Linking Deformation and Metamorphism: Pressure-Temperature-time-deformation Paths through Quantitative Microstructural Analysis and Pseudosections

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Figure 1. Geologic map of Chester and Athens domes area in southeastern Vermont, USA with sample location. Geology after Ratcliffe (1995a,b) and Ratcliffe and Armshong (1995,1994). Yg = Middle Proterozoic basement gneisses of the Green Mountain Massif and the core of the Chester and Athens Domes; CZh = Proterozoic to Early Cambrian Hoosac Formation inclukng the Cavenksh and Gassetts Schists; Cph = Cambrian Pinney Hollow Formation; Co = Cambrian Ottauquechee Formation, Cr = Cambrian Rowe Schists; OCs = Ordovician and Cambrian Stowe Formation; Om = Ordovician Moretown Formation, Ont = Ordovician North River Igneous Suite; Och = Ordovician Cram Hill Formation; SObmf = Silurian to Ordovician Barnard Gneiss; Dsn = Devonian to Silurian Northfield Formation, DSw = Devonian and Silurian Waits River Formation. CD = Chester Dome, AD = Athens Dome, SH = Spring Hill.

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Figure 2. Generalized geologic map showing extent of Taconian and Acadian in western New England after Sutter and others (1985). Isograds represent the peak metamorphic conditions preserved for Taconian and Acadian Orogenies. CD=Chester dome, AD=Athens dome, RD=Rayponda dome.

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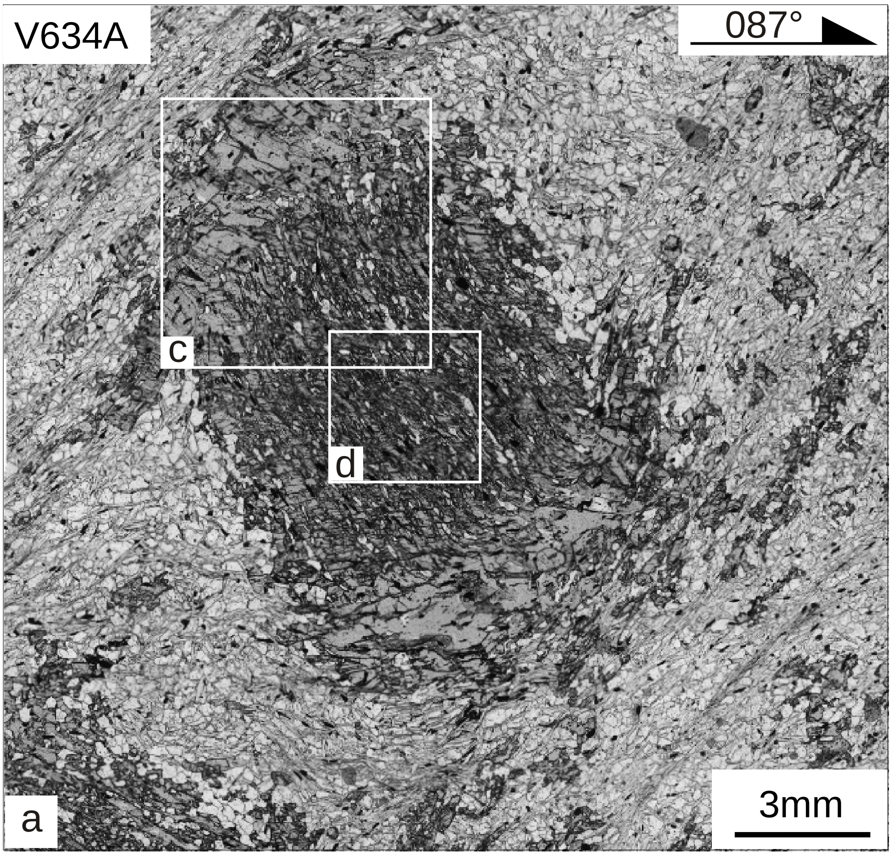
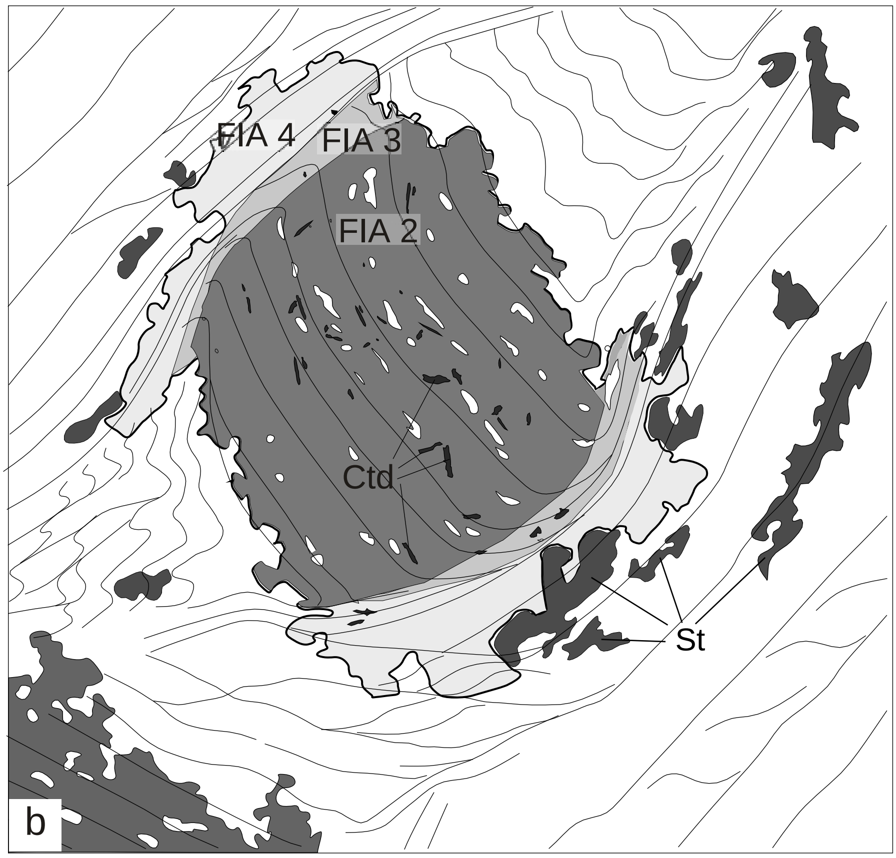
Figure 3. Regional distribution of trends of **f**oliation **i**ntersection **a**xes (FIAs) from Bell and others (1998) with additional data for samples used in this study. The data shown in Spring Hill synform are those used in the study. Further FIA data for Spring Hill are given in Bell and others (1998).

Figure 4a, b. 4a) V634A, photomicrograph of garnet-staurolite schist from the Cram Hill formation, contains garnet porphyroblasts up to 1 cm diameter that are typically surrounded by staurolite. Photomicrograph taken from vertical thin section striking 087°E. Matrix contains a spaced crenulation cleavage dominated by muscovite and quartz with an early crenulation cleavage is preserved in pressure shadows around garnet porphyroblasts (top right corner of photomicrograph). 4b) Interpreted line diagram showing form lines of inclusion trail geometry for porphyroblast and matrix foliations. Garnet porphyroblasts have distinct cores, median and rims that can be differentiated by inclusion trail geometry and inclusion mineralogy. Garnet cores contain early formed chloritoid laths and abundant quartz inclusions that are both absent in the garnet rims. Garnet cores preserve FIA set 2, medians contain FIA set 3 and rims grew during FIA set 4.


V634A
087°
c
d
3mm
a


FIA 4
FIA 3
FIA 2
Ctd
St
b

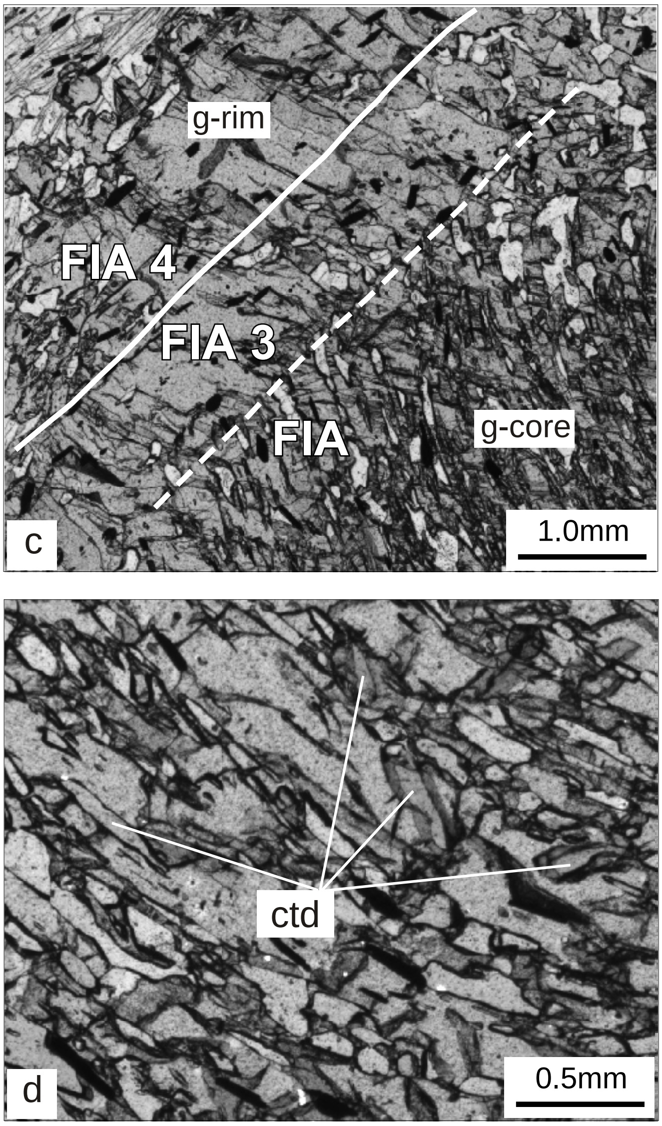
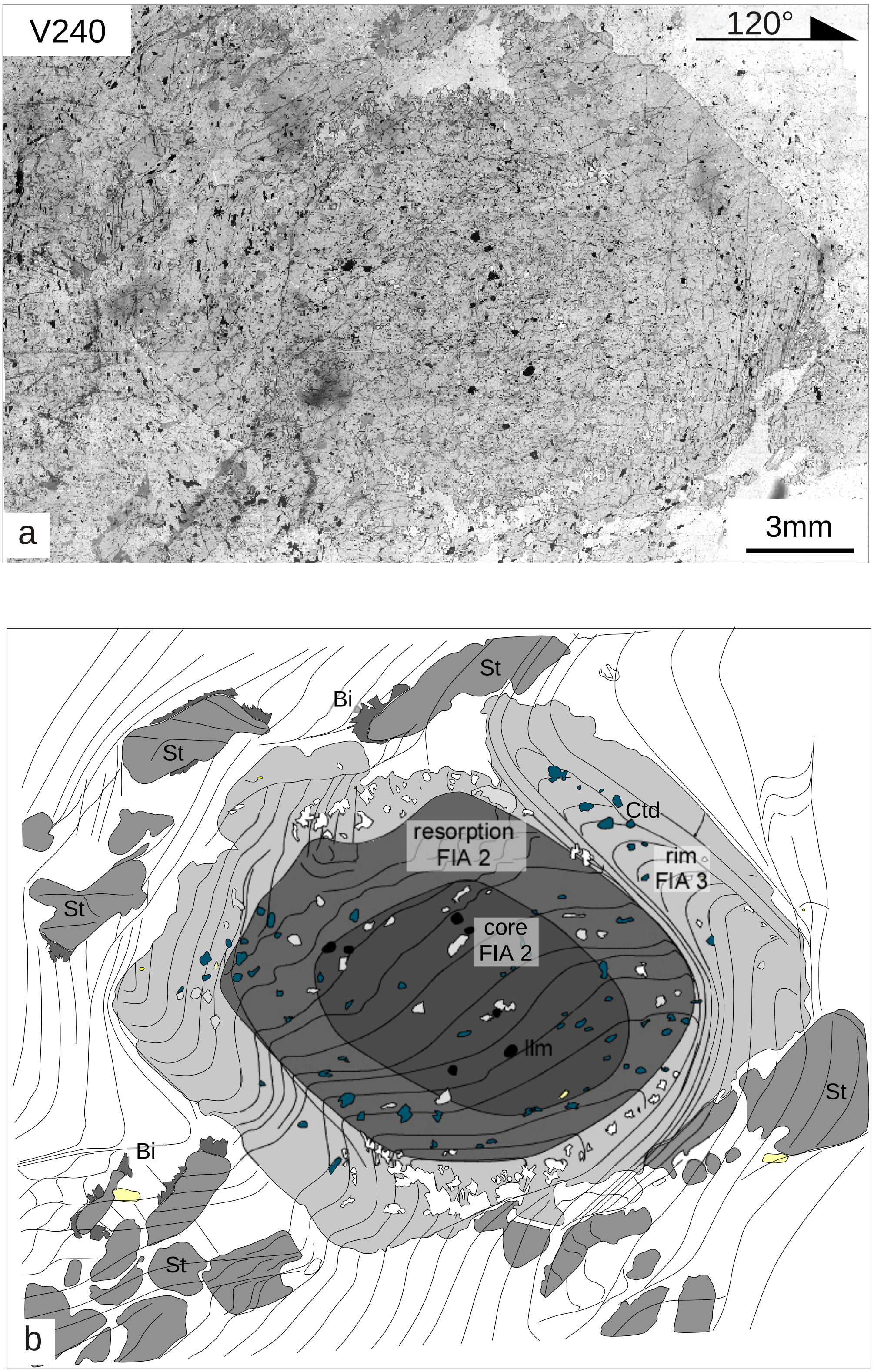


Figure 4c, d. 4c) Photomicrograph of crenulation hinge (dashed line) and microstructural truncation (solid line) developed at the core rim interface for V634A. Core is dominated quartz inclusions and rim is dominated by ilmenite inclusions. 4d) Photomicrograph of a garnet core from V634A containing inclusion trails with oblique chloritoid laths.

Figure 5a, b. 5a) V240, Hoosac Fm, contains garnet porphyroblasts that preserve a complex growth history revealed by both the inclusion trails and the inclusion mineralogy. Photomicrograph of a large garnet porphyroblast from the garnet-staurolite schist in a matrix dominated by muscovite, staurolite and to a lesser extent quartz. Photomicrograph taken from vertical thin section at striking 120°E-SE. 5b) Interpreted line diagram for the porphyroblast showing form lines representing inclusion trail geometry and matrix foliations for grain in figure 5a. Area labeled as resorption represents band of partial recrystallization determined from compositional maps in figure 8 and 9. Garnet contains distinct core and rim determined from combination of microstructure, compositional zoning and inclusion mineralogy. Inclusion trails are continuous across core-resorption boundary and then sharply truncated at the resorption-rim boundary. Garnet core and resorption preserve FIA set 2 and garnet rims grew during FIA set 3. Matrix staurolite grew during FIA set 4.



V240
120°
a
3mm
St
Bi
St
St
Ctd
resorption
FIA 2
rim
FIA 3
core
FIA 2
Ilm
St
Bi
St
b

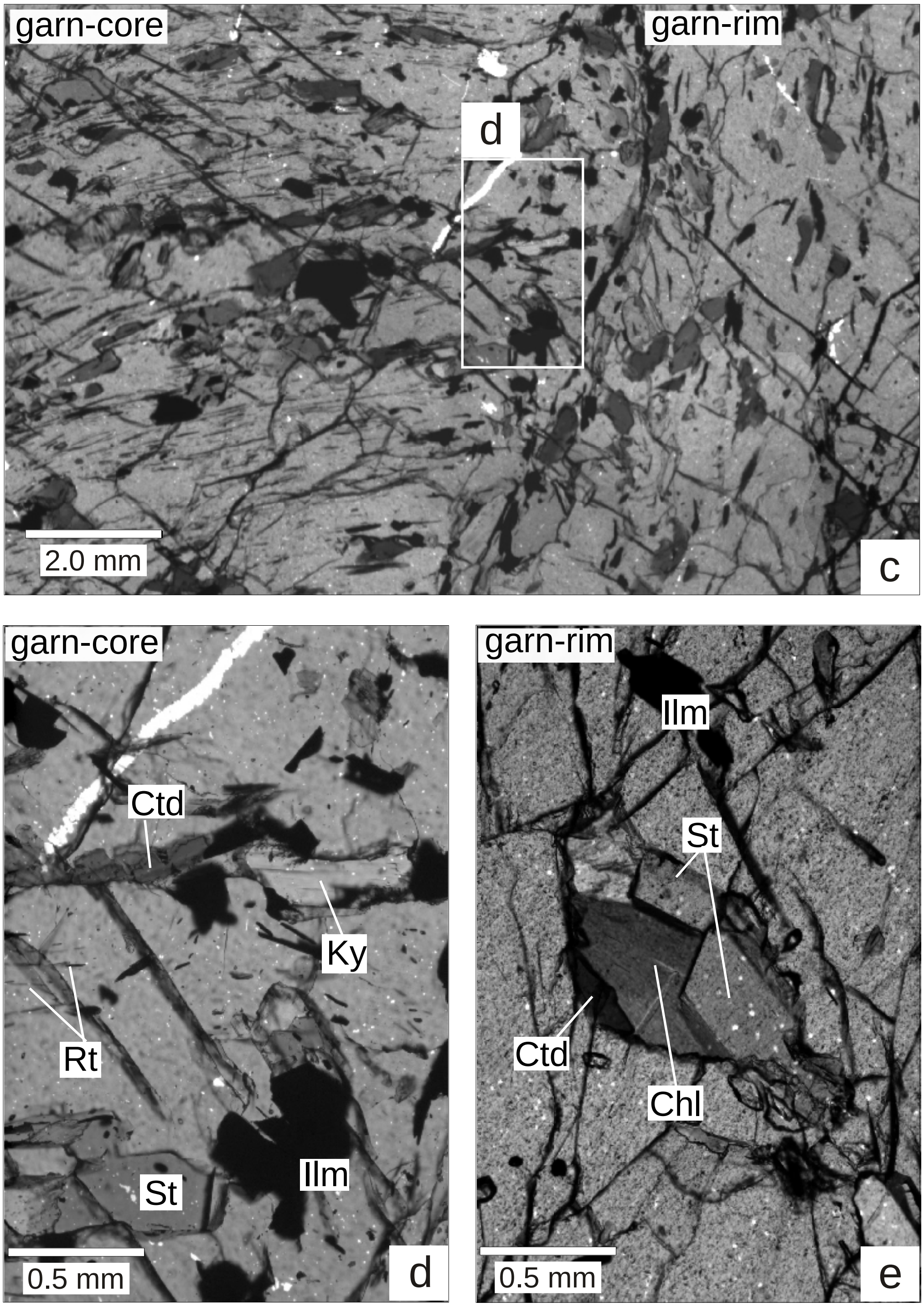


Figure 5 c,d,e. V240, photomicrographs of inclusion trail geometry and inclusion mineralogy at the core/rim interface. 5c) Photomicrograph of orthogonal foliations at the core/rim interface. Scalloped boundary marks interface of orthogonal inclusion tails. Needles in the core that help define foliation are rutile. Note that area to the left of the core-rim interface in figures 8 and 9 has complex chemical zoning that is not apparent from textures in photomicrograph 5d) Photomicrograph of inclusion assemblage (kyanite, staurolite, chloritoid, rutile, and ilmenite) in garnet core. 5e) Photomicrograph of inclusion assemblage (staurolite, chloritoid, chlorite and ilmenite) in garnet rim.

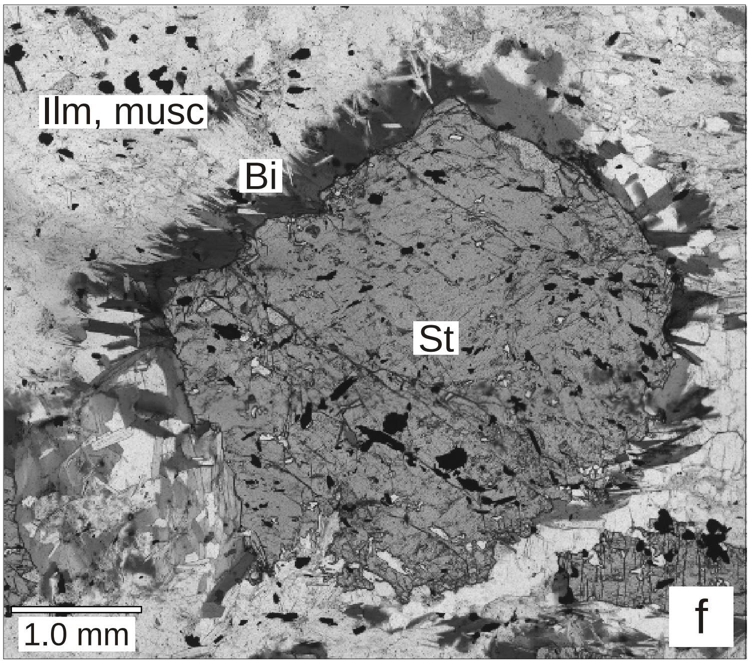


Figure 5f. V240 photomicrograph of an equant staurolite grain in the matrix with quartz and ilmenite inclusions that has been overgrown by chlorite and biotite.