Book Reviews

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The Transantarctic Mountains: rocks, ice, meteorites and water

Gunter Faure & Teresa Mensing
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The Transantarctic Mountains (TAM) are nearly 3000 km long and form the main physiographic and geologic divide between East and West Antarctica. Commonly overlooked by the general earth science community, they form an impressive mountain belt notable for its scale, relief and ancestry. The modern TAM are a relatively young geologic feature uplifted by recent extension along the West Antarctic rift system, yet they encompass some of the oldest rocks in Antarctica (Nimrod Group), they record events related to development of three major supercontinents (Rodinia, Gondwana and Pangea), and they are built upon an older (Ross) orogenic belt. In a word, the topic is huge.

Now comes an equally impressive volume about the geology of the TAM. *The Transantarctic Mountains* is a brick of a book! Geologists Faure & Mensing have assembled a storehouse of information on all aspects of the TAM, from exploration, to physiography, to a wide range of geological topics, including cratonic basement, Ross Orogen sedimentation and tectonics, Gondwana magmatism and sedimentation, meteorites, mountain belt uplift, and glacial geology. What does a reader get out of this expansive and expensive book? *The Transantarctic Mountains* is richly adorned with colour photographs and figures; it contains many topographic and colour geologic maps; it provides geologic summaries of many key areas; it highlights historical background; and it contains dozens of useful tables and a deep reference list. As an all-in-one resource, this volume has no peer.

The Transantarctic Mountains is in many ways a personal narrative by the authors, taken from many years experience studying the geology of Antarctica. It highlights many of the problems the authors have addressed in their own work, and it provides the context for the development of our current understanding, making connections between the first explorers and geographers to the early post-IGY scientific campaigns and beyond. Through personal experience and broad awareness of the scientific literature over many years, the authors weave as much a tale as a final story. From this standpoint, it is easy to read; the authors take care to outline each logical step and explain important methodologies.

Undertaking a project of this magnitude will, of course, entail some limitations. Among the notable shortcomings are that the literature references appear to be current mostly as of about 2002, so it is almost a decade out of date. More recent work on Precambrian basement geology, Proterozoic rift-margin sedimentation, mechanisms of TAM uplift, and Ferrar sill emplacement are particularly lacking. This is understandable given the massive amount of material covered; however, readers should be aware of this at the outset. On the other hand, *The Transantarctic Mountains* is rich in references dating back over a century, particularly including key works between the 1960s and 1980s that are often overlooked.

Some sections of text, particularly at the beginning of chapters, are laden with long descriptions of geography and the locations of geologic features. Although this could be helpful to those unfamiliar with given areas, much of this information could be gained by the reader through examination of readily-available topographic maps for areas of interest. As a result, the book is often ponderous in detail.

The volume lacks graphical stratigraphic charts; rather, stratigraphic relations are depicted in modified tables, making it difficult to visualize stratigraphic relations and correlations as shown. Likewise, most, if not all, of the stratigraphic tables relate to one geographic area only, making it difficult to trace correlations between regions. For example, in the chapter on the Beacon Supergroup, there are eight separate stratigraphic tables. A final summary table attempts to bridge five of the key areas, but the table format is hard to read and largely summarized from a geologically informative correlation diagram of Barrett *et al.* (1986).

Faure has published a series of widely-read texts on isotope geochemistry that are a staple of university courses and reference shelves; the latest of these, published in 2005, is up-to-date and comprehensive. Surprisingly, *The Transantarctic Mountains* gives inordinate space to discussing isotopic approaches that were once applied to studies of TAM geology, but which are now rarely used. For example, the authors recount at some length K-Ar data first published in the 1960s–1980s for igneous and metamorphic rocks of the TAM, even including newly compiled histograms of K-Ar ages that are now over 30 years old. Such summaries mostly neglect the now more widely used $^{40}Ar/^{39}Ar$ method, a far superior approach to investigating cooling histories in crystalline rocks of mountain belts like the Ross Orogen. Although there is historical interest in how the early studies evolved, application of the K-Ar method in high-temperature igneous and metamorphic rocks is unreliable as a chronometer, particularly given that many of these data were obtained from whole-rock samples. Well-established relations between mineral closure temperatures and the ability to recognize problems arising from excess Ar make the $^{40}Ar/^{39}Ar$ method better suited to the task.

I recognize the authors' intent to give fair recognition to the earlier work, but the detailed accounts of geochronological study in several areas have the danger of misinforming the reader about the geologic meaning of these problematic data. Similarly, the authors include a battery of Rb-Sr isochron ages, even though U-Pb zircon geochronology has proven to be a more reliable method for determining crystallization age. Rather than revisit previous arguments about the significance of certain isochron ages, which may never resolve key problems, a reader is more likely to be interested in the current state of understanding for which there are ample data. Indeed, the authors do mention the results of recent $^{40}Ar/^{39}Ar$, U-Pb and fission-track studies throughout the book, but at the end of a long discussion of K-Ar geochronology, these new results are not addressed in detail and seem almost an afterthought. For example, tabulations of age data from the central TAM and northern Victoria Land lack $^{40}Ar/^{39}Ar$ results at all, thereby ignoring an important body of $^{40}Ar/^{39}Ar$ data showing that older basement rocks were reactivated during the Ross Orogeny and that earlier K-Ar ages contribute little to our understanding of pre-Ross geologic history. A better approach might have been to outline why each method was applied in the context of the time period, but then focus on only the most geologically meaningful results.

The authors of *The Transantarctic Mountains* do a creditable job of conveying the evolution in thinking about regional stratigraphic relationships by means of paired sections on "Conventional Stratigraphy" and "Revisions of the Stratigraphy". Stratigraphic relations in the TAM were largely established in the 1960s and 1970s, including a framework for Neoproterozoic, lower Paleozoic and Mesozoic successions. In many areas and time periods, however, the stratigraphic nomenclature is now outdated. Faure & Mensing address these issues with detailed discussion comparing the originally-defined stratigraphic relations with more recent revisions, although in some cases these are so compartmentalized that it is unclear where the problems lie with the conventional scheme. Confusion might also arise from some of the geologic maps that are no longer valid. In discussion of Neoproterozoic stratigraphy in the central TAM, for example, a geologic map in Fig. 5.7 ignores recent (since 1997) revisions to the Beardmore Group (as discussed in the text), thereby vastly over-representing the extent of this unit. The one key map showing the relevant geology therefore shows the erroneous map relations rather than our revised understanding; this is corrected somewhat in a later geologic map (Fig. 5.9), but it follows the Neoproterozoic discussion by several pages, is at odds with the earlier figure, and uses a colour scheme that is different from the earlier figure. Ambiguities such as this make a big difference in how one interprets the Neoproterozoic rift history of East Antarctica. Although it is appropriate to recognize early contributions, these sections are written as if the early views are still valid, requiring the reader to follow the historical development to the end. Because the text is quite long in places, it might not be clear to the reader how to sort out the various levels of information. As an example, a Sm-Nd isochron age was reported in 1990 for pillow basalts at Cotton Plateau in the Nimrod Glacier area. In the book it is treated as an undisputed crystallization age, yet a more recent (2002) U-Pb zircon age that is substantially younger casts doubt on the validity of the isochron age and is only mentioned several pages later in the section on Byrd Group revisions. The younger age could be missed by a less tenacious reader, leading to unnecessary confusion. Without question, an outline of the stratigraphic framework as it evolved over time provides useful historical context, but unfortunately in *The Transantarctic Mountains* it may leave the reader with a false understanding of current thinking.

Despite some shortcomings, this is a remarkable volume, successfully triangulating between personal narrative, Antarctic reference book, and a geochemistry textbook. For those with significant experience in the TAM, it provides a range of scientific breadth that is certain to take one outside a personal specialty. For those new to the TAM, or those interested in getting started in their own discovery, this book will provide a valuable resource. For all readers it gives a thoughtful, introspective view of how our scientific understanding has evolved and how the various problems have been tackled over time. In a credible way, Faure & Mensing help to bridge the span of time between those whose primary vehicle was a sailing ship or a dogsled, and those whose primary tool is an ion microprobe.

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Life in Antarctic deserts and other cold dry environments: astrobiological analogs

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This book, the 5th in the Cambridge Astrobiology Series, provides a broad review of research in cold and dry Antarctic environments, specifically those in the McMurdo Dry Valleys (MDV), with an astrobiological perspective. Terrestrial analogues are locations on Earth that share physical or chemical conditions or features with other planetary bodies, either at present or in the past. The study of analogues is a fundamental aspect of comparative planetary science and astrobiology. As Sun *et al.* indicate in their chapter: "Studies of microbial ecosystems in analogue environments are the only way to provide a realistic basis for speculations of extraterrestrial biota". In essence, the search for extraterrestrial life begins here on Earth. The cold, dry conditions and various