ATHABASCA VALLES AS A CANDIDATE MSL LANDING SITE.

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Introduction: Athabasca Valles is interpreted from geomorphology and topography as a fissure-fed catastrophic flood channel [1,2,3,4]. Its sparsely crater floor has been dated as Late Amazonian [4,5,6], and its pristine morphology also suggests a young age, (but see [7]). Water is generally agreed to have carved the channel, but the last fluid may have been lava [8], glacial ice [9], CO2-charged density flows [10], and/or mud flow [11]. A variety of materials likely overprinted the water flood morphology [e.g., 4, Fig. 7].

MSL Science Goals: Landing in the headward reaches of Athabasca Valles near the Cerberus Fossae will allow MSL to assess potential habitability in several ways. Because Athabasca Valles experienced (a) large-scale aqueous event(s) from the Cerberus Fossae, in-channel deposits [12,13] may provide material from a potential subsurface biosphere [e.g., 14,15]. The Cerberus region in general [16] and Athabasca Valles in particular [13] may have chemical cementation, and precipitates have strong preservation potential for fluid inclusions [17]. Analysis of OMEGA data over the channel's highest thermal inertia areas (350-475 in SI units) [18,19] at its head suggests possible hydrated minerals, which may be the result of hydrothermal alteration of basalt [20]. And post-flood reactivation [5] or collapse [21] of the Cerberus Fossae provides a 'go-to' site with a view into Mars' uppermost crust. Other 'go-to' sites that are safely outside of the landing ellipse include Elysium lavas, sedimentary flood-formed dunes, erosional and depositional streamlined forms, and potential rootless cones/kettle holes/basaltic ring structures/pingo-related forms, each of which would have involved water.

Although the site is primarily composed of young lavas, expulsion of water would likely have entrained older subsurface materials. Such material may be important for past habitability invesitgation, as it would be derived from fractures that may have had substantial contact with liquid water during the Noachian.

Application of MSL science package: Athabasca Valles' chief astrobiological attraction is this possibility of recently deposited material from within a volcanically and aqueously active fissure, and the MSL instrument suite is well-suited for evaluating such deposits. **MastCam** could be used to locate the deposits, and **ChemCam** to characterize their possible hydrated, biotic, and/or pre-biotic compounds. (In addition, ChemCam's stand-off capability would also allow safe imaging of the Cerberus Fossae walls.) **MAHLI** images would show the fine-scale flood sedimentary morphology, and **APXS** data would indicate gradients in the deposits' alteration. XRD/XRF mineral identification by **CheMin** would indicate elemental composition of flood sediments and/or evaporates/duricrusts. **DAN** measurements of near-surface hydrated mineral abundance would indicate the extent of aqueous alternation.

Engineering constraints satisfied: A different, more distal site in Athabasca Valles was considered as a landing site for the MERs, but was deemed unsuitable due to excessive roughness as indicated by radar returns [22]. We propose a more promising site nearer the channel's origin approximately 10-20 km from the Cerberus Fossa trough. Photoclinometry with available MOC images indicates that this new site is within the engineering constraints. The considerable diversity shown in MOC images over areas too small to be mapped by ground-based radar suggests that acceptable landing sites in Athabasca are likely. HiRISE and other new data will be studied to choose the optimal location.

Additional advantages: Athabasca Valles is <-2500 in elevation and equatorial (~10N), which optimizes communication with Earth, simplifies EDL, and places fewer power limitations on an extended mission.

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