16.5C: Hydrothermal Vent Microbial Ecosystems

Hydrothermal vents are home to chemosynthetic bacteria, which are the basis of a unique ecosystem that thrives in total darkness.

Learning Objectives

• Describe hydrothermal vent microbial ecosystems

Key Points

• Hydrothermal vents emit nutrient rich, geothermally heated water. Mats of chemosynthetic bacteria grow around the vents and synthesize carbohydrates from the carbon dioxide ejected by the vent.

• Many species of crabs, worms, snails, and tube worms depend on these bacterial mats for food. These species are often specially adapted to life in the lightless, high pressure, and hot environment of the vent.

• Vents are the target of exploitation of the mining industry, which is a cause for concern among marine biologists. Mining could damage these very unique and diverse ecosystems.

Key Terms

• **chemosynthesis**: The production of carbohydrates and other compounds from simple compounds such as carbon dioxide, using the oxidation of chemical nutrients as a source of energy rather than sunlight; it is limited to certain bacteria and fungi.

• **geothermal**: Pertaining to heat energy extracted from reservoirs in the earth's interior.
Hydrothermal Vents and Their Microbial Communities

A hydrothermal vent is a fissure in the earth’s surface from which geothermally heated water issues. They are typically found deep below the surface of the ocean. Hydrothermal vents are of interest to microbiologists because they have unique microbial communities found nowhere else on earth.

Figure: **Hydrothermal Vents**: Hydrothermal vents are cracks in the earth’s crust where geothermally heated water leaks out.

In most shallow water and terrestrial ecosystems, energy comes from sunlight, but in the deep ocean there is total darkness. However, hydrothermal vents often expel nutrient rich water, containing methane and sulfur compounds. Vent bacteria can synthesize all the compounds they need to live from these nutrients, a process called chemosynthesis. These bacteria form the basis of the entire hydrothermal vent ecosystem.

The chemosynthetic bacteria grow into a thick mat, covering the hydrothermal vent, and this is the first trophic level of the ecosystem. Snails, shrimp crabs, tube worms, and fish feed on the bacterial mat and attract larger organisms such as squid and octopuses. Many of these species are specially adapted to live in the dark and lack eyes. Hydrothermal vents are biodiversity hot spots because they have many species that are uniquely adapted to live in this harsh environment. For example, the Pompeii tube worm *Alvinella pompejana* can resist temperatures up to 176°F. These ecosystems are almost entirely independent of sunlight (although the dissolved oxygen used by some animals does ultimately come from plants at the surface).
Some species of tube worms are specially adapted to withstand the high temperatures found at hydrothermal vents. The ecosystems around hydrothermal vents rely on mats of chemosynthetic bacteria, and many species feed on the bacteria. Hydrothermal vents are some of the most unique ecosystems in the world. Despite being some of the most remote ecosystems in the world, hydrothermal vents are under threat from mining companies. As mineral resources on land have become depleted, mining companies have turned to deep sea
geothermal vents to extract metals and sulfur. Although the technology for deep sea mining is new, conservation biologists are concerned that mining hydrothermal vents will destroy these fragile and unique ecosystems.