

Contents in Context

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Extremophiles: There's More to Life

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Extremophiles, organisms that thrive under extreme conditions, are widespread and have played a critical role in shaping the Earth as we know it today. This introductory essay is intended to give a flavour of the field of extremophile research and briefly introduce the diversity of extremophiles, the role they play in the environment and their utility in biotechnology.

Life on Earth. Extremophiles Continue to Move the Goal Posts

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Since the discovery of a diverse array of microbial life associated with hydrothermal vents on the ocean floor, where conditions are hot, reducing and acidic, scientists have been seeking insight into the mechanisms used by 'extremophilic' organisms (those that reside permanently under environmental extremes of temperature (hot or cold), pH (acid or alkaline), salinity, or pressure) to thrive under such seemingly inhospitable conditions.

Osmoregulation in Bacteria: Compatible Solute Accumulation and Osmosensing

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Bacteria and Archaea have developed two basic mechanisms to cope with osmotic stress. The 'salt-in-cytoplasm mechanism' involves adjusting the salt concentration in the cytoplasm according to the environmental osmolarity and the 'organic-osmolyte mechanism' involves accumulating uncharged, highly water-soluble organic compounds in order to maintain an osmotic equilibrium with the surrounding medium. This highlight gives an overview of the osmoadaptation of prokaryotes employing the organic-osmolyte strategy and introduces a model explaining the fine-tuning of osmoregulatory osmolyte synthesis.

Extraction of DNA from Acidic, Hydrothermally Modified Volcanic Soils

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Microorganisms are intimately involved in geochemical processes. For example, they are major players in the environmental cycling of important elements (e.g. carbon, sulfur, nitrogen, iron), rock weathering, and the formation of ores and petroleum. Identification of the environmental microbiota, commonly achieved via DNA techniques, is essential for an understanding of these processes. The main focus of this Rapid Communication is to demonstrate that endogenous DNA can be extracted from acidic, volcanic soil samples.

Mycosporines in Extremophilic Fungi—Novel Complementary Osmolytes?

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The occurrence of fungi in extreme environments, particularly in hypersaline water and in subglacial ice, is much higher than was previously assumed. When glacial ice melts as a result of calving or surface ablations, these organisms are released in the Arctic soil or sea and have a yet uninvestigated impact on the environment. Knowledge of the metabolites of these extremophilic fungi is important because they could provide signature molecules in the environment, but they can also contribute nutrients to the otherwise oligotrophic polar conditions. In the present work, we examine the osmotic behaviour of fungi grown under hypersaline conditions.

Effect of Cosolvents on Toxaphene Aqueous Solubility

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Remediation of sites contaminated by chlorinated organic compounds is a significant priority. Toxaphene was widely used as a pesticide until its ban by the USA Environmental Protection Agency, but its prevalence in the environment continues to make it a significant priority pollutant. The present research examined the effectiveness of the cosolvents methanol, ethanol, isopropanol, and propanol in increasing toxaphene solubility in water for easier removal in potential field remediation applications. Cosolvents were found to increase toxaphene solubility in water nearly a thousand-fold, and show they can greatly increase the efficiency of removing toxaphene from contaminated soil with water flushing.

Determination of Selective Quinones and Quinoid Radicals in Airborne Particulate Matter and Vehicular Exhaust Particles

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Fine and coarse airborne particulate matter (PM) has been linked to increases in respiratory diseases and lung cancer. PM contains a variety of compounds, such as metals, polycyclic aromatic hydrocarbons (PAHs), nitro-PAHs, and quinones adsorbed in a carbonaceous polymeric matrix. Although quinones are found in small amounts in PM, they are capable of redox cycling and in the presence of oxygen catalyse the generation of reactive oxygen species (ROS) in biological systems. ROS are responsible for the induction of oxidative stress,

especially oxidative damage to cellular proteins and DNA. This paper investigated quantitatively selected quinones and hydroquinones by high performance liquid chromatography in various airborne PM samples. Also, we investigated the presence of persistent semiquinone radicals in solid samples and quinoid radicals in aqueous extracts of alkaline solution by electron paramagnetic resonance spectroscopy.

Sorption of a Xenobiotic Contaminant in Clean and Petroleum-Contaminated Soil: Roles of Water and Xenobiotic Size

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Soil uptake of xenobiotics (e.g. pesticides) can be a complex phenomenon where it is useful to distinguish readily reversible sorption from longer-term retention. A scheme for doing this using fluorescence detection is presented here, along with application to uptake of a model compound in clean and oil-contaminated soils. Both the wetting of the soil and the size of the xenobiotic seem to be important. The present data concern uptake. Desorption is expected to exhibit dependencies on similar factors. The data have implications for understanding persistence.

Reduction of Arsenates by Humic Materials

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Reduction of arsenic(v) to arsenic(III) in the environment is of interest because of the greater toxicity and mobility of the latter. It is important to know to what extent humic materials (which are ubiquitous in soils) can act as abiotic reducing agents, and what factors influence their actions.

Arsenic Speciation: Reduction of Arsenic(v) to Arsenic(III) by Fulvic Acid

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Most technologies for arsenic removal from water are based on the oxidation of the more toxic and more mobile arsenic(III) to the less toxic and less mobile arsenic(v). As a result, research effort has been focussed on the oxidation of arsenic(III) to arsenic(v). It is equally important to explore environmental factors that enhance the reduction of arsenic(v) to arsenic(III). An understanding of the redox cycling of arsenic could result in the development of cheaper and more efficient arsenic removal technologies, especially for impoverished communities severely threatened by arsenic contamination.

In-Cloud Concentrations and Below-Cloud Scavenging Processes in Hong Kong, China

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There are fewer studies of cloudwater than of precipitation because of the limited occurrence of cloud events, and technical and logistic sampling difficulties. In order to assess the importance of in-cloud and below-cloud processes, cloudwater and rainwater samples were collected at the highest mountain in Hong Kong and also near sea level.

Water-Soluble and Total Sulfur in Particulate Matter Determined by Inductively Coupled Plasma Dynamic Reaction Cell Mass Spectrometry (ICP-DRC-MS)

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Sulfate in particulate matter is usually collected by a high-volume air sampler and analysed as a soluble extract by ion chromatography. The use of an inductively coupled plasma mass spectrometer fitted with a dynamic reaction cell enables not only the water-soluble, but also the total sulfate to be determined at the same time as the analyses of metal ions. Results from Hong Kong show that sulfate is strongly correlated with crustal species in particulate matter.