Recurrent slow slip events as a barrier to the rupture propagation of the 2016 Pedernales earthquake in the Ecuadorian margin

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The northern Ecuadorian margin, where Nazca plate subducts beneath South-American plate shows a large spatial heterogeneity of the interseimic coupling. A low coupled area called Punta Galera-Mompiche Zone (PGMZ) separates two high coupled patches: the southern one between 0.4˚ S and 0.35˚ N that matches with the 1942 (7.8 Mw) and the recent 2016/04/16 Pedernales earthquake (Mw 7.8) rupture zones; and the second one between 0.8˚ N and 4.0˚ N that corresponds to the 1958 (7.7 Mw) earthquake. These coupled zones were sources of a sequence of large interplate earthquakes zones [1942, 1958, and 1979). The great 1906 earthquake (Mw ~8.4-8.8) likely ruptured the total area. Our study is focused in the analysis of recurrent sequences of seismic swarms in PGMZ. Among the swarms, the sequence of December 2013 –January 2014 was the best documented. During this period a six-week-transient, interpreted as Slow Slip Event (SSE), was recorded by the GPS network around PGMZ. The microseismicity triggered during this period is well correlated with the spatio-temporal evolution of the SSE. The moment release by the SSE (3.4×10^{18} Nm, 6.3 Mw), over an approximated 60 ×40 km area, is considerably larger than the moment released by earthquakes (5.8×10^{15} Nm, Mw 4.4) during the same time period. In 2007–2008, a similar seismic-aseismic episode occurred, this sequence released higher moments both for the seismic and aseismic processes. Cross-correlation analyses, of continuous seismic waveforms over a 15 years-long period, shows that seismic swarms have a two-year-recurrence, suggesting that the SSEs recurrently affect this area with a subsequent release of accumulated stress in PGMZ, which became a barrier impeding the rupture propagation of the 2016 Pedernales earthquake northward.

Keywords: Ecuadorian margin, Slow Slip Event, Seismic swarm, Interseismic coupling, Pedernales earthquake, Propagation barrier

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