



Code Cracking: Who Murdered The Somerton Man?

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Each student at Level IV in the School of Electrical and Electronic Engineering is required to complete a final-year design or honours project. The course involves approximately 300 hours of project work over the whole academic year. Students are assessed on their performance in the project, the quality of their outcomes, two progress reports, a final report, two seminars and a project exhibition.

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Supervisor: Prof. Derek Abbott, Dr. Matthew Berryman

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Executive Summary

Somerton man case is a very famous unsolved case in Australia which related to an unidentified dead man on Somerton beach. The aim of this project is to find out new clues about Somerton man case. Besides, through researching this case can expend the knowledge for data analysis, code cracking, engineering statistics and digital forensics.

The spectral hair analysis is the main method in my project to find out new clues. Through burning and scan hairs extracted from Somerton man and six other different students (control samples), the hair data with respect to elements content can be recorded separately. Then the hair data comparison between Somerton man and control samples will be processing. Finally, the differences derived from comparison can provide some information about the man's living conditions before death.

This research will involve an unknown study area for Somerton man case and put forward new reasonable assumptions based on hair analysis. This unknown area is that the hairs are tested on quartz plate instead of glass which can contribute to more accurate results.

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1 Introduction

1.1 Background

This project is based on an unsolved murder case that happened on the 1st of December 1948. At 6:30 am of that day, a man was found dead on Somerton beach. This dead man carried with no identifications and his teeth were not matched with any known person, so he is called Somerton man. After postmortem, the coroner picked some information from this dead man, such as the heart was of normal size and the death time was around 2 am of the found day. Besides, the coroner figured out that approximate three to four hours before death the man ate a pasty as meal which Pathologist Dr. Dwyer suggested some poisons causing the man's death. But the pasty should not be the source of poison through further researching. Finally, the coroner could not tell any conclusion about this man's identity or cause of death and the dead man's body was buried in Adelaide's West Terrace Cemetery in 1949. It became one of the Australia's most fascinating cold cases. [2][3][9]

For continuing study, a plaster cast of Somerton man was made in 1949. The hairs which were extracted from Somerton man plaster cast and other six different students are used for spectral analysis. [8] Hairs data is recorded by Inductively Coupled Plasma Mass Spectrometer (ICP-MS) and this instrument is effective for micro-sampling of solid material for trace elements and the analysis of predominantly cation. [1] For collecting data, the hairs were burned by laser. Then, the instrument measured the levels of different isotopes and the relative values of elements. After testing, the comparison for experimental results between Somerton man and six other different students will be processing.

1.2 Motivation

This project aims to provide some useful clues which are derived from hairs spectral analysis for solving this cold case. Even if the case has happened for decades, it is not been forgotten. The residents still would like to see the case is resolved. In addition, this project can expand the knowledge for data analysis, code cracking, engineering statistics and digital forensics. In fact, this dead man was suspected to be a foreign spy due to his unknown identity. So, it is meaningful for country security as well.

1.3 Previous Studies

In addition to police men's investigation, there already have several academic studies. Prof. Derek Abbott has worked on this case for more than 2000 hours. [8] His team took the hairs from Somerton man's plaster cast and recorded elements data by ICP-MS. Since 2009, it had become a final project for the University of Adelaide students and some students participated this project. In 2013, the project group plot some Somerton man's hair elements relative value figures and compared with control samples. [5] They have analysed the differences between Somerton man's hair and control samples. However, those hairs' data were all got from glass test. In this project, we redo the analysis based on the data that got from quartz test. In addition, we will compare those two different data figures. However, the new data should not be compared with old directly due to different drift values. The new data will multiply a constant which is got from the glass test remainder that is a bit rest of Somerton man's unburned hair. Besides, the different year of plasters needed to be considered as well.

1.4 Objectives and Methods

- Understanding the hair biology knowledge and some related chemical knowledge.
- Hair mass spectral experiment: hairs were burned by laser. Then, the instrument measured the levels of different isotopes and the relatively values of elements. The scan speed of mass spectrometer was 5 micrometers per second. The scan length of each control sample was 1000 micrometers, so the method length was 230 seconds including 30 seconds background. The scan length of Somerton man's hair was 6054.6 micrometers and the method length was 1240.9 seconds including 30 seconds background as well. In this experiment, all the hair test will be processed on quartz plate.
- Experiment results analysis: For a healthy person, the hair growth rate is approximate 0.4 millimeters per day [6]. So we can get about 2.5 days information of control and 2 weeks information of Somerton man before his death. All the experiment data is plotted by Matlab and the plotting figures are listed in Appendix A. Then, the comparison between Somerton man and

control samples will be processing. The comparisons are focus on the different elements content in hair which can provide some useful information about living and healthy conditions.

- Put forward some reasonable assumptions and new clues: Based on experiment data analysis, some reasonable assumptions needed to present. These assumptions can be related to some activities before his death and expand research scope. The new clues should be depending on reasonable assumptions.
- Validation of assumptions and clues: clues and assumptions needed to be verified through researching.

1.5 Structure of this Report

The rest of the report will talk about the middle work result which includes the list of elements and some comparison figures. After that, it is going to write the project management which contains timeline, budget and risk management. Then, drawing the conclusion of this project. The Gantt Chart of project timeline will be attached on the end of this document.

2 Middle Sections

2.1 Rate of Progress

The hair data was recorded by mass spectrometer. The data is got from glass test. There are 44 elements gained by laser ablation (shown in Table 1). Three of these elements are needed to be mentioned. The first one is Sulfer (S7) which must exist in human's hair. The value of Sulfer can be refered to the drift value of environment. The second one is Lead (Pb206), the high level of Lead is harmful for human health. The third one is Strontium (Sr88). This element has high percentage in Adelaide's soiled compared with other areas. So, the analysis of the change tendency of Strontium's value will provide uesful information about somerton man's living environment before his death.

Table 1 Elements table

These elements gained by laser ablation of hair mass spectrometer				
Li7	Ca43	Cu65	Zr90	Hf178
B11	Sc45	Zn66	Mo95	Au197
Na23	Ti47	Ga71	Ag107	Hg202
Mg24	V51	As75	Cd111	Tl205
Al27	Cr52	Se77	Sn118	Pb206
Si29	Mn55	Se82	Sb121	Bi209
P31	Fe57	Rb85	Te125	Th232
S34	Co59	Sr88	Cs133	U238
K39	Ni60	Y89	Ba137	

At first, the hair data of Somerton man was plotted by Excel (shown in Figure 1).

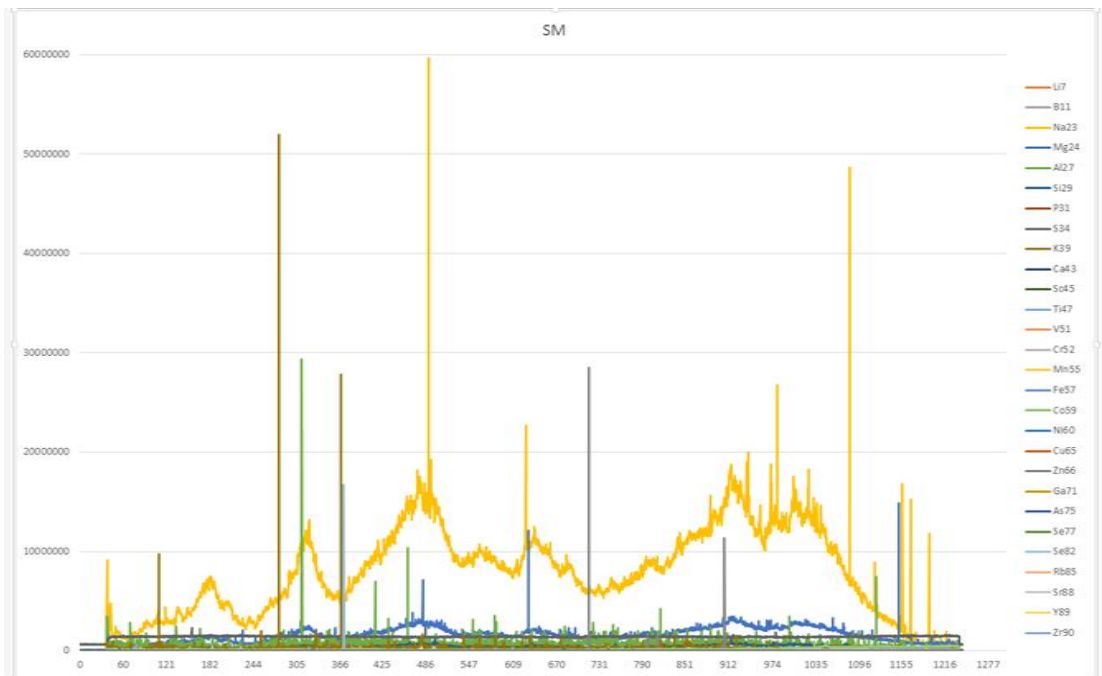


Figure 1 Somerton man's hair data

However, only 28 elements were shown on the chart. Some data was missing due to shortage of Excel. Besides, the elements are not clear except Sodium (Na23). Some traces are out of range and not obvious. Such as the bottom of this chart. So, these troubles result in the difficulties of contrast.

In order to solve these problems, the method is using Matlab to plot each element's content distribution. Figure 2 shows the Lead (Pb206) relative value comparing between Somerton man and control samples.

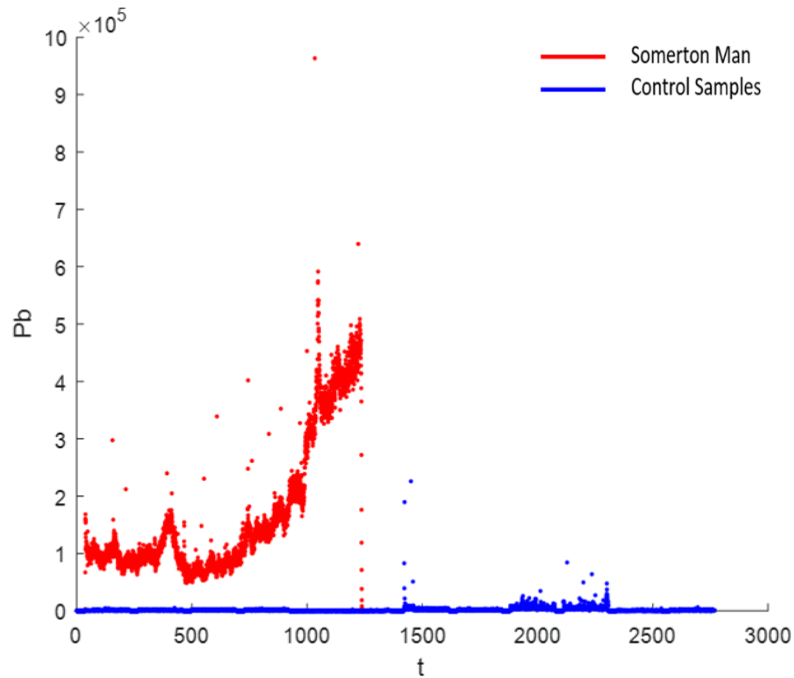


Figure 2 Lead Value Comparison

The X axis demonstrates the scan time of mass spectrometer. The Y axis demonstrates the relative value of Lead content. The mass spectrometer scans from the root of hair. So, the left of figure shows the most recent life of sample. There have found a very high level of Lead in Somerton man's hair compared with control samples especially the end of his hair. However, the Lead value has a visual reduction before his death. So, it can be affirmed that high level of lead was not the cause of his death. This study should focus on his living environment before death. We can search relevant materials to know some information about 1948. Such as the solid analysis, petroleum quality, water quality and nuclear power plant location.

All of the Somerton man's hair elements content figures have been plotted by Matlab (shown on appendix A). The comparison figures and the specific analysis will be done for next work.

2.2 Knowledge Gaps

This project will generate some new clues for the case of Somerton man. New clues can expand research scope and provide new information for continuing research.

2.3 Technical Challenges

The challenge is plotting figures by Matlab. This is a new skill for student.

3 Project Management

3.1 Timeline

The timeline Gantt chart has been attached in appendix B. It has listed the key milestones of the project (shown in Table 3).

Table 3 Key Milestones of The Project

Time	Milestones
Semester A	
Week 1	Research Methods
Week 2-3	Research Information
Week 4-5	Prepare Proposal Seminar
Week 6	Proposal Presentation
Middle Break	1 st Thesis Draft
Week 7-8	Plot Comparison Figure
Week 9-11	Analysis Glass Test Data Verification Viewpoints
Week 12	Semester A Performance
Week 13	Semester A Final Seminar
Semester B	
Week 1	Review
Week 2-3	Plot Comparison Figures
Week 4-5	Analysis Quartz Test Data
Week 6-7	Compare Glass Test and Quartz Test
Week 8-9	Final Report
Week 10	Project Exhibition Poster
Week 11	Create YouTube Video
Week 12	Final Seminar

3.2 Work breakdown

The key task for the project is plotting and comparing data figures. Then, finding clues from the comparison. Due to two group members have different study directions, the project work is individual.

3.3 Task allocation

The project has two directions. In general, two group members work on different specific tasks. This report devote to analyzing the mass spectrometer data of the Somerton man hairs. The other group member works on cracking code and writing software.

3.4 Management Strategy

To ensure finishing project on time, we have set the following strategies:

- Meeting with supervisors frequently
- Receiving effective feedbacks from supervisors
- Finish tasks without delay
- Communicate with group member frequently.

3.5 Budget

The project has 500 dollars budget but the software tools are open source in the University of Adelaide. So we do not need cost money on this project.

3.6 Risk Management

The risks of project are listed in Table 2. The first risk should be considered is misunderstanding project tasks. So, the well communication with supervisors is essential. For this report, the crucial task is plotting figures by Matlab. Matlab unavailable will have influence on project processing. However, the Matlab is available on the computers of university. So, this risk can be negligible.

Table 2 Project Risks

Risk	Likelihood	Rating	Risk Estimation
1. Group member absent	Rare	Low	Medium
2. Group members' communications failure	Unlikely	Moderate	Medium
3. Data Loss	Slight	Negligible	Medium
4. Task completion time delay	Rare	low	Low
5. Bugs in code	Likely	Moderate	Medium
6. Matlab Unavailable	Rare	Moderate	Negligible
7. Group member leaves	Unlikely	Negligible	Negligible
8. Lack of resources	Rare	low	Low
9. Misunderstanding project tasks	Slight	Negligible	Low

4 Conclusions

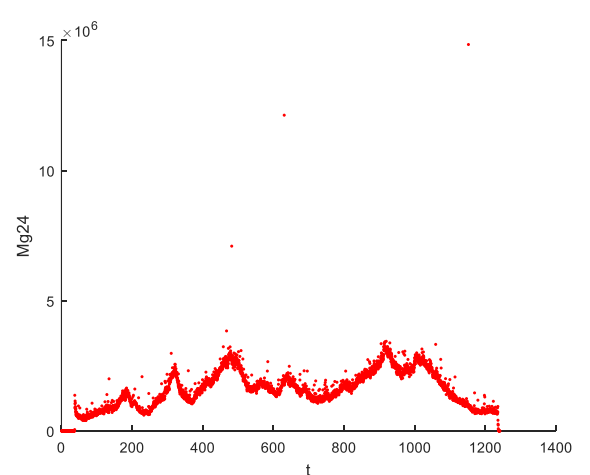
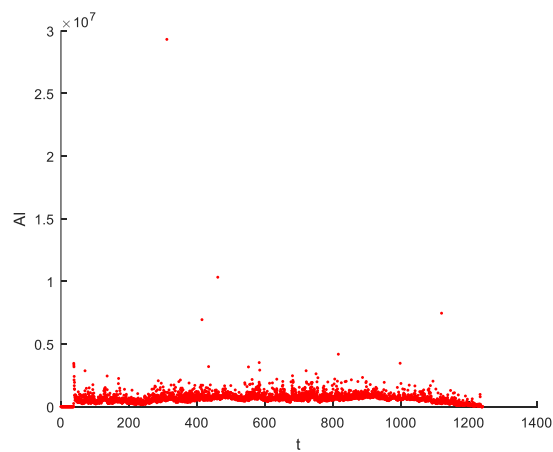
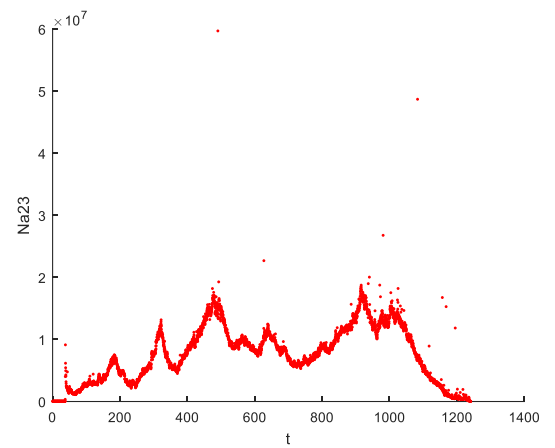
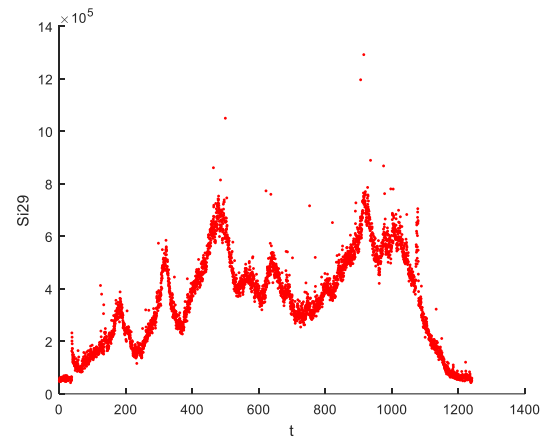
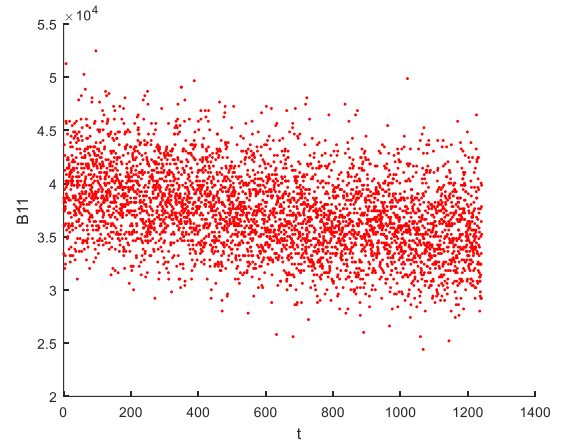
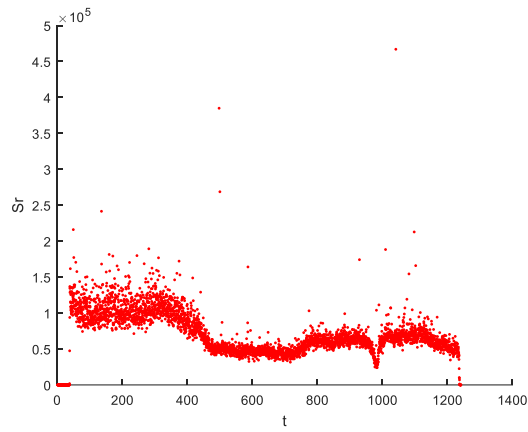
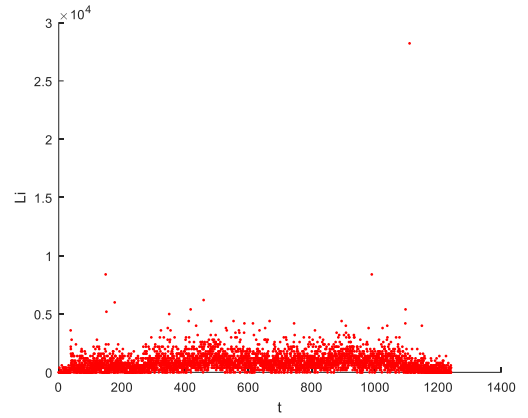
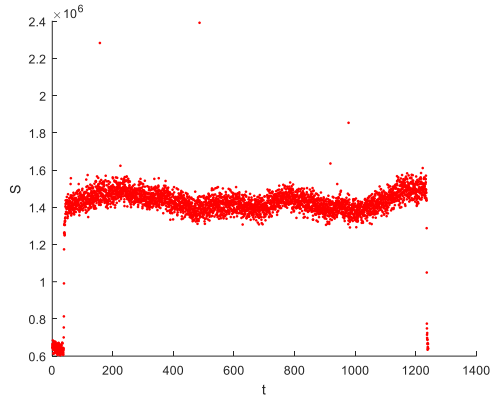
Depending on nearly two months research, I have confidence to complete the project on time. The literature review has provided some useful information for spectral hair analysis and living environment. The further data analysis and comparison will begin.

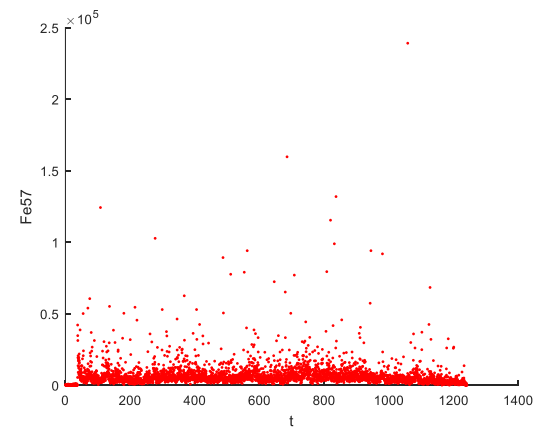
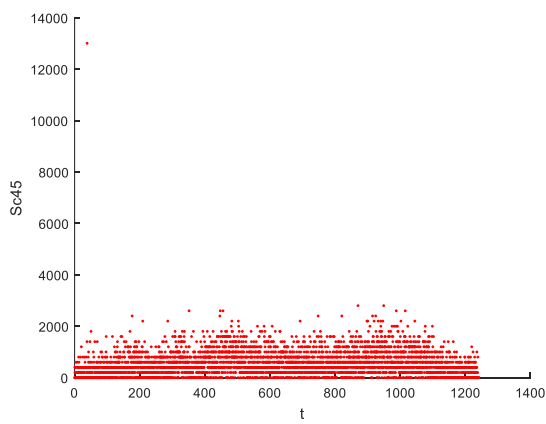
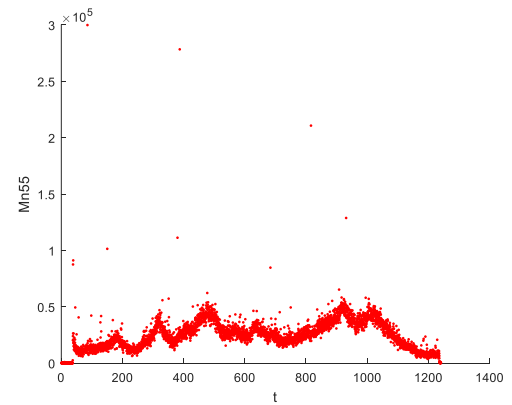
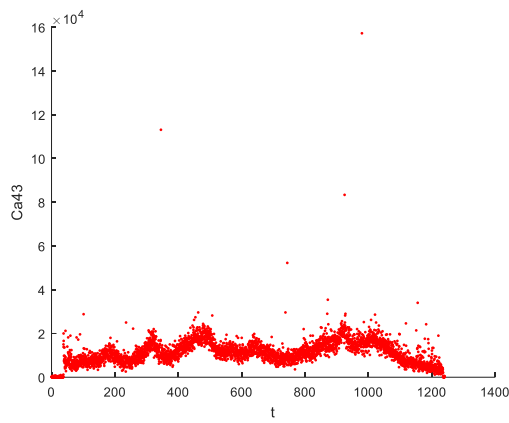
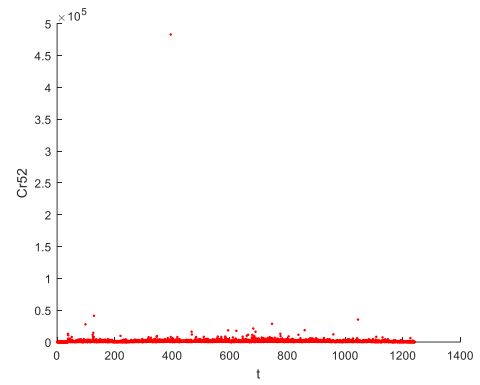
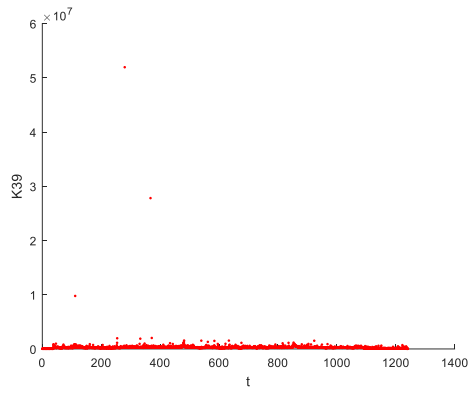
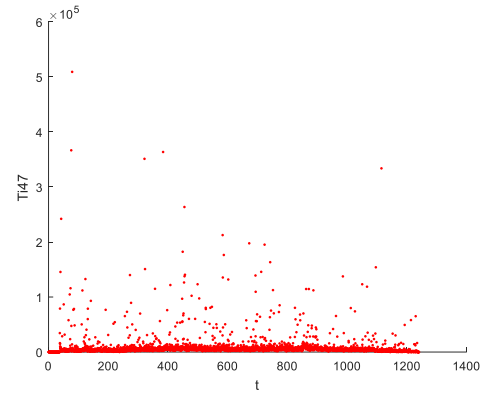
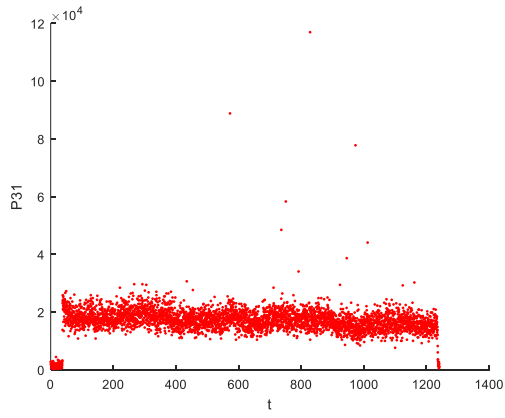
4.1 Future Work

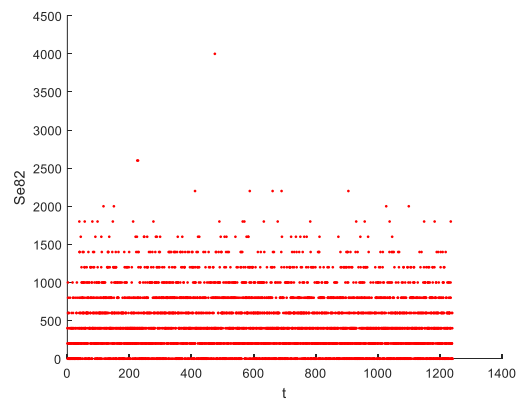
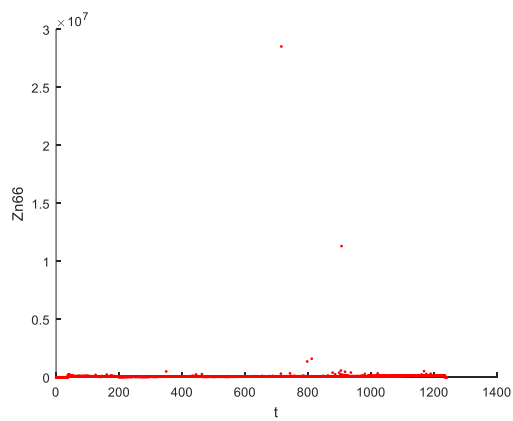
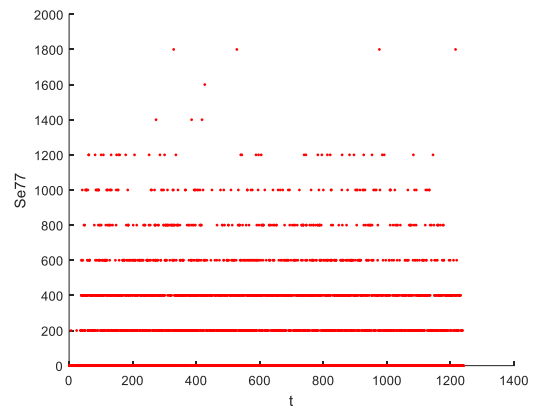
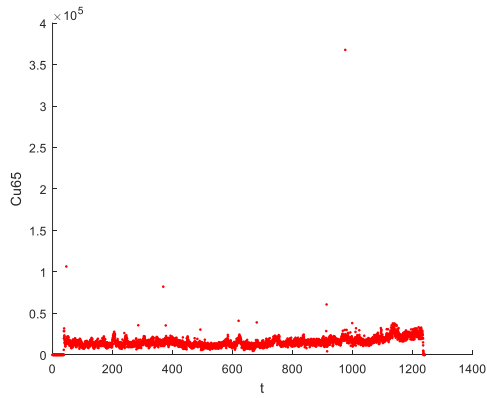
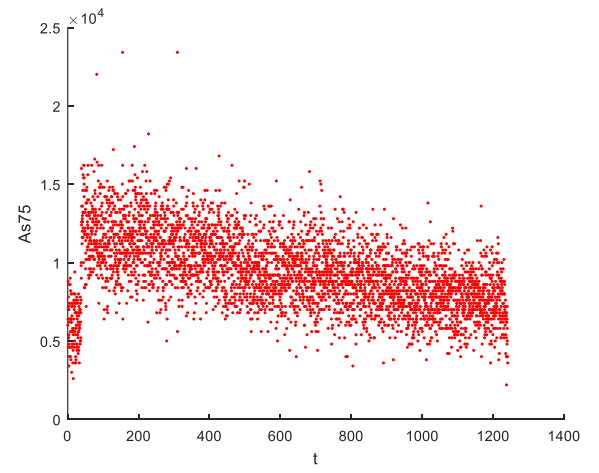
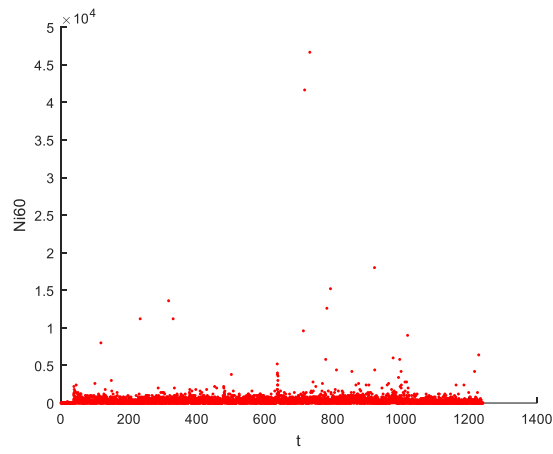
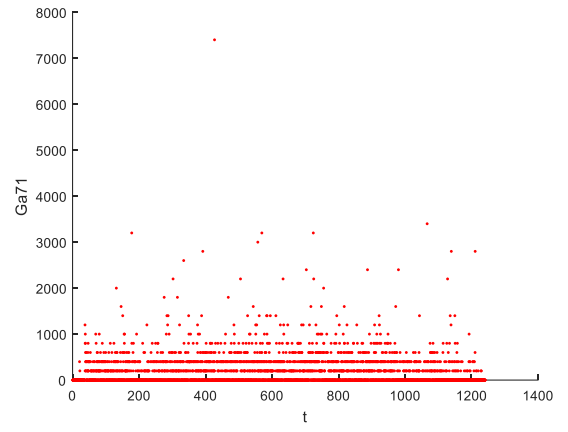
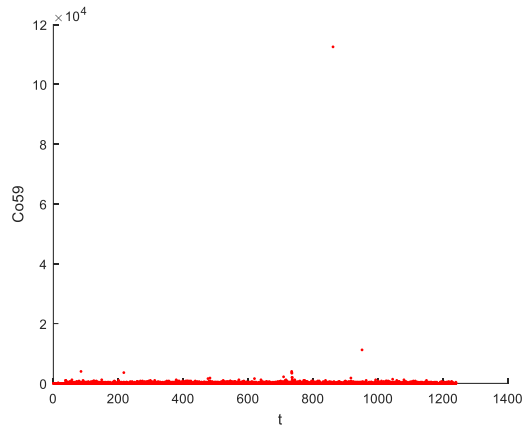
At this moment, Somerton man's hair elements data which got from glass test has been plotted. The future works as following:

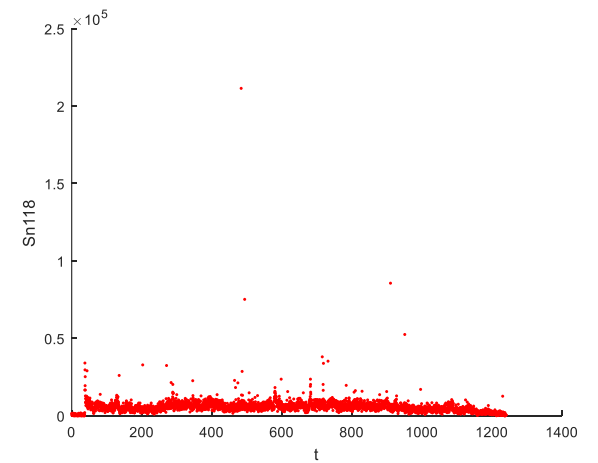
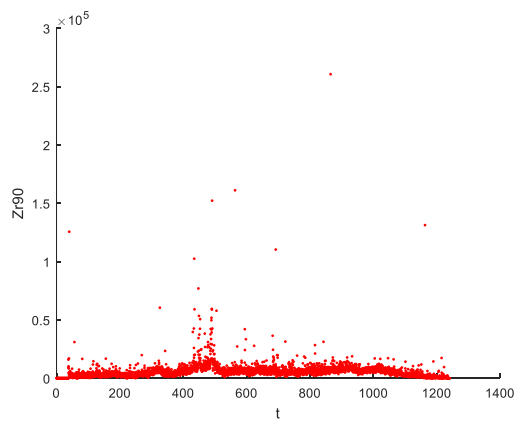
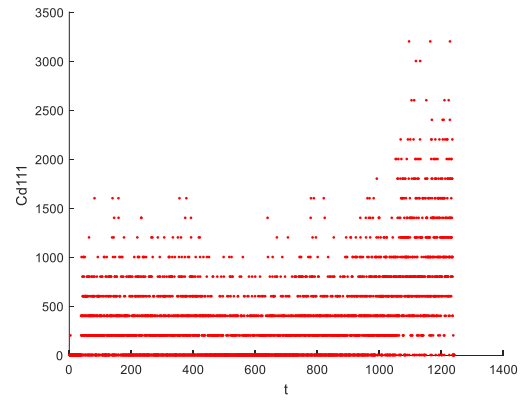
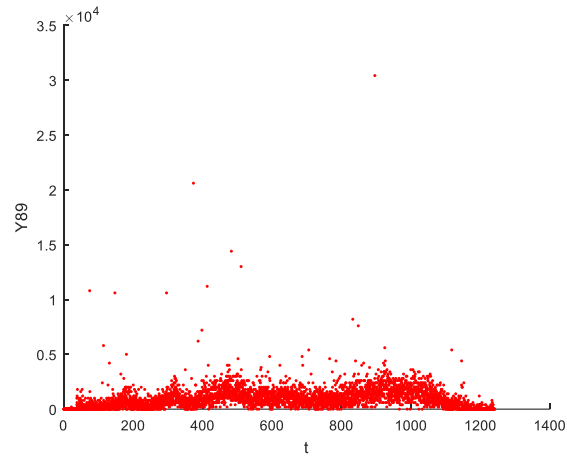
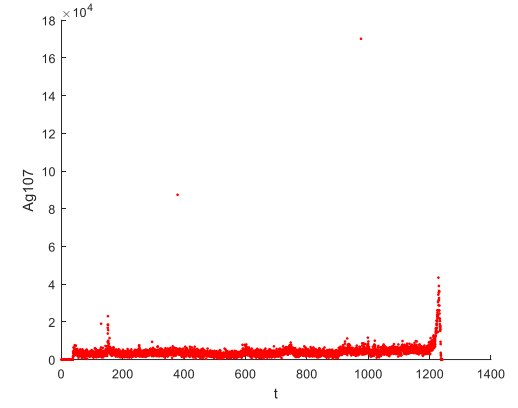
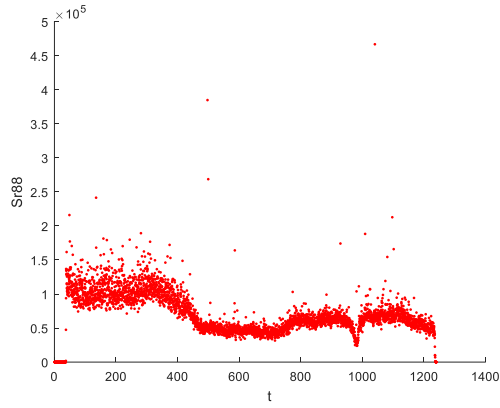
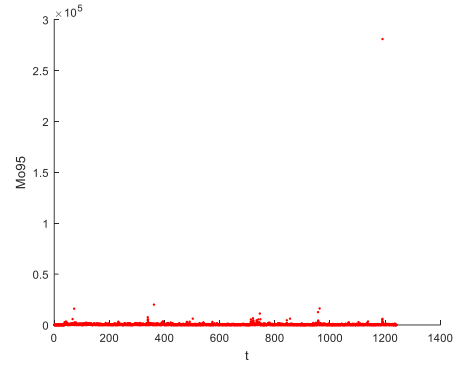
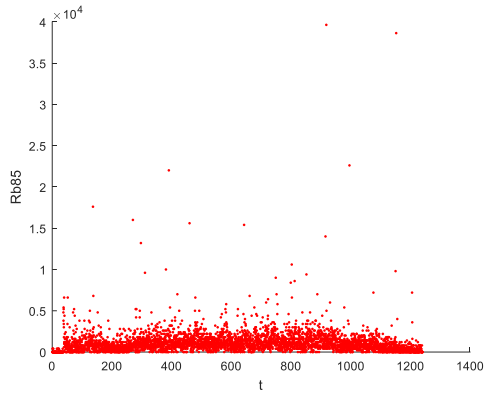
- Plot comparison figures
- Analysing the uncommon elements value of Somerton man's hair
- Find the Somerton man's living environment clues
- Plot quartz test data
- Compare the difference between glass test data and quartz test data

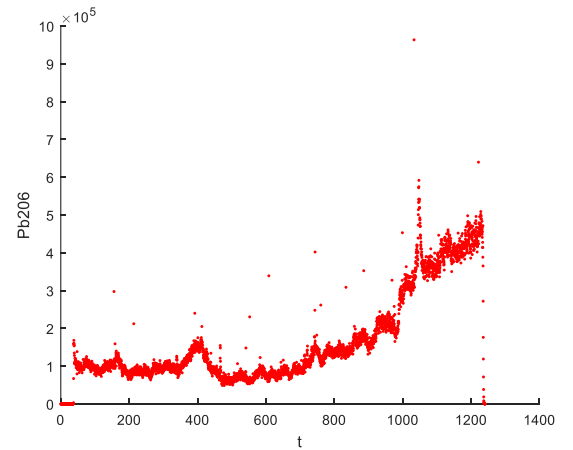
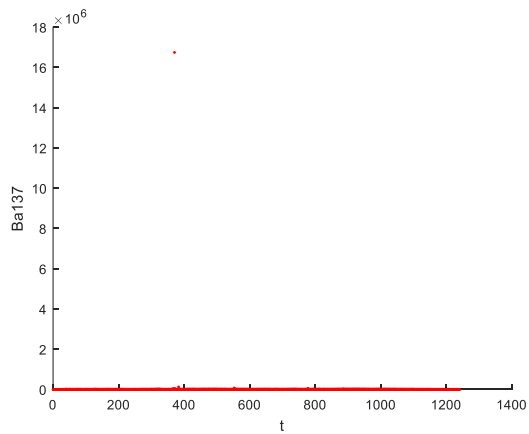
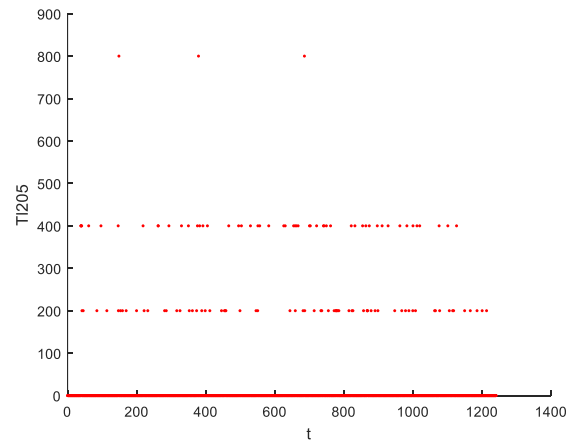
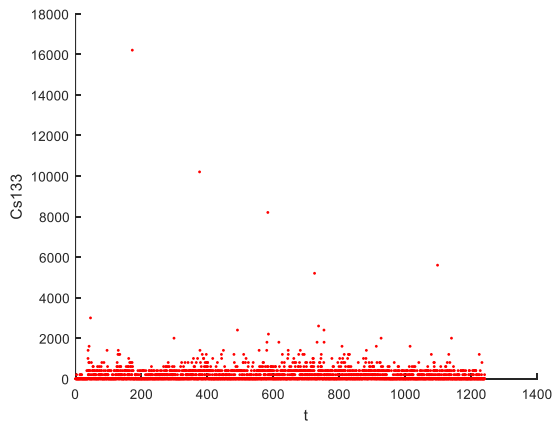
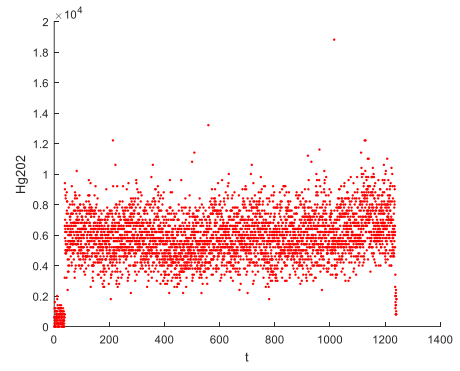
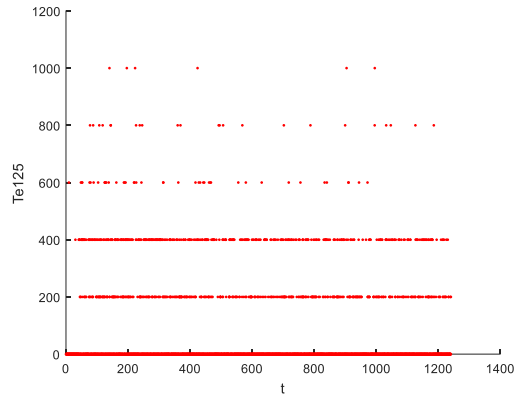
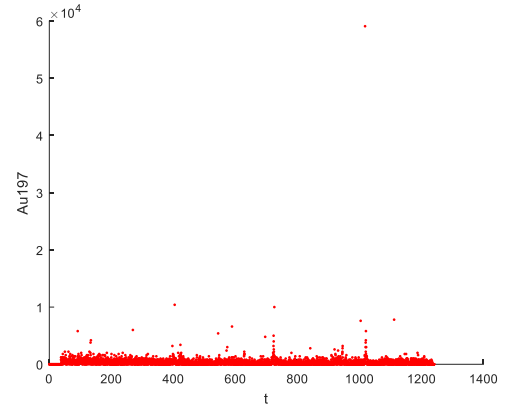
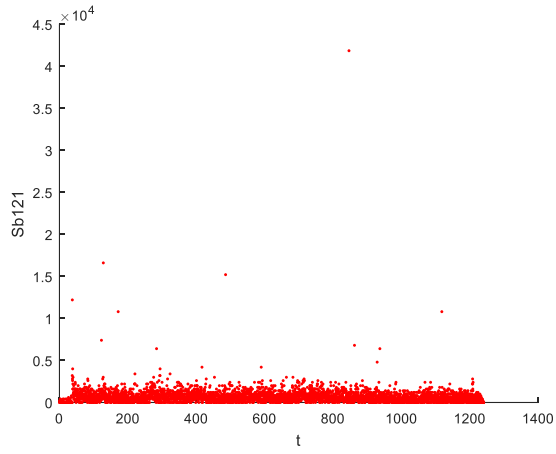
Appendix A: Elements Value Figures of Somerton Man's Hair

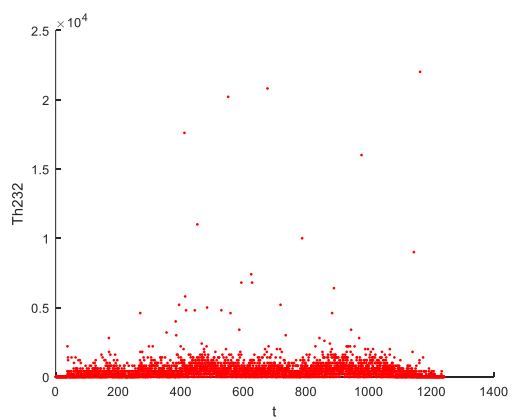
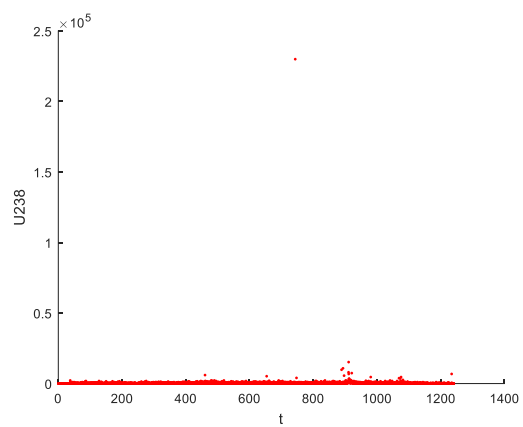
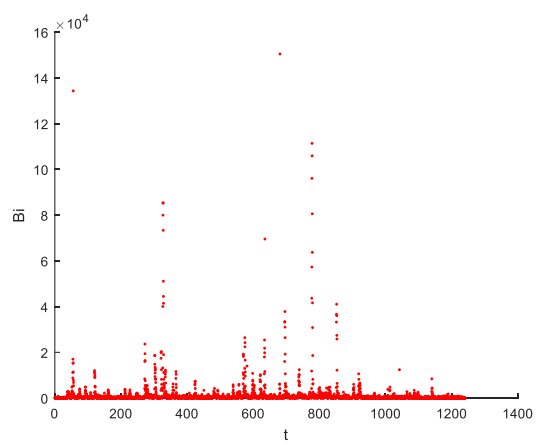












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Glossary and Symbols

ICP-MS: Inductively Coupled Plasma Mass Spectrometer