^{14}C reservoir ages and seasonal isotope records from 17th century Jamestown oyster shells

B. L. GRIMM[1], J. M. HARDING[2], H. J. SPERO[3]* AND T. P. GUILDERSON[4]

[1]University of California Davis, Davis CA 95616, USA blg5044@gmail.com

[2]Coastal Carolina University, Conway SC 29526, USA jharding@coastal.edu

[3]University of California Davis, Davis CA 95616, USA (*correspondence: hjspero@ucdavis.edu)

[4]Lawrence Livermore National Laboratory, Livermore CA 94550, USA guilderson1@llnl.gov

The first permanent English settlement in North America occurred in 1607 with the settlement of Jamestown Island on the James River, VA estuary. During the subsequent century, carbon flow through the James River estuary was transformed as the forested watershed was cleared for farming. Discarded oyster shells from sealed Jamestown wells and nearby archeological deposits were analyzed to explore changes in James River ^{14}C reservoir ages, seasonality (shell $\delta^{18}O$ and $\delta^{13}C$) and carbon cycling.

Sub-seasonal sampling resolution was obtained from the sectioned hinge margins of selected specimens. Analyses of modern water samples demonstrate that estuarine salinity covaries with $\delta^{18}O_{water}$ and $\delta^{13}C_{DIC}$ (n = 20, R^2 = 0.92). Combining oyster hinge $\delta^{18}O_{calcite}$ and $\delta^{13}C_{calcite}$ data, we show that shell $\delta^{13}C_{calcite}$ is primarily controlled by river $\delta^{13}C_{DIC}$ after correcting for a minor metabolic carbon effect and can therefore be used directly as a salinity/$\delta^{18}O_{water}$ proxy. Seasonal temperatures obtained by combining these stable isotope data demonstrate that oyster calcification ceased below 8ºC and above 26ºC, similar to estimates of modern calcification temperature thresholds.

Seasonal sampling of hinge calcite for ^{14}C analysis, based on $\delta^{18}O_{calcite}$ profiles, yields radiocarbon reservoir ages (ΔR) that differ by up to 195 years between winter and summer samples from the same shell. Within the analyzed population of shells, we observe a seasonal-specific ΔR *range* of 197 and 255 years in summer vs fall/winter/spring hinge calcite respectively. These differences are likely due to seasonal changes in the contribution of old remineralized soil carbon to the DIC pool between the rainy and dry seasons. For the mesohaline region of the 17th century James River estuary, a mean summer ΔR of -32 ± 11 years is most appropriate for bulk radiocarbon analyses. However, year to year variations in regional hydrology will increase ΔR uncertainty when dating oysters from different time periods.