

# Mixing, fractionation and crustal assimilation in andesites: Evidence from U–Th disequilibrium data, Ruapehu, New Zealand

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Quantifying the effects of crustal interactions on U-series disequilibria is critical to evaluating the time scales of magmatic processes. The 1945–1996 eruptions of Mount Ruapehu (Gamble et al., 1999) produced lavas that provide an exceptional, temporally controlled suite to examine U-series systematics where crustal contamination may be involved.

The U–Th systematics demonstrate for the first time that an inclined array on the equiline diagram for a single volcanic suite can be the product of open system processes—mixing between mantle or lower to mid-crustal melts and shallow upper crustal components. This dictates that the slope of the Ruapehu array has no time significance and that the mixing processes took place over very short intervals (perhaps as short as 50 years) with respect to the time scale of <sup>230</sup>Th decay. <sup>230</sup>Th–<sup>238</sup>U disequilibria provide evidence that crustal assimilation is also likely to have taken place rapidly (relative to the <sup>230</sup>Th half life).

<sup>226</sup>Ra disequilibria show minor excesses (<15%). Disequilibria become more variable with time suggesting an increased role for open system magma replenishment in the last 50 years, or that the processes of crustal melting have become more variable. The trend towards more Ra–Th variability is matched by decreasing Sr isotope ratios, implying that the progressive involvement of more mafic magma may be a driving factor.

## Reference

Gamble, J.A., Wood, C.P., Price, R.C., Smith, I.E.M., Stewart, R.B., Waight, T., 1999. *EPSL* **170**, 301–314.