Testing Formation Hypotheses for the Hypanis Deposit at the Edge of the Chryse Basin, Mars: Is it a Delta?

Jacob B. Adler*[1] and James F. Bell III[1]

[1]School of Earth and Space Exploration, Arizona State University, 781 E. Terrace Mall, Tempe, AZ 85287, United States

We test formation hypotheses for the Hypanis fan-shaped deposit in Xanthe Terra. This site was a candidate landing site for the ExoMars and Mars 2020 rover missions, and is a proposed human landing site. We found strong evidence supporting that the landform was an ancient delta. Previous crater counting work in the Hypanis Valles upstream catchment suggests that the deposit is ≥3.6 Ga (late Noachian) and was constructed in a period of fluvial activity prior to catastrophic outflow around 3.2 Ga. We constructed a high-resolution regional elevation mosaic, and determined that the fluvial sequence is consistent with a lowering/retreating shoreline. We utilized HiRISE images and HiRISE stereo DTMs to measure dip angles of exposed beds in the deposit's cliff walls and found layers are roughly flat (0° to 2° over large distances). We measured thermal inertia from THEMIS IR images, and found that the deposit likely consists of fine grains (150-240 J m^{-2} K^{-1} $s^{-1/2}$) and the surrounding darker-toned units (270-390 J m^{-2} K^{-1} $s^{-1/2}$) appear to embay and cap the Hypanis deposit. We interpret the geomorphology and composition of the light-toned deposit as incompatible with an alluvial fan or mudflow hypothesis. From our regional stratigraphic mapping we present a timeline of events which shaped the region. First, a Chryse impact formed a basin which filled with sediment. Then, a confined lake or sea formed allowing a large delta to be deposited near its shoreline. The water level receded to the north, and darker sedimentary/volcanic units covered the region. Freeze/thaw cycles and/or desiccation induced local fracturing. Lastly, wrinkle ridges associated with rounded cones warped the landscape. The ancient deltaic deposit we observe today was largely untouched by subsequent catastrophic outflows, and its surface has been only moderately reshaped by 3 billion years of aeolian erosion.