Geophysical Research Abstracts
Vol. 13, EGU2011-11812-1, 2011
EGU General Assembly 2011

Effluent crater breaches and channels on Mars: processes, morphological relationships and implications for understanding hydrology

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This research investigates the relationships between discharges from impounded crater lakes on Mars and the channels incised at the crater rims and beyond. Of all channel geometry parameters, mean width is the most closely associated with discharge (Qw). Given the simple shape of most craters, which can be regarded as single event catchments dominated by slow inputs but rapid outputs, they comprise a useful test-bed for examining the relationships on Mars between effluent channel geometry, especially width, effluent volume and Qw. Consequently, they are valuable tools in the attempt to scale well established morphogenetic parameters from the Earth context to Mars [1].
Although craters breached by channels are common, the vast majority are influent. Craters with effluent breaches occur mainly near the equator or in low southern latitudes. Most are flat-floored, reflecting the presence of fill. The breaches and channels beyond are v-shaped to trapezoidal. The association of breach-channel systems by drainage of fluids impounded in craters, and the morphological characteristics of the breaches and channels, indicate formation by overtopping breaches, similar to embankment dam failures. The maximum discharge (Qmax) associated with overtopping dam breaches is a function of the potential energy (PE) of the impounded water above the height of the breach floor [2]. As PE is partly controlled by g, its control on breach hydrology is useful in scaling Qmax to morphology in the martian context. Also, given that martian impact craters have a consistent depth-to-diameter relationship and that the remaining control of PE is water surface elevation above the breach floor, both effluent Qmax and breach width (b) should be scaled according to crater diameter (D). This relationship is being examined and, so far, reveals that b is scaled by D. If substantiated, this relationship may hold promise as a basis for understanding the evolution of channel geometry on Mars.

[1] Coleman et al. (2007) Icarus 189, 344-361.
[2] Costa and Schuster (1988) GSA Bulletin, 100, 1054-1068.