DISTRIBUTION AND CLASSIFICATION OF MULTIPLE CORONAE ON VENUS. T. Törmänen[1], M. Aittola[1], V.-P. Kostama[1] and J. Raitala[1], [1]Planetology Group, Div. of Astronomy, Dept. of Physical Sciences, P.O. Box 3000, FIN-90014 University of Oulu, Finland (terhi.tormanen@oulu.fi)

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 survey of multiple coronae (coronae with at least 2 linked structures with a common annulus [3,5]) based on the existing catalogues of coronae and related volcano-tectonic features [9-12] as well as identifying additional coronae from Magellan images and topographic data. Double-type coronae were earlier studied based on Magellan data [13-16]. In this new survey we studied all multiple-type features and identified 70 multiple coronae including 12 multiple arachnoids. Of the multiple coronae 48 are Type 1 and 22 Type 2 coronae (Type 1 and 2 as defined in [10]). Multiple coronae may thus be more common in the Type 2 corona population.

Distribution: The distribution of multiple coronae and arachnoids (Fig. 1) appears to be different from the overall distribution of coronae. There are fewer multiple coronae in the southern hemisphere between 0°-180° longitudes compared to all coronae. There are also relatively few multiple coronae in the eastern hemisphere (0°-180°): only 19 (27%) out of 70. Although multiple coronae are concentrated in the Beta-Atla-Themis region, as is also observed for all coronae [e.g. 3,4,9,10,17], 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 (Fig. 1).

Multiple coronae form a distinct group (with both Type 1 and 2 coronae) along and adjacent to the SE Parga Chasmata on Themis Regio and two goups trending obliquely to Parga Chasmata (with only Type 1 coronae). Two other clusters of multiple coronae are observed in Bereghinya Planitia (with mostly Type 2 coronae) and in N/NW Ulfrun Regio.

Geologic Setting: Preliminary analysis indicates that although 60% of multiple coronae are located on or close to deformation (typically fracture) belts (as is also observed for all coronae [e.g. 5,9,10,17]), they are not present on all deformation belts, and are generally absent from the deepest and widest rifts (as was also observed for double coronae [14]). Multiple coronae are present on plains (21%) and volcanic rises (13%). Only few features are located near or on tessera (6%). For Type 1 multiple coronae, 62% are found on or close to deformation belts (compared to 68% of all Type 1 coronae [10]), 19% on plains (18% [10]), 15% on volcanic rises (13% [10]), and 4% near/on tessera. Interestingly, Type 2 multiple coronae 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%). Environments with tensional stress appear to have an influence on multiple corona formation, and perhaps even more for Type 2 multiple coronae.

Morphological Classification: We have devised a 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 morphological classification is a tool for understanding relationships and evolution of the linked parts of a multiple corona, and to better constrain multiple corona formation models. The classification scheme has six classes:

Class A features (12 Type 1 multiple coronae and 7 Type 2) are two-part structures with a common part of the structural or topographic annulus joining the two subparts (Fig. 2a). The features are often almost symmetrical. *Class B* features (13 Type 1 & 2 Type 2) have 2 joined parts, which do not have a clear shared section of an annulus (Fig. 2b). Features are less symmetrical than Class A coronae, and the subparts may differ in size and shape. *Class C* coronae (5 Type 1 & 3 Type 2) are elongated two-part features with a narrow neck-like section between the subparts (Fig. 2c). These coronae sometimes have a narrow peanut-like shape. *Class D* features (4 Type 1 & 5 Type 2) have a part which is clearly smaller than the main part of the corona, often forming a bulge-like extension of the corona (Fig. 2d). *Class E* coronae (11 Type 1 & 5 Type 2) have 3 subparts, which may form a cluster-like arrangement (Class E1; 8 coronae; Fig. 2e), or have a smaller subpart between two larger parts (Class E2; 4 coronae), or form a row of 3 interlinked structures with shared sections of an annulus between them (Class E3; 4 coronae). *Class F*: There are only three Class F multiple coronae (Beiwe, Beruth (Fig. 2f) and Erigone Corona; all Type 1), which have more than three subparts, and are usually complex structures.

Discussion and Future Work: Multiple coronae are not evenly distributed on the surface of Venus and their distribution appears to be different from the general corona distribution, although this difference

needs to be tested quantitatively. It was proposed that multiple coronae may form from several closely spaced, interacting diapirs, from secondary diapirs rising form a larger plume or diapir, or from elogated diapirs [15], or as a result of sublithospheric plume channeling [18]. These formation models can be tested by analysis and comparison of corona morphology, topographic characteristics, evolution and geologic settings. We are currently analysing in more detail corona sizes, topographic characteristics, and geologic settings and performing geologic mapping of multiple coronae to constrain models for multiple corona formation and compare models with arachnoid and nova formation models [e.g. 8,19,20].

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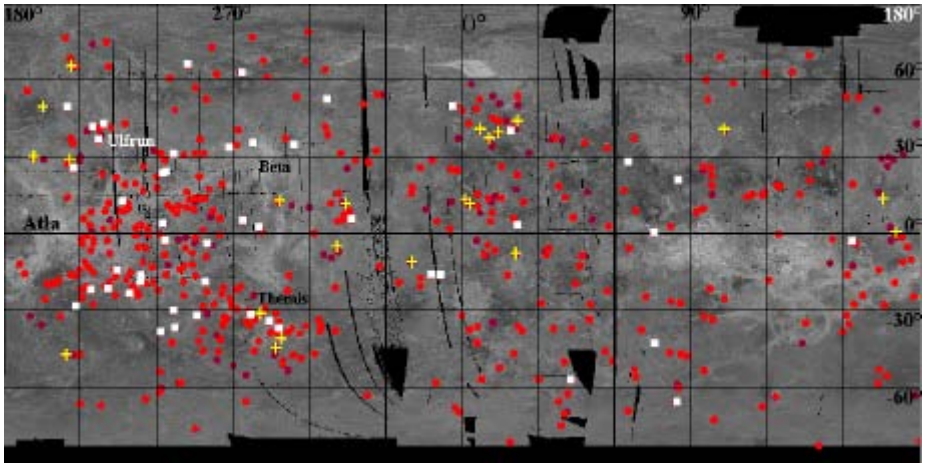

Figure 1. Distribution of multiple coronae: White squares: Type 1 multiple coronae; Yellow crosses: Type 2; orange circles Type 1 coronae [10]; dark red circles: Type 2.

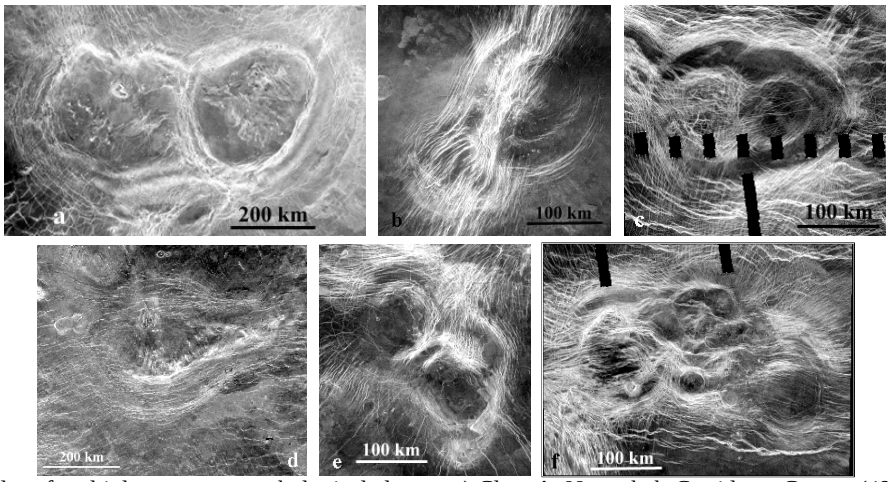

Figure 2. Examples of multiple coronae morphological classes: a) Class A: Neyterkob-Cerridwen Corona (49.7, 203); b) Class B: Seia Corona (-3, 153); c) Class C: Erkir Corona (-16.3, 233.7); d) Class D: Gaia Corona (3.5,21.5); e) Class E1: Momu Coronae (-21, 220); f) Class F: Beruth Corona (-19, 233.5). North is up in all images.