The evolution of lunar rock size-frequency distributions: An updated model

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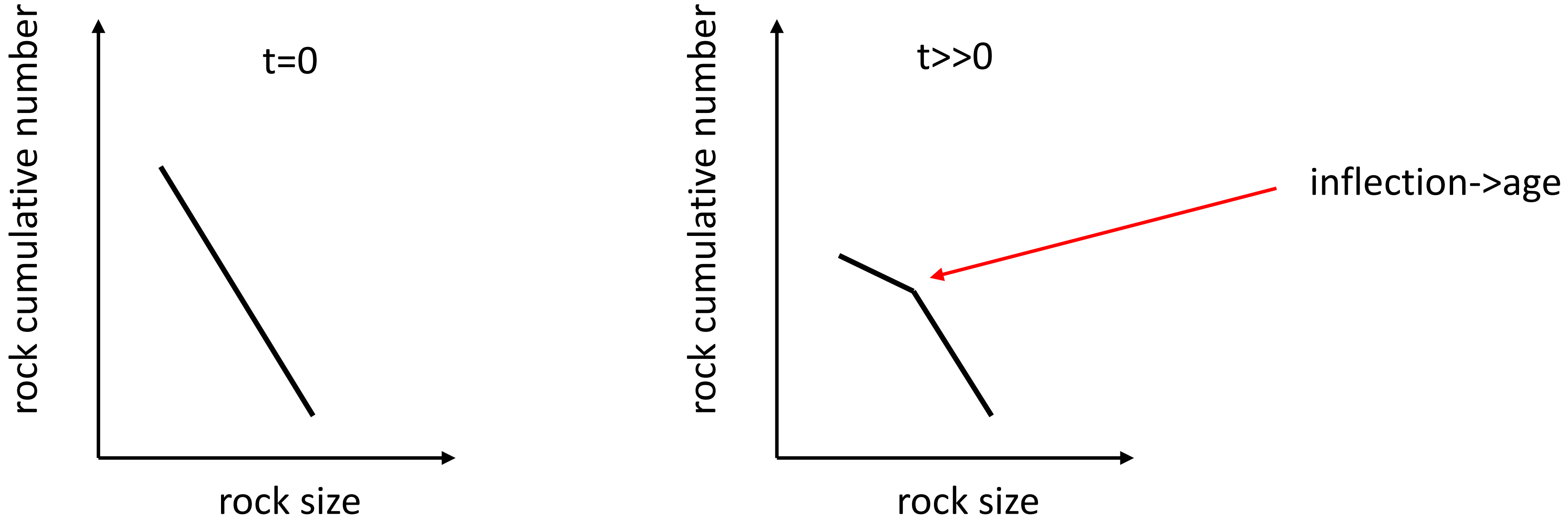
CATASTROPHIC RUPTURE OF LUNAR ROCKS: A MONTE CARLO SIMULATION

F. HÖRZ

frequency distribution. The frequency of the largest masses should be close (or closest) to the original distribution, as they are the least affected. An inflection separating the essentially unaffected from affected masses as determined from a 'standard' distribution may yield relative formation ages of various sized lunar craters.

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FUTURISMO
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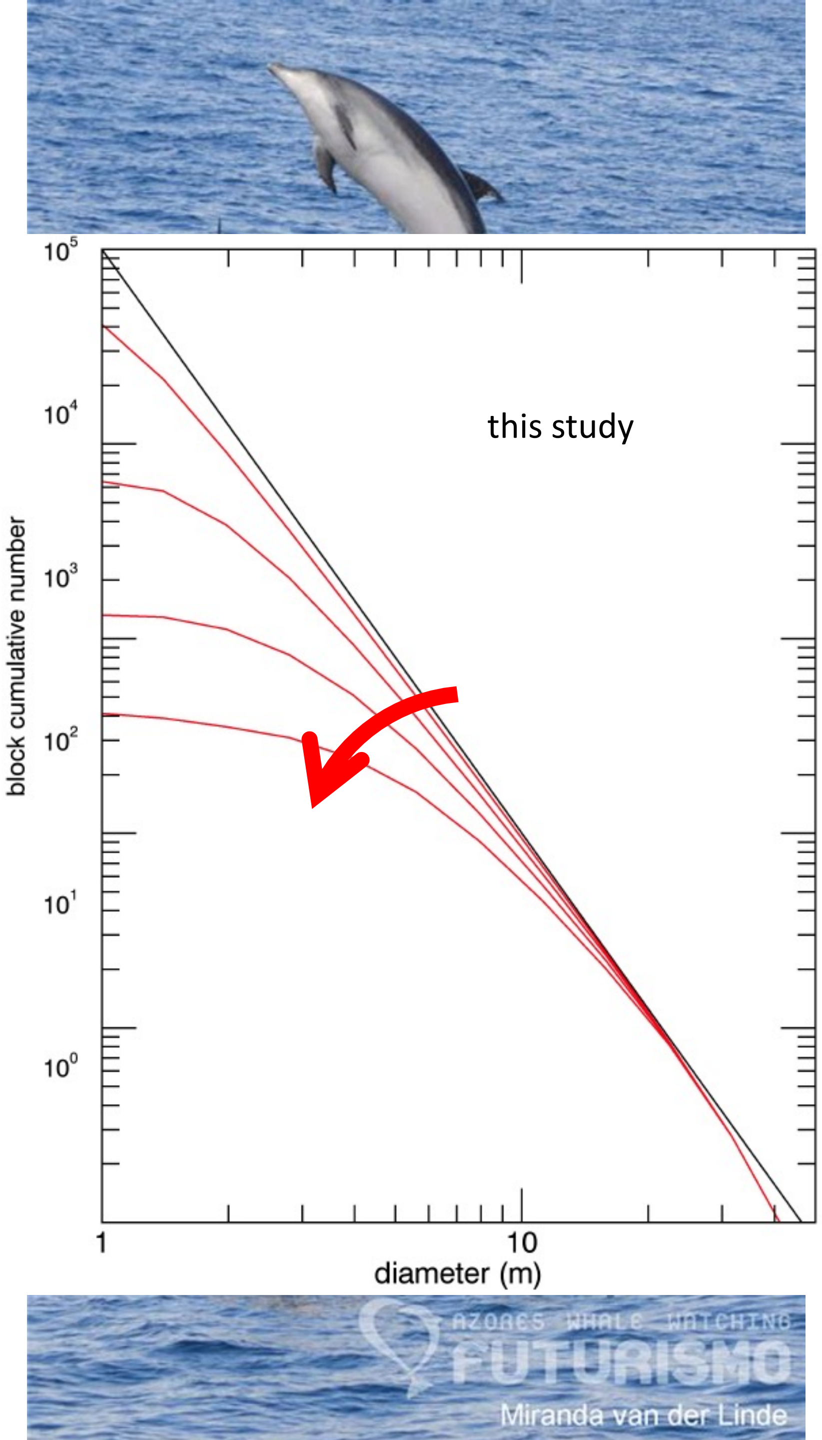

this study
block cumulative number
diameter (m)
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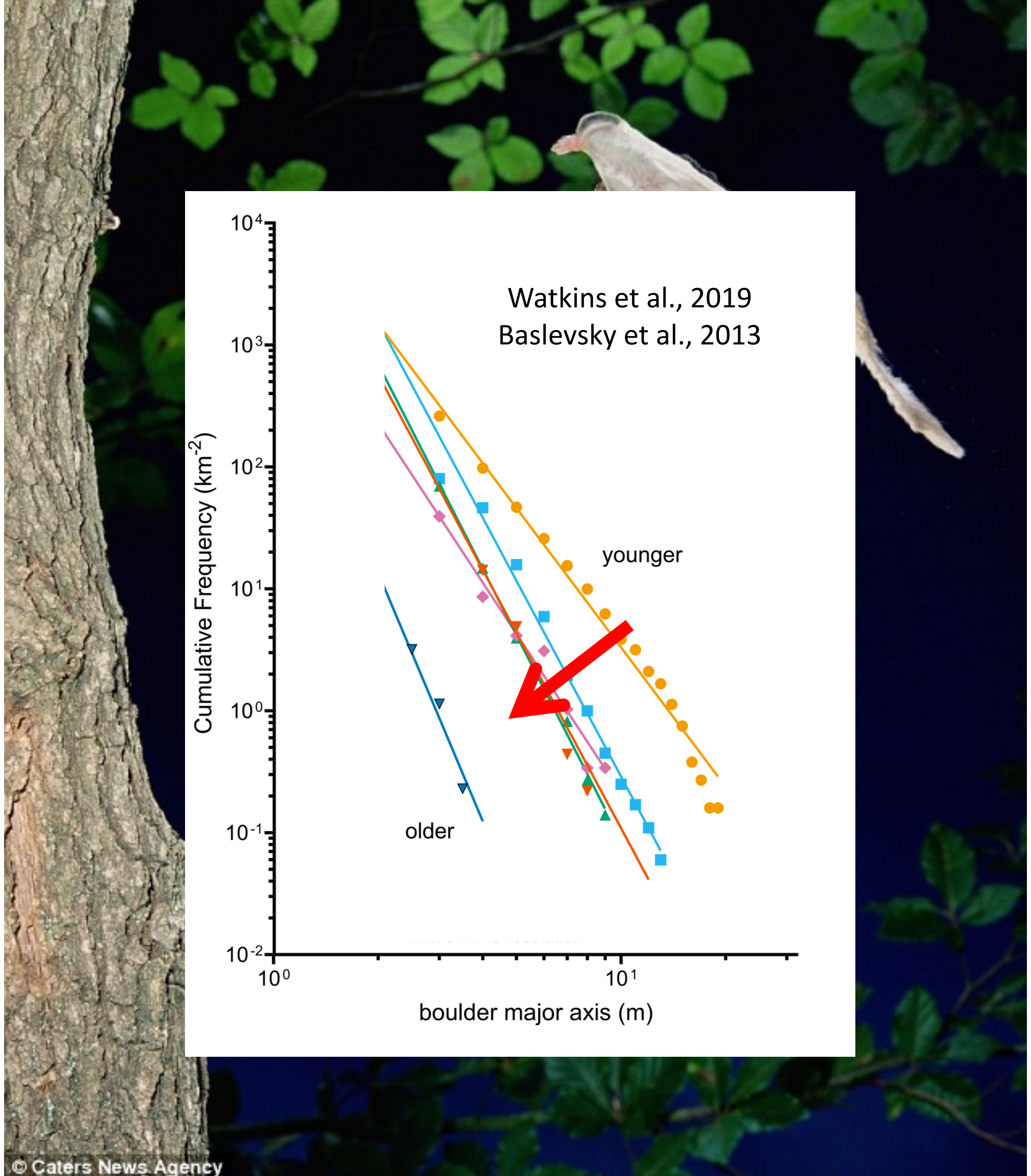

Watkins et al., 2019
Baslevsky et al., 2013
younger
older
Cumulative Frequency (km^{-2})
boulder major axis (m)
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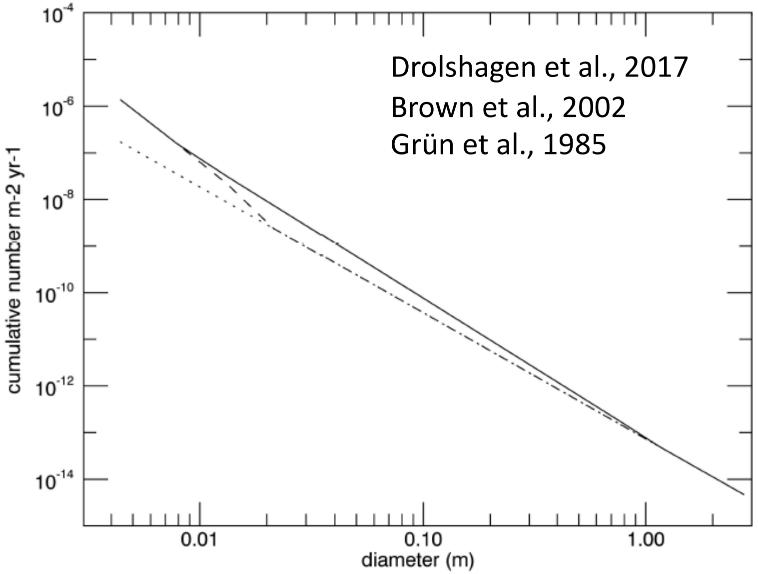
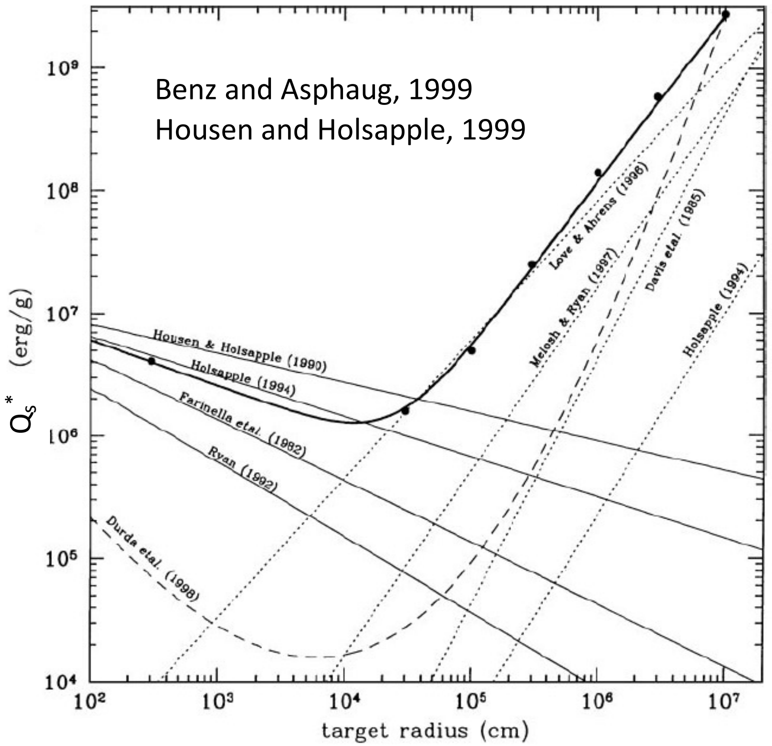
Method

- Same Monte Carlo model as Hörz et al., 1974
  - Rocks accumulate energy from meteoroids impact
  - Rocks shatter (“erasure”) when sufficient energy is accumulated
- New: input functions with respect to rock size (progress of last 47 years)
  - Size-dependent abundance of projectiles (meteoroids): 4 *mm to 2 m*
  - *Probability function for velocity of meteoroids*
  - *Size-dependent energy for shattering* Q_S^*
- Calibration with radiometrically dated boulder field
  - How much energy for “erasure” in LRO/NAC images, Q-NAC ? Scale factor
  - Which functions and which scale factor match the SFD at Tycho best?





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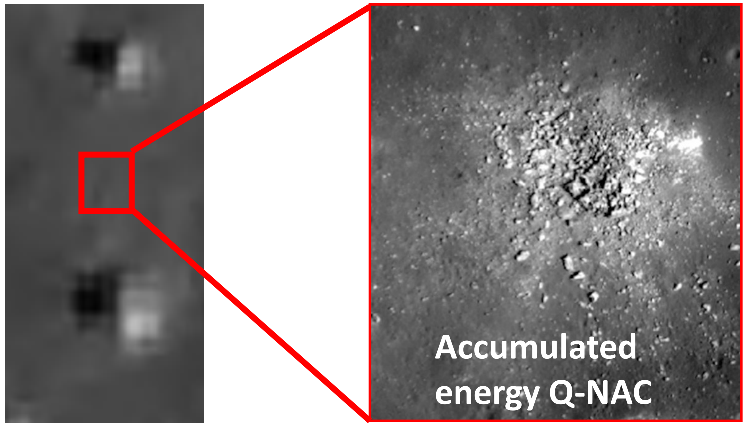
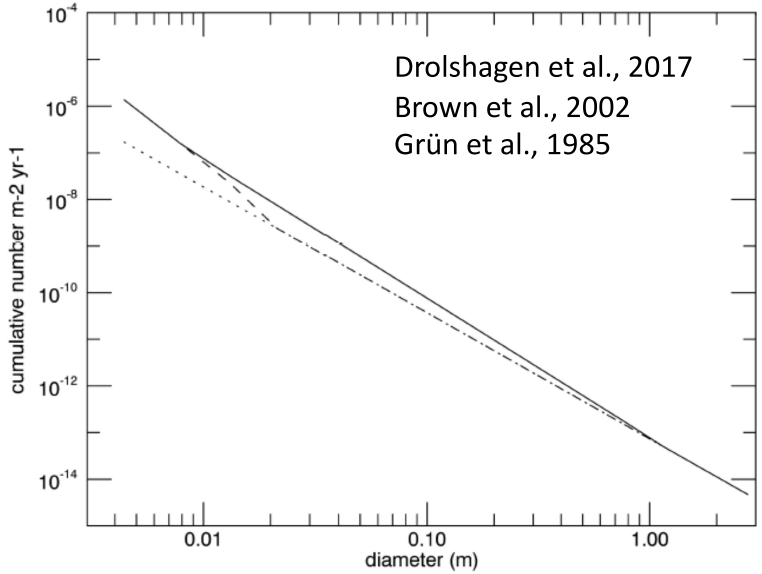
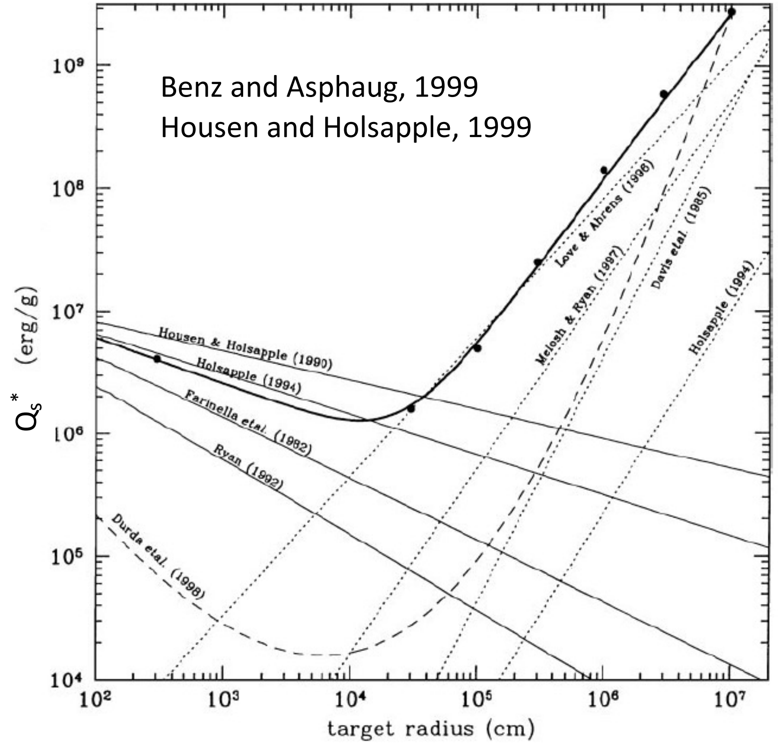
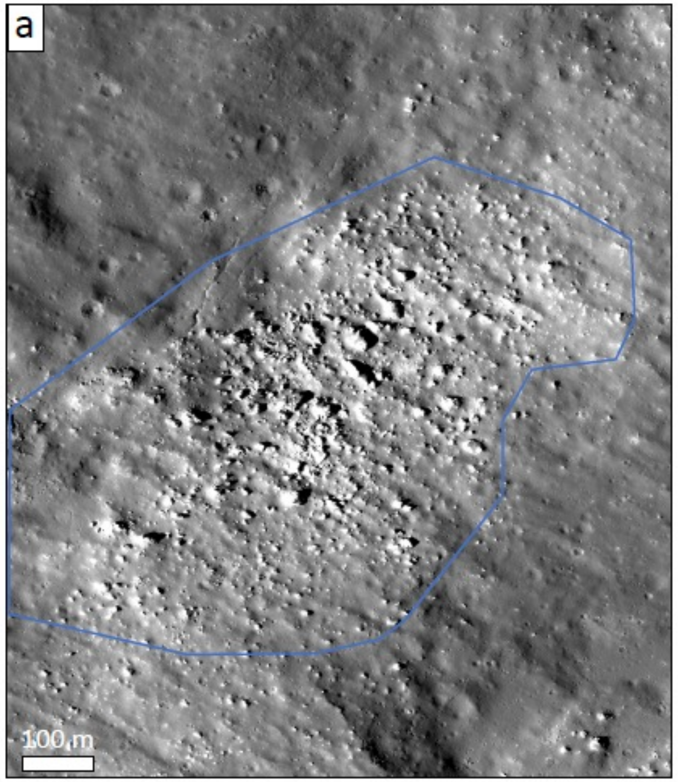
NAC image 0.5 m/px — Not spatially resolved

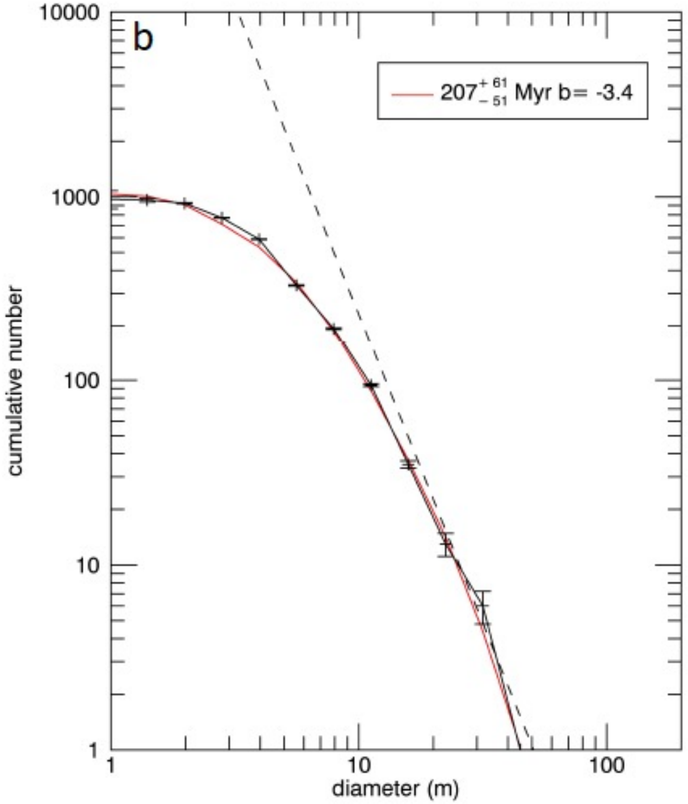


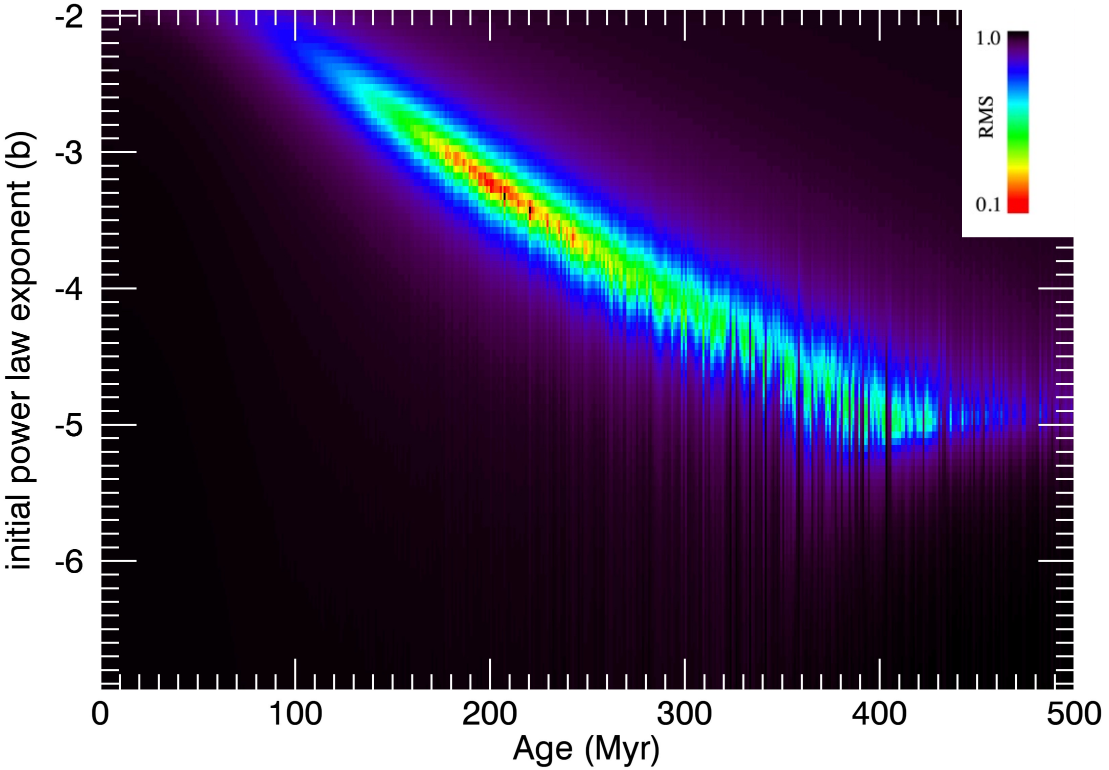




Results: age of lunar craters from their boulder SFD

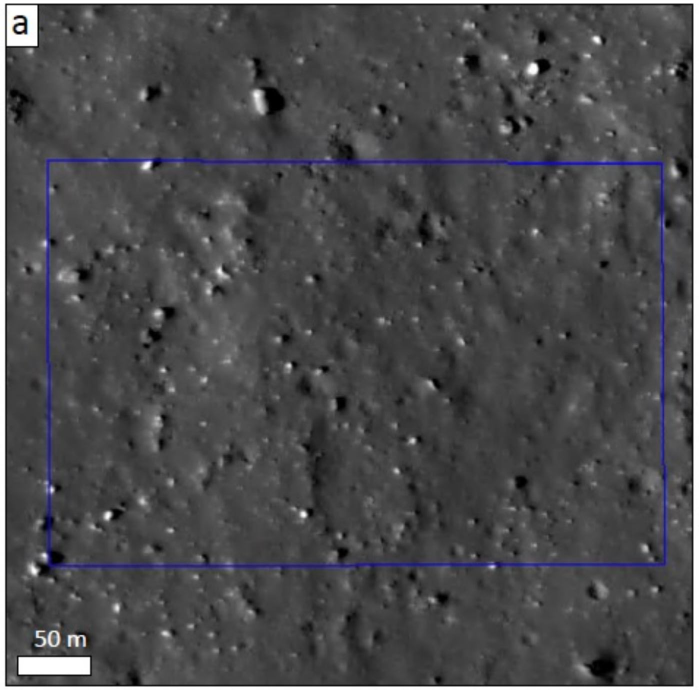


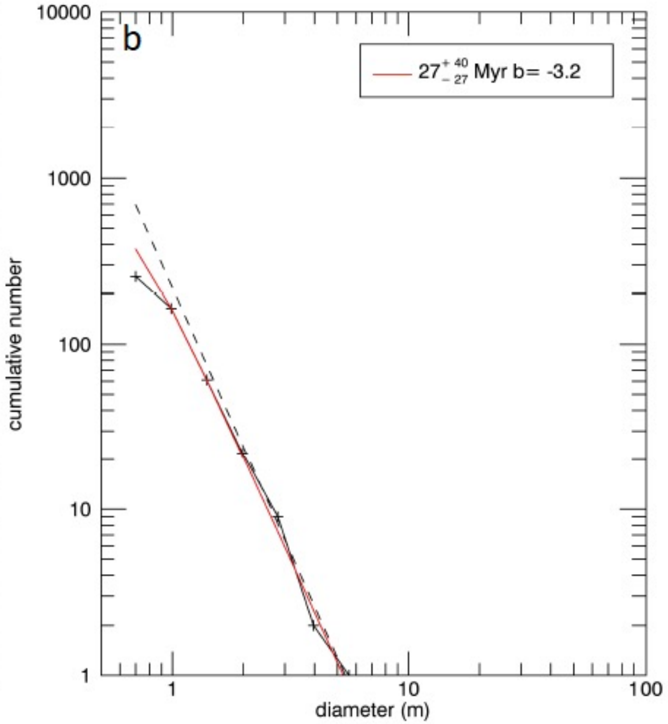


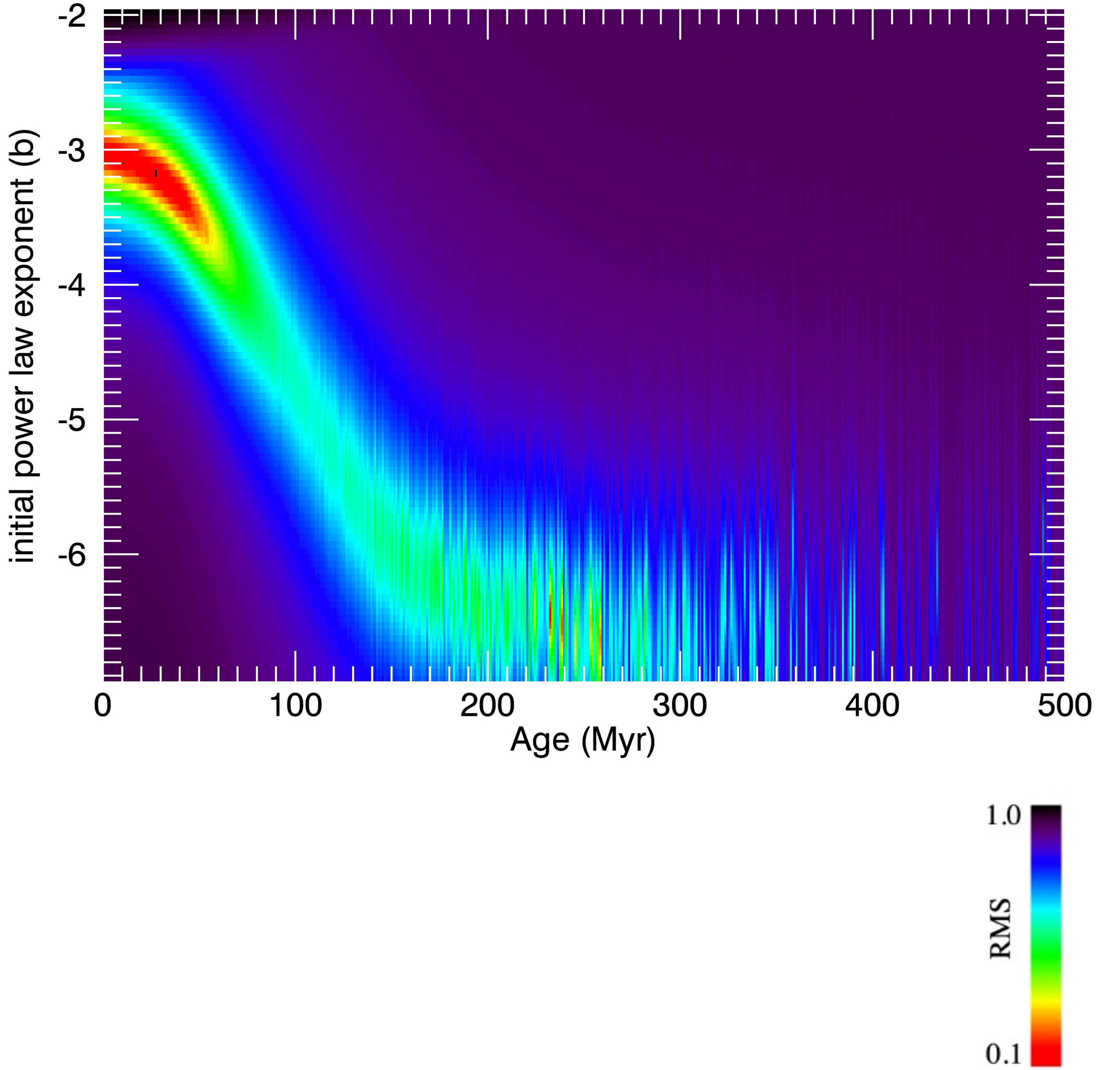


Location	block SFD ages (Myr) (this study)	crater SFD ages (Myr)
Byrgius A	27^{+40}_{-27}	47^{+14}_{-14}
Tycho	120^{+71}_{-51}	109^{+4}_{-4} (radiometric age)
Aristarchus	207^{+61}_{-51}	164 or 280
Jackson	220^{+35}_{-35}	140–210
Copernicus	650^{+50}_{-100}	800^{+15}_{-15} (radiometric age)

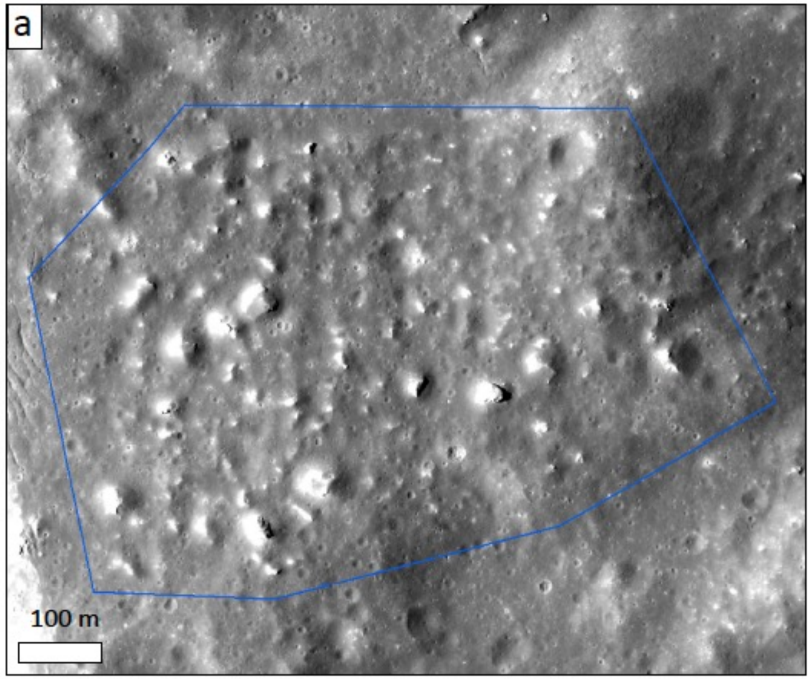
Byrgius A crater

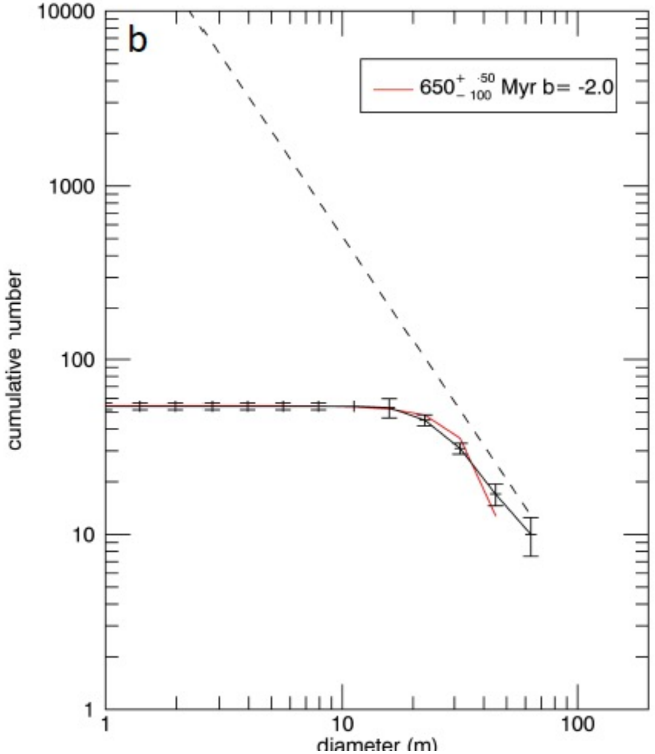


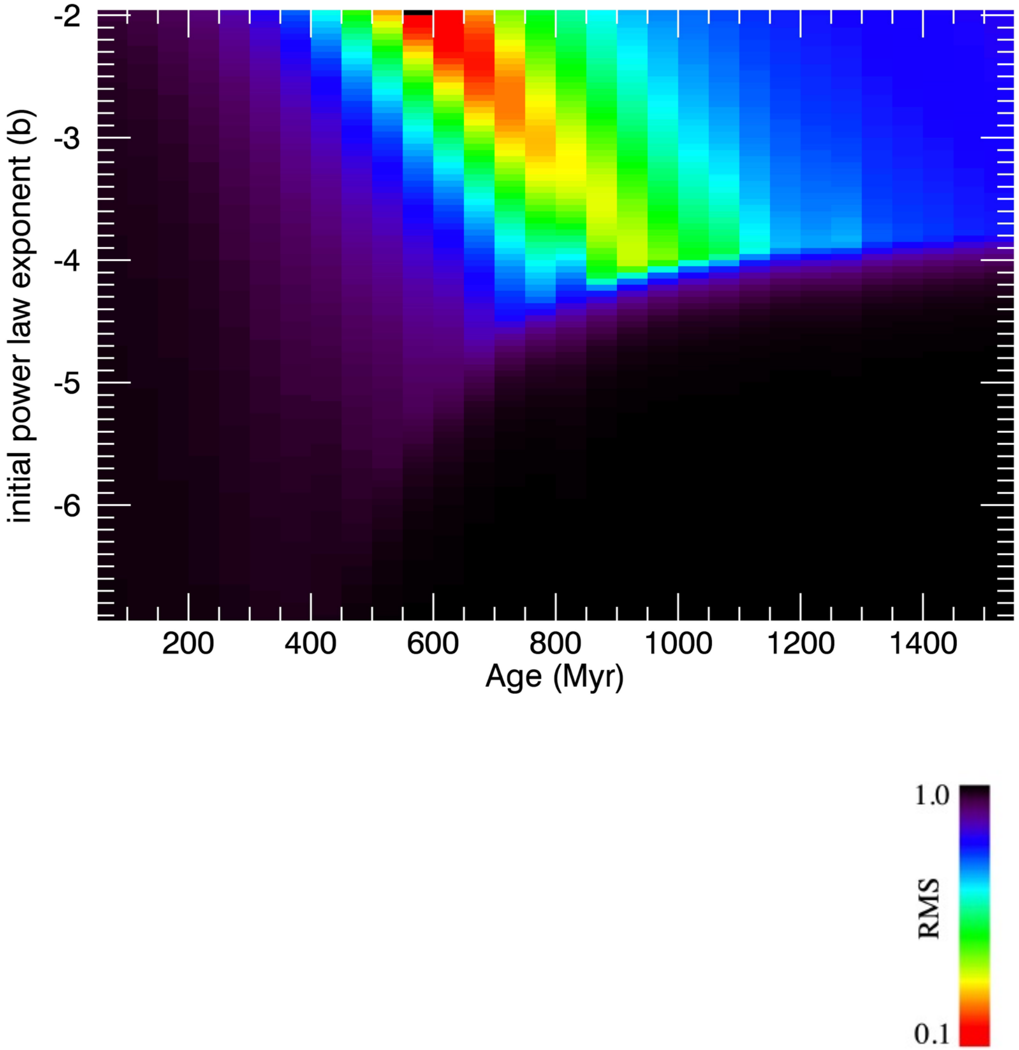




Copernicus crater





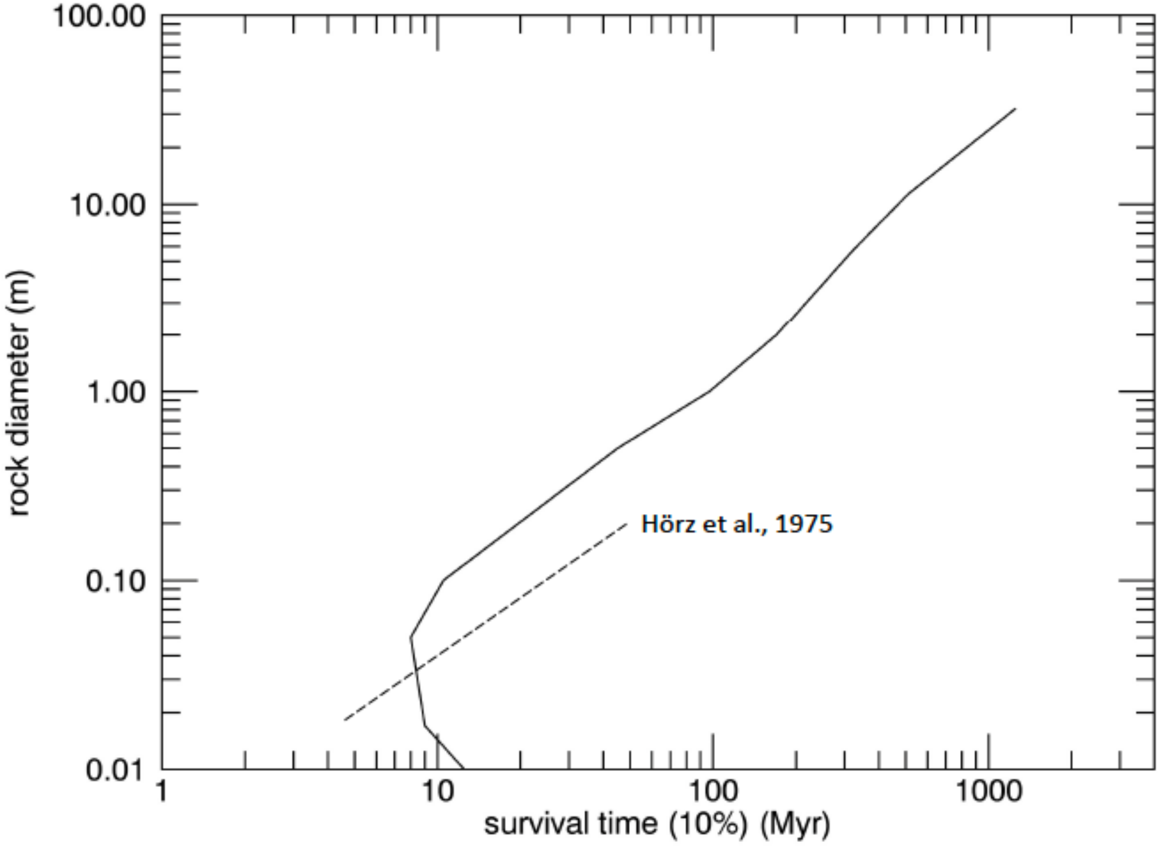


Conclusion

New model provides:

- Evolution of the SFD shape
- Age determination from boulder SFD
- Survival times of lunar boulders with respect to size

Boulder erasure probability at 90 %



Rüsch et al., in revision