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The Use of 51 TITAN Model 600/800 GeoExploration Check Sample X-Ray Gun in Analysing Pb, Cr, Zn, As, Cu, Cd, and Hg Concentrations in Long Island Elementary Schools and Public Parks's Soil

Earth and Environmental Sciences (EAEV)

Other (OTH)

a) Rationale

Due to industrial sites expanding at a rapid pace, mine tailings, large amounts of high metal waste being disposed, gasoline and paints including lead, animal manures, contaminated sewage, pesticides, wastewater irrigation, and atmospheric deposition, soils are becoming contaminated without many people realizing. Children are being exposed to harmful metals every day they are playing at certain playgrounds, leading to a higher health risk.

Heavy metals build an indistinct group of inorganic chemical hazards. The metals that are most commonly found within a contaminated site include lead (Pb), chromium (Cr), arsenic (As), zinc (Zn), cadmium (Cd), copper (Cu), mercury (Hg), and nickel (Ni). Soil serves as a major sink for heavy metals when they are released into the environment. Most metals do not undergo microbial or chemical degradation, as organic contaminants do when oxidized to carbon (IV). Therefore, this results in the soil having a high concentration of heavy metals that persist for a long time after their arrival.

However, there is a possibility that their chemical forms (speciation) and bioavailability can change. If the soil has a high presence of toxic metals, the biodegradation of organic contamination will activate. A high concentration of heavy metals in soil poses a large hazard to the ecosystem and humans through the food chain (soil-plant-human or soil-plant-animal-human), direct ingestion or contact with the contaminated soil, drinking groundwater coming from the contaminated soil, reduction in food quality (safety and marketability), and land tenure problems.

Heavy metals are present in soil naturally, but geologic and anthropogenic activities have increased the concentration of these metals drastically. The elements are now in such high doses that they are harmful to both plants and animals. Some of these activities include mining and smelting of metals, burning of fossil fuels, use of fertilizers and pesticides in agriculture, production of batteries and other metal products in industries, sewage sludge, and municipal waste disposal.

Various methods of remediating metal polluted soils exist; they range from physical and chemical methods to biological methods. Most physical and chemical methods (such as encapsulation, solidification, stabilization, electrokinetics, vitrification, vapour extraction, and soil washing and flushing) are expensive and do not make the soil suitable for plant growth. Biological approach (bioremediation) on the other hand encourages the establishment/reestablishment of plants on polluted soils. It is an environmentally friendly approach because it is achieved via natural processes. Bioremediation is also an economical remediation technique compared with other remediation techniques. This paper discusses the nature and properties of soils polluted with heavy metals. Plant growth and performance on these soils were examined. Biological approaches employed for the remediation of heavy metal polluted soils were equally highlighted.

Heavy metals are elements that exhibit metallic properties such as ductility, malleability, conductivity, cation stability, and ligand specificity. They are characterized by relatively high density and high relative atomic weight with an atomic number greater than 20. Some heavy metals such as Co, Cu, Fe, Mn, Mo, Ni, V, and Zn are required in minute quantities by organisms. However, excessive amounts of these elements can become harmful to organisms. Other heavy metals such as Pb, Cd, Hg, and As (a metalloid but generally referred to as a heavy metal) do not have any beneficial effect on organisms and are thus regarded as the "main threats" since they are very harmful to both plants and animals.

b) Research Question(s)/Hypothesis(es)/Engineering Goal(s)/Expected Outcome(s)

1. Are harmful metals are found within local playgrounds?
    a. Yes, metals such as Pb, Cd, Cr, As, Mg, and Zn will be located inside the soil.
2. If found, what are their concentrations?
    a. Zn will have the highest concentration.
3. Do these harmful metals seep through the soil into the groundwater level? If so, could they be found in our water supply and to what degree?
    a. Yes, these metals will be found within the water in the groundwater level, potentially harming the water flowing throughout our ecosystem.
4. Do plants affiliated to the playground soak up these harmful metals in their roots?
    a. Yes, the metals will be present within plants.

c)Methodology:

Gathering Soil Data from Parks

As the metals that each park are exposed to vary from place to place due to various environmental factors, 64 samples will be tested throughout Long Island. Travel to different parks that each have a distinguishing factor, i.e. close to the ocean, near an industrial park, or next to the highway. Planning areas that are different in location differentiate the results. In this study, 6 samples will be taken from each of the following schools or public parks: Fork

Lane Elementary School, Lloyd Harbor Elementary School, Manorhaven Elementary School, Pine Street Park, Syosset Public Park, Pasadena Elementary School, Front Street Elementary School, Village of Island Park Mayor Landgraf Playground, etc. Using a shovel and wearing gloves, dig down to the top soil region. After digging, place the samples in 6 plastic containers. Then, using a sterile scissor, cut 6 square pieces of saran wrap and cover the samples with plastic saran wrap. After completion, record the coordinates of those 6 samples. Write down the longitude and latitude and take note of any side notes about the weather and what is different about the atmosphere compared to the other sites.

X-Ray Gun Soil Data

Using a 51 TITAN Model 600/800 GeoExploration Check Sample X-Ray Gun, cover the sample with the cover of the X-Ray Gun to prevent dangerous exposure. On the home screen, connect the machine to a computer via bluetooth. Once connected, open the application on the desktop to reveal the range of metals it will be scanning for. In settings, allow the the X-Ray Gun to scan for 85 seconds, ensuring that all important heavy metals will be reached. Press the button that reads “Ready for Testing” and wait 60 second for completion. Once done, record all of the metal concentrations. Form an excel sheet with all of the dangerous metals, in this experiment lead (Pb), chromium (Cr), arsenic (As), zinc (Zn), cadmium (Cd), copper (Cu), mercury (Hg), and nickel (Ni) were recorded, along with their concentrations.

Soil Data from Water Push

Using the 6 samples from each of the locations, mix the 6 soil samples together from one location to create one large sample that replicates the entire park or elementary school. Place the mixed soil on one large weighing boat. Take a test tube and place a funnel on the top. Once placed, carefully insert a coffee strainer in the funnel. Weigh the amount of soil that is in the weighing boat using a scale, and then using a sterile scalpel measure exactly 1g of the soil. Place the 1g of soil on top of a coffee strainer and using a micropipette, micropipette 1000mL of distilled water. Continue to slowly pour the water on top of the soil. If needed, micropipette another 1000mL of distilled water and pour until the water seeps through the soil, leaving 2mL of water in the test tube. Place the water inside the wavelength determining machine and take the data of the wavelength.

Contaminated Water Data from X-Ray Gun Data

After recording the data of the water that seeped through the soil immediately, measure 5mL of the remaining dry soil and put it into a test tube. Then, pour distilled water until it reaches the 10mL mark on the test tube. Leave the mixture inside the test tube for a week. Once a week has passed, repeat the same steps for the wavelength machine, micropipetting 2mL out of the test tube and placing it in the small plastic test tube. Place the test tube inside the wavelength machine and record the date. Secondly, place the contaminated water on the platform of the X-Ray Gun. Place the cover on top and wait 85 seconds for completion. Record the metals found in the water and their concentration.

Compare the metals found in the water to the metals found in the original soil. Write these results down on an excel sheet.

d) Bibliography

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Addendum:

No changes were made from my original research plan.