STRATIGRAPHY OF VENUSIAN PLAINS: COMPARISON OF PRICE [1995] AND BASILEVSKY AND HEAD [1995] UNITS; A.T. Basilevsky, G.A. Burba, and V.P. Kryuchkov; Vernadsky Institute, Russia Academy of Sciences, Moscow, 117975, Russia, abasilevsky@glas.apc.org

SUMMARY. A comparison of the Price [1995] map, in which plains units were identified based on the prominence of lava flow morphology, with the Kryuchkov [1996] map, based on Basilevsky and Head [1995] model of Venus stratigraphy, revealed that at least in the area under study (40-80°N, 140-260°E) the plains units of Price [1995] are mixtures of formations of different ages. Her approach provides evidently the generally correct ranging of large regions of the planet according to their average age but it misses the key events of the geologic history of Venus such as an emplacement of distinctive stratigraphic members of the venusian plains. This should be taken into account when the determined crater densities and corresponding ages are interpreted.

Stratigraphic studies in numerous representative areas of Venus based on the principle of superposition led to revealing a time sequence of geologic formations starting with heavily deformed tessera terrain Tt (Stage 1), overlayed by the suite of vast moderately deformed volcanic plains Pdf+Pfr/RB+Pwr (Stage 2) which, in turn, are locally overprinted by younger Ps/Pl volcanism mostly associated with rifts (Stage 3) [2]. One of the key points of Venus' geology is the absolute age and duration of Stage 2. If they are reliably determined the general style of the morphologically recorded part of the geologic history of Venus is determined too.

To a first approximation, the problem of the average age of Stage 2 formations can be considered as resolved. Indeed based on the impact crater density the average surface age of Venus (T) is estimated to be about 300 to 500 m.y. [5,9]. Stage 2 formations occupy 75-80% of Venus surface. Stage 1 tesera occupies about 8% and its total crater density is indistinguishable from the global average [9]. Stage 3 formations occupy about 10-15% and their average surface age is estimated to be about 1/2 T [4,7]. This is why the estimated average surface age of Venus is also the average surface age of Stage 2 volcanic plains. The question of the duration of Stage 2 is less clear. M.Price [6] subdivided the Venus plains into four stratigraphic units and determined their surface age through crater density. Her approach is based on the conclusion [1] that morphological prominence of the plains-forming lava flows degrades with time. The proposed plains units are (from yonger to older): 1) Pl1, highly lobate plains such as Mylitta Fluctus, occupying ~5% of the total plains; 2) Pl2, plains with distinct but less dramatic flow morphology, ~25%; 3) Pl3, plains with subtle lobate appearance, ~30%; and 4) Ps, smooth plains with no discernable flow morphology present, ~35%. Crater densities increase from Pl1 to Ps and assuming that the planet average surface age is 300 m.y. the average surface age of these plains is estimated to be (m.y.): 210+/-75 for Pl1, 240+/-40 for Pl2, 325+/-45 for Pl3, and 370+/-45 for Ps. These results are interpreted by [6] as the evidence that the plains emplacement lasted at least 100 m.y. and that the "global" resurfacing suggested by [8,9] may be an overstatement.

However this interpretation of the data is vulnerable to criticism. A decrease of preservation of the flow morphology with time [1] is certainly correct in general but its practical use for subdividing plains into age units meets some difficulties.The most important of them is the danger that at least part of the units may be mixtures of geologic formations of such different ages that the average age of each of these mixtures has no real meaning. Besides, the conclusion of [6] that because of the estimated long duration of the plains emplacement, the global resurfacing concept is an overstatement that does not sound convincing. First, because the authors of the global resurfacing model never stated that the global resurfacing was very short in time. Strom et al. [9] stated that "the global resurfacing event probably lasted at least tens of millions of years" (page 10,918) that taking in mind general low accuracy of the estimations of this sort practically coincides with 100 m.y. estimation of [6]. Second, not all the venusian plains are considered by [9] as emplaced during the global resurfacing event. If one uses the stratigraphy of [2] the emplacement of plains with wrinkle ridges (Pwr) was the latest major episode of the global resurfacing while the emplacement of the overlaying smooth and lobate plains (Ps/Pl) was the postglobal resurfacing activity. Among the plains units of [6] at least the uppermost Pl1 unit may represent the postglobal resurfacing; however a correspondence of this and other units of [6] to stratigraphic units of [2] is unclear.

To understand better the significance of the plains units subdivision of [6] and their estimated ages we studied what stratigraphuc units of [2] correspond to the units of [6] and vice versa. This study was done for the area 40-80°N, 140-260°E (that is ~6.5% of Venus surface) mapped by [3] at 1:10M scale based on the stratigraphy model of [2]. Map of [3] contains the following units: Tessera terrain Tt; Densely fractured plains Pdf; Ridge Belts RB; Plains with wrinkle ridges Pwr split into lower Pwr1 unit, rather smooth and low in backscatter, and upper Pwr2 unit, with higher backscatter and prominentt flow-like morphology; Smooth and Lobate plains Ps/Pl; and Crater units C. Coronae have no specific units on the map. Map of [6] contains the following major units: Large volcanoes LV; Plains units Pl1, Pl2, Pl3, Ps; Shield fields SF; Fold belts FB; Tessera T; Coronae CO; and Craters CR. A fragment of map [6] for the area mapped by [3] was transformed to the scale and projection of [3]. Both maps were superposed by a rectangular net of 2555 105x105 km (1x1 deg) cells and for each cell it was determined which unit dominates. The resulting cross-correlation of the units is shown in the Table.

	Ps/Pl	Pwr2	Pwr1	RB	Pdf	T	C	Total	%
LV	77	-	16	-	2	1	-	96	4
Pl1	42	30	14	-	-	-	-	86	3.5
Pl2	66	11	341	10	6	11	-	445	17.5
Pl3	29	49	535	38	22	16	-	689	27
Ps	9	11	561	22	27	12	-	642	25
SF	15	2	57	3	5	1	-	83	3
FB	1	-	15	186	6	11	-	219	8.5
T	-	-	6	9	7	118	-	140	5.5
CO	5	-	27	-	21		-	153	6
CR	-	-	-	-	-	-	2	2	0.1
Total	239	103	1672	270	99	170	2	2555	100
%	9.5	4	65.5	10.5	4	6.5	0.1	100	

It is seen from the Table that because of inevitable errors in the drawing of the unit boundaries on both of the maps as well as errors of the map transformation, the resulting cross-correlation contains some noise. For example, LV unit of [6] contains not only young Ps/Pl volcanics of [2] (that is expected) but also Pwr, Pdf and even Tt. However if we ignore this noise, the resulting picture is very consistent: plains of one map corespond to plains of another map, tessera coresponds to tessera and fold belts of [6] correspond to ridge belts of [2]. The results presented in the Table show that, even if we ignore the noise, all the plains units of [6] are mixtures of plains units of [2] different in their relative and evidently absolute age. In the area under study Pl1 consists of Ps/Pl (~50%), Pwr2 (~35%), and Pwr1 (~15%). Pl2 is mostly Pwr1 with subordinate admixture of Ps/Pl, other admixtures are on the noise level. Pl3 and Ps are mostly Pwr1 with subordinate admixtures of other plains units. In the sequence from Pl1 to Ps the role of younger units of [2] systematically decreases while the role of older units increases. If the area under study would be large enough to get reliable crater density statistics for Pl1, Pl2, Pl3, and Ps, the apparent absolute ages of these units were consistently increasing from Pl1 to Ps. This means that the Price [1995] approach provides evidently the generally correct ranging of large regions of the planet according to their average age but it misses the key events of the geologic history of Venus such as emplacement of distinctive members of the venusian plains that should be taken into account when the determined crater densities and corresponding ages are interpreted.

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