

Seasonality Of Volcanic Eruptions

B G Mason (Dept of Earth Sciences, University of Cambridge, Downing Street, Cambridge, CB2 3EQ United Kingdom; ph +44 1223 333474; fax +44 1223 333450; e-mail bgm21@cam.ac.uk); D M Pyle (Dept of Earth Sciences, University of Cambridge, Downing Street, Cambridge, CB2 3EQ United Kingdom; ph +44 1223 333380; e-mail dmp11@esc.cam.ac.uk); W B Dade (Institute of Theoretical Geophysics, University of Cambridge, Cambridge CB2 3EQ, United Kingdom; ph +44 1223 333485; e-mail bdade@esc.cam.ac.uk); T Jupp (BP Institute for Multiphase Flow, University of Cambridge, Cambridge CB3 0EZ United Kingdom; ph +44 1223 765708; e-mail tim@bpi.cam.ac.uk)

An analysis of volcanic activity in the last three hundred years reveals that the frequency of onset of volcanic eruptions varies systematically with the time of year. We analysed the Smithsonian catalogue of more than 3200 subaerial eruptions recorded during the last 300 years. We also investigated continuous records, which are not part of the general catalogue, of individual explosions at Sakurajima volcano (Japan, 150 events per year since 1955) and Semeru (Indonesia, 100,000 events during the period 1997-2000). A higher proportion (as much as 18 percent of the average monthly rate) of eruptions occur worldwide between December and March. This observation is statistically significant at above the 99 percent level. This pattern is independent of the time interval considered, and emerges whether individual eruptions are counted with equal weight or with weights proportional to event explosivity. Elevated rates of eruption onset in boreal winter months are observed in northern and southern hemispheres alike, as well as in most volcanically-active regions including, most prominently, the 'Ring of Fire' surrounding the Pacific basin. Key contributors to this regional pattern include volcanoes in Central and South America, the volcanic provinces of the northwest Pacific rim, Indonesia and the southwest Pacific basin. On the smallest spatial scales, some individual volcanoes for which detailed histories exist exhibit peak levels in eruption activity during November-January. Seasonality is attributed to one or more mechanisms associated with the annual hydrological cycle, and may correspond to the smallest time-scale over which fluctuations in stress due to the redistribution of water-masses are felt by the Earth's crust. Our findings have important ramifications for volcanic risk assessment, and offer new insight into possible changes in volcanic activity during periods of long-term changes in global sea level.