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MARS GLOBAL SURVEYOR CAMERA TESTS THE ELYSIUM BASIN CONTROVERSY: IT'S LAVA, NOT LAKE SEDIMENTS

MCEWEN, Alfred S., Lunar and Planetary Lab (LPL), University of Arizona, Tucson, AZ, mcewen@lpl.arizona.edu; EDGETT, Ken S., and MALIN, Michael C., Malin Space Science Systems, San Diego, CA; KESZTHELYI, Laszlo, and LANAGAN, Peter, LPL.

The Elysium Basin is a low, flat area that extends ~3000 km E-W and up to 700 km N-S, centered at 5 N, 195 W. Altimetric profiles reveal this to be one of the very flattest regions on Mars (Smith et al. 1998, Science 279, 1686). A controversy over the nature of the basin's surface and history has developed during the 1990s. This controversy has direct implications in the search for evidence of martian life and the selection of landing sites for upcoming Mars missions. Crater densities in the basin are among the very lowest on Mars, indicating a relatively young surface. Plescia (1990, Icarus, v. 88, p. 465-490) proposed that the plains were covered by low-viscosity volcanic flows, which filled previous water-cut channels. Scott and Chapman (1991, Proc. Lunar Planet. Sci., v. 21, p. 669-677) proposed that the basin was filled by a 1.5-km deep lake of water subsequent to the volcanism.

To test the hypotheses about the recent geologic history of Elysium Basin, the Mars Orbital Camera (MOC) acquired images (3.6 to 20 m/pixel) in regions that were poorly resolved (>200 m/pixel) during the Viking mission. The MOC images were obtained during 8 orbits in April and June, 1998. The new images reveal what appears to be the surface of an extensive lava plains with ponded, flood-like flows. The surface in several locations (separated by 100s of km) is characterized by relatively dark plates that have separated from more extensive dark surfaces and moved laterally. The plates can be reconstructed like a jigsaw puzzle. There are also sinuous pressure ridges up to 10 meters wide and a few meters high (with slopes > 50 degrees) and shear structures. The surface appears pristine at this scale, unmodified by wind or water, although the color properties and thermal inertia indicate a coating of dust. The platey-textured lavas are also seen to extend well into the Marte Vallis channel system. The images show no evidence for lacustrine sediment or shorelines. These results confirm that very fluid volcanic eruptions persisted throughout martian history.