Deep Coral Diversity at Emperor Seamount Chain

30-day Post Cruise Report

1. **Ship name**: Falkor
2. **Cruise Dates - Day Departed**: 7/26/2019
3. **Cruise Dates - Day Returned**: 8/26/2019
4. **Cruise Number**: FK190726
5. **Departure Port**: Honolulu, HI
6. **Arrival Port**: Honolulu, HI
7. **Mid-Cruise Port Call (if any)**: N/A
8. **Mid-Cruise Port Call (if any)**: N/A
9. **Participating Organizations, Institutions, Foundations, Government Agencies, etc.**: University of Hawaii at Manoa, University of Louisiana at Lafayette, Texas A&M University, Florida State University
10. **Funding Sources**: NOAA Office of Ocean Exploration Grant number/OER number: NA16OAR0110192
    Project Title: The Current Wall: Exploring the Bathyal Biogeography of the Emperor Seamounts
11. **Describe all of the geographical area(s) where the science occurred**: Emperor Seamount Chain and Hess Rise, NW Pacific Ocean.
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13. Cruise Objectives:

The primary objective of this project was to determine the nature, location, and extent of the biogeographic transition between the North Pacific and North Pacific Boreal bathyal provinces (as defined in Watling et al. 2013) and to understand their phylogeographic connection.

The project was divided into a number of specific objectives designed to help answer and explain what was found regarding the biogeographic boundary or transition area. These include:

1. Geophysical Mapping of the Emperor and Hawaiian Seamounts (Lead: John R Smith)
2. Octocoral Collection and Systematics (Leads: Les Watling, Scott C. France)
3. Geochemical characterization of the extent and interaction of main water masses in the Main Gap and around seamounts (Lead: Henrietta Dulai)
4. Currents and the NPIW, seamounts, and corals (Lead: Glenn Carter)
5. Deep coral paleohistory of the Emperor Seamounts (Lead: Brendan Roark)

In addition, a small side project was added, to look at environmental DNA (eDNA) in the area where corals were abundant.

14. Cruise Summary:

R/V Falkor left Honolulu in the morning of July 26 and steamed northwestward in the direction of the Emperor Seamounts. On July 31, it stopped at a small unnamed seamount on the southeastern part of Hess Rise to use this site as a test of all of our planned operations, from mapping to ROV diving to CTD casts. Further, there had never been any benthic samples taken at Hess Rise, so this was an opportunity to add to knowledge of this unexplored region. This test dive (S280) produced some nice specimens, but also illustrated several issues, both with software and operations, that needed to be fixed and were dealt with while continuing the transit to the Emperor chain.

The Hess Rise activities took about 18 hours, after which *Falkor* continued to transit to Suiko Seamount. The latter is a very large feature, so we worked on the eastern side about midway between the north and south ends. During the transit, we also reconsidered our dive strategy and decided that rather than trying to work the western and eastern sides of each seamount at one depth, we would instead dive at two depths

(approximately 2100 to 1800 m for the deep dive and 1500 to 1200 m for the shallow dive) on the eastern side. We felt such a strategy would give us a better chance to sample the overall diversity of the seamount, and it meant fewer hours spent crossing the seamount as well as fewer hours spent mapping with the compromised capability of the EM 302 multibeam system. Because of the long transit times to and from this seamount chain (16 days) we had only 16 days for conducting our science program, so minimizing transit times between dive sites, etc. was important.

The first dive (S281) on the Emperor Seamounts occurred on Suiko Seamount, beginning at a depth of 2275 m. Eight hours later we left the bottom at 1818 m, having taken several rock, biological, and water samples. Once on the surface, we were informed that during the dive the bow thruster had failed and there was a problem with opening and closing the valve across the hole used to lower the USBL unit. The latter is critical for navigation of the ROV, so no further diving was possible until a solution could be found. Fortunately, there was a spare USBL surface unit on board and a way was found to lower it into the water over the side of the boat using one of the ship's cranes. Two days were lost to this activity. Nothing could be done for the bow thruster so the bridge crew had to learn to control the ship using the variable pitch of the two ship propellers. We were also thus limited to doing ROV dives during the day and to sites and conditions where the ship could be controlled so as to not put the ROV in jeopardy. These conditions were factored into our selection of dive sites for the ROV.

After making fixes and "work-arounds" we resumed the science program at Suiko Seamount conducting a dive (S281) that began at about 1520 m. Following the ROV operations, three hydro casts were conducted over deep water for water chemistry measurements. When they were completed the ship moved to the next seamount or area of interest, conducted brief multibeam bathymetric mapping, and a dive site was chosen and the ROV soon deployed.

For the next six days we dove on Yomei (S283, shallow), Godaigo (S284, deep), Nintoku (S285, deep, and S286, shallow), and Jingu (S287, shallow) seamounts, the latter at the northern edge of the Main Gap. Those dives were all possible due to the weather being overcast, or foggy, or drizzly, all conditions suitable for ROV diving in these latitudes due to the lack of wind. But the wind returned following the Jingu dive, making it impossible to dive, so we spent the 14th August transiting across the Main Gap to a small seamount on the southern edge of the Gap, variously called North Koko or Annei Seamount. Since the Jingu dive was a shallow dive on the northern edge of the Gap, we felt that a deep dive on the southern edge of the Gap would be appropriate. We were unprepared for what we found.

The dive (S288, deep) at Annei Seamount produced many surprises, the biggest of which

was that the fauna, rather than being a mix of northern and southern species, was with a few exceptions, strongly representative of the fauna of the Central Pacific. We knew quickly we had crossed a border. That evening, after the samples had been processed, we decided to stay at Annei and see what the shallower part of the fauna was like. That is, would it also have a strong southern character, or would it still be more like the northern sites we had visited?

The second dive (S289, shallow) at Annei Seamount confirmed what we had seen at the deeper site. There were many indicators of a southern fauna with the occasional stray northern species. We then proceeded to what we thought would be our last seamount visited on this voyage, Koko.

We knew the weather was beginning to deteriorate, and Koko is a very large, flat-topped seamount that has seen decades of fishing activity across the top, so we decided to do a deeper dive in case that was to be the last dive of the trip. The deep dive at Koko (S290) produced more indications that we were indeed in the Central Pacific biogeographic province. The last planned dive on this trip, scheduled for 18 August, was canceled due to weather. Had the bow thruster been operational, it might have been possible to conduct that dive.

Water samples were obtained by CTD cast at three locations, one in the northern region, at Suiko Seamount, one in the Main Gap near Jingu Seamount, and one in the south off Koko Seamount. In addition, water samples were taken for geochemical analyses and for a side project looking at environmental DNA (eDNA). Our program to look at water flow patterns was not as successful since the Expendable Current Profiler (XCP) units purchased were not manufactured correctly and so did not work as claimed. Upper level water column flow was assessed using the ADCP on the ship. We had initially planned to have an ADCP unit mounted on the ROV, but decided to use the XCP units instead. With their failure we used the ROV to visually assess current direction, but no estimates of speed were possible.

In the end, we were able to conduct 11 ROV dives; two were lost, one to equipment failure and one to weather aggravated by equipment failure. All 18 CTD hydro casts were completed successfully, although some time was lost due to hydro-winch issues resulting in the need to re-terminate the wire. We made other adjustments based on time and distance issues. With the seamounts being so large, and the likelihood of using large blocks of time for travel, we decided, for example, to forego the deep dive at Yomei and instead conduct it at the nearby but steeper-sided seamount, Godaigo. Similarly, after getting blown off at Jingu, we moved to Annei. None of these decisions compromised our scientific objectives, in our opinion.

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**:
18. **Total number of CTD casts completed during the cruise:** 18
19. **Total number of AUV dives completed during the cruise:** 0
20. **Total number of ROV dives completed during the cruise:** 12
21. **Total number of ROV samples collected during the cruise:** 273
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:** 5.43