THE GEOLOGY OF THE SOUTHERN PART OF THE NORTH ARM MOUNTAIN MASSIF, BAY OF ISLANDS OPHIOLITE COMPLEX, WESTERN NEWFOUNDLAND WITH APPLICATION TO OPHIOLITE OBDUCTION AND THE GENESIS OF THE PLUTONIC PORTIONS OF OCEANIC CRUST AND UPPER MANTLE

by

John F. Casey

A Dissertation

Submitted to the State University of New York at Albany

in Partial Fulfillment of

the Requirements for the Degree of

Doctor of Philosophy

College of Science and Mathematics

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ABSTRACT

The Bay of Islands Ophiolite Complex forms a discontinuous belt of highly allochthonous mafic and ultramafic massifs in southwestern Newfoundland. The North Arm Mountain Massif contains the only significant exposures of sedimentary rocks overlying the ophiolite and also contains the most extensive exposures of plutonic rocks in the Bay of Islands Complex. Mapping has shown that sedimentary rocks, here named the Crabb Brook Group, rest with a pronounced erosional unconformity on ophiolitic rocks. Lithologic,paleontologic, facies, structural, and tectonic relationships indicate that this Group was deposited on the back of the ophiolite allochthon as it was being obducted onto the early Paleozoic Continental Margin. These sedimentary rocks may correlate with others associated with ophiolites in the Northern Appalachians which, as yet, are of unknown age and affinity. Regional tectonic and paleogeographic relationships in Western Newfoundland allow evaluation of the obduction process and models are developed to explain features which are common to many obducted ophiolite bodies. Many features observed in the plutonic complex of the North Arm Massif are inconsistent with models of ophiolite generation which involve small multiple magma chambers and in many cases are contrary to the notion that the majority of layered plutonic rocks were formed by differential settling and accumulation. A combination of field, structural, and petrographic relationships indicate

that the bulk of the North Arm Plutonic section formed as a result of *in situ* nucleation and crystal growth on the bounding surfaces of a continuously evolving, chemically zoned, steady state magma chamber.

-- To those whose attention has never been called to the former changes in the earth's surface which geology reveals to us, the position of land and sea appears fixed and stable. . . . . In every century the lands in some parts (of the Globe) are raised and in others depressed, and so likewise is the bed of the sea.

Sir Charles Lyell, 1875, p. 253

Sunset over Sandy Pond on the
North Arm Mountain Massif

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This chapter is self-explanatory. Chapter II includes a brief discussion of the regional geological setting of the ophiolite bodies of the Bay of Islands. Chapter III contains descriptions and interpretation of sedimentary rocks now overlying the Bay of Islands Ophiolite of North Arm Mountain and their regional significance in the Northern Appalachians. Chapter IV includes a discussion of mechanisms of emplacement of these ophiolite bodies, and a general discussion of the initiation of subduction zones and the constraints on the type of ocean in which the Bay of Islands was formed. Chapter VV includes descriptions and interpretations of structures and lithologies contained within the residual ultramafic component of the ophiolite. Chapter VI and VII deal with the structure, lithology, and petrography of the plutono-magmatic component of the ophiolite, in particular, the coarse-grained plutonic rocks. Interpretations as to the size, shape, and longevity of the subaxial magma chamber that produced the Bay of Islands plutonic section are made, and a refined model for the plate accretion process at an oceanic spreading center is presented.

Some chapters contain repetitive information and figures

as they have been written as working preprints for future publications. Additional publications (with colleagues as acknowledged) that are already in press or published, and that directly result from this study are presented in the appendices.

1:7 Acknowledgements

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