

Emanuela Guidoboni
and John E. Ebel

Earthquakes and Tsunamis in the Past

A Guide to Techniques in Historical Seismology



CAMBRIDGE

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A Guide to Techniques in Historical Seismology

This handbook defines the discipline of historical seismology by comprehensively detailing the latest research methodologies for studying historical earthquakes and tsunamis. It describes the many historical sources that contain references to seismic phenomena, discusses the critical problems of interpreting such sources, and presents a summary of the various theories proposed (from ancient Greek to modern times) to explain the causes of earthquakes – indispensable factors for understanding historical earthquake descriptions.

The text presents numerous examples of interpretations and misinterpretations of historical earthquakes and tsunamis in order to illustrate the key techniques, with a chapter devoted to an explanation of the date and time systems used throughout history in Mediterranean Europe and the Near-East. The authors also tie historical seismology research to archaeological investigations and demonstrate how new scientific databases and catalogues can be compiled from information derived from the methodologies described.

This is an important new reference for scientists, engineers, historians and archaeologists on the methodologies for analysing earthquakes and tsunamis of the past. Illustrated with examples from a broad geographic region (including Europe, North Africa, the Middle East, central Asia and the Americas), the book provides a valuable foundation for understanding the Earth's seismic past and potential future seismic hazard.

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Preface

In one sense, the person most responsible for this book is our colleague Jelle De Boer, Professor of Geology at Wesleyan University in Middletown, Connecticut. In October 2000 Emanuela Guidoboni made a trip to the United States and one of her stops was to visit Jelle at Wesleyan. Being a good host, Jelle wanted to introduce Emanuela to others in the New England region who were interested in historical seismology (at Yale University and Boston College). In the past, Jelle had worked with John Ebel at Boston College on the past earthquake activity at Moodus, Connecticut, and he was very familiar with John's work on the historical earthquake activity in northeastern North America. Thus, he arranged with John to have Emanuela visit Boston College and give a talk on her work in historical seismology. It was from this meeting that the collaboration of a historian of seismicity from Bologna, Italy, and a seismologist from Boston, Massachusetts began.

The idea for this book came from the mutual awareness that although in many countries of the world historical research into important earthquakes of the past has been performed and is still in progress, there was no handbook on how actually to carry out historical seismology research, with successful strategies and results highlighted and problems, pitfalls and mistakes specified. Such a guide could be a handy reference for professional researchers in many different countries, while students and amateur investigators who were interested in dealing with data on past seismicity could learn from such a text. A similar idea, but on a more limited scale, had been the topic of some work that Emanuela had conducted years before at the request of the International Atomic Energy Authority (particularly, Aybars Gpınar), on behalf of whom she had studied the strong earthquakes of Armenia. Some sketchy 'guidelines' concerning how to carry out research in historical seismology were first drafted in Vienna in December 1994 by Emanuela and some colleagues (for the seismological part, by Agns Levret and Claudio Margottini). Although some pages had already been written, for a

number of years this early effort remained an idea to be expanded upon and brought to fruition. In the meantime, the methodological approach to historical seismology had become much better defined and accepted thanks to the research experiences of a number of investigators. Historical seismology was indeed emerging as a neo-discipline of its own.

Following her visit to Boston College, Emanuela approached John to work with her on her dormant idea of a handbook on historical seismology. John accepted her invitation to play an active role in this project. Because of their importance in the Mediterranean world, we decided to include historical tsunamis along with historical earthquakes as major topics in the book, and we defined historical seismology broadly enough to include archaeoseismology and the seismic effects on monuments. To keep the book at a manageable size and to maintain coherence in the presentation, we decided to omit some topics that are somewhat more peripheral to historical seismology. For example, historical volcanic eruptions and historical earthquakes associated with active volcanoes are important research topics that we have decided not to include directly in our presentation. Even so, many of the ideas that we present concerning research into historical earthquakes and tsunamis are quite pertinent for research into the historical traces of other natural hazard phenomena. Once we had converged on a scope and outline for our book, we convinced Cambridge University Press to be our publisher and set to work on the writing.

From the outset, it was our goal to write a book that would be a useful reference both to those seismologists and earthquake engineers who carry out research into historical earthquakes and to historians and archaeologists who want or need to know about past earthquakes and their consequences for the affected populations and their buildings. Hence we wrote the book as a kind of tutorial with these widely diverse audiences in mind. We have chosen to include many examples, both in pictures and in words, of the many details and subtleties that make accurate historical seismology research and the proper interpretation of seismological parameters from historical seismological sources such a challenge.

While efforts to compile information on historical earthquakes have been undertaken for several hundred years, in many ways historical seismology is still a comparatively young research discipline. It has only been in recent times that historians have brought to bear their full and significant interpretive tools on those historical sources that describe the earthquakes and tsunamis of the distant past. And for those seismologists who have been studying historical seismicity with an eye toward better defining the seismic hazard of different parts of the world, new analytical tools that give a modern understanding to past historical earthquakes have only been developed over the last decade or so. It

is our sincere hope that this book will stimulate new research into historical earthquakes and will lead to the development of new seismological methods for interpreting the data that accrue from that new research.

Both of us owe our thanks to many people for their assistance in the production of this book: Alberto Comastri, for his assiduous, competent and invaluable support, Maria Giovanna Bianchi and Gabriele Tarabusi of SGA, for their help in preparing the figures and maps. Thanks also to Jean-Paul Poirier and Gianluca Valensise for their corrections and suggestions, and to Enzo Boschi, President of the Istituto Nazionale di Geofisica e Vulcanologia, who has supported the historical research into earthquakes in Italy with great foresight, and for his encouragement in writing this book. Dina Smith at Weston Observatory of Boston College provided a thorough proofreading of the book. Susan Francis at Cambridge University Press was of great help to us, and was extremely patient and encouraging when we were tardy meeting our deadlines. Finally, John wishes to thank his wife Martha, whose constant love and support during many evenings and weekends of writing and revising gave him the strength to carry on. Emanuela is grateful to her three wonderful grandchildren, Emmanuel, Luis and Lorenzo, who with their voices and games provided a pleasant background to this book over many a weekend.

The authors apologize for often having resorted to case studies they had themselves analysed or studies pertaining to research they themselves or their work group had performed, which have provided most of the discussion material.

The authors devised and discussed all of the chapters together and jointly reviewed them, commented upon them and at times added to them. However, as a result of their different scientific backgrounds, the drafting of the chapters was subdivided as follows:

Chapters 1, 2: Emanuela Guidoboni and John E. Ebel

Chapters 3, 5, 6, 7, 8, 9, 10 and 11: Emanuela Guidoboni

Chapters 12 and 13: John E. Ebel

Chapter 4: in Section 4.1 Emanuela wrote the part on the ancient world up to the eighteenth century, John the subsequent part; Emanuela wrote Section 4.2.

