

Envisioning an interconnected ocean: Understanding the links between geological ocean structure and coastal communities in the Pacific

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Abstract

Covering nearly one third of the Earth's surface, the Pacific Ocean contains many significant interconnected geologic features extending into the coastal zone and the islands themselves. Trenches, ridges, seamount chains, faults and fracture zones are not only fundamental expressions of Earth processes but also fundamental to life. Without awareness of these features and their natural and cultural importance, marine management and global understanding will remain disjointed.

The Ocean Exploration Trust (OET) will spend the next several years in the Pacific conducting scientific expeditions to better understand the ocean through seafloor mapping and ocean exploration.

Traditional (western) ocean science is one of many ways to perceive and value the structural features of the Pacific. Communities across Pacific islands - often volcanic peaks emerging from deep below - are interconnected by water and by the underlying seafloor.

We acknowledge the wisdom from local communities and recognize the multitude of ways to conceptualize and relate to the Pacific. With the University of Rhode Island's Coastal Resources Center (CRC), OET seeks to collaborate with local communities to reveal the structural significance and interconnected nature of oceanic features, making a link to the livelihoods of Pacific islanders. Further objectives would be co-designed with partners from local communities.

References

Basemap image on all slides: Google Earth, Data SIO, NOAA, US Navy, NGA, GEBCO, Image Landsat/Copernicus

Dunn, D.C., G.O. Crespo, M. Vierros, D. Freestone, E. Rosenthal, S. Roady, A. Alberini, A.-L. Harrison, A. Cisneros, J.W. Moore, M. R. Sloat, Y. Ota, R. Caddell, P.N. Halpin (2017) Adjacency: How legal precedent, ecological connectivity, and Traditional Knowledge inform our understanding of proximity. Policy Brief, DOI: 10.13140/RG.2.2.21359.12968

Harris, P.T., Macmillan-Lawler, M., Rupp, J., and E. Baker (2014) Geomorphology of the oceans. Marine Geology, 352, 4-24.

Shilliam, R. (2015) The Black Pacific: Anti-Colonial Struggles and Oceanic Connections. Bloomsbury Publishing.

Envisioning an Interconnected Ocean

To re-envision the Pacific Ocean as an interconnected space rather than an isolated one

this Ocean-Shot concept aims to link scientific knowledge and exploration of structural marine features to local communities' traditional wisdom and understanding of the interrelation of Pacific islands, peoples, and oceanic features.

Raising Geological
Significance

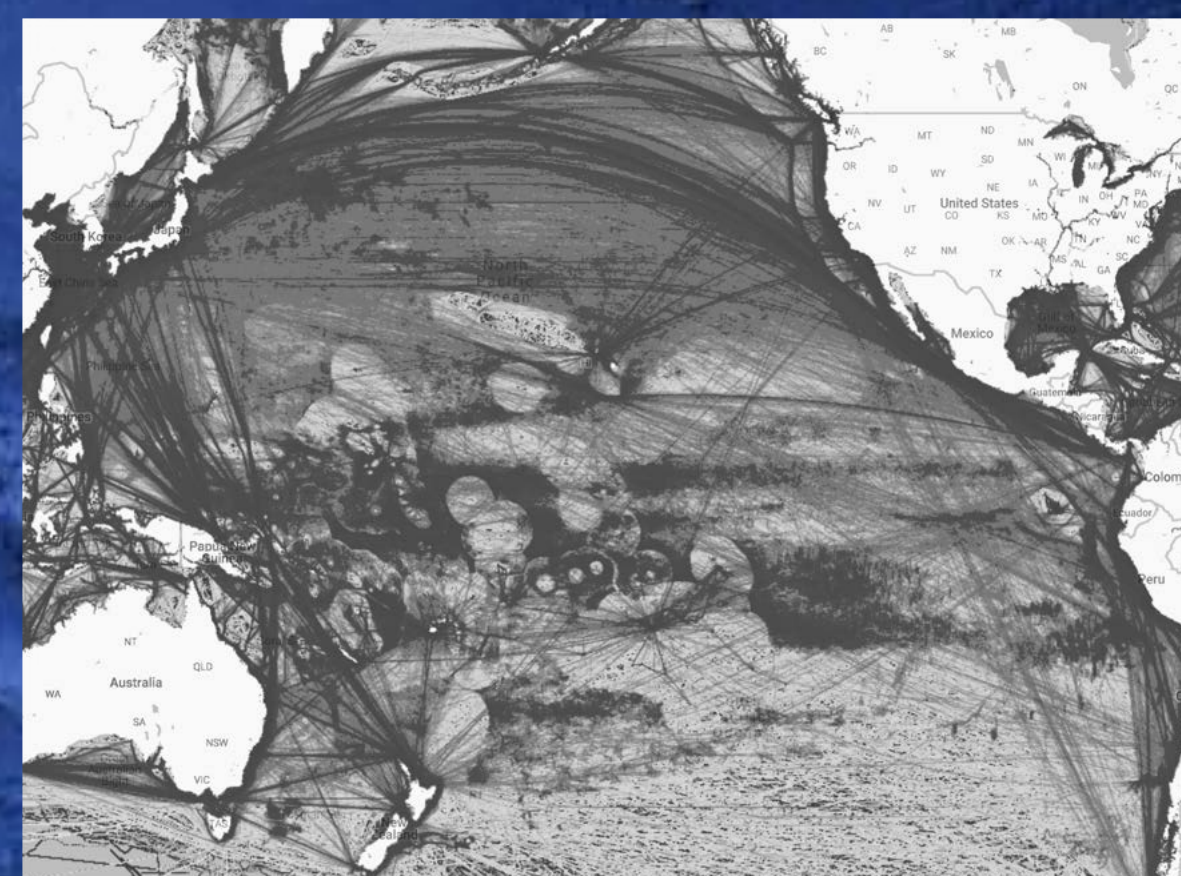
Connecting to
the Coast

Call for
Collaboration

Pacific Ocean

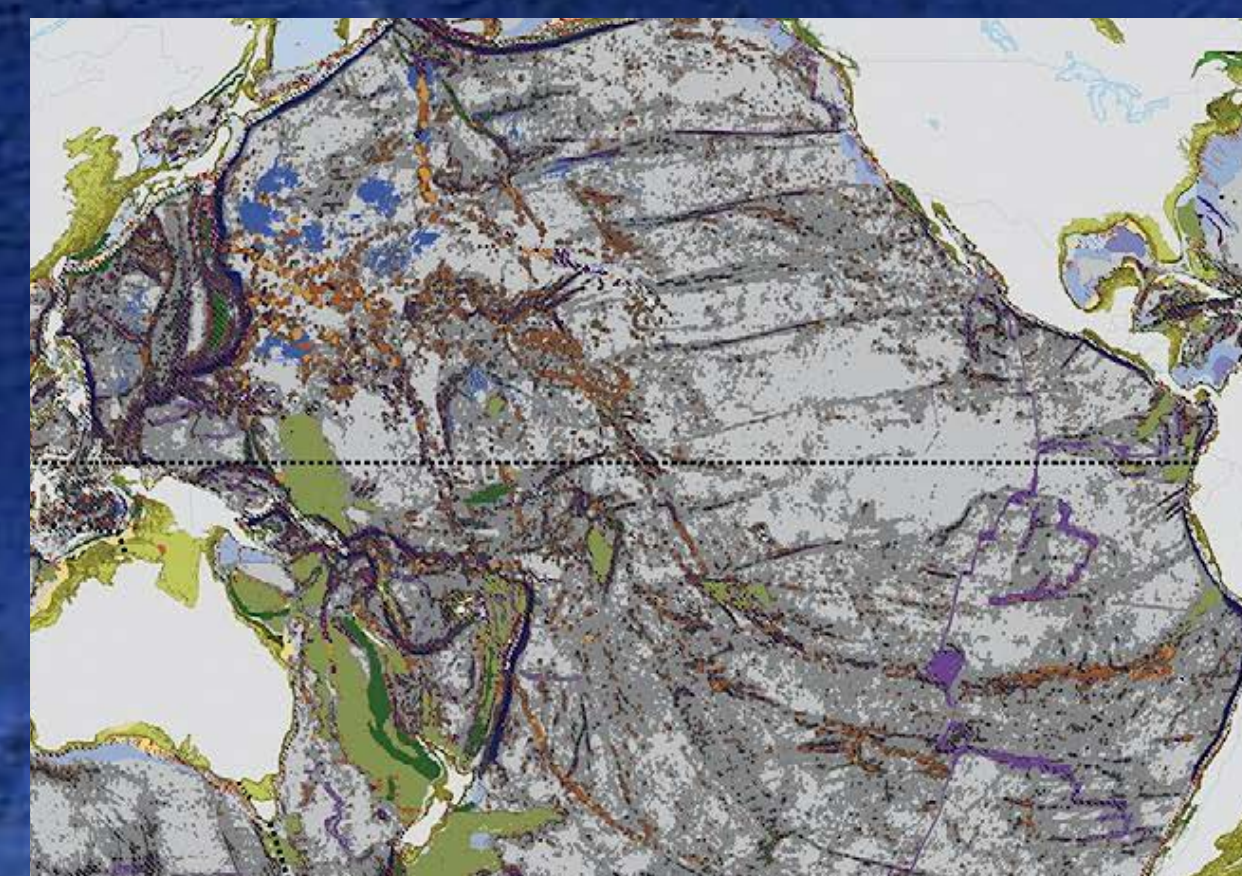
~ 60,000,000 miles² in area, Largest global ocean basin, Greater than Earth's total continental area combined

2019 Total Pacific Vessel Tracks



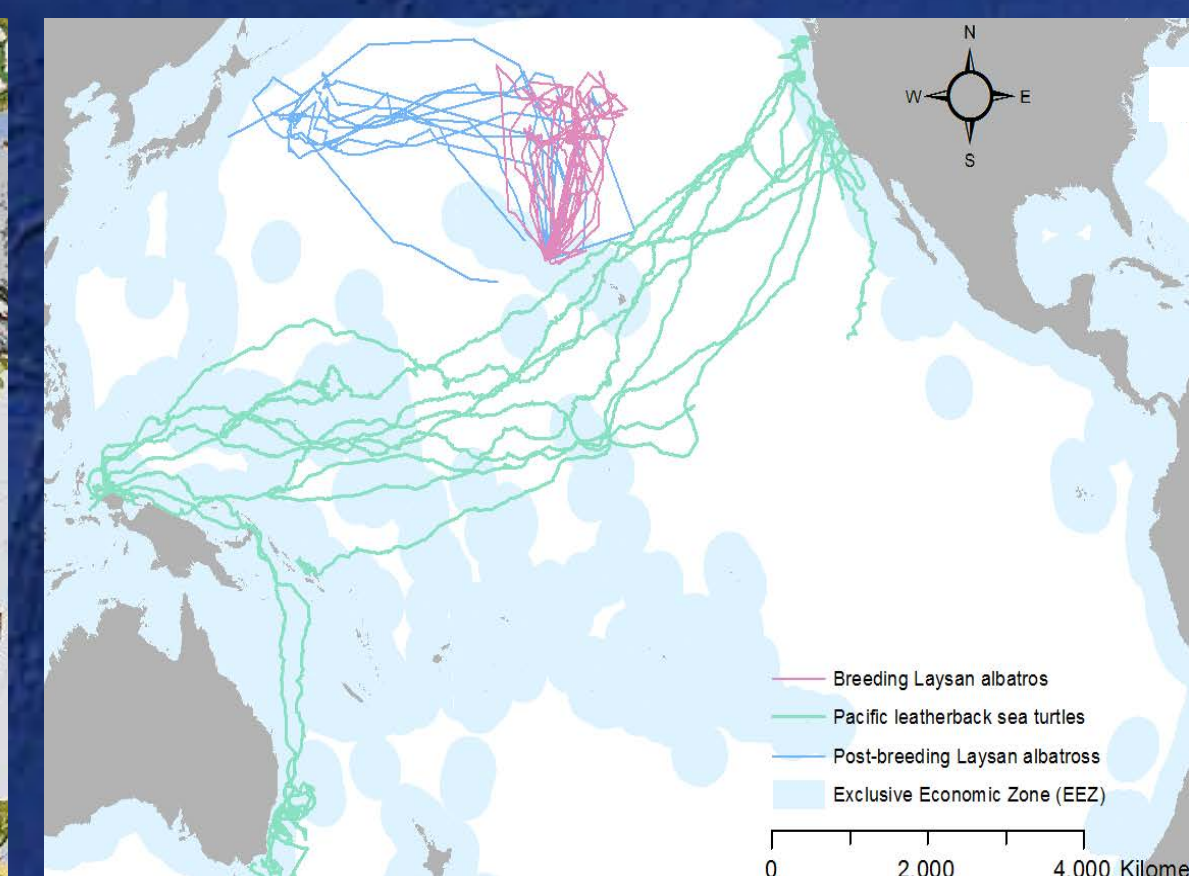
(Map data: Google INEGI, 2021; Marine Traffic Density, 2019)

Pacific Ocean Geomorphology



Interrelated processes that form and break down the crust (adapted from Harris *et al.*, 2014).

Trans-Pacific Ecological Connectivity



Migratory movements of leatherback sea turtles linked to ocean currents (adapted from Dunn *et al.*, 2017)

Oceanic Acknowledgements

We acknowledge that the indigenous and local communities of Oceania including the Polynesians, Melanesians, Micronesians, Papuans, and other Pasifika peoples have stewarded through generations the ocean, seas, coastlines, and lands of what is now the Pacific Ocean or Oceania. We honor and respect the enduring deep relations and interconnections that exist between these peoples and the ocean.

We recognize that the imperial tradition of map-making has framed the Pacific Ocean as a disconnected and remote space. We commit to a decolonial science of 'deep relation' (Shilliam, 2015) and co-cultivation of ocean knowledge.

Ocean Decade Challenges

UN Ocean Decade mission is 'to catalyse transformative ocean science solutions for sustainable development, connecting people and our ocean'. 10 Ocean Decade Challenges represent the most important priorities.

Most relevant Challenges for our Ocean-Shot:

Challenge 8: Through multi-stakeholder collaboration, develop a comprehensive digital representation of the ocean, including a dynamic ocean map, which provides free and open access for exploring, discovering, and visualizing past, current, and future ocean conditions in a manner relevant to diverse stakeholders.

Challenge 10: Ensure that the multiple values and services of the ocean for human wellbeing, culture, and sustainable development are widely understood, and identify and overcome barriers to behaviour change required for a step change in humanity's relationship with the ocean.

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Raising Geological Significance

Significant unexplored geological features in the Pacific are part of complex interconnected geological, biological, and oceanographic systems.

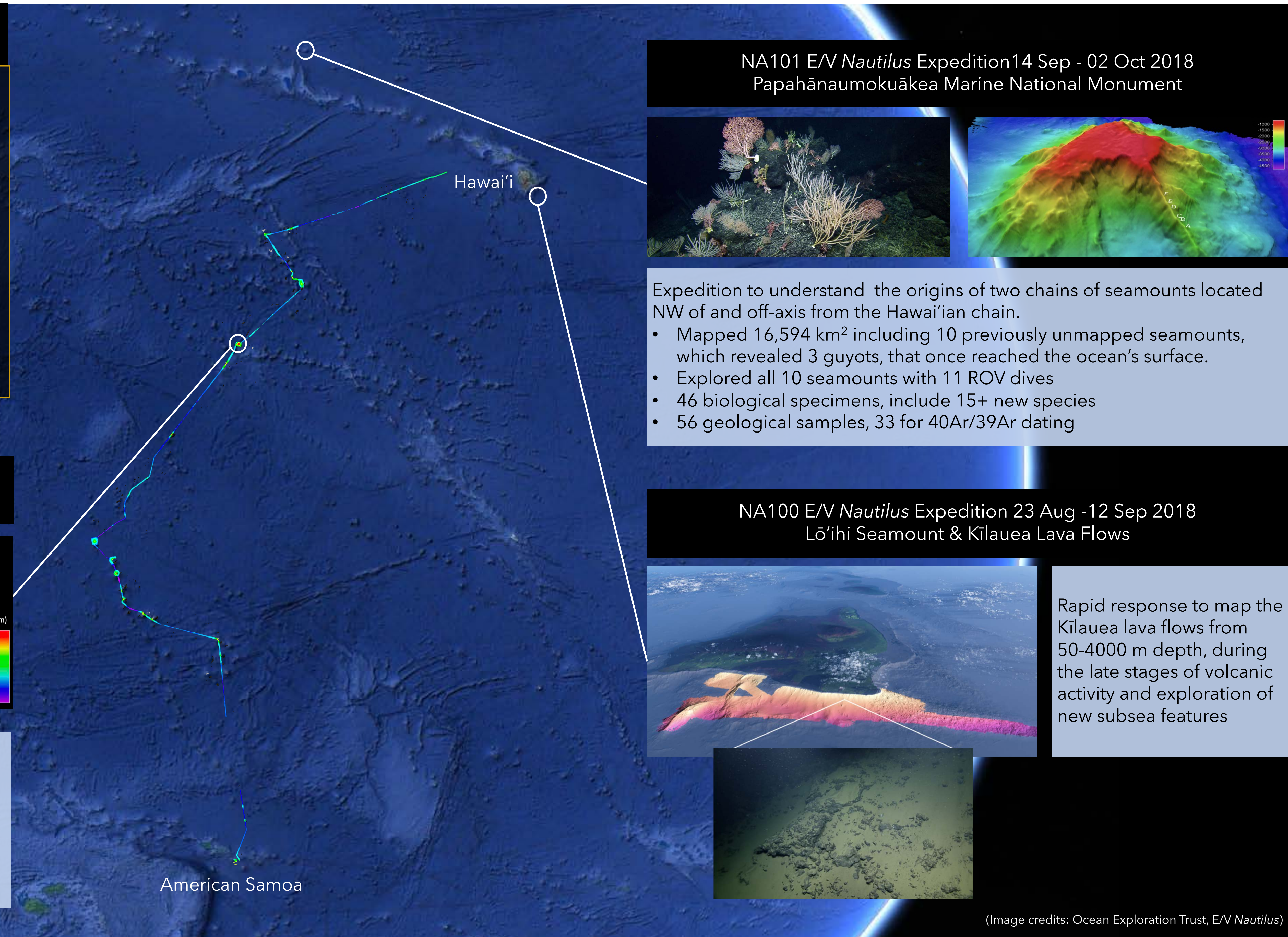
Through two way engagement around the connections the seafloor provides across the Pacific and the geoheritage of this seafloor, this initiative aims to bridge under-represented perspectives to share the significance of geological features and explore new ways of communicating and educating, and seek recognition at the level with biodiversity values, which are increasingly recognized across marine protected areas and the high seas.

NA114 E/V *Nautilus* Expedition 25 Aug -16 Sep 2019
American Samoa to Hawai'i

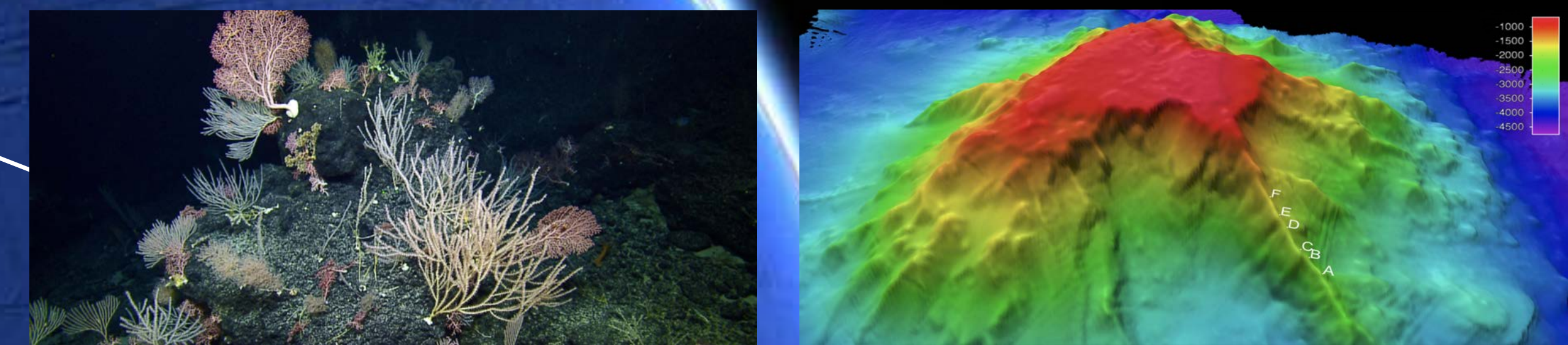


Guyot, located in the High Seas, mapped and explored in 2019, revealing:

- Diverse coral species between 2500 m - 1600 m
- Contributions to ongoing deep-water coral biogeography
- Mid-cretaceous (145-66 Ma) seafloor, Guyot likely 70+ Ma
- Ancient lava flows encrusted in thick botryoidal Fe-Mn deposits
 - Target for seafloor mining - high risk for coral communities
- Outstanding example of several complex geological processes



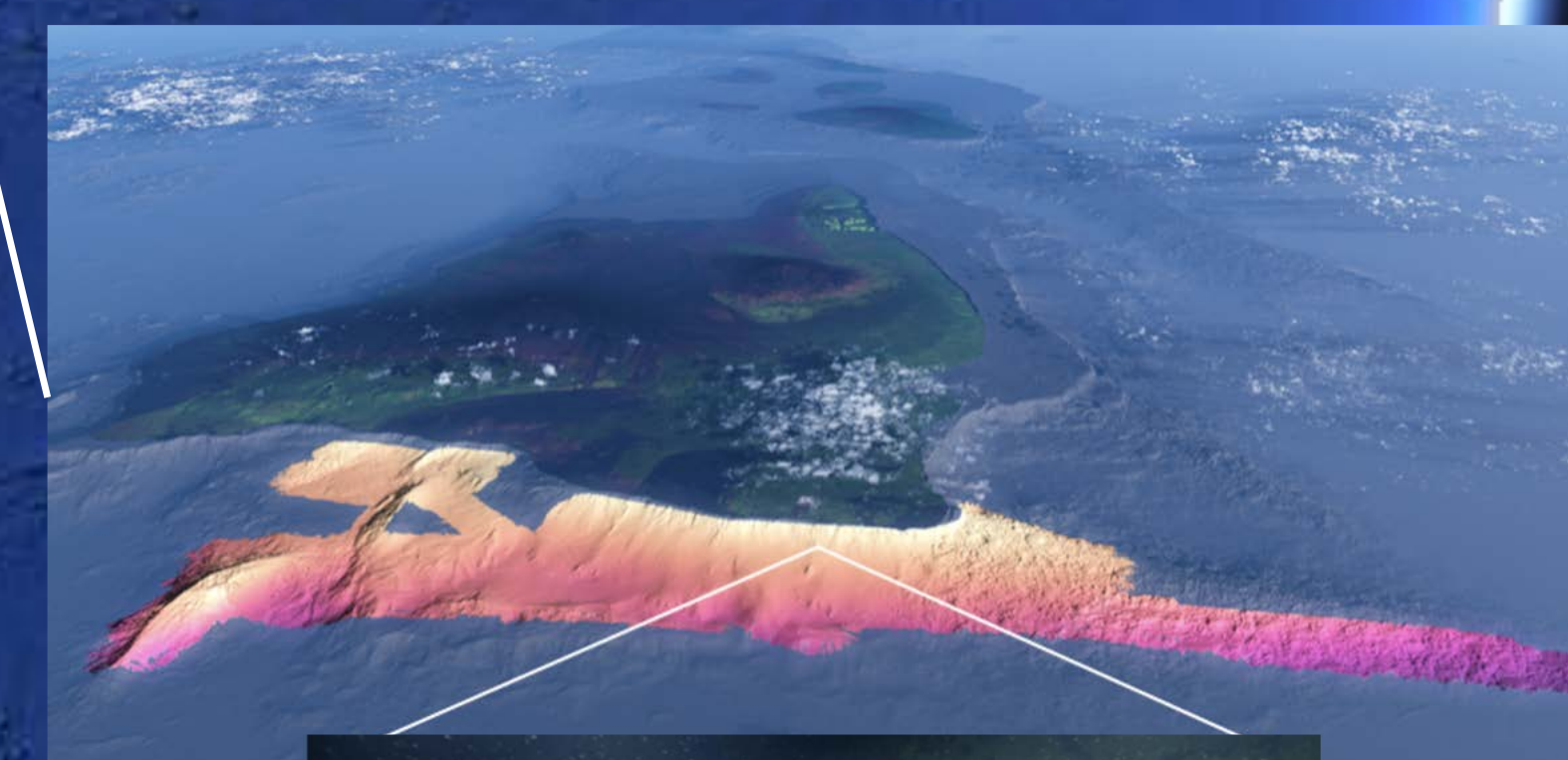
NA101 E/V *Nautilus* Expedition 14 Sep - 02 Oct 2018
Papahānaumokuākea Marine National Monument



Expedition to understand the origins of two chains of seamounts located NW of and off-axis from the Hawai'i chain.

- Mapped 16,594 km² including 10 previously unmapped seamounts, which revealed 3 guyots, that once reached the ocean's surface.
- Explored all 10 seamounts with 11 ROV dives
- 46 biological specimens, include 15+ new species
- 56 geological samples, 33 for 40Ar/39Ar dating

NA100 E/V *Nautilus* Expedition 23 Aug -12 Sep 2018
Lō'ihi Seamount & Kīlauea Lava Flows



Rapid response to map the Kīlauea lava flows from 50-4000 m depth, during the late stages of volcanic activity and exploration of new subsea features

Connecting to the Coast

2018 Kīlauea lava flows, Hawai'i

Soloman Islands

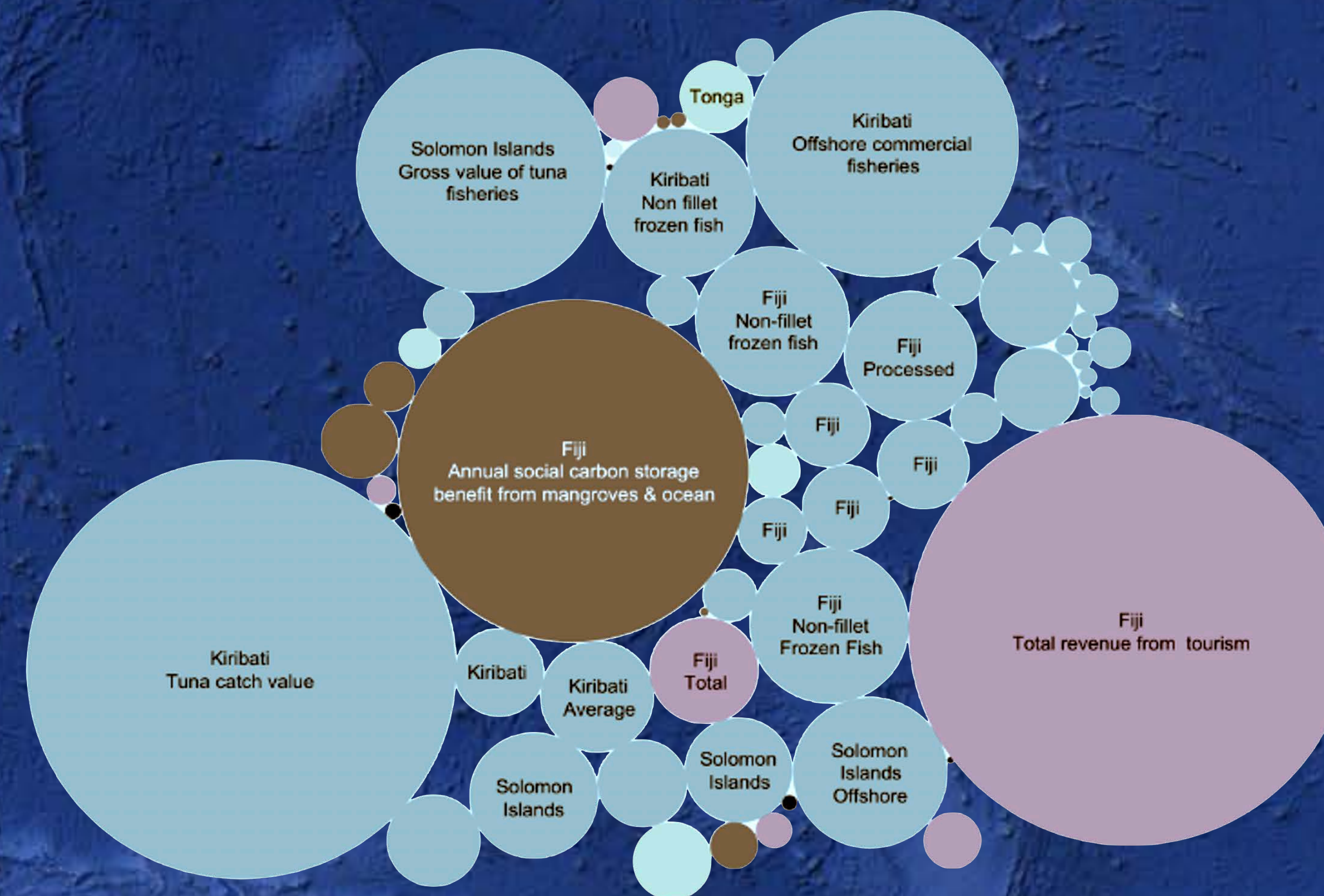
Connecting and communicating systems for valuing marine and coastal resources

(DeCiccio, Inner Space Center)

(Lubetkin, 2018)

Hawaiian Islands formation rooted to geological structure and cultural importance

Birth of the Hawaiian Islands and Native Hawaiian people, union of mother earth (Papahānaumoku) and father sky (Wakea) to create the archipelago



Marine Ecosystem Values in the Pacific as calculated by the Marine and Coastal Biodiversity Management in Pacific Island Countries (MACBIO) Project which supported sustainable economies and livelihoods of Pacific Island Countries (2013-2018)

(Leeman, ruf.rice.edu, 2001)

(Solomon Enos, papahanaumokuakea.gov)

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International Collaboration

OET expeditions and outreach are conducted with the participation of researchers, students, educators, and the public worldwide. Although at-sea capacity of the ship is limited, an extended network of researchers are invited to participate in expeditions via telepresence where the live seafloor video and data are publicly broadcasted for global engagement. CRC has previously worked on coastal and fisheries management in the Pacific and has a current concept in with USAID on coastal fisheries management, engaging with local partners and international NGOs. Centered on the Pacific Ocean, an internationally significant space, we will seek international participation and community collaboration.

Global Capacity Building

OET will apply their robust education and outreach program that includes online educational STEM resources, an at-sea internship program for college students, and a Science Communication Fellowship. We conduct live outreach events including Q&A interactions with classrooms globally to allow the public to learn more about the expedition, the explorers, and pathways to pursue related careers. Through this concept we will continue to encourage and inspire the next generation of ocean scientists while broadening the scope of ocean sciences and ocean knowledge. The project will respond to the increasing demand of ocean science students for societally relevant research.

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Call for Collaboration Ocean-Shot Concept Co-Design and Co-Cultivation

To accomplish the UN Ocean Decade mission
'to catalyse transformative ocean science solutions for sustainable development, connecting people and our ocean'
we must collectively cultivate the decolonial science we need for the ocean we want



To re-envision the Pacific Ocean as an interconnected space rather than an isolated one

We are seeking collaborators to co-design and co-cultivate this concept. Particularly, we would like to work with local communities across Oceania, people of Big Ocean States (or Small Island Developing States) and others across disciplines who are focused on transformative Pacific Ocean re-envisioning.

US Partnerships

With only ~20% of the global ocean mapped, tens of thousands of geologic features remain unresolved and unexplored. OET, a co-partner in the National Oceanic and Atmospheric Association's Ocean Exploration Cooperative Institute (OECI) since 2019, along with several academic institutions, continues to map, explore, educate, and spread a new understanding of the Pacific. Through the URI Graduate School of Oceanography's Inner Space Center the exploration is shared live to the public globally with additional support for one-to-one and one-to-many live broadcasts.

The CRC helps communities become more effective stewards of their coastal and marine resources locally in Rhode Island and around the world. CRC partners with stakeholders to apply science and find solutions to societal issues. Working with communities, other universities, industry, and government, we respond to issues that matter and to build capacity. Expertise at CRC includes a member of the US Advisory Group on Geoheritage and Geoparks.

Transformative engagement

We will pursue collaborations with artists, storytellers, crafts-people, and educators globally to illustrate the structural significance of the Pacific. OET and CRC have extensive experience working at sea and along coasts with communities, across disciplines outside of traditional ocean sciences. We will co-design and co-produce works that bring together different perspectives for a shared purpose.