The timescale of soil and saprolite production inferred from uranium-series isotopes: Case study in temperate Australia

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Uranium-series isotopes can be used to address the timescale of weathering processes because these nuclides fractionate during weathering and their abundance is time-dependent. A recent study of suspended particles and colloids in the Murray-Darling River (SE Australia) shows that, even in an environment characterized by low erosion rates and tectonic stability, the residence time of sediments in the basin (including storage in soils and transport in the river) is only a few thousands of years (Dosseto et al.). Is this timescale truly the timescale for soil evolution or does it reflect the remobilisation of temporary sediment accumulations? To answer this question, we need to know the characteristic timescale for soil production.

Previous attempts to constrain the timescale of soil formation have shown that the U-series isotope signal can be very difficult to interpret (Chabaux et al., 2003). We have applied U-series isotopes to a simple situation where soils of moderate thickness (<1 m) developed over a granodioritic lithology in temperate SE Australia (Bega Valley, NSW). The site has been extensively studied, including the determination of soil production rate from Be-10 and weathering rates from major and trace element compositions (Heimsath et al., 2000, Green et al., 2006). Modeling of U-series data suggests that the timescale for soil production is highly variable: from a few thousands of years to several tens of kyr. The inferred range of soil production rates is similar to the estimates calculated with Be-10 (Heimsath et al., 2000). One of the advantages of our approach is that we are able to determine the variation of soil production rates vertically through the profile. Interestingly, soil production seems to be most active near the surface whereas it is the lowest in the vicinity of the soil–saprolite boundary.

References

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