JAROSITE MORPHOLOGY AS INDICATOR OF WATER SATURATION LEVELS ON MARS K. Miller[1]
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Introduction: Jarosite, which has been identified on Mars [1] is an extremely sensitive recorder of environmental conditions. Water saturation levels are reflected in jarosite's distinctive morphologies. Sample return of jarosite would allow for the identification of these morphologies, providing evidence for the behavior/abundance of water on Mars. This work focuses on SEM images of jarosite collected at Davis Mine, in Rowe, MA. These images reveal two distinct morphologies, which are controlled by water saturation levels. The first, variable jarosite, requires abundant water; the second, donut jarosite, requires a minimal amount of water. The donut morphology may not have been previously described. Its presence suggests that jarosite can form with a very small amount of water, possibly just a film no more than a few microns deep.

Discussion: Samples for this work were collected by hand-auger from cores located in spoil piles and acid sulfate soils at Davis Mine. XRD analysis provided mineral identifications and relative quantification. SEM/EDS analysis confirmed mineral identifications and provided morphological data.

Variable jarosite (Figure 1) was collected from the stream area of a spoil pile. The sample was taken from within the water table fluctuation area. Water samples from this area measured a pH of about 3, and evidenced the high ion concentrations typical of acid mine drainage waters. Seasonal variations in pH and ion concentrations have been noted. [2]

Variable jarosite is identified by variability in size, from about 1 to 5 microns, variability in morphology, from pseudocubes to lathes, and some crystal dissolution. This morphology indicates a consistent water flow, with possible variations in ion concentration.

Figure 1. Variable jarosite, showing rounded pseudocubes, lathes, and an extensive size range.

Donut jarosite (Figures 2,3) was collected from the acid sulfate soils adjacent to the spoil piles. This jarosite morphology is distinguished by a size of less than .5 microns, consistent pseudocubic morphology, no evidence of dissolution, and crystal placement within a mantle only a few microns deep. This morphology suggests minimal water abundance. Therefore, identification of this jarosite type on Mars could suggest that liquid water, while present, could be very scarce, at least at this jarosite formation location.

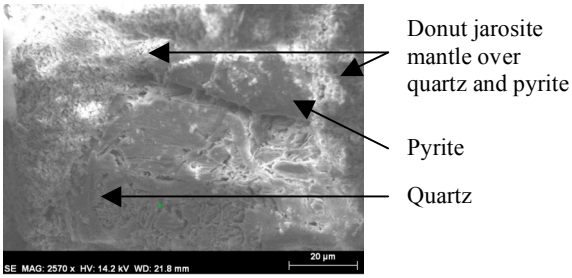

Figure 2. Donut jarosite mantle draped over substrates.

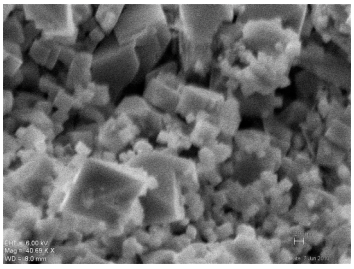

Figure 3. Donut jarosite. Magnification=40.69 K X

These two morphologies differ from that of jarosite produced by acid sulfate fog, which can take a rosette form [3], and from evaporite jarosite crystals, which can show little variation in size or morphology, but appear to be about 2 microns in diameter, with evidence of dissolution.[4]

Conclusion: Jarosite morphologies vary significantly, and provide information about water saturation levels. This work adds to the library of jarosite morphologies that can be linked to water flow behavior. Sample return would permit the analysis of Martian jarosite morphologies. This visual information can provide information about the subtle behavior of water on Mars.

References: [1]Klingelhofer, G. et al (2004), *Sci.*, 306, 1740-1745. [2]Bloom, J. (2005) *Natural Attenuation of Acid Mine Drainage in Groundwater and Streamwater at the Davis Pyrite Mine in Rowe, Massachusetts*, MS thesis. [3]Schiffman, P. et al (2006), *Geology*, 34, 921-924. [4]Hammarstrom, J.M. et al (2005) *Chem Geol*, 215, 407-431.