MARTIAN CHANNELS FORMED BY LAVA EROSION, J.A. Cutts, W.J. Roberts, and K.R. Blasius, Planetary Science Institute, 283 S. Lake Ave., Suite 218, Pasadena, CA 91101

Bahram, Vedra, Maumee and Maja Valles are a series of east-west trending valleys on Mars, located 500 km west of the landing site of the Viking I (VL-I) spacecraft. Morphologic evidence is presented that these valleys formed by the erosive flow of a dense fluid.

Among possible mechanisms of fluid erosion, wind is totally inconsistent with valley morphology; ice and water are compatible with some aspects of the morphology but are rejected because of the lack of morainal or delta deposits. Lava erosion is also compatible with morphology and with the deposits observed at the mouths of the valleys which are widely accepted to be lava.

Crater age data constrain the likelihood of alternative mechanisms of valley formation. Crater density measurements and crater superposition/intersection relationships place the age differential between rilles and surrounding volcanic plains at 0.22 and 0.24 respectively at the 95% confidence level. Penecontemporaneity in age supports a volcanic origin for the rilles through two different lines of argument. Firstly, it is a necessary condition for both plains and rilles to have been formed by lava. Secondly, it requires a remarkable coincidence for an erosional episode involving some other high density flowing medium to have occurred just once in Mars history and almost contemporaneously with the effusion of plains basalts.

The geological setting of these martian channels suggests that they may have formed by overflow of lava from Lunae Planum to Chryse Planitia. McGetchin and Smyth (1977) have also argued geochemical grounds that Mars is hypervolcanic and that therefore catastrophic evolution of lava resulting in erosion is likely.

We develop a phenomenological model of thermomechanical erosion by a hot viscous fluid on a cooler solid substrate of the same composition as the fluid. The parameters in the model have a reasonably direct physical meaning in terms of elementary thermodynamic and mechanical processes. We examine the laminar and turbulent regimes of the boundary layer. Analytic results for the rate of erosion or deposition can be obtained for very simple assumptions and geometry, but for more realistic problems we must resort to numerical solution of the equations. We give numerical results in a form convenient for comparison with observation of erosional cross-sections as a function of slope and thermomechanical properties of the lava.