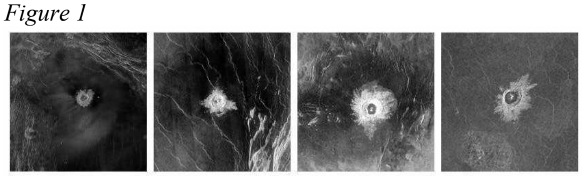
IMPACT CRATERS OF VENUS WITH D>5 KM CLASSIFIED BASED ON DEGREE OF PRESERVATION OF THE ASSOCIATED RADAR-DARK DEPOSITS. A. T. Basilevsky[1,2], J. W. Head[2] and I. V. Setyaeva[3]; [1]Vernadsky Institute of Geochemistry and Analytical Chemistry, RAS, Moscow 119991 Russia, atbas@geokhi.ru; [2]Department of Geological Sciences, Brown University, Providence,RI 02912 USA, [3]Department of Geography, Moscow State University, Moscow 119899 Russia

Introduction. This is a further continuation of work [1], which studied craters ≥30 km in diameter. That work used the approach of [2] to subdivide craters based on character of the associated radar dark deposits. It was suggested by [2] and then confirmed by [3] that the most pristine deposits of that sort are radar-dark parabolas. Non-parabolic radar-dark halos represent the next stage of the deposit evolution and then with time they disappear. So presence and character of crater-associated dark deposit can be used for estimates of the crater age and then for dating other features.

Previous work [1] classified craters into: 1) craters with dark parabola (DP), 2) with clear dark halo (CH), 3) with faint halo (FH) and 4) with no dark halo (NH). It was found that abundances of craters superposed on regional plains (whose mean age is close to the planet mean surface age T) and belonging to DP, CH, FH and NH classes were correspondingly 15, 30, 30 and 25%. From that it was concluded that DP craters are not older than 0.1-0.15T; CH craters formed during the time interval from ~0.5T until 0.1-0.15T ago, and the FH and NH craters formed prior to ~0.5T ago (see details in [1]). It was shown that the DP, CH, FH and NH percentages show only slight apparent dependence on the crater geographic latitudes and no noticeable dependence on the crater size. The present study analyzes a much larger population (all D≥5 km craters) to investigate better the latitude effect and to study if within this larger crater population the size effect exists. First results of this extended approach were presented in [4].

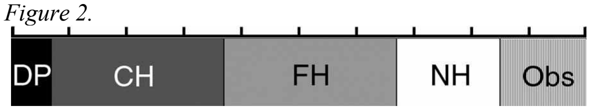
The data analyzed. All craters ≥5 km in diameter imaged on the Magellan C1-MIDRPs and listed in database [5] were classified into DP, CH, FH and NH classes (Fig. 1).

Figure 1



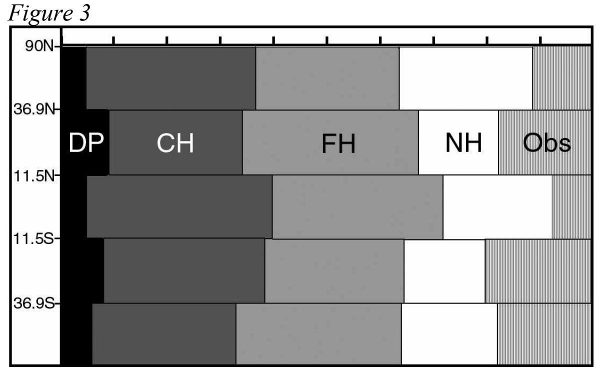
Some craters are obscured by dark deposits of other craters, regional dark mantles and young lavas. So they can not be classified into DP, CH, FH, NH classes and like in [1] the fifth class - "Obscured" - was introduced. Then again as in [1] we sorted out craters superposed on units older than the Psh1+Pwr regional plains (see [6,7] for explanation of the used stratigraphy units) and considered only craters superposed on Psh1-Pwr regional plains and on the younger units (Psh2, Pl, Ps, RT) and structures (F – fractures cutting the regional plains). On total, there are 753 such craters. Among them, there are 51 craters (7%) of class DP, 223 craters (30%) of class CH, 224 craters (30%) of class FH, 140 craters (18%) of class NH and 115 obscured craters (15%) (Fig. 2). This is rather close (except DP) to the class percentages found for craters ≥30 km [1].

Figure 2.



Latitude dependence test. This dependence may potentially exist because of changes in visibility due to variation of radar incidence angle as a function of latitude [8]. Besides, eolian resurfacing and thus the dark deposit lifetime may also be latitude-dependent because of differences in atmosphere circulation at low and high latitudes of the planet (see details in [1]). For this test the studied population of craters was subdivided into five parts, each corresponding to one of the five equal area latitude zones (Figure 3).

Figure 3

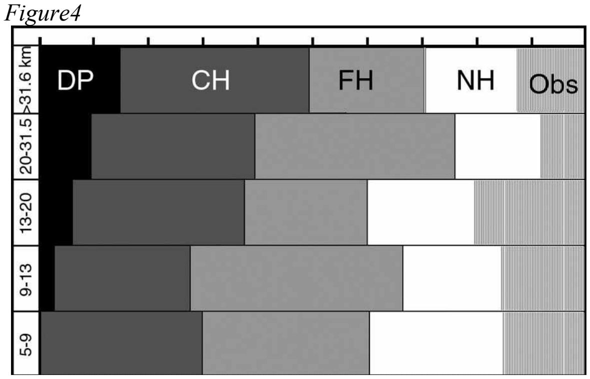


It is seen from Figure 3 that the studied population of 753 craters does not show noticeable latitude effect in the percentages of craters of different classes, especially if we apply to the analysis the appropriate for the Poisson distribution the ±√N confidence level.

Test for size effect. This effect was not found for craters ≥30 km in diameter [1]. But [9] found that dark parabolas were observed in association only with craters ≥12 km in diameter (11.4 km according to [5]). So it is logical to check for existence of size effect for other considered crater classes. In [4] for this test we sorted the considered craters into five size intervals each containing approximately the same amount (150 to 153) of craters. The results of such grouping are shown in Figure 4.

It is seen from Figure 4 that for the considered larger population the size effect is obvious for the DP class: Along with the crater size decrease the DP percentages decrease. For other classes no noticeable size effect is seen, probably because of stochastic noise due to small amount of craters of each given class in the considered five size intervals.

Figure4

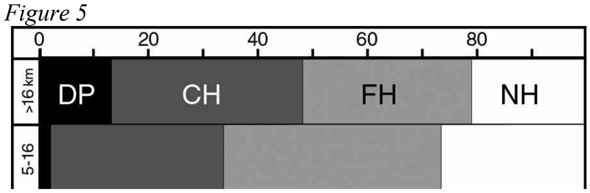


To decrease the stochastic noise we subdivided the considered crater population into smaller amount of size intervals (4, 3, 2), each containing approximately equal amount of craters. At subdivisions into four and three size intervals some trends for the CH, FH and NH classes started to be seen but the most obvious picture is seen when subdivision into two size classes is used. The boundary crater diameter for these two size intervals is about 16 km. This diameter value has also significance for the abundance of DP craters: for craters >16 km in diameter the abundance of DP craters varies around 12-13%, then (below 16 km) sharply falls and among craters <11 km in diameter the DP class is absent.

In the subsequent analysis we considered separately craters superposed on the regional Pwr-Psh1 plains (Subpopulation 1) and on the younger units (Psh2, Pl, Ps, RT) and structures (F – fractures cutting regional plains) (Subpopulation 2).

Size effect in Subpopulation 1. Abundances of craters of the DP, CH, FH and NH classes in Subpopulation 1 are correspondingly: 13, 35, 31 and 21% for craters >16 km and 1, 32, 39 and 27% for craters 5-16 km in diameter (Figure 5).

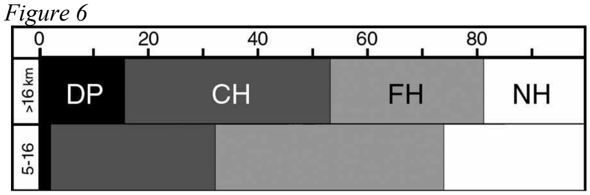
Figure 5



From the given numbers and Figure 5, it is obvious that for the smaller craters, in addition to sharp decrease in DP abundance, a decrease of percentages of CH craters and increase of FH and NH craters take place. As it was shown in [1], percentages of DP, CH, FH craters in Subpopulation 1 are proportional to the lifetimes of these crater classes. So rounding numbers we may conclude that for craters >16 km in diameter, DP craters are not older than 0.1-0.15T; CH craters formed during the time from ~0.5T until 0.1-0.15T ago, and the FH and NH craters formed prior to ~0.5T ago (the same as for craters >30 km [1]). For craters 5-16 km in diameter, DP craters are not typical, CH craters are not older than 0.3T and FH and NH craters formed prior to 0.3T ago.

Size effect in subpopulation 2. Abundances of craters of the DP, CH, FH and NH classes in Subpopulation 2 are correspondingly: 16, 37, 28 and 18% for craters >16 km and 2, 30, 42 and 26% for craters 5-16 km in diameter (Figure 6).

Figure 6



As it is seen from the given numbers and Figures 5 and 6, the class' abundances in Subpopulation 2 are rather close to those in subpopulation 1. Significance of that demands further analysis.

Discussion and conclusions. The described above absence of the noticeable latitude effect means that usage of the crater-associated dark deposits as a tool for estimation of crater age and related analyses is not seriously constrained by the latitude position of the craters. *So at the first approximation analysis we may ignore the problem of crater latitudes.*

The revealed dependence of the DP, CH, FH, NH percentages on the crater diameter is important for the crater age estimates and related analyses. It seems obvious that formation of craters smaller than about 10 km in diameter is not accompanied by the formation of dark parabola. *For craters >16 km in diameter the DP and CH the lifetime estimates are the same as for craters >30 km: 0.1-0.15T for DP and 0.35-04T for CH. Smaller (<16 km) craters have potentially shorter lifetime: 03T for CH.*

Acknowledgments: We gratefully acknowledge financial support from the NASA Planetary Geology and Geophysics Program.

References: [1] Basilevsky A. T. & Head J. W. (2002) *JGR*, 109, 10.1029/2001JE001584, 5-1-5-38. [2] Arvidson R. et al. (1992) *JGR*, *97*, 13303-13317. [3] Izenberg N. et al. (1994) *Geophys. Res. Lett.*, *21*, 289-292. [4] Basilevsky A. T. & Setyaeva I. V. (2002) *Vernadsky/Brown Microsymposium 36th*, abs. ms008, CDROM. [5] Schaber G. G. et al. (1998) *USGS Open-File Report 98-104*, see also (http://wwwflag.wr.usgs.gov). [6] Basilevsky A. T. & Head J. W. (2000) *PSS*, 48, 75-111. [7] Basilevsky A. T. & Head J. W. (2002) *Geology*, 30, 1015-1018. [8] Ford J. P. & Plaut J. J. (1993) *Guide to Magellan Image Interpretation* by J. P. Ford at al., *JPL Publication 93-24*, 7-18. [9] Campbell et al. (1992) *JGR*, *97*, 16249-16277.