STRUCTURAL ANALYSIS OF SALUS TESSERA, VENUS: INTERPRETING SURFACE LINEAMENT SETS USING TOPOGRAPHIC PROFILES S. Khawja[1], R. E. Ernst[1,2], Y.D. Kuiper[3], C. Samson[1,4], [1] Department of Earth Sciences, Carleton University, Ottawa, Canada, [2] Faculty of Geology and Geography, Tomsk State University, Tomsk, Russia, [3] Department of Geology and Geological Engineering, Colorado School of Mines, Colorado, USA, [4] Department of Construction Engineering, École de Technologie Supérieure, Montréal, Canada.

Introduction: Tesserae, also known as complex ridge terrains, occupy approximately 8% of Venus' surface, forming continent-like units (crustal plateaus) embayed by adjacent volcanic plains [1]. Tesserae consists of at least two sets of intersecting lineaments (e.g. ridges and grooves), and are a result of tectonic deformation of a precursor terrain [2]. However, the nature of that precursor terrain, as well as the causes and mechanisms of deformation are still under debate [3,4].

Lineaments are generally interpreted as representing tectonic structures in SAR images. Single lineaments can represent fractures (also fissures and graben) that are expected to appear as thin, and straight or anastomosing lines. Single lineaments can also represent fold crests, which are expected to be wide, and straight or curved. Fractures are typically marked by a sharp zone of radar brightness and overall high contrast with surrounding areas, whereas folds are radar bright along one side and have a gradual brightness transition across them [5].

In this study, we review interpretations of surface lineament sets in tesserae and consider alternative interpretations of their nature by investigating topographic profiles across them. We also briefly describe the use of an alternative visualization method (using the "Outline trace" function in Corel Draw) on identifying sets of unidirectional lineaments for this study.

Study Area: This project focuses on the detailed mapping of Salus Tessera at a scale of 1:5, 000, 000. Salus Tessera has a center latitude and longitude of 48.5° and -1.5° respectively, and spans 850 km in length (See Figure 1). Tools used in mapping of Salus Tessera include ArcGIS, JMARS and Corel Draw. All observations made are specifically applicable to Salus Tessera.

Methodology: We identify sets of lineaments and integrate topographic variation to differentiate between possible steeply-dipping and possible shallowly-dipping structures. Topographic profiles are created perpendicular to prominent sets of lineaments. These sets are chosen with the help of the a "Outline Trace" visualization method that involves grouping pixel intensities from the SAR image into discrete bins and generating a map that provides improved resolution of lineament trends in tesserae (see Figure 2 for example).

In doing this analysis it is essential to avoid placement of the topographic profile near any artifacts in the topographic data (where there are apparent deep holes several pixels wide). One example of an unavoidable artifact is identified by the dashed portion of the line in Fig. 1.1. Also, given the large horizontal uncertainty (5-10 times worse than the vertical resolution) there can be a spatial offset of up to several km with respect to features on the SAR image [6].

Results: Nine topographic profiles were created on Salus Tessera, four of which are given as examples below (Figs. 1.1 – 1.4). We selected profiles in which there were two clear end-member situations. In some cases (e.g. Figs. 1.1 and 1.2) there is minor topographic change (10s of m) across the lineament set (profile length 10s of km). However, in other cases (e.g. Figs. 1.3 and 1.4) a large topographic change (>100s of m to >1000 m), occurs over a profile length of 10s of km.

Discussion: Topographic differences can provide constraints on the dip of layers/structures that are exposed at the surface as lineament sets. Our goal is to test which are steeply dipping (e.g. fissure-graben or strike-slip systems), and which are inclined to subhorizontal (e.g. thrusts faults and primary layering). Our analysis assumes that the topographic variations are not the result of tectonic deformation; however due to the lack of understanding of tesserae tectonics, regional/local folding and faulting cannot be ruled out. Some profiles exhibit topographic step-downs that can be explained by normal faults associated with "rift zones" (Fig. 1.2). Other profiles exhibit progressive topographic variations across lineament sets (Fig. 1.3 and 1.4). Topographic analysis is also conducted along the trends of lineament sets to constrain the dip of the layers using three point problem analysis. In areas with significant topography, where lineament sets are straight, the dip of the layering is likely to be subvertical. If they are wavy, the layering is likely inclined (making V-shapes in valleys), or horizontal (following topography).

References: [1] Bindschadler D.L. and Head J.W. (1991) *JGR, 96.B4,* 5889-5907. [2] Basilevsky A.T. and Head J.W. (1998) *JGR, 103.E4,* 8531-8544. [3] Hansen V.L. and Willis J.A. (1996) *Icarus, 123.2,* 296-312. [4] Gilmore M.S. and Head J.W. (2018) *PSS, 154,* 5-20. [5] Ghent R.E. and Hansen V.H. (1999) *Icarus, 139,* 116 – 136. [6] Herrick R.R. and Stahlke D.L. (2012) *TAGU, 92.12,* 125-126.

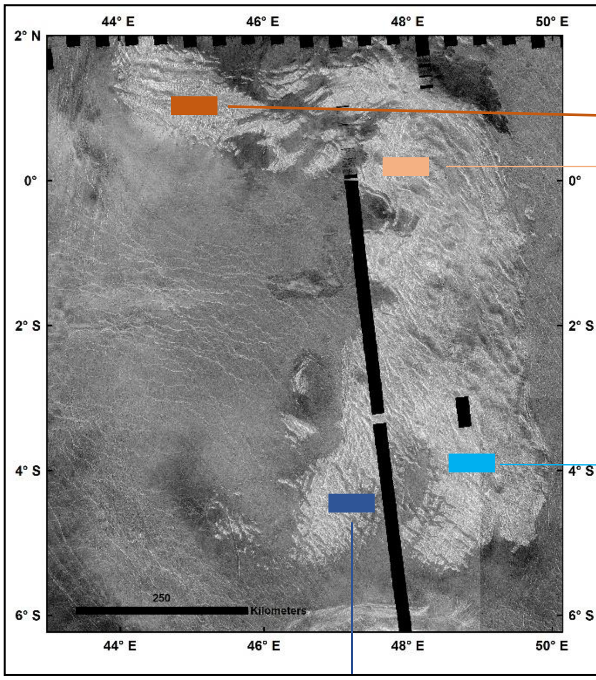

Figure 1. General Map of study area (Salus Tessera).

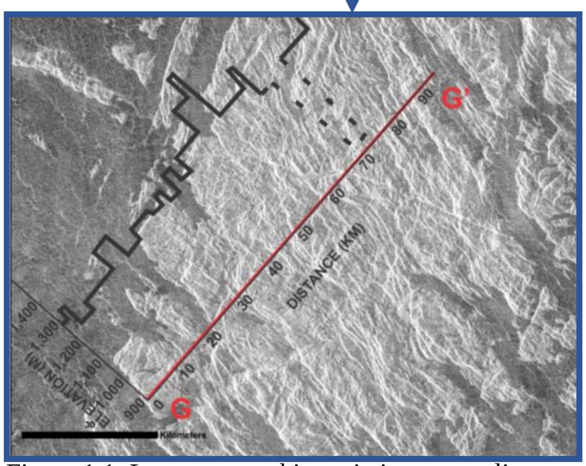

Figure 1.1. Low topographic variation across lineament set. Data artifact is represented by dashed line.

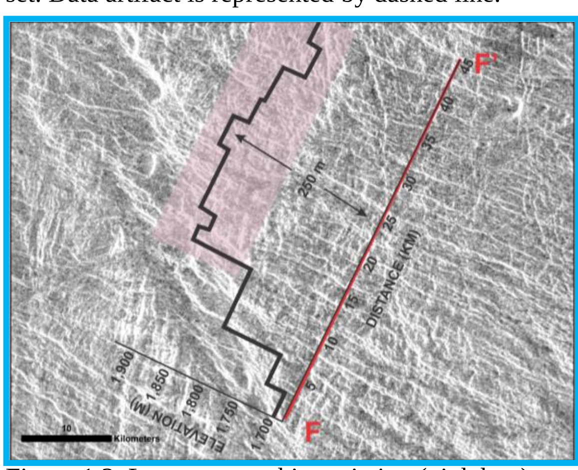

Figure 1.2. Low topographic variation (pink box).

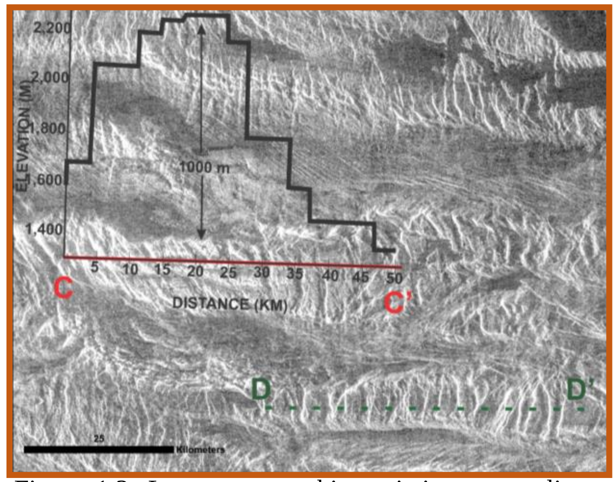

Figure 1.3. Large topographic variation across lineament set.

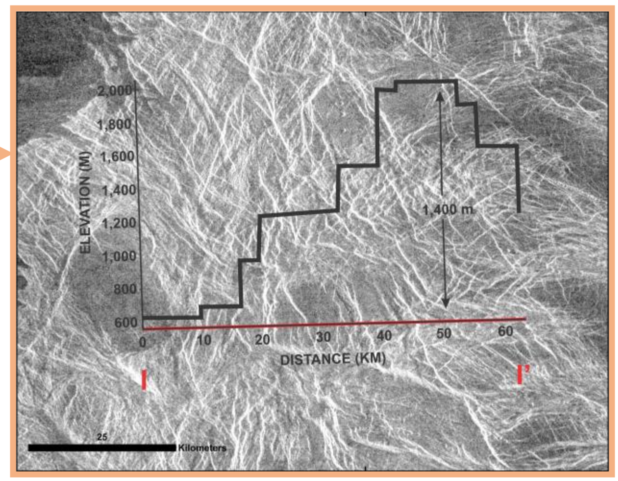

Figure 1.4. Large topographic variation across lineament set.

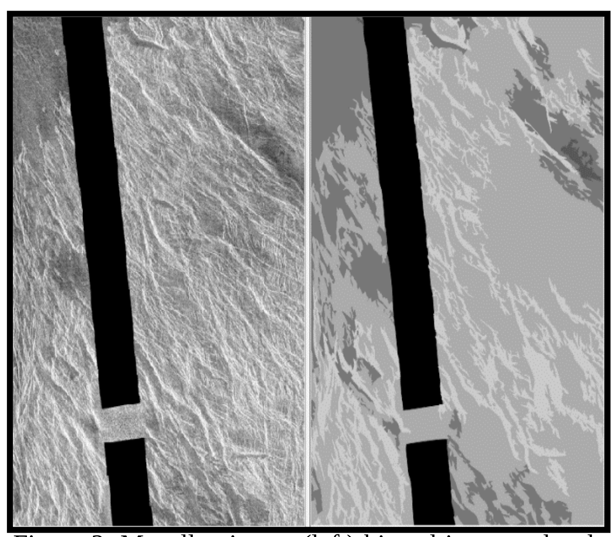

Figure 2. Magellan image (left) binned in seven levels (right) using Outline Trace tool of Corel Draw.