SEARCHING FOR SILICATE BIOWEATHERING ON EARTH AND MARS M. R. Fisk[1] and M. C. Storrie-Lombardi[2], [1]College of Oceanic and Atmospheric Sciences, 104 Ocean Admin Bldg, Oregon State University, Corvallis, OR 97331-5503 mfisk@coas.oregonstate.edu. [2]Kinohi Institute, Pasadena, CA 91001 mike@kinohi.org

Introduction: While recent Mars Express, Mars Global Surveyor, and Mars Exploration Rover findings of equatorial seas [1] and layered deposits [2] on the Mars surface offer the intriguing possibility of finding microfossil remnants of organisms trapped during an earlier warm, wet epoch, fossil preservation in such relatively soft, exposed habitats is problematic. In like fashion, Omega data documenting fluctuations in atmospheric methane [3] and the MARSIS evidence for subsurface water-ice deposits [4] open the possibility of an active subsurface Mars biosphere. Unfortunately the interesting depths for initial exploration of the Mars subsurface putative ecological niches are probably beyond the reach of the engineering constraints for Mars Science Lander.

On Earth more than half the global biomass resides in near and deep subsurface sites [5], primarily in well-protected silicate rocks similar to the Mars surface basalts. We have examined [6] the common, iron-magnesium silicate minerals olivine and pyroxene in surface and deep subsurface basalt and in mantle rocks on Earth to determine if they exhibit textures similar to bioweathering textures previously found [7-9] in basalt glass. Our results show that weathering in olivine may occur as long, narrow tunnels (1–3 μm in diameter and up to 100 μm long) and as larger irregular galleries, both of which have distinctive characteristics consistent with biological activity. These weathering textures in both olivines and glass are associated with characteristic clay mineral by-products and may exhibit alterations in elemental abundance distributions and contain residual nucleic acids.

We also examined olivine and pyroxene in martian meteorites, some of which experienced preterrestrial aqueous alteration. [6, 10] Some olivines and pyroxenes in the martian meteorite Nakhla were found to contain tunnels that are similar in size and shape to tunnels in terrestrial iron-magnesium silicates that contain nucleic acids. Though the tunnels found in Nakhla are similar to the biosignatures found in terrestrial minerals, their presence cannot be used to prove that the metorite alteration features had a biogenic origin. The abundance and wide distribution of olivine and pyroxene on Earth and in the Solar System make bioweathering features in these minerals potentially important new biosignatures that may play a significant role in evaluating whether life ever existed on Mars. Identification of these imaging and elemental abundance signatures is quite feasible using the instrumentation currently being proposed for MSL.

Science and Engineering Constraints: We propose that the MSL engineering capabilities and constraints are well-suited for an exploration of Mars surface and near subsurface basalts structures targeting residual textural and chemical bioweathering signatures. The landing site science requirements present quite favorable engineering characteristics. The scientific constraints include (a) evidence of relatively young volcanism, (b) likely eruption into water or ice, (c) presently exposed rock, (d) basalt surface relatively free of dust,and impact debris. These scientific constraints are easily met by a variety of Mars sites with exceptionally favorable engineering characteristics including (a) low altitude, (b) broad, smooth surface lava flows, (c) relatively low latitude, and (d) minimal surface incline. During the Mars Landing Site meeting we will present terrestrial examples of deep sea pillow lavas, Hawaiian volcano deep lavas exposed by landslides, and exposed pillow basalt outcrops. We will present multiple potentially comparable regions on Mars reviewing data derived from Mars Express, Mars Global Surveyor, and Mars Exploration Rover.

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