Project Krators, 17th August 2022.

Chemical Tests for Biomarkers

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1. DNA/RNA Testing.

- Biomarker we're looking for: DNA and RNA.
- I chose this because: Every living organism has this. If evidence is found, these life forms can be linked back to earth. DNA and RNA contain genetic information that can be extremely valuable and open up new avenues.
- Feasilibity is a question mark to me. I found devices and articles that perform real time DNA/RNA sequencing which can be a useful addition to our rover but expensive I believe. A device to be menitoned - minION developed by Oxford Nanotechnologies.
- Drawbacks can be that DNA can not be preserved for longer than 1 million years,we have to embark with the idea that life is already presented on Mars. We cannot be 100% certain that the life form would resemble earth's life form. Relatively unstable with hig cost of production.
- References: https://www.nature.com/articles/s41598-018-29334-5 https://alum.mit.edu/slice/genetic-testing-life-mars

2. Gas Chromatography

- Biomarker we're looking for: Organic matter/ gases.
- Gas chromatography is a common chromatography technique used to separate and analyze volatile chemical compounds which do not decompose. It is typically used to separate different compounds within a mixture or test sample purity
- I chose this because: this was present in Viking 1&2 as well as the curiosity rover sent to mars. Upon searching more, here are some advantages of using gas chromatography- analysis of a sample can be completed in the space of a few minutes, Wider sample choice, has a high degree of sensitivity.
- One disadvantage of the technique, however, is that it is limited to thermally stable and volatile compounds.

3. HPLC

- High performace liquid chromatography, HPLC can separate and detect each compound by the difference of each compound's speed through the column.
- Biomarker we're looking for: Organic matter/ gases.
- I chose this because: It looks like a highly improved form of column chromatography, as the speed of analysis is increased. It also delivers a higher resolution.
- This is an expensive method, has less efficiency than GC. HPLC pump process reliability relies on of cleanliness of the sample, mobile phase, and proper operation of the system.

4. Mass Spectrometry

- Mass spectrometry is an analytical tool useful for measuring the mass-to-charge ratio of one or more molecules present in a sample. These measurements can often be used to calculate the exact molecular weight of the sample components as well.
- It has been used to classify biological compounds, in particular proteins.
- The disadvantages of mass spec are that identifying hydrocarbons that produce similar ions is not very good and it is not able to separate optical and geometric isomers. The method fails to distinguish between hydrocarbons producing similarly fragmented ions.
- Usuallly combined with GC to give efficient results.

5. Matrix-Assisted Laser Desorption/Ionization

- Matrix-assisted laser desorption/ionization (MALDI) is a technique for soft ionization of mass spectrometry that uses a laser energy absorbing matrix to create ions from large molecules with minimal fragmentation.
- Fast and accurate but high cost of products.
- Used for many organic and microbiological application.