THE ORIGIN OF POTASSIUM FELDSPAR MEGACRYSTSS IN THE LEXINGTON BATHOLITH, WEST-CENTRAL MAINE

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The Lexington batholith (~400 Ma) of western Maine can be divided into 3 lobes. The central lobe is a peraluminous granite consisting of a matrix of quartz, plagioclase, biotite, K-feldspar and muscovite hosting large (to 20 cm long), abundant K-feldspar megacrysts. These megacrysts are euhedral, tabular perthitic microcline crystals that contain abundant inclusions of biotite, plagioclase, quartz and muscovite.

The origin of potassium feldspar megacrysts in granites as phenocrysts or porphyroblasts has been largely settled over the past decades, with abundant textural evidence supporting their origin as phenocrysts. However, questions remain about the magmatic processes that lead to the growth of phenocrysts of such disparate size compared to groundmass crystals. Previous workers (e.g., Cox et al., Journal of the Geological Society of London, 1996) have suggested that influxes of mafic magma into the granitic magma chamber caused K-feldspar to remain on the liquidus over a long time span, during which they grew to megacryst size. In this study we explore the possibility that generation of a flux-enriched boundary layer around the growing crystals could promote the rapid growth of megacrysts in the absence of mafic magma influxes.

Mineral inclusions in the megacrysts occur in one to four concentric zones, as well as scattered in smaller numbers throughout the megacrysts. The concentric zones typically contain specific types of inclusions at specific locations. The two most abundant inclusion types, plagioclase and biotite, commonly alternate in abundance with distance from the core of the megacryst. As a specific type of mineral inclusion crystallizes, nucleating on or near the surface of a growing megacryst, it would consume the ions that it requires and thus deplete the boundary layer of those ions. The growth of this species would also cause the accumulation of those ions that it does not need, and thus create an environment that may be more hospitable for the growth of a new and different species. The boundary layer model was developed by Wang and Merino (Journal of Petrology, 1992) to explain orbicular granites. FTIR water concentration mapping of K-feldspar megacrysts also shows concentric water rich and water poor zones in megacrysts, supporting the model of repeated generation of a boundary layer surrounding megacrysts, which becomes enriched in water as a growing K-feldspar rejects it. The development of fluxed boundary layers enhances the growth of K-feldspar megacrysts because the fluxed ions cause rapid growth of K-feldspar crystals. This model seems more likely than that of mafic influxes that simultaneously affect K-feldspar megacryst growth throughout the entire volume of a large pluton.