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SPECIAL COLLECTION: MARTIAN ROCKS AND MINERALS: PERSPECTIVES FROM ROVERS, ORBITERS, AND METEORITES

Wishstone to Watchtower: Amorphous alteration of plagioclase-rich rocks in Gusev crater, Mars

Steven W. Ruff[1,*] and Victoria E. Hamilton[2]

[1]School of Earth and Space Exploration, Arizona State University, Tempe, Arizona 85287-6305, U.S.A.
[2]Southwest Research Institute, Boulder, Colorado 80302, U.S.A.

Abstract

Previous observations by the Spirit rover in Gusev crater revealed a suite of rocks dubbed Wishstone and Watchtower Class in which the parent lithology and daughter products of a distinctive style of aqueous alteration are evident. Results from Spirit's Miniature Thermal Emission Spectrometer (Mini-TES; ~2000–340 cm^{-1}) were compromised by dust contamination of one of the instrument's mirrors, for which a correction has since been developed. Now we have documented nearly 200 examples of rocks encompassing the span of alteration from Wishstone Class, which spectrally resemble minimally altered plagioclase-phyric basalt, to the most altered Watchtower Class. Among them is a rock dubbed Bruce that may be a previously unrecognized alteration spectral end-member. We employed factor analysis/target transformation and linear least-squares modeling to investigate the spectral characteristics and mineralogy of these rocks. Our results amplify those of a prior preliminary analysis showing that alteration produced a material resembling basaltic glass that masks the spectral features of plagioclase. The association of this amorphous silicate component with a ferric iron nanophase oxide phase identified via Spirit's Mössbauer spectrometer is now clearly shown by our data, further characterizing the distinctive mineralogic expression of the alteration. These components and the absence of any recognizable secondary silicates or opaline silica may be an expression of alteration in the extreme aridity and cold of the martian environment. Similar mineralogic characteristics of soil measured with the CheMin X-ray diffraction instrument on the Curiosity rover in Gale crater may be an indication that this alteration process is widespread on Mars.

Keywords: Mars, alteration, thermal infrared, spectroscopy, plagioclase, amorphous materials