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Morphology and palaeohydrology in Ares Vallis outflow channel: Constraints on water discharge rates from Iani Chaos

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The Martian outflow channels form some of the most dramatic landscapes on the surface of the planet and attest to the largest episodes of erosion of the Martian surface. They are widely believed to have been carved by enormous episodes of catastrophic flooding resulting from abrupt groundwater release. Previous estimates of water discharges associated with formation of the outflow channels have been limited by the ability to accurately determine flood stages from geomorphic indicators in the landscape, lack of spatially continuous topographic data, and associated problems of using interpolated MOLA data. Here we use orthoimagery and high-resolution topographic data derived from the High Resolution Stereo Camera (HRSC) on the Mars Express Mission (Neukum et al. 2004) from the proximal reach of the Ares Vallis to investigate the processes responsible for channel formation and better constrain estimates of channel-carving discharges. The Ares Vallis is a major outflow channel that empties into the Chryse Planitia. It originates at a source region characterised by collapsed chaotic terrain, called the Iani Chaos. Here, we examine the zone of transition between the Iani Chaos and Ares Valles to investigate the morphological evidence for flood-flow produced features. In particular we focus on critical evidence for flood stage indicators. Previous estimates have generally considered bankfull flow conditions, but we identify a variety of landscape elements that provide tighter constraints on flood high-water marks because of the resolution of the topographic data. Such features include terraces on valley margins, the heights of streamlined islands present

on the channel floor, and relationship of tributary channels to the main channel stem. Our detailed (50m gridded topographic data when coupled with recent new guidelines in estimating palaeohydrologic parameters for Martian systems (Wilson et al. 2004; Kleinhans, 2005) enable us to make new estimates of water discharge for Ares Vallis. These data aid in understanding the development of Iani Chaos and its relationship to Ares Vallis.