# PROJECT SUMMARY

The process of generation, segregation, ascent and emplacement of granite magma during orogeny has important implications because melt transfer affects the thermal and rheological behavior of the crust during orogenesis. Models of how melt is generated and segregated are well developed and we also understand well how granite magma is emplaced in both extensional and contractional tectonic settings. However, the mechanism by which melt is transferred from source to sink during orogeny remains a matter of debate. The record of melt transfer may be deciphered by examination of the geometry, petrography, geochronology and geochemistry of leucosomes in migmatites and in associated granite plutons. Within migmatites the geometry of leucosomes and smaller-volume granites may record the melt flow network through the crust. It is apparent that leucosome-granite sheet networks may have recorded a quasi-steady network of melt migration, controlled for the most part by deformation of the melt-bearing rocks. However, experiments have shown that the geometry of leucosomes in migmatites may be only fragments of the conduit geometry since conduits likely close and open periodically during melt flow, and some vein-like leucosomes may travel as a whole during deformation of the host. At the outcrop scale, the presence of granite located in structurally controlled sites within migmatite suggests melt flow through the migmatite during deformation, as supported by experimental data.

It has become important to be able to document the geometry of migmatitic structures and associated plutons. If the leucosome shapes and extents relate to some sort of plumbing, with migmatitic fabrics/structures as the conduits, understanding how melt has flowed through the system begins with documentation of the three dimensional geometry of that system. Despite the possibility that this geometry may be fragmentary or composite, the base of understanding can come only from this type of detailed mesoscale analysis. The same can be said of studying shapes of plutonic bodies and internal structures in granites. From these studies, subsequent geochronological and geochemical data may be placed in a solid, meaningful framework.

The goal of this proposal is to develop a better understanding of the paleomelt-flow network in the cores of contractional zones. We propose to accomplish this through study of migmatite leucosome geometries, migmatite textures, leucosome and associated granite geochemistries, and the geochronology of migmatites and associated granites. The field work will be focused on either single large exposures, small sets of closely-spaced outcrops or along a series of transects in order to properly document these variables. The area of study begins in western Maine, where a firm foundation is in place from which to carry out migmatite-granite studies, and continues into less well-studied rocks in New Hampshire.

The **intellectual merit** of the proposed research is the better understanding globally of melt-transit through the crust in orogens, as well as the capacity to use the results to better constrain regional tectonics. The approach of connecting detailed mesoscale and microscale observation of key exposures is not generally applied because it is labor-intensive. The studies described here are ideal for small-scale field and laboratory studies that can be performed by many workers, operating simultaneously within a given region. Each part of the study, therefore, sums to a larger-scale project aimed at a singular goal. Such studies are perfectly suited for undergraduate student projects that necessarily operate on single-semester to single-year time scales.

The **broader impacts** of this study are primarily in the involvement of a team of undergraduate students from two institutions. Research experiences for undergraduate students take the form of year-long Honors Theses and one-semester Independent Study projects with foci related to distinct and well-constrained parts of the overall project. The focus on team participation in a larger project allows students to immediately reap the benefit of being “invested” in a significant piece of high-level science. This structure allows the students to work in teams while conducting field and laboratory work and see how their individual project is an important component in the larger effort. For some of these students, additional experience will be gained by visiting other facilities in order to perform some of the geochemical and/or geochronological work. Certainly, the collaborative nature of this project will support students from both institutions exchanging ideas and learning from one another that may not have been possible otherwise. This arrangement also has been highly effective in helping the students interact as part of a research group—modeling the experience of most graduate students working in a research group.