THE ROLE OF OBLIQUITY IN POST-NOACHIAN MARTIAN SURFACE CONDITIONS. M. Mansfield[1] and E. Kite[1], [1]University of Chicago Department of Geophysical Sciences, 5734 S. Ellis Ave., Chicago, IL 60637, meganmansfield@uchicago.edu

Introduction: Late-stage Martian alluvial fans suggest the presence of liquid water on post-Noachian Mars about 3.5 Gya[1], but by the late Noachian most of the conditions favorable to warm and wet climates no longer existed: much of Mars's atmosphere was lost before the Noachian and the Martian dynamo shut down around the mid-Noachian[2,3]. Insolation changes driven by orbital variability could offer a potential explanation for why late-stage Martian rivers were able to form under these unfavorable conditions[4]. We seek to understand the role of orbital variability in the post-Noachian Martian climate.

Modeling: To investigate the influence of orbital variability on post-Noachian surface water, physically consistent orbital histories were constructed using the mercury6 N-body integrator [5] and an obliquity code [6]. The orbital histories include periodic variations in orbital parameters, and most importantly include changes in obliquity, which for Mars has jumped from low mean values around 20° to high mean values around 40° between two and four times in its history[7]. These orbital histories were combined with solar brightening and a variety of estimates of Martian atmospheric loss to produce potential insolation histories, which were then used to determine the surface energy balance of a hypothetical Mars surface covered in water ice at 273 K[8,9]. Additionally, melting was only allowed to occur at obliquities greater than 40°, because the fluvial features of interest are located at low latitudes and water ice on the surface of Mars is most stable near the equator only at high obliquity[10]. At low obliquity, water ice on the surface of Mars is most stable at the poles[10].

To be a possible explanation of Martian surface features, these energy balance histories must fit three geologic constraints. First, sediment transport in post-Noachian deltas indicates that liquid water must have been present for at least 10 kyr[11]. Second, the presence of olivine in the river networks means that liquid water must not have been present for longer than 10 Myr during the most recent melting period[12]. Additionally, counts of craters interbedded in post-Noachian alluvial fans indicate that the total time during which periods of melting occurred must have been at least 10 Myr[13].

Results: Preliminary results indicate that the rate of Martian atmospheric loss has a strong influence on favorability of surface conditions toward the presence of liquid water. Significant melting occurs only in cases where the Martian atmosphere was relatively thick 3.5 Gya. However, this result will be affected by values chosen for the albedo and thermal inertia of Martian water ice. The extent to which these two factors influence the potential of Mars to host liquid water is being determined. Additionally, the original model examined only a flat horizontal surface, while the water source regions for the alluvial fans could be better modeled by sloping surfaces. The difference between the insolation received by horizontal and sloping surfaces is also being investigated.

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