

Signs of old Mars: Written in the dust

A major question in the study of Mars concerns the planet's thin atmosphere — whether it was once thick enough for water to have flowed across the surface. Photos of the planet show what appear to be dry river beds, stream channels and floodplains, which most researchers argue could not have formed in the thin atmosphere of the present. But if today's cold, dry Mars once had a climate more like that of warm, wet Earth, where has its thick atmosphere gone?

This week, a team of scientists reported what "may be our first direct evidence that a warmer period, complete with liquid water, also existed on Mars." That evidence, according to Ted L. Roush of the NASA Ames Research Center in Moffett Field, Calif., lies in the planet's dust, which sometimes rises in huge dust storms that engulf the orb for months.

Most of the Martian atmosphere consists of carbon dioxide, and scientists have wondered why no conspicuous signs of carbonate rocks exist on the surface, which presumably would represent a reservoir of the carbon dioxide now in short supply. Last year, scientists reported spectral evidence of a mineral

called scapolite, which might have formed on Mars from the heat-processing of carbonate rock by volcanic activity (SN: 11/12/88, p.319). Other researchers have suggested those spectra may instead indicate carbon monoxide.

Now Roush's group reports signs of carbonate itself. Gases, or volatiles, thought present in Mars' early history include not only carbon dioxide but also water and sulfur dioxide. Hydrated minerals, incorporating water, have been reported in the past, but carbonates (containing CO_3) and sulfates (SO_4) have proved elusive. Roush, together with James B. Pollack, Carol R. Stoker and others from NASA Ames and the Lick Observatory in Santa Cruz, Calif., finds signs of both CO_3 and SO_4 in spectra measured through a telescope aboard NASA's Kuiper Airborne Observatory last Oct. 18.

They reported their findings this week at the 20th Lunar and Planetary Science Conference at NASA's Johnson Space Center in Houston, interpreting them as representing negatively charged carbonate and sulfate ions, whose spectra show up in sunlight reflected from dust in the Martian atmosphere.

The dust grains, according to the group, "represent reservoirs which could permanently incorporate a variety of atmospheric volatiles including CO_2 , SO_4 and water." Still, even if the spectral

identifications are correct, it remains uncertain whether they represent mementos of a Martian atmosphere that no longer exists. Nonetheless, they offer provocative evidence of a different sort than inferences drawn from interpreting photographs. Scientists have suggested, for example, that meteorite impacts or surges of heat from volcanic eruptions could generate liquid water by temporarily melting ice beneath the surface. This might be enough to cut river-like channels in the surface, even if a thin atmosphere promptly let the liquid evaporate or freeze.

Another important reason to resolve the atmosphere question, notes Roush's group, is that "the presence or absence of liquid water on Mars has strong implications regarding the formation of early forms of life there."

Materials on Mars are difficult to identify in spectra measured with telescopes on Earth's surface because of atmospheric interference. Several past attempts to identify spectral clues to such anionic complexes, as Roush's team notes, "all have failed."

However, from the airborne observatory at an altitude of about 40,000 feet, it was possible to identify strong "fundamental" bands, allowing seven separate spectral bands to be detected within a spectral wavelength range of 5.5 to 10.5 microns.

— J. Eberhart

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community to be told to believe that said skeletons were "clad in military attire" since to date we have found no clothing at all, and certainly not "military attire." The only data show small vestiges of textile threads made of cotton, along with collars and decorative elements.

(3) We have determined that the greater number of individuals have bone lesions of differing types. There are several female skeletons in this group. Some skeletons show mutilations and dental incrustations, along with other special aspects. I suggest that to postulate that we are dealing with "military personnel" does not rest on valid principles until such time as in-depth studies have been made of the overall physical characteristics of the skeletons.

(4) With respect to the "sacrifices" at Teotihuacan, other researchers had already confirmed that from approximately 200 A.D. onward there had been human sacrifices of varying kinds. The "new" data shown in the article were previously found by Mexican researchers.

(5) Some of the skeletons do have the hands tied behind their backs. But others do not. We should not speak of "plural sacrifices" as if it were all of them. Some of the individuals could have been volunteers for "eternal sleep." Our opinion is that the individuals probably represented a priestly class that governed Teotihuacan. However, this remains subject to additional studies to confirm the hypothesis.

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