FACING UP TO THE COMPLEXITY OF BATHOLITH CONSTRUCTION:
MAGMATIC LOBES AS WINDOWS INTO LARGE MAGMA CHAMBERS,
TUOLUMNE BATHOLITH, SIERRA NEVADA, CALIFORNIA

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Large, long-lived magmatic systems, like the 94-85 Ma composite Tuolumne batholith (TB), Sierra Nevada, show compositional and structural complexity and record a mixture of various processes during different stages of magma chamber evolution (Paterson et al., this session). Characteristics of the TB magmatic lobes (Memeti et al., 2005) suggest that they are simpler magmatic systems and thus excellent locations to understand batholith construction at the emplacement site. Lobe studies help to a) identify the minimum extent of melt interconnected areas, b) constrain minimum time and length scales of internal processes, c) evaluate source heterogeneity in different units, and d) characterize emplacement and regional strain related structures. Mapping in the Kuna Crest (KC) and equigranular and porphyritic Half Dome (HD) granodiorite lobes shows a concentric lithologic pattern from more mafic margins to more felsic centers with commonly gradational contacts and inward younging. Geochemistry suggests that this pattern is caused by fractional crystallization across the entire extent of the lobes. U/Pb zircon geochronology supports inward younging and indicates fractionation time scales of a few 100 k.y. Mixing and contamination are subsidiary processes locally masking fractionation patterns. Radiogenic isotope data suggest lobe-wide source homogeneity, and generally more primitive magmas in the lobes than in the main batholith. In the lobes, a variety of emplacement mechanisms operated within < 1 m.y. Magmatic lobe studies help to unravel some of the physical and chemical complexity in the main TB chamber. Field data, element and isotope geochemistry, and geochronology from the KC and HD lobes suggest that these 10-40 km$^2$ lobes represent the minimum extent of interconnected melt in the batholith. The lobes are fed from a homogeneous source by one or a few pulses that have been emplaced quick enough and locally focused to coalesce to a single melt-linked body. These lobe-wide melt-present areas underwent dominantly fractional crystallization, which likely is an important internal process in the main batholith body as well, but is masked there by mixing and contamination processes that operated over longer time (several m.y.) and larger length scales, resulting in additional complications in the main batholith.