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Distribution, geologic setting and classification of multiple coronae on Venus

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Introduction: Coronae are large volcano-tectonic structures with concentric and/or radial structures and associated volcanic features [e.g. 1-4]. Coronae are thought to form as a result of buoyant mantle diapirs deforming overlying lithosphere [e.g. 3-8]. We have conducted a new survey of multiple coronae (coronae with at least 2 linked structures with a common annulus [3,5]) based on the existing catalogues and studies of coronae and related volcano-tectonic features [9-13] as well as identifying additional coronae from Magellan images and topographic data. In this survey we identified 70 multiple coronae, of which 48 are Type 1 and 22 Type 2 coronae (Type 1 and 2 as defined in [10]).

Distribution: The distribution of multiple coronae appears to be different from the general distribution of coronae: There are fewer multiple coronae in the southern hemisphere between 0˚-180˚ longitude and in the eastern hemisphere (0˚-180˚) compared to all coronae. Although multiple coronae are concentrated in the Beta-Atla-Themis region, as is also observed for all coronae [e.g. 3,4,9,10,14], there are only few multiple coronae on NE, E and south-central Atla Regio, on the plains between Atla and Beta and along or near Hecate Chasma. There are also distict groups of multiple coronae along Parga Chasmata, in Northern Ulfrun Regio and in Bereghinya Planitia.

Geologic Setting: Multiple coronae are found on all major geologic settings [5,10] on Venus: deformation belts (60% of the multiple coronae), plains (21%), volcanic rises (13%) and tessera (6%). Multiple coronae appear to favor deformation (especially fracture) belt environments (as is also observed for all coronae [e.g. 5,9,10,14]), they are not present on all deformation belts, and are generally absent from the deepest and widest rifts. There are few differences between geologic settings of the Type 1

multiple coronae and all Type 1 coronae: Type 1 multiple coronae are found less often on deformation belts than all Type 1 coronae (62% vs. 68% [10]), although otherwise there are no major differences between geologic settings. Type 2 multiple coronae, however, are more likely to be located on or near deformation belts (55%) or on volcanic rises (9%) than Type 2 coronae in general (43% and 2%, respectively [10]), and less typically as isolated features on plains (27% vs. 56%).

Morphological Classification: We have devised a preliminary morphological classification based on 1) the number of interconnected subparts, 2) degree of interconnectivity between parts and whether there is a clear common section of an annulus, and 3) size difference of the subparts. The classification scheme has six classes:

Class A features (19 multiple coronae) are two-part structures with a common part of the structural or topographic annulus joining the two subparts. The features are often almost symmetrical. *Class B* features (15 coronae) have 2 joined parts, which do not have a clear shared section of an annulus. Features are less symmetrical than Class A coronae, and the subparts may differ in size and shape. *Class C* multiple coronae (8 structures) are elongated two-part features with a narrow neck-like section between the subparts. These coronae sometimes have a narrow peanut-like shape. *Class D* features (9 coronae) have a part, which is clearly smaller than the main part of the corona, forming a bulge-like extension of the corona. *Class E* coronae (16 features) have 3 subparts, which may form a cluster-like arrangement (Class E1), have a smaller subpart between two larger parts (Class E2), or form a row of 3 interlinked structures with shared sections of an annulus between them (Class E3). We found only three *Class F* multiple coronae that have more than three subparts, and are usually complex structures.

Conclusions and Future Work: Multiple coronae are not evenly distributed on the surface of Venus and their distribution seems to be different from the general corona distribution, although this difference needs to be tested quantitatively. Multiple coronae are found on all major geologic settings but most often on or near deformation belts. Type 2 multiple coronae are relatively more often located on deformation belts than Type 2 coronae in general. Environments with tensional stress appear to have an influence on multiple corona formation, and perhaps even more for Type 2 multiple coronae. We have classified multiple coronae into 6 morphological classes, which may reflect different formation processes and environments.

It has been proposed that multiple coronae may form from (1) elongated diapirs, (2) several closely spaced, interacting diapirs, (3) from secondary diapirs rising form a larger plume or diapir, (4) secondary pulses following the main diapir [15], or (5) as a result of sublithospheric plume channeling [16]. These formation models can be tested

by analysis and comparison of corona morphology, topographic characteristics, evolution sequences and geologic settings. We are currently analysing in more detail sizes of the multiple coronae, their topography and geologic settings, as well as performing geologic mapping of multiple coronae to constrain models for multiple corona formation and compare models with arachnoid and nova formation models [e.g. 8,17,18].

References: [1] Barsukov V.L. et al. (1986) *JGR, 91*, 378-398. [2] Head J.W. et al. (1992) *JGR, 97*, 13153-13197. [3] Stofan E.R. et al. (1992), *ibid*., 13347-13378. [4] Squyres S.W. et al. (1992) *ibid*., 13611-13644. [5] Stofan E.R. et al. (1997) in *Venus II*, eds. Bougher S.W. et al., Univ. Arizona Press, Tucson. [6] Koch, D.M. and Manga M. (1996) *GRL, 23*, 225-228. [7] Smrekar S.E. and Stofan E.R. (1997) *Science, 277*, 1289-1294. [8] Krassilnikov A.S. and Head J.W. (2003) *JGR, 108*, 5108-5155. [9] Crumpler L.S. and Aubele J.C. (2000) in *Encyclopedia of Volcanoes*, eds. Sigurdsson H. et al., Academic Press, New York. [10] Stofan E.R. et al. (2001) *GRL*, 28, 4267-4270. [11] Kostama V.-P. and Aittola M. (2001) Catalogue of Venusian Volcano-tectonic Features, http://cc.oulu.fi/tati/JR/Venus/volcanotectonics/catalogue.html. [12] Kauhanen K. and Törmänen T. (1994) *LPS XXV,* 673-674. [13] Törmänen T. and Kauhanen K. (1994) *ibid.,* 1411-1412. [14] Kostama V.-P. and Aittola M. (2001) *LPS XXXII*, Abstract#1185. [15] Törmänen T. and Kauhanen K. (1995) *LPS XXVI,* 1417-1418. [16] Lopez I. (2002) *JGR, 107*, 5116-5127. [17] Aittola M. and Kostama V.-P. (2000) *Planet. Space Sci., 48*, 1479-1489. [18] Aittola M. and Kostama V.-P. (2002) *JGR, 107*, 5112.