AUSONIA CAVUS AND KASEI VALLES: COMPLEMENTARY EXPLORATION ZONE SITES FOR BIOLOGY, GEOLOGY AND ISRU.
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Introduction: Two candidate EZs are proposed that are rich in geologic history and exhibit water evidence for astrobiology. Both sit midway down flow features in erosional valley networks.

Ausonia Cavus (Figure 1) lies at the beginning of the drainage features Dao and Niger Valles downslope of the Noachian volcano Tyrrhenus Mons on the Hesperia Planun which continues past Ausonia Caves down to Hellas Planetia (one of the lowest elevation features in the southern hemisphere). Its geologic attraction is the ability to sample ancient lava flow basalt rocks from the Tyrrhenus Mons erosional deposits and glacial flow. The major lava channel from the caldera and pit craters flows to this area. By analogy with terrestrial shield volcanoes, this area should contain extensive lava tube systems. A nearby Hesperian volcano (Hadriacus Mons) dominates the eastern topography, allowing sampling of that era in close proximity. Ausonia Mensa, a large remnant mountain of the Noachian era, is SSE rising above basaltic sheet flow layers. Many early Noachian highlands massifs exist here. The EZ is NNE of a proposed Mars Science Lab landing site in Hellas Basin/Dao Vallis.

Ausonia Cavus and nearby Peraea Cavus may be paleolakes from the Hesperian Age or earlier. Phyllosilicates and hydrated sulfates (or lack thereof) in or near these would help constrain the Hesperian environment.[1] There is evidence of ice-rich lobate debris features to the west on the low features at base of mound in Promethei Terra. CRISM imagery shows nearby glacial cirques, fan shaped deposits and drop moraines [2].

These lobate debris features are believed to be glaciers covered with a layer of rocks and dust [3]. These features offer an easily accessible source of water without having to go to higher latitudes. These glacial feature offer water concentration of 70% or greater and can reduce the quantity of raw material required by a factor of 10 or greater compared to hydrated minerals [4]. The energy required to extract this resource would also be lower due to the high temperatures required for complete extraction of mineral-bound water.

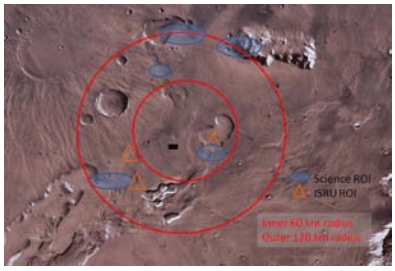
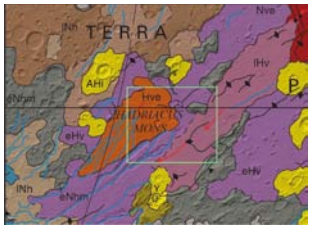
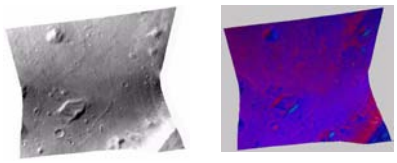


Figure 1- Ausonia Caves (32.0S, 96.5E)



From an exploration viewpoint, the floor of Ausonia Cavus is easily accessible from the south shore with a gentle sloping terrain. MRO imagery shows outflow and runoff near this southern area. This appears to be a breach of the lake with small sediment fans, although outcrops of what may be Fe/Mg phyllosilicates are seen which likely formed in-situ during the period of lake activity. Outcrops of clay minerals (Fe/Mg phyllosilicates) that likely formed under conditions favorable life may contain fossil biosignatures. Clay hydrogels may have been a vector for chemicals to form complex biomolecules in the early evolution of life [5]. Multiple 30-50 m outcrops populate the lake bottom. [6] The lake draining episode may have been short lived with large discharge velocities, creating scablands downstream.*Science ROIs:* Ausonia Mensa - Noachian Massif, Peraea Cavus – paleolake, Hadriacus Mons channel (Hesperian), Upper Niger Valles. *Resource ROIs:* Lobate debris features, Regolith medium dust, Ausonia Mensa - iron regolith filled lake



CRISM images for floor: Visible and Iron/Phyllosilicates

LZ (black box); Landing zone terrain supports ISRU for landing pad with sintered basalt tiles.

Kasei Valles (Figure 2) is attractive because it cuts through and surrounds an early Hesperian highland area exposing the Noachian highland base. It resides at the lower end of the Tharsis region drainage basin/aquifer system thought to be active during the Noachian Period. [7] The basin was subsequently filled lava, sediments, and volatiles partly infilling the basin, resulting in an enormous and productive regional aquifer. Strong flow features abound in this area, with teardrop outcrops to the south west in Sacra Sulci indicating depositional opportunities downslope with evidence for several episodes of flooding and possible glacial activity. [8] MOLA profiles of these outflow channels show several narrow, inner channels which is interpreted that the system was active over a significant period of time and likely involved several separate flood events, and a longer fill time to form the northern Martian ocean. [9]

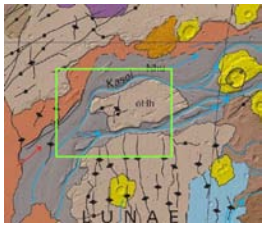
Noachian era terrains are of great astrobiological interest due to evidence of large bodies of water and a denser atmosphere.Exposure of of the Noachian and Hesperian boundary can provide more information on early Martian environmental processes leading to insight on potential mechanisms of biosignature preservation.

Kasei Valles is west of the Viking 1 and Pathfinder landing zones in the Chryse Planitia. There are two subareas in this zone worthy of further consideration.

Both areas sample a wide variety of rock types and ages from surrounding highlands. The first area lies near an outflow channel with access into the lower channel and a large filled crater (Lat and Long). The crater has exposed impact ejecta and infilling sediment. Subarea 2 is at an abrupt change in channel direction, and upstream from the area of thick dust accumulation, as indicated by bright IR night thermal images. This is the likely site of significant deposition in the form of gravel and boulder-rich point bars. The main channels are potential sites of fine-grained material well-suited for ISRU processing. Analog sites exist at glacial outwash plains on Mauna Kea [10], Keanakāko`ì Tephra Drainage Network, Ka'u Desert) [11] and the Channeled Scablands of Washington State.

South of this site lie extensive lava flows. Access into the channel appears to be allowed from the northern bank, where the channel bottom should be rocky and firm as it is cut bank of the gully. This extensive outflow region could harbor subsurface ice left behind in mud flows in the waning stages of fluvial activity. [12]

Figure 2 - Kasei Valles (24.81N, 287.37E)



It has been suggested that platy surface textures are formed by large ice plates carried along in the mud flow. There are also multiple examples of lobate debris aprons that suggest high ice content resulting in ice-assisted creep features. [13] The authors would like to acknowledge these technical contributions from HI-SEAS (Kim Binsted) on astronaut exploration ranges and PISCES (Rodrigo Romo) for rover mobility ranges and construction & sintering ISRU assessments (Christian Andersen).

References:

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