METAMORPHISM IN THE CHESTER DOME, VERMONT

Faculty

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

Students

Aleta Finnila, Pomona
Gerard Grerveldinger, Amherst
Tamir Klaff, Franklin and Marshall
Anne MacEachern, Williams
Thomas Powers, Whitman
Saraha Rogers, Williams

Metamorphism, Deformation, and Igneous Activity in Southeastern Vermont

Paul Karabinos
Department of Geology
Williams College
Williamstown, MA 01267

The Middle Ordovician Taconic orogeny resulted from the collision of the eastern margin of North America with an island arc and involved large scale thrust faulting within rocks of the continental margin (Stanley and Ratcliffe, 1985). Metamorphism during the Taconic orogeny in southeastern Vermont occurred at biotite to staurolite grade (Cook and Karabinos, 1988). The Devonian Acadian orogeny deformed these rocks again along with younger Silurian and Devonian rocks into recumbent nappes and upright domes (Doll et al., 1961; Rosenfeld, 1968). The grade of metamorphism during the Acadian orogeny was higher in most areas than during the Taconic orogeny, it reached as high as kyanite grade in the Chester and Athens domes (Cook and Karabinos, 1988).

The effects of Acadian metamorphism and deformation dominate in southeastern Vermont, but Taconic metamorphism is recorded in porphyroblast textures that indicate two prograde stages of metamorphism (Rosenfeld, 1968; Karabinos, 1984; Cook and Karabinos, 1988). Mineral inclusions in large garnet porphyroblasts appear to preserve the metamorphic history of the area and make it possible to reconstruct Taconic isograds.

For four weeks in August, 1989, three faculty and five students, representing six colleges in the Keck-funded consortium of undergraduate geology departments, studied the metamorphic, structural, and igneous history of southeastern Vermont. During the first week we visited well exposed outcrops to review the stratigraphy and examine metamorphic and structural features. Students and faculty then chose research projects and worked on them individually and in small groups during the next three weeks.

Aleta Finnila (Pomona) studied the garnet isograd in pelitic schists along the east flank of the Green Mountain massif. Gerard Greweldinger (Amherst) examined polymetamorphic textures in high-alumina schists from the Hoosac Formation in the Green Mountain massif. Tamir Klaff (Franklin and Marshall) sampled small granodiorite bodies in southeastern Vermont for geochemical studies. Thomas Powers (Whitman) collected data on folds within the Barnard Volcanic Member of the Missisquoi Formation to compare minor structures with map-scale structures produced during the nappe and dome stages of Acadian deformation. Sarah Rogers (Williams) measured a detailed section through a well exposed sequence of rocks on the west flank of the Athens dome to assess the importance of faulting during the structural evolution of the region. The results of these studies will be presented in the following abstracts.

REFERENCES

Cook, S.M., and Karabinos, P., 1988, Polymetamorphism in southeastern Vermont: Geological Society of America Abstracts 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 Geological Survey, scale, 1:250,000.

Karabinos, P., 1984, Deformation and metamorphism on the east side of the Green Mountain massif in southern Vermont: Geological Society of America Bulletin, v. 95, p. 584-593.

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: Geological Society of America Bulletin, v. 96, p. 1227-1250.

Garnet-Producing Reactions Along the Garnet Isograd in Southeastern Vermont

Aleta Berk Finnila
Pomona College

Pelitic schists from the Pinney Hollow formation in southeastern Vermont have undergone two distinct periods of recrystallization due to the Taconic orogeny and the later Acadian orogeny. Throughout much of southeastern Vermont, the garnet isograd roughly parallels the rock units in a north-south trend. In the Plymouth 7 1/2 minute quadrangle, however, the isograd diagonally crosses the Pinney Hollow formation (Chang, Ern, and Thompson, 1965) and in the northwestern part of the Saxtons River quadrangle the isograd cuts the Lower Paleozoic formations perpendicular to their strike (Fig. 1). This allowed me to study rocks of the same composition on both sides of the garnet isograd. Rocks from the Pinney Hollow formation near the garnet isograd were analyzed both in thin section and by electron microprobe to determine what reaction was responsible for the growth of garnet.

I collected 68 samples (Fig. 1) during a series of traverses which crossed the garnet isograd and paralleled the strike of the formation. This was to ensure that the observed mineralogical changes were a result of changing metamorphic grade and not bulk compositional variation. I collected samples from the most common lithology at an outcrop area as well as from any obviously anomalous lithologies in the vicinity noting mineral content, textures and structures.

I had thirty thin sections made from my samples. I obtained ata on garnet composition using a 5 channel Joel microprobe at the California Institute of Technology, Pasadena, California over the course of two days. The major-mineral assemblage in order of decreasing abundance below the isograd is quartz-muscovite-albite-biotite; just before the isograd it is quartz-muscovite-albite-chlorite-chloritoid; and above the isograd it is muscovite-chlorite-quartz-albite-garnet. Textural evidence indicates that albite and chlorite have been produced in the reaction and that quartz, chloritoid, and muscovite have been consumed. Biotite appears to have been absent from the rock at the time of garnet-production.

The albite in most of the thin sections appears in two distinct habits: as augen-like porphyroblasts in the matrix; and in veins with quartz. The augen formed early because the foliation wraps around them. Some have helicitic texture while others are distinctly zoned. There seems to be a strong relationship between albite and garnet. In the rocks there is an increased amount of albite in the quartz veins with the appearance of garnet, indeed, above the garnet isograd there is often more albite in the quartz veins than quartz. In several instances, albite completely surrounds small garnets. Garnet also seems to always be near a quartz-albite vein.

Chloritoid appears in two thin sections (AF-010, AF-013). In one section, the chloritoid is pervasive if not abundant throughout the matrix immediately below the garnet isograd. The other instance occurs as inclusions in a large garnet. Biotite appears in only one of the thin sections from the Pinney Hollow Formation. It occurs below the garnet isograd in the rock matrix and comprises only about 1% of the rock. Chlorite is notably absent in samples below the garnet isograd in the Pinney Hollow Formation. Just before the garnet isograd, however, some chlorite appears with chloritoid in the matrix. When garnet is present there is usually a significant amount of chlorite in the matrix as well as secondary chlorite which has replaced garnet. Occasionally, chlorite in association with muscovite appears to form veins with larger crystals than appear in the surrounding matrix. Chlorite never