MICROSTRUCTURAL ANALYSIS OF THE RHODE ISLAND FORMATION FROM THE SOMERSET DRILL CORE, NARRAGANSETT BASIN, MA: EVIDENCE FOR ALLEGHANIAN UPPER GREENSCHIST-FACIES METAMORPHISM AND DEFORMATION

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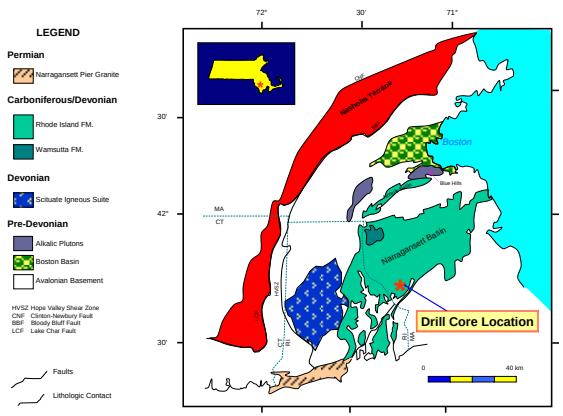
ABSTRACT

The Narragansett Basin represents a Pennsylvanian-age transtensional basin that developed within the Avalon Terrane in Late Paleozoic time. The Narragansett Basin contains a variety of clastic lithostratigraphic units, with the Rhode Island Formation being the most extensive. Following deposition and lithification, the Rhode Island Formation experienced intense deformation and metamorphism as a result of the collision between Gondwana and eastern North America. This event resulted in widespread deformation and high grade metamorphism mainly concentrated throughout southern Rhode Island. Metamorphism within the Narragansett Basin generally decreases from sillimanite grade in the south to very low grade conditions in southeastern Massachusetts.

This project investigated the lithologic and microstructural characteristics of the lower portion of a 500 meter deep drill core obtained along the eastern margin of the Narragansett Basin near Somerset, MA in the early 1970's. The core consists of a tilted and folded sequence of alternating layers of non-marine sandstones and siltstones with varying amounts of organic coal. Microstructural analysis reveals evidence for episodes of low temperature deformation as well as a high temperature event with associated greenschist-facies metamorphism. The low temperature episode is preserved as a predominantly pressure solution cleavage with locally developed pressure fibers of quartz on pyrite. The higher temperature episode was dominated by crystal-plastic deformation in quartz and is preserved as statically recrystallized microtextures. Mineral assemblages near the bottom of the core contain abundant biotite and biotite/chlorite pseudomorphs after garnet. Conditions of metamorphism are estimated to have been in excess of ~450-500°C for the lower portion of the drill core which is consistent with the quartz microstructures. The effects of higher temperature metamorphism within the Narragansett Basin in eastern Massachusetts may be more pronounced than previously thought. Petrologic data from the Somerset drill core provide us with a new perspective for assessing the nature and extent of the Alleghanian Orogeny throughout New England.

Generalized tectonostratigraphic map of eastern New England

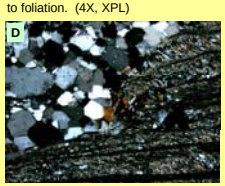


Petrographic-Microstructural Characteristics

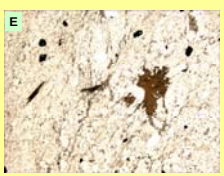
Small fold in quartz-rich layer. Micas and opaque minerals elongated parallel to foliation. (4X, XPL)

Crenulation cleavage in more pelitic layer. (4X, XPL)

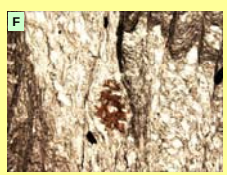
Shearing and alignment of fine-grained micas. (4X, XPL)



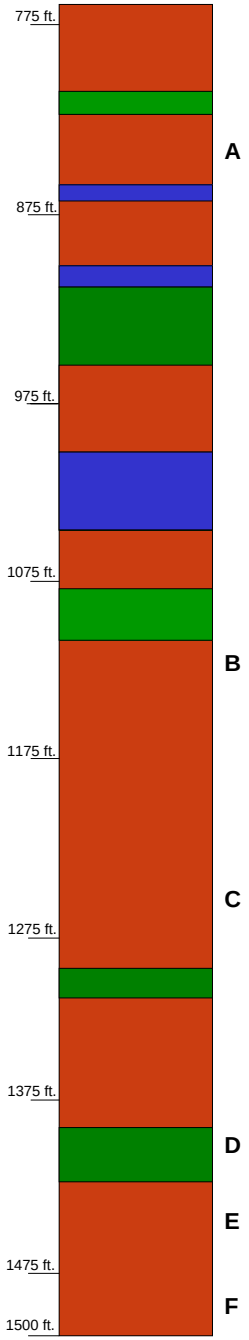
Crenulations within more pelitic-rich layer. Equant quartz grains reflect post-deformation recrystallization. (10X, XPL)



Detrital (?) biotite grain containing a zircon. (4X, PPL)



Photomicrograph of syn-tectonic (?) biotite porphyroblast. (10X, PPL)



Evidence of Low Temperature Deformation

Pressure shadows on opaque grain and well-developed slaty cleavage. (4X, XPL)

Pressure fibers on opaque grain within fine-grained slate. (10X, XPL)

Evidence of High Temperature Metamorphism

Garnet pseudomorph: chlorite and biotite after garnet. (10X, PPL)

Crenulation folds; relict biotite within quartz-rich layer. (4X, XPL)

Pseudomorphs after garnet displaying asymmetric shearing. Low T pressure solution overprints high T fabric. (4X, PPL)

Post-deformation recrystallization of quartz suggesting high T recovery. (4X, XPL)

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