CHASMA AUSTRALE, MARS: STRUCTURAL FRAMEWORK FOR A CATASTROPHIC OUTFLOW ORIGIN

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Abstract

Chasma Australe is the most remarkable of the Martian south pole erosional reentrants carved in the Polar Layered Deposits. This Chasma originates near the south pole and runs across the polar troughs over a distance of *c*. 500 km. Its width varies between 20 and 80 km and, with a depth up to 1,000 m, it reaches the bedrock. Following an idea put forward originally for Chasma Boreale (Benito *et al*., 1997), we propose for the genesis of Chasma Australe a mechanism of catastrophic outflow preceded by a tectonically induced powerful sapping process. A detailed geomorphological analysis of Chasma Australe shows erosional and depositional features which can be interpreted as produced by the motion of a fluid. Like other polar reentrants, Chasma Australe is clearly assymetric, with a steep eastern margin where basal and lateral erosion prevailed, and a gentler western side, where the stepped topography and bedrock spurs favoured deposition. The flow also scoured the distal part of the eastern margin and spilled into marginal areas, eroding the rim of a bedrock crater. These divides and the height of the depositional area provided the lower limit for the high-water elevations used in the discharge estimates. The paleoflow reconstruction was performed on the basis of the Mars Digital Model data, and using the Manning Equation modified to take into account Mars' smaller gravity as compared to Earth's. Hydraulic parameters used in the calculations vary between 0.0013 and 0.0018 for the channel slope, and between 450 and 650 m for the water depth reached by the flow. The water velocity values range between 30 and 50 m sec^{-1}, while the resulting discharge values oscillate between 7 x 10^8 m^3 sec^{-1} and 3 x 10^9 m^3 sec^{-1}, bracketed by values of Manning roughness coefficient from 0.030 to 0.050.

Chasma Australe follows one of the predominant strikes resulting of a tectonic study which included measuring and projecting in rose diagrams nearly 300 lineaments in a surface nearly 20 million km^2 in size centered in Mars' south pole. Of these, 85 were wrinkle ridges, and the rest straight scarps and undefined lineations. The whole set of lineaments could be explained by a pure compression stress field N10ºE in strike, in which the wrinkle ridges would correspond to reverse faults, and the other lineaments to strike-slip faults. The origin of this putative stress field is unknown, but its detection could be relevant in connecting the origin of Mars landscapes to planetary internal processes, a common relationship on the Earth.

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Reference

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