# Death and life beneath the sea floor

Viruses that infect microbes in deep-sea sediments may be a key driver in the world's largest ecosystem and integral to the global carbon cycle, data reveal.

Lytic viruses, which cause infected cells to burst, kill about 80% of the single-celled organisms in the sediment and sub-surface ocean layers, researchers calculate, thereby releasing large amounts of dissolved carbon into the deep seas[1]. Every year this 'viral shunt' releases up to 630 million tonnes of the carbon sequestered by particles sinking into these deep-sea benthic zones, suggesting that viruses should be included in ocean carbon-management models.

The viruses provide a form of population control that may date back to the origin of life on Earth, says bio-oceanographer Roberto Danovaro of the Polytechnic University of Marche in Ancona, Italy, who led the analysis of 232 deep-sea sediment samples with his colleagues. "The viruses kill the microbes and stimulate their growth as well," he says. "It's almost a self-sustaining mechanism."

The viral data are the latest in a series of revelations about the deep-sea ecosystem, which covers 65% of the planet's surface. Around one-tenth of Earth's living biomass exists at the bottom of the ocean, despite cold temperatures, impenetrable darkness and intense pressure. "A few years ago we were assuming the deep-sea ecosystems had no currents, no movements," says Danovaro. "Now we know a lot of material and sediment can be brought up from the deep in a few days."

The nature of the microbes living in and below the sea floor remains hotly debated. It was thought that the majority consists of bacteria. But a study published last week concluded that most cells in the sediment are archaea[2], a similar-looking but distinct form of life.

Previous ocean-floor surveys turned up plenty of bacteria but relatively few archaea. Some studies may have been biased — several were based on DNA extraction and staining methods that may have met with limited success in penetrating the relatively impermeable archaeal cell membrane. Similarly, lipid-profiling methods based on important components of cell membranes called phospholipid-based fatty acids are generally held to be a good marker for living bacteria because these lipids degrade rapidly after the cell dies. Yet many archaea do not make these particular fatty acids.

Kai-Uwe Hinrichs of the University of Bremen in Germany and his colleagues, however, took samples from more than 1 metre below the sediment surface and milled the cells they collected in liquid nitrogen to loosen up their membranes. They also measured a different class of lipid, one that is common in both archaea and bacteria. The researchers discovered an abundance of archaea, finding that at that depth, archaea make up more of the microbial biomass than bacteria do[2,3].

However, results from a few research sites do not reveal what lies on and beneath the entire ocean floor. "We must be careful not to assume that when we find something in a system, it must be true across environments, in different kinds of marine systems," says Mark Gessner, a microbial ecologist at the Swiss Federal Institute of Aquatic Science and Technology in Dübendorf. Indeed, another study published last week surveyed deep-sea hydrothermal vents and found that many of the viruses found there were not lytic, instead being of a type that rarely causes its hosts to burst[4].

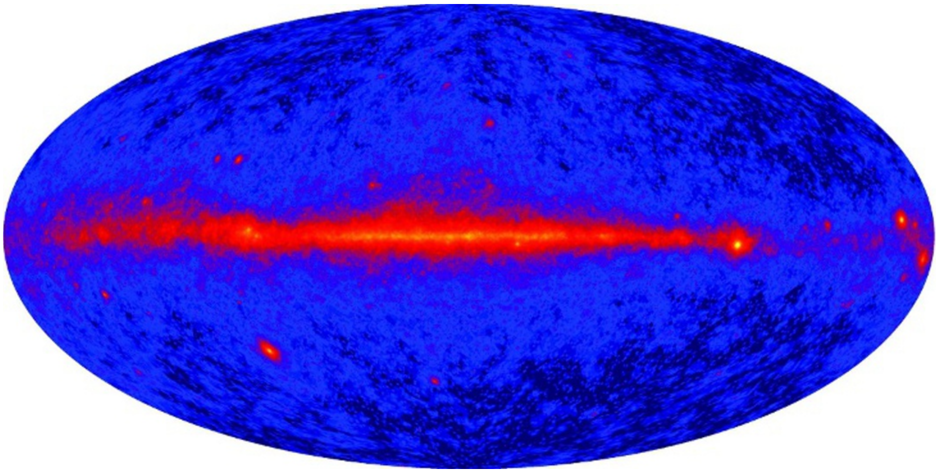
Further technological improvements are needed to get a higher-resolution image of the microbial forest below the sea floor. "We're dealing with very low signal and all of our methods are at the limit of their ability," says Hinrichs. ■

**Heidi Ledford**


1. Danovaro, R. *et al. Nature* **454,** 1084–1087 (2008).
2. Lipp, J. S., Morono, Y., Inagaki, F., and Hinrichs, K.-U. *Nature* **454,** 991–994 (2008).
3. Biddle, J. F. *et al. Proc. Natl Acad. Sci. USA* **103,** 3846–3851 (2008).
4. Williamson, S. J. *et al. ISME J.* advance online publication doi: 10.1038/ismej.2008.73 (21 August 2008).


## SNAPSHOT

## New window on the gamma-ray Universe



NASA/DOE/INTERNATIONAL LAT TEAM

**NASA's Gamma-ray Large Area Space Telescope (GLAST) was launched on 11 June and turned on its main telescope two weeks later. It was immediately blasted with gamma-rays from blazar 3C454.3 — visible in the lower left quadrant of the telescope's first map of the sky. "It's a good example of the kind of things that are in store for us," says project scientist Steven Ritz of NASA's Goddard Space Flight Center in Greenbelt, Maryland.**

**Blazars, supermassive black holes that emit tight jets of particles, are just one of the gamma-ray phenomena that GLAST will study as it scans the whole sky every three hours. Other objects clearly visible in the first map are the Geminga and Crab pulsars, above and below the plane of the galaxy at the far right of the image. The map is based on 95 hours of data: it would have taken the Compton Gamma-Ray Observatory, NASA's previous gamma-ray telescope, a year to amass as much data. At the same time as releasing the map, NASA renamed GLAST the Fermi Gamma-ray Space Telescope.** ■

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