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Roman mausoleum tested for ancient earthquake damage
Ground motion from intraplate earthquakes possible greater than from quakes at plate boundaries

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Roman mausoleum tested for ancient earthquake damage

Built under a sheer cliff, with a commanding view of the forum and castle in the ancient city of Pinara in Turkey, a Roman mausoleum has been knocked off-kilter, its massive building blocks shifted and part of its pediment collapsed. The likely cause is an earthquake, according to a new detailed model by Klaus-G. Hinzen and colleagues at the University of Cologne. They conclude that a 6.3 magnitude earthquake could have caused the damage, and their new finding gives seismologists a new data point to consider when they calculate the likely earthquake hazards for this southwestern region of Turkey.

Researchers have seen other signs of strong seismic activity in Pinara, most notably a raised edge to the ancient town's Roman theater that appears to be due to activity along a fault. But archaeologists and seismologists were not certain how the mausoleum sustained its damage. An earthquake seemed likely, but the mausoleum is also built under a cliff honeycombed with numerous other tombs, and damage from a rockfall seemed possible.

Hinzen and colleagues mapped the position of each part of the mausoleum using laser scans, and transferred 90 million data points collected from the scans into a 3-D computer model of the tomb. They then ran several damage simulations on the 3-D model, concluding that rockfall was not a likely cause of damage, but that an earthquake with magnitude 6.3 would be sufficient to produce the observed damage pattern to the mausoleum's heavy stone blocks.

"Quantitative Archeoseismological Study of a Roman Mausoleum in Pinara (Turkey) – Testing Seismogrenic and Rockfall Damage Scenarios," by Klaus-G. Hinzen, Helen Kehmeier and Stephan Schreiber of Cologne University.

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Can intraplate earthquakes produce stronger shaking than at plate boundaries?

New information about the extent of the 1872 Owens Valley earthquake rupture, which occurs in an area with many small and discontinuous faults, may support a hypothesis proposed by other workers that these types of quakes could produce stronger ground shaking than plate boundary earthquakes underlain by oceanic crust, like many of those taking place along the San Andreas fault.

Published estimates of the 1872 Owens Valley earthquake in southeastern California put the quake at a magnitude 7.4-7.5 to 7.7-7.9. Early work indicates the Owens Valley fault is ~140 kilometers long, and ~113 kilometers ruptured in 1872. Recent work comparing magnitude estimates from reported shaking effects versus fault rupture parameters suggests that the Owens Valley surface rupture was either longer than previously suspected, or that there was unusually strong ground shaking during the event. Colin Amos of Western Washington University and colleagues tested the hypothesis that the 1872 rupture may have extended farther to the south in Owens Valley. They conclude that the 1872 Owens Valley earthquake did not trigger additional rupture in the Haiwee area, indicating that the 1872 rupture was not likely significantly longer than previously reported.

Amos and colleagues dug trenches in the southwestern Owens Valley area to look at the prominent Sage Flat fault east of Haiwee Reservoir. The trench data, combined with dating of the exposed sediment, allowed them to preclude the southern extent of the 1872 rupture from the Sage Flat area and identify two other much older surface-rupturing earthquakes in the area 25,000 to 30,000 years ago. The evaluation of their trench site suggests that the only recent ground disturbance, possibly coincident with the 1872 earthquake, was mostly weak fracturing that may have resulted from ground shaking -- rather than triggered slip along a fault. Soil liquefaction -- the conversion of soil into a fluid-like mass during earthquakes – likely occurred at other nearby saturated wetlands and meadows closer to the axis of the valley.

"Refining the southern extent of the 1872 Owens Valley Earthquake rupture through paleoseismic investigations in the Haiwee area, southeastern California" by Colin B. Amos (Former postdoc at UC Berkeley, now at Western Washington University; Andrew T. Lutz at Lettis Consultants International, Inc.; Angela S. Jayko, Shannon A. Mahan U.S. at Geological Survey; G. Burch Fisher at University of California, Santa Barbara and Jeffrey R. Unruh at Lettis Consultants International, Inc.

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