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Observation and interpretation of an inverted channel feature in the middle member of the Medusae Fossae Formation

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Our work details the first mapping and analysis of an unusual set of martian geomorphological features located on the central lobe of the Medusae Fossae Formation, centered at roughly 5°S, 179°E. These features include an apparent inverted channel system located within a scallop-edged depression and associated with a large crater. In particular it is the inverted channel which is of principal interest, as equivalent examples have yet to be mapped this far eastward in the formation [1,2]. Additionally, there is very good imaging coverage of these features from the High Resolution Imaging Science Experiment (HiRISE; NASA/JPL/University of Arizona) at $\sim$ 30 cm/pixel resolution and the Context Imager (CTX; NASA/JPL/MSSS) at $\sim$ 6 m/pixel.

Positive relief channels are a well studied phenomenon on Earth and can form when a fluvial channel becomes more resistant to erosion than the terrain around it and is then left high-standing as erosion occurs. Processes that lead to such topographic inversion include cementation or armouring of the channel floor, infilling of the channel and even capping by lava [3]. The positive relief channel system described here is over 14 long and over 11 km wide. It lies within a scalloped edged depression of $\sim$ 16 km diameter, which itself intersects with a 20 km diameter impact crater to the north. In planform, the channel system appears dendritic with uneven edges and large (often near right-angled) junction angles between the branches.

From available evidence, including the branching planview pattern, the topography and association with apparent amphitheatre-shaped headscarps, we interpret the inverted relief feature as a relict fluvial channel. We hypothesize that material which appears to "resurface" the floor of the crater to the north is the same material from which the channel is formed and that it flowed northward into the crater, having ponded against and then breached its southern rim.

We will discuss potential models for the origin and development of these features, and how they fit within the regional context of the Medusae Fossae Formation. We conclude that the network formed as a result of mobilization of volatiles from within the Medusae Fossae Formation. These materials could be ice-rich volcanic ash deposits [1] or cyclical deposits laid down in periods of high obliquity [4].

[1] Burr et al., 2010, Journal of Geophysical Research 115, E07011.
[2] Zimbelman and Griffin, 2010, Icarus 205 (1), 198-210.
[3] Pain and Ollier, 1995, Geomorphology 12, 151-165.
[4] Head & Kreslavsky, 2004, Lunar and Planetary Science XXXV Abstract #1635.