Non-symmetric zoning and lack of correlation among neighboring K-feldspar megacrysts in granodiorite

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K-Feldspar Megacrysts in Granites Worldwide

Large, eye-catching K-feldspar megacrysts (crystals >5 cm in the longest dimension; Fig. 1) are common in granite but the details of their formation are not well understood. The textural and compositional characteristics of these megacrysts are complex, and their formation involves multiple processes. Common characteristics include: Chemical and mineral inclusion zones (Fig. 1, left), biotite crusts, and Carlsbad twins. Conditions during megacryst formation bear on late-stage granite textures and related igneous textures.

Conflicting Hypotheses of Formation

1) The classic interpretation: megacrysts grow early in a magma’s crystallization history in abundant melt. There are few crystals and plenty of room to grow. Magma exchanges dissolved and solidified crystals and melts to form new minerals. Eventually, the crystals are homogenized and the crystal set begins to coarsen.

2) Interpretation consistent with experimental data and phase equilibrium: The onset of K-feldspar nucleation does not begin until the latter half of cooling in a thermally immobile system. There is little room to grow in heterogeneous melt pockets in the static crystal framework, and crystal coarsening occurs via dissolution-reprecipitation.

These hypotheses can be tested by mapping mineralogical and chemical zones in megacrysts from the Cathedral Peak Granite-Diorite, Tuolumne Intrusive Suite (Fig. 2), California.

A Novel Approach to Imaging Megacryst Interiors

Ten whole-crystal samples from Cathedral Peak Granite-Diorite were analyzed via Micro CT at the Instrumentation Facility for his assistance during Micro CT data collection.

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Results: Non-Symmetric and Non-Correlated Zones

Images of megacrysts interiors perpendicular to (010) were mapped by distinguishing zone boundaries, inferring zone boundary patterns, and color zoning zones qualitatively based on their grayscale value (Fig. 4–5). Transsects starting at the core and ending at the closest part of the rim on either side were used for analysis.

Results (cont.) & Discussion

Maps of individual megacrysts are clearly unique simply based on an initial visual comparison. The calculated correlation coefficients comparing zoning patterns of different megacrysts and those of the same megacryst indicate that they each crystallized in chemically different melts and crystallized via dissolution-reprecipitation.

Dissolution-reprecipitation occurs during temperature oscillations, and promotes crystal zoning of neighboring crystals via mass transfer (Fig. 7).

Acknowledgements

This project was funded by the University of North Carolina Graduate School, the Department of Geological Sciences, and a National Science Foundation Graduate Research Fellowship. Instrumentation for this project was during Micro CT data collection.

References