TESSERAE ARE HIGHLY ERODED AND GROW BY CAMPUS ACCRETION. R. C. Ghail, Department of Earth Sciences, Royal Holloway University of London, Egham, Surrey, TW20 0EX, United Kingdom. *Richard.Ghail@rhul.ac.uk*

Introduction: Highland tesserae mainly comprise an ancient core surrounded by accreted plains material, many of which are much more eroded than previously realized.

The principal highland tesserae consist of a complex core region surrounded by a number of deformation belts, given an overall appearance similar to accreted Proterozoic terrains surrounding Archaean cores in Tellurian cratons. Since these terrains represent accreted plains material, they may provide an insight into the history of the planet.

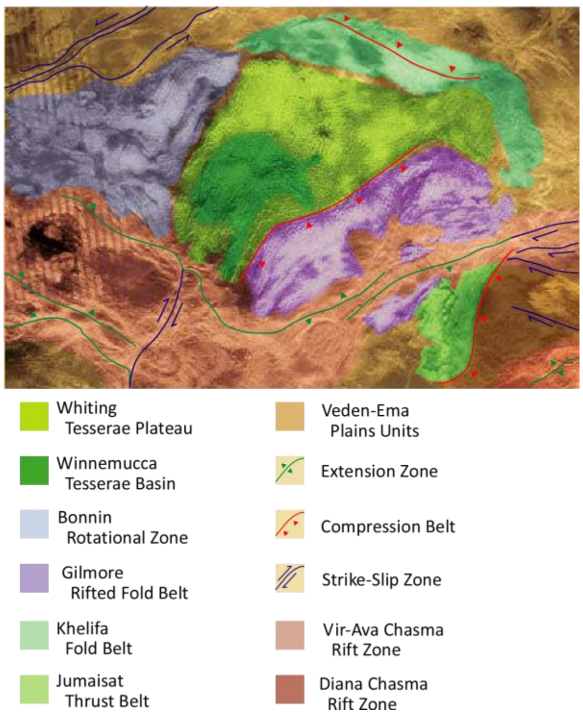

Figure 1. Terrains in Thetis Regio. Each shows several phases of activity; the SE sector is accreting now. Other tesserae uplands have similar distinctive terrains.

Continental Crust: The existence of low-density continental crust on Venus is uncertain but probable [1, 2]. The most likely candidates are the highland tesserae: Alpha, Ishtar, Ovda, Tellus and Thetis. Each appears to consist of a core region, the origin of which is uncertain, perhaps by downwelling and contraction [3], or by upwelling and extension [4]. Surrounding the core are various tectonic belts that are reminiscent of Proterozoic terrains surrounding Archaean cores in Tellurian cratons, which appear to have similarly developed by continental-like accretion [5, 6]. Regardless of their origin, it is probable that they therefore record a long and complex history predating any global resurfacing event [7], but at least on such terrain is forming at the present time (Fig 2).

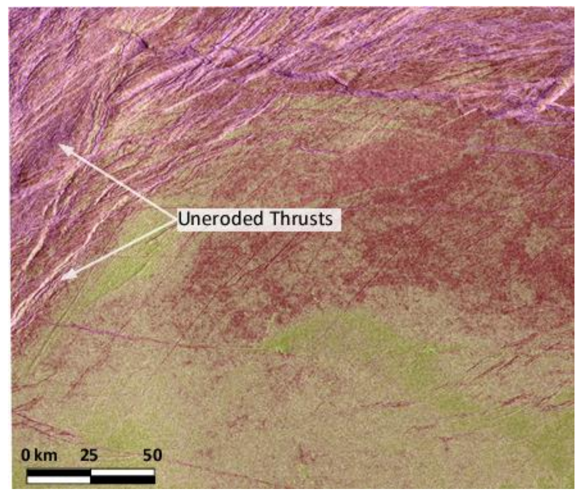

Figure 2. Obduction thrust ramps onto SE Thetis show little sign of erosion [13·5°S, 138·5°E]. In this and subsequent figures, left and right image pairs are combined to show roughness in color on relief: blues represent surfaces smoother than ~6 mm rms height, through green to red being surfaces rougher than ~35 mm rms.

Erosion: Tellurian uplands are highly dissected by fluvial and glacial channels and the absence of these on Venus leaves the impression that erosion is unimportant. While aeolian processes are less effective and far slower than fluvial action, the tesserae are ancient and appear deeply eroded. Altitude is critical: almost all terrain above ~6053 km is subject to enhanced weathering, mass wasting and sediment transport in the dense supercritical fluid atmosphere,

An estimate of the rate of this surface modification may be made from the modification of impact craters. If bright floored craters are not modified by volcanic processes [8] but by sedimentation to become dark floored craters, inspection of their data show that the rim-floor depth is ~300 m less for dark floored than bright floored craters and that rim heights are similarly ~150 m lower, although there is a considerable scatter in both datasets. Again, based on their data, the mean surface age of Venus based on bright floored craters alone is ~150 Ma, implying that, on average, ~1 m of material is deposited per million years, roughly ten times the accumulation rate of marine sediment.

A minimum estimate may be made by assuming that the absence of flow boundaries in the plains is a result of burial by sediments. Eliminating these boundaries requires the deposition of perhaps 20 m over a period of about half the mean planetary age, implying an accumulation rate of ~40 mm per million years, about 40% of the accumulation rate of marine sediment but still forty times more than the intrinsic oceanic sedimentation rate (i.e. sediment derived from within the ocean system rather than from terrestrial or biogenic sources).

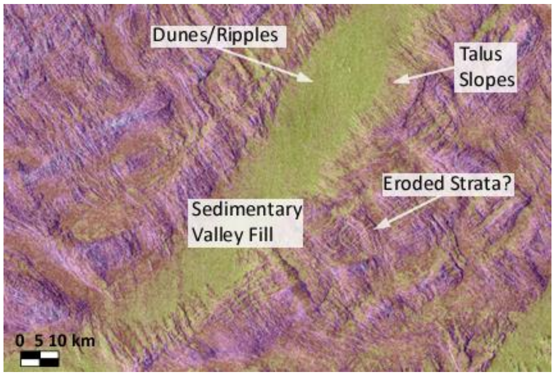

Figure 3. This terrain in NW Ovda appears heavily eroded [1°S, 81°E].

These estimates lead to possible erosion rates across the ~10% of the planet above ~6053 km altitude. Even the lower bound deposition estimate implies that at least several tens of meters, and perhaps a km or more, of material may have been eroded from the tesserae uplands. Inspection of Fig 3 shows that these figures likely underestimate the true rate of modification, since most of the eroded material is too coarse for aeolian transport and simply infills troughs within the tesserae. The morphology of the terrain in Fig 4 is strikingly similar to deeply eroded fold belts on Earth (e.g. the Appalachian Mountains). That folds are evident at all necessitates the erosion of several km of confining material.

Conclusion: The highland tesserae record a long history of collisions with regional plains units through either modern, campus-related [9, 10], movements, or perhaps through earlier conventional plate tectonic processes. Many of these accreted terrains are highly eroded and thus reveal both the deeper structure of plains units and their past nature, perhaps in a cooler and wetter environment. New data, both in situ and orbital, are essential to gaining a greater understanding of these units and learning what led Venus to be so different to Earth.

References:

[1] Hashimoto, G.L., et al., (2008) JGR **113**. [2] Mueller, N., et al.,. (2008) JGR, **113**(E5). [3] Gilmore, M.S., et al., (1998) JGR **103**(E7), 16813-16840. [4] Ghent, R.R. and Hansen, V.L. (1999) Icarus **139**(1) 116-136. [5] Ghail, R.C., (2002) JGR **107**(E8): p. 5060. [6] Gilmore, M. S. and Head, J. W. (2018) PSS **154** 5-20. [7] Romeo, I. and Turcotte, D.L. (2008) EPSL **276**(1-2) 85-97. [8] Herrick, R.R. and Rumpf, M.E. (2011) JGR **116**(E2). [9] Byrne, P. K., Ghail, R. C., Şengör, A. M. C., Klimczak, C., Hahn, R. M., James, P. B., Solomon, S. C. (2018), LPSC #1935. [10] Ghail, R. C., Holman, B., Lawrence, H., Mason, P. J., Byrne, P. K., Gordon, C., Mikhail S. (2018), LPSC #1408