Aqueous Transport of Atmospheric $^{13}CO_2$ to Martian Soil

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Proposed Research

It has been suggested[1] that the apparent balance between soil and atmospheric isotope ratios is evidence for relatively recent (past few hundred million years) liquid water on or just below the surface of Mars. In particular, ^{13}C abundance in carbonates of Martian meteorites has been measured and found to be similar to the atmospheric abundance. The temperature at which the carbonates formed and at what time in the rocks' history is not as well known. Our proposal is to study the transport of isotopes from a Mars like atmosphere prepared in the Andromeda simulation chamber to Mars soil simulant. This will be done with temperatures ranging from 230 K (average present day Mars temperature) to around 1000 K to correspond to the range of proposed temperatures for carbonate formation in previous works[2]. Soils will then be analyzed for enhanced $^{13}C/^{12}C$ ratios and formation rates inferred.

Mars Meteorite Images: a) Mars meteorite ALH 84001. b) & c) photomicrographs of carbonate bearing region in meteorite. d) false color SEM image of carbonate beads.

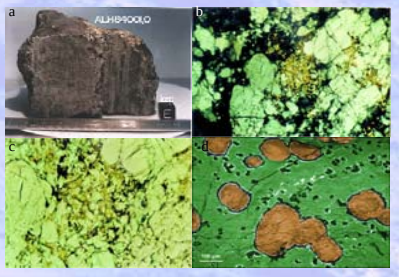

Table 1: Mars Isotope Ratios Relative to Terrestrial

D/H	5
$^{38}Ar/^{36}Ar$	1.3
$^{13}C/^{12}C$	1.05-1.07
$^{15}N/^{14}N$	1.7
$^{18}0/^{16}0$	1.025

Reproduced from [1].

Further Background[1]

Current theories for Mars climate history tell us that some 4 billion years ago Mars was much warmer and wetter. The atmosphere was about 6 times thicker than our current atmosphere, still almost entirely CO_2. About 3.9 billion years ago though, drastic changes occurred, brought on by a combination of increased meteor impacts and the loss of Mars' magnetic field which allowed solar winds to strip off gases from the upper atmosphere. The later process preferentially removed lighter isotopic gases leading to Mars' enhance isotope ratios (table 1) compared to the rest of the solar system.

The Setup

- 95% CO_2, 6 mbar atmosphere prepared in Andromeda chamber
- $^{13}CO_2$ introduced, initial runs may have exaggerated amounts (5-10%) to ease detection.
- Mars soil simulant prepared based on spectral data and meteorite composition.
- 1 week to 1 month exposure times.
- 2 proposed stages for exposure (figure 1).
  - Multiple small containers (held by Andromeda research bucket) each with own temperature or water content (figure 1 a).
  - Single tall container will study mobility of water from cold, dry conditions of Martian surface to warmer region where carbonates form (figure 1 b).
- Analysis by mass spectrometry to determine change in isotope ratios for carbonates in soil.

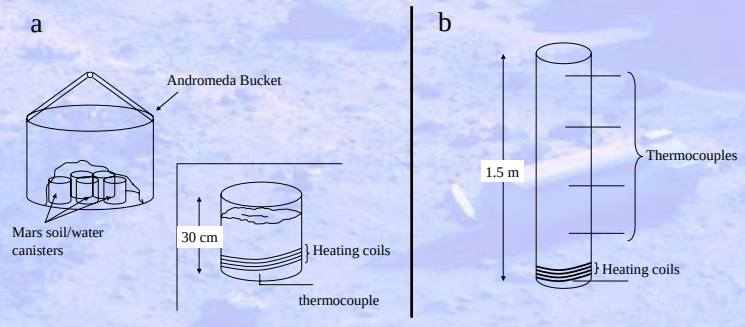

Figure 1.

Cited & Related Literature

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