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# Tectonic controls on the 1960 Chile megathrust-earthquake segment

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Understanding the principles that govern the triggering of great subduction earthquakes and the finite rupture length, and consequently earthquake magnitude, is of utmost importance for a better assessment of natural hazards at active plate margins. In principle, two major processes have been inferred to generate and control the magnitude of a giant subduction earthquake (M > 9): (1) the forearc of the upper plate has to accumulate enough elastic strain to rupture and cause fault slip, and (2) the rupture has to propagate for a length of hundreds of kilometers. The great 1960 Chile earthquake (Mw 9.5) corresponds to such a megathrust event that ruptured ~1000 km of the Nazca-South America plate boundary. Rupture started at 38.2S, adjacent to the Arauco peninsula, and propagated southward until it stalled in the vicinity of the Chile Triple Junction. We integrate geologic, geodetic, and seismologic data to propose three major factors that control rupture propagation and upper-plate contraction during the 1960 earthquake. These include: microplate behaviour of the Chiloe forearc block, subduction of trench sediments, and the geometry of the deep-reaching, inherited Lanalhue fault zone in the South American plate. The first two factors provide a mechanical homogeneity of the upper plate and plate interface, respectively, smoothing the plate interface and reducing seismic strength, ultimately facilitating rupture propagation over a great distance. The third aspect leads to stress concentration and enhanced upper-plate contraction along the Lanalhue fault and the southern Arauco peninsula, at the leading edge of the Chiloe microplate, where the 1960 earthquake sequence nucleated. The combination of these fortuitous factors is not unique. Forearc microplates associated with trench sediments and inherited deep-reaching faults are characteristic of other subduction zones that have generated Mw > 9 earthquakes. In addition to Chile, the Alaska, Sumatra, and Cascadia subduction margins are similar, suggesting unifying characteristics that are key to the generation of giant earthquakes.