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Micropaleontologic record of Pliocene and Quaternary paleoenvironments in the southern Albemarle Embayment, North Carolina, U.S.A

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ABSTRACT

The Albemarle Embayment, a Cenozoic depositional basin on the Atlantic coast of the USA, is an ideal setting to understand the temporal and spatial variation of eustatic sea-level fluctuations, glacio-hydro-isostasy, tectonics, subsidence, environments and sedimentation patterns of a passive margin Quaternary section. A NE–SW transect of cores and seismic data in the southern Albemarle Embayment were analyzed using micropaleontologic (foraminifera, diatoms, pollen), sedimentologic, stratigraphic, and geochronologic data to reconstruct the paleoenvironmental evolution and paleoclimates in the nearly 90 m thick Quaternary section. The study area is a very low gradient Quaternary landscape that is cross-cut by several Pleistocene incised valleys; a Holocene barrier island complex forms its eastern margin. In the subsurface, the Albemarle Embayment is bordered to the north by the Norfolk Arch and to the south by the depositionally-constructed Cape Lookout High, which is positioned on the northern flank of the structural Carolina Platform.

The Quaternary section overlies mid-Pliocene carbonates in three cores; the contact rises in elevation towards the Cape Lookout High. Fossils and sediment characteristics suggest a subtropical, shallow, high energy marine environment during the Pliocene. Overlying units include incomplete Pleistocene, clastic, transgressive-regressive (T-R) deposits. These have similar ages and stratigraphic signatures as the T-R cycles in the central and north-central Albemarle Embayment, although mid-Pleistocene deposits may be older in the southern region. The bulk of the early and mid-Pleistocene record consists of inner to mid-shelf sand and muddy sand. In contrast, late Pleistocene sands are of inner shelf origin, reflecting the infilling of the basin. Lowstand paleovalleys, with fluvial, wetland and estuarine fill, dissect the early, mid- and late Pleistocene marine units; their locations reflect antecedent topography. Holocene sediments were deposited in shoreface and barrier island environments. Quaternary foraminiferal assemblages in the southern Albemarle Embayment exhibit greater species richness than those in the central and north-central embayment reflecting the presence of a major biogeographic boundary at the same location as the modern biogeographic boundary at Cape Hatteras.

1. Introduction

The Atlantic continental margin is a classic passive continental margin (Grow and Sheridan, 1988), where glacial isostatic adjustment (Raymo et al., 2011), dynamic topography driven by mantle convection

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(Rowley et al., 2013) and tectonics (Van de Plassche et al., 2014) complicate stratigraphic patterns along its length. The Albemarle Embayment, North Carolina, USA (Fig. 1) contains one of the thickest and most complete Quaternary sections on the North American Atlantic margin (Riggs et al., 1992; Mallinson et al., 2005, 2010) and thus provides an excellent opportunity to investigate passive continental margin evolution. Understanding the dynamic genetic processes and the spatial and temporal patterns of passive continental margin sedimentary environment evolution in the Quaternary is facilitated by the use of several chronostratigraphic (e.g., Lu and Fulthorpe, 2004) and micropaleontological approaches. Foraminiferal, diatom and pollen data are proven as valuable tools for reconstructing paleoenvironmental change in the late Pliocene to Holocene sedimentary record in the Albemarle Embayment (Culver et al., 2008, 2011; Grand Pre et al., 2011).

The purpose of this paper is to present micropaleontological (foraminifera, diatoms and pollen) and sedimentological data from four deep rotasonic cores (Fig. 1B) in the southern Albemarle Embayment, to interpret paleoclimatic conditions, to reconstruct Quaternary environments, and to integrate with the similar data from further north in the Embayment. Correlation to the paleoenvironmental interpretations of the Quaternary strata in north-central and central Albemarle Embayment (Culver et al., 2008, 2011) provides an approximately strike-

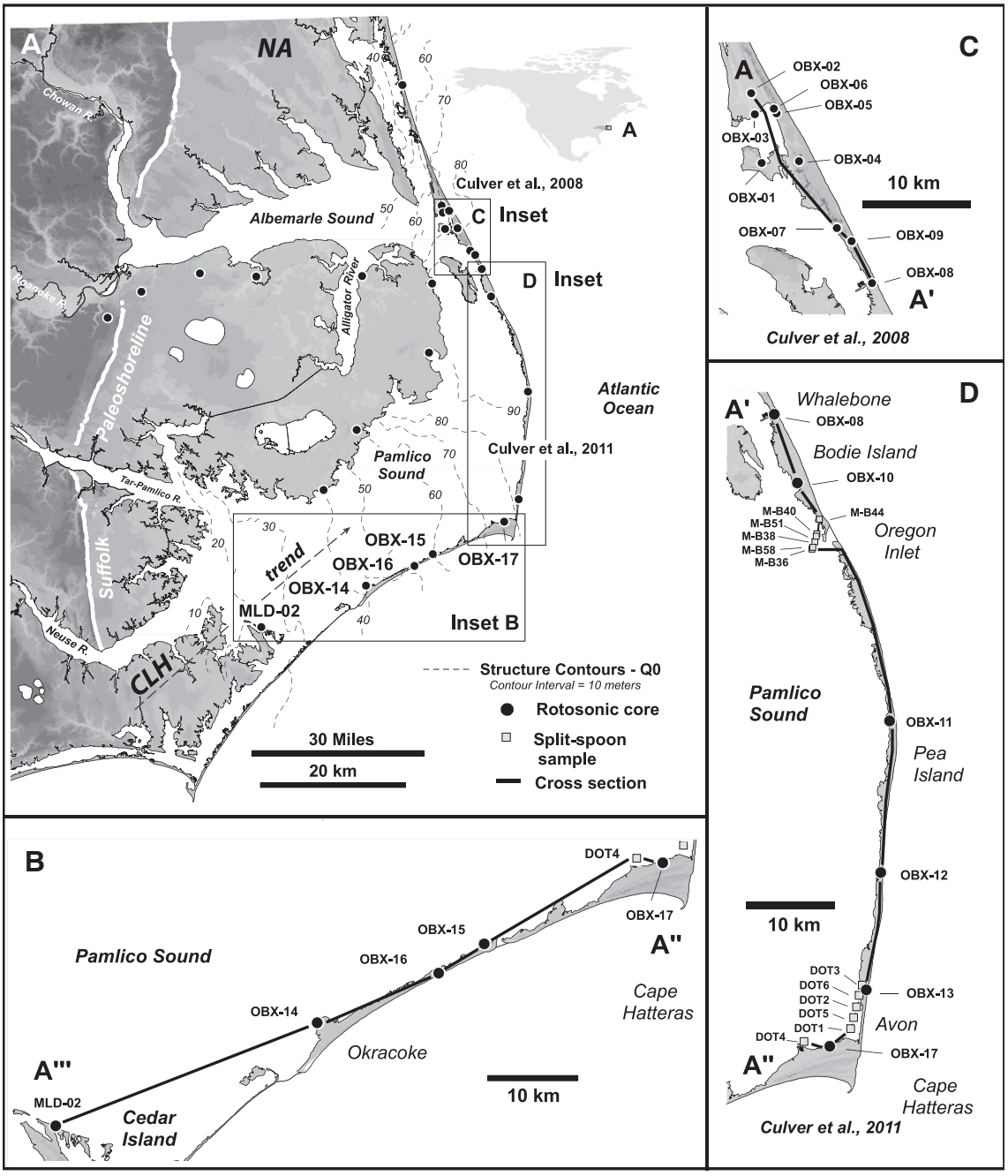

Fig. 1. Location of study area, the Albemarle Embayment, in the context of the modern shoreline and structure contours showing the depth to the Q0 reflection, interpreted as the top of the Pliocene (Mallinson et al., 2010). A, Satellite image of eastern North Carolina. The location of Figs. 1B, 1C and 1D are indicated. NA = Norfolk Arch, CLH = Cape Lookout High. B, Location of four rotosonic drillholes in the southern Albemarle Embayment. A" – A"' indicates the location of the section in Fig. 6. C, Location of rotasonic drillholes and section A–A' in the northern Albemarle Embayment (Culver et al., 2008). D, Location of rotasonic drillholes, split-spoon cores and section A'–A" in the central Albemarle Embayment (Culver et al., 2011).