PATTERNS OF SECONDARY U IN OSTRICH EGGSHELL: APPLICATION TO U-TH DATING OF QUATERNARY TERRESTRIAL STRATA

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Dating late Quaternary terrestrial strata is especially challenging beyond the ~50 ka limit of ^{14}C. Ostrich eggshell fragments (OES) are common in African archaeological sequences, consist of ~2 mm-thick low-Mg calcite with 1-3% organics, and are resistant to diagenesis in semi-arid to arid soils over geologic timescales. OES are amenable to ^{14}C dating and are geochemically suitable for U-Th dating, though previous attempts neglected to account for secondary U derived from soil water upon burial. Recent work[1] has shown that U-Th "burial dates" on OES are concordant with ^{14}C dates for ~10-50 ka OES from an African rockshelter. We present LA-ICP-MS profiles of U and ^{232}Th for ancient OES from 8 archaeological sites in sub-Saharan Africa spanning ~10 to >500 ka. They reveal undesirable elevated detrital ^{232}Th and erratic ^{238}U near OES surfaces and in secondary calcite filling macroscopic pores, guiding optimal sampling for dating. Patterns of U and ^{232}Th are similar in OES from all localities and do not vary systematically with age, suggesting U uptake is self-limiting and [U] is controlled by soil composition. All OES have steep smooth gradients of [^{238}U] (~100s to 10s of ppb) starting at or near their outer surface, continuing through the "palisade layer", then dropping to near zero (primary) values, consistent with diffusive U uptake. SEM imaging and $erfc^{-1}(U/U_0)$ v. distance plots indicate OES calcite structures control U diffusivity. OES >500 ka retain coherent U profiles, suggesting that U-Th burial dating of OES may be useful to the limit of secular equilibrium.

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[1] Sharp et al., *U-Th dating of ostrich eggshell*: American Geophysical Union Fall Meeting 2015; in prep