

Abstract

The second extensively expanded edition of the “Handbook of Deep-Sea Hydrothermal Vent Fauna“ gives an overview of our current knowledge on the animals living at hydrothermal vents. The discovery of hydrothermal vents and progresses made during almost 30 years are outlined. A brief introduction is given on hydrothermal vent meiofauna and parasites. Geographic maps and a table of mid-ocean ridges and back-arc basins with the major known hydrothermal vent fields, their location and depth range and the most prominent vent sites are provided. Higher taxa are presented individually with information on the current taxonomic and biogeographic status, the number of species described, recommendations for fixation, and

schematic drawings, which aim to help non-specialists to identify the animals. 86 authors contributed with their expertise to create a comprehensive database on animals living at hydrothermal vents, which contains information on the morphology, biology, and geographic distribution of more than 500 currently described species belonging to one protist and 12 animal phyla. It comprises also the largest collection of more than 1000 pictures of hydrothermal vent animals taken in situ with submersibles, in vivo after collection, and with various dissection, light, and scanning electron microscopes after fixation and preparations.

Résumé

La seconde édition, considérablement étendue et améliorée du « Handbook of Deep-Sea Hydrothermal Vent Fauna » donne un panorama de notre connaissance sur les animaux qui vivent autour des sources hydrothermales océaniques. Les avancées faites depuis leurs découvertes il y a trente ans environ, donnent lieu à une mise en perspective rédigée par des acteurs des campagnes océanographiques. Une brève introduction est proposée sur la méiofaune et les parasites, puis chaque taxon supérieur est présenté avec des rappels sur la taxinomie, des informations sur sa distribution géographique, des représentations schématiques de la morphologie permettant à des non-spécialistes de comprendre la nomenclature, des informations sur le nombre d'espèces présentes, des conseils pour la fixation et la conservation des échantillons. Des cartes de distribution des

champs hydrothermaux le long des rides océaniques et dans les bassins arrière-arc sont proposées assorties d'un tableau qui donne leur position géographique, leur profondeur et les surnoms des principaux sites. 86 auteurs ont contribué à la création d'une base de données sur les animaux présents dans cet écosystème surprenant, en donnant des informations sur la morphologie, la biologie et la distribution géographique de plus de 500 espèces appartenant à 12 phylums animaux. Cette base de données, présentée sous forme de fiches individuelles, regroupe une série unique de plus de 1000 illustrations comportant dessins au trait, photographies des organismes dans leur milieu, vues d'animaux isolés après récoltes et micro-photographies prises au microscope électronique à balayage.

Zusammenfassung

Die zweite, wesentlich erweiterte Auflage des „Handbook of Deep-Sea Hydrothermal Vent Fauna“ gibt einen Überblick über den momentanen Stand der Forschung. Die Entdeckung der Hydrothermalquellen, Fortschritte der letzten beinahe 30 Jahre, sowie Meiofauna und Parasiten der Hydrothermalquellen werden kurz umrissen. Alle ozeanischer Rücken und Back-Arc Basins mit ihren bekannten Hydrothermalquellfeldern, ihre genaue Lage und Tiefe, sowie ihre benannten Fundstellen werden in geographischen Karten und einer Tabelle gezeigt. Höhere Taxa werden individuell dargestellt mit Information über den momentanen taxonomischen und biogeographischen Stand,

die Anzahl der beschriebenen Arten, Methoden zur Fixierung und schematischen Zeichnungen, die es dem Nicht-Spezialisten die Identifizierung erleichtern sollen. Über 80 Autoren gaben ihren Beitrag zur Erstellung einer umfassenden Datenbank mit mehr als 500 Tieren aus einem Protisten-Stamm und 12 Tierstämmen und Informationen zu deren Morphologie, Biologie und Verbreitung. Darüber hinaus werden die Tiere der Hydrothermalquellen in mehr als 1000 Bildern, Unterwasser-aufnahmen von bemannten und unbemannten U-Booten, in vivo Aufnahmen und diversen licht- und elektronenmikroskopischen Aufnahmen, dargestellt.

Key words: Hydrothermal vents, deep sea, mid-ocean ridge, back-arc basin, hydrothermal vent fauna.

« Toute partie dans la chaise qui ne se voyait pas était tout aussi parfaitement faite que ce qu'on voyait. C'est le principe même des cathédrales. »

Charles Péguy (1873–1914)

“All the elements of the chair that are hidden from view are as perfectly crafted as the visible ones. This is the very principle of the cathedrals.”

Foreword

Deep-sea hydrothermal vents and their associated fauna were discovered in 1977. The presence of these rich oases of life in the food-limited environment of basaltic Mid-Oceanic Ridges fostered the interest of the marine biologists to explore the deep sea using submersibles with a focus on fragmented habitats. During the intervening three decades, a large number of cruises using deep submergence vehicles (HOV or ROV) were devoted to the biological study of the hydrothermal communities on the Pacific, Atlantic, and Indian Ridges as well as in Back-Arc Basins and Volcanic Arcs of the Pacific Rim of Fire. These series of cruises were mainly devoted to the understanding (1) the distribution, the phylogeny, and the dispersal of this specialized fauna which is restricted to this fragmented “extreme” habitat along the world’s oceanic ridges and (2) to the niche characterization and the study of the physiological adaptations of the organisms (or symbiotic associations) living in the mixing zone between the superheated fluid and the cold deep-sea water. This endeavour remains unique in its extent and intensity in the history of biological exploration of the world’s oceans since the early studies of the deep-sea by the pioneering expeditions of the nineteenth century. However, because of logistic constraints, this accomplishment is still far from providing an exhaustive overview of the composition and distribution of hydrothermal vent fauna; some Ridges (South Atlantic and the three Indian Ridges) still deserve obviously more attention and the study of remote targets as high latitude ridges (Arctic and Antarctic Seas) or isolated basins (South Sandwich and Andaman Sea) would bring valuable information on the biogeography of the vent fauna. Multiyear surveys on the East Pacific Rise and the Juan de Fuca Ridge have also demonstrated that the hydrothermal environment is submitted to temporal instability due to volcanic and tectonic events; this instability greatly affects the patterns of the ecosystem development and produces a variation in specific composition of communities only detected by temporal series of sampling.

Reliable morphological identification of collected specimens presently remains the inescapable base of most of the biological work conducted at vents on animals, including the molecular approach. Because of the taxonomic novelty of deep-sea hydrothermal vent communities, an impressive descriptive

work has been conducted for three decades producing more than 500 fully identified species of which descriptions or records are dispersed throughout the scientific literature. Nevertheless the list of animal species living at vents is still evolving every week; new species are described from additional samples in known locations and from new locations, descriptions are revisited, sibling species are detected based on molecular taxonomy, and new combinations are proposed based on studies of large series and molecular information. The technology of imaging in situ greatly improved in the last few years giving considerable information on the shape, colors, behavior, and micro-distribution of living animals. The dialogue between classical and molecular taxonomy brought new insights and clarifies the biogeographic patterns of vent communities as well as their relationships with other deep-sea reduced habitats (cold seeps, food falls, and minimum oxygen zones).

In the foreword of the first edition of the “Handbook of Deep-Sea Hydrothermal Vent Fauna” (Ifremer Editions, 1997), we proposed to publish periodic addenda to the first edition based on new published observations and we invited contributors to help us by sending information and illustration. The results far exceeded our hopes and we realized soon that a new issue of the handbook would be fully justified. At the same time, the Biologiezentrum der Oberösterreichischen Landesmuseen (Biology Center of the Upper Austrian Museums) was preparing an exhibition on deep-sea hydrothermal vent life planned for April 2006 and was looking for authors willing to publish a review on vent biology. It was the perfect opportunity for us to restart the collection of contributions from the worldwide network of taxonomists involved in the study of hydrothermal vent samples. We want to thank here all the contributors who participated in the wording of this new issue.

This book, published under the auspices of InterRidge and Census of Marine Life/ChEss, is an overview of the present taxonomic knowledge of the deep-sea hydrothermal vent fauna, intended for scientists and submersible pilots working at sea, but also for students and the general public curious about the life in the ocean.

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Remarks

Collection of animals as well as in situ photographs and videos of animals from a deep-sea environment are mainly achieved through the use of manned and unmanned submersibles. Valuable sampled animals are often a by-product of large bulk samples, fixation and storage sometimes are less than optimal for all taxa, and the time for taking pictures while on board is often scarce. Also, it is often due to pure luck that in situ photographs and videos are taken at the decision of chief scientists, pilots, and researchers on board as they must interrupt their ongoing tasks and use valuable bottom time to document animals in situ. Good quality pictures taken on the bottom provide a unique set of information on the micro-distribution, behavior, and biological interactions. Even those photographs, which are in low resolution or out of focus, are highly valuable because they give us an impression of where these animals occur and how they behave naturally.

We stress our belief that our successes in understanding the fauna living at hydrothermal vents will be highly influenced by the way we approach solving these issues. So we recommend for taxonomy, ecology and outreach purposes, that researchers take the time on the bottom to video and photograph, that scientists onboard research vessels take high quality photographs of animals before preservation as well as follow instructions for proper fixation and storage, and that they get into contact with taxonomists for identification and appropriate procedures for voucher specimens. Moreover, we hope that more taxonomists will be invited to research cruises to better support our goal of learning more about hydrothermal vents and their inhabitants. Recent experiences demonstrated that the presence of taxonomists on cruises improved by far our knowledge of the faunal composition of vent communities and fostered interactions with other disciplines.

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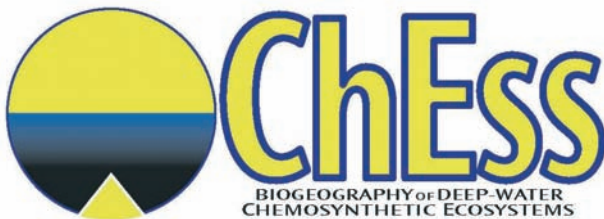
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