

**30 day Preliminary Cruise Report – Unraveling Ancient Sea Level Secrets**

1. Ship Name – Falkor
2. Cruise Dates – Day Departed: 8/25/2017
3. Cruise Dates – Day Returned: 9/27/2017
4. Cruise Number: FK170825
5. Departure Port – Honolulu, HI
6. Arrival Port – Honolulu, HI
7. Mid-Cruise Port Call – Honolulu, HI
8. Mid-Cruise Port Call #2 – none
9. Participating Organizations, Institutions, Foundations, Government Agencies, etc – University of Hawaii, University of South Carolina
10. Funding Sources – University of Hawaii Research Support
11. Describe all of the geographical areas where the science occurred - Hawaii: Penguin Bank (off Molokai) & Lanai; Line Islands: (Palmyra Atoll & Kingman Reef)
12. Name of Chief Scientist – Kenneth Rubin

Organization: University of Hawaii

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1. Cruise Objectives - The goal of this expedition was to study the record of geologically rapid sea level rise in coral reefs of the last ice age to better understand the rate and timing of relative sea level change in Hawaii as compared to elsewhere, and the impacts of rapid sea level change on coral reef ecology and morphology. This was accomplished with a series of observations and sample collections of fossil coral at sea, and will be continued with follow-on studies of collected specimens (primarily geochronology, geochemistry, and microscopic texture analysis). Such records are used in global models to understand ice-melting and global/local relative sea level (RSL) change. Our study focuses on RSL reconstruction in the central Hawaiian Islands (Oahu to Lanai) and Line Islands (Palmyra, Kingman-both US holdings), especially of climatically important glacial melt water pulses.
2. Cruise Summary - This was a 2 leg cruise, with the first leg in Hawaii doing AUV sonar mapping/photo imaging and multibeam mapping using Falkor and the second leg ROV SuBastian diving and additional mapping using Falkor in both Hawaii and Palmyra Atoll and Kingman Reef in the Pacific Remote Islands National Monument. In all we successfully mapped a large intact drowned coral reef section (20km x 6km) in high resolution, and dove with the ROV at those same sites, to develop a detailed understanding of reef facies, coral colony types, and sea bed morphology at different depths on a reef structure that formed as sea level rose during the end of the last ice age. The work was focused on the 100-200 m depth range, which is challenging to work in, as described in one of the blogs from the expedition at: <https://schmidtocean.org/cruise-log-post/getting-shallow-schmidt-ocean-institute/>. The expedition also discovered, mapped and sampled deglacial coral reef deposits at Palmyra Atoll and Kingman Reef, and collected nearly 200 fossil coral specimens. Together, once shore based analyses of the these records are conducted, the data from these sites should lead to vastly improved quantitative understanding of the rates and impacts of sea level change in the Central Pacific Ocean during a period of rapid rise. These sites are among the most straight-forward in the work to interpret (as compared to other past RSL sites nearer the continents and/or in tectonically active environments) due to limited contamination with glacial isostatic adjustment and active tectonic impacts on sea level, which interfere with the pure ice-melt signature.

In detail, AUV mapping on leg 1 included 8 missions, ranging from 6 to 15 hrs in duration (promised 24 hr dives were not accomplished because of battery issues). All but one AUV sonar map was made in the Penguin Bank region west of Molokai, where Rubin has been working on Ice Age coral reefs for the past decade. Falkor MB mapping also focused in this area. This data will form the basis of an innovative remote sensing morpho-ecological reconstruction of the reef structure, ground-truthed by the leg 2 ROV (and previous HOV dives by Rubin) in the area.

**Table 1:** Leg 2 included 12 ROV dives (7 in Hawaii; 5 in the Line Islands) at the sites below:

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Dive #** | Location | Date | Start Time | Start Lat | Start Long | Start depth (m) | End Time | Notes |
| S54 | PB  mid-finger terrace | 11-Sep-17 | 13:00 | 21° 0.52621 | -157° 24.8614 | -143 | 19:00 | Test dive; ½ day |
| S55 | frodo mound | 12-Sep-17 | 7:30 | 21° 0.58465 | -157° 22.8114 | -169 | 19:00 |  |
| S56 | frodo mound | 13-Sep-17 | 7:30 | 21° 0.58499 | -157° 22.8112 | -169 | 15:30 | photosled |
| S57 | N. Lanai 1 | 14-Sep-17 | 8:25 | 20° 56.9619 | -157° 2.86417 | -170 | 11:00 | Site is all sand |
| S58 | N. Lanai 2 | 14-Sep-17 | 12:45 | 20 55.36138 | -157° 5.07581 | -165 | 17:30 | 2nd site, same day |
| S59 | Palmyra W | 19-Sept-17 | 8:08 | 5° 52.90532 | -162° 10.44966 | -194 | 14:00 | ROV problems, ½ dive |
| S60 | Palmyra W | 20-Sep-17 | 7:40 | 5° 52.75024 | -162° 10.49751 | -195 | 17:30 | Start midway through dive 59 waypoints; pull early for daylight MB at east palm |
| S61 | Kingman W | 21-Sep-17 | 7:53 | 6° 23.53128 | -162° 28.94154 | -194 | 18:35 |  |
| S62 | Palmyra E | 22-Sep-17 | 7:45 | 5 ° 52.6705 | -161° 59.94706 | -198 | 14:00 |  |
| S63 | Palmyra SE | 22-Sep-17 | 16:00 | 5 ° 51.5012 | -162° 0.911978 | -193 | 19:00 | 2nd site, same day |
| S64 | Penguin Bank | 26-Sep-17 | 7:45 | 21° 0.94305 | -157° 19.78314 | -168 | 14:00 |  |
| S65 | Penguin Bank | 26-Sep-17 | 15:45 | 21° 0.56105 | -157° 20.97727 | -167.8 | 19:00 | 2nd site, same day |

As noted above, nearly 200 geological specimens were obtained. The PI also invited a graduate student deep sea coral biologist on the expedition, who collected 47 specimens of octocoral for a biogeographical study of a University of Hawaii colleague. Numbers of days lost for various reasons: weather (0); ship issues (3.5 for slow transit speed. "pratice" ROV dives near shore and usbl calibration); lost/broken/delayed science equipment (0.5 for stuck AUV). Recommendations and details of issues with the ship were provided separately on the post-cruise assessment form.

1. Did you collect Measurements or Samples, including Biological Specimens – yes
2. Did you deploy and/or recover any Moorings, Bottom Mounted Gear, or Drifting Systems? – transponders
3. Equipment Used - AUV Remus 600 (WHOI) including navigational transponders and ROV SuBastian
4. Will you be submitting Station Plots? Yes, forthcoming
5. Other - This expedition was just the second science mission for the ROV SuBastian, and occurred in a ground-breaking depth range (shallow seas) that is particularly difficult to work in. Fundamental discoveries made on the expedition regarding the nature, rate and impacts of past sea level change as read through coral reef deposits will lead directly to improved predictions of future sea level change in Hawaii and elsewhere, which has the potential to impact at some level a large fraction of earth's population that lives near or at the coastal zone worldwide.