A STATICAL MODEL OF RELATIVE SURFACE AGE ON VENUS, S. E. Smrekar[1,], M. Xie[2], and M.S. Handcock[2]; [1]Jet Propulsion Laboratory, California Institute of Technology, 4800 Oak Grove Dr., Pasadena, CA 91109, ssmrekar@jpl.nasa.gov. [2]University of California Los Angeles, Los Angeles, CA 90095, meihuixie@ucla.edu.

Introduction: Interpretation of the crater population on Venus is fundamental to understanding its geologic evolution. The crater population has been used to argue that Venus under goes episodic mobile lid tectonics [e.g. 1], that it has experienced voluminous volcanic outgassing events capable of inducing surface temperature changes of ±100°C [2], and that has had either directional or non-directional geologic events [3,4]. The key to interpreting Venus crater population is the interaction between volcanism, craters, and crater ejecta.

Our objective is to follow up on the work of Phillips and Izenberg [5], who used the removal of the extended ejecta, the fine grained halos and parabolas to investigate resurfacing and relative age. We use spatial point processes to examine halo and parabola removal. Rather than using Monte Carlo methods to simulate volcanism, we compare actual volcano populations and geologic units to the relative age units defined by crater density and halo removal.

Background: *Halo removal and relative age.* Impact craters on Venus larger than ~10 km all have fine grained deposits termed halos and parabolas (Fig. 1). The parabolas are all carried downwind to the west by up to ~2000 km. Halos are generally somewhat larger particles with radii of several hundred km. The parabolas cover a much larger area than impact craters, thus making them a indicator of regional resurfacing.

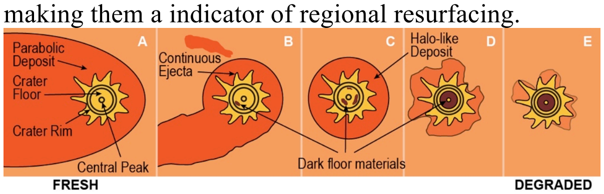

Fig. 1. Impact ejecta degrades from a full parabola, to a halo, to a degraded or absent halo.

Phillips and Izenberg [5] proposed that the combination of crater density (n) and ratio of the number of craters without halos to the total number of craters (p) could be used to infer how parabolas and halos are removed. The hypothesis is that the youngest regions are those that have experienced sufficient volcanism to both fill and thus remove craters as well as halos & parabolas, that old regions have little volcanism but that halos & parabolas are removed via aeolian or chemical weathering. This hypothesis leads to the definitions of relative age regions in Table 1. Rather than the 3 age bins considered by [5] we have 5 bins. Very young differs from young in that the halos have not yet been removed. An additional category has both high n and high p. Such a region might develop if there is little removal of halos via either volcanism or erosion.

Relative age	Crater Density (n)	Ratio of craters w/ halos to total craters (p)
Very Young	Low	High
Young	Low	Low
Intermed.	Average	Average
Old	High	Low
Unmodified	High	High

Table 1. Relative age unit definitions.

Method: We use 60,000 evenly spaced points over the sphere as the counting centers. For the radius of the counting bins, we try 875, 1750, 4000, 6000 km to assess the relevant size of the geologic unit. The numbers of craters, halos, as well as volcanoes in each circular counting bin are recorded in order to study the relative age.

Data Sets: The data sets we use are: 1) The LPI crater database, 2) the Brown volcano database (http://www.planetary.brown.edu/planetary/databases/venus_cat.html) 3) a corona database (Ellen Stofan, pers. comm.) and 4) the geologic map of Ivanov and Head [6] to determine those craters located on plains units. Roughly 40% of the surface consists of volcanic plains regions where distinct volcanoes cannot be resolved. In this analysis coronae are grouped with volcanoes.

Results: The density of craters versus the proportion of craters with halos (Fig. 2) forms the basis for the relative age units. Young units have n < ~1.1

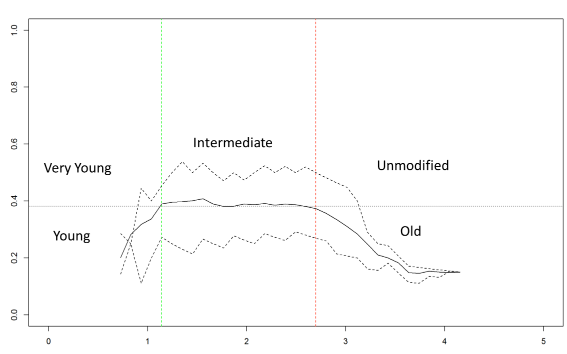

Fig. 2. Total crater density versus the ratio of craters with halos to the total number of craters for a counting region with a radius of 1750 km. Solid line is the mean value within each bin. Dashed lines are the 25th and 75th percentiles.

craters/10^6 km^2, and old units have n> ~2.7 craters/10^6 km^2. For comparison, we plot volcano density versus crater density (Fig. 3). Figure 4 shows the map distribution of these units.

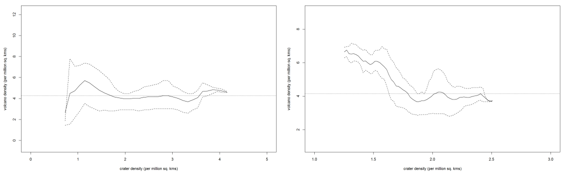

*Fig. 3. Density of identified volcanoes (v) versus n.Left:counting radius 1750km; Right: counting radius 4000km***.**

Discussion & Preliminary Conclusions: The density of identifiable volcanoes (v) shows is greater at low n, and is somewhat greater at high n, corroborating the hypothesis that volcanic resurfacing is operating to remove halos and craters in those regions identified as young. In 'old' regions, those with high n, volcanism may removing halos in some areas, but not craters. Chemical or aeolian weathering may also be removing halos. This will be investigated further. The role of featureless plains will also be investigated.

Note that these results are sensitive to the radius of the counting region. The shape of the curve in Fig. 2 is only seen for a radius of 1750 km. This radius corresponds to the scale of the parabola deposits. However, volcano density is seen to be larger in regions with lower crater density at all scales, and low to average in regions with high crater density. This is consistent with the role of volcanism as the primary means of lower crater density at all scales, and low to average in regions with high crater density. This is consistent with the role of volcanism as the primary means of removing both craters and their extended ejecta blankets.

Identification of relative age units provides valuable insights into Venusian geology. We note that areas with high emissivity from VIRTIS data are at least partially within young or very young units, supporting the interpretation of these regions as relative young [7]. areas could be used to aid targeting of high resolution imaging, interferometry as proposed for VERITAS [8] and planning landing sites.

References:

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Acknowledgement: A portion of this research was conducted at the Jet Propulsion Laboratory, California Institute of Technology, under contract with the National Aeronautics and Space Administration.

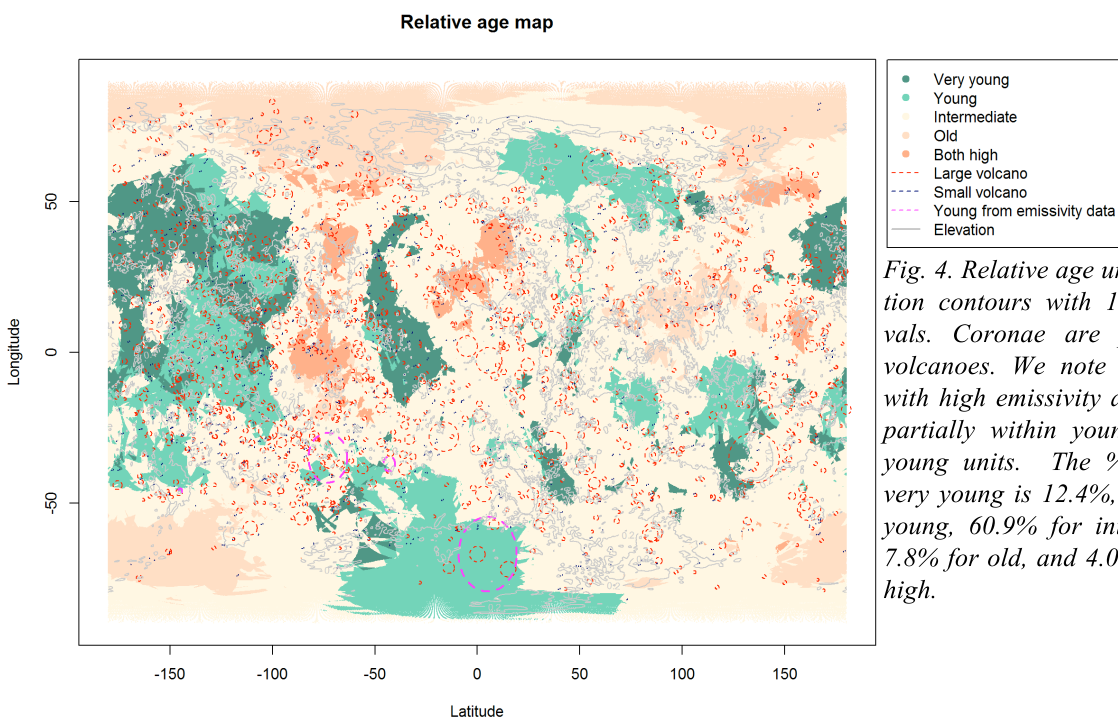

Fig. 4. Relative age units. Elevation contours with 1 km intervals. Coronae are plotted as volcanoes. We note that areas with high emissivity are at least partially within young or very young units. The % area for very young is 12.4%, 14.9% for young, 60.9% for intermediate, 7.8% for old, and 4.0% for both high.