Magmatic lobes as key locations for unraveling complex internal processes in magma chambers: an example from the Tuolumne Batholith, Sierra Nevada, California, USA

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Geochronology of batholiths, representing large frozen magma chambers, has shown that they may form over millions of years during the assembly of a few to many episodically intruded pulses. Dependent on the size of the magma chamber and the frequency, number and size of pulses replenishing the chamber, the area of interconnected melt can be large and the crystallization time long. Thus, internal contacts between individual pulses and physical and chemical processes like fractionation, mixing and mingling, and different emplacement processes can be extremely complex during a batholith’s growth.

Magmatic lobes of individual batholith units are key locations for understanding internal processes in composite batholiths because they represent one stage of magma chamber construction: 1) Lobes cool much quicker than the main batholith and thus preserve shorter increments of host rock material transfer processes (MTP’s) and internal processes; 2) preserved strain within the lobe is less likely to reflect regional deformation; 3) lobes are chemical aliquots of individual pulses because they are less contaminated by subsequently intruding pulses. Therefore, in lobes we can better evaluate 1) the extent of interconnected melt between units; 2) the role of fractionation vs. mixing and mingling; 3) emplacement mechanisms as the chamber grows. Here we focus on the growth and internal processes of the Kuna Crest granodiorite lobe, which extends laterally SE of the ~1000 km² (94-85 Ma) Tuolumne Batholith, CA. Processes associated with this lobe are: a) lobe-wide fractionation and local mixing/mingling, the former of which forms: Hbl-Bt-cumulates, wide, gradational transitions between units and the change from a mafic margin towards a more felsic center; b) multiple, contemporaneous MTP’s such as stoping, subsolidus deformation, shearing, and downward flow at the lobe margin; c) a final increment of lobe growth associated with widespread stoping as late fractionated magmas migrated out the tip of the lobe.