Measuring jarosite dissolution rates to determine jarosite lifetimes on Earth and Mars

M.E. ELWOOD MADDEN[1]*, J.R. GUESS[1], A.S. MADDEN[1] AND J.D. RIMSTIDT[2]

[1]School of Geology and Geopphysics, University of Oklahoma (*correspondence: melwood@ou.edu)
[2]Dept. of Geosciences, Virginia Tech

Lifetimes of metastable mineral particles in aqueous environments can be calculated based on the initial particle size and an appropriate dissolution rate for the mineral of interest using a shrinking sphere model. In this study. K- and Na- jarosite dissolution rates have been measured in the laboratory and the results applied to particle lifetimes to constrain the duration of liquid water at Meridiani Planum following the precipitation of jarosite. Na- and K-jarosite endmembers were synthesized using the methods of [1] and characterized using powder X-ray diffraction, BET surface area analysis, transmission electron microscopy, and atomic force microscopy. Batch reactor dissolution experiments were conducted at 293K. Samples were collected at predetermined intervals while pH was monitored and allowed to drift over the course of the experiment from inital pH = 6 to a final pH = 4.6-4.9 for K-Jarosite and 4.1 for Na-Jarosite . Centrifuged supernatant was measured using atomic absorption spectroscopy to determine K^+ or Na^+ concentration. Rates of K-jarosite and Na-jarosite dissolution in ultrapure water were calculated using the initial rate method [2] and were found to be $1.5x10^{-8}$ $molm^{-2}s^{-1}g^{-1}$ and $4x10^{-10}$ $molm^{-2}s^{-1}g^{-1}$, respectively. These rates are comparable to rates extracted from dissolution data in the literature [3,4] but are slower than AFM measurements of jarosite dissolution rate [5]. Assuming initial particle size of 1 mm diameter, laboratory measurements predict K-jarosite would to survive ~7 years in pure water, while Na-Jarosite would persist for ~250 years.

[1] Driscoll and Leinz (2005) USGS Report - 01C, Mineralogy of non-silicates No. TM 05-D1 [2] Rimstidt & Newcomb (1993) *GCA* **57**, 1919-34. [3] Baron, D. and C. Palmer (1996) *GCA* **60**, 185-195. [4] Smith *et al.* (2006) *GCA* **70**, 608-621. [5] Gasharova *et al.* (2005) C*hem. Geol.***215,** 499-516.

Enhanced Particulate Matter Surveillance Program: A multidisciplinary approach to understanding mineral dusts from the Middle East

J.P. ENGELBRECHT*, E.V. MCDONALD, J.A. GILLIES AND A.W. GERTLER

Desert Research Institute, 2215 Raggio Parkway, Reno, NV 89512-1095 (*correspondence: johann@dri.edu)

The purpose of the Enhanced Particulate Matter Surveillance Program (EPMSP) in the Middle East was to provide US Central Command with scientifically founded information on the chemical and physical properties of dust collected at deployment locations within their Area of Responsibility. Results from this program are available to the US Department of Defense's Occupational and Health Physicians, as well as environmental health professionals, to assist them in assessing the potential human health risks from exposure to ambient particulate matter.

Aerosol and bulk soil samples were collected during a period of approximately one year at 15 military sites – including Djibouti, Afghanistan (Bagram, Khowst), Qatar, United Arab Emirates, Iraq (Balad, Baghdad, Tallil, Tikrit, Taji, Al Asad), and Kuwait (Northern, Central, Coastal, and Southern regions). Three collocated low volume particulate samplers, one each for the total suspended (TSP), less than 10 μm in aerodynamic diameter (PM_{10}) and less than 2.5 μm in aerodynamic diameter ($PM_{2.5}$) particulates were deployed at each of the sites and operated on a "1 in 6 day" sampling schedule.

The purpose of the trace element analysis was to measure levels of potentially harmful metals. The major element and ion chemistry provided an estimate of mineral components which themselves may be hazardous to health or could be carriers of toxic substances. X-ray diffractometry provided a measure of the mineral content of dust, which is the main component of aerosols in desert regions. Scanning Electron Microscopy with Energy Dispersive Spectroscopy was used to analyze chemical composition of small individual particles of relevance to understanding mineralogical interrelationships such as surface coatings, intergrowths and other particle features. Secondary electron images provided information on particle size and shape, which also can be linked with human health effects.

Examples of findings from the EPMSP are discussed in the presentation.