$^{234}U/^{238}U$ in speleothems revisited: Are there generally applicable relationships of this proxy to past environmental change?

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The initial activity ratio of ^{234}U to ^{238}U, $(^{234}U/^{238}U)_i$, is the ratio of ^{234}U to ^{238}U atoms at time of formation of a sample, relative to that at secular equilibrium. It is found using their measured present ratio and the known age of a sample, and is a by-product of all U-Th disequilibrium dating as well as some U-Pb dating of Quaternary samples. As such there is now an enormous body of these data in the published literature. A number of publications have addressed paleoenvironmental significance of $(^{234}U/^{238}U)_i$ over the last few decades but no clear consensus has emerged, other than that this initial disequilibrium is caused by some combination of alpha recoil and selective dissolution of ^{234}U as seepage water makes its way to the cave, and that hydrological factors probably have the greatest influence. General observations are that $(^{234}U/^{238}U)_i$ tends to gradually fall with time at a given location, often to values well below one in relatively old, stable settings, and that significant paleoenvironmental changes invariably lead to some form of change superimposed upon this. The nature of these latter changes remains poorly understood. They vary hugely in magnitude with $(^{234}U/^{238}U)_i$ values as high as 10 and as low as 0.5 having been observed, and are sometimes highly responsive to reconstructed external environmental change and sometimes lagged by thousands of years. Here I will report progress in understanding of the hydrological significance of $(^{234}U/^{238}U)_i$ in speleothems, and of its significance for paleoenvironmental reconstruction and also for dating using the U-U and U-Pb techniques

Hidden hotspot track beneath Eastern United States

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More than two thirds of surface hotspots associated with volcanism can be explained by the interaction between a moving plate and deep-seated mantle plumes[1]. Most of these hotspot tracks are observed on oceanic or thin continental lithosphere. Although there are not many traditional hotspot tracks on old continents, there are diamondiferous kimberlites indicative of deep mantle origins[2]. This poses the question that there could be many more hotspot tracks beneath old continental regions than suggested by the record of surface volcanism. Here we show that seismic waveforms recorded by USArray from a recent Virginia earthquake reveal an unexpected linear, lower lithosphere seismic anomaly extending from Missouri to Virginia without a clear relationship to surface geology. This east-west corridor has *P* velocity reduced by 2.1% along with high attenuation and crosscuts prominent regional features suggesting a link to plate motions. We suggest that a thermal plume-like upwelling interacting with the base of the continental lithosphere can produce the requisite seismic signal. A Late Cretaceous kimberlite in Kentucky, dated 75 Ma, pins a hotspot track that bends northward beneath Virginia. Seismic data indicates that the lower lithospheric anomaly along this northeastern segment is even stronger than the east-west segment, supporting such a hypothesis.

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