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Modeling cultural responses to volcanic disaster in the ancient Jama–Coaque tradition, coastal Ecuador: A case study in cultural collapse and social resilience

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ABSTRACT

The cultural impacts of catastrophic Late Pleistocene and Holocene volcanism are characteristically variable throughout the world due to a wide range of factors such as magnitude of the eruptive event, proximity to the eruption, the geographic and ecological settings of the eruptive footprint, and relative social and political complexity of the societies affected. The reasons why one society succumbs to a volcanic disaster while another may recover are complex and not subject to invariant laws. Likewise, even in cases where recovery is possible, different pathways may be followed depending on a host of contingent factors. In archaeological cases, it is sometimes difficult to distinguish between cultural developments that may be *caused by* volcanic disasters and those that are merely *coincidental with* these events, but not all volcanic eruptions lead to cultural collapse. Archaeological research in the Jama Valley of coastal Ecuador has revealed evidence of three volcanic eruptions emanating from the northern Ecuadorian highlands some 200 km to the east, all three of which represent major stratigraphic breaks in the regional archaeological record. The third of these volcanic events, now thought to have occurred at ~90 AD, significantly affected the Muchique Phase 1 chiefdoms of the Jama–Coaque tradition that occupied much of northern Manabí province. And like the first two eruptive events in the Formative Period that led to centuries-long valley abandonment, this eruption also resulted in valley abandonment for several centuries. But it also ushered in a new ceramic phase (Muchique Phase 2) of the Jama–Coaque tradition, and a notable change in settlement hierarchy, ceramic figural sculpture, evidence for warfare, agricultural intensification and diversification, surplus storage facilities, and new forms of political complexity and chiefly authority. This paper offers a model of differential human response to catastrophic volcanism that focuses attention on human-resource imbalances resulting from such events and identifies a series of contingent circumstances in which complex chiefdoms may cope, and even flourish, in the aftermath of disaster.

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1. Introduction

The cultural impacts of catastrophic Late Pleistocene and Holocene volcanism are characteristically variable throughout the world due to a wide range of factors such as magnitude of the eruptive event, proximity to the eruption, the geographic and ecological settings of the eruptive footprint, and relative social and political complexity of the societies affected. The reasons why one society succumbs to a volcanic disaster while another may recover are complex and not subject to invariant laws. Likewise, even in

cases where recovery is possible, different pathways may be followed depending on a host of contingent factors (Sheets, 1979, 1980, 2004, 2012; Sheets and Grayson, 1979; Reyecraft and Bawden, 2000; Van Buren, 2001; Torrence, 2002, 2014; Torrence and Grattan, 2002; Grattan and Torrence, 2007). Sheets (2012) has referred to this phenomenon as a series of “scaled vulnerabilities” based upon, first and foremost, the magnitude of the volcanic event in question, followed by a series of five social factors including (1) relative social complexity/political organization, (2) societal conflict, (3) demography and mobility, (4) economy and adaptation, and (5) the differential impacts of the disasters on the societies affected as a result of the magnitude of an eruptive event. Sheets (1999, 2001, 2008, 2012) has explored these different

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vulnerabilities in prehistoric test cases throughout Central America and Mesoamerica, highlighting the unique sets of contingencies that played out in each case with special emphasis on Social Factor 1: relative social complexity and political organization and Social Factor 5: differential impacts stemming from magnitude of the eruptive event. In this study, similar sets of contingent circumstances are explored for three separate volcanic events affecting prehistoric populations the Jama Valley in northern Manabí Province in the central coastal lowlands of Ecuador, each of which resulted in cultural collapse and valley abandonment in the immediate aftermath of the eruptive event. The last of these tephra airfall events also demonstrates a remarkable case of valley re-colonization and social resilience in a regenerated post-eruptive environment well after ecosystem recovery would have taken place.

Archaeological research in the Jama Valley of coastal Ecuador (Figs. 1 and 2) has revealed evidence of three volcanic eruptions emanating from the northern Ecuadorian highlands some 200 km to the east, all three of which represent major stratigraphic breaks in the regional archaeological record (Isaacson, 1994; Zeidler and Sutliff, 1994; Zeidler, 1994a, 1994b; Zeidler et al., 1998; Isaacson and Zeidler, 1999; Zeidler and Isaacson, 2003; Pearsall, 2004). The first two of these eruptions marked the end of the Early Formative Period Terminal Valdivia culture (2030–1880 cal BC) and the Late Formative Chorrera culture (1300–457 cal BC), respectively, and in both cases, a relatively long period of valley-wide abandonment was followed by re-colonization by a new archaeological culture (Table 1; see also Zeidler et al., 1998).

Table 1
Summary of major Holocene volcanic events in the Jama Valley. Note different periods of valley abandonment.

Volcanic event	Estimated date	Culture/Phase affected	Abandonment (years)	Probable source	Eruption type	VEI	Col Ht (km)	Volume (km ³)
Tephra III	~90 AD	Jama–Coaque I/Muchique 1	~330	Guagua Pichincha	plinian	4	25–30	0.5
Tephra II	~467 BC	Chorrera/Tabuchila 2	~227	Pululahua	plinian	5	35	0.19
Tephra I	~1880 BC	Terminal Valdivia/Piquigua	~580	Guagua Pichincha	plinian	4?	?	?

The third of these volcanic events, now dated at ~90 AD, significantly affected the Muchique Phase 1 chiefdoms of the Jama–Coaque tradition that occupied much of northern Manabí province subsequent to the post-Chorrera hiatus (Table 1). This date is of crucial importance because this volcanic event was previously dated by volcanologists at 400–500 AD and so valley abandonment was thought to be on the order of decades, not centuries. We now know that like the first two eruptive events in the Formative Period that led to centuries-long valley abandonment, this eruption also resulted in valley abandonment for several centuries (Table 1). But it also ushered in a new ceramic phase of the same Jama–Coaque tradition (Muchique Phase 2) that exhibits notable changes in settlement density, site hierarchies, ceramic figural sculpture, evidence for warfare, agricultural intensification, surplus storage facilities, and new forms of political complexity and chiefly authority. This study offers a model of differential human response to catastrophic volcanism that focuses attention on human-resource imbalances resulting from such catastrophic events and identifies a series of contingent circumstances in which complex chiefdoms may cope, and even flourish, in the aftermath of disaster.

The central questions here are two-fold. First, did the Muchique Phase 1 chiefdoms of early Jama–Coaque society respond to the sudden appearance of the Tephra III ash mantle by abruptly abandoning the valley, and if so, were they able to migrate to adjacent areas of the coastal lowlands and survive in “refuge zones” less affected by this volcanic event? And secondly, after re-colonizing

the Jama Valley, are the cultural innovations found in Muchique 2 causally related to the long-term impacts of the Tephra III airfall, or are they simply coincidental with it temporally (Torrence and Grattan, 2002)? In other words, are the cultural complexities of the Muchique 2 culture the result of deliberate “coping strategies” and “social resilience” (Torrence, 2014) developed as a result of the Tephra III airfall several centuries earlier as a means of successfully re-colonizing a regenerated volcanic landscape? Or were they simply evolving cultural complexities that would have occurred without the presence of regional volcanic impacts?

In order to answer these questions, I examine the differential aftermath of these three volcanic eruptions in the Jama Valley in terms of Jochim (1981) discussion of human-resource imbalances and alternate “compensatory strategies” employed by non-industrial societies to correct these imbalances. The evidence for cultural elaboration in Muchique Phase 2 is briefly presented and special emphasis is placed on three particular cultural innovations as evidence for deliberate compensatory strategies aimed at correcting human-resource imbalances in a regenerated volcanic landscape. This leads to consideration of longer-term “resilience” of local and regional Social-Ecological Systems (as defined by Holling and Gunderson, 2002; Folke, 2006, among others) and the degree to which these multiple coping strategies as outlined by Jochim (1981) can be viewed as a special case of Response Diversity (RD), the consequences of which are seen as beneficial for maintaining Social-Ecological System (SES) resilience in the face environmental perturbations (Leslie and McCabe, 2013). Response Diversity refers to “the range of reactions to environmental change

among species that contribute to the same ecosystem function” (Leslie and McCabe, 2013: 115). In the case of human societies, the term is expanded to encompass the “heterogeneity in human decisions and action that affects one or more of the SES functions...” leading to greater resilience in the face of dramatic environmental and ecosystemic perturbations (Leslie and McCabe, 2013: 115).

2. Volcanism and the Jama–Coaque tradition

The prehispanic Jama–Coaque culture occupied northern Manabí province and adjacent areas beginning as early as 240 BC and extending up to the Spanish Conquest in AD 1531 (Fig. 2). In this sense, it is more properly a long archaeological “tradition,” and it passed through four ceramic phases and many social transformations over that time span. Originally defined by Ecuadorian archaeologist Estrada (1957, 1962) on the basis of reconnaissance and test excavations along the coastal strip, Jama–Coaque was recognized early on as perhaps one of the most complex Regional-Developmental Period cultures (traditionally dated from 500 BC to AD 500) occupying the coastal lowlands, characterized by a wide range of unique ceramic forms such as elaborate ceramic figural sculptures depicting elite personages as well as a variety of other anthropomorphic and zoomorphic imagery, elaborate ceramic seals and stamps, miniature house models or *maquetas*, complex bottle forms, etc. It became clear from the nature of this archaeological

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