Prospects for Dating the South Pole-Aitken Basin through Impact-melt Rock Samples

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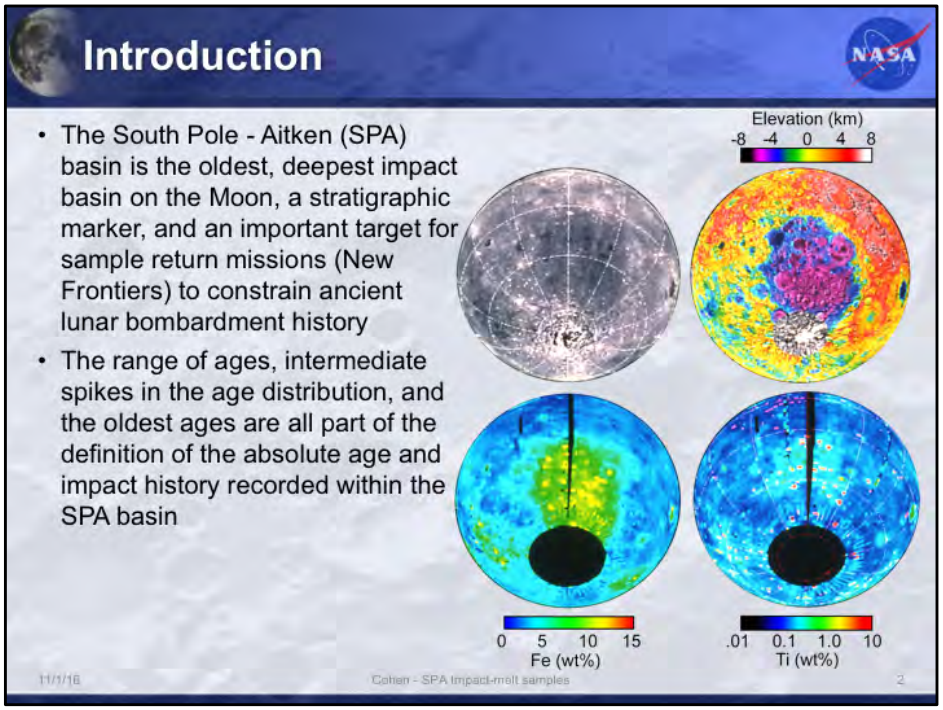
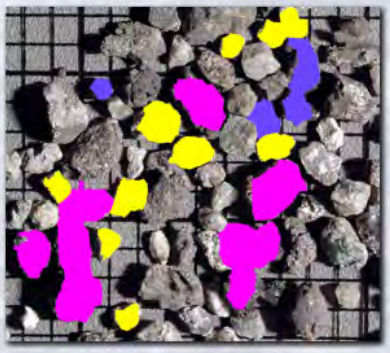


I created this imaging using data from the NASA Planetary Data System (public release data)

Regolith scoop sampling

- Much of the present debate about the ages of the nearside basins arises because of the difficulty in understanding the relationship of recovered samples to their parent basin
- The Nectaris, Imbrium, and Serenitatis basins all have mare-basalt fill obscuring their original melt sheets, so geochemical ties are indirect.
- The SPA interior is a fundamentally different geologic setting than the Apollo sites
  - SPA was filled by a large impact melt sheet (possibly differentiated into cumulate horizons)
  - Regolith formed on this substrate, diluting but not erasing the prominent geochemical signature seen from orbit
- **How much SPA vs foreign ejecta? How much SPA vs foreign impact melt? How will we recognize different impact melt rocks?**



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From formation to the lab

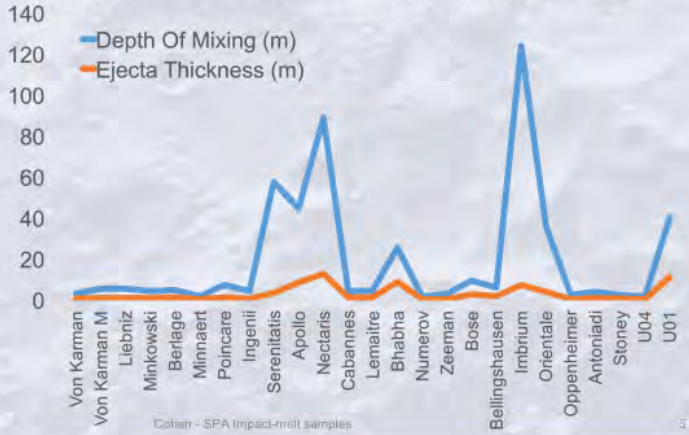
- Considered 4 candidate landing sites: Bhabha, Bose NW, Liebniz-Oppenheimer, Oresme Th

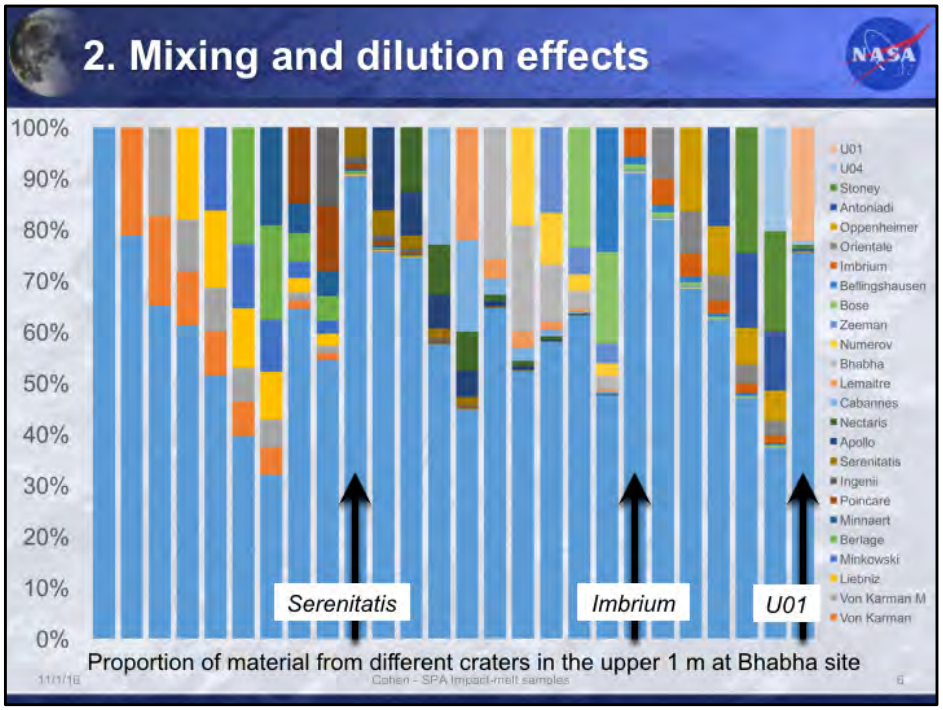
1) What craters and basins contribute significant amounts of material to different sites within the SPA basin (**Ejecta model**)
2) What proportions remain in the upper few m's of the surface (**Mixing and dilution effects**)
3) How much of the ejecta is impact melt that could be used to date craters (**Scaling laws**)
4) How will we distinguish different impact vents when we date the returned sample (**Geochronology model**)

1. Ejecta model

- Ejecta mixing model based on Petro and Pieters (2004) with updated basin inventory and stratigraphy (Neumann et al. 2015, Fassett et al. 2011) and smaller craters within SPA boundaries (Head 2002)
- Ejecta from successive craters contributes material & mixes it to depth

Example thickness and depth of mixing for Bhabha site





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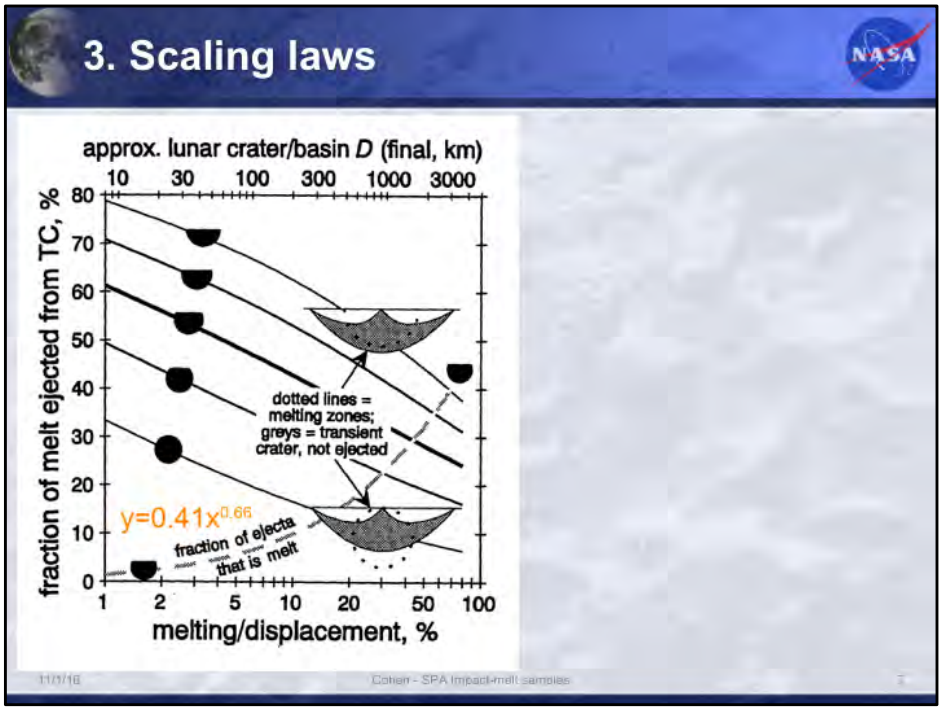
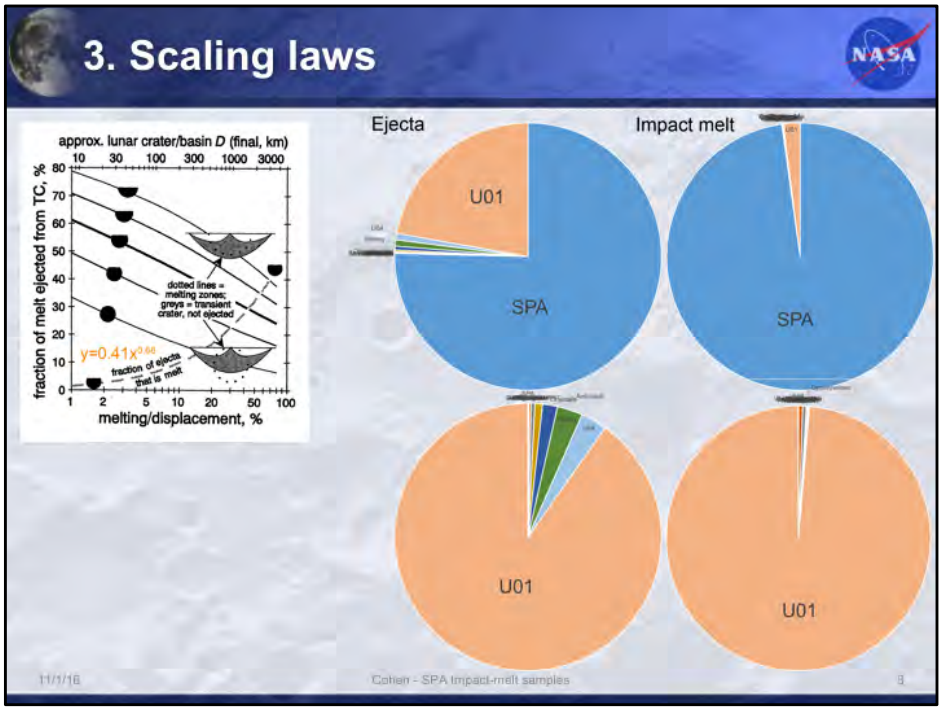


This figure is from Warren, P. H. (1996), Global inventory of lunar impact melt as a function of parent crater size, *Lunar Planet. Sci. Conf.* 27, Lunar and Planetary Institute, #1379-1380. Fair Use.



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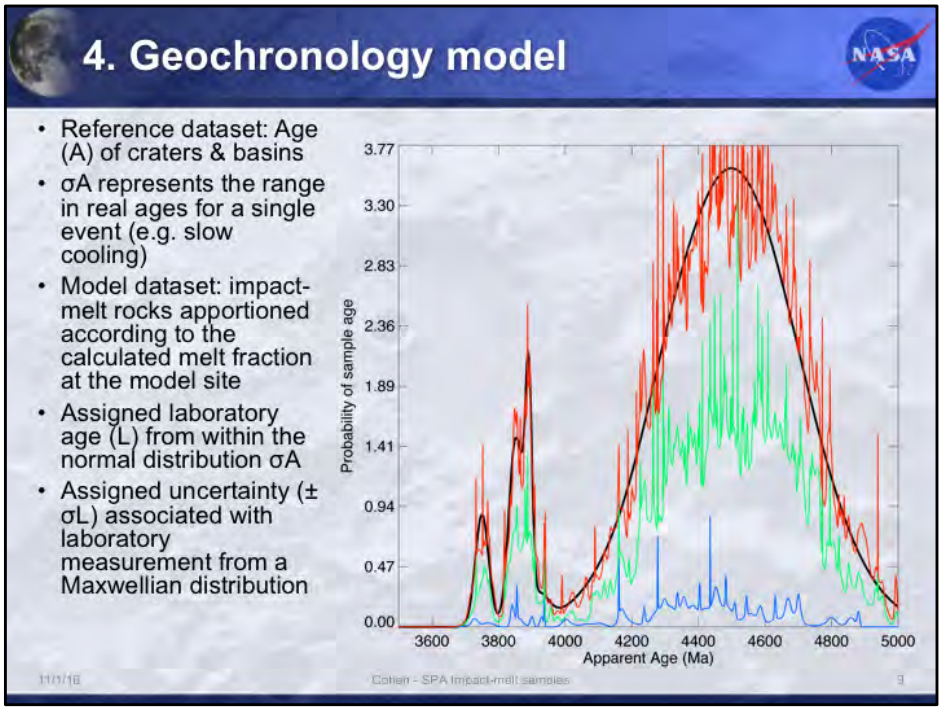

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Conclusions

- SPA-floor impact melt exists at interior landing sites and will be the dominant impact-melt rock type in any sample
  - Landing sites near young, large craters bring pristine SPA material to the surface
- Using corroborating information (petrology, elemental composition, regional context, RS) are important to correct interpretation
- Even if it weren't recognizable by geochemical or petrologic means, dating of a few tens of impact-melt fragments is still likely to statistically yield the age of the SPA basin
- Once you've filtered out SPA materials, the range of younger basins and craters within SPA will be made using statistical means – that is, dating a larger number (hundreds) of "foreign" impact-melt fragments