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Holocene deformation along the Liquiñe – Ofqui Fault Zone, southern Chile: Field observations, tephrochronological correlations and geomorphic analysis

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In the Southern Andes between 38°S and 48°S, the Liquiñe-Ofqui Fault Zone (LOFZ) occurs as a dextral transpressive intra-arc fault zone that partially absorbs the margin parallel component of oblique convergence between the Nazca and South American plates (Lavenu & Cembrano, 1999). Slip rates along this structure have been estimated only at the million-year and modern (geodetic) time scales. At long-term, Rosenau et al. (2006) kinematic models indicate slip rates of 32±6 mm/yr for its southern portion (46°S and 42°S) and 13±3 mm/yr for its northern portion (42°S and 38°S). The earthquake potential of the LOFZ has been demonstrated along its southern extent by the 2007 Aysén earthquake (Legrand et al., 2011); however, little is known about the millennial-scale slip rate for this structure in the northern end, which are crucial for assessing the seismic-related hazard. To help fill this gap, we present evidence of holocene deformation along the northern LOFZ (38°S to 40.5°S). We studied four sites along the northern LOFZ: Lonquimay, Palguín, Liquiñe, and Maihue. All the sites exhibit deformed tephra-bearing fluvial, glacial and lacustrine deposits, together with offset drainages and knickpoints related to fault activity. Tephra deposits were used to constrain the timing of deformation by tephrochronological means (Rawson et al., 2015; Fontijn et al., 2016). We performed a morphometric analysis of the fluvial network to link our punctual observations to kilometric fault traces. Based on this, we determined that our presented evidence is younger than ca. 11 ka. We estimate horizontal slip rates of ~25 and ~14 m/ka on the Lonquimay and Liquiñe site, respectively; and a vertical slip rate of ~0.05 m/ka in the Palguín site. Our results suggest that NNE-ENE oriented kilometric branches of the LOFZ are likely responsible for the deformation that we identified at outcrops. We suggest that holocene deformation is represented by both horizontal and vertical displacements that range from tens of centimeters to hundreds of meters. The deformation is partially due to earthquakes; this hypothesis is supported by the instrumental seismicity along the fault branches related to the study sites. We highlight that millennial slip rates estimated at Lonquimay and Liquiñe sites are like those reported; however, they increase northwards and appears to be localized along single faults that account for the long-term strain partitioning rate. Ongoing work is focused on better determining millennial slip rates and finding appropriate sites to undertake paleoseismological surveys.

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