PROJECT TITLE: Identifying and analyzing mineral inclusions in high-grade, polymetamorphic rocks from western New England to determine early-formed P-T conditions

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Project Description

Very small mineral inclusions are widespread in garnet from complex pelitic rocks from western New England. These inclusions in garnet are too small to be identified using the petrographic microscope but can be identified by laser Raman spectrometry because the laser spot can be as small as 1 to 2 microns. This project is centered on using the laser Raman spectrometer housed in the Department of Geology to identify suites of mineral inclusions, and then analyzing assemblage of inclusions to recover pressure-temperature (P-T) conditions of metamorphism.

The pelitic rocks (metamorphosed shale) to be studied record at least two metamorphic events and understanding the P-T conditions of both events can be related to the tectonic evolution of the mountain belt. One event is likely late Ordovician to early Silurian in age and the other has been dated as Middle Devonian (Acadian). Previous research has quantified metamorphic conditions of the metamorphism of Middle Devonian age using minerals in the rock matrix; this event records emplacement of regional thrust sheets during the Acadian orogeny likely linked to the collision of the Avalon microplate with the margin of Laurentia. An earlier phase of metamorphism seen across southwestern New England may record the collision or one or more island arc terranes with Laurentian, but the conditions of this phase are poorly constrained in the deeply exposed crust of New England in western Massachusetts and Connecticut.

A preserved record of the earlier P-T conditions of metamorphism is recorded by inclusions in garnet. Once armored by garnet, mineral inclusions cannot chemically communicate with other minerals and in effect, they become inert, preserving conditions of their formation. In addition, there are inclusions of quartz in garnet and a new geobarometer using the Raman spectra of quartz in garnet can be used to recover pressure conditions.

Goals for working on this project include (1) learning about the petrologic
and tectonic evolution of the western New England Appalachians; (2) learning about metamorphism and metamorphic rocks and how they record the physical conditions of the middle and lower crust; (3) learning how to run the Raman spectrometer in Dr. Czaja’s lab and how the instrument works; (4) generating Raman spectra and identifying suites of mineral inclusions; and (5) learning how to search and use the databases of Raman spectra to match analyzed spectra to minerals.