During the last glacial maximum, the Hudson River Estuary, a stretch of the Hudson River from Troy, N.Y., to its mouth in New York Harbor, has been through a new phase. Some new deposits have been found that, aside from a few very specific locations, the estuary may have largely stopped filling in with new sediment. The Hudson has gone through many stages of evolution,” said Cecilia M. G. McHugh, a researcher at Columbia’s Lamont-Doherty Earth Observatory and the lead scientist on the study being published in an upcoming issue of the journal Geology. “Now it’s entering a new phase.”

Some new deposits are being laid down as a result of annual rise in sea level, McHugh continued, but on the whole, the river is at equilibrium. This research has important implications because localized areas of new accumulation offer the potential for pollution to concentrate, creating toxic “hot spots” in the river bottom.

Every year the Hudson tributaries to the north discharge sand and silt into the river. The silt is trapped around islands and shoals near Kingston, while the silt washes down into the Hudson River Estuary, filling areas where scouring has occurred. Most of the silt is being trapped in a section of the river near the George Washington Bridge known as the Estuarine Turbidity Maximum (ETM). A small amount of silt is also being washed out to areas around the mouth of the Lower New York Bay.

The valley that the Hudson River occupies is a deep gorge in the bedrock formed over the course of tens of millions of years. During the last glacial maximum, nearly 18,000 years ago, the valley was filled with ice from the Lairentide Glacier. As the glacier receded, ice and melt water formed a series of interconnected lakes in the valley that eventually merged to form the Hudson River. The valley filled with river sediments for nearly 3,000 years until the sea level rose and the river merged with the encroaching Atlantic Ocean to form the Hudson River Estuary.

The estuary, the section of river where river and ocean water mix and that rises and falls with the tide, formed nearly 6,000 years ago. In places, sediment deposits beneath the estuary are more than 700 feet deep. Previously it was thought that this process of sedimentation was continuing today.

McHugh and her colleague believe that accumulation ceased sometime in the last 1,300 years. The researchers examined more than 100 two-meter-long sediment cores taken from the estuary and bay as well as high-resolution sonar and seismic imagery of the bottom. They found that the current rate of sedimentation in the estuary as a whole is approximately 1mm per year, about the same rate as sea level rise. The rise in sea level as well as scouring or dredging are the only processes that are providing space for new sediment in much of the estuary. Of the estimated 1.2 million to 5.6 million metric tons of silt and fine sediment that wash into the river each year, about 300,000 metric tons is trapped in the ETM—the place where friction between seawater and river water creates turbulence that causes fine sediment to drop out of suspension. Currently, the ETM is centered roughly at the George Washington Bridge, but its daily position is influenced by the tides and the strength of the river current. If sea level ever stopped or reversed, said McHugh, the ETM could push all the way out into the mouth of the river, and we could see the formation of an entirely new feature—a Hudson River Delta.

About 50,000 metric tons of fine sediment is trapped every year in bays and bends of the river as well as on the river bottom in the Hudson Highlands where the river is narrow and most of the natural scouring occurs. In many places, only scouring of the river bottom caused by current and tides or human dredging is creating space for an appreciable amount to accumulate. As a result, said McHugh, these local areas of new accumulation could create toxic “hot spots” in the river bottom where pollution could concentrate.

A small amount of sediment carried by the Hudson is flushed out into the Lower New York Bay and settles at Sandy Hook Bay in New Jersey, where it accumulates at a rate of about 5mm per year. McHugh said she had a flash of insight several years ago that something about the river must have changed when she saw sediment cores that displayed unusual scouring marks at the top and found localized accumulations of new sediment next to large expanses of old sediment. “That’s when I thought of the Hudson as a bathtub filled with sand,” she said. “Only if it’s scoured out can you fill it with new material.”

The research was supported by the New York State Department of Environmental Conservation, the Hudson River Foundation, the Lamont-Doherty Climate Center, the City University of New York, and the National Science Foundation.

New Study Finds Straphangers Exposed to Heavy Metals

New York City subway riders endure many unpleasant things during their commutes: packed trains, ear-piercing brakes and an array of odors.

They also breathe in levels of some metals that are 100 times higher than typical neighborhood levels, according to new research by a team of scientists from the Mailman School of Public Health, Columbia’s Earth Institute, Columbia’s Lamont-Doherty Earth Observatory and Harvard.

Although these levels are a health risk and the findings in no way suggest that people should avoid riding the subway, says the study’s lead author, Steven Chillrud, a research scientist at Lamont-Doherty Earth Observatory, the metal exposure comes from the subway’s wheels and rails. “But it’s worth following up on because of the chronic nature of the exposure,” he adds. More researchers, he says, are getting interested in the potential health effects of long-term exposures to low levels of hazardous air pollutants. Their study, to be published in an upcoming issue of Environmental Science & Technology, was designed to measure teenagers’ exposures to current ambient levels of pollutants in urban areas.

The researchers measured the exposure to air pollutants with the help of high school students at the A. Philip Randolph Academy in northern Manhattan. The students carried air monitors for two days in their backpacks and also measured pollutants in their homes and neighborhoods.

When the researchers analyzed the data, they noticed students who took the subway to school were exposed to higher levels of manganese, iron and chromium than students who did not. Further sampling of the subway’s platforms and trains confirmed that most of the students’ exposure to these metals came from the subway and not their homes and neighborhoods.

The research is part of a larger study of air pollutants in New York City and Los Angeles run by Patrick Kinney, associate professor of environmental health sciences at the Mailman School.

Funds for this research were provided by the Mickey Ieland National Urban Air Toxics Center and the NIEHS Center for Environmental Health in Northern Manhattan.