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TECTONOMETAMORPHIC STUDIES IN THE CANADIAN SHIELD (PART II)

PREFACE

The present volume represents the second part of a collection of papers designed to complement the release of a new tectonometamorphic map of the Canadian Shield. Part I, published in 1997 (*The Canadian Mineralogist*, volume 35, October issue), consisted for the most part of contributions summarizing new metamorphic data for relatively small regions of the Canadian Shield, with some implications for regional tectonometamorphic interpretations. In contrast, Part II is weighted toward summaries and presentation of new metamorphic data for relatively large regions that have a more direct linkage to the new tectonometamorphic map of the Canadian Shield (see the introductory statement by Berman *et al*., which follows this Preface). These papers, covering the Superior, Southern and Grenville provinces in Ontario, the Minto block of northern Quebec, the Trans-Hudson orogen in northern Quebec and southern Baffin Island, northern Baffin Island, and the Alberta subsurface are presented first. They are followed by several papers concerned with specific metamorphic problems in geographically more restricted areas. Some of these problem-oriented papers arose from a special session on tectonometamorphic studies in the Canadian Shield held at the GAC–MAC annual meeting in Ottawa, May 19-21, 1997. In addition to the above collection of papers, a brief summary of the tectonometamorphic evolution of the Grenville Province in Quebec and Labrador is provided in the introductory article by Berman *et al*. in this volume.

The two papers by Easton can be regarded as a set of marginal notes for the Ontario portion of the Tectonometamorphic Map of the Canadian Shield (Berman 2000). The first paper focuses exclusively on the history of the Superior Province, and summarizes the available data on the conditions and timing of metamorphism within each subprovince of the Superior Province. The second paper focuses on the metamorphic history of Proterozoic rocks in Ontario, emphasizing the tectonometamorphic history of the Southern and Grenville provinces. In addition to summarizing the available data on metamorphic conditions and age of metamorphism, Easton highlights several outstanding tectonometamorphic problems present in both the Southern and Grenville provinces.

Percival and Skulski provide a summary of the tectonometamorphic history of the Minto block in the Superior Province of northern Quebec based on recent mapping projects and supporting geochronological and petrological studies. They show that this region, previously considered one of the largest granulite-facies domains on Earth, is comprised dominantly of 2.73–2.72 Ga granitoid and igneous

charnockitic rocks formed in a continental arc environment. Sparse supracrustal remnants record low-P/T, amphibole- to granulite-facies metamorphism attained during a *ca*. 2.7 Ga collisional event. The authors relate younger monazite (2.68–2.63 Ga) and titanite (2.64–2.55 Ga) ages to hydrothermal growth from channelized fluids that in their opinion may have been associated with large-scale reheating produced by lithospheric delamination. Percival and Skulski also provide documentation for an earlier orogenic event involving *ca*. 2.8 Ga intraoceanic accretion, Barrovian metamorphism, and subsequent successor arc magmatism.

The paper by St-Onge, Wodicka and Lucas presents a synthesis of the metamorphic and tectonic history of the Quebec–Baffin segment of the Trans-Hudson orogen. By comparing the tectonometamorphic histories of basement and cover units in this convergent-plate-margin setting, the authors are able to link specific metamorphic events to specific phases of orogen assembly. In particular, the authors suggest that in convergent-plate-margin settings, the attainment of granulite-facies *versus* amphibolite-facies conditions at middle levels of the crust is a function of whether the magmatic *versus* structural and geohydrological controls predominate, with granulite-facies conditions being reached in an upper-plate magmatic arc setting, and regional greenschist- to amphibolite-facies thermal peak conditions being favored in a crustal thickening (collisional) setting.

The paper by Jackson and Berman contains a summary of the mostly reconnaissance-level information available concerning geological, geochronological, and metamorphic relations on northern Baffin Island. Although most of northern Baffin Island comprises ~3.0–2.5 Ga rocks of the Committee belt, much of the Archean tectonometamorphic history is obscured by Paleoproterozoic structural and metamorphic reworking. The authors present the first thermobarometric constraints for this region; these reveal a significantly higher-pressure regime for granulite-facies rocks than recorded within the Trans-Hudson orogen on southern Baffin Island, in part described by St-Onge, Wodicka and Lucas. Jackson and Berman suggest that ~9–11 kbar, granulite-facies metamorphism on northern Baffin Island was produced in intracratonic continental crust that was thickened by ~1.84 Ga northwest-directed thrusting related to evolution of the Trans-Hudson orogen to the south, and by ~1.82 Ga southwest-directed thrusting within the Northeast Baffin thrust belt.

The paper by Burwash, Krupička and Wijbrans presents a schematic tectonometamorphic map of the subsurface Precambrian basement of Alberta, on the basis of petrographic, geochronological (U/Pb, Sm–Nd, $^{40}Ar/^{39}Ar$), and thermobarometric constraints from basement core-samples, combined with the structural fabric inferred from aeromagnetic maps for Alberta. The authors suggest that *ca*. 1.8 Ga low-grade reworking of Archean crust in southern Alberta was driven by the escape of volatiles from the subducted Manikewan oceanic crust at the time of terminal collision in the Trans-Hudson orogen. In northern Alberta, Early Paleoproterozoic – Archean crust was reworked at high grade during a *ca*. 2.05 Ga event and during the *ca*. 1.9–2.0 Ga Thelon–Taltson orogeny. Oxygen isotope data indicate that low-grade reworking during the waning stages of the Trans-Hudson orogeny involved deep circulation of meteoric fluids.

The paper by Kistsul, Glebovitsky, Vapnik and Frisch offers an overview of geological, geochronological, and metamorphic relations of the Boothia Uplift in the northern part of the Western Churchill Province, as well providing a regional set of thermobarometric and oxygen isotope data for the central part of the granulite-facies crystalline core of the uplift. On the basis of the similarity in the age of plutonism and high-grade metamorphism (*ca*. 1.9–2.0 Ga), as well as the low-P/T regime, the authors suggest that the Boothia–Somerset granulite terrane likely represents an extension of the 1.9–2.0 Ga Taltson–Thelon orogen. They point out, however, that the Boothia Uplift is marked by a syntectonic, syenitic intrusive suite that has not been reported elsewhere in this orogen.

The paper by Jungwirth, Gordon and Froese addresses the existence of a metamorphic low that had been previously defined on the basis of staurolite-bearing assemblages in the Kisseynew gneiss belt, within the Trans-Hudson orogen in northern Manitoba. The authors present thermobarometric data that indicate relatively uniform conditions across this region, and suggest that staurolite stability is maximized owing to muscovite-free prograde assemblages. They conclude that no metamorphic low is present in this region, the occurrence of staurolite being controlled by differences in bulk composition across the area.

The third paper in this volume to discuss metamorphism within the Superior Province is the regional study by Stone. In this paper, the author attempts to constrain the syn- to post-metamorphic uplift history of the Berens River subprovince through integration of data obtained by amphibole–plagioclase thermometry and Al-in-hornblende barometry with geochronological, geochemical and field data. The pressure measurements indicate that the Berens River subprovince is not a deeply eroded plutonic complex, as had been suggested in the past, as it records pressures of 3–5 kbar, not much different from those recorded from granite–greenstone terranes throughout the Superior province in Ontario. Systematic regional variation in the pressure data is related by Stone to uplift, in part related to inflation of the crust due to the emplacement of large volumes of magma. We felt it important to include this study in this collection because: 1) it uses methods akin to those used in metamorphic petrology, 2) it deals with the important topic of heat source and its role in metamorphism and tectonics, and, 3) such plutonic-suite-dominated terranes are common in the Precambrian shield. This paper provides a case study illustrating one approach to the study of these terranes, and as such, it falls under the broad theme of this issue.

The second paper in this volume focusing on the Grenville Province (Wodicka, Ketchum and Jamieson) addresses some of the same themes as explored by St-Onge, Wodicka and Lucas. Both papers illustrate the sophisticated use of metamorphic studies in addressing tectonic problems. Where St-Onge *et al*. examined a convergent-plate-margin setting, Wodicka *et al*. studied a collisional setting, focusing on two contrasting lithotectonic domains within the southwestern part of the Grenville orogen near Parry Sound, Ontario. Both domains were affected solely by Grenvillian (1300–1000 Ma) metamorphism. Granulite-facies rocks within the Parry Sound domain may have originated from heating of the middle crust caused by subduction roll-back; unlike the situation in the Trans-Hudson, magmatism coeval with granulite-facies metamorphism is volumetrically minor. Wodicka *et al*. conclude that following peak metamorphism, exhumation of the Parry Sound granulites resulted from thrusting that occurred soon after that event, whereas rocks of the Shawanaga domain were exhumed through a process of thrusting and extension. Their study also highlights the need, in geologically complex terranes, for close geographic spacing of samples and careful study of mineral textures if meaningful P–T–t paths are to be derived.

In a third paper on the Grenville Province, Peck and Valley report oxygen isotope data for cordierite–gedrite gneisses present in a discontinuous zone near the boundary between two major tectonic elements of the Grenville orogen in Ontario, the Central Gneiss Belt and the Central Metasedimentary Belt. Their interpretation of the oxygen isotope data suggests a polymetamorphic history for the rocks in question, with an older granulite-facies event and a younger amphilbolite-facies metamorphism. We have included this paper in the collection because some conclusions regarding the metamorphic history of the area need to be tested by traditional metamorphic studies, and because the authors focus on another technique that can be used in conjunction with standard petrological studies.

The papers assembled in this volume provide a summary of what is known of the tectonometamorphic history of a significant part of the Canadian Shield. It is clear from the spectrum of papers assembled here that a satisfactory understanding cannot be achieved without high-precision geochronology linked to detailed geological mapping and petrological studies. Thus, whereas enormous advances in understanding the tectonothermal evolution of the Canadian Shield have been made over the past twenty-two years since publication of the first metamorphic map of the Canadian Shield, there are still many areas that lack some of these essential datasets. We hope that this volume will serve in part as a guide to future studies aimed at understanding the tectonometamorphic history of the Canadian Shield, as well as a useful adjunct to the Tectonometamorphic Map of The Canadian Shield. We also take this opportunity to thank all of the reviewers for their time and expertise, which greatly helped to improve the contributions in this volume.

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It is my turn to add an MAC vote of thanks to Rob Berman and Mike Easton for putting together a solid thematic issue on important advances in field-oriented studies in metamorphic petrology. I have taken the liberty to append one article by Ralph Kretz on mass transfer across reaction zones between amphibolite and quartzofeldspathic gneiss in the Otter Lake area of Quebec, in the southern part of the Grenville Province. Also included is a re-issue of a relevant article by S.R. Elliott-Meadows, E. Froese and E.C. Appleyard, first published in volume 37, pages 375-380. In that article, serious problems arose in the figures after the proofs were seen and approved. Thus rather than reprint an erratum containing only the affected figures, here it is in its entirety.

Robert F. Martin, editor