CLAVIUS: AN OFF-POLAR SITE OPTION FOR THE NASA ARTEMIS BASE CAMP

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Summary: An off-polar site is proposed for NASA's Artemis Base Camp on the Moon, at 61.2°S, 15.5°W, on the floor of Clavius crater. *Clavius Base* would be in a science-rich, operations-friendly, and potential resource-proximal location, with vehicular access to the lunar south polar region (LSPR).

Introduction: Establishing a fixed base on the Moon with a versatile fleet of mobility vehicles enabling multi-range exploration from that base, offers overwhelming strategic advantages for science and exploration over sortie or hybrid mission approaches [1]. The long-term value of a *base-with-mobility-fleet* approach has proven itself in Antarctica (*e.g.*, McMurdo and other bases), the Arctic (*e.g.*, Haughton-Mars Project), and throughout exploration history [1]. Setting up a base, even if initially modest, should be a priority for the Artemis program, as a base will quickly render human exploration safer, scientifically more productive, and logistically more cost-effective. Furthermore, since it is not known yet if H_2O extraction will be economically viable in the LSPR, or where it might become viable, it is premature and high-risk to focus early Artemis crewed missions on sorties to the LSPR. The accumulation of a scattering of infrastructural assets in different locations across the LSPR as a by-product of multiple sortie missions is also of low value, as assets that are not readily usable by subsequent missions lose relevance. Instead, the LSPR, including its permanently shadowed regions (PSRs) which humans cannot dwell in, should be explored via an increased cadence of robotic missions, via NASA's Commercial Lunar Payload Services (CLPS) program and via NASA's own missions. Artemis crewed missions should focus instead on establishing an Artemis Base Camp at an off polar, nearside site at mid to high southern latitude, at a location that is easier to access, view, and operate-in, with nuclear power to survive the lunar night, and from where the rest of the Moon may eventually be accessed.

Clavius Crater: Clavius, a 231 km-wide, 3.5 km-deep, convex-floored, "walled depression" at 58.4°S, 14.4°W, is the second largest impact crater on the lunar nearside (after Bailly) **(Fig.1)**. It is Nectarian in age (3.85-3.92 Ga), *i.e.,* one of the oldest craters on the Moon. Clavius presents diverse geology spanning lunar history and, remarkably, surface molecular water (H_2O) at up to 412 ppm [2].

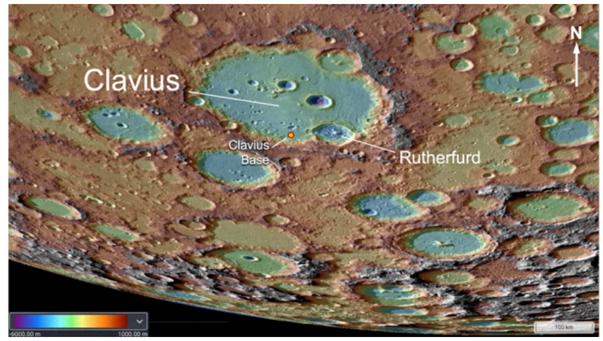

Figure 1. Location of proposed Clavius Base: *Clavius crater floor, 26 km E of Rutherfurd's western rim. (NASA LROC+LOLA/Lunar Quickmap).*

Rutherfurd Crater Lava Tubes, Pits & Caves. On the SSE rim of Clavius lies Rutherfurd crater, a 48 km x 54 km, Copernican age (<1.1 Ga old) impact crater **(Fig.1)**. Rutherfurd's floor presents several patches of impact melt, some with several partially collapsed impact melt lava tubes, pits and caves [3,4]. Many of Rutherfurd's pits and caves are PSRs [4]. Although these are expected to be generally too warm to cold-trap H_2O ice [5,6], exceptionally favorable geometries might allow H_2O ice to accumulate in some pit-PSRs [4].

Clavius Base: A wide open area (~15 km x ~5 km) that is flat (<2° slopes at 100 m scale) and smooth (rock abundances ≤1%) at **61.20°S, 15.50°W (344.50°E),** on the floor of Clavius crater, is identified as a candidate location for a base, hereafter *Clavius Base* **(Fig.1)**. The site's position near the southern rim of Clavius would offer ready access to trafficable (<12° slopes) crater exit routes connecting with the "Northwest Passage" traverse route to the LSPR [7]. *Clavius Base* would also be located near Rutherfurd's shallowest rim ramp (<20-22° slopes), at 60.96°S, 346.25°E, 26 km E of the base, allowing access to Rutherfurd's foor, lava tubes, pits and caves.

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References: [1] Lee 2024a. LSSW-22, #5012; [2] Honniball, C. *et al*. 2021. *Nat Astron* 5, 121-127; [3] Wagner & Robinson 2014. *Icarus 237*, 52-60; [4] Lee 2024b. *In prep.*; [5] Horvath, T. *et al.* 2022. *Geophys. Res. Letters* 49, e2022GL099710; [6] Wilcoski et al. 2023. *J. Geophys. Res. Planets* 128, e2023JE007758; [7] Lee 2024c. *NESF-2024*.