STRUCTURAL CHARACTERISTICS OF THE MORETOWN AND BARNARD MEMBERS OF THE MISSISQUOI FORMATION, CHESTER AND ATHENS DOMES, VERMONT

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INTRODUCTION

The rocks of the Moretown and Barnard Members of the Ordovician Missisquoi Formation have been multiply deformed around the Chester and Athens Domes. This deformation has occurred in several stages, with the last two major stages transpiring during the Acadian orogeny. Structural data from the Moretown and Barnard could provide clues to the nature of these deformations.

PETROGRAPHIC DESCRIPTION

The Ordovician Moretown Member is predominantly composed of alternating thin (one to twenty centimeter thick) layers of quartz-rich and biotite-muscovite-chlorite-epidote-quartz-garnet schist (Doll, at al., 1961). The resulting "pinstripe" effect is highly distinctive of this formation. The parent material of the Moretown is thought to be volcanic material from an island arc situated off-shore during the Ordovician interbedded with sediment from the continent. These eugeosynclinal deposits were sutured onto the continent during the Taconic orogeny (Stanley and Ratcliffe, 1985).

The Ordovician Barnard Member is composed of thick (30 centimeter to several meter) layers of mafic schists separated by thin (several centimeters) layers of felsic schist. The mafic layers contain large amounts of hornblende with actinolite, plagioclase, and biotite. The felsic layers are mostly quartz with some plagioclase, hornblende, and actinolite (Carroll, 1989). It is lithologically very similar to the Ammonoosuc Volcanics present to the east and may have resulted from bimodal volcanic activity related to overthickening of the crust (Stanley and Ratcliffe, 1985).

REGIONAL GEOLOGY

The folding present in the Chester and Athens Domes is primarily a result of the Devonian Acadian orogeny (Karabinos, 1989). The Acadian orogeny appears to consist of two main deformational phases: an early nappe-building phase and a later gneiss doming phase (Thompson, et al, 1968). In most locations in the Chester and Athens Domes fabrics from the earlier phase of nappe building has been heavily overprinted by fabrics from the later phase, and is some locations the earlier fabric is missing completely.

PURPOSE AND METHODS

The purpose of this study is to survey the structural characteristics of the Moretown and Barnard around the Chester and Athens Domes and relate them to the different phases of the Acadian orogeny. Several localities were sampled, including areas near Townsend, Harmonyville, Springfield, Houghtonville, in Proctersville Gulf, and along the William's River (see figure 1). Sampling included hand samples for thin-section analysis and data on foliations, mineral lineations, fold axes, and axial planes.

RESULTS

Figures 1 and 2 present a summary of structural data recorded. It is fairly clear from this data that most of the minor structures sampled are fairly co-linear or co-planar and line up with the large-scale structures of the Chester and Athens Domes. This conclusion is supported by preliminary thin-section data. Certain structures, for example lineations and folds at stops 2 and 3 (see figure 2b and 2c), are not parallel to regional trends. The latter are often overprinted with the former, suggesting that the non-parallel fabrics are from an earlier stage of deformation.

Origin

A granitic rock is said to be peraluminous if it has the ratio:

$ASI = Al_2O_3/(CaO+K_2O+Na_2O) > 1.0$

All five of the analyzed intrusions are highly peraluminous with ASI values much greater than 1.0.

The CIPW normative mineral calculation shows a corundum normative in all of the samples (see table 1). The presence of greater than 1% corundum in the norms for all five intrusions strongly suggests that they are S-type peraluminous granites originating from partial melting of a sedimentary source.

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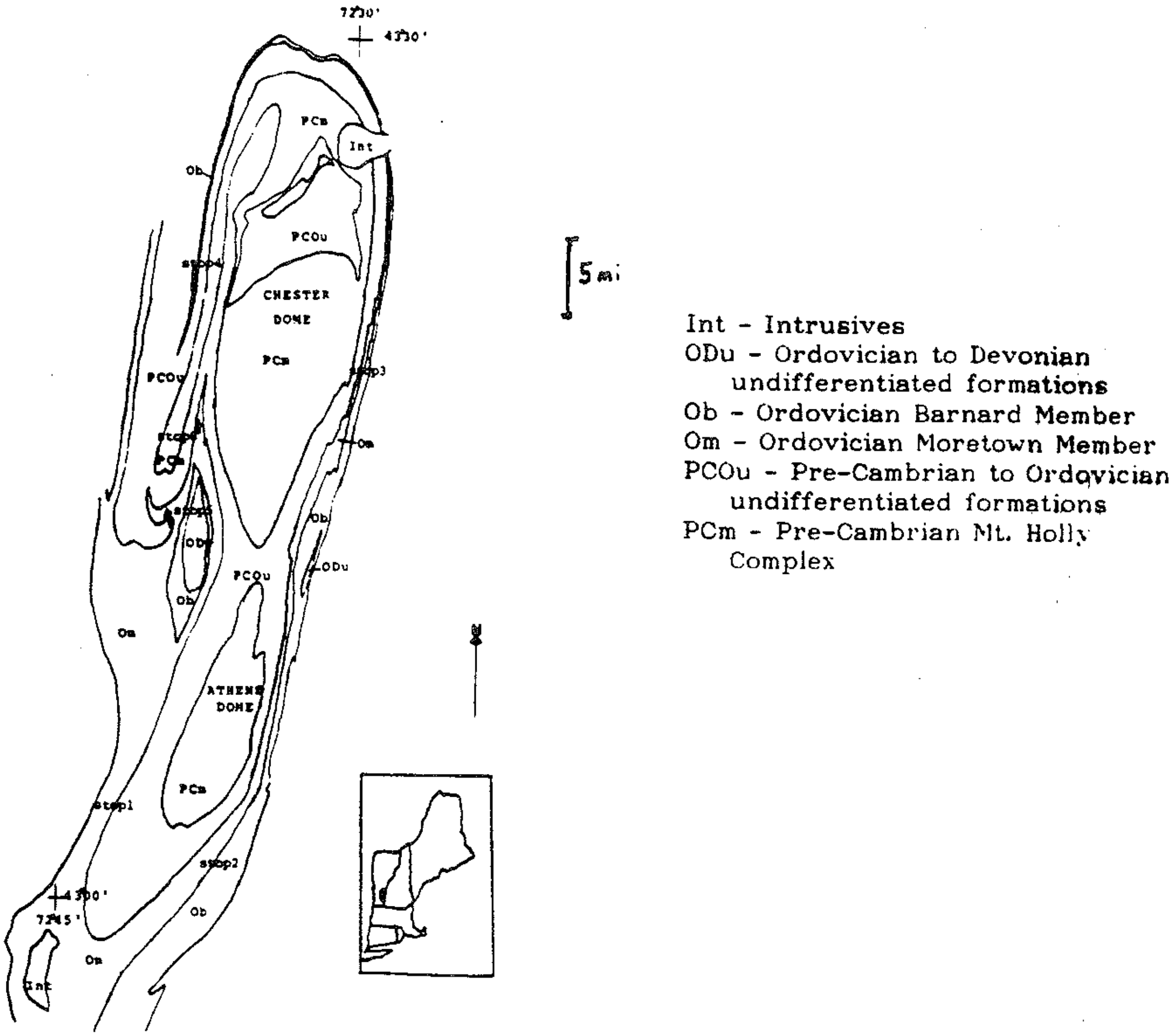
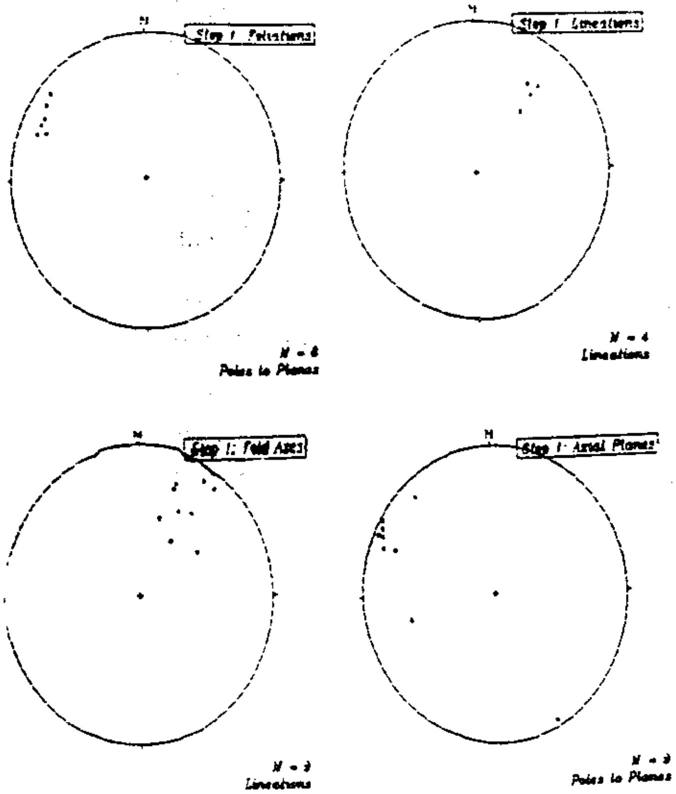
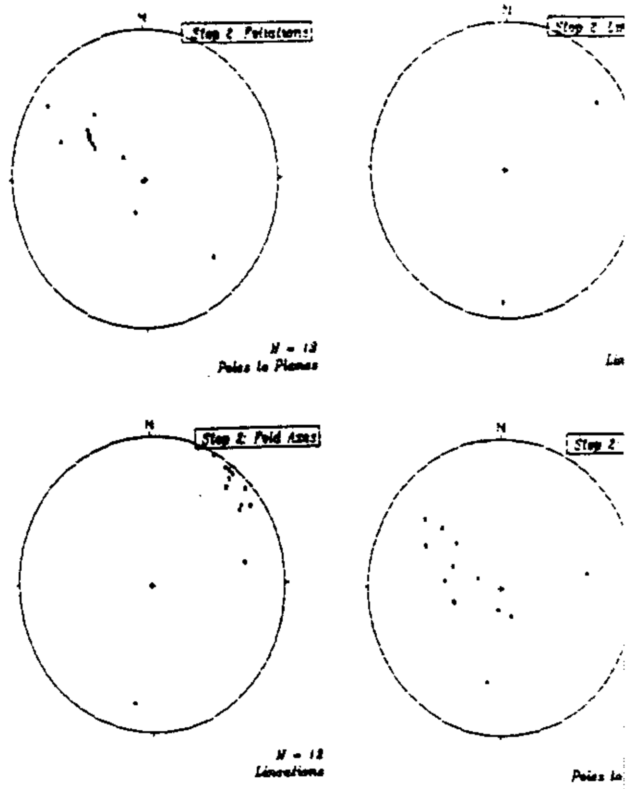


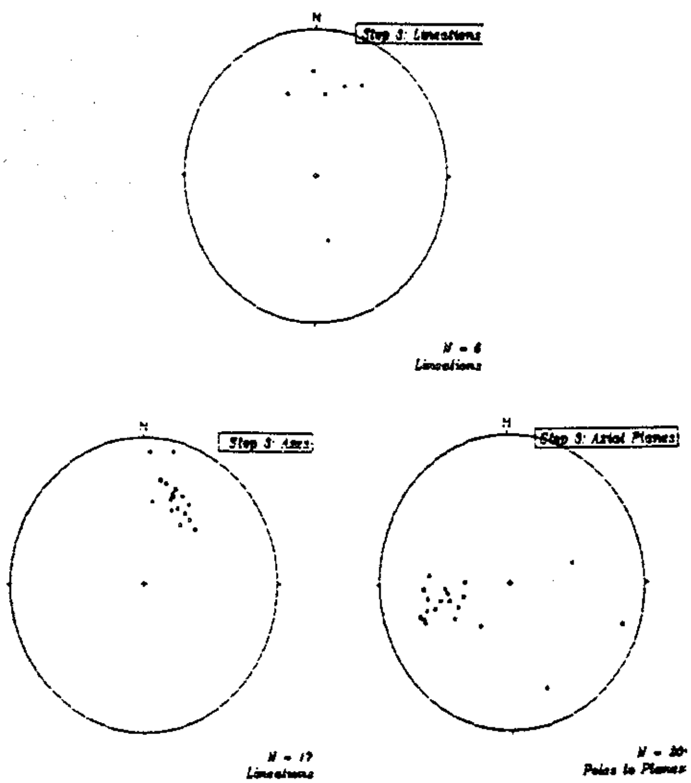
Figure 1 - Generalized Bedrock Map of the Chester Dome Area, Vermont, with sample locations (after Doll et al., 1961).



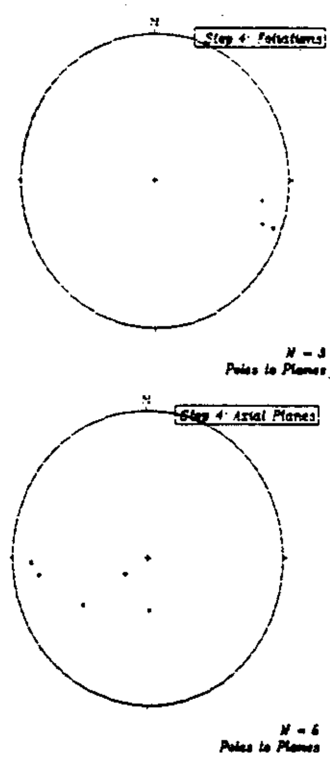
2a Townsend



2b Harmonyville

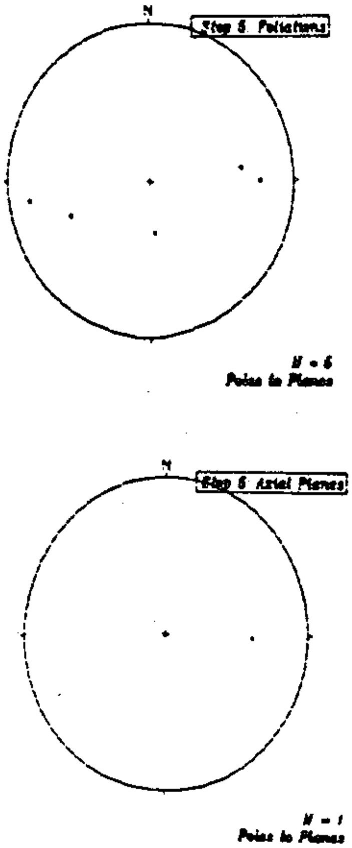


2c Springfield

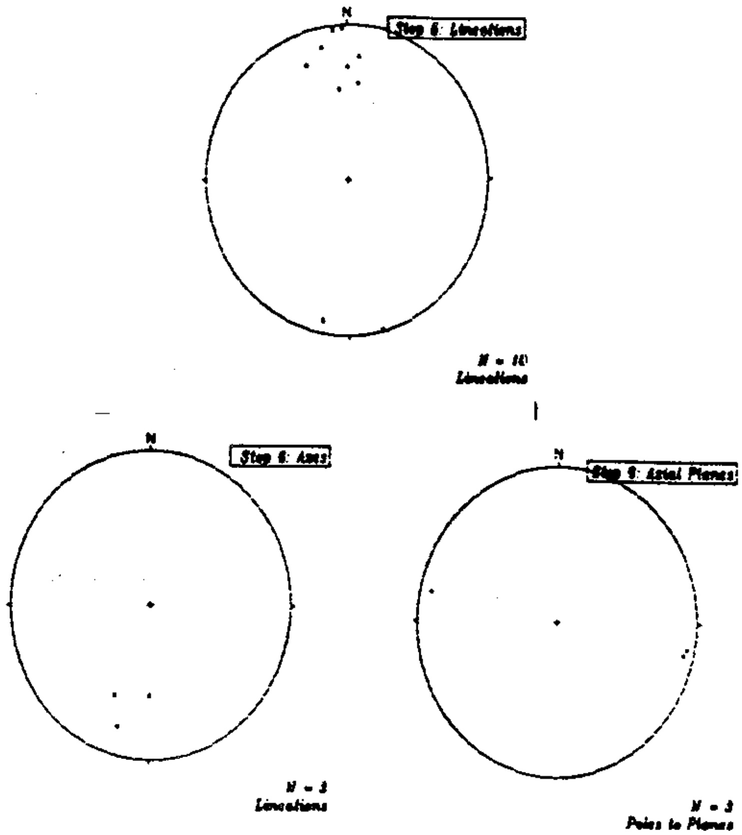


2d Proctersville Gulf

Figure 2 - Stereographic Projections of Foliations, Mineral Lineations, Fold Axes, and Axial Planes for Stops 1 - 6.



2e Houghtonville



2f William's River

STRATIGRAPHY AND METAMORPHISM NEAR THE TOWNSEND RESERVOIR, SOUTHEASTERN VERMONT

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The remarkable exposure of bedrock in the spillway of the Townsend Reservoir in southeastern Vermont provides an excellent opportunity to examine the lithologic sequence and metamorphic history of the rocks present. The study area flanks both the western side of the Athens Dome and the eastern side of the Green Mountain massif. The Green Mountains and Athens Dome are cored by Precambrian Grenville rocks; the units separating them are late Proterozoic to Paleozoic in age.

According to Doll et al. (1961), the rock units in the study area follow the stratigraphic sequence, whereas Stanley and Ratcliffe (1985) argue that thrust faults have eliminated some of the units.

In the field a detailed survey was taken of the rocks in the reservoir spillway. Abundant outcrops both upstream and downstream of the reservoir also were mapped and examined.

A cross section of the Townsend reservoir spillway, a map of rocks upstream of the reservoir, and studies of thirty thin sections of the units were used to compare the lithologic sequence found in the field with that of Doll et al. (1961). These units were also compared among themselves for evidence of the repetition of layers and thrust faulting.

FIELD OBSERVATIONS

Most of the field work for this study was in the spillway of the Townsend reservoir. The outcrop was divided into seven units based on composition. The units are the following: pelitic albite schist; thinly layered (1-2m); pelitic schist (some mafic layers); fine grained Mafic Schist; rusty pelitic garnet schist; fine grained mafic schist; graphitic pelitic garnet schist; fine grained mafic schist; and pelitic schist. Although the nature of the pelitic schists, many of which contain large (>1cm) garnet porphyroblasts, varies substantially, the fine grained mafic schists are indistinguishable from each other. Predominantly, the beds in each unit dip nearly vertical and strike at 030. Complex and small scale folds are common, as are boudinaged layers.

Southeast of the spillway the albite schist outcrops for nearly a third of a kilometer, to where a quartz rich pelitic schist with interbedded mafic layers occurs. Further down, almost a kilometer past the spillway, the Bull Hill gneiss outcrops.

Northwest of the reservoir, along the West River, the rocks are similar to those found in the spillway. They are loosely divided into three units: a pelitic schist of varying composition; a mafic schist; and a pelitic garnet schist.

PETROGRAPHIC OBSERVATIONS

The metamorphism in the study area is garnet grade. Garnet occurs in almost every unit present and porphyroblasts are common. In many of the units, the garnet grew relatively late and overprinted the micaceous fabrics of the rocks. The size of some of the garnets provide an opportunity to look for evidence of two metamorphic episodes as done by Cook (1988). Some apparently late muscovite and chlorite also may show two prograde metamorphic events. Occasionally, quartz and chlorite are zoned.