Press Releases

October 14, 2014
JAMSTEC

Shinkaia crosnieri Obtains Nutrition from Epibiotic Bacteria Found on Setae

~ Nutritional Relationship between Epibiotic Chemosynthetic Bacteria and Deep-sea Invertebrate Clearly Demonstrated ~

1. Overview

A research group led by Dr. Tomo-o Watsuji, Department of Subsurface Geobiological Analysis Research, Japan Agency for Marin-Earth Science and Technology Science (JAMSTEC: Asahiko Taira, President) successfully obtained direct evidence that the predominant deep-sea vent invertebrate Goemon-Koshiori-Ebi (*Shinkaia Crosnieri*) in the Okinawa Trough hydrothermal systems is nutritionally sustained by host-associated chemosynthetic bacteria.

While deep-sea vent invertebrates associated with epibiotic microbial community have been frequently discovered around the world, the nutritional relationship between epibionts and host animals has not been directly shown and its mechanism remains unclear. This study, which demonstrated that chemosynthetic bacterial epibionts are digested and absorbed by the host as a nutrition source, is expected to make significant contributions to elucidating the mechanism of nutritional transfer in ectosymbiosis between chemosynthetic bacteria and deep-sea invertebrates.

This result has been posted on the online ISME Journal on October 14 (11:00PM JST).
Title: Molecular evidence of digestion and absorption of epibiotic bacterial community by deep-sea crab *Shinkaia crosnieri*

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Shinkaia crosnieri

Shinkaia crosnieri is a galatheid crab that predominantly dwells in deep-sea hydrothermal vent areas of Okinawa Trough. It has numerous hairs and a carapace length of 5 cm.

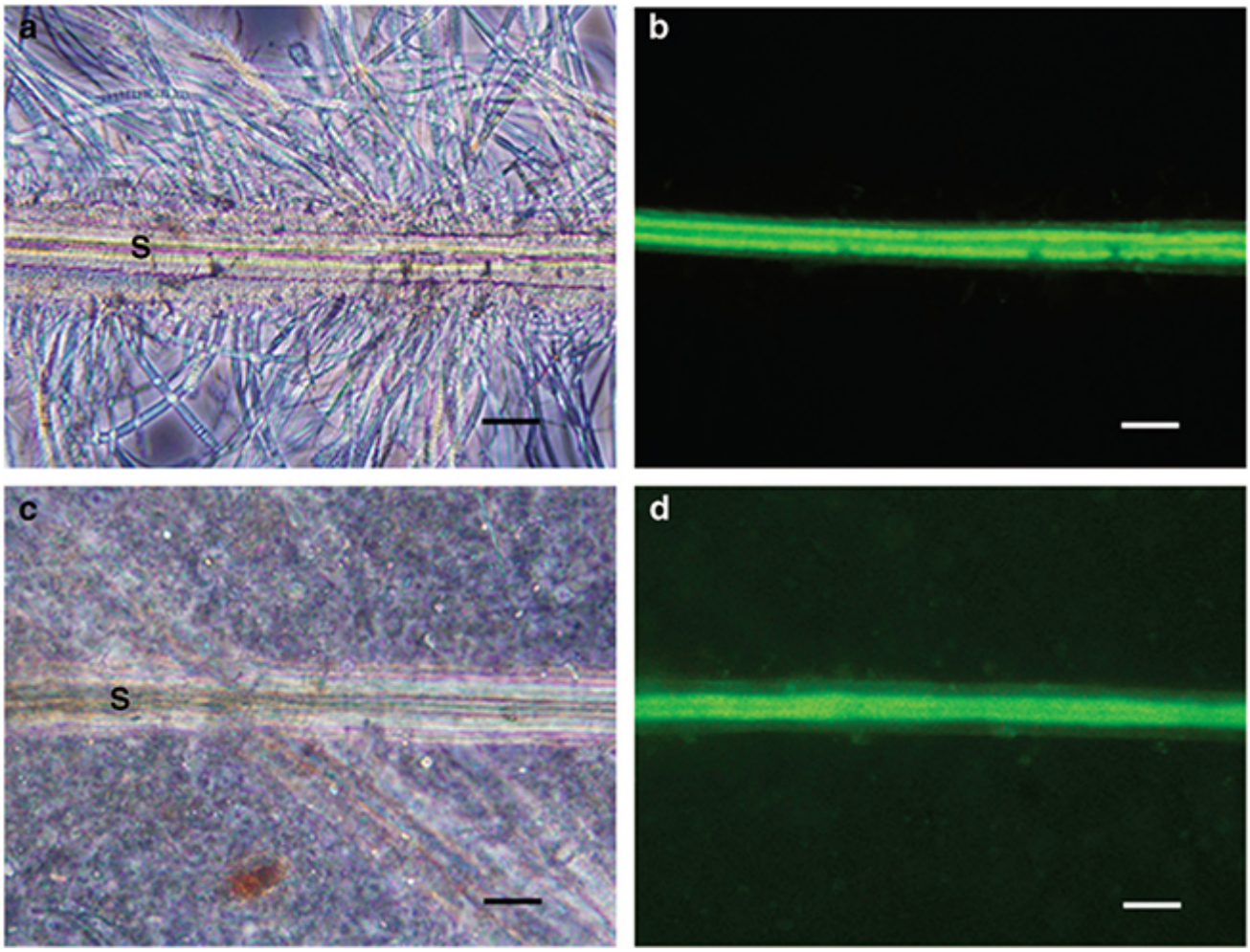

Figure 1: Optical and fluorescence microscopic observation of *S. crosnieri* setae. Optical and fluorescence microscopy of setae cut from a living S. crosnieri and of setae found in an *S. crosnieri* intestine is shown in the top panels (a, b) and in the bottom panels (c, d), respectively. Fluorescence microscopy shows the intrinsic fluorescence of setae (b, d). Optical microscopy shows the dense filamentous epibiotic populations and the typical morphological appearance of setae in a living individual (a) but the absence of epibionts on setae in the intestine (c). Capital S indicates a seta. Scale bars.50 μm (a–d).

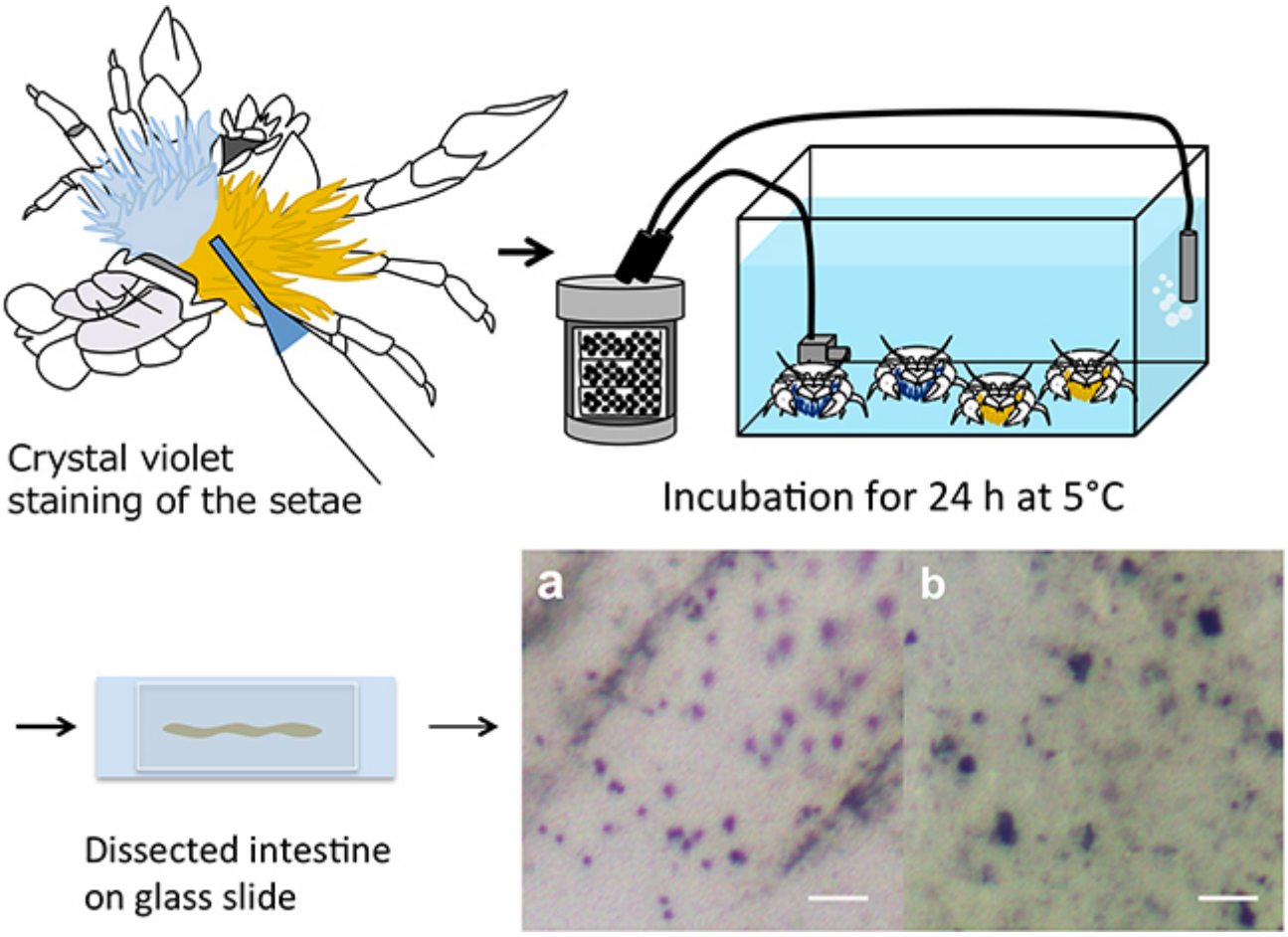

Figure 2: Microscopic observation of intestine ingredients in living *S. crosnieri* individuals with and without dye-labelled epibiont tracer experiment. Intestines and their ingredients obtained from a *S. crosnieri* individual (a)with crystal-violet-stained epibionts and (b) with unstained epibionts. Scale bars = 20 μm (a and b).

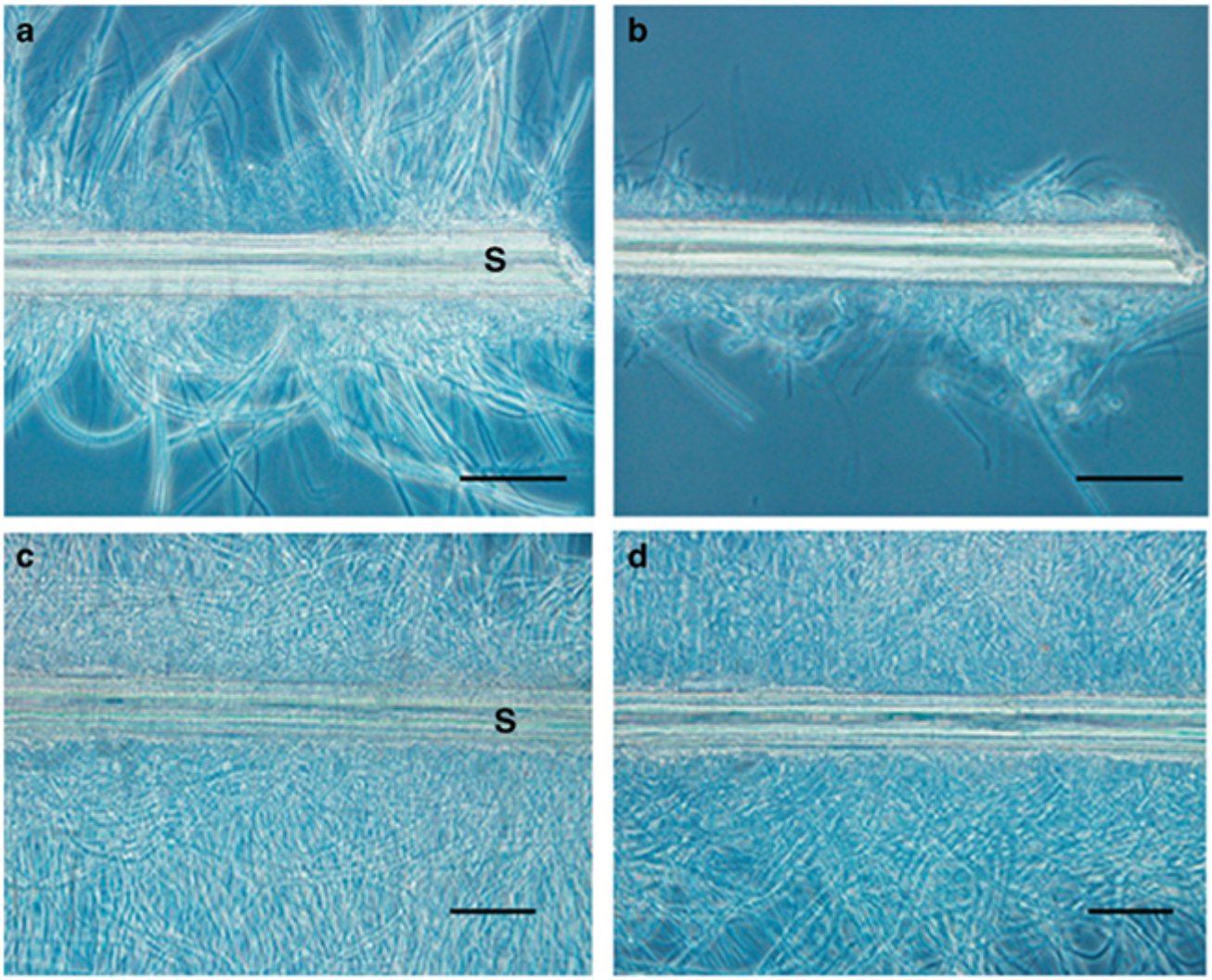

Figure 3: Microscopic observations of setae incubated with and without intestinal extract. Optical microscopy was performed to analyse setae dissected from a *S. crosnieri* individual before (a, c) and after (b, d) incubation with (a, b) and without (c, d) intestinal extract.
Capital S indicates a seta. Scale bars.50 μm (a and b).

Table 1: Activity of digestive enzymes in the intestinal extract.

	α-Amylase	Lipase	Protease
Specific activity (U/mg protein)	22.3	2.2	351

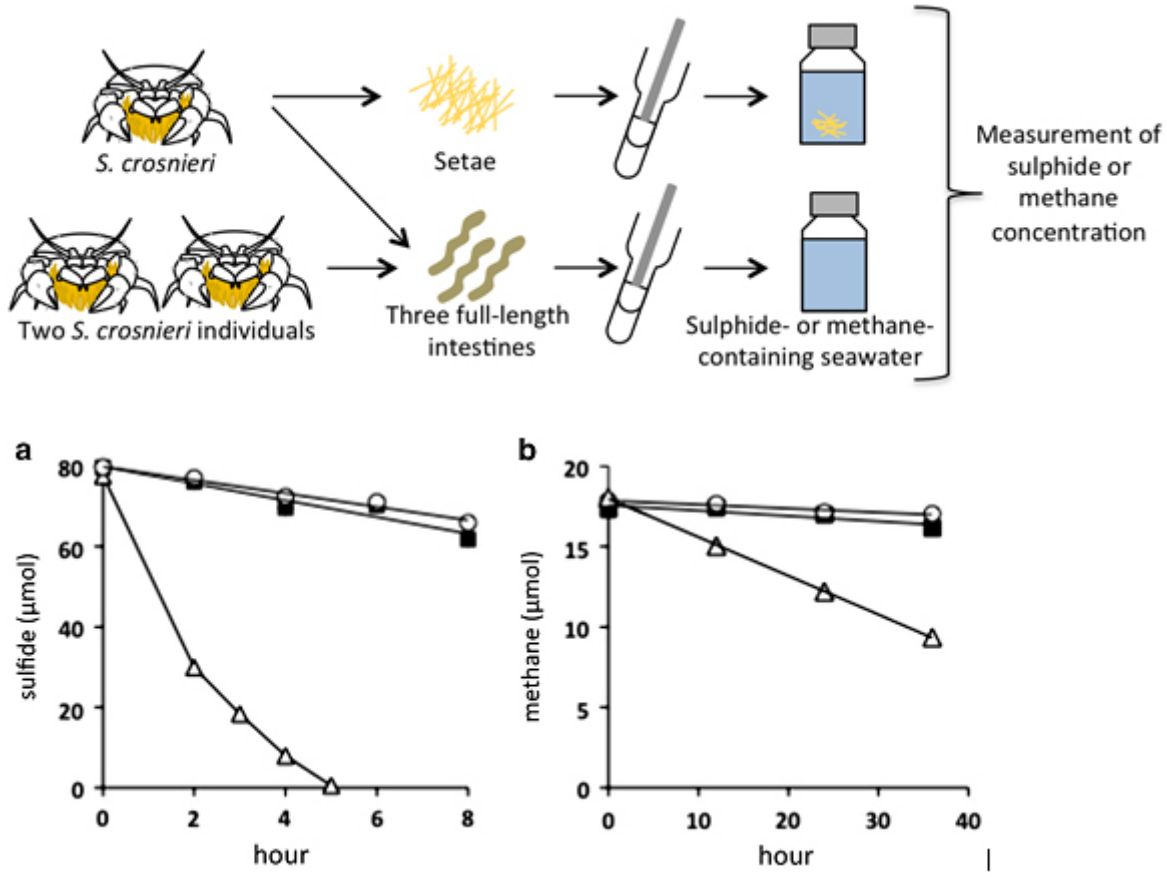

Figure 5: Time course of consumption of sulphide and methane by homogenates of S. crosnieri intestine and setae with epibionts. The concentrations of sulphide (a) and methane (b) were examined at the indicated intervals in the absence of the homogenate sample (■) and in the presence of homogenized setae with epibionts (△) and homogenized intestines (○).

Table 2: Stable carbon isotope compositions of different tissues of a living *Shinkaia crosnieri* individual and a dissected intestine before and after ^{13}C-labelled bicarbonate tracer experiments

Labelled specimen	Tissue	δ^{13}C (‰)		Enrichment of ^{13}C/^{12}C	Total organic carbon/ whole tissue (mmol)	Assimilated ^{13}C/whole tissue
		Natural abundance	†After incubation	(%)		(μmol)
	Setae	−36.4	3530 ± 78	370 ± 8	3.3	133 ± 3
S. crosnieri	Intestine	−33.4	−19.5 ± 0.3	1.4 ± 0.03	1.4	0.22 ± 0.005
	Muscle	−32.6	−22.8 ± 0.1	1.1 ± 0.01	29.1	3.2 ± 0.03
Dissected intestine	-	−33.4	−0.5 ± 0.6	3.4 ± 0.06	1.3	0.48 ± 0.009

†Values were measured in triplicate and were expressed as mean ± standard deviation.

Shinkaia crosnieri during “eating” (Video)

Shinkaia crosnieri at Great Depths (photo taken during Hyper Dolphin cruise) (Video)

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