Hidden Impact Basins and the Early Bombardment History of the Moon

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Late Heavy Bombardment

- a.k.a. ‘Lunar Cataclysm’
- 3.8-4.1 billion years ago
- Accretion Model
  - Cleaning up the Solar System
- Nice Model
  - Spike in bombardment due to migrating orbits and scattering of Trans-Neptunian Objects
Who Cares?

Everyone! (They just don’t know it yet.)

- Major implications for early Earth
- Implications for models used in the search for life
Goals

• To use a new crustal thickness model to produce the most complete inventory of large impact basins (>300 km diameter) on the Moon possible for age-dating
  – To understand the “Late Heavy Bombardment” (LHB) of the Moon
  – To provide constraints on the LHB for the early Earth
Background

- Previously identified basins tested with a new crustal thickness model
  - 45 Named features
  - 61 Quasi-Circular Depressions (QCDs)
    - Identified by old and new topography
  - 27 Circular Thin Areas (CTAs)
    - Identified through an older crustal thickness model
Crustal Thickness Models

- **Previous Model**
  - Clementine’s Laser Image Detection and Ranging (LIDAR) topography
  - Lunar Prospector gravity measurements

- **2011 Model**
  - LRO’s Lunar Orbiter Laser Altimeter (LOLA) topography
  - Kaguya gravity measurements
Categorization of Candidate Basins

Candidate basins are assigned a Crustal Thickness Expression (CTE) as an indication of the strength of their crustal thickness signature.

5 = Very strong circular signature with obvious rim structure (thickening)
3 = Circular signature with very little to no obvious rim structure
1 = Weak signature, often non-circular
0 = No obvious depression or thinned crust
# Candidate Scoring

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<tr>
<th>BASIN NAME</th>
<th>SYM</th>
<th>LAT</th>
<th>W LONG</th>
<th>TE*</th>
<th>CTE**</th>
<th>Sum</th>
<th>TE*</th>
<th>CTE**</th>
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*TE= Topographic Expression

**CTE=Crustal Thickness Expression
Changes in Score
Lorentz

Old CT

New CT
New Candidate Basins

New CT

LOLA

HM-2

HM-11
New Candidate Basins

HM-15

HM-6

New CT

LOLA
Summary

- A new crustal thickness model was applied to 113 large (D>300 km) candidate lunar basins derived from old and new topographic, old crustal thickness, and photogeologic data.

- Most basins were verified, but several candidate basins have been eliminated as new candidates have arisen.
  - Of the original 113 basins, 26 removed
  - In addition to the original list, 9 entirely new CTA’s

- The coolest part: TWO PEAKS!
Thank you for your support!

(No, seriously… I couldn’t have done it without you!)