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Cancer and Soil Pollution

Stephanie Thomas

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CANCER AND SOIL POLLUTION

Stephanie Thomas
CHE 141 404H Fall 2021
Professor: Dr. Britt Carlson

What is soil pollution?

Soil pollution is when there are large quantities of toxic chemicals (or contaminants) in soil which potentially present a risk to human health or the environment itself ("What is Soil Pollution?").

WHAT ARE THE POSSIBLE HEALTH RISKS FOR HUMANS?

- Headaches, rashes on skin, upset stomach, tiredness, irritation in the eyes, neuromuscular blockage, damage in the kidneys and/or liver, and ***CANCER*** (of all different sorts)(“What is Soil Pollution?”)!

(“What is Soil Pollution?”).

www.kindpng.com/free/skull-and-bones/

What contributes to soil pollution?

- Manufacturing Industry
- Waste management
- Too much fertilizer and/or pesticides used agriculturally
- High traffic areas
- Land development
- Housing development

(Soil Science Society of America)

Dennis Finley

HOW DO HUMANS CONSUME CONTAMINANTS?

- Eating food cultivated in the polluted soil
- Inhalation
- Ingesting the soil itself (wash your produce!)
- Absorption through epidermis
- Contaminants from soil may breach into water supply and be consumed

(Soil Science Society of America)

What are the contaminants exactly?

The excess presence of a substance in soil which would not naturally occur, creating a threat to human health(Science Soil Society of America).

Element levels that typically get assessed for soil pollution include; copper, cadmium, lead, zinc, arsenic, aluminum, chromium, manganese, nickel, and iron (S.C Nde, et al,2).

Which contaminants could be associated with which cancers you may be wondering?

In the mainland of Spain from 1999-2008 researchers did an ecological cancer mortality study in 7119 different towns. This study covered 861,441 cancer deaths total.

- Their aim for the study was to find out if specific configurations of top-soil could have an impact on the mortality rates due to different cancers geographically.
- They were also looking to find errors that can be made in epidemiological studies when analyzing the information as a closed number system.

(G. Lopez-Abente et al)

HERE IS WHAT THEY FOUND

RESULTS FOR MEN

High concentrations of lead, zinc, manganese, copper, and cadmium were found to cause tumors to develop in the digestive system.

High concentrations of cadmium contributed to bladder cancer.

High concentrations of arsenic contributed to brain cancer.

RESULTS FOR WOMEN

High concentrations of cadmium contributed to the development of brain tumors.

High concentrations of copper contributed to lung cancer.

(G. Lopez-Abente et al)

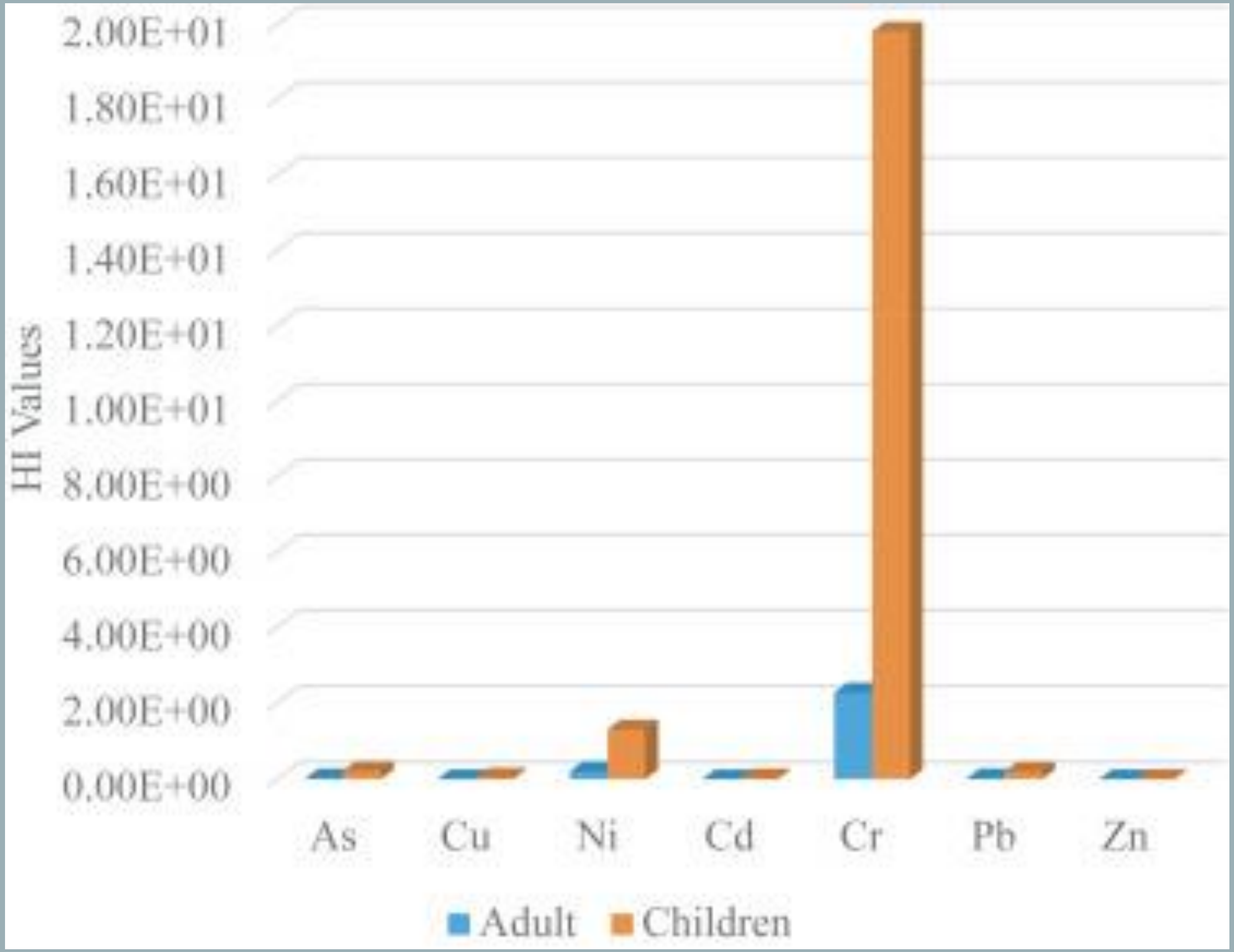
Another study, done in South Africa, had the goal to assess the risks of potentially toxic elements (PTEs) to human health.

- This included carcinogenic risks.
- The soil samples were derived from strictly agricultural settings.

Methods of PTE consumption for adults and children include:

- Respiratory intake
- Absorption through skin
- Digestion

(S.C Nde et al)



The two metals they found to potentially be the most harmful were nickel and chromium, with chromium displaying a much higher risk. The study also showed that children are at higher risk than adults and are most likely to consume the PTEs via digestions and/or absorption through the skin.

(S.C Nde et al)

Experimental Research
Chosen Samples

THE CONTINUOUS CORN NITROGEN FIELD AT PARKLAND

THE WINTER WHEAT COVER FIELD AT PARKLAND

I hope to find which of the two samples are most fertile and to find any other significant differences between the two. I have never worked with or know much about soil so I feel whatever I find will be interesting!

Soil Sampling Lab

The purpose of the Soil Sampling Lab was to dig up two different sample types to conduct experiments on through-out the semester for research and the semester project. Here are my findings!

Continuous Corn Nitrogen

- ❑ Dark and rich in color
- ❑ Sample temped at 28.5˚C
- ❑ Somewhat moist, may still be drying from previous night rain.
- ❑ Presence of some vegetation, no other apparent living organisms.

Winter Wheat Cover Field

- ❑ Darker than C. Corn Sample, appears to be richer in nutrients.
- ❑ Sample temped at 25.7˚C
- ❑ Appeared moister than C. Corn sample.
- ❑ No apparent living organisms in sample.

Continuous Corn Nitrogen Field Location

Winter Wheat Cover Field Location

Sieving Lab

The purpose of this lab was to sieve out a variety of fraction sizes from the samples. We divided them into three different sizes per sample; <2mm, 2-6.4 mm, and >6.4mm.

Winter Wheat Cover-field

- <2mm fraction had a fine in texture and still had a little bit of plant structures within them.
- 2-6.4mm has some small rocks I needed to pick out as well as some plant structures.
- >6.4 also had some plant structures in the mix.

Continuous Corn Nitrogen

- <2mm was also fine in texture but seemed dustier than the wheat sample.
- 2-6.4mm had less plant structures than the wheat but also had some smaller rocks to pick out.
- >6.4mm also had some plan structures in the mix.

K Analysis Lab

The purpose of the K Analysis Lab was to measure the potassium levels in each sample via flame photometry.

Winter Wheat Cover-field

- Concentration of K at 691 lbs/acre

Continuous Corn Nitrogen

- Concentration of K at 648 lbs/acre

- Both samples tested above optimum levels (very high), meaning that both crops would not need any additional K from fertilizers and the crops should be fertile enough. The wheat field would be more fertile than the continuous corn nitrogen field.

- My winter wheat cover-field sample had the highest concentration of potassium compared to my classmates according to the shared spreadsheet. Although it was still within the neighborhood of the other concentrations.

- My continuous corn nitrogen sample had one of the highest concentrations of potassium compared to my classmates. Although it was not the highest, it was still within the neighborhood of the concentrations of the other continuous corn nitrogen samples.

K Analysis Lab

In conclusion I suspect my concentration levels of potassium were on the higher ends than most of my classmates' because I may have gotten my samples from deeper within the fields. When digging for the samples I did not see any holes as far out as mine were at the time.

P Analysis Lab

The purpose of the P Analysis Lab was to analyze the levels of phosphorus within my two soil samples via spectrophotometry.

Winter Wheat Cover-field

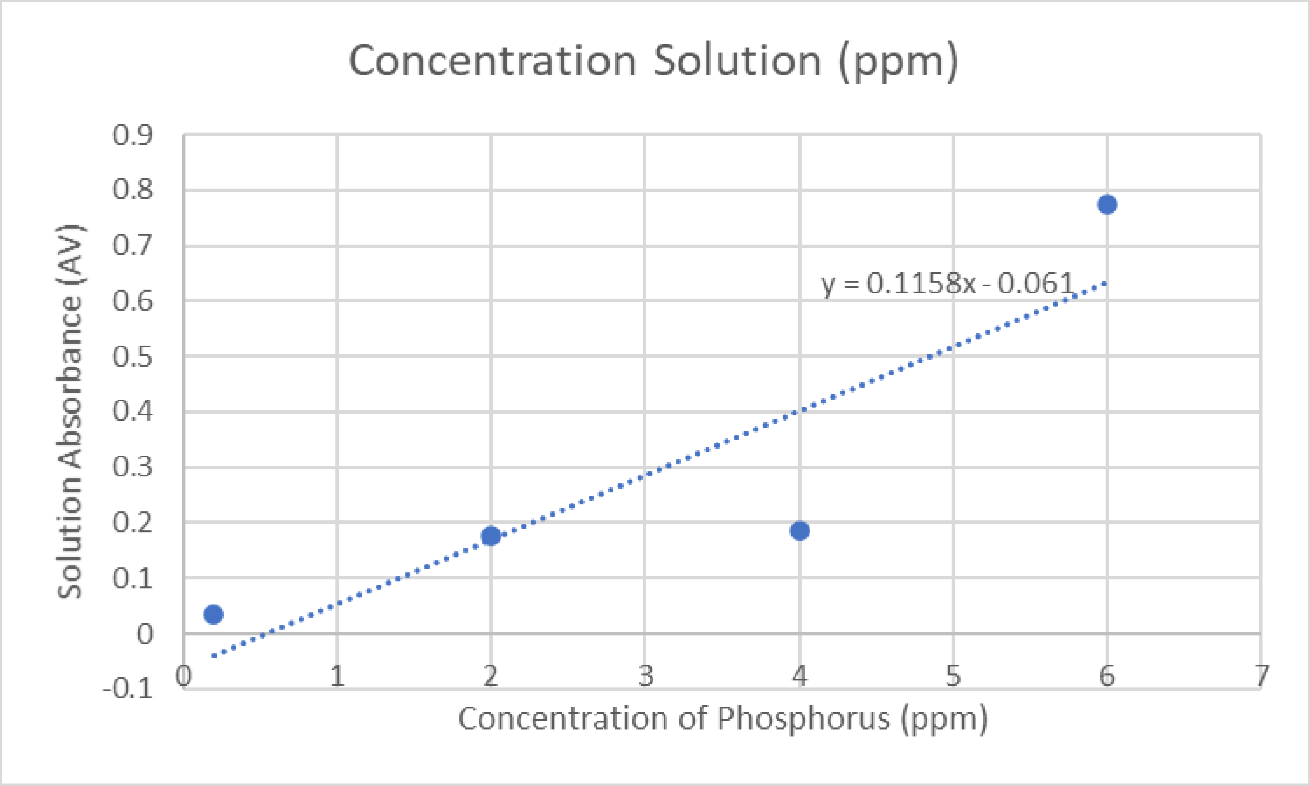
- Concentration of phosphorus at 112 lbs/Acre (5.59ppm)

Continuous Corn Nitrogen Field

- Concentration of phosphorus at 96.8 lbs/Acre (4.84ppm)

- Upon visual inspection and comparison to the standards, I estimated the concentration of both samples would be close to 4.00ppm.
- Both samples tested at optimum (very high) levels of phosphorus. These concentrations also suggest that both samples are very fertile and would not need any phosphorus supplementation from fertilizer.
- My winter wheat cover-field sample had seemingly the highest concentration of phosphorus compared to my classmates' samples.
- My continuous corn nitrogen sample also had the highest concentration of phosphorus compared to my classmates' samples.

The graph on the right shows the absorbance values per concentration of the standards provided in the lab. The absorbance value for the standard with the concentration of 4.00ppm is quite off. This could mean that I possibly sampled from the incorrect test tube. This also could have been because my spectrophotometer got turned off by accident and I had to wait for it to boot back up. I should have re-run the standard to ensure I had the correct reading.



Conclusively, the concentration of phosphorus levels turned out higher than I estimated when visually comparing to the standards. I also suspect my concentration levels were higher than my classmates' because I may have gotten my samples from deeper within the fields than anyone else.

POXC Experimental and Calculations Lab

The purpose of the POXC Experimental Lab was to analyze the reactive carbon levels in my soil samples via spectrophotometry. The POXC Calculations Lab's purpose was to quantify the results of the POXC Experimental Lab and calculate the levels of the reactive carbon present in the samples.

Winter Wheat Cover-field

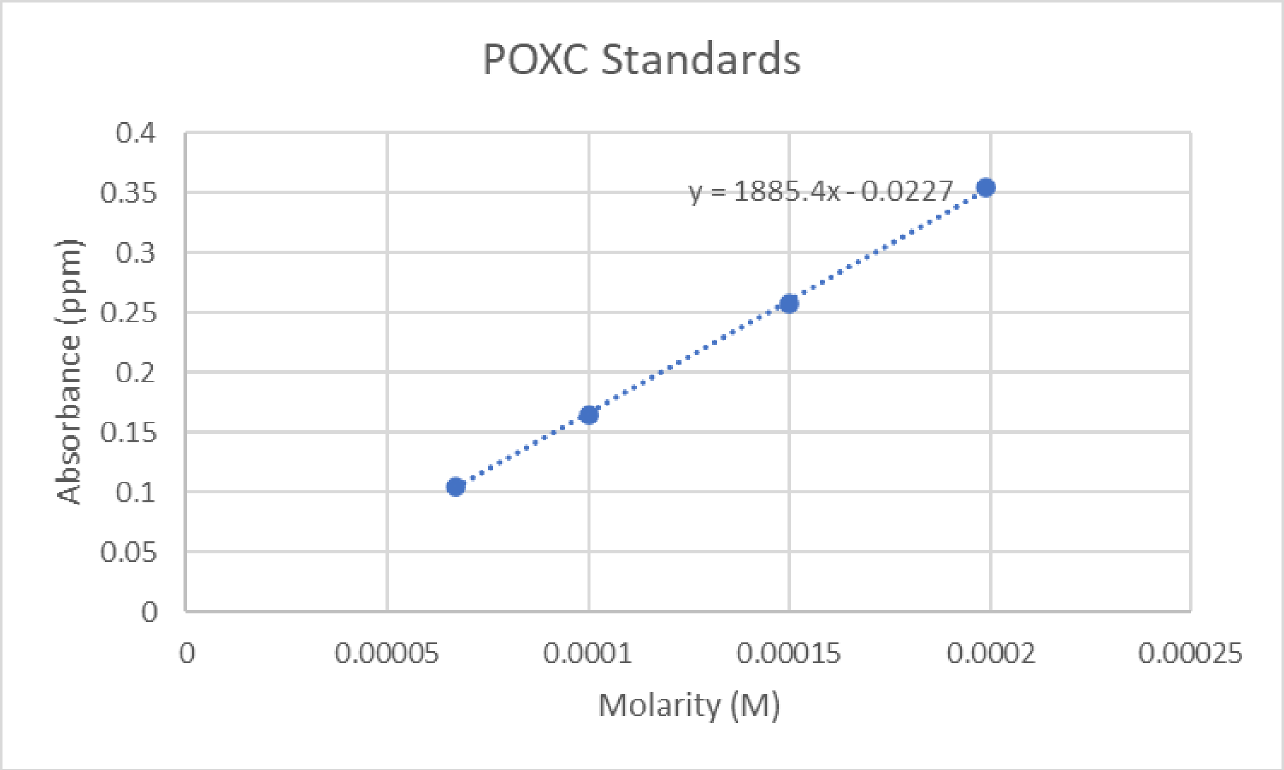
- Experimental; visually inspecting the sample against the standards, I predicted there would be a lower levels of POXC (reactive carbon).
- Calculated 121 mg RC/ kg soil
- This is the lowest amount of reactive carbon within the wheat samples compared to my classmates but still within the neighborhood of a few of their samples.

Continuous Corn Nitrogen

- Experimental; visually inspecting the sample against the standards, I predicted for this sample to also have low levels of POXC.
- Calculated 85.6 mg RC/kg soil
- This is the second lowest amount of reactive carbon within the continuous corn N samples among classmates.

POXC EXPERIMENTAL AND CALCULATIONS LAB

- Errors: Initially I made a few calculating errors. Upon receiving the lab back graded and with notes I fixed the errors. The results in the previous slide are the new calculation results.
- In the POXC Experimental Lab I visually inspected my soil sample dilutions against the standards I prepared and predicted that my samples would have lower levels of reactive carbon. The calculations lab confirmed my prediction. My samples had among the lowest levels of other like samples and had lower levels when comparing to most other soil samples from my classmates.



The graph pictured above is the standard curve for the standards I created to compare the wheat and corn soil samples to. Both my wheat and corn samples would have fallen in between 0.0001-0.00015M.

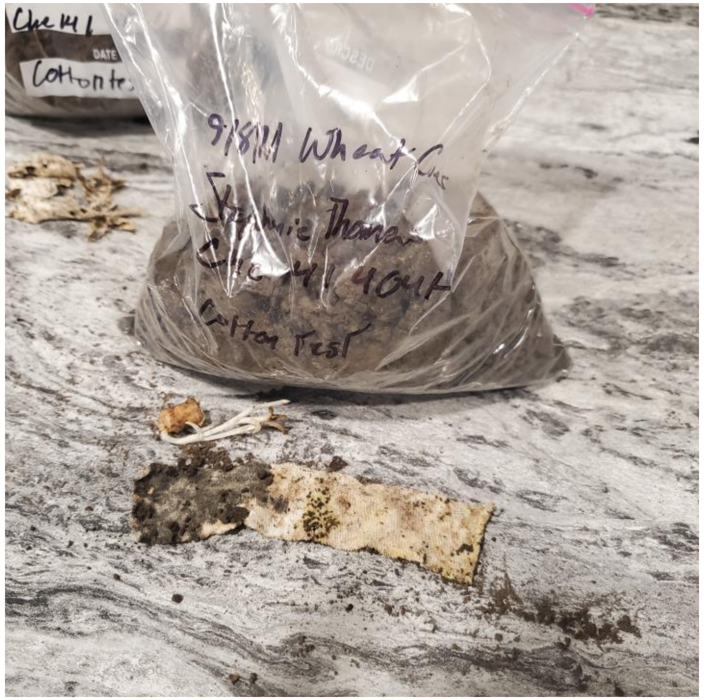
Cotton Test

The purpose of the Cotton Test was to determine what effects different types of soil management had on decomposition.

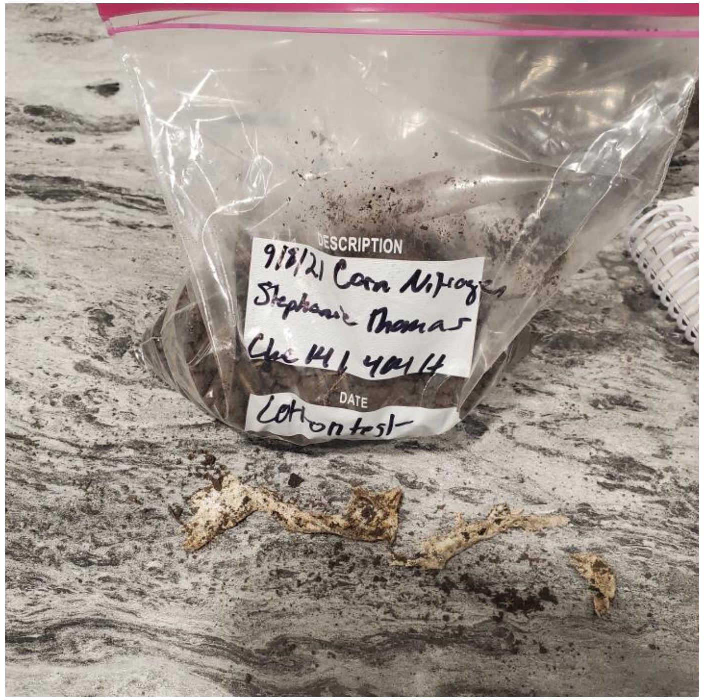
- The cotton strip in the winter wheat cover-field sample was weak when ripping apart but had more resistance than the corn sample strip. The strip had some yellow and darker discoloration.

- The continuous corn appeared to have made the cotton strip decompose quicker than the cotton strip from the wheat sample. The cotton strip ripped more easily and in multiple spots. It is hard to see in the photo but when inspecting the strip in person, it appeared to have some pink/purple discoloring.

Winter Wheat Cover-field



Continuous Corn Nitrogen



COTTON TEST

Decisively, it appears that the continuous corn nitrogen soil sample decomposed the material slightly quicker than the winter wheat cover-field soil sample.

Slake Test

The purpose of the slake test was to compare the presence of organic matter or iron oxides in each sample based off their aggregation stability.

Winter wheat cover-field

- Sample had deeper cracks within ped than c. corn.
- Water was slightly cloudy by end of experiment.
- Did not have as many finer particles on surface of water.

Continuous Corn Nitrogen

- Sample had smaller and slighter cracks within ped.
- Water was cloudier than wheat water.
- Had a greater presence of fine particles on surface of water than winter wheat sample.

The winter wheat cover-field sample appeared to have more aggregation stability than the continuous corn sample. Conclusively the winter wheat sample appears to have had more organic matter or iron oxides.

Errors and Challenges

- ❑ Lack of proper prep work for labs to understand the procedures exactly; leading to poor time-management.
- ❑ Lack of urgency in labs without understanding how quickly I needed to be moving.

Things I will do to remedy all the above mentioned;

- ❑ Read over the lab before writing out pre-lab notes.
- ❑ Take separate notes to ensure proper absorbance of procedure.
- ❑ Try to keep the sense of urgency but not let the stress of urgency become blinding and allow for mistakes.

The more hands-on experience I get in the lab the more comfortable I'll get in using the instruments and build a more accurate speed as well.

Final Thoughts…

Learning what I have from conducting the experimental and literature research, I would love to see what could be found out from agricultural soil samples in the surrounding area. I would also be very curious to figure out the PTE (potentially toxic elements) levels they have.

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