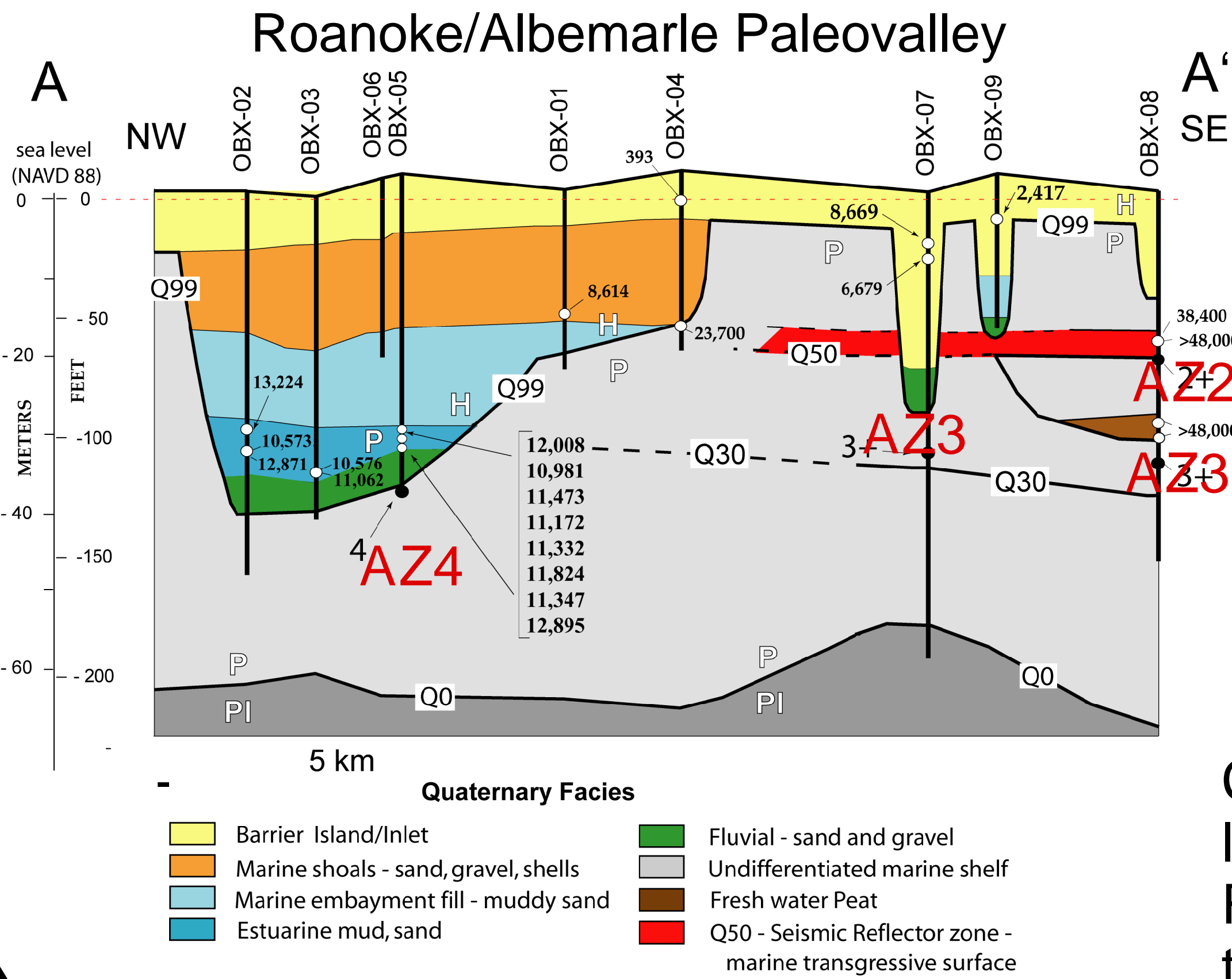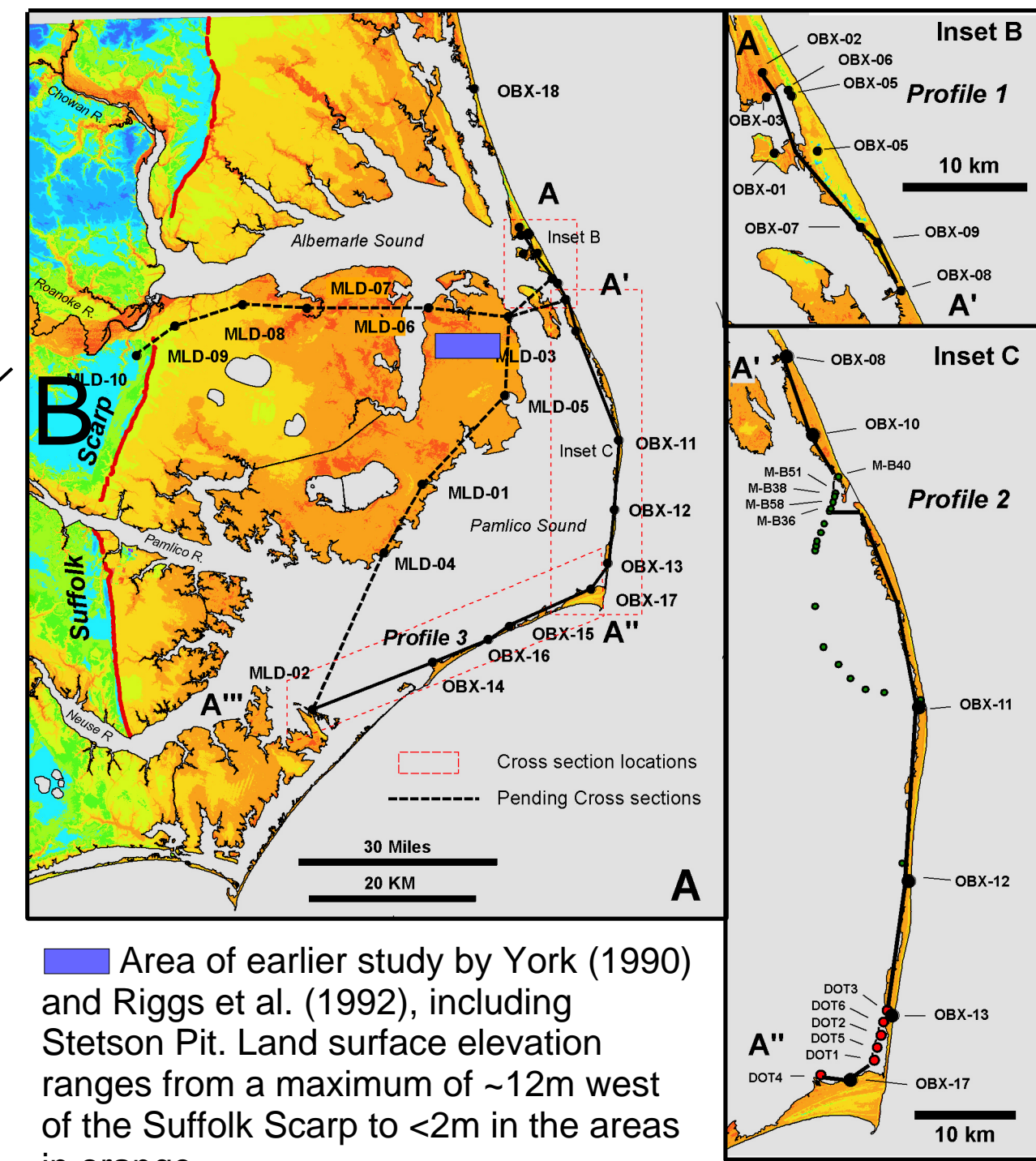# Stratigraphy and geochronology of a long Quaternary coastal record, North Carolina coastal plain, USA

John Wehmiller, University of Delaware; Stanley Riggs, East Carolina University; E. Robert Thieler, uSGS Woods Hole; Kathleen M. Farrell, North Carolina Geological survey; David Mallinson and Steven Culver, East Carolina, with assistance from many other collaborators*

USGS science for a changing world

North Carolina Coastal Geology Cooperative ECU-USGS-NCGS — NC CGC

Study area

Area of earlier study by York (1990) and Riggs et al. (1992), including Stetson Pit. Land surface elevation ranges from a maximum of ~12m west of the Suffolk Scarp to <2m in the areas in orange.

Roanoke/Albemarle Paleovalley

Quaternary Facies

- Barrier Island/Inlet
- Marine shoals - sand, gravel, shells
- Marine embayment fill - muddy sand
- Estuarine mud, sand
- Fluvial - sand and gravel
- Undifferentiated marine shelf
- Fresh water Peat
- Q50 - Seismic Reflector zone - marine transgressive surface

- Q Seismic Reflector
- H Holocene
- P Pleistocene
- Pl Pliocene
- 4 Amino Zone
- ● Amino Acid Racemization (AAR) date
- ○ Carbon-14 date (C-14)
- | core location
- gamma log

## USGS COOP Geologic framework study:

1) Define depositional units using seismic stratigraphy, core lithostratigraphy, paleontology and geochronology.
2) Estimate ages of units using radiocarbon and amino acid racemization (AAR) kinetics.
3) Assess effects of age mixing using AAR on multiple samples at critical stratigraphic positions.
4) Regional depositional history: Albemarle embayment contains a record of multiple (20?) sea level cycles for the entire Quaternary.

Coast parallel barrier island section: major reflectors from Mallinson et al. (2005); lithostratigraphic units from Farrell et al. (in prep.); aminozones 2, 3, and 4 from Riggs et al. (1992) and Wehmiller et al. (submitted) (AZ2, AZ3, AZ4). In many cases these aminozones can be subdivided. AZ2 is late Pleistocene and found above reflector Q50; AZ3 is middle Pleistocene and found between Q30 and Q50; AZ4 is early Pleistocene, found below Q30. Specimens from older aminozones are occasionally mixed into younger units, most often in the intervals where major reflectors are observed.
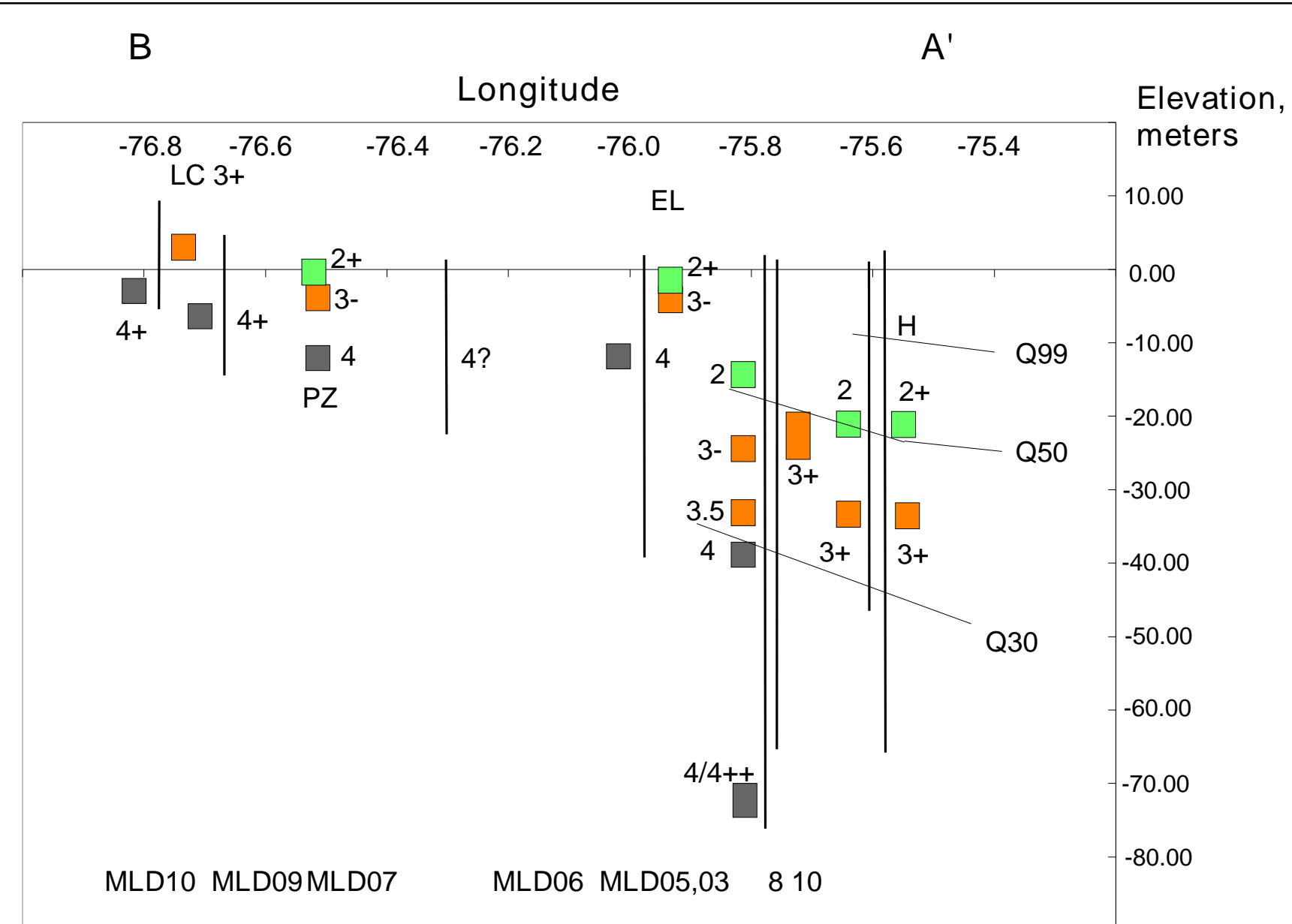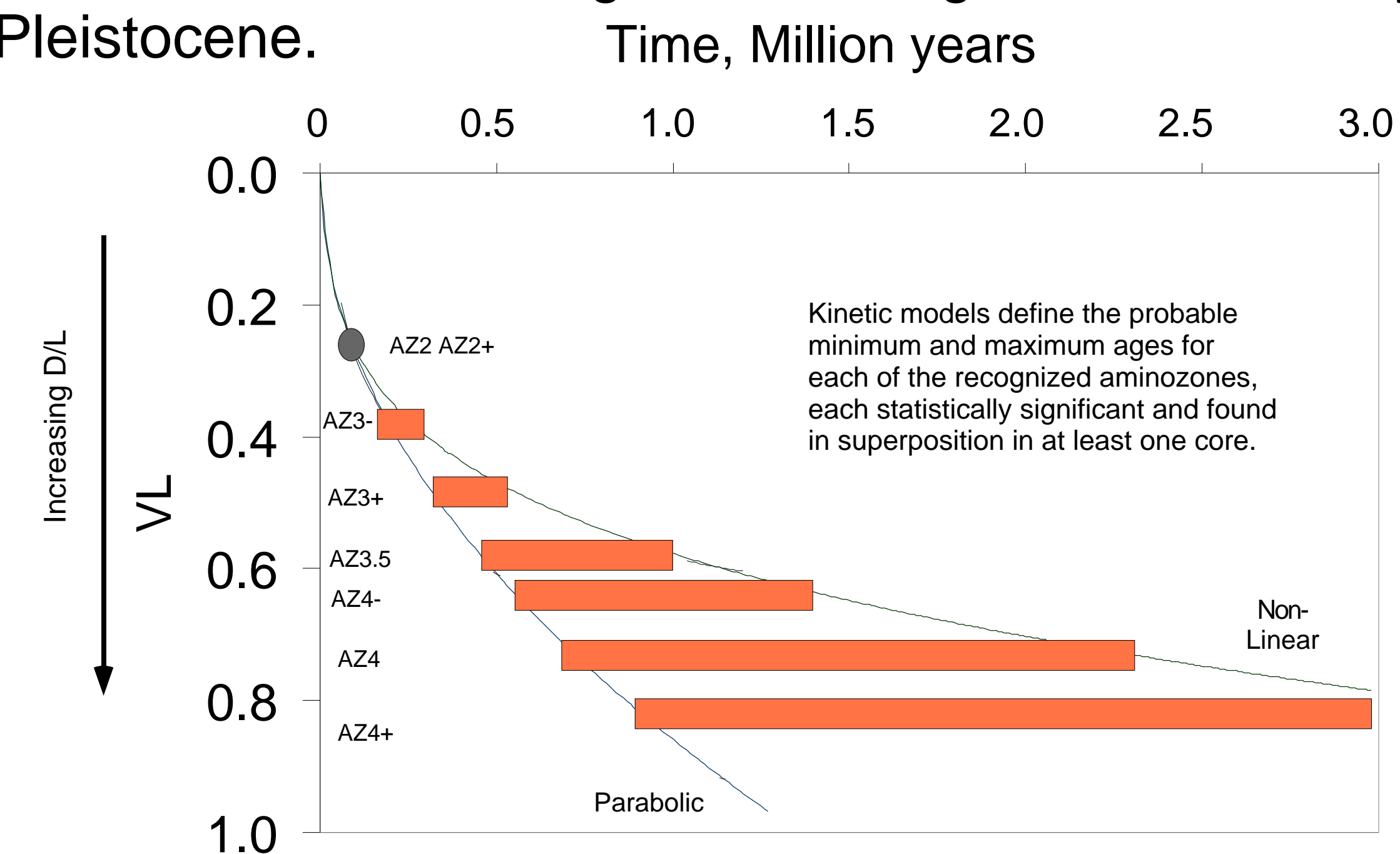

Schematic east-west cross section from MLD10, west of the Suffolk Scarp, to OBX8 & 10, on the barrier island. Major reflectors dip to the east, consistent with trends for aminozones 2, 3, and 4.
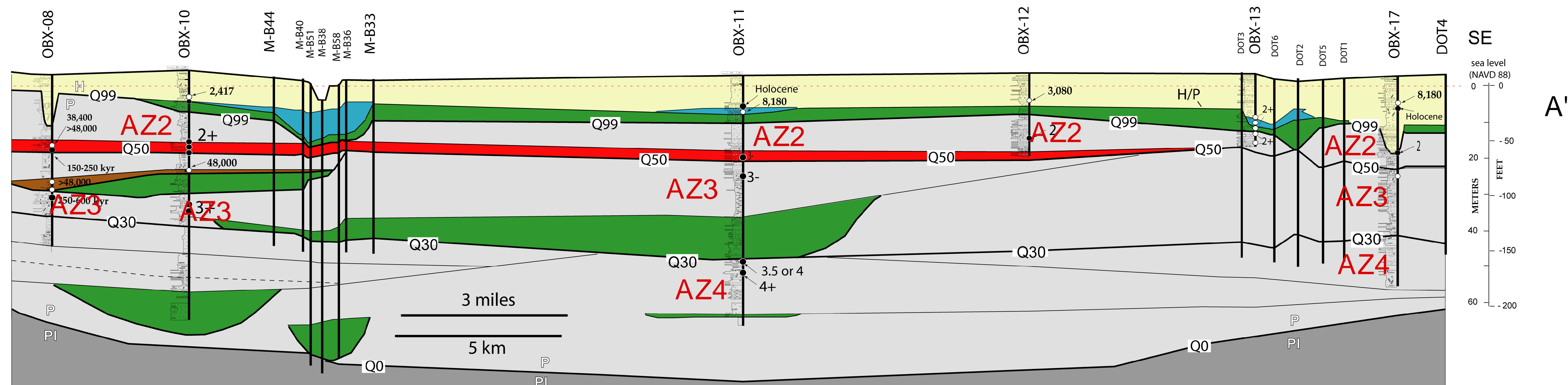
Recognizing aminozones: figure on left shows D/L values for two Holocene specimens, three superposed units at Stetson Pit (SP), and the Pliocene Chowan River formation. D/L values increase with superposition and known chronostratigraphic control. The Stetson aminozones are designated AZ2, AZ3, and AZ4. Figure on right shows that AZ2 can be divided into AZ2 and AZ2+ at MLD01 - this division is seen in a superposed section ~9 and ~10m below land surface, and D/L differences are statistically significant. AZ2 is calibrated with TIMS coral dates at 80 ka (Wehmiller et al., 2004). Data for other cores also support this high-resolution aminostratigraphic separation.
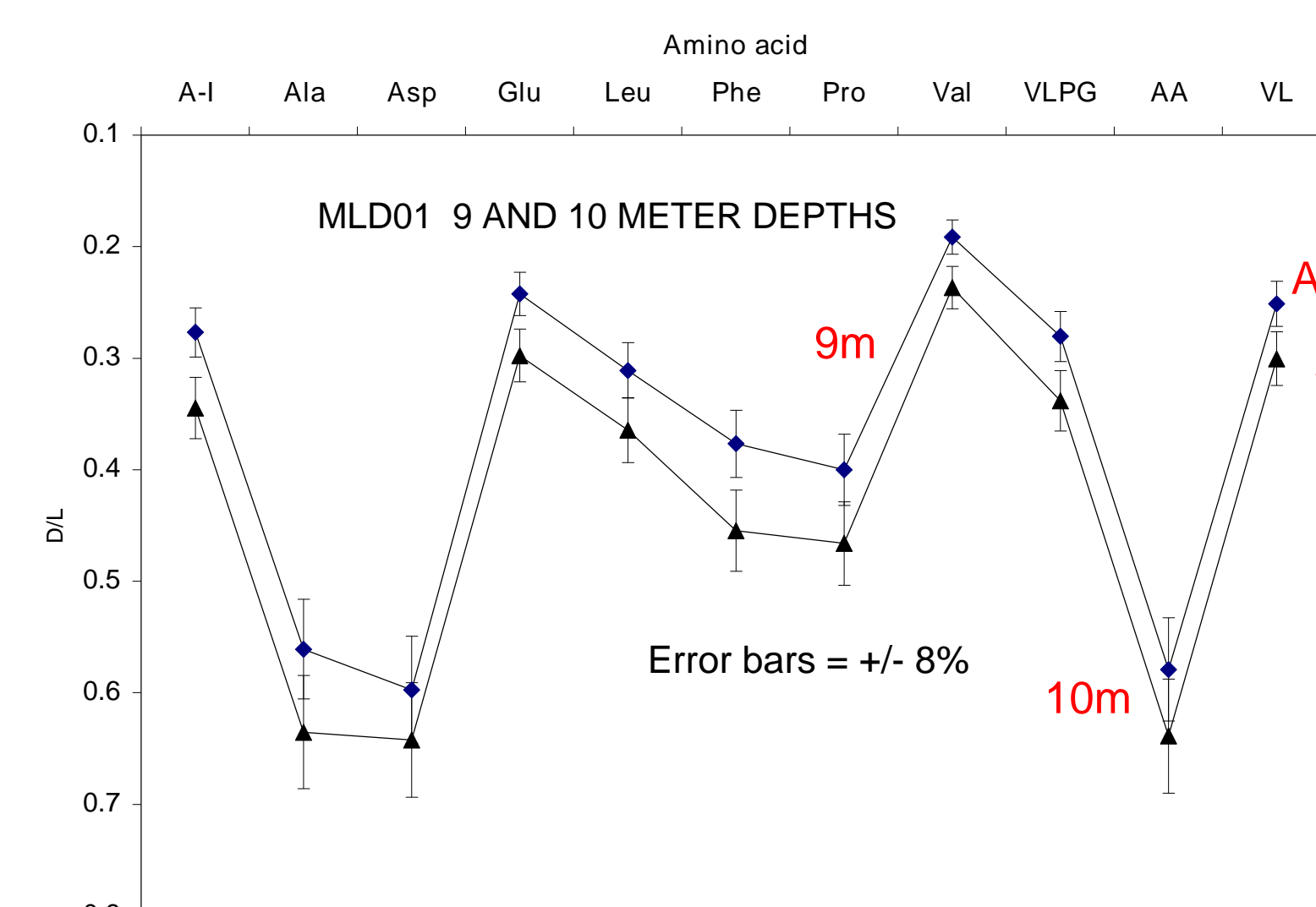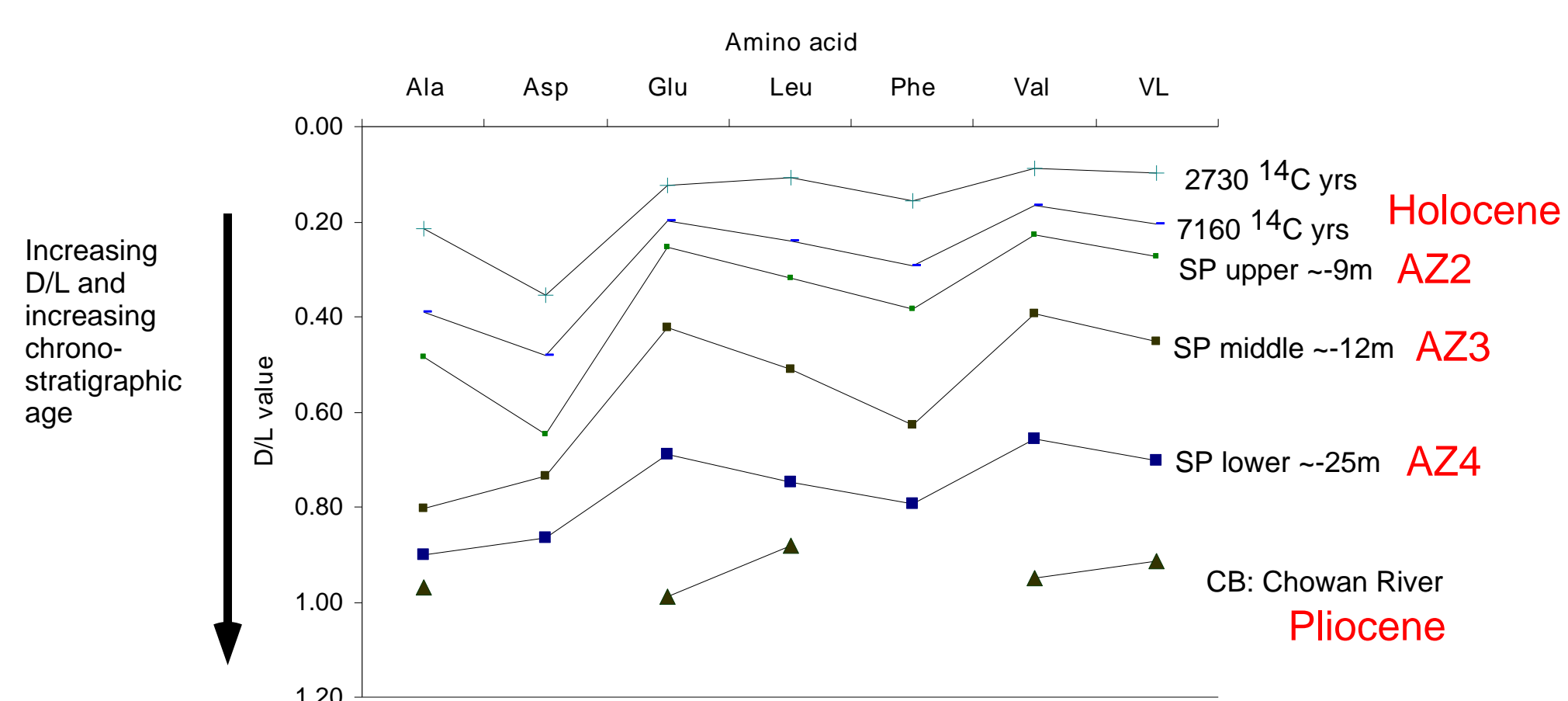
Estimating ages using kinetic models of racemization; two popular models predict vastly different ages for older aminozones. Independent evidence supports the non-linear model ages, indicating that AZ4 is early Pleistocene.

Kinetic models define the probable minimum and maximum ages for each of the recognized aminozones, each statistically significant and found in superposition in at least one core.

Age mixing example:

These beach shells, all collected within ~5m of each other at Cape Point, NC, represent an extreme example of age mixing in the NC Coastal System. All except the lower left shell are Pleistocene, based on both radiocarbon and amino acid data.