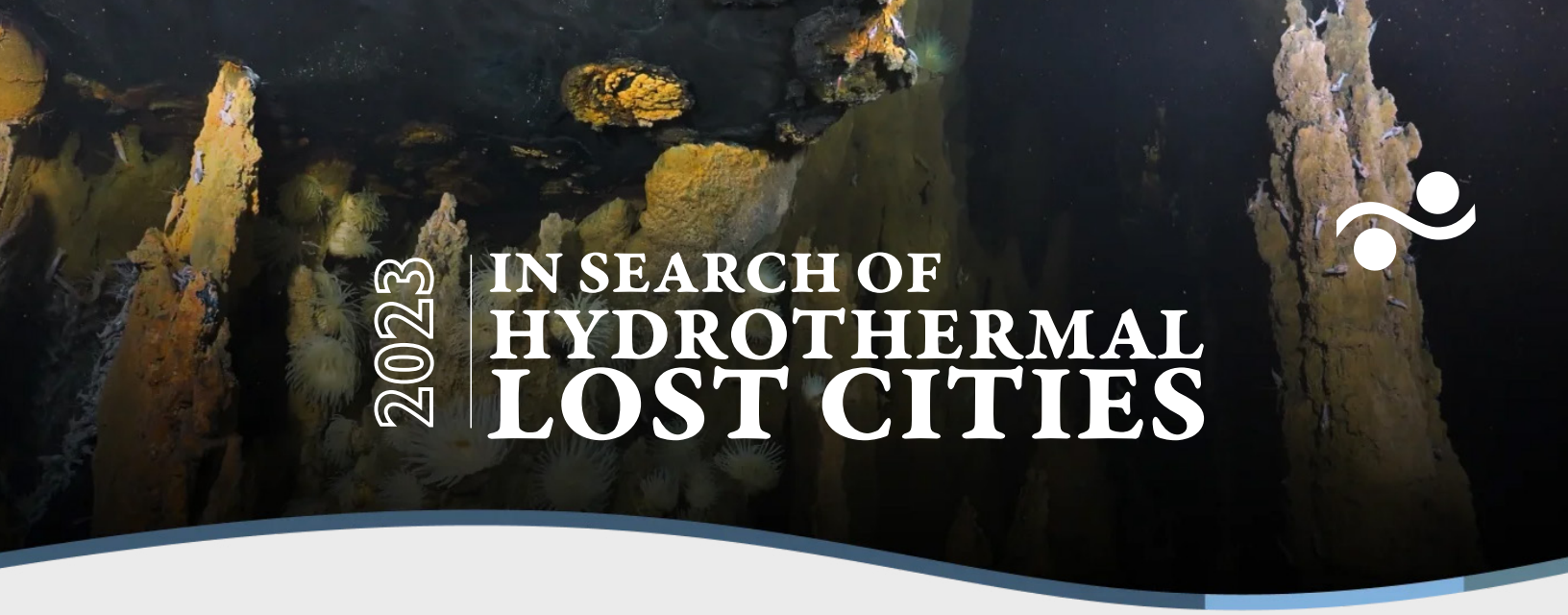

2023 | IN SEARCH OF HYDROTHERMAL LOST CITIES

FKt230303 | #LostCityVents

- Mid-Atlantic Ridge
- 3 March - 11 April 2023
- Dr. David Butterfield, University of Washington & NOAA Pacific Marine Environmental Laboratory
- Ship Track

Arizona State University · Dalhousie University · Ifremer · MBARI Monterey Bay Aquarium Research Institute · NOAA Ocean Exploration · PMEL Pacific Marine Environmental Laboratory · Ocean Exploration Cooperative Institute oeci · OKSI · Oregon State University · University of Toronto · University of Washington · Woods Hole Oceanographic Institution

- **40** science days
- **46** terabytes of data collected
- **14** ROV dives
- **361** ROV samples collected
- **34,100** sq km mapped
- **18** CTD & rosette casts
- **22** AUV and other vehicle deployments

Expedition objectives:

- Accelerate discovery and characterization of deep-sea hydrothermal systems, targeting oceanic core complexes, which are locations where mantle rock is exposed to cold seawater.
- Find hydrothermal activity in the Puys des Folles vent field, an area believed to host only inactive vent structures.
- Demonstrate the effectiveness of a nested approach that uses a combination of technologies to progressively increase the resolution of data collected, making it possible to locate and characterize hydrothermal vents rapidly.

In 2000, scientists found a new alkaline hydrothermal vent system on the Atlantis Massif and named it the Lost City. Ghostly towers made of limestone sprang from the seafloor, spewing clear liquid, with very few creatures dwelling around them. The scientists found the chemistry vastly different from that of black smoker vents on the nearby Mid-Atlantic Ridge volcanoes. They determined that the reaction creating this type of vent occurs on a geologic formation known as an oceanic core complex, where mantle rock is exposed to cold seawater. These carbonate vents form when the seawater and mantle rock react in a process known as serpentinization. The first scientific expedition aboard the research vessel Falkor (too) was designed to accelerate the discovery and characterization of deep-sea hydrothermal systems as they searched for new vents like those at Lost City.

In March, Chief Scientist Dr. David Butterfield led this expedition to explore a section of the Mid-Atlantic Ridge to locate vents where serpentinization occurs. The study area included Puy des Folles, an on-axis volcano, an oceanic core complex associated with the eastern intersection of the Mid-Atlantic Ridge, the Kane Fracture Zone, and one non-transform ridge offset called Grappe Deux.

Ultimately, they did not locate any vents like the Lost City type. However, they systematically searched and discovered three active hydrothermal vent fields. One is located at the Puy des Folles volcano, where there are five active sites over 7 square miles or 18 square kilometers. They discovered high-temperature black smoker vents at the Grappe Deux Vent System and Kane Fracture Zone. These were the first new vents located in the region in more than 40 years.

The expedition team's nested approach included Autonomous Underwater Vehicles, or AUVs, to produce high-resolution maps of the seafloor; Miniature Autonomous Plume Recorders mounted onto the ship's CTD and rosette to sense chemical signals in the water column; and ROV SuBastian to conduct visual surveys and sampling of the seafloor. The effectiveness of using a nested approach is evident as it allowed researchers to discover and characterize vent activity in just a few days, which NOAA Oceanographer Dr. Sharon Walker describes as a miraculous timeframe.

Discovering active venting at these locations also revealed that the region hosts thriving ecosystems. To fully protect these fragile habitats, it is essential to understand where animal communities exist on the Mid-Atlantic Ridge around these active vents and their relationship to the surrounding geological and chemical conditions.

Resulting highlights include:

- Finding active high-temperature hydrothermal vent fields present at all study areas along a 434-mile stretch of the Mid-Atlantic Ridge, including Puy des Folles, previously thought to be inactive.
- The discovery of three new vent fields bustling with organisms in areas previously thought to be devoid of life.
- Demonstrating the success of a nested approach of technologies that rapidly accelerated the time needed to locate and discover hydrothermal vents on the seafloor.