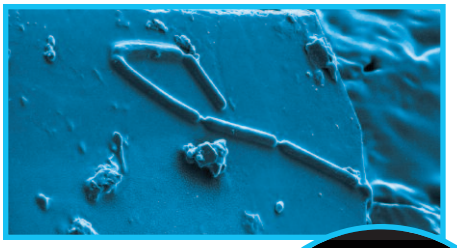
BIOLOGY OF DEEP-SEA LIFE

They can withstand a broad range of temperatures, bathe in — and in many cases — even eat, toxic chemicals, bear the weight of the ocean on their shoulders, and never see the light of day. Such is the life of many of the organisms that inhabit hydrothermal vent sites!

These creatures, from microscopic bacteria to giant tubeworms, thrive under some of the most demanding conditions on the planet. And what further distinguishes them from other life on Earth is their energy source. This is the only complex ecosystem known to live on energy from chemicals from the Earth rather than energy from the sun.

On land and in the ocean's surface layer, the food chain is based on photosynthesis, the process by which green plants use sunlight to make food and energy. A by-product of this activity is oxygen. In fact, it has been estimated that microscopic plants in the ocean generate half the oxygen we breathe.

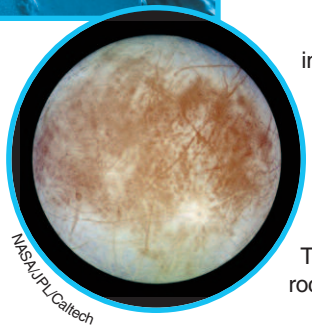
However, at deep-sea vents, where the sun's rays never reach, microbes get their energy from chemicals within the Earth — a process called *chemosynthesis.*



Kirk Czymmek, Univ. of Delaware

▲ *Magnified view of vent bacteria on the surface of pyrite. Shaped like cylinders, these microbes are 4 microns long.*

Do hydrothermal vents, and microbes, lie beneath the frozen surface of Europa, one of Jupiter's moons? ▶



NASA/JPL-Caltech

VENTS SPROUT WEIRD WORMS!

Giant tubeworms (Riftia pachyptila) *live over a mile deep on the Pacific Ocean floor near hydrothermal vents. They may grow as tall as 3 meters (8 ft). Tubeworms have no mouth, eyes, or stomach. They get energy from bacteria living inside them. These bacteria convert the chemicals rocketing out of the vents into food for the worms. Sometimes tubeworms provide food for other deep-sea dwellers. Vent crabs nip at the tubeworm's hemoglobin-rich, red plume.*

Bacteria Play Mighty Role in Vent Ecosystem

The hydrogen sulfide and other chemicals that rocket out of hydrothermal vents would be poisonous to most organisms. But exotic animals flourish in this harsh environment thanks to unique adaptations and special relationships with the tiniest life at the vents: bacteria.

Thick mats of bacteria cover the seafloor and volcanic rock. Snow-like blooms of bacteria may also occur, causing a temporary "white-out" at the vents.

Slow-moving zoarcid fish that inhabit vent sites prey on organisms such as deep-sea shrimp, which, in turn, depend on bacteria for food.

Still other vent dwellers harbor bacteria inside their bodies to make food for them. Tubeworms, for example, have no mouth, eyes, or stomach ("gut"). Their survival depends on a *symbiotic* relationship with the billions of bacteria that live inside them — some 285 billion bacteria per ounce of the worm, by some estimates. These bacteria convert the chemicals rocketing out of the vents into worm fuel.

Frontiers of Science

Scientists want to know more about the tiniest life at the vents because these microbes serve as the mighty first link in the food chain of this strange ecosystem.

Additionally, because these extremophiles can thrive in high temperature and pressure, they could have valuable uses —in generating electricity from waste, removing radioactive metals from the environment, and in making new pharmaceuticals to thwart germs that are resistant to current drugs, to name but a few.

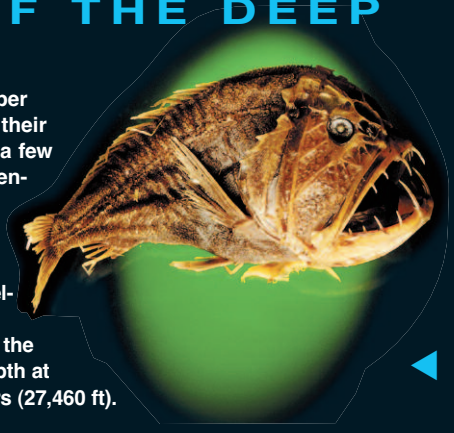
Scientists are also curious about the deep sea's tiniest life because these organisms are among the oldest on Earth. In fact, an ancient life form — Archaea ("ark-ee-uh") — has been found at vent sites. Previously, these microscopic organisms had been discovered in another "extreme environment": hot springs in Yellowstone National Park.

Astrobiologists speculate that if there is life on other planets, it might be vent microbes. Europa, one of Jupiter's moons, is covered in ice. Recent findings suggest that portions of the ice move, which is strong evidence that liquid water lies below. The water may be maintained in its liquid state by hydrothermal vents. If vents exist on Europa, vent microbes might live there, too!

CREATURES OF THE DEEP

As they descend to the deep ocean bottom, marine scientists might encounter any number of bizarre-looking organisms, illuminated in their submersible's headlights. These photos are a few of the deep-sea dwellers that UD marine scientists have seen en route to vent sites nearly 3,000 meters (9,842 ft) down.

While few deep-sea fish live at hydrothermal vent sites — with the exception of pale eel-like zoarcids, also known as eelpouts — fish have been found at great depths elsewhere in the ocean. How low can they go? The greatest depth at which a fish has been recorded is 8,370 meters (27,460 ft).



FANGTOOTH. Food is scarce in the deep sea. The fish that live there must rely on what little food floats down from above — often referred to as "marine snow" — or eat their neighbors! Deep-sea fish typically have big mouths, long sharp teeth, and stretchy stomachs to catch prey in the dark and swallow it whole. This ferocious-looking fish, called "fangtooth," is found at depths of 800 to 1,524 meters (2,600 to 5,000 ft). It grows to about 25 centimeters (10 in) long.

DRAGONFISH. there is no natural light ocean below 1,000 mete many deep-sea fish rely luminescent (light-produ organs to find a mate ar prey. This fish has a lon barbel that glows in the

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