U-series dating of ostrich eggshells

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Ostrich eggshell (OES) fragments occur widely in archaeological contexts in Africa and elsewhere where dates beyond the limits of radiocarbon are needed but may be challenging to obtain. U-series dates for OES and eggshells of other large, flightless birds (emu, the extinct *Genyornis newtoni*) have been reported for >15 years, and Magee *et al*. [1] show that radiocarbon and U-series dates are concordant for a ~31 ka emu eggshell, but independent reliability criteria for OES U-series dates have not been developed.

OES carbonate consists of finely crystalline low-Mg calcite with low primary U, but OES readily acquires U from pore waters upon burial. From outside to inside, OES consists of: (1) a thin (~70 μm) *crystal* layer; (2) a thick (~1600-1800 μm) *palisade* layer; and (3) a *cone* layer (~800 μm thick). We are measuring U and Th concentrations (by LA-ICPMS) and apparent U-Th ages (by solution ICPMS) across OES profiles to: (1) identify the layers most conducive to U-series dating, (2) assess U and Th mobility, and (3) determine if burial ages can be estimated using sub-samples from individual OES. In $\geq$100 ka old OES from sites near Lake Victoria (Kenya), the crystal layer is high in U but also in undesirable ^{232}Th, probably from translocated soil particles. The palisade layer, consisting of closely packed radially elongate crystals, has favorable U/Th ratios and U concentrations that decrease rapidly inward, consistent with a diffusion gradient. The cone layer displays a steep U concentration gradient sloping away from the inner surface of the eggshell and high ^{232}Th at the eggshell's inner surface. For two OES, apparent ages of pairs of samples centered at X (= normalized distance from the outer surface) of ~0.3 and ~0.7 are concordant within analytical errors—i.e., sample 1: 98.5 ±1.8 and 96.7 ±1.9 ka, sample 2: 143.9 ±0.7 and 141.9 ±1.2 ka (1σ)—consistent with rapid U uptake. Such internally concordant apparent ages should closely approach the age of eggshell burial. A third OES yields an inner age older than its outer age, suggesting late U loss from the inner eggshell.

[1] Magee (2009) *Quat. Geochron.* **4** 84-92.