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Creatures of the Thermal Vents by Dawn Stover

The three-person submersible Alvin sank through the cold, dark waters of the Pacific Ocean for more than an hour, finally touching down on the sea floor more than 8,000 feet below the surface. It was December 1993, and the scientists inside the sub had come to this stretch of the East Pacific Rise, an underwater mountain range about 500 miles southwest of Acapulco, Mexico, to inspect a recently formed hydrothermal vent - a fissure in the ocean bottom that leaks scalding, acidic water. Peering out through the sub's tiny windows, the visitors were astonished to see thickets of giant tube worms, some four feet tall. The tail ends of the worms were firmly planted on the ocean floor, while red plumes on the other ends swayed like a field of poppies. Alvin had brought researchers to the same spot less than two years earlier, when they had seen none of these strange creatures. Measurements at the site have since shown that individual tube worms can increase in length at a rate of more than 33 inches per year, making them the fastest-growing marine invertebrates. That means tube worms can colonize a vent more rapidly than scientists once thought. photo ? Al Giddings/Images Unlimited, Inc. The giant tube worm is one of the most conspicuous members of a diverse community that forms around hydrothermal vents. Scientists once thought that no living thing could survive the harsh combination of

toxic chemicals, high temperatures, high pressures, and total darkness at these vents. But in 1977, researchers diving in Alvin discovered tube worms and other bizarre organisms thriving at a vent off the Galapagos Islands. Similar communities have since been found at several hundred hot spots around the world. These creatures are like nothing else on Earth. Vents form where the planet's crustal plates are slowly spreading apart and magma is welling up from below to form mountain ranges known as mid-ocean ridges. As cracks form at these spreading centers, seawater seeps a mile or two down into the hot rock. Enriched with minerals leached from the rock, the water heats and rises to the ocean floor to form a vent. Vents are usually clustered in fields, underwater versions of Yellowstone's geyser basins. Individual vent openings typically range from less than a half inch to more than six feet in diameter. Such fields are normally found at a depth of more than a mile. Most have been discovered along the crest of the Mid-Oceanic Ridge, a 46,000-mile-long chain of mountains that wraps around Earth like the seams on a baseball. A few vents have also been found at seamounts, underwater volcanoes that are not located at the intersection of crustal plates. The largest vent field, called TAG (short for Trans-Atlantic Geotraverse), is about the size and shape of a football stadium. Other fields have more whimsical names like Clam Acres, Mussel Bed, Rose Garden, Garden of Eden, Broken Spur, and Lucky Strike. Snow Blower is named for the white, flaky bacteria discharged from its vents. Genesis is a vent that sputtered out but came back to life a few years later. Hydrothermal vents are underwater oases,

providing habitat for many creatures that are not found anywhere else in the ocean. More than 300 new species have been identified since the first vent was discovered in 1977. Besides the giant tube worms, which have so far been found only in the Pacific, there are pencil-size Jericho worms with accordion-like tubes ; orange worms covered with tiny bristles ; small benthic worms that wriggle through the mud ; and finger-length, dark red palm worms that stand upright, topped with wiglike fronds. A special class of small worms, called Alvinellids (named after the sub), live on the walls of mineral deposits that form around vents. Mussels, shrimp, clams, and crabs are abundant at many vents, but these are not the same species that you find in seafood dishes. The cocktail-size shrimp that dominate vents in the mid-Atlantic, for example, have no eyes. However, at least one species has an extremely sensitive receptor on its head that may be used to detect heat or even dim light coming from vents. Scientists still aren't sure how shrimp and other vent creatures cope with chemical-laden seawater that would kill ordinary shellfish. Biologists have observed a variety of smaller crustaceans around vents, including miniature lobsters called galatheids, and amphipods resembling sand fleas. They have also seen snail-like limpets the size of BBs, sea anemones, snakelike fish with bulging eyes, and even octopuses. While octopuses are at the upper end of the vents food chain, bacteria are at the bottom. They are the first organisms to colonize newly formed vents, arriving in a snowlike flurry and then settling to form white mats or tendrils attached to the ocean floor. Bacteria have been found living beneath the oceans

floor, and it seems likely that they emerge from below when the conditions are right. Vent bacteria can withstand higher temperatures than any other organism. That makes them attractive to researchers who are developing heat-stable enzymes for genetic engineering, and culturing bacteria designed to break down toxic waste. Water pouring out of vents can reach temperatures up to about 400 C ; the high pressure keeps the water from boiling. However, the intense heat is limited to a small area. Within less than an inch of the vent opening, the water temperature ; s to 2 C, the ambient temperature of deep seawater. Most of the creatures that congregate around vents live at temperatures just above freezing. Thus chemicals are the key to vent life, not heat. The most prevalent chemical dissolved in vent water is hydrogen sulfide, which smells like rotten eggs. This chemical is produced when seawater reacts with sulfate in the rocks below the ocean floor. Vent bacteria use hydrogen sulfide as their energy source instead of sunlight. The bacteria in turn sustain larger organisms in the vent community. The clams, mussels, tube worms, and other creatures at the vent have a symbiotic relationship with bacteria. The giant tube worms, for example, have no digestive system - no mouth or gut. "The worm depends virtually solely on the bacteria for its nutrition," says microbial ecologist Colleen M. Cavanaugh of Harvard University. "Both partners benefit." The brown, spongy tissue filling the inside of a tube worm is packed with bacteria - about 285 billion bacteria per ounce of tissue. "Its essentially a bacterial culture," says Cavanaugh. The plumes at the top of the worms body are red because they are

filled with blood, which contains hemoglobin that binds hydrogen sulfide and transports it to the bacteria housed inside the worm. In return, the bacteria oxidize the hydrogen sulfide and convert carbon dioxide into carbon compounds that nourish the worm. Tube worms reproduce by spawning: They release sperm and eggs, which combine in the water to create a new worm. Biologists don't know how the infant worm acquires its own bacteria. Perhaps the egg comes with a starter set. Scientists also don't know how tube worms and other organisms locate new vents for colonization. "The vents are small, and they're separated, like islands," says Cindy Lee Van Dover, a biologist and Alvin pilot who studies vent life. Most vent organisms have a free-swimming larval stage. But scientists aren't sure whether the larvae float aimlessly or purposely follow clues - such as chemical traces in the water - to find new homes. Studying the life cycle of vent organisms is difficult. Researchers have visited only a fraction of the ocean's hot spots. They have been able to observe vent life only by shining bright lights on creatures accustomed to inky darkness, 100Test 下载频道开通，各类考试题目直接下载。详细请访问 www.100test.com