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A case of paleo-creep? Comparison of fault displacements in a trench with the corresponding earthquake record in lake sediments along the Polochic fault, Guatemala

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The Polochic and Motagua strike-slip faults in Guatemala accommodate the displacement (∼2 cm/y) across the boundary between the Caribbean and North American plates. Both faults are expected to produce large destructive earthquakes such as the Mw 7.5 earthquake of 1976 on the Motagua fault. Former large earthquakes with magnitudes larger than Mw 7.0 are suggested from the areal extent of destructions to Precolombian Mayan cities and churches, and both the Motagua and Polochic fault have been suspected as the sources of these earthquakes. The available record, however, is surprisingly poor in large earthquakes, suggesting either that the record is sketchy or that such earthquakes are effectively infrequent. We investigated the activity of the Polochic fault by opening trenches along its major strand in Uspantán, Quiché, and Agua Blanca, Alta Verapaz. Recent displacements are evidenced in Agua Blanca, with soils less than 350 years old disrupted by the fault. We combined the study of the trenches with the study of sediment cores in Laguna Chichój, a lake located 4 km north of the Polochic fault. We had previously conducted an analysis of the sensitivity of the Chichój lake sediments to earthquakes in the 20th century. In the 20th centurey the earthquake record is well known, as well the locally felt intensity of these earthquakes. We found that for MMI intensities of VI and higher turbidites and slumps are produced in the lake. We used this calibration to study the earthquake record of the past 12 centuries and identified a cluster of earthquakes with MMI > VI between 830 and 1450 AD. The oldest seismite temporally matches widespread destructions in Mayan cities in 830 AD. Surprisingly, no earthquakes are recorded between 1450 and 1976 AD. Yet, the trench in Agua Blanca records substantial displacement of the Polochic fault over the period. It seems therefore that this ultimate displacement did not produce any substantial earthquake, and may correspond to a period of creeping on the Polochic fault.