## Dangerous Neighbors: Volcanoes and Cities

In 79 CE, Mount Vesuvius' famous eruption buried the Roman cities of Pompeii and Herculaneum. The volcano has a tendency to erupt explosively and it is only a matter of time before the next eruption, yet this is now one of the more densely populated volcanic regions in the world, with around three million people living nearby.

But what are the real risks posed by a volcanic eruption near a city – how much is fact, and how much is myth? How have volcanic eruptions affected cities in the past, and how can we learn from these events? Why do communities continue to develop in such locations, despite the obvious threat?

In this fascinating new book, Grant Heiken explores global examples of cities at risk from volcanoes, from Italy, the USA, Mexico, Ecuador, the Philippines, Japan, and New Zealand, providing historical and contemporary eruption case studies to illustrate volcanic hazards, and cities' efforts to respond to them, both good and poor. He shows that truly successful volcanic hazard mitigation cannot be accomplished without collaboration between experts in geology and natural hazards, public health, medicine, city and infrastructure planning, and civil protection. This is a topical and engaging read for anyone interested in the history and future activity of these dangerous neighbors.

**Grant Heiken** is an expert in volcanology and interdisciplinary urban studies, having investigated volcanic regions on four continents and the Moon, and co-written or edited ten books, including *Volcanoes – Crucibles of Change* (1997). He holds a Ph.D. in geology, and has worked for NASA during the Apollo program as a researcher and a geology instructor for astronauts. For many years he worked at Los Alamos National Laboratory on geothermal development, many aspects of volcanology from hazard analysis to scientific drilling, and integrated urban science. He was President of the International Association of Volcanology and Chemistry of the Earth's Interior (IAVCEI) from 1995 to 1999, and now works as a freelance writer.

*"Dangerous Neighbours* is a timely and authoritative wake-up call for over 60 global cities which Grant Heiken has identified within range of the world's most dangerous active volcanoes. Devising effective disaster reduction measures for the wide range of volcanic hazards at these cities presents one of the greatest environmental challenges of our times."

– Dr Peter J. Baxter, *University of Cambridge, formerly Consultant Physician in Occupational and Environmental Medicine; health adviser to governments and WHO during many major volcanic eruptions.*

"Since the beginning of the human race, volcanoes have fascinated us, giving inspiration to legends and beliefs, but they also pose serious threats to populations near and far. The examples included in this book have been carefully chosen to fully cover the wide spectrum of possible volcanic scenarios and to illustrate the different problems modern societies face in protecting themselves against volcanoes. Accessible to any interested readers, Heiken's writing does not lack scientific rigour: this excellent book has the potential to rapidly become a bestseller among all those who work with and love volcanoes."

– Professor Joan Martí, *Institute of Earth Sciences "Jaume Almera", CSIC, Barcelona; Secretary General of IAVCEI; Editor-in-Chief of* Journal of Volcanology and Geothermal Research.

"In this excellent book, Heiken places the dangers and disaster potential of populated volcanoes within a varied context of local culture, geologic research, public planning and politics. Like great earthquakes, the world's great volcanoes are ticking time-bombs. This book is a must-read for anyone in the business of hazard forecasting, planning and mitigation in cities located near volcanoes."

– Dr Erik Hauri, *Department of Terrestrial Magnetism, Carnegie Institution of Washington*

"Noted volcanologist Grant Heiken blends historical and archaeological evidence of past urban-volcanic interactions, and shows how current cultural practices and demographic trends shape how people can live with the threat of volcanic activity. This engaging and well-written book will be of interest to a variety of audiences from students with interests in volcano science, cultural anthropology, sustainability, and urban planning, to the general public wanting to learn more about how volcanoes affect our urban environment."

– Dr Thomas Casadevall, *Scientist Emeritus, US Geological Survey*

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# Preface

## MY FIRST "CITY NEAR A VOLCANO" — NAPOLI, ITALY

My personal involvement with the Parthenopean city began in 1987 in Vancouver, British Colombia, at the General Assembly of the International Union of Geodesy and Geophysics, an organization that includes many volcanologists. Giovanni Orsi and Lucia Civetta, volcanologists at the University of Naples, asked if I would be interested in spending two months lecturing on the topic of field work in volcanic fields during the following spring. I was ready for a change of scene from my work at Los Alamos National Laboratory and asked for a couple months of sabbatical leave. With piles of completed paperwork behind me, my wife Jody and I were ready to spend two months in the middle of one of Italy's most colorful cities. The idea of living and working in a densely populated city that overlapped several young volcanic fields held special appeal for me.

Los Alamos, New Mexico, is a small, isolated town located on a forested plateau, and we lived on the edge of even that sparse community. The loudest noise at night was usually the comments of a coyote that might have bagged a rabbit or was simply lonesome. This background did not prepare us for our entry into the ancient and dynamic city of Naples. Giovanni Orsi met us at the airport and spirited us into town to our apartment on the Via Santa Maria de Neves. Our first impressions were of an extremely narrow passage rife with cars, motorcycles, scooters, and people. The streets seemed dirty, noisy, and confusing. All this chaos was apparently just a disguise to fool the taxman. Our newly remodeled apartment was quiet and elegant with views toward Vesuvius (at least from the bathroom) and the Vomero, a ridge that is the backdrop for Naples.

In no part of Naples would it have been possible to avoid historical perspective and centuries of culture. The University of Naples' Department of Geophysics is located in a former monastery near the ancient city center. I got quite a lot of exercise during the months I taught there because the elevator in this multi-story, high-ceilinged building never did work.

Within the first week we found that Naples is a city of villages. There is competition and pride within these neighborhoods and a certain degree of anarchy. In our neighborhood people soon knew who we were and where we came from. Shopkeepers were patient and helpful in instructing us about cultural norms. The bread was baked each morning, and produce was fresh and ripe; we learned not to touch the produce . . . it would be chosen for us by the shop owner. We were soon informed by the local cheese monger that mozzarella was supposed to be consumed within 24 hours; day-old mozzarella was declared "bruta" (ugly or inedible).

Naples is densely packed and therein is the major challenge when considering the threat of a volcanic eruption in the Phlegrean Fields or at Vesuvius. There simply is not enough housing, so families double up. Singles stay with their parents long past their teens and young married couples frequently make their home in parents' apartments. Even if one includes the moderately open areas of parks and hillsides, Naples' population density is 22,000 people per square mile.

The volcanic geology of the Naples metropolitan area is simply spectacular and has been an object of study since Lord Hamilton's work during the eighteenth century. However, the challenge of fieldwork in Naples is daunting. One beautiful spring day we began our work on the Capodimonte, an Arcadian environment with clean, quiet woods and gardens. Below cliffs bounding the plateau there were some small farms. In stark contrast, the margins of these small, cultivated plots were bordered by industrial areas and closely packed apartment blocks. We spotted an excellent outcrop of volcanic rocks behind an abandoned factory and raced over to examine our discovery. Our

euphoria soon subsided when we realized that we were crunching along on a thick deposit of disposable syringes – we had stumbled into a heroin shooting gallery. We gathered our rock samples, made some field observation notes, and quickly retreated. On the same day, we were in the neighborhood of Poggioreale, near the city prison, where a sequence of volcanic deposits is exposed in cliffs below the main cemetery. There, in view of thousands of crypts, a small illiterate kid defended this outcrop and wanted money if we were to see his barren patch of earth. Unraveling Naples' geologic past was also an education in the diverse, colorful cultures that make this city so interesting.

All too soon our time in Naples was over. This intensive first experience of living in a city on the edge of a volcano was fascinating – and very revealing. Maybe it is the underlying threat in these environments that makes people celebrate life to the fullest. Our trip home involved a day's layover in Frankfurt, Germany. We booked a hotel room in a small town near the Frankfurt airport. This attractive German village was cool, quiet, clean, orderly and . . . uh . . . perhaps a bit boring!

Lava flows from the 2002 eruption of Nyiragongo Volcano in the Democratic Republic of the Congo coursed along the main streets of Goma, destroying businesses and homes along the way. Nyirangongo looms menacingly in the distance north of the city. (*Photo: Jack Lockwood, consulting geologist, Volcano, Hawaii*)