VENUS: GEOLOGIC MAPPING AND HISTORY OF THE BETA REGIO STRUCTURE. A. T. Basilevsky [1,2] and J. W. Head[2], [1]Vernadsky Institute of Geochemistry and Analytical Chemistry, RAS, Moscow, 119991, Russia atbas@geokhi.ru; [2]Department of Geological Sciences, Brown University, Providence, RI 02912, USA.

Introduction: This paper combines results of our previous [1] and recent [2] Magellan-image-based mapping of the V17 quadrangle (25-50°N, 270-300°E) (Figs 1 and 2) with the results of our research group in stratigraphy / geological history of other regions of this planet [e.g., 3-14].

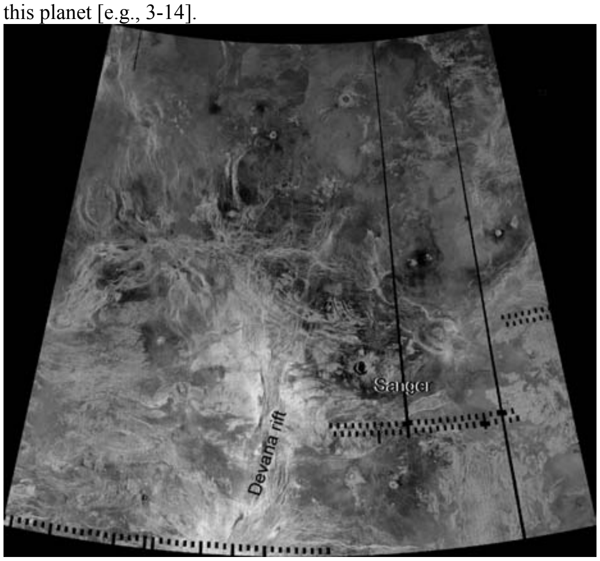

Figure 1. V17 base map.

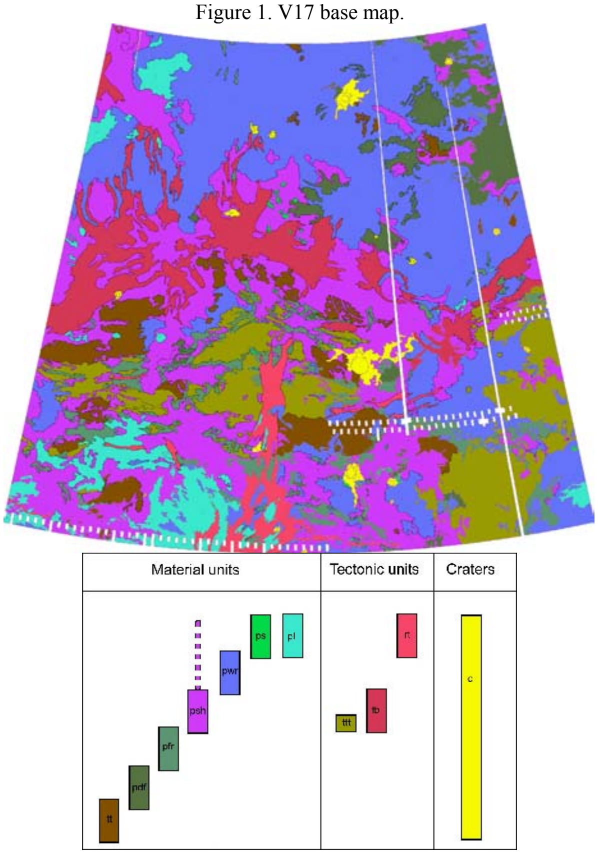

Figure 2. The V17 geologic map and unit correlation chart.

Material and tectonic units of the area. At this stage they include 8 material units and 3 tectonic units:

1) Tessera terrain material (tt) forms islands embayed by practically all younger units. As in other areas of Venus, its surface has two or more intersecting systems of ridges and grooves of obvious tectonic origin [e.g., 3, 15, 16]. On the images, unit *tt* appears radar bright with no or almost no areas free of tectonic structures (Fig. 3).

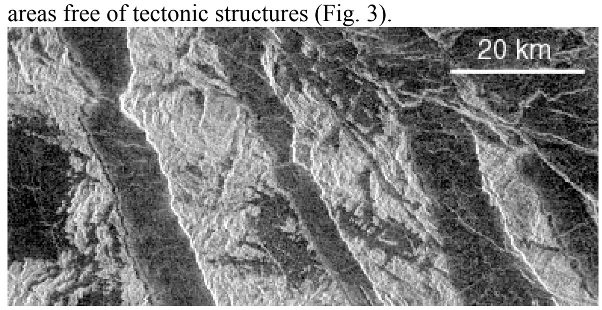

Figure 3. Tessera terrain (bright) north of crater Sanger embayed by the material of *pwr* plains (dark).

2) Material of densely fractured plains (pdf) is observed as islands mostly embayed by the *pwr/psh* regional plains. Its surface morphology is dominated by densely packed grooves.

3) Material of fractured and ridged plains (pfr) is observed either as elongated areas with clusters of broad gently-sloping ridges forming what is usually called ridge-belts [17] or as rather broad plains only locally deformed into a few ridges (Fig. 4). Unit *pfr* embays units *tt* and *pdf* and is embayed by units *psh*, *pwr*, *pl* and *ps*.

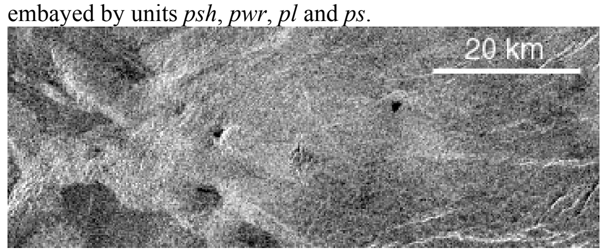

Figure 4. *Pfr* plains deformed (left) in broad gently-sloping ridges seen mostly due to embayment by the darker *pwr* plains.

4) Shield plains material (psh) forms areas consisting of abundant to coalescing small shield-shaped features. In most mapped areas the *psh* unit is deformed with wrinkle ridges which often are smaller than those deforming unit *pwr* and form a denser network. Unit *psh* embays *tt*, *pdf*, *pfr*, and *ttt* units and is embayed by the younger plains.

5) Material of plains with wrinkle ridges (pwr) forms generally smooth intermediate-dark to intermediate bright plains complicated with wrinkle ridges. *Pwr* is the unit most abundant in the V17 area. There is evidence that on a global scale the mean age of *pwr* plains is close to the mean surface age of Venus T [e.g., 5, 8, 11] and that their emplacement compared to time duration T was short [7, 12]. The global-wide crater counts suggest that T ≈750 m.y. [18].

6) Material of smooth plains (ps) forms small fields of radar-dark smooth-appearing terrain. It is not deformed by wrinkle ridges and typically is superposed on Pwr.

7) Material of lobate plains (pl) forms radar-bright flows not deformed by wrinkle ridges. The largest field of *pl* within V17 is associated with the Theia Mons volcano sitting on the Devana rift about 100 km south of the southern boundary of the V17 quadrangle. There is evidence that on the global scale the rate of *pl* emplacement was rather constant so their age in different areas may vary from the present time to ~T [10].

8) Crater materials (c) compose rims, slopes, floors and ejecta, both hummocky facies and outflows. Within V17 there are identified 25 impact craters from 1.3 to 83 km in diameter [19]. As shown by several studies [e.g., 11, 13, 20] the degee of preservation of a crater-associated radar-dark halo is indicative of crater age: craters with dark parabolas (DP) have age <0.1-0.15T, craters with a clear dark halo (CH) - from 0.1-0.15T to ~0.5T (~0.3T if D<10 km), craters with a faint halo (FH) or with no halo (NH) >0.5T (>~0.3T if D<10 km). From the analysis of age relations of craters with surrounding units and structures it is possible to estimate ages of those units and structures (Fig. 5, Table).

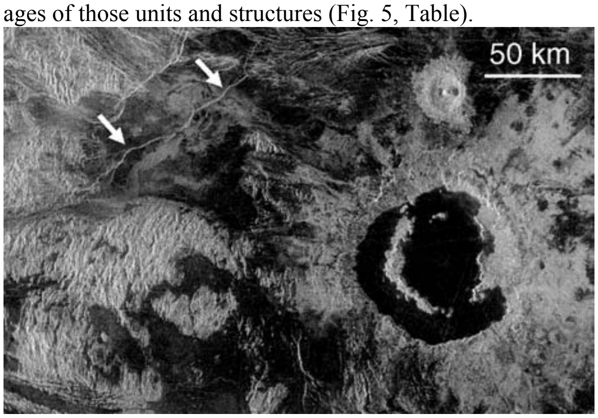

Figure 5. CH crater Sanger whose ejecta outflows are cut by the Devana rift fault (arrows) suggesting that at a time more recent than 0.5T the Devana rifting was still active.

In addition to the material units within the V17 quadrangle three tectonic units have been mapped:

9) Material of tessera transitional terrain (ttt). It was first identified by [9]. Within V17 quadrangle it forms areas of different size. Typically these are elongated very gently-sloping highs composed of *pfr* plains material and criss-crossed by transverse grooves. In some cases, *pdf* material is involved in formation of *ttt* unit.

10) Material of fracture belts (fb) forms elongated zones, mostly at the northern foot of the Beta uplift saturated with subparallel grooves (fractures). The *fb* unit is mostly embayed by *pwr* and younger units but some of *fb* fractures extend into *pwr* plains deforming them. Fracture belts are considered to be ancient rift zones [e.g., 8]. Arcuate fracture belts are parts of some coronae.

11) Material of rifted terrain (rt) composes areas with dominating clusters of faults and graben mostly concentrated in Devana Chasma. The *rt* structures are typically anastomosing with variable width. They cut all units and are locally buried by *pl* flows.

Structures. Eight major types of structures are identified (from older to younger): 1) Tessera-forming deformation represented by criss-crossing ridges and grooves; 2) Swarms of closely spaced grooves deforming the *pdf* material; 3) Ridges deforming the *pfr* unit; 4) Grooves (graben) deforming the *pfr* material thus making it the *ttt* unit; 5) Grooves (graben) typical of the *fb* unit; although close or similar in age to the previous structures (type 4), these are typically longer; 6) Wrinkle ridges forming regional networks on *pwr* and *psh* units; 7) Swarms of anastomosing graben associated with the Devana rift; 8) Long linear graben mostly cutting *pwr* plains. It is important to note that orientation of broad ridges typical for *pfr* plains and networks of wrinkle ridges deforming *psh* and *pwr* plains does not show any control from the planimetric geometry of the Beta uplift that is different from the Western Eistla stucture (21) and some other structures of Venus.

A scenario of geologic history. Until the Beta uplift occurred, the geologic history of the V17 area seems to be simi-lar to that of many other areas of Venus: emplacement of materials of *tt*, *pdf* and *pfr* units and their deformation by the corresponding structures. Within the uplift area there is a deficit of *pwr* plains implying that at the time of their emplacement (~T) this area was topographically higher and volcanically less active than its surrounding. However, the ridge belts and wrinkle ridges are not aligned with the Beta structure implying that significant tectonic uplift occured later. The degree of halo preservation of craters affected by the Devana rifting and Theia volcanism [11] suggests that at the time ~0.5T these processes were still active this agrees with results of 3D geophysical modelling of the uplift [22].

References: [1] Basilevsky (1996) *LPSC 27 Abs.*, 65-66. [2] Basilevsky (2004) Abstracts Planet. Geol. Mapping. Flagstaff, AZ. [3] Ivanov & Head (1996) *JGR*, *101*, 14,861-14,908. [4] Gilmore et al. (1997) *JGR*, *102*, 13,357-13,368. [5] Basilevsky et al. (1997) *Venus II*, 1047-1086. [6] Head & Basilevsky (1998) *Geology*, *26*, 35-38. [7] Collins et al. (1999) *JGR*, *104*, 24,121-24,139. [8] Basilevsky & Head (2000) *PSS*, *48*, 75-111. [9] Ivanov & Head (2001) *JGR*, *106*, 17,515 -17,566. [10] Basilevsky & Head (2002) *JGR*, *107*, 10.1029/2000JE 001471. [11] Basilevsky & Head (2002) *JGR*, *107*, 10.1029/2000JE 00584. [12] Basilevsky & Head (2003) *Geology*, *30*, 1015-1018. [13] Basilevsky et al. (2003) *GRL*, 10.1029/2003GL 017504. [14] Ivanov & Head (2004) *JGR*, *109* 10.1029/2004JE002252. [15] Solomon et al. (1992) *JGR*, *97*, 13,199-13,256. [16] Hansen et al. (1997) *Venus II*, 797-844. [17] Tanaka et al. (1997) *Venus II*, 667-694. [18] Mc Kinnon et al. (1997) *Venus II*, 969-1014. [19] Schaber et al. (1998) USGS Open File Report. [20] Arvidson et al. (1992) *JGR*, *97*, 13,199-13,256. [21] Basilevsky (1994) *LPSC 25 Abs.*, 63-64. [22] Vezolainen et al. (2004) *JGR,109*, 10.1029/2004JE002259.

Table 1. Age estimates of the Beta Regio craters [12, 13, 22].

Name	D, km	Halo	Age	Relations with Beta
Balch	40	NH	>0.5T	Cut by *rt*
Raisa	13.5	FH	>0.5T	Sup. on *pl1*, flood by *pl2*
Tako	10.5	FH	>0.3T	Superposed on *rt*
Sanger	84	CH	<0.5T	Ejecta outflows are cut by *rt*
Olga	15.5	CH	<0.5T	Superpos. on *rt1*, cut by *rt2*

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