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TEXT TO SUPPLEMENT WEHMILLER ET AL. GSA APRIL 2024 SOUTHEASTERN MEETING

AAR work began at the University of Delaware in 1976. Sample preparation and analytical methods were vastly different from today. Under ideal circumstances 4 samples could be processed in a week; currently available methods allow up to 10X this rate, with far greater sensitivity and precision. Review of earlier results and re-analysis of samples collected during the "early era" is an on-going and important process as we try to resolve some of the uncertainties encountered in the early work.

Specimens of Mulinia and Mercenaria have been most frequently analyzed, because of abundance and/or integrity. Mulinia results are emphasized in this poster.

Figure 4a: results in this figure indicate that multiple aminozones can be found in the subsurface stratigraphy beneath a single "terrace" – often in place when a stratigraphic success is collected (Sease Pit) but also likely when shells of different ages are mixing by natural or sampling processes.

Figure 4b: AAR data for beach shells can be used to identify local aminozones. This figure shows D/L values in Mercenaria from Edisto Beach (SC), Tybee Island (GA) and Fernandina Beach (FL) dredge spoil. Distinct and/or overlapping zones identify Holocene and multiple Pleistocene aminozones. The lowest D/L values seen in Pleistocene shells appears to identify an aminozone that is younger than the main MIS 5 onshore aminozone, suggesting an offshore unit that likely represents MIS 3. An equivalent aminozone is likely represented by AAR results from Grey's Reef (Garrison; Wehmiler unpublished). In the 1980's Frank Stapor provided 14C data from shells in the Edisto area and suggested the existence of an "offshore reef" that was the source of Pleistocene shells found on beaches in this area. Additionally, we reported to SCGS (York and Wehmiller, Jan. 2001) data for multiple shells from the "Edisto site" collected by W. Doar at an excavation very near Edisto Beach and near a site collected by Stapor. This report suggested that the Edisto samples represent an aminozone younger than the nearby MIS 5a calibration sites and older than 40ky based on existing 14C results in the region. A coral was collected at the Edisto site but, to our knowledge, was never submitted by SCGS staff for U-series analysis.

Figure 4d: Corrado et al. 1986. Augering was used to recover Mulinia samples from multiple sites in the SC coastal plain. Corrado et al. reviewed the ambiguities in the interpretation of local stratigraphy and aminostratigraphy. A pair of discussion & answer articles appeared in a subsequent issue of South Carolina Geology. Corrado discussed at length various issues (geochemical and sampling) related to the use of Mulinia in coastal plain studies. Our work has duplicated the aminozones identified by Corrado, including results from offshore core and grab samples.

Figures 4e and 4f: Plots of co-varying D/L Aspartic and D/L Glutamic acids in Mulinia from GA-SC onshore and offshore sites. This format is commonly used to plot D/L values with increasing age.

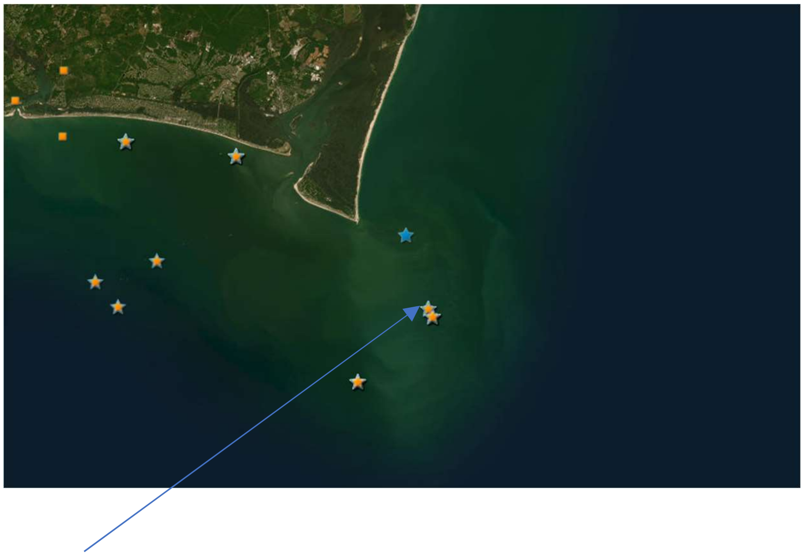
Because the rate of racemization slows with increasing extent of racemization, the age-D/L relation is highly non-linear. The results in these figures allow comparison of offshore data (often with 14C results in the ~35-45 ka range) compare with onshore results for MIS 5 samples associated with MIS 5 U-Th coral ages. SCVC18 and SCVC24 have two apparent aminozones. Figure 4f spans the full range of D/L values to present data for early Pleistocene samples (OBX17, Fountain Quarry, Kennells Bluff), providing perspective on the temporal range represented by results such as these.

Figure 4f also includes some results from southeastern NC (Onslow Bay). These results are reviewed also in Figure 7 where issues of age mixing and paired AAR-14C results are considered.

Figure 5a, b This figure presents co-varying Asp-Glu D/L values in Mercenaria from an extensive study of barrier island, shelf and beach samples from the NC Outer Banks coastal system (Wehmiller et al., 2010; Culver et al. (2008; 2011; 2016). Multiple aminozones are recognized (Holocene, AZ2, AZ3, AZ4, each subdivided) and related to seismic- and litho-stratigraphic units. AZ2 is calibrated to represent all or a portion of MIS 5. AZ4 includes results represented early Pleistocene based on paleontological and Sr-isotope results.

Figure 6a and 6b: 14C results on shells collected from cores taken as part of the SE Atlantic BOEM ASAP project. Note that out of the ~100 shells dated, fewer than 5 yielded "infinite" (beyond detection) results. The water depths for these cores (on the GA-SC-NC shelf (~31-35 deg N) are in the general range of 15 to 20 meters. We are currently investigating the use of AAR results to evaluate the accuracy of some of these 14C results (using results on shells where both AAR and 14C data exist on the same shell). Finite 14C results in the range 35-50 ka, if correct and not minimum ages, have significant implications for the late Pleistocene sea-level history of the region. Paired AAR-14C results can, in at least some cases, yield unequivocal conclusions that these finite 14C are incorrect (Wehmiller et al., 2021)

Figure 7: NCVC08 and NCVC34 tell an interesting story regarding age mixing and the question of minimum 14C ages. Onslow Bay results are the focus of our current effort at AAR data interpretation.



NCVC08 BOEM core yielded Mulinia results indicating two aminozones, the younger one with “finite 14C results ~40 ka. VC08 was taken very near CFNC53, a 1979 ACOE core analyzed by Linda York (unpublished), yielding results identical to those for the youngest zone in NCVC08. NCVC09, southwest of NCVC08, returned D/L values equal to those seen in the youngest (lowest D/L values) in NCVC08. The two aminozones found in NCVC34 are equivalent to those seen in NCVC08 and 09, yet they are found together in VC34, along with a mixture of 14C results. Age mixing in the sediment-starved Onslow Bay region is not surprising. The apparent coherent stratigraphy of the NCVC08 (and VC09?) core on the Cape Fear shoals is perhaps remarkable, given the dynamic environment of this region. The combined NCVC08/09 sequence is an important reference for comparison with other data from the region. See Figure 8 for additional discussion.

(A separate WORD file and associated EXCEL file found in two separate files associated with this poster – these focus on data from the NCVC08/NCVC09 cores)

Figure 8: Plot of mean D/L Glutamic values in Mulinia against latitude, from Delaware to Georgia. Data points from Ga, SC, and NC are seen also in previous graphs. Data for the mid-Atlantic region (376-39 deg N) are from Wehmiller et al., 2021. Note that values in the 0.65-0.75 range (latitude 35-36) represent early Pleistocene units.

The “envelope” of results that rises from north to south represents a projection from the 36-39 deg range of results in Wehmiller et al., 2021. This envelope is interpreted to represent MIS 5 (~75-130 ka) base on the calibration data points available in the mid-Atlantic. The projection of this envelope to southern sites captures observed results for two calibration sites in SC (Berkeley Pit, BPit) and Jones/Skidaway (Jones), both with MIS 5a U-Th coral ages.

Qualitative age estimates for each set of results can be inferred from this figure. If early Pleistocene results are represented by OBX17 (D/L ~0.75), for example and the late Pleistocene is represented by the plotted data envelope, then mid-Pleistocene ages are inferred for the group of results seen in NCVC08 and NCVC34, for example. This figure is a useful way to compare results over a broad region, and it is based on reasonable assumptions about the consistency of temperature histories over this broad region.

Local variations in temperature history, as well as contrasting diagenetic environments at different onshore (or offshore) sites can complicate this approach to regional aminozone correlation.

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