ASTROBIOLOGICAL SIGNIFICANCE OF DEFINITIVE MINERALOGICAL ANALYSIS OF MARTIAN SURFACE SAMPLES USING THE CHEMIN XRD/XRF INSTRUMENT. S. M. Feldman[1], D.F. Blake[1], P. Sarrazin[1], D. L. Bish[2], S. J. Chipera[3], D. T. Vaniman[3], and S. Collins[4] [1]NASA Ames Research Center, MS 239-4, Moffett Field, CA 94035 (Sabrina.M.Feldman@nasa.gov), [2]Dept. Geological Sciences, Indiana University, Bloomington IN 47405, [3]Hydrology, Geochemistry, and Geology, Los Alamos National Laboratory, MS D469, Los Alamos, NM 87545, [4]CCD Imaging Group, Jet Propulsion Laboratory, MS 300-315L, Pasadena, CA 91109

The search for evidence of *habitability*, or of extant or extinct life on Mars, will initially be a search for evidence of past or present conditions supportive of life. The three key requirements for the emergence of life are thought to be liquid water; a suitable energy source; and chemical building blocks. CheMin is a miniaturized XRD/XRF (X-Ray diffraction / X-ray fluorescence) instrument which has been developed for definitive mineralogic analysis of soils and rocks on the Martian surface [1, 2]. The CheMin instrument can provide information that is highly relevant to each of these habitability requirements as summarized below.

Liquid water. CheMin can easily identify any minerals which require liquid water for their formation as well as mineralogical alteration products caused by the presence of liquid water.

Chemical Energy Sources. The CheMin instrument can also provide information on mineralogical energy sources for chemosynthetic lifeforms such as manganese(II) which can be oxidized to manganese(IV), ferrous iron which can be oxidized to ferric iron, and sulfide which can be oxidized to sulfate. In addition, CheMin can identify geochemical reactions such as the conversion of olivine to serpentine (which occurs only in the presence of liquid water) which could serve as an energy source for microbial organisms through the production of H_2 (the basis for many chemoautotrophic biochemical processes).

Chemical Building Blocks. The CheMin instrument will provide information on both the major elements (H, C, O, N, S, and P) and minor/trace elements thought to be required for life. These elements can be indirectly detected (e.g. through the identification of carbonates, phosphates, sulfates, and nitrates) or directly detected by the XRF spectrometer for $8 < Z < 92$. The CheMin instrument can also identify mineralized organic materials and biomineralization products.

Other habitability considerations. Definitive mineralogical analyses of Martian rock and soil samples can establish the environments of formation and alteration of a rock sample by determining temperature and pressure conditions of formation, present/past climate, water activity, the fugacity (activity) of biologically significant gases and the like. This information could provide insight into the early history of Martian volatiles and potentially establish the presence and lateral extent of hydrothermal systems.

In order to illustrate the CheMin instrument's capabilities, we will present results from the CheMin-III instrument (developed to the TRL-6 level) and describe three example Martian surface investigations in which CheMin data could be used to evaluate evidence of present or past habitability. The three are: (i) Evaporite rock strata such as found by MER-B at Meridiani Planum; (ii) an impact-gardened basalt environment such as found by MER-A at Gusev Crater; and (iii) a global Mars soil unit.

*[1] Blake et al. (1992) LPSC XXIII, 117-118. [2] Vaniman et al. (1998) JGR, **103**, 31477-31489.*