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TECTONOMETAMORPHIC STUDIES IN THE CANADIAN SHIELD (PART I)

PREFACE

Since the 1978 publication of the first metamorphic map of the Canadian Shield, there have been fundamental advances in understanding the relationship between metamorphism and tectonics, as well as in developing geochronological and petrological techniques needed to fully characterize the timing and physical conditions of metamorphic events. In order to appreciate the impact of these advances on understanding the tectonometamorphic history of the Canadian Shield, a new tectonometamorphic map of the Canadian Shield is being prepared. The present collection of papers is the first part of a two-part series aimed at complementing the publication of this new map. Part I consists of papers summarizing detailed results from specific areas of metamorphic interest, with some implications for regional interpretations. Part II, to be published next year in this journal, will be weighted toward regional summaries with more direct linkage to the new tectonometamorphic map of the Canadian Shield.

In the present collection, the eleven papers have been arranged in a general geographic progression from west to east across the Canadian Shield. This arrangement also corresponds to a temporal progression from old to young, although no paper in the present collection focuses on Archean metamorphic rocks. The papers include two on the ~1.99–1.93 Ga Taltson Magmatic Zone on the western edge of the Shield, two on the ~1.86–1.80 Ga Trans-Hudson Orogen, one on the ~1.86–1.78 Ga Torngat Orogen, five in the ~ 1.0–1.4 Ga Grenville Orogen, and one on the ~0.4 Ga metamorphism in the Cape Breton Highlands. The occurrence of Precambrian rocks in the Cape Breton Highlands warrants inclusion of the latter paper in this collection. The common thread among these geographically and temporally diverse papers is the integration of field, structural, geochronological and metamorphic data to address specific tectonic problems or to provide constraints on regional tectonic models.

The papers on the Taltson Magmatic Zone (TMZ) by Berman & Bostock (northern TMZ) and Grover *et al.* (southern TMZ) combine field and petrological data with available geochronological data to demonstrate that widespread granulite-facies metamorphism is largely related to Proterozoic (~1.96–1.92 Ga) granite plutonism, rather than to an Archean event, as previously suggested. From observed parageneses and geothermometry results, Grover *et al.* document a decrease in metamorphic grade from west to east in the southern TMZ. The application of a new "Al-in-Opx" thermometer by Berman & Bostock, more resistant to retrograde resetting than Fe–Mg exchange thermometers, indicates attainment of higher temperatures (~950°C) than those encountered in "normal" collisional orogens. A similar study is required in the adjacent Thelon tectonic zone in order to determine whether specialized tectonic processes were operating over the entire Taltson–Thelon zone, or whether they were localized in the TMZ.

The complementary Trans-Hudson Orogen papers by Menard & Gordon and Kraus & Menard present P–T path and P–T data in the context of regional geochronological constraints and relative timing of deformational events, in order to constrain a tectonic model for this orogen. Menard & Gordon present detailed petrographic and chemical data for assemblages within alteration zones in the Kisseynew domain and near Snow Lake. They conclude that similar P–T conditions were reached in both areas during F_2 deformation, but that the Kisseynew

domain underwent near-isobaric heating subsequent to F_2. Kraus & Menard provide new P–T and microstructural data, and summarize geochronological constraints on the timing of deformation and metamorphic events. After reviewing alternative models, they argue that the Kisseynew thermal anomaly was related to heat advection by late (~1.815 Ga) granitic plutons that may have been produced by convective thinning of the lithosphere during crustal thickening.

Mengel & Rivers summarize the results of a detailed traverse across the Komaktorvik shear zone (KSZ), which separates the Burwell domain from Nain Province gneisses in the Paleoproterozoic Torngat Orogen. Peak P–T conditions appear to have been similar within and on both sides of the KSZ. Available geochronological data, however, suggest that peak conditions were not reached synchronously, with exhumation beginning in the core of the orogen and migrating outward toward the foreland. The authors suggest that zircon and titanite systematics reflect dynamic recrystallization below their respective temperatures of closure in high-strain zones following penetrative shearing.

Five papers in this volume deal specifically with metamorphism in the Grenville Orogen. The papers by Indares and Hynes & St-Jean both describe the relationship between metamorphism and regional tectonic history in the eastern Grenville Orogen, near Manicouagan. The paper by Indares describes a newly discovered region of widespread eclogite-facies rocks in the Manicouagan Imbricate Zone; she discusses the difficulties in getting reliable P–T estimates from such rocks. To date, high-pressure rocks have only been reported from the Parautochthonous Belt of the orogen, a relationship that needs to be accounted for in tectonic models of the orogen. It is worth remembering that eclogite-facies rocks were first reported from the western Grenville Orogen only a decade ago. Hynes & St-Jean use metamorphism to understand the late-stage structural history between two adjacent terranes just east of the area studied by Indares. Their work not only illustrates how metamorphic studies can be used to constrain tectonic history between terranes, but how the metamorphic constraints on tectonic history provide additional, contradictory results to those based on structural studies alone. Hynes & St-Jean also provide an example of the difficulties in obtaining reliable geothermobarometric data from high-grade rocks.

The paper by Bethune & Davidson also deals with rocks from the parautochthon, albeit in the western Grenville Orogen near the Grenville Front. They describe the metamorphism of the *ca.* 1.235 Ga Sudbury dike swarm south of the Grenville Front, and the implications for exhumation of rocks within the western Grenville Front Tectonic Zone.

The other two Grenville papers focus on the Central Metasedimentary Belt of the Orogen. Ford & Skippen describe the metamorphic history of ultramafic pods located near the Elzevir–Mazinaw terrane boundary in Ontario, and the linkage between the metamorphism of the ultramafic rocks and adjacent pelitic rocks of the Flinton Group. Streepey *et al.* provide an overview of existing geothermobarometric data for the Central Metasedimentary Belt in Ontario and New York. Although there is an abundance of data for the Central Metasedimentary Belt compared to many other parts of the Shield, there are still many gaps in the coverage that prevent a complete understanding of the metamorphic history of the different terranes and domains of this small part of the Shield.

In the last paper of this volume, Currie & Lynch present new P–T data pertaining to ~0.4 Ga (Silurian–Devonian) metamorphism in the Cape Breton Highlands, which form the plutonic–metamorphic core of the Appalachian Orogen. With application of a recently calibrated hornblende barometer, the authors find a pressure discontinuity that supports the interpretation of a tectonic break between the upper amphibolite Cabot suite and the lower grade Jumping Brook suite. Thermal modeling is used to constrain this metamorphic process as well as the ensuing uplift and cooling history.

Taken as a whole, it is clear from the collection of papers in this volume that advances in quantitative assessment of metamorphic conditions and the timing of metamorphic events have greatly improved our ability to answer first-order questions regarding specific tectonometamorphic events and processes. Although the current data do not allow all aspects of tectonic processes to be defined unambiguously, they do move us closer to this goal by ruling out some possibilities, and by focussing attention on gaps in the data sets, and on questions that need to be addressed in future studies.

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