# Evidence for <1 month between melt segregation, crystal growth and eruption of the Bishop Tuff, CA

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The Bishop Tuff (BT), which erupted ~0.77 Ma in eastern California, was produced when >600 $km^3$ of zoned high-$SiO_2$ rhyolite was explosively erupted in less than a week (Wilson and Hildreth, 1997). An outstanding question is what was the time interval between BT melt segregation from its parent (whether a crystallizing magma or partially melted pluton) and subsequent ascent, phenocryst growth, and eruption. In this study, we present evidence for a remarkably short time interval (<1 month) between melt segregation and eruption of the BT. (1) Among Early BT single pumices, there are strong correlations ($R^2$ = 0.8-0.9) between incompatible element contents (e.g., Rb, Y, Th, Lu) and Fe-Ti oxide temperatures (~700-750°C), which are closely predicted if temperature is a proxy for melt fraction and/or source depletion at the time of melt segregation from a 9-mineral (same 9 in Early BT) crystal-rich mush. Since Fe-Ti oxides re-equilibrate within 2-3 weeks, this requires a time scale between segregation, Fe-Ti oxide crystallization and eruption within that time window. (2) Crystal abundances in the Early and Late BT range continuously between 0-10% and 0-25%, respectively, for samples with the same temperature, water content and composition; this is predicted if there is a kinetic delay to nucleation and growth of cotectic quartz + sanidine during ascent and consistent with ubiquitous diffusion-limited growth textures. Published phase-equilibrium and decompression studies applied to the Bishop Tuff rhyolite point to fluid-absent segregation of the Bishop Tuff melt, followed by initial ascent into super-liquidus conditions, followed by fluid saturation and phenocryst growth during continued ascent, driven by $H_2O$-degassing. (3) Opx and biotite cannot coexist in BT melts under equilibrium conditions, yet are found together in all Late BT samples, without reaction rims on biotite (that form within ~2 weeks under $P_{H2O}$-T conditions where opx is stable). Various $D_i$ (biotite/melt) values applied to biotite in Late BT show it grew from the mafic endmember prior to mixing, whereas textural evidence and published phase-equilibrium experiments on rhyolite show that opx co-crystallized with the predominant plagioclase in Late BT samples (~$An_{21}$) after magma mixing in the Late BT. This implies < 2-3 weeks between post-mixing crystallization of plag (~$An_{21}$), opx+cpx, and rims on qtz and sanidine in Late BT magma and its eruption.