Santorini Volcano
It is recommended that reference to all or part of this book should be made in the following way.

Santorini Volcano


1 Laboratoire Magmas et Volcans (UMR6524 et CNRS), Université Blaise Pascal, 5, Rue Kessler, 63038 Clermont Ferrand, France
2 Department of Earth Sciences, University of Bristol, Bristol BS8 1RJ, UK
3 Department of Earth Sciences, University of Cambridge, Cambridge CB2 3EQ, UK
4 Branch of Isotope Geology, MS 937, US Geological Survey, 345, Middlefield Road, Menlo Park, California 94025, USA
5 NIGL, British Geological Survey, Keyworth, Nottingham NG12 5GG, UK

1999
Published by
The Geological Society
London
THE GEOLOGICAL SOCIETY

The Geological Society of London was founded in 1807 and is the oldest geological society in the world. It received its Royal Charter in 1825 for the purpose of 'investigating the mineral structure of the Earth' and is now Britain’s national society for geology.

Both a learned society and a professional body, the Geological Society is recognized by the Department of Trade and Industry (DTI) as the chartering authority for geoscience, able to award Chartered Geologist status upon appropriately qualified Fellows. The Society has a membership of 8600, of whom about 1500 live outside the UK.

Fellowship of the Society is open to persons holding a recognized honours degree in geology or a cognate subject and who have at least two years' relevant postgraduate experience, or not less than six years’ relevant experience in geology or a cognate subject. A Fellow with a minimum of five years’ relevant postgraduate experience in the practice of geology may apply for chartered status. Successful applicants are entitled to use the designatory postnominal CGeol (Chartered Geologist). Fellows of the Society may use the letters FGS. Other grades of membership are available to members not yet qualifying for Fellowship.

The Society has its own Publishing House based in Bath, UK. It produces the Society’s international journals, books and maps, and is the European distributor for publications of the American Association of Petroleum Geologists (AAPG), the Society for Sedimentary Geology (SEPM) and the Geological Society of America (GSA). Members of the Society can buy books at considerable discounts. The Publishing House has an online bookshop (http://bookshop.geolsoc.org.uk).

Further information on Society membership may be obtained from the Membership Services Manager, The Geological Society, Burlington House, Piccadilly, London W1V 0JU (Email: enquiries@geolsoc.org.uk; tel: +44 (0)171 434 9944).

The Society’s Web Site can be found at http://www.geolsoc.org.uk. The Society is a Registered Charity, number 210161.
Santorini is one of the most spectacular caldera volcanoes in the world. It has been the focus of significant scientific and scholarly interest because of the great Bronze Age explosive eruption that buried the Minoan town of Akrotiri. The recognition of the catastrophic character of this eruption, the realization that the eruption might have had a devastating effect on the ancient civilizations in the eastern Mediterranean and the preservation of exquisite frescoes beneath the pumice deposits at Akrotiri have led to intense research on the geology and archaeology of the islands. Three International Congresses funded by the Thera Foundation have taken place since 1969 and the scientific literature is now replete with contributions on an enormous range of subjects. Santorini has been dormant since 1950, but there have been several substantial historic eruptions. There is a large indigenous population that swells to many tens of thousands during the tourist season. As a consequence of the high potential risk to life and property Santorini has been chosen as one of five European Laboratory Volcanoes by the European Commission. Thus the island is likely to remain a focus of volcanological research for the foreseeable future.

The geology of Santorini has long fascinated geologists. The treatise by Fouqué in 1879 was an early masterpiece in volcanological research, which described the stratigraphy of the caldera wall, recognized the true volcanic origin of the caldera depression and discovered buildings of an ancient civilization beneath the uppermost volcanic layers. The 1936 study of Santorini geology by H. Reck was also a very significant contribution to volcanology and developed a stratigraphy that is still the basis for modern studies. The last three decades have seen numerous studies of various aspects of Santorini geology. A detailed geological map, with further refinements of the stratigraphy, was published by Hans Pichler and colleagues in 1979. Research groups from Denmark, Germany, France, Greece, Holland, Great Britain and the USA have been prominent in developing a modern understanding of the stratigraphy, volcanology, petrology and geochemistry.

One of these groups was based at Cambridge University and later Bristol University where PhD projects on Santorini were instigated in 1980 with the objective of developing a detailed understanding of the pyroclastic deposits and of the overall magmatic evolution of the islands. PhD theses were produced by T. H. Druitt (1983), R. Mellors (1988) and D. M. Pyle (1990) at Cambridge and by R. M. E. Thomas (1993) and L. Edwards (1994) at Bristol University. Although several publications have emerged from this project, a great deal remained unpublished until now. Most of the publications have concerned aspects of the physical volcanology, with one synoptic paper on the stratigraphy (Druitt et al. 1989). Since the 1989 paper, significant new information on the geochemistry and stratigraphy has been obtained. The volcanic field was remapped in 1994/95 at a scale of 1:10000 by the group at Blaise Pascal University in Clermont-Ferrand, France. A large suite of lavas were dated radiometrically by M. Lanphere at the US Geological Survey in order to provide an absolute time framework. A substantial amount of petrological and geochemical data has been collected since 1980, but has hitherto remained unsynthesized and largely unpublished.

A remarkable picture of cyclic volcanic activity and magmatic evolution has emerged from this work. This could not have happened without the detailed understanding of the stratigraphy and physical volcanology of the pyroclastic deposits (the Thera pyroclastics) and the integration of this information with a large body of high quality analytical data on the petrology and geochemistry. This Memoir has thus been produced because the time is now right to synthesize all the data on Santorini and to tell the new story. The new data and ideas in this memoir do not solely derive from the PhD theses. There have been other research groups working over the same period on Santorini and our results and ideas have been integrated with other published work. Colleagues from other institutions have collaborated with the Cambridge/Bristol/Clermont group and are thus involved as co-authors because of their substantial contributions.

The Memoir is organized into eight chapters. Chapter 1 provides a synopsis of the history of research and identifies the landmarks in the evolution of knowledge and ideas. Chapter 2 reviews the geological and tectonic setting of Santorini. It also summarizes recent work on the basement geology of the Aegean islands. Chapter 3 describes the latest interpretation of the stratigraphy, geochronology and physical volcanology of Santorini. This chapter includes information on the stratigraphy and structure of the volcano to complement the new geological map, which is included at the back of the memoir. It also describes the new K–Ar and 40Ar/39Ar dates. Much of the physical volcanology of the main pyroclastic deposits on Santorini has already been published so this aspect is presented only as a summary of the main facts. However new data are presented on the features of the important sequences of minor pyroclastic deposits that occur between the major units. Chapter 4 presents the petrology, mineral chemistry and compositional zoning of the Thera pyroclastics and provides comparisons with published accounts of the lava sequences. Chapter 5 considers the petrochemistry of plutonic nodules that occur in several pyroclastic horizons, which are predominantly gabbros, but also include diorites and granites. These rocks represent part of the high-level intrusive core of the Santorini system. Chapter 6 describes and interprets the major element, trace element and isotope geochemistry of the Thera pyroclastics. Secular variations in magma chemistry are identified and interpreted. Chapter 6 includes new data on the geochemistry of the isotopic compositions of Santorini volcanic rocks and presents modelling of the geochemical and isotopic data which constrains the petrogenesis of the magmas. Isotopic data include radiogenic isotopes (Sr, Pb, Nd) and stable isotopes (O and H) of both whole-rock samples and mineral separates. Chapter 7 discusses results of U–series disequilibria studies on Santorini rocks with new data on U, Th and Ra activities. Chapter 8 summarizes the overall evolution of the Santorini system, discusses the origin of the various kinds of magmatic and volcanic cycles and attempts to elucidate the links between magmatic evolution and volcano behaviour.

Over the years we have enjoyed discussions and collaborations with friends who have also worked extensively on Santorini, in particular Enzo Francaviglia, Walter Friedrich, Mike Fytikas, Grant Heiken, Joel Huismans, Jörg Keller, Buffy McClelland, Floyd McCoy and Georgios Vougioukalakis, Christos Doumas often provided access to the Akrotiri excavations and to his limitless knowledge of the Bronze Age world. Permission to work on Santorini has always been provided by the Greek Institute of Geology and Mineral Exploration.

The Memoir could not have come into existence without the generous and enthusiastic support of Peter Nomikos and funding from the Thera Foundation. Funds from the European Community have also contributed to the production of the Memoir and Map. The Natural Environment Research Council (UK) supported research studentships to T. H. Druitt, R. A. Mellors, D. M. Pyle and L. Edwards and analytical costs at the NERC Isotope Geology Laboratory, Keyworth. Completion of the memoir was also supported by the French Centres de Recherches Volcaniques (CRV) to T. H. Druitt and the Leverhulme Trust to R. S. J. Sparks. We also acknowledge Michelle Dance for her help in drafting the diagrams and Tim Brewer for his excellent help in the XRF analytical work and advice to NERC research students. Reviews by Catherine Deniel, Shan DeSilva, Wes Hildreth, Mike Le Bas, Pete Lipman, Mac Rutherford and Olgeir Sigmarsson are acknowledged. We thank our families for their support and encouragement during the preparation of this Memoir.