OPERATION OF THE WILSON CYCLE IN WESTERN NEW ENGLAND DURING THE EARLY PALEOZOIC: WITH EMPHASIS ON THE STRATIGRAPHY, STRUCTURE, AND EMPLACEMENT OF THE TACONIC ALLOCHTHON

by

DAVID B. ROWLEY

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

Department of Geological Sciences

OPERATION OF THE WILSON CYCLE IN WESTERN NEW ENGLAND DURING THE EARLY PALEOZOIC: WITH EMPHASIS ON THE STRATIGRAPHY, STRUCTURE, AND EMPLACEMENT OF THE TACONIC ALLOCHTHON

by

DAVID B. ROWLEY

Abstract of 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

Department of Geological Sciences

1983

ABSTRACT

This dissertation treats various aspects of the pre-Silurian history of the northern Appalachians. The primary focus is western New England, and the stratigraphy, structure, and emplacement history of the Taconic Allochthon. Detailed mapping in the Lake Bomoseen area (Plates 1-3) and previously completed mapping are used to discuss the stratigraphy (Chapter 3) and structure (Chapter 4) of the Allochthon. The lithostratigraphy of the Giddings Brook slice is revised. The Cambrian? Bull Formation (revised) of the Nassau Group (new) consists of the Mettawee Slate facies (revised), Bomoseen, and Truthville Slate Members. The Lower Cambrian to Middle Ordovician Browns Pond, Middle Granville Slate (new), Hatch Hill (revised), Poultney (revised), and Indian River Slate Formations constitute the Mount Hamilton Group (revised). The West Castleton and White Creek are now considered Members of the Hatch Hill Formation. The Mount Merino and Pawlet Formations comprise the Willard Mountain Group (new).

Chapter 3 also emphasizes along- and across-strike variability in the stratigraphy of the Giddings Brook slice. First-order facies-controlled variations are used to divide the Giddings Brook slice into a number of paleogeographically distinctive sequences (Nappes of Chapter 7) derived from different positions on the ancient continental rise.

The most important structural conclusions derived from the Lake Bomoseen area are that the northern end of the Allochthon is bounded by a folded, D_1 age thrust (the Basal Thrust) associated locally with melange and slivers of carbonate. Comparable D_1 thrusts with tectonic melanges are recognized within the Allochthon. Large-scale D_2 folds

with an associated axial surface slaty cleavage define the map pattern, fold the Basal Thrust, but show variability in amplitude, wavelength, and style within the Allochthon. An unfolded D_3 thrust fault (the Frontal Thrust) marks the western edge of the Allochthon. Similar age thrusts are prominent within the Allochthon. These D_3 thrusts also imbricate the structurally subjacent shelf, and may sole into the Champlain Thrust.

Biostratigraphic correlations of shelf and continental rise sequences are used to examine the relationship between transgressive-regressive history of the shelf with changes in type of sediment and mode of sedimentation on the coeval continental rise in Chapter 5. A close correlation is demonstrated.

Chapter 6 discusses the implications of (1) a completely conformable stratigraphic relationship between the medial Ordovician Pawlet flysch and underlying Taconic sequence in the western Giddings Brook slice, and (2) Taconic-, metasedimentary-, and volcanic-derived clasts within the Pawlet greywackes. These observations suggest that the Allochthon was thrust-stacked from east to west in an accretionary prism environment prior to being emplaced onto the coeval shelf. Thrust stacking and obduction of the Allochthon is correlated with a medial Ordovician arc-continental margin collision.

Chapter 7 emphasizes the importance of recognizing the difference between nappes and slices. Nappes are paleogeographically distinctive stratigraphic assemblages, whereas slices are structural assemblages of nappes juxtaposed along thrust faults decorated with shelf-derived carbonate slivers. The stacking of nappes pre-dates obduction onto the shelf whereas the stacking of slices post-dates it. Models accommodating this distinction are discussed.

The Champlain Thrust juxtaposes sequences of the early Paleozoic shelf that differ markedly in facies, total thickness, thickness per time interval, and age span represented by the sequences. Chapter 8 outlines three trigonometric models for estimating displacement on such thrusts based on the first-order, pre-thrusting geometry of modern Atlantic-type shelf sequences. Calculations of displacement for the Champlain Thrust using these methods suggest that the parautochthonous shelf sequence, Green Mountain anticlinorium, and Taconic sequence were transported westward 80 km or more. This estimate is supported by recently published seismic reflection data.

Chapter 9 analyzes the pre-Silurian stratigraphy of the northern Appalachians and defines about a dozen 'suspect terranes' (Plate 9.1). Particular attention is paid to terranes that record medial Ordovician tectonism. Plate tectonic scenarios are constructed to attempt to explain the stratigraphic, structural, metamorphic, and magmatic histories of these terranes.

ACKNOWLEDGMENTS

It is virtually impossible to adequately thank and acknowledge all of the people who have contributed in various ways to the completion of this dissertation. I apologize to all of those whose names do not appear here, but who have helped to make this work possible.

I thank all of the people who has spent time in the field with me, providing me with their insights, opinions, and contrasting views of this interesting yet often controversial region. I especially thank Bill Bosworth, Jim Pindell, Louise Delano, Bruce Idleman, Michelle Aparisi, Chris Steinhardt, Cal Cooper, Bill Kidd, Barry Doolan, Win Means, John Dewey, Steve Schamel, Bob Hatcher, John Rodgers, Don Fisher, Paul Post, Cliff Ando, Rolf Stanley, and Steve Chisick among many others. I also thank the students of the SUNY-Albany field course for beating the bushes for interesting outcrops and for their enthusiastic questioning of all that is 'known' about Taconic geology.

Field work in the Taconics and adjacent areas of central Vermont was made considerably more pleasant through the assistance and companionship of several field assistants and colleagues, including Wayne Friesatz, Dave Gallo, Steve Tanski, Michelle Aparisi, and Cathy Shrady. The Colgate field course, "The Dog", and Furlows always provided much needed escapes from the night time tasks of field mapping. I especially thank Reneé Gangas for enduring long days, mosquitos, and my frustrations while providing companionship, encouragement, and great gastronomical delights for part of the 1981 field season.

Many colleagues at SUNY-Albany and other institutions provided me with much needed stimulus and criticism through discussions over the many years taken to complete this work. Many of these individuals are mentioned above, but I would like to add to this list, Dwight Bradley, Mike Klimetz, Doug Nelson, A.M.C. Sengor, Dr. Robert Neuman, Nick Ratcliffe, Lucien Platt, Jack Bird, and many other New England geologists. I thank them all.

Dr. E-an Zen has continually encouraged this work and I am deeply indebted to him for sharing his knowledge.

I thank my thesis committee, Drs. Win Means, Kevin Burke, and Barry Doolan, and my advisors Drs. John Dewey and Bill Kidd for taking the time to discuss, read, and criticize the contents of this dissertation. Their comments and encouragement are greatfully acknowledged. In addition, I would also like to thank the rest of the faculty and staff of the Department of Geological Sciences for their help and assistance.

My parents and family have contributed in innumerable ways to the completion of this work. Without their continuing support this dissertation would never have been possible. There is no way to adequately express my deep appreciation.

I also owe a debt of gratitude to Reneé Gangas for her friendship, and for enduring a year of social deprivation and loneliness while I attempted to bring this work to fruition. Her caring and patience can never be repaid.

Heather Sloan and Robin expertly drafted the stratigraphic columns contained in chapter 9 as well as several other figures. Marylin Bowie kindly typed most of the figure captions and helped with the few typing corrections that needed to be made.

Financial support from the Department of Geological Sciences and the State University of New York at Albany are gratefully acknowledged.

This research has also been generously supported by grants from P.B.A., the Geological Society of America Penrose Fund, a National Science Foundation Doctoral Dissertation Improvement Grant, and N.S.F. Grant No. EAR-8116921.

The extreme patience and understanding shown me by Dr. A.M. Ziegler while trying to complete this dissertation as a 'post-doctoral' fellow at The University of Chicago are also gratefully acknowledged. The encouragement and support of my friends and colleagues in the Paleogeographic Atlas Project at the University of Chicago also helped considerably.

Finally, I express my most heartfelt thanks and appreciation to Diane Paton for her friendship, her perseverance, and excellent typing without which all of the necessary details of completing this dissertation would never have been finished.

Thank you one and all!

DEDICATION:

To my Parents and Grandparents -
Who through their example showed
me the pleasure and satisfaction
of hard work and scholarly pursuits

TABLE OF CONTENTS

Page

Page

Page

LIST OF FIGURES

Figure Number		Page

Figure Number		Page

Figure Number		Page

LIST OF TABLES

LIST OF PLATES