Future Missions to the Moon on a Discovery (or less) budget. C. R. Neal[1] [1]Dept. of Civil & Env. Eng. & Earth Sciences, University of Notre Dame, Notree Dame, IN 46556, USA. (neal.1@nd.edu)

Introduction: The Moon features heavily in the current NASA Planetary Sciewnces Division Decadal Survey [1]. The decadal specifies 2 New Frontiers class (cost cap $1billion) lunar missions are highlighted: Sample return from the South Pole-Aitken Basin; a long-lived Lunar Geophysical Network. The decadal also highlights important lunar science issues that should be addressed by future missions (orbital, landed, and sample return):

- Determining the nature of polar volatiles;
- Understanding the significance of recent lunar activity at potential surface vent site;
- Reconstructing the thermal-tectonic and magmatic evolution of the Moon;
- Determining the impact history of the inner Solar System through the exploration of better characterized and newly revealed lunar terranes.

Therefore, we need to be thinking of credible missions to the Moon that will address the science highlighted above, but at a Discovery budget (cost-cap $500 million) or less for those issues not named as New Frontiers missions. Given the plethora of recent orbital missions, future missions will likely need to get to the surface and have some mobility to explore at least the local area. This is not to say that there should not be orbital missions proposed that could, for example, determine the nature of polar volatiles or characterize the global surface mineralogy at higher resolution than M^3. Assuming an upper budget limit of $500 million, landed missions will be limited to the nearside, unless a Com Sat is independently available. I assume here that it won't be and discuss potential landing sites and mission types that will address important lunar science and exploration questions.

Landed missions on the lunar nearside would answer a number of important science questions. I list some examples below in no order of preference:

- A landed mission in the youngest mare terrane (see [2-4] and Fig. 1) would allow a sample return not unlike those of the Soviet Luna 16, 20 and 24 missions (i.e., regolith samples). In addition, such a mission could deploy a heat flow probe as this site is well within the Procellarum KREEP terrane [5] and this would potentially give us an unambiguous idea of lunar heat flow in a KREEP-rich area.
- A rover mission (remotely controlled from Earth) to, for example, the Ina Structure [6] would allow a detailed examination of potential recent lunar activity. A sample return mission to this area would also yield significant scientific advances and potentially the age of the structure/activity.
- A rover mission to a carefully chosen PSR could allow a landing in sunlight in the bottom of a crater and roving into the PSR for relatively brief periods to examine the volatile content, geotechnical properties, and composition of the regolith.
- Sample return from impact craters that sample impact melts would clearly define the age of these craters (e.g., Copernicus, Nectaris).
- Sample/return or rover mission to a high-Th region of the Moon (e.g., Hansteen Alpha [7]) would give vital information about the age and geological setting of potentially evolved igneous constructs.

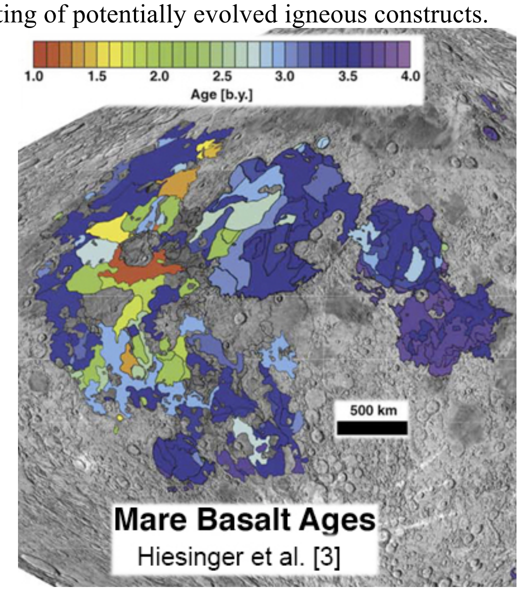

Figure 1: Ages of different mare terranes [3].

There are other mission concepts that I will discuss at the LEAG meeting, but the examples given above address the bulleted list of lunar science objectives that can be addressed by missions. Also, we should not forgot the exploration aspect of these missions, such as ISRU. With the potential for HEOMD to launch Resolve Prospector in 2018 [8], we need to be thinking of not only giving this mission our full support, but what follow on missions could be developed.

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