

Volcanic Hazards And Disasters In Human Antiquity

Effects of scoria-cone eruptions upon nearby human communities

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ABSTRACT

Scoria-cone eruptions are typically low in volume and explosivity compared with eruptions from stratovolcanoes, but they can affect local populations profoundly. Scoria-cone eruption effects vary dramatically due to eruption style, tephra blanket extent, climate, types of land use, the culture and complexity of the affected group, and resulting governmental action. A comparison of a historic eruption (Parícutin, México) with prehistoric eruptions (herein we primarily focus on Sunset Crater in Northern Arizona, USA) elucidates the controls on and effects of these variables. Long-term effects of lava flows extend little beyond the flow edges. These flows, however, can be used for defensive purposes, providing refuges from invasion for those who know them well. In arid lands, tephra blankets serve as mulches, decreasing runoff and evaporation, increasing infiltration, and regulating soil temperature. Management and retention of these scoria mulches, which can open new areas

for agriculture, become a priority for farming communities. In humid areas, though, the tephra blanket may impede plant growth and increase erosion. Cultural responses to eruptions vary, from cultural collapse, through fragmentation of society, dramatic changes, and development of new technologies, to little apparent change. Eruptions may also be viewed as retribution for poor behavior, and attempts are made to mollify angry gods.

Keywords: Scoria cones, geoarchaeology, volcanic risk, agriculture, Sunset Crater, Parícutin.

INTRODUCTION

Scoria-cone volcanoes are the most abundant volcanic landform on Earth (Wood, 1980). About 20 volcanoes per year erupt basaltic magma, some producing scoria cones, and basaltic volcanoes occur in all tectonic settings (Walter, 1993). Most scoria cones are monogenetic centers; therefore, each eruption produces a new volcano. However, these cone-forming eruptions are less frequent, less dramatic, and their environmental effects less widespread than eruptions at stratovolcanoes (Simkin and Siebert, 1994), whose effects on human populations are comparatively well documented (e.g., Sheets and Grayson, 1979; Blong, 1982, 1984; Sheets and McKee, 1994). Thus, the hazards of scoria-cone eruptions have largely been

overlooked. Scoria-cone eruptions, however, commonly occur in areas where people live and farm; therefore, their effects can be profoundly life altering. This paper describes the effects of scoria-cone eruptions on human populations, filling in a significant gap in our understanding of these potentially catastrophic events.

A scoria-cone eruption can produce a cone (up to ~500 m tall) of unconsolidated to welded basaltic to andesitic scoria lapilli and ash. The eruption may also produce one or more lava flows, emitted near the base of the cone, and a blanket of scoriaceous lapilli and ash fallout covering tens to thousands of square kilometers (Vespiernann and Schmincke, 2000). A variety of models explain scoria cones and their deposits (e.g., McGeehin et al., 1974; Heiken, 1978; Valentine et al., 2006). The height of the eruption column, which largely determines the extent of the scoria blanket, and the effusion rate, which largely determines how far lava flows reach, are the two most important features that control their effects on humans. Recent work has shown that many scoria cones were not formed only by Strombolian explosions and Hawaiian fountaining, and "violent Strombolian" eruptions with sustained eruption columns are common in the volcanic record (e.g., Gutmann, 2002; Valentine et al., 2005). Scoria cones commonly form volcanic fields, especially in intra-plate environments, that consist of tens to hundreds of individual volcanoes (e.g., Hasenaka and Carmichael, 1985). These fields

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