

# Discovering Life Below the Seafloor



Photo: Scott Trubey-University of Georgia

**Beth Orcutt** is a marine microbial biogeochemist. Her love of chemistry and her curiosity about the unknown inspired her to become a scientist. She studies tiny bacteria that live in rocks and sediments deep in the ocean floor.

One of the main questions that Beth investigates is; *What lives below the sea floor?* Through reading different scientific publications and talking to colleagues she discovered there are LOTS of different types of bacteria living below the seafloor in some really different and extreme environments

– places like hydrothermal vents and deep basalts. In these places the chemistry and temperatures vary greatly from conditions that we are used to on land. Beth was excited because she realized that little was known about these organisms, which meant that there were LOTS of unanswered questions. This knowledge inspired Beth to do her own investigation into some basic biological questions that had not yet been addressed. For example, she wanted to know; *What factors influence where certain microbes live?* Based on what she had already learned about these microbes, she came up with several hypotheses to test.

## Hypotheses

- The habitat (e.g., the environmental conditions) determines where a microbe can live.
- The region of the world (e.g., geography) determines where a microbe can live.
- Neither the habitat nor the geography determine where a microbe can live.

To test these hypotheses, Beth and her colleagues needed to collect samples from different habitats and regions of the ocean. Because getting samples from the deep ocean was challenging, they had to work with others to design new tools. They used the *JOIDES Resolution* research vessel to send these special tools deep into the ocean floor to bring up the rocks and sediments that likely contained microbes. Once collected, they used microbiological techniques to isolate genetic material from their samples. This helped the researchers identify the particular microbes living in each of the samples. Then they looked for patterns in the data that helped them evaluate each of the hypotheses.

What did the data reveal? Finding patterns in the data was complicated. The researchers discovered that no single hypothesis was completely supported by the data. They found some evidence that supported each of the hypotheses, and some evidence that contradicted the hypotheses.

**For example, the researchers found that**

- Some microbes, such as members of Aquificae, have only been found in hydrothermal vents and nowhere else in the ocean, suggesting that habitat is important for determining where they can live.
- Some microbes, such as the Gamma-proteobacteria, are rather common and found in lots of different areas of the world's ocean suggesting that neither habitat nor geography limits where they can live.

What these researchers learned is that life in the sea floor is more complicated than expected. Some microbes seem to be picky about their habitats and are only found in specialized environmental conditions. Others tend to stick to one region no matter what the conditions, and still others are cosmopolitan and can be found in a range of places and conditions.

These findings inspired Beth to come up with some new hypotheses and ideas for new investigations. After gathering and evaluating more data, having more discussions, reading more literature, and talking to more scientists, Beth and her colleagues had enough information to write a research paper to report their findings. The paper was peer reviewed by a panel of experts to make sure the science was done well. Once reviewed, the paper got published so other scientists could learn from what Beth and her team discovered.

There are many ways in which Beth's research was important. It provided some basic knowledge about what is living deep in the ocean floor, which satisfied some of Beth's curiosity and provided information for other researchers to use. Also, because working in such extreme environments with organisms that are so small and unknown is a huge challenge, they had to invent new tools and technologies to collect and analyze the microbes. Most excitingly, because of Beth's research, there are now many new questions to explore!

**What NEW questions can be pursued?**

- How do microbes survive in such different habitats?
- What are the microbes doing down there?
- Why are certain kinds of microbes more abundant than others?
- How do the microbes affect our ocean ecosystem?

**And there is a lot of potential for practical applications...**

- Can technologies used for this investigation be used to search for the presence of bacteria on other planets?
- Do any of these bacteria have biomedical use?
- Can any of these bacteria be used as an energy source?

Beth and other scientists are working hard to answer these and many more questions about Earth's past, present, and future.

**What do you want to discover?**