Geophysical Research Abstracts
Vol. 21, EGU2019-3880, 2019
EGU General Assembly 2019

Reassessing Mediterranean tectonics and earthquake hazard from the 365 AD earthquake

Richard Ott (1), Sean Gallen (2), Kosuke Ueda (1), Karl Wegmann (3), and Sean Willett (1)

(1) Department of Earth Sciences,ETH Zürich, Zürich, Switzerland (richard.ott@erdw.ethz.ch), (2) Department of Geosciences, Colorado State University, Fort Collins, USA, (3) Department of Marine, Earth and Atmospheric Sciences, North Carolina State University, Raleigh, USA

The hallmark of great earthquakes (Mw $\geq$ 8) in the Mediterranean is the 21 July AD 365 earthquake and tsunami that destroyed cities and killed thousands of people in coastal regions throughout the eastern Mediterranean. The source of this event has been the topic of debate for several decades. Rupture of the central Hellenic subduction zone megathrust has been ruled out due to the inability to match the observed deformation and uplift of a Holocene paleoshoreline that is up to 9 m above present-day sea level on the forearc high of Crete, Greece. The favored hypothesis is that this event nucleated along a hypothesized reverse fault that potentially splays of the subduction interface and daylights offshore of southwestern Crete. Under the assumption that the observed Holocene paleoshoreline was uplifted in a single event in AD 365, the magnitude of this earthquake is Mw 8.3 – 8.5, implying significant regional seismic and tsunamogenic hazards. Here, we present evidence from new and published radiocarbon data that this uplift likely occurred in at least two events, distributed within 2-3 centuries, in agreement with reports of multiple historic earthquakes on Crete in the first centuries AD. We hypothesize that the Holocene uplift observed on Crete is due to rupture of two active, offshore normal faults adjacent to the western and southwestern coastlines of Crete. We evaluate this hypothesis by inverting the Holocene uplift data for fault rupture length, depth, dip and slip using a visco-elastic dislocation model to simulate co-and post-seismic deformation. Results show that rupture of these two known active normal faults fits observed data equally as well as previous reverse fault models. Importantly, the fault dimensions and slip magnitudes for two normal fault events are more realistic than are estimates utilizing a single event on an offshore splay thrust. Furthermore, tsunami propagation modelling shows that normal fault earthquakes better match historic reports of coastal inundation when compared to simulations assuming a splay thrust event. Our results demonstrate that uplift during at least two historical earthquakes provides a more reasonable and parsimonious explanation for observed Holocene paleo-shorelines on Crete. These findings suggests that these historical eastern Mediterranean earthquakes did not exceed Mw 7.8, implying a lower, but still substantial, regional earthquake and tsunami hazards relative to previous work with hazards confined to faults in the upper plate.