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Using 10Be cosmogenic surface exposure dating to determine the evolution of the Purgatorio active fault in the Andean forearc, southern Peru

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Active transpressive deformation has been occurring along the Andean hyperarid forearc for the last 3 Myrs but many of these faults are still not described even if able to produce large damaging earthquakes. Active faulting along the northern part of the Arica Bend can be recognized due to the presence of well-preserved and sharp fault scarps indicating recent surface slip. During the Mio-Pliocene, deposition within the forearc continental basins resulted in the formation of vast fan deposits and conglomerates of the Moquegua Formation, which can be considered as bedrock in this exposure study (∼45–4 Ma; Tosdal et al., 1984; Sebrier et al., 1988a; Roperch et al., 2006). The typical vertical Purgatorio fault scarps offset both the Moquegua bedrock and several younger geomorphic features associated with <300kyrs climatic and 400 years old volcanic extreme events. This study focus on quantifying slip rate variations in time along a 5-meters high vertical fault scarp to understand how the fault is evolving. These results are achieved via surface exposure dating of the sampled seismically broken cobbolds of the Moquegua formation outcroping vertically along the fault scarp. These samples are well-suited to the application of in situ produced cosmogenic radionuclides for surface exposure dating, as the hyperarid region has extremely low erosion rates. We sampled the scarp away from any significant drainage so as to avoid possibly disturbed areas. The sampling did involve extracting quarzite conglomeratic material along the bedrock scarp and on the upper surrounding crests. The aim has been to measure Berylium-20 TCN (Terrestrial in situ Cosmogenic Nuclides) concentrations to determine exposure age as a function of height on the scarp. This has been successfully employed on one scarp in Italy based on Chlorine-36 TCN (Palumbo et al., 2004). However, slow faults behaviour remains unclear and more contributions are needed.
Quaternary activity of the Purgatorio fault system was evidenced by Hall et al. (2008). They highlighted a vertical offset of about ∼100 m for a pediment surface intercepted by the fault, and dated at ∼280 ka. Considering that the pediment surface is horizontal, this would gave a maximum of ∼0.3 mm/yr of vertical deformation since 280 ka. Our new data provide evidences of constant activity of the fault during the Holocene with a mean vertical motion of 2 $\pm$ 1 mm/ yr. These news results strengthen the idea that the Andean forearc is still submitted to contratile deformation, bring additional knowledge on the structural model of the area, and raise the question of the local seismological hazard.