How can the absolute age of this mantle be determined? Emplacement of the latitude-dependent mantle has been described as a martian ice age, driven by variations in orbital and spin-axis parameters, dominantly obliquity (Head et al., 2003). Large variations in Mars' obliquity (tilt of the planetary axis of rotation relative to the orbital plane) have long been recognized as having a large influence on martian (paleo)climate (Ward, 1973; Sagan et al., 1973). These variations are chaotic (e.g., Touma and Wisdom, 1993), but robust numerical solutions for the recent geologic past (20 Ma to present) have been developed by Laskar et al. (2004). A period of enhanced obliquity oscillations from 2.1 Ma to 400 kyr has been described as Mars most recent ice age, during which the observed latitude-dependent mantling was emplaced (Head et al., 2003; Levrard et al., 2004). In this paradigm, the previous ice age waned approximately 2.8 Ma (Head et al., 2003). Similarly, based on the obliquity record (Laskar et al., 2004), Schorghofer (2007) has performed simulations that suggest "forty major ice ages over the past five million years." These advances and retreats of ice stability are of varying extents (Schorghofer and Aharonson, 2005; Schorghofer, 2007) with unknown preservation of geologic evidence, though layered margins (Schon et al., 2009a) certainly support multiple episodes of mantle emplacement.

The youthfulness of high latitude mantling is inferred from the pervasiveness of un-modified polygonally patterned ground (Kreslavsky et al., 2011). Initial efforts to date the mantle by Kostama et al. (2006) using superposed craters suggested a very young crater-retention age and a latitudinal trend toward older mantle surfaces equatorward. These studies lead to a series of questions: What is the absolute age of the LDM? Does mid-latitude (~30°) mantling date from the most recent period of enhanced obliquity variations (~2.1 to 0.4 Ma)? What is the age of the LDM surface at high latitudes, and does it differ from that at lower latitudes? In this investigation we use new sub-meter resolution data from HiRISE (McEwen et al., 2007) to investigate the age and chronology of the ice-rich latitude-dependent mantle at both high latitudes (>60°) and the mid-latitude margin (30°). As part of our study, we date several equatorial rayed craters, which provide additional confirmation regarding the applicability of using small craters to date young surfaces and the validity of the crater chronometry system (e.g., Hartmann et al., 2010).

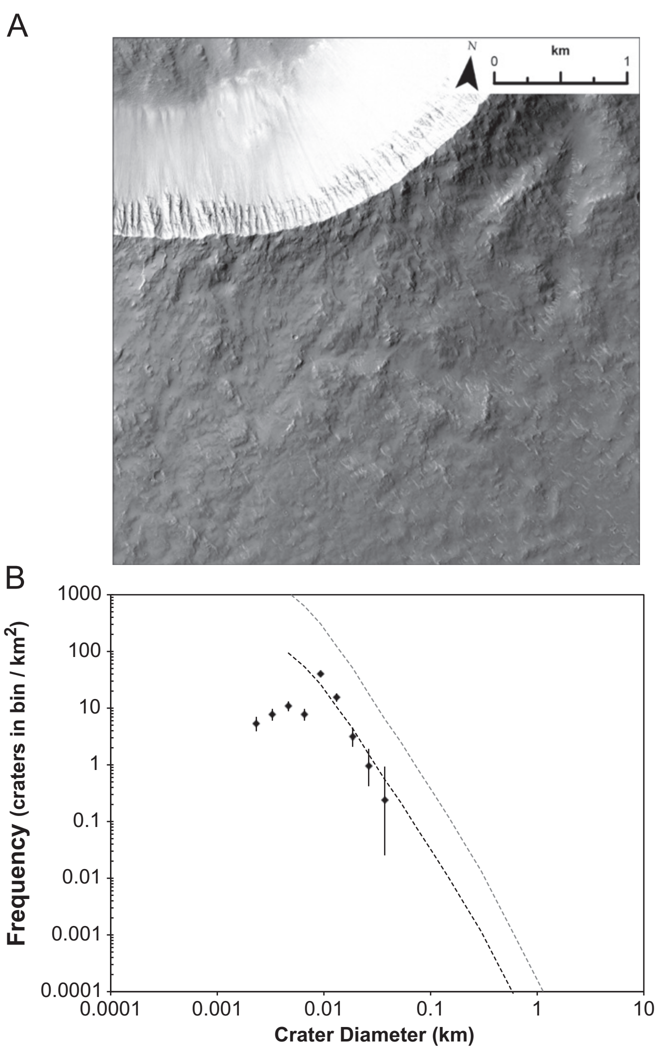


**Fig. 2.** (A) Thila crater (18.1°N, 155.6°E) is a 5.4-km diameter rayed crater identified by Tornabene et al. (2006) in Elysium Planitia. Portion of HiRISE: PSP_009346_1985. (B) A crater count revealed 2790 craters on 4.2 km$^2$ of near-rim deposits surrounding Thila crater. Isochrons of Hartmann (2005) indicate a best-fit age of 23.1 Ma. The grey dashed line marks the Early Amazonian boundary of Hartmann (2005).

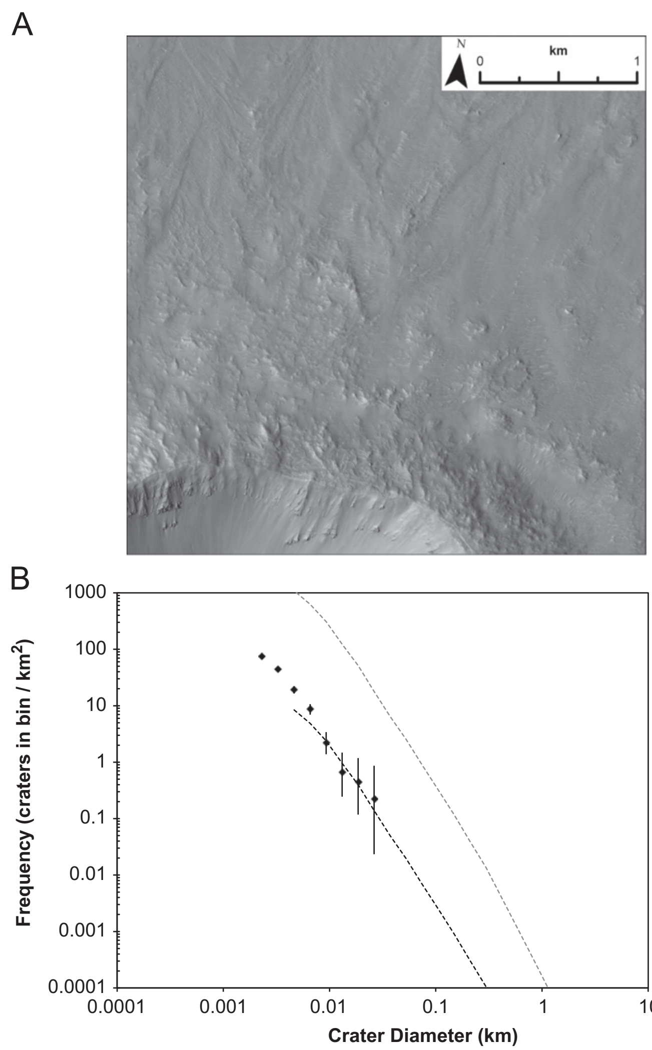


**Fig. 3.** (A) Naryn crater (14.9°N, 123.3°E) is a 3.9-km diameter rayed crater identified by Tornabene et al. (2006) in Elysium Planitia. Portion of HiRISE: PSP_002570_1950. (B) A crater count revealed 3169 craters on 4.5 km$^2$ of near-rim deposits surrounding Naryn crater. Isochrons of Hartmann (2005) indicate a best-fit age of 2.1 Ma. The grey dashed line marks the Early Amazonian boundary of Hartmann (2005).