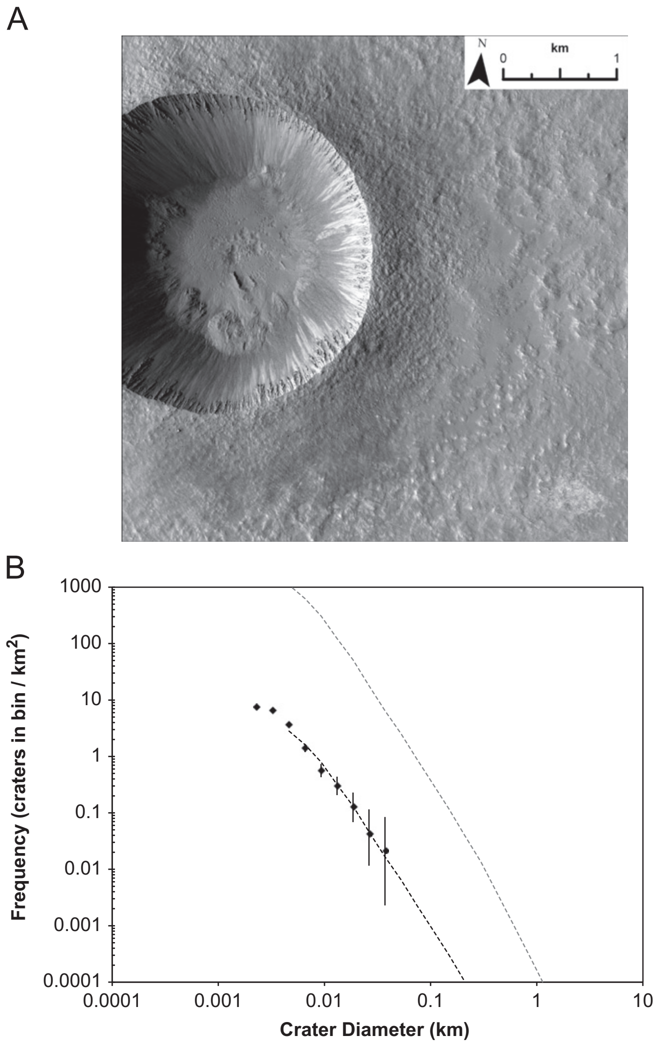

Fig. 14. (A) Zumba crater (28.7°S, 226.9°E) is a 2.9-km diameter rayed crater identified by Tornabene et al. (2006) in Daedalia Planum. No evidence of latitude-dependent mantling is observed. Zumba is a plausible launch crater for some martian meteorites. Portion of HiRISE: PSP_003608_1510. (B) A crater count revealed 1197 craters on 46.0 km^2 of near-rim deposits surrounding the unnamed crater (28.7°S, 226.9°E). Isochrons of Hartmann (2005) indicate a best-fit age of 0.7 Ma. Hartmann et al. (2010) report a crater retention age for Zumba crater of 0.1 to 0.8 Ma. The grey dashed line marks the Early Amazonian boundary of Hartmann (2005).

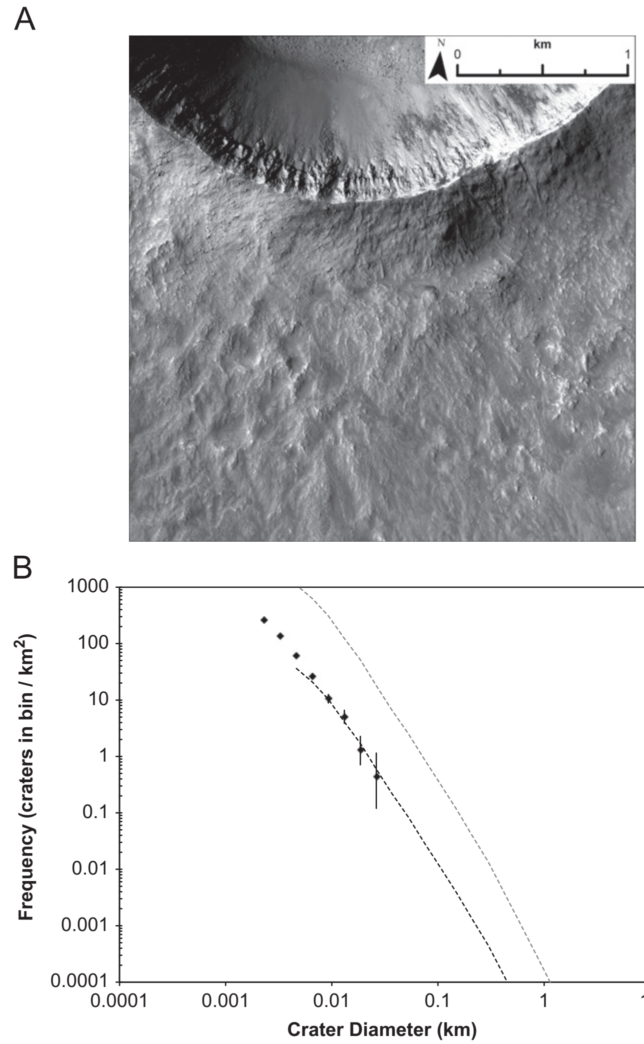

Fig. 15. (A) An unnamed 3.4-km diameter crater is found in Terra Cimmeria (29.5°S, 163.1°E). No evidence of latitude-dependent mantling is observed. Portion of HiRISE: ESP_020752_1500. (B) A crater count revealed 5408 craters on 4.5 km^2 of near-rim deposits surrounding the unnamed crater (29.5°S, 163.1°E). Isochrons of Hartmann (2005) indicate a best-fit age of 0.9 Ma. The grey dashed line marks the Early Amazonian boundary of Hartmann (2005).

estimate. Because basaltic shergottites have ejection ages ranging from 20 to 0.7 Ma and are from surface lava flows with crystallization ages of ~175 Ma and 330–475 Ma (Nyquist et al., 2001), Zumba is a plausible launch crater for some martian meteorites (e.g., Tornabene et al., 2006; Lang et al., 2009). An un-mantled 3.4-km diameter crater in Terra Cimmeria (Fig. 15(A)) has a crater retention age of 0.9 Ma (Fig. 15(B)). This crater (29.5°S, 163.1°E) provides the temporal constraint that geologically-recent mantling deposits have not been emplaced here since formation of the crater, although it is also possible that a mantling unit was emplaced and entirely removed allowing for the accumulation of the observed crater size frequency distribution over a total un-mantled period of at least 0.9 Ma.

Evidence of latitude-dependent mantling deposits and gullies are observed in association with a 1.8-km diameter crater (Fig. 16(A)) in Promethei Terra (32.2°S, 116.2°E). A triangular avoidance zone in the ejecta pattern (Fig. 16(A)) suggests this crater formed in an oblique impact (e.g., Gault and Wedekind, 1978). Mantling deposits within the crater are concentrated on the pole-facing wall and have a degraded morphology that is commonly associated with gully formation (Milliken et al., 2003; Christensen, 2003; Dickson and Head, 2009; Schon and Head, 2011a). In a survey of concentric crater fill deposits and younger latitude-dependent mantle related gullies (Dickson et al., 2011), similar isolated deposits have been observed to occur preferentially on pole-facing slopes at this latitude. Because mantling is not observed on the surrounding terrain, we interpret our crater count (Fig. 16(B)) to represent the formation age of the crater and a bound on the age of the degraded mantling and gullies within the crater, which must be younger (i.e., <26.8 Ma).

Finally, Gasa crater (35.7°S, 129.4°E) provides an example of a young crater that post-dates regional latitude-dependent mantling (Schon and Head, 2011b). Secondaries from ~1.2 Ma Gasa have been used as a stratigraphic marker (Schon et al., 2009b) and the apex slopes of gully fans within Gasa have been compared to other mid-latitude gully deposits (Kolb et al., 2010). Gasa occurs within an 18-km diameter crater that is draped with latitude-dependent mantling deposits. Extensive evidence for the presence of a debris-covered glacier has been documented in the host crater, and melting of this ice by the Gasa impact is the likely source of meltwater for the development of gullies within Gasa