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**SPECIAL COLLECTION: PERSPECTIVES ON ORIGINS AND EVOLUTION OF CRUSTAL MAGMAS**

# Formation of rhyolite at the Okataina Volcanic Complex, New Zealand: New insights from analysis of quartz clusters in plutonic lithics†

**Karina A. Graeter[1,*], Rachel J. Beane[1], Chad D. Deering[2], Darren Gravley[3] and Olivier Bachmann[4]**

[1]Department of Earth and Oceanographic Science, Bowdoin College, Brunswick, Maine 04011, U.S.A.
[2]Department of Geological and Mining Engineering Sciences, Michigan Technological University, Houghton, Michigan 49931, U.S.A.
[3]Department of Geology, University of Canterbury, Christchurch 8140, New Zealand
[4]Institute of Geochemistry and Petrology, ETH Zurich, NW Clausiusstrasse 25, 8092 Zurich, Switzerland

## Abstract

Granitoid lithic clasts from the 0.7 ka Kaharoa eruption at the Tarawera volcano (Okataina Volcanic Complex, Taupo Volcanic Zone, New Zealand) provide insight into the processes of rhyolite formation. The plutonic lithic clasts of the Kaharoa eruption consist of (1) quartz phenocrysts, which are often grouped into clusters of two to eight quartz grains, (2) plagioclase phenocrysts (mostly ~$An_{40}$ with up to $An_{60}$ cores), and (3) interstitial alkali feldspar. Quartz orientations obtained through electron backscatter diffraction (EBSD) methods show that 78% of the 82 analyzed clusters have at least one pair of quartz grains with the dominant dipyramidal faces matched. Variations in cathodoluminescence (CL) zoning patterns of the quartz suggest that quartz clusters came together after initial crystal growth and that many quartz crystals were subject to one or more resorption events. The process of quartz crystals with different magmatic histories coming together into common relative orientations to form clusters is indicative of oriented quartz synneusis and suggests a history of crystal accumulation. The quartz clusters are interpreted to have formed as part of a crystal cumulate mush within a shallow magma chamber where quartz crystals rotated into contact along their dominant dipyramidal faces during hindered settling and/or compaction. The preservation of oriented quartz clusters from the Kaharoa plutonic lithics thus provides evidence for synchronous, shallow pluton formation from a cumulate mush during active silicic volcanism. This result is consistent with models whereby melt-rich, high-silica rhyolite formation occurs via interstitial melt extraction from a low-silica rhyolite mush in the shallow crust.

**Keywords:** Cathodoluminescence, cumulate, EBSD, rhyolite formation, Taupo Volcanic Zone