



**The Geology of North America
Volume G-1**

The Geology of Alaska

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Cover Photo: Mt. Saint Elias and Tyndall Glacier looking north from over the Chaix Hills along the Gulf of Alaska. Bedded marine Tertiary rocks of the Yakutat terrane underlie the foothills in the foreground, and Late Cretaceous metamorphosed flysch and oceanic volcanic rocks of the Chugach terrane underlie snow-covered parts of Mt. Saint Elias and the ridge to the west. The Tertiary strata are tightly folded and imbricated as a consequence of post-Oligocene thrusting relatively beneath the Chugach terrane along the Chugach–Saint Elias fault system at the base of the mountains. Ongoing deformation is manifested by active seismicity, by 1,000 m of emergence of marine strata in the foreground since Pliocene time, and by uplift of coastal terraces at rates that average as much as 11 mm/yr. Mt. Saint Elias, the second highest mountain in Alaska, was the first landfall made by Vitus Bering's discovery expedition in July 1741. Vertical relief from the summit of Mt. Saint Elias to the tidal front of Tyndal Glacier at the head of Icy Bay is 5,489 m in a horizontal distance of 24 km, making it among the steepest in the world.

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Preface

The Geology of North America series has been prepared to mark the Centennial of The Geological Society of America. It represents the cooperative efforts of more than 2,000 individuals from academia, state and federal agencies of many countries, and industry to prepare syntheses that are as current and authoritative as possible about the geology of the North American continent and adjacent oceanic regions.

This series is part of the Decade of North American Geology (DNAG) Project, which also includes six wall maps at a scale of 1:5,000,000 that summarize the geology, magnetic and gravity anomaly patterns, regional stress fields, thermal aspects, and seismicity of North America and its surroundings. Together, the synthesis volumes and maps are the first coordinated effort to integrate all available knowledge about the geology and geophysics of a crustal plate on a regional scale.

The products of the DNAG Project present the state of knowledge of the geology and geophysics of North America through the 1980s, and they point the way toward work to be done in the decades ahead.

In addition to the contributions from organizations and individuals acknowledged at the front of this book, major support for this volume has been provided by the U.S. Geological Survey.

A. R. Palmer
General Editor for the volumes
published by The Geological
Society of America

J. O. Wheeler
General Editor for the volumes
published by the Geological
Survey of Canada

Foreword

To those of you who are using this book for the first—or fiftieth—time, we greet you. Welcome to Alaska, geologically unique among the 50 states and a land of varied geology: active and passive plate margins; volcanoes, great earthquake faults, tsunami waves, landslides, glaciers, permafrost, and mineral and energy resources; and, we believe, a collage of disparate crustal terranes welded to each other and to the North American continent over a span of at least 500 million years.

The Geology of Alaska consists of 33 chapters and 13 plates that describe the geology and geophysics of each of Alaska's principal onshore and offshore regions and also cover a spectrum of topical subjects that include physiography, lithotectonic terranes, igneous and metamorphic petrology, geochronology, geophysics, geochemistry, sedimentary basins, mineral and energy resources, glaciation, permafrost, neotectonics, and tectonic evolution. Areal and topical coverage of the volume closely follows the original outline created during an organizational workshop in 1982, despite several authorship changes and two changes in editorship in the interim.

The geologic premise for most, but not all, of the areal chapters is that most of Alaska consists of displaced fault-bounded slivers, slices, and blocks of crust that were emplaced in their present positions relative to the craton by a variety of tectonic processes. Some of the authors, however, do not agree on the number, distribution, and configuration of these lithotectonic (or tectonostratigraphic) terranes, and others argue that Alaska consists mainly of crust having a local, not distant origin. As a consequence, interpretations of the same data may differ in some chapters in the volume. We regard such diversity of geologic opinion as healthy and a challenge to those who use this book as a basis for future geologic studies in Alaska.

Our aim in *The Geology of Alaska* was to bring together in one volume a summary and bibliography of virtually all that now is known about the geology of the state and its offshore margins, and to offer an interpretation of its tectonic evolution. Like Alaska, the book is unique: there has never been one like it, nor is there likely to be another for a long time. We offer it to the earth science community at large and especially to those willing to wrestle with its still-numerous geologic problems, and, we hope, to gather new data and offer their own new interpretations. For you who take up the challenge, it will be an exciting quest. Welcome!

The Geology of Alaska is the result of the dedicated efforts of more than 80 authors and scores of contributors and peer reviewers. We wish to express our deep appreciation to all of these individuals who selflessly diverted time from their personal research to make this volume possible. In our judgment, their efforts were certainly worthwhile.

We gratefully acknowledge David L. Jones for his lead role in conceiving and organizing

the volume and in identifying and recruiting authors, and John P. Galloway, John S. Lull, Leslie Gergen, and James W. Laney, of the U.S. Geological Survey, for their outstanding technical support to the editors in drafting illustrations for the volume and in shepherding its myriad components along the long and complex path to publication. We also thank the Geologic Division of the U.S. Geological Survey and the Alaska Division of Geological and Geophysical Surveys, whose research scientists, ably supported by technical and secretarial staffs, authored or co-authored most of the chapters and plates; the Branch of Western Technical Reports of the U.S. Geological Survey, whose staff edited most of the chapters and prepared a majority of the illustrations for publication; illustrators of the Branch of Central Technical Reports who prepared Plate 13; and the geology departments of the University of Arizona, Cornell University, Johns Hopkins University, and the ARCO Alaska Company, whose teaching and research staffs made major contributions to the volume.

We dedicate this volume to the generations of Alaska field geologists whose work, often under trying conditions, provided the solid foundation on which the contributions in the book are built.

George Plafker
Henry C. Berg
February 1994