

Cold, dry and lifeless - a new take on Mars

03 June 2005

NewScientist.com news service

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New research on a green mineral that degrades easily in water and is present over much of the Martian surface is fuelling debates over the history of water and the current existence of life on the Red planet.

One study reveals that a region rich in the mineral olivine - which suggests it has been "dry" for about 3 billion years - is actually four times larger than previously thought. That adds to a growing body of evidence suggesting Mars was mostly cold and dry - and not warm and wet - in the past.

The second study asserts that subsurface reactions of olivine and water could produce enough methane to account for recent observations of the gas in the atmosphere, removing the need to invoke living microbes to do the job.

Olivine forms at very high temperatures and is one of the first minerals to crystallize out of molten rock. But at lower temperatures and in the presence of water, it is thermodynamically "unhappy and breaks down really quickly into other minerals", says Phil Christensen, a geologist at Arizona State University in Tempe, US.

He and colleague Victoria Hamilton of the University of Hawaii in Honolulu, US, have used infrared images taken with NASA's Mars Odyssey spacecraft to show that the olivine-rich rocks on the flank of the volcano Syrtis Major cover a surface area of 113,000 square kilometers - about half the size of the UK.

Higher resolution

That is nearly four times larger than the estimate made by NASA's Mars Global Surveyor (MGS) spacecraft. The difference has been attributed to Odyssey's ability to resolve details as small as 100 meters across, a 30-fold improvement over MGS. Christensen and Hamilton's study is published in the journal *Geology* (vol 33, p 433). The rocks, at a latitude of 20° north of the planet's equator, appear to have formed through successive lava eruptions about 3 billion years ago. "To keep olivine around so long suggests this area of Mars may not have seen a lot of water or a warm climate," Hamilton told *New Scientist*.

That finding differs markedly from the recent discoveries made by the Mars rovers of minerals that form in the presence of water. But Christensen says such discoveries represent rare flooding events lasting for weeks or months and that for most of the planet's 4.5 billion-year history, any water has been locked in ice.

"I am not a proponent of the idea that Mars had oceans in the past," says Christensen. He says mineral mapping from orbit reveals most of the planet is covered in volcanic rocks, which "shows most of Mars hasn't seen much water". Scientists have failed to find minerals such as carbonates and clays that form in oceans on Earth, he says.

"I'm moving in the direction of 'cold and dry' more and more," agrees Hamilton. "But there are other scientists headed in the other direction, thinking Mars was warmer and wetter. It is an ongoing discussion."



Olivine-rich rock appears magenta and purple in infrared images from NASA's Mars Odyssey spacecraft (Image: NASA/JPL/ASU)

The discovery of more olivine on the surface of Mars also supports the argument that underground reserves of the mineral could produce methane, says geologist Mukul Sharma of Dartmouth College in Hanover, New Hampshire, US. He and colleague Chris Oze detail their proposal in the journal *Geophysical Research Letters* (vol 32, L10203).

Olivine tends to sink when it crystallizes from magma, which "implies at some depth there has to be a lot more olivine than you see on the surface," says Sharma. The team says there is enough olivine in the top 10 kilometers of the crust to explain the recent detections of methane in Mars's atmosphere - if there are stores of liquid water underground, as many scientists suspect.

Water reacts with a common, iron-rich form of olivine by producing hydrogen gas, which then combines with carbon dioxide to produce methane. The gas could then leak to the surface through gullies.

"The easiest way to produce all the methane people have observed is by the reaction of olivine with water," Sharma told *New Scientist*. Other researchers have proposed that microbes might be a continuous source of the gas, which is easily destroyed by sunlight in the atmosphere.

Is it really quartz?

by B. Jay Bowman

The author must give you a little background. The author is not a mineralogist, but he is a Graduate Gemologist, with a diploma from the Gemological Institute of America. The author has been studying gems since the early 1950's. He was making jewelry and cutting stones for many years as well as reading extensively about various stones. He did not join a formal gem and mineral club until 1980, about the same time that he was finishing the GIA course of study. The author has been involved extensively since that time with judging and uniform rules for judging. It was shortly after the last AFMS Convention and show that the subject of this article came up. The author was informed that a study had been published showing that opal was not a variety of quartz and that the rules needed to be changed and widely disseminated before someone lost points in a display because of mislabeling. The author was informed that it was "widely recognized through the amateur ranks that opal was a form of quartz." After communications with several members of the EFMLS uniform rules committee and other rock hounds around the country, it was found that only a few of the people contacted had heard this before and only one of those thought that opal was a variety of quartz.

The author got out his books on mineralogy and gemology as well as going to the library to read books not in the author's possession. In none of these books was it found that opal was listed as a variety of quartz. Yes they are both silicon dioxide but so is cristobalite, which is listed separately from quartz grows in the triclinic crystal system, coesite which grows in the monoclinic system, and several others. They are all associated with quartz and each other but listed as separate minerals with varying optical and physical characteristics. None are called varieties of quartz and some have varieties of their own (cristobalite-variety, lussatite). So it appears that the mere fact that they have the same chemical formula does not make them all quartz. The AFMS Lapidary list does not include opal in its varieties of quartz. It does list several varieties of opal. The AFMS Mineral Classification List lists both quartz and opal as separate minerals. In one of the references opal is called a "mineraloid" because this reference says a true mineral must have a crystal form. You will also note in the Classification List all of the gem names of the various minerals are discredited. If opal was a gem variety of quartz then it would be discredited as a mineral name. Opal and quartz have distinctive differences in both optical and physical characteristics.

Opal is single refractive with a refractive index of 1.45 (-.080, +.020) and quartz is double refractive with refractive indices of 1.544 and 1.553. The hardness of opal is 5 to 6.5, quartz is 7. The specific gravity of opal is 2.15(-.17, +.07), Quartz is 2.66(+or-.01). Opal is amorphous, and depending on which book you read quartz grows in either the triclinic or the hexagonal crystal system. It does seem that the hexagonal system is mentioned more frequently. Back to the original question "Is it quartz?", the author does not think so and could go on citing many other reasons for this belief but thinks the ones cited should be sufficient to at least make any one who is interested and shows minerals to make their own study and find facts to The author does not judge minerals, but if he did and saw a case of all quartz with an opal in it he would take points off for out of class and require the exhibitor to show a reputable reference that said opal was a form of quartz. Based on the AFMS Lapidary List and the AFMS Mineral Classification List it is strange where this "widespread belief that opal was a variety of quartz" came from.

The Bibliography will be abbreviated since it would take up more space than the article if every reference used by the author was listed.

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from the AFMS Newsletter, 2/05, via BEMS E-Tumbler, 06/05