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Research paper

Volcanic risk perception of young people in the urban areas of Vesuvius: Comparisons with other volcanic areas and implications for emergency management

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Abstract

More than 600 000 people are exposed to volcanic risk in the urban areas near the volcano, Vesuvius, and may need to be evacuated if there is renewed volcanic activity. The success of a future evacuation will strongly depend on the level of risk perception and preparedness of the at-risk communities during the current period of quiescence. The volcanic risk perception and preparedness of young people is of particular importance because hazard education programs in schools have been shown to increase the clarity of risk perception and students often share their knowledge with their parents. In order to evaluate young people's risk perception and preparedness for a volcanic crisis, a multiple choice questionnaire was distributed to 400 high-school students in three municipalities located close to the volcano. The overall results suggest that despite a 60-year period of quiescence at Vesuvius, the interviewed students have an accurate perception of the level of volcanic risk. On the other hand, the respondents demonstrate a clear lack of understanding of volcanic processes and their related hazards. Also, the interviewed students show high levels of fear, poor perceived ability to protect themselves from the effects of a future eruption, and insufficient knowledge of the National Emergency Plan for Vesuvian Area (NEPVA). The latter result suggests that in comparison with volcanic crises in other regions, during a future eruption of Vesuvius, there may not be enough time to educate the large number of people living near the volcano about how to appropriately respond. The inadequate risk education and preparedness of respondents implies that a strong effort is needed to improve communication strategies in order to facilitate successful evacuations. Therefore, it is important to take advantage of the present period of quiescence at Vesuvius to improve the accuracy of risk perception of youth in local communities.

Keywords: risk perception; disasters; evacuation plan; Vesuvius; volcanic hazard

1. Introduction

Vesuvius has a history of explosive eruptions that have proven to be deadly for those living near it. While stories about its most famous eruptions are still prevalent in popular culture, the lack of an eruption since 1944 has led to complacency among residents near the volcano (Dobran, 2006). Almost 600 000 people reside in the Red Zone, an approximately 250-km^2 area around Vesuvius defined by the government's National Emergency Plan for the Vesuvian Area (NEPVA) as likely to experience the most hazardous effects of pyroclastic flows and lahars in the event of a large subplinian eruption (ISTAT, 1991; Presidenza del Consiglio dei Ministri Dipartimento delle Protezione Civile, 1995, 2001; ISTAT, 2001). According to NEPVA, an additional estimated 1 100 000 people could be affected by heavy ash and lapilli fallout and lahars in the 1800-km^2 Yellow Zone.

Past studies have shown that residents near Vesuvius do not have high levels of perceived volcanic risk (Davis et al., 2005; Barberi et al.; 2006, Dobran, 2006). The fundamental equation of volcanic risk is defined as: risk = hazard × vulnerability, where hazard refers to the probability of the occurrence of a specific volcanic phenomenon, and vulnerability defines the degree of loss

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to elements exposed to the hazard (e.g. humans, buildings, economic activities) (Blong, 2000). Risk perception is a subjective judgment that people make about the characteristics and severity of a *risk* (Paton et al., 2001).

The low-levels of perceived volcanic risk are significant because if a high intensity event were to occur, such as a volcanic eruption, people might adopt inadequate behaviors due to a lack of risk awareness and perception. This could lead to a serious crisis management problem (De La Cruz-Ryna et al., 2000). Further, the public's perception of risk is frequently found to be biased, with people exaggerating the impact of large spectacular events and underestimating that of pervasive or frequent ones (Slovic, 1987). Volcanic eruptions are generally less common than other natural hazards, therefore in most cases individuals seldom gain personal experience of such events. This can lead to an individual low level of perception of risk (Johnston and Ronan, 2000). Periods of quiescence, which are most common in volcanically active regions, afford the best opportunity to develop mitigation strategies to maintain risk perception at an effective level. Individuals who have an accurate perception of their vulnerability are more inclined to appropriately respond to warnings and undertake protective behaviors (Mileti and Sorensen, 1990; Lindell, 1994).

On and around Vesuvius, the lack of land-use planning, along with volcanic quiescence since 1944, have led to extensive urbanization on the volcano's slopes during the last 40 years (Cosenza, 1997; Dobran, 2006). A lack of adequate preparedness by local communities could render NEPVA's emergency plans ineffective. The large number of people who would have to be evacuated from the Vesuvian area would make evacuating in a timely manner extremely challenging. In contrast, in slightly urbanized areas close to volcanoes (i.e. villages with less than 60 000 inhabitants), the success of evacuation does not strictly depend on the pre-disaster risk perception and education of local communities, as was illustrated by the 1995 Soufrière Hills volcanic crisis in Montserrat, West Indies (Buffonge, 1999; Kokelaar, 2002) and the 1991 Pinatubo eruption in the Philippines (Johnston and Ronan, 2000). In both cases residents were not prepared to evacuate before eruptions, but evacuations were carried out effectively.

Some studies have been conducted on the risk perception of residents near Vesuvius, but only few have focused solely on the perception of young people in the region. It is important to focus on young people's risk perception because the more a young person is aware of hazards and the realistic risk associated with them, the more potential there is for adults, particularly parents, to be better educated through the child sharing information with them (Ronan and Johnston, 2001). In addition, they have shown that young people involved in hazard education programs demonstrate appropriate risk perceptions. Appropriate risk perception is considered to be demonstrated through the increased knowledge of protective actions and more realistic risk perceptions, and an increased ability to cope emotionally (Ronan and Johnston, 2001). Taking into account the above considerations, schools play a vital role in natural-hazard education by providing one of the most effective and least expensive methods to maintain appropriate risk perceptions (Johnston and Ronan, 2000).

This study examines 400 questionnaires administered to high-school level students living in three municipalities in the Red Zone near Vesuvius. The questionnaire is designed to estimate their volcanic risk perception and volcanic-hazard education, to highlight the level of preparedness and participation of youth in local communities with respect to volcanic risk. This is fundamental for the success of an evacuation, especially at Vesuvius where a large number of people living around the volcano probably will not become immediately aware of the situation during a crisis. The results of the questionnaire are compared with case studies in different volcanic areas to determine differences and similarities in behavior and perception during potential volcanic crises.

2. Vesuvius background

2.1. Eruptive history

Vesuvius is located about 10 km south of the large city of Naples, with a population of about 1 000 000 (Fig. 1). Vesuvius is a stratovolcano that reaches a height of 1281 m above sea level. Volcanic activity dates back to at least 400 000 BP (Arnò et al., 1987). The earliest period of volcanic activity was dominated by four plinian eruptions ("Pomici di Base," 18 300 BP; "Pomici Verdoline," 16 000 BP; "Mercato," 8000 BP; and "Avellino," 3780 BP) (Rolandi et al., 1993). Vesuvius' most famous plinian eruption occurred in A.D. 79 and produced pyroclastic flows that killed approximately 2000 people. Volcanism between A.D. 79 and 1631 included at least two *subplinian eruptions* and a series of small, low-energy interplinian eruptions that produced lava flows and scoria deposits on the southern and western flanks of the volcano (Principe et al., 2004). A subplinian eruption occurred in A.D. 1631, after which there was predominantly *open-conduit* activity with eighteen distinguishable *Strombolian* cycles (Arnò et al., 1987). Most recently, effusive and explosive activity occurred in 1944, marking the volcano's transition to a state of *closed-conduit* activity. There has been no evidence of renewed volcanic activity at Vesuvius since the 1944 eruption (De Natale et al., 2001).

2.2. Eruption scenarios

While the historical eruptive activity of Vesuvius is well known, there is much debate about the scale and timing of the next eruption (Scandone et al., 1993; Lirer et al., 1997; Palumbo, 1999; Borgia et. al., 2004; Santacroce et al., 2005; Mastrolorenzo et al., 2006). Lirer et al. (1997) and Mastrolorenzo et al. (2006) report that the worst-case scenario is possible, which would involve a large plinian eruption similar in scale to the A.D. 79 and 3780 BP eruptions. NEPVA has adopted a different scenario, which is that the next eruption of Vesuvius will be similar in scale to the subplinian A.D. 1631 eruption. Some scientists disagree with this assessment, for example Borgia et al. (2004) who reported that due to spreading processes at Vesuvius, the likelihood of a plinian eruption is reduced, while an effusive eruptive scenario is more likely with associated minor risk.