Structural controls on changing differentiation depths at Mt. Ruapehu volcano

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Mt. Ruapehu lies at the southern end of the Taupo Volcanic Zone (TVZ) in New Zealand where the Pacific Plate is subducted beneath the Australian Plate. TVZ Magmatism appears to have propagated south with time so that the andesitic Ruapehu volcano represents the youngest style of magmatism while older rhyolitic caldera systems to the north represent a more mature phase of the arc. Both magmatic types developed from primary basaltic fluxes out of the mantle and the contrasting development of andesitic versus rhyolitic volcanoes must reflect changes in the depths and/ or conditions under which magma evolves.

Crustal contamination of primary magma is a key component in the generation of Ruapehu andesites. The crust beneath Ruapehu comprises c. 5-10 km thick lower crustal meta-igneous granulite overlain by a 15-25 km thick Permian – mid Cretaceous meta-sedimentary sequence. Previous modelling has demonstrated contamination by meta-sedimentary material. However, new trace element and Sr, Hf and O isotopic data for lavas and crustal xenoliths reveal a distinct change in assimilants between the oldest (Te Herenga) and younger formations (Post Te Herenga) at Ruapehu. Te Herenga lavas are the product of lower crustal differentiation involving assimilation of meta-igneous granulite. Post Te Herenga lavas display evidence of interaction with the same meta-igneous granulite followed by interaction with meta-sedimentary crust. Dating of fault movement suggests that this change in assimilant between the two formations coincides temporally with increased rates of extension at the southern tip of the TVZ. We propose that the change in melt-crust interaction from Te Herenga to Post Te Herenga lavas is a response to adjustments in differentiation depth which, in turn, is controlled by the change in regional stress.

U-series comminution ages from a Pleistocene alluvial fan

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Knowing the duration of time that detrital sediment particles have existed in the Earth's surface environment, from the formation of clasts to the present day, can yield insights into the processes associated with erosion, transport, and storage of sediment. Here we explore the potential of uranium-series isotopes to provide this elapsed time referred to as the comminution age [1] for non-marine alluvial sediments, . The U-series comminution age model is based on the time-dependent decrease in the [$^{234}U/^{238}U$] activity ratio of a sediment particle due to alpha recoil loss of ^{234}U. The [$^{234}U/^{238}U$] ratio thus serves as a clock for determining the elapsed time since a particle has been reduced below a threshold grain size. The determined age depends on the recoil loss factor (fraction of ^{234}U ejected during alpha decay), which must be measured or estimated

We have investigated how [$^{234}U/^{238}U$] of glacially-derived Pleistocene alluvial fan sediment (core from the Kings River Fan, Sierra Nevada, CA) varies depending on: depth in the core, physical properties (grain size and surface area), chemical properties (elemental composition, Nd and Sr isotopes), and the paleodepositional environment. Samples were leached to remove nondetrital phases, then sieved to isolate different grain size populations <20 μm in diameter. We observe the expected decrease in [$^{234}U/^{238}U$] with depth and decreasing grain size for relatively unweathered channel and overbank deposits. The inferred depositional ages are reasonable but not the same as those based on inferences from stratigraphic correlations with other nearby fans. However, moderately mature paleosol samples exhibit a reversed trend (increase in [$^{234}U/^{238}U$] with decreasing grain size), as well as activity ratios all greater than the initial secular equilibrium value. This suggests that soil-forming processes can overprint the recoil-based ^{234}U depletions.

[1] DePaolo, D. J., Maher, K., Christensen, J. N. & McManus, J. (2006) *Earth Planet. Sci. Lett.* **248**, 394-410.