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# Structural geology of the Fort Miller, Schuylerville and portions of the Schaghticoke 7½' quadrangles, eastern New York, and its implications in Taconic geology; and experimental and theoretical studies of solution transfer in deforming heterogeneous systems

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STRUCTURAL GEOLOGY OF THE FORT MILLER, SCHUYLerville AND  
PORTIONS OF THE SCHAGHTICOKE 7½' QUADRANGLES,  
EASTERN NEW YORK, AND ITS IMPLICATIONS  
IN TACONIC GEOLOGY  
and  
EXPERIMENTAL AND THEORETICAL STUDIES OF SOLUTION TRANSFER  
IN DEFORMING HETEROGENEOUS SYSTEMS

by

William P. Bosworth

Abstract of a Dissertation

Submitted to the State University of New York at Albany  
in Partial Fulfillment of  
the Requirement for the Degree of  
Doctor of Philosophy

College of Science and Mathematics  
Department of Geological Sciences

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## ABSTRACT

Stratigraphies previously proposed for the Taconic sequence of southern Washington County, eastern New York, have incorrectly defined and positioned lower Cambrian black slate units. The proper sequence of Cambrian (?) through Cambrian lithologies is (terminology from Jacobi, 1977): Bomoseen green wacke, Truthville green slate, Browns Pond black slate, Mettawee purple and green slate, and West Castleton and Hatch Hill black slates. This and the entire Taconic sequence is conformable within the western Giddings Brook slice. The detailed lithostratigraphy reported by Jacobi (1977) and Rowley (1980) in northern Washington County can be followed at least some 45 kilometers to the south (Fort Miller, Schuylerville, Cossayuna and Cambridge 7½' quadrangles) in the westernmost portions of the allochthon. Within some units, variations between "sub-domains" can be recognized. Lithologic characteristics suggest that each sub-domain records deposition at slightly different positions (distal/proximal) on the Cambro-Ordovician North American continental rise. These stratigraphic sub-domains correspond with areas of internally coherent structure (fold and cleavage orientation, sense of structural facing). Together these define an assemblage of imbricate thrust sheets within the western Giddings Brook slice.

The basal Taconic thrust and thrusts internal to the allochthon cut obliquely across fold axes, hinge lines and cleavage in the allochthon and the underlying Hudson flysch. Allochthon emplacement clearly post-dates the earliest regional

slaty cleavage development and two generations of large-scale tectonic folding. Tectonic slivers and fault rocks (Bald Mountain Terrane) present along the basal Taconic thrust initially formed as the allochthon ramped over the Cambro-Ordovician North American continental shelf. The fold-thrust mode of deformation continues in the underlying flysch sequence of the Hudson River lowlands. The progressive development of structures observed within these units is analogous to the formation of structures within the leading edge of a subduction-accretion assemblage.

\* \* \*

Halite single crystals loaded dry and then placed in brine are preferentially dissolved at surfaces adjacent to regions of high plastic strain. Riecke's Principle satisfactorily accounts for the observed distribution of dissolution rates in these and the circular hole experiments performed by Sprunt and Nur (1977), but plastic strain probably dominates over elastic strain in the free energy calculations. Faster dissolution of crystalline material with high defect concentrations is the mechanism suggested to be responsible for this phenomenon.

Although pressure gradients may dominate over strain energy terms in chemical potential calculations along grain-to-grain contacts, the role of permanent strain should be considered in the total physicochemical process of diffusive mass transfer (pressure solution). Of particular importance is knowledge of the rate limiting step in the transfer sequence,

which may occur at grain boundary - pore fluid junctions. There the kinetics of dissolution/precipitation may play a significant role.

The thermodynamic and kinetic criteria for equilibrium between states are not truly equivalent. This becomes an important consideration when forward and reverse reactions of a given change of state occur by different reaction pathways, as may be the case for dissolution/precipitation at a strained solid-fluid interface. The possibility then arises that solution transfer mechanisms exist which are driven by kinetic rate differentials rather than the energy change between solid and solution state. A complete theoretical analysis of any model designed to represent solid-fluid interactions during deformation will require a knowledge of state energy levels, reaction mechanisms and their associated activation energies, and the various parameters of diffusion within each state and along phase interfaces. Not only must the effects of deformation through fluid-assisted diffusive mass transfer be considered, but also the role of fluid phases in the plasticity of crystalline material. These two general processes may be easily confused in both experimental analogues of geologic systems and the naturally occurring rocks themselves.

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In remembrance of Paul and Josephine Malloy.

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