2023

THE UNDERWORLD OF HYDROTHERMAL VENTS

FKt230602 & FKt231202 | #OctoOdyssey

- International Waters
- 29 June - 28 July 2023
- Dr. Monika Bright, University of Vienna
- Ship Track

- **31** science days
- **35** terabytes of data collected
- **228** ROV samples collected
- **28,907** sq km mapped
- **19** ROV dives

Expedition objectives:

- Describe biosphere diversity beneath deep-sea hydrothermal vents from microbes to animals.
- Clarify the nature and extent of connectivity between biospheres at and below vent systems.
- Test the hypothesis that the larvae of some species living at hydrothermal vents travel through vent fluid in subsurface environments to colonize new vent structures.

Led by Dr. Monika Bright, an international team of scientists on R/V *Falkor (too)* set out to discover, observe, and document the diversity of life living beneath deep-sea hydrothermal vents. They suspected that these ecosystems existed beneath the seafloor, and water being sucked into and pumped out of cracks in the surrounding seafloor and vents could be a mechanism for building new hydrothermal vents. The scientists also thought these subseafloor ecosystems could facilitate the conditions for life dwelling on the vents by spreading animal larvae and adults, and microbial communities between vent fields.
Hydrothermal vents are dynamic ecosystems prone to regular disturbances like volcanic eruptions and earthquakes. Some hydrothermal vents have brief lifespans, appearing and then becoming inactive over a few years. Yet, wherever a hydrothermal vent forms, a biological community almost always follows, and how these animals arrive at the vents had yet to be determined. In the deep Ocean, maintaining the genetic diversity of a population happens by dispersing larvae via currents, wind, and waves to send the organism's larvae far away from the parents. Scientists have plentiful evidence that hydrothermal animals are reproducing, though some species have rarely been detected in the surrounding water. To these researchers, the evidence suggested that hydrothermal animals may not rely only on the open Ocean to disperse their young.

Bright and her team suspected that these mechanisms were taking place beneath the surface and set out to resolve this mystery. They deployed several experiments, including a newly designed mesh box–staining gadget used at tubeworm clumps to study which animals and microbes are flushed out from the subsurface. When these experiments failed to reveal life beneath the surface, pilots used the ROV *SuBastian's* manipulators to break open and overturn a section of the seafloor. When the rocky substrate was overturned, they made a discovery akin to finding life on another planet. They revealed cavities of lobate lava packed with worms, snails, and chemosynthetic bacteria living in the 23.9 degrees Celsius water. It was an entirely new ecosystem!

The team proved that two dynamic vent habitats exist. Vent animals above and below the surface thrive together in unison, both depending on vent fluid from below and oxygen in the seawater from above. Analysis of samples collected from above and below the vents will allow the scientists to assess the connection between these communities.

Ultimately, this discovery transforms our scientific understanding of ecology and the evolution of animal life at and beneath hydrothermal vents in the deep sea. For the researchers, this new knowledge is a reminder that conservation and protection must include what we see on the surface and what is living below.

Resulting highlights include:

- Discovered an entirely new ecosystem brimming with animal life in volcanic cavities beneath the ocean floor.
- Documented an otherworldly community of vent animals traveling beneath the seafloor through vents to establish new habitats in other vent systems.
- Opened up a new field of scientific study — adding a new dimension to hydrothermal vent habitats with animals living below the seafloor — that will result in revised models of hydrothermal vent ecosystems.