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CHEMICAL EFFECTS

Bioaccumulation of organic and inorganic contaminants in biota: A long-term evaluation in the Belgian part of the North Sea

2024-10-10

Determining the extent of pollution in the marine environment remains challenging. Polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), and metals can, during dredging operations, be transported from a port or harbour into the open sea, where they may exert a harmful effect on the marine ecosystem. To fully understand the impact of these chemicals, monitoring programs should not only focus on sediment concentrations, but should also take into account the bioaccumulated concentration in the tissue of multiple target organisms. In this study, the concentration of primary contaminants is determined in common starfish (*Asterias rubens*), flying crab (*Liocarcinus holsatus*), and brown shrimp (*Crangon crangon*) and the difference in the concentration of contamination between different dredge disposal sites at open sea is investigated. Different factors such as lipid weight, dry weight, grain size, and total organic carbon were measured and used to understand the difference between the observed bioaccumulation and the measured sediment concentrations. KEY MESSAGE: Different contaminants are detected in biota such as common starfish, flying crab and brown shrimp. These contaminants can be linked to dredging activities, with disposal sites associated with industrial ports showing higher contamination.

Authors: David Vanavermaete, Bavo De Witte, Kris Hostens, Ann Ruttens, Nadia Waegeneers, Karlien Cheyns, Jenne Leus, Bernard De Baets
Full Source: Marine pollution bulletin 2024 Oct 10;209(Pt A):117068. doi: 10.1016/j.marpolbul.2024.117068.

Determination of Toxicity at Different Trophic Levels of Aqueous Film-Forming Foams (AFFF) Used in Fire Fighting

2024-10-11

Aqueous film-forming foams (AFFF), containing perfluorinated surfactants, can reach the environment. The objective of this study was to determine the ecotoxicity of AFFF, according to the type of fire to be fought (A1: 1.05 g.L⁻¹, A2: 3.15 g.L⁻¹ and A3: 6.30 g.L⁻¹), to bioindicators of different trophic levels. For *Artemia salina* a toxic effect was observed at sample A1 (at concentrations of 100%), A2 (at concentrations above 25%) and A3 (at concentrations above 12.5%). For *Lactuca sativa* all samples affected

Determining the extent of pollution in the marine environment remains challenging.

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the number of germinated seeds, speed and percentage of germination and root length. To the *Eisenia fetida* earthworm, samples A2 and A3 were considered toxic due to the percent avoidance being 70% and 100%, respectively. In *Macaca mullata* renal cell culture test, none of the samples were toxic by the MTT test. Therefore, it is necessary to develop methods for the safe use of AFFF by professionals.

Authors: Paulo Paulino Rodrigues Junior, Patricia Aline Bressiani, Anna Karolina Gomes Oliveira, Juan Carlos Pokrywiecki, Eduardo Michel Vieira Gomes, Irede Angela Lucini Dalmolin, Thalita Grando Rauen, Elisangela Dusman

Full Source: Bulletin of environmental contamination and toxicology 2024 Oct 11;113(4):49. doi: 10.1007/s00128-024-03960-4.

EthoCRED: a framework to guide reporting and evaluation of the relevance and reliability of behavioural ecotoxicity studies

2024-10-12

Behavioural analysis has been attracting significant attention as a broad indicator of sub-lethal toxicity and has secured a place as an important subdiscipline in ecotoxicology. Among the most notable characteristics of behavioural research, compared to other established approaches in sub-lethal ecotoxicology (e.g. reproductive and developmental bioassays), are the wide range of study designs being used and the diversity of endpoints considered. At the same time, environmental hazard and risk assessment, which underpins regulatory decisions to protect the environment from potentially harmful chemicals, often recommends that ecotoxicological data be produced following accepted and validated test guidelines. These guidelines typically do not address behavioural changes, meaning that these, often sensitive, effects are not represented in hazard and risk assessments. Here, we propose a new tool, the EthoCRED evaluation method, for assessing the relevance and reliability of behavioural ecotoxicity data, which considers the unique requirements and challenges encountered in this field. This method and accompanying reporting recommendations are designed to serve as an extension of the "Criteria for Reporting and Evaluating Ecotoxicity Data (CRED)" project. As such, EthoCRED can both accommodate the wide array of experimental design approaches seen in behavioural ecotoxicology, and could be readily implemented into regulatory frameworks as deemed appropriate by policy makers of different jurisdictions to allow better integration of knowledge gained from behavioural testing into environmental protection. Furthermore, through our reporting recommendations, we

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aim to improve the reporting of behavioural studies in the peer-reviewed literature, and thereby increase their usefulness to inform chemical regulation.

Authors: Michael G Bertram, Marlene Ågerstrand, Eli S J Thoré, Joel Allen, Sigal Balshine, Jack A Brand, Bryan W Brooks, ZhiChao Dang, Sabine Duquesne, Alex T Ford, Frauke Hoffmann, Henner Hollert, Stefanie Jacob, Werner Kloas, Nils Klüver, Jim Lazorchak, Mariana Ledesma, Gerd Maack, Erin L Macartney, Jake M Martin, Steven D Melvin, Marcus Michelangeli, Silvia Mohr, Stephanie Padilla, Gregory Pyle, Minna Saaristo, René Sahm, Els Smit, Jeffery A Steevens, Sanne van den Berg, Laura E Vossen, Donald Wlodkowic, Bob B M Wong, Michael Ziegler, Tomas Brodin
Full Source: Biological reviews of the Cambridge Philosophical Society 2024 Oct 12. doi: 10.1111/brv.13154.

ENVIRONMENTAL RESEARCH

Nanomineralogy of thorite in the supergiant Huayangchuan uranium ore deposit: Revealing a new geochemical behavior of actinide in environment

2024-10-03

Thorium (Th) is a naturally occurring radioactive element found in the environment, and recent advancements have been made in identifying and characterizing Th-bearing nanoparticles (NPs). However, the main focus is still on synthesized Th-bearing NPs and knowledge about natural Th-bearing NPs remains limited. Here, high-resolution transmission electron microscopy (HRTEM) observations of thorite from the Huayangchuan uranium ore deposit in Shaanxi Province, Central China, have revealed the nanoscale mineral characteristics of thorite. In this study, thorite NPs ranging from 5-10 nm in size were identified within the uranium ore. A combination of transmission electron microscopy-energy dispersive spectroscopy (TEM-EDS) elemental mapping and corresponding HRTEM images alongside Selected Area Electron Diffraction (SAED) and Fast Fourier Transform (FFT) patterns revealed a complex nanoscale structure in the thorite NPs, consisting of both amorphous and crystalline nanodomains with abundant defects. These nanostructures are associated with a metamictization mechanism in micrometer-sized thorite. Our findings indicate that the metamictization process can generate numerous thorite nanoparticles. Given the high penetrability and mobility of these NPs, the metamictization of thorite poses new challenges for the long-term stability of radioactive substances and the

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storage containers for radioactive waste. Furthermore, considering the likelihood of environmental release and the chemical toxicity, radioactivity, and nanotoxicity of natural Th-bearing NPs, increased attention should be given to the presence of natural thorite NPs in the ore deposit.

Authors: Rui Liu, Jianjun Wan, Peng Zhang, Yaqin Wang, Lei Zuo, Xiaoheng Zhang, José María González-Jiménez, Fernando Gervilla
Full Source: Journal of hazardous materials 2024 Oct 3:480:136027. doi: 10.1016/j.jhazmat.2024.136027.

PHARMACEUTICAL/TOXICOLOGY

Benzo[b]fluoranthene damages coronary artery and affects atherosclerosis markers in mice and umbilical vein endothelial cells

2024-10-10

Polycyclic aromatic hydrocarbons (PAHs) exposure is associated with cardiovascular diseases. Toxic effects of PAHs are diverse, while cardiovascular consequences of benzo[b]fluoranthene (B[b]F) are unclear. Here, we reported the impacts of B[b]F on coronary artery and atherosclerosis markers both in mice and umbilical vein endothelial EAhy.926 cells. In mice, we found that B[b]F decreases heart-to-body weight ratio, affects aortic physiology, elevates serum low-density lipoprotein and total cholesterol, increases aortic levels of collagen fiber and atherosclerotic marker vascular cell adhesion molecule-1 (VCAM-1), and downregulates oxidative stress related nuclear factor erythroid 2-related factor 2 (Nrf2). In EAhy.926 cells, we showed that B[b]F inhibits cell proliferation and migration in a dose-dependent manner, induces cell cycle arrest and apoptosis, increases reactive oxygen species, upregulates VCAM-1 level, and suppresses expression of Nrf2. Taken together, our findings reveal that B[b]F exposure may contribute to coronary artery damage and potentially induce atherosclerosis, possibly via the Nrf2-related signaling pathways.

Authors: Luo Hang, Shanshan Zhao, Jing Zi, Yifan Hu, Yuqin Yao, Jingyuan Xiong

Full Source: Toxicology letters 2024 Oct 10:S0378-4274(24)02041-1. doi: 10.1016/j.toxlet.2024.10.007.

Polycyclic aromatic hydrocarbons (PAHs) exposure is associated with cardiovascular diseases.

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Evaluation of per- and polyfluoroalkyl substances (PFAS) toxic effects on the acute inflammatory response in the medicinal leech *Hirudo verbana*

2024-10-09

Per- and polyfluoroalkyl (PFAS) substances are a large group of chemicals with elevated water and oil-resistance properties, widely implicated in various applicative fields. Due to the extensive use and high resistance to degradative factors, these compounds pose a significant risk of environmental spreading, bioaccumulating also in living organisms. In this context, despite many researches have been performed to demonstrate "legacy" PFAS harmfulness, only few data are still available about all the emerging fluorinated molecules, industrially introduced to replace the previous ones. For this reason, we proposed the medicinal leech *Hirudo verbana* as consolidated invertebrate model to assess the effects of four different PFAS (HFPO-DA, PFMoBa, PFOA and PFMOPrA) following freshwater dispersion. Morphological, immunohistochemical and molecular analyses demonstrate that, despite all the compounds basically induce an acute inflammatory and oxidative stress response, a different cellular and molecular response has been observed. Whereas for PFOA and PFMOPrA an increase in the tested concentration leads to a corresponding rise in the immune response, HFPO-DA and PFMoBa trigger an entirely opposite effect. Indeed, the significant recruitment of both granulocytes and macrophage like cells, typically involved in the removal of non-self, is inhibited with increasing concentrations of these compounds. The data collected revealed a different sensitivity of the leech immune system following PFAS exposure, requiring to deepen the current knowledge on the potential toxicity of these compounds.

Authors: A Calisi, N Baranzini, G Marcolli, C Bon, D Rotondo, D Gualandris, L Pulze, A Grimaldi, F Dondero

Full Source: Chemosphere 2024 Oct 9:143519. doi: 10.1016/j.chemosphere.2024.143519.

[Research on ameliorating pulmonary fibrosis in silicosis mice of *Cordyceps cicadae* polysaccharides]

2024-09-20

Objective: A mouse silicosis model was constructed by injecting silicon dioxide (SiO₂) particles into the trachea to explore the effect and mechanism of *Cordyceps cicadae* polysaccharides (CCP) on ameliorating pulmonary fibrosis in silicosis mice. Methods: In May 2023, CCP were extracted and isolated, the monosaccharide composition

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and functional group composition were analyzed by high performance liquid chromatography and Fourier transform infrared spectroscopy. C57BL/6J mice were injected with 50 μ l 50 mg/ml SiO₂ suspension to construct silicosis mouse model, which were then randomly divided into model group, CCP intervention groups [low dose group (LCCP group), medium dose group (MCCP group) and high dose group (HCCP group)], the control group was administered by physiological saline, 8 mice in each group. Mice in the CCP intervention groups received oral gavage administration once daily with CCP solution (100, 200 and 400 mg/kg), while control group and model group received physiological saline, lasted for 30 days. The body weight of mice was recorded and the lung coefficient was calculated. The pathomorphological changes of mouse lung tissue were determined by HE and Masson staining. The contents of fibrosis indexes [hydroxyproline acid (HYP), connective tissue growth factor (CTGF) and matrix metalloproteinase 2 (MMP-2)] of lung tissue and the pro-inflammatory factors [tumor necrosis factor- α (TNF- α), interleukin-1 beta (IL-1 β) and interleukin-6 (IL-6)] of lung tissue and alveolar lavage fluid were determined by ELISA. The expression level of Collagen was determined by immunohistochemistry. The relative protein expression levels of transforming growth factor- β 1 (TGF- β 1), P-Smad2, α -smooth muscle actin (α -SMA), Toll-like receptor 4 (TLR4), nuclear factor kappa-B p65 (NF- κ Bp65) and myeloid differentiation primary response gene 88 (MyD88) in lung tissue were determined by Western blot. Results: The total sugar content of the CCP was 86.78%, composed of D-mannose, D-rhamnose, D-glucose and D-galactose, with a molar ratio of 12.71 1.53 1.00 12.64. The infrared spectrum indicated the characteristic groups of its polysaccharides. Compared with the control group, the body weight of mice in the model group was decreased, lung coefficient was increased, the contents of HYP, CTGF and MMP-2 in lung tissue were increased, and the contents of TNF- α , IL-1 β and IL-6 in lung tissue and alveolar lavage fluid were increased (P<0.05). The mice lung showed massive inflammatory cell infiltration and collagen fiber deposition, and the silicosis fibrosis was severe. The expression of Collagen in lung tissue of model group was increased, and the proteins expression levels of TGF- β 1, P-Smad2/Smad2, α -SMA, TLR4, NF- κ Bp65 and MyD88 were increased in mouse lung tissue (P<0.05). Compared with the model group, the body weights of mice in the MCCP and HCCP groups were increased, the lung coefficients were decreased, the contents of HYP, CTGF and MMP-2 in lung tissue were decreased, and the contents of TNF- α , IL-1 β and IL-6 in lung tissue and alveolar lavage fluid were decreased (P<0.05). The inflammatory cell infiltration in the lung was reduced, and the degree of fibrosis was improved to varying degrees. The expression level

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of Collagen was down-regulated in the lung tissue of MCCP and HCCP groups, and the protein expression levels of TGF- β 1, P-Smad2/Smad2, α -SMA, TLR4, NF- κ Bp65 and MyD88 were decreased in lung tissue ($P < 0.05$). Conclusion: The CCP could reduce the levels of fibrosis-related indicators and pro-inflammatory factors in lung tissue, ameliorating mouse lung inflammation and silicosis fibrosis caused by SiO₂ particles by inhibiting the activation of TGF- β 1/Smad pathway and TLR4/nuclear factor kappa-B (NF- κ B) pathway.

Authors: L Cao, G L Wang, L Chen, S P Liu

Full Source: Zhonghua lao dong wei sheng zhi ye bing za zhi = Zhonghua laodong weisheng zhiyebing zazhi = Chinese journal of industrial hygiene and occupational diseases 2024 Sep 20;42(9):641-649. doi: 10.3760/cma.j.cn121094-20230714-00250.

OCCUPATIONAL

Urine is better for rare earth elements bimonitoring in long-term exposed population: an exposure-response relationship study

2024-10-09

With the soaring use of rare earth elements (REEs) worldwide in high-technology and clean energy industries, there were growing concerns for adverse health effect from the REEs exposure. However, there is a lack of biomonitoring research concerning both urine and blood in population with definite exposure. We performed a biomonitoring study that involved 103 REEs exposed males and 110 males as non-REEs exposed controls. We measured the levels of REEs in environment and urine and blood samples from participants, and explored the exposure-response relationship between REEs in environment and body fluids. The effects of exposure duration and smoking status on the internal exposure level of REEs were also investigated. The results showed environmental REEs level of exposure group was significantly higher than that of control group (range of geometric mean of exposure vs. control: $1.08-4.07 \times 10^4$ ng/m³ vs. $<LOD-2.16 \times 10^2$ ng/m³). Six elements with detection rates higher than 60% in blood or urine samples were lanthanum (La), cerium (Ce), praseodymium (Pr), neodymium (Nd), samarium (Sm), gadolinium (Gd). We found the REEs concentrations both in urine and blood of exposure population were significantly higher than controls, median range of the above 6 elements of urine and blood was 0.02-1.06 μ mol/mol vs. $<LOD-0.01$ μ mol/mol creatinine and 0.01-0.79 μ g/L vs. $<LOD-0.38$ μ g/L. The

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correlations between both blood and urine level of REEs and environment level showed significant. The correlation coefficients with urine levels are higher than with blood. Biomonitoring results showed good exposure-response relationship in urine REEs, while no positive response in blood samples. Smoking status, drinking status and years of exposure showed little effect on the level of REEs. Our results suggested that both blood and urine can be used to monitor REEs exposure, while urinary REEs is promising for risk assessment in population.

Authors: Zhizhou He, Li Liu, Ting Wang, Cailan Zhou, Xuewei Zhang, Nan Wu, Mengmeng Xu, Jianqiong Gao, Bin Li, Yonglan Wang, Qiang Zhi,

Chenguang Zhang, Yaochun Fan, Jiqiang Dai, Sheng Gao, Huawei Duan
Full Source: Environmental research 2024 Oct 9:120121. doi: 10.1016/j.envres.2024.120121.

Degradation assessment of high-density polyethylene (HDPE) debris after long exposure to marine conditions

2024-10-09

The degradation of high-density polyethylene (HDPE) in marine environments was investigated under various weathering conditions. HDPE debris were collected from coastal areas near Korinthos, Greece which had been exposed to marine conditions for durations ranging from a few months to several decades; were analysed alongside with laboratory-manufactured HDPE specimens subjected to controlled weathering exposure. Four (4) different cases were investigated, including exposure to different conditions, namely to natural atmospheric and sea weathering conditions, accelerated ultraviolet (UV) radiation, and finally submersion to artificial seawater for up to twelve (12) months. The degradation assessment was proposed based on performed tensile mechanical tests, while the chemical/microstructural changes were assessed through Fourier Transform Infrared (FTIR) spectroscopy and Scanning Electron Microscopy (SEM). FTIR spectroscopy indicated the emergence of carbonyl groups, with peaks appearing between 1740 cm⁻¹ and 1645 cm⁻¹, which are crucial indicators of photo-oxidative degradation. Key findings revealed that HDPE specimens experienced significant (8 %) ultimate tensile strength (σ UTS) only after 3 months of atmospheric exposure, while this decrease can reach up to 60 % over the period of 35 years exposure. A strong correlation was observed between the σ UTS decrease between the (a) natural environment and (b) accelerated UV weathering exposure. It is noticed that 1½ month of accelerated UV exposure corresponded to similar tensile strength decrease for 6 months of natural atmospheric degradation. A linear correlation is

The degradation of high-density polyethylene (HDPE) in marine environments was investigated under various weathering conditions.

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proposed to assess the long-term materials' tensile properties degradation in marine environments.

Authors: Nikitas Lourmpas, Paraskevas Papanikos, Eleni K Efthimiadou, Anastasios Fillipidis, Demetris F Lekkas, Nikolaos D Alexopoulos

Full Source: The Science of the total environment 2024 Oct 9:176847. doi: 10.1016/j.scitotenv.2024.176847.

Titanium exposure and gestational diabetes mellitus: associations and potential mediation by perturbation of amino acids in early pregnancy

2024-10-12

Background: Several recent studies reported the potential adverse effects of titanium exposure on glucose homeostasis among the non-pregnant population, but the association of titanium exposure with gestational diabetes mellitus (GDM) is scarce.

Methods: The present study of 1,449 pregnant women was conducted within the Jiangsu Birth Cohort (JBC) study in China. Urine samples were collected in the early pregnancy, and urinary titanium concentration and non-targeted metabolomics were measured. Poisson regression estimated the association of titanium exposure in the early pregnancy with subsequent risk of GDM. Multiple linear regression screened for titanium-related urine metabolites. Mediation analyses assessed the mediating effects of candidate metabolites and pathways.

Results: As parameterized in tertiles, titanium showed positive dose-response relationship with GDM risk (P for trend = 0.008), with women at the highest tertile of titanium exposure having 30% increased risk of GDM [relative risk (RR) = 1.30 (95% CI: 1.06, 1.61)] when compared to those exposure at the first tertile level. Meanwhile, we identified the titanium-related metabolites involved in four amino acid metabolic pathways. Notably, the perturbation of the aminoacyl-tRNA biosynthesis and alanine, aspartate and glutamate metabolism mediated 27.1% and 31.0%, respectively, of the relative effect of titanium exposure on GDM. Specifically, three titanium-related metabolites, choline, creatine and L-alanine, demonstrated predominant mediation effects on the association between titanium exposure and GDM risk.

Conclusions: In this prospective study, we uniquely identified a correlation between early pregnancy titanium exposure and increased GDM risk. We unveiled novel insights into how perturbations in amino acid metabolism may mediate the link between titanium exposure and GDM. Notably, choline, creatine, and L-alanine emerged as key mediators influencing this association. Our findings imply that elevated titanium exposure in early

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pregnancy can lead to amino acid dysmetabolism, thereby elevating GDM risk.

Authors: Yangqian Jiang, Tianyu Sun, Yue Jiang, Xiaoyan Wang, Qi Xi, Yuanyan Dou, Hong Lv, Yuting Peng, Shuxin Xiao, Xin Xu, Cong Liu, Bo Xu, Xiumei Han, Hongxia Ma, Zhibin Hu, Zhonghua Shi, Jiangbo Du, Yuan Lin, China National Birth Cohort (CNBC) Study Group

Full Source: Environmental health : a global access science source 2024 Oct 12;23(1):84. doi: 10.1186/s12940-024-01128-5.

Background: Several recent studies reported the potential adverse effects of titanium exposure on glucose homeostasis among the non-pregnant population, but the association of titanium exposure with gestational diabetes mellitus (GDM) is scarce.