The Hydrothermal Vent Community at 31°S on the East Pacific Rise

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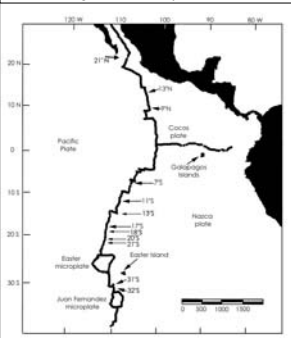
Abstract

Deep-Sea Hydrothermal vents are unique, recently discovered habitats containing new and unusual species with similar evolutionary adaptations. Sites vary from one another, and many are still undescribed or undiscovered. As the first description of this site, we have mapped, classified, and described habitats at 31°S, as well as discussed significant information about the site. This provides a baseline for future study of the site, especially if the site changes dramatically before the next visit.



←The East Pacific Rise

This Map of the East Pacific Rise demonstrates the layout of sites along the EPR as well as the various tectonic plates involved. Note that the Easter microplate separates the two southernmost sites from the rest.

The *Alvin* Submersible →

Introduction

In 1977, the submersible *Alvin* discovered the first deep-sea hydrothermal vent along the Galapagos Rift spreading center (*Lonsdale*, 1977). Since that time, many vents have been discovered, and their biological communities described. During the 1980s alone, over 20 new families, over 90 new genera, and almost 300 new species were registered from hydrothermal vent environments (Reviewed in: *Lutz and Kennish*, 1993). New hydrothermal vents are regularly discovered, described, and revisited. 9°N on the East Pacific Rise (EPR) has been particularly thoroughly described. In 1991, an eruption covered parts of 9°N allowing scientists to observe the development and succession of a vent community from its "birth" (*Shank et al.* 1998).

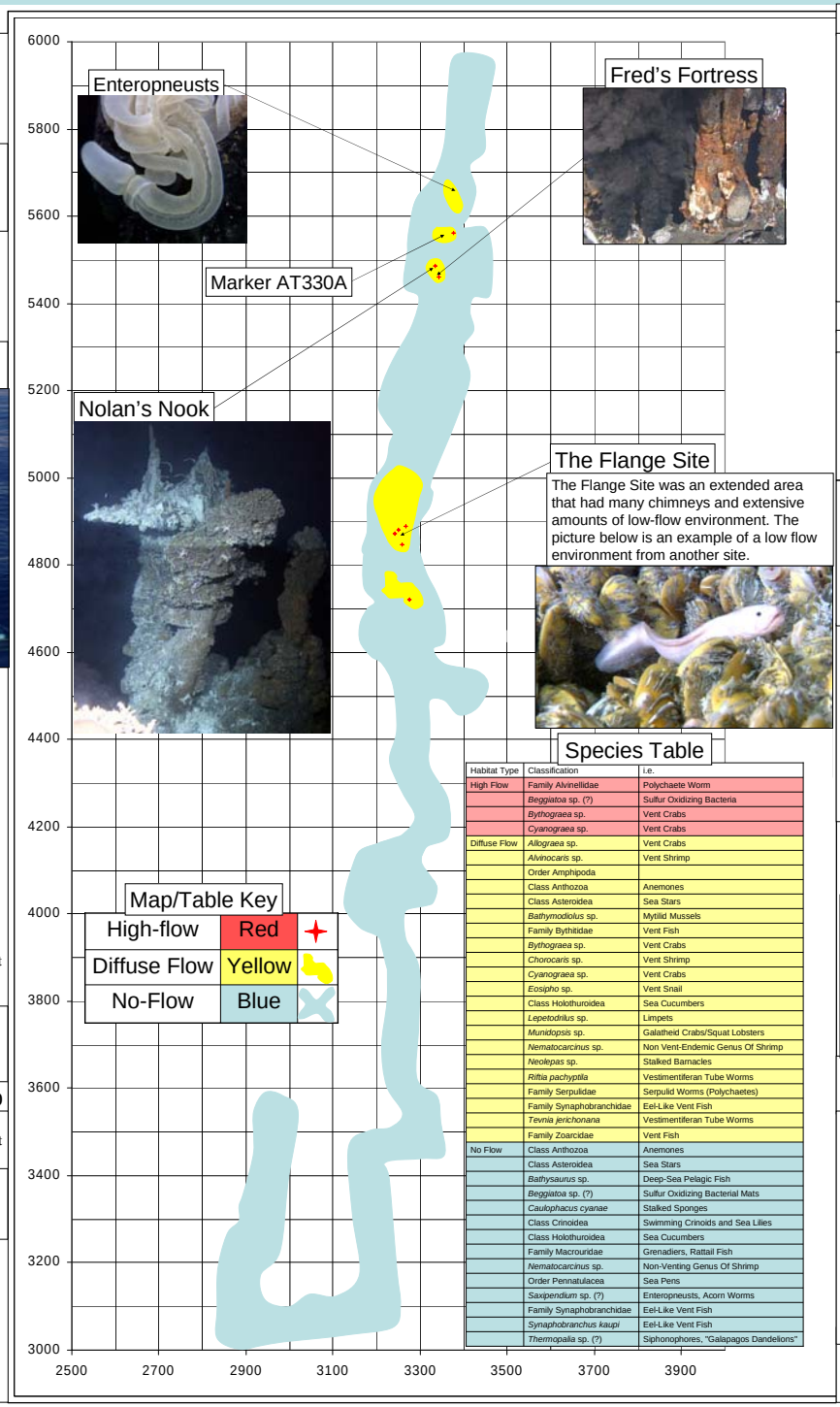
Many deep-sea hydrothermal vents have been previously characterized and compared to other sites. Communities at hydrothermal vents in different ridge axes share much in common but differ in species composition, abundance, and distribution. A similar phenomenon occurs within the same ridge axis along different sites. The communities at sites on the southern East Pacific Rise have been reported to be similar to the sites along the northern EPR; however, 31°S is one of two sites on the southern East Pacific Rise that are separated from other vents by the Easter microplate (see map, below), which may isolate them to some extent from other sites (*Won et al.*, 2003). Because of this situation and the fact that 31°S is undescribed to date, it may prove both interesting and useful to scientists in the future. This study provides a description of 31°S and a baseline to elucidate future changes.

A Galatheid Crab

These were much less common at 31°S than at most other sites on the EPR.

Materials and Methods

Video data was gathered using the submersible *Alvin*, which utilized multiple cameras recording to two video recorders. Description of the site was based on these recordings and samples gathered directly from the site. At 31°S, *Alvin* made three dives totaling approximately 30 hours of bottom time footage. The footage bears video, time, location, and temperature data and has allowed the assembly of a map illustrating the primary biological habitats. Organism identification was made using preserved specimens, identification books, identification papers from the literature, and reference photographs. Hydrothermal was approximated visually. Most species were identified to the genus level, but specificity of classification varied according to information available.



Species Table

Habitat Type	Classification	i.e.
High Flow	Family Alvinellidae	Polychaete Worm
	Beggiatoa sp. (?)	Sulfur Oxidizing Bacteria
	Bythograea sp.	Vent Crabs
	Cyanograea sp.	Vent Crabs
Diffuse Flow	*Allograea* sp.	Vent Crabs
	Alvinocaris sp.	Vent Shrimp
	Order Amphipoda	
	Class Anthozoa	Anemones
	Class Asteroidea	Sea Stars
	Bathymodiolus sp.	Mytilid Mussels
	Family Bythitidae	Vent Fish
	Bythograea sp.	Vent Crabs
	Chorocaris sp.	Vent Shrimp
	Cyanograea sp.	Vent Crabs
	Eosipho sp.	Vent Snail
	Class Holothuroidea	Sea Cucumbers
	Lepetodrilus sp.	Limpets
	Munidopsis sp.	Galatheid Crabs/Squat Lobsters
	Nematocarcinus sp.	Non Vent-Endemic Genus Of Shrimp
	Neolepas sp.	Stalked Barnacles
	Riftia pachyptila	Vestimentiferan Tube Worms
	Family Serpulidae	Serpulid Worms (Polychaetes)
	Family Synaphobranchidae	Eel-Like Vent Fish
	Tevnia jerichonana	Vestimentiferan Tube Worms
	Family Zoarcidae	Vent Fish
No Flow	Class Anthozoa	Anemones
	Class Asteroidea	Sea Stars
	Bathysaurus sp.	Deep-Sea Pelagic Fish
	Beggiatoa sp. (?)	Sulfur Oxidizing Bacterial Mats
	Caulophacus cyanae	Stalked Sponges
	Class Crinoidea	Swimming Crinoids and Sea Lilies
	Class Holothuroidea	Sea Cucumbers
	Family Macrouridae	Grenadiers, Rattail Fish
	Nematocarcinus sp.	Non-Venting Genus Of Shrimp
	Order Pennatulacea	Sea Pens
	Saxipendium sp. (?)	Enteropneusts, Acorn Worms
	Family Synaphobranchidae	Eel-Like Vent Fish
	Synaphobranchus kaupi	Eel-Like Vent Fish
	Thermopalia sp. (?)	Siphonophores, "Galapagos Dandelions"

Results

The vent field at 31°S is in 2300m of water and is made up of three habitats.

1. No-flow habitats consist of a bare basalt substrate with water temperature of ~2°C (Reviewed in: *Van Dover*, 2000). There is no apparent venting. These habitats support benthic fauna in elevated numbers well as exclusively vent species.

2. Diffuse-flow habitats consist of a bare basalt or sulfide substrate with water temperature of 2-20°C (Reviewed in: *Van Dover*, 2000), and diffuse venting. Species composition seems to be determined flow rate. Anemones predominate in low flow, mussels in medium flow, and tube worms in high flow. Flow at these sites is changing, providing organisms alternately with oxygen and sulfur (Reviewed in: *Van Dover*, 2000).

3. High-Flow habitats consist of a sulfide substrate, temperature greater than 20°C (Reviewed in: *Van Dover*, 2000), and vigorous hydrothermal flow. Very little macrofaunal variety was observed.

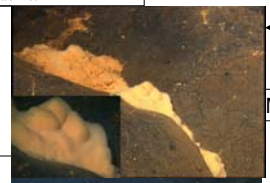
Discussion

There were several notable things about 31°S.

These sites support the *Eosipho* and *Chorocaris* genera, not previously observed on the EPR. Previously, these genera have only been found in the western Pacific. This anomaly suggests isolation from the other EPR sites and raises questions as to how organisms from these genera got from western to eastern pacific.

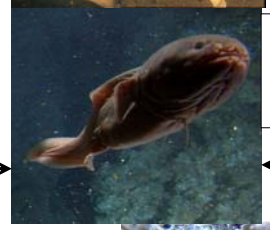
Riftia and *Tevnia* species are much less prevalent at this site than at northern EPR sites, possibly because of community succession, or varying chemistry.

Yellow mats between sites were a notable feature. The yellow color implies a sulfurous nature, but their consistency indicates a bacterial nature, like *Beggiatoa* sp., perhaps stained with sulfur.



Mat at 31°S

Bythitid fish were seen positioning themselves in diffuse flow. Reasons for this are not known. The video gives the impression that the fish prefer the temperature of the flow. They could be feeding on organisms in the flow, but prey was not evident in the video.



Reference photos from other sites.

There was a notable lack of alvinellids on the chimneys of black smoker vents. This could be because venting fluids were well contained within the chimneys so that insufficient flow reached the outside of the chimney for alvinellid growth. It could also result from a fluid chemistry that is unfavorable to prokaryote symbionts.

References and Acknowledgements

- Lonsdale P., "Structural geomorphology of a fast-spreading rise crest: The East Pacific Rise near 3°25′S". Mar. Geophys. *Res., 3*, 251-293, 1977.
- Lutz R.A., M.J. Kennish. "Ecology of Deep-Sea Hydrothermal Vent Communities: a Review". Reviews of Geophysics, Vol. 31, No. 3, August 1993, 241-242. 1993
- Shank T.M., D.J. Fornari, K.L. Von Damm, M.D. Lilley, R.M. Haymon, R.A. Lutz. "Temporal and special patterns of biological community development at nascent deep-sea hydrothermal vents (9°50′N, East Pacific Rise)". *Deep-Sea Research II, 45*, 465-515, 1998.
- Van Dover C.L. The Ecology of Deep-Sea Hydrothermal Vents. New Jersey: Princeton University Press. 2000.
- Won Y., C.R. Young, R.A. Lutz, R.C. Vrijenhoek. "Dispersal barriers and isolation among deep-sea mussel populations (Mytilidae: *Bathymodiolus*) from eastern Pacific hydrothermal vents". *Molecular Ecology*, *12*, 169-184, 2003.

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