Preface

This book presents an integrated overview of all aspects of the geology of the Transantarctic Mountains in easily readable form. The book can also be used to look up specific information about the geology of this mountain range and it records the names of many of the Earth Scientists who have contributed to the understanding we now have of the origin of the Transantarctic Mountains. In spite of the remote location of Antarctica, tens of thousands of men and women have already been there and many more will visit the continent in the future in order to participate in scientific research or to support the research programs that are undertaken by the nations that have joined the Antarctic Treaty. In addition, hundreds of tourists visit Antarctica annually in order to enjoy its natural beauty and to gain an appreciation of their own good fortune for living in the more hospitable regions of the Earth. Antarctica can teach all of us to respect the natural environment that sustains us on the Earth. This book is therefore intended for the men and women who have already visited Antarctica and for those who may visit this continent in the future in order to work there or to be inspired by its natural beauty.

We confine our attention in this book to the Transantarctic Mountains where geologists of many nations have been working since the International Geophysical Year (1957–1958) and where we have also conducted fieldwork between 1964 and 1995. The Transantarctic Mountains are unusual because, for most of their length, they consist of an uplifted and deeply dissected plateau of flat-lying sedimentary and volcanic rocks that were deposited in Phanerozoic time. These rocks are underlain by a basement consisting of a folded and variably metamorphosed volcano-sedimentary complex that was intruded by granitic rocks in the course of the Ross Orogeny during the early Paleozoic Era. Our objectives in writing this book are to summarize the relevant facts about each of the major rock units in the Transantarctic Mountains, to present the hypotheses that have been proposed to explain their origin, and to make our readers aware of issues that are still unsettled. In this way, we hope to encourage further work on geological problems and to identify areas in the Transantarctic Mountains where additional research may be needed. The information we present is derived primarily from the relevant literature supported, when appropriate, by the results of our own work and that of our students. We assume that our readers have a working knowledge of the technical aspects of Earth science and we encourage them to make up their own minds concerning the hypotheses we present.

Antarctica is important not only because of the rocks that form its crust, but also because of the large ice sheet that covers most of the continent. The glaciation of East Antarctica started during the Neogene and has formed an ice sheet that is more than

3 km thick and contains most of the world's fresh water. The stratigraphy of the ice and its isotopic composition of oxygen and hydrogen record variations of the climate extending upto 800,000 years into the past. The history of the East Antarctic ice sheet is also recorded by the geomorphology of the Transantarctic Mountains and by the deposits of till, gravel, and sand the ice sheet has left behind. The ice of the East Antarctic ice sheet adjacent to the Transantarctic Mountains does not melt, except locally on rare occasions. Instead, it ablates directly into the air. Consequently, terrestrial rock debris and extraterrestrial meteorite fragments that are transported by the ice sheet accumulate on the blue-ice surfaces of its ablation zones. Outlet glaciers, that flow from the polar plateau through valleys in the Transantarctic Mountains to the coast of Victoria Land and into the Ross Ice Shelf, descend to the low elevations of the coast where the ice does melt during the austral summer. In the dry (or ice-free) valleys of southern Victoria Land the resulting meltwater collects in lakes and ponds on the valley floors.

In spite of the harsh climate that characterizes the Transantarctic Mountains, bacteria, algae, lichens, and moss grow in sheltered places in the soil and some plants have adapted by becoming endolithic. Even mites and nematodes have been discovered in the ice-free valleys and algal mats thrive in the warm brines that occur at the bottom of the largest and deepest lakes.

These attributes of the Transantarctic Mountains are reflected by the title of this book because a complete description of this mountain range must address not only the rocks, but must also include the ice, the meteorites, and the water. The study of the Transantarctic Mountains is a multi-disciplinary enterprise including aspects of geology, glaciology, meteoritics, aqueous geochemistry, botany, and zoology.

The relevance of Antarctica to the populated areas of the Earth may become more apparent in case global warming causes the Antarctic ice sheet to start melting, thereby raising sea level and flooding coastal areas worldwide. The resulting loss of living space will require the human population to adjust on an unprecedented scale exceeding the increase of sealevel at the end of the Pleistocene Epoch when the population of the Earth was much smaller than it is today.

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