Effects of Martian Surface Materials on the Thermal Decomposition of Hydrogen Peroxide

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While hydrogen peroxide (H_2O_2) has been detected in the martian atmosphere, it has not been detected in surface materials. Since the Viking lander mission, we have sent instruments to Mars with the capability to detect H_2O_2. The Sample Analysis at Mars (SAM) instrument onboard the Curiosity Rover and Thermal and Evolved Gas Analyzer (TEGA) instrument on the Phoenix lander both detected water and oxygen releases from analyzed sediments but whether or not peroxide could be the source of these gases has not been investigated. We are investigating the possible presence of H_2O_2 in martian materials by analyzing Mars-relevant minerals that have been mixed with hydrogen peroxide using lab instruments configured as analogs to Mars mission instruments.

The object of this research is to use lab instruments to find the effects of Mars analog minerals on hydrogen peroxide gas release temperatures, specifically gas releases of water and oxygen and also determine the effect of the peroxide on the minerals. Data that we get from the lab can then be compared to the data collected from Mars.

The minerals hematite, siderite, San Carlos olivine, magnetite and nontronite were chosen as our Mars analog minerals. ~20 mg of analog Mars minerals with 5µl of 50% H_2O_2, and were either run immediately or placed in a sealed tube for 2, 4, or 9 days to look for changes over time with two reps being done at each time step to determine repeatability. Each sample was heated from -60 °C to 500 °C at 20 °C/min and the evolved gases were monitored with a mass spectrometer. Each sample was also analyzed with an X-ray diffraction instrument to look for changes in mineralogy.

Preliminary results show three potential outcomes: 1) peroxide has no effect on the sample (e.g., hematite), 2) the mineral is unaffected but catalyzes peroxide decomposition (magnetite, siderite), or 3) peroxide alters the mineral (pyrrhotite, San Carlos olivine).