New Insight on Mars: A Network of Ancient Lakes and Discontinuous River Segments

With an abundance of ice recently detected just below the surface of Mars [Boynton et al., 2002], the possibility that life has existed or still may exist on Mars may hinge on examining its past climate and the duration of surface water flows. Was Mars ever a warm and wet planet, or has it always been cold and dry? The study of surface depressions, in conjunction with river features, yields new insight into these questions. Together, these features provide a more complete picture of a surface water network that may have existed on what must have been a warmer early Mars.

River features found on the surface of the Martian highlands often appear and end abruptly, lack fine-scale features, and rarely develop into a well-integrated continuous river network [Carr and Malin, 2000]. One widely-accepted explanation for their formation and discontinuous nature is localized groundwater sapping [Aharonson et al., 2002; Goldspiel and Squyres, 2002]. However, we found that many apparently discontinuous river segments may have connected, or flowed into, an abundance of depressions resembling ancient lake beds on the highlands of Mars.

Examination of the river networks in conjunction with depression features shows that many river features begin at one depression and feed into the next (Figures 1 and 2). While most of the deep depressions originated from impact craters and may have been closed basins with limited contributing drainage area (Figure 1), the larger shallow depressions in the main channel system often contain multiple, highly eroded craters and show evidence of stream features in the extensive upland regions draining into them (Figure 2). Thus, their formation cannot be attributed to impact cratering alone. They also become increasingly shallow downstream, suggesting increased sedimentation from water or ice that may have once flowed through them upon the pre-existing surface features (N.G. Barlow, pers. comm., 2002). Using these methods, we were able to reconstruct how surface water may have once flowed across several large drainage basins in the Noachis Terra and Sabaea Terra regions of Mars. Examination of Mars Orbiter Camera (MOC) images [Malin et al., NASA’s online planetary photojournal] and the topographic features of the depressions shows that bottom features are smoother than upland regions, and many contain what may be layered lake bed deposits with some evidence of shoreline features (Figure 2) [Cabrol and Grin, 2001; Malin and Edgett, 2000].

The highly fragmented, incised valleys (shown in yellow), which resemble stream features, connect these depressions and can be identified both through hydrologic models and from visible inspection of topographic maps and MOC
Our results suggest that an active surface water network comprised of numerous lakes and streams may have existed on the surface of Mars at one time in its past. Still unclear is how long such a surface water network may have persisted, and under exactly what climate conditions. The answers to these questions may lie in further examination of the sediments that have accumulated across the many depressions of the surface water network.

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**References**


