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Determining Volcanic Plume Height

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Tephra deposits retain a considerable amount of information about the nature of volcanic eruptions, such as plume height, erupted mass, bulk grainsize distribution and eruption intensity. However fall deposits are often poorly preserved and in some cases only limited outcrops can be sampled. When limited data is available, information regarding the dynamics of the eruption such as column height becomes harder to interpret. In these situations it is important to gain accurate data from the field and maintain this accuracy in subsequent processing so that the optimum amount of information about the eruption can be obtained.

The empirical method proposed by Carey and Sparks (1986) is most commonly used to determine plume height from maximum clast size data. This method uses empirical relationships to determine source conditions from the plume height inferred from the location of the largest clast in an outcrop. In this study we have extended the Carey and Sparks (1986)method by using the predictive numerical model of Woods (1988) to relate plume height to source conditions. The updated model has been tested using the same conditions described in Carey and Sparks (1986, with a single wind and atmospheric profile, and the tropopause fixed at 11 km. These atmospheric conditions describe a temperate environment. Velocity profiles and clast dispersal distances from our updated model produce results that are consistent with those of Carey and Sparks (1986). This approach for modelling plume height from maximum clast dispersal has been further extended to investigate the effects of different atmospheric and wind profiles, making the method better applicable to eruptions in non-temperate climates. The radial expansion of the umbrella cloud has also been modelled using a buoyancy spreading approach (Bursik et al, 1992 and Bonadonna and Philips, 2003). This differs from the Carey and Sparks (1986) model in which radial expansion is modelled by mass conservation. This approach has been applied to fall deposits from the Fogo A palaeo eruption on the Azores, and then to the 1991 eruption of Pinatubo. This is one of the few Plinian eruptions in which the true height of the plume is well known and so the accuracy of the method can be constrained.

A weakness in the application of the Carey and Sparks (1986) nomograms is that there is considerable loss of accuracy in interpolating maximum clast location and plume height information, which is a particular problem when only limited outcrop information is available. The use of a predictive model in place of the nomograms reduces this uncertainty considerably, retaining the accuracy obtained in field measurements of maximum clasts in their interpretation.

Bonadonna, C. and Phillips, J. C. Sedimentation from strong volcanic plumes. Journal of Geophysical Research, 108(B7), 2003.

Bursik, M. I., Sparks, R. S. J., Gilbert, J. S. and Carey, S. N. Sedimentation of tephra by volcanic plumes: I. theory and its comparison with a study of the Fogo a plinian deposit, Sao Miguel (Azores). Bulletin of Volcanology, 54:329–344, 1992.

Carey, S. and Sparks, R. S. J. Quantitative models of the fallout and dispersal of tephra from volcanic eruption columns. Bulletin of Volcanology, 48:109–125, 1986.

Woods, A. W. The fluid dynamics and thermodynamics of eruption columns. Bulletin of Volcanology, 50:169 – 193, 1988.