Extremophiles In Deep Sea Environments

Many Microorganisms and some macro-organisms can live under extreme conditions. For example, high and low temperature, acidic and alkaline conditions, high salt areas, high pressure, toxic compounds, high level of ionizing radiation, anoxia and absence of light, etc. Many organisms inhabit environments characterized by more than one form of stress (Polyextremophiles). Among them are those who live in hypersaline and alkaline, hot and acidic, cold/hot and high hydrostatic pressure, etc. Polyextremophiles found in desert regions have to copy with intense UV irradiation and desiccation, high as well as low temperatures, and low availability of water and nutrients. This book provides novel results of application to polyextremophiles research ranging from nanotechnology to synthetic biology to the origin of life and beyond.

This is the first book covering all aspects of high pressure biochemistry and biophysics of proteins. Hydrostatic pressure is a powerful tool for study of biological systems. As a thermodynamic parameter, hydrostatic pressure has been known for a century to act on biological materials in a similar, but not identical, way to temperature. However, pressure was disregarded for a long time by biochemists mainly because the basic concepts (and the thermodynamics) focused on the chemical reactions involved and because general ideas on what pressure can add to the understanding of the behaviour of proteins were lacking. In recent decades, technological progress in the field of physics has shown, along with parameters such as temperature and solvent conditions, that pressure can be used for more refined thermodynamic and kinetic descriptions of biological processes and regulation of

biological systems. The effects of pressure on proteins, nucleoproteins and membranes have recently been reviewed and several proceedings books have been published.

This book is a printed edition of the Special Issue "Extremophiles and Extreme Environments" that was published in Life

This book is the comprehensive volume of the TAIGA (“a great river ” in Japanese) project. Supported by the Japanese government, the project examined the hypothesis that the subseafloor fluid advection system (subseafloor TAIGA) can be categorized into four types, TAIGAs of sulfur, hydrogen, carbon (methane), and iron, according to the most dominant reducing substance, and the chemolithoautotrophic bacteria/archaea that are inextricably associated with respective types of TAIGAs which are strongly affected by their geological background such as surrounding host rocks and tectonic settings. Sub-seafloor ecosystems are sustained by hydrothermal circulation or TAIGA that carry chemical energy to the chemosynthetic microbes living in an extreme environment. The results of the project have been summarized comprehensively in 50 chapters, and this book provides an overall introduction and relevant topics on the mid-ocean ridge system of the Indian Ocean and on the arc-backarc systems of the Southern Mariana Trough and Okinawa Trough.

Highly recommended by CHOICE, Oct 2018 Extremophiles are nature’s ultimate survivors, thriving in environments ranging from the frozen Antarctic to abyssal hot hydrothermal vents. Their lifeforms span bacteria to fishes, and are categorized as halophiles from hypersaline environments, acidophiles from acidic waters, psychrophiles from cold habitats, and thermophiles from warm waters. Extremophiles: From Biology to Biotechnology comprehensively covers the basic biology, physiology, habitats, secondary metabolites for

bioprospecting, and biotechnology of these extreme survivors. The chapters focus on the novel genetic and biochemical traits that lend these organisms to biotechnological applications. Couples studies of marine extremophile biology/genomics and extremophile culture for biotechnological applications with the latest advances in bio-prospecting and bio-product development Includes practical experiments that a laboratory can use to replicate extreme habitats for research purposes Presents latest advances in extremophile genomics to give the reader a better understanding of the regulatory mechanisms of extremophiles Offers insights into the production of commercially important extremozymes, carotenoids, bioactive compounds and secondary metabolites of medicinal value. This unique guide serves as a resource for biotechnologists who wish to explore extremophiles for their commercial potential, as well as a valuable reference for teaching undergraduate, graduate and postgraduate students.

This book summarizes the key adaptations enabling extremophile fishes to survive under harsh environmental conditions. It reviews the most recent research on acidic, Antarctic, cave, desert, hypersaline, hypoxic, temporary, and fast-flowing habitats, as well as naturally and anthropogenically toxic waters, while pointing out generalities that are evident across different study systems. Knowledge of the different adaptations that allow fish to cope with stressful environmental conditions furthers our understanding of basic physiological, ecological, and evolutionary principles. In several cases, evidence is provided for how the adaptation to extreme environments promotes the emergence of new species. Furthermore, a link is made to conservation biology, and how human activities have exacerbated existing extreme environments and created new ones. The book concludes with a discussion of major open questions in our

understanding of the ecology and evolution of life in extreme environments.

This book describes the state-of-the-art concerning the ‘marine microbiome’ and its uses in biotechnology. The first part discusses the diversity and ecology of marine microorganisms and viruses, including all three domains of life: Bacteria, Archaea, and Eukarya. It discusses whether marine microorganisms exist and, if so, why they might be unique. The second part presents selected marine habitats, their inhabitants and how they influence biogeochemical cycles, while the third discusses the utilization of marine microbial resources, including legal aspects, dissemination, and public awareness. The marine microbiome is the total of microorganisms and viruses in the ocean and seas and in any connected environment, including the seafloor and marine animals and plants. The diversity of microbial life remains unquantified and largely unknown, and could represent a hidden treasure for human society. Accordingly, this book is also intended to connect academics and industry, providing essential information for microbiologists from both fields.

Extremophiles is a component of Encyclopedia of Biological, Physiological and Health Sciences in the global Encyclopedia of Life Support Systems (EOLSS), which is an integrated compendium of twenty one Encyclopedias. The extremophiles represent some of the most fascinating organisms on Earth for the simple reason that they inhabit extreme environments characterized by physical and (or) chemical properties which render them totally inhospitable for most of the other organisms. The work has been sub-divided into 6 main topics related to the above mentioned environmental conditions. These topics consist of a general introduction and of several more specialized chapters that have been written by scientists prominent in the field. The chapters cover the description of the biotopes and inhabiting

species, their specific characteristics as well as what we know about the molecular mechanisms which constitute the fundamentals of the resistance and adaptation of extremophiles to extreme conditions. The theme “Extremophiles” is headed by two chapters introducing the subject for non-specialists in the field, one covering the basic concepts and the other one giving an overview of the biotopes. These three volumes are aimed at the following five major target audiences: University and College students Educators, Professional practitioners, Research personnel and Policy analysts, managers, and decision makers and NGOs.

Recent spacecraft and robotic probes to Mars have yielded data that are changing our understanding significantly about the possibility of existing or past life on that planet. Coupled with advances in biology and life-detection techniques, these developments place increasing importance on the need to protect Mars from contamination by Earth-borne organisms. To help with this effort, NASA requested that the NRC examine existing planetary protection measures for Mars and recommend changes and further research to improve such measures. This report discusses policies, requirements, and techniques to protect Mars from organisms originating on Earth that could interfere with scientific investigations. It provides recommendations on cleanliness and biological burden levels of Mars-bound spacecraft, methods to reach those levels, and research to reduce uncertainties in preventing

forward contamination of Mars.

In this Journey to Microbial Worlds we present the diversity of microorganisms, from the state of fossil microbes in Archaean age rocks to the possibilities of extraterrestrial life. This volume discusses the extremophiles living in harsh environments (from our anthropocentric point) and describes them in considerable detail. Some chapters also review topics such as symbiosis, bacterial luminescence, methanogens, and petroleum-grown cells. The final chapters of this book shed new light on astrobiology and speculate on extremophiles as candidates for extraterrestrial life. All chapters are updated to the latest research level.

This book provides an intriguing look at how life can adapt to many different extreme environments. It addresses the limits for life development and examines different strategies used by organisms to adapt to different extreme environments.

Extremophiles are organisms that are able to live in extreme conditions due to their unique physiological and genetic adaptations. Extremophiles are harnessed for their extremozymes that have wide applications in biotechnology, pharmaceutics, and industry. Recent developments in genomics and proteomics have helped unravel the mechanism of survival, physiological adaptation, and genomics structure of extremophiles. Physiology, Genomics, and Biotechnological Applications of Extremophiles

covers innovative developments in understanding the physiology and biochemistry of extremophiles using the -omics perspective, focuses on the advancement in mechanisms of the extremophiles that makes them able to survive under extreme conditions, and discusses the applications of extremophiles in astrobiology. Covering topics such as genomics and the history and identification of extremophiles, it is ideal for students, professors, researchers, academicians, microbiologists, agricultural scientists, and biotechnologists.

The data in this book are new or updated, and will serve also as Origin of Life and evolutionary studies. Endospores of bacteria have a long history of use as model organisms in astrobiology, including survival in extreme environments and interplanetary transfer of life. Numerous other bacteria as well as archaea, lichens, fungi, algae and tiny animals (tardigrades, or water bears) are now being investigated for their tolerance to extreme conditions in simulated or real space environments. Experimental results from exposure studies on the International Space Station and space probes for up to 1.5 years are presented and discussed. Suggestions for extaterrestrial energy sources are also indicated. Audience Researchers and graduate students in microbiology, biochemistry, molecular biology and astrobiology, as well as anyone interested in the search for extraterrestrial life and its technical preparations.

The papers included in this Special Issue "Bioactive Molecules from Extreme Environments" provide an overview of the growing interest in species biodiversity, highlighting the importance of marine extreme environments as sources of a unique marine chemical diversity of molecules. It is worth noting that six articles in this Special Issue are focused on molecules and enzymes isolated from Antarctica. This means that there is a growing interest in this habitat, most probably due to being perceived as an important source of drug discovery. In fact, the unique environment and ecological pressures of marine polar regions might be the major drivers of a selection of unique biological communities that are able to biosynthesize new compounds with diverse biological activities. It is expected that, in the near future, more marine molecules from polar regions, as well as from other extreme habitats, will find their way into biomedical and biotechnological applications.

Growing evidence, based on observations from orbiters, landers and telescopes, indicates that Mars may still have numerous hidden water reservoirs. "Water on Mars and Life" surveys recent advances made in research into water on Mars together with its astrobiological implications. Addresses not only scientists working in the field but also nonspecialists and students in search of a high-level but accessible introduction to this exciting field of research.

Many organisms in deep-sea environments are extremophiles thriving in extreme conditions: high pressure, high or low temperature, or high concentrations of inorganic compounds. This book presents the microbiology of extremophiles living in the deep sea and describes the isolation, cultivation, and taxonomic identification of microorganisms retrieved from the Mariana Trench, the world's deepest point. Also explained are techniques for recovering pressure-loving bacteria, the barophiles (piezophiles), and for whole genome analysis of Bacillus halodurans C-125. Physiological analysis of the pressure effect in Saccharomyces cerevisiae and Escherichia coli is used to answer the question of how deep-sea organisms survive under high hydrostatic pressure. These research results are useful in both basic science and industrial applications. Readers discover a new microbial world in the ocean depths, with state-of-the-science information on extremophiles.

This book focuses on the diversity and biotechnological applications of metabolites produced by extremophilic microbes thriving in different ecological niches citing the low troposphere, the gastrointestinal tract of ruminants, tropical dry forest, and saline ecosystems. These studies were based on metabolomics and molecular approaches like metagenomics and single-cell genomic analyses. Various implications of Electro-Rheological Fluid are also discussed. The editor embarked on this writing project entitled “Extremophilic Microbes and Metabolites - Diversity,

Bioprospecting, and Biotechnological Applications" to make pertinent contributions accessible to the scientific community. Hopefully, a large audience will benefit from the chapters of this book.

Aimed at research scientists, students, microbiologists and biotechnologists this book is essential reading for scientists working with extremophiles and a recommended reference text for anyone interested in the microbiology of these organisms, as well as bioprospecting, biomining, biofuels and extremozymes. -- Publisher.

High pressure biology is an old, fascinating and stimulating field of research. One of the major reasons for the interest in studying high pressure is that this environmental factor also plays an important role in thermodynamics and consequently in biology. Pressure, from a biological perspective, has a bearing on all living creatures. The book pre

Aimed at research scientists and biotechnologists, this book is an essential reading for those working with extremophiles and their potential biotechnological application. Here, we provide a comprehensive and reliable source of information on the recent advances and challenges in different aspects of the theme. Written in an accessible language, the book is also a recommended as reference text for anyone interested in this thriving field of research. Over the last decades, the study of extremophiles has provided ground breaking discoveries that challenge our understanding of biochemistry and molecular biology. In the applied side, extremophiles and their enzymes have spawned a multibillion dollar biotechnology industry, with applications spanning biomedical, pharmaceutical, industrial, environmental, and agricultural sectors. Taq DNA polymerase (which was isolated from Thermus aquaticus from a geothermal spring in Yellowstone National Park) is the most well-known example of the potential biotechnological application of extremophiles

and their biomolecules. Indeed, the application of extremophiles and their biologically active compounds has opened a new era in biotechnology. However, despite the latest advances, we are just in the beginning of exploring the biotechnological potentials of extremophiles.

From deep ocean trenches and the geographical poles to outer space, organisms can be found living in remarkably extreme conditions. This book provides a captivating account of these systems and their extraordinary inhabitants, 'extremophiles'. A diverse, multidisciplinary group of experts discuss responses and adaptations to change; biodiversity, bioenergetic processes, and biotic and abiotic interactions; polar environments; and life and habitability, including searching for biosignatures in the extraterrestrial environment. The editors emphasize that understanding these systems is important for increasing our knowledge and utilizing their potential, but this remains an understudied area. Given the threat to these environments and their biota caused by climate change and human impact, this timely book also addresses the urgency to document these systems. It will help graduate students and researchers in conservation, marine biology, evolutionary biology, environmental change and astrobiology better understand how life exists in these environments and their susceptibility or resilience to change.

The Extremophiles Handbook brings together the rapidly growing and often scattered information on microbial life in the whole range of extreme environments. This book will be a useful reference for finding clues to the origin of life and for exploring the biotechnology potential of these fascinating organisms.

Astrobiology is a remarkably interdisciplinary field. This reference serves as a key to understanding technical terms from the different subfields of astrobiology, including astronomy, biology, chemistry, the geosciences and the

space sciences.

Koki Horikoshi — discoverer of the alkaliphiles, microbes that thrive in alkaline environments — describes in his autobiography how the research on extremophiles started and developed. He is a pioneer in the study of these microorganisms that thrive in extreme conditions, and in his book he opens a new vista of the microbial world, pushing the field to expand from the surface of the Earth to the subsurface, to the deep sea and outer space. All major developments in extremophiles research are covered, stretching back to the historical use of microbes in mixed fermentation, indigo dyeing and the pasteurisation of sake. Events in Horikoshi's life provide many valuable insights into the life of a budding scientist, inspired by the Renaissance culture of Florence that led him to the discovery of the alkaliphiles. Our daily lives have been greatly affected by Horikoshi's research, such as the extensive screening he conducted for enzymes produced by alkaliphiles, now applied in many industries from biological laundry detergents to pharmaceutics. The book also reflects on numerous milestone events and people who contributed to the establishment of this field, including colleagues from all over the world. This book is a good read for all microbiologists, encouraging readers to reach out to new worlds and discoveries. It will be treasured by all those interested in a life of a real pioneer.

Highly recommended by CHOICE, Oct 2018 Key features: Couples studies of marine extremophile biology/genomics and extremophile culture for biotechnological applications with the latest advances in bio-prospecting and bio-product development Includes practical experiments that a laboratory can use to replicate extreme habitats for research purposes Presents latest advances in extremophile genomics to give the reader a better understanding of the regulatory

mechanisms of extremophiles Offers insights into the production of commercially important extremozymes, carotenoids, bioactive compounds and secondary metabolites of medicinal value Extremophiles are nature's ultimate survivors, thriving in environments ranging from the frozen Antarctic to abyssal hot hydrothermal vents. Their lifeforms span bacteria to fishes, and are categorized as halophiles from hypersaline environments, acidophiles from acidic waters, psychrophiles from cold habitats, and thermophiles from warm waters. Extremophiles: From Biology to Biotechnology comprehensively covers the basic biology, physiology, habitats, secondary metabolites for bioprospecting, and biotechnology of these extreme survivors. The chapters focus on the novel genetic and biochemical traits that lend these organisms to biotechnological applications. This unique guide serves as a resource for biotechnologists who wish to explore extremophiles for their commercial potential, as well as a valuable reference for teaching undergraduate, graduate and postgraduate students.

The true extent of prokaryote diversity, encompassing the spectrum of variability among bacteria, remains unknown. Current research efforts focus on understanding why prokaryote diversification occurs, its underlying mechanisms, and its likely impact. The dynamic nature of the prokaryotic world, and continuing advances in the technological tools available make this an important area and hence this book will appeal to a wide variety of microbiologists. Its coverage ranges from studies of prokaryotes in specialized environmental niches to broad examinations of prokaryote evolution and diversity, and the mechanisms underlying them. Topics include: bacteria of the gastrointestinal tract, unculturable organisms in the mouth and in the soil, organisms from extreme environments, the diversity of

archaea and their phages, comparative genomics and the emergence of pathogens, the spread of genomic islands between clinical and environmental organisms, minimal genomes needed for life, horizontal gene transfer, phenotypic innovation, and patterns and extent of biodiversity.

This book sets forth a set of truly controversial and astonishing theories: First, it proposes that below the surface of the earth is a biosphere of greater mass and volume than the biosphere the total sum of living things on our planet's continents and in its oceans. Second, it proposes that the inhabitants of this subterranean biosphere are not plants or animals as we know them, but heat-loving bacteria that survive on a diet consisting solely of hydrocarbons that is, natural gas and petroleum. And third and perhaps most heretically, the book advances the stunning idea that most hydrocarbons on Earth are not the byproduct of biological debris ("fossil fuels"), but were a common constituent of the materials from which the earth itself was formed some 4.5 billion years ago. The implications are astounding. The theory proposes answers to often-asked questions: Is the deep hot biosphere where life originated, and do Mars and other seemingly barren planets contain deep biospheres? Even more provocatively, is it possible that there is an enormous store of hydrocarbons upwelling from deep within the earth that can provide us with abundant supplies of gas and petroleum? However far-fetched these ideas seem, they are supported by a growing body of evidence, and by the indisputable stature and seriousness Gold brings to any scientific debate. In this book we see a brilliant and boldly original thinker, increasingly a rarity in modern science, as he develops potentially revolutionary ideas about how our world works.

Physiological and Biotechnological Aspects of Extremophiles highlights the current and topical areas of research in this

rapidly growing field. Expert authors from around the world provide the latest insights into the mechanisms of these fascinating organisms use to survive. The vast majority of extremophiles are microbes which include archaea, bacteria and some eukaryotes. These microbes live under chemical and physical extremes that are usually lethal to cellular molecules, yet they manage to survive and even thrive. Extremophiles have important practical uses. They are a valuable source of industrially important enzymes and recent research has revealed novel mechanisms and biomolecular structures with a broad range of potential applications in biotechnology, biomining, and bioremediation. Aimed at research scientists, students, microbiologists, and biotechnologists, this book is an essential reading for scientists working with extremophiles and a recommended reference text for anyone interested in the microbiology, bioprospecting, biomining, biofuels, and extremozymes of these organisms. Shows the implications of the physiological adaptations of microbes from extreme habitats that are largely contributed by their biomolecules from basic to applied research Provides in-depth knowledge of genomic plasticity and proteome of different extremophiles Gives detailed and comprehensive insight about use of genetic engineering as well as genome editing for industrial applications

From arid deserts to icy poles, outer space to the depths of the sea, this exciting new work studies the remarkable life forms that have made these inhospitable environments their home. Covering not only micro-organisms, but also higher plants and animals such as worms, fish and polar plants, this book details the ecological, biological and biogeochemical challenges these organisms face and unifying themes between environments. Equally useful for the expert, student and casual scientific reader, this book also explores the impact of climate change, rapid seasonal changes and

pollution on these extraordinary creatures.
Besides the Introductory Chapter that gives a brief overview of archaeal applications, the present book contains four chapters. The first chapter, by Castro-Fernandez et al., provides an interesting depiction of the phylum Euryarchaeota and its biotechnological applications. The second chapter, by Ben Hania and coauthors, focuses on the promotion of the idea that some specific Archaea are potential next-generation probiotics. The third chapter, by Torregrosa-Crespo et al., emphasizes the main characteristics of biocompounds from haloarchaea and their potential uses in biomedicine, pharmacy, and industry. The concluding chapter, by Mizuno et al., proposes a plasmid curing approach for improving the potential of thermophiles in various biotechnological applications and opens new perspectives on industrial valorization.
This book offers an ecosystem-oriented overview of the diversity, ecological role, and biotechnological applications of marine fungi as well as an in-depth introduction to the marine environment, fungal classification, and ecological principles. It also presents the latest research findings on coastal marine and oceanic ecosystems, such as mangrove, seagrass, salt marsh, algal, coral reef and benthic ecosystems. Focusing on the diversity of fungi as well as their role as symbionts, parasites and saprotrophs, the book also discusses the physiology and biotechnological applications of fungi and highlights topics of future interest. Intended for students and researchers in marine biology and microbiology, it includes detailed descriptions, illustrations, figures, tables, and exhaustive literature citations. A detailed chapter on methods used to study marine fungi, their classification and ecological principles is of particular interest to newcomers in the field.
Cold adaptation includes a complex range of structural and functional adaptations at the level of all cellular constituents,

and these adaptations render cold-adapted organisms particularly useful for biotechnological applications. This book presents the most recent knowledge of (i) boundary conditions for microbial life in the cold, (ii) microbial diversity in various cold ecosystems, (iii) molecular cold adaptation mechanisms and (iv) the resulting biotechnological perspectives.

This book explores microbial lifestyles, biochemical adaptations, and trophic interactions occurring in extreme environments. By summarizing the latest findings in the field it provides a valuable reference for future studies. Spark ideas for biotechnological and commercial exploitation of microbiomes at the extremes of life are presented. Chapters on viruses complement this highly informative book. In a vertical journey through the microbial biosphere it covers aspects of cold environments, hot environments, extreme saline environments, and extreme pressure environments, and more. From the deep sea, through polar deserts, up to the clouds in the air - the diversity of microbial life in all habitats is described, explored, and comprehensively reviewed. Possible biotechnical applications are discussed. This book aims to provide a useful reference for those who want to start a research program in extreme microbiology and, hopefully, inspire new research directions.

Vents and seeps are the epitome of life in extreme environments, but there is much more to these systems than just black smokers or hydrocarbon seeps. Many other ecosystems are characterized by moving fluids and this book provides an overview of the different habitats,

their specific conditions as well as the technical challenges that have to be met when studying them. The book provides the current state of the art and will be a valuable resource for everybody that has an interest in such environments.

Geomicrobiology is a combination of geology and microbiology, and includes the study of interaction of microorganisms with their environment, such as in sedimentary rocks. This is a new and rapidly-developing field that has led in the past decade to a radically-revised view of the diversity and activity of microbial life on Earth. Geomicrobiology e

Written by experts in the field, Marine Microbiology presents the latest experimental techniques in the detail required for modern environmental microbiological research. Chapters start with the introduction and background of a particular method, followed by a concise description of the procedures involved. There is also a list of vendors who supply critical components which includes names, addresses, and websites at the end of each chapter. Covers both established and novel current methods Historical perspective Enumeration of autotrophic picoplankton, bacteria and viruses Fingerprinting Viral Assemblages by Pulsed Field Gel electrophoresis (PFGE) Fluorescence in situ hybridization with rRNA-targeted oligonucleotide probes Detection of phytoplankton by remote sensing Marine pollution microbiology Microbes in extreme environments List of suppliers provided at end of each chapter Colour plate section

A comprehensive guide to carbon inside Earth - its

quantities, movements, forms, origins, changes over time and impact on planetary processes. This title is also available as Open Access on Cambridge Core.

This text is devoted to a particular class of microbe & focuses on its ecology, systematics, physiological & molecular biology. Also included is a discussion of potentially exploitable biotechnological & industrial uses for extremophiles.

For many years, pressure was disregarded by biochemists. Today, there is a growing interest in pressure as a variable acting on biosystems. The activities that are currently of interest to scientists working in the field of High Pressure Bioscience and Biotechnology have been well presented in this volume, with topics ranging from physical biochemistry, microbiology, molecular biology and food science to industrial application. The editors have been successful in promoting the possibility of applying pressure in specific biotechnological areas, not only for food processing but also for biotechnology in general. These proceedings present an up-to-date view of high pressure research and will contribute to future developments in this field.