

Physical volcanology of an explosive eruption at Kīlauea volcano: the Mystery Unit of the Keanakako'i Tephra Formation

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Abstract

Kīlauea eruptions have the reputation of being effusive and non-explosive, as do most other basaltic volcanoes. This seems not to be the case for all eruptions, as Kīlauea has a history of many explosive events. One of these events, which took place in 1790 and makes up part of the Keanakakoi Deposit, will be the focus of our research. The Keanakakoi Tephra on the Big Island of Hawai`i was the product of some of the most violent explosions in the history of Kīlauea volcano. The exact intensity of these explosions, which has been estimated from the predominantly pyroclastic surge phases of the eruption, has yet to be determined. In this study we will instead look at a fall deposit, which offers a clearer perspective on the eruption dynamics of the 1790 eruption. The thickness and maximum clast sizes of each unit were measured in the field at numerous localities. Isopach and isopleth maps were constructed from these thickness and maximum clast size values. Grain size samples were sieved in the field from -6ϕ to -4ϕ . The remaining samples were collected for laboratory analysis. The samples were sieved in the laboratory from -3ϕ to 4ϕ . The grain size data was integrated to give eruptive volumes, eruption rates and an estimate of the whole-deposit grain size. Models of explosive eruption columns have evolved to the point where estimates of column heights and wind velocities can be determined given adequate grain size and dispersal data, so these are calculated as well. Our results are compared with other examples of basaltic explosive volcanism at Kīlauea. We conclude that the parent eruption of the Mystery Unit was subplinian in intensity. It was beneficial to reconstruct an explosive Kīlauea eruption because current hazard maps only concentrate on lava flows and some lava

fountaining. An explosive Kīlauea eruption would have a more devastating effect for residents surrounding the Volcano area than the aforementioned events.