Preliminary Ams 14C Measurements from Holocene-Age Carbonate Concretions

PRELIMINARY AMS 14C MEASUREMENTS FROM HOLOCENE-AGE CARBONATE CONCRETIONS

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Introduction

Determining how fossils form and the ways in which organic matter becomes preserved through geologic time has been a challenge to unravel because decay begins immediately after senescence while diagenesis typically continues progressively over millions of years. Laboratory experiments running days to months provide important insights to some of the processes taking place. However, it would be ideal if fossilization could be caught in the act under natural conditions. In recent years, interest surrounding carbonate concretions has seen a resurgence as potential windows into the fossilization process or the 'diagenetic continuum' (e.g., Melendez *et al.*, 2013). This is because authigenic mineral precipitation has been proposed to entomb carbon within carbonate matrices at various stages of alteration ensuring its survival through the geologic record (Grice et al., 2019). In spite of this interest and potential to unravel the fossilization process, concretion formation continues to be an enigmatic phenomenon. Ubiquitous throughout the geological record, carbonate concretions are thought to be the result of (1) anaerobic microbial decay of a carbon source (e.g., a dead fish) resulting in (2) the localized supersaturation of HCO_3^- ions and other byproducts which generate an alkalinity gradient that is (3) proportional to the rate of decay and diffusion resulting in (4) decreased solubility (i.e., increased saturation index - SI) and consequent precipitation of carbonate (Berner, 1968b; Raiswell, 1976; Coleman, 1993; Raiswell & Fisher, 2000). Moreover, it remains unclear how long it takes for concretions to form, whether they grow by particular mechanisms (i.e., concentric in-to-out: Raiswell and Fisher, 2000, concentric out-to-in: Coleman, 1993, and pervasive: Raiswell and Fisher, 2000), and whether these conditions influence the degree of soft-tissue preservation.

Results & Conclusion

In order to better constrain the timescale and mechanisms for concretion formation, we have analysed two Holocene-age concretions from contrasting depositional environments which display divergent levels of soft-tissue preservation (Figure 1A & 1B). Inorganic carbon samples (carbonate) were taken at successively greater distances from the center of the concretion for accelerator mass spectrometry (AMS) ^{14}C dating (Figure 1A & 1B) (Berner, 1968a). Our preliminary results indicate that the concretions studied here may have grown in a concentric fashion, out-to-in, within a ~450-year and ~1100-year timeframe (Figure 1C & 1D). These results are unexpected and require further investigation. Dating is currently underway of the organic carbon fraction (soft-tissue from the Greenland concretion and melanin from the Canadian concretion) in order to determine whether this age trend is real or perhaps an artefact of old and young carbon reservoir mixing (Gallagher *et al.*, 1989).

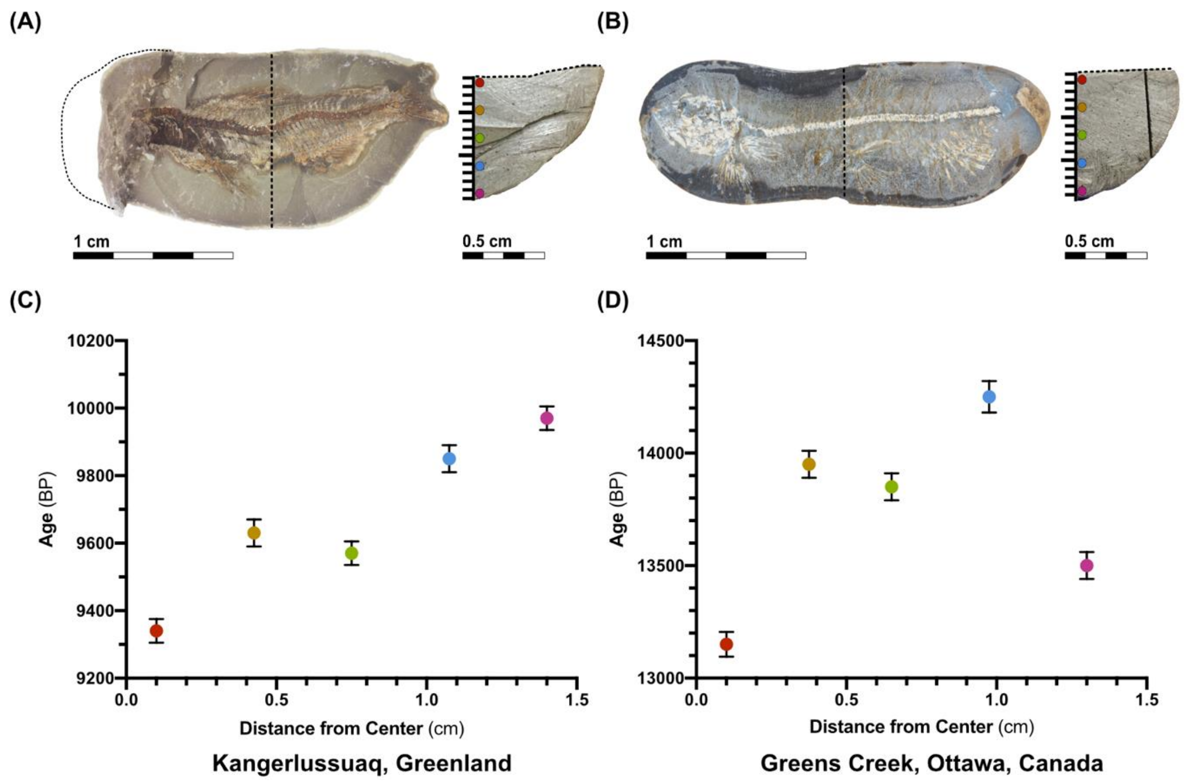

Figure 1 *(a) Concretion from Kangerlussuaq, Greenland with exceptional soft-tissue preservation and (b) fully skeletonized concretion from Ottawa, Canada with* ^{14}C *sampling cross-sections. (c-d) Preliminary radiocarbon ages taken along the sampling transects generally demonstrate younger centers and older edges (perhaps an artifact of young and old carbon reservoir mixing).*

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