POTENTIAL 2003 LANDING SITES IN THE CERBERUS PLAINS, SE ELYSIUM PLANITIA. A. McEwen[1], P. Lanagan[1], R. Beyer[1], L. Keszthelyi[1], and D. Burr[2], [1]Lunar and Planetary Laboratory, University of Arizona, Tucson, AZ 85721, USA, (mcewen@lpl.arizona.edu), [2]Department of Geosciences, University of Arizona, Tucson, AZ 85721, USA.

Summary: There are spectacular and well-preserved volcanic, fluvial, and sedimentary features in the Cerberus plains region, but the surfaces are often extremely rough at the scale of meters to tens of meters, unsafe for landing and impractical for the Athena rover. However, several sites (EP71A, EP74A, EP77A, EP61B, EP62B) appear reasonably smooth over much of the terrain seen in MOC images. All of these sites are just north of the contact between finely-layered sedimentary deposits mapped as part of the Medusae Fossae Formation and very young flood lavas (1 N, 212 W to 5 N, 221 W). Landing in this region could enable study of well-preserved lava flows, possible phreatic cones, finely-layered sedimentary strata, possible shoreline features, and patterned ground. We could answer questions about recent volcanic and fluvial activity, the origin of the layered sedimentary deposits, and whether ground ice is present within the upper tens of meters of the surface.

Background: MOC images have revealed well-preserved volcanic and fluvial features on or near the Cerberus plains (~5 S to 10 N, 180-220W) [1]. Recent (Upper Amazonian) flood lavas in this region were first described by Plescia [2]. Finely-bedded sedimentary deposits similar to those described in [3] overlie or reside near portions of the Cerberus plains, especially in the SE areas. The Cerberus plains comprise the largest region on Mars with well-preserved volcanic and fluvial morphologies, with primary features preserved at the scale of meters. Much of the plains are covered by lava flows with a distinctive platy/ridged morphology similar to portions of lava flows on Iceland [4]. Some of the lava flows appear to be younger than 10 Ma based on counts of small craters [5]. Marte Vallis (~10 N, 180 W) and channels near 8 N, 205 W reveal terraces, longitudinal grooves, and streamlined islands, similar to large paleoflood channels on Earth and elsewhere on Mars [6]. The channels near 8N, 205 W originate from Cerberus Rupes (actually fossae) and/or ancient highland terrains, but disappear to the south beneath the very young Cerberus lavas. The channels in Marte Vallis become recognizable at ~10 N, 180 W in spite of embayment by lava flows, and continue to the NE into Amazonis Planitia. Based on these relations and the MOLA topography, the channels near 8N, 205 W probably continued south and then west into Marte Vallis, but are completely buried by thick lavas in the central Cerberus plains [6]. These channels are probably younger than 500 Ma [2], and may be much younger if we can correctly interpret the size-frequency distributions of small craters.

In southern parts of the the Cerberus plains, some lava flows are being exhumed from beneath weakly indurated sediments of the Medusae Fossae Formation (MFF). Some of these sediments are finely layered [e.g., 3]. Most previous workers have interpreted the age and stratigraphy of the MFF as Upper Amazonian, although [3] have interpreted the layered sediments as Noachian. Sedimentary units of the MFF (not necessarily like those described by [3]) overlie sparsely cratered lava flows in places, so the crater distributions may date the exhumation rather than emplacement of the lava flows. However, a Noachian or Hesperian age for the lavas would require some improbable assumptions about the geologic history, i.e. that an erosion-resistant layer covering a huge area was only very recently breached but left few remnants. In other places lava clearly embays the MFF.

Many origins for the MFF have been proposed. The association with flood lavas suggests that some of these sediments may be volcanic tephra from basaltic lava fountains or from phreatomagmatic explosions where the magma

interacted with ice-rich terrains [4, 7]. If so, then the lava and MFF have nearly the same emplacement age, but the tephra has been eroded by wind over the past ~10^7-10^8 yrs. The best evidence for volcano-ground ice interactions in this region are the many (100s) of cones interpreted as phreatic or rootless cones [8]. Such cones suggest the presence of shallow ground ice (< 10-20 m) at the time of lava emplacement, perhaps only ~10^7 yrs ago. The ground ice could have been recharged within ~5 x 10^8 yrs via fluvial floods. Patterned ground is also common over portions of these plains, probably from cooling and contraction of ponded lava but perhaps due to shallow ground ice.

Potential Landing Sites: About 20 potential landing sites on the Cerberus plains have been identified by Golombek and Parker [9] on the basis of various datasets, not including MOC. MOC high-resolution images show that terrains nearby and contiguous with the landing sites are usually dominated by platy/ridged lava, MFF eroded into a rough wind-sculpted surface, or moderately cratered plains. Both the platy/ridged lava and MFF are extremely rough surfaces at the scales of 1-100 m and should be ruled out as feasible landing sites. Note that many of the very roughest areas as seen by MOC correspond to some of the very smoothest areas seen by MOLA or Viking at larger scales. The moderately cratered plains appear geologically uninteresting.

The most promising sites on this list are EP71A at 1.2 N, 212 W and EP77A at 4.5 N, 220.5 W, and perhaps other sites that lie between these locations (EP74A, EP61B, EP62B). All 5 of these sites have a similar geologic setting, north of the contact between MFF and the Cerberus lavas. EP77A is covered by several MOC images; these and MOC images near the other sites often reveal relatively smooth surfaces. Typical terrains include extensive areas that we interpret as inflated pahoehoe lava flows and patterned ground (probably lava), both of which appear fairly smooth (but this needs to be quantified). There are also regions of platy/ridged lava, which we interpret as rubbly pahoehoe, inflated lavas that have been remobilized and the crust broken up into a chaotic and extremely rough surface. Care must be taken to find a landing ellipse that minimizes this terrain and other rough surfaces. Also present near these sites are hundreds of cones of potential phreatic origin, finely-layered sedimentary strata, and possible small-scale shoreline strands. Exploration of this region could answer questions about recent volcanic and fluvial activity, the origin of the layered sedimentary deposits, and whether ground ice is present within the upper tens of meters of the surface (via composition of phreatic deposits). Such shallow ice in the more accessible and hospitable equatorial region would have important implications for future exploration. The scenery should be quite spectacular from the viewpoint of Athena.

MOC images covering EP77A include M0701753, M0802926, and M0902230; MOC images near the other sites include FHA01586, M0203479, M0001046, M0001434, M0201183, M0305363, M0702180, M0703125, M0703643, M080090 and M0902816.

References:

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