

Letters of Intent: Lau Basin
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Hydroacoustic Monitoring and Analysis of Tectono-Volcanic Earthquakes within the Lau Basin Integrated Study Site

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We propose a three-year deployment of seven autonomous underwater hydrophones (AUHs) to monitor seismicity within the R2K Program's Lau Basin Integrated Study (IS) Site. This array will take advantage of the more efficient propagation of sound in the oceans, relative to the solid Earth, allowing us to detect and locate seismically generated T-waves associated with shallow-hypocenter events along the Eastern Lau Spreading Center (ELSC). A catalog of small-to-intermediate size (>2.5-3.0 mb) earthquakes will be produced and made available to the R2K and ocean science communities as the hydrophone data are processed following annual recovery/deployment cruises. This will allow rapid integration of the seismo-acoustic data with other hydrothermal, petrological and geological datasets from the Lau Basin.

The R2K program seeks to understand the complex linkages that facilitate the flow of energy and material from the mantle into the overlying oceans. As earthquakes represent first-order perturbations to the ridge system, which can be used to track a number of important lithospheric processes, obtaining a record of their spatial and temporal history is essential to the success of this program. We will utilize the hydroacoustic waveform data and T-wave derived earthquake catalog to:

- 1) Evaluate the impact of earthquakes on the hydrothermal system: Our seismic catalog will help to constrain the time and length scales associated with a hydrothermal system's response to small-to-intermediate size earthquakes and provide critical information for the interpretation of repeated or in situ measurements of a geophysical, geochemical or biological nature.
- 2) Examine the temporal and spatial pattern of earthquake production along the ELSC: Integration with previously funded mapping and sampling studies should allow us to develop a comprehensive seismo-tectonic model of the ELSC and examine how its very pronounced along-axis changes in spreading rate, morphology and magma supply correlate with the distribution and clustering of seismicity.
- 3) Quantify the properties of individual earthquake sequences, with emphasis on the discrimination of magmatic and tectonic activity: A quantitative assessment of earthquake sequences often is necessary to properly interpret the triggering mechanism and sort out the relative impacts of magmatic and tectonic processes on other aspects of the ridge system.
- 4) Monitor the spreading centers and volcanic arc for volcanic tremor and constrain those factors controlling its generation in the submarine environment: The Lau Basin's back-arc setting provides a unique opportunity to study submarine harmonic tremor associated with both a silicic arc and compositionally diverse spreading centers. In particular, we hope to constrain the relative influence of seafloor depth and the explosive/non-explosive nature of a submarine volcano on tremor generation.

Because the array will record a variety of natural and man-made noises, the broader impacts of this monitoring effort will be significant and the data will facilitate a wide-range of studies beyond the scope of this proposal. Examples include the use of seismic body-wave arrivals to constrain the velocity structure of the solid earth and the use of T-waveforms to constrain and improve theoretical models of T-wave generation and propagation. Cetacean vocalizations recorded in the basin will allow estimates of the distribution and migration pattern of large baleen whales for a region where little previous information exists. Hydroacoustic data also can be used to estimate sound intensity levels during future airgun experiments and help to assess the impacts airguns have on marine mammal populations.

The efficient distribution of data has been critical in building a truly integrated R2K science community and encouraging public interest. We will maintain a website that provides hydroacoustic data and earthquake locations from the Lau Basin as well as education (e.g. fundamentals of ocean acoustics) and outreach pages (interactive cruise-websites for school children).

We welcome both educational and scientific collaborations at all stages of the research. Contact Del Bohnenstiehl (LDEO del@ldeo.columbia.edu 845-365-8382) for additional information.