INVESTIGATION OF SOIL CONTAMINATION BY HEAVY METALS IN CITY CREEK CANYON

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Abstract

Cottonwood Gulch, a stream which forms high within City Creek Canyon, is suspected to be one of the mobilizers of heavy metals found within the Canyon. The mining that has taken place was sporadic, and unfortunately not well documented. Regardless, the extractions that did take place left a negative lasting impact on the canyon environment.

The City Creek watershed has been designated as having a cadmium impairment by the Utah Department of Environmental Quality (Adams, 2015). The suggested source of the metal pollution was the Treasure Box mine waste rock site. In 2016 Zach Fredrickson, a SLCC geology student, had sampled areas within City Creek finding levels of cadmium in five samples (Table 2). Along the waste rock area I took 10 soil samples, as well as nine samples along City Creek itself and North fork.

Samples taken in 2017 yielded no levels of cadmium or antimony, as well as an inconclusive arsenic trend. Lead is found uniformly in levels below concern in all samples. Although no cadmium has been detected in this particular data set, I believe the answer can be found by following the copper and zinc levels where they are at their highest.

Background

- Prospecting in the canyons of Utah was common and lucrative. This can be seen all throughout Utah, especially in the Park City and Bingham Canyon mining districts.
- Thanks to the Salt Lake City council's protests against extractions in the area, mining in the area was ordered to be halted. Fearing that it would pollute the drinking water,. City Creek Canyon has been a major source of drinking water for the valley since the first pioneers settled the area, and continues to be so today.
- The issue pertaining to the City Creek watershed comes in the form of Cadmium. As outlined in Utah's 303(D) list, Cadmium is a high priority impairment in City Creek (Adams, 2015).
- Cadmium is a naturally occurring element within the Earth's crust. Found when extracting and processing other metals. It is known to have adverse effects on Cardiovascular, Respiratory and Reproductive systems, as well as being known to cause cancer to those areas (ATS, 2011).

Research Question

- Where is the source of cadmium in City Creek water?
- What areas of soil and stream sediment have the highest concentrations of cadmium?

Methods

- Samples were collected along suspected areas that would suggest influence into the City Creek mountain stream (See Figure 1).
- Surface soil was gathered using a trowel, with a 10 foot collection radius as a mediator for homogenization.
- Samples were isolated, marked, and stored in sealable plastic bags, with the coordinates of each sample cataloged using a GPS.
- Each sample was opened and placed on individually marked filters to allow for drying.
- All dried samples were sifted to remove large rocks and organics.
- Sifted samples were then sieved through a No. 60 mesh sieve to prepare for analysis.
- Sieved samples were analyzed with an X-ray fluorescence device for a minimum of 60 seconds, in accordance with EPA method 6200 (EPA, 2007).

Results

- ***Lead***

  Lead was found in every sample within a range of 33-148 ppm (Table 1). Lead in each sample was well below the Resident and Camper levels for soil concentration of 400-1000 mg/kg (Ford, 2004, p.5). The highest lead concentrations were along both forks up City Creek (Table 1).

- ***Arsenic***

  Arsenic was found to be above resident and camper levels in one sample effluent of the North fork at approximately 21 ppm. Another sample brought back arsenic at 15 ppm at the Treasure Box mine waste rock site (Table 1).

- ***Cadmium***

  Cadmium was found in five of the nine samples analyzed by Zach Fredrickson (Table 2). Samples taken in 2017 have not yielded any Cadmium.

- ***Antimony***

  Antimony was below level of detection for all samples screened within the Valley during the 2017 sampling session (Table 1).

Reading	Units	Latitude	Longitude	SAMPLE	Pb	As	Zn	Cu	Cd
698	ppm	40.82994	-111.80923	S1	148.96	<LOD	98.08	42.59	<LOD
699	ppm	40.828014	-111.809685	S2	65.53	<LOD	53.72	39.23	<LOD
700	ppm	40.823208	-111.80981	S3	44.47	<LOD	204.6	41.95	<LOD
701	ppm	40.822014	-111.80859	S4	39.41	<LOD	208.69	<LOD	<LOD
630	ppm	40.825623	-111.79593	SA1	38.64	<LOD	173.04	<LOD	<LOD
631	ppm	40.82476	-111.80038	SA3	44.42	<LOD	121.69	<LOD	<LOD
632	ppm	40.822483	-111.80716	SA4	53.17	<LOD	96.61	<LOD	<LOD
633	ppm	40.820774	-111.81101	SA5	89.96	20.97	355.49	<LOD	<LOD
634	ppm	40.81943	-111.81643	SA6	68.91	<LOD	68.3	<LOD	<LOD
688	ppm	40.833237	-111.77185	SB1	64.06	<LOD	623.53	34.46	<LOD
689	ppm	40.83337	-111.77189	SB2	33.19	<LOD	31.34	<LOD	<LOD
690	ppm	40.833523	-111.77181	SB3	80.91	<LOD	230.72	33.19	<LOD
691	ppm	40.833515	-111.77191	SB4	46.81	<LOD	616.98	<LOD	<LOD
693	ppm	40.833298	-111.77192	SB6	77.53	<LOD	302.22	<LOD	<LOD
694	ppm	40.833073	-111.771965	SB7	94.47	15.32	229.15	<LOD	<LOD
695	ppm	40.832233	-111.77216	SB8	59.22	<LOD	133.68	<LOD	<LOD
696	ppm	40.83134	-111.77233	SB9	88.09	<LOD	169.98	38.79	<LOD
697	ppm	40.830006	-111.77232	SB10	87.95	<LOD	199.84	40.12	<LOD

Table 1. Samples collected and analyzed by Amin Hamidat in 2017.

SAMPLE #	pb ppm	sb	cd	as	LATITUDE	LONGITUTDE
S1	29.1	0	0	14.57	40.833434°	-111.772393°
S2	144.85	0	30.84	19.45	40.833399°	-111.772218°
S3	19.65	0	28.12	0	40.833327°	-111.772307°
S4	64.13	36.18	0	17.15	40.833504°	-111.772168°
S5	15.9	39.13	0	0	40.833327°	-111.772307°
S6	62.58	0	0	11.96	40.833441°	-111.771689°
S7	37.7	55.61	40.95	9.9	40.832668°	-111.772207°
S8	95.22	0	23.96	0	40.832069°	-111.772155°
S9	37.86	0	30.28	0	40.831560°	-111.772314°
DATA FOR TREASURE BOX MINE - Sampler-Zach Fredrickson						

Table 2. Samples collected and analyzed by Zach Fredrickson in 2016.

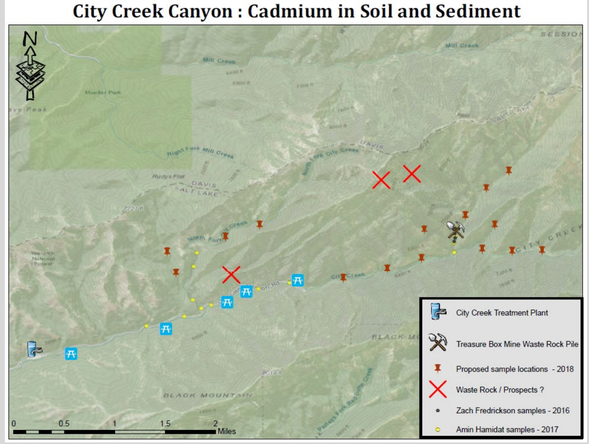

Figure 1. Map of upper City Creek Canyon, along with points of interest and sample locations.

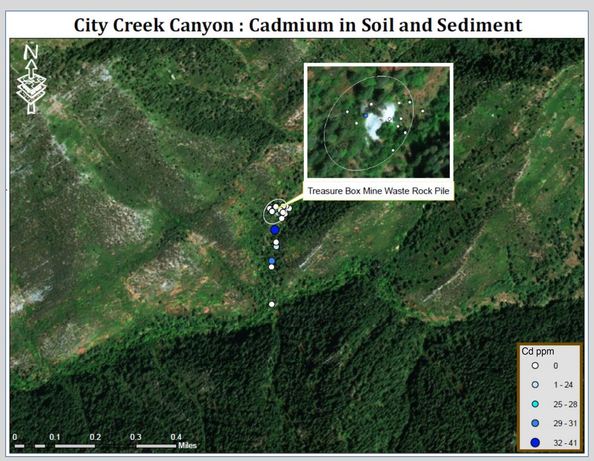

Figure 2. Satellite image of Cottonwood Gulch within City Creek Canyon, with sample points and cadmium findings in parts per million.

Discussion

Lead

Results did not follow any consistent pattern as it was found in all soil samples in varying concentrations. Considering lead was found in all samples, it is safe to assume that its presence is uniform throughout the canyon.

Antimony

Antimony was found in three samples taken by Antimony was below levels of detection in all 2017 soil samples analyzed. Analysis yielded no detectable levels of antimony in any sample.

Arsenic

Arsenic was found in only 2 samples, one at the North fork confluence and the other at the Treasure Box mine waste rock pile (Table 1). The confluence sample was above the camper screening level at 21 ppm (Table 1). Neither of the detected levels are congruent with samples taken around them, resulting in an inconclusive arsenic intrusion.

Cadmium

Cadmium was found in previous studies within Cottonwood Gulch (Table 2). During my 2017 sampling seesions soils analyzed did not return any cadmium levels.

Conclusions

- ➔ Sampling further north of both forks is required to yield conclusive evidence to the canyon's impairment.
- ➔ The large system of mining is poorly documented, leaving for for the possibility of other waste piles existing north of City Creek beneath the soil.
- ➔ The 2017 sampling session resulted in all metals of interest being below levels of detection for all samples regarding cadmium.
- ➔ Cadmium is not mined on its own and is a product of lead, zinc, and copper extraction (Lenntech, n.d.).
- ➔ Since no finds pertaining to the metals of interest were found, I believe the next step to take would be to follow up on the zinc and copper levels detected.. Sampling around these areas upstream from where they were taken could yield higher readings of these metals and lead to a source also releasing cadmium (Table 1).

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