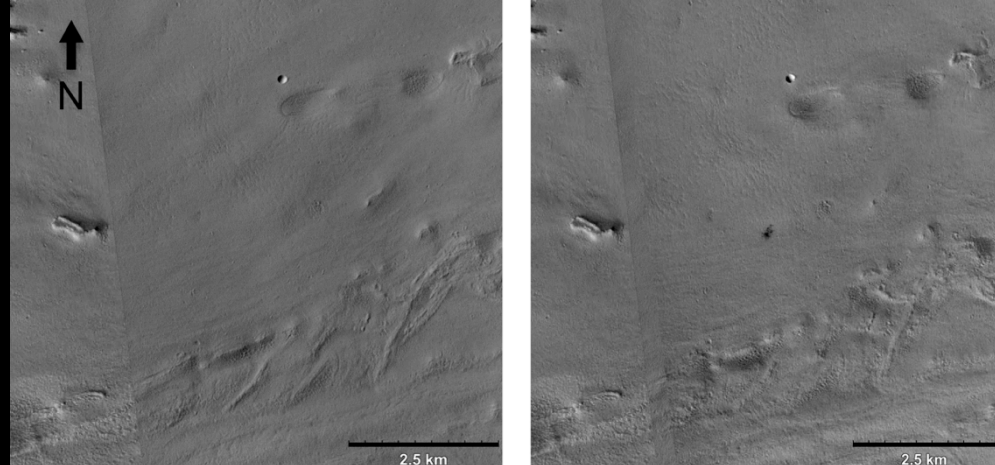


# NEW DATED IMPACTS ON MARS AND THE CURRENT CRATERING RATE



**Ingrid Daubar<sup>1</sup>**

([ingrid@lpl.arizona.edu](mailto:ingrid@lpl.arizona.edu))

A. McEwen<sup>1</sup>, S. Byrne<sup>1</sup>,

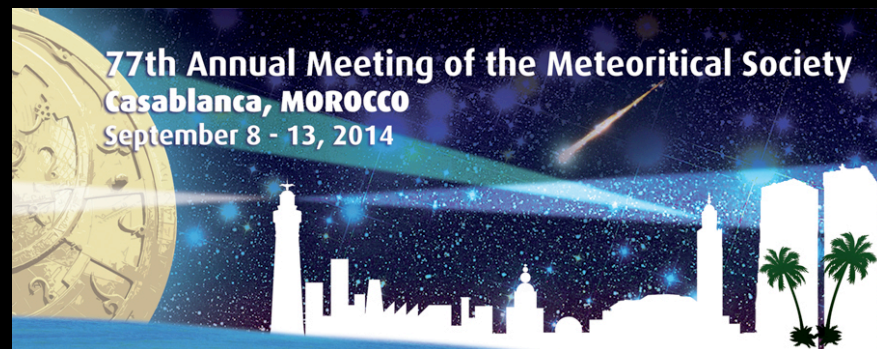
M. Kreslavsky<sup>2</sup>, L. Saper<sup>3</sup>,

M. R. Kennedy<sup>3</sup>

<sup>1</sup>University of Arizona, Tucson, AZ

<sup>2</sup>UC Santa Cruz, Santa Cruz, CA

<sup>3</sup>Malin Space Science Systems, San Diego, CA



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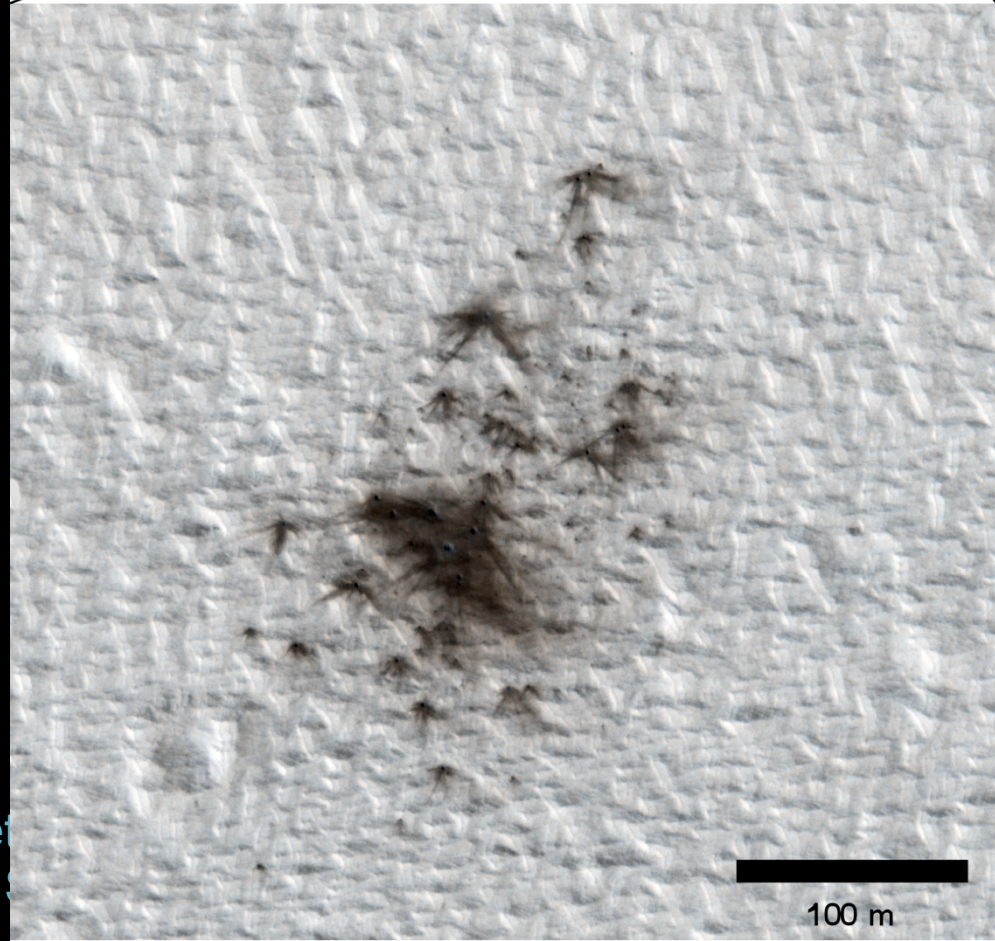
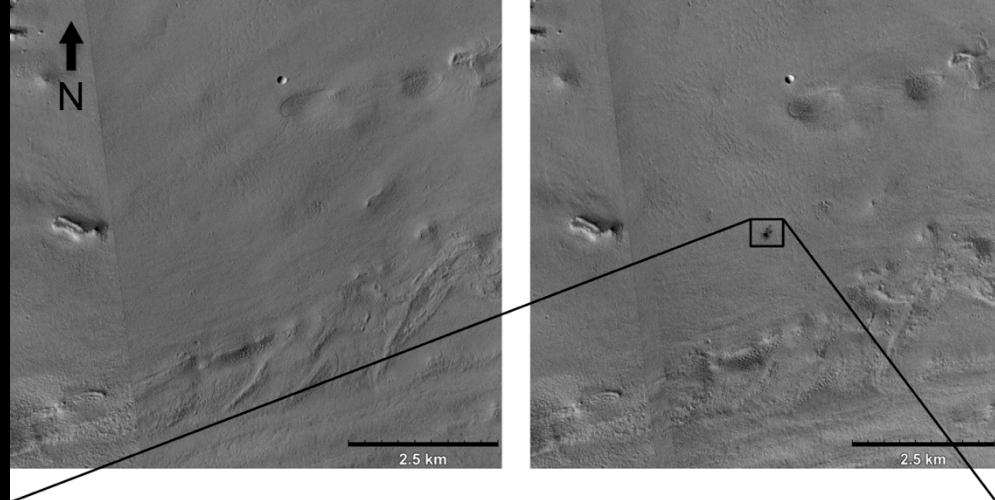
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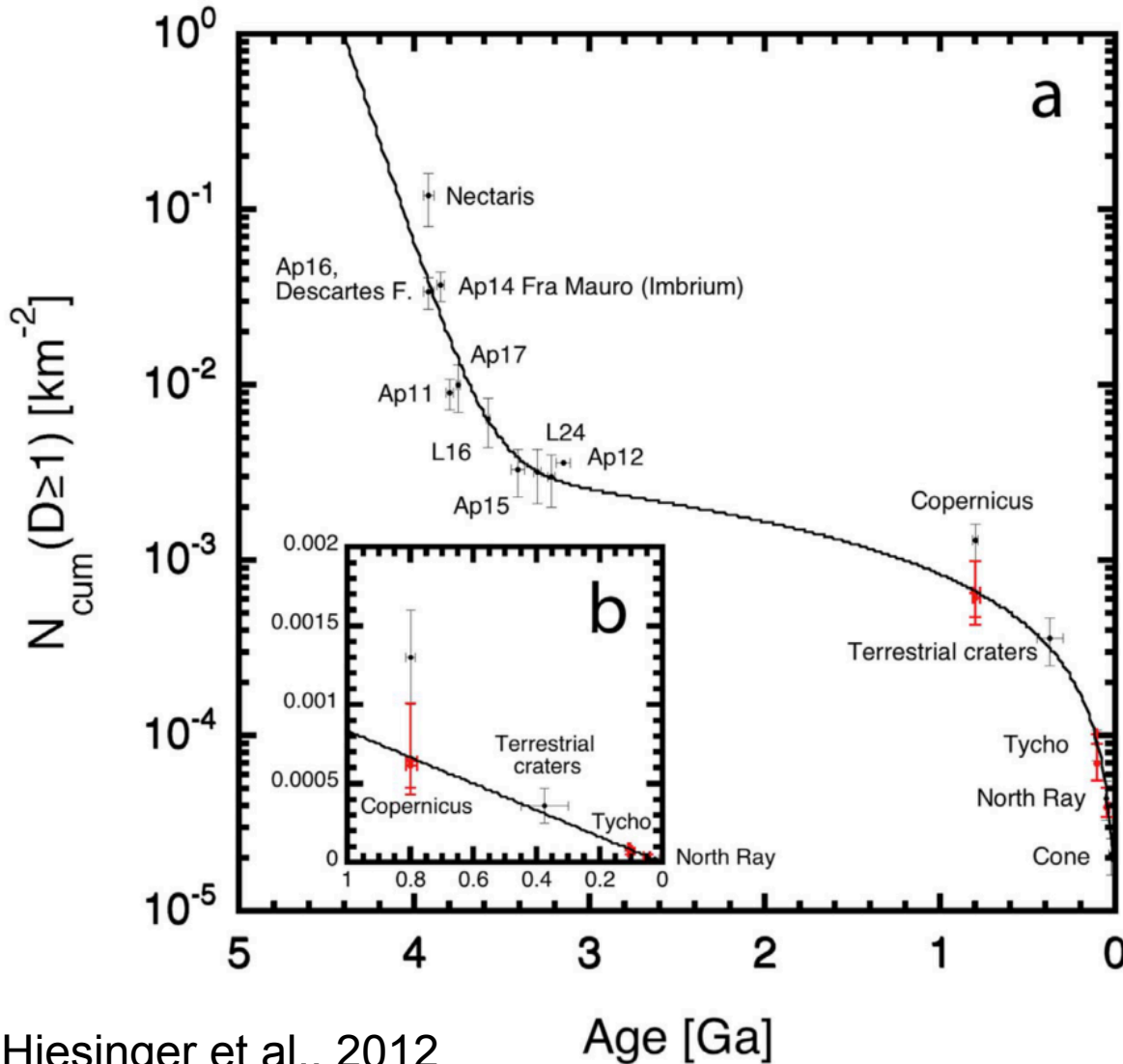
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# Lunar Chronology



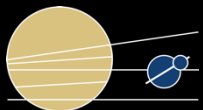
Lunar sample from Apollo 12  
3.2 Ga [Nyquist et al. 1977, 1979]

Hiesinger et al., 2012

Ingrid Daubar • NEW DATED IMPACTS ON MARS

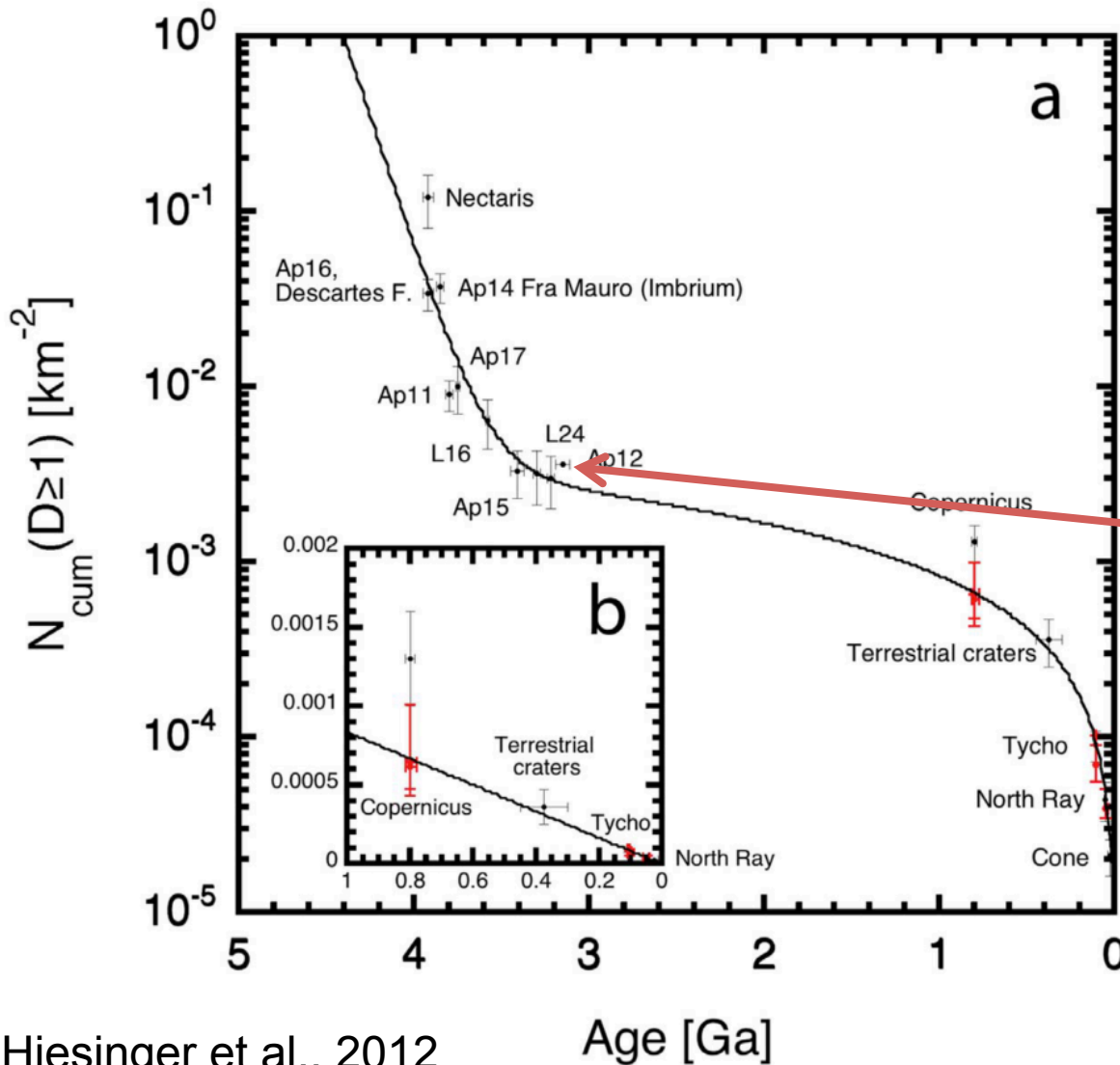
ingrid@LPL.arizona.edu • Meteoritical Society Meeting • 8 Sep. 2014

-3-



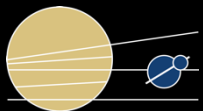
LPL - University of Arizona

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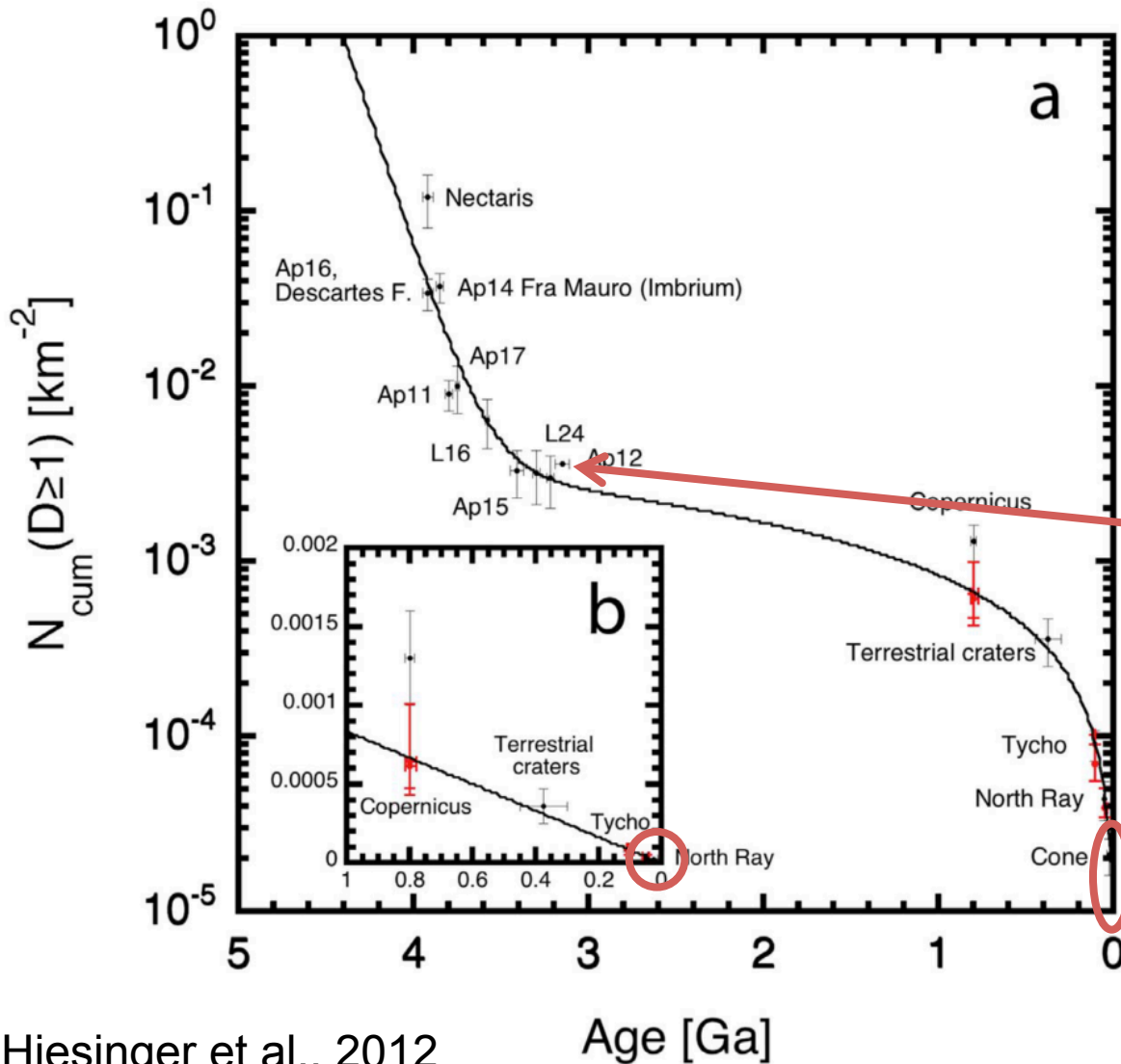


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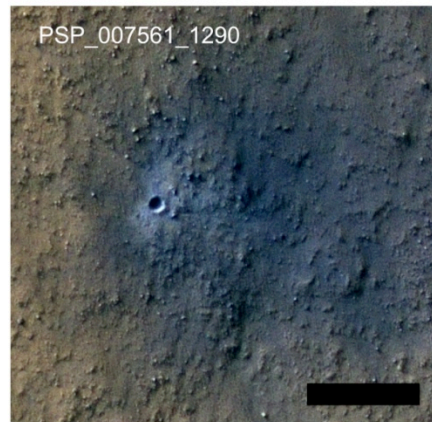
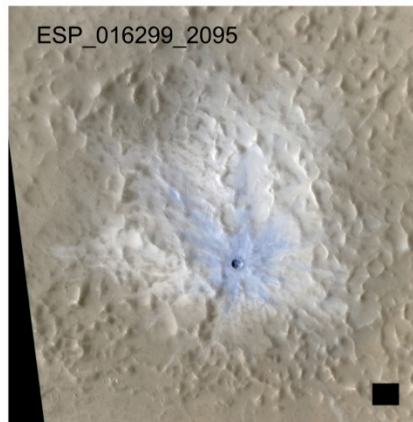
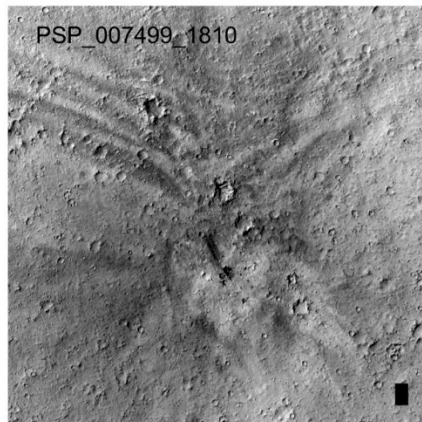
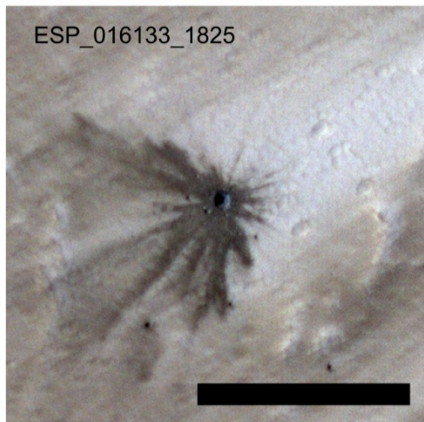
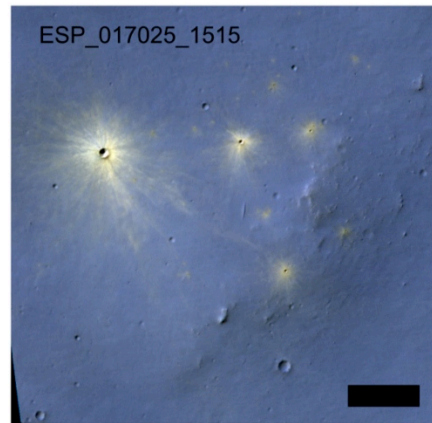
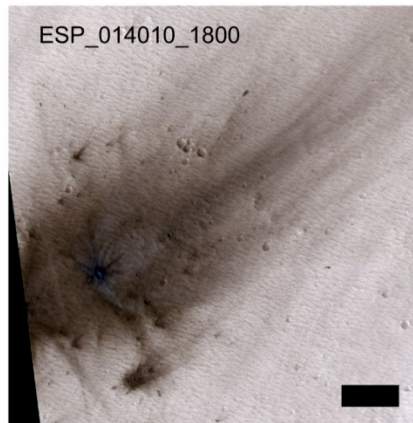
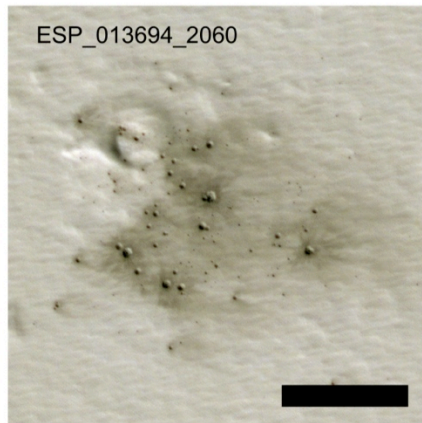
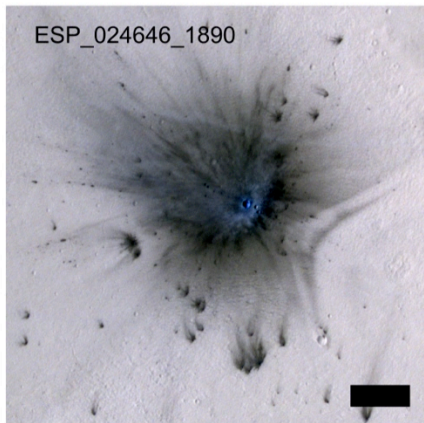
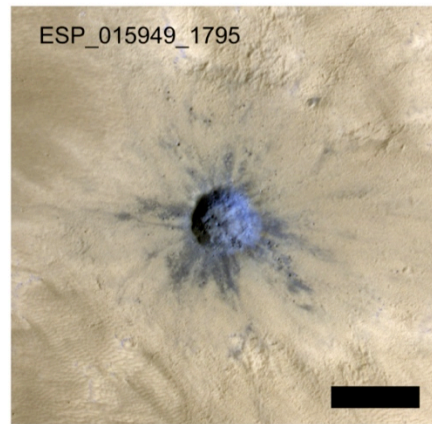
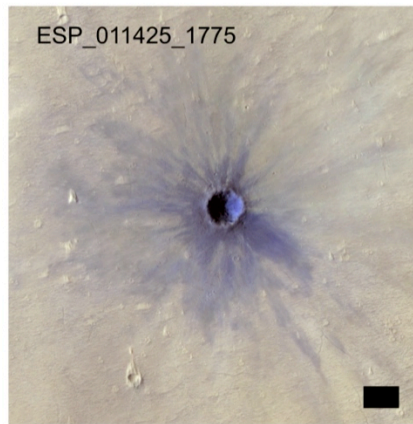
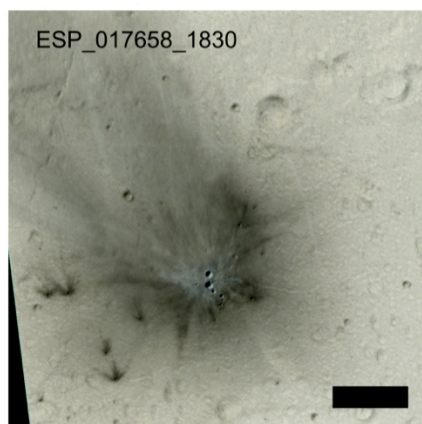
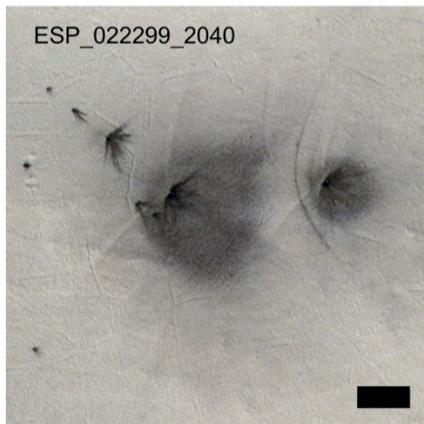
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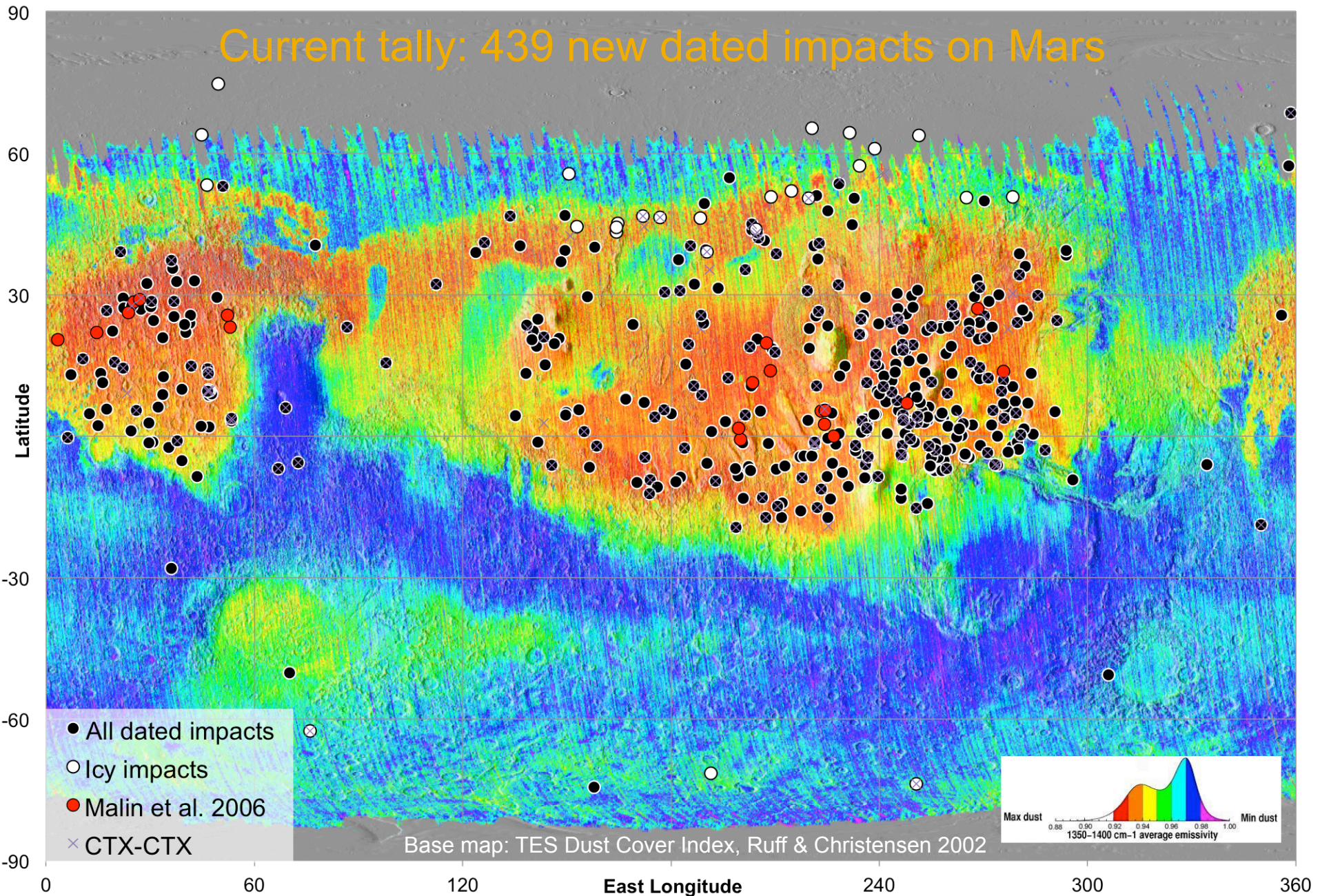
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# Current tally: 439 new dated impacts on Mars



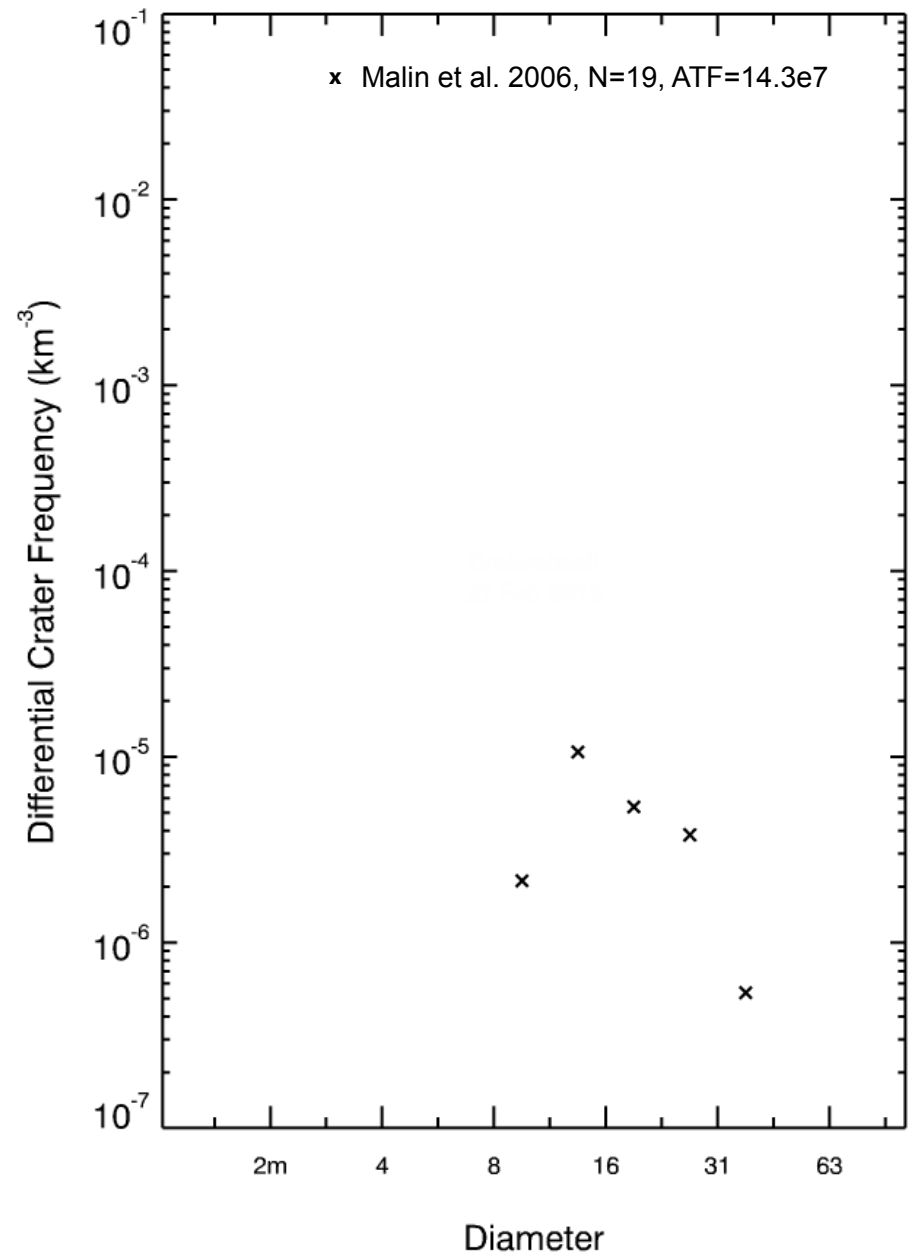
# CURRENT MARTIAN PRODUCTION FUNCTION

- Malin et al. 2006
- MOC-MOC campaign over  
~7 years



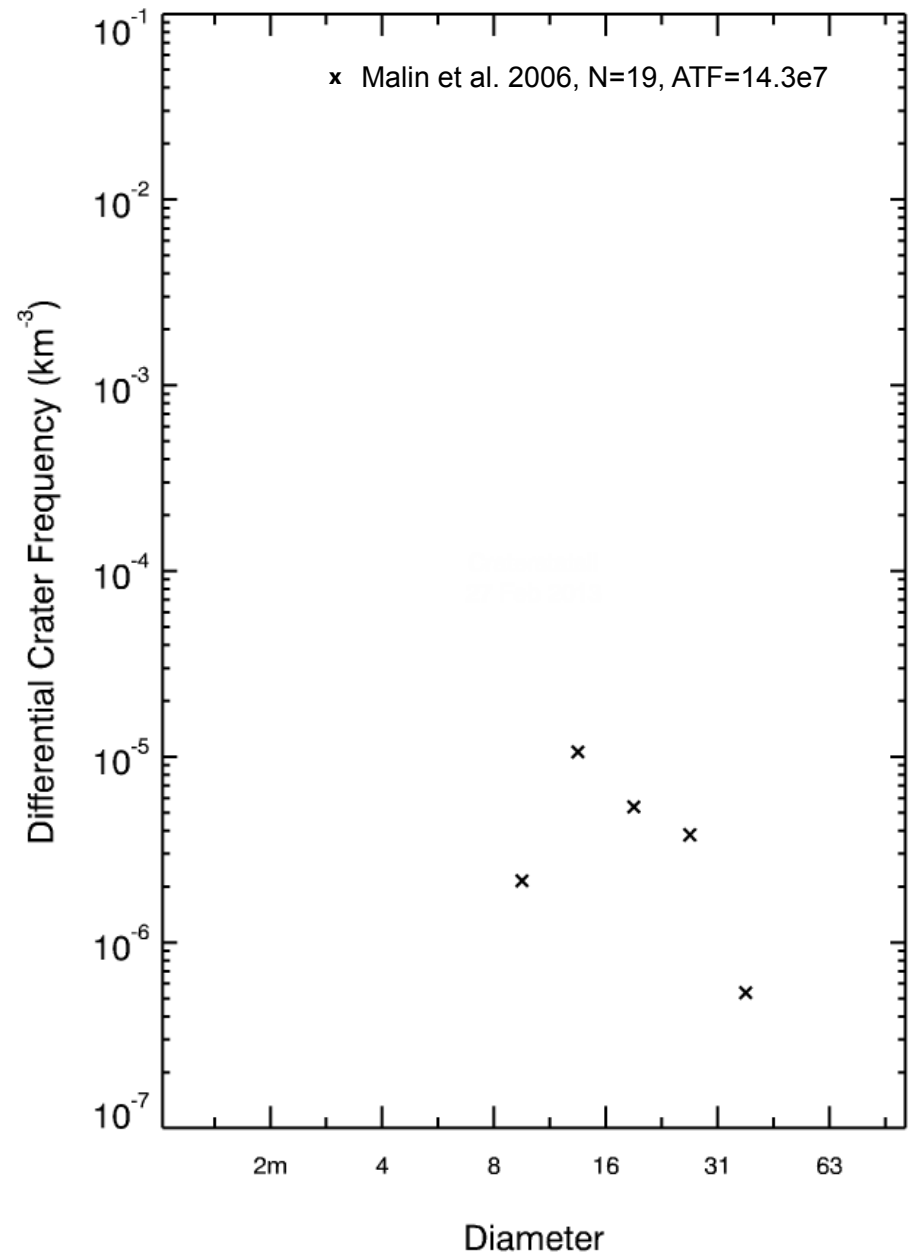
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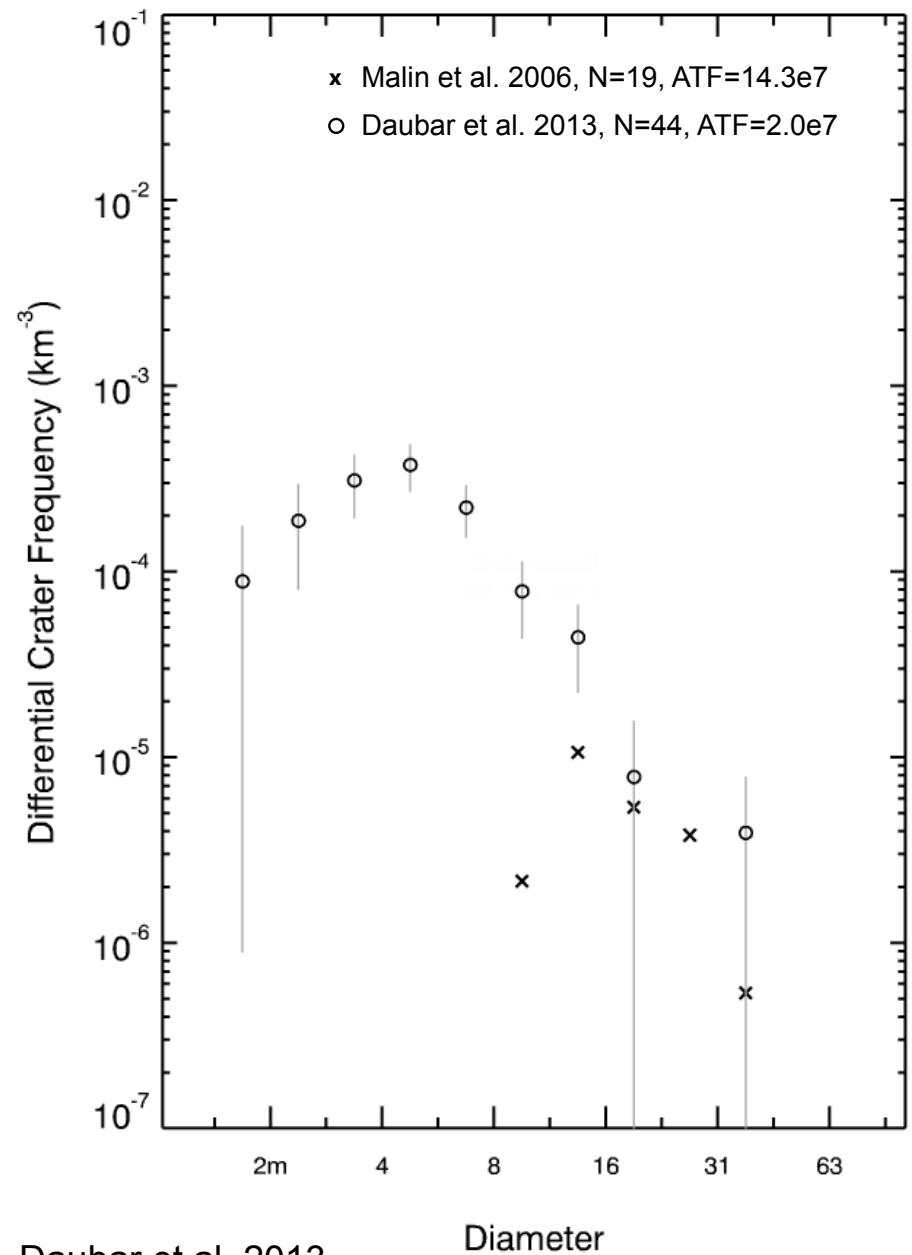
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- Scaled to ATF (Area-Time Factor):  
*Area covered by MOC campaign, multiplied by time separation*



# CURRENT MARTIAN PRODUCTION FUNCTION

- 44 CTX-CTX new crater detections

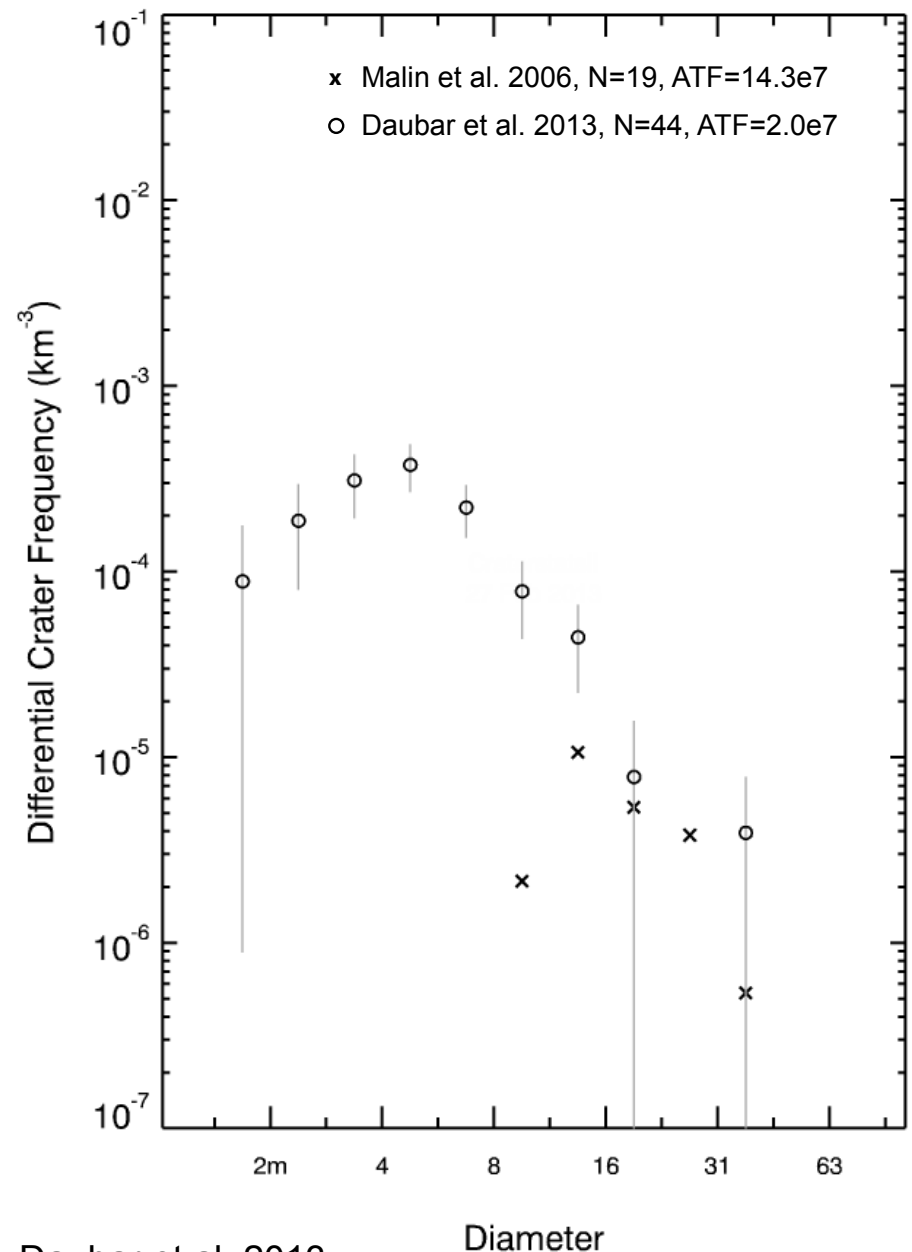


Daubar et al. 2013

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- Effective diameter for clusters:

$$D_{\text{eff}} = (\sum D^3)^{1/3}$$



Daubar et al. 2013

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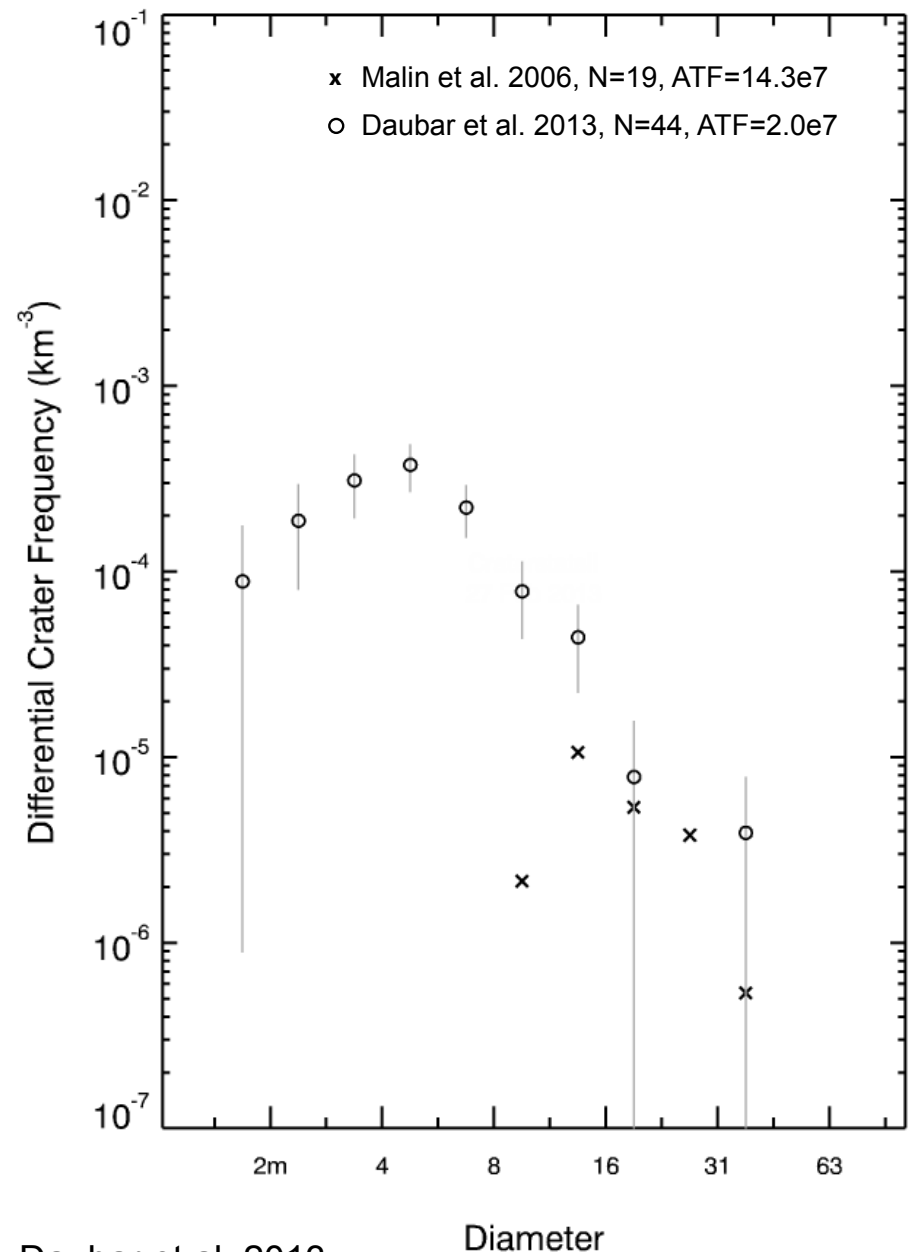
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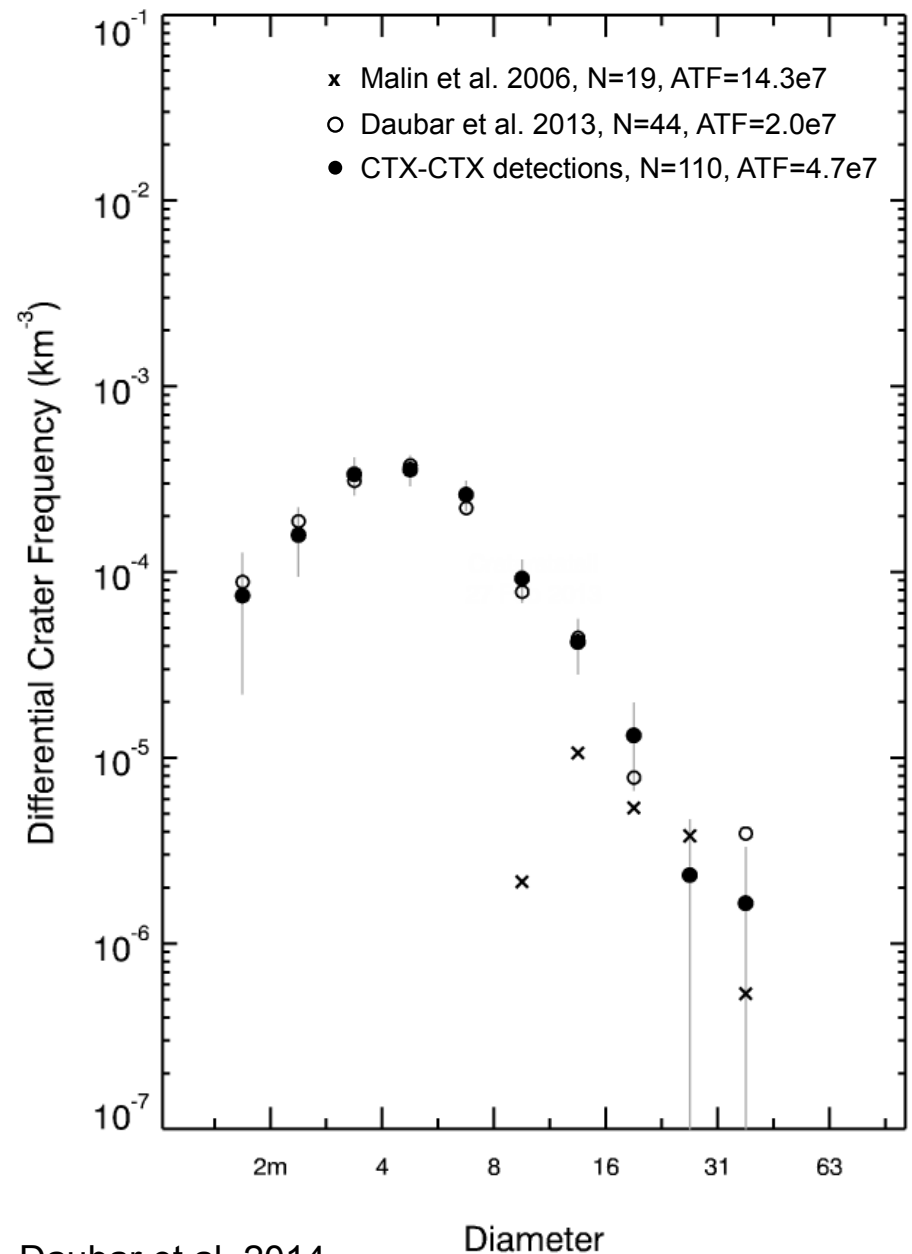
*Sum of area covered repeatedly by CTX over dusty areas, multiplied by  $\Delta t$  between successive images*



Daubar et al. 2013

# CURRENT MARTIAN PRODUCTION FUNCTION

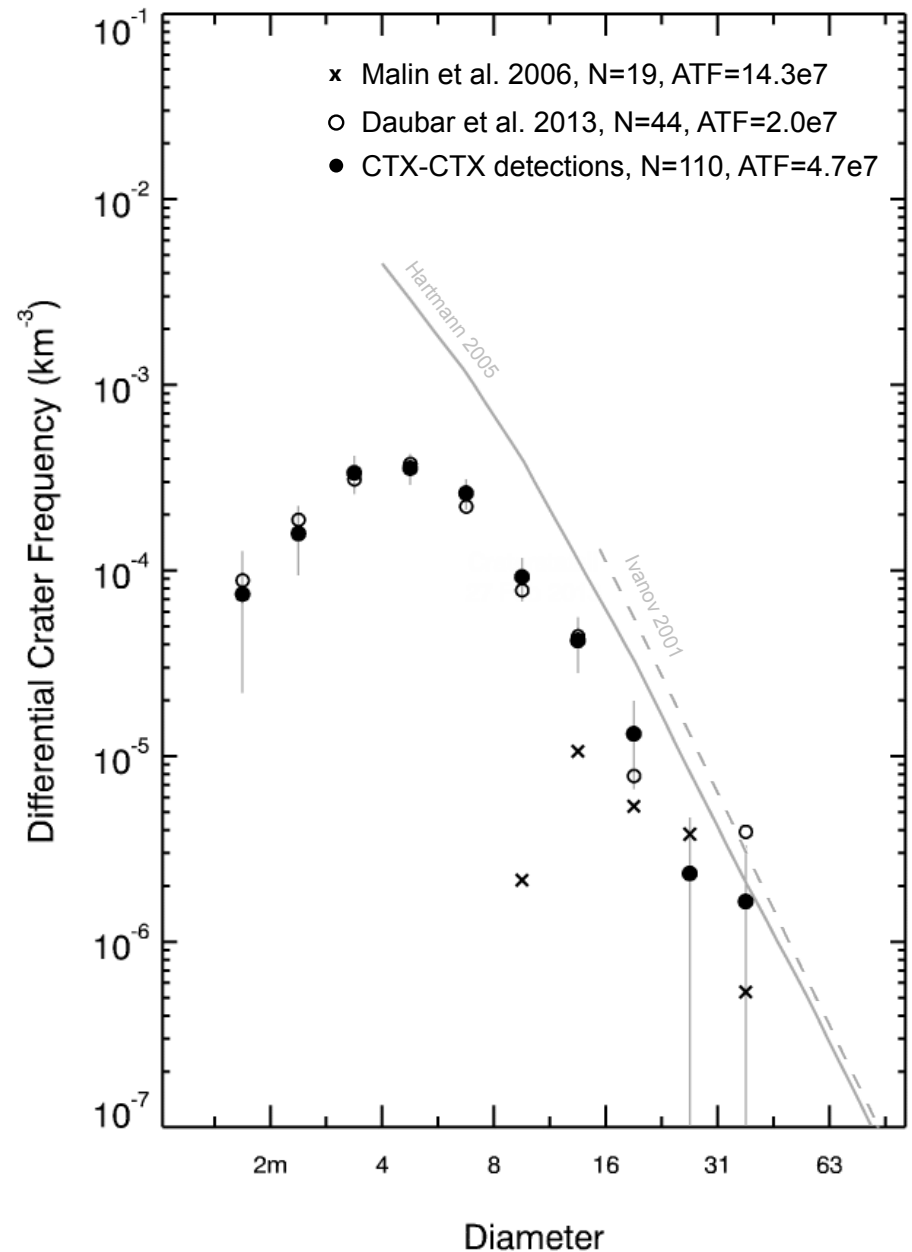
- Update:
  - 110 CTX-CTX new crater detections
  - $D_{\text{eff}}$  for clusters
  - Scaled to ATF
- **Cumulative PF:**  
 **$1.8 \times 10^{-6} D_{\geq 3.9} \text{ m/km}^2/\text{yr}$ ,**  
**slope = -1.5**



Daubar et al. 2014

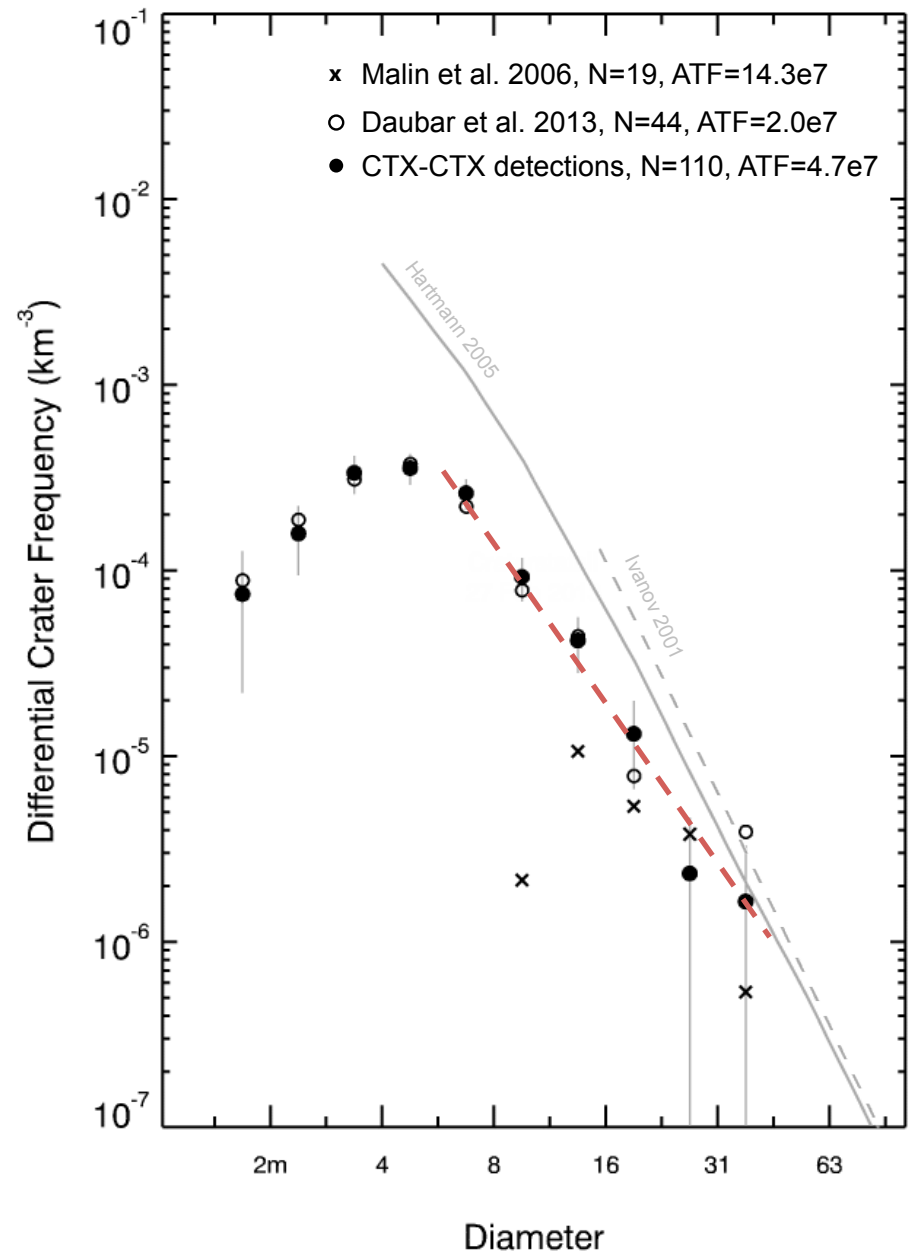
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- Lower than 1y model PFs:
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# CURRENT MARTIAN PRODUCTION FUNCTION

- Lower than 1y model PFs:
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- Shallower slope
- Difference depends on diameter range





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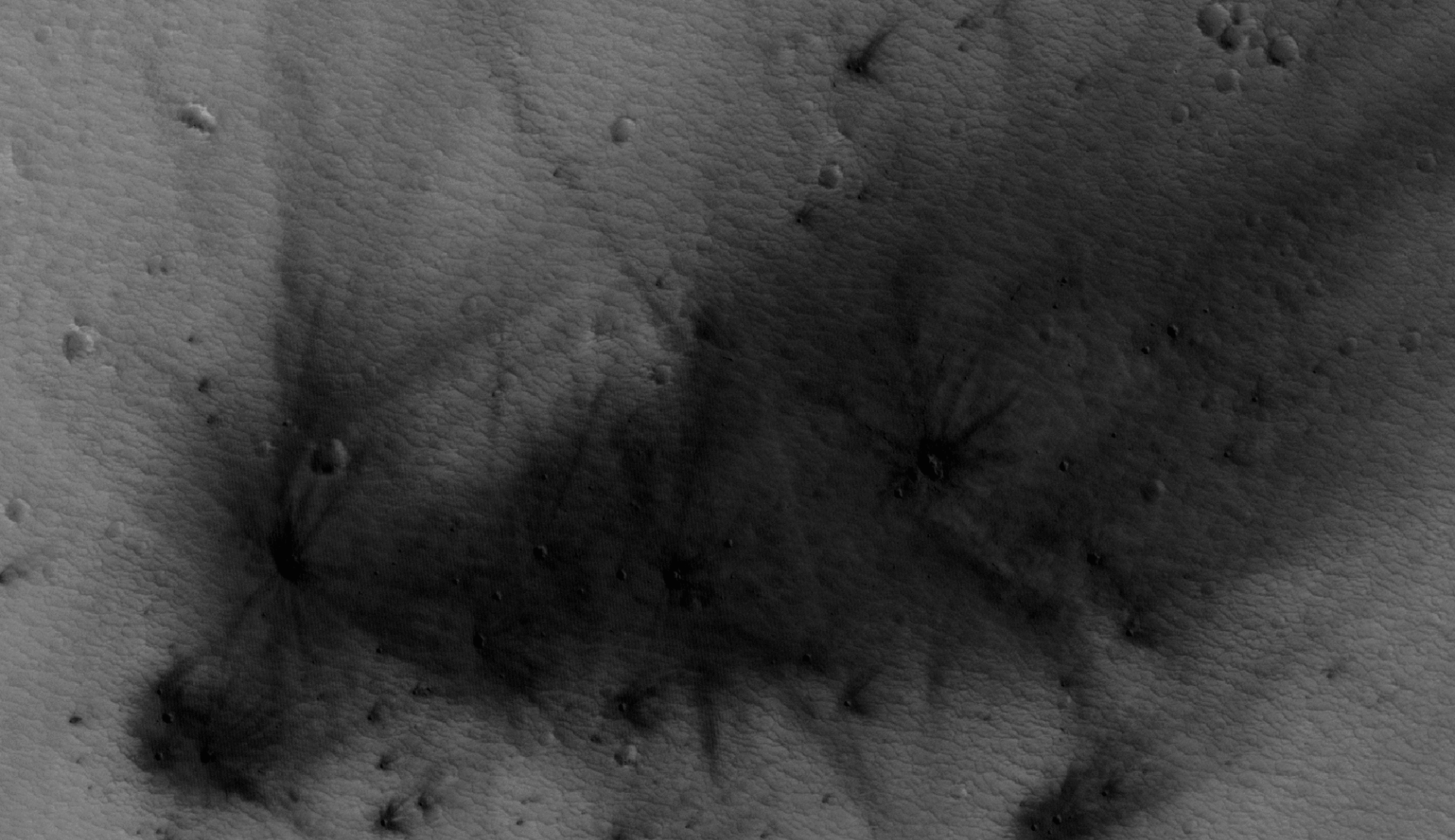
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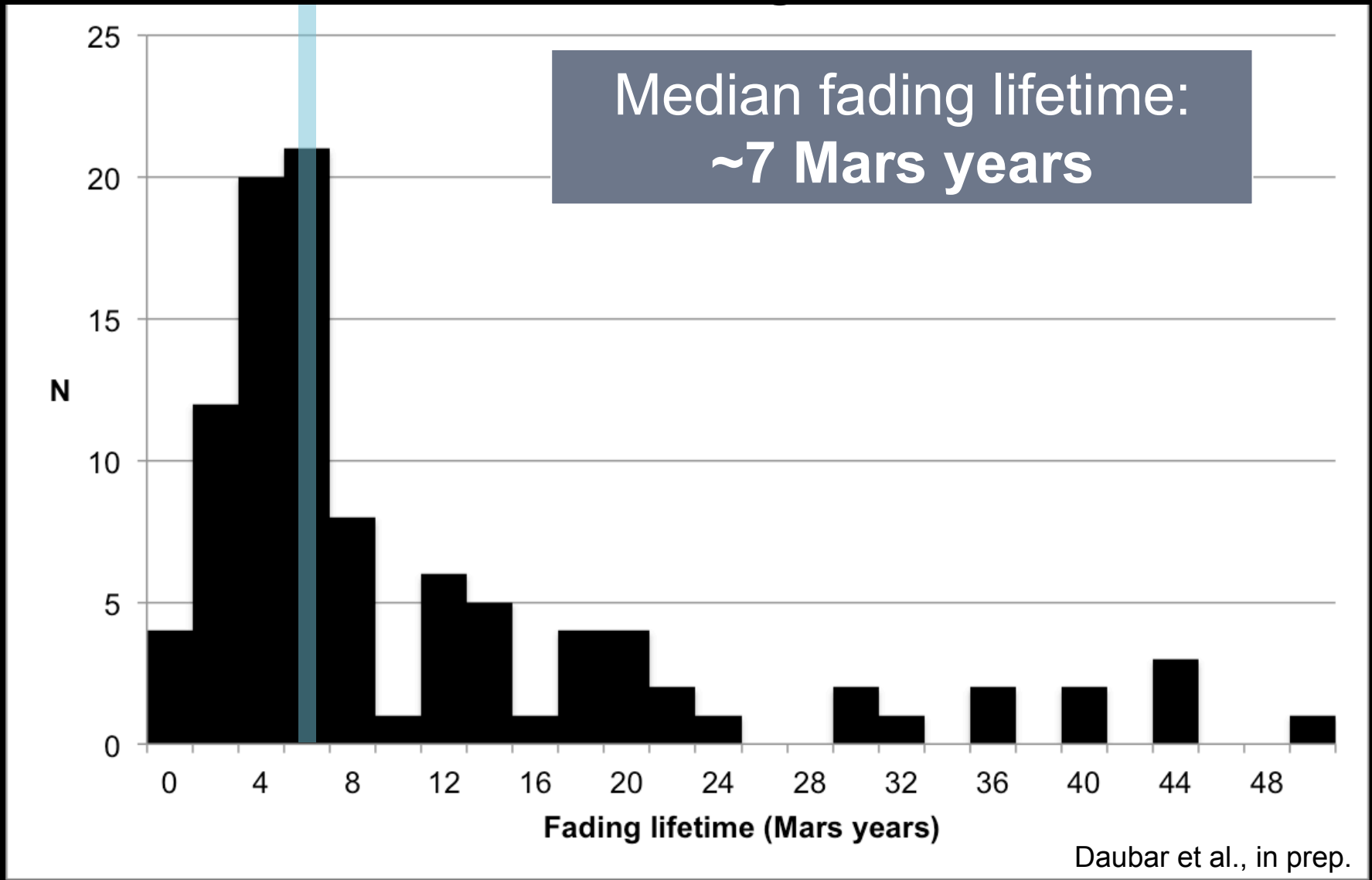
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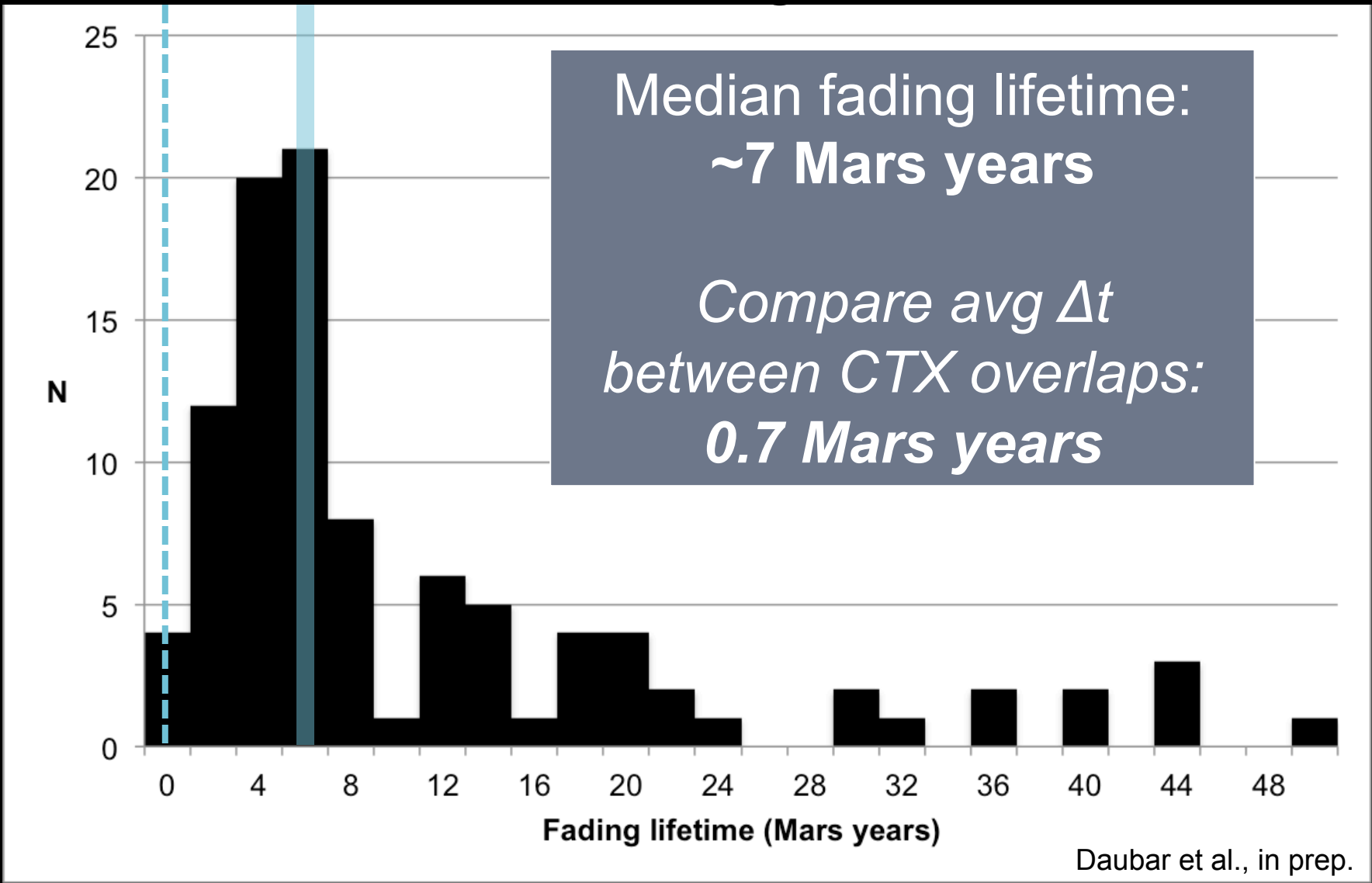


ESP\_014010\_1800, 7/23/09  
ESP\_031917\_1800, 5/18/13 +2 Mars years

# FADING LIFETIMES FOR NEW MARTIAN CRATERS



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Daubar et al., in prep.



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- *All of these contribute to discrepancy*

# Conclusions

- New 1-10m craters on Mars are currently forming at a measurable rate:  $1.8 \times 10^{-6}$   $\text{km}^{-2}\text{yr}^{-1}$   $D_{\text{eff}} \geq 3.9$  m

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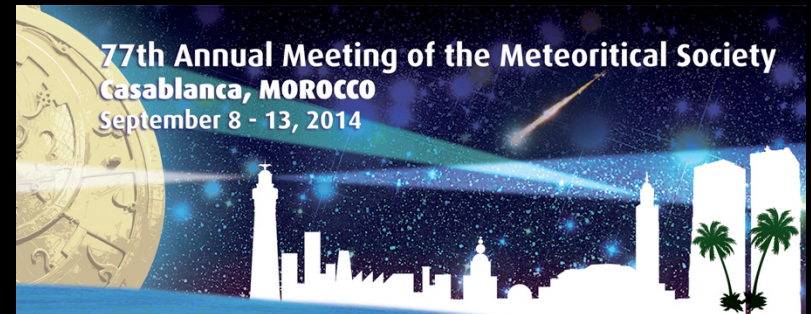
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# Thank you for support from:

Uwingu Graduate Student  
Grant Program for Travel to  
Research Conferences



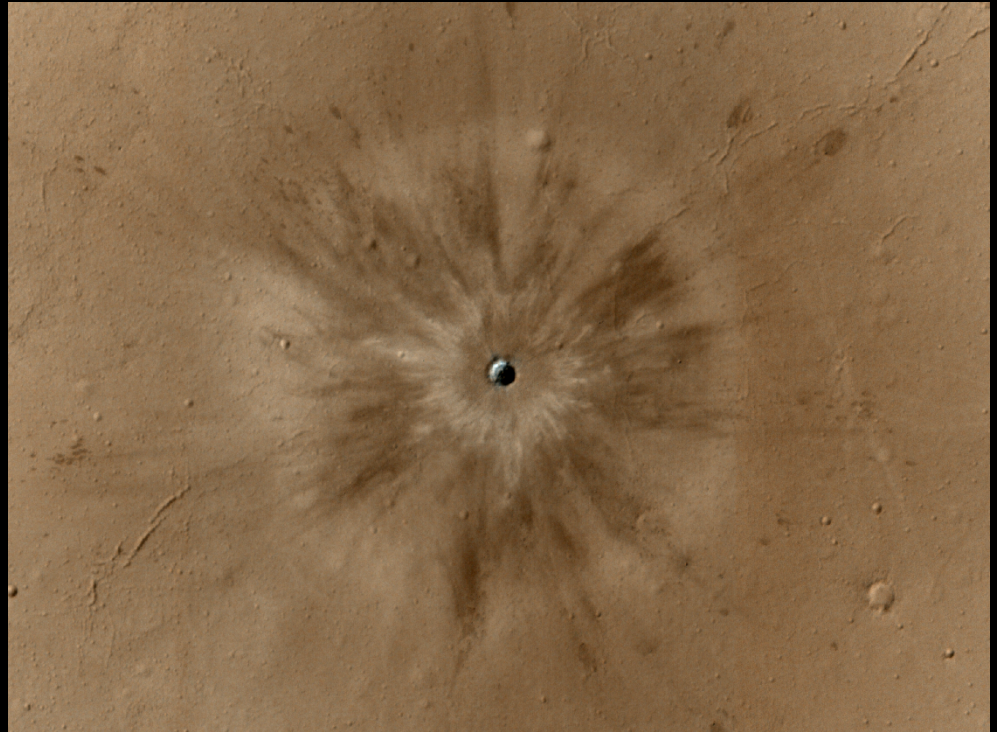
Meteoritical Society  
Student Travel Grant



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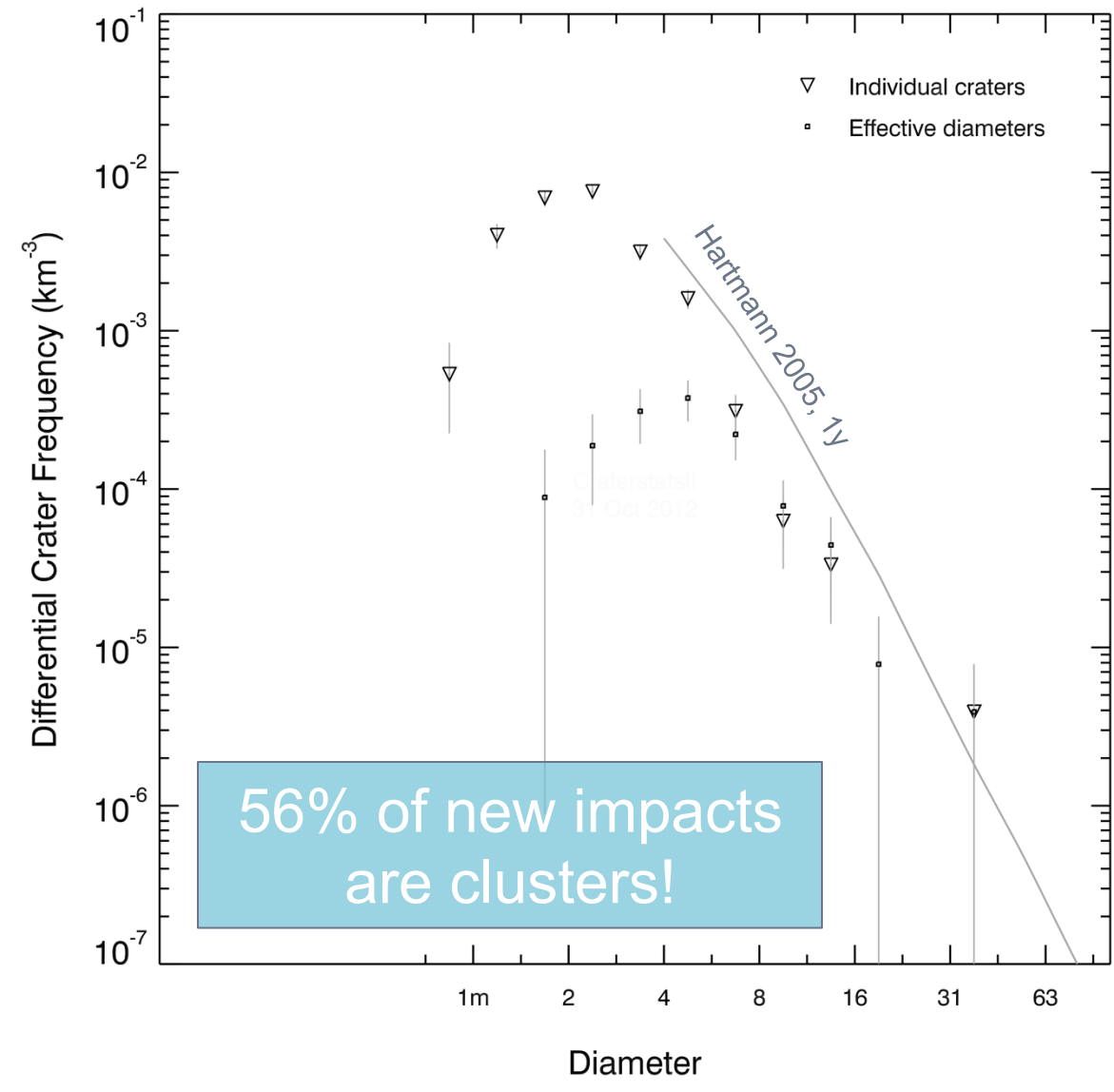
# BACKUP



# Cluster effect

Mistaking individual craters in a cluster as individual impact events →

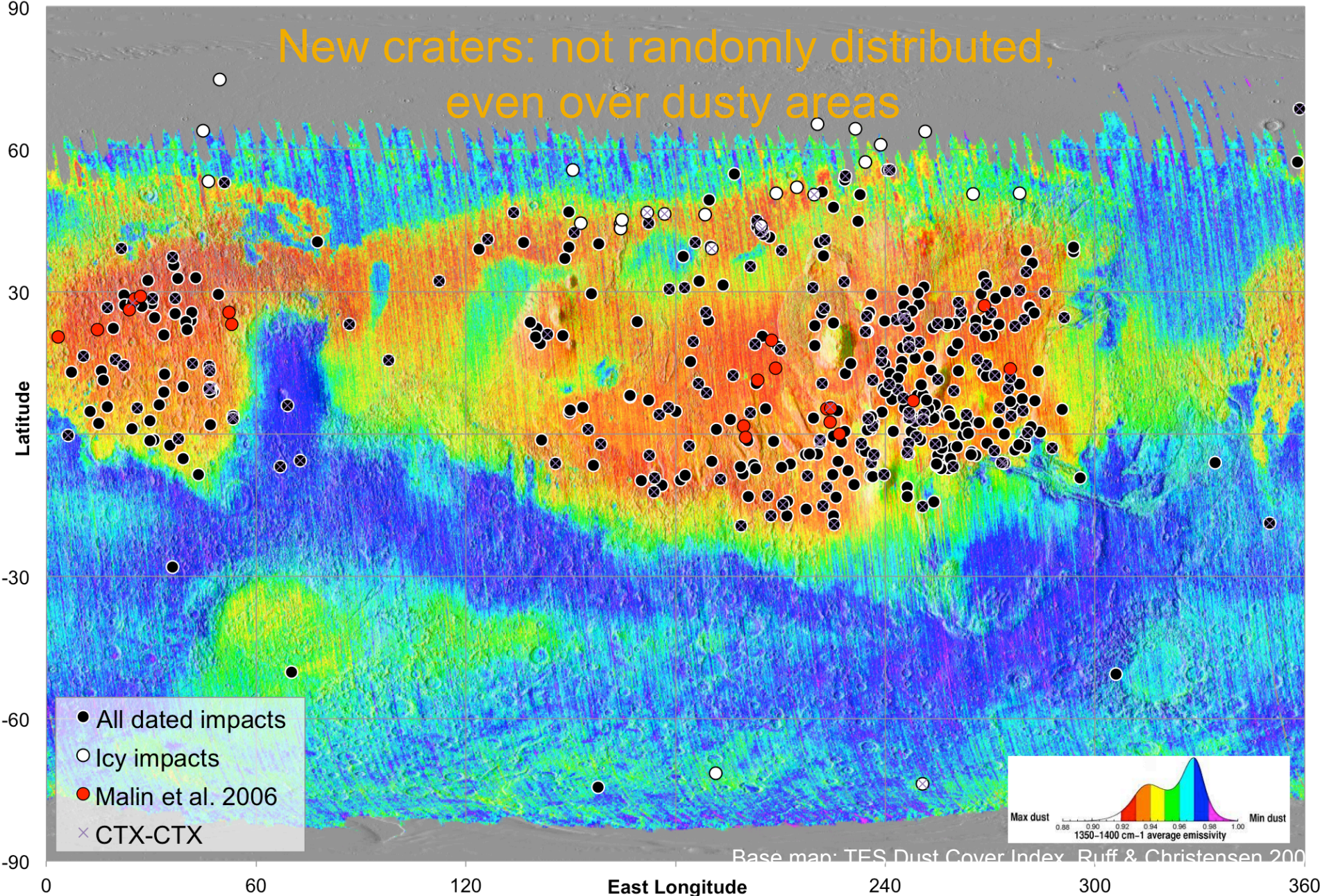
- **Slope steepened** from  $-2.45 \pm 0.36$  to  $-3.07 \pm 0.14$  ( $1.9 \text{ m} \leq D \leq 12 \text{ m}$ ).
- **Model age is increased** >2x, from 0.21 to 0.58 yr (Hartmann 2005 model).
- Turnover at smaller diameters – appearance of completeness.



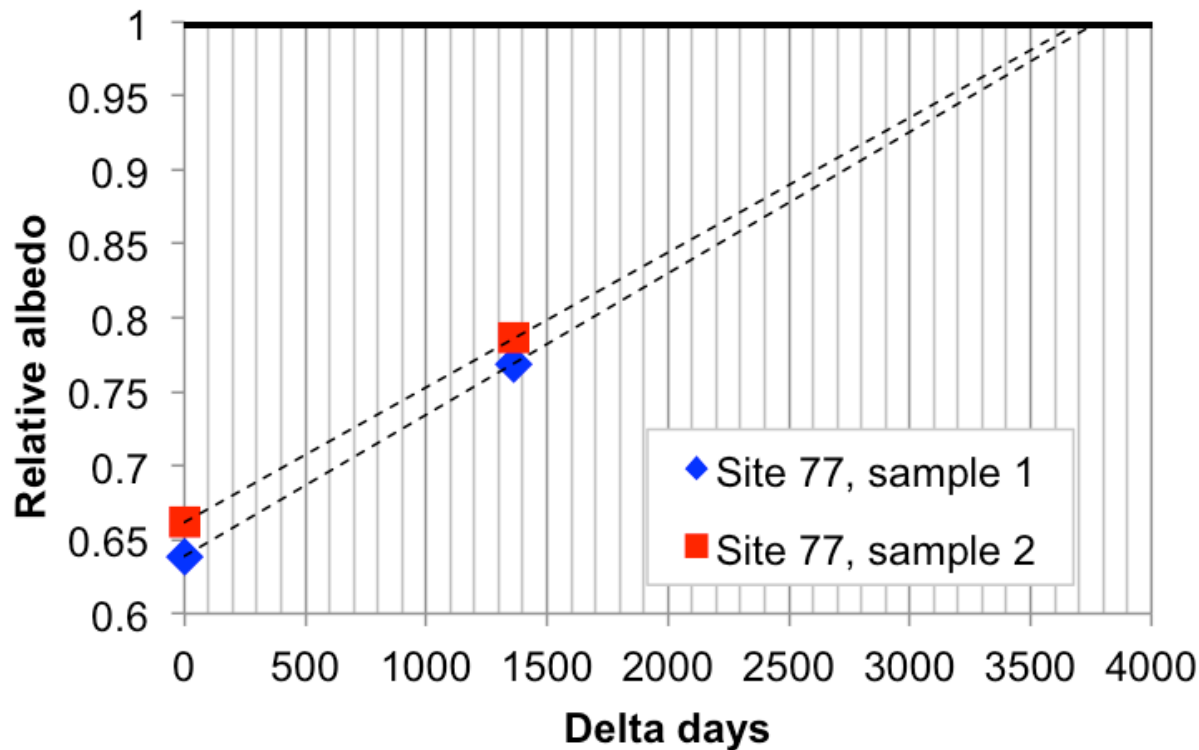
# Randomness correction

- Monte-Carlo simulations to assess spatial randomness of impacts
- → Randomness of the detected population (even within dusty areas) is rejected with great confidence
- → Dark spots are not uniformly created or detected everywhere in dusty region
- To compensate, increase derived cratering rate by  $1.7\times$  (lower boundary)
  - Our current PF is only  $\sim 4\times$  lower than models

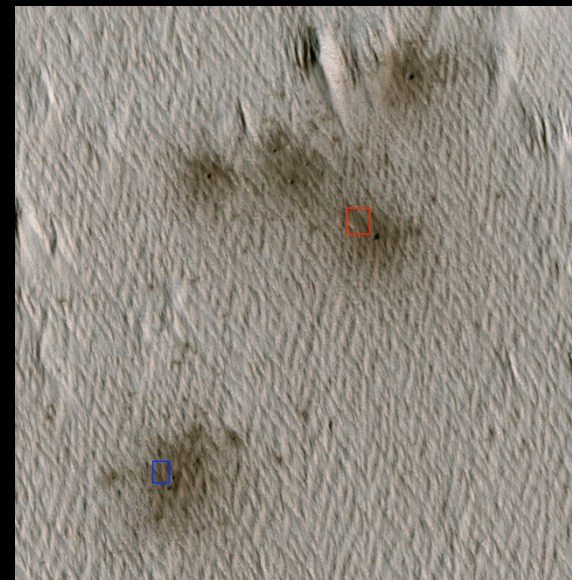
New craters: not randomly distributed,  
even over dusty areas



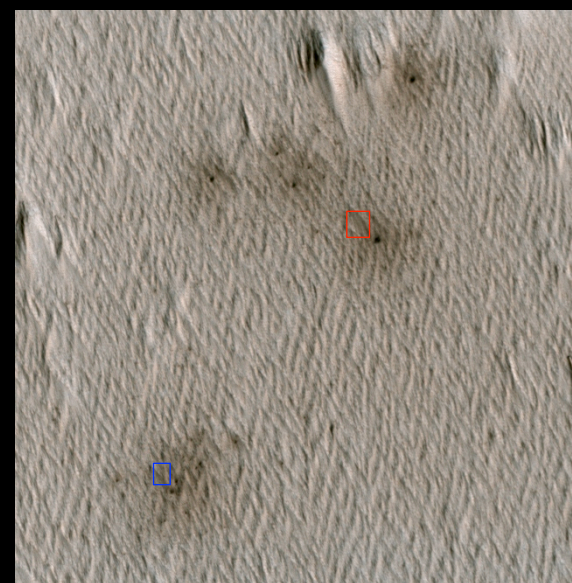
# Estimating Fading Lifetimes



→ Fading lifetime ~3,700 days  
~5.5 Mars years



PSP\_010200\_1805, 9/29/08



ESP\_027685\_1805, 6/22/12

+1362 days ~2 Mars years