DEFLECTIONS IN LAVA FLOW DIRECTIONS RELATIVE TO TOPOGRAPHY IN THE THARSIS REGION OF MARS: INDICATIONS OF POST-FLOW TECTONIC MOTION. D. J. Chadwick[1] , S. S. Hughes[1], and S. E. H. Sakimoto[2], [1] Dept. of Geosciences, Idaho State University, Pocatello, ID 83209, chadjohn@isu.edu; [2] Code 921, Geodynamics Branch, NASA Goddard Space Flight Center, Greenbelt, MD 20771.

Introduction: High-resolution topographic data from the Mars Orbiter Laser Altimeter (MOLA), and imagery from the Mars Orbiter Camera (MOC) and the Thermal Emission Imaging System (THEMIS) allow for the first accurate assessment of lava flow directions relative to topographic slopes in the Tharsis region. Tharisis has long been recognized as the dominant tectonic and volcanic province on the planet, with a complex geologic history [e.g. 1, 2, 3]. In this study, lava flow directions on Daedalia Planum, Syria Planum, Tempe Terra, and near the Tharsis Montes are compared with MOLA topographic contours to look for deviations of flow directions from the local slope direction. The topographic deviations identified in this study are likely due to Tharsis tectonic deformation that has modified the regional topography subsequent to the emplacement of the flows, and can be used to model the mechanisms and magnitudes of relatively recent tectonism in the region. A similar approach was used to identify possible post-flow tectonic subsidence on the Snake River Plain in Idaho [4].

Method: In areas where lava flows are large enough to be visible in MOLA topography data, topographic contours were generated and overlaid on the digital elevation data for direct comparison with flow directions (Figure 1). These products were used to look for a consistent divergence of the local direction of flow from a direction perpendicular to contours. In areas where the flows are smaller or poorly defined, geo-located daytime THEMIS and MOC imagery was used to compare flow directions with topography.

Results: In most of the test areas considered in this study, lava flows closely adhered to local topographic contours and show no indication of post-emplacement tectonic deformation. Small-scale local aberrations from the apparent downhill direction that affected only part of a lava flow were considered to be the result of local topographic undulations that are not apparent in the elevation data, and not to tectonic deformation.

In a few of the test areas, such as in eastern Daedalia Planum and to the east of Arsia and Pavonis Mons, there is a clear indication of regional divergence of lava flow directions from topography. In Figure 1, for example, flows in an area to the north of Noctis Labyrinthus consistently deviate approximately 25-55 degrees from a direction perpendicular to the topographic contours. This is an indication that the contours have been deflected and the regional topography has changed slightly due to tectonic deformation after flow emplacement.

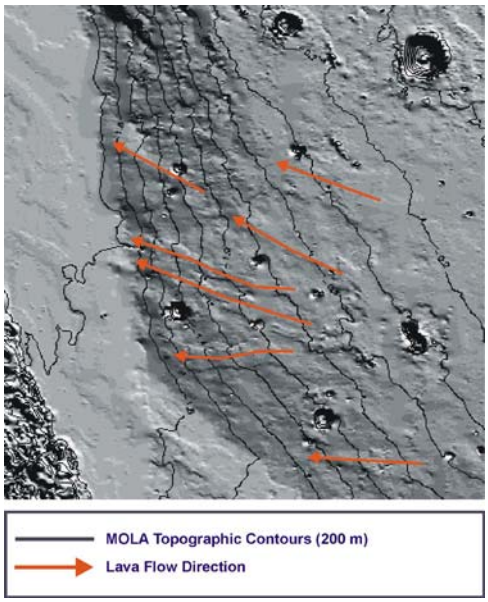

Figure 1a and 1b. Lava flow directions in this area are consistently deflected in a clockwise direction relative to the regional topographic contours.

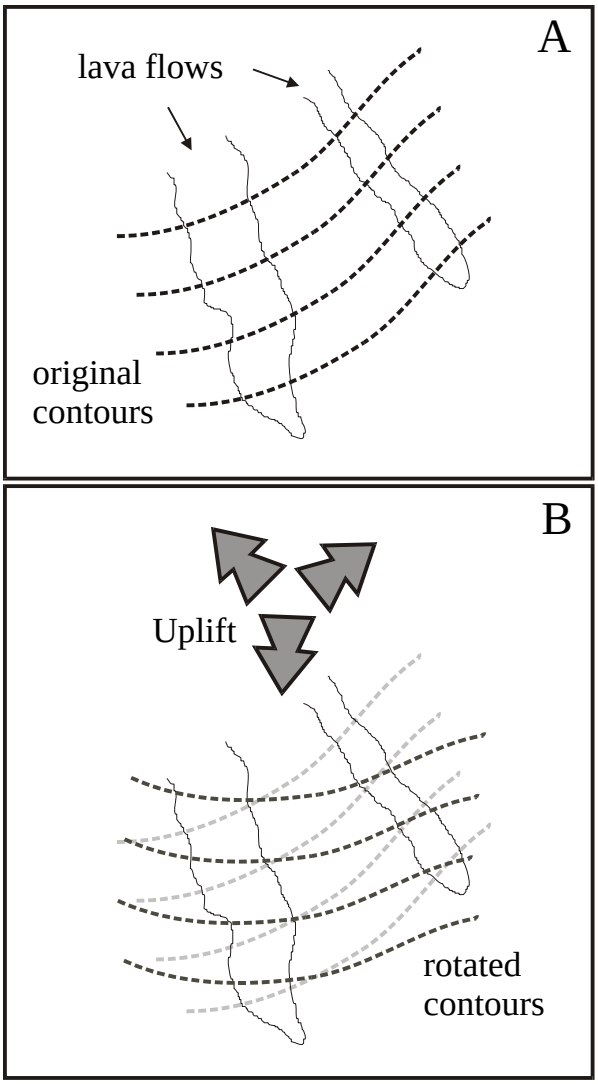

Figure 2. Deflection of topographic contours relative to lava flow directions in response to tectonic uplift. Similar changes in regional topography can also be caused by subsidence or folding.

Tectonic Deformation: Figure 2 illustrates the effect of tectonic uplift on regional topographic slopes. In 2A, lavas flow downhill in a direction perpendicular to local topographic contours. In 2B, contours are subsequently deflected by an uplift (or subsidence) event that changes the regional topography, and the lava flows no longer appear to flow directly downhill.

When this study is complete, lava flows that show indications of topographic change will be mapped throughout the Tharsis area. The topographic deflections identified in this study may potentially be used to understand the timing and mechanisms of the deformation (uplift or subsidence), and to estimate the magnitude of the deformation.

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