Source process of a long-period event at Kilauea Volcano, Hawaii

Hiroyuki Kumagai[1]; Bernard Chouet[2]; Phillip Dawson[3]

[1] NIED; [2] USGS; [3] U.S. Geological Survey

We analyze a long-period (LP) event observed by a dense seismic network temporarily operated at Kilauea Volcano, Hawaii, in 1996. We systematically perform spectral analyses, waveform inversions, and forward modeling of the LP event to quantify its source process.

Spectral analyses identify two dominant spectral frequencies at 0.6 and 1.3 Hz with associated Q values in the range 10--20. Results from waveform inversions assuming six moment-tensor and three single-force components point to the resonance of a horizontal crack located at a depth of about 150~m near the northeastern rim of the Halemaumau pit crater. Waveform simulations based on a fluid-filled crack model suggest that the observed frequencies and Q values can be explained by a crack filled with a hydrothermal fluid in the form of either bubbly water or steam. The shallow hydrothermal crack located immediately above the magma conduit may have been heated by volcanic gases leaking from the conduit. The enhanced flux of heat raised the overall pressure of the hydrothermal fluid in the crack and induced a rapid discharge of fluid from the crack, which triggered the acoustic vibrations of the resonator generating the LP waveform. The present study provides further support to the idea that LP events originate in the resonance of a crack.