METAMORPHISM IN THE CHESTER DOME, VERMONT

Faculty

Paul Karabinos, Williams
John Brady, Smith
Jack Cheney, Amherst
Jill Schneiderman, Pomona

Students

Neena Bashir, Amherst
William Carroll, Colorado
James Crowley, Amherst
Joel Davidow, Amherst
Eileen Heady, Beloit
Mark Meagher, Williams
Stephen Ritz, Williams
Libby Stern, Pomona

METAMORPHISM IN THE CHESTER AND ATHENS DOMES, SOUTHEASTERN VERMONT

Paul Karabinos
Department of Geology
Williams College
Williamstown, Ma 01267

Rocks in the Chester and Athens domes (Figure 1) have been multiply deformed and metamorphosed. Grenvillian rocks in the cores of the domes were strongly deformed and metamorphosed in the Middle Proterozoic. Late Proterozoic to Ordovician metasediments and metavolcanics formed along an ancient continental margin and rest unconformably on the Grenvillian basement (Figure 2). These rocks, together with the basement rocks, were deformed and metamorphosed to garnet and staurolite grade during the Middle Ordovician Taconic orogeny (Rosenfeld, 1968; Cook and Karabinos, 1988). The Taconic orogeny in New England resulted from the collision of eastern North America with an island arc and involved large scale displacement of the continental margin rocks and underlying basement along thrust faults (Stanley and Ratcliffe, 1985). Silurian and Devonian rocks were unconformably deposited on rocks deformed during the Taconic orogeny (Doll et al., 1961). The Devonian Acadian orogeny produced early, large-scale nappes and later domes; deformation occurred during staurolite to kyanite grade metamorphism (Rosenfeld, 1968). Overprinting by Acadian structures makes it very difficult to recognize older Taconic structures.

Multiple deformations are recorded by rock fabrics. An early schistosity is strongly overprinted by a crenulation cleavage, which is, in turn, cross-cut by a spaced cleavage with limited recrystallization parallel to it. One of the key problems is trying to correlate deformation fabrics with specific structures in order to identify Taconic and Acadian structures. This task is difficult because the Acadian orogeny itself involved at least two significant episodes of deformation.

The effects of Acadian metamorphism dominate in the Chester and Athens domes. Porphyroblasts of garnet, staurolite, kyanite, and amphibole which grew during this metamorphism commonly reach several centimeters in longest dimension. However, Rosenfeld (1968) described garnet textures in the Pinney Hollow Formation on the west side of the Athens dome which indicate that garnet grew during two separate stages. Because similar textures are absent in Silurian and Devonian rocks he postulated that the first stage of garnet growth was Taconic and the second was Acadian. Karabinos (1984) recognized similar textures 6 km to the west of the Athens dome near Jamaica, Vermont and used chemical and textural evidence to show that the two garnet growth stages were separated by a retrogression. Cook and Karabinos (1988) demonstrated that these "unconformity" textures are common and widespread in southeastern Vermont.

K-Ar and 40Ar/39Ar data indicate that rocks in western New England were metamorphosed during both the Taconic and Acadian orogenies (Laird et al., 1984; Sutter et al., 1985). No Taconic ages are found in southeastern Vermont, however, reflecting thorough Acadian overprinting. Cheney (1980) also presented evidence for polymetamorphism south of the Chester and Athens domes in western Massachusetts. In a region of such structural complexity, patterns of metamorphism may provide a vital key to interpreting and understanding the deformational history.

For four weeks in August, 1988, four faculty and eight students, representing six colleges in the Keck-funded consortium of undergraduate geology departments, studied the Chester and Athens domes in the field. During the first week we visited well exposed areas in southeastern Vermont to review the stratigraphy (Figure 2) of the area, study some of the structures, and discuss potential research projects. For the next three weeks we worked in small groups and individually on our projects. Six of the eight students used their field work as the basis for senior

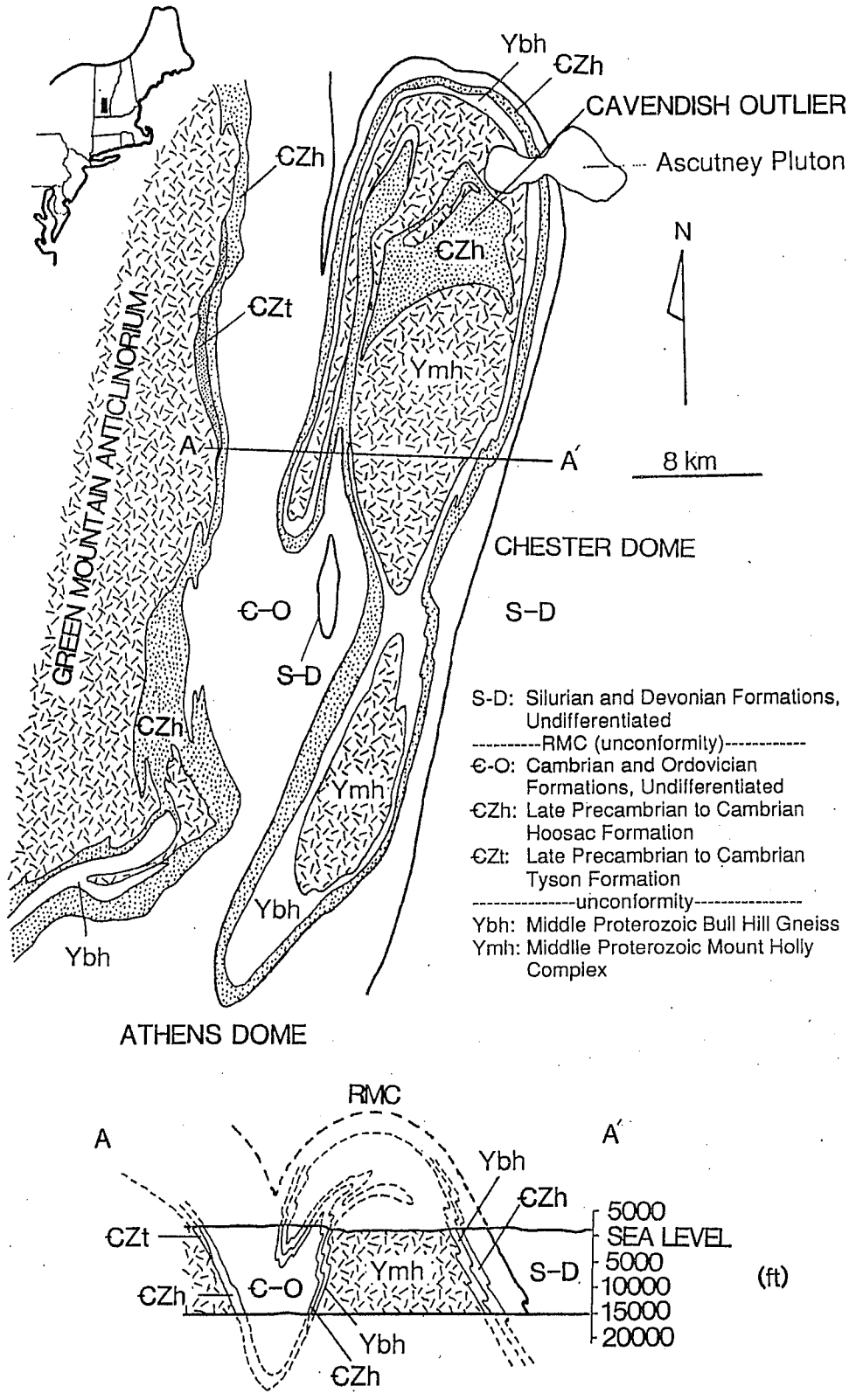

Fig. 1: Generalized Bedrock Map of the Chester Dome Area, Vermont, after Doll et al., (1961)

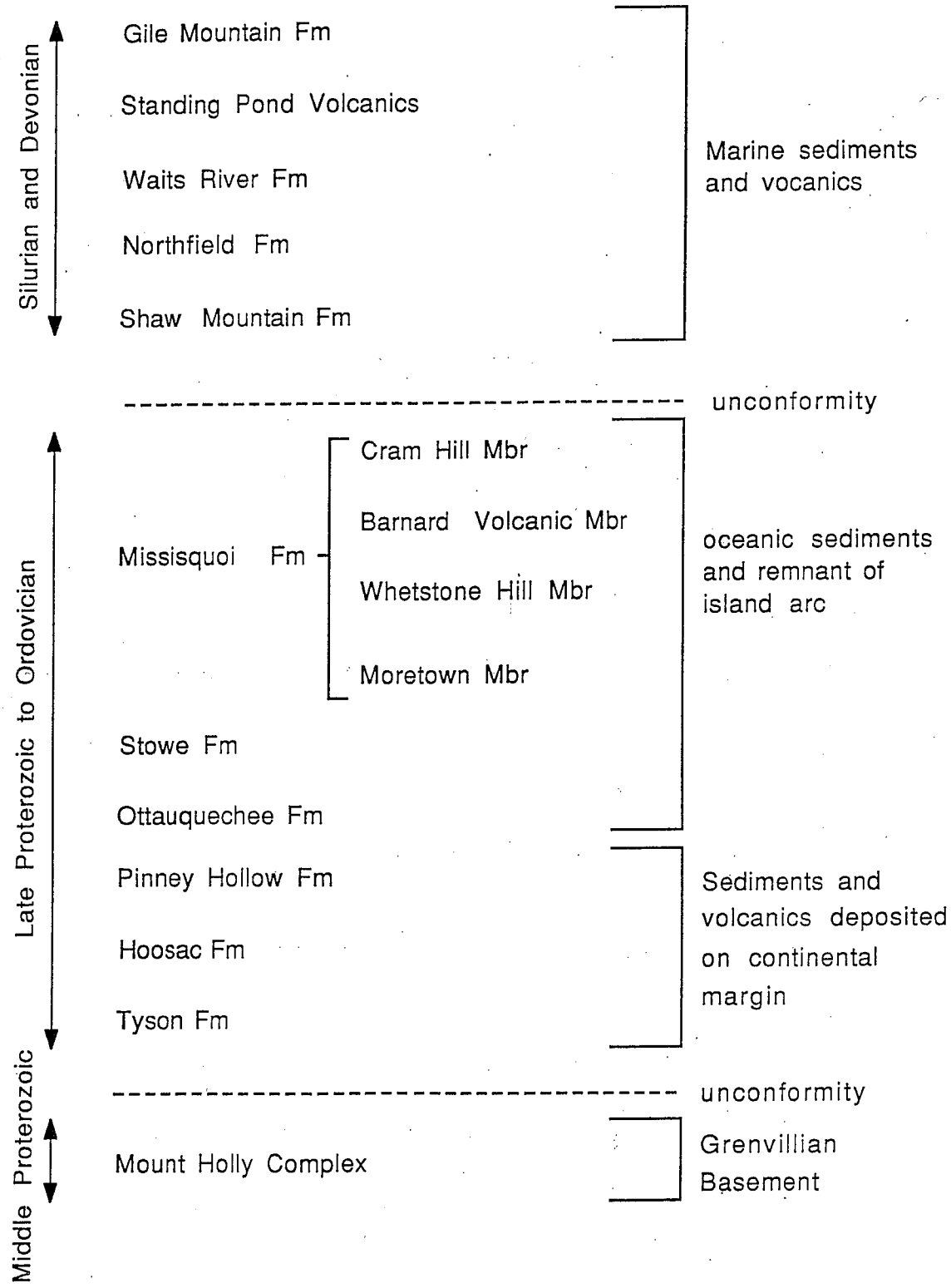

Figure 2. Stratigraphic column of southeast Vt, after Doll et al. (1961)

theses and two completed semester-long independent projects.

James Crowley (Amherst) and Stephen Ritz (Williams) studied metamorphic reactions in a high-alumina schist in the Hoosac Formation exposed in two structurally complicated areas in the Chester dome. Libby Stern (Pomona) examined the formation of albite porphyroblasts in the Hoosac Formation. Eileen Heady (Beloit) collected samples of the Hoosac Formation and the Bull Hill Augen Gneiss to determine feldspar and mica compositions and estimate pressure during metamorphism. Mark Meagher (Williams) studied the Bull Hill Augen Gneiss to find evidence for either a plutonic or volcanic origin of this rock. Neena Bashir (Amherst) collected samples in the Waits River and Standing Pond Formations to use in studies of garnet growth kinetics. Joel Davidow (Amherst) studied the patttern of metamorphism in Silurian and Devonian rocks. William Carroll (Colorado) sampled mafic schists near the contact between Cambro-Ordovician and Siluro-Devonian rocks for geochemical analysis. The results of these studies are presented in the following student abstracts.

REFERENCES

Cheney, J.T., 1980, Chloritoid through sillimanite zone metamorphism of high-alumina pelites from the Hoosac Formation, western Massachusetts: Geol Soc Am Abstr with Programs, v. 12, p. 40.

Cook, S.M., and Karabinos, P., 1988, Polymetamorphism in southeastern Vermont: Geol Soc Am Abstr with Programs, v. 20, p. 13.

Doll, C.G., Cady, W.M., Thompson, J.B., Jr., and Billings, M.P., 1961, Centennial geologic map of Vermont: Vermont Geol Survey, scale, 1:250,000.

Karabinos, P., 1984, Deformation and metamorphism on the east side of the Green Mountain massif in southern Vermont: Geol Soc Am Bull, v. 95, p. 584-593.

Laird, Jo, Lanphere, M.A., and Albee, A.L., 1984, Distribution of Ordovician and Devonian metamorphism in mafic and pelitic schists from northern Vermont: Am Jour Sci, v. 284, p. 376-413.

Rosenfeld, J.L., 1968, Garnet rotation due to major Paleozoic deformations in southeastern Vermont: in Studies of Appalachian Geology, Northern and Maritime, E-an Zen et al. (eds.), Interscience, New York, p. 185-202.

Stanley, R.S., and Ratcliffe, N.M., 1985, Tectonic synthesis of the Taconian orogeny in western New England: Geol Soc Am Bull, v. 96, p. 1227-1250.

Sutter, J.F., Ratcliffe, N.M., and Mukasa, S.H., 1985, 40Ar/39Ar data bearing on the metamorphism and tectonic history of western New England: Geol Soc Am Bull, v. 96, p. 123-136.