INTRAPLATE EARTHQUAKES

Intraplate earthquakes occur away from the well-known tectonic plate boundaries at locations around the world. These locations are particularly difficult to predict, and they can cause huge damage and loss of life: devastating earthquakes have levelled Bhuj in India (2001), Tangshan in China (1976), Charleston in the USA (1886), and Basel in Switzerland (1356). The Bhuj earthquake (featured in this book) was the largest intraplate earthquake for three decades and the rich dataset collected has provided unique insight into these events.

This cutting-edge book brings together research from international leading experts in the field, compiling multidisciplinary data on intraplate earthquakes. Each chapter provides a comprehensive review of the spatial and temporal patterns of these earthquakes in a different global location, ranging from Australia, China, India and the Sea of Japan, to Western Europe, Brazil, New Madrid in Central USA, and Eastern Canada. The book explores the similarities and differences between regional features, and the mechanical models required to explain them. A broad range of techniques are discussed, including geological investigations of neotectonic features; combined analyses of seismicity, geological, GPS, and geophysical data; seismic reflection tomography, and more. Case studies in the book demonstrate that techniques and strategies used for seismic hazard assessment of plate boundary earthquakes are not valid for intraplate settings, and that new approaches are required for these regions.

Providing the first global overview of intraplate earthquakes, this is an essential book for academic researchers and professionals in seismology, tectonics, tectonophysics, geodesy, structural geology, earthquake dynamics, and geophysics, as well as structural engineers working in earthquake-prone areas.

Pradeep Talwani is a Distinguished Emeritus Professor of Geophysics in the Department of Earth and Ocean Sciences at the University of South Carolina. He has over 30 years’ experience researching intraplate earthquakes, particularly in the Eastern United States and Canada, and is a leading authority on the largest intraplate earthquake to strike the Eastern United States in recorded history, the 1886 event at Charleston, South Carolina. Professor Talwani served as Director of the South Carolina Seismic Network from 1990 until 2009, when he retired, and is a Fellow of the Geological Society of America.
INTRAPLATE EARTHQUAKES

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I live in South Carolina, the state that bore the brunt of the destructive 1886 Charleston earthquake. For those who live in South Carolina, the earthquake is a distant memory, but it also is a constant reminder of the devastating potential of intraplate earthquakes (IPE). Being a resident, this earthquake and IPE in general became a lifelong interest of mine. The destructive 1975 Haicheng and 1976 Tangshan earthquakes in China further fueled this interest.

In the past four decades, after the development of the plate tectonic theory, there has been considerable progress in understanding the nature of these rare earthquakes. In the United States, the first systematic attempt to place IPE in a global setting began in the late 1970s, together with a proliferation of seismic networks. In the 1980s, to assess the seismic hazard posed by future IPE, the United States nuclear industry sponsored a systematic study of the phenomenon in the Central/Eastern United States (CEUS). Simultaneously, another major forward step was the compilation of the global in situ stress data. The results of these studies led to the identification of various global, geologic and seismological aspects of IPE. After the discovery in the early 1980s of buried sand blows associated with the 1886 and prehistoric Charleston earthquakes, systematic paleoseismological investigations led to the discovery and dating of several prehistoric earthquakes in the CEUS.

In the 1990s, with the collection of increasingly better geological, seismological, paleoseismological and GPS data, several theoretical models were proposed to explain the IPE in the New Madrid seismic zone. Further breakthroughs occurred when aftershocks of moderate earthquakes in the eastern margin of the Sea of Japan and the destructive 2001 Bhuj earthquake in Western India were recorded on dense networks of seismic instruments. Tomographic inversions of these data led to an identification of the causative structures and to a better understanding of the seismogenesis of these earthquakes. Simultaneous to the developments in the United States and Eastern Canada, IPE were being studied in Australia, Brazil, eastern China, India and Western Europe. Following a special session on IPE at the American Geophysical Union meeting in Iguassu Falls, Brazil, in August 2010, it was thought that a global review of IPE would be of wide interest. This book was borne out of that proposition.
Preface

I sincerely thank the authors of various chapters for their contributions and their patience in responding to various queries and deadlines along the way.

Finally, I want to thank my wife, Anita, and children, Rohit and Radhika, for their love and continual support.

Pradeep Talwani