

In Situ Measurement of Rates of
Chemoautotrophic Carbon Production at Deep-Sea
Hydrothermal Vents*

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Carbon Fixation by Riftia

The two carbon fixation pathways (CBB, rTCA) in Riftia are regulated by environmental conditions, internal heterogeneity, or whether both pathways operate simultaneously.

K. T. Scott (Univ. So. Florida) and Pete Girguis (Harvard)

**Exploration of Seafloor Geological Activity
Associated with Off-Axis Magma Lenses**

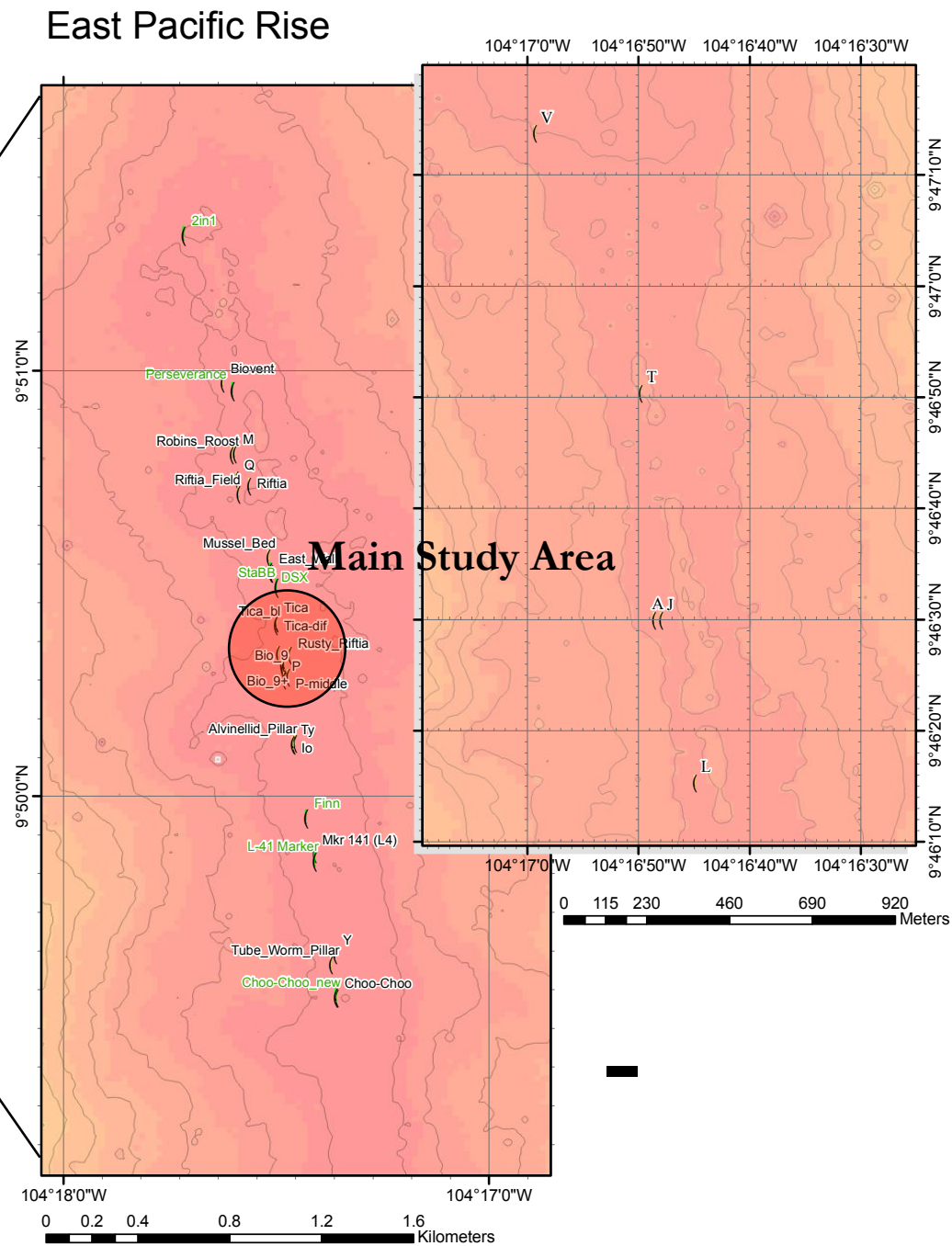
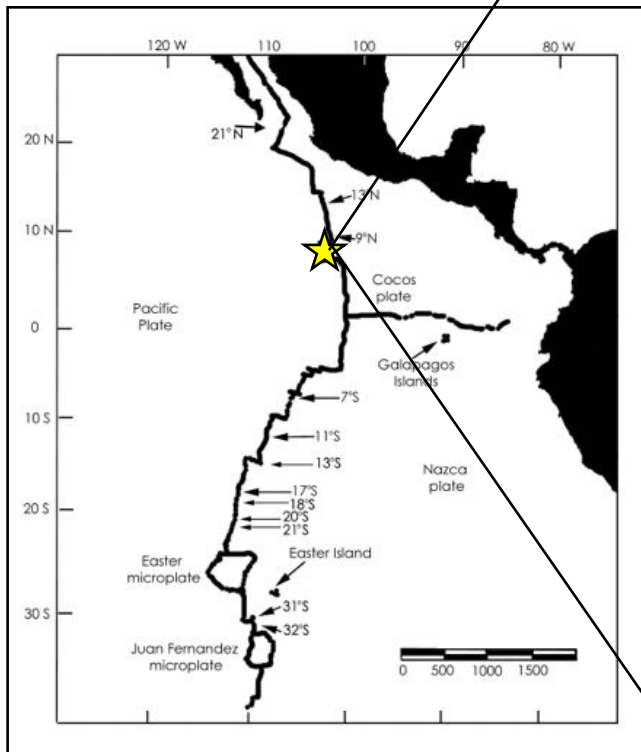
Scott White (Univ. So. Carolina)



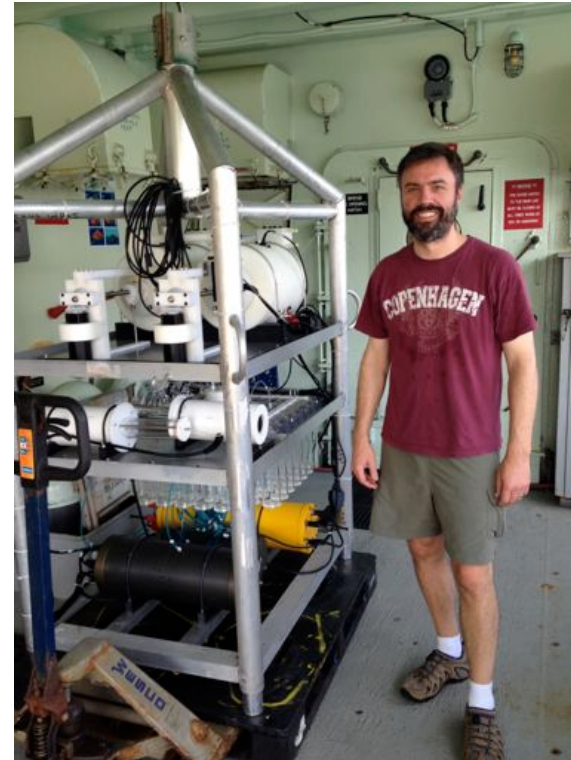
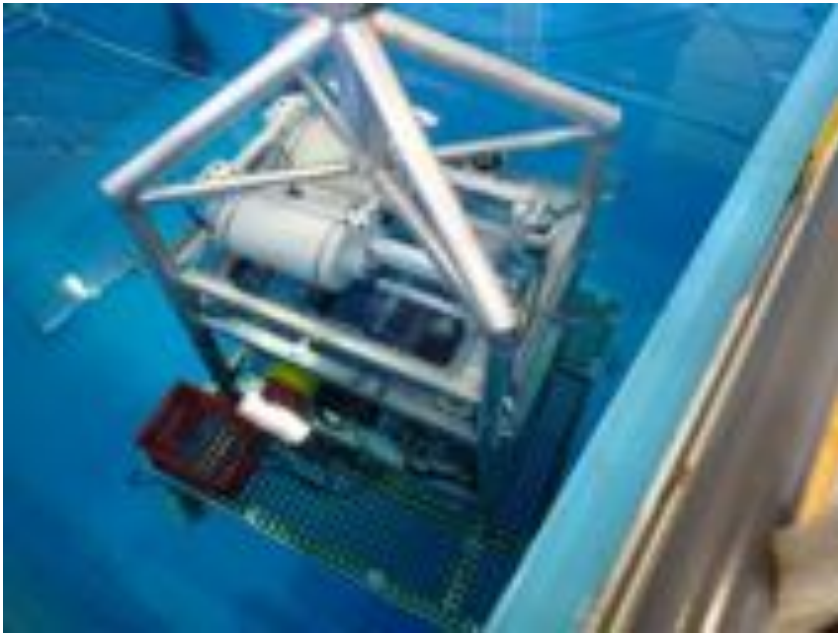
QUESTIONS

- **What are the dominant chemoautotrophs?**
 - Which carbon fixation pathway(s) are they using?
 - What is the relative importance of different carbon fixation pathways?
 - Which metabolic pathways are they using to generate energy?
 - What are the conditions under which corresponding enzymes are expressed?
 - What are the actual activities of microbes and the rates of the processes catalyzed by them?
 - How efficiently is the energy being utilized and transformed into biomass?
 - Are cultivated organisms representative for natural populations?
- **How much carbon is produced?**
- **What is the nature and extent of the subseafloor biosphere?**

Summary of AT26-23 East Pacific Rise



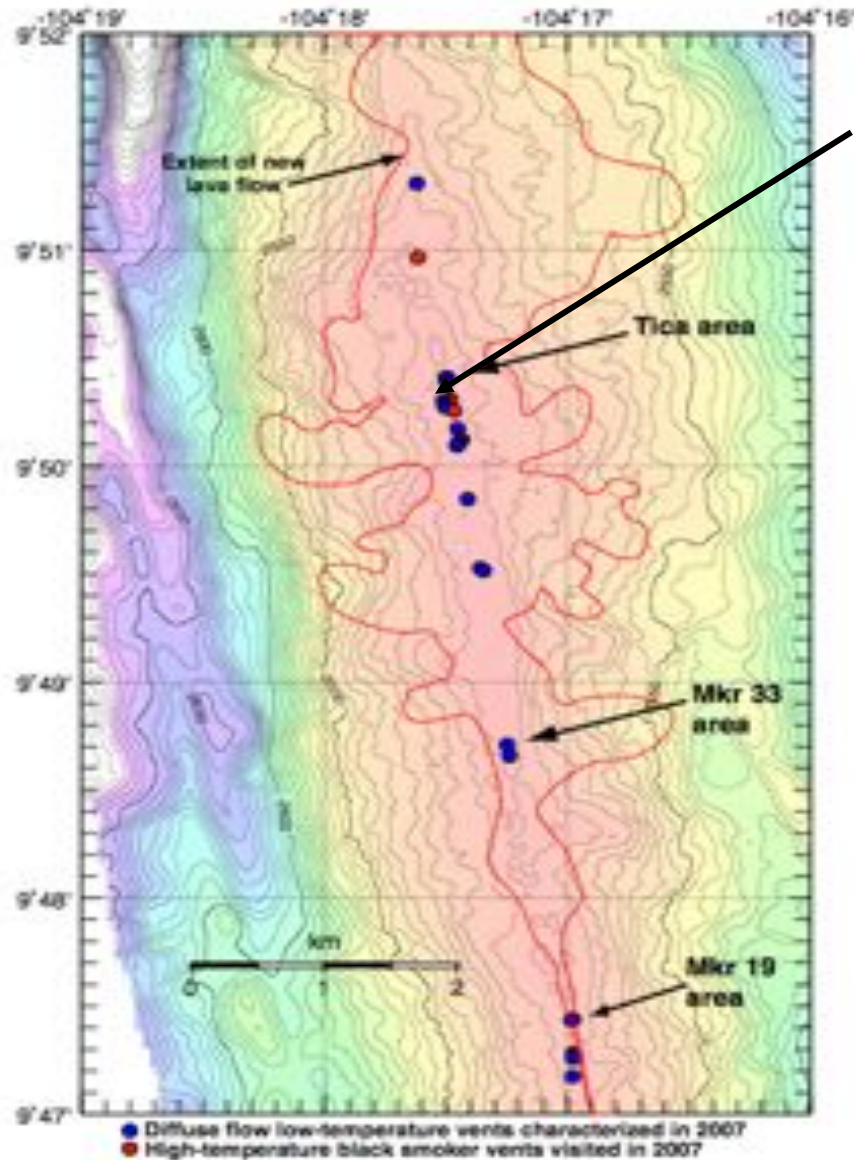
Vent-SID: Vent - Submersible Incubation Device



- Obtain *in situ* rates of chemoautotrophic carbon fixation at a deep-sea hydrothermal vent site.
- Obtain *in situ* nitrate reduction rate measurements at a deep-sea hydrothermal vent site.
- Directly correlate the measurement of these processes with the expression of key genes involved in carbon and energy metabolism.

'CRAB SPA' AT 9°50'N ON EAST PACIFIC RISE

A MODEL SYSTEM TO STUDY CHEMOAUTOTROPHIC PROCESSES AT DEEP-SEA VENTS



Crab Spa at Tica

Temp: ~24-30°C

H₂S: 0.3 - 1 mM

H₂: ~5 μM

pH: 5.8

O₂: 2-50 μM

Sampled in Jan '07, Jan '08, Oct '08, May '10, May '12, Jan '14, Nov '14

Map courtesy of Adam Soule, WHOI

Dive Program

Day		Dive	Scientific Observer	Pilot	Vent-SID	LVP	CTD Night	Sandwiches
1	Nov 5	Dive 4761	Sievert/McNichol	Bob				
2	Nov 6	Dive 4762	Scott/PIT	Bruce/PIT Jefferson	Wire down		x	
3	Nov 7						x	
4	Nov 8	Dive 4763	Taylor/Rich	Phil	Deploy		x	
5	Nov 9	Dive 4764	Seewald/Wang	Bob	Recover		x	
6	Nov 10	Dive 4765	Felbeck/Giovanelli	Bruce			x	
7	Nov 11	Dive 4766	Sylva/PIT	Phil/PIT Jefferson	Wire down			
8	Nov 12	Dive 4767	Sievert/Mino	Bob	Deploy		x	x
9	Nov 13	Dive 4768	Seewald/Panzarino	Bruce	Recover	Wire down		
10	Nov 14	Dive 4769	Sievert/Signori	Phil		Deploy	x	
11	Nov 15	Dive 4770	Sylva/PIT	Bob/PIT Chris		Recover		
12	Nov 16	Dive 4771	White/Lee	Bruce		Wire down		
13	Nov 17	Dive 4772	Felbeck/Leonard	Phil	Wire down	Deploy/Recover		
14	Nov 18	Dive 4772	Sievert/Barone	Phil	Deploy	Recover	x	
15	Nov 19	Dive 4773	Scott/Gonzalez	Bob	Recover			
16	Nov 20	Dive 4774	White/Götz	Bruce				
17		Dive 4775						



14 out of 16 Alvin Dives

- **Fluid samples:**
 - IGTs: 48
 - Incubations: 32/35 (Crab Spa)
 - Chemistry: 13/13 (Bio9, Pvent, Riftia crack, Riftia patch, Flea vent)
 - Wheat samplers: 16
 - Major sampler: 0/1
- **Biological samples**
 - Riftias: 9 collections, 23 Riftias for Horst/Tjorven, 60+ samples for pressure experiments
 - Mussels: 1 main collection, a few opportunistic samplings
 - Alvinella: A few opportunistic samplings
- **Rock samples**
 - Chimneys: Bio9, Pvent, Riftia Patch near Crab Spa
 - Basalt: Crab Spa, off-axis EPR samples
- **Push cores**
 - 16 total (off-axis)
- **Deployments**
 - Vent-SID deployment: 3
 - LVP deployment: 2 (one background seawater)
 - CV colonizers: 4 deployed and 5 recovered
 - Mineral colonizers: 1 x 13 day deployment
- **Night Program: CTD (8 casts)**
 - ORP anomaly over nearest Lamont Seamount to EPR
 - Analyses in OMZ: nutrients and incubation
- **First time divers**
 - 10 (5 male, 5 female)
- **Successful blog**