Is dehydration melting responsible for the evolution of high-K granitic melts throughout the Precambrian?

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Precambrian granitoid terrains mainly show two main intrusion events of granitoid rocks: a first phase of K-poor granitoid melts (granodiorites s.l.). The granodiorites (s.l.) intrude into pre-exisiting crust and are usually of juvenile character with higher influence of mantle material. The mechanisms of first phase granitoid melts experience a major change at the Archaean/Proterozoic boundary as indicated by the existence of TTG complexes only in Archaean times. TTG´s are special in their liquid line of descent as they are not following the main post-Archaean differentiation path (i.e. the "classical" calcalkaline differentiation) as seen in proterozoic first phase melts. In a second magmatic phase the pre-existing crust suffers an anatectic event that produces high K-granitod melts. Second phase melts often intrude in a restricted time interval and field relationsships indicate short transport distances for these melts. In this study K-rich granites of different precambrian granitoid terrains were compared: (i) Meso- and Neoarchaean K-rich granitoids from Barberton Mountain Land (Kaapvaal craton, South Africa/Swasiland), (ii) Paleoproterozoic K-rich granitoids from Västervik area (Baltic Shield, Sweden) and Huab metamorphic complex (Congo craton, Namibia). Archaean and Proterozoic K-rich granites show typical crustal geochemical characteristics. More importantly, Sr-Nd isotopes reveal ternary mixing relationsships. Three end-members can be traced: (1) juvenile mantle material, (2) country rock material and (3) metasomatic fluids. Juvenile material is clearly under-represented and the two main contributing end-members are country rock material and metasomatic fluids. Highly radiogenic Sr initial ratios indicate mica breakdown and thus, dehydration melting as trigger mechanism for the sudden onset of the granite production factory throughout the Precambrian.

U-series crystal ages of plagioclase and zircon from the 1300 CE Kaharoa eruption, New Zealand

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The 1300 CE Kaharoa eruption of Tarawera Volcano in New Zealand offers an excellent opportunity to examine of uranium-series crystal ages of multiple phases in young rhyolitic magma. These lavas and pumices are crystal rich with abundant plagioclase feldspar and zircon (>35 volume % crystals) that can be dated using ^{226}Ra-^{232}Th and ^{230}Th-^{238}U disequilibria, allowing for a thorough comparison of the timing of crystallization for both major and trace phases in this single rhyolite eruption. The Kaharoa eruption at Tarawera produced 2.5 km^3 of rhyolite lava and 5 km^3 of pyroclastic material making it the largest eruption in New Zealand over the last 1,000 years (Nairn, 2002).

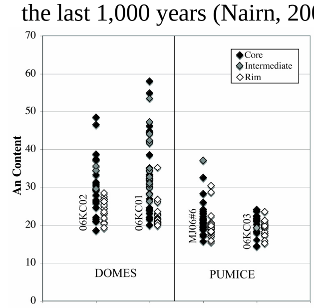

Figure 1: An content of cores and rims of Kaharoa feldspar

Samples from two pumice fall deposits (B and J Pumice) and the Ruawahia Dome and associated block and ash flow were chosen to examine the crystal ages of plagioclase and zircon. All of these samples have a whole rock silica content of 74-75 wt%, while their Zr contents vary: dome samples average 130 ppm and pumice average 93 ppm. This compositional difference is reflected in other trace elements. It is also seen in the An content of plagioclase analyses via electron microprobe (Figure 1). The pumice samples have a narrow range of average An content for both cores and rims (An^{19-22}) while the domes are much more diverse between the cores (An^{30-45}) and the rims (An^{23-25}).

Preliminary U-series analyses of whole rock samples using a Nu Plasma MC-ICP-MS at UC-Davis indicate that the pumice and dome samples have different Th isotopic compositions. Future analyses will include U-Th-Ra analyses of whole rock, glass and plagioclase separates in two different size classes (125-250 µm and 250-500 µm) along with U-Th analyses of single zircon (SHRIMP). Zircon separates will include crystals derived from the groundmass/glass and as inclusions within plagioclase. These analyses will eludicate the timescales of crystallization of major and trace phases within rhyolite magma and determine whether zircon and plagioclase ages record the same magmatic events.

Reference

Nairn I.A. (2002), *Geology of the Okataina Volcanic Centre*, Inst. Of Geol. And Nuclear Science Geologic Map **25**, 156 pp.