



Social resilience and long-term adaptation to volcanic disasters: The archaeology of continuity and innovation in the Willaumez Peninsula, Papua New Guinea



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ABSTRACT

A review of archaeological research on the impacts of multiple volcanic events in the Willaumez Peninsula, Papua New Guinea during the past 40,000 years demonstrates that disaster studies in archaeology would benefit from considering resilience and innovation in addition to the more common emphasis on vulnerability, often glossed as 'collapse.' When analytical time frames are extended beyond the immediate environmental impacts, continuity in cultural practices is often observed. The long-term exchange of obsidian in the Willaumez Peninsula may have been adaptive because the resulting social ties enabled impacted populations to find refuge with other communities.

In contrast, a series of novelties were much less resilient. A hypothetical reconstruction of cultural responses to the high magnitude W-K2 volcanic event is used to illustrate how disasters can provide opportunities for innovative behavior leading to culture change.

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1. Vulnerability, resilience and adaptation

Archaeologists have long been convinced of the role of volcanic disasters in the 'collapse' or 'extinction' of civilizations, cultures, and hominid species, although critical assessment of the nature of causation has been all too rare (e.g., review in Torrence and Grattan, 2002; cf. Middleton, 2012 for a review of studies of cultural collapse). Clearly, the impacts of volcanic eruptions near the epicenter can be absolutely devastating with serious effects from pyroclastic flows, lahars, and airfall tephra often extending over thousands of square kilometers. But until recently, what have often been overlooked, or at least not emphasized, are the remarkable continuities that frequently follow these extreme events. The heavy focus on destruction and loss of lives has been challenged by recent sophisticated and nuanced archaeological studies that highlight innovative cultural responses (e.g., Grattan and Torrence, 2007). The time scale that frames the investigation is an important factor in the difference between a focus on devastation and collapse or continuity and innovation. The major destruction from volcanic events is often experienced in a relatively short time (although damage from some factors such as lahars can continue for long

periods), but anthropological studies have shown how cultural responses to disasters often unfold over long periods of time (e.g., Nolan, 1979; Hoffman, 1999a, 1999b; Oliver-Smith and Hoffman, 2002). For example, although one can point to numerous ancient sites destroyed by and buried under a volcanic tephra, very often a subsequent site sits on top of the volcanic deposits providing evidence for the persistence of a social group, who possibly abandoned the area temporarily, but returned and re-occupied its homelands, often continuing a lifestyle similar to that of its ancestors impacted by the disaster (e.g., Sheets et al., 1991; Allison, 2002; Torrence, 2002a, 2008; Sheets, 2012). An excellent example of continuity over a long time period is the site pictured in Fig. 1. Despite being buried by airfall tephra on 12 occasions, this highly favored place was consistently re-used after each event.

Whether we should best conceive of the archaeological record in Fig. 1 as a series of collapses or a record of continuity is an important question for disaster studies. As a way to stimulate discussion, the major purpose of this paper is to suggest several alternative ways to conceive of the effects of volcanic disasters. First, I argue that the long time scales central to archaeology have an important role to play in understanding the role of environmental disasters in generating culture change. Observing culture history over large blocks of time enables us to question whether life ways have been altered in ways that decrease the effects of further

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Fig. 1. This profile at the archaeological site of Kupona na Dari in Papua New Guinea is a good example of continuity in the face of volcanic disasters. During the Pleistocene, people in this region were repeatedly impacted by air-fall tephra that buried this small hill. The sample holes mark the position of each tephra, some of which are equivalent to the light-coloured layers. Following each event people returned to this location as evidenced by the presence of stone artefacts and oven stones in the soils formed on top of every tephra. For location of the site, see Fig. 2. For information on the tephra, see Table 1. (Photo by Robin Torrence).

volcanic impacts, a process defined here as ‘adaptation.’ A group that is ‘adapted’ is also commonly known as ‘resilient’ in modern disaster studies, as noted below. Secondly, I hope to nudge discussion by focusing on archaeological research in Papua New Guinea to illustrate the kinds of adaptations that might increase social resilience in the face of exposure to volcanic disasters. Third, I explore alternative consequences of volcanic events aside from collapse. Using a hypothetical account of culture change in ancient Melanesia, I explore the role that disasters might play in creating situations which open up possibilities for innovations.

Since the pioneering efforts of Sheets and Grayson (1979), whose edited book was critical in putting volcanic activity on the agenda as a major factor in shaping human history, there have been some key changes in thinking about how the relationships between determinism and natural disasters are conceptualized. Archaeological research on volcanic impacts has followed parallel trends to schools of thought within the broad field of disaster research. For example, as a way of understanding variations in responses to extreme events, social scientists introduced the key concept of ‘vulnerability’ (e.g., Torry, 1979; Oliver-Smith, 1996; Oliver-Smith and Hoffman, 2002), defined as ‘susceptibility to harm’ (Galopin, 2006: p. 295). Understanding how people have experienced the negative impacts of disasters is also reflected in the majority of archaeological studies which have been primarily focused on death and destruction.

In an alternative view, some recent archaeological case studies have shifted the focus from vulnerability to one in which continuity is recognized. This change is also paralleled within the social science approaches to disasters that have adopted and modified concepts originally devised to study ecosystem dynamics. Ecologists who developed the notions of ‘human–environment’ coupled systems (e.g., Turner et al., 2003) or ‘socio-ecological systems’ (SES) (e.g., Folke, 2006) emphasize the property of ‘resilience,’ which can be broadly defined as the ability to avoid or withstand failure (Lorenz, 2013). Archaeologists have also begun to explore the utility of the SES concepts about resilience for understanding how ancient social groups have coped with environmental pressures (e.g., Redman, 2005; Nelson et al., 2012), although as yet these have not

been applied to volcanic disasters. Gunderson’s (2010: Table 1) comparison of ecological and human systems notes that resilience can be used to describe both the time it takes for recovery, generally referred to as the ‘engineering’ definition, or to the ‘amount of disturbance required to shift regimes,’ glossed as the ‘ecological’ concept (cf. Lorenz, 2013). There are, however, cogent criticisms of the application to social groups of concepts derived from ecological systems. For example, Cannon and Müller-Mahn (2010: p. 633) point out that there may be an unexpected political dimension to stressing resilience over vulnerability. A potential negative result is that modern disaster managers who emphasize resilience might not take seriously risks to the most vulnerable sectors of the population. In contrast, Lorenz (2013) argues that focusing strictly on vulnerability can hinder modern attempts to increase social capacity to cope with disasters. It is the assumption that humans can decrease their vulnerability and increase their resilience to extreme natural events that I want to take up in this paper.

Evolutionary theory developed within the framework of the biological sciences is also highly relevant for thinking about how adaptations come to be, generally over long periods of time. This approach provides important concepts for archaeology, as change, as opposed to collapse (vulnerability) or stability (resilience), is considered as a potential consequence of exposure to extreme conditions. For example, Hoffmann and Parsons (1997) have discussed the evolutionary consequences of species subjected to environmental extremes. They pointed out that some have adapted due to the adoption of a ‘stress-resistant life-cycle,’ similar to what the ecologists would gloss as ‘resilience,’ but they also note that the extreme events leading to extinctions often open up opportunities for what they term ‘evolutionary novelties’ and these can lead to ‘periods of evolutionary divergence’ (Hoffmann and Parsons, 1997: pp. 22–23, 204). In other words, severe selection pressure can lead to (1) evolutionary change as well as (2) continuity among adapted populations or (3) extinction. Rather than be caught up in debates about societies as fixed entities that are either vulnerable or resilient, by taking an evolutionary approach, one can trace how resilience comes into being and how it is maintained, processes that I refer to as ‘adaptation’ in this paper. In addition, the evolutionary perspective encourages us to investigate how new forms might emerge following a volcanic disaster, rather like the proverbial phoenix rising from the fire.

Along these lines, it is interesting that in his comparison of how ecological and cultural systems react to disasters, Gunderson (2010: Table 1) notes that the former can only improve resilience through natural selection, which by definition means replacement of one community or species by another, but human groups can maintain themselves by learning to anticipate and prepare for threats and are also capable of innovative, creative changes: i.e. self-transformation. In this light, Galopin (2006: p. 302) has pointed out that within socio-ecological systems, one kind of resilience might be characterized as ‘taking advantage of opportunities,’ an example of which will be presented later in the paper.

A few archaeological case studies of volcanic disasters have already shifted away from a singular focus on immediate, short-term impacts that necessarily lead to an emphasis on destruction and collapse. Recognition is growing that, when viewed on longer time scales following the disaster, continuity and innovation are also characteristic of how societies have coped with large scale volcanic events (e.g., Crittenden and Rodolfo, 2002; Grattan, 2006; Grattan and Torrence, 2007: pp. 8–9; Cronin and Cashman, 2007; Dillan, 2007; Elson et al., 2007; Holmberg, 2007; Torrence and Doelman, 2007; McAnany and Yoffee, 2010; Sheets, 2012). The possibility that some social groups developed a measure of resilience or adapted to volcanic disasters has also been raised within studies that have extended the scope of the analysis beyond a single

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