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Paleoseismic Records of the Dead Sea Reveals Climatic Modulation of Seismicity Along the Continental Transform Fault

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The Dead Sea Basin, a pull-apart basin situated along the Sinai-Arabia transform plate boundary, presents a unique natural laboratory to examine the long-term variability of earthquake activity through its extensive paleoseismic record, spanning the past 220,000 years. This record is constructed from borehole and outcrop data documenting seismites—earthquake-induced sedimentary deformations formed within the ancient lakes of the basin. Preliminary studies have identified a strong correlation between earthquake occurrence and fluctuations in lake levels, pointing to a potential climatic influence on seismic activity.

Through an NSF-funded project, we aim to quantify the relationship between lake-level variations and the paleo-earthquake record by investigating the mechanisms underlying seismite formation. These processes include sediment accumulation, seismic shaking, unit disruption, gravitational sliding, and subsequent deposition. Seismic shaking results from the interplay of tectonic processes such as strain accumulation, surface load changes, pore pressure variations, and stress release. This shaking interacts with sedimentary processes to form seismites. The study incorporates five research components: (1) advanced time series analyses of the 220 ka seismite record; (2) spatial detection analysis to assess the uncertainty of single-core paleo-earthquake event detection; (3) geospatial paleo-bathymetry analysis of sediment availability for turbidite generation at different lake levels; (4) fluid mechanical modeling of sediment rheology and deformation style at varying lake levels; and (5) pore fluid pressure, fault strength and mechanical modeling related to earthquake occurrence on both primary strike-slip and secondary normal faults at This research aims to elucidate the role of climatic factors in modulating seismic activity within the Dead Sea Basin. By integrating methodologies from geology, geodesy, geophysics, paleoseismology, paleoclimatology, and sedimentology, the study provides critical insights into the physical processes governing long-term earthquake variability along continental transform faults.