2007, Tocopilla aftershock sequence

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On 14 November 2007, 15:40:51 UTC a large Mw 7.7 earthquake occurred in the region of Tocopilla in Northern Chile. The epicenter is located at 22.30°S, 69.89°W, $\sim$ 35 km south east of the city of Tocopilla and 160 km north of Antofagasta (earthquake location by GEOFON network). The earthquake took place in the southern part of the Northern Chile seismic gap which is supposed to be at the end of its seismic cycle. Currently, the gap is spanning the rupture area of the Mw=9 1877 Iquique event, a region which is now unbroken for almost 150 years. Therefore, the 2007 Tocopilla earthquake is the first large event that occurred inside the Northern Chile seismic gap since 1877.

We present a study of the spatial and temporal distribution of the aftershock activity following the 2007 Tocopilla event using the frequency-magnitude distribution and other parameters. Studying this aftershock sequence will provide closer insight into the fault dimension of this subduction zone earthquake and the tectonic setting of the region.
The distribution of aftershocks into depth shows that the majority of the hypocenters are located along the subduction interface, reaching down to $\sim$ 50 km depth. In the western part, the aftershock sequence splits into two branches, one heading towards the trench, the other bending into the crust in front of the Mejillones Peninsula.
In the epicentral horizontal, we observe a concentration of aftershocks around the northern part of the Mejillones Peninsula and along the coast up to the Río Loa. This leads to the conclusion that the shallow part in the north west did probably not break during the event. The spatial density of aftershocks shows two offshore patches north-east of the peninsula. Analyzing the spatio-temporal distribution of our aftershock data set, we can see that the fault rupture propagated towards the south west with a fault plane of about 150 km length. These observations are consistent with first results by other studies.

Our preliminary results indicate that the Tocopilla event occured between 22° - 23.15° S with a longitude of 150 km. From our results, we can notice that the aftershock sequence of the Tocopilla earthquake terminated just north of the 1995 Antofagasta main shock nucleation zone. This would then be the symmetric hint and therefore a confirmation for the Mejillones Peninsula acting as a segment boundary. On a more regional scale, we can say that the Tocopilla earthquake ruptured only a very small part of the Northern Chile seismic gap.