The Lunar Geophysical Network Mission

PI: Clive Neal, University of Notre Dame; Deputy PI: Renee Weber, NASA MSFC

Objectives:

- Define the interior structure of the Moon
- Constrain the interior and bulk composition of the Moon
- Delineate the vertical and lateral heterogeneities within the interior of the moon as they relate to surface features and terranes
- Evaluate the current seismo-tectonic activity of the Moon

Secondary science objectives:

- Characterize the present impact flux on the Moon.
- Obtain fundamental information about Moon-plasma interactions

Exploration objectives:

- Evaluate the seismic hazard to human outposts on the Moon
    - Document and locate shallow moonquakes & meteoroid impacts

Mission architecture: The Lunar Geophysical Network (LGN) is a mission currently in formulation for NASA's New Frontiers 5 Announcement of Opportunity. The baseline mission consists of four solar-powered landers, broadly distributed across the Moon's surface, outfitted with identical instruments to make geophysical observations of the Moon's internal structure and thermal state within distinct lunar terranes.

The LGN mission will deploy four landers to permit global distribution (including the far side) and allow for redundancy, as a threshold of two landers can still achieve the goal of global coverage. The landers should be long-lived (6 years with a goal of 10 years) to maximize science and allow other nodes to be added by international and commercial partners during the lifetime of the mission, thus increasing the fidelity and value of the data obtained.

The four landers will be launched on one launch vehicle and sent into lunar orbit, where the landers will be deployed sequentially from a parent spacecraft. The lander-carrying spacecraft will remain in orbit to serve as the communications relay, thus allowing a lander to be placed on the far side of the Moon. Each lander will also be able to send data direct to Earth, so the communications orbiter acts as a back-up for near side landers.

Expected measurements: LGN has four primary science instruments (Figure 1): a seismometer to measure ground motion, a heat flow probe to measure subsurface temperature gradient and thermal conductivity, a magnetotelluric sounder to measure low-frequency magnetic and electric fields, and a laser retroreflector to measure the round-trip travel time of pulses from ground-based lasers. All LGN instruments are currently in development and all except the seismometer will have CLPS flight heritage in time for the New Frontiers 5 solicitation.

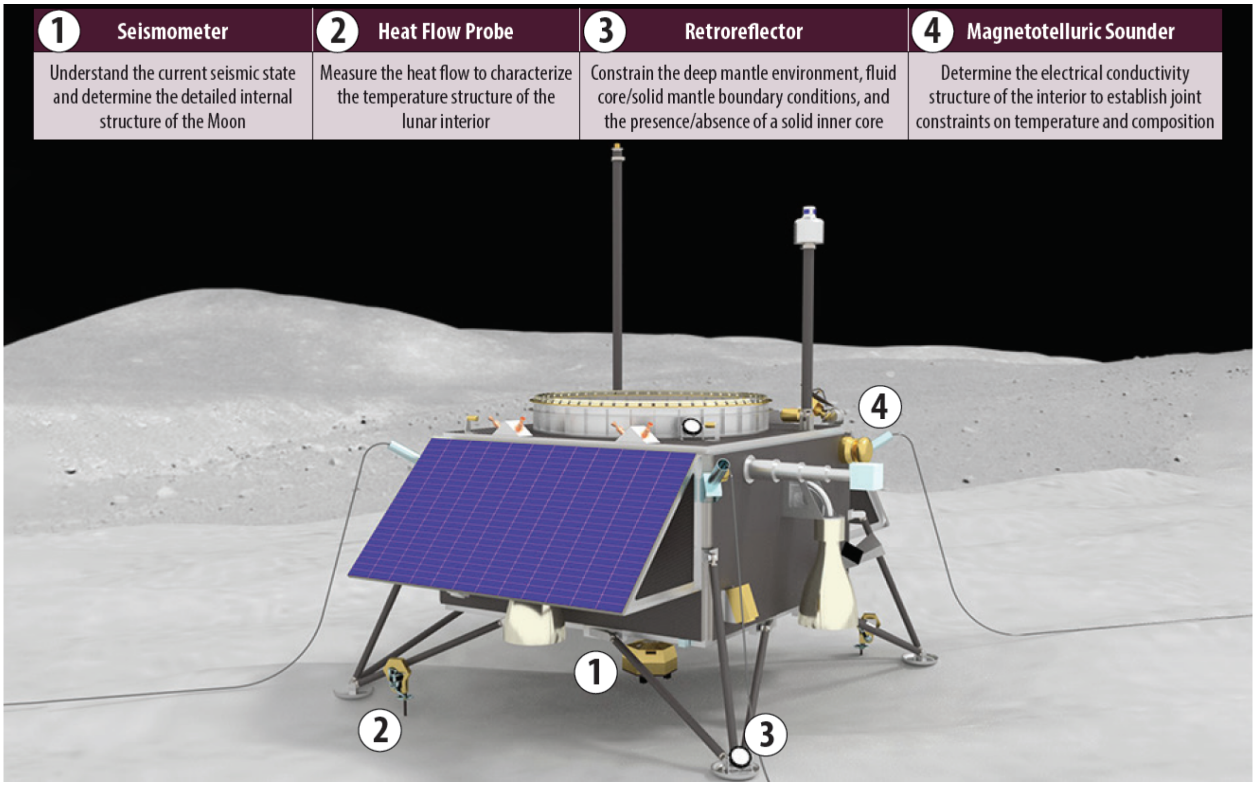

Figure 1: LGN lander concept showing instruments.

Environmental challenges: Unique lunar environmental conditions, including:

- Temperature variations
- Illumination considerations
- Plasma / charging processes

Technology challenges:

- Simultaneous continuous operation of instruments (6 year baseline, 10 year goal)
- Minimization of lander-generated vibrations
- Landed orientation such that the retroreflectors are oriented within 10° azimuth of Earth-Moon vector
- Fixed cameras can't be sun-blinded
- Avoid 0.5m rocks (orbital resolution is 1m)
- Station location accuracy of 200 m
- 4 Landers at 4 widely spaced landing sites including one on the far side:
    - the P-5 region within the Procellarum KREEP Terrane (PKT; lat: 15°; lon: −35°)
    - Schickard Basin (lat: −44°.3; lon: −55°.1)
    - Crisium Basin (lat: 18°.5; lon: 61°.8)
    - Korolev Basin (farside; lat: −2°.4; lon: −159°.3).