Minimum area analysis of impact crater statistics: Lessons for the chronology of the MSL landing sites

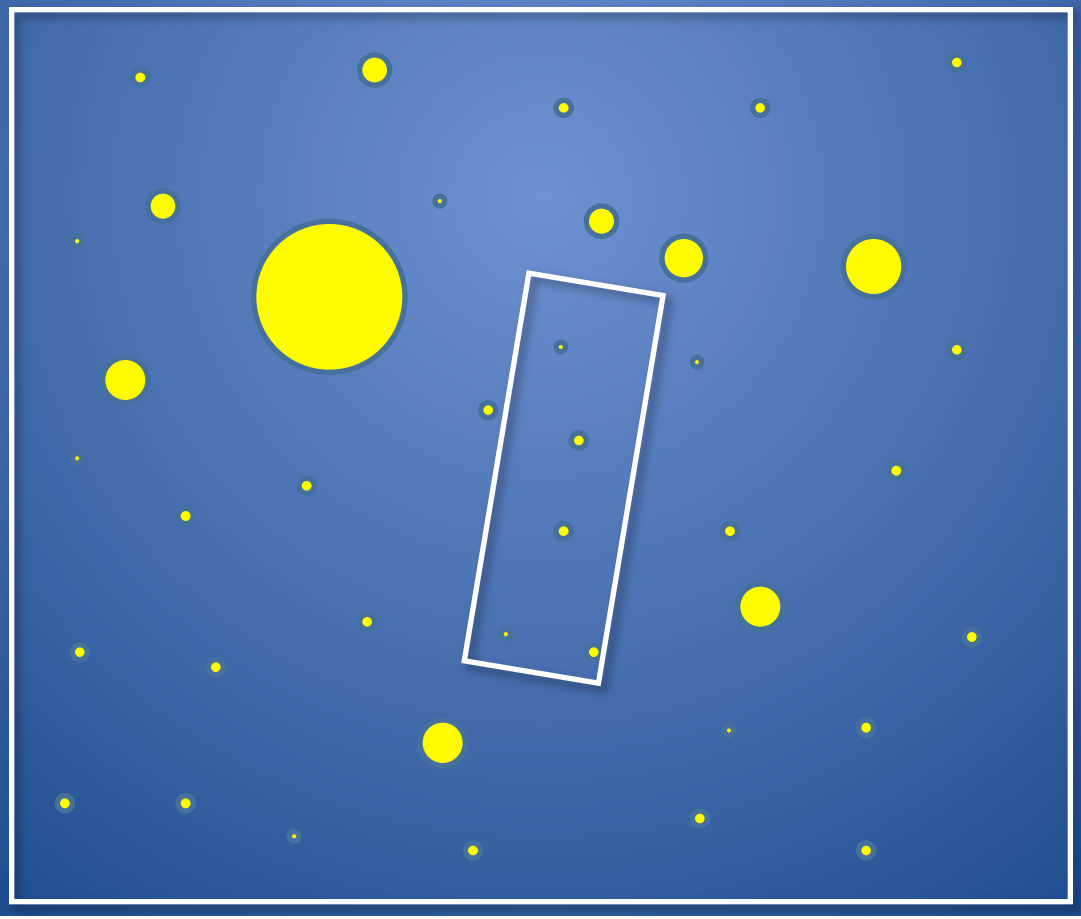
[1]Nick Warner

[1]Kate Goddard, [2]Pete Grindrod, [1]Sanjeev Gupta

[1]Imperial College London
[2]University College London

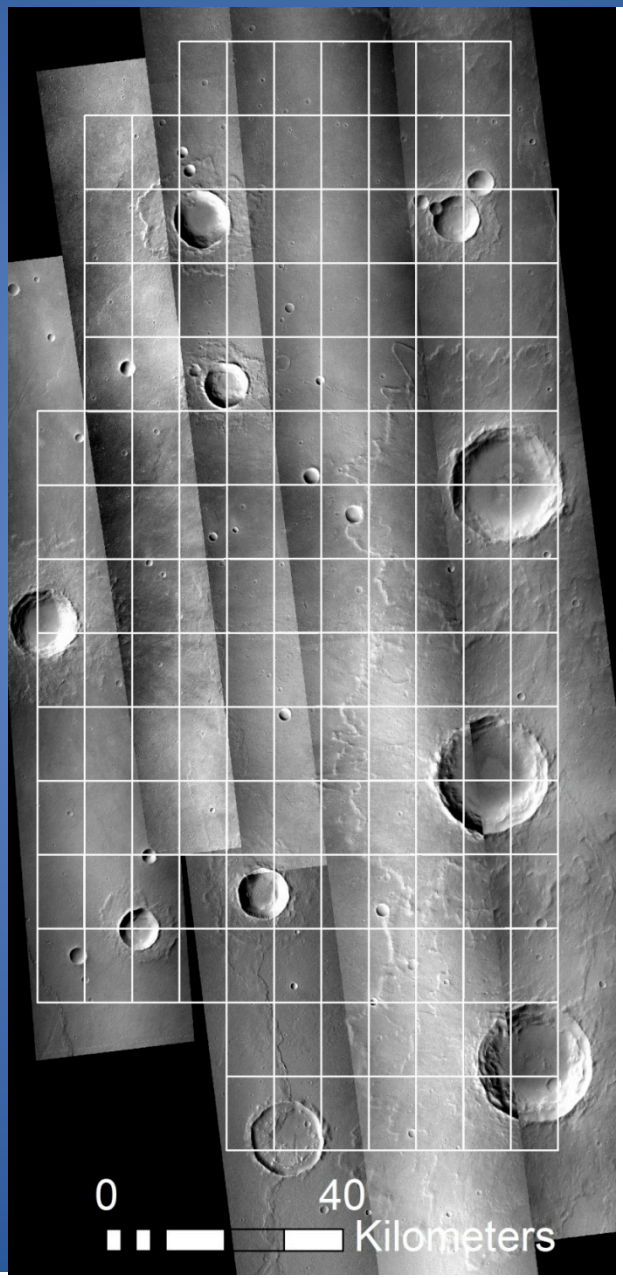
Introduction

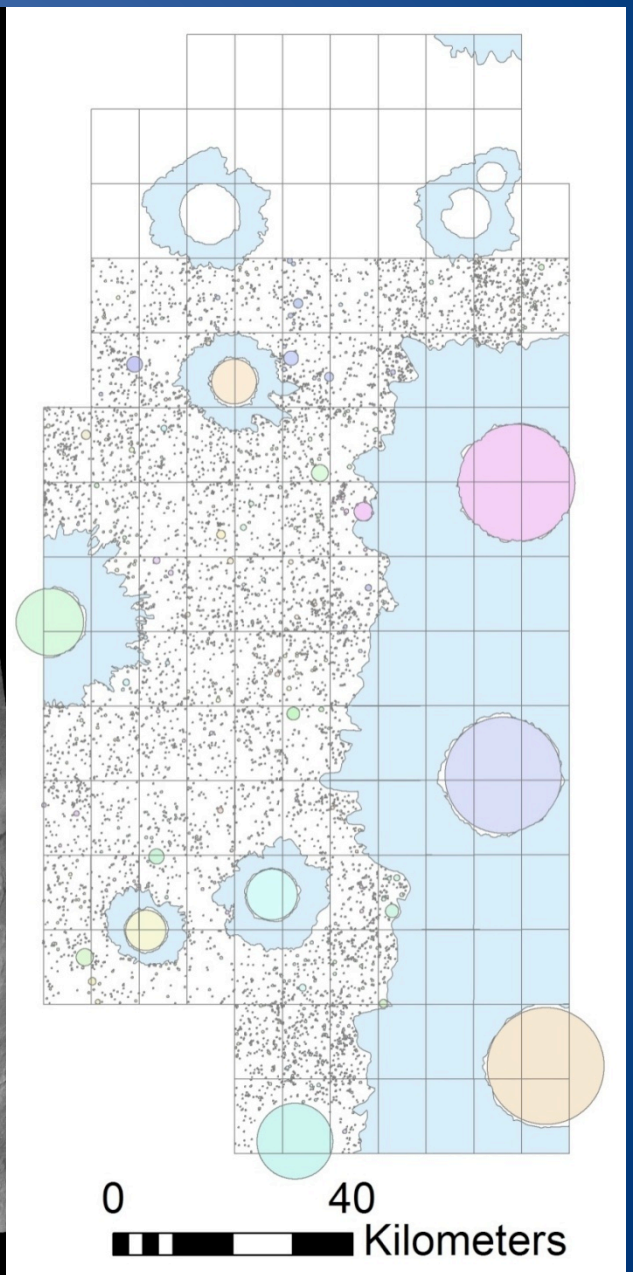
- How small is too small?
  - Number of craters
  - What population is sampled?
- Resurfacing (wind deflation, dust burial, fluvial erosion, lava)
- Landing sites (Eberswalde delta = ~100 km^2)



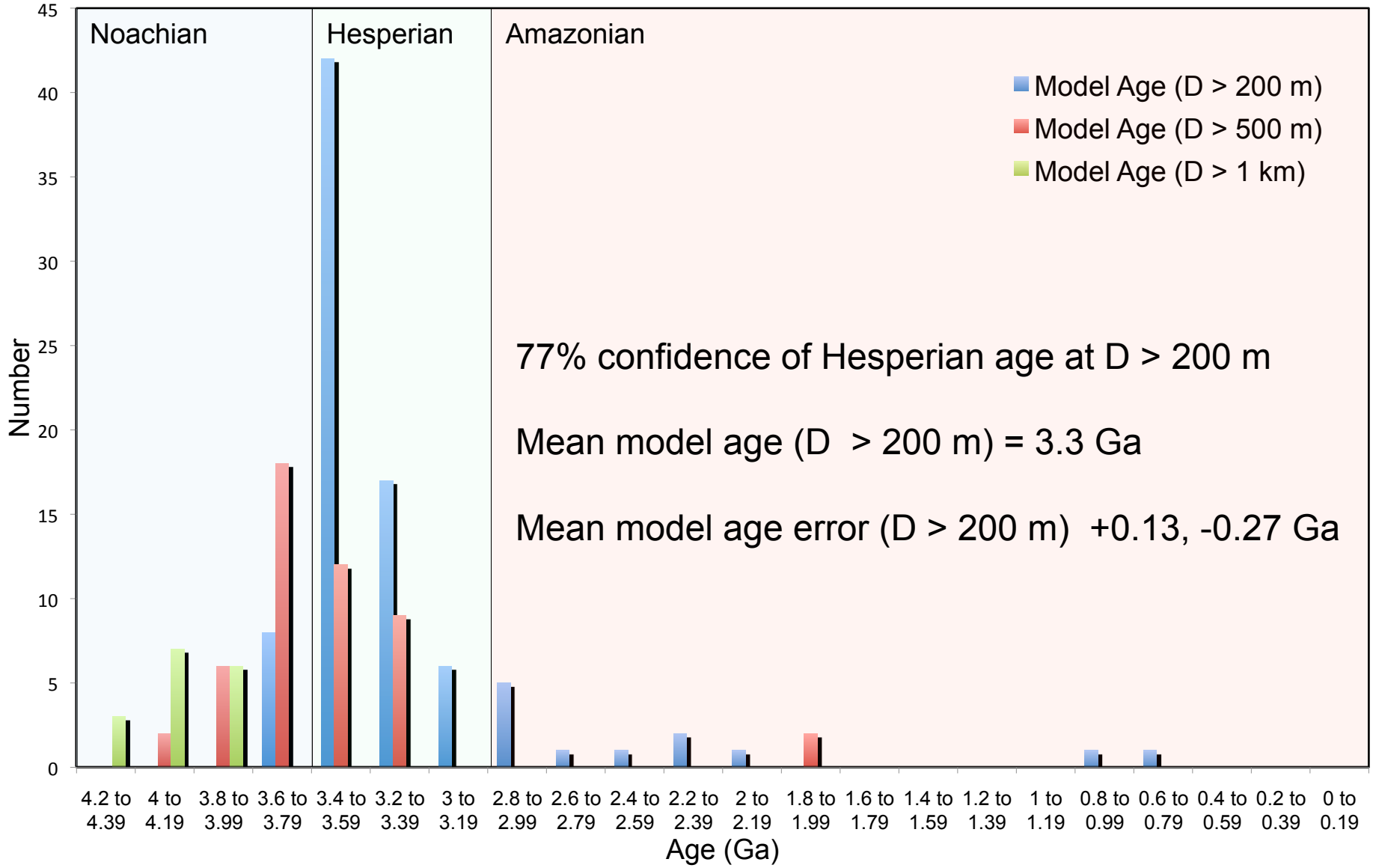
Methods

- Noachis Terra (Nn)
  - 10,000 km^2
  - M-L Noachian
  - Tanaka et al. (2005)
  - D > 5 km
- Repeatability
- Accuracy
- D > 200 m
  - 50 – 100 craters





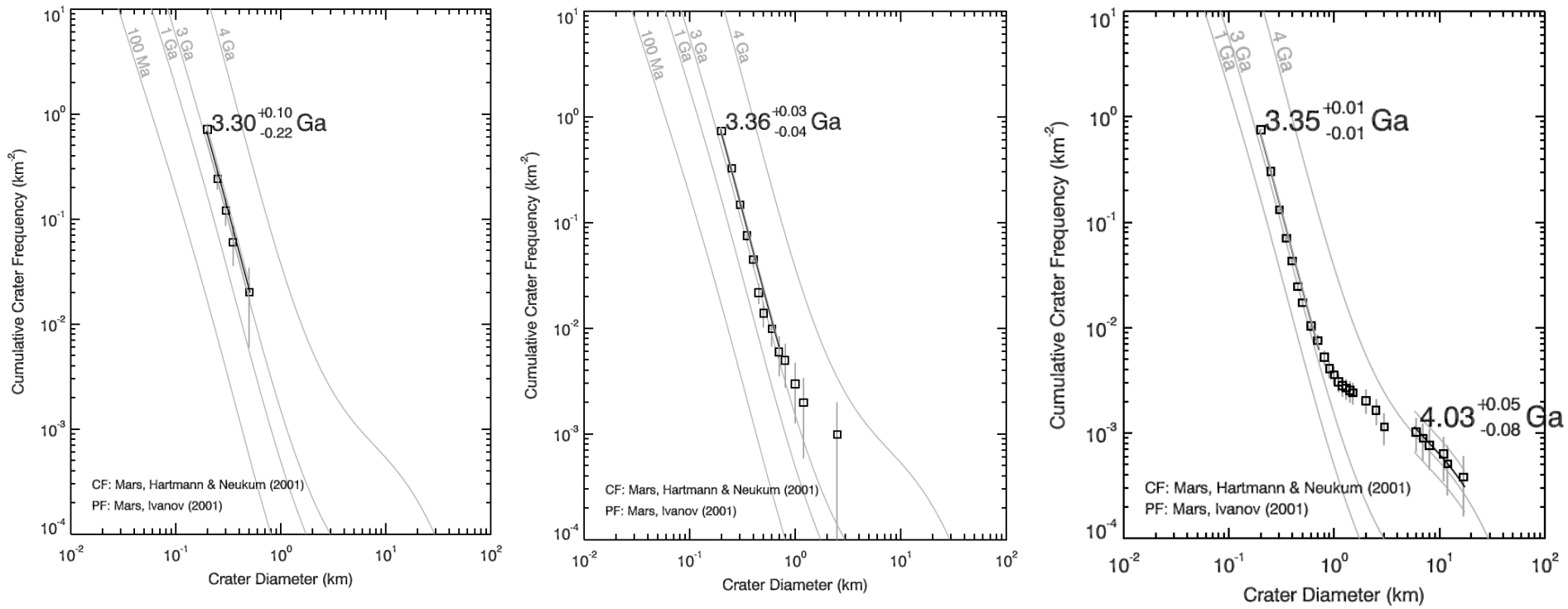
Repeatability (100 km^2)



Hartmann and Neukum, 2001 chronology functions

Accuracy of Model Ages

100 km^2 1000 km^2 10,000 km^2

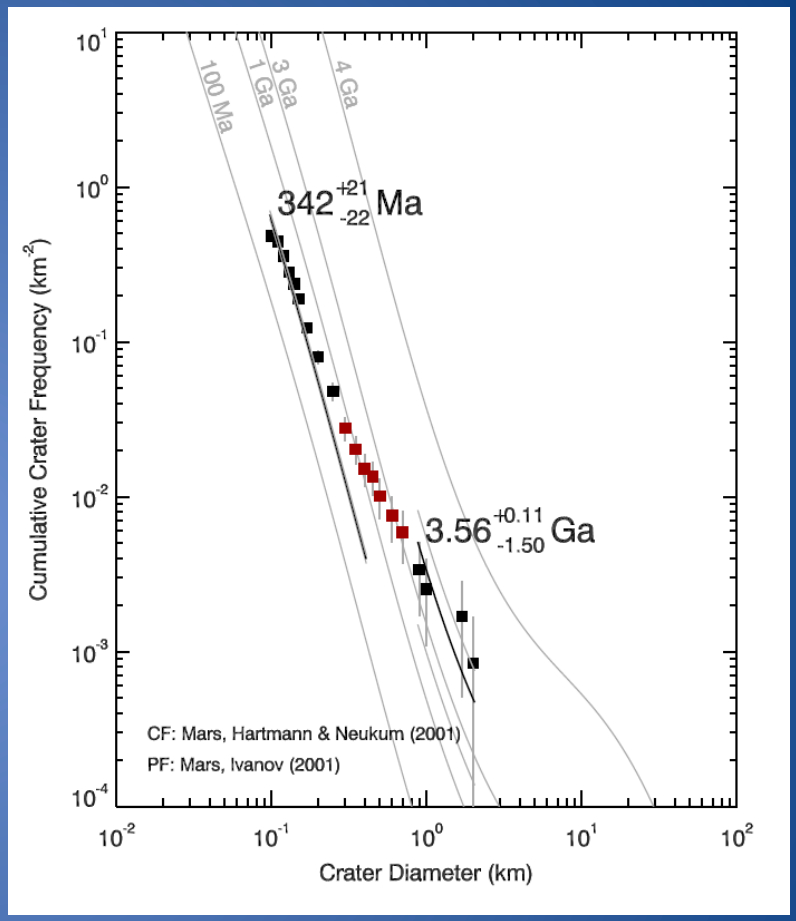


Counts require sufficient area to gain access to specific crater populations.

19 % boxes with D > 1 km, 81% probability of defining Hesperian age.

Eberswalde Crater

- Crater statistics
  - A = 1188 km^2
  - 571 craters, D > 100 m
  - Delta = ~100 km^2



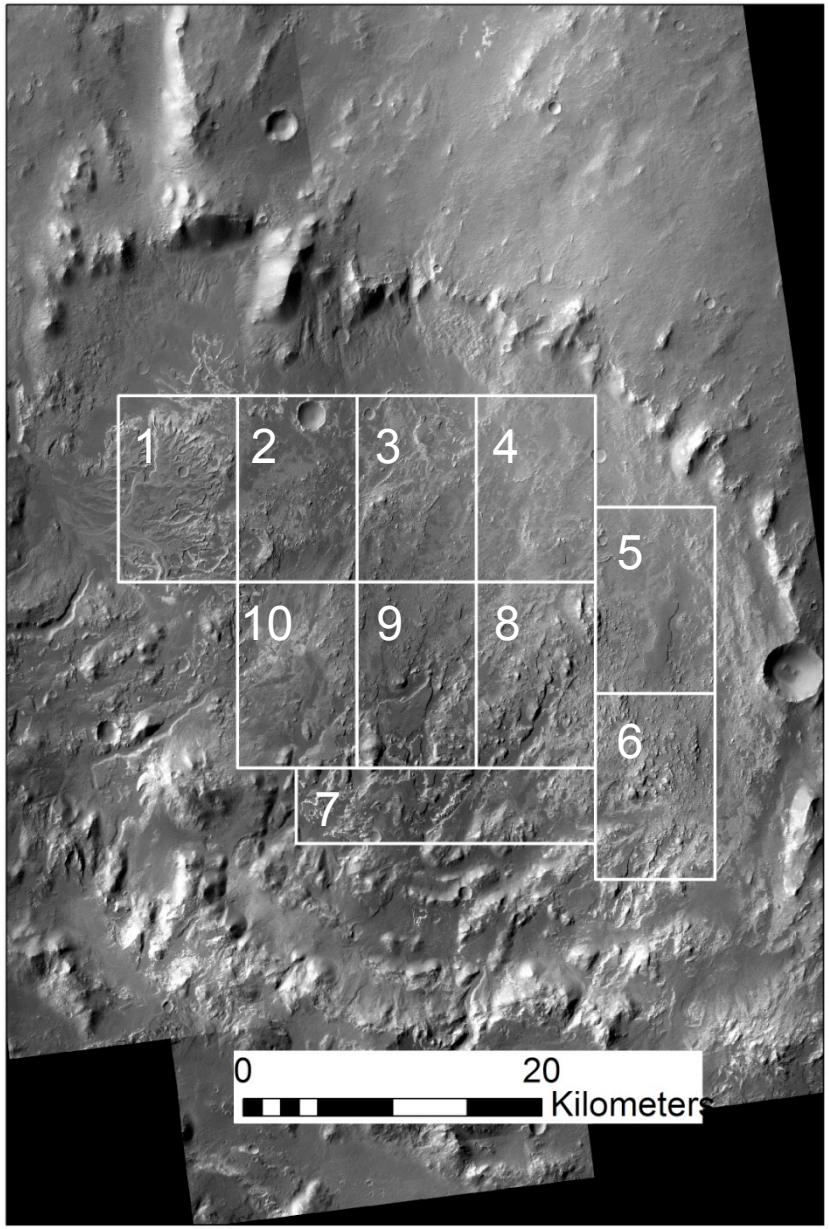
- Degradation?
  - D < 300 m
  - 50 - 80 m of complete resurfacing

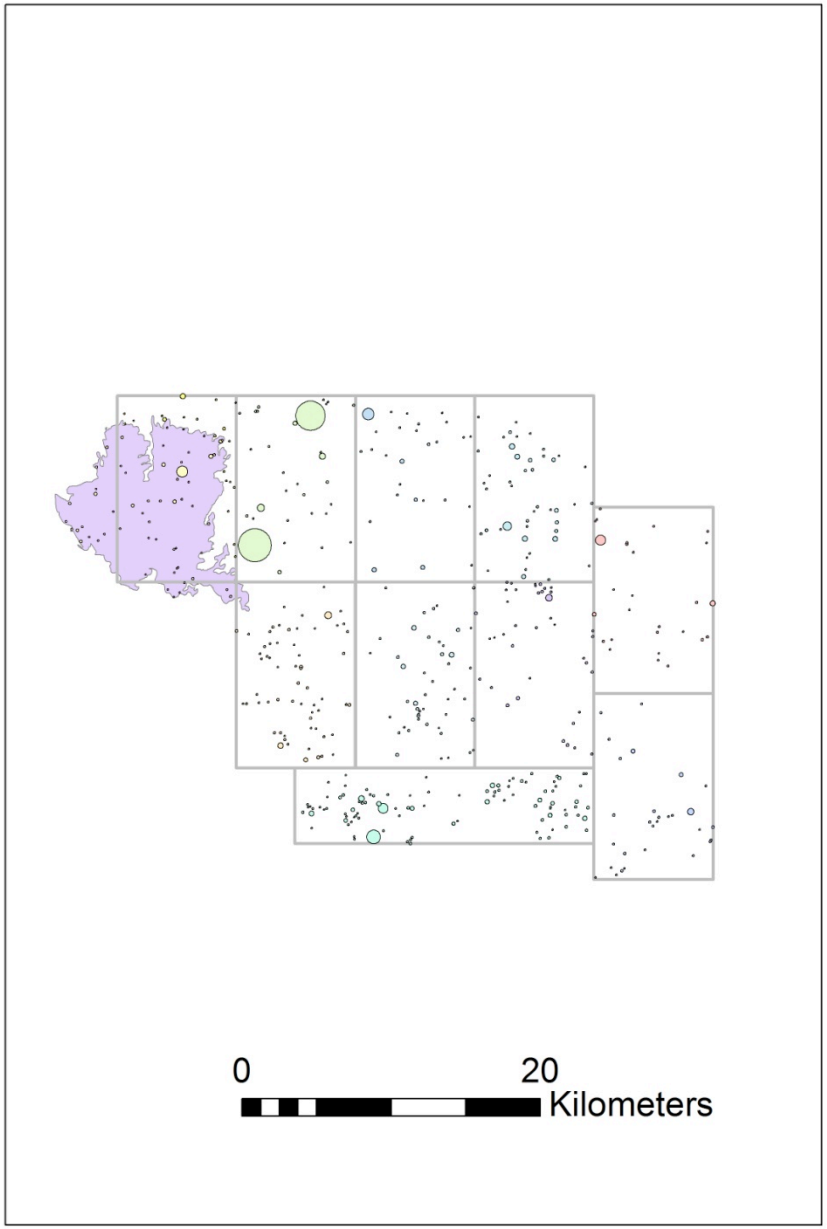
  (*Garvin et al. 2003*)

- Different geologic units?

- Amazonian phase of fluvial activity? (*Grant and Wilson, 2011*)
  - Amazonian delta?

Eberswalde Crater

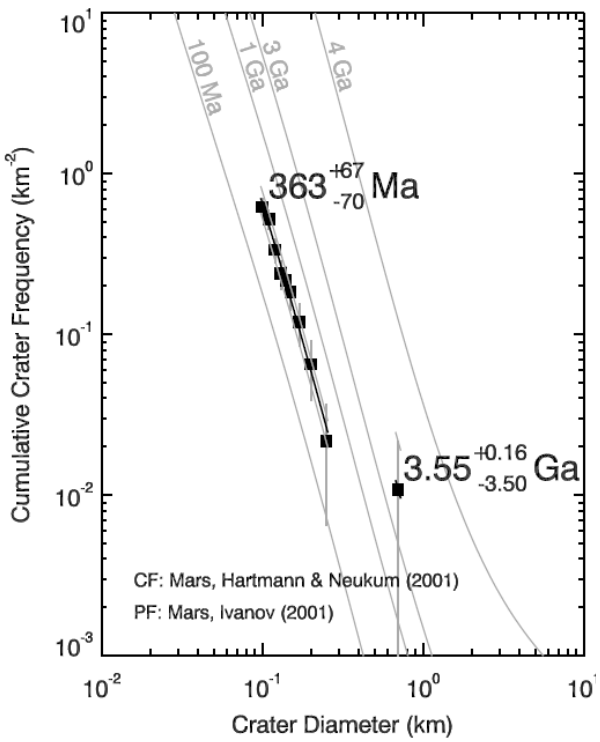




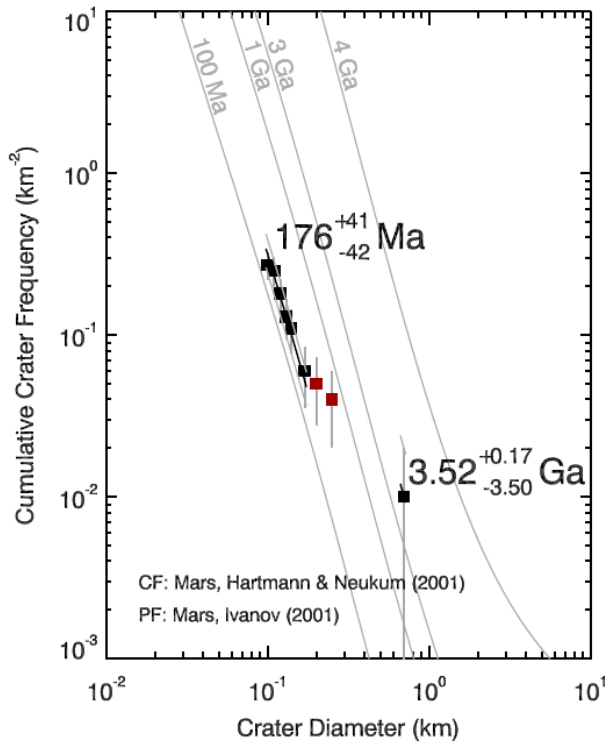
Eberswalde Statistics

- Late Amazonian age for D < 300 m across all boxes.
- Amazonian population is not exclusive to delta.

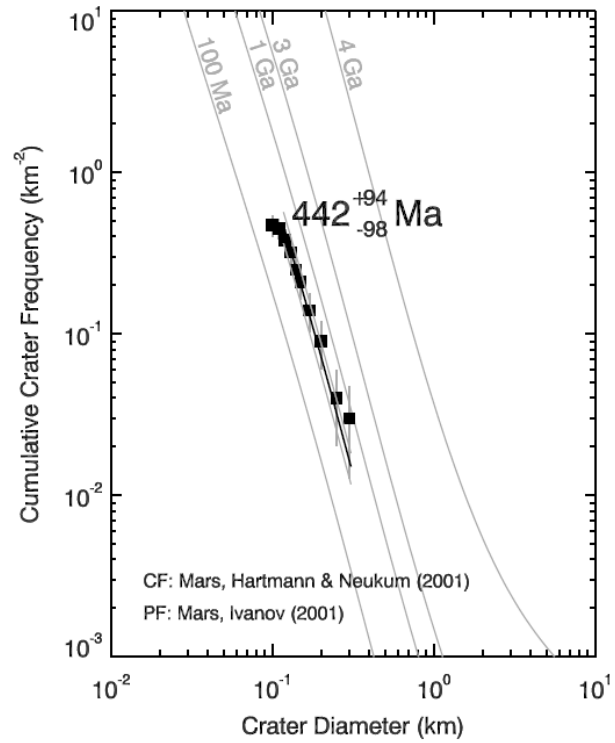
Delta, n = 57 (D > 100 m)



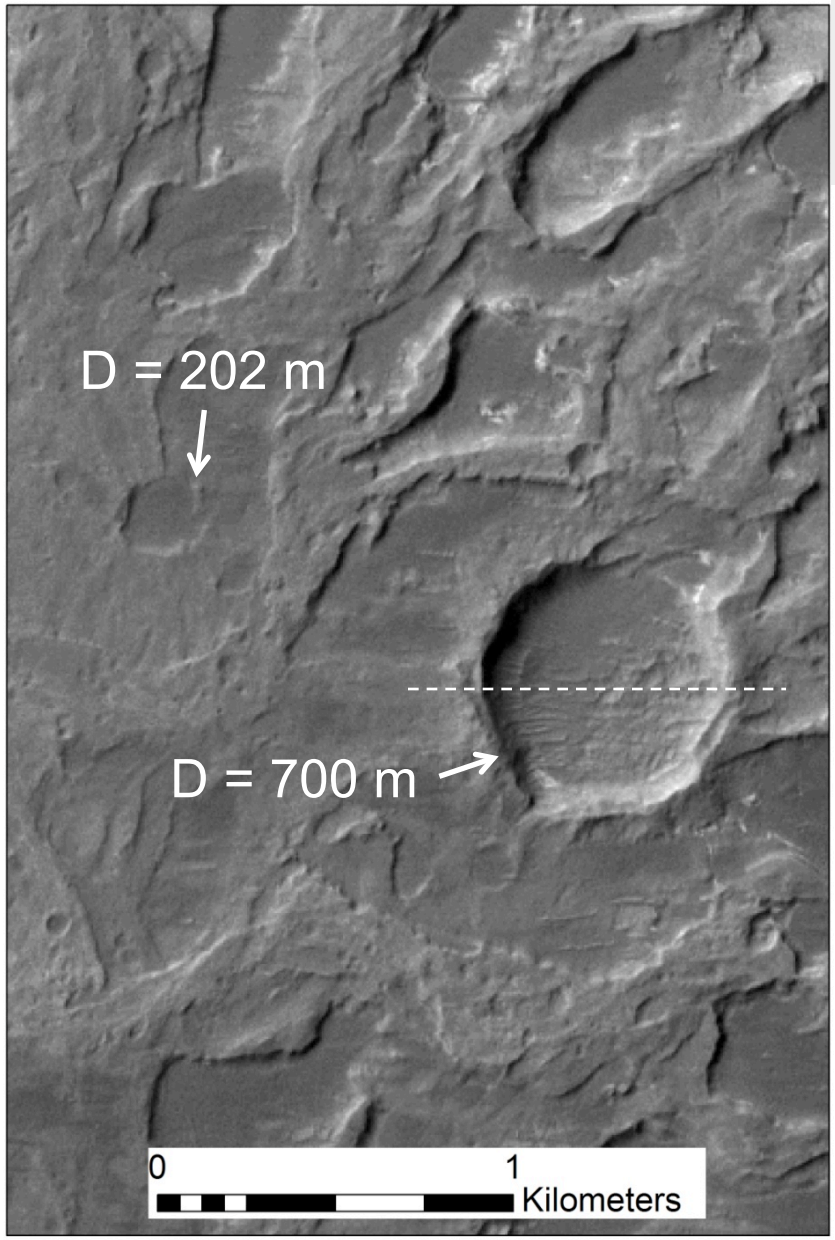
Box 3, n = 27

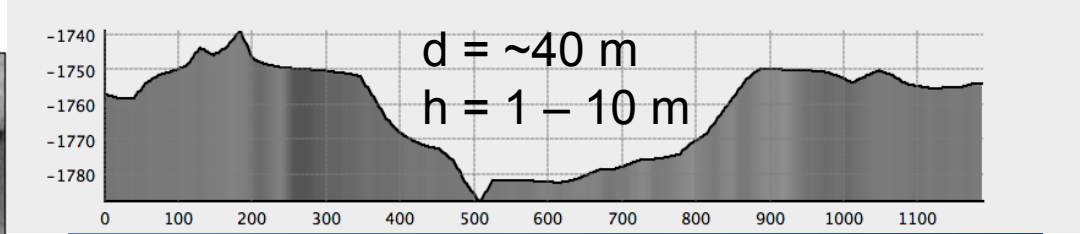


Box 9, n = 47



Crater Preservation on Delta

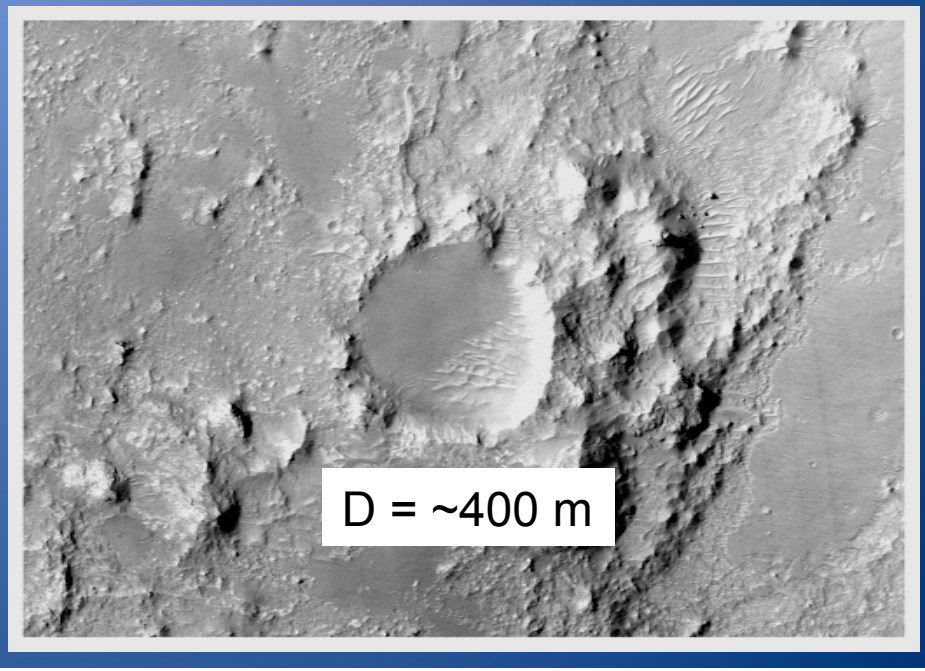




model depth = 150 m
rim height = 36 m
(Garvin et al. 2003)

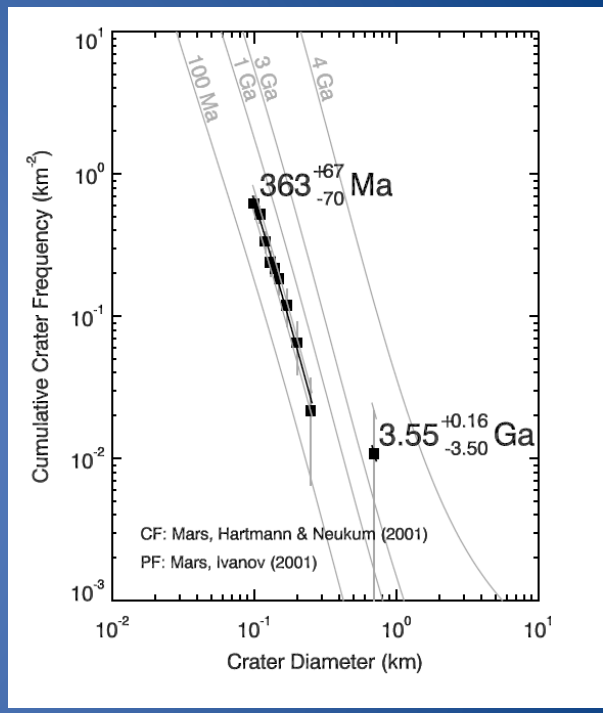
~35 m of rim erosion

crater on floor material



Discussion Point: Eberswalde

- Small area counts (100 km^2) may only record post-resurfacing crater population.

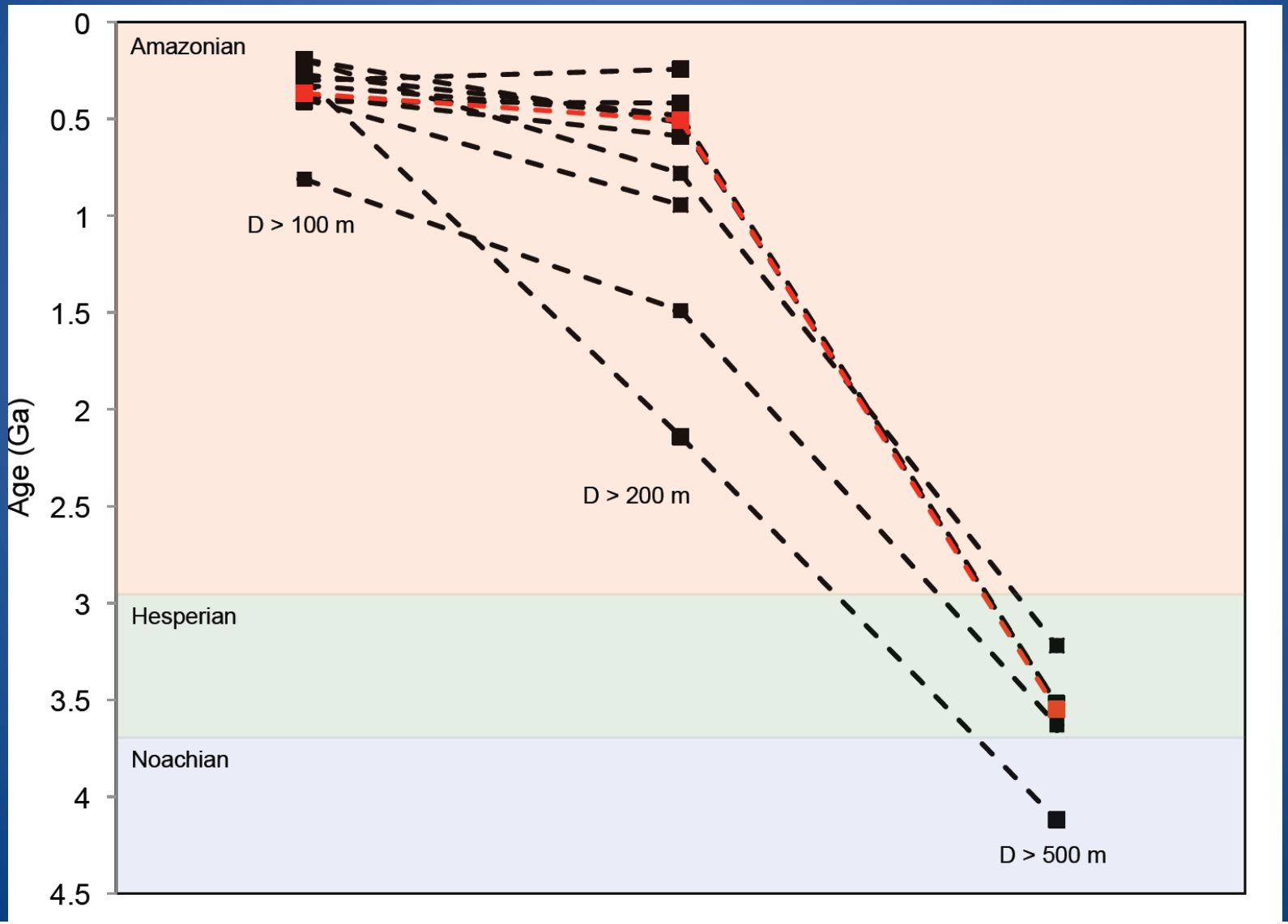


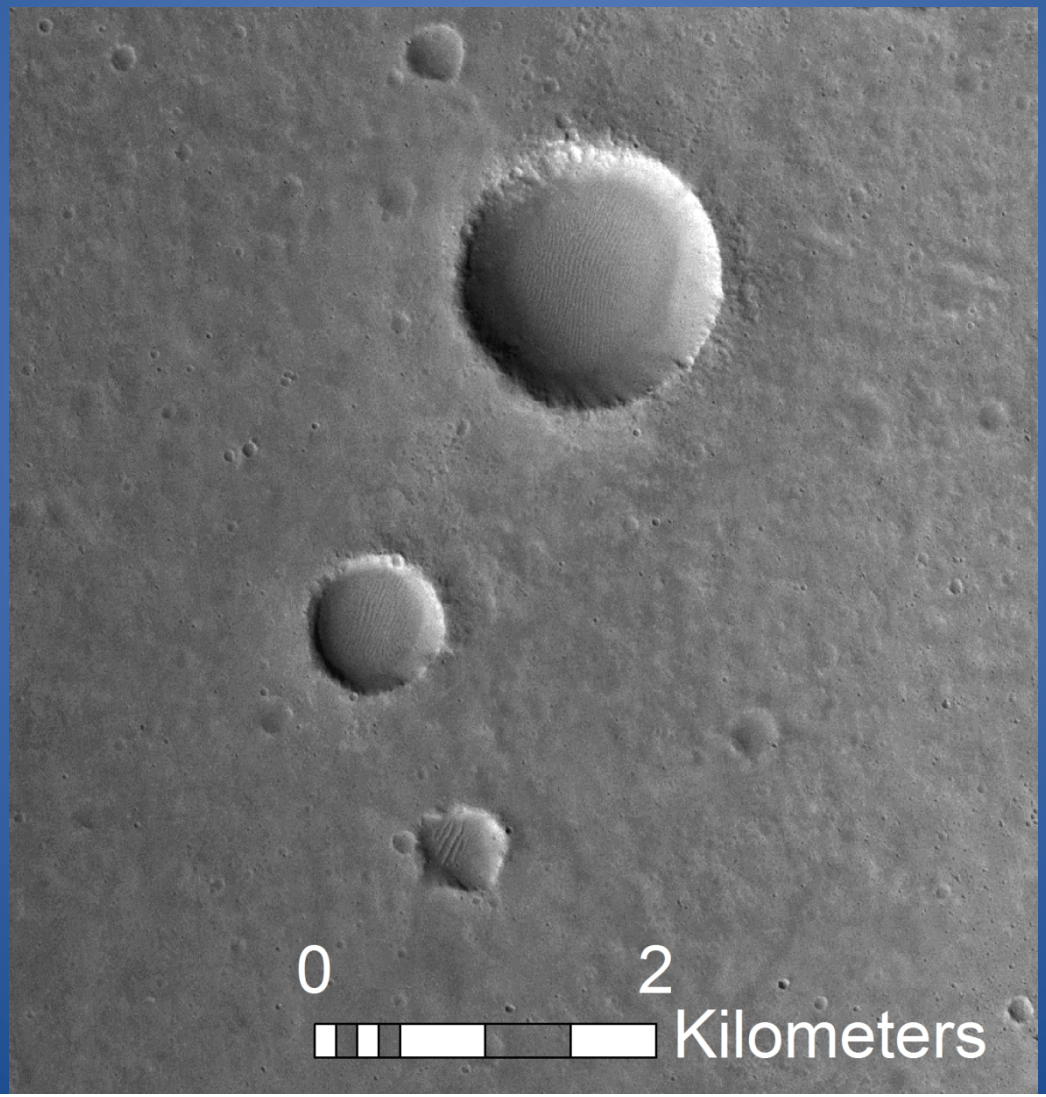
- Record erosional resurfacing
  - Stratigraphy missing (minimum 35 m)

- Post Early-Hesperian delta
  - No Amazonian population that is unique to the delta.
  - Key constraint: Eberswalde delta formed after Holden.
    - Early Hesperian – Late Hesperian (*Ross Irwin*)

Eberswalde Statistics

-Delta model ages are consistent with center of crater.



Morphology of Craters

- Small areas only capture the “new population”.
- Physical evidence of resurfacing not always obvious.