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Isotopic Variability of Sr and Nd in Lateritic Deposits from the Deccan Traps, India: Evidence for an Input of Aeolian Material to the Laterites

Thomas Frederick David Mason[1], **Mike Widdowson** (m.widdowson@open.ac.uk)[2], **Rob M Ellam** (r.ellam@surrc.gla.ac.uk)[3] & **Rachel Oxburgh** (rachel.oxburgh@ed.ac.uk)[4]

[1] T. H. Huxley School, Imperial College, South Kensington, SW7 2BP, UK
[2] Department of Earth Sciences, The Open University, Milton Keynes, MK7 6AA, UK
[3] Scottish Universities Environmental Research Centre, East Kilbride, G75 0QF, Scotland, UK
[4] Department of Geology and Geophysics, Edinburgh University, Edinburgh, EH9 3JW, UK

In the majority of cases, laterites are considered to represent the weathering residuum that remains after intensive *in situ* chemical alteration of a “protolith” bedrock under tropical weathering conditions (Widdowson & Gunnell, 1999). However, it has been proposed that an influx of aeolian material to lateritic weathering profiles can play an important role in supplying immobile constituents to otherwise autochthonous lateritic deposits thus fundamentally modifying their composition (Brimhall et al., 1991). To date, the significance of such an allochthonous input, and its relative contribution to the evolution of weathering profiles remains unclear. Here, we present an approach combining Sr and Nd isotope ratios with elemental concentration data for quantitatively assessing the nature and degree of allochthonous aeolian material incorporated into laterite profiles.

The strontium and neodymium isotope compositions of a complete lateritic weathering profile from the Deccan Trap basalts of India are presented (see Fig. 1), together with strontium isotope data for several discrete laterite occurrences from across the Deccan region. Importantly, these data reveal marked increases in the $^{87}Sr/^{86}Sr$ ratios and decreases in the $^{143}Nd/^{144}Nd$ ratios of the laterites relative to their precursor (i.e. protolith) basalts. This isotopic variation is most plausibly explained by an input of aeolian allochthonous material to the laterites. The allochthonous material is likely to have been derived from Archaean and Proterozoic rocks that together comprise the Dravidian Shield and which outcrop to the south and east of the basalts. Given the Precambrian continental isotopic signature of the Dravidian Shield (Taylor et al., 1984), only a very small input of material is required to produce the isotopic shifts observed in the Deccan laterites, indicating only a very small input of allochthonous material to the weathering profile.

The net input of aeolian material to the laterites increases up-section in the profile as a result of a mass filtering within the profile, such that the majority of material is trapped near the surface. Decoupling in the behaviour of Sr and Nd isotopes in the most altered laterite samples indicates that strontium is leached out of the allochthonous fraction relative to neodymium in the latter stages of laterite development. Moreover, the position of a palaeo-water table can be inferred from both isotopic and major and trace element anomalies within the profile. The identification of a single static palaeo-water table within the profile has important implications for how laterites are believed to develop, and calls into question the role played by migrating water tables during laterite genesis (McFarlane, 1976).

Our approach illustrates the potential for using strontium and neodymium isotopes to study both the input of foreign material to, and the redistribution of material within weathering profiles. Similarly, this method could be applied to studying the input of aeolian material to weathering profiles from a variety of climatic regimes.

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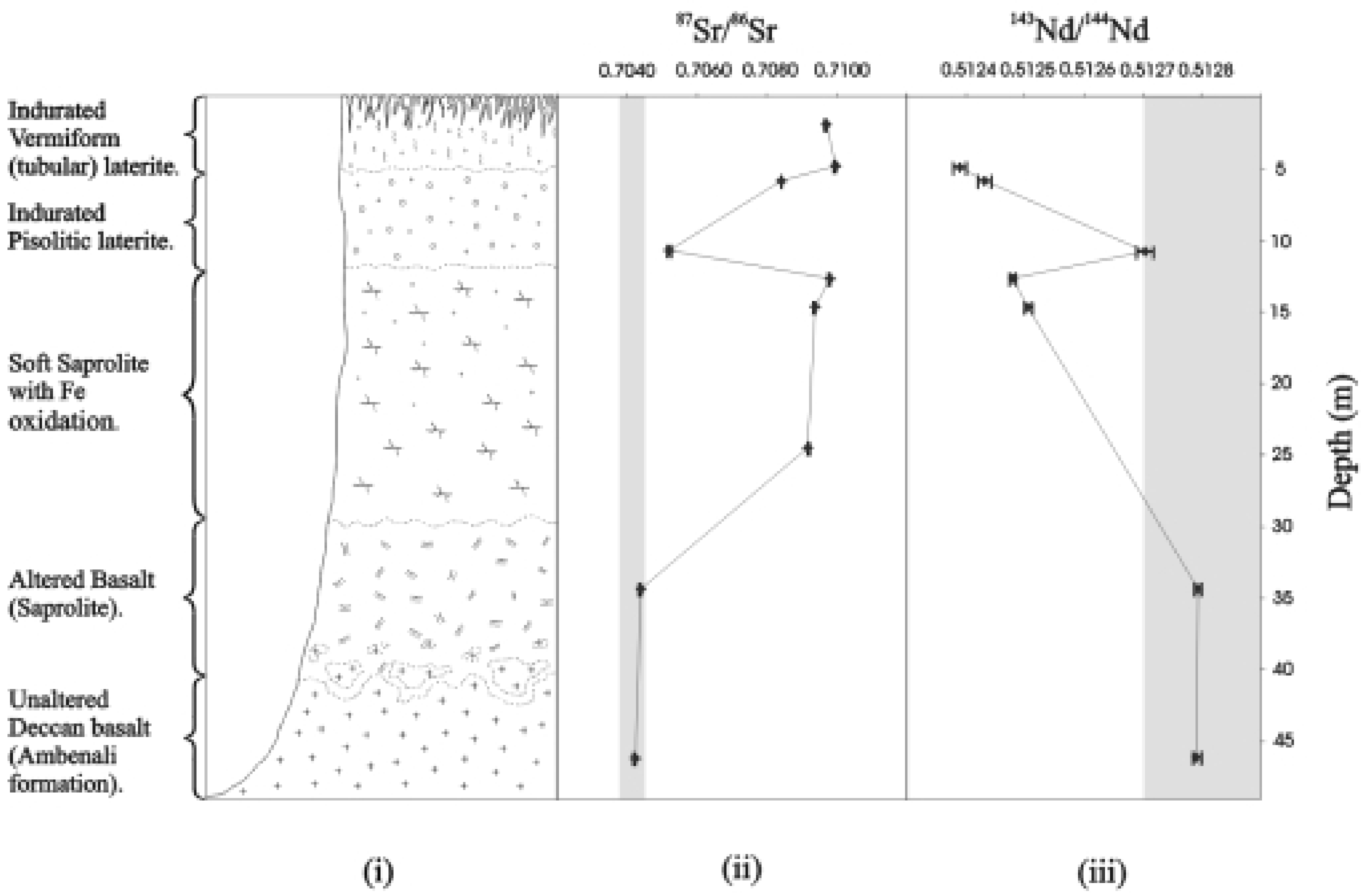

Figure 1. Generalised section through a lateritised weathering profile from Bidar in the southeastern Deccan Traps. A variety of different lateritic textures may be identified in the section (see (i)), but all the boundaries are essentially gradational, with one texture blending into the next. Strontium and neodymium isotopic data for the section are presented in (ii) and (iii) respectively as determined by TIMS following standard procedures. All isotopic data has been aged corrected to 60 Ma, which represents maximum age of the weathering profiles as defined by the underlying Deccan basalts (Widdowson et al., in press). This assumes that the Rb/Sr and Sm/Nd ratios of each lateritic horizon have remained constant since their genesis. The shaded regions represent the natural isotopic variation exhibited by the Ambenali formation upon which the laterite profile developed (Lightfoot et al., 1990). Error bars represent the 2Σ combined error for each isotope measurement.

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