PROCEEDINGS

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2023 MED-GEO MÉXICO

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PREFACE

This book contains the abstracts presented at the 10th MedGeo Conference held in Monterrey, Nuevo León, México in August 2023. In this way, the information provided by the participants who attended the 10th Conference will be available to their medical geology colleagues, developers, and the general public. I really believe that the group of medical geologists that attended this conference was really dynamic. From a pragmatic point of view, medical geology issues are simply basic geological knowledge applied to human and animal health that results invaluable information for mankind´s use.

Without any doubt, this book contains important contributions from a wide variety of professionals interested in the contribution of medical geology to human and animal health and, in consequence, to participate in having more sustainable environments but mostly it provides useful information for the society in general.

The Mexican team is grateful to all the authors for their outstanding contributions; but particularly we would like to thank all the distinguished scientists who offered their energy by serving on the International Scientific Advisory Committee. These scientists supported us from the International Medical Geology Association's promotion and in reviewing the abstracts and all the related material.

It is essential to mention that we thank the city of Monterrey, for supporting the conference and we are also indebted to the Autonomous University of Chihuahua for the tremendous support in organizing this conference.

Hector Rubio Arias

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CONTENT

ANALYSIS OF NITROGEN AND PHYSICOCHEMICAL PARAMETERS IN THE INFLUENT OF A WWTP IN CHIHUAHUA MEXICO

Aarón Alejandro Chacón García[1], Antonia Luna Velazco[2], Mario Olmos Márquez[3,4], Mitzi Rubí Garfio Salas[4], y Beatriz A. Rocha Gutiérrez[1*].

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Abstract: Water reuse represents an alternative supply to replace potable water for several activities such as agriculture, park irrigation, and specific operations in the industry. However, treated water must meet a certain level of quality to reincorporate in any process. The physicochemical parameters in the influent are fundamental to study the efficient removal of nutrients. Nitrogen is one of the most important parameters studied in wastewater treatments. For this reason, it is important to remove nitrogen concentrations to improve the water quality in the effluent. Nitrogen concentrations can affect the operation of biological reactors for nitrification and denitrification, and it is linked to other parameters. The objective of this research was monitoring the physicochemical parameters of: NH_4^+, NO_3^-, pH, TDS, conductivity, and temperature in the influent of a Wastewater Treatment Plant (WWTP) located in a semiarid region of northern Mexico. Twenty-five readings in situ were analyzed in the influent. NH_4^+ was analyzed by ion chromatography, NO_3 with spectroscopy, and the other physicochemical parameters with a sensor. The results showed: conductivity = 1140-1310 µS cm^{-1}, NH_4^+ = 61-80 mg L^{-1}, NO_3^- = 3.8-87.1 mg L^{-1}, pH = 6.26-7.38, TDS = 550-699 mg L^{-1} and Temp = 23-28.2 °C. It is important to continue monitoring the affluent subsequently, the other stages of the process to evaluate the effectiveness of the WWTP.

Keywords: Chihuahua, biological reactor, nitrate, reclaimed water, ammonia

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FROM THE AQUIFER TO OUR TABLE: A REVIEW ON THE OCCURRENCE OF ARSENIC POLLUTION IN EDIBLE PLANTS

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Abstract: Arsenic is a metalloid of geological and anthropogenic origin that is widely present in the groundwater reserves of the northern area of Mexico. The polluted water of this region is destined for both human consumption and irrigation activities. Utilizing polluted groundwater for irrigation exposes the crops to chemical contamination, which goes against the principles of food innocuity. Arsenic is introduced into the food chain through irrigation when edible plants absorb it. Irrigating crops with polluted water increases the concentration of arsenic with which plants have contact. Through biomagnification and bioaccumulation, arsenic reaches higher levels of the trophic chain, posing a risk to public health, and increasing the amount of arsenic to which the general population is exposed. The objective of this review is to identify the species of plants produced in northern Mexico that can uptake significant amounts of arsenic and could potentially present high amounts of this metalloid. An array of species susceptible to arsenic pollution through irrigation water are tomato, cabbage, alfalfa, spinach, onion, and melon. To ensure that these foods are safe for the consumers, the water used to irrigate them must have the appropriate quality and be free of toxic elements like arsenic, which can only be attained through adequate public policies.

Keywords: Arsenic pollution, groundwater quality, food safety, metalloid uptake, innocuity.

INTEGRATING MEDICAL GEOLOGY, DISEASE ANALYSIS, AND SOCIO-ECONOMIC FACTORS: A METHODOLOGICAL APPROACH FOR ADDRESSING HEALTH CHALLENGES IN CHIHUAHUA, MEXICO

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Abstract: In Chihuahua, northern México, numerous health issues are closely linked to geological factors. Medical geology is an interdisciplinary field exploring interactions between geological processes, environment, and human health. Understanding these relationships become even more crucial due to the complex interplay between all these factors. The presence of specific minerals, such as arsenic (As), lead (Pb), and radon gas (Rn), in soil, water, and air can have adverse effects on human health, leading to diseases like arsenicosis, lead poisoning, and lung cancer. These diseases pose significant public health burdens in such resource-limited settings, further exacerbating the challenges faced by the local population. To effectively address health challenges, it is imperative to develop a multidisciplinary methodology. Geological characterization should be conducted to identify areas of concern, delineate high-risk zones, and assess the possible sources. These geological investigations should be complemented by epidemiological studies to understand the prevalence, distribution, and risk factors associated with specific diseases. Moreover, socio-economic factors play a pivotal role in the overall health outcomes of a population. Furthermore, integrating socio-economic analyses within the medical geology framework helps identify vulnerable communities, assess their capacity to mitigate health risks, and develop targeted interventions. Factors such as poverty, limited access to clean water and sanitation, inadequate healthcare infrastructure, and lack of awareness about geological health hazards must be tackled. By bridging disciplinary gaps and incorporating local community participation, this approach aims to inform evidence-based decision-making, develop effective prevention and mitigation strategies, and ultimately improve the health and well-being of vulnerable populations.

Keywords: Medical Geology, Public health, Socio-economic factors, interdisciplinary approach, prevention and mitigation strategies.

NEW ZINC DITHIOCARBAMATE COMPLEXES FROM SECONDARY AMINES FROM BENZALDEHYDE DERIVATIVES AND ALCOHOLAMINES

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Abstract: Antibiotic abuse has given rise to many multidrug-resistant microorganisms, which is the seventh cause of infection-related deaths. Over the past two decades, fungi have become a threat to the health care sector due to an increase in immunocompromised patients. Dithiocarbamates (DTC) are a type of organic compound playing an important role in the development of Chemistry, especially coordination chemistry. This is due to their strong chelating ability with metalions. The high ability of DTC to react with transition metals makes them very useful ligands in inorganic and bioinorganic chemistry, due to their high chelating capacity and the ease of modulating the properties of the metal complexes by varying the substituents on the nitrogen atom. This represents an alternative for combating multidrug-resistant organisms, which allows their properties to be combined to obtain compounds with good solubility and potential biological activity. The recent application of various drugs based on the substitution of metal complex derived DTCs has clearly shown that the biological approaches of a new generation of TCs will be the best way for society to introduce and develop more efficient drugs. Six different secondary amines were synthesized from benzaldehyde and alcohol amine derivatives in more than 80 % yield. They were characterized by nuclear magnetic resonance (NMR) of hydrogen (^{1}H), carbon (^{13}C), and fluorine (^{19}F), and from these six ligands, the DTC type and the corresponding zinc complexes were successfully obtained. They were later characterized by NMR and infrared spectroscopy and had a more than 70% reaction yield.

Keywords: Dithiocarbamate, metal complex, zinc, ethanolamine, propanolamine.

LEVELS AND DISTRIBUTION OF IONIC POLLUTANTS IN DRINKING WATER IN CHIHUAHUA, MEXICO

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Abstract: Access to safe drinking water is essential for all populations worldwide Therefore, supplying quality water represents a challenge for societies and governments in all parts of the world, particularly in areas where high levels of contamination have been reported. For example, high nitrate levels (NO3—N) in drinking water, can cause interference in blood transportation, affecting all humans, mainly infants. On the other hand, fluoride (F) in high concentrations can cause dental and Skeletal fluorosis. This work aimed to evaluate levels of (NO3—N) and F in drinking water in a semiarid region in northern Mexico (Chihuahua), a semi-arid region. Also, other ions like sulfate and chloride were quantified. Ninety-seven drinking water samples were collected in the city of Chihuahua, and anions were analyzed by ion chromatography (EPA Method 300A). The results indicated that both F and NO3-N levels exceed the maximum contaminant level (MCL) permitted by Mexican regulation (NOM-127-SSA-2021) and the World Health Organization (WHO) for human consumption. Fluoride concentrations ranged from 0.09 to 7.66 mg L^{-1}, with 76% of the samples surpassing the MCL of 1 mg L^{-1}. Moreover, some samples' NO3-N levels exceeded 3% of the MCL (11 mg L^{-1}). However, chloride and sulfate concentrations did not exceed the MCL. These results underscore the need to implement effective technologies to remove these contaminants and ensure safe drinking water, safeguarding public health.

Keywords: Fluoride, Nitrate, potable water, public health, fluorosis, semi-arid region.

Acknowledgments: The authors wish to thank the Chemistry Department at the Autonomous University of Chihuahua for the facilities granted to carry out this study.

NUTRIENT LEVEL IN YELLOW MAIZE AS AN INDICATOR OF INORGANIC OVERFERTILIZATION IN THE MENNONITE REGION OF NORTHERN MEXICO

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Abstract: Maize (*Zea mays*) is one of the most important crops in Mexico due to its nutritional, economic, social, and cultural value. The Mennonite community produces high amounts of yellow corn; however, it is well known that the application of inorganic fertilizers is above the requirements of the crops. This reality causes the cost of cultivation to increase and the levels of contamination in soil and water are also higher. The aim was to determine the nutrient content in yellow maize in the Mennonite region of Chihuahua, Mexico. The experiment was conducted in a commercial plot under a furrow irrigation system; maize hybrid (P-1382) was sown at a density of 95,000 seeds ha. To determine the amount of nutrients, samples of stems and leaves were collected during the crop period in eight sample dates. Finally, in the last sampling, the grain was collected for their analysis at Laboratory in CENID-RASPA-INIFAP. The results showed total nitrogen extraction was 15.06 kg ton^{-1}, phosphorous was 2.19 kg ton^{-1}, and potassium was 9.28 kg ton^{-1}. For nitrogen and phosphorus, the most significant extraction to eliminate occurs in grain formation. It should be noted that these elements must be present throughout the phenological cycle. In the particular case of the potassium element, the highest concentration occurred in stems and leaves throughout the vegetative cycle. In brief, the nutrient extraction was find an overage in the commercial plot under study; thus, the crop is over fertilized and may represent a potential contamination of soil and water due to excess application of inorganic fertilizer.

Keywords: fertilization, soil pollution, maize, nitrogen.

Acknowledgment: The work here described was funded by the National Institute for Forestry, Agriculture and Animal production (INIFAP-Mexico).

BLOOD LEAD OF AIRBORNE PARTICLES IN ELECTRO-COMPONENTS MANUFACTURING COMPANY

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Abstract: Lead (Pb) exposure can be the oldest known occupational health hazard. Occupational exposure to lead occurs via the inhalation of lead-containing dust and fumes. This work aimed to characterize the fine particle and the blood lead measurement health assessment of workers in the manufacturing industry. The company where the investigation was conducted produces electro-components using manual processes with special welding equipment, generating particulate matter that directly affects the workers and environment. The environmental monitoring of particle sizes was done for 16 weeks with the FLUKE 983 equipment. Fine particle characterization was realized by scanning electron microscopy and energy-dispersive X-ray spectroscopy analyses. Blood lead measurements were conducted employing Total Reflection X-Ray Fluorescence (TXRF). Environmental monitoring exceeds the value allowed by ISO-14644-1:2015 of 35,200 m^3 in the particle production area of ≤ 0.5 µm. In the welding area, the composition of these particles was determined by the presence of lead. Lead traces in the blood of workers were found in a range of 0-23.24 µg L^{-1}, due to occupational exposure. Chronic occupational exposure to lead is usually associated with health problems, such as elevation of blood pressure, oxidative stress, and even in high concentrations generation bioaccumulation in the human body, accordingly, producing damage to the nervous system, causing neurotoxicity, for it is necessary to develop novel methodologies for toxicological assessment of Pb exposure in both occupational and environmental studies.

Keywords: Lead, TXRF, Occupational-health, Particulate matter, Environmental-Monitoring.

Acknowledgment: The authors are grateful for the support of the laboratories of the Faculty of Chemical Sciences, Faculty of Nursing and Nutrition of the Autonomous University of Chihuahua, and the Laboratory of Chemical Analysis of the Center for Research in Advanced Materials

IMPORTANCE OF LOCAL STATISTICS IN ANALYSING ENVIRONMENTAL DATA

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Abstract: The European Commission adopted the EU Action Plan 'Towards Zero Pollution for Air, Water and Soil' and 'Soil Strategy for 2030', requiring that by 2050, pollution is reduced to levels no longer considered harmful to health and natural ecosystems. It is widely acknowledged that soil pollution is a severe hazard to human and soil health. However, due to the strong spatial heterogeneity, it is challenging to pinpoint the precise locations of soil pollution which is often hidden. With the rapid development of soil database constructions at the regional, national and international scales, there are opportunities to have soil pollution hotspots identified, supporting more effective and wide-spread soil remediation. In this presentation, two techniques for hotspot analysis including local index of spatial association (LISA) and Getis Ord 'G_i^*' are explored based on geochemical databases from Europe, London in the UK and Galway in Ireland. The LISA method can identify spatial clusters of high values and low values, as well as spatial outliers. On the other hand, the Getis Ord G_i^* is effective to identify spatial clusters. In the big data era, such techniques of "local statistics" play important roles in revealing patterns and special features hidden in environmental databases. Furthermore, the idea of "local statistics" can be employed to reveal the complex relationships between environmental parameters which are spatially varying. Spatially varying relationships are further explored using examples of national soil database of Ireland, showing the spatially varying relationships between soil organic carbon and elevation which are related to different types of peat in Ireland. Based on the concept of "local statistics", identification of pollution hotspots and investigation of spatially varying relationship provide effective ways for the assessment of hazard, exposure and risks from soil pollution.

Keywords: Local statistics; Spatial analysis; Hotpot analysis; Spatially varying relationship; Spatial pattern; Environmental geochemistry

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NATURAL SELENIUM IN THE CENTRAL VENEZUELAN PLAIN AND ITS RELATIONSHIP WITH HYDROLOGY AND GEOLOGY

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Abstract: Selenium is a necessary micronutrient that in excess is toxic. This review illustrates the relationship between geology, topography, stream water, soil crops, and finally, plants, animals as well as human bioaccumulation of selenium within the Venezuelan central plain, specifically, in the state of Portuguesa, referred to as the Venezuelan barn due to its rich crop soils, cultivating about 70% of the cereals and oilseeds in regards to the national consumption of Venezuela. According to Ortiz and Carrasquero, 1968 (1); at 1964, Kerdel and Convit reported human selenium intoxications due to the consumption of the nuts derived from the *Lecythis ollaria* tree, with an average value of selenium content of 1000 mg/Kg, based on dry weight. Ortiz and Carrasquero, 1968 (1), established three main Se indicator plants: *Echinocloa colonum*, *Poponax flexuosa* and *Morisonia americana* with Se > 10 mg/Kg, identifying Turen, Portuguesa, Barbacoas and Lara as possible seleniferous regions within central Venezuela (1). Later, some studies identified particularly high levels of selenium in people and meals from Villa Bruzual, Portuguesa. Some examples are Se in children's urine excretion of 0.6270 µg/ml Vs 0.1517 µg/ml mean value when compared to other Venezuela regions; Se in serum blood of people at 314 µg/L; in hair of 1.56 µg/g, with eggs at 0.395 µg/g and rice at 0.134µg/g (2,3). Particular bioaccumulation in Portuguesa is in concordance with high selenium values from the northern Orinoco Basin rivers, originally from the Merida Andean piedmont and percolating to the Portuguesa flood plains. Which are, in a west to east orientation, Guanare river 2,96 µg/L, Morador river 4,08 µg/L, Portuguesa River 2,06 µg/L and Acarigua river, 3,84 µg/L considerably higher than the mean value from global freshwaters of 0.02 µg/L (4,5). The lithology associated with these rivers is Cretaceous mainly sedimentary, highlighting sequences of black lutite, sandstone and conglomerates from piedmont molasses. Organic matter-rich lutites and carbonatic rocks are associated with marine-coastal marine reductive environments with high sulphur, probably associated with selenium (6,7).

Keywords: Selenium, geochemistry, Venezuela.

TOTAL TITANIUM AND TITANIUM DIOXIDE NANOPARTICLES IN FIELD ALFALFA CULTURE

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Abstract: The absorption of chemical elements by plants is a natural process that occurs in the environment. With nanotechnological innovation, many products are being generated that have the potential for incorporation into the soil in the form of nanoparticles. These elements can be considered contaminants which adhere to the epidermis or enter the plant tissue through the natural barriers. TiO_2-NPs are a type of nanoparticle that has a large number of applications. Their presence in the soil-plant system can be considered common, and either favoring or harming the crops with which they come into contact. Furthermore, plants are one of the pathways for these NPs to enter the trophic chain. In the present study, the amount of total Ti in soil and plant was evaluated, and TiO_2-NPs were characterized in alfalfa leaves, in the amended versus the control site. The amount of total Ti in soil did not vary significantly. Values for total Ti in the plant, the root and the stem of the amendment site were significantly different compared to the control by 12 %. Maps of Ti-Ca-S combinations were made in a synchrotron, which allowed visibility of TiO_2-NPs in the epidermis and inside the plant. X-ray absorption near-edge structure (XANES) spectra were also obtained, where anatase and rutile were identified as predominant phases. Likewise, it was found that the smallest TiO_2-NPs were located in the amended site to the tune of around 77%. Anatase dominated the epidermis by 56%, and it was shown that rutile had greater internalization by 15%. The characterization of the TiO_2-NPs phases allowed to identify the possible source, the location in the alfalfa leaf and the need to amend soils with products free of contaminants. It is recommended that further experimentation be carried out on the dynamics of TiO_2-NPs in the plant system in order to provide the basis for designing measures that would guarantee optimum food production and food safety.

Keywords: nanomaterials, crops, emerging contaminants, XRF, XANES.

VOLCANIC GASEOUS MERCURY: FROM THE ENVIRONMENT TO OUR CNS

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Abstract: Volcanoes are important natural sources of Gaseous Elemental Mercury (GEM), which can cross the blood–brain barrier, causing neurotoxicity to the Central Nervous System (CNS). In this presentation we will discuss the main results of our most recent studies regarding the uptake and fate of volcanic GEM. For these studies we used, as biological model, wild mice (*Mus musculus*) from environments with volcanic activity (from Furnas village; study group) and without volcanic activity (Rabo de Peixe; reference group). Our results confirm that inhalation is the main route of GEM entry into the body. We also observed that once mercury enters the body, it reaches the CNS tissues (brain and spinal cord), being inclusively found intracellularly (hippocampal basket cells and mossy cells), causing neuroinflammation in the hippocampus (reactive astrogliosis) and a decrease in the axon's caliber and axonal atrophy. Given that these effects are relevant hallmarks in the neurodegenerative pathologies, our results highlight the importance of the surveillance of the health of populations chronically exposed to active volcanic environments. These studies link, for the first time, the exposure to volcanic GEM to its hazardous effects on the SNC, raising awareness towards the environmental exposure to GEM as a potential trigger for the development of neurodegenerative diseases.

Keywords: Mercury; GEM; neuroxicity; central nervous system; GEM; volcanism.

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BIOLOGICAL FILTERS: A SUSTAINABLE AND ECONOMIC APPROACH FOR THE REDUCTION OF COLIFORMS IN WATER

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Abstract: The most important component for life in the planet is the water. Access to this natural resource is considered a fundamental right. In Mexico, 13% of the rural population do not have a fixed supply of drinking water, consequently the population resorts to using surface water that in some cases is contaminated, causing diarrheal diseases, and even causing death. It is clear that this type of water is not suitable for direct consumption and must therefore be treated. Biological filters are an alternative treatment in rural areas and particularly in natural protected areas. These types of filters are also known as slow sand filters (SSF); where the water flows slowly through granular beds and forms a bio-layer called Schmutzdecke whose function is to consume organic matter and pathogenic bacteria, improving the output water quality. The SSF are environmentally friendly and sustainable and represent a good option for communities with difficult access because their construction materials are economical, easy to access and require little maintenance. The objective of this work was to implement the hydrogeographic analysis using ArcGIS software to determine the optimal site for the installation of the SSF and determine the degree of microbiological contamination through the most probable number technique. This information will allow the installation of a FLA in the rural community of Cumbres de Majalca, which is located within a Natural Protected Area called Cumbres de Majalca National Park, Chihuahua, Mexico.

Keywords: Contaminated water, slow sand filters, removal, SSF, coliforms.

ASSESSMENT OF *EUCALYPTUS GLOBULUS* LEAF BIOMASS AS ORGANIC AMENDMENT AND THE EFFECT IN SOIL PHYSICOCHEMICAL PROPERTIES

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Abstract: The Eucalyptus tree (*Eucalyptus globulus*) has a marked growth in the Portugueseforest area, not only due to invasive nature, but mainly to its economic interest. This particular tree is considered very flammable, increasing the risk of fire, making it essential to control its proliferation. Combining this issue with the need for searching new environmentally friendly strategies for weed control, the following question arose: 'would the leaves from young eucalyptus have potential to be used as an organic amendment with herbicidal potential in agricultural fields?'. In this sense, the PEST (bio)CIDE project aims, through the valorization of eucalyptus leaf biomass, to offer a response for a better management of some areas regenerated after a forest fire, by proposing its use as an effective and environmentally safe biocide. It is also expected that the incorporation of eucalyptus leaves will bring benefits for soil quality and contribute to carbon sequestration. In this sense, several laboratory experiments were first conducted to evaluate the biocidal potential, the safety to non-target species and the influence of different amounts of eucalyptus leaf biomass in soil properties. Based on these results, a field trial was set up: after ploughing and preparing the soil, the area was divided into 30 squares of equal dimensions and ten replicates of three different treatments were applied in a random way: 2.5% m/m of eucalyptus (T1); pre-emergence herbicide S-metalochlor (T2); and control (T3). The results showed that the incorporation of leaf biomass affects some physicochemical properties of the soil, bringing benefits to its quality.

Keywords: soil quality; field trial, valorization.

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BIOINFORMATIC STUDY OF *R2R3-MYB* GENES IN CHILE CHILTEPIN AND ITS COMPARISON WITH PLANTS OF AGRONOMIC INTEREST

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Abstract: The chiltepin chile (*Capsicum annuum* var. *glabriusculum*) is a genetic resource of great importance in Mexico. It is the ancestor of some types of chili and its cultivation, production and sale represent an important economic activity. Its genetic diversity and adaptability to different environments make it an important object of study for crop improvement. This phenotypic plasticity is due to the R2R3-MYB family of transcription factors, which has very diverse functions ranging from the synthesis of secondary metabolites to tissue pigmentation and stress tolerance. The objective of this work was to perform a comparative bioinformatic analysis of the R2R3-MYB genes in chiltepin chile with respect to other varieties of *Capsicum annuum* and plants with agronomic interest. Through the construction of a phylogenetic tree using protein sequences of the previously mentioned organisms, phylogenetic relationships were revealed and the diversity of these genes in this chile bell pepper variety with respect to other plants and variants was determined. The conserved domains, motifs, and the presence of duplications in the genes were also identified to better understand their structure. Finally, a synthetic analysis comparing the presence and position of the R2R3-MYB genes in chiltepin chili with respect to the other organisms was performed. This would be useful for future research and applications in genetic manipulation and crop improvement of this plant to develop significant applications in agriculture and species conservation.

Keywords: *Capsicum annuum*, R2R3-MYB, bioinformatics, chile chiltepin, analysis.

NANODIAMOND-METFORMIN COMPLEX CYTOTOXICITY IN MCF-7 BREAST CANCER CELLS

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Abstract: Breast cancer is the most common neoplasm in women worldwide; its treatment consists of surgical resection and chemotherapy, which cause serious adverse health effects. The nanotherapy based on nanodiamonds complexes appears to be a promising strategy for treating this disease. A nanodiamond-metformin (ND-Met) complex has shown low cytotoxic activity in highly aggressive triple-negative MDA-MB-231 and HS578T breast cancer cells. However, studies on different cell lines are required due to variability in treatment resistance and breast tumor classification. This project aimed to evaluate the cytotoxic effect of the ND-Met complex in the adenocarcinoma MCF-7 breast cancer cell line, an estrogen and a progesterone receptor double positive cell line, which belongs to the luminal A molecular subtype (HTB-22™, ATCC®). With this purpose, cultures with 8 x 10^3 MCF-7 cells were exposed to 0, 5, 15, 25, and 250 µg L-1 of the ND-Met complex and incubated for 24 h. Viable cells were determined using viability curves and the resazurin assay. Cultures with ND or Met alone were performed as controls. The results showed that the ND-Met complex decreased the viability of MCF-7 cells in a dose-dependent manner by a calculated IC50 of 5 µg L-1, which was significantly lower than the IC50 of ND or Met controls (13 µg L-1 and 2,500 µg L-1, respectively; $p \leq 0.05$, ANOVA-Tukey). In conclusion, the results demonstrated that ND-Met complex has a therapeutic potential on luminal breast cancer, which provides the first innovative and promising approach for developing new effective therapies against this type of breast cancer.

Keywords: breast cancer, cytotoxicity, metformin, nanodiamonds.

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POLLUTION STATUS ASSESSMENT USING INDICATOR FACTORS ON SEQUENTIALLY EXTRACTED BIOAVAILABLE HEAVY METALS IN MINE VICINITIES OF ABAKALIKI SOUTH EASTERN NIGERIA

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Abstract: The mining district of Enyigba has over the years raised a source of concern in the area of healthcare and pollution. Researchers had seemed more interested in total heavy metals concentration of the mining environment. However, the total heavy metals concentration of the mining vicinities had rarely matched the heavy metal quantity absorbed by plants; thus, motivating the need to actually determine the bioavailable heavy metals which are accessible to plants and in turn consumed by animals and humans. This would help us ascertain the actual level of health risks the populace within the Enyigba mining vicinities are exposed to as a result of the release of these heavy metals into the biosphere via unplanned mining of the artisan miners. Forty-three (43) soil samples were oven dried at 104^0c, crushed with agate mortar and pestle and sieved with 200-micron mesh thus homogenized. The three-step procedure of *Standard*, *Measurements* and *Technology* program (SM &T) of European Union was applied with acetic acid, hydroxyl ammonium and hydrogen peroxide (including ammonium acetate) as reagents; these were used to extract the exchangeable, reducible and oxidizable fractions of the sediments. The residue was also digested with aqua-regia. The extracts were analysed with Atomic Absorption spectrophotometer to obtain the bioavailable fractions. The mean bioavailable heavy metals are Cu, 1.65 mg/Kg; Zn, 32.35 mg/kg; Pb, 91.53 mg/kg and Cd, 1.69 mg/kg. The results were further subjected to indicator factor assessments. The mobility factors obtained had Pb and Cd beyond 10% limit. The anthropogenic concentration of the heavy metals increases in the order Cu < Zn < Pb < Cd thus indicating that higher anthropogenic Pb and Cd are being introduced into the environment. The geoaccumulation Index was also applied and it was observed that Cu and Zn were uncontaminated being <1 whereas about 50% of the bioavailable Pb and Cd were moderately contaminated using Igeo standard specification. The result further showed that the high pollution index was majorly contributed by Pb and Cd. The entire deductions shows that the study area have been polluted by Pb and Cd and requires urgent respond to forestall a poison outbreak.

Keywords: Indicator factor, pollution index, mobility factor, bioavailable and geoaccumulation index.

ECONOMIC FEASIBILITY OF CILANTRO (*Coriandrum sativum* L.) UNDER THE COVER OF A PECAN ORCHARD IN NORTHERN MEXICO

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Abstract: In Mexico, cilantro occupies a privileged place. it is considered an essential ingredient in the Mexican cuisine and that enhances the flavor of traditional dishes**.** The objective of the research was to identify the cilantro variety under the pecan walnut canopy in the spring-summer cycle and to determine the economic feasibility of the highest-yielding variety. An experiment was carried out in a walnut orchard in the state of Chihuahua. Five varieties (treatments) were tested, which were established in a completely randomized design. The varieties evaluated were; National long, Moroccan, Turkish, Leader and American long. The response variables were germination percentage (PG), stem thickness (GT), height (A), number of stems (NT), fresh weight (PF) and moisture percentage (PH). Preliminary results revealed that the coriander variety with the highest productivity was American Long, which presented a germination percentage of 98%, an average stem thickness of 6.58 mm, an average height of 30.14 cm, and an average number of stems of 7.23. In addition, it showed a fresh weight of 13 t ha-1 and a moisture percentage of 88.66%. It is concluded that these results are very useful for farmers in northern Mexico who wish to produce an additional crop in their pecan walnut orchards.

Keywords: Culinary culture, economic feasibility, productivity, variety, viability.

PRENATAL ARSENIC EXPOSURE AND DNA METHYLATION IN UMBILICAL CORD LYMPHOCYTES OF NEWBORN PARTICIPANTS OF THE POSGRAD BIRTH COHORT

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Abstract: Environmental exposure to arsenic (As) is a serious public health problem and has been associated with various types of cancer, such as skin or colon cancer. Epigenetic changes may be a potential mechanism of As carcinogenesis. The aim of this study was to evaluate the association between prenatal exposure to As and methylation of C18orf8 and ADAMTS9 genes in umbilical cord blood lymphocytes of newborns participating in the POSGRAD cohort study. We obtained gestation and delivery data of the POSGRAD cohort in Morelos, Mexico. Exposure to As was measured through urinary concentration evaluated during pregnancy and gene methylation was performed by sequencing with sodium bisulfite in umbilical cord samples. Two indexes were generated for each gene: an index that grouped those sites with the highest positive correlation with the As concentrations and another index with the negative correlation. Newborns with an As exposure above 49.4 µg per gr^{-1} had a 0.21% decrease in the methylation rate of CpG15, CpG19 and CpG21 sites of the C18orf8 gene adjusted for other variables (adjusted ß = -0.21, p-value = 0.02). No statistically significant association with the ADAMTS9 gene was found. Prenatal exposure to As was associated with decreased DNA methylation at the CpG15, CpG19 and CpG21 sites of the C18orf8 gene. These sites can provide information to determine epigenetic mechanisms related to pathologies associated with prenatal exposure to As such as cancer. This is important because the C18orf8 gene encodes a protein associated with colon cancer.

Keywords: Epigenetic modifications, development programming, cancer, MIC-1, DHA.

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UNDERSTANDING GEOLOGICAL HAZARDS: THE UNIVERSITY COMMUNITY ROLE IN THE DIFUSIÓN OF MEDICAL GEOLOGY

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Abstract: México is a geologically diverse country, the presence of different materials in the soil and subsoil is an important factor because they can release toxic elements for humanhealth, either naturally or as an anthropogenic result. Medical geology is a science thatstudies these phenomena and because of its importance it must be spread as a key tool for preventing and understanding of geological hazards focusedon health andenvironmental sector. Elements such as lead, mercury, cadmium, arsenic, among other, are toxic and can bemobilized into soil, subsoil, water, and air. The prolonged or chronic exposure to them can have serious repercussions on Mexican population health. Some relevant examples of where the natural environmenthas impacted human health have been identified in several regions of the country, mainly on low-income or close to industrial zones communities because they deal with employment access, safe living places, drinking water and adequate medical attention, and in some cases, lack of information about their geological setting can contribute to this problem. Because of this situation, it is fundamental that university community plays more participation on the visualization of these topics, as well as on the diffusion and awareness. In this sense, it is proposed the creation of a university student committeeunder the supervision of the International Medical Geology Association. This universitycommittee would assume the responsibility to perform awareness activitiesin communities where the setting geological information is limited or little spread.

Keywords: pollution, geology, exposure, health, university committee.

FLUORIDE DISTRIBUTION FROM URUGUAY´S AQUIFERS AS DRINKING WATER AND THEIR POSSIBLE EXPOSITION RISK TO HUMAN HEALTH

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Abstract: Uruguay is always characterized by its very good quality groundwater for human consumption. However, in recent years there has been a significant increase in drillings to supply the new demands of the productive and industrial sectors. Therefore, it is imperative to know if there have been changes in water quality. Very few backgrounds of hydrochemical data in Uruguay aquifers are available. The Water Department from UdelaR, in collaboration with Dr Polya group from the University of Manchester, carried out the first risk distribution models of arsenic in groundwater in Uruguay by means of a learning machine approach, using 504 arsenic data of Uruguayan wells from the State Sanitary Services Department (OSE). In this work, we used the same database of OSE from 836 points of extraction and new data was added to investigate possible fluoride exposition risks in Uruguay aquifers. Statistical analysis performed by some of the Python statistical analysis libraries, such as Pandas, Matplotlib as others, shows levels of F^- between 0.038-2.5 mg/L. The maximum value (2.5 mg/L) belongs to Cerro Largo Department (Max. 1.5 mg/L WHO guidelines) and could be related to the Tres Islas Formation, formed by sandstones to pelites, of fluvial facies and Permian age. These are promising results in raising awareness of the importance of monitoring water quality when more than 10% of the Uruguayan population could be affected and promoting the prevention of human health.

Keywords: fluoride, groundwater, human health, arsenic, hydrochemistry

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PRODUCTION OF CHILTEPIN PEPPER (*CAPSICUM ANNUM* L.) UNDER BACKYARD CONDITIONS TO CONTRIBUTE TO THE ECONOMY OF AN ARID GEOENVIRONMENT EN MEXICO

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Abstract: The food culture of Mexico is linked to vegetables, species and in particular to different types of Chile. In other words, chiles are plant species that have great significance in the identity of the people of Mexico. The objective was to analyze the behavior of the chili species called chiltepín produced under backyard conditions to support the economy of rural areas settled in an arid geoenvironment. Efforts were made to preserve the organoleptic conditions that the market currently demands. The methodology was to measure the germination percentage in a completely randomized experiment with five treatments and the control using gibberellic acid as an inducer of germination (3%, 4%, 5%, 6% and 7%). The result showed that the treatment that obtained 95% germination was under treatment 5%. A second process was the transplant of the seedling of the experiment in the backyard using completely random blocks and fertilization treatments. The variables are germination percentage, plant high and yield. To date the experiment is in process and we will show the first data in MEDGEO-2023 conference.

Keywords: Food culture, germination, gibberellic acid, seedling

DISTRIBUTION OF LITHIUM IN SOIL OVER 14 BRAZILIAN STATES: POTENTIAL FOR NEW DEPOSITS AND ITS RELATIONSHIP WITH SUICIDE RATES

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Abstract: In a survey carried out by Geological Survey of Brazil-CPRM covering 3.3 million km² in 14 Brazilian states, 4373 soil samples were collected in a 25x25km grid. The samples (2kg) were dried at 50°C, sieved at 80#, the sieve pass being ground at 200#, reduced with aqua regia and analyzed via ICP-MS. The objective was to determine the behavior pattern of lithium in different environments and where it could be harmful or beneficial to environmental health. The total results obtained for lithium in mg/kg were, a minimum of 0.5, with median 2 and maximum 167. High values stand out in Paraíba-PB state (median 15 and maximum 167), in Minas Gerais-MG (2 and 83), Ceará-CE (7 and 63), Pernambuco-PE (7 and 63) and Mato Grosso do Sul-MS (2 and 61). Minas Gerais and Paraíba have mines that already produce lithium, associated with pegmatites and with the potential to have new deposits. The other states have lower values. Lithium values above the median occupy a prospective area, around 103,000km², about 3% of the studied area. Suicides in Brazil increased by 35% in the period from 2011 to 2020, with the highest suicide rate in the states of SP(22,500)-MG-CE-RJ-BA-GO-PE(3,500), where the states are more populated (South/Southeast) and the lowest rates where they are less populated (North/Northeast), MS(2,000)-PB-ES-AL-RR(500). Comparing the results of this research with the suicide rate by state in Brazil no positive relationship was found between a higher number of suicides and lower levels of lithium.

Keywords: Soil geochemistry, lithium potential, suicide, health, Brazil

SPATIAL DISTRIBUTION AND ECOLOGICAL RISK OF TRACE ELEMENTS IN ATMOSPHERIC PARTICULATE MATTER IN NUEVA ROSITA, COAHUILA. CAMPAIGNS 2022-2023

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Abstract: In recent years, special emphasis has been placed on the diagnosis of air pollution. The WHO considers this to be one of the greatest environmental threats to human health. It is important to understand the local variations of the chemical elements present in the atmosphere for decision-making in environmental and governmental matters. The objective of this research was to analyze the variation of the concentrations of the chemical elements present in the atmospheric particulate matter (APM) of the urban zone of the City of Nueva Rosita and its possible ecological risks. For this, 43 dust samples were collected in an area of 9 km^2, of which 6 were taken in places with little anthropogenic interference to be used as local background values. The sampling was carried out between February-April 2022 and January-April 2023. The elemental concentration was quantified using the ICP-MS technique, finding the highest values corresponding to Zn, Cd, Pb, Cu and Cr, with mean concentrations of 897.76, 3.75, 48.29, 54.32 and 8.42 (mg/Kg) respectively, these concentrations were higher than the local background values. The geoaccumulation index (I*geo*) indicated contamination in the following order: Zn>Cd>Pb>Cu>Cr. The ecological risk index (E*i*) indicated that there are serious risks of contamination by Cd and moderate risk by Zn, Pb, Cu and Cr, with Cd being the main contributor to the high combined ecological index (E*r*). The enrichment factor together with PCA indicate that Pb, Cu and Cr come from natural sources, while Zn and Cd come from anthropogenic sources. In conclusion, these results provide a frame of reference for the diagnosis of APM contamination in the area and its implications for public health.

Keywords: particulate matter, ecological risk, air pollution, diagnosis, monitoring

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ASSESSING LEVELS OF ARSENIC IN THE SALTO, URUGUAY AQUIFERS AND ITSPOSSIBLE INCIDENCE ON HUMAN HEALTH

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Abstract: Arsenic (As) is a natural element of the earth's crust. This metalloid is found in almost all environmental matrices, and it is critical to eliminate due to its high toxicity. In particular, high levels of As in groundwater are of environmental and health concern since limits in drinking water resources obstruct socio-economic growth and the sustainable development of agriculture. To date, Uruguay has a provisional limit of 20 µg/L, and the objective value for 2024 is 10 µg/L, the same as recommended by WHO. For this reason, As in groundwater acquired more geochemical-environmental relevance for us. The aim of this study was to determine As levels in groundwater in the Salto/Arapey Aquifer, which is considered one of the most important intensive horticultural areas in Uruguay. Water demand is mainly provided by private drilling, and its uses include irrigation, drinking water, livestock farming, frost control, and recreation. Groundwater was sampled from 30 wells. The sampling procedure, sample conservation, total As and major and minor ions analysis were performed according to APHA standards. The As levels in water ranged from 0.6 µg/L to 41.7 µg/L. It is important to mention that seven wells had values greater than or equal to 10 µg/L and two wells were greater than 20 µg/L. Simultaneously to the water sampling, surveys were carried out on the owners of the wells to find out the uses of the water. Then our studies continue in order to broaden knowledge in this area

Keywords: arsenic, groundwater, human health, hydrochemistry

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DETERMINATION OF POLYETHYLENE GLYCOL CONCENTRATIONS TO INDUCE WATER STRESS IN CHILTEPIN CHILI (*Capsicum annuum* var. *glabriusculum*) SEEDLINGS *IN VITRO.*

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Abstract: Drought is one of the main abiotic stresses that affect food production worldwide. Chiltepin chili (*Capsicum annuum* var. *glabriusculum*) represents a valuable genetic resource for the improvement of other *Capsicum* cultivars. Therefore, the present study aimed to determine the appropriate Polyethylene glycol (PEG) 6000 concentration to induce water stress in chiltepin seedlings *in vitro*. A completely randomized design was utilized and Pearson´s correlation between seedling survival rate (SSR) and PEG concentration and Scott-Knott test (α=0.05; n=10) were performed. PEG concentrations of 0, 10, 20, 30, 40, and 50% were evaluated (P0, P10, P20, P30, P40, and P50, respectively) in 18-day-old seedlings. The SSR and vegetative parameters such as fresh weight, height, root length, stem diameter, and robustness index were determined after 5 d of treatment. An inversely proportional relationship was found between SSR and PEG concentration (r=- 0.85), with a maximum SSR of 40% at P50. There was a significant reduction in most of the vegetative parameters at P10 except for root length, which was reduced at P30. The most serious affectation was presented as follows: P30-P50 reduced fresh weight and height by 95 and 22%, respectively. P10-P50 reduced stem diameter and robustness index by 36 and 47%, respectively. P40-P50 reduced root length by 61%. Considering these parameters, P30 is the appropriate concentration of PEG 6000 to induce water stress in chiltepin seedlings. *C. annum* var. *glabriusculum* shows greater adaptability to water stress than other chili peppers.

Keywords: Drought stress, chiltepin, polyethylene glycol, vegetative parameters, seedling survival rate.

HEAVY METALS IN THE DIET OF MEXICAN CHILDREN IN ELEMENTARY SCHOOL LEVEL AND POTENTIAL RISK ANALYSIS

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Abstract: This work aimed to determine the probability of health risks for Mexican children exposed to heavy metals by consuming contaminated food. A survey was applied to 607 Mexican school-age children (between 6 and 12 years old) to identify the type of food they consume the most in a regular basis. Based on these results and appropriate analysis, research was made to know the concentration of heavy metals in these foods. The daily intake was calculated with the concentration of lead (Pb) and arsenic (As) reported for 11 different food groups and the intake rate. The estimated average daily intake dose of heavy metal for each food category are within the reference daily oral reference dose via ingestion (R*f*D) of 0.30 µg/kg/d and 0.35 µg/kg/d for the Pb and As, respectively, except for the vegetable category. Health risk assessment results based on hazard quotient calculating showed that the total Hazard Quotient (HQ) of Pb and As in the cereals, meat, drinks, and legumes categories analyzed exceeded 1, with values in a range of 1.25-5.08. Considering the adverse health effects of highly toxic heavy metals intake, special attention should be paid to As and Pb contamination in food. Therefore, it is necessary to conduct a systematic quantitative analysis of heavy metals in different food groups consumed in Latin American countries, particularly in Mexico, and construct a database with the information which could be consulted nationally and internationally.

Keywords: Heavy-metals, Hazard-Quotient, Health-Risk, Food-exposure, Potential-Risk-Assessment.

STANDARDIZATION OF THE TECHNIQUE OF MOLECULAR EXTRACTION FOR THE STUDY OF THE MICROBIOME IN INFANTS

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Abstract: The SARS-CoV-2 pandemic that occurred in the 2020-2022 period strongly motivated all stakeholders to pay more attention to public health care. One of the changes observed after the pandemic is the gastrointestinal microbiome, which was modified by the presence of the virus and current research is focused on detecting the causes of these changes. The objective of this research was to standardize the techniques for extracting genetic material for its sequencing and, to consequently, carry out metagenomic studies. The Autonomous University of Chihuahua has a Coproteca-UACH with a total of 1,489 fecal samples from infants with gastrointestinal diseases, collected between the period 2004-2023. Pre- and post-pandemic samples will be selected for the extraction of genetic material, which will later allow these samples to be evaluated by Shotgun sequencing. As a result of the optimization, DNA/RNA samples with adequate quality were obtained, including concentrations greater than 10 ng/µl and an A260/A280 ratio between 1.8 and 2.0, suitable for sequencing. The optimization of the extraction techniques will make it possible to meet the quality requirements to perform the sequencing and subsequently compare the gastrointestinal microbiome of infants before and after the SARS-CoV-2 pandemic.

Keywords: Gastroenteritis, metagenomics, sequencing, microbiome, Chihuahua.

EVALUATION OF RUNOFF WATERS AND ITS POTENTIAL CONTAMINATION BY TOXIC ELEMENTS OF MINING AREAS OF TAXCO, GUERRERO, MEXICO

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Abstract: Water quality is highly responsive to environmental changes as it passes through diverse land uses within a basin, incorporating materials from both point and diffuse to eliminate pollutants sources. This study aimed to evaluate water quality and the concentration of potentially toxic elements (PTEs) Cd, Cu, Pb, Zn, Fe, As, and Mn, in runoff waters near mining waste sites to assess potential environmental and health risks to communities. Seventeen runoff water sites in close proximity to mining waste deposits were selected as sampling locations. The laboratory conducted measurements of pH, electrical conductivity, total dissolved solids, alkalinity, total and calcium hardness, PTEs, and sulfates. All sampled sites complied with the pH range stipulated by NOM-001-SEMARNAT-2021 for residual water discharges in Mexican rivers. However, sites 1, 4, 10-11, 16, and 17 exceeded the electrical conductivity limit proposed by World Health Organization (2011), while sites 1-4, 16, and 17 surpassed the recommended sulfate levels. The maximum allowable limits for Cl and Na were within acceptable ranges. Concentrations of PTEs such as Cd, As and Pb, were below the maximum permissible limit of 0.4 mg L^{-1}. Likewise, the permissible limit of 20 mg L^{-1} for zinc was not exceeded at any of the sites. Copper concentrations were below the permissible limits in all sampled sites. These results showed that the concentrations of PTE did not exceed the thresholds specified in NOM-001, indicating a minimal environmental potential risk. It is likely that these characteristics result from natural attenuation processes. However, it is not recommended to use this water for human consumption.

Keywords: contamination, natural attenuation, water quality, risk.

Acknowledgment: Ph.D. Ruiz-Huerta appreciates the postdoctoral fellowship granted by the CONAHCYT for the development of this research and the analytical chemistry laboratory of the UNAM.

MARKET DEVELOPMENT OF PRODUCTS DERIVED FROM QUINCE (*Cydonia oblonga*) IN DELICIAS, CHIHUAHUA

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Abstract: It is important to add value to the goods produced in the primary sector through transformation, and thus encourage agro-industry in the region. The objective of this work was to prepare a market development plan for a company that trades quince derivatives. It was contemplated to commercialize the main products in an artisan way such as the caramel, wine and fruits. The study was conducted in the four sectors into which the population of Delicias, Chihuahua is divided. A sample of 115 households was obtained. A market study and the strategic marketing plan were carried out following the Malhotra methodology. As results, the segmentation of the competitor market was obtained, as well as the development of the logo and brand, locating a favorable niche for its commercialization. Being the most favored product the caramel with 65%, since it is the best known sweet in the market; Regarding wine and quince fruit, there is an opportunity for growth in sales since 8% and 13% respectively of those surveyed have consumed them. Therefore; the distribution channel was assigned and a promotional campaign was launched.

Keywords: market strategy, distribution ducts, marketing, local competition, craft products.

Acknowledgment: The work here described was funded by the CONACYT and the Autonomous University of Chihuahua.

LEAD CONCENTRATIONS IN TISSUES OF PIGEONS (*Columba livia*) IN THE URBAN AREA OF COMARCA LAGUNERA, MEXICO

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Abstract: The Comarca Lagunera is one of the most important productive areas in Mexico. Its main economic activities are livestock, agriculture and the processing industry. A wide variety of industries, including one dedicated to the extraction of metals, emit residues that have been considered highly toxic environmental pollutants, with strong negative impacts on public health. The objective of this research was to determine the concentrations of lead present in tissues of pigeons (*Columba livia*) belonging to the urban area of Comarca Lagunera, Mexico. A total of 64 specimens were collected (SPARN/DGVS/06267/22) from the different localities that make up the region (Lerdo n=12; Gómez Palacio n=24; Torreón n=12; Matamoros n=16), which were subjected to a necropsy procedure to the extraction of the tissues to be evaluated (bone, heart, liver, lungs, kidneys and brain). These organs were dried, calcined and diluted in hydrochloric acid to a concentration of 2N. A graphite furnace atomic absorption spectrophotometer was used to determine the lead concentrations in the mentioned tissues. The results demonstrate the presence of lead in all the tissues analyzed in all the cities, with the areas with the highest average concentrations being Torreón, Coahuila, and Lerdo, Durango. The organs with the highest concentration were bone, liver and lung. In this study, the presence of lead in tissues of *Columba livia* from the urban area of the Comarca Lagunera region is confirmed, demonstrating at the same time their ability to function as good bioindicators of environmental pollution.

Keywords: *Columba livia*, bioindicator, urban area, heavy metals, contaminants.

Acknowledgment: The following work was carried out thanks to the support of the Diagnostic Unit of the UAAAN, the Environmental Chemistry Laboratory of the UJED and the Bioindicators Laboratory of CIJE - UAdeC.

USE OF THE GUM COLLECTED FORM THE MEZQUITE (*Prosopis* spp.) AN ENDEMIC TREE OF THE CHIHUAHUAN DESERT TO STABILIZE YOUNG TABLE WINE

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Abstract: Worldwide, gum Arabic is authorized to clarify wines and is used as a protective colloid for young wines. The objective was to replace the use of gum Arabic with mesquite gum to avoid the precipitation of the unstable coloring matter and to increase the balance of the organoleptic characteristics of the wine (smell, color and aroma). At the same time, reduce bitterness, astringency, increase smoothness, body and improve the oily sensation of the wine. An experiment was carried out with four treatments and a control under a completely randomized experimental design. The results revealed the adequate concentration of mesquite gum that achieved colloidal stability in young wines, since, lacking an aging process; they tend to lose some properties. It should be remembered that in red wines the action of the gum on the polyphenolic compounds has an indirect effect on the astringency of the wine, since the hardness of the tannin itself is attenuated, softening the wines and improving the body of the same than due to its production or excessive filtration treatments have become light and this can be perceived in the glass or in the mouth. The color, as well as the clarity of red wines are one of the qualities highly required by consumers. In particular, red wines must present colloidal stability not only at the time of bottling, but also during aging and storage until consumption. This experiment will be repeated in 2023, so only recent data obtained in 2022 will be presented in MEDGEO-2023.

Keywords: colloidal stability, young wines, polyphenol compounds.

DETERMINATION OF THE WATER FOOTPRINT IN UNDERGRADUATE STUDENTS TO DETERMINE WATER CONSUMPTION HABITS

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Abstract: Given the growing population and other important factors, the availability of water is increasingly reduced, both for human consumption as well as for the production of goods and services in all sectors. All human activity generates a direct and/or indirect expense of the water resource, thus each person has a unique Water Footprint based on their individual consumption. Other factors such as location, age and gender, among others, also influence the total amount of water consumed. The objective was to evaluate water consumption among undergraduate students, using the water footprint form as an awareness tool. A digital survey with 45 questions was implemented to 100 students of the Faculty of Chemical Sciences of the Autonomous University of Chihuahua. The students surveyed were selected from the social service brigade. The results were subsequently compared to the average state consumption values. It was determined that the students had a higher consumption (15%) compared to the average state water expenditure (CONAGUA). Moreover, it was observed that the consumption of out-of-state students was higher compared to local students. In conclusion, this preliminary stage revealed elevated water consumption compared to state results, highlighting the need to continue conducting water footprint surveys to support student awareness.

Keywords: Water footprint, water management, resources, water, Chihuahua.

OUTSTANDING CELLULOSE EXTRACTION FROM AGAVE (AGAVE *TEQUILANA* WEBER VAR. AZUL) BAGASSE USING DEEP EUTECTIC SOLVENTS

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Abstract: The agave genus (Agave *tequilana* Weber var. azul) yields large quantities of bagasse duringtequila production. In 2022, it is estimated that around 2,610.8 thousand tons of Agave *tequilana* Weber var. azul were collected, which resulted in the production of a high amount of bagasse. Extracting cellulose from this waste presents an opportunity to create valuable bio-based materials. Our projectproposes a sustainable solution to mitigate the environmental impact of tequila production by utilizing the abundant bagasse as a valuable resource. Therefore, it was investigated the use of deep eutectic solvents (DES) as an eco-friendly and effective alternative for cellulose extraction. This approach aims to promote environmental sustainability and optimize the utilization of agricultural byproducts. Cellulose was extracted using DES, with choline chloride as hydrogen bond acceptor (HBA) and lactic acid, oxalic acid, or glycerol as hydrogen bond donor (HBD). Ligninremoval was optimized through DES solvent pretreatments. Cellulose yield, purity, esterification degree, and substitution degree were assessed using Fourier- transform infrared spectroscopy, X-ray diffraction, and standard analytical techniques. The results suggested that DES-based cellulose extraction from Agave*tequilana* Weber var azul bagasse is a promising method for revaluing agricultural waste. Optimized DES formulations yielded high cellulose extraction and improved purity, highlightingthe potential for downstream processing. A significant part of thisproject involves the utilization of the extracted cellulose to produce membranes for water filtration. The cellulose derived from agave possesses suitable properties for the fabrication of porous membranes with excellent filtration capabilities. These membranes hold promise for applications in water purification and treatment. Furthermore, this approach contributes to waste management and provides an innovative solution to address the global challenge of clean water availability.

Keywords: Agave *tequilana* Weber, bagasse, DES, cellulose, acetylation.

Acknowledgment: The present work was funded by the CONAHCYT, the Advanced Materials Research Center, and the Autonomous University of Chihuahua.

COVID 19 AND THE CONCENTRATION OF METALLIC ELEMENTS IN SOILS AND SEDIMENTS IN ALMOST HALF OF THE BRAZILIAN TERRITORY

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Abstract: In the first year of the Covid 19 pandemic, Chinese researchers have associated China´s well-known low-selenium belt to a possible increase in the severity and number of Covid19 cases. Trying to verify if this fact also occurred in Brazil, a study was carried out with 2020 data taken from DATASUS (Database of Ministry of Health) in the range corresponding to 40% of the national territory already covered by the environmental geochemical sampling of the Geological Survey of Brazil. We used 3,793 soil samples and 15,322 samples of river bottom sediment covering 2,874 cities, after removal of all municipalities of great metropolitan areas and those with more than 250 thousand inhabitants. The number of Covid 19 cases, number of hospitalizations, number of deaths, population and projected data for 10,000 inhabitants were taken from the DATASUS database. Maps of the case numbers, deaths and correlation graphs of some elements are presented, mainly for iron and zinc. The elements originally studied, such as selenium, germanium and lithium, presented a correlation close to zero but with a positive bias. Iron and zinc, on the other hand, presented negative biases, both for the number of cases and for the total number of deaths, and in the latter case, magnesium, manganese and rubidium also show negative biases. The others elements did not show any kind of correlation. The preliminary conclusion is that in regions that are richer environmentally in iron and zinc, the human immune system might be more efficient in the fighting against infections caused by Covid19.

Keywords: Covid19, medical geology, environmental geochemistry, Brazil.

USE OF MESQUITE (*Prosopis* spp.) GUM IN MOLECULAR COOKING: BENEFIT IN THE AGROECOSYSTEMS OF ARID ZONES

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Abstract: One of the most fragile ecosystems and vulnerable to changes in flora and fauna are the deserts. The Chihuahuan desert that is located in the north of Mexico does not escape to these effects. Our Faculty created a line of generation and application of knowledge called sustainable development of the Chihuahuan desert as part of the UN Agenda 20-30. The objective was to determine the minimum mesquite gum treatment required as an additive to perform the air technique (flavored foam) in molecular cooking. The methodology used was based on the recommendations of Mariana Koppmann who suggests the use of soy lecithin at concentrations of less than 1% of the preparation. In consequence, two panel techniques were conducted to evaluate the characteristics of the foam or air based on mesquite and lecithin. The variables were foam (consistency and durability), odor, flavor, and color. In order to identify the minimum required dose of mesquite gum to achieve the elaboration of air, concentrations of 1, 2, 3, 4 and 5% were used, added to 500 ml of natural water, comparing it with a control sample added with 1% soy lecithin. A panel was made with 39 participants. It was concluded that using mesquite gum from 2% began to obtain air with a bubble quality very similar to that obtained with soy lecithin. However, when reaching 3%, the conditions improved since a larger bubble and a greater amount of air were obtained, presenting a very low percentage of rubbery flavors and a higher percentage in fixing the strawberry flavor. A bubble duration test was carried out and it was observed that the average duration was 30 min when using mesquite gum versus that of soy lecithin lasting approximately 15 min.

Keywords: Additives, air, gastronomy, lecithin, emulsion.

QUALITY OF WATER AND PRESENCE OF EMERGING CONTAMINANTS IN THE SANTA CATARINA RIVER IN THE METROPOLITAN AREA OF MONTERREY CITY, MEXICO

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Abstract: Emerging Organic Contaminants (EOC) are substances of concern, since there are constituents of products and medicines used by the population which contain chemical compounds that may be persistent and have a negative effect on human and ecosystem health. The EOC are not removed in the traditional water treatments due to their physicochemical properties. Although, EOC have been found in low concentrations in ppm or ppb, they could be an environmental risk or even became a health issues mainly in males, being this the reason for testing their presence and regulation. The Santa Catarina river crosses the metropolitan area of Monterrey City (ZMM), Nuevo Leon, where there are reports of detection of Bisphenol A (BPA), bis (2-ethylhexyl) phthalate (DEHP) and benzenesulfonamide (SDI). These compounds represent a risk for public health because the water reaches into “El Cuchillo” dam, which is also used as surface source of drinking water for ZMM. Therefore, the aim of this research is to analyze parameters of water quality (pH, temperature, dissolved oxygen, total solids, $NO3^{1}$, $PO4^{2-}$, $SO4^{-2}$) and to determinate the occurrence of BPA, DEHP and SDI in surface and ground water throughout 25 km of Santa Catarina river. For the case of surface water there were selected six points and for ground water three points, which were sampled during two years in dry and rainy seasons. A method of solid phase microextraction and gas chromatography-mass spectrometry (MEFS-CG-MS) was developed for EOC. The physicochemical properties of the water are within established standard with the exception of dissolved oxygen parameter. Besides there was confirmed the presence of BPA, DEHP and SDI on both systems.

Keywords: Bisphenol A; surface water; CG-MS; wastewaters; Cuchillo Dam.

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El BAÑITO HOT SPRING IN NORTHEASTERN MEXICO. ENVIRONMENTAL GEOLOGY AND GEOTHERMOMETRIC RESEARCH

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Abstract: Human thermal experience of mineral springs has lasted since ancient times. Pre-Hispanic cultures in México actively used hot springs for relaxation, healing and religious purposes. There are several health benefits to bathing in natural hot springs. The genesis and hydrogeological characteristics of the El Bañito thermal spring; located at the central part of sierra Cerro de La Silla (near Monterrey, Nuevo León), remained unknown until recent investigations were performed. El Bañito's high temperature ~35ºC and high concentration of Cs, B, Ba, Li, Mo, Rb, Sr, U and Zn make it a very singular thermal spring within the region. The pathway of the meteoric water in the interior of the mountain range forms perched water-bearing zones in the high and intermediate sections, to subsequently reach a groundwater base level where the regional aquifer is located; a peculiarity created by the association of an important thrust, an extensive right lateral fault, and a carbonate evaporite succession at depth that allowed the formation of what we have called the "Low Enthalpy Geothermal System "El Bañito". Geochemical modeling, geothermometers, and geology indicate that the geothermal reservoir is located in a carbonate-evaporite succession at a depth ranging between 800 m and 1,700 m and a temperature between 49ºC and 67ºC. Groundwater of El Bañito hot spring is highly enriched in solutes due to its journey to greater depths and its transit through evaporite rocks, and it is Na-Ca-SO_4-HCO_3 type.

Keywords: Hot spring, groundwater, geothermal reservoir, geothermometers.

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PHYSICOCHEMICAL CHARACTERIZATION OF GUM PRODUCED BY MESQUITE (*Prosopis* spp.*)* AND HUIZACHE (*Vachellia farnesiana*) NATIVE SPECIES OF AN ARID GEOLOGICAL ENVIRONMENT.

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Abstract: The gum produced by mesquite (*Prosopis* spp.) and huizache (*Vacheliia farnesiana*) is used as a food additive, as a microencapsulating agent for flavorings, and as essential oils. Furthermore, the gum can be used as a surfactant for water/oil emulsions. These gums share physicochemical properties with gum arabic, which suggests that they can be considered as a replacement in some processes such as ice cream manufacturing or as emulsifier by better trapping oily compounds. This research is a continuation of the line of generation and application of knowledge (LGAC) of the project called Sustainable Development of the Chihuahuan Desert under the UN 2030 Agenda. The objective was to analyze the chemical composition of both types of rubber, through a proximal analysis. Ashes, carbohydrates, proteins, moisture and fats were determined. In addition, total polyphenolic compounds and condensed tannins were quantified. The results for mesquite were: humidity (9.82%), ashes (2.32%), fats (0.93%), proteins (2.21%) and carbohydrates (84.69%). The total phenol content was 133.76 mgEAG/g. and the quantification of condensed tannins of 0.2738 mgAC/g. For the huizache species the results were: humidity (11.16%), ashes (3.08%), fats (1.63%), proteins (2.58%), carbohydrates (81.52%). The total phenol content was 1.31 mgEAG/g. and the quantification of condensed tannins of 0.0109 mgAC/g. It is concluded that both gums share characteristics with gum arabic, so they can be a substitute in the food and pharmaceutical industry

Keywords: Colloidal stabilizer, minerals, emulsión.

EVALUATION OF EMERGING POLLUTANTS IN SURFACE WATERBODIES OF THE METROPOLITAN MONTERREY AREA

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Abstract: Water represents a vital resource required to achieve social and economic development. However, emerging pollutants (EP) represent a serious issue that affects water quality, signifying a limitation of water resources. Additionally, it is well known that EPs can affect other environmental systems, representing possible ecotoxicological damage to the environment and human health, even if they are presentin trace concentration. On the other hand, due to its emerging nature, more information must be developed to develop limits or efficient remediation treatments. Bisphenol A (BPA) is widely used in the manufacture of plastics, and it is considered an alarming EP, since; its chemical similarity with human hormones, is classified as an endocrine disruptor. This work evaluates the presence and concentration of this compound in selected surface water bodies of the Monterrey Metropolitan Area (MMA). Sampling was conducted in rainy and dry seasons, classifying the sampling areas as industrial and urban zones. The results of this work confirm the successful development of a technique for extracting and detecting BPA and other EPs based on gas chromatography coupled with mass spectrometry. It was possible to identify the presence of different EPs, highlighting some phthalates, phthalic acid esters, caffeine, and BPA, reaching a concentration up to 1.14 ng/ml coming mainly from the industrial area.

Keywords: Water quality, surface water, emerging pollutants, bisphenol A, Gas Chromatography.

Acknowledgment: The study described here was funded by the CONAHCYT and the Universidad Autónoma of Nuevo León.

A MEDICAL GEOLOGY INTERSECTION: WHERE GEOLOGY MEETS THE WORLD HEALTH ORGANIZATION (WHO)

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Abstract: The United Nations published 17 Sustainable Development Goals (SDGs; https://sdgs.un.org/goals) that set an agenda for freeing human society from poverty, hunger, and disease, and provide a peaceful and prosperous environment. The emphasis is on people and society (interlinking with policy, education, and goals). The health of the environment and the significance of the geogenic environment is not the object of these goals but they are essential for the realization of all the SDGs. The SDGs provide a measured and incremental approach to address issues as diverse as Clean Water (SDG6), Clean Energy (SDG7), Sustainable Cities (SDG11), Climate Action (SDG13), and Life on the Land (SDG15). We demonstrate how medical geology enhances the meaning of these goals and provides mechanisms for action. We further demonstrate the validity of the Medical Geology lens with an investigation of SDG3: Ensuring healthy lives for all members of society, to illustrate the power of Medical Geology. To achieve SDG3 we address the complex factors linking human and environmental health outcomes. Partnerships between the geosciences and health sectors is crucial. We explore the concept of wellness and how the geogenic environment supports health and wellbeing. We discuss health financing and trends, and the geogenic environment's role in sustaining both ecosystem and human health, with an emphasis on case studies that demonstrate the essential positives and negatives of how we currently engage with our planet. We demonstrate the global inter-connectedness of systems and explore the significance of the natural environment to human and ecosystem health.

Keywords: SDG, Medical Geology, Health, geogenic.

^{1}H-NMR ANALYSIS OF THE METABOLITES PRESENTS IN THE BIOLOGICAL CONTROL OF *XANTHOMONAS PERFORANS* BY NATIVE *BACILLUS* OFCHIHUAHUA, MEXICO

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Abstract: The genus *Bacillus* has many applications, one of the most relevant is the antagonistic activity against plant pathogens, which is an alternative to the use of pesticides conventional, harmful to the environment. Bacterial spot, caused by *Xanthomonas* spp., is one of the main diseases that affect the pepper, generating losses in the production and fruit quality. In Mexico, the resistance of bacterial spot to the usual treatments has been reported. The objective of this work was to evaluate the activity of native *Bacillus* spp. of the production region as agents of biocontrol against *Xanthomonas* spp. Thirty *Bacillus* isolates were obtained from the soil in the Center-South production area of the State of Chihuahua, which identified by morphological and molecular methods (PCR multiplex). *In vitro* antagonism tests were made in microplate between *Bacillus* and *Xanthomonas perforans*. In addition, the nuclear magnetic resonance technique was standardized for the identification of metabolites related to antagonism. Of the 30 isolates analyzed, 12 showed an inhibition average growth of *Xanthomonas perforans* (70.38%) and nine showed a high inhibition (93.53%). Within this last group, strains of *Bacillus cereus*, *Bacillus thuringiensis* and *Bacillus* of the *Cereus* group. The metabolite profiling, detected via ^{1}H NMR, contained metabolites from the groups of sugars, amino acids, organic acids, and aromatic compounds. By principal component analysis (PCA) differences were demonstrated between antagonism and strains grown independently. As conclusion, most of the native *Bacillus* of the Center-South production area of Chihuahua were effective against the etiological agent of bacterial spot in pepper.

Keywords: bacterial spot, antagonism, biological control, metabolomics, Nuclearmagnetic resonance spectroscopy.

Acknowledgment: The work here described was founded by the Autonomous Universityof Chihuahua.

URANIUM ORE MINERAL TRANSPORTATION FROM NOPAL 1 MINE TO THE LAGUNA DEL CUERVO

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Abstract. The state of Chihuahua, Mexico, has several uranium deposits the most important: the Peña Blanca deposit. The uranium deposits were exploited during the 1980s, and the unprocessed ore mineral was exposed to weathering. The hydrology of the area favors the transport of uranium through the main streams present in the area, flowing into the Laguna del Cuervo. The health effects associated with uranium depend on its chemical and physical form. Chemical toxicity is the main cause of concern, as soluble uranium causes damage to renal tissue. To characterize the transport of uranium by surface water in the form of particles or dissolved constituents, sediment samples were collected near the Nopal 1 mine, and separated into fine sand, silt, and fine silt + clay fractions. By gamma spectrometry we found specific activity of U in the samples. We performed X-ray absorption spectroscopy measurements on the U L3-edge of the samples. The XANES region analyzed indicates the presence of hexavalent uranium. The fit of EXAFS region of the samples indicates the presence of alpha-uranophane. There is evidence that at least the fine sand particles containing alpha uranophane associated with amorphous silica moves through the streams downhill from the Nopal I mine, and that these particles conserve original species. On the other hand, it is theorized that in the case of fine silt + clay fractions there is a prevalence of adsorption caused by the deposit of an aqueous oxygen rich solution containing uranyl ions.

Keywords: Uranium, transportation, Radiation synchrotron, environmental, Mexico.

Acknowledgment: The work here described was funded by the CONAHCYT research project CF 2019 10853.

HEALTH EFFECTS OF SELENIUM-SUPPLEMENTATION AMONG COMMUNITY POPULATION IN CHINA

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Abstract: Selenium (Se) is one of the essential trace elements for humans, which plays an important role in maintaining normal biological function, and in promoting the health levels of cardiovascular, reproductive, etc. Due to the uneven distribution of Se resources, the dietary Se intake for the Chinese population is lower than the world average value. However, the study on the health effects of Se-supplementation among the community population is limited. In this study, we conducted a before-after self-control study for 30 days to explore the health effects of short-term Se-supplementation among the Chinese community population. A total of 51 subjects aged 50-87 years were recruited and finished it. All subjects were given Se-tablet through oral administration for a total of 120 μg/d. We measured hair-Se content (n=26), blood-Se content (n=28), and blood biochemical indices (n=51), including alanine aminotransferase (ALT), homocysteine (HCY), etc. Liner mixed-effect models were fitted to assess the changes in the above health outcomes. The results showed that, after Se-supplementation, the level of blood-Se content increased by more than 20%, and the levels of ALT and HCY decreased (all p<0.050). Additionally, the level of blood glucose also had a downward trend (p=0.117). In conclusion, short-term Se-supplementation could increase the Se content of the human body and improve the health of the community population, such as improving liver function and reducing the risk of cardiovascular disease. Moreover, a long-term Se-supplementation study based on the randomized, double-blind, placebo-controlled design among the community population should be considered in future.

Keywords: Selenium-supplementation, Health effects, Community population, Intervention study, China.

Acknowledgment: All authors appreciate the contributions of all the subjects and researchers in this study.

MEDICAL GEOLOGY AND OTHER NEW MULTIDISCIPLINARY APPROACHES FOR ENVIRONMENT AND HUMAN HEALTH ISSUES. EXAMPLES IN URUGUAY

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Abstract: Recent advances in scientific knowledge of "environmental sciences" included modern technologies, new concepts, and emerging disciplines as medical geology, with multidisciplinary approaches for scientific research and as an input for local / regional policies and actions. The objective is to analyze examples in Uruguay. Medical geology issues have been incorporated by environmental toxicology and geochemistry to assess environmental risks and health impacts due to geological factors. It is an area of recognized trajectory, both at the University (UDELAR) and Geosciences Area of Development Programs (PEDECIBA). Since 2005, studies related to environmental lead pollution and arsenic in groundwater integrated geoscientists, chemists, epidemiologists, physicians, and veterinarians into research teams, and grade and postgraduate student´s courses are dictated. It was linked to Eco-health in transdisciplinary research for metal pollution, as it is globally issued to address human health from an ecosystem perspective which includes the support of affected communities. Consequently, joint official actions related to health and environmental issues were conducted to improve Uruguayan's life quality. A novel approach as "One Health" (by W.H.O) is useful in environmental health and toxicology studies or in public health surveillance when considering common environments and food sources shared by humans and animals. In Uruguay, dogs have proven to be a useful sentinel tool to assess and prevent children´s lead risk exposure when environmental data are not available, as another medical geology research. "Exposome" is another concept for all risk factors involved in environmental diseases. We highlight Medical Geology, as the main approach for study most environmental health problems worldwide.

Keywords: Multidisciplinary Approach, Medical Geology, Environmental health, Uruguay

GROUNDWATER QUALITY ASSESSMENT IN RUSSAS, STATE OF CEARÁ, BRAZIL

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Abstract: Assessing groundwater potability is necessary due to the potential that these have of inflict illnesses caused by chemical substances toxicity , according to Brazilian standards. The goal of this study is to classify and to establish the groundwater quality in the municipality of Russas, State of Ceará, and also to indicate its potability for human consumption and irrigation. The methodology comprised the survey of existing wells, and the collection of samples to evaluate water hydrochemistry in 2019. Eighteen groundwater samples were collected from wells destined for domestic supply (89%) and irrigation (11%). There is registration of physicochemical analysis in the wells of the municipality in several years (1998, 1999, 2000, 2001, 2006 and 2009) which reveal a predominance of Sodium and Chloride ions in the waters. The classification of the 18 samples shows that 40% are chlorinated sodic, 25% mixed chlorinated, 15% are bicarbonated sodic, 5% mixed calcic, 5% bicarbonated magnesian. The waters destined for human consumption (8 wells), which go through desalters, are good (50%), however thosethat did not go through are distributed in the good (12.5%), passable (12.5%) and mediocre (25%) categories. The samples analyzed for irrigation show that 60% present a high to exceptionally high risk of salinization, thus, soil care is needed for cultivation in the region. Therefore, the study evaluated the quality of the water, butit is recommended to monitor possible human health impacts from drinking the waterin the region.

Keywords: Salinity, consumption, irrigation, health.

Acknowledgment: The authors would like to thank the Department of Geology/CC/ UFC, the Laboratory of Geoprocessing of Ceará (GEOCE) for the structure made available to conduct this work, in addition to the Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq) [National Council for Scientific and Technological Development] and the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES) [Coordination for the Improvement of HigherEducation Personnel].

HEALTH EFFECTS DUE TO RADON OF THE INHABITANTS IN THE CITY OF ALDAMA, CHIHUAHUA

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Abstract: Rn is known to cause lung cancer. According to publications, the city of Aldama, Chihuahua, has high values of Rn in air, mainly inside rooms; official data indicates that there is a considerable increase in cases of lung diseases. With published values, the dose of radioactivity received by the inhabitants and the relationship with deaths due to pulmonary affections would be calculated. A relationship will be made between Rn levels in a standard type bedroom; In Aldama the average levels are 225 Bq/m3 and according to WHO data the risk of cancer increases by 16% for every 100 Bq/m3. According to this, there is a proportion of 36% of the inhabitants of Aldama that could present lung cancer. Based on the rate of lung disorders in the city of Aldama provided by the civil registry, there were approximately 12 deaths from lung cancer in the months of January to June 2023 in people between the ages of 50 and 75, in which there is an agreement with the risks due to Radon and official data. According to this, an inhabitant of the city of Aldama has a high risk of suffering a lung disease due to prolonged exposure to Radon in the environment; the lack of information prevents the inhabitants from preventing lung diseases and they continue to be constantly exposed to this radioactive whose long-term effects have a high tendency to be fatal.

Keywords: Radon, cancer, lung, Aldama

COMPUTER APPLICATIONS IN MEDICAL GEOLOGY: AN EXAMPLE OF *"BALNEO-CHECK"*

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Abstract: Balneological resources (water, rocks, minerals, and aerosols) are found in virtually all the continents of the earth, and are useful in balneotherapy. With the advent of medical hydrogeology and recent advances in software engineering, the need to inculcate computer software application in generating and analyzing medical hydrogeological data makes it compelling on modern day inter-disciplinary research to establish a link between geologic materials, their analysis, and their applications. This paper therefore, presents a brief review of AQUAMED software designed for balneological evaluation of mineral/medicinal waters as demonstrated with thermo mineral waters of West Africa. The software uses a Microsoft server SQL database to exchange data between the client system and the server. This evaluation software compares the physical/chemical properties (pH, mineralization, dominating mega ions, and phamarcodynamic elements) of mineral/medicinal waters to standards and generates reports based on these properties. The report covers medical benefits, disease applicable to, as well contra-indication of the medicinal water type. AQUAMED vl.1 was developed using Microsoft Visual Studio.Net platform. AQUAMED version1.1 is a good analytical tool in evaluating the balneological quality of mineral/medicinal waters useful for balneotherapy.

Keywords: Balneological, Balneotherapy, Mineral Waters, Medicinal Waters, Software Engineering.

EVALUATION OF POTENTIAL TOXIC ELEMENTS IN THE PIER OF THE TOURIST ZONE OF XOCHIMILCO, MEXICO AND POSSIBLE ENVIRONMENTAL RISK

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Abstract: Xochimilco is located in the southeastern part of the Mexico City basin, which is influenced by a floating agricultural system called chinampa. In this system, aquatic plants play an important role in the environment and are impacted by a variety of anthropogenic activities. This study aimed to determine the concentrations, distributions, and sources of potentially toxic elements (PTE) in water, sediments, plants, as well as to evaluate the water quality of seven chinampa sites. The plants collected were *Typha latifolia* L. and *Eichhornia crassipes* (Mart.) Solms. *T. latifolia* is an emergent plant whereas *E. crassipes* is a floating one. The results showed that most of the water's physicochemical parameters were within acceptable ranges, except for total dissolved solids, which exceeded the federal law on water rights (FLWR). The PTE did not exceed the limits proposed by SQuiRTs; however, Mn and Zn exceeded FLWR at all sites. PTE concentrations in the channel sediments were within normal ranges. PTE concentrations in the plants were within normal ranges, except for Zn in *T. latifolia* at sampling site 2. Pb was not bioaccumulated, indicating that these plants are Pb excluders or that Pb is not bioavailable. The bioconcentration and bioaccumulation factor showed a high accumulation of Zn in most chinampa sampling sites, indicating its bioavailability. Hazard Quotient and Hazard index showed a risk of ingestion and inhalation of Pb for people through sediments. However, contact with water does not pose a risk of oral ingestion, inhalation, or dermal contact.

Keywords: Chinampas, potentially toxic elements, Pollution.

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HEALTH RISK ASSESSMENT RELATED TO SURFACE WATER CONSUMPTION IN A GEOTHERMAL EXPLORATION AREA IN PUEBLA, MEXICO

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Abstract: Most hydrothermal areas are sources of potentially toxic elements (PTEs) to the environment. Acoculco, Puebla, Mexico is a geothermal exploration zone part of the Transmexican Volcanic Belt. It has low permeability, maximum hydrothermal fluid temperatures of 25°C and sulfated acidic characteristics. Locals normally consume surface water in the region, since there are few groundwater sources. Therefore, the aim of this study was to assess the human health risk associated with the consumption of surface water. The water quality was evaluated with the Water Quality Index (CCME-WQI), for a series of water samples for dry and wet seasons in a period of four years (2015-2018), differentiating the water as: surface water (S), dam water (D), groundwater (GW) and hydrothermal water (H). The detected PTEs that exceeded the recommended values in most water samples, based on international water standards were Al, As, Fe, Mn, Sb and V. In most of the analyzed sites in all monitored years, the water was highly contaminated with As and is not suitable for human consumption. The health risk assessment was performed applying toxicogenetic analyses using micronucleus assays on the presence of micronuclei in oral epithelial cells, cell cycle and fragmentation in terms of non-carcinogenic and carcinogenic risk. Observing genotoxic damage in human cells mainly in children, in comparison to healthy standard values. Nevertheless, more studies are needed to find out the detailed health effects and the mechanism by which the identified PTEs may induce health effects in those children.

Keywords: Anthropogenic, Water Pollution, Micronucleus, Health risk assessment.

DETERMINATION OF HEAVY METALS IN SEDIMENTS FROM URBAN STREAMS: METHODOLOGY DEVELOPMENT AND STUDY OF EFFECTS ON THE ENVIRONMENT.

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Abstract: Over the years, factors as population growth and the excessive increase of industrialization have greatly contributed to the entry into the environment of toxic substances, with very high concentrations, generating several environmental problems. Heavy metals are among the toxic substances that enter into the environment and accumulate in various living beings included humans. The impact generated by the high concentrations of these elements in water courses limits the use of these resources because the accumulation generates a long-term threat to the environment and human health. This work try to generate a first diagnosis for Uruguay that evaluates the relationship between the contamination generated by heavy metals, the urban and the industrial area present near the analyzed stream. The analytical methodology for the determination of heavy metals (zinc, nickel and lead) in sediments of urban streams of 5 cities of the country is being performing. The metal levels of about 60 samples will be determined and quantified, from a total of 15 sampling sites. The sediment sample digestion methodology for the extraction of the aforementioned metals is being developed and will be validated taking into account EPA 3050B, with the objective of using the lowest possible acid content to make it more environmentally friendly. Preliminary results showed Nickel mean values of 12.8 mg/kg for the Santa Rosa, Bella Unión and more results will be coming out in the coming months.

Keywords: heavy metals, environment, sediments, pollution, human health.

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ANALYTICAL METHODS FOR THE DETECTION OF GLYPHOSATE AND HEAVY METALS IN THE WATER OF A SEMI-ARID AGRICULTURAL AREA

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Abstract: Organophosphorus pesticides were used since the ban on organochlorines, The most commonly used in the world is glyphosate, a non-selective herbicide, which is derived from aminomethylphosphonic acid (AMPA) it does not affect transgenic crops, but with has a limited use at present, since it was found that it could be an enhancer for health problems and more in the vulnerable population. At the same time resistant crops to this compound are already being found, also decreasing its spectrum of action. Mexico is one of the countries where pesticides are used the most, with Chihuahua standing out as an important agricultural producer. The objectives of this study were to analyze, detect and quantify glyphosate in the water of a lagoon located in the recreational center "La Lagunita" in Anáhuac Chihuahua, Mexico. High-efficiency liquid chromatography HPLC (UltiMate 3000, Thermo Fisher Scientific, USA) in reverse phase, with an eluent of acetonitrile water was used in this research. Glyphosate concentrations 30 times higher than those established by the EPA in 2014 (0.7 ppm) were measured. Heavy metals and metalloids were also identified with total reflection X-ray fluorescence (TXRF) (S2 Picofox, Brucker, USA) with results lower than those established by NOM-127-SSA1-1994 except for arsenic, with concentrations 5 times over what those established in the standard, (0.05 ppm in drinking water).

Keywords: Glyphosate, AMPA, water analysis, pesticides, arsenic.

ARSENIC LEVEL AND COGNITIVE FUNCTION OF ADULTS AND OLDER ADULTS

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Abstract: Trace element homeostasis plays a vital role in facilitating optimal neural functioning. Both imbalances in essential and exposure to non-essential trace elements (TE) have detrimental consequences for the aging brain and its performance. In this study we aimed to explore potential links between TE and the cognitive performance of adults and older adults. We recruited 76 participants residing in two different geographical regions of Portugal: the Central Coast (CC) and the Inland of Alentejo (IA). Participants completed the Mini Mental State Examination (MMSE) for assessment of general cognitive performance and provided hair samples to be analyzed for eleven TE: aluminum, arsenic, cadmium, chromium, copper, iron, lead, manganese, mercury, nickel, zinc. In 39.5% of our sample, we observed cognitive performances typical of Alzheimer's disease patients (MMSE<26). Of the eleven TE, MMSE total scores correlated significantly with arsenic, chromium, iron, lead, nickel, and zinc (r=-0.238 to r=-0.495). Arsenic was the sole TE to significantly predict MMSE total scores after accounting for age and education as statistical covariates (β=-0.347, p<0.001). When comparing participants from CC and IA, we observed worse cognitive performances and higher arsenic levels in hair within the IA group, regardless of between-group differences in age and education. IA regions are characterized by heightened arsenic levels in soil and water associated with abandoned mining areas related to the Iberian Pyrite Belt. Higher levels of arsenic are seemingly linked to worse cognitive performances among adults and older adults. Environmental indicators of exposure should be further explored, as they hold the potential of constituting a risk factor for cognitive impairment.

Keywords: arsenic, cognitive performance, environment, human health, adults andolder adults.

IMPROVED SELENIUM GEOMEDICAL DATA QUALITY FOR PRACTICAL APPLICATIONS

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Abstract: There are several overviews of selenium (Se) covering aspects of its environmental geochemistry, dietetics, and toxicology. As many reviews on Se nutrition have re-iterated, this element has a multifaceted profile in metabolic processes - as an essential nutrient, a modifier of other toxicants, an anticarcinogenic agent, and a toxic substance *per se*. The objective of this paper is to provide a brief updated summary of existing knowledge on the geomedically relevant characteristics of Se. This knowledge will allow us to improve our understanding of the element's cycling, uptake, and bioavailability; and how its involvement in metabolic processes engenders nutritional benefit or produces disease. A listing is made of some of the several still-existing gaps in knowledge requiring further research. The value of such an approach is underscored by research needs such as the criticality of improved data quality input in Se modelling systems. High quality input data will no doubt improve Se biogeochemical model outputs and increase confidence in predicted Se phenomena such as fluxes in global atmospheric circulation, and quantification of the linkage between Se concentrations in the environment and effects on humans. These are phenomena that until today remain highly uncertain. The comprehensive list of updated references would ensure optimisation of the search process of those wanting to explore the existing knowledge gaps.

Keywords: Selenium; data quality; practical applications; research gaps.

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BIOGEOCHEMICAL CHARACTERIZATION OF ARSENIC (As) IN THE WATER FOR HUMAN CONSUMPTION IN SANTA ROSA DE CABAL (COLOMBIA)

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Abstract: The municipality of Santa Rosa de Cabal (Risaralda, Colombia) has been subjected to water-quality monitoring by the environmental authority. They identified arsenic (As) levels above Colombian allowable limits. in drinking water (10 µg L^{-1}). The Ruiz-Tolima Volcanic complex determine the geological context of the region and the occurrence of hot springs that drain into Campoalegrito river, which is the main water source for the community. The arsenic has a natural origin and its transported for the thermal water. As concentrations in thermal waters were found as high as 3,665.0 µg L^{-1} and stream water prior to potabilization had concentrations up to 91 µg/L (compared to Colombian maximum limit, 50 µg L^{-1}). The drinking water average was 17 µg L^{-1} (above Colombia standard:10 µg L^{-1}). Subsequently, a cross-sectional study was conducted in 153 inhabitants of the municipality. The study included a sociodemographic survey, a clinical evaluation, drinking water and hair sampling. The results showed As concentrations in hair between 0.08 to 31.6 mg kg^{-1} with a median of 0.73 mg kg^{-1} and highest concentrations in men aging between 37 and 59 years and withing overweighted population. Forty percent of the sampled population showed As concentrations greater than 1 mg kg^{-1} in hair (ATSDR reference value). Thirteen percent out of that 40% showed dermal symptoms and 3%, back's leukomelanosis and plantar keratosis. Seventy one percent of the sampled population consume water with As concentrations above the standard (10 µg L^{-1}), with a median of 17.40 µg L^{-1}, ranging from 1.25 to 52.32 µg L^{-1}, evidencing population exposure to As.

Keywords: Arsenic (As), hot springs, drinking water, hair samples, Colombia.

UNCONTROLLED COAL FIRES: AN OPPORTUNITY FOR MEDICAL GEOLOGISTS

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Abstract: Can research opportunities be derived from the neglected health aspects of uncontrolled coal fires that occur in more than 40 countries? These naturally or anthropogenic induced uncontrolled coal fires are a major environmental insult to the air, soil and water and a major threat to the health of those unfortunate enough to work or live nearby. While the adverse health impacts from the extraction, storage, transportation, and utilization of coal have been well documented including exposure to hazardous air pollutants including SO_2, NOx, toxic elements and volatile organic compounds, the threat of uncontrolled coal fires has been largely neglected. Uncontrolled coal fires may occur wherever coal is exposed at the surface. The Jharia fires for example, are notorious for exposure of an estimated 500,000 residents to hazardous emissions. Villagers living close to these fires report a higher incidence of health problems than villagers living a few miles further away. Analysis of the condensates formed around vents releasing gases from underground fires commonly report phases containing As, Se, Pb, F, and Hg along with a host of dangerous gases including benzene, toluene, xylene, etc. Long overdue research to characterize the condensates, gases, local soils, water, and crops should provide scientists a basis to determine what mine workers and local villagers may be exposed to and then to document the subsequent chronic health effects. This information will provide policy makers the tools to assist the impoverished villagers who rely on the coal mines for their livelihood and what remediation efforts are needed.

Keywords: coal fires, human health, adverse health, Jharia, environmental.

SHARING GEOSCIENCE THROUGH SOCIAL NETWORKS: THE PATH FROMSCIENCE TO SOCIETY

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Abstract: In Mexico, geosciences are scarcely included in the basic education curriculum, which has caused that, unlike other branches of science, they are not made visible and prejudices are created about them. Due to the demand for current socio-environmental problems, it is necessary to inform the community about the importance of geosciences in daily life. Currently, social networks have transcended the entertainment barrier and have become an important information exchange tool. Through the use of new technologies, particularly social networks, geosciences have transcended into a social plane where little is said about them. Given the aforementioned needs and in order to communicate about Geosciences in an entertaining and humorous way, the character of La Geóloca was created in 2021, an independent project through social networks. In this talk, ways of communicate the importance Geosciences to society through the use of social networks such as Facebook and Instagram will be shown, especially with the use of humorous memes. The importance of geosciences lies in the fact that they provide us with vital information about natural resources, such as fossil fuels, minerals, water and arable land, in addition, they are essential for making informed and sustainable decisions in relation to natural resources, the environment and human security. It is for the above reasons that sharing geoscientific knowledge can positively influence society.

Keywords: Science communication, Geoscience, Social media.

CORRELATION BETWEEN THE CONCENTRATION OF FLUORIDE LEVEL (F) AND DEPTH OF THE WELL IN THE TABALAOPA-ALDAMA AQUIFER, CHIHUAHUA, MEXICO

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Abstract: The concentration of some contaminants in water, such as heavy metals and metalloids, may vary depending on the location of the aquifer, its depth, and the volume of extraction. The objective was to analyze the fluoride (F) concentration variation with respect to depth in wells of the Tabalaopa-Aldama (TA) aquifer. This is important because this aquifer supplies some drinking water to the city of Chihuahua. Data of F concentration and well´s depth was collected from 21 wells and statistically analyzed. The depths of the wells varied in a range of 160 m and 500 m while the F concentrations varied between 2.06 and 4 ppm with a mean of 2.926 ± 0.698 ppm. The well with the concentration greater than 4 ppm was the 500 m well. The results showed that F concentrations increase according to the depth of the static level of the wells. This increase can be explained by the geological characteristics of the area where the aquifer (TA) is located. It is well known that F is contained in the rocks and is released into the groundwater table when the natural balance is broken due to the drilling process. In other words, the deeper the drilling, the greater the content of the contaminant is released. The foregoing frames the importance of conducting hydrogeological studies in the drilling area and fully identifying the type of soil as well as analyzing historical information to avoid possible sources of contamination that affect the water resource.

Keywords: Pollution, water, aquifer, balance, resources.

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BALKAN ENDEMIC NEPHROPATHY: ¿WHERE ELSE IN THE WORLD CAN IT OCCUR?

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Abstract: Balkan Endemic Nephropathy (BEN) is an irreversible, often lethal kidney disease that occurs in parts of the Balkans where residents drink untreated well-water derived from aquifers. This untreated well water contains potentially toxic organic compounds leached from low-rank coals (lignites). BEN has a high prevalence rate throughout the former Yugoslavia and Romania where deposits of lignites are present. The United States faces a similar BEN-like condition known as Water-Lignite Syndrome in its Gulf Coast regions of Texas, Louisiana, and Arkansas underlain by lignites. A correlation between drinking the groundwater from the Carrizo-Wilcox Aquifer in communication with lignites was observed, resulting in various kidney diseases. The state of North Dakota has a high incidence of kidney disease and the entire western half of the state is underlain by lignites. Although many rural residents drink well water, it is not drawn from aquifers in communication with the lignites. It is likely that the poor health of the Native American population accounts for the high incidence of kidney disease. Although lignites in Greece are similar to those in the Balkans, people do not drink water in communication with the lignites. Lignites occur extensively in the Czech Republic, Germany, Poland, China, Russia, India, and in more than twenty other countries including 10 countries in South America and at least three states in Mexico. Research in these countries should be conducted to determine if people are drinking ground water that has been in communication with lignites and may be at risk for kidney disease.

Keywords: Balkan Endemic Nephropathy, Lignites, End Stage Renal Disease,Chronic Kidney Disease, Water-Lignite Syndrome

UNLAWFUL PRESENCE OF ALDICARB IN GROUNDWATER SUPPLIES: A HUMAN HEALTH RISK IN RUSSAS, STATE OF CEARÁ, BRAZIL

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Abstract: The aldicarb is prohibited in the European Union and has been sold since 2012 in Brazil in the ilegal Market. This product has caused an increase in intoxication cases and substantial relation to colorectal neoplasms, becoming a significant public health problem. It is estimated that in 2020, in Brazil, 20,245 deaths due to colon and rectal cancer (9.56 per 100,000 inhabitants) occurred, and in the state of Ceará, the mortality rate due to colorectal cancer was 6.53 deaths per 100,000 inhabitants. In this context, this research aimed to assess the presence of aldicarb in groundwater for human consumption in the municipality of Russas, Ceará, and discuss the impacts on human health. We performed four cycles of water collection with chromatography between 2021 and 2022. The presence of Aldicarb was detected in the first cycle (<LD at 6.79 µg/L) and in the fourth cycle (<LD at 235.8 µg/L), this being 2,358 times higher than the limit set by the European Union and 23.58 times above the limit set by the GM/MS Ordinance No. 888/2021. It was not detected in the second and third cycles; since the collection occurred in the dry period, the application rate of pesticides is almost zero. The acute intoxication rate for the municipalities that make up the Baixo Jaguaribe sub-basin from 2007 to 2020 shows significant growth, and the municipality of Russas occupies the third position. The authors concluded that ingesting water contaminated with aldicarb due to indiscriminate use has significant potential impacts on human health.

Keywords: water supply, aldicarb, intoxication, legislation.

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ADVANCES IN MEDICAL GEOLOGY UNIVERSITY EDUCATION IN URUGUAY DURING THE COVID 19 PANDEMIC

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Abstract: In March 2020, when our course "Environmental Toxicology and Medical Geology" had just begun, the Covid 19 Pandemic was declared and classes were interrupted until the end of April. As we were already in full use of our virtual educational platform before the outbreak of the pandemic, we stayed in touch with our students. When classes were resumed through livestreaming, we experienced a steady increase in the enrollment numbers for our three regular Medical Geology courses, from May 2020 until present. Furthermore, we had lectures given by Dr. Jose Centeno and various Uruguay Chapter members residing outside Montevideo.This meant that all our students could benefit from seeing and hearing directly some of the founding researchers of this field of study. As a consequence, the overall impact of the pandemic on Medical Geology Education in Uruguay can be regarded as very positive in relation to lecturing and spreading the discipline in our University community, both at undergraduate and postgraduate level.

Keywords: Pandemic, University Education, enrollment, increase.

CO-OCCURRENCE OF FLUORIDE AND ARSENIC IN GROUNDWATER IN THE NORTH-CENTER PART OF MEXICO

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Abstract: Mexico is a country known for the presence of water containing arsenic (As) and fluoride (F). Fluorosis was first reported in the middle 1900s in central Mexico after a high incidence of stained teeth, an unmistakable sign of fluorosis. Health-related problems in affected areas included both dental fluorosis and bone fracture susceptibility in children, as well as altered metabolism in the adult population. Some areas reported arsenicosis in humans, notably the Comarca Lagunera. The origin of fluorosis and arsenicosis were traced to the ingestion of groundwater with high concentrations of these solutes (> 1.5 mg/L F and > 0.025 mg/L As). Concentration maps show that F and As occur in the north-central part of Mexico and in zones with hydrothermal waters. The north-central part of Mexico has abundant volcanic outcrops pointing to these rocks as a major source of As and F, and aridity and long residence times as concentration factors. Despite originating from the same rock and sharing the same climate, the correlation of As and F in groundwater is moderate (r = 0.7 in average). Continuous monitoring of wells is key to fine-tune health risks and to identify specific wells that require treatment.

Keywords: arsenic, fluoride, arid area, weathering, fluorosis, Mexico

EFFECT OF MINERAL AGGREGATES IN THE ELIMINATION OF *E. COLI* ATCC 11229 IN WATER SAMPLES CONTAINING OR NOT DISSOLVED ORGANIC MATTER

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Abstract: The elimination of health relevant microorganisms from water and wastewater is a requirement for the safely use of water for consumption, irrigating crops or recreational uses. Since ancient times, the use of metals as disinfectant agents has been utilized to treat water. However, the use of these agents for disinfecting wastewater is scarce. This research was focused in evaluating the disinfecting effect of a natural mineral aggregate (NMA) from a silver mine by using *Escherichia coli* strain ATCC 11229 as test microorganism in water samples (containing and not containing dissolved organic matter), under controlled laboratory conditions. Results indicated that 1 g of 2.00-3.36 mm particle size NMA in 10 mL of water free of organic matter, containing *E. coli* ATCC 11229 at a concentration between 1 X 10^3 CFU/mL and 1 X 10^4 CFU/mL achieve a 100% disinfection after a contact time of 30 min. In contrast, in the presence of dissolved organic matter (120 mg/L COD) the required contact time was 4 h. The disinfection phenomenon can be explained by computational models, such as docking or chemical computing, which allow visualization and prediction of the behavior of the metallic cations in the presence of proteins, mineralized and/or mineralized organic matter. The foregoing would contribute to the understanding of the behavior of the NMA in the various qualities of water to be disinfected.

Keywords: Natural aggregates, silver, copper, zinc, *E. coli*, wastewater, disinfection.

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PHYSICAL-CHEMICAL CHARACTERIZATION OF GROUNDWATER USED FOR AGRICULTURAL PRODUCTION IN THE MENNONITE REGION OF MEXICO

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Abstract: Groundwater is a natural resource that is considered essential for agricultural production. However, it is a utopia that the same agricultural activities are contributing to the contamination of the aquifers. For example, Mennonite producers in Chihuahua, Mexico, have been characterized as being highly efficient with high applications of inorganic fertilizers and pesticides, which has caused contamination of the water resource. The objective was to identify the physical-chemical properties of groundwater in the Mennonite agricultural zone in Chihuahua, Mexico. In the first step, from August 2022 to February 2023, 30 water samples were obtained from wells in the Mennonite producing area. To each sample, it was quantified "*in situ*" with the following parameters: potential hydrogen (pH), electrical conductivity (EC-µs cm^{-1}), total dissolved solids (TDS-mg L^{-1}), and Temperature (T° C). In addition, the water samples were transferred to the laboratory of the College of Chemical Sciences for the determination of cations (Na^{+}, NH_4^{+}, K^{+}; Mg^{+2}, Ca^{+2}) and anions (F^{-}, Cl^{-} SO_4^{2-}, NO_3^{-}) using an ion exchange chromatography (DIONEX ICS-1100; Thermo Fisher Scientific, Waltham, MA, USA) and total hardness and alkalinity. Our preliminary results suggest the impact of anthropogenic activities (e.g., NO_3^{-}/agrochemicals) on groundwater quality. In addition, the geogenic origin of fluoride in the aquifer. A spatial analysis was conducted to corroborate potential sources of pollutants in groundwater.

Keywords: Aquifer, cations, anions, pollutants.

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DETERMINATION OF ARSENIC (As) IN WATER COMPARING THE TECHNIQUE OF ATOMIC ABSORPTION (AA) AGAINST INDUCTIVELY COUPLED PLASMA OPTICAL EMISSION SPECTROSCOPY (ICP-OES)

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Abstract: Arsenic (As) is one of the chemical elements that can represent a risk to public health such as arsenicism an cancer. The risk is greater when there is prolonged exposure. In Mexico, the primary source of drinking water supply is groundwater, and in the region of Zimapán, Hidalgo, concentrations of up to 1.5 ppm (mg L^{-1}) of As have been found in a well. The objective of this work was to compare the performance of the Atomic Absorption coupled to a Flow Injection Analysis System (AA-FIAS) with the Inductively Coupled Plasma Optical Emission Spectroscopy (ICP-OES) techniques for the determination of As in water samples obtained from different wells of Zimapán. Duplicate samples were taken from 12 wells. One sample was filtered *in situ* (filters made of polypropylene and aluminosilicate to remove As^{5+}) and subsequently acidified with HNO_3, and the other was only acidified for preservation. Due to each technique's different characteristics, the concentration ranges of the calibration curves of each method were: 2-10 µg L^{-1} for AA-FIAS and 0.1-2.5 mg L^{-1} for ICP-OES. Samples for the analyses by AA-FIAS were diluted, but ICP-OES samples were analyzed without dilution. A t-test for paired two-sample means was applied to the results, and a value of t= 0.64 and a critical value of t= 2.11 were obtained, indicating that the methods do not give significantly different values. Each method has specific advantages and disadvantages. However, factors such as the concentration of the analyte, sample's origin, and costs must be considered to use the most appropriate methodology.

Keywords: Arsenic, groundwater, FIAS, ICP-OES, Zimapán. México.

Acknowledgment: The CONAHCYT funded the acquisition of the ICP-OES.

OUR AIR, OUR HEALTH: SPATIALLY MODELLING HEALTH RISK AREAS IN VOLCANIC HYDROTHERMAL AREAS

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Abstract: Human populations living in volcanically active areas are chronically exposed to volcanogenic air pollution, potentially contributing to long-term adverse health effects, particularly of the respiratory tract. However, mapping the chronic exposure to volcanogenic pollutants in outdoor conditions is challenging. In this study we used lichens to spatially model, with time integration, the risk areas of outdoors chronic exposure to hydrothermal air pollution. Lichens (n=39) were transplanted and exposed for 6 months at Furnas volcano, which served as the study area. S isotopic ratio (δ34S) was measured on the lichen matrices and related with *in-situ* measurements of soil CO_2 flux and distance to the Furnas volcano caldera fumarolic fields, to assess its aptness as tracer to spatially predict the long-term dispersal of airborne hydrothermal emissions. By combining δ34S data measured in lichen transplants (as tracer of airborne hydrothermal emissions) and Furnas village habitational areas (as proxy of ongoing human presence), the habitational areas could be spatially modeled by their increased risk. It was estimated that 26% of habitational areas in Furnas village stand at high or very high risk of outdoors chronic exposure to airborne hydrothermal emissions. This methodologic approach to produce chronic exposure risk maps with time-integration and high spatial resolution is applicable to other volcanically active and inhabited areas of the world, contributing in this way for spatially focusing future human health assessments.

Keywords: Volcanic gases; air pollutants; biomonitoring; risk maps.

Acknowledgment: This work was financially supported by FRCT (ref.M3.1.a/F/088/2015), AÇORES 2020 and EC-H2020 (BioVeins-BiodivERsA32015104 and NitroPortugal-TWINN-2015- 692331).

RISK ASSESSMENT EXPLORATORY STUDY ASSOCIATED WITH THE PRESENCE OF ARSENIC IN GROUNDWATER IN A RURAL AREA OF THE MUNICIPALITY OF SAN ANTONIO, URUGUAY

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Abstract: Arsenic is a well-known natural groundwater contaminant but the study of its exposure and health risks is just recent in Uruguay. Although safe drinking water is currently supplied to 94% of the Uruguayan population, by the state company. some rural areas didn´t have this “official” water supply and people drink water from their own wells, which could not be adequately monitored. The aim of this work was to assess the health risks related to arsenic exposure through drinking water in a rural area around San Antonio city (Uruguay). We have selected a working area for a study on human health risk assessment in San Antonio (1650 rural inhabitants) in 2023, where we studied private wells located in a sedimentary basin of Cretaceous age. We have sampled and analyzed the groundwater arsenic levels and conducted a survey in 30 families´ consumers that considered those necessary aspects and variables such as water consumption through a lifetime, certain food in-take, personal and family data. to apply the stages of the recommended process of the WHO (2017) “tool for health risk assessment” for arsenic-associated diseases. More than 90% of the studied samples had higher levels of As, than those recommended by WHO (10µg/L) and first results of risk assessment, have shown that 10% of the wells had an HQ greater than 1 if the water was consumed by the residents daily for fifteen years. The CR was higher than 10^{-4} if 15 years of residence was assumed, so 93% of the wells are unsafe and the population is susceptible to increase cancer risk.

Keywords: Arsenic, groundwater, Risk Assessment, rural community.

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RELEVANCE OF GEOLOGY, GEOCHEMISTRY AND TECTONICS OF THE DEEP AQUIFERS OF THE MONTERREY AREA, NUEVO LEÓN, MEXICO

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Abstract: Last year there was a crisis in the supply of fresh water to the City of Monterrey after a severe regional drought. The objective of this presentation is to analyze and discuss the relevance of knowledge of geology, geochemistry and tectonics of deep aquifers in the area of Monterrey, Mexico. In the solution of this problem, it is very important to know in detail the geological, tectonic and hydrogeological framework of the area because it is a dynamic system with many variables that change over time, mainly due to extraction flows, recharge time, evapotranspiration rate, runoff, and environmental conditions. It is important to know where the stratigraphic sequences with evaporites are located, because they contain sulfates and salts that can deteriorate water quality. One way to know the areal distribution of rocks is through paleogeographic maps, which are indicators of the geochemical composition of the rocks, as well as the sedimentary environments of deposition, and the tectonic framework, in order to know where are located in the subsurface the rock sequences which may contain minerals and chemicalcompounds harmful to human health (i.e. arsenic, fluorite, calcium sulfates, magnesium sulfates, gypsum and anhydrite). When this information is known, it is recommended to drill future wells at depths greater than 2,500 m.

Keywords: Aquifers, geology, human health, Monterrey, Mexico

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EVALUATION OF ORGANIC AND INORGANIC MATERIAL IN SEDIMENTS OF STREAMS AND ALLUVIAL ZONE IN CHIHUAHUA, MEXICO

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Abstract: The soil is made up of organic and mineral particles, among which are the majority elements (Fe, Ca, Ti, Mg, K) and trace elements (Zn, Mn, As, Pb, Cd, Co, U, Cu). The objective of this study was to characterize and evaluate the metals and metalloids, minerals, humic and fulvic acids, and physicochemical parameters present in the sediments of a stream and an alluvial area. Seventeen soil samples (APB1- APB17) were analyzed and sieved to obtain fine sand and silt+clay particles. Total characterization was performed by High Performance Liquid Chromatography (HPLC),Total Reflection X-ray Fluorescence Spectrometry (TXRF) and X-Ray Diffraction (XRD). Resulting in a relative humidity (RH) of 2.25%, bulk density (1.14 g/mL), pH (7.54), electrical conductivity (EC) of 385 µS/cm and organic matter (OM) of 8.18%. There is a presence of humic components (humic and fulvic acids) both in the stream and in the alluvial fan. The majority elements were Fe, Ca, Ti, K, being the most concentrated Ca in silt+clay and abundant trace elements Zn and Mn. Cu and Zn exceed the values recorded by the Mexican Geological Service (SGM) in said area. Samples APB15 and APB16 are found in the floodplain, they contain minerals such asquartz, albite, calcite, magnetite, sanidine, montmorillonite and bentonite; being abundant minerals in Mexico.

Keywords: Heavy metals, minerals, humic acids, soil, distribution.

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EXPERIMENTAL MODELING AND SYNCHROTRON LIGHT ANALYSIS OF URANIUM TRANSPORT BY SURFACE WATER IN SEDIMENTS OF PEÑA BLANCA-LAGUNA DEL CUERVO, CHIHUAHUA

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Abstract: In the state of Chihuahua, Mexico, there are several U deposits; the most important one being Peña Blanca in Chihuahua, México. This deposit was explored in the 1980's by URAMEX, (a U exploration, exploitation and commercialization state company of Mexico). At closure, the ore mineral was confined in rock piles exposed to weathering. Uranium can be transported by runoff from the mountains to the Laguna del Cuervo (located east of Peña Blanca). Sediments were analyzed to identify adsorbed U using synchrotron light (SL) spectroscopic-, microscopic- and liquid scintillation alpha spectrometric techniques. A column adsorption experiment was performed by simulating the grain size sequence and placing a horizon of U ore mineral extracted from Peña Blanca. Columns with mineral were fed with distilled water. Other columns without U ore mineral were fed with uranyl nitrate. The columns were drained for 6 and 12 months, at increasing intervals to analyze the water, and the sediment obtained. SL analyses show U(VI) in the sediments and that the species are uranophane and uranyl nitrate. This study shall explain the transportation of dissolved uranium in the representative granulometry from the area through the dissolution capacity of the minerals, possible maximum adsorption levels of uranium, partition coefficient that this uranium could potentially reach the Laguna del Cuervo and it's surrounding crops.

Keywords: Synchrotron-light, uranyl-nitrate, uranophane, sediment-column, Peña-Blanca.

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ENVIRONMENTAL GEOCHEMISTRY IN THE LOS NEGRITOS HYDROTHERMAL MUD POOLS IN MICHOACAN, MEXICO

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Abstract: Hydrothermal mud pools are present worldwide and have similar chemistry to volcanic sites, being a pollution risk for the ecosystems. The hydrothermal zone of Los Negritos mud pools, located in the state of Michoacán, Mexico seem to be related to the crossing of two structures (El Platanal-Los Negritos Fault). Surface temperatures are between 30 and 82 °C, although the potassium-calcium geothermometer indicates background temperatures between 156 and 243 °C. Livestock and agricultural activities are carried out in the area, as well as the discharge of untreated domestic wastewater into irrigation channels. The aim of this study was to identify sources, interactions, accumulation, spatial distribution and mobilization of potentially toxic elements in water, soil and plants of this zone. Water samples were collected in two seasons (dry and wet). Topsoil and plants were sampled once. The origin of the samples is hydrothermal, lagoon, groundwater, untreated wastewater and irrigation water for crops and animal consumption. The water was alkaline (pH 7-8.45) with positive Eh values and T 17-63°C. Los Negritos hydrothermal mud pools are the main source of As in the environment, found in water (1,506 mg L^{-1}), soil (153 mg kg^{-1}) and bent grass (*Agrostis sp.)* (108 mg kg^{-1}). Chemical elements appear to be immobilized in the soil, susceptible to release when environmental conditions change. For example, Pb is released from the soil into the water when the temperature rises. In addition, the As is mobilized from the mud pools into wastewater and irrigation channels, and bioaccumulates mainly in maize (*Zea mays*, 115 mg kg^{-1}).

Keywords: anthropogenic, enrichment factor, bioaccumulation coefficient.

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PHYTORE-MEDIATORY EVALUATION OF THE BANDERITA, NAVAJITA, PUNTA BLANCA AND EARLY PASTURES ON SOILS CONTAMINATED BY ABANDONED MINING TAILS: GREENHOUSE EXPERIMENT

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Abstract: Soil contamination by heavy metals caused by the mining industry is a serious problem that must be addressed comprehensively and urgently to preserve environmental and human health. The general objective of this study was to determine the accumulation, absorption and retention capacity of Arsenic, Cadmium, Chromium, Copper, Lead and Zinc contained in abandoned mine tailings by four species of endemic grasses banderita (*Bouteloua curtipendula),* navajita *(Bouteloua gracilis),* punta blanca *(Digitaria californica)* and early pastures *(Setaria macrostachya*). The study consisted of applying the phytoremediation method to six substrates made up of different mixtures of mining waste, zeolite and compost. The experiment covered from the sowing of the seed to the germination of the plant. Parts of the plant (stem, root) were analyzed by inductively coupled plasma emission spectroscopy (ICP-OES) to determine the concentration of toxic elements contained in the mining waste. Statistically, an analysis of principal components showed the root is the part of the plant with the highest concentration of the mentioned metals. The results showed similar important levels of removal in the four grass species, which yielded absorption results and showed a similar behavior. The elements with the highest concentration were Zn, Pb and As. A comparison was made with the NOM-147-SEMARNAT/SSA1-2004, which allowed to determine that the concentrations of As and Pb exceeded the norm's maximum permissible limits. In conclusion, it was demonstrated that phytoremediation method is effective for the recovery of areas degraded by mining activities.

Keywords: heavy metal, toxic, absorption, mining tailings, phytoremediation.

Acknowledgment: My gratitude to all the people who were part of this process and the Autonomous University of Chihuahua

COST, BENEFIT AND VARIATION OF APPLYING A NATURAL ZEOLITE IN A DIFFERENT LEVELS TO A SOIL USED FOR ALFALFA (*Medicago sativa* L.) PRODUCTION.

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Abstract: The application of natural zeolites in soils used for agricultural production has been a very valuable practice. Water retention in soil is one of the most effective parameters, especially in the arid and semi-arid environment. The objective of this study was to generate a practical recommendation on cost-benefit-economic feasibility when applying various levels of a natural zeolite to a soil used for the production of alfalfa (*Medicago sativa* L.). The zeolite application to soil of 5, 10 and 15 ton ha^{-1} were the evaluated treatments and also a control treatment (0 kg ha^{-1}) was implemented. The percentage of water retention in the soil was quantified on February 11, February 25, March 31 and April 12, 2021. Prior to the establishment of the experiment the soil (0-30 cm) was characterized by quantifying pH, electrical conductivity (EC), organic matter (OM), N, P, carbonates, bicarbonates and chlorides. The percentage moisture content (%H) in soil was considered the most important parameter and it was obtained by the difference between the weight of the wet soil (SH) and the weight of the dry soil (SS). That is to say; %H=(SH-SS)/SSx100. All treatments with zeolite applications presented a greater amount of water in the soil. In the first sampling, the highest percentage of humidity was obtained with the application of 10 ton ha^{-1} with 33.6%, while in the second sampling; the highest percentage of humidity (28%) was notable in the treatment with 15 ton ha^{-1}. Similar results were noted in the third and fourth sampling. An economic analysis was conducted using the zeolite´s price and the costs that vary with the net benefits. This type of analysis was proposed by the International Maize and Wheat Center (CIMMYT) for the recommendation to apply technologies in different crops. The total income from each treatment was calculated considering the kilograms of forage produced in the field and multiplying it by the sale price less variable costs. The most expensive treatment was with the application of 15 ton ha^{-1} while the most profitable treatment was with the application of 10 ton ha^{-1}. It is clear that the application to the soil of a natural zeolite can be used by Mexican farmers to reduce water levels for irrigation.

Keywords: soil moisture, humidity, zeolite, Mexican farmers.

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BIOACCESSIBILITY BY PERSPIRATION UPTAKE OF MINERALS FROM TWO DIFFERENT SULFUROUS PELOIDS

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Abstract: Testing the risks of peloid usage in thermal centers, spas, or at home is essential for establishing safety guidelines regarding peloid formulations and releasing concerning substances. Additionally, evaluating the beneficial effects of specific elements on human health helps understand the therapeutic action and effectiveness of pelotherapy for dermatological or musculoskeletal disorders. A methodology was developed to study the biogeochemical behavior of elements in formulated peloids. With periodic stirring, two peloids were created with the same clay and two different sulfurous mineral-medicinal glasses of water for 90 days. Bentonite clay, rich in smectite and primary exchangeable cations Ca and Mg, with high heat capacity, was used. The mineral-medicinal waters were collected from recognized Portuguese thermal centers for their efficacy in treating rheumatic, respiratory, and dermatological pathologies. The peloids were used directly from the maturation tank without drying, and a reference sample of bentonite mixed with demineralized water was prepared. An artificial perspiration test simulated the peloids' interaction with the skin. Thirty-one elements extracted from the two prepared peloids were analyzed using ICP-MS. The data were analyzed and compared to the original clay's mineralogical composition and the maturation tanks' supernatant composition. The solubility of potentially toxic elements and the bioaccessibility of metals through perspiration were low, with undetectable amounts extracted from the samples. This analytical method provided reliable information on dermal exposure and identifying elements that may enter the bloodstream, requiring the implementation of surveillance and control measures.

Keywords: Clays, mineral-medicinal water, peloids, artificial perspiration; transdermal delivery.

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ENVIRONMENTAL PROTECTION ON MEXICAN SOILS: PROPOSAL FOR PERMISSIBLE LIMITS OF NOM-147-SEMARNAT/SSA1-2004

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Abstract: The Official Mexican Standard (NOM-147-SEMARNAT/SSA1-2004) establishes the permissible limits of concentration of potentially toxic elements in soils to protect human health and the environment. However, there needs to be more information in Mexico to demonstrate the veracity of the standards, the U.S. EPA 2015 calculated the concentrations of potentially toxic elements in soils. As a result, it suggested that those concentrations were lower than Mexican Standards, making them dangerous according to the U.S. EPA. The disparity of the limits established by Mexico and other agencies is responsible for caring for human health and should be an important issue. Thus, adopting strict criteria is essential for protecting the population and the environment and promoting cooperation and comparability of data at a global level. For this reason, it is necessary to reflect that today's Mexico is constantly developing, and nowadays, NOM-147 needs to be functional for the country. Therefore, Mexican Institutions will carry out calculations of cleaning limits for contaminated areas according to the U.S. EPA methodology. In addition, the NOM-147 will compare with international institutions to know the current situation in Mexico on the permissible limits in contaminated soils to reduce the danger of these agents.

Keywords: update, health, heavy metals, pollution.

DYNAMICS OF PLANT WATER USE AND WATER MOVEMENT; INSIGHTS FROM AN INTEGRATED HYDRO-GEOPHYSICS-GEOCHEMICAL APPROACH OF A HIGHLY DYNAMIC SHALLOW DRYLAND CRITICAL ZONE

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Abstract: In dryland environments, precipitation occurs mostly as short-term and high-intensity followed by relatively long periods of no rainfall. Depending on the magnitude of the precipitation events and the structure of the soil profile, water may infiltrate to various depths and will be available for plant use for different lengths of time. However, the widespread occurrence of shallow (<30cm depth) calcium carbonate horizons in arid soils complicates this reality it is unclear if these horizons act as barriers to infiltrating water or constitute water storages for vegetation during dry spells. The role of calcium carbonate layers in moisture fluxes within the soil, and the ability of desert vegetation to readily take advantage of precipitation pulses and switch water sourcing within the soil profile remain open questions in the field of ecohydrology of arid lands. To address these knowledge gaps, we designed an artificial rainfall experiment on a piedmont site at the Jornada Experimental Station which is located in the northwestern corner of the Chihuahuan Desert. A high-frequency sampling of changing soil moisture conditions, water isotopes in soils and vegetation, and the evolution of the water mass balance in a small (9x5m) experimental plot were performed by integrating: 1) Data from a 2.5-meter height Eddy Covariance system, 2) Time-lapse 3D Electrical Resistivity surveys of the shallow soil (3m depth) and 3) continuous measurements of the changes in the water isotopic signature of plants' xylem water and moisture conditions of the shallow soil. On preliminary results data shows that the water added to the plot evaporate from the soil in the next 4 days, also plants response occurs as greenness and change in the isotopic signature and it can be detectable within 10 days after the experiment.

Keywords: Water, arid soils, caliche, Jornada

CALCULATION OF THE WATER FOOTPRINT IN TURKEY PRODUCTION AND ITS RELEVANCE FOR THE AGRO-INDUSTRIAL SECTOR OF MEXICO

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Abstract: More than 90 percent of the water footprint worldwide corresponds to the agri-food sector. Although there is a lot of information on the water footprint in poultry production, little information is known for turkey production. Last December, around 12,000 tons of turkey meat were available for consumption during the Christmas holidays, where it is notorious that the State of Chihuahua occupies the sixth place in production after the leading States of Yucatan, Puebla and the State of Mexico. The turkey industry has an annual value of 870 million pesos and annually generates more than 20,000 jobs. Regarding imports, about 90% comes from the United States. It is estimated an annual per capita consumption of 1.38 kg in the country. The objective of this research was to calculate the water footprint of a commercial flock of turkeys in the poultry production unit of the Faculty of Animal Production and Ecology of the Autonomous University of Chihuahua, in Mexico, and to analyze its relevance for the agri-food sector. A total of 803 turkeys were fattened for 13 weeks, with a blue water footprint in the average drinking water per bird of 62 l. A live weight at market of 10.6 kg was reached, with a feed conversion of 2.67 to 1. In addition, a total water footprint of 4,030 l of water per kg of turkey was produced, with a favorable indicator of animal welfare of 2.3 drinking water per feed. In reference, there are the water footprint works of Dr. Arjen Hoekstra of UNESCO-IHE, such as 3,900 l per chicken meat produced and 3,300 l per kg of egg laying birds.

Keywords: Turkey production, water, footprint.

UNCOMFORTABLE ENVIRONMENTAL ISSUES: ADVISED CASES FOR MEDICAL GEOLOGY IN MONTERREY, MEXICO

Igor Ishi Rubio Cisneros

Abstract: In the metropolitan area of Monterrey, Nuevo León, Mexico, there are sources of pollutants from natural processes and human activities in free and confined concentrations on the surface, subsurface, and atmosphere. Due to its geological and urban characteristics, the northeast of Mexico is a region of opportunity to recover land under environmental impact for its remediation and reuse. The cases analyzed relate to activities derived from the extraction of natural resources, erosion, deposition, disposal, transformation, and transport of non-renewables. The *ChatGPT* tool facilitated the search for the unknown and data of the research method. The facts of the cases indicate the burial of materials in geological formations and soils, the lowering of the underground water levels contaminated by solids or diluted in suspension, and the saturation of particles in the air that six million inhabitants breathe. The environmental damage and deterioration are present in (i) the modification of the water quality in the hydrological sub-basin of the San Juan River, (ii) the air pollution of the urban circulation that recycles oxygen between the mountains, and (iii) the stability of rock and soil fertility in valleys. Some cases are reported to the Federal Attorney for Environmental Protection in complaints against the environment and the health of the inhabitants. The health problems in the population and Nature are related to 1) the proximity to unstable mountain areas, 2) the environmental contingency due to suspended particles in the air and other dangerous gases, 3) the confinement and surface runoff of waste, and 4) local contamination of the surface aquifer and groundwater flow. Health problems related to the consumption of polluted water have been documented; similarly, the effects on health from exposure to dust transported by the circulation of the wind to the northern zone of the Tropic of Cancer over America. Some symptoms commonly reported by citizens are vertigo, choking sensation, emotional overwhelm, vomiting, and nausea. The exercise of regulation for protecting and defending the environment is scarce and is strengthened by research groups and authorities. The MED-GEO 2023 event in Monterrey is an important step in that direction. Although this work is not exhaustive, it shows the urgency of motivating this collaboration, especially to identify the source areas of pollutants in the metropolitan environment, mitigate their risk to the ecological balance and human health, reduce hazards or non-standard analysis, and recover safe levels in water, air, and soil.

Keywords: medical geology, ecological imbalance, environmental, damage.

TRANSITIONING TOWARDS A WATER CIRCULAR ECONOMY IN THE OF NORTHERN MEXICO: WORKSHOP DISCUSIONS WITH REPRESENTATIVE MEMBERS OF DIFFERENT SOCIETY SECTORS

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Abstract: Using treated wastewater (TWW) in industrial processes represents an alternative to safeguard water resources in arid and semi-arid regions. This research aimed to transform the linear relationship between industries and wastewater treatment plants (WWTPs) into a circular approach that ensures efficient recycling of TWW by reincorporating it into industrial processes across three states in Northern Mexico (Chihuahua, Durango, and Sonora). An important objective was to promote awareness about water resource importance, recycling, and conservation among various stakeholders, including civil society, academia, government, industry, NGOs, ethnic and vulnerable groups. Two citizen science workshops were conducted to gather perspectives on using TWW in industrial and construction processes. The first event, attended by around ~30 participants from the different society sectors listed above, focused on introducing the project and understanding social perceptions regarding the feasibility of TWW utilization in industrial and construction processes. With ~45 attendees from five sectors, the second forum aimed to achieve conceptual homologation about TWW applications. The results indicated that five sectors expressed interest in using TWW for industrial processes such as cooling, with the industrial sector emphasizing the importance of investing in innovative water treatment technologies. The study concluded that establishing a sustainable Circular Water Economy (CWE) within the industry requires continuous improvement and the implementation of comprehensive water conservation policies. By doing so, significant water resource savings can be achieved in the medium and long term.

Keywords: governance, citizen science, sustainable, reclaimed water.

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CONCENTRATIONS OF ARSENIC, FLUORIDE, AND LEAD IN PUBLIC WATER SUPPLY WELLS IN CHIHUAHUA CITY

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Abstract: Addressing the need for universal access to water is included in the UN Sustainable Development Goals. In 2020, 46% of the global population did not use a safely managed sanitation service. In Mexico, according to CONEVAL (National Council for the Evaluation of Social Development Policy), in 2020, 6.7% of the country's population did not have access to safe water. The objective of this work was to obtain the concentrations of arsenic, fluoride, and lead in the wells that supply piped drinking water in Chihuahua city using official information from the Municipal Water and Sanitation Board (JMAS), requested through the National Transparency Platform during the years 2021 and 2022. Of the 70 information requests analyzed, data from 30 Influence Areas (IA) out of the total of 98 were obtained. This sample corresponds to 30.6% of the total, but it represents 66.9% of the supply to the city. It was observed that 86.66% of the IA exceed the maximum permissible limits according to Mexican Regulation (NOM-127-SSA1-2021) of fluoride, 53.33% of arsenic, and 16.66% of lead. According to INEGI (National Institute of Statistics and Geography) data, around 200 thousand inhabitants of these zones could be affected if they drink water from the public supply, and could experience health consequences such as dental pigmentation, bone fragility, melanosis, among others. Therefore, the socialization of this information is of critical relevance for the population to take appropriate measures in their water consumption habits.

Keywords: Public water supply, fluorosis, lead, arsenic, human health.

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CONCENTRATION OF MICRONUTRIENTS IN THE PECAN NUT KERNEL, UNDER MINERAL AND ORGANIC FERTILIZATION

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Abstract: Agricultural soil fertility has traditionally been related to organic matter content. If the function of organic matter were only to provide nutrients to the soil, it would be of little interest since mineral fertilization fulfills this function and is faster. However, the role of organic matter in soil complexity is much more essential and, therefore, irreplaceable. Soil conditions give specific characteristics to food. The walnut was classified among the healthy foods for human consumption. Therefore, this research aimed to analyze the impact on the concentration of micronutrients in the edible part of the nut under mineral and organic fertilization. This research was carried out in the municipality of Aldama, Chihuahua, during 2016, 2017, and 2018 cycles; mineral and organic fertilization doses were tested in a factorial experiment 56 six factors with five levels each limited to 25 treatments using a Taguchi L25 arrangement. , the factors and levels were Nitrogen (N) 0, 12, 60, 120, 240 kg ha^{-1}, phosphorus (P2O5) 0, 6, 30, 60, 120 kg ha^{-1}, potassium (K2O) 0, 5, 25, 50, 100 kg ha^{-1}, calcium (CaO) 0, 20, 100, 200, 400 kg ha^{-1}, liquid humus 0, 180, 900, 1800, 3600 L ha-1 and solid humus 0, 400, 2000, 4000, 8000 kg ha^{-1}, the statistical analysis was by response surface and weighting of factors for recommended dose. The concentration of Fe, Manganese, Zinc, and Copper in the edible part of the nut was analyzed. For iron (Fe), the average was 73.7 mg kg^{-1}, with ranges from 70.5 to 128.3 mg kg^{-1}; the factors that showed weight were P2O5, CaO, and liquid humus. The Mn showed an average of 139.2 mg kg^{-1} in the edible part of the nut; N, CaO, and liquid humus were the main influencing factors. The average Zn was 44.3 mg kg^{-1}. The average for Cu was 10.4 mg kg-1, ranging from 14.1 to 5.8 mg kg^{-1}. Among the main factors were P2O5, CaO, and liquid humus. In general, the main factors were N, P2O5, CaO, and liquid humus; the recommended doses for these factors are 111.2 kg ha^{-1} of N, 113.0 kg ha^{-1} of P2O5, 225.5 kg ha^{-1} of CaO, and 1800.0 l ha^{-1} of liquid humus.

Keywords: micronutrients, humus, zinc, iron, soils.

CYTOTOXICITY OF Fe-Co ALLOYED PARAMAGNETIC NANOPARTICLES OBTAINED BY REACTIVE MECHANICAL GRINDING IN BEAS-2B BRONCHIAL EPITHELIAL CELLS

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Abstract: Currently, paramagnetic nanoparticles of Fe-Co alloy (NP-FeCo) have gained relevance in nanomedicine due to their numerous biomedical applications. However, there is concern and uncertainty about its health implications. Therefore, this project aimed to evaluate the cytotoxic activity of NP-FeCo in bronchial epithelial cells. To this end, different NP-FeCo compositions were through reactive mechanical grinding synthesized, and their physicochemical properties were by X-ray diffraction characterized. Subsequently, BEAS-2B cells (CRL-9609™, ATCC®) were at 37°C in supplemented DMEM cultivated according to the supplier's instructions. To determine the cytotoxic effect of Fe-Co alloys, viability dose-response curves with WST-1 for 24 and 72 h were used. Finally, cell morphology using conventional optical microscopy was evaluated. Results showed a generalized inhibitory effect. This effect was related to the elemental composition, concentration, and exposure time of NP- FeCo, in BEAS-2B cells. The alloy that induced the most significant inhibition in BEAS-2B cells was NP-$Fe_{80}Co_{20}$ (IC_{50}: 177 µg mL^{-1}) at 72 h, with respect to controls of Fe (IC_{50}: 100 µg mL^{-1}) and Co (IC_{50}: 111 µg mL^{-1}) ($p \leq 0.05$, ANOVA). The morphological analysis in BEAS-2B cells revealed that NP-$Fe_{80}Co_{20}$ does not induce cell membrane and nucleus alterations at both exposure times. In conclusion, these findings demonstrated the safety of NP-FeCo in cell models, but studies in animal models are also required to contemplate their possible biomedical applications.

Keywords: Cytotoxicity; Nanoparticles; Fe-Co Alloy; Reactive Mechanical Grinding; BEAS-2B.

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ARSENIC RETENTION MECHANISMS IN LIMESTONE utilizing GROUNDWATER PERCOLATION COLUMNS

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Abstract: The objective was to characterize the arsenic (As) removal mechanisms in calcite and its chemical species formed in this mineral. The calcite is the main component of filters packed with limestone for treating groundwater in experimental columns. The study used a high-resolution technique with synchrotron light radiation, specifically *X-ray absorption spectroscopy* (XAS). This technique provides information about the local chemical environment of As and Ca, the valence state, symmetry, and bond distances. Limestone samples were measured at the K-edge for As and Ca. For data analysis, the *ATHENA: XAS Data Processing* and *Artemis: EXAFS Data Analysis using Feff with Larch or Ifeffit* software were used to identify the main chemical species of these elements present in the samples and to characterize the local coordination environments of As. The analyzed samples, limestone belonging to the Upper Cretaceous Soyatal Formation, are the solid residues of column experiments for As removal in coexistence with any of the following ions: fluoride (F^-), chloride (Cl^-), sulfate (SO_4^{2-}) and bicarbonate (HCO_3^-). Reference standards were synthesized in the laboratory by batch tests using $CaCO_3$ (reagent grade) and As solutions of 300 ppm and 12,000 ppm. The main results indicate that As is retained in the limestone, specifically in calcite, mainly (>90%) by two processes: adsorption (forming corner-sharing inner-sphere surface complexes) and co-precipitation (the AsO_4 unit being substituted at the carbonate site). The installation of home filters promises to be an effective methodology as As is retained by strong chemical interactions.

Keywords: X-ray Absorption Spectroscopy (XAS), arsenic, limestone, groundwater, chemisorption.

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CELLULOSE ACETATES FROM AGAVE BAGASSE USING DEEP EUTECTIC SOLVENTS

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Abstract: Cellulose is one of the most attractive biopolymers on Earth. It can be obtained for biomass feedstocks using appropriate pretreatment methods. Several agricultural wastes can be revalued in Mexico, and obtaining cellulose from them. Agave *tequilana* Weber var. azul bagasse is a tequila residue produced in large amounts. Other works demonstrated the cellulose extraction feasibility by conventional pretreatment process. In a green chemistry aim, natural deep solvents (NADES) have emerged as a new alternative for cellulose extraction. This work to evaluated choline chloride (Ch) as a hydrogen bond donor-acceptor; Oxalic acid (Ox) and glycerol (Gly) were the hydrogen bond donors for NADES conformation.NADES 1 was synthesized by mixing Ch with Ox in 1:1 proportion at 60°C. Pretreatment was made for two hours. NADES 2 was made with a Ch:Gly mixture 2:1 at 70°C. Both biomasses obtained were delignified using chlorite and acetylated by the Fisher method. The cellulose acetates were characterized by Fourier transformed infrared spectroscopy (FTIR). The results showed that acetylation was attained, obtaining porous films by evaporation. These materials have potential as membranes for water purification. The composition and dense structure evidenced by microscopy suggest they could be used for metal and metalloid removal in osmosis processes. These eco-materials can substitute other synthetic polymers provided by the chemical industry.

Keywords: Agave *tequilana* Weber, bagasse, DES, cellulose, acetylation.

Acknowledgment: The work here described was funded by the CONAHCYT, the Advanced Materials Research Center, the Instituto Tecnologico de Tepic and the Autonomous University of Chihuahua.

USING ELEMENTAL CONCENTRATIONS AND DUST LOADINGS AS METRICS OF HUMAN EXPOSURE TO POTENTIALLY TOXIC ELEMENTS IN KINDERGARTEN INDOOR DUST

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Abstract: Due to the hand-to-mouth activities frequently observed among the youngest children, they are likely to ingest higher amounts of indoor dust than adults. Since preschoolers are prone to exposure to potentially toxic elements (PTEs) through the ingestion route, characterising human exposure within kindergarten microenvironments is paramount for children who spend considerable time in school. Ergo, a study encompassing five kindergartens in an industrial city was performed. Indoor dust samples were collected from the kindergartens. The present study reports dust metal concentrations and metal loadings to estimate indoor exposure to PTEs. Total concentrations of chromium (Cr), cobalt (Co), nickel (Ni), cadmium (Cd), arsenic (As) and lead (Pb) were determined by Inductively Coupled Plasma-Mass Spectrometry (ICP-MS) in the <63 µm and <250 µm particle size fractions of the indoor dust. The results showed that the elemental loadings vary widely among the different kindergartens but are consistently higher in the finer dust size fraction. Non-parametric analysis (Spearman's rank-order correlation) showed strong and significant (p<0.001) positive correlations between total dust loading - dust elemental loading. Relatively strong correlations were also obtained between elemental loadings and elemental concentrations, but the relationship is only significant for Ni and Pb. The strong correlation (r_s= 0.73) between Pb concentration and dust Pb loading suggests that total dust loading has a greater influence on dust Pb loading. The results also suggest a negligible influence of dust mass over the dust elemental loading for elements such as Cd, Co, Cr and As.

Keywords: particle size, Portugal, lead, nickel, elemental dust loading.

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GOOD ENVIRONMENTAL PRACTICES AS A TOOL TO GREEN ECONOMIES IN THE MUNICIPALITY OF CHIHUAHUA, MEXICO

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Abstract: Currently, more than half of the world's population live in urban areas, it is estimated that by 2050 it will represent 60%. The expansion of cities has allowed raising the Social and Economic Progress Index (EPI). All over the world, 60% of Gross Domestic Product is generated in cities; Mexico is not the exception. Therefore, the purpose of this research work is to analyze as a strategy to reduce the environmental impacts caused by the productive activity, the Good Environmental Practices (GEP) to diminish the environmental impacts caused by productive activities. As a result, companies will be able to achieve high levels of performance and reduce operating costs and, at the same time, reduce polluting emissions and, above all, make the use of natural resources extraction and utilization more efficient. During the years 2018 and 2019, the GEP program was implemented in fifty-nine companies located in the city of Chihuahua, México, thus participating in the eleventh sustainable development goal on sustainable cities in a community. The five practices that were implemented and whose results will be discussed are: 1) reduction in fuel consumption. 2) minimization of waste and/or use of by-products. 3) efficient use of water. 4) efficient use of raw materials and inputs: and 5) reduction of CO_2 emissions.

Keywords: Environmental Practices, Economics Progress Index.

SPATIAL ANALYSIS OF FLUORIDE (F-) CONCENTRATIONS FOR THE LOCATION OF WATER WELLS IN THE VILLALBA AQUIFER, CHIHUAHUA, MEXICO

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Abstract: The analysis of the concentration of the chemical elements in the water of an aquifer is vital to know its degree of quality. In the north of Mexico there is a dry climate, with little or no runoff water most of the year; therefore, it is essential to locate groundwater sources to alleviate the water needs of the different sectors. The objective was to determine the feasible areas for the construction of water wells in the aquifer called "Villalba" from the analysis of the concentration of fluoride (F-). In a first stage, information from previous works (static frame of reference) was collected and analyzed, where well´s hydrogeochemical data was documented. In a second stage, a concentration map of the analyzed element was built, the influence of lithology on water quality was determined, and the hydrogeological conditions of the aquifer were described. It was hypothesized that there is a correlation between the chemical composition of the water and the geological faces. It is clear that not only the lithological-water relationship must be analyzed, but external factors such as the ionic composition of rainwater and evaporation, among other factors, must be considered. The highest concentration of F- reached values of 3.18 mg L-1 in the southeast sector of the area. The results showed that the most feasible areas for drilling wells are concentrated in the central-western part of the studied area. In this part, which is close to the aquifer recharge zone, the concentration of the element exhibited the lowest values.

Keywords: fluoride, concentration, well, aquifer.

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TREATED WASTEWATER IRRIGATION INCREASES ORGANIC SOIL CARBON CONTENT ACROSS IRRIGATED DISTRICT IN CHIHUAHUA, MEXICO

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Abstract: Farming demands ~72% of the total water in the world, mainly accounting for irrigating field-crops. Across arid and semi-arid regions, a possible alternative for reducing this impact is re-using the treated wastewater (TWW) which aids-up in enhancing soil organic matter and carbon sequestration, adds-up into soil fertility and productivity for maximizing the productive potential of acclimated crop varieties. However, for successful implementation of this technology (TWW) some investigation was required to be appraised aiming at studying the response of organic soil carbon and organic matter content towards irrigation with TWW, along-with comparison of variation in carbon and organic matter ratio (C : O M) between the two irrigation practices *viz.,* groundwater (GW) and TWW irrigation. For addressing these, we sampled through irrigated fields of 3,000 ha's in the communal land commonly addressed as "*Tabalaopa-Aldama"*. We collected 180 soil samples from 60 plots at three different depth increments (0-20 cm; 20-40 cm and 40-60 cm). Soil samples were subjected to analysis of texture by using Bouyoucos, soil organic matter and organic soil carbon content by using Elemental Total Flash 2000. The recorded data (elemental concentration) were spatially visualized using Kriging ArcMap 10.5. Our preliminary results confirmed that irrigation with TWW enhanced the organic soil carbon and organic matter content which were attributed towards the fine-textured clay loam to clay soils of area with good soil water and carbon retention capacities.

Keywords: Treated wastewater irrigation, soil texture, organic matter, carbon and organic matter ratio and groundwater irrigation.

Acknowledgements: This study was funded by Gobierno del Municipio de Chihuahua, Consejo Estatal Agropecuario de Chihuahua, A.C., and INIFAP.

PROVENANCE AND EMISSION SOURCES OF URBAN DUST'S POTENTIALLY TOXIC ELEMENTS AND THEIR RELATIONSHIP WITH RESPIRATORY DISEASE INCIDENCE

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Abstract: Urban dust contains potentially toxic elements (PTEs) that pose health risks to humans. Accurately determining the provenance of urban dust, the sources of PTE emissions, and the associated health risks is crucial. This study aimed to improve the current method of studying PTEs in urban dust, carried out in a city of 1.25 million people in central Mexico. We collected and analyzed urban dust (n=38), rock (n=4), and zinc concentrate (n=2) samples to determine PTE and rare earth element (REE) concentrations using inductively coupled plasma mass spectrometry and x-ray fluorescence. We employed geochemical diagrams, enrichment factor (EF), compositional data analysis (CoDA), the 3.1La-1.54Ce-Zn diagram, mineralogy and morphology analysis, geographic information system, and analysis of respiratory disease incidence. Results from REE and geochemical diagrams (V-Ni-Th10, Zr vs TiO2, and Zr/Ti vs Nb/Y) revealed that urban dust originates from local rocks. Geogenic sources were identified for REEs, Sc, and Zr, while Mn, Cu, Zn, As, and Pb were attributed to anthropogenic sources. The 3.1La-1.54Ce-Zn diagram, mineralogy, and morphology analysis pinpointed the zinc refinery (ZR) as the source of Zn, As, and Pb emissions. Spatial distribution showed high concentrations of Zn (5000 - 20,008 mg/kg), As (120 - 284 mg/kg), and Pb (350 - 776 mg/kg) in urban dust near the ZR, where an estimated population of approximately 68,480 resides. These findings were significantly correlated (p-value < 0.05) with the incidence of respiratory diseases. The highest disease incidence occurred in individuals aged 25-44, with a higher prevalence in women compared to men.

keywords: urban dust, origin, sources, refinery, respiratory diseases.

VARIATIONS IN THE MICROBIOME OF AXOLOTLS EXPOSED TO DIFFERENT LIVING CONDITIONS UNDER HUMAN INFLUENCE, WHICH EXPRESS EXOGENOUS BIOACTIVE PEPTIDES

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Abstract: The axolotl is a salamander endemic from Xochimilco's lake in Mexico, which possesses the ability to regenerate diverse tissues and structures damaged or lost during their life cycle. Therefore, this feature makes it a valuable study model for biomedical research, which is why axolotl colonies have been established and maintained within laboratories around the world. Thus, human intervention in the lifestyle of axolotls could affect the typical composition of its microbiota. Since the microbiome plays a critical role in host health, disease, and environment, we decided to study axolotl microbiome dynamics under specific housing conditions by taxonomic profiling with public RNA-seq data; allowing us to define community structures and subsequent functional analyzes of genes expressed by microbial populations, such as those coding potential bioactive peptides. Briefly, raw RNA-seq data from independent experiments with their own housing conditions for axolotls were obtained from the NCBI using SRA accessions SRR2885595, SRR5042765, and SRR12616766. Data preprocessing was performed with BBTools, while unwanted host reads were discarded by mapping these to the axolotl transcriptome through Bowtie2. Metatranscriptomes were assembled *de novo* using SPAdes and annotated with Trinotate to identify bioactive peptides. Finally, taxonomic classifications were performed using Kraken, and the results analyzed with Pavian. Between the most relevant findings, axolotl microbiomes showed variations for genera of the Ascomycota phylum, such as *Kazachstania, Naumovozyma,* and *Pichia.* Also, commensal bacteria of the genera *Staphylococcus, Streptomyces*, and *Sphingobium* were inferred. Regarding the bioactive peptides expressed by axolotl microbiota, candidates like AfusinC, Capidermicin, and Ericin were identified.

Keywords: Microbiome, axolotl, metatranscriptomics, bioactive peptides, host health.

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INTENSIFICATION OF WATER POLLUTION IN A CLOSED BASIN LAKE REVEALED BY DROUGHT CONDITIONS

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Abstract: The endorheic “Laguna de Bustillos” basin in Chihuahua, Mexico, contains one of the most important wetlands in northern Mexico, Bustillos’ Lake (BL). Long-term intensive agricultural activities in the basin, coupled with climatic stressors have contributed to BL’s water quality deterioration. This work addresses two fundamental questions; 1) What are the main pollutants in the lake? and 2) What are their most likely sources? To investigate these questions, we sampled the lake dividing its area into quadrants, from which 20 were randomly selected. For each sampling site and during three years (2018-2020), we collected water samples at a 0.30 m depth. Physicochemical parameters were measured in situ and Arsenic (As), Calcium (Ca), Cadmium (Cd), Chromium (Cr), Fluoride (F), Magnesium (Mg), Manganese (Mn), Molybdenum (Mo), Nickel (Ni), Phosphorous (P) and Lead (Pb) were analyzed by Inductively coupled plasma mass spectrometry (ICP-MS). The resulting concentration of those elements were spatially analyzed, and a lumped model of mass balance for the lake using conservative tracers was used to investigate the potential sources of the most significant elements concentrations, As and F. Our preliminary results suggest a geogenic origin of those two pollutants whose concentrations appear to be significantly affected by climatic variability in the basin. A mass balance analysis using stable isotopes of water and the concentration of some pollutants was used to determine the potential sources and fluxes of the pollutants in the lake and groundwater.

Keywords: geogenic, agricultural, mass balance, spatial analysis.

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POSTHARVEST TREATMENTS TO CONTRIBUTE TO THE NUTRITIONAL QUALITY OF TABLE GRAPES IN SEMIARID LAND IN THE NORTH OF MEXICO

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Abstract: The world population has increased, and with this, the need to feed this population leads to the use of more resources such as soil, water, inputs, and energy. In addition, food production generates CO_2 emissions that contribute to global warming, climate change, and soil degradation. The degradation of productive soils impacts the production and quality of food because these soils do not have the necessary reserves to produce quality food, causing alterations in processes such as the loss of nutrients, bioactive compounds, and characteristics that reduce quality. And the shelf life of food. This work aimed to carry out a postharvest process on table grapes to maintain the bioactive compounds in the table grapes. The study was carried out during the 2022 production cycle on table grapes of the 'Flame seedless' variety. A 4×4 factorial arrangement bounded to 16 treatments was used using a Taguchi 16 L arrangement with three repetitions. The treatments were a mixture of hydrogen peroxide, potassium, and salicylic acid in different concentrations. Antioxidant capacity and total phenols were measured seven days after harvest. The results indicate that for phenols, an average of 572.8 mg gallic acid 100 g.p.f. was obtained; in the case of antixoding capacity, the average was µ 80.3 mg Trolox 100 g.p.f. for both variables, the three applied products had an effect. It is concluded that the applied treatments contribute to improving the antioxidant capacity and phenolic compounds in table grapes, which contributes to maintaining their nutritional value.

Keywords: Post harvesting, Total Phenolic Content, Antioxidant Potential.

CHEMICAL SENSING OF COMMON MICROORGANISMS FOUND IN BIOPHARMACEUTICAL INDUSTRIES USING MID-INFRARED LASER SPECTROSCOPY AND MULTIVARIATE ANALYSIS

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Abstract: Mid-infrared laser spectroscopy using quantum cascade lasers (QCL) was used to develop a fast, reliable methodology for sensing and differentiating for common bacteria encountered in biopharmaceutical industries with high spectroscopic definition and specificity. This study describes the detection of three different bacteria species using quantum cascade laser spectroscopy coupled to a grazing angle probe (QCL-GAP). Stainless steel material, similar to surfaces commonly used in biopharmaceutical industries, was used as support media substrates for the bacterial samples. QCL-GAP spectroscopy was assisted by multivariate analysis (MVA) to assemble a powerful spectroscopic technique with classification, identification, and quantification resources. The bacterial species analyzed: *Staphylococcus aureus*, *Staphylococcus epidermidis*, and *Micrococcus luteus*, were used to challenge the technique's capability to discriminate from microorganisms from the same family. Principal Components Analysis and Partial Least Squares-Discriminant Analysis differentiated between the bacterial species, using QCL-GAP as the reference. Spectral differences in the bacterial membrane were used to determine if these microorganisms were present in the samples analyzed. Results herein provided effective discrimination for the bacteria under study with high sensitivity and specificity values.

Keywords: quantum cascade laser spectroscopy (QCLS), infrared spectroscopy (IRS), bacteria, stainless steel (SS) substrates, Principal Components Analysis (PCA), Partial Least Squares-Discriminant Analysis (PLS-DA).

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THE USE OF GEOSTATISTICS AND SIG FOR MEDICAL GEOLOGY RESEARCH IN THE STATE OF CEARÁ, BRAZIL

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Abstract: Susceptible areas in terms of medical geology (MG) can be supported bygeoprocessing and overlapping techniques of environmental and social maps. The objective of this work aims to establish a vulnerability and risk index for Medical Geology (IVMG) to evaluate and explain the areas with high correlations between environmental and social indicators with emphasis on health. A total of nine indicators divided into two groups were converted into raster images through the Inverse Distance Weighted (IDW) interpolation method in GIS environment. Afterwards, a weighted map overlay was performed with the support of Analytic Hierarchy Process (AHP) method. The classes established for the map are: very low (1-2); low (2-3); medium (3-4); high (4-5); very high (5-6). The low vulnerability class predominates throughout the state with 55.5% of the whole area; the high andvery high classes account for 11.1%. The final map highlighted the mesoregions Jaguaribe, Center-South Ceará, eastern part of Sertões Cearenses and western part of Northwest Ceará. Jaguaribe, for example, presents flat areas with sedimentary cover on the terrain that are naturally vulnerable and intense anthropicactivities; and the precarious sanitation conditions existing discharge contaminant load to soil and water resources. This situation can be harmful to the health of living beings, whether by contact, inhalation, or ingestion. The IVGM methodology, along with new information register, can prove to be an important tool for future research in GM, planning and management of municipalities and decision-making for mitigating measures.

Keywords: Vulnerability, index, socioenvironmental data, health.

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MULTI-RESISTANT BACTERIA IDENTIFIED IN WATERS SUBJECTED TO TREATMENT PROCESSES: A HUMAN HEALTH PROBLEM

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Abstract: Bacterial resistance in water represents a major challenge to public health. The objective of this review was to measure the prevalence and bacterial resistance in water samples from treatment plants. The methodology employed was the antibiogram, which is a technique that assesses the sensitivity of bacteria to various antibiotics. Initially, data from previous studies and scientific publications investigating the presence of resistant bacteria in treated water were collected. The obtained results from different geographic locations and water treatment systems were analyzed to determine the prevalence and resistance patterns. It was anticipated that the results would reveal widespread presence of resistant bacteria in treated water, as well as identification of specific resistance patterns. These findings would be crucial in understanding the magnitude of the problem and developing effective strategies to address water supply issues. In conclusion, this study provided a comprehensive overview of the presence and resistance of bacteria in treated water. The results laid a strong foundation for implementing preventive measures and improving the systems used to mitigate the risk of infections caused by resistant bacteria, ensuring the safety of the community's water supply.

Keywords: Bacterial resistance in waterTreated water Resistance patterns
Safety of water supply

GUAR [*Cyamopsis tetragonoloba* (L.) Taub.] A PRODUCTIVE ALTERNATIVE TO THE WATER RESOURCE PROBLEM

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Abstract: An efficient use of natural resources including water is important for achieving sustainable agriculture and regional development; this fact, becomes of greater relevant in arid and semi-arid zones. Guar [Cyamopsis tetragonoloba (L.) Taub] is a potential crop that can be grown as a forage or as a seed crop in arid to semi-arid regions due to its low water requirements and heat tolerance. The objective of this study was to evaluate growth, performance and attributes of four guar genotypes (Matador, Kinman, Lewis, and NMSU) to determinate its potential as an alternative crop under the climatic conditions of the Irrigation District 05 (DR-05), located in central part of the state of Chihuahua in northern Mexico. An Analysis of Variance (ANOVA) and a multiple comparison of means test (Tukey) were performed. The growth analysis was carried out through measurements of morphological descriptors. The Matador genotype presented the highest plant height while the genotype Lewis presented the highest values in weight and total biomass. In the chlorophyll concentration index, the genotype Lewis had the highest value. Regarding their forage attributes, in protein content the genotype NMSU had the highest value with 21.84 %, followed by Kinman with 19.46. With respect to acid detergent fiber the genotype NMSU had the lowest values with 16.43 and Kinman with 20.17 and they had the same behavior in relation to neutral detergent fiber and lignin values, being the best NMSU and followed by Kinman. The results showed that Guar crop had a good growth and performance, and its attributes suggest it as a good productive alternative for the stakeholders of the DR-05.

Keywords: guar; cluster bean; water use efficiency; alternative crops, forage

MULTIVARIATE ANALYSIS AS A STATISTICAL TOOL TO IDENTIFY POTENCIAL SOURCES OF CONTAMINANTION

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Abstract: The Ceará state (Brazil) is a semi-arid region where water resources are scarce; therefore, water quality for human consumption assumes a more important role. The Aracati municipality is supplied mainly with groundwater, and there are even some wells of community nature. The wells differ in depth and in some characteristics becoming difficult to access which aquifer layer is being capture. The analysis of 20 wells showed that some parameters were above the maximum limits allowed by legislation. A Principal Component Analysis was performed, and the results showed 3 groups, one associated with salinity, other to Fe and turbidity and another to Al. However, the salinity variables (Cl, Na, CE, TDS) were not enough to establish its origin. In addition, it was obtained information about total depth of the wells, their distance to sea, their distance to Jaguaribe River (highly influenced by ocean tides) and shrimp farming (at the margins of Jaguaribe River shrimp farms are very abundant). In order to establish a link between salinity and the other variables a Correspondent Analysis was performed into the disjunctive matrix relating the chemical elements and physical measures with the other variables. The results revealed three major associations; TDS and Cl above the legislation values are related to higher distances to sea and river, higher levels of CE and Na are related to deeper wells, while higher levels of nutrients, iron and turbidity shrimp farming proximity. It is concluded that the salinity parameter can be explained by the interaction with seawater and that shrimp farming are responsible for the high levels of nutrients.

Keywords: Principal Component Analysis, Correspondent Analysis, Contamination Sources.

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HYDROCHAR FROM SOTOL BAGASSE FOR ARSENIC AND FLUORIDE REMOVALIN GROUNDWATER

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Abstract: At a global level, there is an issue regarding water resources, quality, and supply. A significant portion of water is obtained from aquifers, making it susceptible to various factors such as geological, anthropogenic, and climatic influences. Found recurrent inorganic elements, such as fluoride and arsenic, in the aquifers, surpassing the maximum limits permitted by the World Health Organization (WHO): 0.01 mg/Lfor arsenic and 1.0 mg/L for fluoride. Under these circumstances, the population is exposed to these contaminants through drinking and irrigation water, resulting in a publichealth problem. The major challenge lies in the removal of these mentioned pollutants. Hydrothermal carbonization (HTC) has stood out for its conversion of waste into carbonaceous materials (hydrochar) with active properties that promote the adsorption of metals and metalloids. This study aims to determine the optimal physicochemical parameters (temperature and time), to generate an adsorbent material from sotol bagasse (*Dasyliruion Leiophyllum*) through HTC. Hydrochar was characterized using SEM-EDX, BET, FTIR, and TGA. Adsorption tests with groundwater were also performed. According to the results, arsenic and fluoride can be removed from groundwater using the resulting adsorbent material. The simultaneous adsorption capacity was 0.808 and 91.95 μg g^{-1} for arsenic and fluoride adsorption, respectively. The hydrochar will be used to create water treatment filters, thus contributing to agricultural value.

Keywords: Adsorption, Sotol bagasse, Hydrochar, As, F, Groundwater.

THE 2022 TAX REFORM IN MEXICO: IMPACT ON SMALL AGRICULTURAL PRODUCERS

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Abstract: Tax reform is the instrument promoted by the federal executive to make tax collection more efficient. The 2022 tax reform included important aspects such as the obligation to obtain the RFC at age 18, the payment of fines for the issuance of incorrect invoices and the creation of the simplified trust regime. It was expected that as a result of the application of said reform, the number of taxpayers would increase, informality would be minimized, its implementation would be facilitated, and tax evasion and fraud would be combated. The objective of this study was to evaluate the perception of small agricultural producers in the municipalities of Delicias, Rosales and Lázaro Cárdenas in the state of Chihuahua, Mexico regarding the tax reform of 2022. A survey was conducted among agricultural producers and another one among accountants that offer service to the sector. In addition, two analysis forums were held with small producers. The results showed that 68% of the producers stated that they were registered as taxpayers, 62.4% did not know the benefits of the tax regime and 84.25% considered that the reform made their activity more expensive. In addition, about 62.5% stated that the reduction in the income tax exemption (ITE) was the factor that most affected them as producers. As a result of the forums, it was concluded that the 2022 tax reform negatively affected agricultural activity by increasing the tax and administrative burden and by increasing the costs of its activity.

Keywords: taxes in Mexico, income, costs, training.

INFLUENCE OF LANDFILLS ON GROUNDWATER QUALITY. CASE STUDY CAPULHUAC, STATE OF MEXICO

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Abstract: The main economic activity in Capulhuac is the barbecue industry, which hasgenerated various environmental effects. The slaughter of animals is generally carried out in a backyard, and the solid waste from the animal remains is thrown into the municipal landfill, generating leachate with a high load of organic matter that, when infiltrated into the groundwater, alters its quality, and can incorporate trace elements that represent a risk to human health. The project's objective was to determine the impact of sanitary landfills on the quality of human supply water through physicochemical analysis and the spatio-temporal evolution of trace elements in the water supply in the municipality of Capulhuac. For the development of the project, three samplings were collected in 4 wells adjacent to the municipal landfill. Anion analysis (HCO_3^-, Cl^-, SO_4^{2-}, and NO_3^-) was performed according to standardized methods (APHA). The principal cations (Na^+, K^+, Ca^{2+} and Mg^{2+}) and trace elements were determined by the ICP technique. The results show the presence of N-NO_3^- (3.2 mgL^{-1}), N-NH_3 (0.12 mgL^{-1}), COD (7 mgL^{-1}), Cu (0.072 mgL^{-1}), Zn (0.810 mgL^{-1}), as well as Fe concentrations (0.379 mgL^{-1}) abovewhat is permissible (0.3 mgL^{-1}) by current regulations (NOM-127-SSA1-2000). Within plasma components are Fe (0.9-1.2 mg/100 mL) and Cu (1-1.4 mg/100 mL). The presence of Fe and Cu in the groundwater under study is possibly due to the infiltration of leachate generated in the municipal sanitary landfill.

Keywords: Landfills, physicochemical quality, trace elements, solid waste, leached

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HYDROGEOCHEMICAL PROCESSES AND SPATIAL DISTRIBUTION OF 3D FLUORESCENCE OF DISSOLVED ORGANIC MATTER IN LAKE CHAPALA, MEXICO

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Abstract: The water from the lakes of the world has been analyzed to identify hydrogeochemical processes in the reservoir. Processes like evaporation, dissolution, mixing, mineral precipitation, and chemical exchange between water, sediments, and the atmosphere were evaluated. The quality of surface water depends not only on natural processes, precipitation inputs, erosion, and weathering of crustal materials; anthropogenic influence is included too. Thirty-seven lake water samples were collected to identify the hydrogeochemical processes and the degree of contamination associated with the presence of dissolved organic matter of anthropogenic origin in the water. The physicochemical parameters T, EC, pH, DO, and Alkalinity were determined in situ at each point. Cations (Ca^{2+}, Mg^{2+}, Na^{+}, and K^{+}), metals (Fe, Mn, Al, P), anions (SO_4^{2-}, Cl^{-}, NO_3^{-}), dissolved organic matter, (humic and fulvic acids) were analyzed at the laboratory. The hydrogeochemical process that predominates in Lake Chapala is a mixing process with groundwater due to the water-rock interaction and the upwelling of groundwater towards the central and western parts, which act as hydraulic barriers. The 3D fluorescence analysis showed the presence of natural organic matter, humic and fulvic acids, in most of the lake, while, in the discharge zone of the Lerma River and the vicinity of the towns of Cosalá and Ajijic, the presence of organic matter of anthropogenic origin was observed.

Keywords: water quality, hydrogeochemical processes, contamination, surface water, aromatic proteins, humic acids.

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ARSENIC SPECIATION IN GROUNDWATER OF URUGUAY AND IMPLICATIONS ON PUBLIC HEALTH

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Abstract: Natural Arsenic in groundwater is a global environmental and public health concern, including in Uruguay. Arsenic (As) occurs naturally in various chemical species. The two primary As species present in water are inorganic, including arsenite As(III) and arsenate As(V), both toxic, being As(III) more toxic than As(V). The World Health Organization (WHO) guidelines for As levels in drinking water does not differentiate between As species and establishes a guideline value of 10 µg/L for total inorganic As. In several areas in Uruguay, significant levels of arsenic have been reported in groundwater. One of them is a rural area of San Antonio in the country's south, where well water is the only source of water for the residents (1650 people). The objective of this study was to determine total As and inorganic As species concentrations, in wells from this rural area and to compare As(III) and As(V) levels of two samples from the same well: one taken directly from the well and the other from the kitchen sink. Twenty water samples from private wells in the area were sampled and analyzed by SPE-MP OES for its speciation. All samples exceeded the WHO guideline value for total inorganic arsenic and the highest concentration was 38 µg/L. Remarkably, 40% of the samples contained more As(III) than As(V). Additionally, some of those samples taken from the tap, underwent compositional changes upon reaching the point where people consume the water, while others still maintain As(III) levels unchanged. These findings, can contribute to improve our understanding of the occurrence, health effects, and mitigation strategies associated with arsenite and arsenate in groundwater considering that inorganic As species have different toxicities and bio-availabilities.

Keywords: Arsenic speciation, groundwater, health risk, arsenite, arsenate.

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MAPPING OF TRACE ELEMENTS ON SAL ISLAND (CAPE VERDE) AND BLOOD CONCENTRATIONS IN THE INHABITANTS

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Abstract: Geochemical mapping provides a set of information that assists in decision-making on public policies that address a balance between health, environment and economy of a country. The Sal island (Cape Verde) has an area of 216 km^2. In this study, 60 topsoil samples were collected, corresponding to a density of 1/7 km^2. Soil chemical analyses, including analytical quality control, were carried out following the recommendations of the "IGCP 259 - International Geochemical Mapping" project. The map obtained showed an ecological risk for mercury. In the same locations, 23 of the inhabitants studied had blood mercury levels above the recommended limit. The neuropsychologic assessment performed suggests a lightly correlation between blood mercury levels and the incidence of cognitive disorders. The number of years participants resided in these risk areas correlated with cognitive impairment. The strategy used in this study (geochemistry + biomonitoring + neuropsychologic assessment) may be useful for eventual predictive diagnosis in population screening for cognitive impairment. Improved diagnostic results could be obtained using blood mercury data along with Mini Mental State Examination (MMSE) scores.

Keywords: Trace Elements, mercury, geochemical maps, blood, Sal island, Cape Verde.

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