



## Mars Mania: The search for signs of water



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<http://sd.spacegrant.org>

NASA Jet Propulsion Lab Mars Mission website:  
<http://marsrovers.jpl.nasa.gov/home/index.html>



As of February 2012, one of NASA's two Mars Exploration Rovers named Opportunity has operated for 8 years and 1 month of what was originally planned as a 90-day science mission! This robot continues to provide amazing evidence of ancient and present conditions on Mars. The other rover (Spirit) quit working in March 2010 after providing six years of unprecedented scientific service.

After a seven-month journey, two identical 408 pound rovers successfully landed on opposite sides of Mars in January 2004. Upon Spirit's landing on 1/4/04, Mars was located about 106 million miles from Earth, compared to a distance of 64 million miles at launch on 6/10/03. However, the spacecraft traveled 303 million miles to get there. Successfully hitting the target zone was akin to threading a needle located 15 miles away!

Both rovers have eight radioisotope heaters (each containing a 0.1 ounce plutonium dioxide pellet) to keep the battery and electronics warm enough to operate during the extremely cold temperatures at night, which can dip to -157° F. The rovers are larger, more mobile, and better equipped than the 1997 Mars Pathfinder rover. Each rover serves as a robotic field geologist, carrying sophisticated instruments to search for evidence about whether past environments at selected sites were wet enough to be hospitable to life.

While there is no liquid water on the surface of Mars today, the record of past water activity can be found in the rocks, minerals, and landforms. Each rover carries a high-resolution Panoramic Camera, several types of spectrometers for geologic analyses, a microscopic imager, magnets for collecting magnetic dust, and a rock abrasion tool for exposing fresh surfaces on rocks. Additionally, the rovers have carried out geologic operations on the ground to validate remote sensing observations made by instruments that survey the Martian geology from orbiting spacecraft.

The goal of the mission has been achieved. Using the toolkits on the rovers, scientists have collected at least five kinds of evidence indicating that significant amounts of water existed in Mars' past:

1. tiny concretions (nicknamed "blueberries") likely formed in an aqueous environment,
2. high amounts of sulfur, chlorine, and bromine that are associated with mineral salts deposited in brines as they evaporate,
3. jarosite, a hydrated iron sulfate mineral that typically forms in acidic lakes or hot springs, and goethite,
4. vugs of randomly oriented cavities in the rock that look very similar to those found on Earth where minerals that once formed in brines are later redissolved by water, and
5. structure such as crossbedding and ripple marks, indicating that sediments were deposited in flowing water.

The rovers, first delicately coddled and treated with kid gloves at the start of the mission have now been pushed to the limits of their technology. Although Spirit is no longer operating and Opportunity is showing signs of aging, both rovers have proven to be true workhorses.