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Magma rheology from 3D geometry of martian lava flows

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Volcanism is an important geologic agent which has been recently active at the surface of Mars. The composition of individual lava flows is difficult to infer from spectroscopic data because of the absence of crystallized minerals and the possible cover of the flows by dust. The 3D geometry of lava flows provides an interesting alternative to infer the chemical composition of lavas and effusion rates. Indeed, chemical composition exerts a strong control on the viscosity and yield strength of the magma and global geometry of lava flow reflects its emplacement rate. Until recently, these studies where realized from 2D data. The third dimension, which is a key parameter, was deduced or supposed from local shadow measurements on MGS Themis IR images with an uncertainty of more than 500%. Recent CTX data (MRO mission) allow to compute Digital Elevation Model at a resolution of 1 or 2 pixels (5 to 10 m) with the help of Isis and the Ames Stereo Pipeline pipe line. The CTX images are first transformed in format readable by Isis. The external geometric parameters of the CTX camera are computed and added to the image header with Isis. During a correlation phase, the homologous pixels are searched on the pair of stereo images. Finally, the DEM is computed from the position of the homologous pixels and the geometrical parameters of the CTX camera. Twenty DEM have been computed from stereo images showing lava flows of various ages on the region of Cerberus, Elyseum, Daedalia and Amazonis planitia. The 3D parameters of the lava flows have been measured on the DEMs and tested against shadows measurement. These 3D parameters have been inverted to estimate the viscosity and the yield strength of the flow. The effusion rate has also been estimated. These parameters have been compared to those of similar lava flows of the East Pacific rise.