

The age of dust – a new hydrological indicator in arid environments?

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This data supplement includes Tables DR1-4 in Excel format.

Analytical techniques

Sample localities and data, including those for standard reference materials, are provided in Tables DR1-4. All data were obtained in the Macquarie University GeoAnalytical laboratories. Samples were finely powdered in an agate mill. Organics were removed from the dust samples following the methodology of Schultz et al. (1998). The samples were dissolved overnight in Savillex pressure vials in a HF-HNO₃ mix at 180 °C that X-ray diffraction analysis has shown effectively dissolves accessory phases in fine grained powders. Moreover, detailed scanning electron microscope imaging reported by De Decker et al. (2008) shows that the dust samples are comprised of quartz, feldspar and clay minerals and lack zircon or apatite that become winnowed out during wind blown transport due to their high density.

For trace element analysis the samples were en up in 2% HNO₃, spiked and analysed using an Agilent 7900 inductively-coupled, plasma mass spectrometer following procedures essentially the same as those described by Eggins *et al.* (1997).

Sr was isolated by a single pass through Teflon columns containing Biorad® AG50W-X8 (200-400 mesh) cationic exchange resin. The Nd fraction was purified using EICrom® LN-spec resin according to the method of Pin & Zalduegui (1997). Samples were loaded on to outgassed single (Sr) and double (Nd) rhenium filaments using 2 µl of TaCl₅ + HF + H₃PO₄ + H₂O (Birck, 1986) and 5 µl of 1N HCl: 0.35N H₃PO₄ activator solutions, respectively. Analyses were performed in static mode on a ThermoFinnigan Triton® thermal ionisation mass spectrometer.

Instrument mass fractionation was accounted for by normalising $^{87}\text{Sr}/^{86}\text{Sr}$ and $^{143}\text{Nd}/^{144}\text{Nd}$ to $^{86}\text{Sr}/^{88}\text{Sr} = 0.1194$ and $^{146}\text{Nd}/^{144}\text{Nd} = 0.7219$, respectively.

U, Th and Ra concentrations and isotope ratios were determined on samples that were spiked with ^{226}U - ^{229}Th and ^{228}Ra tracers. After initial dissolution the product was converted to chloride using 6N HCl and then 6N HCl saturated with H_3BO_3 to drive-off residual fluorides. The final product was then converted to nitrate using 14N HNO_3 and finally taken up in 7N HNO_3 . U and Th purification was achieved via a single pass through a 4 ml anionic resin column using 7N HNO_3 , 6N HCl and 0.2N HNO_3 as elutants. We purposefully avoided the use of ElChrom® resins for the U-Th chemistry as these can bleed organics that lead to memory effects and interferences during analysis. Concentrations and isotope ratios were measured in dynamic mode on a Nu Instruments® multi-collector, inductively coupled plasma mass spectrometer. ^{238}U and ^{235}U were analysed on Faraday cups, using the $^{238}\text{U}/^{235}\text{U}$ ratio to determine the U mass bias, assuming $^{238}\text{U}/^{235}\text{U} = 137.88$, whilst ^{236}U and ^{234}U were alternately collected in the IC0 ion counter that is preceded by an energy filter. The IC0 gain was determined during interspersed dynamic analyses of CRM145 assuming a $^{234}\text{U}/^{238}\text{U}$ ratio of 5.286×10^{-5} (Cheng *et al.*, 2000). Methods for Th isotope measurements employed a dynamic routine with ^{232}Th in Faraday cups and ^{230}Th and ^{229}Th alternating on IC0 and using bracketing measurements of the Th”U” standard to obtain the Th mass bias which is different to that for U. Measurements at masses 230.5 and 229.5 were used to derive a correction for residual ^{232}Th tail interference as described in detail by Sims *et al.* (2008) and Turner *et al.* (2011).

The Ra analysis procedure follows that used by Turner *et al.* (2000). Ra was taken from the first elution from the anionic column and converted to chloride using 6N HCl. This was then loaded in 3 N HCl onto an 8 ml cationic column and Ra eluted using 3.75M HNO_3 and the process repeated on a scaled-down 0.6 ml column. The REE were then removed using a 150 μl column of ElChrom® Ln-spec resin™ and 0.1N HNO_3 . Ra and Ba were finally

chromatographically separated using ElChrom® Sr-spec resin™ and 3N HNO₃ as elutant in a 150 µl procedure. Samples were loaded onto degassed Re filaments using a Ta-HF-H₃PO₄ activator solution (Birk, 1986) and ²²⁸Ra/²²⁶Ra ratios were measured to a precision typically ~ 0.5% in dynamic ion counting mode on the ThermoFinnigan Triton®. Organic interferences are often noted at low temperatures during Ra analysis but were eliminated here by using the instrument fitted with a dry scroll pump instead of the standard rotary pump. This prevents leakage of organic molecules into the source during venting.

References

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