DYKE SWARMS AND TRIPLE JUNCTION RIFTING IN WESTERN OVDA TESSERA, VENUS. R. Dean[1], R.E. Ernst [1,2], H. El Bilali[1,2], K.L. Buchan[3], [1]Department of Earth Sciences, Carleton University, Ottawa, Ontario, Canada; raidendean@cmail.carleton.ca; richard.ernst@ernstgeosciences.com; hafidaelbilali@cunet.carleton.ca, [2]Faculty of Geology and Geography, Tomsk State University, Tomsk, Russia, [3]273 Fifth Ave., Ottawa, Ontario, Canada; kbuchan33@gmail.com

Introduction: Western Ovda Regio represents a large tessera terrain with intratessera basins, fracture (shear) zones and fold belts [e.g., 1-6]. We map and interpret widespread sets of extensional structures, including ribbon fabrics (herein interpreted mostly as dyke swarms, following [3]). In addition, we identify triple junction rift zones that may be linked to old mantle plumes and to some of the identified dyke swarms.

Dyke Swarms: Figure 1 shows the distribution of dyke swarms (distinguished by trend), as expanded from initial mapping in [5]. As noted in [5], the oldest lineament sets could be sedimentary or volcanic layering, with the rest representing crosscutting younger dyke swarms ranging in age from pre-plains (not cutting the adjacent plains) to post-plains (cutting the plains).

Triple Junction Rifting: We interpret several prominent linear topographic lows (see Fig. 2a) as rift zones, and their convergence as 'triple junction rifting' that is associated with old mantle plume centres (Fig. 2b). Based on the converging rift patterns we propose three centres:

Centre 1: This centre is on the northern margin of Western and Central Ovda. The western trending rift arm 1a has a steep topographic drop along the tessera margin, consistent with this as a rift margin (with rift flank uplift as observed with many rift arms on Earth). Rift arm 1b lacks a sharp topographic change and is located north of a zone of linear parallel deformation [6]. This could indicate rifting along the margin of an earlier orogen. Rift arm 1c extends into the tessera terrain between Western and Central Ovda, analogous to aulacogens on Earth and representing the classic third failed arm. Rift arms 1a and 1b also likely represent failed breakup, given that a block of tessera terrain is located on the northern conjugate side of the rifts.

Centre 2: This centre is on the southern margin of Western and Central Ovda, and displays a clear triple junction geometry. Rift arms 2a and 2b separate a block of tessera terrain from the main tessera. Rift arm 2c extends into the tessera terrain between Western and Central Ovda, again resembling an aulocagen. Furthermore, the 1c and 2c rift arms (aulocogens) trend toward each other, similar to triple junction rift systems on Earth, where a rift arm from each of two centrres meet, leading to breakup and new ocean formation (e.g. the Atlantic rifts system [7, 8]. However, in the Ovda case, rifting on arms 1c and 2c did not lead to breakup.

Centre 3: The topographic data (Fig. 2a) show a remarkable region of lower topography in the centre of Western Ovda, with linear depressions extending away from this region. Particularly notable is the ~1000 km long rift arm 3a which extends to the tessera margin. Other less distinct rifts may extend west southwest (3b), southwest (3c) and perhaps the northeast (3d).

Connection with younger corona-nova systems: Some of the rifts (marked by topographic lows) are flooded by younger radar dark material, likely representing lava flows, or perhaps sedimentary accumulations in some cases (cf. discussion in [9-10]). This is particularly clear for rift arms 1a and 3a.

In addition, flooding in a number of the rifts is obscured by graben sets associated with younger (likely post-tessera) corona-nova systems (Fig. 2b), many of which are aligned along the proposed rift arms. This suggested that the inferred rift zones are associated with crustal 'thinspots' [11] where plumes or diapirs were able to ascend and produce corona-nova systems.

Link with dyke swarms: Some dyke swarms mapped in Figure 1 are aligned along the proposed rifts. Examples include dykes paralleling rifts 1a, !c, 2c and 3c. Other swarms radiate from the corona-nova systems, including those radiating from H'urau, Kaltash, and Verdandi systems, as well as an unnamed corona-nova along rift arm 2c.

Broader implications: The scale of the rift systems suggests plumes of comparable size to those on Earth (and those inferred for later times on Venus: [12]). In all three Ovda rift systems there is attempted but failed breakup. Thus, the broader question of whether Venusian tesserae are the product of cycles of breakup and convergence, analagous to modern plate tectonics on Earth, remains unanswered.

References: [1] Hansen, V.L. et al. (1999) Geology, 27, 1071-1074. [2] Gilmore, M. S. & Head, J. W. (2018) Planet. Space Sci., 154, 5–20. [3] Hanmer, S. (2020) Earth Science Reviews, 201, 103077 [4] Chetty, T.R.K. et al. (2010) Planet. Space Sci., 58, 1286-1297. [5] Dean et al. (2022) LPSC Abstr. No. 1130. [6] Romeo I. and Capote R. (2011) Planet. Space Sci. 59, 1428-1445. [7] Şengör 2001) In: GSA SP 352. [8] Graff et al. (2018) Icarus, 306, p. 122-138. [9] Khawja et al. (2020) Nat. Comm., 11, 5789. [10] Byrne et al. (2021) Geology, 49, 81–85. [11] Thompson, R.N. & Gibson, S.A. (1991). JGS (London), 148: 973–977. [12] El Bilali et al. 2022 LPSC 1256.

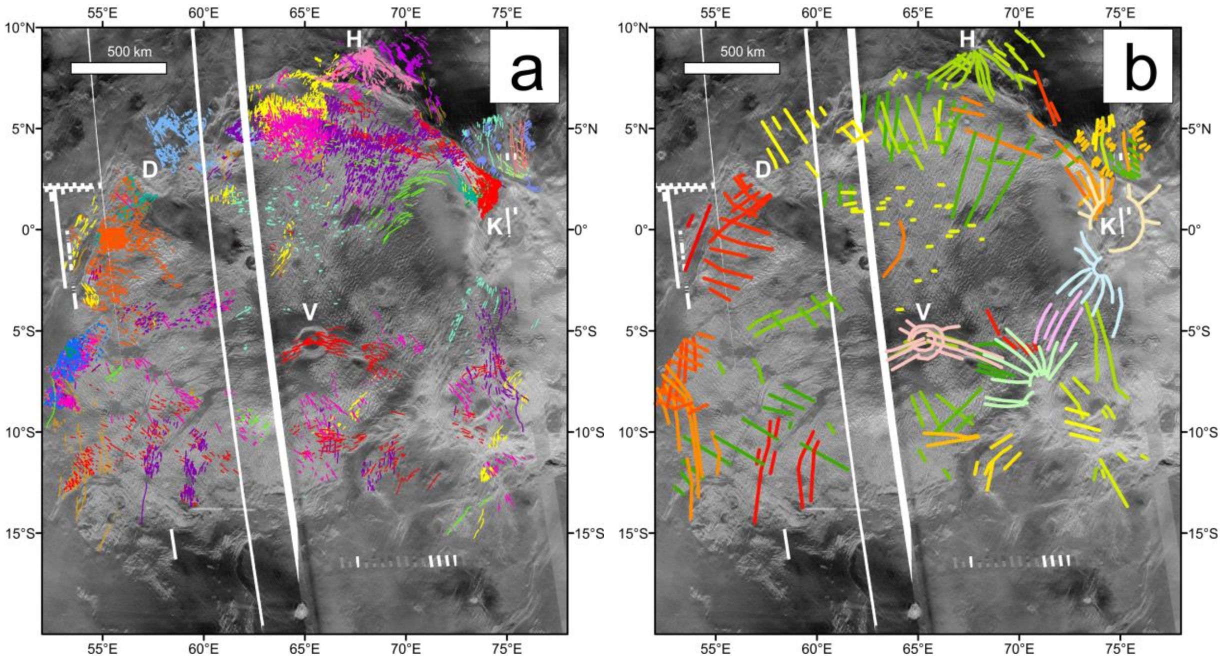

Figure 1*: (a) Distribution of graben systems, mostly associated with ribbon fabric, and other selected geological features in western Ovda Regio (updated from [7]. V = Verdandi, D = Disani, H = H'uraru, K = Kaltash. (b) Generalized graben sets. Superimposed on Magellan SAR image.*

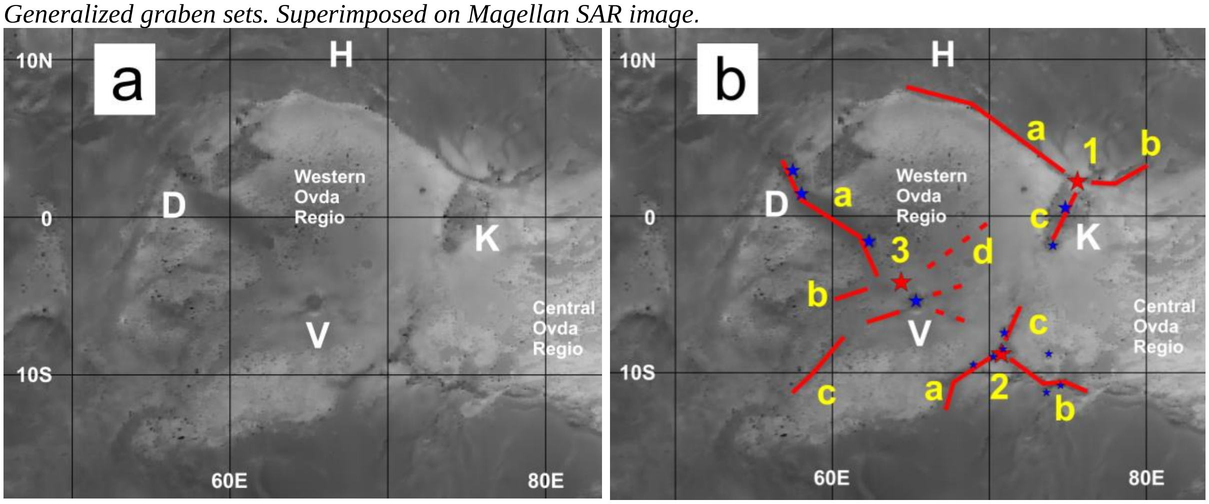

Figure 2: *(a) Topography (from Magellan mission) of Western and Central Ovda Regio. (b) Triple junction rifting systems defined by linear topographic lows and superimposed on the Magellan topography. Red stars mark the three inferred mantle plume centres. Blue stars locate younger corona-nova systems, preferentially aligned along the rift systems and near the centres. V = Verdandi, D = Disani, H = H'uraru, K = Kaltash. The inferred rift systems are syn- or post-tessera but pre-plains.*