Characterizing the Impactors of the Late Heavy Bombardment using Highly Siderophile Elements and Osmium Isotope Systematics in the Lunar Impact Melt Breccia 76055

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Lunar Impact Melts & the Late Heavy Bombardment

What were the compositions of the impacting objects of the Late Heavy Bombardment (LHB) \( \sim 3.9 \) Ga?

Asteroids, comets, or both?

Were complex organics & water delivered during the LHB?
Lunar Impact Melts & the Late Heavy Bombardment

- “Fingerprints” of the 3.9 Ga impactors

Retain the signatures of some elements. The Highly siderophile elements (HSE=Re, Os, Ir, Ru, Pt, Pd, Rh & Au) are the easiest to discern.
Highly Siderophile Element Analysis

- Analyzed seven additional 40-200 mg sub-samples
- High pressure/temperature digestion
- Measured HSE concentrations by isotope dilution techniques using TIMS and ICP-MS
All data from Puchtel et al. (2008)
Adapted from Puchtel et al. (2008) Data for 76055 added
Why are there large ranges in Re/Os, Pd/Ir, Ru/Ir, & Pt/Ir ratios?

- Two Component Mixing
  The impactor & the lunar crust; Re fractionated from Os during impact, Pt, Ru, & Pd fractionated from Ir (Volatility?)

- Three Component Mixing
  One pre-Serenitatis impactor, the Serenitatis impactor, and the lunar crust
  The two impactors are required to have different Re/Os and HSE ratios
Ir Vs Pd
(Hypothetical Mixing of Two Impactors)
Conclusions

• 76055 is unique

  Pt, Pd, and Ru all have non zero intercepts on plots versus Ir

  Range of Os composition reflect variable Re/Os in material

  Pd/Ir, Pt/Ir, Ru/Ir ratios more variable than other lunar impact melt breccias

• Three component mixing between the Serenitatis impactor, a pre- Serenitatis impactor, and the lunar crust
Acknowledgments

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Works Cited:


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