iSAS/IODP Proposal Cover Sheet

584-Full2

☐ **New** ☑ **Revised** ☐ **Addendum**

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Title:	TAG II: Evolution of a Volcanic-hosted Hydrothermal System on a Slow-spreading Ocean Ridge		
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Keywords: *(5 or less)*	Biosphere, hydrothermal, sulfides, ocean ridge, TAG	Area:	TAG hydrothermal field, Mid-Atlantic Ridge, 26°N,45°W

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Permission to post abstract on iSAS Web site: ☐ Yes

Abstract: (*400 words or less)*

We propose TAG II, a second leg of drilling at the TAG hydrothermal field (Mid-Atlantic Ridge 26N, 45oW), considered to be the location of choice for study of a volcanichosted hydrothermal system hosted in slow-spreading ocean lithosphere. TAG II will extend seafloor hydrothermal research in space and time by targeting an interactive assemblage of large massive sulfide mounds ranging from young/hot to old/cold encompassed within the 5 by 5 km area of the TAG field, and will fulfill objectives of the first leg (ODP Leg 158, 1994). This will be accomplished by achieving three goals in support of the deep biosphere, subseafloor ocean, and oceanic lithosphere themes of the IODP Science Plan:

1) Deeper drilling (to 250 mbsf) with coring/logging/water sampling to determine the nature of water-rock reactions and biosphere in the stockwork zone of the active hightemperature sulfide mound drilled on Leg 158 (to 125 mbsf), with the ultimate objective of reaching the reaction zone (2-3 kmbsf) as a legacy hole.
2) Extension of drilling with coring/logging/water sampling from the active hightemperature mound to four other sequentially older active and relict hydrothermal zones within the TAG field to determine the evolution of a seafloor hydrothermal system and its massive sulfide from origin to fate.
3) Determination of the nature of the deep biosphere under a range of conditions from hot to cold (high- and low-temperature venting; high to ambient conductive heat flow), and in young to old hydrothermal deposits (0 to c. 140,000 years) in the five hydrothermal zones.

These goals are attainable with present drilling (AHC, HRRS with HDIC, or DIC), and logging capabilities (LWD and wireline for lithological and structural characterization), and realistic expectations of core recovery (10-20 percent with.RCB, ADCB and other coring devices). Extending drilling downward at the active high-temperature sulfide mound and outward to the sequentially older hydrothermal zones of the TAG field will maximize scientific investment in TAG by placing biological, chemical, and physical processes at the active sulfide mound in context of the evolution of a long-lived major hydrothermal field as a whole, and will elucidate the nature of the typically clustered occurrence of large massive sulfide mounds produced by these systems in the geologic record.

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Scientific Objectives: (*250 words or less*)

1. Determine the nature of the deep biosphere: Use the deeper drilling at the active sulfide mound and the drilling at the other mounds as an exceptional opportunity to investigate the deep biosphere under conditions ranging from high-, to intermediate-, to low- background temperatures representing different regimes of mixing of oxidized nutrient-rich cold seawater and reduced H2S-rich reduced vent fluid.
2. Determine the nature of water-rock reactions in the stockwork and underlying reaction zones beneath the active high-temperature sulfide mound in order to: (i) understand how seawater is transformed into the hydrothermal fluids venting at the seafloor, (ii) evaluate the associated elemental exchanges and their influence on global geochemical budgets.
3. Determine the evolution of a volcanic-hosted subseafloor hydrothermal system and its deposits in space and in time from origin to fate: Volcanogenic massive sulfide (VMS) deposits in the geologic record typically occur as clusters. The TAG hydrothermal field consists of an assemblage of active and relict deposits in different stages of evolution from young/hot to old/cold. This provides an unprecedented opportunity to advance beyond the present focus on active high-temperature deposits and to investigate the temporal and spatial evolution of a modern seafloor hydrothermal assemblage analogous to the clustered mode of occurrence of ancient VMS deposits

Proposed Sites: (Only High Priority Sites are listed here.)

Site Name	Position	Water Depth (m)	Penetration (m)			Brief Site-specific Objectives
			Sed	Bsm	Total	
TAG-1A: Active high-temperature sulfide mound, 0 to 50,000 years old (ODP Site 957)	26°08.21'N, 44°49.57'W	3635-3670			250 m	Drilling, coring, logging, and water sampling for biosphere, water-rock interaction, characterization of sulfide, stockwork, and basalt alteration.
TAG-2A: Shimmering mound (active low-temperature mound)	26°10.25'N, 44°48.88'W	3436-3504			100 m	Drilling, coring, logging, and water sampling for biosphere, water-rock interaction, characterization of sulfide, stockwork, and basalt alteration.
TAG-3A:Mir zone (inactive; high heat flow, 2,000 to 102,000 years old)	26°08.70'N, 44°48.40'W	3430-3575			100 m	Drilling, coring, logging, and water sampling for biosphere, water-rock interaction, characterization of sulfide, stockwork, and basalt alteration.
TAG-4A: Shinkai mound (inactive, cold, 2,000 to 23,000 years old)	26°09.52'N, 44°49.15'W	3545-3615			100 m	Drilling, coring, logging, and water sampling for biosphere, water-rock interaction, characterization of sulfide, stockwork, and basalt alteration.
TAG-5A: Alvin mound (inactive, cold, 50,000 years old)	26°09.54'N, 44°48.89'W	3512-3540			100 m	Drilling, coring, logging, and water sampling for biosphere, water-rock interaction, characterization of sulfide, stockwork, and basalt alteration