Did Sulfur Affect Mars Climate and Geology?

- Mars missions suggest that Mars once had a thick CO₂ atmosphere and liquid water.
- On Earth these conditions lead to formation of carbonate rocks (like limestone).
- But Mars missions detect very little carbonate rock; instead Mars rovers find sulfate rocks.

This rock outcrop studied by the Opportunity rover, contains the sulfur-bearing mineral jarosite. The inset shows a close-up of a hematite ‘blueberry’ believed to form due to water.

The Big Picture

- A minor gas (SO₂) can radically change Mars chemistry, preventing the major gas (CO₂) from forming carbonate rock as on Earth.
- CO₂ in the atmosphere (instead of in rocks) plus H₂O and SO₂ gases provided lots of greenhouse warming for ancient Mars.
- Planetary scientists continue to investigate why the paths of these two planets diverged billions of years ago.

Sulfur gases may have affected the geology and climate of Mars enough to make it habitable in the past.

Why does Mars have more sulfur-rich rocks?

On Earth
- Volcanic SO₂ rapidly reacts with oxygen and water vapor.
- CO₂ absorbed in water, forms carbonate rocks.
- Little CO₂ left in our atmosphere - just enough for a mild greenhouse effect.

Volcanoes on Earth and Mars spewed out CO₂ and SO₂ along with H₂O.

On Ancient Mars
- Less oxygen and water vapor in atmosphere, so some SO₂ absorbed in surface water.
- Water too acidic for carbonate formation, CO₂ stays in atmosphere.
- Sulfur-bearing minerals form in water and make sulfate rocks.

The White cliffs of Dover, composed of carbonate

Endurance Crater, Mars, with countless ‘blueberries’ formed due to acidic liquid water.

For more details...

Press Releases
- Marsdaily.com - 12/24/07 - "How Mars Could Have Been Warm And Wet But Limestone-Free"
  http://tinyurl.com/marswarmwetnolimestone
- Marsdaily.com - 12/24/07 - "Sulfur Dioxide May Have Helped Maintain A Warm Early Mars"
  http://tinyurl.com/marsearlysulfur

Images
- El Capitan and blueberry images courtesy of NASA/JPL
  http://photojournal.jpl.nasa.gov/catalog/PIA05478
  http://photojournal.jpl.nasa.gov/catalog/PIA05474
- Blueberries in Endurance Crater image courtesy of NASA/JPL
  http://marsrover.nasa.gov/gallery/press/opportunity/20040727a.html
- Volcanic eruption diagram Adapted from "The Cosmic Perspective", by Bennett et al., Addison Wesley, Inc.
- Mars & Earth composite image courtesy of NASA/JPL
  http://photojournal.jpl.nasa.gov/catalog/PIA02570

Source Article
  http://www.sciencemag.org/cgi/content/abstract/318/5858/1903

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