

Hot Science Cool Talks

UT Environmental Science Institute

7

Voyage to the Bottom of the Sea

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Voyage to the Bottom of the Sea

Henrietta N. Edmonds

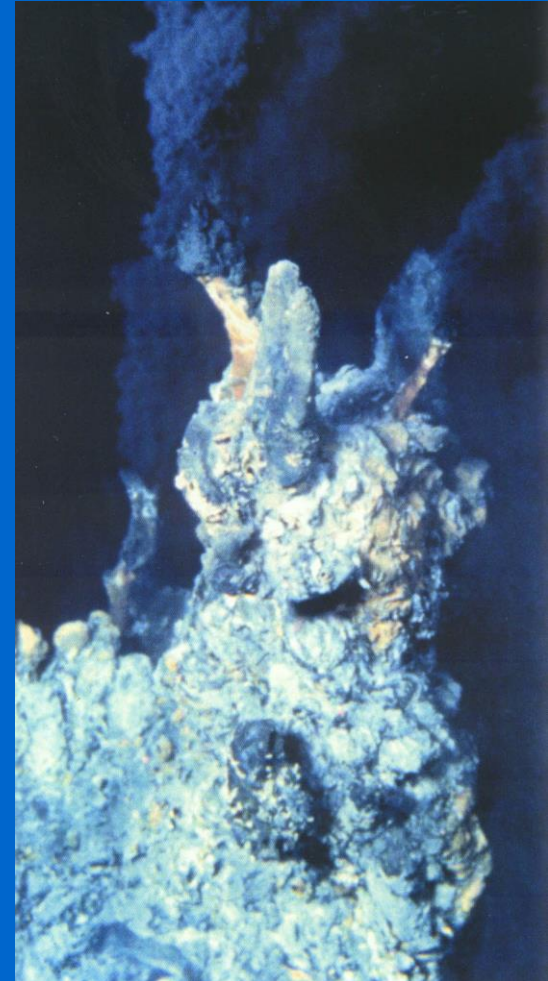
*The University of Texas
at Austin*

Marine Science Institute



Hydrothermal Vents

High temperature (350°C) geysers on the ocean floor — known as “black smokers” due to the presence of black particles which form when the hot water exits chimney-like structures and mixes with seawater



Hydrothermal Vents

Fantastic communities of never before seen — or imagined — creatures



How did we get here?

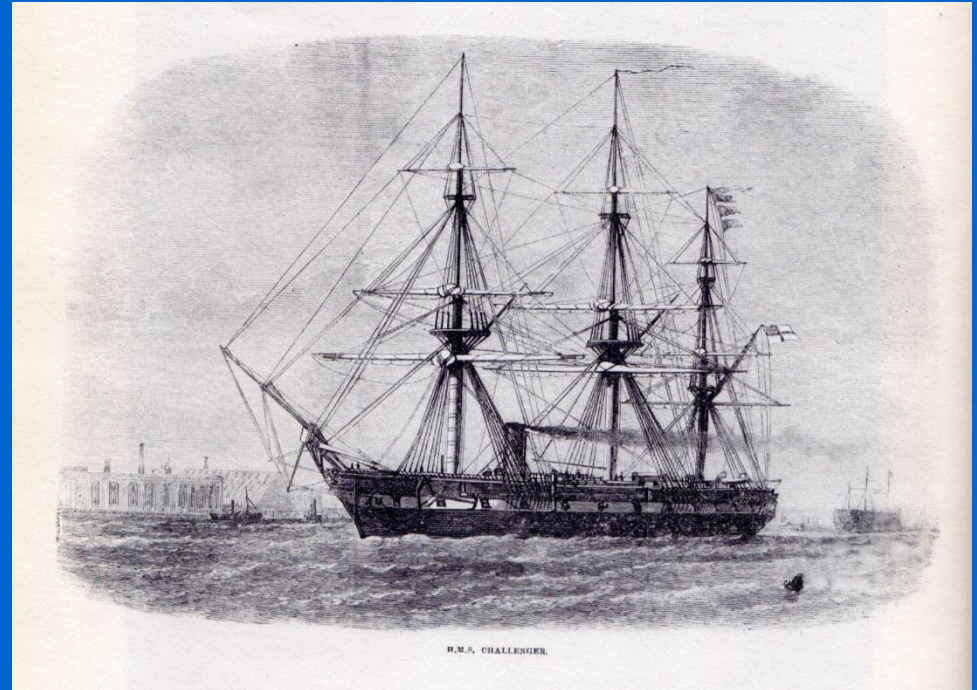
- Hydrothermal vents were discovered in 1977, high-temperature black smokers in 1979
- Some aspects of these discoveries were expected, even predicted, but others, especially the biology, were totally new.

Old ideas about the deep ocean

- It was dark
- It was cold
- It was featureless
- There was very little life below the surface, and what was there must be very primitive

How did we learn about the deep ocean?

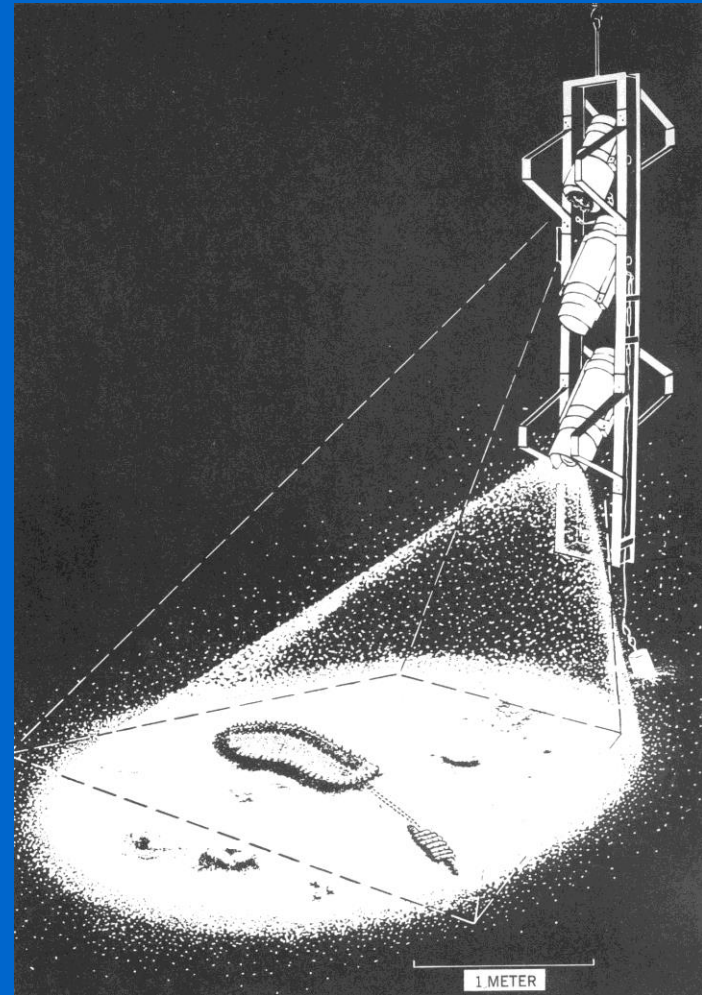
Early oceanographers relied completely on what must really be called “remote sensing” (the term we use today for studies of the Earth from satellites).



We could sample the oceans and seafloor with nets, trawls, dredges, sediment grabs, and corers, but not see it.

Deep sea photography

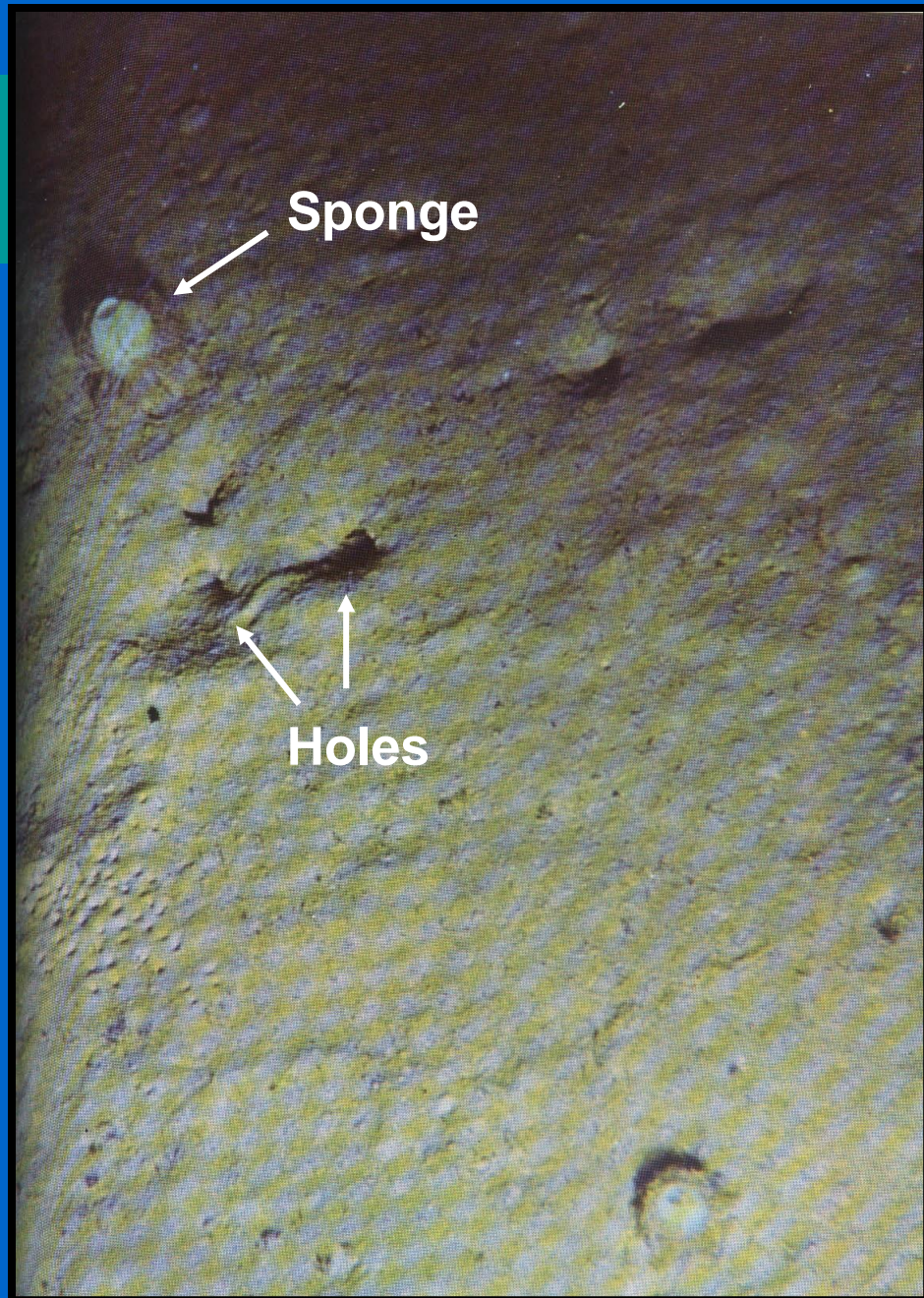
This is a sketch of a type of camera that was widely used, beginning in the 1950s and 60s, to improve geologists' and oceanographers' understanding of the ocean floor.



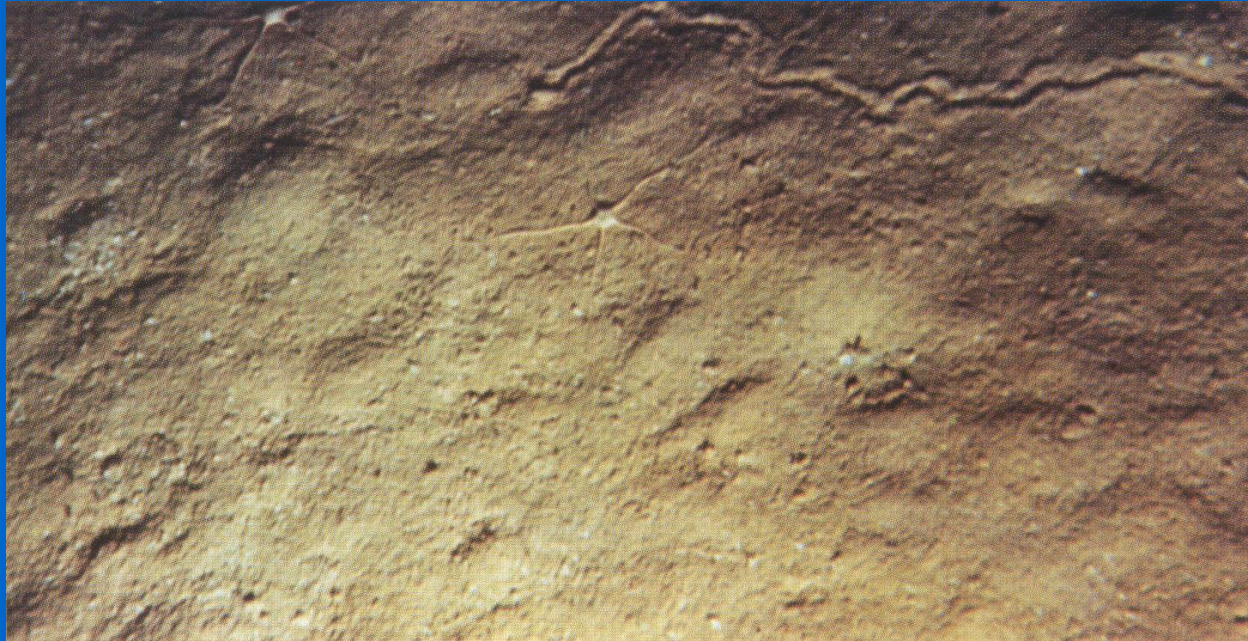
A typical photograph of the sea floor



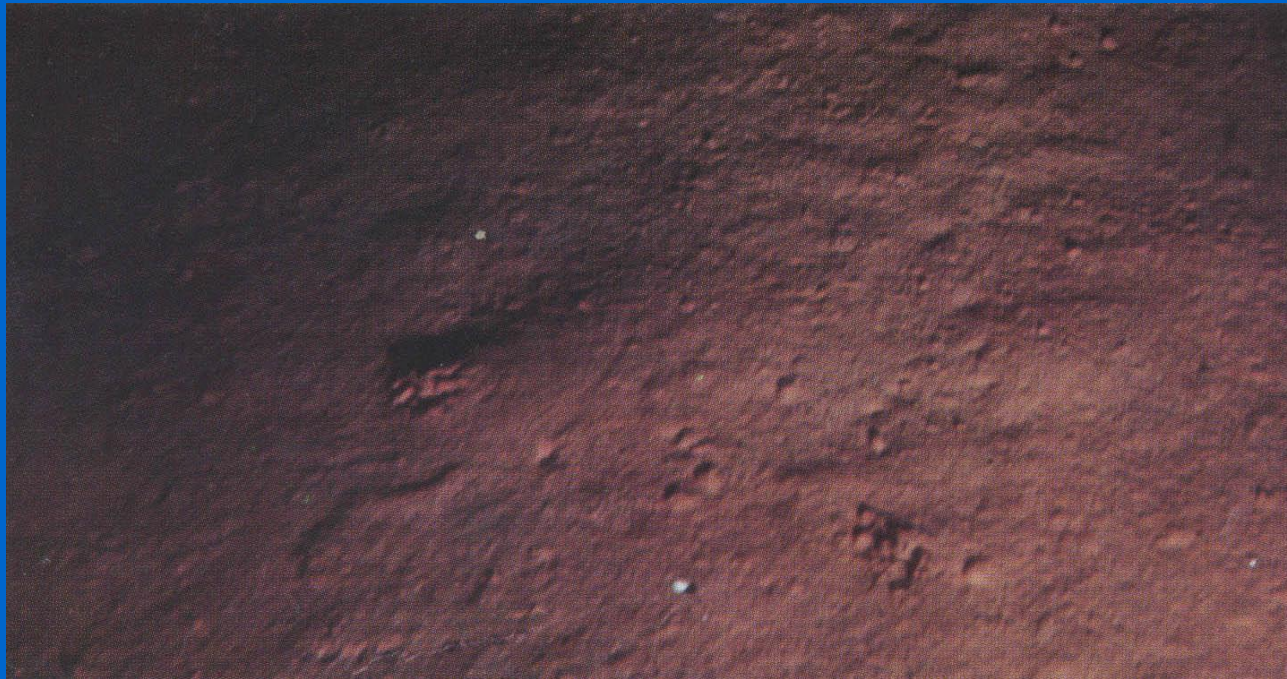
Color:



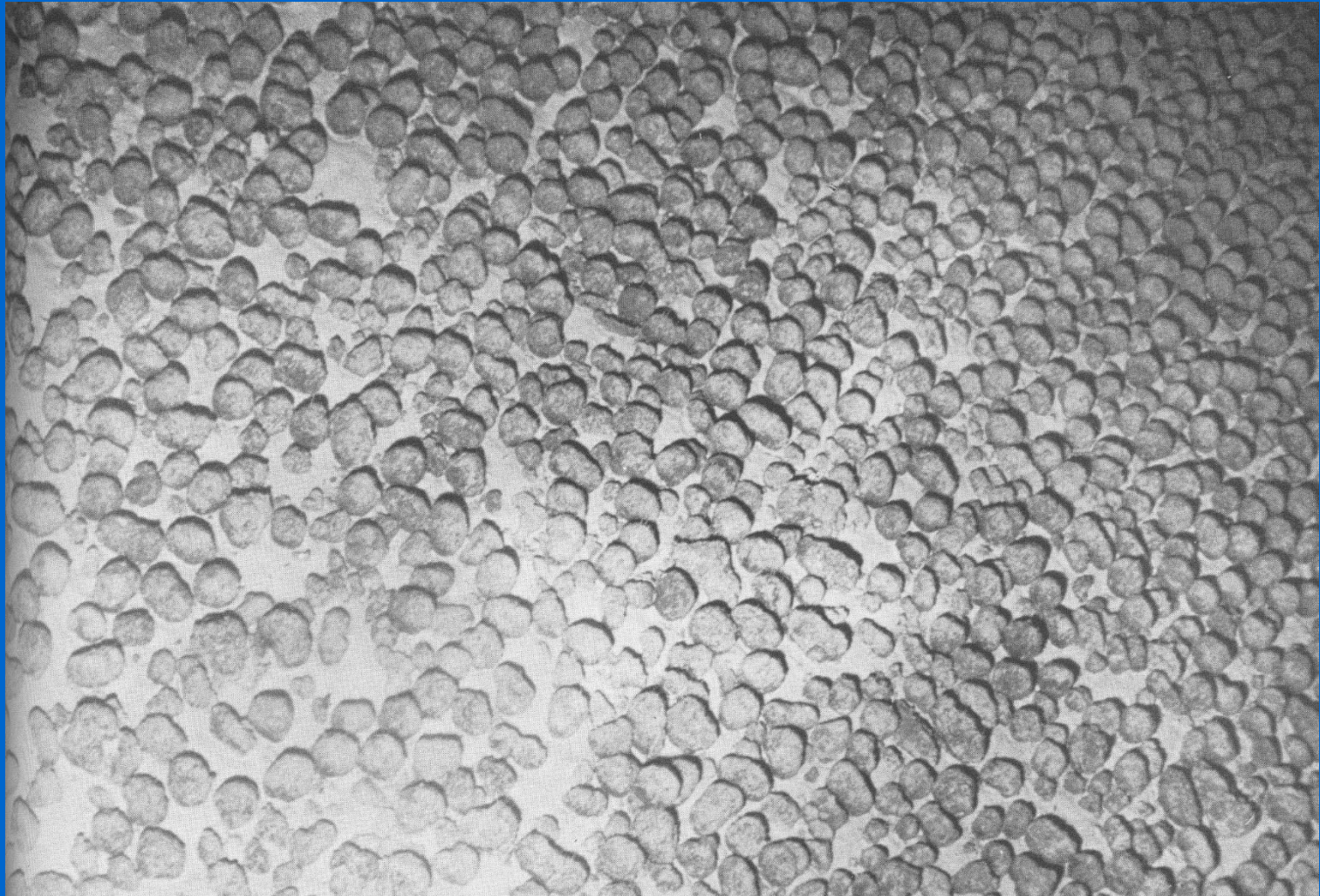
Sediments with animal tracks



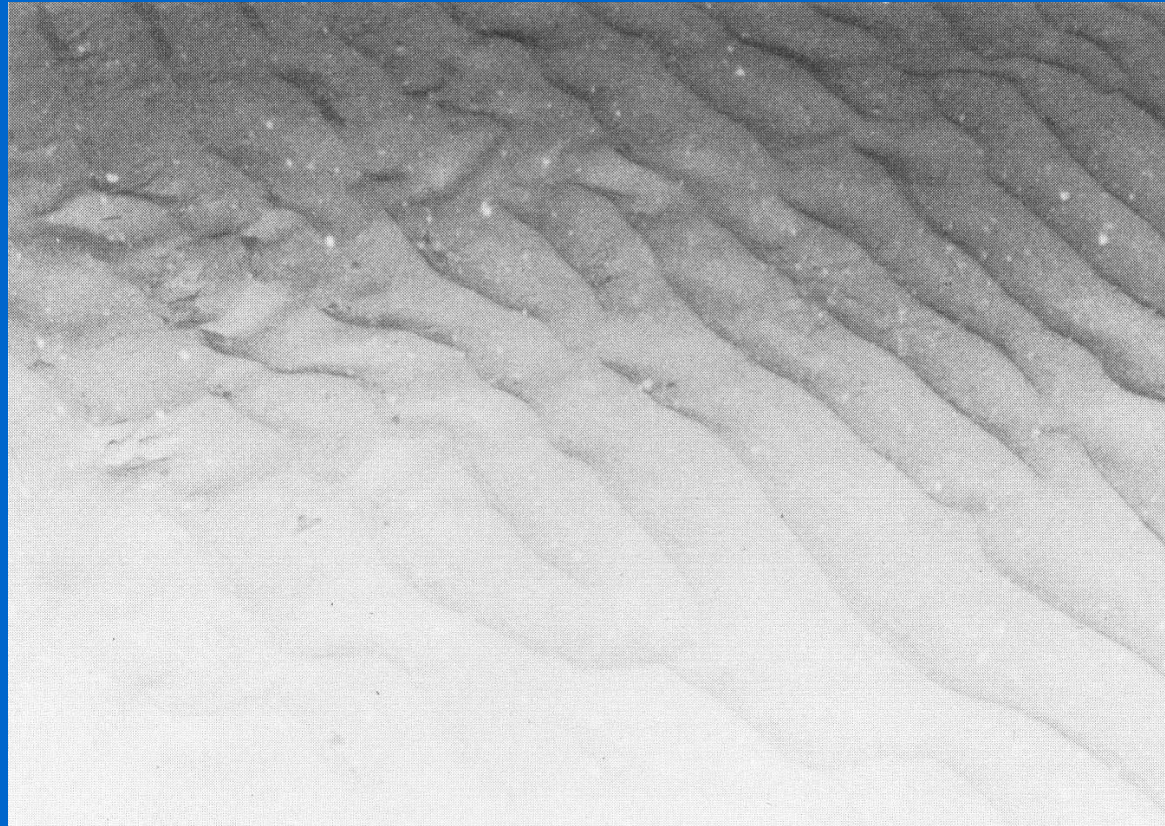
The deepest ocean: red clay



Manganese nodules



Effects of currents



Basalt on the mid-ocean ridge

Basalt is a rock
formed from
volcanic eruptions



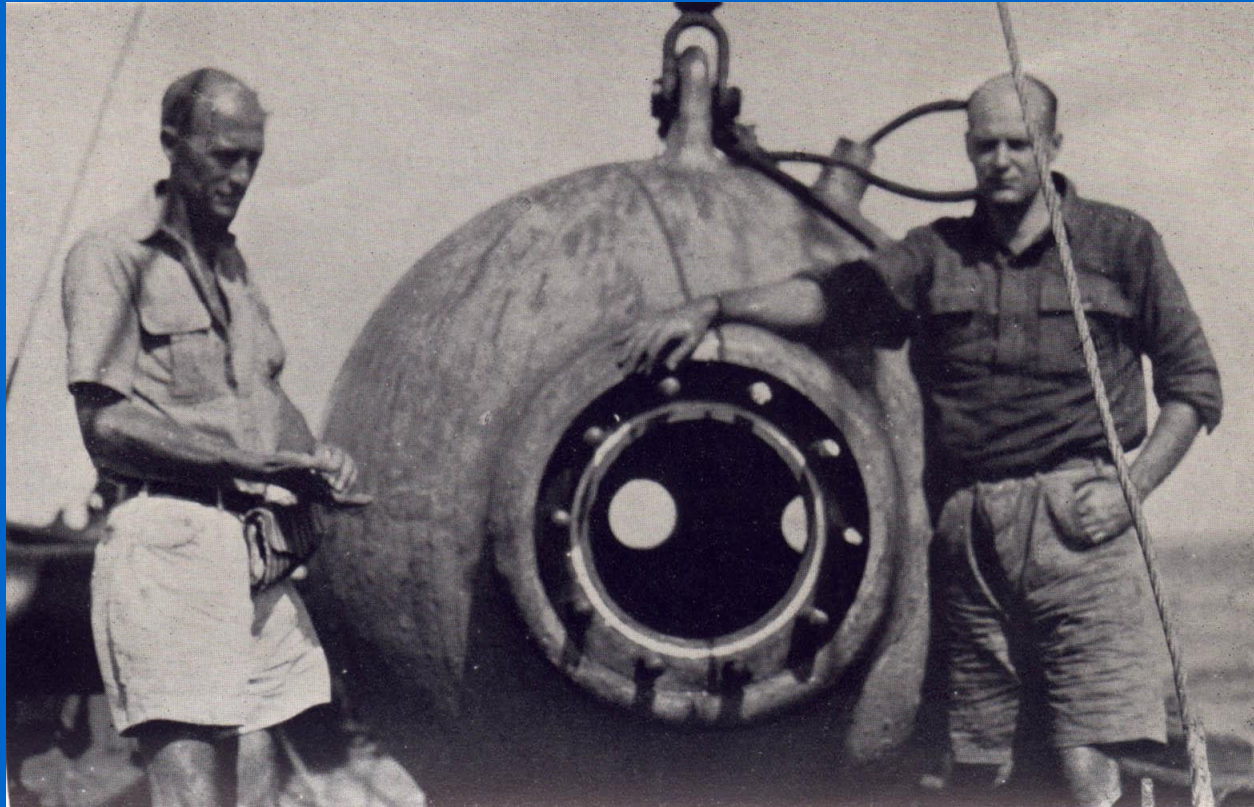
Basalt on land



Going there in person: visiting the seafloor

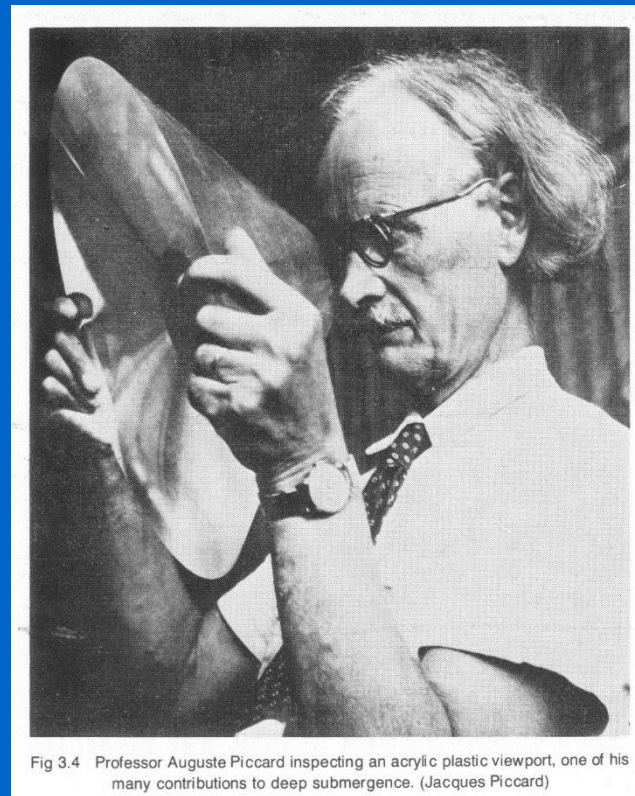
- In parallel with this increasing understanding of the deep ocean, and eventually contributing to it, was an increasing desire to see the bottom of the oceans for ourselves.
- These interests included scientific (biological, geological), military, and commercial interests, and plain old curiosity.

William Beebe's bathysphere

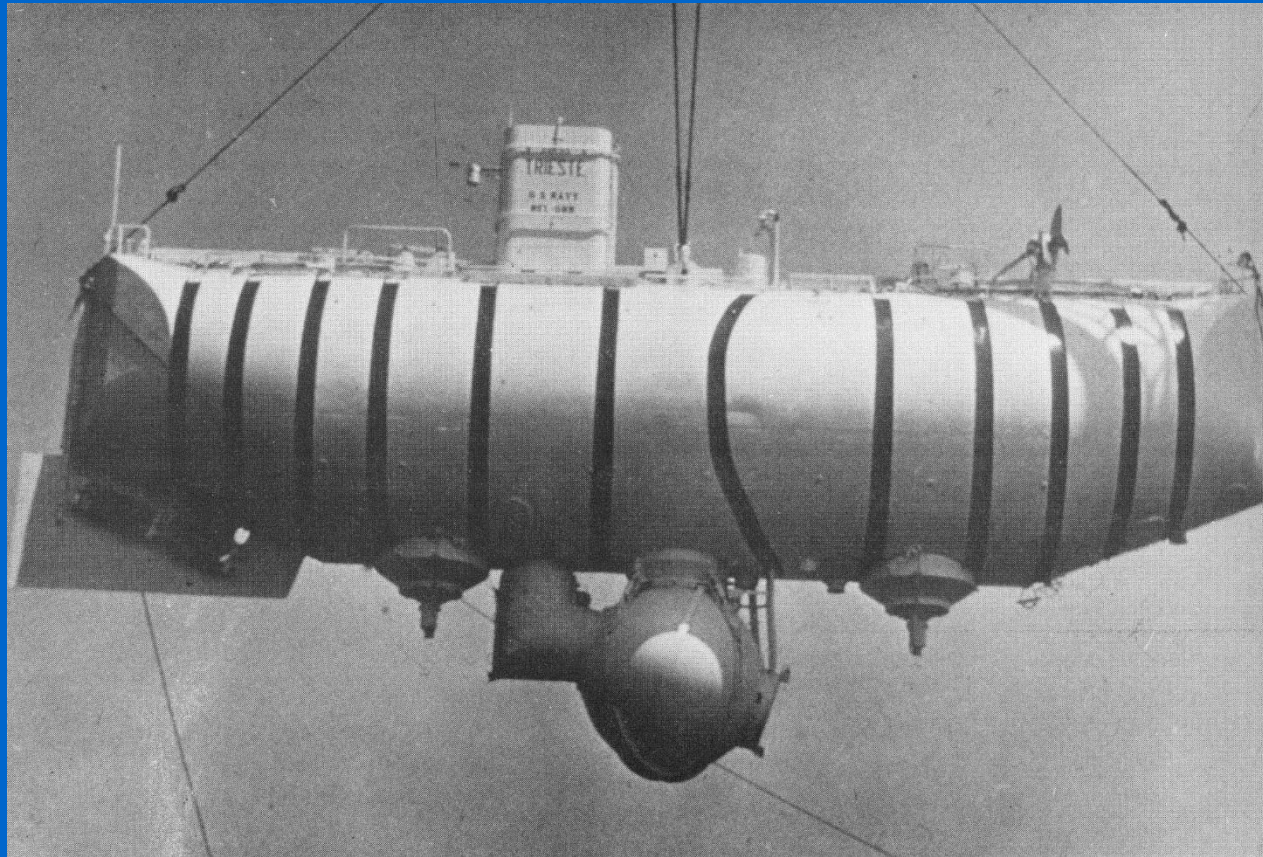


Auguste Piccard and the Trieste

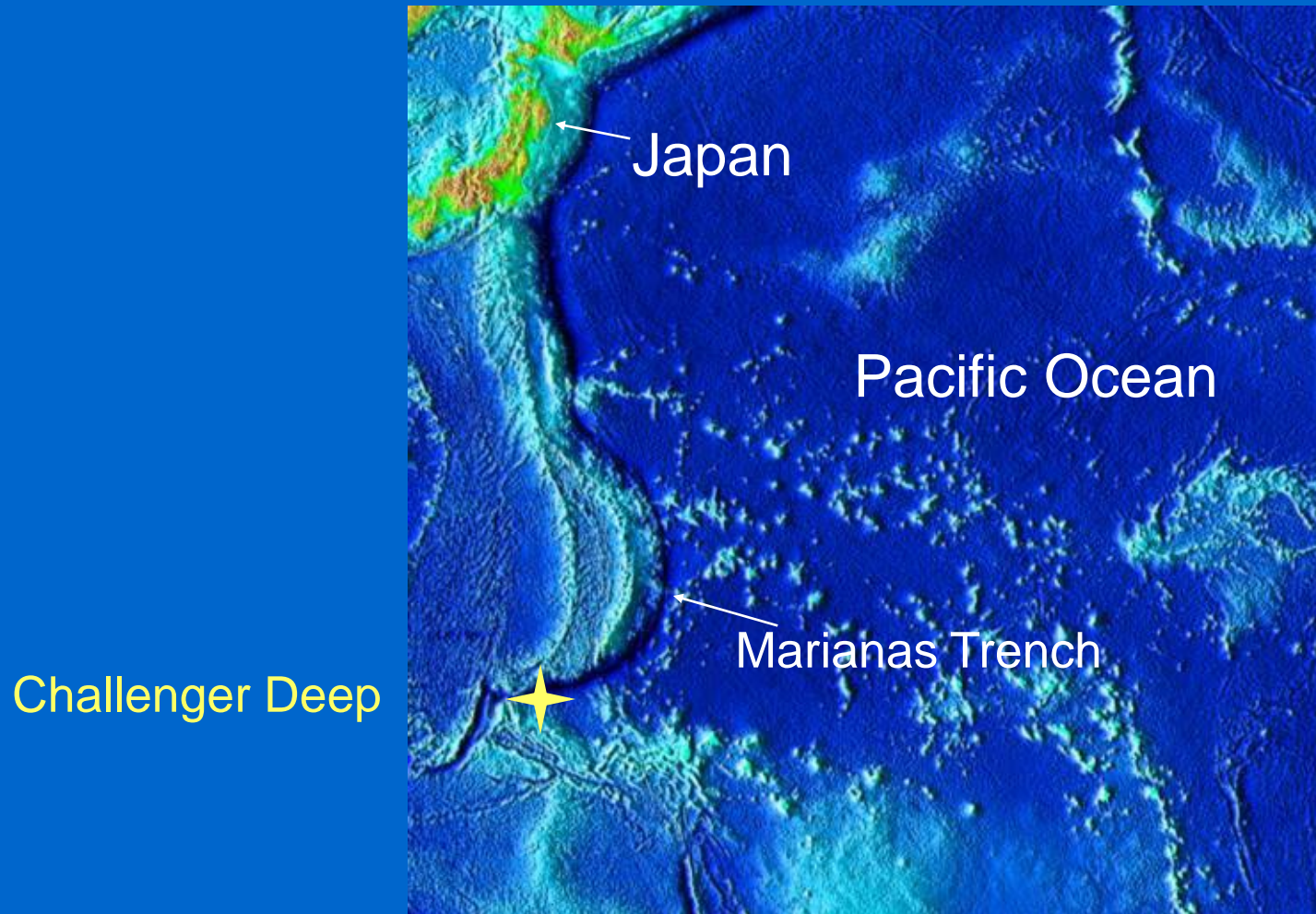
Auguste Piccard (1884-1962) was a Swiss physicist, who was the first man to reach the stratosphere in a balloon, then turned his eyes towards the deep.



The bathyscaphe Trieste



The deepest dive in history



Submersibles and science: Alvin



The discovery of hydrothermal vents

This photograph is the first ever taken of a high temperature black smoker. It was taken by *Alvin* pilot Dudley Foster at 21°N on the East Pacific Rise in 1979.

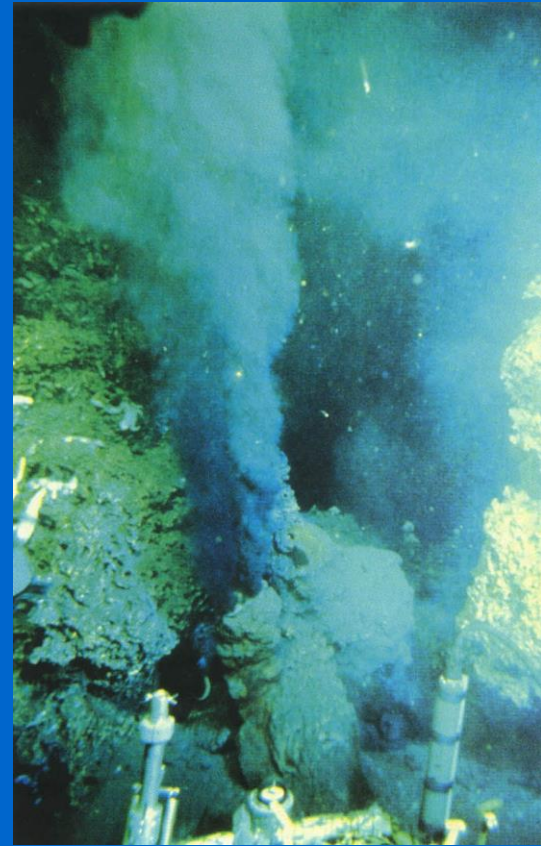


Plate tectonics

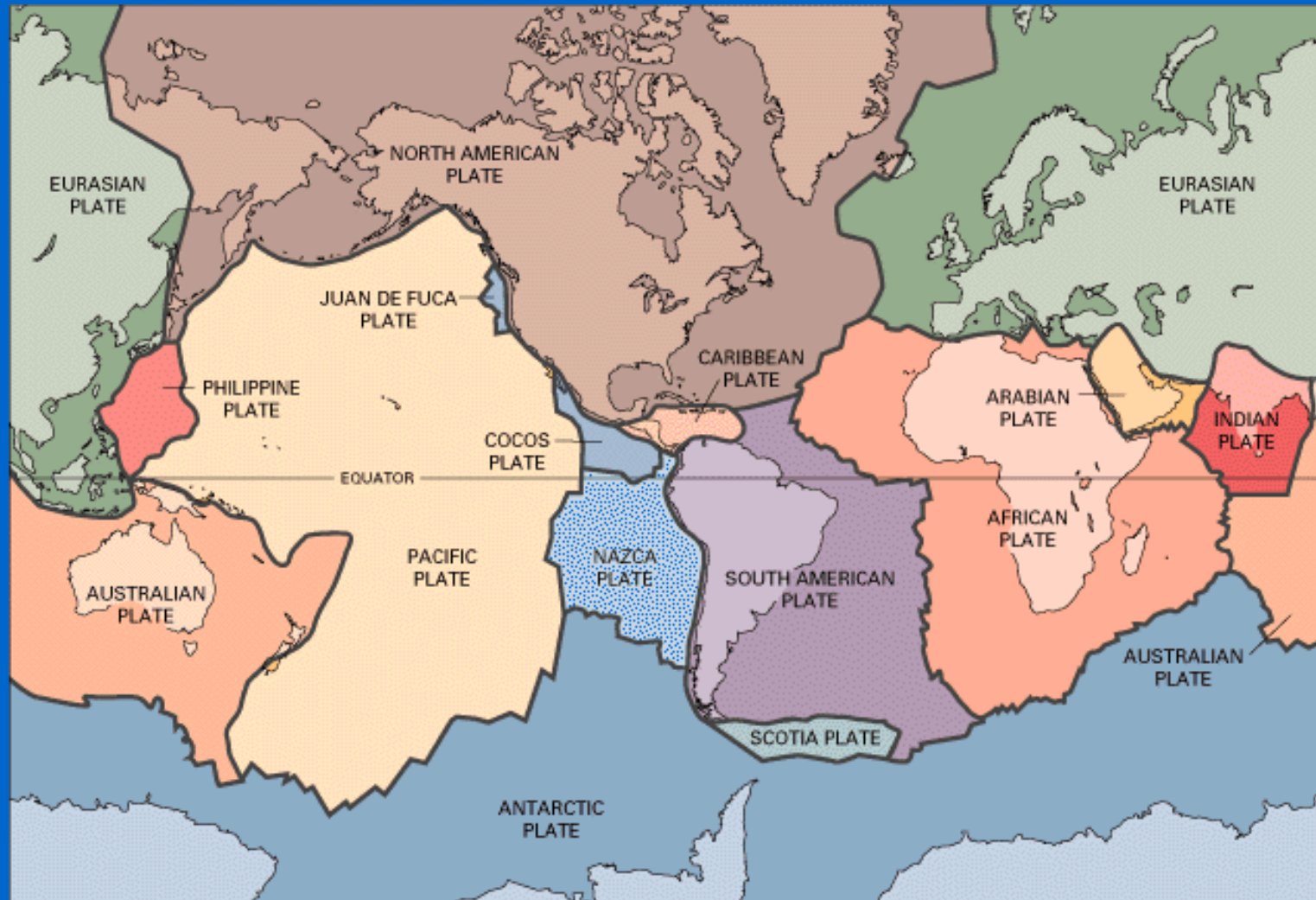
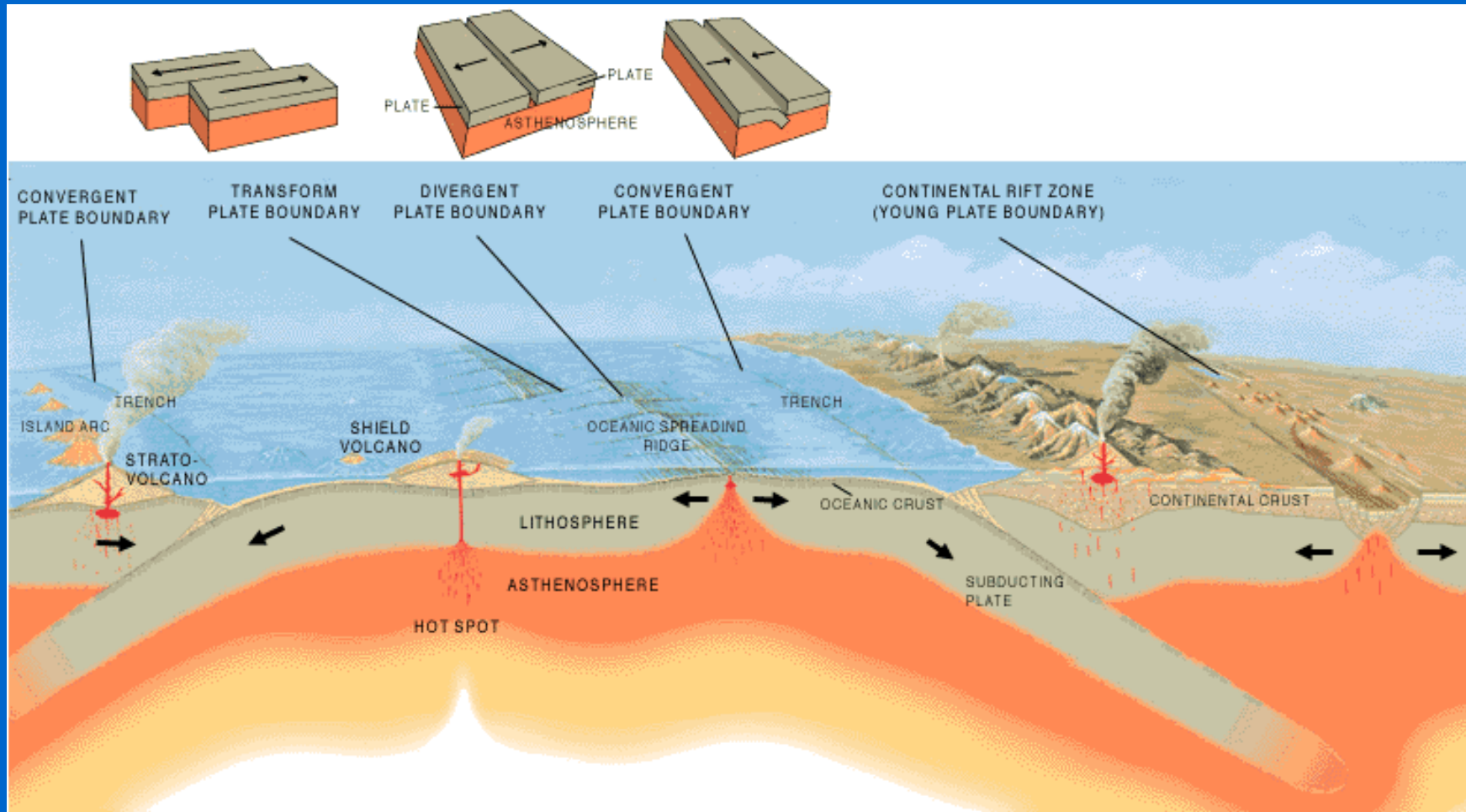
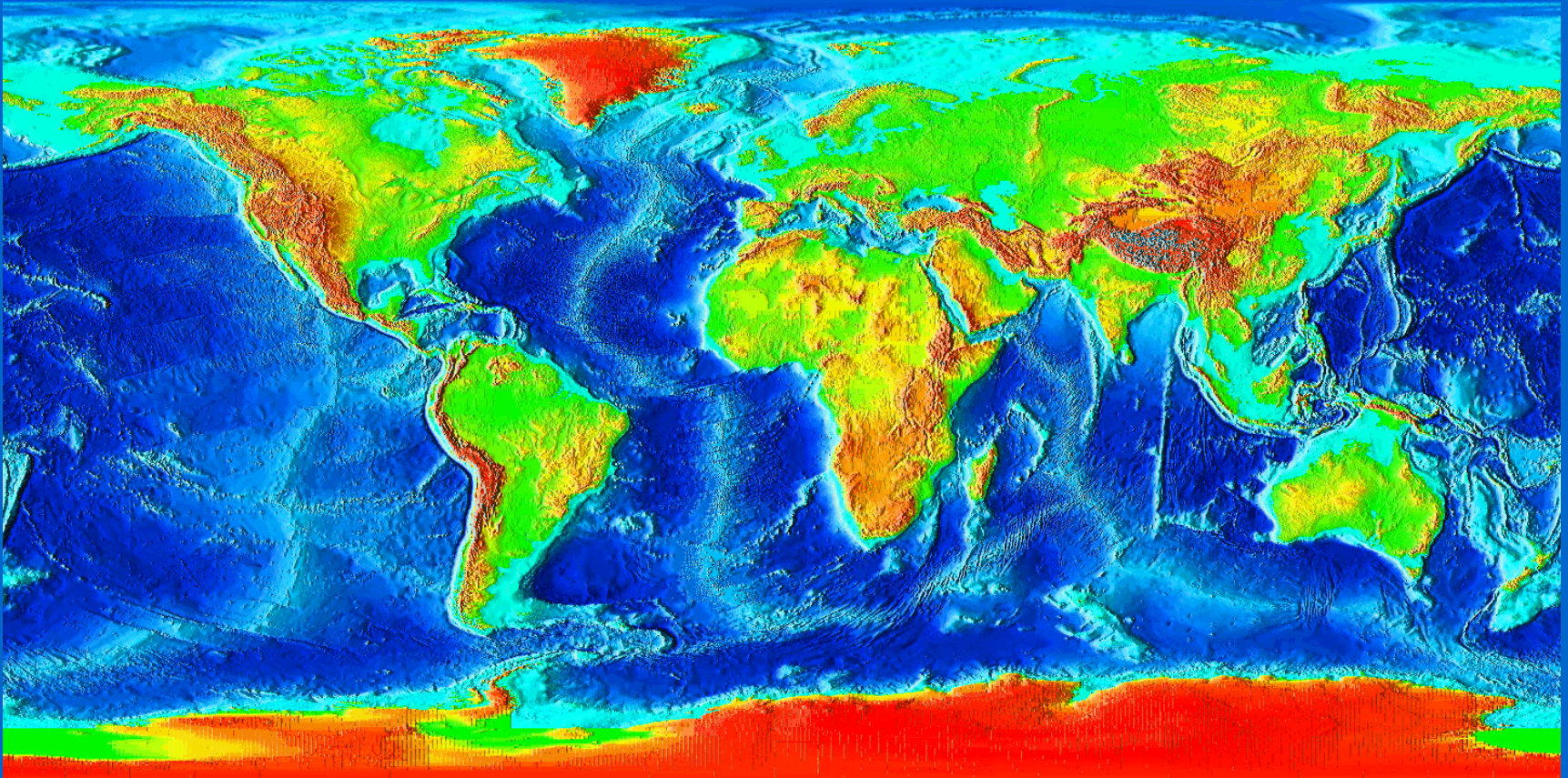


Plate motions



The mid ocean ridge system

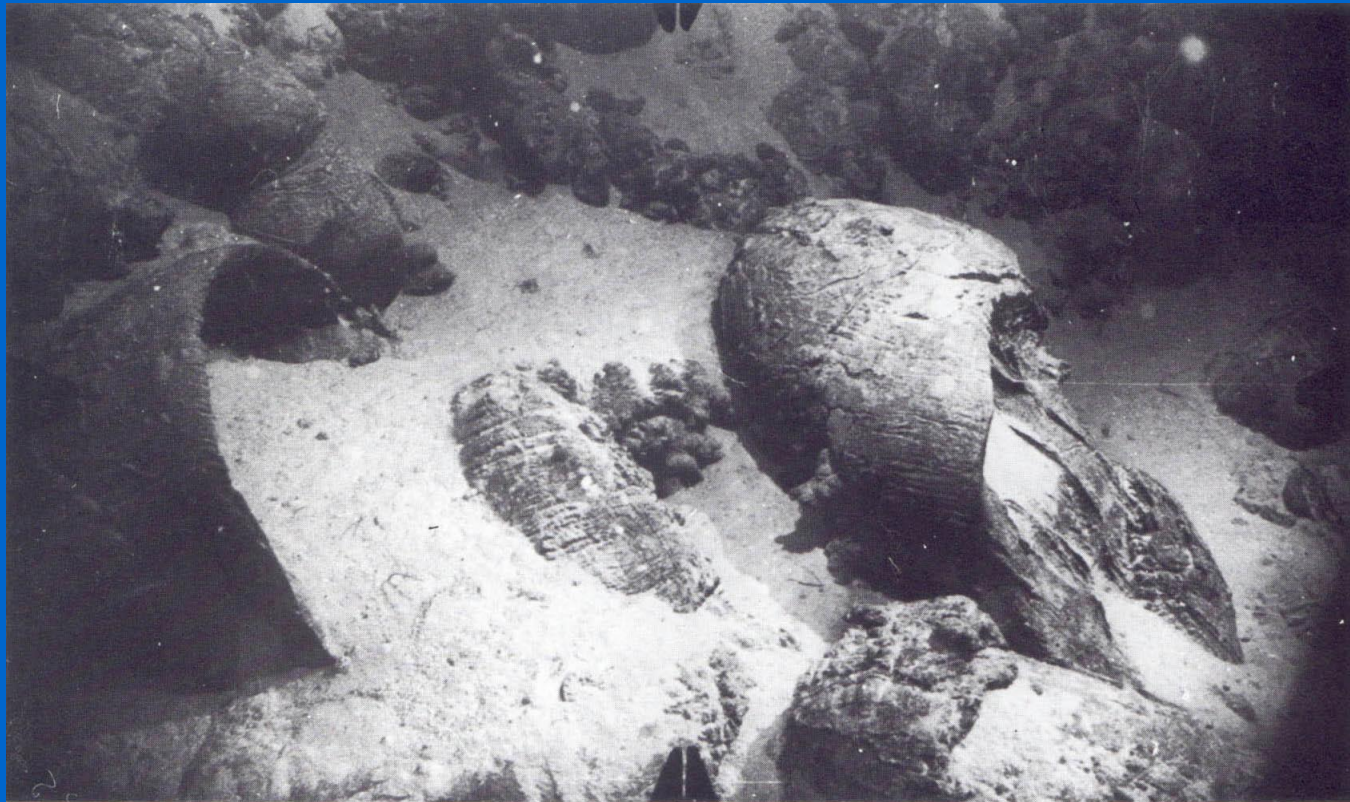


The FAMOUS Expedition, 1973-74

French bathyscaphe *Archimède* and submersible *Cyana*, and *Alvin*, made a total of 45 dives in a 20 mile long section of the Mid-Atlantic Ridge rift valley south of the Azores



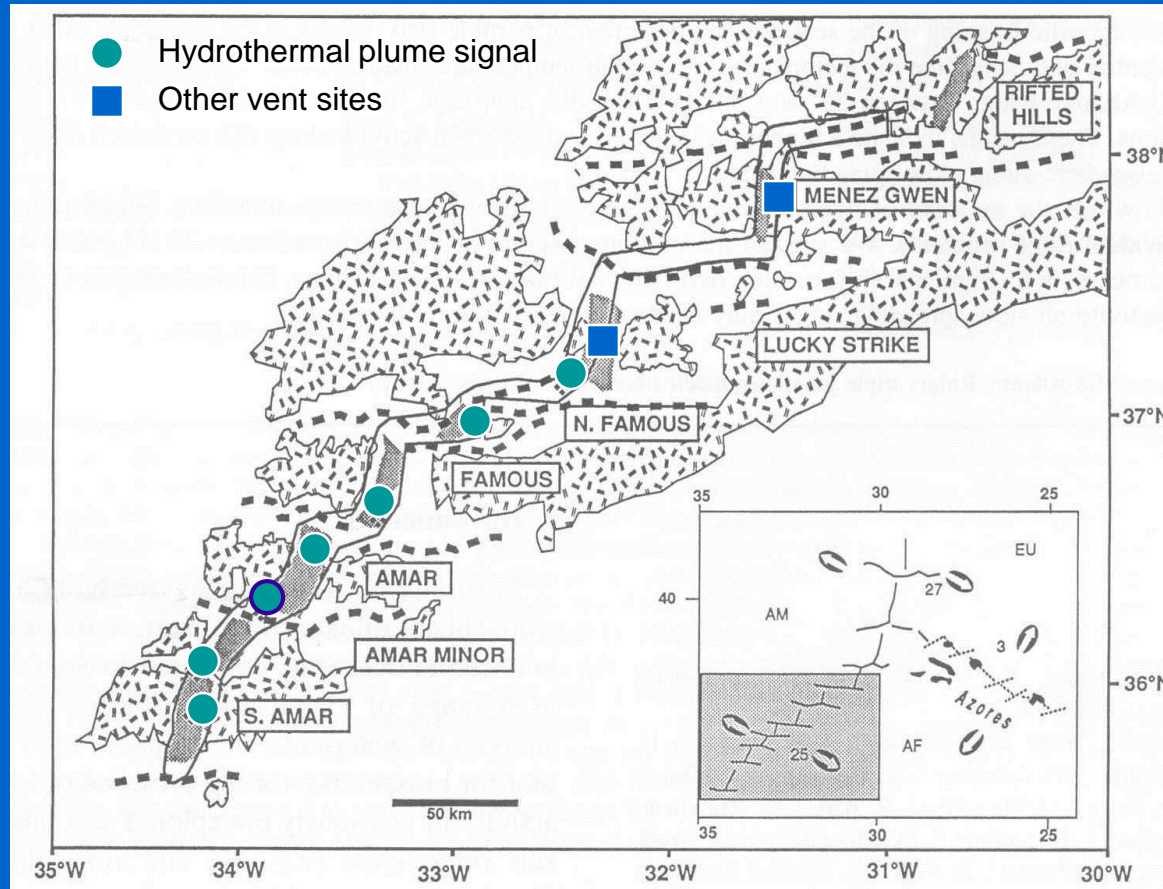
Basalt photographed during FAMOUS



Another basalt on the Mid-Atlantic Ridge



The location of FAMOUS



Predictions leading to the discovery of seafloor hydrothermal vents



Hydrothermal systems: ingredients

The basic requirements for hydrothermal circulation are

- A source of heat
- A source of water
- A pathway for the water to circulate



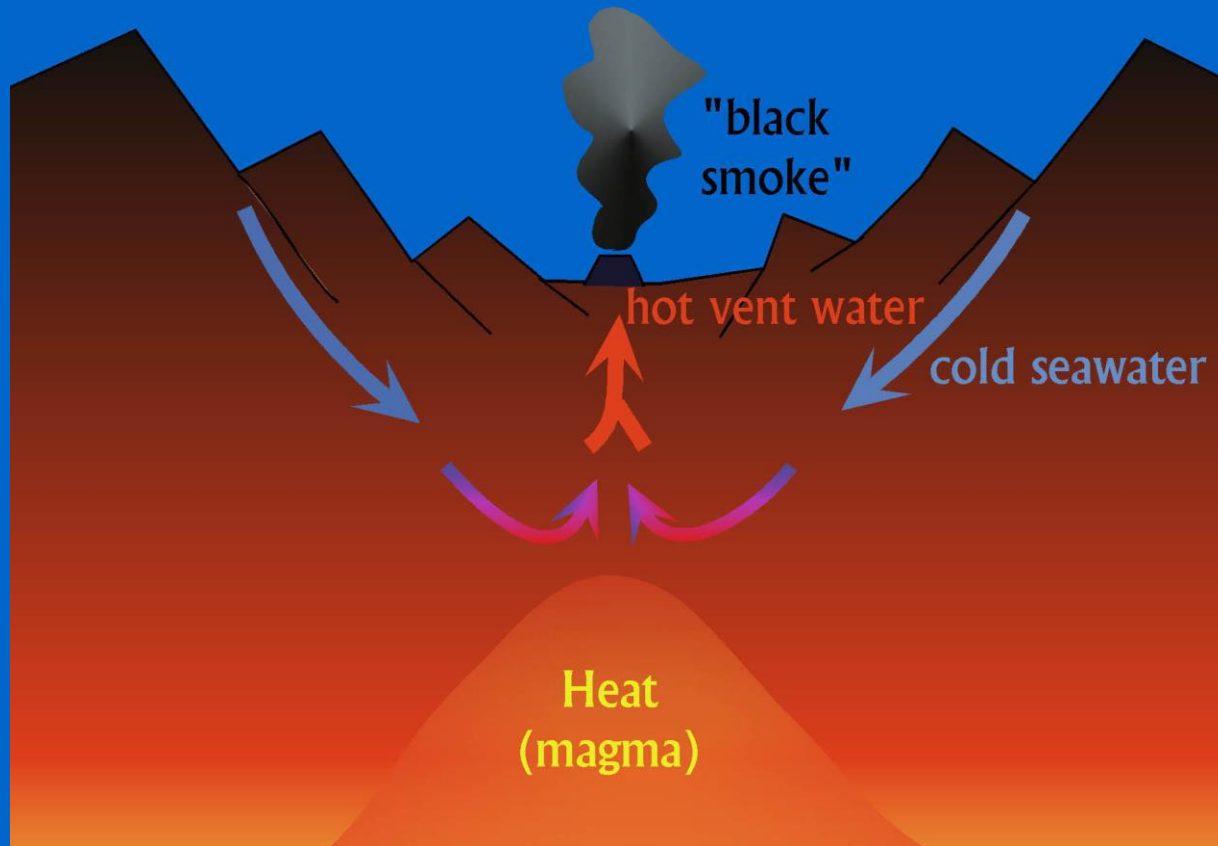
Castle Geyser, Yellowstone



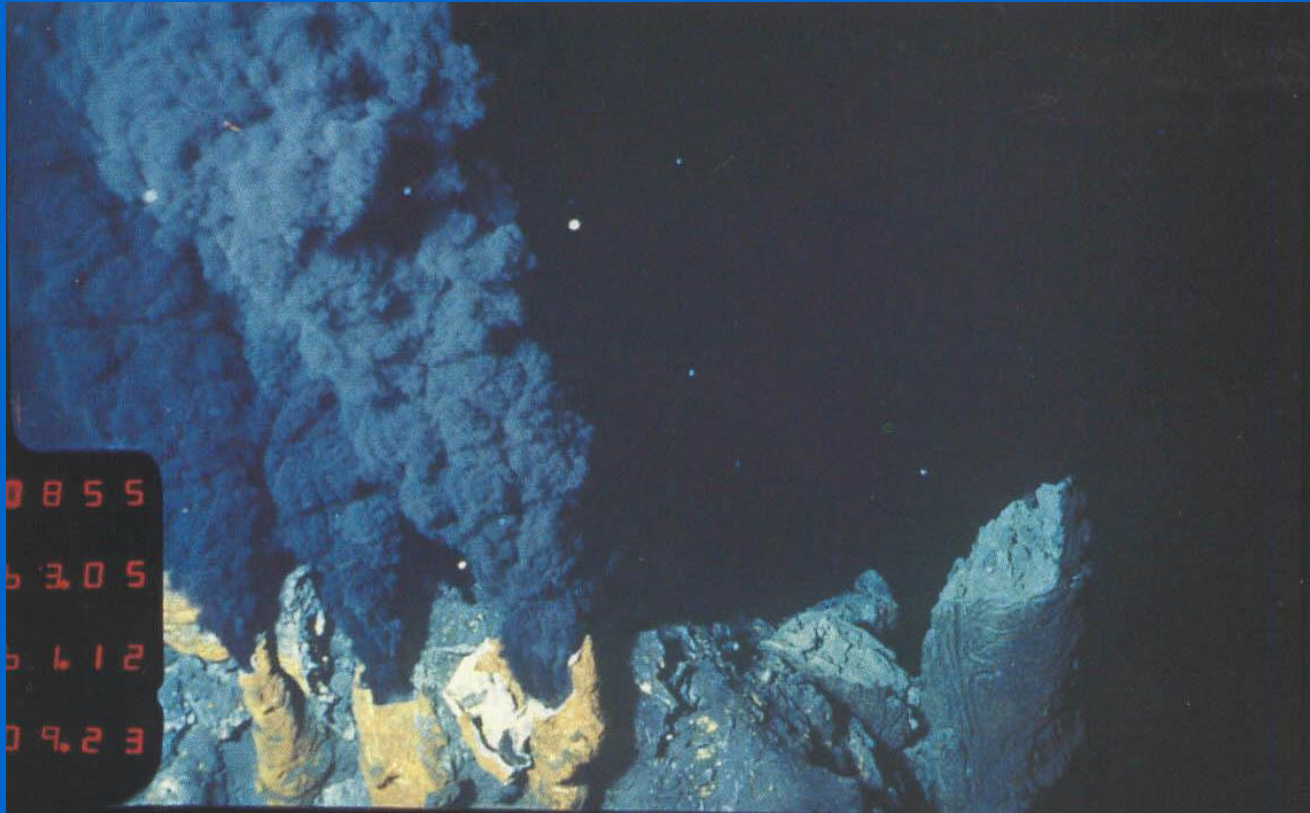
Iceland



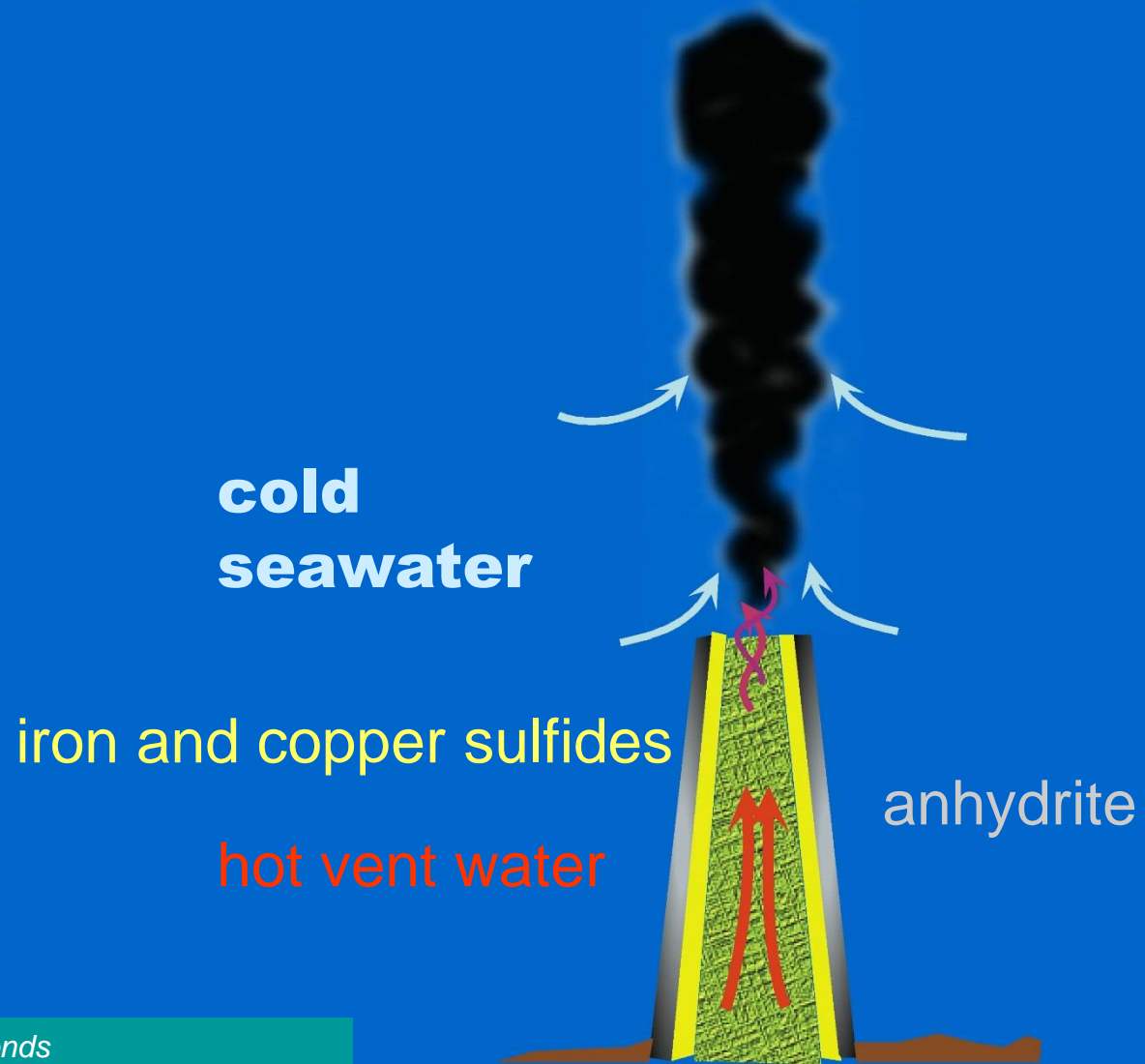
Seafloor hydrothermal circulation



Vent chimneys



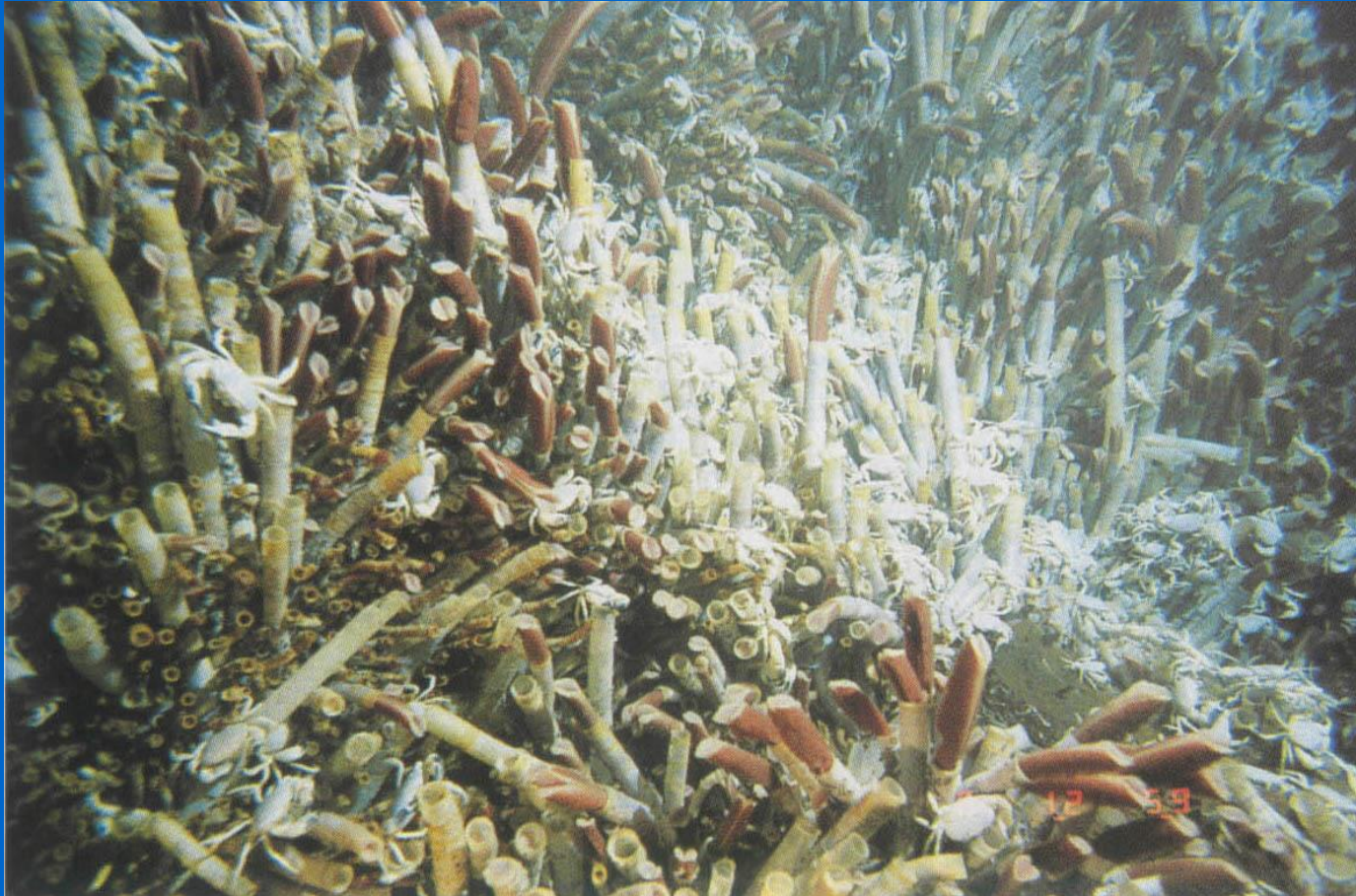
How chimneys & “black smoke” form



Life at hydrothermal vents



Chemosynthesis supports large communities



A dive on the Mid-Atlantic Ridge

The following sequence of photographs are from a research cruise to the TAG (Trans-Atlantic Geotraverse) hydrothermal site that I participated in in 1995.



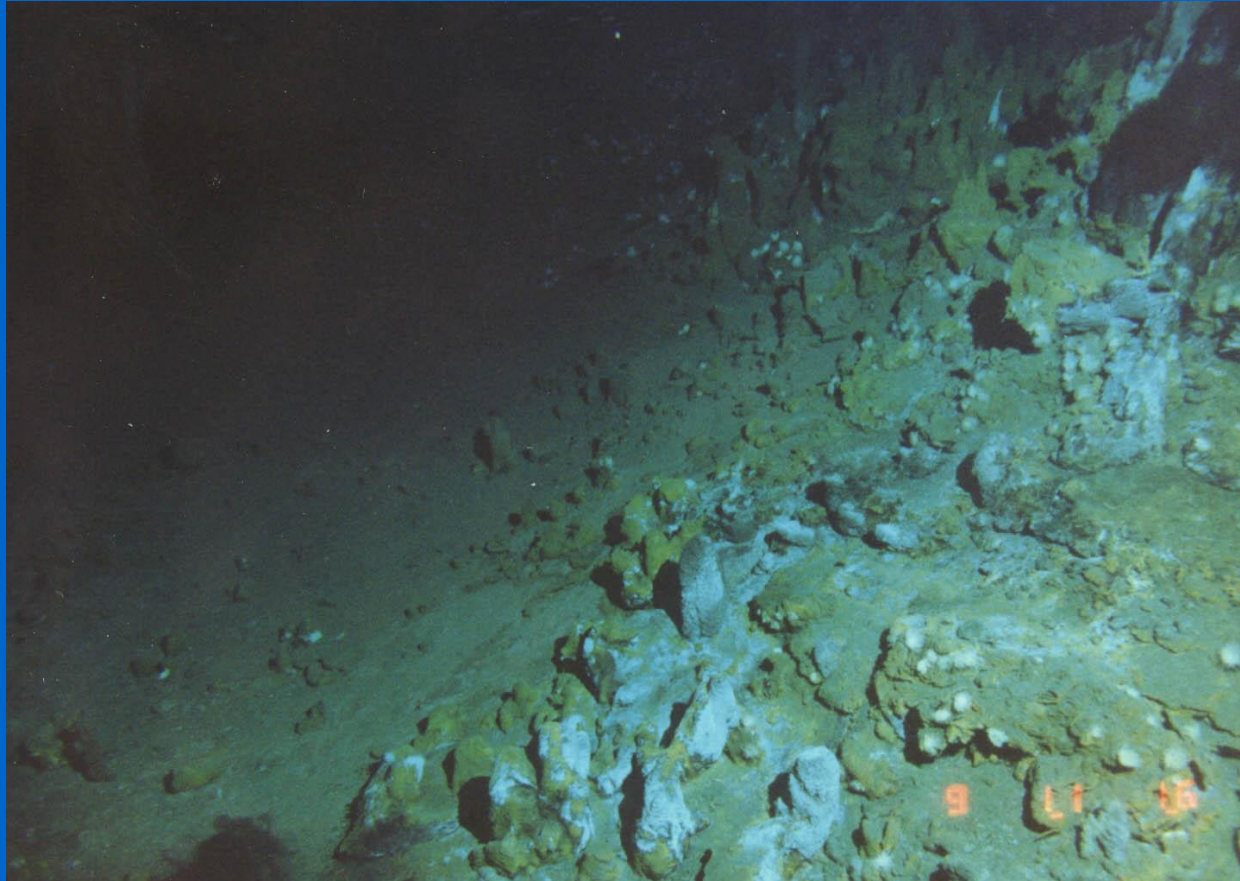
Landing in the rift valley



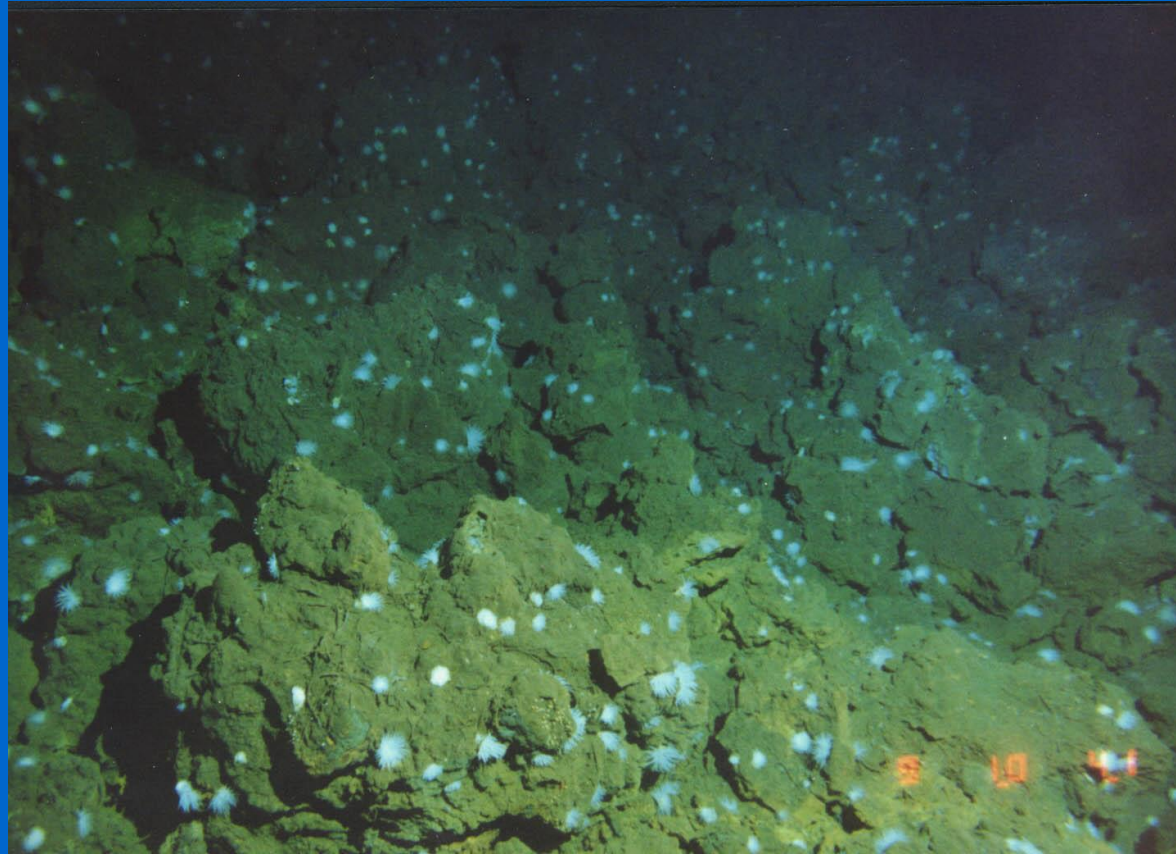
Signs of life



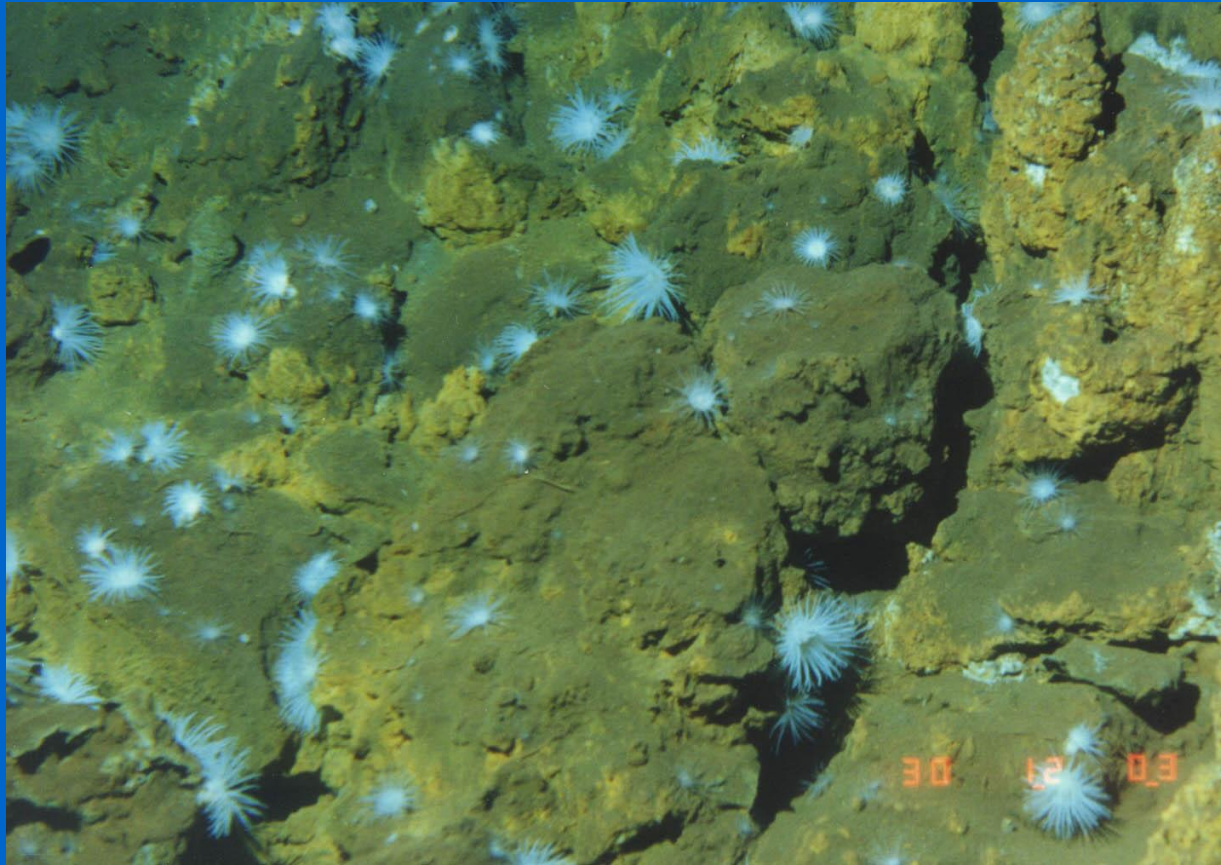
Old chimneys



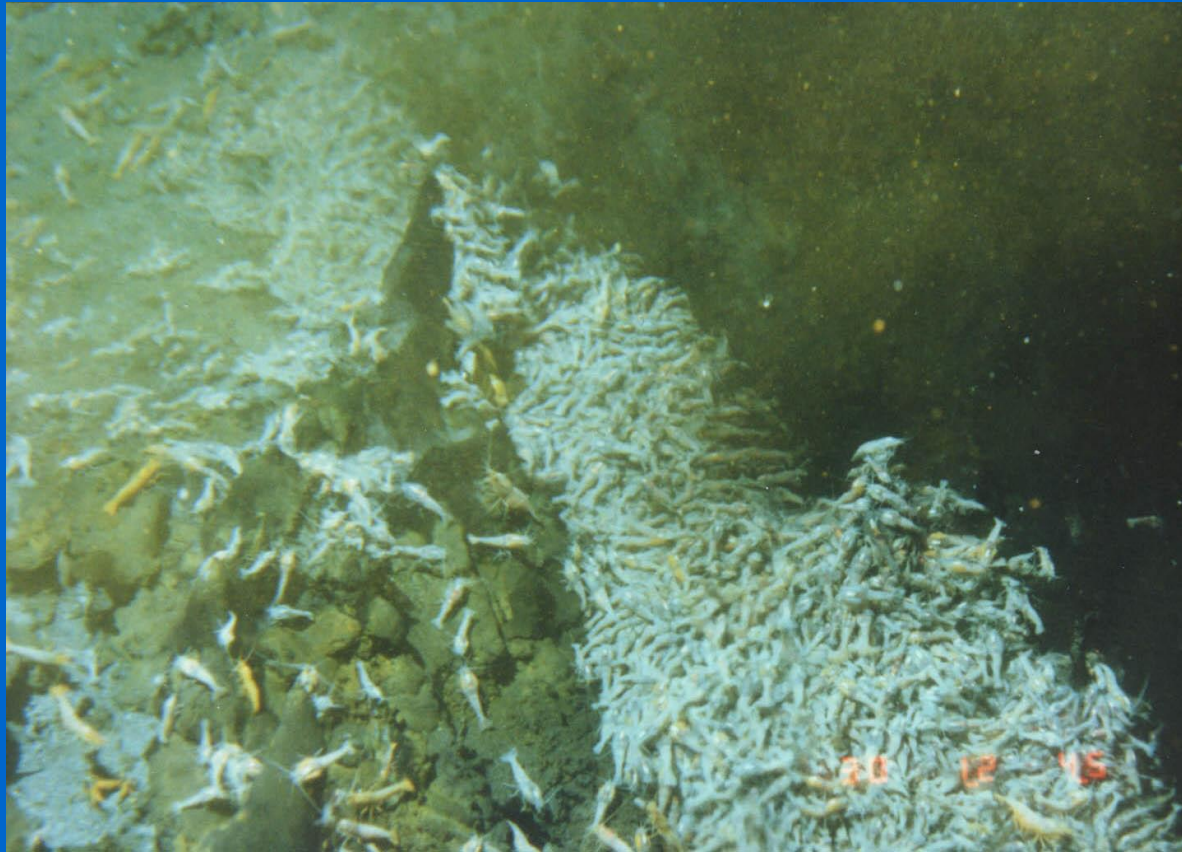
The anemones increase



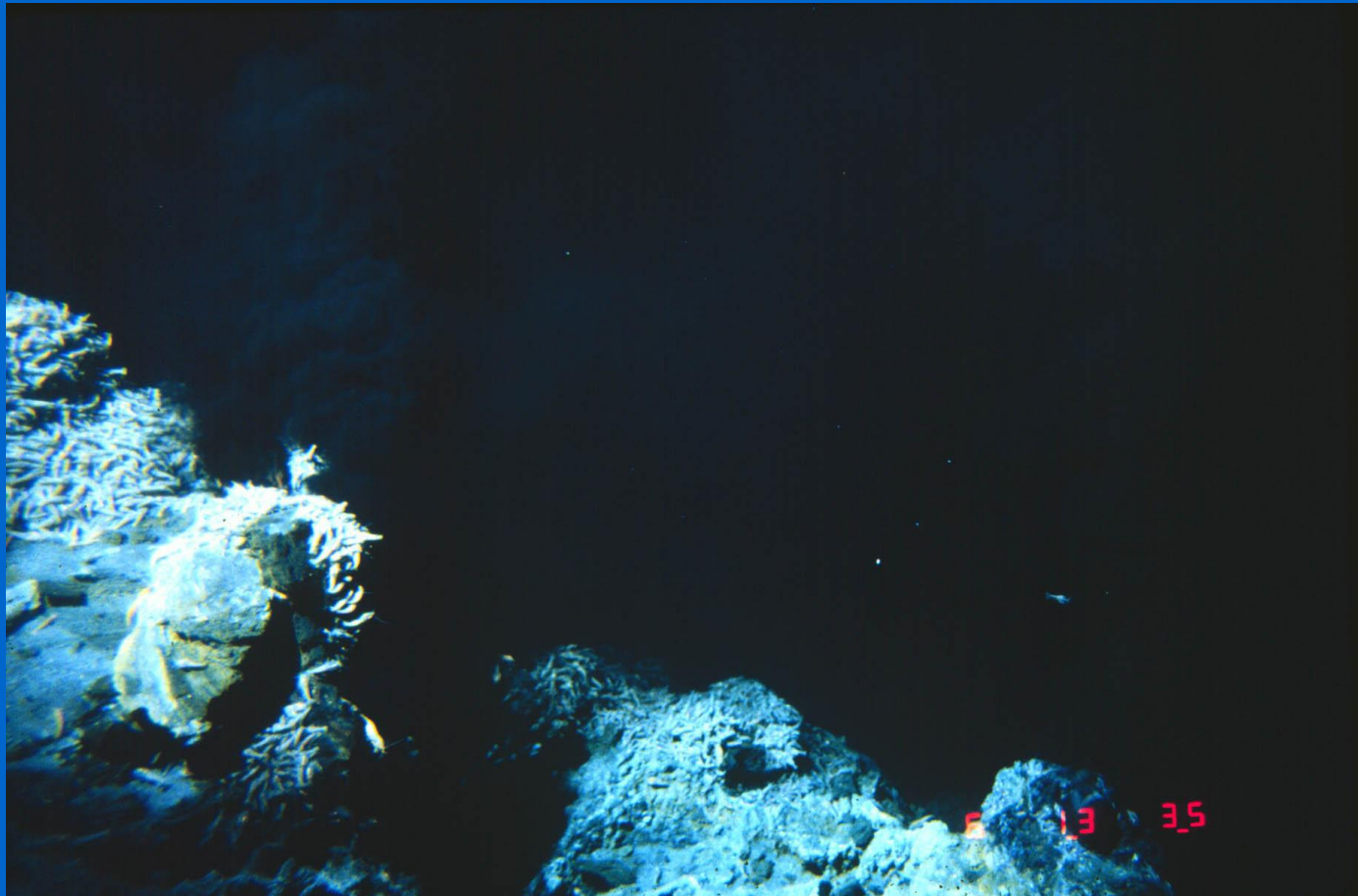
More and more anemones



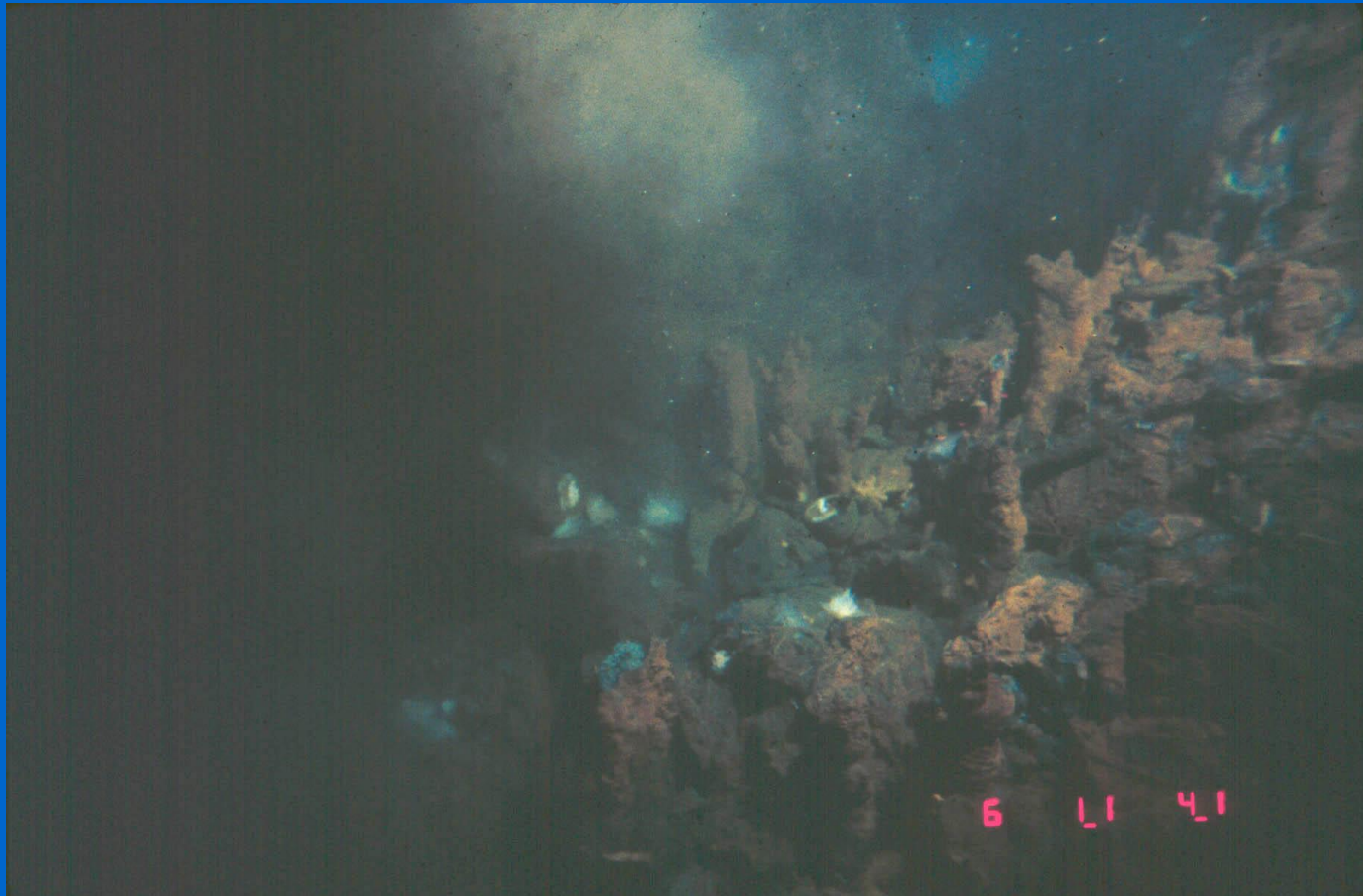
Black smoker and lots of shrimp



Another view of the black smoker



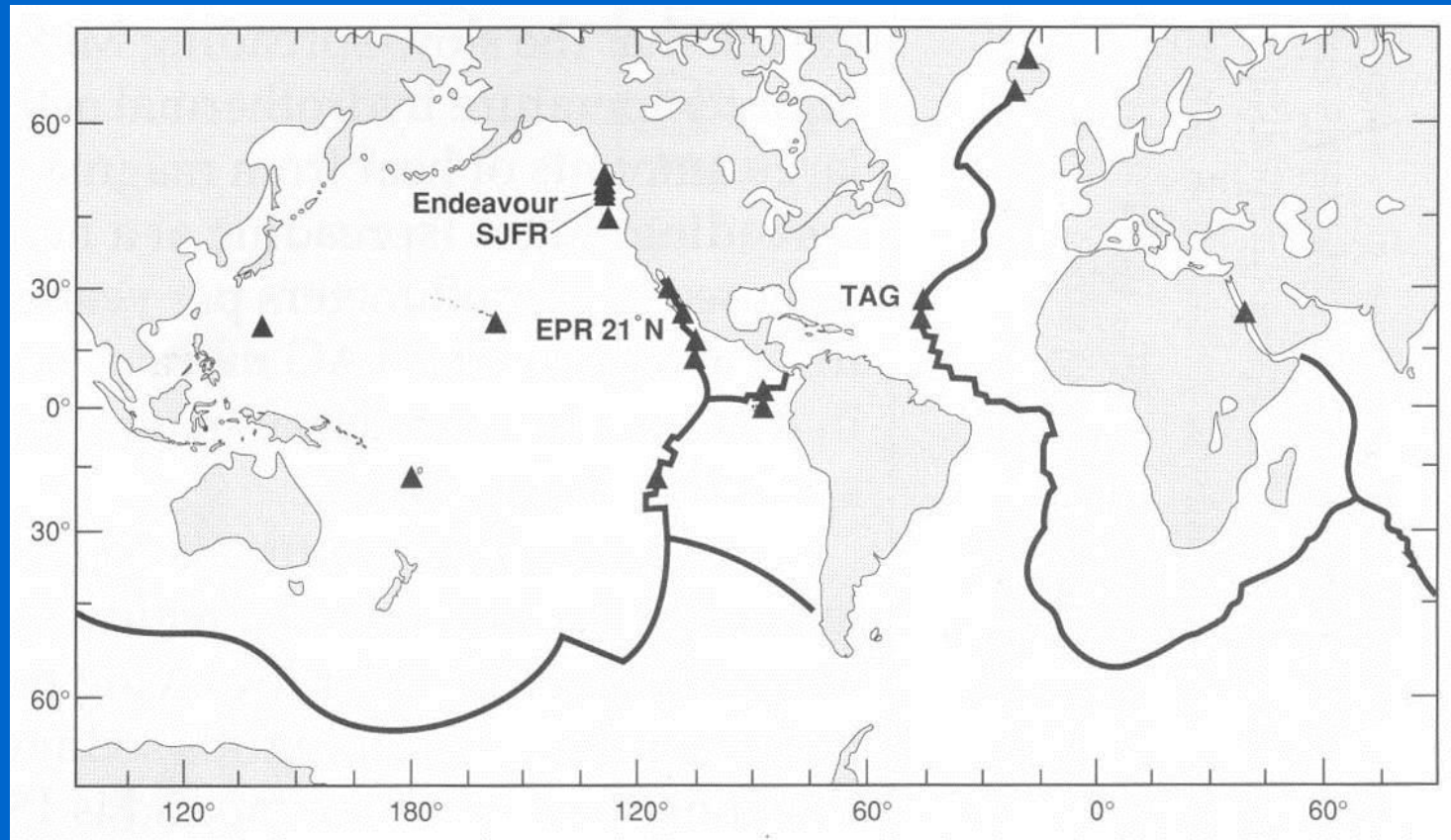
A less active part of the mound



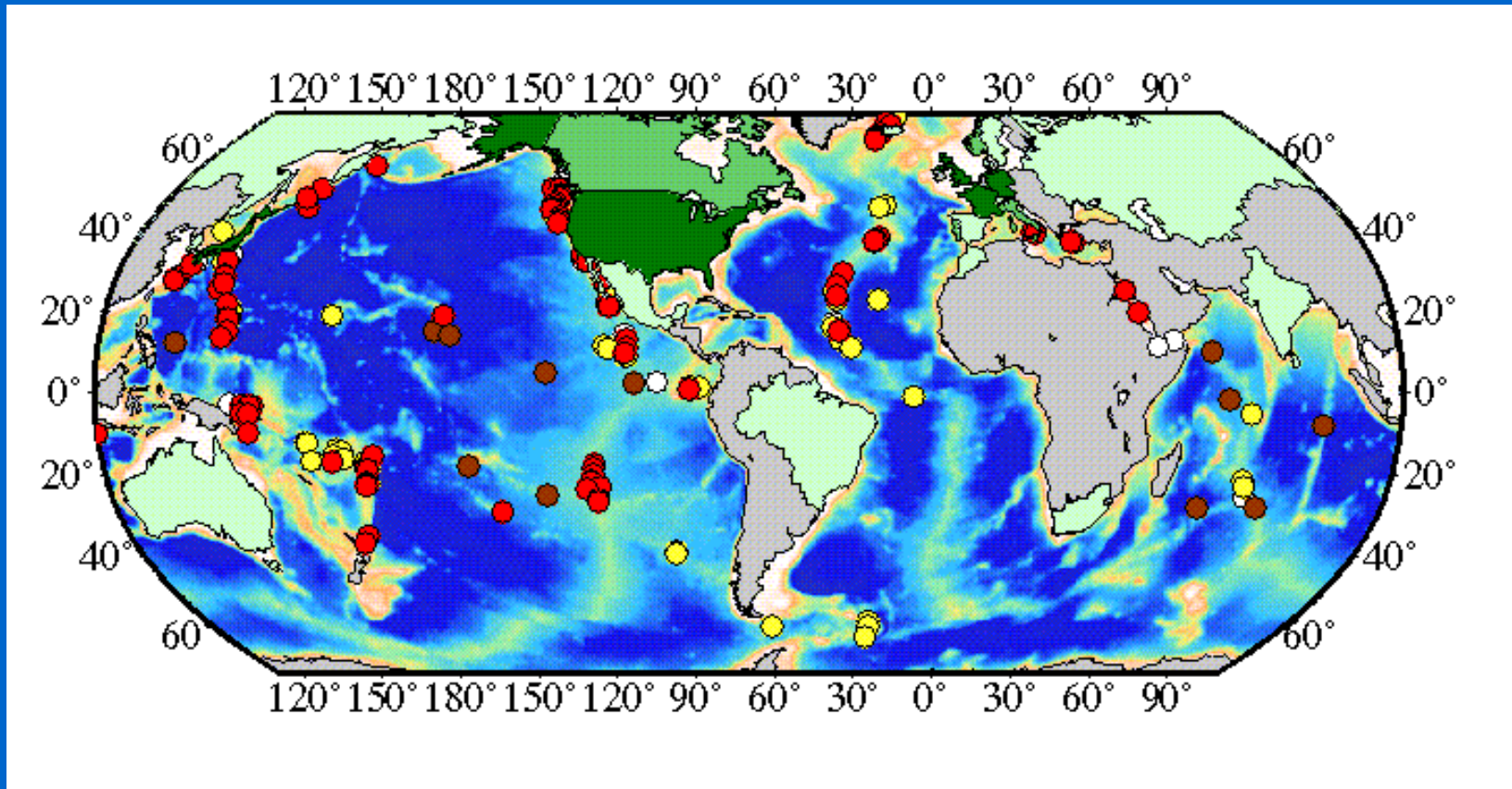
Ongoing research



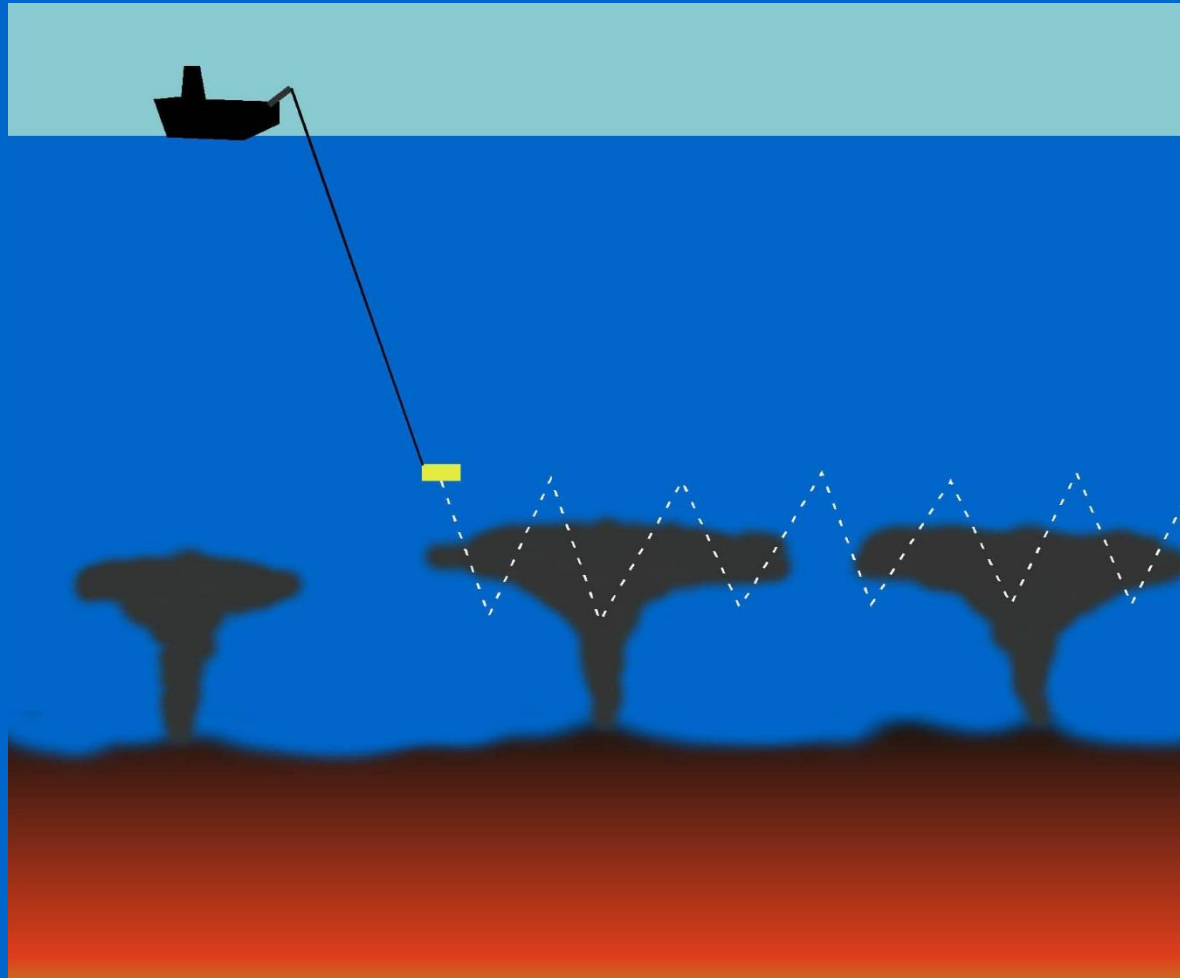
Known vents: 1991



Known vents: 2000



Finding hydrothermal vents



A continuing story



Dr. Henrietta N. Edmonds



Henrietta N. Edmonds is a Research Scientist at the Marine Science Institute and an Assistant Professor in the Department of Marine Science of The University of Texas at Austin, located on the gulf coast in Port Aransas. She received her B.S. in chemistry from Yale University in 1991 and her Ph.D. in oceanography from the Massachusetts Institute of Technology/Woods Hole Oceanographic Institution Joint Program in Oceanography & Applied Ocean Science and Engineering in 1997. She did postdoctoral research at the Graduate School of Oceanography (University of Rhode Island) and the Southampton Oceanography Centre in the United Kingdom before joining the faculty at UT in 1999. Her research covers two major topics: the use of natural chemical tracers to study ocean circulation (primarily in the Arctic and North Atlantic Oceans), and mid-ocean ridge hydrothermal systems. She has participated in nine oceanographic research cruises and has made five dives in deep submersibles to hydrothermal vents. She has published eight papers in scientific journals and has-been asked to contribute an article to the forthcoming Encyclopedia of Ocean Sciences. She teaches undergraduate courses in Marine Chemistry and Marine Geology as well as graduate courses in the Department of Marine Science.