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Geomorphic impact of the 16S 2015 tsunami event in the Coquimbo Bay (Northern Chile)

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On September 16, 2105 a Mw 8.3 earthquake occurred at 22:55 GTM with a focal depth of 23 km and an epicenter located 31.570°S, W 71.670°, in the Coquimbo Region (northern Chile). This event triggered a tsunami with wave heights of more than 6 m that caused damages and flooding in the northern Chilean coast, mainly in the cities of Tongoy and Coquimbo – La Serena. The vertical run-up shows an important saw-tooth like variation due to the sharp changes in the topography, specially towards both ends of the bay. The highest and more irregular values occurred in the South sector, that presents a higher topographic gradient, and progressively decrease towards the North were the topography is flatter. The horizontal flooding reached its maximum values in the bay fluvial valleys where the tsunami wave entered along the river channels. The waves, favored by the confining conditions, entered more than 950 m in the Elqui River mouth and almost 700 m in the Culebrón Stream. Coquimbo Bay comprises a wide and convex littoral zone of approximately 18 km long only interrupted by the mouths of the Elqui River and the Culebrón Stream where small saltmarshes have developed. According to the tide gauge data, the first wave reached the Coquimbo coast only 20 minutes after the earthquake with a maximum height of 0.85 m. 22 minutes later, a second wave arrived with a much higher height (4.3 m) causing the first damages on the littoral and the city. The last wave, the 4th one, occurred 35 minutes after the earthquake and was the highest reaching 4.68 m as well as the most damaging. Despite the existence of works that analyze the characteristics of this event, a more deep and thorough study is still needed of the tsunami geological record in the Coquimbo Bay where a wide variety of forms and deposits were preserved. The making of a geomorphological map has allowed us to differentiate the geological features related with the tsunamigenic event such as sand sheets and debris-boulder fields (tsunamites), littoral erosion scars developed on the saltmarshes, beaches and coastal dunes, erosive backwash channels, degraded wetlands, flooding lagoons or the appearance of new fluvial channels. This morpho-sedimentary assemblage, all together, has enabled us to characterize the conditions in which the tsunami occurred and to quantify it effects along this coastal zone as well their potential preservation.