HUYGENS CRATER: INSIGHTS INTO NOACHIAN VOLCANISM, STRATIGRAPHY, AND AQUEOUS PROCESSES. S. E. Ackiss[1], J. J. Wray[2], K. D. Seelos[3], and P. B. Niles[4], [1]Dept. of Earth, Atmospheric, and Planetary Sciences, Purdue University, West Lafayette, IN (sackiss@purdue.edu), [2]School of Earth & Atmospheric Sciences, Georgia Institute of Technology, Atlanta, GA, [3]Johns Hopkins University Applied Physics Laboratory, Laurel, MD, [4]NASA Johnson Space Center, Houston, TX.

Rationale: Huygens crater (Figure 1) is a well preserved peak ring structure on Mars centered at 13.5°S, 55.5°E in the Noachian highlands between Terras Tyrrhena and Sabaea near the NW rim of Hellas basin. With a diameter of ~470 km, it uplifted and exhumed pre-Noachian crustal materials from depths greater than 25 km, penetrating below the thick, ubiquitous layer of Hellas ejecta. In addition, Huygens served as a basin for subsequent aqueous activity, including erosion/deposition by fluvial valley networks and subsurface alteration that is now exposed by smaller impacts. Younger mafic-bearing plains that partially cover the basin floor and surrounding intercrater areas were likely emplaced by later volcanism.

Regional Geology: *Noachian Crustal Units:* Huygens and the surrounding region has been mapped as early to late Noachian in age with one outcrop of middle Noachian aged material partially covering the crater floor from the western wall eastward to the peak ring [1]. Mineralogy of Huygens has been examined in detail as well [2]. Two types of plains delineated within Huygens consist of olivine-rich and high-calcium pyroxene (HCP)-rich units, both of which exhibit relatively high thermal inertia and lack large amounts of eolian materials (e.g. dunes). As described in [3], the most probable origin of the mafic plains is effusive volcanism, where magma rose to the surface via a dense network of fractures created by the Hellas impact. Subsequent impacts also could have initiated magma formation and assent through decompression melting [4], as craters in the region are also commonly filled with mafic-rich, high thermal inertia material. Exposures of low calcium pyroxene (LCP) occur as well, usually in distinct massif-forming terrain that may be remnants of deep crustal material exhumed by the Hellas impact. LCP-bearing outrcrops are predominantly located outside Huygens but a few occurrances have been identified on the floor.

Aqueous Alteration: Aqueously altered materials are identified both inside (on the floor of) and outside Huygens and include Fe/Mg smectites, Al-bearing phyllosilicates, and Fe/Ca carbonates (see also [5]). These minerals are observed in crater rims/walls, central peaks, and ejecta of smaller subsequent impacts, and therefore inferred to have formed in the subsurface prior to the impacts, not via impact-driven, hydrothermal alteration [6, 7]. Aqueous alteration could have coincided with formation of fluvial valley networks post-Huygens or may have been pre-exisiting (or both); no spatial relationship between alteration mineral outcrops and Huygens-related structures is evident.

Biosignature and Habitability Preservation Potential: The carbonates within the Huygens basin (exposed by the cratering process) are associated with phyllosilicates and occupy layered rocks [5]. These materials record ancient neutral-to-alkaline fluid chemistry of at least regional extent, and may be an important reservoir for paleo-atmospheric CO_2. If formed via subaqueous sedimentation, their preservation potential is high, and in any case their isotope systematics will be valuable tracers of magmatic, atmospheric, and biochemical processes.

Stratigraphic Context and Cross Cutting Relationships: While the Huygens impact itself and all mapped surface units date from early to late Naochian, a finer relative stratigraphy may be discerned using mineralogic information. If the LCP-bearing massifs do indeed represent excavated deep crust from the Hellas impact, this is the oldest exposed material in the region. The Huygens impact panetrated through the Hellas ejecta blanket, potentially sampling pre-Hellas crust and uplifting/redistributing any pre-exisiting alteration minerals. Post-Huygens the surface was modified by fluvial activity, with associated ground water potentially leading to the formation of subsurface alteration minerals. The mafic plains units are the youngest materials, and embay the fluvially dissected terrain. By sampling these types of materials and depositional environments, a mission to Huygens would arguably be exploring the most geologically active time period in martian history.

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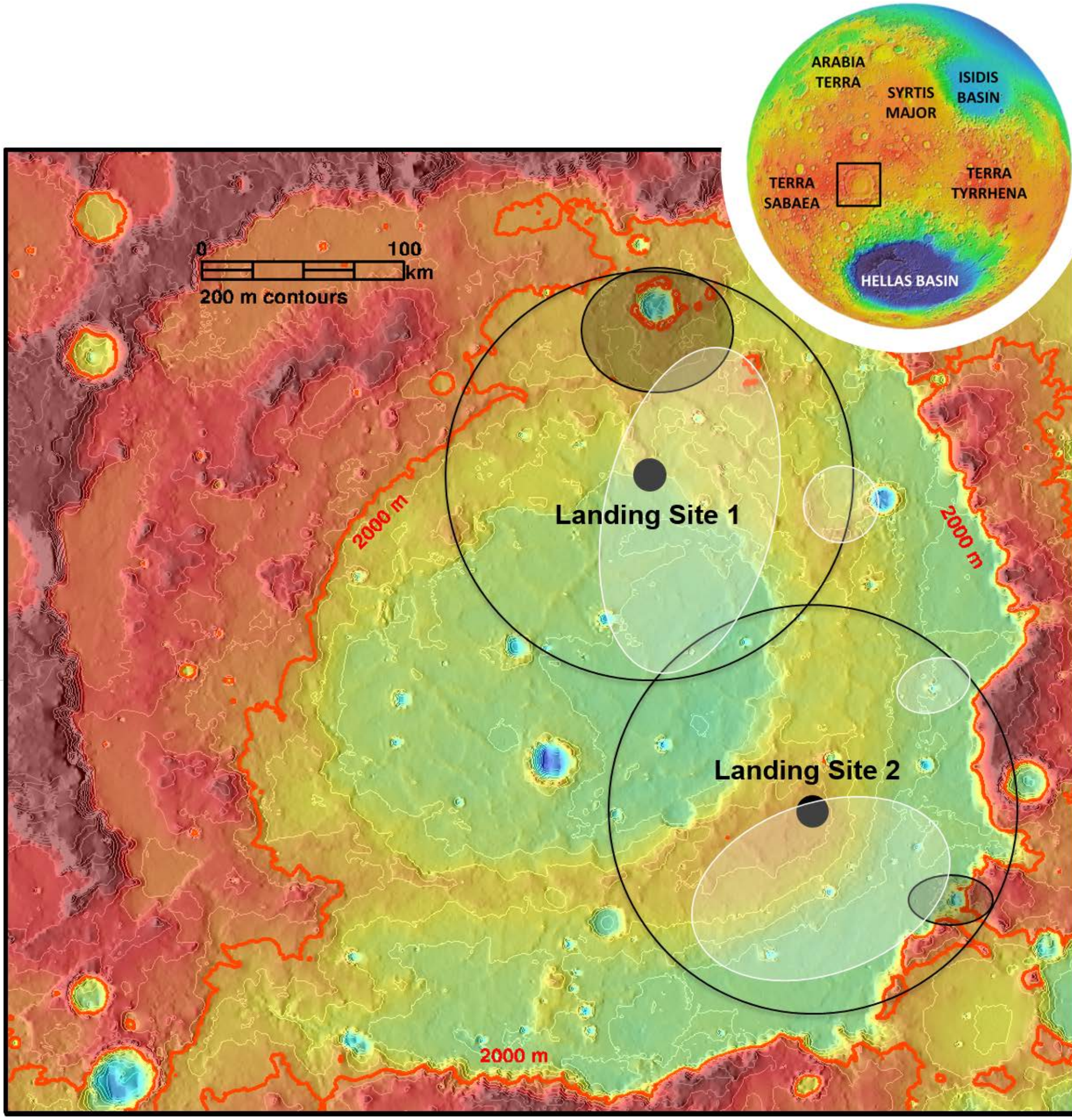

Figure 1. Huygens crater exploration zone over MOLA topography with 2km elevation denoted. Inset shows location on the globe. Black circles indicate resource regions of interest and white cirlces indicate regions covered with expanisve mafic material. Landing site 1 has a larger phyllosilicate/carbonate deposit and mafic plains that can be age dated while Landing site 2 gives access to the crater wall and valley networks that flow into the crater.