OBSERVATIONS AT THE CHASMA AUSTRALE RE-ENTRANT, SOUTH POLAR REGION, MARS. S. van Gasselt, S. C. Werner, G. Neukum. [1]Freie Universitaet Berlin, Insitute for Geosciences, Germany (vgasselt@zedat.fu-berlin.de).

Introduction:

The south polar Chasma Australe re-entrant is a prominent arcuate elongated trough in the south-polar region at 90°E. Its formation has been discussed to be due to eolian processes [2, 3], aqueous carving [4, 5], subglacial volcanic processes [5, 6] as well as tectonically triggered catastrophic outflow events [1] and basal melting [13]. To understand its development we have mapped the circum–Chasma Australe region on the basis of available imagery (Viking, Global Surveyor MOC, Odyssey THEMIS) at all resolutions and performed morphometric measurements on the basis of Laser Altimetry topographic data (MOLA) to evaluate outflow models proposed for the Chasma Australe development. A detailed description of the general morphology of the Chasma Australe has been provided by [1].

Geomorphologic and geologic setting:

The Chasma Australe is an arcuate and elongated steep sided depression with a length of 500 km and a width of 16.5 km at its head and 93 km at its terminus. The Chasma head begins near –82°S/90°E and reaches down to 71°S/86°E with an opening angle of 30° and is formed by an almost circular depression at an elevation of 2500 m with a depth of 950 m. A second depression can be found south of the first with a depth of 100 m and a diameter of 5 km. It terminates in the Promethei Planum, a large circumpolar basin at an elevation of 1060 m where it is constrained by a lobate–shaped remnant of possible base rock material. The trough cuts into the Amazonian aged polar layers (Apl), which have been exposed mainly on the eastern flank. The basis of the re–entrant consists of the Hesperian aged Upper and Lower Dorsa Argentae Formations (Hdu and Hdl) [7].

Observations:

From its head to its terminus the Chasma covers an area of $93.6 \cdot 10^3$ km^2. MOLA-measurements have shown that $28.4 \cdot 10^3$ km^3 of material have been removed from the trough. The main trough (profile b:c) has a length of 300 km and slopes at an average angle of 0.06°. We estimated discharge values Q with the help of eight Chasma cross–sections and obtain values ranging from $3.67 \cdot 10^8 m^3 s^{-1}$ to $4.73 \cdot 10^9 m^3 s^{-1}$, depending on the Manning coefficient n (0.030.05 [11]) and the definition of the hydraulic radius R. For velocities v we obtained values ranging from $37 ms^{-1}$ to $68 ms^{-1}$. The values show a larger range of estimated peak discharges but they are of the same order as calculations by [1] and estimations for outflow systems in mid latitudes [9]. We obtained higher velocities and slightly larger discharge values. The Chasma floor has a rough small–scale surface texture. Except for several crater chains in East–West direction only elongated ridges almost perpendicular to the proposed outflow can be observed. We find no streamlined islands as classic features for mid–latitude outflow channels and we have no evidence for outflow–parallel ridges and terraces as would have been caused by a high energetic flow. In an abundance of MOC–NA imagery we observe a pattern of linear, radial and polygonal crack patterns [10] accompanied by circular and elongated depressions in the vicinity of the Chasma walls and other re–entrants of the south polar region. The crack pattern is aligned parallel to the polar layer outcrops and becomes more densely spaced towards the Chasma walls. These fractures occur mainly near the southern and eastern (steeper) walls. Linear fractures are connected to elongated depressions and radial fractures are connected with circular depressions. In lower resolution imagery we observe a set of lineaments and large circular depressions south of the Chasma Australe head. The lineaments are exposed polar layer deposits and circum-polar troughs which seem to bend in the headward direction of the Chasmata. Profile measurements show depressions situated on a higher elevation level which indicates a headward progressing process of material removal. Near the western walls of Chasma Australe several remnants break through a mantling deposit (s. fig. 2). Between remnant rock and Chasma wall the polar layered deposits remain completely intact.

Conclusions:

For the Chasma Australe we propose a successive headward thermo–erosional formation which was initiated at the Promethei Planum boundary. It is still uncertain whether sapping processes or supraglacial erosion have been the dominant process. Discharge quantities indicate similarities to mid-latitude outflow channels, but no other hints (e.g., streamlines islands, characteristics grooves) can be found. The polygonal fracture pattern favours the idea of contraction cracking of surface material as analogue to terrestrial ice-wedge polygons. Interaction of volcanic and ice related processes cannot be ruled out.

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