

National Aeronautics and Space Administration



Issue  
#5

# ASTROBIOLOGY

The Story of our Search for Life in the Universe.

Produced by the NASA  
Astrobiology Program to  
commemorate 50 years of  
Exobiology and Astrobiology  
at NASA.

[www.nasa.gov](http://www.nasa.gov)

# Astrobiology

## A History of Exobiology and Astrobiology at NASA

This is the story of life in the Universe—or at least the story as we know it so far. As scientists, we strive to understand the environment in which we live and how life relates to this environment. As astrobiologists, we study an environment that includes not just the Earth, but the entire Universe in which we live.

The year 2010 marked 50 years of Exobiology and Astrobiology research at the National Aeronautics and Space Administration (NASA). To celebrate, the Astrobiology Program commissioned this graphic history. It tells the story of some of the most important people and events that have shaped the science of Exobiology and Astrobiology. At just over 50 years old, this field is relatively young. However, as you will see, the questions that astrobiologists are trying to answer are as old as humankind.

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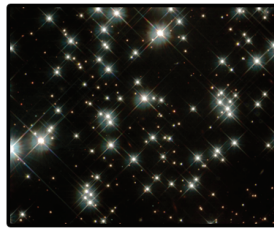
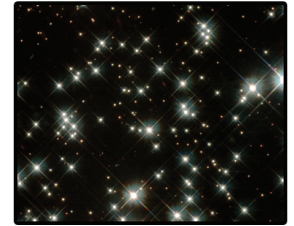
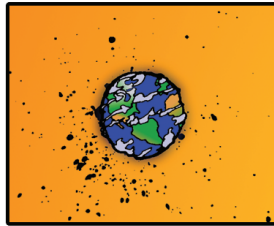
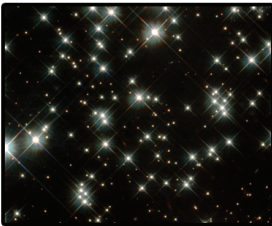
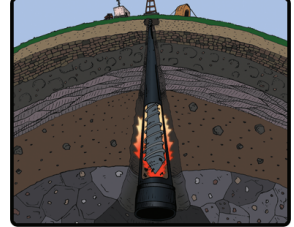
Aaron L. Gronstal

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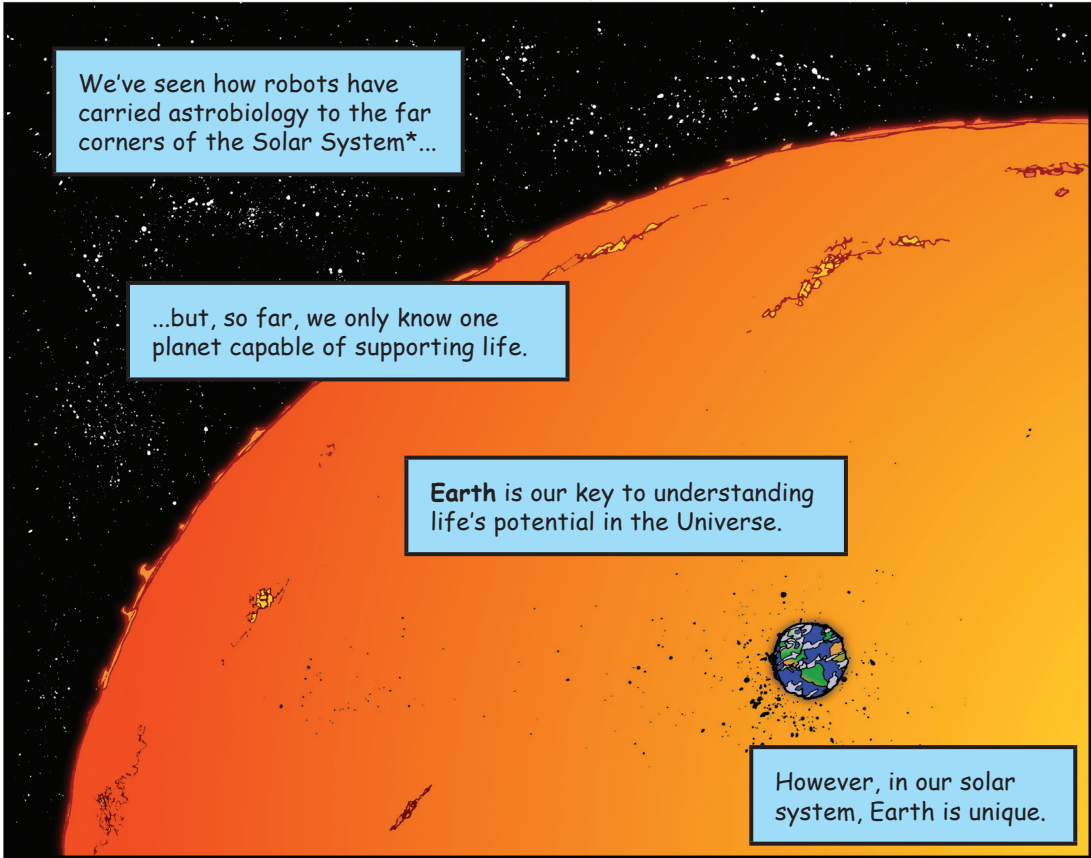


## Issue #5—Astrobiology and the Earth



The year 2010 marked the 50th anniversary of NASA's Exobiology Program, established in 1960 and expanded into a broader Astrobiology Program in the 1990s. To commemorate the past half century of research, we are telling the story of how this field developed and how the search for life elsewhere became a key component of NASA's science strategy for exploring space. This issue is the fifth in what we intend to be a series of graphic history books. Though not comprehensive, the series has been conceived to highlight key moments and key people in the field as it explains how Astrobiology came to be.

-Linda Billings, Editor

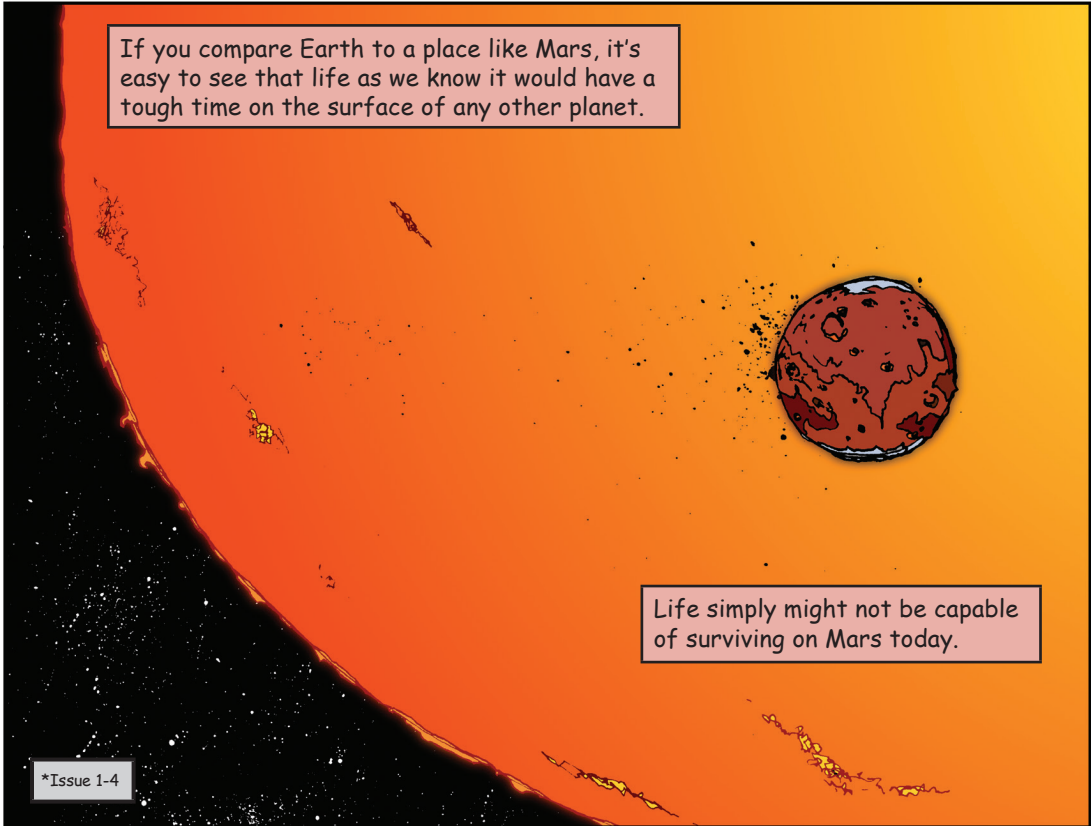


We've seen how robots have carried astrobiology to the far corners of the Solar System\*...

...but, so far, we only know one planet capable of supporting life.

**Earth** is our key to understanding life's potential in the Universe.

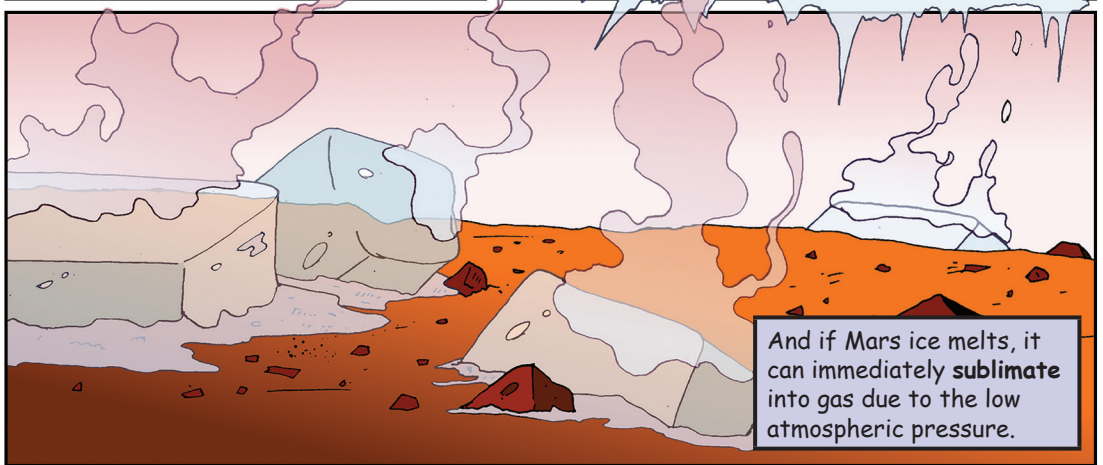
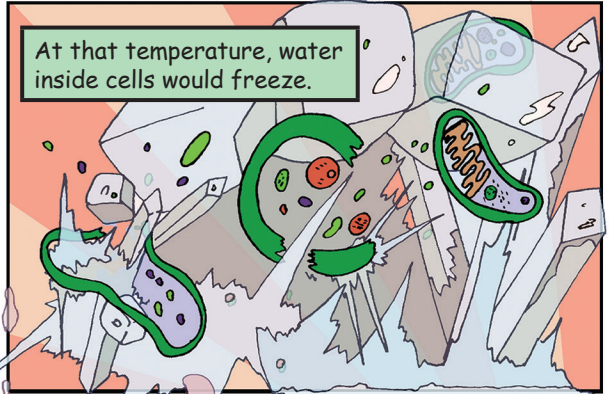
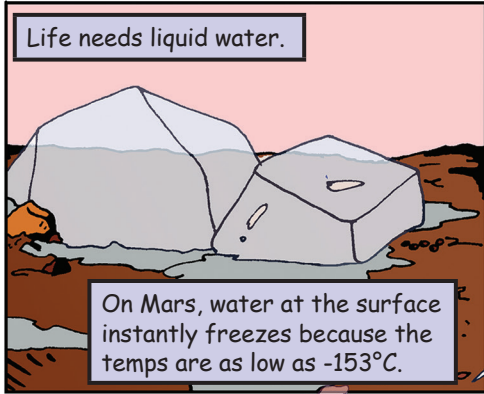
However, in our solar system, Earth is unique.



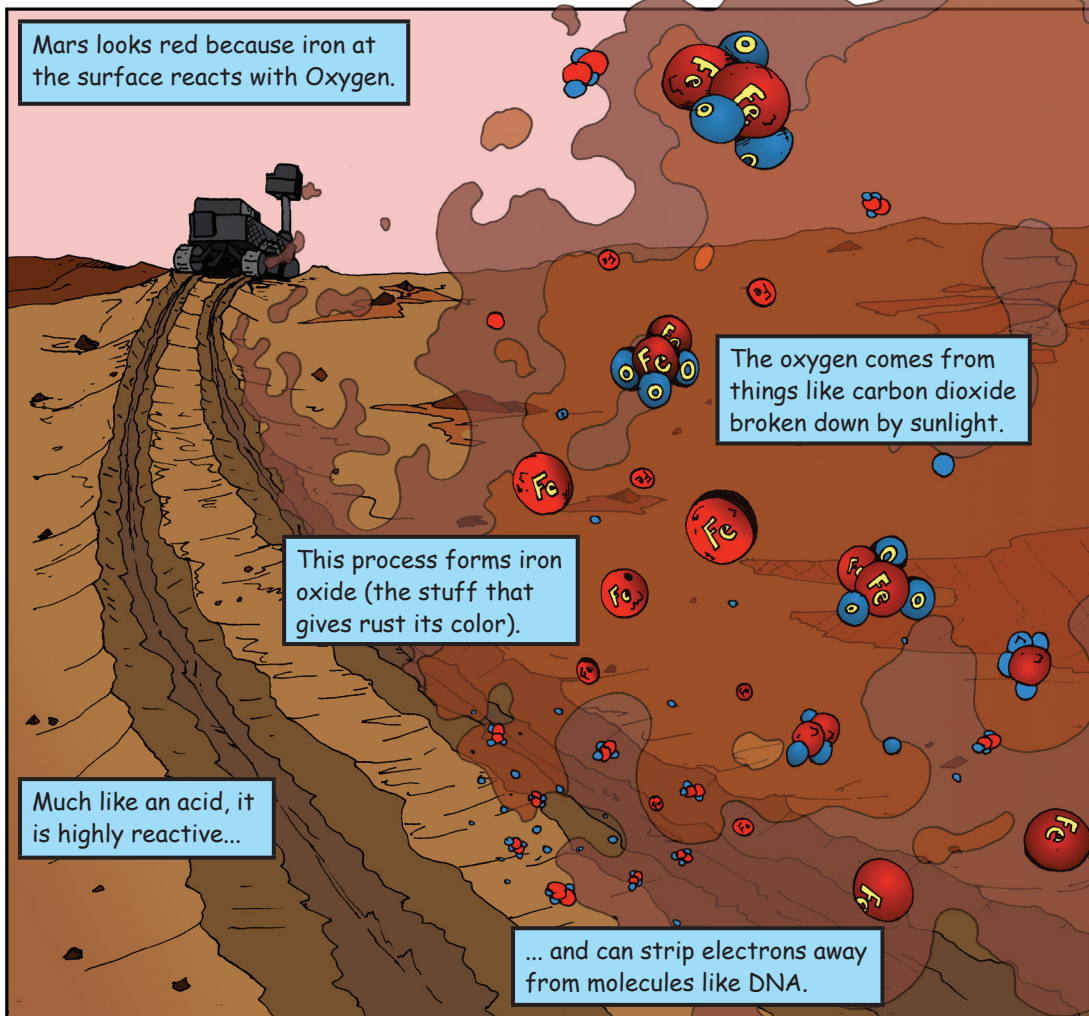
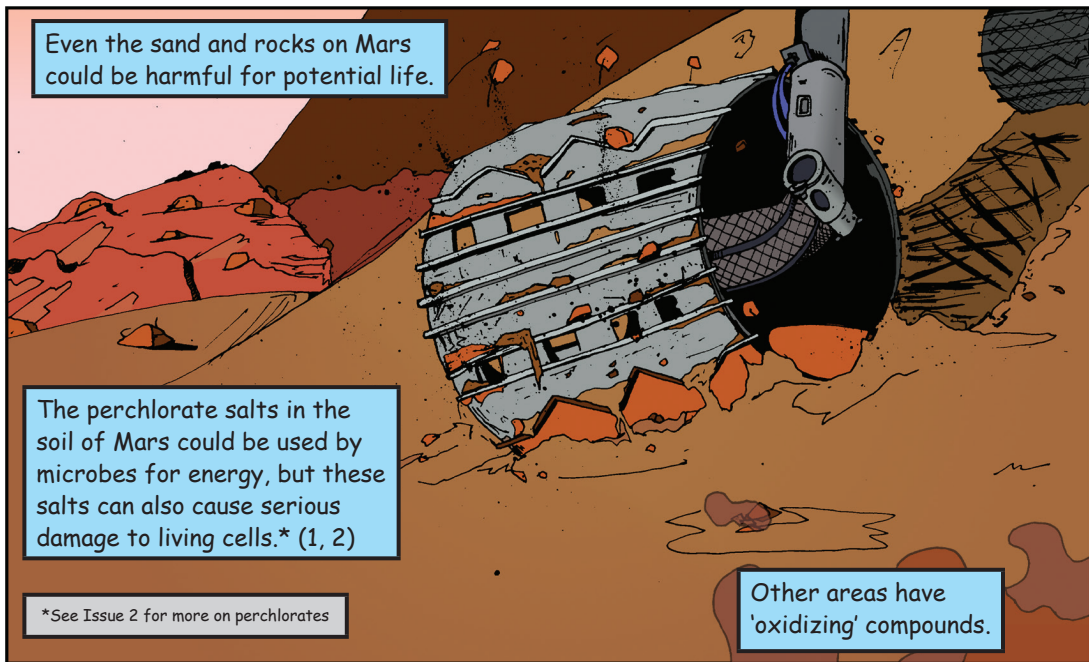
If you compare Earth to a place like Mars, it's easy to see that life as we know it would have a tough time on the surface of any other planet.

Life simply might not be capable of surviving on Mars today.

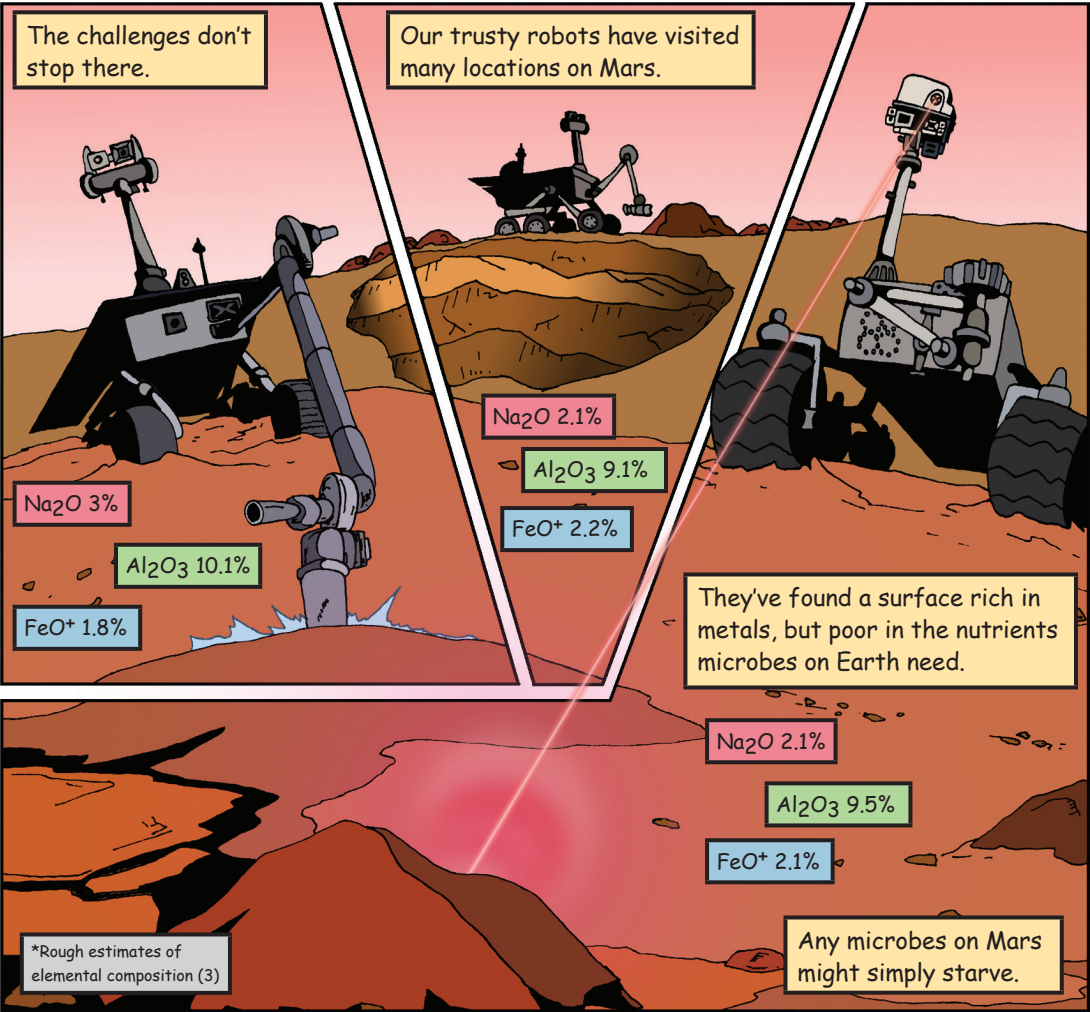
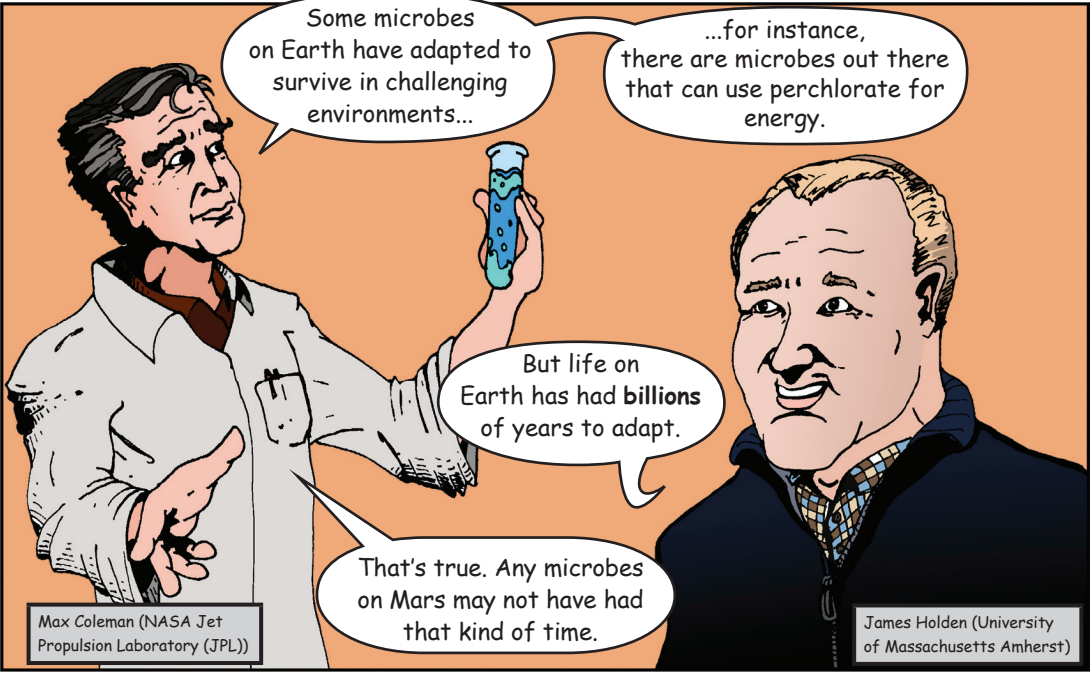
\*Issue 1-4







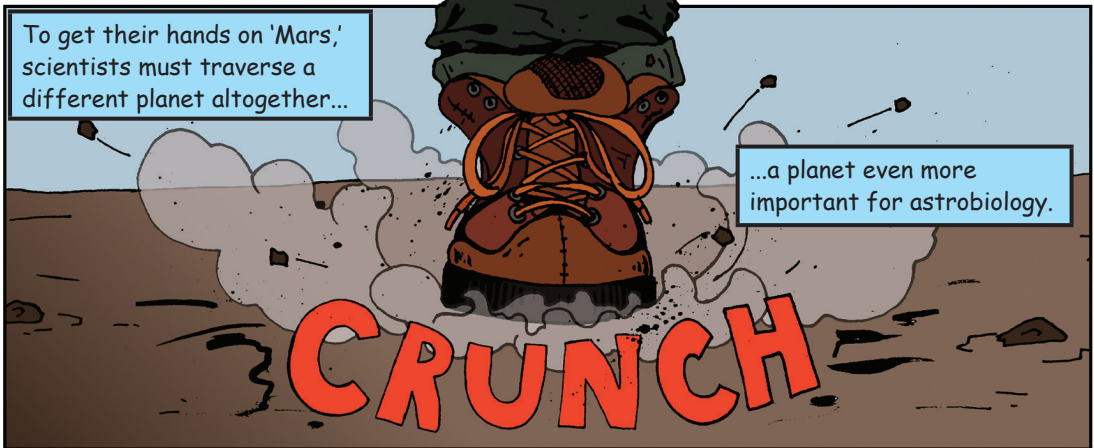






Our robots have discovered so much, but to find life on Mars we may have to go there ourselves.

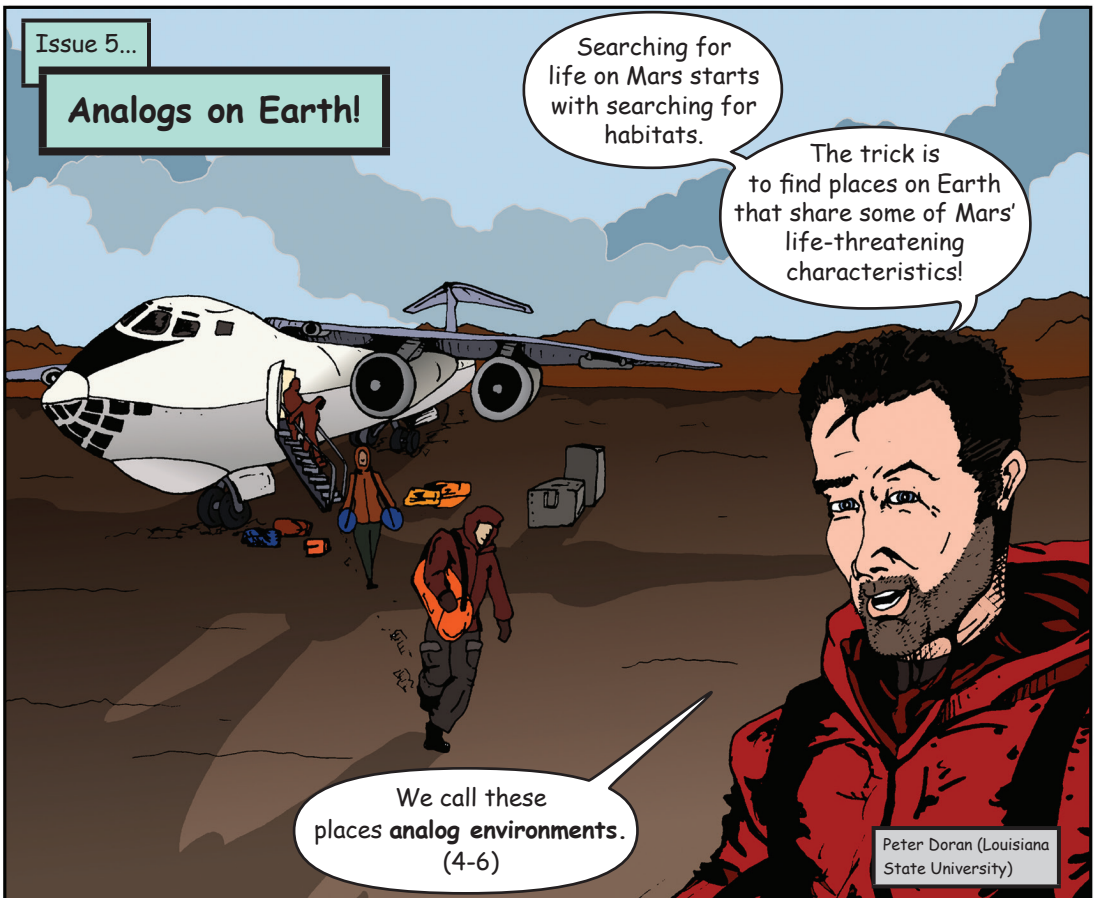
But humans have not yet set foot on the red planet.



To get their hands on 'Mars,' scientists must traverse a different planet altogether...

...a planet even more important for astrobiology.

CRUNCH



Issue 5...

## Analogues on Earth!

Searching for life on Mars starts with searching for habitats.

The trick is to find places on Earth that share some of Mars' life-threatening characteristics!

We call these places **analog environments**.  
(4-6)

Peter Doran (Louisiana State University)



The Viking mission\* really spurred the search for Mars analogs on Earth.

We need somewhere to test the instruments!

Cyril Ponnamperna\* (formerly of the NASA Ames Research Center (ARC).

How about the deserts of Antarctica? They look a lot like the images that Mariner 4\* sent us.

Hmm... In the Antarctic, life as we know it is definitely pushed to the limit. (7,8)

Even in the 1960's, scientists knew such comparisons had their limits. (7)

Truthfully, "the Antarctic desert is far more hospitable to terrestrial life than is Mars, particularly in regard to the abundance of water."

However... "the Antarctic has provided us with a natural environment as much like Mars as we are likely to find on Earth." (9)

Norman Horowitz\* (former head of the Biology Division of NASA JPL)

\*See Issue 2





It was physical appearance that first drew us to Antarctica.

The surface here is shaped by the cycling of ice.

Comparing this place to images from Mars helps us understand how similar features could have been made in the red planet's past, and if water might have been involved.

In fact, there are tons of sites on Earth, from North Africa to the California deserts, that are useful for this type of work.

But if you travel deep into Antarctica, you find rarer types of analog environments.



The best analogs we can hope for are places that get very little rain, and the Antarctic Dry Valleys are as cold and dry as it gets on Earth.

Yet, even here, microbial life thrives in soil and ice-covered lakes.

But always remember, no site on Earth is exactly like Mars. Not even close.

Just because Antarctica looks similar to Mars doesn't always mean the landscapes were formed in the same way.

These valleys are remote, but, like anywhere on our planet, they are still part of Earth's immensely productive global biosphere.

Dawn Sumner (University of California, Davis, and Member of the Mars Science Laboratory team)

Places that are geologically similar to Mars are great for testing technology.

It's a chance to drive rovers through rocky terrain, or to test our methods for performing science in remote landscapes.

This includes places like Haughton Crater in the Canadian arctic, or even the volcanos of Hawai'i.

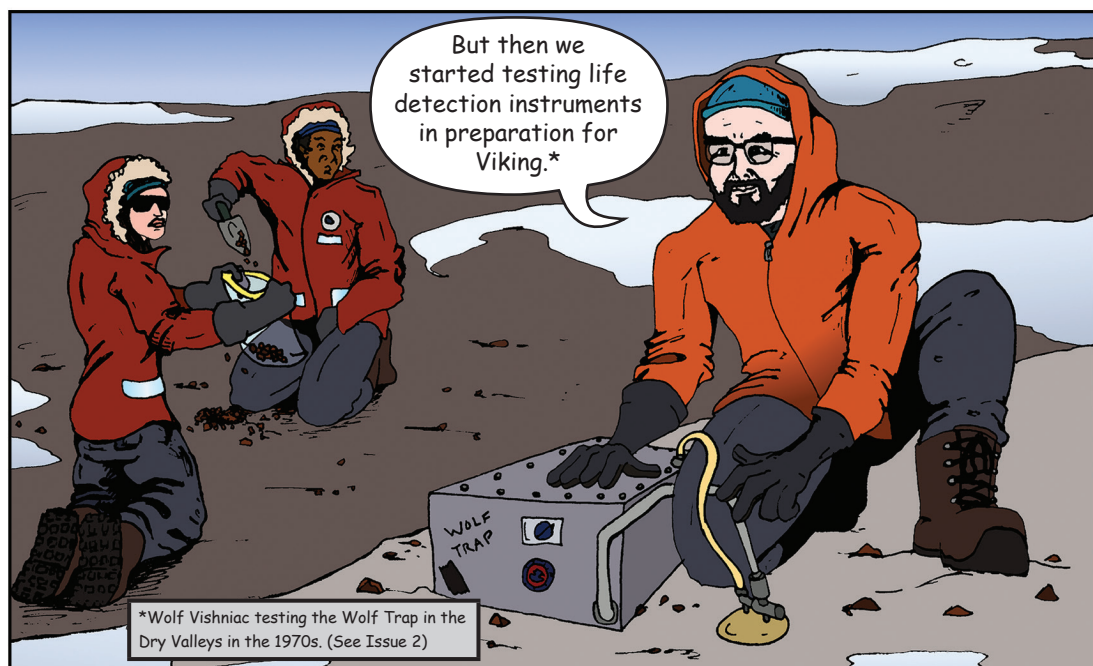
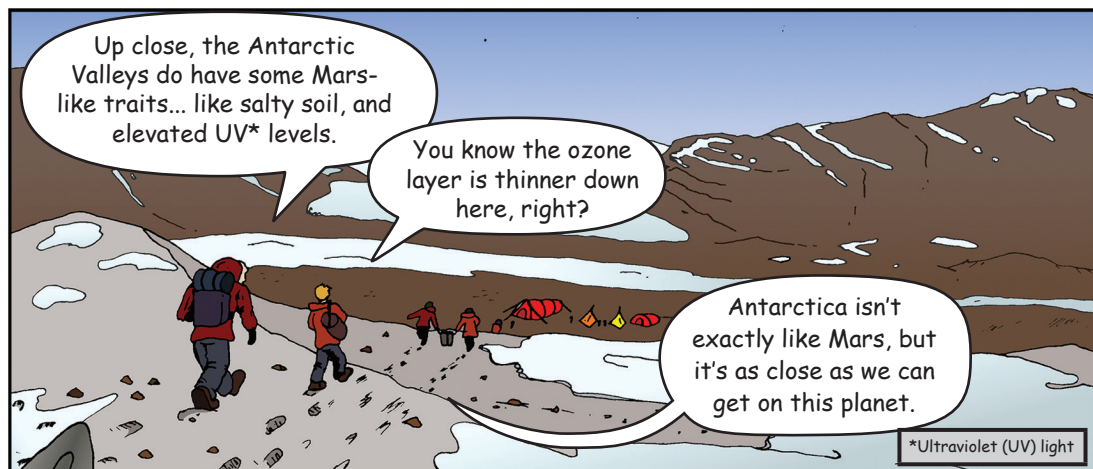
Features like craters and dry stream beds can also help us identify where water may have flowed on Mars.

We study Earth's geology from the ground, air, and space so that we can make comparisons with the images our robotic missions send home.

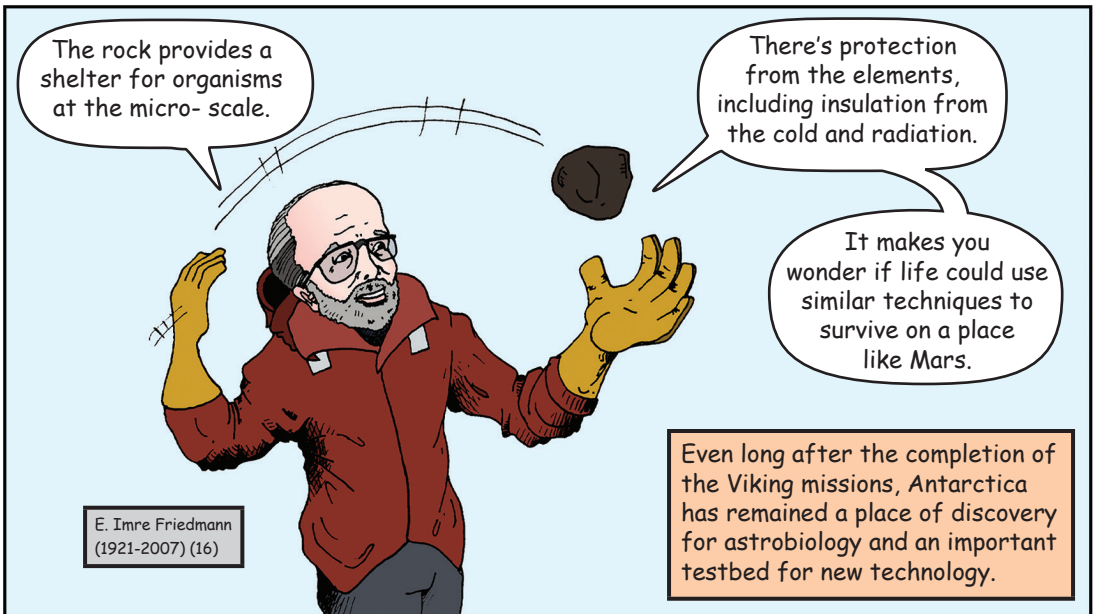
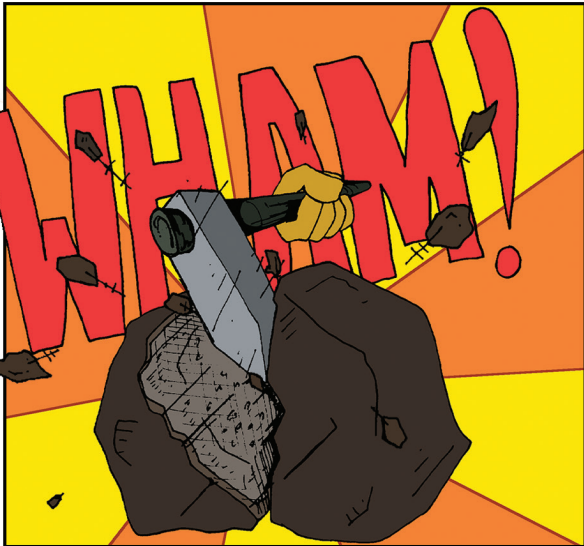
But very few places are good analogs for habitats that might support biology on other worlds.



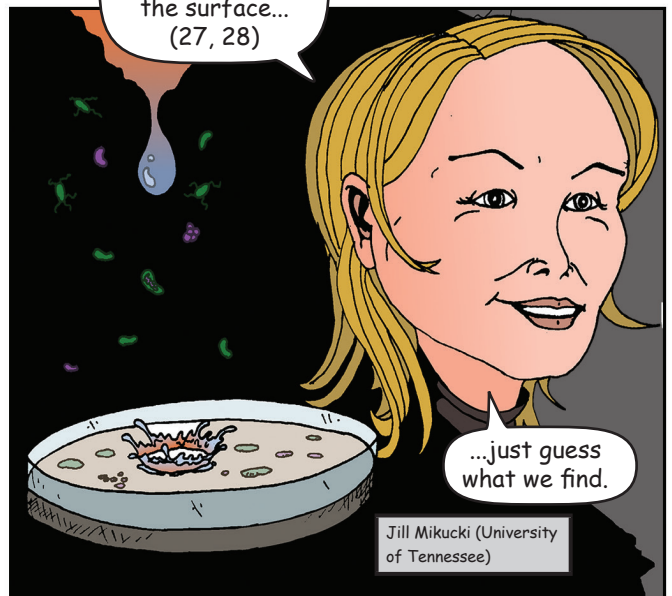
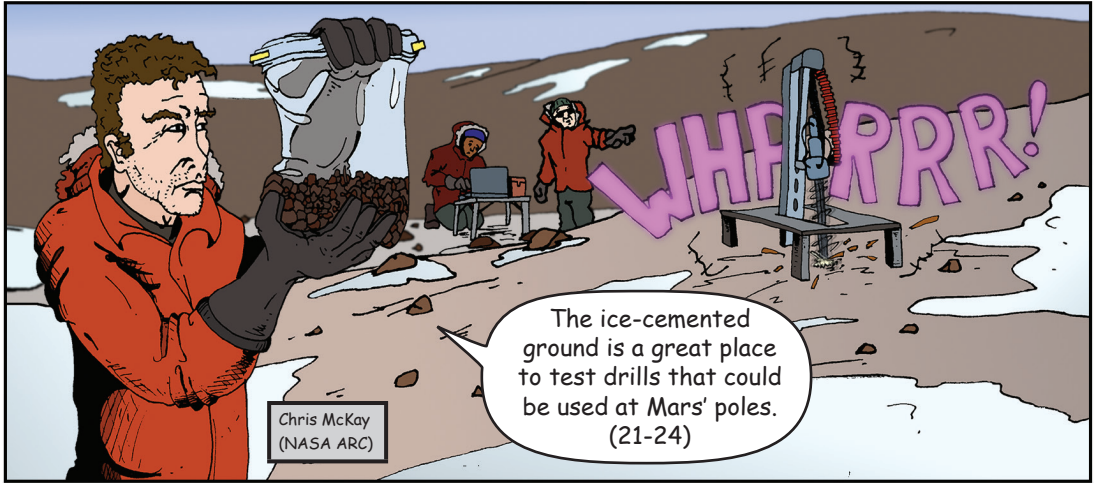


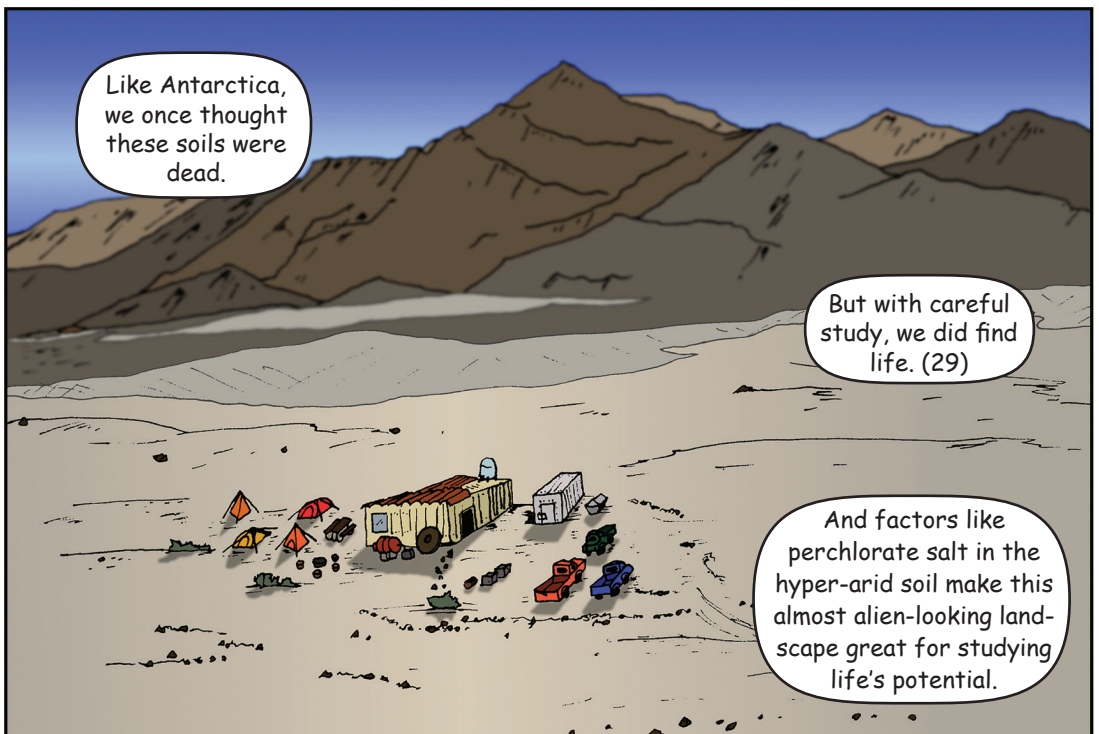
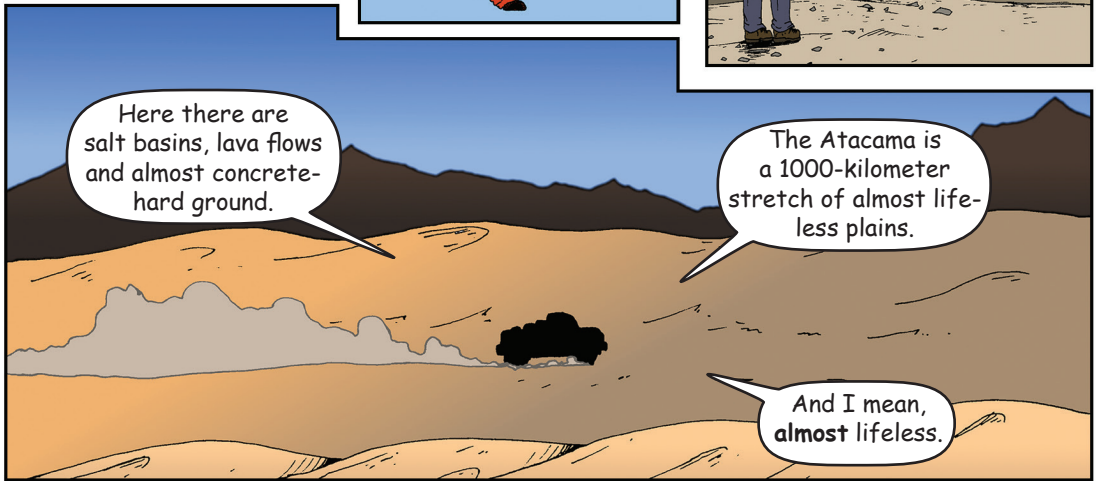
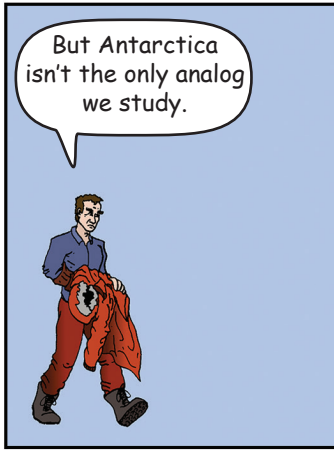




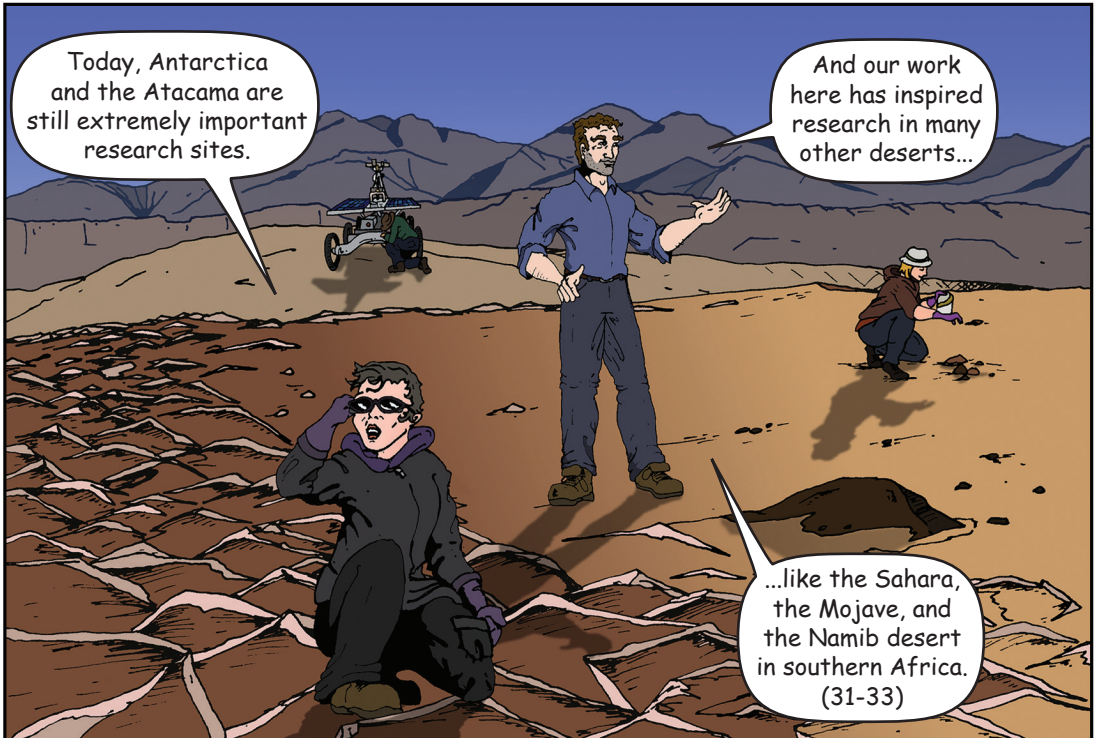
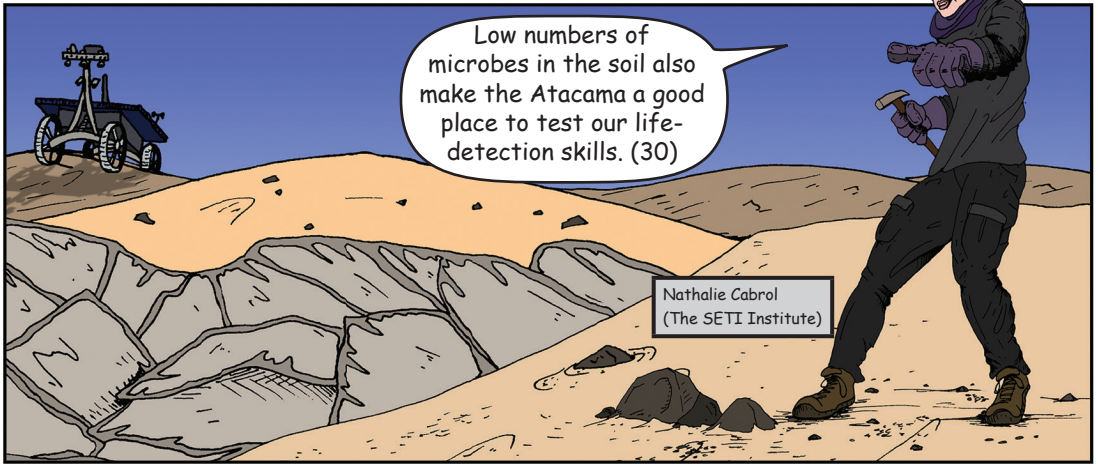
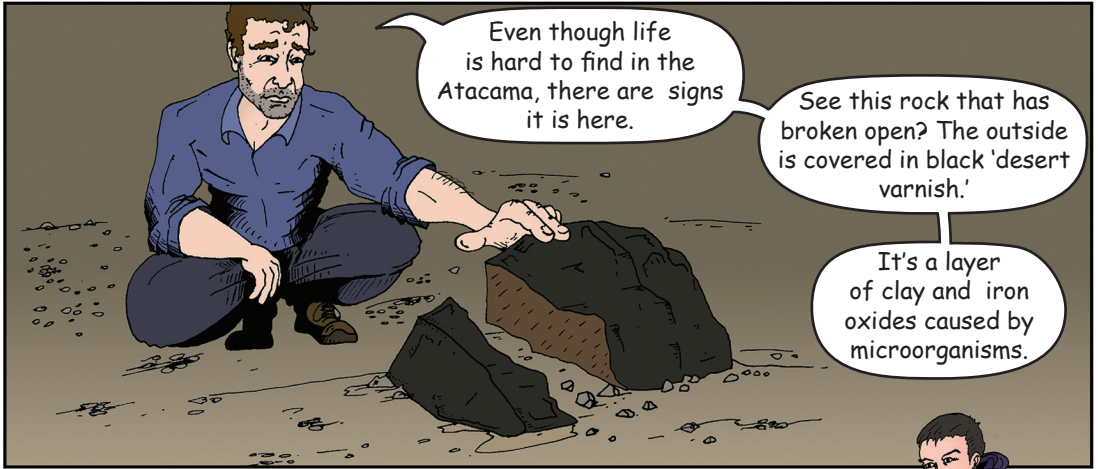














Astrobiologists travel around the world, from the north pole to the south, searching for analogs.

But one of the least explored analogs can be found anywhere in the world...

...although, it's very hard to visit.

That's because it's basically made of solid rock.

When you dig underground, it might just look like dirt and rocks...

Drops of water can be found in tiny cracks and fissures.

And this water is the key to life.

Mary Voytek (NASA)

...but under a microscope the view is very different.

Drilling programs at the ocean floor and on land provided some of our first views into Earth's **deep biosphere.**  
(34-36)



To get to the deep sub-surface, Astrobiologists also explore caves and mines.

Here we can tap into underground water sources and take samples.

We ventured into deep mines in South Africa because drilling from the surface wasn't enough to tell us how life was living down here. (37)

In the mine, we drill sideways into the wall to collect samples that are free from contamination.

In these hidden pockets deep below ground, we find entire ecosystems thriving. (38)

It's true that the surfaces of planets like Mars and Venus are vastly different than the Earth.

But underground, it could be a completely different story.

Penny Boston, Chair of Earth and Environmental Sciences, New Mexico Tech. and Associate Director of the Nat'l Cave and Karst Research Institute

Tullis Onstott (1955-2021)  
(Princeton University)



The surface of Mars might not be habitable today.

But if life existed on Mars in the past...

...could it still be hiding somewhere underground?

Questions about life in Mars' past bring us to the slopes of Licancabur Volcano in the Andes, and another type of analog.

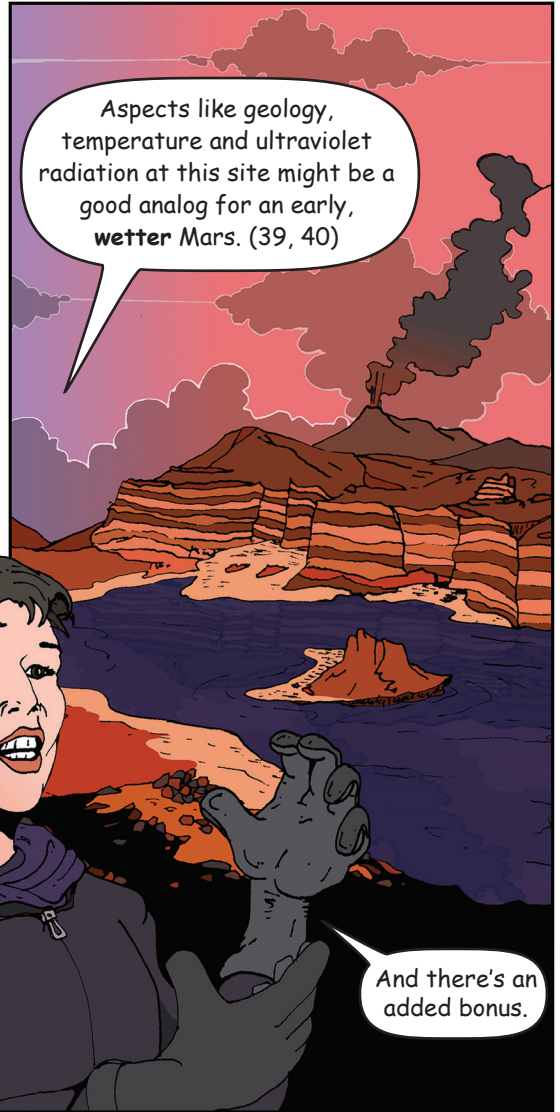
See those lakes behind us?

Those are Laguna Verde and Laguna Blanca.



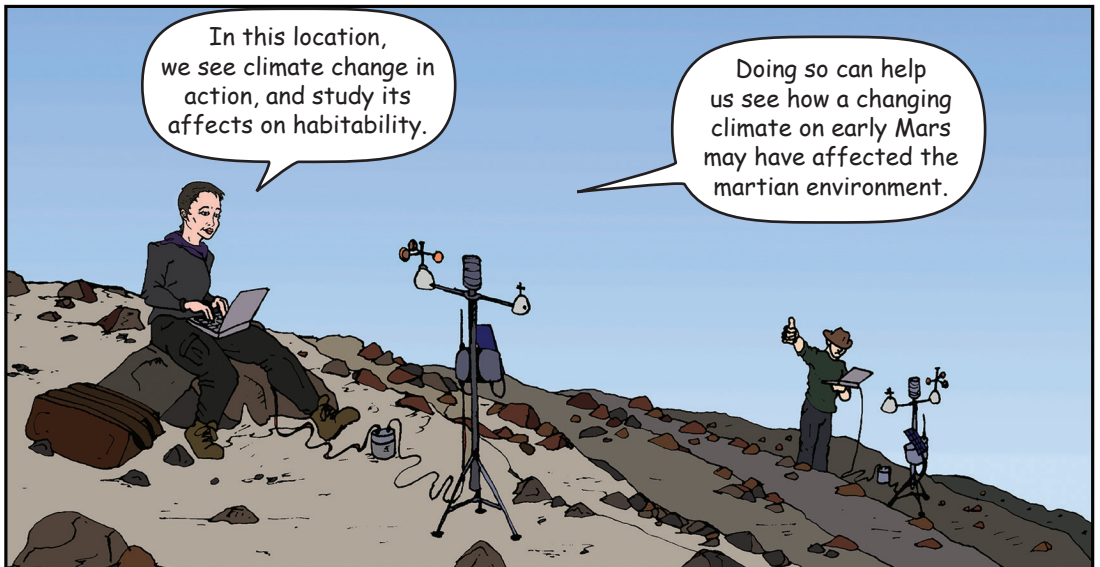


Here we find an analog for a Mars we no longer see.



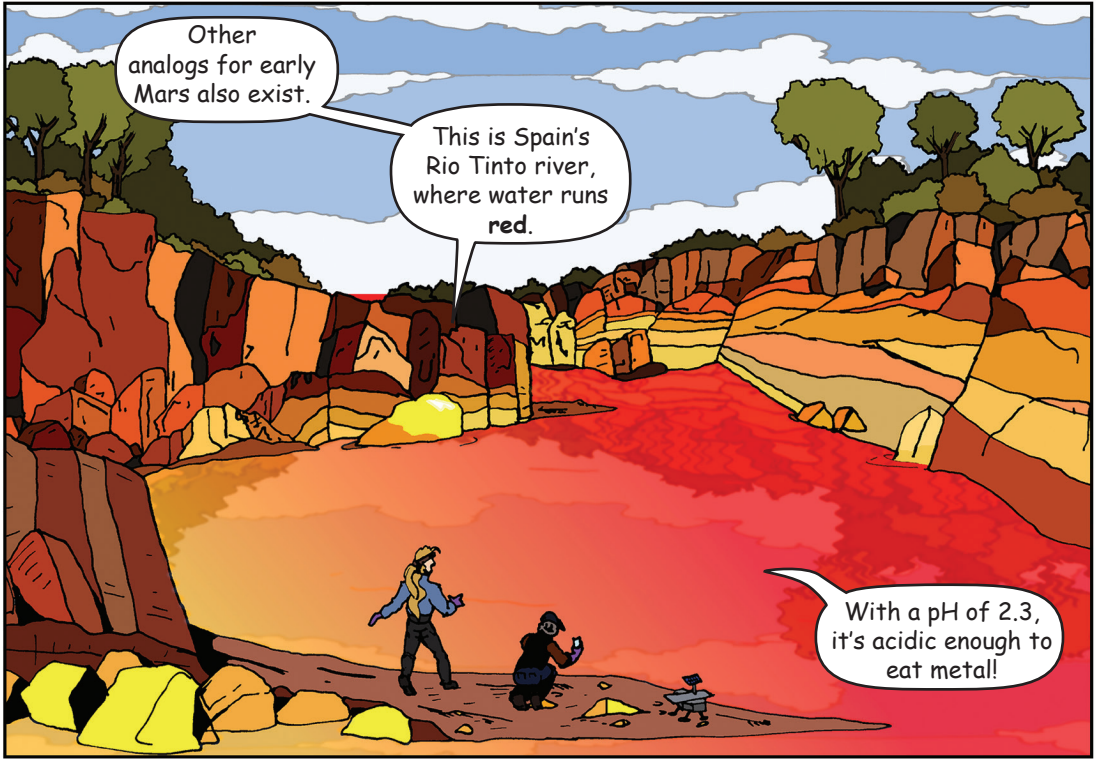
Aspects like geology, temperature and ultraviolet radiation at this site might be a good analog for an early, **wetter** Mars. (39, 40)

And there's an added bonus.

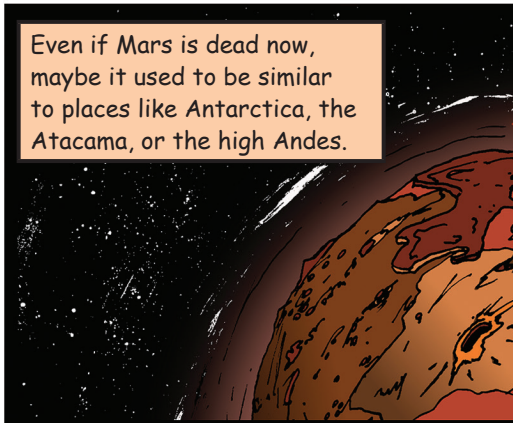


In this location, we see climate change in action, and study its affects on habitability.

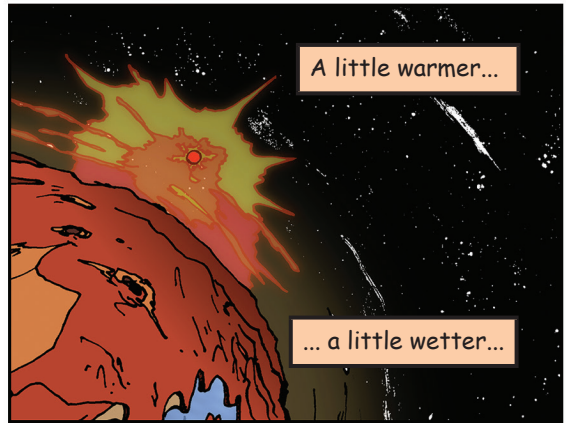
Doing so can help us see how a changing climate on early Mars may have affected the martian environment.





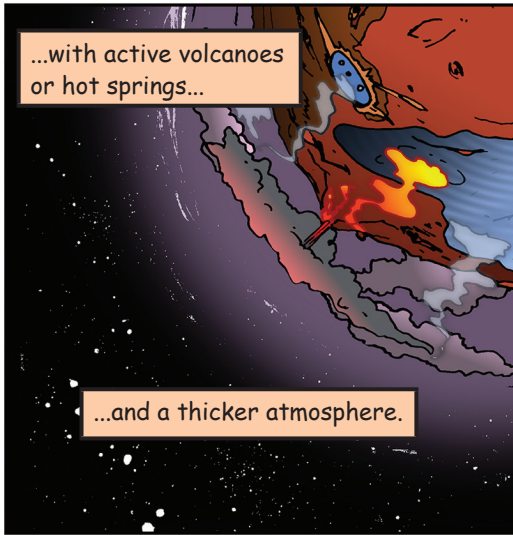


Even if Mars is dead now,  
maybe it used to be similar  
to places like Antarctica, the  
Atacama, or the high Andes.



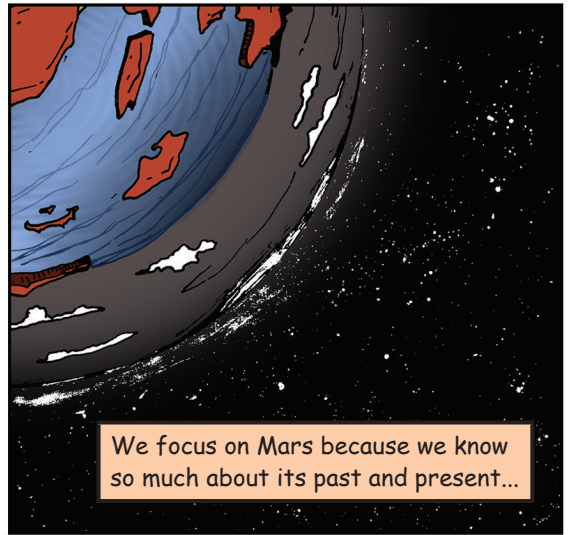
A little warmer...

... a little wetter...

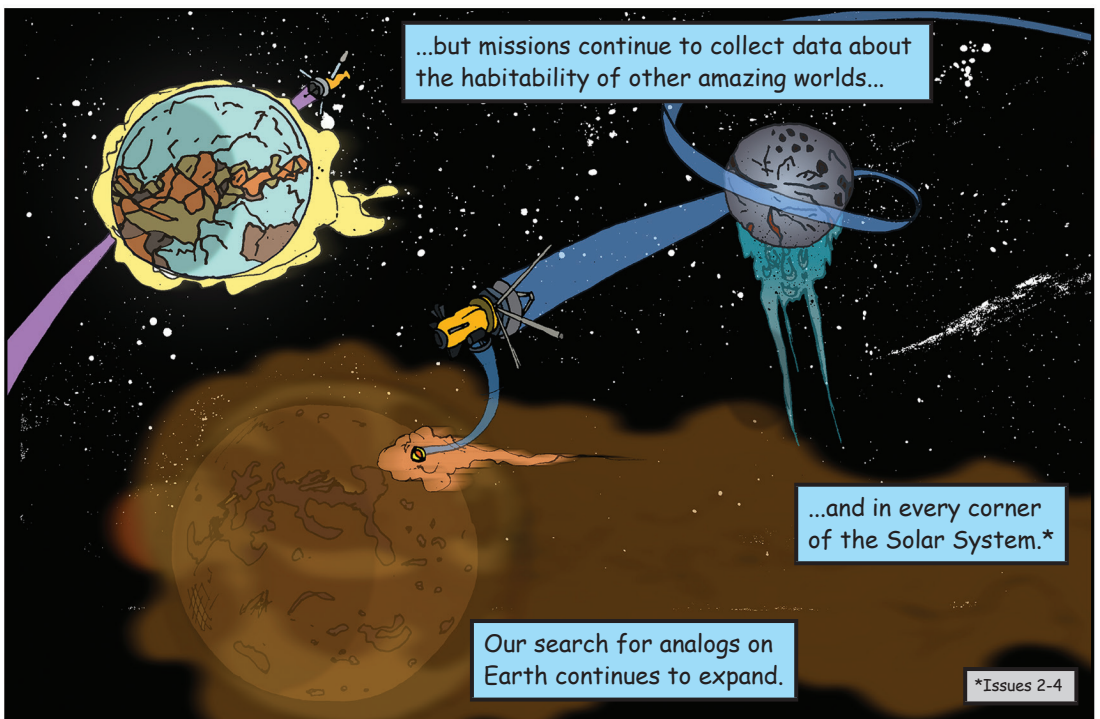


...with active volcanoes  
or hot springs...

...and a thicker atmosphere.



We focus on Mars because we know  
so much about its past and present...



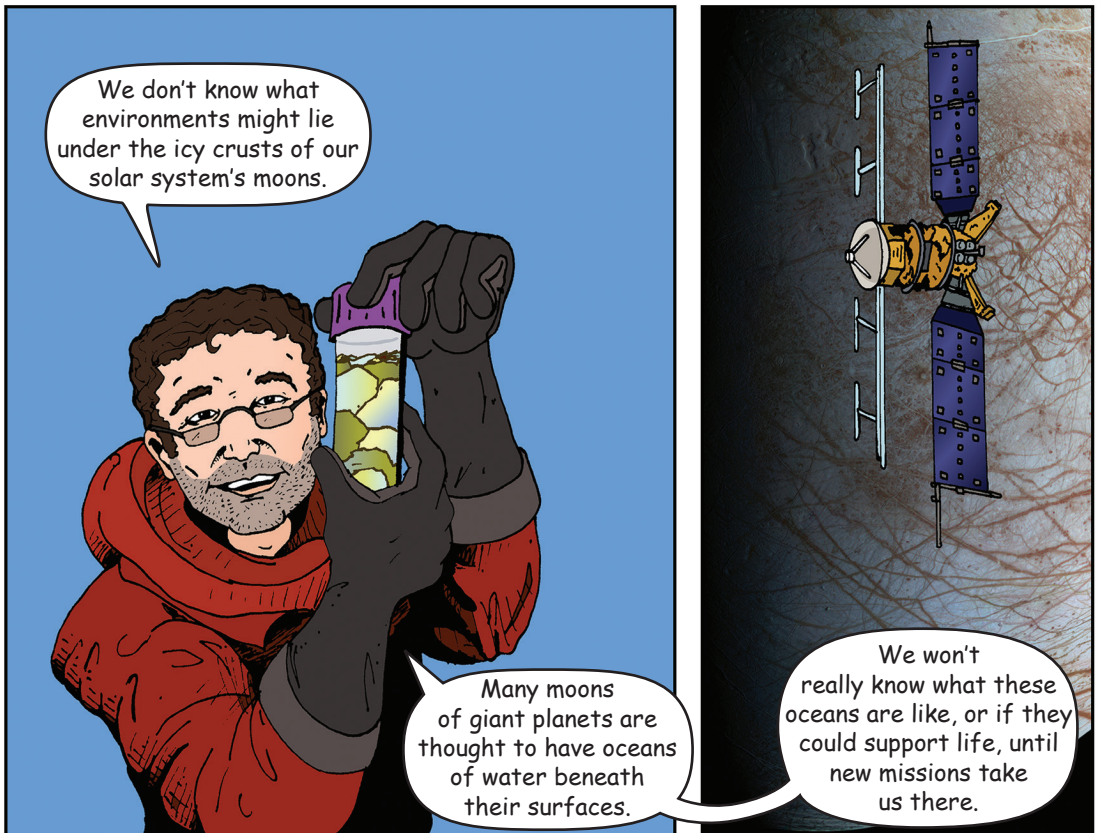
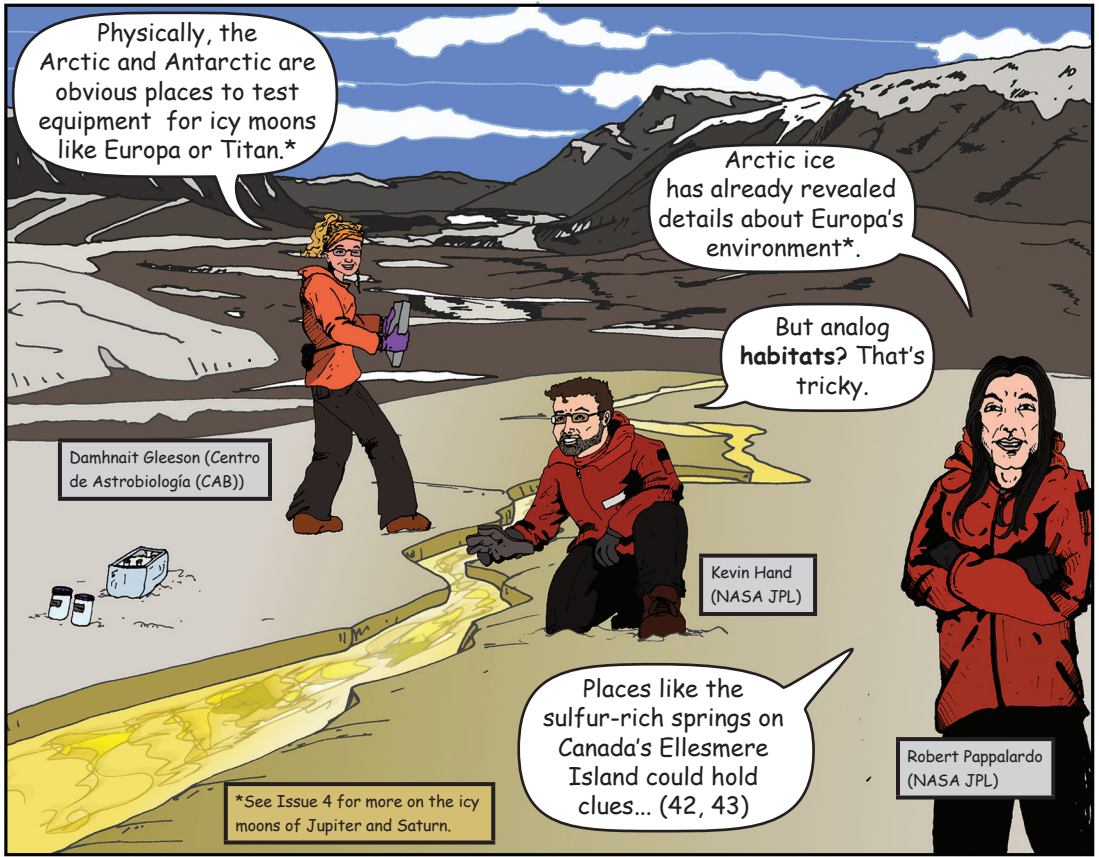
...but missions continue to collect data about  
the habitability of other amazing worlds...

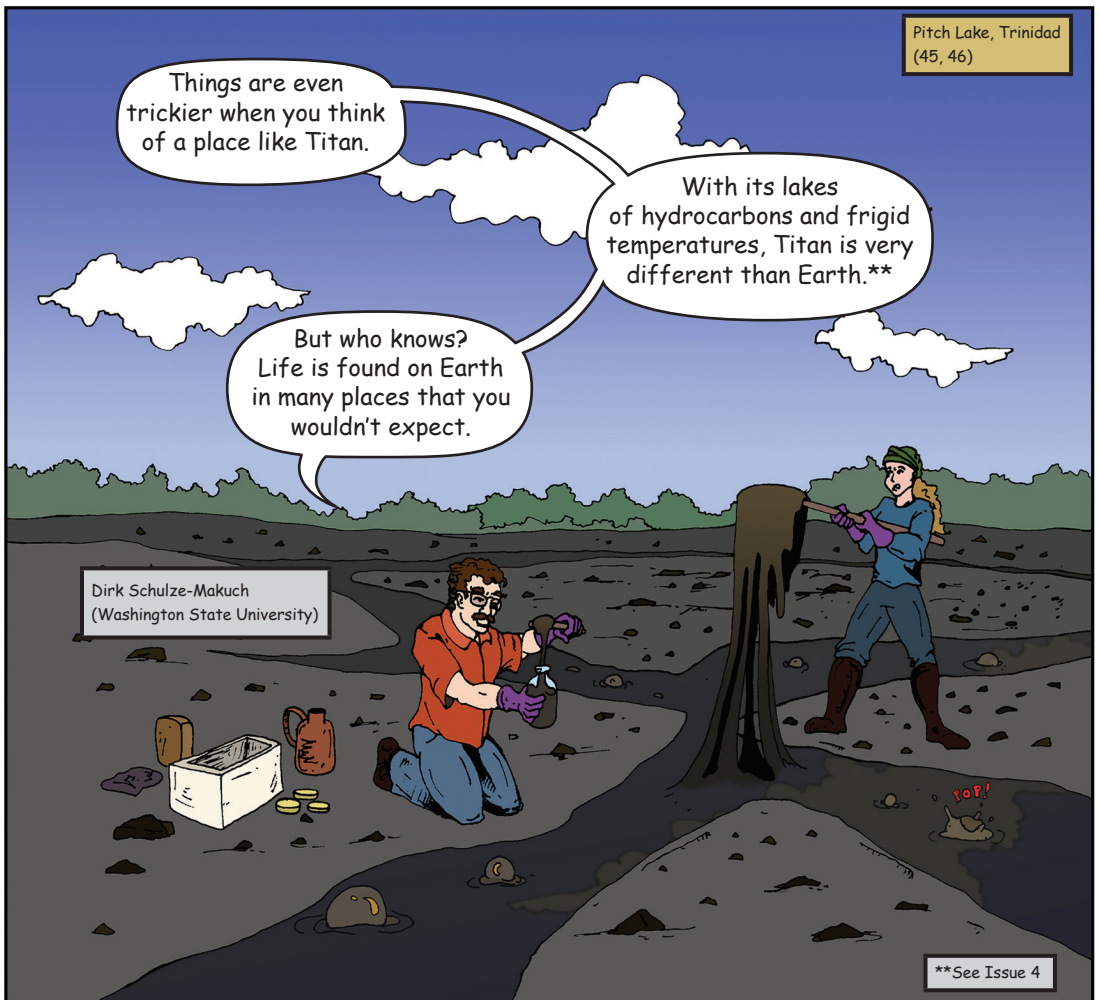
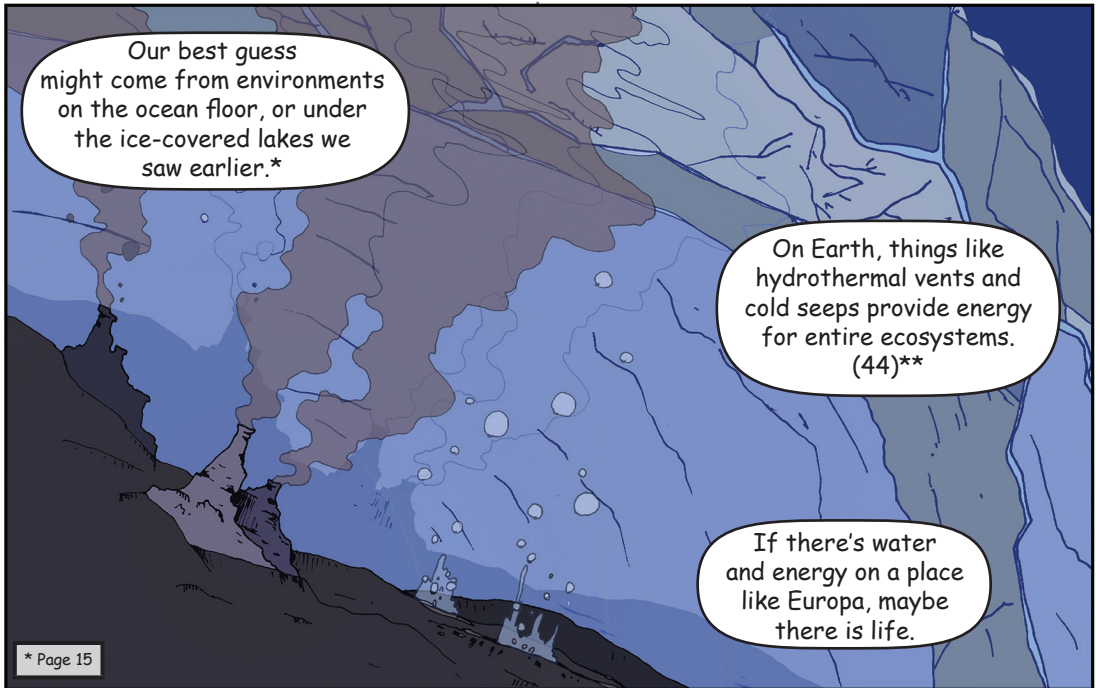
...and in every corner  
of the Solar System.\*

Our search for analogs on  
Earth continues to expand.

\*Issues 2-4



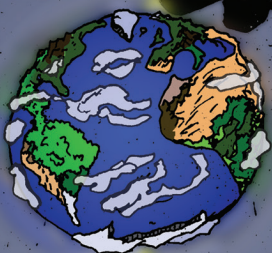






Astrobiologists have traveled around the world to find analogs for places like Mars, Europa, and Titan.

In doing so, they're also starting to understand what makes the Earth itself habitable for life.



What they've learned has turned the Earth into one giant analog environment...

...an analog for potentially habitable worlds in **other** solar systems.



Studying Earth is the key to finding Earth-like planets among the stars.



Next issue...

Living Beyond the Solar System!



# Astrobiology

## A History of Exobiology and Astrobiology at NASA

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