ENVIRONMENTAL HEALTH COUNCIL

Soil Assessment of IEI "Cesar Vallejo" No. 86841, Viscas-Jambón, Áncash, Perú
July 9 2024

The Environmental Health Council
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On July 9, 2024 The Environmental Health Council (The EHC), a non-profit, environmental organization based in the United States, analyzed soil at the IEI "Cesar Vallejo" No. 86841**,** in Viscas-Jambón, Áncash, Perú**.** The objective of the assessment was to determine if there are contaminants from former silver refining operations in the eighteenth and nineteenth centuries at the Santa Catalina mill in the area of the school. The existence of former silver milling operations was identified prior to the assessment based on the reference to the site provided by Antonio Raimondi in his work *Áncash* (Lima, Peru: P. Lira, 1873, p. 226).

The school grounds are partially enclosed by an adobe wall and have a considerable amount of exposed soil. The school buildings are also constructed of adobe, and are overall in poor condition. The roof of one classroom had collapsed at the time of the assessment.

Assessment activities consisted of collecting five shallow soil samples of approximately 3 cm depth within a ten-foot radius, which were then combined in clean new plastic bags and labelled. The samples were then analyzed in Lima on July 12, 2024 with a Niton xl3t GOLDD+ model field portable X-Ray Fluorescence (XRF) calibrated for assessment of heavy metals in soils. Several soil samples were also analyzed by Atomic Absorption Spectroscopy (AAS) by USEPA Methods 3050b and 7471b at Centro Toxicologico S.A.C "CETOX," an accredited laboratory in Lima.

The sample results from CETOX are presented in the attached table. Sample SANT-R-5 was not analyzed at CETOX, so the result presented in the table is from XRF analysis. Ranges of results are presented below:

- Arsenic soil results ranged from 15 to 2020 milligrams per kilogram (mg/kg) or parts per million (ppm)
- Lead results soil ranged from 136 to 38022 mg/kg
- Mercury soil results ranged from below the detection limit (approx. 5 ppm) to 237 mg/kg

The correlation coefficient (R) value of each dataset (ie As XRF vs As AAS) is 0.99, 0.85, and 0.90 for As, Pb, and Hg, respectively. USEPA Method 6200 (Field Portable X-Ray Fluorescence Spectrometry for the Determination of Elemental Concentrations in Soil and Sediment) recommends that the R value between field portable XRF and fixed lab analysis such as AAS, should be 0.7 or higher in order to use the XRF results as screening level data. Datasets with an R value above 0.9 have a high confidence level and may be useable for definitive site decision making, but may require some additional statistical analysis.

The Peru Ministry of Environment (MINAM) screening values for residential exposure (which includes exposure to children) were used for a screening level comparison to the sample results. Arsenic was detected above the MINAM residential soil screening level of 50 mg/kg at six of the seven sample locations. Mercury was detected above the MINAM residential soil screening level of 6.6 mg/kg at six of the seven locations. Lead was detected above the MINAM residential soil screening level of 140 mg/kg at six of the seven locations.

It is important to note that the soil concentrations of lead, arsenic and mercury detected at the school range between 1 and 2 orders of magnitude above health-based screening values. In other words, these results are 10 to 100 hundred times higher than the screening values. In the case of lead, the concentrations far exceed levels that health agencies such as The World Health Organization, or the US Agency for Toxic Substances and Disease Registry recommend for follow-up blood lead analysis. Viewed in comparative perspective, it is notable that the highest soil lead concentration found at Cerro de Pasco, in the Department of Pasco, Peru, was 12000 mg/kg (Van Geen et al, October 10, 2012). Soil lead concentrations in La Oroya, in the Department of Junín, Peru average as high as 3574 mg/kg (Kannan et al, February 2, 2013). Soil lead concentrations in Zamfara, Nigeria were often as high as 10,000 ppm, but generally range from 400 to 23000 mg/kg (Trima et al, September 2016). Each of these locations had follow-up blood-lead analysis and along with several studies that have recommended continued blood-lead monitoring, chelation therapy in some cases, and correlation between neurological impact and elevated soil lead concentrations. In addition, cumulative impacts from elevated arsenic and mercury in soil at the school have not been evaluated but likely increase the risk of neurological and other health impacts to children and school workers.

In un-contaminated areas in much of the Andes, arsenic and mercury can naturally be encountered at or around the following concentrations: arsenic – 30 to 50 mg/kg, lead – 20 to 140 mg/kg, and mercury – below detection of the XRF (< about 6 mg/kg). The attached graph presents the results in comparison to the screening values.

Areas of Concern:

Based on this preliminary assessment, the wall partially enclosing the school, the exterior school grounds and the adjacent football field are all contaminated with As, Pb, and Hg. Most concerning are the As and Pb concentrations on the school grounds and football field.

Red dots on the attached figure presents sample locations where arsenic, mercury, or lead were above the MINAM screening value for exposure to soil contamination.

These areas are of concern because exposure, especially by children, to heavy metals such as lead, mercury and arsenic are known to cause neurological and developmental effects as well as many other health problems.

Recommendations:

Based on this preliminary assessment, the EHC recommends that the appropriate governmental agencies conduct a comprehensive assessment of the site, including the interior of the school buildings. Tests should also be conducted for mercury vapor, and also samples taken to determine if blood lead, arsenic and mercury levels are elevated in both students and professors at the school. Given the extensive and severe contamination of the school grounds, and the deteriorated condition of the

buildings, it is recommended that the school be closed immediately, and a new facility be constructed out of brick on a non-contaminated site.

This should be an urgent priority for the Ministries of Environment and Education and regional and local officials (Governor, Regional Directorate of Health, mayor) and is consistent with actions which would be taken in other jurisdictions such as Environment Canada, the European Union, US Environmental Protection Agency and the United Nations Environment Program. Other actions would involve the removal of contaminated soil, or potentially capping of contaminated soil. At a minimum, children should be kept out of the contaminated areas and workers should be warned of the contamination before working in those areas. The primary exposure route, and risk, is incidental ingestion of contaminated soil during play, or work activities in the exposed soil areas. There may also be limited mercury vapor inhalation risk, especially during disturbance of soil. In Huancavelica, Peru where significant mercury contamination remains in soil from legacy mining, mercury vapor mercury vapor was detected above the MINAM standard (2000 nanograms per meter cubed) (The EHC, Remedial Investigation, 2015). Additional assessment of heavy metals in soil and mercury vapor is warranted in the immediate vicinity of the site, where there are currently homes, as well as the nearby villages of Viscas and Jambón.

Attachments:

Table – Soil Results
Figure 1 – Soil Results compared to Screening Values
Figure 2 – Location of Samples

Table of Soil Sample Results
Santa Catalina
July 2024

Sample ID	Sample Date	As (mg/kg)	Pb (mg/kg)	Hg (mg/kg)	Notes (Soil unless otherwise indicated)
SANT-R-1	7/9/2024	2020	38022	237	Muestra de adobe de la pared del IEI Cesar Vallejo No. 86841
SANT-R-2	7/9/2024	50	846	39	Muestra de adobe cerca de la puerta del IEI Cesar Vallejo No. 86841
SANT-R-3	7/9/2024	114	2744	51	Muestra de la cancha de futbol, Poste #1
SANT-R-4	7/9/2024	196	4226	68	Muestra del centro de la cancha de futbol
SANT-R-5	7/9/2024	15	136	ND	Muestra de la cancha de futbol, Poste #2
SANT-R-6	7/9/2024	901	15430	221	Muestra de tierra del IEI Cesar Vallejo No. 86841
SANT-R-7	7/9/2024	645	14752	306	Muestra de tierra del IEI Cesar Vallejo No. 86841
ECA MINAM		50	140	6.6	
Max		2020	38022	237	
Min		15	136	ND	

Notas:

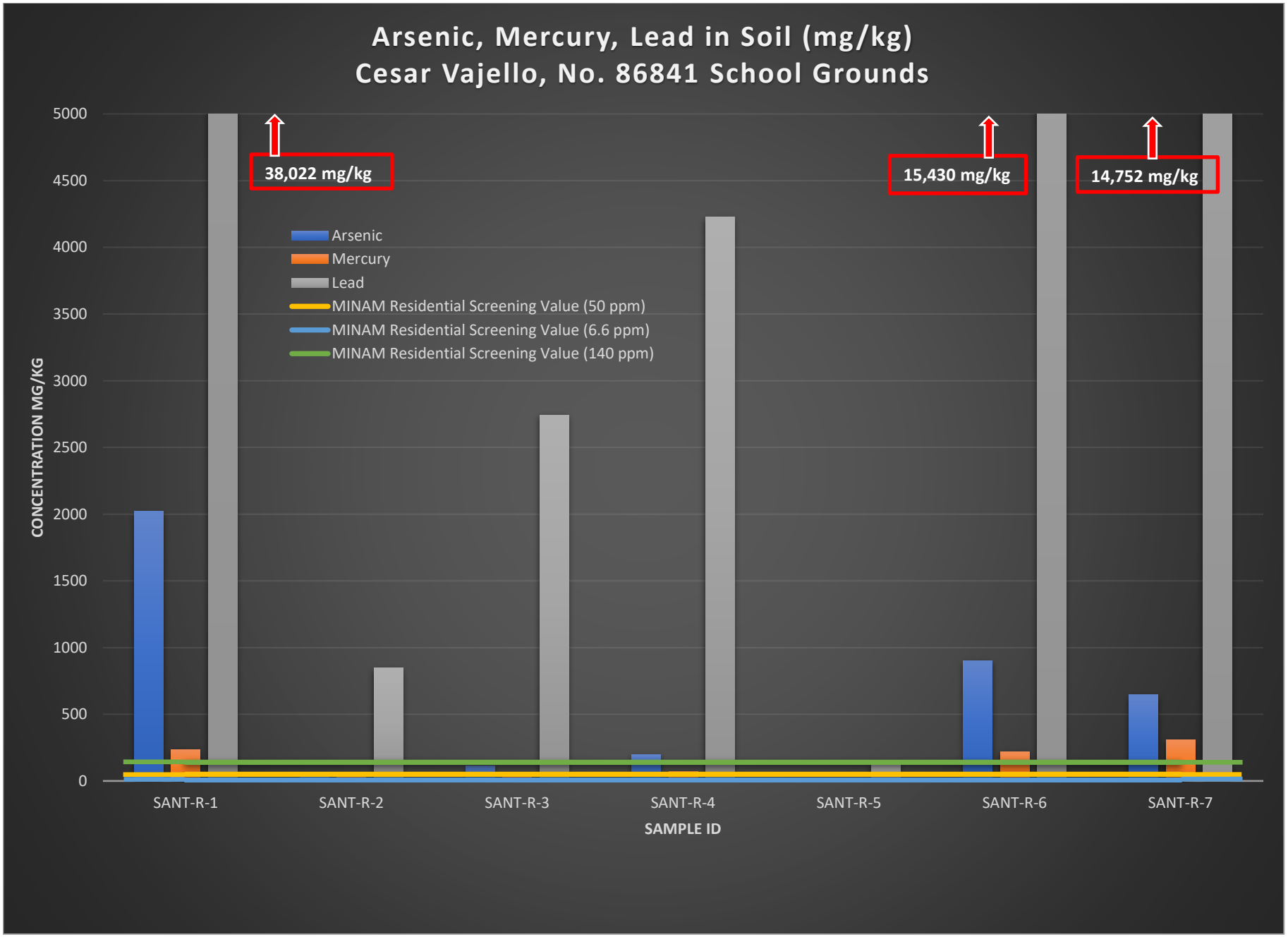
Milligrams por kilograms (mg/kg) o partes por millon (ppm)

No detectado a o encima del limite de detección del instrumento = 5 ppm

Cuadros sresaltado en rojo indican excedencia del ECA

Las muestras, salvo SANT-R-5, se analizó en un laboratorio acreditado Peruano por espectrometría de absorción atómica (Metodos de la USEPA 3050B y 7471B)

La muestra SANT-R-5 se midió por un XRF portatil (Niton xl3t)


Arsenic, Mercury, Lead in Soil (mg/kg)
Cesar Vajello, No. 86841 School Grounds
38,022 mg/kg
15,430 mg/kg
14,752 mg/kg
Arsenic
Mercury
Lead
MINAM Residential Screening Value (50 ppm)
MINAM Residential Screening Value (6.6 ppm)
MINAM Residential Screening Value (140 ppm)
CONCENTRATION MG/KG
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
SANT-R-1
SANT-R-2
SANT-R-3
SANT-R-4
SANT-R-5
SANT-R-6
SANT-R-7
SAMPLE ID

Peru Colonial Site Assessment

7/18/2024

1:1,098

0 0.01 0.01 0.03 mi

0 0.01 0.03 0.05 km

Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community