History of the Great South Bay estuary: Evidence for a catastrophic origin

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The Fire Island barrier shoreline encloses Great South Bay, one of the largest backbarrier lagoons in the northeast U.S. This estuarine system was formed in the Holocene by rising sea level and shoreline transgression, but its age and history remain largely unknown. Here we show results from the first coring and subbottom sonar study of Great South Bay sediments and the geological record contained therein. A baywide survey of subbottom sediments reveals that gravelly sands of Long Island's outwash plain underlie most of the estuary. The Pleistocene outwash surface has as much as 7 m of relief, ranging from shallow plains that outcrop on the modern seafloor to incised channel features that align with mainland creeks such as the Connetquot and Carmans rivers. In most areas of Great South Bay, the outwash is buried by 2 m to 7 m of younger coastal sediments. Cores from these sediment sequences show that two distinct environments became established with an incipient Great South Bay lagoon. One is similar to the modern estuarine setting, with deposition of shelly muds and sands. The other is a fine-grained blackish mud containing leaves, roots, and woody debris that reflects a fresh to brackish swamp setting. Radiocarbon dates from the base these deposits indicate their formation as early as 4000 yr BP, with widespread development by 3500 yr BP. These fresh and estuarine environments coexist for the ensuing 1000-1500 years, suggesting that early Great South Bay was partitioned into smaller sub-basins similar to the modern Moriches and Mecox lagoons.

Around 2200 yr BP, all freshwater environments in the study area are abruptly converted to an estuarine setting as indicated by deposition of shelly muds and sands in place of the fine blackish muds. The 2200 yr age is constrained by radiocarbon dates from several sediment cores and indicates the time that Great South Bay reaches its modern configuration of a broad, open estuarine lagoon. This environmental transition is also marked by the deposition of a 20-30 cm thick sand, gravel, and cobble layer that is variable but typically shows a fining-up structure with multiple graded beds. The subbottom sonar data shows the layer to extend laterally 100s – 1000s of meters along isolated portions of Great South Bay. The coarse texture and graded physical structure of this deposit strongly suggest transport and deposition by high-energy flow. In conjunction with the widespread conversion of swamp environments to open estuarine lagoon, these findings suggest that modern Great South Bay originated 2200 yr BP with the occurrence of a major high-energy event on Long Island's south shore. Continuing research by our lab is seeking to better understand this event, its consequences, and possible cause.