Melting dynamics beneath Iceland from U-Th-Pa-Ra disequilibria in post-glacial tholeiites

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U-series disequilibria in OIB lavas are thought to be controlled by the dynamics of the melting process (upwelling velocity and melt extraction rate) and by physical parameters of the melt source region (porosity and mineralogy).

Here we present new U-Th-Pa-Ra data on a suite of post-glacial basalts (n=18) from Iceland's main rift zone. All samples are less than 3 kyr old and have ^{230}Th and ^{231}Pa excesses ranging from 4 to 26 % and 35 to 97%, respectively. The data form a positive array in a (^{231}Pa/^{235}U) vs. (^{230}Th/^{238}U) diagram (parentheses denote activity ratios). (^{226}Ra/^{230}Th) range from 0.816 to 1.996 and show no correlation with ^{230}Th- and ^{231}Pa-excess.

The lack of correlation of the U-series data with Hf and Nd isotopes and melting parameters such as La/Sm or $\delta_{(Sm/Nd)}$ indicates that the U-series disequilibria are not primarily controlled by source heterogeneity or the degree of partial melting. Rather, the observed U-series disequilibria provide constraints on the dynamics and processes of partial melting (i.e. upwelling velocity, melt extraction rate and/or residual porosity).

A general decrease in ^{231}Pa-excesses (and ^{230}Th-excesses to a lesser extend) towards central Iceland and the presumed centre of the Icelandic plume, suggests progressively increasing upwelling rates (W) towards the plume axis (from 3 to 10 cm/yr) caused by higher excess mantle temperatures. Significant local variations in ^{231}Pa- and ^{230}Th-excesses, especially at Theistareykir (northern Iceland) [1], however, show that considerable local variability in melt extraction rate and/or porosity is superimposed on the general trend of increasing upwelling velocity towards the inferred plume center. Variations in melt extraction rate and/or porosity are compatible with the large spread in (^{226}Ra/^{230}Th).

[1] Stracke A., Zindler A., Salters V.J.M., McKenzie D., & Grönvold, K. (2003). *Geochem., Geophys., Geosyst.* 4(10) 8513.

How interactions between clouds and aerosols depend on scale

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Why is the estimation of aerosol effects on clouds and precipitation challenging? The answer lies within two poles: the inherent complexity of the microphysical and dynamical processes involved and on the other side, the complexity in measuring and modelling them. Scales (of space, time and wavelength) are a key component in understanding both the processes and the modelling-measurements results.

There are two main "channels" in which aerosol can change cloud properties; the microphysical and the radiative channels. Aerosol, serving as cloud condensation nuclei, changes the size distribution of the cloud droplets and therefore can change condensation/evaporation rates, latent heat release, collision coalescence efficiency, cloud dynamics and all the derived cloud properties such as reflectance, lifetime, phase, size, and precipitation. On the other hand, absorbing aerosol interacting with the solar radiation changes the atmospheric profile hence changes the conditions for cloud development such as stability and buoyancy.

The geometrical and optical dimension of the cloud as well the aerosol properties will determine the overall effect and the observer/modeller resolution will effect the interpretation.