Thermal evolution of plutons in the Questa caldera, NM

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New evidence suggests pluton emplacement during caldera complex formation is a dynamic process with multiple chambers that potentially were emplaced incrementally. Zircon U/Pb and Ar/Ar high-resolution geochronometry from minerals with different closure temperatures were used to determine detailed thermal histories for two subvolcanic plutons, the Cabresto Lake pluton (CL) and the Rio Hondo pluton (RH) of the Latir Volcanic Field (LVF), northern New Mexico. The majority of LVF plutons lie within the rim of the mid-Tertiary Questa caldera. Single-crystal laser-fusion sanidine Ar/Ar geochronology of the caldera-associated volcanic sequence was used to understand stratigraphy of units unresolved by field relations, and to correlate volcanic and plutonic episodes.

Preliminary results indicate two new insights into pluton intrusion in the LVF: 1) A significant change of cooling rates from the nearly syn-caldera (~25 Ma) CL and the post-caldera (~23 Ma) RH. The extremely fast cooling rate of the CL correlates well with the timing of maximum Rio Grande rift crustal extension, and the resurgent nature of the pluton. The slow cooling rate of the RH possibly indicates multiple intrusions to sustain high temperatures (>300°C) sufficient enough to eclipse the closure temperature of biotite without exceeding the zircon saturation temperature. Multiple samples of the RH yield concordant yet differing U/Pb ages outside analytical uncertainty of 23.0 (± 0.1) and 22.7 (± 0.1) Ma. This is consistent with field evidence that suggests the RH is an incrementally assembled body. 2) Ar/Ar dating reveals oscillations in the composition of precaldera volcanic units ranging from calc-alkaline to alkaline before cumulating in the peralkaline eruption of caldera forming ~500 km^3 Amalia Tuff (~25.22 Ma). Each volcanic unit provides a snapshot in time of magma chamber composition, and requires multiple chambers to explain the oscillations in the composition of the erupted products. The slowed pluton cooling rate and alternating volcanic sequence requires multiple chambers that potentially were incrementally emplaced.

The alleged carbonatitic-kimberlitic melt continuum: Contrary evidence from West Greenland

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Conventional wisdom dictates a genetic relationship between carbonatite and kimberlite, and Dalton & Presnall [1] proposed that these magma types may be related by an increasing degree of partial melting of carbonated peridotite. They suggested that the Sarfartoq carbonatite complex of West Greenland (ca. 600-550 Ma), which comprises dolomitic carbonatite sheets and carbonate-rich ultramafic silicate dykes (aillikites), represents the best natural analogue for their experimentally produced primary melt continuum at 6 GPa. Major problems arise with this model: (i) new U-Pb ages indicate that the ultramafic magmas started to form at least 10 m.y. earlier than the carbonatite; (ii) Sarfartoq carbonatites differ compositionally from the experimentally produced primary carbonatite melts.

In 2005, a similar carbonatite-aillikite intrusive suite was discovered at Tikiusaaq (ca. 165-150 Ma) south of Sarfartoq and provides a new test case for the melting continuum hypothesis. Like at Sarfartoq, the Tikiusaaq aillikite dykes predate the carbonatite sheets by ca. 5-10 m.y. Petrological and geochemical data suggest that aillikite is close to primary magma composition, whereas the carbonatite body represents differentiated magma and cumulates. Sr-Nd-Pb isotope compositions of the Tikiusaaq aillikites and carbonatites overlap and indicate magma origin from a common carbonated upper mantle source. However, some carbonatites show a pronounced shift towards compositions typical for the Archean crust of West Greenland. This crustal component was most likely attained by fluid exchange during magma emplacement. We favour a model in which a proto-aillikite magma is parental to dolomitic carbonatite and suggest that the differentiation process was mainly controlled by volatile build-up at crustal pressures. Despite the fact that a primary carbonatitic-kimberlitic melt continuum exists in high-P experiments [1], the geology and petrology of central-complex carbonatite intrusions in West Greenland and elsewhere fail to support this hypothesis.

[1] Dalton & Presnall (1998) *J.Petrol.* **39**, 1953-1964.