

## Why the Two Sides of the Moon are So Different

*Prelims: Current events of national and international importance| Geography*

### Why in news?

Recently NASA's Gravity Recovery and Interior Laboratory (GRAIL) mission revealed that moon's two hemispheres look different due to difference in internal composition of Moon.

*The two sides of the Moon—the **nearside** (facing Earth) characterized by large, dark basaltic plains called Maria and the **farside** (facing away) is marked by rugged, heavily cratered terrain.*



- **GRAIL mission** - It is a NASA mission aimed at mapping the Moon's gravitational field to enhance our understanding of its internal structure.
- It is launched in 2011 with two identical orbiters, GRAIL-A and GRAIL-B, later named **Ebb** and **Flow** through a student contest.
- **Objective** - To create detailed gravitational map of lunar surface and understand the Moon's asymmetric thermal evolution.
- **Method** - By measuring distance variations between spacecrafts caused by gravitational anomalies.
- These measurements, accurate to within a micron, allowed scientists to infer the Moon's internal mass distribution.

### Reasons for differences in two hemispheres

- **Tidal deformation and gravitational asymmetry** - The nearside (facing Earth) flexes more during its orbit due to Earth's stronger gravitational pull — a process called tidal deformation.
- This suggests that the *nearside is warmer and more geologically active deep* inside compared to the farside, which is more rigid.
- The difference in *internal flexibility* results in creating the Moon's uneven surface features.
- **Crustal thickness and surface composition** - GRAIL data showed that the *nearside crust is much thinner* than the *farside crust*.
- The thinner crust made it easier for *magma to rise* and erupt, forming flat lava plains.
- In contrast, the *farside's thicker crust blocked magma*, leaving behind a *rugged, cratered highland terrain*.
- This difference in crust thickness also affected how *heat-producing elements* were distributed, deepening the contrast between the two sides.
- **Volcanic activity and heat distribution** - The nearside experienced intense volcanic eruptions billions of years ago, which created dark basalt plains called maria.
- These eruptions also build up *heat-producing elements* like *thorium and titanium* in the *nearside's mantle*.
- As a result, the *nearside is 100-200°C hotter* than the farside, leading to a long-lasting thermal imbalance.
- The *farside, with fewer radioactive elements* and less heat, remained mostly inactive and unchanged.

### Significance of these findings

- **Future lunar missions** - It aids in developing lunar positioning, navigation, and timing systems.
- It is essential for success of upcoming crewed moon missions.
- **Broader space exploration** - The gravitational mapping techniques applicable to other moons for advanced search for extra-terrestrial life.

### Reference

[Times of India| Why the Moon Look So Different on Each Side](#)