POSSIBLE VENT ALIGNMENTS IN FOUR VENUSIAN SHIELD FIELDS: A TEST OF A MATLAB STATISTICAL MODEL. N. P. Lang[1], B. J. Thomson[2], and N. J. Kelly[1], [1]Department of Geology, Mercyhurst University, 501 E. 38th Street, Erie, PA 16546 (nlang@mercyhurst.edu; nkelly87@lakers.mercyhurst.edu), [2]Boston Univ. Center for Remote Sensing, Boston, MA 02215 (bjt@bu.edu).

Introduction: Shield fields are clusters of small (<20 km in diameter and <<1 km in height) volcanic edifices that occur across the Venusian surface [1-3]. Individual edifices (or shields) within a single field reside at the effective resolution of Magellan Synthetic Aperture Radar (SAR) imagery (resolution of ~75 m/pixel), which makes unraveling the formational controls on shield fields and developing a shield field stratigraphy challenging. However, given the widespread occurrence of shields across the Venusian surface, constraining formational controls and a stratigraphy within individual fields may provide a critical window for understanding Venus' volcanic (and possibly tectonic) history.

To better understand histories recorded at individual fields, we have applied a recently developed MATLAB® (MATrix LABoratory)-derived statistical tool [4] to examine potential vent alignments within four shield fields – Chernava (10.5° S, 335° E), Ran (0° N, 162° E), Urutonga (12.5° N, 152° E), and Jurate (57° N, 153° E) collis. Our results highlight regional stress orientations within each field as well as the conditions that influenced the evolution of each field. Future work will also examine potential small-scale (i.e., not whole-field) preferred orientations [5] to help refine the volcanic stratigraphy recorded within each field.

Methodology: Our approach began with mapping four shield fields using ArcGIS 10. Edifice lat-lon coordinates were then exported into a MATLAB GUI [4] that employs the two-point azimuth method of *Lutz* [6] where the orientation between each edifice is determined. For *N* points, there are $N(N-1)/2$ such orientations. Statistical significance is determined by comparing the observed distribution to Monte Carlo results. To determine if a given normalized histogram value is statistically significant to the 95% significance level, the Student's t distribution is used to determine the 95^{th} percentile critical threshold value. Histogram values that exceed the critical threshold are deemed significant. Reported possible edifice alignment orientations were then compared with structure trends observed in the fields.

Field area geology:

Chernava Colles: Chernava Colles is ~834,000 km^2 shield field (Fig. 1) that is spatially and temporally associated with a series of NNW-trending fractures. Shields range from small, steep cones to broader shields; tholi also exist within the field (i.e., intermediate-sized volcanoes 20-100 km in diameter).

Ran Colles: Ran Colles is a ~202,000 km^2 shield field (Fig. 2) where the edifices are defined as circular patches of high radar backscatter. Structurally, the field hosts orthogonal NW and NE-trending wrinkle ridges with local NE-trending fractures.

Jurate Colles: Jurate Colles is a ~617,000 km^2 shield field (Fig. 3) where edifice morphology is predominantly cone-shaped. Structurally, the area is characterized by multiple suites of ridges of varying wavelengths and NW-trending closely-spaced fractures.

Urutonga Colles: Urutonga Colles is a ~192,000 km^2 shield field (Fig. 4) located on the southern margin of Ituana Corona-sourced flow material. Shields are defined here as circular patches of high radar backscatter. Structurally, the field hosts NE-trending wrinkle ridges and NW-trending fractures with local outcrops of basement.

Results:

Chernava Colles: Modeled edifice alignments show an overall NW orientation (~N60W), which is broadly consistent with the NW-trending fractures, which have an orientation of ~N30W. Assuming a one-for-one correlation between the fractures and edifice alignments, there is a bit of a discrepancy represened at this site where modeled alignments reflect field geometry.

Ran Colles: Modeled edifice alignments show an overall NNW orientation (~N30W-N50W), which is consistent with the NW-trending wrinkle ridges (~N30W). Given the absence of NW-trending fractures here, wrinkle ridges likely represent the re-activation of fractures that may have been filled with flow material [e.g., 7].

Jurate Colles: Modeled edifice alignments show an overall NNE orientation (~N30E-N50E), which is consistent with the NE-trending wrinkle ridges (~N30E). Given the absence of NE-trending fractures here, wrinkle ridges likely represent the re-activation of fractures that may have been filled with flow material [e.g., 7].

Urutonga Colles: Modeled edifice alignments do not correspond with mapped structure trends. Although visual inspection suggests a possible NW trend of shields, histogram values in these bins to not exceed the critical value threshold indicated by Monte Carlo modeling. Alternatively, the original fractures may be buried – the trend is broadly consistent with NNW-trending outcrops of regional basement on the west side of the map area.

Conclusions:

1) Model results are broadly consistent with tectonic structure trends in three of the four map areas, giving us confidence we are accurately delineating vent alignments.

2) Some of the delineated alignments are consistent with contractional structures suggesting that the fields have experienced compressive stress since their formation implying reactivation of extensional structures.

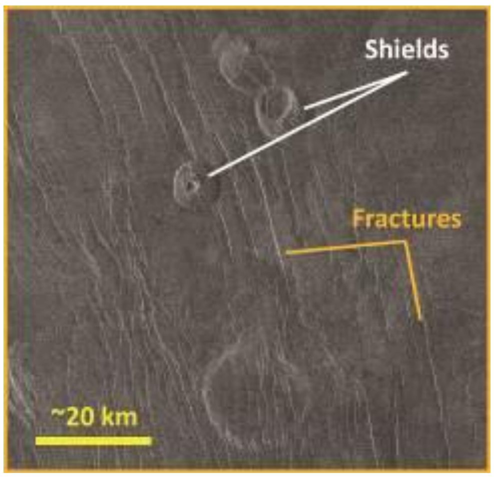

Figure 1: Magellan SAR image of part of Chernava Colles with NNW-trending fractures and shield edifices highlighted. Field area centered near 10°S, 335°E.

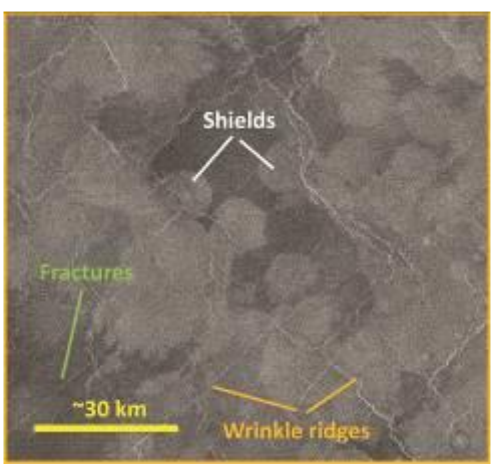

Figure 2: Magellan SAR image of part of Ran Colles highlighting edifice characteristics here as well as fracture and wrinkle ridge orientations. Field area centered near 0°N, 1

Future work will examine potential small-scale (i.e., not whole-field) preferred orientations to help refine the volcanic stratigraphy recorded within each field.

References: [1] Aubele, J.C. and Sliuta, E.N. (1990), *Earth, Moon, Planets, 50*, 493-532. [2] Guest, J.E. et al. (1992), *JGR, 97,* 15,949-15,966. [3] Crumpler L.S. et al. (1997) in *Venus II*, 697– 756. [4] Thomson, B.J. and Lang, N.P. (2013), Abstract, 44th *LPSC*. [5] Thomson, B.J. and Lang, N.P. (2014), *LPSC* this vol. [6] Lutz T.M. (1986) *JGR 91*, 421-434. [7] DeShon et al. (2000), *JGR, 105, 6983–6995.*

Acknowledgements: This work was supported by a NASA Planetary Mission Data Analysis grant to BJT.

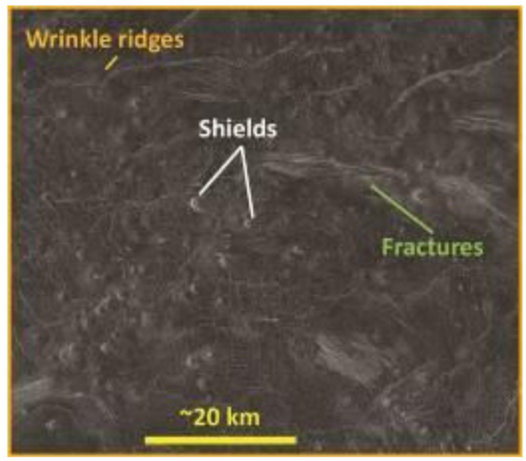

Figure 3: Magellan SAR image of part of Jurate Colles highlighting shield characteristics and fracture and wrinkle ridge orientaitons. Field area centered near 57°N, 153°E.

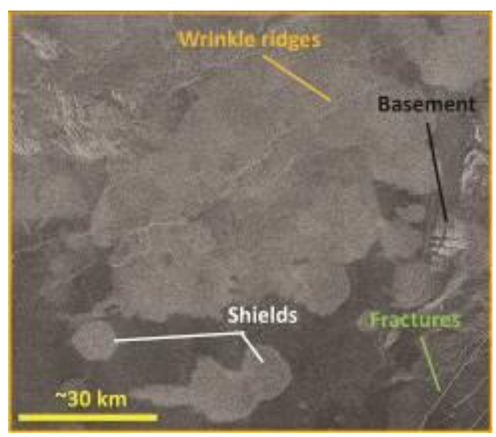

Figure 4: Magellan SAR image of part of Urutonga Colles highlighting shield characteristics and fracture, wrinkle ridge, and basement orientations. Field area centered near 12.5°N, 152°E.