FUTURE LUNAR GEOPHYSICAL MISSION OPPORTUNITIES INCLUDING THE LUNAR GEOPHYSICAL NETWORK AND CLPS. H. F. Haviland[1], R. C. Weber[1], C. R. Neal[2], P. Lognonné[3], R. F. Garcia[4], N. Schmerr[5], S. Nagihara[6], R. Grimm[7], D. G. Currie[5], S. Dell'Agnello[8], T. R. Watters[9], M. P. Panning[10], C. L. Johnson[11,12], R. Yamada[13], M. Knapmeyer[14], L. R. Ostrach[15], T. Kawamura[3], N. Petro[16], P. M. Bremner[1]. [1]NASA Marshall Space Flight Center (heidi.haviland@nasa.gov) [2]U. Notre Dame, [3]IPGP, [4]ISAE-SUPAERO, [5]UMD, [6]Texas Tech U., [7]SwRI, [8]INFN-LNF, [9]Smithsonian Institution, [10]NASA JPL, [11]U. British Columbia, [12]Planetary Science Institute, [13]Aizu University, [14]DLR, [15]USGS, [16]NASA GSFC.

Introduction: In the next few years, several opportunities are underway to take new geophysical observations of the Moon including geodetic and seismic. NASA's novel Commercial Lunar Payload Services (CLPS) program seeks to acquire delivery services from 14 US companies. Nine funded task orders have been selected with payloads from multiple disciplines. Here we review the upcoming geophysical CLPS payloads and their measurement objectives then we provide a review of the Lunar Geophysical Network mission in development for New Frontiers 5.

The Lunar Geophysical Network (LGN) mission is proposed to land on the Moon in the early 2030's and deploy packages at four locations to enable continuous geophysical measurements for a minimum of 6 and a goal of 10 years [1]. Returning to the lunar surface with a long-lived geophysical network is a key next step to advance lunar and planetary science. LGN will greatly expand our primarily Apollo-based knowledge of the deep lunar interior by identifying and characterizing mantle melt layers, as well as core size and state.

To meet the mission objectives, the instrument suite provides complementary seismic, geodetic, heat flow, and electromagnetic (EM) observations. We discuss the network landing site requirements and provide example sites that meet these requirements. Landing sites include 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°), and the farside Korolev basin (lat:-2.4°; lon:-159.3°) (Figure 1).

Network optimization considers the best locations to observe seismic core phases, e.g., ScS and PKP. Ray path density and proximity to young fault scarps are also analyzed to provide increased opportunities for seismic observations. Geodetic constraints from laser ranging require the LGN to have at least three nearside stations at maximum limb distances. Heat flow and EM measurements should be obtained away from terrane boundaries and from magnetic anomalies at locations representative of global trends. In our recent paper [2], an in-depth case study is provided for Mare Crisium. We also discuss the consequences for scientific return of less-than-optimal locations or number of stations.

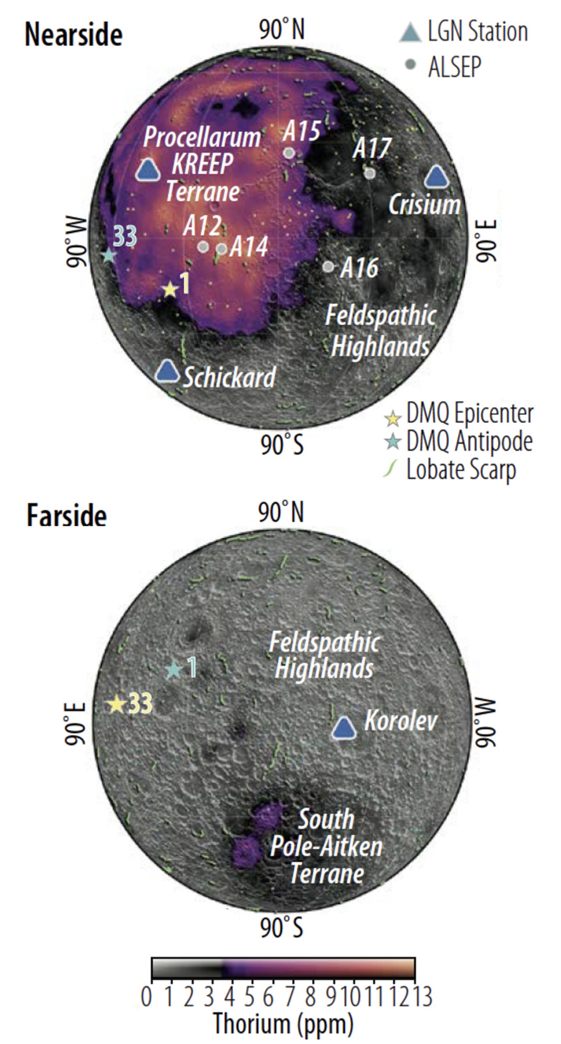

Figure 1: Candidate LGN landing sites (triangles) compared to Apollo (circles). LGN stations will be placed across major lunar terranes and enable new interrogation of the deep lunar interior and tectonic evolution. The two most active nearside and farside deep moonquake clusters (A01 and A33) and their antipodes (yellow and cyan stars, respectively) are highlighted.

References: [1] Neal, C. R. et al. (2020) The Lunar Geophysical Network, Final Report. NASA Planetary Mission Concept Study. [2] Haviland, H. F. et al. (2022) Planetary Science Journal. 3 40. DOI: 10.3847/PSJ/ac0f82