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Geophysical Monograph 121

The History and Dynamics of Global Plate Motions

Mark A. Richards
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Rob D. van der Hilst
Editors

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PREFACE

The new global tectonics that emerged three decades ago profoundly changed our view of the Earth and its evolution. Although the theory of plate tectonics gives a kinematic description of much of Earth's surface motions, our dynamical understanding remains incomplete and unsatisfactory in many ways. Key remaining issues include the mechanics of plate boundaries and intraplate deformation, the relation between plate-scale dynamics and hotspot volcanism, vertical surface motions (dynamic topography) associated with subduction, and the origin of the plate-tectonic style of convection itself. The past two decades have seen fairly steady progress on a number of these problems, spurred in large part by the advent of 3-D seismic imaging of the Earth's interior. More recently, advances in high performance computing have provided long-needed 3-D geodynamic modeling tools that are yielding new insights into the relation between mantle convection and plate tectonics, and the interpretation of seismic heterogeneity structure.

Plate tectonics emerged as a synthesis of previously disparate disciplines of geoscience (e.g., seismology, paleomagnetism, marine geology and geophysics, petrology, and paleontology), and the field continues to advance through multi-disciplinary collaboration. An AGU Chapman conference on the *History and Dynamics of Global Plate Motions* was convened in June 1997 at Pt. Reyes, California, with the purpose of bringing together geodynamicists, tectonicists, and seismologists to improve our understanding of the dynamics of global plate motions. Following this conference, a group of participants and a few selected non-participants were invited to contribute to this volume. Contributors were encouraged to write for a general audience of Earth scientists, to provide a modern view of the field, and to present a combination of tutorial, review, and new research. The volume is organized along scientific themes rather than disciplines. Topics include the basics of mantle convection and its relation to plate motions, continental dynamics and intraplate deformation, detailed application of modern reconstruction and modeling techniques to the Australian region, the relation between 3-D seismic structure and mantle dynamics, and the relation between hotspots and plate motions, the latter emerging from the Chapman conference as a particularly challenging subject.

It is hoped that this grouping of topics and the tutorial and review material contained in the papers will promote a wider appreciation for our current state of knowledge of the dynamics of plate motions, and for the major questions that remain. The editors wish to thank the authors for producing an excellent group of papers and, in particular, their attention to writing for a more general audience than would be normal for journal articles. We thank the many reviewers of the manuscripts, and we are also grateful to the participants at the AGU Chapman Conference, who made for a most enjoyable and exciting gathering of minds. Steven Bell of AGU did a wonderful job of coordinating the conference.

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