PRELIMINARY GLOBAL SURVEY OF CIRCULAR LOWS, A SUBSET OF VENUSIAN CORONAE. B. Shankar[1] and V.L. Hansen[2], [1]Department of Geological Sciences, University of Minnesota Duluth, Duluth, MN 55812 (shank075@d.umn.edu), [2] Department of Geological Sciences, University of Minnesota Duluth, Duluth, MN 55812 (vhansen@d.umn.edu).

Introduction: There are over 500 quasi-circular features called coronae on Venus. Coronae occur in chains (68%), clusters (21%) associated with volcanic rises, or as individual features (10%). Diameters of coronae vary between 60-1100km with an average size of 200km to 300km [reference]. Coronae vary in morphology and volcano-tectonic features - suggesting more than one mode of formation. A major hypothesis is that coronae are surface expressions of rising endogenic diapirs [1-5]. The other hypothesis proposed suggests all coronae are impact craters formed by an exogenic process and later modified [6,7]. We will test both these hypotheses on a subset of coronae called circular lows (CLs) – coronae marked by amphitheatre-like depressions. A previous study of 5 CLs suggest they formed via bolide impact [8]. We will conduct a global survey on CLs, identify characteristics unique to CLs and determine a possible mode of formation.

Background: Coronae are widely hypothesized as surface expressions of mantle diapirs on the lithosphere [1,2,3,5]. Rising diapirs produce broad domal uplifts with radial extension fractures on the surface. Through time, the diapir laterally spreads along the base of the lithosphere or at a neutrally buoyant layer where density contrasts no longer exists, changing the topography from domes to plateaus and topographic rims with concentric structures. Fractures become more focused close to the rim as the diapir continues to spread. The diapir continues to spread until it cools, causing gravitational relaxation or a depression in the interior. Many coronae in clusters and chains display radial and concentric structures. Numerical, experimental and finite-element models predict circular lows to form at this final stage [2,9,10]. The wide range of topographic, geomorphic, and geologic characteristics of coronae are interpreted as recording different stages of diapir evolution.

The other hypothesis states that all coronae mark impact craters that have evolved into coronae through surficial modification [6,7]. Venus preserves ~1000 impact craters that range in diameter from 1.5 km to ~ 270 km. Craters display a topographically low interior surrounded by raised rims, concentric rings, ejecta blankets, and occasional radar smooth or rough halos; however craters lack radial fractures, and the immediate surrounding surface is not structurally deformed. Most craters are pristine, with less than 10% modified by volcanic or tectonic activity [11,12].

Methods: We have conducted a global survey of circular lows using NASA Magellan synthetic aperture radar (SAR), altimetry, synthetic stereo (SS) images, of individual VMap quadrangles (V-1 to V-61). CLs are best recognized in SS where regional differences in the topography and surface features are still distinguishable. For each individual CL, using linked images in Adobe Illustrator, we determined the location, tectonic setting, host terrain, shape (ellipticity), diameter (defined by drop in slope), topographic profiles, annuli character (width, degree spread), presence and extent of radial fractures, and any other criteria that may emerge during this study. Where necessary, higher resolution images SAR images (1408 pixels per degree) of the lows can be imported from USGS Map-A-Planet as required.

We determine depths of each CL using topographic maps generated with macros developed by D.A. Young. At a global scale we use ArcGIS Globe to compare locations and characteristics of CLs with one another, global altimetry, tectonic provinces, impact craters, deformation belts, spatial settings of coronae (chains, volcanic rises, crustal plateaus), and outcrops of ribbon-tessera terrain (ancient terrian).

Summary: We identified 61 CLs (75-375 km; ~125 km median) that are equally distributed across Venus. CLs are typically isolated and favor the lowlands. Ellipticity ranges from 0.47 to 1 (median of 0.86). All CLs display concentric structures, except for one, with ellipticity of 0.56. Ten CLs display radial structures. Ten CLs lack rims. These observations suggest CLs represent a unique subset of coronae, representing either a distinct stage of diapir evolution or a separate mechanism of formation such as negative buoyancy diapir, or exogenic formation.

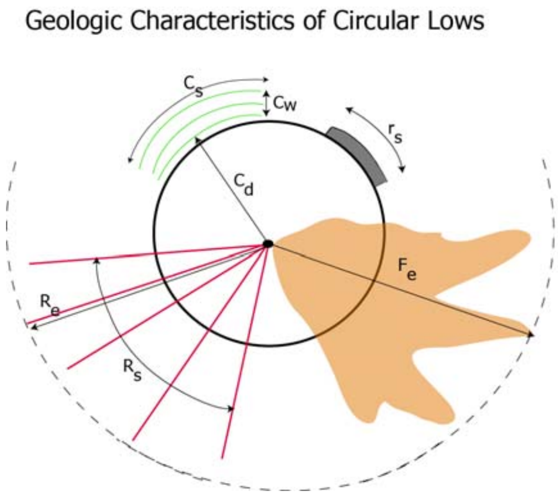

Fig 1: An illustration on recorded measurements of geologic structures within and around a CL. For concentric annuli characteristics such as the width (C_w), degree spread (Cs), and distance from the centre of the CL (C_d) are recorded. Similarly, the extent and degree spread measurements are recorded for present radial annuli (R_e and R_s respectively). Other measurements include the degree spread (r_s) of rims if present, and the extent (F_e) of volcanic flows from the centre of the CL.

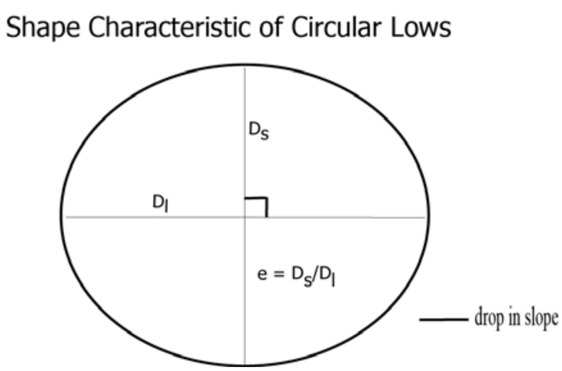

Fig 2: Diameter measurements of a CL, defined by the drop in slope, along both long and short axes. The ellipiticity of the CL is also recorded.

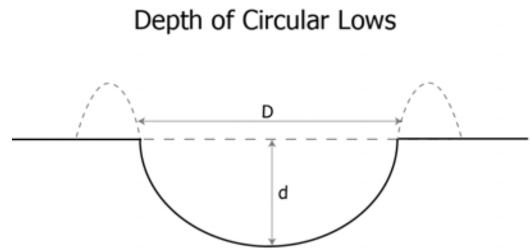

Fig 3: Depth measurements of the CL (d) relative to the surrounding surface. D is the diameter defined by the drop in slope.

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