Is Lada Terra the site of a mantle overturn upwelling zone? R. C. Ghail1 and C. A. J. Hoad1, 1Earth Sciences, Royal Holloway, University of London, Egham, TW20 0EX, Great Britain. Email: richard.ghail@rhul.ac.uk

Introduction: Venus is sometimes considered to be the closest planetary analog in our Solar System to the Archean Earth [1], wherein juvenile lithospheric plates were too warm and buoyant to allow for subduction and the initiation of the plate tectonics. A recent model [2] proposes that mantle Overturn Upwelling ZOnes (OUZO's) could have provided an efficient cooling mechanism through the episodic displacement of large volumes of lower mantle material upwards towards the surface. A morphologic study of Lada Terra, a highland area of proposed mantle upwelling [3], aims to test whether its volcanotectonic character is consistent with the hypothesis that it is undergoing cratoni-
zation and resurfacing via an OUZO-like mantle overturn event.

Overturn Upwelling ZOnes (OUZO's): The OUZO hypothesis proposes that in the absence of efficient cooling via plate tectonics, the Archean mantle underwent thermal and compositional stratification with conductive cooling generating shallow convection cells in the upper mantle, allowing heat to build up in the lower mantle which eventually triggered massive mantle overturns [2]. In these overturn events a voluminous upwelling of hot primitive lower mantle material with a mass equivalent to multiple large Phanerozoic plumes would rise and resurface areas on the order of 10-20% of the Earth's surface in a geologically short time span of ~100 Ma.

Lada Terra: Lada Terra (Fig.1), located at 60°S, 020°E, is one of three highland regions thought to be somewhat analogous to early continental crust. Lada is bound by extensional rift belts and is located to the south of the low-lying Lavinia Planita, the site of a probable major mantle downwelling [4]. The Lada landmass comprises of a diverse array of volcanic plains, wrinkle ridges, rifts, and multiple large coronae, and the ancient fragmented and flooded Cocomama tesserae.

The Lada Terra rise is a broad circular topographic swell in western Lada (70°S, 005°E) characterized by a large domal morphology reaching heights 2.5-3.0 km above the mean planetary radius, with a diameter spanning ~2000 km. The eastern flanks of the rise are occupied predominantly by a tilted, rifted and partially resurfaced portion of Cocomama tesserae. Extensive suites of lava flows radiating from Quetzapetatl Corona, the third largest of Venus' coronae with a diameter of 850 km, cover almost 600,000 km² of the western flanks [5]. Within Quetzapetatl resides the smaller (~300 km diameter) Boala Corona, located at 70°S, 001°W, above the summit of the Lada rise.

Fig.1 Lada Terra topography (color) and SAR image (bottom) with the locations of key features.

The spatial and morphological relationships between Quetzapetatl and Boala Coronae and the Lada rise imply a cogenetic relationship, with the overall size and regional implications of the features suggesting that the area is situated above a zone of mantle upwelling of a scale not present in the terrestrial plume record. Understanding the nature, scale and longevity of so large a resurfacing event at Lada Terra will deepen our understanding of Venusian tectonics and provide a new lens through which stagnant lid models of Archean mantle overturn events may be evaluated.

Tessera Cratonization: Cross cutting relationships indicate that the formation of the rise postdates the formation of Cocomama Tessera, which has since been fragmented, flexed, overprinted and flooded during an episode of extensive magmatism, most apparently towards Eithinoa Corona (Fig.2) to the west.
Fig. 2 Magellan SAR image of Eithinoha Corona with color topographic overlay and map shows material domains and lineaments. Blue lines indicate graben, green lines represent fractures, red lines represent ridges. White boxes indicate localities shown in next figure.

Careful mapping of embayed tessera fragments (fig. 3) reveals a process of destruction by tectonic slicing and flooding by sheet lavas. Ironically, if highland tesserae represent ancient Venusian ‘continental’ cratons, this slicing and embayment is consistent with ongoing cratonization and resurfacing via mantle upwelling.

**Conclusions:** The number and range of volcanic and tectonic features across Lada Terra are consistent with a mantle overturn upwelling zone, similar in scale to the Cretaceous ‘superplume’. Mapping demonstrates that tessera are being destroyed by slicing and embayment, but that these processes may be stabilizing the region into a future craton.

Fig. 3 Upper: Magellan SAR image and geological map showing embayment relationships between Eithinoha- derived flow suites and volcanics (cvm, cvu) with material domains (it, tt) and structural lineaments (ilt).

Lower: Image and map of Eithinoha’s NW annulus showing deflection of graben (blue) to radial alignment, and embayment relationships by flows from rift (rvu, rvl) and corona (cvm, cvu) volcanics. Note sliced and embayed tessera (tt).