

## Subsurface Drilling and Chemical Analysis on Mars

### **Abstract**

In this article, we will cover in-depth how rovers like Perseverance drill core samples from the martian rock and the martian regolith, how they seal and store them securely inside the rover, and finally how we will analyze these core samples to reveal information on past life on Mars.

### **How Subsurface Drilling and Chemical Analysis will be used on Perseverance**

One of the primary examples of Subsurface Drilling on Mars is on the Mars 2020 rover. The plan is for the Perseverance rover to use its 7-foot robotic arm and drill 43 core samples from Mars. Perseverance will then store these core samples in the belly of the rover. Perseverance will then drop these sealed tubes filled with core samples on specified points on the Mars surface where in 2025 (projected) the ESA rover will come, pick up, and bring these samples home.

### **Why does Subsurface Drilling matter?**

First, it is important to learn why Subsurface Drilling matters. One thing is true, the instruments we fly to Mars are no match to what we have here on Earth. This is why it is essential to bring these samples back home. Here on Earth, we have instruments that are able to examine these samples on a nanoscale. By examining these samples and studying the stable isotopes like Oxygen and Hydrogen we will be able to figure out if there was water on Mars in the past. In essence studying these samples will enable us to learn about the history of Mars and past life if there were any.

### **How does Perseverance collect core samples**

On Perseverance's 7 foot arm is located 3 critical instruments that help the rover collect the sample. First is SHERLOC which helps in the detection of minerals, organic molecules and potential biosignatures on the martian surface. This tool helps us identify if Mars was ever inhabited and if not, why not?

Another tool that helps SHERLOC is WATSON which is a spatial color camera that provides detailed images of samples including texture and color.

Finally the Perseverance rover uses its onboard drill to drill the chosen rock and cache the drill sample into the underbelly of the rover.

### **Cleanliness**

During the development of the sample tubes and drilling equipment cleanliness was a big challenge that the engineers at JPL found, why? The goal of the mission which is astrobiology related was to bring back samples that tell us evidence of life on Mars. The worst case scenario would be to bring those samples back, only to realize that we had contaminated the samples with evidence of human life.

The engineers at JPL had a specific manufacturing outline that included assembling in a cleanroom with HEPA filters that circulate 1 million cubic feet of air every minute.

### **Chemical Analysis on Mars Samples**

When these samples are safely returned to Earth. Rather than searching for direct signs of life scientists will look for indirect signs of life such as fossils or even things as small as chemical remnants and isotopic markers. These indirect signs of life are called Biomarkers. Biomarkers are basically answering the question if Mars supported life in the past.