By Stefan A. Science Editor

Black Smokers: Extraterrestrial Life on Earth!

Extreme living conditions

At the bottom of the oceans, the lowest level of the ocean waters, submarine volcanoes are found. They erupt periodically, but also phenomena similar to others that accompany terrestrial volcanoes, such as submarine geysers, can be found and are called hydrothermal vents (hot vents) or black smokers. The submarine vents, linked to the submarine volcanic activity, trigger an unusual life abundance on the bottom of the ocean, at depths of 800-3,500 m (2,660-10,366 ft) in the Atlantic, Pacific and Indian oceans, but also in the Red Sea. In these areas, animal communities emerge, formed of gigantic species, if we compare them to their counterparts at the surface. These animals are usually de-pigmented, white (but not necessarily) and blind, even if some worms and bivalves can be bright red due to the respiratory pigment hemoglobin. All these communities are very different from most of the terrestrial communities; they do not rely on photosynthesis, but on chemosynthesis made by bacteria, using energy delivered by the center of the Earth. These animals are not attracted here by the warm water expelled by the hot vents, but by the abundant food resource. Here, the bacteria are hundreds of times more abundant than in other ocean zones. The dark hot water (up to 500° C) gushing through the 10 m (30 ft) long furnaces is loaded with sulfur, but further away, the water can be just 20° C (usually, the water at the bottom of the ocean has around 2° C). Still, the magma below, that heats the water, can have temperatures of 1,200° C! The water does not turn into the vapors at 300-500° C because of the pressure of 80-350 atmospheres. The gushing water is acid, corrosive and devoid of oxygen. The water gets out through a hole of only several centimeters in diameter. By eroding the basalt, the water gets rich in iron, copper, zinc and sulfur. By combining with hydrogen, the sulfur forms hydrogen sulfide, the base of the food chain around the vent. The sudden cooling of the gushing water forms a powder column up to 300 m (10,000 ft) tall. The walls of the furnaces are formed by the sulfur salt and other mineral deposits, precipitated because of the high pressure. About 95% of the minerals are taken by the submarine currents and dispersed on a range of 50 km (30 mi). The formation of the furnaces can take from 10 months to 10 years, and sometimes thousands of years. In time, the furnaces get dished or collapse because of the submarine earthquakes. In this case, the liquid will start getting out through another nearby orifice, just several meters away, forming another furnace. A sole furnace in the Red Sea expelled 100 million tonnes of minerals, as much as found in a large ground deposit. The water volume expelled annually by the vents matches that of all the rivers of the planet. In 10 million years, the whole ocean passes through the vents! [img=2]The bacteria oxidate the sulfur and hydrogen sulfide to sulfur acid (which forms metallic salts) and the energy they get is used for synthesizing organic compounds, like terrestrial plants do it using sun light, starting from carbon dioxide and water. This process is called chemosynthesis, opposite to photosynthesis. Only amongst the bacteria there are species that really resist to high temperatures, like the ultrathermophile that can stand 113° C. The fauna is located in an area where the water mix has been made and the temperature is no higher than 50° C. This limit is marked by submarine worms, like Riftia, which can have 2 m (6.6 ft) in length. Not the heat, but the toxicity is a more important factor. The Modiolus mussels filter 10 liters of water per hour, for example, and bivalves are sensitive to this issue. If at depths of 3,000 m (10,000 ft) there is one gram of living creatures per square meter of oceanic bed, this value goes to 10-15 kg (22-33 pounds) around these hydrothermal vents. The animals here are so adapted to eat these bacteria that some worms do not have guts, and are totally dependent on the symbiosis with them, having a special bag filled with bacteria, called trophosome. Usually, there we can find clams (up to 30 cm (12 inch) long), mussels, crabs, snails, octopuses, sea anemones, sponges, shrimps, tube worms (over 3 m (10 ft) long), echinoderms and even some fish (like tonguefish). Over 600 endemic species have been found so [img=3]far in these communities. Some are living fossils, whose ancestors disappeared for 350 million years from the surface waters. Clams filter the bacteria, and crabs eat the bacterial mucus deposed over the rocks. Fish and echinoderms prey on all the smaller species. In these deep sea communities, some researchers found densities 100 times higher than on surface communities. The life communities are disposed in circles around the vents, on 100 to 1,000 square meters. Of course, all these animals had to adapt to the extremely toxic

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acid and sulphuric water and to the high temperatures. Some minute worms can make their tubes on the furnaces, where water can be up to 300° C. The life oases around the hot vents can spread over 100 m (300 ft) length and 30 m (90 ft) width. Some volcanic blasts can destroy these communities, but usually they recover quickly. Some specialists say the hot vents fuel the ocean with salts that ensure the ocean's stable chemical composition, crucial for the maintenance of oceanic life communities.

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