MAPPING OF RIFT ZONES ON VENUS, PRELIMINARY RESULTS: SPATIAL DISTRIBUTION, RELATIONSHIP WITH REGIONAL PLAINS, MORPHOLOGY OF FRACTURING, TOPOGRAPHY AND STYLE OF VOLCANISM. O. S. Cherkashina[1], E. N. Guseva[1], A. S. Krassilnikov[1, 2], [1]Moscow State University, Geological department, 119234, Moscow, Russia, [2]Vernadsky Institute, 119991, Moscow, Russia, kras@geokhi.ru

Introduction. Rift valleys on Venus were identified on Pioneer Venus topography data [1,2]. After *"Magellan"* was shown that rift systems are wide spread [3-5]. Two types of rift structures were subdivided [6,7]: 1) rifts (chasmata) and 2) fracture belts. Both of them are hundreds to thousands of kilometers long and are deformed by linear system of faults and graben. Rifts are represented by topographic troughs, fracture belts – by linear raises more than a kilometer above the surroundings. Both of them were mapped without subdivision as "fracture belts" [8] or "rifts" [9]. By [10,11] were determined that chasmata cut regional plains with wrinkle ridges (Pwr) and fracture belts are mostly embayed by them. Synoptic mapping showed the distrubution in space and time of rifts and large volcanoes of Venus [12], and that post-Pwr rifts dominate over the pre-Pwr rifts both in number of mapped segments and in area. **Goals of the study.** To study geological structure of rifts on Venus including: 1) Spatial distribution of linear fracturing on the surface of the planet that may be interpreted as rift zones [8,9,11]; 2) Time relationship of rift zones with Pwr that may be used as stratigraphic marker for Venus [13-15]; 3) Morphology of rift fracturing; 4) Topography of rift zones; 5) Style and rate of rift associated volcanism. **Methods.** We used C1-MIDR SAR "Magellan" images (225 m/px) for analysis and paid special attention on following objectives: 1) *Global and regional photogeological mapping* of rift systems, including detail geological mapping of typical examples. 2) *Study of relationship of rifts zones with Pwr.* Two types of relationship of rift zones with Pwr were observed as in [12]: a) Rift zones predate Pwr – they are embayed by Pwr that are not deformed by rift fracturing; b) Rift zones postdate Pwr - they cut Pwr. Some rifts zones started to evolve before Pwr emplacement and finished after that, they are partly embayed by Pwr and partly deform Pwr. Thus we mapped in detail: a) pre-Pwr rift zones; b) post-Pwr rift zones; c) rift zones that started their evolution before Pwr emplacement and finished after that. 3) *Study of topography of rift zones* on base of GTDR data (resolution ~4 km/px). 4) *Study of morphology of rift fracturing*. Inside rift zones 40 samples have been chosen (50x50 km); 20 inside pre-Pwr rifts and 20 inside post-Pwr rifts. In these samples morphology have been described and fracture to fracture spacing have been measured. 5) *Study of style and rate of volcanism*. We studied 40 samples described and sites of detail mapping drawing attention to following: a) Is volcanic activity connected with rift zone or not? b) If rift related volcanic activity were observed, we studied type of volcanism – shield volcanoes, extensive lobate flows or both of them are connected with rift zone.

Observations and results. 1) *Global map of distribution of rift zones* on Venus have been created (scale 1:50 000 000) (Fig. 1). 2) *Time relationship with Pwr*. Rift zones were subdivided into 2 age groups (pre-Pwr and post-Pwr rift zones) that were mapped separately (Fig. 1, 2). Pre-Pwr rift zones are located generally in equatorial region of planet, post-Pwr rift zones less extend and occupy region mainly from 180° to 315° longitude also in equatorial region. Often post-Pwr rift zones inherit strike of pre-Pwr rift systems, but sometimes cross them. 3) *Topography of rift zones*. Pre-Pwr rifts usually are represented by simple linear depressions (troughs) without upraised "shoulders" at their flanks, seldom by linear raises or troughs with shoulders. Post-Pwr rift zones are usually represented by troughs with shoulders, seldom by troughs without shoulders. 4) *Morphology of rift fracturing.* Fracturing in pre-Pwr rift zones is localized in linear zones (380-400 km width); fractures are poorly sinuous and up to 600 km long; fracture to fracture ~ 2.2 km (σ= 5). Rift fracturing may form arc-like structures around coronae and corona-like features, but may cut coronae without changing of strike. Post-Pwr fracturing is localized in linear zones also (380-390 km width); fractures are more sinuous and up to 700-800 km long, fracture to fracture spacing ~ 2.7 km (σ= 8.4). 5) *Style and rate of rift associated volcanism*. Small shield volcanoes and their clusters are typical for pre-Pwr rift zones; diameters of volcanoes – first tens of kilometers, diameters of cluster up to first hundreds of kilometers. Seldom rift related lava flows are observed, they are no more than a few tens of kilometers long. For post-Pwr rift zones most typical are long lobate lava flows, especially in areas of large volcanoes location (e.g. Atla, Beta Regio) [15]; they are up to a few hundreds of kilometers long. Less typical for post-Pwr rift zones are shield volcanoes and their clusters; diameter of volcanoes up to 10-20 km, diameter of clusters up to 100-200 km. 6) *Correlation of rift zones with geophysical data (geoid anomaly).* Pre-Pwr rift zones show no correlation with geoid anomalies (Fig. 2). Almost all post-Pwr rift zones are located in areas with geoid high.

Interpretations and preliminary conclusions.

♦Two different age groups of rift zones on Venus were subdivided, mapped and studied: pre- and post-Pwr.

♦In most cases strikes of pre-Pwr and post-Pwr rift zones are the same, and old rifts are reworked by young rifts (Fig. 1). That may evidence that axis of rift produced lithospheric extension were changed in some areas only, and dynamic of mantle upwelling during formation of both types of rifts were approximately the same.

♦Topography, high amount of young volcanism and correlation with geoid of post-Pwr rift zones (Fig. 2) evidence that these structures did not finished their evolution, opposite to pre-Pwr rifts.

♦Different morphology of fracturing in different age populations of rifts may evidence for their formation in different geological conditions. Changing of morphology of rift fracturing may evidence for model of thickening of venusian lithosphere with time [16-18].

♦Our observations are in disagreement with results by [11] in two aspects: we showed that pre-Pwr rifts are represented

mostly by linear depression and they dominate over post-Pwr in number of segment and area.

Acknowledgements. The authors thank RFBR grant # 02-05-65068 for support.

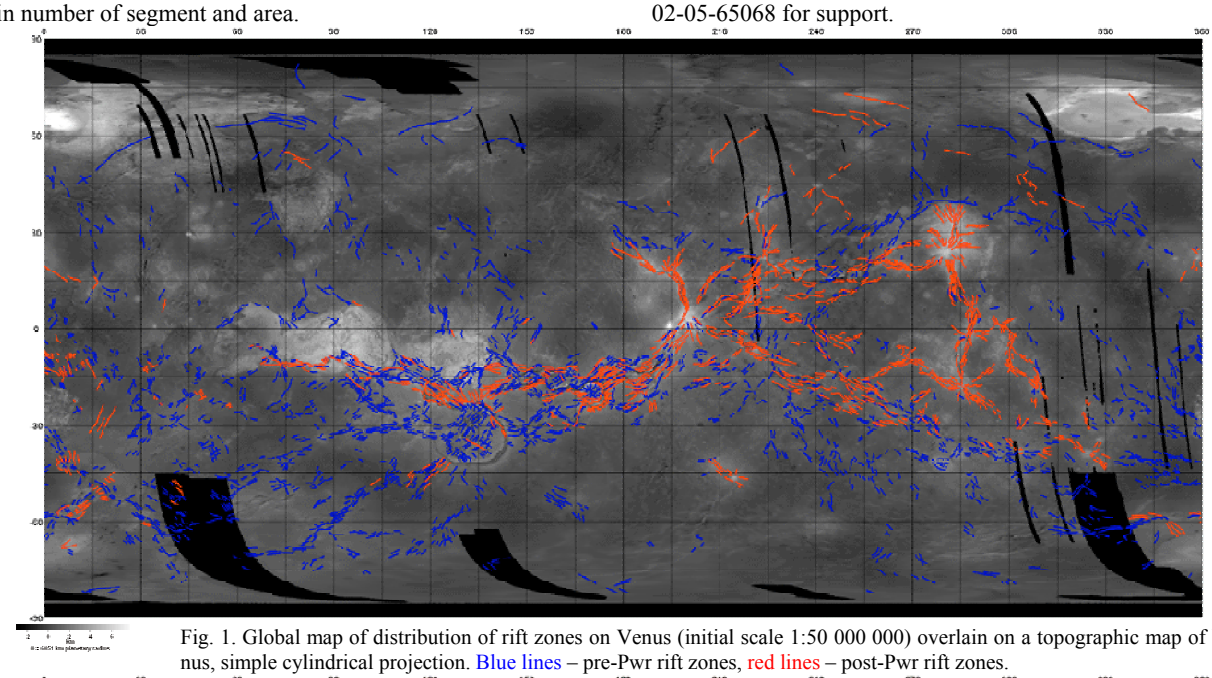


Fig. 1. Global map of distribution of rift zones on Venus (initial scale 1:50 000 000) overlain on a topographic map of Venus, simple cylindrical projection. Blue lines – pre-Pwr rift zones, red lines – post-Pwr rift zones.

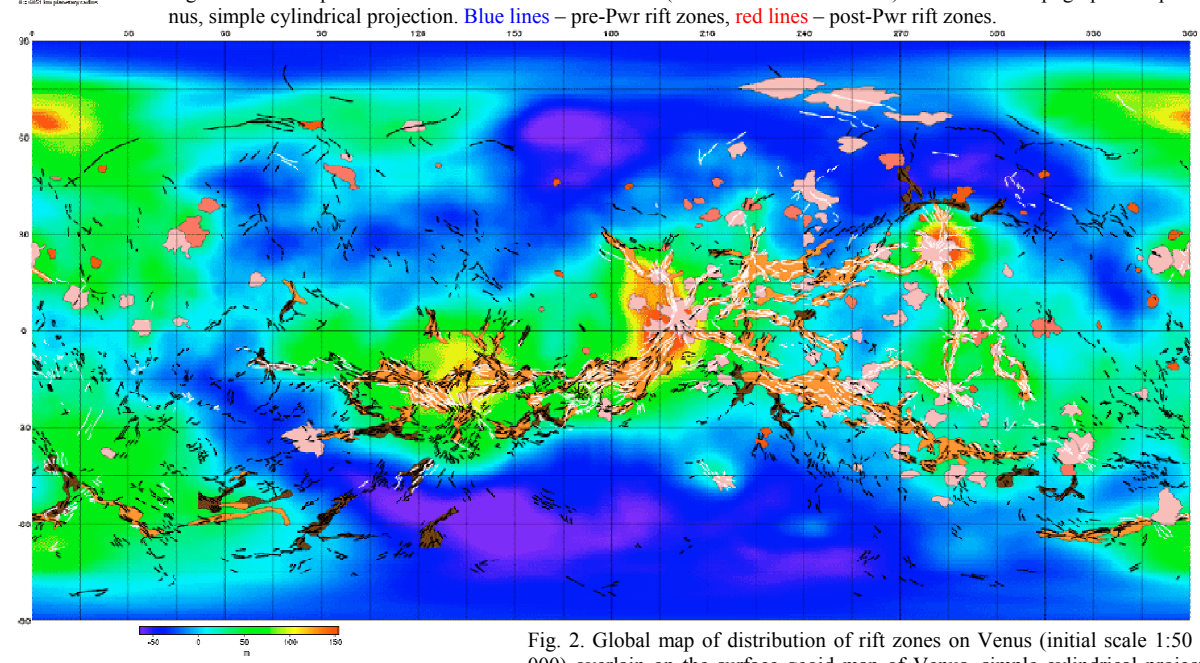
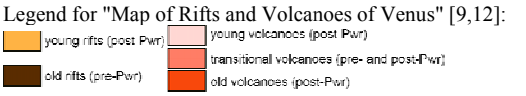


Fig. 2. Global map of distribution of rift zones on Venus (initial scale 1:50 000 000) overlain on the surface geoid map of Venus, simple cylindrical projection (data from NASA planetary data system); and also superposed on "Map of Rifts and Volcanoes of Venus" (modified after [9,12]). Black lines – pre-Pwr rift zones, white lines – post-Pwr rift zones.

Legend for "Map of Rifts and Volcanoes of Venus" [9,12]:



Full resolution maps are available on:
http://geo.web.ru/db/msg.html?mid=1169725&uri=fig_1.html
http://geo.web.ru/db/msg.html?mid=1169725&uri=fig_2.html

References. [1] Masursky H.E. et al. (1980) *JGR, 85,* 8232-8260. [2] Shaber G.G. (1982) *GRL, 9,* 499-502. [3] Solomon S.C. et al. (1992) *JGR, 97,* 13199-13256. [4] Senske D.A. et al. (1992) *JGR, 97,* 13395-13420. [5] Crumpler et al. (1993) *Science, 261,* 591-595. [6] Hansen V.L. (1997) *in Venus II, Univ. Ariz. Press.,* 797-844. [7] Tanaka (1997) *in Venus II, Univ. Ariz. Press.,* 667-696. [8] Senske D.A. et al. (1994) *LPS XXV*, 1245-1246. [9] Price M. (1995) *Dep. of. Geol. Sci., Princeton Univ, Princeton.* [10] Head J.W and Basilevsky A.T. (1998) *Geology, 26,* 35-38. [11] Basilevsky A.T. and Head J.W. (2000) *PSS, 48,* 75-111. [12] Basilevsky A.T. and Head J.W. (2000) *JGR, 105,* 24583-24611. [13] Strom R.G. (1994) *JGR, 99,* 10899-10926. [14] Collins G.C. et al. (1999) *JGR, 102,* 24121-24139. [15] Basilevsky A.T. and Head J.W. (2002) *Geology, 30,* 1015-1018. [16] Turcotte D.L. (1995) *JGR, 100,* 16931-16940. [17] Philips R.J. and Hansen V.L. (1998) *Science, 279,* 1492-1495. [18] Brown C.D. and Grimm R.E. (1999) Icarus, 117, 219-242.