SOURCE DYNAMICS OF PULSATORY ERUPTIONS

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Volcanoes are complex and dynamic systems controlled by the interaction of many processes, whose relations are often non-linear and stochastic. However, these complex systems are not unconstrained and eruptions can show systematic evolutionary trends as well as regular periodic behavior which can be examined in terms of "failure time" through survival analysis. In this study we focus on the dynamics of pulsatory explosive activity and analyze the time interval between single pulses through thermal data and video analysis of Strombolian, violent Strombolian and Vulcanian eruptions. In particular, we focus on data for the explosive eruptions of Cerro Negro (1995), Eyjafjallajokül (2010), Etna (May and July 2012), Fuego (2003), Santiaguito (2003) and Villarrica (2002). The unsteady behavior of these eruptive styles cannot be defined based on their deposits, as the time scale of periodicities cannot be quantified through the stratigraphic record. As a result, classification of eruption style based on the deposit features cannot capture the complexity of unsteady activity. Instead, we characterize the source dynamics based on a statistical analysis of the repose interval, its periodicity and distribution over time, which is viewed as the surface manifestation of the system failure. The repose interval is defined as the time elapsed between the onset of two single pulses, as recorded in thermal data and video footage acquired during each eruption.

Dynamics of unsteady−pulsatory activity can be related to several factors; affecting magma permeability and fragmentation, such as gas segregation, development of fractures, and complex changes in magma permeability. Previous work analyzing the periodicity of pulsatory activity has considered a simple stochastic model: the homogeneous Poisson model. Later, the Weibull distribution was proposed to explain classical failure models, assuming that the probability of eruption increases exponentially with the increase in time interval following the previous eruption. However, many eruptive processes have been broadly explained using the log-logistic distribution. This model describes the processes controlling to the probability of system failure as being due to competing processes influencing the probability of explosion over time. We show the application of various statistical models to the selected eruptions and highlight common features that can aid in the classification of unsteady activity based on source dynamics.

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