

Analysis of Polar Volatile Organic Compounds in Grave Soil by Solid Phase Microextraction with Gas Chromatography Mass Spectrometry (SPME-GC-MS)

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ABSTRACT

The purpose of this research project is to determine polar volatile compounds (VOCs) in soil surrounding bodies during human decomposition. The current literature on decomposition analysis focuses on compounds non-polar in nature and many of the preconcentration methods used in the analysis target nonpolar volatile compounds. Our hypothesis is that the polar organic compounds such as organic acids may be present in decomposition odor and play a significant role in the uniqueness of human decomposition. Additionally, these polar compounds such as organic acids may appear in different stages of decomposition due to the breakdown of fatty tissues. The study of formation of these compounds may provide useful insight on 'odor of death' at different stages of decomposition. Human Remains Detection (HRD) dogs are the most used method for finding human remains and some dog handlers use artificial training aids known as pseudo scents when real human remains are not available. Another goal of this research is to determine the polar VOCs in grave soil to determine the accuracy and efficiency of the synthetic training aids that are currently in use. In this current research, volatile organic compounds in grave soil are preconcentrated using a polyethylene glycol (PEG) SPME fiber and analyzed by GCMS. The soil samples are collected from around decomposing bodies at different stages of decomposition from WCU FOREST facility. Current results confirm the presence of polar organic acids which agree with previously reported studies. Additionally, our results show that these polar compounds are predominantly found in soil samples at later stages of decomposition.

INTRO / GOALS / OBJECTIVES

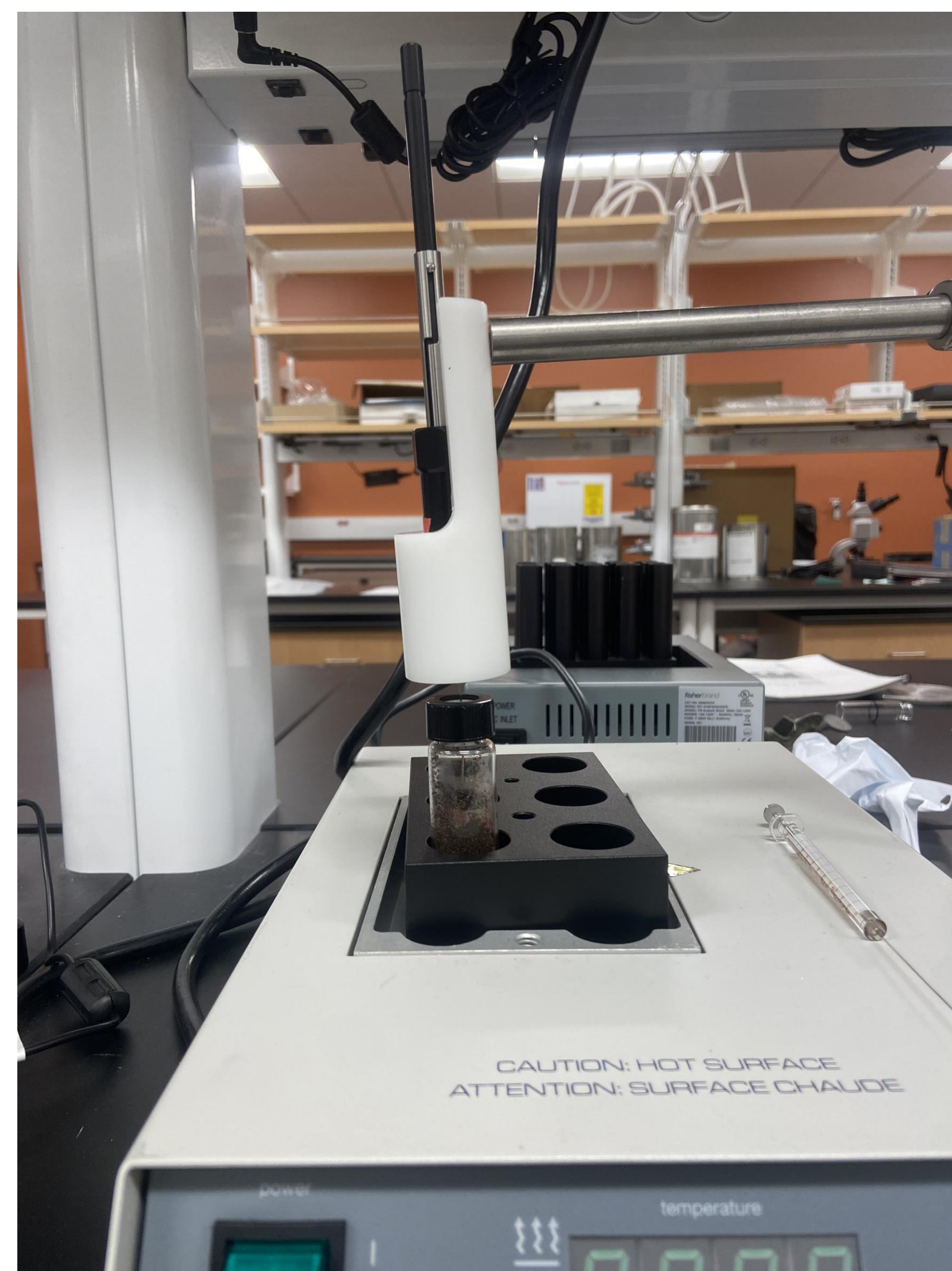
Human decomposition is a natural process that involves the breakdown of tissues after death. While the rate of human decomposition varies due to several factors, including weather, temperature, moisture, pH, oxygen levels, cause of death and body position, all human bodies follow the same four stages of human decomposition.

Human Remains Detection (HRD) Dogs are trained to specifically find the odor of decomposing human remains. HRD dogs are trained to ignore live human scent and animal scent and indicate only on human remains. HRD dogs can be used to find human remains related to crime scenes, missing persons cases, small scent sources, and natural or man-made disaster events

The goals for this project include determining the polar VOCs effect on the "odor of death" and to determine the accuracy and efficiency of artificial training aids.

METHODS

Approximately 5g of soil is collected from the soil around the body of a decomposing body and is placed into a sealed vial with a septum. The vial is heated to 50°C and a PEG SMPE fiber is exposed to the soil to preconcentrate the organic compounds for 30 minutes. The fiber is then removed from the vial and inserted into the GCMS for analysis.

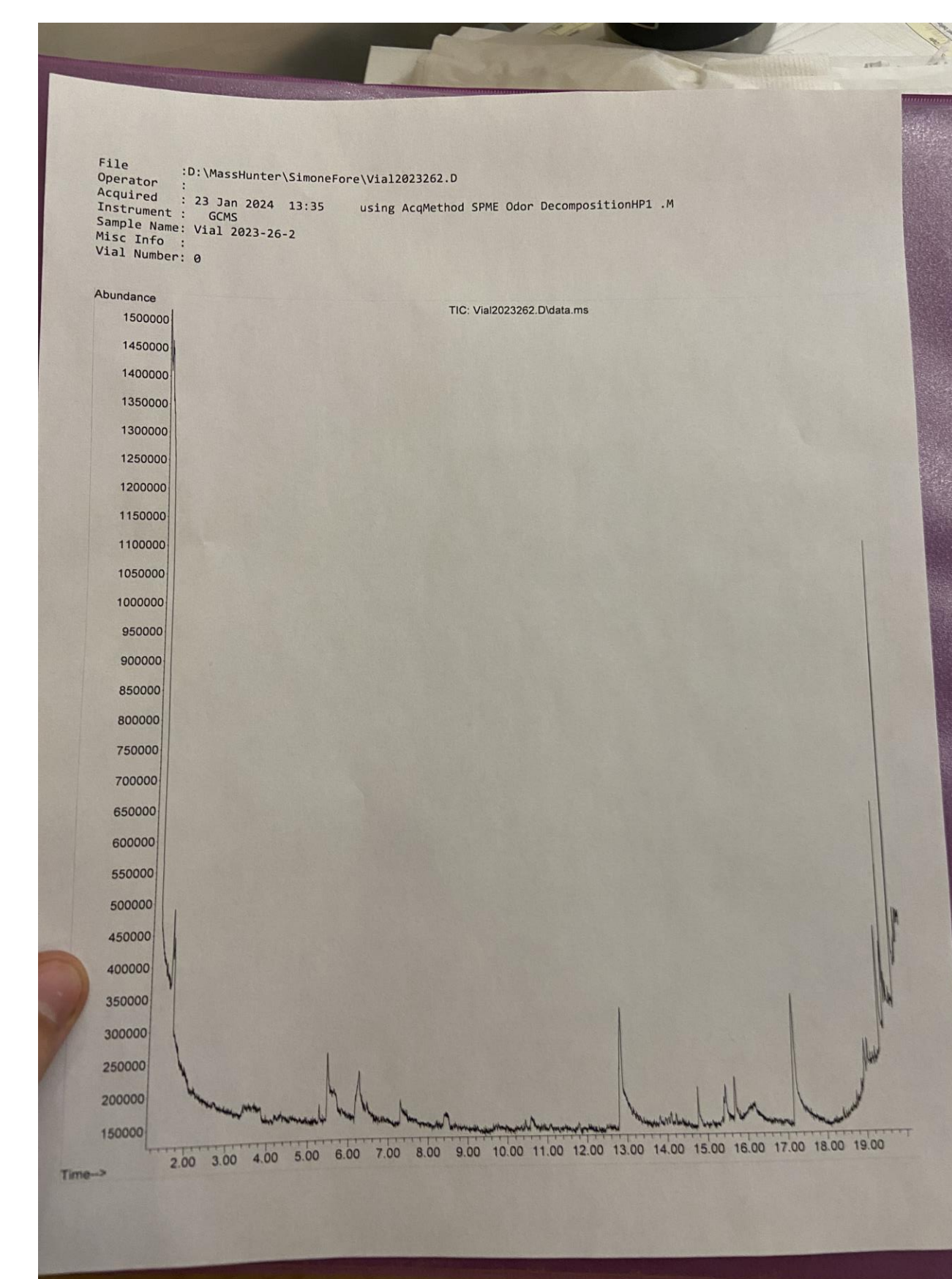


This photo shows the set up for how the vials of soil are heated with the SPME fiber for preconcentration

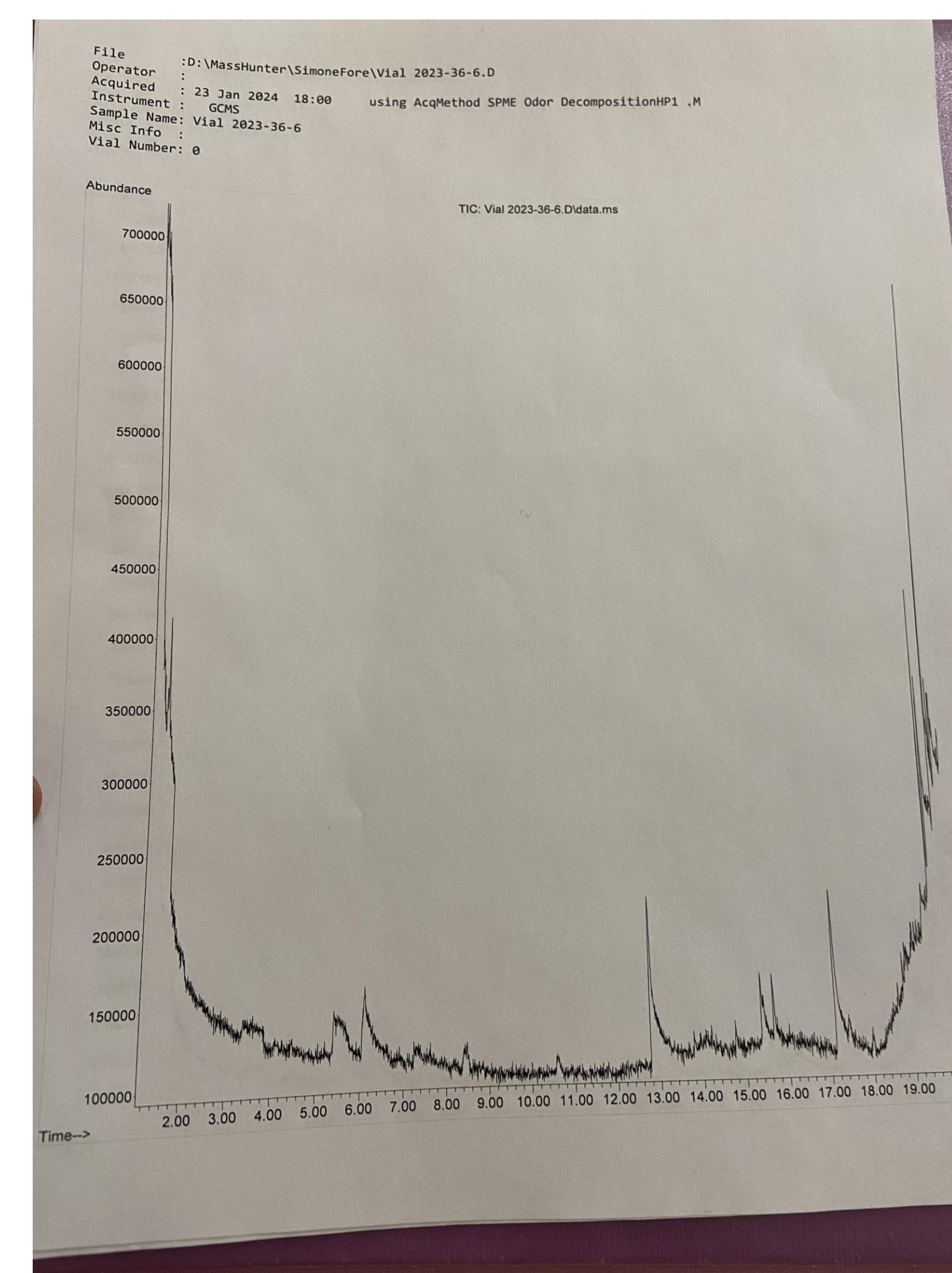
RESULTS

Chromatograms of soil taken at different times from the same decomposing body show differences the farther along in the decomposition process. When a body is farther along in the decomposition process, there are more organic acids present in the chromatogram than earlier in the process of decomposition, since the fatty tissues have to decompose for the compounds to be found.

Chromatogram of Early Stage of Decomposition



Chromatogram of Later Stage of Decomposition



CONCLUSIONS AND RECOMMENDATIONS

The data shows that the farther along a body is in the process of decomposition the more polar compounds will be found in the chromatogram.

Recommendations include:

- Exposing the fiber to the soil for longer times at higher heats
- Testing the artificial training aids and comparing with chromatograms of soil
- Testing soil from different donors at the same stage of decomposition

References

1. <https://www.aftermath.com/content/human-decomposition/>
2. <https://sdoa.org/human-remains-detection-hrd.html>

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