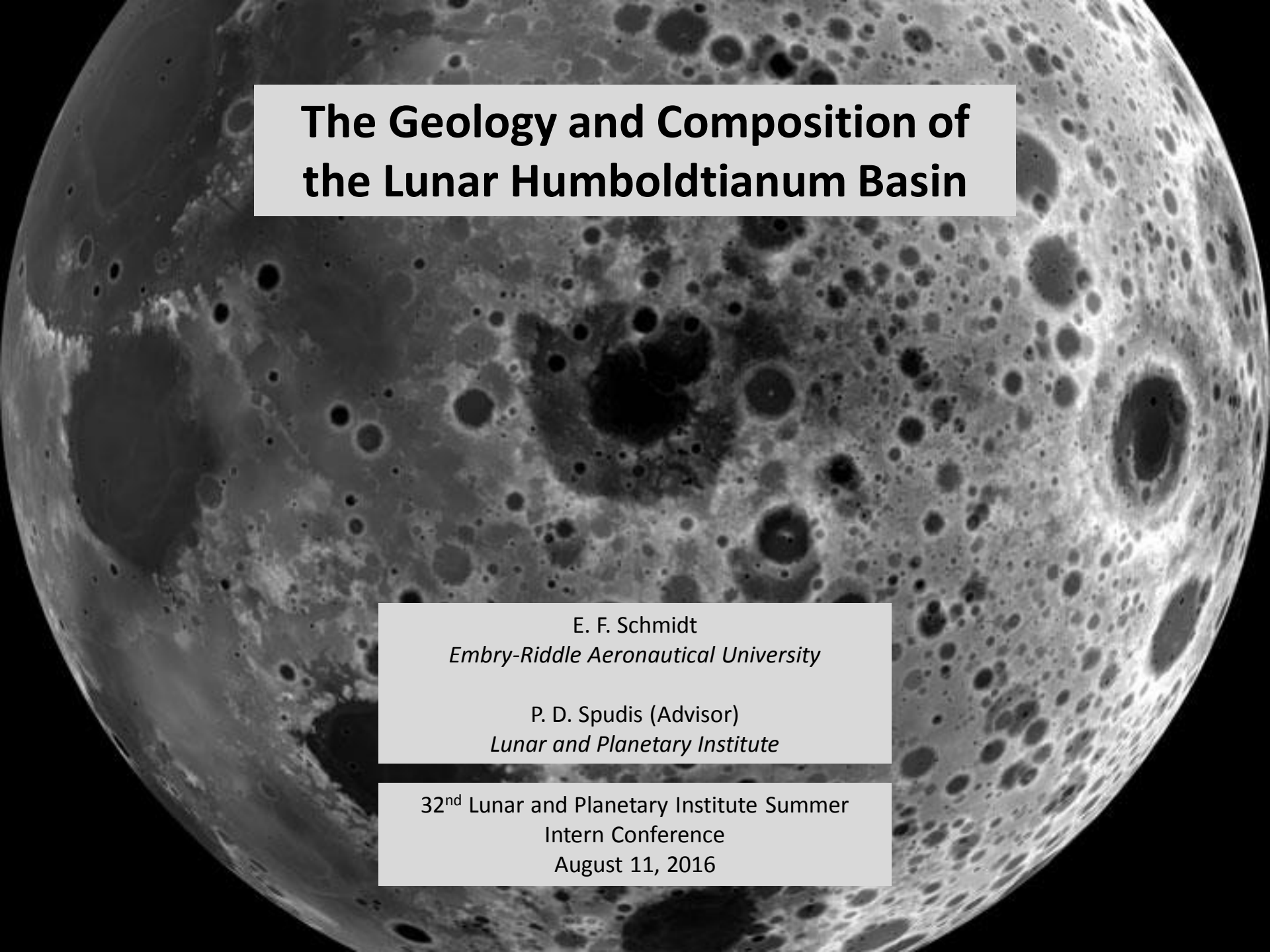

The Geology and Composition of the Lunar Humboldtianum Basin

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Why Create Geologic Maps?

Geologic maps help us to better understand the history, development, and compositional make-up of planetary crusts

We can determine the relative ages of events based on overlay and embayment (e.g. x overlays y, which overlays z, therefore x is younger than z) and erosional state (how 'crisp' an area appears)

Maps provide a piece in the larger puzzle of the history and evolution of the body and Solar System

Project Goals

Create a new geological map of the basin using image and topographic data from LRO, focusing on basin-related deposits

Use chemical concentration data from Clementine (FeO and TiO_2) and Lunar Prospector (FeO and Th) to better understand the geochemical makeup of the basin ejecta deposits and crustal target

Use the compositional analysis to help determine the level of influence of the younger Imbrium and Crisium basins

Some Basin Characteristics

Nectarian age basin centered at 57°N, 82°E

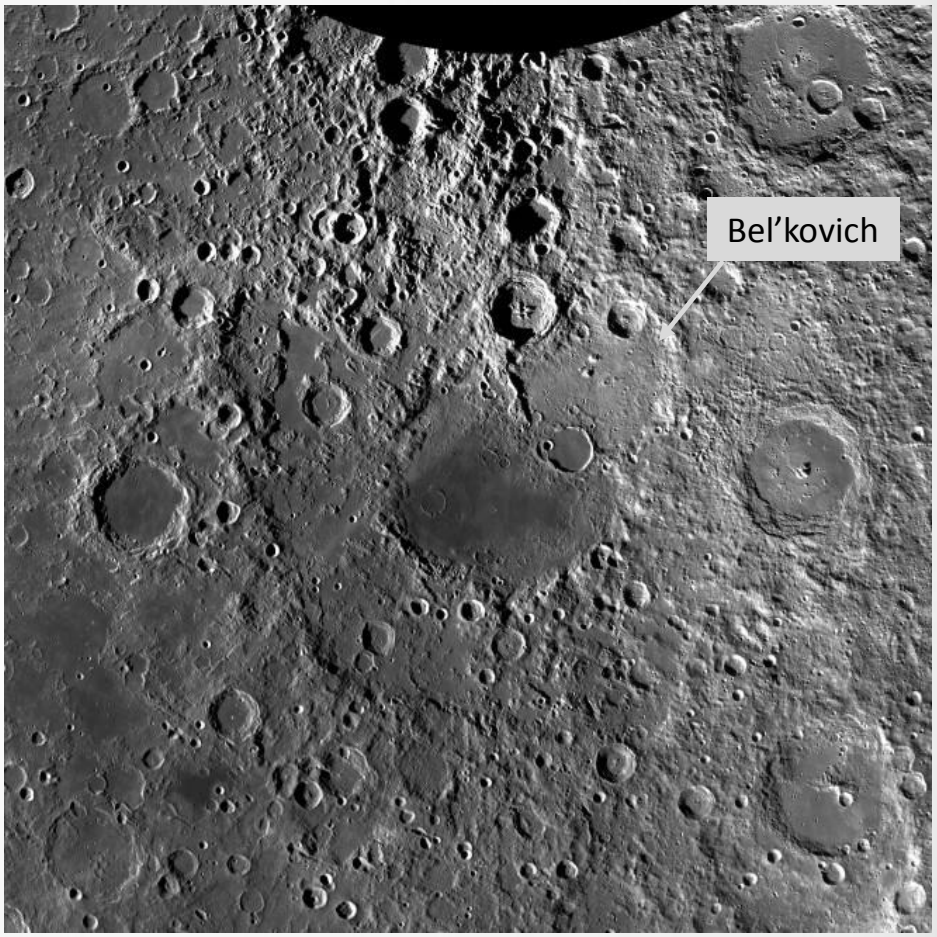
Inner ring ~ 275 km diameter; outer ring ~675 km diameter

Complex morphology

- Well defined inner ring, but outer ring is discontinuous, polygonal and missing entirely in north

Humboldtianum ejecta recognizable on south, east and north sectors of basin exterior

Partly flooded by mare lava (Imbrian age), with minor pyroclastic activity associated with floor fractured craters

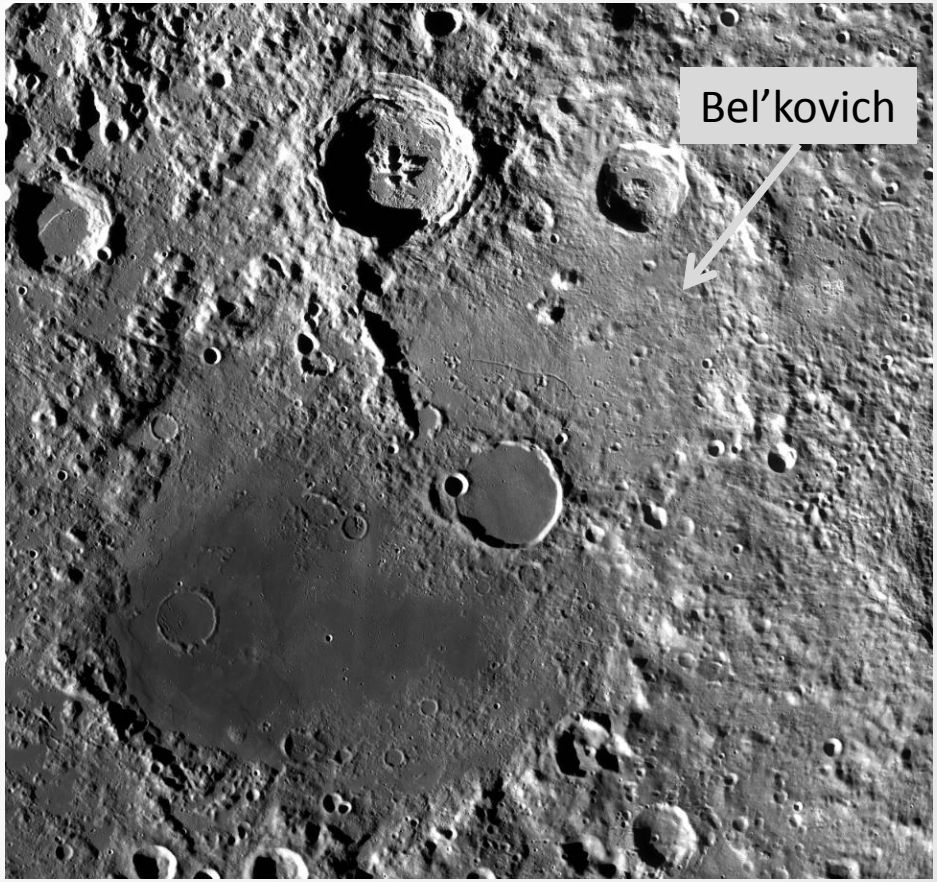


Bel'kovich

Did Bel'kovich form simultaneously with or after Humboldtianum?

<u>Formed After:</u>
Disrupted the north-east corner of the basin
Possible central peak remnant

<u>Formed Contemporaneously:</u>
Decapitation of basin projectile?
Came in as a separate object but formed at the same time from the same parent body



Massifs and Basin Structure

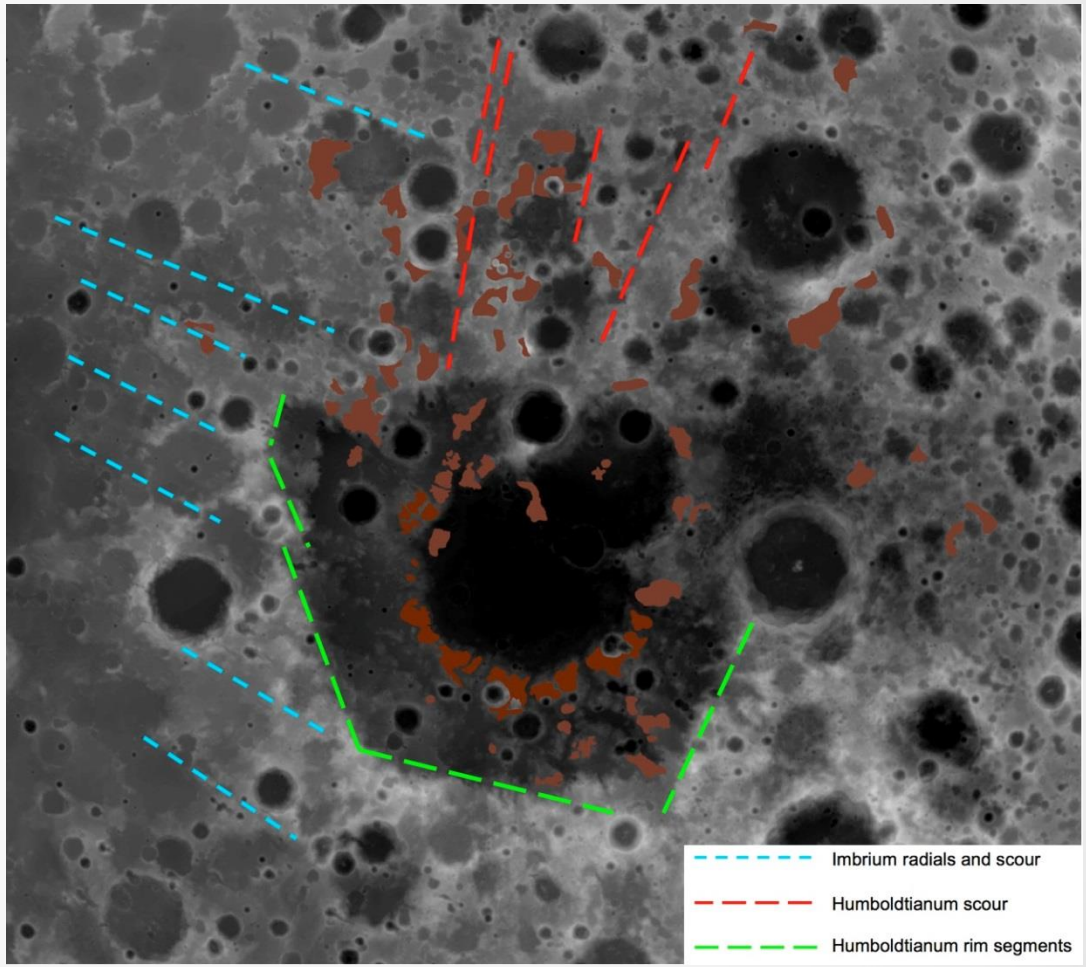
Massifs are found mostly on the north and east sides of basin

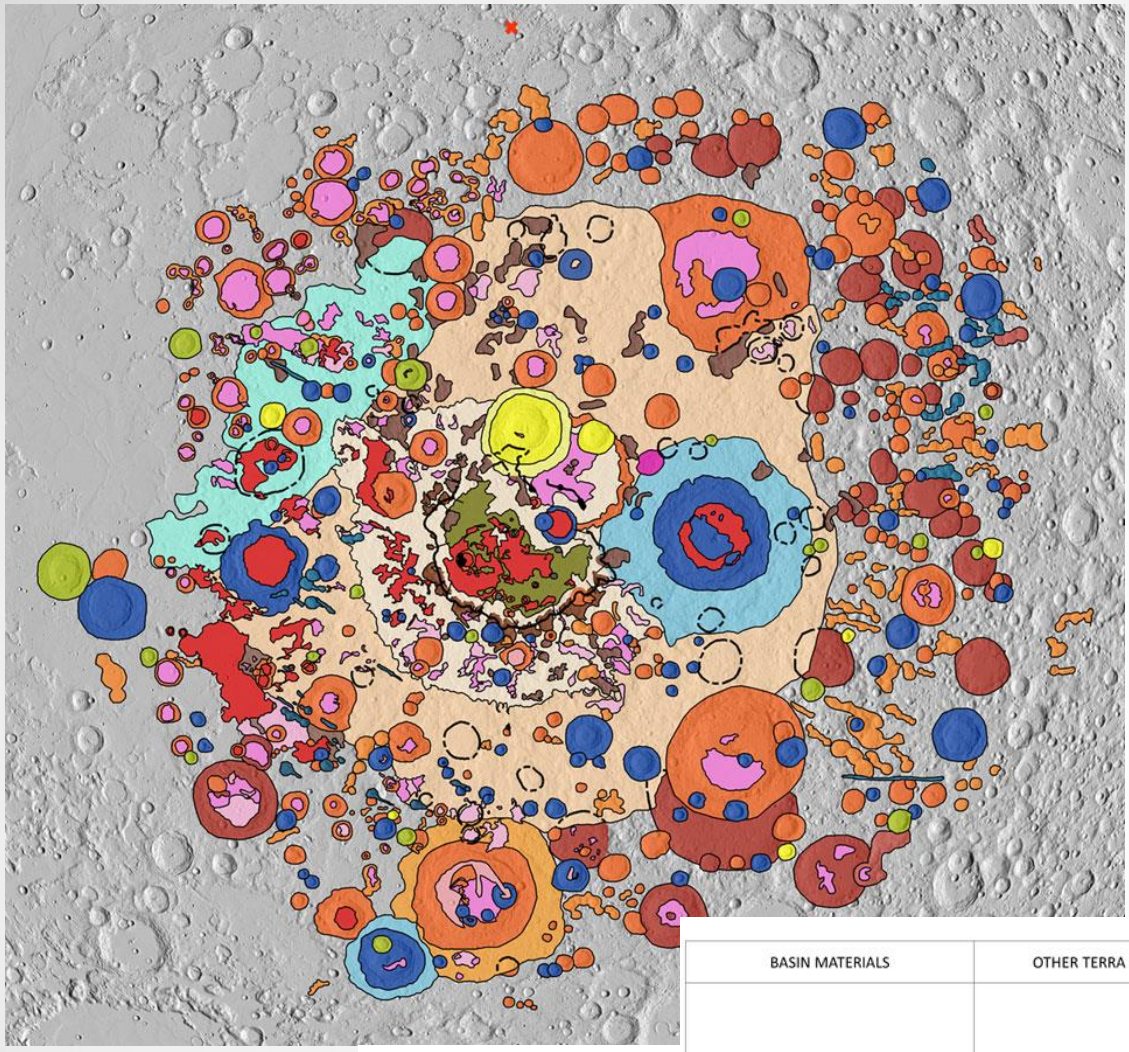
Peaks of northern massifs reach approximately same elevation as highlands south of basin

Basin main rim has rough polygonal outline (truncated septagon)

Downrange scour evident by linear topographic troughs, crater chains

Indicative of an oblique impact? (Projectile comes from south)





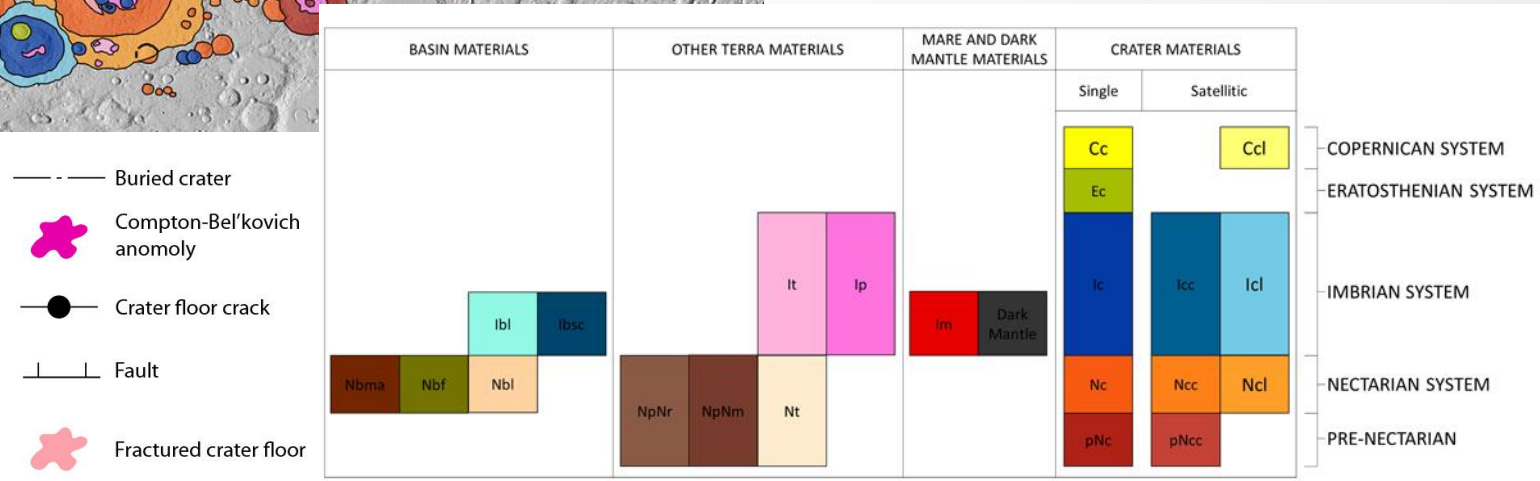
Basin ejecta evident in north, east and south

Imbrium basin overprint on northwestern part of basin

Partial mare flooding of basin; minor pyroclastics (dark mantle) associated with floor-fractured craters

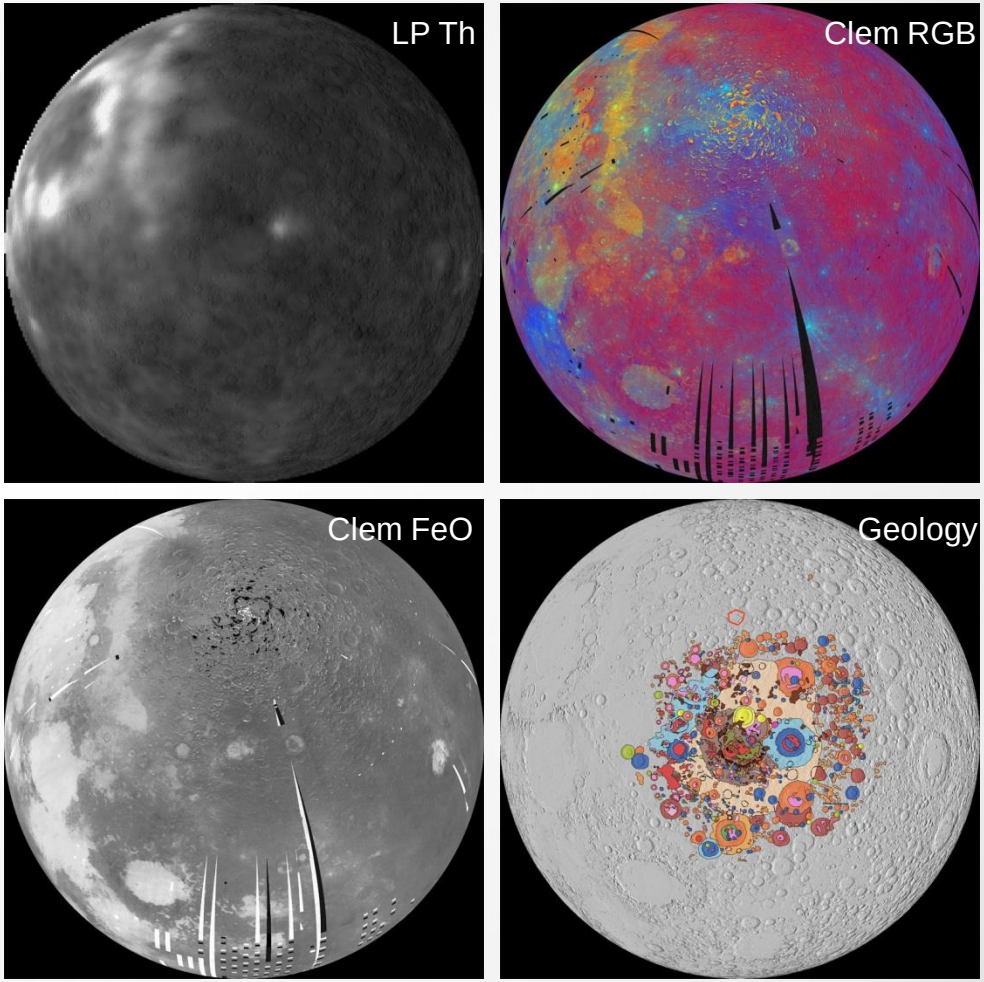
No basin melt sheet remnant identified

Overlain by both Imbrium and Crisium ejecta; Nectarian age



Basin Deposit Compositions

- Clementine mapped FeO, TiO_2, and cpx content
- Lunar Prospector mapped FeO and Th content
- Used basin geological map to identify extent of ejecta
- Pixels of compositional data within mapped ejecta units were isolated and characterized
- Means and s.d. for different units were calculated and analyzed



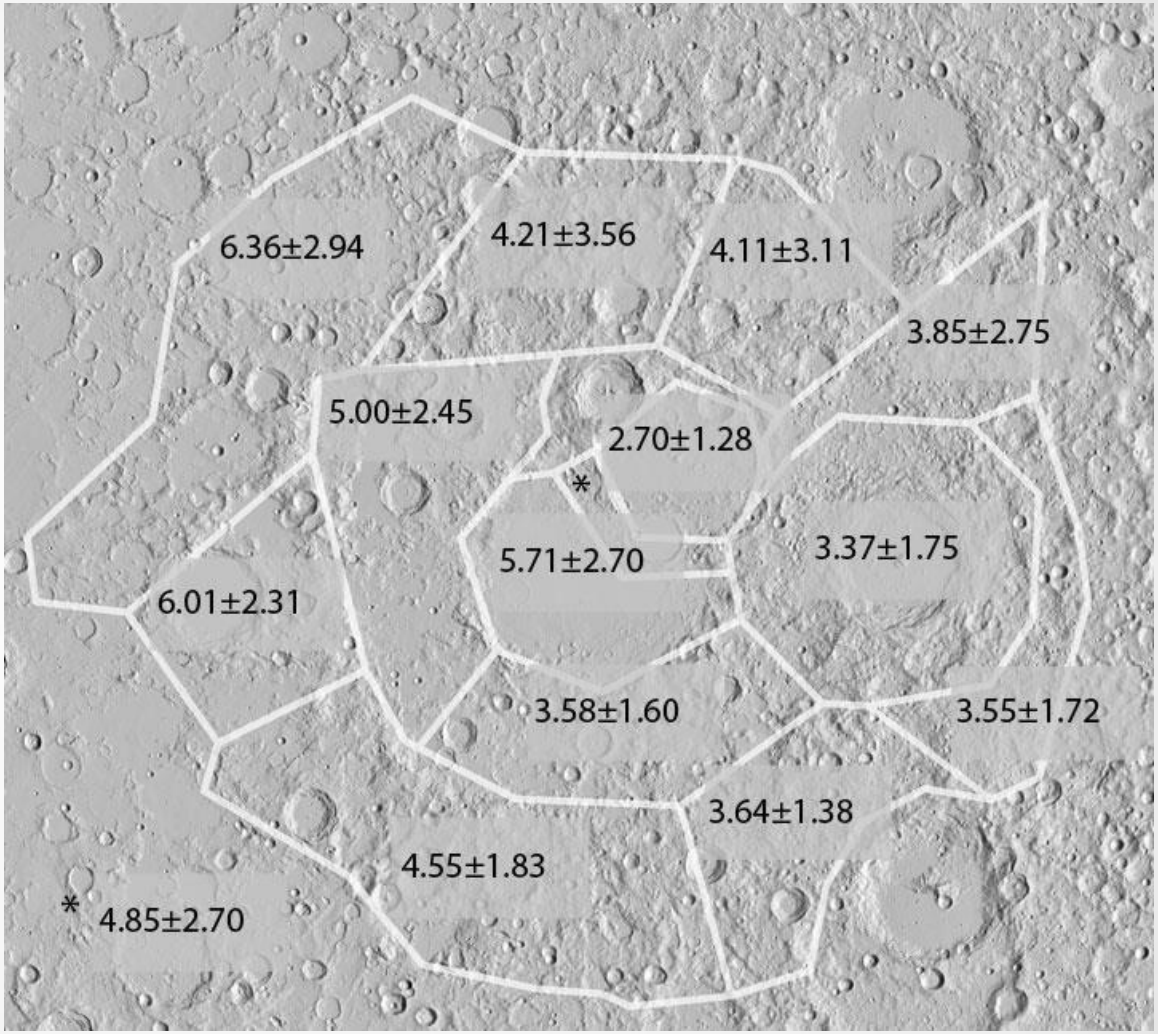
Basin Ejecta - FeO Content

Negative gradient in FeO content from northwest to the southeast

Imbrium ejecta overlay may be greater in extent than seen visually (extends to the south)

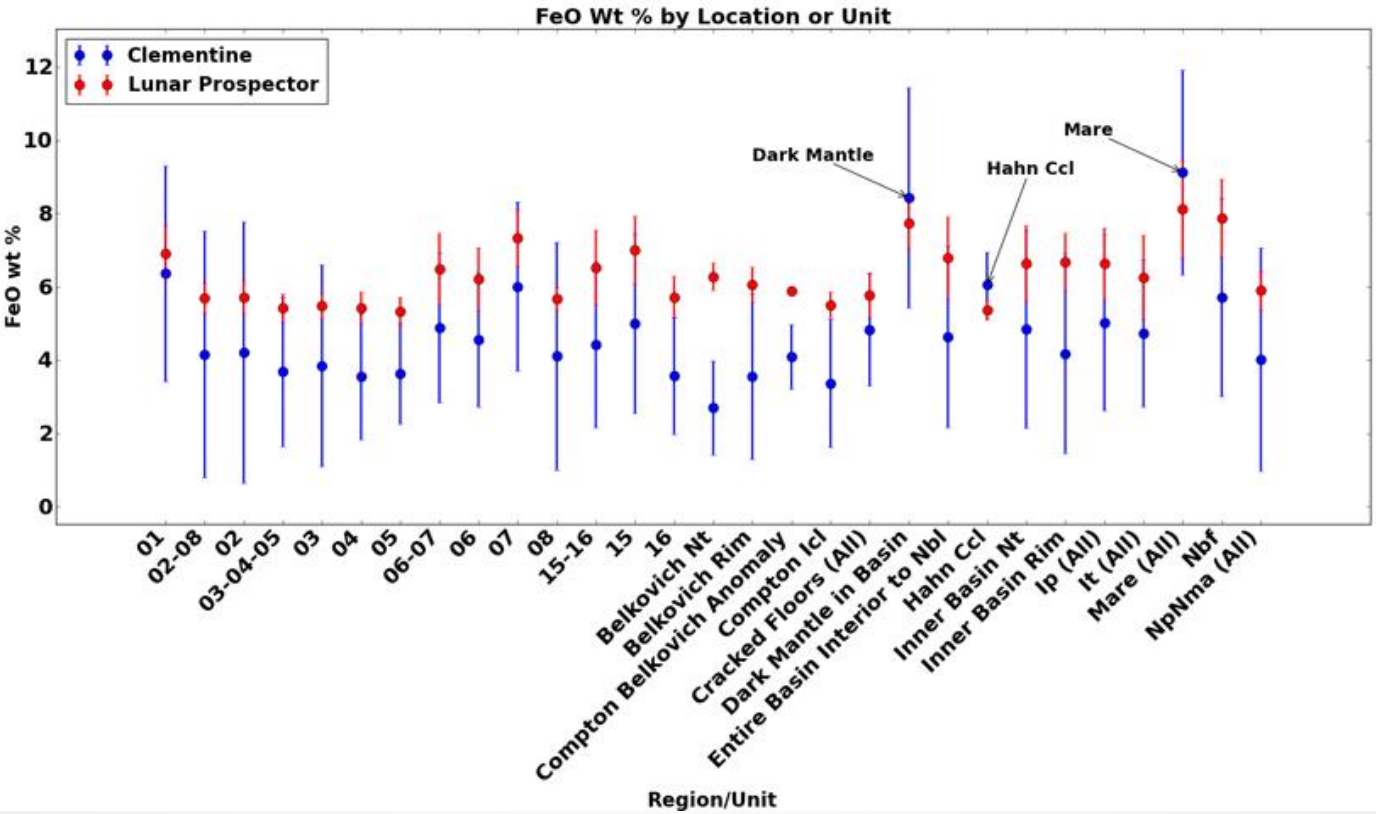
Slightly higher FeO in southern regions possibly caused by ejecta from younger Crisium basin

Large uncertainties in north caused by grazing solar illumination at higher latitudes (specular reflection from crater walls)



wt % ± 1σ

FeO (Basin-Wide)



Clementine values systematically lower, except in three locations, where they are higher, possibly due to low resolution of LP

Likely caused by wider FOV/lower resolution of LP iron vs. Clementine iron data

Overall conclusions remain unchanged: target was highly feldspathic, low-Fe crust

Compositional Summary

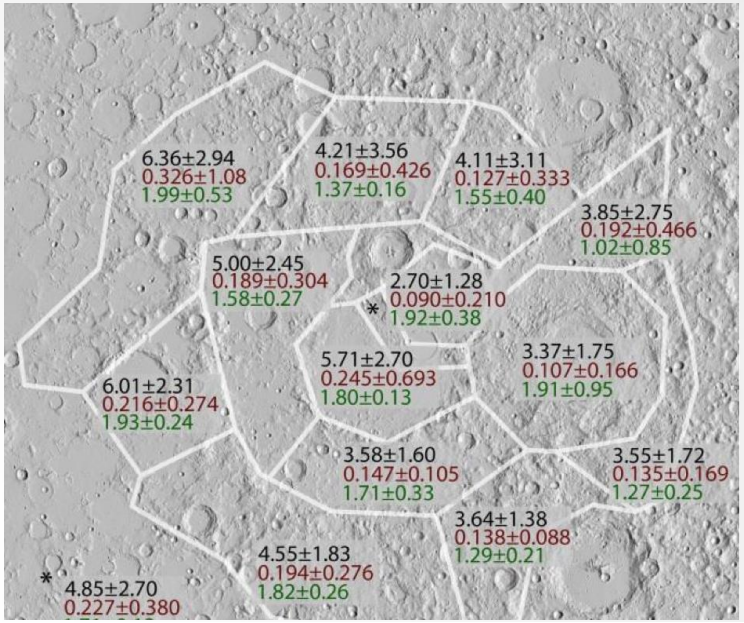
Low $FeO/TiO_2/Th$ of basin deposits = highly feldspathic (anorthositic) composition

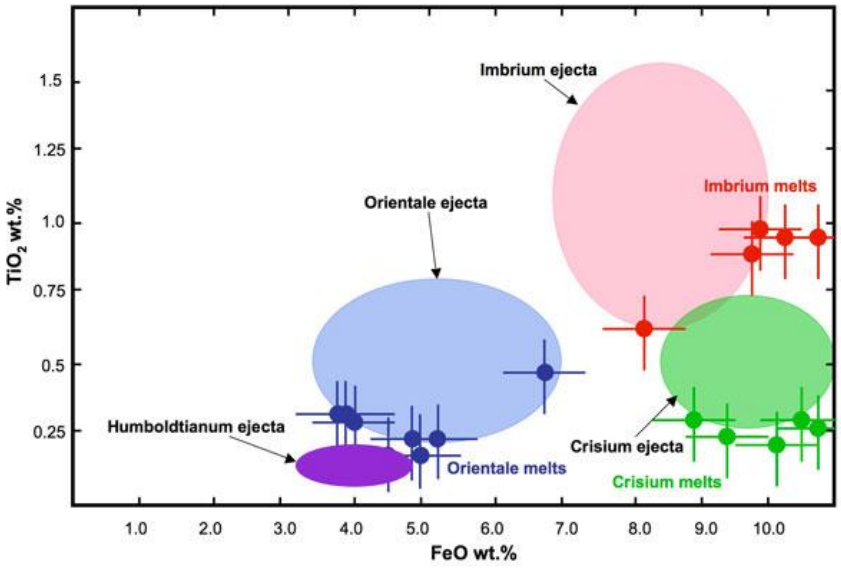
Basin is close to far side, so likely crustal target consisted of ancient anorthositic crust of northern central far side (Jolliff et al. 2000 geologic terranes)

More mafic composition of northwestern basin exterior likely caused by superposition of Imbrium basin ejecta

Humboldtianum ejecta similar to or even slightly more anorthositic than Orientale basin ejecta

Limited extent of compositional envelope likely caused by fewer data points (Humboldtianum is a smaller basin)





Project Conclusions

Pattern of massifs, downrange scour, and unusual, polygonal rim indicates possible oblique impact (from south)

Bel'kovich - post impact crater or created with the basin?

Humboldtianum basin ejecta is low in iron, titanium, and thorium, possibly caused by its location near the central far side highlands, which are predominantly anorthositic rocks

Heavy influence from Imbrium basin ejecta in the western region, raising the iron content of the deposits. Possibly lesser influence from Crisium ejecta to the south

Final Thoughts

One part of a larger puzzle of the geologic evolution of the Moon

Basin formation is a key process in shaping the morphology and composition of the lunar crust

A better understanding of the Moon and its history can help us better comprehend the histories of all the planets and to plan for future lunar and planetary exploration and development