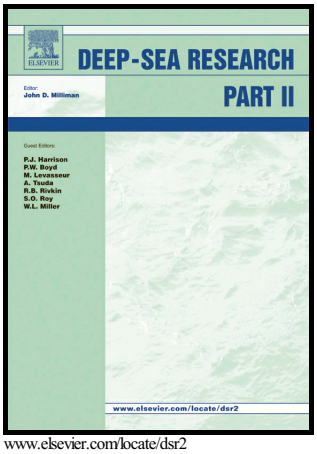

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Complementary acoustic and optical methods for characterization of diffuse venting, gas seeps, and biota distributions at hydrothermal systems: A case study at Kick'em Jenny Volcano, Grenada, West Indies

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ABSTRACT

Quantitatively assessing the impact of hydrothermal circulation on geological and biological systems in submarine environments requires accurate characterization of biota, fluid flow, and, in many shallow systems, gas discharge. In a single vent field, the surface expression of hydrothermal venting and vent biology is often widespread, presenting a significant technical challenge to such characterizations. Typically, attempts to overcome this challenge involve extrapolation of point measurements to estimate field-scale parameters. Extrapolation introduces large uncertainties, however. We present a case study at the Kick'em Jenny Volcano, Grenada, West Indies that jointly applies a set of complementary acoustic and optical measurement methods to significantly reduce uncertainty in field-scale flux estimates of diffuse venting and bubble streams, as well as distributions of biological mats. Two classes of ROV-based methods are used: 1) survey-level techniques for accurately locating fluid and gas discharge across entire vent fields, and 2) local techniques that accurately measure fluid or gas fluxes just above a vent orifice. Survey level techniques included a structured light laser system to locate active diffuse venting and biological mats, and a high-resolution downward facing multibeam system that can resolve individual bubble streams separated by only centimeters. Local techniques included processing of stereo imagery to determine bubble stream parameters (rise rate, bubble size) and application of the Diffuse Flow Velocimetry technique to determine upwelling rates of diffuse effluent. Joint application of these methods provides a several times increase in the number of identified bubble streams relative to ship-board systems and a difference of up to 40 times in field-scale diffuse volume flux estimates relative to currently available techniques.

Keywords: hydrothermal flow, bubbles, seafloor mapping, lasers, classification, diffuse venting

Regional Terms: Lesser Antilles, Grenada, Kick'em Jenny Volcano, 12.30°N 61.64°W