Geophysical Research Abstracts,
Vol. 10, EGU2008-A-12314, 2008
SRef-ID: 1607-7962/gra/EGU2008-A-12314
EGU General Assembly 2008

HiRISE and HRSC studies of the Western Elysium Planitia region, Mars.

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Low-lying, flat plains with distinctive platy morphologies in the Elysium and Amazonis Planitiae regions of Mars have been interpreted to be either flood lavas [e.g. 1,2] or the debris-covered remnants of a frozen sea [e.g. 3,4]. Discriminating between the two hypotheses on the basis of morphology is difficult, due to the lack of both very-high resolution imaging data, and regionally contiguous medium resolution imaging data. Now though, NASA HiRISE (High resolution Imaging Science Experiment) data with spatial resolutions of $\sim$25cm/pixel and ESA HRSC (High Resolution Stereo Camera) data with spatial resolution of 12.5m/pixel, but very large spatial coverage, are available. HiRISE data allow us not only to see the morphologies of the landforms in unprecedented detail, but they also allow more reliable interpretations of superposition relations, by which means geological as well as geomorphological tests can be applied. HRSC data allow a regional view, and can be used to map the spatial extents of individual flows and units over great distances. Here we present an update of our mapping and morphological studies in this region.

The Western Elysium Planitia (west of $\sim$156.5 E) region consists of a series of extremely flat basins with floors covered by decametre- to kilometre-scale ‘platy’ material. The main basin has an area of approximately 10^6km^2 and is fed from Athabasca Vallis, a $<$8Ma old [5] catastrophic flood channel $\sim$20km wide and $\sim$300 km in length, that initiates at a series of fractures named the ‘Cerberus Fossae’. Several smaller sub-basins are connected to the main basin by erosional overspill channels, and the whole of the western part of the complex is delimited by an obvious ‘High

Water Mark' (HWM). There are at least three delta-like forms at the ingress points to sub-basins that suggest that these had already filled from a previous overspill event. Our mapping reveals no obvious flow boundaries, suggesting that the platy terrain of the Western Elysium region was the product of one event.

HiRISE observations of Athabasca were recently used to demonstrate that the floor of the channel was completely draped by lavas [6], mainly based on the interpretations that RMLs ('ring mound landforms', small pitted cones and mounds that sometimes have a moat around them) are volcanic and not intrusive frost mounds (i.e. 'pingos'), as has previously been suggested [e.g. 7,8]. Furthermore, polygonal terrains in Athabasca Vallis were interpreted by [6] to be the result of fracturing in solidified lavas. However, further investigation shows that some of these RMLs are superposed by boulders and, in at least one example, are superposed by the platy terrain itself. This suggests either that they formed before the last flood event, or that they are intrusive. In addition, RMLs are found in secondary channels in the Western Elysium complex, 100s of kilometres away from the source region, and are also found on top of and around the islands of the sub-basin delta-like forms. Again, it is difficult to understand how these RMLs could have formed here if 'floods' of lavas were the last event in this region.

Within the HWM of Western Elysium, a variety of polygonal forms are visible. Both positive relief (low centres, high margins) fracture nets and negative relief (high centres, low margins) 'poly-convex' terrains are visible. The polyconvex terrain, ubiquitous within the HWM and between the plates, is smooth and subdued on the meter scale, with no clear surface expression of fractures. The fracture networks form on islands and channel banks (i.e. highstands), both in Athabasca Vallis and in downstream channels. They appear to be shallow (at most a few meters) fractures, as shown by HiRISE images of polygon blocks at the base of scarps that have retreated by mass wasting. Neither of the polygonal patterns seem consistent with cooling lavas; instead they seem more consistent with permafrost periglacial landforms. In general, our studies support the 'flood, ice, periglacial environment' hypothesis over the volcanic model.

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