A magma plumbing system probed by the Grænavatn Porphyritic Group, East Iceland

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Neogene plagioclase ultraphyric basalts (PUBs) from East Iceland hold up to 45% macrocrysts that may lend clues to a fossil crustal plumbing system. The ~10 Ma old Grænavatn Porphyritic Group consists of 3-10 PUB lava flows and attain maximum thickness (~90m) west of Reyðarfjörður. It is a regional marker horizon, traceable for >50km along strike, but tapers out to the north, south and up-dip to the east. Modal proportions of plagioclase macrocrysts vary both vertically and laterally within single lava flows. Petrographic observations and crystal size distribution have identified three plagioclase populations; (1) single, zoned euhedral macrocrysts (~5mm) with overgrowth rims, (2) unzoned, anhedral glomerophyric macrocrysts (4-10mm) in clusters up to 3cm, and (3) lath-shaped microlites in the groundmass. Macrocryst cores (An75-85) are more primitive than groundmass microliths (An55-65), and therefore in disequilibrium with the host melt. Detailed textural and chemical mapping of zoned macrocrysts reveals complex histories with resorption, overgrowth and stages with entrapment of melt inclusions. Chemical traverses display oscillatory, continuous normal and reverse zoning. Further, we observe discontinuous reverse zoning (ΔAn4-5) that could suggest decompression of ~10km. These PUBs may enable us to examine the structure of a crustal plumbing system potentially involving events of magma ponding, rapid decompression, mixing, recharge and assimilation.

U-series disequilibria during soil weathering

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The weathering of continental rocks influences long-term atmospheric CO_2 and thus climate. In addition, the riverine transport of weathering products to the ocean partially controls marine geochemical budgets. U-series isotopes have long been recognised for their capability to provide time-scales of weathering processes, as well as the nature of the linkage between chemical weathering and physical denuation. However, to fully exploit the potential of the U-series chronometer in weathering studies, an improved understanding of the chemical behaviour and properties of the U-series nuclides in the weathering regime is required.

We have analysed a Scottish soil chronosequence (soil ages from 0.1-13 ka) [1] for ($^{234}U/^{238}U$), ($^{230}Th/^{238}U$) ($^{238}U/^{232}Th$) and ($^{230}Th/^{232}Th$) activity ratios to investigate the behaviour of the U-series nuclides during progressive weathering. All the bulk soil profiles studied show U-series isotopic disequilibrium, including the C-horizons. In the bulk soil samples a clear trend in ($^{234}U/^{238}U$) is observed, with values above unity for the younger soils (up to 1.3), declining towards unity with time. A corresponding trend is observed in the ($^{230}Th/^{238}U$), with values below unity (down to 0.7) for the younger soils, and increasing with older ages (up to 1.3). These observations suggest that there are two competing processes that dominate: (1) U addition to the bulk soil and; (2) soil leaching. The U added is characterised by a high ($^{234}U/^{238}U$), corresponding to the composition measured in local streams (1.3-2.0). This added U is likely to be from perculating groundwaters that adsorbs to soil surfaces. However, with time this U pool declines, likely to be related to changes in the chemical adsorption properties of the soils. The decline in ($^{234}U/^{238}U$) is combined with leaching of the soil, preferentially releasing more U than Th, due to the higher mobility of U than Th.

The U-series data from the soil chronosequences shows the importance of physio-chemical processes during weathering, which affects element and isotope redristibution during weathering. These have to be quantified in studies using the U-series chronometer to constrain time-scales of weathering.

[1] Bain *et al*. (1993) *Geoderma* **57**, 275-293