UPLIFT RECORD OF BALTIS VALLIS, VENUS. J. W. Conrad[1, 2], F. Nimmo[2], B. A. Black[3]. [1]NASA Marshall Space Flight Center, Huntsville, AL 35805 (jwconrad@ucsc.edu), [2]University of California Santa Cruz, Santa Cruz, CA 95064. [3]City University of New York, New York City, NY 10010

Introduction: An uncommon, but spatially widespread class of feature on Venus are the canali, sinuous channels which were likely formed by exotic magmas [1]. Of particular note is the longest, Baltis Vallis (BV). Although BV avoids the older highlands type terrain [2], it seemingly flowed uphill and over ridges (Figures 1 and 2). This uphill "flow" is a signal of the feature's age, as it must have been emplaced before convective uplift and tectonic activity in the region tilted the canali's profile and added shorter wavelength features.

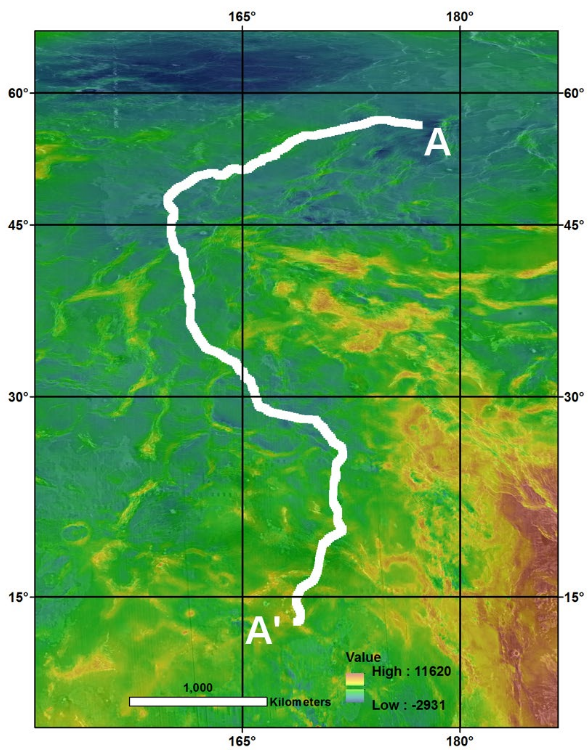

Figure 1: Topographic map of Baltis Vallis in Atla Regio, Venus. [3] placed the source of BV at A and the termination point at A'. Note how the canali avoids the highland terrain to the right, but it "ignores" shorter wavelength features like wrinkle ridges. Elevation scale bar is in meters and sourced from Magellan altimetry.

The ability of BV to act as a recorder for Venus' tectonic uplift history is of interest; for instance, it can be used to determine the characteristic wavelengths of convective uplift or ridge formation. It is also of interest to compare BV with other drainage systems on other planets, where post-emplacement deformation may also have occurred. We discuss this issue below.

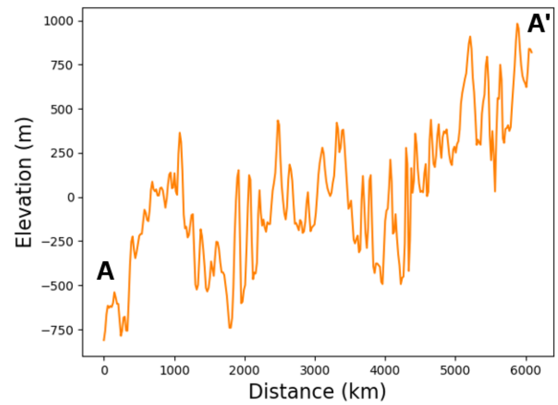

Figure 2: Topographic profile of Baltis Vallis. A and A' correspond to the locations in Figure 1. A wide range of topographic wavelengths are present in the profile.

Conformity Check: While the modern-day BV topography does not resemble a typical fluvial profile, we want to assess the extent to which the canali topography has been altered. To achieve this, we consider two separate metrics to assess the influence of long-wavelength topography on the drainage pattern [4]. [4] used the metrics of the downhill percentage (*%d*) and the conformity factor (Λ) to analyze the drainage systems of the Earth, Mars, and Titan. *%d* represents the proportion of points along the drainage that are at a higher elevation than the next point downstream. Λ is defined as Λ = median[cos(δ)], where δ is the angle between the directions of the drainage and the maximum negative topographic gradient. [4] found that at high spherical harmonic expansions (l_{max}), these metrics trend towards 100% for %d and 1 for Λ, as indeed they should if drainage systems are the youngest features.

We apply the same metric analysis on BV and compare it to [4]'s results to determine how BV behaves compared to other drainage systems. In addition, we compare our BV results with a "BV" that was created with synthetic topography. This is generated using randomized spherical harmonic coefficients that conform to a power spectrum with the same shape as Venus'. This helps to determine both the range of metric values expected from randomized topography, and the possible limitations of using a single (but long) drainage system.

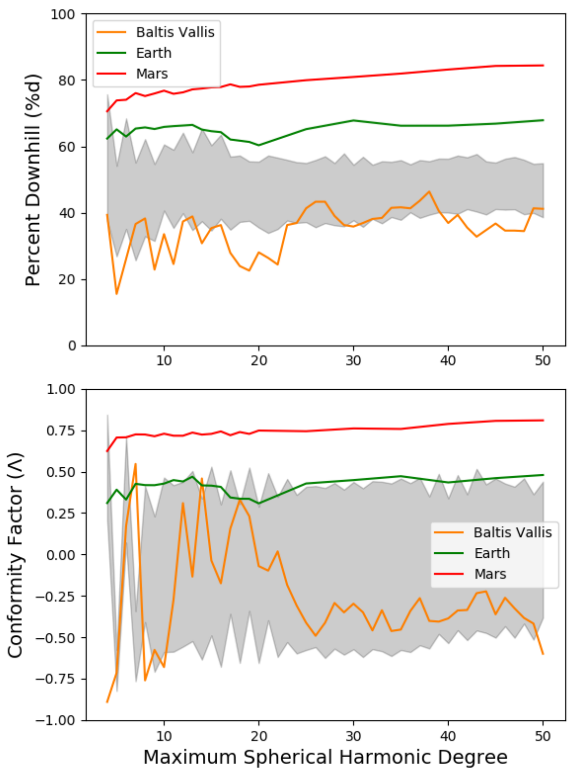

Figure 3: Metric comparison of BV (orange) with Earth (green) and Mars (red), from [4]. The grey regions represent the standard deviation of 20 analyses using Venus topography generated from randomized spherical harmonic coefficients.

For the *%d* metric the randomized harmonics quickly narrow in on ~50±5% as expected. For the individual system of BV, this metric also trends towards 50%. Earth and Mars' metrics are clearly separate from BV and the randomized topography past l_{max} ~10 and show the expected result for worlds where drainage systems either post-dated or were able to keep pace with tectonic uplift. For most of our spherical harmonic degree range BV still falls within the range from the randomized topography for the conformity factor and seems to behave quite differently from Earth and Mars. We are confident that BV formed before most topography forming processes were active in the region; we next investigate what wavelengths may have characterized these processes.

Topographic Power Spectrum: A powerful tool to analyze topography is the topographic power spectra, which allows for quantifying roughness as a function of wavelength (Shepard et al., 2001). To obtain BV's power spectrum, we first calculate the discrete Fourier transform for an evenly spaced, detrended version of the profile (Press, 1992). Then we use the resultant Fourier series to calculate the power spectrum for BV.

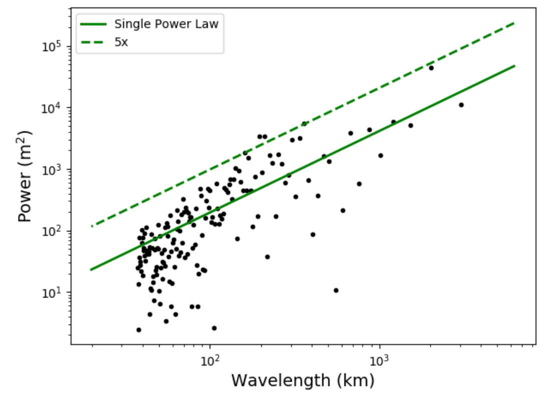

Figure 4: Power distribution spectrum of Baltis Vallis with the best single power-law fit plotted in green. We also apply a single power-law that is a factor of 5 higher to identify points which lie significantly above the overall trend-line.

The BV spectra is best fit by a single power-law. However, there exists points that lie far off the fit. These points fall into two camps: low power "noise" and high-power possible signals. The more physically significant high-power signals (that are about half an order of magnitude greater than the fit) inhabit a range of wavelengths from ~200-400 km. This wavelength range corresponds to both large ridges and uplift/depressions visible in the topographic map (Fig 1).

The other outlying point in our power spectrum is at ~2000 km. While this does not clearly correspond with any individual feature in BV, it does correspond with the thickness of the convecting layer of Venus' mantle [7]. This is interesting as convective uplift is a major process that alters the topography of Venus and would corroborate [7]'s topography-gravity correlation analysis.

Characteristic wavelength results from the simple analysis of our topographic power spectrum can be used to validate the results of geophysical models. We also plan on expanding the conformity analysis to the observed set of canali on the surface of Venus and determine a global range of characteristic wavelengths for the post-emplacement modification of the crust.

References: [1] Komatsu G. et al. (1992) *GRL, 19:1415-1418.* [2] Komatsu, G. and Baker, V.R. (1994) *Icarus, 110(2), pp.275-286.* [3] Baker, V.R. et al. (1992) *JGR: Planets, 97(E8), pp.13421-13444.* [4] Black, B.A. et al. (2017) *Science, 356(6339), pp.727-731.* [5] Shepard M. K. et al. (2001) *JGR: Planets, 106(E12), pp.32777-32795* [6] Press W. H., et al. (1992) *Cambridge University Press* [7] McKenzie D. (1994) *Icarus, 112*(1), *pp.55-88.*