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## Determination of Lead Content in Sidecar Coffee

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# Determination of Lead Content in Sidecar Coffee

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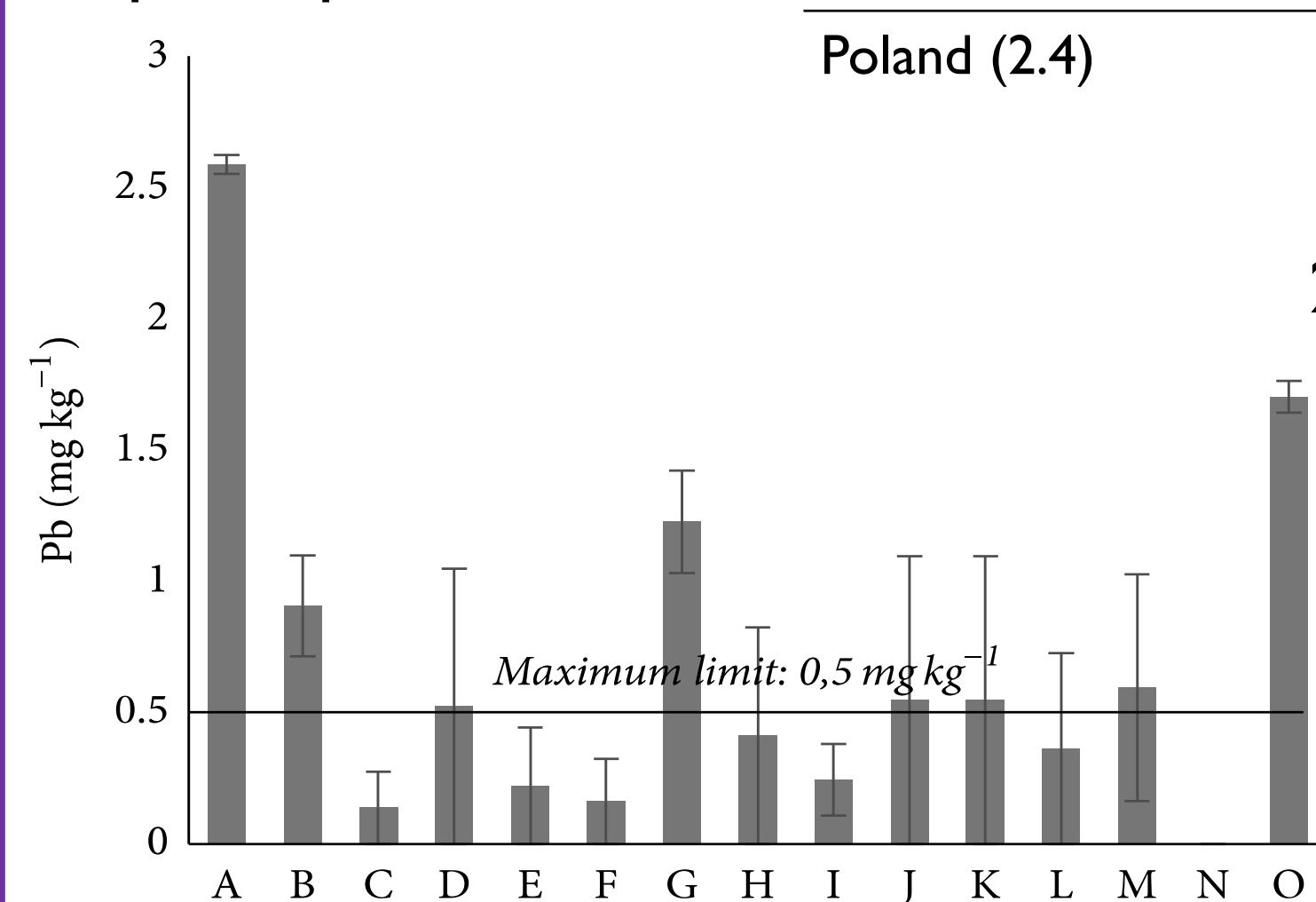


## Background

- Lead intake is a concern with coffee since 400 million cups are consumed daily in the United States<sup>1</sup>
- Too much lead intake can cause many health problems<sup>2</sup>
- Other research has shown that many types of coffee are contaminated with lead<sup>3,4</sup>

1. This study shows that lead intake from coffee was exceptionally high per capita<sup>5</sup>

Country-coffee consumption (kg/capita/year)	Lead intake (mg/capita/year)
Bosnia and Herzegovina (6.1)	4.76-7.56
Brazil (5.8)	3.59-5.13
Lebanon (4.8)	3.33
Poland (2.4)	1.48-2.43



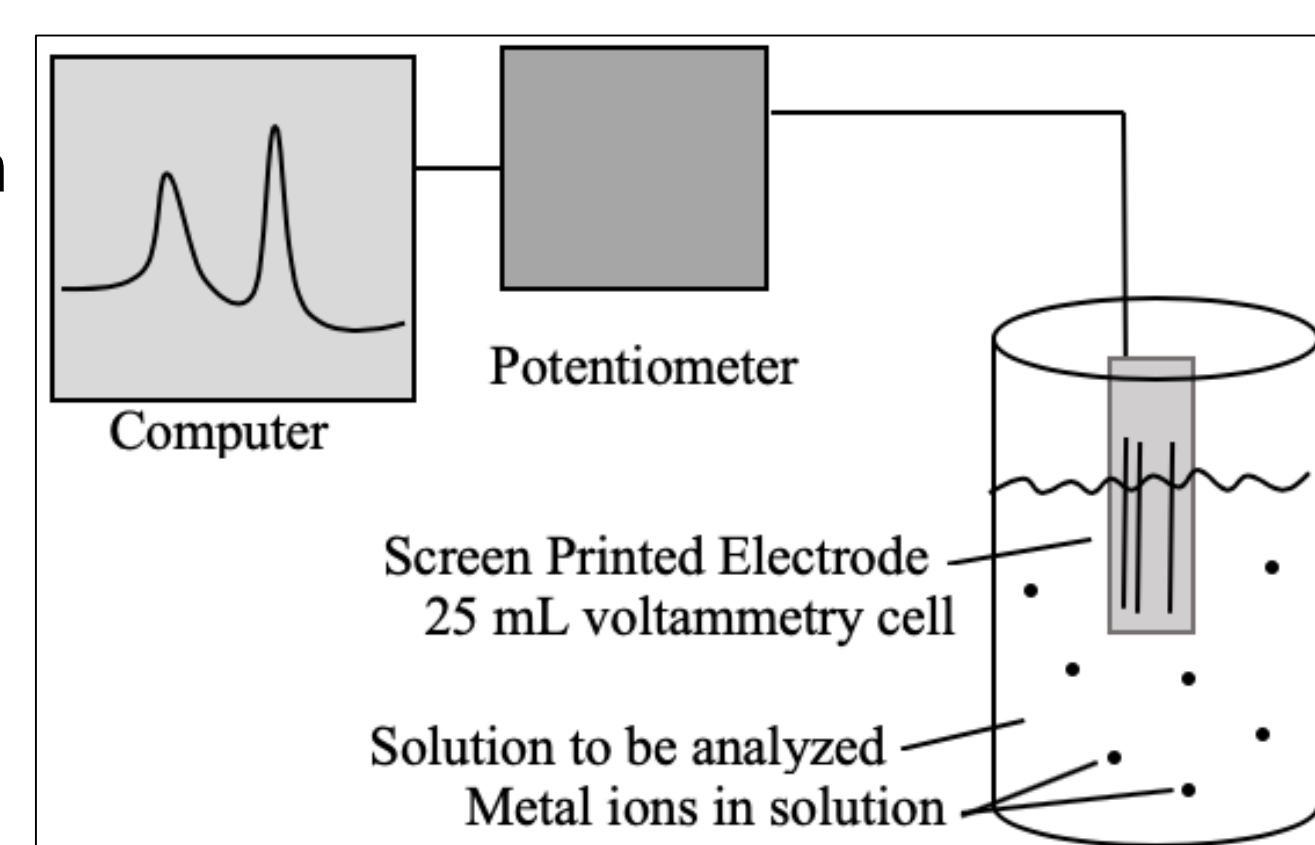
2. In this study from Brazil, 8 out of 15 coffees tested had lead levels above legal limits<sup>6</sup>

- Sidecar Coffee Roasters in Waterloo, IA partnered with us to determine the amount of lead in several different coffees originating from El Salvador, Peru, and Burundi
- The information obtained in this study is crucial for the company and the consumer to know the quality of the coffee that is served

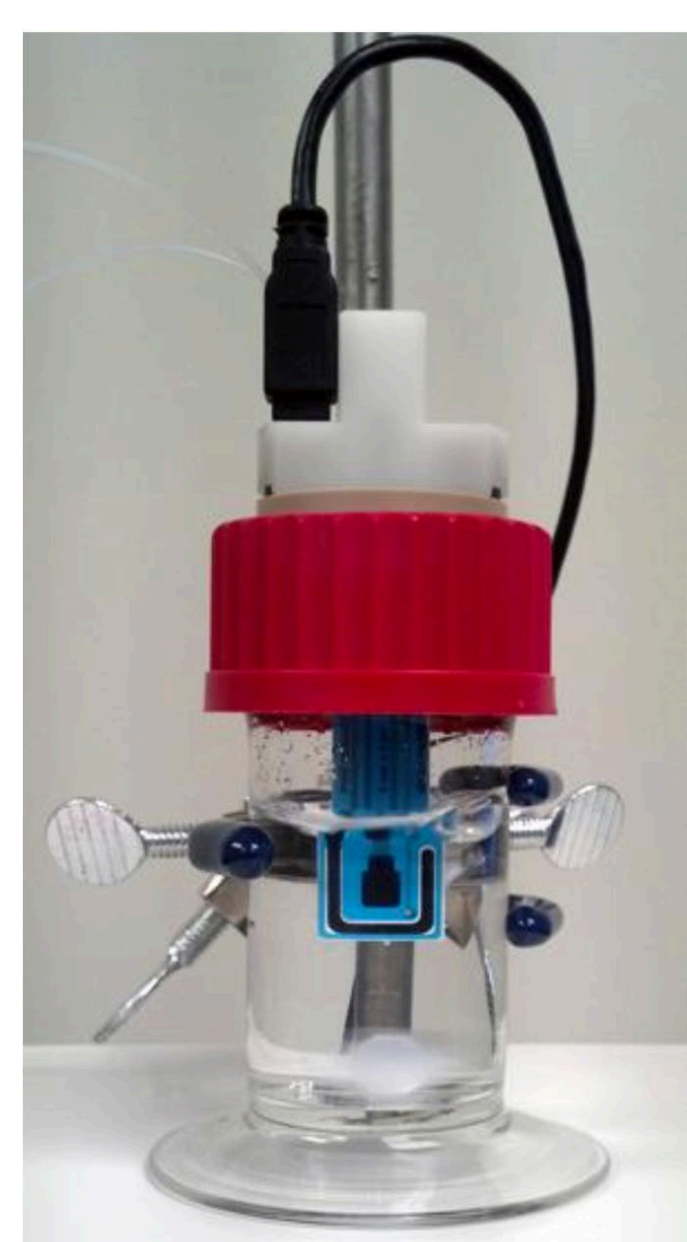
## Instrumentation

### Anodic Stripping with Differential Pulse Voltammetry

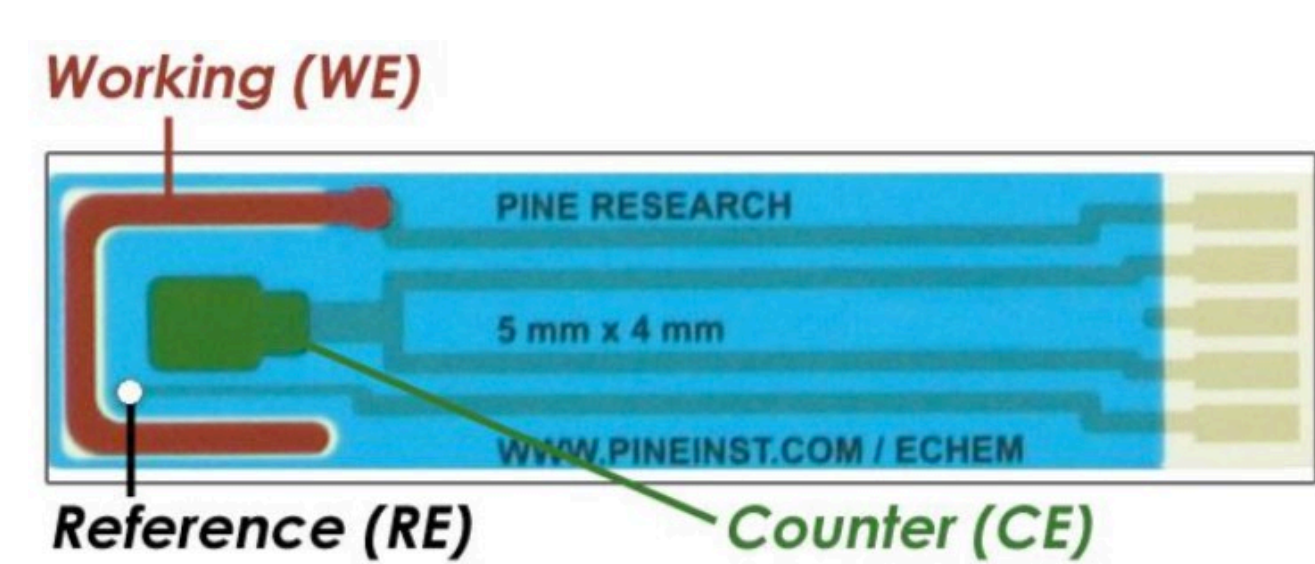
- Benefits:
- High sensitivity in ppb range
  - Simple preparation
  - Straight forward analysis



Basic diagram of Instrument



Voltammetry Cell<sup>7</sup>



Screen-Printed Electrode<sup>7</sup>

### Hg Deposition

- A mercury acetate and HCl solution is used to deposit a thin layer of liquid mercury droplets onto the electrode
- With the electrode in this solution, a negative potential is applied



- These liquid mercury droplets greatly increase the surface area of the electrode

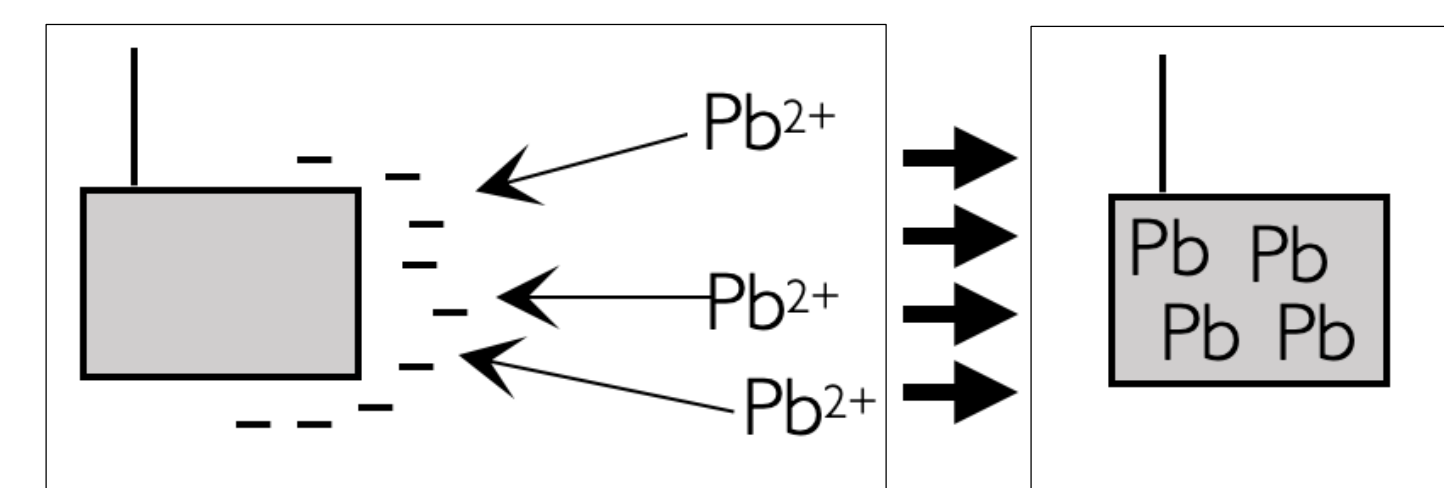
## Instrumentation cont.

### Pre-Treatment

- Samples were prepared with sodium acetate buffer to facilitate extraction, dissolution, and stabilization of lead in solution, as well as to help negate the matrix effects in the solution
- This process allows all lead in the sample to be converted into its aqueous form

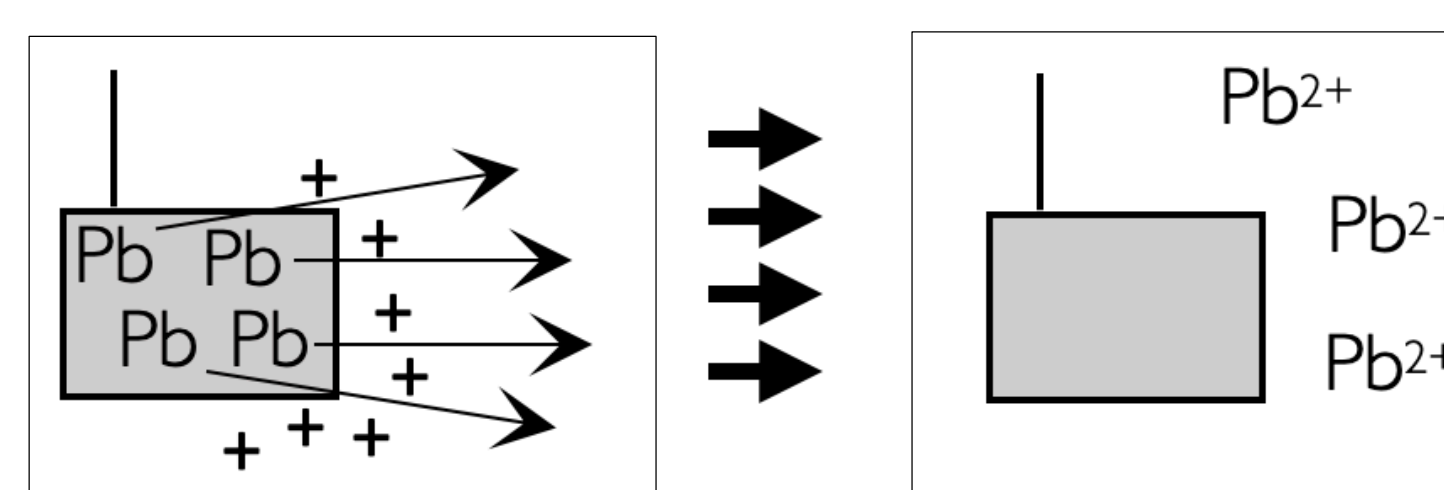
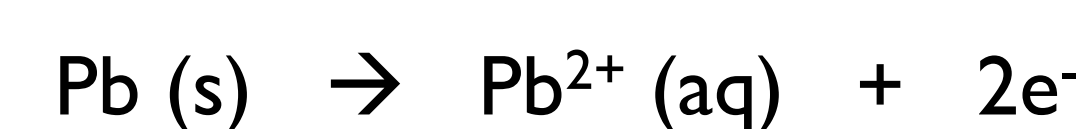
### Pre-Concentration (Enrichment)

- A negative potential reduces and deposits lead on the electrode



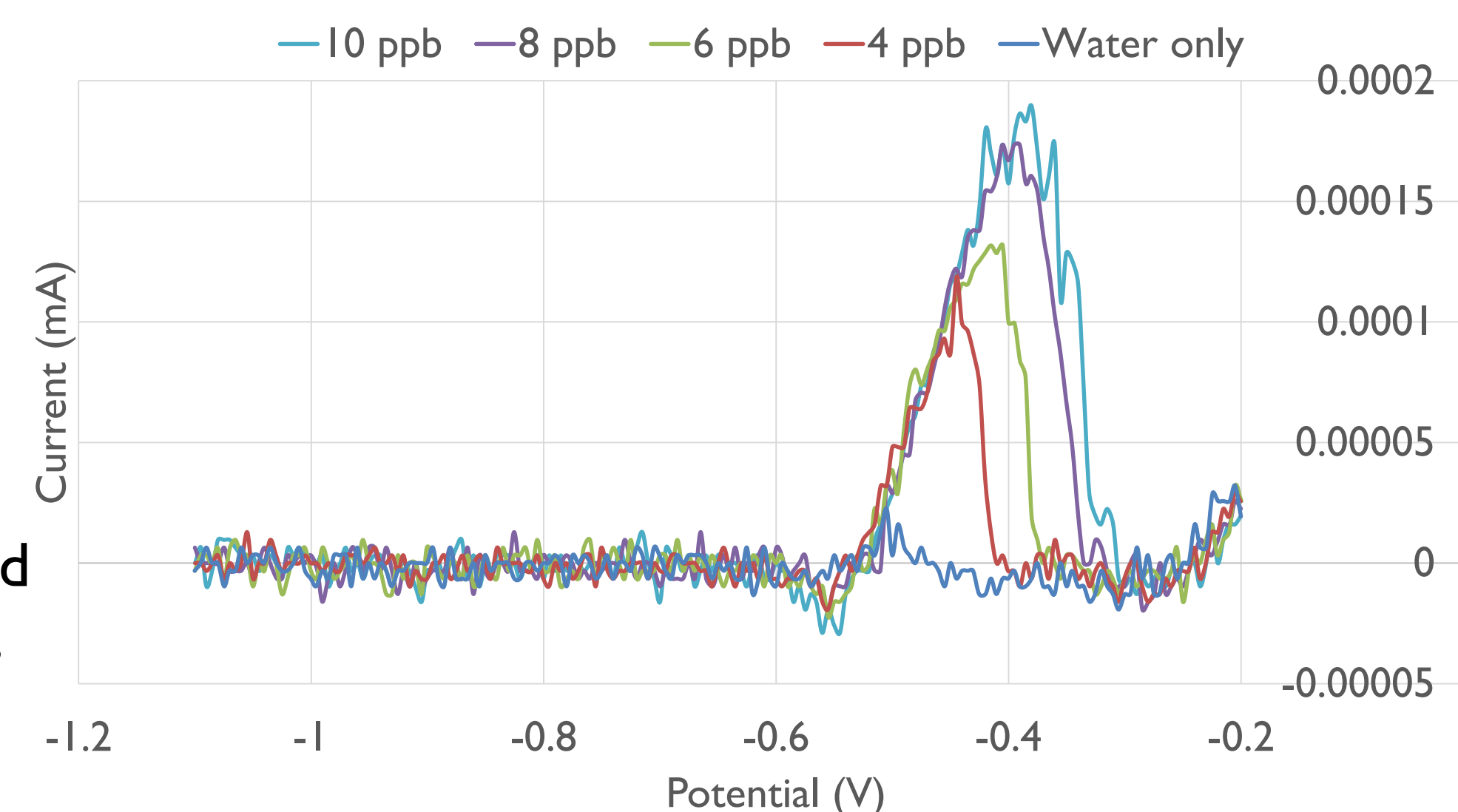
### Anodic Stripping (Differential Pulse)

- A sweep from negative to positive potential is applied to oxidize the lead



### Water

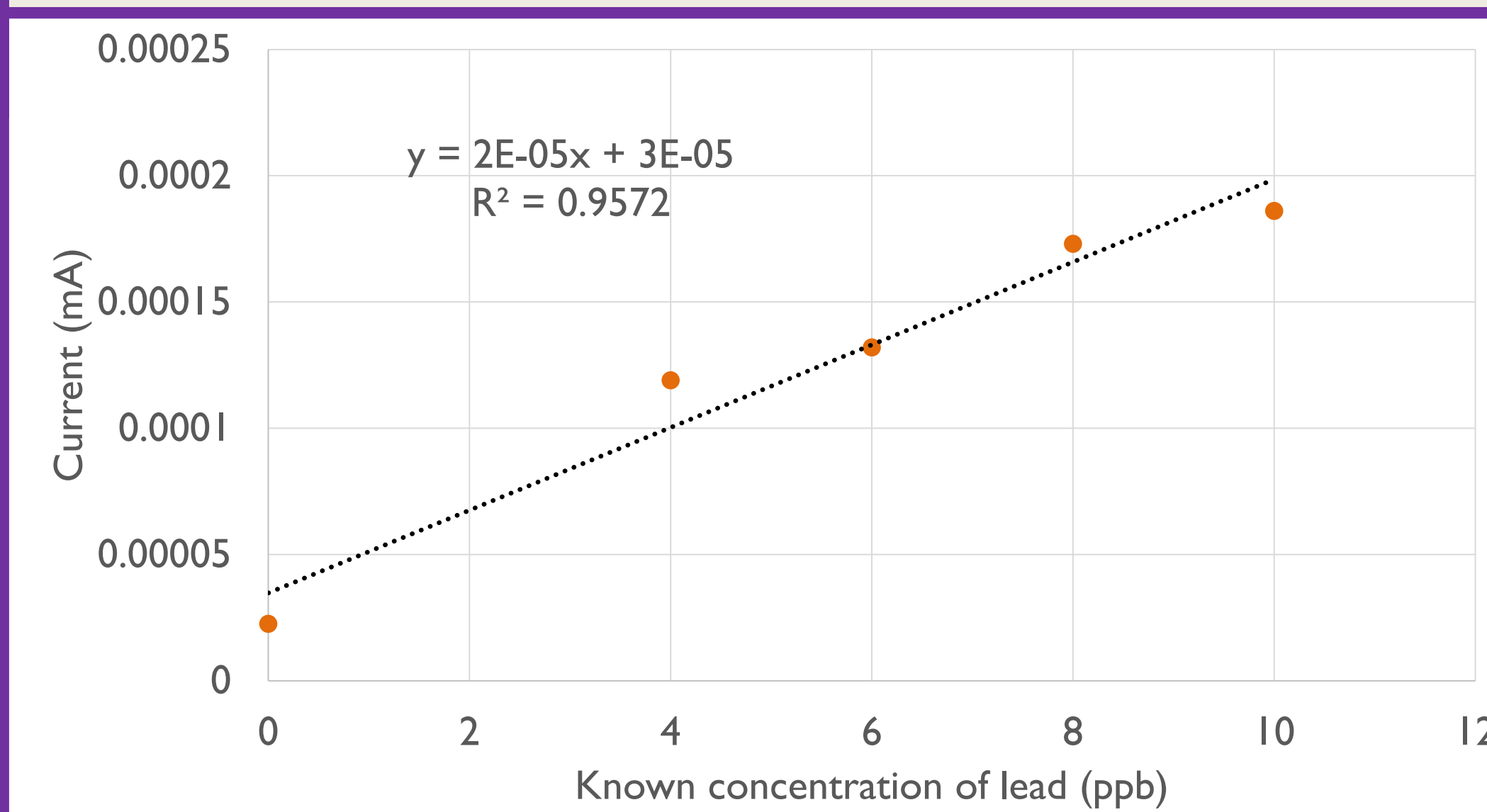
- The water that was used in the coffee samples was tested with successive additions of lead solution



### Coffee Preparation

- 5 g of ground green coffee soaked in 100 mL of water for 1.5 hours
- Mixture filtered and used for analysis

## Results

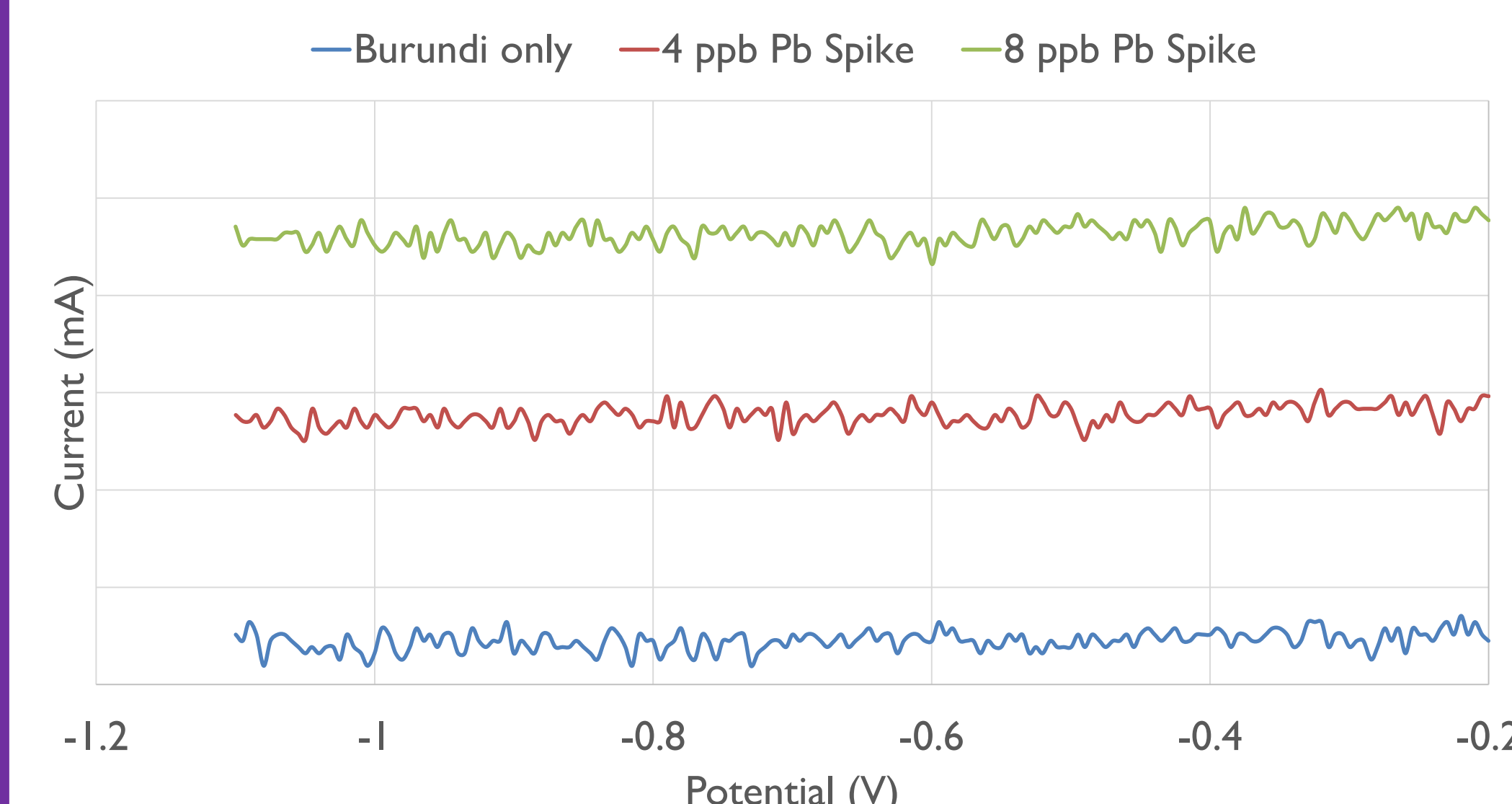
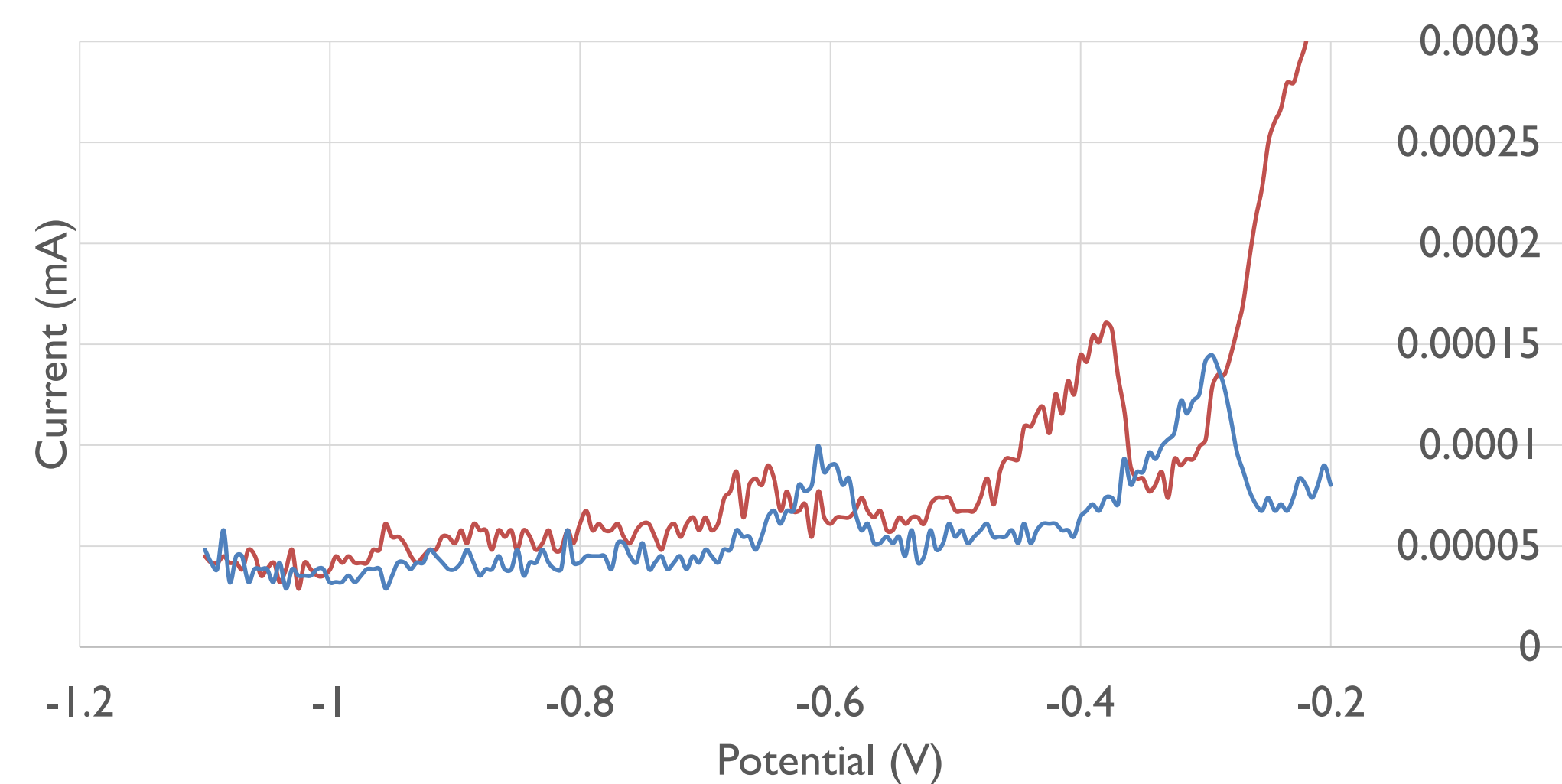


### Water Analysis

- Peak current for each trial was plotted
- Equation for best fit line was solved for the untreated water
- Result showed approximately 1.5 ppb lead in the untreated water

### El Salvador Sample

- Unknown peaks were examined by spiking with known amount of lead
- After the spike, a clearly separate peak appeared for the lead
- This sample has no lead peak initially

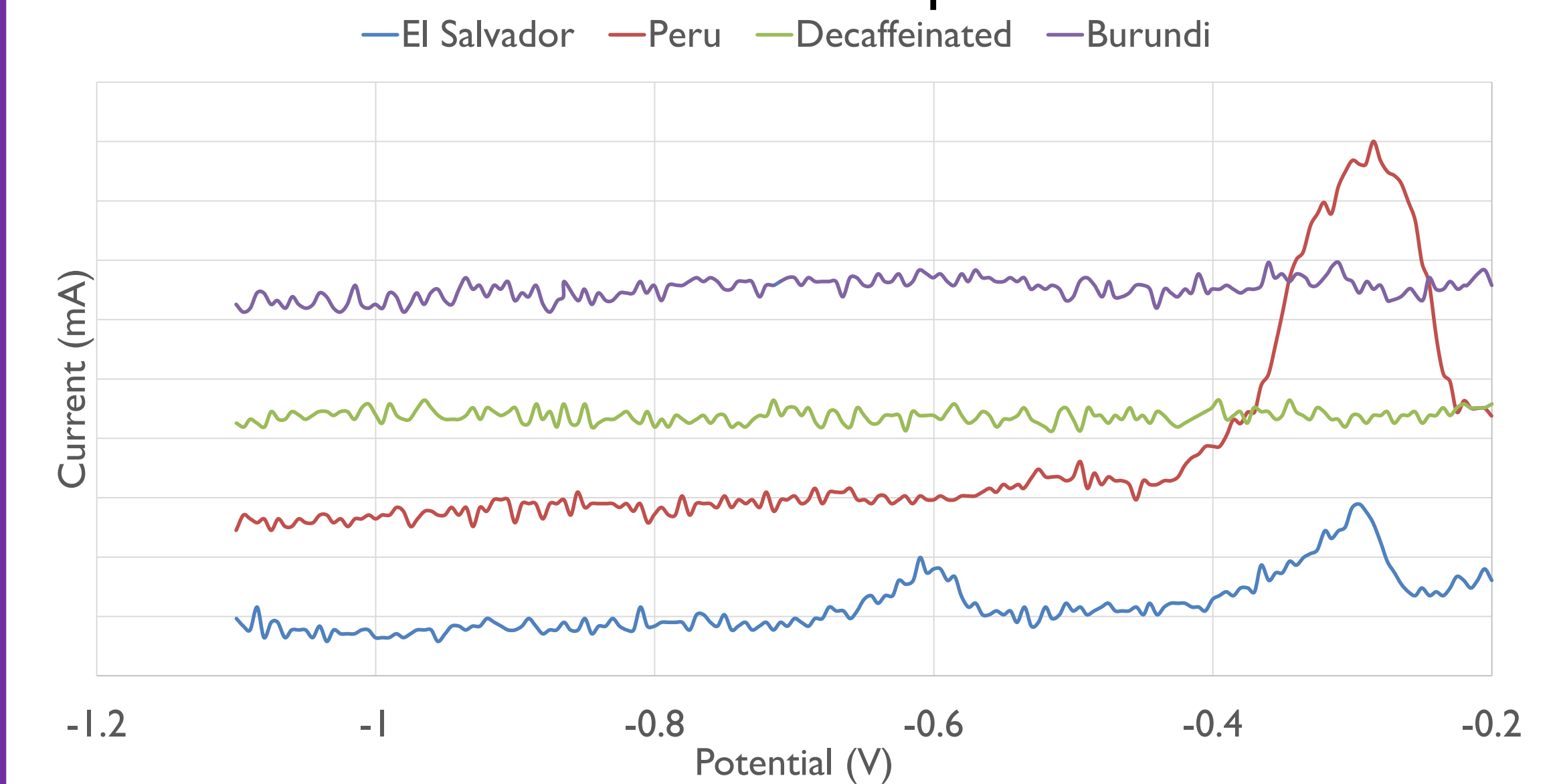


### Burundi Sample

- There was suspicion that the electrode was damaged since lead spikes caused no difference
- It was assumed that the electrode was damaged by the sample
- Similar results occurred for the decaffeinated sample

## Discussion

### All Coffee Samples



- Lead peaks appear around -0.5 V. The height and width of the peak is dependent on the amount of lead present
- The peaks at -0.3 V and -0.6 V in the Peru and El Salvador samples are not lead and are thought to be copper and nickel, or possibly iron
- For the Burundi and Decaffeinated samples, the electrode oxidized because these samples are much more dense than the other two samples, the oxidative effect of the other materials in the sample rendered the electrode useless

## Conclusion

Trial	Sample	Lead Content
1	Double Distilled Water	1.5 ppb
2	El Salvador Coffee	Less than 1 ppb
3	Peruvian Coffee	Less than 1 ppb
4	Decaffeinated Blend	Undetermined
5	Burundi Coffee	Undetermined

- The results show that there is no concern for lead in the El Salvador or Peruvian coffees
- As for the Burundi and decaffeinated blend, no results were able to be determined due to oxidation of the electrode

### Future Work:

- Research other potentially toxic metals in the coffee, such as arsenic and cadmium
- Use a more reliable method, such as ICP-MS to give a definitive answer to metal content
- Continue to research all of the coffees at Sidecar for their metal contents

## Acknowledgements

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- Sidecar Coffee Roasters
- Jordan Smith
- University of Northern Iowa – Department of Chemistry and Biochemistry

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