CONSTRAINTS ON THE TIMING OF OBLIQUITY VARIATIONS DURING THE AMAZONIAN FROM DATING OF GLACIAL-RELATED CONCENTRIC CRATER FILL DEPOSITS ON MARS.

Michael J. Beach and James W. Head. Department of Geological Sciences, Brown University, Providence, RI 02912, USA (michael_beach@brown.edu)

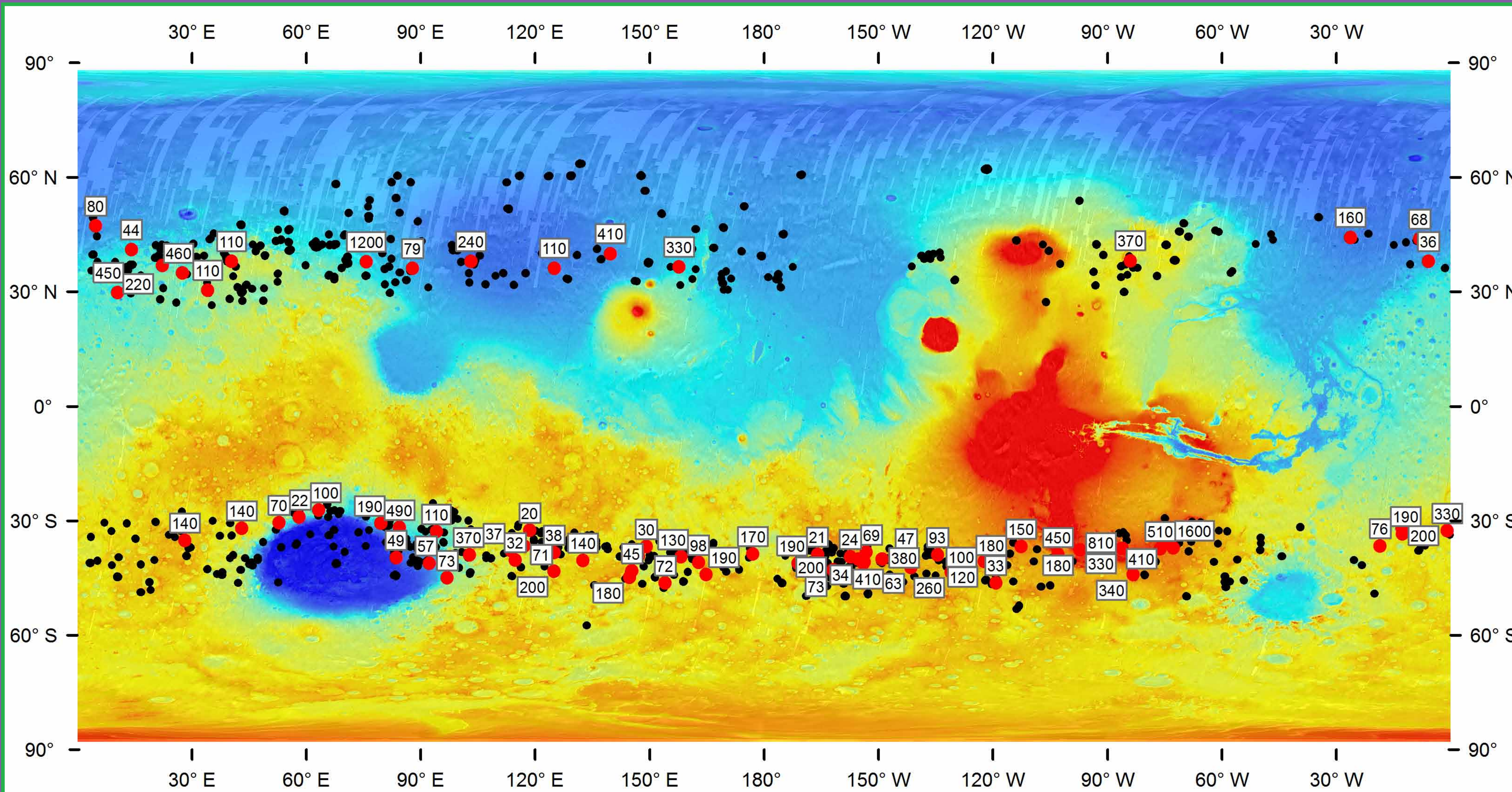


Figure 1. Age istribution map of CCF deposits in Northern and Southern hemispheres. Basemap is ~230 m/pix THEMIS daytime IR Global Mosaic with global MOLA topography overlain. Black dots are locations of CCF deposits from Dickson et al., 2012 [7]. Red dots are locations of CCF deposits dated in this study with calculated ages (Myr) in white boxes.

I. Introduction

- Spin axis/orbital variations during the Amazonian prior to ~20 Ma ago are uncertain [1]; higher obliquities can lead to instability of polar ice deposits, forcing migration of water ice to non-polar latitudes [2-5].
- Polar ice often migrates to the mid-latitudes and is preserved as debris-covered ice deposits [2].
- When such deposits form within craters they produce Concentric Crater Fill (CCF) [6].
- With these data we address the following questions:
  (1) What is the timing of cessation of flow within CCF deposits?
  (2) Can the calculated ages of these deposits help constrain the nature of obliquity variations during the Amazonian?

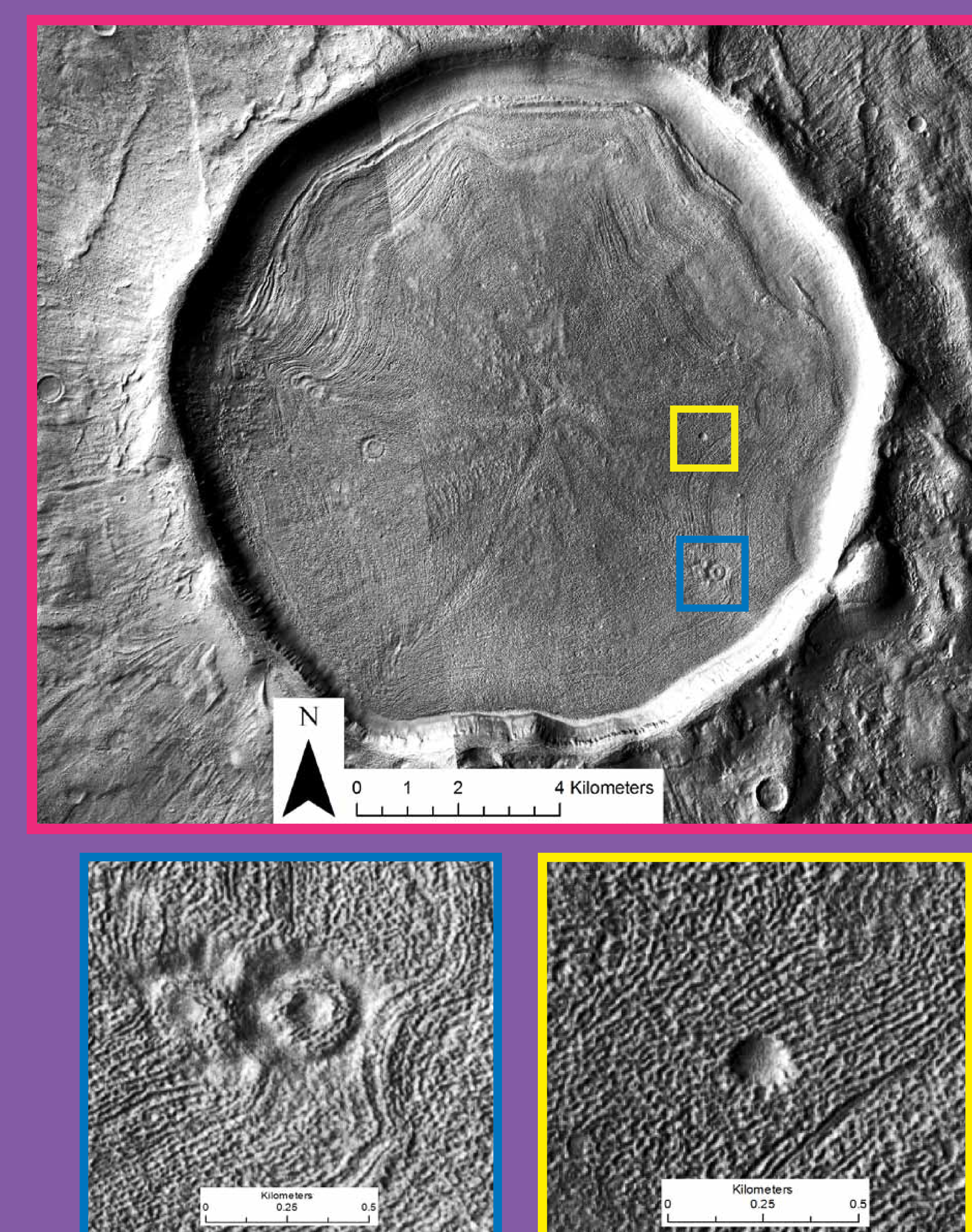
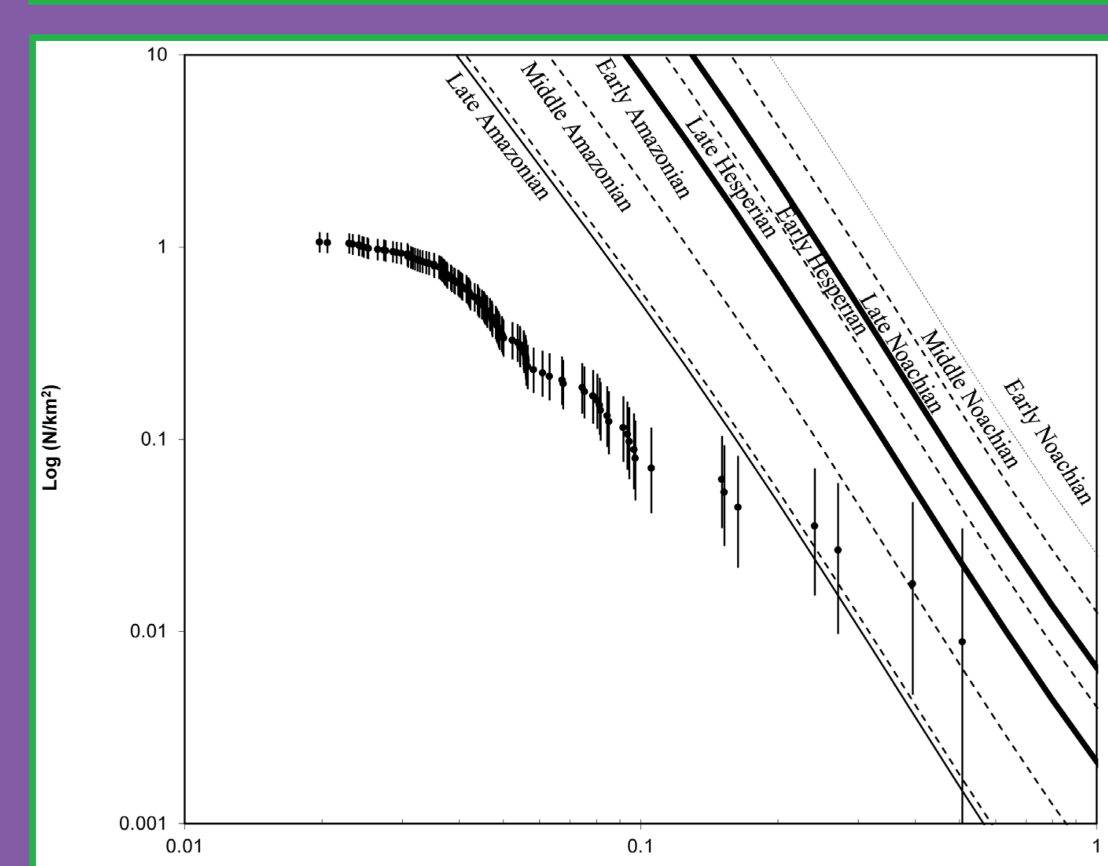


Figure 2. Example of a CCF deposit located at 44.1° S, 83.2° W (above). Inset images are Ring-mold and Bowl-shaped superposed craters on the surface which were used for dating. CSFD plot (below) is an example of a "variable slope" rating. Best fit age = 340 Ma.



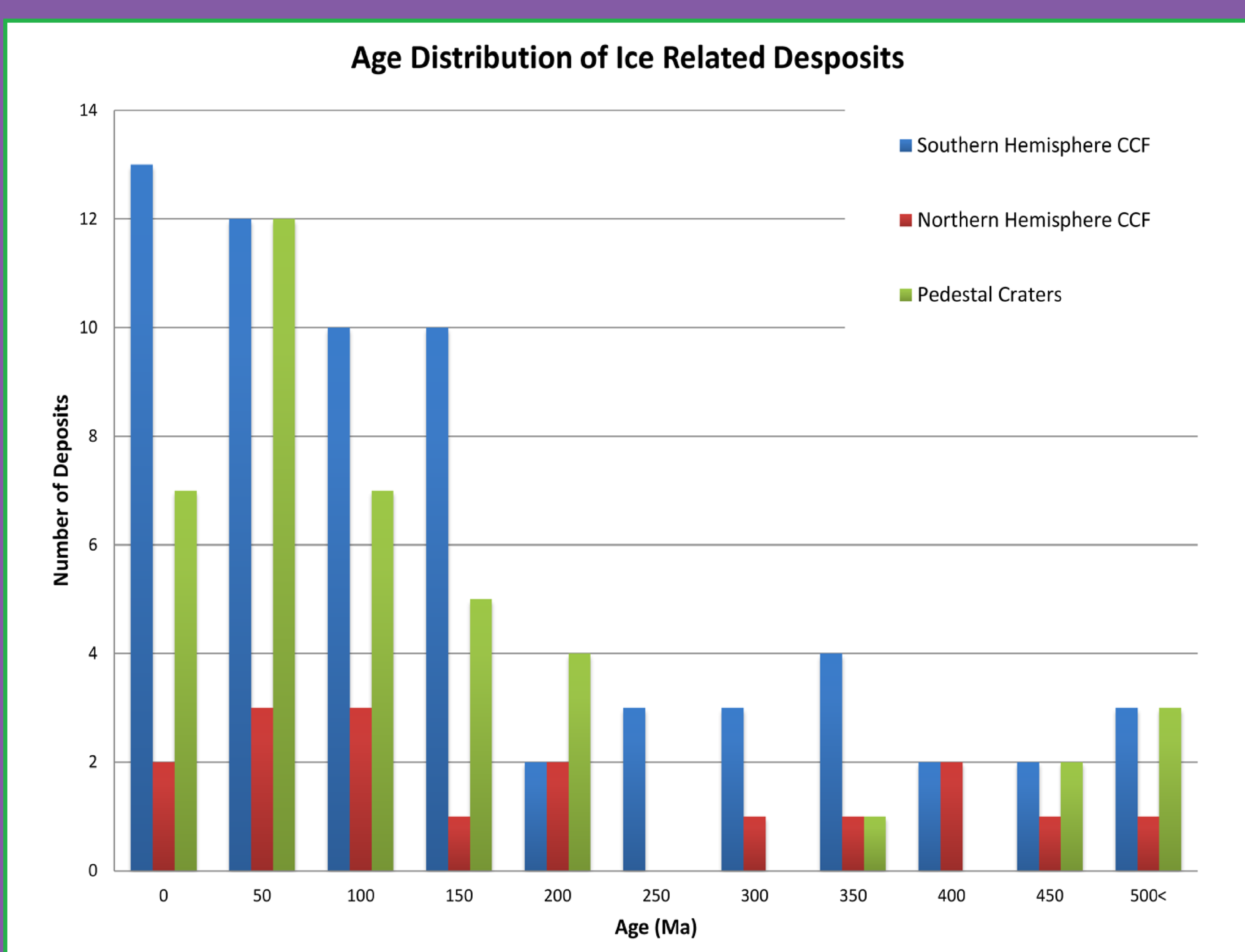


Figure 3. Age distribution histogram for the northern (red) and southern (blue) hemisphere dated CCF deposits (Figure 1, red dots), as well as Pedestal Crater ages [10] (green) for comparison with other ice-related deposits in the intercrater areas between CCF occurrences.

II. Methods and Results

Methods

- ~230 m/pixel THEMIS daytime IR Global Mosaic and CCF flow direction map from Dickson et al., 2012 [7] used to identify CCF for dating (Figure 1) and ~5m/pixel CTX images were used for superposed crater identification (Figure 2).
- CSFD (Neukum distribution function [9]) of undeformed superposed craters on the surface of CCF was used to estimate the timing of flow cessation (Figure 2).
- Deposits were selected based on representative latitudinal and longitudinal coverage in both hemispheres (Figure 1), and pristine CCF flow lineation textures.
- Crater distributions similar to the isochron in the Neukum function were given a "linear" fit, while poor fits were given a "variable slope" rating (Figure 2).

Results

- Using these methods we selected eighty-one craters for analysis (Figure 1).
- Age distribution of the 17 craters dated in the Northern Hemisphere (NH) are shown in Figure 3 (red) and 64 dated CCF deposits in the Southern Hemisphere (SH) (blue)
- (NH) 47 (73%) have calculated ages less than 250 Ma, 14 (22%) have ages between 250 and 500 Ma, and three (5%) have ages older than 500 Ma. About 50% have a linear rating.
- (SH) 11 (65%) have calculated ages less than 250 Ma, five (29%) between 250 and 500 Ma, and one deposit (6%) older than 500 Ma. >50% have a linear confidence rating.

III. Conclusions

- The candidate population of possible Amazonian obliquity histories over the last 250 Myr is widely variable, and includes examples of both consistently high and consistently low obliquities [1].
- The distribution of CCF ages analyzed in this study indicate that the majority of CCF deposits in the mid-latitudes on Mars were deposited during the first of two periods from 0 to ~250 Myr and have higher confidence due to the "linear" nature of the CSFD for many of the deposits.
- During the second period, from ~250 to 500 Myr ago, many fewer CCF deposits were formed and these have more examples of "variable-slope" ratings which have lower confidence in the calculated age.
- These results provide firm support for the conclusion that the actual obliquity history of the late Amazonian involved significant periods of time in which the obliquity was characterized by the intermediate values (~35 degrees), that have been shown to produce mid-latitude glaciation [10]. This result is consistent with dating of other ice-rich features, such as pedestal craters (green in Figure 3.) [11,12], which show a similar range of ages.
- The combination of this study and the Pedestal Craters study [11,12] may indicate more frequent periods of intermediate obliquity during the last 250 Myr as compared with earlier times (Figure 2).

References

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