SEARCHING FOR BIOMARKERS AT THE OUTCROP SCALE. A. Olcott Marshall[1] and N.A. Cestari[1], [1]Department of Geology, University of Kansas, 1475 Jayhawk Blvd, Lawrence KS 66045 olcott@ku.edu n104c682@ku.edu

Introduction: In recent years there has been increasing interest in targeting localities on Mars with macroscale morphologies consistent with microbial activities [1]. These features include stromatolitic laminations [2-4] and sedimentary structures suggestive of microbial mats [5]. There has been extensive debate about whether stromatolitic morphology, even across multiple scales, are sufficient to determine biogenicity [6]. However, it is possible that such morphologies could serve as a way to identify samples worth further analysis by a rover or even caching for an eventual sample return mission. Here, we present the extractable biomarker content of samples collected from one core in the Green River Formation. Upon collection these samples were visually classified as "microbial" or "non-microbial" purely on the basis of their morphology, and then later gas chromatograph/mass spectrometer (GC/MS) analysis revealed that samples visually identified as "microbial" contained a higher concentration of more diverse biomarkers than those identified as "non-microbial," suggesting that this could be a viable detection strategy for selecting samples for further analysis or caching on Mars.

Green River Formation: Our Earth-based analog for this study, Green River Formation, was deposited ca. 50 Ma in a continental lake system that covered large portions of what are now western Colorado, northeastern Utah, and southwestern Wyoming [7-9]. These lakes were terminal lakes, and thus had no outlets and variable shorelines for most of their depositional history [10]. It is thought that these lakes were stratified, with anoxic (perhaps euxinic) bottom waters in the center surrounded by playa lake-like waters around the shore, as geochemical measurements have indicated that the water in the lakes was alkaline and often highly saline [7, 10, 11]. As the salinity and anoxia of the lake would increase, metazoan grazers would not be able to live in the lake, the classic conditions under which microbial mats can be preserved and lithified [12, 13], accounting for the wide variety of microbialites, stromatolites and thrombolites found in the Green River Formation [14]. The rocks of the Green River Formation provide an analog for lacustrine environments found on Mars [15], which could also have been deposited in playa-type environments, and may have precipitated carbonate or evaporative minerals.

Results and Discussion: Ten samples spanning the core were analyzed. At the time of collection, samples were categorized as microbial or non-microbial solely by visual inspection of their laminae as seen in unprocessed core, to mimic the types of visual identification that are necessary on Mars, where samples are currently identified as suggestive of microbial activity purely by their gross morphology [5]. Thus, samples containing carbonate-rich areas with wrinkled, crinkly, or other stromatolitic lamination were identified as microbial, while carbonate-rich samples with planar lamination were identified as non-microbial. An identical amount of each sample was then analyzed by GC/MS, to identify their preserved lipid biomarkers, representing the geological form of a biologically synthesized molecule. Different organisms synthesize different compounds in different environmental conditions, so the presence of a lipid biomarker can be quite informative, revealing ancient biota, paleoenvironments and redox conditions [16]. In addition to a suite of *n*-alkanes, samples identified as microbial contained pristane, phytane, monomethyl alkanes, hopanes and steranes. In contrast, only two non-microbial samples contained any detectable biomarker compounds, in the form of pristane and phytane, and those were at a much lower concentration than the microbial samples.

Remotely selecting samples suitable for in-depth chemical analysis is a process that requires making assumptions, as only limited information is available. However, these results show that a visual examination of morphology to identify potentially microbial samples can be a viable tool to select samples for further analysis.

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