POSSIBLE ORIGIN OF SOME CHANNELS ON ALBA PATERA, MARS

S. E. Postawko and P. Mouginis-Mark, Planetary Geosciences Div., Hawaii Inst. Geophysics, Univ. Hawaii, Honolulu, HI 96822

Several alternative models have been proposed for the origin and mode of formation of channels and valley networks on martian volcanoes, notably Hecates Tholus, Ceraunius Tholus, Alba Patera. Early interpretations of Mariner 9 and Viking images suggested that these features on Alba were lava channels (Carr *et al.*, 1977), while those on Ceraunius Tholus were interpreted as fluvial (Sharp and Malin, 1975) or volcanic debris channels (Reimers and Komar, 1979). Subsequent mapping of Tyrrehna Patera (Greeley and Spudis, 1981) and Hecates Tholus (Mouginis-Mark *et al.*, 1982) has suggested that pyroclastic activity may have characterized eruptions on these volcanoes, and that at least for Hecates the channels were probably formed by fluvial erosion of unconsolidated ash deposits on the flanks of the volcano. As part of a continuing program to better understand the eruptive history of the young volcanic centers on Mars, we have identified numerous channels on the flanks of Alba Patera that resemble the channels on Hecates. As a result, we are exploring the possibility that some of the small channels on the flanks of Alba Patera may be fluvial in origin, and are examining potential water sources and modes of formation.

There are several ways in which these Alba channels could have been formed by fluvial action. One way is by direct rainfall, with the water coming either from degassing of the magma, or being driven out of the regolith due to volcanic heating. Alternatively, this water may have been deposited within the shallow regolith as ice or snow and then melted by intrusives to form channels.

The exposed portion of Alba Patera was evidently formed at a time when any early, dense, warm atmosphere on Mars had disappeared (if such an atmosphere ever did indeed exist) (Cattermole, 1986a). Therefore, it is inferred that the channels formed under climatic conditions similar to those at present-day Alba, with an atmospheric surface pressure of ~6mb and annual average surface temperatures between 180 - 220K (Kieffer *et al.*, 1977). Very little water vapor (a mass mixing ratio on the order of 10^{-4}) is required to saturate the atmosphere at this pressure and temperature range, and even less at greater altitudes in the atmosphere. Since the atmosphere of Mars is, in general, close to saturation on a daily basis (Davies, 1979), the addition of water vapor from degassing magma or evaporation/sublimation of subsurface water/ice due to intrusive heating may well have resulted in precipitation in the vicinity of Alba Patera. This depends, in part, on the release rate of water vapor to the atmosphere, the temperature of the gas, and how the gas is distributed through the atmosphere. Assessing the likelihood of precipitation, of any kind, playing a role in the formation of some of the channels seen on the flanks of Alba Patera is a primary goal of our current research.

Studies of lava flows on Alba Patera indicate the production of large volumes of lava during a given eruption (Cattermole, 1986b; Pieri *et al.*, 1986); meaning either very high rates of effusion for a relatively short period of time, or eruptions of long duration with lower effusion rates. In either case, if the magma initially contained water, then large volumes of lava may have exsolved a sufficient amount of water vapor (Greeley, 1986) to supersaturate the atmosphere. However, Wilson and Head (1983) have shown that even a very low (~0.01 wt.%) volatile content in martian magmas is sufficient to disrupt the magma and result in explosive eruptions. As yet, no evidence of explosive volcanism on Alba Patera has been detected. This does not eliminate the possibility of *very* low volatile magmas releasing some water to the atmosphere, although whether these could provide enough to carve channels is still under investigation.

Another possible source of water is the martian regolith. Calculations by Fanale *et al.* (1986) have shown that subsurface ice is stable at the latitude of Alba Patera, even for present-day climatic conditions. Heating in the vicinity of the volcano may have been enough to drive substantial amounts of water out of the ground and into the atmosphere.

Calculations are presently under way to determine probable amounts and rate of release of water by magmatic outgassing of low volatile magmas, and by warming of the regolith. To date, we have examined the effects of volcanic gases (CO_2, H_2O, and SO_2) on the paleoclimate of Mars, and their ability to warm the atmosphere a sufficient amount to permit surface flow of water or brines (Postawko and Kuhn, 1986). From these calculations, it does not appear that pure water could be released to flow on the martian surface unless local heating by intrusives raised the local temperature of the regolith. Currently, our efforts are therefore focused on the distribution of the vapor through the atmosphere during and immediately after a volcanic eruption. Water released within a volcanic cloud will likely rise quite high in the atmosphere (Wilson and Head, 1983), and may be dispersed before saturation occurs. It is also possible that precipitation may originate from so high up that snow/rain would sublimate/evaporate before reaching the ground. Water released from the regolith may more easily saturate the lower atmosphere, and thus be a more likely source for any water which may have cut channels.

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