Avoiding common Th in U-Th dating of Ostrich Egg Shells

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U-Th dating of ostrich egg shells (OES) offers a new approach to precisely date early human activity, particularly for sites older than 50,000 years where ^{14}C dating techniques are not effective [1]. OES, commonly found in early human sites, form with a crystalline calcite matrix that absorbs U from the soil after burial. Measurement of ^{234}U and ^{230}Th from in situ U decay and modelling the U diffusion into OES allows determination of a burial age [2]. Additionally, a correction for common Th in the OES, a component of the measured ^{230}Th, must be made to determine an accurate U-Th age. Large uncertainties in assumed common Th initial isotopic compositions result in large uncertainties in calculated ages. Avoidance of common Th improves OES U-Th ages.

The crystal, palisade and cone layers of OES (from outside to inside) are composed of crystalline calcite that appears to be largely impervious to the diffusive uptake of Th [3]. However, the cone and crystal layers commonly contain elevated concentrations of common Th, likely from incorporated Th-rich soil particles [3]. These soil particles may also enter the palisade layer of the OES through penetrative pores. TIMS U-Th isotopic analyses of the palisade layers of OES indicate that removal of pore-fill from the palisade layer significantly decreases common Th in analyses.

Cross-sectional surfaces of palisade layers contain 1-3 μm wide streaks of brown calcite that anastomose across the ~2 mm thick layer. We interpret that these are recrystallized pore-fill. To characterize the three dimensional structure of the pores, we imaged OES using high resolution X-ray computed tomography (CT). These images reveal regularly-spaced small clusters of anastomosing channel-like shapes, equivalent to the brown streaks observed on the cross-sectional surface. Discrete clusters of round pores, matching those observed by CT, are visible on surfaces of the palisade layer after removing the cone and crystal layers. We present methods to extract the pore-fill from the pristine palisade layer and analyses of host soils, pore-fill and clean palisade calcite that diminish the impact of the soil component on U-Th age analyses.

[1] Brandt et al. 2012. Quat. Int., p. 274. [2] Sharp et al. (2015) AGU Fall Mtg Abs., San Francisco, CA Dec 14-18, 2015. [3] Sharp et al., 2014, Goldschmidt Mtg. Abs., Sacramento, CA, June 8-13, 2014.