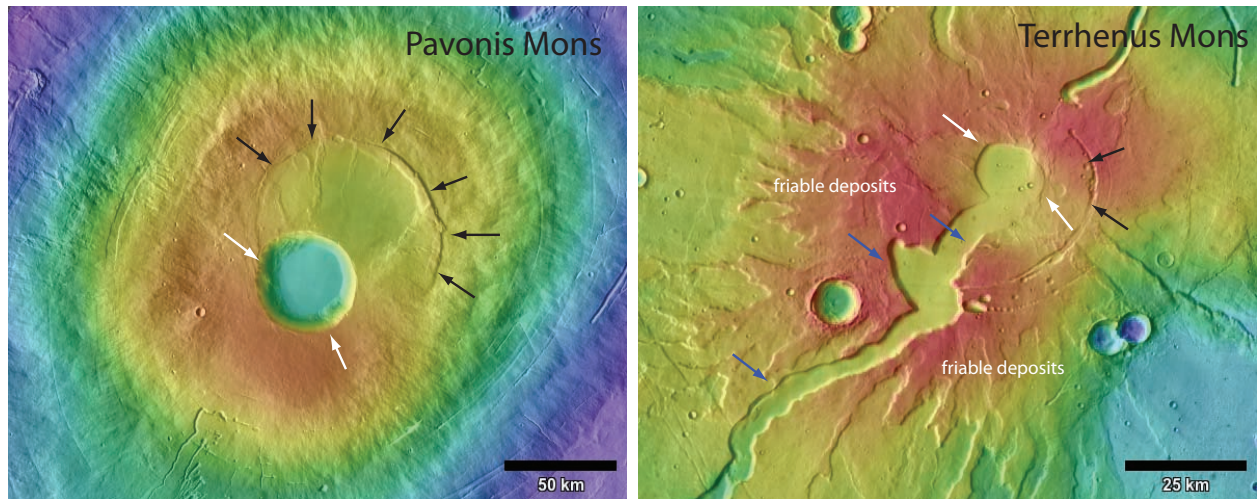
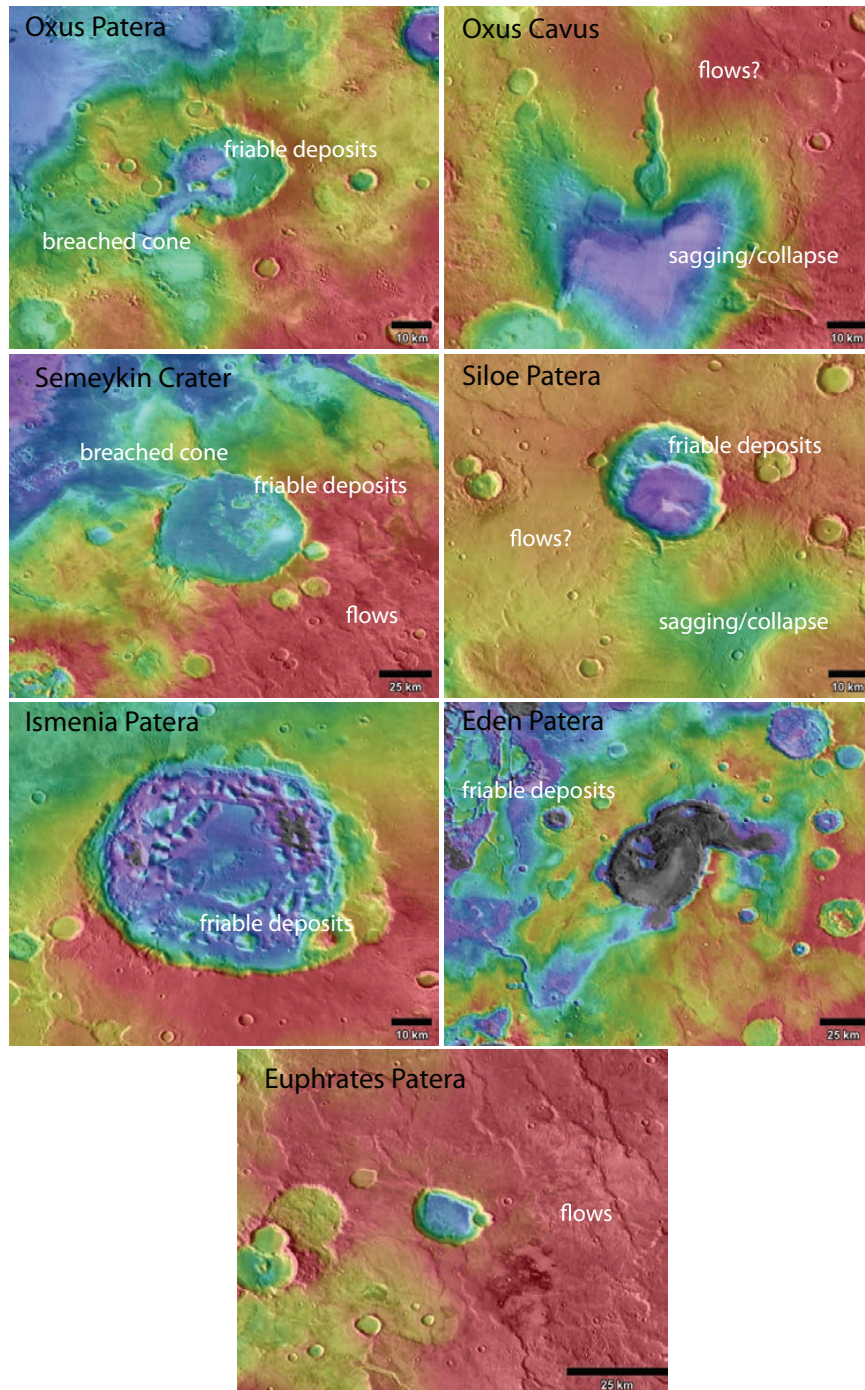
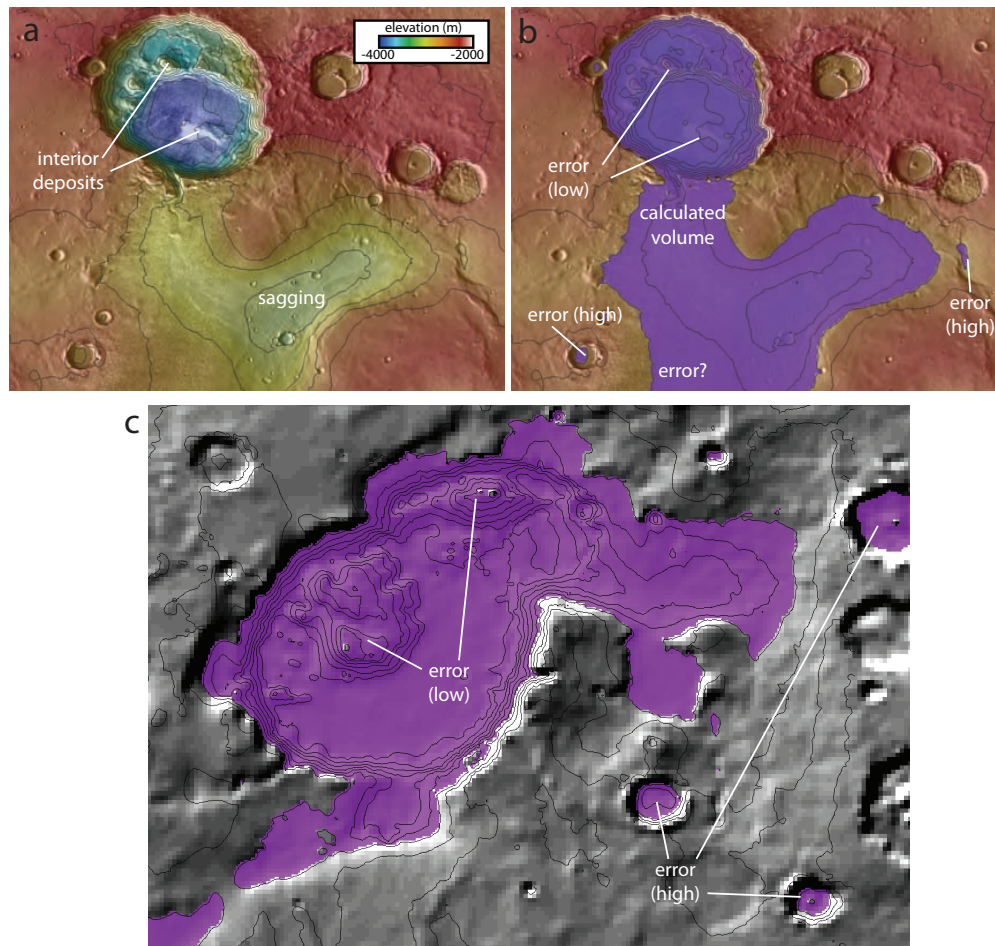




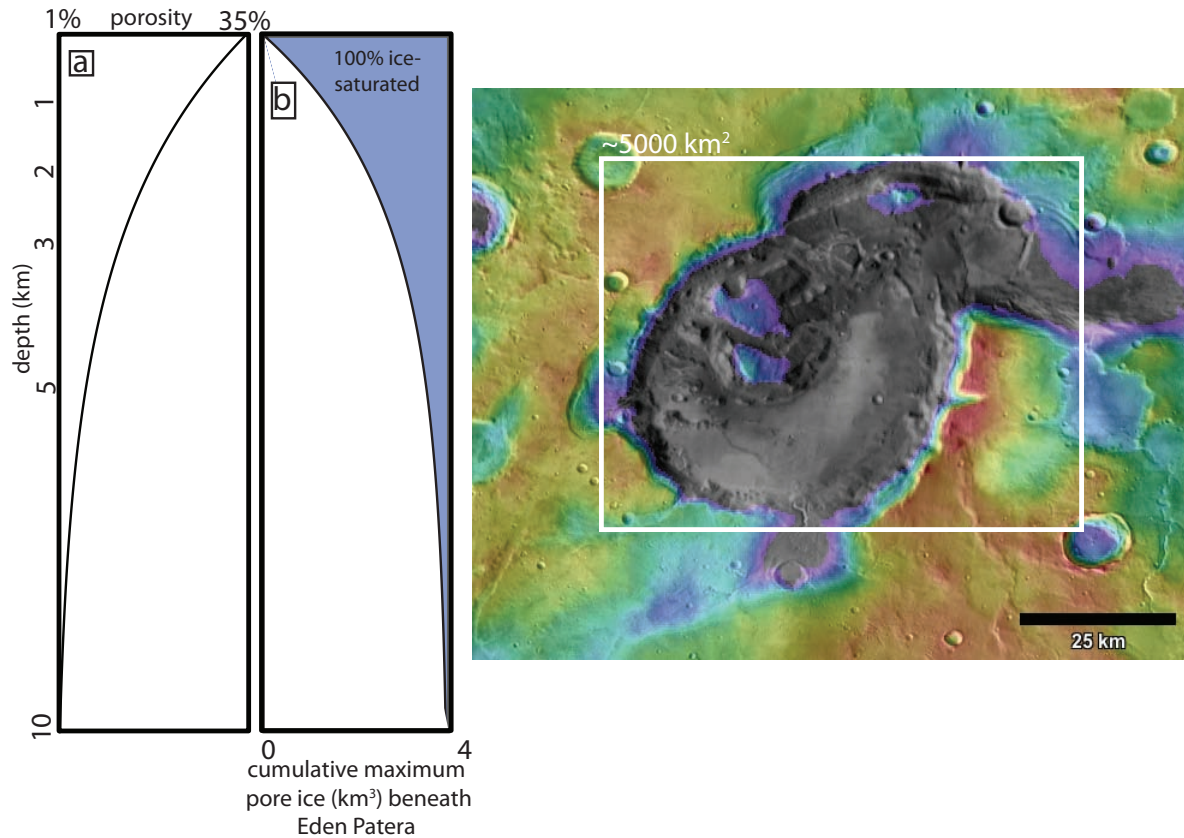
Supplementary Figure 1: MOLA elevation data draped onto THEMIS daytime IR for Pavonis Mons - a Noachian-Hesperian shield volcano- and Tyrrhenus Mons – a Noachian explosive volcano. White arrows point to the central vent. Black arrows point to collapse outside the main vent. Blue arrows point to breached rims and eroded channels possibly produced by lavas, interaction of lava with ice, or pyroclastic flows themselves.



Supplementary Figure 2: MOLA elevation data draped over THEMIS daytime IR for the 7 features discussed in the main text. The features all contain evidence for collapse, and generally are associated with lava flows, friable materials or both.



Supplementary Figure 3: Illustration of volume calculations at Siloe Patera (a-b) and Eden Patera (c). The volumes calculated correspond to void space above modern topography and below a plane fit to the estimated height of the depression (marked by purple color). Errors (low) correspond to areas where underestimation has occurred. Errors (high) correspond to areas where overestimation might have occurred.



Supplementary Figure 4: : Porosity declines as a function of depth on Mars according to equations described by Clifford et al. [36] (a). Given a surface area over which the depression occurs (e.g. $\sim 5000 \text{ km}^2$ for Eden Patera), we calculated the cumulative maximum ice content of the subsurface as a function of depth assuming all of the pore space is entirely filled with ice (b). Panel "c" shows the projection of a 5000 km^2 area over Eden Patera.