

The cyclic process of lava dome emplacement and destruction at Popocatepetl volcano, Mexico

Angel Gomez-Vazquez ¹, Servando De la Cruz Reyna ² and Ana Teresa Mendoza-Rosas ²

¹Posgrado en Ciencias de la Tierra, Universidad Nacional Autónoma de México.

²Instituto de Geofísica, Universidad Nacional Autónoma de México.

Keywords: Cyclic lava dome emplacement, Popocatepetl volcano, Lava dome volumes and rates

Over the past 20 years the activity of Popocatepetl has been characterized by a cyclic sequence of lava dome emplacement and destruction episodes. Previously, from 1919 to 1927, a similar activity was reported by several observers. From reports and photographs of the time, we estimate that 10 domes were emplaced in that sequence, with a total accumulated volume $\sim 3.8 \cdot 10^6$ m³. The current cycle of lava dome emplacements began in March 1996. Between that date and February 2015 we have identified the growth and subsequent destruction of 38 domes. Based on the available aerial photographs and on the seismic signals from the monitoring system operated by CENAPRED, we have estimated the volumes and growth rates of the domes. The net gross accumulated volume issued until 2015 is $\sim 40.5 \cdot 10^6$ m³. The loss of deposited material within the crater by ejected fragments and tephra is $\sim 27 \cdot 10^6$ m³. The average volume of the 38 domes is estimated as $\sim 1 \cdot 10^6$ m³ with a wide range of variability. Both, the volumes and thicknesses of the domes are exponentially distributed. Lava production rates during the dome emplacements (instantaneous rate) were estimated from the measured volumes and the durations of lava-extrusion seismic signals (tremor, LP), yielding a mean value ~ 8.3 m³/s. The average emission rate for the total duration of the process is ~ 0.07 m³/s. Analysis of the data indicates that the dome emplacement and destruction is non-stationary, developing as a succession of alternate, "high" and "low" rates of magma production, fluctuating around a mean value after 2003. This has led to a condition of balance between the rates of volcanic material accumulation within the crater, and the losses caused by explosions that have kept the volumetric capacity of the crater almost stable since that year.