



FK190106 30-day Post Cruise Report

1. **Ship name:** Falkor
2. **Cruise Dates - Day Departed:** 1/6/2019
3. **Cruise Dates - Day Returned:** 1/26/2019
4. **Cruise Number:** FK190106
5. **Departure Port:** Puntarenas, Costa Rica
6. **Arrival Port:** Puntarenas, Costa Rica
7. **Mid-Cruise Port Call (if any):** Puntarenas, Costa Rica
8. **Mid-Cruise Port Call (if any):** Isla del Coco, Costa Rica
9. **Participating Organizations, Institutions, Foundations, Government Agencies, etc.:**
Temple University, Scripps Institution of Oceanography, Cal Tech, University of Rhode Island, University of Costa Rica
10. **Funding Sources:** NSF #1635219 Collaborative research: Quantifying the biological, chemical, and physical linkages between chemosynthetic communities and the surrounding deep sea
11. **Describe all of the geographical area(s) where the science occurred:** Pacific margin of Costa Rica
12. **Name of Chief Scientist:** Erik Cordes
Organization: Temple University
Mailing Address: 1900 N 12th St
City/Town: Philadelphia
State and Zip/Postal Code: PA 19122
Country: USA
Phone 1: +1 215-204-4067
Email 1: ecordes@temple.edu
13. **Cruise Objectives:**
This cruise is a continuation of the ROC HITS (Research On Cold seeps and How they Influence The Sea) program funded by NSF. The overarching goals of the NSF program are to examine the sphere of influence of cold seeps on the surrounding deep-sea ecosystem, using the high-flux seeps of the Costa Rica Margin as a case study. The extent of the physical, chemical, and biological connections between habitats will be

revealed through the use of a combination of oceanographic measurements, community collections, population genetics, stable isotope tracers, microbial diversity, and biogeochemistry. A series of manipulative experiments are being conducted to test specific hypotheses about the influence of seepage on community structure. The work with *Falkor* continued some of these studies on the seeps and expanded them to include a series of seamounts further offshore. These seamounts also have an influence on the community structure and connectivity throughout the region. In one sense, they can serve as a control for the availability of hard substrata in the absence of seepage and local chemosynthetic productivity. In addition, our surveys of the seamounts represent the first descriptions of these habitats and communities, which will further efforts to conserve these habitats between the near-shore marine protected areas and the offshore Isla del Coco National Park within Costa Rica waters.

14. Cruise Summary:

Typical operations involved ROV dives, CTD casts, Wire Flyer deployments, and MBES surveys. The ROV dives included collections of specimens into bioboxes, targeted water sampling, push cores, and transplants of carbonates between habitat types. CTD casts were conducted over specific sites to obtain water samples to verify other oceanographic measurements obtained by sensors. The Wire Flyer is a towed vehicle that conducts rapid vertical profiling of the water column using a suite of sensors, and this vehicle was utilized during the shorter transits between sites. Multibeam bathymetry was obtained over many of the seep and seamount sites that had not been previously surveyed.

At each site, a series of samples were taken to assess the community structure and the biogeochemistry of the habitats. Representatives were collected of as many species as possible. Collections will be deposited at the University of Costa Rica and some specimens will be deposited at the Scripps Institution of Oceanography. We also collected sufficient numbers of gastropod and crustacean species to conduct population genetics and morphometric analyses.

The other major sampling effort was in the push cores for sediment sampling. These were processed numerous ways including for macrofauna identifications and stable isotopes, to look for novel symbioses in the macrofauna, to characterize the microbial communities in the sediments, and to examine geochemical flux rates in the sediments. In particular, they were focused on the role of the Xenophyophores, giant single-celled protists, in the deep-sea community. There were a large number of samples obtained, and the complete processing of these samples will take many months of work in the lab.

The cruise was incredibly successful, and we were fortunate with good weather and a general lack of major equipment failures or technical issues. There was an abundance of fishing activity at some of the sites, and we had to divert our dive plans to avoid

entanglements with fishing line. There was one incident near the end of the cruise where the tether to the vehicle was caught up in what appeared to be a series of long lines on a mooring. The vehicle was being recovered when this was discovered, and the pull of the heavy weight on the mooring caused a few kinks in the tether. One day of operations was lost due to the re-termination of the tether to the vehicle, but a lot of mapping operations were accomplished with that time.

We were able to dedicate 8 dives to the exploration of seamounts along a transect out to Isla del Coco. These dives provided excellent comparative samples for the examination of the background deep-sea community, since there were few hard substrata found beyond the seeps along the continental margin. Deep-sea corals and other hard substrate fauna were collected and can be compared to the seep communities as a reference from a similar range of depths. This exploration will also help provide the data to further the efforts to conserve these seamounts, part of a chain that stretches from Costa Rica to the Galapagos Islands and includes the Isla del Coco, and protect them from offshore fishing and potential mining activities.

Besides the work with SuBastian that was the focus of the research cruise, the “Wire Flyer” survey vehicle were both employed during the nighttime hours. The Wire Flyer was deployed 10 times to provide vertical cross-sections of the water column overlying the seeps and seamounts with a suite of chemical sensor data (temperature, salinity, dissolved oxygen, pH, turbidity, fluorometry, and oxidative-reductive potential) and forward-looking echosounders.

As part of the cruise, we also furthered our outreach and broader impacts goals. We posted a series of social media blogs and images that received an excellent response, with nearly 600 followers on our own sites. In addition, one of the SOI blog posts included a video of cutlass fish in the water column that was viewed over 250,000 times. There were also a series of interactions with both English- and Spanish-speaking classrooms. More directly, we invited the Vice Minister for the Environment of Costa Rica along with the head of Conservation International in Costa Rica to join us on board for a tour and a discussion of deep-sea conservation. We also visited Isla del Coco National Park and hosted the rangers from the park on board for a tour and dinner.

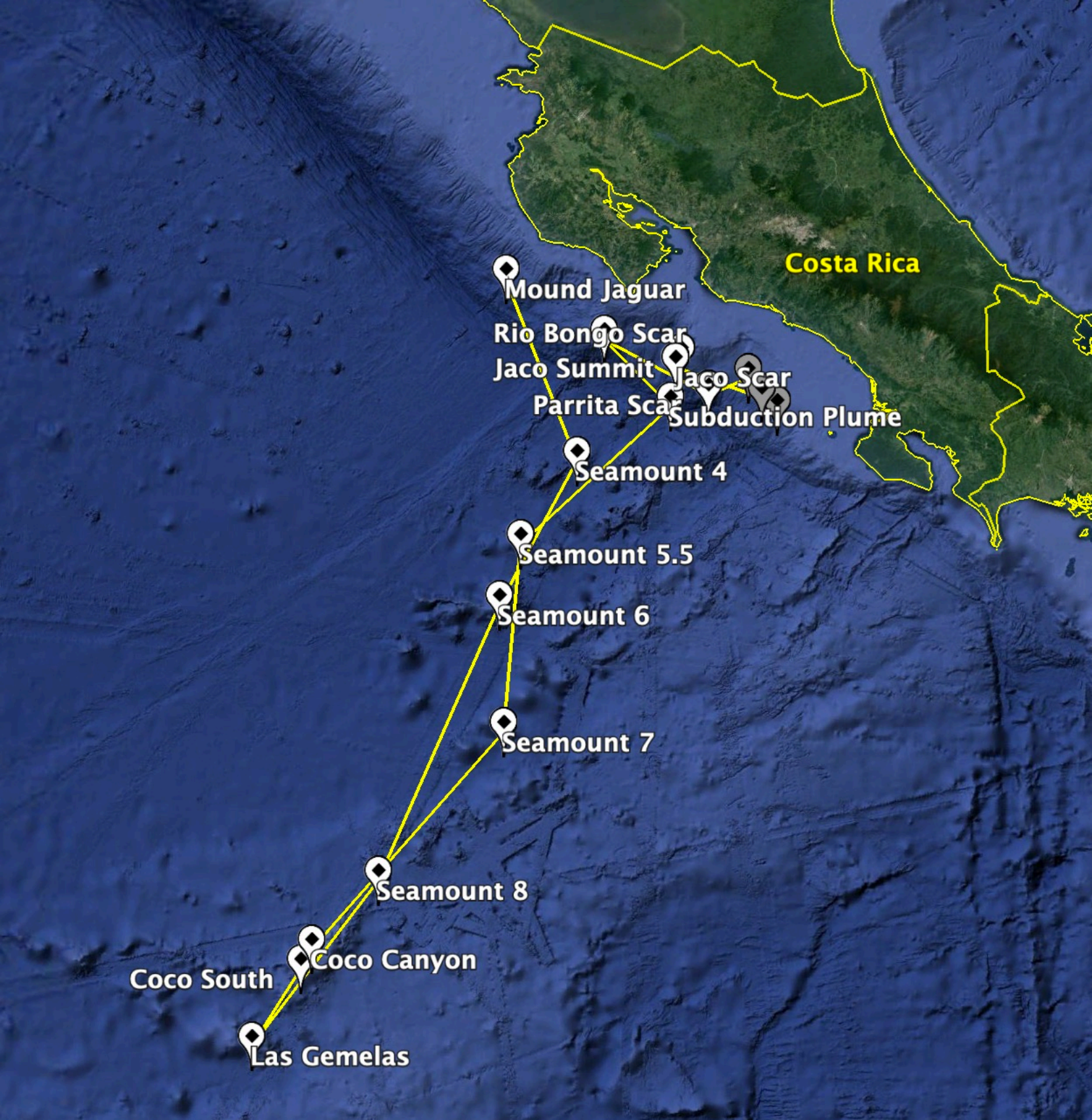
Specimen collections

The biological specimens collected during this expedition have been deposited at (1) the Zoology Museum at the School of Biology of the University of Costa Rica (MZUCR) and (2) the Benthic Invertebrate Collection at the Scripps Institution of Oceanography (SIO-BIC) in La Jolla, California, USA. This expedition resulted in the collection of 634 biological samples (many consisting of more than one species at a time), including deep-sea corals,

annelid worms, yeti crabs and other crustaceans, bivalves, gastropods, echinoderms, and sponges. The specimens at MZUCR and SIO-BIC will serve as reference vouchers for ecological and genetic studies, such as the potential description of new species. The specimens will support fundamental research in biodiversity, enrich the education of undergraduate and graduate students, and contribute to public education at MZUCR and SIO-BIC.

MZUCR and SIO-BIC have successfully collaborated on several previous research projects describing the marine biodiversity of Costa Rica. SIO-BIC contains more than 45,000 specimens from around the world, with a focus on the eastern Pacific Ocean, deep sea, and chemosynthetic ecosystems such as hydrothermal vents and methane seeps. SIO-BIC contains more than 150 type specimens used in species descriptions. The Collection includes material suitable for genetic research, and specimens are available for examination and for loan to scientists worldwide. The SIO-BIC electronic database is publicly available online at: <https://sioapps.ucsd.edu/collections/bi/>.

- 15. Did you collect Measurements or Samples, including biological specimens?** Yes
- 16. Did you deploy and/or recover any Moorings, Bottom Mounted Gear, or Drifting Systems?** No
- 17. Equipment Used:**
 - Wire Flyer vehicle with a suite of sensors (see description above)
- 18. Total number of CTD casts completed during the cruise:** 7
- 19. Total number of AUV dives completed during the cruise:** 0
- 20. Total number of ROV dives completed during the cruise:** 19
- 21. Total number of ROV samples collected during the cruise:** 634
- 22. Total number of Unmanned Aerial Vehicle (UAV) or other vehicle deployments during the cruise:** 0
- 23. Total amount (TBs) of data collected during the cruise:** 14 TB





Mound Jaguar

Rio Bongo Scar

Jaco Summit

Jaco Scar

Parrita Scar

The Thumb

Mound 12

Quepos Slide

Subduction Plume

Seamount 4

Date	dive	Name	Latitude	Longitude	min depth	max depth
5-Jan		Puntarenas				
6-Jan	S0212	Jaco Scar	9.1175	-84.8393	1780	1860
6-Jan	S0213	Jaco Summit	9.17341	-84.8038	730	820
7-Jan	S0214	Jaco Scar	9.1175	-84.8393	1780	1860
8-Jan	S0215	Mound 12	8.93073	-84.31263	965	1015
9-Jan	S0216	Quepos Slide	8.85393	-84.21933	275	400
10-Jan	S0217	The Thumb	9.0486	-84.3945	940	1070
11-Jan	S0218	Parrita Scar	8.94978	-84.63811	1100	1970
12-Jan		Puntarenas				
13-Jan	S0219	Rio Bongo Scar	9.28617	-85.27569	480	650
14-Jan	S0220	Subduction Plume	8.87849	-84.86948	3400	3560
15-Jan	S0221	Seamount 5.5	8.04976	-85.78319	550	1500
16-Jan	S0222	Seamount 7	6.91513	-85.88506	850	1300
17-Jan		Isla del Coco				
18-Jan	S0223	Coco Canyon	5.58638	-87.06833	400	1000
19-Jan	S0224	Coco South	5.46549	-87.13683	180	600
20-Jan	S0225	Las Gemelas	4.98573	-87.44556	200	650
21-Jan	S0226	Seamount 8	6.01151	-86.65466	1300	1700
22-Jan	S0227	Seamount 6	7.68127	-85.91179	500	700
23-Jan	S0228	Seamount 4	8.55108	-85.43993	900	1250
24-Jan	S0229	test dive - retermination				
25-Jan	S0230	Mound Jaguar	9.65582	-85.88131	1880	1990
26-Jan		Puntarenas				

night ops / notes

leaving anchorage, mbes lines north of Jaco summit to fill in gaps

dive ended early due to fishing line on surface

Flyer - short mission

Flyer around Jaco Summit

Flyer crossing Moundo Nuevo

CTD01 @ Moundo Nuevo, Flyer around Moundo Nuevo again

CTD02 @ Moundo Nuevo, Flyer over the fingers

Flyer during transit into port

MBES @ Rio Bongo

Flyer @ Rio Bongo

MBES @ SM5.5

CTD03 @ SM5.5, MBES @ SM7

CTD04 @ SM7, transit to Coco

mapping around Coco

Flyer hits Coco, MBES south of Isla

CTD05 @ South Coco, Flyer and MBES @ Gemelas

CTD06 @ Las Gemelas, MBES over SM8, slight dive delay

transit mapping to SM6, slight dive delay

MBES @ SM4

Flyer from SM4 to Fisher Seamount

MBES around Mound Jaguar

CTD07 NW of Jaguar, transit to port