MS Thesis
Department of Environmental Science and Policy
George Mason University

Candidate: Elizabeth Tedder Wood
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Title: Holocene Benthic Foraminiferal Assemblages of Tidal-Inlet Deposits Along Cedar Island, VA, USA: Insights Into Storm Impacts, Breach Dynamics, And Inlet Evolution

Thesis Director: Dr. Randolph McBride
Committee: Dr. Stacey Verardo and Dr. Kim DeMutsert

ABSTRACT

Cedar Island, VA is a low-profile, mixed energy, rapidly transgressing, barrier island that has breached and formed an ephemeral inlet (Cedar Island Inlet) at least three times in the past sixty years. Historical charts, air photos, satellite imagery, and geomorphic features indicate that Cedar Island Inlet was open from 1956-1962, 1992-1997, and 1998-2007 and was wave-dominated. Nonetheless, the sedimentary record of Cedar Island Inlet, including benthic foraminiferal deposits offers unique insights beyond the current known scope of Cedar Island Inlet activity.

Benthic foraminiferal analyses of three sediment vibracores, from the final 1998-2007 Cedar Island Inlet position, reveal detailed information about inlet dynamics and lifecycle evolution. Four foraminiferal biofacies were identified through cluster analysis and compared with similar studies performed along the U.S. Atlantic coast to determine the depositional environment(s) associated with each biofacies. Accordingly, four depositional environments including inlet channel floor, flood-tidal delta/inlet fill, high energy inlet fill, and washover/beach/aeolian were identified. *Elphidium excavatum* dominates environments low in organics, with sandy substrates, and a range of marine salinities like those found associated with Cedar Island Inlet. Accordingly, *Elphidium excavatum* dominates each of the biofacies and comprises 54-100% of all non-barren samples. The inlet channel floor assemblage is characterized by low abundancies, and the largest proportions of a secondary species, *Haynesina germanica*. Flood-tidal delta/inlet fill contains an abundant, heterogeneous mixture of shelf and estuarine species including *Buccella frigida*, *Ammonia parkinsoniana*, *Haynesina germanica*, and *Trochammina inflata*. The high energy inlet fill biofacies is characterized by low abundances and low diversity and contains predominately shelf species including *Elphidium gunteri*. Washover/beach/aeolian

biofacies also exhibit low abundances and low diversity and contain shelf species including *Buccella frigida*, *Ammonia parkinsoniana*, and *Elphidium mexicanum*. A fifth depositional environment, which includes all barren samples, was identified as a quiescent estuary.

The stratigraphic positions of the foraminiferal biofacies within the cores revealed a previously undiscovered inlet fill/flood tidal delta deposit which may be attributed to the earliest inlet (1956-1962) or an inlet prior to the known scope of Cedar Island Inlet activity (i.e., 1956). Additionally, foraminiferal biofacies distribution and newly obtained historical and satellite imagery reveal that, contrary to previous Cedar Island Inlet lifecycle models, the wave-dominated tidal-inlet does not follow a prescribed lifecycle where the inlet opens, migrates in the direction of net longshore transport, rotates counterclockwise, and closes. Instead, each of the last three Cedar Island Inlet lifecycles has exhibited a different rotational mode of the wave-dominated inlet lifecycle model including clockwise rotation (1956-1962 inlet), no rotation (1992-1997 inlet), and counterclockwise rotation (1998-2007 inlet). Each Cedar Island Inlet experienced a unique lifecycle where the degree of migration and rotation was determined by differing tidal prisms, accommodation space availability, and flood-tidal delta morphologies.