
MARS: IMPACT CRATERS & KNOWLEDGE GAPS

(TOWARDS UNDERSTANDING CHRONOLOGY)

Stuart J. Robbins

stuart@boulder.swri.edu || Southwest Research Institute

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Why Impact Craters Are Important for Chronology

Impact Craters for Chronology

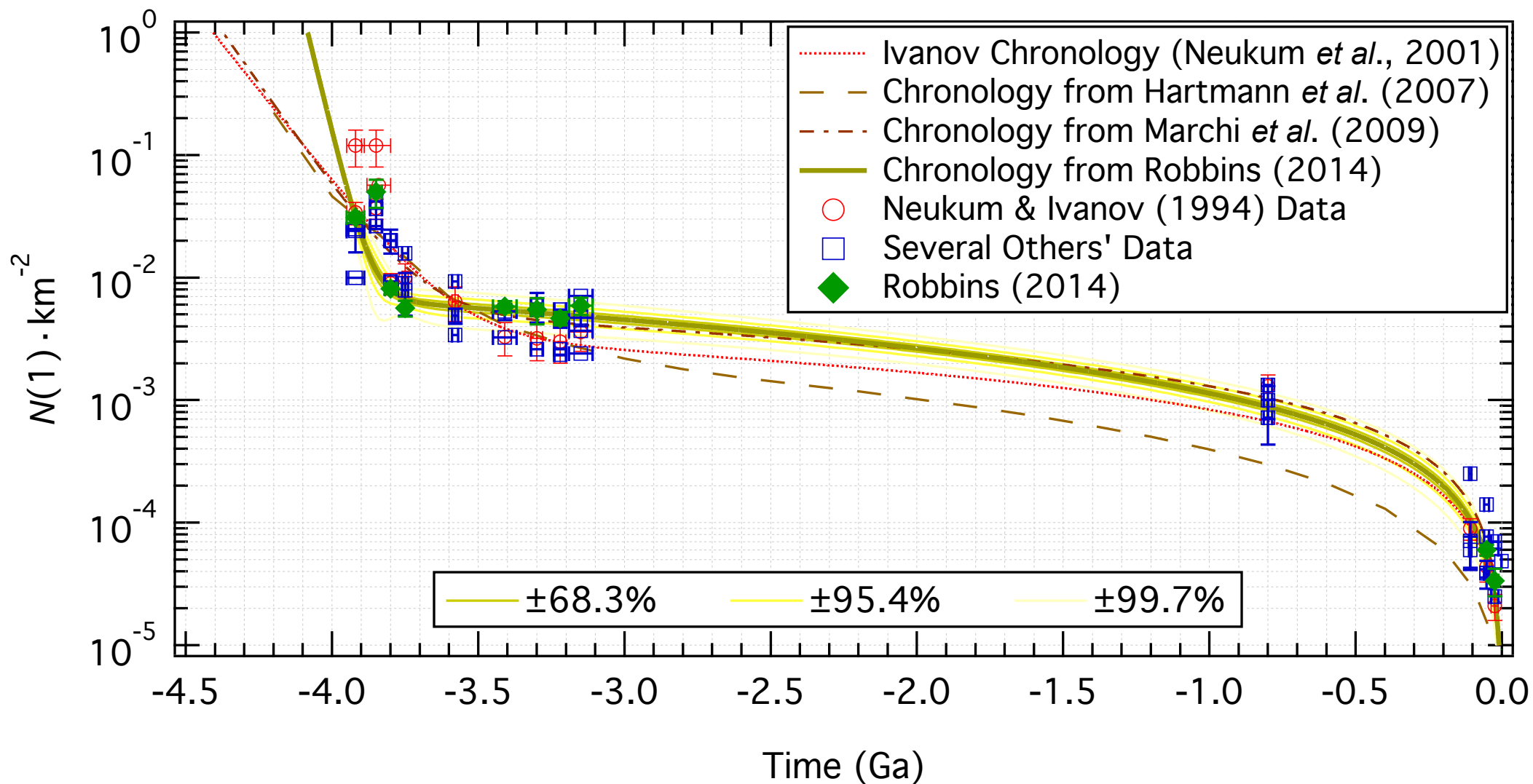
- Overview Concept:
 - Tie crater spatial density to a radiometric age.
 - Do this for a lot of ages.
 - Fit a curve: $time(N(\text{craters}))$
 - Measure crater spatial density somewhere else, use function, get model age.

Impact Crater Population Studies

- Mars' multi-kilometer craters have been cataloged by several people.
- BUT: Craters $\lesssim 1$ km are the worst studied and understood.
 - Critical for recent history (too few / no larger impacts).
 - Small craters are more confusing. *E.g.*, secondary craters are poorly understood, yet (could) start to become important at these sizes and significantly affect chronology.
 - Too many small craters ... need better development of computer-based cataloging.

Knowledge Gaps About Mars' Impact Craters & Chronology

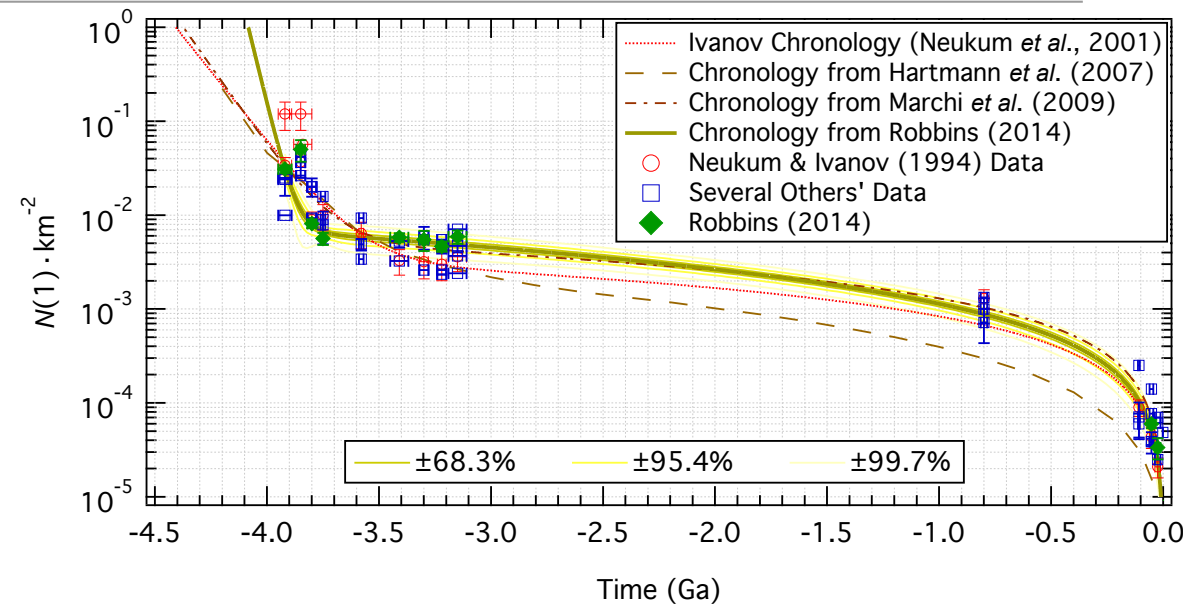
Everything Is Based on the Moon



adapted from Fig. 2 of Robbins (2014)

Everything Is Based on the Moon

- There are several different chronologies (fits) to the lunar data.
- There is a large cloud of possible crater spatial density at any given landing site.
- And lately, numerous questions about whether those landing site samples are actually from the area.
- And, there's a *glaring gap* in sample ages.
- ☆ We need to better understand *all of these* on the Moon before we can hope to transfer it to Mars.



How Do We Scale from the Moon?

- All Mars crater chronology is based on scaling from the Moon.
- Shift the lunar curve based on:
 - Flux (it's closer to Main Belt).
 - Impact velocity (Kepler's Laws).
 - Surface gravity (bigger than Moon).

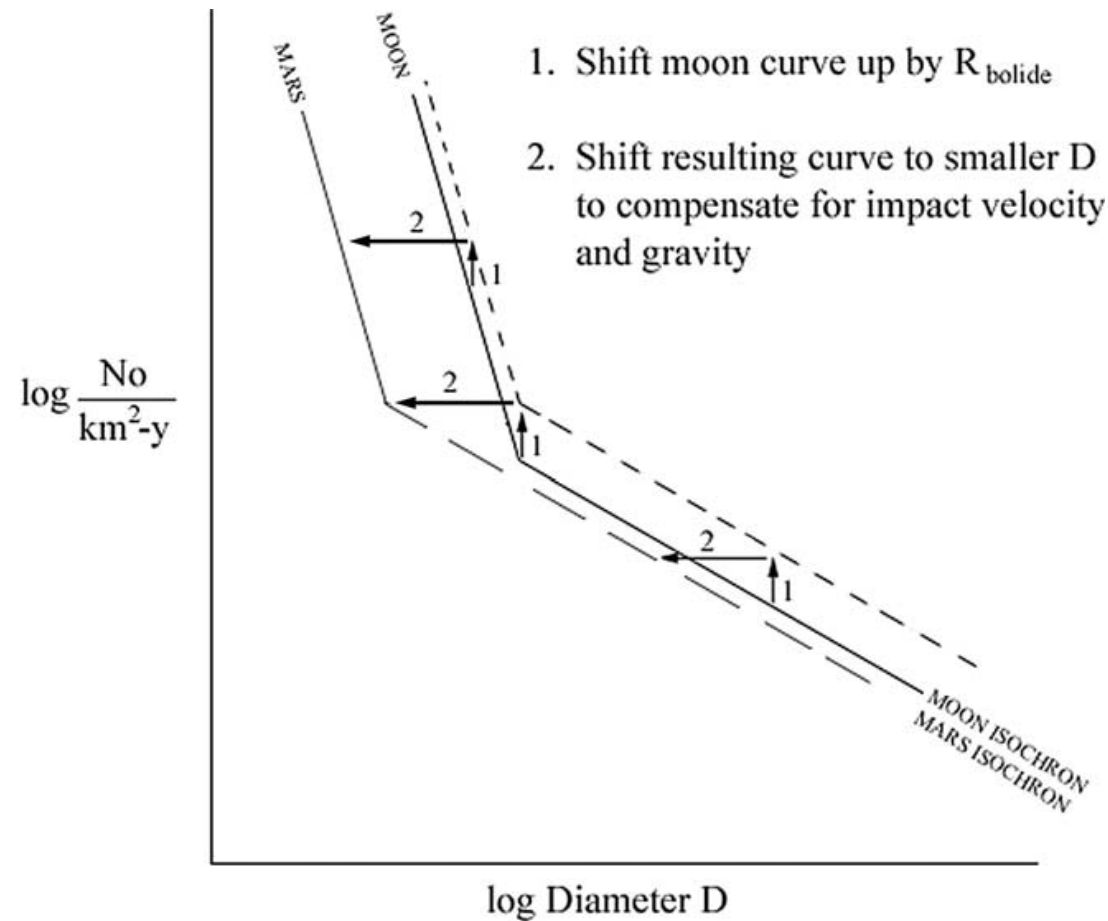


Fig. 3 from Hartmann (2005)

How to Anchor Mars' Chronology?

- 🌐 Better understand lunar chronology (practical acknowledgement of difficulty in Mars dating).
- 🌍 We need dates!
- ★ The best practical way to better understand Mars' chronology, via impact craters, is to have *radiometric dates from samples of known origin(s) linked to unambiguous crater spatial densities.*

Some Open Chronology Questions

- Is the chronology function well-behaved? Was there a Late Heavy Bombardment?
- Where are Mars' big craters? (Moon has ~17 craters >500 km, Mars has ~6, but 4× the surface area)
- What is the role of secondary craters in crater populations? (affects lunar chronology and will affect Martian if we don't properly account for them)
- What are the small primary crater populations? (so, so many craters ...)
- How do we reconcile different mappings, different crater spatial densities at *key* chronology tie points? (some lunar tie points' crater spatial densities vary by >10× depending on what paper you cite! ... we need to better understand repeatability and replicability)

Lots of Implications with an Uncertain Chronology

