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Plains volcanism in Tharsis, Mars: Volumes, rates, and rheology of eruption products

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The morphology and topography of volcanic landforms provides critical information to the investigation of their tectonic setting and the physical characteristics (e.g., rheology) of their eruption products. Their investigation is also an important prerequisite for studies of comparative planetology, e.g., the comparison between surface features of the Earth and other planetary bodies. Numerous small and low shield volcanoes on Mars and associated vents and lava flows have previously been compared to terrestrial plains style volcanism, which is defined as being an intermediate style between flood basalts and the Hawai´ian shields. This study investigates the topography and morphology of Martian landforms associated with plains volcanism using MOLA, MOC, THEMIS, HRSC, and HiRISE data. Our goal is to estimate the volumes of low shields in Tharsis, and the thickness and the basic rheologic properties of associated lava flows in adjacent volcanic plains.

Topographic data from MOLA and HRSC are used to determine the volumes of low shield edifices. Lava flow thicknesses are determined applying the method of Glaze using single MOLA tracks. The thicknesses of lava flows can then be combined with absolute ages to derive volcanic resurfacing and eruption rates. Lava flow rheology is analyzed in image and topographic data, applying previously established methods which allowed to measure plastic viscosity, effusion rates and yield strength. Observations of landforms yield information about eruption styles and help to infer composition and volatile content of magmatic products. The results will put constraints on models of the magmatic evolution of Tharsis. They will also yield estimates of volcanic outgassing, thereby contributing to decipher the atmospheric evolution of Mars.

We mapped 8 lava flows in different parts of Tharsis (southeast from Olympus Mons, in Ceraunius Fossae, near Pavonis Mons) to make a preliminary assessment of the rheology of lava flows associated with plains-style volcanism. Rheologies were determined for (a) shield-building lava flows and (b) lava flows associated with the plains adjacent to the shields. The rheology of both types of lava flows was found to be similar. This might suggest that these two types of lava flows are closely related to each other, with similar composition and eruption conditions. This similarity gives us a unique opportunity to find a relationship between two different types of eruptions: low shields and plain style volcanism.