RAPID DEVELOPMENT OF BIOLOGICAL COMMUNITY STRUCTURE AND ASSOCIATED GEOLOGICAL FEATURES AT HYDROTHERMAL VENTS AT 9°-10° NORTH, EAST PACIFIC RISE

Timothy M. Shank[1], Daniel J. Fornari[2]
Margo Edwards[3], Rachel Haymon[4]
Marv Lilley[5], Karen Von Damm[6], Richard A. Lutz[1]
[1]Institute of Marine and Coastal Science, Rutgers University, New Brunswick, NJ 08903 USA
[2]Dept. of Geology and Geophysics, Woods Hole Oceanographic Institution, Woods Hole, MA 02543 USA
[3]Hawaiian Institute of Geophysics, University of Hawaii at Manoa, Honolulu, HI 96822 USA
[4]Dept. of Geological Sciences and Marine Science Inst., University of California, Santa Barbara, CA 93106 USA
[5]School of Oceanography, University of Washington, Seattle, WA 98195 USA
[6]Dept. of Earth Sciences, University of New Hampshire, Durham, NH 03824 USA

ABSTRACT

The discovery of newly formed hydrothermal vents in April 1991 at areas of recent volcanic activity between 9°45' and 9°52'N on the East Pacific Rise (EPR, depth 2500m) afforded the first opportunity to follow initial biological and geological changes at a number of deep-sea hydrothermal vents. Photographic images taken by the ARGO optical/acoustical system in 1989 had documented well-developed vent communities just sixteen months prior to this discovery. During the course of a submersible dive series in 1991 it became apparent that ongoing eruptions had caused dramatic alterations in the distribution and character of the vent fauna since 1989. These observations, using the DSV Alvin during the eruptive period (April 1991), revealed expansive areas of newly formed terrain extensively draped by 10 to 20cm thick mats of colonizing bacteria. Several areas were characterized by scorched vestimentiferan tissue, burnt and broken mussel shells, and beds of mussels overrun by fresh laval flows. Hydrothermal vent fluid in excess of 400°C was recorded and sampled. Sulphide-laden "black smoke" was observed emanating from bare basalt, whereas hydrogen sulphide concentrations were an order of magnitude higher than ever recorded with pH's of 2.6.

As a result of this discovery, 210 specially designed polyethylene markers were deployed along a 1.37 km segment of the Axial Summit Caldera (ASC) of the EPR between 9°49.61' and 9°50.36'N in March 1992. This transect, which traverses numberous active high temperature vent fields (300-403°C) and zones of low temperature diffuse flow (15-35°C), was extensively documented utilizing a variety of optical imaging systems. Data has been collected from over 16,400 still 35 mm images, 215 hours of 8 mm and Hi-8 mm video, and 2400 electronic still camera (ESC) images. Photographic, chemical and temperature data obtained during five field programs that took place before, during, 11 months, 32 months, and 35 months after the 1991

volcanic event have enabled us to assess temporal changes in geological features, vent fluid geochemistry and biological community structure. To date our field studies have documented: 1) the dramatic colonization of large, thriving populations of reproductively mature Riftia pachyptila where previously there had been only small, sparsely distributed clumps of Tevnia jerichonana, 2) the rapid growth of several new sulfide chimneys 7-10m in height, and 3) the establishment of robust hydrothermal communities including the proliferation of brachyuran and galatheid crabs, zoarcid fish, and swarming amphipods.

The serrendipitous discovery of a volcanic eruption in April 1991 has provided, for the first time, the opportunity to document temporal and spatial changes in hydrothermal vent community structure from the apparent origination of several deep-sea hydrothermal vents. These observations have profoundly altered the conventional perception of timescales on which biological processes operate as deep-sea hydrothermal vents.