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# BOOK REVIEW

VOLCANISM IN THE CAMPANIA PLAIN: VESUVIUS, CAMPI FLEGREI AND IGNIMBRITES, Edited by B. De Vivo, Elsevier Developments in Volcanology 9, Amsterdam, 324 p. (2006) ISBN 0444521766 ($165)

This book is a collection of edited papers stemming from a workshop on Vesuvius and volcanism of the Campanian Plain. The workshop was organized by Bernardo De Vivo, and the results are an expressed effort by scientists from Italian institutions and foreign collaborators to tell the public exactly what is known and unknown about how a volcano works with the goal of avoiding problems that come about from oversimplifications and convenient but misleading models.

De Vivo sets a critical tone in the book's Preface by stating that the existing emergency evacuation plan is "bizarre." He emphasizes this criticism despite the years of ground-breaking efforts by other volcanologists to get volcanic hazards and response on the political agenda. Negotiation and compromise is a fundamental of politics, and if not recognized by scientists the results of this fundamental can be viewed as a "selling out." Unfortunately this dissenting point of view is echoed as an all-to-apparent undertone in many of the chapters of this book, evidenced by an unwilling acknowledgment and in many places a complete disregard of much of the science used to develop the existing emergency plan.

Despite this perhaps negative, critical aspect, the optimism and ingenuity of pure science emerges as the book's 14 chapters (enumerated below) and 128 illustrations progress from discussions of Campi Flegrei and the Campanian Ignimbrite to a focus on Vesuvius ("probably the best-known volcano in the world" in the words of De Vivo). In the following chapters, contributing authors reinterpret some older data and describe new data concerning magma volatile solubility experiments, fluid and melt inclusions, geophysics, geochronology, and tectonism. Some new models based on these data are detailed in order to illustrate a better understanding of the volcanic system behavior.

1. The volcanological history of the volcanoes of Naples: a review (*R. Scandone, L. Giacomelli, and F. Fattori Speranza*).
2. The Pleistocene extension of the Campania Plain in the framework of the southern Tyrrhenian tectonic evolution: morphotectonic analysis, kinematic model and implications for volcanism (*E. Turco, A. Schettino, P.P. Perantoni, and G. Santarelli*).
3. Rapid changes of the accommodation space in the Late Quaternary succession of Naples Bay, Italy: the influence of volcanism and tectonics (*A. Milia, M.M. Torrente, F. Giordano, and L. Mirabile*).
4. Gravitational instability of submarine volcanoes offshore Campi Flegrei (Naples Bay, Italy) (*A. Milia, M.M. Torrente, and F. Giordano*).
5. The Campi Flegrei caldera boundary in the city of Naples (*A. Perrotta, C. Scarpati, G. Luoungo, and V. Morra*).
6. The Late-Holocene evolution of the Miseno area (south-western Campi Flegrei) as inferred by stratigraphy, petrochemistry and $^{40}Ar/^{39}Ar$ geochronology (*D. Insinga, A.T. Calvert, M.A. Lansphere, V. Morra, A. Perrotta, M. Sacchi, C. Scarpati, J. Saburomaru, and L. Fedele*).
7. Magmatic-hydrothermal fluid interaction and mineralization in alkali-syenite nodules from the Breccia Museo pyroclastic deposit, Naples, Italy (*L. Fedele, M. Tarzia, H.E. Belkin, B. De Vivo, A. Lima, and J.B. Lowenstern*).
8. Structural control on the Upper Pleistocene ignimbrite eruptions in the Neapolitan area (Italy): volcano tectonic faults versus caldera faults (*F. Bellucci A. Milia, G. Rolandi, and M. M. Torrente*).
9. The magma feeding system of Somma-Vesuvius (Italy) strato-volcano: new inferences from a review of geochemical and Sr, Nd, Pb and O isotope data (*M. Piochi, B. De Vivo, R.A. Ayuso*).
10. Input of deep-seated volatile-rich magmas and dynamics of violent strombolian eruptions at Vesuvius (*A. Cecchetti, P. Marianelli, N. Metrich, and A. Sbrana*).
11. The role of sulfur in promoting magmatic degassing and volcanic eruption at Mt. Somma-Vesuvius (*J.D. Webster, M.F. Sintoni, and B. De Vivo*).
12. Influence of hydrothermal processes on geochemical variations between 79 AD and 1944 AD Vesuvius eruptions (*A. Lima, B. De Vivo, L. Fedel, and F. Sintoni*).
13. Petrogenesis of the Campanian Ignimbrite: implications for crystal-melt separation and open-system processes from major and trace elements and Th isotope data (*W.A. Bohrson F.J. Spera, S.J. Fowler, H.E. Belkin, B. De Vivo, and G. Rolandi*).
14. A hydrothermal model for ground movements (bradyseism) at Campi Flegrei, Italy (*B. De Vivo and A. Lima*).

The first chapter presents a review of the volcanoes of Naples in a geographical and geochronological sequence that starts with the Campanian Ignimbrite (39 kyr), the most voluminous and widespread volcanic rock of the region, moves to Campi Flegrei (burning fields), comprising caldera features thought to be the source of the Neapolitan Yellow Tuff (15 ka) but strongly debated as to its connection to the Campanian Ignimbrite, and ends with a focus on Vesuvius volcano, best known for its AD 79 Plinian eruption that destroyed Pompeii and other nearby cities. I found this chapter especially useful in its comprehensive overview of important geographical locations, volcanic and tectonic features, radiometric ages, rock compositions, and remaining scientific challenges.

The next 4 chapters discuss regional tectonic and local structural controls of volcanism in Campania, but the presentations are very generalized, including sparse data with interpretations

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that seem somewhat ambiguous, especially in the case of seismic profiles, remote sensing, and stratigraphic successions. For example, Turco et al. present a quantitative model for the evolution of the Tyrrhenian Basin and its influence on the extension of the Campania Plain, but the model is built upon estimated expansion rates, assumptions of rigidity, and "morpho-structural" analysis, which is mostly qualitative interpretation of different remote sensing data. As such, the model they present seems too idealized and loosely connected to measured data. Chapters 3 and 4 discuss submarine seismic profiles in the Bay of Naples and present very qualitative interpretations that I feel need considerable more effort in order to establish a solid scientific significance. With focus on the Campi Flegrei caldera boundary in Chapter 5, ruler-edge (vertical) caldera faults illustrated on maps are shown as dipping toward the caldera in cross section (contradictory) and stratigraphic correlations are made without petrologic and geochemical data for support. At this point I was a bit dismayed with the book, reading more about author's hypotheses than about descriptions of new data. However, Chapter 6 describes a combination of new radiometric age data with carefully correlated marine successions that are logged from drill cores and document the Late-Holocene activity along the southwestern margin of Campi Flegrei. At this point the book began to really engage me.

The final 9 chapters of the book fully allayed my earlier misgivings (with a couple of exceptions noted below) by describing abundant data and clear scientific applications of them. Perhaps this change in direction reflects a much more developed scientific capabilities in the disciplines of mineralogy and petrology than those of volcano tectonics. The comprehensive review of major and trace elements, including Sr, Nd, Pb, and O isotopic data, in Chapter 9 by Piochi et al. is an excellent display of petrological and geochemical systematics in understanding the mantle source, magma plumbing system, and the role of the crustal component in the evolution of Vesuvius magmas. Chapters 7,10, and 12 discuss state-of-the-art hydrothermal fluid and melt inclusion science to quantitatively constrain mineralization near Campi Flegrei and explain hydrothermal influences and violent Strombolian eruptions at Vesuvius. Chapter 11 applies hydrothermal experimental results in demonstrating the importance of sulfur in controlling later-stage magmatic degassing important in determining whether an eruption is effusive or explosive.

Of these chapters, perhaps the most comprehensive study is presented in Chapter 13, which details the petrogenesis of Campanian Ignimbrite, based on 125 sample analyses of major, minor, and trace elements. The authors calculate mass-balanced phase relationships and major element variation using the MELTS algorithm and forward model the concentration of trace elements by Rayleigh distillation. Important results include: (1) the critical role of crystal-liquid separation in evolution of the Campanian magma body and the occurrence of a compositional gap as a consequence of isothermal crystallization at ~884 °C instead of the two-layer mixing model previously proposed; and (2) the quantification of open-system processes for radiogenic isotopes, primarily with respect to Th and Sr, likely caused by assimilation of partial melts of basement rock. That chapter takes a large stride to increase the volcanological understanding of Campania.

Two exceptions to the overall high quality of the final 9 chapters are Chapters 8 and 14. Both of these chapters address important volcanological problems, but their very generalized style does not include strong support for the hypotheses presented. In Chapter 14, DeVivo and Lima propose a hydrothermal model to explain the bradyseismic events (prolonged ground movement) that have long afflicted those living in Campi Flegrei. Their hypothesis involves a change in subsurface fluid pressure conditions from lithostatic to hydrostatic that causes subsurface boiling, hydraulic fracturing, and volcanic tremor followed by pressure release. A hypothesis that is very appealing, built in part by using analogy to porphyry mineralization systems, it needs to be quantitatively developed to constitute a model that can be tested. In Chapter 8, Bellucci et al. pursue an alternative to caldera-related eruption of older ignimbrites including the voluminous Campanian Ignimbrite. Their study involves correlation of onshore stratigraphy (outcrop and interpretation of boreholes documented in the literature) with offshore seismic reflection profiles. By analyzing apparent lateral changes in stratigraphic unit thicknesses with respect to highly idealized (ruler-edge) fault projections, the authors reject the idea that the Campanian Ignimbrite was erupted from a developing caldera (in Campi Flegrei) and propose that it had a fissure source related to an extensional fault system. This proposal is very controversial and constitutes a major schism between two groups of volcanologists in Campania. Citing recent analysis of the Sierra Madre Occidental ignimbrite province in Mexico where eruption from basin and range faults is proposed to explain the voluminous ignimbrite distribution with few known calderas, Bohrson et al. also argue in Chapter 13 in support of the fissure source for the Campanian Ignimbrite. I am a bit surprised that this controversy is not tied to the decades of research done by the U. S. Geological Survey and academic institutions on the origins of ash-flow tuffs in the western U.S. where basin and range faulting obscures the eruptive sources of many known ignimbrites that in many cases show aerial distributions and thicknesses linked to the tectonic fabric. The results of the U.S work in general concluded that caldera formation is intimately tied to formation of large volume ignimbrites and fissure-like vents for ignimbrites form during caldera formation. Another major conclusion from decades of work on ash-flow tuffs that is not well considered in this book is that for a large-volume eruption such as the Campanian Ignimbrite to form, a larger volume source of magma is required, and with its eruption collapse of the roof will occur. This collapse has been found to reflect the shape of the magma body to some degree, and some calderas do have irregular and elongated shapes. But the fissure idea seems to imply a very elongated (dike-like) magma body, and that does not fit well with a petrogenetic model requirements. Other arguments, based on the mapping of maximum ignimbrite thickness and distribution of associated lithic breccias do not uniquely favor fissure eruption over caldera eruption, especially since such features are strongly controlled by factors other than the vent shape.

Overall, I recommend this book to students and researchers, who desire to be current with volcanology in Campania, but I also strongly suggest that previous work by other authors poorly represented in this book be given as much credence.

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The knowledge of the volcanic evolution of Vesuvius and Campi Flegrei has a particular relevance because of the hazards that these volcanoes pose to the about 1.5 million people living in the Neapolitan area. The contributors to the volume bring new The book deals with the study of three important volcanisms in the Campania Plain: Vesuvius, Campi Flegrei and Ignimbrites. The knowledge of the volcanic evolution of Vesuvius and Campi Flegrei has a particular relevance because of the hazards that these volcanoes pose to the about 1.5 million people living in the Neapolitan area. 3. The Pleistocene extension of the Campania Plain in the framework of the southern Tyrrhennian tectonic evolution: morphotectonic analysis, kinematic model and implications for volcanism (E. Turco et al.). 4. Rapid changes of the accomodation space in the Late Quaternari succession of Naples Bay, Italy: the influence of volcanism and tectonics (A. Milia et al.). 5. Gravitational instability of submarine volcanoes offshore Campi Flegrei (Naples Bay, Italy) (A. Milia, M.M. Torrente, F. Giordano). 6. The Campi Flegrei caldera boundary in the city of Naples (A. Perrotta et al.). The Campanian volcanic arc centers on the bay of Naples and includes: *Mount Vesuvius: an active volcano that last erupted in 1944. *Campi Flegrei: a huge, ancient caldera containing the western area of Naples. The area is a collection of numerous extinct craters that are evidence of ancient eruptions; however, also included in this area is solfatara, a shallow volcanic crater still emitting jets of sulphur fumes and, thus, still active. *Mount Epomeo: 20 kilometres west of Naples on the island of Ischia, it last erupted in 1302.Â  (2006) "Volcanism in the Campania Plain, Vesuvius, Campi Flegrei and Ignimbrites". De Vivo: Napoli. ee also. * Volcanism in Italy. Wikimedia Foundation. 2010.