Geophysical Research Abstracts
Vol. 13, EGU2011-4821, 2011
EGU General Assembly 2011
© Author(s) 2011

First analysis of data from two continuously recording gravimeters at Kilauea Volcano, Hawai‘i

Daniele Carbone (1) and Michael P. Poland (2)

(1) Istituto Nazionale di Geofisica e Vulcanologia - Sezione di Catania, Catania, Italy (carbone@ct.ingv.it), (2) Hawaiian Volcano Observatory, U.S. Geological Survey, Hawaii National Park, HI, USA

In May 2010, two continuously recording gravimeters were installed at the summit of Kīlauea Volcano, Hawai‘i. The purpose of the deployment is to establish a continuous gravity monitoring capability at Kīlauea, as a means of detecting fast-evolving mass changes associated with volcanic activity. A ZLS Burris gravimeter was installed in an underground vault, near the Hawaiian Volcano Observatory, on the west rim of Kīlauea caldera (about 2 km from the summit eruptive vent), and records data at a 10-second interval. The second gravimeter, a LaCoste and Romberg G-model instrument, was deployed on the floor of Kīlauea caldera, just east of the rim of Halema‘uma‘u Crater (about 150 meters from the summit eruptive vent), and records data at 2 Hz. Both gravimeters are co-located with continuous GPS stations to assess changes in elevation that may affect gravity signals.
A first analysis of the data from the two gravimeters reveals that the signal is dominated by a component with a period of about 25 sec, also present in the recordings from nearby broadband seismometers and interpreted as very long period tremor. The coupling between gravity and seismic signals over this component suggests a reaction of the gravimeters to inertial acceleration due to ground shaking. This view is also supported by the observation of a highly variable amplitude ratio between the signals from the two instruments, over this frequency band, probably due to a different frequency response to inertial accelerations. Low-pass filtering of the data reveals a low-amplitude oscillation, with a period of 2-5 minutes, in data from both gravimeters. An analysis performed in the frequency domain shows that, over this frequency band, the admittance between the signals from the two gravimeters has a constant value of about 4. This observation supports the gravitational nature of this component and provides a constraint on the position of the source. We also observed changes in the period and amplitude of the 2-5 minutes component over time, which are coupled with changes in background seismic tremor. This component could be due to changes in the magma/gas ratio in the upper part of the volcano's plumbing system, suggesting that degassing from the summit eruptive vent may not be a steady-state process, but might instead be cyclic in nature.
In addition, gravity changes coupled with changes in the lava level inside the vent were observed at the station near the rim of Halema‘uma‘u Crater. Images from a Webcam that looks into the vent indicate the magnitude of the level changes and, hence, the associated volume changes. Comparison with the associated gravity anomalies suggests that, during lava highstands, the lava column was supported by a low-density material (foam), rather than by magma. This finding provides evidence for the mechanism that triggers the lava level changes.