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History of study of Gomez Pit; New Light, Toy Ave., and Womack pits as precursors

The text below is reprinted without revision from Wehmiller (2013) Quaternary Geochronology. That paper is available upon request. Figures cited in the text below are reproduced here without revision. Additional figures related to this discussion are found in associated folders.

#### 4.1 Local aminostratigraphic superposed sections, Mid-Atlantic Coast

A large suite of AAR results from three excavations and 20 subsurface sections in the Mid-Atlantic coastal plain (Figure 2d) provides a rigorous test of analytical precision and stratigraphic consistency for multiple amino acids in *Mercenaria* and other taxa. In addition, results from three of these sites are associated with U-Th coral ages (Wehmiller et al., 2004), and results from several of the remaining sites have been compared with co-existing Sr-isotope age estimates (Wehmiller et al., 2011). These collective results establish an aminostratigraphic reference section for comparison with results to the north or south.

Results from New Light Pit, Virginia Beach, VA (Belknap and Wehmiller, 1980) (Figure 2d) identified two aminozones in apparent superposition, but the transient nature of the exposures prevented detailed study. Because these results challenged the classical model of the history of the region, where only a “single transgression” was identified (Oaks et al., 1974; Mixon et al., 1982), there was understandable resistance to the “two aminozone” concept. In ensuing years, a neighboring commercial excavation (Gomez

Pit: Figure 2d) remained active from ~1980 to ~1998, permitting frequent collection and continuing evaluation of AAR results from different outcrops within this large (~0.2 km<sup>2</sup> excavation). Two distinct shell beds were traceable throughout the excavation, over distances up to 200 m, and during the interval when good collections were possible, hundreds of shells (mostly *Mercenaria* and *Crassostrea*) were collected from dozens of positions within each of these clearly mappable units, the upper one of which has multiple coral U-Th ages of ~75 – 85 ka (Szabo, 1985; Wehmiller et al., 2004). Multiple AAR analyses (by both HPLC and GC) yielded insights into the variability within a single unit, including information on the effects of shell preservation on AAR results (Mirecki, 1990).

The Gomez Pit results demonstrate that the two superposed units have distinct D/L values, confirming the early results from New Light Pit (Belknap and Wehmiller, 1980). These aminozones were designated IIa and IIc, following a system proposed by Wehmiller et al. (1988) for identifying regional clusters of D/L values. There is some suggestion that a third aminozone (II d) is also present, recognized only in transported (reworked?) shells found in the lower unit that is dominated by IIc D/L values (Figure 8a). Aminozone II d may be evidence of diagenetic alteration of some shells (Mirecki, 1990). Further down-section, an exposure of the Plio-Pleistocene Chowan River Formation (Krantz, 1991) at the base of the Gomez Pit excavation yielded *Mercenaria* that have nearly racemic ratios (aminozone IIe), further reinforcing the concept that D/L values conform to basic relative age control (Figure 8a, 8b).

Figure 8b

50 to 100 km south of Gomez Pit, combined AAR and U-Th results for Moycok (Mck) and Stetson Pit (SP) (Figure 2d) expand the local aminostratigraphic reference section. Mck is an active commercial sand and gravel excavation; SP was an exposed section excavated for a county landfill, and both outcrop and split-spoon samples were obtained

from the SP section (Miller, 1982; York et al., 1989). Both sites have yielded corals with U-Th ages of roughly 80 ka (Cronin et al., 1981; Szabo, 1985; Wehmiller et al., 2004). AAR results from SP are consistent with superposition within this section (York et al., 1989). The data for the 80 ka calibrated samples from Moyock, Gomez Pit, and Stetson Pit are shown in Figure 8b, which also includes the results for the lower two aminozones at Stetson Pit and the Plio-Pleistocene Chowan River Formation. The tight cluster of D/L values (representing a total of approximately 30 samples) for the three sites with ~80 ka corals is indicative of the precision that is generally possible with well-preserved *Mercenaria*. Although samples from the Stetson Pit section were limited in number, the unambiguous demonstration of increasing D/L values in two taxa (*Mercenaria* and *Mulinia*) provided one of the best early tests of stratigraphic consistency of AAR results in the Atlantic Coastal Plain (York et al., 1989). The relation of AAR data to the subsurface stratigraphy in northeastern North Carolina was demonstrated further by Riggs et al. (1992), using data from the Stetson Pit section for comparison with data from shells obtained in nearby vibracores.

#### Figure 8c

The different D/L values for aminozones IIa and IIc at Gomez Pit were used by Mirecki et al. (1995) to estimate age differences between these units. Calculated age differences are model dependent, but the current best estimate for this age difference is at least 200 ka, using the kinetic model curves shown in Figure 4. This difference indicates that the unconformity between the two aminozones represents one or perhaps two glacial low sea level cycles. The Gomez Pit results represented one of the major contributions of the early AAR work for the interpretation of Coastal Plain stratigraphy, indicating that unconformities between major sea-level transgressions can be difficult to recognize, even in outcrop. These results established an important aminostratigraphic reference section that was useful for interpretation of other AAR results from the region (e.g., Groot et al., 1990; O'Neal et al., 2000; Ramsey, 2010).

The Stetson Pit study by York et al. (1989) served as a reference section for the interpretation of an extensive AAR dataset from 28 rotasonic cores recently obtained from sites throughout the Albemarle Embayment (Figure 2d) (Culver et al., 2008, 2011; Mallinson et al., 2010; Wehmiller et al., 2010, 2011). The Albemarle Embayment of the Coastal Plain of North Carolina (Figure 2d) contains a thick section (up to ~80 m) of Quaternary strata that record multiple sea-level cycles (Mallinson et al., 2005, 2010; Wehmiller et al., 2010). The study of this section has benefited greatly from a major coring project undertaken by the US Geological Survey in collaboration with several state and local institutions. AAR analyses were conducted on over 500 mollusk samples from most of the cores taken as part of this study (Wehmiller et al., 2010), providing an unusual opportunity to demonstrate the stratigraphic integrity of results for *Mercenaria* and *Mulinia* in the context of seismic-, litho-, and biostratigraphic information (Culver et al., 2008, 2011; Mallinson et al., 2005, 2010; Wehmiller et al., 2010). Although other nearby sites had served as tests of the stratigraphic consistency of *Mercenaria* results (Gomez Pit: Mirecki et al., 1995; Stetson Pit: York et al., 1989), unprecedented insights into the relation between AAR results and the depositional environments preserved in these cores resulted from this project (Wehmiller et al., 2010). Processes such as age mixing, burrowing, and shell alteration are recognized in ~5 – 10% of the results, usually associated with prominent seismic reflections indicating a transgressive or regressive surface. Without the benefit of multiple analyses of at least two taxa, and associated paleoenvironmental, lithologic, and geophysical data, many of these influences on AAR data would have gone unrecognized, and resolution of aminozones would have been more difficult in the absence of the physical superposition of samples in the cores.

For additional information related to the figures below (from Wehmiller, 2013) see figures, maps, and stratigraphic sections in associated folders.



