

INVESTIGATING THE FORMATION OF LAVA CHANNELS ON VENUS WITH NEW MODELS AND NEW TOPOGRAPHY. M. E. Borrelli*, D. A. Williams, and J. G. O'Rourke, School of Earth and Space Exploration, Arizona State University, Tempe, AZ, *meborrel@asu.edu

Introduction: Venus is a volcanic wonderland with many different types of lava channels. Sinuous rilles have lengths of ~10–300 km and widths up to several km. Canali are long, narrow channels that look similar to meandering rivers—over ~500 km long, ~1 km wide, and ~24 m deep on average [1,2]. One canali (Baltis Vallis) is the longest channel that has been found anywhere in the solar system. We are unsure about the origin of these features, though they likely formed from thermomechanical erosion by flowing lava. People typically assume that basaltic lava created lunar and martian rilles, whereas the lava type that formed Venusian canali is uncertain.

Canali-forming lava must have had a low viscosity to create channels with extreme lengths. We will model lava channel (canali and rille) formation by several potential lava compositions to determine which may be viable candidates. It would be particularly impactful to conclude that carbonatite is the most likely composition of canali-forming (and/or rille-forming) lava. Carbonatite volcanism is very rare on Earth but finding that it is common on Venus signals a major difference between the two planets. Large amounts of carbon in Venus's lithosphere would undermine the hypothesis that Venus and Earth formed with the same volatile content.

Methods: We are assembling a database of lava channels. We will use 1-D models to explore all the parameters that govern channel formation. We plan to benchmark these models with more sophisticated, 2-D and/or 3-D simulations.

Assembling a morphologic database of lava channels. Many Magellan-era studies and some recent work focused on canali and rilles. However, no study of these channels has yet incorporated new stereo-derived topography, which has more than an order of magnitude better resolution than the Magellan Global Topographic Data Record [3]. The stereo-derived topography data covers ~20% of Venus's surface, and will provide us with clearer insight into the channel dimensions. For example, we can measure the depth of Baltis Vallis using the stereo-derived topography but not with the GTDR (Figure 1). We will compare our measurements using the stereo-derived topography to those collected calculated using the clinometric method [4]. Should the results agree, we can use the clinometric measurements to fill in gaps in the stereo-derived topography and vice versa.

Modeling channel formation by flowing lava. 1-D models have been used to test the erosional formation

mechanism for two canali and six rilles on Venus, as well as channels on other bodies [5,6]. Our models will explore different lava types and include more detailed treatments of key processes, such as thermal and mechanical erosion and the possible formation of insulating lids. We will use the Markov chain Monte Carlo (MCMC) method to statistically quantify the range of acceptable lava compositions and flow properties. We will first apply our models to previously studied channels. We will then study additional channels for which we have depth profiles from stereo-derived topography. Overall, we must use 1-D models because exploring the parameter space with MCMC requires running tens to hundreds of thousands of individual models. We will benchmark our 1-D models with more sophisticated simulations for channel formation by different lava types.

Ultimately, we eagerly await vastly improved measurements of channel morphology and composition from the new generation of Venus missions.

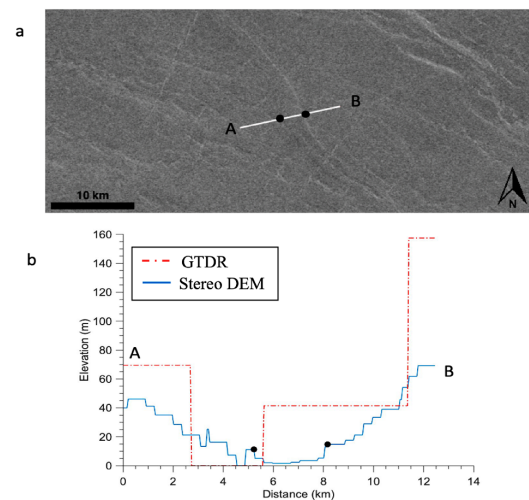


Figure 1: Stereo-derived topography allows us to measure depths of lava channels. a) Image from Magellan of one profile across Baltis Vallis, centered at 32.065°, 165.456° E. b) Baltis Vallis is resolved in the new topographic data but invisible in the GTDR.

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