

2023

# ULTRA FINE-SCALE SEAFLOOR MAPPING



## FKt231024 | #MappingGalápagosVents

-  Galápagos Islands National Park, Ecuador
-  24 October - 22 November 2023
-  Dr. John Jamieson, Memorial University of Newfoundland
-  [Ship Track](#)



Fisheries and Oceans  
Canada  
Pêches et Océans  
Canada



Parque Nacional  
GALÁPAGOS  
Ecuador



32 science days



28 terabytes of  
data collected



16 ROV dives



20,010 sq km  
mapped



4 CTD &  
rosette casts



299 samples

## Expedition objectives:

- Evaluate and develop interferometric synthetic aperture sonar, or InSAS, as a tool for seafloor exploration, classification, and monitoring.
- Investigate the evolution of hydrothermal vents, especially once they become inactive or extinct.

Seafloor mapping is integral to oceanographic research. Bathymetric data illustrate the seafloor's depth, contours, and physical features, and it is often the first essential step in planning a successful submersible operation. Ship-mounted multibeam sonar produces maps that are 50- to 100-meters in resolution; this means features smaller than 50- to 100-meters are not visible.



During this expedition, led by Chief Scientist Dr. John Jamieson, an international team tested a sonar system new to scientific seafloor mapping, [Interferometric Synthetic Aperture Sonar, or InSAS](#), which enabled them to locate seafloor features with greater accuracy and produce detailed, high-resolution maps. Combining bathymetric data from multibeam sonar with acoustic imagery gathered by InSAS, the team generated what the researchers likened to a photograph created with sound instead of light. This technology will transform the ability to map, explore, classify, and monitor the seafloor environment in extremely high detail, and it [dramatically reduces the time needed to explore and locate seafloor features](#).

The discoveries, including a new high-temperature vent field, reveal insights into the distribution of hydrothermal vents along mid-ocean ridges and the distribution of organisms along those vents, which vary among the age of the vent and the amount of venting. As a result, scientists will better understand how these thriving communities evolve once a vent ceases to be active.

Additionally, the team observed 15 species previously not known to live in the region and two that are likely new to science. The list includes a rare in situ sighting and specimen collection of a *Neopilina galatheae*, a limpet-like marine mollusk that has never been seen in this region. The scientists also discovered a Pacific white skate nursery associated with hydrothermal vents.

Using InSAS, the science team imaged individual pillows, chimneys, and faults — features that would not be identifiable in traditional high-resolution multibeam data collected from the vessel. They could determine whether the hydrothermal vents were active or inactive by visualizing the thermal distortion in the imagery caused by the hot fluids. The InSAS data led scientists to discover several active and inactive venting sites on the seafloor, exceeding exploration and sampling expectations for the expedition. Ultimately, the researchers believe InSAS will be a powerful tool for gathering more data on what exactly lies on the ocean bottom. The science team hopes to prove this tool's usefulness and scale its use for government and scientific exploration, informing whether certain regions of the seafloor should be protected and if activities such as fishing or deep-sea mining should be prevented.

## Resulting highlights include:

- Demonstrated that high-quality, detailed InSAS imagery can be generated from an ROV, including over rough terrain, and expanded the known operating conditions — such as speed, altitude, swath, terrain, and variability — under which data can be effectively acquired.
- Discovered a new high-temperature vent field, informally named Tortugas, located within the caldera of the Los Huellos East volcano; several new active vent sites and numerous inactive vent fields were also mapped.
- Video footage revealed the [presence of 15 animal species previously not recorded](#) in this region of the Ocean, some of which may be new to science; a skate nursery associated with hydrothermal vents was also discovered and sampled.

Permits to conduct research in Ecuador and Galapagos Islands National Park waters: DIRNEA-SNA-019-2023 / MAATE-DPNG/DGA-2023-1543-O / PC-51-23

