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MGS MOC PERSPECTIVES ON THE ROLE OF FLUIDS IN IMPACT CRATER FORMATION AND MODIFICATION

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The majority of the > 75,000 Mars Global Surveyor (MGS) Mars Orbiter Camera (MOC) high resolution (0.5–15 m/pix) narrow angle (NA) images acquired to date show impact craters. Many were specifically targeted to address the role of volatiles, particularly groundwater, ground ice and liquid water, in the formation and modification of impact craters. The lobate margins of ejecta associated with martian rampart craters have long been interpreted as resulting from a bolide impacting a fluid-laden substrate. However, meter-scale evidence for the role of fluids in ejecta emplacement is absent: there is no indication that boulders on the ejecta were transported in a flowing fluid nor are there channels on or beyond the ejecta indicating dewatering of a flow. Fluids may be involved in the generation of fan-shaped landforms on crater walls during or closely associated with the impact event in one exceptional Xanthe Terra crater. The fans in 'Mojave' Crater (provisionally-accepted IAU name; 7.6°N, 33.0°W) have morphological characteristics consistent with fluid-driven alluvial sedimentation, including tributary and distributary channel networks. The MOC imaging and research effort reveals abundant geologic evidence supporting post-impact modification of martian craters by volatiles, particularly fluids. Meter-scale evidence for glaciation or ice-related modification of craters in the MOC dataset is controversial (e.g. rare tongue-shaped lobes on crater walls, polygonal patterns on high-latitude crater floors). Young gullies on middle- and high-latitude crater walls have attributes consistent with the flow of fluids. An extensive campaign to survey new crater walls, complete MOC NA coverage and monitor known gully sites has been ongoing for > 3 years. Examination of > 14,000 individual gullies yielded the following results: (a) no new gully formation observed, (b) gullies are located poleward of 30° (few examples poleward of 27°S), and (c) contrary to the original report, gullies do not exhibit a pole-facing preferential orientation. Subaerial and subaqueous sedimentation occurred within many crater basins. Where a valley enters a crater, if a depositional apron is present it is one of two types: 1) single-lobe apron with concentric steps interpreted to result from mass movement, or 2) single and multiple-lobe aprons with distributary drainage patterns interpreted to be alluvial fans or deltas. Noteworthy is the 'Eberswalde' Crater (24.3°S, 33.5°W) fan complex, interpreted as a lithified and eroded deltaic deposit. Persistent fluvial activity is indicated by an inverted relief cut-off meander loop at this site. Finally, the MOC NA dataset has yielded insights into the 'cratered volume' nature of the upper martian crust, including the recognition that craters can be filled, buried and exhumed. Fluvial processes and lacustrine sedimentation were involved in the development of layered strata within craters as well as strata that buries craters.

Key Words:
5415 Erosion and weathering
5420 Impact phenomena (includes cratering)
5470 Surface materials and properties