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Welcoming a monster to the world: Myths, oral tradition, and modern societal response to volcanic disasters

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ABSTRACT

Volcanic eruptions can overwhelm all senses of observers in their violence, spectacle and sheer incredibility. When an eruption is catastrophic or unexpected, neither individuals nor communities can easily assimilate the event into their world view. Psychological studies of disaster aftermaths have shown that trauma can shake the very foundations of a person's faith and trigger a search – supernatural, religious, or scientific – for answers. For this reason, the ability to rapidly comprehend a traumatic event by "accepting" the catastrophe as part the observer's world represents an important component of community resilience to natural hazards. A relationship with the event may be constructed by adapting existing cosmological, ancestral, or scientific frameworks, as well as through creative and artistic expression. In non-literate societies, communal perceptions of an event may be transformed into stories that offer myth-like explanations. As these stories make their way into oral traditions, they often undergo major changes to allow transmission through generations and, in some cases, to serve political or religious purposes. Disaster responses in literate societies are no different, except that they are more easily recorded and therefore are less prone to change over time. Here we explore ways in which the language, imagery and metaphor used to describe volcanic events may link disparate societies (both present and past) in their search for understanding of volcanic catastrophes. Responses to modern eruptions (1980 Mount St Helens, USA, and 1995–present Soufriere Hills, Montserrat) provide a baseline for examining the progression to older historic events that have already developed oral traditions (1886 Tarawera, New Zealand) and finally to oral traditions many hundreds of years old in both the Pacific Northwest US and New Zealand (NZ). We see that repeated volcanism over many generations produces rich webs of cosmology and history surrounding volcanoes. NZ Maori have incorporated volcanoes into the lineage of tribes and individuals, thus good and bad outcomes from volcanism are part of long-term cycles of reciprocity and equilibrium that link modern Maori to their ancestors. In both regions, cosmologies and mythologies not only document the attempts of past cultures to recover from the impacts of volcanic disasters, but also provide a means by which following generations can understand, contextualize, and therefore recover from, future volcanic catastrophes. We further suggest that such local traditions can provide a valuable community education tool as well as an important means of aiding the psychosocial recovery of individuals and communities after volcanic disasters.

1. Introduction

"Everybody takes it personally. Some get mad… Some take it ethically… But everybody takes it personally. We try to reduce it to human scale. To make a molehill out of the mountain."

Ursula LeGuin (1980)

History has shown that humans persist in living with active volcanism, despite repeated catastrophes caused by damaging eruptions (e.g., Cashman and Giordano, 2008-this volume). This suggests that past societies developed strategies that provided them with long-term physical and psychosocial resilience to volcanic disruption. In modern societies, adaptation to the physical hazards posed by volcanoes has led to a range of coping mechanisms, including engineering solutions (e.g., Sabo dam technology of Japan and lava flow barriers in Italy), monitoring systems, evacuation plans, and land-use restrictions. By contrast, development of adaptations related to community recovery from the psychosocial impacts of natural hazards has lagged behind (e.g., Herman, 1992; Young, 1994).

Recent studies show that steps to successful individual and/or community recovery from a disaster depend, in large part, on the availability of simple explanations for the occurrence of an "inconceivable" event (Taylor, 1999). The first step in recovery is accepting that the event occurred. The next step involves incorporating the new

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phenomena into both the personal and community world-views by developing explanations (stories, language, descriptions) that enable communities to make sense of disasters. These explanations are framed by prevailing educational and spiritual states; they are universal to the extent that "every human society maintains its sense of identity with a set of stories which explain, at least to its satisfaction, how things came to be" (Deloria, 1995).

In non-literate societies, some of these stories are passed down as oral traditions that explain both the history of the people and the natural world. Although shaping by compression and stylization is inevitable given their transmittal through generations (e.g., Vansina 1985; Barber and Barber, 2004), these stories may be constructed, in part, to insure the adaptation of the society to the environment (Minc, 1986), including mitigation of local volcanic hazards (Cronin and Cashman, 2008). To stress these adaptive aspects of oral traditions, Masse et al. (2007) have recently *defined* myth as narrative that uses "supernatural elements and images in order to categorize and explain observed natural phenomenal and events that are of perceived vital importance or of special relevance to the social order and well-being of a given culture".

Not surprisingly, cultures that inhabit volcanically active regions commonly have rich mythologies related to volcanoes. The past few decades have seen an increase in detailed geological and archaeological analyses of oral traditions related to eruptions in the SW Pacific (Blong, 1982; Taylor, 1995; Cronin and Neall, 2000; Nunn, 2001), Hawaii (Kauahikaua and Camara, 2000; Kauahikaua et al., 2002; Swanson, 2008), Central America (Sheets, 1979; Dull et al., 2001), North America (Moodie et al., 1992), and the Aleutians (Black, 1981). As volcanic eruptions typically involve several different phases and produce impacts that vary with distance from the vent, these oral traditions may have very different forms even when recording the same event (the "Mismatch Effect" of Barber and Barber, 2004). Geographic separation of individual settlements may further encourage propagation of alternate versions of local stories (e.g., Blong, 1982). Additionally, stories often become more stylized with time, as illustrated by Greene's (1992) elegant analysis of Hesiod's *Theogony* as a mythologically encoded record of volcanic eruptions of Santorini volcano in Greece, and Etna volcano in Sicily.

Here we suggest that oral traditions may also provide important clues about ways in which cultures react to catastrophic events. Studies of recent natural disasters show that the extreme conditions, incredible natural phenomena, and resultant trauma of such events challenge the world-views of both the individuals and communities they affect. Common responses include a search for meaning through religion (Hoffman and Oliver-Smith, 2002) or loss of faith in the prevailing natural or divine order (Herman, 1992). How does the cognitive process of understanding and accepting the inconceivable (Bower and Sivers, 1998) link to the development of an ongoing cultural memory in the form of oral tradition? Here we address this question by using eyewitness accounts of recent volcanic eruptions (e.g., Rosenbaum and Waitt, 1981; Loughlin et al., 2002) as a window into human perceptions of catastrophic volcanic events. We then compare the imagery and themes of these modern responses to selected oral traditions of volcanic activity in the northwest US and New Zealand, with the specific goal of evaluating aspects of these traditions that are inherited from individual or community attempts to recover by incorporating the catastrophic event into their lives. Our volcanological perspective complements recent studies of oral traditions from the perspectives of anthropology (e.g., Minc, 1986) and cognition (e.g., Barber and Barber, 2004; Masse et al., 2007) by using the physical nature of the event itself as a starting point for studying perceptions of volcanic disasters.

2. Background

From an anthropological perspective, disasters occur when societies fail to adapt successfully to their environment (Oliver-Smith, 1996). The vulnerability of a society is measured by its ability to respond to and recover from a disaster (Oliver-Smith, 1996; Hoffman and Oliver-Smith, 2002). One adaptive strategy to reduce the vulnerability of a community to natural hazards is to strengthen societal interdependence in handling resources. Thus societies with large social territories and strong social relationships have generally been most resilient to natural disasters (e.g., Saltonstall and Carver, 2002; Johnson, 2002; Torrence, 2002; Diamond, 2004; Neall and Wallace, 2008; Ort et al., 2008). Another adaptive strategy is to improve community knowledge of potential hazards. The infrequent occurrence of many natural hazards, such as volcanic eruptions, further requires that this knowledge be transmitted successfully across generations (for example, through oral traditions; Minc, 1986; Mason, 2000).

2.1. Trauma and psychological resilience to disasters

Once a disaster has occurred, culturally acceptable forms of explanation are important for regaining emotional stability within the community (Bode 1977, 1989). Importantly, simple explanations, whether or not they take the form of myths (McLeish, 1996), enable communities to make sense of the experience (Taylor, 1999). The forms that these explanations take will depend on the prevailing educational and spiritual state of the population, and commonly rely on creative interpretations based on "cosmologies vibrant with metaphor" (Hoffman, 2002). Explanations can be based on supernatural belief, or scientific proof, or both; a combination of supernatural and scientific sources is used when either knowledge-based or scripture-based explanations alone are insufficient to account for the events (Taylor, 1999).

When such explanations are not available, psychological recovery from a disastrous event is hindered. For example, Torrence and Grattan (2002) describe how the community affected by a deadly CO_2 eruption from Lake Nyos in 1986 has failed to come to terms with the event because the survivors have not found an acceptable explanation for the sudden deaths. In contrast, neighboring communities had learned not to live by the "exploding" lakes, stories of which were passed along through oral traditions (Shanklin, 1989). New forms of the myth were then created in response to the 1986 event, stories that merged traditional story elements with modern mis-information (e.g., that the explosion was caused by detonation of a nuclear bomb; Shanklin, 2007). Similarly, survivors of the catastrophic lahars from the 1985 eruption of Nevado del Ruiz volcano, Columbia, have refused to accept that these flows originated at the volcano, instead preferring to believe that they were the result of an upstream dam burst (Calvache, 2006). As a result, it has been difficult to enforce land-use regulations designed to prevent future lahar disasters.

Both examples illustrate ways in which natural disasters can pose threats to the fundamental belief systems held by individuals or communities. One consequence of such threats is to throw both individuals and societies into crisis (Bower and Sivers, 1998; Herman 1992; Young 1994): "Trauma causes the survivor to experience that he or she lives in a universe governed by some horrendous evil if not demonic force. …trapped in a perceived world governed by false gods" (Jordan, 2000). Recovery of a community from a disaster thus requires more than physical recovery; also critical is psychological recovery, that is, restoration of individual and community aims, ambitions, aspirations, attitudes, belief systems, and cultural and spiritual values (Taylor, 2004).

An important coping mechanism that operates during recovery is transfer of responsibility for the disastrous event to an individual, often of higher powers (e.g., Jordan 2000; Taylor, 2001). Barber and Barber (2004) refer to this as the *Willfulness Principle* — humans will things to happen, therefore if something happens it must have been willed. The individual may be monstrous, as recognized by Hoffman (2002) in individual responses to the 1991 fires in Oakland, CA, or religious, as seen in Goodspeed's (1945) afterward to her novel about the 1943–1952 eruption of Parícutin volcano, Mexico. She tells of a

local land dispute that preceded the eruption, a dispute symbolized by a cross that had been placed at the contested boundary. "And it is their belief that because of the destruction of the cross, the men of Parícutin incurred the anger of either the Christian god or of a pagan god." Similarly, in the *Voyage of the Beagle* Darwin (2001 [1839]) tells the story of an earthquake in Chile that was believed to be the responsibility of an old Indian woman who had stopped an eruption of a local volcano (Antuco). Darwin attributed this linkage to the need "to apply the witchcraft to the point where their perception of cause and effect failed." Another example is the association by native peoples of Spanish arrival and renewal of activity at Popocatepetl volcano in Mexico (Plunkett and Uruñuela, 1998). More recently, the cessation of propitiation rites for Popocatepetl in 1988 was blamed for resumption of activity in 1994 (the rituals have now resumed).

When explanations are not sufficient, post-traumatic stress disorders may result. "Post-traumatic stress disorder" includes a range of symptoms that includes reliving the event, avoiding any reminders of it, and hyperarousal (Horowitz et al., 1979; American Psychiatric Association, 1994; Young et al., 1998). The latter symptom may generate an explosion in human expression – political or artistic – in response to a catastrophe (Pennebaker et al., 1989; Smyth and Pennebaker, 1999; Smyth et al., 2002). Individual and group attempts to contextualize an event are permanently recorded by modern communications tools such as the printed press, internet, television, and radio. In societies where a written/recorded outlet is not available (e.g., in pre-literate societies), the creative outlets of the culture (dance, song, story, art) provide a more malleable, collective, and time-averaged response to the same stimulus.

2.2. Role of oral traditions

Oral traditions are one manifestation of non-literate response to natural disasters; they may serve several different purposes in society, including disaster recovery (e.g., Shanklin, 2007). In addition to providing coherent rationalizations for unexplainable events, however, they may also define appropriate behavior, document why and how a group came to occupy a place, and explain physical formation of landscape. They differ from oral histories in that they are not first hand accounts, but instead require first generation, then transmission, of the message (Vansina, 1985). Oral traditions operate over two different time scales (Minc, 1986). *Secular oral traditions* (folk tales, songs, histories) depend on repetition for emphasis, are prone to distortion, and are therefore used for information of immediate (short term) importance. *Sanctified oral traditions* (ritual performances) rely on correct reproduction and are designed to aid a society in crisis situations that recur on multi-generational time scales (see also Barber and Barber, 2004). In general, the longer the time interval and the greater the magnitude of the event, the more likely that the information will be sanctified by ritual. If transmitted effectively, ritual behavior may take the place of "rational calculation" in a community's response to disastrous events (Paine, 2002). Myths lie between these extremes: they lack the strict transmission of ritual performance but may provide survival strategies over longer time scales than folk tales.

The process by which oral histories are transformed to myth is complex and utilizes specific linguistic strategies (Barber and Barber, 2004). Strategies of redundancy, analogy, and assumed knowledge

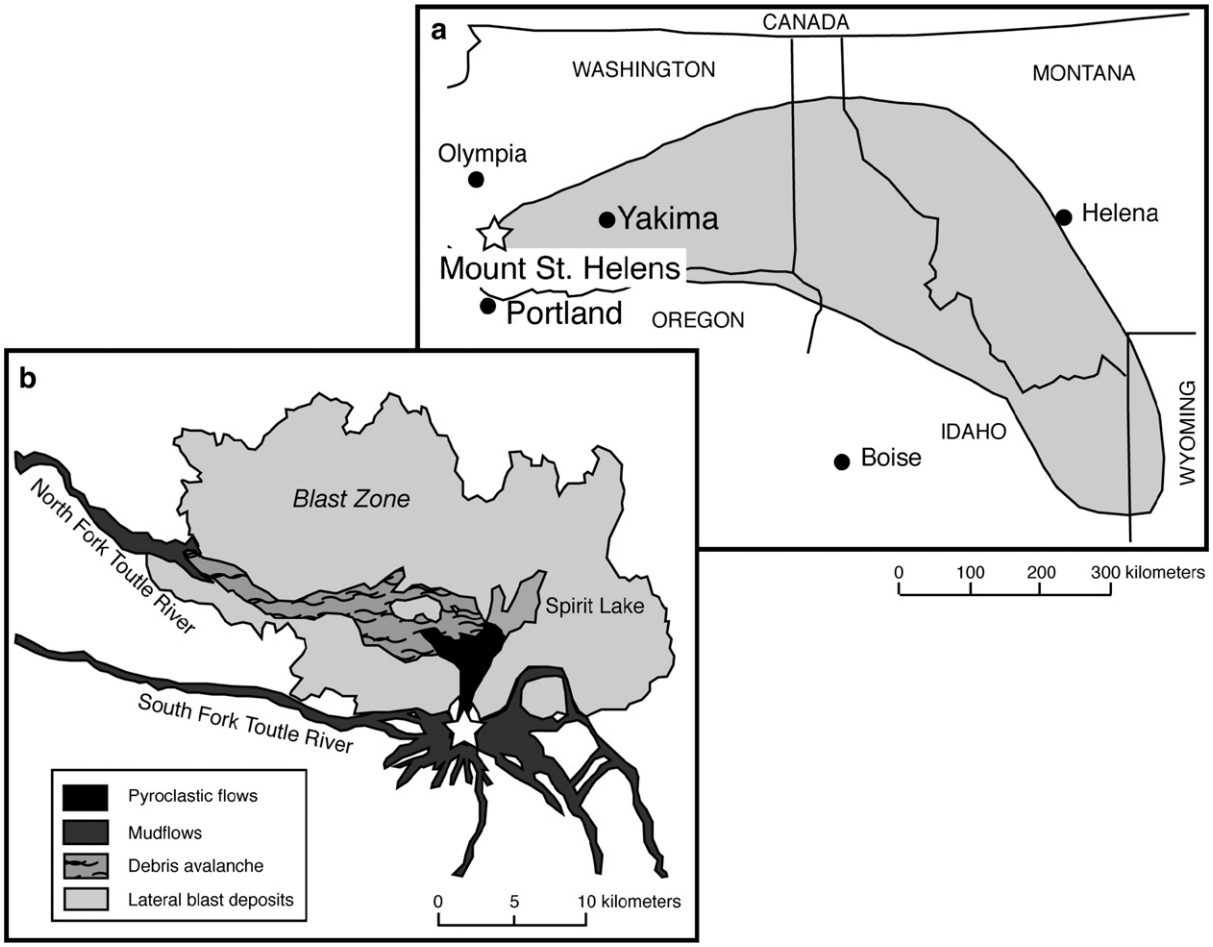

Fig. 1. Effects of the May 1980 eruption of Mount St. Helens. (a) Map showing the aerial distribution of ash by 1815 (local time) on the 18th of May. Shown on this map are capital cities plus the location of Portland, OR, and Yakima, WA (mentioned in text). Redrafted from Topinka, CVO website: (http://vulcan.wr.usgs.gov/Volcanoes/MSH/Maps/map_may18_ash_path.html). (b) Map showing the impact of the eruption on areas proximal to the volcano, including distribution of pyroclastic flows, mudflows, debris avalanche and lateral blast deposits. Redrafted from Topinka, CVO website: (http://vulcan.wr.usgs.gov/Volcanoes/MSH/Maps/may18_devastmap.html).

impart layers of interpretation and motive that may render the original event, or even the original intended message, obscure from modern perspectives (Vansina, 1985). Can these filters imposed by transmission and readaptation be penetrated? Here we suggest that one way of reversing the process is to examine responses to two recent volcanic eruptions, those of Mount St. Helens, USA, 1980, and Soufriere Hills Volcano, Montserrat, 1995–present. These serve as modern oral histories that, although imbued with a scientific perspective, maintain metaphoric language and emotional components that provide insight into human responses to an extreme event. We then look at the historic (1886) eruption of Tarawera volcano in New Zealand, a major eruption that has already spawned myths. Through these examples we seek to view volcanic disasters from the perspective of the people who experience them and to gain insight into the oral tradition and myth-making process prior to examining the myths themselves.

3. Responses to recent eruptions

3.1. Mount St. Helens, 1980

Prior to 1980, Mount St. Helens had been dormant since the middle of the 19th century. As the previous activity had been recorded in both print and paintings, many people living in small communities close to the volcano were aware that the volcano had been active in the past (Saarinen and Sell, 1985). This was not true of people who had recently moved to large northwest cities (such as Portland OR and Seattle WA) or people living in distant downwind regions. Thus although precursory activity in March and April of 1980 allowed officials to clear much of the area to the north of the volcano, which had a sparse and largely seasonal population, and provided sufficient time for local populations to be educated about volcanic hazards, most people did not fully comprehend the magnitude of the impending disaster, warnings went unheeded, and the climactic eruption imposed severe physical and psychological disruption on nearby communities (e.g., Shore et al., 1986). Additionally, communication with downwind communities of eastern Washington was largely neglected. For this reason, both the physical consequences of heavy ash fall and the psychological effects of prolonged darkness, isolation due to road closures, and other disruptions to "normal" life that occurred in this region as a result of the climactic eruption were unanticipated (Adams and Adams, 1984; Saarinen and Sell, 1985).

At 8:32 am on May 18, 1980, the oversteepened north flank of Mount St. Helens failed with no immediate warning, sending both a landslide and lateral blast to the north (Lipman and Mullineaux, 1981). The blast was followed by 9 h of near-continuous activity, creating a Plinian eruption column that transported ash far to the east, pyroclastic flows through the breach created by failure of the north flank, and mudflows that traveled down drainages around the volcano (Fig. 1). Eyewitness accounts of the main phase of activity (Ota et al., 1980; Finley, 1981; Rosenbaum and Waitt, 1981; Barber and Barber, 2004) provide direct observations of the landslide, directed blast, noises, winds, lightning, mudflows, and fall deposits produced during the eruption.

Within proximal areas, the overwhelming impression of the blast was of first cold, then intense heat that caused throats to burn, then a near-impenetrable darkness, with a duration that was difficult to estimate. One observer to the north viewed the oncoming blast as a "big black inky waterfall". The base of the blast looked "like avalanches of black chalk dust — first, one part of the cloud would shoot out, then another, then another, like waves lapping up on a beach". Subsequent upward movement of the blast was interpreted several observers as it being "stood up" by something (or someone?). In the Toutle River Valley, a hot (37 °C) mudflow went "roaring through Camp Baker like a tidal wave", transporting an estimated 50,000 cut logs into the Cowlitz River (Ota et al., 1980). As the ash cloud arrived in Yakima WA, 100 km

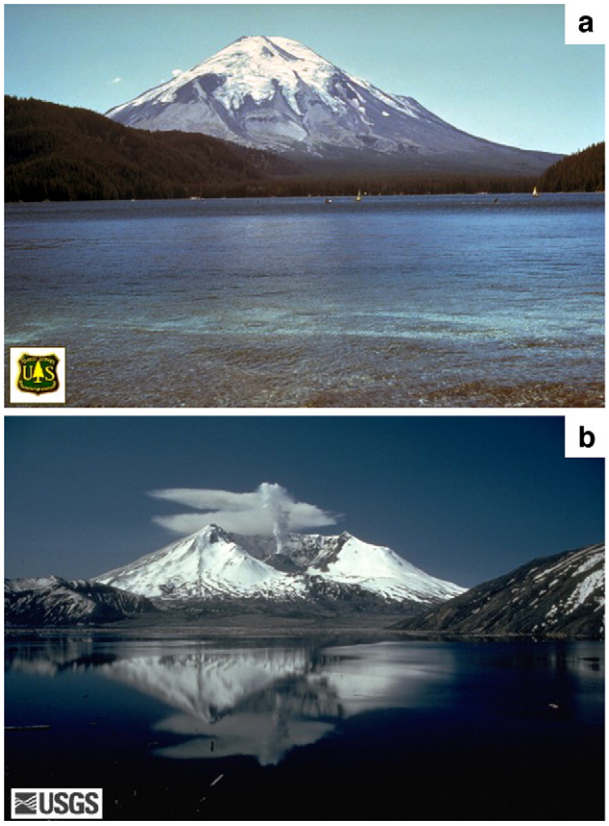

Fig. 2. Pictures of Mount St. Helens and Spirit Lake (a) before and (b) after the 1980 eruptions. Both photographs are from the USGS CVO website general slide set (http://vulcan.wr.usgs.gov/Volcanoes/MSH/SlideSet/ljt_slideset.html); (a) is a US Forest Service photo by Jim Nieland; (b) is a US Geological Survey photo taken by Lyn Topinka.

to the east, it brought "more than blackness — it was blackness that hid the unknown", a "black, black, cloud, a blackness I had never seen" (Finley, 1981). The sky rained "ice-cold mudballs" and ash fell "like snowflakes", like a "giant sifter was over you", "like someone pouring a bag of it over your head" (Rosenbaum and Waitt, 1981). From the city of Portland, 90 km southwest of the volcano (and out of the main ash plume), a stunned population responded to the devastation of the once familiar skyline feature (e.g., Fig. 2):

> Lofty, near-symmetrical Mount St. Helens is no more. Where it had towered, there now squats an ugly, flat-topped, truncated abomination. From its center rises a broad unremitting explosion of ash, turning blue–gray in the overspreading shadow of its ever widening cloud. In the far deepening gloom, orange lightning flashes like the flicking of serpents' tongues. From the foot of the awesome mountain there spreads a groundveiling pall (Finley, 1981).

Several common themes can be identified in these immediate responses to the eruption. First, inconsistency among the accounts of those who experienced the most intense effects of the eruption reflect the extreme stress under which observations were made (Rosenbaum and Waitt, 1981). Second is the evident struggle to place an event that is beyond both experience and comprehension into context — i.e., to build as an individual a relationship with the event within the personal "rules" of understanding and then to expand these personal beliefs and knowledge to include the event and possibly the reasons for it. Analogies of waterfalls, waves, sifters, and snowflakes serve to make the unfamiliar familiar. Concurrently, analogies of serpents and tidal waves emphasize the unfamiliar (and possibly supernatural) nature of the event. Third is the sense among some observers that there was a hidden higher power behind the event, something that

'stood up' the blast cloud and authoritatively sent down the ash. Finally, these accounts bear witness to the "psychological shock waves of unbelief" (Finley, 1981) that spread across the Pacific Northwest as a consequence of the event, a shock rendered more profound in that the transformation involved something as stereotypically immovable as a mountain.

Rather than being lessened by scientific explanations, these psychological responses were often enhanced by mis-information passed along by rumor and the media: "The psychological effect was by far the worst effect on people. People were scared at first, from news reports of high acidity leading to radiation burns. Everyone who's working in it is pretty much aware that there's going to be a long-term effect on health" (Saarinen and Sell, 1985). Rumors about radiation are reminiscent of the rumors reported by Shanklin (2007) that the explosion of Lake Nyos was caused by nuclear testing; in both cases, an extraordinary natural event is made more terrifying by invoking unseen (and poorly understood) technological dangers.

In the months after the eruption, the stress caused by the eruption was manifested as reports of strange illnesses and perceptions of earthquakes where none were recorded by seismometers. A 1983 study of communities that had been strongly impacted by the 1980 eruption showed elevated incidences of general anxiety, major depression, and post-traumatic stress disorder (together designated "MSH disorders" by Shore et al., 1986). Accompanying this stress response was the beginning of the myth of Harry Truman, the owner of the Spirit Lake Lodge. Before the eruption, Harry had gained fame for his crusty personality, his colorful language, his perceived defiance of authority – of the government, of the scientists, and of the volcano itself – and for his refusal to evacuate: "I am part of that mountain; the mountain is part of me" (Finley, 1981). Harry's death on May 18, 1980, by burial under tens of meters of pyroclastic flows, raised him, in the eyes of many, to heroic stature. Within a few years of the event, Harry was the subject of local folk songs (e.g., *Harry Truman (Of Mount St. Helens)* by T. Hunter; *Harry Truman: Your Spirit Lives On* by R. Allen), as well as a movie (*St. Helens*, 1981; Harry was played by Art Carney). Today, more than 25 years later, Harry Truman's name is still famous and his story more closely associated with the folklore of the volcano than any other (e.g., Barber, 2000; Hamilton, 2004; http://www.opb.org/radio/archives/2005/05/mt_st_helens_25.php).

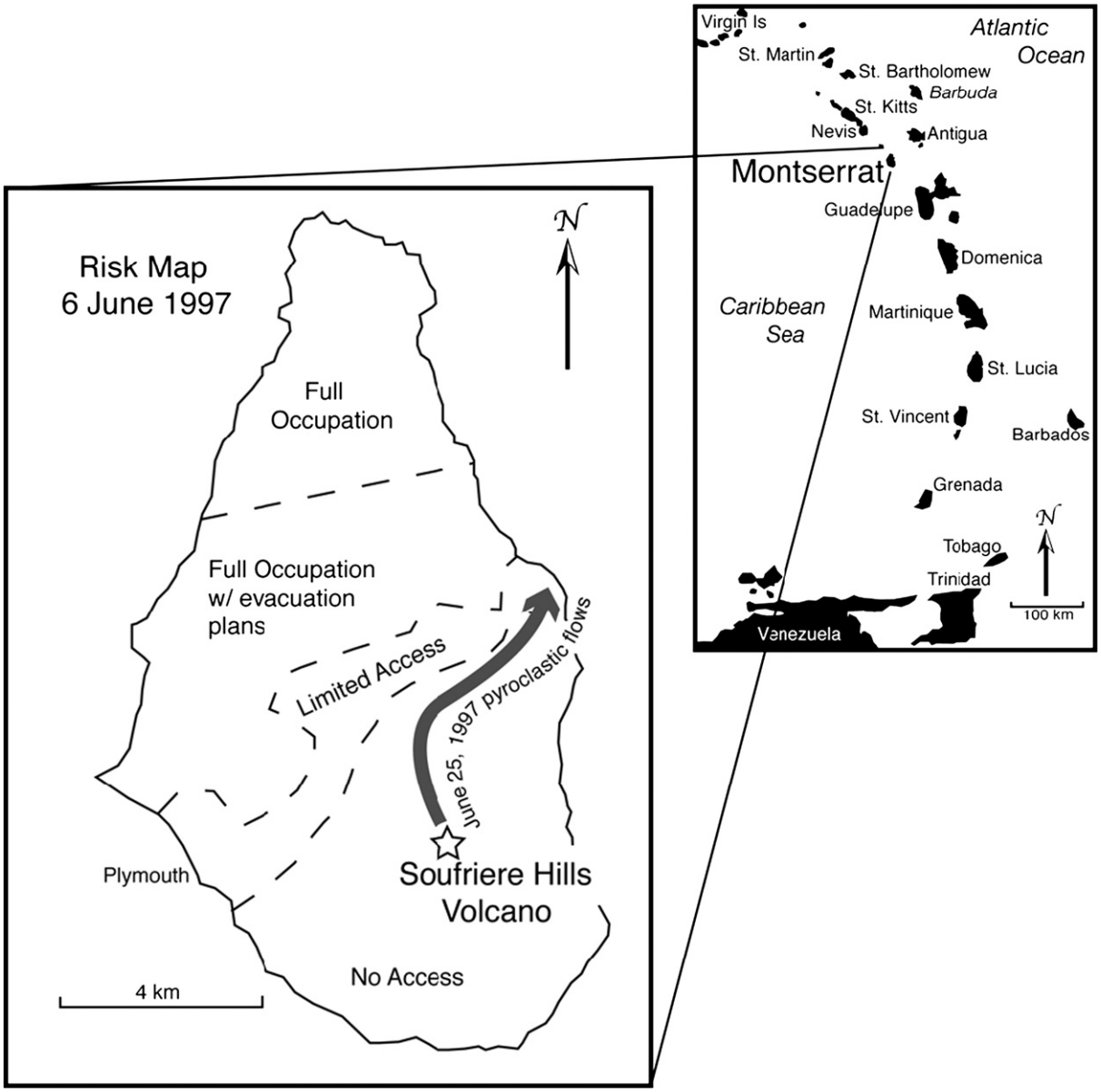

Fig. 3. Risk map of areas around Montserrat volcano on June 6, 1997 (that is, at the time of the June 25, 1997 pyroclastic flows). Map is modified from Loughlin et al. (2002); location map is modified from Kokelaar (2002).

3.2. Soufriere Hills, Montserrat, 1995–present

Soufriere Hills Volcano on the Caribbean island of Montserrat has been erupting since 1995 and provides an interesting comparison with Mount St. Helens. The eruption is of smaller magnitude but has lasted longer and, because of the small size of the island and the proximity of the population to the eruptive vent, has had a much more profound impact on the local population. The last eruption of Soufriere Hills was about 350 years ago, although more recent seismic crises occurred in 1897–98, 1933–37, 1966–67, and 1992. Despite this activity, however, there was apparently no widespread understanding that Soufriere Hills was an active volcano. This lack of community memory may reflect colonization by Irish and English settlers in the decades *following* the most recent known eruptions of 16th and early 17th centuries (Kokelaar, 2002).

Eruptive activity began with phreatic explosions and gas jetting on July 18, 1995. Over the intervening 12 years, the southern half of the island of Montserrat, including the capital city Plymouth, has been made uninhabitable and emigration has reduced the population to approximately one-third of pre-eruption levels (Fig. 3). The most devastating activity occurred on June 25, 1997, when a retrogressive partial collapse of the growing lava dome generated pulsatory block-and-ash flows and pyroclastic surges that killed 19 people and injured 7 others (Sparks and Young, 2002). Although the people had experienced almost 2 years of scientific outreach, education, and hazard warnings, these were not heeded because there was no cultural memory or understanding of this type of volcanic activity: "me say nah believe what they say, me had to see meself" (Loughlin et al., 2002).

Eyewitness accounts (Loughlin et al., 2002) of the June 25 activity show numerous similarities to those from the Mount St. Helens eruption. In the words of one observer:

> Was grey and black, one mighty cloud… No hear a thing before I saw it. After, I hear hard cracking sound and thundering. Saw lightning. Start to feel hot, hot, hot, like I was in an oven. The whole place turn black for about 20 minutes, heavy ash falling… black like black cloth… Fire was pitching on the pavement by the school. Fire was pitching in the air as well… It came down sly and sneaky… The pieces of fire were small and it was there before the place turned black. I think it must be the end of the world. Gas bottles blew and went 'pow pow pow pow'. Pyroclastic flow take over the whole place like a mighty sea. The heavy winds were like a hurricane.

As in the oral histories of Mount St. Helens, familiar analogies are used — in this case storms, ocean waves, and hurricanes, the most common natural disasters in the Caribbean. Additionally, this particular eyewitness imbued the event with the human attribute of malicious intent: "It came down sly and sneaky". At the same time, the witness uses scientific words such as "ash" and "pyroclastic flow", clear evidence of the scientific education that the public had received.

The psychological impact of the event is best illustrated in songs by local artists and poems by local school children (Edwards, 1996; Shotte, 1996). Language used in the songs illustrates the relationship between the volcano and the community. Arrow's song *One Day at a Time* – "Another ash cloud rises high/ It grips your soul, down comes the sky" – gives a sense of the physicality of the ash cloud, combining the "authority" described for the Mount St. Helens ash fall with fear for the loss of the permanence of the sky itself. Zunky Greenaway's *Keep the Faith* describes the volcanic crisis as "a dagger aimed at the heart", a "monster" that "rose up to haunt us/And push us back to the ground." Here again the metaphorical language reflects the perceived unnaturalness of the volcanic awakening. The children's poetry provides more personal and individual responses to the volcanic crisis, from the terror of seeing a familiar landscape transformed – "What a scary frightening sight/See wan bright day tun to night" (*Ashfall-November 4th*, L. Skerritt; Shotte, 1996) – to the every day nuisance of a continuing eruption: "Ee seem lek every time me wash/ Dat is de time volcano start to ash" (*Volcano Action*, T. Thomas; Shotte, 1996). Importantly, the poems allow the children to process for themselves the experience of devastating individual eruptions such as that of *September 17th, 1996*: "Lightning flashing/Thunder rolling/ When is it going to stop?//Rock and ash falling/People running and screaming/When is it going to stop?//People are moving to different places/The rocks are giving people crazy faces/When is it going to stop?" (S. Greenaway; Edwards, 1996).

There has also been anger over the situation, most often directed not at the mountain itself, but at the officials and scientists who recommend evacuation. This is a manifestation of the individual and community need to transfer responsibility to someone, preferably someone with authority (who should therefore be able to do something to fix the situation or at least take the blame). Interestingly, limited scientific knowledge gleaned from education efforts is often used by individuals to argue *against* evacuation of areas around Montserrat: "There is NO bulge on the northwestern side… the authorities are getting us softened up by trying to scare us with the use – mainly *overuse* – of those frightening words "lateral blast" so we will willingly go when they try to evict us from our homes and businesses in and around Salem" (Diogenes, writing in The Montserrat Reporter, March 2007). American expatriates in Montserrat go a step farther, invoking Mount St. Helens and the myth of Harry Truman as an argument for their being allowed to remain in their homes (public meeting, March 2006). Here the myth has overtaken common sense, as they appear unwilling to admit that by this act of stubbornness, Harry lost his life.

3.3. The birth and evolution of a myth — Tarawera (New Zealand), 1886

The examples provided above illustrate ways in which modern communities merge metaphors, heroic exploits, unsubstantiated rumors and scientific explanations to make sense of devastating volcanic activity. Out of this was created the myth of Harry Truman, which has already been transferred to the ongoing crisis at Montserrat. Here we examine the evolution of a volcano-generated myth that has emerged over the last century, one that utilizes traditional story elements (similar to those reported by Shanklin, 2007) to explain a disastrous eruption of Tarawera volcano (Central North Island, New Zealand) on June 10, 1886, where a major basaltic fissure eruption with highly explosive Plinian and phreatomagmatic phases killed ~250 people and destroyed the world-renowned Pink- and White Terraces (Thomas, 1888; Keam; 1988). The death toll from the eruption, which produced >1.5 km^3 of tephra fall, was this low only because the area was very sparsely settled at the time. Prior to this event, Tarawera had not erupted for >500 years.

The eruption, occurring during the early hours of 10 June 1886, must have been terrifying. Explosions were heard throughout New Zealand, as far as Christchurch in the South Island and c. 1000 km away. In locations 100–200 km distant, inhabitants were awakened to witness spectacular electrical storms emanating from large black clouds "… meteors [sic] on all sides shot out from the cloud in every direction, shedding unearthly blueish lights." (Keam, p., 103, 1988). Ash fall in many parts of the eastern and northeastern North Island caused an "almost intense darkness, and as the day further advanced a peculiar and weird aspect was given by a neutral glow similar to a total eclipse" (Keam, p. 113, 1988).

Despite the spectacular nature of the event itself, one of the most enduring eyewitness accounts associated with the Tarawera eruption is that of a "phantom" canoe seen on Lake Tarawera by both Europeans and Maori 10 days before the eruption (Keam, Chapter 5, 1988). On this day, seiche-like waves were noted in the lake as a party set out to view the Terraces. All observers agree that they clearly saw a War-canoe, moving rapidly within a few hundred meters of the viewers. Three of the figures on the War-canoe stood as they passed but they otherwise

made no response to the hails of the tourist party and guides. There was no War-canoe known on the lake and the appearance of this spectral-canoe was regarded by the local Maori as a sign of impending calamity. This warning signal was known to Maori before the event (Orbell, 1995) because Tarawera is related to the local tribes within Maori cosmology; this "sign" can thus be viewed as vitally important to Maori understanding and acceptance of the event, illustrating the relationship of the Maori ancestors (and hence them) to both the volcano and the eruption.

Sophie, a famous Maori guide on the tourist boat, later achieved fame as a witness to the eruption. After the destruction of her village (and death of most of her kinfolk), Sophie relocated to Rotorua to guide tourists in the thermal areas for more than 20 years. Even the earliest versions of her accounts reported the phantom canoe. As she repeated her story of the eruption to visitors many hundreds of times, however, the story took on increasingly supernatural elements. As was the case with Harry Truman at Mount St. Helens, the story seized the public imagination at the time. Paintings, newspaper articles, and writings about the sighting fueled embellishments to the story, such that it eventually achieved mythical status (Keam, 1988).

3.4. Summary of responses to modern eruptions

To summarize, both metaphorical and mythical elements are readily apparent in all of the stories presented above. Metaphors are used to place unfamiliar events into a familiar framework, while unnatural metaphors and resulting myths supply local populations with defiant heroes and supernatural explanations of the events. Elaboration of these mythical elements through time is well illustrated by the phantom canoe sighting that preceded the Tarawera eruption. It is also strongly apparent that the language used by all observers, invokes universal metaphors that can be recognized in volcano-related myths around the world. These modern responses also show both the benefits and inadequacies of scientific explanations for catastrophic events, particularly when scientists fail to communicate adequately – "I expected to see a little dust. I didn't expect to be smothered in the stuff" (a local official from eastern Washington speaking about Mount St. Helens; Saarinen and Sell, 1985) – or among populations whose livelihood requires that they inhabit dangerous areas "Me know the volcano; the volcano could kill me, but me had to look after me cattle…" (Loughlin et al., 2002). For the remainder of this study we focus on two locations, the northwest US (location of Mount St. Helens) and the North Island of New Zealand (location of Tarawera). We show that stories from these areas not only record important details about volcanic activity over the past several hundred years, but also place these events within a social context that provided both warnings of, and explanations for, possible future events.

4. From oral history to oral tradition

4.1. Myths from the Cascade volcanoes, northwest US

Clarke (1953) assembled an important collection of oral traditions from the Pacific Northwest US using original accounts of 19th and early 20th century settlers. The geologic origin of selected stories was first discussed by Vitaliano (1973) in her landmark book that established the discipline of geomythology. More recently, the same stories have been reviewed with the specific intent of both emphasizing the 'euhemerist' interpretation of these stories, that is, their basis in historic events (Deloria, 1995), and investigating ways in which the original event has been transformed into myth (Barber and Barber, 2004). Here we take a different perspective. First we examine ways in which the stories echo metaphors used in the oral traditions reproduced above, then we look at conditions under which these explanations for infrequent volcanic phenomena may (or may not) have decreased the vulnerability of local communities to the psychological, as well as physical, effects of volcanic activity.

When Paul Kane, a landscape painter, visited Mount St. Helens in 1847 (during the last eruptive period of the volcano, which lasted from c. 1800–1857), he complained that he couldn't persuade any of the natives to go with him to the mountain because "this mountain has never been visited by either whites or Indians; the latter assert that it is inhabited by a race of beings of a different species, who are cannibals, and whom they hold in great dread" (Colasurdo, 1997). Clarke (1953) records several versions of this story, some involving cannibals, other with giants: "Sometimes people would hear three whistles, and soon stones would begin to hit their lodges. Then they knew that the giants were coming." In still other stories, salmon in the lake just north of the mountain were thought to be ghosts of evil people (hence the name Spirit Lake); later versions of the stories incorporated the arrival of Europeans, claiming that the evil spirits were punishing the local tribes for allowing white people into the area (Williams, 1980).

That these stories were common in the vicinity of Mount St. Helens is not surprising given its frequent volcanic activity over the past 4000 years (Mullineaux, 1996; Fig. 4). In fact, the mountain had several different names that referred to its volcanic nature – *Loo-wit-lat-kla*, or "Keeper of the Fire", *Lawelatla*, "One from Whom Smoke Comes", and *Tah-one-lat-clah*, or "Fire Mountain" (Williams, 1980) – all clearly with the same meaning but coming from the different cultures that lived to the east (Klickitats) and west (Chinooks and Cowlitz) of the volcano. We further suggest that the imagery of the unnatural, or supernatural, helped to both explain the ongoing and varied eruptive activity of the 19th century and to keep people away from a dangerous area (e.g., Cronin and Cashman, 2008). As described above, interpretation of volcanic activity as the responsibility of supernatural beings obeys Barber and Barber's (2004) Willfulness Principle; it also reflects the human impulse to cope with the trauma caused by the unusual activity by transferring responsibility to higher beings (e.g., Jordan, 2000; Taylor, 2001). Later interpretations of 19th century volcanic activity as revenge of those same spirits for the actions of newly arrived Europeans is similar to explanations of post-European volcanic activity in Mexico (Plunkett and Uruñuela, 1998) and New Zealand (see below), serving to both transfer responsibility to the new arrivals and to incorporate those invaders into the changing world view of the community.

At the same time, European perceptions of volcanic activity in the Pacific NW were "an amalgam of the intense curiosity shown by the educated man of science, the mild interest shown by the educated man of letters, and the general disinterest shown by the man on the street" (Folsom, 1970). This "general disinterest" reflected the location of major settlements far from the volcanic peaks and the arrival of most settlers *after* a large explosion of Mount St. Helens that occurred around 1800 (Yamaguchi, 1983). This eruption produced a tephra fall deposit to the northeast that extended over 500 miles into northeastern WA and Idaho (Mullineaux, 1996; Okazaki et al., 1972). It seems likely that this ash fall is the one reported by Moodie et al. (1992) in their study of Athabascan oral traditions, originally recorded by anthropologist Verne F. Ray in the late 1920s from the Sanpoil and Nespelem Indians of northeast WA and thought to refer to a volcanic eruption around the turn of the 19th century (Ray, 1980):

> When my grandmother was a little girl a heavy rain of white ashes fell. The people called it snow… The ashes fell several inches deep all along the Columbia and far on both sides. Everybody was so badly scared that the whole summer was spent in praying. The people even danced — something they never did except in winter. They didn't gather any food but what they had to have to live on. That winter many people starved to death.

Additional stories about this event were preserved by the Spokane Indians of eastern Washington, who thought "the world was falling to pieces" and the Kalispel of northern Idaho, who remember a rain of "cinders and fire" that caused them to "suppose that the sun had burnt

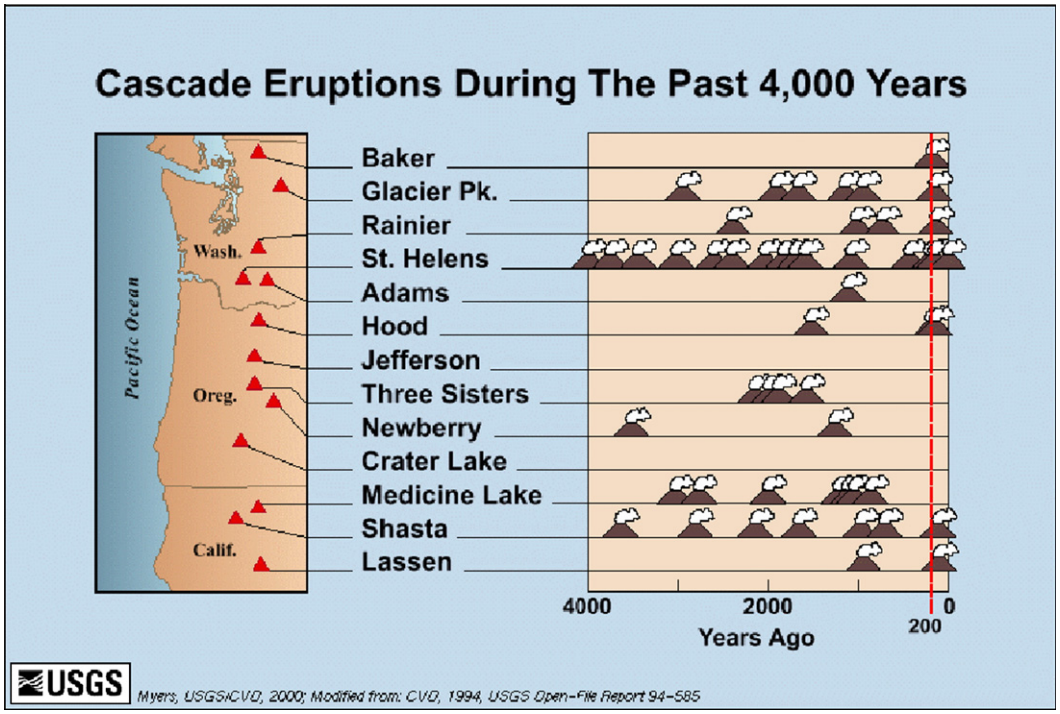

Fig. 4. Location and recent eruptive history of Cascade volcanoes. Map is from http://vulcan.wr.usgs.gov/Volcanoes/Cascades/EruptiveHistory/cascades_eruptions_4000yrs.pdf, modified from USGS Open File Report 94-585.

up, and that there was an end of all things." They also record "a great dance and feast" to celebrate the return of the sun (Williams, 1980).

The ash fall experience for these people was probably very similar to the "blackness I had never seen" in eastern Washington, on May 18, 1980. Both the trauma response of the Athabascans – ritual praying and dancing for an entire summer – and its adverse effect (starvation) are vividly told in the story. That the stories were still being told 120 years after the event speaks to its importance. Interestingly, however, the ritual response, which neglected putting away food for the winter, suggests that there was no memory within these groups of previous tephra fall events. One reason for this lack of memory could be the long time period between events sufficiently large to affect distal areas (the previous large eruption at Mount St. Helens was in 1482 (Mullineaux, 1996). Additionally, explanations for the event may have been lacking, particularly given the lack of context (knowledge of the volcano itself).

Recent volcanic activity at other Cascade volcanoes, although commonly less explosive and less frequent than at Mount St. Helens, is also recorded in oral traditions (Clarke, 1953). As at Mount St. Helens, monsters and evil spirits within the volcanoes explained their destructive behavior: "Mount Baker (Komo Kulshan) got so mad that a big piece fell off and slid way down the mountain. This made a big fire and lots of noise." Mount Rainier (Tacobud) "drew in such a deep breath that she burst her blood vessels. All over her body, rivers of blood gushed forth and flowed down her sides." Mount Hood (Wyeast) contained evil spirits who "became so angry that they threw out fire and smoke and streams of hot rocks." The stories describe the destruction of the landscape, particularly changes that affected the local populations. Lahars from Wyeast created "rivers of liquid rock [that] ran toward the sea, killing all growing things and forcing the Indians to move far away", while lahars from Kushan caused the mountain to become "black all over. The waters in the rivers became black and warm. Fish came floating down the rivers cooked. Lots of Indians and animals fled."

From the perspective of societal resilience, however, it is interesting to compare these stories not from the similarity in the ways that they portray the events, but in the different outcomes projected for the populations that continue to live nearby. The last large eruption of Mount Baker was about 6600 years ago, although a small hydrovolcanic explosion created Sherman Crater as recently as 1843 (Gardner et al., 1995). From the perspective of those living in the lowlands, then, Mount Baker has been fairly peaceful for a long time, despite persistent fumaroles on the volcano itself. This tranquility is emphasized by the end of the Kulshan story, where a wrong is righted, the people return, the place is restored to its former glory, and "since then Kulshan has never been mad."

A similar resolution can be seen in the Tacobud story from Mount Rainier. Mount Rainier had a very large sector collapse that produced a massive lahar about 5600 years ago, a moderate-sized explosive eruption about 2200 years ago, and a smaller lahar down the Puyallup valley toward Orting about 600 years ago (Hoblitt et al., 1995). This most recent lahar was apparently not linked to volcanic activity, consistent with all versions of the Tacobud story, which describe a flood (or breakout of the summit lake) but not an eruption. This story also ends with the death of the mountain monster, accompanied by the proclamation: "Hereafter, Tacobud shall be harmless. The streams of blood shall turn to rivers of water. The waters shall have plenty of fish, for the good of all the people who come to the lakes and rivers on the mountain." Again, the tranquil ending of the story shows that for people in the lowlands, life around Mount Rainier has been fairly peaceful for the last several hundred years.

In contrast, the last moderate-sized eruption of Mount Hood was about 200 years ago, at which point lahars filled most of the valleys around the volcano (Scott et al., 1997). A similar eruption occurred about 1500 years ago. Clarke (1953) does not specify the origin of the Wyeast story, but it was clearly recorded within a few generations of the most recent lahar-producing eruption, probably from people living close to the mountain. As a result, the story of Wyeast has a much less optimistic ending, with a chief of people who "were taller than they are now" losing his battle with "the evil spirits that live in the mountain" in a "river of fire" such that "he had failed to protect his people, and his land was a blackened ruin. He sank upon the ground

and was soon buried by streams of hot rocks." Although eventually the people returned to the area, they never became as tall and strong as the earlier people and they still await a great chief who will fight the mountain demons. This imbalance between the people and the evil spirits appears to be a form of the reciprocity ethos that is a central component of the Maori cosmology (see below). From a hazard perspective, knowledge that the balance has not been restored could be viewed as a mechanism to encourage the group to be more vigilant and to be prepared for future eruptions.

In summary, myths from the northwestern US provide rich details about Holocene volcanic activity throughout the Cascades. They are remarkable for their specificity regarding types of volcanic activity and for the consistency of the metaphorical language, with use of characteristic analogies and imagery for different types of events. They also allow interesting speculation on the "time depth" of these stories, which appear to transfer specific hazard warnings over decades but encode information over at least centuries. Also manifested are many of the myth-making principles outlined by Barber and Barber (2004), particularly the Willfulness Principle which, as we have suggested above, may also reflect transfer of responsibility to cope with the trauma. Perhaps more surprising, we see the same metaphors and principles manifested in oral traditions from the Polynesian culture of New Zealand.

4.2. New Zealand (Aotearoa) Maori myths and conceptions of volcanism

To understand the generation of oral tradition of Maori of New Zealand, one must first understand the cosmology of the culture, which is fairly uniform throughout the country despite slight regional variations between the major *iwi* (tribes); this uniformity stands in sharp contrast to the multiplicity of Native American nations. Maori culture defines the place of modern people in the context of the natural environment. Recent (post missionary) cultures define a single ancestral source, Io (Marsden and Henare, 1992). However, before the Io concept was introduced, there were the domains of sky (Ranginui) and earth (Papatuanuku), who, in turn, have numerous children (*atua* spirits or gods) who control various domains of the environment such as forests and weather. The gods eventually brought birth to people (*tangata whenua*), which means that all *iwi* (tribes) can trace the lineage or *whakapapa* of their members back through their local natural features (e.g., volcanoes, mountains, rivers) to Ranginui and Papatuanuku.

A whakapapa of any one volcano is normally attributed to the initial parting of Ranginui and Papatuanuku, leaving the baby Ruaumoko, (also known as Ruaimoko, Rūwaimoko, Rūamoko, Rūaimokoroa and Rū) with his mother. Most *iwi* regard Ruaumoko, the youngest *atua*, as still unborn, lying in the womb of his mother, who lives in the underworld in the company of Mahuika (Goddess of fire) and Hine-nui-te-po (Goddess of Death) (Smith, 1915; Orbell, 1995; Stokes, 2000). Other *iwi* regard him instead as a growing *atua* who is married to Hine-nui-te-po (Smith, 1915; Anderson, 1928; Best, 1976, 1982; Stokes, 2000). Ruaumoko controls volcanic, earthquake and geothermal activity, as from within the confines of his mother he generates *ahi tupua* — supernatural fire or volcanic heat (Stokes, 2000; Best, 1982). At least 21 *atua* live with Ruaumoko, including his older brother Tane, from whom *tangata whenua* — people of the land, descend (Stokes, 2000; Best, 1982).

Given this cosmology, Ruaumoko is connected to present *tangata whenua* by lineage, requiring that certain protocols be used toward volcanoes. The relationship between people and Ruaumoko is both positive/constructive and deadly/destructive. Events in the present are conceptualized by comparing them to the dynamics within a family, particularly events that have happened in the past either among *atua* or between people and *atua*. The most important of these were early transgressions of Tane with his brother Whiro who is an ally of Ruamoko (Best, 1982). An important principle for *tangata whenua* involves *utu* (reciprocity), whereby an extreme natural event such as a volcanic eruption is but one of many reciprocal acts of the world. Utu often transcends time such that a breach of *tapu* (protocol or what is forbidden) within any part of the lineage may not be reciprocated immediately but instead may be passed down to the most vulnerable person or group until the breach or wrongdoing is *ea* (balanced). These relationships generate an equilibrium with both negative (eruptions) and positive (hot springs, volcanic warmth, fertile soils) outcomes for *tangata whenua*. This also means that volcanic areas contain a *mauri* (life force or vitality) that has strong *mana* (great power, authority, respect) and is very *tapu* (sacred/forbidden). In a direct analogy to the fierce giants or cannibals that inhabited and effectively guarded the forbidden areas of the summits of some Cascades volcanoes, Maori knew of an "early people" or te rapuwai (Orbell, 1995), giants who inhabited *tapu* places at the tops of mountains, along with other Maero (wild beings/cannibals that were not gods nor men). Those of Tongariro volcano were known as Te Ririo, and travelers in the region could often hear them shouting and screaming and they shielded their eyes from the peaks, lest they gaze at the *tapu* heights (Cowan, 1930; Best, 1982; Orbell, 1995).

The initiation of volcanism in Aotearoa/New Zealand is attributed to Ngatoro-i-rangi, a great *tohunga* (priest, navigator, part-spirit) who played a role in many events of early Maori arrival and initial colonization of the land (Grey, 1928; Orbell, 1995). In one of his many journeys he attempted to climb to the summit of Tongariro (the name given to all of the volcanic peaks in this area). He reached the top with his slave Auruhoe (hence the name of one of the volcanoes is Ngauruhoe) and they were bitterly cold. Ngatoro-i-rangi called on his sisters in *Hawaiki* (the homeland ≠ Hawaii) for help, at which point they brought fire to him and the volcano, stopping by other North Island volcanoes on the way (Fig. 5).

Given the influence of *whakapapa* and the concepts of *utu*, the 1886 Tarawera eruption described above had its origins, for Maori, in events that took place five centuries before. Notably, these events probably relate to the time of the large, rhyolitic Plinian Kaharoa eruption, dated at AD 1314 (Hogg et al., 2003). They describe the tale of the ancient *tangata whenua* or *atua*, Tama-o-hoi (Cowan, 1930; Orbell, 1995). Tama-o-hoi was a fierce cannibal who lived on Tarawera and was feared by all those who lived nearby. To rid the area of this scourge, Ngatoro-i-rangi created a huge chasm on Tarawera, forcing Tama-o-hoi into it. Tama-o-hoi remained buried in the heart of the mountain, beneath a peak named Ruawahia (meaning chasm burst open) and a strong *tapu* was placed on the area. This crater was a major vent for the early phases of the AD 1314 eruption and was subsequently filled by a lava dome (Nairn et al., 2004). As the Kaharoa eruption probably lasted for 4–5 years (Nairn et al., 2001), there would have been ample opportunity for observers to witness both excavation and filling of the crater. Centuries later in 1886, Tuhoto, a *tohunga* (priest/elder) of the tribe surrounding Tarawera, called upon Tama-o-hoi and Ruaimoko to punish the younger members of his tribe who were being corrupted by European influences of alcohol and immorality (Cowan, 1930). This brought on the signs of impending disaster, such as the spectral (*tipua*) canoe that appeared before the eruption. Notably, Tuhoto survived the eruption, despite being trapped within his *whare* (native house) for several days (Keam, 1988). However, as he was seen as responsible for invoking the eruption, he was ignored by all other Maori survivors of the event, and despite help by Europeans and hospitalization, gave up on life soon afterward.

The story of Tarawera illustrates that the entirety of Maori understanding of how volcanoes, and thus their actions and those that influence them (good and bad), fit into their own family or ancestry. In this way, the horror and immensity of their actions can be placed into a context of family relationships and the unknown, or unknowable, aspects of a catastrophe (the main cause of trauma as described above) can be rapidly rationalized. This interpretation is consistent with Maori

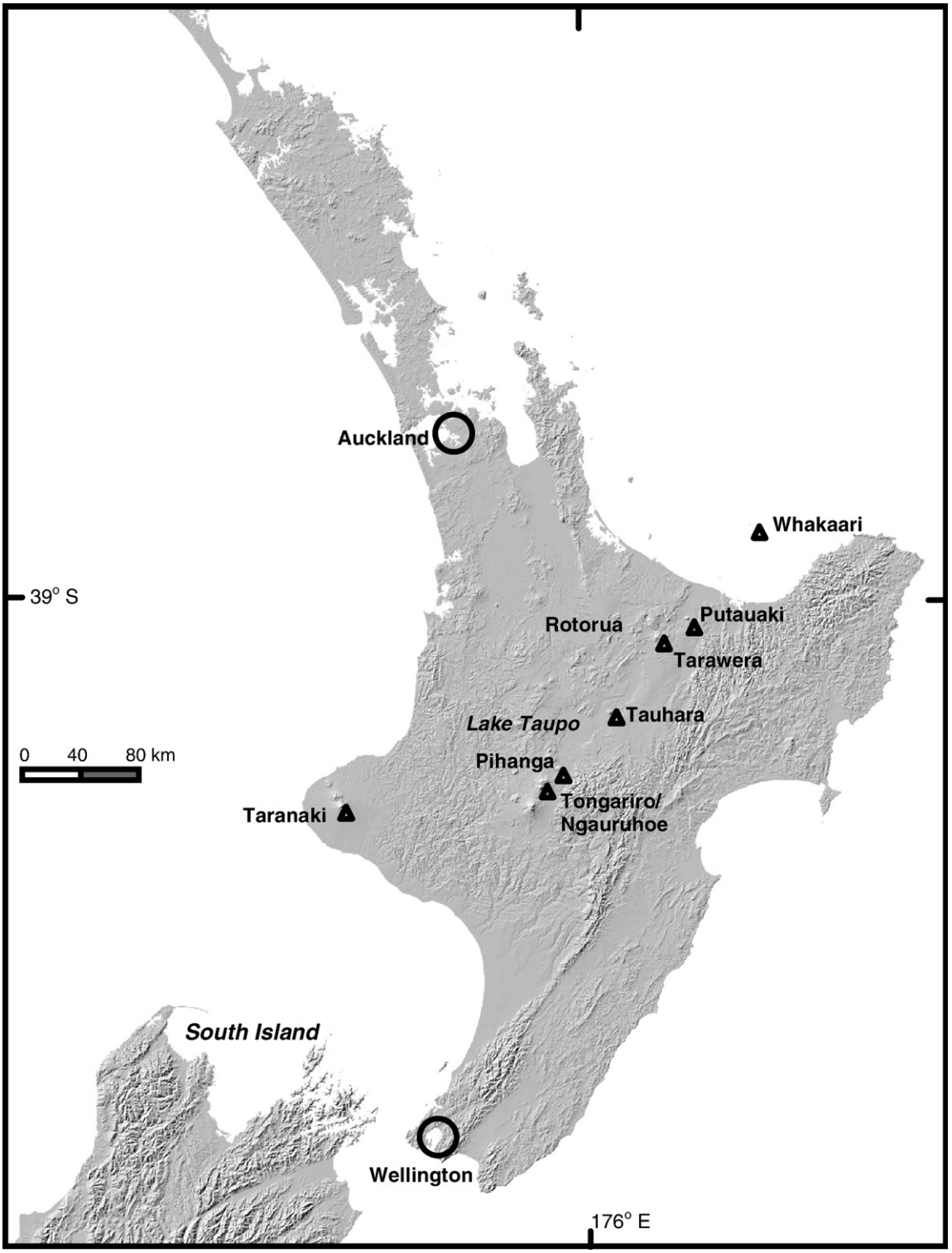

Fig. 5. Locations of the North Island volcanoes in New Zealand involved in Maori oral traditions and described in the text.

expertise in the psychosocial, as well as physical, healing of communities through their fourfold conception of well-being (Durie, 1985): mental (te kaha hinengaro), physical (te kaha tinana), social (te kaha whanau), and spiritual health (te kaha wairua). We infer that the rich mythical and oral traditions of the Maori provided an effective safety net of context for large-scale and potentially traumatic events. From this perspective, it is not surprising that the spectral-canoe sighting was so readily grasped as a sign from the ancestors (a link between the eruption and the world of the living), or that this sighting was later transformed into a more elaborate myth-like explanation for the eruption. The myth was a natural extension of the reciprocity context provided by the existing oral tradition of Tama-o-hoi. It was also rapidly transfigured into a moral tale for the surviving Maori. Thus the 1886 Tarawera eruption could be comprehended in terms of cultural norms, history, *whakapapa*, and perhaps most importantly, *utu*. Although we know less about the indigenous cultures who inhabited the Cascades, it seems likely that the cosmologies surrounding the eruptive histories of Mount St. Helens and Mount Hood provided a similar safety net of context.

5. Summary and conclusions

Numerous similarities appear when one compares modern oral histories and responses to volcanic disasters with aspects of oral traditions that appear to derive from an initial search for an explanation (relationship of the event to the living). First, all narratives remark, not surprisingly, on the immediate effects of volcanic eruptions on both lives and property. In proximal areas, darkness and heat are dominant, while people inhabiting more distal regions are likely to record the effects of lahars on both water quality and fish life within the rivers, or damage to the land caused by widespread tephra blankets. Second, descriptions use common analogy to contextualize unfamiliar phenomena, as well as supernatural (or otherworldly) metaphors to set these events beyond the norms of daily life. Lava flows become serpents tongues (see also Greene, 1992; Barber and Barber, 2004), lahars are rivers of blood, pyroclastic flows are oceans or hurricanes of flame, volcanoes are inhabited by monsters, cannibals and giants, and ash deposition reflects falling of the sky itself. Third, the aftermath of an eruption leaves a much altered environment that is perceived as ruined, ugly, blackened, burned, and an abomination. For this reason, many oral traditions end from a perspective of many years later, after people, animal and fish have returned, such that order (balance, *ea*) is restored. Finally, most narratives view the event as the responsibility of a higher power that is either directly or distantly related to the living (often a god, monster, giant, or ancestor).

These narrative features both highlight components identified as important in the making of myths (e.g., Barber and Barber, 2004; Masse et al., 2007) and record attempts of communities to come to terms with disastrous and, at some level incomprehensible, natural events. In response to trauma, or as a means to limit it, story-telling redefines these events in terms of understandable (everyday) phenomena, gives individuals an outlet to inner feelings of shock and disbelief, and provides a relationship to the event (through relation to ancestry or through definition of the moral or religious transgressions that caused the event). The oral traditions are, however, not merely a passive record of how communities attempt to cope; they also may hold valuable volcanic hazard mitigation information (Cronin and Cashman, 2008), and provide a cultural safety net of context within which to place and comprehend future catastrophic events (e.g., Minc, 1986; Deloria, 1995; Masse et al., 2007). The second point is especially well represented by the rich cosmology and tales of *utu* in the Maori traditions.

Finally, our work suggests a number of questions and challenges for future research: (1) As story-telling (used in the broadest sense) appears to be an important mechanism for coping with the effects of natural disasters, could this approach be more broadly utilized in modern treatment of trauma resulting from volcanic (or other natural) disasters? While scriptotherapy (Smyth and Greenberg, 2000; Smyth et al., 2002) has been used in trauma treatment, other creative outlets could also be added, including story-telling, poetry (particularly well demonstrated as helping Montserrat schoolchildren to come to terms with the ongoing eruption of Soufriere Hills volcano) and artwork. (2) To what extent does the metaphorical language of both modern responses (captured in songs, poetry, art, dance) and oral traditions provide insight into the specific response of a culture (or cultures) to natural disasters? The past decades have seen a growing interest in measuring ways in which people perceive hazard and risk (e.g., Slovic, 1987). The most common technique for acquiring this information is through use of questionnaires. However, there appears to be an enormous untapped source of information within the spontaneous narrative (and artistic) responses of people to disastrous events. (3) As noted by Cronin and Cashman (2008), the long time depth of some volcanic myths illustrates the effectiveness of oral traditions as adaptive strategies in traditional cultures. Given the described failure of modern methods to change behavior in response to hazard warnings (e.g., Paton et al., 2001; Johnston et al., 2005; Gregg et al., 2006), and the critical importance of psychological components of community resilience, we suggest that a challenge for the future is to develop ways in which these traditional methods of adapting to volcanically active areas can be added and incorporated into modern emergency planning.

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