Were the Density Offsets in Hudson River Sediment Cores Caused by Tsunami, Storm Surge, or River Flood?

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Density data for various Hudson River estuary sediment cores reveal a pronounced offset representing a high-energy, erosional event. Three mechanisms are proposed to have caused the unconformity: tsunami, storm surge, or river flood. All of these scenarios pose a significant danger due to the estuary's proximity to New York City. Cores CD01-01 and SD30 were chosen for study due to ^{14}C ages that reveal the offset in both cores to be c. 2200 BP. Core CD02-13 was chosen for its obvious unconformity, though no ages have been obtained for it. In each core, glass-cemented breccias occurred right above the unconformity, accompanied by peaks in magnetic susceptibility. Assemblages of both pelagic and benthic foraminifera were found at the top of the layer and throughout it, respectively, helping to constrain the layer thickness. Above the top in every core, there are no marine microfossils. In addition, glauconite microfossil casts, a feature previously unknown in the estuary, were found several centimeters below the top of the layer in both SD30 and CD02-13. Further, SEM microscopy revealed that some of the foraminifera contain coccoliths, remains of organisms that do not live in the estuary. No pelagic foraminifera should have been living in the Hudson at the time of the event, pointing towards a transport mechanism with a source somewhere in or near the open ocean. In addition, mineral coatings of the foraminifera were qualitatively assessed using the SEM and showed distinct manganese, iron, barite, and pyrite peaks, which, along with the glauconite casts, also hint that the source area was likely marine and highly biologically-productive with low oxygen concentrations. This evidence makes the river flooding scenario very unlikely, shifting our focus to assessing for tsunami or storm surge. The estuary's mean water height has been roughly at sea level for thousands of years and there is no known significant rise in sea level around 2200 BP that could have deposited marine sediments in the Hudson. Tsunami deposits are characterized by graded beds of mostly sheets of sand with thicknesses of less than 25 cm, whereas storm surge deposits typically have layer thicknesses greater than 30 cm. The constrained layers in both SD30 and CD01-01 are too small to accurately assess for graded bedding. CD02-13, with a layer thickness of 20 cm, reveals the characteristic graded bedding. In addition, storm surges cannot affect sediments in water depths greater than 10 m. The paleowater depths of SD30, CD01-01, CD02-13 are 8.63±1m, 4.26±1m, 13±1m, respectively. The paleowater depths significantly strengthen the tsunamogenic hypothesis for the observed density offsets. More knowledge of the paleotsunami, including its genesis, would contribute to modeling of tsunami risk and protection for the northeast seaboard.