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### **Revised location of 1906 rupture of San Andreas Fault in Portola Valley**

*Modern technology resolves confusion caused by human error*

SAN FRANCISCO – New evidence suggests the 1906 earthquake ruptured the San Andreas Fault in a single trace through Portola Village, current day Town of Portola Valley, and indicates a revised location for the fault trace.

Portola Valley, south of San Francisco, has been extensively studied and the subject of the first geological map published in California. Yet studies have offered conflicting conclusions, caused in part by a misprinted photograph and unpublished data, as to the location and nature of the 1906 surface rupture through the area.

“It is critical for the residents and leaders of Portola Valley to know the exact location of the fault – an active fault near public buildings and structures,” said co-author Chester T. Wrucke, a retired geologist with the U.S. Geological Survey and resident of Portola Valley. Independent researcher Robert T. Wrucke and engineering geologist Ted Sayre, with Cotton Shires and Associates, are co-authors of the study, published by the Bulletin of the Seismological Society of America (BSSA).

Using a new high-resolution imaging technology, known as bare-earth airborne LiDAR (Light Detection And Ranging), combined with field observations and an extensive review of archival photography, researchers reinterpreted previous documentation to locate the 1906 fault trace.

“People back then were hampered by thick vegetation to see a critical area,” said Chester Wrucke. “Modern technology – LiDAR – and modern techniques made it possible for us to see the bare ground, interpret correctly where old photographs were taken and identify the fault trace.”

The 1906 earthquake changed the landscape of Portola Valley, breaking rock formations, cracking roads, creating landslides and forcing other changes masked by vegetation. With easy access to the area, local professors and photographers from Stanford created a rich trove of field observations, photos and drawings.

J.C. Banner, then a geology professor at Stanford, was among the scientists who, along with his students, submitted their observations of the 1906 fault rupture to the California Earthquake Commission to include in an official compilation of the cause and affects of



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the earthquake. While the compilation, published in 1908, contained a final conclusion that the earthquake ruptured along a single fault trace in Portola Valley, a key map of that trace – Map 22 -- included unintentional errors of the fault location.

Studies of the area resumed 50 years later, and those studies relied on literature, including Map 22. Subsequent studies published variations of Map 22, further altering the assumed location of the fault and suggesting the earthquake ruptured along multiple traces of the fault.

The authors sought to answer a seemingly simple question – where did the fault cross Alpine Road? “With variations in the literature and interpretation of the data, we decided to pay close attention to the original work,” said Robert Wrucke.

The authors relied on Branner’s description, together with 1906 photographs, a hand-drawn map, a student notebook and an analysis of changes to Alpine Road for clues to confirm the location of where the fault crossed Alpine Road.

Scanning archives to study all available photos from 1906 and notes from observers, the researchers compared geological features to LiDAR images. Their forensic analysis suggests the primary rupture in 1906 in Portola Valley was along the western of two main traces of the San Andreas Fault. Their analysis shows that there was no step-over within the town to the other trace.

“The biggest practical benefit of knowing the correct fault position is the ability to keep proposed news buildings off the critical rupture zone,” said Sayre.

“We had the luxury of LiDAR and were able to meld LiDAR data with old photos and made a breakthrough,” said Bob Wrucke. “Modern technology helps with geological interpretation. Our experience may be useful for others in situations where there’s confusion.”

Published by the Seismological Society of America (SSA), BSSA is the premier journal of advanced research in earthquake seismology and related disciplines. SSA is an international scientific society devoted to the advancement of seismology and the understanding of earthquakes for the benefit of society.

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