A MINERALOGIC AND MORPHOLOGIC ANALYSIS OF FOUR NEW PHYLLOSILICATE-BEARING MARTIAN FAN DEPOSITS. A.C.G. Hughes1,2, D.M. Burr1, J. E. Moersch1, S.L. Murchie2, D.L. Buczkowski2, F.P. Seelos2, K.D. Seelos2; 1Department of Earth and Planetary Sciences, University of Tennessee, Knoxville, TN (aceughughes@gmail.com); 2JHU/Applied Physics Laboratory, Laurel, MD.

Introduction: Fan-shaped deposits are an important key to understanding the geologic history of Mars, as the unique characteristics of these deposits can suggest possible formation in a lacustrine environment [e.g., 1-4]. High-resolution remote sensing observations from the Compact Reconnaissance Imaging Spectrometer for Mars (CRISM), the High Resolution Imaging Science Experiment (HiRISE), and the Context Camera (CTX) on the Mars Reconnaissance Orbiter, have enabled detailed studies of these fans. Observations at several fans supporting a lacustrine origin include sub-horizontal layering, polygonal fracturing, and the occurrence of beds rich in phyllosilicates in fan deposits and their surroundings [5-8]. Phyllosilicates are of special interest because they can be formed or concentrated by sorting and redeposition, in lacustrine environments, and they are able to entomb organic materials [9].

Our study examines the 33 fans described by Irwin et al. (2005) [4], to test multiple hypotheses for the mechanisms that formed the fans (e.g., deltaic, alluvial fan, debris flow, volcanic flow, glacial deposition). All of the deposits discussed here are located at the mouths of valleys which incise crater rims, or in other topographic depressions hypothesized to be paleolake basins. This abstract presents the mineralologic and morphologic results for four fans newly identified to contain phyllosilicates (Fans #2, #21, #25, & #26, as named by [4]). Table 1 shows locations and data coverage of these fans.

Data and Methods: CRISM data (e.g. Figure 1) were used to analyze the mineralogy of all of the 33 fans identified by [4] and/or their nearby regions. Spectral indicators of major minerals were examined, and fans where phyllosilicates are detected were further characterized morphologically using HiRISE and CTX. Key diagnostic observations are the general morphology of the deposits (indicative of dominant formation processes), and the presence or absence of small-scale features associated with aqueous processes, including vertical stratification of layers (e.g., compositional layering), polygonal fracturing, large (HiRISE-resolvable) clast inclusions (indicating very poor sorting), inlet valleys, and fan distributary channels.

Observations and Interpretations:
Fan #26 Observations: Fe/Mg-phyllosilicates with absorption features at ~1.4, ~1.9, and ~2.2 µm, in the lower beds of the fan. Al-phyllosilicates have also been identified surrounding the knob on which Fe/Mg-phyllosilicates were previously identified. From the top of this knob to its base, the strength of the absorption feature associated specifically with Fe/Mg-phyllosilicates (~2.3 µm) decreases and the strength of the feature associated with Al-phyllosilicates (~2.2 µm) increases.

In addition to the fan-shaped deposit characterized by [4], there is an older depositional feature which lies stratigraphically below fan #26. Both of these deposits exhibit small-scale horizontal layering in their lower beds, determined by apparent variations in material strength of the rock layers. Polygonally fractured units are present in beds of the fan toe, and large boulder-sized clast inclusions are apparent in lower beds of the fan. Heavily eroded, radially oriented negative relief features are present on the fan surface.

Fan #26 Interpretations: Vertical stratification of layering is inferred based on variations in material strength of the rock layers (possibly indicating compositional layering or differences in grain sizes), and radial gullies on the fan surface suggest the presence of fan distributary channels. This deposit is unique because it is the first fan deposit in which both Fe/Mg- and Al-phyllosilicates have been identified, possibly indicating different lithologies deposited during a single or multiple fluvial events, or altered in place. The abundance of aqueous morphology and the presence of phyllosilicates in lower beds and surrounding areas of this fan are consistent with, but not diagnostic of, deltaic processes in the formation of this deposit and the older, superimposed deposit, previously hypothesized to be a delta or an alluvial fan [11].

Fan #21 Observations: Newly identified phyllosilicates are exposed in high albedo regions near the toe of this fan. CRISM spectra are consistent with Fe/Mg smectite. Strong signatures of Fe/Mg-phyllosilicates are also present in the watershed from which the fan’s inlet valley originates.

Small scale polygonal fractures are present in high albedo material distal to the fan toe and in upstream portions of the inlet valley.

Fan #21 Interpretations: Phyllosilicates are inferred to have been transported to this deposit due to the fact that they are present in both the lower beds of the fan and in the drainage basin. Polygonal fracturing and apparently segregated concentrations of phyllosili-
Lunar bedding, and concentrations of phyllosilicates in the be deltas or alluvial fans [14]. Phyllosilicates were pre-

nius Cavus is a paleolake basin [4, 10, 14]. The pres-

inverted channels. The polygonal fracturing, horizontal and positive relief sinuous ridges are inferred to be near the fan apex is inferred to be an incised channel, and positive relief sinuous ridges are inferred to be inverted channels. The polygonal fracturing, horizontal bedding, and concentrations of phyllosilicates in the center of this crater support the hypothesis that Isme

tures of negative and positive relief fluvial features are consistent with deltaic deposi-
tional processes in the formation of this fan.

Conclusions: Analyses in this study are ongoing, but preliminary results show that at least four fans, in addition to those previously documented in Holden, Eberswalde, and Jezero craters [5-8], exhibit both morphologic and detectable mineralogic evidence consistent with formation in a persistent surficial liquid water (e.g., lacustrine) environment.


Table 1: Locations and data coverage of fans

<table>
<thead>
<tr>
<th>Fan</th>
<th>Depression Name</th>
<th>Lat.</th>
<th>Lon. (E)</th>
<th>CRISM</th>
<th>HIRISE</th>
</tr>
</thead>
<tbody>
<tr>
<td>#26</td>
<td>Nepentes Mensae</td>
<td>2.1</td>
<td>121.6</td>
<td>FRT147 E0 FRT16525</td>
<td>ESP_015980_1820</td>
</tr>
<tr>
<td>#21</td>
<td>Aeolis Mensae</td>
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<td>132.85</td>
<td>FRT64CE FRT1963E</td>
<td>ESP_001884_1750</td>
</tr>
<tr>
<td>#25</td>
<td>Unnamed</td>
<td>-39.2</td>
<td>-103.4</td>
<td>FRT944A</td>
<td>PSP_006798_1405</td>
</tr>
</tbody>
</table>
| #2  | Isme

Caves | 33.9 | 17.5 | FRT19B14 | ESP_013531_2140 |

Figure 1: Spectra of Fe/Mg- and Al-phyllosilicates in/on fans, showing absorption features near 1.4, 1.9, and 2.2 µm (Al) or 2.3 µm (Fe/Mg).