AMINOSTRATIGRAPHIC MAPPING OF QUATERNARY COASTAL UNITS, CAROLINA COASTAL PLAIN

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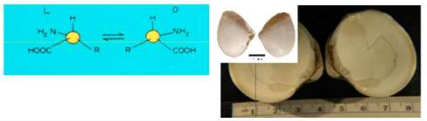
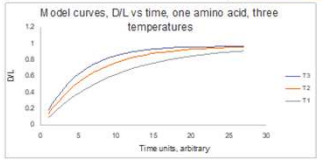
INTRODUCTION

- Amino acid racemization (AAR) results define "local **aminozones"** (clusters of D/L values) that can be interpreted as depositional units. Stratigraphic sequences provide a **rigorous test of the validity of the method**.
- Interpretations are sensitive to taxonomic, geochemical and thermal factors, as well as age-mixing.
- AAR data exist for hundreds of onshore and offshore sites resulting from ~50 years of study using multiple methods. Current effort is a comprehensive data review for quality assessment.
- Multiple collaborators have been involved, as have multiple methods. Each method has advantages and disadvantages; comparison of results from different methods is challenging, but newest results (since 2014) provide insights regarding age-mixing and other complicating factors.
- Over 50 years, work has evolved from slide rules to Chemstation, from Apple II to Access and ArcGIS.
- 2014-present BOEM offshore coring project has yielded extensive AAR dataset (Reverse phase) providing a broad latitudinal perspective for both onshore, offshore, and barrier island samples.
- Study areas described in this poster (**NC-AE, GA-SC, and CR-CL regions – Figure 2**) demonstrate how AAR can be used to derive local stratigraphic sequences; correlations between regions are more subjective.
- AAR results, combined with 14C, have implications for the late Pleistocene (MIS 5-4-3) sea-level record of the NC-SC coastal plain and the integrity of 14C dates near the 14C detection limit.

PRINCIPLES OF AAR





- L-amino acids convert reversibly to D-amino acids. Rate depends on temperature, sample type (genus), D/L values affected by shell alteration, and potential contamination.
- *Mercenaria* and *Mulinia* are commonly used samples – each has advantages. *Mulinia* is abundant at almost all sites, but has a thin shell vulnerable to diagenetic effects. *Mercenaria* is abundant, robust, potentially reworked, and has large intra-shell variability.

STUDY REGION: VA, NC, SC, & GA

The QR code below will access an output map and descriptive text, along with relevant references, collaborators, and a timeline for different projects and instrumental programs at the University of Delaware. *Map is best opened in MapViewer Classic.*

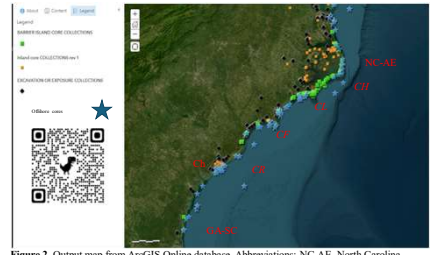


Figure 2. Output map from ArcGIS Online database. Abbreviations: NC-AE, North Carolina Albemarle Embayment; CH, Cape Hatteras; CL, Cape Lookout; CF, Cape Fear; CR, Cape Romain; Ch, Charleston SC; GA-SC, Georgia-South Carolina (onshore-offshore).

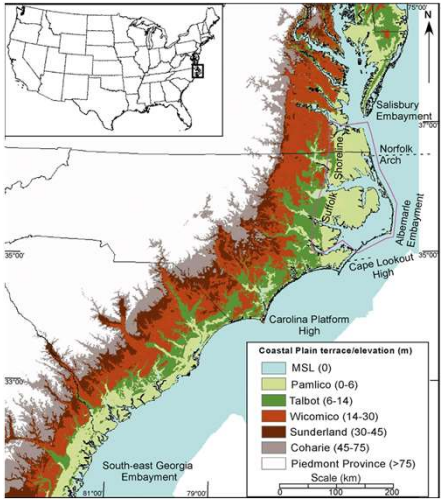


Figure 3. Map from Parham et al. (2013) showing Coastal Plain terraces and associated elevations. AAR results from Albemarle Embayment, GA-SC, and Caroling Platform High (CPH) are discussed in this poster. See Wehmiller et al. (2021) for DelMarVa-Chesapeake region AAR. AAR results for the CPH region are derived primarily from offshore and beach samples. See Figures 6a, 6b, and 7.

GA-SC AMINOSTRATIGRAPHY

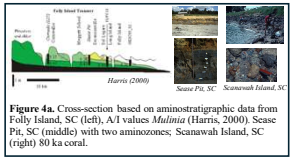


Figure 4a. Cross-section based on aminostratigraphic data from Folly Island, SC (left), A/I values *Mulinia* (Harris, 2000). Seasc Pit, SC (middle) with two aminozones; Scanawah Island, SC (right) 80 ka coral.

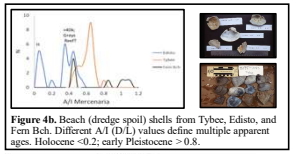


Figure 4b. Beach (dredge spoil) shells from Tybee, Edisto, and Fern Bch. Different A/I (D/L) values define multiple apparent ages. Holocene <0.2; early Pleistocene > 0.8.

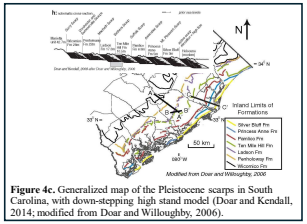


Figure 4c. Generalized map of the Pleistocene scarps in South Carolina, with down-stepping high stand model (Doar and Kendall, 2014; modified from Doar and Willoughby, 2006).

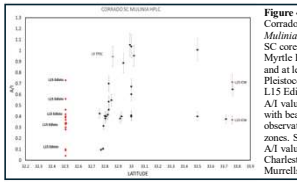


Figure 4d. Data from Corrado et al., 1986. *Mulinia* A/I values from SC cores, Edisto to Myrtle Beach. Holocene and at least three Pleistocene aminozones. L15 Edisto shows mixed A/I values, consistent with beach shell observations => multiple zones. Similar clusters of A/I values seen offshore Charleston (Harris) and in Murrells Inlet (York).

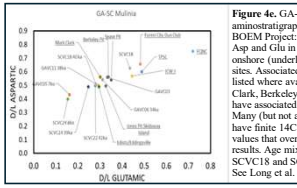


Figure 4e. GA-SC aminostratigraphy from the SE BOEM Project: co-varying D/L Asp and Glu in *Mulinia* from onshore (underlined) and offshore sites. Associated 14C results listed where available. Mark Clark, Berkeley, and Jones all have associated MIS 5 coral ages. Many (but not all) offshore sites have finite 14C results but D/L values that overlap with MIS 5 results. Age mixing inferred from SCVC18 and SCVC24 results. See Long et al. 2021.

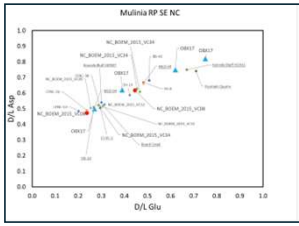


Figure 4f. Co-varying Asp-Glu D/L values in *Mulinia* from SE NC onshore and offshore sites. The lowest D/L group (~0.28, ~0.5) is associated with finite 14C results (~32-48ka). For reference, the two zones at Kennells Bluff are late and early Pleistocene.

NC OUTER BANKS AMINOSTRATIGRAPHY

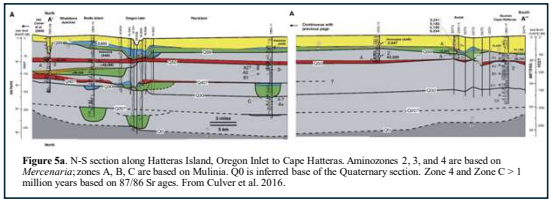
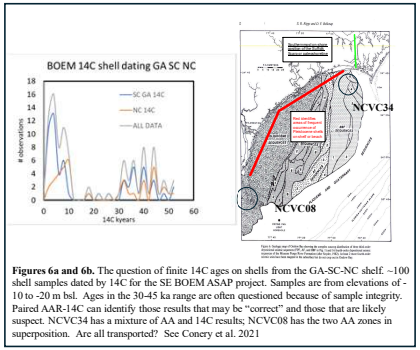


Figure 5a. N-S section along Hatteras Island, Oregon Inlet to Cape Hatteras. Aminozones 2, 3, and 4 are based on *Mercenaria*; zones A, B, C are based on Mulinia. Q0 is inferred base of the Quaternary section. Zone 4 and Zone C > 1 million years based on 87/86 Sr ages. From Culver et al. 2016.



Figures 6a and 6b. The question of finite 14C ages on shells from the GA-SC-NC shelf. ~100 shell samples dated by 14C for the SE BOEM ASAP project. Samples are from elevations of -10 to -20 m bsl. Ages in the 30-45 ka range are often questioned because of sample integrity. Paired AAR-14C can identify those results that may be "correct" and those that are likely suspect. NCVC34 has a mixture of AA and 14C results; NCVC08 has the two AA zones in superposition. Are all transported? See Conery et al. 2021

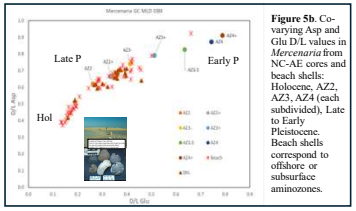


Figure 5b. Co-varying Asp and Glu D/L values in *Mercenaria* from NC-AE cores and beach shells: Holocene, AZ2, AZ3, AZ4 (each subdivided), Late to Early Pleistocene. Beach shells correspond to offshore or subsurface aminozones.

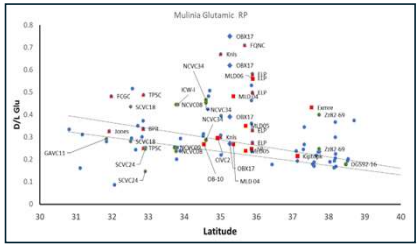


Figure 8. *Mulinia* D/L Glutamic vs. latitude. Envelope is projected from the mid-Atlantic region 36-39° (Wehmiller et al., 2021) to include all data points representing MIS 5 (broadly defined as 130 to 75 ka). The projection captures data points for two MIS 5 calibration sites in GA and SC (Jones, BPit). Offshore data relevant to the question of finite 14C results include SCVC24 and NCVC08. For additional age control, note that OBX 17 likely spans the entire Quaternary, and FQNC is early Pleistocene – these ages reflect the fact that the relation of D/L to age is non-linear (see Figure 1).

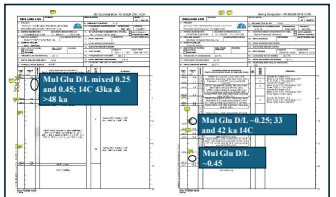


Figure 7. Two cores show how AAR data reveal both age-mixing (VC34) and superposition (VC08). VC08 has two amino-zones, lower D/L zone also seen in nearby VC09. Both zones seen in other NC & SC BOEM cores. Finite 14C are most likely minimum ages, but some are consistent with AAR. What is the source of these transported shells in this sediment-starved system?

The following individuals have participated in this work over the past 40+ years, through field or lab work, provision of samples, or in discussions of results. JFW takes responsibility for any omissions.

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