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Soil Science Society of China

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SSSC Newsletter

CONTENTS

Latest News *page 1*

The IUSS Distinguished Service Medal 2021 awarded to Dr. Taolin Zhang *1*

Launch of the International Network on Soil Pollution *2*

Three sites in China designated FAO Globally Important Agricultural Heritage Systems *2*

Research Frontiers *page 5*

Deciphering Roles of Soil Fauna in Regulating of Antibiotic Resistance in the Soils from Diverse Ecosystems *5*

Degradation of mineral-immobilized pyrene by ferrate oxidation: Role of mineral type and intermediate oxidative iron species *6*

Multikingdom interactions govern the microbiome in subterranean cultural heritage sites *7*

Atomically Dispersed Manganese on Biochar Derived from a Hyperaccumulator for Photocatalysis in Organic Pollution Remediation *8*

Global methane and nitrous oxide emissions from inland waters and estuaries *9*

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The IUSS Distinguished Service Medal 2021 awarded to Dr. Taolin Zhang

The President of the International Union of Soil Sciences (IUSS), Dr. Laura Bertha Reyes-Sánchez, announced on 6 June, 2022 that the IUSS Distinguished Service Medal for 2021 had been awarded to Dr Taolin Zhang, Vice Minister of Agriculture and Rural Affairs of China. Dr. Zhang is a distinguished member and was elected as an inaugural Fellow of Soil Science Society of China. He has actively promoted cooperation between both the Chinese government and its research agencies and international organizations, including UNFAO, UNDP, the Global Environment Facility, the World Bank, the Asian Development Bank and other international organizations in the fields of soil health, land protection and sustainable agricultural development.

Dr. Taolin Zhang (© SSSC)

The IUSS, established in 1924 as the International Society of Soil Sciences (ISSS), is a key link to the world's 50,000 soil scientists. Since 2012, the IUSS has recognized outstanding world soil science leaders who have translated soil science into action, by awarding the IUSS Distinguished Service Medal.

Read more:
https://www.iuss.org/about-the-iuss/awards-prizes/iuss-distinguished-service-medal/

Launch of the International Network on Soil Pollution

The International Network on Soil Pollution (INSOP) was launched on 22 April, 2022 by the Food and Agricultural Organization (FAO) of the United Nations to bring together experts on soils and contamination science from around the world. Prof. Ravi Naidu (University of Newcastle, Australia) was elected as the Chairperson and Dr. Deyi Hou (Tsinghua University, China) as the Vice Chairperson of INSOP at its inaugural event, attended by more than one thousand representatives

Logo of INSOP (© Food and Agriculture Organization of the United Nations)

from over 180 countries. INSOP will help countries to strengthen their laws, codes of practice and technical skills to avoid pollution of food-growing soils and human food. The creation of this network is a response urgently needed to scale-up global efforts and will allow for effective, coordinated and inclusive communication among all stakeholders to implement the global action agenda on soil pollution, and to move toward a world with zero pollution. Six working areas have been established: soil pollution assessment; soil pollution mapping; monitoring and regulation of polluted soils; sustainable management and remediation; soil and water pollution relationships; and food security and interaction with soil pollution.

Read more:
https://www.fao.org/global-soil-partnership/resources/highlights/detail/en/c/1477522

Three sites in China designated FAO Globally Important Agricultural Heritage Systems

Three sites in China – an ancient tea-producing area, a nomadic livestock-rearing region and a rain-fed stone terrace farming system – have been formally recognized as Globally Important Agricultural Heritage Systems (GIAHS) for their unique ways of using traditional practices and knowledge while maintaining unique biodiversity and ecosystems.

The sites were designated during a meeting of the GIAHS Scientific Advisory Group which took place in Rome 17–19 May, 2022. The selection criteria stipulate that sites must be of global importance, have value as a public good and support food and livelihood security, agro-biodiversity, knowledge systems, social values and culture, as well as outstanding landscapes.

GIAHS, which will celebrate its 20th anniversary in October 2022, is an FAO flagship program. "GIAHS has proven its potential as a model of sustainable agriculture through its remarkable agro-ecological approach. It is a way to revitalize rural communities and promote rural development by utilizing their unique features embedded in the agricultural systems," said FAO Deputy Director-General Maria Helena Semedo.

To date, a total of 18 sites in China have been added to the global agricultural heritage systems list. FAO's worldwide agricultural heritage network now consists of 65 sites in 22 countries around the globe.

An ancient tea-producing area

Anxi Tieguanyin Tea Culture System (© FAO)

Tea production in Anxi, located in southeastern Fujian Province, is believed to date from the 10th century, with its most famous tea, Tieguanyin, which means Iron Goddess of Mercy, coming into existence in the 18th century. Tieguanyin belongs to the semi-fermented Oolong tea category, between green teas and black teas.

Local farmers' unique know-how includes well-honed practices for managing the natural environment to guarantee the best conditions for tea cultivation and the production of a tea leaf of exceptional quality. These legacies have ensured the long-term stability and sustainability of the ecological systems of the region's tea plantations and have embedded this emblematic product as part of the identity of the local communities.

A nomadic grassland system

Ar Horqin Grassland Nomadic System (© FAO)

The Ar Horqin grassland nomadic system in northern China's Inner Mongolia region is the first nomadic agricultural heritage area designated in China and is an example for global sustainable animal husbandry and for the management of fragile grazing lands. There is evidence of early inhabitants hunting and living a nomadic life in the area as far back as Neolithic times. More recently, the region's largely ethnic Mongolian population has been able to preserve its traditional nomadic lifestyle and livestock production while adapting to a changing environment.

The region has a variety of ecosystems, such as forests, grasslands, wetlands and rivers, with important ecological functions. To adapt to the fragile grassland environment, the ancestors of today's herders adopted a typical nomadic lifestyle. By constantly moving their grazing grounds, they ensured the protection of the vegetation and the rational utilization of water resources, avoiding soil degradation and overgrazing and bringing a steady supply of livestock products, such as meats and cheese, to local communities.

The Shexian Dryland Stone Terraced System

Shexian Dryland Stone Terraced System(© FAO)

Located in northern China's Hebei Province, the Shexian Dryland Stone Terraced System is a rain-fed agricultural system dating back to the 13th century. Set amid the harsh environment of the region's mountains, the stone terraced fields still play an important role in making agriculture possible on the steep slopes. Farming provides local people with a stable livelihood, and serves as a model for sustainable, ecological and cyclical agriculture in this northerly, limestone, mountainous area despite a shortage of soil and rain.

The region is well known for growing walnut and Chinese prickly ash, with millet, corn, soybean, black jujube and other agricultural and forestry products also cultivated on the terraces. With this variety of crops and the use of environmentally friendly farming techniques, local communities have managed to guarantee their food security and well-being over hundreds of years, while shaping a remarkable landscape that bears witness to the ability of the local people to live in harmony with their environment.

Read more:
https://www.fao.org/newsroom/detail/three-china-sites-designated-global-agricultural-heritage-systems-200522/en;
https://www.fao.org/giahs/giahsaroundtheworld/designated-sites/asia-and-the-pacific/en/

Deciphering Roles of Soil Fauna in Regulating of Antibiotic Resistance in the Soils from Diverse Ecosystems

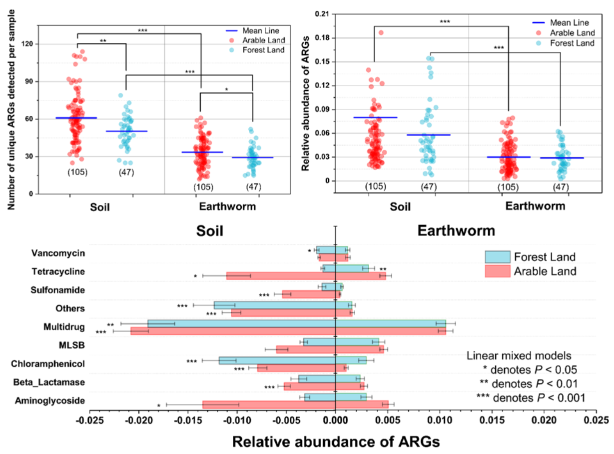


Figure 1. Comparison of number and relative abundance of ARGs between soil and earthworm gut samples.

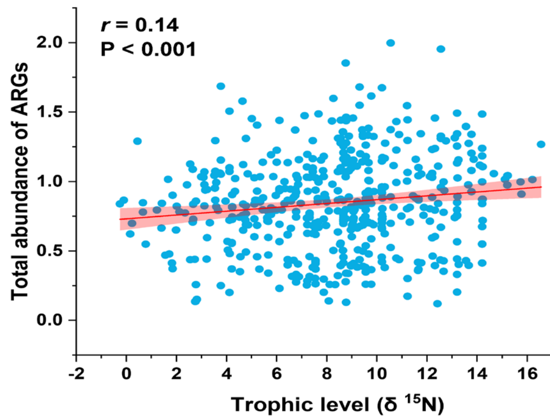


Figure 2. Linear regression revealed the relationships between soil fauna trophic level (δ ^{15}N value) and relative abundance of ARGs.

Accumulation of medically relevant antibiotic resistance genes (ARGs) in the environment is an emerging global environmental and health crisis. Soil animals are an important component of soil ecosystems, performing many important ecological functions. However, little is known about the variation of ARGs among different animals in the soil food web.

The research group of Prof. Yongguan Zhu, Institute of Urban Environment, Chinese Academy of Sciences, addressed this knowledge gap through large-scale field survey and controlled experiment. Result showed that earthworms consistently reduce the diversity and abundance of ARGs both in natural and agricultural ecosystems (Figure 1). Processes in the earthworm gut affect the abundance of ARGs by reducing the abundance of dominant bacterial phylotypes that are the likely hosts of ARGs. Earthworms could provide a sustainable and natural solution to address the global ARG crisis. In addition, they further found that abundant and diverse ARGs are harboured in the soil animal microbiome. Trophic level of animal had a significant effect on the variation of ARGs in the soil food web (Figure 2). This suggested that we can mitigate the spread of ARGs in the environment by regulating key animal species in the soil food web.

Read more:
https://doi.org/10.1021/acs.est.1c00811
https://doi.org/10.1021/acs.est.2c00710

Degradation of mineral-immobilized pyrene by ferrate oxidation: Role of mineral type and intermediate oxidative iron species

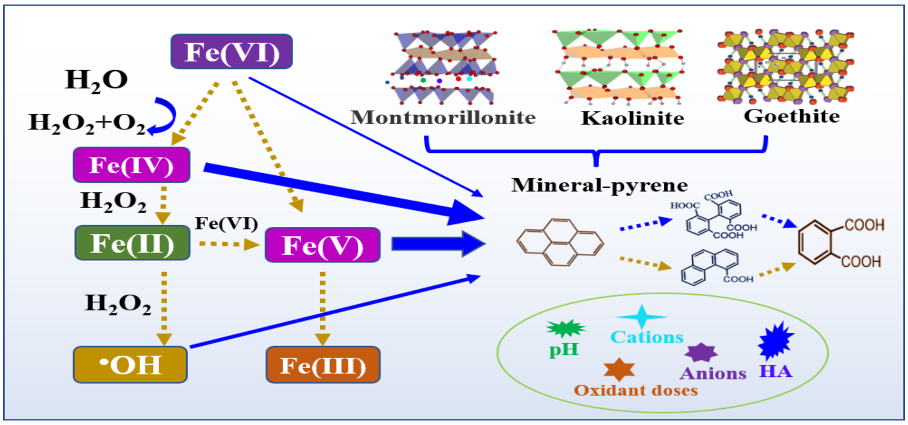


Figure. Degradation mechanism of mineral-immobilized pyrene by ferrate oxidation.

Ferrate (Fe(IV)) is an efficient multifunctional oxidant working in oxidation, adsorption, precipitation, coagulation, disinfection and other processes. Minerals, as the main component of soil and sediment, might play an important role in ferrate oxidation remediation. Understanding the process and mechanism of degradation of organic pollutants by ferrate at mineral interface is of great significance for the development of green and efficient remediation technology in soil and groundwater.

Recently, in a new study published in Water Research, professor Fang Wang's group from Institute of Soil Science, Chinese Academy of Sciences, demonstrated the process and mechanism of ferrate oxidation of polycyclic aromatic hydrocarbons at mineral interfaces by application of ferrate for oxidation of pyrene immobilized on three minerals-montmorillonite, kaolinite and goethite. Results showed that ferrate could efficiently oxidate pyrene at mineral interface, with 87%–99% of pyrene (10 μM) being degraded at pH 9.0 in the presence of a 50-fold molar excess Fe(VI). Protonation and Lewis acid on montmorillonite and goethite assisted Fe(VI) oxidation of pyrene. The intermediate ferrate species (Fe(V)/Fe(IV)) were the dominant oxidative species accountable for pyrene oxidation, while the contribution of Fe(VI) species was negligible. Hydroxyl radical was found involved and contributed to 5.1%~27.4% of the pyrene degradation depending on mineral type. The ferrate reduction product—Fe(III) species might benefit for the microbial remediation of organic pollutants by stimulating microbial activity through mediating the extracellular electron transfer between the microbes and minerals.

Read more:
https://doi.org/10.1016/j.watres.2022.118377

https://doi.org/10.1016/j.scitotenv.2021.150324

Multikingdom interactions govern the microbiome in subterranean cultural heritage sites

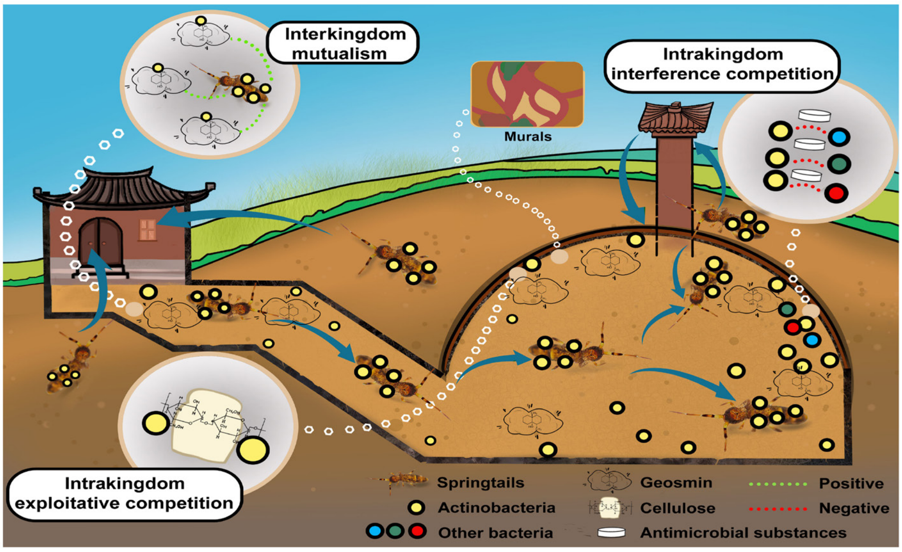
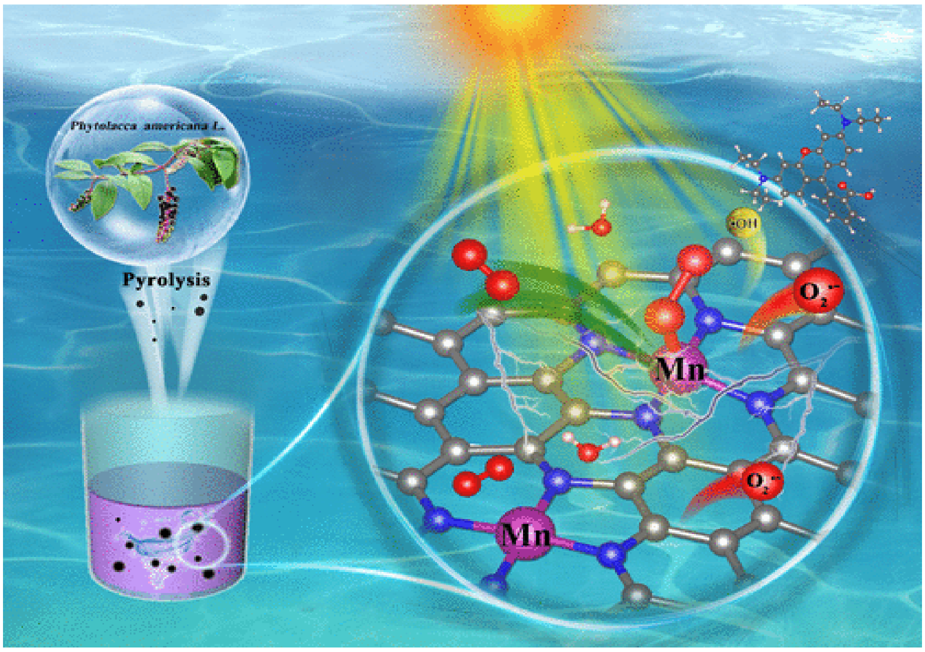


Figure. Sketching map of multikingdom interactions governing the microbiome of the cultural relics in the Dahuting Han Dynasty Tomb.

Microbial biodeterioration is a major concern for the conservation of historical cultural relics worldwide. However, the ecology involving the origin, composition, and establishment of microbiomes on relics, once exposed to external environments, is largely unknown. Here, we combined field surveys with physiological assays and biological interaction experiments to investigate the microbiome in the Dahuting Han Dynasty Tomb, a Chinese tomb with more than 1,800 y of history, and its surrounding environments. Our investigation finds that multikingdom interactions, from mutualism to competition, drive the microbiome in this subterranean tomb. We reveal that Actinobacteria, Pseudonocardiaceae are the dominant organisms on walls in this tomb. These bacteria produce volatile geosmin that attracts springtails (Collembola), forming an interkingdom mutualism, which contributes to their dispersal, as one of the possible sources into the tomb from surrounding environments. Then, intrakingdom competition helps explain why Pseudonocardiaceae thrive in this tomb via the production of a mixture of cellulases, in combination with potential antimicrobial substances. Together, our findings show that multikingdom interactions play an important role in governing the microbiomes that colonize cultural relics. This knowledge is integral to understanding the ecological and physiological features of relic microbiomes and to supporting the relics' long-term conservation.

Read more:
https://doi.org/10.1073/pnas.2121141119

Atomically Dispersed Manganese on Biochar Derived from a Hyperaccumulator for Photocatalysis in Organic Pollution Remediation



Phytoremediation is a potentially cost-effective and environmentally friendly remediation method for environmental pollution. However, the safe treatment and resource utilization of harvested biomass has become a limitation in practical applications. To address this, a novel manganese-carbon-based single-atom catalyst (SAC) method has been developed based on the pyrolysis of a manganese hyperaccumulator, Phytolacca americana. In this method, manganese atoms are dispersed atomically in the carbon matrix and coordinate with N atoms to form a Mn–N4 structure. The SAC developed exhibited a high photooxidation efficiency and excellent stability during the degradation of a common organic pollutant, rhodamine B. The Mn–N4 site was the active center in the transformation of photoelectrons via the transfer of photoelectrons between adsorbed O2 and Mn to produce reactive oxygen species, identified by in situ X-ray absorption fine structure spectroscopy and density functional theory calculations. This work demonstrates an approach that increases potential utilization of biomass during phytoremediation and provides a promising design strategy to synthesize cost-effective SACs for environmental applications.

Read more:
https://doi.org/10.1021/acs.est.2c00992

Global methane and nitrous oxide emissions from inland waters and estuaries

Inland waters (rivers, reservoirs, lakes, ponds, streams) and estuaries are significant emitters of methane (CH_4) and nitrous oxide (N_2O) to the atmosphere, while global estimates of these emissions have been hampered due to the lack of a worldwide comprehensive data set of CH_4 and N_2O flux components.

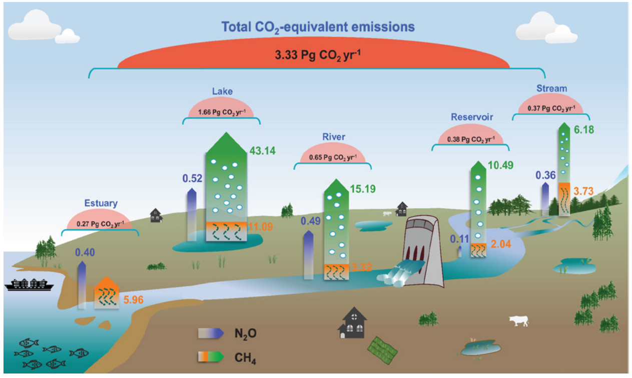


Figure: Global budgets of CH_4 and N_2O emissions from four major inland waters and estuaries.

Here, we synthesize 2997 in-situ flux or concentration measurements of CH_4 and N_2O from 277 peer-reviewed publications to estimate global CH_4 and N_2O emissions from inland waters and estuaries. Inland waters including rivers, reservoirs, lakes, and streams together release 95.18 Tg CH_4 $year^{-1}$ (ebullition plus diffusion) and 1.48 Tg N_2O $year^{-1}$ (diffusion) to the atmosphere, yielding an overall CO_2-equivalent emission total of 3.06 Pg CO_2 $year^{-1}$. The estimate of CH_4 and N_2O emissions represents roughly 60% of CO2 emissions (5.13 Pg CO_2 $year^{-1}$) from these four inland aquatic systems, among which lakes act as the largest emitter for both CH_4 and N_2O. Ebullition showed as a dominant flux component of CH_4, contributing up to 62%–84% of total CH_4 fluxes across all inland waters. Chamber-derived CH_4 emission rates are significantly greater than those determined by diffusion model-based methods for commonly capturing of both diffusive and ebullitive fluxes. Water dissolved oxygen (DO) showed as a dominant factor among all variables to influence both CH_4 (diffusive and ebullitive) and N_2O fluxes from inland waters. Our study reveals a major oversight in regional and global CH_4 budgets from inland waters, caused by neglecting the dominant role of ebullition pathways in those emissions. The estimated indirect N_2O EF5 values suggest that a downward refinement is required in current IPCC default EF5 values for inland waters and estuaries. Our findings further indicate that a comprehensive understanding of the magnitude and patterns of CH_4 and N_2O emissions from inland waters and estuaries is essential in defining the way of how these aquatic systems will shape our climate.

Read more:
https://doi.org/10.1111/gcb.16233