RELATIONSHIP BETWEEN RADIAL/CONCENTRIC VOLCANIC/TECTONIC FEATURES ON VENUS (CORONAE, NOVAE, ARACHNOIDS AND CALDERAS). A. S. Krassilnikov[1,2], [1]Vernadsky Institute, 119991, Moscow, Russia, kras@geokhi.ru, [2]Moscow State University, 119992, Geological Department, Moscow, Russia.

Introduction: There are 4 main types of large radial/concentric volcanic/tectonic features on Venus: coronae, novae, arachnoids and calderas.

1) Coronae are structures with diameters of 100 to over 1000 km [1-5]. According to [3] "these features are defined by a dominantly concentric or circular structure consisting of an annulus of concentric ridges or fractures, an interior that is either topographically positive or negative, a peripheral moat or trough, and, frequently, numerous volcanic and tectonic landforms in the interior". Coronae have varied topographical shapes, radial and concentric fracturing and compressional tectonic structures for their annulae are common, as well as massive volcanism [1-5]. Coronae are the result of updoming and fracturing on the surface due to interaction of hot mantle diapirs with the lithosphere and its subsequent gravitational relaxation [1-9]. According to [10] there are 514 coronae on Venus. There are a few geological [1,4,5], numerical [2,7] and analog [8,9] models of coronae formation.

2) Novae are "radially fractured centers" 100-300 km in diameter and 64 have been identified on Venus. According to [3] novae are "structures that have prominent radial fracture patterns forming a starburst or stellate pattern in map plan which generally consist of a plexus of graben". Dense radial fracturing, upraised topography and massive volcanism are common for novae. Concentric tectonic features are observed in some, similar to coronae [6]. Novae are the result of updoming and fracturing of the surface due to interaction of mantle diapirs with the lithosphere [1-9], and radial fracturing caused by dike emplacement [6]. There are a few geological [1,4-6], numerical [2,7] and analog [8,9] models of novae formation.

3) Arachnoids are features "characterized by concentric or circular pattern of fractures or ridges and radial fracture patterns or ridges extending outward for several radii" [3]. According to [11] 265 arachnoids are observed. They are most common between 50 and 175 km diameter and are represented by depressions [3,12-14]. Small amount of volcanism is connected with them [13-14]. They are formed by evolution (collaps) of rather small mantle diapirs with rather deep position [3, 12-14]. High tangential stress by diapir collaps take place during formation of arachnoids that leads to radial compressional features formation. Some of arachnoids are corona-like [14].

4) Calderas "are defined as circular to elongate depressions not associated with a well-defined edifice and are characterized mainly by concentric petterns of enveloping fractures, geologic characteristics indicative of a depression, and a smooth or dark central region with the appearance of late filing lavas" [3]. They are between 40 and 80 km in diameter [3,15,16]. [11] includes 97 calderas. Formation of this calderas is related to evolution (collaps) of rather small magmatic diapirs and a small volume of pressure release melting in a diapir head, mechanically similar to arachnoid and coronae [5,6,14,16]. Some of calderas are corona-like [15-16]. Moderate or poor volcanism is connected with most of calderas [15-16]. Formation of this calderas occur without previous formation of large strato- or shield volcano [15-16].

Goals of the study: There is no clear differentiation between all these types of structures. On base of our study we suggest principal chart of structural and genetic relationship between coronae, novae, arachnoids and calderas. Our interpretations are based on: (1) Geological analysis of whole population of structures: *Novae* - 64 structures were analyzed [6]; *Calderas* - 97 structures [15-16] were analyzed. (2) Geological analysis of significant part of population of structures: *Coronae* - 20% of the whole population were analyzed, each 5th structure from the [17,18], in total 104 coronae; *Arachnoids* - 53 arachnoids have been studied, 20% of population, each 5th structure from [14]. (3) Compilation of detail geological maps of typical structures. More than 60 detail maps of novae, coronae, calderas and arachnoids have been done [6,14-18]. (4) Analysis of geological [1,4,5,14,19], numerical [2,7] and analog [8,9,20] models of coronae, novae, arachnoids and calderas formation. Previously we suggested scenarios of evolution of radial/concentric features on Venus depending on the following factors [6,14,16]: 1) the depth of the neutral buoyancy level of the uplifting mantle diapir; 2) the rheological characteristics of the part of the lithosphere which the evolving diapir influences; 3) whether or not visco-plastic material of lower lithosphere above diapir spreads; 4) the character of the influence of regional stress and rifts.

Discussion. These radial/concentric structures are formed due to interaction of mantle diapirs with the lithosphere by its uprising and gravitational relaxation [1-6]. Varieties in tectonics and morphology depend on the relationship of different geological factors of their formation: (1) Size of the diapir that determines the scale of the structure; (2) Relationship between size of the diapir and its depth that determines prominence of the structure on the surface; (3) Position of the neutral buoyancy level of the mantle diapir that determines: a) prominence of the structure on the surface; b) style of tectonic features, type of relaxation of diapir body and upper part of the lithosphere; c) role of radial dike swarms emplacement that in turn determines existence or lack of radial tectonic features, d) volume and rate of related volcanism. On the basis of these key factors we composed schematic chart of relationship of these four types of structures (Fig. 1). Coronae are the most wide class of the structures, they have varied topographical shapes and most full set of tectonic features. Novae, calderas and arachnoids have transitional structures to coronae [6,14,16]. Because of that we suggest coronae as transitional type of structures between novae, calderas and frachnoids that we consider as end-members of ternary relationship diagram. Diapir size increases in the direction of "novae field", its position is shallower (and/or smaller ratio of its diameter and depth), shallower magma reservoir is forming and producing large amount of volcanism and radial dike swarms that in turn form well prominent radial fracturing. Gravitational relaxation leads to formation of concentric tectonic features in some novae. In the direction to "calderas and arachnoids fields" diapir size decreases, its position becomes deeper (and/or larger ratio of its diameter and depth), deeper magma reservoir is forming; poor volcanism takes place. Collaps of diapir and magma chamber leads to formation of concentric fracturing. In case of arachnoids, conversely to calderas, this collaps occurs with significant lateral movement of diapir body that leads to formation of tangential stress and radial compressional features formation.

We can suggest that very likely coronae, novae, arachnoids and calderas were formed due to same process controlled by few main geological factors that determine main characteristics of the structures [6,14,16]. Transition between types of structures is not sharp, gradual changing of tectonic and morphological features between different types of radial/concentric volcanic/tectonic features takes place.

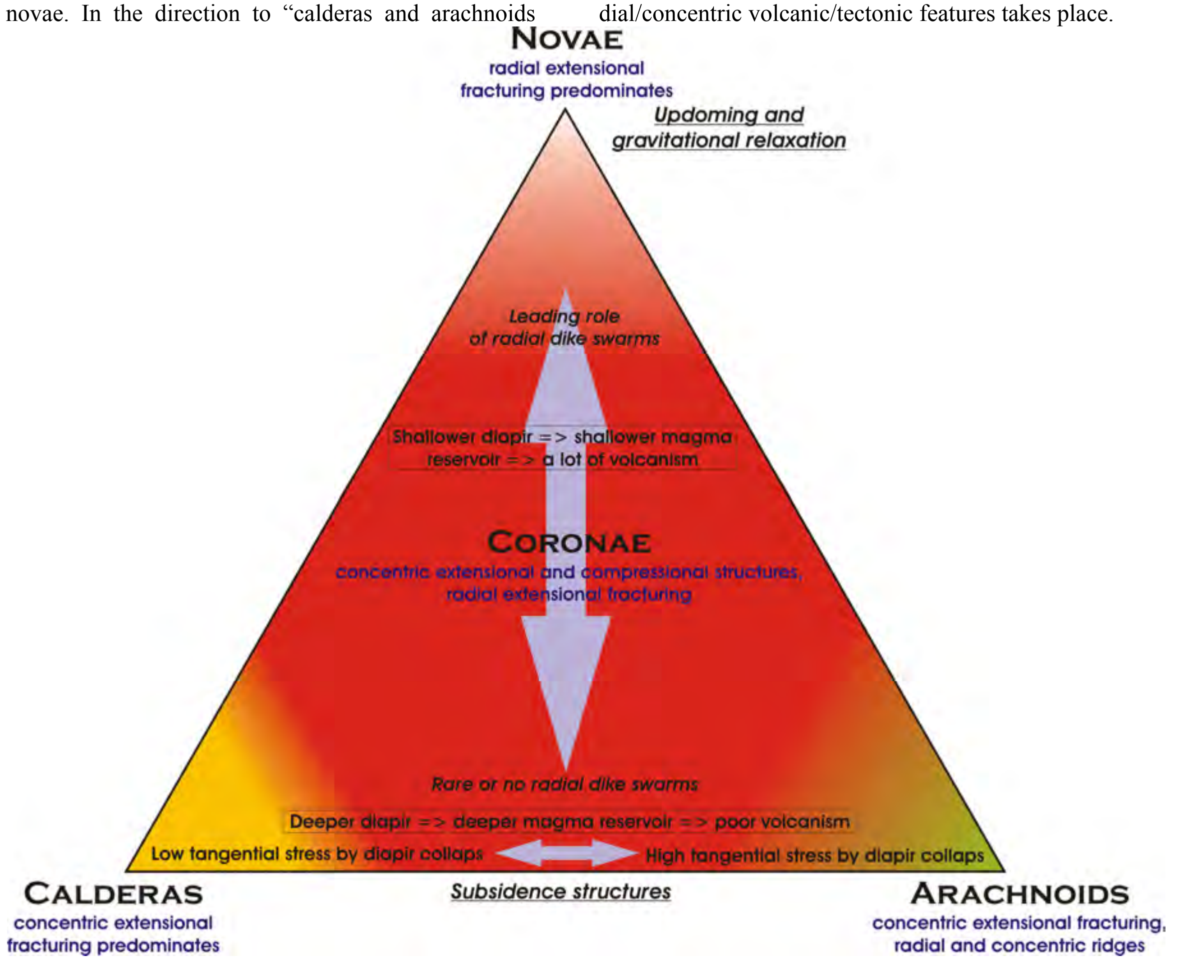

Fig. 1. Morphological and genetical relationship between coronae, novae, arachnoids and calderas on Venus.

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