Fractures of the Hilina Pali Fault Zone, Hawaii

09 December 2022

Figure 1: Hilina Fault escarpment with the South-East coast of Big Island (Hawaii) on the background. View to South-West

The Hilina fault zone, located on the south flank of the Kilauea volcano (Hawaii), is an important structural feature of the regional landscape, forming cliffs up to 500 m in height. It is considered the scarp of large gravitational slope instability, sometimes called the Hilina slump. During the M7.4 Kalapana earthquake sequence in 1975, a complex thrust rupture on a deep detachment structure triggered the landslide's motion and normal displacement of several meters on the Hilina fault zone (e.g., Cannon, Bürgmann, and Owen 2001). During the M6.9 Kalapana earthquake sequence in 2018, the story was repeated. A network of seismometers could identify two depths with intense seismic activity at 7 km (basal detachment) and 3.5 km (Lin and Okubo 2020). The shallow structure has various interpretations, including the motion of the Hilina landslide (Yamazaki, Lay, and Cheung 2021).

Hazards caused by the Hilina landslide are important for Hawaii because of the risks to people visiting the coastal areas, including land motion and tsunamis. The landslide is situated in the Hawaii volcanoes national park, near the Ka'aha, Halape, and Apua Point campsites. As the Mauna Loa, the largest volcano on Earth, experiences a new phase of eruption, we are reminded of the importance of characterizing hazards related to volcanism, in particular, slope deformation and fault activity following the arrival of fresh magma.

In this project, you will use new aerial photos (from a field campaign in February 2023) to identify and map fractures along the Hilina fault zone and on the landslide in 3D. You will learn about the digital fracture mapping process, which is getting increasingly important for many aspects of geology. The aim is to understand better structures of the region and their potential implication for regional models. If time allows, you will participate in the comparison between the recent digital elevation model of February 2023 and older ones to characterize the land motion in the recent past, enlightening, among others, what happened during the eruption of the Mauna Loa and its possible effect on the volcano flank instability.

Dr. Nicolas Oestreicher and Prof. Joel Ruch

Chair of Engineering Geology and
Volcano Tectonic Laboratory Group
Section of Earth and Environmental Sciences
University of Geneva

References

Cannon, Eric C., Roland Bürgmann, and Susan E. Owen. 2001. “Shallow Normal Faulting and Block Rotation Associated with the 1975 Kalapana Earthquake, Kilauea Volcano, Hawaii.” *Bulletin of the Seismological Society of America* 91 (6): 1553–62. https://doi.org/10.1785/0120000072.

Lin, Guoqing, and Paul G. Okubo. 2020. “Seismic Evidence for a Shallow Detachment Beneath Kīlauea’s South Flank During the 2018 Activity.” *Geophysical Research Letters* 47 (15): 1–10. https://doi.org/10.1029/2020GL088003.

Yamazaki, Yoshiki, Thorne Lay, and Kwok Fai Cheung. 2021. “A Compound Faulting Model for the 1975 Kalapana, Hawaii, Earthquake, Landslide, and Tsunami.” *Journal of Geophysical Research: Solid Earth* 126 (11): 1–19. https://doi.org/10.1029/2021JB022488.