Estimation of clast-size distribution and eruption energy partition from the thermal images of debris ejected by dome-destruction explosions: Applications to Colima and Popocatepetl volcanoes

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Sequential thermal images of the cooling of clasts ejected by explosions at Popocatepetl and Colima volcano, Mexico, during periods of high lava-dome destruction activity (1998-2002 and 2005-2007 respectively) are used to estimate the relative thermal energy release by eruptions, and the degree of conversion into mechanical energy spent in the fragmentation of the ejecta. The cooling rate from successive thermal images, obtained immediately after explosions, is measured on selected pixels of the thermal images where ejected fragments have been deposited on the volcano flanks. The observed rate of cooling is then compared with different possible distributions of hot-fragment sizes in the pixels. The optimal fitting of a fragment distribution reveals the degree of fragmentation of individual explosions, and the use of a model of the cooling process allows estimating the relative proportion of thermal energy released on the area covered by the image. The sequence also provides information about the kinetic energy of the ejected tephra. In addition, the results indicate that the radiative thermal conductivity plays a significant role in the outer shell of the fragments, suggesting a free mean path of thermal infrared photons in the range of a few centimeters.