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Evolution of catastrophic flooding in the circum-Chryse outflow channels from the Mars Express High Resolution Stereo Camera

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The circum-Chryse outflow channel systems of Mars are the largest known erosional planetary landscapes in the Solar System, and are widely considered to have formed by catastrophic floods released from groundwater aquifers. Understanding their history of water discharge is important to reconstructing the global hydrological cycle on Mars, and establishing the occurrence of putative oceans. Despite numerous observational and numerical modelling studies, the geomorphological evolution of the channels and the water discharges involved in their erosion remain poorly constrained. The lack of high-resolution topographic data over the outflow channels has hindered reconstruction of their detailed history of flooding and accurate determination of channel dimensions with which to constrain their palaeohydrology. Recently acquired image and topographic data from the High Resolution Stereo Camera (HRSC) onboard Mars Express (Neukum et al. 2004) permit detailed reconstruction of the morphology of outflow channel in the southern part of the Chryse Planitia (Xanthe Terra). High-resolution digital terrain models of outflow channels such as Ares Vallis coupled with orthoimagery reveal distinctive morphological evidence that indicates outflow channel incision was accomplished by multiple episodes of catastrophic flood erosion rather than in single events. Our observations suggest that catastrophic release of water from subsurface aquifers in the chaos source regions occurred at repeated intervals involving smaller water discharges than inferred by previous studies, thus supporting recent

numerical modelling studies. Here we present geological and geomorphological evidence for catastrophic flood channel evolution, and place constraints on their palaeohydrology.