Establishing a Lunar Geophysical Network for Exploration and Solar System Science. C. R. Neal[1], [1]Department of Civil Eng. & Geological Sciences, University of Notre Dame, Notre Dame, IN 46556, USA (neal.1@nd.edu)

Introduction: After the announcement by President Bush of the Vision for Space Exploration in 2004, the years immediately thereafter sparked a tremendous and international refocusing on the Moon and lunar exploration. From the science side, one of the important aspects of exploring the Moon was to establish a global geophysical network to truly understand the interior of our nearest neighbor. Such a mission requires multiple landers including some on the lunar farside, which resulted in cost estimates that were in the billion dollar range. This led to the development of the International Lunar Network (ILN) mission (http://science.nasa.gov/missions/iln/) whereby NASA with international partners would establish several nodes of a geophysical network on the Moon, with NASA establishing 4 anchor nodes [1].

The change of administration in 2009 changed NASA's direction and the Moon was by-passed in favor or near Earth asteroid exploration. This change of emphasis has dulled enthusiasm at NASA for the ILN. However, NASA's Planetary Sciences Division underwent its decadal survey in 2010 [2]. Due to community input, a New Frontiers class mission to establish a Lunar Geophysical Network was recommended.

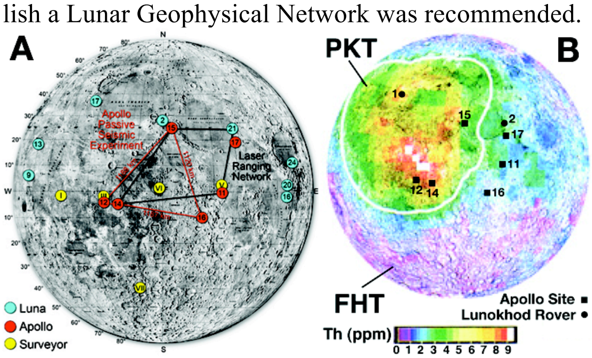

Fig. 1: ***A*** *– Map of human and robotic lunar landing sites;* ***B*** *– Map of Apollo and Lunokhod landing sites relative to lunar terranes. PKT = Procellarum KREEP Terrane; FHT = Feldspathic Highlands Terrane.*

The Lunar Geophysical Network (LGN): Seismic, heat flow, laser ranging, and magnetic field/electromagnetic sounding data are critical for understanding the Moon's interior [2], but multiple stations are needed across the lunar surface covering a much wider footprint that the Apollo stations did (Fig. 1A).

Importance of the LGN for Lunar Science: Establishing a global geophysical network is critical for understanding the crustal structure within the different lunar terranes [3; Fig. 1B], as well as the deep mantle structure and confirming the tantalizing results about the lunar core [4]. The Moon represents the initial end-member of terrestrial planet differentiation because it is the smallest differentiated body in the inner solarsystem. A globally distributed network of stations, well within terrane boundaries and returning data outlined above, would allow the thermal and chemical nature of the lunar core, mantle and crust to be elucidated.

Implications for Astrohpysics: A relay orbiter would enable not only the emplacement of landers on the farside, but could also radio astronomy because the farside hemisphere is shielded from terrestrial radio interference, and during the lunar night the farside is also shielded from solar emissions. For these reasons, the farside of the Moon has been considered to be an excellent site for low-frequency radio astronomy [5,6]. The two Radio Astronomy Explorer satellites launched in 1968 and 1973 are the only spacecraft to have made low frequency radio measurements in the frequency range of 0.02 to 13.1 MHz. From the collected data (total flux only), these spacecraft could study only solar, Jovian and terrestrial radio emissions [7].

Implications for Exploration: Although not ideal, the Apollo network (Fig. 1) identified issues that have particular relevance for long-term human exploration of the Moon. Of the 4 types of lunar seismic events recorded, shallow moonquakes are the most enigmatic and potentially dangerous for any outpost [e.g., 8]. The Apollo passive seismic network (1972-1977) recorded 28 such events, which are of higher frequency than the other types, and 7 of these were of body wave magnitude ≥ 5. As the Moon has a much higher seimic Q than the Earth [9], it means the maximum amplitude of moonquakes exist for tens of minutes. While these moonquakes are classified as "shallow," (50-200 km) the exact depths and locations are poorly known because all were outside the Apollo network. Obviously, siting a Moonbase in regions where shallow moonquakes occur would be disastrous! However, the causes of these "high frequency teleseismic events" [10] is unknown. The LGN mission would go a long way to defining the causes and locations of these mysterious and potentially catastrophic seismic events.

References: [1] ILN SDT Report (2009) http://iln.arc.nasa.gov/. [2] Vision & Voyages for Planetary Science in the Decade 2013-2022. NAS http://www.nap.edu/catalog/13117.html. [3] Jolliff et al. (2000) *JGR* **105**, 4197-4216. [4] Weber et al. (2011) *Science* **331**, 309-312. [5] Mimoun et al. (2011) *Exp. Astron*. (in press). [6] Jester & Falcke (2009) *New Astron. Rev*. **53**, 1-26. [7] Alexander et al. (1975) *Astron. Astrophys.* **40**, 365-371. [8] Neal (2005) SRR-LEAG Joint mtg. Abs. 2065. [9] Nakamura & Koyama J. (1982) *JGR* **87**, 4855-4861. [10] Nakamura (1977) *PEPI* **14**, 217-223.