CONSTRAINTS ON SUBDUCTION ON VENUS FROM RADAR IMAGING, TOPOGRAPHY, COMPOSITION, AND GRAVITY DATA. Heni A. Barnes[1] and Suzanne E. Smrekar[2], [1] Department of Geological Engineering, University of Alaska, Fairbanks, AK 99775, [2] Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA 91101.

Introduction: Plate tectonics contributes to the long-term habitability of planets and has only been observed on Earth. Subduction is necessary to initiate plate tectonics as it creates the necessary elements of the slab pull force on the down going plate, transform faults along the edges of the slab, and allows for extension in the lithosphere in other areas. Subduction has been proposed to be involved in the formation of coronae on Venus [Schubert and Sandwell, Davaille, Gerya]. Coronae are near-circular volcanotectonic features unique to Venus and have been found across the planet. Laboratory experiments produced coronae through plume induced subduction [Davaille]. Unlike prior models, this hypothesis provides an explanation for the majority of features found at corona, including the partial trench arc, external extension, and small-scale corona-like features. To understand the conditions necessary for plume induced subduction, we examine coronae > 500km and some < 500km.

Methods: We use left-look Magellan SAR data and global topography data record (GTDR) to search for the signature of subduction including external and internal rifting, partial trench arcs, small scale extensional fractures perpendicular to the trench arcs, and flexure signatures. Using ArcGIS, coronae >500 km in diameter and some < 500 km were examined.

We first examined a list of coronae that demonstrate possible subduction characteristics based on present-day terrestrial subduction zones [1] rather than plume induced subuduction [2]. Coronae in the fracture belts of Dali Diana, Parga, and Hecate have been omitted due to the complicated rift structures. It is harder to identify the features we are looking for due to the deformation in these areas.

The three main characteristics of plume induced subduction we looked for are: a partial topographic trench arc with an assymetric flexural profile, small strain extensional fractures perpendicular to the trench, and internal rifting. During the mantle upwelling stage of coronae formation, external and internal rifts form due to uplift of the topography caused by the plume. Loading by surface volcanism, the formation of new crust, and the weight of the lithospheric slab combine to cause the lithosphere to founder along segments analogous to rollback subdcution. These segments form a partial arc of subduction which creates the trench. Low strain extensional fractures occur as the planar lithosphere stretches as it is being bent downward along an arcuate trench. The trench, small strain extension perpendicular to the trench, and flexure signatures form due to the subduction. If the coronae have these characteristics, they are good candidates for plume induced subduction. Other parameters examined at the coronae are: the extent of the trenches, secondary small-scale coronae-like features, the extent and type of volcanism in the area (which can cover the faulting we are looking for), and tessera within or nearby the coronae.

Topographic profiles were taken to search for a flexural signature, which will be modeled to estimate elastic thickness of the lithosphere near the coronae. Higher resolution stereo topography data [4] will be utilized where available.

Results & Discussion: Of the 27 coronae examined, only three lack the characteristics we define. Some will be reviewed again as the flexure profiles were questionable.

Small strain extensions perpendicular to the trench are common, crossing one another in areas (Figure 1). These demonstrate the portion of corona formation where the lifted plume and lithosphere collapsed into a circular opening.

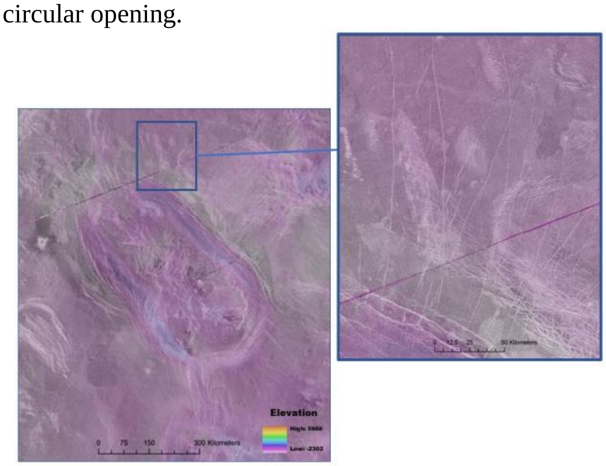

Figure 1. *Small strain extension on Demeter corona. The near vertical (N-S) white lines are the fractures with others slightly tilted (NE). These fractures cross near the bottom of the image. Radar and topographic imaging are utilized. Bright features represent the faulting and are rough areas, while dark portions represent smoother areas.*

Some coronae have a linear portion of the trench (Figure 2) where these small scale extension features do not occur. Subduction processes may differ in these areas as the subducted slab is much larger than those at the partial arcs.

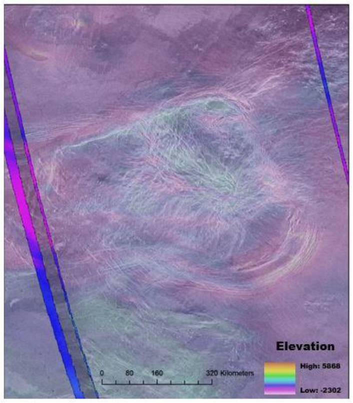

Figure 2. *Linear trench on the North side of Ninmah corona*

Large internal and external rift branches were measured for length and abundance (Figure 3).

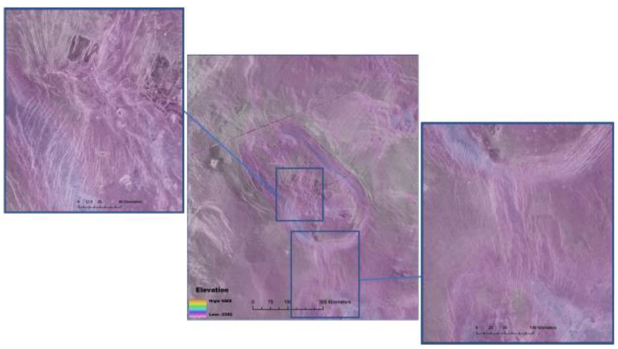

Figure 3. *Internal rifting in multiple directions in Demeter corona and an external rifting branch on the South side of Demeter corona.*

The internal rifting branches may occur in one direction or splay in multiple. External branches occur perpendicular to the trench with most coronae having multiple.

Overall, coronae over 500 km commonly exhibit the characteristics shown in plume induced subduction. Some under 500 km were also examined and still contained these features, thus further examination of smaller coronae will prove beneficial in determing the necessary constraints for plume induced subduction.

Those that fit criteria lacked one feature at most, which may have been covered by lava flows, tessera, or unrecognizable with the imaging. Secondary features such as volcanics were common, while secondary coronae were only observed a few times in the larger coronae. Formation of the secondary coronae signify convection within the magma plume related to the corona. Studies on these may aid in better understanding how these are involved with coronae formation.

With respect to the external and internal rifting, frequently, two external rift branches were observed per corona. Internal rifting was found to commonly have two branches and directions, rather than one main direction. Some coronae showed a radial pattern for the internal rifting.

Flexure signatures were common and found at both the partial arc trench and linear trench segments, if present. Fractures and graben due to small strain extension usually occurred on opposite sides of the coronae and were only along arcuate segments of the trenches and not along the linear trenches.

For coronae that did not fit criteria, this model may not apply. Another explanation is that the diagnostic features are volcanically flooded or deformed.

Examination of maps from (Anderson and Smrekar, 2006) provided values for estimated elastic thickness and crustal thickness at the investigated coronae. Crustal thickness among these coronae range from 0-80 km with the majority lying between 30-50 km. The elastic thickness had the same range, while the majority of coronae had values between 0-10 km. These will later be compared to our calculated values of elastic thickness to verify the gravity data and find the resolution.

Further Work: After examining the coronae on our current list, those that fit the criteria for plume induced subduction will be reexamined using the present flexure signatures to calculate the elastic thickness. Emissivity data will also be examined and can be related to surface composition. Following the flexure profile fits, the estimated elastic thickness will be used to derive mechanical lithospheric thickness as part of the overall goal of determining the conditions required to allow the initiation of subduction above mantle plumes.

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