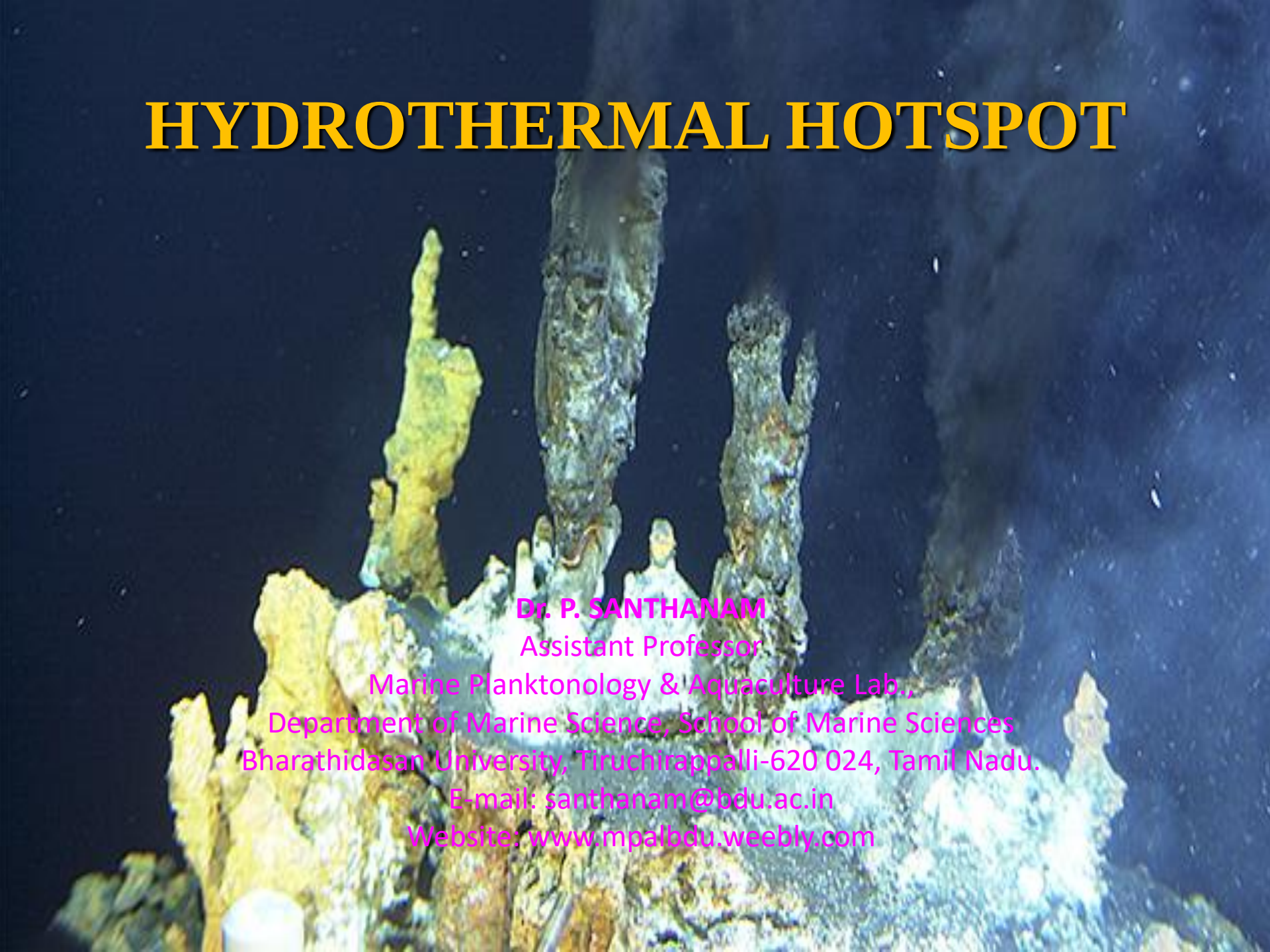
HYDROTHERMAL HOTSPOT



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HYDROTHERMAL HOTSPOT

- A **hydrothermal hotspot** is a fissure in a planet's surface from which geothermally heated water issues. Hydrothermal vents are commonly found near volcanically active places, areas where tectonic plates are moving apart, ocean basins, and hotspots.

- Hydrothermal vents are locally very common because the earth is both geologically active and has large amounts of water on its surface and within its crust.

- Common land types include hot springs, fumaroles and geysers. The most famous hydrothermal vent system on land is probably within Yellowstone National Park in the United States.

- Under the sea, hydrothermal vents may form features called black smokers.

HYDROTHERMAL VENTS

Relative to the majority of the deep sea, the areas around submarine hydrothermal vents are biologically more productive, often hosting complex communities fueled by the chemicals dissolved in the vent fluids.

Chemosynthetic archaea form the base of the food chain, supporting diverse organisms, including giant tube worms, clams, limpets and shrimp.

Hydrothermal vents in the deep ocean typically form along the Mid-ocean ridges, such as the East Pacific Rise and the Mid-Atlantic Ridge. These are locations where two tectonic plates are diverging and new crust is being formed.

The water that issues from seafloor hydrothermal vents consists mostly of sea water drawn into the hydrothermal system close to the volcanic edifice through faults and porous sediments or volcanic strata, plus some magmatic water released by the upwelling magma.

HYDROTHERMAL VENTS

The water emerges from a hydrothermal vent at temperatures ranging up to 400°C, compared to a typical 2°C for the surrounding deep ocean water.

The high pressure at these depths significantly expands the thermal range at which water remains liquid, and so the water doesn't boil.

Water at a depth of 3,000 m and a temperature of 407°C becomes supercritical. However the increase in salinity pushes the water closer to its critical point.

The initial stages of a vent chimney begin with the deposition of the mineral anhydrite.

Sulfides of copper, iron and zinc then precipitate in the chimney gaps, making it less porous over the course of time. Vent growths on the order of 30 cm per day have been recorded.

HYDROTHERMAL VENTS

Life has traditionally been seen as driven by energy from the sun, but deep sea organisms have no access to sunlight, so they must depend on nutrients found in the dusty chemical deposits and hydrothermal fluids in which they live.

Previously marine biologists assumed that vent organisms were dependent on a "rain" of detritus from the upper levels of the ocean, like deep sea organisms.

This would leave them dependent on plant life and thus the sun.

Some hydrothermal vent organisms do consume this "rain," but with only such a system, life forms would be very sparse.

Compared to the surrounding sea floor, however, hydrothermal vent zones have a density of organisms 10,000 to 100,000 times greater.

HYDROTHERMAL VENTS

The chemosynthetic bacteria grow into a thick mat which attracts other organisms such as amphipods and copepods which graze upon the bacteria directly.

Larger organisms such as snails, shrimp, crabs, tube worms, fish, and octopuses form a food chain of predator and prey relationships above the primary consumers.

The main families of organisms found around seafloor vents are annelids, pogonophorans, gastropods, and crustaceans, with large bivalves, vestimentiferan worms, and "eyeless" shrimp making up the bulk of non-microbial organisms.

HYDROTHERMAL VENTS

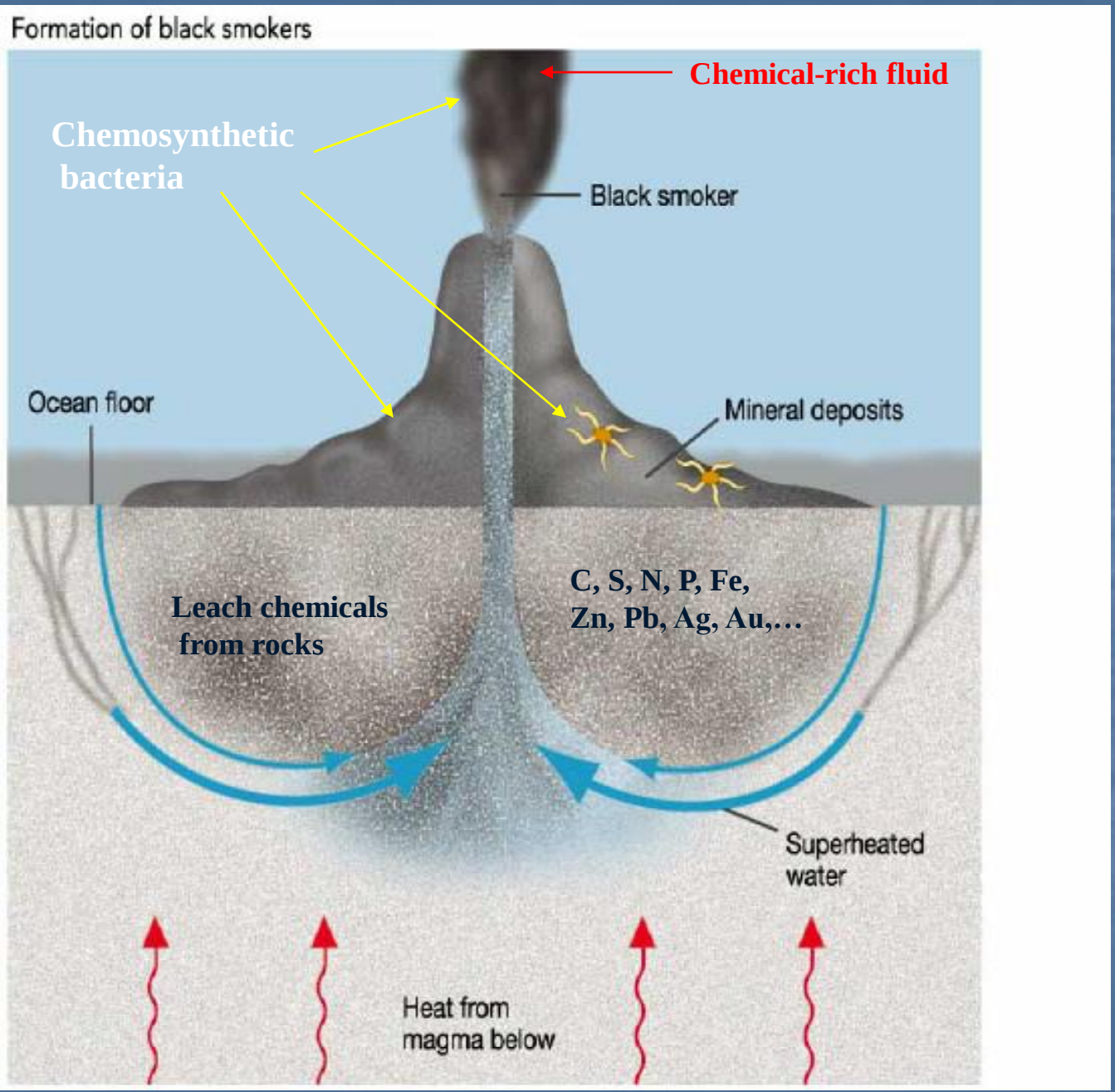
Vestimentiferans are marine and benthic. *Riftia pachyptila*, a vestimentiferan, is known only from the hydrothermal vent systems.

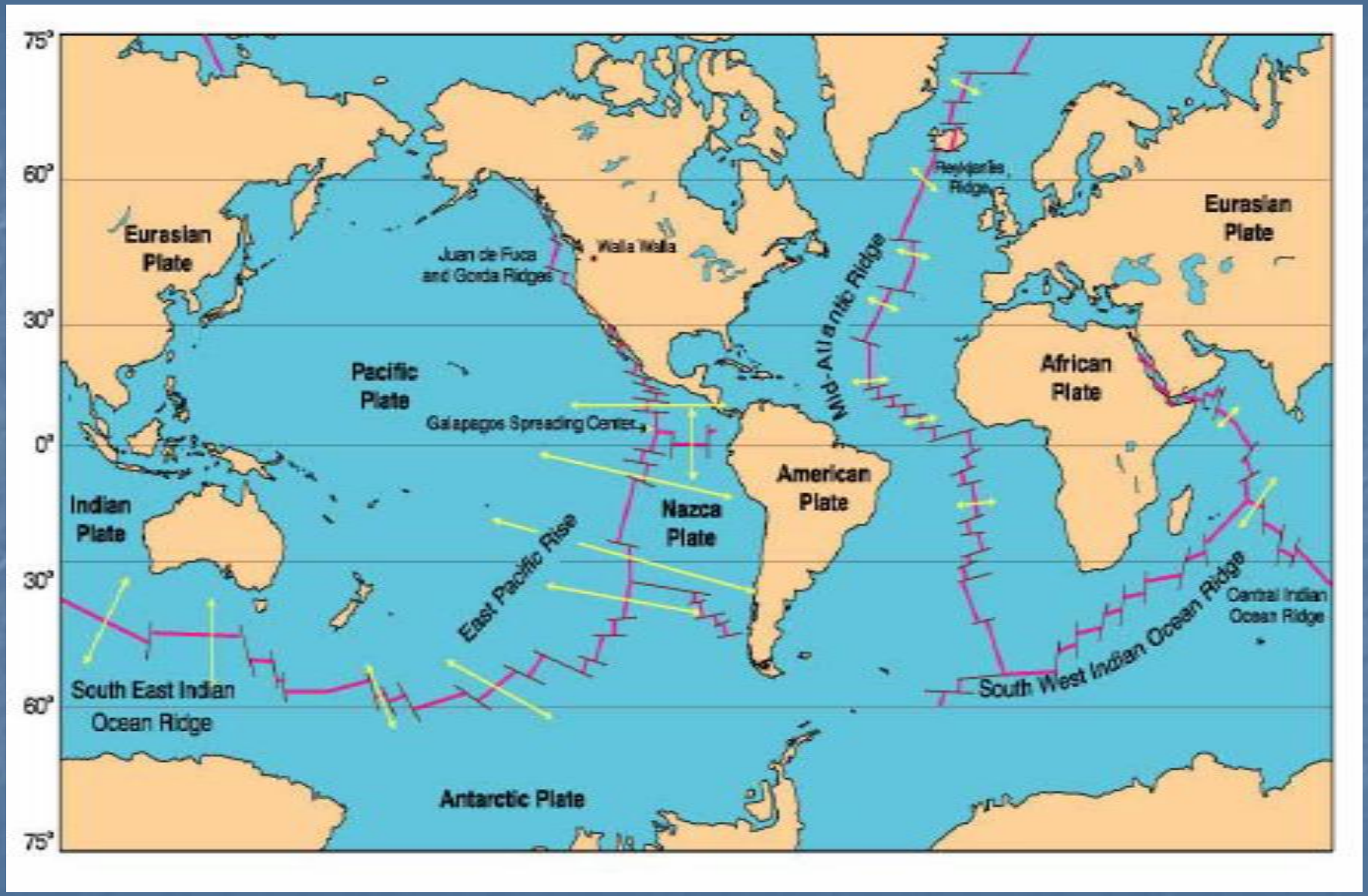
The vestimentiferans possess an anterior first body part called the obturaculum. Their main trunk of the body bears winglike extensions, the vestimentum, from which their name is derived.

Also, unlike other siboglinids that never have a digestive tract, they have one that they completely lose during metamorphosis.

They feed primarily on symbiotic hydrogen sulfide- or methane-oxidizing bacteria living in an internal organ, the trophosome. One gram of trophosome tissue can contain one billion bacteria.

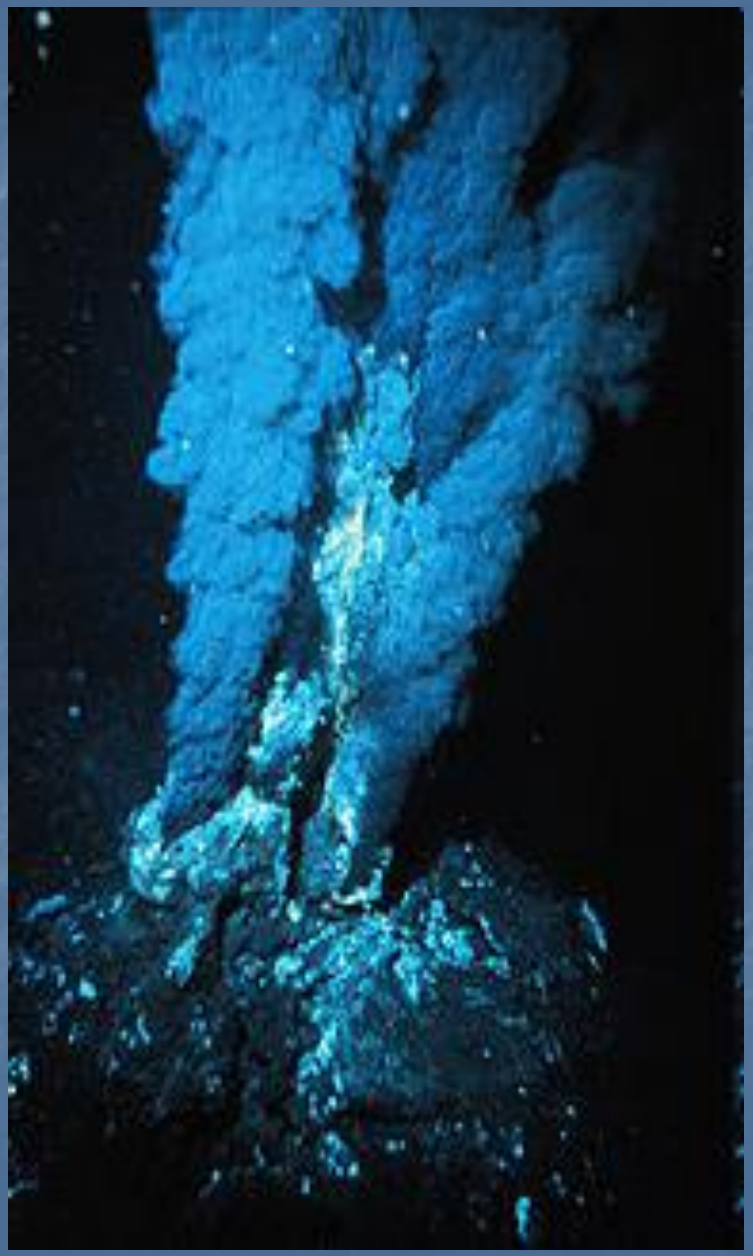
The first specimen was dredged from the waters of what is now Indonesia in 1900. These specimens were given to French zoologist Maurice Caullery, who studied them for nearly 50 years.


Formation of black smokers
Chemical-rich fluid
Chemosynthetic bacteria
Black smoker
Ocean floor
Mineral deposits
Leach chemicals from rocks
C, S, N, P, Fe, Zn, Pb, Ag, Au,…
Superheated water
Heat from magma below



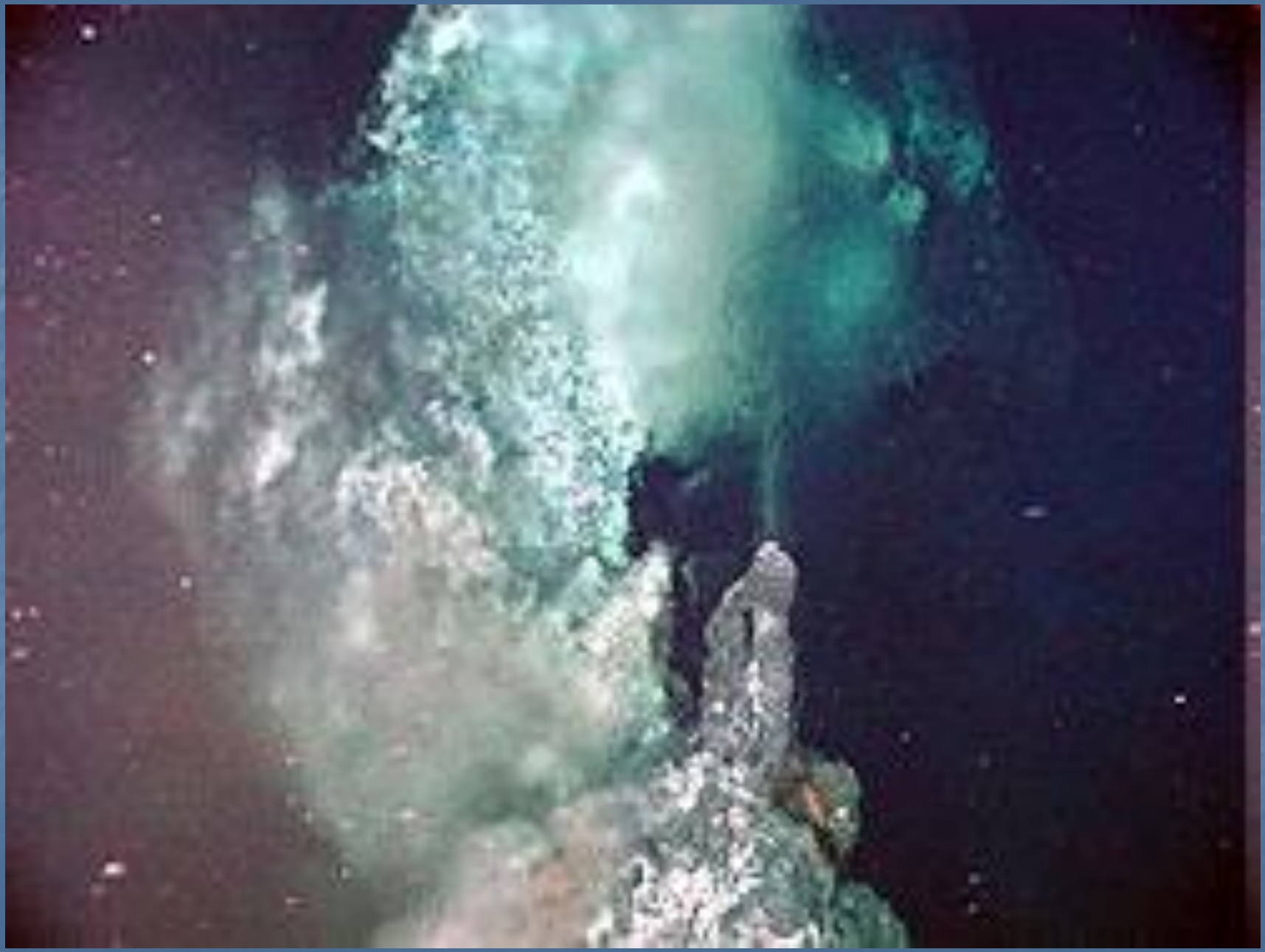
Located along tectonically-active plate margins e.g., *mid-ocean ridges*

A black smoker, a type of hydrothermal vent



White smokers at Champagne Vent on Dominica

Sulfide chimney of the Magic Mountain hydrothermal field, British Columbia, Canada



TUBE WORMS

TUBE WORMS

Vent Copepod

Bresiliid shrimp

vent crab

Brachiopoda

Vent Fish

Vent Amphipod

Vent Octopus