

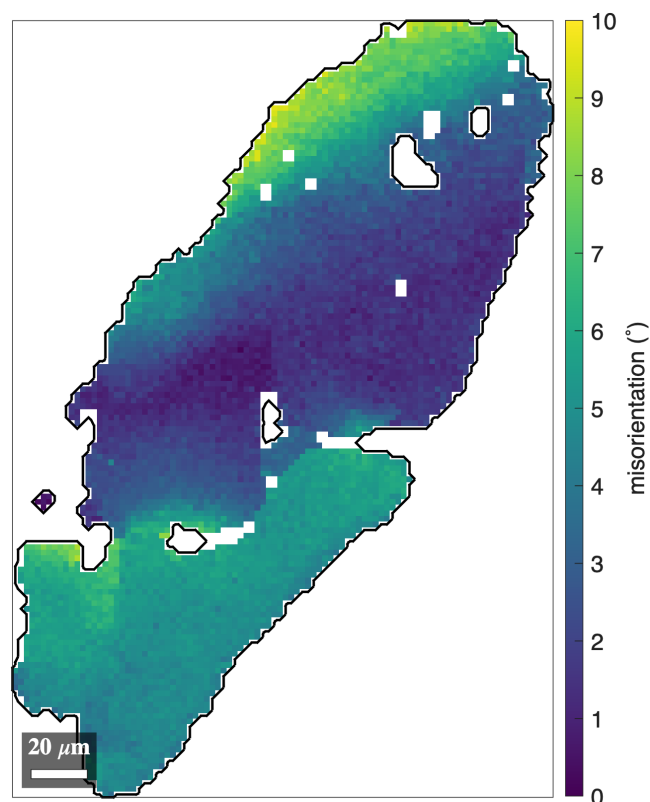
Microscopic Analysis of Deformed Minerals Reveals Large Scale Magmatic Processes

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Pluton emplacement, rock formation by the cooling of large magma chambers deep in Earth's crust, is not fully understood; emplacement requires an abundance of space, but the specific processes that allow the crust to accommodate large volumes of magma are unclear. Shear zones, areas of intense deformation, may facilitate the movement of magma by weakening the crust. How then, is pluton emplacement accommodated in areas without shear zones?

To investigate this question, I analyzed minerals from the Tuolumne Intrusive Suite of plutons in Yosemite, California. Titanite, a common mineral in plutonic rocks, can undergo a distortion (bending) of its crystal structure when subjected to deformation. Because the rocks I studied appeared to be non-deformed when collected in the field, we would expect that the crystal lattice of the titanite from the rocks would also be non-deformed.

This summer, I picked and prepared titanite minerals for imaging with Bowdoin's scanning electron microscope. I used the microscope to view chemical variations in the titanite crystals and the orientation of the crystal lattice. Analyzing over two hundred titanite minerals with these methods, I collected surprising results. The titanite from these non-deformed rocks did record deformation in its crystal structure. This suggests that these plutons that appear to be non-deformed actually record small amounts of deformation related to their formation.



The analysis of titanite to characterize deformation processes is an emerging field, and my work contributes to scientific understanding of the value of titanite as a recorder of deformation. Due to the surprising and interesting nature of my results, I am continuing this research into the fall semester as an independent study and will present my results at a geoscience conference in October. This fall, I will analyze the chemical content of the titanite minerals and use radioactive isotopes to date the minerals. This will allow me to understand the timeline of deformation and emplacement and to evaluate the accuracy of titanite age in the context of pluton emplacement.

Figure 1. A titanite crystal that displays crystal lattice misorientation due to deformation.

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