Joint Seminar - Structural Engineering and SRHM

CEE 595 S and SRHM

Waves and Oscillations in Volcanoes and Conduit-Crack Systems

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Abstract:

Many natural and engineered systems consist of coupled networks of fluid-filled conduits and cracks: volcanoes, hydraulic fractures and wells in the energy industry, drainage pathways in ice sheets, etc. We explore the rich variety of waves and oscillation modes of these systems, which can be used to place constraints on geometry and fluid properties from remote observations. Theory and computational simulations are complemented with a detailed study of the shallow plumbing system at Kilauea Volcano, Hawaii, through analysis of seismic recordings of two types of ~20-40 s VLP (very long period) events. One event type corresponds to magma oscillations in a ~300 m conduit connected to a ~1-2 km reservoir, with oscillations driven by buoyancy from density stratification within the conduit. The second event type, observed during the summer 2018 Kilauea eruption, arises from sloshing modes of magma in the summit lava lake (surface gravity wave seiches) that couple through the conduit to the reservoir. Examples are drawn also from the oil and gas industry, where tube waves in wells can resonantly interact with crack waves in hydraulic fractures.

Bio:

Eric M. Dunham is an Associate Professor in the Department of Geophysics at Stanford University and an affiliated faculty member with Stanford's Institute for Computational and Mathematical Engineering. He received his PhD in Physics from the University of California, Santa Barbara, in 2005, before moving to Harvard University as a Reginald A. Daly postdoctoral fellow and later as a Lecturer on Applied Math. He has been a professor at Stanford since 2009. Drawing on his background in theoretical physics, Prof. Dunham uses modeling and computation to study natural hazards like earthquakes, volcanoes, and tsunamis. He is an Alfred P. Sloan Fellow in Physics and a recipient of the National Science Foundation CAREER award and the Stanford School of Earth Sciences Excellence in Teaching Award.

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1310 Yeh Student Center