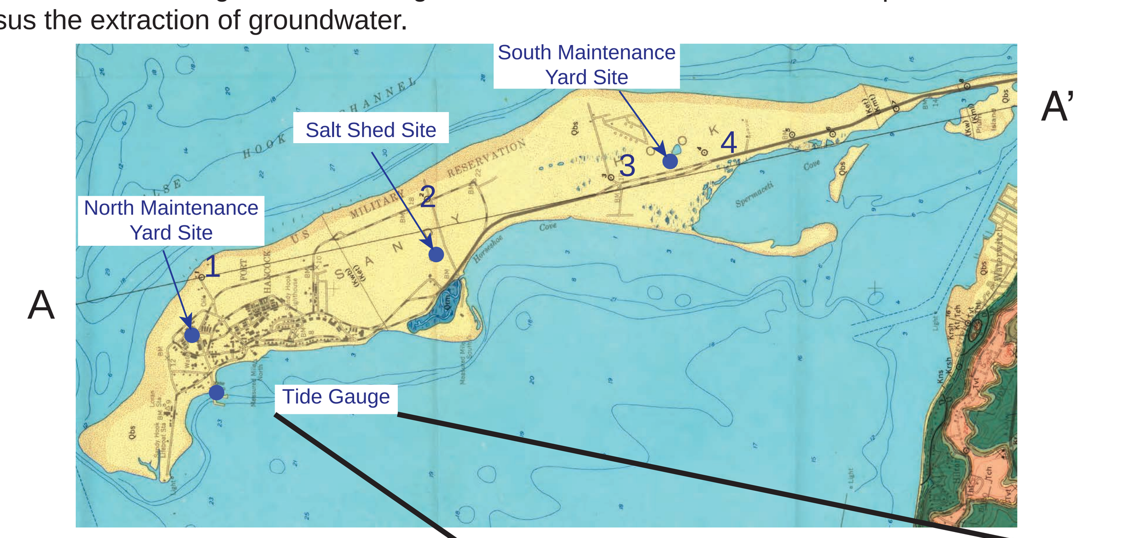
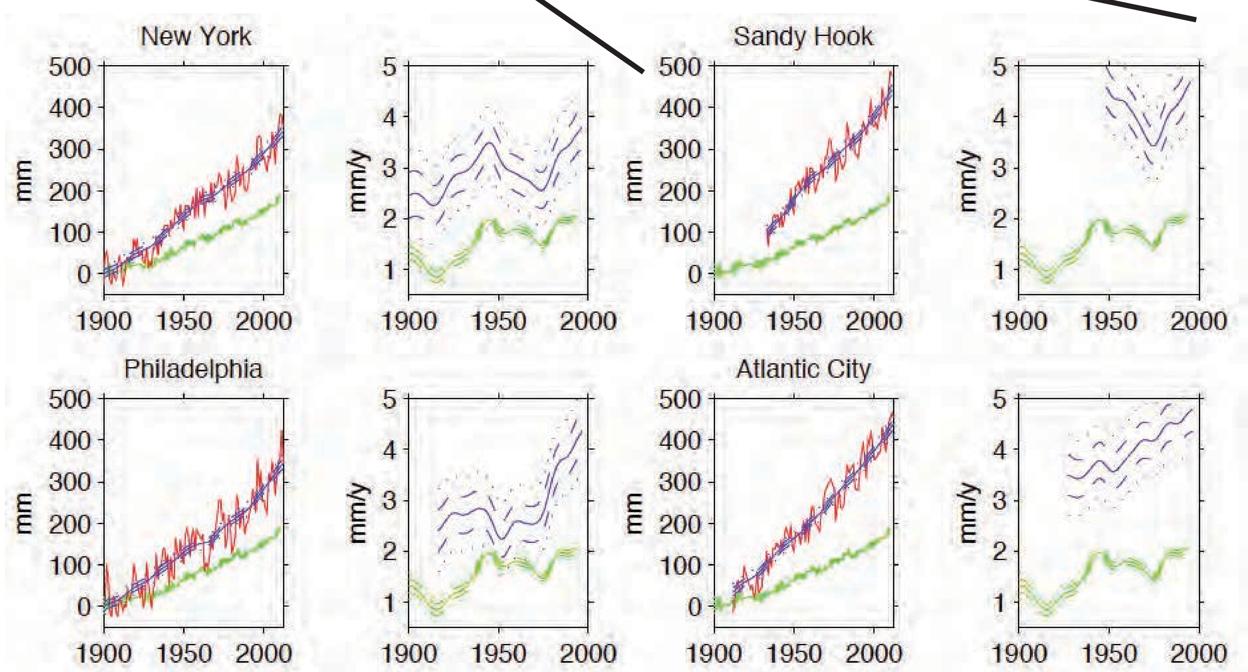
Why does Sandy Hook have that sinking feeling?
Localization of sea-level changes

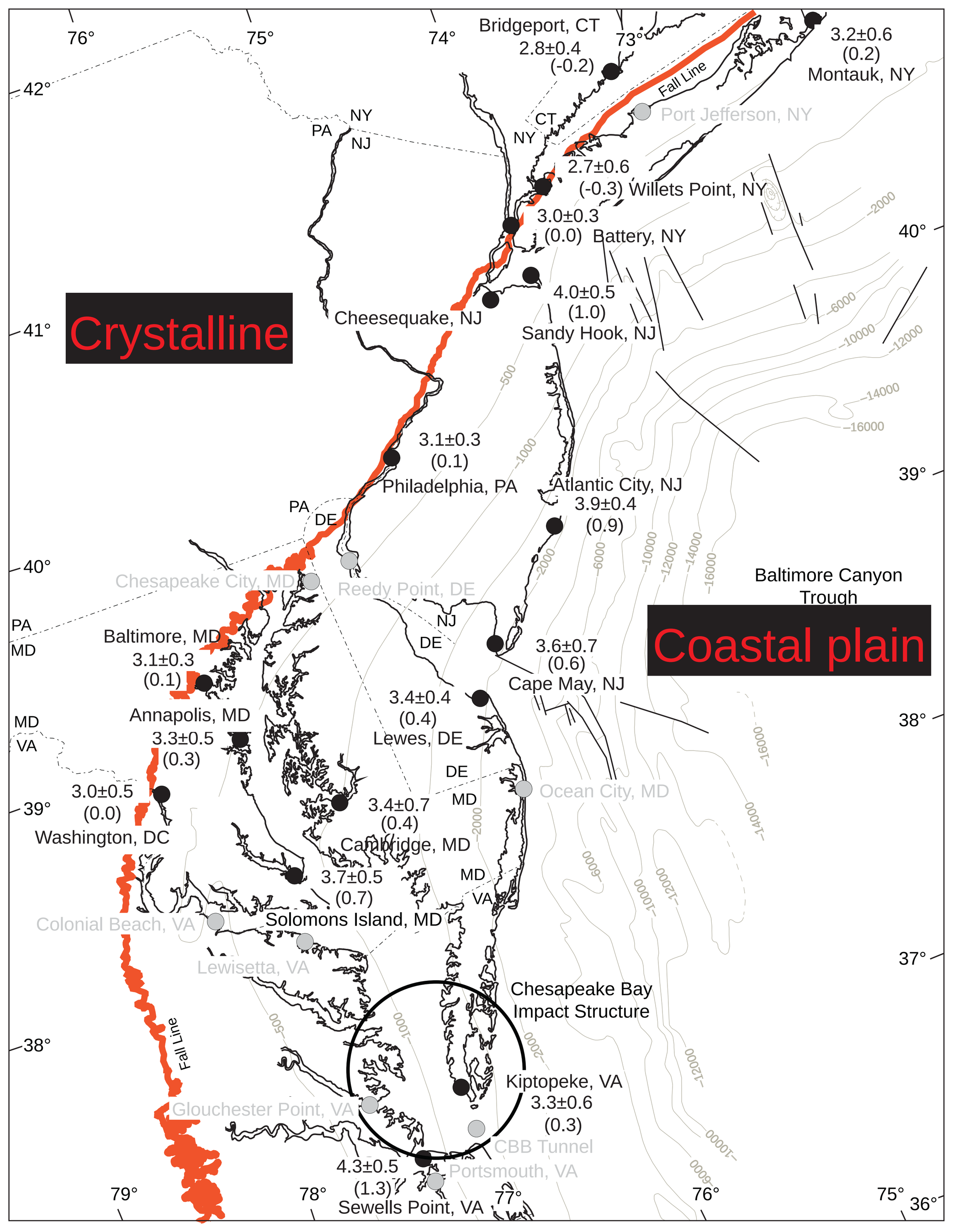
K.G. Miller, J.V. Browning, S. Stanford, P.J. Sugarman, M. Farzaneh and the members of the Sandy Hook drilling project

Background

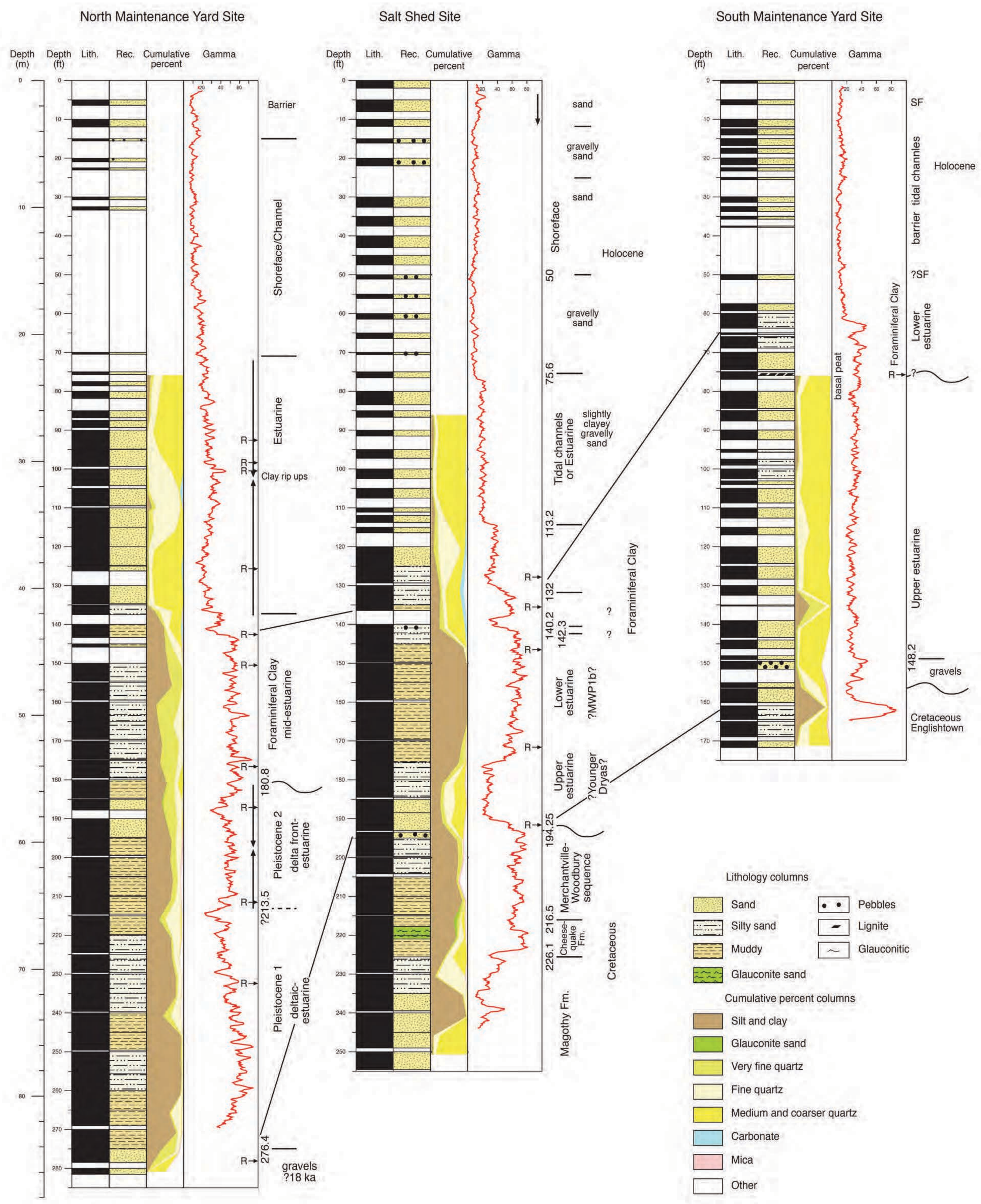
We continuously cored 3 upper Pleistocene to Holocene sites (North Maintenance Yard [SH-NMY], Salt Shed [SH-SS], and South Maintenance Yard [SH-SMY] Fig. 1) along a transect on the Sandy Hook peninsula to interpret the geomorphic evolution of this spit and determine its relationship to sea-level rise. The spit has prograded nearly 1 mile into Sandy Hook Bay since 1764 when the Sandy Hook lighthouse was built. Evaluation of the Holocene geological history of Sandy Hook is important to understand current rates of relative sea-level rise and to localize sea-level projections. Sea-level rise is more rapid at the Sandy Hook tide gauge (4.0±0.5 mm/yr) than at the nearby tide gauge at the Battery, New York (3.0±0.3 mm/yr). Relative sea-level rise at the Battery is similar to other tide gauges located on bedrock (e.g., Philadelphia, Baltimore, Washington, DC), whereas relative sea-level rise at Sandy Hook is more similar to coastal plain sites underlain by sediment (e.g., Atlantic City, Cape May). Deciphering the cause of this excess relative sea-lezvel rise is a major goal of the Sandy Hook coring project that will provide an understanding of the roles of ground subsidence due to natural compaction of Holocene sediments versus the extraction of groundwater.

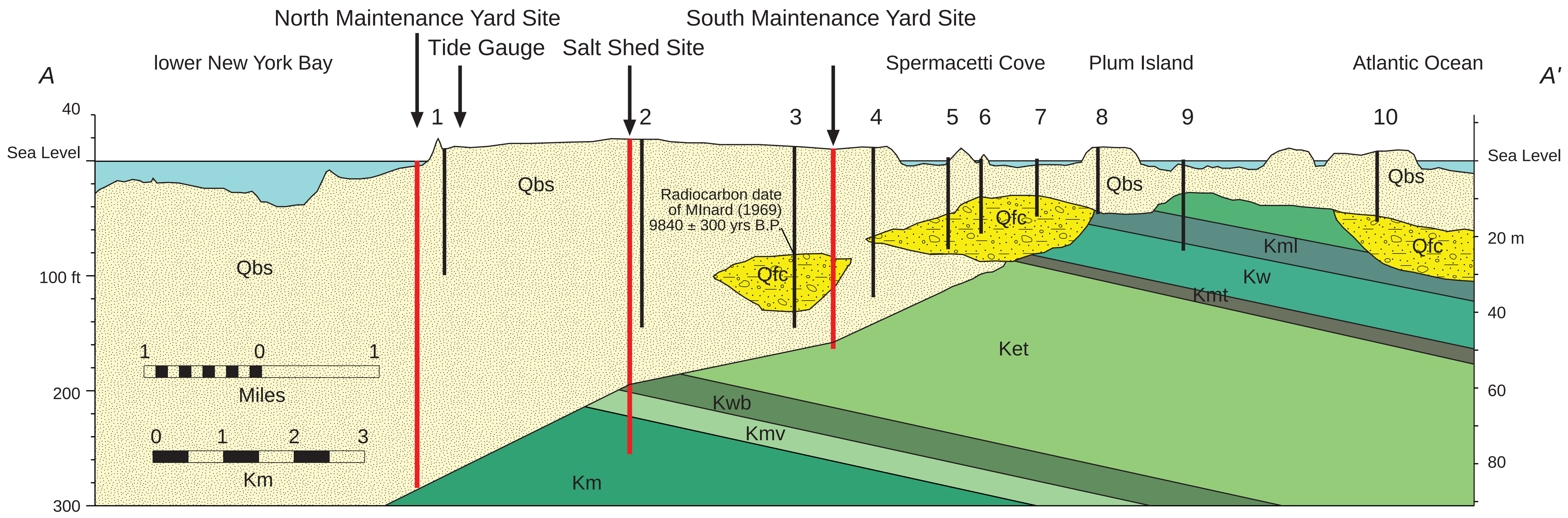






1) Left: Tide gauges showing 1 mm/yr excess subsidence of Sandy Hook versus sites on the Fall Line (Crystalline Bedrock) (Miller et al., 2013).
2) Top: Map showing rates of relative sea-level rise (Miller et al., 2013).
3) Bottom: Geologic cross-section (A-A') showing auger holes (black, Minard, 1969) and three new coreholes (red).





Results

We recovered upper Pleistocene muds (135 ft, 41 m) and Holocene sands (140 ft, 43 m) at the SH-NMY site sitting on basal Pleistocene (ca. 18 ka?) gravels; compaction of the Pleistocene muds is the likely cause of the excess subsidence of this site and the adjacent tide gauge. At the SH-SS site, the upper Pleistocene is 62 ft (19 m) thick and consists of upper estuarine sands (similar to the modern Raritan River) overlain by lower estuarine muds (similar to the modern Raritan Bay) and Holocene barrier deposits (132 ft, 40 m). This succession is consistent with slower relative rise during the Younger Dryas and flooding during meltwater pulse 1a deglaciation. Thinner muds at this site suggest that compaction and subsidence would be less. The SH-SMY site cored Pleistocene gravels and estuarine sands (80 ft, 24 m) and Holocene barrier sands (75 ft, 22.8 m), that suggest much less compaction and subsidence at this site. Undergrad Michael Farzaneh has collected 96 coarse fraction samples that quantify the mud percentages and grain size trends. Future work will include radiocarbon dating (post doc. Nicole Kahn) and evolution of compaction using porosity data (graduate student C. Johnson).