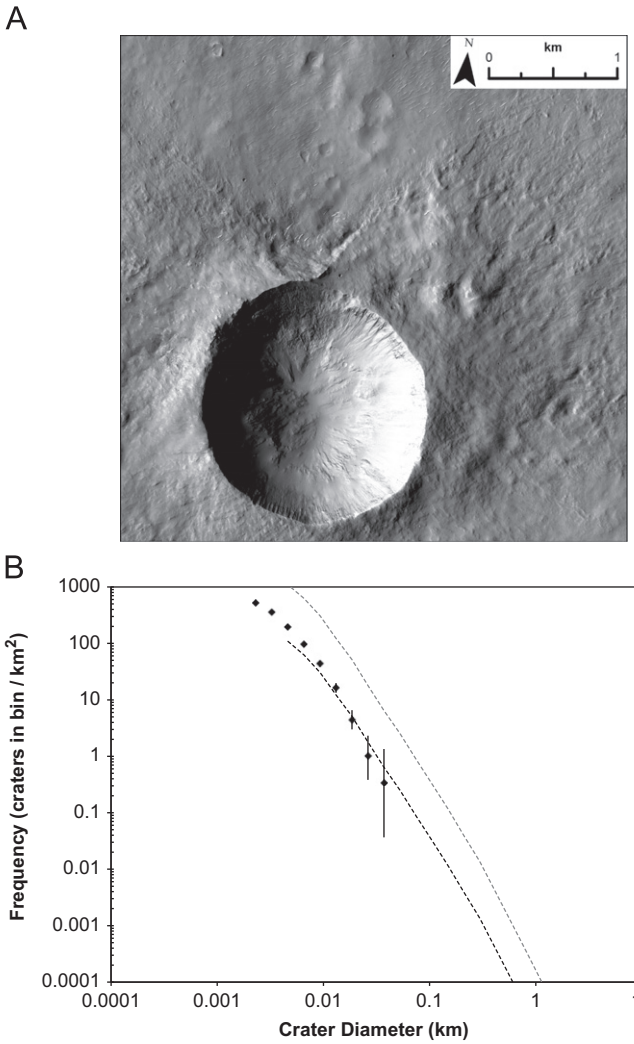

Fig. 16. (A) An unnamed 1.8-km diameter crater is found in Promethei Terra (32.2°S, 116.2°E) A triangular avoidance zone in the ejecta pattern (at top) indicates that this crater formed in an oblique impact. A small area of remnant latitude-dependent mantling is concentrated on the pole-facing crater wall in association with several gullies. Portion of HiRISE: ESP_020701_1475. (B) A crater count revealed 4834 craters on 2.9 km^2 of near-rim deposits surrounding the unnamed crater (32.2°S, 116.2°E). Isochrons of Hartmann (2005) indicate a best-fit age of 26.8 Ma. The grey dashed line marks the Early Amazonian boundary of Hartmann (2005).

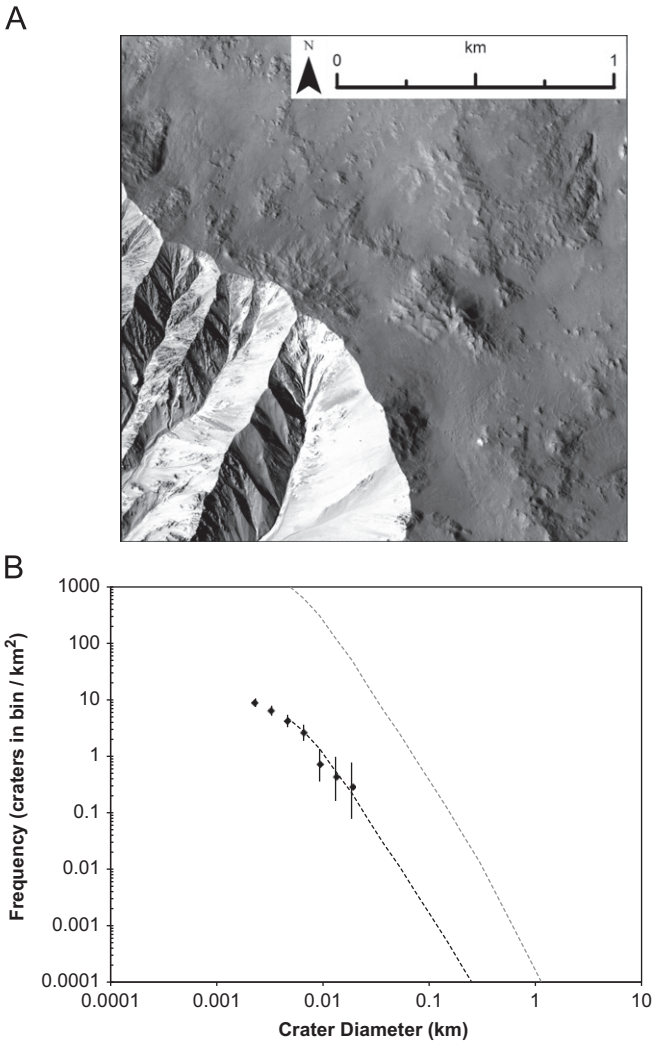

Fig. 17. (A) Gasa crater (35.7°S, 129.4°E) is a 7.0-km diameter rayed crater in Promethei Terra. Rays and secondaries from Gasa are observed on latitude-dependent mantling in the area (Schon et al., 2009b; Schon and Head, 2011b). Gully development within Gasa has been linked to impact into a debris-covered glacier (Schon and Head, 2011b). Portion of HiRISE: PSP_004060_1440. (B) A crater count revealed 289 craters on 6.8 km^2 of smooth near-rim deposits surrounding Gasa crater (Schon et al., 2009b). Isochrons of Hartmann (2005) indicate a best-fit age of 1.2 Ma. The grey dashed line marks the Early Amazonian boundary of Hartmann (2005).

(Schon and Head, 2011b). Therefore, although Gasa has gullies (Fig. 17(A)), it is a young crater (Fig. 17(B)) that postdates emplacement but not degradation (gully formation) of latitude-dependent mantling in its region. Crater rays from Gasa are observed on the latitude-dependent mantle (Schon et al., 2009b).

5. Interpretations of LDM chronology

Obliquity-driven climate change has long been recognized as an important feature of the Amazonian (e.g., Ward, 1973; Sagan et al., 1973; Soderblom et al., 1973; Toon et al., 1980; Touma and Wisdom, 1993). Recognition of the latitude-dependent mantle and its youthfulness (Kreslavsky and Head, 2000; Mustard et al., 2001; Kreslavsky and Head, 2002) led to the interpretation of a recent ice age during a period of enhanced obliquity variation from 2.1 to 0.4 Ma (Head et al., 2003). With new sub-meter resolution image data, crater counts on homogenized surfaces can be used to constrain the history of this deposit. We present the isochron fits to our crater counts in Table 1. Of course using small craters and areas for dating leads to some uncertainties (Hartmann, 2005; Hartmann, 2007; Hartmann et al., 2010) and we thus do not use these values for specific individual age constraints, but rather we base our interpretations and conclusions on multiple crater counts and factor-of-several to factor-of-ten differences in crater retention ages.

In our interpretation, crater retention ages <1 Ma (Fig. 5; Fig. 6; cf. Kostama et al., 2006; Levy et al., 2009; Kreslavsky et al., 2011), in conjunction with the pervasive mantling and polygonalization of decameter and larger craters, are consistent with the emplacement of ice-rich latitude-dependent mantling during the most recent ice age (2.1–0.4 Ma; Fig. 18, Fig. 19). Crater retention ages of <1 Ma and the timescale of polygon formation suggest that thermal cycling could form polygons under current conditions (e.g., Korteniemi and Kreslavsky, 2011). The absence of rayed craters from these latitudes also supports our interpretation of geologically recent mantling events.

Our observations indicate that the current equatorial margin of remnant latitude-dependent mantle is variable as might be