

## **An assessment of volcanic unrest in the 21st century: pre-eruptive processes and timescales of reactivation**

Georgia Phillipson, Joachim Gottsmann  
University of Bristol, United Kingdom  
E-mail: [j.gottsmann@bristol.ac.uk](mailto:j.gottsmann@bristol.ac.uk)

One of the most pertinent issues in volcanic risk management is the question whether volcanic unrest will culminate in an eruption in the short-term or not. This question is particularly difficult to answer at volcanoes where unrest is preceded by lengthy periods of quiescence and where hard data on pre-eruptive processes before previous eruptions is absent. Here, we review and evaluate global unrest reports between January 2000 and June 2011, which draw largely from information presented by the Global Volcanism Program but also from the scientific literature. We aim to evaluate the nature and length of unrest activity in a view to help better assess future unrest episodes. The available information on 229 volcanoes is categorised into eruptive and non-eruptive unrest to evaluate the temporal distribution of unrest activity and to test the significance of observed unrest patterns at different volcano types. Timelines for different volcanoes were created to demonstrate how unrest develops over time and to highlight different modes of unrest including reawakening, pulsatory, prolonged, and sporadic unrest. Through combination of time series and statistical analyses we find that 2 out of 3 volcanoes with reported unrest erupt in the short-term. Although this ratio varies when considering different volcano types, the median average unrest duration is about one month before eruption, regardless of the length of the inter-eruptive period. Assuming that the investigation period is representative for any given observation period then there is an almost 50% chance of an eruption within about 20 days of the beginning of unrest. By contrast, if unrest outlasts a period of about 11 weeks, the chance of an immediate eruption decreases significantly to about one in five. We find that there are very poor correlations between the length of the inter-eruptive periods and unrest durations across all investigated volcano types. This suggests that the hypothesis that volcanoes with long periods of quiescence between eruptions will undergo prolonged periods of unrest before eruption is not supported by our analysis. Our findings may have implications for hazard assessment, risk mitigation and scenario planning during future unrest crises.