A GLOBAL SEARCH FOR ACTIVELY FORMING CORONAE ON VENUS. J. A. Mikosz and A. J. Dombard, Dept. of Earth and Environmental Sciences, University of Illinois at Chicago, 845 W. Taylor St., SES MC186, Chicago, IL 60607 (jmikos3@uic.edu, adombard@uic.edu).

Introduction: Evidence for geologically recent volcanic resurfacing of Venus may indicate ongoing activity. Approximately 500 coronae (quasi-circular volcanic features unique to Venus) are found on the Venusian surface. Dombard et al. [1] suggested formation as a result of partial melting created by upwelling mantle transients, and compared topographic, geoid, and Bouguer gravity anomaly sequences to published geologic maps created from Magellan SAR data. This technique was applied to the Beta Atla Themis (BAT) region. Their analysis suggested 2 active coronae in that region, with an additional 4 identified solely on the basis of their geophysical signals (i.e., published geologic maps were not available). Here, we have expanded this search globally, in which so far 13 coronae have been found to be active.

Methods: Following [1], we construct band-pass-filtered maps of the topography, geoid, and Bouguer gravity anomaly, between spherical harmonic degrees 15 and 44 (with a cosine taper between 41-44 to reduce ringing), thereby highlighting the signals on the surface arising from the impinging mantle thermals. (The data was downloaded from the NASA Planetary Data System.) On these maps, we superimpose the locations of all Type 1 and Type 2 coronae [2, 3]. According to the model [1], actively impinging thermals (presumably crowned by active coronae) should produce positive topographic and geoid anomalies and a negative Bouguer anomaly.

From these maps, we identify candidates for active features, which we classify as either "likely" or "marginal." These candidates are then compared against geologic maps published from the NASA/USGS planetary mapping program. Examined candidates are assigned into three categories: active, inactive, or indeterminate. A candidate is classified as active if the temporal relations associated with flows directly eminating from the coronae imply relative youth. A candidate is inactive if the mapped geology does not support young ages for the flows associated with the corona. Some candidates may fit into the indeterminate category, if their geologies are confusing, temporal relations are difficult to explore, or if larger signals from topographic highs drown the signal of the coronae and create an ambiguous relationship.

Preliminary Results: From the geophysical maps, we identify 103 coronae (55 likely and 48 marginal) for which we can compare against published maps. Of these, 53 are located within the boundaries of published geologic maps. Thus, we have found 13 that we can classify as active. Two of these coronae, Atete and Maram, were suggested to be active in [1]. Here, we provide the results for the other 11.

Mead Quadrangle V-21 [4]: Didilia (19° N, 38° E), Pavlova (14.3°, 38.9°), Isong (12°, 49.2°), Ninmah (16.3°, 49°). The Mead Quadrangle is dominated by volcanic deposits from four major coronae (Didilia, Pavlova, Ninmah, and Isong) that appear to be effused together. These coronae exhibit similar flow units, each consisting of unit fc as the main flow, with uplifted rims of older unit ld (densely lineated plains material), all surrounded by older unit pr (ridged plains material). Only a few small patches of younger material are found nearby (unit hb, which represents pyroclastic flow materials). Ninmah Corona is the only type 2 out of all active candidates.

Sif Mons Quadrangle V-31[5]: Eingana (5°, 350°). Eingana is a small corona that lies on the edge of larger, inactive Heng-O Corona. Eingana is composed of unit vc, described as volcanic center material. This unit is younger than surrounding units prG (regional plains) and pmH (mottled plains) of Guinevere Planitia, as well as a late-stage flow belonging to Heng-o Corona.

Meskhent Tessera Quadrangle V-3 [6]: Fakahotu (59.1°, 106.4°), Melia Mons (62.9°, 119.5°). Fakahotu Corona is likely in its last stages of activity. Its center is composed of older material, but signs of younger flanking activity on its edges are present. The center is composed of units gb (groove belt material), rp1 (regional plains material phase 1, of volcanic origin but source unknown), and pr (regional plains material, source unknown). The younger flows surrounding the center include units pl (lineated plains), and ps (smooth plains), interpreted to be the youngest units in the quadrangle. The corona is otherwise surrounded by unit psh (shield plains material), an older plains unit. Melia Mons, a corona-like volcanic edifice that is included in corona database used here [2, 3], is also composed of units psh, pl and gb, with small patches of unit pdl visible. A small patch of shield cluster material appears near the center, labeled unit sc. Units pl, psh and sc are interpreted to be the youngest of flows within the area.

Aino Planitia Quadrangle V-46 [7]: Cailleach (-48°, 88.3°), Ohogetsu (-25.7°, 85.7°). Cailleach Corona is composed of two main flows, fCl1 and fCl2, both of which are described as Cailleach Corona material, specifically lava units formed from vents at or within its margins. Unit fCl1 is embayed by unit fCl2. Both of these units are superposed onto nearby units fMk and pMk of Makh Corona, as well as onto puA and psA (some of the younger units of Aino plains material). Ohogetsu Corona is one of the most geologically and stratigraphically complex coronae in Aino Planitia. The corona has its own distinct flows, described as lava units from vents at or within its margins. These include units fOa, fOb, fOc, and fOd, with unit fOa being the youngest. Only unit fK2 from the nearby Kunapipi Mons edifice embays fOa. All other surrounding units are plains material units pUa, pCa, pdAc, and are all older than the corona.

Kaiwan Fluctus Quadrangle V-44 [8]: Derceto (-46.8°, 20.2°). Derceto Corona is mostly composed of unit prl (older lineated plains material unit) and largely flooded by unit fUA. Unit fUA, the youngest unit in this area, is described as the Ubaset Fluctus and Astkhik Planum flow material, and is believed to emanate from the vicinity of Derceto Corona. The only other unit the the area is an older ridged plains unit pdr, and is found in patches around the area.

Helen Planitia Quadrangle V-52 [9]: Kulimina (-27.5°, 262.5°). Kulimina Corona is completely covered by unit fchP, and it is suggested that the corona is one possible source of this flow. Although local temporal relationships are difficult to assess, flow fronts of unit fchP that appear to emanate from Kulimina Corona overprint older flows of unit fchP.

Discussion: All published maps (23 out of 62 possible quadrangles) have been compared against our geophysical maps. Of the 53 candidates based on their geophysical signals that lie within the bounds of these published maps, we have determined 13 coronae to be active (10 we initially classified as likely, and 3 marginal). Twenty coronae have been labeled inactive (8 likely, 13 marginal), and another 20 have been labeled indeterminate (11 likely, 8 marginal).

The question is how to deal with the indeterminates. There are 2 obvious approaches: (1) a conservative approach assuming that all indeterminates are inactive and (2) applying an estimate of activity based on our marginal- and likely-signal success rates. The conservative approach leaves 13 active coronae, while using the success rates adds 6 indeterminate coronae geophysically classified as likely and 2 marginal ones, for 21 active coronae within the mapped regions.

We can extrapolate our results to determine the number of globally active coronae. The most straightforward method would be to assume that the areal density of coronae is globally constant. Since we have assessed the coronae within 23 of 62 possible quadrangles, this method suggests ~35-57 active coronae, over twice the number (17) proposed by Dombard et al. [1].

However, such a simple extrapolation does not take into account the confidence levels we assign to our candidates. We determine that 10-16 out of 29 likely candidates are active, while 3-5 out of 24 marginal candiates are active. Thus of the 26 unmapped likely candidates, we can expect 10-14 to be active, while an additional 3-5 of the 24 unmapped marginals may be active. These extrapolations yield ~26-32 coronae that are active globally, ~50-90% greater than determined previously [1] but less than the simple areal extrapolation above.

We can compare our extrapolations of the global population of active coronae to that of Dombard et al. [1]. They estimated that Venus is losing its heat at the rate of ~0.5-50 TW through its coronae. Our current estimates are ~50-90% greater, but still of the same order of magntiude. Thus, the conclusion still holds that a substantial fraction of the heat loss of Venus is through the thermals postulated to create coronae. A surprising finding is that our current estimate is in fact larger than the previous one, because Dombard et al. [1] only considered the BAT region, which has the strongest concentration of coronae on the surface. If anything, our estimates here should be lower. It is possible, however, that so many thermals are impinging within the BAT region that it becomes difficult to identify candidates. If this is the case, then our total numbers would be even greater.

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