

DERIVING THE ANCIENT LUNAR POLE PATH FROM IMPACT INDUCED GRAVITY ANOMALIES

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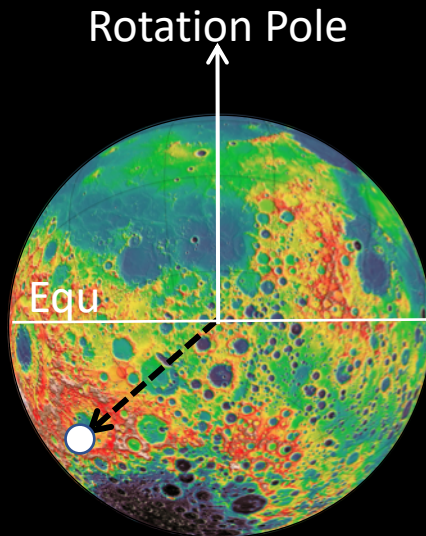
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INTRODUCTION

- The present rotational stability of the Moon is a result of its present, and unchanging, mass distribution
- The gravity anomalies, mascons and basins, are a part of this stability
- But the lunar rotation pole has not always been in its present position
- When the gravity anomalies were created during periods of bombardment the pole position would have moved as the lunar mass distribution changed
- We estimate the effect of 11 large gravity anomalies on the movement of the lunar pole position during the period of bombardment

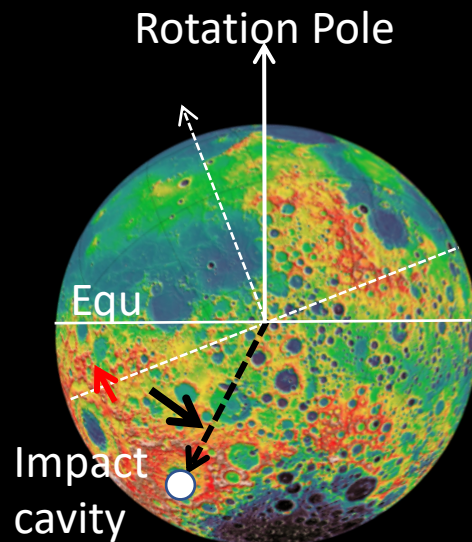
GRAVITY ANOMALIES and POLE POSITION

The Moon prior to an impact



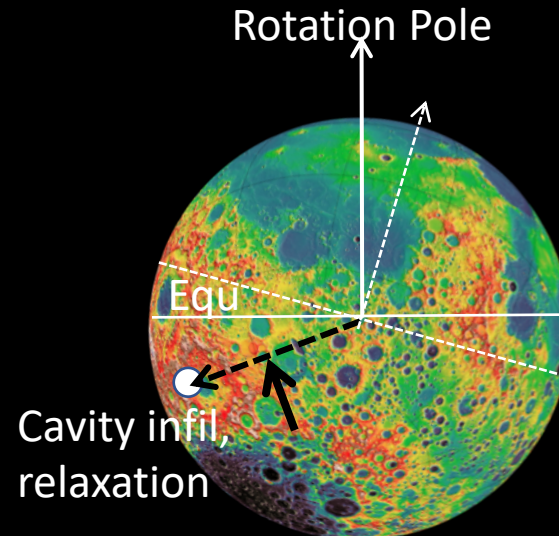
1. Cavity creates negative gravity anomaly. Impact location moves towards the pole

The Moon post-impact



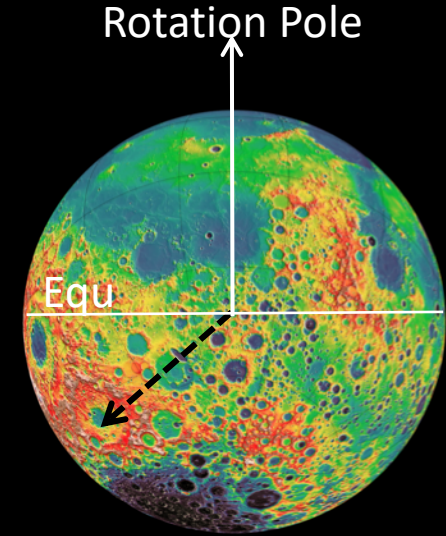
2. Infill and relaxation of crater reduces gravity anomaly. Impact location moves back towards the equator

Infill and crustal relaxation reduces gravity anomaly



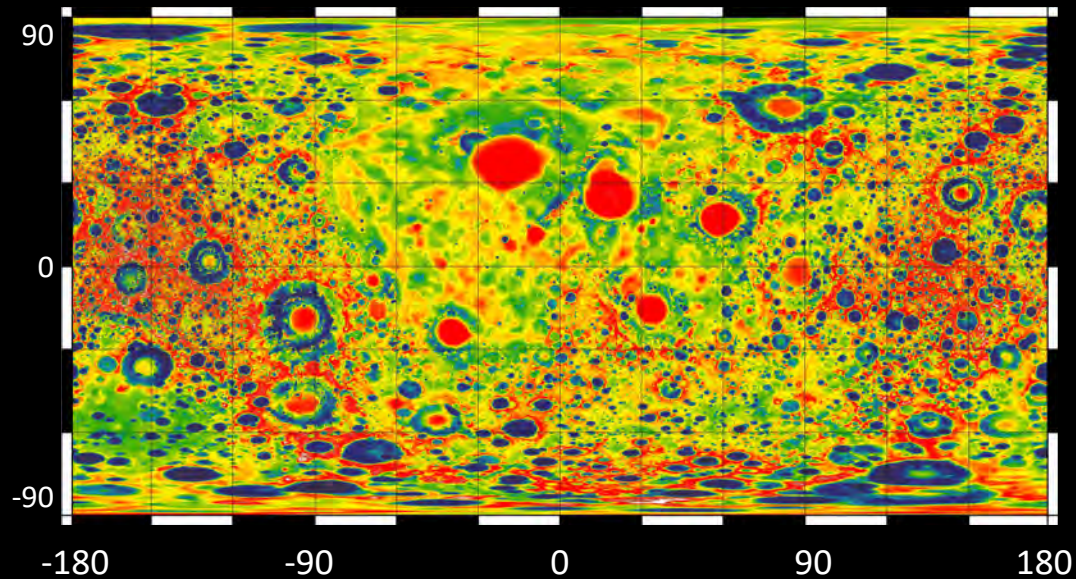
3. If FA anomaly is positive, impact location is closer to equator; if negative, impact location is closer to the pole. No net change in pole position due to impact if gravity anomaly = zero

The Moon after rebound and relaxation completed

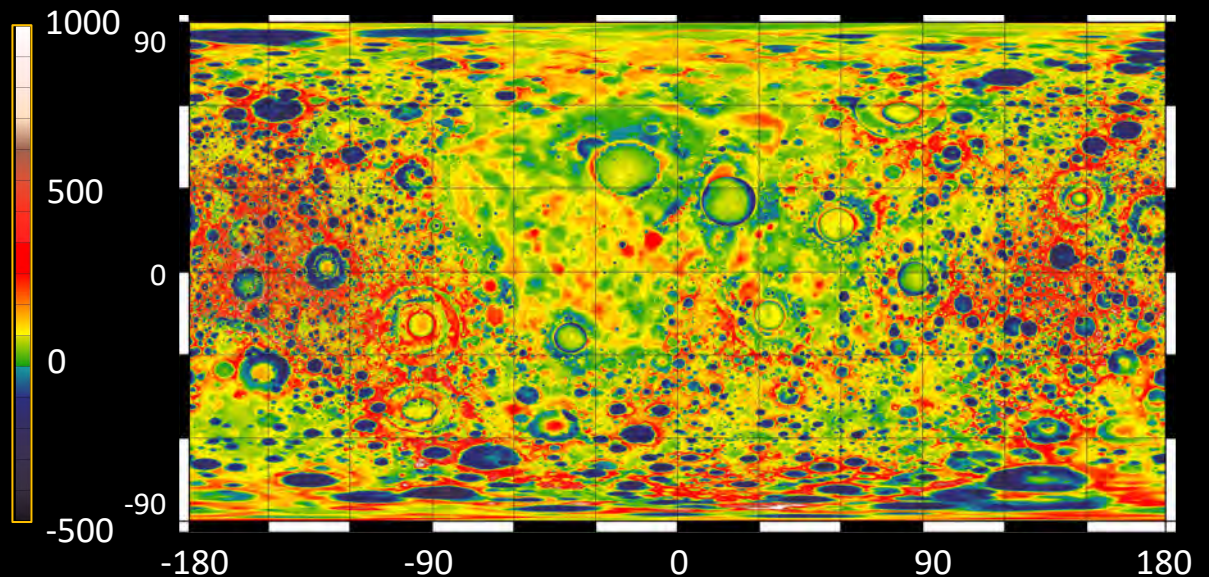


The GRAIL Moon: Free Air Gravity, GRGM1200B

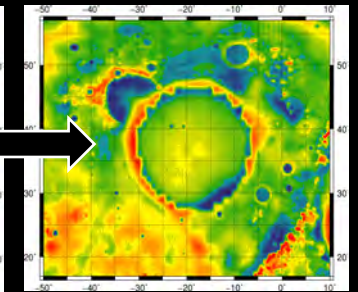
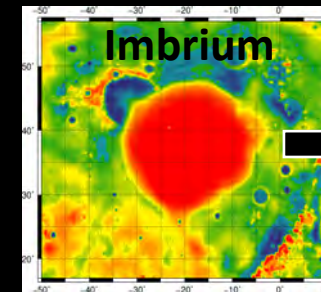
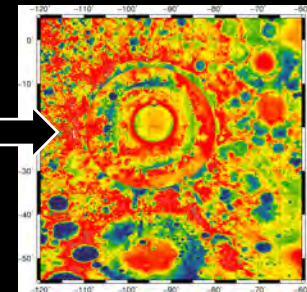
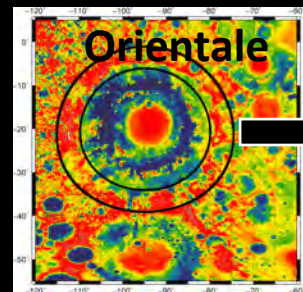
Lunar Gravity Model : Mass Anomalies
Shown in Red



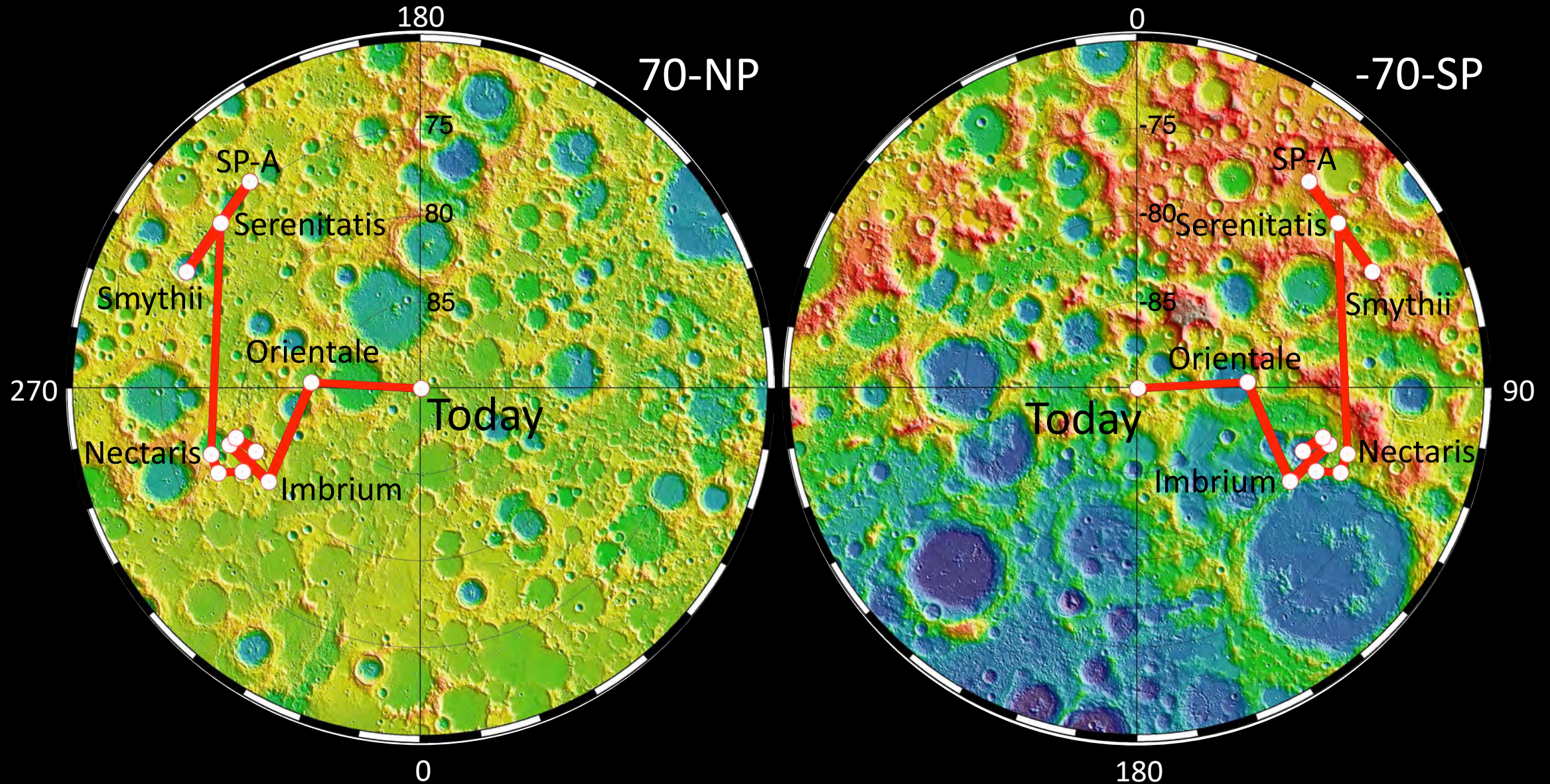
Lunar Gravity Model with 11 Mass
Anomalies Removed



We remove the central gravity
high and the surrounding low, if
necessary. Two examples ---->



ESTIMATED ANCIENT POLE PATH FROM 11 LARGE GRAVITY ANOMALIES



SUMMARY and CONCLUSIONS

- We have estimated the effect of 11 gravity anomalies on the position of the location of the rotation pole since immediately prior to SP-A being formed.
- The results indicate the pole has moved approximately 15 degrees over time.
- The grouping of 6 pole positions suggest that for a time period during the creation of the anomalies the pole remained almost fixed, raising the possibility that Moon's lithosphere/interior may have responded differently during this period.
- Caveat: It should be noted that the pole path is sensitive to the modeling of the anomaly; our best estimate is 5-20% error in any anomaly magnitude.
- A work in progress!