The UU-NIOZ joint project: Protecting deep seabed hydrothermal vent fields through areabased management tools



Samantha Robb^{1,2}, Catherine Blanchard^{1,2}, Erik Molenaar², Sabine Gollner¹, Lise Klunder¹
1 Royal Netherlands Institute of Sea Research (Royal NIOZ)
2 Utrecht University, Netherlands Institute for the Law of the Sea (NILOS)

Active hydrothermal vents meet criteria to proceed with protection. What area would need protection?*

Sabine Gollner

Royal Netherlands Institute for Sea Research NIOZ (Netherlands)



*presented on 10th of May 2023

Deep-sea mineral resources

polymetallic nodules/abyssal plains, polymetallic sulfides/hydrothermal vents, cobalt-rich crusts/seamounts









The vent ecosystem: hot fluids, enriched in sulfide and metals

The vent ecosystem:

Fluids derive from ocean water which (1) sinks through cracks into crust

(2) gets heated by magma and enriched in metals

(3) exits through channels & precipitatesthe metals (= black smokers)

OR (=INACTIVE VENTS)

(4) Fluids can't exit anymore (channels naturally blocked thus stopping temporally vent fluid emissions).



The vent ecosystem and its biodiversity



Unique vent endemic species occur in high biomass:

- Microbes
- Snails
- Mussels
- Shrimp
- Tubeworms

- spatially close
- The subseafloor, seafloor and water column are geologically and biologically connected.



Vulnerable species:

- Corals
- Sponges

The vent ecosystem has many unique species and many crucial ecosystem services.

But are vent fields unique and fragile? And if yes – all of them?

Unique vent fields along the nMAR -> scientific review ->based on scientific knowledge (from the past ~40 years)

Locations of the 11 hydrothermal vent fields within the Area on the nMAR and of the exploration contract blocks (\leq 10 km x 10 km; not to scale) awarded by the International Seabed Authority to date.

From the InterRidge Global Database of Active Submarine Hydrothermal Vent Fields Version 3.4. PANGAEA.

Land

Ifremer (France)



Vent fields on the nMAR. a)Lost City b) Broken Spur c) TAG d) Snake Pit e) Logatchev-1 f) Logatchev-2 g) Semyenov-2 h) Irinovskoe i) Ashadze-2 j) Ashadze-1 Images copyright Ifremer

Unique vent fields in the Indian Ocean ->scientific review ->based on scientific knowledge (from the past ~20 years)

Active hydrothermal vent ecosystems in the Indian Ocean are in need of protection

Naomi van der Most^{1*}, Pei-Yuan Qian^{2,3*}, Yan Gao⁴ and Sabine Gollner¹

TYPE Review PUBLISHED 25 January 2023 DOI 10.3389/fmars.2022.1067912





- Vent fields at IOR (A) Daxi (B) Wocan (C) Tianxiu (D) Onnuri (E) Dodo (F) Solitaire (G) Edmond (H) Kairei Pelagia (1) Tiancheng (J)
- (K) Longqi
- (L) Duanqiao

Application of scientific criteria

for identifying hydrothermal ecosystems in need of protection

S. Gollner, A. Colaço, A. Gebruk, P.N. Halpin, N. Higgs, E. Menini, N.C. Mestre, P.-Y. Qian, J. Sarrazin, K. Szafranski, C.L. Van Dover

Criteria (e.g. uniqueness, functional significance, fragility,...) adapted from FISHING

Food and Agricultural Organization (FAO) Vulnerable Marine Ecosystems (VMEs)

MARITIME ACTIVITIES

International Maritime Organization (IMO) Particularly Sensitive Sea Areas (PSSAs)

BIOLOGICAL DIVERSITY

Convention on Biological Diversity (CBD) Ecologically or Biologically Significant Areas (EBSAs)

Highlights

- Criteria exist to assess vulnerability and importance of marine ecosystems.
- Nine criteria were applied to 11 hydrothermal vents on the Northern Mid-Atlantic Ridge, and to 12 in the Indian Ocean
- Suites of physico-chemical and biological attributes are unique at each vent field.
- All vent fields meet multiple or all criteria for vulnerability and importance.
- While further research always adds insight, **enough is known** about active hydrothermal vents now **to proceed with their protection (worldwide).**





Application of scientific criteria for identifying hydrothermal ecosystems in need of protection

S. Gollner ^a ∧ ⊠, A. Colaço ^b, A. Gebruk ^c, P.N. Halpin ^d, N. Higgs ^e, E. Menini ^d, N.C. Mestre ^f, P.-Y. Qian ^g, J. Sarrazin ^h, K. Szafranski ^{i, j}, C.L. Van Dover ^d

CRITERION	SUBCRITERIA	nMAR Vent Fields in the Area (North to South)										
		Lost City	Broken Spur	TAG	Snake Pit	Pobeda	Logatchev 1	Logatchev 2	SemVenov	Irinovskoe	Ashadze 2	Ashadze 1
 Uniqueness or rarity. An area or ecosystem that is unique or that contains rare species whose loss could not be compensated for by similar areas or ecosystems. These include: 	1.1 habitats that contain endemic species											
	1.2 habitats of rare, threatened, or endangered species; only in discrete areas											
	1.3 nurseries or discrete feeding, breeding, or spawning areas	?										
	1.4 unique or unusual biotic or abiotic features (chemical, physical, geological)											
 Functional significance. A discrete area or habitats that are necessary: 	2.1 for survival, function (e.g., feeding), spawning/reproduction, or recovery of species							?				
	2.2 for specific life history stages (e.g., nursery grounds or rearing areas, migratory routes for fish, reptiles, birds, mammals, invertebrates)	?						?				
	2.3 for rare, threatened, or endangered marine species							?				
3. Fragility.	3.1 An area that contains a relatively high proportion of sensitive habitats, biotopes or species that are functionally fragile (highly susceptible to degradation or depletion by human activity or by natural events)											
4. Life-history traits that make recovery difficult. Ecosystems that are characterized by populations or assemblages of species with one or more of the following characteristics	4.1 slow growth rates							?				
	4.2 late age of maturity							?				
	4.3 low or unpredictable recruitment							?				
	4.4 long-lived species							?				
5. Structural complexity. An area or ecosystem that is characterized by:	5.1 complex physical structures created by biotic and abiotic features											
	5.2 ecological processes are dependent on these structured physical systems							?				
6. Biological diversity.	6.1 An area that contains comparatively higher diversity of ecosystems (including high diversity associated to complex structures), habitats, communities, or species, or has higher genetic diversity											
7. Biological productivity.	7.1 An area that has a particularly high rate of natural biological production. Such productivity is the net result of biological and physical processes which result in an increase in biomass							?				
8. Naturalness.	8.1 An area with a comparatively higher degree of naturalness due to lack of or low level of human-induced disturbance or degradation							?				
9. Econystem services. An area or ecosystem that provides or has high potential to provide:	9.1 provisioning services, such as food and energy, which are directly used by people (including marine genetic resources and bioprospecting, bioinspired materials, bioinspired processes)							?				
	9.2 regulating services, that cover the way ecosystems regulate other environmental media or processes (including climate regulation, biological pump, and carbon sequestration)							?				
	9.3 cutural services that are related to the cultural or spiritual needs of people. These include spiritual services, servetiles crevices, recreation, education (e.g., an area that offers an exceptional opportunity to demonstrate natural phenomena), and science (e.g., a research are that has high scientific interest, increasing scientific knowledge, or e.g., an area that suitable for baseline monitoring conditions because it is in near natural condition)											
	9.4 supporting services, such as ecosystem processes and functions that underpin other three types of services (including primary production, nutrient cycling)											

What area would need protection?

From a science perspective we know enough to proceed with the protection of the vent ecosystem.

Current protection in ABNJ includes a point-coordinate for active vents (SINP) and a zoning scheme for protection (not further defined).

Assumption: There is a need to define the 3-D space that protects the unique and fragile active vent to safeguard the high ecosystem services.

Goal: A standardized approach to define this 3-D space that may be applied by different bodies.

The sphere of vent influence

The vent ecosystem:

- Active & inactive deposits can be spatially close.
- The subseafloor, seafloor and water column are geologically and biologically connected.
- Biodiversity and function are connected.



Environmental mining impacts

- Removal of mineral resource
 ->Habitat loss, fragmentation, modification
- Change of vent fluid conditions

 >community change, as vent endemic
 organisms are adapted to certain environmental
 conditions
- Sediment plumes (vehicle & return plume)
 ->burial, clogging of filter apparatus, toxic
 effects (especially VME species at inactive
 vents; effects on larvae?)
- Sound & Light
- ->shallow water animals (same faunal groups) use sound as trigger for settlement



What area would need protection? Only considering the active vents

During the presentation on 10th of may 2023, a preliminary table was presented that relates ecosystem services to sphere of vent influence (the vent ecosphere) and how they might be impacted by extractive industries. Based on the vent ecosphere, spatial protection measures including the seafloor, sub-seafloor and water column were discussed. A more advanced table is currently in preparation.

The UU-NIOZ joint project: Protecting deep seabed hydrothermal vent fields through areabased management tools

->Lise Klunder: Case study Rainbow Vent



Samantha Robb^{1,2}, Catherine Blanchard^{1,2}, Erik Molenaar², Sabine Gollner¹, Lise Klunder¹
1 Royal Netherlands Institute of Sea Research (Royal NIOZ)
2 Utrecht University, Netherlands Institute for the Law of the Sea (NILOS)