

Boulders Ejected from 100-m size craters

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Motivation

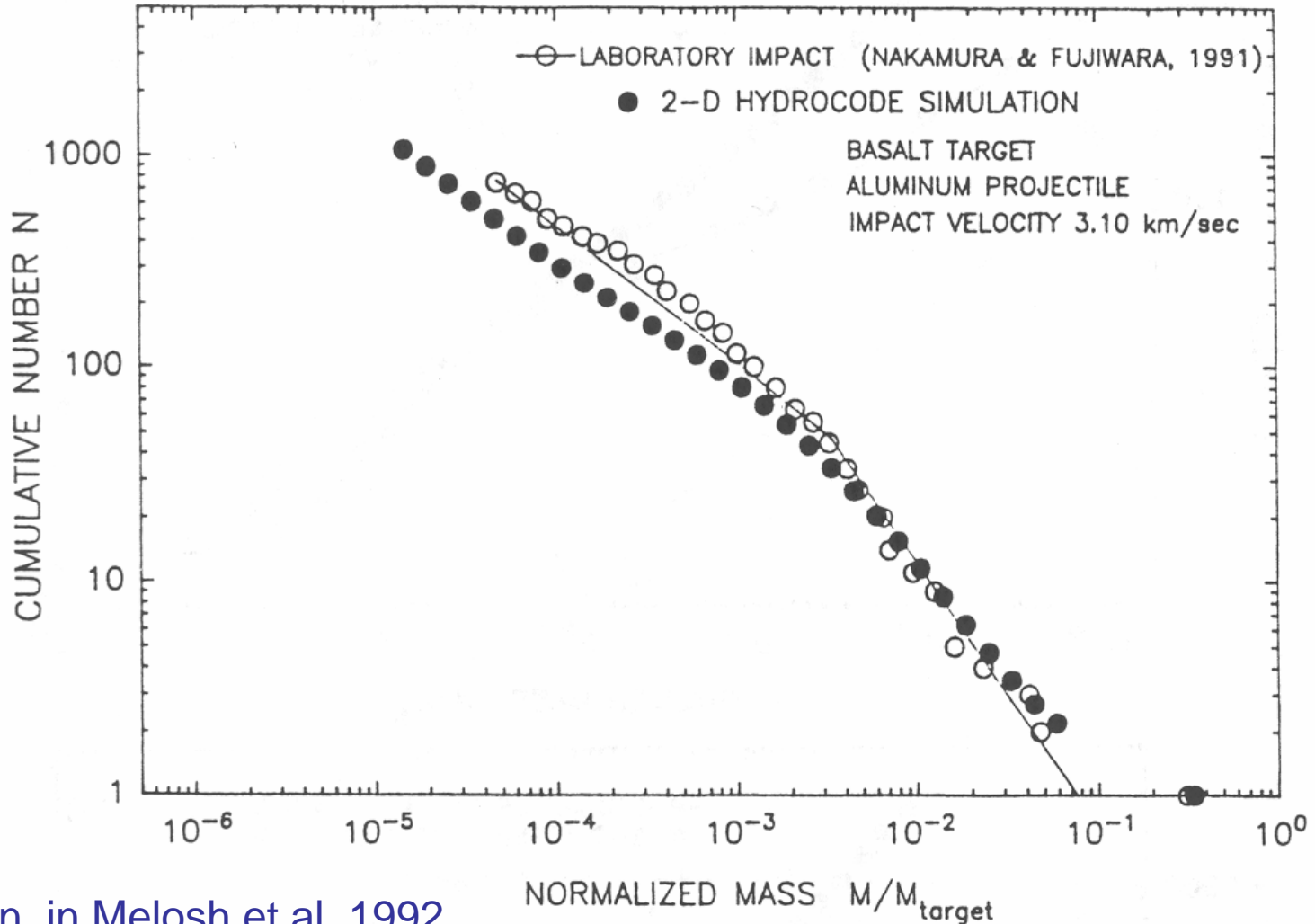
- Provide constraints for numerical models
- Provide data relevant to secondary cratering debate

Previous Work:

constraints on numerical models

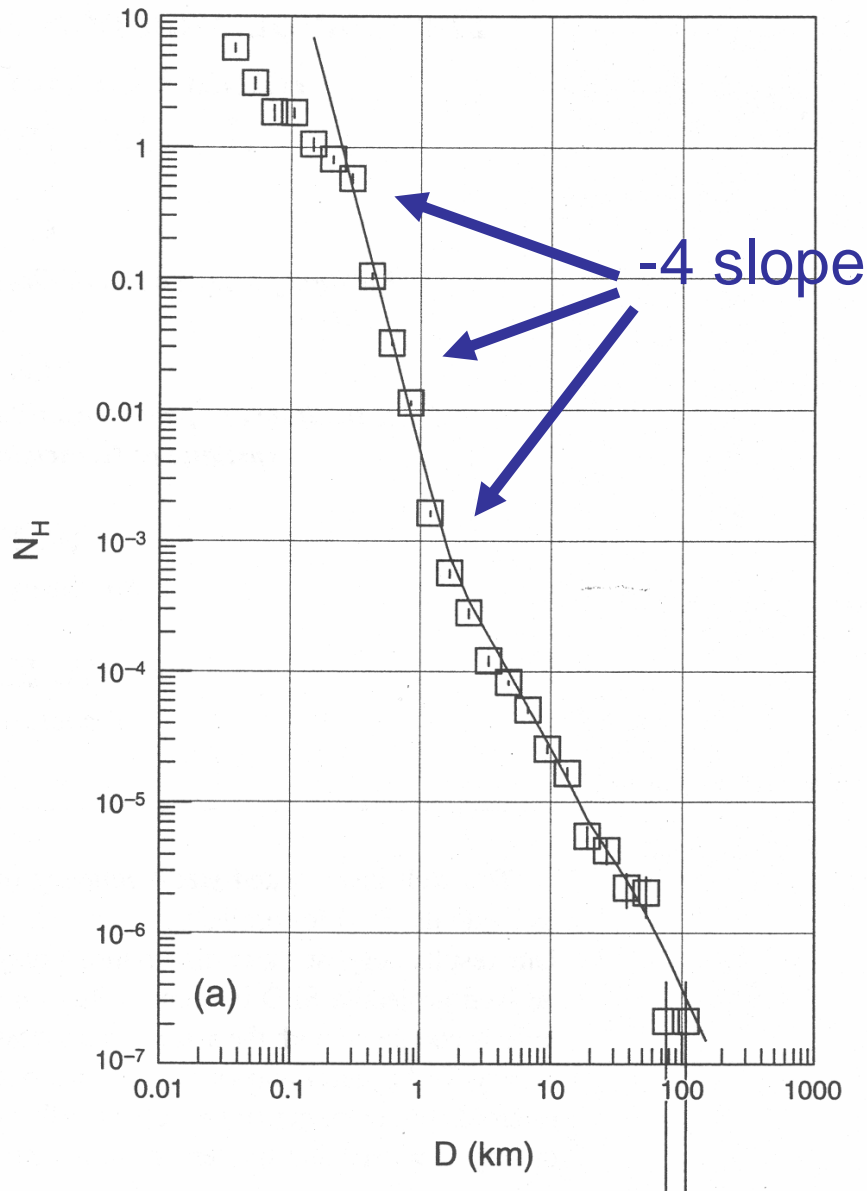
- E. Ryan (published in Melosh et al. 1992)
- Compared results from laboratory cm-size craters to hydrocode models
- Found good agreement
- But: scale is **cm** rather than **m** or **km**

Lab vs. Code model: cm size



E. Ryan, in Melosh et al. 1992

Cumulative plot of lunar craters



- For crater diameters < 1.41 km, the slope of the plot is **-4**.
- For larger craters the slope is \sim **-2**.
- Plot and data from Ivanov et al in *Asteroids III* (2002)
“Size-Frequency Distribution”

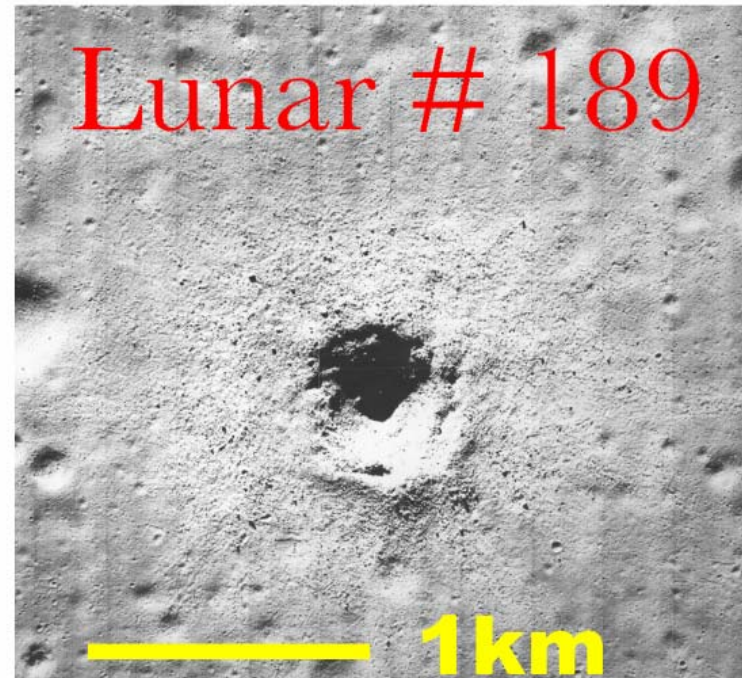
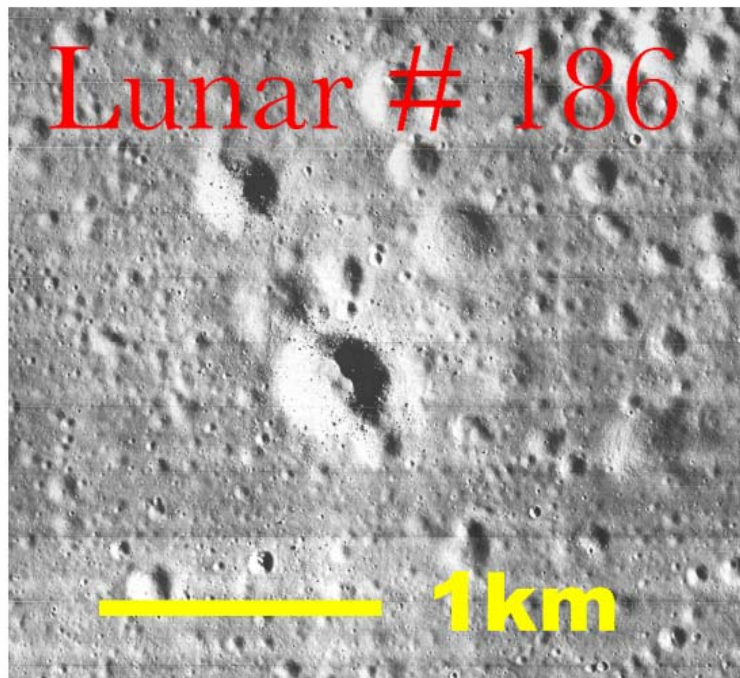
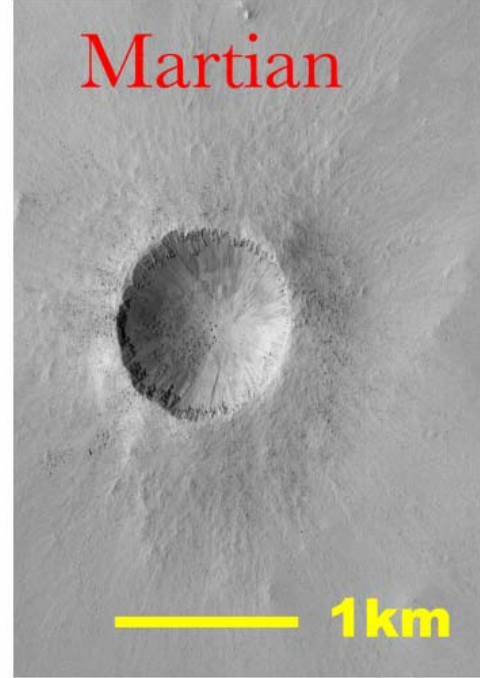
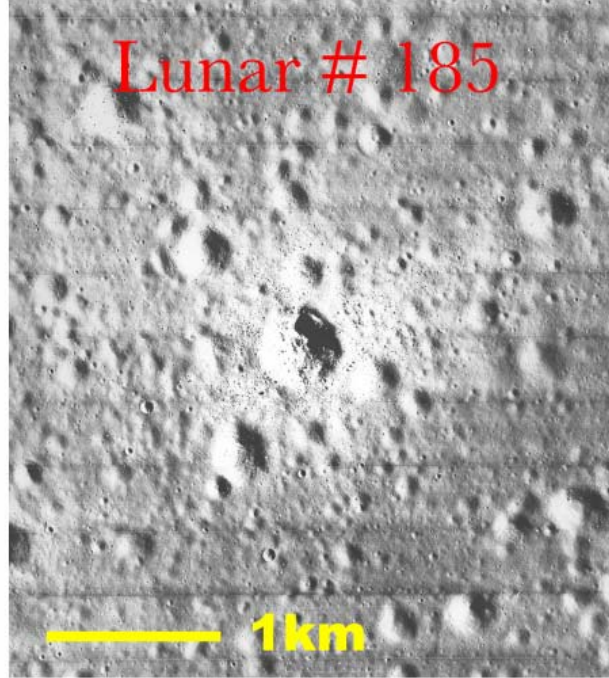
Previous Work:

the secondary cratering debate

- Small craters plot at slope = -4
 - Are they primary craters? (Neukum 2001)
 - Or distant secondary craters? (McEwen 2005)
- Answer affects surface ages obtained from crater counting
- Ejected boulders form secondary craters

Method

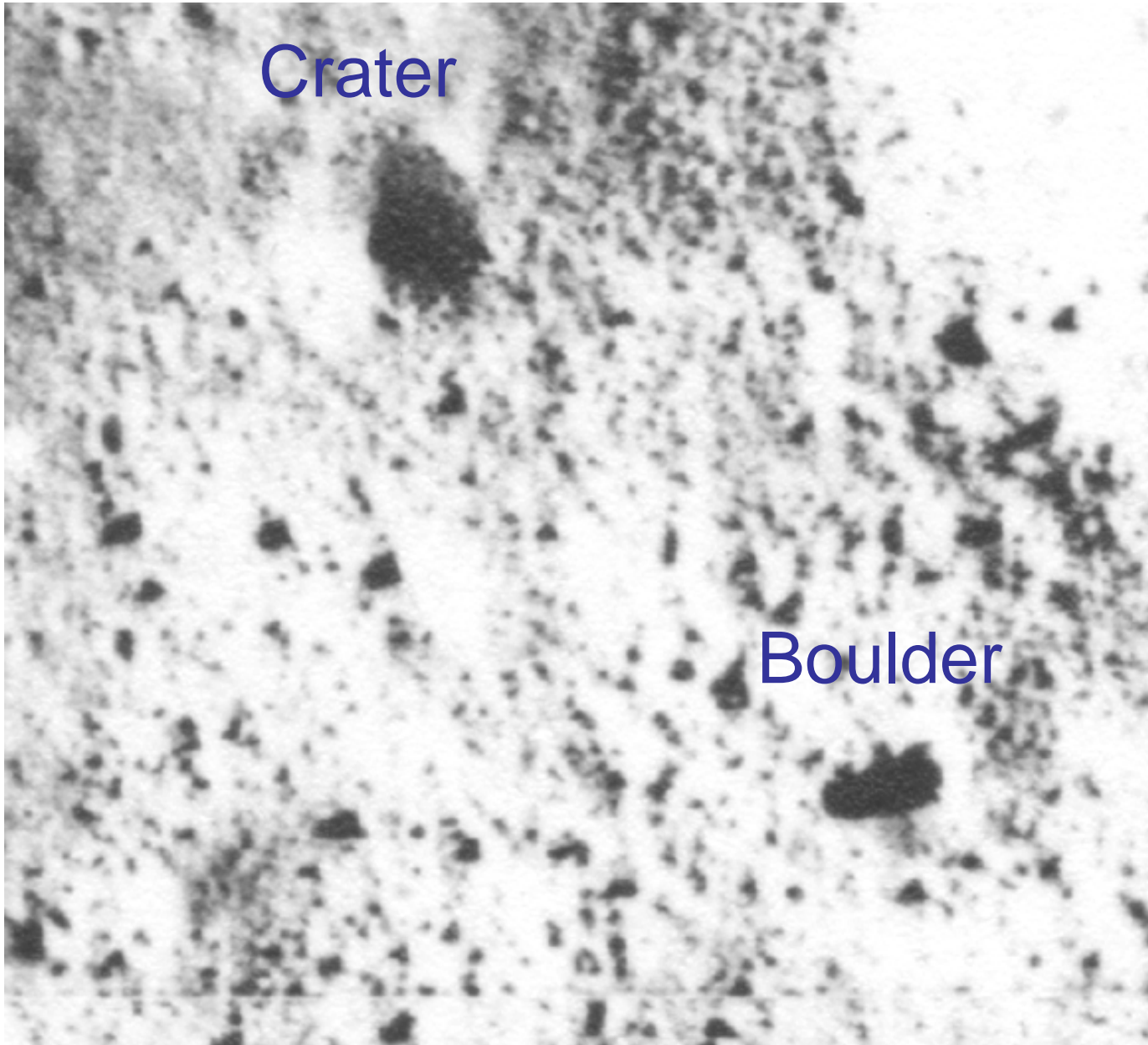
- 3 lunar craters and 1 martian crater
- Diameters range from 300 m to 1 km
- Measured 7000 boulders
 - Diameter
 - Distance from crater center
- Output plots
 - Cumulative plot of boulder sizes
 - Distance vs. size of boulder
 - Distance vs. ejection velocity of boulder





Crater # 185

Diameter 300 m



Crater

Boulder

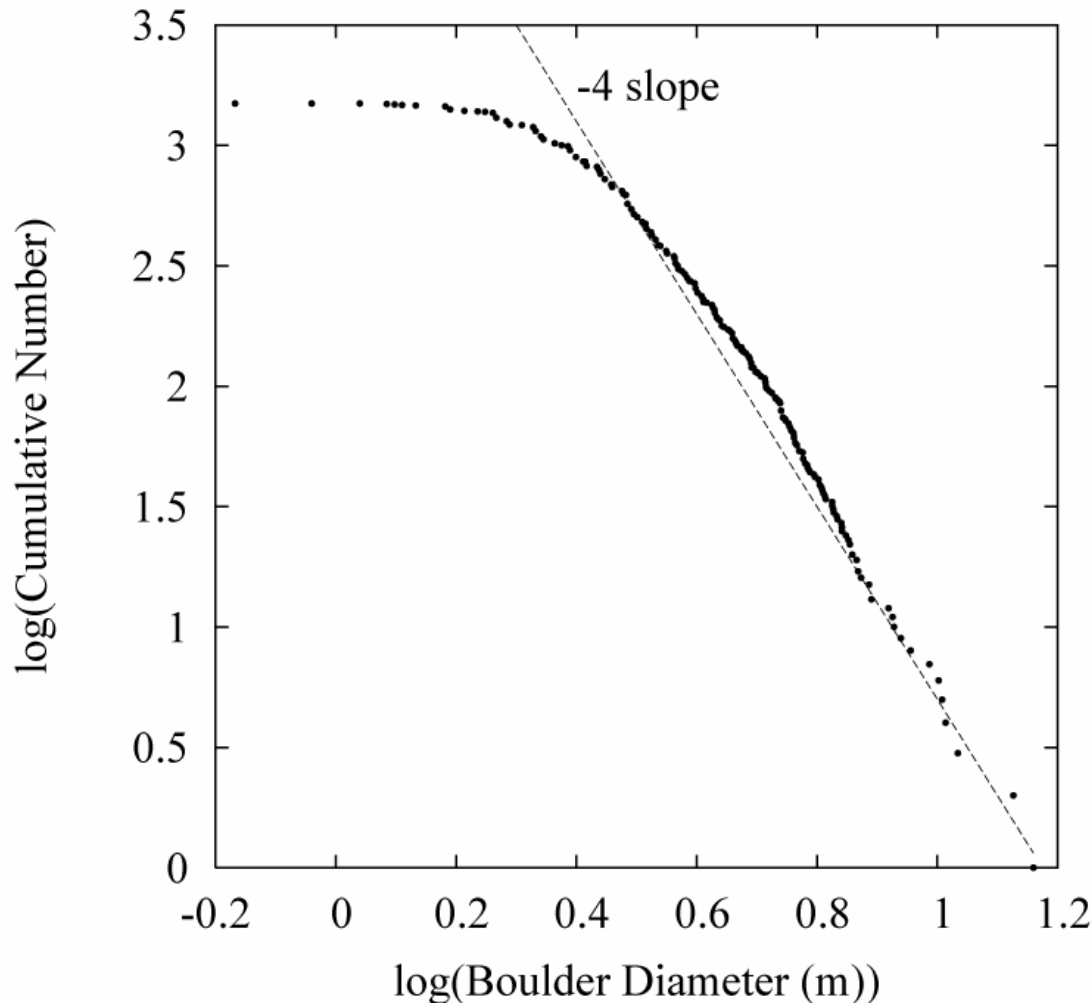
- Craters:
sunward rim in
shadow; far rim
illuminated

SUN



- Boulders:
bright sunlit
side, dark
shadow behind

Cumulative boulder plot



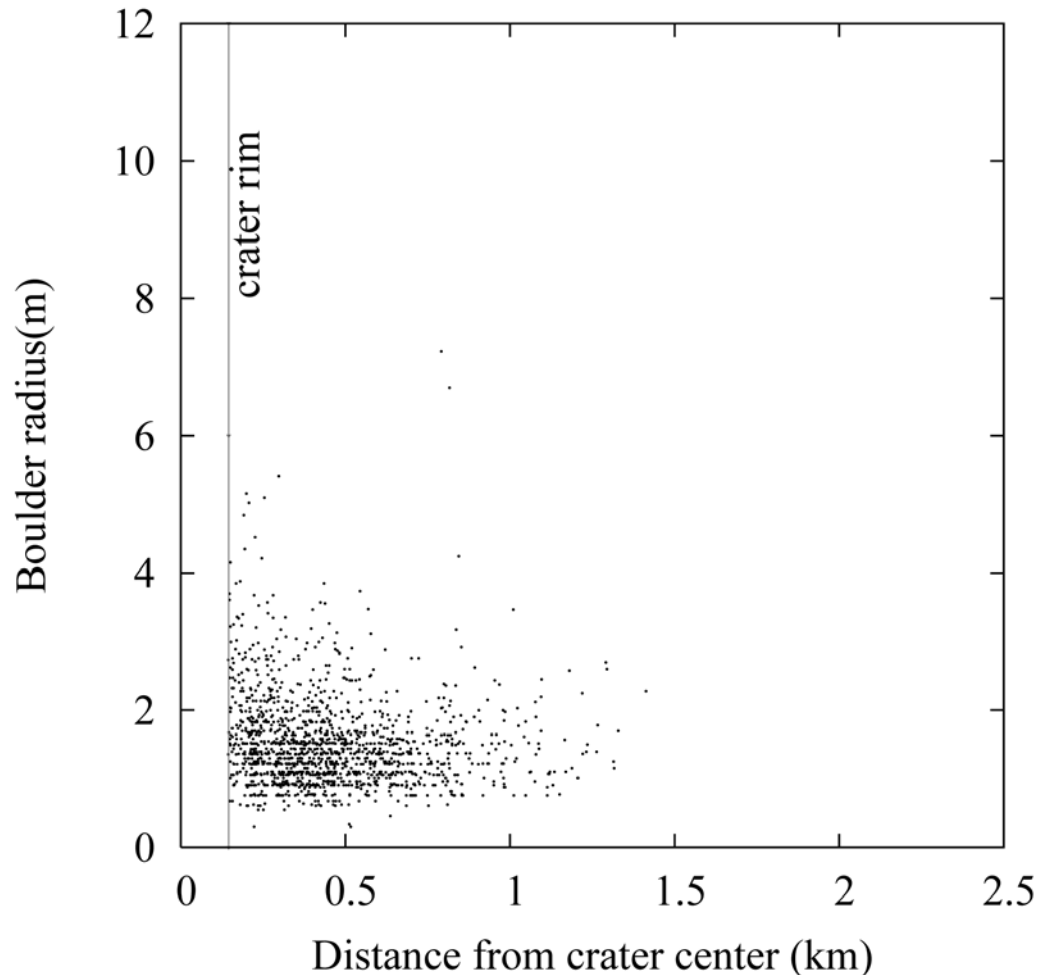
Data from crater 185

- -4 slope similar to slope for secondary craters
- Data flattens at small sizes due to resolution effects

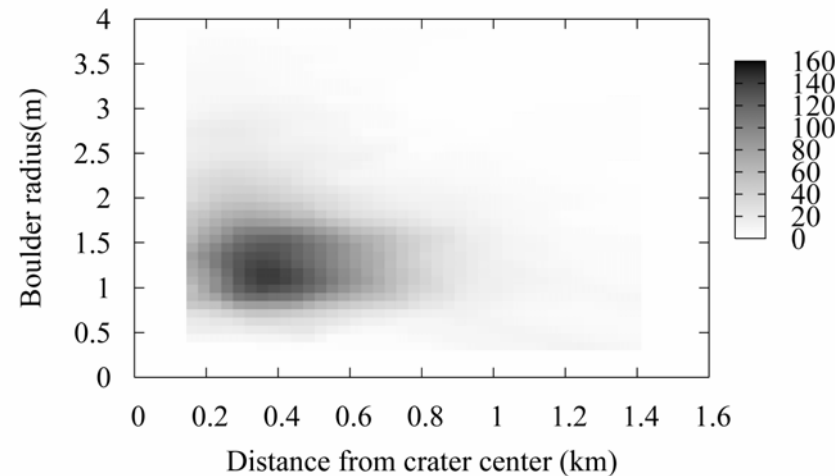
Boulder size vs. distance from crater

Crater 185

data

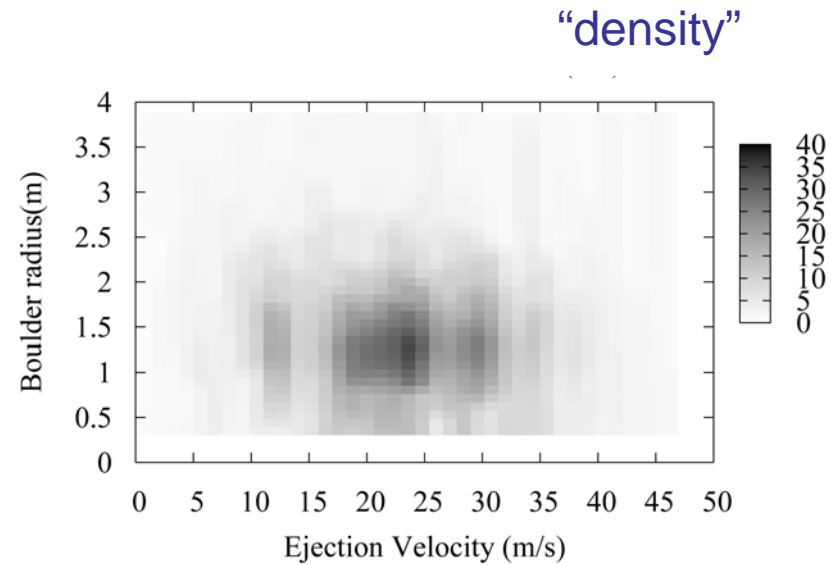
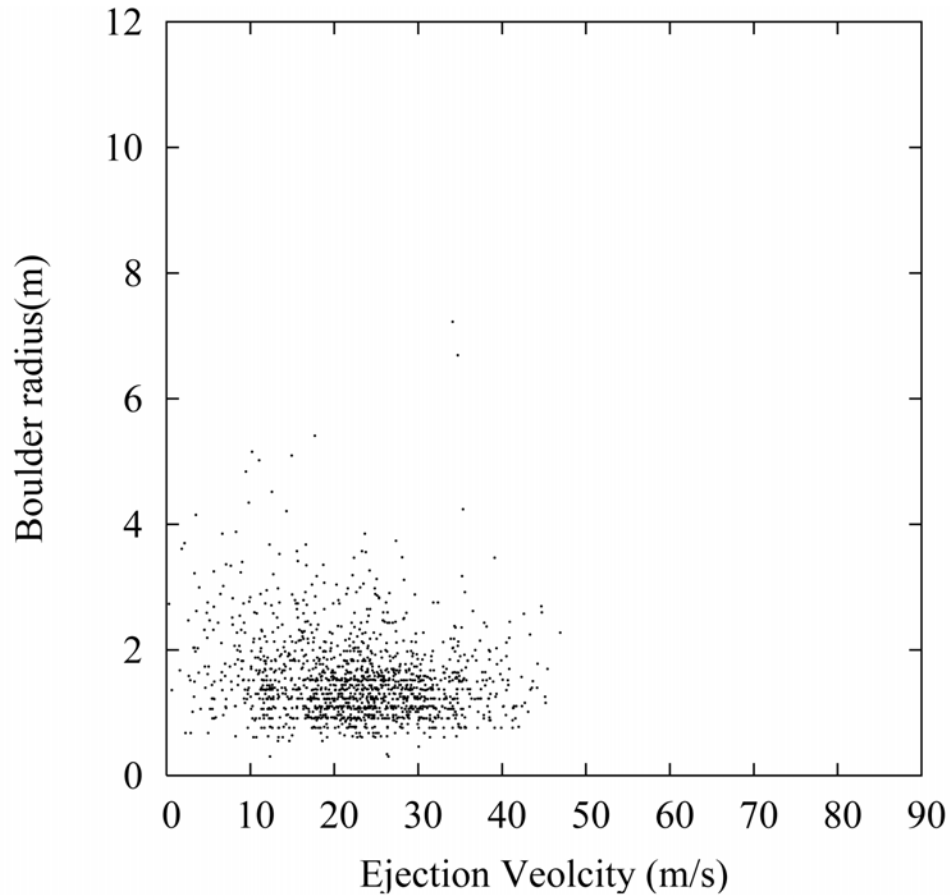


“density” plot



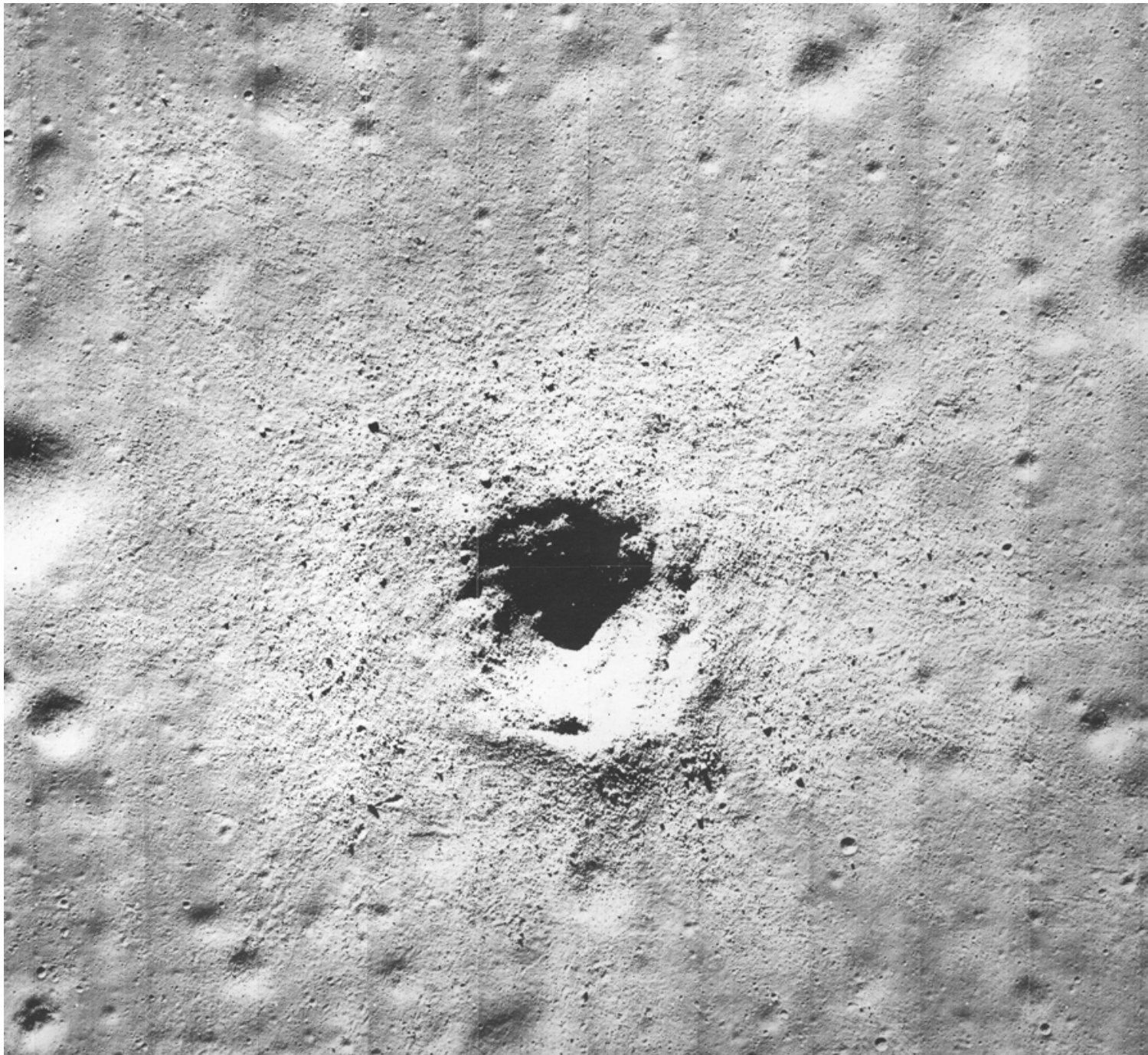
Boulder size vs. Boulder ejection velocity

Crater 185



Conclusions

- Cumulative plot of boulders shows similar slope to cumulative plots of small lunar craters (<1.4 km).
 - Since secondary craters are formed from ejected boulders, our data supports the hypothesis that many small lunar craters are secondary craters.
- Provided data for comparison to numerical simulations of crater ejecta.



Crater 189