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Unstable portion of crater rim at Vulcano (Aeolian archipelago, Italy): evidence of thermal expansion and gravity sliding inferred from geodetic measurements

A. Bonaccorso, A. Bonforte, and S. Gambino

Istituto Nazionale di Geofisica e Vulcanologia, Sezione di Catania, Catania, Italy (bonforte@ct.ingv.it, +39 095 435801)

Since 1990, a geodetic array has been installed in the northern sector of the crater terrace of Vulcano island and measured by EDM techniques from the northern promontory of the island, aimed at investigating the movement of the north upper slope of the cone and monitoring its slope instability.
The measurements carried out during the period 1990 - 1994 showed a marked shortening of about 6-7 cm on the baselines connecting a small area of the northern rim. However, in the following years these baselines showed a slow extension (at a rate of about 1 cm/y) that gradually recovered most of the previous deformation.
We considered the relationship between the measured ground deformation and the crater fumaroles temperature variations recorded in the same period. Between 1987 and 1993, these temperatures were characterized by the highest values since the 1920's, increasing from about 300 °C in 1987 to 690 °C in May 1993 and then decreasing to 400 °C in 1996-1997.
We hypothesized that the shortening/lengthening of the EDM baselines was due both to the increasing/decreasing of the temperature of the rock body lying close the sliding area, where fumaroles activity and thermal anomalies were well evident, and to a permanent sliding movement. We verified this hypothesis by calculating the expected dilatation of this body, as a function of the volume of the rock and its thermal expansion coefficient, and comparing the expected deformation to the observed one.
Both thermoelastic and sliding effects increase the slope instability. The geodetic investigation showed that the instable portion affects a small area of the rim.