

IODP Proposal Cover Sheet

☐ New☒ Revised☐ Addendum**601-Full3**

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Title:	The DEEP HOT BIOSPHERE Drilling: Exploration of Subseafloor Microbial Ecosystem Associated with Physical, Geochemical and Hydrogeologic Variations in a Mid Okinawa Trough Hydrothermal System	
Proponent(s):	Ken Takai, Fumio Inagaki, Satoshi Nakagawa, Takuro Nunoura, Andreas Teske, Joel Querrellou, Jun-ichiro Ishibashi, Urumu Tsunogai, Toshiro Yamanaka, Tomohiro Toki, Yu-ichiro Ueno, Geoff Wheat, Masataka Kinoshita, Hidenori Kumagai, Kentaro Nakamura, Yasuyuki Nakamura, Hideaki Machiyama, Hitoshi Chiba	
Keywords: (5 or less)	Subseafloor microbial ecosystem, Sub-vent biosphere, hydrothermal system, methanogenesis, subseafloor fluid migration	Area: Okinawa Trough East China Sea

Contact Information:

Contact Person:	Ken Takai		
Department:	Subground Animalcule Retrieval (SUGAR) Program		
Organization:	Japan Agency for Marine-Earth Science & Technology (JAMSTEC)		
Address	2-15 Natsushima-cho, Yokosuka 237-0061, Japan		
Tel.:	+81-46-867-9677	Fax:	+81-46-867-9715
E-mail:	kent@jamstec.go.jp		

Permission to post abstract on IODP Web site: ☒ Yes ☐ No

Abstract: (400 words or less)

Possible existence of functionally active, metabolically diverse microbial ecosystem beneath deep-sea hydrothermal seafloor, so-called 'subvent biosphere', has been predicted by a number of interdisciplinary investigations in a variety of hydrothermal systems with different tectonic and geological settings, but it has been yet-unproved directly by drilling. We propose here a drilling expedition for the subvent biosphere that we call: 'DEEP HOT BIOSPHERE (subseafloor biosphere in a deep-sea hydrothermal system in mid Okinawa Trough) Drilling', with the goal of characterizing the architecture of microbial ecosystem in physical, geochemical and hydrogeologic variations strongly associated with the hydrothermal activities in the middle Okinawa Trough (Iheya North field as a target), a sediments-hosted, backarc rifting, continental margin. The proposed project focuses on the compositional and isotopic shift in biologically essential chemical components in fluids such as carbon dioxide, methane, hydrogen, sulfur/sulfide, ammonia, oxygen and organic compounds, which are enriched or depleted by physical, chemical and biological processes throughout the overall hydrothermal fluid pathway in the middle Okinawa Trough. These chemical substrates energize the formation of unique subseafloor microbial communities in different habitats of hydrothermal fluid migration and maturation. Extremely high concentrations of gaseous carbon compounds (CO₂ and CH₄) in the hydrothermal fluids, their stable carbon isotopic characteristics, potentially widespread fluid reservoirs in the sediments and pyroclastic deposits and phase-separation and -partition of hydrothermal fluids provide key clues to understanding how the active deep biosphere is operative and associated with subseafloor hydrothermal ocean in the mid Okinawa Trough, which is one of primary scientific goals declared in the Initial Science Plan (ISP). During the long history of DSDP, ODP and IODP, none of the drilling expeditions has been performed toward such a hydrothermal system of the sediments-hosted, backarc rifting or spreading, continental margin. Interdisciplinary approaches will contribute to provide clues to evolution and early success of primordial microbial ecosystems on Earth as well as to understand nature of deep hot biosphere in the present Earth.

Scientific Objectives: (250 words or less)

- (1) directly to prove existence of functionally active, metabolically diverse subvent biosphere associated with subseafloor hydrothermal activities in the Iheya North field by drilling;
- (2) to clarify architecture, function and impact of subseafloor microbial ecosystems in physical, geochemical and hydrogeologic variations throughout the overall hydrothermal fluid pathway on the basis of:
 - (a) characterization of variability in biomass, diversity, structure and function of microbial communities in various habitats occurring in vertical and horizontal extensions of subseafloor hydrothermal flow,
 - (b) characterization of compositional and isotopic variability in fluid chemistry associated with hydrothermal abiotic and biotic processes in vertical and horizontal extensions of subseafloor hydrothermal flow,
 - (c) characterization of compositional and isotopic variability in mineral formation and alteration of sediments throughout hydrothermal abiotic and biotic processes, and
 - (d) reconstruction of subseafloor hydrothermal fluid pathway and hydrogeologic structure by means of distribution and transportation of naturally existing microbial and chemical tracers relevant to hydrothermal activity together with geophysical site survey data.

Please describe below any non-standard measurements technology needed to achieve the proposed scientific objectives.

Proposed Sites:

Site Name	Position	Water Depth (m)	Penetration (m)			Brief Site-specific Objectives
			Sed	Bsm	Total	
INH-1A	N27°47.45, E126°53.82	980		50	50	NBC hydrothermal mound
INH-2A	N27°47.51, E126°53.79	960		50	50	NEC hydrothermal mound
INH-3A	N27°47.41, E126°53.80	980		50	50	SBC hydrothermal mound
INH-4A	N27°47.40, E126°53.86	1020	50	50	100	Local discharge-recharge zone
INH-5A	N27°47.41, E126°54.04	1050	150	50	200	Local discharge-recharge zone
INH-6A	N27°47.41, E126°54.80	1100	250	50	300	Potential recharge entry
INH-7A	N27°47.41, E126°55.20	1150	300	50	350	Potential fluid reservoir
INH-8A	N27°48.00, E126°55.20	1200	350		350	Potential fluid path
INH-9A	N27°49.00, E126°54.80	1300	550	50	600	Potential fluid and methane source
INH-10A	N27°47.41, E126°47.30	1500	1200	200	1400	Potential fluid and methane source