Research Assessment #7

Date: December 1, 2016

Subject: Astrobiology: *ALH 84001 Meteorite*

Source:

1.) *Schirber, Michael. "The Continuing Controversy of the Mars Meteorite - Astrobiology Magazine." Astrobiology Magazine. N.p., 21 Oct. 2010. Web. 01 Dec. 2016.*

2.) *Savage, Donald L., James Hartsfield, and David Salisbury. "Meteorite Yields Evidence of Primitive Life on Early Mars." NASA. NASA, 7 Aug. 1996. Web. 01 Dec. 2016.*

3.) *Treiman, Allan H. "Fossil Life in ALH 84001?" Fossil Life in ALH 84001? Lunar and Planetary Institute., n.d. Web. 01 Dec. 2016.*

Analysis:

The glowing red planet is 225 million kilometers from Earth. It seems to be empty and lifeless but it fosters treasures that will revolutionize our understanding of the universe and even life. Mars finally gave us a crucial clue about its past through ALH 84001, a martian meteorite. Groups of scientists from NASA and Stanford spend years analyzing and what they found changed our understanding of the universe forever.

How did this all begin? In 1984, a group of people from the National Science Foundation's Antarctic Meteorite Program set off on an expedition to find meteorites in the coldest part of the planet. That is when they found ALH 84001. The meteorite was kept in Johnson Space Center's Meteorite Processing Laboratory. However, it wasn't known that meteorite was martian in origin until 1993. They found that it was from Mars by comparing its chemical composition to the Viking's data on the Martian atmosphere. The two data sets were strikingly similar, which confirmed it was from the red planet. Not only that, it was proven to be the oldest martian meteorite ever to be found on Earth, dating as far 4.5 billion years old. The age of this meteorite acted as a major clue into how Mars was 4.5 billion years ago. This was important because we could learn about the red planet's history at a time we think was habitable for life to form and flourish. So,what exactly did scientists find in this meteorite? Well, Dr. David McKay and his team found three main things from the sample. All of the features that were found were either in or near the carbonate globules. Before, we go into what the three components was, we need to understand what carbonate globules are. As mentioned earlier, about 3-4.5 billion years ago, it is believed that Mars had warmer temperatures and also consisted of water. With that said, the water was most likely filled with carbon dioxide molecules from the martian atmosphere. Through scientific research, the water is believed to have seeped through the cracks of the rock, as a result, scientists believed that the water left deposits of carbonate minerals, creating carbonate globules. In addition to that, they also believed that biological activity could've contributed with this formation on the rock. The carbonate globules provided essential information into Mars' biological past. Researchers from NASA and Stanford

found organic molecules called polycyclic aromatic hydrocarbons (PAHs). This molecule is formed during the decomposition of any organic material. To make sure the PAHs wasn't from Earth, McKay's team cleaned and used ALFs free lab equipment. After this, they analyzed the sample and concluded that ALF was from Mars. The next thing they found was microscopic shapes that were similar to bacteria and bacterial fossils here on Earth. The shapes were "tubular and rope like." In order to make sure that these shapes weren't created on Earth, McKay's team looked at other Antarctic Meteorite samples to see if bacteria from Earth had accidently gotten into the samples but they found that none did. This helped their case tremendously. The third thing that they found was microscopic mineral grains. These grains were strikingly identical to grains produced by bacteria on Earth. The NASA team used a transmission electron microscope to see the exact minerals that were found. They identified magnetite, pyrrhotite, and greigite minerals to be in the carbonate globules. These specific three components have been found to be the outcome of biological activity here on Earth. These three features found with carbonate globules in ALH 84001 changed the way scientists looked at our world and the universe. In a way, it did pave the way for astrobiology and now scientists all over the world are studying the biology of space, specifically Mars.

The reason why we need to focus our attention on Mars is because Earth will not always be habitable for living organisms. To better understand this,, we know that Earth is currently in the habitable zone. However, researchers have discovered that our Sun's luminosity is increasing, giving off more heat and radiation to Earth. Astrobiologists have predicted that in around 2.5 billion years from now the Earth will

no longer be in the habitable zone and instead Mars will be in the habitable zone. Right now, Mars is really cold due its distance from the sun. As a result, living conditions on that planet is currently really harsh. But, when the sun gets brighter, Mars will also start to warm up, resulting in optimal temperature for living organisms. Looking at this,we can conclude that our best chance of survival is to move to Mars and start colonizing there. However, if want to achieve this, we must get a very detailed understanding of the red planet. There is a high chance that we humans will call Mars our home instead of Earth.