**Supplementary Material S1**

**Geochemistry method**

For elemental analysis, samples were crushed in an agate ball mill. Concentrations of major elements were determined by XRF at the Open University on fused glass discs manufactured from the fusion of 1 part rock powder (dried at 110˚C) with 5 parts of dried lithium metaborate/tetraborate flux (Johnson Matthey Spectroflux 100B) in Pt-5%Au crucibles at 1100°C. Percentage loss on ignition (LOI) of volatile components (e.g. H2O, CO2 etc.) was determined separately by calculating weight loss after ignition at 1000°C for 1 hour. Analyses were performed using an ARL 8420+ dual goniometer wavelength-dispersive XRF spectrometer employing routine XRF procedures of the laboratory (Potts et al., 1987). Laterite standards VL-1 and VL-2 (LaBrecque & Schorin 1987) were added to the suite of calibration reference samples to aid analysis of soil-like samples. Large LOI are common in carbon-rich and clay-rich materials. To allow for direct comparison of elemental abundances within the current sample suites, the XRF major element concentrations were re-normalised to 100% on an LOI-free basis.

Limits of determination are typically reported at the 6 confidence level (Potts et al., 1987); the LoD for major elements determined using fused beads manufactured from a range of basalt-derived alteration products are, in most instances, calculated as significantly less than 0.05 wt%.  Replicate analyses (n > 20) were performed upon the standard materials and demonstrate that error in reproducibility for major elements is typically less than 0.2 wt%.

Flame atomic absorption spectrometry was undertaken for the analysis of Mg, Ca, Na, P, Sr, Ba and Al. approximately 3g of powdered rock samples were subjected to digestion using Aqua Regia. Samples were digested for >16 hours before being transferred to a heating block, with further digestion at 80˚C for a further 3 hours. Cooled distillates were filtered and 1ml of 10% potassium chloride solution was added as an ionization suppressant. Duplicate blanks and test samples utilizing a standardized modern soil sample were also prepared for each batch analysed. Distillates were subsequently analysed in a Perkin Elmer flame atomic absorption spectrophotometer using air/Acetylene and Nitrous Oxide/Acetylene to atomize the samples (Allen, 1989). One sample was duplicated for every twenty analyzed with an additional seven standards.