ASTRO SCIENCE JOURNAL FOR TEENS

What can we learn from carbon on Mars?

TEACHER'S KEY

UPPER READING LEVEL

Check your understanding

1 Why did the researchers choose to take samples in the Yellowknife Bay Formation on Mars?

Answer

The area had characteristics that indicated it was once a lake-like environment. Biological life overwhelmingly needs water in order to survive. If there was life on Mars at some point in the past, there's a good chance that evidence of it would be in an environment like this.

2 Why did we combust our sample at two different temperatures?

Answer

Some carbon is stuck in macromolecules or minerals. These are very stable and hard to break down. This also means that they don't combust very readily. The technical term for this type of carbon is called refractory carbon. A much higher temperature is needed to break the bonds in these molecules and release carbon. The researchers combusted their sample twice at the higher temperature to make sure they had released as much carbon as possible from these molecules.

3 Where did we determine the carbon in our sample came from? Why can't we say for sure whether it came from biological sources?

Answer

The carbon isotope values overlapped with known values for Mars meteorites, carbonate, and volcanic rocks. They also overlapped with biological carbon isotope values. Many of the carbon isotope values of meteorites, carbonate, volcanic rocks, and biological sources overlap with each other, so we can't say how much of our sample came from which source. It's possible that none of our carbon actually came from biological sources, but because the carbon isotope values overlap, it can't be ruled out.

4 Brainstorm with your classmates. What are some challenges that scientists might face when they try to do research on Mars?

Answer

- Working with a rover
  - It takes a long time to communicate with the rovers.
  - Programming and problem-solving take time and skill.
  - No human upkeep – when something physically breaks, that capability is completely lost.
  - The limited time span of work with the rover while it has power. The rovers are solar-powered and the time of day, season, and dust accumulation will impact the amount of power available to use scientific equipment.
- Limitations on the scope of research
  - The rovers only have the instrumentation and sampling capabilities that they were created with. There are no options to do anything new unless old instrumentation can be re-programmed.
  - No humans to clean up – researchers have to work within the "mess" previous experiments have left behind.
  - Rovers can't travel very far or very quickly.
  - Competition between scientists about the most important science to do.

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5 Bonus research task: What evidence would researchers need to collect to show that Mars could have supported life?

Answer

- Water – living organisms need water to survive. Water has been found on Mars and is contained mostly in the Martian ice caps and under the surface.
- Evidence of biological activity or conditions that could allow biological activity – the presence of organic carbon, nutrients that organisms would need like nitrogen and phosphorus and the absence of toxic heavy metals.
- Radiation – without a thick protective atmosphere, the surface of Mars is exposed to cosmic radiation that is dangerous to biological organisms. If life existed or exists on Mars it would likely be under the surface, where it is protected from this radiation.
- Biomarker gases – methane has been detected in the atmosphere in low concentrations. This could be an indication of bacterial metabolism, but it can also be produced by non-biological reactions.

Which steps in the experiment produced the most carbon?

Answer

Steps 1 and 2.