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Review

On silica-rich granitoids and their eruptive equivalents

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Abstract

Silica-rich granites and rhyolites are components of igneous rock suites found in many tectonic environments, both continental and oceanic. Silica-rich magmas may arise by a range of processes including partial melting, magma mixing, melt extraction from a crystal mush, and fractional crystallization. These processes may result in rocks dominated by quartz and feldspars. Even though their mineralogies are similar, silica-rich rocks retain in their major and trace element geochemical compositions evidence of their petrogenesis. In this paper we examine silica-rich rocks from various tectonic settings, and from their geochemical compositions we identify six groups with distinct origins. Three groups form by differentiation: *ferroan alkali-calcic* magmas arise by differentiation of tholeiite, *magnesian calc-alkalic or calcic* magmas form by differentiation of high-Al basalt or andesite, and *ferroan peralkaline* magmas derive from transitional or alkali basalt. *Peraluminous leucogranites* form by partial melting of pelitic rocks, and *ferroan calc-alkalic* rocks by partial melting of tonalite or granodiorite. The final group, the *trondhjemites*, is derived from basaltic rocks. Trondhjemites include Archean trondhjemites, peraluminous trondhjemites, and oceanic plagiogranites, each with distinct geochemical signatures reflecting their different origins. Volcanic and plutonic silica-rich rocks rarely are exposed together in a single magmatic center. Therefore, in relating extrusive complements to intrusive silica-rich rocks and determining whether they are geochemically identical, comparing rocks formed from the same source rocks by the same process is important; this classification aids in that undertaking.

Keywords: Granite, rhyolite, geochemistry, trondhjemite, leucogranite, petrogenesis, Invited Centennial article, Review article