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News: Argon – 40 in Moon

- Recently, Chandra's Atmospheric Composition Explorer-2 (CHACE-2), a payload onboard Chandrayaan-2, has made the first-of-its-kind discovery on the distribution of one of the noble gases, Argon-40.

Findings of CHACE–2

- The Argon gas found in the lunar exosphere is believed to have escaped from the lunar surface.
- The CHACE-2 observations reveal that the distribution in Ar-40 has significant spatial heterogeneity.
- There are localised enhancements (termed as Argon bulge) over several regions including the KREEP [potassium (K), Rare-Earth Elements, and Phosphorus (P)] on South Pole Aitken terrain (impact crater on the far side of the Moon).

Lunar Exosphere

- 'Exosphere' is the outermost region of the upper atmosphere of a celestial body where the constituent atoms and molecules rarely collide with each other and can escape into space.

- Earth's Moon features a surface-boundary-exosphere.

For Moon, different constituents in the exosphere are fed from the surface by a variety of processes such as:

- **Thermal Desorption**: The exospheric atoms may be lost to space by the thermal escape (also known as the Jean's escape).
- **Photo-Stimulated Desorption**: The atoms get ionised by photo-ionisation and charge exchange with the solar wind ions.
- **Solar wind Sputtering**: The atoms can be swept away by the convective electric field of the solar wind.
- **Micrometeorite Impact Vaporisation**: The impact of micrometeoroid is usually sufficiently energetic to cause vaporisation of the impacting particle as well as produce an impact crater of volume an order of magnitude greater than the impacting particle.
- A micrometeoroid is orbital debris which is smaller than a grain of sand.
- Thus, the lunar exosphere exists as a result of a dynamic equilibrium between several sources and sink processes.

Significance of the Discovery

- Noble gases serve as important tracers to understand the processes of surface-exosphere interaction, and Argon-40 (Ar-40) is such an important tracer atom to study the dynamics of the lunar exospheric species.
- It will also help decipher radiogenic activities in the first few tens of metres below the lunar surface.
- Ar-40 originates from the radioactive disintegration of Potassium-40 (K-40) present below the lunar surface.
- Once formed, it diffuses through the inter-granular space and makes its way up to the lunar exosphere through seepages and faults.
- The CHACE-2 observations provide the diurnal and spatial variation of Ar-40 covering the equatorial and mid latitude regions of the Moon.
- The uniqueness of this result from Chandrayaan-2 mission lies in the fact that although Apollo-17(1972) and Lunar Atmosphere and Dust Environment Explorer (LADEE Mission 2014) have detected the presence of Ar-40 in the lunar exosphere, the measurements were confined to the near-equatorial region of the Moon.
- The observations of Argon bulge by CHACE-2 are indicative of unknown or additional loss processes.