Geophysical Research Abstracts, Vol. 9, 04487, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-04487

Recurrence rates of large explosive volcanic eruptions

N. I. Deligne (1, 2), S. G. Coles (3), R. S. J. Sparks (1)

(1) Department of Earth Sciences, University of Bristol, UK, (2) Now at the Seismological Laboratory, California Institute of Technology, USA, (3) Dipartimento di Scienze Statistiche, Università di Padova, Italy (deligne@gps.caltech.edu / Fax: +1 626-5640715 / Phone: +1 626-3958906)

A global database of large explosive volcanic eruptions has been compiled for the Holocene and analyzed using extreme value theory to estimate magnitude – frequency relationships (known as "return periods" by statisticians). The database consists of explosive eruptions with magnitude (M) greater than or equal to 4, where magnitude is defined as log(mass erupted products (kg)) – 7. Two models are applied to the data, one assuming no under-recoding of eruptions and the other taking under-reporting into consideration. Results from the latter indicate that the level of under-reporting is fairly constant from the start of the Holocene until about 1 AD, and then increases dramatically. Results indicate there is only a probability of approximately 20% that an explosive eruption of M = 6 occurring prior to 1 AD is recorded. Analysis of the dataset in the time periods 1750 AD and 1900 AD to present (assuming no under-reporting) suggests that that these periods are likely to be too short to give reliable estimates of return periods for explosive eruptions with $M > 6$. Analysis of the Holocene dataset with corrections for under-reporting bias provide robust magnitude – frequency relationships up to M = 7, with results predicting that an M = 5.5 eruption (e.g., Shiveluch, 1964) occurring every 25 years, and an M = 6.0 eruption (e.g., Quizapu, 1932) occurring every 50 years. Extrapolation of the model to greater magnitudes ($M > 8$) gives results inconsistent with geological data, predicting eruption size upper-limits much smaller than known eruptions such as the Fish Canyon Tuff. We interpret this result as the consequence of different mechanisms operating for explosive eruptions with $M > 7$.