In Boston Harbor, microbes clean up

Two centuries after the Boston Tea Party, a lot more than tea has accumulated on the floor of Massachusetts Bay—and much of it is anything but potable.

Now scientists have some good news for Boston Harbor. A new study finds that bacteria can degrade toxic petroleum byproducts in the bay's sediment, despite its lack of oxygen.

"The Destruction of Tea at Boston Harbor." Copy of lithography by Sarony & Major, 1846.
National Archives and Records Administration

What is true in the laboratory is also true in nature, the researchers found. In the laboratory, certain bacteria degrade substances known as PAHs through a process called 'anaerobic' breakdown, in which sulfate replaces oxygen. This process, the researchers suggest, also occurs in Boston Harbor.

"The capacity of sediment to purify itself is greater than previously thought," says Derek R. Lovley, a microbiologist at the University of Massachusetts in Amherst who led the study. The findings appear in *Environmental Science and Technology*.

PAHs, or polycyclic aromatic hydrocarbons, enter sediment following oil spills, in runoff from industrial waste, and through marine activities that release petroleum. The substances can cause cancer in fish, animals and possibly humans.

Researchers once considered PAHs permanent residents in sediment thicker than about a millimeter, because oxygen does not penetrate much deeper. Lovley's group had published evidence that some PAHs could indeed be broken down in the absence of oxygen, at least in a test tube.

In the latest work, the researchers took samples of sediment from water near a former coal-tar processing facility that operated for more than 60 years. They maintained the bay's water temperature to mimic the natural environment.

Confirming the previous experiment, they saw that PAHs in the harbor samples did succumb to the microbes. The largest PAHs were broken down at a rate of about 15 percent a year, while smaller ones degraded faster.

In the future, says Lovley, environmental cleanup crews might consider adding a form of insoluble sulfate, like gypsum, to polluted waters to kick-start anaerobic activity below. In another prior study, his group reported that adding sulfate to sediments accelerated the degradation of PAHs.

Little is known about the organisms that live on PAHs—they do not even have a name; the researchers call them sulfate-reducers. Lovley's team has undertaken genomic studies of these creatures, which may help uncover the mechanism by which they break down pollutants.